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INTEGRATED APPROACH TO DESIGNING WORKSTATIONS IN ERGONOMICS

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Abstract:

Requirements for the design, operation and convenience of workstations. Ergonomics includes designing a workplace that meets the needs of the worker. The article talks about research in the design of product design parameters in the ergonomic design of workstations.

Keywords: workstation design, ergonomic design, design parameters, design, environment, protection

Introduction

Designing workstations is a very important task. For every ergonomist, the above statement may seem trivial. Moreover, every ergonomist recognizes that working life around the world is full of not only ergonomic deficiencies, but also blatant violations of basic ergonomic principles. Apparently, there is widespread ignorance of the importance of workstation design among those responsible: production engineers, supervisors, and managers.

The goal of ergonomic research is to facilitate the employee's adaptation to natural, social-psychological and technical-organizational conditions in production. The focus of ergonomics is to find ways and methods of adapting human activity, production environment to the characteristics and capabilities of the human body in specific production conditions. It is worth noting that there is an international trend in industrial work, which emphasizes the importance of ergonomic factors: the demand for product quality, flexibility and accuracy of product delivery is increasing. These requirements are incompatible with a conservative view of work and workplace design.

Although the physical factors of workplace design deserve the main attention in today's environment, it is important to remember that the physical design of the workstation cannot be separated from the actual work organization. This principle is evident in the design process described below. The quality of the final result of the process rests on three pillars: ergonomic knowledge, the participation of productivity quality requirements must meet this integration, and this is the main focus of this article.

RESEARCH MATERIALS AND METHODOLOGY

Workstations are designed for work. It should be recognized that the starting point in the workstation design process is to achieve a specific production goal. The designer—often a manufacturing engineer or other middle-management level person—develops an internal vision of the workplace and begins to implement that vision through its planning tools. The process is iterative: starting with a rough first attempt, the solutions gradually become more and more precise. It is important to consider ergonomic aspects in each iteration as work progresses.

It should be noted that ergonomic design workstations are closely related to ergonomic evaluation workstations. In fact, the structure to be observed here applies equally to situations where a workstation already exists or is in the planning stage.

There is a need for a structure that ensures that all relevant aspects are taken into account in the design process. A traditional way of dealing with this is to use a checklist that contains a series of variables that should be considered. However, general purpose checklists are usually bulky and difficult to use because only a portion of the checklist may be relevant in a particular design situation. Also, in practical design situations, some variables are more important than others. A methodology is required to consider these factors together in a design setting. Such a methodology is proposed in this paper.

RESEARCH RESULTS

Workstation design recommendations should be based on an appropriate set of requirements. It should be noted that it is not enough to take into account threshold values for individual variables. The recognized common goal of maintaining productivity and health requires a more ambitious approach than the traditional design case. In particular, the issue of musculoskeletal complaints is a key aspect in many industrial settings, although this category of problems is not limited to the industrial environment.

During the design and implementation of a workstation, there is always a need to inform users and organize the project to ensure full user participation and increase the possibility of full acceptance of the end result. Consideration of this goal is beyond the scope of this treatise, which focuses on the problem of achieving an optimal solution for the physical design of the workstation, but the design process nevertheless allows for the integration of such a goal. The following steps should always be taken into account in this process:

1. a set of requirements defined by the user
2. priority of requirements
3. transfer requirements to specifications according to (a) technical requirements and (b) user requirements
4. Iterative development of the physical layout of the workstation
5. physical implementation
6. trial period of production
7. full production
8. assessment and identification of recreation problems.

Here, the focus is on the first to fifth steps. Often, only some of these steps are included in the design of workstations. There may be various reasons for this. This may be the case when economic or time constraints are severe, or where there is neglect due to a lack of knowledge or understanding at management level.

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Experience shows that all these actors have their own unique knowledge, which should be used in this process.

