THE IMPACT OF WORKER EXPERIENCE AND HEALTH LEVEL TO VIBRATION ABSORBED BY HAND

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ABSTRACT: This study was set to identify how working environment affected workers' stress level and to determine the differences of vibration absorbed by hand in both good and bad health conditions. To achieve the first aim, a survey method was employed to gather data from the workers who were involved in the composite cutting job. Meanwhile, to achieve the second aim, an experiment to investigate the effects of performing the cutting job using hand tools was conducted on five participants with different health conditions. The results of the study revealed that the workers felt that their working environment was stressful. The workers who had bad health condition as average would absorb 237.8% (for 5mm thickness) and 17.46% (for 3mm thickness) more vibration from the hand tools while performing the cutting job than the others. The paper discusses whether workplace stress and vibration absorption from using hand tools will finally lead or contribute to health problems especially the hand arm vibration disease.

KEYWORDS: *Workplace Stress; Composite; Cutting Job; Vibration Absorption; Health Problems*

1.0 INTRODUCTION

Recently, many health problems occurred in the manufacturing industry, especially aerospace companies which produce aerospace components for commercial use [1]. The cutting method used in these companies is likely to cause adverse effects to the workers' health. Workers who are exposed to a long period of composite cutting process such as cutting thick composite panels using hand tools will contribute to the existence of more severe health problems as a result of the acceptance level of vibration from hand tool to hand [2]. The longer the process is carried out, the more vibration will be absorbed to the hand [3], and the thicker the panel to be cut, the higher vibration will be received.

Workers with low level of health mean that they are receiving a higher level of vibration into their hands, which will invite more long-term complicated health problems [4]. This happens when a worker is not really fit for a particular job due to his previous health problem, requiring him to grip the hand tool as tight as he can. This also means that more energy or force is needed to grip the hand tool while cutting, causing more vibration to be absorbed by a worker with a bad health condition compared to a worker with a good health condition.

The main objectives of this study are to identify how working environment affected workers' stress level and to determine the differences of vibration absorbed by hand in both good and bad health conditions.

2.0 METHODOLOGY

A questionnaire was used to collect data from five workers who were involved in the composite panel cutting process. These five workers were the maximum number of workers who were selected for the particular job. The information gathered was related to the condition of the working environment as experienced by the workers. The data were compiled, analyzed descriptively and presented in a graphical form.

The next step involved an experiment which was conducted to obtain a group of vibration absorption reading data by using a Dotco router gun at a constant speed of 20 rpm, at different thickness of 3 mm and 5 mm panels. The data taken from each worker showed that different amount of vibration was absorbed from the cutting hand tool into the workers' hand during the material cutting process.

