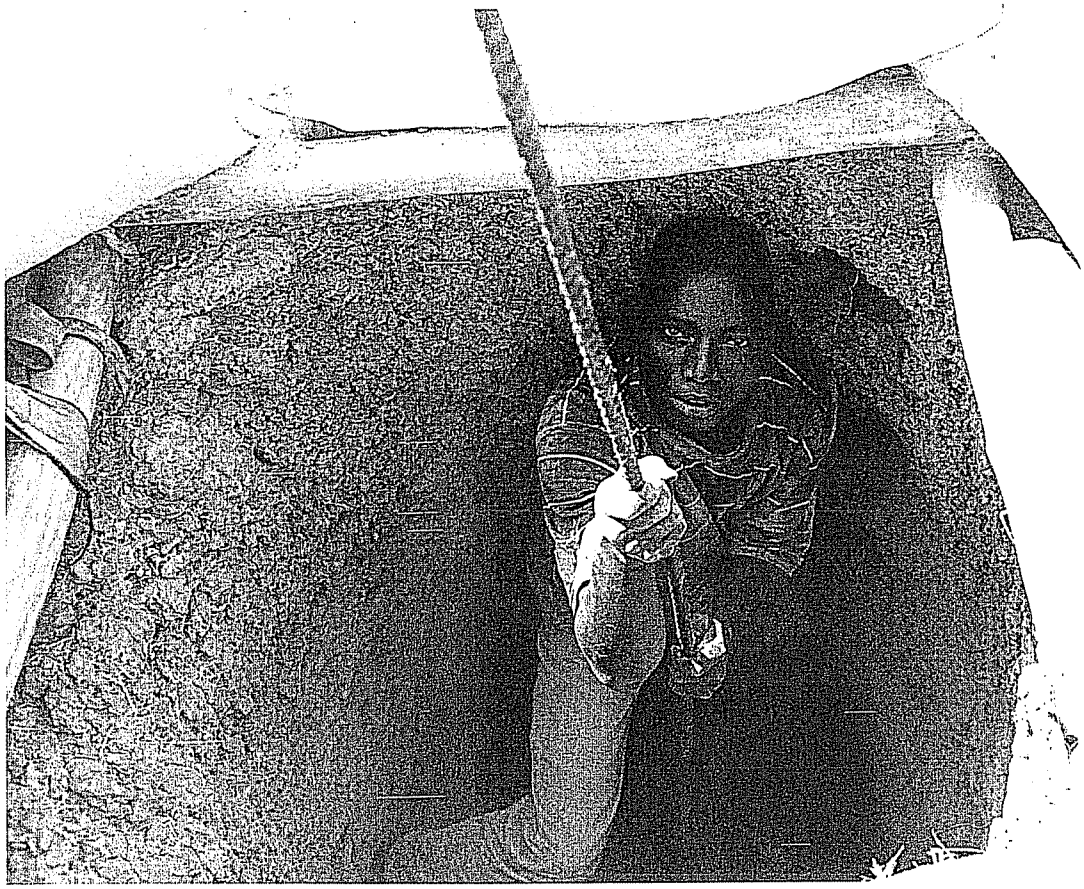

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Ergonomics as a practice for safe and healthy mining in South African mines

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Introduction

Reducing occupational injuries and ill health is a strategic objective of all the stakeholders in the South African mining industry. In order to achieve this objective, it is necessary to provide the safest and healthiest work environment possible for all mine workers, men as well as women. It is generally accepted that the application of sound ergonomics principles in the design of mining tasks and the human-machine interface will minimize design-induced human error, and will also eliminate significant occupational health and safety risks. In short, the application of ergonomics has the potential to promote the maintenance of health, efficiency and well-being among mine workers.

Ergonomics strategy

An industry-wide risk assessment identified the lack of a strategy for introducing ergonomics into the South African mining industry as a major contributing factor to the development of work-related injury and disease. Following these findings, a comprehensive strategy to facilitate the implementation of ergonomics in the local mining industry on an integrated basis was developed (1). On the basis of participatory ergonomics, the proposed strategy involved four groups of role-players, namely government, employers, employees and manufacturers/suppliers of mining equipment.. The specific involvement proposed for role-players entails the reviewing of existing legislation addressing ergonomics and the drafting of an ergonomics implementation plan by government, the establishment of formal ergonomics programmes for mines by employers, the active participation and involvement in the ergonomics programmes by employees, and the use of ergonomics design guidelines and specifications suitable for the local user population and mining conditions by manufacturers/suppliers of mining equipment.