A set of user-defined requirements must meet a number of criteria:

1. Hunger. The filter should not be used at the initial stage of the process. All points of view should be noted without criticism.
2. Non-discrimination. At this stage of the process, each category of viewpoint should be treated equally. Be aware that some people may be more open than others, and there is a risk that they will silence other actors.
3. Development through dialogue. There should be an opportunity to adapt and develop requirements through dialogue between participants from different backgrounds. Prioritization should be considered as part of the process.
4. The majority. The process of gathering user-defined requirements should be reasonably cost-effective and should not require the involvement of expert consultants or long time requirements on the part of the participants.

It should be noted that a quality function can be achieved by using a methodology based on a set of criteria. Aspects related to the working environment and safety, efficiency and quality should be covered. This activity can usually last ten to fifteen minutes as needed. A set of requirements defined by the user forms one of the bases for developing a requirement specification. Additional process information may be developed by other categories of participants, such as product designers, quality engineers, or economists; However, it is important to realize the potential contribution that users can make in this context.

According to the above considerations, ergonomic assessment of workplaces is largely a communication problem, given the complex set of variables that must be considered. Based on the discussion of the priorities described above, a cube model was developed for the ergonomic assessment of workplaces (Kadefors 1993). The main goal here was to develop a didactic tool for communication purposes, based on the assumption that in most situations output power, position, and time dimensions constitute interrelated, priority key variables.

It is recognized that the requirements for each of the key variables can be grouped by level of severity. Here, it is suggested that such grouping be done in three classes: (1) low requirements, (2) medium requirements, or (3) high requirements. The requirement level can be established using any scientific evidence or using a consensus approach with a panel of users. These two alternatives are certainly not mutually exclusive and may lead to similar results, but perhaps with different degrees of generality.

As mentioned, the combination of the main variables largely determines the level of risk for the development of musculoskeletal complaints and cumulative trauma diseases. For example, high time demands may make the work situation unacceptable in situations where there are at least moderate demands on strength and posture. It is essential that the most important variables are considered together when designing and evaluating workplaces.

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DISCUSSION

In addition to the main variables discussed above, depending on the specific conditions of the analyzed situation, it is necessary to take into account a set of variables and factors that characterize the workplace from the point of view of ergonomics. They include:

- precautions to reduce the risk of accidents
- specific environmental factors such as noise, lighting and ventilation
- exposure to climatic factors
- exposure to vibration (from hand tools or the whole body)
- Ease of meeting productivity and quality requirements.

The design process checklist observed here should be read in conjunction with user-defined requirements.

A QFD process was implemented to provide a set of workstation requirements with user conditions. Welders, production engineers and product designers were involved. User requirements not listed here covered many aspects such as ergonomics, safety, productivity and quality.

Using a cube model approach, the panel defined thresholds between high, moderate, and low burden based on consensus:

1. Mandatory variable. A loaded mass of less than 1 kg is called a low load, and more than 3 kg is a high load.

2. Postural stress variability. High-strain work positions include elevated, flexed, or deeply bent arm positions and kneeling positions, as well as situations in which the wrist is held in excessive flexion/extension or deviation takes A low tension state occurs directly when standing or sitting and the hands are in the optimal working zones.

3. Time is variable. Less than 10% of the work time devoted to welding is considered low demand, and more than 40% of the total work time is considered high demand. Average requirements occur when the variable falls between the above ranges or when the situation is uncertain.

From the evaluation using the cube model (Figure 1), it was found that high time demands are unacceptable if there are simultaneously high or moderate demands in terms of strength and postural tension. This design approach has significant advantages compared to just looking at plans. This allows the user to immediately see what the intended workspace will look like.

