What’s Changed in Building Design Since 9/11?

On February 26, the 10-year anniversary of the first attack on World Trade Center, a group of designers, builders and code officials met to discuss what has changed for those who design, construct and operate buildings since September 11.

JIM CROCKETT: We come together for this discussion at a very timely confluence of events: The imminent announcement of the winner of the new World Trade Center development; the announcement of the findings of the City of New York’s post-9/11 Task Force; and unfortunately, the club tragedies in Chicago and Rhode Island. So this is a particularly appropriate time to discuss building design and where we’re going. I thought that Ronny (Livian) could start by talking about some of the 21 recommendations that the city is currently contemplating.

RONNY LIVIAN: The task force was formed in March of 2002 with a view to improving the safety of high-rise buildings in every sense — for fire protection, for structural strength and to address other possible threats such as chemical attack. It considered both immediate recommendations, which are included in this report, as well as additional recommendations that need further testing. These were referred to NIST and FEMA, which are starting their studies on things like spray-on fireproofing and other materials that need to be tested more to find a better solution than exists right now.

The 21 recommendations in the report are mainly to improve the strength of buildings. The World Trade Center actually performed pretty well considering the amount of fire and the temperature and everything else. If, for example, it lasted another 15 minutes or half hour, that would have saved probably a few thousand more lives. That is really the intention of the report. Not to have a foolproof building that will not be damaged at all, but to have a building that will last longer and that can take a little bit more and the exits will stand a little more heat and blast and it will be safer. But we also were concerned that any recommendation may increase the cost of construction to the point that there will not be any more high-rises built in the city. Some people in the group made sure that we didn’t recommend something that is not buildable.

So some of the recommendations are things such as recommending that the progressive collapse features of the building be improved, mainly using the U.K. regulation on progressive collapse, which is a little more elaborate than what exists right now in our building code.

The report made some other recommendations. For
New York City Department of Buildings
WORLD TRADE CENTER BUILDING CODE TASK FORCE RECOMMENDATIONS

1. Publish structural design guidelines for optional application to enhance robustness and resistance to progressive collapse.

2. Prohibit the use of open web bar trusses in new commercial high-rise construction over 75 feet in height, pending the development of an appropriate standard recommended by NIST.

3. Encourage use of available impact resistant materials in the construction of stair and elevator shaft enclosures until appropriate standards can be developed.

4. Work with the Department of City Planning to exempt floor areas of stairwells above minimum requirements from zoning Floor Area Ratio (FAR) calculations to encourage the inclusion of more stairwells or wider stairwells in buildings.

5. Prohibit the use of scissor stairs in high-rise commercial buildings with a floor plate of over 10,000 square feet.

6. Improve marking of the egress path, doors and stairs with photo-luminescent materials and retrofit existing exit signs with either battery or generator backup power.

7. Mandate a full building evacuation plan for non-fire related events.

8. Work with the Department of City Planning to exclude floor area of “fire towers” from Floor Area Ratio (FAR) calculations to encourage their use.

9. Mandate protected vestibules at elevator lobbies in newly constructed occupancy group E buildings greater than 75 feet.

10. Require controlled inspections to ensure that fireproofing is fully intact on all structural building members exposed by subsequent renovations to ensure continued compliance with applicable code requirements.

11. Require all high-rise commercial buildings over 100 feet without automatic sprinkler protection to install a sprinkler system throughout the building within 15 years.

12. Require all occupancy group E buildings to maintain a Building Information Card (BIC) listing a building’s vital features.

13. Enhance Fire Department emergency response communications in high-rise commercial buildings.

14. Provide additional training for Fire Safety Directors.

15. Limit diameter of fuel oil transfer piping in systems using day tanks.

16. Implement standards for piping that is utilized to distribute fuel oil to equipment without the use of a day tank.

17. Exclude floor drains for elevator vestibule and shafts from being counted as fixtures in calculating normal waste water pipe capacity.

18. Require air intakes in all new construction to be located at least 20’ above grade and away from exhaust discharges or off street loading bays.

19. Require controlled inspections of HVAC fire dampers in newly constructed occupancy group E buildings.

20. Wait for the recommendation of Mayoral Commission on adoption of national model code and incorporate Task Force recommendations into any locally specific modifications.

21. Encourage buildings within NYC geographic boundaries and subject to other jurisdictional authority to comply with NYC Building Code through collaborative agreements.
instance, at this time we don’t have enough data on lightweight open-web construction, so we are not going to allow it in high-rise buildings until we learn more about it.

The only part of the recommendations that will affect existing buildings are sprinkling of the high-rise buildings. That is, if a high-rise building is more than 100 feet high and at this time is not sprinkled, they would have to be sprinkled within 15 years from the time that these recommendations become effective.

CROCKETT: How about voice evacuation along with sprinklers?

LIVIAN: Regarding voice communication and fire department communication — no. That is a separate recommendation from this for high-rise buildings. The only thing about that is the fire department has not finalized what system they want to use. Most of the buildings would have to be changed slightly with limited costs, I think under $20,000, to allow the fire department communication equipment in.

The reason for 15 years was to consider the number of leases. Usually, the average lease time is seven years, so in two lease terms it was expected that there will be a change over and the buildings will be able to be sprinklered. You mentioned other types of safety issues as far as HVAC systems. The recommendations are simple, just to have the air intake 20 feet above ground so that there is less danger of some chemical or other biohazardous attack to the buildings.

There was a lot of discussion about the amount of oil storage in oil tanks in the buildings. You hear the reports that there was some concern that some of the fire (in buildings following the World Trade Center attacks) was based on the oil tanks in the different buildings, which increased the fire load. On the other hand those oil tanks provide for emergency generators, which are also necessary for the buildings. The recommendation is to protect them more, to limit the size of the piping that is providing this oil to the tanks and to the generator, but there is no recommendation to eliminate them.

