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ANALYSIS OF OCCUPATIONAL RISKS IN THE ACTIVITIES OF CARPENTRY AND LOCKSMITHING IN PAU DOS FERROS / RN: a case study

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ABSTRACT

Carpentry and locksmithing activities are strongly marked by the use of old tools and unskilled workers, which contributes to the occurrence of accidents and other occupational hazards. Through these discussions, this work aims to analyze the environmental accident and ergonomic risks in a Carpentry shop located in the City of Pau dos Ferros / RN. Thus, the aim was to quantify the exposure to noise, to measure the ambient temperature and humidity values, as well as the ambient illumination values. For this purpose, environmental measurements were taken, as well as photographic records and interviews with those responsible for the establishment. According to the research carried out, it is noticed that a series of aspects contribute to the establishment studied to present unhealthy conditions.

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Among the points to be cited, lighting, as well as temperature and noise production are the most striking factors. Besides these aspects, the disorganization is also a problematic present in this work environment, since the waste is not properly discarded and the raw materials are heaped amid the debris and equipment. Another point to be cited is the use of PPE, which does not occur due to employees' refusal.

Keywords: Carpentry; Occupational risks; Environmental measurements

1. INTRODUCTION

The activities of joinery and locksmiths go along with humanity from its earliest days. In this way, it is relevant for the maintenance of daily necessities, such as the manufacture of utensils and furniture. In the course of history, it is undeniable that many factors impacted this activity, among which the industrial revolution is the most important factor, since many machines and equipment were included in this production segment.

In contrast to these points, it can be seen that the evolution occurred did not meet the evolutionary needs that this sector possesses, considering that it is a segment strongly discriminated by the use of tools still devoid of technologies, as well as the use of hand of low-skilled work, which limits the expansion in relation to the other sectors. Thus, the activities of carpentry and locksmithing, in its expressive majority is developed by micro-enterprises, with limited resources (LIPKUS et al., 2005; CAMPO et al., 2010; BRUTTO; REICH; ZAMBRANO, 2013; GRYTNES, 2017).

Although all the points cited above concern mainly the economic aspects of the activity, they negatively impact the health, well-being and safety of the workers, since the use of outdated tools as well as the adoption of untrained employees increases significantly the possibility of accidents occurring in the work environment, as well as exposure to environmental and ergonomic hazards (KOHAMMADI, et al., 2016).

Thus, this work aims to analyze environmental risks in a carpentry shop located in the City of Pau dos Ferros / RN. Thus, it is sought to quantify the exposure to noise, to measure the values of temperature and ambient humidity, as well as the values of ambient illuminance. For this, environmental measurements were taken, as

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well as photographic records and interviews with those responsible for the establishment.

2. THEORETICAL REFERENCE

2.1. The carpentry and its evolution

Wood was one of the first materials that man had access to, where it was initially used in the most rudimentary way possible, due to the lack of techniques to mold them, but with the advent of time, the activities carried out with this material became developed and improved, suppressing the needs of man more and more, making the work with the wood as malleable as possible.

Over time, economic activities around the world started to develop and the work with wood was not different, so the use of the material generated a great demand in several sectors ranging from the production of domestic furniture to the construction. Thus, there was a need to create new technologies and handling techniques.

Based on Tinoco and Araújo (2007), carpentry and locksmithing are very old trades. In addition, the authors state that locksmithing is more specifically divided into four main areas of activity: naval, military, civil and industrial. Given this context, we can see that these activities evolved over time, in order to continue to meet the demands imposed by the market.

Evolution becomes explicit in observing the amount of tools and equipment employed, since in the early days of mankind, even when man did not yet have adequate tools, these activities were already practiced, since many weapons, household goods and dwellings were made of wood, in an artisan way. But, this reality was slowly transformed until the Middle Ages, where manufacturing still prevailed, however, the instruments and quality of parts and services provided developed considerably.

Historically, progress has not finished at this point, since the Industrial Revolution has automated and broadened the horizons of industry. In this sense, the activities of joinery and locksmithing have also progressed, reaching an industrial level, which remains directly active in the most diverse sectors, mainly in the civil construction and furniture production.

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All this process has occurred through the development of machines and other technologies that enable the rapid repetition of processes, such as: cutting, finishing and assembling activities. All this has provided what we can call production on a large scale.

