

UNIVERSITI TEKNOLOGI MALAYSIA

BORANG PENGESAHAN STATUS TESIS^U

JUDUL: **THE INDOOR ENVIRONMENTAL IMPACT ON RESIDENTIAL – INDUSTRIAL NEIGHBOURHOOD IN PAKA INDUSTRIAL ESTATE, TERENGGANU.**

SESI PENGAJIAN: **2007/2008**

Saya ALIFFADILLAH BIN JAFFAR
(HURUF BESAR)

mengaku membenarkan tesis (PSM/Sarjana/Doktor Falsafah)* ini disimpan di Perpustakaan Universiti Teknologi Malaysia dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hak milik Universiti Teknologi Malaysia.
2. Perpustakaan Universiti Teknologi Malaysia dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (✓)

SULIT

(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

TERHAD

(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

TIDAK TERHAD

Disahkan oleh

(TANDATANGAN PENULIS)

(TANDATANGAN PENYELIA)

Alamat Tetap:

KG GONG DATOK, MENGABANG TELIPOT,**21300 KUALA TERENGGANU****TERENGGANU DARUL IMAN****DR ROZANA ZAKARIA**

Nama Penyelia

Tarikh: **5 MAY 2008**Tarikh: **5 MAY 2008**

CATATAN:

* Potong yang tidak berkenaan.

** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD.

U Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah dan Sarjana secara penyelidikan, atau disertasi bagi pengajian secara kerja kursus dan penyelidikan, atau Laporan Projek Sarjana Muda (PSM)

“I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of the degree of Bachelor of Civil Engineering”

Signature :.....
Name of supervisor : DR ROZANA BINTI ZAKARIA
Date : 5 MAY 2008

KESAN KUALITI PERSEKITARAN DALAMAN
UNTUK KAWASAN KEJIRANAN PERUMAHAN DAN INDUSTRI DI KAWASAN
PERINDUSTRIAN PAKA TERENGGANU

ALIFFADILLAH BIN JAFFAR

Laporan ini dikemukakan sebagai memenuhi
sebahagian daripada syarat penganugerahan
Ijazah Sarjana Muda Kejuruteraan Awam

Fakulti Kejuruteraan Awam
Universiti Teknologi Malaysia

MAY, 2008

THE INDOOR ENVIRONMENTAL IMPACT
OF RESIDENTIAL – INDUSTRIAL NEIGHBOURHOOD
AT PAKA INDUSTRIAL ESTATE TERENGGANU

ALIFFADILLAH BIN JAFFAR

A report submitted in partial fulfillment of the
requirement for the award of the degree of
Bachelor of Civil Engineering

Faculty of Civil Engineering
Universiti Teknologi Malaysia

MAY, 2008

STATEMENT OF ORIGINAL AUTHORSHIP

The word contained in this thesis has not been previously submitted for a degree or diploma at any other higher education institution. To the best of my knowledge and belief, the thesis contain no material previously published or written by another person except where due reference is made.

Signature : -----
Name of Author : ALIFFADILLAH BIN JAFFAR
Date : 5 MAY 2008

This Research is dedicated especially

to my family:

Father, Jaffar bin Pak Chik;

Mother, Maimun binti Khalid,

Sister,

Nurul Wahida,

Nur Ain Husna;

Brothers, Mohd Kamil Ashraf;

And my BELOVED.

ACKNOWLEDGEMENT

In the past two semesters provided for the completion of this research, I have received generous assistance and support from many people. Without their cooperation and support, this research would not have been completed.

First and foremost, I would like to express my in depth gratitude to Dr Rozana Zakaria for her guidance and supervision throughout the course of my research. Thanks to all ideas and knowledge that make me able carried out this research properly and systematically.

I would also like to take this opportunity to thank my beloved family for their full support and assistance. I am most grateful that during the course of my research, I was given the highest moral support and help was always at hand to assist me at times when a thing goes difficult.

I would also like to thank all parties who were directly or indirectly involved in my research, who's giving me permission to conduct an interview, as well as allowing me to obtain valuable information and data. Special thanks are deeply dedicated to my friend Mohd Sabri Yahya who sharing the the experiences and helped me during conducting the questionnaire survey.