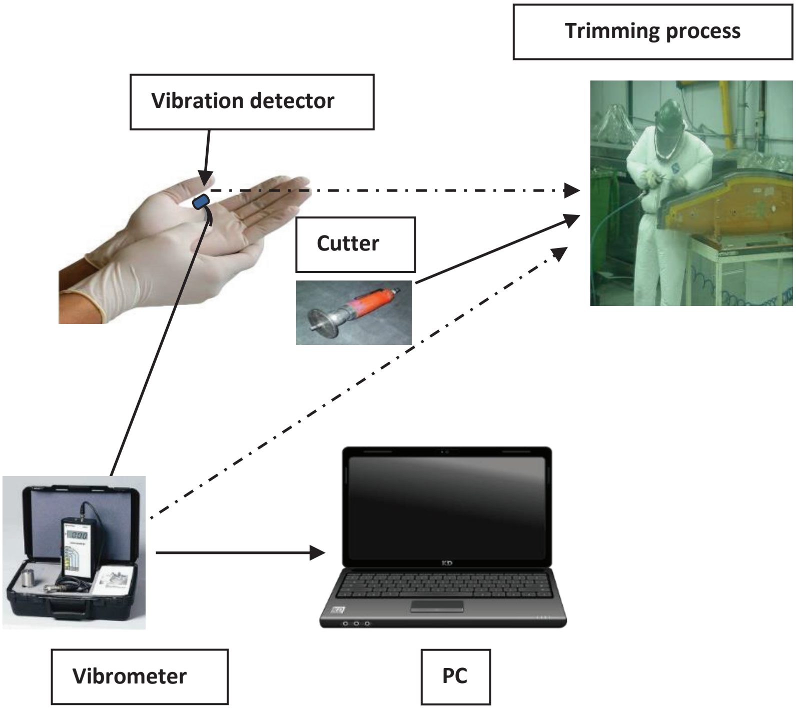


Figure 1: Data collection process

Figure 1 shows the data collection process involved in this study. A ring was fixed on worker's finger and it was connected through a wire to the vibrometer, which was also fixed to the worker's waist. The workers bring these equipments along with them into the cutting process room. The vibration data was read for an average cutting process period of 20 minutes and after that he will bring it out from the room and unfix that equipment from his body. The same process was repeated on the other four workers. The data collected in the vibrometer then was transferred into a PC with a specific software and then to be generated into graphical forms. These two methods are highly related in order to find out the significant result of the impact of vibration in the situation.

3.0 RESULTS AND DISCUSSION

It was found from the survey that most of the employees were not satisfied with the poor working conditions provided by the company.

Figures 2, 3 and 4 show the feedback from five workers connected with the three conditions: i) uncomfortable working environment, ii) working space is well ventilated and iii) the ambient temperature is not very hot. Only five workers were involved in this study because five was the maximum number of workers required for a trimming process. Skilled workers are mandatory for the trimming part since the part requires precision and concentration while cutting. A mistake done during the trimming part will result in rejection and the part may cost thousands of ringgits.

In Figure 2, the 5-points scale is used in the questionnaire with the range from Scale 1 for most agree, scale 2 for really agree, scale 3 for agree, scale 4 for not agree and scale 5 for really not agree. Meanwhile, the 5-points scale are also used in Figures 3 and 4 with the range from Scale 1 for most disagree, scale 2 for really disagree, scale 3 disagree, scale 4 for agree and scale 5 for really agree.

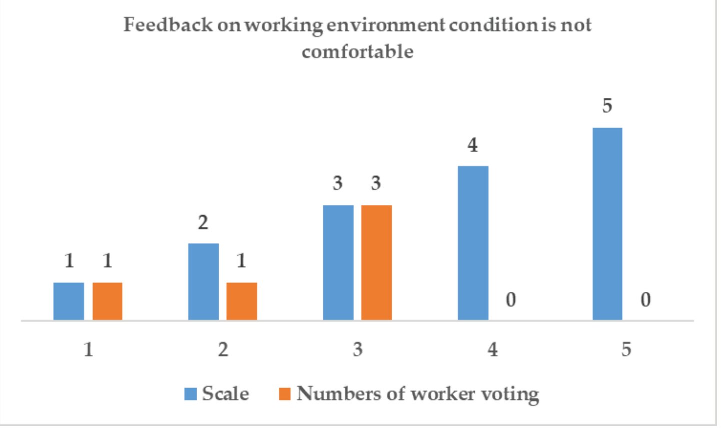


Figure 2: Feedback on working environment condition is not comfortable

From Figure 2, it can be seen that three from six workers agreed on the statement that the working environment was not uncomfortable. Thus, it can be concluded that most of the workers need a comfortable working area. It is agreed that comfortable working area can be contributed from the physical environment such as thermal environments, ventilation, indoor air quality, noise, vibration, vision and lighting [5]. Figure 3 shows that three of the workers agreed with the statement that the working space is well ventilated. It implied that most of the workers need a good and well-ventilated space in the cutting room. It was stated that even though nobody complains about the ventilation, it does not mean that the air quality is acceptable [6].

