INDOOR ENVIRONMENTAL QUALITY (IEQ)
IN MARA VOCATIONAL TRAINNING WORKSHOPS

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INDOOR ENVIRONMENTAL QUALITY (IEQ) IN MARA VOCATIONAL TRAINNING WORKSHOPS

By

MOHD AZAM BIN MOHD SALEH

Project Report Submitted in Partial Fulfillment of the Requirement for the Degree of Master of Science in the Faculty of Engineering Universiti Putra Malaysia

October 2003

DEDICATION

Special for;

My father and mother,
Allahyarham Mohd Saleh bin Hj. Abdullah
Bakiah binti Omar

My father and mother in law,
Allahyarham Che Wil bin Che Dolah
Aishah binti Yusof

My beloved wife,
Che Romoh @ Azlina binti Che Wil

My son and daughter,
Mohd Azri bin Mohd Azam
Noor Azni bin Mohd Azam

My brother and sister,
Azmah
Azwa
Azlina
Azlan
Azidda
Aziati
Azhatta
Azura
Azlin

ABSTRACT

Abstract of project report presented to the Senate of Universiti Putra Malaysia in Partial fulfillment of the requirement for the degree of Master of Science

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By

MOHD AZAM BIN MOHD SALEH

October 2003

Supervisor: **Associate Professor Dr. Ir. Nor Mariah Adam**

Co-Supervisor: **Ir. Fuad Abas**

Faculty: **Engineering**

This study is to evaluate the Indoor Environmental Quality (IEQ) of MARA Vocational Training workshops particularly welding, fabrication, foundry and machine shops. The study was conducted in twenty-eight workshops at Institut Kemahiran MARA (IKM) Kuala Lumpur, Lumut, Perak and Tan Sri Yahya Ahmad (TSYA), Pekan, Pahang. The measurements collected are inclusive of temperature, relative humidity, carbon monoxide, carbon dioxide, dust, air velocity, sound pressure and light level. Results showed the temperature measured were exceed the recommended level by American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) which is between 22-27°C; the relative humidity for twenty four workshops was not comply within 30-60% range recommended by ASHRAE; while carbon dioxide of two workshops also exceed the ASHRAE required level which is 650ppm. Twenty-six workshops have the air velocity level below 0.25m/s the recommended by World Health Organisation (WHO). Finally the lighting levels of twelve workshops were below 160 Lux the Australian Standard (AS) recommended level. From the study made, it is concluded that the IEQ in MARA Vocational training workshops is unhealthy and not comfortable for occupancy.

ABTRAK

Absrak laporan projek yang di kemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi sebahagian keperluan untuk Ijazah Master Sains

KUALITI PERSEKITARAN DALAMAN DI BENGKEL-BENGKEL LATIHAN VOKASIONAL MARA

Oleh

MOHD AZAM BIN MOHD SALEH

Oktober 2003

Penyelia:	**Professor Madya Dr. Ir. Nor Mariah Adam**
Penyelia Bersama:	**Ir. Fuad Abas**
Fakulti:	**Kejuruteraan**

Kajian ini adalah untuk menilai Kualiti Persekitaran Dalaman bengkel-bengkel latihan kemahiran MARA terutama bengkel kimpalan, fabrikasi, foundry dan mesin. Kajian telah dijalankan di dua puluh lapan buah bengkel Institut Kemahiran MARA (IKM) Kuala Lumpur, Lumut, Perak dan Pekan, Pahang. Ukuran suhu, kelembapan bandingan, karbon monoksida (CO), karbon dioksida (CO_2), habuk, kelajuan angin, bunyi dan cahaya telah dikumpul. Keputusan menunjukan ukuran suhu melebihi paras cadangan 'American Society of Heating, Refrigeration and Air-Conditioning Engineers' (ASHRAE) antara $22\text{-}27^{\circ}C$; Kandungan kelembapan bandingan bagi dua puluh empat bengkel tidak memenuhi diantara 30-60% kadar yang dicadangkan ASHRAE; Walau bagaimanapun kandungan CO_2 dua buah bengkel melebihi takat yang dibenarkan oleh Organisasi Kesihatan Dunia (WHO). Bagi kelajuan angin di dua puluh enam bengkel adalah di bawah takat yang diperlukan oleh WHO sebanyak 0.25m/s. Bagi paras pencahayaan dua belas bengkel pula adalah kurang daripada takat yang dicadangkan oleh Standard Australia (AS) sebanyak 160Lux. Daripada kajian yang dijalankan, kesimpulannya bengkel-bengkel latihan kemahiran MARA adalah didapati tidak sihat dan tidak selesa untuk dihuni.

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In the name of ALLAH, the Beneficent, Peace and Blessing upon His Messenger and Servant, Muhammad. There is no god but ALLAH and Muhammad is His Apostle. All praise is to Allah SWT who has grant and blessing until writer be able and success to completing this project report, which all the best is come from Allah SWT and all the frail is from writer weakness.

Writer sincerely would like to express his deepest appreciation and gratitude to project supervisor Professor Dr. Ir. Nor Mariah Adam and co-supervisor Ir. Fuad Abas for their continuous effort, support and guidance at all times in every aspect that gave the writer the ability in completing this project. Not forgetting to Professor Dr. Ir. Mohammed Daud for his guidance and sharing of invaluable knowledge in overcoming the challenge faces during the preparation of this project.

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An expression of appreciation is extended to writer's mother, wife, son and daughter for their moral support that gives the motivation also their patience, tolerance and understanding with limitless sacrifice all the while to complete this studies.

APPROVAL SHEET

This project report attached hereto, entitled:

**INDOOR ENVIRONMENTAL QUALITY (IEQ)
IN MARA VOCATIONAL TRAINNING WORKSHOPS**

Prepared and submitted by Mohd Azam bin Mohd Saleh (GS 10938) in the fulfilment of the requirements for the Degree of Master of Science is hereby accepted.

Date: 28/10/03

Associate Professor Dr. Ir. Nor Mariah Adam
Project Supervisor

Date: 28/10/03

Ir. Fuad Abas
Project Co-Supervisor

DECLARATION

I hereby declare that this project is based on my original work except for quotations and citations, which have been duly acknowledged.

I also declare that the project has not been previously or current submitted for any degree at Universiti Putra Malaysia or other higher institutions.

Signed,

Candidate: Mohd Azam bin Mohd Saleh
October 2003.

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LIST OF ABBREVIATIONS

%	Percent
°C	Degree centigrade.
ANSI	American National Standard Institute
AS	Australian Standard
ASHRAE	American Society of Heating, Refrigeration and Air-Conditioning Engineers.
BRI	Building Related Illness.
CO	Carbon monoxide.
CO_2	Carbon dioxide.
dBA	Decibels on the A scale, a unit of measure of sound intensity.
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency.
FMA	Factories and Machinery Act
HVAC	Heating, ventilation and air-conditioning.
IAQ	Indoor air quality
IEQ	Indoor environmental quality
IKM	Institut Kemahiran MARA
ISO	International Standard Organization
KL	Kuala Lumpur

m/s	Meter per second
MARA	Majlis Amanah Rakyat
mg/m3	Milligram per meter cube
MS	Microsoft
NFPA	National Fire Protection Agency
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Act
PEL	Permissible exposure limit
ppm	Parts of contaminant per million
RH	Relative humidity
SBS	Sick building syndrome
SPL	Sound pressure limit
SPSS	Statistical package for special social sciences
TLV	Threshold Limit Value
TSYA	Tan Sri Yahya Ahmad
TWA	Time weight average
UBBL	Uniform Building By law
USA	United State of America
WHO	Worlds Health Organization

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CHAPTER 1

INTRODUCTION

Indoor environmental quality (IEQ) has become a hot topic of late. We often think of environmental issues as relating to outside the building. It is no wonder since we always seem to hear about pollution from vehicles or factories in the news. But there's more to our environment that just outside. Today researchers know that IEQ is key to healthy living. Symptoms of poor IEQ can include headaches, dizziness, fatigue, and, the irritation of eyes, ears, nose and throat could result from poor air quality. Prolonged exposure to continued pollution could lead to serious illness including respiratory, heart disease, and, cancer.

According Donald (1997), the diagnosis of indoor air quality problems is complicated by the fact that air pollutants affect people in different ways. A certain contaminant at a certain concentration might cause headache in one person, dizziness in another, skin irritation in another, and have no effect on still another person. Changing the concentration of the same contaminant could change its effects among the same individuals.

Kathleen (2002) mentioned that initial symptoms might be mistaken for the common flu and cold. This includes shortness of breath on mild exertion, mild headaches, restlessness, and nausea. As exposures increase, the individual may experience severe headaches, mental confusion, dizziness, nausea, rapid breathing, and even fainting. In extreme cases, not normally encountered in indoor air quality situations, exposures may result in unconsciousness and possible death.

The use of natural ventilation in buildings has received much attention in the last decade. Natural ventilation is thought of as a low energy cooling strategy which can provide year round comfort, with flexible user control, at a low capital and maintenance cost. A key consideration in adopting natural ventilation is climate. Architects and engineers in Northern European countries may be more willing to embrace natural ventilation because of the cold to moderate climate. Yet, we must be aware that climate is not the primary barrier to the use of natural ventilation. The main barrier may be a lack of design tools and simple understanding of the principles of natural ventilation. There are two related concepts: the use of natural ventilation to control IEQ and the use of natural ventilation to control temperature.

1.1 Statement Of Problem

IEQ problems are not limited to homes. In fact, many buildings have significant air pollution sources. Some of these buildings may be inadequately ventilated. For example, ventilation systems may not be designed or operated to provide adequate amounts of outdoor air in the building.

The National Institute for Occupational Safety and Health (NIOSH), USA (1995) found that the primary sources of indoor air quality problems are due to several factors namely 52 % of the problems are due to inadequate ventilations, 16 % due to contamination from inside the building, 10 % due to contamination from outside the building, 5 % as a result of microbial contamination, 4 % contamination from building fabrics and 13 % from unknown sources.

In Malaysia, there are guidelines such as Uniform Building By Law (UBBL) 1984, Occupational Safety and Health Act 1994, and the Factory and Machinery Act 1967 for building owners to ensure that air quality in workshop be within acceptable conditions. Institut Kemahiran MARA (IKM) provides vocational training on 40 skills such as mechanical, electrical, electronic, civil, building, etc. mainly at 13 training centers.

Due to little attention given by the management and MARA Building Standard Committee (Jawatankuasa Bangunan dan Piawaian MARA - JKBPM), most of the MARA vocational training workshops are not designed to provide adequate natural ventilation. As a result, the occupants of the workshop may have been exposed to hazards and risks to their health.

Earlier study conducted in dining halls at IKM Kuala Lumpur and Johor Bahru's and found the temperature level more than 27°C and relative humidity above 60%, which exceeded ASHRAE standard. However, the occupants of the dining hall only spent 15 to 60 minutes whereas, the workshop's occupants have to spent nearly 8 hours per day. On the other hand, the workshop occupants have more chances being expose to the unhealthy environment. Therefore, a research should be held to identify the MARA vocational training workshops IEQ safe to occupy.

1.2 Objective

The general objective of this study is to determine the indoor environmental quality of MARA vocational training workshops.

Specific objective are as follows,

i. To measure indoor pollutants for example carbon monoxide and carbon dioxide in MARA vocational training workshops.

ii. To measure indoor stressors example sound pressure level, temperature profile, lighting level and relative humidity in the said workshops.

1.3 Expected Outcome of The Research

From this study, the Indoor Environmental Quality (IEQ) of MARA Vocational Training Workshops can be known as baseline information.

1.4 Scope and Limitations

The scope of this study is limited to ten MARA Vocational Training workshops in Kuala Lumpur. Another ten workshops in Lumut and also eight workshops in Pekan (appendix 1) This study was conduct in two months started April 2003 and end May 2003.

CHAPTER 2

LITERATURE RIVIEW

The public is probably more familiar with the terms "Indoor Air Quality" and "Sick Building Syndrome". "Indoor Air Quality," as the name implies, simply refers to the quality of the air in a building environment. "Sick Building Syndrome" is a term many people use to convey a wide range of symptoms they believe can be attributed to the building itself. Workers typically implicate the workplace environment because their symptoms are alleviated when they leave the workplace. Many investigators have found that environmental quality may be influenced by a number of factors, encompassing more than air contamination. Other factors such as comfort, noise, lighting, ergonomic stressors (poorly designed work stations and tasks) and job related psychosocial stressors can individually and in combination contribute to complaints. Hence, IEQ more accurately describes the scope of the problem.

2.1 Indoor Air Quality and Climate

Most people, excepting the agrarian community, spent nearly all of their life in the built environment and maybe 90% of their life in the indoor environment. The causes and effects of air and other pollutions, which can affect the health, and well being of people are therefore vital subjects of concern. The quantitative risk assessment of potential environmental hazards is also subject to scrutiny.

According to Donald (1997), the main motivation for management to clean the air has been a moral desire not to cause harm to workers. In addition, there is a growing realization that poor indoor air quality affects company productivity as a consequence of, through absenteeism, fewer work years (early deaths), lower productivity, lower morale, and higher insurance rates (refer to table 2.1). Still, some management with the best of intentions has put off action on satisfactory improvements because they plan to work it into "next year's" budget.

Table 2.1 Worker symptoms that can be due to building materials

Symptom	**Contaminant or Condition**				
	Combustion Materials	**Solvents**	**Formaldehyde**	**Ozone**	**Spores, Molds, etc.**
Asthma	2	0	11	11	11
Mucous Membrane Irritation	10	9	11	11	11
Eye Irritation	9	10	11	11	11
Congestion, Runny Nose	9	1	11	11	11
Headache	12	7	11	6	6
Fatigue, Weakness	9	11	11	7	11
Dizziness	7	7	0	4	2
Nausea	10	6	0	1	3
Diarrhea, Constipation	1	0	0	0	0
Rashes	1	11	2	11	11
Sneezing, Cough	10	10	2	11	11
Chest Pain	7	6	3	5	6
Intestinal Cramps	1	0	0	0	0
Discomfort	12	12	12	12	12
Chronic Conditions	6	7	8	6	10

(Courtesy of Professional Service Industries, Inc., Portland, Oregon. 1991)

2.2 Sick Building Syndrome (SBS)

The term "sick building syndrome" (SBS) is used to describe situations in which building occupants experience acute health and comfort effects that appear to be linked to time spent in a building, but no specific illness or cause can be identified. The complaints may be localized in a particular room or zone, or may be widespread throughout the building. In contrast, the term "building related illness" (BRI) is used when symptoms of diagnosable illness are identified and can be attributed directly to airborne building contaminants and clinically proven.

Donald (1997), defined BRI refers to illness brought on by exposure to the building air in which symptoms of diagnosable illness are identified (e.g., certain allergies or infections) which are directly attributed to environmental agents in the air. Legionnaires' disease and hypersensitivity pneumonitis are examples of BRI that can have serious, and even life-threatening, consequences.

A 1984 World Health Organization Committee report suggested that up to 30 percent of new and remodelled buildings worldwide might be the subject of excessive complaints related to IEQ. Often this condition is temporary, but some buildings have long-term problems. Frequently, problems result when a building is operated or maintained in a manner that is inconsistent with its original design or prescribed operating procedures. Sometimes indoor air problems are a result of poor building design or occupant activities.

In the early and mid 1900's, building ventilation standards called for approximately 15 cubic feet per minute (cfm) of outside air for each building occupant, primarily to dilute and remove body odors. As a result of the 1973 oil embargo, national energy conservation measures called for a reduction in the amount of outdoor air provided for ventilation are reduced to 5cfm per occupant. In many cases these reduced outdoor air ventilation rates were found to be inadequate to maintain the health and comfort of building occupants. Inadequate ventilation, which may also occur when heating, ventilating, and air conditioning (HVAC) systems do not effectively distribute air to people in the building. In an effort to achieve acceptable IEQ while minimizing energy consumption, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) recently revised its ventilation standard to provide a minimum of 15cfm of outdoor air per person (20cfm/person in office spaces). Up to 60cfm/person may be required in some spaces (such as smoking lounges) depending on the activities that normally occur in that space (ASHRAE Standard 62-1989).

Baechler (1991) mentioned that mechanical ventilation is the forced movement of air by fans into and out of a building. The primary purpose of the mechanical ventilation system is to provide a healthy and comfortable indoor environment for building occupants. Other purposes include temperature and humidity control, improved thermal comfort, air exchange control, and exhausting smoke, waste heat, and toxic pollutants. Mechanical ventilation systems are designed to provide a range of ventilation rates. Most HVAC systems are designed to operate on a minimum of outside air--averaging 15% to 20% of total airflow. Through intentional control of the dampers, or even failure of the damper controls, the percentage of outside air introduced to the ventilation system can range from 0% to 100%.

Donald (1997) said the HVAC system must not only provide a comfortable environment but must also be one of the main tools used to control contaminants. Poor indoor environmental quality occurs when ventilation is inadequate to the task of keeping contaminant concentrations below levels that produce occupant health problems. The perception of still or stale air, odor, draftiness, or errant temperature and humidity leads to discomfort. Most IEQ complaints originate from the HVAC system's inability to meet occupant needs of the more than 1200 IEQ investigations performed in recent years by NIOSH, over half were attributed to inadequate ventilation.

2.3 Natural Ventilation

Using natural ventilation to prevent overheating within a building presents a very different challenge to maintaining an acceptable IEQ standard. In this case, natural ventilation is used especially at night when outdoor air is typically cooler than daytime air. This applies to a cold to moderate climate and not necessarily to the climate of a city such as Kuala Lumpur, which experiences very hot and humid condition. For cooling, important considerations are internal heat loads and external solar gains, as well as building characteristics, such as thermal mass and insulation level, and the overall building floor and site layout.

Leven (1989) reports that four British studies found higher symptom prevalence rates in sealed, mechanically ventilated buildings than in those naturally ventilated. One of these studies found that buildings with humidification had the greatest symptom rates. A third study found a threefold excess of symptom rates in mechanically ventilated buildings compared to naturally ventilated buildings. A study of 30 British buildings found little difference between natural and mechanically ventilated buildings, but did find higher symptom prevalence in air-conditioned buildings as compared to non-air-conditioned buildings. This study also found higher symptom rates in women than in men, and in public-sector buildings than in private-sector buildings.

Table 2.2 Recommended Airflow Rates (cfm/person) Contained in ASHRAE Standard 62-1981 and 62-1989

Building Area Type	**Standard 62-1981**		**Standard 6Z-1989**
	Nonsmoking	**Smoking**	
Office spaces	5	20	20
Retail stores	5	25	0.02-0.30 cfm/ft2
Classrooms	5	25	15
Dining rooms	7	35	20
Hotel conference rooms	7	35	20
Office conference rooms	7	35	20
Ballrooms and discos	7	35	25
Spectator areas	7	35	15
Theater auditoriums	7	35	15
Transporting waiting rooms	7	35	15
Hospital patient rooms	7	35	25
Residences	10	10	1.5 ACH[a]
Bars/cocktail lounges	10	50	30
Beauty shops	20	35	25
Smoking lounges	-	-	60

(a) Air changes per hour

2.4 Thermal Comfort

Thermal comfort in the workplace is a function of a number of different factors; temperature, humidity, air distribution, personal preference, and acclimatization are all determinants of comfort in the workplace. However, determining optimum conditions is not a simple process (David 2002). To achieve "thermal comfort" means that a person wearing a normal amount of clothing feels neither cold nor warm. Such comfort is important both for one's well being and for productivity and can be achieved only when the air temperature, humidity and air movement are within the specified range often referred to as the "comfort zone".

Where air movement is virtually absent and when relative humidity can be kept at about 50%, the ambient temperature becomes the most critical and debated factor for maintaining thermal comfort. Unfortunately, temperature preferences vary greatly among individuals and there is no one temperature that can satisfy everyone. Nevertheless, it is fair to say that a workshop, which is too warm, makes its occupants lethargic; on the other hand, one that is too cold causes the occupants' attention to drift, making them restless and easily distracted.

2.4.1 Thermal Comfort Conditions

Two conditions must be fulfilled to maintain thermal comfort. One is that the actual combination of skin temperature and the body's core temperature provide a sensation of thermal neutrality. The second is the fulfilment of the body's energy balance: the heat produced by the metabolism should be equal to the amount of heat lost from the body. The relationship between the parameters: skin temperature, core body temperature and activity, which result in a thermally neutral sensation, are based on a large number of experiments.

Sweat production was chosen as a parameter instead of the core body temperature, but as the sweat production is a function of the deep body and skin temperature this does not in principle change anything in the thermal sensation model.

2.4.2 Clothing

Clothing reduces the body's heat loss. Therefore, clothing is classified according to its insulation value. The unit normally used for measuring clothing's insulation is the Clo unit, but the more technical unit $m^{2\circ}C/W$ is also seen frequently (1Clo = 0.155 $m^{2\circ}C/W$).

The Clo scale is designed so that a naked person has a Clo value of 0.0 and someone wearing a typical business suit has a Clo value of 1.0. The Clo value can be calculated if the person's clothing and the Clo values for the individual garments are known, by simply adding the Clo values together. Table 2.3 contains a list of clothing items and their corresponding Clo values.

Obtaining the Clo value through calculation normally gives a sufficient accuracy. If exact values are required, it is better to measure the Clo value using a heated mannequin dummy.

When calculating Clo values, it is important to remember that upholstered seats, car seats and beds reduce the heat loss from the body too, and therefore, these must be included in the overall calculation.

Table 2.3 Clo-Values for Different Items of Clothing and Ensembles

CLOTHING	Clo-VALUE
Naked	0.0
Briefs	0.06
T-shirt	0.09
Bra and panties	0.05
Long underwear	
Upper	0.35
Lower	0.35
Shirt	
Light, short sleeve	0.14
Heavy, long sleeve	0.29
Add 5% for tie or turtleneck	
Skirt	0.22-0.70
Trousers	0.26-0.32
Sweater	0.20-0.37
Socks	0.04-0.10
Light summer outfit	0.3
Working clothes	0.8
Typical indoor winter clothing combination	1.0
Heavy business suit	1.5

Note: The clo-value is a measure of insulation provided by articles of clothing. A clo-value of 1 roughly equals R-0.88. Clo-values are additive, so one can calculate the clo-value for a person wearing a T-shirt and light socks (0.09 + 0.04) = 0.13. (Adapted from *ASHRAE Fundamentals* and "Technical Review of Thermal Comfort," Bruel and Kjaer, No. 2, 1982.)

2.4.3 Elements of Thermal Comfort

The "Clo-value" of clothing closely corresponds to the R-value of fibreglass and other building materials. Researchers in Denmark and the United States have measured the Clo-values of different clothing ensembles. By definition, a nude person has a Clo-value of 0.0, while a typical business suit has a Clo-value of 1.0. An Eskimo's cold-weather parka has a Clo-value of about 4.0. Table 2.3 shows the Clo-values for different items of clothing and ensembles. There are also estimates of Clo-values of animals' skins. The tiny shrew's fur coat provides only a clo-0.3 whereas the polar bear's coat is about clo-5.

2.5 Relative Humidity (RH)

Most buildings require some form of humidity control - dehumidification, humidification or both - to maintain occupant comfort levels and indoor air quality. ASHRAE Standard 62-1989 recommends maintaining indoor relative humidity between 30% and 60%. Humidity levels less than 30% cause some people respiratory discomfort while levels over 60% promote the growth of some forms of mold and mildew. Today, microbiological contamination (mold and mildew) is one of the most common causes of occupant complaints and IEQ problems in buildings.

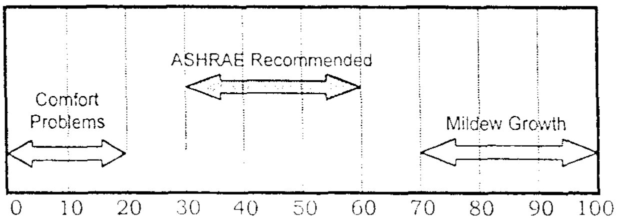

Figure 2.1: Recommended Relative Humidity (ASHRAE)

ASHRAE Standard 62-1989 addresses the need to control relative humidity:

> *"High humidity's can support the growth of pathogenic or allergenic organisms. Examples include certain species of fungi, associated mycotoxins and dust mites ... Relative humidity in habitable spaces preferably should be maintained between 30% and 60% to minimize growth of allergenic and pathogenic organisms." (Section 5.11)*

2.6 Air Pollution

Environment Protection Agency (EPA) studies have found that pollutant levels indoor can be two to five times higher than outdoors. After some activities, indoor air pollution levels can be 100 times higher than outdoors. There are many sources of indoor pollutants. Obvious ones are chemicals, cleaning products, and pesticides. Less obvious are pollutants caused by such simple tasks as cooking, bathing, or heating the home.

How do we know if the indoor air is dangerous to our health? Often, it is difficult to determine which pollutant or pollutants are the sources of a person's ill health, or even if indoor air pollution is the problem. Many indoor air pollutants cannot be detected by our senses (e.g., smell) and the symptoms they produce can be vague and sometimes similar, making it hard to attribute them to a specific cause. Some symptoms may not show up until years later, making it even harder to discover the cause. Common symptoms of exposure to indoor air pollutants include: headaches, tiredness, dizziness, nausea, itchy nose, and scratchy throat. More serious effects are asthma and other breathing disorders and cancer.

2.6.1 Carbon Monoxide (CO)

Carbon monoxide (CO) is a colourless, odourless, and highly poisonous gas produced by the incomplete combustion of any carbon-based material. Common sources include automobile exhaust, cigarette smoke, kerosene heaters, furnaces, etc. Dangerous amounts of CO can accumulate as a result of poor installation, poor maintenance or failure or damage to an appliance in service, where the fuel is not burned properly, or when rooms are poorly ventilated. Brnitez (1993) says CO is a product of the incomplete combustion of carbonaceous fuels. The greatest anthropogenic source of this pollutant is internal combustion engines used for transportation.

Baechler (1991) mentioned CO is formed whenever fuel is incompletely burned. The CO concentration in the indoor environment is mostly a result of combustion appliances such as gas stoves, portable kerosene and gas space heaters, and wood stoves. Tobacco smoking is a lesser source. Outdoor sources of CO, including emissions from vehicles in attached garages, also contribute to indoor levels of CO. The CO emission rate for tobacco smoking is 52 to 105 mg/cigarette.

The effects of carbon monoxide - Carbon monoxide produces the following physiological effects on people exposed to the concentrations shown table 2.4.

Table 2.4 Carbon monoxide physiological effects (Baechler, 1991)

CONCENTRATION OF CO IN AIR	INHALATION TIME AND TOXIC DEVELOPED
50 parts per million (ppm)	Safety level as specified by the Health and Safety Executive
200 ppm	Slight headache within 2-3 hours
400 ppm	Frontal headache within 1-2 hours, becoming widespread in 3 hours
800 ppm	Dizziness, nausea, convulsions within 45 minutes, insensible in 2 hours

Carbon monoxide poisons by entering the lungs via the normal breathing mechanism and displacing oxygen from the bloodstream. Interruption of the normal supply of oxygen puts the functions of the heart, brain and other vital functions of the body at risk.

Table 2.5 Symptoms as a function of CO concentration and exposure time (Baechler, 1991)

Concentration (PPM)	Exposure Duration	Symptom or Effect
35	8 hours	This is the maximum exposure allowed by OSHA in the workplace over an eight hour period
200	2-3 hours	Mild headache, fatigue, nausea, and dizziness
400	1-2 hours >3 hours	Serious headache; other symptoms intensify Life threatening
800	45 minutes within 2 hours within 2-3 hours	Dizziness, nausea, convulsions Unconsciousness Death
1600	20 minutes within 1 hour	Headache, dizziness, and nausea Death
3200	5-10 minutes within I hour	Headache, dizziness, and nausea Death
6400 12800	1-2 minutes 25-30 min	Headache, dizziness, and nausea Death
	1-3 minutes	Death

2.6.2 Carbon dioxide (CO_2)

Carbon dioxide is a colourless, odourless gas, which is heavier than air, most commonly generated by respiration, cooking heating systems, wood stoves, etc. The highest permissible exposure limit (PEL) assigned to any material is assigned to carbon dioxide, namely 5000ppm (WHO has recommended a Standard of 1.0% or 10000ppm for a 10-hours work shift with a ceiling of 3.0% or 30000ppm for any 10-minutes period).

According to Kathleen (2002), the primary source of carbon dioxide indoors is human expelled air. The expelled air builds up in airtight buildings, confined air spaces (e.g., enclosed offices with no air supply), overcrowded spaces (e.g., classrooms), and high activity areas (e.g., health clubs).

Baechler (1991) mentioned that the single greatest contributor to indoor CO_2 is human metabolic activity. Significant quantities of CO_2 are also generated by gas stoves and portable kerosene and gas space heaters, and can be introduced to the indoor environment if not vented properly. Wood stoves and tobacco smoking produce smaller amounts.

Furthermore, these concentrations are far more an expression of good practice than a line between "safe" and "dangerous." Actually, the concentration of carbon dioxide must be over about 2% (20000ppm) before most people are aware of its presence unless the odour of an associated material (auto exhaust or fermenting yeast, for instance) is present at lower concentrations. Above 2%, carbon dioxide may cause a feeling of heaviness in the chest and/or more frequent and deeper respirations. If exposure continues at that level for several hours, minimal "acidosis" (an acid condition of the blood) may occur.

As the carbon dioxide concentration climbs above a few percent, the concentration of oxygen in the air inhaled begins to be affected. At 6% carbon dioxide, for instance, the concentration of oxygen in air has decreased from 20.96% to 19.9%. WHO has indicated that the lowest oxygen concentration for shift-long exposure is 19.5%, corresponding to a carbon dioxide concentration well above 6% (60000ppm).

2.6.3 Dust

Particles in the air which settle (or can potentially settle) on surfaces are called "dust." After settling, dust particles may become airborne when disturbed. The health effects of airborne dust particles depend on the size and type of particles. Some particles may contain heavy metals, toxic materials, or fibers. They may be carcinogenic, allergenic, or relatively harmless. Environmental factors such as space and ventilation can determine the size of the particle. A common source of dust particles is smoke from pipes, cigars, and cigarettes, combustion appliances, and fireplaces.

The U.S. Environmental Protection Agency (EPA) Ambient Air Quality standard for particles less than 10 microns in diameter (PM 10) is 50ug/m3 for a 24-hour average. The Occupational Safety and Health administration (OSHA) standard is 500ug/m^3 for an 8-hour day.

2.6.4 Action That May Decrease Exposure to Dust Particles

Cleaning, particularly vacuuming, can resuspend particles causing allergic reactions in some persons. Vacuum cleaners equipped with high efficiency filtration or central vacuum systems can help minimize this problem. Filters in ventilation systems should be upgraded to medium efficiency filters where possible. Filters should be changed frequently. To help control house dust mites and biological dust, relative humidity should be kept below 50%.

Dust should be kept at a minimum through good housekeeping practices. Damp dusting is preferred to dry dusting. Smoking indoors should be eliminated or confined to smoking lounges with direct exhaust to the outside. Combustion appliances should be exhausted to the outside wherever possible. Flues and chimneys should be maintained and kept clean.

Capturing and filtration can range from 5% to 99.97% effective. We can be easily misled by efficiencies because of testing methods used. We can stop 100% of golf balls with a store-bought fibreglass filter, but it will only stop 5% of I micron size particles, which happens to be the hardest size to catch. Three current test methods are arrestance, ASHRAE Dust Spot (1 Micron), and DOP/HEPA (.3 Micron).

According to the Factories and Machineries Act. 1967 (FMA 1967), no employee shall be exposed to mineral dust, containing free silica of less than 1% in weight, at a concentration greater than 5mg/m^3 of respirable dust or 10mg/m^3 of total dust averaged over an eight-hour period. No employee shall be exposed to crystalline silica at concentration for averaged over an eight-hour period greater than:

i. 0.05mg/m^3 of respirable cristobalite; or

ii. 0.1mg/m^3 of respirable quartz; or

iii. 0.05mg/m^3 of respirable tridymite,

2.7 Noise

Noise is unwanted sound; it is derived from the Latin word "nausea," meaning seasickness. Noise is among the most pervasive pollutants today. Noise from road traffic, jet planes, jet skis, garbage trucks, construction equipment, manufacturing processes, lawn mowers, leaf blowers, and boom boxes, to name a few, are among the unwanted sounds that are routinely broadcast into the air. The problem with noise is not only that it is unwanted, but also that it negatively affects human health and well-being. Problems related to noise include hearing loss, stress, high blood pressure, sleep loss, distraction and lost productivity, and a general reduction in the quality of life and opportunities for tranquillity (David, 2002).

Sound is produced by vibrating objects and reaches the listener's ears as waves in the air or other media. When an object vibrates, it causes slight changes in air pressure. These air pressure changes travel as waves through the air and produce sound. To illustrate, imagine striking a drum surface with a stick. The drum surface vibrates back and forth. As it moves forward, it pushes the air in contact with the surface. This creates a positive (higher) pressure by compressing the air. When the surface moves in the opposite direction, it creates a negative (lower) pressure by decompressing the air. Thus, as the drum surface vibrates, it creates alternating regions of higher and lower air pressure. These pressure variations travel through the air as sound waves (Figure 2.2).

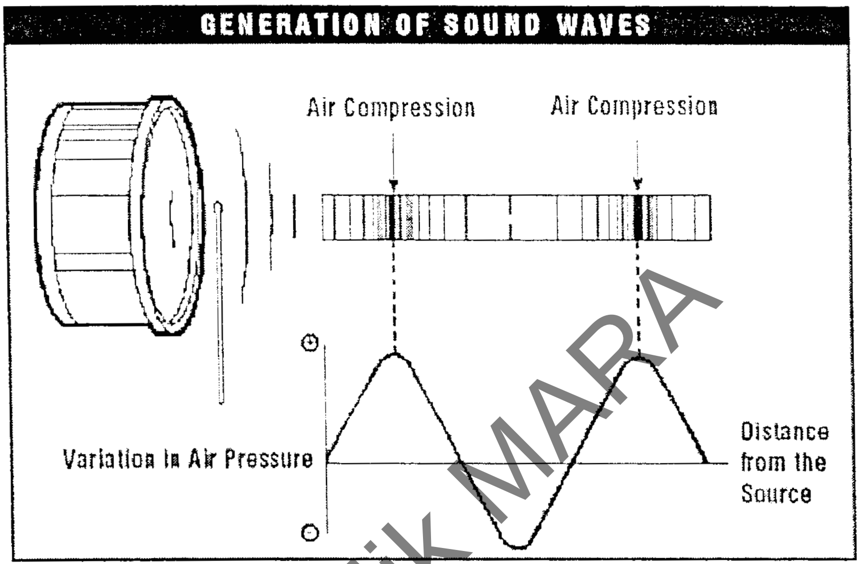

Figure 2.2. Generation of sound waves (Baechler, 1991)

Table 2.6 lists the approximate velocity of sound in air and other media. In gases, the higher the velocity of sound, the higher the pitch will be.

Table 2.6 Approximate Speed of Sound in Common Materials (Crocker, 1984)

MEDIUM	SOUND VELOCITY M/S
Air, dry (0C and 76 mm Hg)	330
Wood (soft - along the fibre)	3400
Water (15C)	1400
Concrete	3100
Steel	5000
Lead	1200
Glass	5500
Hydrogen (0C and 76 mm Hg)	1260

2.7.1 Workplace Hazard

According to Consumer Association of Penang (1985), (CAP, 1985) explains that the body's response to noise is an automatic action, that is, the individual has no control over the response. Everyone has felt the body jerk in response to a very loud noise. This is an automatic physiological response to noise.

Noise is one of the most common occupational health hazards. In heavy industrial and manufacturing environments, as well as in workshops, permanent hearing loss is the main health concern.

Annoyance, stress and interference with speech communication are the main concern in noisy offices, schools and computer rooms.

As a first step in dealing with noise, workplaces need to identify areas or operations where excessive exposure to noise occurs.

The properties of noise, which are important in the workplace, are:

- Frequency
- Sound pressure
- Sound power
- Time distribution

2.7.2 How Noise Damages Hearing

CAP (1985) mentioned that there are two types of physiological responses to noise, they are: loss of hearing and arousal responses. Noise-induced hearing loss seldom involves total hearing loss or deafness. However, the damage cannot be repaired and hearing aids can do little good. Constant exposure to noise affects the inner ear. The first sign of hearing damage is an inability to hear higher pitched sounds; with continued exposure to noise, the ability to tell musical tones apart becomes impossible. Eventually, with continual exposure to excess noise, the ability to hear normal conversation is impaired.

Noise is too loud when:

i. Your ears ring after prolonged exposure to noise (temporary threshold shift).

ii. Speech and other sounds seem muffled after exposure.

iii. You lose the ability to tell musical tones apart.

iv. You fail to hear high-pitched sound.

2.7.3 Sound Pressure Level

Sound pressure converted to the decibel scale is called sound pressure level (Lp). Figure 2.3 compares sound pressures in Pascals and sound pressure levels in decibels (dB). The zero of the decibel scale (0 dB) is the sound pressure of 0.00002 Pa. This means that 0.00002 Pa is the reference sound pressure to which all other sound pressures are compared on the dB scale. This is the reason the decibels of sound are often indicated as dB re 0.00002 Pa (refer to figure 2.3).

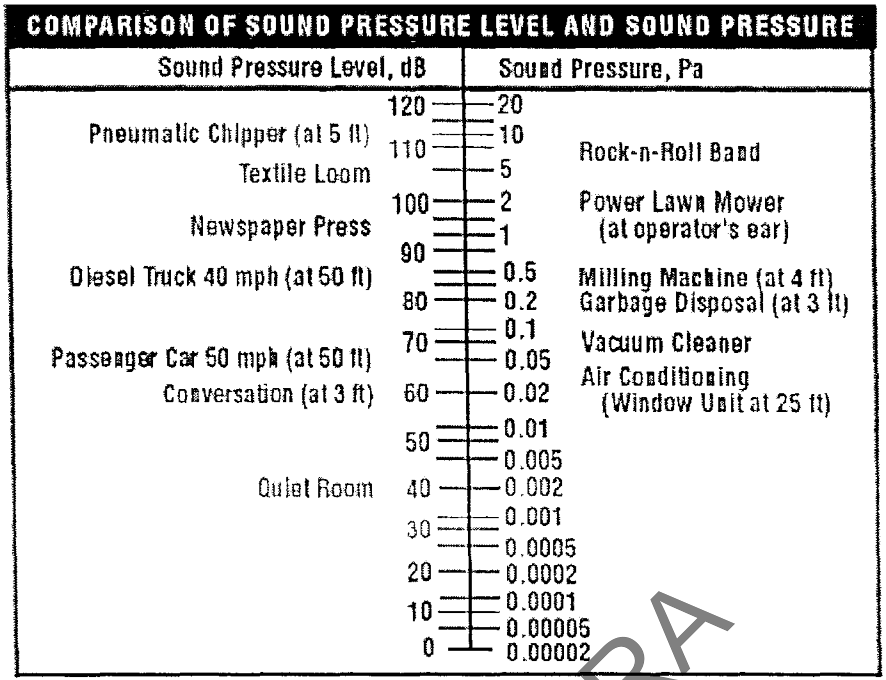

Figure 2.3. Comparison of sound pressure level and sound pressure (Baechler, 1991)

2.7.4 Types of Noise

Noise can be continuous, variable, intermittent or impulsive depending on how it changes over time. Continuous noise is noise which remains constant and stable over a given time period. The noise of boilers in a powerhouse is relatively constant and can therefore be classified as continuous.

Most manufacturing noise is variable or intermittent. Different operations or different noise sources cause the sound changes over time. Noise is intermittent if there is a mix of relatively quiet periods and noisy. Impulse or impact noise is a very short burst of loud noise, which lasts for less than one second. Gun fire or the noise produced by punch presses are examples of such noise.

Recommended levels for noise exposure have been incorporated into many types of safety and health legislation in Canada. These limits should serve as a guide to all persons involved in agricultural work. The Factories and Machineries Act. 1967, sets the permissible exposure limits in Malaysia. (Table 2.7)

Table 2.7. Permissible exposure limits (FMA, 1967)

Noise Level [dB (A) – Slow]	Duration of Exposure Permitted per day (hour – minute)
85	16 – 0
86	13 – 56
87	12 – 8
88	10 – 34
89	9 – 11
90	8 – 0
91	6 – 58
92	6 – 4
93	5 – 17
94	4 – 36
95	4 – 0
96	3 – 29
97	3 – 2
98	2 – 50
99	2 – 15
100	2 – 0
101	1 – 44
102	1 – 31
103	1 – 19
104	1 – 9
105	1 – 0
106	0 – 52
107	0 – 46
108	0 – 40
109	0 – 34
110	0 – 30
111	0 – 26
112	0 – 23
113	0 – 20
114	0 – 17
115	0 – 15

2.7.5 A Weighted Decibels

The sensitivity of the human ear to sound depends on the frequency or pitch of the sound. People hear some frequencies better than others. If a person hears two sounds of the same sound pressure but different frequencies, one sound may appear louder than the other. This occurs because people hear high frequency noise much better than low frequency noise.

Noise measurement readings can be adjusted to correspond to this peculiarity of human hearing. An A-weighting filter which is built into the instrument de-emphasizes low frequencies or pitches. Decibels measured using this filter are A-weighted and are called dB(A). Legislation on workplace noise normally gives exposure limits in dB(A). Table 2.8 lists examples of typical noise levels.

A weighting serves two important purposes:

i. Gives a single number measure of noise level by integrating sound levels at all frequencies

ii. Gives a scale for noise level as experienced or perceived by the human ear

Table 2.8. Typical Noise Levels (Crocker, 1984)

NOISE SOURCE	dB(A)
Pneumatic chipper at 1 metre	115
Hand-held circular saw at 1 metre	115
Textile room	103
Newspaper press	95
Power lawn mower at 1 metre	92
Diesel truck 50 km per hour at 20 metres	85
Passenger car 60 km per hour at 20 metres	65
Conversation at 1 metre	55
Quiet room	40

2.7.6 Basic Rules of Working with Decibel (dB) Units

The use of dB unit makes it easy to deal with the workplace noise level data provided we use a set of simple rules as summarized in Table 2.9.

Table 2.9. Decibel (dB) basics (Crocker, 1984)

CHANGE IN dB	CHANGE IN SOUND ENERGY
3 dB increase	Sound energy doubled
3 dB decrease	Sound energy halved
10 dB increase	Sound energy increased by factor of 10
10 dB decrease	Sound energy decreased by factor of 10
20 dB increase	Sound energy increased by factor of 100
20 dB decrease	Sound energy decreased by factor of 100

2.7.7 Noise Levels Added

Sound pressure levels in decibels dB or A-weighted decibels dBA are based on a logarithmic scale. They cannot be added or subtracted in the usual arithmetical way. If one machine emits a sound level of 90 dB, and a second identical machine is placed beside the first, the combined sound level is 93 dB, not 180 dB. Table 2.10 shows a simple way to add noise levels

Table 2.10. Addition of Decibels (Crocker, 1984)

Numerical difference between two noise levels [dB(A)]	**Amount to be added to the higher of the two noise levels [dB or dB(A)]**
0	3.0
0.1 - 0.9	2.5
1.0 - 2.4	2.0
2.4 - 4.0	1.5
4.1 - 6.0	1.0
106.1 - 10	0.5
	0.0

Step 1: Determine the difference between the two levels and find the corresponding row in the left hand column.
Step 2: Find the number [dB or dB(A)] corresponding to this difference in the right hand column of the table.
Step 3: Add this number to the higher of the two-decibel levels.

For instance, using the example of two machines each emitting a noise level of 90dB:

- Step 1: The numerical difference between the two levels is 0 dB (90-90= 0), using the first row.

- Step 2: The number corresponding to this difference of 0, taken from the right hand column, is 3.

- Step 3: Add 3 to the highest level, in this case 90. Therefore, the resulting noise level is 93dB.

When the difference between two noise levels is 10dBA or more, the amount to be added to the higher noise level is zero. In such cases, no adjustment factor is needed because adding in the contribution of the lower in the total noise level makes no perceptible difference in what people can hear or measure.

2.8 Lighting

Improper lighting is likely the largest environmental factor contributing to visual discomfort. Although it is necessary and important to have adequate illumination, this is not usually the most important aspect of good lighting.

The geometry of the lighting in the room is normally the most important aspect of lighting as it relates to visual comfort. The geometry of the lighting is akin to the quality of the lighting. This involves not only the light sources, but how the light is directed into the office through the use of lighting fixtures, baffles, blinds, drapes, etc., and how it is reflected from the various surfaces in the room such as walls, ceilings, furniture, etc. A good lighting situation is one in which all of the visual objects in the field of view have nearly equal brightness.

The most important principle of good lighting is: eliminate bright sources of light from the field of view and strive to obtain a relatively even distribution of luminances (brightness) in the field of view.

Baechler (1991) said that lighting could also affect occupants' perceptions of buildings. Sterling and Sterling (1984) report that there is a significant relationship between poor lighting and reported building illness. Office workers having poor building lighting were found to be more likely to think of their buildings as contributing to poor health. Noise has also been identified as a potential cause of SBS symptoms.

Light `flow' from a lamp is measured in *lumens*. A uniform point source of one candela (luminous intensity in any direction [defined for 555 nm radiant intensity of 1/683 watt per steradian) ~ one dinner candle) at the center of sphere of 1-foot radius gives 1 lumen per square foot. This is also one lumen per steradian. Area of the one foot sphere is 12.57 sq. ft. so the 1 cd. source produces 12.57 lumens.

- a 60 watt incandescent lamp emits about 1000 lumens
- a 50 watt high pressure sodium lamp emits 3900 lumens

2.9 Conclusion

A satisfactory environment is the ultimate aim of good building design. This is very important because it gives a cause of 'comfort' to the occupants. The comfort of human being is governed by many physiological, mechanism of the body and these vary from person to person. There are many factors that contribute to the development of a satisfactory environment such as thermal comfort, proper ventilating, sound etc. Some of these factors can be controlled mechanically, however this will incur higher maintenance cost. Thus a full advantage must be taken at the natural resources to achieve the required comfort.

Literature shows that indoor parameters of temperature, relative humidity, air velocity must be measured. Common indoor pollutants are CO and CO_2 while sound pressure level and lighting level are stressors.

CHAPTER 3

METHODOLOGY

This chapter describes the method used in conducting the research in MARA Vocational Training workshop. There are four methods that were used in the process of gathering information, which are preliminary study, questionnaires, field measurement and observations.

3.1 Preliminary study

Preliminary study was conducted in dining halls at IKM Kuala Lumpur on August 7, 2002 and IKM Johor Bahru on August 9, 2002 (refer figure 3.1 to 3.3). The test was involved determining the temperature, relative humidity, carbon dioxide and sound pressure level at twelve pre-determined locations.

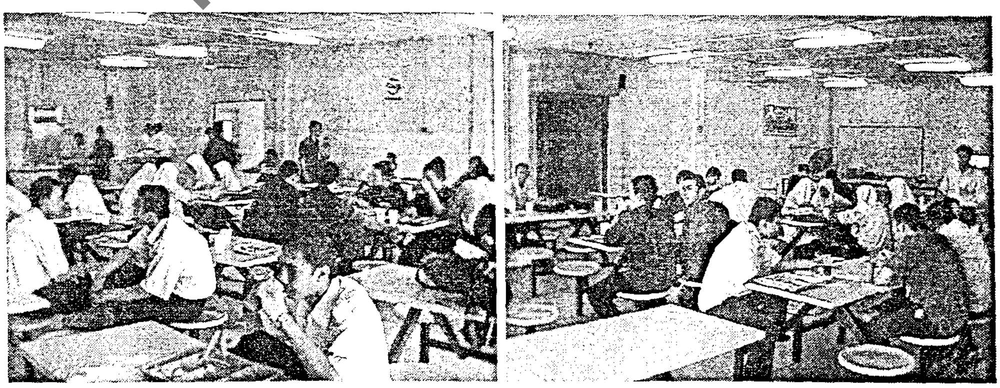

Figure 3.1. IKM Kuala Lumpur dining hall

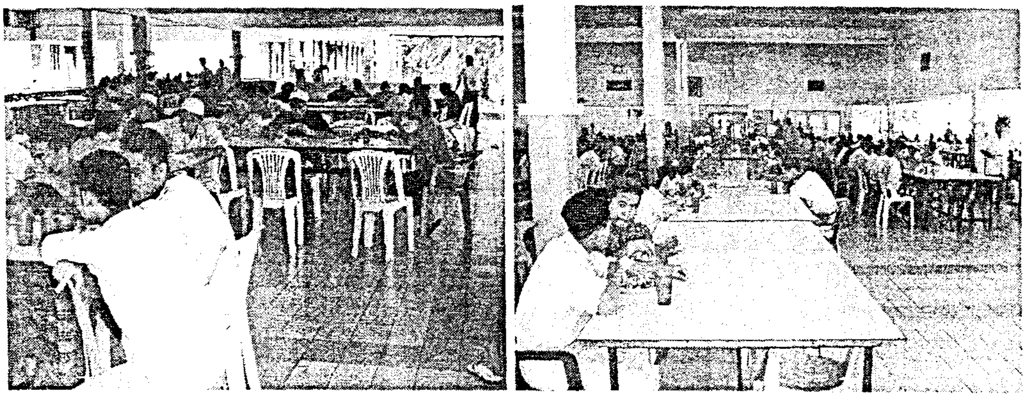

Figure 3.2. IKM Johor Bahru dining hall

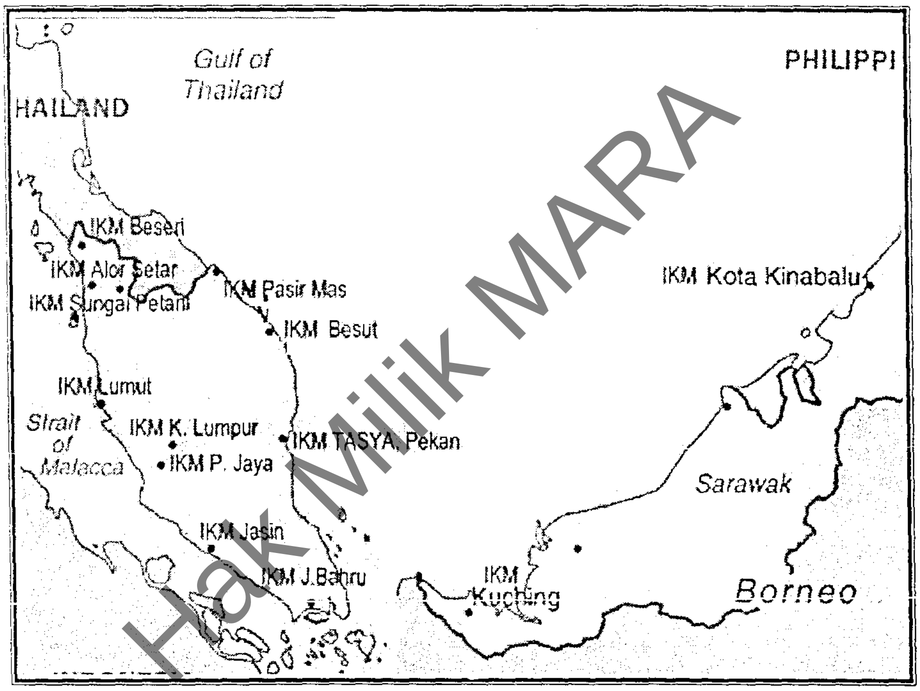

Figure 3.3. Location of 13 MARA Vocational training center

A total of 3960 measurements were recorded from each of the dining hall evaluated. The measurements were taken at an average of 15 to 30 minutes. The results of the study are tabulated in Table 3.1 & 3.2.

Table 3.1. Result on Indoor

NO	CENTER	INDOOR (MEAN)				
		TEMP. (°C)	RH (%)	CO (PPM)	CO_2 (PPM)	SOUND (dBA)
1	IKM Johor Bahru	**30.3**	**64.3**	3.9	584.5	67.0
2	IKM Kuala Lumpur	**31.0**	**63.7**	3.6	601.0	66.8
STANDARD		22-27 (ASHRAE)	30-60 (ASHRAE)	9 (WHO)	650 (ASHRAE)	90 (FMA)

Table 3.2. Result on Outdoor

NO	CENTER	OUTDOOR (MEAN)				
		TEMP. (°C)	RH (%)	CO (PPM)	CO_2 (PPM)	SOUND (dBA)
1	IKM Johor Bahru	**31.5**	**65.8**	4.4	537.1	66.3
2	IKM Kuala Lumpur	**31.8**	**65.5**	4.0	511.0	66.7
STANDARD		22-27 (ASHRAE)	30-60 (ASHRAE)	9 (WHO)	650 (ASHRAE)	90 (FMA)

3.2 Questionnaires

Overall, the questionnaires were designed to focus on areas; personal background (three questions), pollution exposure (nine questions), safety background (ten questions), health background (five questions) and recommendation (one question). Two sets of questions had been distributed to lecturers and students. The questions are based on multiple choices and fill in the blank. (Appendices 6 & 7)

3.2.1 Population and Sample of study

The population of study was 533 from 6 different courses (refer table 3.3). A total of 266 respondents were randomly selected.

Table 3.3 Population and Sample of study

NO	COURSE	N		S	
		STUDENT	LECTURE	STUDENT	LECTURE
1	Welding & Fabrication Technology	84	15	40	12
2	Mech. Eng. (Machine Maintenance)	84	9	35	8
3	Electrical Engineering (Domestic & Industry)	109	9	50	8
4	Electrical Engineering (Chargeman)	85	9	45	8
5	Air-Conditioning Technology	57	9	22	8
6	Metal Fabrication Technology	54	9	22	8
	TOTAL	*473*	*60*	**214**	**52**

Note;

N = population
S = Sample

3.2.2 Respondent

Two groups of respondent were requested to answer the questionnaires containing 28 simple questions. They are a group of 52 lecturers and another group of 214 students. All respondents were selected randomly.

3.3 Field Measurement

The measurement is taken in three chosen center as the research site; IKM Kuala Lumpur, Lumut and Tan Sri Yahya Ahmad (TSYA), Pekan. Measurements were taken from twenty-eight workshops to determine the temperature, relative humidity, carbon monoxide, carbon dioxide, dust, air velocity, sound and light level at the ten selected workshops in each IKM Kuala Lumpur and IKM Lumut. Another eight selected workshops in IKM TSYA, Pekan. (refer table 3.4).

Table 3.4 List of workshops measured

NO	WORKSHOPS	IKM KL	IKM LUMUT	IKM TSYA
1	Air-Condition Workshop	✓		
2	EDI Workshop I	✓		
3	KMPM Workshop I	✓		
4	KMPM Workshop II	✓		
5	Welding Workshop	✓		
6	EDI Workshop II	✓		
7	PJE Workshop	✓		
8	EDI Workshop III	✓		
9	Sheet Metal Workshop I	✓		
10	Sheet Metal Workshop II	✓		
11	Arc Workshop I		✓	
12	Spray Painting Workshop		✓	
13	Foundry Workshop		✓	
14	Pattern Workshop		✓	
15	Machine Workshop I		✓	
16	Machine Workshop II		✓	
17	Electrical Workshop I		✓	
18	Arc Workshop II		✓	
19	Arc Workshop III		✓	
20	Electrical Workshop II		✓	
21	Petrol (Automobile)			✓
22	Transmission (Automobile)			✓
23	Store (Automobile)			✓
24	Laboratory (Automobile)			✓
25	Petrol (Automotive)			✓
26	Diesel (Automotive)			✓
27	Fitting (Spray Painting)			✓
28	Machine Shop			✓

3.3.1 Location of sample taken

The measurement is taken from ten to twelve locations of every workshop at the three centers: two at the outside of the workshop (near to the entrance and exit door) and the other ten locations are inside the workshop. These spots are selected basing on the possibilities where the majority of the students hang around to do their activities such as workbench area, work bay, machine area, front entrance and exit route (refer figure 3.4).

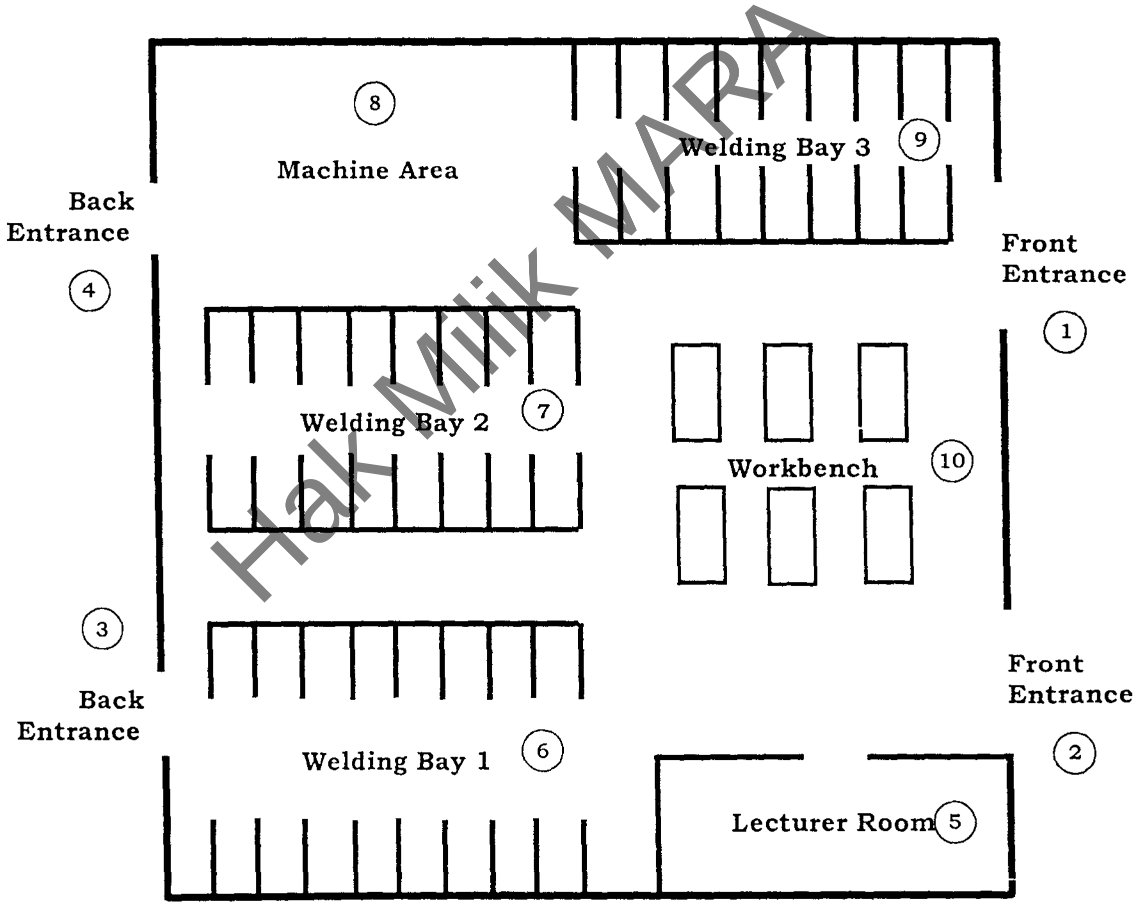

Figure 3.4. Sampling point in workshops
(Arc 1, IKM Kuala Lumpur)

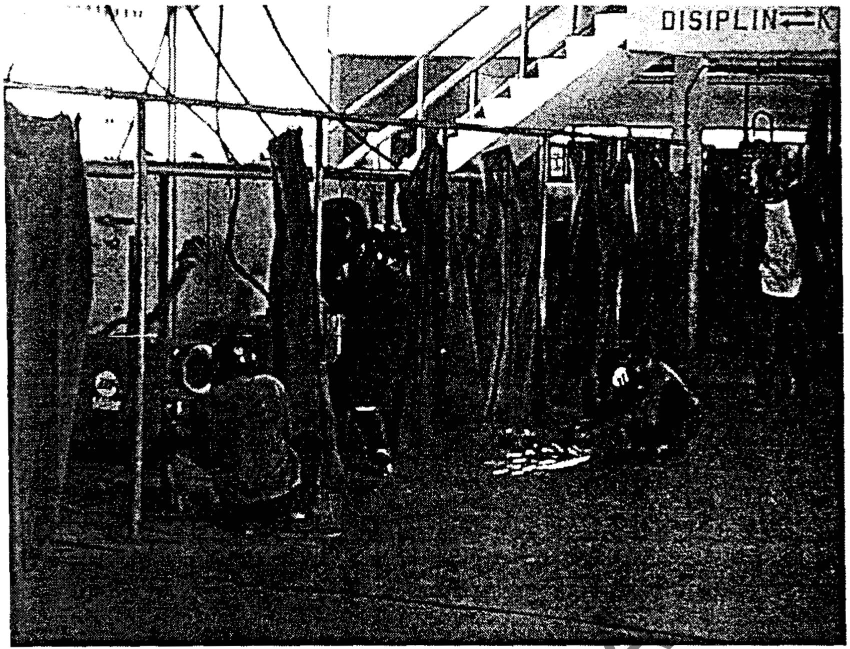

Figure 3.5. TIG welding bay

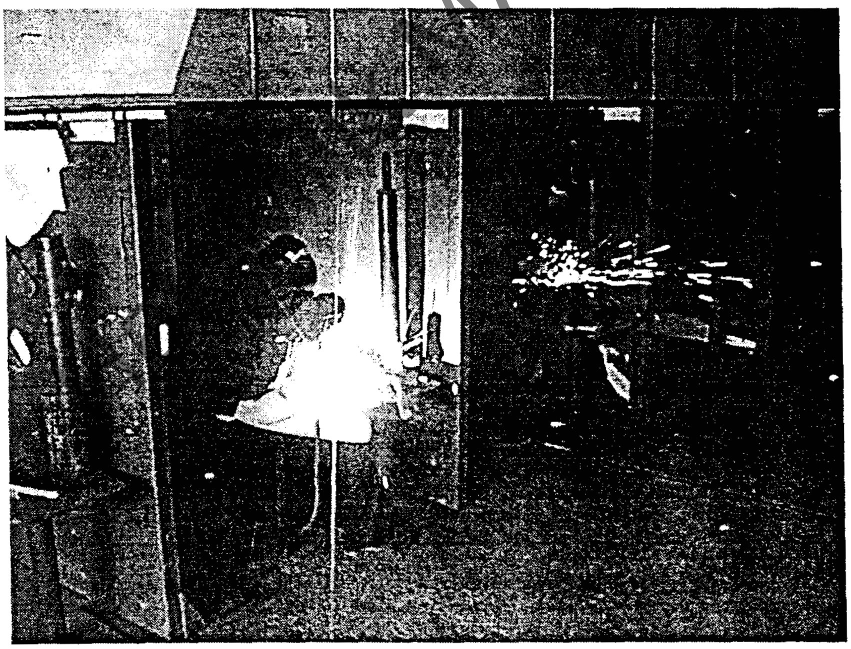

Figure 3.6. ARC welding bay

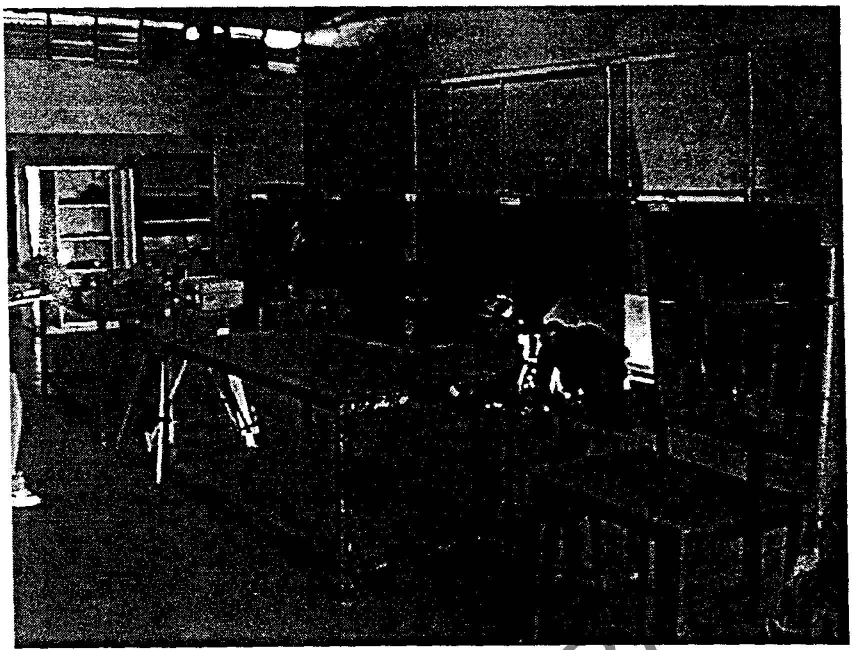

Figure 3.7. Workbench area

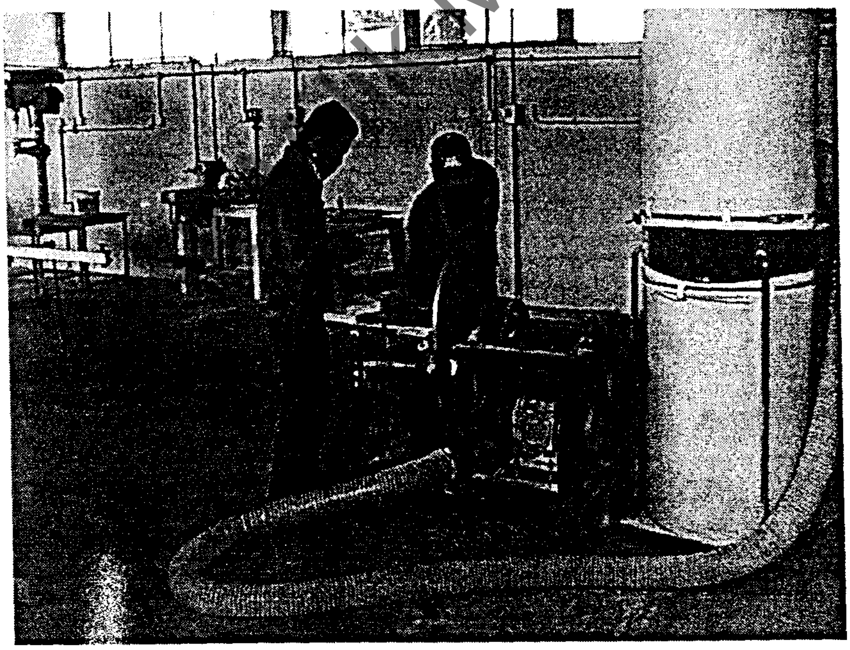

Figure 3.8. Machine area

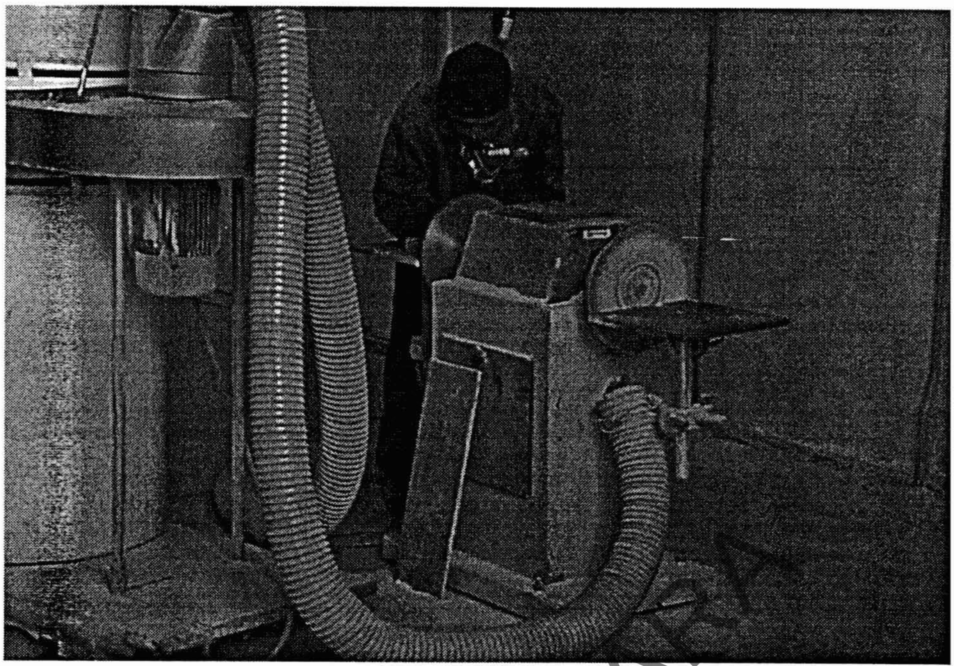

Figure 3.9. Machine area

3.3.2 Measurement tools for IAQ

TSI's IAQ-Calc™ Meters Models 8762 was used for investigating and monitoring building air quality to measure CO_2, CO, temperature, relatives humidity, and calculates dew point, wet bulb temperature, absolute humidity, humidity ratio and percentage outside air.

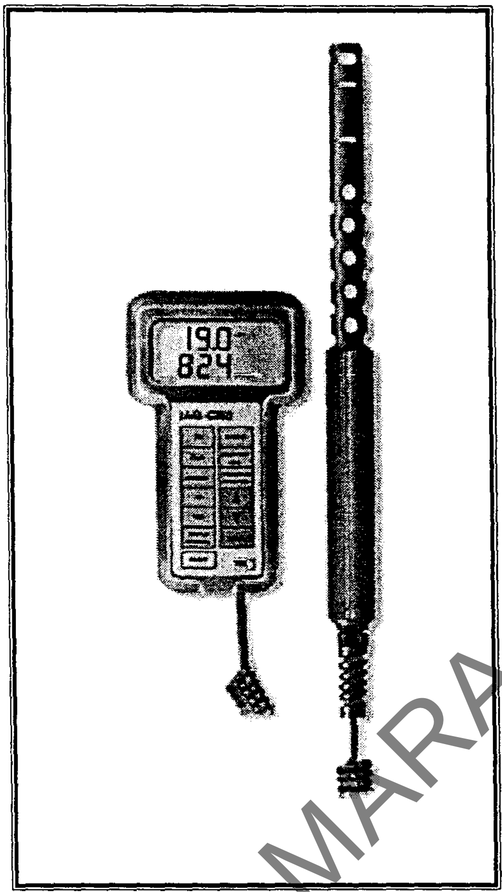

Figure 3.10. IAQ meter

Sampling function records multiple point measurements. Data logging allows user to log 14,000 samples with a time and date stamp. Statistics function displays average, maximum and minimum values, and the number of recorded samples.

This equipment measures temperature in the range of 0 to 60°C with accuracy ±0.6°C and 0.1°C resolution. This meter can also measure relative humidity in the range 5 % to 95 % RH with an accuracy ±2.0% RH and resolution 0.1% RH. Besides temperature and relative humidity, CO_2 and CO reading also be measured with these meter; in range 0 to 5000ppm with ±3.0% of reading or ±50ppm, whichever is greater and resolution 1ppm for CO2. The reading of CO in range of 0 to 500ppm with accuracy of with ±3.0% of reading or ±50ppm, whichever is greater and resolution 0.1ppm. (Appendices 11 & 12)

3.3.3. Measurement Tools for Dust Level

A portable, battery-operated, laser-photometer DUSTTRAK Aerosol Monitor was used to measure aerosols in a wide variety of environments, from offices to industrial workplaces and records airborne dust concentrations. Common applications include indoor air quality investigations, industrial workplace monitoring, environmental monitoring, evaluation of filters and engineering controls and real-time remote site and perimeter monitoring.

With the DUSTTRAK Aerosol Monitor, an easy-to-read digital display shows real-time concentrations in milligrams per cubic meter (mg/m^3) while data is simultaneously logged into memory. The DUSTTRAK has enough memory to record a week's worth of data, even at one-minute intervals.

The DUSTTRAK monitor is factory-calibrated for the respirable fraction of standard (ISO 12103-1, A1) test dust, which typifies common ambient aerosols. For ultimate precision, it can be conveniently calibrated in the field for the specific airborne contaminant in your workplace, even liquid aerosol mists.

