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Applications of Ergonomics and Work Study in an Organization (A Case Study)

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Abstract:- In many organizations the workers are suffered with Musculoskeletal disorders (abbreviation: MSD), Repetitive strain injury, Carpal tunnel syndrome. MSD is a term that refers to soft tissue injuries that occur gradually over time and can affect muscles, tendons, ligaments, joints, and nerves. Working for longer periods in a standing position can cause muscular fatigue, sore feet, and lower back pain. Physically demanding jobs such as heavy lifting, pulling, pushing, and moving of equipment in awkward postures may result in Musculoskeletal disorders (MSDs). In addition, the improper layout of work areas can cause irregular movements of workers which causes major health issues. Thus, the prime objective of this research is the Risk Assessment of Working Postures using Ergonomic Tools like Rapid Entire Body Assessment (REBA), and to make necessary changes in the workplace layout using work study techniques.

***Keywords*:-** *Musculoskeletal Disorder, Repetitive Strain Injury, RULA, REBA, Work Study.*

I. INTRODUCTION

Problems related to Ergonomics are caused by both works associated, and non-work associated conditions can either individually or by both interacting with each other. The main risk for ergonomic problems like musculoskeletal disorders, Repetitive strain injury, and carpel Tunnel syndrome are the frequent motion tasks, awkward posture, vibrations, forceful movements, stress at workplace, poor workplace setup.

Work study is the systematic examination of the methods of carrying out activities to improve the effective use of resources and to set up standards of performance for the activities being carried out. Work study helps to improve job performance, optimum usage of plants and machinery, standardization of work methods, etc.

The proposed work is done in a XYZ organization which is engaged in overhauling of the locomotive components. Major problems faced in this organization are the irregular movements of the workers and their awkward working postures. This paper explores the use of ergonomic risk assessment tools and work study techniques.

➢ *Objectives of the Study*

- To assess the industrial ergonomics and its effects on the workers in an organization.
- To know and understand employees work postures and Repetitive body movements at work.
- To study the present work layout process and identify the areas having delays.
- To suggest changes in the existing layout to reduce the movements of the workers.

➢ *Scope of Study*

The overall objective of the project is to identify the difficulties of the employees at the workplace, and to determine the risks involved in their working postures. The scope of the study is limited to risk assessment of the working postures and to suggest changes in the workplace layout only.

II. LITERATURE REVIEW

Malashree, P., et al. [1] focused on the movements of the workers and their relationship with their work environment. The author conducted a video work study and evaluated every minute movement of the workers. By utilizing ergonomic tools, the risk assessment was carried out and the nature of risk is highlighted. It also focused on the effective utilization of resources using work study techniques, and the areas having unnecessary movements. The delays are eliminated by combining some activities.

Yadi, et al. [2] Conducted MSDs risk assessment using RULA and REBA Ergonomic tools, and the main aim is to reduce the potential risk of awkward work postures in suspending agent workstations in chemical industries. The statistical hypothesis tests using the RULA/REBA method showed that these improvements would decrease the risk of workers involved in awkward postures.

Sujay Biswas, et al. [3] In this paper, work study is adopted in an air duct manufacturing company, in west Bengal. At first, the Manufacturing Enterprises units have been observed and thereafter, a particular operation of the enterprise is observed minutely. The past record of product is observed. The stillness of the worker is noted and the interaction with the hierarchy of the production unit is also observed. In this way, the main cause of work study is analyzed for improving productivity.

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Saheb Gowda, et al. [4] In this case study, it is based on ergonomic study of a workstation, the main aim is to reduce musculoskeletal, physiological stresses of the workers and to find the RULA and REBA score. According to the score and risk factor identified, the workstation is redesigned to reduce the risk of WMSD. After implementation, the working area in plastic industry RULA score, and REBA score are reduced considerably.

Murshida Khatun, et al. [5] produced a relationship between productivity and efficiency using work study techniques. The focus was to identify the areas having irregular worker movements, improper work layouts and to improve production methods by eliminating, combining of the activities and to reduce the production time, and the improvement of Ergonomics.

