

# THE AFTERMATH OF SEPT. 11

by Dobby Gibson,  
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Engineers who played a critical role in the rescue and recovery efforts at Ground Zero share their experiences and thoughts about the long-term impacts of Sept. 11.

**Ask a group of engineers about the terrorist attacks of Sept. 11, 2001, and they will struggle for words, as millions have, to describe the unimaginable horror and sadness they heard about and witnessed, including the death of 14 colleagues in the initial attacks. But get them to talk long enough, particularly about the attacks on the World Trade Center (WTC), and they will begin to reveal the critical role their industry played in the Sept. 11 rescue and recovery efforts, and the ways they feel engineering has been changed forever.**

**Even months after the attacks, engineers remained on the front lines. In New York City, consulting engineers worked 24-hour days alongside police and firefighters, playing an invaluable role in solving the myriad engineering problems posed by Ground Zero's massive, twisted rubble. The questions are only just beginning. Engineers everywhere are being asked: Do we continue to build office or residential buildings so high? How do the events of Sept. 11 affect the way we build structures in general? And what is the future of the engineering marketplace post-Sept. 11?**

## **Unsung heroes at Ground Zero**

"Nobody could really contemplate what that site looked like on the 12th," says George Tamaro, a senior partner with Mueser Rutledge Consulting Engineers. "Dante would have a hard time describing it."

"What you saw on TV was like a movie," says Andy Ouzoonian, a principal of Weidlinger Associates, "but when you were down there, it was completely different. The emotion—forget the sound, the smell, everything else—the emotion there was all over the place. You spent your 12-hour shift down there, and the next day, to be honest with you, you were just in a daze."

Mueser Rutledge and Weidlinger Associates were both subcontractors to LZA/Thornton-Tomasetti, the lead firm responsible for overseeing all of the engineering support for search, rescue and demolition at Ground Zero. The engineering support facilitated a stable rescue site from which precious survivors could be found and debris removed as safely and efficiently as possible.

LZA/Thornton-Tomasetti and its subcontractors had four responsibilities at Ground Zero. First, they had to make an assessment of the buildings and remnants of buildings in the immediate area: What should be done to these structures to make the search and rescue

effort safe? This included an assessment of the WTC foundation area by Tamaro, who was involved in its original construction.

The WTC towers were built atop garbage: six acres of landfill dropped into the Hudson River to artificially extend the island of Manhattan. As a result—and due to the sheer height of the towers—the foundation of each tower had to reach 70 feet below ground level to find solid bedrock. A slurry wall, referred to by Tamaro as "the bathtub," was used to keep the Hudson River at bay.

"Everybody was looking up, looking at buildings," says Tamaro. "I was really the only person who had a good grasp of what was

going on underground. Firemen weren't aware of what was below them. They weren't aware they were over structure instead of over street."

Second, once the integrity of the slurry wall was assured and the firemen informed of what lay beneath their treacherous steps, the engineers began to help the firefighters and rescue personnel gain access to those trapped or buried in the rubble.

"We had to put cranes where cranes had never gone before," says Richard Tomasetti, president of Thornton-Tomasetti. This included devising a means to place a crane on the WTC pedestrian plaza, which was never designed to withstand such a load.

Third, the engineers had to take a long-term look at the more than 400 buildings in the immediate area: checking, for instance, the facades of buildings lining Broadway to see if the avenue could be reopened safely. Remarkably, aside from the seven impacted WTC buildings, the engineers found that less than 10 buildings suffered significant structural damage.

Finally, the engineers had to help contractors design procedures for demolition and haul-away. For instance, early on, a means to take down the remnants of Tower 1 and Tower 2 had to be designed in such a way to avoid further damage to the site.

Perhaps the greatest testament to the work of the engineers at Ground Zero has been the safety record at the site.

"We have had some injuries, but I know of no fatalities, and it's extraordinary considering the conditions we encountered," says Tamaro, knocking on the wood of his desk.

When Tomasetti reflects on

## ACEC Member "Heroes" Speak at Symposium



ACEC members who spoke at a National Building Museum symposium on Ground Zero—including Charles Thornton (left), chairman and managing principal of the Thornton Tomasetti Group (TTG); Daniel Cuoco, president and managing principal of LZA Technology; and George Tamaro, senior partner of Mueser Rutledge Consulting Engineers—were called "heroes of Sept. 11" by ACEC President Dave Raymond in his opening remarks. TTG was responsible for overseeing all of the engineering support for the site's search, rescue and demolition efforts.

his experience at Ground Zero, he says, "I've worked on some major disasters before, but I have never experienced anything like that in my life. But I will tell you this, I was heartened by the spirit of our industry."

Says Tamaro, "We all jumped in and started working without really having a good grasp of what the insurance coverage was, what the liability exposures were. Everybody just started working, period. And we'll sort it out later. You just do it. I think that was the spirit of what was going on down there."

### Long-term impacts

One of the first predictions in the wake of the WTC attacks was that the skyscraper would become obsolete. Supporting this prediction were bomb scares and evacuations at skyscrapers in just about every American city, a decline in upper-floor office space prices and a spike in demand for once merely humorous contraptions such as the Executive Parachute.

