THEORETICAL STUDY & FIELD MEASUREMENT OF NOISE EXPOSURE IN INDUSTRY BASED ON NOISE EXPOSURE REGULATIONS 1989

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A thesis report submitted to faculty of mechanical engineering in partial fulfillment of the requirement for the award of bachelor degree of Mechanical Engineering (Structure & Materials)

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April 2007

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 Bachelor of Mechanical Engineering (Structure & Materials).

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"I hereby the author, declare this report entitled "Theoretical Study & Field Measurement Of Noise Exposure In Industry Based On Noise Exposure Regulations 1989" is my own except for quotations and summaries which have been duly acknowledged".

Signature : .....

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ACKNOWLEDGEMENTS

Thank you to my supervisor, Mr. Lee Yuk Choi. I thanks for helping me to maintain focus and direction throughout the research process, and for his attention to detail. I am appreciative of his kindness and encouragement, and for valuable guidance in all aspects of scientific research.

I am grateful to the factory manager, Mr. Kiyoshi Toda who allows me to take noise measurements, for assistance with the preparation of the measurements, and for providing access to some of the testing equipment.

Thank you to my family for their continuous encouragement and support throughout the course of this work. I am particularly grateful for their valuable assistance in numerous trips to libraries for photocopying and for proof-reading thesis chapters.

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ABSTRACT

This thesis present the theoretical study and field measurement of noise exposure in industry based on the noise exposure regulations 1989. The thesis presented herein is discussed about the high noise arising from the factory in Malaysia. Noise measurements were conducted at one of the factory in Batu Berendam, Malacca. Noise measurements can provide an evaluation of the noise exposure levels and the assessment of the risk of hearing impairment of the worker in the factory. The noise levels and noise type characteristics can be obtained from the punching room. From the room, the noise exposure of the workers was in between 91 – 95 dBA. We discovered that even though a combination of many complicated techniques and specialized knowledge of acoustics, the noise zoning can be mapped out by using AutoCAD, Acid Sonic & etc. software. From the chart, we can see the noise zoning, which allows us to identify the boundary line of different noise levels in the room. Besides that, a comparison between the theoretical & experiment measurements was made in order to analyze the results. Finally, the room prediction of noise levels was made if two more machines were added into the room. The results showed that the predicted and theoretical results yield a good agreement in terms of minimal error.

ABSTRAK

Tesis yang dipersembahkan ini adalah mengenai kajian teori dan pengukuran di tapak pendedahan bunyi dalam industri berdasarkan peraturan-peraturan pendedahan bunyi 1989. Ia juga membentangkan suatu perbincangan berkenaan dengan bunyi tinggi yang wujud daripada kilang di Malaysia. Penyelidikan yang dikendalikan ini telah dijalankan pada satu kilang yang berada di Batu Berendam, Melaka. Bunyi boleh menjejaskan pekerja-pekerja. Tesis ini menyediakan suatu penilaian tahap pendedahan bunyi dan penilaian risiko kecacatan pendengaran kepada pekerja-pekerja tersebut dalam kilang. Teknik yang digunakan untuk penyukatan data ialah alat meter aras bunyi. Tahap-tahap bunyi bising dan ciri-ciri jenis bunyi bising boleh didapati daripada bilik penebukan. Dalam bilik tersebut, pendedahan bunyi kepada pekerja adalah di antara 91 – 95 dBA. Kita dapat menerokai bahawa sungguhpun kombinasi daripada pelbagai teknik dan pengetahuan khas yang agak rumit dari pakar mengenai kajian bunyi, penzonan hingar masih boleh dilukiskan dengan teliti oleh perisian AutoCAD, Sonic Acid dan sebagainya. Melalui charta berkenaan, kita dapat melihat graf penzonan hingar, yang mana dapat menunjukkan dengan terang mengenai garisan sempadan tahap-tahap bunyi yang berbeza dalam bilik itu. Di samping itu, perbandingan di antara teori & eksperimen pengukuran boleh diperolehi selepas keputusan dianalisakan. Akhirnya, jangkaan bunyi boleh dibuat jika kita menambahkan lagi dua buah mesin ke dalam bilik itu. Keputusannya menunjukkan perbezaaan di antara eksperimen jangkaan bunyi data tersebut adalah cuma tinggi sedikit sahaja. Kesimpulan akhir menunjukkan keputusan-keputusan dari jangkaan dan teori dapat menghasilkan suatu persetujuan yang sehala dengan syarat jika kita melakukan kesilapan yang minima.