CROCKETT: Rick (Bell), to Ronny’s point, how do we encourage the construction and design of safer and better high-rise buildings without making them cost prohibitive?

RICK BELL: I think you start with the premise that New York real estate, Manhattan real estate, is more expensive than just about any other place in the country. There are cost issues attached to building in Manhattan that differentiate the quality and the quality standards, that typically have necessitated higher costs, so that some of these recommendations are a drop in the bucket in comparison. The AIA New York Chapter has been strongly in support of everything in this report, particularly the issues of floor plan and egress considerations. People in the real estate industry have looked at those recommendations as perhaps problematic in terms of costs. There is a recommendation that there shouldn’t be scissor stairs for buildings with floor plates over 10,000 square feet. That’s fundamental. Hardening of the stairwells is a differential cost if more expensive materials are used.

I would like to swing it back to a question you posed even before the presentation of the report, the question of when dreams are tempered by reality, or conversely when reality is tempered by dreams. One of the issues that has arisen in the discussion of the new designs for the World Trade Center real estate has to do with the inclusion of a bus garage underneath. How that translates out in terms of the things that transcend Manhattan’s real estate and the New York City building code, and the adoption of an international building code in New York City, are very real in all communities across the nation where cars are parked under buildings.

CROCKETT: What are the big-picture, long-term matters to think about as we contemplate other high-rise buildings being planned around the country?

DAVID MAOLA: First of all, I think that the questions regarding whether to build high-rise buildings, and where to put them, and are they viable was being asked before 9/11 for a number of reasons. Certainly those issues are much more focused after 9/11. However, the economic concerns of whether to build a high-rise and whether it makes economic
sense were certainly on the table before 9/11, because there hadn’t been a super tall building built in the United States for 25 years. If you want to say the original super tall buildings were planned in the early ’60s — I’m talking about the World Trade Center and the Hancock building in Chicago and the Sears Tower — they were (built) at least as much for their iconic value as they were to fill office space.

The question at some point then became well, how do you make these super tall buildings economically viable. You have a footprint in Manhattan that’s only so big and elevators are going to take up so much space, how much rentable floor space do you have in these giant buildings? I think at some point developers started to ask that question, the hard economic question: do these buildings make sense?

I should have started with my disclaimer, I find myself in the room again being the only non-architect/engineer type, so feel free to correct me. These economic-type questions I think were being asked by developers prior to 9/11 and now the public is kind of being brought into this debate because there is a very palatable security and safety concern that the public never really thought about before.

In some vague way I think the general public would look at these giant buildings and ask, ‘Are these things really safe?’ Engineers and architects, forgetting about airplanes for a minute, know these buildings are safe; they are not going to fall down. Whereas your average person on the street looks at a 100 story building and wonders, ‘How can it stand up?’ I think what the Council on Tall Buildings has been trying to do since September 11 is educate the public and try to have the profession — and by the profession I’m talking about anybody involved in the design, construction and operation of these buildings — have the profession drive the debate about what the appropriate questions are to ask about the design and construction of these buildings.

Once the debate shifts to the political realm and the popular opinion realm you’re in trouble, because you have non-experts and people ignorant of the facts of how these buildings are built and how they are operated driving this debate on safety.

How are buildings going to change in the future and how are these designs going to change? All of these issues that Ronny has brought up are very good and they are similar to some of the findings that the Council has made. I think most important from our perspective is the debate on where to build these buildings, how they should be designed, what they should do, how they should fit. This debate should be driven by designers and engineers and not by knee-jerk concerns of the public and the political spectrum.

CROCKETT: Charlie (Hopkins), I would like you to follow up on that. You mentioned that since 9/11, you have had an increasing amount of security work, including things never ever contemplated by anybody before the attacks. And to David’s point, can you help us differentiate what is a knee-jerk reaction and what owners should really be thinking about?
CHARLIE HOPKINS: Common sense needs to be the driving force here. Obviously we are limited with the amount of real estate we have to work with in Manhattan, but some of the fundamentals that you mentioned about architecture you also have to take into account for site selection and vehicle access.

In a building as tall as we’re about to build, considering the amount of tenants that will be inside, there didn’t used to be much thought about the daily traffic, shipping, receiving and trash removal. How do we have any control of who is driving these vehicles? All you need is basically a commercial driver’s license and you have direct access to the structural members of the building. Are we taking that into account? Are we thinking about that?

If you get into a different type of space, like a manufacturing space, the countermeasures you put in place can impact operations and how you do business. For instance, if you go to a level orange state of alert, what does that mean? Do you have to change your level of operation? Are you searching every vehicle? And if so, how long does it take to search a vehicle? While we get 15 vehicles an hour, if it takes 20 minutes to search each vehicle, now we have a queue lane of trucks going out into the roadway. So do you have to design and build and search for a site that will allow that? What is the maximum you are going to design to? What is the highest level of alert and what would be the maximum amount of security countermeasures that make sense for that type of building? Or do you need to back off from there, so it’s more of an operational change in security than it is anything else.

Here in the city, we’re faced with some serious issues with our tall buildings being less than 20 feet away from the curb. And how large of a charge does it take to make those concrete panels fail? And how much of a charge is actually going to enter the building?

We didn’t think about that 25, 30, 40 years ago when we built these roadways and accesses to these large tall buildings. But now it’s something we need to think about, as well as the costs associated with having to move or relocate an entire office building and the tenants. Does it make sense? Downtown in the financial district you have some of the trading floors. They can’t move, and in some cases they are less than 20 feet from the curb.

