Buildings and Infrastructure Protection Series

Integrated Rapid Visual Screening of Buildings

BIPS 04/September 2011

Homeland Security
Science and Technology

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Foreword and Acknowledgments

Foreword

Since the events of September 11, 2001, government officials, law enforcement, the design community, public and private stakeholders, and first responders have understood that the risk environment has changed and that the Nation's critical assets must be protected. The Department of Homeland Security (DHS) has sponsored the development of a methodology for assessing the risk and resilience of buildings to terrorist attacks and selected natural hazards. The methodology, referred to as the integrated rapid visual screening (IRVS) for buildings, was developed by the DHS Science and Technology Directorate (DHS S&T), Infrastructure Protection and Disaster Management Division (IDD), and public- and private-sector stakeholders involved in the design, operation, and management of critical infrastructure. The IRVS is intended to provide an assessment of the risk and resilience of the buildings in our Nation's cities and communities that can be used by law enforcement, the design community, building managers, and first responders.

"Integrated" in IRVS indicates that the methodology includes the risk of both terrorist acts and natural hazards and an assessment of both risk and resiliency.

The IRVS is intended to be used in a tiered assessment of the critical vulnerabilities of buildings. A tiered assessment consists of successively more refined analyses such as the framework set forth in FEMA 452, *Risk Assessment: A How-To Guide to Mitigate Potential Terrorist Attack Against Buildings*

(FEMA, 2005). The information gathered as part of this procedure can also be used to support and facilitate higher level assessments by expert investigators.

The result of an IRVS for buildings is a quantifiable assessment of the risk to a given building to a terrorist attack or natural disaster that leads to catastrophic losses (fatalities, injuries, damage, or business interruption) and a quantifiable assessment of the resiliency of the building (ability to recovery from such an event). The methodology is intended to be applicable nationwide for all conventional building types.

Need and Purpose

The approximately 98,000 cases of high-profile international and domestic terrorist attacks and disrupted plots from 1970 through 2010 underscores the determination and persistence of terrorist organizations. Terrorists have proven to be relentless, patient, opportunistic, and flexible, learning from experience and modifying tactics and targets to exploit vulnerabilities. The sophisticated attacks on buildings including on the World Trade Center (WTC) and Pentagon on September 11, 2001, have caused significant physical and societal damage and require unique defenses.

> There were approximately 98,000 cases of high-profile international and domestic terrorist attacks and disrupted plots from 1970 through 2010.

The attack on the WTC towers was unique in planning, scope, and weaponry (hijacked Boeing 767 planes). The explosion from the impact compromised the structural integrity of both towers, leading to their collapse. Debris from the collapsing towers severely damaged nearby buildings, including WTC-7, which collapsed. Approximately 3,000 people died. This event illustrates the severe consequences of an explosive attack on a building and demonstrates that aggressors can successfully attack well-guarded buildings in major cities.

The more common method of attacking a building with an explosive is a bomb in a car or truck, as exemplified by the 1995 bombing of the Murrah Federal Building in Oklahoma City. The blast killed 167 people, injured 684, and destroyed or damaged 347 buildings.

Terrorist attacks are intended to attract attention, disrupt order and the economy, and create fear. The selection of buildings and type of attack are often random and cannot easily be anticipated. As security measures increase around attractive targets, terrorists are likely to shift their attention to less protected targets.

The Nation's critical infrastructure is susceptible not only to manmade threats but also to natural hazards such as earthquakes, flooding, and wind. Buildings are exposed to the direct impact, disruption, and cascading effects of natural disasters. Examples of recent natural disasters are listed below.

Examples of Natural Disasters in the United States, 1994 to 2011

Name/Hazard	Year	Location	Deaths	Estimated Damage	Source
Northridge Earthquake	1994	California	57	$20 billion	NISEE (2005)
Hurricane Ivan	2004	Texas, Florida, East Coast	92	$14 billion	NWS (2006)
Hurricane Katrina	2005	Gulf Coast	1,833	$108 billion	KNABB ET AL. (2005)
Hurricane Rita	2005	Gulf Coast	62	$12 billion	KNABB ET AL. (2006)
Hurricane Wilma	2005	Florida	23	$21 billion	PASCH ET AL. (2006)
Severe flooding	2005	East Coast	11	$30 million	USA (2005); MSNBC (2006)
Hurricane Ike	2008	Texas, Louisiana	20	$25 billion	BERG (2009)
April Tornado Outbreak (336 tornadoes)	2011	Midwest, South, East Coast	342	$6 billion	MSNBC (2011); INSURANCENEWSNET.COM. 2011
Tornado	2011	Joplin, MO	162	$3 billion	PRI (2011); USA TODAY (2011)

Manmade and natural disasters can threaten national security, result in mass casualties, weaken the economy, and damage public morale and confidence. Protecting and ensuring the continuity of the critical infrastructure in the United States is essential to the Nation's security, public health and safety, economic vitality, and way of life.

Recent advances in building design and technology have made some buildings more resistant to manmade and natural disasters, but assessing the vulnerability of the buildings in the Nation's critical infrastructure remains difficult because of the wide array of infrastructure that spans important aspects of the U.S. Government, economy, and society. Planning and preparedness for the Nation's building inventory must continue to adapt to a dynamic threat environment and address vulnerabilities and gaps in physical protection in an all-hazards context. Stakeholders must manage the risk of their assets

Recent advances in building design and technology have made some buildings more resistant to manmade and natural disasters, but assessing the vulnerability of the buildings in the Nation's critical infrastructure remains difficult.

through comprehensive risk assessments and mitigation. Improvements in protection and resilience can make it more difficult for terrorists to launch destructive attacks, decrease the impact of an attack or natural disaster, and provide greater resilience in response and recovery.

To better quantify, qualify, and mitigate the risks to buildings, DHS S&T has developed a methodology to assess the risk and resilience of buildings. The results of the assessment are sufficient for formulating action plans and programs to enhance resilience, reduce vulnerability, deter threats, and mitigate potential consequences. The primary purpose of the methodology is to prioritize the relative risk and resilience among a collection of buildings in a city or community, but the methodology can also be used to develop infrastructure-specific risk information for risk management activities.

IRVS and FEMA 455

The conceptual framework and field application of the IRVS methodology is based on FEMA 455, *Handbook for Rapid Visual Screening of Buildings to Evaluate Terrorism Risks* (FEMA 2009a). FEMA 455 was developed in response to the need for a preliminary assessment of the risk of terrorist attack to a building that was quick and simple. The methodology was successful in providing a product that could be used by screeners who are not experts in anti-terrorism or structural design but was limited in that only manmade threats (chemical, biological, radiological, and explosive threats) were considered. DHS S&T has expanded the IRVS of buildings to include natural hazards and is applicable to a variety of types of buildings across all sectors.

The IRVS of buildings methodology includes the following:

- **Assessment of Multihazard Interactions –** Effects of a decision concerning the behavior of the building in a particular hazard on the behavior of the building due to another hazard. Designing for multihazards may reinforce one another, thus reducing cost and improving protection, but it has also been recognized that at times there may be conflicts between designs for different hazards. An assessment of multihazard interactions can help decision-makers make cost-effective decisions related to mitigation measures, retrofits, maintenance, or rehabilitation of buildings.
- **Assessment of Resilience –** The three components of resilience: robustness, resourcefulness, and recovery.
- **Building Types –** Based on model building types in FEMA (2002) and FEMA (2009b). The model building types categorize buildings

with similar structural systems Building types are differentiated by their responses to certain events in terms of amount of damage and types of losses.

- **Continuity of Operations –** An evaluation of the impact of an event on the critical functions of the building and its ability to maintain operations through redundancy.
- **IRVS Database –** Facilitates data collection and functions as a data management tool. The software can be used during all phases of the IRVS (pre-field, field, and post-field).

"Integrated" in IRVS indicates that the methodology includes the risk of both terrorist acts and natural hazards and an assessment of both risk and resiliency.

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Relationship to the National Infrastructure Protection Plan

The IRVS methodology closely follows the general risk management framework and definitions relating to risk in DHS's National Infrastructure Protection Plan (NIPP) (DHS, 2009), including the 18 Critical Infrastructure and Key Resources (CIKR) Sectors to facilitate a broad applicability for the methodology. A CIKR Sector consists of assets, systems, and networks that provide similar functions to the economy, government, or society. The IRVS incorporates the 18 CIKR Sectors in the target density evaluation and includes all sectors in determining the threat of collateral damage from attacks on other targets.

The risk management framework in the NIPP involves scenario-based consequence and vulnerability estimates and an assessment of the likelihood that a postulated threat will occur. The IRVS basic analytical principles are based in part on the NIPP's core criteria for risk assessments to ensure that the methodology is:

- **Documented –** This manual includes the types of information that are collected during the IRVS and how the information is synthesized to generate a risk and resiliency assessment. All assumptions, weighting factors, and subjective judgments are explained.
- **Reproducible –** The methodology has been tested to ensure that the results are reproducible.
- **Defensible –** The components of the methodology are integrated logically, and disciplines that are relevant to the methodology are incorporated appropriately (e.g., engineering, architecture, construction,

emergency management, security). The methodology has been validated."

- **Complete –** For every building type, the methodology includes an assessment of consequences, threats, and vulnerabilities for every defined scenario and an assessment of the resiliency to postulated threats.

Partnerships

DHS S&T worked in partnership with several public- and private-sector organizations to develop the methodology. The partners reviewed the factors involved in the risk and resiliency scoring and conducted pilot and field studies of a variety of buildings susceptible to multiple hazards throughout the Nation. The partnerships provided a framework to exchange ideas, approaches, and best practices. All organizations involved provided DHS with invaluable information that has helped determine, in a plausible and realistic manner, the scope and the effective use of this methodology.

> Partnerships provide a framework to exchange ideas, approaches, and best practices.

The public-sector partners are:

- New York State Division of Homeland Security and Emergency Services
- Arlington County, Virginia
- New York Police Department
- U.S. Department of Veteran Affairs
- U.S. DHS Office of Infrastructure Protection
- National Institute of Building Sciences
- U.S. DHS Federal Protective Services
- Los Angeles Police Department
- Chicago Police Department
- Charleston Police Department

The private-sector partners are:

- URS Group, Inc.
- Weidlinger Associates, Inc.
- Cushman & Wakefield, Inc.
- Beacon Capital Partners, LLC
- The John Buck Company
- Kodiak Realty Services, LLC
- The Shooshan Company
- Vornado Charles E. Smith

Intended Audience

This manual is intended for both technical and stakeholder audiences from a wide array of public- and private-sector partners. Technical audiences include potential screeners and trained personnel with knowledge about building systems but not necessarily with a high level of expertise. Stakeholders include building owners, operators, and decision-makers involved with the planning, construction, and maintenance of the built environment. Interested technical and stakeholder groups are expected to include the following:

> This manual is intended for both technical and stakeholder audiences from a wide array of public- and private-sector partners.

- Facility managers
- City, county, and State officials
- Emergency managers
- Law enforcement agencies
- Lenders
- Insurers
- Security consultants
- Engineers, architects, and other design professionals

Acknowledgments

This publication has been produced by the Department of Homeland Security (DHS), Science and Technology (S&T) Directorate, Infrastructure Protection and Disaster Management Division (IDD). It will be revised periodically, and comments and feedback to improve future editions are welcome. Please send comments and feedback to bips@dhs.gov.

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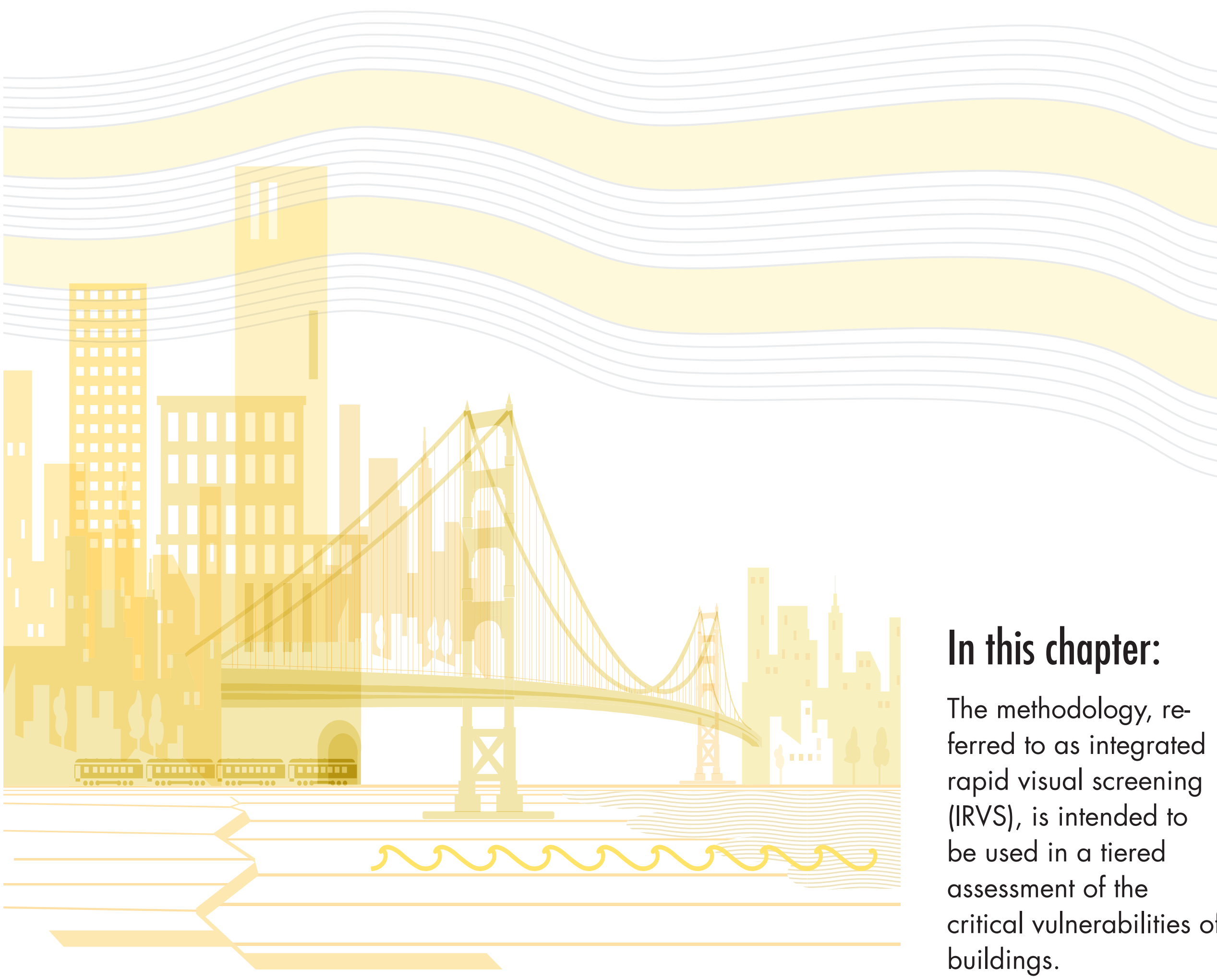
Overview of the IRVS Methodology



In this chapter:

The methodology, referred to as integrated rapid visual screening (IRVS), is intended to be used in a tiered assessment of the critical vulnerabilities of buildings.

1 OVERVIEW OF THE IRVS METHODOLOGY

In response to the need to improve the protection of the Nation's critical assets, the Department of Homeland Security's Science and Technology Directorate (DHS S&T) has developed the Integrated Rapid Visual Screening (IRVS) methodology for assessing the risk and resilience of critical infrastructure to terrorist attacks and natural hazards that result in catastrophic losses (fatalities, injuries, damage, or business interruption). The assessment includes terrorist attacks caused by chemical, biological, and radiological (CBR) agents and explosives and by natural disasters resulting from earthquakes, floods, wind, and fire. The methodology is applicable across all Critical Infrastructure and Key Resources (CIKR) Sectors.

This IRVS is intended to be used in a tiered assessment. A tiered assessment consists of successively more refined analyses when more detailed information is required. The trade-off between level of effort and level of refinement allows an assessment to meet a variety of benefit/cost considerations for different infrastructure. As the first step in an overall process, the IRVS is intended to be a quick and simple tool for obtaining a quantifiable initial risk and resilience rating for one or more infrastructure assets. There are practical limitations on how much information can be considered in a rapid assessment. The IRVS methodology is often used to obtain a basic understanding of risk and resilience and to prioritize more detailed assessments over the entire inventory of infrastructure considered.

> This Integrated Rapid Visual Screening (IRVS) is intended to be used in a tiered assessment. A tiered assessment consists of successively more refined analyses when more detailed information is required.

1.1 IRVS Series

DHS S&T has developed the IRVS methodology for mass transit stations, tunnels, and buildings (See Figure 1-1). The IRVS methodology is described in the following documents:

- BIPS 02, *Integrated Rapid Visual Screening of Mass Transit Stations* (DHS, 2011a)
- BIPS 03, *Integrated Rapid Visual Screening of Tunnels* (DHS, 2011b)
- BIPS 04, *Integrated Rapid Visual Screening of Buildings* (this publication)

Each IRVS assessment is tailored to evaluate the unique characteristics of the infrastructure type that influence risk and resiliency. The IRVS series can be used in conjunction with the evaluation of a system or area that may include mass transit stations, tunnels, or buildings.

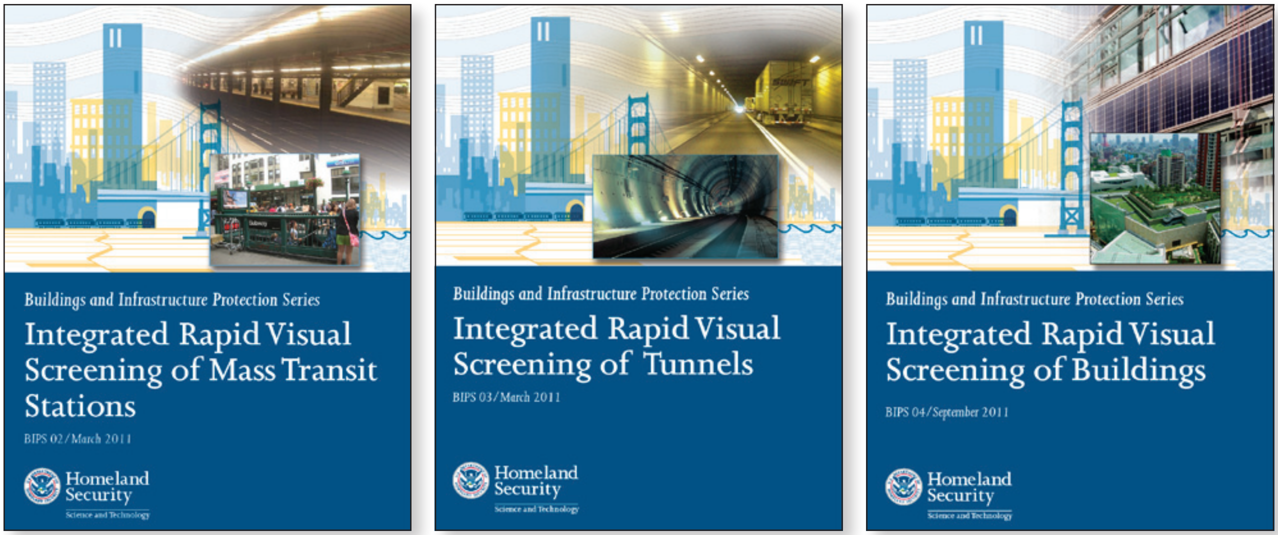


Figure 1-1. IRVS series

1.2 Validation

DHS S&T validated the IRVS methodology through alpha and beta testing in partnership with many public- and private-sector organizations. The first objective of the alpha and beta testing was to evaluate or determine the following:

- User-friendliness of the documentation and software
- Clarity of the description of the methodology
- Duration of a typical evaluation by newly trained screeners
- Sensitivity of the scoring system (attribute weights) to various attributes
- Variation among scores for building types
- Consistency of results

The second objective was to collect data on a wide array of building types, mass transit stations, and tunnels with unique characteristics throughout the Nation.

The results of the alpha and beta testing were used as a basis for:

- Adding, deleting, and modifying characteristics
- Modifying the weighting factors for attribute options
- Calibrating the tool to obtain accurate, consistent, and reasonable risk scores for each IRVS for different types of buildings, mass transit

stations, and tunnels. Scoring calibration includes the overall risk score and the scores for each threat scenario and the consequences rating, threat rating, and vulnerability rating.

The IRVS of buildings was validated in several U.S. municipalities with varying hazard exposure. The IRVS pilot test cities were Arlington, VA; Albany, NY; New York, NY; Washington D.C.; Los Angeles, CA; Charleston, SC; and Chicago, IL.

1.3 Risk and Resilience

The objective of the IRVS of buildings is to assess a building's risk to manmade threats and natural hazards and resilience to undesirable events. The screener must understand the concepts of risk and resilience in the context of infrastructure protection to be able to successfully conduct a screening, interpret the results, and use the results in risk decision-making.

1.3.1 Risk

Risk is the potential for an unwanted outcome resulting from an incident, event, or occurrence, as determined by its likelihood and the associated consequences (DHS, 2009). Risk is influenced by the nature and magnitude of a threat, the vulnerabilities to the threat, and the consequences that could result. Risk is an important means of prioritizing mitigation efforts for partners ranging from facility owners and operators to Federal agencies. Evaluating risk enables risk-informed decision-making related to critical infrastructure (DHS, 2009). The IRVS risk assessment provides a relative risk profile that defines which assets are at the greatest risk.

def-ə-

Consequence is defined as the effect of an event, incident, or occurrence.

Risk is assessed as a function of consequences, threat, and vulnerability.

- **Consequence** is defined as the effect of an event, incident, or occurrence (DHS, 2009). The consequences considered for a national-level comparative risk assessment are based on criteria set forth in *Homeland Security Presidential Directive 7: Critical Infrastructure Identification, Prioritization, and Protection* (HSPD-7) (DHS, 2008). The criteria divide consequences into four categories:
    - **Public health and safety –** Effect on human life and physical well-being (e.g., fatalities, injuries/illness).

- **Economic –** Direct and indirect economic losses (e.g., cost to rebuild an asset, cost to respond to and recover from attack, downstream costs resulting from disruption of a product or service, long-term costs due to environmental damage).

- **Psychological –** Effects on public morale and confidence in national economic and political institutions. Psychological effects encompass changes in perceptions emerging after a significant incident that affect the public's sense of safety and well-being and can manifest in aberrant behavior.

- **Governance/ mission impact –** Effects on the ability of a government or industry to maintain order, deliver minimum essential public services, ensure public health and safety, and carry out missions related to national security.

The indirect and cascading impacts of disruptions are difficult to understand and even more difficult to assess. Indirect economic losses are the long-term economic effects on the local, regional, or national community such as downstream costs resulting from the disruption of services. Estimating indirect impacts requires numerous assumptions and other complex variables. Cascading impacts occur when there are relationships or dependencies among assets, systems, or networks within or across sectors. Many assets, systems, and networks rely on connections to CIKR functions. For instance, all sectors have relationships with elements of the Energy, Information Technology, Communications, Banking and Finance, and Transportation Systems Sectors. In many cases, the failure of an asset or system in one sector will affect the ability of interrelated assets or systems in the same or another sector to perform necessary functions. An example is the effects of a fire in a telecommunications building, which could affect services in an entire area if there is no redundancy.

