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Prevention through Design (PtD): An Interdisciplinary Annotated Bibliography

Behm, M. (2008). "Construction sector." J Safety Res 39(2): 175-178.
(Rapparteur's report of PtD construction stakeholder workshop)

Behm, M. (2012). "Safe design suggestions for vegetated roofs." Journal of Construction Engineering and Management 138(8): 999-1003.

Rooftop vegetation is becoming increasingly popular because of its environmental benefits and its ability to earn green-building certification credits. With the exception of one international guideline, there is little mention of worker safety and health in vegetated-roof codes and literature. Observations and photo investigations, and interviews of 19 vegetated roofs in the United
ecific hazards. Design for safety strategies and the integration of life -cycle
with green-building credits systems are the preferred methods to reduce risk to
etated roofs. Design suggestions have been developed to add to the body of
findings complement several National Institute for Occupational Safety and
) construction and prevention through design (PtD) goals and are congruent
afe Green Jobs initiative. Organizations that install and maintain vegetated
the findings to understand hazards, take precautions, and incorporate safety

l. M., et al. (2014). "Occupational Risk Index for Assessment of Risk in
ork by Activity." Journal of Construction Engineering and Management 140(1):

cern for occupational health and safety in construction work is reflected in the
e measures taken. However, examples of the systematic assessment of project
ed at minimizing occupational hazards are rare. This paper proposes a measure
safety [occupational risk index (ORI)] that is based solely on the project design
nstruction process, and is a function of the activities carried out and their
ional risk (probability and consequences of occurrence). The ORI can thus be
ator to feed multicriteria decision-analysis tools. The proposal is illustrated with
e in which two alternatives (one precast and the other constructed in situ) are
ms of occupational safety, and certain aspects related to redesign are briefly
the ORI, occupational safety goes from having a passive influence (application
have already been designed) to an active one (influence on the design concept
ngs and that 12 of
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experienced designers and constructors. Fortunately, feasible prevention techniques through design and construction safety management strategies exist and can be used to mitigate the safety risk associated with the design features and means and methods of construction used to achieve LEED certification. Most commonly, designers and contractors identified

research efforts were (1) identification of the typical building design elements and associated construction activities; (2) quantification of the unit and cumulative risks of the design elements and construction activities; and (3) development of an online design risk-assessment tool. Absolute safety risks were quantified for 141 design elements and 683 construction activities using the survey-analytical research method. The risk factors developed were incorporated into an online tool titled Safety in Design Risk Evaluator (SliDeRulE). The research contributes to the construction industry body of knowledge by providing quantitative values that link specific design features to construction safety. The website is designed to assist building designers with assessing the level of construction safety risk associated with their designs and is intended for use by designers during the design phase to create buildings that are safer to construct.

Fortunato III, B. R., et al. (2012). "Identification of safety risks for high-performance sustainable construction projects." Journal of Construction Engineering and Management 138(4): 499-508.

The United States Green Building Council (USGBC)-sponsored Leadership in Energy and Environmental Design (LEED) green building program represents the largest program in the United States for the measurement, verification, and certification of green buildings. A recent study found that LEED-certified buildings have accounted for a higher injury rate than comparative traditional non-LEED buildings. This finding served as the impetus for the present study, which aimed to identify and evaluate the safety and health risks associated with the design elements and construction management practices implemented to achieve LEED certification. To explore this topic, six detailed case studies and two validation case studies were conducted following a strict protocol developed from guiding -2 (i)-12 (on (s)-1 (t)-7 (a)46l)-2 (di)-2 (ngs

activities, and design elements in the system. The degrees of connectivity are defined as: interacting with the design element during its construction (DoC #1); interacting with the design element in its final form to attach another component to it (DoC #2) or by working in the vicinity of it (DoC #3); and indirectly interacting with the design element through another worker (DoC #4). To support and verify the presence of the concept in practice, the researchers conducted a survey of construction personnel. The survey results confirm that the four different degrees of connectivity are present and felt during construction operations, and indicate that attention should be given to all design elements, activities, and workers to which a worker is

safety practices: management commitment, preproject planning, and pretask planning. The present study revealed that lean principles and practices can provide a valuable opportunity to further improve construction worker safety; however, the findings show that there is a difference between lean construction and safety management practices, revealing a gap with respect to worker behavior. Understanding and eliminating this gap is important for the industry to realize the full benefit that lean principles and practices can have on worker safety. To do so, the authors suggest expanding lean practices to further directly engage field workers and address worker behavior issues along with carefully communicating the lean message to construction personnel. © 2016 American Society of Civil Engineers.