Khalid S, et al. [6] in this paper, a survey was conducted and according to the survey results, a workplace layout was selected, and the process of a particular section of the automobile industry is critically examined. During the study the process having delays was identified with an operation process chart, and analysis was done with the help of simulation software called Arena. And then obtained the suitable solution to increase the production capacity.

Prem Chouhan et al. [7] This paper highlights a methodology developed for improving the employee's productivity and lowering fatigue in manufacturing line by using Work Study techniques. It revealed the excessive movements of operators and workers. Work study in productivity improvement could be done in time study.

Centindere et al. [8] used to implement work and time study technique for earth energy glass Manufacture Company they worked upon the location of mold room subject to the work and time study forces the molder walk for meters during the days and this applies also to the machine operator who comes and collects the ready molds.

Gujar et al. [9] in this project, the focus is the improvement of Productivity using work study technique in a manufacturing industry. The project was conducted live, where several tools and techniques were employed to increase the efficiency and productivity of the industry.

Lakhwinder pal Singh [10] presented an effective utilization of Ergonomic tools for the risk assessment of the workers. RULA and REBA techniques are well developed methods of ergonomic risk assessment, and they are utilized in the assessment of workers risk in welding areas and manual material lifting areas. After evaluating the nature of the risk involved, a safer means of doing the work is suggested by considering the RULA and REBA score.

III. METHODOLOGY

A. Ergonomics

REBA (Rapid Upper Limb Assessment): In REBA, the body is divided into two segments, first includes neck, trunk, and legs, then second consists of arms and wrists. Each segment is to be rated individually with reference to movement planes. From the figure 1 we can observe that,

Fig 1 Assembling Piston Head

The neck of worker is in extension. Therefore, his neck score is 2. As the neck is twisted add +1. Total neck score is 3, the trunk position is bent forward, hence trunk score is +3. And, trunk is twisted and side bending, add +2. Total trunk score is 5. The legs are straight and sometimes adjusted, hence leg score is 2. The posture score A obtained is 8. As the worker is engaged in lifting the components of weight more than 7kgs, the load score is taken as +2. Final score A is obtained by adding load score and posture score A. Final score A is 9, the upper arm position is bent more than 90˚, hence upper arm score is 4, and the shoulder is raised, so add +1. The total upper arm score is 5. The lower arm position is more than 60˚, hence lower arm score is 2. The wrist is engaged at more than 30˚, and the wrist is twisted, therefore the total wrist score is 3. The look up posture score B is obtained using upper arm and lower scores. The posture score B obtained is 8. The manual gripping of the components is poor, and not acceptable, hence coupling score is taken as +2. Final score B is obtained by adding coupling score and posture score B. Final score B is 10, the overall grand score C is obtained using posture score A and posture score B. The overall grand score C obtained is 12. Since the worker is engaged in assembling and dismantling operations, he is required to repeat actions, and some body parts are held in static position more than 1 minute, hence the activity score is +1. Final REBA score is calculated by adding Score C and activity score. The final REBA score is 13. The REBA score for existing method is 13, and the level of MSD is very high risk.

