

Risk Assessment of Different Activities in Marble Industries

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Abstract

Pakistan is blessed with large reserves, in which marble reserves are the most economic one. Marble industry are one of those industries which requires a large number of labors. Marble processing is very risky starting from extraction to the end product. In marble processing material handling are mostly common in which labor's manual handling in different activities are frequent. Also the environment is unsafe for workers within industry and for the residents nearby. To assess different types of risk and unsafe methods in marble industry a questionnaire was conducted. Through that questionnaire some risky activities were assessed and also the availability of some basic safety and health related facilities were checked. Many preventive measurements are to be taken to make the marble processing safe and supportive for the environment. For this few recommendations are also mentioned in this paper.

Keywords: Small and Medium Enterprises Development Authority (SMEDA); Pakistan Stone Development Company (PSDC).

Introduction

For the development of every country the economic position plays a vital role. Economy mainly depends on the country products that is their exports. Now to improve exports there is a need of many strong industries to boost their county economy. Natural resources play an important role in industrialization. A country having natural resources can progress and develop quickly as compared to those countries having less or no natural resources. The economists and other have a strong believe that those countries which are blessed with natural resources have an advantage over other countries in the world (Nour, 2014). Pakistan is among those countries which has enormous amount of natural resources which can be utilized for the benefit and development of this country. Marble and granite is one the natural resource that are present in huge amount in Khyber Pakhtunkhwa and Baluchistan regions. According to Pakistan stones development PASDEC company, Pakistan has an estimated 297 billion tons of marble and granite reserves. More than 2000 processing units and 1200 quarries sites are operational in the country which are providing jobs for 200,000 labors approximately (Muhammad, 2016). As industrialization flourishes then there is an increase for labors also. World population mainly consisting of working class people which spend much

of their time at working place (Guitar et al., 2005). Now if someone stays in the working place then he or she will face the hazards and risks relating to that specific work environment. Depending on the work place they will face injuries, death or related incidences that are occurring in that work environment. To loss a life is more frightful and fearsome than to loss a property or wealth. Mineral industries have an important role for the development of an economy, especially for the countries like Pakistan where millions of workers are directly involved in marble processing (Hilson, 2002). For human health an environmental quality plays an important role, if this determinant deteriorates then it will leave impact on poor health and poor quality of life as a result country development will affected.

In Pakistan marble industries were developed in late sixties. In the mid-seventies then industrialists have imported some modern machineries from Italy to cut slabs more precisely. But still at that time they don't have trained workers to work on that machinery but they were taking the risk and run those machineries with untrained workers. A lot of wastes were produced at the marble processing and they mainly rely on manual operation. Due to which the marble processing become a hazardous and risky industry (SMEDA).

Marble is a Greek word which means a shining stone made of calcium carbonate. Marble is a decorative material used in different types of luxury buildings and tombs. Market research for the year 2017 shows that the world top marble exporter is Turkey having 1.1 billion US Dollar exports followed by Italy with 452.5 million US Dollar. In this list Pakistan was placed at ninth position having 28.1 million US Dollar exports by covering a share of 1.1 percent of total marble exports. Total estimated marble reserves in Pakistan is 160.2 million tons in which Khyber Pakhtunkhwa province have a share of 87 percent (PSDC). Thousands of labors are involved in marble extraction, transportation and marble processing without having proper safety and health measurements and precautions. Apart from this, these marble processing has badly disturbed the surrounding ecosystem through their wastes and noise. Marble processing can be categorized mainly into extraction, transportation and cutting of slabs. In extraction they are using old techniques of blasting through which a lot of stone is wasted and also disturb the surrounding through the noise and vibration of the earth due to the severity of that blast. Also during this process of blasting many workers have lost their life and many have received some severe injuries. The next step is the transportation of these raw shaped marble block to the processing unit where it can be cut into slaps. Transportation is another risky and troublesome activity for the residents of that specific area because of overloading and traffic delays. In the processing unit these raw shaped marble is cut into proper slabs where it can be sized according to the user demand. In all these steps the main risky and severe activity is the manual handling of stones. During the extraction in quarrying sites the raw shaped marble stone was then balanced through manual method by putting small stones beneath them due to which many time that large raw shaped stone has trapped body parts of the workers and then they have received severe injury or sometime death. Also during the transportation process sometime stone loaded on the trucks have lost their balance and fell down due to which many people have injured and some had lost their precious life. Apart from this due to the trucks movement the normal traffic has badly affected. In the processing units when these raw shaped marble stones are unloading then at that time it also causes severe injuries to the workers due to manual handling. In the processing unit some of the basic safety and health related facilities are not available to the workers due to which they are facing the risky work environment. In figure 1 below, the marble chain is given.



