Lessons Not Learned

By James Lefter, P.E.

"Experience is a dear teacher, but some will learn from no other."

- BEN FRANKLIN

There are many *Lessons not Learned* in spite of experience. Thankfully there are also examples of *Lessons Learned* through experience that have contributed to meeting technical and ethical responsibilities. As engineers, we should pursue the latter. The most tragic and devastating LESSON NOT LEARNED in our lifetime is the undoing of all of the bitter lessons learned through experience in battling pandemics. Today's coronavirus pandemic has wreaked havoc, bringing death, economic depression, widespread disease, unemployment, education disruption, and more.

In 2005, WHO published a checklist for controlling a pandemic: preparation, surveillance, case investigation and treatment, and preventing the spread of the disease in the community. Despite strong advocacy by the medical community, the U.S. has been reluctant to relearn this lesson.

Every four years, the American Society of Civil Engineers (ASCE) issues a report card on Infrastructure investment needs. It covers 16 categories, ranging from hazardous waste to bridges and dams to parks and recreation. The report card effort originated from a 1988 congressionally chartered report that graded America's Infrastructure as a C. ASCE independently continued the grading in 1998. Since then, the U.S. performance has not risen above its current grade of D+. A $2 trillion total funding gap is estimated. The public is aware of these problems, but political leaders seem intent on lowering taxes and depleting the available funding. In the past, economic recovery largely depended on government infrastructure investment to provide employment and rebuild the economy. Proposals are being considered by the current legislature to fund infrastructure as an economic stimulus; time will tell whether the lesson was learned.

OSHA Construction Industry Reports

At job sites, OSHA has reported that the construction industry, with only 5% of the total industry workforce, suffers more than 21% of on-the-job deaths. The disproportionate risk is most often caused by falls, electrocution, struck-by-object accidents, and caught-in-between mishaps. Despite OSHA standards developed for worker protection, deficiencies still exist in worker training, site safety practices, planning, and worker risk acceptance.

WTC Disaster

Employing lessons learned from the 1946 airplane strike on the Empire State Building in New York City, the World Trade Center (WTC) Towers were designed structurally to withstand a jet plane impact. The designers knew that most of the Empire State Building deaths were due to fire. The WTC Towers were designed to resist impact by small planes. The FEMA study into the collapse indicated that the structures could have remained standing following the jet impact for an extended period had it not been for the fires. Unfortunately, the collapse's primary driver was due to the fire and failures of the fire protection systems, from the type, adhesion, and thickness of the fireproofing to damage to passive systems caused by the impact and inaccessibility to firefighters.

Based on the WTC experience, new recommendations from the National Institute for Standards and Technology (NIST) have been adopted in model building codes. These changes include additional exit stairways, supports for passive fireproofing systems, increased bond strength for fireproofing, and higher fire resistance ratings for primary structural frames of buildings 420 feet and taller.

Most public buildings post code-required warnings that occupants should not use the elevators in a fire emergency. Many handicapped and disabled persons cannot use stairs and must congregate in designated areas awaiting rescue crews to carry them out. The WTC disaster refuted this policy. New building codes permit the use of elevators in a fire emergency if the elevators are in a standalone smoke-proof hoist way, have emergency power, and have manual operation by a firefighter.

San Fernando Earthquake

In the aftermath of the 1971 San Fernando earthquake that destroyed an old Veterans Administration (VA) hospital and killed 46 patients and staff, the VA Administrator challenged the staff: "this must never happen again." As a result, the VA issued its new earthquake design code in 1972. It was the first code to require a structural seismic design based on drift, rather than force, a concept now widely accepted. It provided not only provisions for the design of the structural and other building systems, but also for special access to the facility and backup utilities so that a VA hospital would remain operational after an event. This was chiefly because it was expected that firefighting and rescue equipment could not reach VA sites immediately after a large earthquake. The VA also initiated a program to evaluate and reinforce its 160 existing hospitals. Those found to be too vulnerable to strengthen were evacuated and demolished.

The U.S. State Department followed the 1972 VA design code for its new Embassy in Haiti. Hit by the 2010 Haiti earthquake that claimed over 250,000 lives, the Embassy building survived the earthquake without damage and provided community assistance in the aftermath.

Today, many building codes require that some structures be designed to resist attacks, as well as earthquakes and other natural disasters. As a general rule, many technical measures in the current *International Building Code* (IBC) for high-risk seismic zones can also be useful in mitigating terrorist attacks.

Structural Engineers

Generally, building codes are based on observed experience and may not foresee challenges on a specific project. Few owners, operating on tight budgets, encourage design that exceeds code requirements. There may be a conflict between an owner's cost concerns and the engineer's prime ethical concerns, or design responsibilities by contract may fall outside the structural engineer's purview.

A critical *Lesson Learned*, especially for younger engineers, is to review specific issues with construction workers at the job site. They often know about construction and repair methods that may shed light on the issue at hand.

Finally, all engineers are encouraged to participate in professional society meetings where many important technical issues are discussed, share both successes and failures with other engineers, and utilize these lessons learned in future design and construction.▪

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