

Disaster Preparation for Structural Engineers

By Fred Nelson, S.E.



Earlier this year, I was returning to my home in Mesa, Arizona from Kanab, Utah, a 380 mile trip over mostly desolate desert. I had gone about 10 miles when I saw a man holding a gas can beside a stranded van on the other side of the highway. Perhaps contrary to my better judgment, I felt compelled to stop and find out what he needed and how I could help. As I approached him, I noticed that he was on crutches and his foot was wrapped in bandages. He explained that he had been waiting for about 30 minutes for a ride into town to fill his can, and was obviously unable to negotiate the long walk into town. As we chatted, at least a dozen vehicles passed going his way, so I determined that if I didn't help him, no one would for a while. I took him into Kanab where he filled his gas can, after which I returned him to his vehicle. As I left him to continue my journey home, the inner warmth I felt of helping was somewhat compromised as I wondered if I should have given him one or two \$20 bills, as he was almost out of cash and his destination was about 300 miles away.

In a way, this experience is a microcosm of what structural engineers experience when bombs explode outside Federal buildings, or airplanes fly into buildings, or when natural events like hurricanes, tornadoes, mudslides, earthquakes, and tsunamis cause massive damage. These events never occur when it is convenient for us. Moreover, when we volunteer our services, there is always a risk that we will make a mistake, endangering lives and property. Our personal well-being is at risk...we thrust ourselves into uncertain situations that are not within our control, where secondary

collapses and/or additional attacks render us vulnerable. We certainly feel inner warmth as we bring our experience and training to an arena where others are unable or unwilling to do what we do. And we always wonder if we did enough or performed our assignments well enough.

Birth of the SEERP Program

The Structural Engineer's Emergency Response Plan (SEERP) had its birth with the September 11, 2001 attack on the World Trade Center. In response to requests from the City of New York, the Structural Engineers Association of New York (SEAoNY), supplemented by the National Council of Structural Engineers Associations (NCSEA), organized teams to assist in a variety of efforts, including the assessment of damaged buildings and the initial search and rescue efforts. That effort, which coordinated the service of approximately 350 voluntary structural engineers, was spontaneous without formal guidelines, and was dependent upon the experience of individuals on the various teams. Although at risk, both in their personal well-being and in the consequence of their decisions, these volunteer engineers demonstrated the highest ideals of our profession.

The successes and shortcomings of this 9-11 effort were collected and evaluated by August "Gus" Domel, S.E., Ph.D., a Chicago structural engineer/attorney who spent

two memorable days at Ground Zero. Dr. Domel compiled this information into a document published by NCSEA, *World Trade Center Disaster: Structural Engineers at Ground Zero*, which led to the formation of the NCSEA Structural Engineering Emergency Response Plan (SEERP) committee. This dedicated group published the *SEERPlan Manual* in August 2003, and issued a mandate to state Structural Engineers Associations to train and prepare structural engineers to respond to future incidents. Like many other states, Arizona (SEAoA) accepted the mandate. Because of my experience in FEMA Urban Search and Rescue (USAR), I accepted the assignment to organize/chair the SEERP Committee in Arizona.

Initial Implementation of the SEERPlan in Arizona

The Arizona SEERP committee was organized on September 16, 2003, following an invitation to all SEAoA members and sister organizations (AIA, ASCE and the Arizona Consulting Engineers Association). Using a preliminary draft of the SEERPlan, our focus was to follow the National Guidelines. We immediately created the following subcommittees chaired by key members of the SEERP Committee:

- 1) Personnel
- 2) Logistics
- 3) Government Interface
- 4) Bridges

The issues we addressed immediately were to:

- 1) Initiate contact with existing State emergency services, including The Arizona Council on Earthquake Safety, The Arizona Department





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Dr. Corley received his Bachelor of Science degree in civil engineering from the University of Illinois in 1958. He received his Master of Science degree and Ph.D. degree in structural engineering from the University of Illinois in 1960 and 1961, respectively. He has authored over 175 technical publications.

Dr. Corley is an active member of the National Academy of Engineering, an Honorary Member of ASCE, an Honorary Member of ACI, and member of several other engineering societies. He is Past President of the National Council of Structural Engineers Associations, and past-Chairman of the ASCE Council on Forensic Engineering and past-Chairman of ACI-318. Currently he serves as President of the National Council of Examiners for Engineering and Surveying.

Following the September 11, 2001 attack, Dr. Corley was asked by ASCE to lead the team to do the Building Performance Study of the World Trade Center. ASCE and FEMA sponsored the WTC study.