Ventilation and Indoor Air Quality (IAQ) must be complied according to standard. Good IAQ includes ensuring adequate ventilation (introduction and distribution of clean indoor air), controlling contaminants travelling in the air and maintaining acceptable thermal comfort. Finally, as shown in Figure 4, three out of five workers either disagreed or did not really agree on the statement that the ambient temperature is not very hot. This suggests that most of the workers also need a cool temperature in the cutting room. Taken together, the unfavorable working conditions, due to lack of room ventilation and hot temperature, are causing stresses to workers, making them uncomfortable that they lose their focus on the cutting job. As a result, the quality of products will be severely affected. This is supported by Ramsey et al. [7] and Kahya [8] who noted that hot working environments, job characteristics and working conditions do affect the job performance of the workers.

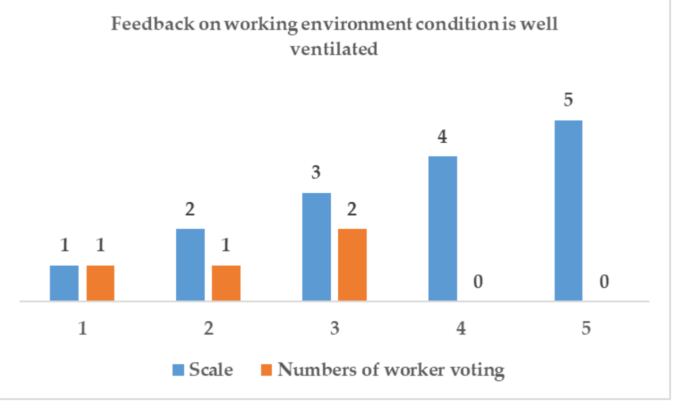


Figure 3: Feedback on working space is well ventilated

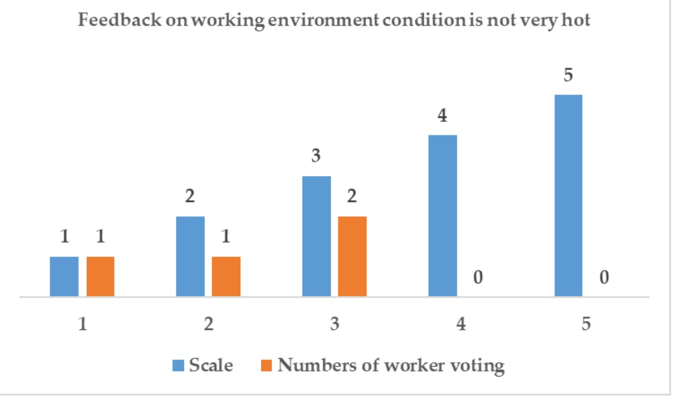
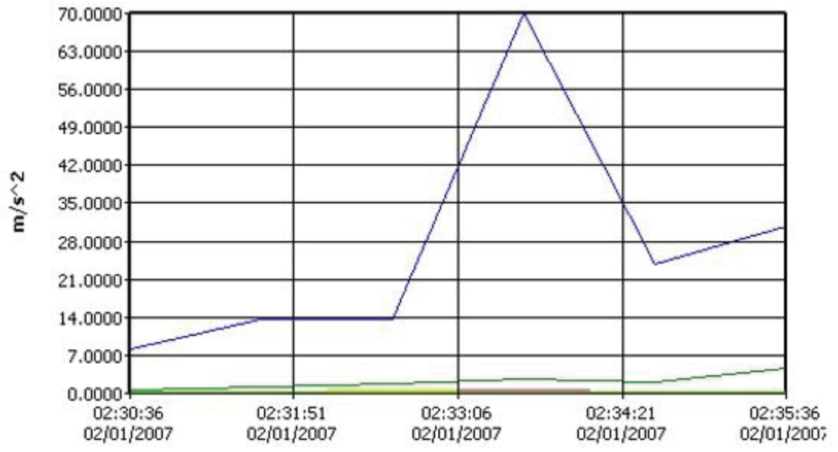