MAOLA: I just want to follow up on one thing you just said. The cost involved is an excellent point because it’s very easy for the public and the politicians to say, ‘We want these buildings to be safe,’ ‘We don’t want them to fall down,’ ‘We don’t want them to be severely damaged.’ On the other side of that coin is: ‘Here’s what it’s going to cost you.’ Then the response is, ‘Well, we don’t want it to be that safe.’

It’s going to become an economic decision. Not everybody drives a Volvo. All of these things cost money, everything that you can do to enhance the building’s safety and security costs money and at some point somebody, either the owner operator or the tenant or somebody, is going to draw the line and say, ‘I don’t need that much safety. I only need this much.’
HOPKINS: As far as master planning, these are some of the fundamental questions to ask if you are going to develop a property. What are you going to build, what operation is this, how are you going to make your money, what’s this facility being designed to do, what would it take to shut down this operation, to stop it, and then what would it take then to protect it. Basically it’s about managing rooms.

BELL: I think it unfortunately sometimes takes a disaster to force code changes. New York City has suffered under an inadequate building code that has been resistant to change for many, many years for political reasons. Speaking as an architect, sometimes it’s not the architects or the building department officials or the building owners who can effectuate significant change to building code. I think the educated lay people and emotionally charged conversations about prevention of future loss of life adds to the debate.

MAOLA: I agree. I didn’t mean to exclude them from the debate. One of the things that the chairman of the Council, Ron Klemencic, said shortly after 9/11 — which I think that a lot of people in the engineering and architecture community were also thinking — was, ‘How could these buildings possibly have stood up for an hour and whatever minutes?’ That’s an entirely different question than was being asked in the popular media and by the public, which was, ‘How could these buildings have fallen down?’ It’s very easy to throw up a picture of a burning building and ask ‘How can this happen?’ It's much more difficult — and a much more informed opinion — to say no, that’s not the right question. The right question is how could these buildings stand up a lot longer allowing these people to escape.

ROB FRIEDEL: I think the debate right here is interesting as to why it will probably take quite a number of years for real code changes to be enacted based on what happened down at the World Trade Center. You talk about a super tall structure versus a high-rise structure, where a high-rise structure by codes is anything over 75 feet, and we’re sitting here mainly focused on buildings in excess of 1,000 feet. So you have two really different groups. You have iconic structures that people think, ‘Hey, this will be a target for a terrorist.’ And you also have buildings that happen to be 81 feet tall that are nestled somewhere in a part of Manhattan where they are not necessarily a high-risk target.

I would say, from an engineering standpoint, the current systems do work. I don’t think that there is a case of a building that was fully sprinklered having collapsed under normal fire situations — ever. You do need to take from that horrible situation on September 11, to try to plan and do things better. However, I think there needs to be an understanding of what is the definition of safe and who can say what’s safe. One of the problems we are running into, as an industry, is the ‘but what if’ scenario. Reportedly the twin towers were safe against a 707 crashing into it with low fuel during landing. Well now it’s not a 707, but ‘What if it’s the Airbus?’ Depending on the model of the plane, it can be even bigger than that. You can move the air intakes up to 20 feet off of the ground but if someone is determined to do something, they are going to find a way. A lot of the security measures that we’ve seen in buildings post 9/11 are the security guards, the uniformed personnel checking building IDs and making it just a little bit more difficult for unknown people to get in. That doesn’t necessarily make me feel more safe, but it might make others feel safe.

It’s a real difficulty when you are talking about what you need to do code-wise: what’s the definition of safe? I think whatever is built down at the World Trade Center site is going to get more scrutiny than any other building anywhere. Certainly by just rebuilding on that site some people would say that becomes a target. That’s a real issue: What is safety and to what degree do you take safety?

David’s point about cost is interesting. The United States construction market is about a half a trillion dollars, about $500 billion. If you made code changes that were to increase the cost by 1 percent, you’re talking about $5 billion, so it can be quite a large sum of money rather quickly.

HOPKINS: Taking a common sense approach to it, what’s the likelihood of a threat being delivered by an aircraft. I guess we did think about it, but the likelihood of that happening...no one really considered it. What we really need to look at is what is most likely. What we have seen happening in the Middle East right now with the suicide bombers, it’s a simple calculation about how much one person can carry, so what do you look for, what do you screen for. Then the second threat would be a vehicle bombing. How much can something carry and what standard is your building designed to. If you are going to
have a superstructure 70 stories or taller, what would be a common sense setback distance from the roadway? Or separate shipping and receiving facilities where everything would be screened, if you had to go to that next heightened level. Those are the kinds of questions that need to be asked not only from a code standpoint but regarding site selection and construction. How do you design the lower levels? That’s where the threat is. Someone is more likely going to carry it in or drive it in, than likely fly it in.

CROCKETT: Leo (Argiris), can you address David and Rick’s point about these structures standing beyond what anyone really expected?

LEO ARGIRIS: We tend to work on buildings all around the world, and that area is quite diverse. It was very interesting for us to see what happened immediately after September 11 with the various buildings that were actually under construction. The way that we tried to approach this is that what happened on September 11 was an extreme event. It is not an event that one can design for, or one that the codes necessarily are going to address. It’s the wrong discussion to say the building is safe or not safe for that event. It’s outside the design envelope of what we’re normally going to consider in a building.

However, having said that, there are tools available and we do have the capability of designing buildings that will perform better in those extreme events, and that’s the way that we like to approach it. As one approaches building design, it’s much easier today to actually have that conversation early on in the design process as to what can we do differently or what can we do better. How can we design a building that, yes, meets the code, it meets all the functional requirements, meets all the operational requirements, but in the case of an extreme event performs better. There are definitely measures that can be taken. Now, the World Trade Center performed very, very well. It was a redundant structure that stood and allowed thousands of people to escape.