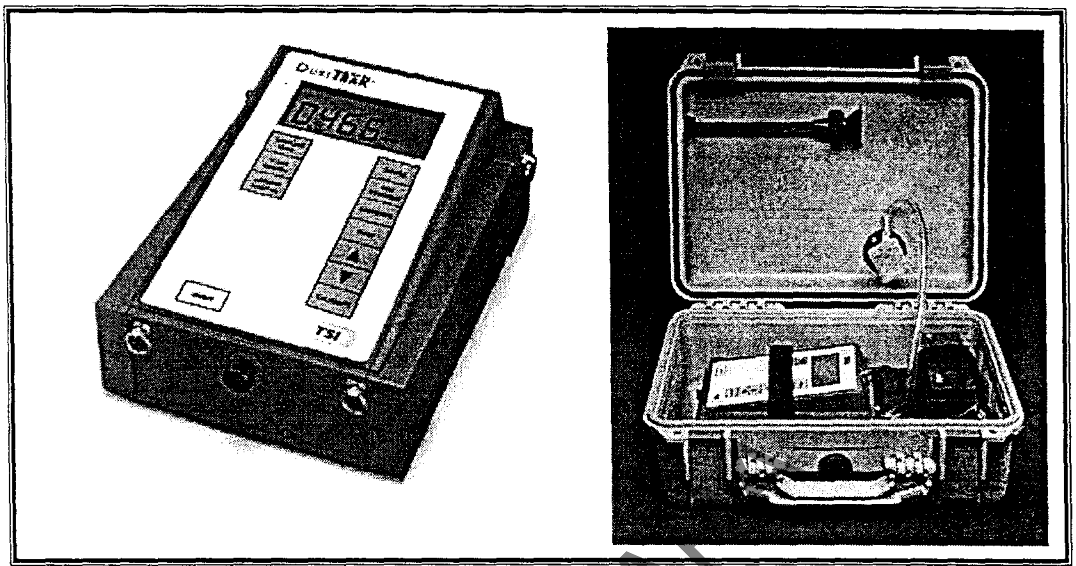

Figure 3.11. Dust level meter

3.3.4 Measurement Tools for Air Velocity

Equipment used for this measurement was TSI's VELOCICALC Plus Meters Model 8386. This meter simultaneously measure and data log several ventilation parameters using a single probe with multiple sensors. This meter measures velocity, temperature, and calculates volumetric flow rate in range of 0 to 50m/s with accuracy ±3.0% of reading or ±0.015m/s, whichever is greater and 0.01m/s resolution. Relative humidity also be measured in range 0 to 95% RH with accuracy ± 3% RH and 0.1% resolution. (Appendix N)

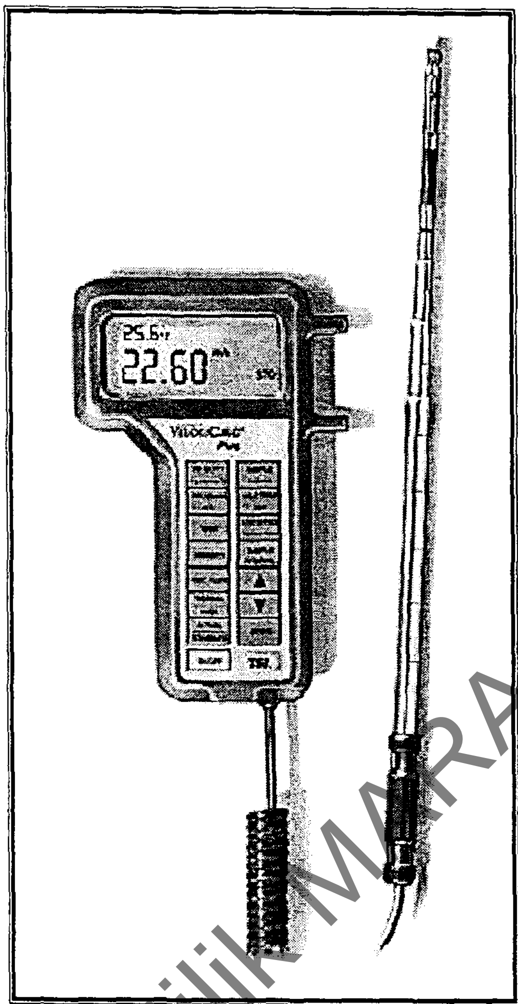

Figure 3.12 Air Velocity Meter

3.3.5 Measurement Tools for Sound Level

Equipment used for this measurement was Digital Sound Level meter model 407736. It is hand-held meter, a product of Extech Instruments, USA. This is a battery-powered instrument for measuring sound level. This meter provides a built-in calibration check. The calibration screw adjust is located on the front panel under Function switch. This meter is calibrated in dB unit. The

Sound Level Meter is for general purpose and high (75 to 130dB) and low (35 to 90dB) measuring ranges with 0.1dB resolutions.

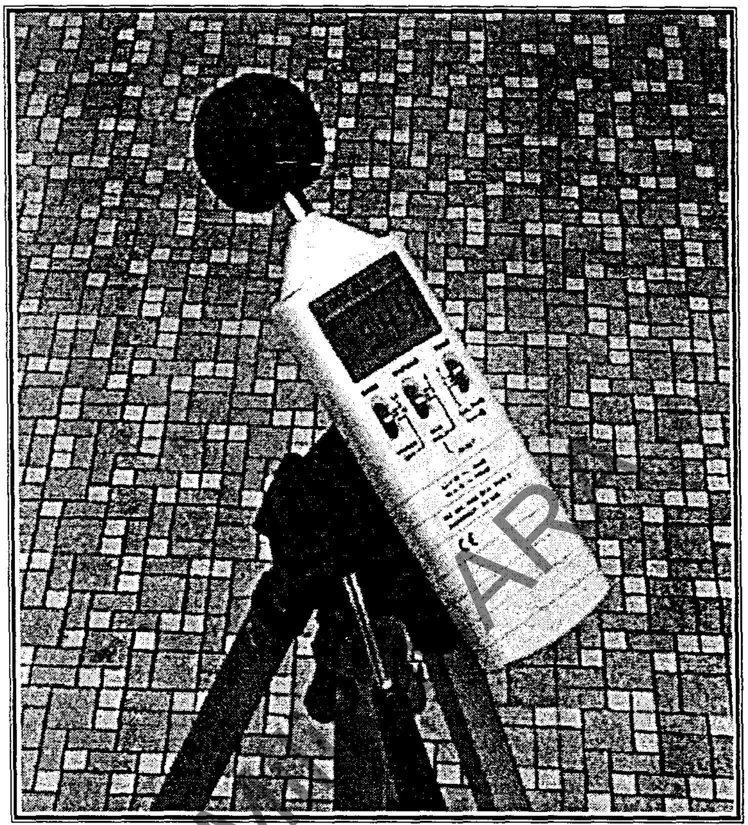

Figure 3.13. Sound Level Meter

3.3.6 Measurement Tools for Lighting Level

Equipment used for this measurement was hand-held meter model 840020 from Sper Scientific, USA. This Digital Light Meter is for general purpose and high accuracy measurements. This model has fast and accurate response and a hold function. The sensors are cosine and color corrected and hermetically sealed to ensure long-term stability with range 2000 FC (20,000Lux) and full scale accuracy ± 5% rdg. (Appendices 14 & 15)

Figure 3.14 Light Level Meter

3.4 Observations

During field measurement, the observation was focus on the building design together with its orientation to find out whether the building has a good ventilation system.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Result on the Preliminary Study

The indoor environmental quality in two IKM was conducted in Kuala Lumpur on August 7, 2002 and IKM Johor Bahru on August 9, 2002. The parameters measured were temperature, relative humidity, carbon dioxide and sound pressure level at twelve pre-determined locations for every dining hall. (Appendix 16)

These standard measurements used for the purpose of the analyses are based on table 4.1 below.

Table 4.1. Guidelines For Standard Parameter

PARAMETER	LIMIT/RANGE	REFERENCE
Temperature level	22°C – 27°C	ASHRAE
Relative Humidity level	30% – 60%	ASHRAE
Carbon Monoxide level	9 ppm	WHO
Carbon Dioxide level	650 ppm	ASHRAE
Sound Pressure level	90dBA	FMA

Note;
ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning Engineers
WHO - World Health Organization
FMA - Factory and Machinery Act, Malaysia

After identifying the twelve locations, during the walkthrough observations in each of the dining hall visited, the measurements were recorded on the work sheet. All the readings made were subsequently keyed in Microsoft Excels before the analyses are made. A total of 3960 measurements were recorded from each of the dining hall evaluated (Appendix S to AE). The measurements were taken at an average of 15 to 30 minutes.

Table 4.2 is the overall reading recorded on the measurement made in each of the dining hall evaluated. The results include the descriptive analysis on temperature, relative humidity, carbon monoxide, carbon dioxide and sound pressure level.

Table 4.2. Overall result indoor and outdoor measurement

NO	CENTER	OUTDOOR (MEAN)					INDOOR (MEAN)				
		TEMP. (°C)	RH (%)	CO (PPM)	CO_2 (PPM)	SOUND (dBA)	TEMP. (°C)	RH (%)	CO (PPM)	CO_2 (PPM)	SOUND (dBA)
1	IKM Johor Bahru	31.5	65.8	4.4	537.1	66.3	30.3	64.3	3.9	584.5	67.0
2	IKM Kuala Lumpur	31.8	65.5	4.0	511.0	66.7	31.0	63.7	3.6	601.0	66.8

The mean score indoor temperatures were 30.3°C in IKM Johor Bahru and 31.0°C in IKM Kuala Lumpur, with outside temperatures 31°C in both places. The contents of indoor temperatures are lower compared to the measurement made in outdoor 31.5°C and 31.8°C. These temperatures exceed the ASHRAE recommendations of 22-27°C (refer Table 4.2).

The mean score of indoor relative humidity were 64.3% in IKM Johor Bahru and 63.7% in IKM Kuala Lumpur, outdoor was 65.8% and 65.5%, respectively these relative humidity level exceeded within the ASHRAE recommendations of 30-60% (refer Table 4.2).

Results for mean score of carbon monoxide measurements are 3.9ppm in IKM Johor Bahru and 3.8ppm in IKM Kuala Lumpur, outdoor were 4.4ppm and 4.0ppm, respectively these values are fall below the recommended level of 9ppm (WHO) (refer Table 4.2).

Results for mean score carbon dioxide measurements are 5384.5ppm in IKM Johor Bahru and 601.0ppm in IKM Kuala Lumpur, outdoor was 537.1ppm and 511.0ppm, respectively these results are fall below the recommended level of 650ppm (WHO) (refer Table 4.2).

The mean score sound pressure level measurements are 67.0dBA in IKM Johor Bahru and 66.8dBA in IKM Kuala Lumpur, outdoor was 66.3dBA and 66.8dBA, respectively these values are fall below the recommended level of 90dBA (FMA, 1967) (refer Table 4.2).

4.2 Result on the Questionnaires

266 questionnaires were distributed in random sample and only 249 questionnaires were returned which is 93.6 % (refer table 4.3). All of the questionnaires have been analyses by descriptive test with SPSS and MS excel program. (Appendix 17 – 29)

Table 4.3. Total questionnaires returned

NO	RESPONDENT	POPULATION (N)	SAMPLE (S)	RETURNED	% RETURNED
1	Lecturers	60	52	47	90.4
2	Students	473	214	202	94.4
	TOTAL	**533**	**266**	**249**	**93.6**

4.2.1 Respondent Personal Background

From the 249 respondent's surveyed, 100 % are male. (refer table 4.4). This is because the courses offered are popular among male students.

Table 4.4. Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	249	100.0	100.0	100.0

Table 4.5 shows that 25.5% of the lecturers have 1 to 5 years working experience. Meanwhile 34% respondents have 6 to 10 years and another 14.9% have 11 to 15 years working experience. There are also 25.5% respondents who have above 16 years working experience. The result shows that more respondents who have 6 to 10 years working experience.

Table 4.5. How long have you been working in IKM? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5 years	12	25.5	25.5	25.5
	6-10 years	16	34.0	**34.0**	59.6
	11-15 years	7	14.9	14.9	74.5
	Over 16 years	12	25.5	25.5	100.0
	Total	47	100.0	100.0	

Table 4.6 shows that majority of the respondents (42.1 %) have 1 to 6 months studying experience. Another 3% have 7 to 12 months and 37.1% have 13 to 18 months. There are also 16.8% respondents who have 19 to 24 months and only 1% has 31 to 36 months. Generally, the results show that more respondents have 1 to 6 months studying experience.

Table 4.6. How long have you been studying in IKM? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-6 months	83	41.1	**42.1**	42.1
	7-12 months	6	3.0	3.0	45.2
	13-18 months	73	36.1	37.1	82.2
	19-24 months	33	16.3	16.8	99.0
	31-36 months	2	1.0	1.0	100.0
	Total	197	97.5	100.0	
Missing	System	5	2.5		
Total		202	100.0		

Table 4.7 a total of 26.7% respondents took 3 to 4 hours continuously in the workshop within one day. 55.6% took 5 to 6 hours. Only 17.8% took 7 to 8 hours continuously. This shows that majority of the respondents took up 5 to 6 hours per day continuously in the workshop.

Table 4.7. How long have you spent continuously in the workshop within one day? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3-4 hours	12	25.5	26.7	26.7
	5-6 hours	25	53.2	55.6	82.2
	7-8 hours	8	17.0	17.8	100.0
	Total	45	95.7	100.0	
Missing	System	2	4.3		
Total		47	100.0		

Based on the analysis of the Table below, 20.1% respondents took 3 to 4 hours per day continuously in the workshop. However, majority of the respondents (51.8%) took 5 to 6 hours while 27.1% took 7 to 8 hours. Only 1.0% spent 1 to 2 hours in the workshop. This shows that more respondents spent 5 to 6 hours continuously in the workshop.

Table 4.8. How long have you spent continuously in the workshop within one day? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-2 hours	2	1.0	1.0	1.0
	3-4 hours	40	19.8	20.1	21.1
	5-6 hours	103	51.0	51.8	72.9
	7-8 hours	54	26.7	27.1	100.0
	Total	199	98.5	100.0	
Missing	System	3	1.5		
Total		202	100.0		

4.2.2 Pollution Exposure

From the study conducted 72.3% of the lecturer feel uncomfortable, only 27.7% feel comfortable in the workshop.

Table 4.9. Do you feel comfortable in the workshop? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	13	27.7	27.7	27.7
	No	34	72.3	72.3	100.0
	Total	47	100.0	100.0	

Table 4.10 shows that 52.0% of the respondents feel uncomfortable and only 48.0% feel comfortable in the workshop.

Table 4.10. Do you feel comfortable in the workshop? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	95	47.0	48.0	48.0
	No	103	51.0	52.0	100.0
	Total	198	98.0	100.0	
Missing	System	4	2.0		
Total		202	100.0		

Although majority of the respondents felt that the temperature in the workshop was too high only 19.1% of respondents admitted that they feel the temperature was suit to their body. However, it is just a matter of time before the respondents got themselves used to the environment.

Table 4.11. Is the temperature too high in the workshop? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	38	80.9	80.9	80.9
	No	9	19.1	19.1	100.0
	Total	47	100.0	100.0	

Table 4.12 shows that only 46.9% said that the temperature in the workshop was too high and 53.1% of the respondents' feel that the temperature was suited to their body.

Table 4.12. Is the temperature too high in the workshop? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	92	45.5	46.9	46.9
	No	104	51.5	53.1	100.0
	Total	196	97.0	100.0	
Missing	System	6	3.0		
Total		202	100.0		

59.1% of respondents mentioned that the temperature range of 26-30^{0}C, only 40.9% Of respondents said that the temperature is 31-35^{0}C.

Table 4.13. What is the temperature (Celsius) in the workshop? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	26-30	26	55.3	59.1	59.1
	31-35	18	38.3	40.9	100.0
	Total	44	93.6	100.0	
Missing	System	3	6.4		
Total		47	100.0		

From the analysis, 41.7% of respondents who felt that the temperature was range in 31-35^{0}C as indicate in table 4.14. However, 32.6% of respondents said that the temperature is 36-40^{0}C. Another 2.8% of respondents felt that the temperature was ≤ 25 ^{0}C. For the other 2.8%, the temperature was <25 ^{0}C.

Table 4.14. What is the temperature (Celsius) in the workshop? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<25	4	2.0	2.8	2.8
	26-30	29	14.4	20.1	22.9
	31-35	60	29.7	41.7	64.6
	36-40	47	23.3	32.6	97.2
	<41	4	2.0	2.8	100.0
	Total	144	71.3	100.0	
Missing	System	58	28.7		
Total		202	100.0		

Although majority of the respondents felt that the workshop environment was not too humid, 15.6% of respondents admitted that they feel the environment was too humid. However, it is just a matter of time before the respondents got themselves used to the environment.

Table 4.15. Is the workshop environment too humid? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	7	14.9	15.6	15.6
	No	38	80.9	84.4	100.0
	Total	45	95.7	100.0	
Missing	System	2	4.3		
Total		47	100.0		

From the study conducted (table 4.16), 88.5% of the students felt that the environment in the workshop was not too humid and only 11.5% said that they felt uneasy with the workshop environment.

Table 4.16. Is the workshop environment too humid? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	23	11.4	11.5	11.5
	No	177	87.6	88.5	100.0
	Total	200	99.0	100.0	
Missing	System	2	1.0		
Total		202	100.0		

Table 4.17 shows that, 77.8% admitted that they do not feel breezy during their working hours in the workshop. Only 22.2% of the respondents felt breezy in the workshop.

Table 4.17. Do you feel breezy in the workshop? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	10	21.3	22.2	22.2
	No	35	74.5	77.8	100.0
	Total	45	95.7	100.0	
Missing	System	2	4.3		
Total		47	100.0		

From table 4.18, 80.1% of respondents stated that they do not feel breezy in the workshop. Only 19.9% felt breezy.

Table 4.18. Do you feel breezy in the workshop? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	39	19.3	19.9	19.9
	No	157	77.7	80.1	100.0
	Total	196	97.0	100.0	
Missing	System	6	3.0		
Total		202	100.0		

83.0% of respondents as shown in Table 4.19 found that the workshop environment was too dusty. Only 17.0% claimed that the workshop environment free from dust.

Table 4.19. Is the workshop environment too dusty? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	39	83.0	83.0	83.0
	No	8	17.0	17.0	100.0
	Total	47	100.0	100.0	

Based on the analysis, 57.1% of respondents agreed. They felt that the workshop environment was too dusty. The other 42.9% of respondents who did not agreed felt that the workshop environment is free from dust.

Table 4.20. Is the workshop environment too dusty? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	112	55.4	57.1	57.1
	No	84	41.6	42.9	100.0
	Total	196	97.0	100.0	
Missing	System	6	3.0		
Total		202	100.0		

As shown in Table 4.21, majority of the respondent (74.5%) were not able to see the work piece clearly. Another 25.5% respondents could see the work piece clearly.

Table 4.21. Can the work piece be seen clearly? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	12	25.5	25.5	25.5
	No	35	74.5	74.5	100.0
	Total	47	100.0	100.0	

As shown in Table 4.22, majority of the respondent (87.5%) were able to see the work piece clearly. Another 12.5% respondents were not able to see the work piece clearly.

Table 4.22. Can the work piece be seen clearly? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	175	86.6	87.5	87.5
	No	25	12.4	12.5	100.0
	Total	200	99.0	100.0	
Missing	System	2	1.0		
Total		202	100.0		

The study shows that, the workshop environment affects 74.5% of the respondents hearing. Another 25.5% answered that their hearing did not affected. This shown that, they able to cope the workshop environment.

Table 4.23. Does the workshop environment affect your hearing? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	35	74.5	74.5	74.5
	No	12	25.5	25.5	100.0
	Total	47	100.0	100.0	

The study shows that the workshop environment affects 57.2% of the respondents hearing. Another 42.8% answered that their hearing did not affected. This shown that, they able to cope the workshops environment.

Table 4.24. Does the workshop environment affect your hearing? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	115	56.9	57.2	57.2
	No	86	42.6	42.8	100.0
	Total	201	99.5	100.0	
Missing	System	1	.5		
Total		202	100.0		

Table 4.25 analyses that 54.5% of the respondents could not hear clearly when talking in the workshop. 45.5% respondents felt that they do not have problem of hearing when talking in the workshop.

Table 4.25. Do you hear clearly while talking in the workshop? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	24	51.1	54.5	54.5
	No	20	42.6	45.5	100.0
	Total	44	93.6	100.0	
Missing	System	3	6.4		
Total		47	100.0		

Table 4.26 analyses that 55.7% of the respondents could not hear clearly when talking in the workshop. 44.3% respondents felt that they do not have problem of hearing when talking in the workshop.

Table 4.26. Do you hear clearly while talking in the workshop? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	112	55.4	55.7	55.7
	No	89	44.1	44.3	100.0
	Total	201	99.5	100.0	
Missing	System	1	.5		
Total		202	100.0		

4.2.3 Safety Background

Analysis of this study shows that 70.2% of the respondents said that Personal Protective Equipment (PPE) was supply in the workshop. However, only 29.8% respondents said that the management does not supply the Personal Protective Equipment.(refer table 4.27)

Table 4.27. Is Personal Protective Equipment (PPE) supplied in the workshop? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	33	70.2	70.2	70.2
	No	14	29.8	29.8	100.0
	Total	47	100.0	100.0	

Analysis of this study shows that majority (92.6%) of the respondents said that Personal Protective Equipment (PPE) was supply in the workshop. However, only 7.4% respondents said that the management does not supply the Personal Protective Equipment.

Table 4.28. Is Personal Protective Equipment (PPE) supplied in the workshop? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	187	92.6	92.6	92.6
	No	15	7.4	7.4	100.0
	Total	202	100.0	100.0	

As shown in Table 4.29, 70% to 100% of the respondents admitted that goggle; face shield, glove, safety boot and apron were supply by the management. On the other hand, below 7% of respondents agreed that ear plug, respirator and helmet were supply.

Table 4.29. List PPE supplied in the workshop? (Lecturer)

	Goggle	Face Shield	Glove	Respirator	Ear plug	Apron	Helmet	Safety boot
N	47	47	47	47	47	47	47	47
Sum	42	42	41	2	3	36	1	47
Mis.	5	5	6	45	44	11	46	0
%	**89.4**	**89.4**	**87.2**	**4.3**	**6.4**	**76.6**	**2.1**	**100.0**

As shown in table 4.30, 80% to 100% of the respondents admitted that goggle, safety boot and glove were supply by the management. Meanwhile, 40% to 60% respondents claimed those apron and face shields are supply. Below 10% agreed that helmet, ear plug and respirator are supply.

Table 4.30. List PPE supplied in the workshop? (Student)

	Goggle	Face Shield	Glove	Respirator	Ear plug	Apron	Helmet	Safety boot
N	202	202	202	202	202	202	202	202
Sum	186	110	175	8	4	97	15	200
Mis.	16	92	27	194	198	105	187	2
%	**92.1**	**54.5**	**86.6**	**4.0**	**2.0**	**48.0**	**7.4**	**99.0**

Table 4.31 analyses that 44.7% of the respondents always wear Personal Protective Equipment in the workshop. 55.3% respondents are did not wear Personal Protective Equipment in the workshop.

Table 4.31. I always wear PPE in the workshop. (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	21	44.7	44.7	44.7
	No	26	55.3	55.3	100.0
	Total	47	100.0	100.0	

Nearly all respondents (94.6%) are always wearing Personal Protective Equipment in the workshop. Only 3.5% respondents are did not wear Personal Protective Equipment in the workshop.

Table 4.32. I always wear PPE in the workshop. (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	191	94.6	96.5	96.5
	No	7	3.5	3.5	100.0
	Total	198	98.0	100.0	
Missing	System	4	2.0		
Total		202	100.0		

As shown in Table 4.33, 80% to 100% of the respondents wearing goggle and safety boot. Meanwhile, 30% to 60% respondents wear face shield, apron and glove. Furthermore, below 5% wear respiratory, helmet and ear plug.

Table 4.33. List PPE that you wear in the workshop. (Lecturer)

	Goggle	Face Shield	Glove	Respirator	Ear plug	Apron	Helmet	Safety boot
N	47	47	47	47	47	47	47	47
Sum	42	18	27	1	2	20	1	46
Mis.	5	29	20	46	45	27	46	1
%	**89.4**	**38.3**	**57.4**	**2.1**	**4.3**	**42.6**	**2.1**	**97.9**

As shown in Table 4.34, 70% to 100% of the respondents wear goggle, safety boot and glove. Only 53.5% respondents wear face shield and 3% to 12%% wear respirator and apron. Another 0.5% only wear safety helmet. Unfortunately there is nobody wear earplug, may be in this case the earplug is not compulsory.

Table 4.34. List PPE that you wear in the workshop. (Student)

	Goggle	Face Shield	Glove	Respirator	Ear plug	Apron	Helmet	Safety boot
N	202	202	202	202	202	202	202	202
Sum	163	108	148	6	0	23	1	200
Mis.	39	94	54	196	202	179	201	2
%	**80.7**	**53.5**	**73.3**	**3.0**	**0.0**	**11.4**	**0.5**	**99.0**

68.9% of the respondents felt comfortable wearing Personal Protective Equipment and the other 31.1% respondents are uncomfortable wearing Personal Protective Equipment. (Refer table 4.35)

Table 4.35. Do you feel comfortable wearing Personal Protective Equipment (PPE)? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	31	66.0	68.9	68.9
	No	14	29.8	31.1	100.0
	Total	45	95.7	100.0	
Missing	System	2	4.3		
Total		47	100.0		

82.5% of the respondents felt comfortable wearing Personal Protective Equipment and the other 17.5% respondents are uncomfortable wearing Personal Protective Equipment.

Table 4.36. Do you feel comfortable wearing Personal Protective Equipment (PPE)? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	165	81.7	82.5	82.5
	No	35	17.3	17.5	100.0
	Total	200	99.0	100.0	
Missing	System	2	1.0		
Total		202	100.0		

Analysis of these study shows that 46.8% of the respondents last wear Personal Protective Equipment was this month. Another 46.7% respondents are wearing Personal Protective Equipment for the last 2-6 months ago and the rest wear it in 7-11 months ago.

Table 4.37. When is the last time you use PPE? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	This month	22	46.8	48.9	48.9
	2-6 months ago	21	44.7	46.7	95.6
	7-11 months ago	2	4.3	4.4	100.0
	Total	45	95.7	100.0	
Missing	System	2	4.3		
Total		47	100.0		

Analysis of these study shows that 68.9% of the respondents last wear Personal Protective Equipment was this month. Another 27.3% respondents are wearing Personal Protective Equipment for the last 2-6 months ago and the rest 3.8% wear it in 7-11 months ago.

Table 4.38. When is the last time you use PPE? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	This month	126	62.4	68.9	68.9
	2-6 months ago	50	24.8	27.3	96.2
	7-11 months ago	7	3.5	3.8	100.0
	Total	183	90.6	100.0	
Missing	System	19	9.4		
Total		202	100.0		

From Table 4.39, a total of 91.5% respondents agreed that management should supply the earplug in the workshop. There are 2.1% to 21.3% agreed that face shield, apron, helmet and respirator also must be supply in the workshop.

Table 4.39. List PPE that should be supplied in the workshop. (Lecturer)

	Goggle	Face Shield	Glove	Respirator	Ear plug	Apron	Helmet	Safety boat
N	47	47	47	47	47	47	47	47
Sum	3	1	0	10	43	1	7	0
Mis.	44	46	47	37	4	46	40	47
%	**6.4**	**2.1**	**0.0**	**21.3**	**91.5**	**2.1**	**14.9**	**0.0**

From Table 4.40, a total of 30.2% above respondents agreed that management should supply the respirator and earplug in the workshop. There are 1.0% to 1.5% agreed that glove and apron also must be supply but not the face shield and helmet.

Table 4.40. List PPE that should be supplied in the workshop. (Student)

	Goggle	Face Shield	Glove	Respirator	Ear plug	Appron	Helmet	Safety boat
N	202	202	202	202	202	202	202	202
Sum	20	0	2	61	109	3	0	0
Mis.	182	202	200	141	93	199	202	202
%	**9.9**	**0.0**	**1.0**	**30.2**	**54.0**	**1.5**	**0.0**	**0.0**

60.0% of respondents stated that dustcoat is the appropriate clothes to wear in the workshop. On the other hand, 22.2% respondents felt that jacket is the right clothes to wear and another 17.8% find that overall is the best clothes to wear in the workshop. (Refer table 4.41)

Table 4.41. What type of clothes do you wear in the workshop? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Dust Coat	27	57.4	60.0	60.0
	Jacket	10	21.3	22.2	82.2
	Overall	8	17.0	17.8	100.0
	Total	45	95.7	100.0	
Missing	System	2	4.3		
Total		47	100.0		

72.9% of respondents stated that jacket is the appropriate clothes to wear in the workshop. On the other hand, 27.1% respondents felt that overall is the right clothes to wear.

Table 4.42. What type of clothes do you wear in the workshop? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Jacket	145	71.8	72.9	72.9
	Overall	54	26.7	27.1	100.0
	Total	199	98.5	100.0	
Missing	System	3	1.5		
Total		202	100.0		

Majority of the respondents found that safety boot is the appropriate shoe to use in the workshop.

Table 4.43. What type of shoes do you wear in the workshop? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Safety boot	46	97.9	100.0	100.0
Missing	System	1	2.1		
Total		47	100.0		

100 % of the respondents found that safety boot is the appropriate shoe to use in the workshop (table 4.44).

Table 4.44. What type of shoes do you wear in the workshop? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Safety boot	197	97.5	100.0	100.0
Missing	System	5	2.5		
Total		202	100.0		

According to the 63.8% of respondents, they can freely move around in the workshop. The other 36.2% felt that they could not move easily (table 4.45).

Table 4.45. I can freely move in the workshop. (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	30	63.8	63.8	63.8
	No	17	36.2	36.2	100.0
	Total	47	100.0	100.0	

Based on the findings below, majority of respondents (84.6%), they can freely move around in the workshop and only 15.4% felt that they could not move easily.

Table 4.46. I can freely move in the workshop. (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	170	84.2	84.6	84.6
	No	31	15.3	15.4	100.0
	Total	201	99.5	100.0	
Missing	System	1	.5		
Total		202	100.0		

4.2.4 Health Background

Based on the findings below, 30% to 60% of respondents are suffering from cold, sore throat and headache. Meanwhile, more than 2.1% up to 4.3% are suffering from vomiting, asthma and dizzy.

Table 4.47. Please tick health affect that you suffer during your working in IKM. (Lecturer)

	Headache	Dizzy	Cold	Vomiting	Sore throat	Asthma
N	4	47	47	47	47	47
Sum	2	2	16	1	20	2
Mis.	2	45	31	46	27	45
%	**51.**	**4.3**	**34.0**	**2.1**	**42.6**	**4.3**

Based on the table 4.48, 20% to 50% of respondents are suffering from sore throat, headache and cold. The other 1.0% respondents have asthma and 2.0% are suffering from dizzy.

Table 4.48. Please tick health affect that you suffer during your working in IKM. (Student)

	Headache	Dizzy	Cold	Vomiting	Sore throat	Asthma
N	20	202	202	202	202	202
Sum	6	4	99	0	50	2
Mis.	13	198	103	202	152	200
%	**32.**	**2.0**	**49.0**	**0.0**	**24.8**	**1.0**

Analysis of these study shows that 34.1% of the respondents had their latest medical leave above one year ago. Another 54.5% respondents had their medical leave in 7-11 months ago. Only 11.4% got their medical leave in 2-6 months ago.

Table 4.49. When was your latest medical leave? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2-6 months ago	5	10.6	11.4	11.4
	7-11 months ago	24	51.1	54.5	65.9
	> One years ago	15	31.9	34.1	100.0
	Total	44	93.6	100.0	
Missing	System	3	6.4		
Total		47	100.0		

Analysis of this study shows that 40.6% of the respondents had their latest medical leave one year ago. Another 46.2% respondents had their medical leave in 7-11 months ago. The other 11.3% got their medical leave in 2-6 months ago. Only 1.9% respondents have their medical leave in this month.

Table 4.50. When was your latest medical leave? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	This month	2	1.0	1.9	1.9
	2-6 months ago	12	5.9	11.3	13.2
	7-11 months ago	49	24.3	46.2	59.4
	1 year ago	43	21.3	40.6	100.0
	Total	106	52.5	100.0	
Missing	System	96	47.5		
Total		202	100.0		

From the 47 respondents, only 21.7% went to see a doctor in 2-6 months ago. Another 52.2% respondents see the doctor in 7-11 months ago. Only 26.1% go to see the doctor above one year ago.

Table 4.51. When did you last see the doctor? (Lecturer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2-6 months ago	10	21.3	21.7	21.7
	7-11 months ago	24	51.1	52.2	73.9
	> one years ago	12	25.5	26.1	100.0
	Total	46	97.9	100.0	
Missing	System	1	2.1		
Total		47	100.0		

From the 202 respondents, only 1.6% went to see a doctor during one month ago. 9.7% go to see the doctor in 2-6 months ago. Another 69.4% respondents went to the doctor in 7-11 months ago. The other 18.4% go to see the doctor in one year ago.

Table 4.52. When did you last see the doctor? (Student)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	This month	2	1.0	1.6	1.6
	2-6 months ago	12	5.9	9.7	11.3
	7-11 months ago	86	42.6	69.4	80.6
	1 year ago	24	11.9	19.4	100.0
	Total	124	61.4	100.0	
Missing	System	78	38.6		
Total		202	100.0		

The figures above had proven that the management do not provide routine medical check-up.

Table 4.53. Does the management provide routine medical check-up?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	47	100.0	100.0	100.0

Table 4.54. If yes, how frequent has check-up been done?

		Frequency	Percent
Missing	System	47	100.0

4.2.5 Recommendations

More than 34.0% of lecturer stated that in order to improve the comfort level, all of the workshop must have enough space, good lighting and good ventilation. 8.5% respondents felt that the workshop layout itself also will help the improvement of the comfort level. The other 2.1% respondents also suggest that cleanliness of the workshop will help the situation.

Table 4.55. Give your recommendations how to improve the comfort level in the workshop. (Lecturer)

	Workshop Space	Routine Medical Check-up	Good ventilation	Cleanliness	Lighting	Enough PPE	Workshop Layout	Good condition machine
N	47	47	47	47	47	47	47	47
Sum	16	1	30	1	21	0	4	0
Mis.	31	46	17	46	26	47	43	47
%	**34.0**	**2.1**	**63.8**	**2.1**	**44.7**	**0.0**	**8.5**	**0.0**

In order to improve the comfort level, 31.2% of students stated that all of the workshop must have good ventilation. Another 16.3% respondents felt that the workshop lighting system should be upgrade to improve the comfort level. More than 4.0% respondents also suggest that cleanliness, enough PPE and workshop space of the workshop will help the situation. 2.5% of respondents agreed that the workshop layout also contribute to the comfortable of the workshop environment. 3.5% of the students as shown in Table 4.56 found that good condition machine was another factor affect the comfort level in the workshop. Only 1.0% respondents want the management provide routine medical check-up to overcome the comfort level in the workshops.

Table 4.56. Give your recommendations how to improve the comfort level in the workshop. (Student)

	Workshop Space	Routine Medical Check-up	Good ventilation	Cleanliness	Lighting	Enough PPE	Workshop Layout	Good condition machine
N	202	202	202	202	202	202	202	202
Sum	19	2	63	8	33	11	5	7
Mis.	183	200	139	194	169	191	197	195
%	9.4	1.0	31.2	4.0	16.3	5.4	2.5	3.5

4.3 Results on the Field Measurement

A total of 11440 measurements were recorded from twenty-eight workshops evaluated (Appendix 39). The measurements were recorded on the work Sheet. All the readings record was subsequently keyed in Excels before the analyses are made.

These standard measurements use for the purpose of the analyses are based on Table 4.57.

Table 4.57 Guidelines For Standard Parameter

NO	PARAMETER	LIMIT/RANGE	REFERENCE
1	Temperature level	22°C – 27°C	ASHRAE
2	Relative Humidity level	30% – 60%	ASHRAE
3	Carbon Monoxide level	< 9 ppm	WHO/ASHRAE
4	Carbon Dioxide level	< 650 ppm	ASHRAE
5	Dust level	< 10 mg/m^3	FMA
6	Air Velocity level	> 0.25 m/s	WHO
7	Sound Pressure level	< 90dBA	FMA
8	Lighting level	> 160 Lux	AS

Note;
ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning Engineers
WHO - World Health Organization
FMA - Factory and Machinery Act. Malaysia
AS - Australian Standard

4.3.1 Descriptive Test

Descriptive test has been done to analyze all of the questionnaires using SPSS program and MS Excel with the view of exploring data and to summarize and describe the study. (Appendix AR – AAL)

4.3.2 Result of the Temperature Level

Results on the temperature measurements for the workshops are presented in table 4.58. The minimum temperature ranged between 26.2°C - 28.6°C and the highest temperature ranged between 31.8°C – 35.6°C. These temperatures exceed within the ASHRAE recommendations of 22°C - 27°C. The maximum temperature recorded 37.8°C at outdoors in IKM TSYA.

Table 4.58. Indoor and outdoor measurement of temperature level (°C)

No	Center	Indoor			Outdoor		
		MIN	MAX	MEAN	MIN	MAX	MEAN
1	IKM Kuala Lumpur	**26.2**	**35.6**	31.5	31.1	33.6	32.3
2	IKM Lumut	28.6	31.8	30.8	31.0	33.2	32.1
3	IKM TSYA, Pekan	28.1	33.6	31.4	**30.9**	**37.8**	34.6

4.3.3 Result of the Humidity Level

From table 4.59, the minimum relative humidity ranged from 55.4% to 64.2% and the highest ranged between 79.8% to 83.6%. This relative humidity exceed within the ASHRAE recommendations of 30% - 60%. The highest relative humidity recorded 83.6% at indoors in IKM Kuala Lumpur.

Table 4.59. Indoor and outdoor measurement of humidity level (%)

No	Center	Indoor			Outdoor		
		MIN	MAX	MEAN	MIN	MAX	MEAN
1	IKM Kuala Lumpur	**55.4**	**83.6**	66.3	59.5	**71.4**	64.9
2	IKM Lumut	64.2	79.8	70.0	60.3	72.1	66.1
3	IKM TSYA, Pekan	59.5	82.6	68.7	**44.0**	73.3	58.0

4.3.4 Result of the Carbon Dioxide Level

Table 4.60, shows that the minimum carbon dioxide ranged between 330ppm to 396ppm and the maximum ranged between 294ppm to 3342ppm. The mean of carbon dioxide is 463.9ppm. Although the maximum content of CO_2 reach up to 3342ppm in

IKM Kuala Lumpur, but the mean is 463.9ppm and it is below the ASHRAE recommendations of 650ppm.

Table 4.60. Indoor and outdoor measurement of carbon dioxide level (ppm CO_2)

No	Center	Indoor			Outdoor		
		MIN	MAX	MEAN	MIN	MAX	MEAN
1	IKM Kuala Lumpur	**330**	**3342**	466.9	388	**594**	431.0
2	IKM Lumut	396	1166	498.1	382	458	421.0
3	IKM TSYA, Pekan	377	594	426.8	**350**	504	400.8

4.3.5 Result of the Carbon Monoxide Level

Analysis of this study shows in table 4.61. The minimum value ranged between 0.0ppm – 0.8ppm and the maximum values ranged between 2.8ppm – 4.5ppm. These values are fall below the recommended level of 9ppm (WHO). The maximum carbon monoxide Level recorded 4.5ppm inside the workshops (indoor) in IKM Lumut.

Table 4.61 Indoor and outdoor measurement of carbon monoxide Level (ppm CO)

No	Center	Indoor			Outdoor		
		MIN	MAX	MEAN	MIN	MAX	MEAN
1	IKM Kuala Lumpur	0.0	2.8	1.2	0.8	2.8	1.6
2	IKM Lumut	0.1	**4.5**	1.5	1.4	2.8	1.9
3	IKM TSYA, Pekan	0.8	2.8	1.5	0.0	1.8	0.8

4.3.6 Result of the Dust Level

Table 4.62 shows the results of dust level measurements. The minimum value ranged between 0.000 mg/m^3 – 0.119 mg/m^3 and the maximum values ranged between 0.041 mg/m^3 – 1.380 mg/m^3. These values are fall below the recommended level of 50 mg/m^3 (ASHRAE). The highest dust level recorded 1.380 mg/m^3 at indoor in IKM Lumut.

Table 4.62. Indoor and outdoor measurement of dust level (mg/m^3)

No	Center	Indoor			Outdoor		
		MIN	MAX	MEAN	MIN	MAX	MEAN
1	IKM Kuala Lumpur	0.002	0.217	0.011	**0.001**	0.005	0.004
2	IKM Lumut	0.119	**1.380**	0.477	0.094	**0.135**	0.113
3	IKM TSYA, Pekan	**0.000**	**0.041**	0.007	0.015	0.055	0.031

4.3.7 Result of the Air Velocity Level

Results on the air velocity measurements are presented in Table 4.63. The minimum air velocity is 0.00m/s and the maximum was ranged between 0.46m/s - 0.738m/s. The average level air velocity is 0.107 m/s and it's below within the ASHRAE recommendations of 0.25m/s. The highest air velocity recorded 0.73m/s at IKM TSYA.

Table 4.63. Indoor and outdoor measurement of air velocity level (m/s)

No	Center	Indoor			Outdoor		
		MIN	MAX	MEAN	MIN	MAX	MEAN
1	IKM Kuala Lumpur	**0.00**	0.60	0.14	0.35	0.66	0.53
2	IKM Lumut	**0.00**	0.46	0.04	0.00	0.18	0.02
3	IKM TSYA, Pekan	**0.00**	**0.73**	0.14	0.00	**0.73**	0.11

4.3.8 Result of the Sound Pressure Level

Table 4.64 shows the minimum value of sound pressure level ranged between 53.4dBA – 53.3dBA and the maximum values ranged between 106.0dBA – 109.4dBA. The average value is 77.3dBA and these values fall below PEL of 90dBA (FMA). The highest sound pressure level recorded 109.4dBA inside the workshops in IKM Lumut.

Table 4.64. Indoor and outdoor measurement of sound pressure level (dBA)

No	Center	Indoor			Outdoor		
		MIN	MAX	MEAN	MIN	MAX	MEAN
1	IKM Kuala Lumpur	**56.3**	106.0	77.2	59.8	78.6	67.4
2	IKM Lumut	54.6	**109.4**	78.9	**59.3**	79.6	68.3
3	IKM TSYA, Pekan	53.4	108.1	75.7	59.8	**80.6**	70.3

4.3.9 Result of the Lighting level

Based on the analysis, writer found that the minimum lighting level ranged between 50.1Lux – 62.6Lux and the highest ranged between 231Lux – 996Lux. It shows that this lighting level exceed 160Lux as the AS recommendations. The highest indoor lighting level recorded 996Lux at IKM TSYA.

Table 4.65. Indoor and outdoor measurement of lighting level (Lux)

No	Center	Indoor			Outdoor		
		MIN	MAX	MEAN	MIN	MAX	MEAN
1	IKM Kuala Lumpur	**50.1**	231.0	**129.1**	**461.0**	798.0	612.8
2	IKM Lumut	70.3	962.0	250.2	1086.0	**1244.0**	904.1
3	IKM TSYA, Pekan	92.6	**996.0**	560.3	1159.0	1426.0	1247.2

4.3.10 IEQ Comparison Indoor and Outdoor the Workshops

Based on the analysis of table 4.66 and 4.67, it is obvious that the IEQ especially the contents of RH inside the workshops are generally higher compared to the measurement recorded at the outside of the workshops. IKM Lumut's workshops record the highest contents of RH compared to the outside measurement.

Table 4.66 – Mean score of Indoor IEQ

NO	CENTER	Temp. (°C)	RH (%)	CO_2 (ppm)	CO (ppm)	Dust (mg/m3)	Air Vel. (m/s)	Sound (dBA)	Light (lux)
1	IKM KL	31.5	66.3	467	1.2	0.011	0.14	77.2	129.1
2	IKM Lumut	30.8	70.0	498	1.5	0.477	0.04	78.9	250.2
3	IKM TSYA	31.4	68.7	427	1.5	0.007	0.14	75.7	560.3
	MEAN	31.1	68.3	464	1.4	0.165	0.11	77.3	313.2

Table 4.67 – Mean score of Outdoor IEQ

NO	CENTER	Temp. (°C)	RH (%)	CO_2 (ppm)	CO (ppm)	Dust (mg/m3)	Air Vel. (m/s)	Sound (dBA)	Light (lux)
1	IKM KL	**32.3**	**64.9**	431	1.6	0.004	**0.53**	67.4	612.8
2	IKM Lumut	**32.1**	**66.1**	421	1.9	0.113	**0.02**	68.3	904.1
3	IKM TSYA	**34.6**	**58.0**	401	0.8	0.031	**0.11**	70.3	1247.2
	MEAN	33.0	63.0	**418**	**1.4**	**0.049**	0.22	**68.7**	**921.4**

4.3.11 Overall Result

Overall result on table 4.68 and 4.69 shows that the temperature levels for all workshops are exceed the ASHRAE recommendations of 22°C-27°C accept air-conditions workshop in IKM Kuala Lumpur. Result on relative humidity of twenty-four workshops is also exceeding the ASHRAE recommendations of 30%- 60%. Overall results on air velocity levels of twenty-six workshops are below the ASHRAE recommendations of 0.25m/s and although mean score for overall workshops are above the 160Lux as the AS recommendations, there are twelve workshops below the AS recommendations. From the analysis, CO_2, CO and dust level are comply with the ASHRAE and FMA standard.

Table 4.68. Mean score overall results

PARAMETER	IKM KL	IKM LMT	IKM TSYA	RESULTS
Temperature level (°C)				[ASHRAE; 22°C-27°C]
Min.	26.2	**28.6**	**28.1**	
Max.	**35.6**	**31.8**	**33.6**	
Mean	**31.5**	**30.8**	**31.4**	**NOT COMPLY**
Relative Humidity level (%)				[ASHRAE; 30%-60%]
Min.	55.4	**64.2**	59.5	
Max.	**83.6**	**79.8**	**82.6**	
Mean	**66.3**	**70.0**	**68.7**	**NOT COMPLY**
Carbon Dioxide level (ppm)				[ASHRAE; <650ppm]
Min.	330	396	377	
Max.	**3342**	**1166**	594	
Mean	467	498	427	COMPLY
Carbon Monoxide level (ppm)				[ASHRAE; <9ppm]
Min.	0.0	0.1	0.8	
Max.	2.8	4.5	2.8	
Mean	1.2	1.5	1.5	COMPLY
Dust level (mg/m^3)				[FMA; <10mg/m^3]
Min.	0.002	0.119	0.000	
Max.	0.217	1.380	0.041	
Mean	0.011	0.477	0.007	COMPLY
Air Velocity level (m/s)				[WHO; >0.25m/s]
Min.	**0.00**	**0.00**	**0.00**	
Max.	**0.60**	**0.46**	**0.73**	
Mean	**0.14**	**0.04**	**0.14**	**NOT COMPLY**
Sound Pressure level (dBA)				[FMA; <90dBA]
Min.	56.3	54.6	53.4	
Max.	**106.0**	**109.4**	**108.1**	
Mean	77.2	78.9	75.7	COMPLY
Lighting level (lux)				[AS; >160lux]
Min.	**50.1**	**70.3**	**92.6**	
Max.	231.0	962.0	996.0	
Mean	**129.1**	250.2	560.3	**IKM KL NOT COMPLY**

Note;

ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning Engineers
WHO - World Health Organization
FMA - Factory and Machinery Act. Malaysia
AS - Australian Standard

Table 4.69. Mean score every workshops

TESTID	WORKSHOPS	Temp. (°C) ASHRAE (22°C-27°C)	Humid. (%) ASHRAE (30%-60%)	CO_2 (ppm) ASHRAE (<650PPM)	CO (ppm) WHO (<9PPM)	Dust (mg/m^3) FMA (<10mg/m^3)	Air Vel. (m/s) WHO (>0.25m/s)	Sound (dBA) FMA <90dBA)	Light (Lux) AS (>160Lux)
	CENTER : IKM Kuala Lumpur								
1	Air-Condition	27.3	60.0	**801**	0.9	0.032	**0.12**	68.3	**157.3**
2	EDI I	**29.5**	**80.5**	456	1.3	0.003	**0.17**	71.8	**107.6**
3	KMPM I	**31.8**	**65.7**	632	1.4	0.003	**0.14**	84.0	**129.3**
6	KMPM II	**31.9**	**65.3**	406	1.5	0.003	**0.14**	71.6	**167.7**
7	Welding	**35.1**	58.8	352	1.5	0.021	**0.20**	81.6	**101.0**
8	EDI II	**32.0**	**64.6**	399	1.4	0.032	**0.11**	81.1	**113.0**
9	PJE	**28.8**	**81.6**	411	1.1	0.004	**0.08**	78.3	**110.0**
10	EDI III	**32.3**	**63.4**	399	0.2	0.003	**0.16**	83.6	**113.9**
11	Sheet Metal I	**32.7**	**62.4**	410	1.5	0.003	**0.11**	73.3	**149.2**
12	Sheet Metal II	**33.1**	60.7	403	1.4	0.003	**0.12**	78.7	**141.9**
		31.5	**66.3**	467	1.2	0.011	**0.14**	77.2	**129.1**
	CENTER : IKM Lumut								
1	Arc I	**29.8**	**77.0**	**857**	4.1	1.090	**0.01**	74.2	176.5
2	Spray Painting	**29.4**	**76.6**	587	1.3	0.848	**0.08**	77.1	862.2
3	Foundry	**30.9**	**67.5**	462	1.1	0.656	**0.03**	78.4	239.8
6	Pattern	**30.7**	**66.7**	439	0.7	0.545	**0.03**	72.8	228.5
7	Machine I	**31.0**	**65.5**	419	0.6	0.434	**0.02**	81.0	225.5
8	Machine II	**31.4**	**65.0**	485	0.4	0.347	**0.03**	77.7	227.5
9	Electrical I	**30.6**	**74.7**	455	2.2	0.308	**0.09**	80.3	198.3
10	Arc II	**31.2**	**70.6**	436	2.0	0.228	**0.02**	86.0	**80.0**
11	Arc III	**31.4**	**69.1**	428	1.4	0.177	**0.02**	84.1	**77.8**
12	Electrical II	**31.7**	**67.6**	413	1.4	0.136	**0.02**	77.7	185.6
		30.8	**70.0**	498	1.5	**0.477**	0.04	78.9	**250.2**
	CENTER : IKM TSYA, Pekan								
1	Petrol (Automobile)	**28.7**	**79.3**	448	1.2	0.016	**0.13**	70.3	929.9
2	Transmision (Automobile)	**30.6**	**74.7**	455	2.2	0.004	**0.21**	74.0	832.3
3	Store (Automobile)	**31.4**	**69.1**	428	1.4	0.017	0.27	71.5	**95.4**
6	Laboratory (Automobile)	**31.9**	**65.3**	406	1.5	0.004	0.27	78.5	222.8
7	Petrol (Automotive)	**32.0**	**64.6**	399	1.4	0.001	**0.13**	76.0	919.0
8	Diesel (Automotive)	**32.3**	**63.4**	399	1.5	0.001	**0.06**	73.7	921.2
9	Fitting (Spray Painting)	**31.1**	**72.7**	459	1.3	0.013	**0.02**	79.6	281.6
12	Machine Shop	**33.4**	60.1	420	1.4	0.003	**0.02**	81.6	280.4
		31.4	**68.7**	427	1.5	**0.007**	0.14	75.7	**560.3**

4.4 Result on the Field Observations

There are two main factors that being focusing during the field observations done. The factors are the building design itself and the building orientation whether it's design will influence the ventilation system in the workshops.

4.4.1 Building Design

From the observation, writer found that two type of ventilation system design, 'cross system' and 'stack effect'. The cross system is where the air will flow from one direction to another direction (Refer Figure 4.1).

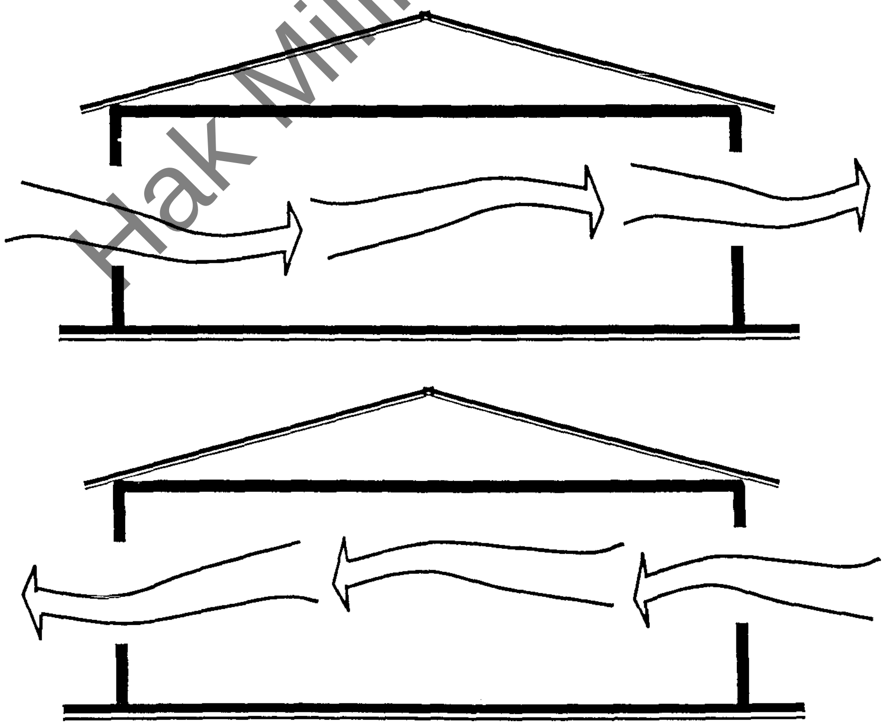

Figure 4.1. Cross System air flow

From the design it can be said that the air inside the workshop will circulate from left to right or right to left. This will create a fresh air on the floor level and allows cool outside air to enter the workshop through the windows. This continuous ventilation cycle also will certainly promotes ventilation and theoretically cools the floor level.

However, there may be possible that the air from the left and right is very strong that it will enter the building through the windows. This will be a disadvantage because the air will be circulating inside the building instead. (Refer Figure 4.2).

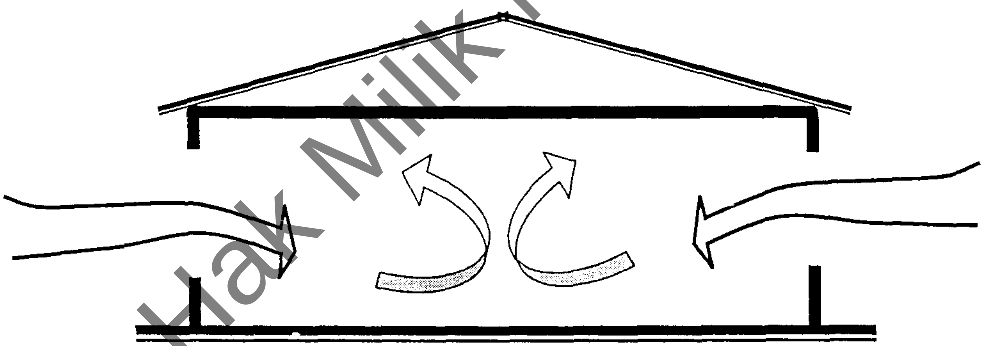

Figure 4.2 The air circulating inside

Whereas the 'stack effect' system found in the double roof design where the middle portion of the roof is raised higher than the surrounding roof level. (Refer Figure 4.3)

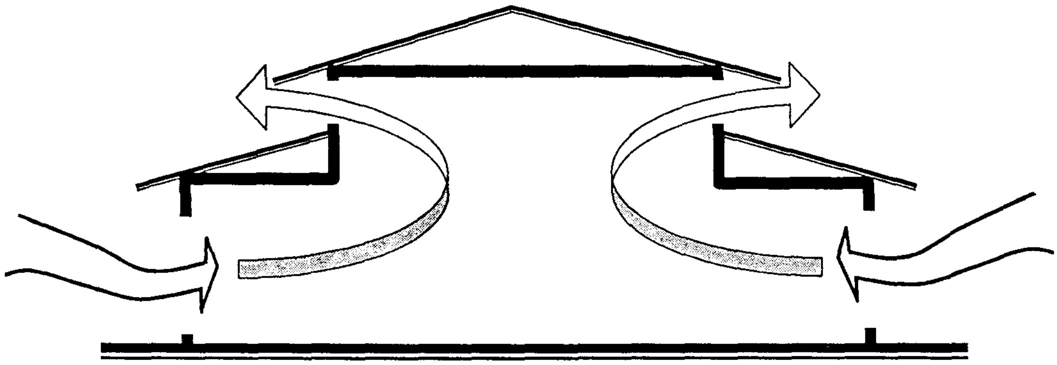

Figure 4.3 Stack Effect System

From the design it can be said that the hot air inside the workshop will rise to the top and escaped through the opening on the raised roof level. This will create a partial vacuum on the floor level and allows cool outside air to enter the workshop through the windows. This continuous ventilation cycle will certainly promotes ventilation and theoretically cools the floor level.

However, there may be possible that the air on the upper level is very strong that it will enter the building through the stack. This will be a disadvantage because it will restrict ventilation, if the air on the ground level is equally strong. The air will be circulating inside the building instead. The low ceiling does not help the problem. (Refer Figure 4.4).

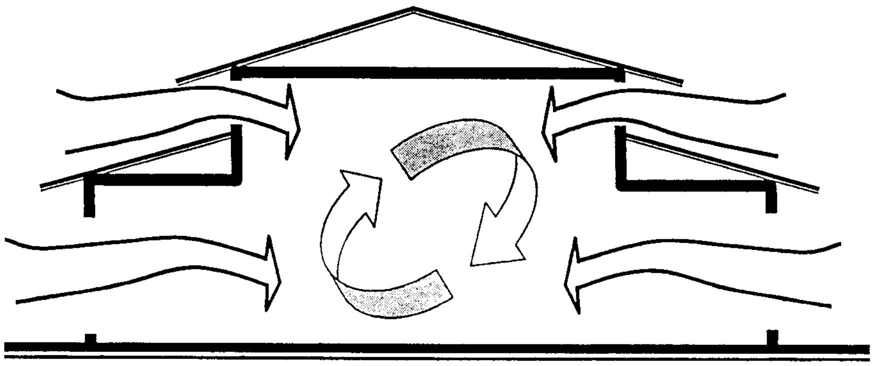

Figure 4.4 The air circulating inside

4.4.2 Building Location

The building location also is one of the factors that, equally contributes to the satisfactory environment of the building. Even though the design of the building is considerably effective to promote ventilation, thus promote cooling inside the building, writer observed that this is also not the case. It is extremely hot especially in the afternoon even when all the windows and doors are open.

Writer concluded that this fact might be done to the location of the building. The fact that double storey buildings surround the building, does not promote ventilation. The surrounding buildings may provide shade from direct sunlight; however at the same time it created a wind shadow in the area. The wind when passing these obstacles will be reduced in speed and also creating vortices around the building. This will create a negative pressure area.

Therefore, even though the building is designed as such, the rate of ventilation is considerably slow. This is noticed due to the lack of sensation of draughts.

4.4.3 General View

A satisfactory environment is the ultimate aim of good building design. This is very important because it gives a cause of 'comfort' to the occupants. The comfort of human being is governed by many physiological, mechanism of the body and these vary from person to person. There are many factors that contribute to the development of a satisfactory environment such as thermal comfort, proper ventilating, sound etc. Some of these factors can be controlled mechanically, however this will incur higher maintenance cost. Thus a full advantage must be taken at the natural resources to achieve the required comfort. These factors should be seriously considered during the planning and designing stage.

CHAPTER 5

CONCLUSIONS AND RECOMENDATIONS

5.1 Conclusions

Twenty-eight workshops were evaluated for indoor environmental quality (IEQ). Parameters measured were temperature level, relative humidity level, carbon monoxide contents, carbon dioxide contents, dust level, air velocity level, sound pressure level and lighting level. From the research made, it is established the IEQ in MARA vocational training workshops is unhealthy and is not comfortable for occupancy.

The temperature measured were exceed the recommended level by ASHRAE between 22°C-27°C indoor; the relative humidity for twenty four workshops were exclusive 30%-60% of recommended by ASHRAE; while carbon dioxide of two workshops also exceed the required level at 650ppm (ASHRAE). Air velocity at twenty-six workshops is below the recommended 0.25m/s by WHO. The lighting level for twenty-two workshops were also below 160Lux the range of recommended by AS.

Majority of the respondents claimed that the workshop environment was uncomfortable for the training activities. They are being working in high temperature level, high dust level, high sound level and also the light level below the standard. Although more than 90% respondents were using PPE such as goggle, face shield, glove and safety boots. Result shows that 65.9% of the lecturers have medical problem slightly higher than students. Respondents also recommending that the ventilation system in the MARA Vocational training workshops must be improved and upgraded to the appropriate and recognized standard together with the lighting system.

From the audit and evaluation conducted, it is ascertained that the operations of workshop in three centers have neglected the safety and health requirements of the occupants. Besides, the Regulations provided by OSHA are not specific on the IEQ in MARA vocational training workshops. The students and staffs those that patronized workshop are exposed to many hazards resulting from poor IEQ.

Design wise, it should promote better ventilation in the building. However, due to the unsuitability of location, the design cannot be fully utilized for ventilation. This brought one thought to the mind. Were environmental factors considered during the planning and design stages, or it is just another type of standardization of building, which is a common practice nowadays.

If we were to look at other workshops such as in IKM Lumut and IKM TSYA, we will notice that they have the same design; only the location and orientation are different. With this observation, the writer presumed that standardization was the criteria when the building was constructed. This practice may save some time and money for the developer. That was why in order to increase the rate of ventilation and cool down the space the designer had to use ceiling and extractor fans. This is the advantage of modern technology. However, this will also increase the maintenance costs.

5.2 Recommendations

Further work on reduction of temperature level can be done to reduce its level in workshops with high temperature level, which is above 27°C, high level of humidity, which is above 60%, low level of air velocity which is below 0.25m/s and low lighting level which is below 160 Lux. Preventing indoor environmental quality problems in workshops can best be done through the implementation of a Pro-Active IEQ program. Such a program has the MARA or principle of IKM develop a profile of the building, looking for potential indoor environmental quality problems, before they actually occur.

An IEQ profile is a description of the features of the building structure, function, and occupancy that influence indoor environmental quality. The IEQ profile can help building management to identify potential problem areas and prioritize budgets for maintenance and future modifications. Combined with information on lighting, security, and other important systems, it can become an owner's manual that is specific to the building and that will serve as a reference in a variety of situations.

Finally, the actions to be taken by management are:

- Supply enough PPE such as earplug and respirator to all lecturers and students and it must be convinced to wear during the training activities.
- The management should implement routine medical check up to all workshops occupant especially lecturers.
- Install exhaust fan at identified workshops to improve air circulation where possible, the use of local exhaust ventilation and enclosure to capture and remove contaminants generated by specific process should be discharged directly outdoors rather than re-circulated.
- Increase the lighting level up to the recommendation standard with suitable industrial lamps with proper layout.

- The use of natural, dilution, and local exhaust, or increased ventilation efficiency. The most effective engineering control for prevention of indoor environmental quality problems is assuring an adequate supply of fresh outdoor air through natural or mechanical ventilation.

- When possible, use local exhaust ventilation and enclosure to capture and remove contaminants generated by specific processes. Room air in which contaminants are generated should be discharged directly outdoors rather than re-circulated.

- The location of the building is almost important in determining the environmental comfort for the occupants. Obstacles should not surround the building in order to achieve an optimum wind velocity. The best orientation is one facing the prevalent wind. Design wise may be efficient, however without proper planning on location, the design will not be fully utilized.

- Standardization of building may be one of the best methods to save time and money but may not be feasible on the environmental aspects. Every site has its own characteristics thus a good design for a particular site, may not be good enough for another. Thus every site must be studied individually

- Different activities or usage from space will require different rate of ventilation. This can be seen by the different requirement for workshops, laboratories and classes area.

- Normally ventilation and thermal comfort come hand in hand. It is difficult to separate both because it is mutually supporting. To get better comforts, both problems should be tackled together.

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Appendix
1 - 5

Date and place measurement has been taken

NO	WORKSHOPS	IKM KL								IKM LUMUT								IKM TSYA							
		Temp.	Humid.	CO_2	CO	Dust	Vel.	Sound	Light	Temp.	Humid.	CO_2	CO	Dust	Vel.	Sound	Light	Temp.	Humid.	CO_2	CO	Dust	Vel.	Sound	Light
1	Air-Condition Workshop	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03																
2	EDI Workshop I	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03																
3	KMPM Workshop I	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03																
4	KMPM Workshop II	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03																
5	Welding Workshop	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03																
6	EDI Workshop II	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03	8.4.03																
7	PJE Workshop	9.4.03	9.4.03	9.4.03	9.4.03	9.4.03	9.4.03	9.4.03	9.4.03																
8	EDI Workshop III	9.4.03	9.4.03	9.4.03	9.4.03	9.4.03	9.4.03	9.4.03	9.4.03																
9	Sheet Metal Workshop I	9.4.03	9.4.03	9.4.03	9.4.03	9.4.03	9.4.03	9.4.03	9.4.03																
10	Sheet Metal Workshop II	9.4.03	9.4.03	9.4.03	9.4.03	9.4.03	9.4.03	9.4.03	9.4.03																
11	Arc Workshop I									17.4.03	17.4.03	17.4.03	17.4.03	17.4.03	29.4.03	17.4.03	17.4.03								
12	Spray Painting Workshop									17.4.03	17.4.03	17.4.03	17.4.03	17.4.03	29.4.03	17.4.03	17.4.03								
13	Foundry Workshop									17.4.03	17.4.03	17.4.03	17.4.03	17.4.03	29.4.03	17.4.03	17.4.03								
14	Pattern Workshop									17.4.03	17.4.03	17.4.03	17.4.03	17.4.03	29.4.03	17.4.03	17.4.03								
15	Machine Workshop I									17.4.03	17.4.03	17.4.03	17.4.03	17.4.03	29.4.03	17.4.03	17.4.03								
16	Machine Workshop II									17.4.03	17.4.03	17.4.03	17.4.03	17.4.03	29.4.03	17.4.03	17.4.03								
17	Electrical Workshop I									18.4.03	18.4.03	18.4.03	18.4.03	18.4.03	30.4.03	18.4.03	18.4.03								
18	Arc Workshop II									18.4.03	18.4.03	18.4.03	18.4.03	18.4.03	30.4.03	18.4.03	18.4.03								
19	Arc Workshop III									18.4.03	18.4.03	18.4.03	18.4.03	18.4.03	30.4.03	18.4.03	18.4.03								
20	Electrical Workshop II									18.4.03	18.4.03	18.4.03	18.4.03	18.4.03	30.4.03	18.4.03	18.4.03								
21	Petrol (Automobile)																	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03
22	Transmision (Automobile)																	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03
23	Store (Automobile)																	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03
24	Laboratory (Automobile)																	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03
25	Petrol (Automotive)																	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03
26	Diesel (Automotive)																	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03	5.5.03
27	Fitting (Spray Painting)																	6.5.03	6.5.03	6.5.03	6.5.03	6.5.03	6.5.03	6.5.03	6.5.03
28	Machine Shop																	6.5.03	6.5.03	6.5.03	6.5.03	6.5.03	6.5.03	6.5.03	6.5.03

Appendix 1

Appendix 2

MOHD AZAM BIN MOHD SALEH
Pelajar Sarjana
Perancangan dan Respon Kecemasan,
Fakulti Kejuruteraan,
Universiti Putra Malaysia,
43400 Serdang,
Selangor Darul Ihsan.

6 Ogos 2002

Kepada,

Pengetua,
Institut Kemahiran MARA
Jalan Belangkas,
Kampong Pandan,
55100 Kuala Lumpur

KEBENARAN MEMBUAT KAJIAN BERKAITAN DENGAN KESELAMATAN DAN KESIHATAN DI KAMPUS INSTITUT KEMAHIRAN MARA KUALA LUMPUR.

Perkara di atas dengan hormatnya adalah dirujuk.

2. Saya seperti nama dan alamat di atas ingin memohon jasa baik puan untuk membuat kajian berkenaan bagi memenuhi syarat kerja kursus yang saya sedang ikuti di Universiti Putra Malaysia. Antara tempat kajian yang akan dijalankan adalah di Dewan Makan dan Bengkel Kursus Teknologi Kimpalan dan Fabrikasi Logam.

3. Kerjasama puan sangat dihargai dan didahului dengan ucapan ribuan terima kasih.

Sekian.

Yang benar

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Appendix 3

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31 Mac 2003

Kepada,

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Jalan Belangkas,
Kampong Pandan
55100 Kuala Lumpur.

KAJIAN "INDOOR ENVIRONMENTAL QUALITY IN MARA VOCATIONAL TRAINING WORKSHOPS" DI IKM KUALA LUMPUR.

Percakapan dengan tuan mengenai perkara di atas dengan hormatnya adalah dirujuk.

2. Kajian tersebut akan dibuat selama lebih kurang dua bulan bermula dari 3 April 2003 ini. Insyalah pada hari khamis 3 April ini, seorang pensyarah dari Fakulti Kejuruteraan Universiti Putra Malaysia iaitu Prof. Madya Dr. Ir. Nor Mariah Adam akan turut serta dalam kajian yang akan dilakukan.

3. Bengkel-bengkel yang terlibat adalah (1) Bengkel Teknologi Kimpalan dan Fabrikasi, (2) Teknologi Mekanikal (Pembuatan), (3) Teknologi Penyejukan dan Pendingin Udara, (4) Teknologi Fabrikasi Kepingan Logam, (5) Teknologi Elektrik (EDI & PJE) dan (6) Teknologi Penyelengaraan Mesin

4. Kejasama tuan dalam kajian ini didahului dengan ucapan terima kasih.

Sekian.

Yang benar

MOHD AZAM BIN MOHD SALEH
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s.k.

i. Pengarah
Bahagian Kemahiran MARA

Appendix 4

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15 April 2003

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Pengetua
Institut Kemahiran MARA Lumut,
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32040 Seri Manjung,
Perak Darul Ridzuan

KAJIAN "INDOOR ENVIRONMENTAL QUALITY IN MARA VOCATIONAL TRAINING WORKSHOPS" DI IKM LUMUT

Perkara di atas dengan hormatnya adalah dirujuk.

2. Saya seperti nama di atas adalah seorang pelajar tahun akhir Sarjana Perancangan dan Respon Kecemasan dari Fakulti Kejuruteraan, Universiti Putra Malaysia. Sebagai memenuhi syarat penganugerahan Ijazah Sarjana, saya dikehendaki menyediakan satu projek kajian seperti di atas.

3. Pengumpulan data bagi kajian tersebut telah bermula dari 3 April 2003 dan dijangkakan ianya mengambil masa selama lebih kurang dua bulan. IKM Lumut adalah salah satu IKM yang dipilih dalam kajian tersebut. Kajian akan dilakukan pada 17 dan 18 April 2003 di IKM tuan. Bengkel-bengkel yang terlibat adalah (1) Bengkel Teknologi Kimpalan dan Fabrikasi Logam, (2) Bengkel Teknologi Kej. Mekanikal (Pembuatan), (3) Bengkel Teknologi Kej. Elektrik dan (4) Bengkel Teknologi Foundri dan Pembuat Corak.

4. Kerjasama tuan dalam kajian ini didahului dengan ucapan terima kasih.

Sekian untuk tindakan tuan,

Terima kasih

Saya yang benar

MOHD AZAM BIN MOHD SALEH
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Appendix 5

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26 April 2003

Kepada,

Pengetua
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Kawasan Perindustrian Peramu Jaya,
26600Pekan,
Pahang.

KAJIAN "INDOOR ENVIRONMENTAL QUALITY IN MARA VOCATIONAL TRAINING WORKSHOPS" DI IKM TSYA, PEKAN.

Perkara di atas dengan hormatnya adalah dirujuk.

2. Saya seperti nama di atas adalah seorang pelajar tahun akhir Sarjana Perancangan dan Respon Kecemasan dari Fakulti Kejuruteraan, Universiti Putra Malaysia. Sebagai memenuhi syarat penganugerahan Ijazah Sarjana, saya dikehendaki menyediakan satu projek kajian seperti di atas.

3. Pengumpulan data bagi kajian tersebut telah bermula dari 3 April 2003 dan dijangkakan ianya mengambil masa selama lebih kurang dua bulan. IKM TSYA adalah salah satu IKM yang dipilih dalam kajian tersebut. Kajian akan dilakukan pada 5 dan 6 Mei 2003 di IKM tuan. Bengkel-bengkel yang terlibat adalah (1) Bengkel Teknologi Kej. Automobil, (2) Bengkel Teknologi Kej. Mekanikal (Pembuatan), (3) Bengkel Teknologi Baikpulih Badan Kenderaan, (4) Bengkel Teknologi Kej. Automotif (Perdagangan) dan (5) Bengkel Teknologi Kimpalan.

4. Kerjasama tuan dalam kajian ini didahului dengan ucapan terima kasih.

Sekian untuk tindakan tuan,

Terima kasih

Saya yang benar

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Appendix
6 - 16

Appendix 6

LECTURER
Pengajar

Faculty of Engineering
Universiti Putra Malaysia

INDOOR ENVIRONMENTAL QUALITY (IEQ)
IN MARA VOCATIONAL TRAINNING WORKSHOPS
Kualiti Persekitaran Dalaman Di Bengkel Latihan Kemahiran MARA

Dear Respondent,

I am a final year student Master In Emergency Response and Planning, Faculty of Engineering, Universiti Putra Malaysia. A research on Indoor Environmental Quality (IEQ) in MARA Vocational training workshops is being conducted in order to fulfill the requirements for the award of the master degree.

The objective of the questionnaires is to get related information for this research. You are not required to write your name on this questionnaire. All information given is confidential and will be used for this research only.

You are kindly requested to answer all of the questions, and please do not discuss with others. ***Before answering the questions, please read it carefully.***

Thank you for your cooperation.

Kepada Responden,

Saya seorang pelajar tahun akhir program Ijazah Sarjana Perancangan dan Respon Kecemasan Fakulti Kejuruteraan, Universiti Putra Malaysia. Kajian Kualiti Persekitaran Dalaman di bengkel latihan kemahiran MARA ini adalah untuk memenuhi syarat penganugerahan Ijazah Sarjana tersebut.