Golabchi, A., et al. (2015). "An Automated Biomechanical Simulation Approach to Ergonomic Job Analysis for Workplace Design." Journal of Construction Engineering and Management 141(8): 04015020.

Work-related musculoskeletal disorders (WMSDs) are reported to be the most common category of nonfatal occupational injuries that result in days away from work and are also a leading cause of temporary and permanent disability. One of the most effective approaches to preventing WMSDs is to evaluate ergonomics considerations early in the design and construction planning stage before the worker encounters the unsafe conditions. However, a lack of tools for identifying potential ergonomic risks in a proposed workplace design has led to difficulties in integrating safety and health into workplace design practice. In an effort to address this issue, this study explores a motion data-driven framework for ergonomic analysis that automates and visualizes the evaluation process in a virtual workplace. This is accomplished by coupling the ergonomic analysis with three-dimensional (3D) virtual visualization of the work environment. The proposed approach uses motion data from the 3D model of the jobsite to evaluate the risk factors that can produce excessive physical loads on the human body through a biomechanical an(ur)3 (i)-2 (e)4 (s)-1 (t)-2 ne eg Td[(ni)-2l(r)4 (t)-niut-1 (t)-2u (e)6t(r1
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The paper identifies the proper application and conditions for successful use of various crew-scheduling techniques and provides a comprehensive comparison that outlines a variety of crew-scheduling options, along with their impact on labor efficiency, project duration, worker safety, and project cost. Contractors can use the results to aid them in the selection of a scheduling technique to best meet the specific requirements of a project. © 2013 American Society of Civil Engineers.

Hecker, S. and J. A. Gambatese (2003). "Safety in design: a proactive approach to construction worker safety and health." Appl Occup Environ Hyg 18(5): 339-342.

Howard, J. (2008). "Prevention through Design--introduction." J Safety Res 39(2): 113.
We believe that the Prevention through Design (PtD) initiative is an extremely worthwhile endeavor. Putting safety into design practices is the natural next step in the construction business, as well as all other industries. PtD is part of our Continuous Improvement Program. This also embodies a social improvement aspect, which includes the welfare of the workforce, and green construction and design elements. These efforts are driven not only by social responsibility, but also by commodities costs, which are rising faster than anyone expected. The expense of having an inefficient or unsafe environment is enormous. The entire company needs to be up to speed on safety practices and protocols. We've been incorporating safety in design because it's the next step in our industry and in our continuous improvement process to meet the goal of zero injuries. We should all assist the universities in incorporating safe design curricula. Those discussions and training sessions should include different disciplines working together to solve the same problem.

Jin, Z., et al. (2023). "Analysis of prevention through design studies in construction: A subject review." J Safety Res 84: 138

Topics in Construction Safety and Health:

Nussbaum, M. A., et al. (2009). "Development of a decision support system for residential construction using panellised walls: approach and preliminary results." Ergonomics 52(1): 87-103.

There is a high prevalence of work-related musculoskeletal disorders (WMSDs) among residential construction workers, yet control in this industry can be difficult for a number of reasons. A decision support system (DSS) is described here to allow early assessment of both ergonomic and productivity concerns, specifically by designers. Construction using prefabricated walls (panels) is the focus of current DSS development and is based conceptually on an existing 'Safety in Construction Design' model. A stepwise description of the development process is provided, including input from end users, taxonomy development and task analysis, construction worker input, detailed laboratory-based simulations and modelling/solution approaches and implementation. Preliminary results are presented for

based on data from 25 construction projects and found to accurately represent the safety performance of large projects. The SCSH rating system can be used as an effective tool to develop and plan construction safety and health programs and evaluate the potential safety performance of construction projects.

