Proposed Design of Workstation for Rural Blacksmith

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Abstract—Ergonomic consciousness is increasing among the blacksmiths and agricultural workers of India. Traditional workstation of rural blacksmith having many disadvantages as far as ergonomics is concerned. With the purpose of identification and assessment of end user requirements it is necessary to integrate human factors into design from the start of the design lifecycle. Hence, anthropometric data will helpful for efficient and safe design of blacksmith’s workstation, hand tools and machines. To achieve better efficiency of performance, more human comfort and to reduce musculoskeletal injury, it is necessary to design the hand tools and equipment keeping in consideration the operator’s capabilities and limitations. The design of equipment is always a compromise between the operator’s biological needs, which are determined by the ergonomics guidelines, and physical requirements of the equipment. In this regard, the basic information required is the anthropometric body dimensions of the users of tools and equipment.

Keywords—Workstation Design, Industrial Design, Principle of Motion and Economy, Ergonomically Design

I. INTRODUCTION

There is no need to mention that appropriate technology can help us in improving the working efficiency of the blacksmiths and their trades. It can also help us in improving the quality of the finished products. Blacksmiths have been the most important group and enjoyed utmost respect in the traditional rural setup. No agriculture, no rural industry could sustain without blacksmith. They were the tools suppliers for the agriculture and at the same time tools suppliers for the agro industry sector, providing repair and maintenance service both. Villages still depend a lot on these traditional blacksmith despite lot of technological improvements taking place in the industrial mode of factory type production. This is also true that most of these blacksmiths have not been benefitted by technical assistance through government or non government efforts and still work with age old technologies. At the same they are able to just service because products and service that they are providing at an affordable cost to the rural society are yet not given through any other group. Therefore it is essential to preserve, promote and support blacksmith, who can in future play a key role in rural industrialization. Design of workstation for Rural Blacksmith of South Gujarat is one step towards the same.

The rest of the paper is divided as follows: Section II Explains Traditional Blacksmith’s Workstations Section III Deals with Human Factors Integration Section IV. Discuss The Principle of Motion Economy, A Use of the human body, B Arrangement of the workplace. C Design of tool and equipment Section V. Classification of Movements. Section VI Discusses Workplace Layout and Simplification of Movements. Section VII explains Blacksmiths Operation. Section VIII Gives Proposed Design. Section IX States Conclusion.

II. TRADITIONAL BLACKSMITH’S WORKSTATIONS

Different blacksmith’s workstations from different places of South Gujarat are shown in following figures. Traditionally blacksmith is having sitting workstation for their work which is ergonomically very poor design. As shown in figures furnace, toolbox, coal storage, anvil and quench basin are not in the reach of the lady. Time taken for movement of hands from furnace to quench basin is also more that is why they have to do more hammering and repeat it again and again until the shape will be made. So productivity and efficiency is less. Due to poor design as far s ergonomics is concerned, they are having muscular problems.

Figure I Workstation of Blacksmith at Buhari of South Gujarat.
In order to promote operability and reliability of the facility, it is essential that end user requirements are captured in the development phases, and implemented into the system design. HF integration enables designers to understand what end users can and cannot do as compared to the tasks they will be required to undertake once the ‘system’ is operational. Workstation design in terms of physical dimension, including seating can solve lots of problem of end user. This aims to minimize the risk of operator discomfort and related muscular-skeletal problems such as back and shoulder complaints. Workstation layout, should such that specifically the positioning of equipment on and around the workstation to ensure that it is visible and within easy reach of the operators who will use it [1].

III. HUMAN FACTORS INTEGRATION

Without Human factors integration, system designers and end users may not have an adequate understanding of each other’s requirements. If a project proceeds on this basis, with engineering design and operations planning being insufficiently integrated, the project may deliver a facility that has operability problems and hence potential reliability and safety concerns.

IV. THE PRINCIPLE OF MOTION ECONOMY

There numbers of “principles” concerning the economy of movements which have been developed as a result of experience and which form a good basis for the development of improved methods at the workplace. They may be grouped under three headings:

A. Use of the human body
B. Arrangement of the workplace
C. Design of tools and equipment

A. Use of the human body

1. The two hands should begin and complete their movements at the same time.
2. The two hands should not be idle at the same time except during periods of rest.
3. Motions of the arms should be symmetrical and in opposite directions and should be made simultaneously.
4. Hand and body motion should be made at the lowest classification at which i.e. is possible to do the works satisfactorily.
5. Momentum should be employed to help the worker, but should be reduced to a minimum whenever it has to be overcome by muscular effort.
6. Continuous curved movements are to be preferred to straight line motions involving sudden and sharp changes in direction.
7. “Ballistic” (i.e. free swinging) movements are faster, easier and more accurate than restricted or controlled movements.
8. Rhythm is essential to the smooth and automatic performance of a repetitive operation. The work should be arranged to permit easy and natural rhythm whenever possible.
9. Work should be arranged so that eye movements are confined to a comfortable area, without the need for frequent changes of focus.

