Sustainability, Agri, Food and Environmental Research, (ISSN: 0719-3726), 12(X), 2024:
http://dx.doi.org/

Implementation of real-time construction worker posture analysis during flooring in construction.

Implementación de análisis de postura de trabajadores de la construcción en tiempo real durante el piso en construcción.

Aleena Josey[1], Nazneen Niyas[2], Ameer Suhail M S[3], Sahimol Eldhose[4]

[1,2,3]Student, Department of Civil Engineering, Toc H Institute of Science & Technology, Kerala,

[4]Assistant Professor, Department of Civil Engineering, Toc H Institute of Science & Technology, Kerala

aleenajosey15@gmail.com, ameersuhail2015@gmail.com, nazneenniaz.coc@gmail.com,
sahimol@tistcochin.edu.in

ABSTRACT

Construction industry is one of the highly risky industries with more number of accident and injuries. The increasing number of injuries caused by repetitive motion, excessive force and awkward postures, ergonomics has become a critical factor in workplace safety. The postures related to the corresponding works are finding out by taking their live images during their work using the Software POSTUREZONE. For more accuracy the same worker's posture from different sides are find out and after that angles obtained is collected for assessing risk using REBA worksheet. In this project risk is analyzed using work sampling observation area made on workers involved in the task. The hazards are then evaluated using flooring. REBA Score is then developed to describe the posture, repetition of work and the level of risk. In this method ergonomic risk factors are identified based on checklist or score.It can provide comprehensive results in determining a good work position and it can minimize the risk of work accidents for operators when working.

Keywords: Ergonomics, REBA, Risk factor, Posture.

RESUMEN

La industria de la construcción es una de las industrias de mayor riesgo con mayor número de accidentes y lesiones. Con el creciente número de lesiones causadas por movimientos repetitivos, fuerza excesiva y posturas incómodas, la ergonomía se ha convertido en un factor crítico en la seguridad en el lugar de trabajo. Las posturas relacionadas con los trabajos correspondientes se van conociendo tomando sus imágenes en vivo durante su trabajo utilizando el Software POSTUREZONE. Para mayor precisión, se determina la postura del mismo trabajador desde diferentes lados y luego se recopilan los ángulos obtenidos para evaluar el riesgo utilizando la hoja de trabajo REBA. En este proyecto se analiza el riesgo mediante muestreos de trabajo en el área de observación realizados a los trabajadores involucrados en la tarea. Luego se evalúan los peligros utilizando pisos. Luego se desarrolla la

puntuación REBA para describir la postura, la repetición del trabajo y el nivel de riesgo. En este método, los factores de riesgo ergonómicos se identifican en función de una lista de verificación o puntuación. Puede proporcionar resultados integrales para determinar una buena posición de trabajo y puede minimizar el riesgo de accidentes laborales para los operadores cuando trabajan.

Palabras clave: Ergonomía, REBA, Factor de riesgo, Postura.

INTRODUCTION

Construction site is a high hazard industry with a wide range of activities that may expose construction workers to serious hazards, such as falling from heights, unguarded machinery, being struck by heavy construction equipment, electrocutions, and ergonomics hazards. The construction workers are frequently exposed to Work-Related Musculoskeletal Disorders (WRMSDs) risk factors such as lifting heavy items, bending, reaching overhead, pushing and pulling heavy loads, working in awkward body awkward body postures and performing same tasks respectively. Ergonomics risk assessment is an objective measure of the risk factors in our work environment that may lead to musculoskeletal disorders among workforce.

N. Jaffar et.al (2017) focused on the ergonomics definition and risk factors in the construction industry. Through the review, ergonomics mainly can be defined as the relationship between humans, machines systems, job design and the work environment. Generally, the aim of ergonomics is to fit the task to the individual and not the individual to the task. The study also found the most significant ergonomic risk factors or conditions that may increase the likelihood of injury to musculoskeletal system. The risk factors include working in awkward posture, vibration and force which may come from gripping, lifting, pushing or pulling or due to poor lighting. Repetition which involves in doing a task that uses the same muscles over and over with little chance for recovery or working in extreme temperature condition either extremely cold or extremely hot also are the main risk factors. Working in uncomfortable static position or contact stress of muscles and tend on also will increase the likelihood of injury.