Last but not least, I would like to thank the residents of Taman Uda and Taman Perumahan TNB who were very kind and willing enough to take part in this research. Without their participation, this research could not be realised in this manner.

ABSTRAK

Kejian mengenai kesan perumahan – industri berjiran telah mendapat perhatian daripada pihak perancang Bandar dan juga pihak berkuasa yang lain disebabkan kepentingannya dalam memaparkan keadaan sebenar cara hidup sesebuah masyarakat. Kajian ini juga dijalankan berdasarkan hipotesis yang menyatakan bahawa aktiviti industri sebagai penyumbang kepada kesan pencemaran kepada kawasan perumahan berhampiran. Secara umumnya, proses perkilangan dan industri akan menghasilkan sisa tercemar yang mana ia adalah berbahaya kepada manusia dan juga alam sekitar. Oleh sebab itu, satu jangkaan dibuat bahawa kebanyakan penduduk di kawasan Perindustrian Paka terdedah kepada masalah persekitaran dalaman. Merujuk kepada perkara ini, satu usaha telah dibuat menerusi satu kajian bagi menilai tahap kepuasan penduduk setempat berkenaan kualiti persekitaran dalaman dan tahap hidup sihat di kawasan kajian. Terdapat beberapa parameter seperti kualiti udara dalaman, tahap pencemaran bunyi, kesan peningkatan suhu dan tahap kesihatan telah dipertimbangkan bagi mentakrif keadaan sebenar kualiti persekitaran dalaman dikawasan terlibat. Keputusan kajian menunjukkan Kawasan Perindustrian Paka mempunyai kualiti persekitaran dalaman yang kurang sihat akibat daripada kesan bahan pencemar luaran, khususnya daripada kawasan perindustrian berhampiran.

ABSTRACT

The impact of industrial – residential neighbourhood study is increasingly gaining the attention of urban planners and also to the responsible parties due to its usefulness in representing the actual condition in the human habitant area. This study is carry out based on hypothesis that industrial activities contributed pollutants to nearby residential area. There are common for the manufacturing and industrial process to produce the hazardous waste where it is dangerous or potentially harmful to the human health and environment. Therefore, it was anticipated that residential – industrial housing in Paka Industrial Estate would experienced indoor environment problems. With this in mind, an attempt was made in this study to assess the satisfaction of the local inhabitant corresponding to their indoor environmental quality as well as the level of health living in case study area. There are several parameters including air quality, excessive noise, local temperature effect and the level of health have been assessed in order to define the actual condition of local indoor environmental quality. The result indicated that residential – industrial housing in Paka Industrial Estate have poor indoor environmental quality due to affects from substances of outdoor sources, particularly from industrial emission and transportation.

TABLE OF CONTENTS

	Page
Thesis status confirmation.....	i
Statement of declaration.....	ii
Page title.....	iii - iv
Statement of original authorship.....	v
Statement of dedicated.....	vi
Acknowledgement.....	vii
Abstract.....	viii - ix
Table of content.....	x - xiv
List of table.....	xiv - xvii
List of figures.....	xvii - xviii

CHAPTER 1 – INTRODUCTION

1.0	Background.....	1
1.1	Statement of problems.....	4
1.2	Aim of study.....	5
1.3	Research objective.....	5
		Page
1.4	Scope of study.....	6
1.5	Significant of study.....	6

1.6	Overview of research methodology.....	7
1.7	Outlines of study.....	8

CHAPTER 2 – INDUSTRIAL EMISSION AND IEQ

2.0	Introduction.....	9
2.1	Sustainable development in the residential – industrial neighbourhood context.....	10
2.2	Indoor Environmental Quality (IEQ).....	10
	2.1.1. Indoor air Quality.....	12
	2.1.2. Ventilation.....	13
	2.1.3. Thermal Comfort.....	14
	2.1.4. Noise.....	15
2.3	The Health Factor.....	17
2.4	Indoor air quality pollution effect.....	18
	2.4.1 Carbon monoxide (CO).....	18
	2.4.2 Carbon dioxide (CO ₂).....	19
	2.4.3 Nitrogen Dioxide (NO ₂).....	21
	2.4.4 Sulfur Dioxide (SO ₂).....	21
	2.4.5 Radon.....	22
	2.4.6 Particulate matter (PM ₁₀).....	23
2.5	Indoor environmental quality guidelines.....	24