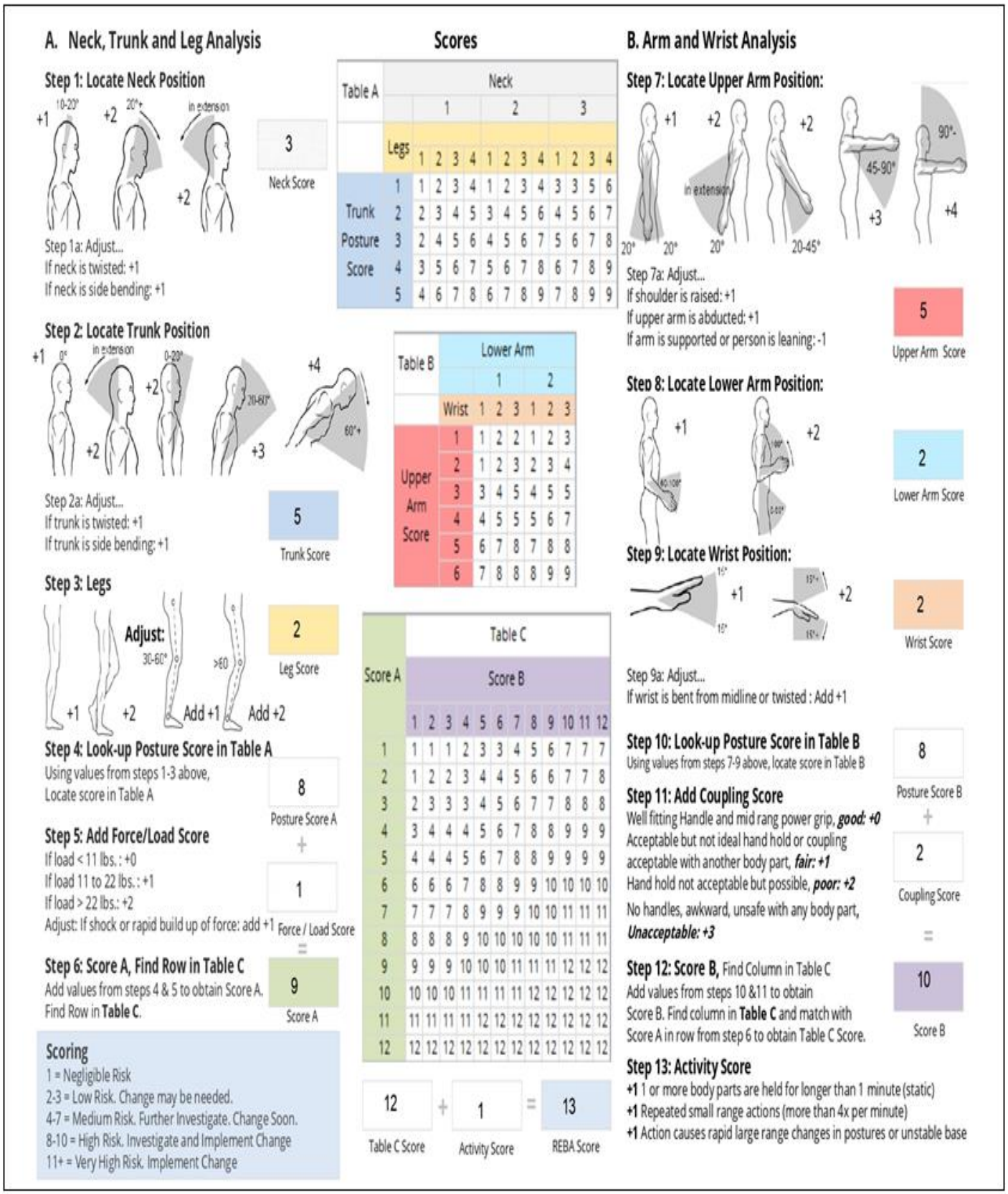

Fig 2 REBA Worksheet of an Employee Involved in Overhauling Process

B. Method Study

To accomplish the objective of the research, method study concept was selected. The steps in the method study are, the selection of work to be studied and to note the relevant facts about existing method, and then study the documented facts critically and in ordered sequence and the next step is to develop the most economical, realistic, and effective method. Finally state new method and set in place as standard method and sustain the standard practice by typical checks.

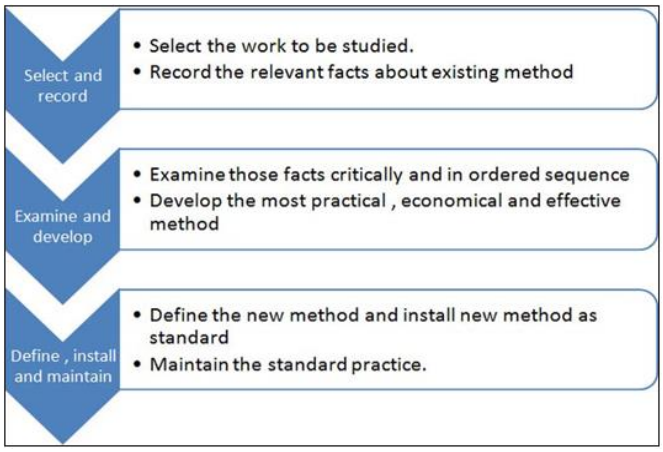

Fig 3 Method Study

➢ *Select*

By close observation of the operations of the plant and the various movements made by the workers, it was found that X-section of the plant was engaged in overhauling process of the motor, and it involved many irregular movements. Hence, this section was selected for the conducting method study.