Unique challenges to ergonomics interventions

Mining operations are associated with difficult working conditions, and mining (especially underground) is considered to be one of the most physically demanding occupations (2). The actual workplaces in deep level mines present unique challenges to ergonomics interventions. Owing to the nature of ore bodies, narrow gold-bearing reefs, geological constraints and the depth at which mining takes place (up to 3,500 m below ground surface), mining layouts are primarily aimed at reducing the major cause of fatalities in the South African mining industry, namely fall of ground. As a result of this, mining takes place in very restrictive work areas with low ceiling heights and high thermal heat loads, and it still involves a large component of physical work despite the introduction of engineering measures and mining equipment intending to make work easier.

Mining equipment

Mining equipment used in narrow reef mining operations is frequently designed only for functionality without considering basic ergonomics principles (3). Typical ergonomics-related hazards associated with trackless mining equipment underground are restricted vision (obscured line of sight) from the driving position, restricted driver cabin space, difficult vehicle access (ingress/egress) for the operator, and exposure to whole-body vibration, noise and dust. One of the shortcomings to implementing ergonomics design, namely the lack of recent information on the anthropometry and functional strength of South African miners, has been addressed. Information on the functional anthropometry of male and female miners (i.e. those body dimensions that are essential for the design of workstations, mining machines and mobile equipment) is now available for the design of articles used at the mines in order to meet ergonomics as well as statutory requirements (4).

Work-related musculoskeletal disorders

The results of ergonomics assessments (5) conducted in the underground environment indicated that many of the known musculoskeletal injury risk factors, usually in combination, are associated with the typical mining tasks. Risk factors identified included awkward body posture, manual materials handling, repetitive motions, force and vibration. Of these, working in an awkward posture and manual materials handling are considered to be the major risk factors.

The results of a retrospective record review (5), aimed at getting a "snapshot" of the situation regarding work-related musculoskeletal disorders (WMSD) in the South African mining industry, indicated that 16% of the 1,235 medical records examined at a gold mine participating in the study concerned WMSD. Of these musculoskeletal disorders, 15% were associated with the upper limbs, 16% with the lower limbs and 69% with the back region. In the case of the platinum mine used in the study, 41% of the 75 medical records dealt with WMSD, and 62% of those records dealing with WMSD were associated with the upper limbs, 8% with the lower limbs and 30% with the back region. At a colliery participating in the study, a total of 226 medical records dealing specifically with WMSD were examined. Analysis revealed that 37% of the musculoskeletal disorders were associated with the upper limbs, 13% with the lower limbs and 50% with the back region.

The implementation of ergonomically sound interventions in the workplace has the potential to reduce the risk of WMSD. Owing to the uniqueness of the workplace in mines, generic solutions do not necessarily fully address ergonomics-related risks at all mines. A mine-specific ergonomics programme, based on participatory principles, is an essential component of a comprehensive plan for preventing musculoskeletal injuries.

Physiological strain

To create an optimal work environment, it is of cardinal importance to determine what is actually happening in the miners' work environment, i.e. to ask the question: What levels of physical strain and work stress are mine workers experiencing while performing their tasks? Very little information is available on the physiological strain (the combined strain reflected by the thermoregulatory and cardiovascular systems) experienced by mine workers. Where information is available, it has been based on the physiological responses of young, healthy males.

With the recent changes in the demographics of the workforce in South African mining that have resulted from the milestone set for the employment of female mine workers, the need arose to establish the role of gender in the physiological strain experienced by miners during typical mining activities. In view of their smaller physical work capacity, lower physical strength and lower heat tolerance, female mine workers may experience undue physiological strain when performing physically demanding tasks such as those common in mining.

The results of an exploratory study to assess the physiological strain experienced by male and female mine workers during their routine underground work indicated that female mine workers experience higher levels of physiological strain than male mine workers when performing physically demanding tasks (6). Although expected, this observation cannot be ignored in the allocation of female miners to occupations with a high physical-work component.

Good ergonomics design of workplaces and tasks is the primary strategy for preventing excessive physiological strain experienced by female and male mine workers in the underground environment. However, when technical and physical constraints in the mining environment hinder the implementation of this strategy, the selection of workers on the basis of physical abilities is necessary as part of a comprehensive plan for reducing excessive levels of physiological strain associated with mining tasks. Under these circumstances, it is necessary to maximize the fit between the person and the work environment in the interest of health and safety.

Conclusion

The application of sound ergonomics principles in the South African mining industry has the potential to enhance the efficiency with which mining tasks are carried out and their effectiveness, and also to eliminate significant occupational health and safety risks. Although understanding of the contribution of ergonomics to mining in the South African mining industry still appears to be poor, ergonomics as a practice is evolving and will in future become more integrated into health and safety management systems. The costs of implementing ergonomics in the mining industry should be regarded as an investment with long-term benefits. There will also be benefits that cannot be expressed in monetary terms, such as improved human health, safety, comfort and well-being, which are actually the main aims of implementing ergonomics in the local mining industry.

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