CHAPTER 3 – METHODOLOGY

	Page
3.0 Introduction.....	27
3.1 The questionnaire survey.....	29
3.2 The profile of residents and related detail.....	29
3.3 The case study.....	30
3.4 Statistical analysis from the questionnaire responses.....	31
3.5 Average index analysis.....	31

CHAPTER 4 – DATA ANALYSIS

4.0 Introduction.....	33
4.1 Data analysis (Questionnaire survey).....	33
4.1.1 Section A: Demographic Information.....	34
4.1.1.1 Age and level of income of survey respondents.....	34
4.1.1.2 Duration of occupancy.....	36
4.1.1.3 House ownership.....	38
4.1.2 Section B: The satisfaction of indoor environmental quality.....	40
4.1.2.1 Satisfaction of indoor air quality.....	40
4.1.2.2 Satisfaction of thermal effect.....	47
4.1.2.3 Satisfaction of building material damage.....	52
4.1.3 Section C: Health complaint.....	55

	Page
4.1.4 Section D: The awareness of sustainable development principle.....	60
4.1.5 Summary of key finding.....	66

CHAPTER 5 – DISCUSSION AND FINDING

5.0 Introduction.....	68
5.1 Research finding from the Paka Industrial Estate case study.....	68
5.1.1 Overall indoor environmental quality.....	69
5.1.2 The occupant’s awareness of sustainability.....	71
5.2 Pre – conclusion.....	72

CHAPTER 6 – CONCLUSION

6.0 Introduction.....	73
6.1 Conclusion of this study.....	73
6.3 Recommendation.....	74
6.1.1 The recommendation to improve the quality living in residential – industrial neighbourhood in Malaysia.....	74
6.1.2 The recommendation for future study.....	75
6.2 Limitation of this research.....	76

AFFIX

	Page
Reference.....	77
Appendix A – Paka Industrial Estate Local Plan – Land uses.....	79
Appendix B – Questionnaire for house occupants.....	80

LIST OF TABLE

Table 2.1	Long-term goals for indoor environmental quality parameter (World Health Organization Regional Office for Europe, 2000).....	24
Table 2.2	List of contaminant and maximum allowable limits (DOSHS, 2005).....	25
Table 2.3	Guidelines for maximum concentration of specific indoor air contaminants (institute of environment and epidemiology,1996).....	26
Table 3.1	The percentage of questionnaire handed out in total at Taman Uda and Taman Perumahan TNB.....	30
Table 4.1	Frequency distribution for Age grouping of respondents in Paka Industrial Estate in 2007.....	34
Table 4.2	Frequency distribution for occupant's income level.....	35
Table 4.3	Frequency distribution for length of occupancy of participants.....	37

		Page
Table 4.4	Frequency distribution of respondent's house ownership.....	38
Table 4.5a	The respondent's satisfaction of indoor air quality.....	40
Table 4.5b	Descriptive statistics for the respondent's satisfaction of indoor air quality.....	41
Table 4.6a	Frequency distribution of level of agreement for indoor odor effect from industrial emission.....	42

LIST OF TABLE – Continued

Table 4.6b	Descriptive statistics for the level of agreement of indoor odor effect from industrial emission.....	43
Table 4.7a	Frequency distribution for the satisfaction of dust, haze, and smog or soot problem.....	44
Table 4.7b	Descriptive statistics of the dust, haze, and smog or soot problem.....	44
Table 4.8	Average mean index for responses to sources of dust, soot, haze and smog problem.....	45
Table 4.9a	Frequency distribution for satisfaction of increasing temperature due to industrial activities.....	47

	Page
Table 4.9b Descriptive statistics for the satisfaction of increasing temperature due to industrial activities.....	48
Table 4.10a Frequency distribution for higher temperature level experienced by respondents.....	49
Table 4.10b Descriptive statistics for the higher temperature level experienced by respondents.....	49
Table 4.11a Frequency distribution for level of agreement of occurrence noise disturbance.....	50
Table 4.11b Descriptive statistics for the satisfaction of noise Disturbance due to industrial activities.....	51