Now that some time has passed, engineers seem to have reached a consensus on this issue: The skyscraper is here to

stay. What will change, most engineers say, is the design and scale of skyscrapers. They will be constructed of different materials, engineered with more redundancy and perhaps not built as high.

Ouzoonian speaks for many engineers when he says, "I don't think skyscrapers should be outmoded. We have to look at it another way, in a more practical sense. You want to look at more redundancy." And, he adds, no more height for height's sake.

"At least in the immediate future, I suspect that skyscrapers are not going to be built so out of scale with their surroundings, as the World Trade Center towers were," says Henry Petroski, the Aleksandar S. Vesic professor of civil engineering and a professor of history at Duke University [see "Henry Petroski," p. 30]. "I think the World Trade Center towers looked good in their context, but they clearly stood out by being so much taller than their surrounding buildings by about half. [Such a scale differential presents] too obvious a target."

Whatever the scale, it's fairly certain that a higher premium

will be placed on fire-resistant building materials.

"Our profession and the architectural profession should probably look at fire protection and the exiting of all these high rise buildings." Ouzoonian says. "The older buildings [that survived the fires associated with the WTC collapse] didn't have the spray-on fireproofing. They had the tile work or brick around the steel members to protect them, which seems to have worked better."

Computer models will be used to understand structural response to large scale impacts and fires. The materials and designs that allowed some buildings to withstand the WTC collapse better than others will affect how similar buildings are constructed in the future.

"I think we'll start seeing some of that come into our codes, or at a minimum, engineering practice," Tomasetti told *The New York Times*.

Engineers are also in agreement that fully disaster-proof skyscrapers are not viable from a financial and functional perspective.

Petroski asks, "Can we build buildings where this wouldn't

happen? Yes, by making them with massive columns and no windows, but who wants that? The Pentagon suffered very little damage, especially compared to the World Trade Center, yet it was hit by the same weapon. The Pentagon was undergoing strengthening. The accident demonstrated how the engineers were right on. We could build all of our buildings low like the Pentagon, and spread out, but that would clearly take away a certain excitement from the nature of cities.”

Leslie Robertson, director of design at Leslie E. Robertson Associates and one of the two engineers behind the WTC, told *Newsweek*, “You could always prepare for more and more extreme events, but there has to be a risk analysis of what’s reasonable.”

What risks will become accepted as reasonable? This is the central question, and its answer is dependent primarily on the ability of the U.S. government to better secure its infrastructure and sustain preventative foreign policy. No engineer wants a terrorist attack to be a reasonable risk factor.

Tamaro is adamant on this point. “[Sept. 11 was] a foreign policy failure—a political failure—not a building failure. When we respond with ‘We’re going to build stronger buildings’—the building was quite suitable. It withstood the original attempt to bring it down, and it took a tremendous and dedicated

attack to bring the both of them down.” We don’t need to focus on the construction of terrorist-proof skyscrapers, Tamaro believes, we need to focus on the terrorists themselves.

Petroski agrees. “I don’t think the finger has been pointed at engineering. Everybody seems to recognize that there are limitations to what engineers can do, or should do. There is always something that can be thrown [at a structure] that will destroy it.”

Robertson, understandably still very shaken by the attacks, remains proud of the engineering behind the WTC towers, and rightly credits the structures’ design for saving lives. “If [the towers] had fallen down immediately, the death counts would have been unimaginable. The World Trade Center performed admirably, and everyone involved in the project should be proud.”

### **Insurance market in flux**

The terrorist attacks of Sept. 11 dealt a serious blow to the insurance markets, which remain in flux. Toward the end of 2001, property coverage for large risks increased approximately 75-80 percent, and terrorism exceptions were being added to many new policies. Insurers providing casualty coverage are now much more conscious of what they call “aggregation risk,” where a large number of employees or policy

holders are in a single location.

While property and casualty insurance and reinsurance companies estimate their losses from Sept. 11 to total approximately \$18 billion, the industry appears to be adequately capitalized to pay for the losses. Much will depend on interest rates and the performance of the stocks and bonds markets.

The consensus among those who watch the insurance markets seems to be that things will get worse before they stabilize, and that ultimately the commercial marketplace, not the government, will provide the risk solutions developers demand. And new skyscrapers will once again rise above city streets.

Finally, a change in the marketplace that engineering firms should anticipate—if not participate in first-hand—is the new emphasis on business continuity planning. Companies are spending an increased amount of time and money reviewing or creating crisis management programs, from the CEO down. These programs typically include an employee assistance program, an employee communication plan, a thorough assessment of the security of company property and emergency and business recovery planning. In the wake of Sept. 11, even engineering firms themselves have some reevaluating to do.