Rohit Sharma et al(2018) developed a postural examination tool utilizing REBA for evaluation, which demonstrates that the workers are working to a great extent. The investigation was conducted on 30 employees working in the small-scale industry. Subsequently it was inferred that; there is an absence of ergonomics mindfulness and comprehension in the small-scale enterprises. Assessment utilizing postural examination REBA demonstrates that the specialists are working to a great extent. The working levels of the workers are having very clumsy stances. Therefore, the workers were told not to be in a bad posture and to change their postures in order to get rid of musculoskeletal problems. From the literature review, most significant ergonomics risk factors occur due to repetitive work and awkward posture.

METHODOLOGY

Assign Risk Level-After assigning score, classify risk level done with reference to REBA worksheet.The risk levels are shown in table 1.

Table1: posture score

Table 1	Neck											
		1				2				3		
	Pelvis	1	2	3	4	1	2	3	4	1	2	3	4
Torso	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

The postures related to the corresponding works are found out by taking their live images during work using the Software Posture Zone. Posture Zone provides compelling visual evidences of improvement or decline. It helps to measure distortions in degrees to track postural changes, balance and symmetry of the head, torso and pelvis over the center of the feet. For more accuracy the same worker's posture from different sides were found.

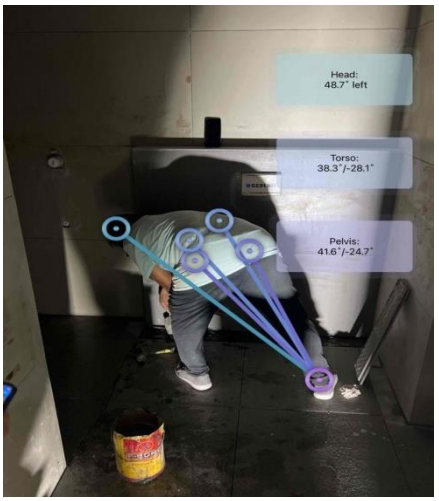

Fig 1: Angles obtained during Flooring Works

The angles observed from POSTURE ZONE software of flooring activities are collected for further calculating risks score from postural hazard analyis sheet and the values obtained from the Table A scores are given below and from this hazard score can evaluate the levels of risks such as low, medium or high.

Table 2: Angles obtained from posture zone software during flooring work.

Worker No.	Observation1 Head	Torso	Pelvis	Observation 2 Worker No.	Head	Torso	Pelvis
0	2.3^0	6.8^0	13.7^0	4	27.9^0	14.3^0	2.4^0
1	6.2^0	4.8^0	7.6^0	5	8.9^0	4.7^0	10.8^0
2	1.9^0	3.8^0	8.9^0	6	0.6^0	3.6^0	6.7^0
3	25.4^0	4.7^0	9.3^0	7	0.4^0	4.1^0	12.1^0
4	32.7^0	12.5^0	3.5^0	8	19.3^0	40^0	46^0
5	42.4^0	45^0	46^0	9	7.2^0	7.8^0	12.1^0
6	43.9^0	47.6^0	25.6^0	1	34.8^0	8.9^0	13.4^0
7	23^0	25.6^0	13.8^0	2	3.3^0	11.6^0	37.3^0
1	27^0	31.5^0	19^0	3	6.7^0	7.1^0	7.1^0
2	19.1^0	18.7^0	30.9^0	4	23.1^0	17.2^0	13.4^0
3	2.7^0	5.4^0	13.2^0	5	4.2^0	11.4^0	14.0^0
4	1.1^0	8.3^0	10.5^0	6	32.3^0	5.7^0	3.6^0
5	$_3 0$	10^0	12.4^0	2	1.5^0	3.2^0	6.8^0
6	7.3^0	6.9^0	18^0	3	$_4 0$	3.2^0	6.8^0
1	8.6^0	11.3^0	17^0				

From all the observations taken the max angles were found for flooring workers and the angles corresponding to each workers posture was 40.50,48.70,43.60,41.90,41.60 and 48.70 for Head,Torso and Pelvis respectively

