NOISE EXPOSURE OF CONSTRUCTION WORKERS DURING THE EARTHWORK STAGE

NORAKMALHIDAYAH EMBONG

UNIVERSITI TEKNOLOGI MALAYSIA

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NORAKMALHIDAYAH EMBONG

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ABSTRACT

Exposure to hazardous and excessive noise level among construction workers may affect the workers mentally and physically. It also generally may lead to more serious consequences that affected their safety and health as well. The aim of this study is to determine the noise exposure level experienced among construction workers during the earthwork stage. In order to achieve this aim, questionnaire surveys related to perception on noise exposures were carried out on management team and workers. It followed by the measurement of sound power level of construction machineries which are widely used during earthwork stage as these machineries are the noise sources in construction site. The measurements of noise exposure level experienced by operator and non-operator working in the area were then acquired. Sound power level of machineries were determined according to ISO 112000, Acoustics-Noise emitted by machinery and equipment while noise exposures were measured according Factories and Machinery Act 1967 (Act 139) P.U. (A) 1/89 Factories and Machinery (Noise Exposure) Regulations 1989. The result from questionnaire survey found that 43% of the construction workers experiencing hearing loss symptom whereby 34.3% of them were among the workers who worked for more than 10 years in construction. It was obtained that 65% of construction machineries generated hazardous sound level (≥85 dBA) and 49% of measured workers were exposed to noise above action level (≥85 dBA). Analysis shows that noise exposure level of workers has good relationship with sound produced by machineries ($r = 0.65$). The measurement results on noise exposure proved that construction workers at excavation stage susceptible to risk of developing hearing loss and this is coinciding with the finding from questionnaire survey.

ABSTRAK

Pendedahan kepada bunyi bising (hingar) yang berbahaya dan berlebihan di kalangan pekerja pembinaan boleh menjejaskan pekerja secara mental dan fizikal. Ia juga boleh membawa kepada akibat yang lebih serius dan memberi kesan kepada keselamatan serta kesihatan mereka. Tujuan kajian ini adalah untuk menentukan tahap pendedahan hingar yang dialami di kalangan pekerja pembinaan semasa peringkat kerja tanah. Bagi mencapai matlamat ini, kaji selidik yang berkaitan dengan persepsi mengenai pendedahan bunyi dilakukan terhadap pihak pengurusan pembinaa dan juga para pekerja. Ia diikuti dengan pengukuran tahap kuasa bunyi jentera pembinaan yang digunakan secara meluas semasa peringkat kerja tanah di mana jentera ini adalah sumber bunyi bising utama di tapak bina. Pengukuran tahap pendedahan hingar yang dialami oleh pengendali dan bukan pengendali yang bekerja di kawasan tersebut turut diukur. Tahap kekuatan bunyi jentera telah ditentukan mengikut ISO 112000, Akustik-Kebisingan yang dihasilkan oleh jentera dan pendedahan bunyi pula diukur mengikut Akta Kilang dan Jentera 1967 (Akta 139) P.U. (A) 1/89 Peraturan-Peraturan Kilang dan Jentera (Pendedahan Bunyi) 1989. Hasil daripada kaji selidik didapati bahawa 43% pekerja pembinaan mengalami gejala kehilangan pendengaran di mana 34.3% daripada mereka adalah pekerja yang bekerja lebih dari 10 tahun dalam pembinaan. Didapati juga, 65% daripada jentera pembinaan menjana tahap bunyi berbahaya (≥85 dBA) dan 49% pekerja pembinaan terdedah kepada bunyi melebihi tahap tindakan (≥85 dBA). Analisa menunjukkan tahap pendedahan bunyi pekerja mempunyai hubungan yang baik dengan bunyi yang dihasilkan oleh jentera ($r = 0.65$). Hasil pengukuran terhadap pendedahan bunyi membuktikan bahawa pekerja pembinaan di peringkat penggalian mudah terdedah kepada risiko kehilangan pendengaran dan ini adalah bertepatan dengan hasil dari kaji selidik.

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LIST OF ABBREVIATIONS

FMR	=	Factories and Machinery (Noise Exposure) Regulation
OSHR	=	Occupational Safety and Health (Noise Exposure) Regulation
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
ER	=	Exchange Rate
ISO	=	International Organization for Standardization
TWA	=	8-hoursTime-Weighted Average

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Over these recent years, Malaysia is acknowledged as a fast-developing country where the construction sector plays an important task to accelerate and sustain its economic expansion. The construction sector performs an important and vital part in strengthening the economy of the nation by generating revenue, formatting the capital and creating employment which eventually established the gross domestic product and also the socio-economic growth of the country (Khan *et al*., 2014). As the construction industry growing and developing, the noise released from the construction activities in construction sites become a concern to the nation as it is one of the main contributors to noise pollution. Construction not only creates a high level of noise but also causes high noise exposure risk as well as other safety issues to the workers. Excessive noise is very annoying and disturbing the human's life by causing hearing loss, high blood pressure and irregular heartbeat (Geetha and Ambika, 2015). In 2017, there were 6020 cases of occupational diseases and poisoning reported to the Malaysian Department of Safety and Health (DOSH). About 4787 cases or 78.9% were related to occupational diseases essentially hearing disorders and noise-induced hearing loss caused by excessive exposure to high-level noise.

