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S Lokeeshvar
Department of Mechanical Engineering, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology, Chennai,Tamilnadu,India, lakeshcivil@gmail.com

Surrya Prakash D
Department of Mechanical Engineering, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology, Chennai,Tamilnadu,India, dsurryaprakash@veltech.edu.in

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Ergonomic Risk Assessment of Maintenance Workers in Educational Institute

S Lokeeshvar, Surrya Prakash D

Department of Mechanical Engineering,
Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, Chennai, Tamilnadu, India

ABSTRACT

Risks associated with ergonomics are pervasive groups that have crept into people's daily lives. Ergonomic risks have been linked to long-term health effects like musculoskeletal disorders, cumulative trauma disorders, and lower back pain. Due to the limitations of their jobs, workers are most impacted by these repetitive, continuous labour activities. The main objective of this project is to provide a solution to the ergonomic problems that construction workers in the educational maintenance industry encounter. Based on the conditions, only a few jobs were identified, and samples were obtained by watching and asking people about their jobs. For tasks like plantation, rebar bending, material transportation, etc., the RULA and REBA method is used in this project. This study aims to investigate the ergonomic hazards experienced by educational maintenance construction workers.

Keyword- *Educational sector, Ergonomic testing, REBA and RULA tools, correlating.*

1. INTRODUCTION

One of the least automated businesses is construction. Workers handle the majority of the construction-related duties manually. Building employees are vulnerable to workplace dangers that could result in

injuries or even fatalities. Construction workers are more likely than employees in many other industries to develop specific health problems and illnesses [1]. Heavy body motions and aberrant postures are required for these tasks, which frequently cause back, shoulder, knee, wrist, arm, and leg injuries among construction workers. Work related musculoskeletal disorders are caused by prolonged and continuous exposure to these body parts [2].

Muscle, tendon, and nerve problems collectively known as WMSD cause severe pain. 92% of all workers in India work in the unorganized sector. Residential construction is one of the principals, largely manual activity in this enormous unorganized economy. This study is about evaluating the health of construction workers who work on homes.

The goal of this study is to provide information about risk factors and to influence workers' behavior to reduce the danger of physical stress, health problems, and unneeded weariness.

Examining their working attitude is one way to judge the introduction to the physical components of development efforts. The most difficult work tasks and positions (as determined by work meetings and assessment) are taken into consideration when choosing the roles to be appraised. The position, where the most important power loads occur, was carried out for the best time allotment.

1.1 Indian construction labourers

A fraction of the most marginalised and in needed parts of society in developing countries receives opportunities for truly necessary work in the construction industry. Construction yield is heavily gathered in industrialised countries in terms of value. 30% of the global

yield is controlled by the high-yielding countries of Europe, 21% by the United States, and 20% by Japan.

While China's yield is just 6%, despite its enormous size and recent rapid monetary development, our country's yield is only 1.7%. While the industrialised countries account for 75% of yield, they also account for 75% of enrolment. Due to the unreliable statistics present in this vast unorganised sector, these numbers may be slightly higher [3].

The reason for this difference is technology. According to the International Labour Organization (ILO), robots have essentially replaced experts in a variety of new improvement endeavours in wealthier countries where labour costs are high (despite the fact that maintenance and repair are still much higher-paid jobs). Most projects are now carried out manually with minimal use of equipment and technology in developing nations where the quality of the job is poor [4].

1.2 Risk elements specific to the construction sector

Construction workers are susceptible to a variety of work-related injuries, such as strains, sprains, and musculoskeletal problems since the task is so physically demanding. The most well-known work-related medical conditions are WMSDs. For instance, 25% of workers in European Union (EU) countries suffer spinal discomfort, while 23% report muscle pain. The most common reason for missed work in the US is WMSDs [5].

The shoulder joints, neck, back, and knees must curve in order for construction workers to carry out their tasks. If the intention is to stress the affected bodily parts over an extended period of time, it may result in exhaustion, sores, or in extreme

circumstances, permanent disfigurement.

The severe Manual Material Handling (MMH) exercises are causing a significant number of medical issues for Indian workers. The Workplace and the Factory Act, 1948, does not include any protected load restrictions for site labourers in India. Contrary to Western nations, there aren't as many resources about hazards and fatalities available to Indian construction workers [6, 7].

1.3 Risk Factors' Effects

Back discomfort and strains are among the most often reported injuries among construction workers.

