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A PATH FOR HORIZING YOUR INNOVATIVE WORK

DESIGN OF BENCH VICE WORKSTATION BY CONSIDERING ERGONOMIC ASPECTS

PROF M. R.DHAWADE, PROF R.A. KUBDE

1. **Department of Mechanical Engg. IBSS College of Engg, Amravati.**
2. **Department of Mechanical Engg. PRMIT&R Amravati.**

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Corresponding Author

Prof. M. R. Dhawade

Abstract

The construction & use of filing station which allows the workers to work comfortable at standing position , Its adjustability allows a working height to suit 5th percentile & 95th percentile & preventing low back injuries at work or for accommodating injured employees who return to work.

ANTHROPOMETRIC DESIGN:

Anthropometry is the branch of the human science dealing with measurements of the size, weight & properties of the human body to achieve comfort, fit, & usability. All products including clothes, consumer products as well as system of products such as office workplace, vehicles & assembly lines need to be adjusted to user anthropometrics to maximize usability & minimize the negative effects on the user. The use of anthropometry in the workplace include,

- To evaluate postures & distance to reach control
- To specify clearance separating the body from hazards such as surrounding equipments
- To identify objects or elements that constrict movements
- To assist in the biomechanical analysis of forces & torque

Incorrect workplace adjustments to anthropometric characteristics lead to discomfort, pain & disorders in the neck & shoulders, arm, hand wrist, & back musculoskeletal disorders due to these reasons have been found in different context, such as the office, assembly line & filing workstations etc.

The obvious mismatch between the user's requirement & the engineering fitter was noted during study. The standard engineering fitter's bench as a height of 850mm when fitted with a conventional vice the top of the vice is 1020mm from the floor. The anthropometric data indicated elbow height is as shown in below table. It can be seen that the work surface of the bench lower than the elbow level of the 5th percentile female by 65mm & 95th percentile male by 308mm. The top of the conventional vice from the floor is lower than the 95th percentile male elbow height by 138mm. for the 5th percentile female elbow height is below the top of the conventional vice by 105mm which is unacceptable for many tasks.

The bench Height for standing work is usually designed to suit the smaller operator on basis of that it is easier for the taller person to stoop than it is for a smaller person to work with the arms constantly raised .However stopping is acceptable to most clients especially those suffering from the spinal disorders. It was prevented that an adjustable vice mount would allow to be positioned so that minimum stooping ensured.

Elbow height chart

	5th percentile	95th percentile
Male	983mm	1158mm
female	915mm	1051mm

A good workstation design is based on the Biomechanical, physiological, psychological Requirement of the user. There is a difference between work place design & work station Design. The workplace may include physical Fixture such as furniture, equipment, stairs Vehicles & is affected by environment variables Such as lighting, temp & noise. Workstation is defined as a location where the operator may stand only a portion of the working shift.

Methods & material:

Students are recruited by considering their height & weight. Student having no experience on filing on workstation & no history of musculosketel injuries are selected. Fifteen students participated in the vice evaluation experiment. All the students were 20 to 40 years of age or older.

Apparatus:

A workstation adjustable in height was constructed to simulate the vice task in a workshop. For the adjustment of height we can mount vice on a adjustable jack. At the workstation the height which was given above controlled from the floor. The workstation height adjustment ranges were determined to accommodate 5^{th} percentile to 95^{th} percentile population in terms of stature. Two instruments were used to measure physiological response in the experiment.

GRIP FORCE

The design, sizing & guidelines for tool handles are critical for hand tool comfort, functionality & safety. Tool handles should be extending beyond the hand when gripped to optimize these measures. Minimum handle length suggested between 10.2cm to 11.4cm. in addition to handle length, handle diameter is also important. Optimum range of handle diameter for males reporting that is 3 to 4cm. Size of handle should be rounded with as large as of a radius as possible.

Design considerations: (Fit the task, fit the user, and avoid injuries)

A) Fit the task- Grips Power grip:

i) Force parallel to forearm.eg. a file

ii) Force at angle to forearm, eg. A hammer

iii) Torque about the forearm eg. a screwdriver

Precision grip:

i) Internal where tool is held inside the hand eg. A table knife,

ii) External where the tool is held in thumb & index finger eg. A pen

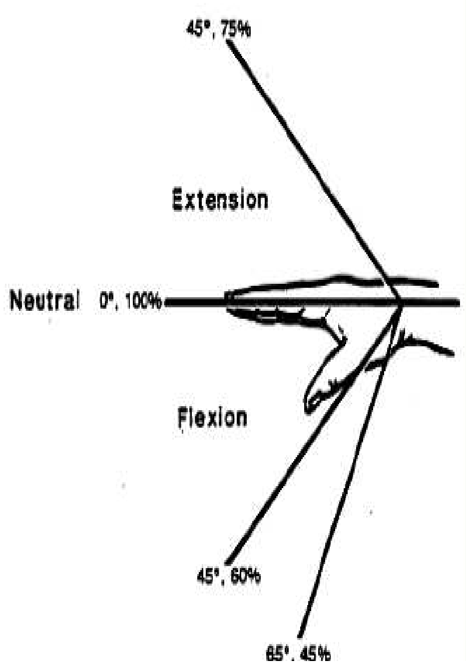
B) Fit the user: size of hand of population

