Risk Management Series

Handbook for Rapid Visual Screening of Buildings to Evaluate Terrorism Risks

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RISK MANAGEMENT SERIES

Handbook for Rapid Visual Screening of Buildings to Evaluate Terrorism Risks

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FOREWORD AND ACKNOWLEDGEMENTS

This rapid visual screening procedure has been developed for use in assessing risk of terrorist attack on standard commercial buildings in urban or semi-urban areas, but it is also intended to be applicable nationwide for all conventional building types. It can be used to identify the level of risk for a single building, or the relative risk among buildings in a portfolio, community, or region as a prioritization tool for further risk management activities. The information gathered as part of this screening procedure can also be used to support and facilitate higher level assessments by expert investigators performing building-specific evaluations of threat, consequences, and vulnerability.

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Principal Authors

Eve Hinman, Hinman Consulting Engineers, Inc., Applied Technology Council Project Technical Director
Christopher Arnold, Building Systems Development
Mohammed Ettouney, Weidlinger Associates, Inc.
Milagros Kennett-Reston, FEMA, Project Officer, Risk Management Series Publications
Stephanie King, Weidlinger Associates, Inc.
Terrence Ryan, Raytheon UTD, Inc.

Contributors

William Blewett, Battelle
Sharon Gallant, Hinman Consulting Engineers, Inc.
David Hattis, Building Technology, Inc.
Jon A. Heintz, Applied Technology Council
Stephen Hollowell, Cerberus Security Services
Eric Letvin, URS
Arturo Mendez, New York Police Department
Christopher Rojahn, Applied Technology Council

Pilot Study Participants

Amy Baker, URS
Bruce Botkin, Las Vegas Metropolitan Police Department
Ed Carubis, ESRI Professional Services
Ernest Chambers, Las Vegas Police Department

John Chirillo, New York Police Department
Gonzalo Cordova, Department of Homeland Security
Jason DeVilbiss, Las Vegas Metropolitan Police Department
Charles Famulari, New York Police Department
Keith Foisey, New York Police Department
Scott Gregory, ESRI Professional Services
Robert Hall, ESRI Professional Services
Robert Hoyle, Las Vegas Metropolitan Police Department
Mary Ellen Hynes, Department of Homeland Security
Al Iglesias, New York Police Department
Dave Kehrlein, ESRI Professional Services
Ari Maas, New York Police Department
Patrick O'Neill, New York Police Department
Mary Raymond, Department of Homeland Security
Andrea T. Schultz, Department of Homeland Security
Dave Shepherd, Readiness Resource Group
Cindy Stimpfel, New York Police Department
Joe Tadrick, Department of Homeland Security
Arturo Willis, New York Police Department

Advisory Participants

Robert Chapman, NIST
Cathy Crowley, Department of Homeland Security
Doug Hall, Smithsonian Institution
Mark Harvey, Department of Homeland Security
Mike Kaminskas, Raytheon UTD
Fred Krimgold, Virginia Tech
Ken Mead, Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health
Elizabeth Miller, National Capital Planning Commission
Matt Nichols, Department of Homeland Security
Robert Smilowitz, Weidlinger Associates, Inc.
Frank Tabert, New York State Office of Homeland Security
Pax Williams, Battelle

Report Production

Peter Mork, Applied Technology Council

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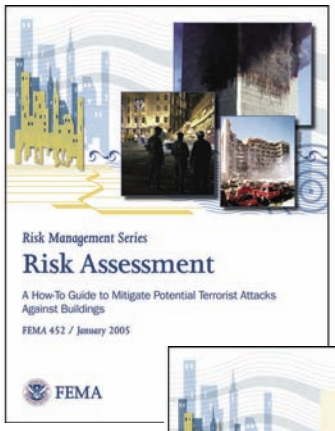
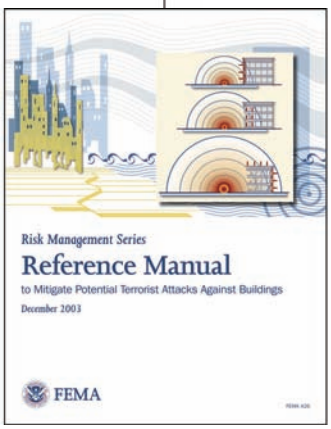
BACKGROUND





Implementation of FEMA 452, *Risk Assessment, A How-to Guide to Mitigate Potential Terrorist Attacks Against Buildings*, has demonstrated the need for a preliminary procedure to assess the risk of terrorist attack that is quick and simple to use. It has also shown that such a procedure needs to be usable by screeners who are knowledgeable about building systems, but not necessarily experts in anti-terrorism or structural design. This will reserve the use of experts for higher risk buildings requiring more detailed assessment when resources are limited.

In this document, the concepts for rapid visual screening are combined with a risk-based procedure for manmade threats defined in FEMA 426, *Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings*, and FEMA 452, *Risk Assessment, A How-to Guide to Mitigate Potential Terrorist Attacks Against Buildings*, from the FEMA Risk Management Series of publications.

OBJECTIVES AND SCOPE

This handbook outlines a rapid visual screening procedure that quantifies the risk to a building due to a terrorist attack that is capable of causing catastrophic losses in terms of fatalities, injuries, damage, or business interruption. The primary purpose of this screening procedure is to prioritize the relative risk among a group of buildings in a portfolio or community but it can also be used to develop building-specific risk information. It is intended to be the first step in a tiered assessment process that includes successively more refined analyses when more detailed information is needed.

Terrorism is an unlawful act of force or violence against persons or property with the intent to intimidate or coerce a government or civilian population in furtherance of political or social objectives. In the context of this report, terrorism can take the form of armed intrusion, explosive attack, or chemical, biological, or radiological release.

Three generic types of terrorist threat are considered in this procedure. These include intrusion into the building, a vehicle borne improvised explosive device (VBIED), and a chemical, biological or radiological (CBR) release.

Quantification of relative risk is based on the methodology outlined in FEMA 426, in which risk is characterized as the product of three factors: consequences, threat, and vulnerability. In this rapid visual screening procedure, these three factors are evaluated using a Data Collection Form based on checklists and worksheets contained in

FEMA 426 and FEMA 452. To make the screening procedure rapid, the assessment is limited to the most dominant features governing the overall risk to a building given a terrorist attack. In this procedure there is an emphasis on the vulnerability factor, due in part to the relatively significant level of control that the owner has with respect to this factor for a given building compared with the other two factors: threat and consequences.

LIMITATIONS

This rapid visual screening procedure was developed based on assessing the risk of terrorist attack for office buildings in urban or semi-urban areas. The following limitations apply to the use of this procedure:

- The unique characteristics of non-building structures such as tunnels, bridges, transmission towers, dams, and monuments are not considered.
- The exceptionally high risk associated with one of a kind iconic buildings of symbolic value is not considered, such as the White House or the Pentagon. Risk to this class of buildings should be evaluated using more detailed assessment procedures.
- Second order collateral effects such as loss of functionality (e.g., loss of power) due to separate targeting of remote utility infrastructure systems is not considered.
- The design of mitigation measures to reduce the risk of terrorist attack is not addressed in this procedure. (However, a discussion of some basic mitigation concepts has been included).
- The threat rating defined in this report provides an indication of the buildings threat attractiveness rather than the probability of attack.

Rapid visual screening is designed to be performed using limited information from the visual inspection of the building exterior and public areas. Interior inspections or interviews with key stakeholders are highly desirable but not always practical. Consequently, conditions contributing to increased vulnerability will not always be visible, and high-risk buildings may not be identified as such. Conversely, buildings initially identified as high risk may prove to be otherwise based on additional information.

Also note that some of the building characteristics will require pre-field information gathering to obtain an accurate scoring. If such research is not performed, the quality of the risk assessment may not be completely accurate.

For buildings identified as having unacceptable levels of potential risk using this approach, additional study is warranted using a more refined assessment method.

INTENDED AUDIENCE

This handbook is intended for use by both technical and stakeholder audiences. Technical audiences include potential screeners and trained personnel knowledgeable about building systems, but not necessarily experts in anti-terrorism design. Stakeholder audiences include building owners/operators/decision makers involved with the planning, construction, and maintenance of the built environment. It is expected that interested technical and stakeholder groups would include the following:

- City, County and State Officials
- Emergency Managers
- Law Enforcement Agencies
- Lenders
- Insurers
- Facility Managers
- Security Consultants
- Engineers, Architects and other design professionals.

The procedure is primarily intended for office, commercial and government buildings, but also can be used for schools, hospitals, industrial buildings, and other types of buildings.

CONTENT AND ORGANIZATION

This handbook provides the information needed to rate a building or group of buildings that have been selected for rapid visual screening of their potential risk to terrorist attack. Screeners are guided through the details of how to evaluate and score key features contributing to the overall risk to the building, and how to develop an overall risk assessment rating based on three factors:

consequences, threat rating, and vulnerability rating. Stakeholders are provided guidance on how to use and interpret the results.

The information is arranged in chapters in the following order:

- Performing a Rapid Visual Screening. An overview of the screening procedure and its application, with discussion of screener qualifications, and an introduction to the Data Collection Form and Risk Scoring Worksheet.
- Consequences Assessment. Guidance on how to complete Section 1 of the Data Collection Form, which is used to evaluate building characteristics that affect consequences.
- Threat Assessment. Guidance on how to complete Section 2 of the Data Collection Form, which is used to evaluate building characteristics related to threat rating.
- Vulnerability Assessment. Guidance on how to complete Sections 3 through 8 of the Data Collection Form, which are used to evaluate the vulnerability of the building.
- Risk Assessment Rating. Guidance on how to complete the Risk Scoring Worksheet and how to interpret the risk rating scores.
- Mitigation Options. Outlines some mitigation design strategies that may be used to lower the risk.

In addition there are five appendices. Appendix A contains the Data Collection Form and Risk Scoring Worksheet. Appendix B contains a field version of the Data Collection Form to be used during the site inspection. Appendix C contains a description of the numerical derivation of the risk scoring procedure. Appendix D contains an abbreviated version of the taxonomy used by the Department of Homeland Security to define facility types. Appendix E contains guidance on the use of an electronic version of the procedure. A list of references follows.

PERFORMING A RAPID VISUAL SCREENING

OVERVIEW

This rapid visual screening procedure is intended to be a first step in a tiered assessment process, as outlined in FEMA 452, *Risk Assessment, A How-to Guide to Mitigate Potential Terrorist Attacks Against Buildings*. In a tiered approach, a series of successively more refined analyses are performed, and additional effort is expended, when more detailed information is needed. This trade-off between level of effort and level of refinement allows an assessment to meet a variety of benefit/cost considerations for different buildings.

As a first step in an overall process, rapid visual screening is intended to be a quick and simple tool for obtaining an initial risk assessment rating for a building or group of buildings. As such, there are practical limitations on how much information can be considered in performing the rapid assessment, accompanied with a corresponding level of uncertainty in the results. In general, rapid visual screening procedures are most often used to obtain a basic understanding of the risk, and to prioritize more detailed assessments over the entire inventory of buildings considered. More detailed assessments, such as FEMA 452 Tier 1, Tier 2 or Tier 3 assessments, are usually needed to confirm results on any one building, although some building-specific vulnerability information can be obtained using this screening procedure. In this context the rapid visual screening procedure is a *Pre*-Tier 1 tool for assessment.

The information gathered as part of this screening procedure is designed to support and facilitate higher level assessments by expert investigators performing building-specific evaluations of consequences, threat, and vulnerability using FEMA 452, or other similar risk assessment methodology.

This chapter gives an overview of the screening procedure. Subsequent chapters provide detailed information on evaluating a building to determine the risk score.

RAPID VISUAL SCREENING PROCEDURE OVERVIEW

The rapid visual screening procedure involves the following sequence of activities:

- Understand the rapid screening framework;

- Assemble the assessment team;
- Understand the risk scoring procedure;
- Organize and mobilize necessary resources ;
- Collect and record assessment data (i.e., assess Consequences, Threat Rating and Vulnerability);
- Complete the Risk Scoring Worksheet; and
- Interpret and use results.

Each of these activities is described in the sections below.

UNDERSTANDING THE RAPID SCREENING FRAMEWORK

FEMA 452 identifies three tiers of assessment, which are summarized in Table 1.

Table 1 Summary of FEMA 452 Tiered Assessment Levels

Tier	Description	No. of Screeners	Duration	Building Types
1	Screening Evaluation	1-2	Up to 2 days	Majority of standard commercial office buildings and other non-critical facilities and infrastructure
2	Full On-Site Evaluation	3-5	3-5 days	Most high-risk buildings, iconic commercial buildings, government facilities, schools, hospitals and other designated high value infrastructure assets
3	Detailed Evaluation	8-12	Several days to weeks	High value or critical infrastructure assets.

In FEMA 452, Tier 1 is characterized as a screening phase that identifies primary building vulnerabilities and involves a "quick look" at the site perimeter, building, core functions, infrastructure, drawings, and plans. The approximate level of effort consists of one-to-two experienced professionals for up to two days. A FEMA 452 Tier 1 assessment is usually considered a sufficient level of assessment for most commercial buildings and other non-critical facilities.

Buildings identified as having an unacceptable level of risk based on a Tier 1 assessment will require more detailed evaluation in a FEMA 452 Tier 2 assessment. This type of assessment requires more detailed information about building characteristics and security features, and will require a multi-disciplinary team of experts to execute. A FEMA 452 Tier 2

assessment is usually considered a sufficient level of assessment for most moderate-risk facilities.

If additional information is needed, quantitative engineering analysis is performed in a FEMA 452 Tier 3 assessment of potential damage and casualties. This type of assessment requires a still larger group of experts and more time to execute, and is typically reserved for high-value or critical facilities.

This rapid visual screening procedure in the context of FEMA 452 is effectively a "*Pre*-Tier 1" assessment. Similar to a Tier 1 assessment it is designed to be conducted by one or two screeners, and depending on the level of effort, can be completed in 1-to-5 hours per building, depending on the level of desired accuracy and access to building information. Buildings identified as having an unacceptable level of risk using this rapid visual screening procedure can be reassigned directly to FEMA 452 Tier 2 assessment.

Reliability and confidence in the rapid visual screening results can be increased if structural, mechanical, and security features can be verified with further information from: (1) interior inspections with knowledgeable building representatives; (2) interviews with building security and other key personnel; and (3) review of additional building documentation, such as available building drawings and security operations manuals. If detailed interviews and substantial background materials are reviewed, this procedure can take up to two days per building. The more information that is considered during rapid visual screening, the more accurate the risk scoring process will be. To facilitate the process, it is strongly recommended that authorities, and building owners and operators be contacted prior to the commencement of assessment.

Successively fewer buildings are generally considered for each subsequent tier of evaluation. Note that for highly iconic one of-a-kind buildings (e.g., the Pentagon, White House), the rapid visual screening procedure is not appropriate, and a FEMA 452 Tier 2 or Tier 3 assessment is required.

ASSEMBLING THE ASSESSMENT TEAM

The rapid visual screening approach facilitates the prioritization of resources in the screening process, reserving the use of experts for the highest risk buildings that require more detailed assessment. It is recommended that teams include members who are comfortable with building sciences and security concepts. In some cases, stakeholders may decide to provide training for the screeners or to have an expert in

antiterrorism oversee the assessment process. In general, the more knowledgeable the screener is with the concepts presented in this document, the more accurate the assessment and potentially the better the reliability of the score.

Discussions about the rapid visual screening methodology with the team prior to implementation may help ensure consistency among assessments, high quality of collected data, and uniformity of decisions among screeners. Discussions should address building systems, including site design, architectural, mechanical, electrical, plumbing, and security systems. Other pertinent topics include: how buildings behave when subjected to extreme events; how to use the Data Collection Form, and the electronic database version; what to look for in the field; what to bring to the field; and how to account for uncertainty.

Teams can simultaneously consider and rate buildings of several different types and compare results early in the assessment process. This will serve as a "calibration" for the screeners and improve consistency of results.

UNDERSTANDING THE RISK SCORING PROCEDURE

The risk scoring procedure used in rapid visual screening is based on the risk assessment equation in FEMA 426, *Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings*, and FEMA 452, *Risk Assessment, A How-to Guide to Mitigate Potential Terrorist Attacks Against Buildings*. As shown in Equation 1, risk is defined as the product of three factors for a given threat scenario:

$$R = C \times T \times V \qquad (1)$$

where:

C = Consequences Rating
T = Threat Rating
V = Vulnerability Rating

Consequences is defined as a degree of debilitating impact that would be caused by the incapacity or destruction of an asset. To put this into the context of other risk assessment methodologies, sometimes consequences is referred to as "asset value". Assets refer not only to monetary value but also value to the community.

Threat is defined as any indication, circumstance, or event with the potential to cause loss of, or damage to, an asset.

Vulnerability is defined as any weakness that can be exploited by an aggressor to make an asset susceptible to damage.

The risk scoring procedure considers the variables listed in Table 2. Each of the three risk factors is evaluated through the collection of building data, considering key individual building characteristics across all building systems.

Table 2 Variables Considered in the Risk Scoring Procedure

Threat Types	a. Internal Attack b. External Large Scale Vehicle Borne Improvised Explosive Device c. External Large Scale Chemical Biological or Radiological (CBR) release using air-borne contaminants
High Value Target Types (in the proximity of the building)	a. Agricultural/Food Processing b. Banking and Finance c. Chemical Processing d. Commercial Key Assets e. Critical Manufacturing f. Dams g. Defense Industrial Base h. Emergency Services i. Energy j. Governmental k. Information and Telecommunications l. National Monuments m. Nuclear n. Postal and Shipping o. Public Health p. Transportation Systems q. Water Supply
Target Zones	a. Zone I – less than 100 feet from the building b. Zone II – more than or equal to 100 feet and less than 300 feet from the building c. Zone III – more than or equal to 300 feet and less than or equal to 1000 feet from the building
Threat Scenarios (in terms of threat type and target zone)	a. Internal Explosive Attack b. Internal CBR Release c. Other Internal Attack (Intrusion) d. External Zone I Explosive Attack e. External Zone II Explosive Attack f. External Zone III Explosive Attack g. External Zone I CBR Release h. External Zone II CBR Release i. External Zone III CBR Release
Occupancy Types	a. Group I – low risk b. Group II – moderate risk c. Group III – high risk
Building Systems	a. General b. Site c. Architectural d. Building Envelope e. Structural Systems f. Mechanical/Electrical/Plumbing Systems g. Security Systems

Building information is recorded on a Data Collection Form and building characteristics are scored using a discrete numerical scoring system, where the lowest value represents the lowest contribution of the building characteristic to risk, and the highest value represents the highest contribution. Results from the Data Collection Form are entered in the risk scoring worksheets to calculate the risk assessment score for the building (or calculated internally if the electronic database version of the Data Collection Form is used).

A numerical value is assigned for each of the 3-to-5 building attributes describing a building characteristic included on the Data Collection Form. Consistent with FEMA 452, the sum of the numerical values for the building characteristics that contribute to each risk factor and threat scenario range from 1 for the lowest risk contribution to 10 for the highest risk contribution.

A detailed description of the development of the risk scoring procedure is provided in Appendix C.

ORGANIZING AND MOBILIZING NECESSARY RESOURCES

Rapid visual screening of a building requires the collection and review of building and security data from a number of different resources. Efficient execution of a rapid visual screening requires a systematic and organized approach to data collection and field verification of information.

A summary of rapid visual screening activities, and when they should be performed in the rapid visual screening process, are provided in Table 3. As noted in the table, certain activities indicate elements of a more refined screening that would increase the anticipated level of effort and duration of the assessment. All other activities represent the minimum that is required for a rapid visual screening.

At a minimum, building information is obtained through publicly available sources and visual observation of the exterior. For more detailed screening, data for rapid visual screening may be obtained from private (building owner) resources, available building documentation, interviews with key personnel, visual observation of publicly accessible areas or a tour of selected interior areas. A sample list of key personnel to interview and relevant building documentation to review is provided in Table 4.

Table 3 Rapid Visual Screening Activities

Pre-field Activities	a. Identify key objectives of the screening from building stakeholders b. Select inventory of buildings to be included in study c. Identify screeners and discuss methodology (and provide training if needed) d. Complete the pre-field information on page 1 of the Data Collection Form as completely as possible including gathering publicly available information on buildings and potential high value targets in the vicinity e. Obtain and review available materials obtained from the building owner, including operations and security procedures, policies, and construction drawings (*) f. Make arrangements for access to the buildings
Field Visit	a. Take this Handbook to the field to refer to guidance on evaluating the various building characteristics b. Use the "Field Version" of the Data Collection Form to collect data at the site, as provided in Appendix B b. Verify information already obtained c. Tour exterior and publicly accessible areas of the building filling in Data Collection Form and photographing building characteristics. d. Interview stakeholders (*) e. Tour critical internal areas (*)
Post-field Activities	a. Transfer data from the Field Version of the form to the long form, or the electronic data base (preferred format) b. Calculate the risk score for each of the building, using the Risk Scoring Worksheet (this process is automated when using the electronic database version of the Data Collection Form) c. Review ratings and make appropriate adjustments based on additional materials reviewed and interviews performed (*) d. Interpret scoring e. Identify buildings requiring further analysis f. Prepare a written report summarizing findings

* Elements of a more refined screening that would increase the anticipated level of effort and duration of the assessment (see Table 4).

COLLECTING AND RECORDING ASSESSMENT DATA

The Data Collection Form has been developed to assist in gathering, recording, and scoring information on building features relevant to the risk assessment. Information gathered prior to and during the field visit to the building can be documented using the abbreviated Field Version of the Data Collection Form (Appendix B), which has been designed for use during the field visit to be later transferred to the long version of the form (Appendix A) or the electronic database version of the Data Collection Form (discussed in detail in Appendix E). The first page of the Data Collection Form is intended to document basic building identification and target density information, and is to be filled in prior to the on-site evaluation. The next 8 pages of the form (long-form version containing scores for the various attribute options) identify information to

Table 4 Key Personnel and Relevant Building Documentation

Key Personnel	a. Building Owner b. Building Manager c. Chief of Engineering d. Chief of Information Technology e. Emergency Manager f. Security Director g. Major tenant representatives h. Local law enforcement, fire and emergency medical services representatives i. State or county representatives j. Local utility, telecommunications and other service representatives k. Critical function representatives
Relevant Building Documentation	a. Security assessments b. Emergency response and disaster recovery plans c. Security inspection results d. Hazmat plans e. Policy and legal requirements f. Federal, state, and local law enforcement threat assessments g. Drawings for original design and any implemented modifications h. Historical reports i. Local zoning ordinances j. Information on the facility systems operations capability k. Information on agreements with the surrounding community and federal agencies l. Population statistics m. Manpower surveys n. Emergency notification o. Emergency evacuation p. First responder access and routing q. Shelter-in-place strategies r. Designated shelter capacities and travel routes s. Off-site rally point and roll call t. Emergency engineering systems shutdown u. Portable protective equipment v. Personal protective equipment w. Exercise of plans

be gathered during the on-site or field evaluation, beginning with features visible from the exterior, transitioning to features observable in publicly accessible internal areas, and finally other internal areas that may only be accessible with permission or an escort (the 6-page abbreviated Field Version of the form identifies the same building characteristics and attribute options as the long form, but excludes the scores for each attribute option).

When using the long-form version of the form, the Risk Scoring Worksheet (Appendix A) is used to determine risk ratings.

When using the electronic database version of the Data Collection Form, the data from the Field Version of the form are transferred to the electronic version, where computation of the risk ratings is automated, eliminating the use of the Risk Scoring Worksheet. Every effort should be made to collect

and document the assessment information as completely and accurately as possible to obtain an accurate risk score. The two methods for obtaining risk scores are summarized in Table 5

Table 5 Risk Scoring Methods

<table>
<tr><th>Step</th><th>Method 1
(Hand Method)</th><th>Method 2
(Electronic Database)</th></tr>
<tr><td>Pre-Field</td><td colspan="2">Fill in Page 1 of the Field Version of the Data Collection Form</td></tr>
<tr><td>Field</td><td colspan="2">Complete pages 2-6 of the Field Version of the Data Collection Form</td></tr>
<tr><td rowspan="2">Post-Field</td><td>Transfer data to long version of the Data Collection Form</td><td rowspan="2">Transfer data into the electronic database</td></tr>
<tr><td>Complete Risk Scoring Sheet</td></tr>
</table>

The data collection process is designed to collect and store information on each of seven building systems: general; site; architectural; building envelope; structural systems; mechanical, electrical and plumbing systems; and security systems (see Table 2). This grouping of systems has been distilled from the 13 building systems contained in the FEMA 452 Vulnerability Checklist. The building characteristics identified for each building system cover the most dominant and visually observable factors governing the overall risk to a building given a terrorist attack. Additional information obtained from other sources may also be used to provide more refined scoring. The entire rapid visual screening procedure is designed with expert knowledge embedded into the scoring selected for each building attribute option so as to limit the information needed by the screener.

Page 1 of the Data Collection Form is shown in Figure 1. Note that Page 1 of the Data Collection Form is identical to Page 1 of the Field Version of the form. It provides space to document basic building information, including name, address, year built, number of stories, total floor area, and other identifying information prior to the field visit. It also provides space to document target density information. Additional information may be attached to the form (or entered into the electronic database). Some useful publicly accessible websites for building information include: http://earth.google.com and www.emporis.com. It is important to ascertain and document the information identified on Page 1 of the form as completely as possible before visiting the facility to obtain an accurate scoring. Some of the information may be directly used to respond to specific building characteristics contained on other pages of the Data

FEMA 455 DATA COLLECTION FORM, PAGE 1 **GENERAL BUILDING INFORMATION**

PRE-FIELD INFORMATION

This page of the form is to be completed *before* the field visit from available documentation or from a knowledgeable site representative.

Building Name/ID _____

Address: _____

Cross Streets: _____

Year Built: _____

Year(s) of major retrofits: _____

Retrofit Description _____

Type of Glass: _____

Number of Floors/Building Height: _____

Occupants _____

Total Area (sq ft): _____

Footprint Area (sq ft) _____

Occupancy Use: _____

(Critical Infrastructure and Key Resources [CI/KR] Sector and Sub-Sector Info)

Hazardous Material Kept on Site: _____

Replacement Value: _____

Target Potential to this Facility _____

Target Potential to this Facility Type: _____

Historic Registry Listing _____

TARGET DENSITY

Number of potential *high value* targets within vicinity of subject building.

Facility Type (CIKR Sector):	Distance		
	< 100 feet	≥100 ft and < 300 ft	≥ 300 ft and ≤ 1000 ft
Agriculture and Food			
Banking and Finance			
Chemical			
Commercial			
Critical Manufacturing			
Dams			
Defense Industrial Base			
Emergency Services			
Energy			
Government Facilities			
Information Technology			
National Monuments/Icons			
Nuclear			
Postal and Shipping			
Public Health and Healthcare			
Telecommunications			
Transportation Systems			
Water Supply			
TOTAL =			

Figure 1 Page 1 of Data Collection Form.

Collection Form and some of the information on this page will enable the screener to make a more educated decision regarding the appropriate attribute option to select. All the information contained on this page of the Data Collection Form, should be verified in the field, if possible.

Although the information on Page 1 of the Data Collection Form does not directly affect the risk rating, it is used for identification, interpretation, and validation of the scoring. It also provides initial information useful for higher level (Tier 2 or Tier 3) assessments.

Pages 2 through 8 of the Data Collection Form (see Figure 2) address the three factors needed to determine the risk assessment score: *consequences* rating (C), *threat* rating (T), and *vulnerability* rating (V). These portions of the Data Collection Form are completed by selecting the most appropriate response, or attribute option. When using the long-form version of the Data Collection Form (Figure 2 and Appendix A), the associated numerical value for each selected attribute option is transferred to each of the boxes on the right hand side of the form, which is not filled with gray; if an attribute is not relevant to determining the consequences, threat, or vulnerability rating for a particular threat scenario, the box is shaded, and no score is entered; in this way, the numerical values are assigned only to those threat scenarios that are affected by that building characteristic.

Space is provided at the bottom of the rating section for each factor (*consequences*, *threat*, and v*ulnerability*) to summarize scores for characteristics that contribute to that rating factor for one or more threat scenarios. This information is then transferred to the Risk Scoring Worksheet (Appendix A) to compute risk ratings for the building, as described below.

Note that the attribute scores have been omitted from the Field Version of the form for easy use during the field visit. Instead of scoring on the right hand side of the field version of the form, there is a "red flag" and a "comments" column. The red flag column may be checked for those items that require further follow-up research or verification. The comments

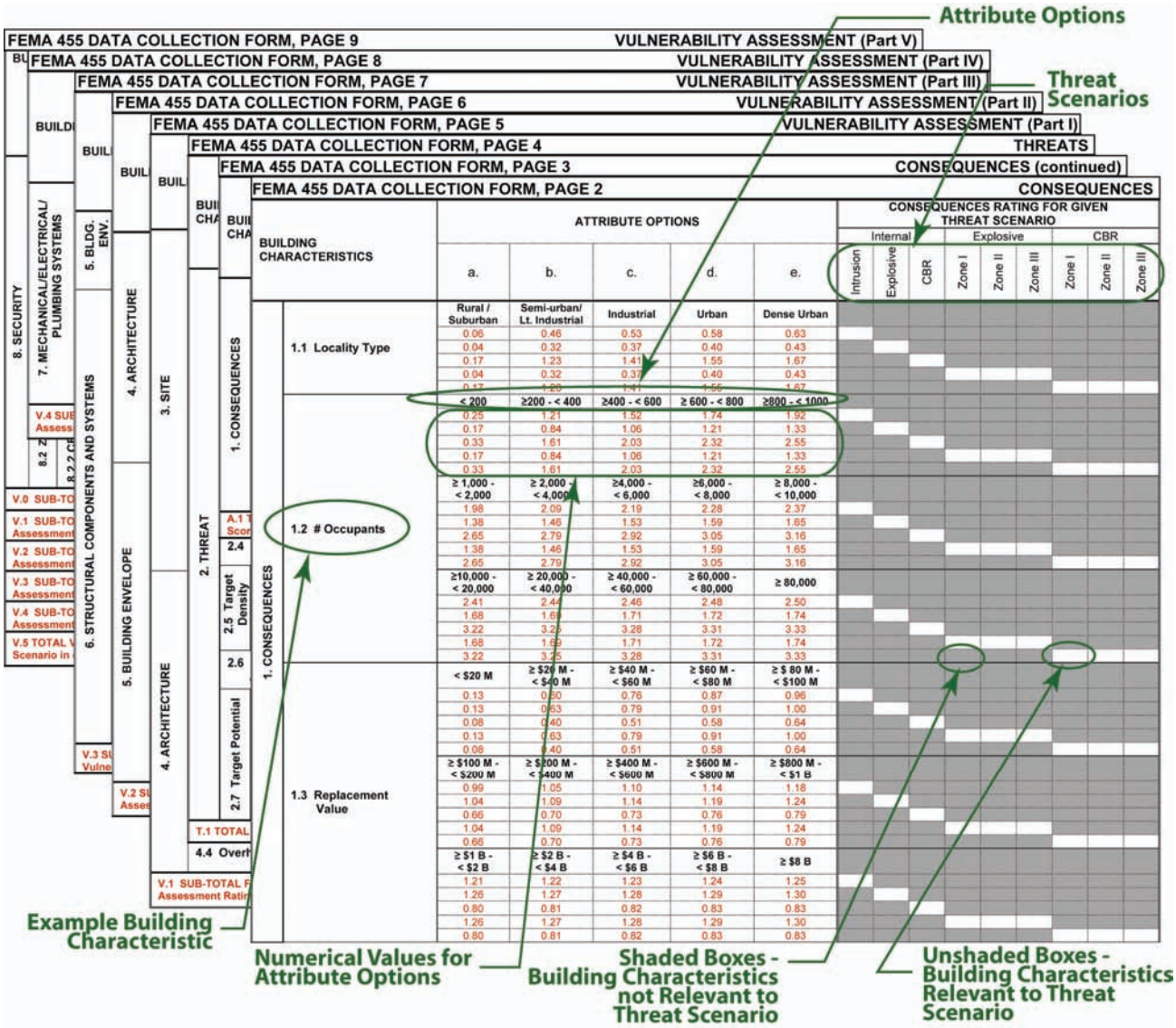


Figure 2 Pages 2 through 9 of Data Collection Form. Full-sized versions of each page are provided in Appendix A.

column may be used to provide more detail regarding the building characteristic and/or the red flag issue that requires resolution. This handbook should be brought to the field as a reference guide. Of particular use in the field are the tables in the next three chapters, which provide useful information to help the screener select the most appropriate option. The information from these tables has also been included in the electronic version for use in post-field verification of selected options.

The following chapters provide general guidance on how to determine the consequences rating, threat rating and vulnerability rating, respectively, using the Data Collection Form. Below is some general guidance for troubleshooting some overarching issues that may arise.

SCORING WHEN A BUILDING CHARACTERISTIC IS UNKNOWN OR NOT APPLICABLE

The correct application of the risk scoring procedure in rapid visual screening relies on accurate and thorough completion of the Data Collection Form. The risk scoring procedure uses results from pages 2 through 9 of the Data Collection Form (long-form version) to determine the overall risk rating for the building. Therefore, it is imperative that an attribute option be selected for each applicable building characteristic, and every attempt should be made to complete the form in its entirety.

Lack of selection of an attribute option for one or more of the building characteristics can be interpreted as “unknown”, “not applicable”, “none”, or it may be that the issue or building characteristic has been skipped by mistake. The screening procedure has been designed to minimize these situations, but they will inevitably occur. Screeners should err on the side of recording too much information, making liberal use of any free space on the form and attaching extra sheets if necessary to document additional comments (and documenting this information in the electronic version, if used).

Basic options for accounting for unknown information include:

- Estimating the value based on a pre-defined correlation with other known information such as selecting the building envelope to be precast concrete based on the modular character of the exterior.
- Making an educated guess based on engineering judgment.

- Using a pre-determined default score, such as the average of the lowest and highest values assigned to that building characteristic.
- Selecting the most common attribute for that building characteristic, based on knowledge of other similar buildings in the region.
- Eliminating one or more building characteristics from consideration for all buildings in the study, such as for a study that only includes exterior observation (eliminating all building characteristics that may only be identified by internal inspection).

The goal of this rapid visual screening procedure is to identify buildings as having either relatively high or relatively low levels of potential risk, and to identify those buildings that should undergo further study. The uncertainty inherent in the selection of an attribute option should not incorrectly identify buildings as having high or low risk just because the relevant information is not known.

In the situation where two or more attribute options for a given building characteristic could be selected, the dominantly occurring attribute option should be used. In the case of two or more possible attribute options in which one is not clearly dominant, or an educated guess is not possible because the relevant information is not known, then the highest risk option (which corresponds to the largest numerical value) for the building characteristic under consideration should be selected. This approach may lead to a few buildings being incorrectly identified as high risk. The number of times a screener makes an assumption due to unknown information should be kept to a minimum. Particular care should be given to the option selected for building characteristics that are identified as being "heavily" weighted (see chapters on Threat and Vulnerability Assessment). For these building characteristics, guessing will significantly impact the risk scoring and will distort results.

COMPLETING THE RISK SCORING WORKSHEET

Results from the Data Collection Form are tabulated on the Risk Scoring Worksheet (Figure 3) to determine a single overall risk assessment score for the building, or to evaluate the risk contributed by each of the nine threat scenarios or three threat types (see Table 2). Note that the Risk Scoring Worksheet is located at the end of the Data Collection Form (Appendix A)

Once the building characteristics have been recorded in the Data Collection Form, the risk factors are evaluated by summing the scores entered for each building characteristic contributing to Consequences (*C*),

Threat Rating (T), and Vulnerability Rating (V) for each of the nine threat scenarios, and entering the sums on the Risk Scoring Worksheet. The risk rating for each threat scenario is computed by multiplying the three factors C, T, and V for the given scenario. An overall total risk rating for the building encompassing all nine scenarios is determined by using an equation that considers the risk rating for each threat scenario and a scaling factor and power-summation formulation that controls the limit of the total risk rating. Details of this formulation are provided at the beginning of the chapter entitled, "Risk Assessment Rating."

Use of the electronic database version of the procedure will permit seamless inputting of data during the on-site evaluation and automatic calculation of scoring. See Appendix E for more information.

FEMA 455 RISK SCORING WORKSHEET

THREAT SCENARIO		Consequences (C)	Threat Rating (T)	Vulnerability Rating (V)	Threat Scenario Risk Rating (C x T x V)
Internal	Intrusion				
	Explosive				
	CBR				
Explosive	Zone I				
	Zone II				
	Zone III				
CBR	Zone I				
	Zone II				
	Zone III				
A. TOTAL RISK RATING FOR BUILDING					

Figure 3 Risk Scoring Worksheet.

USE OF SCREENING RESULTS

Because the procedure is quick and relatively simple to perform, it is designed to be performed routinely as part of the security operations of the building. It is recommended that as a baseline, a screening is performed during peak occupancy times, and that the procedure be used routinely during periods of high threat alert, when the facility or the facility type has been threatened.

Results of the rapid visual screening process can be used for a wide variety of applications: (1) prioritization of buildings for further evaluation; (2) establishing building inventories that characterize a community's risk to

terrorist attack; (3) developing emergency preparedness plans in the event of a high threat alert; (4) planning post-event mass evacuation, rescue, recovery and safety evaluation efforts; (5) prioritizing a community's (or agency's) mitigation needs; and (6) developing building-specific vulnerability information for purposes such as insurance rating and decision-making during building ownership transfers.