RESULTS AND DISCUSSION

Ergonomic Risk

Table 3: flooring Workers risk score

Site No(S)-Worker No(W)	Total Score	Site No(S)-Worker No(W)	Total Score	Site No(S)-Worker No(W)	Total Score	Site No(S)-Worker No(W)	Total Score
S1W1	52.5	S3W1	37.0	S2W1	46.0	S4W1	14.8
S1W2	86.0	S3W2	66.0	S2W2	94.4	S4W2	40.0
S1W3	75.0	S3W3	55.5	S2W3	55.0	S4W3	29.6
S1W4	59.0	S3W4	71.0	S2W4	64.0	S4W4	42.4
S1W5	134.0	S3W5	121.6	S2W5	90	S4W5	44.8
S1W6	112.0	S3W6	68.8	S2W13	46.0	S5W7	64.0
S1W7	100.0	S3W7	73.6	S2W14	94.4	S5W8	69.6
				S2W15	55.0	S5W9	44.8

The Ergonomics risks of workers were calculated using POSTUREZONE and their posture score was found out. The maximum posture angles were found out for flooring, the observed angles were 17.0^0, 77.5^0, $30.8^0$and 13^0, 62.6^0, 53^0 for Head, Torso and Pelvis Respectively. After that the risk score corresponding to environmental factors, repetition, duration was found out for each worker and then the total score was found out. The scoring chart for flooring, are given

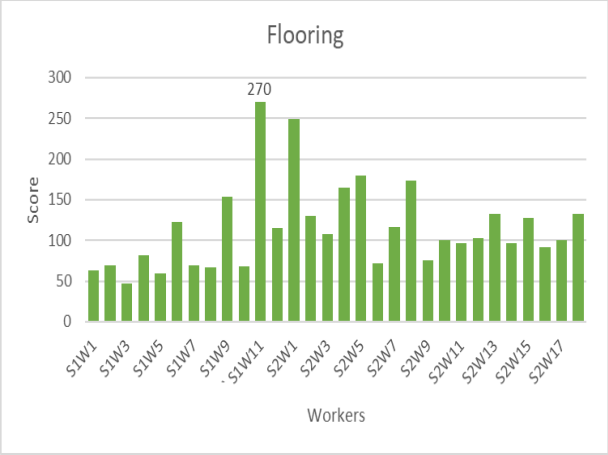

Fig 2 Graph showing flooring score

CONCLUSION

Out of 50 observations made for flooring work it was found that 17 workers were in negligible risk zone, 6 workers in the medium risk zone, 1 worker in the high-risk zone and remaining 2 in the very high-risk zone. 24 workers in the low risk zone, 6 workers in the medium risk zone and one worker was in the high-risk zone. Thereby from all observations made 4 people needed immediate action.

REFERENCES

Nath N.D., Akhavian R., Behzadan A.H. Ergonomic analysis of construction worker's body postures using wearable mobile sensors. Appl. Ergon. 2017; 62: 107–117.

Ray S.J., Teizer J. Real-time construction worker posture analysis for ergonomics training. Adv. Eng. Inform. 2012;26: 439–455.

Lee W., Seto E., Lin K.Y., Migliaccio G.C. An evaluation of wearable sensors and their placements for analyzing construction worker's trunk posture in laboratory conditions. Appl.Ergon. 2017;65 :424–436.

Jebelli H., Choi B., Lee S. Application of wearable biosensors to construction sites. II: Assessing workers' physical demand. J. Constr. Eng. Manag. 2019; 145: 0401908Seo

J., Lee S. Automated postural ergonomic risk assessment using vision-based posture classification. Autom. Constr. 2021;128:103725.

Wang D., Dai F., Ning X. Risk assessment of work-related musculoskeletal disorders in construction: State-of-the-art review. J. Constr. Eng. Manag. 2015;141: 04015008.

Valero E., Sivanathan A., Bosché F., Abdel-Wahab M. Analysis of construction trade worker body motions using a wearable and wireless motion sensor network. Autom. Constr. 2017; 83: 48–55.

Yunus M.N.H., Jaafar M.H., Mohamed A.S.A., Azraai N.Z., Hossain M.S. Implementation of kinetic and kinematic variables in ergonomic risk assessment using motion capture simulation: A review. Int. J. Environ. Res. Public Health. 2021;18: 8342., Vol 07 issue 08.

Received: 30th March 2023; Accepted: 03th August 2023; First distribution: 31th October 2023.