COMPARISON OF NOISE EXPOSURE AMONG AIRPORT WORKERS AT TWO SELECTED STATES

by

NUR HAMIZAH BINTI AB HALIM

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LIST OF SYMBOLS AND ABBREVIATIONS

a.m.	Noon
dB	Decibel
dB (A)	A-Weighted decibel
DOE	Department of Environment
E	East
EEA	European Environment Agency
FMA	Factories and Machinery Act
ft	Feet
Hz	Hertz (Frequency unit)
ICAO	International Civil Aviation Organisation
IQR	Interquartile range
ISO	International Standard Organisation
km	Kilometre
km^2	Square kilometre
LAeq	Average level of sound pressure within a certain time period.
m	Metre
mi	Mile
N	North
NIHL	Noise-induced Hearing loss
NIOSH	National Institute for Occupational Safety and Health
Pa	Pascal
p.m.	Afternoon

PPE	Personal protective equipment
r	Correlation Coefficient
Reg.	Regulation
S. D.	Standard deviation
SLM	Sound Level Meter
SPSS	Statistical Package for the Social Sciences
OSHA	Occupational Safety and Health Administration
WHO	World Health Organisation
W/m^2	Watt per square metre
Z	Standard score
%	Percentage

PERBANDINGAN TAHAP PENDEDAHAN BUNYI BISING DALAM KALANGAN PEKERJA LAPANGAN TERBANG DI DUA NEGERI TERPILIH

ABSTRAK

Kajian terdahulu mendapati bahawa pekerja lapangan terbang terdedah kepada risiko kerosakan pendengaran akibat kebisingan. Kajian ini bertujuan untuk menentukan dan membandingkan tahap pendedahan bunyi bising dalam kalangan pekerja lapangan terbang di Lapangan Terbang Sultan Abdul Halim, Kedah dan Lapangan Terbang Sultan Ismail Petra, Kelantan. Selain itu, perbandingan tahap pendedahan bunyi bising antara waktu siang dan malam di kedua-dua lapangan terbang ditentukan. Perkaitan antara bilangan pesawat beroperasi dan tahap bunyi bising di kedua-dua lapangan terbang juga dilakukan. Tahap bunyi bising di kawasan terminal diukur menggunakan meter paras bunyi. Bunyi bising pesawat telah direkodkan pada 6 titik persampelam di mana titik pertama adalah 5 m dari sumber bunyi bising sehingga 30 m. Berdasarkan keputusan yang diperoleh, pekerja di Lapangan Terbang Sultan Ismail Petra, Kelantan mempunyai pendedahan kepada bunyi bising yang lebih tinggi berbanding pekerja di Lapangan Terbang Sultan Abdul Halim, Kedah dengan purata75.87 ± 3.75 dB (A). Walau bagaimanapun, tahap bunyi bising tersebut tidak melebihi had pendedahan yang dibenarkan [paras bertindak: 85 dB (A)] sepertimana dinyatakan di bawah Peraturan-Peraturan Kilang dan Jentera (Pendedahan Bunyi Bising) 1989. Dengan menggunakan ujian Mann-Whitney, tiada perbezaan yang signifikan bagi pendedahan bunyi bising antara pekerja di kedua-dua lapangan terbang. Hal ini kemungkinan disebabkan oleh bunyi bising dikeluarkan oleh jenis pesawat yang sama dari kedua-dua lapangan terbang. Di samping itu, terdapat perbezaan yang signifikan bagi tahap kebisingan antara waktu siang dan malam di Lapangan Terbang Sultan Ismail Petra, Kelantan ($p = 0.008$). Hal ini kerana masa penerbangan yang lebih pendek pada waktu malam di mana beberapa pesawat dilihat mendarat pada masa yang sama. Melalui ujian Korelasi Spearman, tiada perkaitan antara bilangan pesawat beroperasi dan tahap bunyi bising di kedua-dua lapangan terbang. Faktor meteorologi dan bunyi bising latar belakang lain boleh mempengaruhi paras bunyi bising di lapangan terbang. Walaupun pekerja di kedua-dua lapangan terbang ini tidak terdedah kepada bunyi bising melebihi had yang dicadangkan, tetapi kesan jangka panjang akibat pendedahan berterusan terhadap bunyi bisng tidak boleh dipandang ringan. Kesimpulannya, majikan bertanggungjawab untuk memastikan tahap bunyi bising yang selamat di tempat kerja dengan melakukan pemantauan bunyi bising dan pengawasan kesihatan secara berkala kepada pekerja.