The most wounds are found among labourers, carpenters, circuit repairers, roofers, and pipefitters. These are caused by excessive activity and exertion in big numbers. Due to the risk involved in the job, every construction worker was likely to become temporarily unfit for duty sooner or later [8].

1.4 The Aim of Ergonomic Science

The goal of ergonomics research is to identify the "optimal fit" between worker & work environment. The objective of ergonomics is to provide solutions that will keep workers safe, comfortable, and productive [9].

Another topic for the building business is ergonomics, however the ideas have been around for a while. The importance of ergonomics in the field of development should be advanced by ergonomists and ergonomics research. In addition, the improvement method needs to be redesigned and looked at to better its unstable situation against WMSDs [10].

1.5 Ergonomic Program Needed

Many ergonomics experts recommend that businesses and joint work administration groups develop

their own distinctive ergonomic programmes in order to assess risk concerns at the workplace and find solutions [11]. These programmes may be a part of the site's wellbeing and security programme or they may exist independently.

A programme for ergonomics can be a very efficient way to lower worker pay costs, increase worker assurance, and reduce injuries. Over time, the effectiveness of these initiatives can rise. Construction can use ergonomics to decrease accidents, boost profitability, and reduce incidental costs. [12].

1.6 Civil workers - Mason,Helper

Assisting a mason who may be using stone, brick, or tile is a masonry helper. They would help the mason prepare the site for the project and transport the equipment and supplies required for the job. They might even assist with the mortar and then, at the conclusion of each day, aid with site cleanup.

Bricklaying, supplying stone for a wall or road, and smoothing out brick mortar are all examples of simple masonry labour. To obtain the research objective, section 2 has classified as Literature Review, section 3 methodology, section 4 as result and section 5 as conclusion.

2. Literature Review

Hanushek (2009) asserts that a more pleasant and secure working environment is more likely to draw in instructors. Maintaining a safe atmosphere for teachers while also boosting their morale and increasing productivity all depend on ergonomics. Uche (2015) argues that the current era of globalisation enables the educational system to change in order to give an education that is more competent and adaptable to the rapidly expanding global environment [13].

The design of the facilities and tools employed is crucial to an efficient teaching and learning process. Everything a teacher uses should ideally be specifically created to fit the needs of a body at work or be adaptable to a better working process. The users' comfort, safety, and health are of the utmost significance. When these requirements are not followed, there may be probable justifications and absenteeism because of health issues brought on by ergonomic risks [14]. All of the tools and resources utilised by the instructor are taken into account, as well as environmental factors like temperature, humidity, and ventilation. These resources' insufficient design could have harmful impacts on one's health.

Teaching and learning cannot occur when the learning environment is no longer secure, healthy, and welcoming for its users, according to Altaman (1975). A facility's poor design has an impact on how well students can learn and teach. According to the definition of ergonomics, which combines numerous disciplines, actual facilities should also be created cooperatively by a number of experts, including teachers, students, and planners. To make sure that each user's demands are addressed, an experienced specialist is required to assess and evaluate the ergonomic risk [15].

In order to maintain proper working postures and workstation layouts, ergonomic workstation evaluation is necessary. Making the workplace as efficient, secure, and comfortable as possible is the aim of ergonomics. Although ergonomic procedures have assisted in preventing fatalities and promoting safe and healthy practises for construction workers, they still appear to have a lot of potential for a wider range of uses. The usage and advancements of DHM

systems in the industrial sector have already been addressed in detail [16].

In a variety of sectors, computerised human models in various forms are utilised for ergonomic evaluations and workplace planning. Several categories of professionals, including painters, machinists, polishers, presses, technicians, forklift operators, and warehouse deliverers, have been researched as applications impacted by the manufacturing industry [17].

Numerous earlier studies have identified the types of construction injuries that are specific to the different construction vocations. The DHM method is effective for predicting ergonomic designs and evaluating injuries. Bidirectional has been increasingly incorporated into complex systems and specialised CAD software programmes since the 1990s, such as Apolinex, a human programme developed using CAD that manipulates postures for the purposes of ergonomic simulation [18].

The modelling features and settings used by the aforementioned software applications vary.

Despite great advancements, challenges still need to be solved in human body simulation. The static strength prediction programme (3DSSPP) predicts the user's dynamic strength for various actions like lifts and pushes, but it shouldn't be used as the only factor [19-20].

