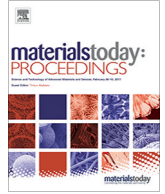




Contents lists available at ScienceDirect

Materials Today: Proceedings

journal homepage: www.elsevier.com/locate/matpr

Analysis of ergonomic risk factors in construction industry

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ARTICLE INFO

Article history:

Received 11 July 2020

Accepted 10 August 2020

Available online xxxxx

Keywords:

Ergonomics

Risk factors

Analysis

Remedial measures

Safety

ABSTRACT

The study on ergonomics makes the engineer or the managing person to arrange the machineries, tools, skilled labours and their environment to be in order and conventional to complete the task in an effective manner. To intensify the success rate by executing Ergonomics, there should be a need for good communication between the managing level and workers level. In the construction field, even though with safety precautions, still workers face stress due to health issues and mental issues. In this paper, the risk factors that govern the gap between top and bottom level in various psychological and administrative factors, analysis of ergonomics measurement in context with questionnaire survey conducted in five construction sites, the remedial measures and challenges in implementing ergonomics were discussed. The proper implementation of ergonomics is ingrained through the flowchart for both administration and workers which has been recommended to the construction field.

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Selection and peer-review under responsibility of the scientific committee of the International Conference on Newer Trends and Innovation in Mechanical Engineering: Materials Science.

1. Introduction

Construction Industry which is one of the unavoidable industry involves in mass workers to work together at different stages in the environment where high significance need to be provided in the areas of safety and health criteria. Most of these occupational groups face musculoskeletal disorders [1–4]. Young workers face this problem due to their work in the same posture for a long time. Due to their routine work, construction workers have discomfort and sufferings in shoulders, back, neck, legs and in some parts of the body. In regard to the economical status of the workers, they choose the local remedies to get rid of these physical discomforts. However, sometimes the construction workers become unfit for work due to this MSD problem [5–8].

In simple words, Ergonomics may be defined as a study on arranging and managing the source of construction such as equipment, machineries, facilities, environment and even skilled labors such that achieving the results in a contentment manner. The word ergonomics is a Greek-derived word, in which Ergon stands for the meaning “Labor” and Nomos stands for the meaning “Study of”.

Occupational Safety & Health Administration (OSHA) insists the employers to provide an environment in safety and in a comfort-

able way to work. Ergonomics helps in finding a way for employees to work in a danger-free zone environment. The employer is mainly responsible to provide the environment in a suitable safe manner to work and even employees should maintain the habits which make them feel healthy and comfortable. Proper Ergonomics should be designed in order to prevent the occupational workers to prevent from some muscular pains and injuries. If Ergonomics is not properly maintained, then the workers face a threat in their life due to musculoskeletal disorders.

2. Literature review

A large number of research papers based on ergonomics have appeared in the published literature during the past decade. This research paper investigates work-related problems that exist in the construction industry. The risk factors, timings of work and environment of the workplace have been discussed in the literature.

Behnam Asl et.al (2013), analyzed the musculoskeletal disorder for steel bar benders. The work of steel bar bending has been considered to be noteworthy in the construction site as it involves four to six hours of work in awkward posture and close contact of eyes of swarf. Nordic Questionnaire, a standardized method has been carried out with twenty samplers to investigate the musculoskeletal symptoms. The prolonged working postures

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become a threat to the employees. They analyzed the action involved in bar bending from picking up the rebar to bending of rebar, the time taken to complete each activity and the posture of the employee during each action of work. They consummate by giving suggestions to the employers to design the workplace with good lighting and ventilation, providing breaks and to provide training to workers to make them skilled and to prevent them from injuries.

Atishey Mittal et.al (2013) suggested activities in order to improve the ergonomics by adopting better communication by conducting regular meetings with high authorities and the workers, giving clear ideas about the structures, designing the workplace with good lighting, ventilation and environment, providing safety tools to avoid injuries and effectively working. They also suggest that giving good knowledge by educating makes the workers to understand the job better. They initiate the employers to have insurance on lower premiums to workers which indirectly make reliable feel to the workers on the organization. [9–13].

3. Significance of ergonomics

In the current scenario, construction workers were involved in various stages of work in the field and exposed to health and mental challenges. Ergonomics is the study that is helpful in creating the consciousness to the workers regarding the health and mental issues they face in their work. Ergonomics also improve the efficiency of workers by providing the training programme and guiding them in warm-up exercises which make the workers to work without any pain in their body and also to work in a safe environment [14–17].

This makes the employers to be satisfied as it

- a) Increase productivity
- b) Reduction in accident and injuries, in turn reduce compensation amount

The employee also get benefitted as this

- a) Reduce the mental stress of the worker
- b) Reduce musculoskeletal pain
- c) Increase the efficiency, making them to work hard without absenteeism
- d) Major accident and injuries have been reduced
- e) Increased confidence level

Overall, the organization and the workers will recognize the early symptoms of the musculoskeletal pain and can reduce the basic risk factors which lead the project completion of an organization in an efficient manner [18–22].