COMPARISON OF NOISE EXPOSURE AMONG AIRPORT WORKERS AT TWO SELECTED STATES

ABSTRACT

Previous study found that airport workers are exposed to risk of hearing damage due to noise. This study was aimed to determine and compare noise exposure level among aircraft workers at Sultan Abdul Halim Airport, Kedah and Sultan Ismail Petra Airport, Kelantan. Besides, comparison of noise exposure level between day-time and nigh-time at both airports was determined. Association between the numbers of aircraft operates and the noise level at both airports was also conducted. Area noise levels at the terminal were measured using a sound level meter. The aircraft noise was recorded at 6 sampling points where the first point was 5 m distance from the noise source to 30 m. Based on the findings, workers at Sultan Ismail Petra Airport, Kelantan have higher exposure to noise than workers at Sultan Abdul Halim Airport, Kedah with average 75.87 ± 3.75 dB(A). However, the noise level did not exceed the Permissible Exposure Limit [action level: 85 dB (A)] as stated under Factories and Machinery (Noise Exposure) Regulations 1989. By using Mann-Whitney test, there was no significant difference of noise exposure between workers at both airports. This might be due to noise that emitted from the same type of aircraft at both airports. In addition, there was a significant difference of noise level between day-time and night-time at Sultan Ismail Petra Airport, Kelantan ($p=0.008$). This is because of shorter flight time at night where several flights were seen landing at the same time. Through Spearman Correlation test, there was no association between number of aircraft operates and noise level at both airport. Meteorological factor and other background noise can influence noise level at the airport. Even though, the workers at both airports were not exposed to noise beyond the recommended limit, long term effect due to continuous exposure of noise cannot be underestimated. As a conclusion, employers are responsible to ensure a safe level of noise at the workplace by conducting regular noise monitoring and health surveillance to the workers.

CHAPTER 1

INTRODUCTION

1.1 Background Information

Noise is one of the occupational issues that produce effect to exposed workers. Noise can be defined as unwanted sound. Sound is responded in a different way and subjectively by people. It is described as loudness, noisiness, annoyance and speech interference.

Noise can be produced by many sources and one of them is a transportation noise. Transportation noise can be divided into two, which are surface and air transportation. Traffic, railroads, off-road recreational vehicles, ships and hovercraft are main sources of surface transportation noise (Cunniff, 1977). While air transportation noise problem comes from commercial aircraft, jet, aviation aircraft and helicopter.

Since the middle of the twentieth century, the growth of air transport becomes widely spread. It has resulted in increasing numbers of people being affected by aircraft noise (Commission, 2013). Aircraft generally increase by the growing of airport in the country. An airport is a location where aircraft such fixed-wing aircraft, helicopters, and aircraft take off and land. Aircraft may be stored or maintained at an airport. Major commercial airports generate positive economic benefits to the airport and promote the air transport industry. The effects of aircraft noise on the health and well-being of the workers must be understood before creating strategies and counter-measures. The concept of life quality, a multidimensional construct is increasingly important in socio-economic research.

Noise can affect the workers especially who are working in high noise exposure area. According to the study done by Hong and Kim (2001) at Korea, occupational noise exposure threatens the hearing of many workers. They study about hearing loss of airport workers and they suggest an aggressive hearing conservation program is needed at the airport, emphasising both job-related noise exposure and personal risk factors for hearing loss.

Exposed to high level of noise can give health effects to human. Effects of noise can be divided into two, auditory and non-auditory effects. Auditory effects related to hearing loss and non-auditory effects related to physiological and psychological effects. Auditory effect such as noise induced hearing loss (NIHL) is the most serious health effects that may affect the airport workers. Studies have investigated the risk of NIHL in employees working at civil airports whose exposure to noise was mainly from aircraft (Merluzzi, 1988; Tubbs, 1991; Chen, 1992). Merluzzi (1988) found there is a moderate degree of risk of hearing damage due to noise for airport workers during the first 10 years on the job. However, the risk rises significantly after that period.

1.2 Problem Statement

Aircraft is the major source of noise pollution in the airport. Noise becomes a major problem worldwide. According to Suter (2000), about 9 million workers are exposed to sound level of 85 dB and above. Besides, in the European Union, 28% of workers surveyed reported that they need to loud out the voices during conversation at workplace (European Agency for Health and Safety at Work (EASHW), 2000).

To achieve vision 2020, Malaysia as a rise country will produce more facility for ease the trip in a short time. The present of new airports are coming up while the existing airport then being upgraded and expanded to support the increasing population in country (Bhawan, 2008). In Malaysia, as an example, in 2015 the new airport is in the progress of being built at Kulim, Kedah for addition of international airport in northern area. It is expected that the noise level from air transportation will be increased.

Noise at the airport is usually comes from the aircraft's engines. They produced high level of noise that can affect the workers who are working around the area. This may cause many impacts either in short or long term.

Noise can produce long term effects to workers which can affect their quality of life. Annoyance, interfere with speech communication and sleep disturbance are the effects of aircraft noise to workers. Study by Miedema et al. (2001) has derived exposure-effect associations for the effects of different noise sources on annoyance responses. They found that aircraft noise produces greater annoyance responses than road traffic noise at the same level of exposure.