According to questionnaire-based assessments of various construction occupations, scaffolders, metal fixers, form workers, and those in lofty positions all had significant rates of work fatigue and physical feeling complaints [21]. Although they have some limitations, software tools for digital human modelling (DHM), such as the Digital Enterprise Lean Manufacturing Interactive Application (DELMIA), were used in

a variety of situations and postures to reduce health risks and issues in the actual system. K2 RULA, a semi-automatic evaluation software programme, was created to assess the JACK toolkit and analyse various ergonomic positions.

The REBA results show that 7.63% of employees are at risk and need changes made right away, while 44.6% are at high risk and need changes made right away. In order to meet workers' demands and decrease occupational injuries, ergonomics in the workplace should result in improvements to workplace design and work organisation [22].

The DHM software's implementation was discussed, along with its difficulties and useful compliments . A case study for ergonomic analysis was used to adapt techniques including motion creation, biomechanical analysis, virtual visualisation, sensing, and action recognition from video recordings.

A DHM feature called Tecnomatix in the Siemens NX software programme also models human postures for ergonomic purposes [23]. A separate job was used to do the ergonomic analysis on 2D and 3D digital workstations using Catio and DELMIA simulation and compare it to a conventional approach [24]. To avoid fatigue and injury, the welder's current postures and adjustment technique were examined using 3D simulation [25]. According to earlier research, 78% of MSD pains in workers were discovered while performing brick and block masonry work [26-30].

3. Methodology and Analysis

3.1 The Participants and the Construction Site

Residential areas were selected for the study, and workers who performed fundamental construction tasks such handling materials, concreting, masonry work, and

plastering were examined. There are both men and women working in the various age groups.

3.2 Data Gathering

Information regarding the sites was gathered through interviews with labourers, and a thorough questionnaire was created. The ergonomic evaluation programmes RULA and REBA were used to analyse the video graphs used to collect the data on the work postures.

3.3 Rapid Upper Body Assessment Instrument

Nigel Corlett and Lynn McAtamney of the University of Nottingham in England are the creators of RULA. It is a research method created for use in ergonomic investigations of work environments where occupational upper limb illnesses are prevalent. In RULA, the necessary body stance, power, and emphasis are evaluated using a single page worksheet [31-34].

Based on the evaluation, scores are entered in portions A and B for the wrist and arm and the trunk and neck for each body zone. Table 1 and Table 2 are used to combine the risk factors and create a single score that accounts for the likelihood of MSD after the data for each territory has been compiled and scored.

Table 1 List of the RULA Measurement Scale

SCORE	Risk of MSD severity
1-2	minimal risk, no need for action
3-4	Low risk; potential for change
5-6	Medium risk, additional research, impending change
6+	High risk; make the adjustment now

3.4 Tool for Rapid Whole-Body Assessment

Dr. Sue Hignett and Lynn McAtamney created REBA. A postural focusing approach called REBA is used to evaluate the risks associated with whole-body work-related issues. A REBA evaluation provides a worker with a quick and accurate assessment of the postural risk to their entire body. The evaluation of required or chosen body posture, special efforts, type of development or action, excess, and coupling is done on a single page worksheet [35-37].

The evaluator will use the REBA worksheet to evaluate each of the accompanying body parts, such as the wrists, lower arms, elbows, shoulders, neck, trunk, back, legs, and knees. Tables on the edge are then utilised to total the hazard factor components, creating a single score that addresses the level of MSD probability, after the data for each region has been put together and rated.

Table 2: REBA Measurement Scale

SCORE	Risk Level of MSD
1	Minimal risk, no need for action
2-3	Low risk; potential for change
4-7	Medium risk, additional research, impending change
8-10	High danger, make the change right away
11+	High risk, make the modification

An ergonomics-based occupational risk assessment technique called the Rapid Upper Limb Assessment (RULA) (McAtamney and Corlett, 1993) enables users to estimate the

likelihood of musculoskeletal loading in the upper limbs and neck. The usage of RULA is rapid and simple, and it doesn't necessitate the use of expensive equipment. Figure 1 shows the concept of research.