Tujuan soalselidik ini adalah untuk mendapat maklumat berkaitan dengan kajian yang dibuat. Saudara/Saudari tidak perlu menulis nama pada kertas soalselidik ini. Segala maklumat yang dicatitkan adalah sulit dan ianya hanyalah digunakan untuk tujuan kajian sahaja.

Saudara/saudari adalah diharapkan menjawab dengan jujur dan ikhlas. dan diminta tidak berbincang dengan orang lain kerana pendapat mereka boleh mempengaruhi jawapan sebenar anda. ***Sila baca dengan teliti sebelum menjawab apa-apa soalan.***

Kerjasama dari Saudara/Saudari diucapkan ribuan terima kasih

MOHD AZAM BIN MOHD SALEH
GS 10938
Master In Emergency, Response and Planning
Faculty of Engineering
Universiti Putra Malaysia

INDOOR ENVIRONMENTAL QUALITY (IEQ)
IN MARA VOCATIONAL TRAINNING WORKSHOPS
Kualiti Persekitaran Dalaman Di Bengkel Latihan Kemahiran MARA

QUESTIONNAIRE
Soalselidik

Please tick ☑ in empty box
Sila tandakan ☑ pada petak kosong

A.	**Personal Background** *Latarbelakang Peribadi*		
1	Gender *Jantina*	☐ Male *Lelaki*	☐ Female *Perempuan*
2	How long have you been working in Institut Kemahiran MARA? *Berapa lama anda telah bertugas di Institut Kemahiran MARA?* ☐ 1 – 5 years (*Tahun*) ☐ 6 – 10 years (*Tahun*)	☐ 11 – 15 years (*Tahun*)	☐ Over 16 years (*Melebihi 16 Tahun*)
3	How long have you spent continuously in the workshop within one day? *Berapa lama anda berada berterusan di bengkel dalam satu hari?* ☐ 1 – 2 hours (*jam*) ☐ 3 – 4 hours (*jam*)	☐ 5 – 6 hours (*jam*)	☐ 7 – 8 hours (*jam*)
B.	**Pollution Exposure** *Pendedahan Pencemaran*		
4	Do you feel comfortable in the workshop? *Adakah anda merasa selesa ketika berada di bengkel ?*	☐ Yes (*Ya*)	☐ No (*Tidak*)
5	Is the temperature too high in the workshop? *Adakah suhu di dalam bengkel terlalu tinggi?*	☐ Yes (*Ya*)	☐ No (*Tidak*)
6	What is the temperature (Celsius) in the workshop? *Berapa celciuskah suhu di dalam bengkel?*	________ °C	
7	Is the workshop environment too humid? *Adakah keadaan persekitaran bengkel terlalu lembab?*	☐ Yes (*Ya*)	☐ No (*Tidak*)
8	Do you feel breezy in the workshop? *Adakah anda rasa berangin semasa berada di bengkel?*	☐ Yes (*Ya*)	☐ No (*Tidak*)
9	Is the workshop environment too dusty? *Adakah keadaan persekitaran bengkel terlalu berhabuk?*	☐ Yes (*Ya*)	☐ No (*Tidak*)
10	Can the workpiece be seen clearly? *Adakah bendakerja anda di lihat dengan jelas?*	☐ Yes (*Ya*)	☐ No (*Tidak*)
11	Does the workshop environment affect your hearing? *Adakah suasana dalam bengkel mengganggu pendengaran anda?*	☐ Yes (*Ya*)	☐ No (*Tidak*)
12	Do you hear clearly while talking in the workshop? *Adakah anda boleh mendengar dengan jelas semasa berbual di bengkel?*	☐ Yes (*Ya*)	☐ No (*Tidak*)
C.	**Safety Background** *Latarbelakang Keselamatan*		
13	Is Personal Protective Equipment (PPE) supplied in the workshop? *Adakah Alat Pelindungan Keselamatan Diri ada disediakan di dalam bengkel.?*	☐ Yes (*Ya*)	☐ No (*Tidak*)

14	List PPE supplied in the workshop? *Senaraikan alat perlindungan keselamatan diri yang disediakan di dalam bengkel?*	i. ______ ii. ______ iii. ______ iv. ______ v. ______ vi. ______ vii. ______ viii. ______ ix. ______ x. ______
15	I always wear PPE in the workshop. *Saya sentiasa memakai alat perlindungan keselamatan diri semasa berada di dalam bengkel.*	☐ Yes (*Ya*) ☐ No (*Tidak*)
16	List PPE that you wear in the workshop. *Senaraikan alat perlindungan keselamatan diri yang anda gunakan semasa di bengkel.*	i. ______ ii. ______ iii. ______ iv. ______ v. ______ vi. ______ vii. ______ viii. ______ ix. ______
17	Do you feel comfortable wearing Personal Protective Equipment (PPE)? *Adakah anda berasa selesa apabila memakai alat perlindungan keselamatan diri?*	☐ Yes (*Ya*) ☐ No (*Tidak*)
18	When is the last time you use PPE? *Bilakah kali terakhir anda menggunakan alat perlindungan keselamatan diri?*	______
19	List PPE that should be supplied in the workshop. *Senaraikan alat perlindungan keselamatan diri yang perlu disediakan di dalam bengkel.*	i. ______ ii. ______ iii. ______ iv. ______ v. ______ vi. ______ vii. ______ viii. ______ ix. ______ x. ______
20	What type of clothes do you wear in the workshop? *Apakah jenis pakaian yang anda gunakan semasa di bengkel?*	______
21	What type of shoes do you wear in the workshop? *Apakah jenis kasut yang anda pakai semasa di bengkel?*	______
22	I can freely move in the workshop. *Saya bebas bergerak dari satu tempat ke satu tempat di dalam bengkel.*	☐ Yes (*Ya*) ☐ No (*Tidak*)

D.	**Health Background** *Latarbelakang Kesihatan*
23	Please tick health affect that you suffer during your working in Institut Kemahiran MARA. *Tandakan penyakit-penyakit yang anda alami semasa bekerja di Institut Kemahiran MARA.* ☐ Headache (*Sakit kepala*) ☐ Vomiting (*Muntah*) ☐ Dizzy (*Pitam*) ☐ Sore throat (*Sakit tekak*) ☐ Cold (*Selsema*) ☐ Asthma (*Lelah*)
24	When was your latest medical leave? *Bilakah kali terakhir anda mendapat cuti sakit?* ________________
25	When did you last see the doctor? *Bilakah kali terakhir anda berjumpa dengan doktor?* ________________
26	Does the management provide routine medical check-up? ☐ Yes (*Ya*) ☐ No (*Tidak*) *Adakah pihak pengurusan menyediakan ujian kesihatan secara berjadual?*
27	If yes, how frequent has check-up been done? *Jika ya, berapa kali setahun ujian dilakukan?* ☐ Once a year (*Sekali setahun*) ☐ Three time a year (*3 kali setahun*) ☐ Twice a year (*2 kali setahun*) ☐ Four time a year (*4 kali setahun*)

E.	**Recommendations** *Cadangan*
28	Give your recommendations how to improve the comfort level in the workshop. *Berikan cadangan anda untuk memperbaiki tahap keselesaan di bengkel* ________________ ________________ ________________ ________________ ________________ ________________ ________________ ________________ ________________ ________________ ________________

Thank for your cooperation
Terima kasih atas kerjasama anda

Appendix 7

STUDENT
Pelajar

Faculty of Engineering
Universiti Putra Malaysia

INDOOR ENVIRONMENTAL QUALITY (IEQ)
IN MARA VOCATIONAL TRAINNING WORKSHOPS
Kualiti Persekitaran Dalaman Di Bengkel Latihan Kemahiran MARA

Dear Respondent,

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Tujuan soalselidik ini adalah untuk mendapat maklumat berkaitan dengan kajian yang dibuat. Saudara/Saudari tidak perlu menulis nama pada kertas soalselidik ini. Segala maklumat yang dicatitkan adalah sulit dan ianya hanyalah digunakan untuk tujuan kajian sahaja.

Saudara/saudari adalah diharapkan menjawab dengan jujur dan ikhlas. dan diminta tidak berbincang dengan orang lain kerana pendapat mereka boleh mempengaruhi jawapan sebenar anda. ***Sila baca dengan teliti sebelum menjawab apa-apa soalan.***

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IN MARA VOCATIONAL TRAINNING WORKSHOPS
Kualiti Persekitaran Dalaman Di Bengkel Latihan Kemahiran MARA

QUESTIONNAIRE
Soalselidik

Please tick ☑ in empty box
Sila tandakan ☑ pada petak kosong

A.	**Personal Background** *Latarbelakang Peribadi*		
1	Gender *Jantina*	☐ Male *Lelaki*	☐ Female *Perempuan*
2	How long have you been studying in Institut Kemahiran MARA? *Berapa lama anda telah menuntut di Institut Kemahiran MARA?*	☐ 1 – 6 months (*bulan*) ☐ 7 – 12 months (*bulan*) ☐ 13 – 18 months (*bulan*)	☐ 19 – 24 months (*bulan*) ☐ 25 – 30 months (*bulan*) ☐ 31 – 36 months (*bulan*)
3	How long have you spent continuously in the workshop within one day? *Berapa lama anda berada berterusan di bengkel dalam satu hari?*	☐ 1 – 2 hours (*jam*) ☐ 3 – 4 hours (*jam*)	☐ 5 – 6 hours (*jam*) ☐ 7 – 8 hours (*jam*)
B.	**Pollution Exposure** *Pendedahan Pencemaran*		
4	Do you feel comfortable in the workshop? *Adakah anda merasa selesa ketika berada di bengkel ?*	☐ Yes (*Ya*)	☐ No (*Tidak*)
5	Is the temperature too high in the workshop? *Adakah suhu di dalam bengkel terlalu tinggi?*	☐ Yes (*Ya*)	☐ No (*Tidak*)
6	What is the temperature (Celsius) in the workshop? *Berapa celciuskah suhu di dalam bengkel?*	________ °C	
7	Is the workshop environment too humid? *Adakah keadaan persekitaran bengkel terlalu lembab?*	☐ Yes (*Ya*)	☐ No (*Tidak*)
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11	Does the workshop environment affect your hearing? *Adakah suasana dalam bengkel mengganggu pendengaran anda?*	☐ Yes (*Ya*)	☐ No (*Tidak*)
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16	List PPE that you wear in the workshop. *Senaraikan alat perlindungan keselamatan diri yang anda gunakan semasa di bengkel.*	i. ____ ii. ____ iii. ____ iv. ____ v. ____ vi. ____ vii. ____ viii. ____ ix. ____
17	Do you feel comfortable wearing Personal Protective Equipment (PPE)? *Adakah anda berasa selesa apabila memakai alat perlindungan keselamatan diri?*	☐ Yes (*Ya*) ☐ No (*Tidak*)
18	When is the last time you use Personal Protective Equipment (PPE)? *Bilakah kali terakhir anda menggunakan alat perlindungan keselamatan diri?*	____
19	List PPE that should be supplied in the workshop. *Senaraikan alat perlindungan keselamatan diri yang perlu disediakan di dalam bengkel.*	i. ____ ii. ____ iii. ____ iv. ____ v. ____ vi. ____ vii. ____ viii. ____ ix. ____ x. ____
20	What type of clothes do you wear in the workshop? *Apakah jenis pakaian yang anda gunakan semasa di bengkel?*	____
21	What type of shoes do you wear in the workshop? *Apakah jenis kasut yang anda pakai semasa di bengkel?*	____
22	I can freely move in the workshop. *Saya bebas bergerak dari satu tempat ke satu tempat di dalam bengkel.*	☐ Yes (*Ya*) ☐ No (*Tidak*)

D. Health Background
Latarbelakang Kesihatan

23 Please tick health affect that you suffer during your training in Institut Kemahiran MARA.
Tandakan penyakit-penyakit yang anda alami semasa mengikuti program latihan di Institut Kemahiran MARA.

☐ Headache (*Sakit kepala*) ☐ Vomiting (*Muntah*)
☐ Dizzy (*Pitam*) ☐ Sore throat (*Sakit tekak*)
☐ Cold (*Selsema*) ☐ Asthma (*Lelah*)

24 When was your latest medical leave?
Bilakah kali terakhir anda mendapat cuti sakit?
____

25 When did you last see the doctor?
Bilakah kali terakhir anda berjumpa dengan doktor?
____

26 Does the management provide routine medical check-up? ☐ Yes (*Ya*) ☐ No (*Tidak*)
Adakah pihak pengurusan menyediakan ujian kesihatan secara berjadual?

27 If yes, how frequent has check-up been done?
Jika ya, berapa kali setahun ujian dilakukan?

☐ Once a year (*Sekali setahun*) ☐ Three time a year (*3 kali setahun*)
☐ Twice a year (*2 kali setahun*) ☐ Four time a year (*4 kali setahun*)

E. Recommendations
Cadangan

28 Give your recommendations how to improve the comfort level in the workshop.
Berikan cadangan anda untuk memperbaiki tahap keselesaan di bengkel

____
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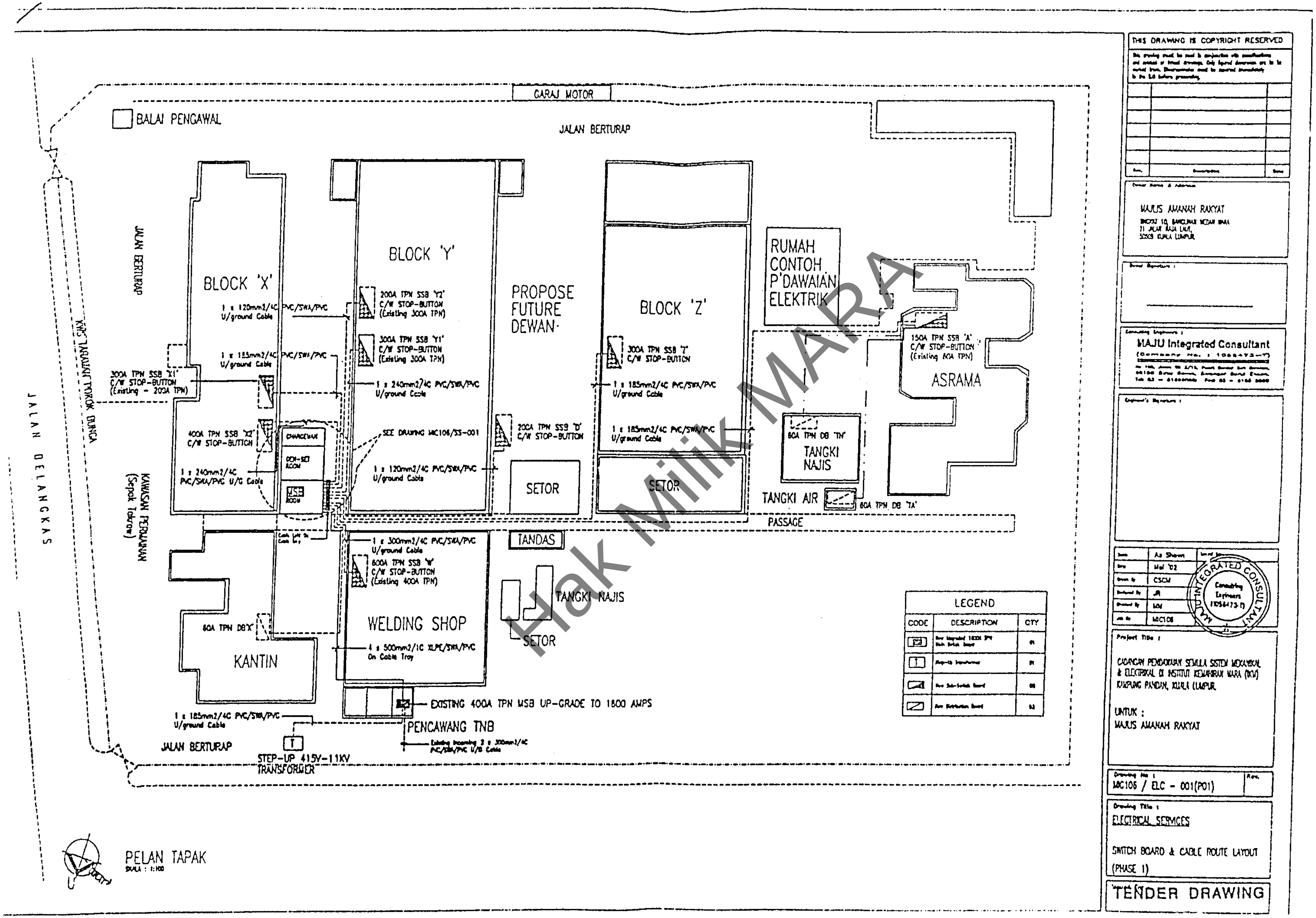
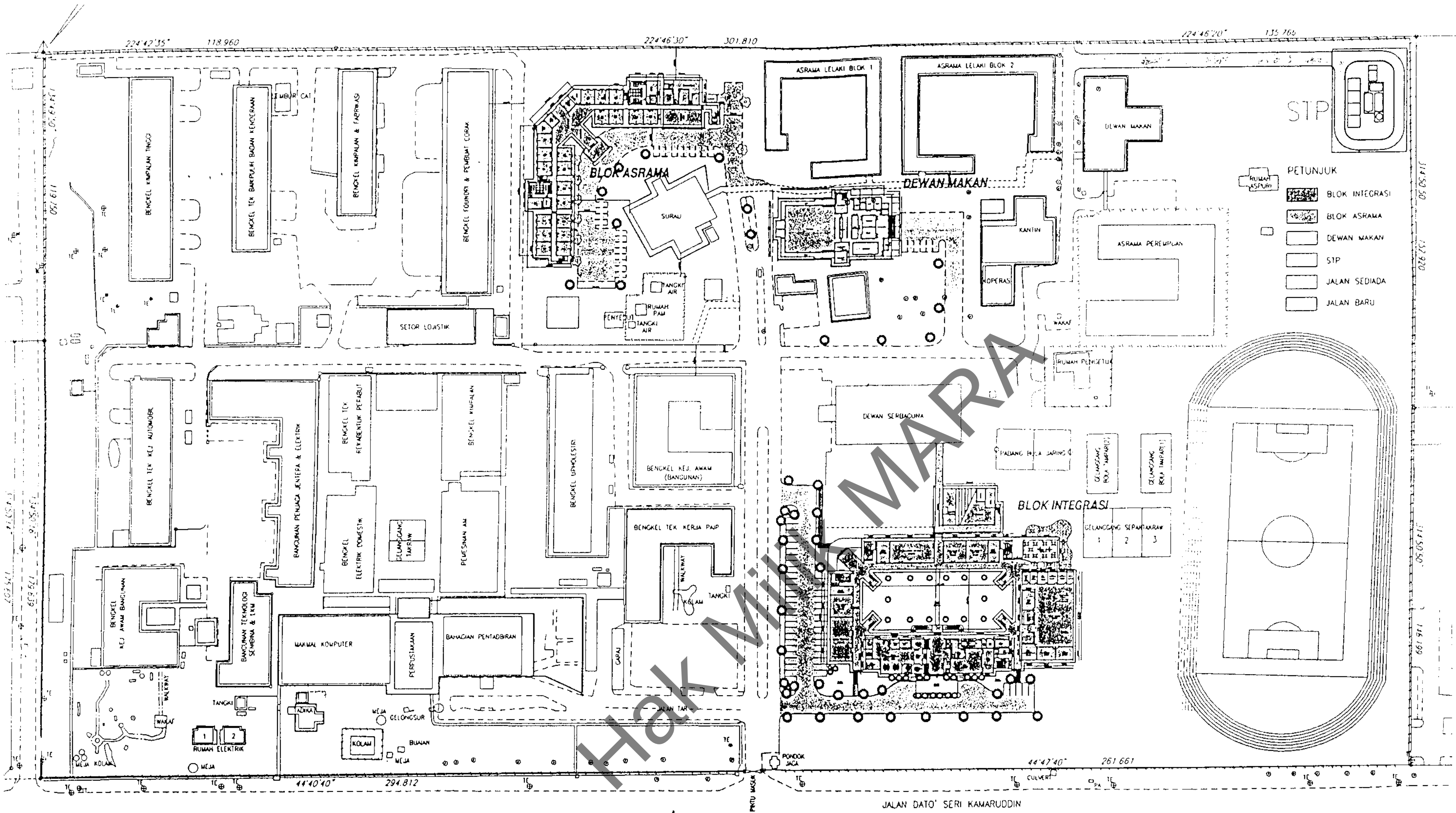
Thank for your cooperation
Terima kasih atas kerjasama anda


GARAJ MOTOR
BALAI PENGAWAL
JALAN BERTURAP
BLOCK 'X'
BLOCK 'Y'
PROPOSE FUTURE DEWAN
BLOCK 'Z'
RUMAH CONTOH P'DAWAIAN ELEKTRIK
ASRAMA
SETOR
TANGKI NAJIS
TANGKI AIR
PASSAGE
TANDAS
WELDING SHOP
KANTIN
PENCAWANG TNB
EXISTING 400A TPN MSB UP-GRADE TO 1800 AMPS
STEP-UP 415V-11KV TRANSFORMER
JALAN BERTURAP
JALAN DELANGKAS
KAWASAN PERMAINAN (Sepak Takraw)
PELAN TAPAK
LEGEND
CODE
DESCRIPTION
QTY
200A TPN SSB 'Y2' C/W STOP-BUTTON (Existing 300A TPN)
300A TPN SSB 'Y1' C/W STOP-BUTTON (Existing 300A TPN)
300A TPN SSB 'Z' C/W STOP-BUTTON
150A TPN SSB 'A' C/W STOP-BUTTON (Existing 60A TPN)
200A TPN SSB 'D' C/W STOP-BUTTON
600A TPN SSB 'W' C/W STOP-BUTTON (Existing 400A TPN)
400A TPN SSB 'X2' C/W STOP-BUTTON
300A TPN SSB 'X1' C/W STOP-BUTTON (Existing - 200A TPN)
60A TPN DB 'X'
60A TPN DB 'TN'
60A TPN DB 'TA'
SEE DRAWING MC106/SS-001
THIS DRAWING IS COPYRIGHT RESERVED
MAJLIS AMANAH RAKYAT
MAJU Integrated Consultant
As Shown
CSCM
MC106
CADANGAN PENDAWAIAN SEMULA SISTEM MEKANIKAL & ELEKTRIKAL DI INSTITUT KEMAHIRAN MARA (IKM) KAMPUNG PANDAN, KUALA LUMPUR
UNTUK :
MAJLIS AMANAH RAKYAT
MC106 / ELC - 001(P01)
ELECTRICAL SERVICES
SWITCH BOARD & CABLE ROUTE LAYOUT (PHASE 1)
TENDER DRAWING

Appendix 8

Appendix 9



PELAN SUSUNATUR

SKALA 1:1500

PEMILIK :

MAJLIS AMANAH RAKYAT

PENGURUS PROJEK :

tech building quality

ARKITEK :

CADANGAN PEMBESARAN DAN PENINGKATAN INSTITUT KEMAHIRAN MARA (IKM) LUMUT, PERAK DARUL RIDZUAN

MEKANIKAL & ELEKTRIKAL :

NASMIE 2 ASSOCIATE

JURUTERA PERUNDING

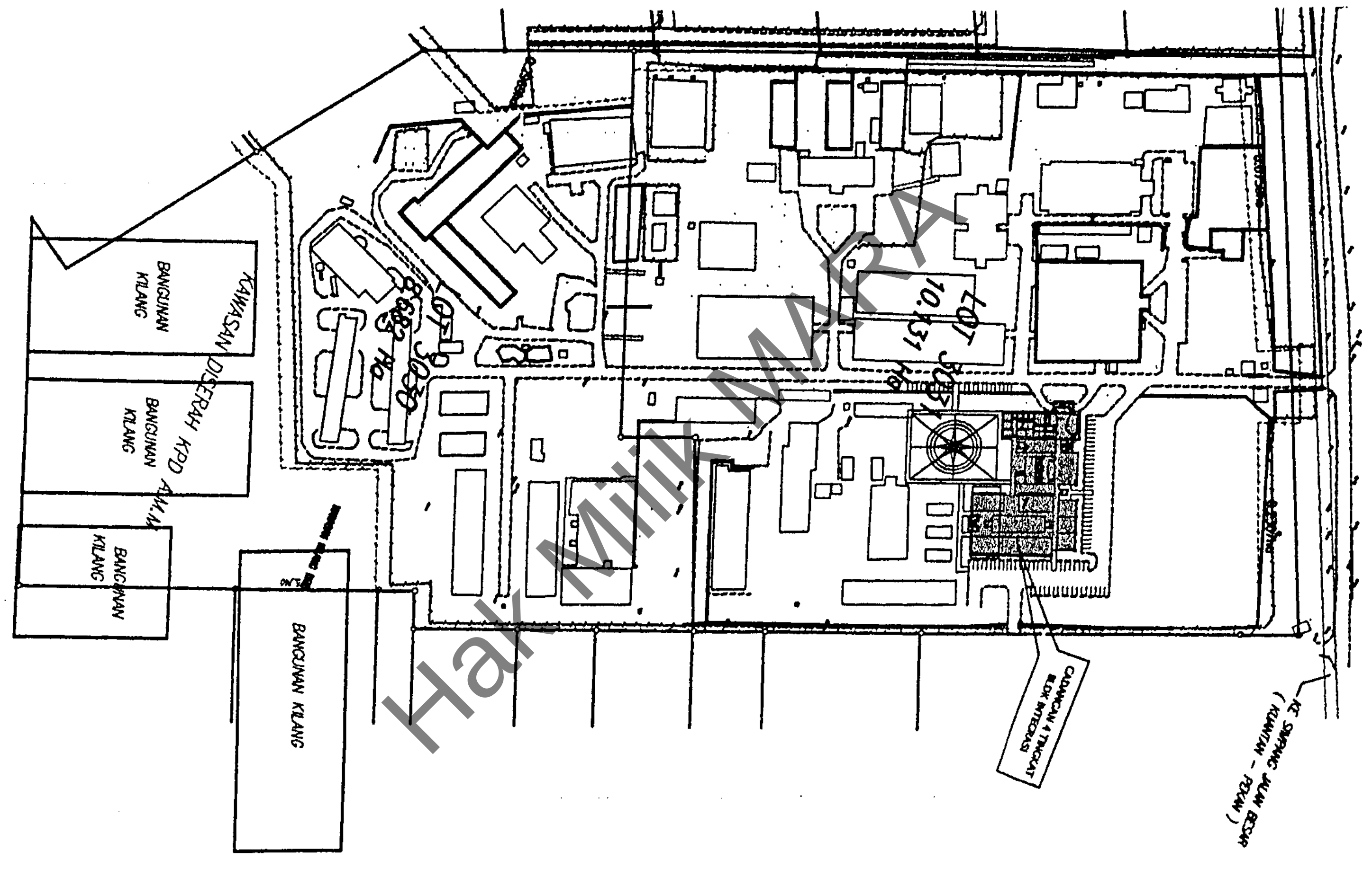
SIVIL & STRUKTUR :

JURUKUR BAHAN :

FENDI CONSULT

PERUNDING JURUKUR BAHAN & KOS BAHAN

Appendix 10



PELAN KERJA UKUR

CADANGAN KERJA-KERJA PEMBESARAN DAN PENINGKATAN, INSTITUT KEMAHIRAN MARA, PEKAN, PAHANG DARUL MAKMUR.

not to scale

TSI CERTIFICATE OF CALIBRATION AND TESTING

TSI Model 8762-M-UK TSI Serial No. 02070021

Description IAQ Meter with CO2 and CO

Calibration Standard Multi-Gas Calibration Bench #127

CALIBRATION VERIFICATION RESULTS

Error Compared to Tolerance — *Limit-* 0 *Limit+*

Calibration Standard	*Instrument Output*	*Difference*
0 PPM	-8 PPM	-8 PPM
500 PPM	485 PPM	-15 PPM
1002 PPM	1006 PPM	4 PPM
3000 PPM	2995 PPM	-0.2 %
4993 PPM	4987 PPM	-0.1 %
60.0°C	60.0°C	0.0°C
0.0°C	0.1°C	0.1°C
10.0 %rh	9.6 %rh	-0.4 %rh
30.0 %rh	29.8 %rh	-0.2 %rh
50.0 %rh	49.8 %rh	-0.2 %rh
70.0 %rh	70.0 %rh	0.0 %rh
90.0 %rh	90.0 %rh	0.0 %rh
0.0 PPM	0.0 PPM	0.0 PPM
50.0 PPM	51.1 PPM	1.1 PPM
100.0 PPM	99.1 PPM	-0.9 %
197.8 PPM	195.4 PPM	-1.2 %

Tolerance Limits:

CO_2: 50PPM or 3% of reading
rh: ± 2%rh
Temp: ± 0.56°C
CO: 3PPM or 3% of reading

TSI Incorporated does hereby certify that all materials, components, and workmanship used in the manufacture of this equipment are in strict accordance with the applicable specifications agreed upon by TSI and the customer and with all published specifications. All performance and acceptance tests required under this contract were successfully conducted according to required specifications. Furthermore, all test and calibration data supplied by TSI has been obtained using standards whose accuracies are traceable to the National Institute of Standards and Technology (NIST) or has been verified with respect to instrumentation whose accuracy is traceable to NIST, or is derived from accepted values of physical constants. Calibration procedures for this instrument comply with MIL-STD-45662A. The accuracy of the calibration facilities is greater than a ratio of 1:1 with respect to the accuracy specifications of the instrument being calibrated.

Applicable Test Report	Report Number	Date Last Verified
DC Voltage	517979	09-20-01
Barometric Pressure		05-10-02
Pure Nitrogen	T-0047	09-27-01
CO2 1000 PPM in N2	ALM031039	06-26-02
CO2 5000 PPM in N2	AAL4342	06-10-02
Temperature 0 C	254798	08-11-00
Temperature 60 C	216642	08-11-00
Humidity	2500	08-03-99
CO 200 PPM in N2	cc80449	04-11-02

Lana
Calibrated by

☐ Final
Function Check

Jul 2, 2002
Calibration Date

TSI Incorporated
Environmental Measurements
and Controls Division

Mailing Address: P.O. Box 64394 St. Paul, MN 55164 USA
Shipping Address: 500 Cardigan Road Shoreview, MN 55126 USA
Phone: (800) 777-8356 or (651) 490-2711 Fax: (651) 490-2874

TSI Incorporated
500 Cardigan Road
P.O. Box 64394
St. Paul, MN 55164-0394
USA

Tel 800 777 8356
651 490 2711
Fax 651 490 2874
E-mail answers@tsi.com
Web www.tsi.com

TSI

Serial Number/Seriennummer/Serie nummer/
Sarjanumero/Numéro de série/Numero de seroe

MANUFACTURER'S DECLARATION OF CONFORMITY

Model Number: 8732/8760/8762

Description: IAQ-CALC™

Year of Manufacture: 2002

TSI Incorporated does hereby certify that, to the best of its knowledge and belief, the product referenced above meets the essential requirements and is in conformity with the relevant EC Directive(s) listed below using the relevant section of the EC Standard:

EC Directive 89/336/EEC, as amended, Relating to Electromagnetic Compatibility.

EN 55011 / 1991
EN 61326 / 1998

The required performance and safety tests were successfully conducted according to harmonized standards. The CE Marking has been affixed on the device according to EC Directives.

KONFORMITÄTSERKLÄRUNG DES HERSTELLERS

Modellnummer: 8732/8760/8762

Produktbeschreibung: IAQ-CALC™

Herstellungsjahr: 2002

TSI Incorporated bestätigt hiermit, daß das oben genannte Produkt nach bestem Wissen und Gewissen die wesentliche(n) Forderung(en) erfüllt und in Übereinstimmung ist mit den relevanten EG-Richtlinien mit Bezug auf die unten aufgeführten relevanten Abschnitte der EG-Norm:

EG-Richtlinie 89/336/EEC, wie erweitert bezüglich der elektromagnetischen Verträglichkeitsanforderung.

EN 55011 / 1991, Elektromagnetische Verträglichkeit, Teil 1
EN 61326 / 1998, Elektromagnetische Verträglichkeit, Teil 1

Die erforderlichen Leistungs- und Sicherheitstests wurden erfolgreich gemäß der vereinheitlichten Normen durchgeführt. Das CE-Zeichen wurde gemäß der EG Richtlinie auf dem Gerät angebracht.

TILLVERKNINGS DEKLARATION

Modell nummer: 8732/8760/8762

Beskrivning: IAQ-CALC™

Tillverkningsår: 2002

TSI Incorporated deklarerar härmed utifrån vår bästa kunskap och tro att produkten ovan möter kraven och är i samspel med relevanta EU direktiv. De relevanta EU direktiven är listade nedan:

EU direktiv 89/336/EEC, som relaterar till elektromagnetisk kompabilitet.

EN 55011 / 1991
EN 61326 / 1998

De krav som ställts på utförande och säkerhet har uppfyllts och är test utförda enligt den harmoniserade standarden. CE-märket har placerats på utrustningen enligt EU direktiven.

VALMISTAJAN YHDENMUKAISUUDEN SELVITYS

Mallinumero: 8732/8760/8762

Selostus: IAQ-CALC™

Valmistusvuosi: 2002

TSI Incorporated todistaa täten, parhaimpaan tuntemukseensa ja uskomukseensa viitaten, että yllämainittu tuote täyttää tärkeimmät vaatimukset liittyen EC Direktiiveihin jotka ovat alla mainittuina käyttäen EC standardin relevanttia osaa ja että tuote on yhdenmukainen samoihin direktiiveihin.

EC Direktiivi 89/336/EEC, liittyen sähkömagneettiseen sovellutukseen.

EN 55011 / 1991
EN 61326 / 1998

Vaadittavat suorituskyky- ja turvallisuuskokeet ovat suoritettu menestyksellisesti noudattaen alaan liittyviä standardeja. CE merkki on asetettu laitteeseen kiinni EC Direktiivien mukaisesti.

ATTESTATION DE CONFORMITE DE FABRICATION

Référence du modèle: 8732/8760/8762

Description: IAQ-CALC™

Année de fabrication: 2002

TSI Incorporated certifie par la présente, au meilleur de ses connaissances, que le produit référencé ci-dessus est conforme aux paragraphes de la directive de la Communauté Européenne relative aux normes:

Directive de la CE 89/336/EEC, amendement relatif à la compatibilité électromagnétique

EN 55011 / 1991
EN 61326 / 1998

Les caractéristiques requises et les tests de sécurité ont été menés avec succès selon les normes harmonisées. Le marquage CE est apposé sur les appareils en conformité avec les directives CE.

DECLARACION DE CONFORMIDAD DEL FABRICANTE

Numero de modelo: 8732/8760/8762

Descripcion: IAQ-CALC™

Año de fabricacion: 2002

TSI Incorporated certifica que, segun su leal entender y saber, el producto antes mencionado cumple con los requisitos esenciales y esta conforme a las directivas pertinentes de "EC" listados a continuacion usando las normas de la seccion EC:

Directiva EC 89/336/EEC, Relativa a la Compabitilidad Electromagnetica.

EN 55011 / 1991
EN 61326 / 1998

El cumplimiento solicitado y test de seguridad fueron realizados satisfactoriamente de acuerdo con las normas establecidas. La marca CE se ha puesto en el aparato segun las directivas EC.

BULLETIN NO. **H-11**

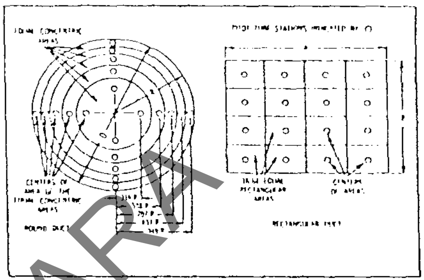
AIR VELOCITIES WITH THE DWYER PITOT TUBE

AIR VELOCITY

The total pressure of an air stream flowing in a duct is the sum of the static or bursting pressure exerted upon the sidewalls of the duct and the impact or velocity pressure of the moving air. Through the use of a pitot tube connected differentially to a manometer, the velocity pressure alone is indicated and the corresponding air velocity determined.

For accuracy of plus or minus 2%, as in laboratory applications, extreme care is required and the following precautions should be observed:

1. Duct diameter 4" or greater.
2. Make an accurate traverse per sketch at right, calculate the velocities and average the readings.
3. Provide smooth, straight duct sections a minimum of 8½ diameters in length upstream and 1½ diameters downstream from the pitot tube.
4. Provide an egg crate type straightener upstream from the pitot tube.



In making an air velocity check select a location as suggested above, connect tubing leads from both pitot tube connections to the manometer and insert in the duct with the tip directed into the air stream. If the manometer shows a minus indication reverse the tubes. With a direct reading manometer, air velocities will now be shown in feet per minute. In other types, the manometer will read velocity pressure in inches of water and the corresponding velocity will be found from the curves in this bulletin. If circumstances do not permit an accurate traverse, center the pitot tube in the duct, determine the center velocity and multiply by a factor of .9 for the approximate average velocity. Field tests run in this manner should be accurate within plus or minus 5%.

The velocity indicated is for dry air at 70°F., 29.9" Barometric Pressure and a resulting density of .075#/cu. ft. For air at a temperature other than 70°F. refer to the curves in this bulletin. For other variations from these conditions, corrections may be based upon the following data:

$$\text{Air Velocity} = 1096.2\sqrt{\frac{P_V}{D}}$$

where P_V = velocity pressure in inches of water
D = Air density in #/cu. ft.

$$\text{Air Density} = 1.325 \times \frac{P_B}{T}$$

where P_B = Barometric Pressure in inches of mercury
T = Absolute Temperature (indicated temperature °F plus 460)

Flow in cu. ft. per min. = Duct area in square feet x air velocity in ft. per min.

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DWYER INSTRUMENTS, INC.
P. O. BOX 373 • MICHIGAN CITY, INDIANA 46360, U.S.A.
Telephone 219/879-8000
Fax 219/872-9057

SPER
SCIENTIFIC Ltd.
7720 E. Redfield #7, Scottsdale AZ, 85260
Tel: 480-948-4448 Fax: 480-967-8736

LIGHT METER TEST REPORT

Certificate Number: 011018035112
Model Number: 840020C
Description: LIGHT METER LUX/FC
Tolerance: ±5%
Serial Number: 035112
Calibration Type: Full Calibration

Relative Humidity
45%
Ambient Temperature
20°C

Range	Test Point	As Found Reading	Within Specs	Adjustment Made	Adjusted Reading
1	100.00	N/A	YES	YES	99.9
2	1000.0	N/A	YES	YES	1002
3	10000	N/A	YES	YES	10010

Appendix 15

SPER
SCIENTIFIC LTD.

7720 EAST REDFIELD, #7, SCOTTSDALE, AZ 85260
TEL: (480) 948-4448 • FAX: (480) 967-8736 email: spersci@worldnet.att.net

CERTIFICATE OF CALIBRATION

ITEM: 840020C
Serial Number: 035112

CERTIFICATE NUMBER: 011018035112
DATE: 10/18/01

The above light meter was calibrated in a controlled environment with calibration points at 10 fc (100.0 lux), 100 fc (1000 lux), and 1000 fc (10000 lux). Sper Scientific Ltd. certifies that this instrument has been calibrated using standards and instruments which are traceable to the U. S. National Institute of Standards and Technology.

Equipment Used:

Manufacturer	Model	Serial No.	Calibration Due
Hoffman Engineering Corp.	PCS-100	001	October 16, 2002

This System is traceable to the National Institute Of Standards and Technology in accordance with ISO 10012-1 and MIL-STD 45662A. This instrument has been calibrated in terms of the standards maintained at this laboratory traceable to NIST test. Luminous Intensivity Standard Lamp: NBS # 534/2211461-1, Detector Spectral Responce Standards: NBS # 844/262303-99 and is within its stated accuracy, when compared against a tungsten - halogen light source, operating a 2856 ° K, correlated color temperature. Uncertainties of the standards are: ±2%. Supporting documentation relative to traceability is on file at this office, and is available for examination upon request.

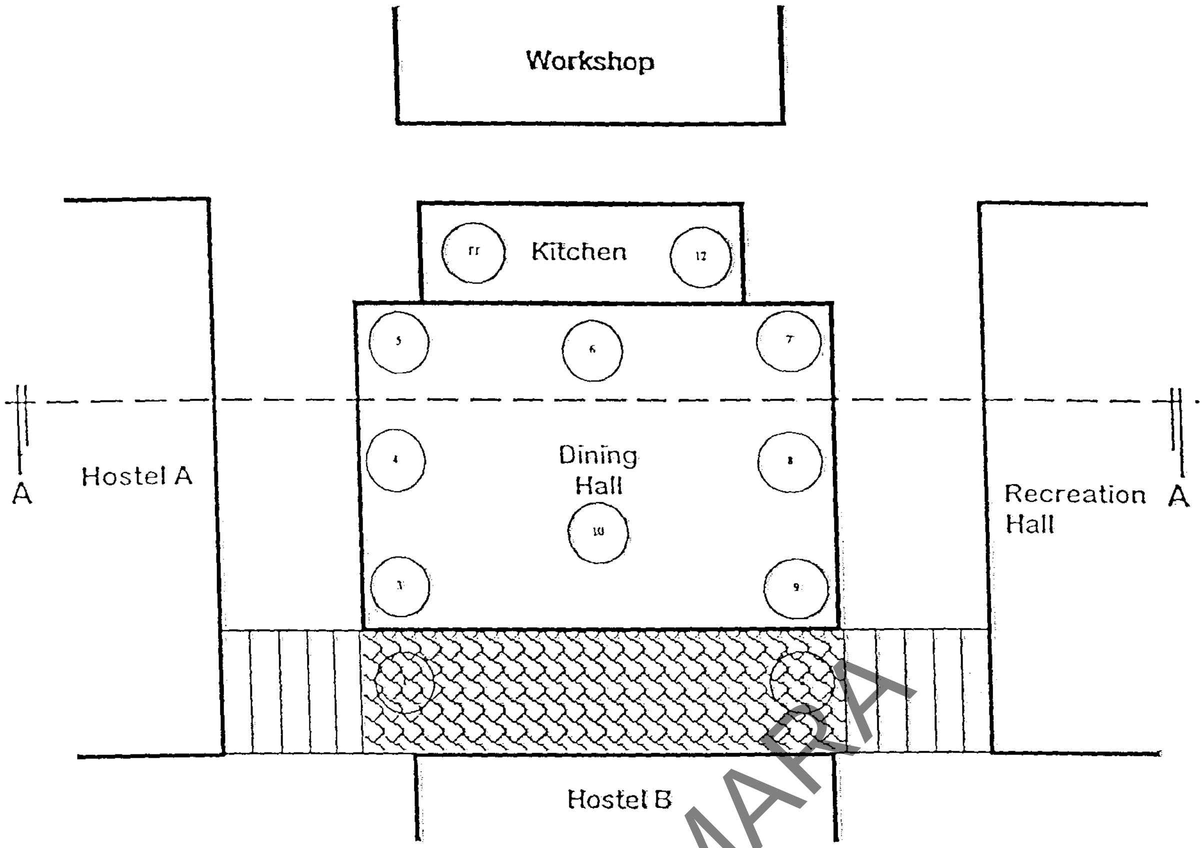
RELATIVE HUMIDITY: 45%
TEMPERATURE: 20° C

CALIBRATION METER DUE: 10/18/02
TEST REPORT LINE NUMBER: 25262

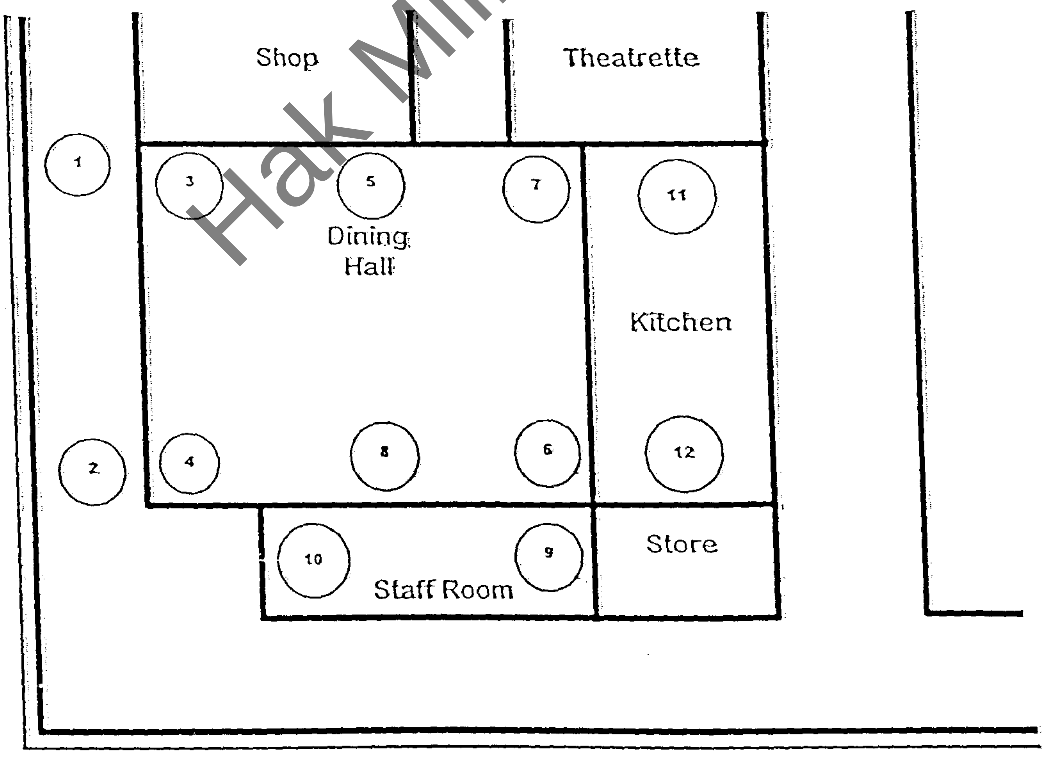
N. Vinnikov.

Nikolay Vinnikov
Supervisor-Quality Assurance

Appendix 16



TWELVE LOCATION OF SAMPLE POINT OF IKM JOHOR BAHRU



TWELVE LOCATION OF SAMPLE POINT OF IKM KUALA LUMPUR

Appendix
17 - 26

Appendix 17

Table 10 - Overall indoor and outdoor measurement of Temperature Level (°C) of IKM Kuala Lumpur

TIME	OUTDOOR LOCATION		INDOOR LOCATION										MEAN
	1	2	3	4	5	6	7	8	9	10	11	12	
7.45	26.5	26.0	26.9	27.9	27.5	27.7	27.0	27.1	27.3	27.8	27.4	27.9	**27.3**
8.00	26.8	27.3	27.0	28.1	27.6	28.3	27.6	27.4	28.3	28.1	27.9	28.4	**27.7**
8.30	27.6	28.6	27.6	28.4	28.3	28.8	28.2	28.0	28.9	28.3	28.5	28.9	**28.3**
9.00	28.0	29.3	28.1	28.0	27.9	28.0	28.0	27.6	28.7	28.6	29.0	29.3	**28.4**
9.15	28.5	29.6	29.4	28.5	27.4	27.9	27.9	27.9	28.8	29.0	29.4	29.7	**28.7**
9.30	28.8	30.4	30.0	28.4	27.0	27.6	27.8	28.0	29.0	29.4	30.2	30.9	**29.0**
9.45	29.1	32.8	29.7	28.7	28.2	27.9	28.1	28.5	28.1	29.7	30.0	31.0	**29.3**
10.00	29.9	32.2	31.3	29.0	29.8	28.2	29.8	29.0	29.3	30.6	31.6	31.2	**30.2**
10.15	31.0	33.0	31.8	30.4	31.0	30.4	30.6	30.6	30.1	31.1	31.5	32.3	**31.2**
10.30	32.3	32.8	31.6	31.3	32.5	31.6	31.4	31.6	30.8	32.4	31.7	32.7	**31.9**
11.00	32.4	33.2	32.4	31.6	32.0	31.7	31.7	31.8	31.0	32.5	31.0	32.9	**32.0**
12.00	33.7	33.8	32.8	32.1	32.3	32.5	32.0	31.9	31.8	32.4	31.6	32.7	**32.5**
12.30	33.5	33.4	33.0	32.5	32.5	32.4	32.6	32.3	32.0	32.3	32.0	33.6	**32.7**
13.00	34.5	33.9	34.7	32.6	32.7	32.3	32.9	32.2	32.6	32.7	32.3	33.5	**33.1**
13.15	34.6	34.0	34.6	32.5	32.0	32.6	32.4	32.1	32.8	32.4	32.1	33.4	**33.0**
13.30	34.5	34.2	35.0	32.8	32.1	32.5	32.0	32.3	32.9	32.6	32.4	33.2	**33.0**
13.45	35.0	34.7	35.3	33.1	32.4	32.3	32.3	32.3	33.0	32.9	32.0	33.4	**33.2**
14.00	35.5	35.2	35.9	33.0	32.5	32.4	32.6	32.4	33.1	32.8	32.5	33.0	**33.4**
14.15	35.0	34.9	35.2	32.8	32.6	32.0	32.1	32.0	32.4	32.4	32.4	32.7	**33.0**
14.30	34.8	34.1	34.2	32.5	32.4	32.2	32.5	32.1	32.6	31.5	31.7	32.9	**32.8**
15.00	34.0	32.8	34.0	31.9	31.8	31.9	32.3	31.9	32.0	31.6	31.9	32.1	**32.4**
15.30	33.8	32.4	33.7	31.6	31.4	31.7	32.0	31.5	31.6	31.2	31.2	32.2	**32.0**
16.00	33.4	32.7	33.3	31.4	31.6	31.8	31.6	31.6	31.8	31.3	31.5	32.3	**32.0**
16.30	33.0	32.6	33.5	31.1	31.2	31.5	31.3	31.3	31.2	31.0	31.4	32.1	**31.8**
17.00	32.5	32.6	33.4	31.0	31.4	31.6	31.1	31.2	31.0	31.1	31.4	32.0	**31.7**
17.15	32.0	32.3	33.0	31.2	31.5	31.8	31.0	31.4	31.2	31.6	31.3	32.1	**31.7**
17.30	32.3	32.4	32.4	31.0	31.1	31.4	31.2	31.1	29.7	31.4	31.3	31.7	**31.4**
18.00	31.7	31.5	32.3	30.6	30.6	31.1	30.1	30.7	29.6	31.1	31.1	31.8	**31.0**
18.30	31.4	31.6	31.5	30.8	30.7	30.7	29.5	30.9	29.9	30.7	30.8	31.9	**30.9**
19.00	30.7	30.8	31.7	30.4	30.4	30.9	29.8	30.6	29.8	30.9	30.9	31.5	**30.7**
19.30	30.2	30.4	30.4	30.7	30.3	30.2	29.9	30.4	30.0	30.5	30.7	31.4	**30.4**
19.45	29.5	29.7	29.7	30.3	30.5	31.3	30.0	30.1	30.4	30.6	30.6	31.2	**30.3**
20.00	29.2	29.0	28.0	30.0	30.6	30.5	30.4	30.0	30.5	30.7	30.8	31.0	**30.1**
MIN.	26.5	26.0	26.9	27.9	27.0	27.6	27.6	27.1	27.3	27.8	27.4	27.9	**26.0**
MAX.	35.5	35.2	35.9	33.1	32.7	32.6	32.9	32.4	33.1	32.9	32.5	33.6	**35.9**
MEAN	31.7	31.9	31.9	30.8	30.7	30.8	30.6	30.6	30.7	31.0	31.0	31.7	**31.1**

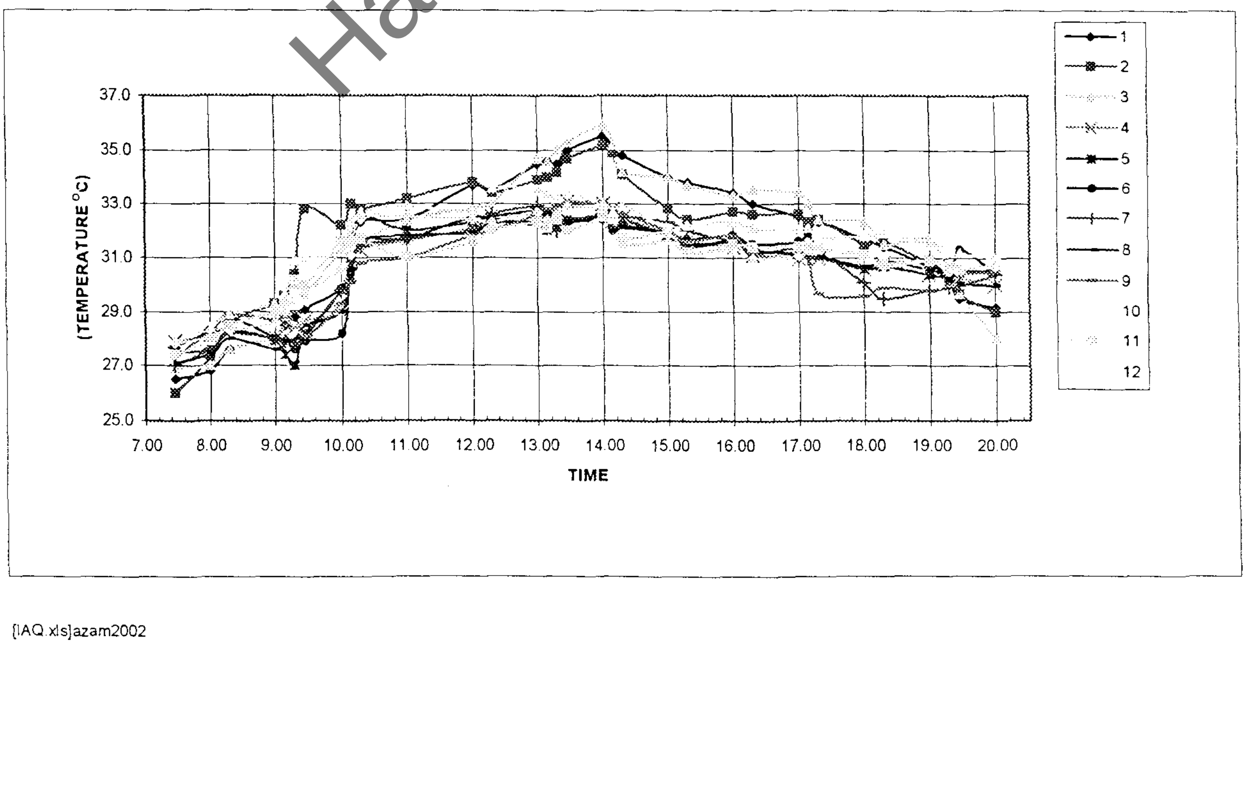
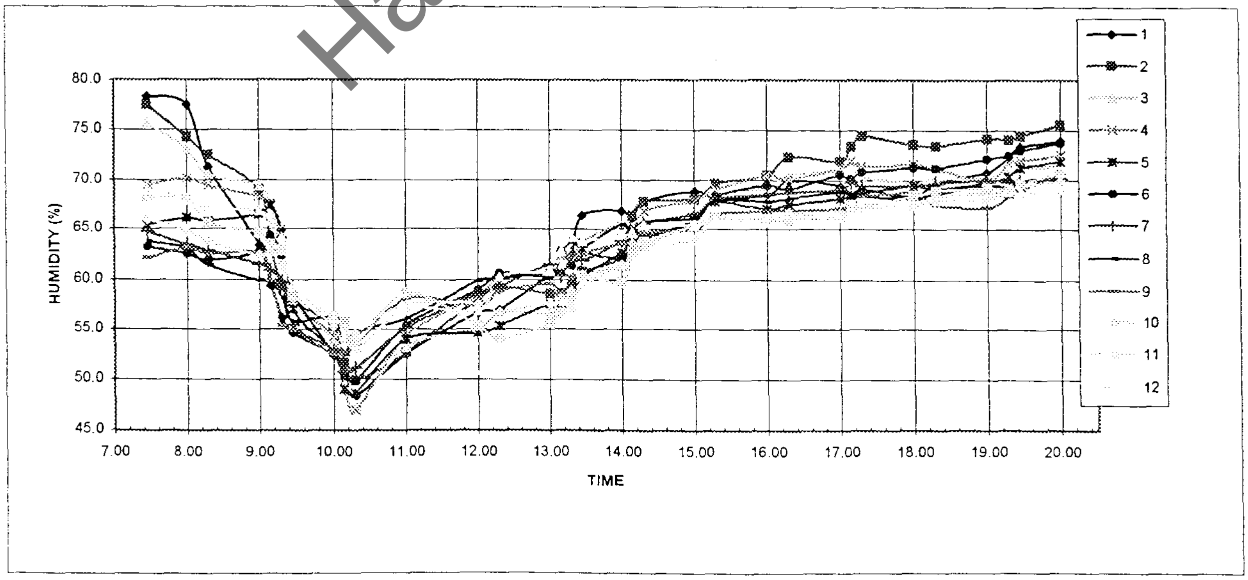


Table 12 - Overall indoor and outdoor measurement of Relative Humidity Level (%) of IKM Kuala Lumpur

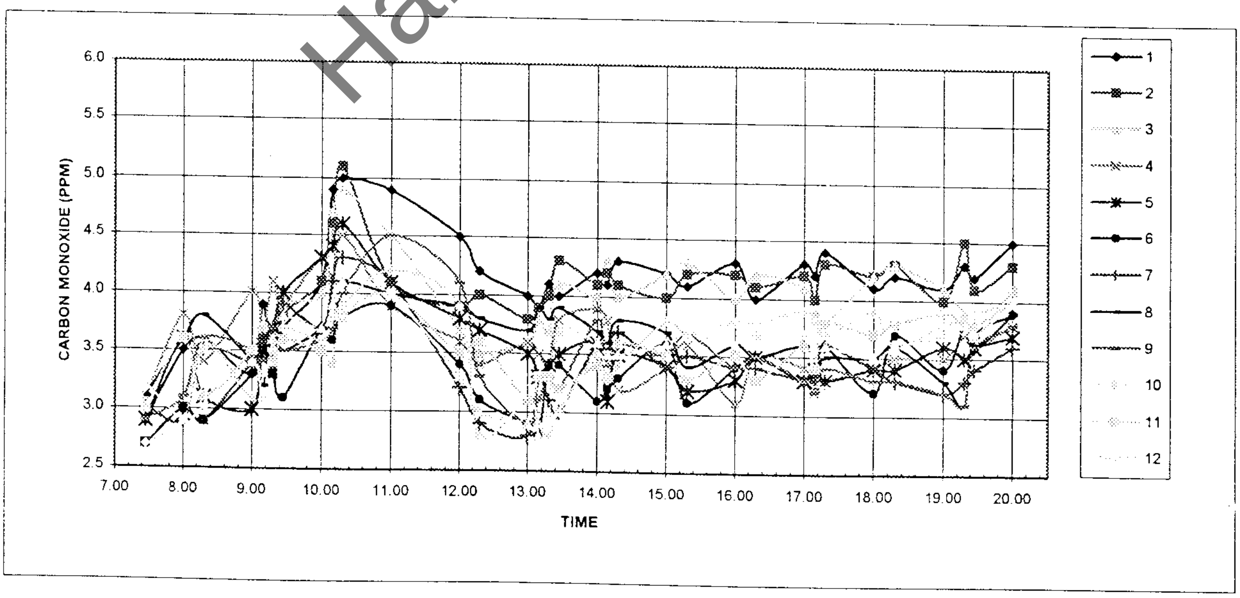
TIME	OUTDOOR LOCATION		INDOOR LOCATION										MEAN
	1	2	3	4	5	6	7	8	9	10	11	12	
7.45	78.3	77.5	75.7	69.5	65.4	63.2	64.7	63.7	62.1	65.9	68.1	69.0	**68.6**
8.00	77.5	74.3	73.1	70.2	66.1	62.5	63.4	63.0	63.1	64.8	67.9	68.0	**67.8**
8.30	71.3	72.5	70.6	69.4	65.8	61.9	62.8	61.4	62.5	63.7	65.6	67.1	**66.2**
9.00	63.4	69.0	69.4	68.3	66.5	62.7	61.5	59.9	62.6	62.4	64.6	66.8	**64.8**
9.15	59.4	63.2	67.5	67.6	67.4	64.3	60.9	59.7	59.9	62.7	63.5	65.8	**63.5**
9.30	56.2	59.3	62.0	65.0	64.5	62.4	59.8	58.2	55.4	61.3	62.9	64.1	**60.9**
9.45	54.6	57.8	57.6	58.0	57.1	58.6	55.4	55.8	54.9	58.6	58.4	59.4	**57.2**
10.00	52.3	55.3	53.9	54.2	52.6	52.4	52.8	56.1	52.4	55.3	56.3	56.1	**54.1**
10.15	50.4	51.6	49.5	49.1	49.0	50.3	50.7	52.4	52.6	53.4	55.7	55.3	**51.7**
10.30	48.4	49.9	47.3	47.0	48.6	49.8	51.1	54.7	53.4	54.6	53.6	53.0	**51.0**
11.00	52.5	52.6	53.2	54.3	54.0	55.4	55.1	56.1	58.1	57.5	58.7	57.0	**55.4**
12.00	56.7	58.1	55.1	58.4	54.6	59.0	58.7	59.9	57.4	57.6	55.3	56.9	**57.3**
12.30	57.0	59.3	56.7	60.1	55.3	60.6	59.3	60.1	58.9	56.8	54.0	60.3	**58.2**
13.00	60.5	58.6	56.6	60.7	57.6	60.4	61.5	60.9	59.6	57.6	55.6	60.9	**59.2**
13.15	60.6	58.7	58.4	62.4	56.9	62.8	60.4	62.6	58.7	56.4	56.7	62.8	**59.8**
13.30	62.5	59.6	58.9	61.9	58.1	61.4	62.5	63.7	60.4	57.1	58.1	64.2	**60.7**
13.45	66.4	60.8	60.5	63.7	60.4	62.6	61.9	63.3	62.5	59.4	60.4	63.8	**62.1**
14.00	66.8	62.3	61.4	65.4	62.7	62.1	63.8	65.4	63.6	61.5	59.8	64.5	**63.3**
14.15	66.2	66.4	62.8	64.1	64.5	63.9	64.6	64.9	64.2	63.6	62.8	64.7	**64.4**
14.30	67.8	67.8	63.4	66.8	64.1	64.5	65.6	65.7	64.7	63.4	63.7	65.5	**65.3**
15.00	68.9	68.1	65.8	67.9	65.9	65.7	66.6	66.2	65.0	64.0	65.4	65.4	**66.2**
15.30	68.2	69.7	68.4	69.0	67.8	68.4	68.1	67.9	66.5	65.9	66.1	65.9	**67.7**
16.00	68.5	70.5	69.2	70.5	67.0	69.5	68.5	67.8	66.8	65.8	65.8	66.0	**68.0**
16.30	69.9	72.4	70.5	70.1	67.5	69.1	68.7	68.1	66.9	66.7	65.9	66.5	**68.5**
17.00	69.4	71.9	71.1	71.2	68.1	70.6	69.1	68.8	67.1	66.6	66.4	66.2	**68.9**
17.15	68.2	73.4	71.9	71.9	68.5	70.1	69.8	68.5	67.8	66.9	67.5	67.0	**69.3**
17.30	69.1	74.5	70.4	71.4	68.7	70.8	69.4	68.4	68.4	67.5	67.4	67.2	**69.4**
18.00	68.3	73.6	69.8	71.6	69.5	71.3	69.5	68.1	68.7	67.4	68.4	67.5	**69.5**
18.30	69.8	73.5	70.1	71.2	69.1	71.2	69.7	68.7	67.5	68.4	68.9	67.9	**69.7**
19.00	70.8	74.2	70.3	70.0	69.8	72.2	70.0	69.5	67.2	68.7	69.2	68.2	**70.0**
19.30	72.4	74.1	70.8	71.8	70.4	72.5	69.8	69.4	68.4	69.0	69.1	68.8	**70.5**
19.45	73.4	74.5	71.2	72.0	71.3	73.0	69.9	69.9	69.1	69.4	69.7	68.7	**71.0**
20.00	74.0	75.6	71.5	72.6	71.9	73.8	70.2	70.4	70.6	69.9	70.8	69.1	**71.7**
MIN.	48.4	49.9	47.3	47.0	48.6	49.8	50.7	52.4	52.4	53.4	53.6	53.0	**47.0**
MAX.	78.3	77.5	75.7	72.6	71.9	73.8	70.2	70.4	70.6	69.9	70.8	69.1	**78.3**
MEAN	**64.8**	**66.1**	**64.4**	**65.4**	**63.2**	**64.2**	**63.5**	**63.6**	**62.6**	**62.7**	**63.1**	**64.2**	**64.0**



Appendix 19

Table 14 - Overall indoor and outdoor measurement of Carbon Monoxide (PPM) of IKM Kuala Lumpur

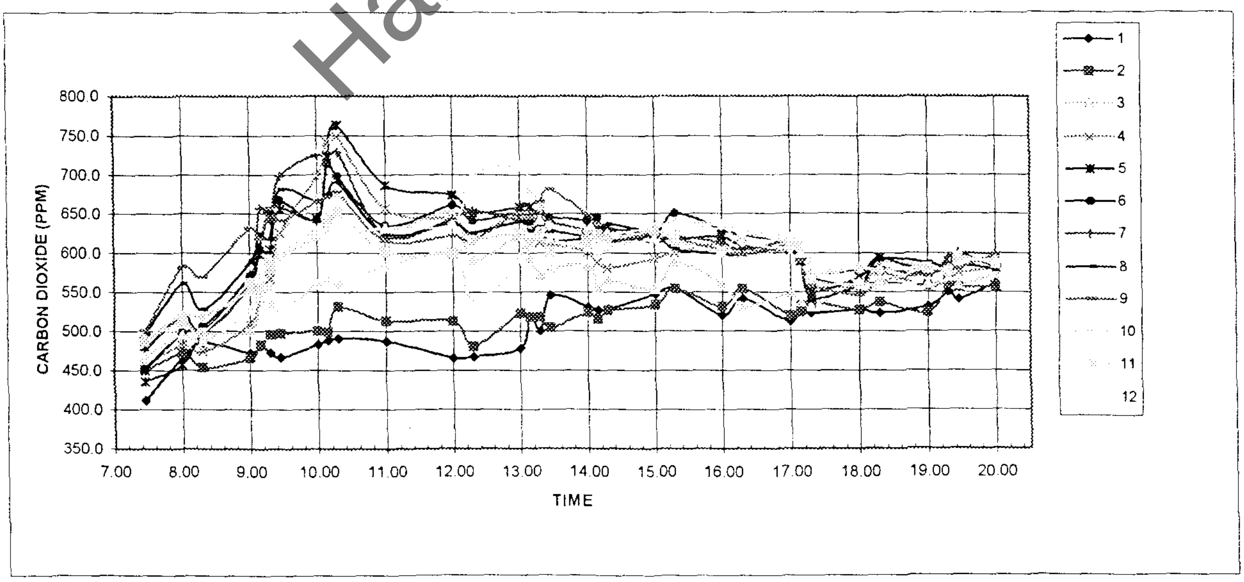
TIME	OUTDOOR LOCATION		INDOOR LOCATION										MEAN
	1	2	3	4	5	6	7	8	9	10	11	12	
7.45	2.9	2.7	3.0	3.1	2.9	2.7	3.0	3.1	2.9	2.7	3.0	3.2	2.9
8.00	3.5	3.0	2.9	3.8	3.6	3.0	2.9	3.6	3.1	2.9	3.6	2.9	3.2
8.30	3.6	2.9	3.6	3.4	3.1	2.9	3.5	3.8	3.6	3.5	3.1	3.0	3.3
9.00	3.3	3.4	3.1	4.0	3.0	3.3	3.4	3.4	3.5	3.4	3.5	3.4	3.4
9.15	3.9	3.6	3.7	3.7	3.5	3.5	3.6	3.2	3.4	3.3	3.7	3.1	3.5
9.30	3.4	3.3	3.6	4.1	3.7	3.3	3.7	3.6	3.7	3.5	3.4	3.6	3.6
9.45	3.7	3.8	3.9	3.9	4.0	3.1	3.9	3.5	3.5	3.7	3.6	3.8	3.7
10.00	4.1	4.1	4.0	4.3	4.3	3.7	3.7	3.7	3.6	3.6	3.5	3.7	3.9
10.15	4.9	4.6	4.7	4.1	4.4	3.6	4.1	3.9	3.7	3.8	3.4	3.9	4.1
10.30	5.0	5.1	4.9	4.5	4.6	3.8	4.3	4.1	4.0	3.9	3.8	4.1	4.3
11.00	4.9	4.1	4.5	3.9	4.1	3.9	4.1	4.0	4.5	4.2	4.0	4.0	4.2
12.00	4.5	3.9	3.7	3.6	3.8	3.4	3.2	3.9	4.1	3.9	3.5	3.3	3.7
12.30	4.2	4.0	3.5	3.4	3.7	3.1	2.9	3.8	3.3	2.8	3.6	3.0	3.4
13.00	4.0	3.8	3.6	3.6	3.5	2.9	2.8	3.7	2.9	3.1	3.1	2.9	3.3
13.15	3.9	3.9	3.8	3.5	3.3	2.8	3.3	3.9	3.1	2.9	3.3	2.8	3.4
13.30	4.1	4.0	3.7	3.4	3.4	3.4	3.1	3.8	3.3	2.8	3.3	3.0	3.4
13.45	4.0	4.3	4.1	3.8	3.5	3.4	3.0	3.9	3.2	3.0	3.2	3.7	3.6
14.00	4.2	4.1	4.0	3.9	3.6	3.1	3.6	3.7	3.8	3.5	3.4	3.6	3.7
14.15	4.1	4.2	4.3	3.8	3.1	3.2	3.5	3.6	3.4	3.3	3.3	3.5	3.6
14.30	4.3	4.1	4.0	3.2	3.5	3.3	3.7	3.8	3.6	3.4	3.6	3.5	3.7
15.00	4.2	4.0	4.2	3.4	3.4	3.6	3.4	3.7	3.5	3.8	3.5	3.6	3.7
15.30	4.1	4.2	4.3	3.6	3.2	3.1	3.5	3.4	3.7	3.7	3.3	3.7	3.7
16.00	4.3	4.2	4.0	3.1	3.3	3.4	3.4	3.6	3.4	3.8	3.5	3.6	3.6
16.30	4.0	4.1	4.2	3.5	3.5	3.5	3.4	3.5	3.5	3.8	3.3	3.7	3.7
17.00	4.3	4.2	4.1	3.4	3.3	3.3	3.3	3.6	3.3	3.9	3.6	3.7	3.7
17.15	4.2	4.0	3.9	3.2	3.4	3.4	3.3	3.4	3.2	3.8	3.4	3.6	3.6
17.30	4.4	4.3	3.8	3.3	3.3	3.6	3.6	3.5	3.4	3.7	3.8	3.6	3.7
18.00	4.1	4.2	4.2	3.4	3.4	3.2	3.4	3.5	3.3	3.9	3.7	3.5	3.7
18.30	4.2	4.3	4.3	3.5	3.4	3.7	3.3	3.6	3.3	3.6	3.8	3.6	3.7
19.00	4.1	4.0	4.1	3.5	3.6	3.4	3.2	3.3	3.2	3.8	3.9	3.7	3.7
19.30	4.3	4.5	3.9	3.7	3.5	3.8	3.3	3.1	3.1	3.8	3.8	3.8	3.7
19.45	4.2	4.1	3.8	3.6	3.6	3.6	3.4	3.7	3.6	3.7	3.7	3.9	3.7
20.00	4.5	4.3	4.0	3.8	3.7	3.9	3.6	3.9	3.8	4.0	4.1	4.0	4.0
MIN.	2.9	2.7	3.0	3.1	2.9	2.7	2.8	3.1	2.9	2.7	3.0	3.2	**2.7**
MAX.	5.0	5.1	4.9	4.5	4.6	3.9	4.3	3.9	4.1	4.2	4.0	4.1	**5.1**
MEAN	4.1	4.0	3.9	3.6	3.6	3.4	3.4	3.6	3.5	3.5	3.5	3.5	**3.6**



Appendix 20

Table 16 - Overall indoor and outdoor measurement of Carbon Dioxide (PPM) of IKM Kuala Lumpur