If we are doing a building today and looking at super tall towers, and there are several around the world under construction right now, there are systems and there are ways of extending the life of those buildings in such an extreme event. I think that’s very important, and it goes beyond the code. I don’t think that the code can actually mandate that level of performance. We’re talking about things that have to get into the designer’s and the owner’s thought process and that’s an education that needs to be addressed above and beyond the code.

CROCKETT: Is there a danger, whether it be a fire in Rhode Island or the World Trade Center, that the reaction is only local? In other words, in New York the new World Trade Center will be a super building — the model of what high-rise buildings should be — but are such high standards adopted elsewhere?

LIVIAN: One thing that we learned is you cannot generalize. There are so many different kinds of buildings going up and so many different high-rises that have different risks, and you cannot build every building to the high risk standard. Something like 7 World Trade Center is in between. 7 World Trade Center right now, even though it’s being built by the Port Authority — which can build according to the state code — they have decided to apply the safety considerations of the code and even some of these new recommendations. So they are designing with sufficient backups — with sufficient structural strength — maybe not necessarily for an airplane attack, but for bombing and for sufficient strength to prevent a progressive collapse. It has more than enough exits, more than the code-required number of exits, and in other safety systems — like sprinklers and standby power — it has a backup, which is more than the code requires. It’s designed or recommended to meet the U.K.’s (United Kingdom’s) progressive collapse requirement.

Progressive collapse has different requirements. There are three ways of designing it or three options. One is to design it so if a column or a portion of the building is removed, the structure wouldn’t collapse for more than three levels above and one or two bays beyond. The other way is to actually design it with enough backup design so that if a portion of the building or some section of the building is removed, the collapse wouldn’t progress to the rest of the building. There is another option, the empirical design, which involves strengthening your connections enough to handle some additional load. Right now, most of the design only involves vertical load. Your connections are strong enough so that even if some of the floor collapses in the middle, the connections will hold and not collapse because of the moment.

ARGIRIS: If one looks at the U.K.’s progressive collapse requirements that are codified, they are quite good. In all
likelihood, if one were to take the World Trade Center and go back and check it versus those provisions, the original buildings would have met those provisions. It’s important to keep that in context. I think it’s important to realize that the U.K. code provisions are really there to address a bomb that comes into the building. So you can lose a member, you can lose something. And they have proved themselves over many years and many occurrences. They are not designed for an airplane impacting the building.

HOPKINS: Do they quantify the size of the charge they are designed to?

ARGIRIS: They quantify the fact that you lose a member, so then you can back calculate what it takes to take out a structural column.

HOPKINS: In the Oklahoma City bombing, for instance, that vehicle was 26 feet from the facade of the building. It was estimated that it was a 4,000 pound equivalent charge. It was a fertilizer bomb which is ammonium nitrate and diesel fuel, which is the equivalent of 4,000 pounds of TNT, but only 26 feet from the building and you saw the progressive collapse and the number of columns that failed. There were several columns that did fail in that structure. The building adjacent to it was about 120 feet away and there was no structural damage to it whatsoever. It was just broken glass, facade; there were no deaths, just some injuries from falling glass. That’s a two-part question: what is the size of the charge and what is the distance from the charge to the building, which is going to impact the results.

CROCKETT: This revisits the notion that these incidents were extraordinary events and maybe there’s a need for a separate standard for extraordinary buildings. In other words increased standards are great, but how do people in the building community execute these changes in the face of real budgets and real cost issues?

KIM METCALF-KUPRES: I think one of the biggest challenges we have is the way the buildings get built in the first place. The design process and then the construction process, which tends to favor a fragmented and highly specialized focus around different pieces of the building. This tends to be an obstacle when we try to either assess threats within an existing facility or design for comprehensive security, as well as operation of a facility that’s on the board.

CROCKETT: Back to the issue of “iconic” buildings, are there any on the drawing books right now?

BELL: Let’s take as an example the proposal by Lord Norman Foster for the Hearst Tower near Columbus Circle. The presentation changed somewhat, not in terms of the building form. It’s just as beautiful and structurally just as exciting and in terms of its glazing just as shimmering. I think what’s changed is the degree of public access to this glorious atrium space that’s at the heart of the building. Imagine the Citicorp building without anyone from the outside world being able to enter. Imagine the Citicorp building with the subway entrance totally disjointed from the pedestrian access to the quasi-public spaces of that building. There are iconic buildings that are being designed by wonderfully talented architects and engineers that are being redesigned by insurance company constraints. I think in relation to your earlier question about what is being tempered by reality, it’s not just anti-terrorism insurance, it’s also the fears that people have working on certain floors.

CROCKETT: Does that become a bit of an industry sell as a whole? How do you do that without sounding cavalier?

HOPKINS: Education is the key. If you do the correct screening, there are things you can do in existing facilities, like for the mail room as an example, when you are getting small packages or large packages for that matter. There is something as simple as hardening the mail room. You may lose the mail clerk, but the primary and secondary debris that’s spread through the building that causes injury can be greatly reduced.

Codes as far as how close we can put a bollard to the curb, those are codes written here in New York City that have presented some obstacles. What does it take, six months to get a variance or a change on that? If you go to a level orange or a level red, do you have to wait six months to even consider putting in a bollard?

BELL: Charlie, a couple of times you talked about setback from the street base, from the curb line. New York is different from many other places around the country in terms of not just an aesthetic appreciation of creating a street wall, it’s been perceived traditionally in New York
that buildings do have to create a street wall on the sidewalk, security be damned. What you have said a couple of times is that that poses significant security problems because it’s easier to get closer to a perimeter wall if it’s only 20 feet from the curb than if it were 100 feet from the curb. The anecdote I would use is about a pot belly stove in a house boat that was eight feet wide. The instructions said please don’t install pot belly stove less than four feet from the wall because it could be a fire hazard. Obviously it had to be installed closer to a wall and one dealt with that.