In the IRVS methodology, the analysis has been simplified by focusing on asset-oriented consequences (i.e., direct impacts related to the loss of a building or disruption of the services that are provided in the building) in order to be able to complete the assessment in a timely manner. A higher level assessment is needed to include cascading impacts in the assessment of consequences.

- **Threat** is defined as any natural or manmade occurrence, individual, entity, or action that has or indicates the potential to harm life, information, operations, the environment, and/

> **Threat** is defined as any natural or manmade occurrence, individual, entity, or action that has or indicates the potential to harm life, information, operations, the environment, and/ or property.

or property (DHS, 2009). In the armed services, the intelligence community, and law enforcement, "threat" is typically used to describe the design criteria for terrorist or other types of manmade disasters. FEMA and other civil agencies use "hazard" in several contexts. "Natural hazard" typically refers to a natural event such as a seismic, flood, or wind disaster.

- **Vulnerability** is defined as any physical feature or operational attribute that renders an entity, in this case a building, open to exploitation or susceptible to a given hazard (DHS, 2009). The vulnerabilities evaluated in the IRVS are associated with physical, cyber, and human factors. The assessment of vulnerabilities includes the identification of building weaknesses that can increase the potential for damage from a manmade or natural disaster. Additionally, the building is evaluated to determine whether there is a lack of redundancy in its critical systems.

def-ə-

Vulnerability is defined as any physical feature or operational attribute that renders an entity, in this case a building, open to exploitation or susceptible to a given hazard.

1.3.2 Resilience

Resilience is defined as "the ability to resist, absorb, recover from, or successfully adapt to adversity or a change in conditions" (DHS, 2009). Resilience is the ability of an asset to maintain or recover its critical functionality within a short period after the impact of an adverse event. Figure 1-2 is an example of an asset's resilience after an event.

def-ə-

Resilience is defined as the ability to resist, absorb, recover from, or successfully adapt to adversity or a change in conditions.

Resilience can be characterized by three key features: robustness, resourcefulness, and rapid recovery.

- **Robustness** is defined as "the ability to maintain critical operations and functions in the face of crisis" (DHS, 2009). Robustness measures include barriers, cameras, alarms, access control, and redundancy of critical infrastructure systems and components. Robustness measures also include mitigating construction techniques that are designed to prevent a structure from collapsing after an explosion, structural retrofits, and debris mitigation techniques such as window films.
- **Resourcefulness** is defined as "the ability to skillfully prepare for, respond to and manage a crisis or disruption as it unfolds" (DHS, 2009). Resourcefulness factors include training and preparedness, exercises, information sharing, security awareness programs, and ongoing assessment of risk.

- **Recovery** is defined as "the ability to return to and/or reconstitute normal operations as quickly and efficiently as possible after a disruption" (DHS, 2009).

Although complementary, resiliency should not be confused with infrastructure protection. Infrastructure protection is the ability to prevent or reduce the effect of an adverse event.

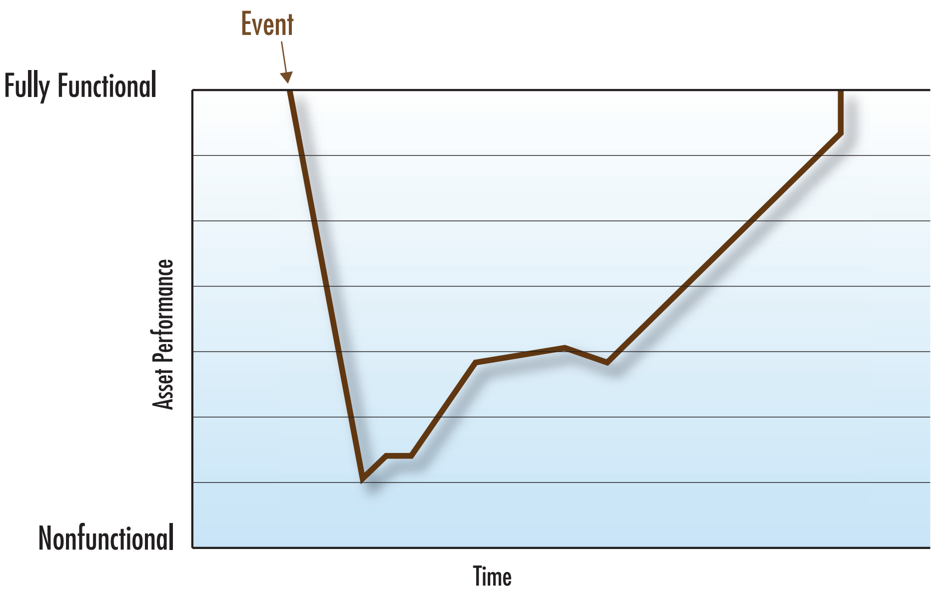


Figure 1-2: Example of resilience

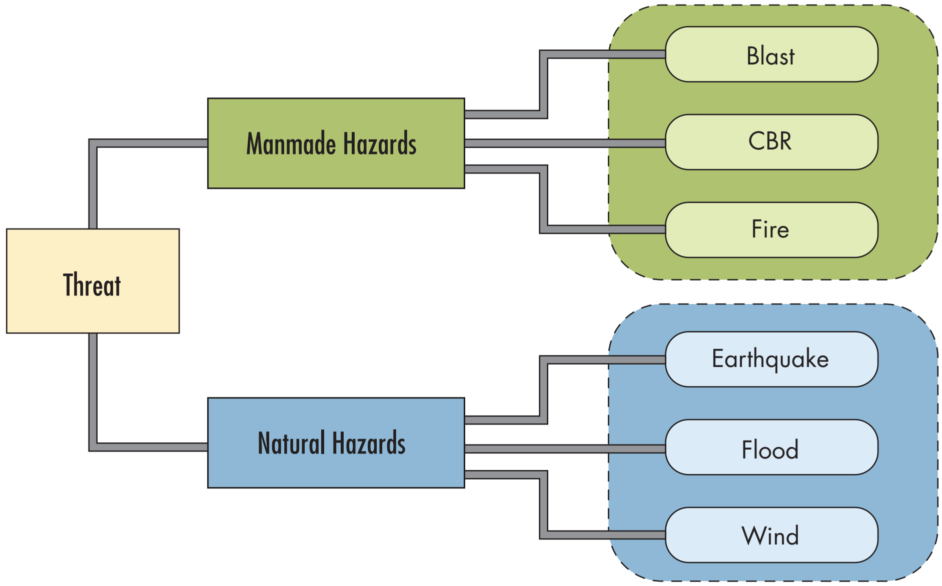
1.4 All-Hazards Assessment

The IRVS of buildings consists of an assessment of the risk and resilience of building infrastructure across all sectors in an all-hazards context. "All-hazards" encompasses all conditions, environmental or manmade, that have the potential to cause injury, illness, or death; damage to or loss of equipment, infrastructure services, or property; or social, economic, or environmental functional degradation.

The IRVS methodology takes into account selected manmade and natural threats (see Figure 1-3).

An all-hazards approach to the IRVS was selected because of the catastrophic events that have occurred in the recent past and because most sites in the United States are vulnerable to multiple hazards. An all-hazards approach is effective for buildings or infrastructure in areas that are exposed to a variety of manmade and natural disasters and results in cost savings, increased efficiency, and better performance of the IRVS.

Figure 1-3.
IRVS all-hazards breakdown



Examples of catastrophic manmade and natural disasters from 1993 to 2005 are as follows:

- **Terrorism –** Explosive. World Trade Center, New York City, February 1993. On Friday, February 26, 1993, at 12:18 pm, a large explosion ripped through the public parking garage of the World Trade Center (see Figure 1-4). The explosion resulted in 6 deaths, more than 1,000 injuries, and $300 million in property damage.

The explosion was caused by a 1,500-pound urea-nitrate bomb in a van that had been parked in the basement parking garage. The blast instantly cut off the center's main electrical powerline, knocking out the emergency lighting system. The bomb caused smoke to rise up to the 93rd floor of both World Trade Center towers. The garage sustained extensive damage.

Figure 1-4:
Underground damage after the 1993 World Trade Center bombing

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- **Earthquake. Northridge, California, January 1994**. On January 17, 1994, at 4:31 am, an earthquake with a magnitude of 6.7 shook the San Fernando Valley in California (see Figure 1-5). The earthquake's epicenter was about 20 miles northwest of downtown Los Angeles near the community of Northridge. The earthquake was responsible for 57 deaths and more than 9,000 injuries and extensive damage to many of the region's structures.

  A building in the Northridge Meadows apartment complex collapsed, resulting in 16 deaths, and several commercial facilities also collapsed. California's strict building codes and excellence in design and construction minimized the loss of life, but economic losses were estimated at $46 billion.

Figure 1-5:
Building damaged by the Northridge Earthquake

- **Terrorism – Explosive. Murrah Federal Building, Oklahoma City, April 1995.** On April 19, 1995, at 9:02 am, a truck bomb exploded outside the Alfred P. Murrah Federal Building in Oklahoma City, causing 168 fatalities and 684 injuries. See Figure 1-6. The explosion was a result of a 7,000-pound truck bomb that was detonated no farther than 20 feet from the face of the structure. The explosion blew of the front façade of the building and caused the progressive collapse of part of the structure.

Figure 1-6:
Aftermath of the Murrah Federal Building bombing

SOURCE: FEMA 277

- **Terrorism – Explosive. World Trade Center, New York City, September 2001.** Early on the morning of September 11, 2001, aggressors from a Middle Eastern terrorist group (Al-Qaeda) orchestrated the hijacking of four commercial airliners en route to San Francisco, Boston, Newark, and Washington, D.C. At 8:46 am, the hijackers of American Airlines Flight 11 crashed the plane into the World Trade Center's North Tower, followed by United Airlines Flight 175, which hit the South Tower at 9:03 am.

  The impacts of jets at high speeds in combination with subsequent fires weakened the trusses supporting the floors, making the floors sag. The sagging floors pulled on the exterior steel columns to the point where exterior columns bowed inward. The fire eventually compromised the building's structural integrity leading to the progressive collapse of both towers. Numerous other buildings at the World Trade Center site were destroyed or severely damaged from the collateral effects. The tragedy was responsible for nearly 3,000 deaths and had a significant economic impact on the United States and world markets.

- **Hurricane (wind and flooding). Hurricane Katrina, Gulf Coast, August 2005.** On August 25, 2005, Hurricane Katrina made landfall and began crossing over the Gulf Coast, causing the greatest natural disaster in U.S. history. The storm caused extensive damage to the region's infrastructure and critical facilities. Southeast Louisiana and the coast of Mississippi bore the brunt of the damage.

  Wind damage was widespread and severe in many areas, but the greatest damage was caused by Hurricane Katrina's storm surge flooding (see Figure 1-7). Many buildings (commercial, residential, and industrial) were destroyed or severely damaged. Many people had to be evacuated. The estimated death toll exceeded 1,800. Estimated total economic losses are in excess of $150 billion and insured losses are $40 billion, making Katrina the most expensive natural disaster in the Nation's history.

Figure 1-7:
Flooding caused by Hurricane Katrina

1.4.1 Manmade Threats

Manmade threats (also known as "human-caused hazards") refer to potential events caused directly by deliberate or negligent human actions. Manmade threats consist of technological hazards and terrorism and are distinct from natural hazards primarily because they originate in human activity. Technological hazards (e.g., fire caused by faulty electronics) are generally assumed to be accidental with consequences that are unintended. Terrorism is considered an unlawful act of force and violence against persons or property to intimidate or coerce a government or the civilian population to further political or social objectives. Throughout history, many manmade threats have caused large-scale loss of life, destruction of property, and devastating economic loss.

Terrorism is considered an unlawful act of force and violence against persons or property to intimidate or coerce a government or the civilian population to further political or social objectives.

In the IRVS of buildings methodology, manmade threats focus on terrorist attacks. Perpetrators of such attacks seek publicity for their cause, monetary gain in some instances, or political gain. Attacks can include injuring or killing people; destroying or damaging facilities, property, equipment, or resources; or stealing equipment, material, or information. A threat may originate in two or more groups with differing methods and motives.

The methodology addresses blast or explosive threats; chemical, biological or radiological (CBR) releases; and fire.

1.4.1.1 Blast or Explosive Threat

A blast or explosive threat is one of the most common types of terrorist attack. Ingredients for homemade bombs and instructions for bomb making are both easy to obtain. Attacks with explosive devices are easy and quick to execute. Bombs are typically in a vehicle or hand delivered. Vehicle bombs can contain enough explosives to cause devastating structural damage. Hand-delivered bombs can cause significant damage when brought into vulnerable, unsecured areas of the interior of a building. Figure 1-8 shows the pressure effects of a bomb on a building.

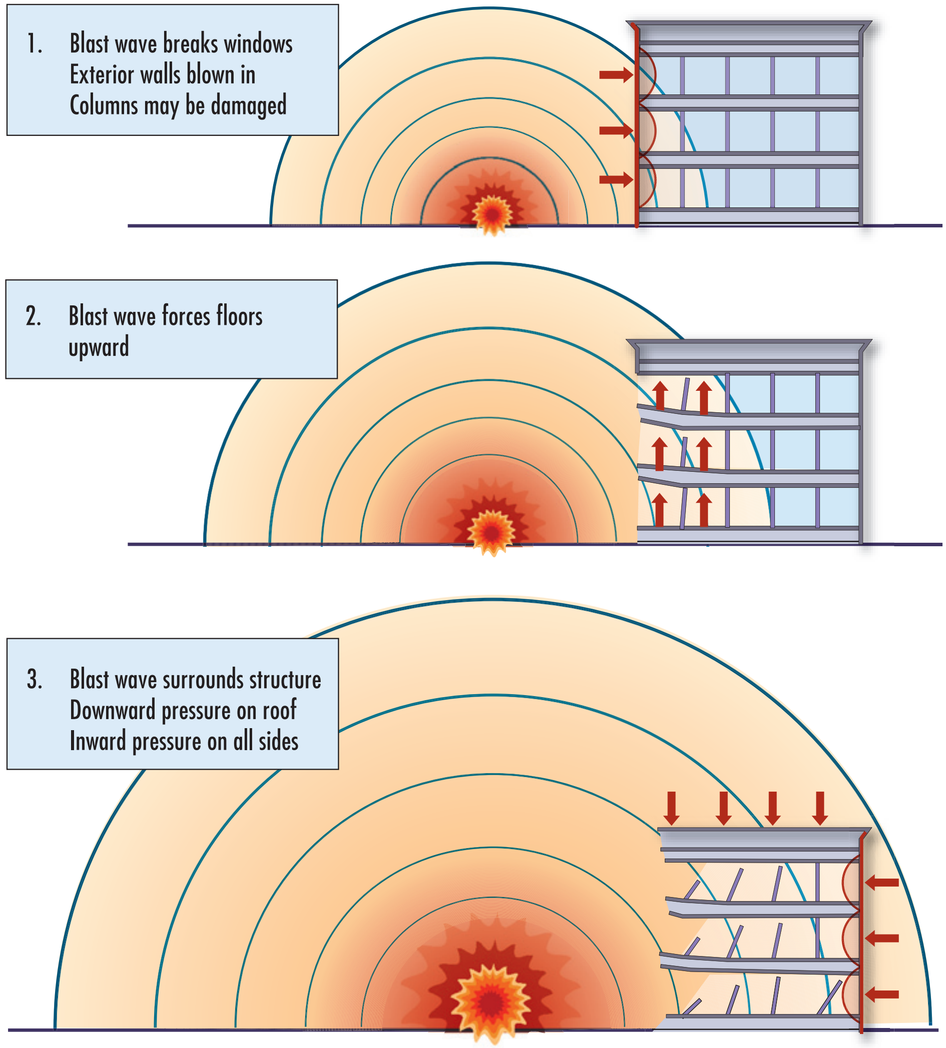
1.4.1.2 Chemical, Biological, and Radiological Threat

There are hundreds of chemical, infectious, and radiological agents that can be used in a terrorist chemical, biological, or radiological (CBR) attack. Chemical agents are toxic substances that are developed or selected for use in warfare to kill or incapacitate people. Biological agents include bacteria, viruses, fungi, and other microorganisms that are used to cause illness or death. Radiological agents emit alpha, beta, or gamma radiation. The severity of the threat is determined by the agent's toxicity and persistence.

CBR attacks are an emerging threat of great concern because of the large geographic area that can be contaminated, numbers of people who can be affected, and the high cost of response and recovery.

Figure 1-8:
Blast pressure effects on a building

SOURCE: NAVAL FACILITIES ENGINEERING SERVICE CENTER, USER'S GUIDE ON PROTECTION AGAINST TERRORIST VEHICLE BOMBS, MAY 1998



1.4.1.3 Fire Threat

Fire is a common threat that can be the primary attack method or the secondary effect of another type of threat. An example of fire as the primary attack method is arson. Fire resulting from a blast is an example of a secondary effect. The threat of fire can be considered a natural hazard when the fire is the secondary effect of an earthquake.

1.4.2 Natural Hazards

Natural hazards are naturally occurring events such as floods, earthquakes, hurricanes, high winds, tornadoes, tsunami, coastal storms, landslides, and wildfires that strike populated areas. A natural event is a hazard when it has the potential to harm people or property. Some natural hazards can be predicted and occur repeatedly in the same geographical locations because they are related to weather patterns or physical characteristics. Every year in the United States, natural hazards cost lives and billions of dollars in damage.

Natural hazards are naturally occurring events such as floods, earthquakes, hurricanes, high winds, tornadoes, tsunami, coastal storms, landslides, and wildfires that strike populated areas.

The methodology addresses three natural hazards — earthquake, flooding, and wind.

1.4.2.1 Earthquake

Earthquakes are low probability, high-consequence events that can have devastating effects. Earthquakes are the result of a sudden release of energy in the Earth's crust that creates seismic waves. Earthquakes are caused primarily by the rupture of geological faults but also by volcanic activity, landslides, mine blasts, and nuclear experiments.

As shown in Figure 1-9, more than 40 of the 50 states are at risk from earthquake-caused damage, loss of life, injuries, and economic impacts. Most of the well-known faults are in the western United States where most recent earthquakes have occurred, but the eastern and central sections of the country are also vulnerable to devastating earthquakes.

The earthquake risk of a building is related to the following:

- Ground motion
- Proximity of a fault
- Soil-bearing capacity under or near the building
- Earthquake- induced landslides near the building
- Earthquake-induced waves in bodies of water near the building (tsunami on the ocean and seismic seiche on lakes)

More than 40 of the 50 states are at risk from earthquake-caused damage, loss of life, injuries, and economic impacts.

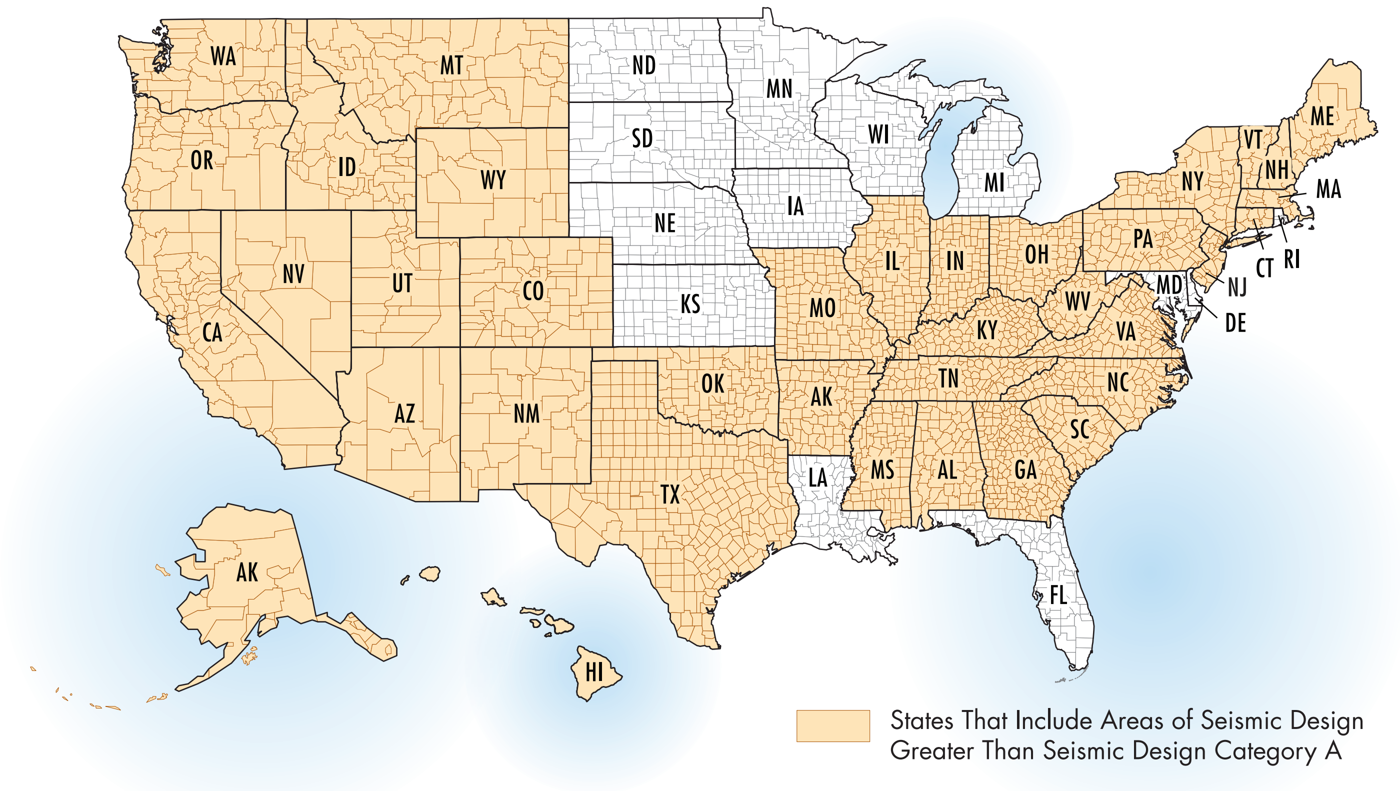


Figure 1-9: States with seismic risk

SOURCE: FEMA, P-424

1.4.2.2 Flooding

Flooding is the most common natural hazard in the United States, affecting more than 20,000 local jurisdictions and representing more than 70 percent of Presidential disaster declarations. Evaluations have estimated that 7 to 10 percent of the Nation's land area is subject to flooding (FEMA, 2010). Some communities have very little flood risk while others lie entirely within a floodplain.

> Flooding is the most common natural hazard in the United States, affecting more than 20,000 local jurisdictions and representing more than 70 percent of Presidential disaster declarations.

Flooding is a natural process that may occur in a variety of forms: long-duration flooding along rivers that drain large watersheds; flash floods that send a devastating wall of water down a mountain canyon; and coastal flooding that accompanies high tides, on-shore winds, hurricanes, and Nor'easters. Flooding is considered a problem only when human development is located in flood-prone areas. Such development exposes people to potentially life-threatening situations and makes property vulnerable to serious damage or destruction.

