OCCUPATIONAL NOISE EXPOSURE AMONGST ROAD CONSTRUCTION WORKERS

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This thesis is specially dedicated to my beloved parents and children

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ABSTRACT

Overexposure among construction workers to hazardous noise level may affect workers safety and health. The aim of this study is to determine the level of noise exposure among road construction workers. To achieve this aim, the sound power level of construction machineries, workers noise exposure level and the prevalence of hearing loss symptoms and hearing ability among them were measured. Sound power level of machineries were measured according to ISO 112000. The workers consist of operator of machineries, site supervisors and premix workers were measured according to *Peraturan-Peraturan di bawah Akta Kilang dan Jentera 1967 (Akta 139) P.U. (A) 1/89 Factories and Machinery (Noise Exposure) Regulations 198.* A total of seventy three workers who worked in road work, drainage and pavement stage were measured their noise exposure level. These workers also were evaluated their hearing loss symptoms and hearing ability using questionaire survey and interview. Machineries consisting of roller compacter, back-pusher, vibratory roller and paver have high sound power level. There are 44% of workers including operators, site supervisors and premix workers had experienced noise level above hazardous level (≥85 dBA). Vibratory roller operator obtaining high exposure level with the highest exposure appeared in pavement stage. Highest prevalence symptoms of hearing loss was recorded in road work stage with 39% of workers positive hearing loss due to factors of workers' age, racing and karaoke activity. Poor hearing ability were observed for workers with age of 60 years old and greater. It is suggested that workers exposed to noise greater than 85 dBA should wear hearing protection device (HPDs) with suitable NRR values. In conclusion, road construction workers also exposed to hazard which require them to wear hearing protection.

ABSTRAK

Pendedahan berlebihan bunyi bising di paras yang berbahaya di kalangan pekerja binaan memberi kesan terhadap kesihatan dan keselamatan pekerja. Tujuan penyelidikan ini adalah untuk mendapatkan tahap pendedahan bunyi di kalangan pekerja pembinaan jalan . Untuk mencapai tujuan ini, tahap kuasa bunyi jentera pembinaan, tahap pendedahan bunyi bising di kalangan pekerja dan kewujuadan simptoms kehilangan pendengaran serta tahap pendengaran di kalangan pekerja diukur. Tahap kuasa bunyi jentera diukur mengikut ISO 112000. Pekerja yang terdiri daripada operator jentera, penyelia tapak dan pekerja turapan diukur mengikut *Peraturan-Peraturan di bawah Akta Kilang dan Jentera 1967 (Akta 139) P.U. (A) 1/89 Factories and Machinery (Noise Exposure) Regulations 198.* Sejumlah 73 pekerja yang bekerja di dalam kerja jalan,kerja perparitan dan kerja turapan telah diukur tahap pendedahan bunyi bising mereka. Pekerja-pekerja ini juga dinilai kewujudan simptoms kehilangan pendengaran dan tahap pendengaran menggunakan bancian dan temu bual. Jentera yang terdiri daripada penggelek, traktor, penggelek bergegar dan penurap mempunyai kuasa bunyi yang tinggi. Sebanyak 44% pekerja daripada operator jentera, penyelia tapak dan pekerja turapan mengalami pendedahan bunyi bising di atas paras bahaya (≥85 dBA). Operator penggelek bergetar merekodkan paras pendedahan bunyi tertinggi dengan pendedahan tertinggi direkodkan dalam kerja turapan. tendedahan bunyi tertinggi direkodkan oleh penggelek bergetar dari kerja turapan. Kewujudan simptoms kehilangan pendengaran tertinggi direkodkan oleh kerja jalan dengan 39% pekerja positif simptoms kehilangan pendengaran disebabkan oleh factor umur pekerja, aktiviti berlumba dan karaoke. Tahap pendengaran yang buruk didapati pada pekerja yang berumur lebih daripada 60 tahun. Cadangan untuk pekerja yang terdedah pada bunyi bising melebihi 85 dBA boleh meggunakan alat pelindung pendengaran dengan nilai NRR yang sesuai. Kesimpulannya, pekerja pembinaan jalan juga terdedah kepada bahaya yang memerlukan mereka memakai alat pelindung pendengaran.

