



# CTBUH Research Paper

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Title: **Where Do We Go From Here? - In the Aftermath of the World Trade Center Attacks**

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# Where Do We Go From Here?



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The attacks on the World Trade Center Towers in New York City and the Pentagon outside Washington, D.C., on September 11, 2001, mark the beginning of a new age of awareness of safety and security in the built environment. Many say the world changed that fateful day, yet terrorism has existed for decades. Until recently, most threats had been foiled or failed. What did change on 9/11 is our awareness of these threats.

As architects, engineers, planners, and building officials, we are problem solvers by nature and training. In the aftermath of the attacks, we all felt the urge to “do something.” An enormous “problem” had been presented, and we were compelled to find a solution. Since 9/11, many have questioned the appropriateness of our building codes and suggested that immediate and sweeping changes are required. Yet, before making any modifications to the codes and standards, we must first determine *which* issues we are attempting to address.

### **Improving Safety and Security: The First Step**

There is no doubt that we are all in favor of improving the safety and security of our built environment, particularly if this can be accomplished without significant economic burden or relinquishment of our freedoms. How can and should we accomplish this? An appropriate first step is to ask the “right” questions: What types of threats exist that we should be considering? Which of these threats do we, as a society, want to address by fortifying our buildings and infrastructure? Which of these threats should we address through alternate means? Which buildings

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are most susceptible to terrorist threats? If we are to enhance the built environment, or specific buildings, what is the most effective way to do so?

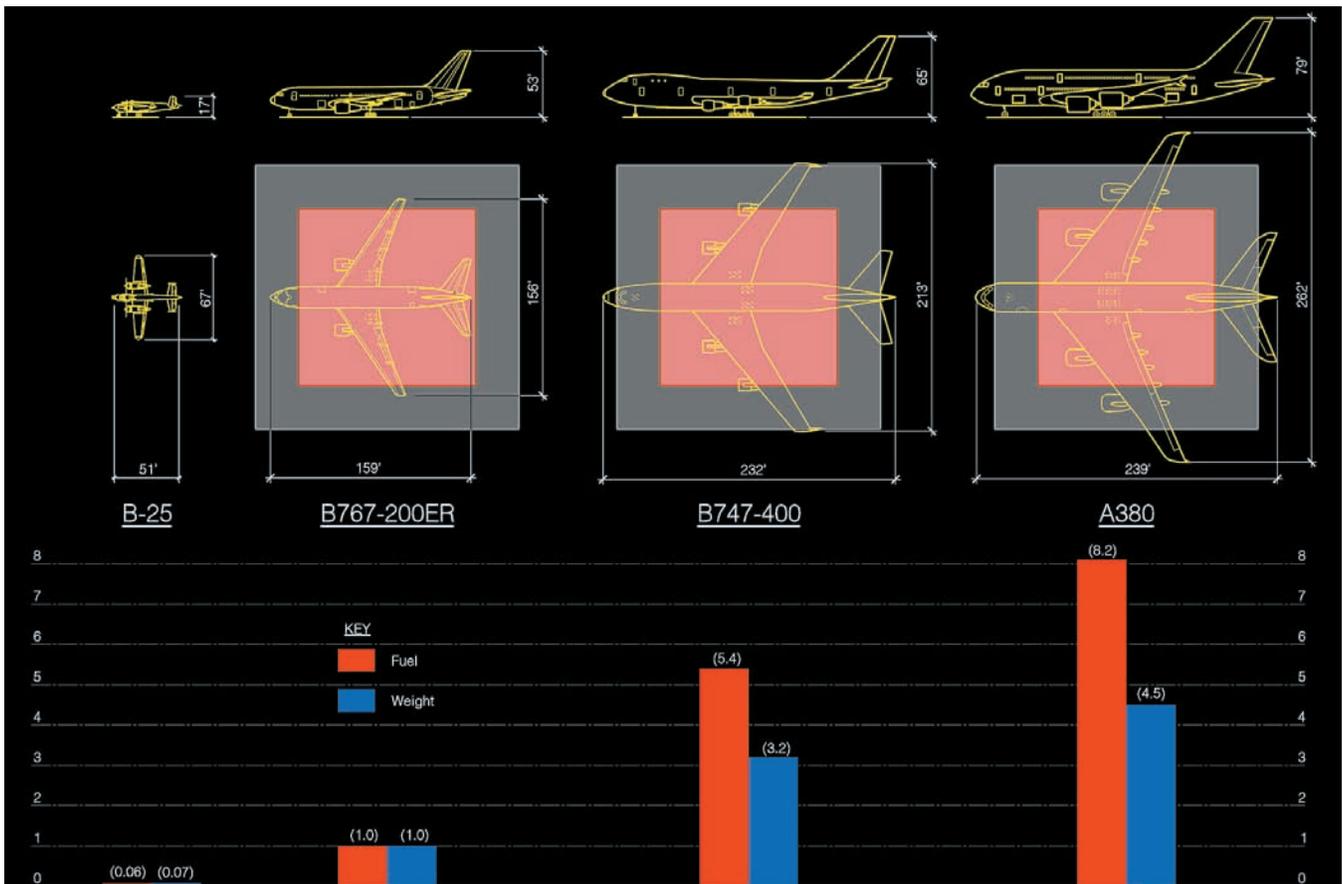
As we have studied the events of 9/11, one thing has become clear: we should NOT design buildings for airplane attack. The nature and magnitude of these attacks were of a scale that buildings cannot respond to in any realistic way. Furthermore, the Boeing 767-300 aircraft used in the attacks are not even the largest aircraft flying today. Still-larger airplanes are planned for the future. Building design will never overcome this threat; enhanced airport and airplane security is clearly the most effective use of our resources.