Considering the problem of increase level of noise due to air traffic, the need to generate uniform and reliable database are essential for better noise control and less effect.

1.3 Study Objectives

1.3.1 General Objective

To compare aircraft noise exposure at Sultan Abdul Halim Airport, Kedah and Sultan Ismail Petra Airport, Kelantan.

1.3.2 Specific Objectives

1. To determine noise exposure level at two airports.
2. To compare noise exposure level between two airports.
3. To compare noise exposure level between day-time and night-time at two airports.
4. To associate between numbers of aircraft operates and the noise level at two airports.

1.4 Alternative Hypothesis

1.4.1 There is a significant difference of noise exposure level among workers between two airports.

1.4.2 There is a significant difference of noise exposure level between day-time and night-time at two airports.

1.4.3 There is a significant association between numbers of aircraft operates and the noise level at two airports.

1.5 Significance of Study

Exposure to high level of noise can affect workers' daily life and also their health. This study can help employer and employee know the noise level at their workplace. From the results obtained, the employer aware of the noise level exposed to their workers and they have to manage this issue by noise reduction. For example, employer can provide personal protective equipment (PPE) and also provide audiometric testing for their workers.

This study can also give information to employer according to noise at airports. The employer is responsible for the health, safety and welfare of the employees. So, it is employer's responsibilities to ensure their employees have no impairment due to noise. According to Occupational Safety and Health Act 1994, Malaysia, it is the duty of every employer and every self-employed person to ensure, so far as it practicable, the safety, health and welfare at work of all his employees.

Besides, by this study, the employer can easily identify the target group who are really exposed to high level of noise. From the observation, the target groups involved are luggage carrier, aircraft maintenance workers, security workers and runner.

Furthermore, employee knows their responsibility to care of themselves and their friends from high noise level. They will also aware of the safe distance to carry out their tasks as to reduce the noise exposure.

CHAPTER TWO

LITERATURE REVIEW

2.1 Noise Definition

Sound is produced by any mechanical movement and is propagated as a motion wave through the air or any other material. Therefore, sound is defined by its mechanical energy and is measured in energy-related units. Sound pressure proportional to the square of sound intensity (W/m^2) is expressed in Pascal units (Pa), whereas sound pressure level is expressed in decibel units (dB) on a logarithmic scale, owing to the wide range covered. Sound transmits physiological signals in the auditory system constituted by the ear and the auditory pathways. However, some sounds do not evoke those signals as they are out of the auditory perception range in humans, which theoretically ranges from 20 to 20,000 Hz (Muzet, 2007).

Noise is generally defined as an unwanted sound or set of sounds. This definition means that it is not possible to classify sounds as noise on the unique basis of their physical characteristics. The general agreement is that noise is an audible acoustic phenomenon that adversely affects, or may affect, people. The effects of noise can be appreciated physiologically but also psychologically (annoyance and disturbed well-being). People will felt pain if they are exposed to sound levels between 130 to 140 dB (Berglund & Lindvall, 1995).

Figure 2.1 explains that the threshold of hearing is about 1000 Hz means 0 dB. Jet or aircraft might produce 120-140 dB which can produce threshold of pain to people in the expose area.

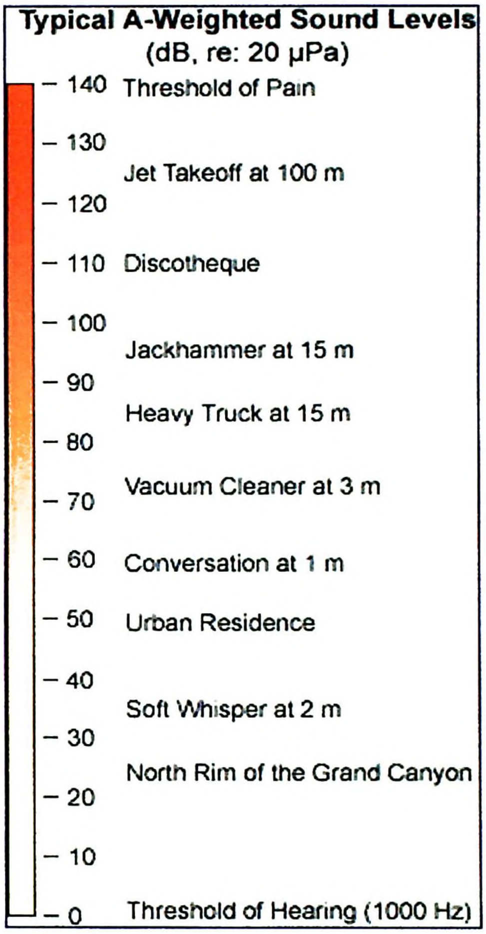

Figure 2.1: Noise level for typical A-weighted noise

(Berglund & Lindvall, 1995)

2.2 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 power house 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 and noisy periods. When machinery operates in cycles, or when single vehicles or airplanes pass by, the noise level increases and decreases rapidly (Bruel & Kjaer, 2000).