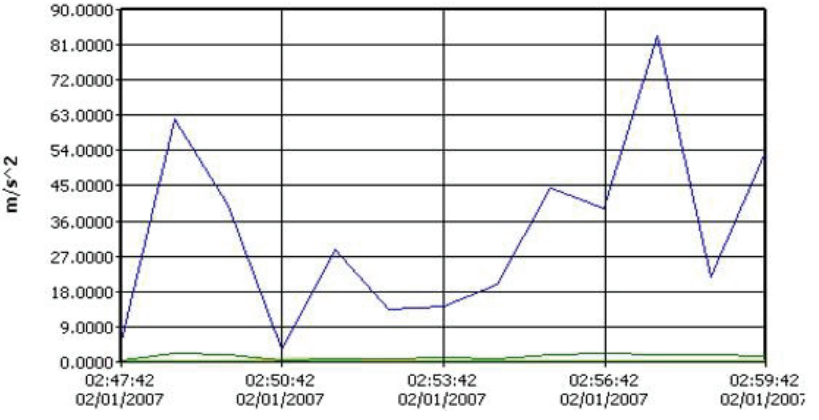
Figure 4: Feedback on the ambient temperature is not very hot



Worker	Max. Vibration	Min. Vibration	Average
Mohd Zahir	70 m/s^2	11m/s^2	40.5 m/s^2

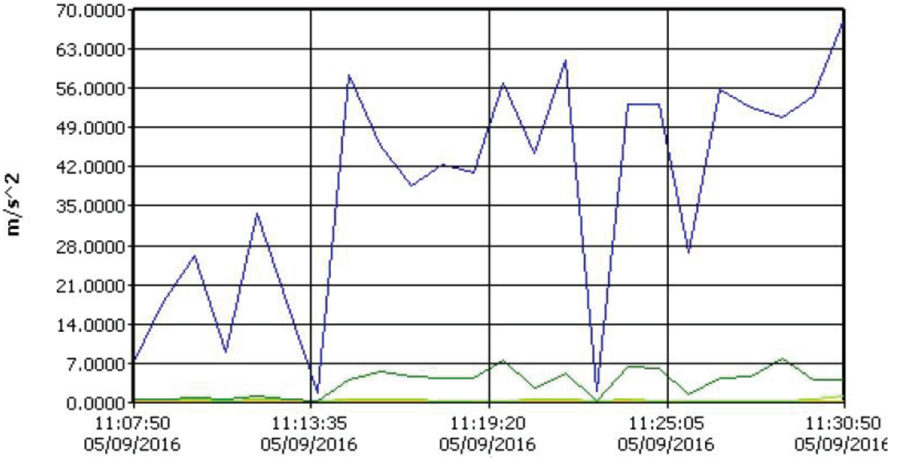
Figure 5: Vibration absorption at 3mm (thickness) produced by Mr. Zahir

For the experiment, a set of data taken in the year 2016 was utilized. The data were taken using a vibrometer [9] and transferred to a computer for analysis. Figures 5, 7, 8, 10-13 are shown normal result from good healthy workers. Figure 6 and Figure 9 (for 3 mm thickness) show that two workers, Mr. Hidir and Mr. Ahmad Fakir who suffered from health problems resulted from a long exposure of vibration previously, absorbed more amount of vibration from hand tools compared to the other healthier workers. It can be seen in Figure 11 and Figure 14 (for 5 mm thickness) that the same workers, Mr. Hidir and Mr. Ahmad Fakir absorbed about four times more vibration amount from hand tools compared to the other healthier workers. Mr. Hidir and Mr. Ahmad Fakir have suffered from a back pain from the shoulders to the arm, which may be due to long-term exposure to equipment vibration. Vihlborg et al. [10] highlighted that 21% of the employees were judged to have vibration-related problems even though the exposure to vibrations was judged to be relatively low. Charles et al. [11] also agreed that occupational exposure to vibration and awkward posture are associated with shoulder and neck musculoskeletal disorders (MSDs). Roseiro et al. [12] said that impacts and transient vibrations lead to a higher musculoskeletal injury while Xu et al. [13] found that the hand-transmitted vibration transmissibility generally reduced with the increasing of the distance from the vibration source. Hamouda et al. [14] had mentioned that testing of gloves according to ISO 10819 in year 2013 cannot reliably measure the effectiveness of the glove to reduce the risk of HAVS. López-Alonso et al. [15] explained that 83% of the tool vibration data provided by the manufacturers producing the vibration levels for a reference period of 1 hour which are exceeding the exposure limit value.