LIST OF TABLE – Continued

Table 4.12a Frequency distribution for level of agreement for Occurrence of material damage (corrosion).....	52
Table 4.12b Descriptive statistics for the satisfaction of material damage problem (corrosion).....	52
Table 4.13a Frequency distribution for the level of agreement of material damage (discoloration).....	53
Table 4.13b Descriptive statistics for the satisfaction of material damage due to discoloration.....	54
Table 4.14a Frequency distribution for level of agreement of health complain.....	55

	Page
Table 4.14b Descriptive statistics for the level of agreement for health complain.....	55
Table 4.15a Frequency distribution for level of agreement for experience of frequent health symptoms.....	57
Table 4.15b Descriptive statistics for level of agreement for experience of frequent health symptoms.....	57
Table 4.16a Frequency distribution for level of agreement that leaving the house gives relief from health complaint.....	58
Table 4.16b Descriptive statistics for level of agreement that leaving the house gives relief from health complaint.....	59

LIST OF TABLE – Continued

Table 4.17a Frequency distribution for level of agreement for respondent's awareness of sustainable development.....	60
Table 4.17b Descriptive statistics for level of agreement for respondent's awareness of sustainable development.....	60
Table 4.18a Frequency distribution of level of agreement for the level of understanding about sustainable development principle.....	62
Table 4.18b Descriptive statistics for the level of understanding about sustainable development principle.....	63

	Page
Table 4.19 The Average Index for the response to the need of sustainable development.....	64

LIST OF FIGURE

Figure 2.1 Information for first responders to an indoor chemical release.....	14
Figure 3.1 Research methodology.....	28
Figure 4.1 Frequency diagram for age of respondents in Paka Industrial Estate in 2007.....	35

LIST OF FIGURE – Continued

Figure 4.2 Frequency diagram for respondent's income level in Paka Industrial Estate in 2007.....	36
Figure 4.3 Frequency diagram for respondent's duration of occupancy in Paka Industrial Estate in 2007.....	37
Figure 4.4 Frequency diagram for respondent's house ownership in Paka Industrial Estate in 2007.....	39
Figure 4.5 Average mean index for responses to sources of dust, soot, haze and smog problem.....	46
Figure 4.6 The average index for the response to need of sustainable development.....	65

	Page
Figure 4.7 The degree of satisfaction of problem and issues among the local respondents.....	66
Figure 4.8 The average index for response to the need of sustainable development and the average index of the factor for air pollution in case study area	67

CHAPTER 1

INTRODUCTION

1.0. Background.

Industrial developments are a major contributor to our economic and social development. This situation has dragged our government to perform mixed land use concept between industrial area and residential area. The change land use concepts, indirectly, influence the vulnerability of places and people to climatic, economic or socio-political perturbations (Kasperson, Kasperson, & Turner, 1995; Kasperson & Kasperson, 2001). On the other hand, migration process also encouraging due to a lot of job opportunities offered by industrial sector in order to perform their activities. The migration process permitted the population from other place to come and increased the local population on the industrial area. The population growth had forced local government to expand the current local residential area in order to accommodate a great number of populations. In addition, the growth in population had also caused the other facilities such as road, health centre, education centre and others to be developed or renovated. These facilities can be defined as supported facilities to the industrial process. To deal with this phenomena needs, the urban

planners are moving away from the traditional approach of planning and have adopted a more comprehensive approach in planning the urban environment in which the main focus will be on the demands and needs of the people (Schmandt and Bloomberg, 1969). Other than that, the government had also enforced some act such as the Environment Quality Act (sewage and industrial effluent) to ensure the whole industrial activities would be performed systematically and hazard free to their neighbourhood area. Therefore, the quality of life must be considered as important issue in this neighbourhood area.