Flooding along waterways normally occurs as a result of excessive rainfall or snowmelt that creates water flows exceeding the capacity of channels. Flooding along shorelines is usually a result of coastal storms that generate storm surges or waves above normal tidal fluctuations. The flood hazard can be characterized by a relationship between the depth of flooding and the annual chance of inundation to that depth. Depth, duration, and velocity of water are the primary factors contributing to flood losses.

Flood frequency studies define the flood hazard in terms of the chance that a certain magnitude of flooding is exceeded in any given year. What is commonly called the 100-year flood is not a flood that occurs every 100 years but a flood that has a 1 percent chance of occurring in any year.

Figures 1-10 and 1-11 show the hydrostatic and hydrodynamic loads on buildings from flooding.

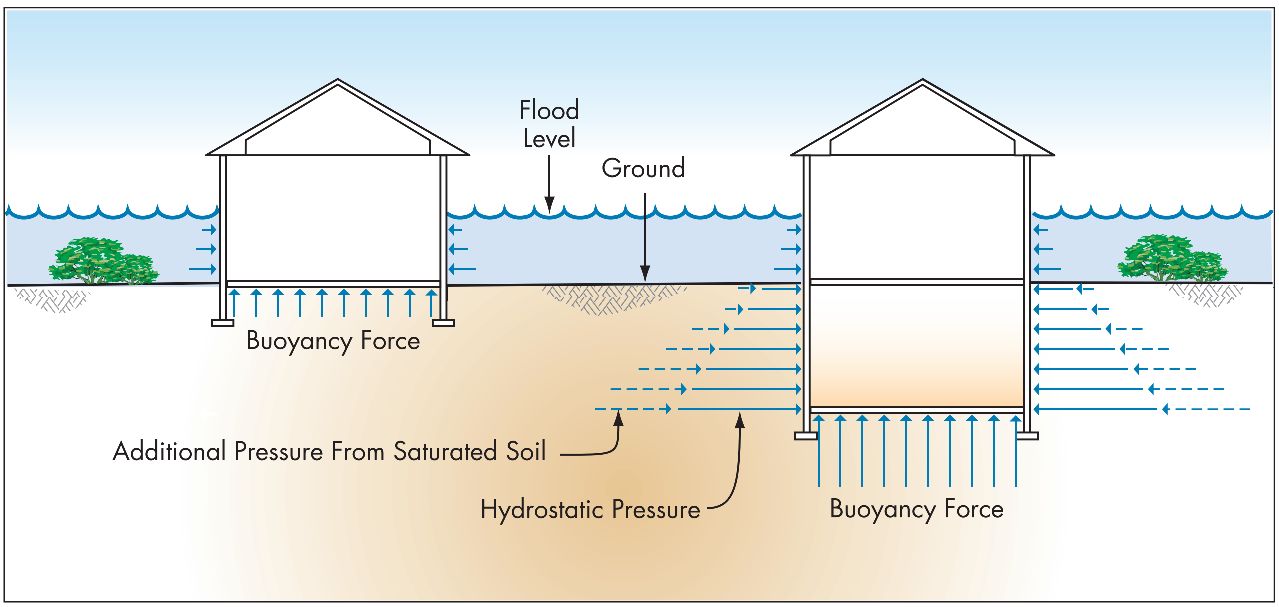


Figure 1-10. Hydrostatic loads on buildings from flooding (FEMA, 2007a)

SOURCE: FEMA 543

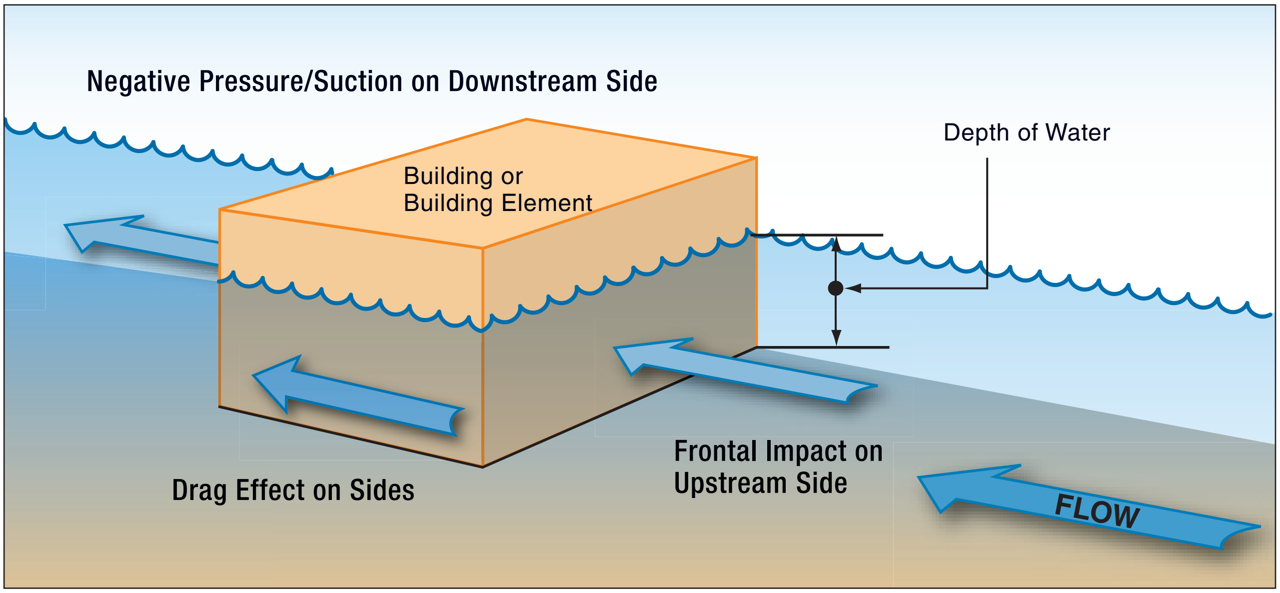


Figure 1-11: Hydrodynamic loads on a building or building element from flooding (FEMA, 2007a)

SOURCE: FEMA 543

1.4.2.3 Wind

A variety of windstorm types occur in the United States. The primary storm types are straight-line winds, down-slope winds, thunderstorms, downbursts, Nor'easters, hurricanes, and tornadoes. Of all the storm types, hurricanes and tornadoes have the greatest potential for devastating an area.

In terms of wind interaction with buildings, winds create both positive and negative pressures. A particular building must have sufficient strength to resist the applied wind loads to prevent wind-induced building failure or damage. The magnitude of the pressure is a function of the following:

- Exposure (characteristics of the terrain)
- Basic wind speed
- Building height (wind speed increases with height above the ground)
- Internal pressure (building pressurization/depressurization)—the opening through the building enclosure, in combination with wind interacting with a building, can cause either an increase in the pressure within the building or a decrease in the pressure
- Building shape, which affects the value of pressure coefficients and therefore the loads applied to the various building surfaces

Figure 1-12 shows the wind-induced pressures on a building.

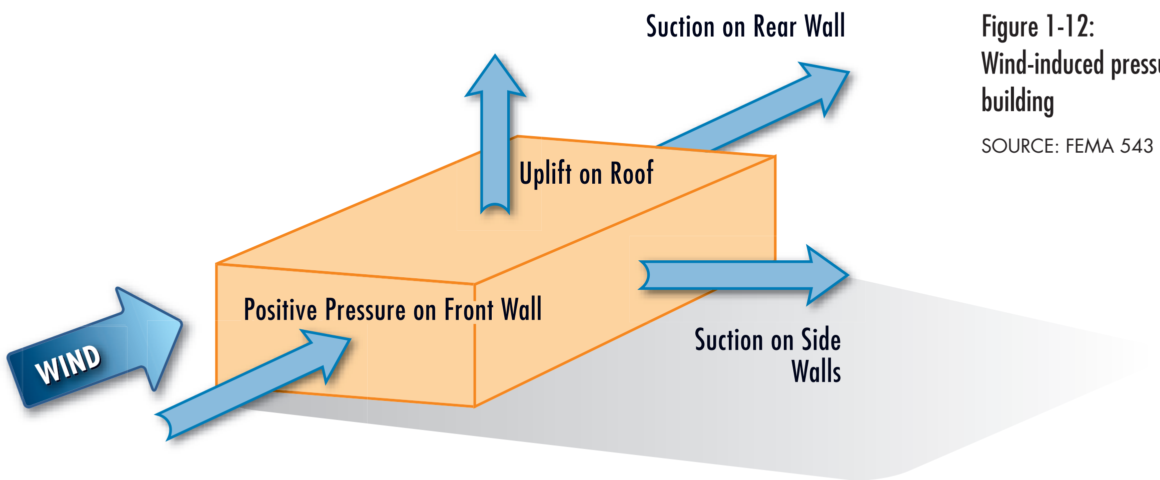


Figure 1-12: Wind-induced pressures on a building

SOURCE: FEMA 543

1.5 Cost-Effectiveness

The IRVS procedure can be implemented relatively quickly and inexpensively to develop a risk and resilience profile of a group of buildings without the high cost of a detailed risk analysis of individual buildings by technical experts.

The results of the IRVS can be used to establish priorities, and the available resources can be focused on risk management actions that offer the greatest mitigation of risk.

1.6 Organization of the Manual

This manual provides the information needed to understand and perform an IRVS of buildings. Information is provided on evaluating the key features that contribute to the risk and resiliency of the building, recording data in the IRVS Database, and interpreting and using the risk and resiliency scores.

Information is presented in the following order:

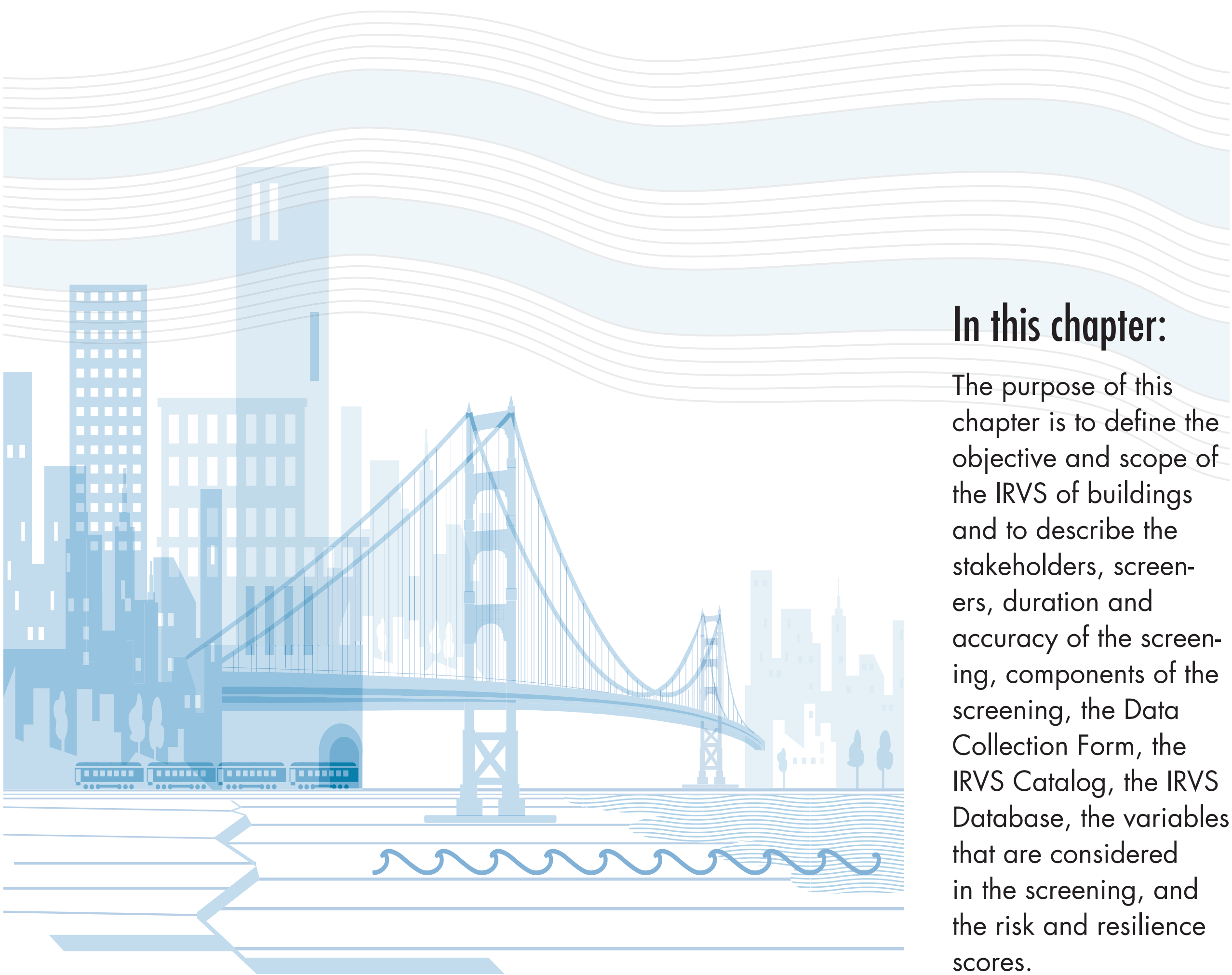
- Chapter 1: Overview of the IRVS Methodology
- Chapter 2: Introduction to the IRVS of Buildings
- Chapter 3: Conducting an IRVS of Buildings
- Chapter 4: Completing the Data Collection Form
- Chapter 5: References

Supplemental information is provided in the following appendices:

- Appendix A: Acronyms and Abbreviations
- Appendix B: Glossary
- Appendix C: IRVS Database User Guide
- Appendix D: Data Collection Form (Paper Version)
- Appendix E: DHS Infrastructure Taxonomy

2

Introduction to the IRVS of Buildings



In this chapter:

The purpose of this chapter is to define the objective and scope of the IRVS of buildings and to describe the stakeholders, screeners, duration and accuracy of the screening, components of the screening, the Data Collection Form, the IRVS Catalog, the IRVS Database, the variables that are considered in the screening, and the risk and resilience scores.

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2.1 Objective and Scope

The objective of the IRVS of buildings is to quantify the risk and resilience of a single building or a group of buildings to manmade and selected natural hazards that are capable of causing catastrophic losses in fatalities, injuries, damage, or business interruption. The IRVS is intended to be the first step in a tiered assessment that includes successively more refined analyses when more detailed information is needed. The methodology can be implemented relatively quickly and inexpensively. The methodology can be applied to buildings across all sectors. It is intended for existing buildings but can be applied to the design of new buildings.

> The objective of the IRVS of buildings is to quantify the risk and resilience of a single building or a group of buildings to manmade and selected natural hazards.

The hazards that are considered are manmade (blast; chemical, biological or radiological (CBR) release, and fire) and natural (earthquake, flooding, and wind).

Quantification of risk is based on a formula in the *National Infrastructure Protection Plan* (NIPP) (DHS, 2009), in which risk is characterized as the product of three factors: consequences, threat, and vulnerability. In the IRVS of buildings, these factors are evaluated based on FEMA 426, *Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings* (FEMA, 2003); FEMA 452, *Risk Assessment: A How-To Guide to Mitigate Terrorist Attacks, Risk Management Series* (FEMA, 2005); FEMA 454, *Designing for Earthquakes* (FEMA, 2006); and FEMA 543, *Design Guide for Improving Critical Facility Safety from Flooding and High Winds* (FEMA, 2007a).

> The methodology can be applied to buildings across all sectors. It is intended for existing buildings but can be applied to the design of new buildings.

The assessment is limited to the features of a building that contribute to the risk of a terrorist attack or natural disaster and the building's resilience to such an event. The emphasis is on vulnerability because the owner has more control over a building's vulnerability than over threat and consequences.

2.2 Stakeholders

A stakeholder in this manual is a person, group, or entity that holds an interest in or will benefit from an IRVS. The stakeholders typically decide to conduct an IRVS, own the results of the IRVS, and make many of the decisions regarding the IRVS. In most cases, the stakeholder is the owner or operating authority of the building or group of buildings but can also be a building tenant, law enforcement agency, or a Federal, State, or local government agency.

> A stakeholder in this manual is a person, group, or entity that holds an interest in or will benefit from an IRVS

The stakeholder or the stakeholder's personnel may conduct the IRVS. For example, an organization may create a task group consisting of its security personnel and engineers to conduct an IRVS of the building. The organization may also decide to hire a consulting group to conduct the IRVS.

2.3 Screeners

The IRVS was developed so that screeners could be building operators, law enforcement, and others outside the design community without a high level of expertise . Screeners can conduct an IRVS with a reasonable level of certainty after brief training, thus reserving technical experts such as engineers and architects for more in-depth assessments. See Section 3.1.2 for more information about screeners and the IRVS team.

> The IRVS was developed so that screeners could be building operators, law enforcement, and others outside the design community without a high level of expertise.

2.4 Time Required for the IRVS

One of the strengths of the IRVS of buildings is how quickly it can be completed. Pre-field data gathering can typically be conducted in a few hours by one or two screeners coordinating with facility management and key staff. The field assessment is designed to be completed by two screeners in 2 to 5 hours, depending on the complexity of the building and the availability of information prior to the assessment.

> One of the strengths of the IRVS of buildings is how quickly it can be completed.

2.5 IRVS Accuracy

The accuracy of the IRVS assessment is a function of the quality of the input. The accuracy of the IRVS will be improved if screeners obtain and review relevant information about the building prior to the field assessment and also review the IRVS methodology. Reviewing information such as building drawings, emergency plans and procedures, and site plan documentation prior to the field assessment is important because the more knowledge the screeners have about the building, the more accurate the assessment will be. A review of the IRVS methodology by the team of screeners for a group of buildings prior to the field assessment will help ensure consistency among assessments, a high quality of collected data, and uniformity of decisions among screeners.

The quality of the IRVS assessment is a function of the quality of input.

Reliability and confidence in the assessment can also be increased by obtaining information from building representatives who are available for questioning.

2.6 Characteristics and Attribute Options

The features of a building that are evaluated in the IRVS are referred to as characteristics. A characteristic is a physical component, function, or operation that relates to consequences, threat, or vulnerability. Examples of characteristics are locality type, number of occupants, building height, structure type, the presence of hazardous materials, and target density.

Each characteristic has several attributes. Screeners evaluate each characteristic by selecting one attribute. For example, for the locality/density characteristic, the attribute options may be rural/suburban, semi-urban/light industrial, industrial, urban, and dense urban. If the building being assessed is in Manhattan, the screener would select "dense urban."

Characteristics are grouped into the risk components of consequences, threat, and vulnerability, depending on which component the characteristic would affect. See Section 1.3 for information on the components of risk. Some characteristics affect more than one component. Furthermore, certain characteristics can also contribute to the components of resilience (robustness, resourcefulness, and time and speed of recovery).

"Characteristic" refers to the physical components, function, and operation of a building. **"Attribute"** is a subcategory of a characteristic.

Attribute option selections are weighted depending on their degree of risk, related threats, and the impact on the resilience of the building. For example, the dense urban attribute has the most risk of the locality/density attributes and is therefore given the heaviest weight of the attribute options for locality/density.

The attributes of characteristics that are more important than others are weighted more heavily than the attributes of less important characteristics. Characteristics with heavily weighted attributes require careful evaluation because of their influence on the risk score. A small difference in the assessment of these characteristics can change the risk and resilience scores significantly.

The following list contains the characteristics that are heavily weighted. The numbers in parentheses refer to the ID number in the Data Collection Form (DCF) and IRVS Catalog where the characteristics appear. The IRVS Catalog is provided in Chapter 4.

- Target Potential – Facility (PF-5.1)
- Target Density – Zone I (PF-6.1)
- Target Density – Zone II (PF-6.2)
- Target Density – Zone III (PF-6.3)
- Soil Type (PF-17)
- Structure Type (PF-18)
- Overall site accessibility (2.3)
- Topography/slopes (3.7)
- Location of critical functions/valuables: Exposure to Wind Events (3.13.1)
- Location of critical functions/valuables: Exposure to Flood Events (3.13.2)
- Appendages (e.g., chimneys, parapets, ornaments) (4.9)
- Total Percent Window Area (5.2)
- Transfer Girder Conditions (6.5)
- Seismic Design/Retrofit (6.9)
- Primary External Air Intake Location (7.1)
- Upgraded to Meet Current Code/Governing Standard (8.1a and 8.1b)

2.7 Subjective Judgments

Screeners may use subjective judgment when selecting attribute options for certain characteristics. The information in the catalog is intended in part to minimize the number of times the screener must use subjective judgment. When subjective judgment is used, the screener should document why the attribute was selected.

2.8 Data Collection Form

In the IRVS, information is recorded using the Data Collection Form (DCF), which is in the IRVS Database (see Figure 2-1). Screeners input data and evaluate characteristics by selecting attributes from dropdown menu. The screener can input data into the DCF using a laptop or tablet computer or by using a paper version if necessary (see Figure 2-2 and Appendix D), but the electronic version is preferred. If the paper version is used, data must be transferred to the IRVS Database. The risk and resilience scores can be generated only if the screening data are in the database.

See Chapter 4 for information on completing the DCF.