In contrast to all these aspects, it is a very restricted and underdeveloped sector that needs technological innovations and skilled labor. According to Rodrigues et al. (2012), in Brazil, the woodworking and locksmithing sectors are mostly micro and small enterprises with production on demand and destined to the local market. The authors also affirm that the professionals of the area are not technically qualified and that commonly these companies possess equipment and facilities that are almost always deficient and outdated.

Due to the characteristics of this activity, the emergence of risks in the safety and health of the worker are easily perceptible, since the use for long periods of the machinery usually entails problems in its operation, which together with the lack of inspection by the employer or lack of interest in replacing machinery with compromised operation, results in dangerous situations for workers or, in certain cases, visitors in the work environment. According to Grytnes (2017, p. 2) "based on relatively high numbers of workplace injuries in construction and among young workers in particular, safety education programs have been introduced within vocational education and training (VET)".

In this way, it is verified that the urgencies in relation to the structural improvement of the companies are not limited only to the physical aspects, considering the need to train the employees and managers, that is of vital importance for a development in the productive process allowing what improvements can be made and thus achieve satisfactory and competitive levels of production and quality.

2.2. Classification of occupational hazards

Occupational risks form a group of environmental, ergonomic and accident hazards. In this sense, according to Peixoto and Ferreira (2012), in industrial activities there are processes capable of generating, in the work environment, physical substances and phenomena that, depending on their nature, concentration or intensity, when they come in contact with the body of Workers, can cause illness

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or damage to your health. In the cases of accidents and ergonomic risks, (A, 2012) affirm that these are analyzed from the occupational hygiene.

Workers are subject to several risks in their work environment and thus end up being vulnerable to them, according to Santos et al. (2012), vulnerability can be understood as a set of factors that can lead to the development and reduction of risks That workers are exposed in all their workplace environments, but also allows them to understand the chances of contracting diseases, so it is extremely important to value the work environment so that it can minimize problems with them. Figure 1 shows the number of work accidents per month in the state of Rio Grande do Norte between 2013 and 2015.

Months	Total			With CAT Registered														No Recorded CAT		
				Total			Motivo													
							Typical			Path			Work Sickness							
	2013	2014	2015	2013	2014	2015	2013	2014	2015	2013	2014	2015	2013	2014	2015	2013	2014	2015		
Total	**6.889**	**7.156**	**6.808**	**4.614**	**4.895**	**4.969**	**3.240**	**3.215**	**3.310**	**1.145**	**1.341**	**1.246**	**229**	**339**	**413**	**2.275**	**2.261**	**1.839**		
January	605	562	528	390	385	361	266	268	234	102	102	109	22	15	18	215	177	167		
February	499	565	554	309	396	369	215	257	241	75	120	109	19	19	19	190	169	185		
March	571	632	616	367	410	432	248	266	328	89	107	92	30	37	12	204	222	184		
April	670	615	603	436	413	455	310	271	311	94	111	115	32	31	29	234	202	148		
May	599	645	558	391	453	408	290	310	293	84	108	89	17	35	26	208	192	150		
June	528	503	600	338	339	445	237	214	280	86	103	112	15	22	53	190	164	155		
July	607	671	605	424	456	465	296	300	274	112	120	108	16	36	83	183	215	140		
August	638	676	602	414	459	450	303	302	275	93	117	119	18	40	56	224	217	152		
September	572	612	578	392	414	413	280	259	269	99	116	113	13	39	31	180	198	165		
October	654	664	576	465	447	423	329	284	279	115	124	85	21	39	59	189	217	153		
November	509	550	503	368	386	365	242	262	252	115	107	99	11	17	14	141	164	138		
December	437	461	485	320	337	383	224	222	274	81	106	96	15	9	13	117	124	102		

Figure 1: Number of work accidents in Rio Grande do Norte
Source: DATAPREV, CAT, SUB (2015, p.147)

Due to the activities carried out, they are exposed to risks such as: physical, chemical, biological, ergonomic and accidents, when they begin to carry out these activities in a repetitive way causes the problems in the health of the workers, causing a poor quality in the work, in which affects the professionals contribute to affect the activities of the companies, with this, it is noticeable that the development of safety in the work tends to contribute positively to the productive process of the work environment.