The results can also be used on a building-specific basis as a prioritization tool for more detailed study, verification of results, and development of mitigation measures that will reduce the risk rating value to levels that are more acceptable to the building owner or other stakeholders.

OVERVIEW

The basic definitions used to assess the Consequences associated with a terrorist attack are given in this chapter, along with detailed information and guidance on how to select the appropriate attribute options for each building characteristic related to Consequences.

CONSEQUENCES

The term "Consequences" refers to the criticality of the building in terms of the importance of the building operation to the owner and the locality. It can be applied to the entire building or significant portions of a very large building. Examples of important operations include emergency functions within a city, or core business functions of a corporation. The Consequence Assessment is intended to capture the impact of a terrorist event due to losses incurred as a result of building damages, casualties and business disruption.

Consequence is a function of building characteristics that are primarily related to the use and occupancy of the building. To evaluate Consequences the following building characteristics need to be assessed:

- Locality Type
- Number of Occupants
- Replacement Value
- On Historic Registry
- Business Continuity
- Physical Loss Impact

Information used to determine consequences typically comes from owner(s)/operator(s), governmental sources, those benefiting from the use of the facility, and publicly accessible information. Note that consequence is defined from the perspective of the building stakeholders, not the terrorists.

Figure 4 shows the portion of the Data Collection Form used to evaluate the Consequences Rating

In the FEMA Risk Management Series, "Consequences" are defined as the results of a terrorist attack or other hazard that reflect the level, duration, and nature of the loss resulting from the incident. Consequences are divided into four main categories: public health and safety (i.e., loss of life and illness); economic (direct and indirect), psychological and governance/mission impacts. Consequences also include the degree of debilitating impact that would be caused by the incapacity or destruction of the asset.

To put this into the context of other risk assessment methodologies, sometimes Consequences is referred to as "Asset Value."

FEMA 455 DATA COLLECTION FORM, PAGE 2 — **CONSEQUENCES**

BUILDING CHARACTERISTICS		ATTRIBUTE OPTIONS					CONSEQUENCES RATING FOR GIVEN THREAT SCENARIO								
							Internal			Explosive			CBR		
		a.	b.	c.	d.	e.	Intrusion	Explosive	CBR	Zone I	Zone II	Zone III	Zone I	Zone II	Zone III
1. CONSEQUENCES	1.1 Locality Type	Rural / Suburban	Semi-urban/ Lt. Industrial	Industrial	Urban	Dense Urban									
		0.06	0.46	0.53	0.58	0.63									
		0.04	0.32	0.37	0.40	0.43									
		0.17	1.23	1.41	1.55	1.67									
		0.04	0.32	0.37	0.40	0.43									
		0.17	1.23	1.41	1.55	1.67									
	1.2 # Occupants	< 200	≥200 - < 400	≥400 - < 600	≥ 600 - < 800	≥800 - < 1000									
		0.25	1.21	1.52	1.74	1.92									
		0.17	0.84	1.06	1.21	1.33									
		0.33	1.61	2.03	2.32	2.55									
		0.17	0.84	1.06	1.21	1.33									
		0.33	1.61	2.03	2.32	2.55									
		≥ 1,000 - < 2,000	≥ 2,000 - < 4,000	≥4,000 - < 6,000	≥6,000 - < 8,000	≥ 8,000 - < 10,000									
		1.98	2.09	2.19	2.28	2.37									
		1.38	1.46	1.53	1.59	1.65									
		2.65	2.79	2.92	3.05	3.16									
		1.38	1.46	1.53	1.59	1.65									
		2.65	2.79	2.92	3.05	3.16									
		≥10,000 - < 20,000	≥ 20,000 - < 40,000	≥ 40,000 - < 60,000	≥ 60,000 - < 80,000	≥ 80,000									
		2.41	2.44	2.46	2.48	2.50									
		1.68	1.69	1.71	1.72	1.74									
		3.22	3.25	3.28	3.31	3.33									
		1.68	1.69	1.71	1.72	1.74									
		3.22	3.25	3.28	3.31	3.33									
	1.3 Replacement Value	< $20 M	≥ $20 M - < $40 M	≥ $40 M - < $60 M	≥ $60 M - < $80 M	≥ $ 80 M - < $100 M									
		0.13	0.60	0.76	0.87	0.96									
		0.13	0.63	0.79	0.91	1.00									
		0.08	0.40	0.51	0.58	0.64									
		0.13	0.63	0.79	0.91	1.00									
		0.08	0.40	0.51	0.58	0.64									
		≥ $100 M - < $200 M	≥ $200 M - < $400 M	≥ $400 M - < $600 M	≥ $600 M - < $800 M	≥ $800 M - < $1 B									
		0.99	1.05	1.10	1.14	1.18									
		1.04	1.09	1.14	1.19	1.24									
		0.66	0.70	0.73	0.76	0.79									
		1.04	1.09	1.14	1.19	1.24									
		0.66	0.70	0.73	0.76	0.79									
		≥ $1 B - < $2 B	≥ $2 B - < $4 B	≥ $4 B - < $6 B	≥ $6 B - < $8 B	≥ $8 B									
		1.21	1.22	1.23	1.24	1.25									
		1.26	1.27	1.28	1.29	1.30									
		0.80	0.81	0.82	0.83	0.83									
		1.26	1.27	1.28	1.29	1.30									
		0.80	0.81	0.82	0.83	0.83									

FEMA 455 DATA COLLECTION FORM, PAGE 3 — **CONSEQUENCES (continued)**

BUILDING CHARACTERISTICS		ATTRIBUTE OPTIONS					CONSEQUENCES RATING FOR GIVEN THREAT SCENARIO								
							Internal			Explosive			CBR		
		a.	b.	c.	d.	e.	Intrusion	Explosive	CBR	Zone I	Zone II	Zone III	Zone I	Zone II	Zone III
1. CONSEQUENCES	1.4 On Historic Registry	No	Yes												
		0.25	2.50												
		0.04	0.43												
		0.08	0.83												
		0.04	0.43												
		0.08	0.83												
	1.5 Business Continuity	Very High	High	Moderate	Low	Very Low									
		0.13	0.92	1.05	1.16	1.25									
		0.09	0.64	0.73	0.81	0.87									
		0.17	1.23	1.41	1.55	1.67									
		0.09	0.64	0.73	0.81	0.87									
		0.17	1.23	1.41	1.55	1.67									
	1.6 Physical Loss Impact	Local	Statewide	Regional	National	International									
		0.19	1.38	1.58	1.74	1.88									
		0.52	3.84	4.40	4.84	5.22									
		0.17	1.23	1.41	1.55	1.67									
		0.52	3.84	4.40	4.84	5.22									
		0.17	1.23	1.41	1.55	1.67									
A.1 TOTAL RATING FOR CONSEQUENCES (C): Sum values in for Consequences and enter in column C on Risk Scoring Worksheet															

Figure 4 Pages 2 and 3 of Data Collection Form, Consequences

CONDUCTING THE FIELD ASSESSMENT

During the field assessment of Consequences, the screener evaluates all building characteristics of interest for Consequences, as identified above. The abbreviated Data Collection Form (Field Version, as provided in Appendix B) is to be used to document (circle) the selected attribute option for each building characteristic; this information is later transferred to the long version of the form or the electronic database, where the risk scoring occurs automatically. When the long-form Data Collection Form containing scores is used, the score for the selected option is circled and inserted in the blank cell(s) to the right under one or more Threat Scenario columns (gray shading indicates that a score is not required); scores are then totaled at the bottom of the form and entered on the Risk Scoring Worksheet (Appendix A).

Guidance and information to how to choose between attribute options for the building characteristics pertaining to Consequences are provided in Table 6. The information contained in this table is useful in the field to provide guidance.

Table 6. Guidance on Consequences Assessment: 1. Consequences

1 Consequences		
ID	**Building Characteristics**	**Attribute Options**
1.1	**Locality Type** This attribute characterizes the general population density and land use in the area surrounding the building. The screener should determine the predominant locality type based on the descriptions provided to the right. When determining if a locality is Urban or Dense Urban, consider the time of day or year when the locality is at maximum capacity. For instance, for a business district in a city the highest population may occur during the morning rush hour when the population is best described as Dense Urban. In this situation, option e is to be selected rather than option d.	**Options:** **a Rural/Suburban** – low ratio of inhabitants to open land or an outlying part of a city or town, typically single family residential area. **b Semi-urban/Light Industrial** – a small town or city with low population density or mixed use office park, warehouse and manufacturing. **c Industrial** – heavy manufacturing and warehouse with a lower population density than light industrial. **d Urban** – metropolitan area within a city or large town. **e Dense Urban**– a densely populated area within a major urban corridor or a major resort corridor where there are clusters of commercial buildings located on congested streets. In these situations there is a significant chance of collateral consequences to populations, on the streets and in adjacent buildings.

Table 6. Guidance on Consequences Assessment: 1. Consequences (continued)

1 Consequences		
ID	**Building Characteristics**	**Attribute Options**
1.2	**Number of Occupants** This building characteristic should have been filled in prior to the field visit on Page 1 of the Data Collection Form. There are three sets of attribute options corresponding to 'low', 'moderate or 'high' population levels as defined to the right. In total, there are 15 attribute options for this building characteristic. The time of peak occupancy should be considered when selecting an appropriate attribute option. Only the persons inside the building are to be considered for this building attribute. The population outside the building is captured in building characteristic 2.3 (Site Population). Also, note that this building characteristic is identical to the building characteristic 2.2 in the Threat Rating section because it is a factor in the threat attractiveness of the building. Some examples of load ratios for various types of buildings are given in the table to the right. Several examples of buildings with different populations are provided below. **Low: option (a) 150 occupants** **Moderate: option (b) 2,500 occupants**	**Options:** **Low** a Less than 200 b More than or equal to 200, less than 400 c More than or equal to 400, less than 600 d More than or equal to 600, less than 800 e More than or equal to 800, less than 1,000 **Moderate** a More than or equal to 1,000, less than 2,000 b More than or equal to 2,000, less than 4,000 c More than or equal to 4,000, less than 6,000 d More than or equal to 6,000, less than 8,000 e More than or equal to 8,000, less than 10,000 **High** a More than or equal to 10,000, less than 20,000 b More than or equal to 20,000, less than 40,000 c More than or equal to 40,000, less than 60,000 d More than or equal to 60,000, less than 80,000 e More than or equal to 80,000 **NOTE**: THIS BUILDING CHARACTERISTIC IS HEAVILY WEIGHTED IN THE SCORING. A MINOR CHANGE IN THE CHOICE OF ATTRIBUTE OPTION SELECTED MAY CAUSE A DISPROPORTIONATELY LARGE CHANGE IN THE FINAL RISK SCORE.

General Use	Occupancy Load Ratio
Assembly	1 person per 10 sf (square feet) of floor area or seating area
Commercial	Occupancy load varies; use 1 person per 50 to 200 sf.
Emergency Services	Occupancy load is typically 1 person per 100 sf.
Government	Occupancy load varies; use 1 person per 100 to 200 sf.
Industrial	Occupancy load is typically 1 person per 200 sf except warehouse which is 1 person per 500 sf.
Office	Occupancy load varies; use 1 person per 100 to 200 sf
Residential	Occupancy load varies; use 1 person per 300 sf of floor area in dwellings, 1 person per 200 sf of floor area in multi-unit, except 1 person per 100 sf for dormitories.
Educational	Occupancy load varies; use 1 person per 50 to 100 sf.

Table 6. Guidance on Consequences Assessment: 1. Consequences (continued)

1 Consequences		
ID	**Building Characteristics**	**Attribute Options**
1.2 (contd)	 **High: option (b) 20,000 occupants** Photograph courtesy of J. Crocker.	
1.3	**Replacement Value** There are three sets of attribute options for this building characteristic depending on whether the replacement cost is 'low', 'moderate' or 'high' as defined to the right. In total there are 15 attribute options for this building characteristic. The replacement value of a facility is a function of the current market cost of construction times the gross square footage of the building. It refers to the replacement value of the building including the tenant improvements and its contents. The replacement value of a building will vary by the construction costs within a region, the community type such as downtown urban or outside of the urban core, building size given that a large building may be less expensive to build per square foot than a small building, and the use of the building considering premiums paid for tenant improvements such as finishes (e.g., 4-star vs. 2-star hotel) and infrastructure (e.g., data center versus commercial office).	**Options:** **Low** a Less than $20 million (M) b More than or equal to $20M, less than $40M c More than or equal to $40M, less than $60M d More than or equal to $60M, less than $80M e More than or equal to $80M, less than $100M **Moderate** a More than or equal to $100M, less than $200M b More than or equal to $200M, less than $400M c More than or equal to $400M, less than $600M d More than or equal to $600M, less than $800M e More than or equal to $800M, less than $1Billion **High** a More than $1Billion (B) or equal to, less than $2B b More than $2B or equal to, less than $4B c More than $4B or equal to, less than $6B d More than $6B or equal to, less than $8B e More than or equal to $8B

Table 6. Guidance on Consequences Assessment: 1. Consequences (continued)

<table>
<tr><th colspan="3">1 Consequences</th></tr>
<tr><th>ID</th><th>Building Characteristics</th><th>Attribute Options</th></tr>
<tr><td>1.3
(contd)</td><td>A space has been provided for replacement value information on Page 1 of the Data Collection Form, which should be filled out before the field visit. Information is to be obtained directly from a knowledgeable site representative. If this is not possible, it can be estimated based on the approximate costs per square foot given in HAZUS-MH MR-3 Technical Manual for the Flood Model (FEMA, 2007), RS Means, recent purchase or construction cost or other source.

For situations where the building contains invaluable or irreplaceable contents, such as is found in art museums or in a rare book library, then the insurance coverage limits may be used to provide an estimate.</td><td>NOTE: THIS BUILDING CHARACTERISTIC IS HEAVILY WEIGHTED IN THE SCORING. A MINOR CHANGE IN THE CHOICE OF ATTRIBUTE OPTION SELECTED MAY CAUSE A DISPROPORTIONATELY LARGE CHANGE IN THE FINAL RISK SCORE.
Example Cost Ranges
<table>
<tr><th>Primary Building Function</th><th>Range of Cost (per sq.ft.)</th></tr>
<tr><td>Commercial Office</td><td>$135 to $220</td></tr>
<tr><td>Light Industrial</td><td>$40 - $100</td></tr>
<tr><td>Research</td><td>$200 - $225</td></tr>
<tr><td>Emergency Services</td><td>$150 - $200</td></tr>
<tr><td>Governmental Facilities</td><td>$230 - $300</td></tr>
<tr><td>Hospitality</td><td>$120 – $180</td></tr>
<tr><td>Information and Telecommunications</td><td>$400 – $750</td></tr>
<tr><td>Museum/Library</td><td>$250 - $300</td></tr>
<tr><td>Hospital</td><td>$220 - $300</td></tr>
<tr><td>Medical Office/Clinic</td><td>$150 - $200</td></tr>
<tr><td>Residential</td><td>$250 – $450</td></tr>
<tr><td>Educational</td><td>$100 – $200</td></tr>
</table></td></tr>
<tr><td>1.4</td><td>On Historic Registry

This attribute characterizes whether or not the subject property is on the national, state, local or non-governmental historic registry.

The screener should determine whether the building is on a historic registry. Otherwise, it is recommended that the screener perform an internet search. For buildings listed on the National Register consult www.nationalregisterofhistoriplaces.com. Individual states, local jurisdictions, and non-governmental organizations may also have listings of historically significant buildings within the locality. Sometimes there is a plaque outside the building indicating its status as an historic property.

An example of an historic building in Cleveland, Ohio is the Society Bank which was the first skyscraper in Cleveland.

This building characteristic has been included on Page 1 of the Data Collection Form and should be evaluated prior to the field visit.</td><td>Options:

No
Yes

Example of option: Yes
Photograph courtesy of Westlake Reed Leskosky Architects.</td></tr>
</table>

Table 6. Guidance on Consequences Assessment: 1. Consequences (continued)

1 Consequences		
ID	**Building Characteristics**	**Attribute Options**
1.5	**Business Continuity** Business Continuity refers to the degree to which an organization may achieve uninterrupted stability of operations. It is aimed at allowing an organization to continue functioning after (and ideally, during) a disaster, rather than simply being able to recover after a disaster. In terms of redundancy, it is measured in terms of how easily operations can be replaced, be returned to service, or replicated at another location. Included in this are human factors such as the confidence needed for people to return to that building or continue their relationship with that business into the future. The term 'stability of operations' is a function of the primary use of the building. For instance, if it is an apartment building, the 'stability of operations' refers to the ability of people to be able to maintain their pre-event quality of life. If the building is a museum, the 'stability of operations' is dependent on the contents remaining intact and in an environment that is safe and secure. Some business sectors and local governments require business continuity plans in place to ensure operations are maintained during a disaster. There are also associations that provide best practice recommendations. The screener is recommended to become familiar with the regulatory requirements governing various businesses, sectors and governmental entities to be able to better judge what level of continuity a building may be able to achieve. Security representatives or local law enforcement are recommended as good sources for this type of information for a given building. Below are some open source information sources regarding business continuity: Financial Services Information Sharing and Analysis Center (http://www.fsisac.com/) Information Technology Information Sharing and Analysis Center (https://www.it-isac.org/) Information Sharing and Analysis Center Council (http://www.isaccouncil.org/about/) Food and Agriculture Information Sharing and Analysis Center (http://www.fmi.org/isac/)	**Options** a **Very High**: The building is fully able to maintain functions during and after an attack, with completely redundant back-ups available off-site. There would be almost no interruption of service or function provided by the building if it were attacked. b **High:** The building has a high capability to maintain functions during or after an attack, with most back-ups available off-site. There would be minor interruption of service or function provided by the building if it were attacked. c **Moderate:** The building has a moderate capability to maintain functions during or after an attack, with some back-ups available off-site. There would be moderate interruption of service or function provided by the building if it were attacked. d **Low:** The building has a low level of capability to maintain functions during or after an attack. There would be significant interruption of service or function provided by the building if it were attacked. e **Very Low:** The building has little or no capability to maintain functions during or after an attack. There would be devastating impact and complete loss of service or function provided by the building if it were attacked.

Table 6. Guidance on Consequences Assessment: 1. Consequences (continued)

1 Consequences		
ID	**Building Characteristics**	**Attribute Options**
1.5 (contd)	Open source information affecting the business continuity of various sectors may found on the web site for the Department of Homeland Security: (http://www.dhs.gov/xinfoshare/programs/Copy_of_press_release_0046.shtm) Homeland Security Threat Advisories contain actionable information about an incident involving, or a threat targeting, critical national networks or infrastructures or key assets. They could, for example, relay newly developed procedures that, when implemented, would significantly improve security or protection. They could also suggest a change in readiness posture, protective actions, or response. This category includes products formerly named alerts, advisories, and sector notifications. Advisories are targeted to Federal, state, and local governments, private sector organizations and international partners. Homeland Security Information Bulletins communicate information of interest to the nation's critical infrastructures that do not meet the timeliness, specificity, or significance thresholds of warning messages. Such information may include statistical reports, periodic summaries, incident response or reporting guidelines, common vulnerabilities and patches, and configuration standards or tools. It also may include preliminary requests for information. Bulletins are targeted to Federal, state, and local governments, private sector organizations, and international partners. A color-coded Threat Level System is used to communicate with public safety officials and the public at-large through a threat-based, color-coded system so that protective measures can be implemented to reduce the likelihood or impact of an attack. Raising the threat condition has economic, physical, and psychological effects on the nation; so, the Homeland Security Advisory System can place specific geographic regions or industry sectors on a higher alert status than other regions or industries, based on specific threat information. The DHS Daily Open Source Infrastructure Report (Daily Report) is collected each week day as a summary of open-source published information concerning significant critical infrastructure issues. Each Daily Report is divided by the critical infrastructure sectors and key assets defined in the National Strategy for the Physical Protection of Critical Infrastructures and Key Assets. (http://www.dhs.gov/xinfoshare/programs/editorial_0542.shtm).	

Table 6. Guidance on Consequences Assessment: 1. Consequences (continued)

1 Consequences		
ID	**Building Characteristics**	**Attribute Options**
1.6	**Physical Loss Impact** This building characteristic is intended to capture the human and direct economic consequences in the event of a terrorist attack. Human consequences refer to loss of life and the extent and severity of injuries incurred. It also refers to the impact on public confidence. Direct economic consequences refer to the loss of functionality of that building for some period of time. This could be due to the lost income to people working there, lost revenues for businesses, or the costs required to regain a level of functionality for that building to pre-event levels. Each attribute option defines the geographic limits of the economic impact of a terrorist event, ranging from the local community through the global or international community. For instance, the loss of a federal building outside of Washington DC may have an impact that extends regionally, whereas, the loss of a multi-national corporate headquarters may have international implications. Note that this building characteristic is independent of the population within the building. For instance, if the people within the building are largely from the international community, it does not mean that attribute option e (i.e., international) applies.	**Options:** **a Local**. An impact locally is expected if an attack on this building were to occur. **b Statewide**. An impact throughout the state is expected if an attack on this building were to occur. **c Regional**. An impact to the region is expected if an attack on this building were to occur. **d National**. An impact to the nation is expected if an attack on this building were to occur. **e International**. An impact internationally is expected if an attack on this building occurs. **NOTE:** THIS BUILDING CHARACTERISTIC IS HEAVILY WEIGHTED IN THE SCORING. A MINOR CHANGE IN THE CHOICE OF ATTRIBUTE OPTION SELECTED MAY CAUSE A DISPROPORTIONATELY LARGE CHANGE IN THE FINAL RISK SCORE. .

OVERVIEW

The basic definitions used to assess the Threat associated with a terrorist attack are given in this chapter, along with detailed information and guidance on how to select the appropriate attribute options for each building characteristic related to Threat Rating.

THREAT RATING

The Threat Rating represents the relative likelihood that terrorists will attack the building with a given weapon and means of delivery. Information used to determine the Threat Rating typically comes from law enforcement and intelligence communities familiar with credible threats.

Threat rating is a function of the following building characteristics:

- Occupancy Use
- Number of Occupants
- Site Population Density
- Visibility/Symbolic Value
- Target Density
- Overall Site Accessibility
- Target Potential

The Threat Rating is based on a defined set of threat types and scenarios executed within a certain distance from the targeted building(s). These basic concepts are discussed in the sections below.

Although the building characteristics used for the Threat Rating are nearly identical to those used for Consequences, the screener should keep in mind that the Threat Rating is from the terrorist perspective, whereas the Consequence rating is from the owner/operator perspective.

Threat is defined as any indication, circumstance or event with the potential to cause loss of, or damage to an asset.

Page 4 of the Data Collection Form (Figure 5) is used to determine Threat Ratings for each of the nine threat scenarios, as a function of the subset of building characteristics and attribute options that pertain to the given threat. This organization has the advantage of enabling

this screening procedure to be easily expanded as additional threats are identified.

THREAT TYPES

Terrorist threats that have the ability to cause catastrophic losses in terms of damages, casualties and business interruption are considered in this rapid visual screening procedure. Specifically, the following three generic threat types are considered:

- *Internal Attack.* Intrusion into the building by a person or persons with the intent of executing an attack by means of an explosive, chemical, biological or radiological (CBR) release or other attack type. An internal attack could also refer to the introduction of a weapon or hazard into the building from the exterior. Examples of this include introduction through openings in the building exterior such as a door, window, utility line or air intake. Alternatively, it may be delivered into the building by mail.
- *External Explosive Attack.* A vehicle weapon (e.g., car bomb, VBIED).
- *External Chemical, Biological, Radiological (CBR) Release.* An exterior ground release of an airborne chemical, biological, or radiological agent. Radiological agent does not refer to a nuclear weapon. It refers to a "dirty bomb" or a radiological dispersal device combining a conventional explosive, such as dynamite, with radioactive materials.

ZONE DEFINITIONS

For commercial office or other standard-use buildings, it is likely that the building under consideration is not the target of attack, but is close to one or more high-profile targets. In this case, the building will be subject to collateral effects, which will vary in severity depending on the proximity to the target and the magnitude of the threat.

This rapid visual screening procedure has been designed to address both target and non-target buildings; however, it should not be used if the building is a one-of-a-kind iconic building, such as the White House or Pentagon. In these cases, the building would have a significantly greater likelihood of attack, and a higher level risk assessment procedure, such as is found in FEMA 452, should be used to evaluate the risk.

FEMA 455 DATA COLLECTION FORM, PAGE 4 **THREATS**

BUILDING CHARACTERISTICS		ATTRIBUTE OPTIONS					THREAT RATING FOR GIVEN THREAT SCENARIO								
							Internal			Explosive			CBR		
		a.	b.	c.	d.	e.	Intrusion	Explosive	CBR	Zone I	Zone II	Zone III	Zone I	Zone II	Zone III
2. THREAT	2.1 Occupancy Use	Occupancy Group I	Occupancy Group II	Occupancy Group III											
		0.14	1.13	1.4											
		0.11	0.89	1.1											
	2.2 # Occupants	< 200	≥ 200 - < 400	≥ 400 - < 600	≥ 600 - < 800	≥ 800 - < 1000									
		0.14	0.68	0.85	0.97	1.07									
		0.11	0.53	0.67	0.77	0.84									
		≥ 1,000 - < 2,000	≥ 2,000 - < 4,000	≥4,000 - < 6,000	≥6,000 - < 8,000	≥ 8,000 - < 10,000									
		1.11	1.17	1.23	1.28	1.33									
		0.87	0.92	0.96	1.00	1.04									
		≥10,000 - < 20,000	≥ 20,000 - < 40,000	≥ 40,000 - < 60,000	≥ 60,000 - < 80,000	≥ 80,000									
		1.35	1.36	1.38	1.39	1.4									
		1.06	1.07	1.08	1.09	1.1									
	2.3 Site Population Density (per sq ft)	Very Low (1/10000)	Low (1/1000)	Moderate (1/400)	High (1/40)	Very High (1/10)									
		0.11	0.81	0.93	1.02	1.1									
		0.30	2.21	2.53	2.78	3.0									
	2.4 Visibility/Symbolic	Very Low	Low	Moderate	High	Very High									
		0.29	2.14	2.45	2.69	2.9									
		0.24	1.77	2.02	2.23	2.4									
	2.5 Target Density: 2.5.1 Zone I (< 100 ft)	0	1	2	3	≥ 4									
		0.12	0.88	1.01	1.11	1.2									
	2.5 Target Density: 2.5.2 Zone II (≥100 - <300 ft)	0	1-3	4-6	7-9	≥ 10									
		0.30	2.21	2.53	2.78	3.0									
	2.5 Target Density: 2.5.3 Zone III (≥300 - ≤1000 ft)	0	1-6	7-12	13-19	≥ 20									
		0.80	5.89	6.75	7.43	8.0									
	2.6 Overall Site Accessibility	Inaccessible	Accessible												
		0.14	1.4												
		0.06	0.6												
	2.7 Target Potential: 2.7.1 Facility	No	Yes												
		0.15	1.45												
		0.13	1.25												
		0.20	2												
		0.10	1												
	2.7 Target Potential: 2.7.2 Facility Type	No	Yes												
		0.15	1.45												
		0.13	1.25												
		0.20	2												
		0.10	1												
T.1 TOTAL THREAT RATING (T): Sum values for each Threat Scenario in column T on Risk Scoring Worksheet															

Figure 5 Page 4 of Data Collection Form, Threats.

For Internal threats, the subject building is, by definition, the target building. Exterior threats may or may not be targeting the building. To make this distinction, three external zones are defined as shown in Figure 6.

Zone 1 refers to an attack occurring at a target less than 100 feet from the exterior envelope of the building under consideration; Zone 2 refers to an attack occurring at a target at least 100 feet and less than 300 feet from the subject building; and Zone 3 refers to an attack occurring at a target at least 300 feet but not more than 1000 feet from the subject building.

The Zone 1 distances are based on the distances required to cause catastrophic effects in terms of casualties, damages, and business interruption. Zone 2 distances are based on the distances required to cause a moderate hazard level and Zone 3 corresponds to a minor hazard level.

Not to be confused with FEMA 452 layers of defense, *Zones* are areas around the building under consideration, defined by the distances shown in Figure 6. *Zones* are used to inventory the number and location of potential targets in the vicinity of the subject building to define *Target Density*.

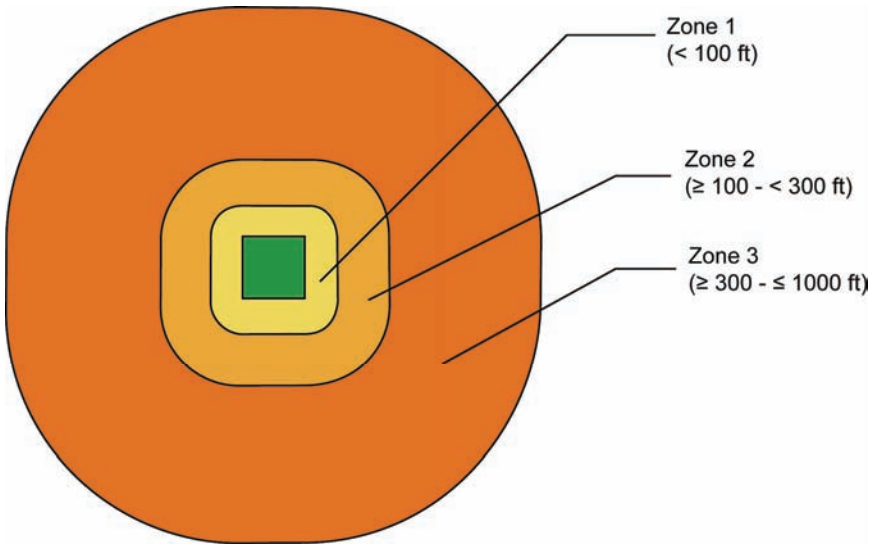


Figure 6 Zone Definitions.

THREAT SCENARIOS

To address both targeted and non-targeted buildings, nine distinct threat scenarios across three threat types are considered in this procedure, as summarized in Table 7.

Table 7. Threat Scenarios and Threat Types

Threat Scenario	Threat Type
1. Internal Explosive Attack 2. Internal CBR Release 3. Other Internal Attack	Internal Attack
4. External Zone I Explosive Attack 5. External Zone II Explosive Attack 6. External Zone III Explosive Attack	External Explosive Attack
7. External Zone I CBR Release 8. External Zone II CBR Release 9. External Zone III CBR Release	External Chemical, Biological, Radiological (CBR) Release

Threat scenarios 1 through 3 comprise the Internal threat, scenarios 4 through 6 comprise the External Explosive threat, and scenarios 7 through 9 comprise the External CBR threat. The final risk score reports risk ratings as a single overall risk assessment score encompassing all nine scenarios, and for individual scenarios or threat types.

CONDUCTING THE FIELD ASSESSMENT

As before, the Field Version is used to document (circle) the selected attribute option for each building characteristic that affects Threat Rating; this information is later transferred to the electronic database, where the risk scoring occurs automatically, or to the long form. When the long-form Data Collection Form containing scores is used, the score for the selected option is circled and inserted in the blank cell(s) to the right under one or more Threat Scenario columns; scores are then totaled at the bottom of the form and entered on the Risk Scoring Worksheet.

Guidance and information to how to choose between attribute options for the building characteristics pertaining to Threat Rating are provided in Table 8. This table is a useful tool to be used in the field to accurately evaluate the appropriate attribute option.

Table 8. Guidance on Threat Assessment: 2. Threat

2 Threat		
ID	**Building Characteristics**	**Attribute Options**
2.1	**Occupancy Use** This building characteristic is included on Page 1 of the Data Collection Form and it is recommended that it is researched prior to the field visit. In the field the use of the building may be verified by reviewing the directory in the lobby, speaking with a site representative, or from law enforcement familiar with the property. Examples of occupancy types within each group are given to the right. Because this procedure focuses on building structures, the examples are only for buildings in these categories. Note also that examples of occupancy types within these groups are arranged alphabetically. Based on historical data from past terrorist attacks (ref.: National Consortium for the Study of Terrorism and Responses to Terrorism, Global Terrorism Database (http://209.232.239.37/gtd2/Default.aspx), different occupancies have varying degrees of target attractiveness. For the purpose of determining the Threat Rating, this rapid visual screening procedure considers three occupancy groups, listed in order of increasing contribution to risk.	**Options** (with examples of occupancy types) a **Occupancy – Group I** • ***Agricultural*** - processing plants for meat, dairy or grain type foods (also see Group III). • ***Chemical*** – chemical processing plant buildings, petrochemical manufacturing, hazardous chemical transport (pipelines, pumping stations, control centers, tankers, freight rail, chemical warehousing and storage). • ***Critical Manufacturing*** – iron and steel mills, power transmission equipment, electrical equipment, transportation equipment. • ***Dams*** – maintenance and operation buildings. • ***Defense Industrial Base*** - buildings clearly marked with the name of a major defense contractor, manufacturing plants associated with the production of military munitions, aircraft, space industry, combat vehicles, troop support or other product used by the military. • ***Drinking Water and Treatment Systems*** - waste treatment facility buildings, maintenance and operations buildings.

Table 8. Guidance on Threat Assessment: 2. Threat (continued)

2 Threat		
ID	**Building Characteristics**	**Attribute Options**
2.1 (contd)	The group definitions provided are based on the target attractiveness of the critical infrastructure sectors defined by the Department of Homeland Security. An abbreviated version of this taxonomy is provided in Appendix D (ref.: *Infrastructure Taxonomy*, Version 2, Risk Management Division Office of Infrastructure Protection, Department of Homeland Security, November 1, 2006). The groups are arranged in order of increasing target attractiveness. The electronic database version of this procedure allows the screener to identify the use by means of pull down menus to define not only the sector, but also sub-sectors of critical infrastructure. Note that the sectors may shift as the terrorist threat evolves or may vary in specific geographic regions. For a multi-use building, the highest risk occupancy should be selected, but in some cases using judgment may be more appropriate. For instance, if there is an automatic teller machine in the lobby of a multi-tenant office building, banking and finance would not necessarily be the appropriate occupancy group (unless the tenant base was dominantly in the banking and finance sector).	• ***Information Technology*** - data centers, microprocessor manufacturing facility, high-technology corporate office buildings. • ***Postal and Shipping*** - post offices, shipping processing plants. b **Occupancy – Group II** • ***Commercial Nuclear Reactors/Materials*** - processing plant buildings for nuclear materials and waste; research laboratories using nuclear materials. • ***Energy*** - power plant buildings, petroleum refinery buildings, maintenance and operation buildings. • ***National Monuments/Icons*** – Federally owned buildings that are significant to the national identity of Americans, e.g., Liberty Bell Center. • ***Public Health and Healthcare*** - hospitals, medical centers, clinics, medical research laboratories, and pharmaceutical facilities, medical educational facilities. • ***Telecommunications*** - telephone switching centers, telephone or internet related firm office facilities. c **Occupancy – Group III** • ***Agricultural/Food*** - restaurants, bars, nightclubs, supermarkets, convenience stores, gourmet food shops (also see Group I). • ***Banking and Finance*** - *clearly marked or commonly recognized* office building for a commercial bank, investment bank, insurance company, board of trade, mercantile exchange, stock exchange, or federal reserve building. Note that a store front bank branch or automated teller machine(s) is a low-risk example that falls within this group. • ***Commercial*** – A broad range of building types fall under this category. Some are listed below. – Community Organization Facilities – social advocacy, civic and social organization facilities. – Entertainment and Media Facilities – broadcasting (cable, radio, television), internet publishing, motion picture, sound recording, newspaper, magazine, publishing. – Gambling Facilities/Casinos (Resorts) – horse and dog racetracks, land-based casinos. – Industrial Assets – heavy manufacturing, operations and maintenance facilities, assembly plants, factory buildings. – Lodging Facilities – hotels, motels.

Table 8. Guidance on Threat Assessment: 2. Threat (continued)

2 Threat		
ID	**Building Characteristics**	**Attribute Options**
2.1 (contd)		– Industrial – heavy manufacturing, operations and maintenance facilities, assembly plants, factory buildings. – Museum/Library – buildings of great historical value due to contents. – Office – office buildings typically housing clerical and management functions. – Public Assembly/Sports Leagues Facilities – convention centers, movie theaters, museums, performing arts centers and auditoriums, arenas. – Recreational – gymnasiums, amusement arcades, bowling alleys, indoor swimming pools, indoor tennis courts, pool and billiard parlors. – Religious – places of worship, buildings housing religious objects or functions. – Residential – houses, townhouses, apartment complexes, multi-family dwellings. condominiums, dormitories, single family homes. – Retail – shopping centers, department stores. • ***Educational*** – pre-kindergarten, licensed day care facilities, K-12 schools, higher education facilities, specialized education facilities. • ***Emergency Services*** - police stations, emergency operations or control centers, fire command stations, armories. • ***Government*** - federal, state, county or city buildings including city halls, state capital buildings, federal office buildings, courthouses, or governmental service agency center. • ***Military*** – army, navy, marine corps, air force and coast guard bases. National guard facilities, joint and combined military installations and reservations. • **Transportation Systems** – port, airport, and light rail terminals; rapid transit stations.
2.2	**Number of Occupants** (See 1.2).	**Options** Use same option as was used for Building Characteristic 1.2. When using the electronic database version of the procedure, this building characteristic is automatically filled in using the same option as was used in 1.2. **NOTE**: THIS BUILDING CHARACTERISTIC IS HEAVILY WEIGHTED IN THE SCORING. A MINOR CHANGE IN THE CHOICE OF ATTRIBUTE OPTION SELECTED MAY CAUSE A DISPROPORTIONATELY LARGE CHANGE IN THE FINAL RISK SCORE.