C) Avoid injuries: Neutral position

POSTURE DESIGN

Working posture in sitting & standing has intrinsic advantage & disadvantages. Sitting gives stability to the torso & therefore good proximal fixation for the arms & eye to work with precision, while the legs & feet can relax. Demands on metabolism & circulation are lower in sitting than in standing. The disadvantage with sitting is reduced range of reach for the arms & an increased load on the lumber discs due to the tendency for the pelvis to tilt backwards. Standing gives advantage of mobility, reach & overview in comparison to sitting. The back is more easily held in a neutral position without increase of lordoses&kyphoses, on the other hand standing entails an increased risk for muscle fatigue in the lower extremities & back.

Affect of posture on grip strength:



EFFECTE DUE TO PROLONG WORKING

A document was produced by the international ergonomics association (IEA) technical committee on musculoskeletal disorders with the endorsement of the international commission on occupational health (ICOH). The jobs that potentially cause biomechanical overload due to repetitive movements of exertions of the upper limb. Risk assement requires identification & quantification of the following main risk factors,

- Frequency of action
- Awkward postures
- Movements of the upper limb
- Excessive use of force
- Lack of postural variations
- Inadequate recovery periods

Design of experimentation:

TOOL SELECTION –

- **Tool:**

A hand file is selected for the filing of material.

- **Specification of files:**

1) Type of file: Rough

Width of file	Weight of file	Length of file

2) Type of file: Smooth

Width of file	Weight of file	Length of file

- **Specification Of handle:**

1) Type of file: Rough

Length of handle	Diameter of handle

2) Type of file: Smooth

Length of handle	Diameter of handle

- **Material selection:**

Mild steel material is taken for experiment.

- **Size of material:**

50mmx5mm thickness M.S. flat

In this study of filing workstation, work surface height, gender of subject & height of subject are effect factors. Eight different combinations are used for study,

- Rough file with hand gloves & workstation is not designed ergonomically.
- Rough file without hand gloves & workstation is not designed ergonomically.
- Smooth file with hand gloves & workstation is not designed ergonomically.
- Smooth file without hand gloves & workstation is not designed ergonomically.
- Rough file with hand gloves & workstation is designed ergonomically.
- Rough file without hand gloves & workstation is designed ergonomically.
- Smooth file with hand gloves & workstation is designed ergonomically.
- Smooth file without hand gloves & workstation is designed ergonomically.

Design guidelines:

- Avoid design that incur static muscle tension
- Design the workstation to prevent overloading of the muscular system.
- Use footrests, wrist rest, proper backrest, and other ergonomic features to prevent fatigue.
- Design for allowing changes in posture
- Work surface height should depend on the size of the worker & the type of task performed i.e. precision, light assembly or heavy manual.
- Aim at dynamic work, avoid static work. Static work or static loading of the muscles is inefficient & accelerates fatigue. Static work can occur when holding a weight in one's arm for an extended period or constant bending of the back to perform some task.
- Primary control devices & workplaces should be placed within the normal working area.
- Work with both hands. Do not use one hand.
- Hands should move in symmetrical & opposite directions & use the feet as well as the hands.
- Design knowing the capacity of the fingers, do not overload the fingers.
- Counter balance tools when possible to reduce the weight & forces.
- Train the individuals to use the workstation facility & equipment properly.
- Design to accommodate more than just average user, make tools & the work environment adjustable or designed to fit a majority of the users.
- Design for the tallest workers where working height of the hands cannot be adjusted.
- Limit the amount of reaching & twisting required in handling tools.
- Design the bend in the tool to prevent twisting & bending of the wrist & use of excessive force.
- Avoid sharp or hard edges where hands contact tools.
- Incorporate changes in position or short breaks into the job or workstation to avoid static work situation.
- Use controls & displays that respond in the way most people expect them to, such as a knob that turns clockwise to increase volume.

Plan of experimentation:

The experiment will be conducted on 15 subject in which two sides of the given 5mm thickness M.S. plate will be made in right angle by using above mentioned different combinations for minutes. A heart rate, Grip force & Room temperature will measured .Also weight of material before & after filing will be measured.

Result:

We will measure pulse rate & grip force of the subject during operation by using eight different combinations. After taking all data we will explain our analysis in tabular & graphical form. Our result is awaited.

Measuring Instruments:

1) Heart rate monitorPOLAR ELECTRO OY (Made in Finland)
2) Hand dynamometer

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