Ergonomic modifications of shovels in India

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From time immemorial, manual material handling (MMH) has been one of the main tasks in agricultural and industrial work. With technological development, the use of capital intensive machinery reduces the workload considerably for a worker and saves a lot of time and energy. In the industrially developing countries, however, it is cheaper to use people for awkward jobs in MMH.

The shovel is one of the most important implements used in different types of MMH work in railway yards, docks, mines, factories, in construction industry, agricultural fields, etc. where the nature of work is mainly loading, unloading and placement of materials from one point to another.

The shovel is a third-class lever where, in the case of a right-handed person holding the traditional handle, the right hand acts as a fulcrum as the load is lifted by the left hand. Thus, a large part of the applied energy is wasted owing to the lower mechanical advantage. During shovelling, the worker has also to bend his body, which may lead to lumbar back pain and fatigue.

For more than 150 years, the design of shovels has not been improved. Sen and Bhattacharya[1,2] have improved the existing design of shovel to increase the mechanical advantage by fitting a second handle near the base of the shovel. This improves the performance of the MMH task by reducing the bending posture, lowering the physiological demand as revealed by the lower heart rate of the worker, and increasing the amount and the throwing distance of the materials. Figure 1 and Plate 1 show the improved design.

The additional handle, when not in use, could be clipped on the traditional handle (the clip has not been shown in the illustrations) or it can be detached, if required.

The benefits in using the modified shovel are:
1 awkward bending postures and the resultant back pain in the lumbar region of the workers are minimized;
2 the additional handle, to increase the mechanical advantage and to reduce the physiological demand, could be clipped on to the standard handle or easily detached, as required. A chain in place of the additional handle can also be used;
3 the amount and throwing distance of the materials are increased by about 25 per cent. Thus a furnace man would be able to throw materials, such as coal, into the furnace from a greater distance, and avoid the effects of undue radiant heat exposure.

The extra cost of the additional handle for a mass produced shovel would not be more than Rs30 - or approximately US$1.00. The benefits in the use of the shovel according to the new design outweigh the negative effect.

Figure 1
Labelled diagramatic sketch of the ergonomically improved shovel
some initial practice with the improved design may be necessary in the training of the worker on the use of the newly-designed shovel.

Comment

This example illustrates how a modicum of scientific knowledge, coupled with common sense, could go a long way towards lightening the physical demands of manual work in developing countries.

References

1 Sen, R.N. and Bhattacharya, S., “Development of an ergonomic design of a shovel from the viewpoint of increasing productivity in MMH in India”, Project Report No. 23, Ergonomic Laboratory, Department of Physiology, University of Calcutta, India, 1976, p. 13.