Figure 1, Marble Processing

The basic aim of this research work is to visit and observe the marble processing to analyze and assess different activities that how much they are risky. Also to know and check that how much the basic safety and health related facilities are available for the workers working there. This research is all about the risk assessment of different activities involved in marble processing starting from the quarrying to the storage of slabs.

Literature Review

Marble industry have some potential risk on environment despite their contribution to the economy. In environmental point of view marble industry has a human impact on environment due to their mismanagement and not following the safety precautions. Marble industries must have to be installed in the specified industrial zones to lower their risk on environment and to allow competition amongst them. Also the present marble industries have to do some mitigation measures to lower their impact on the environment (Gammal et al., 2011).

The marble slurry that are flowing into clean water rivers having calcium carbonate and therefore have greatly influenced the surface and subsurface water. Due to this, the river water contains a large amount of ions that are dissolved in water. The level of CaCO_3 and turbidity also increased in those water which are affected by marble wastes. The sediments levels in these river water have high level of calcium and magnesium. Pollution index analysis finds that marble wastes sites acts as anthropogenic source of toxic heavy metals (Simsek et al., 2005). The effluent of marble industry is flowing into the river water. Also the villagers get water which are contaminated by marble effluent for daily usage. A study was conducted in district Buner, Khyber Pakhtunkhwa, in which the villagers revealed that they found calcium mass precipitants in their pots when boil water. Therefore, this might be a reason that people living near to marble industries have more issues or problem of kidney infections. Therefore, it shows that marble industry has human impact with environmental risks (Jehangir et al., 2015).

These marble slurry powder can be used in partial replacement of Portland cement up to 15% some extent by which the strength of concrete increases. Under hydrochloric medium the marble powder mixed with cement concrete shows a positive result in properties (Talha et al., 2015). To have the marble sludge in building blocks may prove to be environmental friendly and safe for health. This will also reduce the maximum use of natural resources and will reduce the land fill occupation areas. Consequently, it will save an agricultural land and will also save the ecosystem and environment (Aukour, 2009). The concrete that obtained from the mixture of white cement and marble powder has an architectural aesthetics. Also marble concrete can use as structural concrete due to their compressive strength. Marble concrete can also absorb water therefore it means that it is also durable like other normal concrete. So marble sludge can be used as a concrete material to reduce the wastage of such useful material which have aesthetic, ecofriendly and durable properties (Alyamac and Tugrul, 2014).

Marble sludge can also be used in ceramic industries by replacing pentonite used as raw material in ceramic industry. By doing so it will reduce the shrinkage value of tiles where other properties will not have affected. So the ceramic industries are using a large amount of raw materials, therefore by using marble sludge the wastage of this material will reduce and environment will also be not affected (Hamaiedh, 2010). According to the unified soil classification system, Bannu soil classified as CH group. This soil can stabilize by using the marble waste that is marble waste in powder form. This will improve the poor properties of expensive soil and will also be helpful to prevent the river water from deterioration. The addition of these marble powder shape waste will reduce the liquid limit of Bannu soil (Ali et al., 2014).

Company productivity or labor productivity can be increased by ensuring the safety and health related measurements to minimize the work related accidents and injuries. To analyze the risk in marble industry the ten riskiest activity was selected. The first three risky activities are raw shape block unloading, loading block shape stone to trolley and loading block for slabs cutting. Then some precautionary measures were taken to reduce these risk, it was noted that by following those steps the risk value for these activities were drastically decreased. So to repeat the safer method the risk involved in that activity will decrease or eliminate finally (Ersoy et al., 2017).

A study was conducted to analyze the cutting of marble slabs by automated computer system through increase or decrease speed of rotation of the cutter blades. A result was obtained that by increasing the travel speed the cutting energy decrease but increase was noted in cutting efficiency. To increase the rotation of cutting speed it will increase the active power demand of motor, which means consuming more energy for same work (Cimen and Mahmut, 2005).