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 is examples of such noise (Canadian Centre of Occupational Safety and Health (CCOSH), 2014).

2.3 Characteristic of Noise

Sound involves the transfer of energy. Sound travels through a medium such as air without mass transfer, oscillates like a wave of air molecules to move energy. Four essential features of normal air pressure are frequency, amplitude, velocity and wavelength.

2.3.1 Frequency

Frequency is the rate at which the source produces sound waves, i.e. complete cycles of high and low pressure regions. In other words, frequency is the number of times per second that a vibrating body completes one cycle of motion. The unit for frequency is the hertz (Hz = 1 cycle per second) (CCOSH, 2014).

2.3.2 Amplitude (Loudness)

Amplitude is the objective measurement of the degree of change (positive or negative) in atmospheric pressure (the compression and rarefaction of air molecules) caused by sound waves. Sounds with greater amplitude will produce greater changes in atmospheric pressure from high pressure to low pressure. Amplitude is almost always a comparative measurement, since at the lowest-amplitude end (silence), some air molecules are always in motion and at the highest end, the amount of compression and rarefaction though finite, is extreme (Hass, 2013).

2.3.3 Velocity

Velocity is speed of sound through a medium depends upon the density and pressure of the medium. Velocity is vector measurement of the rate and direction of motion or, in other terms, the rate and direction of the change in the position of an object (Mohamed, 1997).

2.3.4 Wavelength.

Wavelength can be defined as the distance between corresponding points of two consecutive waves. "Corresponding points" refers to two points or particles in the same phase. It is an important property of sound, when the objective is to block the sound (Brittania, 2015).

2.4 Decibel (dB)

Commonly, noise is measured using a decibel (dB) unit. One unit decibels corresponds to a ratio of 2 form of electrical signals or acoustic power that can be equated to 10 times the logarithm of this ratio. An increase in noise by 10 decibels is considered twice as loud to the human ear (Mohamed, 1997).

Human hearing availability is less sensitive at very low and very high frequencies. In order to account for this, weighting filters can be applied when measuring sound. The most common frequency weighting in current use is "A-weighting" providing results often denoted as dB (A), which conforms approximately to the response of the human ear (Bruel & Kjaer, 2000).

2.5 Aircraft Noise

Aircraft noise is a significant concern for approximately 100 km^2 surrounding most major airports. Aircraft noise is the second largest (after roadway noise) source of environmental noise. While commercial aviation produces the preponderance of total aircraft noise, private aviation and military operations also play a role (Wahab, 2008).

Most of the noise generated from the aircraft engines typically occur from the high velocity exhaust gases and the air flow in the fan system. A common finding in the syntheses of annoyance and sleep disturbance studies was that at the same A-weighted average noise exposure level or noise indicator, aircraft noise was more annoying than road traffic noise and railway noise was less annoying than road traffic noise (Wolfgang et al., 2009).

Aircraft noise produced during take-off, flyover and landing operations can cause community annoyance. Annoyance is broadly defined as the physical or psychological discomfort caused by noise and its interference with different activities. Aircraft noise is considered to be annoying when it interferes with daily activities, for examples, day-to-day communication, recreation, sleep, cognitive performance and class-room learning activities (Basner et al., 2006).

During take-off, some aircraft may generate sound levels in excess of 100 dB at ground level, with approach and landing creating lower levels. Since aircraft landing in inner-city airport are often lower than 60 meters (20 ft) above roof level, a sound level above 100 dB (A) can be realised (International Civil Aviation Organisation (ICAO), 2008).

Nowadays, aircraft noise is the major issue in many countries. It becomes critical issue among workers at the airport. Aircraft noise can be defined as noise pollution which is produced by any aircraft or its parts, during various stages of a flight (Kryter et al., 1994).

Motions of air molecules are produced when they pass through jet engine resulting in air compression and rarefaction. This movement transmits via the air as pressure waves. Within the audible frequency spectrum, if these pressure waves are sufficiently strong, it may produce hearing sensation. Each type of aircraft has different noise level and frequencies. Three main sources of aircraft noise are aerodynamic noise, engine and other mechanical noise plus aircraft system noise (Kryter et al., 1994).

2.6 Noise Sources at Airport

Airport noise comes from engine and other mechanical noise. Much of the noise propeller aircraft comes equally from the propellers and aerodynamics. Typically noise is generated when flow passes an object on the aircraft, for instance the wings or landing gear. There are broadly two main types of airframe noise such as bluff body noise which is alternating vortex shedding from either side of a bluff body, creates low pressure regions at the core of the shed vortices which manifest themselves as pressures waves or sound. The separated flow around the bluff body is quite unstable, and the flow rolls up into ring vortices which later break down into turbulence (Wahab, 2008).