Table 8. Guidance on Threat Assessment: 2. Threat (continued)

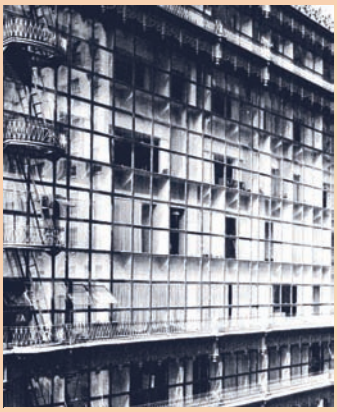
2 Threat		
ID	**Building Characteristics**	**Attribute Options**
2.3	**Site Population Density** Refers to the population that are not in the building, but are nearby on the sidewalk, in vehicles, in adjacent or nearby buildings and below ground, for example, in pedestrian tunnels, or subway train stations. The time of peak population density is to be considered, for instance, during rush hour, or during an event when there is a public gathering.	**Options:** a **Very Low** (1 person per 10,000 sq. ft.) b **Low** (1 person per 1,000 sq. ft.) c **Moderate** (1 person per 400 sq. ft.) d **High** (1 person per 40 sq. ft.) e **Very High** (1 person per 10 sq. ft.) **NOTE**: THIS BUILDING CHARACTERISTIC IS HEAVILY WEIGHTED IN THE SCORING. A MINOR CHANGE IN THE CHOICE OF ATTRIBUTE OPTION SELECTED MAY CAUSE A DISPROPORTIONATELY LARGE CHANGE IN THE FINAL RISK SCORE.
2.4	**Visibility/Symbolic**  **Example of Very Low Option (a):** Hallidie Building, San Francisco, 1906: first true glass curtain wall building in the U.S. **Example of Low Option (b):** Flatiron Building, New York City, 1903, on triangular site, a very significant early skyscraper; many similar buildings exist in other cities.	**Options:** a **Very Low** - The facility is unrecognizable to locals. Its significance can be recognized by experts only. No information is available to the general public. It has no media value or symbolism to the general public. b **Low** - The facility is recognizable but can be confused with other similar facilities. Insider information is required. The facility is rarely featured in the mass media at any level. c **Moderate** - The facility is easily recognizable around the state and somewhat regionally. The facility has media value and events at the site that are televised regionally and sometimes nationally. d **High** - The facility is recognizable to state and local residents. The facility is featured in the mass media on a regional and sometimes on a national level. Some events at the facility are televised internationally. e **Very High** - The facility is easily recognizable, and is featured in the mass media internationally. Its media value guarantees its recognition and events at the site are almost always televised nationally and internationally. **NOTE**: THIS BUILDING CHARACTERISTIC IS HEAVILY WEIGHTED IN THE SCORING. A MINOR CHANGE IN THE CHOICE OF ATTRIBUTE OPTION SELECTED MAY CAUSE A DISPROPORTIONATELY LARGE CHANGE IN THE FINAL RISK SCORE.

Table 8. Guidance on Threat Assessment: 2. Threat (continued)

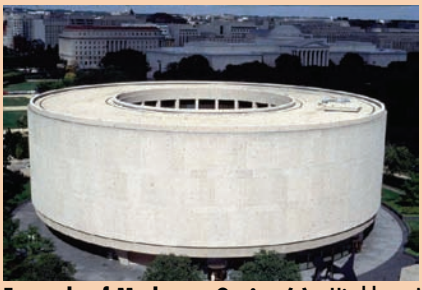
2 Threat		
ID	**Building Characteristics**	**Attribute Options**
2.4 (contd)	 **Example of Low Option (b):** World Market Center in Las Vegas is recognizable to locals and interior designers who go to events there, but it is away from the main tourist area and is not well recognized by the general public. Photograph by Paulette Nelson, July 2005.  **Example of Moderate Option (c):** Hirshhorn Museum in Washington DC is well known in the local region with occasional national exposure. Photograph by Charles Phillips,1995. **Example of High Option (d):** Transamerica Pyramid, San Francisco, is generally recognized nationally as a symbol of San Francisco. **Example of High Option (d):** Mandalay Bay Casino and Hotel in Las Vegas; this hotel is shown in the opening sequence of a television show that is popular internationally. Photograph courtesy of Mandalay Bay Casino and Hotel.	

Table 8. Guidance on Threat Assessment: 2. Threat (continued)

2 Threat		
ID	**Building Characteristics**	**Attribute Options**
2.4 (contd)	**Example of Very High Option (e):** The Empire State Building is recognized nationally and internationally as symbol of USA. Photograph courtesy of www.empire.state.ny.us.	
2.5	**Target Density** Target density is defined as the number of *high-value targets* within *a certain distance of the building under consideration.* This information is included on Page 1 for pre-field assessment. Potential targets are grouped into Zones 1, 2, or 3, depending on their distance from the exterior face of the building. The number of targets within these zones is referred to as the target density. Note that this building characteristic refers to the facilities around it, not the building itself. It is important to do the research for this building characteristic before visiting the building. The quality of the risk score is a function of the quality of input that goes into the scoring. Sources of information include the internet (e.g., Googlearth) or the local building department. When performing the site visit, it is also valuable to take the time to walk around the area and gather additional information that is not accessible through other methods. Note that the definition of a target refers to a structure that is commonly known or recognized within the community or clearly marked as a facility that is considered significant to the economy, health or welfare of the community. This may be a building structure or other type of structure such as a bridge or dam. A list of the Critical Infrastructure and Key Resources sectors defined by the Department of Homeland Security is provided as a reference tool for evaluating target density (ref.: *National Infrastructure Protection Plan*, DHS, 2006). Sub-sectors within each category should also be reviewed as a part of the research for this characteristic and have been included within the pull down menu of the electronic version of the procedure.	**Options:** **Zone 1-** less than 100 ft **Zone 2 –** equal to or more than 100 ft less than 300 ft **Zone 3 –** more than or equal to 300 ft less than or equal to 1000 ft **NOTE**: THIS BUILDING CHARACTERISTIC IS HEAVILY WEIGHTED IN THE SCORING. A MINOR CHANGE IN THE CHOICE OF ATTRIBUTE OPTION SELECTED MAY CAUSE A DISPROPORTIONATELY LARGE CHANGE IN THE FINAL RISK SCORE. Critical Infrastructure and Key Resources Sectors: 1. Agricultural/Food 2. Banking and Finance 3. Chemical 4. Commercial 5. Critical Manufacturing 6. Dams 7. Defense Industrial Base 8. Emergency Services 9. Energy 10. Government Facilities 11. Information Technology 12. National Monuments/Icons 13. Nuclear 14. Postal and Shipping 15. Public Health and Healthcare 16. Telecommunications 17. Transportation Systems 18. Water Supply (See building characteristic 2.1 for building examples)

Table 8. Guidance on Threat Assessment: 2. Threat (continued)

2 Threat		
ID	**Building Characteristics**	**Attribute Options**
2.6	**Overall Site Accessibility** Site access provides a general assessment of the physical and operational security measures in place. It refers to the ability of the terrorist to become well-positioned to successfully execute a major attack against the building under consideration. It is a function of the site, the building layout, and the security measures in place. Site in this context refers to everything that is outside the building, but is on the property. In the case of urban environments, it also includes the sidewalk. Site access by pedestrians and vehicles are both to be considered. Landscaping features, parking restrictions, street configuration, sidewalk width as well as perimeter security are all factors to include in this evaluation. This is a general access of the accessibility of the site taking into consideration the overall effectiveness of the design features of the site to deter, delay or otherwise facilitate the execution of a terrorist attack. **Example Inaccessible Option (a):** water feature and steps as effective barrier to vehicles. Photograph by Frank Ooms, NBBJ Architects. **Example Accessible Option (b):** easy access to building security office.	**Options:** a **Inaccessible** b **Accessible**

Table 8. Guidance on Threat Assessment: 2. Threat (continued)

2 Threat		
ID	**Building Characteristics**	**Attribute Options**
2.7	**Target Potential** This building characteristic addresses the likelihood of a terrorist attack occurring at the Facility under consideration or for the Facility Type represented in the context of the 18 critical infrastructure categories (see list of sectors for building characteristic 2.5 and the examples shown for building characteristic 2.1). Facility refers to the campus, compound, base, installation, etc. on the same property where the building under consideration is located. Facility Type refers to the Critical Infrastructure and Key Resources (CI/KR) sector corresponding to the primary type of business that is conducted within the building. For instance, if the facility is occupied primarily by tenants who are in the banking industry, then the Facility Type is "Bank". If, based on open source material, the Facility Type is currently, or has in the past been, targeted within the continental United States, then the attribute option is YES. For instance, if the Facility Type is "Bank", and Banking/Finance, Government and Commercial HAVE been targeted, then the option selected would be YES. This building characteristic is partially based on available factual information. However, in many cases judgment is required. It has been included on Page 1 for pre-field assessment. Information is most reliably obtained from a senior security representative for the building. Other sources include law enforcement officials in the area, newspapers and internet searches. The Target (threat) potential may change rapidly based on new information that becomes available. The screener is to base their response on the best available information at the time the screening is conducted. Target Potential refers to past AND present potential. The screener is to attach detailed information to the form explaining the reasoning behind the selection of YES or NO. Note that the area or district within the vicinity of the facility is NOT to be considered for this building characteristic. This concept is addressed under Target Density.	**Options:** **2.7.1 Facility** a No b Yes Yes or No for the Facility is based on a credible threat to a subunit within the facility. For example, if a major tenant in the building under consideration has been targeted, then the facility has been targeted (i.e., the attribute option is Yes). Similarly, if a building within a compound of buildings has been threatened, then the compound (facility) has been threatened. **2.7.2 Facility Type** a No b Yes Yes or No for the Facility Type is based on a credible threat against the sector. For example, if the Las Vegas strip has been targeted or received a credible threat, all casinos may be considered to have the same target potential (i.e., the attribute option is Yes) **NOTE**: THIS BUILDING CHARACTERISTIC IS HEAVILY WEIGHTED IN THE SCORING. A MINOR CHANGE IN THE CHOICE OF ATTRIBUTE OPTION SELECTED MAY CAUSE A DISPROPORTIONATELY

OVERVIEW

In this chapter the factors used to determine the vulnerability rating are discussed.

In the context of this rapid visual screening procedure, the vulnerability rating is the likely damage and loss resulting from each of the threat scenarios defined in the previous chapter. The vulnerability rating is a composite measure of the expected outcome, in terms of damage, casualties, and business interruption, given the threat is successfully carried out. Information used to assess the vulnerability rating typically comes from engineering analysis and expertise.

Vulnerability is defined as any weakness that can be exploited by an aggressor to make an asset susceptible to hazard damage. A vulnerability assessment is an analysis of the building functions, systems and site characteristics to identify building weaknesses and lack of redundancy.

DETERMINING THE VULNERABILITY RATING

Assessment of the vulnerability rating for each threat scenario is more extensive than the assessment of consequences and threat rating because the vulnerability rating requires assessment of whether or not visually observable features of the building enhance or detract from the overall performance under terrorist attack.

In this rapid visual screening procedure, building types are defined based on both the construction of the building exterior and the skeletal or structural frame type, since these are the dominant features that dictate performance for explosive attack. These definitions are biased towards building types found in dense urban, urban, and semi-urban areas; however, the definitions are versatile enough to be used for other building types, if needed.

The age of the building is considered an important vulnerability parameter. Age can be tied to the year during which building codes incorporated requirements that significantly reduce the vulnerability of buildings subjected to terrorist attack. Age is also an indicator of the mass of the building, which has an impact on its resistance to explosive loads. Since elements of modern wind design improve the ability of the building exterior to resist impact loads, key dates associated with code updates for wind design are noted for their effects in increasing resistance to blast loads.

For CBR attacks, key features that have an impact on the overall vulnerability of the building are the elevation of the air intakes and the height of the building. The elevation of the outdoor air intakes reflects the ease of CBR source introduction directly into the HVAC (Heating,

Ventilation, Air Conditioning) system (a form of internal CBR attack) as well as how much contaminant can enter the building due to an exterior event. These factors, as well as the details related to the type of ventilation systems and filters used, are included in the assessment of the vulnerability rating for the CBR threat scenarios.

CONDUCTING THE FIELD ASSESSMENT

As before, the process for archiving field assessment information depends on whether the screener is using the electronic version of the Data Collection Form, or the long form that contains scores for the various attribute options. Pages 5 through 9 of the long-from version of the Data Collection Form address building characteristics pertaining to vulnerability rating. In the Field Version of the form, which is used to document selected attribute options for later entry in the electronic version of the Data Collection Form, pages 4 through 6 cover building characteristics pertaining to vulnerability rating. Attributes are arranged according to the following individual building systems/ characteristics that may be adversely affected due to a terrorist attack:

- Site
- Architecture
- Building Envelope
- Structural Components and Systems
- Mechanical/Electrical/Plumbing (MEP) Systems
- Security

Like the Consequences and Threat Rating, the Vulnerability Rating is focused on the building characteristics that may be visually observed and are critical to the overall risk to the building. The screener selects the most appropriate attribute option for each building characteristic, and circles the selected option, or associated numerical value. When the selected attribute options are entered in the electronic database, risk scores are calculated automatically. When the long-form version of the Data Collection Form is used, risk scores are calculated using the Risk Scoring Worksheet (Appendix A).

More detailed instruction on how to choose between attribute options is provided in the tables included in this chapter. The sections that follow are arranged by building system/characteristic affected.

The tables included in this chapter are useful in the field for evaluating the appropriate attribute option.

SITE

Parts I and II of the Vulnerability Assessment portion of the Data Collection Form (see Figure 7 and 8) address site issues, architecture issues, and building envelope. This section provides detailed guidance on selecting attribute options pertinent to site issues; the subsequent section provides similarly detailed guidance on architecture issues, followed by a similarly detailed section on building envelope.

The site refers to the area between the building and the property line. For densely urban areas, this may constitute just a portion of the sidewalk. For a campus setting, the site may be an expansive park like setting. Guidance on choosing between attribute options for building characteristics that address site vulnerability issues are provided in Table 9.

FEMA 455 DATA COLLECTION FORM, PAGE 5 — **VULNERABILITY ASSESSMENT (Part I)**

BUILDING CHARACTERISTICS		ATTRIBUTE OPTIONS					VULNERABILITY RATING FOR GIVEN THREAT SCENARIO								
							Internal			Explosive			CBR		
		a.	b.	c.	d.	e.	Intrusion	Explosive	CBR	Zone I	Zone II	Zone III	Zone I	Zone II	Zone III
3. SITE	3.1 Distance to Unsecured Vehicles (ft)	≥ 75	≥ 50 - < 75	≥ 25 - < 50	≥ 5 - < 25	< 5									
		0.06	0.46	0.53	0.58	0.63									
	3.2 Perimeter Boundary	Continuous Anti-Ram Barriers	Effective Anti-Ram Design	Well-Integrated CPTED	Ornamental, Temp, or Anti-Climb Barriers	No Security/ Discon-tinuous									
		0.03	0.22	0.25	0.28	0.30									
		0.01	0.08	0.09	0.10	0.11									
		0.03	0.23	0.26	0.29	0.31									
		0.02	0.15	0.17	0.19	0.2									
	3.3 Unobstructed View (ft)	≥ 30	≥ 20 – < 30	≥ 10 - < 20	≥ 5 - < 10	< 5									
		0.06	0.45	0.51	0.57	0.61									
		0.01	0.08	0.09	0.10	0.11									
		0.02	0.12	0.13	0.15	0.16									
		0.02	0.15	0.17	0.19	0.2									
	3.4 Unsecured Underground Access	None	Utility Tunnel or Culvert to Site	Utility Tunnel to Bldg.	Pedestrian Tunnel to Bldg.										
		0.24	1.77	2.13	2.4										
		0.09	0.63	0.76	0.86										
	3.5 Storage of Hazardous Materials	None	Low	Moderate	High										
		0.06	0.45	0.54	0.61										
		0.04	0.32	0.38	0.43										
		0.02	0.12	0.14	0.16										
		0.01	0.06	0.07	0.08										
	3.6 Collateral Underground / Adjacent Structures	None	Small	Medium	Major	Significant									
		0.10	0.72	0.83	0.91	0.98									
		0.09	0.67	0.77	0.84	0.91									
4. ARCHITECTURE	4.1 Building Height (ft)	< 20 (1 flr)	≥ 20 - < 50 (2-3 flr)	≥ 50- < 100 (4-8 flr)	≥ 100 - <150 (9-12 flr)	≥ 150-< 200 (13-15 flr)									
		0.02	0.10	0.13	0.15	0.16									
		0.01	0.07	0.09	0.11	0.12									
		0.02	0.09	0.12	0.13	0.15									
		0.07	0.41	0.52	0.59	0.65									
		≥ 200 - < 500 (16-40 flr)	≥ 500 - < 800 (41-60 flr)	≥800 -<1000 (61-80 flr)	≥1000 -<1500 (81-120 flr)	≥ 1500 (≥121 flr)									
		0.16	0.17	0.17	0.17	0.176									
		0.12	0.12	0.12	0.13	0.128									
		0.15	0.15	0.15	0.16	0.16									
		0.67	0.68	0.70	0.71	0.72									
	4.2 Ratio of Total Area / Footprint Area	< 10	≥ 10 - < 30	≥ 30 - < 50	≥ 50 - < 100	≥ 100									
		0.00	0.03	0.04	0.04	0.044									
		0.00	0.02	0.03	0.03	0.032									
		0.00	0.03	0.03	0.04	0.04									
		0.02	0.13	0.15	0.17	0.18									
	4.3 Building Configuration	Circular/ Convex	Box	Re-entrant Corners	Concave										
		0.01	0.08	0.10	0.11										
		0.03	0.23	0.28	0.31										
	4.4 Overhang (ft)	None	< 5	≥5 – <10	≥10 – <15	≥ 15									
		0.03	0.23	0.26	0.29	0.31									
		0.02	0.12	0.13	0.15	0.16									
V.1 SUB-TOTAL FOR VULNERABILITY RATING (V): Sum values in each column and enter on line V.1 on Vulnerability Assessment Rating (Part V)															

Figure 7 Page 5 of Data Collection Form, Vulnerability Assessment (Part I), Site and Architecture Characteristics Contributing to Vulnerability Rating.

Table 9 Guidance on Vulnerability Assessment: 3. Site

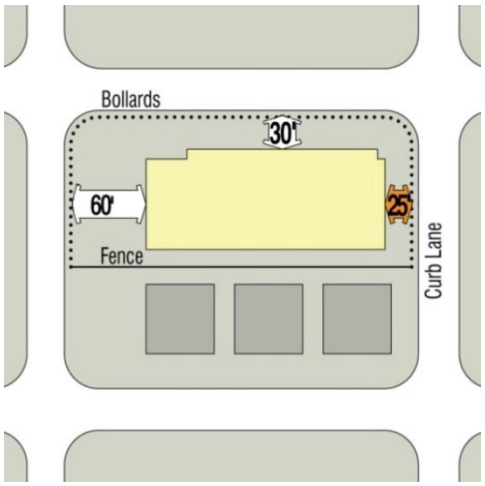
3 Site		
ID	**Site Characteristics**	**Attribute Options**
3.1	**Distance to Unsecured Vehicles (ft)** This building characteristic refers to the shortest distance from the building facade to a vehicle that may constitute a threat (an unsecured vehicle). It includes locations accessible by unsecured vehicles to: ❍ a public road ❍ a public parking area ❍ an outside of secured perimeter, or ❍ a drop off zone In addition to the explosive hazard, the distance of roadways may be significant in the event of CBR attack, especially if they are used to transport hazardous materials to and from chemical facilities. Note that major highways and rail lines, which are known to be used for transport of hazardous materials, may be considered in the Target Density Zone to Transportation Systems discussed in Building Characteristic 2.5.	**Options:** a **more than or equal to 75 ft** b **more than or equal to 50 ft and less than 75 ft** c **more than or equal to 25 ft and less than 50 ft** d **more than or equal to 5 ft and less than 25 ft** e **less than 5 ft.**  Example of building with various standoffs. The least standoff of 25 feet, corresponding to attribute option d, controls. Illustration courtesy of David Shafer, Architect.
3.2	**Perimeter Boundary** This building characteristic describes the line separating the site surrounding the building from access by a vehicle that may constitute a threat (an unsecured vehicle). Note that if the perimeter boundary is not described well by any of the options, than select the option which offers a similar level of vulnerability.	**Options:** a **Continuous Anti-ram Barriers** • The facility has anti-ram barriers on all sides of the perimeter. • There are active barriers (e.g., retractable bollards) at the vehicle access points • The barriers are able to stop a vehicle from reaching the building. b **Effective Anti-Ram Design** • The design takes all the site attributes into consideration, and denies penetration of a vehicle. • The facility reduces the risk of vehicle penetration to a reasonable and consistent level on all sides.

Table 9 Guidance on Vulnerability Assessment: 3. Site (continued)

3 Site (continued)		
ID	**Site Characteristics**	**Attribute Options**
3.2 (cont)	**Perimeter Boundary (continued)** Also known as deterrent landscaping, Crime Prevention Through Environmental Design (CPTED) seeks to create a physical environment that discourages or minimizes criminal activity. It can be effective in delaying and deterring an attack. Examples include a monumental staircase, a circular driveway, speed bumps, terraced landscaping, public art strategically placed, and large planters that serve as truck traps.	**Options (continued)** c **Well Integrated CPTED** • The landscaping makes it difficult to gain entry to the property (e.g., deep ditch, moat). • The landscaping provides "line of sight" to potential criminal activity. • The landscaping enhances a facility's surveillance of surrounding area. d **Ornamental/Temporary/Anti-climb Fence Barriers** • Barriers can be defeated easily by vehicles traveling at low velocities. • Decorative planters resting on the sidewalk are the only deterrent. • There are only temporary solutions like jersey barriers, or police barricades around the building. • Parking restrictions are the only deterrent around the site. • There is an active barrier system but it is not activated (i.e., it is in the "down" position allowing vehicles to pass through). e **No Security/ Discontinuous Security** • There are locations along the perimeter where vehicles can penetrate the perimeter. • There are no obstacles to stop the impact of a vehicle into the building. • There are only light poles, parking meters, standpipes and other street furniture to deny penetration.
3.3	**Unobstructed View** Unobstructed view is the smallest distance surrounding the building that is available for conducting counter-surveillance on potential criminal activity. This refers to the view from the building interior to public areas outside. Look for the features that can obstruct views from the building like: parked cars, hedges, shrubbery higher than 6 inches, newspaper kiosks, and lobby security desk located such that the building exterior cannot be seen.	**Options:** a **more than or equal to 30 ft** b **more than or equal to 20 ft, less than 30 ft** c **more than or equal to 10 ft, less than 20 ft** d **more than or equal to 5 ft, less than 10 ft** e **less than 5 ft**

Table 9 Guidance on Vulnerability Assessment: 3. Site (continued)

3 Site (continued)		
ID	**Site Characteristics**	**Attribute Options**
3.4	**Unsecured Underground Access** Unsecured underground access refers to miscellaneous openings that penetrate the perimeter and/or basement. This could be a pedestrian tunnel from an adjoining building or subway, or it could be a sewer line, culvert, drain pipe, utility tunnel, conduit or other means of access. Access requires that there is a void area of at least 96 square inches in cross sectional area and that there aren't any physical obstructions (e.g., metal bars, metal cages, locking devices) or technology such as contact sensors to prevent access.	**Options:** a **None** - There is not any way for a person to access the site or building from underground. All access is either too small or is blocked or controlled by sensors or other means. b **Utility tunnel or culvert to site** - There is a utility tunnel or a culvert that provides access onto the site. However, the access does not extend into the building. This access may be through a manhole cover or other means. c **Utility tunnel to building** - There is a utility tunnel into the building from the site perimeter. d **Pedestrian tunnel to building** – There are secured and/or unsecured pedestrian tunnels that provide access to the building from unsecured areas on or off the site. **NOTE**: THIS BUILDING CHARACTERISTIC IS HEAVILY WEIGHTED IN THE SCORING. IT IS VERY IMPORTANT TO SELECT THE APPROPRIATE OPTION TO GET AN ACCURATE SCORING FOR THE BUILDING.
3.5	**Storage of Hazardous Materials** Facilities that store hazardous materials pose a higher risk to occupants due to an explosive attack, potentially causing secondary fires, deflagrations, toxic releases or other unsafe conditions. The attribute options (e.g., Low, Moderate, and High) are based on the hazard classifications presented in the 2006 *International Building Code (IBC)*. The screener should obtain the building hazard occupancy category from the site representative or building drawings. Note that there is abundant open-source information that can be obtained from an internet search, such as the EPA website, state office of emergency management or local fire department.	**Options:** a **None** b **Low** - factory industrial uses that involve the fabrication or manufacturing of noncombustible materials (2006 *IBC* Classification S-2), buildings used for storage of noncombustible materials (2006 *IBC* Classification S-2) c **Moderate** - factory industrial uses that present a fire hazard or buildings occupied for storage uses for combustible materials (2006 *IBC* Classification F-1 and S-1). d **High** - uses of buildings or structures that involve the manufacturing , processing, generation or storage of materials that constitute a health hazard in quantities that exceed the levels defined in 2006 *IBC* (Tables 307.7,1 & 2. Classification H)

Table 9 Guidance on Vulnerability Assessment: 3. Site (continued)

3 Site (continued)		
ID	**Site Characteristics**	**Attribute Options**
3.6	**Collateral Underground/Adjacent Structures** This Building Characteristic refers to nearby structures that are not controlled by the owner of the building under consideration. **Example of Option (c) where there is an elevated walkway connecting two buildings with separate security systems.** **Example of Option (d): Entrance to a train station inside the footprint of a building.**	**Options** (with example conditions)**:** a **None** - No underground tunnels are under site; high value targets are more than 300 feet from building. b **Small** - Utility tunnel or culvert to site. c **Medium** - Building is above a subway tunnel and near a subway station; an elevated walkway across a street provides access to the building. d **Major** - Building is above a subway station; high profile building is immediately adjacent to building; an above-ground public garage is immediately next to building; an underground public garage is in an immediately adjacent building. e **Significant** - Building is directly above a major roadway, vehicle tunnel, or primary transportation hub.

ARCHITECTURE

Location of publicly accessible building functions with respect to occupied spaces is a key concern governing the architectural vulnerability of buildings. In addition the height and the use of overhangs are key to the overall vulnerability.

Guidance and information to how to choose between attribute options for the building characteristics pertaining to Vulnerability Rating of the architecture are provided in Table 10.

Table 10 Guidance on Vulnerability Assessment: 4. Architecture

4 Architecture		
ID	**Building Characteristics**	**Attribute Options**
4.1	**Building Height** The building height is classified according to the height above grade level. Estimates of the number of floors are also provided in parentheses after the height in feet for each attribute option. In general the story height may be assumed to be roughly 13 feet. Subsets of building height categories are provided for "low" buildings (those with less than 16 floors above grade level), and for "high" buildings (those with 16 floors or more above grade level).	**Options:** **Low** a Less than 20 ft (1 floor) b More than or equal to 20 ft, less than 50 ft (2-3 floors) c More than or equal to 50 ft, less than 100 ft (4-8 floors) d More than or equal to 100 ft, less than 150 ft (9-12 floors) e More than or equal to 150 ft, less than 200 ft (13-15 floors) **High** a More than or equal to 200 ft, less than 500 ft (16-40 floors) b More than or equal to 500 ft, less than 800 ft (41-60 floors) c More than or equal to 800 ft, less than 1000 ft (61-80 floors) d More than or equal to 1000 ft, less than 1500 ft (81-120 floors) e More than or equal to 1500 ft (at least 121 floors) Mix of building heights in urban setting

Table 10 Guidance on Vulnerability Assessment: 4. Architecture (continued)

4 Architecture (continued)		
ID	**Building Characteristics**	**Attribute Options**
4.1 (cont)	 **Facade design can sometimes conceal location of floors and careful observation is necessary.** **Varying difficulty of floor counting**	 Option b (High Building) In this sixty story building, the visible horizontal divisions occur every six floors. Note the 4 story commercial building in the foreground

Table 10 Guidance on Vulnerability Assessment: 4. Architecture (continued)

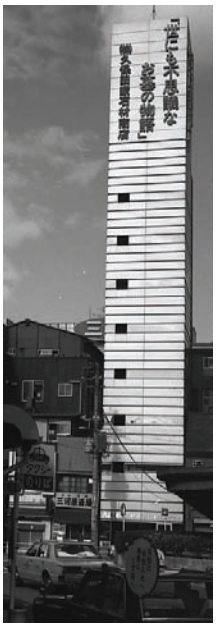
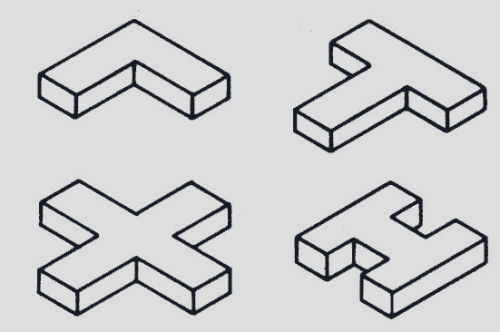
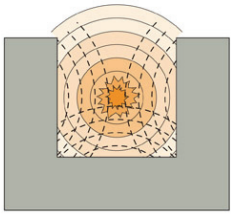
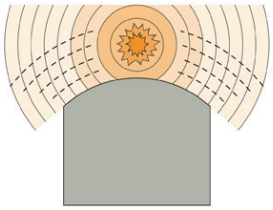
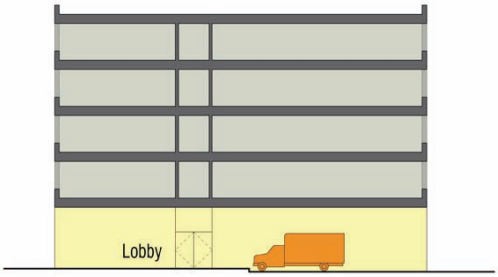
4 Architecture (continued)		
ID	**Building Characteristics**	**Attribute Options**
4.2	**Ratio of Total Area / Footprint Area** Buildings that are very tall and skinny are in general more vulnerable to terrorist attack than buildings that are very low but long and wide. Tall buildings tend to be more prone to progressive collapse following a terrorist attack, as compared with a low-rise building with a large footprint where a more localized effect may be expected (i.e., people on the end of the building furthest from the attack may not be aware or affected by an attack and will be better able to evacuate safely and quickly). The footprint refers to the area of the building at its base. In some cases this will be the area of the building at its ground floor. Total area refers to the total gross area of the building.	**Options:** a **less than 10** b **more than or equal to 10, to less than 30** c **more than or equal to 30, to less than 50** d **more than or equal to 50, to less than 100** e **more than or equal to 100** Example of a building that has a very large foot print compared to its total area (Option a)  Example of a building that has a very small footprint compared with its total area (Option e)

Table 10 Guidance on Vulnerability Assessment: 4. Architecture (continued)

4 Architecture (continued)		
ID	**Building Characteristics**	**Attribute Options**
4.3	**Building Configuration** The building configuration – its three-dimensional shape – influences how a shock-wave from an explosion imparts load to the structure. Circular and convex shapes tend to shed the air-blast loading better than a flat surface such as a rectangular "box" shaped building. Re-entrant corners – buildings with H, L, U, T, or combinations of these plan configurations – and concave surfaces tend to trap the shock-wave and amplify the effect of the air-blast due to multiple reflections. Note that sometimes the re-entrant corner may be provided by an adjacent building that is offset from the building under configuration. Configuration issues are only significant up to height of about 50 feet. Therefore, if the shape of the building changes above 50 feet, consider only the base of the building below 50 feet. Note that an explosion adjacent to high-risk buildings may result in damage to an un-targeted building.  **Re-entrant corner configurations**	**Options:** a **Circular and Convex** b **Rectangular Box** c **Re-entrant corners** d **Concave shapes**  Re-entrant corner plan showing multiple reflection condition Option c  Circular (convex) showing the air blast "shedding" Option a Illustration courtesy of David Shafer, Architect. Concave building shape (Option d)
4.4	**Overhang** This building characteristic pertains to overhangs or open floors that are up to two stories in height above the ground level, with the underside of the structural framing supporting occupied spaces or critical functions above. Pedestrian bridges are not considered an overhang unless they house office space, other occupied area, or critical functions. If the floor level above the overhang is not occupied or has critical functions, then option 'a' should be selected. Depth, measured from inside face of the free standing column to the face of the exterior envelope, can be a critical dimension. If the column spacing along the exterior is less than the depth, then use the spacing of the columns. In some cases this building characteristic may apply to drive-through conditions where the building lobby is accessed from an area that is covered by part of the building. (see figure, right).	**Options:** a **None** b **Less than 5 ft** c **More than or equal to 5 ft, less than 10 ft** d **More than or equal to 10 ft, less than 15 ft** e. **More than or equal to 15 ft**  Illustration courtesy of David Shafer, Architect.

FEMA 455 DATA COLLECTION FORM, PAGE 6 — **VULNERABILITY ASSESSMENT (Part II)**

BUILDING CHARACTERISTICS		ATTRIBUTE OPTIONS a.	b.	c.	d.	e.	VULNERABILITY RATING FOR GIVEN THREAT SCENARIO: Internal: Intrusion	Internal: Explosive	Internal: CBR	Explosive: Zone I	Explosive: Zone II	Explosive: Zone III	CBR: Zone I	CBR: Zone II	CBR: Zone III
4. ARCHITECTURE	4.5 Lobby/Retail Location (in relation to main building footprint)	Detached	External & Separated	External but not Separated	Within Footprint	Adjacent to Occupied Areas									
		0.04	0.32	0.36	0.40	0.43									
	4.6 Loading Dock and/or Mail Screening Location	Offsite / None	Exterior to Building	At Perimeter & Separated	Adjacent to Assets	Under Building									
		0.04	0.32	0.36	0.40	0.43									
		0.01	0.06	0.07	0.07	0.08									
	4.7 Vehicular Penetration of Exterior Envelope	No	Yes												
		0.06	0.63												
	4.8 Garage Location	None	Adjacent & Above Ground	Adjacent to Critical Utilities	Adjacent to Occupied Areas										
		0.04	0.32	0.38	0.43										
		0.07	0.52	0.63	0.71										
		0.01	0.06	0.07	0.08										
5. BUILDING ENVELOPE	5.1 Window Support Type	No Windows	Punched	Glass & Metal Framing	Ribbon	Point Supported									
		0.06	0.46	0.53	0.58	0.63									
		0.13	0.96	1.10	1.21	1.3									
	5.2 Window Bite Depth	≥ 0.5 in.	< 0.5 in.												
		0.03	0.31												
		0.07	0.67												
	5.3 Total % Window Area	< 20	≥ 20 - < 40	≥ 40 - < 60	≥ 60 – < 80	≥ 80									
		0.03	0.22	0.25	0.28	0.3									
		0.07	0.49	0.57	0.62	0.67									
		0.13	0.96	1.10	1.21	1.3									
		0.05	0.37	0.42	0.46	0.5									
	5.4 Glass Type	Laminated Glass	Security Film	Tempered Glass	Heat Strength-ened Glass	Annealed Glass									
		0.03	0.23	0.26	0.29	0.31									
		0.06	0.46	0.53	0.58	0.63									
		0.13	0.96	1.10	1.21	1.3									
	5.5 Wall Type	Cast-in-place Reinforced Concrete	Curtain Wall	Precast or Reinforced Masonry	Massive Unreinforced Masonry	Lt. Frame or Slender Unreinforced Masonry									
		0.03	0.23	0.26	0.29	0.31									
		0.07	0.49	0.57	0.62	0.67									
		0.03	0.22	0.25	0.28	0.3									
V.2 SUB-TOTAL FOR VULNERABILITY RATING (V): Sum values in each column and enter on line V.2 on Vulnerability Assessment Rating (Part V)															

Figure 8 Page 6 of Data Collection Form, Vulnerability Assessment (Part II), Architecture and Building Envelope Characteristics.

Table 10 Guidance on Vulnerability Assessment: 4. Architecture (continued)

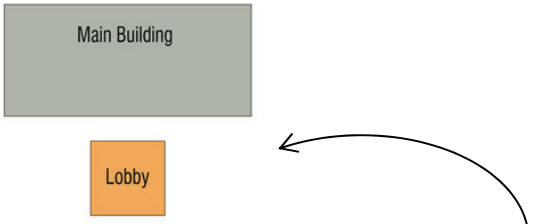
4 Architecture (continued)		
ID	**Building Characteristics**	**Attribute Options**
4.5	**Lobby/Retail Location (in relation to main building footprint)** Public areas of buildings, including the lobby and retail, are considered high risk areas where an explosive (or CBR) device could be placed undetected. The location of these spaces in relation to occupied/critical areas or primary structural framing affects the vulnerability of the building to explosive attack. It affects the vulnerability to CBR threats because of the potential for contaminants to be transmitted throughout the building. All figures in section 4.5 courtesy of David Shafer, Gensler Architects.	**Options:**  a: **Detached* -** In this case the public areas of the facility are in a separate building.