Dr. Corley was Principal Investigator for the ASCE and FEMA on the investigation of the Oklahoma City Bombing and has done investigations of earthquake damage in Central America, South America, Japan, and California. He is a Licensed Structural Engineer in Illinois, and holds Professional Engineer licenses in 25 states.

Seminar Cost: \$250 per connection
Information: 312-649-4600 x201
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NCSEA WEB SEMINAR

Tuesday September 25, 2007

10:00 am - 11:30 am Pacific

11:00 am - 12:30 pm Mountain

12:00 pm - 1:30 pm Central

1:00 pm - 2:30 pm Eastern

Thorough Preparation of Construction Documents

Preparation of supporting calculations, to minimize disputes, has become a significant part of any structural project. Successful projects can depend on understanding the role calculations play in avoiding ambiguity in construction documentation. Accurate and well-supported technical presentations by the engineer of record are essential. This presentation offers guidance on these calculations and supporting documents. Also, qualifications needed in order to support design drawings are discussed. Limits on acceptable documentation are described and numerical examples are presented for some recent case studies.

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of Emergency Management, the Arizona Department of Emergency Services, and local Fire Service.

- 2) Establish an inventory of our resources, and create a personnel list.
- 3) Arrange for ATC 20 Training and OSHA Training.
- 4) Identify existing "Good Samaritan Laws" and whether these laws are applicable to Arizona SEERP activities.
- 5) Volunteer structural engineering services to the Pima County (AZ) Highway Department to help with the design/construction of three small bridges and an earth retaining wall damaged in the 2004 "Aspen (forest) Fire" in the Mount Lemmon/Summerhaven area north of Tucson.
- 6) Coordinate our efforts with other professional societies, including AIA and ASCE.
- 7) Support our members in training to respond to actual emergencies.

Arizona SEERP Activities

Within a few months of organizing, we began implementing our plan. In areas where we had direct control over the outcome, we have been successful; in areas where we depend on bureaucracy, our efforts have led to continued frustration and stagnation. It

is primarily because of those successes and frustrations that this article was developed, in the hope that other SEERP committees may benefit and perhaps provide us with insight into how we can perform our task better.

Contact with Government Agencies

- 1) We have met with The Arizona Department of Emergency Management and given them a short PowerPoint presentation about how rescue engineers are a valuable asset. We have become part of their permanent plan. They are performing a mock response to a dirty bomb incident in October 2007, as one of three sites selected by Homeland defense. We will participate with them.
- 2) Our committee chair applied for one of two public positions with the Arizona Department of Emergency Services in May, 2004. However, the Governor appointed a Native American to one of the positions (logical choice as Arizona has 14 tribes), and a person with



experience in industrial environmental health and security.

- 3) The Phoenix metropolitan area has a Life Safety Council consisting of upper management from area Fire Departments. We presented a short PowerPoint summary about how rescue engineers are a valuable asset. This was a very successful meeting, as the chiefs requested that we prepare a course on structures and emergency structural engineering. We also reached an understanding that should we be



needed, we could use the standard SEERP *Letter Agreement for Emergency Professional Services* to achieve the needed services.

Personnel List and Inventory of Assets

Our committee has over 40 members, who each have a SEERP manual, and over 75 individuals who are on our email list. At the present time, the Arizona SEERP committee does not have a cache of equipment, and our policy is that individuals should provide their own equipment using the suggested list in the SEERP manual.

ATC 20 and ATC 45 Training

In 2004, we presented a seminar, *Planning and Procedures for Post-Disaster Structural Evaluation*, to approximately 40 engineers and

5 fire captains. The ATC-20 *Structural Assessment for Earthquake Damage* part of the program was presented by August "Gus" Domel and Chad Fischer of the NCSEA SEER Committee and Thomas McCluskey, P.E., S.E. of the Chicago area. These presenters also provided Pre-ATC 45 *Windstorm and Floods* training as part of their session. In addition, we had OSHA training from the Construction Safety Council.

We completed ATC 45 *Safety Evaluation of Buildings After Windstorms and Floods* as part of our SEAOA Spring 2007 meetings.

Good Samaritan Laws

The first thing we did was to invite local attorneys to research Good Samaritan Laws in Arizona, and to train our members in an evening session. Attorneys found three existing Arizona statutes that appear to offer protection to professional engineers during an "authorized emergency." However, none of these statutes provide exactly what we

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The following are personal experiences of assistance provided by volunteer professionals during actual emergencies:

Oklahoma City Murrah Building - April 1995

AZ TF1 was the first FEMA team to Oklahoma City, arriving about 12 hours after the event. The 9-story cast-in-place concrete building lost four of approximately 30 columns, but about 50% of its area. Several remaining columns were damaged and in danger of collapse. On two of these columns, two floors had totally collapsed, leaving 36-foot high damaged concrete columns, supported mainly by debris. Prior to our arrival, partial horizontal bracing had been installed by locals, consisting of 4-foot pipes spanning a distance of 35 feet in only one direction, and only at one floor. We were grateful for the local efforts, although this bracing gave a false sense of security to the Oklahoma City rescuers; we quickly determined that the columns needed to be braced at both floors in both directions, and that the existing bracing had a slenderness ratio about 50% too high. It was a start, which we eventually corrected by installing the needed bracing and by making the slender braces part of trusses.