TIME	OUTDOOR LOCATION		INDOOR LOCATION										MEAN
	1	2	3	4	5	6	7	8	9	10	11	12	
7.45	412.0	450.0	496.0	457.0	436.0	451.0	476.0	496.0	501.0	491.0	487.0	467.0	468.3
8.00	465.0	471.0	500.0	482.0	456.0	498.0	520.0	561.0	582.0	521.0	512.0	495.0	505.3
8.30	485.0	453.0	498.0	473.0	498.0	506.0	498.0	528.0	569.0	519.0	498.0	487.0	501.0
9.00	472.0	465.0	501.0	509.0	563.0	571.0	563.0	588.0	631.0	552.0	562.0	526.0	541.9
9.15	481.0	482.0	542.0	554.0	599.0	606.0	657.0	624.0	618.0	545.0	554.0	571.0	569.4
9.30	472.0	495.0	581.0	567.0	604.0	653.0	642.0	618.0	657.0	534.0	587.0	556.0	580.5
9.45	466.0	497.0	625.0	625.0	656.0	667.0	699.0	681.0	641.0	528.0	596.0	597.0	606.5
10.00	483.0	500.0	668.0	699.0	643.0	642.0	726.0	666.0	665.0	559.0	621.0	626.0	624.8
10.15	488.0	498.0	725.0	743.0	724.0	714.0	715.0	675.0	671.0	564.0	643.0	631.0	649.3
10.30	490.0	531.0	678.0	750.0	763.0	699.0	729.0	690.0	678.0	562.0	651.0	621.0	653.5
11.00	487.0	513.0	630.0	656.0	687.0	634.0	621.0	624.0	615.0	583.0	601.0	632.0	606.9
12.00	465.0	512.0	651.0	642.0	674.0	661.0	643.0	637.0	621.0	598.0	599.0	637.0	611.7
12.30	467.0	480.0	591.0	623.0	651.0	641.0	653.0	625.0	616.0	541.0	615.0	699.0	600.2
13.00	478.0	523.0	621.0	651.0	658.0	652.0	642.0	639.0	651.0	594.0	624.0	712.0	620.4
13.15	519.0	518.0	592.0	642.0	658.0	639.0	648.0	628.0	645.0	678.0	613.0	692.0	622.7
13.30	500.0	518.0	571.0	613.0	645.0	640.0	653.0	635.0	665.0	658.0	621.0	642.0	613.4
13.45	546.0	504.0	580.0	611.0	630.0	645.0	640.0	615.0	681.0	634.0	601.0	618.0	608.8
14.00	531.0	524.0	584.0	601.0	621.0	641.0	628.0	619.0	649.0	627.0	615.0	608.0	604.0
14.15	527.0	516.0	555.0	587.0	630.0	645.0	621.0	624.0	636.0	617.0	623.0	604.0	598.8
14.30	528.0	526.0	565.0	581.0	631.0	618.0	629.0	636.0	614.0	624.0	617.0	608.0	598.1
15.00	548.0	534.0	554.0	593.0	624.0	624.0	613.0	624.0	625.0	631.0	628.0	618.0	601.3
15.30	554.0	554.0	587.0	600.0	618.0	650.0	620.0	605.0	618.0	639.0	616.0	627.0	607.3
16.00	521.0	531.0	561.0	612.0	620.0	630.0	613.0	599.0	604.0	634.0	601.0	636.0	596.8
16.30	542.0	554.0	531.0	599.0	610.0	623.0	604.0	598.0	599.0	813.0	624.0	628.0	593.8
17.00	512.0	520.0	549.0	603.0	605.0	613.0	615.0	608.0	609.0	605.0	613.0	618.0	589.2
17.15	536.0	524.0	537.0	598.0	589.0	591.0	604.0	591.0	589.0	603.0	608.0	599.0	580.8
17.30	523.0	536.0	531.0	560.0	551.0	542.0	574.0	568.0	559.0	574.0	567.0	589.0	556.2
18.00	527.0	527.0	565.0	557.0	569.0	558.0	579.0	561.0	546.0	581.0	559.0	563.0	557.7
18.30	523.0	537.0	589.0	576.0	594.0	561.0	581.0	592.0	563.0	578.0	561.0	559.0	567.8
19.00	532.0	524.0	581.0	556.0	574.0	581.0	573.0	587.0	573.0	581.0	581.0	582.0	565.4
19.30	550.0	561.0	579.0	567.0	584.0	571.0	594.0	581.0	583.0	579.0	577.0	570.0	574.7
19.45	541.0	556.0	560.0	574.0	590.0	583.0	600.0	598.0	581.0	594.0	595.0	589.0	580.1
20.00	562.0	558.0	573.0	581.0	588.0	581.0	599.0	583.0	598.0	587.0	586.0	591.0	582.3
MIN.	412.0	450.0	496.0	457.0	436.0	451.0	476.0	496.0	501.0	491.0	487.0	467.0	412.0
MAX.	562.0	558.0	573.0	750.0	763.0	699.0	729.0	690.0	678.0	678.0	613.0	692.0	763.0
MEAN	507.1	514.9	577.3	595.2	610.4	609.4	617.3	609.2	613.7	585.7	592.6	599.3	586.0



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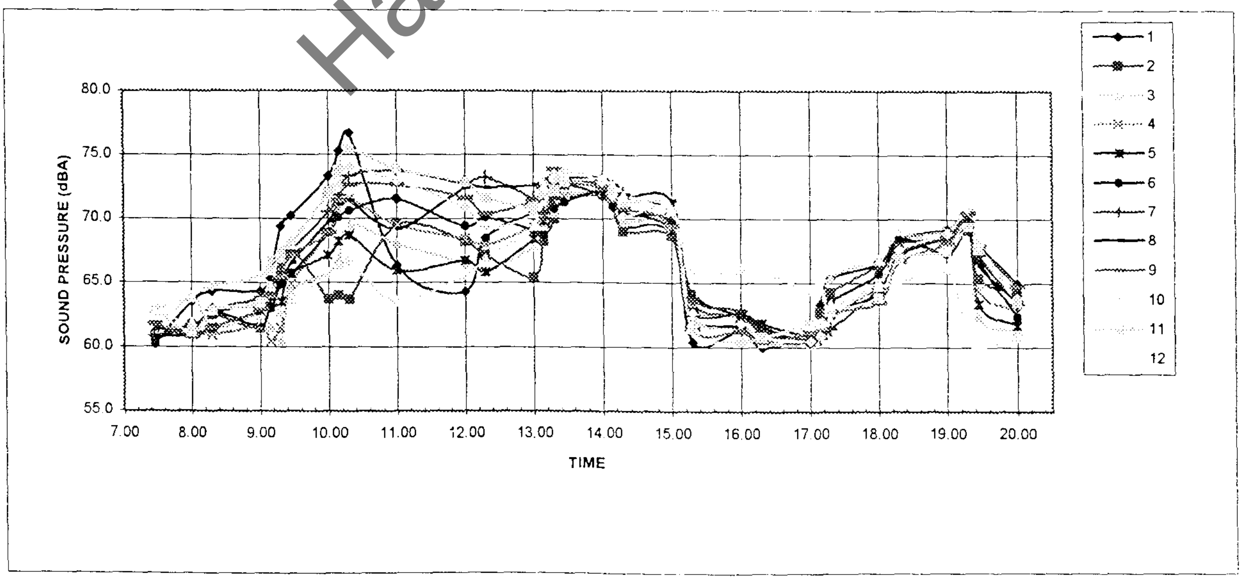
Appendix 21

Table 18 - Overall indoor and outdoor measurement of Sound Pressure Level (dBA) of IKM Kuala Lumpur

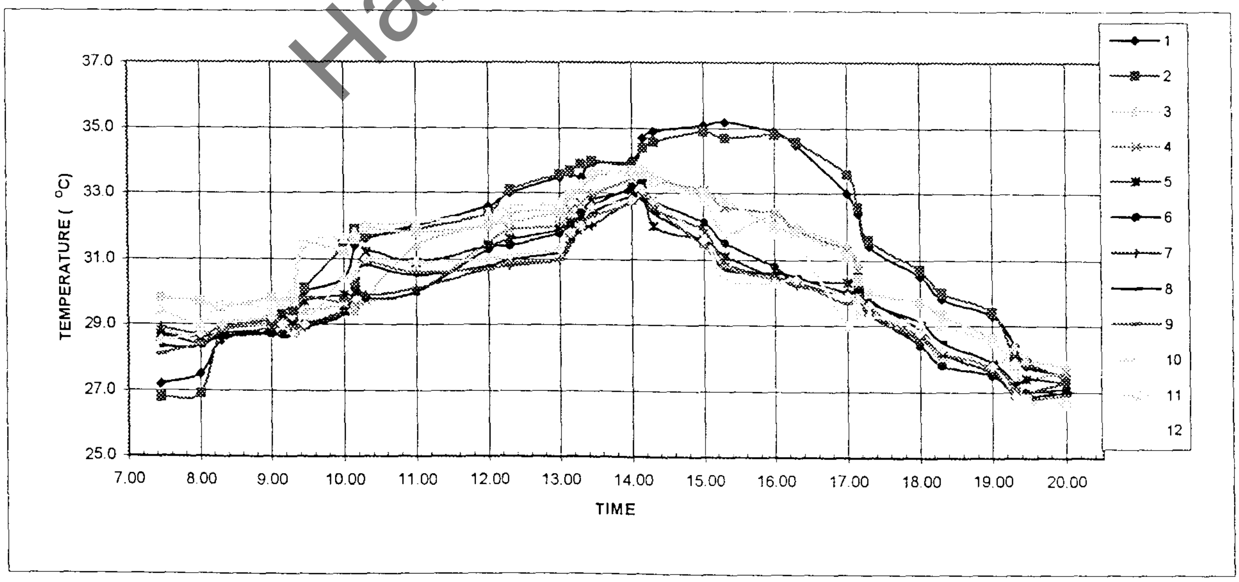
TIME	OUTDOOR LOCATION		INDOOR LOCATION										MEAN
	1	2	3	4	5	6	7	8	9	10	11	12	
7.45	60.2	60.8	61.4	61.6	61.5	60.5	60.8	60.8	61.8	62.8	62.8	62.7	**61.5**
8.00	63.5	61.5	63.8	61.4	60.9	61.8	61.7	61.0	60.8	63.9	61.1	61.9	**61.9**
8.30	64.3	62.5	61.5	60.9	61.5	62.6	62.8	62.7	61.5	64.7	62.8	62.9	**62.6**
9.00	64.3	61.5	62.5	61.6	62.8	63.4	63.8	61.7	62.9	65.4	63.4	63.5	**63.1**
9.15	65.3	64.3	61.5	60.4	63.1	63.0	64.5	63.7	63.9	66.7	65.9	64.7	**63.9**
9.30	69.4	66.8	60.4	61.5	63.5	64.8	65.8	64.8	65.4	67.4	66.9	62.7	**65.0**
9.45	70.2	67.8	64.3	64.8	65.7	65.6	67.4	66.5	67.1	68.2	67.9	63.7	**66.6**
10.00	73.3	63.7	65.7	68.9	67.1	68.9	70.5	69.8	68.9	71.8	72.1	65.7	**68.9**
10.15	75.3	64.0	66.7	70.8	68.2	70.1	71.8	71.1	71.4	72.4	73.8	66.4	**70.2**
10.30	76.7	63.7	69.5	71.5	68.7	70.6	73.3	71.4	72.6	74.1	75.4	66.7	**71.2**
11.00	66.3	69.5	68.0	69.5	65.9	71.5	73.7	69.2	72.6	72.9	73.9	63.5	**69.7**
12.00	64.3	68.2	66.5	68.4	66.7	69.4	72.8	72.4	71.6	70.9	72.8	65.6	**69.1**
12.30	68.5	67.1	65.8	67.9	65.8	70.1	73.2	72.4	70.4	69.2	71.6	66.8	**69.1**
13.00	70.5	65.4	67.8	69.4	68.4	69.1	71.5	72.6	71.4	70.4	70.9	69.4	**69.7**
13.15	71.8	68.2	69.4	70.2	69.8	68.7	70.4	73.0	72.4	72.8	71.9	72.4	**70.9**
13.30	70.9	70.0	70.5	72.6	71.8	70.8	71.6	72.7	73.9	73.0	72.2	73.5	**72.0**
13.45	71.6	72.8	71.9	71.8	72.6	71.3	72.8	73.1	72.9	73.8	72.9	73.5	**72.6**
14.00	71.8	72.6	72.0	72.0	71.9	72.3	73.0	73.2	72.4	72.9	73.0	73.1	**72.5**
14.15	70.9	71.5	71.9	71.6	71.4	71.9	72.5	72.6	71.5	71.8	72.1	72.6	**71.9**
14.30	69.4	69.0	69.8	70.5	70.5	70.4	71.9	71.6	70.8	70.2	71.3	71.8	**70.6**
15.00	68.8	68.7	69.5	69.3	69.1	69.8	70.4	71.4	69.4	70.6	70.6	70.8	**69.9**
15.30	60.4	63.4	62.4	63.1	62.8	64.2	63.9	62.8	61.5	62.7	61.5	65.9	**62.9**
16.00	61.4	62.4	61.5	62.5	62.7	62.5	62.9	61.6	61.3	61.9	60.5	66.1	**62.3**
16.30	60.0	61.2	60.4	61.4	61.9	61.7	61.3	60.5	60.4	60.8	60.8	65.9	**61.4**
17.00	61.2	60.4	60.3	60.8	60.9	60.4	60.6	61.2	61.3	60.5	61.8	64.5	**61.2**
17.15	63.4	62.8	61.3	61.5	61.6	61.8	60.7	61.3	61.5	60.9	61.9	65.2	**62.0**
17.30	65.4	64.3	65.4	62.5	62.7	63.6	61.5	62.8	62.8	62.7	62.9	63.4	**63.3**
18.00	66.5	66.4	66.8	64.5	64.8	65.7	64.6	64.3	63.5	64.9	63.9	64.8	**65.1**
18.30	68.5	68.1	68.9	68.3	67.2	68.4	67.4	68.4	66.7	67.6	66.9	65.0	**67.6**
19.00	69.2	68.5	68.1	69.1	68.7	67.3	68.7	67.3	68.1	68.9	67.5	66.1	**68.1**
19.30	70.1	69.1	69.4	70.5	70.6	69.4	69.9	69.4	70.5	70.9	69.4	60.4	**69.1**
19.45	68.1	65.4	62.4	64.5	63.4	66.8	67.2	66.4	67.9	68.1	67.6	60.0	**65.7**
20.00	65.0	64.2	61.3	62.8	61.8	62.4	63.4	63.6	64.8	63.9	63.6	60.8	**63.1**
MIN.	60.0	61.2	60.4	60.4	63.1	63.0	60.6	61.2	61.3	60.5	61.8	64.5	**60.0**
MAX.	76.7	63.7	69.5	72.6	71.8	70.8	73.7	69.2	72.6	63.9	63.6	60.8	**76.7**
MEAN	67.5	65.9	65.7	66.3	65.9	66.7	67.5	67.2	67.1	67.9	67.7	66.1	**66.8**



Appendix 22

Table 9 - Overall indoor and outdoor measurement of Temperature Level (°C) of IKM Johor Bahru

TIME	OUTDOOR LOCATION		INDOOR LOCATION										MEAN
	1	2	3	4	5	6	7	8	9	10	11	12	
7.45	27.2	26.8	28.9	28.7	28.6	28.7	28.9	28.3	28.1	28.5	29.8	29.4	**28.5**
8.00	27.5	26.9	28.4	28.6	28.6	28.4	28.7	28.3	28.4	28.7	29.7	29.0	**28.4**
8.30	28.5	28.7	28.6	28.9	28.7	28.6	28.9	28.7	28.8	29.0	29.5	29.6	**28.9**
9.00	28.8	29.0	28.7	29.0	28.9	28.7	29.1	28.7	29.2	29.2	29.8	29.5	**29.1**
9.15	29.4	29.3	28.9	29.1	29.3	28.7	28.9	28.6	29.1	29.0	29.6	29.7	**29.1**
9.30	29.5	29.4	29.0	28.7	29.0	28.9	28.7	28.7	28.9	28.7	29.7	30.1	**29.1**
9.45	30.0	30.1	29.4	29.0	29.7	29.0	28.9	28.9	29.8	29.0	31.4	31.5	**29.7**
10.00	30.4	31.4	29.5	29.4	29.9	29.4	29.4	29.3	29.7	30.4	31.2	31.6	**30.1**
10.15	31.4	31.9	29.4	29.6	30.0	30.1	30.2	30.4	30.2	30.5	31.6	31.8	**30.6**
10.30	31.6	31.7	29.8	29.7	31.2	29.8	29.9	30.8	30.9	31.0	31.9	32.0	**30.9**
11.00	32.0	31.9	31.4	30.0	30.9	30.0	30.1	30.5	30.6	30.9	31.8	32.1	**31.0**
12.00	32.6	32.4	32.0	31.5	31.4	31.3	30.7	30.8	30.7	31.0	32.0	32.4	**31.6**
12.30	33.0	33.1	32.1	31.9	31.6	31.4	30.8	31.0	30.9	31.1	32.4	32.6	**31.8**
13.00	33.5	33.6	32.4	32.0	31.9	31.8	31.0	31.2	31.0	31.3	32.5	32.7	**32.1**
13.15	33.6	33.7	32.3	32.5	32.1	32.0	31.5	31.6	31.7	31.8	32.9	33.0	**32.4**
13.30	33.5	33.9	32.6	32.7	32.3	32.4	31.9	32.0	32.1	32.0	33.1	33.3	**32.7**
13.45	33.9	34.0	33.0	32.9	32.8	32.6	32.0	32.4	32.3	32.6	33.5	33.7	**33.0**
14.00	34.0	33.9	33.4	33.5	33.1	33.2	32.8	32.9	32.7	32.8	33.7	33.6	**33.3**
14.15	34.7	34.4	33.8	33.7	33.6	33.4	33.0	32.8	33.0	33.1	33.6	33.8	**33.6**
14.30	34.9	34.6	33.6	33.4	32.0	32.8	32.5	32.4	32.6	32.8	33.4	33.3	**33.2**
15.00	35.1	34.9	32.8	33.1	31.6	32.1	31.9	31.5	31.4	31.6	33.0	32.8	**32.7**
15.30	35.2	34.7	31.8	32.6	31.1	31.5	30.9	30.7	30.8	30.4	32.8	31.9	**32.0**
16.00	34.9	34.8	32.4	32.4	30.5	30.8	30.5	30.6	30.4	30.3	32.0	31.8	**31.8**
16.30	34.5	34.6	32.0	31.9	30.4	30.3	30.2	30.5	30.3	30.4	31.8	31.6	**31.5**
17.00	33.0	33.6	31.4	31.3	30.3	30.0	30.0	30.0	29.7	29.9	31.1	29.0	**30.8**
17.15	32.4	32.6	30.9	30.7	30.5	30.1	30.2	30.1	30.2	29.8	30.4	29.4	**30.6**
17.30	31.4	31.6	29.5	29.6	29.8	29.4	29.3	29.7	29.4	29.6	30.0	29.3	**29.9**
18.00	30.5	30.7	28.7	28.6	28.9	28.4	28.6	29.1	28.7	28.8	29.7	29.1	**29.2**
18.30	29.8	30.0	28.0	28.1	28.2	27.8	28.3	28.5	28.2	28.3	29.3	29.0	**28.6**
19.00	29.3	29.4	27.8	27.9	27.6	27.5	27.7	27.9	27.8	27.8	28.6	28.5	**28.2**
19.30	28.4	28.0	28.4	27.3	27.2	26.9	26.9	27.3	27.1	26.9	27.8	27.9	**27.5**
19.45	27.8	27.9	28.0	27.4	27.4	27.0	27.0	26.9	26.8	26.7	26.8	26.7	**27.2**
20.00	27.5	27.4	27.8	27.6	27.3	27.1	27.3	27.0	26.9	26.7	26.7	26.6	**27.2**
MIN.	27.2	26.8	28.9	27.3	27.2	26.9	26.9	27.3	27.1	26.7	26.7	26.6	**26.6**
MAX.	35.2	34.7	31.8	33.7	33.6	33.4	33.0	32.8	33.0	33.1	33.6	33.8	**35.2**
MEAN	**31.5**	**31.5**	**30.5**	**30.4**	**30.2**	**30.0**	**29.9**	**29.9**	**30.0**	**30.0**	**31.0**	**30.9**	**30.5**

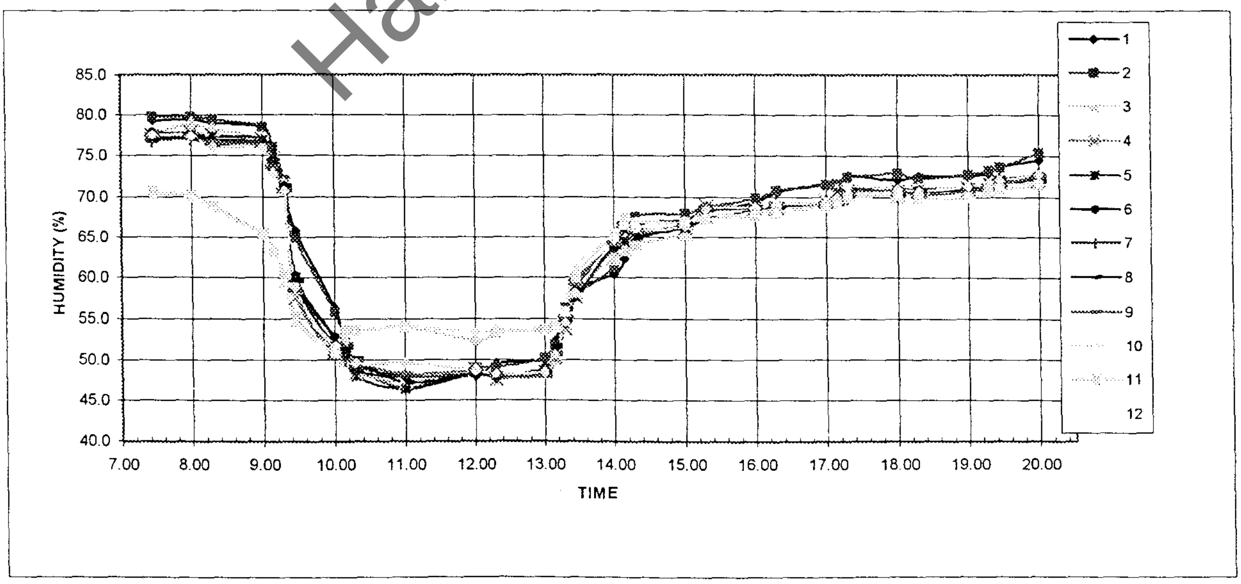


[IAQ.xls]azam2002

Appendix 23

Table 11 - Overall indoor and outdoor measurement of Relative Humidity Level (%) of IKM Johor Bahru

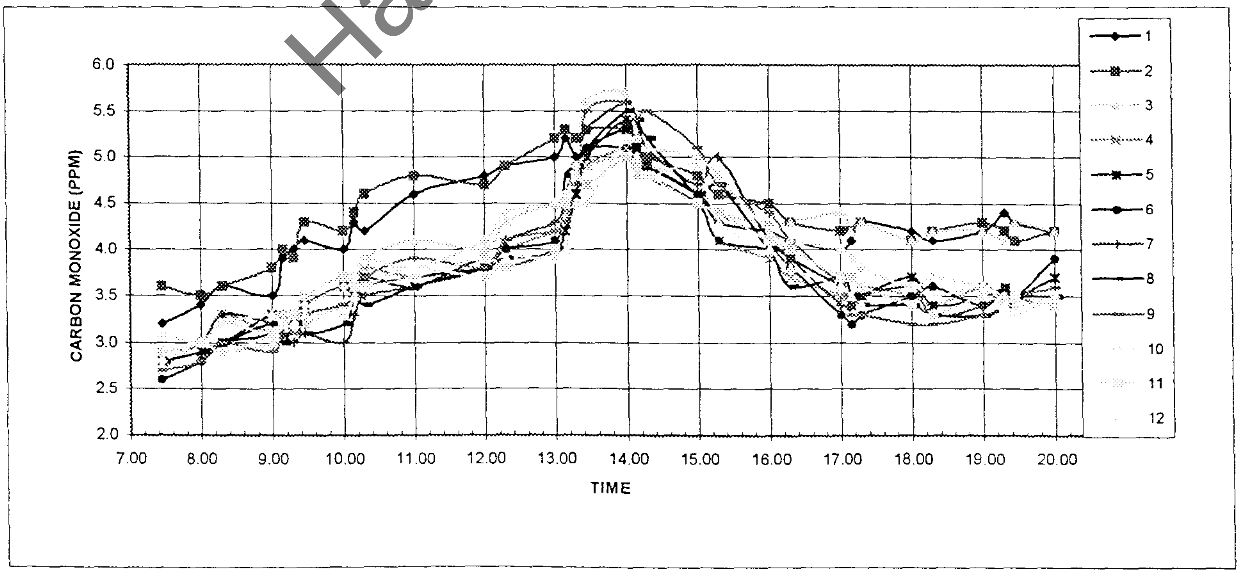
TIME	OUTDOOR LOCATION		INDOOR LOCATION										MEAN
	1	2	3	4	5	6	7	8	9	10	11	12	
7.45	79.3	79.8	77.7	77.5	77.1	77.9	76.9	77.2	77.5	77.6	70.6	70.2	**76.6**
8.00	79.5	79.8	78.9	77.8	77.5	77.6	77.0	77.1	77.3	77.4	70.2	70.0	**76.7**
8.30	79.0	79.5	78.2	77.5	77.3	76.9	76.7	76.4	76.5	76.1	68.9	68.6	**76.0**
9.00	78.4	78.5	77.1	76.9	77.0	76.6	76.6	76.3	76.2	75.9	65.5	65.3	**75.0**
9.15	75.8	76.1	74.5	74.6	73.8	74.6	74.5	73.5	73.6	72.9	63.2	63.6	**72.6**
9.30	71.2	72.0	71.5	71.6	71.0	71.2	70.9	71.3	70.8	70.7	60.3	59.4	**69.3**
9.45	65.8	64.8	58.9	57.6	60.0	60.2	59.5	59.6	58.4	58.8	55.3	54.6	**59.5**
10.00	56.3	55.8	52.1	51.3	52.6	52.8	51.6	51.4	50.3	51.6	51.3	50.8	**52.3**
10.15	51.3	52.4	50.0	50.3	50.6	50.4	50.0	51.6	51.9	52.4	53.6	53.4	**51.5**
10.30	49.3	49.2	48.5	48.5	47.9	48.6	49.2	50.1	49.9	49.6	53.6	53.4	**49.8**
11.00	47.9	46.5	47.6	47.2	46.3	47.8	47.8	47.2	48.2	49.6	54.0	54.1	**48.7**
12.00	48.0	48.9	48.6	48.8	48.3	48.1	48.2	48.2	48.6	48.6	52.3	53.4	**49.2**
12.30	49.5	49.0	47.5	47.6	48.0	47.9	47.8	48.0	48.1	48.2	53.2	53.6	**49.0**
13.00	50.0	50.2	48.6	48.5	48.3	48.9	48.6	48.1	47.9	48.5	53.6	53.8	**49.6**
13.15	52.3	51.9	50.3	50.2	51.3	51.4	50.6	51.6	50.7	50.6	54.0	53.9	**51.6**
13.30	55.6	56.4	54.2	53.8	55.6	55.8	54.8	56.1	55.3	54.6	56.0	55.9	**55.3**
13.45	58.6	57.9	58.3	57.6	57.6	59.2	59.6	58.4	59.2	58.1	60.0	61.1	**58.8**
14.00	60.4	61.2	62.5	63.4	63.9	63.6	64.1	63.8	64.2	64.7	65.3	65.3	**63.5**
14.15	62.3	63.5	63.6	64.6	64.5	66.3	66.8	65.8	66.3	67.8	66.5	66.8	**65.4**
14.30	66.3	67.5	64.1	65.3	65.1	65.9	65.8	65.0	65.8	66.1	66.8	66.9	**65.9**
15.00	67.2	67.9	65.5	66.2	66.2	66.3	66.5	66.6	66.4	66.3	66.9	67.0	**66.6**
15.30	68.3	68.8	67.5	68.9	67.3	68.2	68.3	68.4	68.7	68.5	67.3	67.7	**68.2**
16.00	69.4	69.8	67.6	68.7	68.4	68.6	68.9	68.7	68.6	68.7	68.0	67.9	**68.6**
16.30	70.6	70.8	68.9	68.6	68.9	68.8	69.0	68.7	69.1	69.2	68.5	68.0	**69.1**
17.00	71.6	71.5	69.4	69.5	69.2	69.0	69.4	69.3	69.0	69.4	69.0	68.8	**69.6**
17.15	71.3	71.6	70.8	70.2	70.6	69.6	69.5	69.3	69.4	70.0	69.5	69.0	**70.1**
17.30	72.6	72.4	70.3	70.8	70.6	70.9	70.0	70.6	70.6	71.2	70.0	70.3	**70.9**
18.00	72.1	72.9	70.2	70.8	70.7	71.0	70.2	70.5	70.8	71.0	70.1	70.5	**70.9**
18.30	72.6	72.3	71.0	70.8	70.6	70.9	70.6	70.8	70.2	70.8	69.9	70.0	**70.9**
19.00	72.6	72.8	71.3	71.0	71.2	71.0	71.2	70.9	70.8	71.3	70.0	70.1	**71.2**
19.30	73.0	73.3	71.5	71.6	71.8	71.5	71.6	71.0	71.4	71.8	70.9	70.6	**71.7**
19.45	73.8	73.7	72.0	71.9	72.1	71.9	72.2	71.6	71.7	72.1	71.0	71.4	**72.1**
20.00	74.6	75.4	72.1	72.0	72.6	72.3	72.8	72.0	72.5	72.8	71.5	71.9	**72.7**
MIN.	47.9	46.5	47.6	47.2	46.3	47.8	47.8	47.2	48.2	48.2	53.2	53.6	**46.3**
MAX.	79.5	79.8	78.9	77.8	77.5	77.6	77.0	77.1	77.3	77.6	70.6	70.2	**79.8**
MEAN	65.7	65.9	64.3	64.3	64.4	64.6	64.5	64.4	64.4	64.6	63.5	63.6	**64.5**



Appendix 24

Table 13 - Overall indoor and outdoor measurement of Carbon Monoxide (PPM) of IKM Johor Bahru

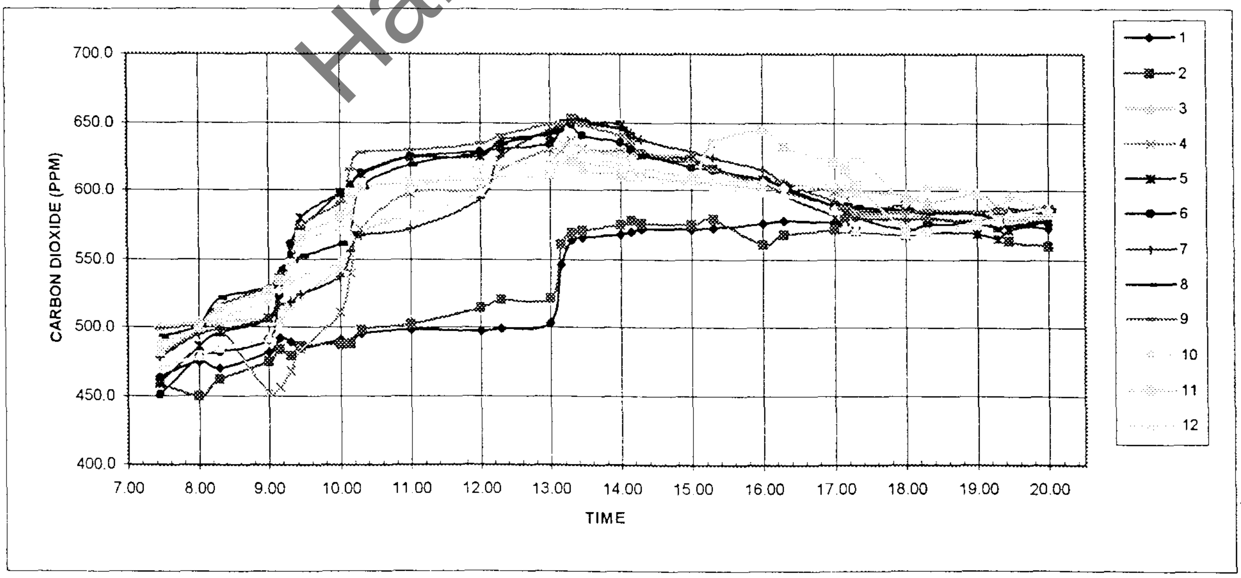
TIME	OUTDOOR LOCATION		INDOOR LOCATION										MEAN
	1	2	3	4	5	6	7	8	9	10	11	12	
7.45	3.2	3.6	2.7	2.9	2.8	2.6	2.9	2.8	2.7	2.8	2.9	3.1	**2.9**
8.00	3.4	3.5	3.0	3.0	2.9	2.8	3.0	2.9	2.8	3.0	3.0	3.0	**3.0**
8.30	3.6	3.6	2.9	3.3	3.0	3.0	3.3	3.0	3.0	2.9	3.2	3.2	**3.2**
9.00	3.5	3.8	3.0	3.1	3.3	3.1	3.2	3.2	2.9	3.1	3.1	3.3	**3.2**
9.15	3.9	4.0	3.2	3.2	3.2	3.3	3.1	3.0	3.2	3.3	3.2	3.2	**3.3**
9.30	4.0	3.9	3.1	3.3	3.3	3.2	3.0	3.2	3.1	3.2	3.3	3.2	**3.3**
9.45	4.1	4.3	3.2	3.5	3.4	3.4	3.1	3.1	3.3	3.4	3.5	3.3	**3.5**
10.00	4.0	4.2	3.4	3.7	3.6	3.6	3.0	3.2	3.4	3.6	3.7	3.3	**3.6**
10.15	4.3	4.4	3.6	3.6	3.5	3.5	3.3	3.5	3.5	3.7	3.6	3.5	**3.7**
10.30	4.2	4.6	3.9	3.8	3.7	3.6	3.5	3.4	3.7	3.9	3.6	3.6	**3.8**
11.00	4.6	4.8	4.1	3.7	3.6	3.7	3.6	3.6	3.9	3.8	3.7	3.8	**3.9**
12.00	4.8	4.7	4.0	3.8	3.9	3.8	3.8	3.8	3.8	4.1	3.9	3.7	**4.0**
12.30	4.9	4.9	4.3	4.0	3.8	4.0	4.1	3.9	4.1	4.4	3.8	3.9	**4.2**
13.00	5.0	5.2	4.5	4.2	4.0	4.1	4.3	4.0	4.2	4.5	4.0	3.9	**4.3**
13.15	5.2	5.3	4.6	4.4	4.2	4.5	4.6	4.8	4.3	4.6	4.5	4.0	**4.6**
13.30	5.0	5.2	4.8	4.6	4.6	4.9	4.9	4.9	4.7	4.9	4.8	4.5	**4.8**
13.45	5.1	5.3	4.9	4.9	5.0	5.1	5.3	5.1	5.5	5.6	4.7	4.5	**5.1**
14.00	5.1	5.3	5.0	5.1	5.4	5.3	5.6	5.5	5.6	5.7	5.0	5.2	**5.3**
14.15	5.0	5.1	4.8	5.0	5.1	5.1	5.4	5.4	5.4	5.2	4.9	5.0	**5.1**
14.30	4.9	5.0	4.9	4.8	4.9	4.8	5.1	5.2	5.5	5.1	4.8	4.8	**5.0**
15.00	4.6	4.8	4.7	4.5	4.6	4.5	4.7	4.6	5.1	5.0	4.5	4.9	**4.7**
15.30	4.3	4.6	4.4	4.1	4.4	4.1	5.0	4.7	4.7	4.8	4.4	4.3	**4.5**
16.00	4.2	4.5	4.3	3.9	4.1	4.0	4.1	4.0	4.4	4.2	4.1	4.0	**4.2**
16.30	4.1	4.3	4.3	3.7	3.9	3.8	3.9	3.6	4.1	4.1	4.0	3.8	**4.0**
17.00	4.0	4.2	4.4	3.5	3.6	3.3	3.4	3.7	3.6	4.0	3.7	3.6	**3.8**
17.15	4.1	4.2	4.2	3.4	3.4	3.2	3.4	3.5	3.3	3.9	3.7	3.5	**3.7**
17.30	4.3	4.3	4.3	3.6	3.5	3.3	3.5	3.4	3.3	3.8	3.6	3.4	**3.7**
18.00	4.2	4.1	4.1	3.5	3.7	3.5	3.6	3.4	3.2	3.6	3.4	3.6	**3.7**
18.30	4.1	4.2	4.2	3.4	3.4	3.6	3.3	3.3	3.2	3.7	3.3	3.5	**3.6**
19.00	4.2	4.3	4.2	3.6	3.5	3.4	3.4	3.3	3.3	3.6	3.5	3.6	**3.7**
19.30	4.4	4.2	4.1	3.5	3.6	3.6	3.6	3.4	3.4	3.5	3.4	3.4	**3.7**
19.45	4.3	4.1	4.3	3.5	3.5	3.5	3.5	3.5	3.5	3.4	3.5	3.3	**3.7**
20.00	4.2	4.2	4.2	3.4	3.7	3.9	3.4	3.5	3.6	3.5	3.4	3.5	**3.7**
MIN.	3.2	3.6	2.7	2.9	2.8	2.6	2.9	2.8	2.7	2.8	2.9	3.1	**2.6**
MAX.	5.2	5.3	4.6	5.1	5.4	5.3	5.6	5.5	5.6	5.7	5.0	5.2	**5.7**
MEAN	**4.3**	**4.4**	**4.0**	**3.8**	**3.8**	**3.8**	**3.8**	**3.8**	**3.9**	**4.0**	**3.8**	**3.8**	**3.9**



Appendix 25

Table 15 - Overall indoor and outdoor measurement of Carbon Dioxide (PPM) of IKM Johor Bahru

TIME	OUTDOOR LOCATION		INDOOR LOCATION										MEAN
	1	2	3	4	5	6	7	8	9	10	11	12	
7.45	464.0	459.0	500.0	480.0	460.0	451.0	478.0	493.0	499.0	489.0	482.0	470.0	477.1
8.00	475.0	450.0	503.0	498.0	486.0	478.0	495.0	501.0	502.0	499.0	500.0	479.0	488.8
8.30	470.0	462.0	504.0	499.0	496.0	482.0	498.0	521.0	516.0	506.0	513.0	485.0	496.0
9.00	482.0	475.0	505.0	452.0	506.0	491.0	506.0	529.0	529.0	519.0	526.0	492.0	501.0
9.15	492.0	484.0	504.0	456.0	534.0	523.0	516.0	542.0	538.0	527.0	534.0	501.0	512.6
9.30	489.0	479.0	515.0	468.0	552.0	561.0	518.0	549.0	549.0	534.0	546.0	526.0	523.8
9.45	485.0	486.0	523.0	484.0	580.0	572.0	524.0	552.0	574.0	561.0	567.0	537.0	537.1
10.00	491.0	487.0	543.0	510.0	598.0	598.0	537.0	561.0	591.0	572.0	581.0	548.0	551.4
10.15	489.0	488.0	556.0	540.0	604.0	602.0	556.0	568.0	615.0	581.0	598.0	567.0	563.7
10.30	495.0	498.0	570.0	572.0	612.0	613.0	567.0	602.0	628.0	599.0	602.0	578.0	578.0
11.00	498.0	502.0	582.0	598.0	624.0	625.0	572.0	619.0	630.0	601.0	606.0	582.0	586.6
12.00	497.0	514.0	598.0	600.0	625.0	629.0	594.0	628.0	635.0	618.0	608.0	599.0	595.4
12.30	499.0	520.0	609.0	615.0	638.0	631.0	625.0	635.0	641.0	620.0	610.0	609.0	604.3
13.00	503.0	521.0	612.0	631.0	641.0	635.0	645.0	643.0	649.0	621.0	612.0	613.0	610.5
13.15	546.0	561.0	618.0	630.0	648.0	646.0	648.0	651.0	650.0	634.0	618.0	618.0	622.3
13.30	564.0	569.0	621.0	638.0	654.0	649.0	652.0	654.0	655.0	635.0	623.0	629.0	628.6
13.45	566.0	571.0	615.0	631.0	651.0	641.0	650.0	651.0	649.0	631.0	621.0	625.0	625.2
14.00	568.0	575.0	611.0	629.0	649.0	636.0	646.0	646.0	641.0	625.0	616.0	619.0	621.8
14.15	570.0	578.0	610.0	628.0	638.0	631.0	643.0	638.0	637.0	621.0	613.0	611.0	618.2
14.30	572.0	576.0	608.0	626.0	626.0	628.0	638.0	626.0	629.0	617.0	611.0	608.0	613.8
15.00	572.0	575.0	605.0	625.0	623.0	617.0	629.0	621.0	621.0	610.0	609.0	605.0	609.3
15.30	573.0	579.0	606.0	615.0	616.0	615.0	624.0	615.0	615.0	608.0	635.0	601.0	608.5
16.00	576.0	561.0	601.0	608.0	607.0	608.0	615.0	608.0	605.0	606.0	645.0	599.0	603.3
16.30	578.0	568.0	602.0	606.0	597.0	601.0	606.0	603.0	599.0	602.0	632.0	597.0	599.3
17.00	577.0	572.0	603.0	599.0	581.0	589.0	592.0	589.0	587.0	604.0	621.0	586.0	591.7
17.15	581.0	579.0	601.0	598.0	573.0	587.0	589.0	590.0	588.0	598.0	616.0	574.0	589.5
17.30	584.0	584.0	599.0	584.0	571.0	581.0	581.0	588.0	583.0	625.0	604.0	572.0	588.0
18.00	586.0	589.0	597.0	580.0	568.0	572.0	579.0	586.0	584.0	591.0	572.0	569.0	581.1
18.30	581.0	580.0	591.0	584.0	570.0	575.0	580.0	584.0	586.0	602.0	570.0	571.0	581.2
19.00	578.0	578.0	598.0	583.0	569.0	576.0	578.0	583.0	585.0	598.0	578.0	576.0	581.7
19.30	579.0	574.0	587.0	582.0	566.0	574.0	583.0	579.0	587.0	578.0	579.0	579.0	578.9
19.45	576.0	564.0	576.0	580.0	572.0	575.0	586.0	586.0	586.0	596.0	580.0	583.0	580.0
20.00	573.0	560.0	581.0	579.0	578.0	579.0	584.0	586.0	589.0	584.0	583.0	587.0	580.3
MIN.	464.0	459.0	500.0	452.0	508.0	491.0	478.0	493.0	499.0	489.0	482.0	470.0	452.0
MAX.	586.0	589.0	597.0	638.0	654.0	649.0	652.0	654.0	655.0	635.0	623.0	629.0	655.0
MEAN	537.2	536.9	577.4	573.0	588.3	587.0	582.8	591.7	596.1	588.2	588.2	572.6	576.6

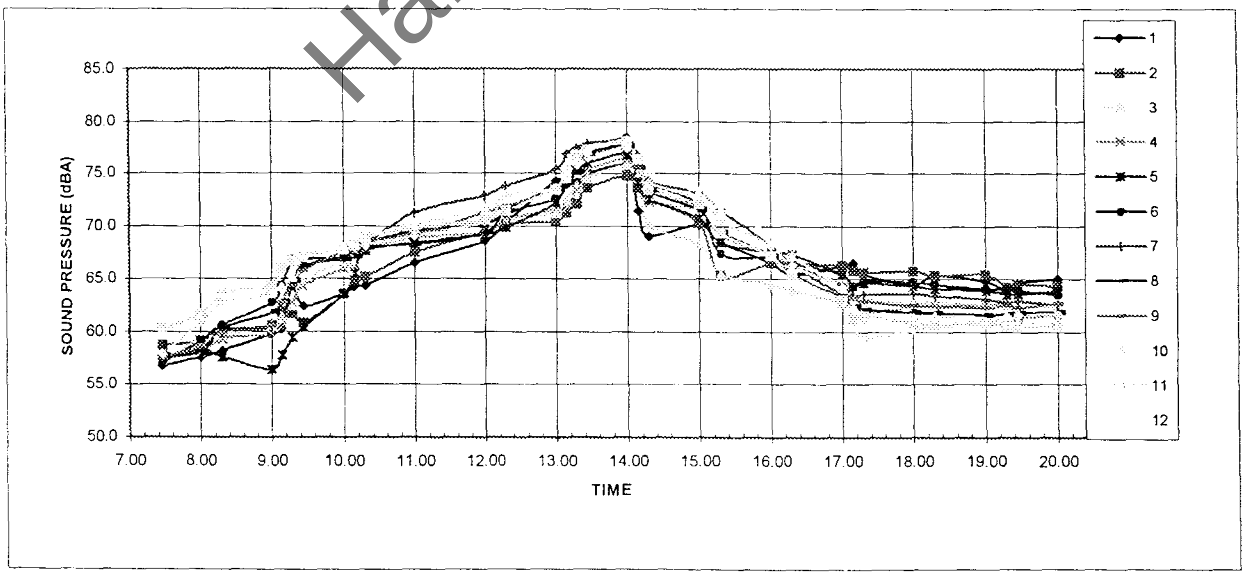


[IAQ.xls]azam2002

Appendix 26

Table 17 - Overall indoor and outdoor measurement of Sound Pressure Level (dBA) of IKM Johor Bahru

TIME	OUTDOOR LOCATION		INDOOR LOCATION										MEAN
	1	2	3	4	5	6	7	8	9	10	11	12	
7.45	56.8	58.7	57.3	57.5	57.6	57.1	57.4	57.8	57.6	57.9	60.2	60.1	**58.0**
8.00	57.6	59.1	59.3	58.0	58.3	59.1	58.3	58.0	58.6	60.9	61.6	61.3	**59.2**
8.30	58.2	60.1	59.6	59.3	57.6	60.6	59.9	60.2	59.9	62.8	63.5	63.5	**60.4**
9.00	59.8	60.5	60.5	59.7	56.4	62.7	60.4	61.8	60.5	63.6	64.3	63.9	**61.2**
9.15	60.2	61.8	61.3	60.4	57.8	64.3	62.6	62.8	62.7	65.7	66.0	64.2	**62.5**
9.30	64.3	61.7	62.4	62.8	59.4	66.8	64.9	64.8	64.3	66.5	66.7	65.1	**64.1**
9.45	62.4	60.8	64.6	64.3	60.4	66.9	66.2	66.3	65.7	67.2	67.1	67.3	**64.9**
10.00	63.6	63.5	66.7	65.9	63.5	67.0	66.9	66.8	67.6	67.8	67.8	67.9	**66.3**
10.15	64.2	64.8	67.3	66.1	65.5	68.2	67.7	67.1	68.2	68.0	68.2	68.5	**67.0**
10.30	64.3	65.1	68.5	67.8	67.6	68.4	68.3	67.9	68.6	68.2	68.9	69.0	**67.7**
11.00	66.5	67.5	69.1	68.9	68.4	69.5	71.3	68.3	69.2	69.1	69.8	70.2	**69.0**
12.00	68.6	69.4	70.6	69.4	69.2	70.2	72.9	69.4	71.3	70.5	70.6	71.6	**70.3**
12.30	70.4	70.2	70.5	70.6	69.9	71.3	73.8	71.5	71.9	72.8	71.5	72.9	**71.4**
13.00	74.3	70.5	71.3	71.6	72.3	72.6	75.4	73.6	73.5	73.6	73.5	73.5	**73.0**
13.15	74.6	71.3	72.6	71.8	74.6	73.9	76.9	74.1	75.1	75.4	74.6	75.6	**74.2**
13.30	74.2	72.1	73.8	73.4	75.3	75.2	77.4	75.2	76.5	75.9	76.8	76.4	**75.2**
13.45	75.0	73.6	74.6	75.3	76.0	76.9	77.9	76.9	76.9	76.5	77.2	77.2	**76.2**
14.00	75.6	74.8	75.8	76.4	76.8	78.4	78.1	77.6	77.3	77.5	78.1	78.2	**77.1**
14.15	71.5	73.6	74.6	74.5	74.2	76.5	76.8	75.6	75.6	76.3	76.3	76.5	**75.2**
14.30	69.1	72.5	70.2	72.3	72.6	74.2	74.3	73.4	73.6	74.2	73.5	75.3	**72.9**
15.00	70.2	70.3	68.3	71.6	70.8	72.1	73.2	71.6	71.9	72.6	72.1	73.2	**71.5**
15.30	68.5	65.3	65.4	69.2	68.5	67.4	71.6	69.5	69.5	70.6	69.4	71.6	**68.9**
16.00	66.5	66.5	64.5	67.2	67.5	67.1	68.2	67.2	67.3	68.2	67.2	69.4	**67.2**
16.30	65.4	66.4	63.9	65.3	67.3	66.5	66.4	65.4	66.3	66.3	65.3	67.2	**66.0**
17.00	66.2	66.3	62.7	63.2	65.4	65.4	63.5	63.2	64.5	64.1	63.0	64.2	**64.3**
17.15	66.5	65.8	62.4	62.4	64.3	64.3	63.4	62.4	63.2	61.2	61.2	62.4	**63.3**
17.30	65.4	65.6	63.0	61.9	64.6	64.8	63.5	62.1	62.9	59.4	61.5	61.3	**63.0**
18.00	64.5	65.7	62.7	62.4	64.3	64.7	63.6	61.9	62.5	60.2	60.9	61.3	**62.9**
18.30	65.3	65.3	62.8	62.5	64.1	64.5	63.4	61.8	62.4	60.5	60.7	61.5	**62.9**
19.00	64.8	65.4	62.6	62.6	63.9	64.1	63.1	61.6	62.3	60.8	60.8	61.0	**62.8**
19.30	63.9	64.2	62.5	62.7	63.5	64.0	62.8	61.7	62.5	61.5	60.6	60.9	**62.6**
19.45	64.6	64.5	62.3	61.5	63.6	63.9	62.9	61.8	62.3	61.6	60.5	60.8	**62.5**
20.00	65.0	64.3	62.4	61.6	63.8	63.5	62.6	61.9	62.7	61.7	60.5	60.8	**62.6**
MIN.	56.8	58.7	57.3	57.5	57.6	57.1	57.4	57.8	57.6	57.9	60.2	60.1	**56.8**
MAX.	75.6	74.8	75.8	76.4	76.8	78.4	78.1	77.6	77.3	77.5	78.1	78.2	**78.4**
MEAN	**66.3**	**66.3**	**65.9**	**66.1**	**66.2**	**67.6**	**67.7**	**66.7**	**67.1**	**67.2**	**67.3**	**67.7**	**66.9**



[IAQ.xls]azam2002

Appendix
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Table 11 - Indoor and outdoor measurement of Temperature Level (°C)

NO	DINING HALL	OUTDOOR			INDOOR		
		MIN.	MAX.	MEAN	MIN.	MAX.	MEAN
1	IKM Johor Bahru	26.8	35.2	31.5	26.6	33.8	30.3
2	IKM Kuala Lumpur	26.0	35.5	31.8	26.9	35.9	31.0

Table 12 - Indoor and outdoor measurement of Relative Humidity Level (%)

NO	DINING HALL	OUTDOOR			INDOOR		
		MIN.	MAX.	MEAN	MIN.	MAX.	MEAN
1	IKM Johor Bahru	46.5	79.8	65.8	46.3	78.9	64.3
2	IKM Kuala Lumpur	48.4	66.1	65.5	47.0	75.7	63.7

Table 13 - Indoor and outdoor measurement of Carbon Monoxide (PPM)

NO	DINING HALL	OUTDOOR			INDOOR		
		MIN.	MAX.	MEAN	MIN.	MAX.	MEAN
1	IKM Johor Bahru	3.2	5.3	4.4	2.6	5.7	3.9
2	IKM Kuala Lumpur	2.7	5.1	4.0	2.7	4.9	3.6

Table 14 - Indoor and outdoor measurement of Carbon Dioxide (PPM)

NO	DINING HALL	OUTDOOR			INDOOR		
		MIN.	MAX.	MEAN	MIN.	MAX.	MEAN
1	IKM Johor Bahru	459.0	589.0	537.1	452.0	655.0	584.5
2	IKM Kuala Lumpur	412.0	514.9	511.0	436.0	763.0	601.0

Table 15 - Indoor and outdoor measurement of Sound Pressure Level (dBA)

NO	DINING HALL	OUTDOOR			INDOOR		
		MIN.	MAX.	MEAN	MIN.	MAX.	MEAN
1	IKM Johor Bahru	56.8	75.6	66.3	57.1	78.4	67.0
2	IKM Kuala Lumpur	60.0	67.5	66.7	60.4	73.7	66.8

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Table 16 - Comparison On IAQ Indoor and Outdoor The Dining Hall

NO	DINING HALL	OUTDOOR (MEAN)					INDOOR (MEAN)				
		TEMP. (OC)	RH (%)	CO (PPM)	CO_2 (PPM)	SOUND (dBA)	TEMP. (OC)	RH (%)	CO (PPM)	CO_2 (PPM)	SOUND (dBA)
1	IKM Johor Bahru	**31.5**	**65.8**	4.4	537.1	66.3	**30.3**	**64.3**	3.9	584.5	67.0
2	IKM Kuala Lumpur	**31.8**	**65.5**	4.0	511.0	66.7	**31.0**	**63.7**	3.6	601.0	66.8

Table 19 - Overall Measurement Indoor Dining Halls On Temperature, Relative Humidity, Carbon Monoxide, Carbon Dioxide and Sound Pressure.
(Minimum, Maximum and Mean)

NO	DINING HALL	NUMBER MEASURED	TEMP. (°C)			RH (%)			CO (PPM)			CO2 (PPM)			SOUND (dBA)		
			MIN.	MAX.	MEAN	MIN.	MAX.	MEAN	MIN.	MAX.	MEAN	MIN.	MAX.	MEAN	MIN.	MAX.	MEAN
1	IKM Johor Bahru	1980	26.6	**33.8**	**30.3**	46.3	**78.9**	**64.3**	2.6	5.7	3.9	452.0	**655.0**	584.5	57.1	78.4	67.0
2	IKM Kuala Lumpur	1980	26.9	**35.9**	**31.0**	47.0	**75.7**	**63.7**	2.7	4.9	3.6	436.0	**763.0**	601.0	60.4	73.7	66.8

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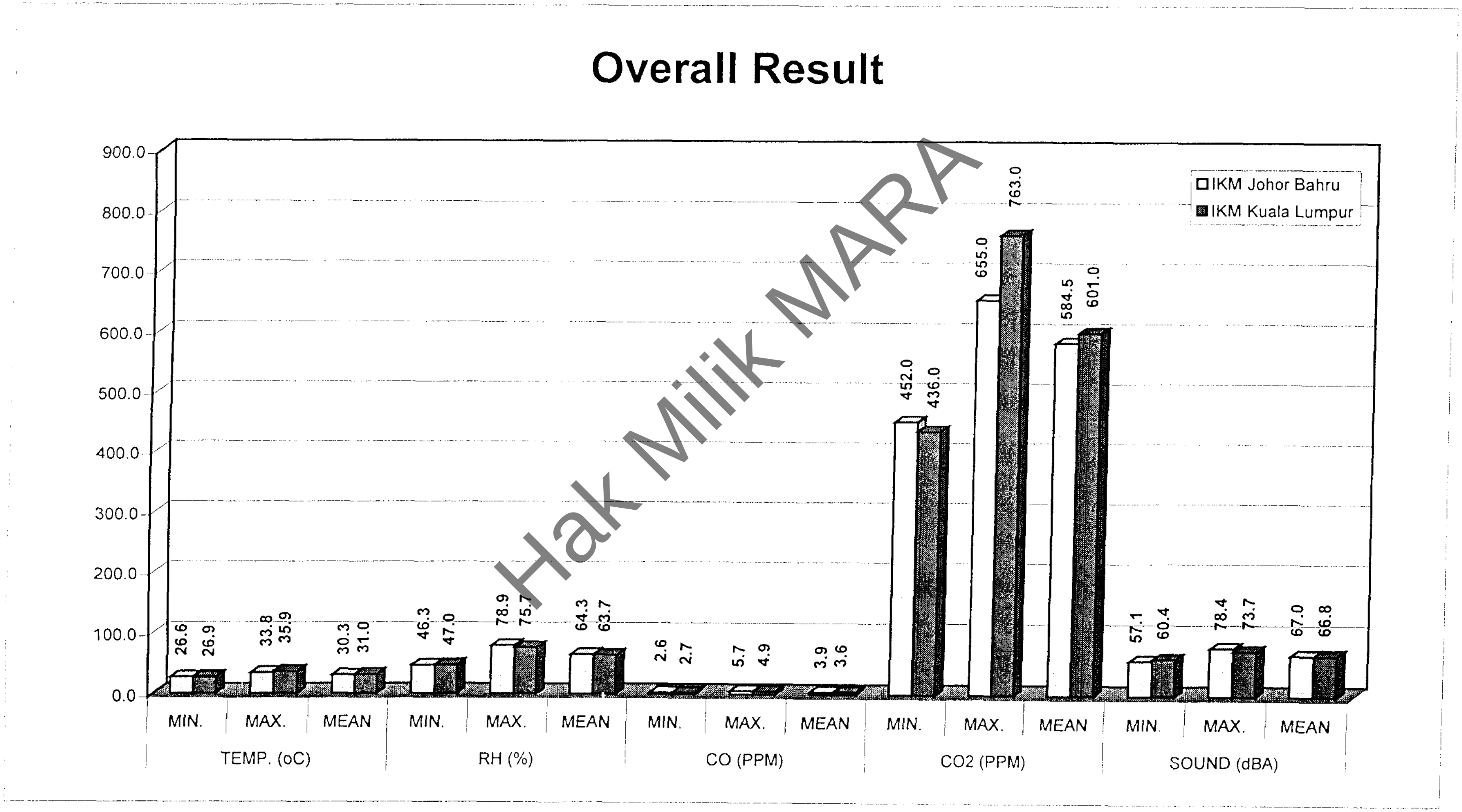
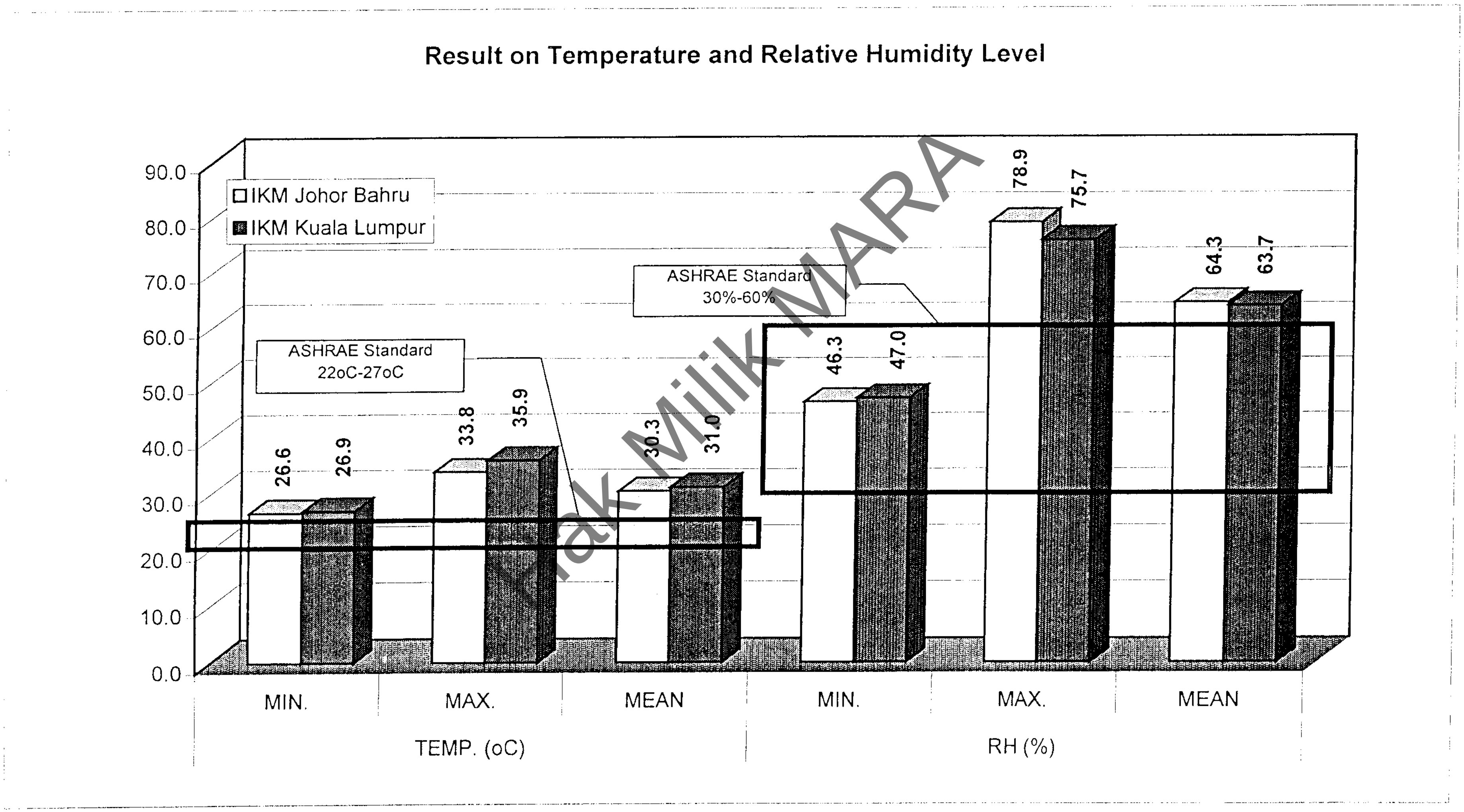


Overall Result
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
IKM Johor Bahru
IKM Kuala Lumpur
26.6
26.9
33.8
35.9
30.3
31.0
46.3
47.0
78.9
75.7
64.3
63.7
2.6
2.7
5.7
4.9
3.9
3.6
452.0
436.0
655.0
763.0
584.5
601.0
57.1
60.4
78.4
73.7
67.0
66.8
MIN.
MAX.
MEAN
TEMP. (oC)
RH (%)
CO (PPM)
CO2 (PPM)
SOUND (dBA)



Result on Temperature and Relative Humidity Level
IKM Johor Bahru
IKM Kuala Lumpur
ASHRAE Standard
22oC-27oC
ASHRAE Standard
30%-60%
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
26.6
26.9
33.8
35.9
30.3
31.0
46.3
47.0
78.9
75.7
64.3
63.7
MIN.
MAX.
MEAN
MIN.
MAX.
MEAN
TEMP. (oC)
RH (%)

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Respondent : Lecturer

	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10	q11	q12	q13	q15	q17	q18	q20	q21	q22	q24	q25	q26
1	1	4 .		2	1	2	2	2	1	1	1	2	1	2	1	1	1	1	1	3	3	2
2	1	2	3	2	1	3	2	2	1	2	1	2	2	1	2	1	2	1	1	2	2	2
3	1	2	4	2	1	2	2	2	1	2	2	2	1	2	2	1	3	1	2	3	2	2
4	1	4	2	2	1 .		2	2	1	1	1	2	1	1	2	1	3	1	2 .		2	2
5	1	4	3	2	1	2	1	2	1	2	1	2	1	1	1 .		1 .		1	4	4	2
6	1	2	3	2	1	2	2	2	1	2	1	2	1	1	1	1	2	1	1 .	.		2
7	1	1	3	1	2	2	2	2	1	2	1	2	1	2	1 .		2	1	2	4	4	2
8	1	1	3	1	2	2	2	2	1	2	1	2	1	1	1	2	1	1	2	4	4	2
9	1	4	3	1	1	3	2	1	2	1	2	1	1	2	1	2	2	1	1	3	3	2
10	1	4	3	2	1	3	1	2	1	2	1	2	2	2 .		1 .		1	1	4	4	2
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12	1	4 .		1	2	3 .		2	1	2	1 .		2	1	1	2	1	1	1	3	3	2
13	1	2	3	2	1	2	2	2	1	1	1	2	2	2	1	2	1	1	1	4	4	2
14	1	3	3	2	1	2	2	2	1	2	1	1	1	2	1	3	1	1	2	3	3	2
15	1	2	2	2	1	2	2	2	1	2	1	2	1	1	2	1	2	1	1	2	2	2
16	1	1	2	1	1 .		2	2	1	2	2	2	1	2	2	1	3	1	2	3	2	2
17	1	3	3	1	1 .		1	2	2	2	2	1	1	1	2	1	3	1	2 .		2	2
18	1	4	4	2	2	2 .		2	2	1	2	1	1	2	1	1	2	1	1	3	3	2
19	1	1	3	2	1	3	1	2	1	2	1	1	1	2 .		1 .		1	1	4	4	2
20	1	4	3	2	1	3	2	1	2	1	1	1	2	1	1	2	1	1	1	3	3	2
21	1	2	3	2	1	3	2	1	1	2	1	1	1	1	1	1	1	1	1	3	3	2
22	1	1	2	2	1	2	1	2	1	2	1	2	2	2	1	2	1	1	1	4	4	2

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23	1	4	2	1	1	2	2.		1	2	1	1	1	2	1	2	1	1	2	2	2	2
24	1	2	3	2	2	2	2	2	1	2	1	1	1	1	2	1	2	1	1	4	4	2
25	1	1	2	2	1	3	2	2	1	2	2	1	1	2	2	1	3	1	2	3	3	2
26	1	2	4	2	1	2	2	2	1	2	1	1	1	2	1	2	1	1	2	3	3	2
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30	1	2	3	2	1	2	2	2	1	1	1	2	2	2	1	2	1	1	1	4	3	2
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32	1	2	2	2	1	2	2	2	1	2	1	2	1	1	2	1	2	1	1	2	2	2
33	1	1	2	1	1	3	2	2	1	2	2	2	1	2	2	1	3	1	2	3	3	2
34	1	4	3	2	1	3	2	1	2	1	1	1	2	1	1	2	1	1	1	3	3	2
35	1	3	3	2	1	3	2	1	1	2	1	1	1	1	1	2	1	1	1	3	3	2
36	1	4	2	2	1	2	1	2	1	2	1	2	2	2	1	2	1	1	1	4	3	2
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38	1	4	3	2	2	2	2	2	1	2	1	1	1	1	2	1	2	1	1	4	4	2
39	1	2	2	2	1	3	1	2	1	2	2	1	1	2	2	1	3	1	2	3	3	2
40	1	2	4	2	1	2	2	2	1	2	1	1	1	2	1	2	1	1	2	3	3	2
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46	1	3	3	1	2	3	2	2	1	2	1.		2	1	1	2	1	1	1	3	3	2
47	1	2	3	2	1	2	2	2	1	1	1	2	2	2	1	1	1	1	1	4	4	2

SPSS 11.0

Respondent : Lecturer

	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10	q11	q12	q13	q15	q17	q18	q20	q21	q22	q24	q25	q26
1	Male	Over 16 years		No	Yes	26-30	No	No	Yes	Yes	Yes	No	Yes	No	Yes	This month	Dust Coat	Safety boat	Yes	7-11 months ago	7-11 months ago	No
2	Male	6-10 years	5-6 hours	No	Yes	31-35	No	No	Yes	No	Yes	No	No	Yes	No	This month	Jacket	Safety boat	Yes	2-6 months ago	2-6 months ago	No
3	Male	6-10 years	7-8 hours	No	Yes	26-30	No	No	Yes	No	No	No	Yes	No	No	This month	Overall	Safety boat	No	7-11 months ago	2-6 months ago	No
4	Male	Over 16 years	3-4 hours	No	Yes		No	No	Yes	Yes	Yes	No	Yes	Yes	No	This month	Overall	Safety boat	No	.	2-6 months ago	No
5	Male	Over 16 years	5-6 hours	No	Yes	26-30	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	.	Dust Coat	.	Yes	> one years ago	> one years ago	No
6	Male	6-10 years	5-6 hours	No	Yes	26-30	No	No	Yes	No	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	.	.	No
7	Male	1-5 years	5-6 hours	Yes	No	26-30	No	No	Yes	No	Yes	No	Yes	No	Yes	.	Jacket	Safety boat	No	> one years ago	> one years ago	No
8	Male	1-5 years	5-6 hours	Yes	No	26-30	No	No	Yes	No	Yes	No	Yes	Yes	Yes	2-6 months ago	Dust Coat	Safety boat	No	> one years ago	> one years ago	No
9	Male	Over 16 years	5-6 hours	Yes	Yes	31-35	No	Yes	No	Yes	No	Yes	Yes	No	Yes	2-6 months ago	Jacket	Safety boat	Yes	7-11 months ago	7-11 months ago	No
10	Male	Over 16 years	5-6 hours	No	Yes	31-35	Yes	No	Yes	No	Yes	No	No	No	.	This month		Safety boat	Yes	> one years ago	> one years ago	No
11	Male	1-5 years	7-8 hours	Yes	Yes	31-35	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	2-6 months ago	Dust Coat	Safety boat	Yes	7-11 months ago	7-11 months ago	No
12	Male	Over 16 years		Yes	No	31-35	.	No	Yes	No	Yes	.	No	Yes	Yes	2-6 months ago	Dust Coat	Safety boat	Yes	7-11 months ago	7-11 months ago	No
13	Male	6-10 years	5-6 hours	No	Yes	26-30	No	No	Yes	Yes	Yes	No	No	No	Yes	2-6 months ago	Dust Coat	Safety boat	Yes	> one years ago	> one years ago	No
14	Male	11-15 years	5-6 hours	No	Yes	26-30	No	No	Yes	No	Yes	Yes	Yes	No	Yes	7-11 months ago	Dust Coat	Safety boat	No	7-11 months ago	7-11 months ago	No
15	Male	6-10 years	3-4 hours	No	Yes	26-30	No	No	Yes	No	Yes	No	Yes	Yes	No	This month	Jacket	Safety boat	Yes	2-6 months ago	2-6 months ago	No
16	Male	1-5 years	3-4 hours	Yes	Yes	.	No	No	Yes	No	No	No	Yes	No	No	This month	Overall	Safety boat	No	7-11 months ago	2-6 months ago	No
17	Male	11-15 years	5-6 hours	Yes	Yes	.	Yes	No	No	No	No	Yes	Yes	Yes	No	This month	Overall	Safety boat	No	.	2-6 months ago	No
18	Male	Over 16 years	7-8 hours	No	No	26-30	.	No	No	Yes	No	Yes	Yes	No	Yes	This month	Jacket	Safety boat	Yes	7-11 months ago	7-11 months ago	No
19	Male	1-5 years	5-6 hours	No	Yes	31-35	Yes	No	Yes	No	Yes	Yes	Yes	No	.	This month	.	Safety boat	Yes	> one years ago	> one years ago	No
20	Male	Over 16 years	5-6 hours	No	Yes	31-35	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes	2-6 months ago	Dust Coat	Safety boat	Yes	7-11 months ago	7-11 months ago	No
21	Male	6-10 years	5-6 hours	No	Yes	31-35	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	This month	Dust Coat	Safety boat	Yes	7-11 months ago	7-11 months ago	No
22	Male	1-5 years	3-4 hours	No	Yes	26-30	Yes	No	Yes	No	Yes	No	No	No	Yes	2-6 months ago	Dust Coat	Safety boat	Yes	> one years ago	> one years ago	No

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23	Male	Over 16 years	3-4 hours	Yes	Yes	26-30	No	.	Yes	No	Yes	Yes	Yes	No	Yes	2-6 months ago	Dust Coat	Safety boat	No	2-6 months ago	2-6 months ago	No
24	Male	6-10 years	5-6 hours	No	No	26-30	No	No	Yes	No	Yes	Yes	Yes	Yes	No	This month	Jacket	Safety boat	Yes	> one years ago	> one years ago	No
25	Male	1-5 years	3-4 hours	No	Yes	31-35	No	No	Yes	No	No	Yes	Yes	No	No	This month	Overall	Safety boat	No	7-11 months ago	7-11 months ago	No
26	Male	6-10 years	7-8 hours	No	Yes	26-30	No	No	Yes	No	Yes	Yes	Yes	No	Yes	2-6 months ago	Dust Coat	Safety boat	No	7-11 months ago	7-11 months ago	No
27	Male	11-15 years	5-6 hours	No	Yes	26-30	No	Yes	Yes	No	Yes	No	No	No	Yes	2-6 months ago	Dust Coat	Safety boat	Yes	> one years ago	> one years ago	No
28	Male	1-5 years	7-8 hours	Yes	Yes	31-35	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	This month	Dust Coat	Safety boat	Yes	7-11 months ago	7-11 months ago	No
29	Male	11-15 years	5-6 hours	Yes	No	31-35	No	No	Yes	No	Yes	.	No	Yes	Yes	2-6 months ago	Dust Coat	Safety boat	Yes	7-11 months ago	2-6 months ago	No
30	Male	6-10 years	5-6 hours	No	Yes	26-30	No	No	Yes	Yes	Yes	No	No	No	Yes	2-6 months ago	Dust Coat	Safety boat	Yes	> one years ago	7-11 months ago	No
31	Male	11-15 years	5-6 hours	No	Yes	26-30	No	No	Yes	No	Yes	Yes	Yes	No	Yes	2-6 months ago	Dust Coat	Safety boat	No	7-11 months ago	7-11 months ago	No
32	Male	6-10 years	3-4 hours	No	Yes	26-30	No	No	Yes	No	Yes	No	Yes	Yes	No	This month	Jacket	Safety boat	Yes	2-6 months ago	2-6 months ago	No
33	Male	1-5 years	3-4 hours	Yes	Yes	31-35	No	No	Yes	No	No	No	Yes	No	No	This month	Overall	Safety boat	No	7-11 months ago	7-11 months ago	No
34	Male	Over 16 years	5-6 hours	No	Yes	31-35	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes	2-6 months ago	Dust Coat	Safety boat	Yes	7-11 months ago	7-11 months ago	No
35	Male	11-15 years	5-6 hours	No	Yes	31-35	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	2-6 months ago	Dust Coat	Safety boat	Yes	7-11 months ago	7-11 months ago	No
36	Male	Over 16 years	3-4 hours	No	Yes	26-30	Yes	No	Yes	No	Yes	No	No	No	Yes	2-6 months ago	Dust Coat	Safety boat	Yes	> one years ago	7-11 months ago	No
37	Male	1-5 years	3-4 hours	Yes	Yes	26-30	No	.	Yes	No	Yes	Yes	Yes	No	Yes	2-6 months ago	Dust Coat	Safety boat	No	2-6 months ago	2-6 months ago	No
38	Male	Over 16 years	5-6 hours	No	No	26-30	No	No	Yes	No	Yes	Yes	Yes	Yes	No	This month	Jacket	Safety boat	Yes	> one years ago	> one years ago	No
39	Male	6-10 years	3-4 hours	No	Yes	31-35	Yes	No	Yes	No	No	Yes	Yes	No	No	This month	Overall	Safety boat	No	7-11 months ago	7-11 months ago	No
40	Male	6-10 years	7-8 hours	No	Yes	26-30	No	No	Yes	No	Yes	Yes	Yes	No	Yes	2-6 months ago	Dust Coat	Safety boat	No	7-11 months ago	7-11 months ago	No
41	Male	6-10 years	5-6 hours	No	No	26-30	No	No	Yes	No	Yes	Yes	Yes	Yes	No	This month	Jacket	Safety boat	Yes	> one years ago	7-11 months ago	No
42	Male	1-5 years	3-4 hours	No	Yes	31-35	No	No	Yes	No	No	Yes	Yes	No	No	This month	Overall	Safety boat	No	7-11 months ago	7-11 months ago	No
43	Male	6-10 years	7-8 hours	No	Yes	26-30	No	No	Yes	No	Yes	Yes	Yes	No	Yes	2-6 months ago	Dust Coat	Safety boat	No	7-11 months ago	7-11 months ago	No
44	Male	1-5 years	5-6 hours	No	Yes	26-30	No	Yes	Yes	No	Yes	No	No	No	Yes	2-6 months ago	Dust Coat	Safety boat	Yes	> one years ago	> one years ago	No
45	Male	6-10 years	7-8 hours	No	Yes	31-35	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	7-11 months ago	Dust Coat	Safety boat	Yes	7-11 months ago	7-11 months ago	No
46	Male	11-15 years	5-6 hours	Yes	No	31-35	No	No	Yes	No	Yes	.	No	Yes	Yes	2-6 months ago	Dust Coat	Safety boat	Yes	7-11 months ago	7-11 months ago	No
47	Male	6-10 years	5-6 hours	No	Yes	26-30	No	No	Yes	Yes	Yes	No	No	No	Yes	This month	Dust Coat	Safety boat	Yes	> one years ago	> one years ago	No

