Impacts of New and Innovative Building Designs on First Responder Operations

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As the design and engineering of buildings becomes more sophisticated and begins to incorporate innovative forms and shapes, lighter-weight materials, sustainable design and blast and other security related design enhancements, it is important to consider the effects of these newer design practices on first responders and their emergency operations.

While, existing building and fire codes address many design impacts on emergency operations through requirements such as alarm and sprinkler systems and the use of fire proofing materials; they often address problems through hindsight (i.e. injuries or fatalities have occurred) rather than foresight, not all materials and configurations are addressed by code requirements and even the ones that are addressed do not always consider the implications to first responders of emergency operations resulting from abnormal loading scenarios such as explosions and high energy impacts.

It is important for cutting edge designers and engineers to ***understand*** what types of operations first responders engage in, to look forward and ***predict*** how new design and building practices might adversely affect these operations, and to proactively develop solutions to ***mitigate*** these adverse impacts.

Understand

The first question to be asked by engineers, researchers and designers is: what are the emergency operations that might be impacted by a new design or new material? These include:

- Fire suppression from both the interior and exterior of a building
- Occupant rescue from fire
- Emergency egress for firefighters from untenable conditions
- Overhaul after a fire
- Smoke exhaust
- Search and rescue in collapsed buildings

For these operations, first responders have to be able to:

- Easily approach a building or structure
- Quickly and efficiently enter and exit the building from all sides (and in some cases all floors of the building)
- Quickly and easily traverse the corridors of the building and move between floors,
- Make openings in the facades, roofs and/or floors of the buildings to create ventilation or emergency access/egress points
- Open up walls, roofs and floors to ensure that the fire is put out in all void spaces (overhaul)

In the case of collapsed building they may have to remove debris, tunnel through the damaged structure, breach and break through building materials and carry out crane and other heavy equipment operations.

Predict

The next question to ask ourselves is: how is our design/material impacting these functions? The following are some examples:

Lighter-Weight Materials

- Lightweight wood trusses and engineered wooden I-beams fail very quickly after fire is applied and are responsible for firefighter fatalities and a large number of firefighter near misses.

Sustainable Design

- Green roofs can impede the ability of firefighters to cut holes in roofs to ventilate fires.
- Secondary power sources such as emergency generators, turbines and solar panels can cause problems if they backf-eed a building after firefighters think they have cut power to the building. Larger, commercial buildings build this into design, but residential solar panels do not always address and if a building owner has a portable generator hooked up to the building for some reason, it may not be addressed
- Sunscreens exterior to the building façade can form a barrier between exterior firefighting operations and the occupied areas requiring water.

Security

- Blast and ballistic resistant windows can create remove or slow down the ability of firefighters to gain access to buildings and can make it dangerously difficult for firefighters to quickly exit buildings in untenable environments.

Starchitects

- Unusual shapes, less redundancy, non-traditional structural systems - makes it harder for firefighters to understand the load paths of a building and makes it difficult to make informed decisions in fire and other catastrophic loading conditions.
- New materials can release toxins as products of combustion or can make it more difficult for firefighters to cut through or breach floor, wall and roof systems when necessary for firefighting or occupant rescue.

Mitigation

The final question is: how to mitigate potential adverse affects to first responders? The answer lies in the level of impact that is anticipated. Does the new design approach mean that buildings will fail more quickly when subjected to fire? If yes, then the answer may be to do re-design to develop more redundancy or to enhance the material's resistance to fire. Does the new design approach represent additional levels of effort for firefighters as they respond to everyday fires? If yes, then the answer may be an awareness training program and reporting requirements to let responders know that the conditions exist and what the expected impacts will be.

We rely on First Responders to protect us, it is only right that we work toward protecting them in return.