World Trade Center Infrastructure - September 2001

One of the speakers at a special Plenary Session at the ASCE National Convention on October 12, 2001 in Houston, TX was Eugenia Roman, E.I.T., President of the North Jersey Branch, New Jersey Section. Although only 26 years old, Ms. Roman coordinated the effort of 14 individuals in gathering plans and maps of the WTC area so that the rescue engineers would have useful drawings about the incident. A grid system was superimposed on the drawings; she helped with mapping and got information from the NJ Office of Emergency Management. A fire fighter with burned hands later came up to her and shook her hand, saying, "You saved our lives...those prints were amazing." She commented how reluctant she was to shake the burned hand, but did so out of respect.

World Trade Center USAR Experience - September 2001

AZ TF1 spent two days behind the Banker's Trust Building on Vessey Street, adjacent to WTC 2. A column in the front of the building had been severely impacted and detached from approximately the 9th to the 22nd story by a "bear claw" like piece of debris from the facade of Tower 2. This large piece had grabbed onto the building and was hanging ominously, approximately 75 feet above the ground. While other rescue personnel were concerned that it might fall, I was concerned about the overall strength of the building and whether it was in danger of collapse. This concern was eased when I learned that local structural engineers, with more resources than I could ever hope to marshal, had performed a structural analysis of the building with the missing column, and concluded that its moment frame redundancy was adequate to compensate for the lost strength.

La Conchita Mudslide - January 2005

The Conchita mudslide occurred in a small community approximately 75 miles north of Los Angeles, CA, following 15 days of record rainfall. It resulted in 10 fatalities and 14 significant injuries. Victims were trapped in their homes and rescued using bulldozers and other heavy equipment. Fire Chief Tom Emald, who was one of the first responders and a fellow USAR member, with experience working with structural engineers, noted to me that a pair of geologists offered their services during the event. His take on their input is that it was too technical to be of much value to the rescuers. The lesson learned here is that when we respond with rescuers, we need to provide clear and concise information that is in an understandable and usable form.■

need. The attorneys reviewed these statutes with an audience of over 40 in February, 2004. In addition, they expressed our need for "Workman's Compensation" protection in the event that our services are needed.

One of these statutes provides protection for the Arizona State Board of Technical Registration and "members of advisory committees" who provide emergency services at the scene of a disaster. We presented our case to the Board to be an advisory committee, but the State Attorney General ruled that our group is not protected by the Statute.

We have reviewed model legislation in several other states, including California, Colorado, Connecticut, Florida, Georgia, Illinois, Kansas, Kentucky, North Carolina, North Dakota, Oklahoma, Pennsylvania and Utah. Arizona State Representative John Nelson, P.E. (Civil) introduced similar "Good Samaritan" legislation in the Arizona House. It failed to pass by one vote.

Our committee policy is that we will not risk our members without Good Samaritan legislation, but we will use the standard SEERP *Letter Agreement for Emergency Professional Services* should a real need develop.