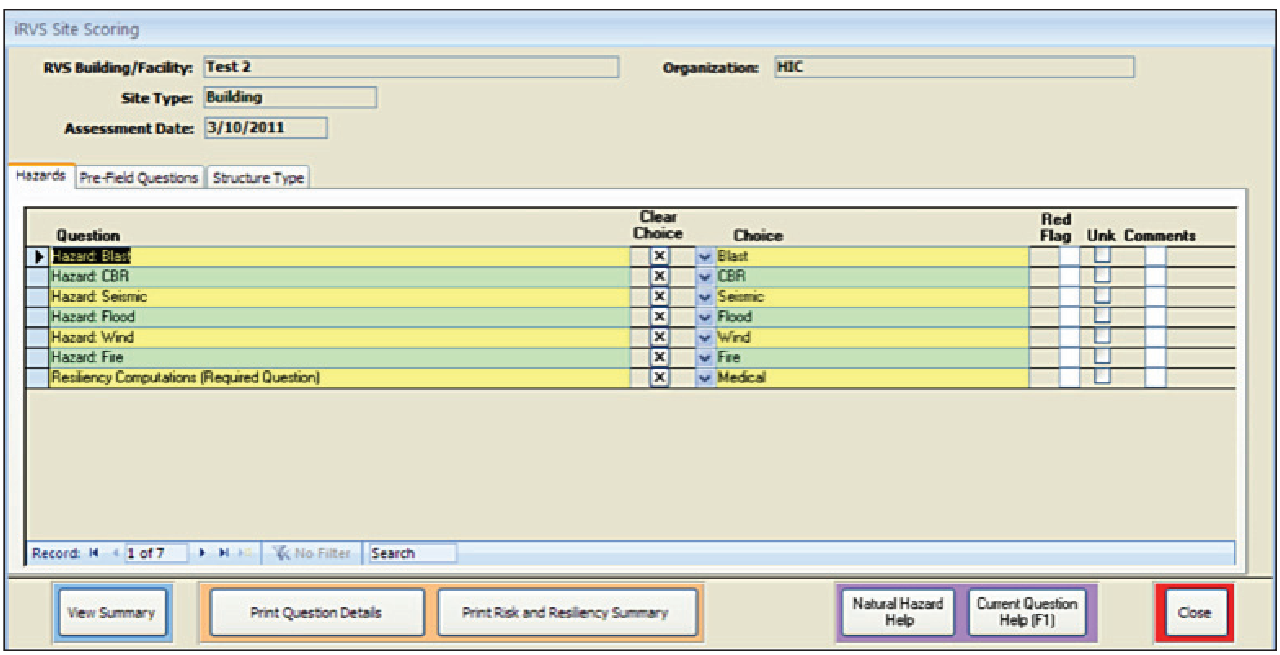


Figure 2-1: Example of electronic DCF in the IRVS Database

Pre-Screen Questionnaire

Building Characteristic			Attribute Options (a) / (f)	(b) / (g)	(c) / (h)	(d) / (i)	(e) / (j)	Red Flag	Comments
PF-1	Number of Occupants		< 100	≥ 100, < 500	≥ 500, < 2,000	≥ 2,000, < 5,000	≥ 5,000, < 10,000		
			≥ 10,000, < 12,500	≥ 12,500, < 15,000	≥ 15,000, <17,500	≥ 17,500, < 20,000	> 20,000		
PF-2	Replacement Value		< $1 million (m)	≥ $1 m, < $5 m	≥ $5 m, < $10 m	≥ $10 m, < $15 m	≥ $15 m, < $20 m		
			≥ $20 m, < $150 m	≥ $150 m, < $400 m	≥ $400 m, < $750 m	≥ $750 m, < $1 billion (b)	> $1 b		
PF-3	Historic Site		No	Yes	—	—	—		
PF-4	Occupancy Use		Group I	Group II	Group III	—	—		
PF-5	Target Potential (Credible Threats)	**PF-5.1** Target Potential: Building	No	Yes	—	—	—		
		PF-5.2 Target Potential: Sector	No	Yes	—	—	—		
PF-6	Target Density	**PF-6.1** Target Density: Zone I	0	1	2	3	4 or more		
		PF-6.2 Target Density: Zone II	0	1	2	3	4 or more		
		PF-6.3 Zone III	0	1	2	3	4 or more		
PF-7	Seismic Zone		Low	Medium	High	—	—		
PF-8	Proximity to an Active Seismic Fault		Farther than 10 miles from a fault (active or inactive) or within 10 miles of an inactive fault	Within 10 miles of an active fault	—	—	—		
PF-9	Floodplain		No	Yes	—	—	—		
PF-10	Maximum Flood Depth		No previous flooding	Low	Medium	High	—		

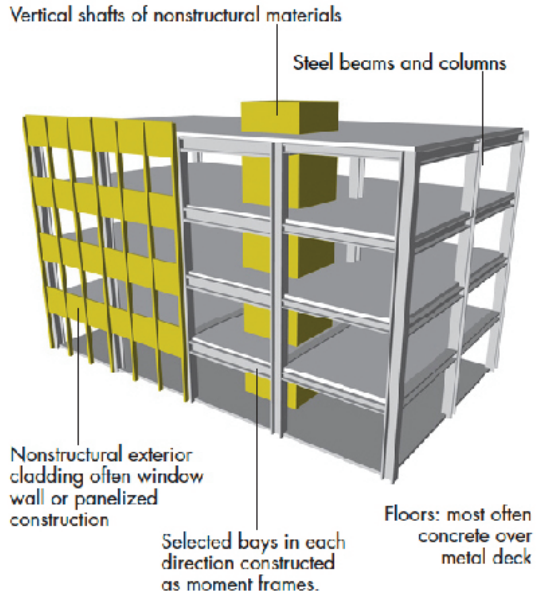
Figure 2-2: Example of paper version of the DCF

2.9 IRVS Catalog

The IRVS Catalog contains a description of the characteristics and associated attributes that are evaluated during the IRVS (see Figure 2-3). The purpose of the catalog is to help screeners, including those without a technical background, evaluate the characteristics accurately.

> Screeners should use the catalog during all phases of the screening.

Screeners should use the catalog during all phases of the screening. Following the catalog closely will ensure consistency when different screeners assess a group of buildings. The catalog is provided in Chapter 4 of this manual and is also in the IRVS Database.

Structure Type		
ID	**Building Characteristics**	**Attribute Options**
S1	**Steel Moment Frame** Buildings with a steel moment frame have steel columns and beams with cast-in-place concrete slabs or metal decks with concrete fill supported on steel beams, open web joists, or steel trusses. Lateral forces in steel moment frame buildings are resisted by rigid or semi-rigid beam-column connections. When all of the connections are moment-resisting connections, the entire frame participates in lateral force resistance. When only selected connections are moment-resisting connections, resistance is provided along discrete frame lines. The structure is usually concealed on the outside by exterior nonstructural walls, which can be constructed of almost any material (e.g., curtain walls, brick masonry, precast concrete panels). Walls may consist of metal panel curtain walls, glazing, brick masonry, or precast concrete panels. When the interior of the structure is finished, frames are concealed by ceilings, partition walls, and architectural column furring. Foundations consist of concrete spread footings or deep pile foundations.	 *Steel moment frame* SOURCE: FEMA 454 (FEMA, 2006)

2.10 IRVS Database

The IRVS Database supports the IRVS series (buildings, mass transit stations, and tunnels). The IRVS Database is a standalone application that is both a data collection tool and a data management tool. See Figure 2-4.

The IRVS Database is designed to be loaded on the IRVS team's laptop for conducting assessments in the field (Field Database) and on a computer at the organization's headquarters for collecting the results, printing reports, and analyzing the information (Master Database) and allowing the operational manager to keep data compartmentalized and secure.

For more information on the database including instructions on installation, system requirements, using the database to conduct a screening, and administrative functions, refer to the user guide in Appendix C.

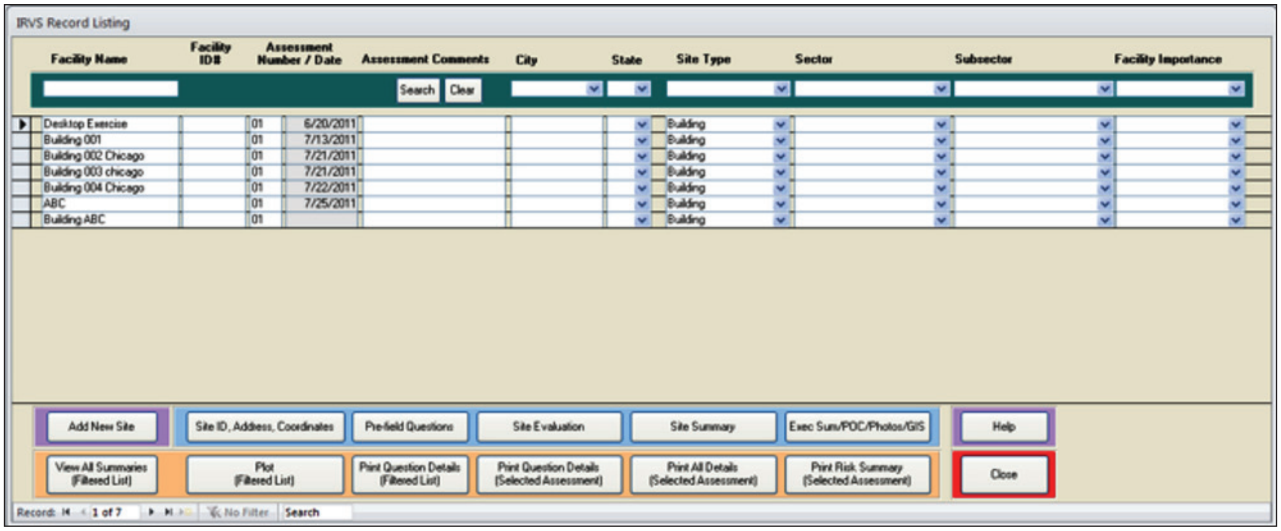


Figure 2-4: IRVS Database

2.11 Variables Considered in the IRVS

Scoring is subject to the following major considerations: threat types and scenarios, high value targets/target density, occupancy type, structure type, building systems, and links along with the evaluation of characteristics and attributes. These considerations are described in the following subsections.

2.11.1 Threat Types and Scenarios

The IRVS assesses risk with respect to a specific threat scenario or set of scenarios (see Table 2-1). The threat scenarios establish the potential source of harm to the building, the operations, and the occupants. The IRVS includes an assessment of the risk of both terrorist threats and natural hazards. The risk components (consequence, threat, and vulnerability) are evaluated for each scenario.

The IRVS assesses risk with respect to a specific threat scenario or set of scenarios.

Table 2-1: Threat Types and Scenarios

Threat Type	Threat Scenario
Internal Attack	Explosive Attack
	CBR Release
	Intrusion
External Explosive Attack	External Zone I Explosive Attack
	External Zone II Explosive Attack
	External Zone III Explosive Attack
External CBR Release	External Zone I CBR Release
	External Zone II CBR Release
	External Zone III CBR Release
Earthquake	Ground Shaking
	Ground Failure
Flooding	Stillwater
	Velocity Surge
Wind	Hurricane (Wind and Water)
	Tornado
	Other High Wind
Landslide	Rainfall
Fire	Resulting from Earthquake
	Resulting from Blast
	Arson or Incidental

The threat scenarios are defined below.

- **Internal**
  - **Explosive Attack –** Detonation of an explosive device in the interior of the building.
  - **CBR Release –** Release of a CBR agent in the interior of the building.
  - **Intrusion –** Any kind of attack other than an explosion that occurs in the interior of the building.
- **External Explosive Attack**
  - **External Zone I –** Detonation of an explosive device outside the building within 100 feet of the building.
  - **External Zone II –** Detonation of an explosive device outside the building from 100 to 300 feet of the building.
  - **External Zone III –** Detonation of an explosive device outside the building from 300 to 1000 feet of the building.

- **External CBR Release**
  - **External Zone I CBR Release –** Ground release of an airborne CBR agent outside the building within 100 feet of the building.
  - **External Zone II CBR Release –** Ground release of an airborne CBR agent outside the building from 100 to 300 feet of the building.
  - **External Zone III CBR Release –** Ground release of an airborne CBR agent outside the building from 300 to 1000 feet of the building.
- **Earthquake**
  - **Ground Shaking –** Vibration or movement of the Earth's surface at the site of the building.
  - **Ground Failure –** Landslides, liquefaction, lateral spreading, and any other consequence of shaking that affects the stability of the ground.
- **Flooding**
  - **Stillwater –** Very low velocity or stagnant floods in backwater areas and expansive floodplains.
  - **Velocity Surge –** High velocity floodwaters or wave action associated with flash floods or storm surge.
- **Wind**
  - **Hurricane (Wind and Water) –** System of spiraling winds converging with increasing speed toward the storm's center (eye of the hurricane). Hurricanes bring light to heavy rain along with light to extremely strong winds for several hours, a day, or longer.
  - **Tornado –** Violently rotating column of air extending from the base of a thunderstorm to the ground.
  - **Other High Wind –** Variety of events including straight-line wind, down-slope wind, thunderstorms, down burst or microburst, and Nor'easter with sufficient speed to cause damage to buildings.
- **Landslide**
  - **Rainfall –** Ground movement that is the result of rainfall that causes unstable conditions and slope failure.
- **Fire**
  - **Resulting from Earthquake –** Fire hazard inside a building caused by an earthquake.
  - **Resulting from Blast –** Fire hazard inside a building resulting from a blast.

- **Arson or Incidental –** Fire in a building or affecting the building that was intentionally set (arson); fire caused by faulty electronics, natural wildfires, or other non-intentional causes (incidental).

2.11.2 High Value Targets/Target Density

The IRVS for buildings addresses both target and non-target buildings. A threat may or may not target a building, but the threat could affect the building in either case. Commercial office and other standard-use buildings are not likely to be the target of an attack but may be near one or more buildings that are high-value targets. High-value targets are well-known or recognized assets or critical infrastructure in the community that are considered significant to the economy, health, or welfare of the community. A high-value target may be a building or another type of structure such as a bridge or dam. Non-targeted buildings may receive collateral damage in a terrorist attack or natural hazard that varies in severity depending on the hardiness of the building, proximity to the target, and magnitude of the threat.

For internal threats, the subject building is the target building.

In the IRVS of buildings, three zones are considered in the evaluation of target density and external blast and CBR threats. The external zones are shown in Figure 2-5.

Zone 1 refers to an external attack directed at the subject building or occurring at a building less than 100 feet from the enclosure of the subject building.

Zone 2 refers to an attack that occurs between 100 feet and 300 feet from the subject building.

Zone 3 refers to an attack that occurs between 300 feet and 1000 feet from the subject building.

An attack in Zone 1 would cause catastrophic casualties, damage, and business interruption. An attack in Zone 2 is a moderate hazard level, and an attack in Zone 3 is a minor hazard level.

> An attack in Zone 1 would cause catastrophic casualties, damage, and business interruption.

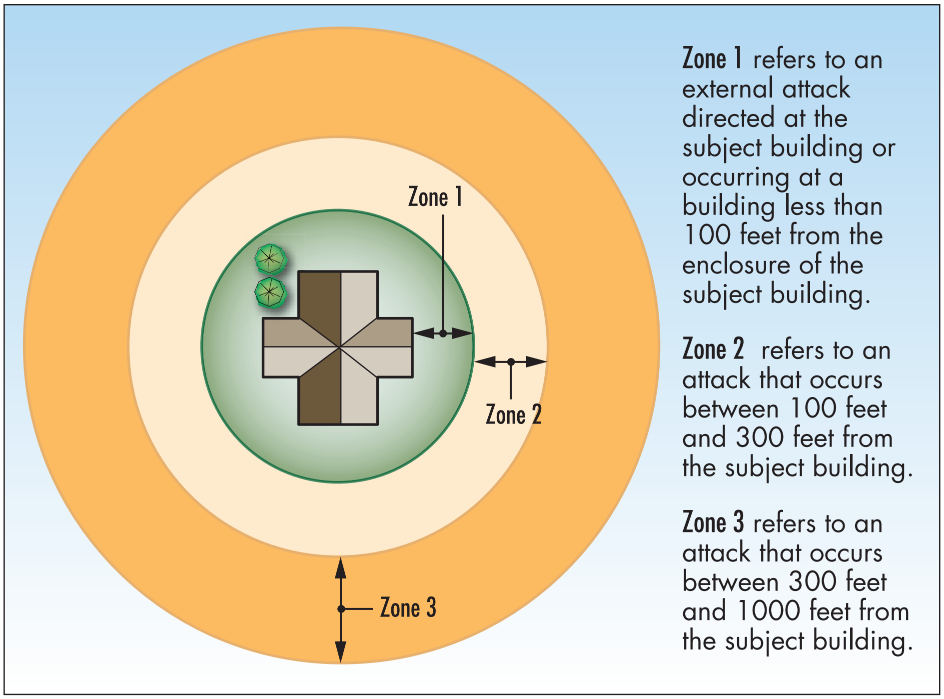


Figure 2-5: Target zones

2.11.3 Occupancy Type

Occupancy type pertains to the function of a building. The evaluation of occupancy type in the IRVS is based on the CIKR Sectors identified in the NIPP (DHS, 2009). A CIKR Sector consists of assets, systems, and networks that provide similar functions to the economy, government, or society.

The 18 CIKR Sectors are listed below. Appendix E contains an abbreviated version of the infrastructure taxonomy prepared by DHS and a list of facility types included in the 18 CIKR Sectors.

- Agriculture and Food
- Banking and Finance
- Chemical
- Commercial Facilities
- Communications
- Critical Manufacturing
- Dams
- Defense Industrial Base
- Emergency Services
- Energy
- Government Facilities
- Healthcare and Public Health
- Information Technology
- National Monuments and Icons
- Nuclear Reactors, Materials, and Waste
- Postal and Shipping
- Transportation Systems
- Water

2.11.4 Structure Type

The structure type is evaluated using 15 model structure types consistent with the model structure types identified in FEMA (2002) and FEMA (2009b). The structure types represent buildings with similar structural systems and are differentiated by their responses to certain events in terms of amount of damage and types of losses.. In general, buildings behave differently due to the types of structural systems they have (e.g., wood versus steel); the codes to which they were designed; heights; shapes; footprints; and local construction practices.

For each structure type, a basic structural hazard score has been computed that reflects the building's performance if subjected to certain hazards. The hazard scores are based on professional judgment and historical data of building performance under certain hazard conditions. This building characteristic is heavily weighted and significantly impacts the risk and resiliency scores.

The 15 building types are as follows:

- Wood frame
- Steel moment frame
- Steel braced frame
- Steel light frame
- Steel frame with cast-in-place concrete shear walls
- Steel frame with unreinforced masonry infill walls
- Concrete moment frame
- Concrete shear walls
- Concrete frame with unreinforced masonry infill walls
- Precast concrete tilt-up walls
- Precast concrete frames with concrete shear walls
- Reinforced masonry bearing walls with wood or metal deck diaphragms
- Reinforced masonry bearing walls with precast concrete diaphragms
- Unreinforced masonry bearing walls
- Manufactured homes

2.11.5 Building Systems/Characteristics

The vulnerability of the following building systems/categories is assessed:

- Site
- Architecture
- Building enclosure
- Structure
- Mechanical/electrical/plumbing (MEP) systems
- Fire protection systems
- Security systems
- Cyber/communication infrastructure
- Continuity of operations

2.11.6 Links

Several links between characteristics and attributes are taken into account in the IRVS scoring procedure. Some characteristics affect more than one risk component. For example, the number of occupants affects both consequences and threat. As the number of occupants increase, the consequences and threat ratings are both expected to increase.

In addition, some linked characteristics have different effects on risk components when a certain combination of attribute options is selected. For example, a building may have a vulnerable building façade (for instance, an unreinforced masonry wall), but the vulnerability of the exterior wall type will be negated if the site is evaluated as inaccessible and the standoff distance is very high.

2.12 IRVS Risk and Resilience Scores

The IRVS Database generates scores for risk and resilience using formulas in Excel spreadsheets. The following subsections describe the calculations and equations used to compute the risk and resilience scores.

2.12.1 Calculation of the Risk Score

The risk scoring procedure used in the IRVS is based on the risk assessment equation in BIPS 426, *Reference Manual to Mitigate Potential Terrorist Attack Against Buildings* (DHS, 2011c) and the NIPP framework for assessing risks (DHS, 2009).

The procedure is as follows:

1. The consequences, threat, and vulnerability ratings are generated for each threat scenario.

   Three scores (each from 0.1 to 100%) represent the consequences of the scenario, the threat of the scenario, and the vulnerability of the building to the scenario.

   The three ratings for each scenario are derived using the weights for the selected attributes. The scores are defined below and in Table 2-2:

   C = **Consequences –** Degree of impact that would result from the incapacity or destruction of the building's assets (occupants, critical functions, and infrastructure) as a result of a catastrophic event causing fatalities, social and economic losses, and/or business disruption.

   T = **Threat –** Relative likelihood that a threat or hazard will affect the building.

   V = **Vulnerability –** Relative weaknesses of functions, systems, and sites in regard to a particular threat/hazard; the likelihood that damage, casualties, and business disruption will occur.

Table 2-2: Consequences, Threat, and Vulnerability Ratings

Scale	Consequences Rating	Threat Rating	Vulnerability Rating
Very high (70–100%)	Loss or damage that would have exceptionally grave consequences, such as extensive loss of life; widespread severe injuries; or total loss of primary services, core processes, and functions for a very long period. Exceptionally grave effect on public health and safety and exceptionally grave economic, psychological, and governance impacts.	Extremely high likelihood of one or more threats/hazards affecting the site or a history of numerous past events at the site resulting in damage.	One or more major weaknesses that make the building extremely susceptible to a terrorist attack or natural hazard. Lack of redundancies/physical protection/resilience.
High (50–70%)	Loss or damage with serious consequences, such as serious injuries or impairment of core processes and functions for a long period. Serious effect on public health and safety and serious economic, psychological, and governance impacts.	Significant possibility of one or more threats/natural hazards. May or may not be a history of damage from past events.	Important weakness that makes the building very susceptible to a terrorist attack or natural hazard. Inadequate redundancies/physical protection/resilience.
Medium (30–50%)	Loss or damage that would have moderate consequences, such as minor injuries or minor impairment of core functions and processes for a considerable period. Moderate effect on public health and safety and moderate economic, psychological, and governance impacts.	Moderate to low possibility of one or more threats/hazards. May or may not be a history of damage from past events	Weakness that makes the building somewhat susceptible to a terrorist attack or natural hazard. Fair level of redundancies/physical protection/resilience.
Low (0–30%)	Loss or damage that would have minor or negligible consequences. Negligible effect on public health and safety and negligible economic, psychological, and governance impacts.	Little or no likelihood of one or more threats/natural hazards. No history of damage from past events.	Minor or no weakness. Good level of redundancies/physical protection/resilience.

2. The consequences, threat, and vulnerability ratings for each scenario are combined using the following equation to produce a risk score for a particular scenario (de-aggregated risk score).

$$R_i = \sqrt[\beta_i]{C_i \times T_i \times V_i} \qquad (1)$$

where

R_i = risk score of the i^{th} threat scenario

C_i = consequences rating of the ith threat scenario

T_i = threat rating of the i^{th} threat scenario

V_i = vulnerability rating of the i^{th} threat scenario

β_i = function of the relative magnitudes of C_i, T_i, and V_i

β_i is computed using the following procedure:

$$A_{\max} = \max(C_i, T_i, V_i)$$

$$A_{\min} = \min(C_i, T_i, V_i)$$

$$\alpha_i = \frac{A_{\min}}{A_{\max}}$$

Note that

$0.0 \le \alpha_i \le 1.0$

The value of β_i depends on α_i in this manner

If $\alpha_i \le 0.1$, then $\beta_i = 4.0$

if $\alpha_i \ge 0.9$, then $\beta_i = 3.0$

If $0.1 < \alpha_i < 0.9$, then $\beta_i = a + b\alpha_i$

With

$b = 1.25$

$a = 3.875$

Note that the above risk expressions satisfy the limits

$R_i|_{max} = 10$, which occurs when $C_i = 10$, $T_i = 10$, and $V_i = 10$

$R_i|_{min} = 0$, which occurs when $C_i = 1$, and/or $T_i = 0$, and/or $V_i = 0$

The de-aggregated risk score that is categorized by threat scenario ranges from 0.1 to 100. De-aggregated risk scores are color-coded as low (green), moderate (yellow), high (orange), and very high risk (red) in the IRVS summary of results.

The de-aggregated risk score for each threat scenario provides a better understanding about a building's risk to a specific threat or hazard. The de-aggregated scores provide useful information to help prioritize further action specific to the building. Using this information, a specialist in a given type of threat/hazard (e.g., seismic) could be hired to further study the risk to the building caused by a specific threat.

3. The de-aggregated risk scores are combined using the statistical algorithm shown below to produce a single overall risk score (aggregated risk score) for the building for all of the scenarios.

$$R = \propto \sqrt[n1]{\sum_{i=1}^{n2} R_i^{n1}} \tag{2}$$

where

R = aggregated (overall) risk

R_i = risk score of the i^{th} threat scenario

$n2$ = total number of threat scenarios

$n1$ = 10 (power value)

$\propto$ = scaling factor of 1/12

C_i, T_i, and V_i are all scaled to be in the range of 0.1 to 100%. As such, the resulting risk score for thee i^{th} threat scenario is also in the range of 0.1 to 100%. The overall risk score (aggregated for all scenarios) is displayed as a percentage to indicate the level of risk associated with the building.

The risk score is color-coded as low (green), moderate (yellow), and high risk (red) in the IRVS summary table. Table 2-3 indicates the different levels of risk.