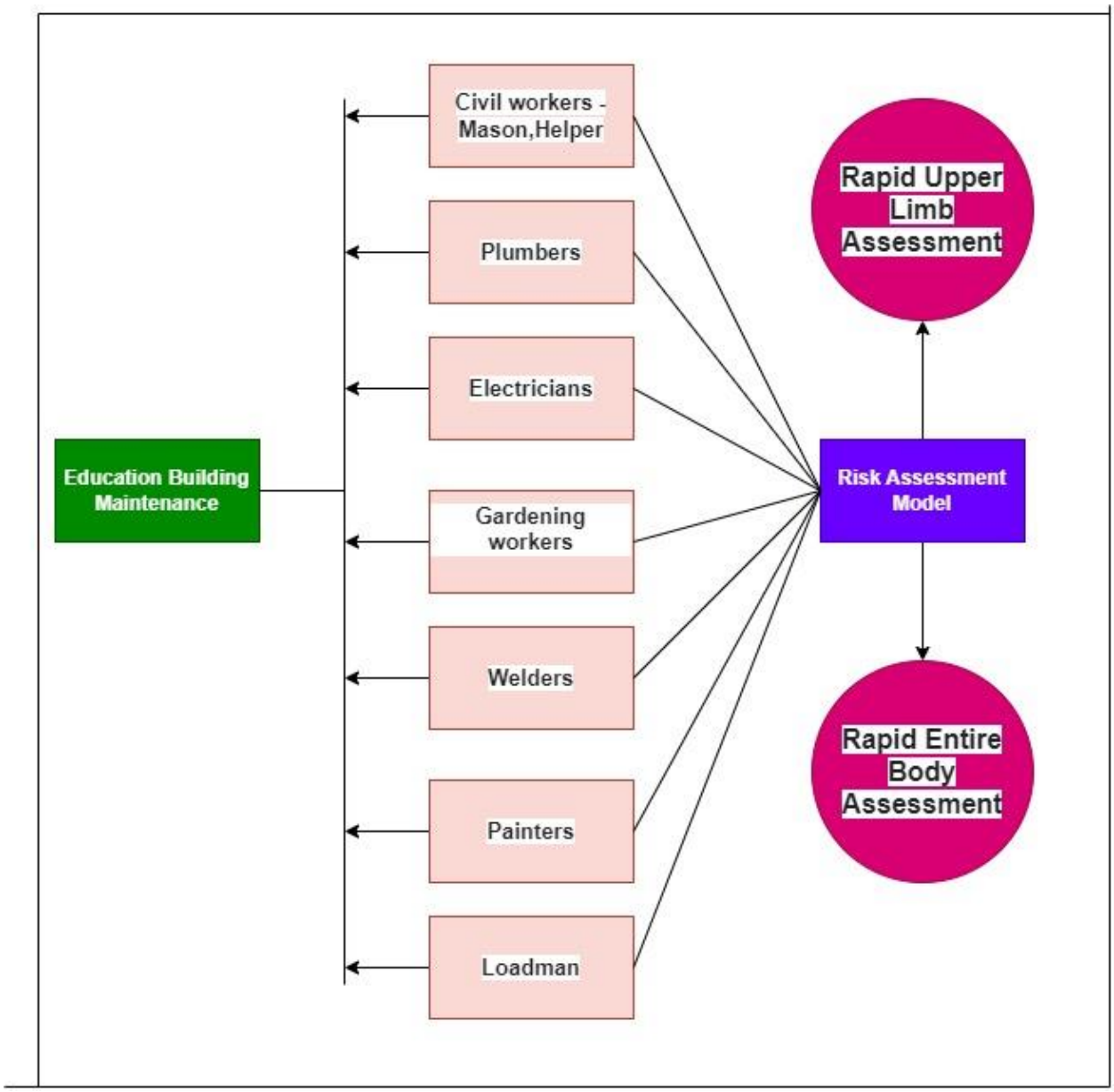

Fig.1 Concept of research

The following goals guided the development of the Rapid Upper Limb Assessment:

1) To offer a technique for screening a working population to determine exposure to a high risk of upper extremity disorders connected to the workplace.

2) To recognise the muscular effort that is connected to certain working positions and excessive pressures used during repetitive or static activity, which may result in muscle fatigue.

3) To offer a straightforward grading system that recognises an indicator of urgency with an output at the action level.

4) To offer a simple assessment method that takes little effort, time, or equipment.

3.5 Limitations of Rapid Upper Limb Assessment:

1) Ignores the task's duration, the amount of recovery time, or hand-arm vibration.

2) Requires the usage of representative postures since the evaluator may only evaluate one employee's worst-case posture at a time.

3) Needs separate evaluation of the right and left sides of the body, though you can usually tell which side of the body is most at risk for MSDs right away.