1.2 Background Study

Noise is severely affected the construction workers in Malaysia nowadays due to the construction activities such as drilling, blasting, excavating and others which caused loud noise emission to the environment. Besides, the extensive usage of the heavy type of machinery such as earthmoving vehicles, drilling machinery, etc. in

construction activities also created excessive noise levels hazardous to the workers. The study revealed that 33% of construction workers in Malaysia were exposed to average noise exposure levels more than 90 dBA whereby 47% of them were dealing with heavy machinery during their working hours (Nawi et al., 2016). Heavy types of machinery like excavators, dozers, compactors and dump trucks are broadly utilized during the earthwork stage of a project particularly for excavation, site clearing, cutting and filling as well as compaction. Due to the impacts of multi types of heavy machinery employed at this stage higher noise level is generated compared to other stages in the construction process. Excavation generated the loudest level of noise since it has great variability of transmitted level of high noise essentially due the massive disparity between the background noise of the machinery engines and the peak levels effected by the hoe loading (Ballesteros et al., 2010) while recent study reported that 15.4% of the respondent found that excavators as the primary noise sources during the earthwork stage (Lee et al., 2019). Haron et al. (2014) also summarized that heavy machinery operators except excavators were exposed to time weighting averages (TWA) more than 90 dBA if they work within an open cab which was surpassing the hazardous noise level (≥85 dBA) prescribed by FMR 1989.

1.3 Problem Statement

The sound level produced by construction machinery affected the exposure level of the operators as well as workers who worked nearby the machinery in construction site. Previous research elsewhere reported that many construction workers were killed after being crushed by construction vehicles (Lancaster *et al*., 2016) due to construction workers fail to hear the alarm of the construction vehicles. In Malaysia, Nawi *et al*. (2016) reported that the awareness of construction workers regarding noise hazard is still at low because of the acceptance that noise is a common enigma and become the reason for not correctly employed the personal protective equipment among the construction workers. Further, Mazlan *et al*. (2018) found that there was no direct relationship between noise in the construction area with hearing impairment experienced by the workers who seek SOCSO compensation although the workers were exposed between 70 to 140 dBA. However, this finding may be different

if the analysis was carried out by replacing the area noise (working environment) with the intensity of noise produced by machine as this parameter is more relevant with the noise exposure level of operators and consequently can affect their hearing. Based on this problem, the study investigation was conducted to determine the noise intensity produced by machine and noise exposure levels among machinery operators and non-operators as well as determine its relationship. The awareness and perceptions regarding the workers' noise exposure among the management and workers were also evaluated.

1.4 Research Objective

The study aims to evaluate the level of noise emitted by construction machinery which extensively involved during the earthwork stage as well as the noise exposure level endured by construction workers and the assent of permissible noise exposure to the construction sector. To achieve this aim, the study will be carried out based on the following objectives:

a) To obtain the awareness of noise exposure of construction workers issues among management and workers as well as the prevalence of hearing loss among workers;

b) To assess the intensity of sound produced by construction machinery during the earthwork stage;

c) To evaluate the noise exposure levels experienced by operators and non-operators.

1.5 Research Scope

The scopes of study will be concentrating on the real on-site assessment as well as other related matters as per listed below;

a) This study will be narrowed to the real on-site measurement of the level of noise exposure among construction workers emitted by machinery such as loader, compactor, excavator and dozer which are the common machinery employed during the earthwork stage. The sound power level of machinery will be measured according to ISO 112000, Acoustics-Noise emitted by machinery and equipment.

b) The noise exposure level of construction workers which consists of the operator of machinery, nearby construction workers and site supervisors will be measured according to the Factories and Machinery Act 1967 (Act 139) P.U. (A) 1/89 Factories and Machinery (Noise Exposure) Regulations 1989.

c) The real on-site measurement of construction noise will be carried out at a few construction sites located at the state of Perak.

d) The measured level of noise exposure is then compared with the level of permissible limit in Malaysian Factories and Machinery (Noise Exposure) Regulations 1989.

e) The brief overview of Malaysian Factories and Machinery (Noise Exposure) Regulations 2019 and Occupational Safety and Health (Noise Exposure) Regulation 2019.

1.6 Significance of Research

The sound power level generated by construction machinery affected the exposure level of the operators as well as nearby workers on site. Their noise exposure levels were believed to be higher compared to other off-site workers due to their direct involvement in the situations. Significance of this study are as follows;

a) The measured level of noise produced by the construction machinery at the construction site could be a reference to related parties especially the construction contractor.

b) The data obtained from noise exposure level among the construction workers in Perak to be used as proof in claims of occupational disease related to noise.

c) The study also can be a reference to the public and private sector towards awareness and perception of construction workers on noise exposure and the readiness of the management of construction sites to comply with the new regulation regarding the audiometric test among workers highlighted by OSHR 2019.

1.7 Summary

The noise produced by machinery in construction sites precariously affected construction workers' health as well as their safety. However, their claims for compensation from the authority most of the time rejected or found the dead-end because of failing to prove the hearing impairment they experienced was an occupationally related disease. Replacing the parameter with the noise intensity produced by the machine would make a difference as this parameter is more relevant to the noise exposure level of operators and consequently can affect their hearing.

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