Research Methodology

Marble is a crystalline metamorphic rock mostly found in Baluchistan and Khyber Pakhtunkhwa regions. In Pakistan marbles are mostly found in white, black, gray, green, pink, brown and yellow color in regions of Baluchistan, Tribal region, Nowshera, Chitral, Swat and Buner districts of Khyber Pakhtunkhwa. To assess the risky activities in marble industry, this study was carried out in district Buner. District Buner is one the most marble producing district in Khyber Pakhtunkhwa where above 200 marble processing units are operational anytime. District Buner is located in North-West region of Pakistan. Marble factories are installed on

all three main routes of district Buner. Therefore, data was collected from all three routes to assess risky activities. This study was conducted through a questionnaire to collect data regarding different activities to assess the severity of that activity. Three-part questionnaire was developed, in the first one some questions were asked regarding the hazardous activities or impacts of marble processing from the workers and the residents near to that marble processing unit. In response to that the worker's response were recorded in the following manner

Insignificant	Minor	Moderate	Major	Severe
1	2	3	4	5

In second part of the questionnaire some questions were asked about the work environment and the workers may have to agree or disagree with the asked question in the following sequence

Strongly Disagree	Disagree	In between	Agree	Strongly Agree
1	2	3	4	5

In third part of the questionnaire some basic safety and health related facilities availability were examined and asked from the workers also. The available facility was marked YES and non-available facility were marked NO.

Now to collect data 250 worker's data was collected from different marble factories. Also 250 sample data were also collected from the nearby resident to the marble processing units regarding the severity of different dangers that are arising due to the marble factories for the surrounding environment. After the data collection, this data was put into an excel sheet and obtain a mean value to every activity and then a correlation was also obtained to check the relation between different risks.

Data Analysis

In part first of the questionnaire the severity of some activities were asked and their response were noted. The workers were asked to choose the severity of that specific activity in the range of Insignificant, Minor, Moderate, Major, and Severe. Different risky activities and their responses are as follow in table 1

Table 1

Degree of danger for the workers

Sr. No	Quantify the degree of danger while working in marble industry.	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Severe (5)	N=250
1	Electric shock	39	133	23	30	25	250
2	Unloading trucks	03	18	51	99	79	250
3	Manual handling	0	20	50	100	80	250
4	Noise	0	01	09	90	150	250
5	Fall of potato rock	0	08	58	79	105	250
6	Machine operation	02	45	73	70	60	250
7	General health issues	11	55	122	26	36	250
8	Operational procedure	02	111	75	40	12	250
9	Injury status	0	47	63	90	50	250

Now to get the mean and round values then the following table 2 will be obtained.

Table 2

Mean and Round values

Sr. No	Quantify the degree of danger	Mean	Round values	Danger Value
1	Electric shock	2.47	2	Minor
2	Unloading trucks	3.93	4	Major
3	Manual handling	3.96	4	Major
4	Noise	4.55	5	Severe
5	Fall of potato rock	4.12	4	Major
6	Machine operation	3.56	4	Major
7	General health issues	3.08	3	Moderate
8	Operational procedure	2.67	3	Moderate
9	Injury status	3.57	4	Major

In table 2 above different hazardous activities are given which shows the severity of these activities. By studying the above table, the risk of electric shock is measured as minor. The unloading of trucks is valued as 4 which is a major risk. Also the manual handling, fall of rock, injury status and machine operation are valued as 4 which is a major risk. The severe risk is noted is noise which has a value of 5 indicating the severity. Two activities are noted as moderate risk having a value of 4 that are general health issues and operational procedure.