The different bodily postures needed, energetic efforts, the sort of movement or action, repetition, and difficulty of taking are all evaluated using the REBA method. Each of the following body parts receives a score: the wrists, forearms, elbows, shoulders, neck, trunk, back, legs, and knees.

The following goals guided the development of REBA:

1) To offer a basic posture analysis system that is attentive to musculoskeletal risks in various tasks.

2) To split the body into discrete parts for evaluation in relation to postures and movement planes.

3) To offer a grading system for muscular activity brought on by steady, unstable, dynamic, or quickly changing postures.

4) To take into account coupling as a significant factor in the handling of loads.

5) To provide a result at the action level that also conveys urgency.

6) To offer a simple, time-, effort-, and resource-efficient assessment tool.

3.6 Limitations of Rapid Whole Body Assessment:

1. Does not assess the danger of hand-arm vibration or take into account the task's duration or available recovery time.

2. Requires the use of representative postures because it only permits the evaluator to evaluate one employee's worst posture at a time.

3. Needs separate evaluation of the right and left sides of the body, though you can usually tell which side of the body is most at risk for MSDs right away.

The REBA method's primary benefits are [25]:

- Positive cost-effectiveness ratio.
- It is simple to use. For data collecting, a pen and paper are sufficient, however there are computer programmes that can speed up or facilitate its use.

- The individual score acquired after evaluating each body area identifies the ergonomic

4. RESULT AND DISCUSSION

A questionnaire was utilised to determine the availability of tools and equipment on the construction site, and the results suggest that education building maintenance workers fewer mechanised tools and rely more on manual labour to handle their equipment while using the most fundamental building techniques.

Using the ergonomic analysis tools REBA and RULA, education building maintenance workers engaged in tasks like concreting, mason work, material handling, and plastering were chosen and examined.

From six education building maintenance works, about 40 labourers were chosen. Their actions were observed and noted in order to analyse the degree of MSD risk and evaluate each worker's ergonomic performance. These tools were used to track and record the movement, body position, and angles for further analysis.

This outcome demonstrates that the majority of the examined workers (57.5%) fell within action category 4. shows that modifications in their working postures must be made right away; over 40% of labourers fall into action category 3, which calls for improvements to be made right away; roughly 2.5% fall into category 4. Action Category 2 demands adjustments, however Action Category 1 labour does not apply. Table 3 express the observed labours affected level by RULA.

Table 3 The observed labours' affected level (RULA)

ACTION LEVEL	SCORE	NO. OF LOBOURS	PERCENTAGE
1	1-2	0	0%
2	3-4	1	2.5%
3	5-6	16	40%
4	6+	23	57.5%

It has been noted that there appears to be an increased risk of musculoskeletal problems and injuries highest among masonry and material handling labours, and then concreting labours, of the four, plastering labour is the least impacted. Figure 2 shows the construction worker RULA scores.