Occupational hazards can be divided into several groups; physical risks are those that transmit some type of energy to workers such as: noise, vibrations, extreme temperatures abnormal pressures among others, as far as the chemical ones are those caused by agents which may be absorbed by the body, skin or ingestion.

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As regards the ergonomic is related to the subject and the work, thus analyzing the posture that they are in the performance of their activities as well as the repetition of movements in the work, the biological is characterized by agents such as viruses, fungi, bacteria, bacilli, protozoa and parasites; Accidents are the factors that present some danger to the workers. Thus, Table 1 presents the occupational hazards and their main causal sources:

Table 1: Occupational Risks

Physical	Chemical	Biological	Accidents	Ergonomic
Noise	Dust	Bacteria	Inadequate physical arrangement	Bad conditions in the work environment
Vibrations	Smoking	Fungi	Inadequate lighting	Excessive weight lifting
Extreme temperatures	Mists	Protozoa	Electricity	Monotony
Abnormal pressures	Mists	Bacillus	Machines and equipment without protection	Repeatability
Humidity		Virus	Slippery floor	Inadequate postures
Radiation			Fires	Stress

Source: Peixoto and Ferreira (2012). Adapted.

2.3. Classification of occupational hazards

Based on Souza (2004), carpentry and locksmiths activities present risks to the health of the worker, notwithstanding their experience. Risks are common in industries of the same business sector, then the proportion that occurs in the mentioned activities is much more characteristic, since the realizations of specific operations present in the production process of this activity create situations of high risk. These situations arise from the lack of knowledge of norms and work techniques, in which professionals in the field are "educated" by the practice.

When comparing results obtained from carpentries with standards that concern occupational risks in this work environment, it is well known that in most cases there are a large number of irregularities that can put the worker at risk. The lack of information that workers and entrepreneurs have, the urgency to increase productivity, the reduction of costs and the immediate and continuous changes in the Legislation as the main causes of the lack of conformity to the standards (SILVA, 1999)

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Because it is a considerably underdeveloped sector, the activities encompassing the joinery and locksmiths provide a series of occupational hazards to workers working in the area. Therefore, the Ministry of Labor and Employment (2008) states that the sub-activities related to joinery and locksmithing have high accident rates, and there is an annual percentage increase of approximately 20%.

In this sense, Hegedus et al. (2011) states that accidents that lead to amputation of limbs such as fingers, arms and hands occur mainly due to the use of cutting machines and that in 2001, the segments of sawmills and joinery were responsible for 15% of all cases of amputations in work environments.

In addition to accidents, there are other risks that are also very present, among which it is possible to mention ergonomic risks, since (B, 2012) point out repetitive activities as the main cause of occupational diseases. According to the authors, the finishing of parts, which comprises surface sandpaper and paint are the main responsible for the emergence of musculoskeletal problems in employees.

The physical, chemical and biological risks also play a part in this reality, since Santos and Almeida (2016) point out that woodworkers and carpenters are the two most exposed to wood particles, mainly due to the machines they use, usually indoors and with inadequate ventilation.

Still based on (C, 2016), some sectors of the wood industry use solvents and other chemical compounds to ensure greater resistance to microorganisms and greater durability. However, a number of problems are unleashed with regard to human health, since cognitive, neurological and emotional performance are compromised.

In relation to the biological risks, (C, 2016) indicate that the wood may contain microorganisms, giving rise to the toxic syndrome associated with organic dusts, which becomes even more expressive throughout the wood processing, since these elements are circulated via aerial.

The noise is classified as a physical hazard, which according to Pepplow (2010) corresponds to an undesirable sound, which is usually emitted by industrial machines, equipment or processes that exposes the body of workers or visitors to unpleasant situations such as irritation, nervousness and blood pressure, and when subjected for prolonged time, damage may be irreversible. Following this idea, Braga

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et al. (2005) add the individual factor, since for certain individuals, a specific sound can be quite annoying, while others may admire or find it normal.

3. METHODOLOGY

The present research was developed in a carpentry shop, located in the City of Pau dos Ferros / RN. This establishment has strong characteristics of micro-enterprise, considering that it has only 02 employees, who in turn work an average of 08 hours a day and do not have a fixed salary, with salaries corresponding to 15% of the monthly production. Another aspect to be highlighted is that this enterprise has a family value, since the establishment has been operating for more than 22 years and has passed through other generations.