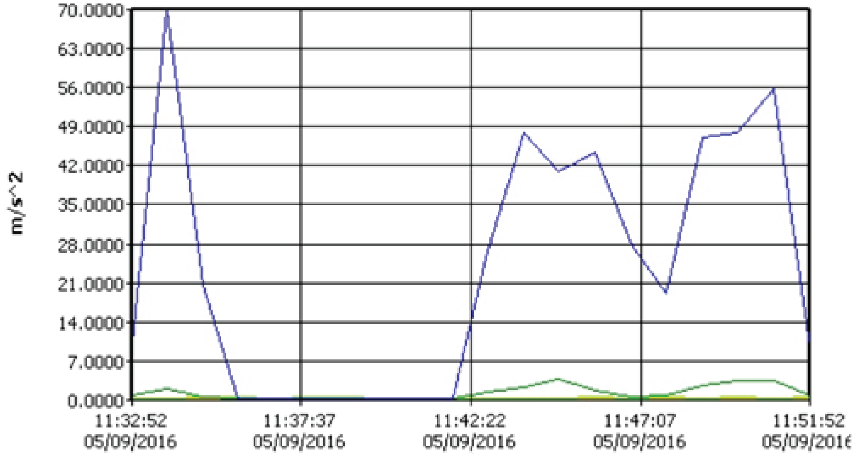
Worker	Max. Vibration	Min. Vibration	Average
Hidir	83 m/s^2	18 m/s^2	50.5 m/s^2

Figure 6: Vibration absorption at 3mm (thickness) produced by Mr. Hidir



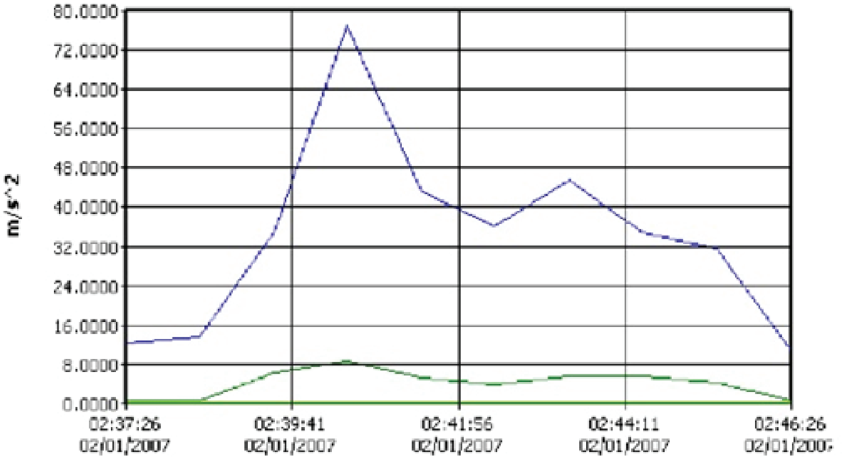
Worker	Max. Vibration	Min. Vibration	Average
Rossley	68 m/s^2	17 m/s^2	42.5 m/s^2