Besides, the taxiing also contributes to noise at airport. Taxiing is the movement of aircraft on the ground, under its own power. An aircraft use taxiways to move from one place at airport to another place such as runway. The term "taxiing" is not used for the accelerating run along the pathway prior to takeoff, or the decelerating run immediately after landing. Take off is the phase of flight in which an aircraft goes through a transition from moving along the ground (taxiing) to flying in the air, usually starting a runway. Landing is an opposite to take off where it is accomplished by slowing down and descending to the runway. This speed reduction is accomplished by reducing push and inducing greater amount of drag using flaps, landing gear or speed brakes (Wells & Young, 2003).

2.7 Background Noise

Background noise is an unwanted or harmful outdoor sound and it is spreading, both in its duration and geographical coverage (European Environment Agency (EEA), 2012).

Sound waves travel from source to receiver through a variety of media. In outdoors, it will be through the atmosphere and will then be influenced by wind turbulence and gradients, air temperature, ground reflections, etc. The amplitude, the spectrum as well as the duration of the sound will be affected. For instance, the sound will be attenuated by air absorption, fog, rain or snow, barriers such as walls and buildings, and by ground effects. However, under certain circumstances, attenuation may not take place, for example, wet snow on ground or at night for thin growth of trees and shrubs (Berglund & Lindvall, 1995).

2.8 Occupational Noise

Occupational noise is the noise that produced from the workplace and it was affecting workers who are exposed to high noise level. Although noise is associated with almost every work activity, some activities are associated with particularly high levels of noise, the most important of which are working with impact processes, handling certain types of materials and flying commercial jets (Barriento et al., 2004).

High levels of occupational noise remain a problem in all regions of the world. In the United States of America (USA), for example, more than 30 million workers are exposed to hazardous noise (NIOSH, 1998). In Germany, 4–5 million people (12–15% of the workforce) are exposed to noise levels that are defined as hazardous by WHO (2002).

2.9 Health Effects

Health effects due to noise exposure can be categorised into two which are auditory effects and non-auditory effects.

According to research by Chen et al. (1992), the results of audiograms in this study revealed the prevalence rate of high frequency loss in all employees was 41.9%. The incidences of NIHL were highest in the groups of maintenance workers (65.2%) and firemen (55.0%), who are almost continuously exposed to aircraft noise. Besides, both click threshold and latencies showed that the impairment was most severe in the groups of maintenance workers and firemen. This suggests that involvement of the central auditory pathway, especially between the pons and midbrain, is present. In summary, the degree of auditory damage coincided with job patterns. Furthermore, damage of both peripheral cochlear organs and the central auditory pathway by high-frequency aircraft noise exposure was confirmed.

Besides, noise can cause non-auditory effects. In general, the effects are including cardiovascular function such as hypertension, changes to blood pressure and heart rate, and also changes in breathing (CCOSH, 2014).

In the other study, heart rate, blood pressure and noise perception in relation to aircraft noise was measured in residents around Frankfurt Airport. Average blood pressure was significantly higher in the West group with higher noise exposure. Morning systolic and diastolic blood pressure was higher in the west group rather than east group which far away from the airport (Aydin & Kaltenbach, 2007).

Figure 2.2 is the mechanism that had been produced by WHO (2011) and Moorhouse (2009). The flowchart is about how noise exposure can affect the health and quality of life. High noise level can cause health effects whether auditory or non-auditory effects. Hearing loss is the example for auditory effects while for non-auditory effects, its included hypertension and also mental health. Besides, noise can reduce the quality of life because it can cause sleep disturbance and stress. All these effects then can reduce the productivity and learning impact such as productivity and also cognitive impairment in children.