Therefore, it is a case study, considering that addressing a single establishment provides a broader and more detailed study of the problems in the establishment. As for the methodologies applied, the presence of qualitative and quantitative methods is noticed.

Initially, bibliographical studies were carried out, where the historical evolution of this segment was discussed, as well as the classification of occupational hazards and the main occupational hazards present in carpentry and locksmithing activities. For that, the information provided by (D, 2008), as well as articles published in periodicals, dissertations and theses were consulted.Gil (2008) affirms that the bibliographic study is developed from works already finished, where commonly used books and articles scientists.

Subsequently, noise measurements were performed, where the decibelimeter model DEC 490 was used; Temperature and humidity, from the Thermo-hygrometer Model HT 4000; and luminosity through the MLM 1011 model luxmeter. Based on these measurements, it was possible to analyze the environmental conditions of work environments and to determine if workers are being exposed to hazards. In addition to the measurements, interviews were carried out with the person in charge of the carpentry shop, as well as photographic records.

This last stage, mainly characterizes the quantitative aspect of the research, due to the environmental measurements, which are defined by (E, 2008) as being a survey procedure. However, there is an exploratory analysis due to interviews.

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4. RESULTS AND DISCUSSIONS

According to the measurements made, it is verified that noise production is presented as one of the most aggravating problems in the Carpentry where the study was conducted. In this sense, 994 measurements were taken and from these it was verified that the noise produced in the environment had a minimum value of 92.1 dBA and a maximum of 102.5 dBA. In addition, the mean of the measurements was 98.15 dBA and the most repeated value was 98.4 dBA. To calculate the sound pressure level in the environment, as reference it was followed the NR 15 and it was found that the noise produced was intermittent with a value of 98.8 dBA. Figure 2 shows the graph generated by the decibelmeter.

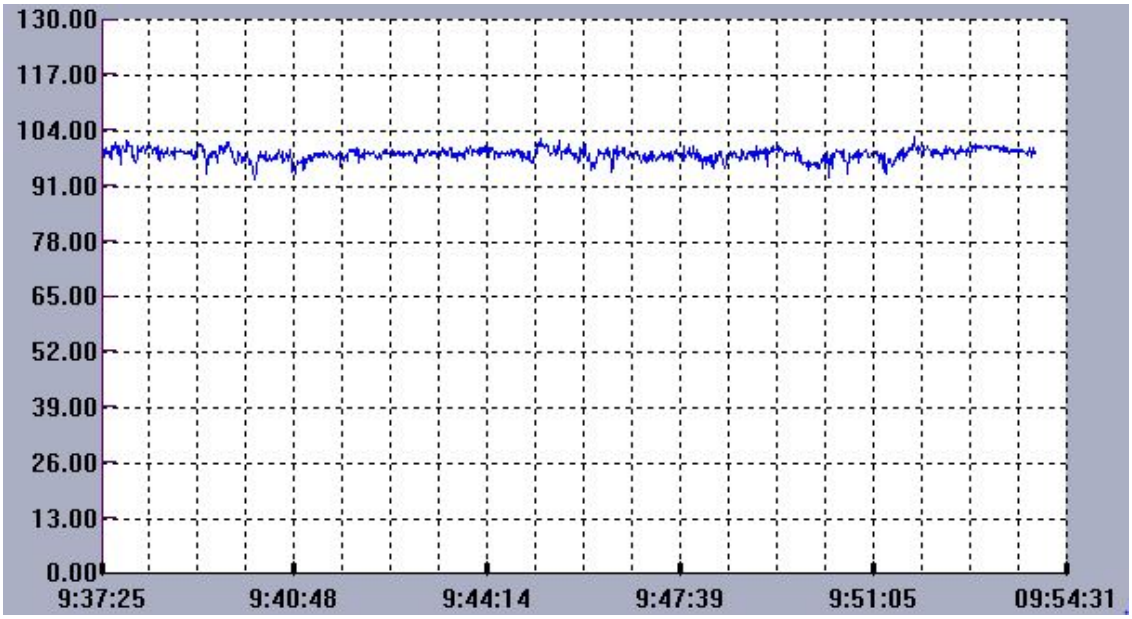

Figure 2: Graph of noise measurement

Comparing this value with the aspects of NR 15, it is evident that the production of noise in the establishment is much higher than allowed, since the maximum value allowed for an exposure of 8 hours per day is 85 dBA. This is due to the fact that equipment routinely used in this work environment presents an excessive noise level, either by the characteristics of the machinery or by the methods executed to perform a certain production task. Damage caused by exposure to noise, in this case, may become irreversible, since the time exposed in relation to the observed level are highly detrimental to the workers.

