

Chapter 4

Case Study

4.1 Introduction

In this chapter, the case study mines and field visits for data collection and vibration measurement are discussed. The subjects considered for the study are also briefly explained.

4.2 Case Study Mines and Field Visits

Data were collected from four opencast coal mines. The mines are located between latitudes $23^{\circ} 47' N$ to $24^{\circ} 12' N$ and longitudes between $81^{\circ} 48' E$ & $82^{\circ} 52' N$ in the northern part of the Sone-Mahanadi master basin. The mines are coded as Mine-1 to Mine-4. The periods of data collection are mentioned below:

Mine-1: 18-26 May 2017 and 21-31 May 2018

Mine-2: 05-18 Oct 2017 and 21-31 May 2018

Mine-3: 06-16 Feb 2018

Mine-4: 08 -17 October 2018

All the mines are highly mechanized in 2017-2018. Some details of the case study mine, as to production level, machinery deployed, working method adopted and manpower employed, are given in Table 4.1

Table 4.1 Method of working and machine deployment in the case study mines

	Production	Working method	Machinery	Average daily manpower
Mine 1	2.1 MT	Shovel–dumper combination	Rope shovel, hydraulic shovel, backhoe, dumper, dozer, drill, cranes, water tanker, grader	786
Mine 2	7.5 MT	Coal: Shovel–dumper combination OB: Dragline	Dragline, rope shovel, hydraulic shovel, back hoe, dumper, dozer, drill, cranes, water tanker, grader	894
Mine 3	12.43 MT	Coal: Shovel–dumper combination OB: Dragline	Dragline, rope shovel, hydraulic shovel, back hoe, dumper, dozer, drill, cranes, water tanker, grader, tyre handler	1435
Mine 4	15.50 MT	Coal: Shovel– dumper combination OB: Dragline	Dragline, rope shovel, hydraulic shovel, back hoe, dumper, dozer, drill, cranes, water tanker, grader, tyre handler	497

4.3 Data Collection

Data were collected with prior permission of mines management. All the concerned operators were informed pros and cons of the data collection system.

4.3.1 Study sites

All four opencast coal mines are owned and operated by the same company. The case study mines have, in general, similar occupational, safety and health practices. The opencast method of coal mining through drilling and blasting is practiced in all the mines. The height of the benches was 10 m in overburden as well as ore with the bench width more than or equal to the bench height. Three types of HEMM operators were considered for the study. The down-the-hole method of drilling is being practiced with 150 mm diameter drills. Loading was carried out with the combination of shovel, hydraulic excavator and front-end loader of capacity 2.7–4.6 m³. Coal as well as overburden was transported by 100-ton or 120-ton rear discharge dumpers. All of the dumpers were working for either coal transportation from the coal face to the coal handling plant or overburden transportation from the face to the dumping yards.

4.3.2 Study subjects

This study included a total of 260 subjects of which 150 were HEMM operators and 110 are workers in mines. Participants volunteered to allow onsite access to their measurement. Operators were selected through random sampling from the available list of operators at the site during the study. After the vibration measurement, each operator completed a questionnaire detailing personal information such as age, weight, height, anthropometric dimensions and work experience, and their work-related

musculoskeletal pain. Operators were asked which part of the body was associated with pain in the last 6 months and the severity of the pain mentioned in the questionnaire was recorded. The following body parts were mentioned: neck, shoulder, upper back, lower back, right/left elbow, right/left wrist or hand, right/left knee and right/left ankle or foot. However, only a few of these health symptoms have been considered during analysis. The age of the operator was recorded from the identity card, where the date of birth is mentioned. The height of the operators was measured using a measuring tape. The participants' weight was recorded using a standard weighing machine. Years of experience included the period an operator has worked in the present organization, in addition to the period he has previously worked in any other organizations. The dumper operators work 300 days a year, 6 days a week and 8 h a day. The operators were asked to answer the queries related to symptoms of MSDs, and their responses were recorded as 'always', 'occasionally', 'rarely' or 'never'. The break up of mine-wise data collection for different category of HEMM operators is given in Table 4.2.

Table 4.2 Distribution of total number of data collected from the mines

Name of mine	HEMM operators (Case group)			Control group
	Dumper	Drill	Shovel	
Mine-1	34	2	2	24
Mine-2	43	0	4	38
Mine-3	33	5	8	48
Mine-4	0	13	6	0
Total	110	20	20	110

4.4 Summary

This chapter presents the location of mines and their level of mechanization. The HEMMs deployed in mines are presented. The field visits conducted and the HEMM operators assessed for WBV measurement and survey are also presented. The distribution of control group of workers from each mine are also presented. The procedure adopted for conducting WBV measurement, its calculation and vibration magnitude is presented in Chapter 5.