IMPACT OF NOISE POLLUTION AT WORKPLACE: A CASE STUDY OF LOCO RUNNING SHED AND SHOP, PAKISTAN RAILWAYS KARACHI

Saleem Raza Samo*, Abdul Rehman Jatoi**, Kishan Chand Mukwana** Muhammad Mureed Tunio** and Abdul Nasir Laghari**

* Professor, Department of Energy and Environment Engineering, Quaid-e-Awam University of Engineering, Science and Technology (QUEST), Nawabshah

**Assistant Professor, Department of Energy and Environment Engineering, Quaid-e-Awam University of Engineering, Science and Technology (QUEST), Nawabshah

Email*: sfaizsamo@yahoo.com Email**: arjatoi@quest.edu.pk

ABSTRACT

Railway is one of the most important means of transportation for public and goods. However, its engines make unwanted noise, which is unpleasant to the general public and workers. The purpose of this study was to determine the noise level at locoshed, shop, fuel filling station and load test section of Pakistan Railways Karachi. The noise levels of the selected locations were measured with the help of CR-262A, Sound Level Meter after calibration with an acoustic calibrator. The workers were personally interviewed and a questionnaire was also distributed, filled up and collected for the determination of noise impact on workers' performance. An analytical hierarchy process model was used for the analysis of noise impact with different alternatives namely locoshed, shop, load test and fuel filling station. The maximum average and peak noise level at locoshed, locoshop and load test sections was found to be exceeding 1.3 to 1.5 times from World Health Organization standards. It was discovered from the model results that there were inconsistency of 0.45. The study revealed that the noise level was more than standards at the selected locations and performance of the employees and workers were seriously affected due to the critical conditions at and near the workplace.

Keywords: Noise level, analytical hierarchy process model, railway engine noise, workers' performance

1. INTRODUCTION

Development of science and technology not only brought numerous conveniences, easiness and comfort for human beings but also created global problems [1]. High level of noise degrades the quality of human life in urban areas across the world [2]. The uncontrolled growth, urbanization, industrialization and transportation system are responsible for this unsustainable environment [3]. Urban environmental pollutants are mostly emerged from modern modes of heavy transportations, like highways, railways, and air traffic [4]. Railway transportation is the most important source for the development of country economy with basic principle to provide transport facility to the public and goods [5]. However, it creates the major air and noise pollutions in urban areas, especially near railway stations, yards, and their maintenance places.

Karachi is one of the biggest, industrialized and dynamic mega cities of Pakistan, facing environmental degradation problems including high level of noise [6]. Noise is a universal environmental hazard of the modern world, originating from a wide variety of sources including vehicles, air and railway traffic, and industrial operations [7]. Railway noise emitting sources are broadly classified into two sources i.e. railway line and railway station. Railway line noise includes the whistling noise of locomotives and train operating noises (composed of rolling noise, traction noise and aerodynamic noise), traction motors, radiator fan, turbo charger and locomotive conditions. Railway station noise comprised of the whistling noise of trains in passenger, cargo, and operating stations, engineering and engine workshop as well as loudspeaker broadcasts in the various locations of railway stations [8]. The high level of noise at workplace directly affects the auditory and non-auditory systems of employees and workers [9]. It disturbs the human comfort and decreases the workers performance [10]. It also creates sleep disturbance, annoyance, irritation, headache, conversation, leading to increases in the chances of accidents at work place, hypertension, heart failure, hearing damage [11-13].

The impact of loco engine noise on employees can be gauged with the help of different models. An analytic Hierarchal Process (AHP) model (Expert Choice 11.5) is one of the most employed models for estimation of noise inconsistency and decision of alternative choice [14]. This model can also be used to assess the risk hazard. Complex number of problems could be resolved through this model [15]. The purpose of this study was to determine the railway noise level at the different workplaces of employees and their impact on the workers performance using analytical hierarchy process (AHP) model.