➢ *Record*

In this process, the sequence of activities is that the unit to be overhauled comes from the storage area to the receiving floor by using crane. Then the unit number is checked and noted. Then the unit is picked up by the crane and then it is sent to the dismantling bench. After a short delay (due to lack of tools), the unit is completely dismantled. The parts are then sent to the blower section. The blowing operation is carried out to remove the dust particles, and then the parts are sent into oven for heating process. After heating the parts at a certain temperature, they are taken out and allowed to cool for some time. After this delay, the whole unit and the parts are sent to the assembly section using a crane. After a delay (due to lack of tools and oil), the greasing operation and assembly operation is performed. After the assembly operation, the unit is sent to the inspection section by crane. After a short delay, the inspection process is carried out on the outer part of the unit. It is then picked up by the crane and then again sent to the test bench for testing. After successful testing, it is then picked up by the crane and then sent to the storage area. The c sequence of operations has been recorded on a flow process chart shown in figure 4.

➢ *Examine*

A critical examination using the questioning technique, at once raises many questions like, why is the dismantle section placed far from the test bench? Why are the two ovens placed far away? Why the unit is sent to inspection section after assembly operation, even though it can be done there itself? Why there is a waiting period before every operation?

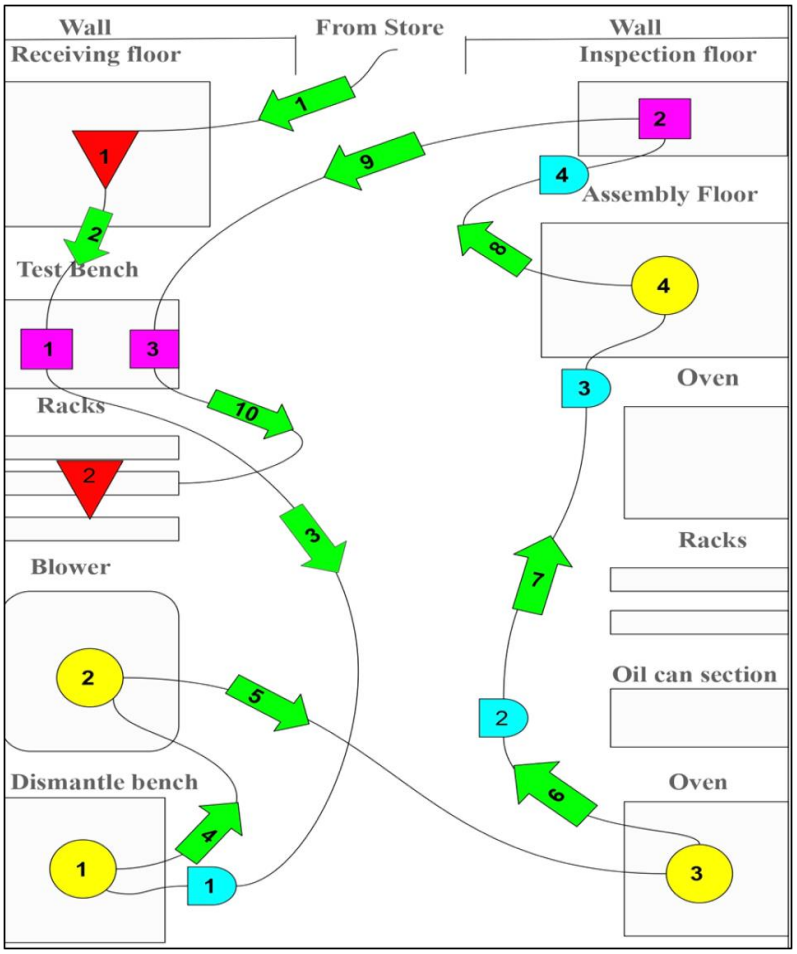

Fig 4 Unit Dismantling, Cleaning, Assembling and Inspection (Original Method)