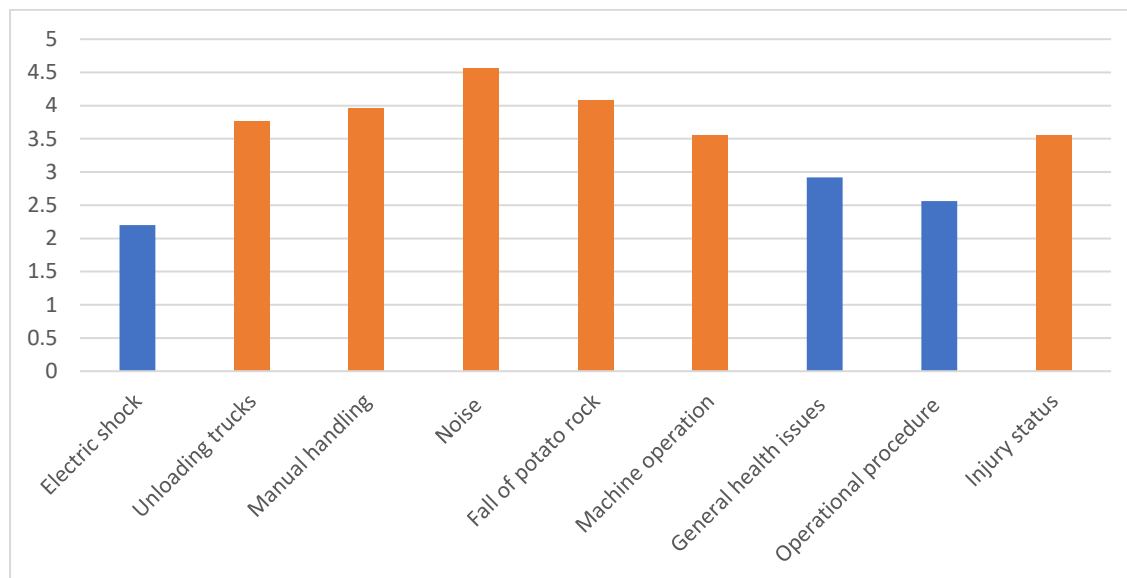


Fig. 1 Severity of danger of different activities

The graph given above in figure 1 are the result obtained from the table 2 having a representation of all the asked activities. All the red bars indicating the severe or major risky activities while the other shows the minor or moderate risky activities.

Apart from this another questionnaire part was also conducted from the surrounding residents who are affected due to the marble processing. A sample of 250 questionnaires was collected by asking about eight questions regarding the risky activities or impacts of marble processing. The same criteria were set for this questionnaire also where their response was collected in the parameter of ‘insignificant’, ‘minor’, ‘moderate’ ‘major’ and ‘severe’. Also same values were allotted to these options that is 1,2,3,4, and 5 respectively. The asked questionnaire and their responses are given in table 3 below.

Table 3

Degree of danger for the surrounding

Sr. No	Quantify the degree of danger while living nearby marble industry.	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Severe (5)	N 250
1	Solids wastes	0	0	30	120	100	250
2	Marble slurry	0	0	0	20	230	250
3	Traffic delay	0	0	10	90	150	250
4	Water pollution	0	0	0	20	230	250
5	Air pollution	90	70	30	50	10	250
6	Noise	0	10	20	10	210	250
7	Water scarcity	20	60	50	100	20	250
8	Electricity problems	0	0	30	120	100	250

Now if the mean values and round values can be found according to the specified parameters then table 4 will be obtained that is given below

Table 4

Mean and Round values

Sr. No	Quantify the degree of danger while living nearby marble industry.	Mean	Round value	Danger value
1	Solids wastes	4.28	4	Major
2	Marble slurry	4.92	5	Severe
3	Traffic delay	4.56	5	Severe
4	Water pollution	4.92	5	Severe
5	Air pollution	2.28	2	Minor
6	Noise	4.68	5	Severe
7	Water scarcity	3.16	3	Moderate
8	Electricity problems	4.28	4	Major

Now from table 4, where different activities or effect of marble processing are given that are disturbing for the surrounding environment. According to the questionnaire data the resident considers some of the activities or effect like marble slurry, Traffic delay, water pollution and noise as a severe risk or problem for the surrounding. They also consider solid wastes and electricity problems due to marble processing unit as a major thread to the surrounding. Because due the excessive use and demand of electricity for the marble processing units there is a load shedding and low voltage problem for that specific area. Also the marble slurry that is white powder are flowing to the clean river water due to which rivers become white in color and their water is of no use. Traffic delay is another severe problem and so as the noise of the marble cutting machines.