Coordination with other Professional Societies

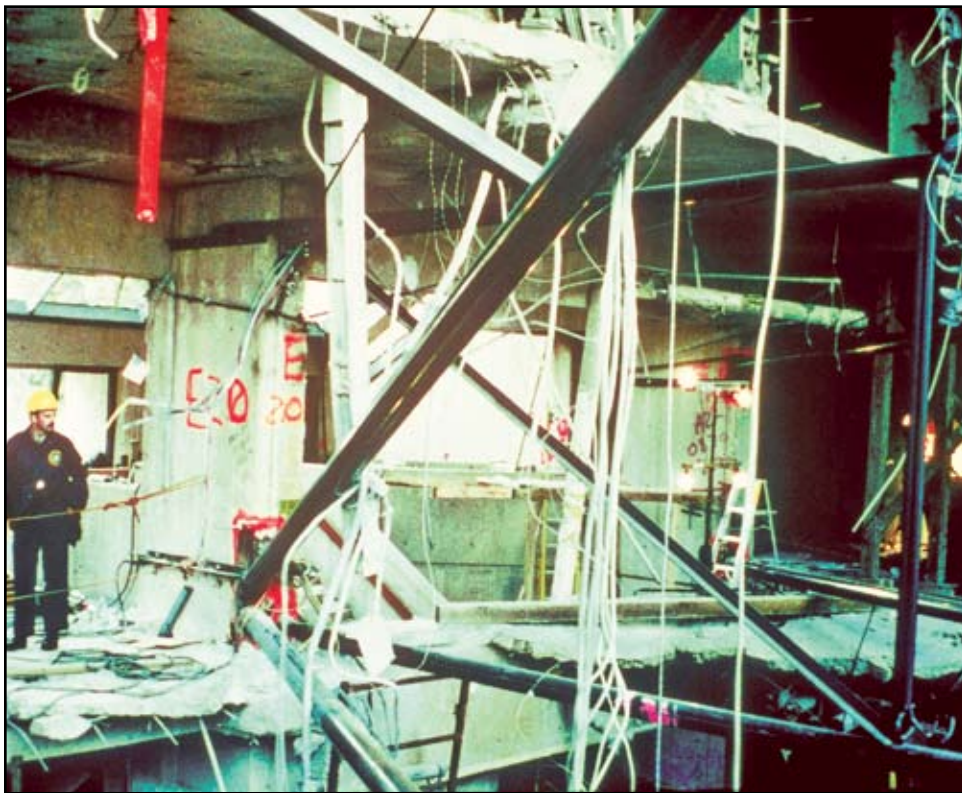
AIA and ASCE have not yet actively participated in our training. ACEA, however, has been supportive of our efforts to mingle with Arizona Legislators and to obtain "Good Samaritan Legislation." In addition, local providers of Professional Liability Insurance have been actively involved in some of our meetings and in responding to our questions.

Moreover, we have had direct contact with our counterparts in other states, including Colorado and Washington.

Supporting our Members to Respond to Actual Emergencies

We have had two events where our members have volunteered services: the Aspen Fire in the Mountains above Tucson and Hurricane Katrina.

- 1) The Aspen Fire occurred during our organizational phase, and Pima County Highway Department contracted the renovation of their bridges and retaining wall to local consultants.
- 2) In the aftermath of Hurricane Katrina, approximately 10 of our members offered their services, which offer we communicated with NCSEA as we had continual email contact with NCSEA. We were not alone, as 16 of the 39 NCSEA Member Organizations marshaled over 350 volunteers. However, only a very few were able to make it



to the hurricane ravaged area. Dave Swanson, Chair of NCSEA SEERP Committee, later informed us that only California volunteers made it, and they got to go because they were sent by the California Office of Emergency Management.

Our conclusion is that we should have coordinated our efforts with The Arizona Department of Emergency Management, who have authority to coordinate efforts between states. This we will do in the future.

In summary, over the past four years, we have attempted to follow the guidelines presented in the SEERP manual. Progress has been painfully slow. When post 9-11 enthusiasm was high, we were able to train over 40 members. Although we have not yet succeeded in obtaining Good Samaritan legislation, we are making the effort. We have also made ourselves known to The Arizona Department of Emergency Management, local fire service and other key state personnel. Although we were not able to get to Katrina, we were willing to go and serve.

Summary

Like the traveler who encounters a stranded motorist on a desolate highway, we never know when someone else might need our help, or how our offer to help might be received, or what dangers we might encounter. Nevertheless, like Teddy Roosevelt, we are anxious to enter that arena, with knowledge that:

It is not the critic who counts; not the man who points out how the strong man stumbles, or where the doer of deeds could have done them better. The credit belongs to the man who is actually in the arena, whose face is marred by dust and sweat and blood; who strives valiantly; who errs, who comes short again and again, because there is no effort without error and shortcoming; but who does actually strive to do the deeds; who knows great enthusiasms, the great devotions; who spends himself in a worthy cause; who at the best knows in the end the triumph of high achievement, and who at the worst, if he fails, at least fails while daring greatly, so that his place shall never be with those cold and timid souls who neither know victory nor defeat.

Theodore Roosevelt, Paris, France
April 23, 1910 ■

Fred M. Nelson, S.E., is a partner with Gervasio & Associates, Phoenix, AZ. He is Chair of the Arizona Structural Engineer's Emergency Response Committee, and is a past President of the Arizona Society of Civil Engineers, a Section of ASCE. He has been a member of AZ TFI, a FEMA Urban Search and Rescue (USAR) team, sponsored by Phoenix Fire, since 1994. In his USAR role, Mr. Nelson was deployed at the Oklahoma City Murrah Building bombing; the Atlanta Olympics (on stand-by); the World Trade Center Response; and Hurricane Rita. He can be reached via email at fmn@gervasioeng.com.