Flow process chart	Material Type			
Subject charted: Used motors	**Activity**		**Present**	**Proposed**	**Saving**
Activity: Motor stripping, cleaning, Greasing and inspection.	Operation		4		
	Transport		10		
	Delay		5		
	Inspection		3		
Method: present	Storage		2		
	Distance (m)		50.3		
Location: M7 section	Time(work-min)				

Description	Qty	Dis (M)	Tim (min)	Symbol	Remarks
Stored in motor storage area.					
Motor transported to receiving floor.		5			By crane
Motor checked and noted.					
Transported to test bench.					
Testing/ test run		1			By crane
Transported to dismantle bench.					
Stored temporarily waiting for tools.					By crane
Motor stripped.					
Main components carried to blower.		14			
Blowing/ vacuum operation					By crane
Transported to oven.		2			
Heating process					
Taken out of oven.					By crane
To cool					
Transported to assembly floor.		3.3			By crane
Stored temporarily waiting for tools.					
Assembling process					
Transported to inspection floor.		1			By crane
Waiting for inspection tools					
Inspection					
Transported to test bench.		11			By crane
Testing process					
Transported into racks.		3			
Storage		4			
TOTAL		**50.3**		**4 10 5 3 2**	

Fig 5 Flow Process Chart: Unit Dismantling, Cleaning, and Assembling (Original Method)

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➢ *Development of the method*

From the questions raised above we can ask "Why does the delay occur every time before operation?", the answer for this is that to have a separate tool room space for this section would eliminate this problem. And, for the location of storage racks it is advised to place the storage racks at the entrance of the layout. The assembly and inspection operations could be done at the same place to eliminate unnecessary movements of the workers. And the test bench position is also advised to be placed after the assembly section. It will be seen from the summary on the flow process chart (figure 5) that the "inspections" can be reduced from two to one, the "transports" from nine to seven and the "delays" (or temporary storages) from four to one. The distance travelled can be reduced from 50.3 to 31.8 meters.

