

Applying Prevention through Design to Solar Energy Design and Installation for Residential Projects

Chung Ho, and Hyun Woo Lee
University of Washington
Seattle, Washington

John Gambatese, Ph.D.
Oregon State University
Corvallis, Oregon

As a viable, efficient, clean, and renewable energy source, solar installation in the U.S. has increased drastically in recent years due to a reduced payback period. Most future solar installations are expected to take place on the rooftops of existing houses. This forces workers to face unique safety hazards in terms of existing roof conditions and panel installation. In 2002, the construction industry reported that falls accounted for about 35% of worker fatalities. Previous studies showed that almost 50% of construction fatalities and accidents were linked to decisions made during design process. In response, Prevention through Design (PtD) has been developed and promoted as a proactive method in design process to prevent safety hazards and can contribute to fall prevention in the solar industry. However, no identified study has aimed at determining how PtD can be effectively applied to prevent safety hazards and risks, especially related to fall hazards during solar installation. To fill this knowledge gap, the present research project aims to investigate how, during the design process, to address workers' safety concerns during solar energy installation on small buildings. This project is federally funded through the Center for Construction Research and Training (CPWR). The research is carried out from August 2016 to July 2017.

The overarching objective of this research is to develop knowledge and resource that support the application of PtD in solar energy design and installation and lead to improved safety performance of construction workers. The specific aims of this study are to: (1) identify the attributes of solar energy systems and roof conditions that affect safety risk; (2) analyze the identified attributes through case studies; and (3) develop a PtD protocol for solar energy design and installation. A mixed methods approach that incorporates experiential data from interviews with solar contractors plus observational data from in-depth project case studies is applied in this research. This research relies on contextual data from actual construction projects and construction personnel who install solar system. The contextual data allows for the identification of safety hazards and risks associated with roof conditions, roof features, solar panel characteristics, and the development of design parameters to be used in PtD. Our preliminary investigation has revealed a number of PtD attributes that could be considered during design process to address safety hazards and risks including roof materials, roof slope, roof accessory, panel layout, fall protection system, lifting method and electrical system. Some roof materials such as metal or wood are very slippery when raining, increasing falling hazards. The higher roof slope, the more dangerous for installation process. Solar contractor must be very careful and may need special installation method when working on a steep roof. Roof accessories such as chimney, skylight, roof vent pose different safety impacts to workers. The layout of solar panels and the clearance between roof edge and panel edge can hinder or facilitate the movement of workers on the rooftop. For the use of a fall protection system, consideration should be given to roof slope, roof height, roof accessories, roof layout, and the number of workers working on the roof. Solar energy installation involves frequent heavy lifting for solar panels, and hence solar panel size, panel weight and wind condition should be carefully reviewed when deciding on a lifting method. In addition to shocking hazard, components of electrical system such as wires and conduits can cause tripping hazard. These attributes should be effectively addressed from design process to reduce associated safety hazards and risks.

The outcome of this project is a design protocol for solar energy systems that small solar businesses can apply to improve safety practice. It will contribute to NIOSH's national PtD initiative and Green Jobs/Safe Jobs initiative, and support NORA strategic Goal 1.0 "Reduce construction worker fatalities and serious injuries caused by falls to a lower level" and Strategic Goal 13.0 "Increase the use of prevention through design (PtD) approaches to prevent or reduce safety and health hazards in construction". In addition, the study results are expected to contribute to: (1) NORA's agenda for supporting small businesses by increasing their capability in safety management, and (2) the SunShot Initiative of U.S. Department of Energy that focuses on improving the cost effectiveness of solar energy by reducing overhead costs of insurance and hidden costs of accidents.

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