The buildings, in particular the World Trade Center Towers, performed heroically in light of the damage they sustained. At least six safety systems present in the towers were completely and immediately disabled

or destroyed upon impact: fire proofing, automatic sprinklers, compartmentalization and pressurization, lighting, structure, and exit stairs. No building can be expected to perform with the total destruction of multiple safety systems.

## Careful Evaluation of Code Changes

It is the position of the Council on Tall Buildings and Urban Habitat (CTBUH) that no immediate building code changes are required in response to the terrorist attacks of 9/11. In the months and years ahead, there will undoubtedly be building code modifications proposed as a result of the attacks. We must be careful not to over-react. The impact of proposed code changes must be carefully considered, including possible economic and/or social implications. It is important to remember that not ALL buildings are subject to the same risks or threats.



As an example, there has been a great deal of focus in recent months regarding exit stairs. Should our building codes require wider stairs, or more stairs? Is staged evacuation of high-rise buildings an appropriate safety strategy, or do we need to plan for the mass evacuation of all towers? The evacuation of the World Trade Center Towers on 9/11 does not provide any clear evidence that any changes are required. In fact, 99% of all those building occupants located at, or below, the impact floors were able to safely exit the building.

Another example is the effectiveness, or lack thereof, of spray-on fireproofing in the World Trade Center Towers. In the investigation following the collapse of the towers, there was clear evidence that the spray-on fireproofing was likely knocked off the steel during the initial impact of the aircraft, leaving the steel exposed to the heat of the fire. Similar conditions existed in the surrounding buildings hit by falling debris. Increasing the thickness of this material would have not changed the outcome.

Having said this, threats *do* exist of a nature and scale that perhaps should be directly addressed by some portion of our built environment. Car bombs, bio/chemical attacks, and deliberately set fires fall into this category. Still, not every building requires enhancement against such threats. We must consider the potential threat as it relates to the nature of the building. Is the building in question a potential terrorist target? Is it an icon? Does the building house a high-risk tenant such as the FBI or the corporate headquarters of a major financial institution?

High-risk buildings account for only a small percentage of our overall building inventory. Addressing these buildings on a case-by-case basis is a rational response to the potential threat of terror. Penalizing all buildings by imposing well-intended, yet ill-conceived, building code provisions is not the answer to a safer world.

### **An Obligation of Leadership**

It has become clear in the months following the attacks that there is a great need for leadership in the building industry. The public is demanding more information about safety, and design professionals are wondering how best to respond. Faced with these demands, the CTBUH has identified what is not only a *need* for leadership, but an *obligation* for ALL design professionals and building officials. An obligation exists to educate the general public so that appropriate expectations can be formulated regarding building performance in response to various hazards and threats.

Towards this end, the CTBUH has published two guidebooks:

The "Building Safety Assessment Guidebook" is aimed at the general public. It is intended as a resource to educate the reader about the various safety systems present in modern buildings. The Assessment Guidebook provides an overview on how buildings are expected to perform when faced with hazards such as fire, explosions, bio/chemical attacks, windstorms, and earthquakes. In a sense, the Assessment Guidebook is to buildings what *Consumer Reports Magazine* is to appliances and automobiles. Using the guidebook, the average employee, business owner, or apartment dweller will be able to compare the safety aspects of different buildings and make a more informed personal safety choice.

