Communicating Structural Risk

By Dan Eschenasy P.E., F.SEI

The British have tasked two organizations – CROSS (Confidential Reporting on Structural Safety) and SCOSS (The Standing Committee on Structural Safety) – to work jointly to collect information on structural failures, to maintain a database and to provide reports interpreting the data. When reading CROSS' alerts and reports in its newsletters, I cannot help but reflect on the way we communicate risk within the United States, and question if our current practice is capable of providing adequate warnings about some potential structural risks.

The lessons learned from extraordinary environmental events are well disseminated. A hurricane or earthquake happens in a short period of time and in a defined geographical area. This relative unity of time and place facilitates observations of common modes of structural failure. These failures take place as buildings are subjected to combinations of loads close to or exceeding code design values. However, what about structural collapses that occur under service loads? How many incidents happen in the absence of rare environmental events? What are the causes? Because these failures occur isolated in time and geography, we look at them as separate cases. Despite being very rare, are they unique? Is it possible to document trends using the present outlets for sharing information? In my view, identification of risk requires the determination of both failure cause and the probability of its occurrence.

Generally, forensic engineering analyses are commissioned for the cases that are likely to involve litigation or substantial insurance payments. Some of the flashier or more notorious cases, and their related lessons learned, become the object of presentations at congresses or articles published in technical journals. But, the more benign cases might remain completely off the radar and some others are not shared, due to legal concerns. Because they record only cases that were published, even the larger compilations fail to include benign cases.

Forensic engineers that specialize in particular technical domains may have the opportunity to observe some failures of similar modes. Derived from multiple cases, their lessons learned are more relevant to the engineering practice, but still do not carry the weight conferred by statistical analyses. In my opinion, case studies cover only the descriptive aspect of risk communication. Case analysis alone is not capable of providing a sense of trends or probability of occurrence associated with the identified cause.

K. Wardahana and F. Hadripriono's *Study of Recent Building Failures in the United States* covers a building stock with large variation in age, structural type, height, function, code regulation, etc. The authors searched reports in technical magazines and mainstream press to examine building failures between 1989 and 2000, but were only able to identify 225 incidents. The information thus collected could not be characterized as a random sample or as a comprehensive population. Consequently, the reach of the findings was limited and the authors could only present distributions of different categories (type of errors, types of occupancy, building height, etc.) within the population of failures they had assembled from mainstream media.

The media can be useful for communicating some structural problems to a larger, but local public. Many of the examples listed by R.Ratay in *Changes in Codes, Standards and Practices Following Structural Failures* are in debt to the local press coverage that made the public sensitive to building or construction failures.

The mainstream media report building failures, but this is not their main mission. The information is of unequal reliability, as it is provided by reporters typically having little technical knowledge on the reported subject. Searching these reports will not produce even a reliable number of failures as data is skewed towards geographic areas with larger press presence and days when other more sensational news are missing. Most reporting is done only immediately after the accidents and follow-up reporting is rare, although essential information might be uncovered later.

Clearly more relevant technical findings can result from the polling of engineering firms. M. O'Rourke and J. Wikoff in *Snow Related Roof Collapses and Implications for Building Codes* were able to closely identify some of the main causes of roof collapses during the winter of 2010-11 using practicing engineers' responses to questionnaires.

It is my view that we need a system where the entire engineering profession is engaged in reporting *in-service* building failures. Each report should be a communication of facts and, where possible, a description of potential risk. The systematic collection of such reports will lead to the formation of a database that in turn will allow use of statistical tools to determine correlations and probability of occurrence. Some examples of areas of potential findings are: evaluation of the adequacy of some provisions of past or present building codes, information on the in-situ aging of materials or of specific details, identification of common type of human or design errors, and identification of types of structures at a higher risk of aging or of less reliable building solutions. When working on a particular project, practitioners would be able to search for information on the potential weaknesses of that type of building or detail.

Comprehensive data collection is possible. Some federal and local governmental entities manage to keep track of some specific accidents or failures of structures. For example, both the Occupational Safety and Health Administration and the New York City Department of Buildings record construction accidents and make public a short description of each. Fire statistics are also collected nationwide.

The design of the reporting system should be simple, yet sufficient for effective use of the information. One would have to clarify the definition and level of failure to be reported, to decide if one needs to count failures during the construction process, and to establish categories of failures (e.g. envelope vs structural frame, architectural vs engineered systems, etc.) in a standardized format.

When managed and maintained by engineers, a standardized system of communicating risk will provide benefits that far exceed the effort required by its development.▪

Dan Eschenasy, P.E., F.SEI, is the New York City Buildings Department Chief Structural Engineer. He is an Honorary Member of SEAoNY.