HOPKINS: You did things to the wall.

BELL: You did things to the wall and also maybe operated it differently and that’s what I wanted to introduce to your equation. You’re saying maybe the loading docks are outside of the building instead of tucked underneath. It really is an operational question, not just a design question about how loading docks are dealt with, how building mechanical systems are operated, the control systems that might mitigate against biomechanical terrorism.

HOPKINS: Or where you place critical systems in reference to that loading dock — the electrical, what’s critical to that facility. You know you’re going to have to have trash removal, you know you’re going to have to have outside firms, third parties. You have no way of regulating who’s driving their vehicles. It’s up to them to screen their drivers. You’re powerless. You can go through all of these countermeasures and as soon as you bring that outside component into the equation, all of a sudden you’re at risk again.

A lot of common sense in the pre-planning is the floor plans and the location of these spaces that we never really had to think about before, but we should have.

CROCKETT: We talked about having air intakes 20 feet above ground levels. What other kind of measures, from an HVAC and mechanical design perspective, can be done or should be contemplated? There’s a fear right now about biological attacks. Other than buying duct tape or plastic, what can be done? What’s practical?

FRIEDEL: When you think about codes and why codes get written and how they are used by engineers and architects, they are really for very specific concerns. That’s how a code comes to be. You have a certain problem, it repeats, someone says ‘Hey, we have to eliminate that.’ The code gets enacted and people now design to that minimum standard.

One of the difficulties we have in changing codes for a terrorist threat is it’s too wide open of an arena. Nobody knows what it may or may not be. It’s designing to the unknown. I would say to Leo’s point earlier that since 9/11, without any changes to the code being made whatsoever, our designers think differently about how to design systems and try to think and assess risks more on their own, as opposed to five years ago not even having to consider them. Yet each situation is somewhat different, depending on whether you’re in an iconic structure, whether you’re in a site where there is no setback available whatsoever.

The designers, the professionals know how to address what are pretty much normal risks that you deal with all the time. It’s this unknown that’s the biggest challenge and I’m not sure if I’m ready to wait for code legislation to change that design to that.

MAOLA: That’s a great point. I wanted to follow up on something you said, too, Leo. We were talking about reporters earlier. After 9/11, I was talking to reporters every day who were constantly calling. I was getting Chinese food one night for my family, my cell phone rang and I picked it up and it happened to be a guy from U.S.A. Today and I had had it up to here with reporters asking the same questions over and over. I said something at the time that made the newspaper and I got a lot of negative feedback. What I said was, and it goes to what you two were talking about, on December 8, 1941, nobody was asking ‘How could these ships have sunk? We need to
make ships unsinkable.’ There was no public outcry that these ships at Pearl Harbor had sunk. I don’t know that ship builders sat around the table like this and tried to figure out, ‘What else are we going to be able to do? What can we do to these ships so that they don’t sink.’

That event was so far out of the spectrum of what they planned for when they built a ship that it transfers to this arena as well. You have to keep airplanes away from buildings. They are not designed to withstand a direct hit of a fuel laden 767. It’s not to say we can’t make them safer. It’s not to say that Ronny’s code provision changes and everything that Rick is saying shouldn’t be done. It should. But, these kind of events are way outside of what design and construction anticipates and can predict.

ARGIRIS: The one area that has a lot of work to be done is, once an event happens, whatever it may be, whether it is a biological attack, whether somebody opens a canister on the 17th floor or a plane flies into the building, I think we have to get better and more educated at what is the appropriate response. Because up to now, operationally the response has always been sort of one way. There is a prescriptive response and everybody follows that. I think in the future what we need is to be able to have better education and for people to be able to respond differently, depending on what the event is. I don’t think we can design for all of these myriad possibilities, but we can actually learn a lot and be much more proficient at how we respond to these events.

METCALF-KUPRES: We can leverage technology as well to do that. We have the ability today to have these systems talk to each other so that you have the flexibility to respond to a crisis, change the operation of a system. That’s exactly what our team at the Pentagon was able to do on September 11. A lot of lives were saved because they were able to leverage technology that was in place. Unfortunately, in most of the buildings that exist today, those systems are completely separate.

HOPKINS: Correct.

BELL: The design professionals can design to prevent confusion, especially in a panic situation. But then there’s an operational question. In New York, for instance, the city’s Department of Design and Construction has built excellent tuberculosis treatment centers, neighborhood family care health clinics with high performance air filtration systems. But those systems only work so long as the filters are changed.

It may not be sufficient to say ‘here’s wonderful technology’ if there is no education operationally about what should happen next. Lives might have been saved in the World Trade Center if people were better informed, if there had been a better communication system. The structural systems were not necessarily at fault. There was time to escape, but many people didn’t.

FRIEDEL: I agree. At the time the announcements were being made in tower two, that was pretty much standard operating procedure in every high-rise structure. We don’t want people to egress out to the plaza because we have a serious problem in tower one. That was David’s point earlier. Who was ready to design or to think at that point: ‘You know I better egress everybody, all 50,000 occupants of buildings, as fast as I can, put them out the street where there is debris falling from the first tower.’

I think that’s what Kim said earlier. You can get caught up in a no-win situation sometimes, but you do need to try to do whatever you can to make it as safe as possible. System-wide shutdowns for buildings, if there is an alert situation, no doubt about it, that’s the way to proceed. But it’s very hard to fault the systems that were in place on 9/11 because I think it was so far out of the realm of possibility at that time. I don’t know what I would have done if I was in tower two, because there was a big problem in tower one. Walking outside probably wouldn’t have seemed like the best option.