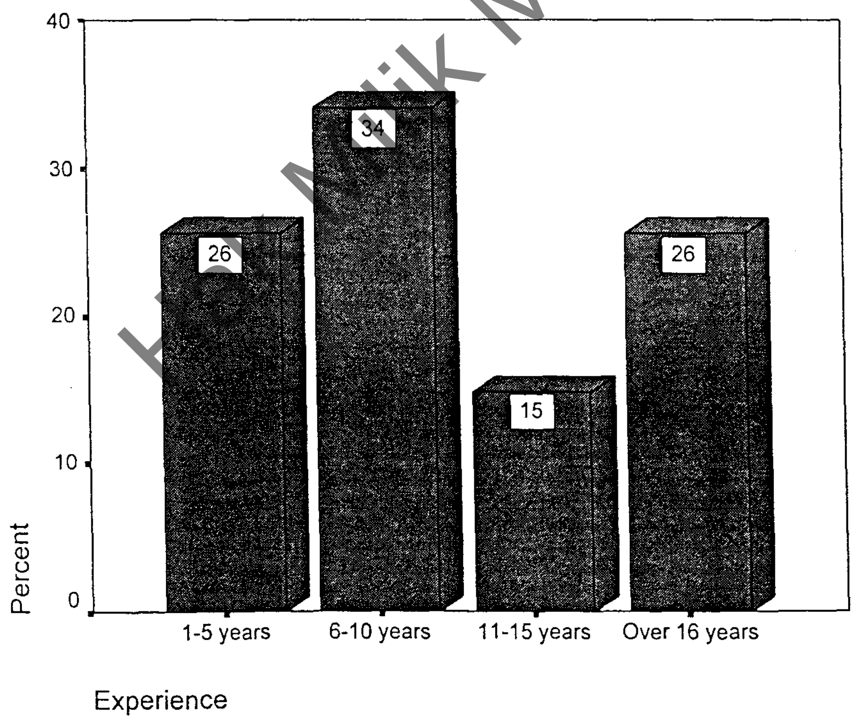
Frequency Table (Lecturers)

1. Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	47	100.0	100.0	100.0

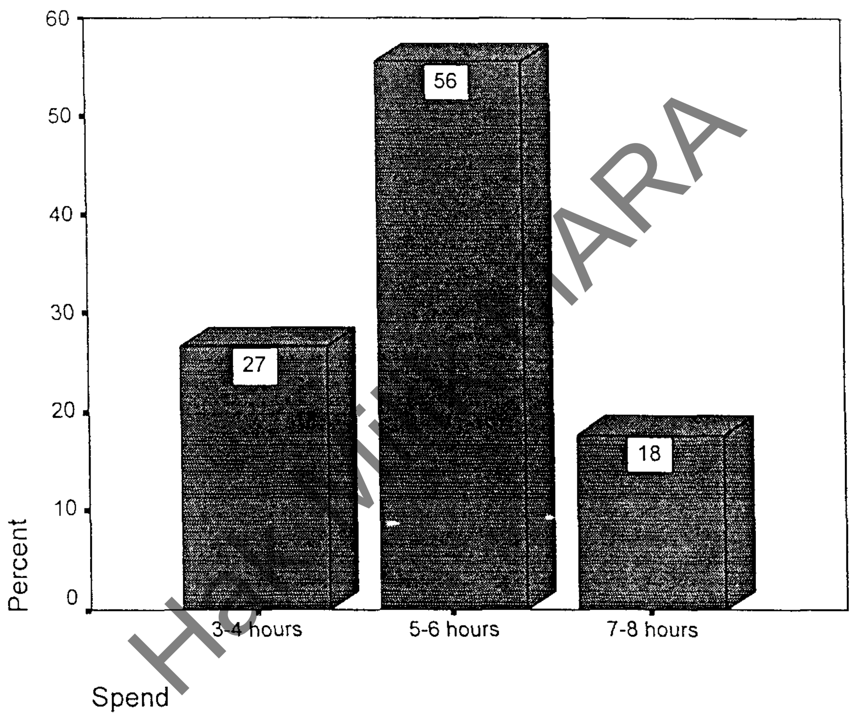
2. Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5 years	12	25.5	25.5	25.5
	6-10 years	16	34.0	34.0	59.6
	11-15 years	7	14.9	14.9	74.5
	Over 16 years	12	25.5	25.5	100.0
	Total	47	100.0	100.0	



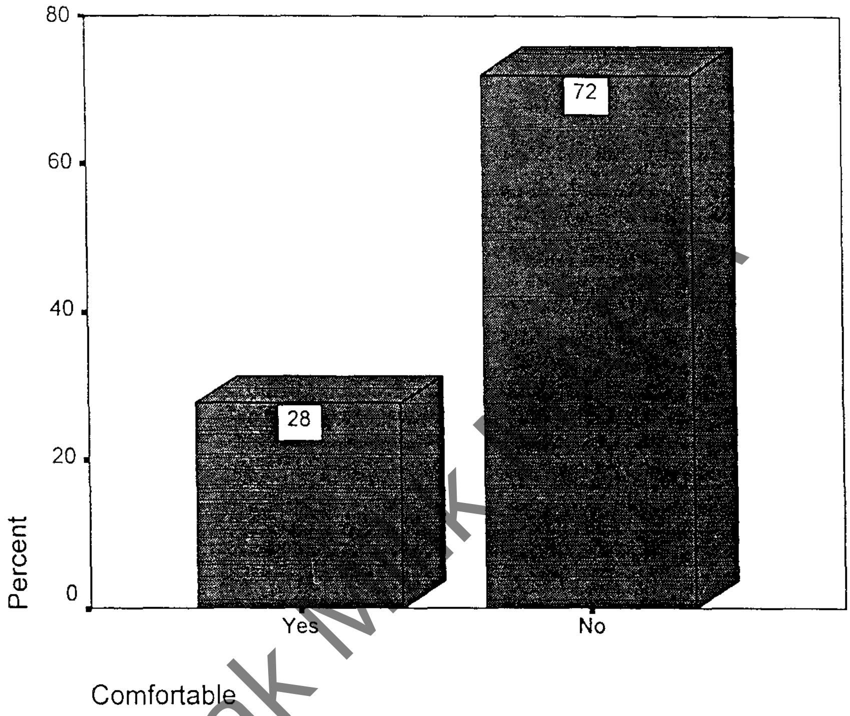
3. Spent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3-4 hours	12	25.5	26.7	26.7
	5-6 hours	25	53.2	55.6	82.2
	7-8 hours	8	17.0	17.8	100.0
	Total	45	95.7	100.0	
Missing	System	2	4.3		
Total		47	100.0		



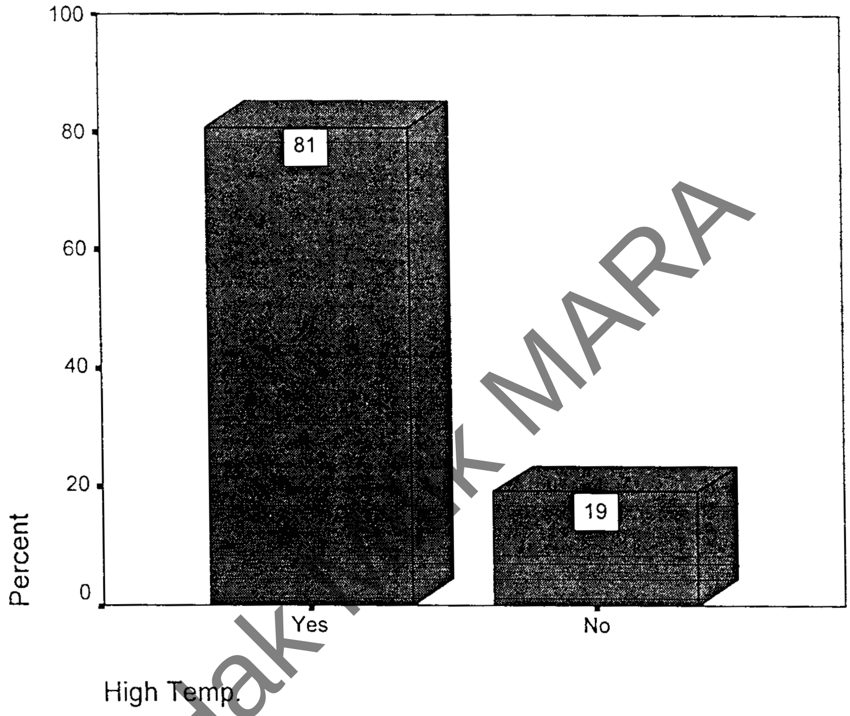
4. Comfortable

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	13	27.7	27.7	27.7
	No	34	72.3	72.3	100.0
	Total	47	100.0	100.0	



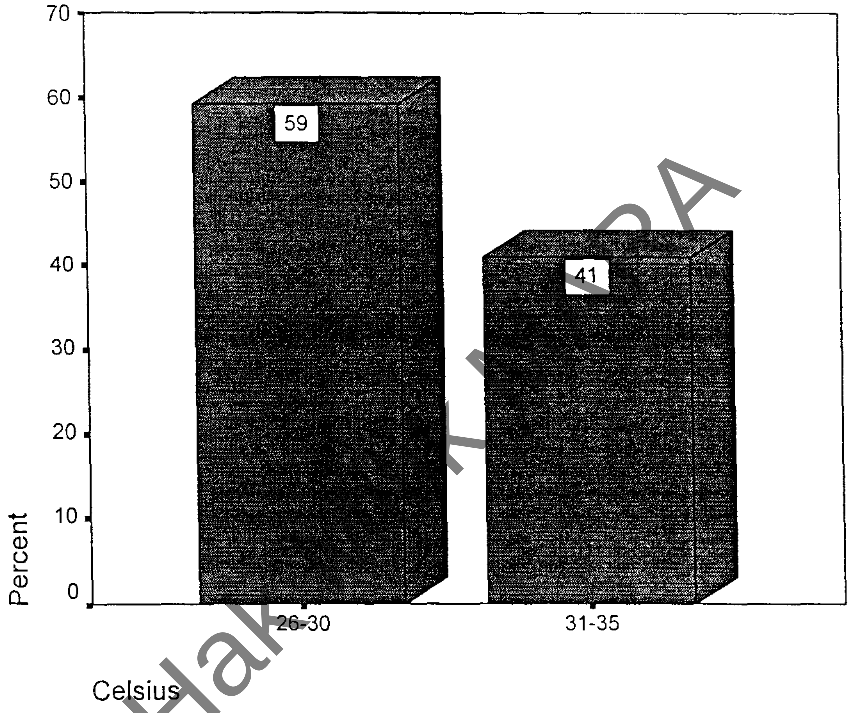
5. High Temperature

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	38	80.9	80.9	80.9
	No	9	19.1	19.1	100.0
	Total	47	100.0	100.0	



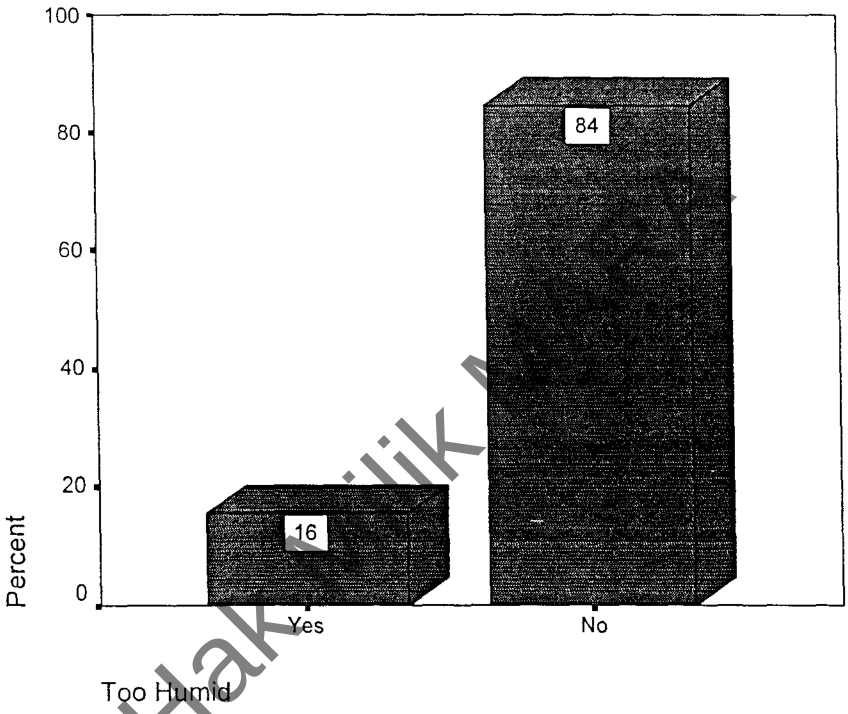
6. Celsius

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	26-30	26	55.3	59.1	59.1
	31-35	18	38.3	40.9	100.0
	Total	44	93.6	100.0	
Missing	System	3	6.4		
Total		47	100.0		



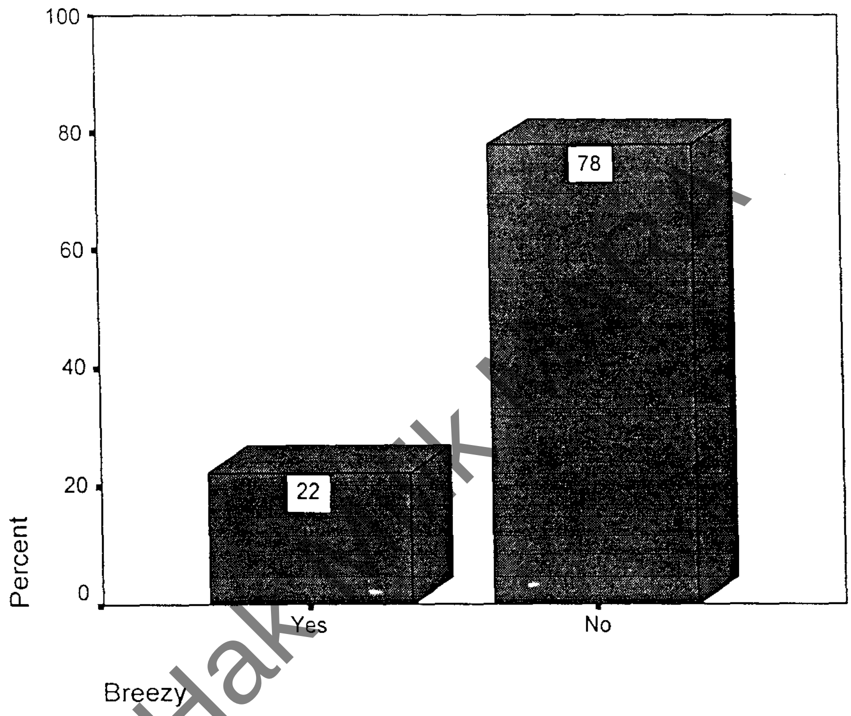
7. Too Humid

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	7	14.9	15.6	15.6
	No	38	80.9	84.4	100.0
	Total	45	95.7	100.0	
Missing	System	2	4.3		
Total		47	100.0		



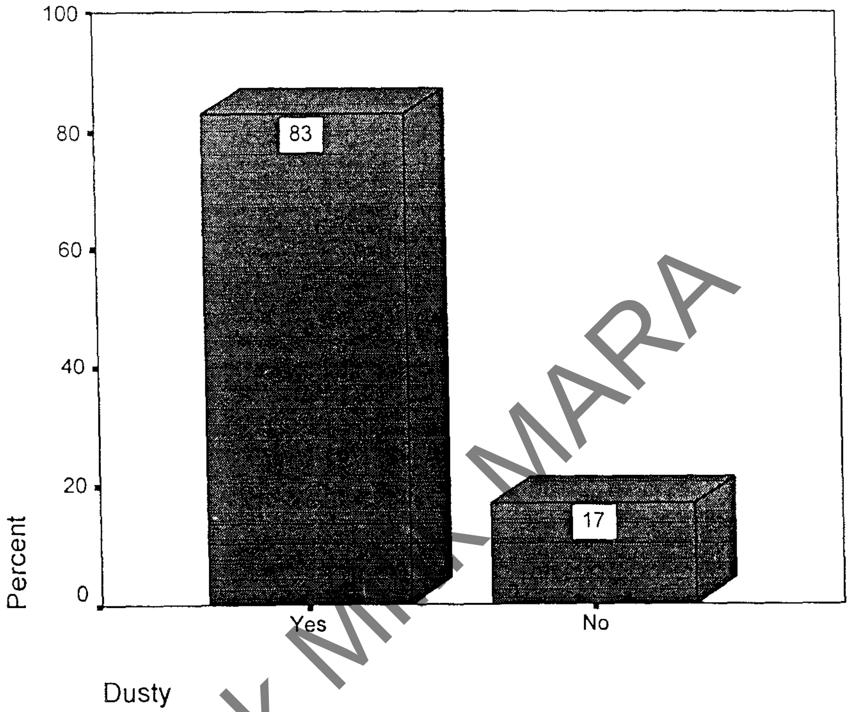
8. Breezy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	10	21.3	22.2	22.2
	No	35	74.5	77.8	100.0
	Total	45	95.7	100.0	
Missing	System	2	4.3		
Total		47	100.0		



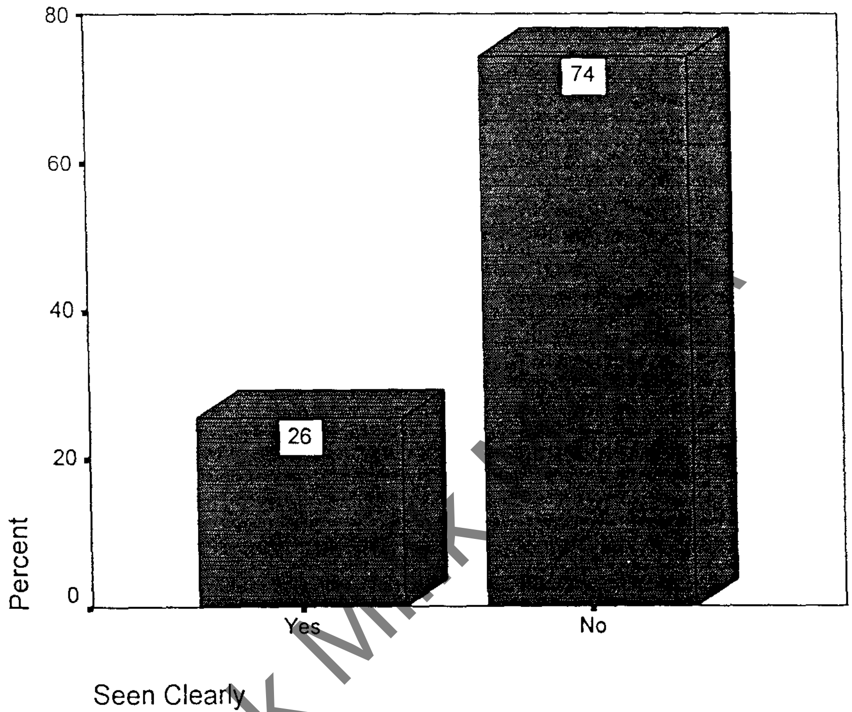
9. Dusty

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	39	83.0	83.0	83.0
	No	8	17.0	17.0	100.0
	Total	47	100.0	100.0	



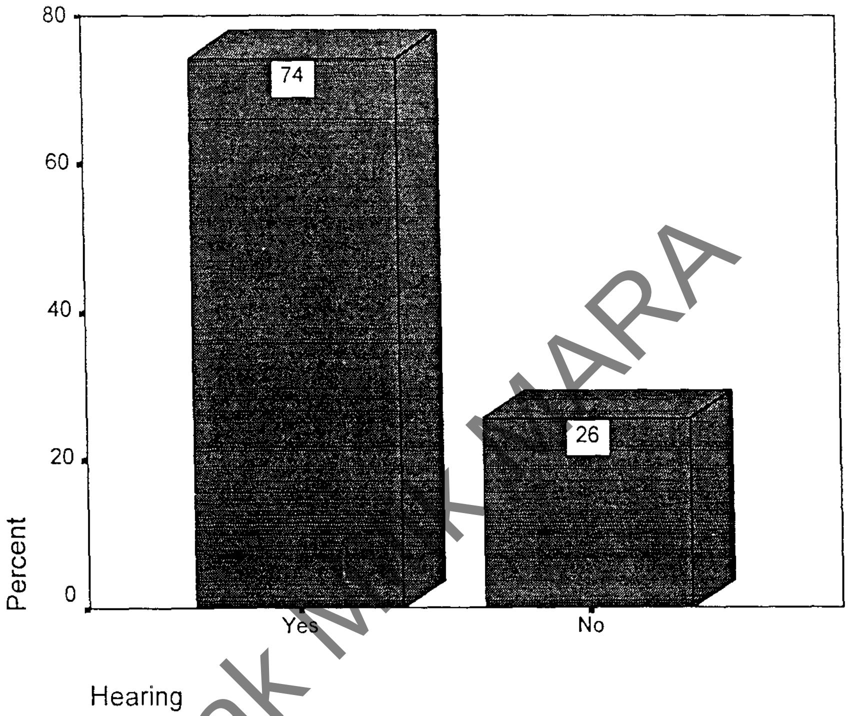
10. Seen Clearly

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	12	25.5	25.5	25.5
	No	35	74.5	74.5	100.0
	Total	47	100.0	100.0	



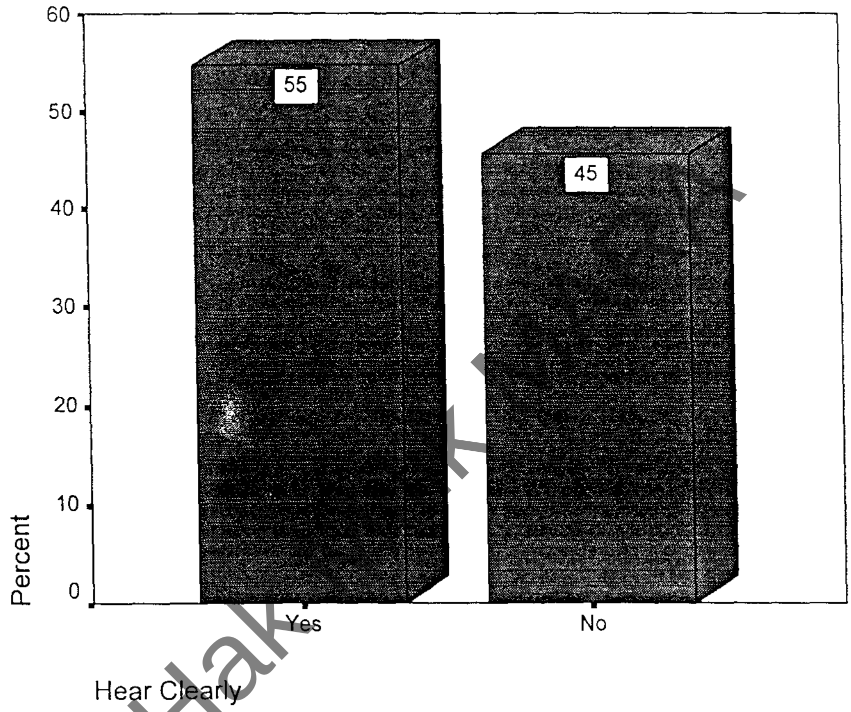
11. Hearing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	35	74.5	74.5	74.5
	No	12	25.5	25.5	100.0
	Total	47	100.0	100.0	



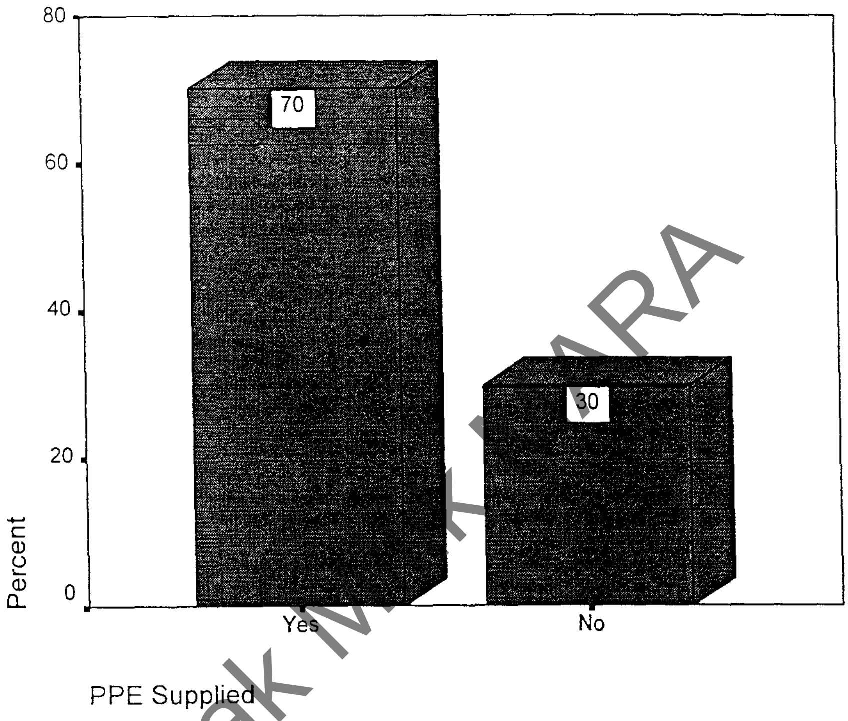
12. Hear Clearly

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	24	51.1	54.5	54.5
	No	20	42.6	45.5	100.0
	Total	44	93.6	100.0	
Missing	System	3	6.4		
Total		47	100.0		



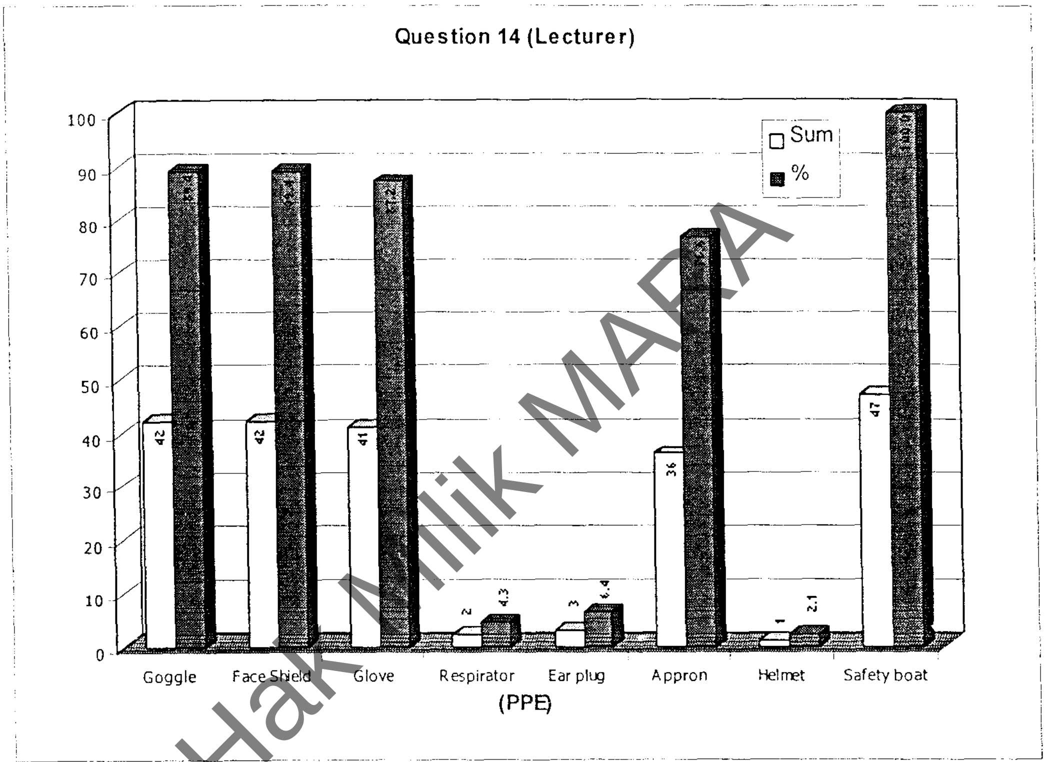
13. PPE Supplied

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	33	70.2	70.2	70.2
	No	14	29.8	29.8	100.0
	Total	47	100.0	100.0	



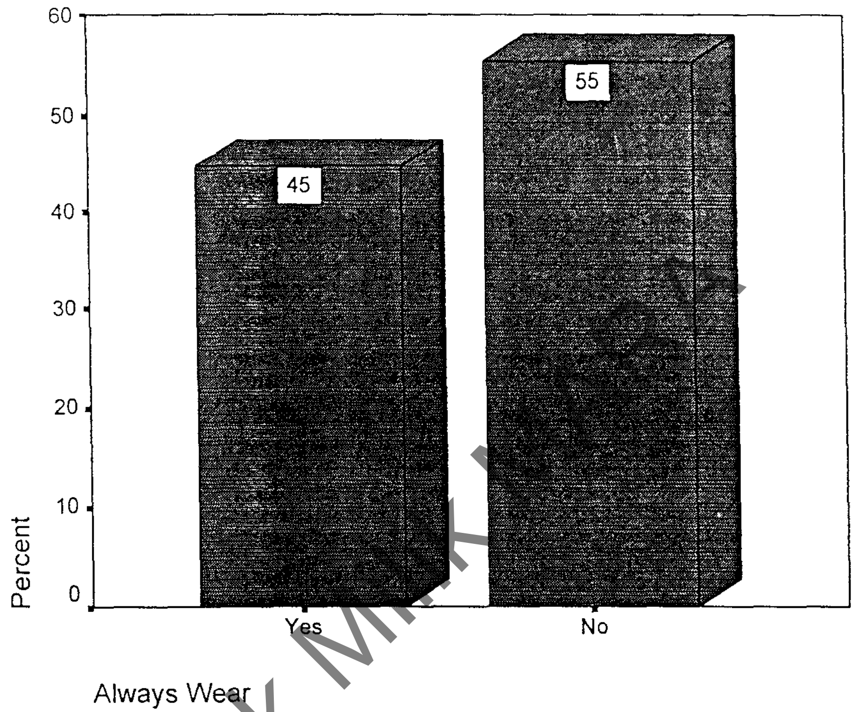
14. List Supplied

	Goggle	Face Shield	Glove	Respirator	Ear plug	Apron	Helmet	Safety boat
N	47	47	47	47	47	47	47	47
Sum	42	42	41	2	3	36	1	47
Mis.	5	5	6	45	44	11	46	0
%	89.4	89.4	87.2	4.3	6.4	76.6	2.1	100.0



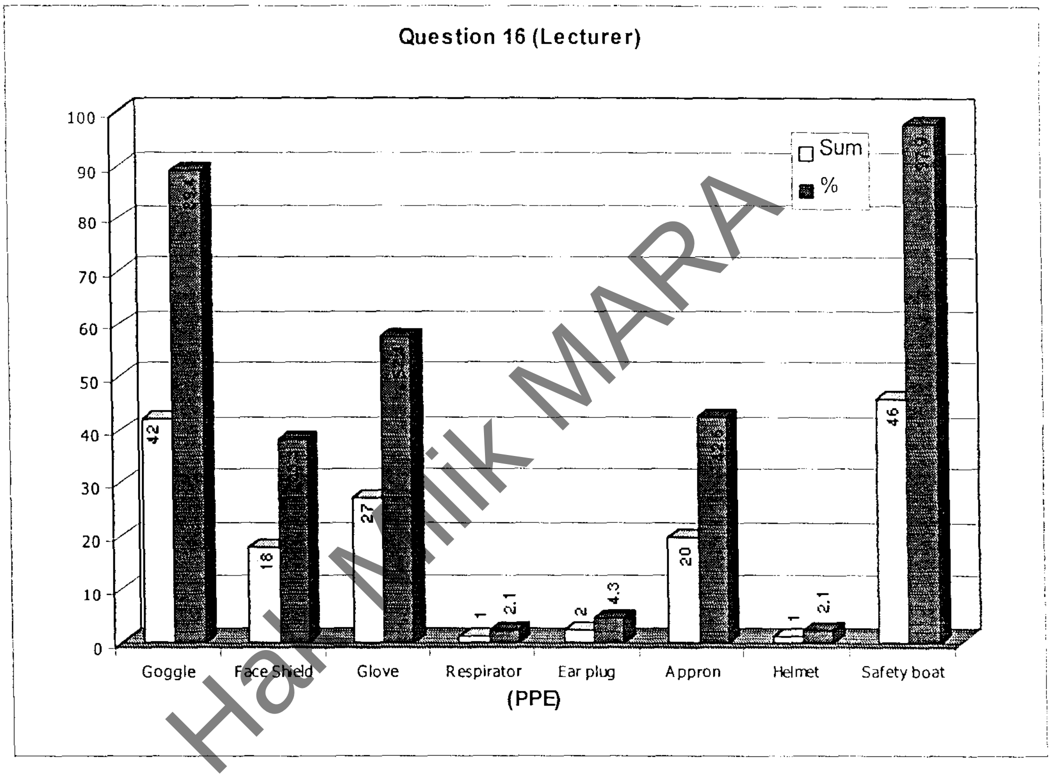
15. Always Wear

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	21	44.7	44.7	44.7
	No	26	55.3	55.3	100.0
	Total	47	100.0	100.0	



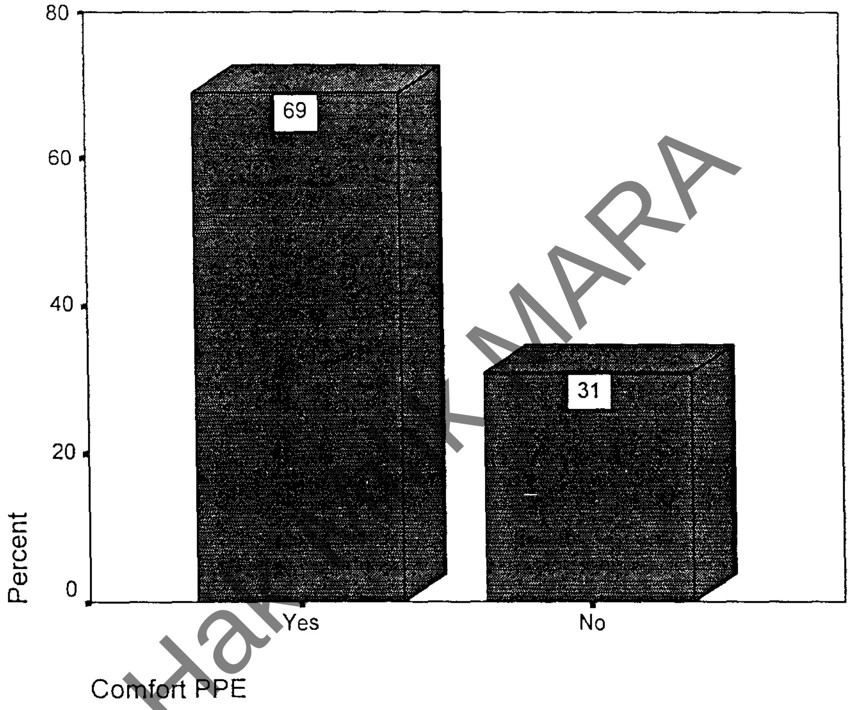
16. Wearing

	Goggle	Face Shield	Glove	Respirator	Ear plug	Apron	Helmet	Safety boat
N	47	47	47	47	47	47	47	47
Sum	42	18	27	1	2	20	1	46
Mis.	5	29	20	46	45	27	46	1
%	89.4	38.3	57.4	2.1	4.3	42.6	2.1	97.9



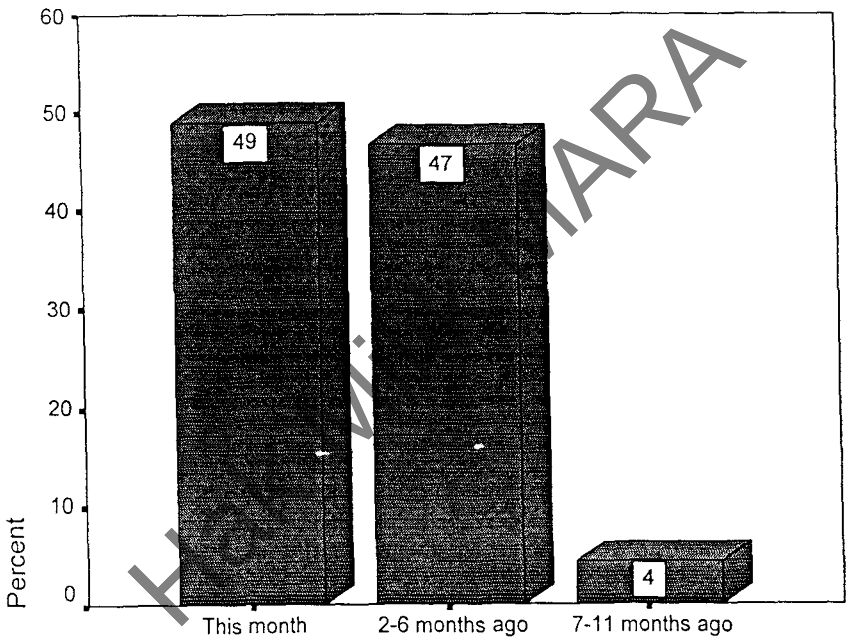
17. Comfort PPE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	31	66.0	68.9	68.9
	No	14	29.8	31.1	100.0
	Total	45	95.7	100.0	
Missing	System	2	4.3		
Total		47	100.0		



18. Use PPE

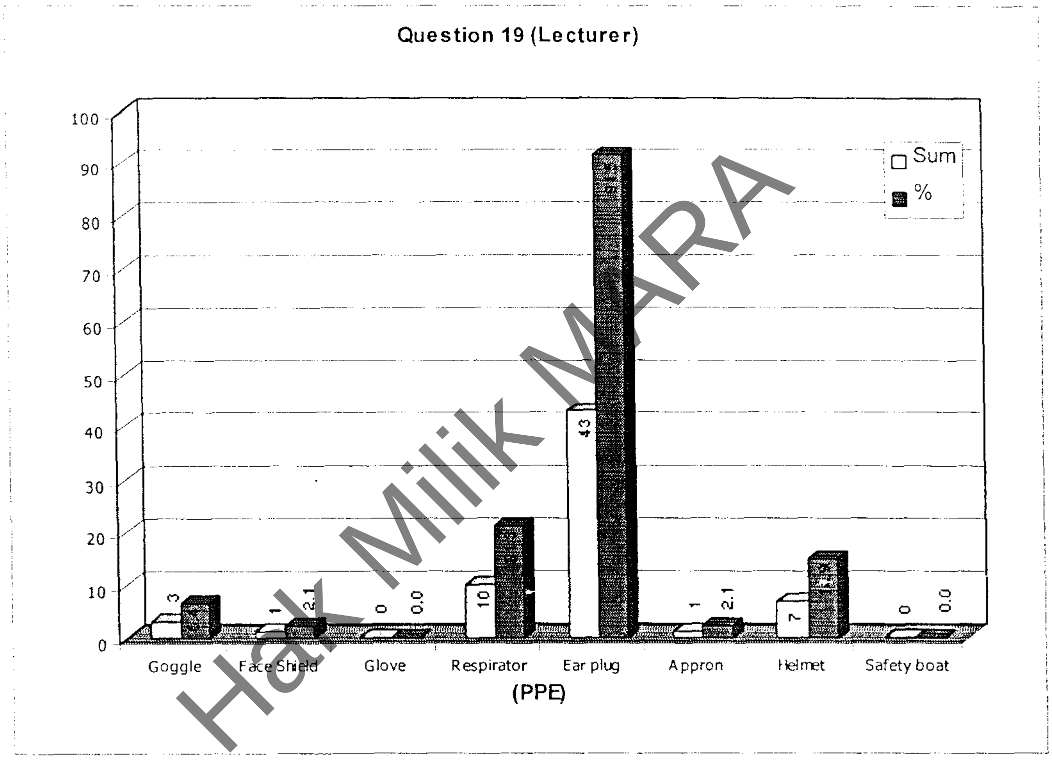
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	This month	22	46.8	48.9	48.9
	2-6 months ago	21	44.7	46.7	95.6
	7-11 months ago	2	4.3	4.4	100.0
	Total	45	95.7	100.0	
Missing	System	2	4.3		
Total		47	100.0		



Use PPE

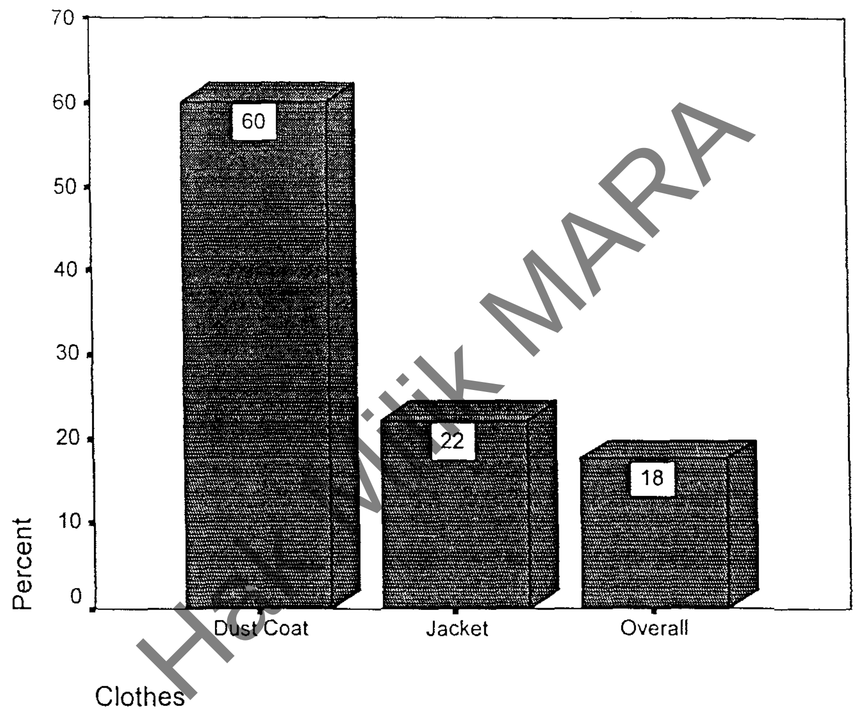
19. Should Supplied

	Goggle	Face Shield	Glove	Respirator	Ear plug	Apron	Helmet	Safety boat
N	47	47	47	47	47	47	47	47
Sum	3	1	0	10	43	1	7	0
Mis.	44	46	47	37	4	46	40	47
%	6.4	2.1	0.0	21.3	91.5	2.1	14.9	0.0



20. Clothes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Dust Coat	27	57.4	60.0	60.0
	Jacket	10	21.3	22.2	82.2
	Overall	8	17.0	17.8	100.0
	Total	45	95.7	100.0	
Missing	System	2	4.3		
Total		47	100.0		

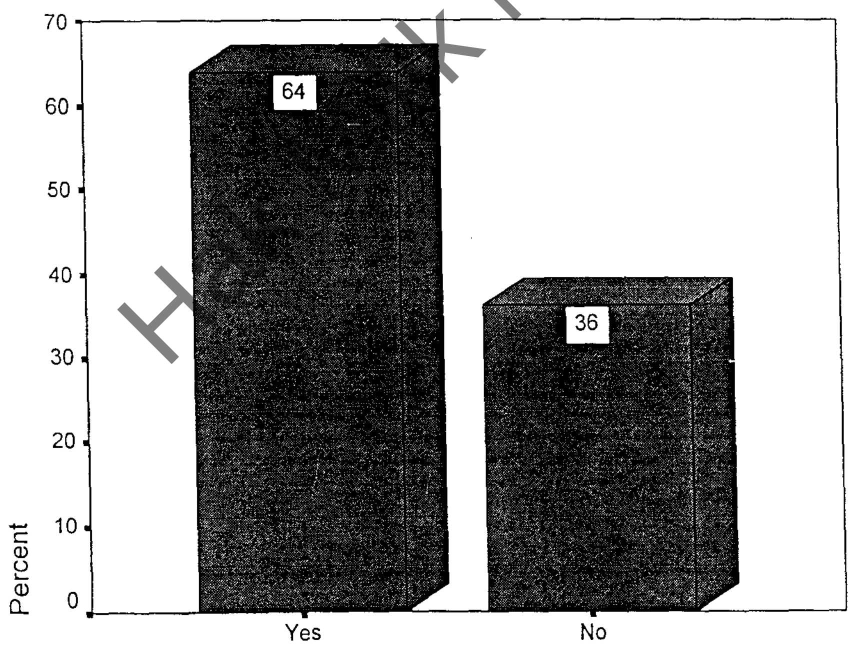


21. Shoes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Safety boat	46	97.9	100.0	100.0
Missing	System	1	2.1		
Total		47	100.0		

22. Freely

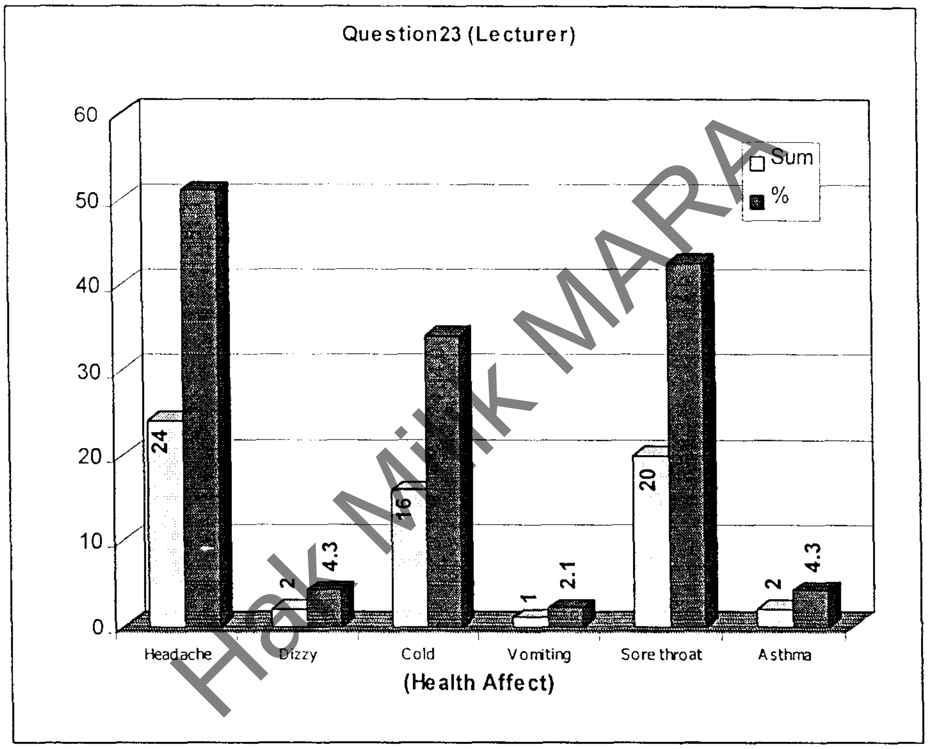
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	30	63.8	63.8	63.8
	No	17	36.2	36.2	100.0
	Total	47	100.0	100.0	



Freely

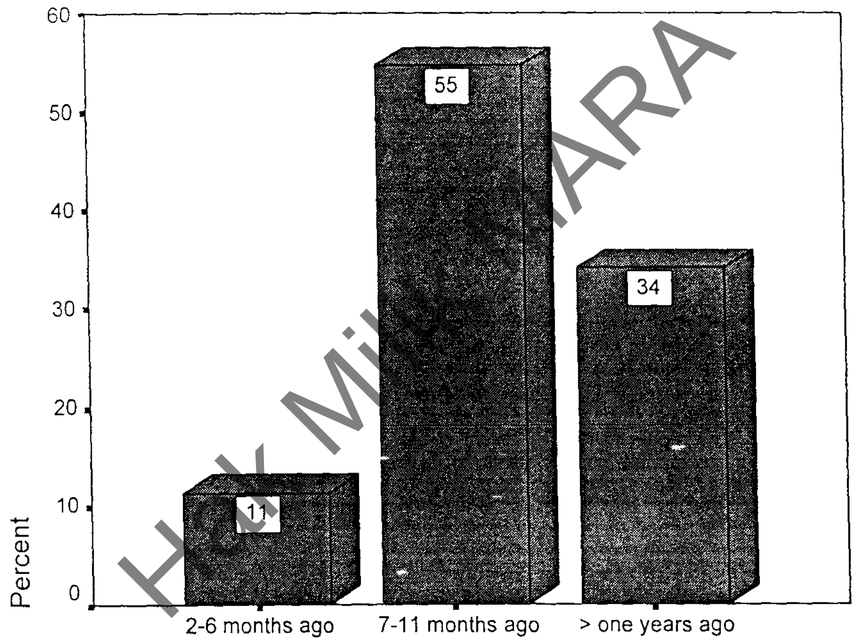
23. Health affect

	Headache	Dizzy	Cold	Vomiting	Sore throat	Asthma
N	47	47	47	47	47	47
Sum	24	2	16	1	20	2
Mis.	23	45	31	46	27	45
%	51.1	4.3	34.0	2.1	42.6	4.3



24. Latest MC

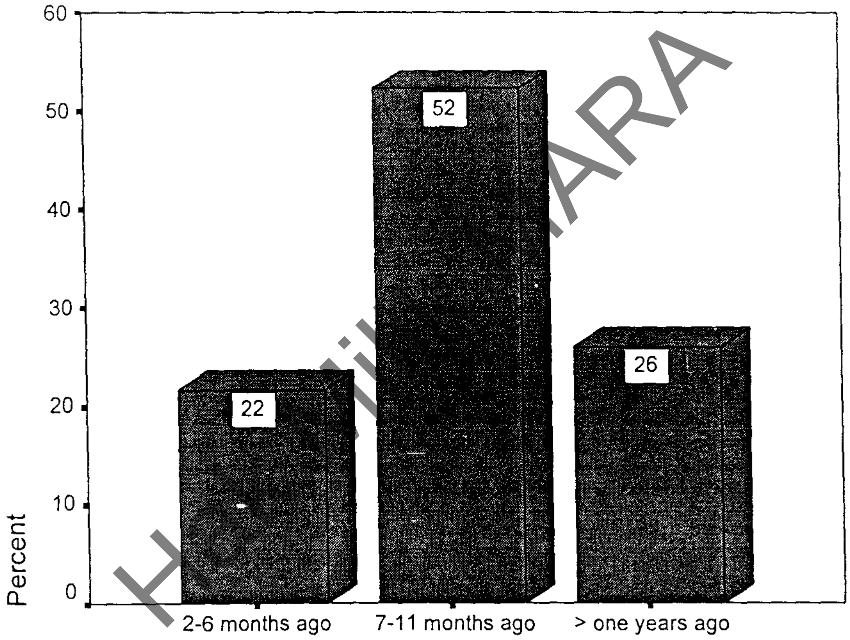
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2-6 months ago	5	10.6	11.4	11.4
	7-11 months ago	24	51.1	54.5	65.9
	> One years ago	15	31.9	34.1	100.0
	Total	44	93.6	100.0	
Missing	System	3	6.4		
Total		47	100.0		



Latest MC

25. Doctor

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2-6 months ago	10	21.3	21.7	21.7
	7-11 months ago	24	51.1	52.2	73.9
	> one years ago	12	25.5	26.1	100.0
	Total	46	97.9	100.0	
Missing	System	1	2.1		
Total		47	100.0		



Doctor

26. Check Up

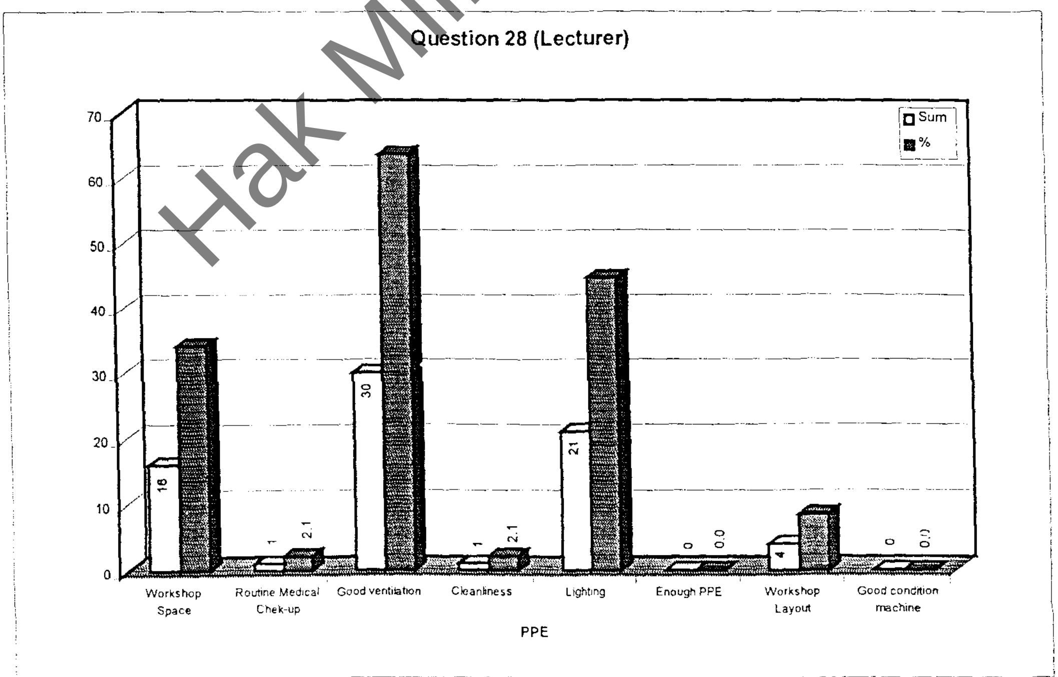
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	47	100.0	100.0	100.0

27. Frequent

		Frequency	Percent
Missing	System	47	100.0

28. Recommendations

	Workshop Space	Routine Medical Check-up	Good ventilation	Cleanliness	Lighting	Enough PPE	Workshop Layout	Good condition machine
N	47	47	47	47	47	47	47	47
Sum	16	1	30	1	21	0	4	0
Mis.	31	46	17	46	26	47	43	47
%	**34.0**	**2.1**	**63.8**	**2.1**	**44.7**	**0.0**	**8.5**	**0.0**



Appendix
33 - 35

SPSS 11.0

Respondent : Student

	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10	q11	q12	q13	q15	q17	q18	q20	q21	q22	q24	q25	q26
1	1	3	4	1	2	4	2	1	2	1	2	2	1	1	1	1	2	1	1	4	4	2
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SPSS 11.0

Respondent : Student

	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10	q11	q12	q13	q15	q17	q18	q20	q21	q22	q24	q25	q26
1	Male	13-18 months	7-8 hours	Yes	No	36-40	No	Yes	No	Yes	No	No	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	Last year	Last year	No
2	Male	19-24 months	5-6 hours	No	Yes	31-35	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	This month	Overall	Safety boat	Yes	Last month	Last month	No
3	Male	19-24 months	5-6 hours	No	Yes	31-35	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	Last month	Last month	No
4	Male	19-24 months	5-6 hours	No	No	31-35	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	Last week	Last week	No
5	Male	19-24 months	5-6 hours	No	Yes	31-35	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	Last year	Last year	No
6	Male	19-24 months	5-6 hours	No	Yes	31-35	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	Last week	Last week	No
7	Male	19-24 months	5-6 hours	No	No	36-40	No	No	Yes	Yes	No	No	Yes	Yes	Yes	This month	Overall	Safety boat	No	Last month	Last month	No
8	Male	13-18 months	7-8 hours	Yes	No	31-35	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	.	Last month	No
9	Male	.	7-8 hours	Yes	Yes	.	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	Last month	Last month	No
10	Male	13-18 months	7-8 hours	Yes	No	.	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	Last month	Last month	No
11	Male	13-18 months	7-8 hours	Yes	No	.	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	.	Jacket	.	Yes	.	.	No
12	Male	13-18 months	7-8 hours	Yes	No	31-35	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	.	.	No
13	Male	13-18 months	3-4 hours	Yes	No	26-30	No	.	No	Yes	No	Yes	Yes	Yes	Yes	This month	Jacket	.	Yes	.		No
14	Male	13-18 months	7-8 hours	No	Yes	36-40	No	No	Yes	Yes	Yes	No	Yes	No	Yes	.	Jacket	Safety boat	Yes		.	No
15	Male	13-18 months	7-8 hours	Yes	No	36-40	No	No	No	Yes	No	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	.	.	No
16	Male	13-18 months	3-4 hours	.	Yes	.	Yes	No	Yes	Yes	No	Yes	Yes	.	Yes	.	Jacket	Safety boat	Yes		.	No
17	Male	13-18 months	5-6 hours	Yes	.	.	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	Last month	Last month	No
18	Male	13-18 months	7-8 hours	No	No	36-40	No	No	No	Yes	Yes	No	Yes	Yes	No	This month	Jacket	Safety boat	Yes	.	Last month	No
19	Male	13-18 months	7-8 hours	Yes	No	36-40	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	.	.	No
20	Male	13-18 months	7-8 hours	Yes	No	26-30	No	No	No	Yes	No	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	Last year	Last year	No
21	Male	13-18 months	5-6 hours	Yes	No	.	No	No	No	Yes	No	Yes	Yes	Yes	No	This month	Jacket	Safety boat	Yes	.	.	No

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22	Male	13-18 months	5-6 hours	Yes	Yes	.	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	.	.	No
23	Male	.	3-4 hours	.	No	36-40	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	Last month	Last month	No
24	Male	13-18 months	3-4 hours	Yes	No	.	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	.	Jacket	Safety boat	Yes		.	No
25	Male	13-18 months	5-6 hours	Yes	Yes	.	No	No	Yes	Yes	No	Yes	Yes	Yes	No	2-6 months ago	Jacket	Safety boat	Yes	Last year	Last month	No
26	Male	13-18 months	7-8 hours	Yes	Yes	26-30	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	Last year	Last year	No
27	Male	13-18 months	7-8 hours	No		.	No	No	No	Yes	No	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	.		No
28	Male	13-18 months	7-8 hours	No	No	.	No	No	No	Yes	No	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes		.	No
29	Male	13-18 months	7-8 hours	No	Yes	36-40	No	No	No	Yes	.	.	Yes	Yes	No	2-6 months ago	Jacket	Safety boat	Yes	Last month	Last month	No
30	Male	13-18 months	5-6 hours	No	Yes	36-40	No	No	Yes	Yes	No	Yes	Yes	Yes	No	2-6 months ago	Jacket	Safety boat	Yes	Last month	Last month	No
31	Male	13-18 months	7-8 hours	Yes	No	36-40	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	Last month	Last month	No
32	Male	31-36 months	7-8 hours	Yes	No	36-40	No	Yes	No	Yes	No	Yes	Yes	No	Yes	This month	Jacket	Safety boat	Yes	.	.	No
33	Male	31-36 months	5-6 hours	Yes	Yes	31-35	No	No	Yes	Yes	No	No	Yes	Yes	Yes	.	Jacket	Safety boat	Yes	Last year	Last month	No
34	Male	13-18 months	7-8 hours	No	No	36-40	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	7-11 months ago	Jacket	Safety boat	Yes	Last month	Last month	No
35	Male	13-18 months	7-8 hours	Yes	No	31-35	No	No	No	Yes	Yes	No	Yes	Yes	No	This month	Jacket	Safety boat	Yes	.	.	No
36	Male	1-6 months	5-6 hours	No	Yes	31-35	No	No	.	Yes	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	Last year	Last month	No
37	Male	1-6 months	5-6 hours	No	Yes	.	No	No	Yes	Yes	No	Yes	No	Yes	Yes	This month	Jacket	Safety boat	Yes	.	Last month	No
38	Male	1-6 months	5-6 hours	Yes	No	.	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	.	Last month	No
39	Male	1-6 months	5-6 hours	No	Yes	31-35	Yes	No	Yes	Yes	No	No	No	Yes	Yes	This month	Jacket	Safety boat	Yes		.	No
40	Male	1-6 months	7-8 hours	No	Yes	26-30	No	No	Yes	Yes	No	Yes	Yes	Yes	No	This month	Jacket	Safety boat	Yes	.	.	No
41	Male	1-6 months	5-6 hours	Yes	No	.	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	Last year	Last year	No
42	Male	1-6 months	3-4 hours	Yes	Yes	36-40	No	No	No	Yes	Yes	No	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	.		No
43	Male	1-6 months	7-8 hours	Yes	No	36-40	No	No	No	Yes	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	.	Last month	No
44	Male	1-6 months	5-6 hours	No	Yes	36-40	No	No	.	Yes	No	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	Last year	Last month	No
45	Male	1-6 months	3-4 hours	Yes	No	26-30	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	.	Last month	No

46	Male	1-6 months	5-6 hours	Yes	No	26-30	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes		.	No
47	Male	1-6 months	7-8 hours	Yes	No	31-35	No	No	No	Yes	Yes	Yes	No	Yes	Yes	This month	Jacket	Safety boat	Yes	Last month	Last month	No
48	Male	1-6 months	5-6 hours	No	Yes	31-35	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes		.	No
49	Male	1-6 months	5-6 hours	Yes	No	31-35	No	No	No	Yes	No	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	.	.	No
50	Male	1-6 months	3-4 hours	Yes	No	36-40	No	No	No	Yes	No	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	Last year	Last month	No
51	Male	1-6 months	3-4 hours	No	Yes	<25	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	No	Last year	Last month	No
52	Male	1-6 months	.	No	No	.	No	.	Yes	Yes	Yes	No	Yes	Yes	Yes	.	Jacket	Safety boat	Yes	.	.	No
53	Male	13-18 months	5-6 hours	Yes	No	36-40	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	Last year	Last year	No
54	Male	13-18 months	5-6 hours	No	Yes	26-30	No	No	Yes	Yes	Yes	No	Yes	Yes	No	This month	Jacket	Safety boat	No	Last month	Last month	No
55	Male	1-6 months	5-6 hours	No	No	36-40	No	No	Yes		Yes	Yes	Yes	Yes	.	.	.	.	.	.	.	No
56	Male	1-6 months	5-6 hours	No	Yes	36-40	No	No	Yes	Yes	Yes	No	Yes	Yes	No	This month	Overall	Safety boat	Yes	.	.	No
57	Male	1-6 months	5-6 hours	No	No	36-40	No	No	Yes	.	Yes	No	Yes	Yes	No	.	Overall	Safety boat	Yes	Last year	Last year	No
58	Male	1-6 months	5-6 hours	Yes	No	.	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	This month	Overall	Safety boat	Yes	Last month	Last month	No
59	Male	1-6 months	7-8 hours	Yes	Yes	31-35	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	.	.	No
60	Male	13-18 months	7-8 hours	No	Yes	<41	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	Last month	Last month	No
61	Male	1-6 months	3-4 hours	Yes	.	.	.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	.	.	No
62	Male	1-6 months	3-4 hours	No	Yes	26-30	No	No	No	Yes	No	Yes	No	Yes	Yes	This month	Jacket	Safety boat	Yes	Last month	Last month	No
63	Male	13-18 months	5-6 hours	Yes	No	.	No	No	Yes	No	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	Last month	Last month	No
64	Male	7-12 months	5-6 hours	No	No	.	No	No	Yes	No	Yes	No	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	Last month	Last month	No
65	Male	13-18 months	5-6 hours	No	Yes	.	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No	This month	Jacket	Safety boat	No	Last month	Last month	No
66	Male	13-18 months	5-6 hours	No	No	26-30	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	No	.	.	No
67	Male	13-18 months	1-2 hours	No	Yes	<41	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	This month	Overall	Safety boat	No	This week	This week	No
68	Male	7-12 months	3-4 hours	No	Yes	.	No	No	Yes	No	Yes	No	No	Yes	Yes	2-6 months ago	Overall	Safety boat	Yes	Last year	Last year	No
69	Male	13-18 months	7-8 hours	Yes	No	.	No	No	Yes	Yes	No	No	Yes	Yes	No	2-6 months ago	Overall	Safety boat	Yes	Last year	Last year	No

70	Male	13-18 months	3-4 hours	No	No	.	No	Yes	Yes	No	Yes	No	No	Yes	No	.	Jacket	Safety boat	Yes		.	No
71	Male	13-18 months	3-4 hours	No	Yes	31-35	No	No	Yes	No	Yes	No	Yes	Yes	No	7-11 months ago	Overall	Safety boat	No	Last month	Last month	No
72	Male	1-6 months	5-6 hours	No	Yes	31-35	No	No	Yes	No	Yes	No	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	.	Last year	No
73	Male	1-6 months	.	No	No	.	No	No	Yes	Yes	Yes	No	No	Yes	No	This month	Jacket	Safety boat	Yes	.	.	No
74	Male	13-18 months	3-4 hours	No	Yes	31-35	No	No	Yes	Yes	Yes	No	Yes	No	No	.	Jacket	Safety boat	No	.	.	No
75	Male	13-18 months	3-4 hours	No	Yes	.	No	No	Yes	No	Yes	Yes	Yes	Yes	No	2-6 months ago	Overall	Safety boat	No	.		No
76	Male	13-18 months	5-6 hours	No	No	31-35	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	.	.	No
77	Male	7-12 months	3-4 hours	No	Yes	36-40	Yes	.	Yes	Yes	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	No	Last year	Last year	No
78	Male	1-6 months	5-6 hours	Yes	.	.	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	.	.	No
79	Male	1-6 months	3-4 hours	Yes	No	.	No	No	Yes	No	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	.	.	No
80	Male	13-18 months	5-6 hours	No	Yes	.	No	No	Yes	Yes	No	No	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	No		.	No
81	Male	13-18 months	5-6 hours	No	No	26-30	No	No	No	Yes	Yes	No	Yes	Yes	.	2-6 months ago	Jacket	Safety boat	Yes		.	No
82	Male	1-6 months	7-8 hours	Yes	No	36-40	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	.		No
83	Male	1-6 months	5-6 hours	No	No	36-40	No	No	Yes	Yes	Yes	No	Yes	Yes	No	This month	Jacket	Safety boat	No		.	No
84	Male	7-12 months	3-4 hours	Yes	Yes	36-40	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	Last year	Last year	No
85	Male	13-18 months	5-6 hours	Yes	Yes	.	No	No	Yes	No	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	.		No
86	Male	13-18 months	5-6 hours	No	Yes	.	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes			No
87	Male	13-18 months	5-6 hours	No	Yes	.	No	No	Yes	No	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	No		.	No
88	Male	13-18 months	5-6 hours	Yes	Yes	36-40	No	No	Yes	Yes	Yes	Yes	Yes	.	No	This month	Jacket	Safety boat	Yes	.	.	No
89	Male	1-6 months	5-6 hours	No	Yes	26-30	No	No	Yes	No	Yes	No	Yes	Yes	No	This month	Overall	Safety boat	Yes		.	No
90	Male	1-6 months	5-6 hours	No	No	.	No	No	No	Yes	Yes	Yes	Yes	Yes	No	.	Jacket	Safety boat	No	Last year	Last year	No
91	Male	1-6 months	3-4 hours	No	Yes	.	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No	.		Safety boat	Yes		.	No
92	Male	1-6 months	7-8 hours	Yes	No	26-30	No	No	Yes	No	No	No	Yes	Yes	Yes	This month	Overall	Safety boat	No	Last month	Last month	No
93	Male	19-24 months	5-6 hours	No	Yes	31-35	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	Last month	Last month	No

94	Male	19-24 months	5-6 hours	No	No	31-35	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	Last week	Last week	No
95	Male	19-24 months	5-6 hours	No	Yes	31-35	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	Last year	Last year	No
96	Male	19-24 months	5-6 hours	No	Yes	31-35	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	Last week	Last week	No
97	Male	19-24 months	5-6 hours	No	No	36-40	No	No	Yes	Yes	No	No	Yes	Yes	Yes	This month	Overall	Safety boat	No	Last month	Last month	No
98	Male	13-18 months	7-8 hours	Yes	No	31-35	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	7-11 months ago	Jacket	Safety boat	Yes	.	Last month	No
99	Male	.	7-8 hours	Yes	Yes	.	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	Last month	Last month	No
100	Male	13-18 months	7-8 hours	Yes	No	.	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	Last month	Last month	No
101	Male	1-6 months	5-6 hours	Yes	No	.	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	Last year	Last year	No
102	Male	1-6 months	3-4 hours	Yes	Yes	36-40	No	No	No	Yes	Yes	No	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	.	.	No
103	Male	1-6 months	7-8 hours	Yes	No	36-40	No	No	No	Yes	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	.	Last month	No
104	Male	1-6 months	5-6 hours	No	Yes	36-40	No	No	.	Yes	No	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	Last year	Last month	No
105	Male	1-6 months	3-4 hours	Yes	No	26-30	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	.	Last month	No
106	Male	1-6 months	5-6 hours	Yes	No	26-30	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	.	.	No
107	Male	1-6 months	7-8 hours	Yes	No	31-35	No	No	No	Yes	Yes	Yes	No	Yes	Yes	This month	Jacket	Safety boat	Yes	Last month	Last month	No
108	Male	1-6 months	5-6 hours	No	Yes	31-35	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	.	.	No
109	Male	1-6 months	5-6 hours	Yes	No	31-35	No	No	No	Yes	No	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	.	.	No
110	Male	1-6 months	3-4 hours	Yes	No	36-40	No	No	No	Yes	No	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	Last year	Last month	No
111	Male	1-6 months	3-4 hours	No	Yes	<25	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	No	Last year	Last month	No
112	Male	13-18 months	5-6 hours	No	Yes	.	No	No	Yes	No	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	No	.	.	No
113	Male	13-18 months	5-6 hours	Yes	Yes	36-40	No	No	Yes	Yes	Yes	Yes	Yes	.	No	This month	Jacket	Safety boat	Yes	.	.	No
114	Male	1-6 months	5-6 hours	No	Yes	26-30	No	No	Yes	No	Yes	No	Yes	Yes	No	This month	Overall	Safety boat	Yes		.	No
115	Male	1-6 months	5-6 hours	No	No	.	No	No	No	Yes	Yes	Yes	Yes	Yes	No	.	Jacket	Safety boat	No	Last year	Last year	No
116	Male	1-6 months	3-4 hours	No	Yes	.	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No	.	.	Safety boat	Yes		.	No
117	Male	1-6 months	7-8 hours	Yes	No	26-30	No	No	Yes	No	No	No	Yes	Yes	Yes	This month	Overall	Safety boat	No	Last month	Last month	No

