

CONCEPT MITIGATION OPTIONS

OVERVIEW

The risk assessment process, using the tiered approach described in the chapter entitled “Performing a Rapid Visual Screening”, is designed to isolate the highest risk buildings. In this chapter, some basic concepts and qualitative guidance is provided to begin the process of developing mitigation options. Further guidance may be found in other publications within the FEMA Risk Management Series, including FEMA 452, *Risk Assessment: A How-To Guide to Mitigate Potential Terrorist Attacks*, Chapter 7, and FEMA 427, *Primer for Design of Commercial Buildings to Mitigate Terrorist Attacks*.

USING THE RAPID VISUAL SCREENING PROCEDURE TO EVALUATE MITIGATION OPTIONS

For each building that is considered for upgrade, a prioritization process needs to occur to isolate which site and building specific characteristics have the strongest influence on the risk score overall, or the risk score associated with the threat scenario(s) of most concern.

The rapid visual screening procedure may then be used for beginning the mitigation design process by reviewing the attribute options for the critical building characteristics. Attribute options with lower scores will give lower risk scores. Generally the first attribute labeled (a) will have the lowest risk score, with the subsequent choices representing successively lower levels of protection. One or a combination of several options may be considered to investigate the impact on the risk score. *The electronic database tool makes this type of investigation particularly easy by interactively modifying the attribute options to monitor the effect on the risk score.*

A good place to start the mitigation evaluation process would be to review the heavily weighted building characteristics, which have especially high impact on the overall scoring:

- Number of Occupants (1.2, 2.2)
- Replacement Value (1.3)
- Physical Loss Impact (1.6)

- Site Population Density (2.3)
- Visibility / Symbolic (2.4)
- Target Density (2.5)
- Target Potential (2.7)
- Unsecured Underground Access (3.4)
- Transfer Girder Conditions (6.6)
- Primary External Air Intake Conditions (7.1)
- Return Air Intake System (7.2)
- Internal Air Distribution System (7.3)
- Critical Utilities Located Close to High Risk Areas (7.4)
- Internal Threat - Security Systems (8.1)
- Zone 1 Threat - Security Systems (8.2)

Improving the protection provided by any one of these building characteristics may be as effective as upgrading several building characteristics not on this list.

Although quick and useful, there are some limitations to using the rapid visual screening procedure for mitigation concept evaluation including:

- There are limited attribute options provided, which limits the types of mitigation types that can be considered;
- Some of the attribute options are not useable for retrofit situations (they are more appropriate or cost effective for new construction) and;
- Cross correlation between any two building characteristics may not be properly accounted for in the scoring for a given set of mitigation measures.

In some cases, the building characteristic that controls the risk assessment is so inherent to the building or the site that it can not be changed, or the mitigation measures required seem excessive. This may be an indication that mitigation measures alone are insufficient for reducing the risk to tolerable levels and that critical assets may need to be relocated to another facility.

PRACTICAL CONSIDERATIONS FOR EVALUATING MITIGATION OPTIONS

Some additional guidance is given below for evaluating effective mitigation concepts.

It is tempting to pick mitigation options based on ease of implementation and available funding, but if the mitigation is not reducing the risk much, then no real benefit has been achieved. For example, it may be inexpensive to apply security film to the windows, but the benefit may be very low for a building that is close to a major transportation artery, for instance. In this case, the risk of progressive collapse may far outweigh the risk of lacerations due to glass fragments, making a window upgrade nearly useless for reducing risk. This should be easily verified through use of the rapid visual screening procedure that captures information about setback and window design.

Another example of an ineffective mitigation is to place film only on the windows on the first three floors, when credible explosive threat levels will cause hazardous glass breakage for the entire building. In the rapid visual screening procedure, this is accounted for by noting that the attribute option for security film assumes that the film has been applied to all or most of the building. An analogous example would be to place bollards only along part of the perimeter to resist a ramming threat.

Tailoring an upgrade to a specific threat does not always make sense for a variety of reasons including the uncertainty associated with the threat size and the potential for the threat to change over the life of the building. For these reasons, it is often most effective to develop a set of mitigation options that optimize the inherent level of protection that the building is able to achieve. For instance, if the structural frame is the weakest part of the structural design for an explosive threat, it is cost prohibitive to perform a structural upgrade. In this case, the benefit of upgrading the exterior envelope to match the capacity of the frame is a more reasonable approach.

