International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 03 | Mar 2020 www.irjet.net p-ISSN: 2395-0072

Ergonomic Assessment in Vehicle Assembly Line using REBA Tool

Sandeep K G[1], Jishin Jayan T[2], Dr Muthukumar K[3]

[1]PG student, Industrial Safety Engineering, Bannari Amman Institute of Technology, TamilNadu, India
[2]Assistant Professor, Industrial Safety Engineering, Bannari Amman Institute of Technology, TamilNadu, India
[3]Professor, Industrial Safety Engineering, Bannari Amman Institute of Technology, TamilNadu, India

---

Abstract - *Ergonomics is the most common issue for increased Musculoskeletal Disorders in all the industries. In order for the betterment of anthropometric position to reduce MSDs regular ergonomic study must be done. In this manuscript the ergonomical study has been done in a vehicle assembly line at an Automobile Industry. The vehicle assembly line is divided in to 36 different jobs and risk level is identified for each job using REBA (Rapid Entire Body Assessment) assessment tool. The data was collected at the shift starting as well as at the end of the shift in order to verify whether time changes bring any job position variations. Thus on further consolidation the maximum risk level for the particular job was identified. Based on the risk level identified the most affected region due to carrying out of the job is identified and possible changes were suggested in order to reduce the risk level of the job.*

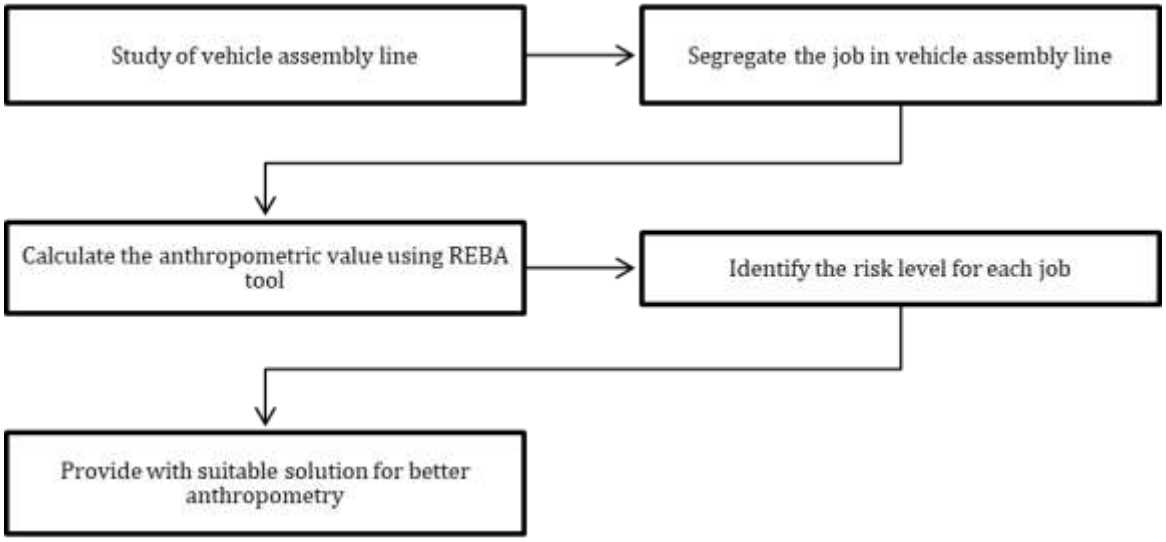
***Key Words*: Musculoskeletal Disorder, REBA, Risk Level, Ergonomics, Assembly Line**