CROCKETT: You raise an interesting point about better educating people in buildings. I think the recent fires we’ve had in some these clubs crystallizes that point. No one knew how to get out of these buildings or the doors were locked. Does it become necessary that cities,
states and federal agencies need to get involved, to say, ‘Hey, you need to show in a log your fire evacuation practices, show in your log that you did a fire drill this month. Do city, state and federal agencies need to get more active-more legislative?

LIVIAN: I think what we learned from the night clubs and from Happy Land (the 1990 club fire in Honduras) and others is that we need both. Education is necessary so people that go to the clubs know where the exits are and making sure that the exits are not blocked, but we cannot rely on the operators to be safe. Their general idea is not to take safety into consideration, they are always concerned about people coming through the exit door so they always put a chain on the exit door. In addition to that, we have to have a strong enforcement team and almost continuously watch these people to make sure that they keep their club safe.

CROCKETT: Let me ask everybody — taking the practicality out of the equation — what would be a wish-list item that you would like to put in all of your projects?

LIVIAN: The repeaters are actually part of the recommendations and they will go in. There was a lot of discussion about who would make a decision in evacuating a building. Is it the fire marshal, or will it be a standard practice. Again, the problem is that there are so many different situations. There are conditions that if you evacuate the whole building you will create a panic situation that is worse than not evacuating it. It still has to be a decision at the time that should we evacuate a few or should we evacuate the whole building or what to do. With complex buildings in the city it still has to be a human decision at the time.

METCALF-KUPRES: Do you really believe that people are going to wait to be evacuated? Because I know in the week after 9/11 the Sears Tower self-evacuated twice, and that was a real problem for them because they had a couple of false alarms and people were not going to stay and wait.

LIVIAN: That’s part of the education that’s being discussed. We considered having all the buildings in the lobby have a videotape of what to do in case of an emergency and it may be an option for some of the buildings. We didn’t think that it should be a requirement that every building should have it. But it is a good idea to have an educational piece that in cases you want to evacuate the whole building and in certain cases you don’t and you make sure that people know that.

ARGIRIS: You’re absolutely right that it is ultimately a human decision that has to be made as to what is the appropriate action to take in an emergency. The trick is how do you get appropriate information in the hands of that decision maker, and who is that decision maker. One of the things that I think the fire department, for example, needs is much better information about the buildings. They actually have time on their hands as they are approaching a fire, and you’ve got to be able to use technology to get them information about the building they are going to be running into. That’s something that doesn’t exist. I know it’s something that the fire department is looking at and quite anxious about how can they use technology to do that.

Similarly, how can we make better information about the building known to whoever that decision maker is, because it may be somebody in the building, it may be somebody outside of the building. We can do a lot more with the technology that we have today.

HOPKINS: There are other things associated with the way we handle lobbies. If you have to go to a heightened state of alert, how are you going to handle visitor control? What is your plan for that? The same with letting the
limos stand next to the curb that says ‘no standing.’ That happens all over the city. What are the procedures, and are they known, and how are they capable of enforcing them and demonstrating that they actually have a plan to go to the next level.

CROCKETT: Do you think that people are open to these kind of more autocratic decisions? For example, in the airport yesterday, one of the screeners announced it would be a good idea to take tennis shoes off if anyone was wearing them. I complied, as I figured that’s 10 minutes I won’t have to deal with these guys if the buzzer went off.

BELL: There are risks, there are comparable threats, there are states of alert that might engender specific security devices, but having hardened lobbies, magnetometers in buildings isn’t always necessary. I work in a building that has a lot of furniture showrooms. It does not have a need for magnetometers. What I’m saying is we shouldn’t give up thinking more globally. Good design in a democratic society should elicit a sense of openness and transparency. A building by Rafael Vinoly for the Bronx Criminal Courthouse on 161st Street is a four block area, super-block courthouse, that was designed before Oklahoma and redesigned slightly after the bombing in Oklahoma. One change that was made is that a road no longer goes through the middle of the site underneath a portion of the bridge superstructure. But the facade didn’t change appreciably because of Oklahoma.

What I would argue for is putting the risks in perspective, not designing to a state of siege, but taking common sense precautions that are affordable, whether it’s using different types of materials for stair enclosures, or changing things that incrementally will become accepted. In the same way that at an airport recently there was a little device, it was almost like a shoe-shine machine. You put your shoe down and if it beeps then you’re going to have a problem when you go through the real metal detector and it would be advisable to take them off. If it doesn’t beep you’re probably all right. It was a technological modification that was very easy and not expensive to do so everybody wouldn’t have to take off their shoes.

CROCKETT: My question is, obviously in an airport situation there is that time factor, so you might be more willing to give up some of your personal freedoms. But when you are entering a lobby, to visit a store or to see somebody, are you willing to make the same trade-off?

FRIEDEL: You said earlier, if you had a “blue-sky” world, what would you design, what would you design to. I would like to see security systems being more integrated into the overall building package. Right now they are more of an add-on after the fact. I would like, since we’re blue sky ing it, more integrated fire life safety systems. We should be providing redundancy wherever possible to those systems and to communication systems. To follow up on repeaters, to be able to make sure that you can communicate throughout the building. The redundancy doesn’t have to be one for one. If you have a hard-wired security or internal communication system, maybe there is a wireless solution that’s not as expensive but at least provides a second degree of communication if something should happen to the original. So I would like redundancy as far as building-wide safety systems. Again it’s blue sky, because owners are going to look at the cost and say maybe I don’t want to do this.

HOPKINS: Common sense has to rule. After what happened on September 11, I was working with an airport security manager, a police officer actually, and we were walking through the airport. We had already been through security and we were looking in one restaurant and there was a man there cutting a steak with a steak knife. He had already been
through security. The way we design airport terminals is to entertain passengers between flights and having a good meal is part of that.