Table 10 Guidance on Vulnerability Assessment: 4. Architecture (continued)

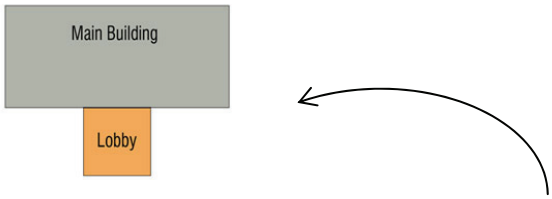
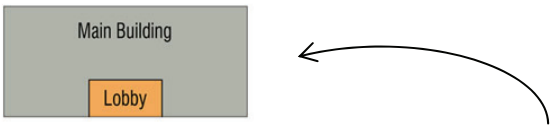
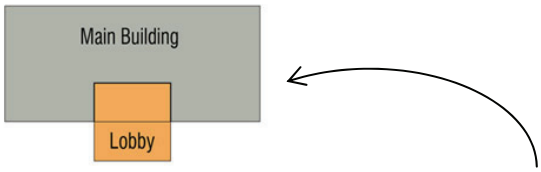
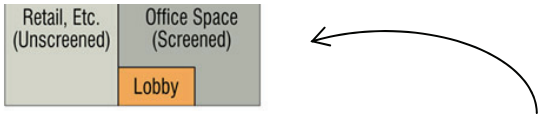
4 Architecture (continued)		
ID	**Building Characteristics**	**Attribute Options**
4.5 (cont)	**Lobby/Retail Location (continued)** **Detached screening lobby, Option(a). Photograph courtesy of Gensler Architects.**	**Options (continued)*:**  b: **External and Separated*** - The public areas are external to the main footprint of the building and are separated from the secured areas by a solid wall with limited openings. No routinely occupied areas or critical utilities are internal to the wall.  c: **External but not Separated*** - Public areas are separated from the secured occupied/critical areas, but are not in the same "space" or "room" and are not separated by a physical barrier like a wall. This would apply to an multistory atrium for instance with a public lobby at the ground floor.  d: **Within Footprint*** – The public areas of the building are inside the main footprint of the building but are not immediately adjacent to secured areas that are routinely occupied (i.e., hotel rooms, apartments, offices) or contains critical utilities. It is acceptable if public areas are adjacent to storage areas, restrooms, locker rooms or other support space.  e: **Adjacent to Occupied Areas*** - Public areas are underneath or next to regularly occupied space. *Illustrations courtesy of David Shafer, Architect

Table 10 Guidance on Vulnerability Assessment: 4. Architecture (continued)

4 Architecture (continued)		
ID	**Building Characteristics**	**Attribute Options**
4.6	**Loading Dock/Mail Screening Location** The loading dock and/or mail screening areas are considered high-risk where an explosive or CBR threat could be delivered to the building undetected. The screener should question the site representative or walk around the exterior of the building to ascertain the location of the loading dock and mail screening area, and select the attribute option that most closely represents its general location relative to the main building footprint and proximity to occupied/critical areas. If screener does not have access to interior areas, look for screening equipment located on the loading dock and visible from the outside. **Loading dock under building (Option e)**	**Options:** a **Offsite / None** - All deliveries are screened at a separate building before entering building. b **Exterior to Building** - Loading dock and/or mail screening occurs outside the main footprint of the building. c **At Perimeter and Separated** - Loading dock and/or mail screening are located inside the building footprint, but along the building perimeter and not adjacent, under or over occupied/critical areas. d **Adjacent to Assets** - Loading dock and/or mail screening are located next to occupied areas or other critical assets, but not underneath or over. e **Under Building** - Loading dock and/or mail screening are located underneath or over occupied/critical areas.

Table 10 Guidance on Vulnerability Assessment: 4. Architecture (continued)

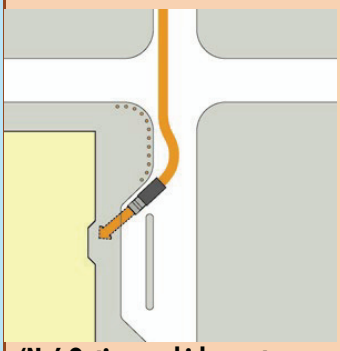
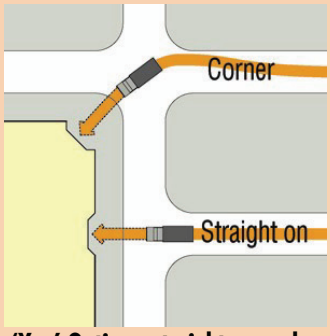
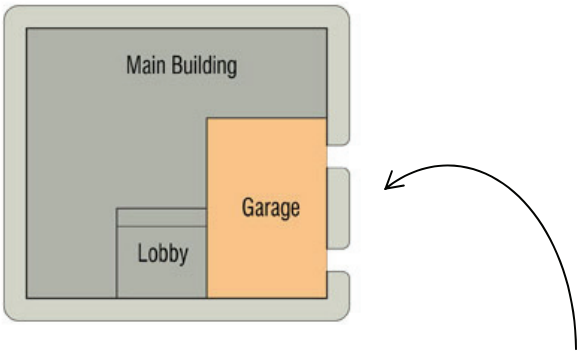
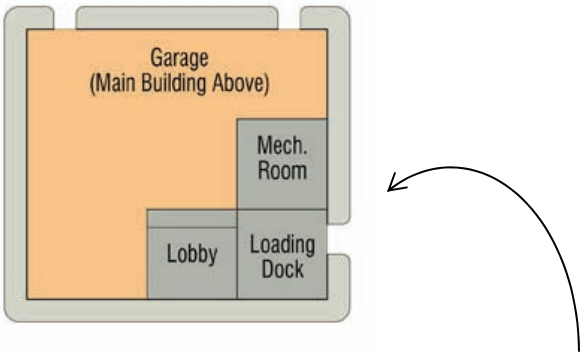
4 Architecture (continued)		
ID	**Building Characteristics**	**Attribute Options**
4.7	**Vehicular Penetration of Exterior Envelope** This building characteristic addresses the potential for high speed vehicular impact and penetration into the building. A moving vehicle can pose a substantial threat to a building if it is able to accelerate to a high speed on adjacent streets prior to impact. This is a function of the site layout, adjacent street configuration and perimeter security. The screener should review the potential vehicle approach paths to the building along roadways or wide walkways and determine the exposure of the building to a high speed vehicle impact. **Example 'No' Option: Minimum standoff but well defended perimeter**  **'No' Option: vehicle must swerve significantly**  **'Yes' Option: straight-on and corner** **Illustration courtesy of David Shafer, Architect.**	**Options:** a **No** - The site is configured on all sides such that a high-speed approach is mitigated by means of landscaping, anti-ram barriers, terrain, or other methods around the entire perimeter, including vehicle access points. Alternatively, the site is such that an oncoming vehicle would need to turn or approach the building from an angle to impact it on one or more sides Conditions considered as None should be assessed as "NO" b **Yes** - The site is configured such that a straight-on approach of a high-speed vehicle is possible on one or more streets. This occurs, for instance, at street corners or "T" intersections. Conditions considered as Straight-on should be assessed as "YES"

Table 10 Guidance on Vulnerability Assessment: 4. Architecture (continued)

4 Architecture (continued)		
ID	**Building Characteristics**	**Attribute Options**
4.8	**Garage Location** The garage is a particularly high-risk area where an unscreened or screened vehicle could potentially deliver a weapon. The screener should question the site representative or walk around the exterior of the building to ascertain the location of a parking garage and select the attribute option that most closely represents its location relative to the building footprint and proximity to occupied/critical areas. **Underground parking garage (Option d)** **Garage Entrance Adjacent to Occupied Areas (Option d)**	**Options:** a **None** - There is no garage in the building  b **Adjacent and Above Ground*** - The garage is immediately adjacent to the building and above ground. No part of the garage is under or over the main building.  c **Adjacent to Critical Utilities*** - The garage is over, next to, or below critical building utilities, but not immediately under office space or regularly occupied areas. Transitory space such as lobby, restrooms, storage or corridors is acceptable. d **Adjacent to Occupied Areas** - The garage is over, below, or next to office space or regularly occupied areas. It may or may not be adjacent to critical utilities. *Illustrations courtesy of David Shafer, Architect.

BUILDING ENVELOPE

Parts II and III of the Vulnerability Assessment Rating portion of the Data Collection Form (see Figures 8 and 9) address the building envelope, which refers to the exterior of the building. The building characteristics of concern are the window and wall system visible from the building exterior and the degree of debris impact protection.

Guidance and information to how to choose between attribute options for the building characteristics pertaining to Vulnerability Rating of the building envelope are provided in Table 11. Further information on building envelope design concepts is provided on the Whole Building Design Guide web site (www.wbdg.org), which is maintained by the National Institute of Building Sciences (NIBS).

Table 11 Guidance on Vulnerability Assessment: 5. Building Envelope

5 Building Envelope		
ID	**Building Characteristics**	**Attribute Options**
5.1	**Window Support Type** Window support type refers to the manner in which the typical windows are connected into the exterior envelope and the structure. Note that the windows at lower floors and/or the entrance of a building are often different from the typical windows on upper floors and are ***not*** what should be used when categorizing the window support type. In other cases, there may be one or two floors at the top of the building or at another floor that have larger windows. Again, these are not the typical windows and should not be used when assessing the risk to the entire building except if the critical assets are located in the region of that window type. In cases where there is more than one window type, the type in the most vulnerable location, or the type that is the most vulnerable may be used, depending on the other site characteristics. For instance, the typical window type on the building side closer to a public street will be more vulnerable than a window type on other sides of the building and therefore govern. On the other hand, if the standoff distance is comparable on all sides of the building, then it may make more sense to use the most vulnerable window type based on how it is supported in the frame.	**Options:** a **No Windows** - Buildings that do not have windows or have very few windows include warehouses, 'big box' stores, data centers and telecommunications facilities. Buildings with no windows are the least vulnerable condition; this option is intended specifically for these and other specialized building types. b **Punched** - This type of window may consist of two panes that can slide open vertically (i.e., double sash windows), or it can be opened like a door or a pivot mechanism. In other cases, a punched window may have intermediate framing between several window panes that is oriented in the horizontal direction. c **Glass and Metal Framing** - For this glazing type, a significant part of the building exterior is covered with windows supported by aluminum or possibly steel framing. d **Ribbon** - Ribbon windows have thin vertical metal framing separating the individual panes, and are supported by the wall at the top and bottom. This framing system tends to be less robust than punched windows, and usually the wall spans horizontally and is attached only to each floor instead of spanning vertically and being secured to a lower and upper floor. The system is very economical and a common façade type.

Table 11 Guidance on Vulnerability Assessment: 5. Building Envelope (continued)

5 Building Envelope		
ID	**Building Characteristics**	**Attribute Options**
5.1 (cont)	 **Example of older building that has 'no windows' (Option a)** **Example of punched windows (Option b).** Punched windows are considered less vulnerable than other window types because the frame is attached directly into the wall on all sides, which is generally of more robust construction. It is very common to see these types of windows used for older masonry buildings and also for residences.	**Options (continued):** e **Point Supported** - Point supported windows are usually held in place by a metal system of cables behind the window that are connected to the glass at points near the corner. This is considered the most vulnerable window type in terms of the hazard presented to the people inside if there is an explosive event outside.

Table 11 Guidance on Vulnerability Assessment: 5. Building Envelope (continued

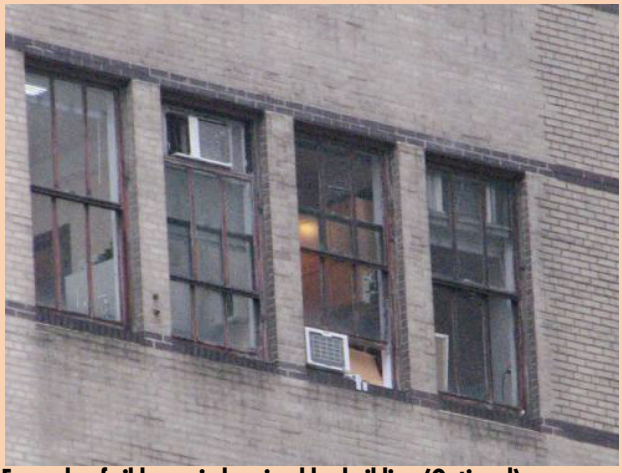
5 Building Envelope		
ID	**Building Characteristics**	**Attribute Options**
5.1 (cont)	 **Example of glass and metal framing. This building has floor-to-ceiling glass, with the floor structure concealed by metal paneling (Option c)** Option 'c' windows (Glass and Metal Framing/Curtain Wall) have an increased risk of the glass *and* the framing becoming a flying hazard compared with punched windows. However, it has more resiliency than support types 'd' and 'e' due to its flexibility, which allows it to bend significantly before failing. In some situations, the glass will be opaque near the floor level but will still be glass. In other situations, a light weight material like metal panel or wood or plastic is used near the floor levels. A glass curtain wall may provide the complete wall for the building envelope, as shown in Option 'b' of Building Characteristic 5.5 (Glass Curtain Wall).  **Example of ribbon window in older building (Option d)**	

Table 11 Guidance on Vulnerability Assessment: 5. Building Envelope (continued)

5 Building Envelope (continued)		
ID	**Building Characteristics**	**Attribute Options**
5.1 (cont)	 **Example of ribbon window in newer building with continuous wall elements above and below (Option d)** Ribbon windows (Option 'd') in older buildings consist of several window panes side by side with narrow framing between. Newer ribbon windows, dating from the 1960's and after, consist of alternating bands of glazing and opaque material constructed using precast panels, poured concrete or insulated metal panels. The opaque area conceals the floor structure and is referred to as a 'spandrel'. . **Example of common type of ribbon window with alternating horizontal bands of window and spandrel (Option d)**	

Table 11 Guidance on Vulnerability Assessment: 5. Building Envelope (continued

5 Building Envelope		
ID	**Building Characteristics**	**Attribute Options**
5.1 (cont)	 **Example of point supported with cable (Option e)** Sometimes the supports for Point Supported windows (Option 'e') include cables that look more like brackets at the corners, or there is sturdy metal framing present but only on the interior. The panes are typically separated by a clear or translucent polymer material instead of the metal framing (referred to as "butt glazed"). A cable supported system that supports glazing by tensioned cables is a resilient system with better performance than a typical point supported system.	

Table 11 Guidance on Vulnerability Assessment: 5. Building Envelope (continued)

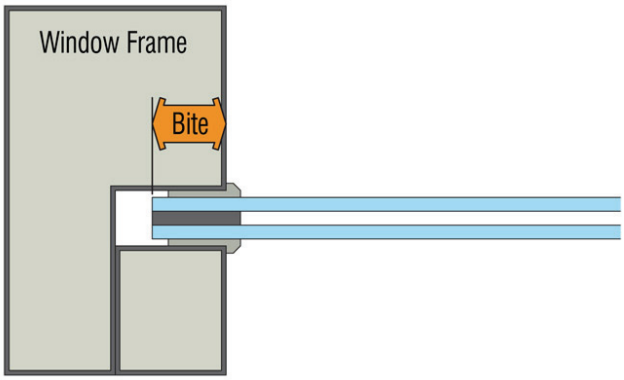
5 Building Envelope (continued)		
ID	**Building Characteristics**	**Attribute Options**
5.2	**Window Bite Depth** Bite refers to the depth of window glass captured by the frame for the *typical* windows. This part of the window often cannot be seen from the outside because it is inside the frame. This characteristic provides a measure of how firmly the window is held in place by the frame. Sometimes bite can be measured, but often it cannot. The following guidance will help the screener to determine which attribute option to choose: **a More than or equal to 0.5 in** Situations where the bite is often greater than or equal to 0.5 in are: (1) newer buildings constructed in the 1980's or later. (2) Large panes of glass (3) High rise construction (4) Commercial construction (5) High wind areas Other conditions when this attribute may be selected include: ❍ when structural silicone sealant (a translucent material connecting the glass and frame) is provided. This material acts as a 'glue' to adhere the glass to the frame, helping it to stay in place. ❍ when the window film is mechanically attached. (i.e., the window film is placed over the framing members with battens to hold it in place). ❍ when the windows of a commercial building have been replaced in the past decade to provide additional energy efficiency (look for windows that look much newer than the rest of the building). **b Less than 0.5 in** Older construction, which typically uses smaller panes of glass, will tend to have smaller window bites. For these windows a rubber gasket will typically be used to hold the glass tight into the frame. Also, this option is typical for residential construction.	**Options:** a **More than or equal to 0.5 in** b **Less than 0.5 in**  **NOTE**: The age of the building provided on Page 1 of the Data Collection Form, which is determined prior to the field visit, provides useful input to selecting the appropriate attribute option.

Table 11 Guidance on Vulnerability Assessment: 5. Building Envelope (continued)

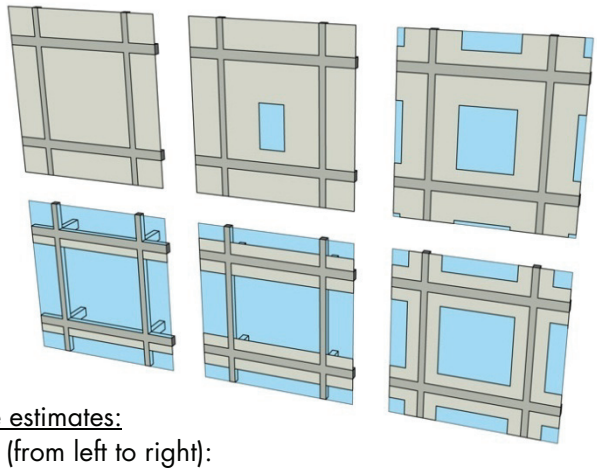
5 Building Envelope (continued)		
ID	**Building Characteristics**	**Attribute Options**
5.3	**Total % Window Area** The exposure of building occupants to failed window glass provides a serious hazard in explosive events. The % window area is defined as the ratio of the window area to the total wall area, where walls are assumed to provide greater protection than windows to occupants. Estimates can be based a typical area of the building between two column lines (i.e., one bay width). Examples of % window area: **Greater than or equal to 20%, less than 40% (Option b)** **Greater than or equal to 40%, less than 60% (Option c)**	**Options:** a **less than 20%** b **Greater than or equal to 20%, less than 40%** c **Greater than or equal to 40%, less than 60%** d **Greater e than or equal to 60%, less than 80%** e **Greater than or equal to 80%**  <u>Example estimates:</u> Top row (from left to right): Option a: < 20% Option b: 25% Option c: 40% Bottom row: Option e: 80% Option d: 75% Option c: 55% Illustrations courtesy of David Shafer, Architect. Greater than or equal to 80% (Option e)

Table 11 Guidance on Vulnerability Assessment: 5. Building Envelope (continued)

5 Building Envelope (continued)		
ID	**Building Characteristics**	**Attribute Options**
5.4	**Glass Type** For the purposes of this rapid visual screening procedure, five categories of glass are provided as attribute options for typical windows. For buildings where there may be a variety of glass types, select the type that is likely to cause the most hazard due to a variety of factors including window size, number of windows of that type, location, and occupancy level, using a "worst-reasonable-case standard" approach. **a Laminated Glass** For low impact conditions, the laminate holds the glass in the frame, which is safer than if the glass fragments are thrown from the window. For higher impact conditions the glass pieces adhere to the laminate forming "clumps" of glass, which exit the frame. Again, this situation is safer than if no laminate is used. Laminated glass is relatively uncommon for conventional construction. However, it is used often for buildings that are designed to mitigate the effects of explosive attack. Newer government buildings or buildings with high-risk tenants may have laminated glass construction. It should be shown on the construction drawings and can be determined by using a glass meter. For insulated glass with two glass panels separated by a small air gap, typically it will only be the inner pane that is laminated. Often a conversation with the building manager will be sufficient for determining whether laminated glass has been used. Laminated glass is safety glazing certified by the Safety Glazing Certification Council (SGCC®) and identified by a permanent label affixed to the product. A typical label would include the following information: SGCC® Licensee or Primary Producer Company Name (optional) Laminated Glass ANSI Z97.1-2004 16 CFR 1201 CII SGCC 9999 6mm U A	**Options:** a **Laminated glass** - Laminated glass refers to two or more glass panels connected or "glued" together with layers of polyvinyl butryal (PVB). It is used most commonly as safety glass for skylights or for glass panels that are near the floor and could be accidentally broken through impact. b **Security film** - Security film, which varies from 4 mil to about 20 mil in thickness, is thicker than solar film or glare film. Access to typical windows is needed to confirm that security film has been added to windows. c **Tempered glass** - Tempered glass, like laminated glass, is considered to be safety glass and may be used for the same applications where impact is a concern (e.g., skylights, lobbies). When impacted it breaks into small cubes rather than sharp shards like other types of unlaminated glass. d **Heat strengthened glass** - Heat strengthened glass is the most typical type of glass used for commercial office buildings today. e **Annealed glass** - Annealed glass is the weakest type of glass and creates shards when it is broken. Non-retrofitted glazing in older (pre 1960s) buildings will usually be annealed glass. This glass type may also be used in residential buildings.

Table 11 Guidance on Vulnerability Assessment: 5. Building Envelope (continued)

5 Building Envelope (continued)		
ID	**Building Characteristics**	**Attribute Options**
5.4 (cont)	**b Security Film** Installing security film on the inside of window glass is a common retrofit used for office buildings where terrorist attack is a concern. For daylight applications, the film may be detected along the edges. Older film retrofits may peel, have air bubbles, or be clouded. In some cases, the film will be attached into the framing using metal plates or battens. Solar film, which typically is 2 mil thick, is much thinner than security glass, and does not qualify as security film. Knowledge of retrofit is needed to select this option (refer to Page 1 of the Data Collection Form where retrofit information is requested). **c Tempered Glass** Sometimes tempered glass is used for all or some glass panes at the ground floor so that firefighters or other first responders can safely gain access to the building in case of emergency. Like laminated glass, there is a marking in the corner of the pane indicating that it has been tempered. Note that it is relatively uncommon to use tempered glass for typical vision panels above the ground floor. **d Heat Strengthened Glass** Heat strengthened glass may be easily identified if the glass has been tinted. For high-rise commercial buildings built during the last thirty years and/or with large glass panes, it may be assumed that the glass is heat strengthened. **e Annealed Glass** While annealed glass is typically installed in older buildings built before 1960 (refer to age of building requested on Page 1), it is still often used for ❍ Single family residences ❍ Smaller multi-family apartment buildings ❍ Commercial buildings constructed prior to World War II or with multi-pane windows	

Table 11 Guidance on Vulnerability Assessment: 5. Building Envelope (continued)

5 Building Envelope (continued)		
ID	**Building Characteristics**	**Attribute Options**
5.5	**Wall Type** Wall type refers to the type of wall construction used on the building exterior to support the window and wall system (i.e., façade). The screener should determine the composition of the exterior wall through site observations and, if available, as-built drawing review. This information may also be ascertained through questioning of the site representative or facility engineer. If it is not known what the wall type is, the screener should select the option that is the closest to the options provided. **Cast-in-place reinforced concrete (Option a)** **Glass curtain wall (Option b) concealing the floor structure.**	**Options:** a. **Cast-in-Place Reinforced Concrete** - Reinforced cast-in-place concrete walls have a very solid appearance with punched windows. Often cast-in-place reinforced concrete walls are used in monumental construction or in high-seismic or high-wind-load areas. The concrete usually has an architectural textured finish, or has an applied veneer of natural stone slabs. b. **Curtain wall** - Glass curtain wall construction refers to a façade consisting of glass panels supported by metal framing. In some cases, instead of glass, the panels are light, insulated, metal panels. c. **Precast Panels/Reinforced Masonry** - Precast concrete panels can give the appearance of just about any material and be any color or architectural style. Reinforced masonry refers typically to concrete masonry unit (CMU) construction with steel reinforcing bars in the voids. Look for the vertical and horizontal seams between the panels, or evidence of the stacking of reinforced masonry blocks. These construction types are typically used for smaller office or government buildings. d. **Massive Unreinforced Masonry** – Older unreinforced masonry (URM) buildings with multi-wythe brick walls having a height-to-thickness ratio less than or equal to ten. Sometimes the brick is covered with stucco or other material that disguises the brick. Older buildings used for civic construction are often of this type of construction. e. **Light Frame or Slender Unreinforced Masonry** - Smaller brick residential or commercial buildings with height-to-thickness ratios more than ten. Light frame refers to wood or metal-stud construction with a light weight exterior wall like gypsum board covered with stucco. It also refers to Unreinforced Masonry Units (i.e., concrete blocks) or tile backed with plaster and lath.

Table 11 Guidance on Vulnerability Assessment: 5. Building Envelope (continued)

5 Building Envelope (continued)		
ID	**Building Characteristics**	**Attribute Options**
5.5 (cont)	Precast concrete panels (Option c) Example reinforced masonry building (Option c) Example massive unreinforced masonry building (Option d)	**Options (continued):**

Table 11 Guidance on Vulnerability Assessment: 5. Building Envelope (continued)

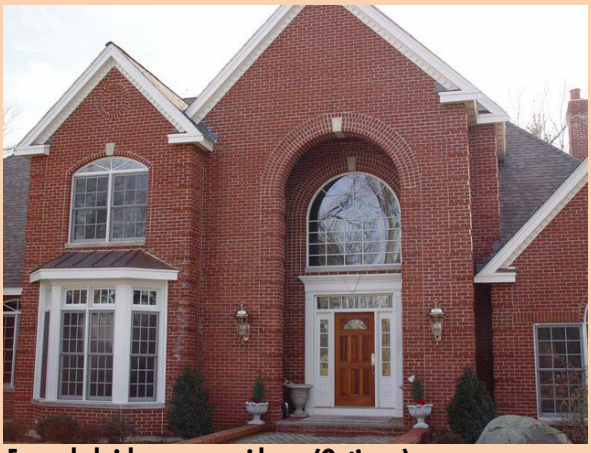
5 Building Envelope (continued)		
ID	**Building Characteristics**	**Attribute Options**
5.5 (cont)	 Example of light wood or metal frame (Option e) Example unreinforced masonry (brick) historic residential apartment row (Option e).  Example brick veneer residence (Option e) Photograph courtesy of Petrillo and Sons Corporation, North Reading, Massachusetts.	

Table 11 Guidance on Vulnerability Assessment: 5. Building Envelope (continued)

5 Building Envelope (continued)		
ID	**Building Characteristics**	**Attribute Options**
5.5 (cont)	**Wall Type (continued)** **Light Frame or Slender Unreinforced Masonry (Option e) buildings:-** Note that finished brick, stone, or ceramic tile are often used as a veneer over a sheet backing, which is attached to a wood, steel or concrete frame structure. Other identifying features of brick veneer buildings are: • brick layers that are not staggered • larger windows than traditional brick buildings • small keystones over arches for decoration • much newer then traditional brick buildings. • Over five stories high	

FEMA 455 DATA COLLECTION FORM, PAGE 7 — **VULNERABILITY ASSESSMENT (Part III)**

BUILDING CHARACTERISTICS		ATTRIBUTE OPTIONS					VULNERABILITY RATING FOR GIVEN THREAT SCENARIO								
							Internal			Explosive			CBR		
		a.	b.	c.	d.	e.	Intrusion	Explosive	CBR	Zone I	Zone II	Zone III	Zone I	Zone II	Zone III
5. BLDG. ENV.	5.6 Windborne Debris Impact Protection	Post Benchmark Year	All Other												
		0.02	0.16												
		0.03	0.31												
		0.07	0.67												
6. STRUCTURAL COMPONENTS AND SYSTEMS	6.1 Structural System	Reinf Conc Shear Wall or Bundled Tubes	Braced Exterior Frame	Frame w/ Core or Precast	Tilt-up or Frame w/ infill or Reinf. Masonry or Belt Truss	Lt. Metal Frame or Brick or Timber									
		0.04	0.32	0.36	0.40	0.43									
		0.03	0.23	0.26	0.29	0.31									
		0.07	0.49	0.57	0.62	0.67									
	6.2 Number of Bays in Short Building Direction	≥ 5	≥ 3 - < 5	< 3											
		0.04	0.35	0.43											
		0.03	0.27	0.33											
	6.3 Column Spacing (ft)	< 15	≥ 15 - < 25	≥ 25 - < 40	≥ 40 - < 60	≥ 60									
		0.04	0.32	0.36	0.40	0.43									
		0.03	0.24	0.28	0.31	0.33									
	6.4 Column Height (ft)	< 12	≥ 12 - < 24	≥ 24 - < 36	≥ 36										
		0.04	0.32	0.38	0.43										
		0.03	0.24	0.29	0.33										
	6.5 Publicly Accessible Column	None	Yes, Massive	Yes, Slender											
		0.04	0.35	0.43											
		0.03	0.27	0.33											
	6.6 Transfer Girder Conditions	None	Int. Girder Sup. 1 column	Int. Girder Sup. > 1 column	Ext. Girder Supporting 1 column	Ext. Girder Supporting > 1 column									
		0.09	0.63	0.73	0.80	0.86									
		0.06	0.46	0.53	0.58	0.63									
		0.13	0.96	1.10	1.21	1.3									
		0.07	0.51	0.58	0.64	0.69									
	6.7 Structural Enhancements & Weaknesses	Hardened	Robust	None	Marginal	Sub-standard									
		0.09	0.63	0.73	0.80	0.86									
		0.06	0.46	0.53	0.58	0.63									
		0.10	0.77	0.88	0.97	1.04									
		0.11	0.81	0.93	1.02	1.1									
V.3 SUB-TOTAL FOR VULNERABILITY RATING (V): Sum values in each column and enter on line V.3 on Vulnerability Assessment Rating (Part V)															

Figure 9 Page 7 of Data Collection Form, Vulnerability Assessment (Part III), Building Envelope and Structural Components and Systems Contributing to Vulnerability Rating.

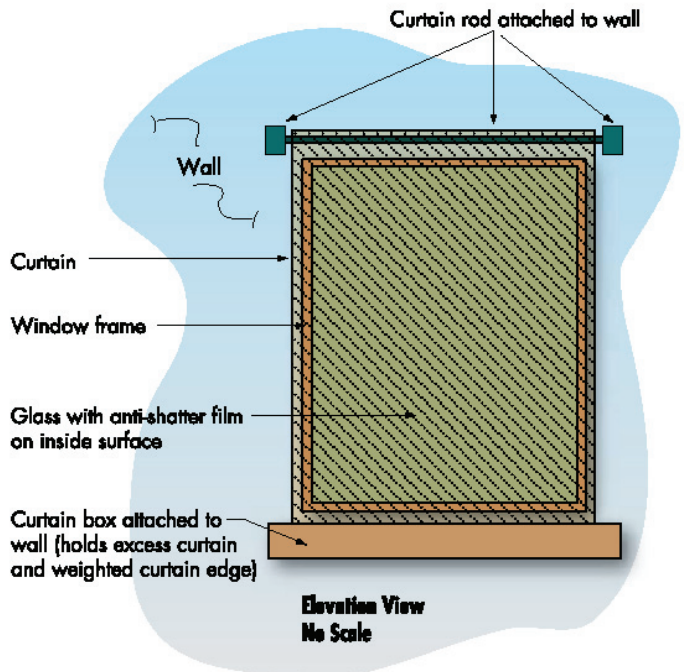
Table 11 Guidance on Vulnerability Assessment: 5. Building Envelope (continued)

5 Building Envelope (continued)		
ID	**Building Characteristics**	**Attribute Options**
5.6	**Windborne Debris Impact Protection** This characteristic refers to benchmark years for windborne debris impact protection, primarily established through code requirements after the year 2000, with some locations earlier. The table to the right may be used to identify the locations within a state where windborne debris impact is a consideration. The year in which these provisions were initiated are shown in the right most column.	**Options:** a **Post-benchmark year** – building was designed after bench-mark year, or has window screens that meet bench-mark year wind-borne debris impact standards. b **All other buildings**

State	Locality	Bench-mark Year*
ALABAMA	City of Mobile, and possibly some smaller communities	2001
CONNECTICUT	The jurisdictions of East Lyme, North Stonington, Ledyard, Old Lyme, New London, and Stonington	2007
DELAWARE	Sussex County East of the canal (in lieu of one mile from the coast)	2005
FLORIDA	Panhandle: one mile inland from the coast; in all other counties except Dade, Broward, and Palm Beach County: at least 5 miles inland from the coast	2002
	Dade and Broward Counties: at least 5 miles inland from the coast	1994
	Palm Beach County: at least 5 miles inland from the coast	1999
LOUISIANA	City of New Orleans	2003
MARYLAND	Worcester County (excluding Ocean City) within 1 mile of the Atlantic	2003
MASSACHUSETTS.	Within one mile from the coast except Boston	2005
NEW JERSEY	Within one mile from the coast	2003
NEW YORK	All of Long Island East of Riverhead, and within one mile from the North and South coasts of Long Island (except possibly NYC)	2003
NORTH CAROLINA	1,500 feet inland from Atlantic Ocean	2006
RHODE ISLAND	South of highway US 1 from the Connecticut border to Sauderstown (about midway on the south coast), including Block Island	2004
SOUTH CAROLINA	All counties seaward of the 120 mph Windspeed contour	2005
TEXAS	All areas seaward of the Intercoastal Waterway (mostly Barrier Islands)	1998
	First tier coastal counties (all of Calhoun, Chambers, and Galveston Counties; other 11 counties seaward of the 120 mph Windspeed contour, Defined as specific highways, mostly US 77 and US 59)	2003
VIRGINIA	Within one mile from the coast, excluding Chesapeake Bay	2005

* Year in which windborne debris impact protection code requirements were adopted and enforced. It is recommended that local building codes be consulted to verify these benchmark dates.

Table 11 Guidance on Vulnerability Assessment: 5. Building Envelope (continued)

5 Building Envelope (continued)		
ID	**Building Characteristics**	**Attribute Options**
5.6 (cont)	Window screens used to meet windborne debris impact can protect against impact due to explosive effects. An example of a screen used to resist explosions is shown to the right. Similar solutions are provided for hurricane protection. Buildings constructed prior to the benchmark years may be retrofitted to meet standards by using shutters, storm windows or a curtain system.	

STRUCTURAL COMPONENTS AND SYSTEMS

The ability of a screener to observe the building structure by way of a rapid visual screening will be limited by the extent to which the structure is covered by finishes, such as granite on the outside of the building or a tile ceiling on the inside of the building. As a result, the following steps should be taken to identify the structural characteristics that most closely represent the subject building:

- Review the structural as-built drawings, including renovations/upgrades, prior to the site visit or make arrangements to review them at the site. Drawings will provide the most detailed information about the building structure.
- Make arrangements for the building engineer to be available for the walkthrough and questioned while performing the site visit. It

is advisable to meet with the most senior building engineer who has been at the site the longest and would be knowledgeable in past renovations and upgrades.

- Request access to areas of the building where interior finishes are not present such as interstitial spaces, mechanical rooms and loading docks.
- Make arrangements for a ladder to be located within an unoccupied tenant space to remove a few ceiling tiles for observation of the underside of the structural floor system. It is advisable to perform this at the building perimeter and at a column line where both the exterior façade and its attachment to the structure could also be determined.

The above information-gathering measures should be arranged prior to the site visit, keeping time constraints in mind. Review of the building drawings and questioning of the building engineer may prove to be the most efficient, while performing site observations may be more time consuming but highly recommended when building drawings are unavailable.

The structural building characteristics addressed on the Data Collection Form (see Figure 9), and discussed below, are expected to be readily identifiable and have a strong influence on a building's performance when subjected to extreme loading scenarios generated by an explosive event, with potential for progressive collapse. Characteristic 6.7 *Structural Enhancements and Weaknesses* may be difficult to interpret. It is recommended that the screener review information in this section prior to the walkthrough, consult with the checklist of structural questions and commentary presented in FEMA 426, *Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings*, or consult with a knowledgeable professional.

The vulnerability of a structural system to an explosive event is dependent upon the magnitude of the air-blast shock wave as it loads walls, columns and floor/roof framing. Typically, air-blast loading causes localized damage that may in-turn initiate a progressive collapse. Progressive collapse is the spread of damage caused by the redistribution of loads to other supporting elements around a localized point of failure. As these elements are overwhelmed beyond their capacity, they fail and cause further damage.

Air-blast loading decreases exponentially with distance, with the closest structural elements to the explosive event sustaining more extreme

loading and severe damage than elements further away. Potential loading scenarios include: a package weapon within close proximity to a heavily loaded column whose failure initiates the successive failure of the floor framing it supports; failure of a weak façade wall due to a large exterior vehicle weapon threat that in-turn damages the perimeter bay of the floor system due to uplift loading; and failure of the floor system immediately above and below an interior weapon with debris that overloads floors below and causes their collapse.

Precast frames and shear wall buildings that consist of precast concrete planks, tees or double tees supported on precast girders and columns, with resistance to lateral loads provided by concrete shear walls, are especially vulnerable, primarily because the interconnection between structural elements is provided through rigid, non-ductile welded inserts that are susceptible to fracture under extreme loading conditions. These buildings are mainly parking garages or low- to mid-rise office facilities.