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LIST OF ABBREVIATION

OSHA	=	Ocupational Safety and Health Administration
NIOSH	=	National Institute of Safety and Health
NIHL	=	Noise-Induced Hearing Loss
HPDs	=	Hearing Protection Devices
PPE	=	Personal Protective Equipment
dB	=	Decibel without frequency weighting
dBA	=	Decibel in A-Weighted
NRR	=	Noise Reduction Rating
HCP	=	Hearing Conservation Program
ER	=	Exchange Rate
ISO	=	International Organization for Standardization
MLR	=	Multiple Linear Regression
TWA	=	8-hoursTime-Weighted Average

LIST OF SYMBOLS

LAeq	=	A-Weighted Daily Noise Exposure Level
L_w	=	Sound Power Level
R	=	Distance (m)
T_e	=	Time of measurement
T_0	=	8 hours time of measurement
L_{avg}	=	Exposure level over the entire time of measuremt
L_{min}	=	Minimum exposure level
L_{max}	=	Maxmimum exposure level

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Malaysia is one of the rapidly industrializing countries. Major and minor construction projects, including road construction are all over Malaysia which indicate that the road construction is increasing every year. This growth was viewed as an accomplishment for our nation, but the noise generated from construction activities were observed to affect worker's safety and health. Noise is one of a common problem at workplace in most countries. Generally, noises from construction sites are generated by construction machineries. The noise generated by these machineries was very loud and brought negative impacts on the machineries operators and nearby workers (Carletti, 2013).

1.2 Background of Study

Noise in industry is widespread and is one of a common occupational hazard in various industrial sectors including construction (Suter, 2002). This is because construction site is a noisy workplace due to the usage of noisy construction machineries. Among others, old machineries are used widely in construction sector which could generate loud noise compare to new machineries. This loud noise is potentially harmful to workers which may cause hearing loss, annoyance and disturbance to physical and psychosocial well-being, distraction and loss in productivity, Tinnitus and interference with communication. International Standards Organization (ISO) determined that the maximum exposure in workplace should range from 85dBA to 90 dBA for 8 hours/day to prevent the risk of harmful effects. Previous studies have highlighted the effects of noise towards worker's safety and health. In construction industry, there were fewer studies on loud noise generated by road construction activities compare to other construction projects. Road construction appeared to generate noisy activities especially during pavement stage. Therefore, this study is significant to determine the levels of exposure among road construction workers.

1.3 Problem Statement

Construction machineries mostly generated high noise levels at construction sites. Sound power levels of these machineries affect the operators directly since their positions are on the machineries. Nearby workers are also exposed to sound generated by these machines according to their distance from the machineries. Prolong exposure to loud noise might affect workers' safety and health including hearing impairment which caused higher compensation in the construction industry

(Pinto et al, 2011). Therefore, OSHA required noise monitoring among overexposed workers since the noise from construction activities mostly exceeded. Noise monitoring performed by Hong (2005), and Suter (2002)showed that most construction workers worked in the presence of hazardous noise. Noise control on the machineries was hard to implement due to the construction culture where most contractors rent or lease the machineries rather than own it. Thus, hearing protector was provided to protect the workers as required by FMR 1989. However, previous studies from Endelson et al., (2009) and Lusk et al., (1999) showed that the usage of hearing protector among construction workers was poor. Therefore, this study determines the hazard level of noise exposure among road construction workers in Malaysia.

1.4 Objectives

The objectives of the study are:

- To obtain sound power level of construction machineries from different road construction stages.
- To obtain noise exposure levels of road construction workers
- To determine the effects of noise exposure on workers
- To evaluate the factors affected noise exposure level and prevalence symptoms of hearing loss
- To obtain workers' hearing ability
- To propose suitable NRR values of hearing protector for construction workers

1.5 Research Scope

The scopes of this research are as follows:

1. This research focus only on new construction and reconstruction of road in Johor Bharu, Malaysia.
2. The data were collected using Sound Level Meter Type 1and Personal Noise Dosimeter during working hours.
3. machineries and construction workers that undergo noise measurement were randomly selected from different road construction sites around Johor Bahru.
4. Road construction stage in this research was created according to the availability of the activities from representing sites.

1.6 Significance of Research

Sound power level generated by construction machineries affected the exposure level of the operators as well as nearby workers on site. Their noise exposure levels were believed to be higher compare to other off-site workers. Prolong exposure to loud noise is capable of worsening human hearing ability. Malaysia implements Factory and Machinery Noise Exposure Regulation 1989 which set a limit to the noise exposure level at the workplace in order to protect the workers from developing hearing impairment and other adverse effects. However, studies from Yoshioko et al (2010) and Spencer (2007)) showed that construction workers are exposed to hazardous noise level and are prone to suffer from hearing loss. Therefore, this study was conducted in order to give information on the exposure level of construction workers on site and the prevalence of hearing loss

symptoms among them since workers' awareness of the risks of noise and other exposures is low in this industry (Nietzal and Seixas., 2005).

1.7 Brief Methodology

This research was carried out in five phases according to research objectives. Phase 1 of the study focused on the on-site measurements of construction machineries sound power level. Follow-up measurement of worker's noise exposure was conducted in phase 2. The third phase involved identification of workers with positive hearing loss symptoms and hearing ability of measured worker was rated. Statistical analysis was performed in phase 4 to find the factors affected workers' noise exposure level and prevalence symptoms of hearing loss. Suitable NRR values of hearing protector for construction workers were proposed in stage 5. Recommendations were given in this research to improve the existing system in order to protect workers safety and health.

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