Saunders, L. W., et al. (2017). "Developing an inter-organizational safety climate instrument for the construction industry." Safety science 98: 17-24.

In the construction industry, recent literature has promoted a design for safety approach that discusses the benefits of considering safety from the very start of the project lifecycle. With this approach, non-construction p tsd airficltn(ppr)34 nces2arttclar 3Td[n4

research in this area to data is within a single country. © 2016, © Emerald Group Publishing Limited.

Tayabji, S., et al. (2012). "Joint load transfer and support considerations for jointed precast concrete pavements." Transportation Research Record: 74-80.

Many agencies recently have started investigating strategies for pavement rehabilitation and reconstruction that are faster to implement and can produce longer-lasting pavements than previous strategies. Most highway agencies no longer consider expedient rehabilitation that results in a shorter pavement lifespan acceptable. One promising alternative rehabilitation strategy is the effective use of modular pavement technologies, principally precast concrete pavement (PCP) systems, which provide for the rapid repair and rehabilitation of pavements and also result in durable, long-lasting pavements. Rapid construction techniques can significantly minimize the impact on the driving public because lane closures and traffic congestion are minimized. Road user and worker safety also are improved by reduced road users' and workers' exposure to construction traffic. The renewal focus area under Strategic Highway Research Program 2 (SHRP 2) emphasizes the need to complete highway pavement projects rapidly, with minimal disruption to highway users and local communities, and to produce pavements that are long lasting. One goal of this focus area includes applying new methods and materials to preserve, rehabilitate, and reconstruct roadways. The effective use of PCP technologies for rapid repair, rehabilitation, and reconstruction of pavements addresses this goal. One of the projects funded under SHRP 2 is Project R05, Modular Pavement Technology. The objective of Project R05 was to develop better guidance for use by highway agencies to design, construct, install, maintain, and evaluate modular pavement systems, principally PCP systems. Findings related to joint load transfer and support considerations for jointed PCP from the Project R05 study are presented.

Toole, T. M. (2005). "Increasing engineers' role in construction safety: opportunities and barriers." Journal of Professional Issues in Engineering Education and Practice 131(3): 199-207.

A number of factors suggest engineering and construction professionals should discuss increasing designers' role in construction safety. Design civil engineers could contribute to construction worker safety by performing five tasks differently than current custom and practice: reviewing their designs, creating design documents, assisting the owner in procuring construction, reviewing submittals, and inspecting work in progress. However, four sets of major barriers would prevent designers from increasing worker safety through these tasks: lack of safety expertise, lack of understanding of construction processes, typical contract terms, and professional fees. Potential ways for reducing these barriers are suggested. The United Kingdom regulations requiring engineers to design for safety are summarized, but it is concluded that similar legislation in the United States would not be appropriate.

Toole, T. M. and G. Carpenter (2013). "Prevention through design as a path toward social sustainability." Journal of Architectural Engineering 19(3): 168-173.

Design and construction professionals who have studied sustainability know that sustainability encompasses not just environmental equity but also social equity and economic equity. Most of the literature on social sustainability in the built environment focuses on regional urban planning issues, not on specific actions capital project owners and design

professionals can take. Prevention through design (PtD) (also known as design for construction safety) is an emerging initiative in the design and construction industry in which design professionals consider the safety of construction workers during the design phase. This paper provides an overview of the PtD concept and suggests that PtD should be a required aspect of social equity on capital projects. A recent survey (n=103) indicates that the expected challenges to diffusion of PtD - lack of knowledge, higher costs, industry structure, and fear of liability - may not prove to be significant barriers, but these challenges may be relevant to other social-

Tymvios, N. and J. A. Gambatese (2016). "Direction for Generating Interest for Design for Construction Worker Safety - A Delphi Study." Journal of Construction Engineering and Management 142(8).