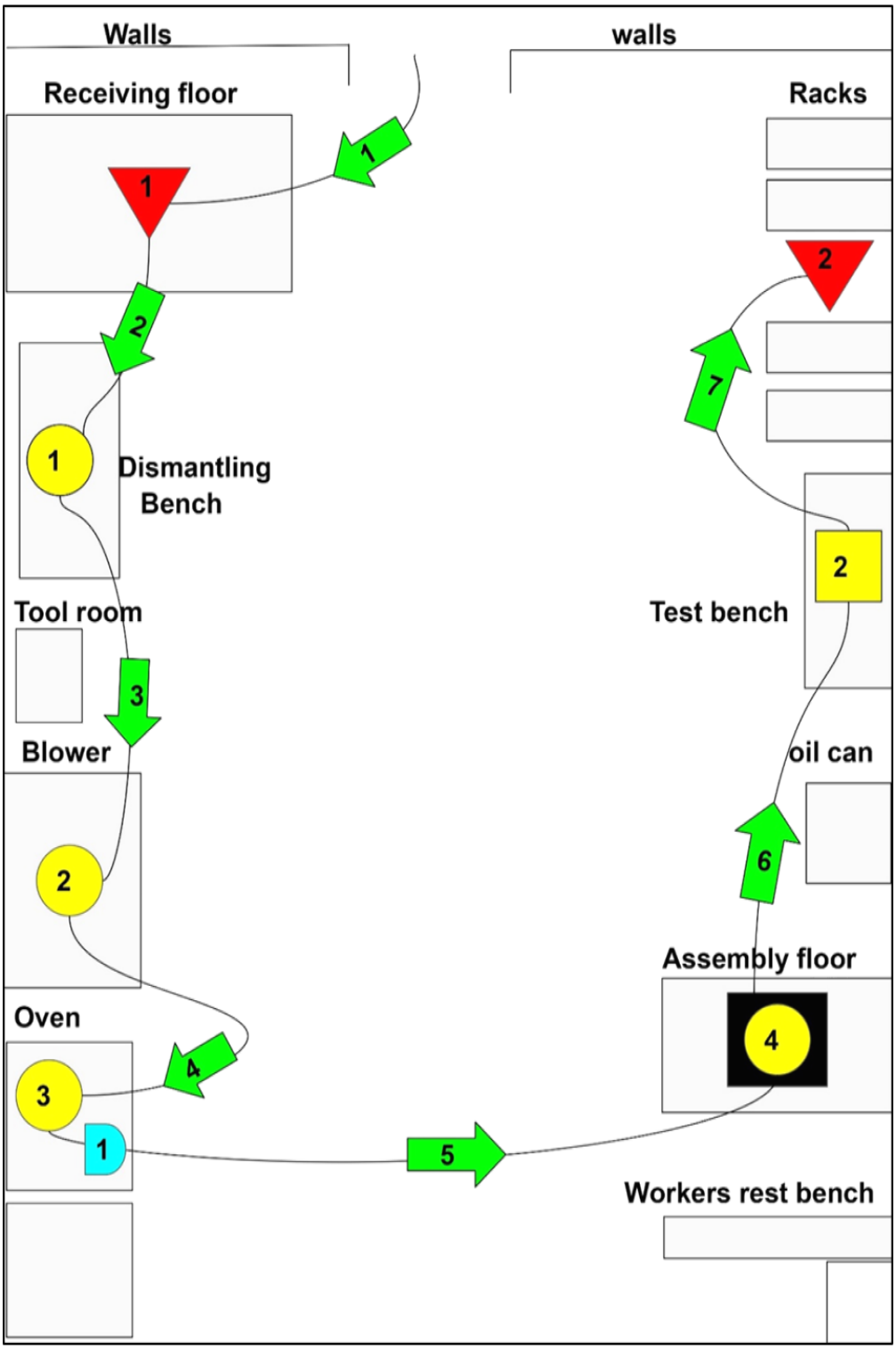

Fig 6 Flow Diagram: Unit Dismantling, Cleaning, Assembling and Inspection (Proposed Method)

Flow process chart	Material Type			
Subject charted: Used Motors	**Activity**		**Present**	**Proposed**	**Saving**
Activity: Motor stripping, cleaning, Greasing and inspection.	Operation		4	4	--
	Transport		10	7	3
	Delay		4	2	3
	Inspection		2	1	1
	Storage		2	2	--
Method: present	Distance (m)		50.3	31.8	18.5
Location: M7 section	Time(work-min)				

Description	Qty	Dist. (M)	Time (min)	Symbol
Stored in motor storage area.				
Motor transported to receiving floor.		5		
Motor checked and noted.				
Transported to dismantle bench.		3.5		
Motor stripped.				
Main components carried to blower.				
Blowing/ vacuum operation		5		
Transported to oven.				
Heating process				
To cool		2		
Transported to assembly floor.				
Assembling & Inspection process		3.3		
Transported to test bench.				
Test run		6		
Transported into racks.				
Storage				
		7		
Total		31.8		3 7 2 1 2 1

Fig 7 Flow Process Chart: Unit Dismantling, Cleaning, and Assembling (Proposed Method)

IV. RESULTS AND DISCUSSIONS

Regarding the problem of work posture 1, the assessment score obtained is 13. This implies that the worker is highly affected, and the complete working posture should be changed immediately. In this case, adopting the height adjustable benches will enable the workers to maintain an appropriate working height according to their requirements.

Regarding the problem of workplace layout, in the existing method there are lot of unnecessary movements by workers and delays because of poor workplace layout. In the new method, by changing the work layout most of the non-value-added activities can been eliminated. From suggested improvement ideas, the transport can be reduced from 10 to 7, and distance involved can also be reduced from 50.3 to 31.8 meters, delays can be reduced from 4 to 1, and a saving of over 36.77 percent in travel of each motor can be achieved.

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