

# Ergonomic Aspects and Workers Subjective Complaints on Martapura Diamond Polishing at Banjar Regency

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**Abstract-** Diamond polishing is a type of work that requires high accuracy therefore it requires adequate supporting facilities in order to avoid the possibility of potential interference / complaints occurring as the result of non-ergonomic working facilities. This is a descriptive research to describe the state of the working desks and chairs used by the workers on Martapura diamond polishing. The research purposes were to identify the dimensions of working-desks and chairs that are being used and the perceived impact by workers on Martapura diamond polishing business unit. The working-desk and chairs measurement was conducted by using gauge instrument while the data of working-desks and chairs utilization impact was collected by observation and interview to all workers on working site. The measurement result showed that working-desks and chairs at Martapura diamond polishing business unit were not ergonomic yet. Those non-ergonomic conditions have several impacts on diamond polishing workers in the form of fatigue (14.28%), back pain (87.5%), and scoliosis (14.28%). The efforts that should be made to reduce the subjective complaint is with the use of designated working-desks and chairs appropriate with the results of anthropometry calibration in Martapura diamond polishing workers in example for the working-desks is 51-62 cm high and 63-76 cm width, while the chairs is 47-54 cm high, 33-42 cm width, 50-55 cm length and equipped with a backrest. In addition, the workers need to perform relaxation movements such as changing sitting position once in a hour, doing light movement to avoid tingling and also always to work in the upright sitting position to minimized back pain experience. This research was expected could be used as an input and consideration in creating a safe working environment and meet the health requirements, particularly in the diamond processing industry.

**Index Terms-** ergonomic aspects, subjective complaints, diamond polishing

## I. INTRODUCTION

In the globalization era, competitions between industries are barely unavoidable. Diamond polishing, as one of informal field of works also facing a competition challenge to increase their productivity and competitiveness. But in order to achieve maximum productivity and competitiveness, this industry still had to deal with unproductive workers cause by non-ergonomics working facilities such as working-desk and chairs. The working facilities that cannot fulfill the worker anthropometric conditions

also give bad influences to workers health, which are fatigue, back pain and scoliosis.

Basically diamond polishing industries required an extra skills, precision and expertise. Those kind requirements will have an impact on workers condition. Therefore an ergonomic working position becomes a necessity to improve the performance of workers. Work performance is a function of working posture and work productivity. With the ergonomic working postures, then a worker will be able to work with effective, convenient, safety, healthy and efficient while the opposite condition, working posture can cause pain and tired quickly than an ergonomic working postures<sup>1</sup>. Health problems such as fatigue also can be prevent by using a suitable and ergonomic working tools, that can impact to higher working efficient and productivity.<sup>2</sup>

South Kalimantan has a the one and only diamond craft industry located at Banjar Municipal in the form of Martapura Diamond Polishing Working Unit. In their main activity, the diamond polishing workers perform their work in sitting position. The treated materials were placed in front of the worker body, than the workers posture was adjusted with materials positions. This kind working conditions forcing workers to always be in a static and unnatural position for a long term. Several researches have shown that working in non-ergonomic conditions could cause low back pain, fatigue event accident. A research conducted by Richard (2001) has shown that 80% of adult peoples have suffered back pain caused by non-ergonomic working positions and 40% of them shown absenteeism on their work<sup>3</sup>. Working in a static position on a long term also can cause a faster complaint regarding *musculoskeletal* system.<sup>4</sup>

## II. RESEARCH METHOD

This is a descriptive research that describe the condition of working-desk and chairs and the workers anthropometric condition. The research population was all of 12 workers at Martapura Diamond Polishing Working Unit. Samples were taken with purposive sampling; generate 8 workers that meet inclusive criteria as research sample. The research inclusive criteria were (1) Workers did not work in other places beside Martapura Diamond Polishing Working Unit as a diamond craftsman (2) Homogeneous type of work performed was shaping and polishing the underside of diamonds.