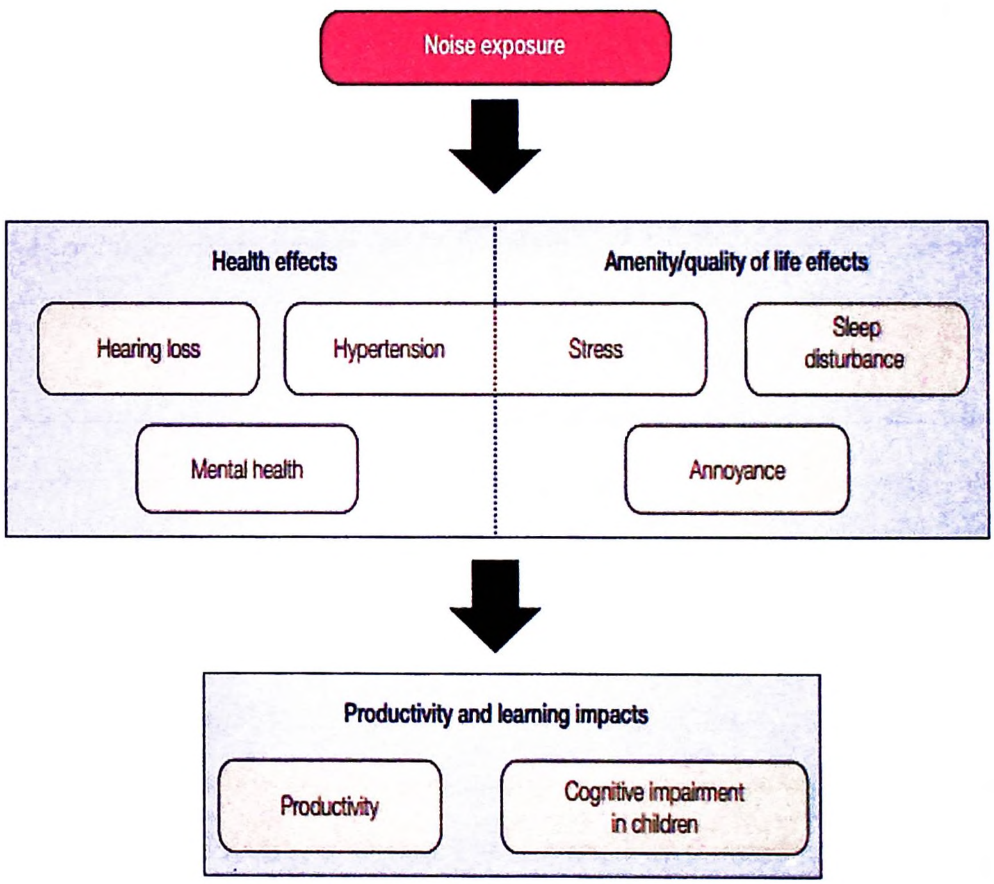

Figure 2.2 Mechanism of noise exposure

(WHO, 2011; Moorhouse, 2009)

2.9.1 Psychological Effects

Noise is a prominent feature of the environment including noise from transport, industry and neighbour. Noise interferes in complex task performance, modifies social behaviour and causes annoyance (Stansfeld & Matheson, 2003).

a) Annoyance

Annoyance is defined as the physical or psychological discomfort that caused by noise. High level noise such as aircraft noise is considered to be annoying when it interferes with daily activities (Basner et al., 2006).

The association between noise and noise annoyance has been extensively investigated. Annoyance is a complex psychosocial concept including both evaluation and component (Guski, 1999). Annoyance is a term used in general for all negative feelings such as disturbance, dissatisfaction, displeasure and nuisance (Ouis, 2002).

A study that had been conducted at Narita Airport, the effects or aircraft noise are including social and behavioural effects such as change mood to unhappy because they are reporting very annoyed to aircraft noise (Hiramatsu, 2007).

b) Speech Interference

Noise can disturb and interrupt with people conversation. If an individual need to speak louder or like a scream while talking, it is means that the noise had been interfere with the speech. During the loudest part of a noise event, it could interfere with communications even though the average level over several hours is low (Shashikant, 2011).

c) Sleep Disturbance

Sleep disturbance is one of the effects of aircraft noise. Evidence from study on sleep disturbance based studies of noise exposed populations shows that aircraft noise really affects the quality of sleep of the exposed population (Miedema & Vos, 2007; Hume, 2011).

Michaud's recent review identified a range of sleep outcomes which have been examined for aircraft noise exposure including interference with ability to fall asleep, shortened sleep duration, awakenings, increased bodily movements and perceived quality of sleep (Michaud et al., 2007).

2.10 Acts and Regulations

There are many acts and regulations that concern about noise exposure. In Malaysia, the main act that had been used for noise is includes Factories and Machinery Act 1967.

Under Reg. 5 in Factories and Machinery (Noise Exposure) Regulations 1989, sub-regulation (1) no employee shall be exposed to noise level exceeding equivalent continuous sound level of 90 dB (A) or exceeding the limits specified in the First Schedule (Table 2.1) or exceeding the daily dose of unity, while under sub regulation (2) no employee shall be exposed to noise level exceeding 115 dB (A) at any time. If the workers are exposed to high level of noise, they should stay at that area for a short time.

Under Reg. 6 of the same Regulation, no employee shall be exposed to impulsive noise exceeding a peak sound level of 140 dB. Every occupier shall also conduct employee exposure monitoring to determine if any employee may be exposed to noise level at or above the action level. All continuous, intermittent and impulsive noise level from 80 dB (A) to 130 dB (A) shall be integrated into the computation to determine employee exposure (Reg. 8).

Table 2.1 Permissible exposure limits for occupational noise

Noise Level (dB (A))	Duration of Exposure Permitted per day (hours-minute)
90	8-0
92	6-4
95	4-0
97	3-2
100	2-0
102	1-31
105	1-0
110	0-30
115	0-15

First Schedule, Regulation 5(1),

Factories and Machinery (Noise Exposure) Regulations 1989

CHAPTER THREE

METHODOLOGY

3.1 Study Design

The study design was a cross-sectional study with purposely to compare the noise level at Sultan Abdul Halim Airport, Kedah and Sultan Ismail Petra Airport in Pengkalan Chepa, Kelantan.