2. MATERIAL AND METHODS

The selected location for this study was within the premises of Pakistan Railway Station Cantonment, Karachi. The selected site is one of the busiest locations of railways due to repairing, maintenances, trip schedules and examining locomotive engines. The noise intensity at locoshed, locoshop, load test, loco foreman office and works manager office, and interior of mechanical store were measured. The noise level was recorded continuously for three months at the interval of three days from morning till evening using CR-262A sound level meter. The data was taken as minimum, maximum, average and peak dB (A). The meter was held 1.3m above from ground surface and 7.5m away from sources as per standards [3, 6, 16]. The calibration of noise meter was performed through acoustic calibrator at 93.7 dB standard after each set of measurement [17]. The flow intensity of fleets was calculated using traditional method from 8 am to 8 pm at the site. A questionnaire was developed for recording the workers and officers perception about impact of noise on their performance. Direct interview was conducted with 200 workers. It may be added that the objectives of the study were explained to each employees before the beginning of interview [18-21]. In addition, an Analytic Hierarchal Process (AHP) model (Expert Choice 11.5) was used to estimate the impact of loco engine noise on employees and calculate the noise inconsistency. Four alternatives e.g. locoshed, shop, load test and fuel filling station with three different criteria namely annoyance, irritation and headache were set for the model as shown in Fig. 1. The significant statistical data was controlled through sensitivity analysis [22, 23].

Fig. 1. AHP Model with Inputs

3. RESULTS AND DISCUSSIONS

The overall noise level in diesel locoshed was recorded and found with a minimum value of 62 dB (A), maximum 119.3 dB (A), average 84.01dB (A) and peak 130 dB (A) during assessment period as shown in Fig. 2. The daily minimum noise value was found 61 dB (A), maximum 96.5 dB (A), average 78.3 dB (A) and peak 113.5 dB (A) at in front of works manager office. The daily average minimum value observed was 66.6 dB (A), maximum 109 dB (A), average 77.9 dB (A) and peak 127 dB (A) at locoshop. The minimum level of locomotive noise near fuel filling station was 63.7 dB (A), maximum 109.9 dB (A), average 75.58 dB (A) and peak 120.7 dB (A). At load test section, the minimum noise level was found as 55.6 dB (A), maximum 110.6 dB (A), average 92.1 dB (A) and peak 127.7 dB (A). The highest recorded maximum noise level was 119.3 dB (A) with the peak value of 130 dB (A) at locoshed, which was more than standard value of 85 dB (A) [24-25].

The noise emitting from the engines at locoshed was directly reached and received at almost same intensity in locoshop because both sections were adjoining, and there was no barrier between both workplaces. In these places there were various sources of noise such as, engine sound, radiator fan, wheel rolling, cast iron brakes, pressure horn, and shunting of engines. Such noise can be reduced through utilization of newest spare parts, proper maintenances and trip schedules.

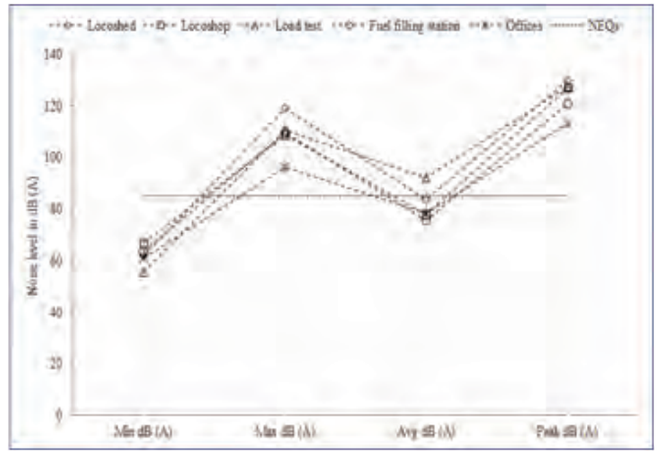

Fig. 2. Comprehensive intensity of noise at selected locations of locoshed and shop Pakistan Railways Karachi

The traditional method was adopted for computing the flow intensity of fleets from morning (8.00 am) to evening (8.00 pm) at the selected locations. The overall flow intensity of loco engines were found 14 at locoshed, 21 at offices, 7 at workshop, 14 at fuel filling station and 4 at load test section as shown in Fig. 3. It was observed that the in front of offices, fuel station and locoshed were found to be noisy locations as compared to shop due to shunting of engines, filling of fuel in locomotive engines, and arrival and departure of passenger fleets from cantonment station.