III. RESULTS AND DISCUSSION

Diamond formation process starts from the raw materials that undergo a Brutting process of diamonds (round shaped) then the top is formed into 33 parts (including the flat section / table) and the bottom is formed into 24 sections so that when the polished diamond that has been formed into 57 facets / angle then that is what is called the diamond. 37.5% of respondents in the research were categorized as productive age (26-30 years old). Overview of the respondents working period can be seen in Table 1 below

**Table 1. Working period of Martapura diamond polishing workers**

No	Working Period (years)	Frequency (peoples)	Percentage (%)
1	1-5	1	12.5
2	6-10	1	12.5
3	11-15	5	62.5
4	16-20	1	12.5
<b>Total</b>		8	100.0

Working hours of all workers is 8 hours per day with a working time of at 08.00-16.00 pm punctuated by breaks for 1 hour which was made during the time of prayer and lunch. Working conditions in the Martapura diamond polishing working unit can be seen in Table 2 below:

**Table 2. Conditions of Workers Working Environment**

No	Working Conditions	Yes	(%)	No	(%)
1	Insufficient lighting	8	100	0	00.0
2	Workplace atmosphere noisy	3	37.5	5	62.5
3	Room coloring is blinding	0	0	8	100.0
4	Comfortable air temperature	8	100	0	00.0
5	Adequate fresh air supply	8	100	0	00.0
6	The layout of the working-desks and chairs make space for workers to move narrowed	5	62.5	3	37.5

Based on interviews conducted to eight workers, working environment is considered quite feasible due to sufficient lighting vision that the workers need in addition of table light. The sound of diamonds polishing machines considered quite un-noisy, un-blinding room's color, sufficient fresh air requirements while the layout of working-desk felt too narrow to move by the workers. From 8 interviewed workers, 7 of them feel the presence subjective complaints. Type of subjective complaints experienced can be seen in Table 3 below

**Table 3. Type of subjective complaints experienced by the workers of Martapura diamond polishing working unit**

No	Type of subjective complaints	Frequency	Percentage (%)
1	Fatigue	1	11.1
2	Back pain	7	77.8
3	Scoliosis	1	11.1

From the table above shows that most perceived subjective complaints by the workers is back pain (77.8%). From interview data, the workers stated that the perceived of subjective complaints related to the use of working-desks and chairs mostly happened when they were working (71.4%). For detail can be seen on the table below

**Table 4. The time of the workers subjective complaints emerged**

No	The time emerge	Frequency	Percentage (%)
1	Before work	0	00.0
2	While working	5	71.4
3	After work	2	28.6

Working-desk that used by workers in diamond polishing scrubbing section is made of iron, in which the table is provided by the manager of Martapura Diamond Polishing Working Unit and adjusted based on the size of the working-desk used by the craftsmen in Continental Europe (Netherlands) with a homogeneous size. There are twelve working desk that are used in polishing the diamonds and almost activities carried out on the working desk. The result of measurement can be seen in table 5 below

**Table 5. The diamond polishing working-desk size**

No	Criteria	Measurement result (cm)	Standard (cm)
1	High	89	68-75
2	Width	94	± 80
3	Thickness	9	± 5
4	Surface	qualify	flat, not blinding
5	Footrest	as required	As required

In doing their work 100% of activities performed in a sitting position in a chair. From the observation, the used chairs all made of iron with the same size (homogeneous). The results of measurements on worker chairs can be seen in table 6 below:

**Table 6. The diamond polishing chairs size**

No	Criteria	Measurement result (cm)	Standard (cm)
1	Cushion high	63	38-43
2	Cushion long	49	36
3	Cushion width	38	40-44
4	Backrest	not available	Not exceed the lower edge of the tip of the scapula and the bottom as high as the hip line

From the anthropometric measurement data to eight workers gained the data as shown in Table 7 below:

**Table 7. The diamond polishing workers anthropometric size**

Respondent no.	Anthropometric size					
	Sh	Eh	Hw	HI	Dwk	Dkf
1	90	28	36	73	55	49
2	85	24	33	71	50	49
3	76	21	36	63	50	37
4	79	27	42	76	52	50
5	82	28	34	67	53	47
6	82	32	38	75	55	54
7	79	25	38	66	51	46
8	78	28	35	73	54	45

**Remarks**

Sh: Sitting height

HI: Hand Length

Hw: Hips width

Eh: Elbow height

Dwk: Dent the waist to knee

Dkf: Dent the knee to feet

Various diseases can occur due to poor jobs or working facilities that are less congenial. Health problems that arise can be physical and mental health disorders. The non-ergonomic working tools will cause rapid muscle fatigue and when the work equipment and manpower are appropriate, then the fatigue can be prevented and the results will be more efficiently. The results of an efficient work process means to obtain high productivity<sup>2</sup>. Several studies have shown that working in non-ergonomic conditions can cause various problems, such as: pain, fatigue, and even accidents. This is also proved by a research conducted by Richard (2001) which states that there are currently 80% of people live as adults experience back pain, and resulted in 40% of them were absent from their work.<sup>3</sup>