It is always worthwhile to reduce the profile of the building to be less noticeable. It may be sufficient to reduce the overall visibility of a facility, for instance, by eliminating or changing the signage to be less noticeable to passersby. In some cases it may be more beneficial *not* to place bollards along the curb (for instance if none of the other buildings on the block have bollards) so as not to draw attention to the building. Making the building more unobtrusive in these ways may be

as effective as more expensive solutions. Note that this type of mitigation is not directly addressed in the rapid visual screening procedure.

Also, beware of instituting mitigation measures that may reduce the *perception* of risk but not the *actual* risk. Some examples include:

- using untrained guards who are unable to respond appropriately in an emergency; or
- installing card access readers with alarms that are set off so often that no one pays attention.

These attribute options would only be discerned by the rapid visual screening procedure if the screener observed building operations during the field visit.

Finally, in some cases, mitigation measures can reduce the risk for a particular terrorist threat but worsen it for another threat that may be more apt to occur. One example is that by hardening the exterior envelope, the ability to easily get into and out of the building in an emergency may be compromised. Another example is that some materials that perform well for blast, perform poorly for other threats. For instance polyurethane has blast resistant properties but may generate toxic fumes in the event of a fire.

Any mitigation product manufacturer who is being considered needs to be able to produce testing results that verify that the product resists a credible threat level. The threat needs to be fully quantified in the test report and the test specimen attachments need to correspond to the actual built condition in order for a test report to be useful for decision making (e.g., window frames and attachments need to be included for any window glass test).

MITIGATION PROTECTION LEVELS

Depending on the acceptable level of risk for the facility, the mitigation measures may be selected to achieve a low, moderate or high level of protection.

Examples of low, moderate and high levels of protection for a hypothetical building are provided in Table 17 for each of the building systems considered in the procedure.

Table 17 Examples of Protection Levels for a Hypothetical Building

Building System	Low	Moderate	High
Site	Close street lane and use vehicles to block vehicle entrances at times of high alert	Attractive street furniture around perimeter; drop arm at vehicle access points	Fixed anti-ram barriers around perimeter; Wedge barrier at vehicle access points
Exterior Envelope	Daylight security film on all windows	Replace vision panels and strengthen structural framing from windows into floor system	Replace windows and upgrade walls to consistent level
Architecture	Optimize internal spaces to separate secure from unsecure spaces.	Create an entry pavilion and loading dock area outside main footprint.	Offsite deliveries, parking and visitor screening.
Structural	Harden publicly accessible columns for credible design threat.	Strengthen exterior frame connections to resist effects of column removal at first two ground levels.	Strength exterior frame connections to resist effects of column removal at any floor level.
MEP	Raise air-intakes	Raise air-intakes, Install a detection for contaminants	Raise air-intakes, Install detection and filtration systems for contaminants
Security	Screen all persons entering secured spaces	Screen all persons at building entrance and at entrance to secured areas	Screen all persons at property line, at building entrance and at entrance to secured areas

NEXT STEPS

To develop the mitigation options further, it is recommended that a team of experts in anti-terrorist design be engaged to verify the conclusions developed using the rapid visual screening procedure, and further improve the chances of effective mitigation measures being implemented. Such experts can be invaluable in performing analyses to evaluate effectiveness of various mitigation options and in assisting in the selection of mitigation products. A list of antiterrorist disciplines on the team may include:

- Architect
- Security Professional
- Blast Engineer
- Structural Engineer
- MEP Engineer
- Cost Estimator
- General Contractor
- Specialty Contractors

For a turnkey approach, all these disciplines are engaged as a team to develop an integrated mitigation solution from the beginning of concept design through implementation. In other situations, a more sequential approach is taken in which a conceptual design is first developed, then a final design, and finally, construction. In the latter case, the conceptual design typically includes a narrative with sketches, calculations, and a preliminary cost estimate. The final design includes a set of construction documents for bidding. To contain costs and minimize disruption, the retrofit may be planned to be in phases and clearly marked as such on the drawings. During construction, shop drawings will be provided by the specialty contractors for the exterior envelope and perimeter protection. After construction, it is recommended that a set of as-built drawings be kept on file for future retrofits.