Table 2-3: Risk Levels

Risk Level	Risk Score
Very High (Red)	>70%
High (Orange)	≥50%, ≤70%
Moderate (Yellow)	≥30%, ≤50%
Low (Green)	<30%

2.12.2 Calculation of the Resilience Score

The characteristics in the IRVS cover most of the important issues that affect the resilience of a building. Each characteristic can affect the quality of performance (robustness), resourcefulness, and/or time and speed of recovery. Each attribute option for the characteristics that pertain to resilience is assigned a weight from 0 to 10. The weight represents the importance of the attribute in the resiliency of the building. At the end of the assessment, all of the adjusted weights of the attributes that control quality of performance, Q_i , are summed. The quality of performance describes the ability of the building to maintain critical operations and function. Similarly, all of the adjusted weights of the characteristics that control recovery and resourcefulness, also known as the time measure, T_i, are summed. The time measure describes preparedness effectiveness (such as training, plans, and policies) and the ability to re-institute operations after a hazard event. The sum of Q_i and T_i are inserted into the following equations:

$$Q_{TOTAL} = 10\left(\frac{\sum_{i=1}^{N} Q_i}{\sum_{i=1}^{N} Q_i\big|_{MAX}}\right) \qquad (3)$$

Equation

and

$$T_{TOTAL} = 10\left(\frac{\sum_{i=1}^{N} T_i}{\sum_{i=1}^{N} T_i\big|_{MAX}}\right) \qquad (4)$$

Equation

where

Q_{TOTAL} = scaled quality of performance

T_{TOTAL} = scaled time measure

Q_i = quality of performance (robustness)

N = upper boundary (number of characteristics with a weight being summed)

T_i = time measure (recovery and resourcefulness)

$Q_{i|MAX}$ = maximum quality of performance

$T_{i|MAX}$ = maximum time measure

$Q_{i|MAX}$ and $T_{i|MAX}$ represent the maximum weighted values of the quality of performance and the recovery/robustness values, respectively. Now the values of Q_{TOTAL} and T_{TOTAL} represent a scaled, accurate measure of quality of performance and time measure that control resiliency (the two axes in Figure 1-1). The scale for both variables ranges from 0.01 to 10. The objective value of the station resilience is

$$RES = 100 - (Q_{TOTAL}\ T_{TOTAL}) \tag{5}$$

where

RES = *resilience*

Thus, a *RES* of 0% indicates there is no resilience in the station when affected by the postulated hazard. A *RES* of 100% indicates a perfect resilience in the station when affected by the postulated hazard.

Resilience scores can be used in decision-making and planning for hazardous events for the asset (building). These scores can also be used in planning for community (network) resiliency. Table 2-4 indicates the levels of resilience and how to interpret these levels.

Table 2-4: Resilience Levels and Scores

Resilience Level	Resilience Score	Description
Very High	>70%	The building has an extensive continuity of operations and an emergency management plan and has taken significant actions to ensure that key functions will not be interrupted by an event. The building has several redundancies and backups that are available on- or off site.
High	≥50%, ≤70%	The building has taken reasonable steps to maintain continuity of operations and/or has taken reasonable action to ensure that key functions will not be significantly affected by an event.
Medium	≥30%, ≤50%	The building has taken moderate steps to maintain continuity of operations and/or has taken moderate action to ensure that key functions will not be significantly affected by an event.
Low	<30%	The building has taken few or no steps to maintain continuity of operations and/or has taken little or no action to ensure that key functions will not be significantly affected by an event.

2.13 Other Considerations

Limitations, the perspective of the screener (owner verses tenant), and interconnected buildings are issues that should be considered before conducting a screening.

2.13.1 Limitations

The following limitations apply to the IRVS:

- The exceptionally high risk associated with iconic buildings with national symbolic value, such as the White House and Pentagon, is not appropriate for this methodology. Risk to this class of buildings should be evaluated using more detailed assessment procedures.
- Second-order collateral effects (or cascading effects), such as the loss of functionality due to separate targeting of remote utility infrastructure systems, are not considered.
- The design of mitigation measures to reduce the risk and increase resiliency is not addressed. The screener should refer to companion publications for mitigation options.
- The threat rating defined in this report for manmade hazards provides an indication of the building threat attractiveness rather than the probability of attack.
- IRVS is designed to be performed using limited information from research and visual inspection of the building interior and exterior. Interior inspections or interviews with key stakeholders are highly desirable but not always practical. Consequently, on rare occasions, a building initially identified as high risk may prove to be otherwise based on additional information.
- Some of the building characteristics require gathering pre-field information . If this information is not obtained, the results of the risk assessment may not be as accurate as they would have been had the information been obtained.

2.13.2 Perspective of the Screener (Owner verses Tenant)

The screener's perspective relative to the subject building is important. The perspective depends on the stakeholders. If the building owner is one of the stakeholders, the screener should answer all of the questions from the owner's perspective. If a building tenant is the stakeholder and not the building owner, the screener should answer all of the questions from a tenant's perspective. For example, when asked about the building's ability to return to operation following an event, the owner may consider only electricity and water while the tenant may include telephone and Internet connectivity. These differences will not adversely affect the scores as long as the DCF is completed consistently from one perspective.

2.13.3 Interconnected Buildings

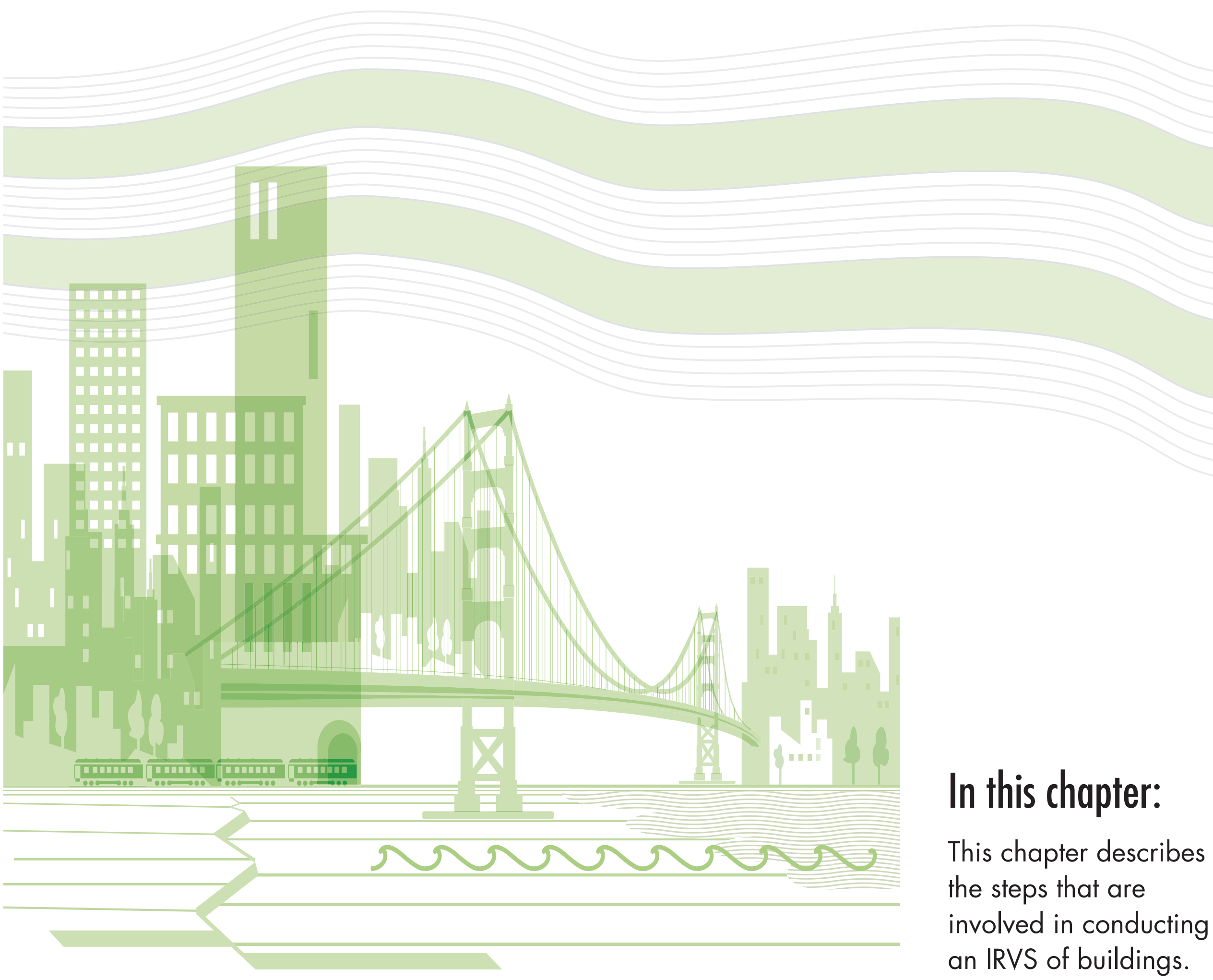
The IRVS of buildings was developed for individual buildings. For a facility with multiple, interconnected buildings, some care needs to be given to conduct the screening properly.

Interconnected buildings may be joined by pedestrian passageways that may or may not have retail or other uses. Often, each building has a separate, distinct use and unique characteristics in terms of risk. In operational security, the interconnected buildings may reasonably be considered one building. However, interconnected buildings are often structurally isolated, and an explosive attack on one may therefore not mean the other building will be damaged. The buildings and possibly the passageways are likely to have separate ventilation systems with separate controls (which should be verified). For these reasons, it is recommended that each building be considered separately.

Interconnectedness may be addressed through careful consideration of the building characteristics that focus on the collateral effects of an attack under, next to, or connected to the subject building. The screener needs to pay careful attention to the attribute options for these building characteristics to capture the impact of their interrelationship on the terrorist risk.

3

Conducting an IRVS of Buildings



In this chapter:

This chapter describes the steps that are involved in conducting an IRVS of buildings.

This chapter describes the steps that are involved in conducting an IRVS of buildings, which are listed in Table 3-1. The IRVS process can be adjusted as needed. Chapter 4 describes how to complete the Data Collection Form (DCF).

Table 3-1: IRVS Process

Pre-Field Activities	• Select the building to be assessed • Identify the IRVS team • Train the IRVS team • Identify key objectives of the IRVS • Complete as much of the DCF as possible by reviewing publicly available information and available materials from building owner/facility managers, including operations and security procedures, policies, and construction drawings • Identify the conditions for the field assessment • Schedule a meeting with key staff or stakeholders and schedule the building tour • Assemble the equipment that is needed for the field assessment
Field Assessment	• Interview and meet with key staff and stakeholders • Tour the exterior and publicly accessible areas of the building • Tour the critical areas of the interior of the buildings • Record data on the DCF • Photograph the building after obtaining permission
Post-Field Activities	• Transfer data from the paper version of the DCF to the electronic DCF (IRVS Database) if necessary • Use the scores in a variety of ways including identifying the buildings that require a more detailed assessment • Summarize the results in a written report

3.1 Pre-Field Activities

Pre-field activities are typically completed prior to the field assessment.

3.1.1 Selecting Buildings to be Assessed

The IRVS can be used to assess a single building or a group of buildings. The stakeholder typically selects the buildings that will be assessed (see Section 2.2 for more information on the stakeholder). Budget is often a factor in the selection of buildings for the IRVS.

3.1.2 Identifying the IRVS Team

The stakeholder appoints the IRVS team leader, who is responsible for identifying the IRVS team. The team leader should be familiar with risk assessment. The IRVS team should include members who are knowledgeable about building systems and security concepts and at least one member who is familiar with the construction and operations of the building.

The IRVS was developed so that screeners inside or outside the design community could conduct an IRVS with a reasonable level of certainty after a brief training, thus reserving technical experts such as engineers and architects for more in-depth assessments. The more knowledgeable the screeners, the more accurate the assessment will be, and potentially, the more accurate the results. Training is recommended to ensure that the IRVS team understands the IRVS concepts. At a minimum, the IRVS team should review this manual.

3.1.3 Training the IRVS Team

Training should be required to ensure accuracy and uniformity of decisions among screeners. Training includes reviewing the IRVS methodology. The review should include:

- Building systems (e.g., site design; architectural, mechanical, electrical, plumbing, fire protection, security, and cyber systems)
- How to complete the DCF (see Chapter 4)
- How to use IRVS Database (see Appendix C)
- What screeners should bring to the field assessment (see Section 3.1.9)
- What screeners should look for when performing the field assessment (See Section 3.2.2)
- How to account for uncertainty (see Section 4.2)

The training should include a desktop exercise, which is a simulated IRVS conducted in a classroom using photographs of buildings. The desktop exercise can be created by gathering photographs of and information about an actual building.

3.1.4 Identifying the Objectives of the IRVS

The stakeholders and IRVS team should determine the objectives of the assessment early in the pre-field activities. Examples of objectives are:

- In an assessment of a group of buildings, determine which buildings require more detailed analysis
- Evaluate the risk for a building during a period of high threat alert in order to implement protective measures
- Prioritize a group of buildings for mitigation
- Prepare a risk report of buildings in order to apply for grant funding
- Collect risk and resilience information for a building inventory

The goal of the IRVS is to enhance protection and resiliency through the implementation of focused risk-reduction strategies.

Objectives define outcomes and conditions of the assessment. For instance, if the objective is to evaluate the risk of a building during a period of high threat alert, the condition for the assessment will be the worst case and the outcome will be to establish immediate protective measures to lower the risk score. Objectives can also help determine the resources, time, and effort that are needed and how the risk and resiliency results will be used. If the objective includes assessing a group of buildings, more time and effort will be needed than if only a single building is assessed. Objectives may vary across and within the public and private sector.

The goal of the IRVS is to enhance protection and resiliency through the implementation of focused risk-reduction strategies.

3.1.5 Gathering Pre-Field Data

The IRVS team should complete as much of the DCF as possible before the field assessment by reviewing publicly available information and information that is provided by the building owner (e.g., operations and security procedures, policies, and construction drawings). At a minimum, the pre-field data section of the DCF should be completed prior to the field assessment. Electronic documents can be stored in the IRVS database as Microsoft (MS) Word files or PDFs. Documents that are not available electronically can be scanned and imported into the database.

Examples of useful documents are:

- Drawings for original design and any implemented modifications
- Site plans for utilities and communications
- Floor plans
- Structural drawings
- Construction specifications
- Security assessments
- Emergency response and disaster recovery plans
- Security master plan
- Security inspection results
- Hazardous materials plans
- Policy and legal requirements
- Federal, State, and local law enforcement threat assessments
- Historical reports
- Information on the facility systems operations capabilities
- Information on incidents within the building
- Population statistics
- Manpower
- Floodplain management ordinances and maps
- Earthquake maps
- Wind speed maps

The IRVS team should also review emergency plans, policies, and procedures. These documents are useful in evaluating characteristics related to resilience. Examples of these documents are:

- Notification procedures
- Evacuation procedures
- First responder access and routing
- Shelter-in-place procedures
- Emergency engineering systems shutdown (e.g., heating, ventilation, and air conditioning [HVAC], electrical, Information Technology, communications)
- Exercise plans
- Continuity of operations plans

The screener can also obtain information by conducting phone interviews of building owners/managers, key building staff, and other stakeholders.

3.1.6 Identifying Conditions for the Field Assessment

The assessment team must identify the conditions that are relevant to calculating consequence, threat, and vulnerability. Buildings can have a different level of risk for different times (hours, day, month, or season). For instance, most buildings are occupied and operate on a fixed schedule, usually during regular working hours, which means that attacks or events at different times of the day will have different consequences.

The conditions for which consequences, threats and vulnerabilities will be considered throughout the assessment should be determined before the field assessment is conducted. Two conditions are recommended:

- **Current condition –** The building will be assessed for the conditions at the time of the assessment.
- **Worst-case condition –** Combination of events that would have the most harmful consequences. Physical conditions should be considered at their most disadvantageous state.

Reasonable worst-case conditions are recommended to assess the risk and resiliency when the building would be most vulnerable and consequences would be maximized. The concept of worst case should be moderated by reason. Scenarios should not be compounded by including numerous unlikely conditions unless the focus of the contingency and other planning is on extremely rare events. In addition, scenarios should not be based simply on average conditions. Each type of target will have different reasonable worst-case conditions.

The assessment team must identify the conditions that are relevant to calculating consequence, threat, and vulnerability.

After selecting a condition, screeners should be consistent when evaluating all characteristics and attributes of the building. If necessary, multiple scores can be obtained for different situations. Stakeholders can use conditions to conduct an assessment in anticipation of a special event to evaluate the risk and to plan protective measures.

3.1.7 Scheduling a Meeting with Key Staff and Stakeholders and Scheduling the Building Tour

The IRVS team should arrange a brief meeting or interview with key staff and stakeholders before or during the field assessment to review the pre-field data. The IRVS team leader decides which key staff and stakeholders should be interviewed based on the composition of the team and the team's familiarity with the building. The team should prepare a list of questions before the meeting.

Key personnel include:

- Building owner
- Building manager
- Chief of engineering
- Chief of security
- Chief of information technology
- Emergency manager

> The IRVS team should arrange a brief meeting or interview with key staff and stakeholders before or during the field assessment to review the pre-field data.

Other useful personnel may include:

- Major tenant representatives
- Local law enforcement, fire, and EMS representatives
- State or county representatives
- Local utility, telecommunications, and services representatives
- Critical function representatives

The IRVS team also needs to schedule a building tour. The IRVS team should plan which areas of the building (see Section 3.2.2) need to be viewed and obtain the proper permissions to survey the building.

3.1.8 Assembling the Equipment for the Field Assessment

The screener should take the following to the field assessment:

- A laptop or tablet loaded with the IRVS Database, which contains the DCF and catalog. The database user guide is included in this manual as Appendix C.
- The paper version of the DCF if a laptop or tablet is not available. The paper version is included in this manual as Appendix D.
- A digital camera for photographing the building.
- Global positioning system (GPS) device if the team wants to obtain coordinates and elevations.

3.2 Field Assessment

The field assessment is an onsite visit to the building to record and/or verify information on the DCF.

3.2.1 Interviewing Key Personnel and Stakeholders

The field assessment includes interviewing key personnel and stakeholders. Key personnel and stakeholders may accompany the IRVS team on the tour of the building.

3.2.2 Touring the Building

The IRVS team should tour the exterior of the building, publicly accessible areas, and internal, secure areas of the building. The following are locations that the team should tour:

- Main lobby/entryway
- Perimeter of building
- Basement (condition of foundation and/or retaining walls)
- Mechanical/electrical rooms
- Security control room
- Loading dock
- Garage
- Typical floor
- Roof

Some questions in the DCF may be answered by visiting locations in the building other than the locations listed above. The list of building locations is only a guide to help the screener complete the assessment as efficiently as possible.

3.2.3 Photographing the Building

If permission is granted, the IRVS team should photograph as much of the building as possible for two reasons:

- To revisit any characteristics or attributes that the team may have been uncertain about or questioned
- To include in the database or report as a visual reference or verification of the DCF inputs

3.3 Post-Field Activities

The following activities are typically conducted after completing the DCF and the field assessment.

3.3.1 Transferring Data to the IRVS Database

If the paper version of the DCF is used, the information must be transferred to the IRVS Database in order to generate the risk and resiliency scores. Any photographs taken or documents obtained during the field assessment should be imported into the database.

3.3.2 Viewing and Interpreting the IRVS Scores

After completing the data entry in the IRVS Database, the risk and resiliency results are computed automatically and displayed in the Risk and Resilience Summary screen (see Figure 3-1). See the database user guide in Appendix C for instructions.

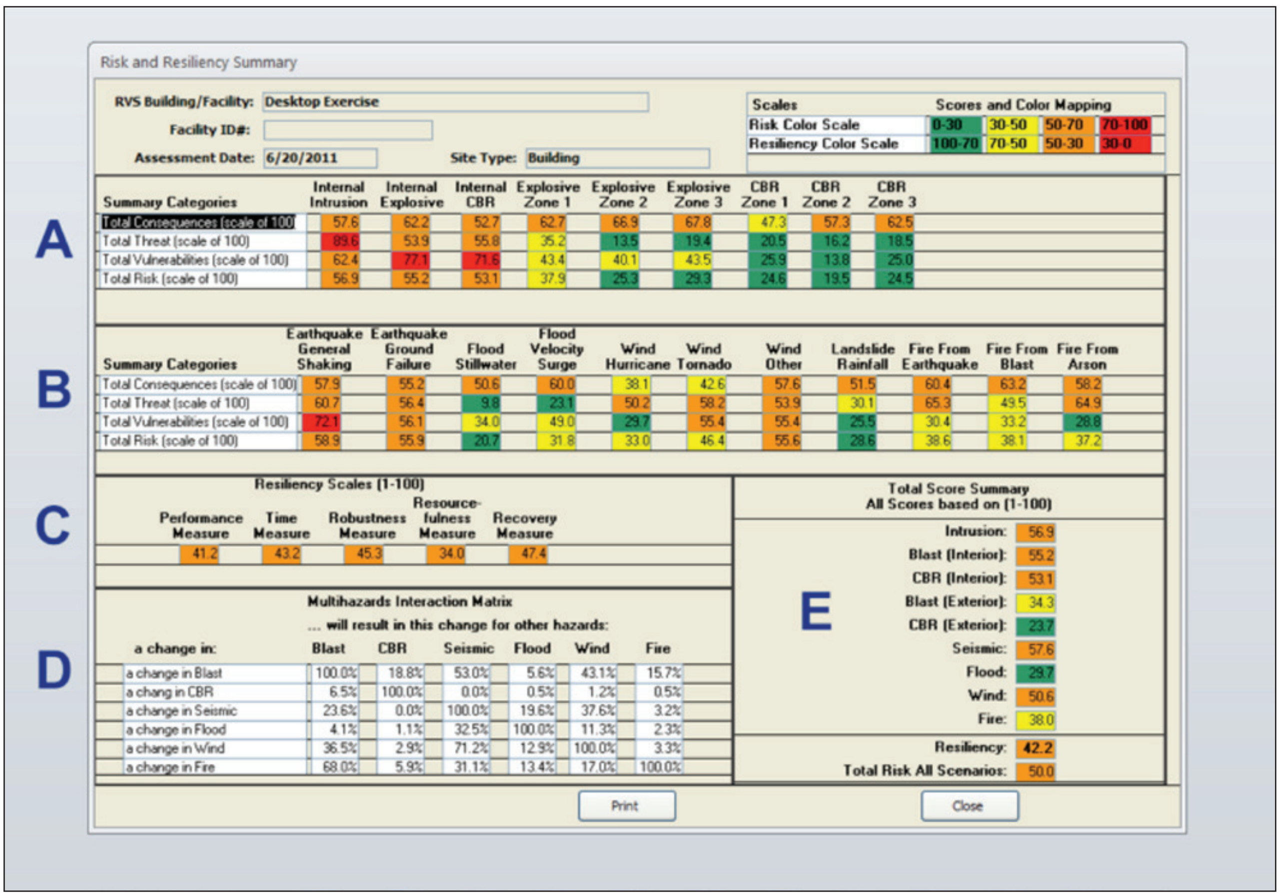


Figure 3-1: IRVS Risk and Resiliency Summary

The sections of the Risk and Resilience Summary screen are:

A. Consequence rating, threat rating, vulnerability rating, and de-aggregated risk score for the manmade threat scenarios

B. Consequence rating, threat rating, vulnerability rating, and de-aggregated risk score for the natural hazard scenarios

C. Resilience scales including the performance, time, robustness, resourcefulness, and recovery measure

D. Multi-hazard interaction matrix

E. Risk score for each threat and hazard along with the total resilience score and total (aggregated) risk score for all scenarios

The risk scores are color-coded as low (green), moderate (yellow), high (orange), and very high (red). The scale for resilience is inverted because a high resilience score is good and a low resilience score is bad. The cut-off scores are defined in Figure 3-2 and displayed in the IRVS risk scoring summary sheet in the upper right corner.