1. INTRODUCTION

Ergonomics is also known as human factor which is a scientific discipline which deals with the understanding of interaction among the human and other element of a system and the profession that applies theoretical principles, data and methods to design in order to optimize human well being and overall system performance. According to the data provided by health and safety executive annual statistics government of UK in 2019 498,000 workers are suffering from work related musculoskeletal disorder which caused 6.9 million working hours lost where 41% was reported with upper limb and neck problem, 40% was reported with back injuries and 19% with lower limb problem which created the importance for development of ergonomics within the industrial premises[1] .The most common WMSDs caused due to improper ergonomics are tendonitis ,tenosynovitis ,bursitis ,ganglionic cyst ,neurovascular disorders ,thoracic outlet syndrome, vibration syndrome and nerve entrapment disorders. This led to a proper study of anthropometry dealing with manual material handling[2].The most common factors that affect the workers health are physical and mental factors, psychosocial factors and organisational factors thus leading to decreased productivity ,increased absenteeism ,increased staff turnover ,increased injury and accident rates and increased error rates and quality problems. These factors leads to several occupational based musculoskeletal disorder which are chronic in nature. Thus it's an important issue for the improvement of ergonomics within the organisation to reduce the occupational health diseases and to follow different ergonomical practices for the betterment of working postures[3]. The main reason for the ergonomic study is to identify the physical and the psychological characteristics causing anthropometric changes. Work place problems is the most important issues for improper anthropometric conditions within the industrial premises. Thus its very important to bring in health and safety within the industry with respect to that of ergonomics and human factors thus leading to continuous ergonomic assessment[4] .There are different evaluation techniques that are followed in ergonomics. The first ergonomic assessment method was survey using participatory ergonomic tool. The questionnaire methods like Nordic Musculoskeletal Disorders questionnaire and the UBC ergonomic checklist were used as a qualitative data collection method. Then which further let to the evaluation of quantitative analysis tool they are RULA(Rapid Upper Limb Assessment) and REBA(Rapid Entire Body Assessment). Then on further analysis CATIA software can be used for virtual design of ergonomic station. Where in this manuscript we are using the REBA tool for complete study of anthropometric which includes legs also when compared to the RULA[5,6].Utilization the REBA assessment tool is very important for improvement of ergonomics. The exact angle variations with respect to the body changes must be identified for better scoring. Further identification of the score by determining the pain in the neck ,leg ,upper arm, lower arm, trunk, wrist with respect to the load carried or force applied and coupling with the tools. Then further identify the final score with respect to the activity carried out[7]. By identifying the score using the REBA assessment tool , the MSDs risk level are to be identified for the various jobs with respect to the postural changes during the work carried out[8]. The discomfort can also be identified using cornell musculoskeletal disorder questionnaire. The discomfort rate is compared with respect to height and age. But this is qualitative analysis where REBA is quantitative analysis[9]. Human performance conceptual model play an important role in identification of variation of human factors. Human performance depends on two main factors task complexity and human capability.Using the human performance conceptual model the risk level with respect to human factors are determined whereas in REBA the risk level is obtained with respect to the activity score obtained from the REBA assessment tool.[10]

Thus in this manuscript ergonomic study has been carried out with respect to body postural changes by using REBA assessment tool which is the best evaluation tool for quantitative analysis.

2. METHODOLOGY



There are several processes in automobile industry the main processes is vehicle assembly. The vehicle assembly line is segregated in to 36 different jobs. The anthropometric value was calculated using REBA assessment tool for each job. The risk level for each job was studied and the identified with maximum risk level during the shift starting and after break during the shift period was identified for ten different workers and suitable suggestions where provided for the improvement of postural changes.

3. CONCEPTUAL STUDY

The design of the vehicle assembly line is as mentioned in the figure 1 .The 36 different jobs carried out are 1.Frame Assembly 2.Front Bottom Assembly 3.Main Wiring Assembly stage 4.ABT Stage 5.SPT Stage 6. Front Above Assembly 7.Fender Rear Assembly 8.Swing Arm Assembly 9.Drums Assembly 10.Rear Axle Assembly 11.TSL Assembly 12. Vehicle Loading 13.Engine Loading 14.Engine Bracket Assembly 15. Air Filter Assembly 16.Clutch Case Assembly 17.Engine Tightening 18.Chain Play Adjustment 19.Electrical Connection 20.Chain Case Assembly 21.Battery Holder Assembly 22.Saree Guard Assembly 23.3rd Mounting Assembly 24.Front Brake Assembly 25.Sprocket Cover Assembly 26.SAI Assembly 27.Electrical Inspection 28.BS VI ECU Flashing 29.Zone Inspection 30.Tail Cover Assembly 31.Head Lamp Assembly 32.Tank Assembly 33.Vent Testing 34.Cover Frame Logo Assembly 35.Cover Frame Assembly 36.TI Inspection. Ergonomic study was carried out for each job using REBA assessment tool.