Decisions made prior to construction impact the safety of construction workers. Past research has shown that there is a link between design decisions and fatalities. Prevention through Design (PtD) is a concept that attempts to identify and mitigate hazards early in the design process with the goal of eliminating the risks of injury to workers and/or damage to facilities during construction. PtD is a required practice in some countries, primarily because of legislation. In the United States, however, PtD is not well known by design professionals and there is opposition to its practice. The objective of this paper is to present the results of a Delphi study, in which the Delphi panel was tasked to identify: (1) the construction industry group with the most influence to generate interest in PtD in the United States, (2) the method with which that interest can be achieved, and (3) the industry group that should be targeted with that method. The Delphi panel came to a consensus that owners have the greatest influence to generate interest, and they should be the group to be targeted using the business case method. © 2016 American Society of Civil Engineers.

Tymvios, N. and J. A. Gambatese (2016). "Perceptions about design for construction worker safety: Viewpoints from contractors, designers, and university facility owners." Journal of Construction Engineering and Management 142(2).

Decisions made before construction can affect safety on the construction site, either positively or negatively. This was observed from past research that identified the link between design decisions and fatalities. The concept of implementing design decisions that positively affect safety falls under the general concept of prevention through design e (nt) (5e)4 (pt)-12 (i(th)2 3i)-2(e)4 h

teams to plan for PtD education and training efforts on projects and by construction industry organizations to develop PtD diffusion strategies. © 2015 American Society of Civil Engineers.

Weidman, J., et al. (2015). "Intervention to Improve Purchasing Decision-Maker Perceptions of Ventilated Tools." Journal of Construction Engineering and Management 141(6): 04015007.

A theory-based intervention strategy to improve purchasing decision-maker perceptions of ventilated tools was developed, implemented, and tested. The intervention was designed to target key constructs of the prevention through design adoption readiness model (PtD ARM), a previously published conceptual model. A Web-based intervention was developed that included information about the health effects of construction dust, a testimonial by a firm owner, and a video demonstrating side-by-side use of both ventilated and nonventilated tools, which provided visual evidence of dust generation and productivity performance. In a pretest/posttest with a control group and an experimental design, purchasing decision makers (n=49)

Weidman, J., et al. (2016). "Effective Intervention Strategy to Improve Worker Readiness to Adopt Ventilated Tools." Journal of Construction Engineering and Management 142(8).

An effective theory
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The optimal method of preventing occupational illnesses, injuries, and fatalities is to design out the hazards and risks, thereby eliminating the need to control them during work operations. In 2007, the National Institute for Occupational Safety and Health launched a national Prevention through Design (PtD) initiative calling on all major industrial sectors to emphasize hazard mitigation at the design stage. PtD applies to the design of all tools, equipment, materials, and work processes that are employed during the construction process. This article reviews the asphalt roofing health hazards and currently available design solutions for their control and identifies gaps and priorities for further research. PtD solutions such as tanker systems, insulated hot luggers, mechanical asphalt spreaders, fume-suppressing asphalt, and local exhaust ventilation systems are discussed in terms of effectiveness and availability.

Zhang, P., et al. (2015). "Work-Health and Safety-Risk Perceptions of Construction-Industry Stakeholders Using Photograph-Based Q Methodology." Journal of Construction Engineering and Management 141(5): 04014093.

Work health and safety (WHS) on construction sites can be influenced by decisions made upstream from the construction stage. The effectiveness of WHS risk management relies on decision makers' ability to decide appropriate strategies to mitigate/control risks. However, it is unclear whether upstream decision makers share similar WHS risk perceptions with those who undertake the construction work. This study used Q methodology to explore WHS risk perceptions of architects, engineers, construction managers, and WHS professionals. Photographs depicting different technologies/methods were used to capture professionals' WHS risk judgments. Data were analyzed to identify the within-group and between-group similarity/difference in professionals' WHS risk perceptions. The data-analysis result indicates the coexistence of within-group difference and similarity, as well as between-group difference and similarity in WHS risk perceptions. The research contributes to the body of knowledge by showing that WHS risk is subjective in nature and that social, psychological, and technical factors interact to shape subjective risk judgments. The research finding challenges traditional risk-management thinking, which assumes risk is objective and easily quantifiable.

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