Specific examples of the Guidebooks contents include questions that an individual could ask a potential landlord such as: "Does the building have a formal, written emergency response plan?" or "Are there at least two exit stairs, in good repair, from each floor of the building?" The Guidebook is intended to give the reader a basic understanding of what safety systems should be present in a building constructed according

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to modern day codes and standards. Ultimately, the Guidebook should ease concerns about high-rise safety by empowering the reader's ability to make informed choices when comparing one building to the next.

The "Building Safety Enhancement Guidebook" is aimed at building owners, managers, and designers. The Enhancement Guidebook provides a listing of possible enhancements that, if incorporated, can fortify a building *beyond* the requirements of standard building codes. Examples of the suggested enhancements range from the structural strengthening of columns, beams, and connections against the effects of a blast to locating a building's electronic/security control center away from public access areas.

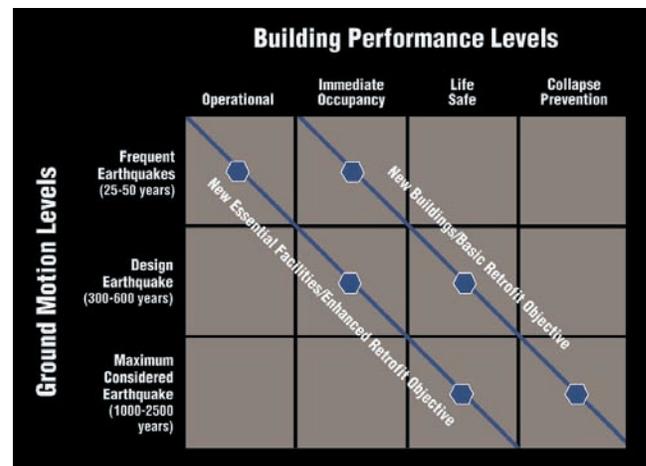
While the "Building Safety Enhancement Guidebook" discusses enhancements beyond basic building codes, it is important to note that the CTBUH is NOT promoting code changes to incorporate the enhancements presented. Instead, the CTBUH is advocating a "Performance-Based Design" approach when considering safety and security enhancements. Under such an approach, each building is evaluated relative to its unique set of circumstances and possible threats. Once the specifics for each building are identified, appropriate design criteria can be developed.

### Why Performance-Based Design?

It is clear that all buildings are not subject to the same level or type of potential threat. For instance, a 100-story office building in a downtown environment is subjected to significantly different risks than a distribution warehouse located in the suburbs. Likewise, the performance we expect from a hospital or school is different than the performance we expect from a shopping center.

A "Performance Based Design" approach provides a framework for designers to directly address specific hazards and desired performance levels. For any specifically defined hazard, appropriate design solutions can be developed which result in clearly defined performance objectives. Identifying the possible hazards and performance levels should be the result of a dialogue between building owners and designers.

For instance, an office building housing a high-risk tenant such the FBI may consider the effects of a street-level blast directed at the building. The size and proximity of the blast threat can be defined, such as a 50-pound explosive located 25 feet from the building. Next, the performance objective of the building can be defined, such as "operational." In other words, if the defined blast were to occur, the desired performance would be for the building to remain operational, even while sustaining some damage. By specifically defining desired performance criteria, appropriate design solutions can be developed and implemented.



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### Researching a Safer World

More research is required in support of a Performance-Based Design approach. Today, much of what we know about enhanced safety design is qualitative rather than quantitative. Research is needed in areas such as blast protection, air quality management, fire protection, and building egress to understand the effectiveness of various enhancement proposals. The National Institute of Standards and Technology in the United States, for one, is embarking on a multi-year research program to determine some answers. Moving forward, clear and quantitative information will allow the development of appropriate and effective design solutions.

Our new awareness of the possible threats to our built environment will undoubtedly result in a safer world. We must, as an industry, provide the leadership necessary to ensure an appropriate and effective use of our common resources. The CTBUH hopes to continue to contribute to this positive end. For more information about CTBUH or the Guidebooks, refer to [www.ctbuh.org](http://www.ctbuh.org).

### About the Author

Ron Klemencic is Chairman of the Council on Tall Buildings and Urban Habitat, and President of Magnusson Klemencic Associates in Seattle, Washington.