Regarding damages, Mendes (2011) defines as reversible and irreversible: the first classified as auditory fatigue, manifested by a temporary decrease in hearing

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capacity, determined by hearing loss and the time it takes to return to initial conditions; The second classified as deafness, which depends on the characteristics of the noise that the individual is exposed, the time subject to exposure and individual susceptibility. This effect can affect not only the hearing aid, but also negatively influence communication, concentration, and danger alerts, as well as decreasing the performance of the worker. Therefore, in addition to the use of PPE, there is a necessity to adopt more rigorous measures, such as distancing or enclosing machines and equipment.

Regarding pressure and temperature measurements, Figure 3 shows the graph generated by the thermo-hygrometer.

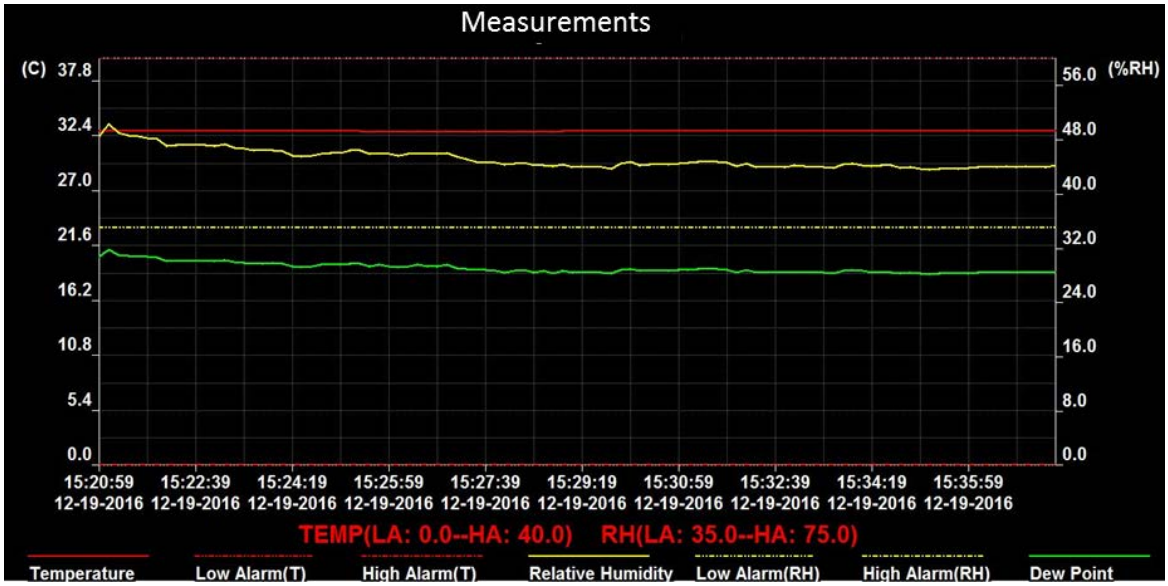

Figure 3: Graphs for pressure and temperature variations

According to Figure 3, the environment temperature that the establishment presented was approximately 32.4ºC, which according to NR 17 is not appropriate for the activities developed, since the maximum allowed would be 23ºC. These temperature values come from the location of this work environment that is located in the northeast region of the country, where in the time of measurements it was facing a drought and, on top of that, the temperature throughout its region was above average. As a measure of combat, it would be necessary to implement a cooling system, since the norm defines an ideal temperature lower than that submitted by the workers, however this strategy would be improper due to the characteristics of the activity in question, thus becoming a difficult factor to be fixed. Relative humidity, on the other hand, presented values that were in agreement, since according to the

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graph the average value is approximately 44% and the minimum value allowed is 40%.

Also in relation to the high temperature detected in the studied environment, in addition to not having a cooling system, other methodologies couldn't be identified in order to alleviate this problem, such as exhaust fans and coolers. In this case, it is noticeable that the thermal comfort of the working environment is still merely being taken into account.