3.2 Study Location

This study had been carried out at two different airports which are Sultan Abdul Halim Airport, Alor Star, Kedah and Sultan Ismail Petra Airport, Pengkalan Chepa, Kelantan.

Sultan Abdul Halim Airport, which located in Kepala Batas, is 15 km (9.3 mi) away from town. The location is at latitude 06°11'33.72"N and longitude 100°24'8.64"E. The new terminal is already operational by 5 May 2006 to cater for future traffic growth. It has three aerobridges and serves Malaysia Airlines, Firefly, and Air Asia. The new terminal has the capacity to receive the Airbus 330 operations as the runway was extended from the previous 1,963 m × 45 m (6,440 ft × 148 ft) to 2,745 m × 45 m (9,006 ft × 148 ft) (Figure 3.1) (Department of Civil Aviation Malaysia, 2006).

The Royal Malaysian Air Force training division is also co-located and uses the same runway as the airport.

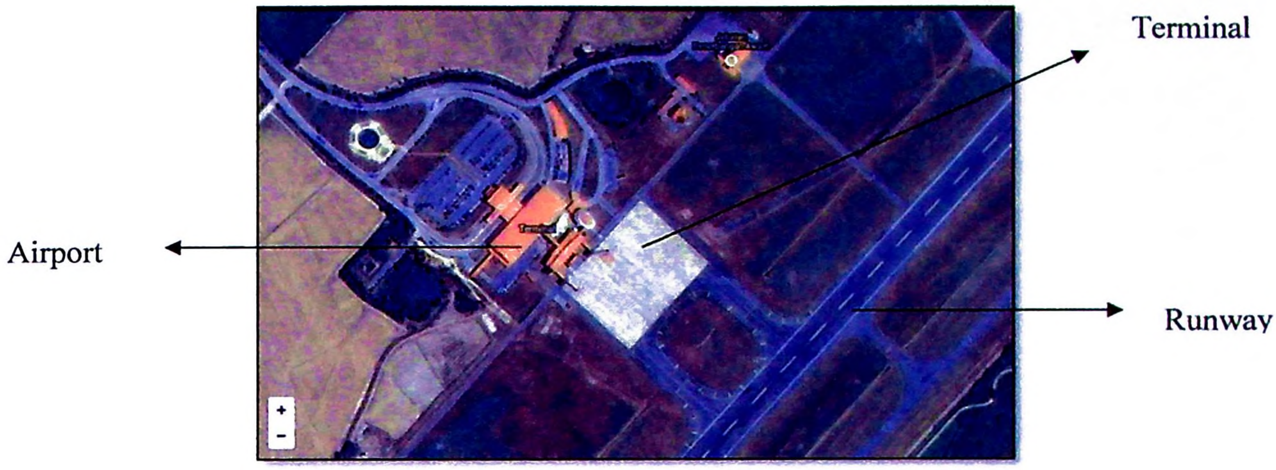

Figure 3.1: Top view of Sultan Abdul Halim Airport, Kedah

(Google View Satellite, 2015)

Sultan Abdul Halim Airport serves Kedah and neighbouring state such as Perlis. Its new terminal operational from 2006 and the aircraft movement is being fluctuated since 2006 until 2014. From the data of aircraft movement, it shows that the airport is less busy than the Sultan Ismail Petra Airport, Kelantan.

TRAFFIC

YEAR	PASSENGERS	CARGO MOVEMENTS (TONNES)	ALL AIRCRAFT MOVEMENTS
2014	660,264	230	17,365
2013	535,073	126	15,752
2012	433,644	123	18,006
2011	407,717	46	19,621
2010	400,997	34	22,187
2009	421,314	34	24,031
2008	307,564	41	17,705
2007	291,006	55	20,277
2006	292,549	111	18,495
2005	323,669	118	17,632
2004	346,502	67	14,784

Figure 3.2: Aircraft movement of Sultan Abdul Halim Airport, Kedah

(Malaysia Airport, 2015)

Sultan Ismail Petra Airport was relocated to a new terminal in 2002. It serves the city of Kota Bharu and the state of Kelantan. It has three aerobridges and serves Malaysia Airlines, Firefly, and Air Asia. In 2011, the runway was lengthened from 1,981 to 2,400 m to accommodate the Airbus A330 and Boeing 737-800 (Figure 3.3). It also houses the Asia Pacific Flight Training flying school (Malaysia Airport, 2015).