### **A new age of engineering?**

Just as the firefighters of New York have taken a well-earned spot on the cover of the nation’s newsweeklies and NYPD hats top the heads of professional athletes, the engineers associated with the design and construction of the WTC and Pentagon, the strengthening of the Pentagon and the rescue and cleanup efforts have found their work recognized by a new and larger audience. If these engineers aren’t quite household names, they are galvanizing a broader appreciation for the art and science of engineering.

As Petroski says, “There is so much attention being given to how [the WTC towers] failed, what they symbolized and what’s going to replace them, that engineering is clearly a very visible partner in all of this in a way that maybe it had not been in the past.”

Engineers of all kinds are facing new questions, asked with a new urgency from an awakened public.

As Petroski himself wonders aloud, “What are the limitations of engineering? What can engineers do to help us fight terrorism and feel good about ourselves that also has an aesthetic presence and is symbolic of overcoming what has happened?”

The answers, of course, remain to be seen.

## THE POST-SEPT. 11 MARKETPLACE:

# A Bumpy Road for STATE FUNDING

by John Horsley, executive director,  
American Association of State Highway and Transportation Officials (AASHTO)

As governors and legislatures across the nation survey the year ahead, 36 states face budget deficits. The slowdown in the national economy last year has had spillover effects in many states, forcing budget cuts that in some cases impact transportation plans. At the same time, in at least two states, California and Florida, spending for transportation has been increased despite a need for overall state budget cuts.

California has identified cuts to bridge a funding gap of more than \$12 billion, yet its proposed transportation budget of \$8.9 billion represents a \$1.1 billion increase in spending from the previous year. It preserves earlier commitments Gov. Gray Davis and state lawmakers made to dedicate \$8.1 billion from the general fund over eight years to transportation. As of February 2002, \$6 billion in improvements were underway. And California's legislature, with the governor's backing, placed an amendment on the March 5 ballot to fully dedicate

state sales tax funds from gasoline to transportation use.

Last fall, Florida's recession led to two special sessions of the legislature during which the governor and lawmakers made \$722 million in cuts to address a \$1.3 billion revenue shortfall. But the economic stimulus program that Gov. Jeb Bush and the

As of February 2002, the member states of AASHTO also face a serious threat of almost \$9 billion in federal highway cuts, as analysis from the U.S. Treasury shows tax revenues dipping below previous forecasts. Such a reduction would entail the loss of more than 140,000 jobs. AASHTO is working with ACEC and other interested groups

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Florida Legislature approved maintained a focus on transportation and will create thousands of jobs in the state. In addition to the \$668 million the stimulus package devoted to transportation—accelerating 63 projects—money for education and state tourism was also included.

to encourage Congress to sustain funding to meet pending needs and avoid job cuts. If the current scenario does not change, states could be facing an additional almost 30 percent cut in federal highway funding on top of the cuts state DOTs have already made to balance their budgets.

## THE POST-SEPT. 11 MARKETPLACE:

# What Your Peers Are SAYING

“The incident of Sept. 11 is a tragic national event, but was not the sole factor in the current economic slowdown. From an infrastructure perspective, the budget cuts by state and local agencies due to revenue shortfalls have impacted current programs in the short term. A renewal in economic growth and investment will correct the current slowdown.”

—Ed Mulchahy, principal, *TransSystems Corp.*

“We've seen a slowdown in engineering services in Colorado, but it's hard to say whether it's attributable to Sept. 11. In commercial and industrial areas it has been slower, and we've had some layoffs in the Denver area. In the longer term, state budgets are being reduced, and more money is being siphoned to security that was earmarked for design. It pretty much will be that way for the next six months. Interestingly, our firm is seeing more RFQs for security projects.”

—Mark Hamouz, principal and vice president, *LONCO, Inc.*

“The market in Connecticut, and in most of Southern New England, remains strong. The economy in this region has diversified since the recession of the early 1990s, and the only cloud on the horizon would be state fiscal problems as they relate to government projects. Some projects may be delayed or put off until [the state] can resolve some of those issues.”

—Paul Brady, executive director, *Connecticut Engineers in Private Practice*

“The impact of Sept. 11 varied greatly depending on a firm's business sector. I am certain those involved directly or indirectly in the airline industry experienced a significant impact. Our firm is involved in all modes of transportation, and I consider the impact moderate and short term. I feel the most significant impact has been in how we interact with one another and our increased focus on—or realignment of—priorities. The time and energy spent on trivial matters has been reduced. Generally, people seem more focused on 'what matters most.' I hope this

effect from the tragedy will be long term.”

—Mike Krannitz, senior associate, *Wilbur Smith Associates*

“In simple terms, there are fewer projects being undertaken by owners, and the nature of those projects has changed significantly. The events of Sept. 11 had an immediate and substantial impact on airport revenues, which has forced our capital program to be revised in order to delay the implementation of capital improvements. As a result, there are fewer project opportunities available to consulting firms. Also, there has been a significant shift in priorities, and security enhancement projects are now the primary focus of the airport. This, in many ways, has created a new market for consulting firms, as the same firms that have been doing business with Massport for years reinvent themselves in order to be responsive to the owner's security needs.”

—Maureen McDonough, contract administration manager, *Massport*