Referring to the detriments caused by exposition to excessive heat and lac of appropriate ventilation, Saliba (2000) states that in addition to causing discomfort in the performance of occupational activities, the agents mentioned can also cause loss of productivity and damage to the health of the worker, such as irritability, weakness and difficulty to keep concentration.

Measurements regarding brightness were made according to the distribution of the machines in the working environment. In this sense, the establishment was divided into five segments to provide a more detailed analysis. The obtained illuminance values are set forth in Table 2.

Table 2 – Illumination in the workplace

Machines	*Illumination in the environment*	*Appropriate Values*
Planer	109 lux	500 -1000 lux
Trencher saw	125,5 lux	500 -1000 lux
Desengrosso	1093,8 lux	500 -1000 lux
Band saw	677,8 lux	500 -1000 lux
Cutting table	167 lux	500 -1000 lux

Source: Research (2016) and NBR 5413/92

According to Table 2, all illuminance values are not in conformity with what is foreseen in NBR 5413/92. In this sense, it is perceived that this factor makes the working environment unhealthy and increases the chances of accidents occurring. Regarding this, the NR 17 establishes: in all workplaces there must be adequate, natural or artificial lighting, general or supplementary, appropriate to the nature of the activity. Likewise NBR 5413/92 establishes that in environments where work related to machinery, office and that require normal visual requirements are developed the illuminance should be in the range of 500 to 1000 lux.

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Thus, Gottardo (2013) states that in addition to effects on the body, the lack of adequate lighting also compromises productivity. As main effects can be cited: visual fatigue, discomfort, headache, glare, reduced visual efficiency and mental accidents.

Another aspect analyzed was the organization of the workplace, considering that this factor has great impacts on the well-being and safety of the workers due to the lack of organization being a propeller to increase the accident rates. In this way, Figure 4 shows the environment where the activities are developed.

Figure 4 – Workplace

Based on Figure 4, there is a severe disorder in relation to the accommodation of the wood, as well as the accumulation of dust coming from the activities performed. These factors, in addition to providing an increase in accidents, may generate the occurrence of more risks, which can be environmental, ergonomic or accident hazards.

Thus, the best measures to be take would be the disposal of solid wastes, as well as the adequate accommodation of the wood. Another aspect that can be improved is the distribution of equipment within the environment.

When analyzing the physical aspects, it is possible to verify that the external environment presents a good natural light, but the internal environment, even having artificial lighting, is very deficient.

In addition to these risks, it was verified that the electrical installations of the building in which the enterprise is established are obsolete, there being no residual-current device (RCD) that would be able to protect the worker against leakage currents. It was also noticed that in most of the environment the wires were not protected by conduits, especially in the surroundings of the engines of the machines.

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Therefore, the studied location is a place of risk, because workers are exposed in an unprotected environment and that can generate accidents related to discharges of electric energy.

Knowing that the presence of wood and sawdust resides create a perfect path for the propagation of fire, sawmills and carpentry places must have firefighting systems sized to meet the requirements of NR 23.

On the other hand, no fire-fighting instrument, guidance or emergency exits were identified in the study in order to protect workers in that situation.

Regarding the use of PPE, it was verified that this is a factor that is in disagreement with the NR 06, since according to the responsible occurs the distribution of the equipment, however the workers refuse to use them. Thus, NR 06 defines the rights and duties of the employer and employees, and it is verified that it is the duty of the employer to provide, enable and require the use of PPE and it is the employees' responsibility to preserve and use the equipment.

5. CONCLUSION

According to the study carried out, it is noticed that a series of aspects contribute to the establishment studied to present insalubrious conditions. Among the points to be cited, the lighting, as well as temperature and noise production are the most striking factors.

In this context, it has been found that intermittent noise production is well above the allowable value for the daily workload provided by employees, which in the long run can lead to serious health problems for employees. The same is true for the temperature, which is very high.

As far as lighting is concerned, it is also a matter of concern since illuminance levels are far below the reference values. Therefore, it is necessary to improve and expand the internal lighting system.

Besides these aspects, the disorganization is also a problematic present in this work environment, since the waste is not properly discarded and the raw materials are heaped amid the debris and equipment. Another aspect to be mentioned is the use of PPE, which does not occur due to employees' refusal.

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