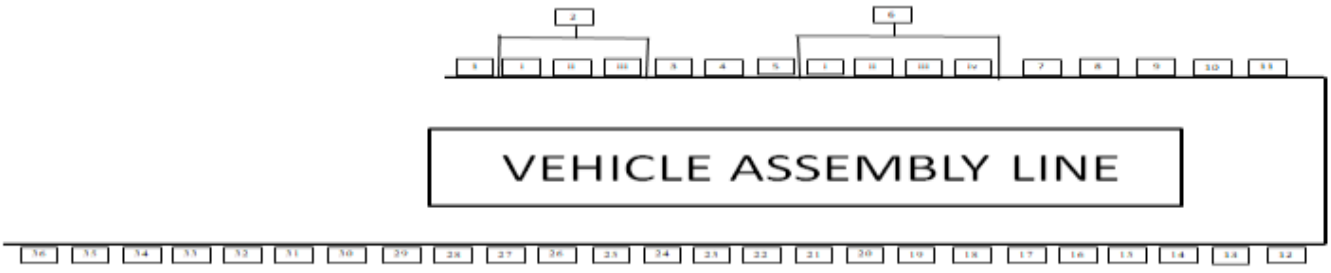


Fig -1: Vehicle Assembly Line

4. RESULTS AND DISCUSSION

The risk level has been identified for various job during the shift starting and after the break for ten different workers as shown in table 1 and table 2.Further the risk level was compared in order to verify does any hourly changes brings sudden postural changes but on verification it was identified the risk level obtained for the jobs where similar with respect to data obtained from ten different persons. Thus among all the jobs front brake assembly possess very high risk level and TI inspection possess the negligible risk. Frame assembly possess the high risk level. The most affected region in the front brake assembly is upper arm and back region. The back is bend at an angle of 20 to 60 Similarly in frame assembly back region and legs are affected due to frequent adjustment of legs at an angle more than 60 during the job. In order to improve ergonomics at front brake assembly the job position is to be changed from 24 as mentioned in conceptual study to 7(Fender Rear Assembly) due to the increased height of the conveyor in that region. In the frame assembly ergonomic level is improved by placing a hydraulic ramp at the workplace in order to increase the height of the trolley to prevent the back injury.

REBA ASSESSMENT IN VECHICLE ASSEMBLY LINE(shift starting) RISK LEVEL							
POSTURE	ACTIVITY	Sub Activity	NEGLIGIBLE	LOW	MEDIUM	HIGH	VERYHIGH
1	Frame Assembly					6	4
2	Front Bottom Assembly	Front Fender Sub Assembly	2	8			
		Cone Bottom and Front Fork sub assembly		1	9		
		Front Wheel Sub Assembly				9	1
3	Main Wiring Assembly Stage				4	6	
4	ABT Stage				10		
5	SPT Stage				6	4	
6	Front Above Assembly	Lockset Sub Assembly		9	1		
		Caliper to HB Sub Assembly		8	2		
		HL BRKT Sub Assembly		9	1		
		Handle Bar Assembly			5	5	
7	Fender Rear Assembly				10		
8	Swing Arm Assembly			1	9		
9	Drums Assembly			6	4		
10	Rear Axle Assembly				7	3	
11	TSL Connection			10			
12	Vehicle Loading				5	3	2
13	Engine Loading					7	3
14	Engine Bracket Assembly				10		
15	Airfilter Assembly			7	3		
16	Clutch Case Assembly				10		
17	Engine Tightening			1	9		
18	Chain Play Adjustment					8	2
19	Electrical Connection			7	3		
20	Chain Case Assembly				9	1	
21	Battery Holder Assembly				10		
22	Saree Guard Assembly				3	7	
23	3rd Mounting Assembly				10		
24	Front Brake Assembly					4	6
25	Sprocket Cover Assembly			4	5	1	
26	SAI Assembly			2	8		
27	Electrical Inspection		3	7			
28	BS VI ECU Flashing				5	5	
29	Zone Inspection				10		
30	Tail Cover Assembly				10		
31	Head Lamp Assembly				10		
32	Tank Assembly				7	3	
33	Vent Testing		1	5	4		
34	Cover Frame Logo Assembly			10			
35	Cover Frame Assembly			5	5		
36	TI Inspection		10				

Table 1 REBA Assessment in Vehicle assembly line shift starting

REBA ASSESSMENT IN VECHICLE ASSEMBLY LINE(After break) RISK LEVEL							
POSTURE	ACTIVITY	Sub Activity	NEGLIGIBLE	LOW	MEDIUM	HIGH	VERYHIGH
1	Frame Assembly					6	4
2	Front Bottom Assembly	Front Fender Sub Assembly	2	8			
		Cone Bottom and Front Fork sub assembly		1	9		
		Front Wheel Sub Assembly				7	3
3	Main Wiring Assembly Stage				4	6	
4	ABT Stage				10		
5	SPT Stage				4	6	
6	Front Above Assembly	Lockset Sub Assembly		8	2		
		Caliper to HB Sub Assembly		4	6		
		HL BRKT Sub Assembly		7	3		
		Handle Bar Assembly			6	4	
7	Fender Rear Assembly				10		
8	Swing Arm Assembly				10		
9	Drums Assembly			7	3		
10	Rear Axle Assembly				8	2	
11	TSL Connection			10			
12	Vehicle Loading				6	4	
13	Engine Loading					5	5
14	Engine Bracket Assembly				10		
15	Airfilter Assembly			6	4		
16	Clutch Case Assembly				10		
17	Engine Tightening			1	9		
18	Chain Play Adjustment					9	1
19	Electrical Connection			7	3		
20	Chain Case Assembly				8	2	
21	Battery Holder Assembly				10		
22	Saree Guard Assembly				1	9	
23	3rd Mounting Assembly				10		
24	Front Brake Assembly					4	6
25	Sprocket Cover Assembly			3	6	1	
26	SAI Assembly			2	8		
27	Electrical Inspection		3	7			
28	BS VI ECU Flashing				6	4	
29	Zone Inspection				10		
30	Tail Cover Assembly				10		
31	Head Lamp Assembly				10		
32	Tank Assembly				8	2	
33	Vent Testing		1	6	3		
34	Cover Frame Logo Assembly			10			
35	Cover Frame Assembly			5	5		
36	TI Inspection		10				

Table 2 REBA Assessment in Vehicle Assembly Line After Breakare now ready to style your paper.