166	Male	13-18 months	7-8 hours	Yes	No	.	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	Last month	Last month	No
167	Male	13-18 months	7-8 hours	Yes	No	.	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	.	Jacket	.	Yes	.		No
168	Male	13-18 months	7-8 hours	Yes	No	31-35	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	.		No
169	Male	13-18 months	3-4 hours	Yes	No	26-30	No	.	No	Yes	No	Yes	Yes	Yes	Yes	This month	Jacket	.	Yes	.	.	No
170	Male	13-18 months	7-8 hours	No	Yes	36-40	No	No	Yes	Yes	Yes	No	Yes	No	Yes	.	Jacket	Safety boat	Yes	.	.	No
171	Male	13-18 months	7-8 hours	Yes	No	36-40	No	No	No	Yes	No	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes		.	No
172	Male	13-18 months	3-4 hours	.	Yes	.	Yes	No	Yes	Yes	No	Yes	Yes	.	Yes	.	Jacket	Safety boat	Yes	.		No
173	Male	13-18 months	5-6 hours	Yes	.	.	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	Last month	Last month	No
174	Male	13-18 months	7-8 hours	No	No	36-40	No	No	No	Yes	Yes	No	Yes	Yes	No	This month	Jacket	Safety boat	Yes		Last month	No
175	Male	13-18 months	7-8 hours	Yes	No	36-40	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	.		No
176	Male	13-18 months	7-8 hours	Yes	No	26-30	No	No	No	Yes	No	Yes	Yes	Yes	Yes	7-11 months ago	Jacket	Safety boat	Yes	Last year	Last year	No
177	Male	13-18 months	5-6 hours	Yes	No	.	No	No	No	Yes	No	Yes	Yes	Yes	No	This month	Jacket	Safety boat	Yes		.	No
178	Male	13-18 months	5-6 hours	Yes	Yes	.	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes			No
179	Male	19-24 months	5-6 hours	No	Yes	31-35	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	Last month	Last month	No
180	Male	19-24 months	5-6 hours	No	No	26-30	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	Last week	Last week	No
181	Male	19-24 months	5-6 hours	No	Yes	26-30	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	Last year	Last year	No
182	Male	19-24 months	5-6 hours	No	Yes	31-35	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	Last week	Last week	No
183	Male	19-24 months	5-6 hours	No	No	31-35	No	No	Yes	Yes	No	No	Yes	Yes	Yes	This month	Overall	Safety boat	No	Last month	Last month	No
184	Male	13-18 months	7-8 hours	Yes	No	26-30	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	7-11 months ago	Jacket	Safety boat	Yes	.	Last month	No
185	Male	1-6 months	5-6 hours	No	Yes	31-35	No	No	.	Yes	No	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	Last year	Last month	No
186	Male	1-6 months	3-4 hours	Yes	No	31-35	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	.	Last month	No
187	Male	1-6 months	5-6 hours	Yes	No	31-35	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes		.	No
188	Male	1-6 months	7-8 hours	Yes	No	31-35	No	No	No	Yes	Yes	Yes	No	Yes	Yes	This month	Jacket	Safety boat	Yes	Last month	Last month	No
189	Male	1-6 months	5-6 hours	No	Yes	31-35	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	Yes	.	.	No

190	Male	1-6 months	5-6 hours	Yes	No	36-40	No	No	No	Yes	No	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes			No
191	Male	1-6 months	3-4 hours	Yes	No	36-40	No	No	No	Yes	No	Yes	Yes	Yes	Yes	This month	Jacket	Safety boat	Yes	Last year	Last month	No
192	Male	1-6 months	3-4 hours	No	Yes	26-30	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	2-6 months ago	Jacket	Safety boat	No	Last year	Last month	No
193	Male	1-6 months	3-4 hours	No	No	31-35	No	.	Yes	Yes	Yes	No	Yes	Yes	Yes	.	Jacket	Safety boat	Yes		.	No
194	Male	19-24 months	5-6 hours	No	Yes	31-35	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	This month	Overall	Safety boat	Yes	Last month	Last month	No
195	Male	19-24 months	5-6 hours	No	Yes	31-35	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	Last month	Last month	No
196	Male	19-24 months	5-6 hours	.	No	31-35	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	Last week	Last week	No
197	Male	19-24 months	5-6 hours	No	Yes	31-35	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	Last year	Last year	No
198	Male	19-24 months	5-6 hours	No	Yes	31-35	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	This month	Overall	Safety boat	Yes	Last week	Last week	No
199	Male	19-24 months	5-6 hours	No	No	36-40	No	No	Yes	Yes	No	No	Yes	Yes	Yes	This month	Overall	Safety boat	No	Last month	Last month	No
200	Male	13-18 months	5-6 hours	No	Yes	.	No	No	Yes	No	Yes	No	Yes	Yes	Yes	This month	Jacket	Safety boat	No	.	.	No
201	Male	13-18 months	5-6 hours	Yes	Yes	36-40	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	This month	Jacket	Safety boat	Yes	.	.	No
202	Male	1-6 months	5-6 hours	No	Yes	26-30	No	No	Yes	No	Yes	No	Yes	Yes	No	This month	Overall	Safety boat	Yes	.	.	No

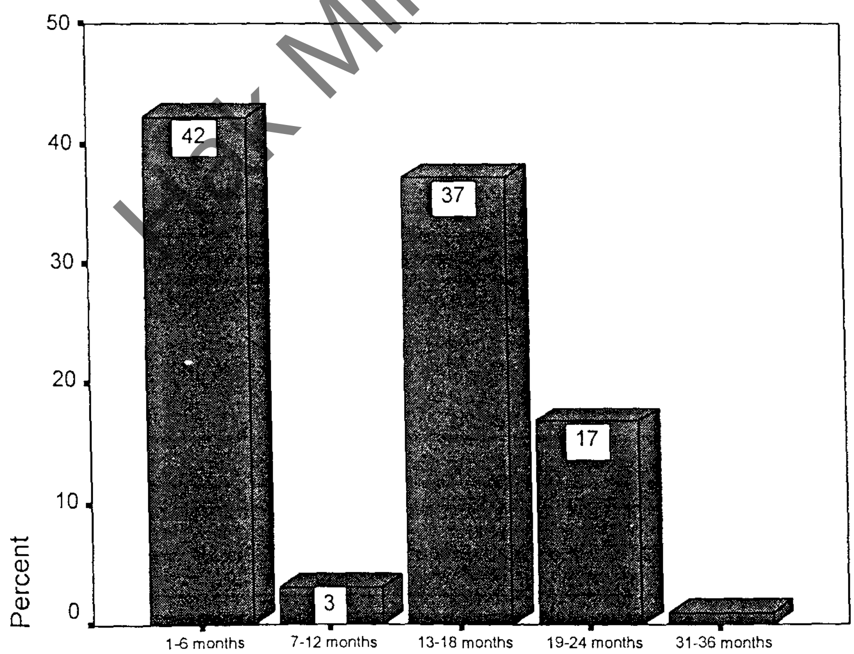
Frequency Table (Students)

1. Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	202	100.0	100.0	100.0

2. Experience

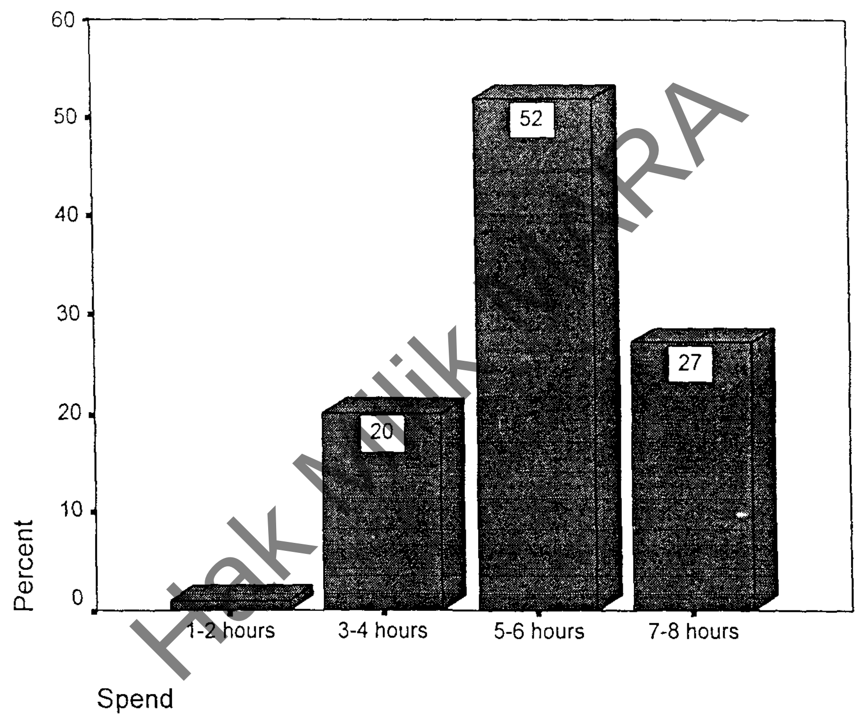
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-6 months	83	41.1	42.1	42.1
	7-12 months	6	3.0	3.0	45.2
	13-18 months	73	36.1	37.1	82.2
	19-24 months	33	16.3	16.8	99.0
	31-36 months	2	1.0	1.0	100.0
	Total	197	97.5	100.0	
Missing	System	5	2.5		
Total		202	100.0		



Experience

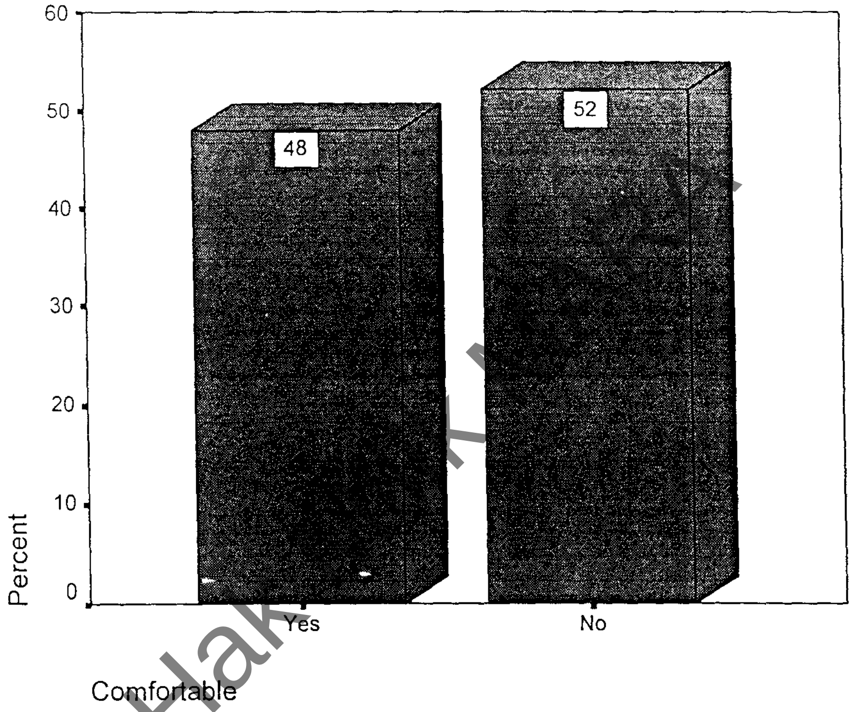
3. Spent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-2 hours	2	1.0	1.0	1.0
	3-4 hours	40	19.8	20.1	21.1
	5-6 hours	103	51.0	51.8	72.9
	7-8 hours	54	26.7	27.1	100.0
	Total	199	98.5	100.0	
Missing	System	3	1.5		
Total		202	100.0		



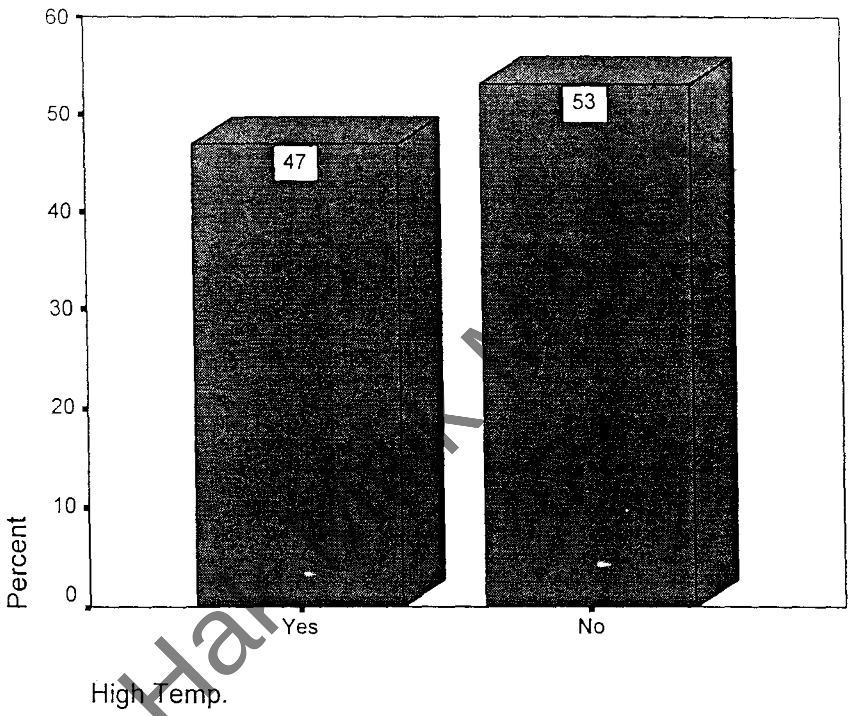
4. Comfortable

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	95	47.0	48.0	48.0
	No	103	51.0	52.0	100.0
	Total	198	98.0	100.0	
Missing	System	4	2.0		
Total		202	100.0		



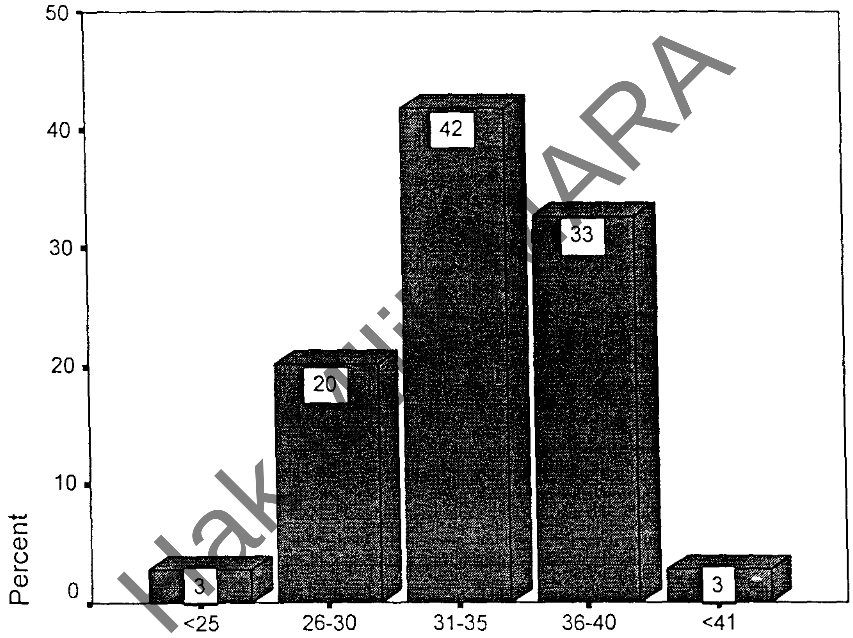
5. High Temperature

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	92	45.5	46.9	46.9
	No	104	51.5	53.1	100.0
	Total	196	97.0	100.0	
Missing	System	6	3.0		
Total		202	100.0		



6. Celsius

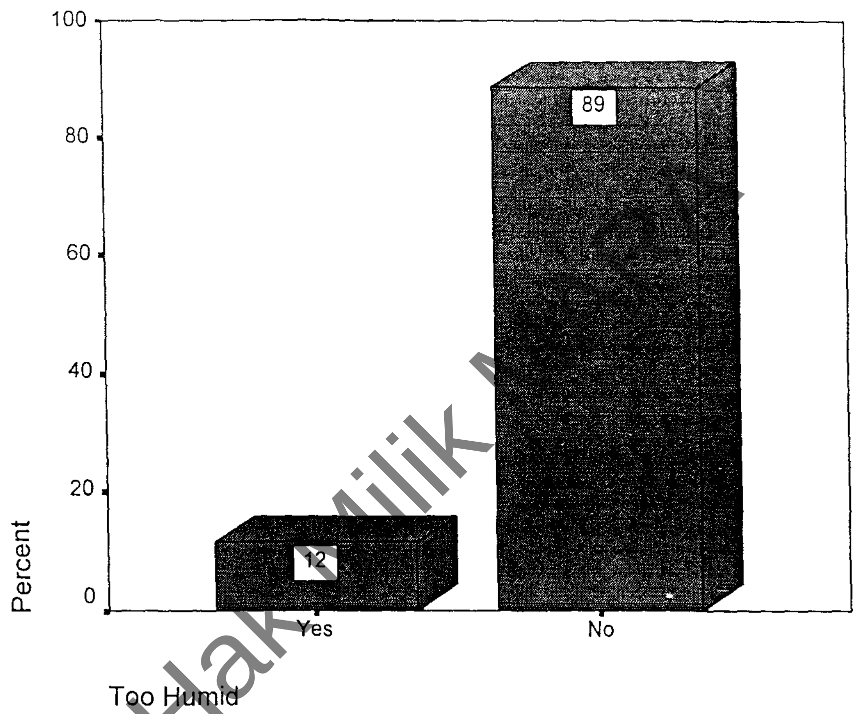
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<25	4	2.0	2.8	2.8
	26-30	29	14.4	20.1	22.9
	31-35	60	29.7	41.7	64.6
	36-40	47	23.3	32.6	97.2
	<41	4	2.0	2.8	100.0
	Total	144	71.3	100.0	
Missing	System	58	28.7		
Total		202	100.0		



Celsius

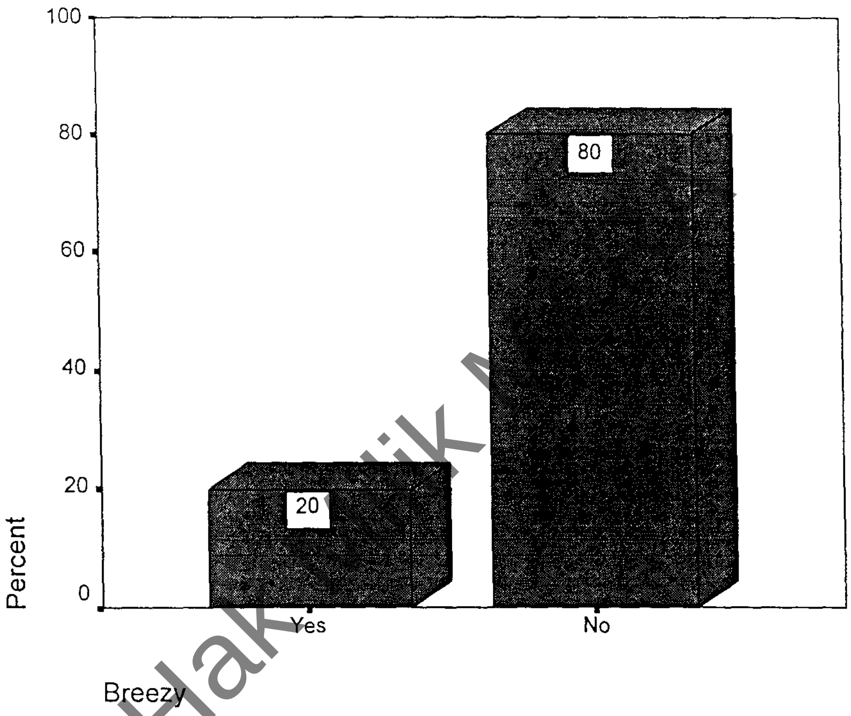
7. Too Humid

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	23	11.4	11.5	11.5
	No	177	87.6	88.5	100.0
	Total	200	99.0	100.0	
Missing	*System*	2	1.0		
Total		202	100.0		



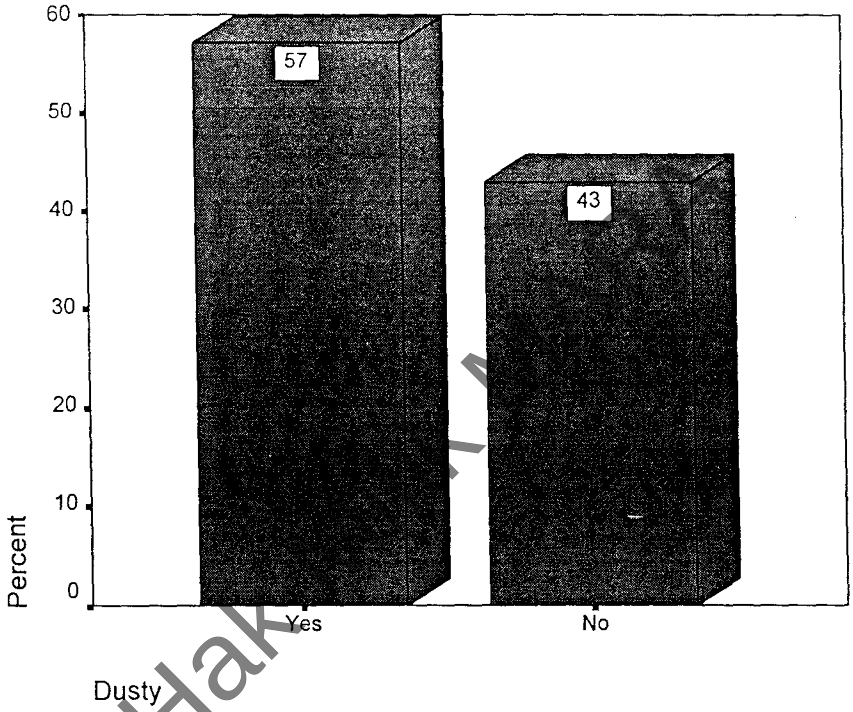
8. Breezy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	39	19.3	19.9	19.9
	No	157	77.7	80.1	100.0
	Total	196	97.0	100.0	
Missing	System	6	3.0		
Total		202	100.0		



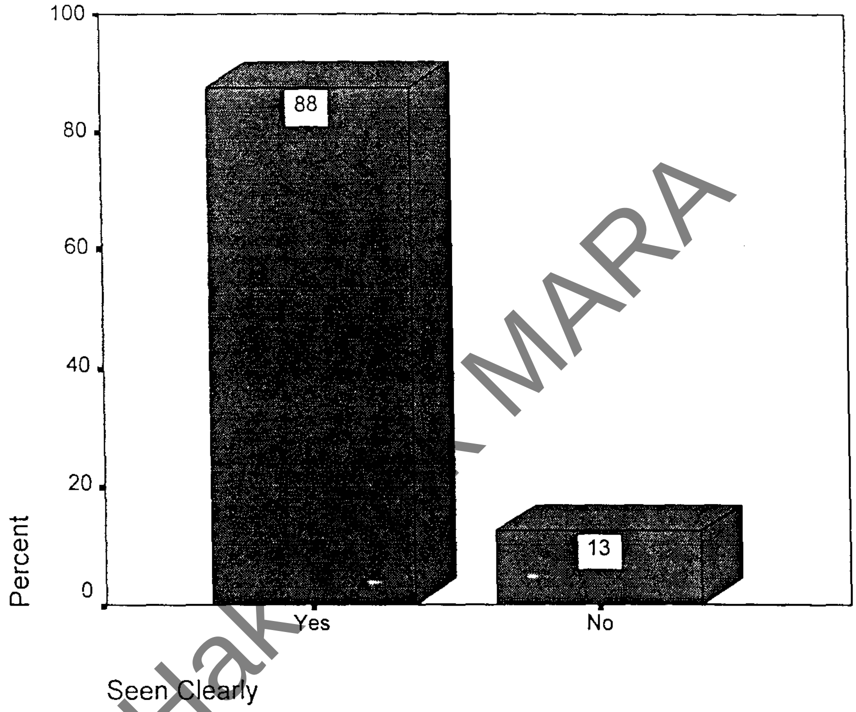
9. Dusty

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	112	55.4	57.1	57.1
	No	84	41.6	42.9	100.0
	Total	196	97.0	100.0	
Missing	System	6	3.0		
Total		202	100.0		



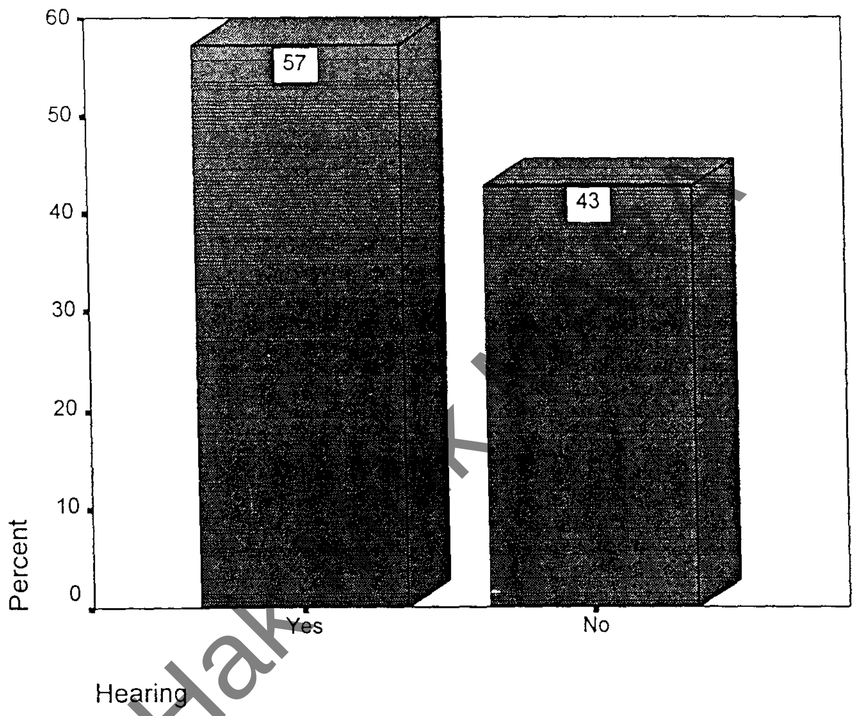
10. Seen Clearly

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	175	86.6	87.5	87.5
	No	25	12.4	12.5	100.0
	Total	200	99.0	100.0	
Missing	System	2	1.0		
Total		202	100.0		



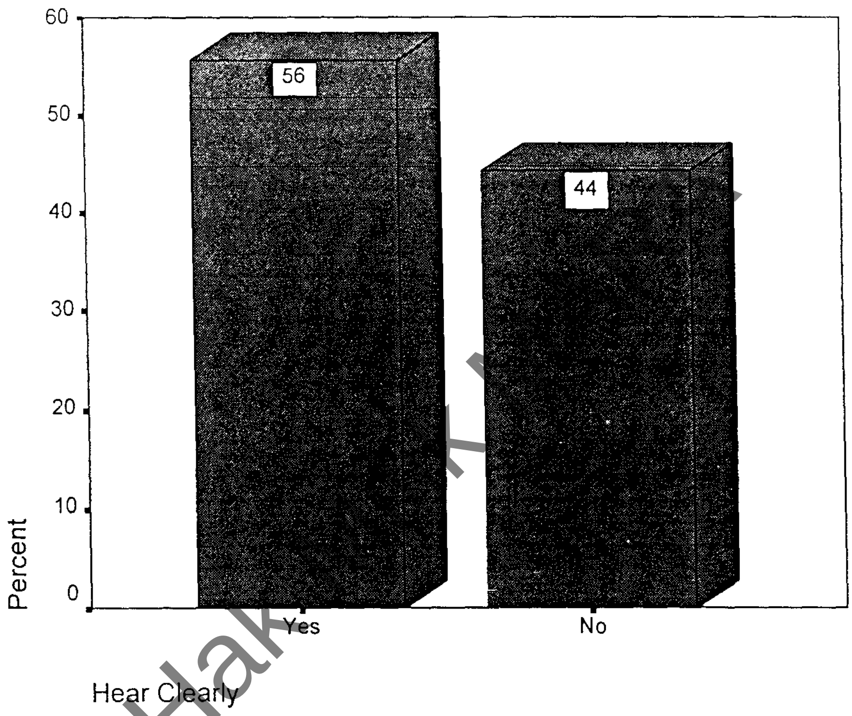
11. Hearing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	115	56.9	57.2	57.2
	No	86	42.6	42.8	100.0
	Total	201	99.5	100.0	
Missing	System	1	.5		
Total		202	100.0		



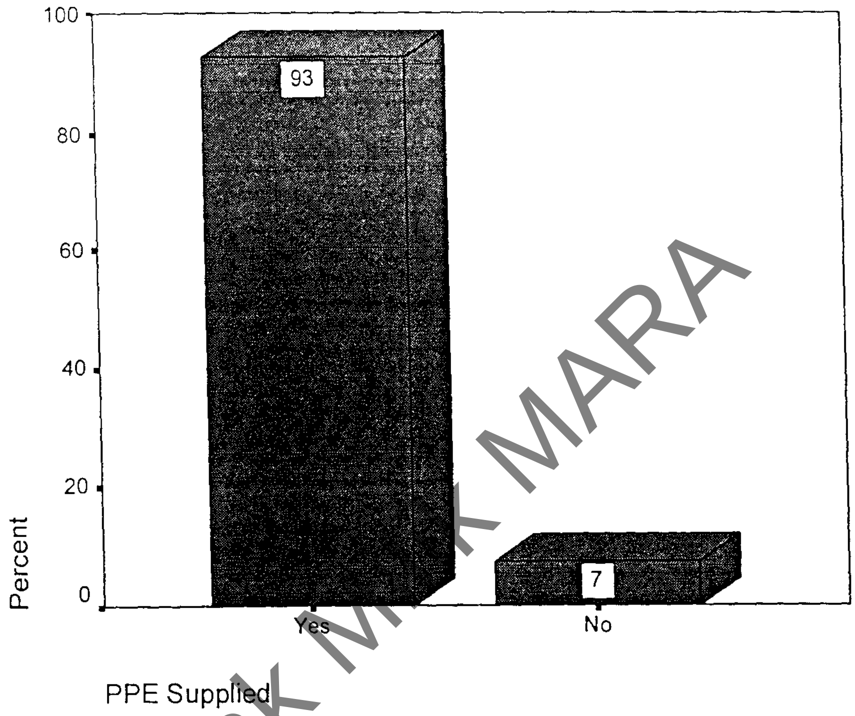
12. Hear Clearly

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	112	55.4	55.7	55.7
	No	89	44.1	44.3	100.0
	Total	201	99.5	100.0	
Missing	System	1	.5		
Total		202	100.0		



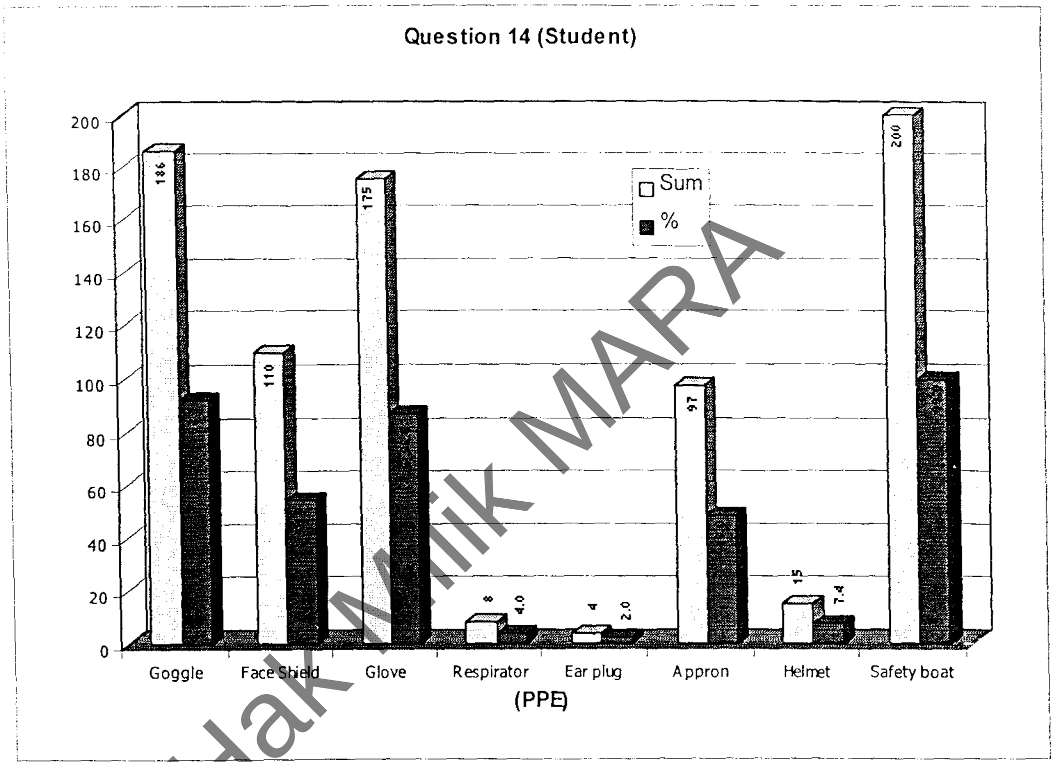
13. PPE Supplied

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	187	92.6	92.6	92.6
	No	15	7.4	7.4	100.0
	Total	202	100.0	100.0	



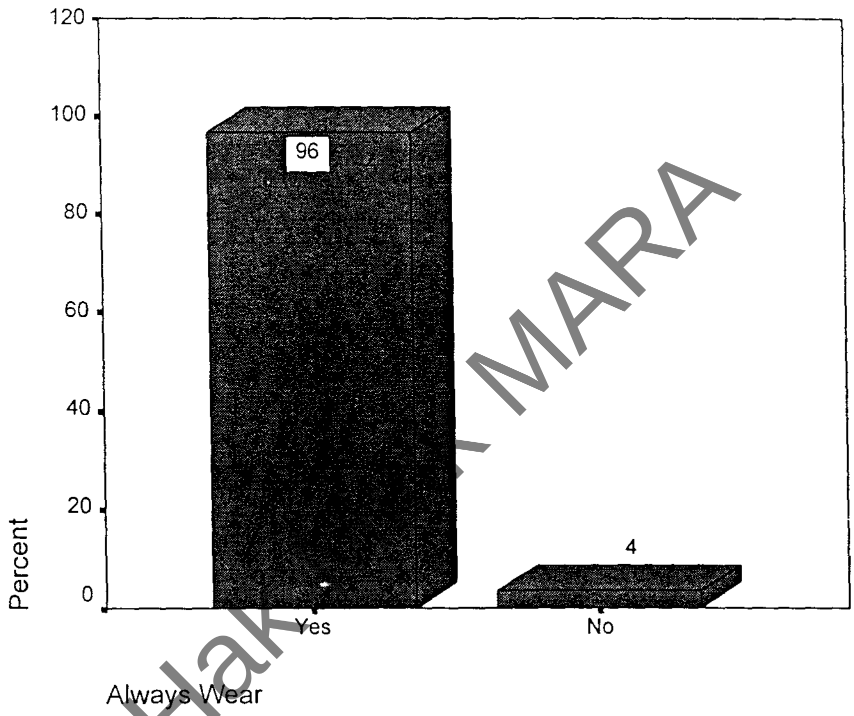
14. List Supplied

	Goggle	Face Shield	Glove	Respirator	Ear plug	Apron	Helmet	Safety boat
N	202	202	202	202	202	202	202	202
Sum	186	110	175	8	4	97	15	200
Mis.	16	92	27	194	198	105	187	2
%	**92.1**	**54.5**	**86.6**	**4.0**	**2.0**	**48.0**	**7.4**	**99.0**



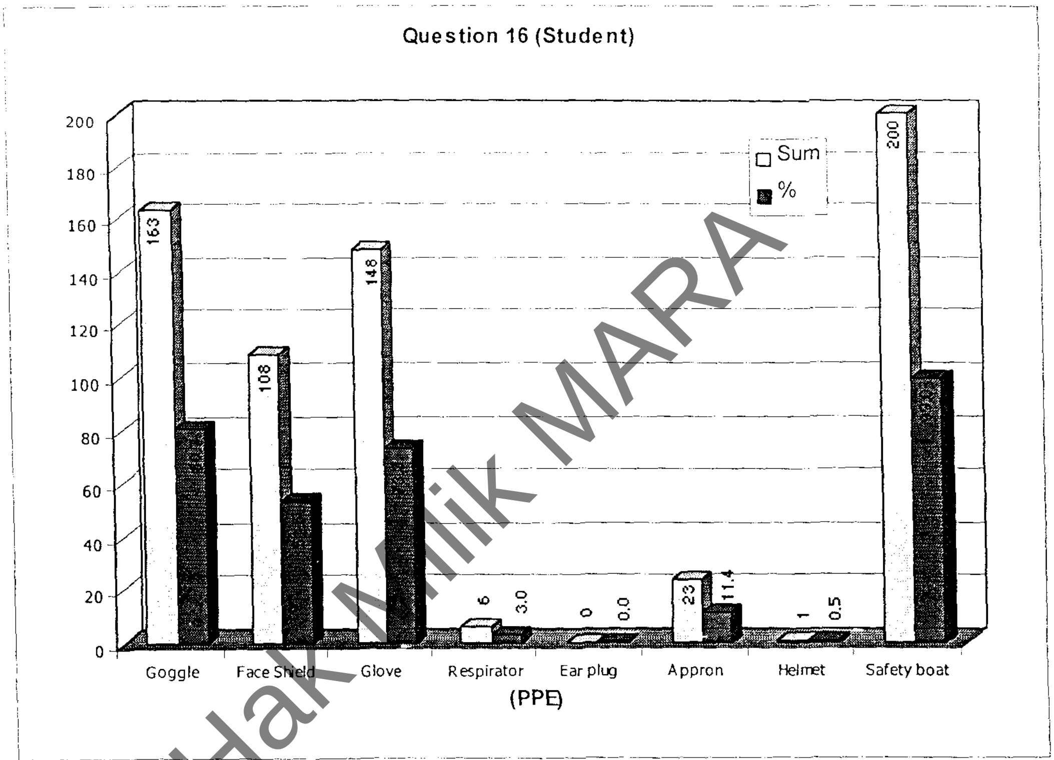
15. Always Wear

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	191	94.6	96.5	96.5
	No	7	3.5	3.5	100.0
	Total	198	98.0	100.0	
Missing	System	4	2.0		
Total		202	100.0		



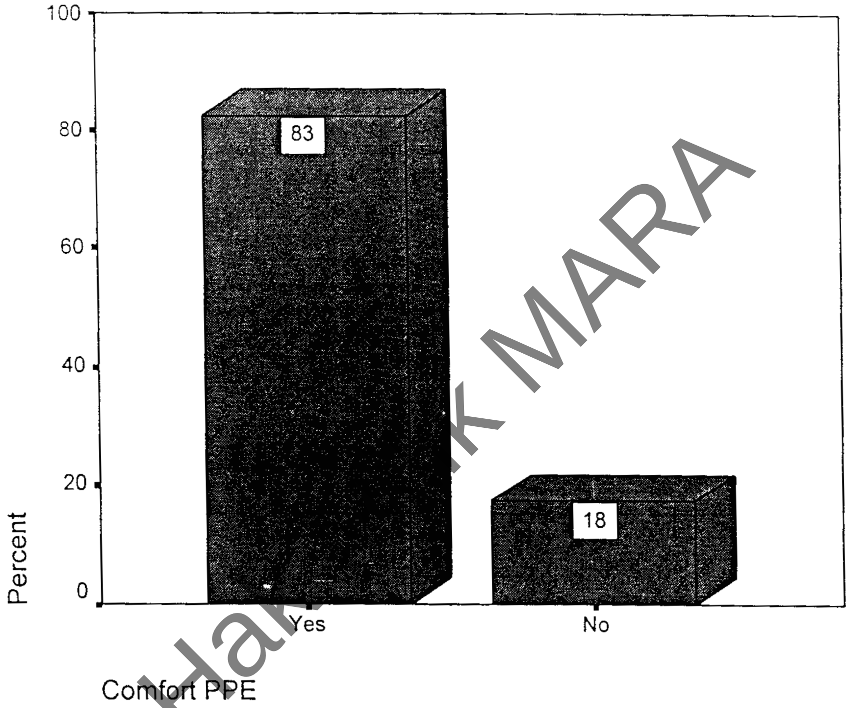
16. Wearing

	Goggle	Face Shield	Glove	Respirator	Ear plug	Apron	Helmet	Safety boat
N	202	202	202	202	202	202	202	202
Sum	163	108	148	6	0	23	1	200
Mis.	39	94	54	196	202	179	201	2
%	80.7	53.5	73.3	3.0	0.0	11.4	0.5	99.0



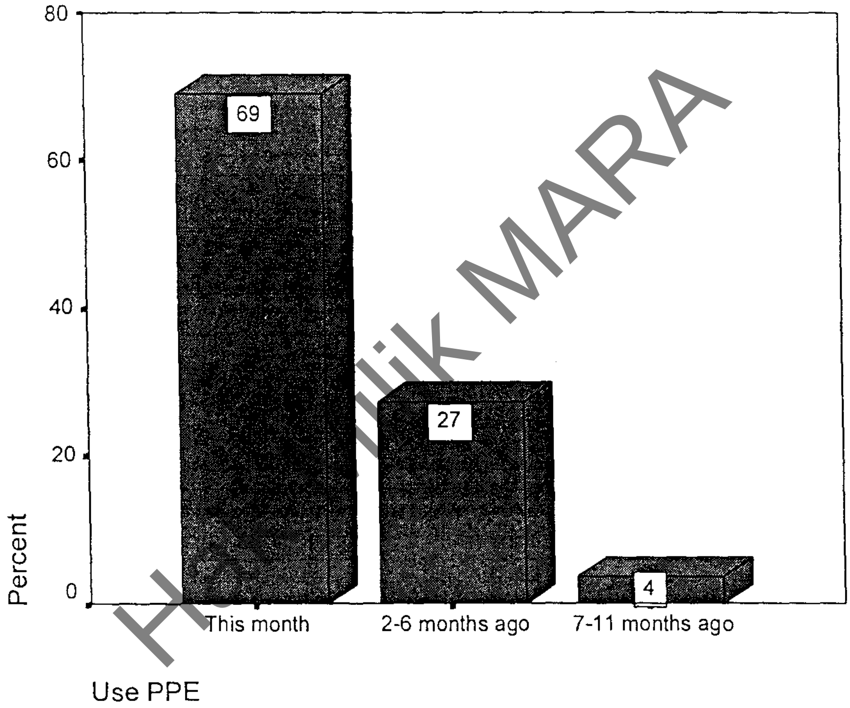
17. Comfort PPE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	165	81.7	82.5	82.5
	No	35	17.3	17.5	100.0
	Total	200	99.0	100.0	
Missing	System	2	1.0		
Total		202	100.0		



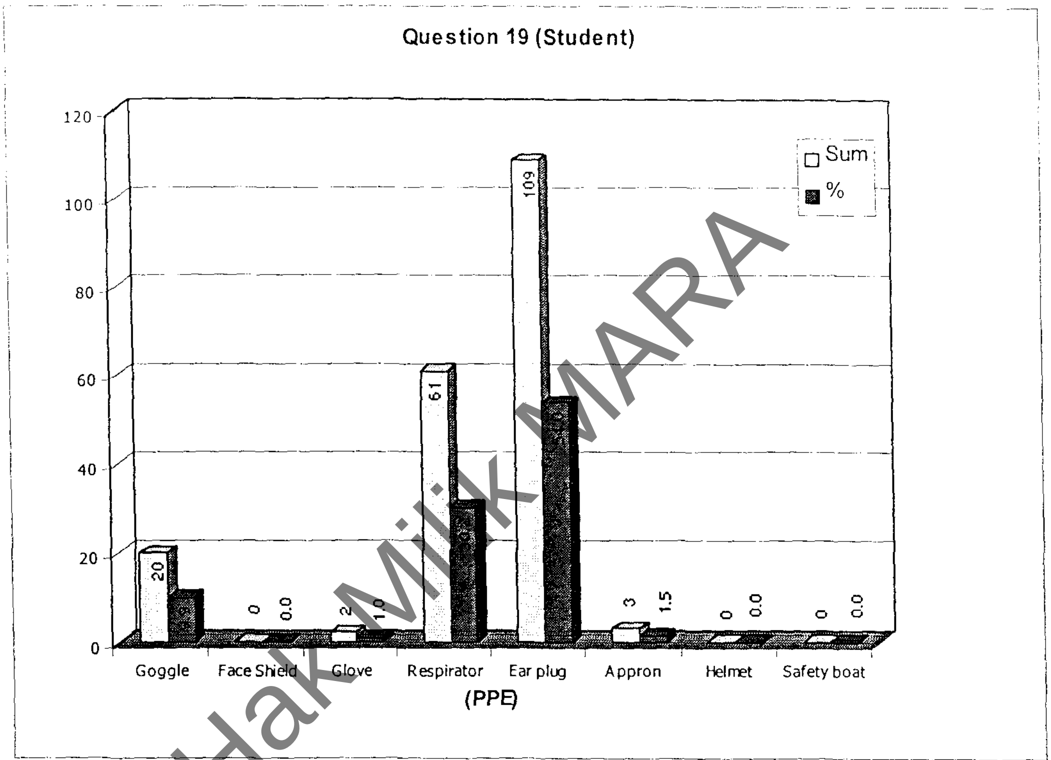
18. Use PPE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	This month	126	62.4	68.9	68.9
	2-6 months ago	50	24.8	27.3	96.2
	7-11 months ago	7	3.5	3.8	100.0
	Total	183	90.6	100.0	
Missing	System	19	9.4		
Total		202	100.0		



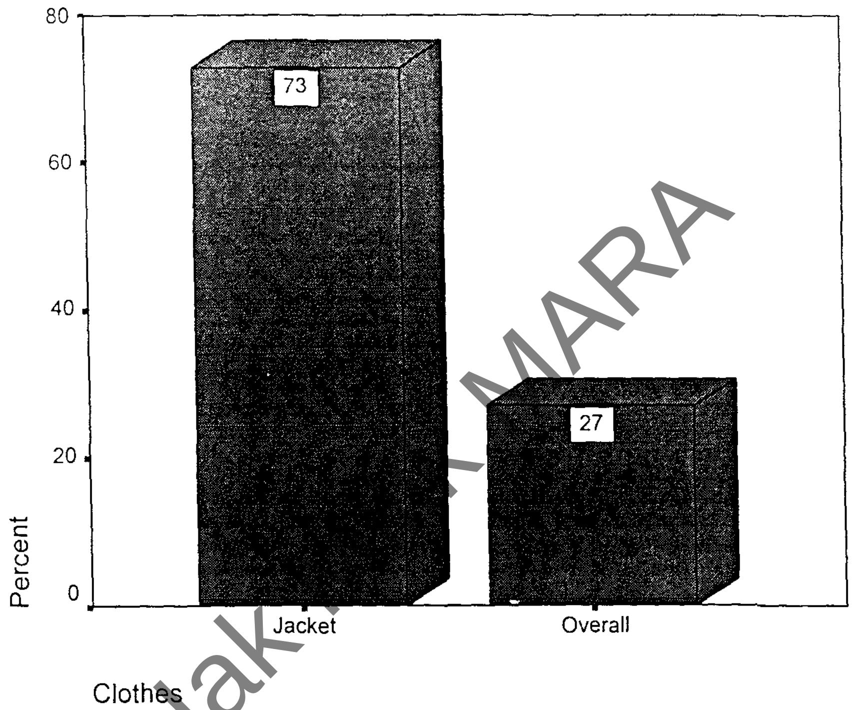
19. Should Supplied

	Goggle	Face Shield	Glove	Respirator	Ear plug	Apron	Helmet	Safety boot
N	202	202	202	202	202	202	202	202
Sum	20	0	2	61	109	3	0	0
Mis.	182	202	200	141	93	199	202	202
%	9.9	0.0	1.0	30.2	54.0	1.5	0.0	0.0



20. Clothes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Jacket	145	71.8	72.9	72.9
	Overall	54	26.7	27.1	100.0
	Total	199	98.5	100.0	
Missing	System	3	1.5		
Total		202	100.0		

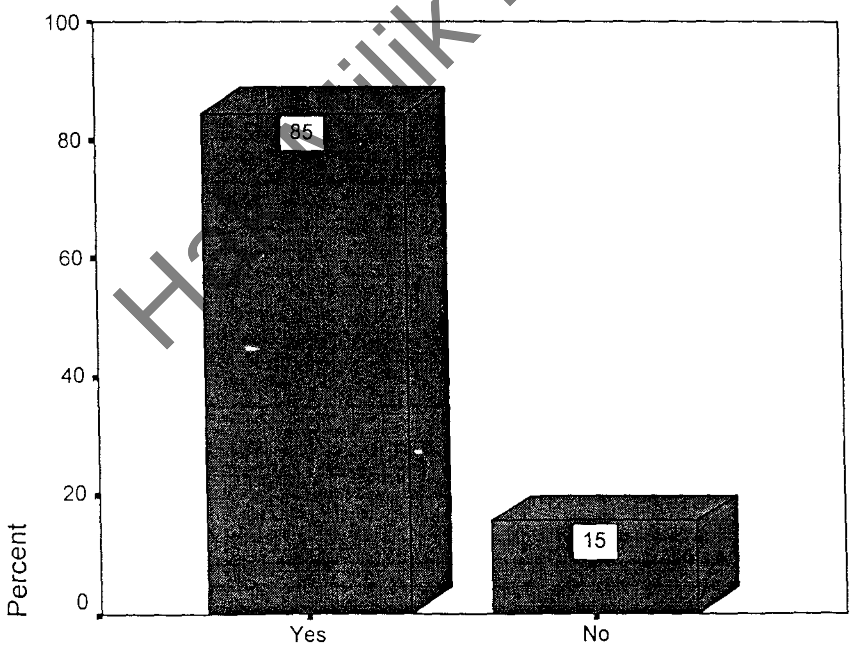


21. Shoes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Safety boot	197	97.5	100.0	100.0
Missing	System	5	2.5		
Total		202	100.0		

22. Freely

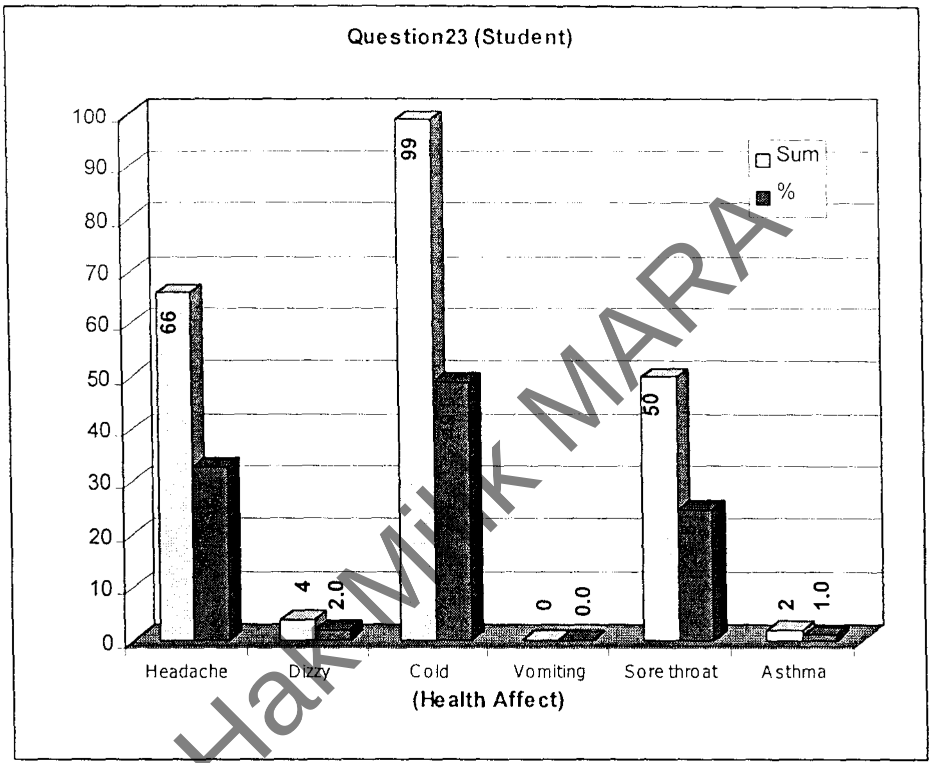
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	170	84.2	84.6	84.6
	No	31	15.3	15.4	100.0
	Total	201	99.5	100.0	
Missing	System	1	.5		
Total		202	100.0		



Freely

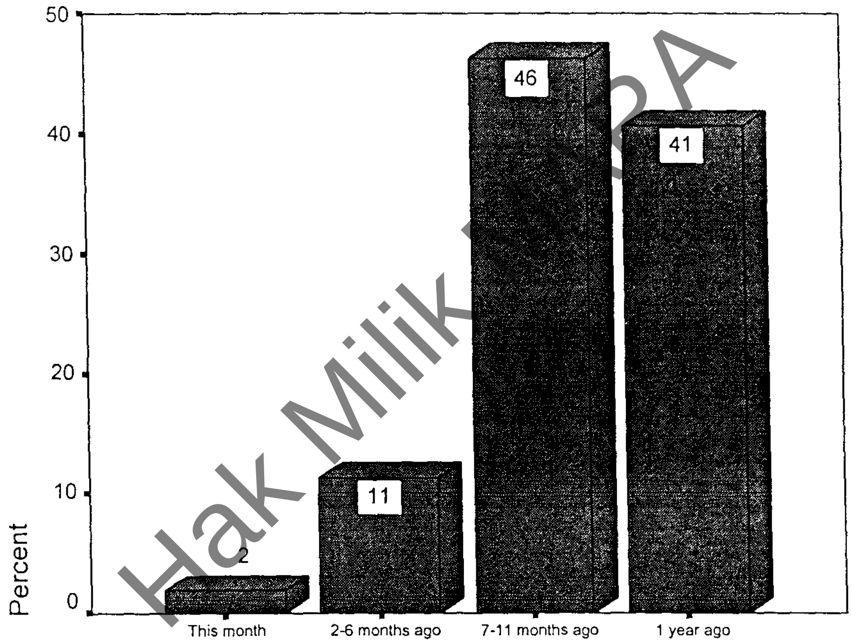
23. Health affect

	Headache	Dizzy	Cold	Vomiting	Sore throat	Asthma
N	202	202	202	202	202	202
Sum	66	4	99	0	50	2
Mis.	136	198	103	202	152	200
%	32.7	2.0	49.0	0.0	24.8	1.0



24. Latest MC

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	This month	2	1.0	1.9	1.9
	2-6 months ago	12	5.9	11.3	13.2
	7-11 months ago	49	24.3	46.2	59.4
	1 year ago	43	21.3	40.6	100.0
	Total	106	52.5	100.0	
Missing	System	96	47.5		
Total		202	100.0		



Latest MC

25. Doctor

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	This month	2	1.0	1.6	1.6
	2-6 months ago	12	5.9	9.7	11.3
	7-11 months ago	86	42.6	69.4	80.6
	1 year ago	24	11.9	19.4	100.0
	Total	124	61.4	100.0	
Missing	System	78	38.6		
Total		202	100.0		

Doctor

26. Check Up

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	202	100.0	100.0	100.0

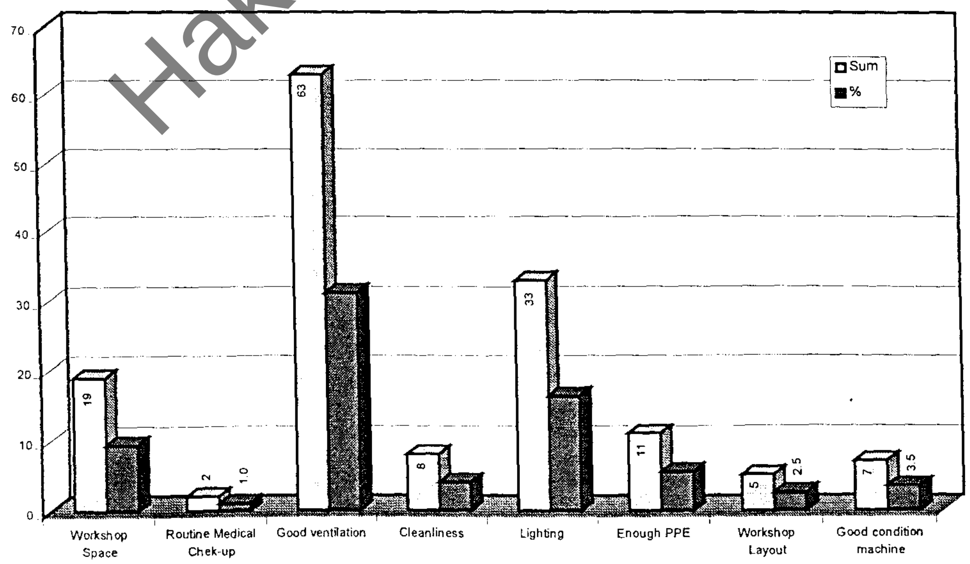
27. Frequent

		Frequency	Percent
Missing	System	202	100.0

28. Recommendations

	Workshop Space	Routine Medical Check-up	Good ventilation	Cleanliness	Lighting	Enough PPE	Workshop Layout	Good condition machine
N	202	202	202	202	202	202	202	202
Sum	19	2	63	8	33	11	5	7
Mis.	183	200	139	194	169	191	197	195
%	**9.4**	**1.0**	**31.2**	**4.0**	**16.3**	**5.4**	**2.5**	**3.5**

Question 28 (Student)

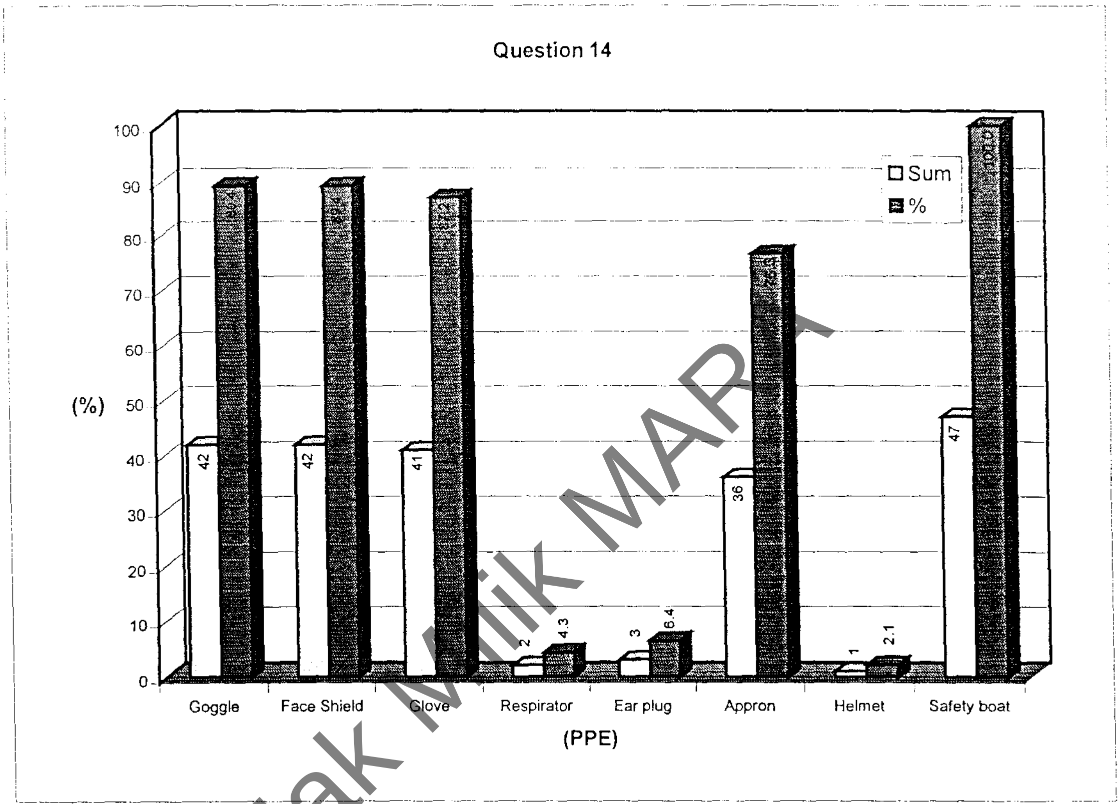


Appendix
36 - 38

Appendix 36

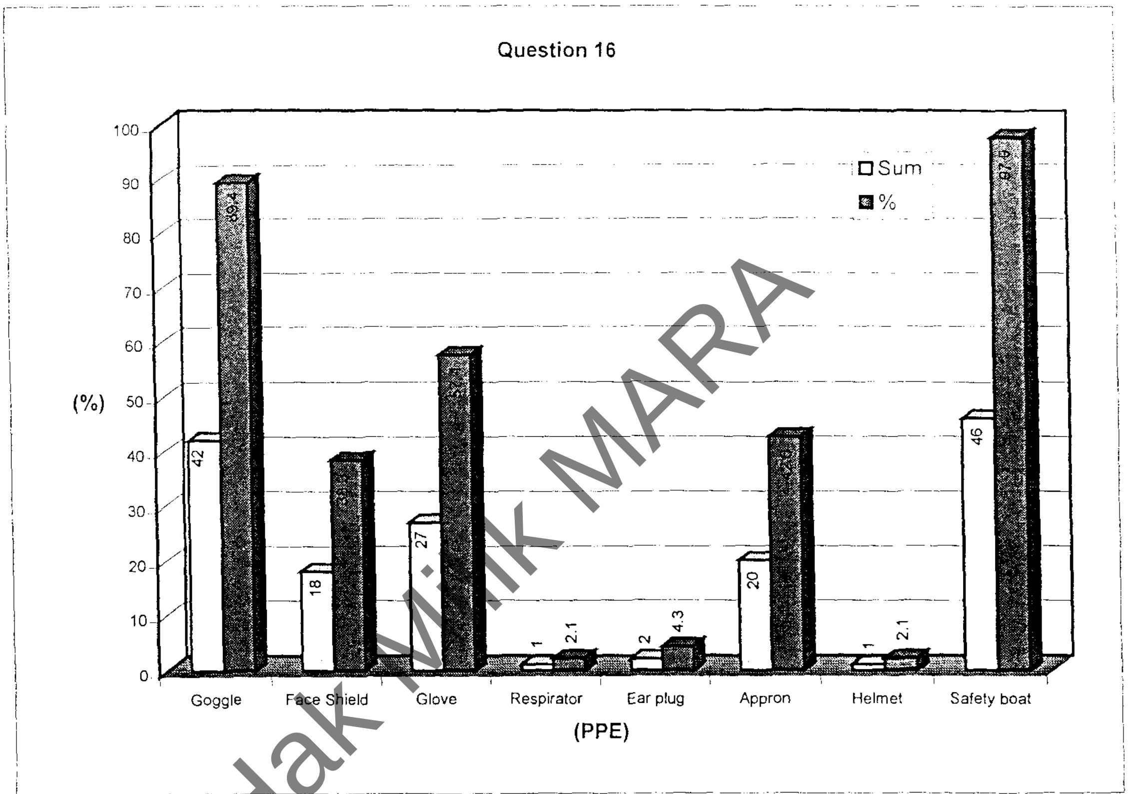
	q14 (Lecturers)							
	Goggle	Face Shield	Glove	Respirator	Ear plug	Appron	Helmet	Safety boat
1	1	1	1			1		1
2	1	1	1					1
3	1	1	1					1
4	1		1					1
5		1		1	1		1	1
6		1	1			1		1
7	1	1						1
8	1	1	1			1		1
9	1							1
10	1		1	1		1		1
11	1		1					1
12	1		1					1
13	1	1	1			1		1
14	1	1	1			1		1
15	1	1	1			1		1
16	1	1	1			1		1
17	1	1	1			1		1
18	1	1				1		1
19	1	1	1			1		1
20		1	1			1		1
21	1	1	1		1	1		1
22	1	1	1					1
23	1	1	1			1		1
24	1	1	1			1		1
25	1	1	1			1		1
26	1	1	1			1		1
27	1	1	1			1		1
28	1	1	1			1		1
29	1	1	1			1		1
30	1	1	1			1		1
31	1	1	1			1		1
32	1	1	1					1
33		1	1			1		1
34	1	1	1			1		1
35	1	1	1			1		1
36	1	1	1			1		1
37	1	1				1		1
38	1	1				1		1
39	1	1	1			1		1
40	1	1	1			1		1
41	1	1	1			1		1
42	1	1	1			1		1
43	1	1	1					1
44	1	1	1		1	1		1

45		1	1			1		1
46	1	1	1			1		1
47	1	1	1			1		1
N	47	47	47	47	47	47	47	47
Sum	42	42	41	2	3	36	1	47
%	**89.4**	**89.4**	**87.2**	**4.3**	**6.4**	**76.6**	**2.1**	**100.0**



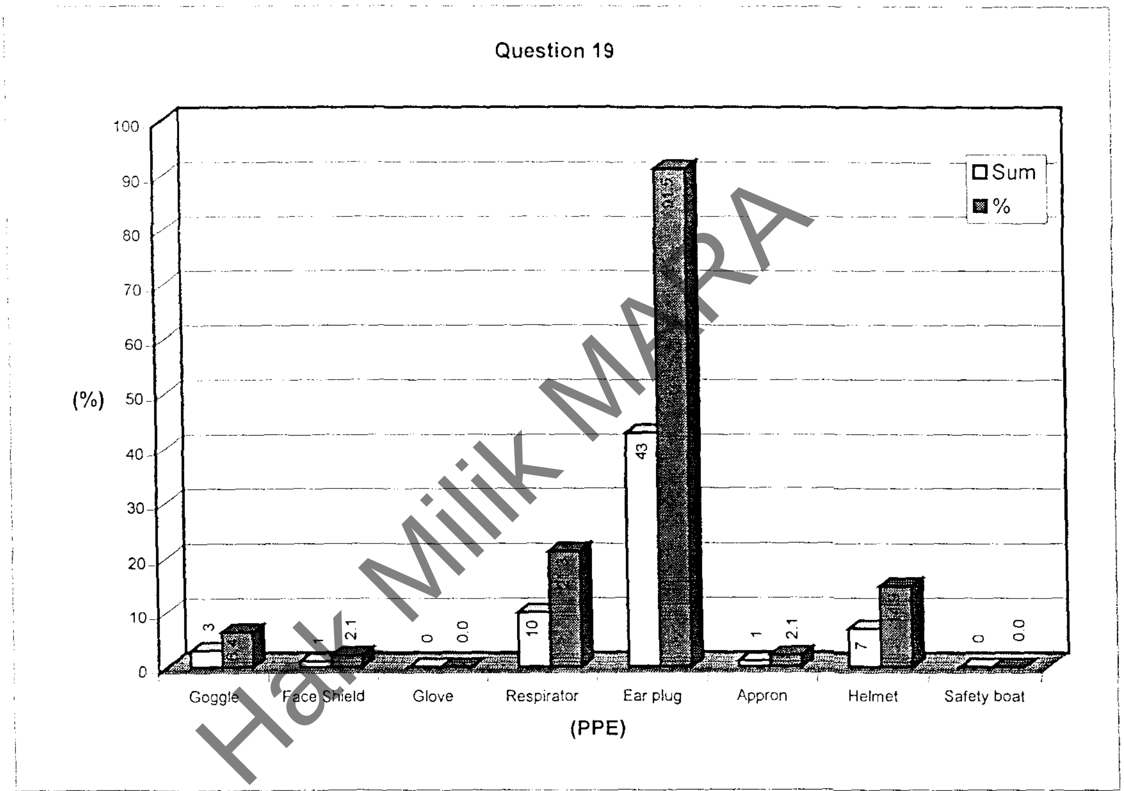
	q16 (Lecturers)							
	Goggle	Face Shield	Glove	Respirator	Ear plug	Appron	Helmet	Safety boat
1	1	1						1
2	1	1	1					1
3	1	1	1		1			1
4	1						1	1
5								1
6								1
7	1	1						1
8	1							1
9	1	1						1
10	1	1			1	1		1
11	1		1					1
12	1							1
13	1	1				1		1
14	1		1					1
15	1							1
16	1	1				1		1
17		1	1					
18	1					1		1
19	1	1	1			1		1
20	1		1					1
21	1		1					1
22	1	1				1		1
23	1	1	1					1
24	1					1		1
25	1	1				1		1
26	1		1					1
27	1	1	1					1
28	1	1				1		1
29	1		1					1
30	1	1	1			1		1
31			1			1		1
32	1		1					1
33	1		1	1				1
34	1		1			1		1
35	1		1			1		1
36	1		1					1
37	1		1			1		1
38	1		1					1
39	1		1			1		1
40	1		1			1		1
41	1		1					1
42								1
43	1					1		1

44	1		1					1
45	1	1				1		1
46	1	1	1			1		1
47	1		1			1		1
N	47	47	47	47	47	47	47	47
Sum	42	18	27	1	2	20	1	46
%	89.4	38.3	57.4	2.1	4.3	42.6	2.1	97.9



	q19 (Lecturers)							
	Goggle	Face Shield	Glove	Respirator	Ear plug	Appron	Helmet	Safety boat
1				1	1		1	
2					1			
3				1	1			
4								
5	1						1	
6								
7					1			
8	1				1	1		
9					1			
10					1			
11				1	1			
12					1		1	
13					1			
14					1			
15					1			
16								
17					1			
18	1				1		1	
19					1			
20					1			
21				1	1			
22					1			
23					1			
24				1	1			
25					1			
26		1			1			
27				1	1		1	
28				1	1			
29					1			
30					1			
31					1			
32					1			
33					1			
34					1			
35					1			
36					1			
37					1		1	
38				1	1			
39					1			
40					1			
41					1			

42					1			
43					1			
44					1		1	
45					1			
46				1	1			
47				1	1			
N	47	47	47	47	47	47	47	47
Sum	3	1	0	10	43	1	7	0
%	6.4	2.1	0.0	21.3	91.5	2.1	14.9	0.0



Appendix 37

	q14 (Students)							
	Goggle	Face Shield	Glove	Respirator	Ear plug	Appron	Helmet	Safety boat
1	1	1	1			1		1
2		1						1
3		1						1
4		1						1
5	1	1						1
6	1	1	1				1	1
7		1					1	1
8	1	1	1			1		1
9	1	1	1			1		1
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68	1	1	1				1
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81							
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93	1	1	1			1	1

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98		1	1			1		1
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114	1		1				1	1
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140			1					1
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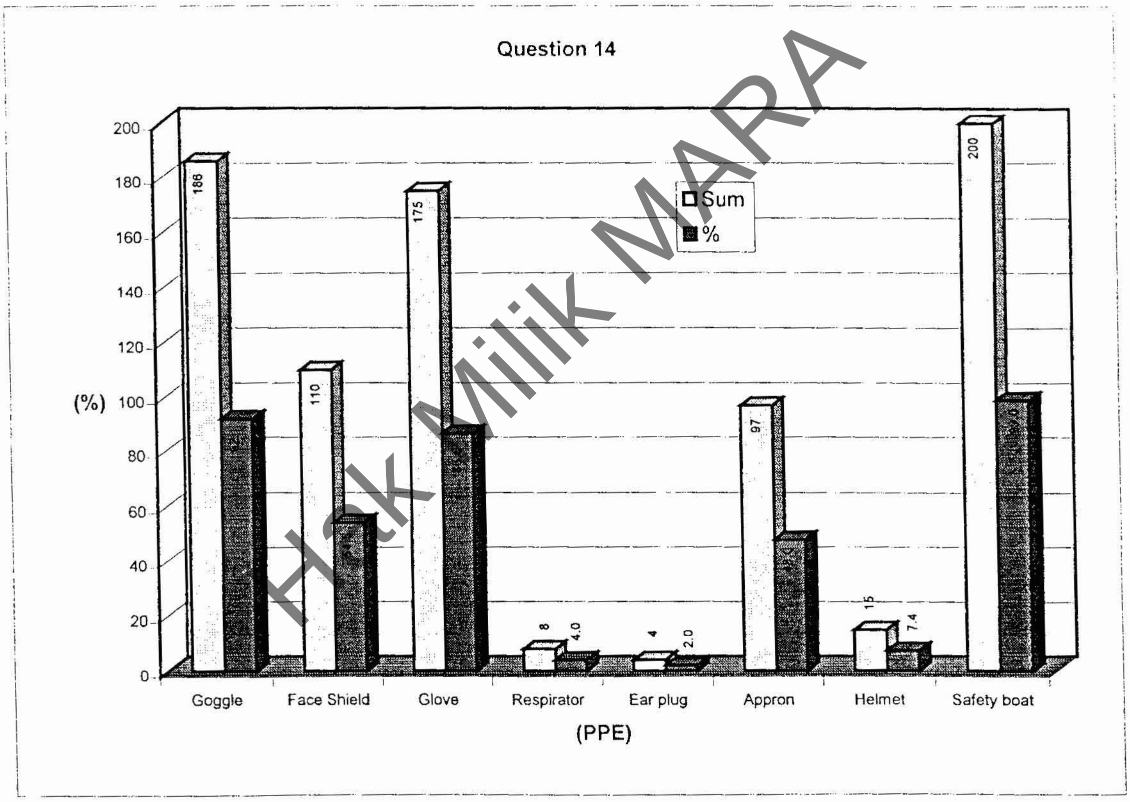
188	1	1	1	1	1
189	1	1	1	1	1
190	1	1	1	1	1
191	1	1	1	1	1