Many people often used the economic growth and development as a measurement of quality of life. However, this is not true as the measurement for the quality of life is not only comprised of one factor or aspect, but there are much more factors to be considered. Factors like the politic, economy, culture, social, environment, and individual aspects are often interdependent to each other, and all of these factors must be taken into account when measuring the quality of life. Seed and Lloyd (1997), in their book "*Quality of Life*", stated that quality of life is simultaneously about the needs and hopes of individual people and about groups of people. It is also about an individual's personal environment and our shared global environment, encompassing social, economic and environmental dimensions. There are two indicator available in order to classify the quality of life which is objective and subjective indicator. The objective indicator is usually used in neighbourhood area, city and country level in order to identify various basic needs such as food and shelter. On the other hand, the subjective indicator is more focused to the level of individual satisfaction for their life quality.

The study of the impact of industrial - residential neighbourhood is important to our construction industry to obtain better understanding about how to create a better quality of life to our communities besides improving our economic development. The better understanding is needed to improve planning approach of our urban planning. A compatible planning is also needed for the industrial and residential neighbourhood because it can be categorised as higher risks area. The population around this area has significant probability of exposing to the hazard from industrial activities. This fact are already been proved by recent outdoor study such as from UNESCAP (United Nation Economic and Social Commission for Asia Pacific). The result from this study shown that there are various type of pollution immersed in industrial and residential neighbourhood such as air pollution, noise pollution, local temperature increase and material damages. These negative effects influence the quality of life for the local communities and it is directly affect the health of the population and property damage. Therefore, it is important to perform a study to identify the problem that experienced by local population and explore the efficiency of the whole initiative from liable parties and propose with alternative solution.

1.1. Statement of problem

A lot of industrial area was developed by our government in order to increase the productivity. This progress contributed a lot to our economic development. The rapid development in the industrial sector produced more job opportunities to our inhabitant. This situation will allow the migration process where the population from

other place come and increased the local inhabitant at the industrial area. The rapid growth in local population will encourage the increases of local demand for better infrastructures and this will cause the local economic activities will become lively.

Industrial and residential neighbourhood development need a better planning and enforcement from the local authority to make sure better a quality of life for the local population. Without compatible control, this kind of mixed – used urban development may give a lot of negative effects to local population such as air pollution, noise pollution, increase local temperature and odour pollution. The hazard may influence the health of local population and damages to the public properties.

Paka industrial estate can be categorised as developing area. This industrial complex consists of heavy industrial activities such as petrochemical industry from PETRONAS Carigali Sdn Bhd, Exxon Mobile – Malaysia Inc, Optimal (US) and Polyethylene Malaysia Sdn Bhd. On the other hand, this case study area also provides space for supporting industry and light industry such as PCV industry, polymer and etc. Rapid industrial development in this area, indirectly increase the rate of pollution such as air pollution, increase local thermal and worse noise. Therefore, without impressive control it can contribute worse impact to the local inhabitant.

Given the situation, it can be seen that it is the time to take serious effort in studying the possible hazard that may arise from this mixed – used urban development.

1.2. Aim of study.

Currently, our country experienced rapid development in industrial and residential sector in order to grow up the economic sector. This phenomenon leads our government to have more and more mix – used urban development. Thus, the aim of this study is to identify the impact as well as the condition of healthy living in residential area that located proximity to industrial area.

1.3. Objectives of study

The objectives of the study are as follows:

1. To identify the most important environmental factors leading to Indoor Environment Quality (IEQ) problems in residential – industrial neighbourhood area.
2. Identify concern and issues among local residents in residential – industrial neighbourhood.
3. To review the level of understanding of sustainable development issues among the occupants.

1.4. Scope of study.

The study was conducted at two different residential areas located next to the Paka Industrial Estate which is Taman Perumahan TNB and Taman Uda. This study involved the data collection of local inhabitant satisfaction about the impact from industrial activities. In addition, this study also considered the local residents feedbacks on their sustainable development awareness. The data collection process for this study was conducted through the distribution of 110 questionnaires to local residential occupant from each suburb.