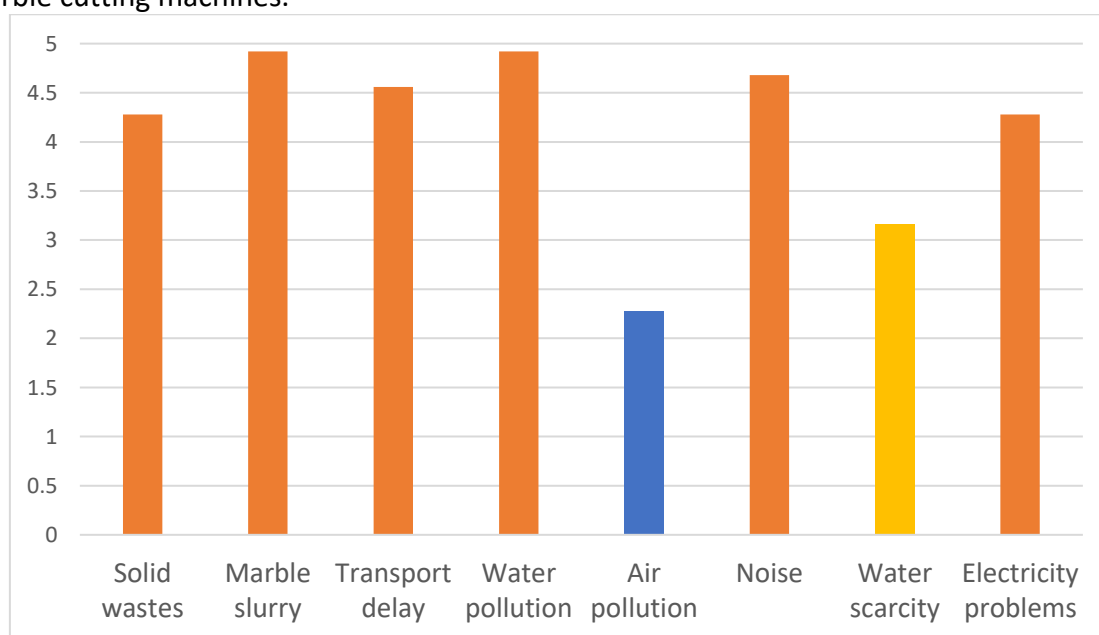


Fig. 2; Degree of danger as an effect on surrounding.

In figure 2 above, which shows the effect of different activities of marble processing for the surrounding. In which the red bars for solid wastes, marble slurry, Traffic delay, water pollution, noise and electricity problems are considering as severe or major caused by the marble processing for the surrounding. It also highlights that air pollution are minor issue while water scarcity due to marble processing are moderate risk.

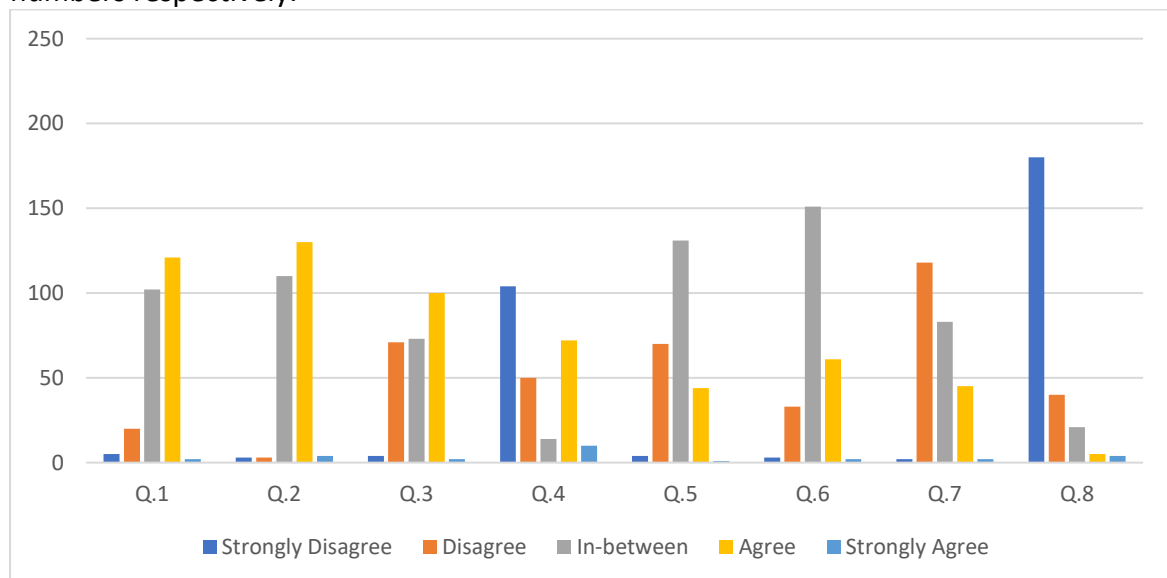
In second part of the questionnaire some questions were asked about the work environment that how much the safety parameters are following or maintained that is necessary for the marble processing units. The response of the workers to the asked questions are given below in table 5

Table 5
Work Environment

Facility availability and work environment						Total
Q.1	The layout of workplace is suitable for work?					
Options.	Strongly Disagree	Disagree	In-between	Agree	Strongly Agree	
Frequency	5	20	102	121	2	250
Q.2	Overall the physical work environment is good?					
Options.	Strongly Disagree	Disagree	In-between	Agree	Strongly Agree	
Frequency	3	3	110	130	4	250
Q.3	The location of facility is suitable for the factory?					
Options.	Strongly Disagree	Disagree	In-between	Agree	Strongly Agree	
Frequency	4	71	73	100	2	250
Q.4	Machines are run under the supervision of experts?					
Options.	Strongly Disagree	Disagree	In-between	Agree	Strongly Agree	
Frequency	104	50	14	72	10	250
Q.5	The owners are making sufficient efforts to ensure safety for workers?					
Options.	Strongly Disagree	Disagree	In-between	Agree	Strongly Agree	
Frequency	4	70	131	44	1	250

