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Designing for Construction Ergonomics

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Abstract

Relative to other industries in South Africa and construction industries worldwide, the construction process generates a disproportionate number of fatalities, injuries and disease, and both the direct and indirect costs contribute to the cumulative cost of construction. Designers influence construction ergonomics directly and indirectly. The direct influence is as a result of design, details and method of fixing, and depending upon the type of procurement system, supervisory and administrative interventions. The indirect influence is as a result of the type of procurement system used, pre-qualification, project duration, partnering, and the facilitating of pre-planning. The purpose of the paper is to present the results of a study conducted among architectural technologists in South Africa using a self-administered questionnaire, to determine their perceptions and practices relative to construction ergonomics. Descriptive statistics in the form of frequencies and a measure of central tendency were computed from the collected data. The following constitute the salient findings. Cost, quality, and time are more important to architectural technologists than construction ergonomics and project health and safety (H&S). Ergonomics during the user phase is more important to architectural technologists than the other phases. A range of design related aspects impact on construction ergonomics. To a degree, construction ergonomics is considered on most design, procurement, and construction occasions by architectural technologists. Experience predominates in terms of the means by which ergonomics knowledge was acquired. A range of aspects have the potential to contribute to an improvement in knowledge and the application of construction ergonomics. The paper concludes that architectural technologists contribute to construction ergonomics, but that there is potential for and a clear need for enhanced contributions. Recommendations include the inclusion of construction ergonomics in architectural technologists' tertiary education, and continuing professional development (CPD), to remedy shortcomings in practitioners' knowledge.

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1. Introduction

The South African Construction Regulations [1] state that during the design stage, designers must take cognizance of ergonomic design principles in order to minimize ergonomic related hazards in all phases of the life cycle of a structure. This amplifies the need for ‘designing for safety’, which Behm [2] defines as “The consideration of construction site safety in the preparation of plans and specifications for construction projects.”

Hecker et al. [3] contend that H&S through design is a fundamental principle of ergonomics. They further contend that architects and engineers regularly address ergonomics in their designs, but with a significant limitation, namely that the concerns apply almost exclusively to the end-user of a facility, rather than the workers who construct it. They also cite Behm who states that such an approach is problematical in that there is growing evidence that the design of permanent structures has a significant impact on risks to those who construct them.

Hecker and Gambatese [4] maintain ‘H&S through design’ is a familiar concept to occupational hygienists in that they invoke the primacy of ‘engineering controls’ in the hierarchy of controls that is fundamental to the process of hazard reduction. They further maintain that construction workers have previously received limited benefit from ‘H&S through design’, and although designers consider H&S in their designs it has been relative to the end user of the facility rather than the workers that construct it. Gambatese [5] emphatically states that historically, the design profession has not addressed construction H&S. Furthermore, he states that designers feel that they are not adequately educated or trained to address construction H&S, and they contend that they do not have the contractual authority to dictate site activities.

The paper reports on a study conducted among members of the South African Institute of Architectural Technologists (SAIAT), the objectives being to determine the:

- Importance of project parameters to architectural practices and contractors;
- Importance of ergonomics during the various project phases to architectural practices;
- Frequency at which architectural practices consider construction ergonomics on various occasions and relative to various design related aspects;
- Extent to which various design related aspects impact on construction ergonomics;
- Source of ergonomics knowledge;
- Potential of various aspects to contribute to an improvement in construction ergonomics, and
- Degree of awareness relative to certain provisions of the Occupational Health and Safety Act (OH&S Act) and the Construction Regulations.

2. Review of the literature

2.1 Legislation and recommendations pertaining to designers

The South African OH&S Act [6] schedules comprehensive requirements. Prior to the promulgation of the Construction Regulations all designers were required to address H&S, as in terms of Section 10 of the OH&S Act designers are allocated the responsibility to ensure that any ‘article’ is safe and without risks when properly used.

The Construction Regulations [1] lay down important requirements with respect to clients and designers. Clients are required to, inter alia: prepare a baseline risk assessment (BRA); prepare an H&S specification based on the BRA; provide the designer with the H&S specification; ensure that the designer takes the H&S specification into account during design; ensure that the designer carries out the duties in Regulation 6 ‘Duties of designers’; include the H&S specification in the tender documents; ensure that potential PCs have made provision for the cost of H&S in their tenders, and ensure that the PC to be appointed has the necessary competencies and resources.

Designers are required to, inter alia: ensure that the H&S standards incorporated into the regulations are complied with in the design; take the H&S specification into consideration; include in a report to the client before tender stage all relevant H&S information about the design that may affect the pricing of the work, the geotechnical-science aspects, and the loading that the structure is designed to withstand; inform the client of any known or anticipated dangers or hazards relating to the construction work, and make available all relevant information required for the safe execution of the work upon being designed or when the design is changed; modify the design or

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