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Physical workload in ship maintenance:
Using The Observer to solve ergonomics problems

Berna van Wendel de Joode, Caroline Verspuy and Alex Burdorf

Using The Observer for Ergonomics Research

Physical load and musculoskeletal disorders

Musculoskeletal disorders are an important cause of incapacity to work and lenghty absenteeism. This is a serious problem in many countries; in the Netherlands alone, some 250.000 persons each year are declared incapable to work due to physical complaints. These ailments can often be attributed to work-related physical load. An example of work involving significant physical load is ship maintenance. This consists of the cleaning and conservation of ships. Ships are docked on a shipyard and rest on logs of about 1.40 m height. The job of maintenance workers involves various manual operations, such as sandblasting, high-pressure water cleaning and spray painting. This is heavy physical labor and, as a result, ship maintenance workers frequently suffer from musculoskeletal disorders. In order to assess the physical workload we carried out an ergonomic workplace survey of the work done on the outside of the ship. In particular, we tried to answer the following questions:

- How does the physical load of workers relate to other jobs?
- How do various tasks contribute to the average physical load?
- How can the ergonomy of the workplace be improved in order to reduce physical load?

The OWAS method

The physical workload was assessed using the Ovako Working-posture Analysis System (OWAS). This is a multi-moment observation method that was originally designed in Finland for the steel industry. The Observer 3.0 was used to collect the data during observation at the workplace. A configuration file was created, with the codes for the defined working postures. This file contained 4 categories for the back, 7 for the lower limbs, 3 for the upper limbs, 5 for external loads being handled or applied and 9 for performed tasks. Apart from the OWAS method, the revised NIOSH method was used for the equation and evaluation of manual lifting tasks

Observations and data collection

In our study we used The Observer with two different handheld computers as event recorders: Psion Organiser LZ64 and Psion HC110. Thirty-two workers were observed for three periods of 30 minutes on a working day. Their postures were sampled every 20 s, by typing the predefined codes on the handheld computers. Data were collected by two investigators, each using her own handheld computer with the same configuration. After a number of observations, inter-observer reliability was tested; this turned out to be over 90%. After all observations had been completed, the data were uploaded to a PC. Subsequently, elementary statistics calculated by

The Observer were exported to SPSS for detailed statistical analysis.

Data analysis

We assessed the physical workload in different ways. On average, 28% of the working time was spent in akward body postures. This was mainly due to working with a bent or twisted back and one or both arms above shoulder level. During almost 25% of working hours, forces exceeding 400 N were exerted. Over 10% of working hours the postural load was severe. A further analysis showed as the most strenuous tasks: high-pressure water spraying (52% of time in awkward postures) sandblasting (42%) and spray painting (35%). Together these tasks are responsible for almost 60% of the awkward postures. While performing them under the ship's hull, severe postural load is seen 3-7 times more often than otherwise. Lifting of paint cans and pulling of sandblast hoses also considerably contribute to the physical load.

Discussion

Ship maintenance work compares well with other heavy physical jobs like garage work, concrete manufacturing and filling containers. Physical load in ship maintenance should be lowered by reducing awkward working postures and exertion of large forces. Adjusting the performance of tasks under the ship, high-pressure water spraying and sandblasting will reduce the physical load a lot. Improvements can be found in mechanization, using appropriate tools, adjusting work techniques, introducing task rotation and more short breaks. Changes are also needed for lifting of paint cans and pulling of sandblast hoses. Pulling of hoses should be carried out with more people and paint should be delivered in a container or the weight of the cans should be reduced.

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Contact Information

Berna van Wendel de Joode, Caroline Verspuy, Alex Burdorf. Erasmus University Rotterdam, Rotterdam, the Netherlands

E-mail: burdorf@mgz.fgg.eur.nl