Guidance and information to how to choose between attribute options for the building characteristics pertaining to Vulnerability Rating of the structural components and systems are provided in Table 12. This table is useful during the field visit as a reference document.

Table 12 Guidance on Vulnerability Assessment: 6. Structural Components and Systems

6 Structural Components and Systems		
ID	**Building Characteristics**	**Attribute Options**
6.1	**Structural System** The structural system is what enables the building to support its own weight, the weight of the contents and resist loads due to wind and earthquake. Sometimes, the structural system is the same as the exterior envelope, but often it is not. If the exterior envelope is the 'skin' of the building, then the structural system is the 'bones' or skeletal frame of the building. It is what enables the building to remain standing even if the exterior envelope is pierced by explosive forces. **a Reinforced Concrete Shear Walls, or Bundled Tubes** **Shear wall buildings** typically have significant resistance to blast loads and airborne contaminants, particularly when the walls are solid along the entire perimeter. Walls with punched openings for windows, as shown in the photo on the following page, often have a structurally strong center core. While rare, solid perimeter-wall configurations may be more common in hot climates where concrete is used for energy conservation purposes.	**Options:** a **Reinforced concrete shear walls, or bundled tubes** – This option covers buildings having either reinforced concrete shear walls, or bundled tubes. **Shear wall** buildings may have solid, or "punched" exterior concrete walls along their perimeter, with modest-sized window openings, or may have shear walls along both interior and exterior wall lines at selected locations. **Bundled tube** buildings have structural systems that consist of vertical "tubes" that are "bundled" together; such buildings are designed so that in the event one of the "tubes" is severely damaged, the others will remain intact.

Table 12 Guidance on Vulnerability Assessment: 6. Structural Components and Systems (continued)

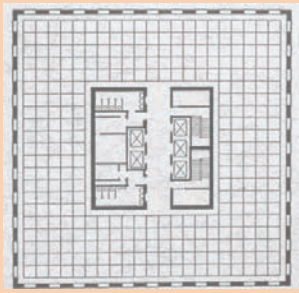
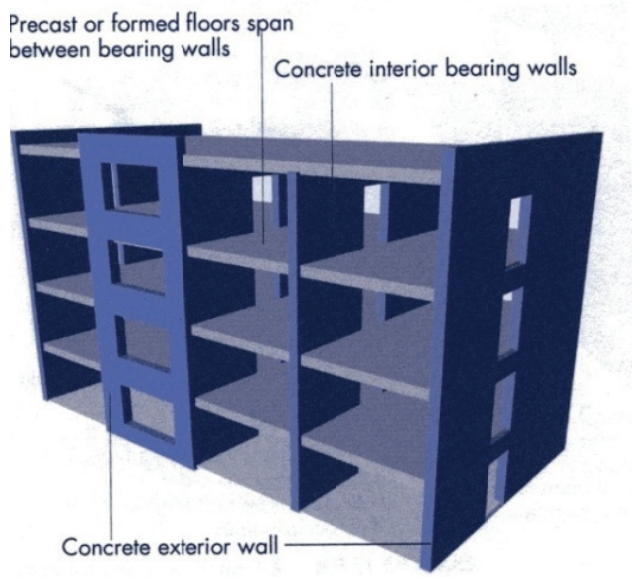
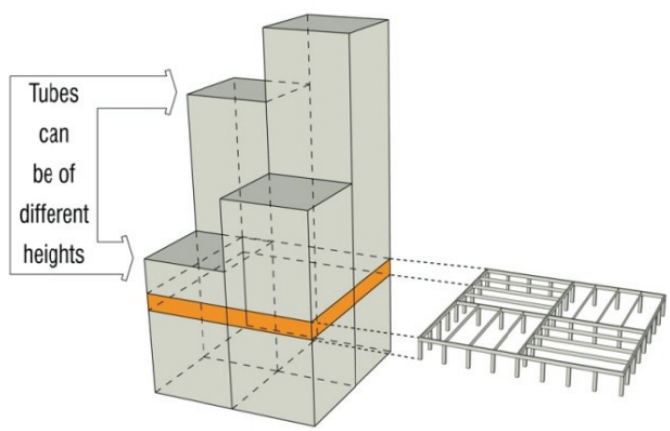
6 Structural Components and Systems (continued)		
ID	**Building Characteristics**	**Attribute Options**
6.1 (cont)	**Structural System (continued)** **Example reinforced concrete shear wall building (Option a)**  **Plan of reinforced concrete shear wall building with center core** Important note: Some older buildings may appear to have concrete shear walls, but in fact have walls of unreinforced masonry. See Option d. **Bundled Tubes.** This type of construction is typically used for very tall buildings in dense urban locations. It has a high level of redundancy because it is structurally compartmentalized so that it is able to localize damage by structurally isolating part of the structure from other parts. Note: this attribute option may also be used for buildings with other structural systems that are structurally compartmentalized in a way that significantly localizes the damage to a building.	**Options (Continued):** a **Reinforced concrete shear walls, or bundled tubes (continued)**  Three-dimensional schematic of building with reinforced concrete shear walls along selected interior and exterior wall lines (Option a)  Schematic of bundled tube structure, with closely spaced exterior columns between each window (Option a). Illustration courtesy of David Shafer, Architect.

Table 12 Guidance on Vulnerability Assessment: 6. Structural Components and Systems (continued)

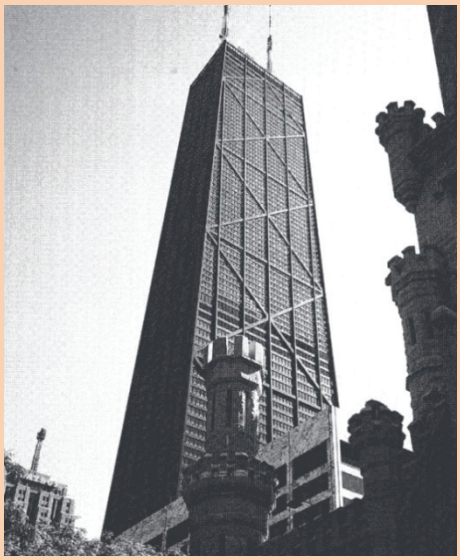
6 Structural Components and Systems (continued)		
ID	**Building Characteristics**	**Attribute Options**
6.1 (cont)	**Structural System (continued)** **Example bundled tube building (Option a)** **b Braced Exterior Frame Buildings** Often the braces are exterior to a glass curtain wall and may be easily identified by visual observation.  **Example braced exterior frame building (Option b)**	**Options (Continued):** a **Reinforced concrete shear walls, or bundled tubes (continued)** b **Braced exterior frames** - This type of construction contains braced exterior frames that provide lateral support throughout the height of the building.

Table 12 Guidance on Vulnerability Assessment: 6. Structural Components and Systems (continued)

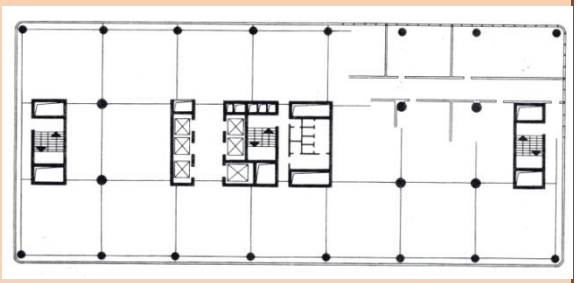
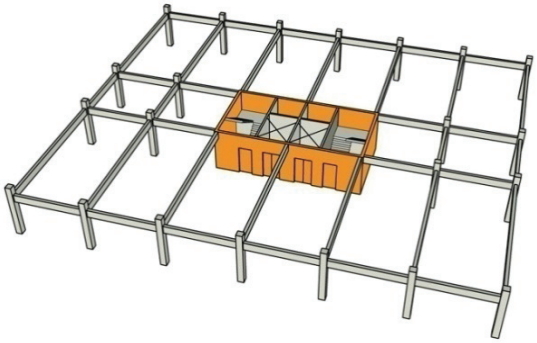
6 Structural Components and Systems (continued)		
ID	**Building Characteristics**	**Attribute Options**
6.1 (cont)	**Structural System (continued)** **c Frame with Core, or Precast** **Frame with core** is a common type of structural system used for office buildings. The core can often be seen through the exterior windows, or by inspecting the lobby. When a glass curtain wall is used on the exterior of the building without any solid areas of exterior walls, which is a common configuration, there is little protection against contaminants or explosive loads; therefore this building type is not considered very robust. All the structural strength is at the center of the building. In core buildings it is typical for the elevator shafts, stairwells, electrical conduit, and bathrooms to be placed in the core. Many design variations are possible: large plan buildings may have two or more cores, small plan buildings may have clear span framing from core to perimeter, and irregular shaped plans can be accommodated.  **Plan of office building with center core and end stairs (Option c)** **Office building with central core (Option c).**	**Options (Continued):** c **Frame with core, or precast** - This option covers buildings having either a frame with a strong structural core, or a structural system composed of precast concrete panels and elements. In **frame-with-core** systems, the core acts like a backbone to the building and provides lateral support, with the frame serving as the ribs and an exterior frame supporting curtain walls. The frame may be constructed of steel or reinforced concrete. **Precast** concrete buildings typically consist of precast concrete planks, tees or double tees supported on precast girders and columns; concrete shear walls provide lateral-load resistance.  Typical frame with strong structural core (Option c). Illustration courtesy of David Shafer, Architect.

Table 12 Guidance on Vulnerability Assessment: 6. Structural Components and Systems (continued)

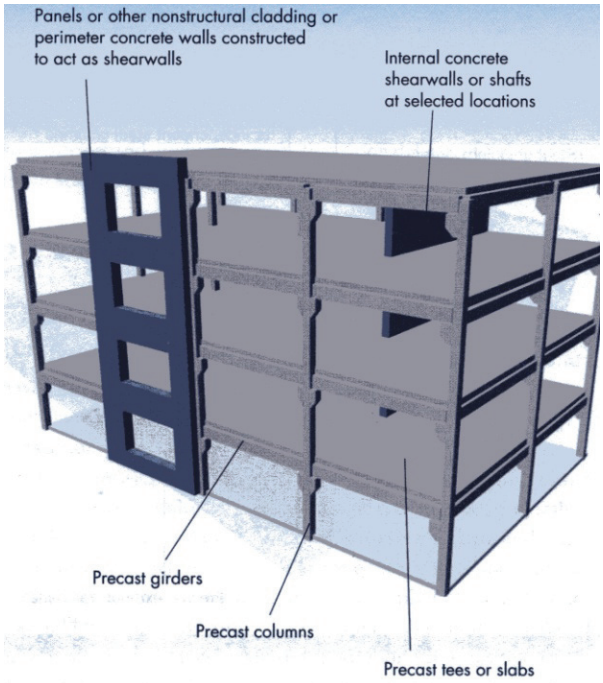
6 Structural Components and Systems (continued)		
ID	**Building Characteristics**	**Attribute Options**
6.1 (cont)	**Structural System (continued)** **Precast concrete** buildings can be especially vulnerable if interconnection between structural elements is provided through rigid, non-ductile welded inserts that are susceptible to fracture under extreme loading conditions. Structural systems of this type are mainly used for parking garages or low- to mid-rise office buildings. **Example of precast parking structure (Option c)** In some cases, an "egg crate" design may be used, in which precast shear walls are used instead of columns to separate the bays; in these instances, the building may have significant ductility if the connections are robust. This type of construction is typically used for residential construction where large open spaces are not required. Note that precast concrete systems, as described herein, are also termed structural precast, which is different from architectural precast that is used as exterior cladding for the facade. Structural precast refers to the skeletal structure of the building.	**Options (Continued):** c **Frame with core, or precast (continued)**  Three-dimensional schematic of building with structural precast girders and columns; shear walls at selected locations resist lateral loads (Option c)

Table 12 Guidance on Vulnerability Assessment: 6. Structural Components and Systems (continued)

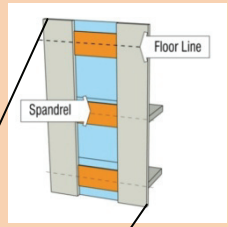
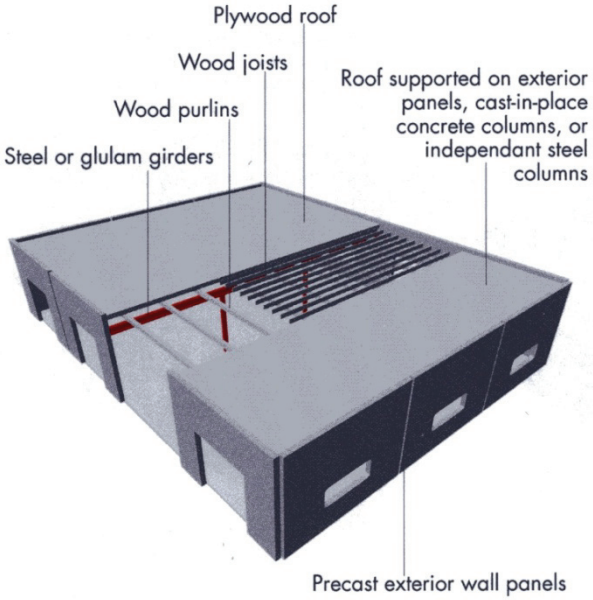
6 Structural Components and Systems (continued)		
ID	**Building Characteristics**	**Attribute Options**
6.1 (cont)	**Structural System (continued)** **d Precast tilt-up, Frame with Infill, Reinforced Masonry, or Belt Truss** **Precast tilt-up** construction is typically used for mixed use office, manufacturing and warehouse, or large retail facilities. Such buildings are low-rise (between one and three stories). Perimeter walls resist lateral loads and, in some cases, braced frames are located in the interior to support large-span roof and floor diaphragms. **Example of precast tilt-up R&D building (Option d)** **Frame buildings with infill** are typically pre-1950s vintage steel frame structures, in which the entire steel frame is cast within concrete for fire-proofing purposes and then clad with a brick or stone veneer; in other instances the perimeter frames are fully encased in exterior unreinforced masonry. The infill in this case may not be well connected into the frame and therefore can fail easily in the event of an explosive attack. In many cases, a distinguishing feature of this construction type are spandrels between column lines.  **Steel frame with infill spandrel diagram (Option d). Illustration courtesy of David Shafer, Architect.**	**Options (Continued):** d **Precast tilt-up, or frame with infill, or reinforced masonry, or belt truss** - This option covers buildings having one of the following types of structural systems: (1) precast tilt-up, (2) concrete or steel frame with unreinforced masonry infill walls, (3) reinforced masonry walls, or (4) framing system with diagonal bracing at selected locations. **Precast tilt-up** buildings are low-rise, with precast concrete perimeter panels that are cast on site and tilted up into place. Floor and roof framing is of light frame construction. **Frame with infill** buildings are typically older steel frame structures with concrete or masonry infill between exterior columns. **Reinforced masonry** wall buildings are typically low- or mid-rise, with reinforced grouted brick or concrete block masonry walls that support floor and roof framing. **Belt truss** systems, which contain diagonal bracing at selected floor levels, are typically used in high-rise construction.  Three-dimensional schematic of building with precast tilt-up construction (Option d)

Table 12 Guidance on Vulnerability Assessment: 6. Structural Components and Systems (continued)

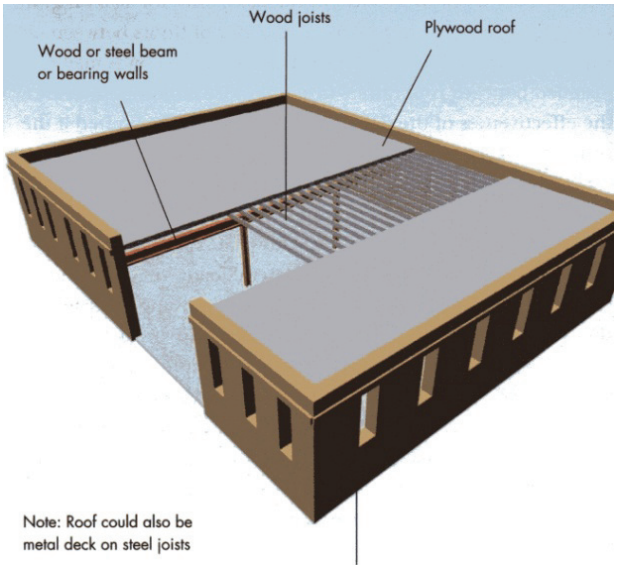
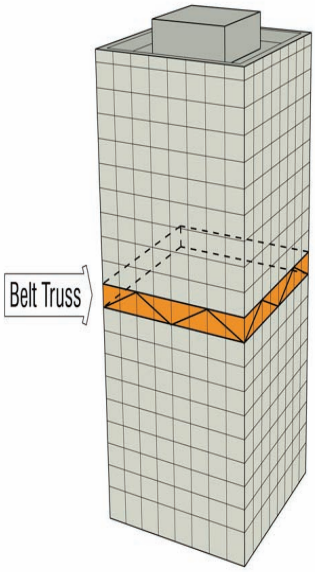
6 Structural Components and Systems (continued)		
ID	**Building Characteristics**	**Attribute Options**
6.1 (cont)	**Structural System (continued)** **Reinforced Masonry** wall buildings generally have punched openings with substantial wall area and light-frame floor/roof construction. This structural system type is often used in instances where building function is more important than the appearance. It may be used for educational, governmental or health facilities, but is typically not used for high-rise construction. The masonry may be disguised by the façade, so some internal inspection may be needed to confirm this construction type. **Example of reinforced masonry school (Option d)** **Belt Truss** construction in high-rise buildings typically consists of diagonal braces at selected floor levels, which may be visible on the building exterior, or hidden by louvers. Often belt trusses are located at mechanical equipment floor levels because there aren't any windows at these levels, and extra bracing may be needed due to a larger floor-to-floor height required for mechanical equipment. **Mid-height mechanical equipment floor (Option d)**	**Options (Continued):** d **Precast tilt-up, or frame with infill, or reinforced masonry, or belt truss (continued)**  Three-dimensional schematic of building with reinforced masonry construction (Option d)  Three-dimensional schematic of building with belt truss (Option d). Illustration courtesy of David Shafer, Architect.

Table 12 Guidance on Vulnerability Assessment: 6. Structural Components and Systems (continued)

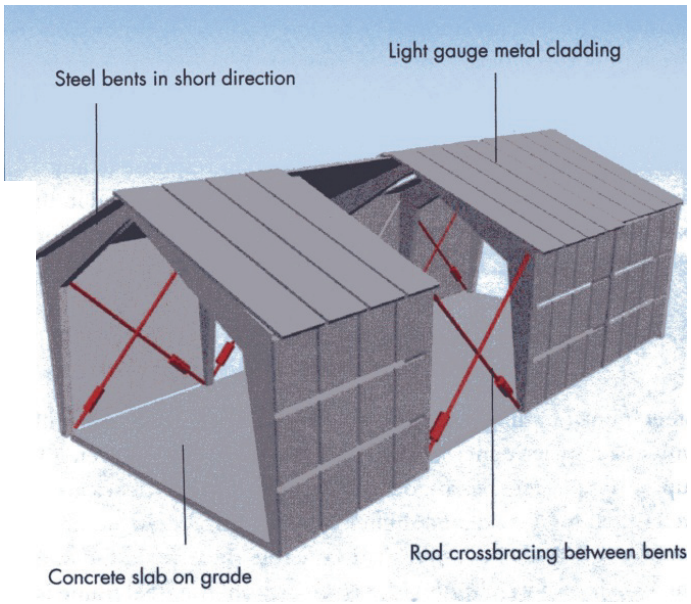
6 Structural Components and Systems (continued)		
ID	**Building Characteristics**	**Attribute Options**
6.1 (cont)	**Structural System (continued)** **e Light-Metal Frame, Brick, or Timber** **Light Metal Frame** buildings are one story and typically house mechanical equipment or storage. These buildings are clad in light-gage metal stud construction at roofs and walls that would have little resistance to very high explosive loads.	e **Light-metal frame, or brick, or timber** - This option covers buildings having one of the following types of structural systems: (1) light-metal frame, (2) unreinforced brick bearing wall, or (3) timber (wood) stick-frame or post and beam construction. **Light-metal frame** buildings are pre-engineered and pre-fabricated structures, with steel rod tension-only bracing in the longitudinal direction and tapered steel wide-flange moment-frames in the transverse direction. Unreinforced **brick** buildings are typically older structures with thick bearing perimeter walls and wood frame floors. **Timber** "stick frame" and "post and beam" structures are typically residential or office buildings.  Three-dimensional schematic of light metal frame (Option e)

Table 12 Guidance on Vulnerability Assessment: 6. Structural Components and Systems (continued)

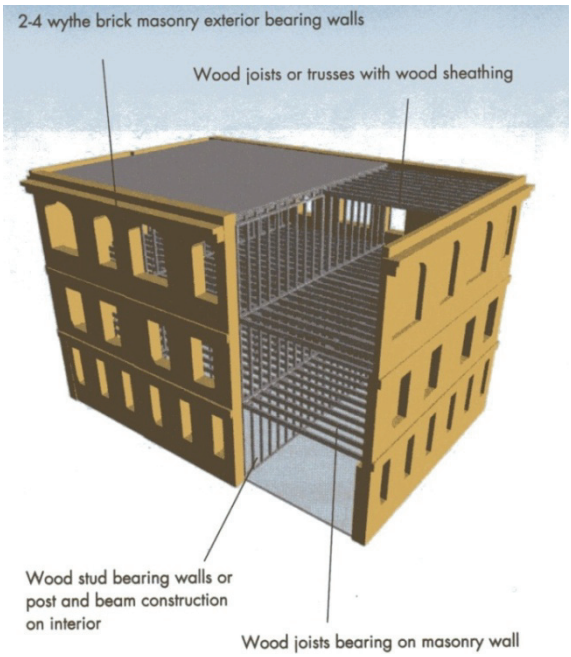
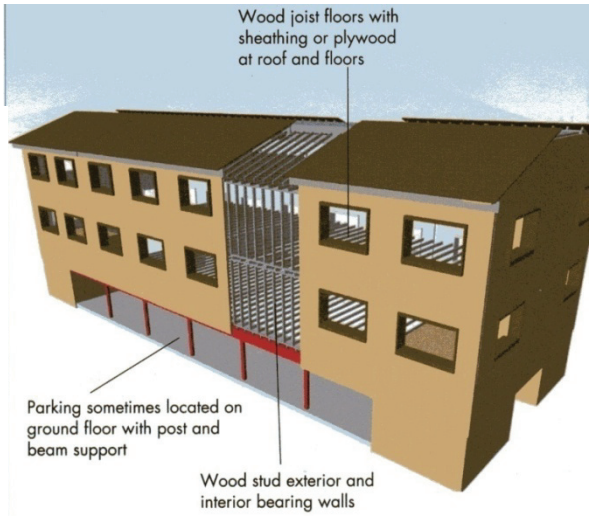
6 Structural Components and Systems (continued)		
ID	**Building Characteristics**	**Attribute Options**
6.1 (cont)	**Structural System (continued)** **Brick** masonry buildings are typically older buildings with little or no reinforcement within their walls and light-frame floor/roof construction. These buildings are differentiated from their reinforced counterparts by the thickness of their exterior walls. Reinforced masonry and cast-in-place bearing walls are typically 6-to-8 inches thick while unreinforced masonry walls can vary from 12 inches for one- or two-story buildings up to 24 inches for taller buildings. **Timber** buildings are either of "stick frame" or "post and beam" construction. Stick frame buildings are typically single-family or multi-unit residential buildings with exterior and interior bearing walls providing the principal means of gravity support. Post and beam buildings have larger volume interior spaces such as those in warehouses and low-rise institutional buildings. Deep beams or large wood-frame trusses span between 20 and 80 feet to large posts (8 inches or greater in each dimension). Wood-frame buildings are of "light" construction and do not possess the mass and strength needed to resist the effects of a relatively close-in explosive event. However, these buildings are highly ductile, with stick frame construction providing a good measure of redundancy that would be effective in resisting the impacts of a far-range explosive event and mitigating the potential spread of damage, avoiding progressive collapse. **Heavy timber, post and beam building (Option e)**	e **Light-metal frame, or brick, or timber (continued)**  Three-dimensional schematic of unreinforced brick masonry construction (Option e)  Three-dimensional schematic of wood frame residential type construction (Option e)

Table 12 Guidance on Vulnerability Assessment: 6. Structural Components and Systems (continued)

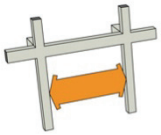
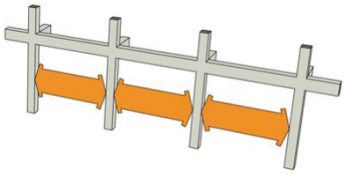
6 Structural Components and Systems (continued)		
ID	**Building Characteristics**	**Attribute Options**
6.2	**Number of Bays in the Short Building Direction** A "bay" refers to the space between two columns. In most cases, the building footprint is wider in one direction than in the other. The "short direction" refers to the smaller footprint direction. The number of bays in the short building direction is an indication of its ability to remain standing in the event of the loss of a primary supporting member such as a column. The higher the number of bays, the higher the chances are that it will withstand the loss of a column or other primary load carrying element. Note that the shorter building width does not always correspond to the number of bays. The bay sizes could be longer in one direction than in the other. Also note that the column spacing may be different on the building exterior than on the interior so the interior of the building should be inspected. **Example three bay buildings in short direction (Option b).** A small number of bays is common for casino hotels, which typically have a single long corridor with rooms on either side on each floor.	**Options:** a **5 or more bays** b **3 to less than 5 bays** c **less than 3 bays**   Option c**:** 1 bay (less than 3) Option b**:** 3 bays (3 to less than 5). Illustrations courtesy of David Shafer, Architect. Seven bay building in short direction (Option a) One bay building in short direction (Option c)

Table 12 Guidance on Vulnerability Assessment: 6. Structural Components and Systems (continued)

6 Structural Components and Systems (continued)		
ID	**Building Characteristics**	**Attribute Options**
6.3	**Column Spacing (ft)** The column spacing or structural bay size is the distance between column centerlines or bearing walls along each principal direction. Building columns and cross-walls that are closely spaced do not support as much of the weight of the building as those that are further apart due to the relative tributary area that each column supports from floor to floor. The screener should determine the typical spacing between columns/bearing walls in each principal direction and use the maximum of these values to determine the distance for use in completing the Data Collection Form. A laser distance measuring tool is helpful in the field for determining the column spacing. **Example of building with columns spaced 40-to-60 feet apart (Option d)**	**Options:** a **less than 15 feet** b **more than or equal to 15 ft, less than 25 ft** c **more than or equal to 25 ft, less than 40 ft** d **more than or equal to 40 ft, less than 60 ft** e **more than or equal to 60 ft** Building with columns spaced less than 15 feet apart for full height of building (Option a). Photograph courtesy of www.aviewoncities.com.

Table 12 Guidance on Vulnerability Assessment: 6. Structural Components and Systems (continued)

6 Structural Components and Systems (continued)		
ID	**Building Characteristics**	**Attribute Options**
6.4	**Column Height (ft)** The column height refers to the height of a column that is not braced by a floor system or by beams in two directions. Often the lobby area or the building exterior will have greater heights than typical floor levels. The column height is an indication of the stability of the structure. Taller columns, particularly if they are slender, will have a larger chance of failing in the event of an explosion than shorter or stouter columns. Select the worst case scenario for this Building Characteristic (i.e., pick the longest column supporting the most number of floor levels). Note that in some cases there may be very long columns that are not under the main foot print of the building and are supporting only a few floor levels. These are not the columns to select for this Building Characteristic. Instead select the longest column supporting the tower.	**Options:** a **less than 12 ft** b **more than or equal to 12 ft, less than 24 ft** c **more than or equal to 24 ft, less than 36 ft** d **more than or equal to 36 ft** Less than 12 ft column height (Option a) Column height in the 12-to-24 ft range (Option b)

Table 12 Guidance on Vulnerability Assessment: 6. Structural Components and Systems (continued)

6 Structural Components and Systems (continued)		
ID	**Building Characteristics**	**Attribute Options**
6.5	**Publicly Accessible Column** The vulnerability of publicly accessible columns to explosive loading depends on the exposure of the columns to a potential weapon and how much of the column (tributary area) would be loaded. Optional attributes for this building characteristic are 'none', 'yes, massive', and 'yes, slender', where 'massive' and 'slender' refer to column size. Slender refers to columns that have a height-to-width ratio of more than 5, and massive refers to columns that have a height-to-width ratio of less than 5. Slender columns are more common on modern and/or steel buildings, whereas massive columns are more common on older and/or concrete buildings. The existing column conditions vary, depending on the architecture and structural system of the building: ❍ *Protected* – Columns that are located behind and separated from the building facade and are enclosed by an architectural cover that extends at least 6 inches from face of column. ❍ *Inside Wall* – Columns that are part of the exterior building facade, such as a steel frame with concrete or masonry infill where the infill also serves as the exterior wall. ❍ *Bracing Curtain Wall* – Columns with an exterior curtain wall attached along its height, where the column would potentially be loaded for a full column bay width of area. **Example of massive, publicly accessible column in the basement of a concrete building (Option b)**	**Options:** a **None** b **Yes, massive** c **Yes, slender** Example of a publicly accessible massive column (Option b) Example of a publicly accessible slender column (Option c)

Table 12 Guidance on Vulnerability Assessment: 6. Structural Components and Systems (continued)

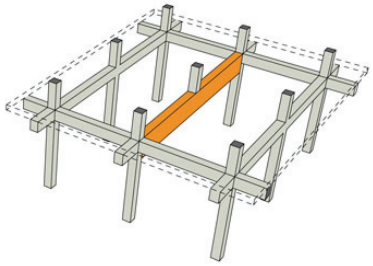
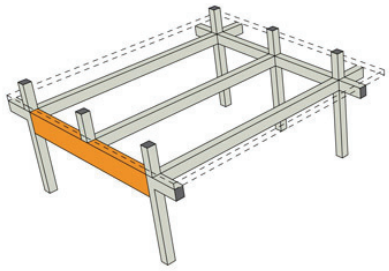
6 Structural Components and Systems (continued)		
ID	**Building Characteristics**	**Attribute Options**
6.6	**Transfer Girder Conditions** Transfer girders are typically long-span beams supporting a discontinuous column above. They typically span over high volume areas such as a main lobby, loading dock or auditorium. Transfer girders supporting an upper-story column may be especially hazardous if they support disproportionately large loads when compared to girders supporting floor areas at only one level. The failure of a transfer girder or the column that supports it could potentially initiate a progressive collapse, if the structural design does not otherwise provide a means to resist such a failure. Interior transfer girders are the most challenging to identify. Sometimes there is a very long clear span in the lobby of a building, which may be an indication that the above ground floors have closer column spacing. To verify this, it is helpful to look at the above ground floor levels to see if the long span exists everywhere or just on the ground level. Another indication of a transfer condition is if there is a regular spacing of columns in both directions, except for one location where it looks like a column is missing. In this case, attempt to verify that on the floor above there is not a column that is "missing". This Building Characteristic can be difficult even for trained structural engineers to identify with certainty, based on a visual inspection alone. Inspection of structural drawings by an engineer and a discussion with the site representative is necessary to verify these conditions. Additional guidance is also available in other FEMA Risk Management Series documents, including FEMA 426, *Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings.*	**Options:** a **None** – all columns are continuous from roof to foundation b **Interior girder supporting one column** – a beam/girder that spans over an interior space and supports one column above c **Interior girder supporting more than one column** – a beam/girder that spans over an interior space and supports more than one column d **Exterior girder supporting one column** – a beam/girder that is located along the perimeter of the building and is supporting one column above e **Exterior girder supporting more than one column** – a beam/girder that is located along the perimeter of the building and is supporting more than one column above **NOTE**: THIS BUILDING CHARACTERISTIC IS HEAVILY WEIGHTED IN THE SCORING. IT IS VERY IMPORTANT TO SELECT THE APPROPRIATE OPTION TO GET AN ACCURATE SCORING FOR THE BUILDING. Examples of transfer girder conditions:  Option b  Option d Illustrations courtesy of David Shafer, Architect.

Table 12 Guidance on Vulnerability Assessment: 6. Structural Components and Systems (continued)

6 Structural Components and Systems (continued)		
ID	**Building Characteristics**	**Attribute Options**
6.6 (cont)	**Transfer Girder Conditions (continued)**	 Example of transfer beam to create wide service entry at building exterior (Option d)
6.7	**Structural Enhancements and Weaknesses** This building characteristic is intended to account for enhancements or weaknesses that will serve to improve or downgrade performance of a structural system or individual elements (e.g., slabs, beams and columns). Inspection of structural drawings by an engineer and a discussion with the site representative are necessary to verify these options. If this is not possible, than assume Option c (None), unless the building being assessed is an older building that has not been maintained (as evidenced by cracked or broken exterior elements), in which case Option d (Marginal) or Option e (Substandard) should be selected. Note that certain public buildings built after 1993 in cities like New York City and Washington, DC, have undergone some level of required hardening.	**Options:** a **Hardened** - a building designed to resist the effects of explosive attack b **Robust** - a building designed or retrofitted to meet current extreme loading conditions related to high levels of hurricane or earthquake loads, or designed to resist progressive collapse c **None** - The building does not have any structural enhancements or weaknesses, as described by the other attribute options. This is the most common case. d **Marginal** - buildings designed using old versions of codes that are no longer considered acceptable for meeting serviceability conditions, or are designed using materials or connections that have been shown to perform poorly in abnormal loading situations. This option may be selected in some cases if the building has not been maintained well (e.g., corrosion or large cracks are visible). e **Substandard** - buildings that are designed to a level that has extremely little, if any, reserve strength to withstand any abnormal loads without catastrophic failure.

MECHANICAL/ELECTRICAL/PLUMBING (MEP)

Mechanical, Electrical and Plumbing systems are often not readily observable from the building exterior. A tour of the interior mechanical areas, review of drawings and an interview with the facilities manager is recommended to ensure that the vulnerability of these systems are captured during the screening process.

Four MEP building characteristics are addressed by the Data Collection Form (see Figure 10). Guidance and information to how to choose between attribute options for the building characteristics pertaining to Vulnerability Rating of the mechanical, electrical, and plumbing components and systems are provided in Table 13.

FEMA 455 DATA COLLECTION FORM, PAGE 8 — **VULNERABILITY ASSESSMENT (Part IV)**

BUILDING CHARACTERISTICS		ATTRIBUTE OPTIONS					VULNERABILITY RATING FOR GIVEN THREAT SCENARIO								
							Internal			Explosive			CBR		
		a.	b.	c.	d.	e.	Intrusion	Explosive	CBR	Zone I	Zone II	Zone III	Zone I	Zone II	Zone III
7. MECHANICAL/ELECTRICAL/ PLUMBING SYSTEMS	7.1 Primary External Air Intake Conditions	> 30 ft or Roof	>10 - ≤30 ft	>0 - ≤10 ft	Ground Level	Below Grade									
		0.03	0.24	0.27	0.30	0.32									
		0.37	2.73	3.12	3.43	3.7									
		0.62	4.57	5.23	5.76	6.2									
		0.53	3.91	4.47	4.92	5.3									
	7.2 Return Air Intake System	Ducted Secured	Ducted Accessible	Unducted	Subject to Buoyancy										
		0.12	0.85	1.02	1.15										
		0.15	1.09	1.31	1.48										
		0.30	2.21	2.66	3.00										
	7.3 Internal Air Distribution System	High Risk Separated	Multi-Zoned/ Single System Ducted	Single System/ Unducted											
		0.12	0.93	1.15											
	7.4 Critical Utilities Located Close to High Risk Areas	No	Yes												
		0.04	0.43												
		0.02	0.16												
V.4 SUB-TOTAL FOR VULNERABILITY RATING (V): Sum values in each column and enter on line V.4 on Vulnerability Assessment Rating (Part V)															

Figure 10 Page 8 of Data Collection Form, Vulnerability Assessment (Part IV), Mechanical/Electrical/Plumbing Systems Contributing to Vulnerability Rating.