Figure 7: Vibration absorption at 3mm (thickness) produced by Mr. Rossley



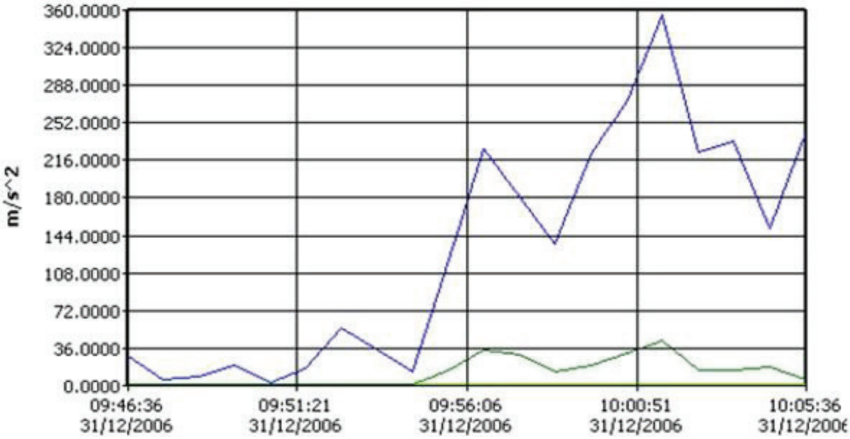
Worker	Max. Vibration	Min. Vibration	Average
Mohd Fauzi	70 m/s²	13 m/s²	41.5 m/s²

Figure 8: Vibration absorption at 3mm (thickness) produced by Mr. Fauzi



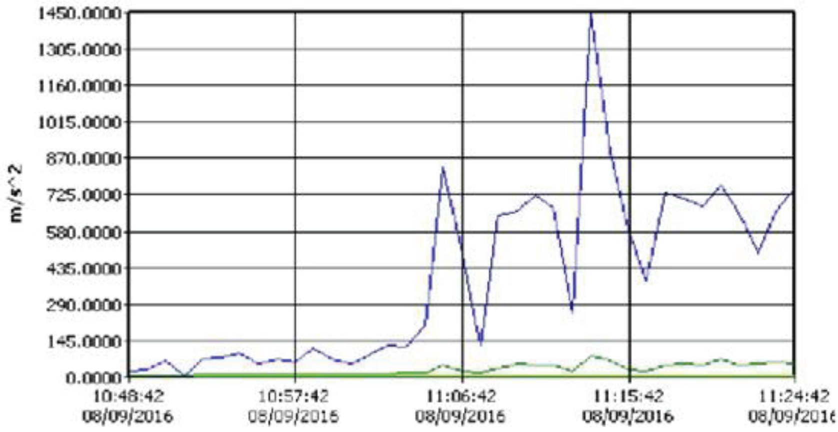
Worker	Max. Vibration	Min. Vibration	Average
Ahmad Fakir	76 m/s²	18 m/s²	47 m/s²

Figure 9: Vibration absorption at 3mm (thickness) produced by Mr. Fakir



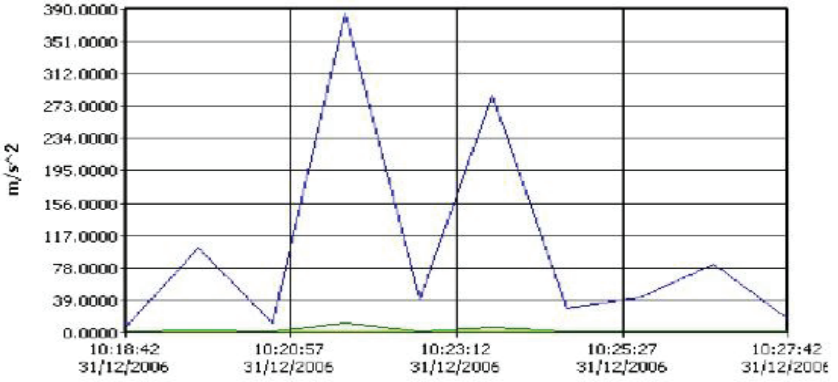
Worker	Max. Vibration	Min.Vibration	Average
Mohd Zahir	355 m/s^2	75 m/s^2	215 m/s^2