MAOLA: Many airports have a mall. There is a whole wing of the airport that’s a mall and it’s on the other side of security. After going through the magnetometer and getting patted down, I can go to Brookstone and buy a barbecue fork and knife set that I can use to stab and kill you and know whether you’re medium rare or well done. There are a number of stores where you can buy weapons after you’ve gone through security. It sounds bizarre, but a real danger would be pointing that out to a guard because then you’re a suspect. If you go up to the guard and say ‘I can go into Brookstone and buy a fork,’ he’s going to pat you down again.

CROCKETT: Again, I wonder if there is a need for a standard between a “normal” building and a more iconic or high-profile building like the Pentagon or the new WTC?

HOPKINS: It’s hard to build codes around that, because you really don’t know. The tenants occupying that building could change and the world economy can change. Events in Washington can change and now all of a sudden the threat has shifted. One of the things that we have done with the Department of State, with embassy designs, is to set a minimum standard to occupy the building for a diplomatic mission. You can be in a Third World-type country where they are very friendly with the United States and then all of a sudden you have a military coup or some sort of bad decision making in Washington, and then we are in a high threat environment. What do you do, shut down the embassy or change the way it operates? Because they do have minimum standards. We really don’t know who is going to occupy these tenant spaces that would now make a building iconic or not iconic.

MAOLA: And who’s next door.

CROCKETT: Moving on, would more national codes help? Currently there is the International Building Code (IBC), which New York State has adopted, and NFPA 5000, which is in a few cities, Phoenix for one. Jon (Traw), obviously you’re very intimate with what ICC (International Code Council) has done with the whole IBC. Perhaps you can talk about whether or not a national code would help with security and other types of issues we’ve discussed.

JON TRAW: The major difficulties for governmental agencies is, of course, to be able to maintain their regulations on an updated basis, incorporating new findings, new information from the technical community. Any time you can bring the forces together into a single effort to do that, I think the resulting document can benefit.

That doesn’t necessarily mean that a single code is going to answer all of the issues or questions. Because you can have the best regulations on the book and if the system is not in place in terms of the use of those by the design community, the oversight by the various agencies and the execution in the field, you don’t end up with the result you initially desired.

CROCKETT: One of the things, Jon, that’s been an undercurrent through our discussion is what a code is actually capable of doing. Maybe there needs to be more operational changes in the way a business is run or a building runs. For example, the way we go through airports operationally has changed, and maybe it has helped eliminate a security issue of planes crashing into buildings. What is the balance between what codes can do versus operational changes?

Another frustration that came up was the time frame it’s taken for a national code to
get to this stage. People maybe don’t necessarily want to wait for a code to address a topic; they are going to address these issues in their own business. What are the most important things that the code bodies should be focusing on?

**CROCKETT:** Jon, in a previous conversation, you mentioned you had recently attended a building-hardening summit in London and that you may be going to Kuala Lumpur for another one to talk about these issues and how we can address this whole hazard/consequence relationship. Can you share your observations with us?

**TRAW:** The London summit was a good start. It pulled together people from around the world, some who were rather sophisticated from the standpoint of their approach to designing tall buildings, others who were public policy makers wondering what needed to be done in terms of the design of tall buildings from a public policy viewpoint. Most felt something needed to be done but they weren’t quite sure what to do.

As a result, there were three major syndicates that broke out to discuss some very specific issues. One of those was the structural aspects — toughness, redundancy, robustness, etcetera. Another was evacuation and emergency response issues. The third, and perhaps one of the integral parts to any system, is risk management decision-making, communication with stakeholders, if you will.

The whole realm of stakeholders — what they do or do not want to accomplish, and how do we communicate as a technical community what the various levels of risk are, putting them in terms that building owners can understand and evaluate from a business perspective: What is the risk of loss of life in a particular building? What is the risk of a collapse? What’s the risk to business operation? I think it’s that area where we have not done a good job globally, if you will, in being able to inform owners and stakeholders about how you deal with this probability issue.

The end result of the London summit was agreement that we need to develop a tool by which we can communicate with stakeholders how they evaluate risk within the business environment.

The setting for the Kuala Lumpur summit is to follow up, to take what came out of London and build on that and further refine it.

**CROCKETT:** Earlier here we discussed the whole notion of an iconic building, something that may be more of a target of a potential incident, and whether there is a need to have two different standards, or is it possible to have two different standards. What were some of the international community’s thoughts?

**TRAW:** These aren’t necessarily in the order of priority, but number one, I think in other parts of the world, especially within the European community, from a structural aspect, they not only look at the capacity to support a load but they also look at a thing they call robustness, you might say toughness, ability to not only resist the initial loads, but some level of impact of unknown forces.

It’s different than redundancy, where you are talking about a load transfer capability, or multiple path of transfer, versus toughness within the inherent structure. There was a significant amount of discussion about whether or not from a public policy viewpoint we need to protect what we call iconic structures. They did not have any difficulty with agreeing that there is probably a need to take a look at dual standards. One for what is classified as an iconic structure and one for structures that are not.

You take the U.K.’s Big Ben, the Petronas Towers in Kuala Lumpur, which may be some of those iconic structures. You make take a city like Hong Kong, which has a rather large number of significant structures, and they have a far more difficult time dealing with iconic structures. I think we shouldn’t dismiss the fact that there may be iconic geographic locations. You have a high-rise in Des Moines, Iowa — and,
I don’t mean to pick on Des Moines — but a high-rise may not represent, from a security viewpoint, the kind of target that you see in Washington, New York, Los Angeles, San Francisco or other major metropolitan areas.

CROCKET: The issue that’s always going to come up is cost. You’re talking about better educating users. What was the general feeling of how people would react to that — specifically building owners or operators or shareholders?