Q.6	Workers are feeling safe and secure in industry?					
Options.	Strongly Disagree	Disagree	In-between	Agree	Strongly Agree	
Frequency	3	33	151	61	2	250
Q.7	Every worker job is secure?					
Options.	Strongly Disagree	Disagree	In-between	Agree	Strongly Agree	
Frequency	2	118	83	45	2	250
Q.8	Functional slurry pools?					
Options.	Strongly Disagree	Disagree	In-between	Agree	Strongly Agree	
Frequency	180	40	21	5	4	250

The above table can be put into chart form to understand it easily, so the chart will be obtained as shown in figure 3 below. In below chart all the questions are shown by serial numbers respectively.



Fig; 3, Work Environment.

Now if we can try to find the mean values for each question then the following table data will be obtained as shown in table 6.

Table 6

Work Environment mean values.

Sr. No	Work Environment	Mean Value	Round Value	Danger Value
Q.1	The layout of workplace is suitable for work?	3.38	3	In-between
Q.2	Overall the physical work environment is good?	3.516	4	Agree
Q.3	The location of facility is suitable for the factory?	3.1	3	In-between
Q.4	Machines are run under the supervision of experts?	2.336	2	Disagree
Q.5	The owners are making sufficient efforts to ensure safety for workers?	2.872	3	In-between
Q.6	Workers are feeling safe and secure in industry?	3.104	3	In-between
Q.7	Every worker job is secure?	2.708	3	In-between
Q.8	Functional slurry pools?	1.452	1	Strongly Disagree

The above table can also be put into a chart form to understand the severity of the work environment that how much work environment is safe for workers. It will give us the following chart in figure 4.

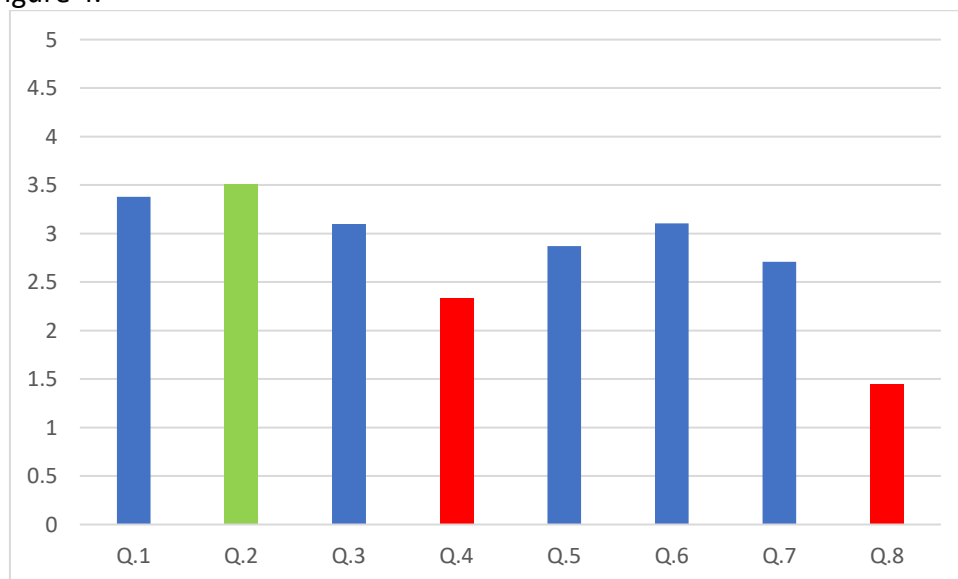


Fig. 4, Mean Values

This chart tells us that in second part of the questionnaire some questions like question number one to three and five to seven the workers don't consider such factors severe but questions like supervision of experts and functional slurry pools that is question number four and eight, workers consider these question very severe and therefore they are totally disagree to the asked question.

In third part of the questionnaire some questions were asked about the basic safety and health related facilities. The workers will just have to answer in YES or NO form. The asked questions and their response are given below in table 7.