Figure 3-2:
IRVS risk and resilience scales

Scales	Scores and Color Mapping			
Risk Color Scale	0-30	30-50	50-70	70-100
Resiliency Color Scale	100-70	70-50	50-30	30-0

The scores may be used by IRVS team and stakeholders to make risk management decisions and to prioritize buildings for further studies. Buildings with very high risk or low resilience scores should receive the highest priority. Stakeholders determine the scores that are considered acceptable. Risk and resilience scores are not absolute values but are instead relative values to be used to compare the risk of an event relative to non-exposed building

Multihazard interaction scores represent interactions among hazards on a scale from 0 to 100 based on built-in weights and building characteristics. The higher the score, the more interaction between hazards. Multihazard interaction scores can be used in decision-making to understand the impacts that mitigation of one threat would have on another.

For example, in Figure 3-3, the matrix indicates that a change in blast would have a 52.8% impact on the risk components for seismic hazard. Therefore, if the building owner decides to mitigate against the threat of blast and the IRVS inputs are re-adjusted to reflect this change, the risk components for seismic would change by approximately 52.8%. The interaction scores indicate the level of interaction or impact and do not indicate whether the impact is positive or negative. Further study would be required to determine whether the change would improve protection against other threats or make the building more vulnerable to other threats.

Multihazards Interaction Matrix

... will result in this change for other hazards:

a change in:	Blast	CBR	Seismic	Flood	Wind	Fire
a change in Blast	100.0%	3.7%	52.8%	3.2%	51.1%	10.9%
a chang in CBR	2.0%	100.0%	0.0%	0.9%	2.1%	0.0%
a change in Seismic	48.4%	0.0%	100.0%	24.5%	73.7%	4.6%
a change in Flood	1.9%	1.0%	15.9%	100.0%	6.0%	2.1%
a change in Wind	33.4%	2.5%	52.6%	6.6%	100.0%	2.0%
a change in Fire	3.6%	0.0%	1.7%	1.1%	1.0%	100.0%

Figure 3-3: Multihazards Interaction Matrix

3.3.3 Using the IRVS Scores

IRVS data and scores can be used to:

- Identify buildings in a group of buildings that require more detailed assessments
- Prioritize mitigation needs in a group of buildings
- Develop building-specific vulnerability information
- Develop an inventory of building assets and collect information pertinent to risk management
- Evaluate the potential consequences of a terrorist attack or natural disaster
- Implement protective programs and resilience strategies to reduce the identified risk
- Measure the effectiveness of mitigation
- Conduct what-if exercises by selecting different attributes to see how the scores are affected
- Understand resilience, potential down time, and economic and social implications if a building is affected by a catastrophic event
- Rank vulnerabilities and consequences within a community to indicate which buildings have a higher risk and require higher protection
- Understand the impact of implementing mitigation for one hazard on the building's vulnerability to other hazards

- Compare the scores of threat scenarios to identify the relative exposure to different threats
- Compare risk scores for different scenarios
- Allocate resources (such as grant money) to cost-effectively reduce vulnerabilities
- Assess a building as part of security or maintenance operations
- Identify which security measures should be implemented during high alerts
- Develop emergency preparedness plans to reduce anticipated risk
- Understand the risk of special events that affect the occupancy of the building in order to plan for and implement protective measures
- Develop vulnerability information for purposes such as insurance rating and decision-making during building ownership transfers

3.3.4 Identifying Buildings that Require Further Assessment

The IRVS team and stakeholders may identify buildings that need a more detailed assessment. The IRVS team and stakeholders must determine the levels of risk and resiliency that are considered unacceptable and that would trigger a more detailed assessment. Unacceptable risk and resilience may be defined differently for different buildings.

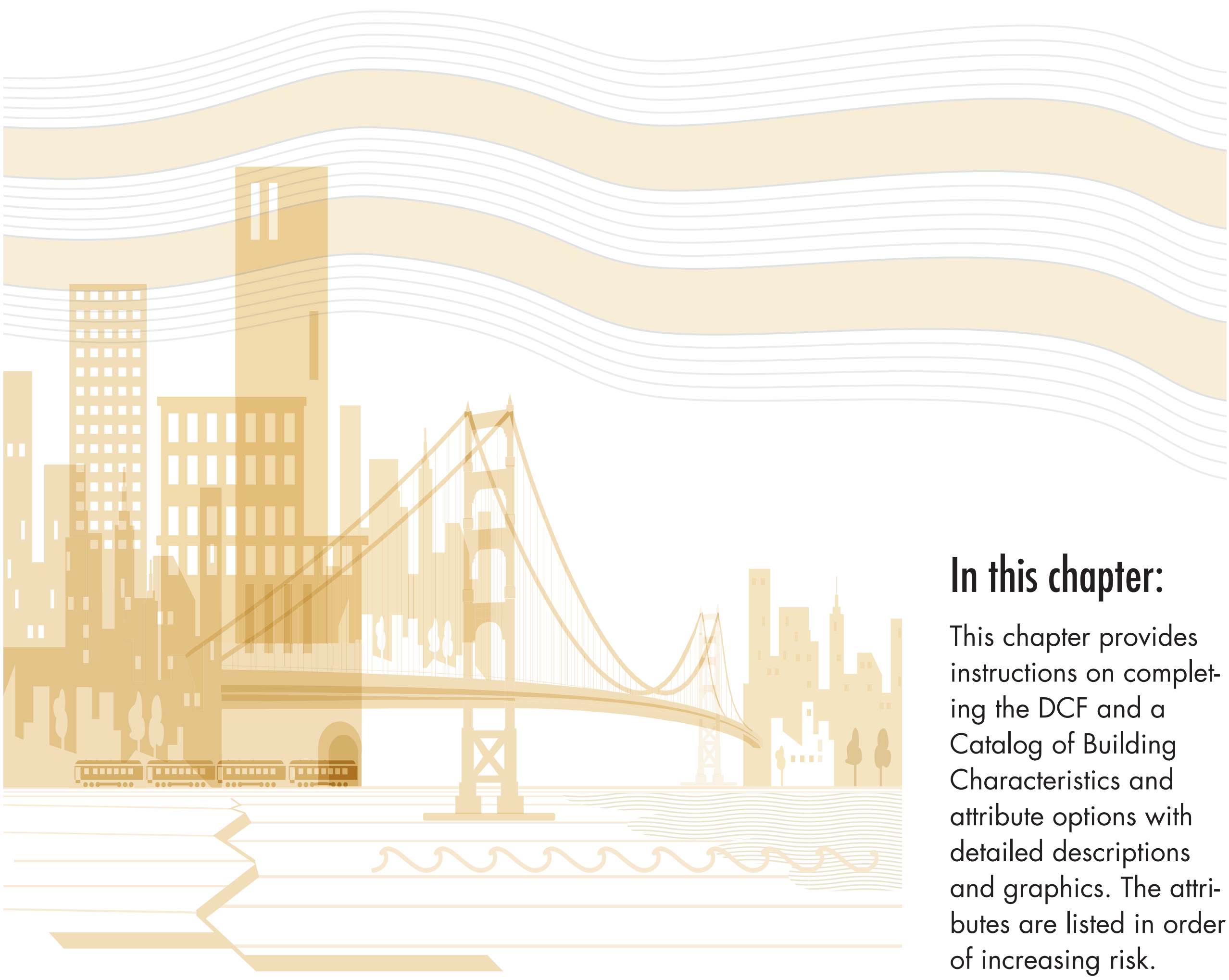
Generally, the risk and resilience can be interpreted as unacceptable when the risk score is above 70 percent and the resilience score is below 30 percent.

3.3.5 Preparing a Written Report

The IRVS database can be used to generate a generic report for one building or a group of buildings. The report includes the information that was input into the database and the risk and resiliency scores. The report is generated as an MS Word document and can be edited by the IRVS team.

4

Completing the Data Collection Form



In this chapter:

This chapter provides instructions on completing the DCF and a Catalog of Building Characteristics and attribute options with detailed descriptions and graphics. The attributes are listed in order of increasing risk.

The information that is collected during the IRVS is recorded electronically on the Data Collection Form (DCF) in the IRVS Database or manually on the paper version of the DCF. The screener can input data directly in the IRVS Database using a laptop or tablet computer. If the paper version is used, the information must be transferred to the IRVS Database so using the electronic version is more efficient. The paper version is provided in Appendix D.

This chapter provides instructions on collecting the data and includes a catalog of the building characteristics and attribute options. The attributes are listed in order of increasing risk.

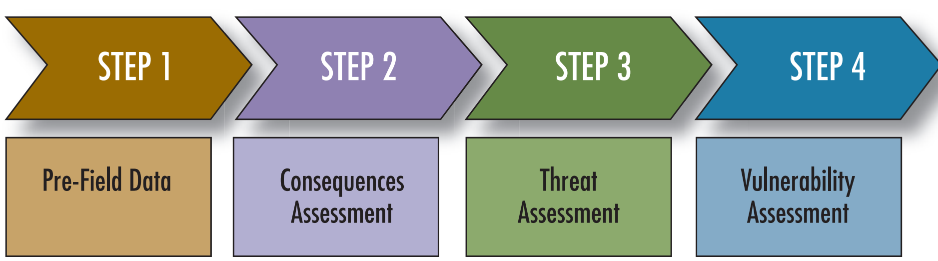
The attribute options are provided in dropdowns menu in the electronic DCF. When using the paper version of the DCF, the screener circles the appropriate attribute for each building characteristic.

The DCF is typically completed during the field assessment, but it can also be completed before or after the field assessment.

- **Before the field assessment –** The DCF is completed collectively by the IRVS team and key personnel during a desktop workshop, and the information is verified during the field assessment. Completing the DCF before the field assessment is typically done by screeners who are familiar with the building.
- **During the field assessment –** The DCF is completed during the field assessment either electronically or using the paper version.
- **After the field assessment –** After the IRVS team records observations, conducts interviews, and takes pictures during the field assessment, upon returning, the IRVS team collectively completes the DCF.

The DCF should be completed according to the building condition that was selected (see Section 3.1.6). Screeners should document the assessment as completely as possible to optimize the accuracy of the risk and resilience scores. The sections of the DCF are completed in this order: pre field data, consequence rating, threat rating, and vulnerability rating (see Figure 4-1).

Figure 4-1:
Procedure for completing the DCF



4.1 Red Flags and Comments

The screener can flag items on the DCF (electronic or paper version) that need more research or verification and add a comment that explains the reason for the flag, provides additional information, or provides the rationale for selecting an attribute when the selection is subjective.

4.2 Accounting for Uncertainty

The accuracy of the risk and resilience scores relies on the accuracy and completeness of the answers in the DCF. The screener must select an attribute option for each applicable building characteristic and should make every attempt to complete the form in its entirety.

The screener may want to leave a characteristic blank when attribute options are interpreted as "unknown," "not applicable," or "none," or an attribute may be skipped by mistake. The IRVS is designed to minimize these situations, but they will inevitably occur. Screeners should err on the side of recording too much information and document uncertainty in the comments.

> The accuracy of the risk and resiliency scores rely on an accurate and thorough completion of the DCF.

Options for accounting for unknown information are:

- Selecting "Not Applicable" when available
- Estimating the value based on a predefined correlation with known information (e.g., selecting precast concrete for the building enclosure based on the modular character of the exterior)
- Making an educated guess based on engineering judgment
- Selecting the most common attribute for that building characteristic based on knowledge of similar buildings in the region
- Not selecting an attribute (this will exclude the attribute from the risk and resilience scores and is not recommended)

When two or more attribute options for a given characteristic could be selected, the dominant option should be selected. For instance, if the building structural system is mainly a steel moment frame but the roof penthouse is a steel light frame, the dominant option would be steel moment frame. When one is not clearly dominant or an educated guess is not possible because the relevant information is unknown, the screener should select the option with the higher risk.

Particular care should be given to the characteristics that are heavily weighted. For these characteristics, guessing will significantly affect the risk and resilience scores. See Section 2.6 for a list of the characteristics that are heavily weighted.

4.3 Step One: Pre-Field Data

The first step in completing the DCF is completing the pre-field data (see Figure 4-2). Pre-field data can be gathered by searching the Internet, reviewing key documents, and conducting interviews. See Section 3.1.5 for a list of possible sources of pre-field data. Pre-field data include building identification information, relevant threats and hazards, type of building occupancy to determine resilience computation, structure type, and other types of data that are not readily available in the field. Pre-field data can be completed in one to two hours by one or two people. See Section 4.3.6 for the catalog of the pre-field data categories. The catalog provides guidance and sources of information for the pre-field data.

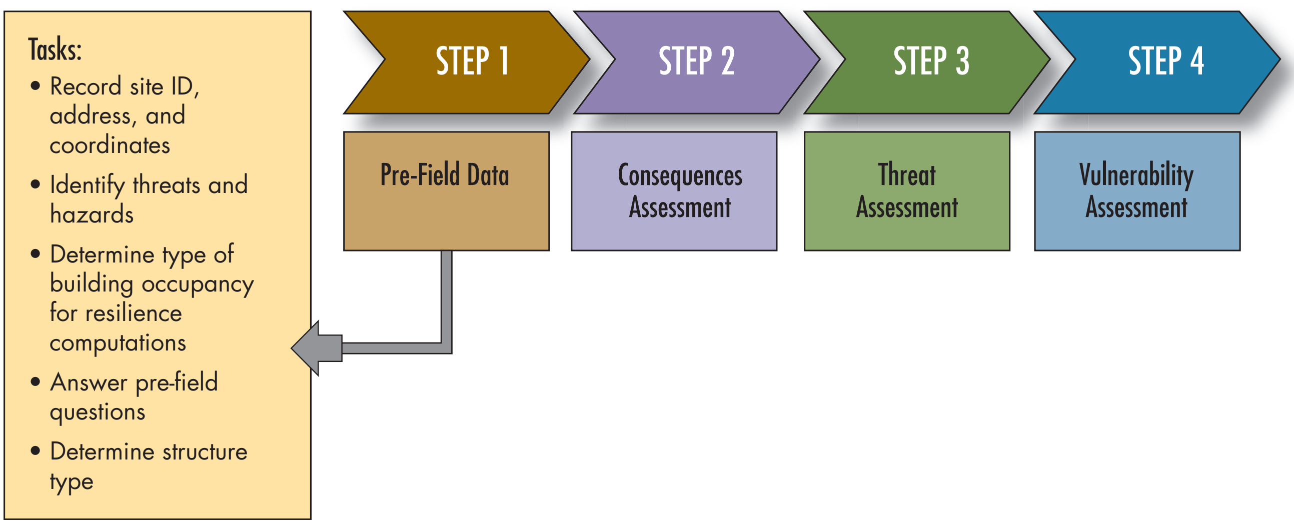


Figure 4-2:
Pre-field data tasks

4.3.1 Site Identification, Address, and Coordinates

Proper identification of the building is important in hazard assessment and mitigation (particularly in organizing and storing information when assessing a group of buildings). See Figure 4-3. Accurate coordinates are needed to plot the target zones, which is done using the Google Earth application (see Appendix C).

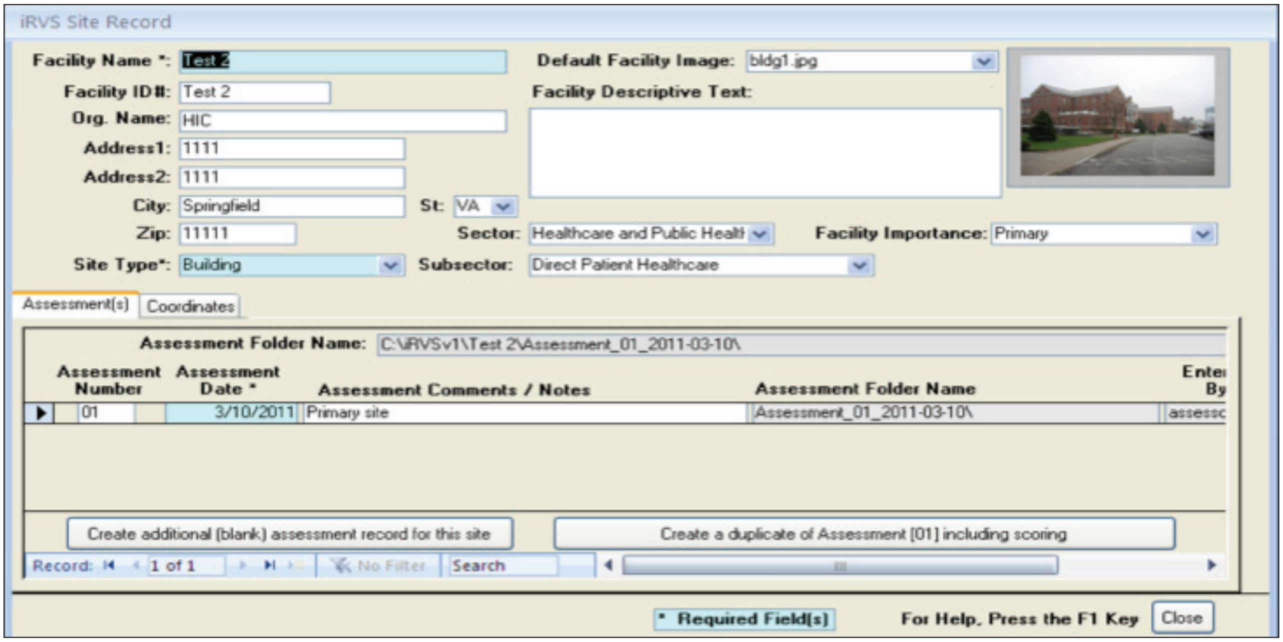


Figure 4-3: IRVS Database: Site identification, address, and coordinates

4.3.2 Threats and Hazards

As stated previously, the IRVS methodology allows for an assessment that is based on a single threat or multiple threats or on a single hazard or multiple hazards. In the IRVS Database, the screener selects the threats and hazards that will be used in the risk and resiliency computations. The building characteristics that are evaluated depend on the threats and hazards that are selected. Building characteristics that do not pertain to at least one of the selected threats or hazards are omitted and excluded from the scoring results.

The criteria for selecting the threats and hazards are listed in Table 4-1. The criteria are only recommendations. The screener or stakeholder will determine which threats and hazards to include based on the screening objectives.

The IRVS methodology allows for an assessment that is based on a single threat or multiple threats or on a single hazard or multiple hazards.

Table 4-1: Recommended Criteria for Selecting Threats and Hazards

Threats/Hazards	Criteria
Blast	• The building is in a major city or dense urban location • The building is surrounded by high-value buildings • The building has a history of threats • The local community has a history of threats • The building is in the Government Facilities, Agriculture and Food, Banking and Finance, Defense Industrial Base, or Transportation Systems Sector • The building's functions or its tenants are attractive targets for terrorists • The building has economic, cultural, or symbolic importance
CBR	• Same as blast
Seismic	• The region has been affected by seismic events • The building is near a known active fault • The building is in a high or medium seismic zone • The region has been affected by landslides • The soil conditions at the site have potential for liquefaction • FloodThe building is near a body of water with or without a mapped flood hazard area (e.g., river, canal, lake, pond, reservoir, coast)
Flood	• The building is near a body of water with or without a mapped flood hazard area (e.g., river, canal, lake, pond, reservoir, coast) • The building is near a water-retaining structure such as a dam or levee • The building is in a FEMA flood zone • Critical functions, equipment, or assets are in the basement or on the ground floor • The site has been affected by flood events • There a history of drains backing up due to flooding
Wind	• The building is generally subjected to strong winds such as straight-line wind, down-slope wind, thunderstorms, down burst or microburst, or Nor'easter • The region has been affected by hurricanes • The region has been affected by tornadoes
Fire	• The building is being assessed for blast, CBR, or seismic hazards • The construction of the building is older (more than 20 years ago) • The structure type is susceptible to fire • The building contains hazardous materials

CBR = chemical, biological, radiological
FEMA = Federal Emergency Management Agency

4.3.3 Resiliency Computations

Under the Hazards tab in the IRVS Database, the screener must select the type of building occupancy to determine the resiliency computations that will be completed. The options are:

- No resiliency computations are needed
- General
- Government
- Medical
- School K12
- Business/Financial
- Retail

The options reflect the continuity of operations section of the DCF, which categorizes critical functions for the six general occupancy types. Occupancies other than government, medical, school, business/financial, and retail are categorized as "General." The database will present for evaluation the resilience characteristics that pertain to the occupancy type that has been selected.

The resilience portion of the IRVS is optional. When "No resiliency computations are needed," the building characteristics that contribute solely to the resilience score are omitted, and the continuity of operations section is omitted. The risk assessment is required. The screener cannot conduct a resilience assessment and omit the risk assessment.

4.3.4 Pre-Field Questions

Answering the pre-field questions requires research that is beyond what can be observed onsite. The answers contribute to the consequence, threat, and vulnerability ratings. The catalog provides guidance and sources for answering the pre-field questions. See Section 4.3.6.

4.3.5 Structure Type

Two assumptions in the IRVS are (1) the screener will be able to determine the structure type and (2) the structure type is one of the 15 structure types that are identified in the building stock in the United States and the model structure types in FEMA (2002) and FEMA (2009b). The structure

Two assumptions in the IRVS are (1) the screener will be able to determine the structure type and (2) the structure type is one of the 15 structure types that are identified in the building stock in the United States and the model structure types.

Structure type is heavily weighted and has a significant impact on all factors in the risk and resiliency computations.

types are listed in Section 2.11.4 and in Table 4-2 (ID PF-18). Ideally, the screener will be able to determine the structure type prior to the field assessment by reviewing construction documents or consulting with building personnel. If not, the determination must be made during the field assessment.

Structure type is heavily weighted and has a significant impact on all factors in the risk and resiliency computations. Accurately determining the structure type is therefore critical to the accuracy of the screening. For more information on heavily weighted characteristics, see Section 2.6. Information on structure type is provided in the catalog (see Table 4-2). The information will allow screeners who are not familiar with building construction to determine the structure type.

4.3.6 Catalog of Pre Field Data

The catalog of pre-field data is provided in Table 4-2. The catalog is also part of the DCF, which is in the IRVS Database. The ID numbers in the catalog correspond to the numbers in the database. Screeners should use the catalog as a reference, as needed, when selecting attribute options.

Table 4-2: Catalog of Pre-Field Data

Pre-Field Data		
ID	**Building Characteristics**	**Attribute Options**
PF-1	**Number of Occupants**	

Number of Occupants

The number of occupants is important because of the potential for casualties (injuries and deaths) from building damage or failure of life safety systems during a terrorist attack or natural disaster.