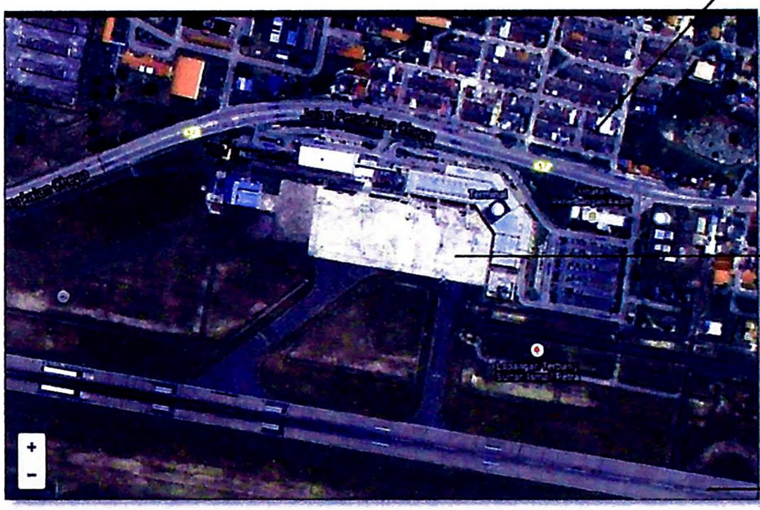

Figure 3.3: Top view of Ismail Petra Airport

(Google View Satellite, 2015)

Sultan Ismail Petra Airport located at latitude 06°10'05.1738"N and longitude 102°17'36.6432"E serves more passengers than Sultan Abdul Halim Airport. From Figure 3.4, it shows that the aircraft movements reach until 75,906 in 2010 and the passengers on 2012 reach until 1,259,205 persons. This made Sultan Ismail Petra is the busiest airport in the East Coast Malaysia by passenger traffic and aircraft traffic movement. The new terminal is equipped with facilities and services to cater the increasing flow of tourist to Kelantan (Malaysia Airport, 2015).

TRAFFIC			
YEAR	PASSENGERS	CARGO MOVEMENTS (TONNES)	ALL AIRCRAFT MOVEMENTS
2014	1,800,836	397	44,628
2013	1,585,238	179	50,406
2012	1,259,205	147	50,991
2011	1,132,345	164	64,114
2010	1,047,755	177	75,906
2009	1,003,162	185	74,863
2008	836,060	181	57,102
2007	759,316	163	58,996
2006	678,306	210	38,352
2005	635,397	168	11,194
2004	639,871	235	11,869

Figure 3.4: Aircraft movement of Sultan Ismail Petra Airport, Kelantan

(Malaysian Airport, 2015)

3.3 Instrumentations

3.3.1 Sound Level Meter

Sound level meter (SLM) (Figure 3.5) was used to measure the ambient noise level at airport area. Ambient noise means the all-encompassing noise associated with a given environment, being usually a composite of sound levels from many sources near and far.

SLM model Bruel & Kjaer (type 2250) had been calibrated before used for this research. This tool is available at Environmental and Occupational Health Laboratory, USM.

Figure 3.5: Sound Level Meter

3.3.2 Tripod Stand

The purpose for tripod stand is for placed the sound level meter while doing monitoring. It also can be adjusted so that can achieve the standard position for noise monitoring.

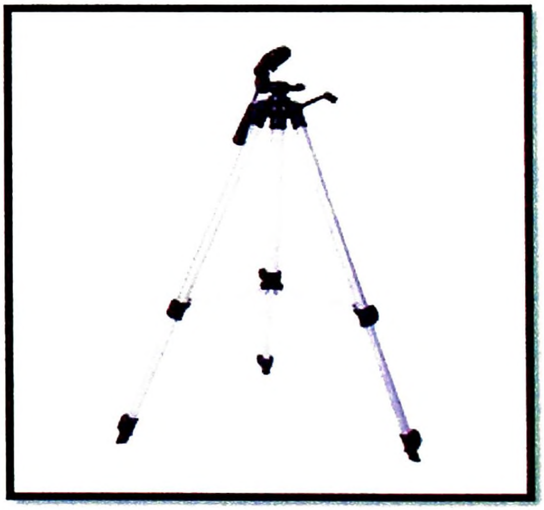

Figure 3.6: Tripod stand

3.3.3 GPSMAP 62SC

GPSMap was used for identifying the coordinate of sampling location.

Figure 3.7: GpsMap

3.3.5 Measuring Tape

In order for doing noise contouring, the distance from noise source is needed. To ensure the distance is clear and fixed, measuring tape was used for the task.

3.4 Data Collection

3.4.1 Monitoring of Noise

Before conducted this study, permission letter had been obtained from airport manager (Appendix A). Noise monitoring was done by measuring the area noise exposure at the terminal of both airports. This will give indication of exposure to noise among workers who are working in that area including luggage carriers, maintenance workers, security workers and runners. Data collections started with monitoring of the noise area. Based on the map as in Appendix B, 8 point was