192	1	1	1			1		1
193	1	1	1			1		1
194	1	1	1			1		1
195	1	1				1		1
196	1	1	1					1
197		1	1			1		1
198	1	1	1			1		1
199	1	1	1			1		1
200	1		1			1		1
201	1	1	1			1		1
202	1	1	1			1		1
N	202	202	202	202	202	202	202	202
Sum	186	110	175	8	4	97	15	200
%	92.1	54.5	86.6	4.0	2.0	48.0	7.4	99.0



q16 (Students)								
	Goggle	Face Shield	Glove	Respirator	Ear plug	Appron	Helmet	Safety boat
1	1	1						1
2								1
3		1						1
4		1						1
5	1	1	1					1
6	1		1				1	1
7	1	1	1			1		1
8	1	1	1			1		1
9	1	1						1
10	1	1	1			1		1
11	1	1	1					1
12	1	1	1			1		1
13	1	1						1
14	1	1	1			1		1
15	1	1	1					1
16	1	1						1
17	1	1	1			1		1
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19	1	1						1
20	1	1	1					1
21	1	1				1		1
22	1	1	1					1
23	1	1						1
24	1	1						1
25								
26	1	1	1					1
27	1	1	1			1		1
28	1	1	1					1
29	1	1						1
30	1	1	1			1		1
31	1	1	1					1
32	1	1	1					1
33	1	1	1					1
34	1	1	1					1
35	1	1	1	1				1
36	1	1	1	1		1		1
37	1	1	1			1		1
38	1	1	1	1				1
39	1	1	1					1
40	1	1	1					1
41	1	1						1
42	1	1	1	1		1		1
43	1	1	1	1		1		1

44	1	1	1			1
45	1	1	1		1	1
46	1	1	1			1
47	1	1	1			1
48	1	1	1			1
49	1	1	1		1	1
50	1	1	1			1
51	1	1	1			1
52	1	1	1			1
53	1	1				1
54	1	1	1			1
55						
56	1	1	1			1
57	1	1	1		1	1
58	1	1	1			1
59	1	1	1			1
60	1	1	1		1	1
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64	1	1	1			1
65	1	1	1			1
66	1	1	1			1
67	1	1	1			1
68	1	1	1			1
69	1	1	1			1
70	1	1	1			1
71	1	1	1			1
72		1	1		1	1
73	1	1	1			1
74	1	1	1	1	1	1
75	1	1	1			1
76	1	1	1			1
77		1				1
78	1	1	1			1
79	1	1	1			1
80	1	1	1		1	1
81	1	1	1		1	1
82		1	1			1
83	1	1	1			1
84	1	1	1		1	1
85	1	1			1	1
86	1	1				1
87		1	1			1
88		1	1			1
89	1	1	1			1
90	1	1	1			1
91	1	1	1			1
92	1	1	1			1

93	1	1	1	1
94	1	1	1	1
95	1	1	1	1
96	1	1	1	1
97	1	1	1	1
98	1	1	1	1
99	1		1	1
100	1		1	1
101	1		1	1
102	1		1	1
103	1		1	1
104	1		1	1
105				1
106			1	1
107	1		1	1
108	1		1	1
109	1		1	1
110	1			1
111	1			1
112			1	1
113	1		1	1
114	1		1	1
115	1			1
116	1		1	1
117			1	1
118	1		1	1
119	1		1	1
120			1	1
121				1
122				1
123				1
124	1		1	1
125	1		1	1
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127			1	1
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129	1			1
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133	1			1
134	1			1
135	1			1
136	1			1
137				1
138				1
139	1		1	1
140	1		1	1
141			1	1

142				1
143				1
144				1
145	1			1
146	1		1	1
147	1		1	1
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149	1		1	1
150	1		1	1
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163	1		1	1
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165	1		1	1
166	1		1	1
167			1	1
168	1			1
169	1			1
170	1			1
171	1		1	1
172			1	1
173	1		1	1
174	1		1	1
175				1
176				1
177	1		1	1
178	1		1	1
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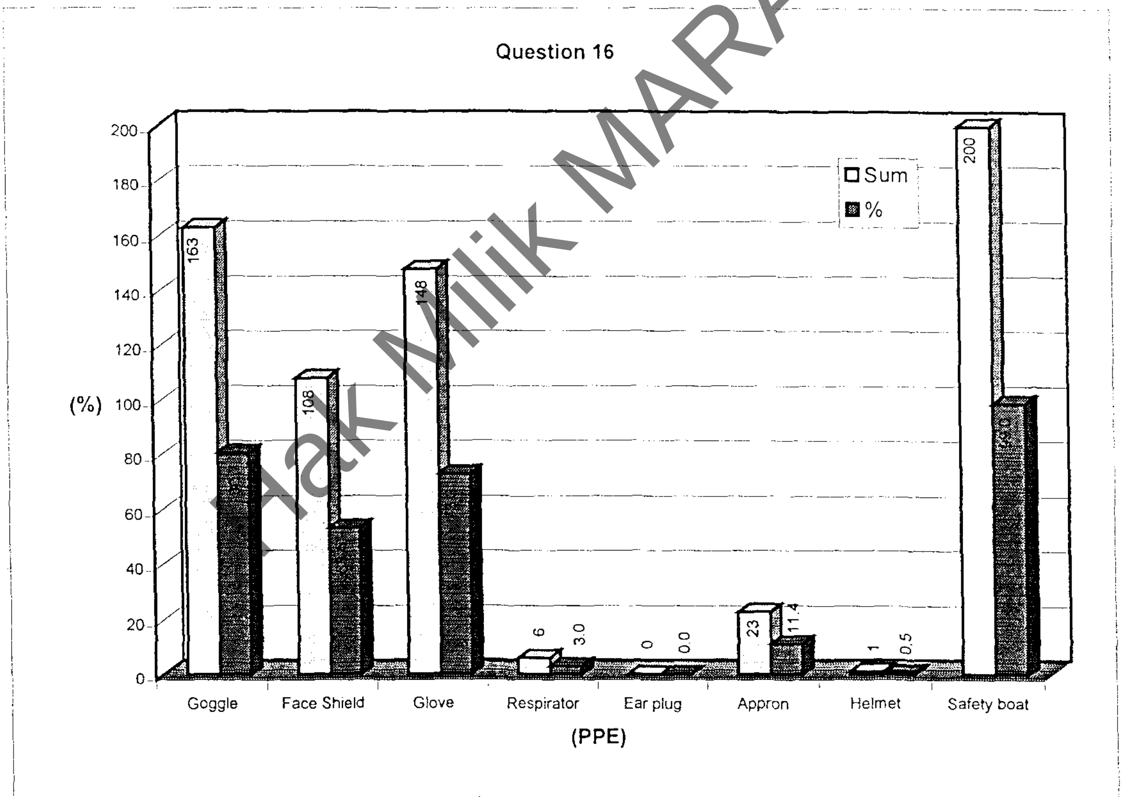
180	1			1
181				1
182	1		1	1
183			1	1
184	1		1	1
185	1		1	1
186	1		1	1
187	1		1	1
188	1		1	1
189	1	1	1	1
190	1	1	1	1

191	1	1						1
192		1						1
193	1	1	1					1
194	1	1	1					1
195	1	1	1					1
196		1	1					1
197	1	1						1
198	1	1						1
199		1						1
200		1	1					1
201	1	1	1					1
202	1	1	1					1
N	202	202	202	202	202	202	202	202
Sum	163	108	148	6	0	23	1	200
%	**80.7**	**53.5**	**73.3**	**3.0**	**0.0**	**11.4**	**0.5**	**99.0**



	q19 (Students)							
	Goggle	Face Shield	Glove	Respirator	Ear plug	Appron	Helmet	Safety boat
1								
2								
3								
4								
5								
6								
7					1			
8			1					
9						1		
10			1					
11								
12				1	1			
13								
14								
15				1	1			
16					1			
17					1			
18				1				
19				1	1			
20					1			
21					1			
22				1	1			
23								
24					1			
25								
26				1	1			
27				1				
28				1	1			
29					1			
30					1			
31					1			
32					1			
33				1				
34				1				
35				1	1			
36								
37				1	1			
38				1	1			
39				1	1			
40				1				
41				1	1			
42					1			
43					1			

44		1
45		1
46		1
47		1
48		
49		1
50		
51		1
52	1	1
53	1	
54	1	1
55		1
56		1
57		1
58	1	
59	1	
60	1	1
61		1
62		1
63		1
64	1	
65	1	
66		
67		1
68		1
69		
70		1
71		1
72		1
73	1	
74	1	1
75		1
76	1	1
77	1	1
78		1
79		
80	1	
81	1	
82		1
83		
84	1	1
85		
86		
87		
88	1	
89	1	1
90		1
91		1
92		1

93			1	
94		1	1	1
95			1	
96			1	
97		1	1	
98		1		
99		1		
100			1	
101			1	
102			1	
103				
104				
105				
106			1	
107			1	
108		1	1	
109		1	1	
110		1		
111		1		
112		1	1	
113		1	1	
114		1	1	
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119	1		1	
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121	1			
122				
123				
124				
125	1			
126	1			
127				
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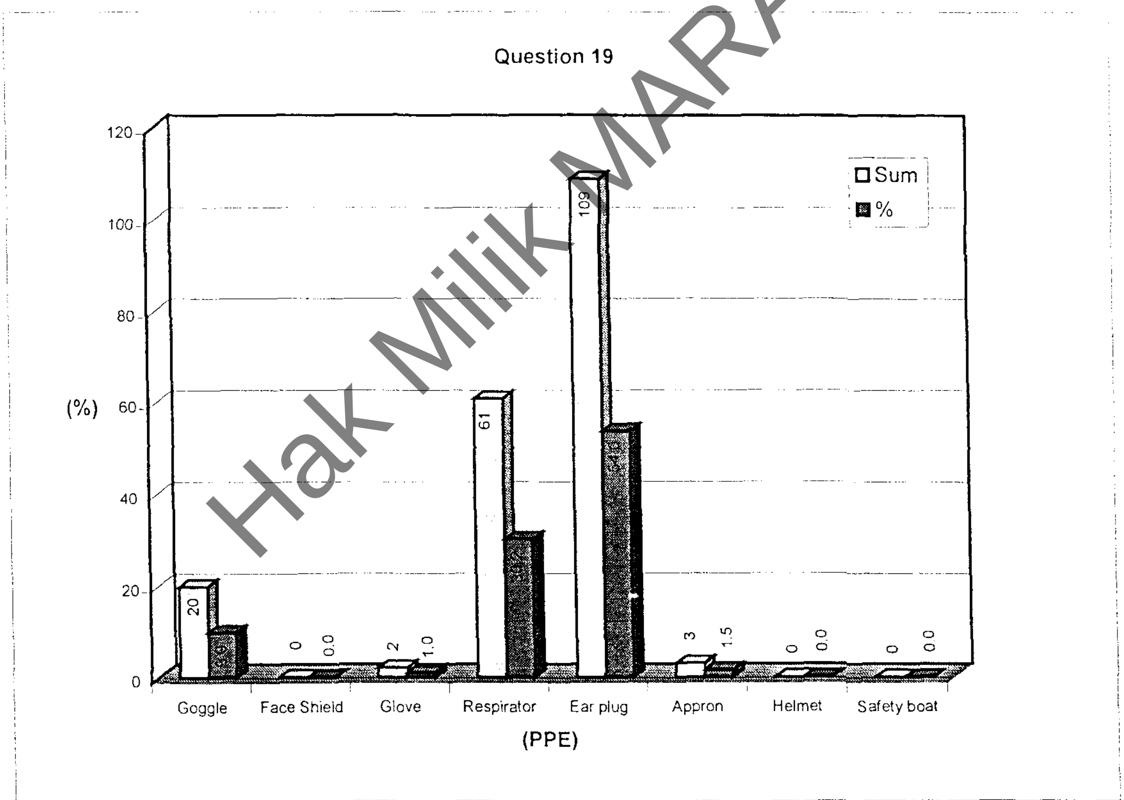
129			1	
130		1		
131	1	1		
132	1		1	
133				
134				
135			1	
136			1	
137			1	
138				
139			1	
140				
141				

142			
143			1
144			1
145			
146		1	
147	1	1	
148			
149			
150	1	1	
151	1		
152	1		1
153			1
154			1
155			
156			
157			
158			1
159		1	
160			
161			1
162			1
163			
164			
165			
166			
167	1	1	
168			
169	1		
170	1		
171			
172			1
173			1
174			
175	1	1	
176	1		1
177	1		
178			
179			1
180			
181			
182			1
183			1
184			1
185			
186		1	1
187			
188		1	1
189	1	1	
190			

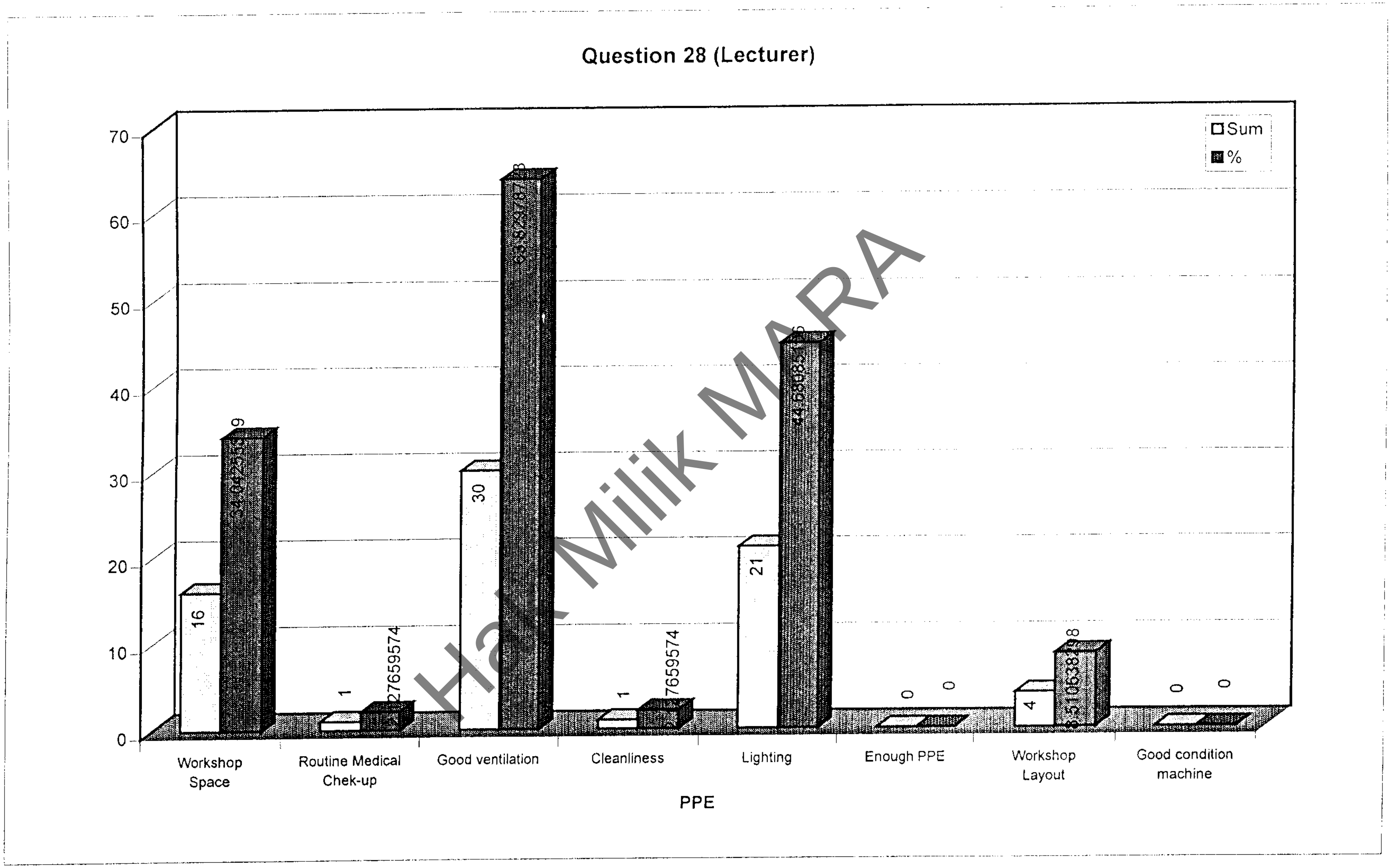
191					1			
192					1			
193					1			
194					1			
195					1			
196	1				1			
197				1	1			
198				1	1			
199				1	1			
200				1				
201					1			
202					1			
N	202	202	202	202	202	202	202	202
Sum	20	0	2	61	109	3	0	0
%	9.9	0.0	1.0	30.2	54.0	1.5	0.0	0.0



	q28 (Lecturer)							
	Workshop Space	Routine Medical Chek-up	Good ventilation	Cleanliness	Lighting	Enough PPE	Workshop Layout	Good condition machine
1	1		1					
2	1		1				1	
3			1		1		1	
4	1							
5	1		1				1	
6	1		1		1			
7	1							
8			1					
9	1							
10		1						
11			1					
12					1		1	
13	1			1	1			
14			1		1			
15			1		1			
16			1		1			
17	1		1					
18	1		1					
19			1					
20	1							
21	1		1		1			
22	1		1					
23	1		1					
24	1							
25			1		1			
26			1		1			
27			1		1			
28			1		1			

Appendix 38

29			1					
30			1					
31			1					
32			1					
33			1		1			
34					1			
35					1			
36	1							
37			1					
38					1			
39					1			
40			1					
41								
42			1		1			
43								
44					1			
45			1					
46			1		1			
47					1			
N	47	47	47	47	47	47	47	47
Sum	16	1	30	1	21	0	4	0
Mis.	31	46	17	46	26	47	43	47
%	**34.0**	**2.1**	**63.8**	**2.1**	**44.7**	0.0	**8.5**	**0.0**


Question 28 (Lecturer)
Sum
%
70
60
50
40
30
20
10
0
16
1
30
1
21
0
0
4
0
0
27659574
7659574
Workshop Space
Routine Medical Chek-up
Good ventilation
Cleanliness
Lighting
Enough PPE
Workshop Layout
Good condition machine
PPE

	q28 (Student)							
	Workshop Space	Routine Medical Chek-up	Good ventilation	Cleanliness	Lighting	Enough PPE	Workshop Layout	Good condition machine
1	1							
2								
3								
4								
5								
6		1						
7								
8			1					
9		1						
10				1				
11			1					
12								
13					1			
14						1		
15			1					
16			1			1		
17							1	
18				1				
19							1	
20								
21			1					
22							1	
23								
24			1	1	1			
25			1					
26						1		

27						
28				1		
29						
30		1				
31						1
32						1
33		1				
34		1				
35						
36		1				
37		1			1	
38		1				
39			1			
40				1		
41		1	1			
42		1	1			
43		1	1			
44						
45	1			1		
46	1					
47				1		
48						
49						
50						1
51				1		
52		1				
53		1	1			
54	1					
55						1
56			1			
57						

58							
59							
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61					1		
62							1
63							
64	1	1					
65		1		1			
66			1				
67	1						
68	1	1		1			
69				1			
70		1					
71	1						
72		1					
73	1						1
74							
75	1	1		1			
76		1					
77	1						
78	1	1		1			
79	1						
80	1	1		1			
81							
82							
83	1						
84							
85							
86		1		1	1		
87							
88						1	

89	1	1	1
90			
91	1	1	
92		1	1
93			
94	1	1	1
95	1	1	1
96			
97		1	
98		1	
99			
100			
101			
102			
103			
104			
105			
106			
107		1	
108			
109			
110			
111			
112			
113			
114			
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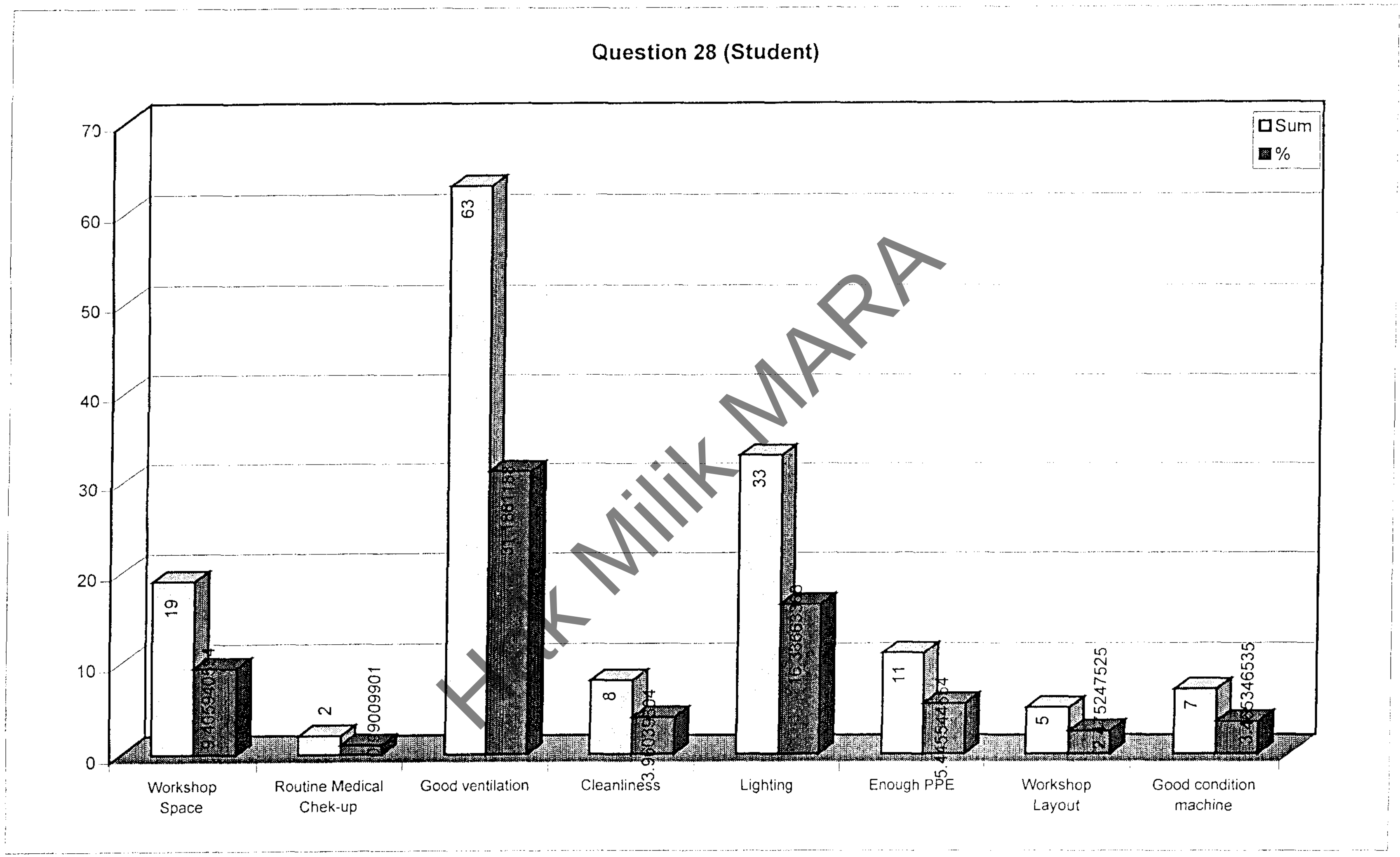
116			
117		1	
118		1	
119			

120		
121		
122		
123		
124		
125		
126	1	
127		
128		
129		
130		1
131	1	1
132	1	
133		
134		
135	1	
136		
137		
138	1	
139		
140	1	
141	1	
142		
143		
144	1	
145		
146		
147		
148		
149		
150	1	

151			
152			
153			
154			1
155			1
156			
157			
158	1		
159	1		
160	1		
161	1		
162			
163			
164			
165			
166			1
167			
168			
169			
170			
171	1		
172			
173	1		
174			
175	1		
176		1	
177		1	
178	1	1	1
179			
180			1
181			1

182					1			
183								
184								
185								
186					1			
187			1					
188			1					
189			1					
190								
191								
192								
193			1					
194								
195			1		1			
196								
197					1			
198					1			
199					1			
200			1					
201								
202								
N	202	202	202	202	202	202	202	202
Sum	19	2	63	8	33	11	5	7
Mis.	183	200	139	194	169	191	197	195
%	**9.4**	**1.0**	**31.2**	**4.0**	**16.3**	**5.4**	**2.5**	**3.5**



Question 28 (Student)
Sum
%
70
60
50
40
30
20
10
0
19
2
9009901
63
8
33
11
5
5247525
7
65346535
Workshop Space
Routine Medical Chek-up
Good ventilation
Cleanliness
Lighting
Enough PPE
Workshop Layout
Good condition machine

Appendix
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Apendix 39

Total measurement has been recorded

	NO	WORKSHOPS	TEMP.	HUMID.	CO_2	CO	DUST	VEL.	SOUND	LIGHT	TOTAL
INDOOR	1	IKM Kuala Lumpur	600	600	600	600	300	300	120	120	**3240**
	2	IKM Lumut	600	600	600	600	600	600	120	120	**3840**
	3	IKM TSYA, Pekan	480	480	480	480	480	480	96	96	**3072**
OUTDOOR	1	IKM Kuala Lumpur	60	60	60	60	32	32	24	24	**352**
	2	IKM Lumut	60	60	60	60	60	120	24	24	**468**
	3	IKM TSYA, Pekan	60	60	60	60	60	120	24	24	**468**
		TOTAL	**1860**	**1860**	**1860**	**1860**	**1532**	**1652**	**408**	408	**11440**

Appendix 40

INDOOR

Temperature Level (°C)

CENTER : IKM Kuala Lumpur

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Air-Condition Workshop	26.4	29.5	27.3	26.7	26.9	0.90	60
2	EDI Workshop I	**26.2**	30.1	29.5	29.4	29.5	0.50	60
3	KMPM Workshop I	31.7	31.9	31.8	31.8	31.8	0.10	60
6	KMPM Workshop II	31.8	32.0	31.9	32.0	31.9	0.10	60
7	Welding Workshop	34.7	**35.6**	35.1	34.9	35.0	0.20	60
8	EDI Workshop II	31.8	32.2	32.0	32.0	32.0	0.10	60
9	PJE Workshop	28.1	29.6	28.8	28.3	28.3	0.60	60
10	EDI Workshop III	32.1	32.5	32.3	32.3	32.3	0.10	60
11	Sheet Metal Workshop I	32.2	33.1	32.7	33.0	32.8	0.30	60
12	Sheet Metal Workshop II	32.8	33.3	33.1	33.2	33.1	0.10	60
		26.2	*35.6*	*31.5*				

CENTER : IKM Lumut

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Arc Workshop I	29.2	30.4	29.8	29.9	29.9	0.28	60
2	Spray Painting Workshop	**28.6**	30.1	29.4	29.4	29.4	0.43	60
3	Foundry Workshop	30.3	31.5	30.9	30.7	30.8	0.28	60
6	Pattern Workshop	30.4	31.4	30.7	30.7	30.7	0.23	60
7	Machine Workshop I	30.5	31.4	31.0	31.1	31.1	0.20	60
8	Machine Workshop II	31.1	31.8	31.4	31.7	31.4	0.23	60
9	Electrical Workshop I	29.8	31.1	30.6	30.9	30.7	0.38	60
10	Arc Workshop II	31.0	31.5	31.2	31.1	31.2	0.13	60
11	Arc Workshop III	31.1	**31.8**	31.4	31.3	31.4	0.21	60
12	Electrical Workshop II	31.7	**31.8**	31.7	31.7	31.7	0.04	60
		28.6	*31.8*	*30.8*				

CENTER : IKM TSYA, Pekan

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Petrol (Automobile)	**28.1**	29.9	28.7	28.3	28.4	0.48	60
2	Transmision (Automobile)	29.8	31.1	30.6	30.9	30.7	0.38	60
3	Store (Automobile)	31.1	31.8	31.4	31.4	31.4	0.21	60
6	Laboratory (Automobile)	31.8	32.0	31.9	32.0	31.9	0.08	60
7	Petrol (Automotive)	31.8	32.2	32.0	32.0	32.0	0.09	60
8	Diesel (Automotive)	32.1	32.5	32.3	32.3	32.3	0.10	60
9	Fitting (Spray Painting)	30.4	32.1	31.1	30.6	31.1	0.46	60
12	Machine Shop	33.1	**33.6**	33.4	33.4	33.4	0.13	60
		28.1	*33.6*	*31.4*				

OUTDOOR

Temperature Level (^{o}C)

CENTER : IKM Kuala Lumpur

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	31.3	31.5	31.4	31.4	31.4	0.05	15
5	**31.1**	31.4	31.2	31.1	31.2	0.12	15
13	33.2	33.3	33.2	33.2	33.2	0.04	15
14	33.5	**33.6**	33.5	33.5	33.5	0.04	15
	31.1	*33.6*	*32.3*				

CENTER : IKM Lumut

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	31.1	31.3	31.1	31.1	31.1	0.06	15
5	**31.0**	31.2	31.1	31.1	31.1	0.06	15
13	32.8	33.0	32.9	32.9	32.9	0.05	15
14	33.0	**33.2**	33.1	33.1	33.1	0.08	15
	31.0	*33.2*	*32.1*				

CENTER : IKM TSYA, Pekan

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	32.2	32.5	32.4	32.4	32.4	0.10	15
5	**30.9**	31.7	31.3	31.4	31.4	0.28	15
10	37.1	**37.8**	37.6	37.7	37.6	0.18	15
11	37.0	37.3	37.1	37.3	37.1	0.12	15
	30.9	*37.8*	*34.6*				

Appendix 41

INDOOR

Humidity Level (%)

CENTER : IKM Kuala Lumpur

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Air-Condition Workshop	**55.4**	63.0	60.0	60.0	60.2	1.95	60
2	EDI Workshop I	79.7	81.7	80.5	79.7	79.9	0.86	60
3	KMPM Workshop I	64.8	66.6	65.7	65.6	65.7	0.44	60
6	KMPM Workshop II	64.3	66.2	65.3	65.9	65.2	0.51	60
7	Welding Workshop	56.1	59.8	58.8	59.6	59.2	1.08	60
8	EDI Workshop II	63.8	65.8	64.6	64.3	64.7	0.45	60
9	PJE Workshop	79.7	**83.6**	81.6	80.6	82.2	1.21	60
10	EDI Workshop III	61.9	65.3	63.4	63.3	63.2	0.94	60
11	Sheet Metal Workshop I	60.4	63.3	62.4	62.8	62.6	0.58	60
12	Sheet Metal Workshop II	59.5	61.3	60.7	60.9	60.8	0.46	60
		55.4	*83.6*	*66.3*				

CENTER : IKM Lumut

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Arc Workshop I	74.8	78.8	77.0	76.8	77.0	1.03	60
2	Spray Painting Workshop	73.5	**79.8**	76.6	77.7	76.9	1.76	60
3	Foundry Workshop	64.4	71.1	67.5	65.9	67.5	1.65	60
6	Pattern Workshop	65.5	68.0	66.7	66.5	66.7	0.63	60
7	Machine Workshop I	64.5	66.5	65.5	65.2	65.4	0.54	60
8	Machine Workshop II	**64.2**	66.1	65.0	64.6	64.9	0.53	60
9	Electrical Workshop I	71.9	77.9	74.7	72.5	74.7	1.74	60
10	Arc Workshop II	68.5	72.1	70.6	71.0	71.0	1.09	60
11	Arc Workshop III	67.6	69.6	69.1	69.2	69.2	0.39	60
12	Electrical Workshop II	66.2	68.2	67.6	67.6	67.8	0.57	60
		64.2	*79.8*	*70.0*				

CENTER : IKM TSYA, Pekan

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Petrol (Automobile)	73.0	**82.6**	79.3	81.5	80.9	2.90	60
2	Transmision (Automobile)	71.9	77.9	74.7	72.5	74.7	1.74	60
3	Store (Automobile)	67.6	69.6	69.1	69.2	69.2	0.39	60
6	Laboratory (Automobile)	64.3	66.2	65.3	65.9	65.2	0.51	60
7	Petrol (Automotive)	63.8	65.8	64.6	64.3	64.7	0.45	60
8	Diesel (Automotive)	61.9	65.3	63.4	63.3	63.2	0.94	60
9	Fitting (Spray Painting)	70.6	75.4	72.7	74.0	72.6	1.50	60
12	Machine Shop	**59.5**	61.3	60.1	60.1	60.1	0.38	60
		59.5	*82.6*	*68.7*				

OUTDOOR

Humidity Level (%)

CENTER : IKM Kuala Lumpur

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	69.2	71.1	70.4	71.0	70.4	0.60	15
5	68.5	**71.4**	69.4	68.5	68.8	1.19	15
13	**59.5**	60.4	60.1	60.4	60.1	0.30	15
14	59.7	60.0	59.8	59.8	59.8	0.09	15
	59.5	*71.4*	*64.9*				

CENTER : IKM Lumut

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	71.1	**72.1**	71.7	72.0	72.0	0.40	15
5	70.9	71.1	71.0	71.0	71.0	0.06	15
13	**60.3**	61.0	60.6	60.3	60.6	0.27	15
14	60.6	61.3	61.1	61.2	61.1	0.19	15
	60.3	*72.1*	*66.1*				

CENTER : IKM TSYA, Pekan

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	62.0	63.3	62.7	62.4	62.8	0.38	15
5	71.3	**73.3**	72.6	72.8	72.8	0.55	15
10	**44.0**	51.7	46.5	-	46.5	2.02	15
11	48.6	51.9	50.3	-	50.4	1.01	15
	44.0	*73.3*	*58.0*				

Appendix 42

INDOOR

Carbon Dioxide Level (ppm CO_2)

CENTER : IKM Kuala Lumpur

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Air-Condition Workshop	689	1016	801	705	779	93.5	60
2	EDI Workshop I	405	500	456	497	487	42.1	60
3	KMPM Workshop I	398	**3342**	632	402	404	595.7	60
6	KMPM Workshop II	379	493	406	403	403	24.7	60
7	Welding Workshop	**330**	367	352	358	354	9.1	60
8	EDI Workshop II	377	475	399	393	393	21.4	60
9	PJE Workshop	374	436	411	433	428	23.0	60
10	EDI Workshop III	379	429	399	389	392	16.1	60
11	Sheet Metal Workshop I	381	434	410	419	418	16.5	60
12	Sheet Metal Workshop II	382	425	403	394	403	12.1	60
		330	*3342*	*466.9*				

CENTER : IKM Lumut

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Arc Workshop I	704	**1166**	857	762	801	139.0	60
2	Spray Painting Workshop	516	771	587	519	572	59.3	60
3	Foundry Workshop	405	537	462	412	458	40.3	60
6	Pattern Workshop	421	517	439	430	432	19.6	60
7	Machine Workshop I	405	453	419	415	418	8.7	60
8	Machine Workshop II	419	662	485	424	447	68.0	60
9	Electrical Workshop I	420	518	455	457	452	15.3	60
10	Arc Workshop II	421	458	436	441	437	9.8	60
11	Arc Workshop III	409	450	428	429	429	8.3	60
12	Electrical Workshop II	**396**	427	413	416	416	8.6	60
		396.0	*1166.0*	*498.1*				

CENTER : IKM TSYA, Pekan

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Petrol (Automobile)	434.0	481.0	448.0	437.0	445.0	11.70	60
2	Transmision (Automobile)	420.0	518.0	455.0	457.0	452.0	15.40	60
3	Store (Automobile)	409.0	450.0	428.0	429.0	429.0	8.34	60
6	Laboratory (Automobile)	379.0	493.0	406.0	403.0	403.0	24.70	60
7	Petrol (Automotive)	**377.0**	475.0	399.0	393.0	393.0	21.40	60
8	Diesel (Automotive)	379.0	429.0	399.0	399.0	392.0	16.10	60
9	Fitting (Spray Painting)	420.0	544.0	459.0	435.0	455.0	31.70	60
12	Machine Shop	388.0	**594.0**	420.0	416.0	411.0	42.50	60
		377.0	*594.0*	*426.8*				

OUTDOOR

Carbon Dioxide Level (ppm CO_2)

CENTER : IKM Kuala Lumpur

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	430.0	448.0	438.0	440.0	438.0	5.15	15
5	421.0	448.0	429.0	421.0	424.0	10.04	15
13	**388.0**	404.0	396.0	399.0	396.0	4.50	15
14	411.0	**594.0**	461.0	416.0	418.0	70.08	15
	388.0	*594.0*	*431.0*				

CENTER : IKM Lumut

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	438.0	**458.0**	447.0	441.0	447.0	6.82	15
5	424.0	442.0	432.0	431.0	431.0	4.66	15
13	**382.0**	397.0	390.0	395.0	391.0	4.50	15
14	408.0	420.0	415.0	416.0	415.0	3.76	15
	382.0	*458.0*	*421.0*				

CENTER : IKM TSYA, Pekan

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	381.0	392.0	387.0	384.0	387.0	3.30	15
5	433.0	453.0	444.0	453.0	444.0	6.80	15
10	359.0	**504.0**	410.0	-	395.0	39.80	15
11	**350.0**	388.0	362.0	364.0	363.0	9.90	15
	350.0	*504.0*	*400.8*				

Appendix 43

INDOOR

Carbon monoxide Level (ppm CO)

CENTER : IKM Kuala Lumpur

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Air-Condition Workshop	0.3	1.4	0.9	1.4	1.0	0.36	60
2	EDI Workshop I	1.0	1.4	1.3	1.4	1.4	0.15	60
3	KMPM Workshop I	1.1	2.2	1.4	1.4	1.4	0.15	60
6	KMPM Workshop II	1.4	2.5	1.5	1.4	1.4	0.22	60
7	Welding Workshop	1.4	**2.8**	1.5	1.4	1.4	0.36	60
8	EDI Workshop II	1.1	1.7	1.4	1.4	1.4	0.08	60
9	PJE Workshop	0.6	1.4	1.1	1.1	1.1	0.21	60
10	EDI Workshop III	**0.0**	0.8	0.2	0.3	0.3	0.21	60
11	Sheet Metal Workshop I	1.4	2.2	1.5	1.4	1.4	0.19	60
12	Sheet Metal Workshop II	0.8	1.7	1.4	1.4	1.4	0.12	60
		0.0	*2.8*	*1.2*				

CENTER : IKM Lumut

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Arc Workshop I	2.8	**4.5**	4.1	4.2	4.2	0.38	60
2	Spray Painting Workshop	1.1	1.5	1.3	1.4	1.4	0.09	60
3	Foundry Workshop	**0.1**	3.1	1.1	1.4	1.2	0.54	60
6	Pattern Workshop	0.2	1.2	0.7	0.9	0.8	0.28	60
7	Machine Workshop I	0.2	1.0	0.6	0.7	0.6	0.20	60
8	Machine Workshop II	**0.1**	0.7	0.4	0.4	0.4	0.15	60
9	Electrical Workshop I	1.4	2.8	2.2	2.5	2.2	0.37	60
10	Arc Workshop II	1.4	2.8	2.0	1.4	1.7	0.54	60
11	Arc Workshop III	1.1	1.7	1.4	1.4	1.4	0.11	60
12	Electrical Workshop II	1.4	1.4	1.4	1.4	1.4	0.00	60
		0.1	*4.5*	*1.5*				

CENTER : IKM TSYA, Pekan

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Petrol (Automobile)	**0.8**	1.4	1.2	1.3	1.3	0.17	60
2	Transmision (Automobile)	1.4	**2.8**	2.2	2.5	2.2	0.37	60
3	Store (Automobile)	1.1	1.7	1.4	1.4	1.4	0.11	60
6	Laboratory (Automobile)	1.4	2.5	1.5	1.4	1.4	0.22	60
7	Petrol (Automotive)	1.1	1.7	1.4	1.4	1.4	0.08	60
8	Diesel (Automotive)	1.4	**2.8**	1.5	1.4	1.4	0.36	60
9	Fitting (Spray Painting)	1.0	1.4	1.3	1.3	1.3	0.10	60
12	Machine Shop	**0.8**	1.7	1.4	1.4	1.4	0.12	60
		0.8	*2.8*	*1.5*				

OUTDOOR

Carbon monoxide Level (ppm CO)

CENTER : IKM Kuala Lumpur

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	1.4	**2.8**	1.7	1.4	1.4	0.43	15
5	1.4	**2.8**	1.8	1.4	1.5	0.58	15
13	**0.8**	1.4	1.3	1.4	1.4	0.21	15
14	1.4	1.7	1.4	1.4	1.4	0.08	15
	0.8	*2.8*	*1.6*				

CENTER : IKM Lumut

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	**1.4**	**2.8**	2.4	2.5	2.5	0.37	15
5	**1.4**	**2.8**	2.0	1.7	1.7	0.51	15
13	**1.4**	1.9	1.5	1.4	1.4	0.15	15
14	**1.4**	1.9	1.5	1.4	1.4	0.17	15
	1.4	*2.8*	*1.9*				

CENTER : IKM TSYA, Pekan

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	1.4	**1.8**	1.4	1.4	1.4	0.11	15
5	0.4	1.0	0.8	1.0	0.8	0.19	15
10	**0.0**	1.7	0.6	0.3	0.3	0.56	15
11	0.1	0.8	0.4	0.4	0.4	0.23	15
	0.0	*1.8*	*0.8*				

Appendix 44

INDOOR

Dust Level (mg/m^3)

CENTER : IKM Kuala Lumpur

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Air-Condition Workshop	**0.002**	**0.217**	0.032	0.003	0.008	0.0510	30
2	EDI Workshop I	**0.002**	0.004	0.003	0.003	0.003	0.0004	30
3	KMPM Workshop I	0.003	0.004	0.003	0.003	0.003	0.0004	30
6	KMPM Workshop II	0.003	0.004	0.003	0.003	0.003	0.0010	30
7	Welding Workshop	0.014	0.033	0.021	0.025	0.020	0.0050	30
8	EDI Workshop II	0.003	**0.217**	0.032	0.004	0.005	0.0510	30
9	PJE Workshop	**0.002**	0.008	0.004	0.003	0.003	0.0010	30
10	EDI Workshop III	**0.002**	0.004	0.003	0.003	0.003	0.0004	30
11	Sheet Metal Workshop I	0.003	0.004	0.003	0.003	0.003	0.0010	30
12	Sheet Metal Workshop II	0.003	0.004	0.003	0.003	0.003	0.0005	30
		0.002	*0.217*	*0.011*				

CENTER : IKM Lumut

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Arc Workshop I	0.966	**1.380**	1.090	1.097	1.090	0.082	60
2	Spray Painting Workshop	0.735	0.929	0.848	0.959	0.855	0.053	60
3	Foundry Workshop	0.582	0.752	0.656	0.648	0.659	0.039	60
6	Pattern Workshop	0.498	0.616	0.545	0.566	0.542	0.025	60
7	Machine Workshop I	0.380	0.509	0.434	0.429	0.429	0.032	60
8	Machine Workshop II	0.315	0.382	0.347	0.340	0.343	0.018	60
9	Electrical Workshop I	0.283	0.331	0.308	0.320	0.306	0.011	60
10	Arc Workshop II	0.180	0.285	0.228	0.189	0.227	0.034	60
11	Arc Workshop III	0.146	0.220	0.177	0.158	0.177	0.018	60
12	Electrical Workshop II	**0.119**	0.154	0.136	0.138	0.137	0.008	60
		0.119	*1.380*	*0.477*				

CENTER : IKM TSYA, Pekan

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Petrol (Automobile)	0.007	0.029	0.016	0.009	0.015	0.006	60
2	Transmision (Automobile)	0.002	0.007	0.004	0.004	0.004	0.001	60
3	Store (Automobile)	0.007	**0.041**	0.017	0.012	0.013	0.009	60
6	Laboratory (Automobile)	0.001	0.008	0.004	0.002	0.004	0.002	60
7	Petrol (Automotive)	**0.000**	0.002	0.001	0.001	0.001	0.001	60
8	Diesel (Automotive)	**0.000**	0.002	0.001	0.000	0.000	0.001	60
9	Fitting (Spray Painting)	0.006	0.024	0.013	0.008	0.012	0.006	60
12	Machine Shop	0.001	0.007	0.003	0.003	0.003	0.001	60
		0.000	*0.041*	*0.007*				

OUTDOOR

Dust Level (mg/m^3)

CENTER : IKM Kuala Lumpur

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	**0.001**	0.004	0.003	0.004	0.003	0.0010	8
5	0.004	**0.005**	0.005	0.005	0.005	0.0010	8
13	0.004	**0.005**	0.004	0.004	0.004	0.0005	8
14	0.003	0.004	0.004	0.004	0.004	0.0004	8
	0.001	*0.005*	*0.004*				

CENTER : IKM Lumut

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	0.111	0.128	0.118	0.122	0.120	0.005	15
5	0.108	**0.135**	0.118	0.112	0.114	0.009	15
13	0.101	0.120	0.113	0.119	0.115	0.007	15
14	**0.094**	0.109	0.101	0.099	0.101	0.004	15
	0.094	*0.135*	*0.113*				

CENTER : IKM TSYA, Pekan

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	0.039	**0.055**	0.045	0.052	0.044	0.005	15
5	0.029	0.039	0.034	0.036	0.034	0.003	15
10	0.021	0.029	0.025	0.025	0.025	0.002	15
11	**0.015**	0.022	0.018	0.018	0.018	0.002	15
	0.015	*0.055*	*0.031*				

Appendix 45

INDOOR

Air Velocity Level (m/s)

CENTER : IKM Kuala Lumpur

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Air-Condition Workshop	0.01	0.45	0.12	0.06	0.11	0.09	30
2	EDI Workshop I	0.04	0.41	0.17	0.14	0.14	0.09	30
3	KMPM Workshop I	0.03	0.39	0.14	0.11	0.12	0.09	30
6	KMPM Workshop II	**0.00**	**0.60**	0.14	0.04	0.12	0.12	30
7	Welding Workshop	0.02	0.57	0.20	0.05	0.17	0.15	30
8	EDI Workshop II	0.01	0.32	0.11	0.13	0.09	0.07	30
9	PJE Workshop	0.01	0.18	0.08	0.08	0.08	0.04	30
10	EDI Workshop III	0.03	0.39	0.16	0.17	0.15	0.10	30
11	Sheet Metal Workshop I	0.02	0.32	0.11	0.03	0.11	0.07	30
12	Sheet Metal Workshop II	0.01	0.46	0.12	0.16	0.08	0.12	30
		0.00	*0.60*	*0.14*				

CENTER : IKM Lumut

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Arc Workshop I	**0.00**	0.11	0.01	0.00	0.00	0.02	60
2	Spray Painting Workshop	**0.00**	**0.46**	0.08	0.00	0.03	0.12	60
3	Foundry Workshop	**0.00**	0.15	0.03	0.00	0.01	0.04	60
6	Pattern Workshop	**0.00**	0.18	0.03	0.00	0.01	0.04	60
7	Machine Workshop I	**0.00**	0.19	0.02	0.00	0.00	0.04	60
8	Machine Workshop II	**0.00**	0.20	0.03	0.01	0.01	0.05	60
9	Electrical Workshop I	**0.00**	0.22	0.09	0.06	0.09	0.05	60
10	Arc Workshop II	**0.00**	0.10	0.02	0.00	0.00	0.02	60
11	Arc Workshop III	**0.00**	0.12	0.02	0.00	0.01	0.03	60
12	Electrical Workshop II	**0.00**	0.13	0.02	0.00	0.00	0.03	60
		0.00	*0.46*	*0.04*				

CENTER : IKM TSYA, Pekan

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Petrol (Automobile)	0.01	0.38	0.13	0.04	0.11	0.09	60
2	Transmision (Automobile)	0.01	0.54	0.21	0.23	0.21	0.11	60
3	Store (Automobile)	0.02	**0.73**	0.27	0.29	0.26	0.15	60
6	Laboratory (Automobile)	0.03	0.68	0.27	0.12	0.24	0.16	60
7	Petrol (Automotive)	**0.00**	0.38	0.13	0.19	0.12	0.09	60
8	Diesel (Automotive)	**0.00**	0.19	0.06	0.01	0.03	0.06	60
9	Fitting (Spray Painting)	**0.00**	0.13	0.02	0.00	0.01	0.03	60
12	Machine Shop	**0.00**	0.14	0.02	0.00	0.01	0.03	60
		0.00	*0.73*	*0.14*				

OUTDOOR

Air Velocity Level (m/s)

CENTER : IKM Kuala Lumpur

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	0.35	0.61	0.47	-	0.46	0.11	8
5	0.39	**0.66**	0.53	-	0.53	0.11	8
13	0.39	0.65	0.52	-	0.52	0.11	8
14	**0.55**	**0.66**	0.60	-	0.60	0.04	8
	0.35	*0.66*	*0.53*				

CENTER : IKM Lumut

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	**0.00**	**0.18**	0.05	0.01	0.03	0.05	8
5	**0.00**	0.07	0.01	0.00	0.01	0.02	8
13	**0.00**	0.02	0.00	0.00	0.00	0.01	8
14	**0.00**	0.13	0.03	0.01	0.02	0.03	8
	0.00	*0.18*	*0.02*				

CENTER : IKM TSYA, Pekan

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	**0.00**	0.17	0.05	0.01	0.03	0.05	30
5	0.01	0.15	0.07	0.01	0.06	0.05	30
10	**0.00**	0.10	0.01	0.00	0.00	0.02	30
11	0.09	**0.73**	0.30	0.21	0.26	0.16	30
	0.00	*0.73*	*0.11*				

Appendix 46

INDOOR

Sound Pressure Level (dBA)

CENTER : IKM Kuala Lumpur

TESTID		MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Air-Condition Workshop	58.8	79.8	68.3	62.7	68.0	6.3	12
2	EDI Workshop I	65.0	81.1	71.8	69.6	70.3	4.9	12
3	KMPM Workshop I	75.9	99.3	84.0	-	81.7	7.8	12
6	KMPM Workshop II	56.9	91.7	71.6	68.3	70.2	9.5	12
7	Welding Workshop	69.6	99.3	81.6	69.6	82.7	9.0	12
8	EDI Workshop II	**56.3**	99.7	81.1	-	81.1	13.8	12
9	PJE Workshop	59.4	99.1	78.3	-	78.0	11.2	12
10	EDI Workshop III	75.3	101.2	83.6	98.6	79.7	9.9	12
11	Sheet Metal Workshop I	61.7	100.7	73.3	-	67.8	11.9	12
12	Sheet Metal Workshop II	66.4	**106.0**	78.7	-	76.1	13.0	12
		56.3	*106.0*	*77.2*				

CENTER : IKM Lumut

TESTID		MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Arc Workshop I	60.5	99.6	74.2	70.6	70.6	12.0	12
2	Spray Painting Workshop	63.5	97.6	77.1	-	75.7	10.2	12
3	Foundry Workshop	66.9	91.8	78.4	-	78.1	8.2	12
6	Pattern Workshop	**54.6**	97.3	72.8	-	71.0	11.9	12
7	Machine Workshop I	74.3	97.8	81.0	81.3	79.5	6.4	12
8	Machine Workshop II	61.3	97.3	77.7	-	75.9	10.0	12
9	Electrical Workshop I	68.4	102.8	80.3	75.3	75.7	11.5	12
10	Arc Workshop II	66.1	101.3	86.0	-	87.5	11.0	12
11	Arc Workshop III	67.5	99.5	84.1	76.4	83.3	11.4	12
12	Electrical Workshop II	61.3	**109.4**	77.7	71.3	73.8	14.4	12
		54.6	*109.4*	*78.9*				

CENTER : IKM TSYA, Pekan

TESTID		MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Petrol (Automobile)	**53.4**	**108.1**	70.3	61.8	61.8	18.8	60
2	Transmision (Automobile)	66.0	94.1	74.0	66.0	69.8	9.6	60
3	Store (Automobile)	54.7	81.4	71.5	-	70.6	7.6	60
6	Laboratory (Automobile)	58.9	90.9	78.5	80.4	79.0	7.5	60
7	Petrol (Automotive)	62.9	88.1	76.0	80.0	78.6	7.6	60
8	Diesel (Automotive)	66.8	81.7	73.7	71.3	71.5	5.2	60
9	Fitting (Spray Painting)	69.4	91.6	79.6	81.4	79.4	6.0	60
12	Machine Shop	78.4	87.1	81.6	79.4	81.1	2.5	60
		53.4	*108.1*	*75.7*				

OUTDOOR

Sound Pressure Level (dBA)

CENTER : IKM Kuala Lumpur

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	60.6	70.4	65.1	-	64.6	4.3	6
5	**59.8**	75.2	66.7	-	66.9	5.9	6
13	66.9	**78.6**	73.0	-	73.2	4.8	6
14	59.8	71.0	64.6	-	64.1	4.3	6
	59.8	*78.6*	*67.4*				

CENTER : IKM Lumut

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	61.8	79.6	69.2	-	64.6	4.3	6
5	**61.9**	77.6	69.0	-	66.9	5.9	6
13	61.5	**78.1**	71.2	-	73.2	4.8	6
14	59.3	72.6	63.9	-	64.1	4.3	6
	59.3	*79.6*	*68.3*				

CENTER : IKM TSYA, Pekan

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	61.6	78.6	71.1	-	71.1	6.4	6
5	68.4	80.4	73.0	-	72.1	4.4	6
10	68.4	**80.6**	72.6	-	71.0	4.6	6
11	**59.8**	71.0	64.5	-	64.1	4.3	6
	59.8	*80.6*	*70.3*				

Appendix 47

INDOOR

Lighting Level (Lux)

CENTER : IKM Kuala Lumpur

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Air-Condition Workshop	104.0	213.6	157.3	-	169.5	35.9	12
2	EDI Workshop I	104.2	110.6	107.6	-	108.0	1.8	12
3	KMPM Workshop I	92.8	**231.0**	129.3	-	110.5	45.7	12
6	KMPM Workshop II	102.0	225.0	167.7	-	171.5	38.7	12
7	Welding Workshop	**50.1**	156.0	101.0	-	105.5	30.5	12
8	EDI Workshop II	87.2	127.4	113.0	-	117.1	12.9	12
9	PJE Workshop	101.0	121.8	110.0	-	108.6	8.2	12
10	EDI Workshop III	100.3	126.3	113.9	-	115.7	9.5	12
11	Sheet Metal Workshop I	120.0	178.0	149.2	178.0	151.0	24.1	12
12	Sheet Metal Workshop II	118.0	175.1	141.9	-	135.5	18.5	12
		50.1	*231.0*	*129.1*				

CENTER : IKM Lumut

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Arc Workshop I	153.0	201.0	176.5	-	178.0	14.3	12
2	Spray Painting Workshop	762.0	**962.0**	862.2	-	873.0	66.3	12
3	Foundry Workshop	206.0	268.0	239.8	253.0	248.5	20.2	12
6	Pattern Workshop	189.0	257.0	228.5	-	238.5	24.3	12
7	Machine Workshop I	196.0	245.0	225.5	-	231.5	16.5	12
8	Machine Workshop II	198.0	247.0	227.5	216.0	228.0	17.3	12
9	Electrical Workshop I	168.0	226.0	198.3	-	200.5	19.2	12
10	Arc Workshop II	74.3	88.3	80.0	-	78.7	3.9	12
11	Arc Workshop III	**70.3**	81.4	77.8	79.4	79.4	3.6	12
12	Electrical Workshop II	168.0	201.0	185.6	186.0	186.0	10.5	12
		70.3	*962.0*	*250.2*				

CENTER : IKM TSYA, Pekan

TESTID	LOCATION	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
1	Petrol (Automobile)	867.0	**996.0**	929.9	889.0	922.5	52.9	12
2	Transmision (Automobile)	716.0	913.0	832.3	903.0	810.5	64.3	12
3	Store (Automobile)	**92.6**	99.4	95.4	-	95.0	2.1	12
6	Laboratory (Automobile)	211.0	256.0	222.8	234.0	217.0	13.1	12
7	Petrol (Automotive)	907.0	934.0	919.0	916.0	918.0	7.8	12
8	Diesel (Automotive)	856.0	937.0	921.2	-	917.5	39.7	12
9	Fitting (Spray Painting)	263.0	299.0	281.6	281.0	280.5	9.7	12
12	Machine Shop	258.0	289.0	280.4	288.0	283.0	8.9	12
		92.6	*996.0*	*560.3*				

OUTDOOR

Lighting Level (Lux)

CENTER : IKM Kuala Lumpur

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	**461.0**	473.0	468.2	-	469.5	4.40	6
5	476.0	493.0	481.5	-	480.5	6.10	6
13	721.0	733.0	728.5	-	730.0	4.60	6
14	746.0	**798.0**	773.0	-	770.0	18.40	6
	461.0	*798.0*	*612.8*				

CENTER : IKM Lumut

Lighting Level (Lux)

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	**1086.0**	1243.0	1163.8	-	1165.0	59.8	6
5	1098.0	**1244.0**	117.2	-	1178.5	68.2	6
13	1124.0	1204.0	1149.5	-	1143.0	28.4	6
14	1156.0	1210.0	1185.8	-	1190.5	21.4	6
	1086.0	*1244.0*	*904.1*				

CENTER : IKM TSYA, Pekan

TESTID	MIN	MAX	MEAN	MODE	MEDIAN	STDEV	N
4	**1159.0**	1265.0	1229.7	-	1256.0	46.9	6
5	1203.0	1241.0	1222.7	-	1221.5	13.6	6
10	1200.0	1259.0	1220.5	-	1211.0	23.3	6
11	1216.0	**1426.0**	1315.8	-	1309.0	76.6	6
	1159.0	*1426.0*	*1247.2*				

Appendix 48

Table 1 - Indoor and outdoor measurement of Temperature Level (°C)

No	Center	Indoor			Outdoor		
		MIN	MAX	MEAN	MIN	MAX	MEAN
1	IKM Kuala Lumpur	26.2	35.6	31.5	31.1	33.6	32.3
2	IKM Lumut	28.6	31.8	30.8	31.0	33.2	32.1
3	IKM TSYA, Pekan	28.1	33.6	31.4	30.9	37.8	34.6

Table 2 - Indoor and outdoor measurement of Humidity Level (%)

No	Center	Indoor			Outdoor		
		MIN	MAX	MEAN	MIN	MAX	MEAN
1	IKM Kuala Lumpur	55.4	83.6	66.3	59.5	71.4	64.9
2	IKM Lumut	64.2	79.8	70.0	60.3	72.1	66.1
3	IKM TSYA, Pekan	59.5	82.6	68.7	44.0	73.3	58.0

Table 3 - Indoor and outdoor measurement of Carbon Dioxide Level (ppm CO_2)

No	Center	Indoor			Outdoor		
		MIN	MAX	MEAN	MIN	MAX	MEAN
1	IKM Kuala Lumpur	330	3342	466.9	388	594	431.0
2	IKM Lumut	396	1166	498.1	382	458	421.0
3	IKM TSYA, Pekan	377	594	426.8	350	504	400.8

Table 4 - Indoor and outdoor measurement of Carbon monoxide Level (ppm CO)

No	Center	Indoor			Outdoor		
		MIN	MAX	MEAN	MIN	MAX	MEAN
1	IKM Kuala Lumpur	0.0	2.8	1.2	0.8	2.8	1.6
2	IKM Lumut	0.1	4.5	1.5	1.4	2.8	1.9
3	IKM TSYA, Pekan	0.8	2.8	1.5	0.0	1.8	0.8

Table 5 - Indoor and outdoor measurement of Dust Level (mg/m^3)

No	Center	Indoor			Outdoor		
		MIN	MAX	MEAN	MIN	MAX	MEAN
1	IKM Kuala Lumpur	0.002	0.217	0.011	0.001	0.005	0.004
2	IKM Lumut	0.119	1.380	0.477	0.094	0.135	0.113
3	IKM TSYA, Pekan	0.000	0.041	0.007	0.015	0.055	0.031

Table 6 - Indoor and outdoor measurement of Air Velocity Level (m/s)

No	Center	Indoor			Outdoor		
		MIN	MAX	MEAN	MIN	MAX	MEAN
1	IKM Kuala Lumpur	0.00	0.60	0.14	0.35	0.66	0.53
2	IKM Lumut	0.00	0.46	0.04	0.00	0.18	0.02
3	IKM TSYA, Pekan	0.00	0.73	0.14	0.00	0.73	0.11

Table 7 - Indoor and outdoor measurement of Sound Pressure Level (dBA)

No	Center	Indoor			Outdoor		
		MIN	MAX	MEAN	MIN	MAX	MEAN
1	IKM Kuala Lumpur	56.3	106.0	77.2	59.8	78.6	67.4
2	IKM Lumut	54.6	109.4	78.9	59.3	79.6	68.3
3	IKM TSYA, Pekan	53.4	108.1	75.7	59.8	80.6	70.3

Table 8 - Indoor and outdoor measurement of Lighting Level (Lux)

No	Center	Indoor			Outdoor		
		MIN	MAX	MEAN	MIN	MAX	MEAN
1	IKM Kuala Lumpur	50.1	231.0	129.1	461.0	798.0	612.8
2	IKM Lumut	70.3	962.0	250.2	1086.0	1244.0	904.1
3	IKM TSYA, Pekan	92.6	996.0	560.3	1159.0	1426.0	1247.2

Appendix
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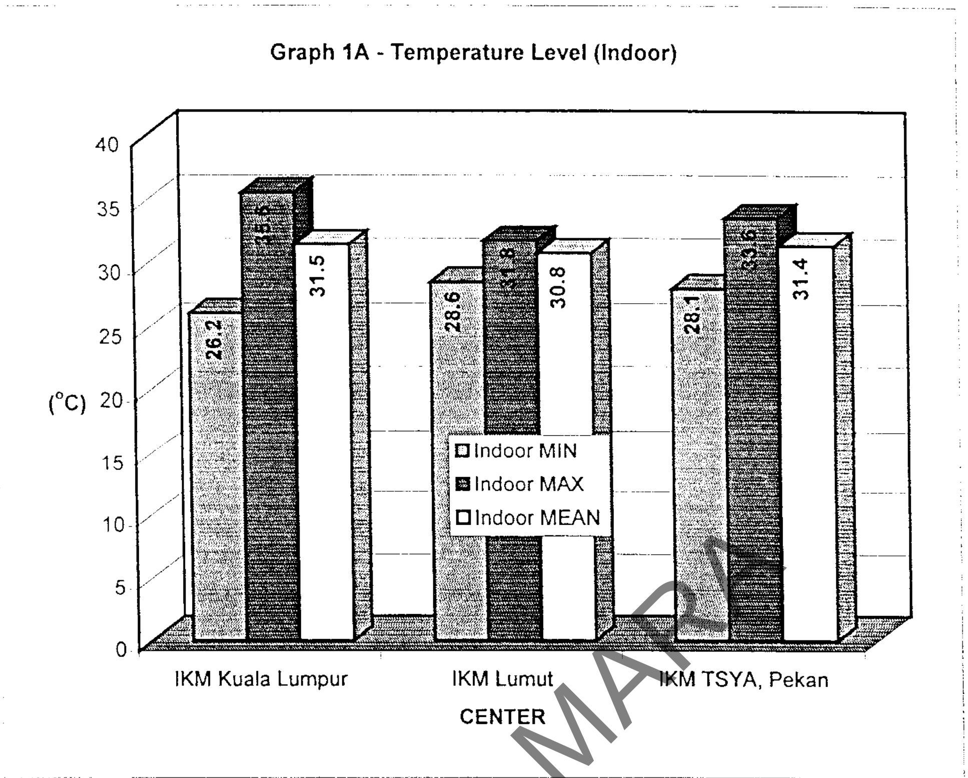
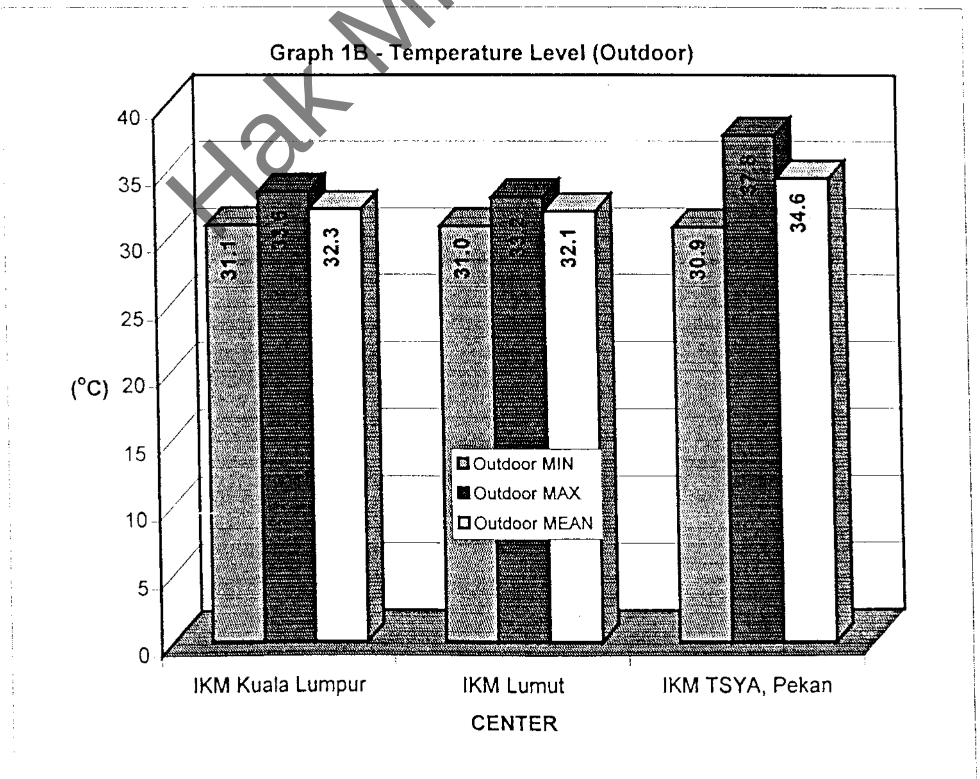
Appendix 49

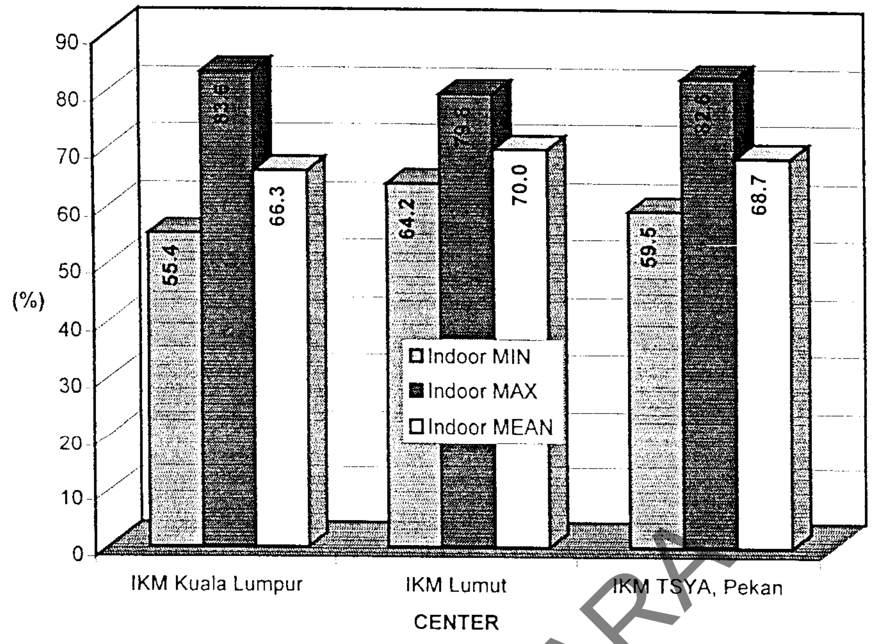


Graph 1A - Temperature Level (Indoor)
40
35
30
25
(°C) 20
15
10
5
0
26.2
35.6
31.5
28.6
31.8
30.8
28.1
33.5
31.4
Indoor MIN
Indoor MAX
Indoor MEAN
IKM Kuala Lumpur
IKM Lumut
IKM TSYA, Pekan
CENTER

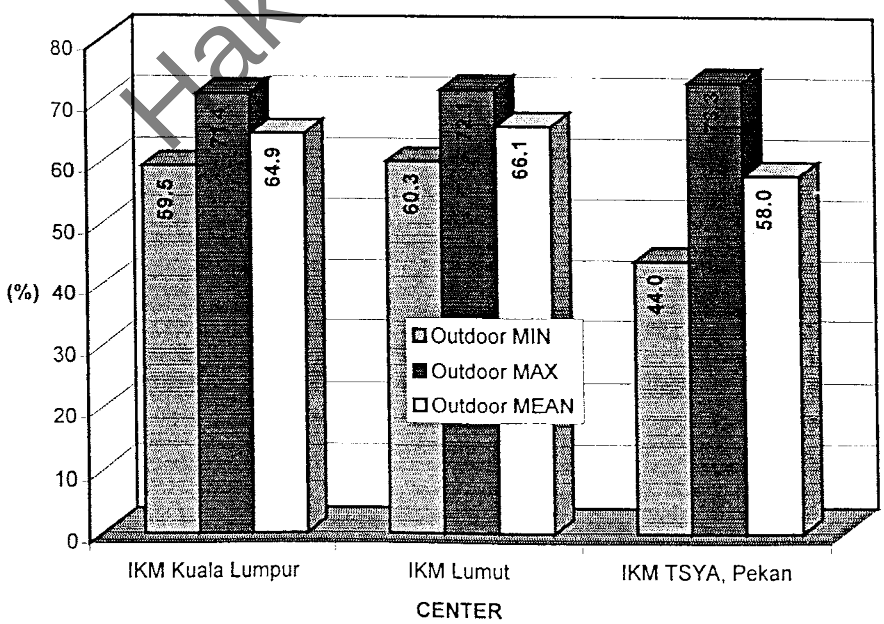


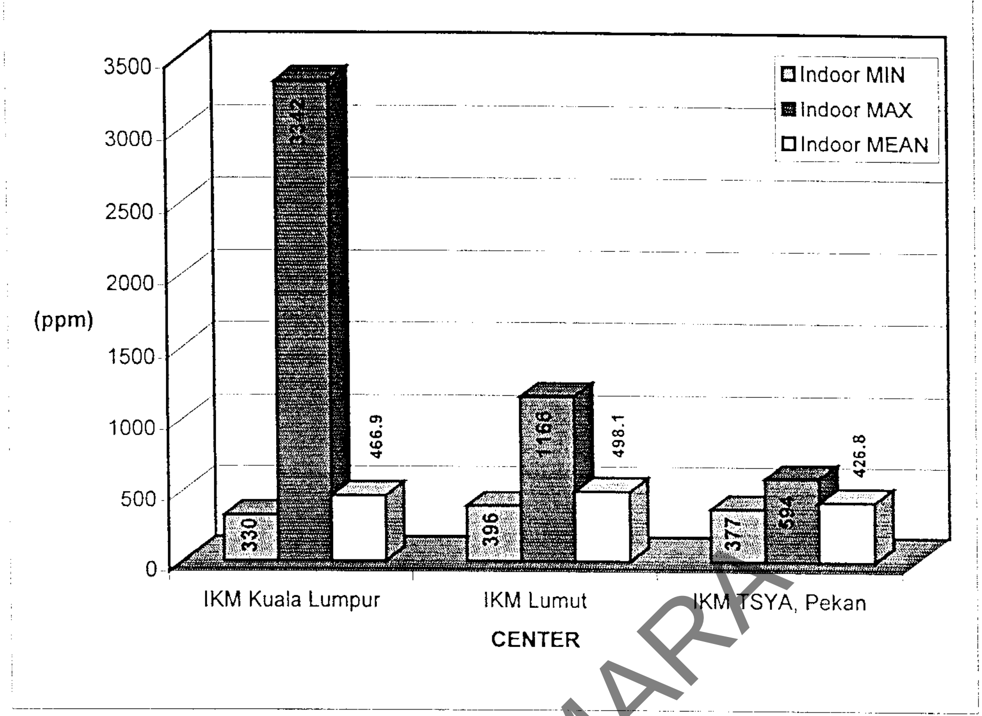
Graph 1B - Temperature Level (Outdoor)
40
35
30
25
(°C) 20
15
10
5
0
31.1
32.3
31.0
32.1
30.9
34.6
Outdoor MIN
Outdoor MAX
Outdoor MEAN
IKM Kuala Lumpur
IKM Lumut
IKM TSYA, Pekan
CENTER

Graph 2A - Humidity Level (Indoor)

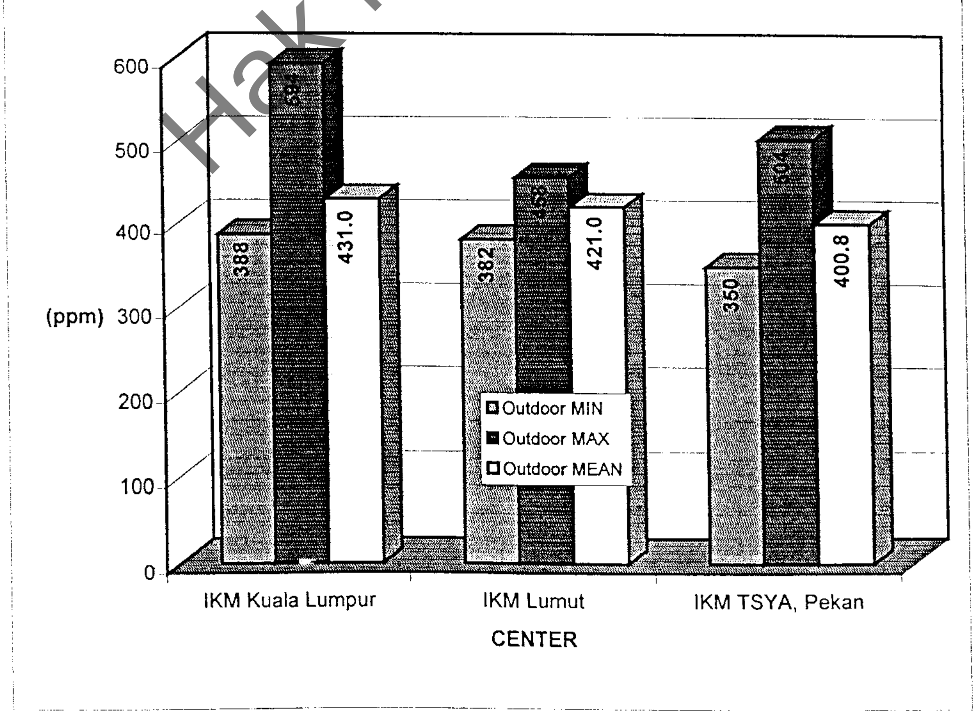


Graph 2B - Humidity Level (Outdoor)