Table. 7

Safety and Health Related Facility Availability

Sr. No	Safety and Health related facility	YES	NO	TOTAL	Availability Percentage
1	First aid Facility	212	38	250	84.8 %
2	Emergency Exit	117	133	250	46.8 %
3	Ambulance	00	250	250	00.0 %
4	Report and record incident system	75	175	250	30.0 %
5	Alarms	00	250	250	00.0 %
6	Paid treatment costs	204	46	250	81.6 %
7	Bath place	171	79	250	68.4 %
8	Dining hall	26	224	250	10.4 %
9	Cloth exchange room	180	70	250	72.0 %
10	Break time	220	30	250	88.0 %
11	Safety glasses	78	172	250	31.2 %
12	Safety helmet	37	213	250	14.8 %
13	Safety belts	60	190	250	24.0 %
14	Plastic gloves	244	06	250	96.6 %
15	Shoes	230	20	250	92.0 %
16	Protective clothing	117	133	250	46.8 %

The above table tells us that how much the required safety and health related facilities or equipment's are available to the marble factory workers. In table 7 above the safety and health related facilities like emergency exit, ambulance, report and record system, alarms, dining hall, safety glasses, safety helmets, safety belts and protective clothing are mostly unavailable to the marble factory workers. In above table the safety and health related facilities like ambulance and alarms system are completely unavailable in all marble factories, which is a primary need for any emergency situation. To have an ambulance for every factory that seems difficult but they can arrange it on collective basis. To understand easily the above data are also given in the chart shape in following figure.

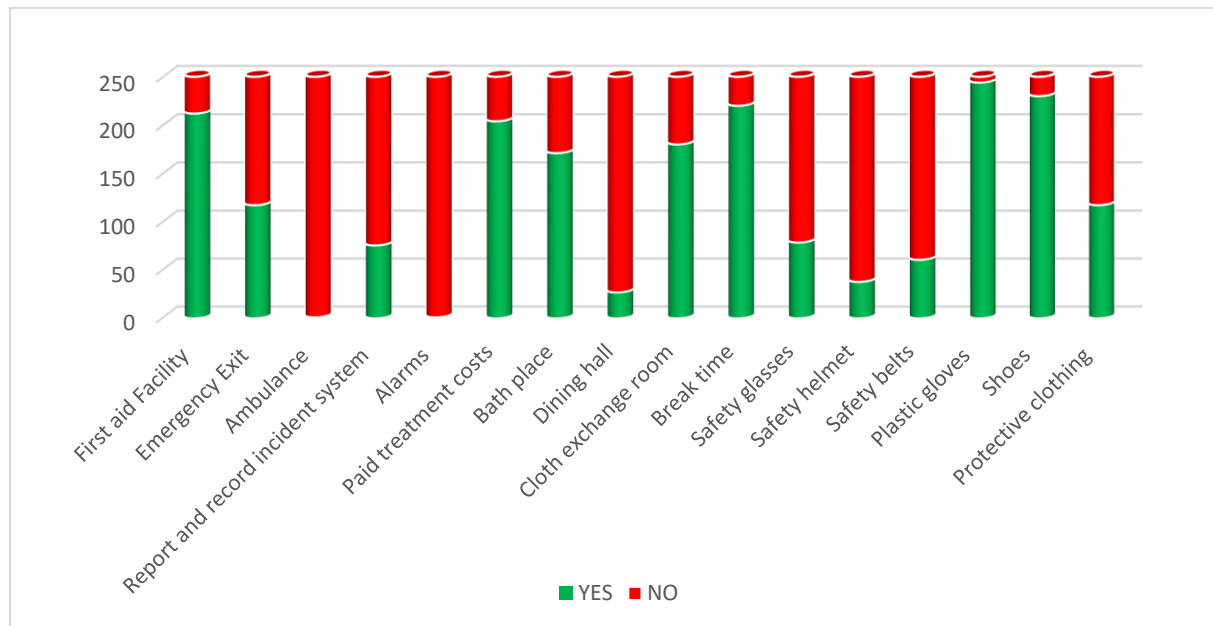


Figure 5, Availability of safety and health related facilities

Now if all the above data of the questionnaire can be put into the Excel sheet to find the correlation among all three parts of the questionnaire then the following results will be obtained.

1		
2	Quantify the degree of danger	Round values
3	Electric shock	2
4	Unloading trucks	4
5	Manual handling	4
6	Noise	5
7	Fall of potato rock	4
8	Machine operation	4
9	General health issues	3
10	Operational procedure	3
11	Injury status	4
12	Solids wastes	4
13	Marble slurry	5
14	Transport delay	5
15	Water pollution	5
16	Air pollution	2
17	Noise	5
18	Water scarcity	3
19	Electricity problems	4
24	Facility availability and work environment	Round Values
25	The layout of workplace is suitable for work?	3
26	Overall the physical work environment is good?	4
27	The location of facility is suitable for the factory?	3
28	Machines are run under the supervision of experts?	2
29	The owners are making sufficient efforts to ensure safety for workers?	3
30	Workers are feeling safe and secure in industry?	3
31	Every worker job is secure?	3
32	Functional slurry pools?	1

