

Posture Study and Enviournmental Factors as a Tool to Enhance Work Efficiency

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Abstract—Ergonomics is the science of designing the job to fit the worker, rather than physically forcing the worker's body to fit the job. Workstation design from an ergonomics perspective can effectively enhance productivity and minimize stress through the interaction between the various system components. Ergonomics (or human factors) is the scientific discipline concerned with understanding of the interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design, in order to optimize human well-being and overall system performance. Derived from the Greek words i.e. *ergon* (work) and *nomos* (laws) to denote the science of work, ergonomics is a systems-oriented discipline, which now applies to all aspects of human activity.

Ergonomics (work laws) can be applied in following ways :-

1. Study of biomechanical parameter like pain in limbs and body.
2. Analysis of working posture for an operation.
3. Changing work enviournment like temperature, humidity, light intensity, air purity etc.
4. Decreasing sound, vibration, dust level.

Stress is given on former two as later can be observed and manipulated in a comparatively easier way.

Keywords: {Boggies;Ergonomics;R.E.B.A;Wagon;}

1. INTRODUCTION

In wagon manufacturing workshop the basic work that are carried out are as follows:-Deptt.

Planning Deptt-requirement of steel & bought out items

Drawing Deptt-jigs, fixtures and guage layout plan

Purchase Deptt-referrals & past clients

Production Deptt-welding, shearing, bending, drilling, milling, turning, straightening, wheel mounting, shot blasting.

Quality Deptt-visual inspection, guage testing, radiographic inspection, rdso approval

R.D.S.O is railway design standard organization. It has its main office in lucknow, U.P

It carries out all approval for design standards for railway coaches.

Railway wheel manufacturing unit is situated at R.W.F. Bangalore

Integral coach manufacturing unit is situated at perambdur and kapurthala.

1.1 Rapid entire body assessment (REBA)

REBA is a posture-based analysis system responsive to musculoskeletal risks in various tasks, in particular for assessment of working postures (Pillastrini et. al., 2007). The classification of postures is derived from body part diagrams. The REBA is a method for estimating the risks of entire body WMSDs, gives a quick and logical assessment of the complete body postural risks to a worker and it is appropriate for evaluating tasks where postures are dynamic, static, or where gross changes in position take place. The design of REBA is very similar to that of Rapid Upper Limb Assessment Method (RULA) and special attention is devoted to the external load acting on trunk, neck, and legs and to the worker-load coupling using the upper limbs (Motamedzade et. al., 2011 and Janowitz et. al., 2006). The REBA method analyzes posture by measuring the articular angles and by observing the load or force and repetitiveness of movements and the frequency of position changes. The postures of the neck, trunk, upper and lower arms, legs, and wrists are grouped into ranges. Each posture range, relative to the anatomical regions evaluated, is associated with a score corresponding to values that get progressively higher as the distance from the segment's neutral position increases (Pillastrini, 2007). Figure 2.11 shows the REBA score sheet. Procedure adopted for analysis.

1. First of a particular operation is selected in manufacturing for study.
2. Suppose welding is taken and photograph of worker is taken in different posture of working.
3. Different techniques are studied like Rapid Entire Body Assessment (REBA) and 3D-SSPP(3D-Static Strength process prediction)
4. A score is given for every position of limb for a particular posture in welding.
5. Total Score is calculated for a particular posture against that working pose.
6. Comparison is done between ideal working posture score and current working posture score for that particular

operation (welding) using Rapid Entire Body Assessment technique.

7. As per score for each limb position modification is suggested to obtain optimized total score.
8. Finally new working posture is determined showing greater efficiency and getting rid of different body limbs pain.
9. Other working conditions are also recorded like temperature of production house, sound level, intensity of vibration, dust pollution level, light intensity, air purity, provision of first aid etc.
10. Changes if required are suggested as per study in above said parameters for betterment of prevailing conditions.

Observations are taken via a study conducted in Central India Machine Manufacturing Company, Bharatpur .

1.2 Study conducted

1. Analyse the posture data gathered in shop via Rapid Entire Body Assessment Software.

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

Step 1: Locate Neck Position

 Step 1a: Adjust...
 If neck is twisted: +1
 If neck is side bending: +1
 Neck Score:

Step 2: Locate Trunk Position

 Step 2a: Adjust...
 If trunk is twisted: +1
 If trunk is side bending: +1
 Trunk Score:

Step 3: Legs

 Leg Score:

Step 4: Look-up Posture Score in Table A
 Using values from steps 1-3 above, locate score in Table A.