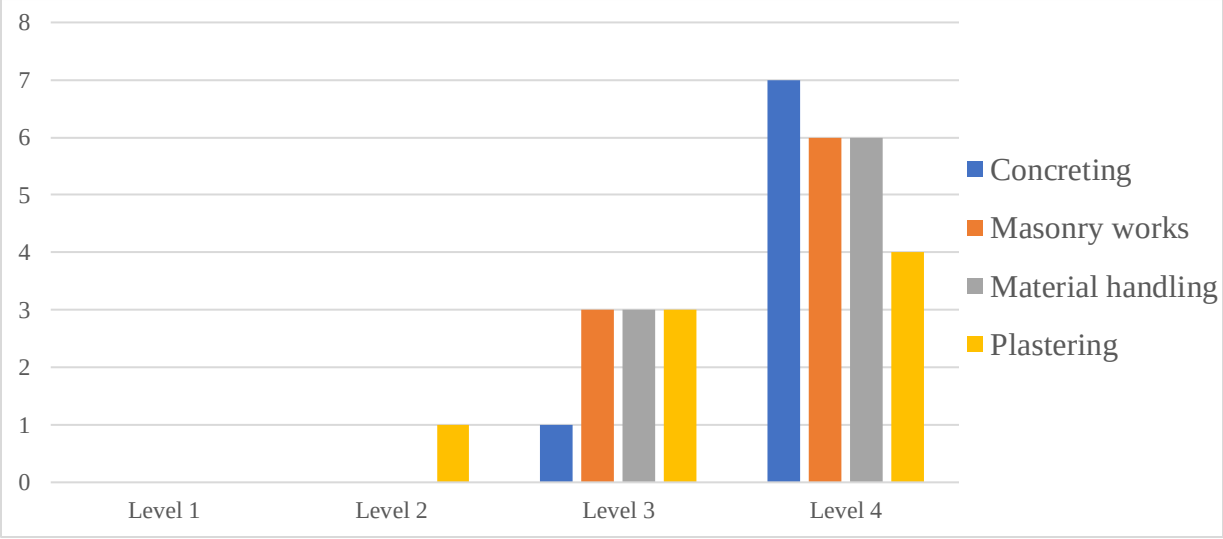

Fig 2 Construction Workers' RULA Scores

Table 4 The Observed Labours' Affected Level (REBA)

RISK LEVEL	SCORE	NO. OF LOBOURS	PERCENTAGE
1	1	0	0%
2	2-3	0	0%
3	4-7	34	85%
4	10-11	6	15%
5	11+	0	0%

About 85% of construction workers fall into the medium risk category, according to the REBA results, while 15% fall into the high-risk category. Table 4 shows the observed labour affected level by REBA.

Plastering work appears to be the least at risk of musculoskeletal injuries or disorders of the four, with concreting work appearing to be the most at risk, followed by masonry and material handling work. Figure 3 shows the REBA scores.

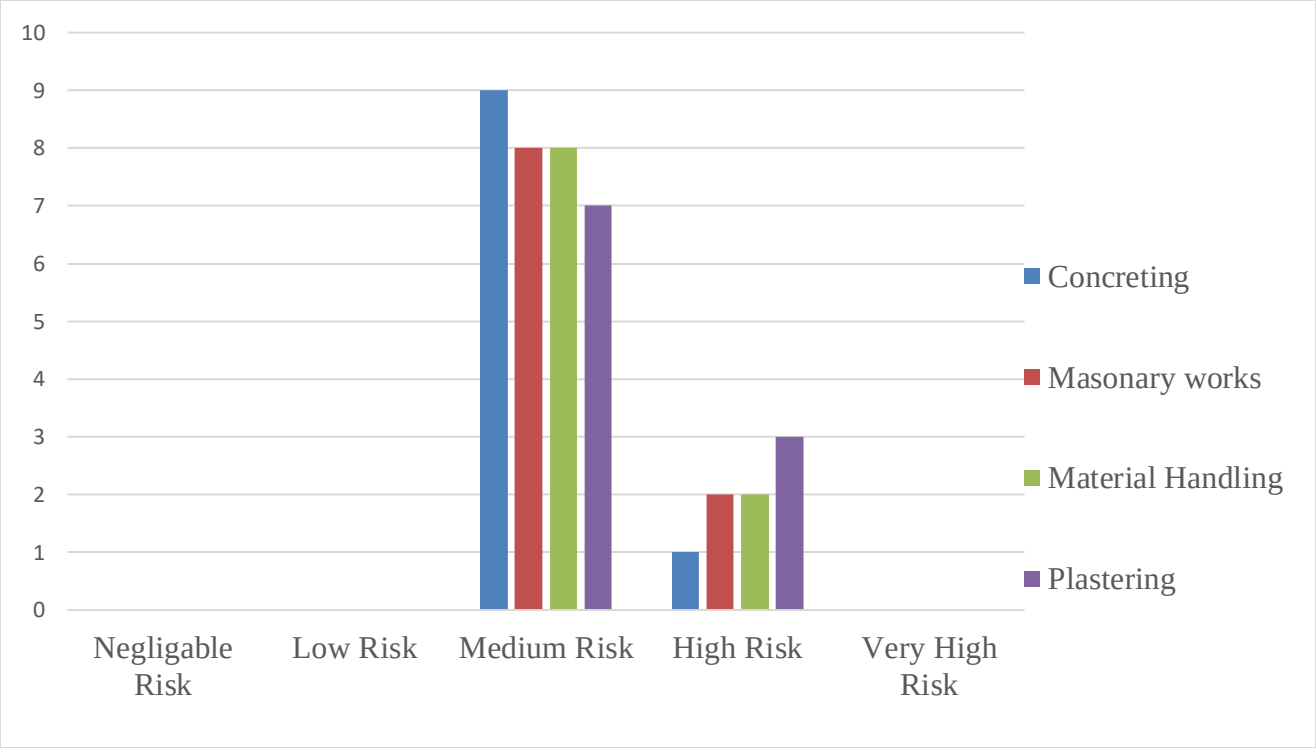

Fig 3 Construction Workers' REBA Scores

The procedures used to evaluate musculoskeletal problems differ by nation, the businesses performing them, the workplace, etc. Because of this, they can be categorised as direct, semi-direct, or indirect approaches.