	B	C
44	Safety and Health related facility	Availability Percentage
45	First aid Facility	84.80%
46	Emergency Exit	46.80%
47	Ambulance	0.00%
48	Report and record incident system	30.00%
49	Alarms	0.00%
50	Paid treatment costs	81.60%
51	Bath place	68.40%
52	Dining hall	10.40%
53	Cloth exchange room	72.00%
54	Break time	88.00%
55	Safety glasses	31.20%
56	Safety helmet	14.80%
57	Safety belts	24.00%
58	Plastic gloves	96.60%
59	Shoes	92.00%
50	Protective clothing	46.80%

	C	D	E	F
1	Safety and Health related facility	Health related facility		the value divided by 100
2	0.03	84.80%	84.8	0.848
3	0.04	46.80%	46.8	0.468
4	0.03	0.00%	0	0
5	0.03	30.00%	30	0.3
6	0.03	0.00%	0	0
7	0.03	81.60%	81.6	0.816
8	0.03	68.40%	68.4	0.684
9	0.03	10.40%	10.4	0.104
10	0.04	72.00%	72	0.72
11	0.02	88.00%	88	0.88
12	0.03	31.20%	31.2	0.312
13	0.03	14.80%	14.8	0.148
14	0.03	24.00%	24	0.24
15	0.03	96.60%	96.6	0.966
16	0.04	92.00%	92	0.92
17	0.04	46.80%	46.8	0.468

H	I	J	K
	<i>Quantify the degree of danger</i>	<i>Facility availability and work environment</i>	<i>Safety and Health related facility</i>
Quantify the degree of danger	1.37109375		
Facility availability and work environment	0.080246914	0.27734375	
Safety and Health related facility	0.000802469	0.004969136	2.77344E-05
	<i>Quantify the degree of danger</i>	<i>Facility availability and work environment</i>	<i>Safety and Health related facility</i>
Quantify the degree of danger	1		
Facility availability and work environment	0.101945891	1	
Safety and Health related facility	0.101945891	1	1

Conclusion

The marble industry is a high-risk industry, with a number of potential hazards for workers and the environment. This research work consists of mainly three parts in which the risk assessment was done in relation with marble industry in district Buner. Activities like unloading of trucks, manual handling, fall of potato shape raw block and machine operation are recorded “major” risky activities with in marble processing units. Apart from this other major hazards are dust inhalation, noise exposure, vibration exposure, chemical exposure, physical hazards and ergonomic hazards. Also there is a significant impact on environment that pollute the air, water and soil. Due to which it contributes in climate change. In the work environment some threads like physical work environment, machine operation under non-trained staff and non-functional marble slurry pools are considered a risky activity. Some basic safety and health related facilities like ambulance and alarm system were found completely unavailable. Apart from these facilities like report and record system, emergency exit, dining halls, safety glass, safety helmets, safety belts and protective clothes were also found mostly unavailable for the workers working in marble industries. Therefore, the overall work environment of the marble processing is risky and hazardous for the workers and the surrounding ecosystem.

Recommendations

To make the marble processing safe for the workers and the surrounding environment some of the recommendations and suggestions are following:

- All the required personal protective equipment’s (PPE) should be made available to the workers.
- A clear safety and health policy should have formulated to follow that.
- Proper training programs or workshops have to be arranged for the workers.
- In every factory there should have to be a report and record incidents system to keep record of the injuries.

- A group of factories should have to arrange a collective base ambulance that can be used in emergency situation.
- Alarms should be installed in every factory.
- Slurry pools should have to be functional all the time to stop the marble powder/slurry flowing to the clean water.
- A Traffic system will have to be safer and the load should be in the approved parameters that is 20 to 30 tons.
- Dumping places must be assigned so that the slurry pools wastes can be stored there.
- In the quarrying site the explosion method should have to be banned and promote the wire-saw cutting technique.
- Noise reduction technique to be introduced in factories.
- Vibration damping equipment to be installed in factories.
- Proper environmental regulation body to be established to control air, water and soil pollution.
- In the last a proper market has to established, so that every factory and also the seller can contact only there for the products.

This research work covers mainly the severity of different activities in marble industries. It shows us that which activity or activities have severe danger level and which one have low level of hazards. This paper also highlights that which basic safety and health related facilities are available and which are not. It also highlights the impact of these marble activities on the ecosystem. But more work is needed to do some research, that how the marble slurry can be used in different products to avoid their flow into the clean water. Also, some work is needed that how to use the modern technology to avoid and replace the old or manual techniques of performing different activities that arises danger and hazards to the workers and environment.

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