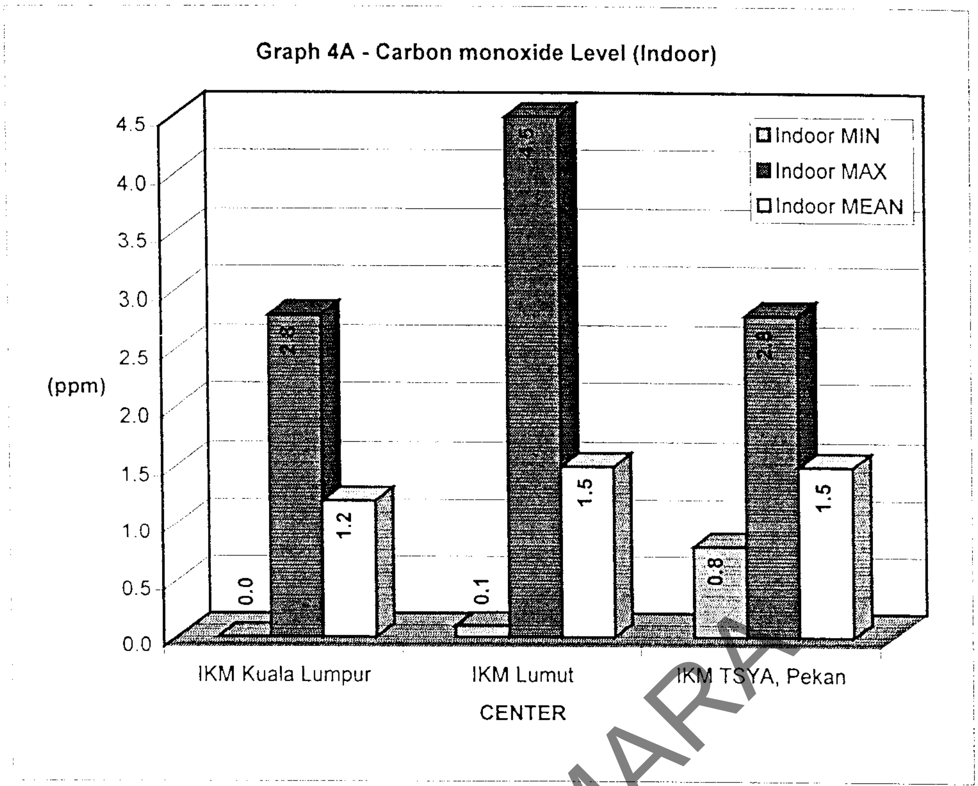




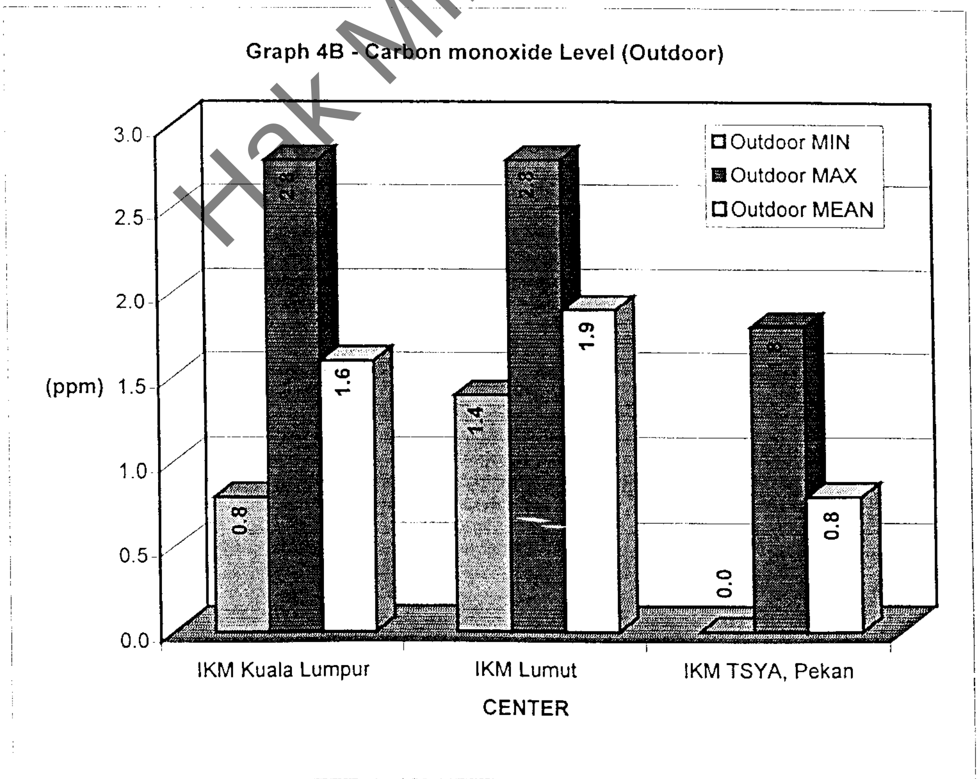
Graph 3A - Carbon Dioxide Level (Indoor)



Graph 3B - Carbon Dioxide Level (Outdoor)

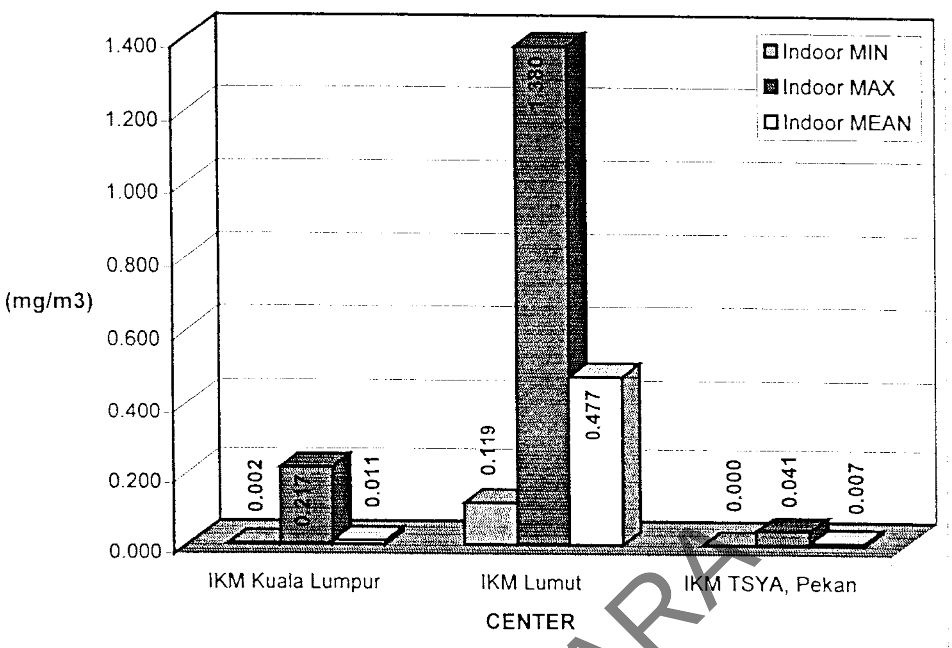


Graph 4A - Carbon monoxide Level (Indoor)
Indoor MIN
Indoor MAX
Indoor MEAN
(ppm)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
2.8
1.2
0.1
4.5
1.5
0.8
2.8
1.5
IKM Kuala Lumpur
IKM Lumut
IKM TSYA, Pekan
CENTER

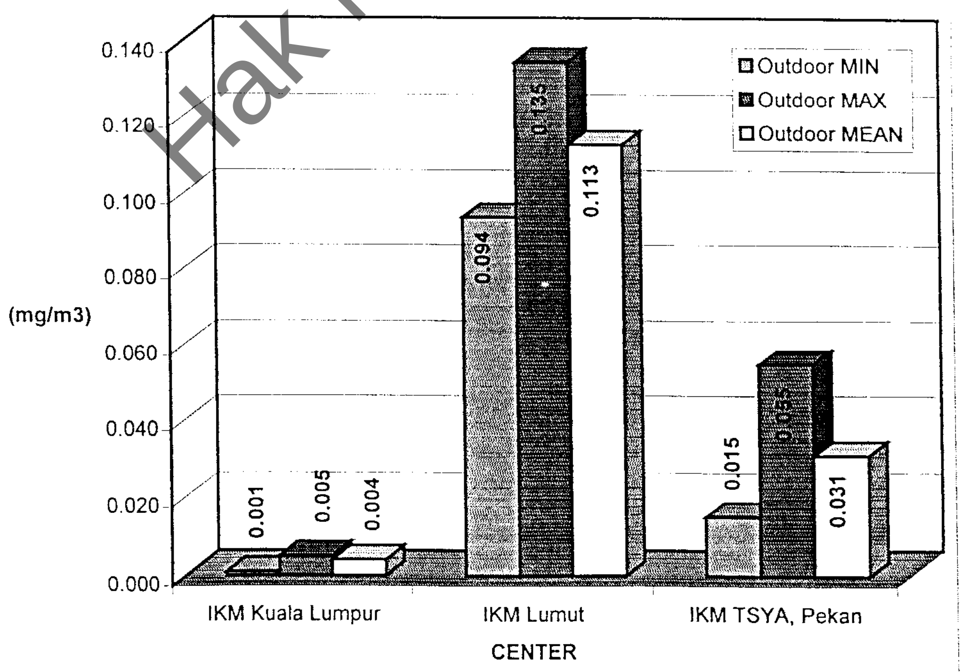


Graph 4B - Carbon monoxide Level (Outdoor)
Outdoor MIN
Outdoor MAX
Outdoor MEAN
(ppm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.8
2.8
1.6
1.4
2.8
1.9
0.0
0.8
IKM Kuala Lumpur
IKM Lumut
IKM TSYA, Pekan
CENTER

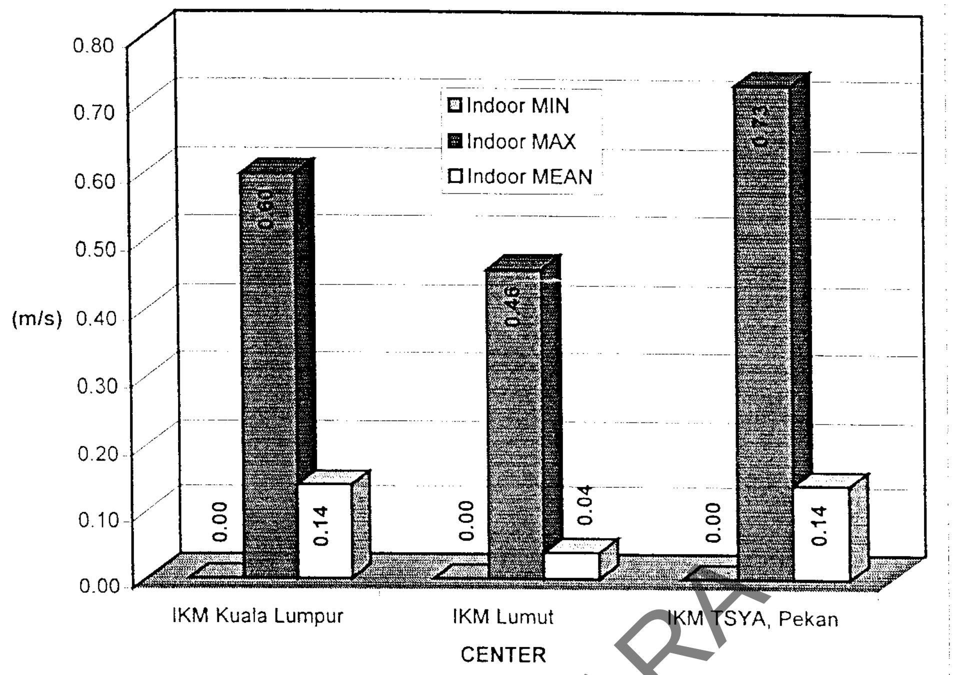
Graph 5A - Dust Level (Indoor)



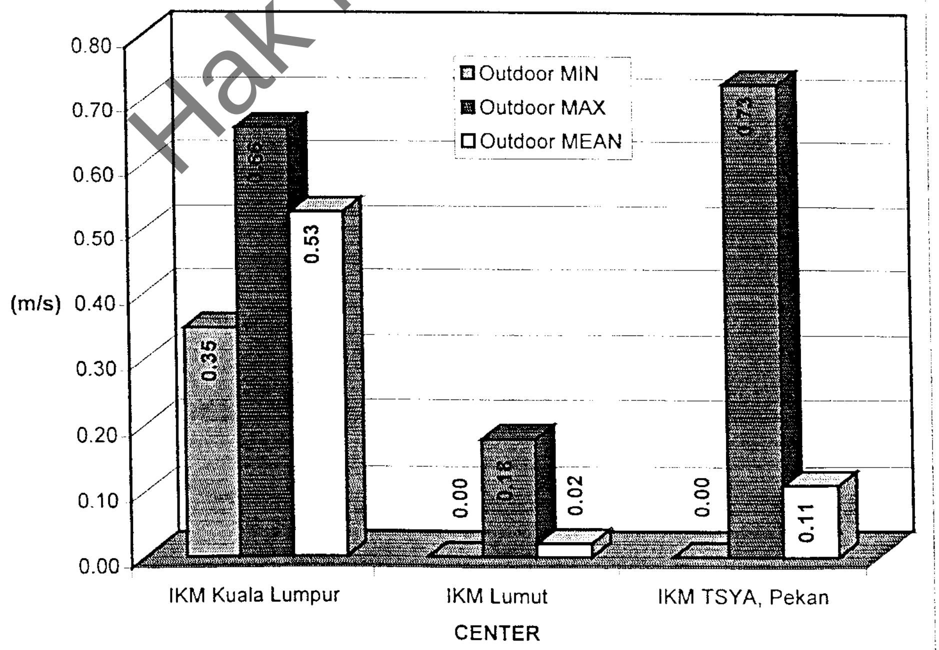
Graph 5B - Dust Level (Outdoor)

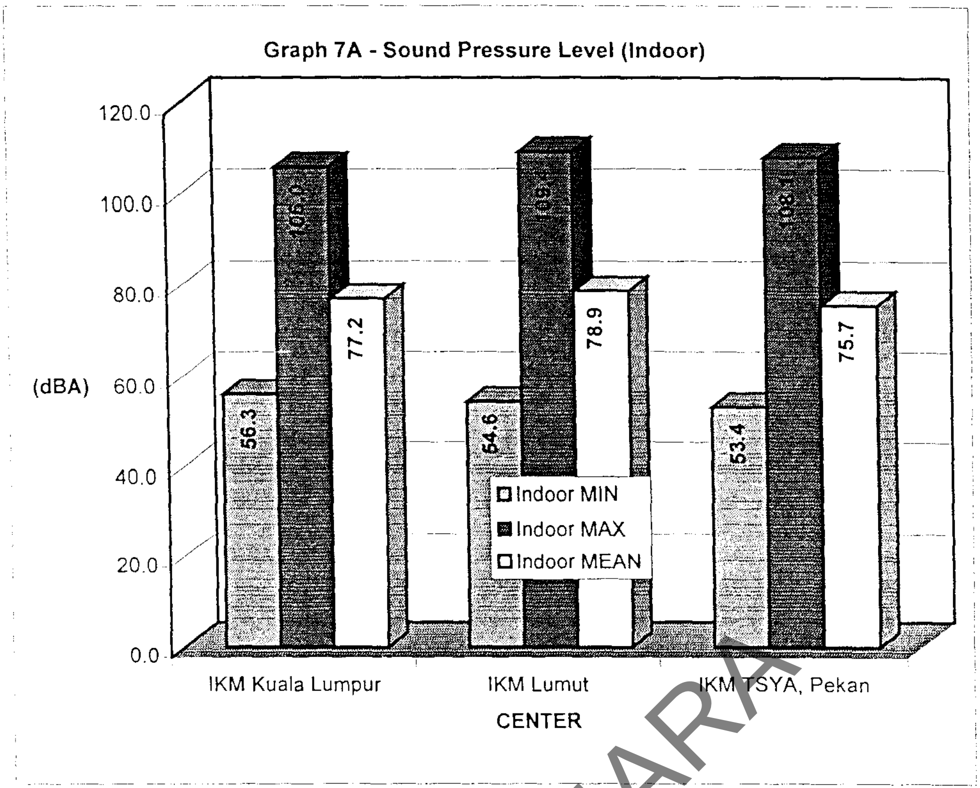


Graph 6A - Air Velocity Level (Indoor)

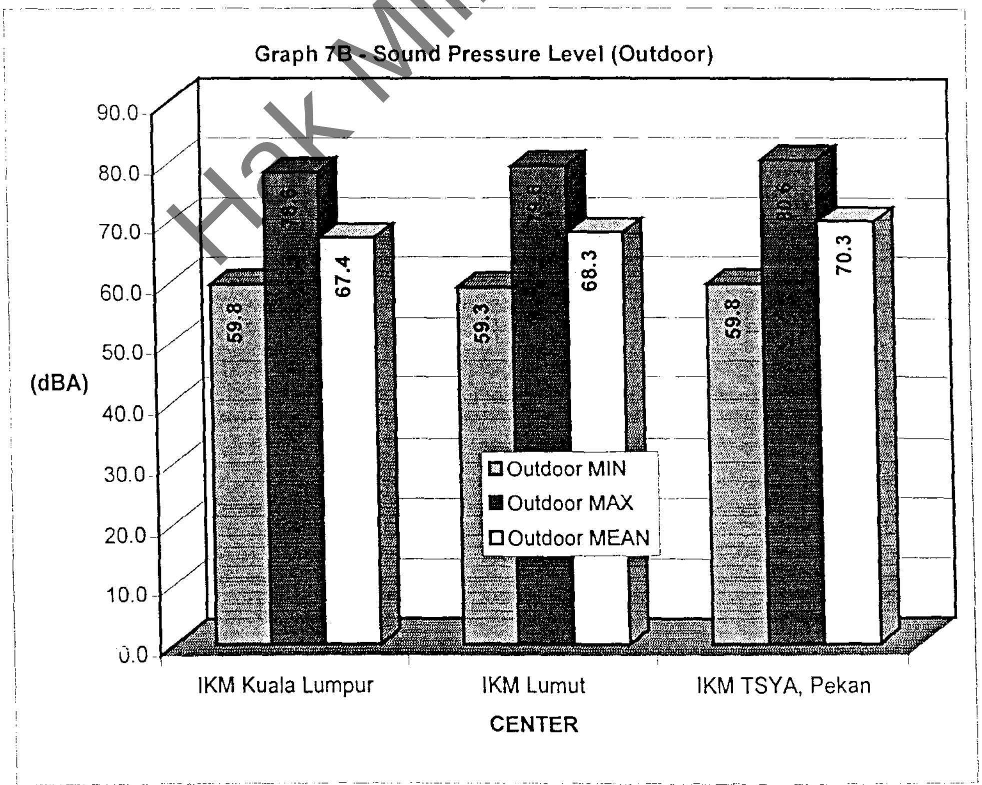


Graph 6B - Air Velocity Level (Outdoor)

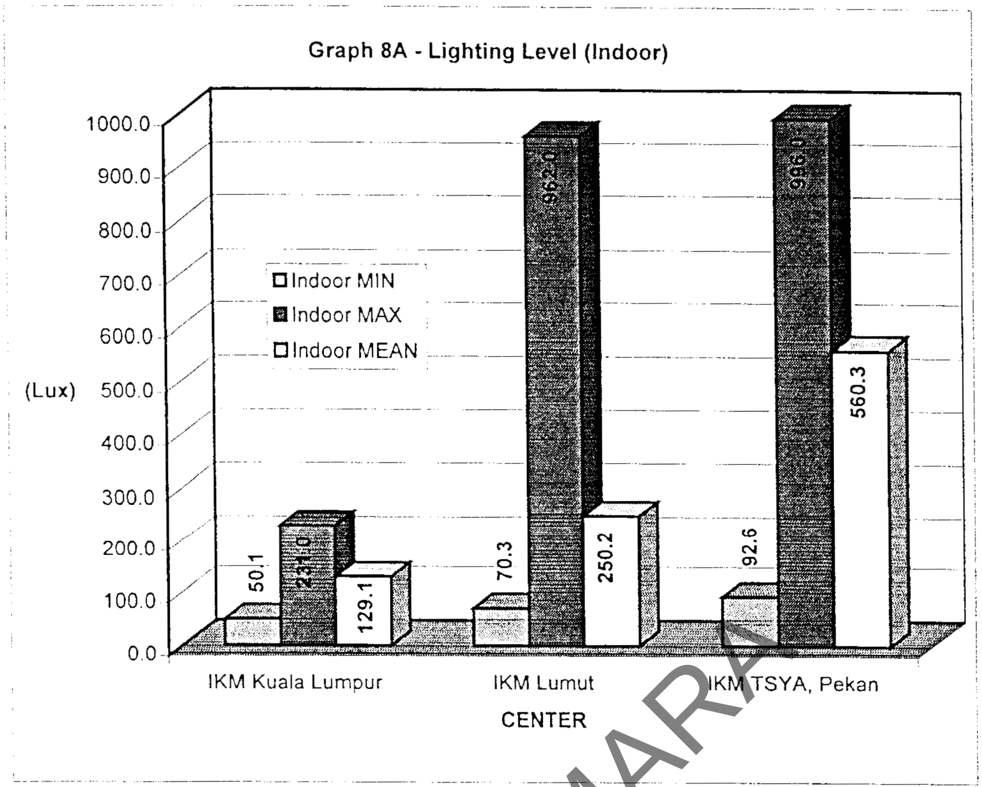


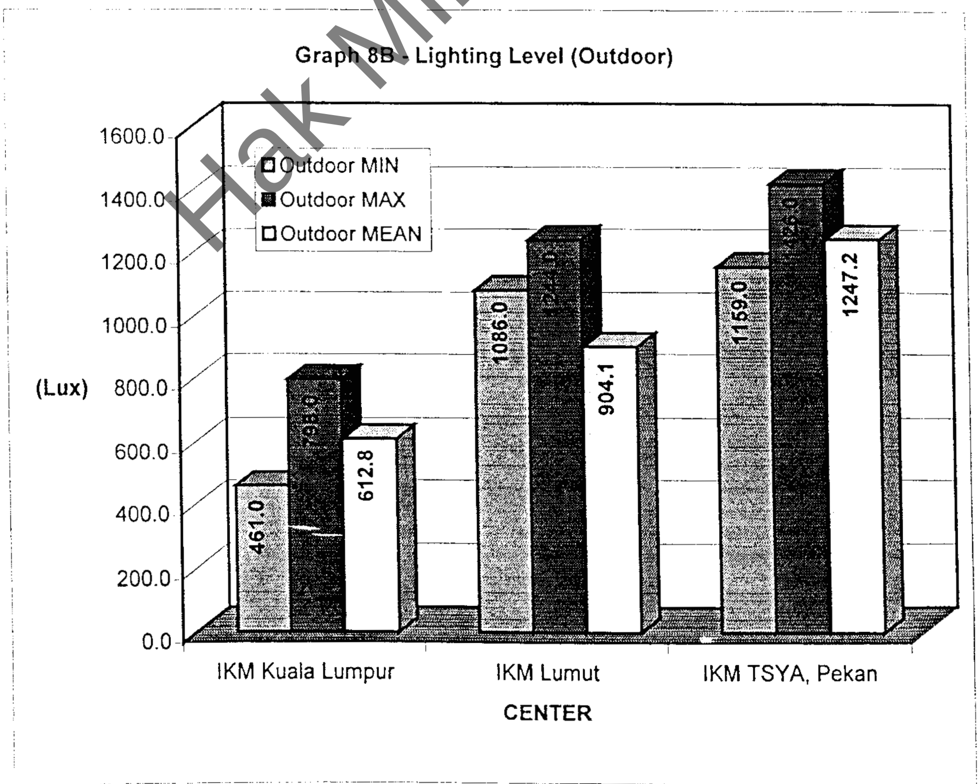


Graph 7A - Sound Pressure Level (Indoor)



Graph 7B - Sound Pressure Level (Outdoor)


Graph 8A - Lighting Level (Indoor)
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
(Lux)
Indoor MIN
Indoor MAX
Indoor MEAN
50.1
231.0
129.1
70.3
962.0
250.2
92.6
996.0
560.3
IKM Kuala Lumpur
IKM Lumut
IKM TSYA, Pekan
CENTER


Graph 8B - Lighting Level (Outdoor)
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
(Lux)
Outdoor MIN
Outdoor MAX
Outdoor MEAN
461.0
612.8
1086.0
904.1
1159.0
1247.2
IKM Kuala Lumpur
IKM Lumut
IKM TSYA, Pekan
CENTER

OVERALL AVERAGE (INDOOR)

TESTID	WORKSHOPS	Temp. (°C) ASHRAE (22°C-27°C)	Humid. (%) ASHRAE (30%-60%)	CO_2 (ppm) ASHRAE (<650PPM)	CO (ppm) WHO (<9PPM)	Dust (mg/m^3) FMA (<10mg/m^3)	Air Vel. (m/s) WHO (>0.25m/s)	Sound (dBA) FMA <90dBA)	Light (Lux) AS (>160Lux)
	CENTER : IKM Kuala Lumpur								
1	Air-Condition	27.3	60.0	**801**	0.9	0.032	**0.12**	68.3	**157.3**
2	EDI I	**29.5**	**80.5**	456	1.3	0.003	**0.17**	71.8	**107.6**
3	KMPM I	**31.8**	**65.7**	632	1.4	0.003	**0.14**	84.0	**129.3**
6	KMPM II	**31.9**	**65.3**	406	1.5	0.003	**0.14**	71.6	**167.7**
7	Welding	**35.1**	58.8	352	1.5	0.021	**0.20**	81.6	**101.0**
8	EDI II	**32.0**	**64.6**	399	1.4	0.032	**0.11**	81.1	**113.0**
9	PJE	**28.8**	**81.6**	411	1.1	0.004	**0.08**	78.3	**110.0**
10	EDI III	**32.3**	**63.4**	399	0.2	0.003	**0.16**	83.6	**113.9**
11	Sheet Metal I	**32.7**	**62.4**	410	1.5	0.003	**0.11**	73.3	**149.2**
12	Sheet Metal II	**33.1**	60.7	403	1.4	0.003	**0.12**	78.7	**141.9**
		31.5	**66.3**	**467**	**1.2**	**0.011**	0.14	**77.2**	**129.1**
	CENTER : IKM Lumut								
1	Arc I	**29.8**	**77.0**	**857**	4.1	1.090	**0.01**	74.2	176.5
2	Spray Painting	**29.4**	**76.6**	587	1.3	0.848	**0.08**	77.1	862.2
3	Foundry	**30.9**	**67.5**	462	1.1	0.656	**0.03**	78.4	239.8
6	Pattern	**30.7**	**66.7**	439	0.7	0.545	**0.03**	72.8	228.5
7	Machine I	**31.0**	**65.5**	419	0.6	0.434	**0.02**	81.0	225.5
8	Machine II	**31.4**	**65.0**	485	0.4	0.347	**0.03**	77.7	227.5
9	Electrical I	**30.6**	**74.7**	455	2.2	0.308	**0.09**	80.3	198.3
10	Arc II	**31.2**	**70.6**	436	2.0	0.228	**0.02**	86.0	**80.0**
11	Arc III	**31.4**	**69.1**	428	1.4	0.177	**0.02**	84.1	**77.8**
12	Electrical II	**31.7**	**67.6**	413	1.4	0.136	**0.02**	77.7	185.6
		30.8	**70.0**	**498**	**1.5**	**0.477**	**0.04**	**78.9**	**250.2**
	CENTER : IKM TSYA, Pekan								
1	Petrol (Automobile)	**28.7**	**79.3**	448	1.2	0.016	**0.13**	70.3	929.9
2	Transmision (Automobile)	**30.6**	**74.7**	455	2.2	0.004	**0.21**	74.0	832.3
3	Store (Automobile)	**31.4**	**69.1**	428	1.4	0.017	0.27	71.5	**95.4**
6	Laboratory (Automobile)	**31.9**	**65.3**	406	1.5	0.004	0.27	78.5	222.8
7	Petrol (Automotive)	**32.0**	**64.6**	399	1.4	0.001	**0.13**	76.0	919.0
8	Diesel (Automotive)	**32.3**	**63.4**	399	1.5	0.001	**0.06**	73.7	921.2
9	Fitting (Spray Painting)	**31.1**	**72.7**	459	1.3	0.013	**0.02**	79.6	281.6
12	Machine Shop	**33.4**	60.1	420	1.4	0.003	**0.02**	81.6	280.4
		31.4	**68.7**	**427**	**1.5**	**0.007**	**0.14**	**75.7**	**560.3**

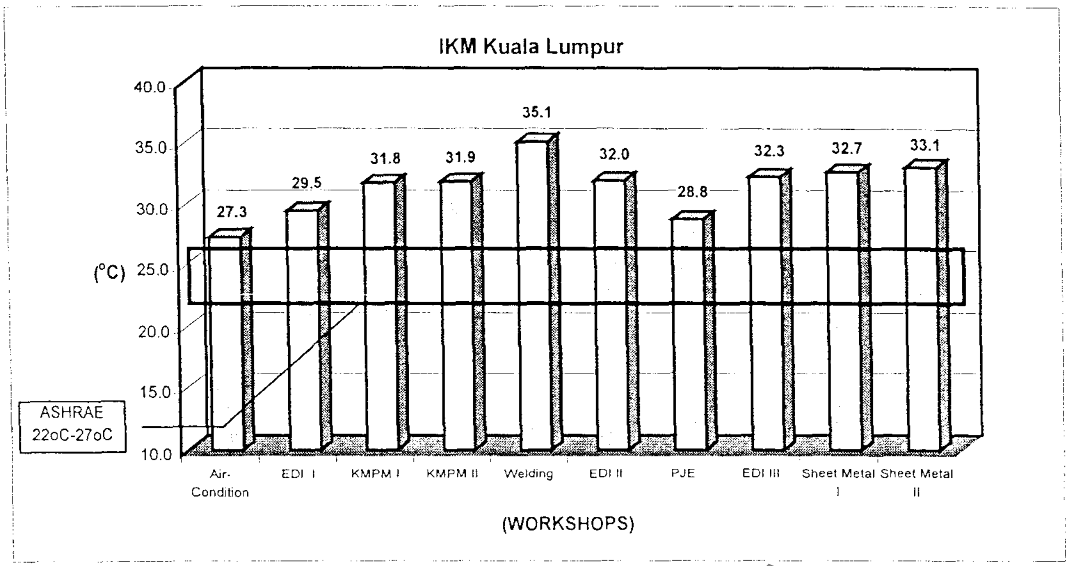
Appendix 50

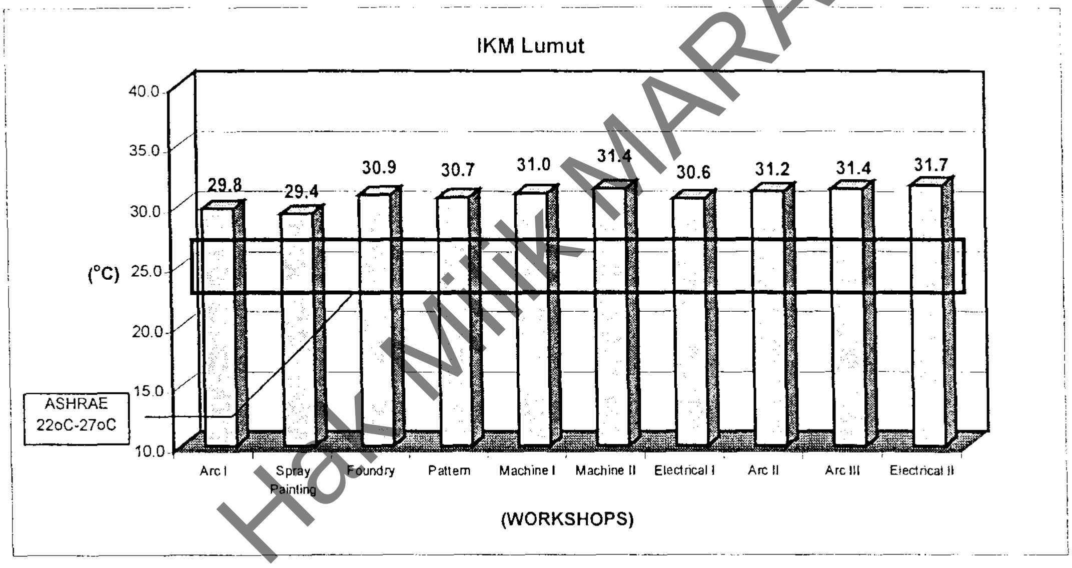
OVERALL AVERAGE (OUTDOOR)

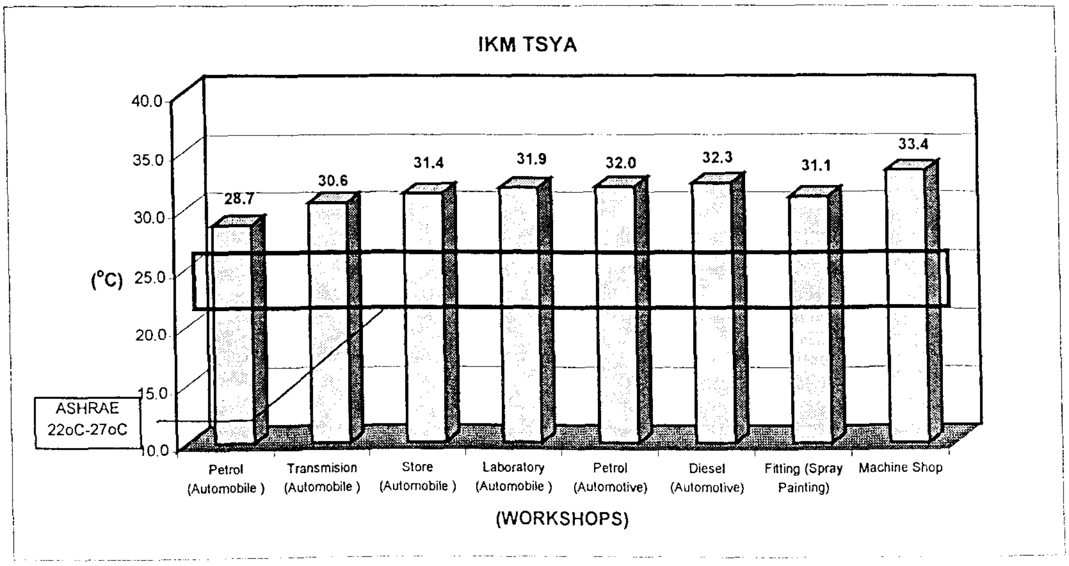
TESTID	Temp. (°C) ASHRAE (22°C-27°C)	Humid. (%) ASHRAE (30%-60%)	CO_2 (ppm) ASHRAE (<650PPM)	CO (ppm) WHO (<9PPM)	Dust (mg/m^3) FMA (<10mg/m^3)	Air Vel. (m/s) WHO (>0.25m/s)	Sound (dBA) FMA <90dBA)	Light (Lux) AS (>160Lux)
CENTER : IKM Kuala Lumpur								
4	**31.4**	**70.4**	438.0	1.7	0.003	0.47	65.1	468.2
5	**31.2**	**69.4**	429.0	1.8	0.005	0.53	66.7	481.5
13	**33.2**	**60.1**	396.0	1.3	0.004	0.52	73.0	728.5
14	**33.5**	59.8	461.0	1.4	0.004	0.60	64.6	773.0
	32.3	**64.9**	**431.0**	**1.6**	**0.004**	**0.53**	**67.4**	**612.8**
CENTER : IKM Lumut								
4	**31.1**	**71.7**	447.0	2.4	0.118	**0.05**	69.2	1163.8
5	**31.1**	**71.0**	432.0	2.0	0.118	**0.01**	69.0	**117.2**
13	**32.9**	60.6	390.0	1.5	0.113	**0.00**	71.2	1149.5
14	**33.1**	**61.1**	415.0	1.5	0.101	**0.03**	63.9	1185.8
	32.1	**66.1**	**421.0**	**1.9**	**0.113**	**0.02**	**68.3**	**904.1**
CENTER : IKM TSYA, Pekan								
4	**32.4**	**62.7**	387.0	1.4	0.045	**0.05**	71.1	1229.7
5	**31.3**	**72.6**	444.0	0.8	0.034	**0.07**	73.0	1222.7
10	**37.6**	46.5	410.0	0.6	0.025	**0.01**	72.6	1220.5
11	**37.1**	50.3	362.0	0.4	0.018	0.30	64.5	1315.8
	34.6	58.0	400.8	0.8	0.031	0.11	70.3	1247.2

Appendix 52

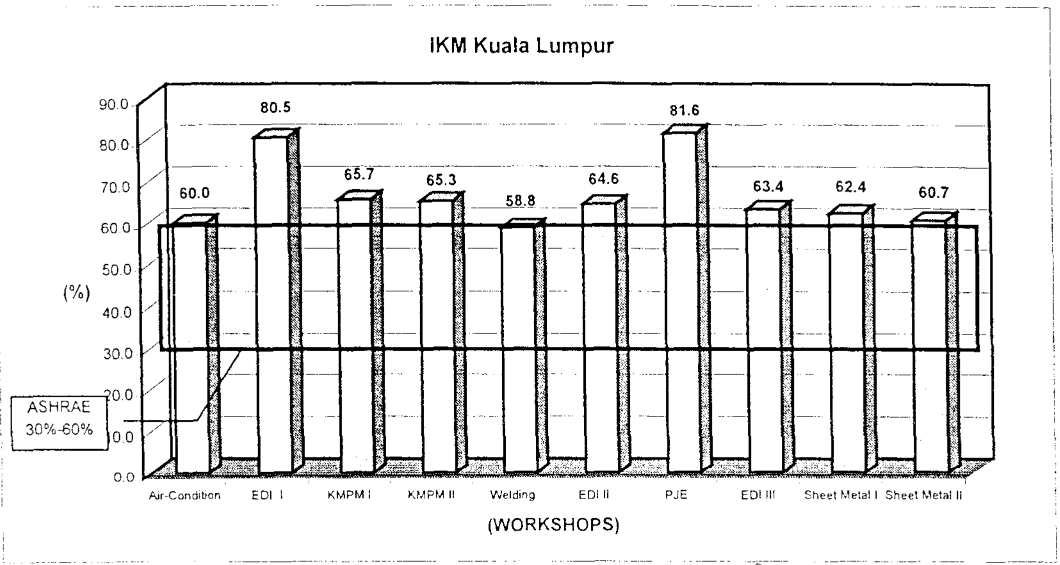
OVERALL RESULT ON TEMPERATURE LEVEL (INDOOR)

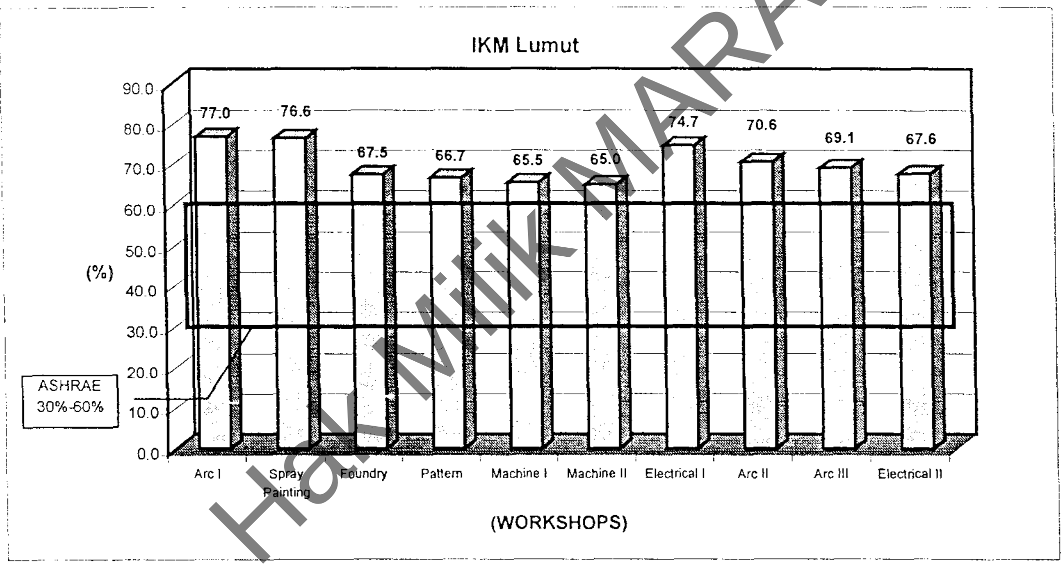


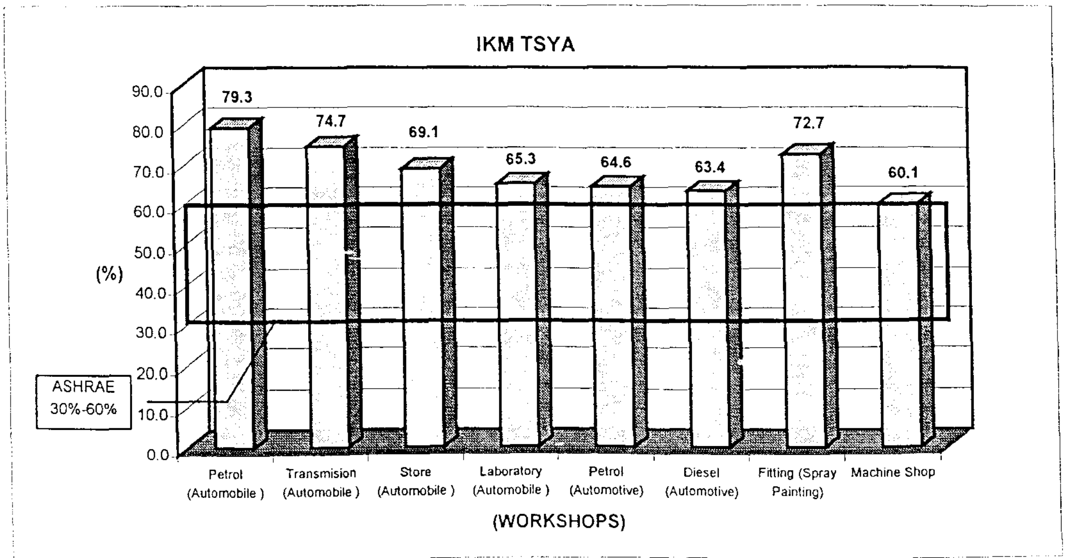




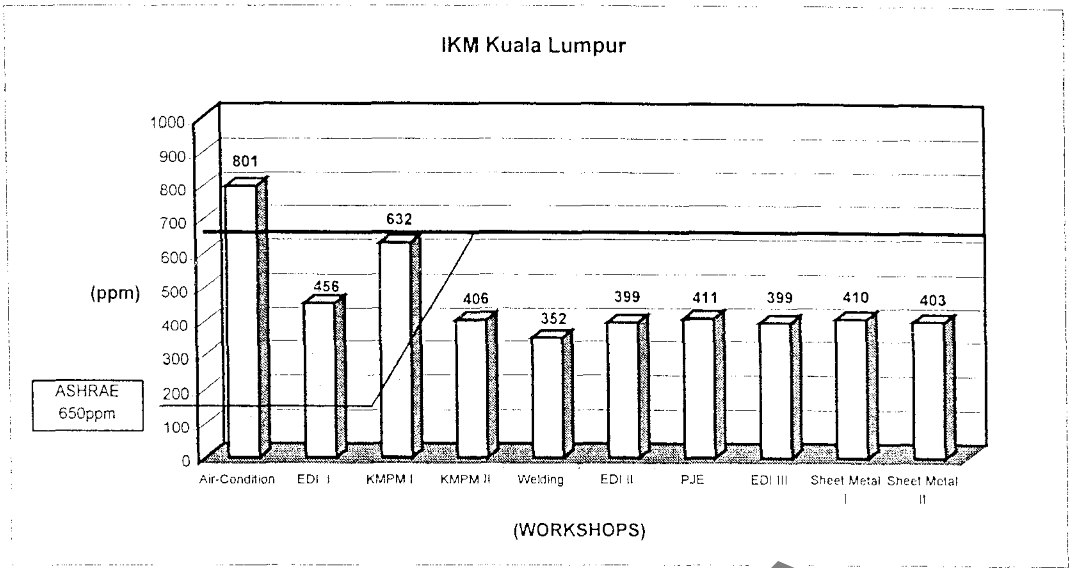
OVERALL RESULT ON HUMIDITY LEVEL (INDOOR)

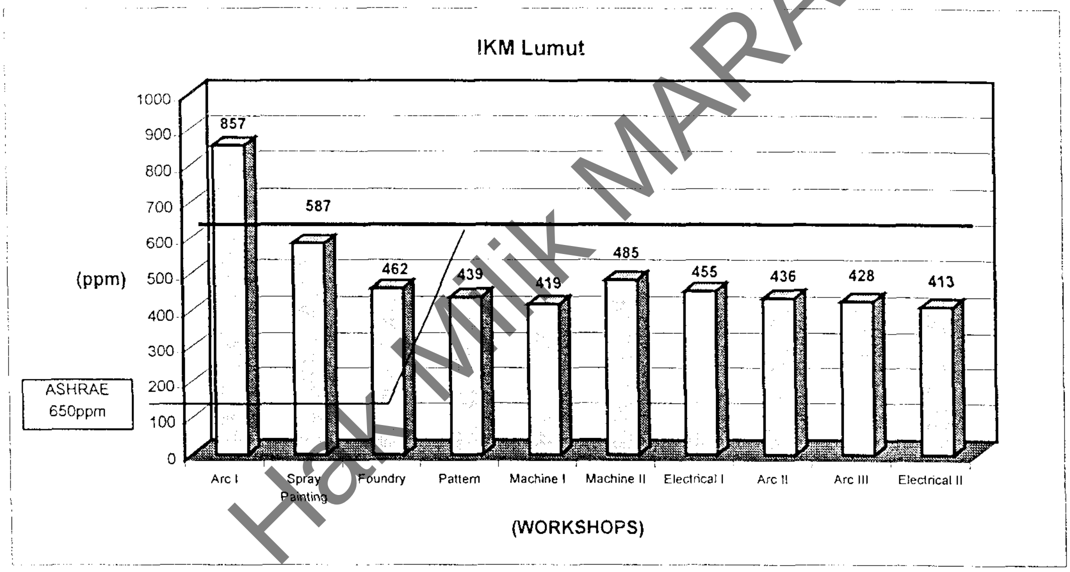


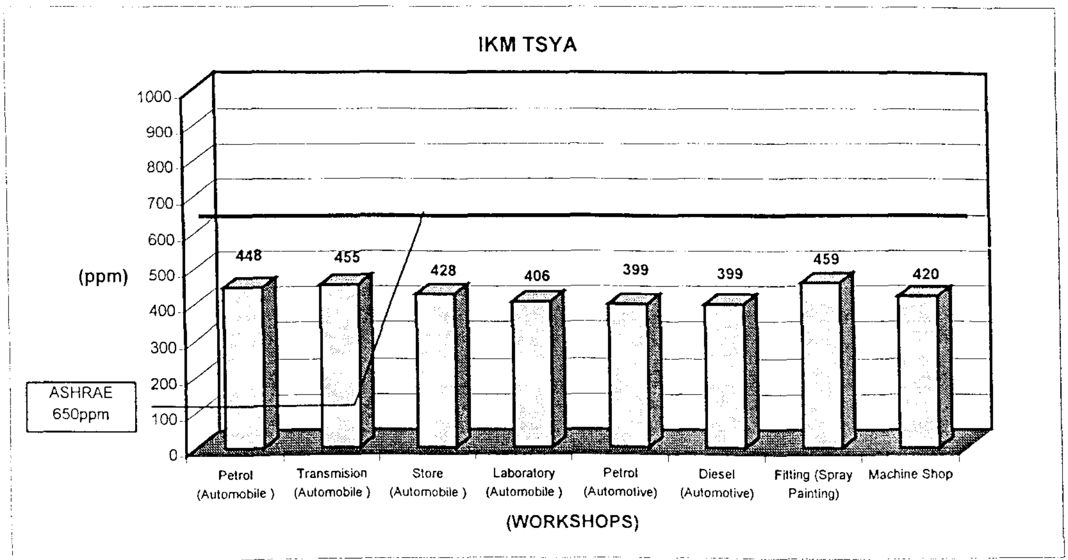




OVERALL RESULT ON CARBON DIOXIDE LEVEL (INDOOR)

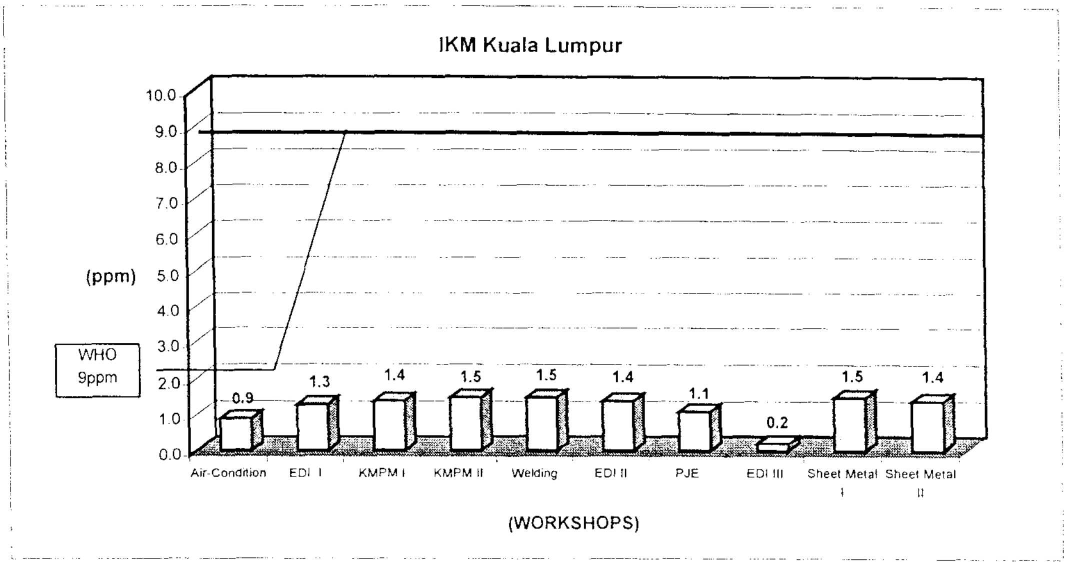


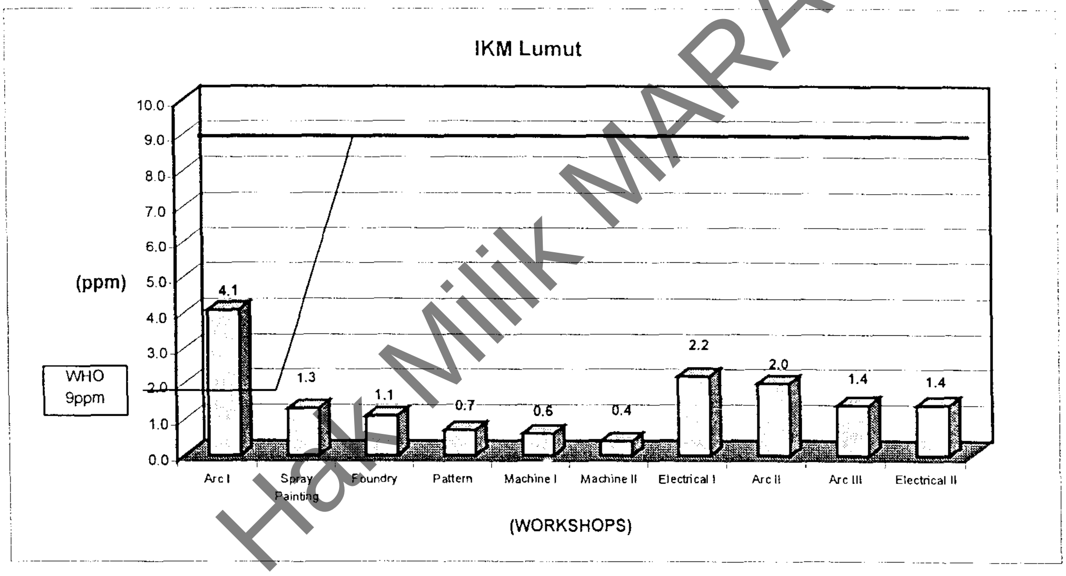


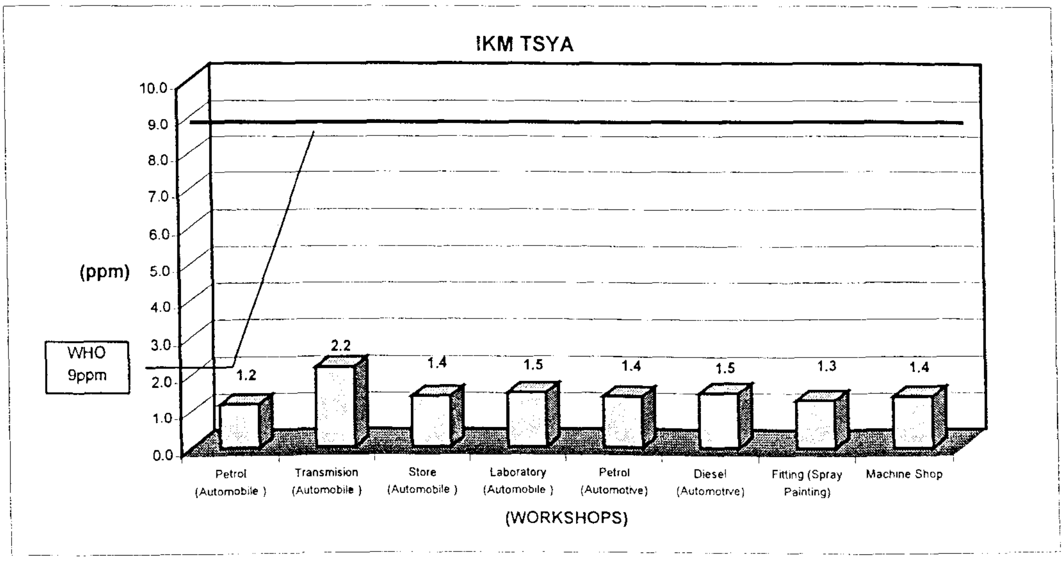


Appendix 55

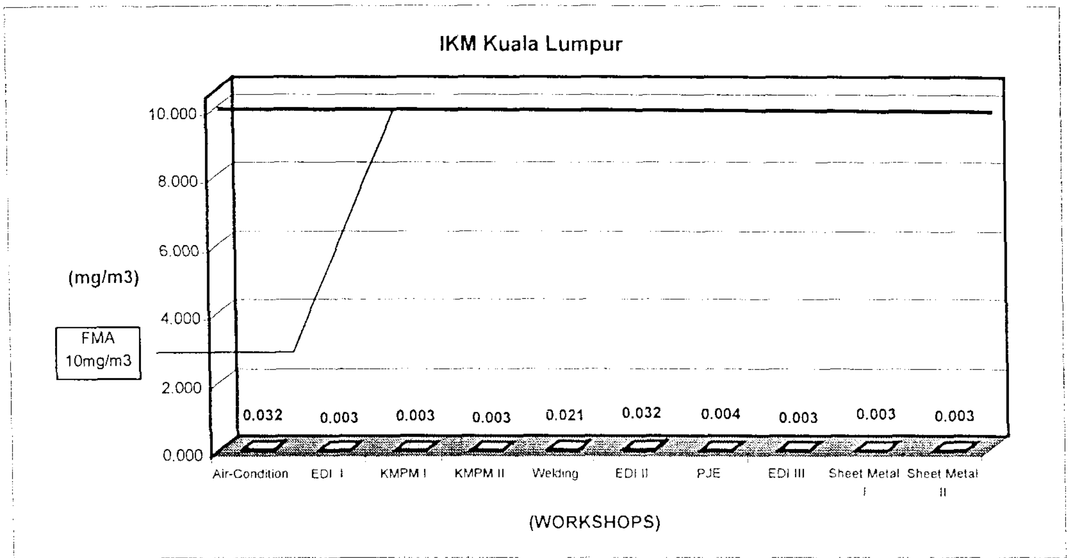
OVERALL RESULT ON CARBON MONOXIDE LEVEL (INDOOR)

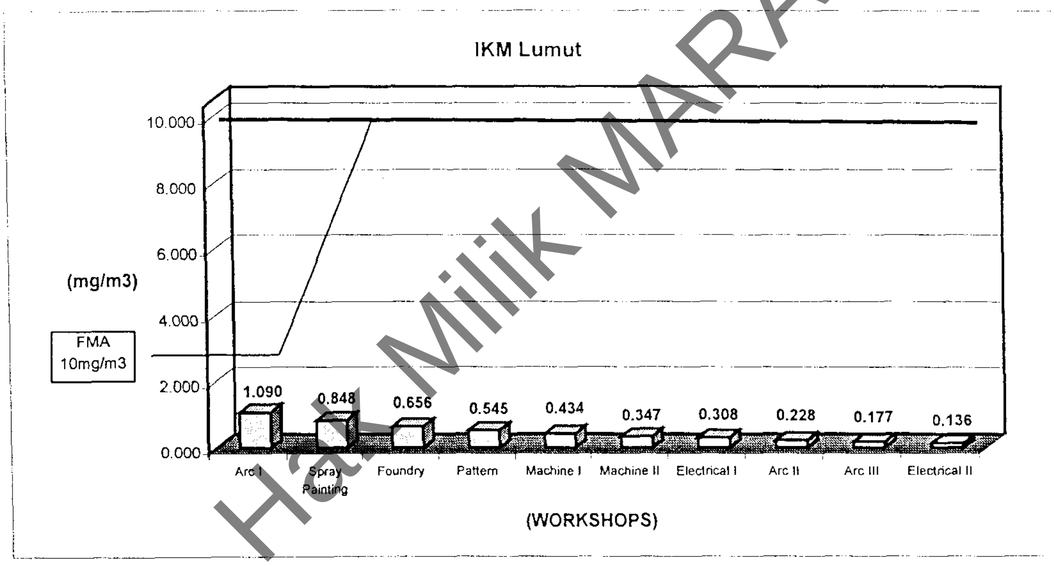


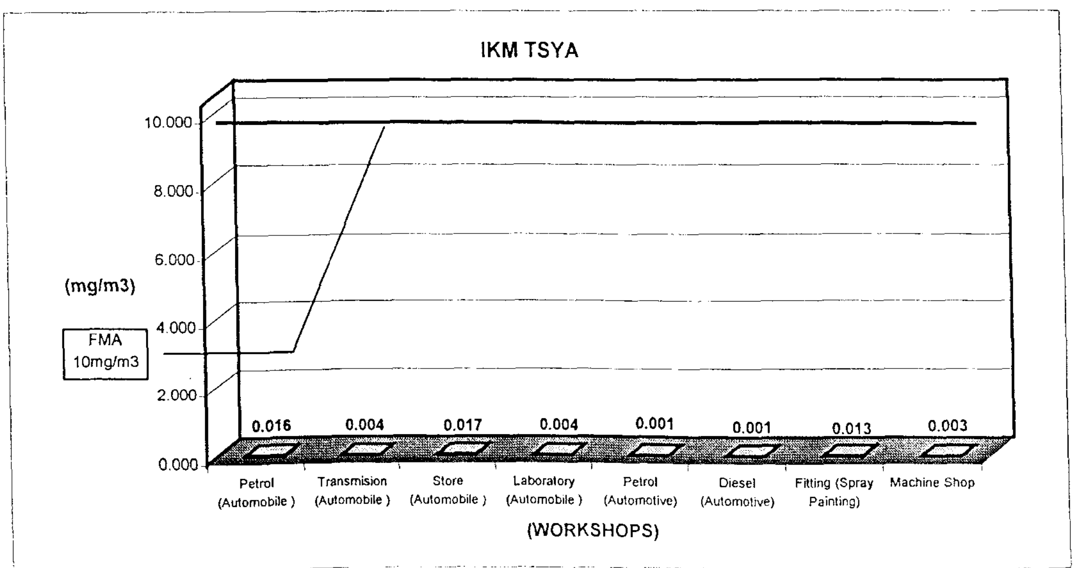




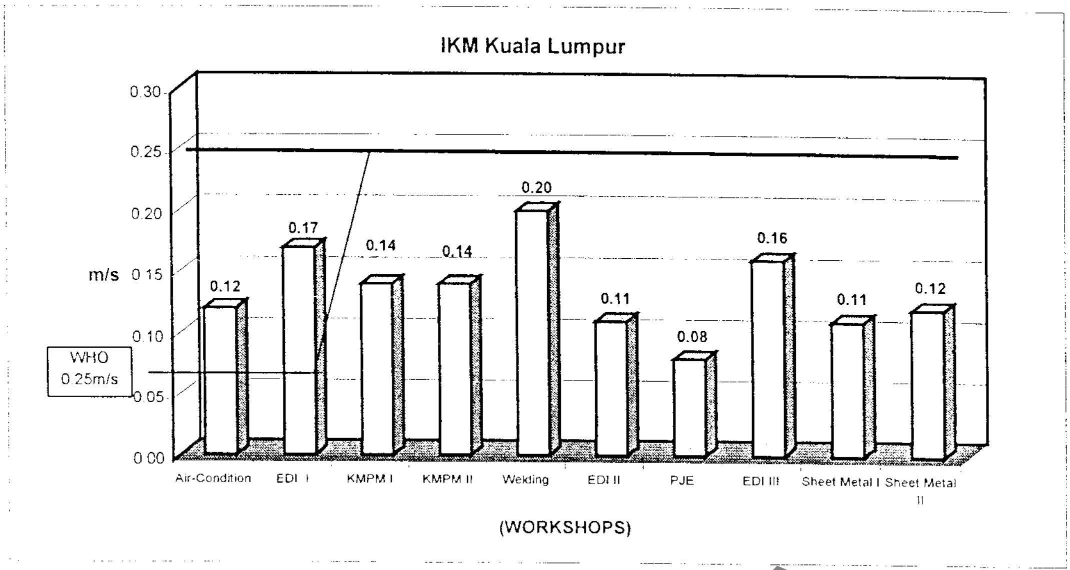
OVERALL RESULT ON DUST LEVEL (INDOOR)

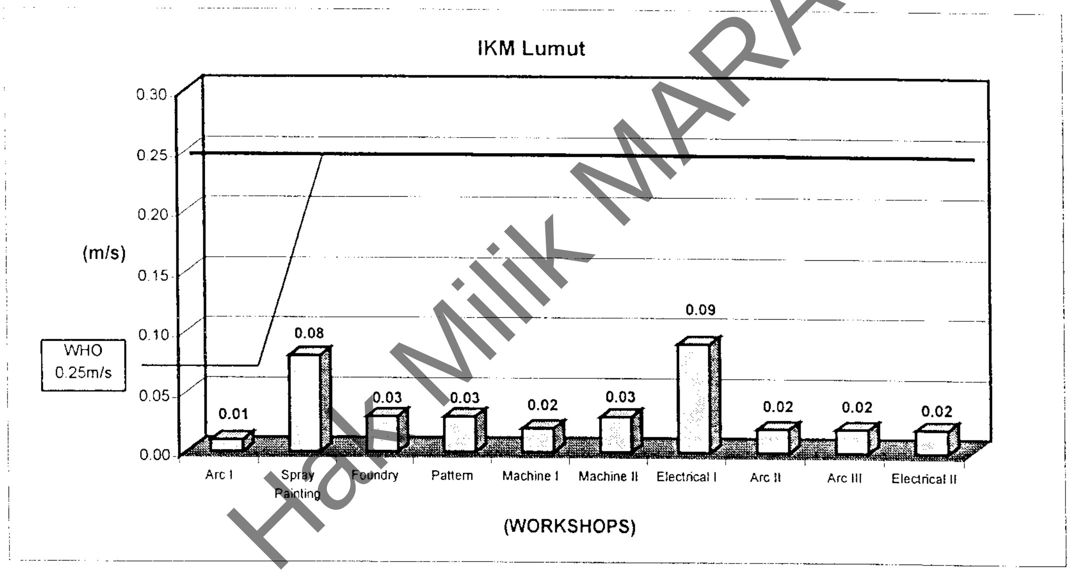


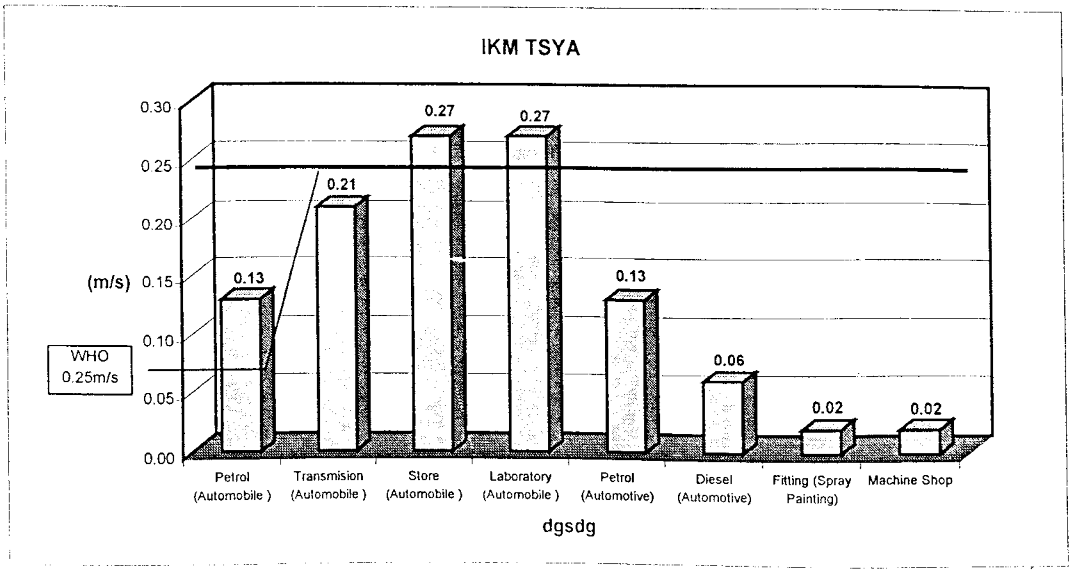




OVERALL RESULT ON AIR VELOCITY LEVEL (INDOOR)

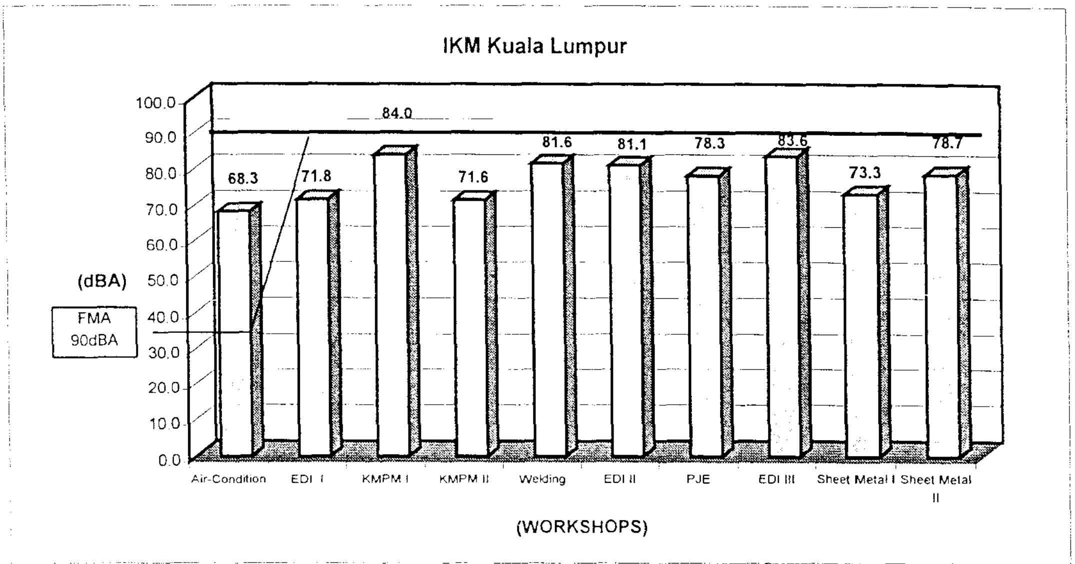


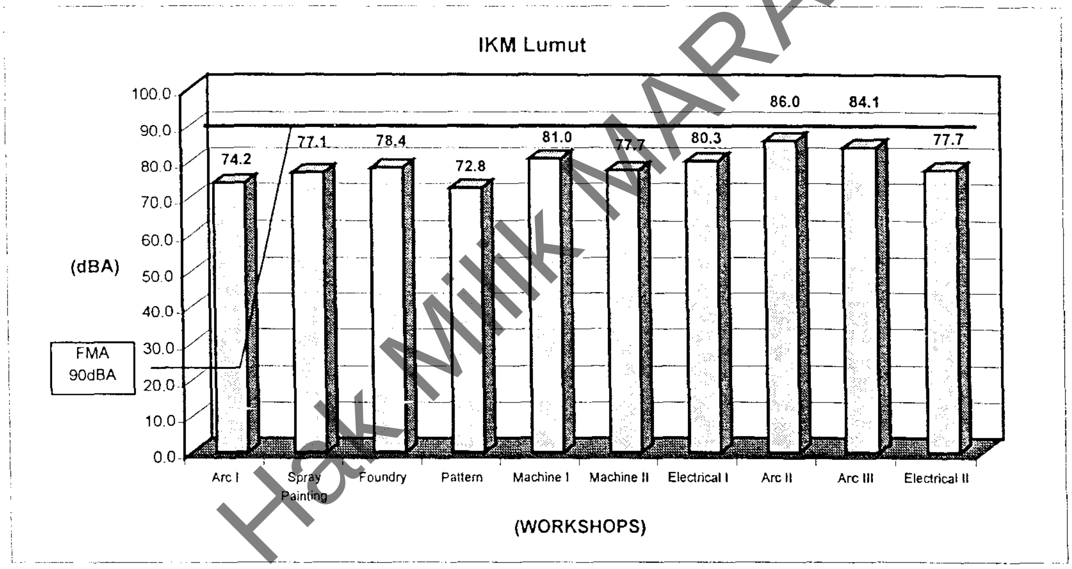


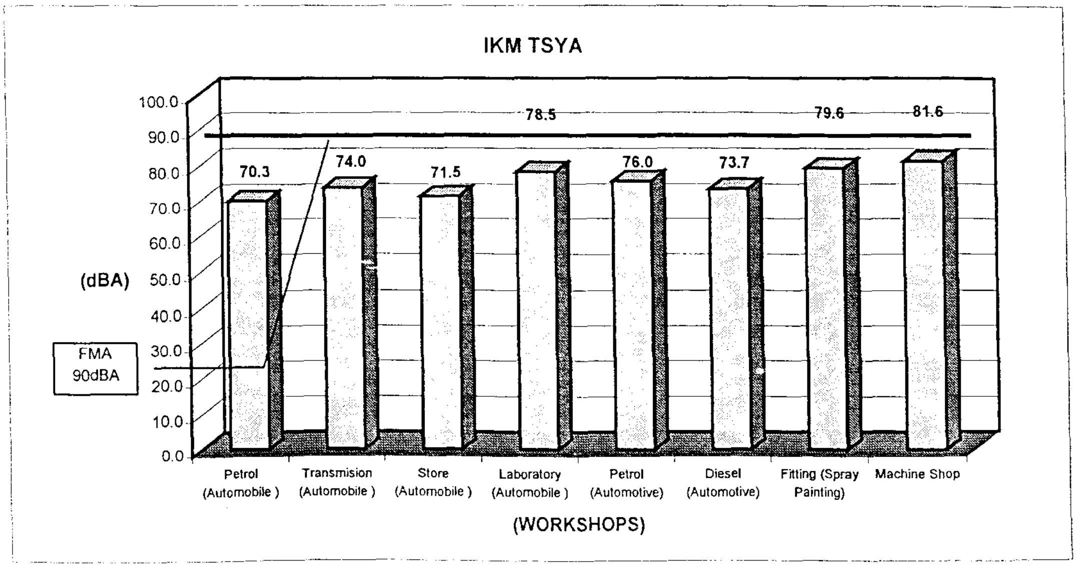


Appendix 58

OVERALL RESULT ON SOUND PRESSURE LEVEL (INDOOR)







Appendix 59

OVERALL RESULT ON LIGHTING LEVEL (INDOOR)