B. Arrangement of the workplace

1. Definite and fixed stations should be provided for all tools and materials to permit habit formations.
2. Tools and materials should be pre-positioned to reduce searching.
3. Gravity feed, bins and containers should be used to deliver the materials as close to the point of use as possible.
4. Tools, materials and controls should be located within the maximum working area and as near to the worker as possible.
5. Materials and tools should be arranged to permit the best sequence of motions.
6. “Drop deliveries” or ejectors should be used wherever possible, so that the operative does not have to use his or her hands to dispose of the finished work.
7. Provisions should be made for adequate lighting and a chair of the type and height to permit good posture should be provided. The height of the workplace and seat should be arranged to allow alternate attending and sitting.

C. Design of tools and equipment

1. The hand should be relieved of all work of “holding” the work piece where this can be done by a jig, fixture or foot operated device.
2. Two or more tools should be combined wherever possible.
3. Handles should be so designed that as much surface of the hand as possible can come into contact with the handle. This is especially necessary when considerable forces have to be used on the handle.

V. CLASSIFICATION OF MOVEMENTS

The fourth rule of motion economy in the use of the human body calls for movement’s to the of the lowest classification possible. The classifications are built up on the pivots around which the body members must move, as shown in table.

<table>
<thead>
<tr>
<th>Class</th>
<th>Pivot</th>
<th>Body movement(s) moved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Knuckle</td>
<td>Finger</td>
</tr>
<tr>
<td>2</td>
<td>Wrist</td>
<td>Hand and Fingers</td>
</tr>
<tr>
<td>3</td>
<td>Elbow</td>
<td>Forearm, Hand and Fingers</td>
</tr>
<tr>
<td>4</td>
<td>Shoulder</td>
<td>Upper arm, Forearm, Hand and Fingers</td>
</tr>
<tr>
<td>5</td>
<td>Trunk</td>
<td>Torso, Upper arm, Forearm, Hand and Fingers</td>
</tr>
</tbody>
</table>

It is obvious that each movement above class 1 will involve movements of all class below it. Thus the saving in effort resulting from using the lowest class possible is obvious. If, in laying out the workplace, everything needed is placed within easy reach, this will minimize the class of movement which the work itself requires from the objective.

VI. WORKPLACE LAYOUT AND SIMPLIFICATION OF MOVEMENTS

1. If similar work is being done by each hand, there should be a separate supply of materials or parts for each hand.
2. If the eyes are used to select material, as far as possible the material should be kept in an area where the eyes can locate it without there being any need to turn the head.
3. Use semi-circular arrangements.
4. Design the workplace using ergonomic principles.
5. The nature and the shape of the material influence its position in the layout.
6. Hand tools should be picked up with the least possible disturbance to the rhythm and symmetry of movements. As far as possible the operator should be able to pick up or put down a tool as the hand moves from one part of the work to the next, without making a special journey. Natural movements are curved, not straight: tools should be placed on the arc of movements of any material which has to be slid along the surface of the bench [2], [3].

VII. BLACKSMITHS OPERATION

Blacksmith must try to make each hammer blow as effective as possible with a minimum expenditure of body energy. The way to accomplish this is not as obvious to the beginner as it may seem, but must be learned through practice, until it becomes automatic. Any effort that concentrates action in the shoulder alone should be avoided.

Blacksmith stand at the anvil with legs spread enough to brace him firmly, one foot a little back and the other forward under the anvil overhang. Bend our head directly over the anvil, but hold it a little to the side to make certain that the hammer swings safely past it. There is a real danger that the hammer, bouncing back from an accidentally missed stroke, could hit
your head. At the same time, keep our head close to the work, in order to have a clear view of every mark made on the hot steel by the hammer. This allows you to judge where to strike next [4], [5], [6].

VIII. PROPOSED DESIGN

Proposed design is made with the use of ergonomics principle and principles of motion economy. It is just sample of design which can produce better productivity than the old one design. The efficiency of this design may also higher due to time compensation. The muscular pain also less due to sitting and operational comforts. One may be able to change the dimensions of the design with respect to body dimensions like stature, vertical reach, vertical grip reach and so on. As body dimensions are differ with geographical location this design dimensions are also differs [7], [8].

Figure IV Front view for Proposed Design of workstation

IX. CONCLUSION

To achieve better efficiency of performance, more human comfort and to reduce musculoskeletal injury, it is necessary to design the hand tools and equipment keeping in consideration the operator’s capabilities and limitations. The design of equipment is always a compromise between the operator’s biological needs, which are determined by the ergonomics guidelines, and physical requirements of the equipment.

- Integrating human factors into design projects as a means to bridge the gap between designers and end-users.
- There is great scope of improving workstation of Rural Blacksmiths and their hand tools and equipment based on scientific application of anthropometric data of Blacksmiths.

REFERENCES