Work equipment design principles should be able to solve problems that arise in the reality of human interaction with equipment comprehensively. The ergonomics requirement of a working-desk is adjustable on height according to the concerned workers, so workers with different heights can use the working-desk. The working-desk settings should work not only based on height only, but to the size of the body itself. If the working-desk height cannot be adjusted according to the height of worker, the working-desk height can be adjusted to the size of the highest worker rather than the shortest one. For the shortest worker can wear a higher pads so that it can adjust to the plains of the workplace.<sup>5</sup>

The position of working desk is quite too high, if used continuously, it can cause fatigue in the muscles of the wrist and forearm. This is proven by research that 12.5% of diamond polishing workers feel tired because the position of desk that is

not ergonomic. Supposedly if the of working-desk was adjustable, then the existence of footrest is not necessary anymore, while working-desk that is too low can cause the body lying too bent down so effected on the related muscles to such as pain in back, shoulders and the waist.<sup>6</sup>

The ergonomic requirement of a work chair is capable of creating a stable sitting posture and provides relaxation of the muscles that are not being used for work and did not experience the emphases on the body that can interfere with blood circulation and sensibility of these parts.<sup>5</sup> A good working chair high is designed in accordance with the worker's body anthropometry. The size of the seat that is too low or too high can cause new problems in the spine due to the burden resting on the bottom of the thigh, so that the blood flow to the legs to a standstill.<sup>6</sup>

Based on the existing provisions, the backrest should exist in a working chair design, adjusted to the workers physiology and anatomy as well as adjustable backrest for keeping the state of waist curvature straight. But if the backrest cannot be adjustable, then usually the worker working attitude tend to up straight, so it cannot support the back perfectly.<sup>4</sup> Backrest becomes important to support the back weight towards the back (lumber spine). It must be designed so that the backrest can be moved up and down as well as forward and backward. In addition it should also be able to set its flexibility to fit the shape of the back. This measure can reduce muscular effort required to maintain a rigid or tense posture. Backrest on chair able to stabilize posture and produce a reaction to the movement slightly pushed forward during the work.<sup>6</sup>

As much as 71.43% of workers feel their subjective complaints while performing their work and will gradually disappear when the work has finished, although for the other 28.57% stated that they still feel the subjective complaints even they have returned to their homes. This indicates that these complaints was indeed caused by the used of non-ergonomic working-desk and chairs. This condition would influentially affect the emergence of fatigue and the decrease of workers concentration level.

To obtain an ergonomic working-desk and chair it is necessary to design an anthropometrical calibrated working-desk and chairs so that both the workers with small or large body can use the working-desk and chairs as can be seen on the table 8 below

**Table 8. Calibrated workUniting desk and chairs in Martapura Diamond Polishing Working**

Objects	Measurement	Actual size (cm)	Recommended size (based on average worker anthropometry)
Working Desk	Height	89 cm	51 to 62 cm (include th desk thickness)
	Width	94 cm	63 to 73 cm
Chairs	Height	63 cm	47 to 54 cm
	Length	49 cm	50 to 55 cm
	Width	38 cm	33 to 42 cm
<b>Using 5 and 95 percentile</b>			

In addition there is the possibility of other factor that may cause the occurrence of subjective complaints, which is the lack of relaxation movement that can reduce fatigue caused by continuously carried of work. Moreover the potential boredom is a manifestation of their monotonous atmosphere especially for workers who are almost 100% of their work is done in a sitting position. Psychological factors often arise because of the repeated working conditions.<sup>6</sup>

#### IV. CONCLUSION

From the research that has been conducted, it can be concluded that the size of working-desk and chairs in Martapura Diamond Polishing Working Unit has not meet with the anthropometrical standards for diamond polishing worker (non-ergonomic), the workers body size (anthropometry) vary greatly, with the average of seat high is 81.38 cm, 26.13 cm elbow high, 52.13 cm knees high, 36.50 cm hips wide, 30.35 cm length of upper arm, 40.25 cm length forearm, 52.50 cm waist to knee dent and knee to feet 47.13 cm curved, the working conditions in Martapura Diamond Polishing Working Unit is quite feasible due the sufficient lighting, unnoisy sound generated from polishing machines, unblinding room colors, and sufficient air temperature and fresh air supply for the workers need, the most subjective complaints felt by workers is low back pain (87.5%), follow by fatigue (14.28%) and Scoliosis (14.28%).

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