According to an interview with site workers, the materials are handled by hand without the use of any special tools, and the workers typically lift more than 30 pounds. Plastering and masonry work are also handled by workers without the use of any safety equipment, and mixing concrete is done by hand without the use of any specialised clothing or safety gear.

Several body parts, including the upper arm, lower arm, neck, trunk, legs, wrist angle, wrist movements, and load were examined for construction work, including concrete, masonry, material handling, and plastering, with the help of the

ergonomic assessment tool RULA. According to this analysis, 57.5% of labourers fall into action category 4, which means they are in extremely high risk situations and need to change their work postures right away.

Only 2.5% of labour is classified as action category 2, where changes are not really required, while 40% of labour is classified as action category 3, which denotes medium risk and requires quick changes to work postures..

Different body parts, including the upper arm, lower arm, neck, trunk, and legs, were examined for coupling and the type of activity the four jobs required using the ergonomic assessment tool REBA.

This analysis revealed that 85% of workers fall into the category of medium risk, indicating the need for further research and modifications. 15% of labours are classified as high risk, requiring immediate inquiry.

The findings of this study indicate that residential labourers have medium overall risk and extremely high risk in the area of the upper limb, and that improvements in work posture should be implemented to improve the health of residential labourers.

Anybody component exposed to continuous stabilisation or acceleration may experience discomfort. Wounds can be brought on by two features of body position. The first one refers to physical positioning. When a body part reaches its maximum range of development, tendons and nerves expand and gain weight. We are more likely to develop WMSDs for settled and uncomfortable body positions. Maintaining the shoulder and neck in a fixed position is the second angle that contributes to WMSDs.

Arm muscles must contract and hold their contraction for however long the task demands in order to carry out any created tasks [13]. To reduce the risk of MSDs, corrective actions, improved work postures, and changes to work-rest schedules are recommended.

The main goal of ergonomics is to ensure that the maximum number of people are taken into account in the design and are not outperformed by the ideal. Perfect means replacing the general public necessities with the sincere requirements.

The following points will thereafter be conceivable to encounter in the construction site at the conclusion:

- ✓ Provide a safe and sound work environment.
- ✓ Improve Quality Acquire a nice capacity in an ideal setting
- ✓ needed restraint and balance
- ✓ Basic labour operations should be made
- ✓ Limit problems
- ✓ Cut expenses

Increasing the labours' confidence. To find activities that fit within the confines of their jobs, construction workers, contractors, and associations must work together. Ergonomists must provide them with specific examples of how construction workers can be impacted by compounded wounds in order to help them refine their mental states.

In the event that they don't take care of themselves in the current condition of work, ergonomists also need to create a picture of what future labours will look like [14]. For affiliations, ergonomic exercises can provide knowledge that helps assignments become more aware of the benefits that ergonomic plans offer for both business prosperity and

the safety and well-being of their employees.

Contract employees need research and verifiable data to show that ergonomic projects actually reduce wounds while maintaining p. To keep their bright personnel, they must see how it benefits them over time [14]. Making a security culture for implementing an ergonomic improvement involves the skills and ingenuity of the workers who are managing every day and certifiable issues at the forefront of development.

Finally, they are the problem-solvers, the coordinators, the general population responsible for increasing workplace security, and the general public who is suffering [15]. The experiences they shared seem to be helpful in understanding their needs and the circumstances that instruct a social advancement methodology. They would be exceptional among other options for making ergonomics a case study in overcoming difficulty for the development workforce.

5. CONCLUSION

Continuous maintenance is essential for educational institutions as failure can lead to major mishaps. Among them are those who carry out the most important maintenance work such as Civil workers - Mason, Helper, Plumbers, Electricians, Gardening workers, welders, painters, load men, etc. In this research, the ergonomic model of educational institution maintenance was investigated using REBA and RULA methods. The examination of forced postures is the primary application of the REBA approach. For evaluating repetitive movements, it is ineffective. In this research literature review, ergonomics analysis for Civil workers-Mason employees has been done.

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