The time of peak occupancy should be considered when selecting an attribute option unless the building is being assessed for specific conditions (such as for a specific event or specific time). Only the people inside the building should be considered for this attribute. The population outside the building is captured in ID 2.1 (Site Population Density).

The number of occupants the facility may serve after an event should be considered. For example, a hospital in an area struck by a major hurricane may have many more patients in the days after the event than at the time of the event. Loss of the facility could have more of an impact if it is a critical facility requiring continued operations after the event to serve the community.

Occupancy load ratios for various types of buildings

Type of Building	Occupancy Load Ratio
Assembly	One person per 10 square feet (sq ft) of floor or seating area
Commercial	Occupancy load varies; 1 person per 50 to 200 sq ft
Emergency Services	Occupancy load is typically 1 person per 100 sq ft
Government	Occupancy load varies; 1 person per 100 to 200 sq ft
Industrial	Occupancy load is typically 1 person per 200 sq ft except for warehouses, which have 1 person per 500 sq ft
Office	Occupancy load varies; 1 person per 100 to 200 sq ft
Residential	Occupancy load varies; 1 person per 300 sq ft of floor area in single-family dwellings, 1 person per 200 sq ft of floor area in multi-family dwellings, and 1 person per 100 sq ft for dormitories.
Educational	Occupancy load varies; 1 person per 50 to 100 sq ft

Attribute Options

a. < 100
b. ≥ 100, < 500
c. ≥ 500, < 2,000
d. ≥ 2,000, < 5,000
e. ≥ 5,000, < 10,000
f. ≥ 10,000, < 12,500
g. ≥ 12,500, < 15,000
h. ≥ 15,000, < 17,500
i. ≥ 17,500, < 20,000
j. > 20,000

The number of occupants contributes to the consequences and threat ratings.

b. Building with approximately 150 occupants

SOURCE: FEMA 455

Pre-Field Data		
ID	**Building Characteristics**	**Attribute Options**
PF-1 (Cont.)	 *d. Building with approximately 2,500 occupants* SOURCE: FEMA 455  *j. Building with approximately 20,000 occupants* SOURCE: J.CROKER	
PF-2	**Replacement Value** The replacement value of a building is the current cost of construction per square foot multiplied by the gross square footage (sum of total floor area for each floor of the building) of the building. Replacement value includes tenant improvements and contents. Replacement value varies by construction costs within a region, the community type (e.g., downtown urban, outside the urban core), building size (a large building may be less expensive to build per square foot than a small building), and use of the building considering the cost of tenant improvements such as finishes (e.g., 4-star vs. 2-star hotel) and infrastructure (e.g., data center versus commercial office). Cost information should be obtained directly from a knowledgeable site representative. If this is not possible, cost can be estimated based on the approximate cost per square foot in the *HAZUS-MH Technical Manual for the Flood Model FEMA*, (2009b), an industry-accepted cost-estimating guide, a known local construction cost, or other source. When the building contains invaluable or irreplaceable contents, such as in an art museum or a rare book library, insurance coverage limits may be used to provide an estimate.	a. < $1 million m. b. ≥ $1 m, < $5 m c. ≥ $5 m, < $10 m d. ≥ $10 m, < $15 m e. ≥ $15 m, < $20 m f. ≥ $20 m, < $150 m g. ≥ $150 m, < $400 m h. ≥ $400 m, < $750 m i. ≥ $750 m, < $1 billion b. j. > $1 b Replacement value contributes to the consequences rating.

Pre-Field Data

ID	Building Characteristics	Attribute Options
PF-2 (Cont.)	Examples of Cost per Square Foot	

Primary Building Function	Cost (per sq ft)
Commercial Office	$135 – $220
Light Industrial	$40 – $100
Research	$200 – $225
Emergency Services	$150 – $200
Governmental Facilities	$230 – $300
Hospitality	$120 – $180
Information and Telecommunications	$400 – $750
Museum/Library	$250 – $300
Hospital	$220 – $300
Medical Office/Clinic	$150 – $200
Residential	$250 – $450
Educational	$100 – $200

PF-3 Historic Site

Historic value relates to the symbolic or landmark status of a building and whether it is on a national, State, local, or nongovernmental historic register.

The screener can ask a site representative whether the building is on a historic register or do an Internet search. The National Register of History Places is available at http://www.nps.gov/nr/, and The List of National Historic Landmarks is available at http://www.nps.gov/nhl/designations/listsofnhls.htm. States, local jurisdictions, and nongovernmental organizations may also have listings of historically significant buildings within a locality. Sometimes a plaque is affixed to the outside of the building indicating its status as an historic property.

Typical plaque on buildings listed on the National Register of Historic Places

Attribute Options:

a. No

b. Yes

Historic value contributes to the consequences rating.

Example of an historic building: Society Bank, in Cleveland, Ohio, and the first skyscraper in Cleveland

SOURCE: WESTLAKE REED LESKOSKY ATCHITECTS

<table>
<tr><th colspan="3">Pre-Field Data</th></tr>
<tr><th>ID</th><th>Building Characteristics</th><th>Attribute Options</th></tr>
<tr>
<td>PF-4</td>
<td>

Occupancy Use

Occupancy use pertains to the function of the building as it relates to the target attractiveness of DHS's 18 Critical Infrastructure and Key Resources (CIKR) Sectors (DHS, 2009). For instance, if a building is occupied primarily by tenants in the banking industry, the building is in the Banking and Finance Sector. An abbreviated version of the taxonomy is provided in Appendix E.

For purposes of the IRVS of buildings, the 18 Sectors are divided into three groups that are in order of increasing target attractiveness. Group I has the lowest risk, and Group III has the highest risk.

In the field, the occupancy use of the building may be verified by reviewing the directory in the lobby or by speaking with a site representative or a law enforcement official who is familiar with the building.

For a multi-use building, the highest risk occupancy should be selected, but using judgment is sometimes more appropriate. For instance, if the lobby of a multi-tenant office building has an automatic teller machine, Banking and Finance is not necessarily the appropriate occupancy group unless the tenant base (companies or organizations leasing space in the building) is predominantly in the Banking and Finance Sector).

a. Building occupied by a critical manufacturing company (Group II, Critical Manufacturing Sector)

Occupancy use contributes to the threat rating.

</td>
<td>

a. Group I

- Agricultural and Food. Capacity to feed and clothe people well beyond the boundaries of the Nation
- Chemical. Basic chemicals, specialty chemicals, agricultural chemicals, pharmaceuticals, consumer products
- Critical Manufacturing. Primary metal, machinery, electrical equipment, appliances and components, transportation equipment manufacturing
- Dams. Assets, systems, networks, and functions related to dam projects, navigation locks, levees, hurricane barriers, mine tailings impoundments, or other similar water retention and/or control facilities
- 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 products used by the military
- Information Technology. Virtual and distributed functions that produce or provide hardware, software, IT systems and services, and the Internet
- Postal and Shipping. Differentiated from general cargo operations typical loading docks in buildings. by a focus on small- and medium-sized packages and by service from millions of senders, including high-volume automated processing facilities; local delivery units; many and varied collection, acceptance, and retail operations; mail transport vehicles including vans, trucks, tractor trailers, and aircraft; information and communications network

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<tr><th colspan="3">Pre-Field Data</th></tr>
<tr><th>ID</th><th>Building Characteristics</th><th>Attribute Options</th></tr>
<tr><td>PF-4 (Cont.)</td><td>

b. Hospital (Group II, Healthcare and Public Health Sector)</td><td>b. Group II
• Nuclear Reactors, Materials and Waste. Nuclear power plants; non-nuclear-power reactors used in research, testing, and training; nuclear materials used in medical, industrial, and academic settings; nuclear fuel fabrication facilities; decommissioned reactors; transportation, storage, or disposal of nuclear material and waste.
• Energy. Power plant buildings, petroleum refinery buildings, maintenance and operation buildings
• National Monuments and Icons. Buildings listed on either the National Register of Historic Places or the List of National Historic Landmarks have some or all of the following characteristics: a monument, physical structure, object, or geographic site; widely recognized as representing the Nation’s heritage, traditions, or values or widely recognized as having important national cultural, religious, historical, or political significance; point of interest for visitors and educational activities.
• Healthcare and Public Health. Hospitals, medical centers, clinics, medical research laboratories, pharmaceutical facilities, medical educational facilities
• Communications. Diverse, competitive, and interconnected industry using terrestrial, satellite, and wireless transmission systems
• Water. Waste treatment facility buildings, maintenance and operations buildings.</td></tr>
</table>

Pre-Field Data		
ID	Building Characteristics	Attribute Options
PF-4 (Cont.)	 *c. Building occupied by a critical manufacturing company (Group II, Critical Manufacturing Sector)*	c. Group III • 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 store-front bank branches and automated teller machines fall into this group. • Commercial Facilities. Broad range of building types, including those related to: – Community organization. Social advocacy, civic, and social organizations – Entertainment and media. Broadcasting cable, radio, television. , Internet publishing, motion picture, sound recording, newspaper, magazine, publishing – Gambling/casinos resorts. . Horse and dog racetracks, land-based casinos – Industrial. Heavy manufacturing, operations and maintenance facilities, assembly plants, factory buildings – Lodging. Hotels, motels – Museum/library. Museums are buildings with special collections such as artifacts, artwork, and other important exhibits that have importance to the public and may be historical. Libraries are buildings with large collections of books that are typically open to the public. – Office. Office buildings typically housing clerical and management functions – Public assembly/sports leagues. 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

Pre-Field Data		
ID	Building Characteristics	Attribute Options
PF-4 (Cont.)		c. Group III (cont.) • Emergency Services. Police stations, emergency operations or control centers, fire command stations, armories • Government Facilities. General-use office buildings and special-use military installations, embassies, courthouses, national laboratories, and structures that may house critical equipment and systems, networks, and functions. Educational facilities are considered government facilities. • Transportation Systems. Broad range of building types, including those related to: – Aviation. Aircraft, air traffic control systems, commercial airports and additional airfields, civil and joint use military airports, heliports, short takeoff and landing ports, seaplane bases – Highway. Roadways and supporting infrastructure, vehicles including automobiles, buses, motorcycles, and all types of trucks – Maritime. Ports, navigable waterways, and intermodal landside connections, which allow the various modes of transportation to move people and goods to, from, and on the water. – Mass transit. Multiple-occupancy vehicles, such as transit buses, trolleybuses, vanpools, ferryboats, monorails, heavy (subway) and light rail, automated guide way transit, inclined planes, cable cars designed to transport customers on local and regional routes – Pipeline systems. Vast networks of pipeline that traverse the country, carrying nearly all of the Nation's natural gas and about 65 percent of hazardous liquids, as well as various chemicals – Rail. Railroads, track, more than 1.3 million freight cars, roughly 20,000 locomotives

<table>
<tr><th colspan="3">Pre-Field Data</th></tr>
<tr><th>ID</th><th>Building Characteristics</th><th>Attribute Options</th></tr>
<tr><td>PF-5</td><td colspan="2">Target Potential (Credible Threats)

Target potential relates to the likelihood that a terrorist attack that would affect the subject building will occur. Target potential refers to past and present potential. It is evaluated by determining whether there are current or previous credible threats to the building and the CIKR Sector the building is in. If the building or Sector is currently or has been a target within the continental United States, the attribute option should be Yes.

Target potential is based on available information, but judgment may also be required. Information obtained from senior security personnel for the building is the most reliable. Other sources of information are law enforcement officials in the area, newspapers, and the Internet.

The target potential can change rapidly. The screener should select the attribute option based on the best available information at the time of the screening and should explain the reasons for selecting Yes or No in a comment in the DCF.

Target potential contributes to the threat rating.</td></tr>
<tr><td>PF-5.1</td><td>Target Potential: Building

The attribute option should be Yes if there is a current or previous threat targeting:
• The subject building
• Part of the building
• The major tenant in the building
• The compound of buildings the subject building is in</td><td>a. No
b. Yes

Target potential of a building is heavily weighted.</td></tr>
<tr><td>PF-5.2</td><td>Target Potential: Sector

If the Sector has a current or previous threat, the attribute option should be Yes. 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, and the attribute option should be Yes.</td><td>a. No
b. Yes</td></tr>
<tr><td>PF-6</td><td>Target Density

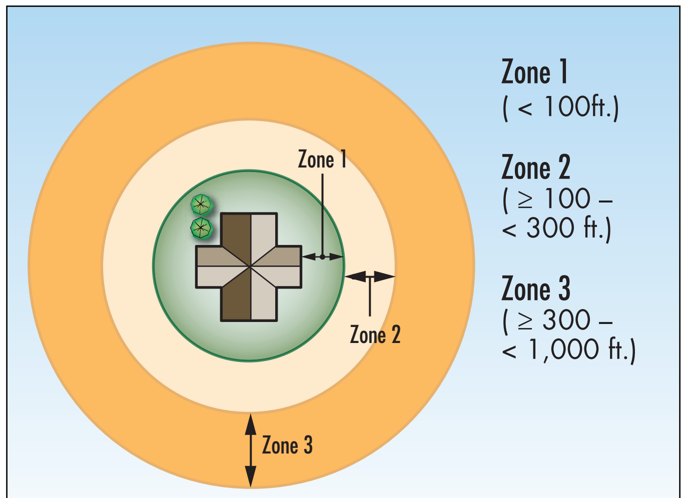
Target density is defined as the number of high-value targets within a certain distance of the subject building. Distances are divided into Zones 1, 2, and 3. Target density does not include the subject building.

A high-value target is defined as an asset that the incapacity or destruction of which may have a debilitating impact on the security, economy, public health or safety, or environment in any Federal, State, regional, territorial, or local jurisdiction. A high-value target may be a building or other type of structure such as a bridge or dam.</td><td>Target density contributes to the threat rating and is heavily weighted.</td></tr>
</table>

<table>
<tr><th colspan="3">Pre-Field Data</th></tr>
<tr><th>ID</th><th>Building Characteristics</th><th>Attribute Options</th></tr>
<tr><td>PF-6 (cont.)</td><td colspan="2">Target density should be determined before the field visit if possible. The IRVS Database includes a Google Earth application that can be used to display the target density zones around the building if mapping software is installed on the computer that contains the database. For more information, see the IRVS Database User Guide. Target density information also can be obtained on the Internet (Google or Bing maps).

A list of the CIKR Sectors (DHS, 2009) is provided as a reference for evaluating target density. The screener can use the list to help identify individual high-value targets for each Sector so high-value targets are less likely to be overlooked .

CIKR Sectors
• Agriculture and Food
• Banking and Finance
• Chemical
• Commercial Facilities
• Communications
• Critical Manufacturing
• Dams
• Defense Industrial Base
• Emergency Services
• Energy
• Government Facilities
• Healthcare and Public Health
• Information Technology
• National Monuments and Icons
• Nuclear Reactors, Materials and Waste
• Postal and Shipping
• Transportations Systems
• Water



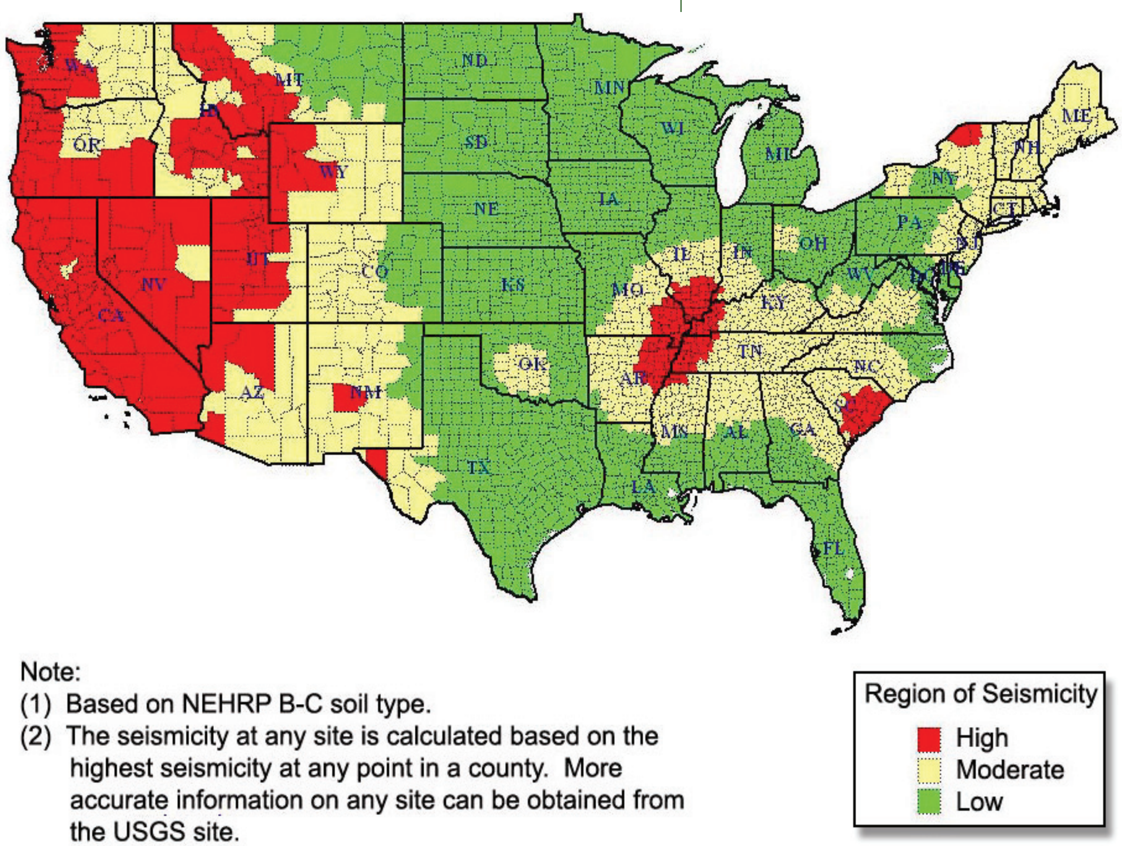
IRVS Target Zones</td></tr>
<tr><td>PF-6.1</td><td>Target Density: Zone I

Number of targets within 100 feet of any point of the building.</td><td>a. 0
b. 1
c. 2
d. 3
e. 4 or more</td></tr>
<tr><td>PF-6.2</td><td>Target Density: Zone II

Number of targets between 100 and 300 feet of the building.</td><td>a. 0
b. 1
c. 2
d. 3
e. 4 or more</td></tr>
<tr><td>PF-6.3</td><td>Target Density: Zone III

Number of targets between 300 and 1000 feet of the building.</td><td>a. 0
b. 1
c. 2
d. 3
e. 4 or more</td></tr>
</table>

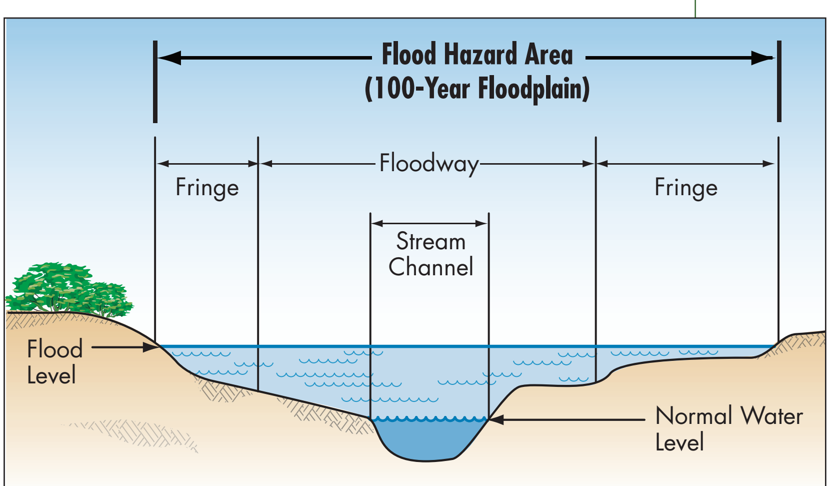
Pre-Field Data		
ID	**Building Characteristics**	**Attribute Options**
PF-7	**Seismic Zone** Seismic zone indicates the frequency and location of earthquakes within a particular area. In the IRVS, seismic zone is rated high, medium, or low. The screener can identify the seismic zone for the subject building by: Finding the location of the building on the seismic map shown below and identifying the seismic zone (high, medium, or low). Going to the U.S. Geological Service (USGS) Web site at http://earthquake.usgs.gov/ for seismic information based on the latitude and longitude or zip code of the subject building)	a. Low b. Medium c. High Seismic zone contributes to the threat rating.



Seismicity regions of the conterminous United States

SOURCE: USGS

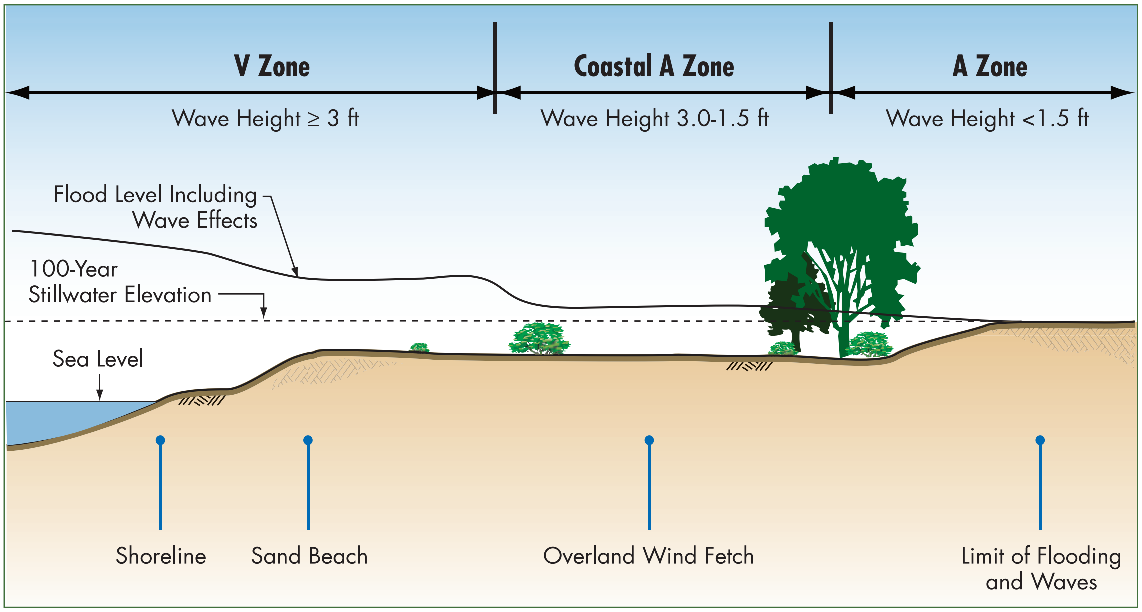
Pre-Field Data		
ID	**Building Characteristics**	**Attribute Options**
PF-8	**Proximity to an Active Seismic Fault** A seismic fault is a planar fracture or discontinuity in a volume of rock across which there has been significant displacement. Energy release associated with the rapid movement of a fault is the cause of most earthquakes. Fault movements usually recur in geologically weak areas. Proximity of an active seismic fault refers to active faults within a 50 mile radius of the subject building. An active fault in the IRVS is defined as a fault that has exhibited surface displacement or rupture within the last 11,000 years. The U.S. Geological Survey (USGS) and many State geological surveys produce maps of active seismic faults that show the locations of fault movements that have ruptured the ground surface. Not all seismic faults are currently mapped. Information about and maps of faults are available on the USGS Web sites listed below. State and local fault maps may also be available. Interactive fault maps: **http://earthquake.usgs.gov/hazards/qfaults/imsintro.php** Static fault maps: **http://earthquake.usgs.gov/hazards/qfaults/usmap.php** Quaternary fault database: **http://geohazards.cr.usgs.gov/cfusion/qfault/index.cfm**	a. Farther than 50 miles from a fault active or inactive. Or within 50 miles of an inactive fault b. Within 50 miles of an active fault Proximity to an active seismic fault contributes to the threat and vulnerability ratings.
PF-9	**Floodplain** A floodplain is land adjacent to a body of water that is periodically or occasionally flooded. The screener can determine whether the subject building is in a floodplain by reviewing flood maps of the region and the community's flood hazard maps. The primary source of flood information is the Flood Insurance Rate Map (FIRM) and the Flood Insurance Study (FIS) that accompanies the FIRM. FEMA Map Service Center: **http://www.msc.fema.gov/**	a. No building is not in a floodplain. b. Yes building is in a floodplain.



