Design Criteria for Temporary Structures in Uncertain Extreme Natural Hazard Load Environments

E. Saleh[1], and J. Mohammadi[1]

[1]Civil, Architectural and Environmental Engineering, Illinois institute of technology, Chicago 60616, United states, email address

Keywords: *temporary structure; wind load; uncertainty; optimization.*

Abstract

Temporary structures, including structures under construction, have a short service time and are designed for a less severe natural hazard load. However, they are more vulnerable to failure during a natural hazard (e.g., a hurricane). Design load levels for temporary structures, more appropriately, can be decided based on the uncertainty in the natural hazard occurrences and availability of a risk mitigation plan. The question often asked is "What is an appropriate design load level for a temporary structure, given that future loads are uncertain?" This is especially applicable in hurricane areas, where the chances of extreme wind pressure exist; yet there is uncertainty on whether a forecasted hurricane will actually make a landfall to affect any structure. Thus uncertainties in extreme load events and structural performance demands need to be considered in design.

To include uncertainty, one solution is to use information on the extreme event probability and proper modeling of construction sequences, along with any risk mitigation plan, to arrive at an optimum design load. This is a decision-based model and can be crafted to account for any expected constraints to arrive at a feasible solution at an optimum cost. In this paper, a three-stage decision-based programming model is introduced to determine design loads resulting from probable extreme hazard events for temporary structures with application for hurricane and extreme wind pressure events.

Stage 1 represents a "normal situation" before any information on a probable event is known. Stage 2 is when information on extreme events becomes available. At this stage, for structures under construction, an improvised decision on the construction sequence is also made. Stage 3 focuses on planning and is based on the outcome in the previous two stages and also based on whether a mitigation strategy is considered. For example, during the erection process and with the forecast for a hurricane, one must decide on a change in design load to minimize the risk of failure considering the uncertainty on whether the event would actually occur. At Stage 3, the model provides an optimum value for the structural demand with considerations for any restrictions imposed on the structure. For example, if a mitigation plan in the form of using a bracing system is considered, the model determines the optimum design load and the associated cost for the bracing system compared with the case with no bracing implemented. Illustrative examples to demonstrate the applicability of the model are also provided in the paper.