Table 13 Guidance on Vulnerability Assessment: 7. Mechanical/Electrical/Plumbing Systems

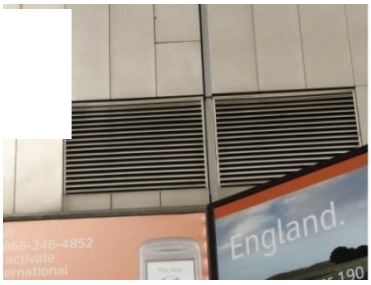
7 Mechanical/Electrical/Plumbing Systems		
ID	**Building Characteristics**	**Attribute Options**
7.1	**Primary External Air-Intake Conditions** The likelihood of a CBR contaminant being introduced into a building's air system is dependent on the accessibility to the building's external air-intake. Air-intakes are often located at ground level because mechanical rooms and garages are located at or below ground level in buildings. Some air-intakes are located below grade with sidewalk grates over them, and these are generally the most vulnerable if they are in public areas. Sometimes air-intakes at ground level service only the garage and not the critical equipment or occupied spaces. Wall-mounted intakes are usually covered with louvers. These are also vulnerable if they are at a height that can be easily accessed by a person on the sidewalk or street. The vulnerability of occupants to a CBR contaminant being introduced into a building's air-intake system depends on many variables such as prevailing winds, distance from the release, height of the building, air-pressure differential between inside and outside, and air-tightness of the facade. Another variable is the location of the air-intake along the height of the building. The screener should determine where air-intakes are located relative to the exterior of the building. Once air-intakes are located, the screener should determine which of the five options indicated best represents the existing condition. It should be noted that the rapid visual screening procedure for assessment of exterior air-intake conditions is intended as an initial assessment, and is not comprehensive. More detailed investigation of this issue should be performed by a security expert with extensive experience in performing complicated and exhaustive threat assessments of exterior air-intake conditions. **Mechanical rooms and intakes at upper floors of high-rise building (Option a)**	**Options:** a **Greater than 30 ft (above ground level) or roof** – The primary air-intakes are located on the roof of a building, at the third floor level, or higher b **Greater than 10 ft but less than or equal to 30 ft (above ground level)** - The air-intake is covered with a protective louver or grate with a minimum slope of 45 degrees c **Between ground level and less than or equal to 10 ft (above ground level) -** The air-intake is covered with a protective louver or grate with a minimum slope of 45 degrees, and is protected by security fencing maintaining access at least 30 feet away from the air intake louver d **At ground level** - the air-intake is in a public area that has surveillance as a means to deter delivery of a CBR contaminant e **Below grade, or at ground level with unrestricted access** **NOTE**: THIS BUILDING CHARACTERISTIC IS HEAVILY WEIGHTED IN THE SCORING. IT IS VERY IMPORTANT TO SELECT THE APPROPRIATE OPTION TO GET AN ACCURATE SCORING FOR THE BUILDING.  Air-intake about 15 ft above ground (Option b) Air-intake is above ground but less than 10 ft from ground surface (Option c)

Table 13 Guidance on Vulnerability Assessment: 7. Mechanical/Electrical/Plumbing Systems (continued)

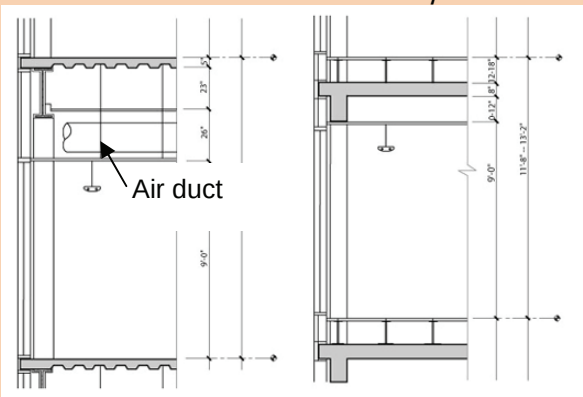
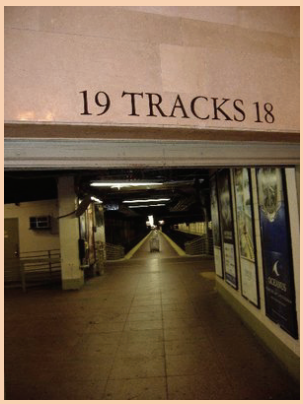
7 Mechanical/Electrical/Plumbing Systems (continued)		
ID	**Building Characteristics**	**Attribute Options**
7.2	**Return Air-Intake System** CBR filtration and detection are rare for all but the most high-risk buildings. If a building has CBR filtration and detection systems, it is likely not a suitable candidate for the rapid visual screening procedure and should have a more sophisticated assessment performed. It will be necessary to question the site representative or facility engineer to ascertain whether the return air system is ducted or unducted. Ducted return air is less vulnerable than unducted or plenum air systems that are, for instance, under the floor or through corridors. The following sketches of typical building cross sections illustrate the difference between ducted and unducted air return systems.  **Ducted air return system (Option b)** **Unducted air system (Option c)** 'Subject to Buoyancy' is an attribute option that relates mainly to connecting tunnels. For example in a building that is connected to an adjacent subway station by a tunnel, buoyancy-driven flows will transport contaminants from the subway into the building under certain conditions. (Typically buoyancy only pertains to buildings where there is a train station under the building.)  **Subject to buoyancy condition (Option d)**	**Options:** a **Ducted secured** - air-handling equipment rooms are ducted and inaccessible in secure observable locations b **Ducted accessible** - the air-return system is ducted but accessible to the public c **Unducted** - the air-return system is unducted d **Subject to buoyancy** - the air-return system is subject to buoyancy because the building is situated above a tunnel (e.g., subway tunnel) **NOTE**: THIS BUILDING CHARACTERISTIC IS HEAVILY WEIGHTED IN THE SCORING. IT IS VERY IMPORTANT TO SELECT THE APPROPRIATE OPTION TO GET AN ACCURATE SCORING FOR THE BUILDING. Ducted accessible air return system (Option b) Unducted floor air return system (Option c)

Table 13 Guidance on Vulnerability Assessment: 7. Mechanical/Electrical/Plumbing Systems (continued)

7 Mechanical/Electrical/Plumbing Systems (continued)		
ID	**Building Characteristics**	**Attribute Options**
7.3	**Internal Air Distribution System** High-risk areas such as lobby, loading dock, mail room and retail spaces within a building pose a potential for introduction of a CBR contaminant into the internal air distribution system. It will be necessary to question the site representative or facility engineer to ascertain the design of the internal air system and determine the most appropriate attribute option for this building characteristic.	**Options** a **High Risk Separated** – areas of high risk that have their own dedicated HVAC system and are maintained with positive pressure to less secured areas of the building b **Multi-Zoned/Single System Ducted** - there is only one HVAC system serving the entire building and it is ducted c **Single System/Unducted** - there is only one HVAC system serving the entire building and it is unducted **NOTE**: THIS BUILDING CHARACTERISTIC IS HEAVILY WEIGHTED IN THE SCORING. IT IS VERY IMPORTANT TO SELECT THE APPROPRIATE OPTION TO GET AN ACCURATE SCORING FOR THE BUILDING.
7.4	**Critical Utilities Located Close to High Risk Areas** Protecting critical utilities will serve to mitigate post-event hazards, such as fire, and expedite evacuation and search and rescue efforts by emergency responders. Critical Utilities include: (1) emergency generators including fuel systems, day tank, fire sprinkler and water supply; (2) normal fuel storage; (3) main switchgear; (4) telephone distribution & main switchgear; (5) fire pumps; (6) building control centers; (7) uninterrupted power supply (UPS) systems controlling critical functions; (8) main refrigeration systems if critical to building operation; (9) elevator machinery and controls; (10) shafts for stairs, elevators, and utilities; and (11) critical distribution feeders for emergency power. It will be necessary to question the site representative or facility engineer to ascertain the location of critical utilities. Once located, the exposure to a potential threat and the implication of losing function should be evaluated using the 'no' and 'yes' options provided.	**Options**: a **No** - critical utilities are located at least 50 feet away from high-risk areas that include lobbies, loading docks, mailrooms and parking, or are separated by a hardened partition wall (i.e., reinforced concrete or concrete masonry block wall anchored to floor framing at top and bottom b **Yes** - critical utilities are located within 50 feet of high risk areas and are not separated by a hardened partition wall **NOTES**: A. THIS BUILDING CHARACTERISTIC IS HEAVILY WEIGHTED IN THE SCORING. IT IS VERY IMPORTANT TO SELECT THE APPROPRIATE OPTION TO GET AN ACCURATE SCORING FOR THE BUILDING. B. IT IS RECOMMENDED THAT THIS INFORMATION BE OBTAINED FROM A KNOWLEDGEABLE SITE REPRESENTATIVE.

SECURITY

Part V of the Vulnerability Assessment Rating portion of the Data Collection Form (see Figure 11) addresses security issues and characteristics.

The effectiveness of security systems is highly dependent on proper design as well as operational and training procedures in place. Because of this, it is worthwhile for the screener to have some basic understanding of security principles. It is also recommended that security personnel are interviewed during the screening. Review of security systems documentation may also be of help.

FEMA 455 DATA COLLECTION FORM, PAGE 9 — **VULNERABILITY ASSESSMENT (Part V)**

BUILDING CHARACTERISTICS				ATTRIBUTE OPTIONS					VULNERABILITY RATING FOR GIVEN THREAT SCENARIO								
									Internal			Explosive			CBR		
				a.	b.	c.	d.	e.	Intrusion	Explosive	CBR	Zone I	Zone II	Zone III	Zone I	Zone II	Zone III
8. SECURITY	8.1 Internal Threat	8.1.1 Intrusion	8.1.1.1 Number of Detection Systems	≥ 3 Systems	2 Systems	1 System	None										
				0.12	0.90	1.08	1.216										
			8.1.1.2 Overall Security Effectiveness	Highly Effective	Effective	Meets Min. Requirements	Ineffective	No Security									
				0.49	3.58	4.10	4.52	4.864									
		8.1.2 Explosion	8.1.2.1 Number of Detection Systems	≥ 3 Systems	2 Systems	1 System	None										
				0.05	0.39	0.48	0.536										
			8.1.2.2 Overall Security Effectiveness	Highly Effective	Effective	Meets Min. Requirements	Ineffective	No Security									
				0.21	1.58	1.81	1.99	2.144									
		8.1.3 CBR	8.1.3.1 Number of Detection Systems	≥ 3 Systems	2 Systems	1 System	None										
				0.09	0.65	0.78	0.884										
			8.1.3.2 Overall Security Effectiveness	Highly Effective	Effective	Meets Min. Requirements	None	No Security									
				0.35	2.61	2.98	3.28	3.536									
	8.2 Zone 1 Threat	8.2.1 Explosion	8.2.1.1 Number of Detection Systems	≥ 3 Systems	2 Systems	1 System	None										
				0.03	0.22	0.26	0.294										
			8.2.1.2 Overall Security Effectiveness	Highly Effective	Effective	Meets Min. Requirements	Ineffective	No Security									
				0.12	0.87	0.99	1.09	1.176									
		8.2.2 CBR	8.2.2.1 Number of Detection Systems	≥ 3 Systems	2 Systems	1 System	None										
				0.07	0.53	0.64	0.724										
			8.2.2.2 Overall Security Effectiveness	Highly Effective	Effective	Meets Min. Requirements	Ineffective	No Security									
				0.29	2.13	2.44	2.69	2.896									
V.0 SUB-TOTAL FOR VULNERABILITY RATING (V): Sum values in each column and enter here																	
V.1 SUB-TOTAL FOR VULNERABILITY RATING (V): Enter values for each column from line V.1 on Vulnerability Assessment Rating (Part I)																	
V.2 SUB-TOTAL FOR VULNERABILITY RATING (V): Enter values for each column from line V.2 on Vulnerability Assessment Rating (Part II)																	
V.3 SUB-TOTAL FOR VULNERABILITY RATING (V): Enter values for each column from line V.3 on Vulnerability Assessment Rating (Part III)																	
V.4 SUB-TOTAL FOR VULNERABILITY RATING (V): Enter values for each column from line V.4 on Vulnerability Assessment Rating (Part IV)																	
V.5 TOTAL VULNERABILITY RATING (V): Sum values from lines V.0, V.1, V.2, V.3, and V.4 and enter total for each Threat Scenario in column V on Risk Scoring Worksheet																	

Figure 11 Page 9 of Data Collection Form, Vulnerability Assessment (Part V), Security Characteristics Contributing to Vulnerability Rating.

Security building characteristics apply only for internal threats or external threats within 100 feet (i.e., within Zone 1). Security building characteristics are also a function of the scenario, i.e., intrusion, explosive or CBR. In total, five of the nine scenarios are affected by security measures:

- 3 scenarios for Internal Threats – Intrusion, Explosive Zone 1, CBRZone 1; and
- 2 scenarios for External Threats – Explosive, CBR

Vulnerability assessment of the security characteristics begins with a review of the security-related detection systems available in the building and the determination of the effectiveness of each system. Detection systems considered by the assessment process are described in Table 14, and effectiveness criteria are provided in Table 15. The screener initially characterizes the overall effectiveness of the detection systems and documents the effectiveness on the Security Vulnerability matrix, which is provided in Figure 12. The objective of this initial step is to assess the ability of a given security system in thwarting intrusion, explosive or CBR threat separately.

The screener then documents the number and effectiveness of the security detection systems on the Data Collection Form (Field Version). The screener should note that, at tightly controlled sites, there may be more than one layer of security system. For instance there may be security guards at the site entrance and at the garage entrance. In this case, the screener may decide that there are two systems operating, one at each layer of security. It is also noteworthy that certain systems may be effective for detecting one type of threat, but not another. For instance, an electronic screening system may be effective for detecting an explosive but not a CBR threat.

Table 16 provides guidance and information to assist in selecting attribute options pertaining to Vulnerability Rating of the Security system(s). The information is organized first by threat type, and then threat scenario, which is different from the formulation used for other aspects of the Vulnerability Rating. For each of the five threat scenarios affected by security measures (see above), two building characteristics are defined:

- Number of Detection Systems; and
- Overall Security Effectiveness.

Table 14 Building Security Detection Systems and Desired Attributes

Intrusion Detection	❍ The facility has perimeter intrusion alarms ❍ Intrusion alarms around the perimeter are of the following types: contact sensors, motion sensors, cameras with motion sensors; or an equivalent system ❍ Intrusion alarms function in the manner appropriate for the facility ❍ The alarms are tested frequently ❍ The alarm system is locally audible when activated ❍ The alarm system and/or major components of the alarm system are younger than their design life. ❍ The alarm system is approved by Underwriters Laboratories, Inc. (UL approved) ❍ Output from the intrusion sensors and/or detection devices are transmitted outside the facility
Video Surveillance and Assessment	❍ The perimeter is monitored by cameras ❍ The cameras are functioning as required by facility ❍ The cameras are in protective housing ❍ The cameras monitor and record on a 24 hours/day, 7 days/week basis ❍ The cameras are tested frequently ❍ Cameras are present at the following locations o Entrance gate that is manned or unmanned if the facility is in a suburban area and has grounds before one reaches the building(s) o The perimeter of the building envelope monitoring areas such as entrances/exits, internal fire exits and any utility such as electric boxes o HVAC intakes, if accessible from the ground. o Entrance to any parking area, especially if underground o The lobby areaa o Turnstile or other access screening area o Elevator lobby o Loading dock o Mail room entrance (if entrance is external)
Security Guards Key attributes for this system type are the number and placement of guards at the public access points for pedestrians and vehicles. Also of importance is the visual inspection of people and contents as they enter on to the property or into the building. Security guards locations depend very much on the current needs of that facility. Generally, they should be found at an entrance gate (if there is one), within the lobby at the reception desk and at the screening point to the core of the building (i.e., turnstiles or other type of entrance).	❍ There are security guards at the facility ❍ Security guards are monitoring or patrolling the perimeter ❍ Security guards are on site 24 hours/day, 7 days/week ❍ Security guards are in uniform or dress suit attire ❍ Security guards possess communication devices ❍ There is a combination of static and roving posts ❍ The security guard system meets license requirements of the state ❍ Security guards have received a formal training program and it is on going ❍ Security guards are stationed at access points and are examining documentation of the drivers to verify authorization ❍ Security guards physically inspect vehicles ❍ Security guards positioned at access points are armed ❍ Security guards that control the active barriers are stationed in a protective structure/building or ballistic resistant booth

Table 14 Building Security Detection Systems and Desired Attributes (continued)

Security Lighting The two primary purposes of lighting are to create a psychological deterrent to intrusion and to enable detection. It is recommended that the screeners visit the site at night to see how effective the lighting is. For this building characteristic, only proprietary lighting is to be considered, not municipal provided lighting.	❍ There is external proprietary lighting at the perimeter, exterior of building envelope, entrances, emergency exits, and parking areas ❍ The lighting appears adequate in order to identify vehicles and pedestrians at the aforementioned areas ❍ The lighting properly illuminates all facility roads ❍ Perimeter illumination is adequate for the exterior "clear zone" area (if applicable) ❍ The perimeter illumination scheme consists of overlapping cones of light ❍ The facility has a separate emergency lighting system that activates when the main lighting fails ❍ There is adequate exterior and interior lighting to provide a safe and secure environment for facility operations ❍ All exits are equipped with emergency lights and illuminated exit signs ❍ Protective lighting is tested periodically ❍ All switch boxes, photoelectric cells, and/or automatic timers are secure ❍ Someone is assigned responsibility for immediate replacement of burned out luminaries ❍ The current security lighting system is cost effective ❍ There is an emergency back-up power system for the protective lighting system ❍ Emergency lighting is available for the data center if a power failure should occur ❍ The facility's power supply is monitored to detect the occurrence of electrical transients ❍ Emergency lighting in all facility areas illuminates fire extinguishers even if there is a power outage
Vehicle Access Control and Screening This security-system addresses the control of vehicles to ensure that only employees and authorized visitors are permitted entry to the site or building. Secure vehicle access points are entrances that are physically protected using technology, security personnel, and/or active barriers at the locations where vehicles are permitted onto the property.	❍ There are procedures for inspecting all vehicles permitted within the perimeter zone ❍ Vehicles are searched when entering the perimeter zone ❍ Vehicles are searched when leaving the perimeter zone ❍ All individual members of a group entering or leaving the perimeter zone in the same vehicle are checked for authorization and identification ❍ The access points are monitored by video assessment and surveillance systems (i.e., cameras) ❍ The access points are electronically controlled (e.g., active vehicle anti-barrier, access card) ❍ X-ray or CBR detection equipment is used for screening; dogs may be used to inspect vehicles/packages
Pedestrian Access Control and Screening This security system addresses the control of pedestrians to ensure that only employees and authorized visitors are permitted entry to the site or building. Secure pedestrian access points are entrances that are physically protected using technology, security personnel, and/or active barriers at the locations where pedestrians are permitted onto the property and into secure areas.	❍ Security personnel control all perimeter openings to the facility ❍ There is a designated individual responsible for authorizing building entry, including when it is unattended ❍ There is a procedure to control badges, keys, combinations, and/or cards used for entry to the facility ❍ Authorization lists and control mechanisms allowing entry into the facility are updated when a person's authorization for entry has been revoked ❍ There are effective procedures in place for authorizing perimeter zone entry ❍ There is an independent verification of the requests for perimeter entry authorization ❍ Positive identification is required for a person to receive authorization for perimeter entry ❍ Entrances or gates to the perimeter are zone controlled ❍ All entrances to the perimeter zone are controlled during normal working hours ❍ All entrances to the perimeter zone are controlled after normal working hours ❍ All entrances to the perimeter zone are controlled during emergencies

Table 14 Building Security Detection Systems and Desired Attributes (continued)

Pedestrian Access Control and Screening (continued)	❍ Entry to the perimeter zone is controlled by a guard(s) ❍ Entry to the perimeter zone is permitted by a guard (i.e. verifying ID from a list, visual recognition, checking badge) ❍ The access points are monitored by video assessment and surveillance systems (i.e., cameras) ❍ The access points are electronically controlled (e.g., active vehicle anti-barrier, access card)
Package Screening	❍ Vehicles are screened by a security guard before they are permitted entry ❍ A mirror is used to inspect the undercarriage of any entering vehicles ❍ The interior of any entering vehicles is inspected ❍ The shipping/receiving area or building is surrounded by a fence with a controlled access gate ❍ Access to all loading and unloading areas and platforms is strictly controlled ❍ All loading and unloading areas and platforms are designed so vehicle operators do not have direct access to merchandise storage areas without passing through a monitored area such as shipping or receiving processing office ❍ All freight doors are secured when not in immediate use ❍ Security officers regularly patrol the shipping/receiving areas ❍ The receiving and shipping areas are physically separated ❍ There are separate areas for employee and visitor parking ❍ All parking and building areas are well lit ❍ There are surveillance cameras located in the inventory area ❍ All areas are covered by a monitored intrusion alarm ❍ Employee's entrances are monitored by electronic access controlled keypads that record all employee pass code transactions ❍ Employee pass code transaction records are regularly reviewed by security for irregularities ❍ All shipments are loaded and unloaded only by company personnel ❍ All shipments are checked against the corresponding manifests to insure that all merchandise items listed are physically accounted for ❍ There is an established procedure for inspecting merchandise at the beginning and end of a trip or route ❍ There are special procedures and documentation for removing packages from an area or building ❍ An individual has been assigned direct responsibility for the supervision and monitoring of high value storage areas ❍ There are special inspection procedures for personnel or merchandise entering an area such as metal detectors, X-ray, BCR machines, or dogs ❍ There are cameras strategically located at the screening areas

Table 15 Examples of Building Security System Effectiveness Criteria

Example Criteria Regardless of how many security systems are provided, if they are not effective, they are will not be helpful for thwarting attacks. The criteria provided to the right are examples of criteria that render security systems effective.	❍ Vehicle access points have been minimized ❍ Employee and public vehicle entry points are separated ❍ Access points are designed so that a vehicle denied access can be safely turned away from the facility. ❍ The deportment of guards is professional and alert as opposed to guards that lean against walls or are unobservant. ❍ Active barrier are activated at all times except when an authorized vehicle is permitted into the facility. ❍ Redundant systems are provided ❍ The loading dock is designed so that vehicles refused entry can exit without first entering the facility ❍ There are separate entrances for truck and pedestrian deliveries ❍ The loading dock is located on the ground floor, away from any major entrance or exit. ❍ There is adequate queuing, which is well placed, so trucks are not lined up in front of the building

	8.1 Internal Threat			8.2 External Threat (Zone 1)	
Systems	8.1.1 Intrusion	8.1.2 Explosion	8.1.3 CBR	8.2.1 Explosion	8.2.1 CBR
Intrusion Detection					
Video Surveillance and Assessment					
Security Guard					
Security Lighting					
Vehicle Access Control and Screening					
Pedestrian Access Control and Screening					
Package Screening					

Figure 12 Security System Effectiveness Matrix. For each system in place that is able to detect, delay or deny an aggressor from executing the listed threat scenarios, indicate the effectiveness of the overall system in the appropriate box with one of the following descriptors:
(a) Highly effective;
(b) Effective;
(c) Meets Minimum Requirements;
(d) Ineffective; or
(e) No Security.

Table 16 Guidance on Vulnerability Assessment: 8. Security

8 Building Security		
ID	**Building Characteristics**	**Attribute Options**
8.1	**Internal Threat** **8.1.1 Intrusion** **8.1.1.1 Number of Detection Systems** Redundant detection systems are highly desirable. The screener is given the option of selecting 3 systems, 2 systems, 1 system or none.	**Options***: a **3 or more systems** b **2 systems** c **1 system** d **None**
	8.1.1.2 Overall Security Effectiveness Regardless of how many security systems are provided, if they are not effective, they are will not be helpful for thwarting attacks. This building characteristic is intended to capture the overall effectiveness of the systems collectively.	**Options***: a **Highly Effective** b **Meets minimum requirements** c **Ineffective** d **No security**
	8.1.2 Explosion **8.1.2.1 Number of Detection Systems** Redundant detection systems are highly desirable. The screener is given the option of selecting 3 systems, 2 systems, 1 system or none.	**Options***: a **3 or more systems** b **2 systems** c **1 system** d **None**
	8.1.2.2 Overall Security Effectiveness Regardless of how many security systems are provided, if they are not effective, they are will not be helpful for thwarting attacks. This building characteristic is intended to capture the overall effectiveness of the systems collectively.	**Options***: a **Highly Effective** b **Meets minimum requirements** c **Ineffective** d **No security**
	8.1.3 CBR **8.1.3.1 Number of Detection Systems** Redundant detection systems are highly desirable. The screener is given the option of selecting 3 systems, 2 systems, 1 system or none.	**Options***: a **3 or more systems** b **2 systems** c **1 system** d **None**
	8.1.3.2 Overall Security Effectiveness Regardless of how many security systems are provided, if they are not effective, they are will not be helpful for thwarting attacks. This building characteristic is intended to capture the overall effectiveness of the systems collectively.	**Options***: a **Highly Effective** b **Meets minimum requirements** c **Ineffective** d **No security**

Table 16 Guidance on Vulnerability Assessment: 8. Security (continued)

8 Building Security		
ID	**Building Characteristics**	**Attribute Options**
8.2	**External Threat (Zone 1)** **8.2.1 Intrusion** **8.2.1.1 Number of Detection Systems** Redundant detection systems are highly desirable. The screener is given the option of selecting 3 systems, 2 systems, 1 system or none.	**Options***: a **3 or more systems** b **2 systems** c **1 system** d **None**
	8.2.1.2 Overall Security Effectiveness Regardless of how many security systems are provided, if they are not effective, they are will not be helpful for thwarting attacks. This building characteristic is intended to capture the overall effectiveness of the systems collectively.	**Options***: a **Highly Effective** b **Meets minimum requirements** c **Ineffective** d **No security**
	8.2.2 CBR **8.2.2.1 Number of Detection Systems** Redundant detection systems are highly desirable. The screener is given the option of selecting 3 systems, 2 systems, 1 system or none.	**Options***: a **3 or more systems** b **2 systems** c **1 system** d **None**
	8.2.2.2 Overall Security Effectiveness Regardless of how many security systems are provided, if they are not effective, they are will not be helpful for thwarting attacks. This building characteristic is intended to capture the overall effectiveness of the systems collectively.	**Options***: a **Highly Effective** b **Meets minimum requirements** c **Ineffective** d **No security**

***NOTE**: THIS BUILDING CHARACTERISTIC IS HEAVILY WEIGHTED IN THE SCORING. IT IS VERY IMPORTANT TO SELECT THE APPROPRIATE OPTION TO GET AN ACCURATE SCORING FOR THE BUILDING.

OVERVIEW

In this chapter, the calculation and interpretation of risk assessment ratings are discussed.

The potential risk, *R*, to a building subjected to terrorist attack is defined as a function of the product of three factors across all threat scenarios as follows:

$$R = \alpha \sqrt[n]{\sum_{i=1}^{9} \left(C_i \times T_i \times V_i\right)^n} = 7.227 \sqrt[10]{\sum_{i=1}^{9} \left(C_i \times T_i \times V_i\right)^{10}} \qquad (2)$$

where:

C_i = Consequences Rating for threat scenario i
T_i = Threat Rating for threat scenario i
V_i = Vulnerability Rating for threat scenario i

The multiplier of 7.227 (α, a scaling constant) and the 10th power summation formulation controls the limits of R such that $9 \le R \le 9000$. A power value of $n = 10$ produced realistic and practical risk scores, when validated during three formal pilot studies of this procedure in two cities within the United States.

Consequences rating refers to the relative importance of the building to an owner and the surrounding region, and the potential consequences of a terrorist attack. Threat rating refers to the attractiveness of the building to attack, analogous to a measure of the relative likelihood of the threat occurring. Vulnerability rating refers to the expected outcome, in terms of damage, casualties, and business interruption, given a threat is successfully carried out.

The value of each of the parameters *(C, T,* and *V)* varies from 1 to 10, where 1 represents the lowest risk and 10 represent the highest contribution to risk. The various attributes that contribute to the overall value of *C, T* and *V* are embedded in the scoring design of the Data Collection Form. A detailed description of the numerical derivation of the risk scoring procedure is provided in Appendix C.

DETERMINING THE RISK RATING

The values for each of the risk factors determined on the Data Collection Form are tabulated on the Risk Scoring Worksheet. The risk rating for each threat scenario is then computed as the

product of *consequences* rating (*C*), *threat* rating (*T*), and *vulnerability* rating (*V*), where *consequences* rating, *threat* rating and *vulnerability* rating are threat-specific and building-specific. The overall risk assessment rating for the building is then computed using Equation 2. An example of the use of the Risk Scoring Worksheet is shown in Figure 13.

FEMA 455 RISK SCORING WORKSHEET

THREAT SCENARIO		Consequences (*C*)	Threat Rating (*T*)	Vulnerability Rating (*V*)	Threat Scenario Risk Rating (*C* x *T* x *V*)
Internal	Intrusion	7.36	8.32	9.13	559
	Explosive	9.31	8.32	8.33	645
	CBR	8.77	8.32	7.68	560
Explosive	Zone I	9.31	9.17	8.96	765
	Zone II	9.31	10.00	8.56	797
	Zone III	9.31	10.00	8.68	808
CBR	Zone I	8.77	9.17	5.22	420
	Zone II	8.77	10.00	1.62	142
	Zone III	8.77	10.00	2.38	209
A. TOTAL RISK RATING FOR BUILDING (using Equation 2)					6427

Figure 13 Risk Rating Example.

Note that the total risk rating is NOT a simple addition for the component values, but the 10th root of the sum of the de-aggregated risk scores each raised to the power of 10, as represented in Equation 2. Assuming cutoff scores to distinguish low, moderate, and high total risk scores at the one third and two third values of the maximum achievable score of 9000, low-risk scores are less than 3006, and medium-risk scores are less than 6003 but more than or equal to 3006. Using these cutoffs, the total risk score for the example in Figure 13 is considered a high-risk score.

The de-aggregated values for each threat scenario and the individual risk factors can be used to obtain a more detailed understanding of the building's risk. For each threat scenario and risk factor, the higher the score, the greater the risk contribution. For example, using the risk factor and threat scenario risk rating results shown in Figure 13, the following observations can be made about the building's risk:

- The external and internal explosive threats, with consequence ratings of 9.31, have the highest consequences in terms of damages, business interruption and casualties;
- Explosive threats represent a greater risk than CBR threats; and
- The greatest overall risk for this building is an external explosive threat located more than 300 feet but less than 1000 feet from the building.

WEIGHTED BUILDING CHARACTERISTICS

The Data Collection Form contains a limited number of building characteristics that have more importance in the overall risk scoring than others. In part this "heavier" weighting is a function of the importance of the individual building characteristic. In addition, weighting is used to balance the scoring, so that the building systems with fewer building characteristics have scores that are comparable to those with many building characteristics. The building characteristics with heavily weighted scoring require more careful consideration than the others, because a slight difference in scoring of these may cause a significant change in the overall risk score. The heavily weighted building characteristics are identified in the tables that provide guidance for selecting attribute options in the individual chapters for each of the three risk factors: Consequences, Threat Rating and Vulnerability Rating.

A listing of the heavily weighted building characteristics is given below with the corresponding identification number (ID) on the Data Collection Form.

- 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)

EVALUATING THE RISK FOR MULTIPLE BUILDINGS IN A LOCALIZED AREA

This rapid visual screening procedure is well suited for obtaining the relative risk among buildings in a portfolio, community, or region, where each building is scored separately. In some cases it may be desirable to obtain a single risk rating for a group, or "cluster", of buildings that are located in close proximity to each other in a particular area. In this context, a cluster is defined as a group of buildings within a 1-mile radius for an area with a total target density of 10 or more for the three zones.

To evaluate a single risk rating for a cluster of buildings, it is recommended that up to six building types be identified that are representative of buildings that exist in the cluster. The risk rating for the cluster is taken as the weighted average rating of these representative buildings, based on the number of buildings of each type in the cluster.

EVALUATING THE RISK FOR INTERCONNECTED BUILDINGS

This screening procedure was developed for use on individual buildings. For a facility with multiple interconnected buildings some care needs to be given to proper application of the procedure.

Interconnected buildings may be joined by means of pedestrian passage ways that may or may not contain retail or other uses. Often, each of the buildings has a separate, distinct use, which has unique characteristics in terms of its risk. From an operational security viewpoint, the interconnected buildings may be reasonably considered one building. However, from a structural perspective often these types of interconnected buildings are structurally isolated and therefore an explosive attack on one may not mean the other building will be damaged. It Is also likely that there are separate ventilation systems with separate controls (which should be verified) for each building and

possibly the passageways. For this reason, it is recommended that each structure is considered separately. Consideration of the interconnectedness may be addressed through careful consideration of the building characteristics that focus on collateral effects associated with an attack on a structure under, next to, or connected to the building under consideration. The screener will need to pay careful attention to the attribute options provided for these building characteristics to capture the impact of their interrelationship on the terrorist risk. If a single score is desired, the average of the scores for the individual buildings may be computed when the assessments are complete.

INTERPRETATION OF THE RISK ASSESSMENT RATING

The risk scoring procedure results in an aggregated rating for the building, which is a power formulated summation of the ratings attributed to the nine defined threat scenarios. It also provides de-aggregated risk ratings for each threat scenario. Both the aggregated and de-aggregated scores are shown on the Risk Scoring Worksheet.

The aggregated and de-aggregated risk scores are identified as low, moderate or high risk in the electronic version of the tool by means of green, yellow and red color coding respectively. The cut-off scores are defined so that the low/moderate risk cut off is one third of the maximum range of scores (from 9 to 9,000), and the medium/high risk cut-off score is at two thirds of the maximum score range. These cut-offs were found to be accurate during the three pilot studies performed as part of the development of this procedure.

The specific cut-off values defining low-, moderate-, and high-risk may vary based on the priorities of the stakeholders. Risk management decisions and prioritization for further studies can be based on the overall risk assessment rating. Buildings identified as high risk should receive the highest priority for further evaluation while buildings identified as low risk should receive lower priority.

Decisions regarding moderate risk buildings would depend on the specifics of the risk management program and available resources. Regardless of the range in which the total ratings fall, the buildings can be ranked by overall risk assessment rating to determine the order in which further evaluation should be performed as resources become available.

De-aggregated ratings for each threat scenario, including the average risk rating of the nine threat scenarios and the maximum risk rating among the nine threat scenarios, provide useful information to help prioritize further action. The results identify the relative contribution of each to the overall risk rating for the building. Using this information, a specific aspect of the building may be identified for further evaluation or a specialist in a given type of threat (e.g., CBR) could be hired to further study the risk to the building caused by a specific threat.

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 noticable. 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.

DATA COLLECTION FORM AND RISK SCORING WORKSHEET A

FEMA 455 DATA COLLECTION FORM, PAGE 1

GENERAL BUILDING INFORMATION

PRE-FIELD INFORMATION

This page of the form is to be completed *before* the field visit from available documentation or from a knowledgeable site representative.

Building Name/ID _____

Address: _____

Cross Streets: _____

Year Built: _____

Year(s) of major retrofits: _____

Retrofit Description _____

Type of Glass: _____

Number of Floors/Building Height: _____

Occupants _____

Total Area (sq ft): _____

Footprint Area (sq ft) _____

Occupancy Use: _____

(Critical Infrastructure and Key Resources [CI/KR] Sector and Sub-Sector Info)

Hazardous Material Kept on Site: _____

Replacement Value: _____

Target Potential to this Facility _____

Target Potential to this Facility Type: _____

Historic Registry Listing _____

TARGET DENSITY

Number of potential *high value* targets within vicinity of subject building.