1.5. Significant of study.

This study was conducted in order to represent actual local satisfaction about the problem faced due to the impact from Industrial-residential neighbourhood development. On the other hand, this study also investigated the degree of understanding among local inhabitant about the correlation between sustainable development concept and current land used development planning concept. This is important to improve the quality of life of local inhabitation correspond to the development planning. Therefore, the finding of this study is expected representing the quality of life of residents in industrial-residential neighbourhood area, so that it becomes valuable references to future development.

1.6. Overview of the research methodology.

The research methodology is an important component to concert the direction of the study. There are several method have been planned in this study in order to achieve its objectives. The research literatures have been done at the preliminary stage in order to assemble all the information and to provide better understanding about the problem of the study. The author can extract the related information for the study through many ways such as from prior research.

The questionnaire session was conducted in order to acquire data from participant on the selected suburb. Through this session, the participant can concert their feeling or certificate about theirs indoor environmental quality.

After all the distributed questionnaires have been received, all the data from the questionnaire analysed using the statistical analysis method. The sample data have been established to obtain the Mean (of the ranked scores), Standard Deviation, the Mode (most common scores), the maximum and minimum scores for each stated variable. This session is important in order to justify the hypothesis that has been assumed previously.

Finally the result established from the analysis has been discussed and also has been compared with other references and existing IEQ guidelines.

1.7. Outline of study

This report consists of six components. A brief summary of each is outlined below:

Chapter 1: This chapter describe about introductory section that will develops the reason and the direction of this investigation. To make this section significant, it also consists of research background, research problem, research objectives, overview of research methodology and the research scope.

Chapter 2: Discuss the key term used in this research. This chapter comprises the literature review on the indoor environmental impact on industrial-residential neighbourhood. It also discuss about a further justification of the relevant indoor environmental quality (IEQ) and related IEQ guidelines that currently apply and enforce by World Health Organization (WHO) and other related parties.

Chapter 3: Describes the research design and methodology in detail including the research plan, data collection method, type of data collected, the participant involved, pilot study, reliability, validity and the method of data analysis.

Chapter 4: Present the analysis and interpretation of quantitative data that obtain from survey questionnaire by using SPSS software. Generally, this chapter has shown the house's occupants point of view about their indoor environmental quality.

Chapter 5: Present the finding of the quantitative research and discussed the research outcomes of indoor environmental quality in residential- industrial neighbourhood.

Chapter 6: Comprises the conclusion and recommendation of this research.

CHAPTER 2

THE INDUSTRIAL EMISSION AND INDOOR ENVIRONMENTAL QUALITY

2.2. Introduction

The detail discussion about impact of industrial – residential neighborhood will be expressed in this chapter and their relation to indoor environmental quality (IEQ). The Meriam Webster dictionary (2003) defines in residential – industrial neighbourhood as a place where people live in close to proximity to industry. The latter attract people to the area by providing well-paying job. Industrial activities can release substances into the environment. There are a part of this substances are contaminant at harmful concentration and indirectly contributes adverse effect not only to outdoor but also to indoor environmental quality of local residential. Therefore, there are a lot of complain by occupant in term of health symptoms, discomfort and odours. Keep this in mind, the detail discussion about the effect of indoor contaminant also been highlighted in this session. On the other hand, this chapter also concerned about the current guidelines that

had been introduced by several parties such as The World Health Organization (WHO), The National Institute of Occupational Safety and Health (NIOSH), The National Ambient Air Quality Standard (NAAQS) and The International Standard Organization (ISO).

2.3. Sustainable development in the residential – industrial neighbourhood context.

Sustainable development is the one of the important aspect that should be considered during making a decision for planning development. This principle were introduced to establish equivalent development without ignore the environment interest. Therefore, the sustainable development issue does not focus solely on environmental issues. More broadly, sustainable development policies encompass economic, social and environmental factors at the policy, planning and management levels. This influences the actions of all groups in society, including Governments, industry and individuals as well as those who have important implications for the efficiency and sustainability of development.

2.4. Indoor Environmental Quality (IEQ)

Recently, the concern about Indoor Environmental Quality (IEQ) enhanced slightly among the people or public society. Therefore, building are increasingly design and proposed to be “sustainable” or “green” in order to provide better indoor environmental quality to residential. Indoor environment is a central to public health because occupant spent more of their time there. Keep this fact in mind, the