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NOMENCLATURE

C	=	Speed of sound
f	=	Frequency
T	=	Time
L_{Aeq}	=	Standard equivalent continuous A-weighted sound pressure level
L	=	Level in decibels
^{o}K	=	Absolute temperature, degree Kelvin
L_I	=	Intensity level
L_p	=	Sound pressure level
NC	=	Noise criteria number
NR	=	Noise rating number
P	=	Acoustic pressure
r	=	Radial (Spherical) co-ordinate
R_i	=	Sound reduction index
T_{60}	=	60 dB reverberation decay time
Z_A	=	Acoustic impedance
SPL	=	Sound pressure level
SWL	=	Sound power level
$\bar{\alpha}$	=	Sound absorption coefficient
λ	=	Wavelength
Rc	=	Room constant
RT	=	Reverberation time

CHAPTER 1

INTRODUCTION

1.1 Introduction

The recognition of noise as a source of annoyance began in antiquity, that may exist between noise and money seems to be a development of more recent time. A number of studies of noise exposure have been conducted rapidly in recently years to investigate the noise exposure affects to the industries. The review indicates the noise exposure at industries will bring the affects for workers who are works over a standardized limited time condition based on noise exposure regulations 1989, Malaysia.

The recognition of noise as a serious health hazard is a development of modern time. The studies of noise will be popular issues in future regarding the human at new generation have good education. People are detected the harmful side at industries will affect the workers and human live around the working environment. Noise will create annoyance. A human will be suffered in both physical & psychological if under the long time annoyance condition. The high noise levels will cause critical physiologies affect of deafness.

Measurement of the noise levels and diagnosis the problems in the measurement site is a necessary for the occupier to give the fully protection for their employee work at the workplace for nowadays. The measurement can benefit both of the occupier and employee, and the environment.

1.2 Objectives

The objectives of this thesis are concerned with the theoretical study and field measurement of noise exposure in industry based on noise exposure regulations 1989. The objectives are listed as follow:

1. To determine the alternative method for monitoring occupational noise exposure in industry.
2. To establish what is currently known about the noise levels and the noise exposure of workers in industries.
3. To evaluate the degree of noise exposure and type of noise.

1.3 Project Scopes

The scopes of project are listed as follow:

1. Literature review survey.
2. To understand the industrial noise regulation 1989.
3. Obtain noise mapping.
4. Identify work areas having high noise levels, and what may be of risk to the workers

5. Comparison between theoretical and experimental results.
6. Noise prediction if new machines are added in the room.

1.4 Problem statement

Noise is an unwanted noise. Noise is among the major problems occurred in many industries nowadays. Many of the occupiers are not aware how the noise affects on their employee in the industries. Some of the occupiers, who consider their employee's health and safety, might be spending some money to get the consultancy for the noise control activities.

According the way to control noise level in the industries, there a several methods can used to resolve this problems, the occupier can find some competent person (whose are approved by Chief Inspector in writing) to conduct the noise monitoring in order to identify work areas which having a high noise levels. If the employee is exposures at or above the permissible noise levels, they had to provide hearing protection to the employee. From the measurement report, the data can be used to determine the noise zoning in the room.

Once the noise levels are determine, the occupier should give the warning signs with an indication of the high risk noise area for the employees. If possible, they can provide the audiometric testing programme for the employee. If most of the occupier always aware with noise exposure in their workplace, the problem of employee hearing impairment can be reduced to as low as possible.

1.5 Gantt chart

Table 1.1: Gantt chart of PSM 1

No.	Activities or Tasks	Semester 2006/2007 Week															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Confirmation of Thesis title																
2	Understanding Theoretical Study and Field Measurement of Noise Exposure, & the noise expose regulations.																
3	Industrial visit																
4	Collect data, conduct noise measurements in industry, and evaluate the degree of noise exposure.																
5	Preparations for the first seminar or presentation of PSM 1																
6	Analysis of the previous PSM 1 for improvement in PSM 2																

Table 1.2: Gantt chart of PSM 2

No.		14	15	16
1	Continue of PSM 1. Improvement for PSM 2, analysis on the previous tasks.			
2	Second Industrials visit for data collections.			
3	Obtain noise contouring to map out the measurement site and evaluate the degree of noise exposure.			
4	Conducts the results between theoretical and experimental based on industry.			
5	Preparations for the 2nd seminar and presentation of PSM 2			
6	Thesis write-up.			

CHAPTER 2

LITERATURE REVIEW

Elizabeth Brueck BSc MIOA (2006) [1] performed the control of noise exposure for individual's works at live music events. The music entertainment sector is working under the Noise Exposure Regulations 1989. The noise method is make three permanently fixed dosimeters were attracted on Richard Heaton and Paul Pitts of the Noise and Vibration section. An A-weighted levels noise source will be generated from the volunteers daily personal noise exposure ($L_{EP,D}$) based on ranged from 15 minutes to 1 hour. The noise levels ranged from 79 db (A) to 111 db (A) around the measured sites are suitable working area for people.

Marion Burgess & Joseph Lai (1999) [2] were presented the noise management and improvement for the building industry at Work Cover NSW, Australia. Statistics showed that 7% deafness case in the construction industries. Implementation of OHS on building sites are provided such as basic safety issues and personnel hearing protection for the workers. They were no surprising for those workers which were suffered hearing loss. The code of practice has been developed with assistance of several parties to improve implementation of the reducing noise exposure affects for workers.