Figure 10: Vibration absorption at 5mm (thickness) produced by Mr. Zahir



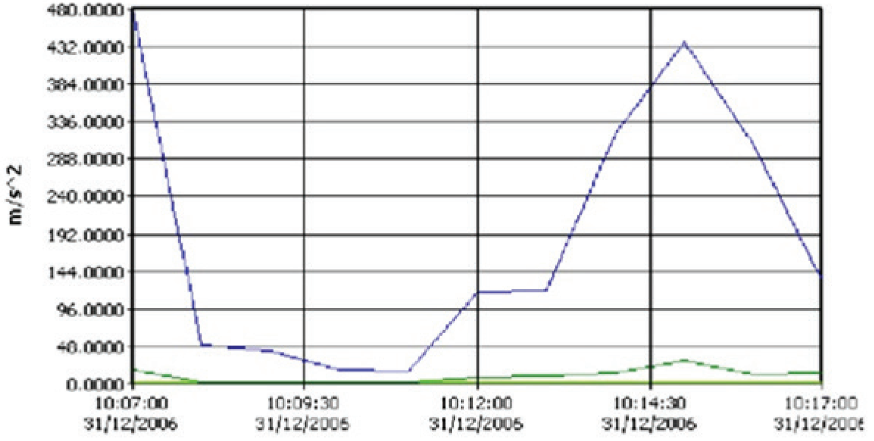
Worker	Max. Vibration	Min. Vibration	Average
Hidir	1450 m/s^2	366 m/s^2	908 m/s^2

Figure 11: Vibration absorption at 5mm (thickness) produced by Mr. Hidir



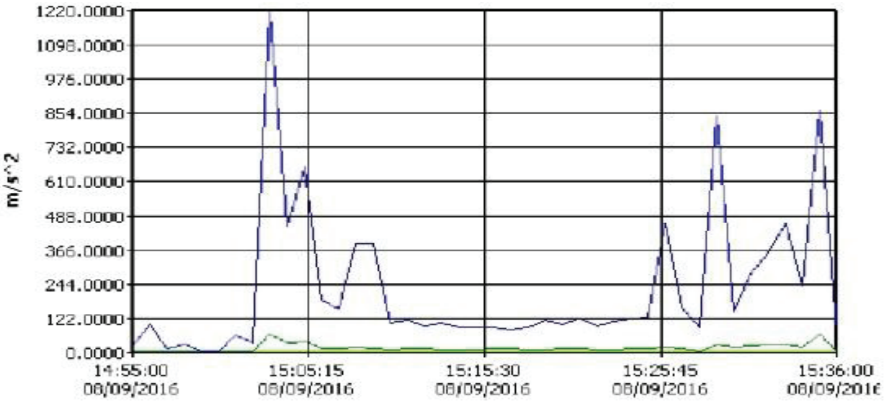
Worker	Max. Vibration	Min. Vibration	Average
Rossley	383 m/s^2	72 m/s^2	227.5 m/s^2

Figure 12: Vibration absorption at 5mm (thickness) produced by Mr. Rossley



Worker	Max. Vibration	Min.Vibration	Average
Mohd Fauzi	479 m/s^2	97 m/s^2	288 m/s^2

Figure 13: Vibration absorption at 5mm (thickness) produced by Mr. Fauzi



Worker	Max. Vibration	Min. Vibration	Average
Ahmad Fakir	1209 m/s²	265 m/s²	737 m/s²

Figure 14: Vibration absorption at 5mm (thickness) produced by Mr. Fakir

4.0 CONCLUSION

The results of the study revealed that the workers felt that their working environment was stressful. It was also found that the workers who had bad health condition would absorb more vibration from the hand tools while performing the cutting job. The unhealthy workers need more energy and power to hold and grip the tools than the healthy workers. The uncomfortable working environment also contributes to this high vibration absorption. The study is hoped to alleviate the problems related to vibration from tools which may have negative implications on the health of employees.

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