Step 5: Add Force/Load Score
 If load < 11 lbs : +0
 If load 11 to 22 lbs : +1
 If load > 22 lbs : +2
 Adjust: If shock or rapid build up of force: add +1
 Force/Load Score:

Step 6: Score A, Find Row in Table C
 Add values from steps 4 & 5 to obtain Score A.
 Find Row in Table C.

Scoring:
 1 = negligible risk
 2 or 3 = low risk, change may be needed
 4 to 7 = medium risk, further investigation, change soon
 8 to 10 = high risk, investigate and implement change
 11+ = very high risk, implement change

SCORES

Table A

	Neck												
	1				2				3				
Legs	1	2	3	4	1	2	3	4	1	2	3	4	
Trunk Posture Score	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

Table B

	Lower Arm					
	1			2		
Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2
	2	1	2	3	2	3
	3	3	4	5	4	5
	4	4	5	5	5	6
	5	6	7	8	7	8
	6	7	8	8	8	9

Table C

Score A (score from table A plus force/load score)	Score B, (table B value coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	7	8	8	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	10	10	10	11	11	11
8	8	8	8	9	10	10	10	10	11	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	12	12	12	12	12	12
11	11	11	11	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

B. Arm and Wrist Analysis

Step 7: Locate Upper Arm Position:

 Step 7a: Adjust...
 If shoulder is raised: +1
 If upper arm is abducted: +1
 If arm is supported or person is leaning: -1
 Upper Arm Score:

Step 8: Locate Lower Arm Position:

 Lower Arm Score:

Step 9: Locate Wrist Position:

 Step 9a: Adjust...
 If wrist is bent from midline or twisted: Add +1
 Wrist Score:

Step 10: Look-up Posture Score in Table B
 Using values from steps 7-9 above, locate score in Table B.

Step 11: Add Coupling Score
 Well fitting Handle and mid range power grip, good: +0
 Acceptable but not ideal hand hold or coupling acceptable with another body part, fair: +1
 Hand hold not acceptable but possible, poor: +2
 No handles, awkward, unsafe with any body part, Unacceptable: +3
 Coupling Score:

Step 12: Score B, Find Column in Table C
 Add values from steps 10 & 11 to obtain Score B. Find column in Table C and match with Score A in row from step 6 to obtain Table C Score.

Step 13: Activity Score
 +1 1 or more body parts are held for longer than 1 minute (static)
 +1 Repeated small range actions (more than 4x per minute)
 +1 Action causes rapid large range changes in postures or unstable base

Final REBA Score

Task name: _____ Reviewer: _____ Date: _____/_____/_____
 This tool is provided without warranty. The author has provided this tool as a simple means for applying the concepts provided in REBA. © 2004 Human Consulting, Inc. provided by Practical Ergonomics rbarber@ergosmart.com (816) 444-1667

2. OTHER FACTORS

Moisture content

Winter condition- Relative humidity <40%

Summer condition-Relative humidity<60%

Most desirable range- 30%-70%

Air Quantity

1-1.5 cubic metre per minute per worker is required in a factory.

Air motion

Air velocity inside workshop<8-12 metre/minute.

Most desirable-5-8 m/min

Air velocity above the occupied zone should be very high for good distribution of air.

Optimum effective temperature

Winter-19 degree celcius

Summer-22 degree celcius

Sound level

level<60 decibel

Prolonged exposure to sound above 80db(noisy factory) may lose concentration, increase annoyance and may even cause hearing loss.

Noise control strategy

1. Use damping wooden partitions in factory etc.
2. Changing orientation of noisy m/c away from workers
3. CAST iron foundation
4. Installing m/cs on bases having hydraulic /pneumatic shock absorbing system
5. Filling silica sand in workshop floors.

3. RESULT/CONCLUSION

Height of table for assembling or welding should be 10 to 12 cm below elbow level for welding work. Elbow height for welding is 1000 m. Table height is made adjustable and it can vary from 300 mm to 900mm.

Limitation in designing of table is that worker can work up to his eye height.

Width of table should be within forward arm reach or mid position length. So table width is taken 810 m

4. FUTURE RESEARCH DIRECTION

This study can be used as a reference for further study to design ergonomic workstation for table

This study can also used for to design new tools and improve other ergonomic factors.

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