TRAW: I’m going to break it down as follows. The cost issue is always a major item and it splits into two categories, from a codes and standards viewpoint. These are: cost issues related to requirements that come into play in a mandatory form in a code or a regulation, versus cost issues relative to system designs that go beyond that minimum level of codes and standards. If we address the cost issues relative to the mandatory standards there is a much larger reaction from the building owners, those who have to pay the bill, to what level of regulations should we have. We are making some progress globally, even in the United States, relative to taking a look at performance approaches rather than prescriptive approaches. Where we truly understand what we are getting for what we are putting into the building.

The owner or the one paying the bill is provided with more information than just, ‘We just have to do this because this code says we do it.’ There is some rationale behind it, within the performance design to achieve the objectives of the codes and standards. It’s going to take some years before we finally sort through our prescriptive standards to determine whether we really need all of them, whether we have some redundancies that shouldn’t be there, whether we have some gaps.

Now, if we go beyond that and talk about how to address risk, how to inform owners about addressing risk and the cost to do that, we are better placed today than we ever have been. This is true not only for new buildings but to go back and take a look at our existing buildings to determine whether or not the protection systems we have in place are going to perform the way we think they should for the hazard we’ve contemplated and the consequence resulting from that hazard.

There are a lot of people who would like to talk about a risk and when they use the term they think only of the hazard side of the equation, i.e. plane crashes into building. Risk is actually a combination of the hazard and the consequences from the hazard. For example, take the plane that went into the Empire State Building [in 1945 in thick fog]. There is certainly a hazard, but the consequence is quite significantly different than the consequence in the Trade Center. I think we’re developing better tools to inform owners, but we still haven’t learned how to effectively communicate with owners and the people paying the bill as to what risk is associated with the various hazards.

BELL: I just wanted to react to one point in the context of the current office market in New York City and not just think in terms of the present day but long-term. Currently we are looking at a vacancy rate among office buildings in New York that totals the entire square footage of office space in Des Moines, Davenport and Topeka, and then some. That colors what’s economically possible.

On the other hand, it provides an opportunity because in a market that’s as competitive as one with more than 10 million square feet of office space downtown and an equivalent amount of vacant office space in Midtown coming on line, how do buildings differentiate themselves? Traditionally in the New York real estate market the three determining factors of a building being more leasable and valuable than another are location, location and location. I think there is a perceptual thing about the ability of a building to react to things other than location. One of these is how comfortable tenants are. This is a question for the decision-makers on the facility side, as well as the people who are working at desks and offices and cubicles. How safe, healthy and comfortable are they in the building, not just how easy it is to commute to and from. Maybe that will become a distinguishing factor in the emerging New York office market.

If the Schumer report can be believed, it may not be this year or five years from now, but down the road a lot the office space that’s vacant now is going to become desirable.
and necessary. More will be built, and it should be built to safety standards that we are beginning to talk about as we move to the adoption of the International Building Code in New York City. There is the political opportunity to do it now that might not ever come again.

We have seen a lot of alignment over the issues of changing to a model code, not because of just how good the IBC is, but because it allows for continual updating and change.

**TRAW:** I think that actually there is a significant opportunity within New York because in terms of competition to lease space by people, they are trying to determine not only as you said the location but some of the other attributes for the building. . . . (It) is going to be different for New York than I think any other city just because that’s where the incident occurred. It’s certainly on everybody’s mind as to well, ‘Do I really want to take this space? Are my employees going to feel comfortable there?’

There’s been a fair amount of work done on the psychological side relative to work space, which I think is somewhat akin to this issue. Not only to their physical environments but to their mental attitude as it relates to their productivity. There is some interesting work that’s gone on within the ASTM that deals with functionality and there are actually some programs to go and interact with businesses and determine functionality needs as indicated by the employees and the users, and then a method of checking whether or not the space provided is going to meet their needs, not only on an initial basis but on a continuing basis. They found that the investment made has paid off significantly in actual productivity.

**CROCKETT:** Do you think it’s safe to say that if there is a movement to a national code, the IBC or NFPA 5000, are we going to see a domino effect?

**BELL:** I remember the number as something like 36 states have already adopted the IBC, no criticism of the NFPA 5000 intended. New York is not ahead of the rest of the country, not ahead of cities like Chicago. We have a lot learn from other places. You can sort of twist the song and say if it can happen in New York it can happen anywhere, but it’s not necessarily in terms of code issues. The New York City Building Code has not changed much over the years.

**LIVIAN:** We know a certain number of cities and states are waiting to see what New York will do, maybe more populated cities and states that haven’t adopted are waiting for New York. It’s not a great number. New York is not the forerunner in any code changes because any code change will affect 900,000 buildings. Right now, as you mentioned, it’s a great opportunity to look at the International Building Code and maybe we can adopt it with some changes.

**TRAW:** One of the things that traditionally has happened in the codes and standards arena is a reactive kind of forum, reaction to events, whether they be a severe earthquake, a World Trade Center disaster, a hurricane, bombing, you name it. In this particular case we are trying to take not a reactive view but a well thought out proactive view, so that we ensure that we understand things that went on before we all of a sudden make changes.

I’m going to give you one example. There are some folks who are pushing for wider stairways. All the information I have shows that the stairway widths, where the stairways were available in the two towers, allowed 99 percent of the people to get out. Video shots of people in the stairway did not show extreme panic. So, rather than assuming that we need to widen the stairways, we need to analyze and investigate this. Bottom line, I am so supportive of the Congressional approach and taking our national lab to do a thorough investigation of this. Then we can start thinking about changes that may need to be made, before we start throwing more cost and more features into buildings, not knowing whether they are or are not going to achieve an end result.

Susanne Arbitman, coordinator of the World Trade Center Building Code Task Force; Thomas C. Seaver, Director of Advanced Systems for Lockwood Greene, and William Schacht, Director of Design Architecture & Urban Design with Lockwood Greene, attended the panel as observers.