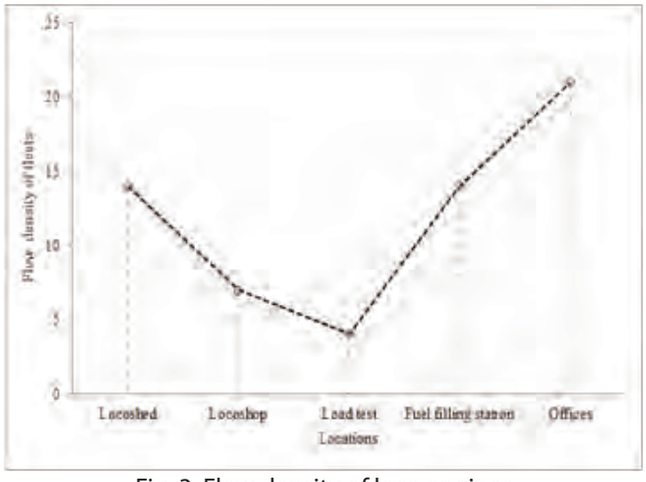

Fig. 3. Flow density of loco engines

The opinion of the workers regarding workplace noise pollution and its impact on their health and performance was collected. The statistical data was controlled through sensitivity analysis. The inconsistency was found to be 0.45 as shown in Fig. 4 and sensitivity is shown in Fig. 5. The analysis showed that the employees of locoshed and shop were at high risk of health and mental stress due to consistent severe noise pollution.

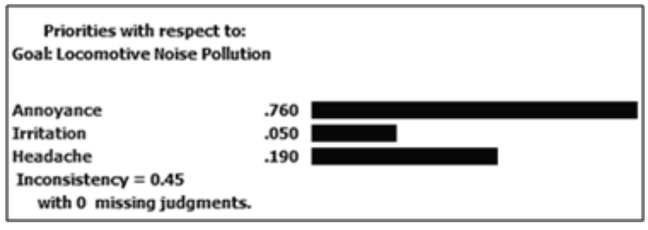

Fig 4. Priorities with respect to goal and Inconsistency

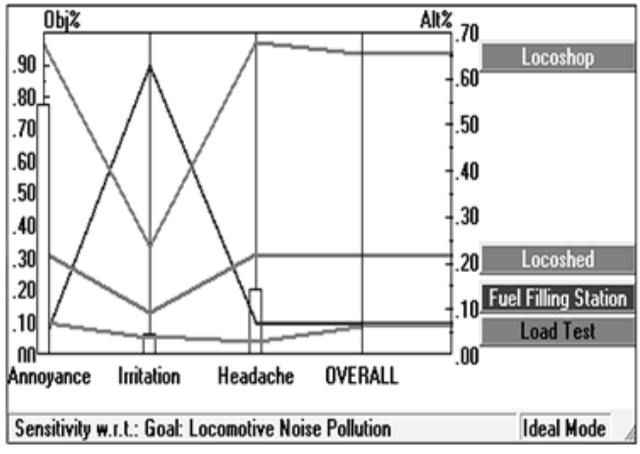

Fig. 5. Sensitivity with respect to goal

4. CONCLUSIONS

The maximum average and peak noise level at locoshed, locoshop and load test sections was found to be exceeding 1.3 to 1.5 times from the standards. The maximum engine flow density was found to be 21 under operation at offices whereas 14 were recorded at diesel locoshed. The severe noise level had adverse impact on the performance of the workers which is responsible for poor health and complications at the workplace. The inconsistency was found 0.45 using Analytical Hierarchy Process model. It is suggested that a noise assessment and management system should be implemented to reduce the impact of noise on the workers. Proper maintenance, trip schedules, sealing of engine doors, usage of bell warning system instead of pressure horn, proficient speeds in yard can minimize the noise exposure. The use of earplugs and muffs and job rotation practice can also decrease the effects of amplified noise on the health of workers.

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