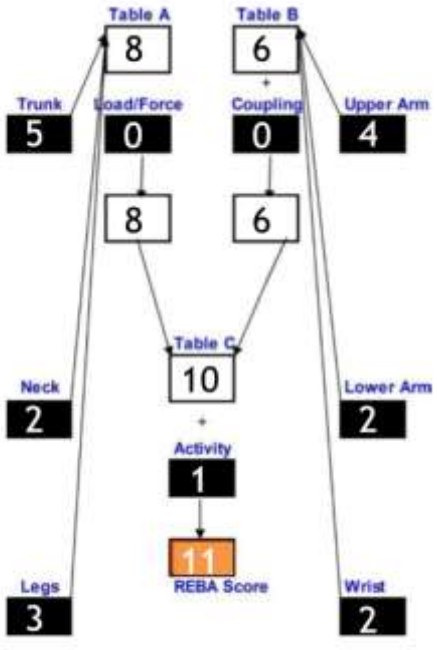


Fig 2.REBA score Front Brake Assembly

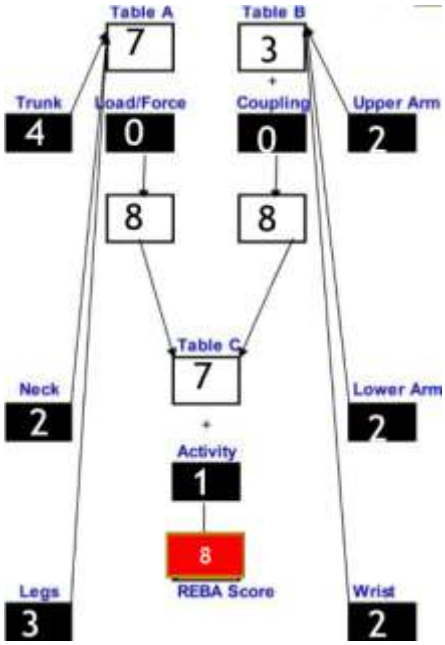


Fig 3.REBA score Frame Assembly

5. CONCLUSION

The study indicated that each job possess its own ergonomical hazards. The very high was indicated for front brake assembly, where the immediate changes must be done in order to improve the postural changes. Thus suggestions are provided for the improvement. After the changes are made again ergonomic study must be done to identify whether the control method suggested have reduced the risk level. The ergonomic programme at the workplace should not only focus on postural changes but also adequate lighting, workspace layout, contact stress , rest level between the jobs and proper training to workers.

REFERENCES

[1] Annual Statistics, Health and Safety Executive,30th October 2019.

[2] Birnbaum, 1.S., The Musculoskeletal Manual, 2nd ed.,W.B. Saunders, Philadelphia, PA, 1986.

[3] Pat Scott, Kazutaka Kogi, Barbara McPhee, "Ergonomics Guidelines for Occupational Health Practice in Industrially Developing Countries", ICOH, August 2009.

[4] Atef Boulila, Mahfoudh Ayadi, Khadija Mrabet, "Ergonomics Study and Analysis of workstations in Tunisian Mechanical Manufacturing", Human Factors and Ergonomics in Manufacturing, Wiley, Feb 2019.

[5] "Ergonomics and Human Factors at Work", Health and Safety Executive, 03/13.

[6] Sue Hignett , Lynn McAtamney , "Rapid Entire Body Assessment " , Applied Ergonomics,ELSEVEIR,17 jun 1999.

[7] " REBA: A Step by Step Guide" , Ergonomics Plus Inc.

[8] Mojtaba Kamalinia, Dohyung Kee, Mostafa Hosseini , Alireza Choobineh,"Postural Loading Assessment in Assembly Workers of an Iranian Telecommunication Manufacturing Company" , International Journal of Occupational Safety and Ergonomics, June 2013.

[9] Krishnamoorthy Muthukumar , Krishnasamy Sankaranarayanasamy , Anindya Kumar Ganguli, "Analysis of Frequency , Intensity and Interference of Discomfort in Computerized Numeric Control Machine Operations " , Human Factors and Ergonomics in Manufacturing and Service Industries ,2012.

[10] Lorenzo Comberti , Micaela Demichela, "Human Factor Assessment in Assembly Line: an Operative Model" , CHEMICAL ENGINEERING TRANSACTIONS , VOL 67 2018.