4. Methodology adopted

The study was conducted in order to investigate the knowledge and application of ergonomics in the construction field. The use of questionnaire made the whole study easier to know the basic information on ergonomics assessment. Both grading scale and subjective rate scale has been adopted to know the situation in the construction field clearly. The grading scale involves with the like scale with 1 = Strongly agree, 2 = Agree, 3 = Disagree, 4 = Strongly disagree. The subjective scale is useful in order to get the information in detail and to know the risk factors clearly. The methodology adopted throughout the study has been represented in Fig. 1.

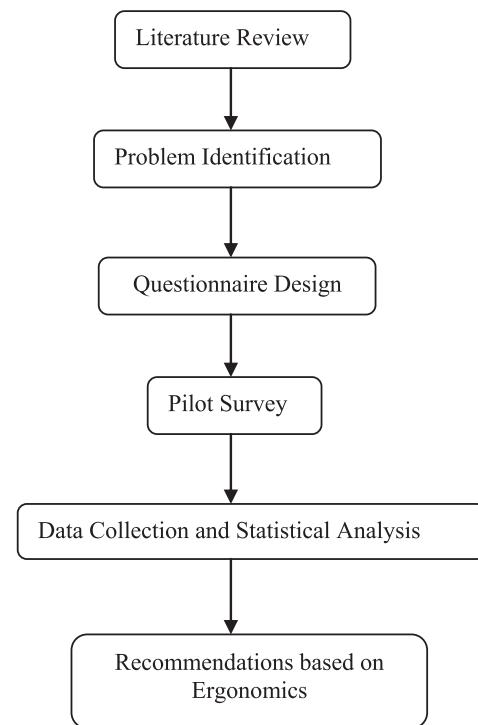


Fig. 1. Methodology.

5. Women workers in construction

The women worker were involved in construction for the activities such as Lifting and carrying of bricks, carrying water, stone crushing for surkhi work and sand sieving etc., The primary concern for occupational women worker in handling the heavyweight may cause

- a) There is a pressure applied in the abdominal area, leading to miscarriage
- b) Strain in spinal cord and stress in the backbone
- c) Menstrual cycle flow increases
- d) Stress in elbow joints, knee joint, shoulder joint
- e) Heart rate increases due to the stress

6. Questionnaire information

The interview was done with workers collecting the basic information with these following aspects

1. Personal Information: It covers the basic information such as Gender, Age, Marital Status, Family size, and any other family member working condition in the family
2. Health Issues: It covers whether they face any breathing problem, heart pain, asthma, sugar, blood pressure
3. Nature of Job: Type of activity, time of work, Load they carried
4. Others: Food intake, Scheduled breaks, Holidays, Overtime, welfare amenities

With these as primary information, basic health test has been carried out to note the weight, height of the individual, their blood pressure has been also noted.

7. Risk factors identification

With the help of Questionnaire survey, the Ergonomic risk factors which contribute to the stress in workers have been identified.

The risk factors were categorized into Administrative risk factors, Environmental risk factors, Health-related risk factors and Miscellaneous Risk factors. To provide a safe and comfortable environment of the workers, every behavior of worker, machines, tools and activities were understood in a brief manner. The Characterized Risk Factors have their own features which have been tabulated in Table 1.

8. Risk analysis

In the construction industry, workers need to work in different sites at different shifts to perform their activity which leads in stress for workers when worked in a prolonged manner. In order to prioritize the indicators involved in this survey, the Relative Importance Index (RII) is used. RII is selected as the tool to work with Liker Scale. Four scale rating (1 = Strongly agree, 2 = Agree, 3 = Disagree, 4 = Strongly disagree) was involved in this questionnaire study on ergonomics which made the survey easier. From these results, the graph representing the risk factors and their averaged rating was shown in Fig. 2

9. Results and discussion on survey

To implement the ergonomics in the construction field is difficult has the workers involved in this job does many activities at different stages. The same worker does different tasks in their work at different stages. It is necessary to consider all the controlling factors which influence the posture and health issues of the workers. Ergonomics help the workers to fit in a safer and comfortable zone. Few control measures have been recommended in order to ensure the workers to be in an appropriate workplace. The approach involves i) Good communication between the employer and employee, ii) Education and Skill Programme to the workers, iii) Ergonomics Design Factors.

10. Recommendation on ergonomics tools

10.1. Communication

To improve the communication between the higher level to the lower level workers, supervisors or head for each task should be assigned. This step may eliminate the accidental distortion of the message and encourages the good relationship between the workers.

Some important points to be followed were,

- The objectives should be clear to the workers
- Express the importance of ergonomics for safe and comfortable work.