Professor Dr. Ir. Mohd Salman Leong [3] performed a survey that the noise do effect for us in many way, such as either at the work place, industries environmental, or at home. Based on the Factories and Machinery Act (Noise Exposure) Regulations 1989, and the Occupational and Safety Health Act 1994. The survey of Malaysian Industrial workers confirmed that approximately 26.9 percent of industrial employees suffer a hearing threshold at 3000 Hz and 6000 Hz greater than normal during the working environmental. Besides that 21.9 percent workers had detectable hearing impairment. The statistics show no different significant between gender. Different source of noise in the work place have different sound level situation, textile factories are produce not so much of a single high noise, metal industries will make extremely high impulsive noise, and for the non-metallic mineral product industry which the noise level for drilling and crushing of rockers will often exceed the maximum permissible noise limit of 115dBA. High noise may be health hazards for people and may cause permanent hearing loss. The field of study to design or manufactured a low noise and vibration harshness is a high mention for the corporation between authorities and parties.

N S Seixas, B Goldman, L Sheppard, R Neitzel, S Norton, S G Kujawa (2005) [4] was analyzed the noise induced damage to hearing at construction industry. From the data analysis, 328 subjects/people (632 ears) were monitored annually an average of 3.4 times. To parallel the measurement, noise exposure and hearing protection device (HPD) were used extensively monitoring during construction work tasks. By neglecting the variable use of hearing protection for each subjects, the trade specific mean exposure Leq levels were calculated. The data collection can accurately calculate and determine the noise exposure over time for a large cohort of subjects who were working at numerous worksites, within a highly intermittent and variable exposure. The results indicates that the average noise exposures under have a measurable losses of hearing function during the first three years of work.

Noah S. Seixas, Lianne Sheppard and Rick Neitzel (2003) [5] performed the comparison of tasked based estimates of noise exposure with full-shift measurements. From the experiment, 502 full-shift measurements were made and 6 task based models of varying degree of specificity were used to obtain the estimation of sound exposure level. The task based estimates can be predicted alone or including with other variance and shift-specific residual means. Almost 10 – 60% full-shift measured by variability; adding the residual mean produced estimates that explained about 90 % of the variability. The task based estimates are important for exposure estimation when task time varies substantially. There are two types of noise exposure surveys among construction workers; first is an assessed noise level among four trades (carpenters, laborers, operating engineers, and ironworkers) on four large commercial/industrial building sites. And the second is survey focused on electricians working on another five building sites. Task based assessment can holds a significant promise for improving exposure assessment for epidemiologic studies or work environments.

S J Stephenson and B C Postlethwaite (2003) [6] performed an investigation in assessment of noise from sources and assist it in noise mapping process. A method was developed based on results of extensive noise modelling carried out to investigate the errors inherent in determining and distributing source strengths and the subsequent modelling of the propagation of sound. The 300 industrial sites were considered to be affecting their areas. The research showed that 78% of these sites were associated with tonal, impulsive or low frequency characteristics. In terms of the subsequent distribution of the source sound power for the purposes of noise mapping, the research established that the most accurate way of modelling a noise source is by distributing the sound energy in a manner. A reasonable degree of accuracy can be obtained by modelling the sound power as either a 2 dimensional area source or a point source. The results of the modelling indicated that the directivity of the source can significantly influence the accuracy of the calculated

values of the noise contours. For this reason, the proposed method includes provision for determining the acoustic centre and directivity of the source.

Dr B McKell, Mr S Fisher, Mr N Jones, Miss Jane Evans and Mr Brian Stark [7] were performed a study of the issues surrounding the collection and handling of data to associate with the mapping requirement. The noise maps production data have been provided by a related organizations and agency. The experimental data can identify the location and characteristics of noise sources. Data can be regarded in two elements: map data (topological and topographic); and attribute data. Map data was essential to identify the geographical location of objects and features to be included in the modelling assessment. This map data must be 'captured' digitally as either points, lines or polygons. It is essential to capture map data with high degree of positional accuracy, therefore an understanding of digitizing error from source mapping or imagery of different scales is required. For attribute data, all the predictions for all noise sources must be based on the same year.

Declan Waugh B. Sc [8] conducted a research to establish a comprehensive baseline data for relative quite areas by carrying out extensive noise monitoring programme throughout Ireland. The study systems include capabilities of strategic environmental assessment for noise & provide an integrated environmental planning methodology for noise control. The project executed in 15 sites in the Irish countryside as reference locations for the assessment of the baseline noise environmental. The report focuses on investigation due to the impact of further economic development, implementation guidelines for improving the environmental noise.

J. Malchaire and A. Piette (1996) [9] were presented the evaluation of the daily noise exposure level ($L_{EX,d}$ in dB (A)) and the assessment of the risk of hearing impairment. The risk was defined the probability of the workers will get a hearing deficit within a long time exposure working area. They use strategy by concepts of homogeneous group of exposure (HGE) and stationary interval (S.I.). A number of workers as a sample were taken in the experimental for discussion. A semi-random sampling was recommended in this test, formula used to estimate the $L_{EX,d,}$ it standard error and the corresponding risk of hearing impairment.