Title: **Engineering Systems an Incremental Response to Terrorist Threat**

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Engineering Systems an Incremental Response to Terrorist Threat

The design approach of a new building, or safety assessment of an existing one, must look at the overall performance of the integrated buildings systems.

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Buildings designed and constructed in accordance with present day codes and standards provide a fundamentally safe environment. Safety guidelines have been developed and modified over time with fire and natural hazards in mind. Present day threats, including terrorist attacks, are much more difficult to predict since they can take many forms.

The design approach of a new building, or safety assessment of an existing one, must look at the overall performance of the integrated building systems. The performance of the structural systems, curtain wall, security systems, mechanical, electrical, fire protection systems, etc. must be analyzed against the threat and perceived risks. The building location, occupancy, function, setting and stature must be considered in this assessment.

The primary motivating factors for designing high-performance buildings are to:

- Decrease the exposure to terrorism.
- Mitigate the effects of an attack.
- Increase the probability of achieving full evacuation in the event of a disaster.

The application of techniques such as diversity, proximity, redundancy, decentralization, material selection and hardening/rigidity can help in improving the performance of a building.

Accessibility Control

The goals of perimeter security and access control systems are to identify and control a threat before it enters a facility. Many building owners have put new measures in place for controlling access to their buildings, including pre-screening visitors, visual identification and tenant escorts throughout the building.

The parameters of surveillance, security and detection have expanded to include non-traditional areas. CCTV can now be found at air intake louvers, mechanical rooms, electrical rooms, telecommunication spaces, rooftops, etc. Security and access control points now make use of card access controls to lock MER's, limit elevator stops to certain floors and monitor the movements of personnel in restricted areas.

Identifying and Containing the Threat

Biological and chemical threats have required that building owners and managers review mail receiving operations, truck dock access, security of ventilation and air intake and the monitoring of maintenance access to the building.

For example, with the threat of bio-chemical weapons, mail-receiving and truck dock areas have been provided with dedicated ventilation and air conditioning systems which limit the spread of contaminants should they enter the building. These rooms can be structurally isolated from the rest of the building by increasing the strength of the envelope that encloses them. The box around high-risk areas could be constructed of reinforced concrete or block to increase its blast resistance.

The secure location of outside air intakes, and the surveillance of those most readily accessible to the public, is the most important precaution that can be taken in existing and new construction projects.

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A quick response to the possibility of a bio-chemical attack increases the chances for the safe isolation of a building's occupants. If a bio-chemical release is suspected, a complete HVAC system shutdown may be the best approach. The building's HVAC systems should ideally be controlled by the building automation system, with a single instruction resulting in the quick shutdown of all systems. Once the details of the event are investigated, the appropriate action for these systems can be identified and implemented.

Redundancy

Introducing redundancy into a building's system will strengthen its integrity, eliminating single points of failure in a building's critical life safety systems. A building's response is a function of availability when it is called upon to operate. Run redundant services, such as emergency power distribution feeders, life-safety wiring and communications, and water and oil risers, through hardened pathways. For example, employ masonry walls for all stair shafts containing standpipes and employ a "sonnet ring" approach to critical systems.

Multiple, looped, sprinkler and standpipe risers reduce the possibility of an event severing available water supply. Redundant water services, including supply for each sprinkler zone, increase the reliability of fire suppression. Appropriate valving, where services are combined, will help isolate portions of the system in an emergency. Redundant fire pumps, Redundant sources should be remotely located from each other, for example on the roof and in the basement.

reliant on different sources, could be provided in remote locations. For instance, one electric pump supplied from utility and/or generator power, and a second, diesel fire pump.

Redundant fire command centers remotely located from each other allow system operation and control from alternate locations. Hardened construction of the local fire command center in a blast-resistant area, adjacent to the building entrance will maintain capability for on-site monitoring and response.

Proximity

Locate the emergency power source directly at the load. Fire alarm system design, consisting of distributed intelligent fire alarm panels, connected in a peer-to-peer network allows each panel to function independently, and process alarms and initiate sequences within its respective zone. Exit signs along egress pathways, and emergency lighting, could be provided with integral battery packs to facilitate egress in a utility power outage. Emergency communication can be enhanced by providing extra emergency phones separate from PBX that connect directly to a central office, an in-building repeater system for emergency response team radios, and redundant or wireless fireman's communications in the building.

An emergency generator system provides a crucial alternate should utility power become unavailable. Redundant sources should be remotely located from each other, for example, on the roof and in the basement. Reduce the outside air requirements for an internal generator by using a combination of remote radiators and air conditioning to limit the intake louver requirements to combustion air only. Non-traditional emergency sources, such as photovoltaic cells, provide a self-sufficient power source for the most critical loads without depending on remote fuel sources.

In combination with other smoke control systems, pressurization of the stairwell and vestibule maintain a clear path of egress to safe areas or to building evacuation. This two-step protection for the stairway system is not required in the United States in buildings where sprinklers are provided. This is an example of an incremental response. In high-rise buildings, the system should be distributed rather than centralized. Although the provision of a pressurized fire service elevator speeds response to higher floors, one of the bigger questions is the application of elevator lobby pressurization for evacuation. A further consideration may involve the addition of elevator lobby pressurization to provide a safe haven refuge area in the event of an emergency.

Biological/Chemical Attack Identification and Response

Building air conditioning systems are provided with filters, which trap a percentage of particles of all sizes. Air filtration efficiency can be improved by providing multiple layers of filters, and increasing from the standard 85% to 95% DOP filters, electrostatic filters, or 99.97% HEPA filters. Air filtration for bio/chemical hazards could be increased with the installation of activated carbon filters and ultraviolet light systems. Filters, however, do not identify the presence of hazardous agents and cannot provide 100% removal of these agents. In existing buildings, increased filtration may result in major costs to upgrade HVAC system motors and associated electrical power.

Measures vary depending upon a building's functionality. The U.S. State Department advocates cascading pressure relationships in combination with HEPA use, and does not allow internal re-circulation within the spaces. Typically, there are three pressure zones, the lowest for public spaces, the second for state department work areas, and the highest for critical areas requiring clearance. This helps to minimize distribution of an internally released contaminant.

Sensors quick and reliable enough to automatically initiate the appropriate protection mode are not readily available, however, air quality detection systems are one of the primary focuses of major manufacturers' research and development divisions. For instance, a system employing a monoclonal antibody approach through the application of electronic chips with chemical or biological receptors on their surface, is currently under development. Beyond most air filtration systems, these receptors are tuned to particular chemical or biological agents which, when detected, provide an immediate response by the building automation system to operate in a safe mode.

Technology is changing on a daily basis, and advances must be closely analyzed for potential application in the building service arena.

The building owner must assess the potential threat to his building and his tenants and identify the most prudent performance-based solutions

Conclusion

All security and system hardening measures are not advocated for all buildings. The building owner must assess the potential threat to his building and his tenants and identify the most prudent performance based solutions.

Each system upgrade, beyond those common for the built environment, will undoubtedly require a cost/ benefit analysis. Unfortunately, in this new period of American history, the costs entering into the equation are not only counted in dollars and cents.

About the Authors

Norman Kurtz is a managing principal at Flack + Kurtz, Inc., a longstanding contributor to the Engineering community, and a member of the Council on Tall Buildings and Urban Habitat. Andrew Hlushko is the Director of Technical Services and Electrical Department Head at F+K's NY Headquarters, and spearheads the design of MEP systems for many high profile projects. Dan Nall is the Director of Advanced Building Sciences, a LEED-Certified Professional, and co-chair of the US Green Building Council's Energy and Atmosphere Technical Advisory Group.