10.2. Posture analysis

The working posture is important in analyzing and adapting ergonomics in possible stress factors of employers. Due to the static workload with prolonged time give rise to musculoskeletal problems and back and neck joint dislocation. The use of tools such as Shovel work done in track maintenance, the strokes involved in the digging of soil, the upper shoulder erect posture during vibration of concrete was noted. The workers were given medical facilities in order to note the degree of discomfort and pain. Psychological advice is needed to be given in order to avoid mental stress due to this discomfort.

10.3. Management control

The management should provide the proper workplace with a suitable environment to implement the ergonomics in the organization. The size of the working place should be enough to fit with the number of workers. Proper lighting and protective equipments need to be provided to the employers. The maintenance of the

Table 1
Risk Factors and their categories.

Administrative Risk Factor	Environmental Risk Factor	Health related Risk Factor	Miscellaneous Risk Factor
1.No. of Breaks (Interval)	1. Lighting in Site	1. Age	1. Type of Tools handled
2. Over time	2. Air Quality	2. Gender	2. Size of machinery
3. Deadline Stress	3. Underground work Temperature	3. Diseases	3. Protective measure to operate machine
4. No. of labors engaged in same job	4. Noise	4. BP, Sugar	4. Skill and Experience in handling the machine
		5. Unhealthy Habits	

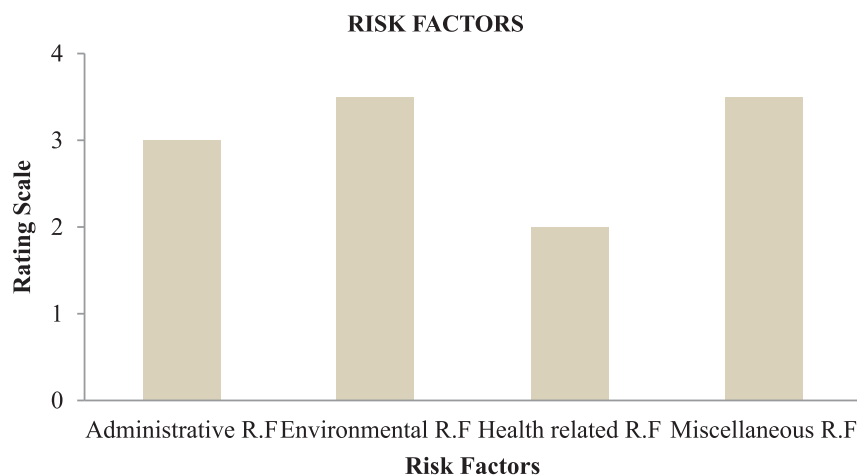


Fig. 2. Ergonomics Risk Factors.

machinery at proper intervals should be insisted. The extreme movement with heavy loads, static posture of the worker should be minimized. Providing the rest breaks makes the workers to be relaxed and continue the work in an efficient manner. The endurance limit of the employee should not be tested. Increasing the number of workers in a task to distribute the work makes them feel comfortable. Management should play a safe role in worker's life. Job rotation is also preferred in which the same group of employees was not used.

10.4. Ergonomics design factors

To control the workplace stress, ergonomics plays a vital role in designing the workplace. By designing the environment to accommodate in a good manner. The adjustable tools need to be provided considering the height of the user. Modern tools need to be provided in order to minimize the twisting and handling of loads.

10.5. Training and Education

To create awareness about ergonomics, training and educating the workers in an effective way is necessary. The issues faced by the workers like back pain, prolonged posture issues need to be addressed to the employees in advance. The managers from the top level and workers from the bottom level need to be clear about the hazards while carrying out the job.

In-depth, following recommendations to be considered to implement ergonomics.

- Understand the organization objectives and goals
- Medical records of an employee also to be maintained
- Use of alternative materials, reducing the vibration power of machineries.

11. Conclusion

Optimum compatibility by improving the design of tools, simplification of work, and by eliminating the hazardous enhances the performance of ergonomics. The painful part of this survey is the posture of the workers with a twisted position and back bent were noticed which occurred due to the prolonged working nature. In the construction field, both static and dynamic working were involved which highly influence on physical postures of the employee. The modification in tools and machinery used frequently makes it comfortable for the employees. It is hoped that steps need to be taken in other organizations to implement the ergonomics for the sake of employees to work more productively and employer to enhance the output.

The awareness created about ergonomics makes the workers to work with high potential. Some warm-up exercise and training makes the workers to get rid of musculoskeletal symptoms. Human welfare is implemented in satisfaction, safety and health aspects. Labor friendly handlings tools need to be provided to get organized and potential work from employees.

Recommendations

- a) Streamline the workers at all levels to voice their problem, opinions to the concerned Management.
- b) Ensure the Periodic Monitoring of health and safety level of the workers
- c) Conduct the awareness programme need to be mandatory.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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