Figure 1. CAD version of the workstation for manual welding that came in the design process

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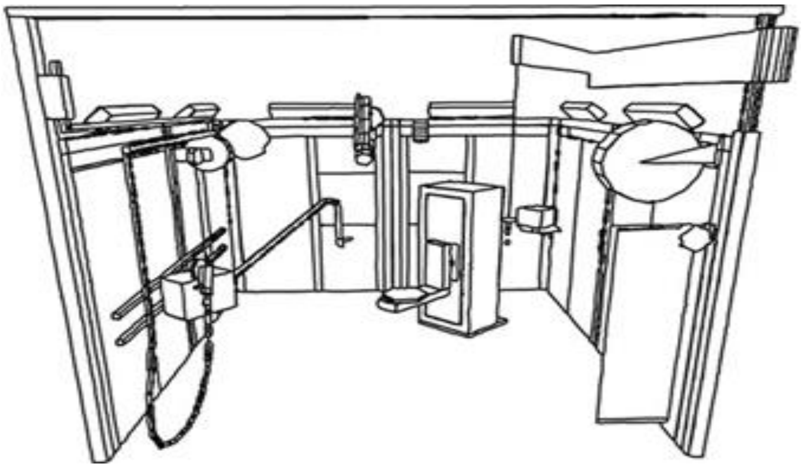

Figure 1 shows a welding workstation using a CAD system. It is a workstation that minimizes strength and posture requirements and meets almost all residual user requirements.

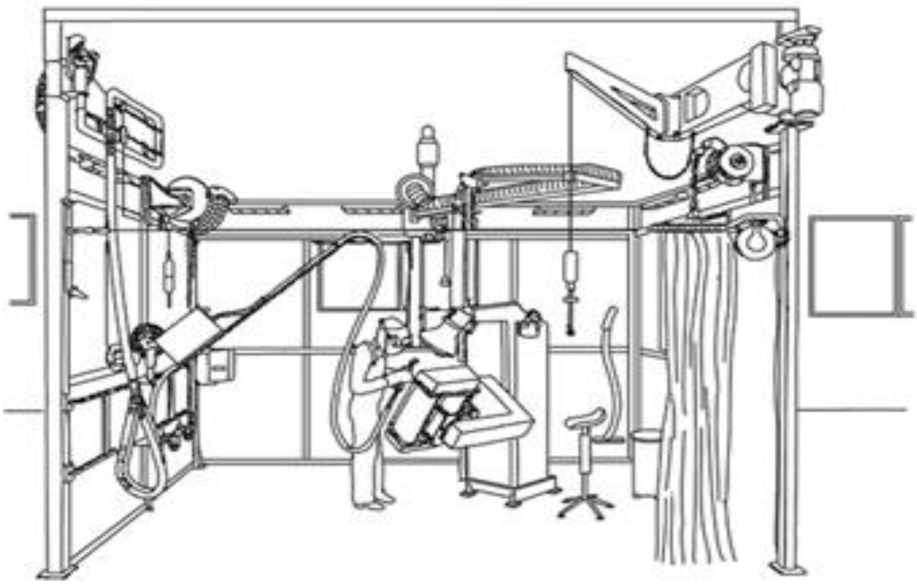

Figure 2. Implemented welding workstation

Based on the results of the first stages of the design process, the welding workplace (Fig. 2) was implemented. The assets of this workplace include:

1. Work in an optimized zone is facilitated by a computerized processing device for welding objects. A forklift is available for transportation. Alternatively, the facility is provided with a balanced lifting device for easy handling.
2. The welding gun and grinding machine are suspended, reducing power requirements. They can be placed anywhere around the welding object. A welding chair is provided.
3. All media comes from above, meaning no cables on the floor.

4. The workstation has three levels of lighting: general, workplace and process. Lighting of the workplace comes from the ramps above the wall elements. The process lighting is installed in the welding fume ventilation network.

5. There are three levels of ventilation in the workstation: general variable ventilation, ventilation of the work area with the help of a moving arm and ventilation integrated in the MIG welding gun. Ventilation of the workplace is controlled from the welding gun.

6. There are noise-absorbing wall elements on three sides of the workplace. A transparent welding curtain covers the fourth wall. This allows the welder to be aware of what is happening in the shop environment.

CONCLUSION:

Some of the basic documents in this article may need a broad set of background information to be able to properly design a workplace. Such data may include anthropometric data of user categories, data on load-bearing strength and other power output capacity of male and female populations, characteristics that constitute optimal work zones, and more.

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