Facility Type (CIKR Sector):	Distance		
	< 100 feet	≥100 ft and < 300 ft	≥ 300 ft and ≤ 1000 ft
Agriculture and Food			
Banking and Finance			
Chemical			
Commercial			
Critical Manufacturing			
Dams			
Defense Industrial Base			
Emergency Services			
Energy			
Government Facilities			
Information Technology			
National Monuments/Icons			
Nuclear			
Postal and Shipping			
Public Health and Healthcare			
Telecommunications			
Transportation Systems			
Water Supply			
TOTAL =			

FEMA 455 DATA COLLECTION FORM, PAGE 2

CONSEQUENCES

BUILDING CHARACTERISTICS		ATTRIBUTE OPTIONS					CONSEQUENCES RATING FOR GIVEN THREAT SCENARIO								
							Internal			Explosive			CBR		
		a.	b.	c.	d.	e.	Intrusion	Explosive	CBR	Zone I	Zone II	Zone III	Zone I	Zone II	Zone III
1. CONSEQUENCES	1.1 Locality Type	Rural / Suburban	Semi-urban/ Lt. Industrial	Industrial	Urban	Dense Urban									
		0.06	0.46	0.53	0.58	0.63									
		0.04	0.32	0.37	0.40	0.43									
		0.17	1.23	1.41	1.55	1.67									
		0.04	0.32	0.37	0.40	0.43									
		0.17	1.23	1.41	1.55	1.67									
	1.2 # Occupants	< 200	≥200 - < 400	≥400 - < 600	≥ 600 - < 800	≥800 - < 1000									
		0.25	1.21	1.52	1.74	1.92									
		0.17	0.84	1.06	1.21	1.33									
		0.33	1.61	2.03	2.32	2.55									
		0.17	0.84	1.06	1.21	1.33									
		0.33	1.61	2.03	2.32	2.55									
		≥ 1,000 - < 2,000	≥ 2,000 - < 4,000	≥4,000 - < 6,000	≥6,000 - < 8,000	≥ 8,000 - < 10,000									
		1.98	2.09	2.19	2.28	2.37									
		1.38	1.46	1.53	1.59	1.65									
		2.65	2.79	2.92	3.05	3.16									
		1.38	1.46	1.53	1.59	1.65									
		2.65	2.79	2.92	3.05	3.16									
		≥10,000 - < 20,000	≥ 20,000 - < 40,000	≥ 40,000 - < 60,000	≥ 60,000 - < 80,000	≥ 80,000									
		2.41	2.44	2.46	2.48	2.50									
		1.68	1.69	1.71	1.72	1.74									
		3.22	3.25	3.28	3.31	3.33									
		1.68	1.69	1.71	1.72	1.74									
		3.22	3.25	3.28	3.31	3.33									
	1.3 Replacement Value	< $20 M	≥ $20 M - < $40 M	≥ $40 M - < $60 M	≥ $60 M - < $80 M	≥ $ 80 M - < $100 M									
		0.13	0.60	0.76	0.87	0.96									
		0.13	0.63	0.79	0.91	1.00									
		0.08	0.40	0.51	0.58	0.64									
		0.13	0.63	0.79	0.91	1.00									
		0.08	0.40	0.51	0.58	0.64									
		≥ $100 M - < $200 M	≥ $200 M - < $400 M	≥ $400 M - < $600 M	≥ $600 M - < $800 M	≥ $800 M - < $1 B									
		0.99	1.05	1.10	1.14	1.18									
		1.04	1.09	1.14	1.19	1.24									
		0.66	0.70	0.73	0.76	0.79									
		1.04	1.09	1.14	1.19	1.24									
		0.66	0.70	0.73	0.76	0.79									
		≥ $1 B - < $2 B	≥ $2 B - < $4 B	≥ $4 B - < $6 B	≥ $6 B - < $8 B	≥ $8 B									
		1.21	1.22	1.23	1.24	1.25									
		1.26	1.27	1.28	1.29	1.30									
		0.80	0.81	0.82	0.83	0.83									
		1.26	1.27	1.28	1.29	1.30									
		0.80	0.81	0.82	0.83	0.83									

FEMA 455 DATA COLLECTION FORM, PAGE 3

CONSEQUENCES (continued)

BUILDING CHARACTERISTICS		ATTRIBUTE OPTIONS					CONSEQUENCES RATING FOR GIVEN THREAT SCENARIO								
							Internal			Explosive			CBR		
		a.	b.	c.	d.	e.	Intrusion	Explosive	CBR	Zone I	Zone II	Zone III	Zone I	Zone II	Zone III
1. CONSEQUENCES	1.4 On Historic Registry	No	Yes												
		0.25	2.50												
		0.04	0.43												
		0.08	0.83												
		0.04	0.43												
		0.08	0.83												
	1.5 Business Continuity	Very High	High	Moderate	Low	Very Low									
		0.13	0.92	1.05	1.16	1.25									
		0.09	0.64	0.73	0.81	0.87									
		0.17	1.23	1.41	1.55	1.67									
		0.09	0.64	0.73	0.81	0.87									
		0.17	1.23	1.41	1.55	1.67									
	1.6 Physical Loss Impact	Local	Statewide	Regional	National	International									
		0.19	1.38	1.58	1.74	1.88									
		0.52	3.84	4.40	4.84	5.22									
		0.17	1.23	1.41	1.55	1.67									
		0.52	3.84	4.40	4.84	5.22									
		0.17	1.23	1.41	1.55	1.67									
A.1 TOTAL RATING FOR CONSEQUENCES (C): Sum values in for Consequences and enter in column C on Risk Scoring Worksheet															

FEMA 455 DATA COLLECTION FORM, PAGE 4

BUILDING CHARACTERISTICS		ATTRIBUTE OPTIONS					THREAT RATING FOR GIVEN THREAT SCENARIO								
							Internal			Explosive			CBR		
		a.	b.	c.	d.	e.	Intrusion	Explosive	CBR	Zone I	Zone II	Zone III	Zone I	Zone II	Zone III
2. THREAT	2.1 Occupancy Use	Occupancy Group I	Occupancy Group II	Occupancy Group III											
		0.14	1.13	1.4											
		0.11	0.89	1.1											
	2.2 # Occupants	< 200	≥ 200 - < 400	≥ 400 - < 600	≥ 600 - < 800	≥ 800 - < 1000									
		0.14	0.68	0.85	0.97	1.07									
		0.11	0.53	0.67	0.77	0.84									
		≥ 1,000 - < 2,000	≥ 2,000 - < 4,000	≥4,000 - < 6,000	≥6,000 - < 8,000	≥ 8,000 - < 10,000									
		1.11	1.17	1.23	1.28	1.33									
		0.87	0.92	0.96	1.00	1.04									
		≥10,000 - < 20,000	≥ 20,000 - < 40,000	≥ 40,000 - < 60,000	≥ 60,000 - < 80,000	≥ 80,000									
		1.35	1.36	1.38	1.39	1.4									
		1.06	1.07	1.08	1.09	1.1									
	2.3 Site Population Density (per sq ft)	Very Low (1/10000)	Low (1/1000)	Moderate (1/400)	High (1/40)	Very High (1/10)									
		0.11	0.81	0.93	1.02	1.1									
		0.30	2.21	2.53	2.78	3.0									
	2.4 Visibility/Symbolic	Very Low	Low	Moderate	High	Very High									
		0.29	2.14	2.45	2.69	2.9									
		0.24	1.77	2.02	2.23	2.4									
	2.5 Target Density: 2.5.1 Zone I (< 100 ft)	0	1	2	3	≥ 4									
		0.12	0.88	1.01	1.11	1.2									
	2.5 Target Density: 2.5.2 Zone II (≥100 - <300 ft)	0	1-3	4-6	7-9	≥ 10									
		0.30	2.21	2.53	2.78	3.0									
	2.5 Target Density: 2.5.3 Zone III (≥300 - ≤1000 ft)	0	1-6	7-12	13-19	≥ 20									
		0.80	5.89	6.75	7.43	8.0									
	2.6 Overall Site Accessibility	Inaccessible	Accessible												
		0.14	1.4												
		0.06	0.6												
	2.7 Target Potential: 2.7.1 Facility	No	Yes												
		0.15	1.45												
		0.13	1.25												
		0.20	2												
		0.10	1												
	2.7 Target Potential: 2.7.2 Facility Type	No	Yes												
		0.15	1.45												
		0.13	1.25												
		0.20	2												
		0.10	1												
T.1 TOTAL THREAT RATING (T): Sum values for each Threat Scenario in column T on Risk Scoring Worksheet															

FEMA 455 DATA COLLECTION FORM, PAGE 5

VULNERABILITY ASSESSMENT (Part I)

BUILDING CHARACTERISTICS		ATTRIBUTE OPTIONS					VULNERABILITY RATING FOR GIVEN THREAT SCENARIO								
							Internal			Explosive			CBR		
		a.	b.	c.	d.	e.	Intrusion	Explosive	CBR	Zone I	Zone II	Zone III	Zone I	Zone II	Zone III
3. SITE	3.1 Distance to Unsecured Vehicles (ft)	≥ 75	≥ 50 - < 75	≥ 25 - < 50	≥ 5 - < 25	< 5									
		0.06	0.46	0.53	0.58	0.63									
	3.2 Perimeter Boundary	Continuous Anti-Ram Barriers	Effective Anti-Ram Design	Well-Integrated CPTED	Ornamental, Temp, or Anti-Climb Barriers	No Security/ Discon-tinuous									
		0.03	0.22	0.25	0.28	0.30									
		0.01	0.08	0.09	0.10	0.11									
		0.03	0.23	0.26	0.29	0.31									
		0.02	0.15	0.17	0.19	0.2									
	3.3 Unobstructed View (ft)	≥ 30	≥ 20 – < 30	≥ 10 - < 20	≥ 5 - < 10	< 5									
		0.06	0.45	0.51	0.57	0.61									
		0.01	0.08	0.09	0.10	0.11									
		0.02	0.12	0.13	0.15	0.16									
		0.02	0.15	0.17	0.19	0.2									
	3.4 Unsecured Underground Access	None	Utility Tunnel or Culvert to Site	Utility Tunnel to Bldg.	Pedestrian Tunnel to Bldg.										
		0.24	1.77	2.13	2.4										
		0.09	0.63	0.76	0.86										
	3.5 Storage of Hazardous Materials	None	Low	Moderate	High										
		0.06	0.45	0.54	0.61										
		0.04	0.32	0.38	0.43										
		0.02	0.12	0.14	0.16										
		0.01	0.06	0.07	0.08										
	3.6 Collateral Underground / Adjacent Structures	None	Small	Medium	Major	Significant									
		0.10	0.72	0.83	0.91	0.98									
		0.09	0.67	0.77	0.84	0.91									
4. ARCHITECTURE	4.1 Building Height (ft)	< 20 (1 flr)	≥ 20 - < 50 (2-3 flr)	≥ 50- < 100 (4-8 flr)	≥ 100 - <150 (9-12 flr)	≥ 150-< 200 (13-15 flr)									
		0.02	0.10	0.13	0.15	0.16									
		0.01	0.07	0.09	0.11	0.12									
		0.02	0.09	0.12	0.13	0.15									
		0.07	0.41	0.52	0.59	0.65									
		≥ 200 - < 500 (16-40 flr)	≥ 500 - < 800 (41-60 flr)	≥800 -<1000 (61-80 flr)	≥1000 -<1500 (81-120 flr)	≥ 1500 (≥121 flr)									
		0.16	0.17	0.17	0.17	0.176									
		0.12	0.12	0.12	0.13	0.128									
		0.15	0.15	0.15	0.16	0.16									
		0.67	0.68	0.70	0.71	0.72									
	4.2 Ratio of Total Area / Footprint Area	< 10	≥ 10 - < 30	≥ 30 - < 50	≥ 50 - < 100	≥ 100									
		0.00	0.03	0.04	0.04	0.044									
		0.00	0.02	0.03	0.03	0.032									
		0.00	0.03	0.03	0.04	0.04									
		0.02	0.13	0.15	0.17	0.18									
	4.3 Building Configuration	Circular/ Convex	Box	Re-entrant Corners	Concave										
		0.01	0.08	0.10	0.11										
		0.03	0.23	0.28	0.31										
	4.4 Overhang (ft)	None	< 5	≥5 – <10	≥10 – <15	≥ 15									
		0.03	0.23	0.26	0.29	0.31									
		0.02	0.12	0.13	0.15	0.16									
V.1 SUB-TOTAL FOR VULNERABILITY RATING (V): Sum values in each column and enter on line V.1 on Vulnerability Assessment Rating (Part V)															

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VULNERABILITY ASSESSMENT (Part II)

BUILDING CHARACTERISTICS		ATTRIBUTE OPTIONS					VULNERABILITY RATING FOR GIVEN THREAT SCENARIO								
							Internal			Explosive			CBR		
		a.	b.	c.	d.	e.	Intrusion	Explosive	CBR	Zone I	Zone II	Zone III	Zone I	Zone II	Zone III
4. ARCHITECTURE	4.5 Lobby/Retail Location (in relation to main building footprint)	Detached	External & Separated	External but not Separated	Within Footprint	Adjacent to Occupied Areas									
		0.04	0.32	0.36	0.40	0.43									
	4.6 Loading Dock and/or Mail Screening Location	Offsite / None	Exterior to Building	At Perimeter & Separated	Adjacent to Assets	Under Building									
		0.04	0.32	0.36	0.40	0.43									
		0.01	0.06	0.07	0.07	0.08									
	4.7 Vehicular Penetration of Exterior Envelope	No	Yes												
		0.06	0.63												
	4.8 Garage Location	None	Adjacent & Above Ground	Adjacent to Critical Utilities	Adjacent to Occupied Areas										
		0.04	0.32	0.38	0.43										
		0.07	0.52	0.63	0.71										
		0.01	0.06	0.07	0.08										
5. BUILDING ENVELOPE	5.1 Window Support Type	No Windows	Punched	Glass & Metal Framing	Ribbon	Point Supported									
		0.06	0.46	0.53	0.58	0.63									
		0.13	0.96	1.10	1.21	1.3									
	5.2 Window Bite Depth	≥ 0.5 in.	< 0.5 in.												
		0.03	0.31												
		0.07	0.67												
	5.3 Total % Window Area	< 20	≥ 20 - < 40	≥ 40 - < 60	≥ 60 – < 80	≥ 80									
		0.03	0.22	0.25	0.28	0.3									
		0.07	0.49	0.57	0.62	0.67									
		0.13	0.96	1.10	1.21	1.3									
		0.05	0.37	0.42	0.46	0.5									
	5.4 Glass Type	Laminated Glass	Security Film	Tempered Glass	Heat Strength-ened Glass	Annealed Glass									
		0.03	0.23	0.26	0.29	0.31									
		0.06	0.46	0.53	0.58	0.63									
		0.13	0.96	1.10	1.21	1.3									
	5.5 Wall Type	Cast-in-place Reinforced Concrete	Curtain Wall	Precast or Reinforced Masonry	Massive Unreinforced Masonry	Lt. Frame or Slender Unreinforced Masonry									
		0.03	0.23	0.26	0.29	0.31									
		0.07	0.49	0.57	0.62	0.67									
		0.03	0.22	0.25	0.28	0.3									
V.2 SUB-TOTAL FOR VULNERABILITY RATING (V): Sum values in each column and enter on line V.2 on Vulnerability Assessment Rating (Part V)															

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VULNERABILITY ASSESSMENT (Part III)

BUILDING CHARACTERISTICS		ATTRIBUTE OPTIONS					VULNERABILITY RATING FOR GIVEN THREAT SCENARIO								
							Internal			Explosive			CBR		
		a.	b.	c.	d.	e.	Intrusion	Explosive	CBR	Zone I	Zone II	Zone III	Zone I	Zone II	Zone III
5. BLDG. ENV.	5.6 Windborne Debris Impact Protection	Post Benchmark Year	All Other												
		0.02	0.16												
		0.03	0.31												
		0.07	0.67												
6. STRUCTURAL COMPONENTS AND SYSTEMS	6.1 Structural System	Reinf Conc Shear Wall or Bundled Tubes	Braced Exterior Frame	Frame w/ Core or Precast	Tilt-up or Frame w/ infill or Reinf. Masonry or Belt Truss	Lt. Metal Frame or Brick or Timber									
		0.04	0.32	0.36	0.40	0.43									
		0.03	0.23	0.26	0.29	0.31									
		0.07	0.49	0.57	0.62	0.67									
	6.2 Number of Bays in Short Building Direction	≥ 5	≥ 3 - < 5	< 3											
		0.04	0.35	0.43											
		0.03	0.27	0.33											
	6.3 Column Spacing (ft)	< 15	≥ 15 - < 25	≥ 25 - < 40	≥ 40 - < 60	≥ 60									
		0.04	0.32	0.36	0.40	0.43									
		0.03	0.24	0.28	0.31	0.33									
	6.4 Column Height (ft)	< 12	≥ 12 - < 24	≥ 24 - < 36	≥ 36										
		0.04	0.32	0.38	0.43										
		0.03	0.24	0.29	0.33										
	6.5 Publicly Accessible Column	None	Yes, Massive	Yes, Slender											
		0.04	0.35	0.43											
		0.03	0.27	0.33											
	6.6 Transfer Girder Conditions	None	Int. Girder Sup. 1 column	Int. Girder Sup. > 1 column	Ext. Girder Supporting 1 column	Ext. Girder Supporting > 1 column									
		0.09	0.63	0.73	0.80	0.86									
		0.06	0.46	0.53	0.58	0.63									
		0.13	0.96	1.10	1.21	1.3									
		0.07	0.51	0.58	0.64	0.69									
	6.7 Structural Enhancements & Weaknesses	Hardened	Robust	None	Marginal	Sub-standard									
		0.09	0.63	0.73	0.80	0.86									
		0.06	0.46	0.53	0.58	0.63									
		0.10	0.77	0.88	0.97	1.04									
		0.11	0.81	0.93	1.02	1.1									
V.3 SUB-TOTAL FOR VULNERABILITY RATING (V): Sum values in each column and enter on line V.3 on Vulnerability Assessment Rating (Part V)															

FEMA 455 DATA COLLECTION FORM, PAGE 8

VULNERABILITY ASSESSMENT (Part IV)

BUILDING CHARACTERISTICS		ATTRIBUTE OPTIONS					VULNERABILITY RATING FOR GIVEN THREAT SCENARIO								
							Internal			Explosive			CBR		
		a.	b.	c.	d.	e.	Intrusion	Explosive	CBR	Zone I	Zone II	Zone III	Zone I	Zone II	Zone III
7. MECHANICAL/ELECTRICAL/ PLUMBING SYSTEMS	7.1 Primary External Air Intake Conditions	> 30 ft or Roof	>10 - ≤30 ft	>0 - ≤10 ft	Ground Level	Below Grade									
		0.03	0.24	0.27	0.30	0.32									
		0.37	2.73	3.12	3.43	3.7									
		0.62	4.57	5.23	5.76	6.2									
		0.53	3.91	4.47	4.92	5.3									
	7.2 Return Air Intake System	Ducted Secured	Ducted Accessible	Unducted	Subject to Buoyancy										
		0.12	0.85	1.02	1.15										
		0.15	1.09	1.31	1.48										
		0.30	2.21	2.66	3.00										
	7.3 Internal Air Distribution System	High Risk Separated	Multi-Zoned/ Single System Ducted	Single System/ Unducted											
		0.12	0.93	1.15											
	7.4 Critical Utilities Located Close to High Risk Areas	No	Yes												
		0.04	0.43												
		0.02	0.16												
V.4 SUB-TOTAL FOR VULNERABILITY RATING (V): Sum values in each column and enter on line V.4 on Vulnerability Assessment Rating (Part V)															

FEMA 455 DATA COLLECTION FORM, PAGE 9 — VULNERABILITY ASSESSMENT (Part V)

BUILDING CHARACTERISTICS				ATTRIBUTE OPTIONS a.	b.	c.	d.	e.	VULNERABILITY RATING FOR GIVEN THREAT SCENARIO: Internal Intrusion	Internal Explosive	Internal CBR	Explosive Zone I	Explosive Zone II	Explosive Zone III	CBR Zone I	CBR Zone II	CBR Zone III
8. SECURITY	8.1 Internal Threat	8.1.1 Intrusion	8.1.1.1 Number of Detection Systems	≥ 3 Systems	2 Systems	1 System	None										
				0.12	0.90	1.08	1.216										
			8.1.1.2 Overall Security Effectiveness	Highly Effective	Effective	Meets Min. Requirements	Ineffective	No Security									
				0.49	3.58	4.10	4.52	4.864									
		8.1.2 Explosion	8.1.2.1 Number of Detection Systems	≥ 3 Systems	2 Systems	1 System	None										
				0.05	0.39	0.48	0.536										
			8.1.2.2 Overall Security Effectiveness	Highly Effective	Effective	Meets Min. Requirements	Ineffective	No Security									
				0.21	1.58	1.81	1.99	2.144									
		8.1.3 CBR	8.1.3.1 Number of Detection Systems	≥ 3 Systems	2 Systems	1 System	None										
				0.09	0.65	0.78	0.884										
			8.1.3.2 Overall Security Effectiveness	Highly Effective	Effective	Meets Min. Requirements	None	No Security									
				0.35	2.61	2.98	3.28	3.536									
	8.2 Zone 1 Threat	8.2.1 Explosion	8.2.1.1 Number of Detection Systems	≥ 3 Systems	2 Systems	1 System	None										
				0.03	0.22	0.26	0.294										
			8.2.1.2 Overall Security Effectiveness	Highly Effective	Effective	Meets Min. Requirements	Ineffective	No Security									
				0.12	0.87	0.99	1.09	1.176									
		8.2.2 CBR	8.2.2.1 Number of Detection Systems	≥ 3 Systems	2 Systems	1 System	None										
				0.07	0.53	0.64	0.724										
			8.2.2.2 Overall Security Effectiveness	Highly Effective	Effective	Meets Min. Requirements	Ineffective	No Security									
				0.29	2.13	2.44	2.69	2.896									
V.0 SUB-TOTAL FOR VULNERABILITY RATING (V): Sum values in each column and enter here																	
V.1 SUB-TOTAL FOR VULNERABILITY RATING (V): Enter values for each column from line V.1 on Vulnerability Assessment Rating (Part I)																	
V.2 SUB-TOTAL FOR VULNERABILITY RATING (V): Enter values for each column from line V.2 on Vulnerability Assessment Rating (Part II)																	
V.3 SUB-TOTAL FOR VULNERABILITY RATING (V): Enter values for each column from line V.3 on Vulnerability Assessment Rating (Part III)																	
V.4 SUB-TOTAL FOR VULNERABILITY RATING (V): Enter values for each column from line V.4 on Vulnerability Assessment Rating (Part IV)																	
V.5 TOTAL VULNERABILITY RATING (V): Sum values from lines V.0, V.1, V.2, V.3, and V.4 and enter total for each Threat Scenario in column V on Risk Scoring Worksheet																	

FEMA 455 RISK SCORING WORKSHEET

THREAT SCENARIO		Consequences (C)	Threat Rating (T)	Vulnerability Rating (V)	Threat Scenario Risk Rating (C x T x V)
Internal	Intrusion				
	Explosive				
	CBR				
Explosive	Zone I				
	Zone II				
	Zone III				
CBR	Zone I				
	Zone II				
	Zone III				
A. TOTAL RISK RATING FOR BUILDING					

DATA COLLECTION FORM (FIELD VERSION) B

FEMA 455 DATA COLLECTION FORM (FIELD VERSION), PAGE 1 GENERAL BUILDING INFORMATION

PRE-FIELD INFORMATION

This page of the form is to be completed *before* the field visit from available documentation or from a knowledgeable site representative.

Building Name/ID _____

Address: _____

Cross Streets: _____

Year Built: _____

Year(s) of major retrofits: _____

Retrofit Description _____

Type of Glass: _____

Number of Floors/Building Height: _____

Occupants _____

Total Area (sq ft): _____

Footprint Area (sq ft) _____

Occupancy Use: _____

(Critical Infrastructure and Key Resources [CI/KR] Sector and Sub-Sector Info)

Hazardous Material Kept on Site: _____

Replacement Value: _____

Target Potential to this Facility _____

Target Potential to this Facility Type: _____

Historic Registry Listing _____

TARGET DENSITY

Number of potential *high value* targets within vicinity of subject building.

Facility Type (CIKR Sector):	Distance		
	< 100 feet	≥100 ft and < 300 ft	≥ 300 ft and ≤ 1000 ft
Agriculture and Food			
Banking and Finance			
Chemical			
Commercial			
Critical Manufacturing			
Dams			
Defense Industrial Base			
Emergency Services			
Energy			
Government Facilities			
Information Technology			
National Monuments/Icons			
Nuclear			
Postal and Shipping			
Public Health and Healthcare			
Telecommunications			
Transportation Systems			
Water Supply			
TOTAL =			

FEMA 455 DATA COLLECTION FORM (FIELD VERSION), PAGE 2

CONSEQUENCES

BUILDING CHARACTERISTICS			ATTRIBUTE OPTIONS a.	b.	c.	d.	e.	Red Flag	Comments
1. CONSEQUENCES	1.1. Locality Type		Rural/ Suburban	Semi-urban Lt. Industrial	Industrial	Urban	Dense		
	1.2. # Occupants	Low	< 200	≥ 200 < 400	≥ 400 < 600	≥ 600 < 800	≥ 800 < 1000		
		Medium	≥ 1,000 < 2,000	≥ 2,000 < 4,000	≥ 4,000 < 6,000	≥ 6,000 < 8,000	≥ 8,000 < 10,000		
		High	≥ 10,000 < 20,000	≥ 20,000 < 40,000	≥ 40,000 < 60,000	≥ 60,000 < 80,000	≥ 80,000		
	1.3. Replacement Value	Low	< $20M	≥ $20M < $40M	≥ $40M < $60M	≥ $60M < $80M	≥ $80M < $100M		
		Medium	≥ $100M < $200M	≥ $200M < $400M	≥ $400M < $600M	≥ $600M < $800M	≥ $800M < $1B		
		High	≥ $1B < $2B	≥ $2B < $4B	≥ $4B < $6B	≥ $6B < $8B	≥ $8B		
	1.4. On Historic Registry		No	Yes					
	1.5. Business Continuity		Very High	High	Moderate	Low	Very Low		
	1.6 Physical Loss Impact		Local	Statewide	Regional	National	International		

FEMA 455 DATA COLLECTION FORM (FIELD VERSION), PAGE 3
THREAT

BUILDING CHARACTERISTICS			ATTRIBUTE OPTIONS a.	b.	c.	d.	e.	Red Flag	Comments
2. THREAT	2.1. Occupancy Use		Occupancy Group I	Occupancy Group II	Occupancy. Group III				
	1.2. # Occupants	Low	< 200	≥ 200 < 400	≥ 400 < 600	≥ 600 < 800	≥ 800 < 1000		
		Medium	≥ 1,000 < 2,000	≥ 2,000 < 4,000	≥ 4,000 < 6,000	≥ 6,000 < 8,000	≥ 8,000 <10,000		
		High	≥ 10,000 < 20,000	≥ 20,000 < 40,000	≥ 40,000 < 60,000	≥ 60,000 < 80,000	≥ 80,000		
	2.3 Site Population Density (per sq ft)		Very Low (1/10000)	Low (1/1000)	Moderate (1/400)	High (1/40)	Very High (1/10)		
	2.4. Visibility/ Symbolic		Very low	Low	Moderate	High	Very High		
	2.5 Target Density	2.5.1. Zone I (< 100 ft)	0	1	2	3	≥ 4		
		2.5.2. Zone II (≥ 100 ft , < 300 ft)	0	1 – 3	4 - 6	7 - 9	≥ 10		
		2.5.3. Zone III (≥ 300 ft , ≤ 1,000 ft)	0	1 – 6	7 - 12	13 - 19	≥ 20		
	2.6. Overall Site Accessibility		Inaccessible	Accessible					
	2.7 Target Potential	2.7.1 Facility	No	Yes					
		2.7.2 Facility Type	No	Yes					

FEMA 455 DATA COLLECTION FORM (FIELD VERSION), PAGE 4
VULNERABILITY

BUILDING CHARACTERISTICS			ATTRIBUTE OPTIONS a.	b.	c.	d.	e.	Red Flag	Comments
3. SITE	3.1. Distance to Unsecured Vehicles (ft)		≥ 75	≥ 50 < 75	≥ 25 < 50	≥ 5 < 25	< 5		
	3.2. Perimeter Boundary		Continuous Anti-Ram Barriers	Effective Anti-Ram Design	Well-Integrated CPTED	Ornamental Temporary or Anti-Climb Barriers	No Security/ Dis-continuous		
	3.3. Unobstructed View (ft)		≥ 30	≥ 20 < 30	≥ 10 < 20	≥ 5 < 10	< 5		
	3.4. Unsecured Underground Access		None	Utility Tunnel or Culvert to Site	Utility Tunnel to Bldg.	Pedestrian Tunnel to Bldg.			
	3.5. Storage of Hazardous Materials		None	Low	Moderate	High			
	3.6. Collateral Underground /Adjacent Structures		None	Small	Medium	Major	Significant		
4. ARCHITECTURE	4.1.Building Height (ft)	Low	< 20 (1 flr)	≥ 20, < 50 (2-3 flr)	≥ 50, < 100 (4-8 flr)	≥ 100, < 150 (9-12 flr)	≥ 150, < 200 (13-15 flr)		
		High	≥ 200,< 500 (16-40 flr)	≥ 500,< 800 (41-60 flr)	≥ 800, < 1000 (61-80 flr)	≥ 1000, < 1500 (81-120 flr)	≥ 1500 (≥121 flr)		
	4.2. Ratio of Total Area / Footprint Area		< 10	≥ 10, < 30	≥ 30 < 50	≥ 50 < 100	≥ 100		
	4.3 Building Configuration		Circular/ Convex	Box	Re-entrant Corners	Concave			
	4.4. Overhang (ft)		None	< 5	≥ 5 < 10	≥ 10 < 15	≥ 15		
	4.5. Lobby/Retail Location (in relation to main building footprint)		Detached	External & Separated	External But Not Separated	Within Footprint	Adjacent to Occupied Areas		
	4.6. Loading Dock and/or Mail Screening Location		Offsite/ None	Exterior to Building	At Perimeter & Separated	Adjacent to Assets	Under Building		
	4.7. Vehicular Penetration of Exterior Envelope		No	Yes					
	4.8. Garage Location		None	Adjacent & Above Ground	Adjacent to Critical Utilities	Adjacent to Occupied Areas			

FEMA 455 DATA COLLECTION FORM (FIELD VERSION), PAGE 5

VULNERABILITY (Cont'd)

BUILDING CHARACTERISTICS		ATTRIBUTE OPTIONS					Red Flag	Comments
		a.	b.	c.	d.	e.		
5. BUILDING ENVELOPE	**5.1. Window Support Type**	No Windows	Punched	Glass & Metal Framing	Ribbon	Point Supported		
	5.2. Window Bite Depth	≥ 0.5 in.	< 0.5 in.					
	5.3. Total % Window Area	< 20	≥ 20 < 40	≥ 40 < 60	≥ 60 < 80	≥ 80		
	5.4. Glass Type	Laminated	Security Film	Tempered Glass	Heat Strength-ened Glass	Annealed Glass		
	5.5. Wall Type	Cast-in-Place Reinf. Concrete	Curtain Wall	Precast or Reinf. Masonry	Massive Unreinf. Masonry	Lt. Frame or Slender Unreinf. Masonry		
	5.6. Windborne Debris Impact Protection	Post Benchmark Year	All Other					
6. STRUCTURAL COMPONENTS AND SYSTEMS	**6.1. Structural System**	Reinf Conc Shear Wall or Bundled Tubes	Braced Exterior Frame	Frame w/ Core or Precast	Tilt-up or Frame w/IInfill or Reinf. Masonry or Belt Truss	Lt. Metal Frame or Brick or Timber		
	6.2 Number of Bays in Short Building Direction	≥ 5	≥ 3 < 5	< 3				
	6.3. Column Spacing (ft)	< 15	≥ 15 < 25	≥ 25 < 40	≥ 40 < 60	≥ 60		
	6.4. Column Height (ft)	< 12	≥ 12 < 24	≥ 24 < 36	≥ 36			
	6.5. Publicly Accessible Column	None	Yes, Massive	Yes, Slender				
	6.6. Transfer Girder Conditions	None	Int. Girder Sup. 1 Column	Int. Girder Sup. > 1 Column	Ext. Girder Supporting 1 Column	Ext. Girder Supporting > 1 Column		
	6.7. Structural Enhancements & Weaknesses	Hardened	Robust	None	Marginal	Sub-standard		
7. M/E/P SYSTEMS	**7.1. Primary External Air Intake Conditions (ft)**	> 30 or Roof	> 10 ≤ 30	> 0 ≤ 10	Ground Level	Below Grade		
	7.2. Return Air Intake System	Ducted Secured	Ducted Accessible	Unducted	Subject to Buoyancy			
	7.3 Internal Air Distribution System	High Risk Separated	Multi-Zoned/ Single Sys. Ducted	Single System/ Unducted				
	7.4. Critical Utilities Located Close to High Risk Areas	No	Yes					

FEMA 455 DATA COLLECTION FORM (FIELD VERSION), PAGE 6

VULNERABILITY (Cont'd)

BUILDING CHARACTERISTICS				ATTRIBUTE OPTIONS					Red Flag	Comments
				a.	b.	c.	d.	e.		
8. SECURITY	8.1 Internal Threat	8.1.1 Intrusion	**8.1.1.1 # Detection Systems**	≥ 3 Systems	2 Systems	1 System	None			
			8.1.1.2 Overall Security Effectiveness	Highly Effective	Effective	Meets Min. Req'ments	Ineffective	No Security		
		8.1.2 Explosion	**8.1.2.1 # Detection Systems**	≥ 3 Systems	2 Systems	1 System	None			
			8.1.2.2 Overall Security Effectiveness	Highly Effective	Effective	Meets Min. Req'ments	Ineffective	No Security		
		8.1.3 CBR	**8.1.3.1 # Detection Systems**	≥ 3 Systems	2 Systems	1 System	None			
			8.1.3.2 Overall Security Effectiveness	Highly Effective	Effective	Meets Min. Req'ments	Ineffective	No Security		
	8.2 Zone 1 Threat	8.2.1 Explosion	**8.2.1.1 # External Detection Systems**	≥ 3 Systems	2 Systems	1 System	None			
			8.2.1.2 Overall Security Effectiveness	Highly Effective	Effective	Meets Min. Req'ments	Ineffective	No Security		
		8.2.2 CBR	**8.2.2.1 # Detection Systems**	≥ 3 Systems	2 Systems	1 System	None			
			8.2.2.2 Overall Security Effectiveness	Highly Effective	Effective	Meets Min. Req'ments	Ineffective	No Security		

RISK SCORING METHODOLOGY C

In this screening procedure, the quantification of risk follows directly from the method used in FEMA 452, providing a consistent and logical link among the recently-published FEMA assessment guides for addressing terrorism risk.

This appendix contains a description of the step-by-step process used to develop the scoring procedure as a function of the Data Collection Form building characteristics and corresponding attribute options. It explains the logic and methodology embedded in the ratings contained within the forms. The process for developing the ratings contained within the Data Collection Form (and the companion electronic version of the procedure) is described in detail so that users can complete the scoring procedure in an informed and knowledgeable manner, which will result in ratings that are more reliable and consistent. An example of how screeners can use the Data Collection Form to develop a rating is provided at the end of this appendix.

Conceptually the risk scoring methodology has been developed so that each of the three factors (Consequences, *C*; Threat Rating, *T*; and Vulnerability Rating, *V*) is ultimately assigned a value in the range of 1 to 10, where 1 indicates the lowest value of the factor and 10 indicates the highest, in terms of contribution to the risk for a given threat scenario. Risk ratings for each of the nine threat scenarios are computed as the product of the assigned values (in the range, 1 to 10) for each of these three factors (*C*, *T*, and *V*). The methodology development process involved the following steps.

1. Building characteristics contributing to each of these three factors (*C*, *T*, and *V*) for the building systems considered (see Table 2), along with possible attribute options, were initially identified, based on the project team's knowledge and expert judgment.
2. For each set of possible attribute options for a given building characteristic (where each set ranges from two to five multiple-choice options – a., b., c., d., or e.) rating values were initially assigned based on a scale of 1 to 10, where 1 indicates the lowest level of hazard or risk and 10 the highest.
3. For each building characteristic in the subset corresponding to a given factor, the relative contribution of that building characteristic to the overall value of the given factor was then assigned. The

relative contribution was denoted by VH (very high), H (high), M (medium), or L (low).

Table C-1 illustrates the development of the scoring values, as prescribed in Steps 1 through 3 above, for building characteristics and attribute options initially assigned to Consequences (*C*). As indicated, the assigned values range from 1 to 10, and the relative contributions of each building characteristic are denoted with VH (very high), H (high), M (medium), or L (low).

Table C-1 Information Used in the Initial Risk Scoring Methodology Development for Consequences

BUILDING CHARACTERISTICS	a.	b.	c.	d.	e.	CONSE-QUENCES
1.1. Locality Type	Rural/ Suburban	Semi-urban/ Lt. Industrial	Industrial	Urban	Dense Urban	L
	1	3	5	7	10	
Non-Dense Urban	< 100	100 - 500	500 - 2000	2000 - 5000	> 5000	H
Dense Urban	< 1000	1000 - 3000	3000 - 7000	7000 - 10000	> 10000	
1.3. # Occupants	1	4	6	8	10	
Non-Dense Urban	< $1M	$1M - $20M	$20M – $100M	$100M – $500M	> $500M	M
Dense Urban	< $20M	$20M - $150M	$150M – $400M	$400M – $750M	> $750M	
1.5. Replacement Value	1	4	6	8	10	
1.7. Historic Value	No	Yes				L
	1	10				
1.8. Operational Redundancy	Very High	High	Moderate	Low	Very Low	M
	1	3	5	7	10	
1.9. Impact of Asset Physical Loss	Local	Regional	Statewide	National	Inter-national	VH
	1	4	6	8	10	

4. The results of Step 3 (the relative contribution of each relevant building characteristic to each factor) were used to develop weighting factors that essentially averaged the values associated with each attribute option (defined in Step 2) for the relevant building characteristics that comprise each factor.

Step 4 of the methodology can be illustrated by examining the information in Table C-1, which identifies six building characteristics pertinent to Consequences, one of which has a very high (VH) contribution, one a high (H) contribution, two a medium (M) contribution, and two a low (L) contribution. In this initial development of the scoring system, the weighting factors (six in this case) were normalized to sum to 1.0. For computing Consequences, VH was set to 0.44, H was set to 0.22, M to 0.11 and

L to 0.055 (this corresponded to un-normalized weighting factors of 8, 4, 2, and 1 respectively).

5. The results of Step 4 (the weighting factors) were used to normalize the values associated with each attribute option (defined in Step 1) for the relevant building characteristics that comprise each factor.

   Initially the normalization was essentially just the multiplication of the values from 1 to 10 for each multiple attribute option on the Data Collection Form (shown in the example in Table C-1) by the appropriate weighting factor for each building characteristic. For this example, the values of 1, 3, 5, 7, and 10 corresponding to attribute options for building characteristic 1.1 were multiplied by 0.055. Similarly the values of 1, 5, and 10 corresponding to attribute options for building characteristic 1.3 were also multiplied by 0.22, while the values for building characteristic 1.5 were multiplied by 0.11, the values for building characteristic 1.7 were multiplied by 0.055, the values for building characteristic 1.8 were multiplied by 0.11, and the values for building characteristic 1.9 were multiplied by 0.44. The result of this step is shown in Table C-2 for the example of Table C-1.

Table C-2: Example Initial Values in Risk Scoring Methodology for Consequences

BUILDING CHARACTERISTICS	a.	b.	c.	d.	e.	CONSE-QUENCES
1.1. Locality Type	Rural/ Suburban	Semi-urban/ Lt. Industrial	Industrial	Urban	Dense Urban	
	0.06	0.17	0.28	0.39	0.56	
Non-Dense Urban	< 100	100 - 500	500 - 2000	2000 - 5000	> 5000	
Dense Urban	< 1000	1000 - 3000	3000 - 7000	7000 - 10000	> 10000	
1.3. # Occupants	0.22	0.89	1.3	1.8	2.2	
Non-Dense Urban	< $1M	$1M - $20M	$20M – $100M	$100M – $500M	> $500M	
Dense Urban	< $20M	$20M - $150M	$150M – $400M	$400M – $750M	> $750M	
1.5. Replacement Value	0.11	0.44	0.67	0.89	1.1	
1.7. Historic Value	No	Yes				
	0.06	0.56				
1.8. Operational Redundancy	Very High	High	Moderate	Low	Very Low	
	0.11	0.33	0.56	0.78	1.1	
1.9. Impact of Asset Physical Loss	Local	Regional	Statewide	National	Inter-national	
	0.44	1.8	2.7	3.6	4.4	

6. The normalized factors from Step 5 for each building characteristic attribute option were inserted in an initial Data

Collection Form for use in the first pilot testing of the methodology in New York City. The pilot testing was designed to evaluate the:

- user-friendliness of the documentation and scoring forms;
- clarity of the description of the methodology;
- duration of typical building evaluation by newly-trained assessors;
- sensitivity of the scoring system to various building attributes;
- variation among resulting scores for different building types; and
- consistency (repeatability) in the assessment results.

The initial pilot testing involved the use of the initial Data Collection Form as well as the initial electronic version of the procedure, which is described in Appendix E. Attribute options for each building characteristic considered were selected based on observed features of the building, and the ratings for these options (normalized in Step 5 above) were entered on the open (un-shaded) cell in the Data Collection Form. The values of the cells in each column were totaled to compute one value for Consequences, one value for Threat Rating, and one value for Vulnerability Rating for each of the nine pertinent threat scenarios. As a result of the normalization of the attribute option ratings in Step 5 above, the resulting total values for each of the three factors (C, T, and V) range from 1 to 10, corresponding to the scales used in FEMA 452 to quantify Consequences rating, Threat Rating, and Vulnerability Rating.

The values of the factors (C, T, and V) were then copied into the Risk Scoring Worksheet in the appropriate columns for each threat scenario. The risk rating for each threat scenario, i, was computed using Equation C-1 for a given row in the Risk Scoring Worksheet.

$$R_i = C_i \times T_i \times V_i \qquad \text{(C-1)}$$

where:

C_i	=	Consequences rating for threat scenario i
T_i	=	Threat rating for threat scenario i
V_i	=	Vulnerability rating for threat scenario i

7. Threat scenario risk ratings from Step 6 were evaluated by participants in the initial Pilot Study, and used as a basis for adding,

deleting, and modifying, as required, the building characteristics for each factor as well as the ratings for each attribute option. The method for calculating the Total Risk Rating, *R*, for a given building was also evaluated and revised to increase the total score to match perceived levels of risk (for the buildings evaluated in the pilot testing). As a result, the method for calculating *R* was changed from a simple summation of the threat scenario risk ratings (for each of the nine threat scenarios considered) to incorporate a power summation formulation and a scaling factor, α, that together control the limits of R such that $9 \le R \le 9000$. The revised formulation for computing *R* is as follows:

$$R = \alpha \sqrt[n]{\sum_{i=1}^{9} \left(R_i\right)^n} \qquad \text{(C-2)}$$

where α equals 7.227 and $n = 10$.

A value of $n = 10$ was found to produce realistic results that avoids the apparent averaging results (when $n = 1$) that would imply direct correlation between all nine scenarios.

A revised Data Collection Form was then developed that incorporated the revised building characteristics, and corresponding attribute option ratings. The initial electronic version of the procedure was similarly updated to incorporate the changes to the initial Data Collection Form.

8. A pilot testing of the revised Data Collection Form (Version 2) was again conducted in New York City and included some of the same buildings tested previously and some that were new. The new buildings in the second Pilot Study were selected to exercise risk characteristics that had not been explored in the first Pilot Study, including a high-consequence, low-threat building and a low-consequence, low-threat building. Using data collected during the second pilot testing, threat scenario risk ratings and the Total Risk Rating, *R*, were again calculated (using equations C-1 and C-2), and the results were used as a basis for adding, deleting, and modifying, as required, the building characteristics for each factor as well as the ratings for each attribute option.

   As before, a revised Data Collection Form was again developed (Version 3) that incorporated the revised building characteristics, and corresponding attribute option ratings. The electronic version of the procedure was also updated to incorporate the changes to the Data Collection Form and the scoring process.

9. A final pilot testing of Version 3 of the Data Collection Form was then conducted in Las Vegas. Using data collected during the third pilot testing, threat scenario risk ratings and the Total Risk Rating, *R*, were again calculated (using equations C-1 and C-2), and the results were used as a basis for adding, deleting, and modifying, as required, the building characteristics and attribute options. Version 4 of the Data Collection Form (final version, as provided herein) was then developed, incorporating the revised building characteristics, and corresponding attribute option ratings. The electronic version of the procedure was again updated to incorporate the changes to the Data Collection Form.

Example Application of the Procedure

An example application of the scoring procedure for Consequences (C_i) for the nine threat scenarios (using Version 4 of the Data Collection Form) is provided below. In this example, surveyors of the example building selected the attribute options shown in Table C-3.

Table C-3 Building Characteristics and Selected Attribute Options

Building characteristic	Attribute Option
1.1 Locality Type	Semi Urban
1.2 # Occupants	Greater than or equal to 4,000 Less than 6,000
1.3 Replacement Value	Greater than or equal to $600 M Less than $800 M
1.4 Historic Value	No
1.5 Business Continuity	Moderate
1.6 Physical Loss Impact	National

To carry out the scoring procedure, the user circles the numeric values in the Consequences portion of the Data Collection Form (as shown in Tables C-4 and C-5) that correspond to the selected attribute options identified in Table C-3. Those numeric values are then transcribed into the corresponding locations for each of the nine scenarios, as shown on the right side of Tables C-4 and C-5. A simple sum over each column for each threat scenario results in the Consequence score for that particular threat scenario C_i.

The method for computing the values for Threat Rating and Vulnerability Rating follows the same process as described in the above example for computing Consequences.

Table C-4 Example Values in Risk Scoring Methodology of Consequences, Page 2

FEMA 455 DATA COLLECTION FORM, PAGE 2 — **CONSEQUENCES**

BUILDING CHARACTERISTICS		ATTRIBUTE OPTIONS					CONSEQUENCES RATING FOR GIVEN THREAT SCENARIO								
							Internal			Explosive			CBR		
		a.	b.	c.	d.	e.	Intrusion	Explosive	CBR	Zone I	Zone II	Zone III	Zone I	Zone II	Zone III
1. CONSEQUENCES	1.1 Locality Type	Rural / Suburban	Semi-urban/ Lt. Industrial	Industrial	Urban	Dense Urban									
		0.06	0.46	0.53	0.58	0.63	0.46								
		0.04	0.32	0.37	0.40	0.43		0.32							
		0.17	1.23	1.41	1.55	1.67			1.23						
		0.04	0.32	0.37	0.40	0.43				0.32	0.32	0.32			
		0.17	1.23	1.41	1.55	1.67							1.23	1.23	1.23
	1.2 # Occupants	< 200	≥200 - < 400	≥400 - < 600	≥ 600 - < 800	≥800 - < 1000									
		0.25	1.21	1.52	1.74	1.92									
		0.17	0.84	1.06	1.21	1.33									
		0.33	1.61	2.03	2.32	2.55									
		0.17	0.84	1.06	1.21	1.33									
		0.33	1.61	2.03	2.32	2.55									
		≥ 1,000 - < 2,000	≥ 2,000 - < 4,000	≥4,000 - < 6,000	≥6,000 - < 8,000	≥ 8,000 - < 10,000									
		1.98	2.09	2.19	2.28	2.37	2.19								
		1.38	1.46	1.53	1.59	1.65		1.53							
		2.65	2.79	2.92	3.05	3.16			2.92						
		1.38	1.46	1.53	1.59	1.65				1.53	1.53	1.53			
		2.65	2.79	2.92	3.05	3.16							2.92	2.92	2.92
		≥10,000 - < 20,000	≥ 20,000 - < 40,000	≥ 40,000 - < 60,000	≥ 60,000 - < 80,000	≥ 80,000									
		2.41	2.44	2.46	2.48	2.50									
		1.68	1.69	1.71	1.72	1.74									
		3.22	3.25	3.28	3.31	3.33									
		1.68	1.69	1.71	1.72	1.74									
		3.22	3.25	3.28	3.31	3.33									
	1.3 Replacement Value	< $20 M	≥ $20 M - < $40 M	≥ $40 M - < $60 M	≥ $60 M - < $80 M	≥ $ 80 M - < $100 M									
		0.13	0.60	0.76	0.87	0.96									
		0.13	0.63	0.79	0.91	1.00									
		0.08	0.40	0.51	0.58	0.64									
		0.13	0.63	0.79	0.91	1.00									
		0.08	0.40	0.51	0.58	0.64									
		≥ $100 M - < $200 M	≥ $200 M - < $400 M	≥ $400 M - < $600 M	≥ $600 M - < $800 M	≥ $800 M - < $1 B									
		0.99	1.05	1.10	1.14	1.18	1.14								
		1.04	1.09	1.14	1.19	1.24		1.19							
		0.66	0.70	0.73	0.76	0.79			0.76						
		1.04	1.09	1.14	1.19	1.24				1.19	1.19	1.19			
		0.66	0.70	0.73	0.76	0.79							0.76	0.76	0.76
		≥ $1 B - < $2 B	≥ $2 B - < $4 B	≥ $4 B - < $6 B	≥ $6 B - < $8 B	≥ $8 B									
		1.21	1.22	1.23	1.24	1.25									
		1.26	1.27	1.28	1.29	1.30									
		0.80	0.81	0.82	0.83	0.83									
		1.26	1.27	1.28	1.29	1.30									
		0.80	0.81	0.82	0.83	0.83									

Table C-5 Example Values in Risk Scoring Methodology of Consequences, Page 3

FEMA 455 DATA COLLECTION FORM, PAGE 3 — **CONSEQUENCES (continued)**

BUILDING CHARACTERISTICS		ATTRIBUTE OPTIONS					CONSEQUENCES RATING FOR GIVEN THREAT SCENARIO								
							Internal			Explosive			CBR		
		a.	b.	c.	d.	e.	Intrusion	Explosive	CBR	Zone I	Zone II	Zone III	Zone I	Zone II	Zone III
1. CONSEQUENCES	1.4 On Historic Registry	No	Yes												
		0.25	2.50				0.25								
		0.04	0.43					0.04							
		0.08	0.83						0.08						
		0.04	0.43							0.04	0.04	0.04			
		0.08	0.83										0.08	0.08	0.08
	1.5 Business Continuity	Very High	High	Moderate	Low	Very Low									
		0.13	0.92	1.05	1.16	1.25	1.05								
		0.09	0.64	0.73	0.81	0.87		0.73							
		0.17	1.23	1.41	1.55	1.67			1.41						
		0.09	0.64	0.73	0.81	0.87				0.73	0.73	0.73			
		0.17	1.23	1.41	1.55	1.67							1.41	1.41	1.41
	1.6 Physical Loss Impact	Local	Statewide	Regional	National	International									
		0.19	1.38	1.58	1.74	1.88	1.74								
		0.52	3.84	4.40	4.84	5.22		4.84							
		0.17	1.23	1.41	1.55	1.67			1.55						
		0.52	3.84	4.40	4.84	5.22				4.84	4.84	4.84			
		0.17	1.23	1.41	1.55	1.67							1.55	1.55	1.55
A.1 TOTAL RATING FOR CONSEQUENCES (C): Sum values in for Consequences and enter in column C on Risk Scoring Worksheet							6.84	8.66	7.95	8.66	8.66	8.66	7.95	7.95	7.95

INFRASTRUCTURE TAXONOMY D

This appendix contains an abbreviated version of the Infrastructure Taxonomy prepared by the Department of Homeland Security. It provides a listing of facility types included as part of each of the 18 critical infrastructure categories. Selected facilities provided below focus on facility types that include buildings. This appendix may be used as a reference for defining Occupancy Use and also Target Density definitions provided on the Data Collection Form. The electronic version of this procedure includes a drop down menu for Occupancy Use and Target Density, which is a complete and unabridged version of the DHS listing.

AGRICULTURE AND FOOD

- Supply
- Processing/Packaging/Production
- Agriculture and Food Product Storage
- Agriculture and Food Product Transportation
- Agriculture and Food Product Distribution
  - Farm Product Wholesalers
  - Grocery and Related Product Wholesalers
  - Food and Beverage Retailers
    - Supermarkets and Grocery Stores
  - Food Service and Drinking Facilities
    - Full Service Restaurants
    - Limited Service Food Facilities
    - Drinking Establishments
      - Bars
      - Nightclubs
- Agriculture and Food Supporting Facilities
- Regulatory, Oversight, and Industry Organizations

BANKING AND FINANCE

- Banking and Credit
- Securities, Commodities and Financial Investments
- Insurance Carriers

CHEMICAL AND HAZARDOUS MATERIALS INDUSTRY

- Chemical Manufacturing Plants
- Hazardous Chemical Transport
- Hazardous Chemical Storage/Stockpile/ Utilization/ Distribution
- Regulatory, Oversight, and Industry Organizations

COMMERCIAL FACILITIES

- Entertainment and Media Facilities
  - Broadcasting
    - Cable and Other Subscription Programming
    - Radio Broadcasting
    - Television Broadcasting
  - Internet Publishing
  - Motion Picture and Sound Recording Facilities
  - Print Media
    - Newspaper and Periodical Publishing
    - Other Print Publishing
- Gambling Facilities/Casinos (Resorts)
  - Gambling Cruises
  - Horse and Dog Racetracks
  - Land-Based Casinos
  - Permanently-Moored Casinos
  - Riverboat Casinos
  - Other Gambling Establishments
- Lodging Facilities
  - Bed and Breakfast Inns
  - Hotels and Motels
  - Other Lodging Facilities
- Outdoor Events Facilities
  - Amusement, Theme and Water Parks
  - Community Parks, Fairgrounds, Pavilions
  - Community Water Facilities
  - Community Special Gatherings
    - Parades
    - Special Events
- Public Assembly/Sports Leagues Facilities
  - Amphitheaters
  - Arenas
  - Convention Centers
  - Golf Courses and Country Clubs
  - Motor Racetracks
  - Movie Theaters
  - Museums, Planetariums
  - Performing Arts Centers and Auditoriums
  - Stadiums
  - Zoos, Aquariums, Botanical Gardens
- Public Assembly/Other Facilities
  - Entertainment Districts
  - Fitness and Recreational Facilities
  - Marinas
  - Skiing Facilities
  - Other Amusement and Recreational Facilities
- Real Estate Facilities
  - Office Buildings
    - Office Buildings – Stand Alone

- Office Districts
- Office Parks
- Residential Units
  - Multi-Family Residences
  - Single-Family Residences
- Retail Facilities
  - Store Retailers
    - Shopping Centers and Malls
    - Shopping Districts
    - Stand-Alone Stores
  - Non-Store Retailers
- Industrial Assets
  - Manufacturing Facilities
    - Food, Beverage, Tobacco Product Manufacturing
    - Textile, Textile Product, Apparel, Leather Manufacturing
    - Wood Product Manufacturing
    - Paper Manufacturing
    - Printing and Related Support Activities
    - Petroleum and Coal Products Manufacturing
    - Chemical Manufacturing
    - Plastics and Rubber Products Manufacturing
    - Non-Metallic Mineral Products Manufacturing
    - Primary Metal Manufacturing
    - Fabricated Metal Manufacturing
    - Machinery Manufacturing
    - Computer and Electronic Product Manufacturing
    - Electrical Equipment, Appliance, Component Manufacturing
    - Transportation Equipment Manufacturing
    - Furniture and Related Products Manufacturing
    - Miscellaneous Manufacturing
  - Mining
    - Oil and Natural Gas Extraction
    - Coal Mining
    - Metal Ore Mining
    - Nonmetallic Mineral Mining
- Community Organization Facilities
  - Religious Organization Facilities
  - Social Advocacy Organization Facilities
  - Civic and Social Organization Facilities
  - Political Organization Facilities
- Other Commercial Facilities
  - Weather Forecasting Services

CRITICAL MANUFACTURING

Primary Metal Manufacturing
Machinery Manufacturing
Electrical Equipment, Appliance, and Component Manufacturing
Transportation Equipment Manufacturing

DAMS

Dam Projects
Navigation Locks
Mine Tailings Dams
Hurricane Barriers
River Control Structures
Levees
Regulatory, Oversight and Industry Organizations
Other Dam Facilities

DEFENSE INDUSTRIAL BASE

Shipbuilding Industry
Aircraft Industry
Missile Industry
Space Industry
Combat Vehicle Industry
Ammunition Industry
Weapons Industry
Troop Support Industry
Information Technology Industry
Electronics Industry
Electrical Industry Commodities
Electronic Industry Commodities
Mechanical Industry Commodities
Structural Industry Commodities

EMERGENCY SERVICES

Law Enforcement
Fire, Rescue, and Emergency Services
Search and Rescue
Emergency Medical Services
Emergency Management

ENERGY

Electricity

- Petroleum
- Natural Gas
- Coal
- Ethanol
- Regulatory, Oversight, and Industry Organizations

GOVERNMENT FACILITIES

- Personnel-Oriented Government Facilities
  - Personnel-Oriented Buildings and Structures
    - Offices and Office Building Complexes
      - Agency Headquarters
      - Field, District and Satellite Offices
      - Legislative Chambers and Offices
      - Judicial Chambers and Offices
      - Data and Call Centers
    - Housing
    - Correctional Facilities
    - Embassies, Consulates and Border Facilities
    - Educational Facilities
      - Pre-Kindergarten
      - Licensed Day Care Facilities
      - K-12 Schools
      - Higher Education Facilities
      - Specialized Education Facilities
  - Personnel-Oriented Land
- Service-Oriented Government Facilities
  - Service-Oriented Buildings and Structures
    - Emergency Services
    - Maintenance and Repair Shops
    - Operations, Command, Dispatch and Control Centers
    - Training Buildings
    - Libraries
  - Service-Oriented Land
- Government Research Facilities
  - Government Research and Development Buildings and Structures
    - Analysis and Assessment Research Facilities
    - Environmental Research
    - Basic Science Research
    - Aerospace Research Facilities
    - Military Research
  - Government Research and Development Land
- Government Storage and Preservation Facilities
  - Storage and Preservation Buildings and Structures
    - Archive and Record Centers
    - Warehouses
    - Weapons and Ammunition Storage

- Precious Metal Storage
- Currency Storage
- Special Nuclear Materials and Waste Storage
- Storage and Preservation Land

Government Sensor and Monitoring Systems
- Global Positioning System
  - GPS Space Segment
  - GPS Control Segment
- Government Observation Systems

Government Space Systems
- Military Facilities
  - Launch Vehicles
  - Launch Facilities
  - Mission Control Facilities
  - Satellites
- NASA Facilities
  - Launch Vehicles
  - Launch Facilities
  - Mission Control Facilities
  - Satellites

Military Facilities
- Army Bases
- Navy Bases
- Marine Corps Bases
- Air Force Bases
- Coast Guard Bases
- National Guard Facilities
- Joint and Combined Military Installations and Reservations

Other Government Facilities
- Other Government Buildings and Structures
- Other Government Land

HEALTHCARE AND PUBLIC HEALTH

Direct Patient Healthcare
Public Health Agencies
Healthcare Educational Facilities
Health Supporting Facilities
End-of-Life Facilities
Regulatory, Oversight, and Industry Organizations

INFORMATION TECHNOLOGY

Hardware Production
Software Production
Information Technology Services
Internet

Next Generation Networks
Regulator, Oversight and Industry Organizations

NATIONAL MONUMENTS AND ICONS

National Monument/Icon Structures
National Monument/Icon Geographic Areas
National Monument/Icon Documents and Objects
Other National Monuments and Icons

POSTAL AND SHIPPING

U.S. Postal Service
Couriers
Other Postal and Shipping Facilities

TELECOMMUNICATIONS

Wired Telecommunications
Wireless Telecommunications
Satellite Telecommunications
Internet
Information Services
Next Generation Networks
Regulatory, Oversight and Industry Organizations
Other Telecommunication Facilities

TRANSPORTATION

Aviation
Railroad
Road
Maritime
Mass Transit
Pipelines
Regulatory, Oversight and Industry Organizations

WATER

Raw Water Supply
Raw Water Transmission
Raw Water Storage
Water Treatment Facilities
Treated (Finished) Water Storage
Treated Water Distribution Systems
Treated Water Monitoring Systems
Treated Water Distribution Control Centers
Wastewater Facilities
Regulatory, Oversight and Industry Organizations

SCREENER'S GUIDE TO ELECTRONIC VERSION OF PROCEDURE E

RAPID VISUAL SCREENING DATABASE

To support Rapid Visual Screening (RVS), the data collection process has been incorporated into the existing FEMA Risk Assessment Database application, FEMA 452, *Risk Assessment: A How-To Guide to Mitigate Potential Terrorist Attacks Buildings.*

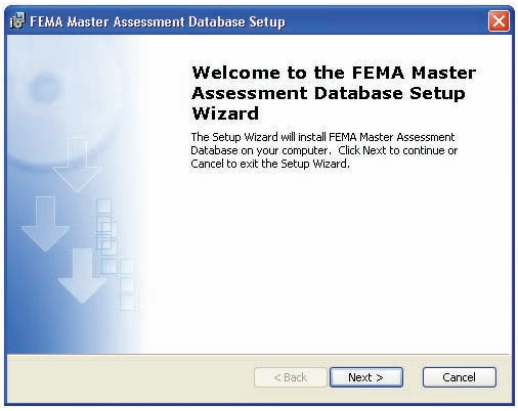
The database tool is designed to support a quick collection of RVS information as well as photos, GIS portfolios, and other files to facilitate analysis. In addition, the database tool is designed to be compatible and exchange information with other assessments in the FEMA 452 Risk Management Database.

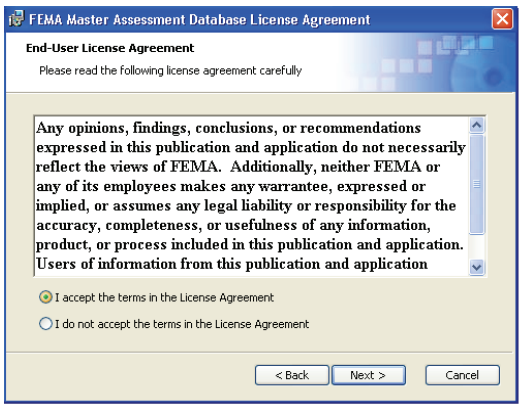
Download and install the database program from the FEMA website: http://www.fema.gov/plan/prevent/rms/rmsp452.shtm. Follow the download and self installation instructions. It is recommended to install the database on two separate systems: one as the permanent database at an organization's headquarters and one on the computer(s) that your RVS assessors will use to collect data, such as a laptop. For small organizations, one copy of the database can be used to perform both management and data collection functions. Note: a full user guide is provided with the database and can be opened from the Help button on the database screens.

INSTALLATION PROCESS

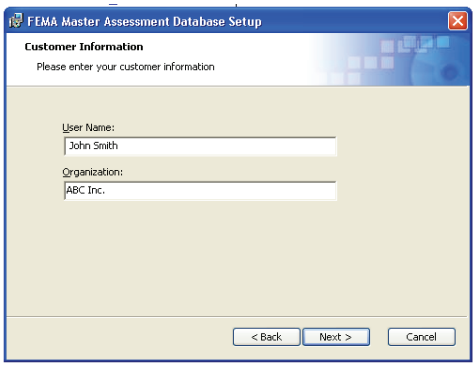
- Download the database program from the FEMA website: http://www.fema.gov/plan/prevent/rms/rmsp452.shtm.
- After downloading the program, begin the installation process by first closing all other programs and then left click on the SETUP.EXE file. Note: If the program was previously downloaded to your computer, left click <Start>, <Run>, identify the location where the SETUP.EXE program can be found (CD, C:/Temp, or some other storage location on hard drive or media) and then left click on the SETUP.EXE file.
- The Install Wizard first identifies the name of the software being installed. Left click <Next> to continue after confirming that this is the software you want to install.

- A standard screen showing the End User License Agreement will appear. Read as you feel appropriate, then left click on the <Accept> circle, and left click on <Next> to continue with the installation.

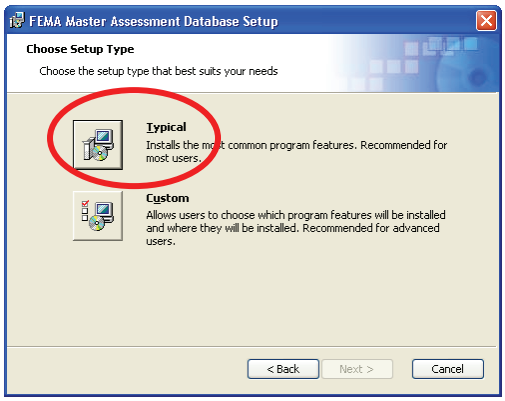


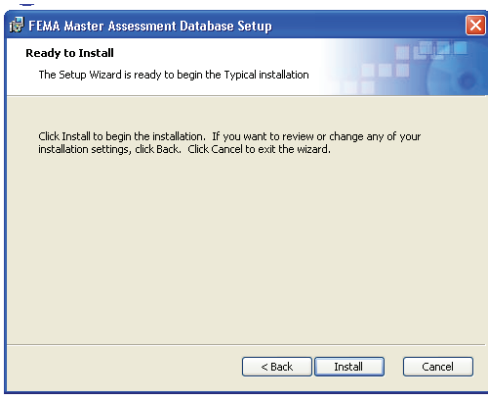


- Add the User Name and Organization in the appropriate windows. Continue with the installation by left clicking <Next>.

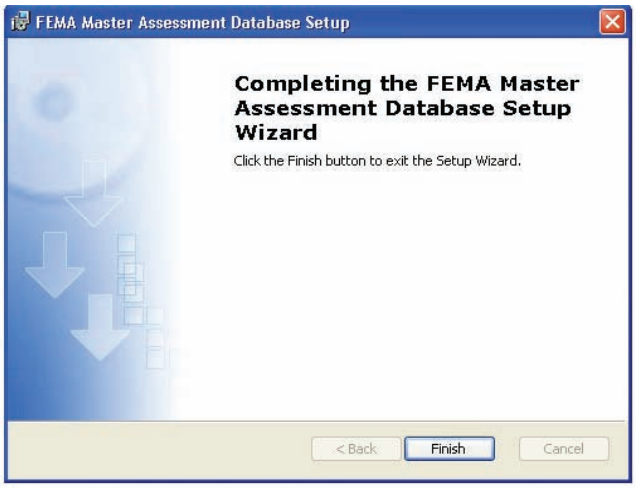


- There is no advantage in using the Custom Installation. There are no component programs to select. The only feature that the Custom Installation allows is to change the file name and/or file location. In most cases you should follow the Typical Installation. To proceed, left click on <Typical>.
- A standard screen to ensure you are ready to install will appear. Proceed by left clicking <Install>.





- If the Access program is not located in the standard location, the Install Wizard will take a long time looking for it with a searching flashlight. It should eventually find it and get to this screen. The final standard screen indicates the Install Wizard has completed the installation. Left click <Finish> to end the installation.

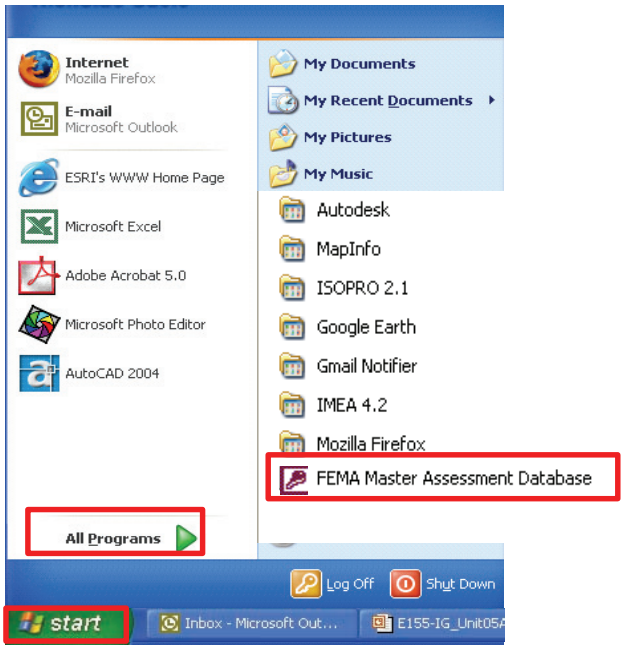


- Following the same procedure, install a second copy of the program to use in the Assessment Tool operating mode on the computer(s) that your assessors will use to collect data, such as a laptop.

OPENING THE DATABASE

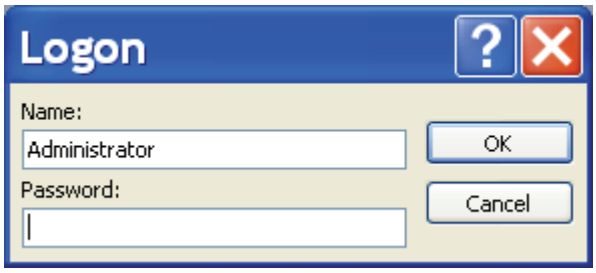
To open the Master Assessment Database, you first left click on <Start>, select "Open" from the menu, then double-click <Programs>, and look for the <FEMA Master Assessment Database> to left click. The FEMA Master Assessment Database should be at the end of the Startup Program Menu immediately after the

installation. You can copy the shortcut icon for the FEMA Master Assessment Database to another location at any time.



Note: the database can only be opened by left clicking on the FEMA Master Assessment Database Icon.

The first action to enter the database is the Logon. You can enter the database Tool as an Assessor, Editor, Reader or Administrator. It is recommended that the database be accessed the first time using the Administrator log on, which provides access to all functions of the program. The initial Password for Administrator is "Administrator". The Database Manager / Administrator will be able to establish new user accounts and passwords. If this has been completed use your assigned user name and password.



- This leads to a Main Menu of the database. It may start either in the Assessment operating mode or in the Master Database operating mode. (It opens in the mode for which it was last used.)

The following are the hardware and software requirements for the Risk Assessment Database:

- Pentium® 4 or equivalent processor
- Windows XP®
- MS Access® 2002
- 256 MB of RAM recommended for all components

Note: the Database must be opened using the shortcut installed during the initial setup.

The initial passwords are:

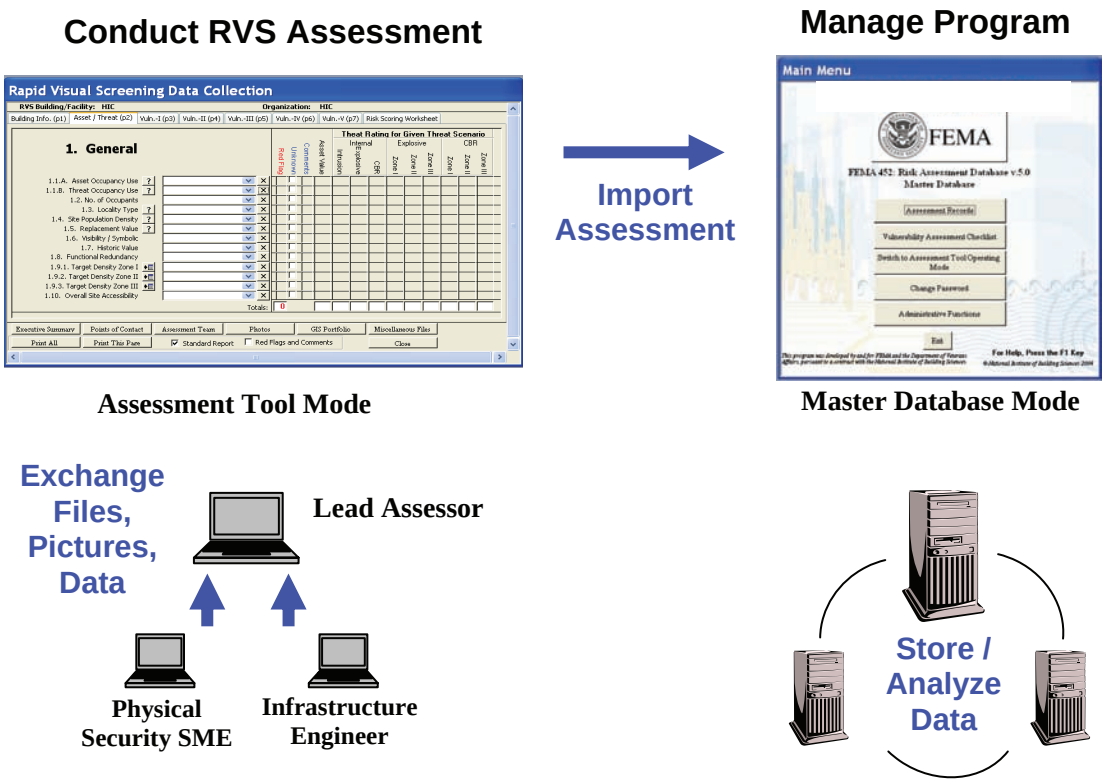
Name: Administrator	Password: Administrator
Name: Assessor	Password: Assessor
Name: Editor	Password: Editor
Name: Reader	Password: Reader

It is highly recommended that your database administrator assign new user names and change these passwords following the initial installation of the database. See the Database Administrator Information section and the Change Password section of the User Guide for more detailed information.

USE OF THE DATABASE

The database is designed to be loaded on several different systems and to allow an organization to exchange information between two or more copies of the database: one database (or more) loaded on the assessor team laptop(s) and operating in the Assessment Tool mode for conducting assessments in the field; and one database loaded on a computer at an organization's headquarters and operating in the Master Database mode for collecting the results, printing reports, and analyzing the information from a number of assessments. The Master Database copy also provides the organization the ability to search for vulnerabilities common to many assessed facilities, search for specific vulnerabilities, and other functions. Essentially it can be used as a Risk Management tool to identify and track mitigation measures to reduce risk.

The Assessment Tool mode was designed for engineers and security specialists to be able to easily collect data from the facility being assessed. As you will see, the software is very user friendly. The Master Database mode was designed for the Program Manager.



The diagram provided above shows how the copies of the database interact. When an organization collects pre-assessment information and prepares to conduct an assessment of a facility or a series of facilities, an assessment record is prepared in the lead assessor's database using the Assessment Tool operating mode (usually on a laptop computer). Into this assessment record is placed references, site plans, GIS portfolios, and other facility specific data that is known about the assessment facility or is developed during the pre-assessment phase.

This assessment record is then exported (if required) to other assessment team members by an administrator using the Import Assessor Database function in the Master Database operating mode. The assessment team then conducts the assessment and records information using the Assessor Tool operating mode. At the end of the assessment, the assessment team leader uses the Import Checklist function in the Assessment Tool operating mode to combine the

team's checklist, vulnerability and recommendation entries into one record. They also combine photos, and miscellaneous files into the lead assessor's database folder using the "Add Photo", "Add GIS Portfolio Images" and "Miscellaneous Files" functions. The Project Manager then uses the Import Assessor Database function in the Master Database operating mode to transfer the complete assessment data and files into the Master Database for analysis and printing.

Note: a full user guide is provided with the database and can be opened from the Help buttons on the database screens.

DHS, 2005, *Protective Measures Infrastructure Category: Commercial Office Buildings,* Protective Measures Section, Protective Security Division, Department of Homeland Security, Washington, D.C. (For Official Use Only [FOUO]).

DHS, 2006, *Infrastructure Taxonomy*, Version 2, Risk Management Division Office of Infrastructure Protection, Department of Homeland Security, Washington, D.C.

DHS, 2006, *National Infrastructure Protection Plan*, Department of Homeland Security, Washington, D.C.

DOJ, 1995, *Vulnerability Assessment of Facilities*, Department of Justice, Washington, D.C.

FEMA, 2003a *Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings,* FEMA 426, Federal Emergency Management Agency, Washington, D.C.

FEMA, 2003b, *Primer for Design of Commercial Buildings to Mitigate Terrorist Attacks*, FEMA 427, prepared by the Applied Technology Council for the Federal Emergency Management Agency, Washington, D.C.

FEMA, 2005, *Risk Assessment: A How-To Guide to Mitigate Potential Terrorist Attacks Against Buildings, Risk Management Series*, FEMA 452, Federal Emergency Management Agency, Washington, D.C.

FEMA, 2007, *HAZUS-MH MR-3 Technical Manual for the Flood Model*, at: http://www.fema.gov/plan/prevent/hazus/hz_manuals.shtm, Federal Emergency Management Agency, Washington, D.C.

FHWA, 2003, *Recommendations for Bridge and Tunnel Security*, Requested by American Association of State Highway and Transportation Officials, Prepared by: Blue Ribbon Panel on Bridge and Tunnel Security, Washington, D.C.

GSA, 2003, *Progressive Collapse Analysis and Design Guidelines*, U.S. General Services Administration (GSA), Washington, D.C.

ISC, 2004, *Security Design Criteria*, Interagency Security Committee (ISC), Washington, D.C. (FOUO)