Riverine floodplain

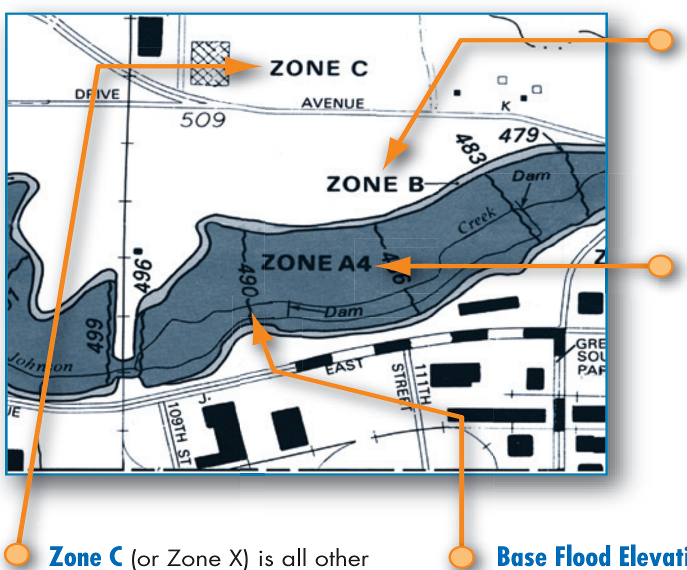
SOURCE: FEMA 543 (FEMA, 2007A)

Pre-Field Data		
ID	Building Characteristics	Attribute Options
PF-9 (cont.)		

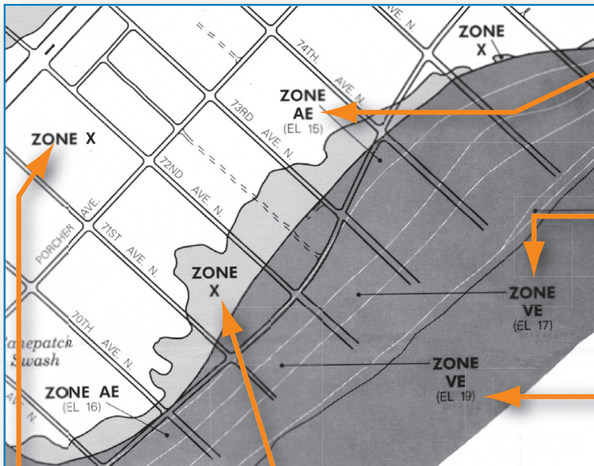


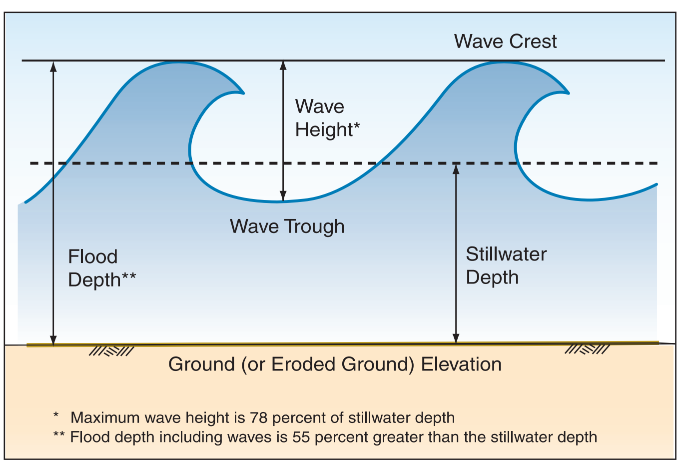
Coastal Floodplain SOURCE: FEMA 543 (FEMA, 2007A)

The following two graphics are provided to help the screener use FEMA floodplain maps to decide whether a building is in a floodplain. Buildings in all of the flood zones that are shown in the two graphics below, including Shaded Zone X, are in a floodplain except Zone C and Zone X. Buildings in Zone C and Zone X are not in a floodplain. However, a building location may have ponding or drainage problems, which are taken into account in ID PF-10 (Maximum Flood Depth) and PF-11 (Flood Duration).



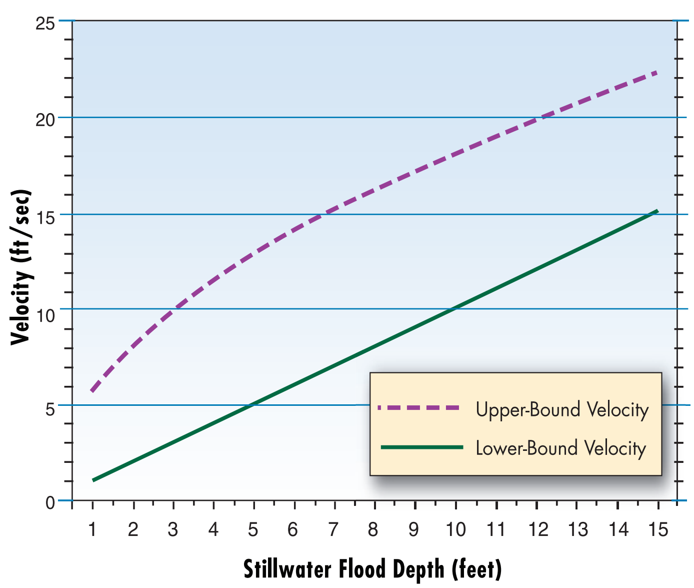
Riverine flood hazard zones SOURCE: FEMA 543 (FEMA, 2007A)

<table>
<tr><th colspan="3">Pre-Field Data</th></tr>
<tr><th>ID</th><th>Building Characteristics</th><th>Attribute Options</th></tr>
<tr><td>PF-9
(cont.)</td><td colspan="2">


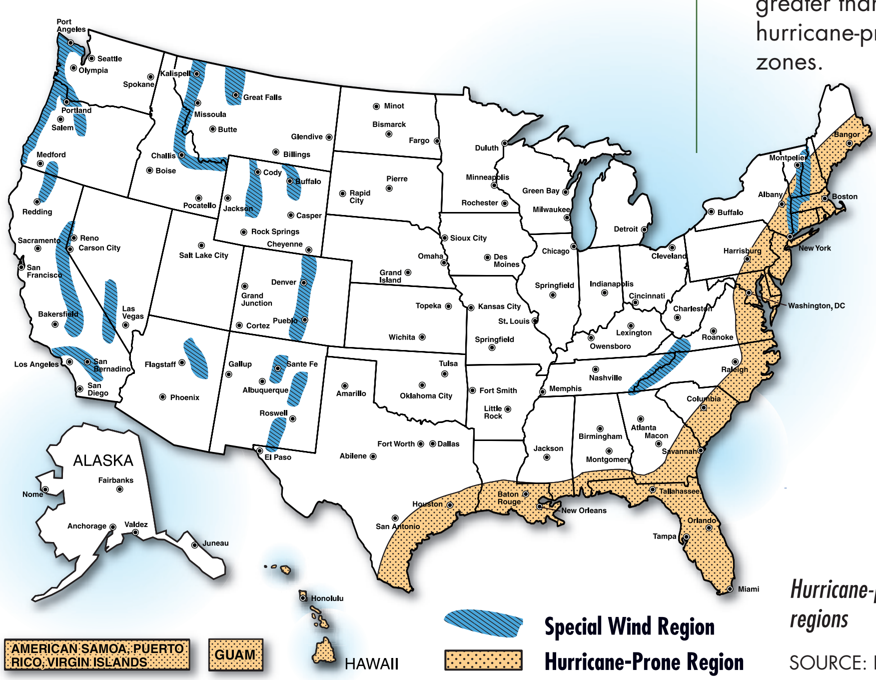
Zone A, A Zones A1-A30, and **Zone AE** are subject to flooding by the base or 100-year flood (1 percent annual chance), and waves less than 3 feet.
Zone V, V Zones V1-V30, and **Zone VE** are where waves are expected to be 3 feet or more.
Base Flood Elevation (BFE) is the predicted water surface elevation (in feet above datum).
Zone X is all other areas.
Shaded Zone X (or Zone B) is subject to flooding by the 500-year flood (0.2 percent annual chance).
Coastal Flood Hazard Zones
SOURCE: FEMA 543 (FEMA, 2007A)
</td></tr>
<tr><td>PF-10</td><td>
Maximum Flood Depth
Flood depth is the difference between the flood elevation and ground elevation. Maximum flood depth is the maximum depth of flooding in floods with depth data. The depth of coastal flooding is influenced by factors such as the tidal cycle, storm duration, ground elevation, and presence of waves. FIRMs or historical flood data can be used to determine the maximum flood depth at the subject building.
Flood depth is a critical factor in building damage because of its relationship to the cost of repairs or replacement.
Under certain conditions, hurricanes can produce storm surge flooding that is 20 to 30 feet above mean sea level or, in extreme cases such as Hurricane Katrina, as much as 35 feet above mean sea level.


</td><td>
a. No previous flooding
b. Low 1 to 2 feet.
c. Medium 2 to 4 feet.
d. High above 4 feet.
The maximum flood duration contributes to the threat and vulnerability ratings.
Coastal Flood Hazard Zones
SOURCE: FEMA 543 (FEMA, 2007A)
</td></tr>
</table>

Pre-Field Data		
ID	**Building Characteristics**	**Attribute Options**
PF-11	**Flood Duration** Flood duration refers to approximately how long the water level remains above the normal level. The screener should use the maximum duration of past flooding events. The duration of riverine flooding is primarily a function of watershed size and longitudinal slope of the valley. Floods in small watersheds are likely to be flash floods (floodwater levels that rise and fall rapidly). Areas adjacent to large rivers may be flooded for weeks or months. Most coastal flooding is influenced by the normal tidal cycle and how fast coastal storms move through the region. Areas subject to coastal flooding can experience flooding of long duration when drainage is poor or slow because of topography or the presence of flood control structures. More commonly, coastal flooding is of short duration (12 to 24 hours). Flooding along large lakes, including lakes that are behind dams, can be of very long duration because the large volume of water takes longer to drain. Flooding records are the best source of duration. Floodplain analyses do not include flood duration.	a. No previous flooding b. Short few hours, flash flood. c. Medium up to 1 day. d. Long up to 1 week. e. Very long more than a week. Flood duration contributes to the threat rating.
PF-12	**Floodwater Velocity** Floodwater velocity ranges from extremely high (associated with coastal storm surge) to very low or nearly stagnant (in backwater areas and expansive floodplains). Flood velocity is typically measured in feet per second (fps). The screener should use the maximum floodwater velocity of past flooding events. Velocity is a factor in determining the hydrodynamic load and impact loads from flooding. Estimating velocity is difficult. Flood records and floodplain studies may contain velocity information. Velocity estimates in flood records are more reliable than estimates in floodplain studies. The following information may help the screener determine floodwater velocity: • Very shallow flooding (less than 1 foot) or ponding typically indicates low velocity (<5 fps) • Structural damage typically indicates high velocity (10 to 15 fps) • Sloped topography may indicate high velocity (10 to 15 fps) • Coastal surges and tsunamis often have extreme velocities	a. No previous flooding b. Low < 5 feet per second [fps]. c. Medium 5 to 10 fps. d. High 10 to 15 fps. e. Extreme >15 fps.

Pre-Field Data		
ID	**Building Characteristics**	**Attribute Options**
PF-12 (cont.)	**Estimating Flood Velocity – Riverine** There are few sources of information that are readily available for estimating flood velocities at specific locations along rivers. If a riverine source has been studied and the study includes a hydraulic analysis, some information may be available. Studies prepared for the National Flood Insurance Program contain data for waterways for which floodways have been delineated. For specified cross sections along a waterway, floodway data include a mean velocity in feet per second. Mean velocity is the average of all velocities across the floodway. The screener should use the maximum velocity if it can be determined; otherwise, the mean velocity in the floodway can be used. **Estimating Flood Velocity – Coastal** Estimating flood velocities in coastal flood hazard areas is subject to considerable uncertainty. Waves contribute to erosion and scour and contribute significantly to design loads on buildings. Waves must be accounted for along coastal shorelines in flood hazard areas that are inland of open coasts and in areas where winds can generate flooding. Coastal velocity can be derived from the graph below based on stillwater flood depth. Factors such as topography, distance from the source of flooding, and proximity to other building or obstructions can direct and confine floodwaters and accelerate the velocity. An increase in velocity is referred to as the expected upper bound. The expected lower bound velocities are experienced in areas where those factors are not expected to influence the direction or velocity of floodwaters. Velocities caused by Hurricane Katrina along the Mississippi coast have been estimated at nearly 30 fps.  	*Flood velocity (coastal) as a function of stillwater flood depth* SOURCE: FEMA 543 (FEMA, 2007A)

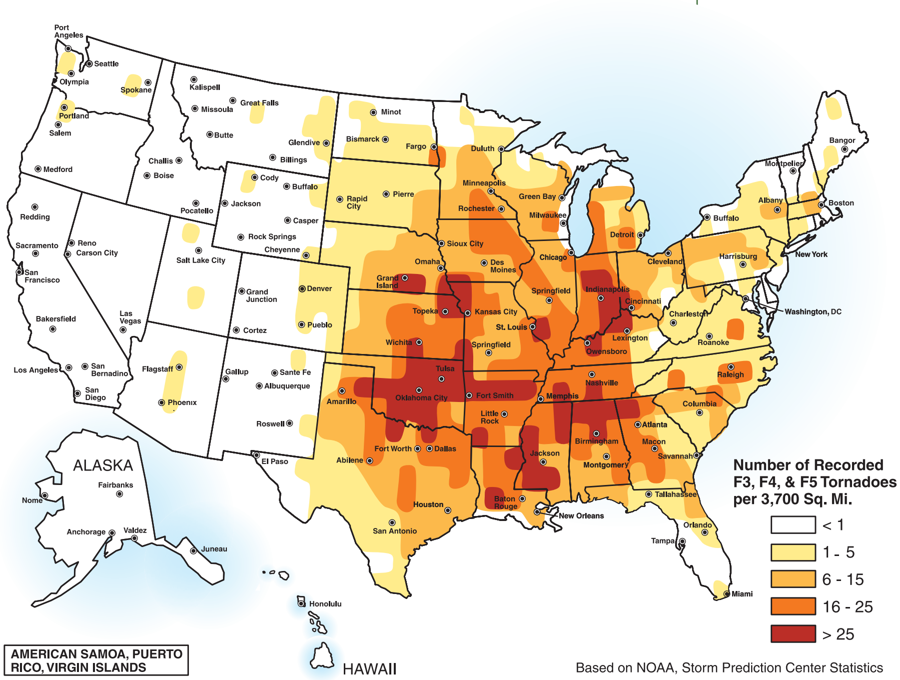
Pre-Field Data		
ID	**Building Characteristics**	**Attribute Options**
PF-13	**Distance from a Flooding Source** A flooding source is a waterway such as a river, canal, or stream or a large body of water such as a lake or ocean. The distance from a flooding source can be determined easily from satellite imagery provided by Google maps and other public sources. Proximity to a waterway or other body of water increases the probability that a building is in a floodprone area. Flooding along waterways normally occurs as a result of excessive rainfall or snowmelt that creates water flows that exceed the capacity of channels. Flooding along shorelines is usually a result of coastal storms that generate storm surges or waves above normal tidal fluctuations. The distance from a flooding source can affect the frequency and severity of flooding that may affect a building. All bodies of water are flooding sources, but not all contribute to the determination of a floodplain on FIRMs.	a. Far >1 mile from a flooding source. b. Medium within 1 mile of a flooding source. c. Close within 1,000 feet of a flooding source. d. Adjacent within 300 feet of a flooding source. Distance from flood sources contributes to the threat rating.
PF-14	**High Wind Speed Zone** High wind speed zone maps provide information about wind speeds in a particular region (an area of 3,700 square miles). Windstorm types vary throughout the United States. The primary types are straight-line winds, down-slope winds, thunderstorms, downbursts, nor'easters, hurricanes, and tornados.	a. Low zone with winds of low to moderate speeds – winds below 75 mph peak gust. b. Medium zone exposed to strong winds – winds between 75 and 111 mph peak gust. c. High building subjected to damaging winds with speeds of greater than 111 mph, generally in hurricane-prone or tornado-prone zones.



Hurricane-prone regions and special wind regions

SOURCE: FEMA 543 (FEMA, 2007A)

Pre-Field Data		
ID	**Building Characteristics**	**Attribute Options**
PF-15	**Hurricane Frequency in the Region** Frequency of hurricanes in a particular region (an area of 3,700 square miles) is available on the Web sites listed below. HAZUS-MH (FEMA, 2009b) also includes a list of hurricanes. http://www.nhc.noaa.gov/HAW2/english/history.shtml http://www.weather.com/encyclopedia/tropical/history.html Hurricane frequency in a region contributes to the threat rating.	a. Never. No record of a hurricane in the region b. Rare. One or two hurricanes in the last 100 years c. Medium. One or two hurricanes in the last 20 years d. Frequent. Multiple hurricanes in the last 20 years that significantly affected the region
PF-16	**Tornado Frequency in the Region** Historical data on tornadoes is available on the Internet. Frequency is shown in the map below. "Region" refers to a 3,700-square-mile area. Tornadoes are classified according to the Enhanced Fujita Scale (FScale), a National Oceanic and Atmospheric Administration (NOAA) scale for rating tornado intensity based on damage to human-built structures and vegetation.	a. Never. No record of a tornado affecting the region b. Rare. One or two tornadoes in the last 10 years c. Medium. Three to five tornadoes in the last 10 years d. Frequent. Six or more tornados in the last 10 years



Tornado events contributes to the threat rating.

Frequency of recorded F3, F4, and F5 tornados 1950–1998
SOURCE: FEMA 543 (FEMA, 2007A)

Pre-Field Data

ID	Building Characteristics	Attribute Options
PF-16 (cont.)	Enhanced Fujita Scale for Rating Tornados	

Scale	Estimated Wind Speed	Potential Damage
EF0	65 – 85 mph	Low damage
EF1	86 – 110 mph	**Moderate damage.** The lower limit is the beginning of hurricane wind speed; surface peeled off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads; attached garages may be destroyed.
EF2	111 – 135 mph	**Considerable damage.** Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; high-rise windows broken and blown in; light-object missiles generated.
EF3	136 – 165 mph	**Critical damage.** Roofs and some walls torn off well-constructed houses; most trees in forest uprooted; skyscrapers twisted and deformed with massive destruction of exteriors; heavy cars lifted off the ground and thrown.
EF4	166 – 200 mph	**Severe damage.** Well-constructed houses leveled; structures with weak foundations blown away some distance; trains overturned; cars thrown and large missiles generated. Skyscrapers and high-rises toppled and destroyed.
EF5	>200 mph	**Devastating damage.** Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile-sized missiles fly through the air in excess of 109 yards); trees debarked; steel reinforced concrete structures badly damaged.

Historical information on tornado events is available at:

http://www.tornadoproject.com/

http://www.weather.com/encyclopedia/tornado/history.html

PF-17 Soil Type

Soil type, a major factor in the seismic resiliency of the building, is the type of soil/rock on which a building foundation is built. For foundations close to the surface, the soil surrounding the building is critical to the integrity of its foundation and structure. Deep foundations, including piles and caissons, usually sit on bedrock or very firm soil.

Since soil conditions cannot be readily identified visually, geologic and geotechnical maps and other information should be reviewed during the pre-field assessment. If there is no basis for classifying the soil type, the screener should select Option "b" (medium). Sites with high water tables typically indicate unstable soil conditions and should be rated as Option "c" (poor).

Soil type contributes to the threat and vulnerability ratings and is heavily weighted.

Attribute Options:

a. Hard rock

b. Medium

c. Poor

Soil Rank for Foundations

Soil Foundation	Rank
Hard rock and rock	Best
Sand and gravel	Medium
Medium and hard clays	Medium
Silts and soft clays	Poor
Organic silt and clays	Poor
Peat	Poor

Structure Type		
ID	**Building Characteristics**	**Attribute Options**
PF-18	**Structure Type** The structure type is assumed to be one of 15 types listed in the table on the right. These types are consistent with the model structure types in FEMA (2002) and FEMA (2009b) and are described below. Since this characteristic is heavily weighted and has a significant impact on all factors in the risk and resiliency computations, identifying the structure type accurately is crucial to the accuracy of the screening. Structure type is heavily weighted. **Identifying the Structure Type** The best way to identify the structure type is to review construction drawings or talk to a building engineer or representative. If these options are not available, two other methods are to (1) go to an unfinished floor of the building where the columns and beams are exposed (typically the basement or mechanical rooms) (2) observe the exterior of the building from the adjacent sidewalk or from across the street. Identifying the structure type from the street may be difficult if building veneers overlay the structural skeleton, which is common in concrete frame and steel frame buildings. Each structure type has features that distinguish it from other types that can be used to help identify the type. The following features should be considered when trying to identify or narrow the structure type: • **Age:** The approximate age of a building can help indicate the structure type based on typical structural systems used at the time of construction. Age may be difficult to determine visually but may be available on the Internet. • **Height:** The number of stories may indicate possible types of construction. Some structure types are more common in low-rise buildings while others are more common in high-rise buildings (see tables in right column). • **Locality:** The structure type can sometimes be deduced if an urban or suburban area is commonly known to use a particular structure type for similar buildings.	**Structure Type Identifier Definitions** (see table below)

Structure Type Identifier Definitions

Identifier	Structure Type
W	Wood frame
S1	Steel moment frame
S2	Steel braced frame
S3	Steel light frame
S4	Steel frame with cast-in-place concrete shear walls
S5	Steel frame with unreinforced masonry infill walls
C1	Concrete moment frame
C2	Concrete shear walls
C3	Concrete frame with unreinforced masonry infill walls
PC1	Precast concrete tilt-up walls
PC2	Precast concrete frame with concrete shear walls
RM1	Reinforced masonry bearing walls with wood or metal deck diaphragms
RM2	Reinforced masonry bearing walls with precast concrete diaphragms
URM	Unreinforced masonry bearing walls
MH	Manufactured homes

Structure Type

ID	Building Characteristics	Attribute Options
PF-18 (cont.)	Other useful information is as follows:	The following tables from FEMA 154 (FEMA, 2002) provide the assumed structure type based on occupancy, number of stories, and age of construction. The information in these tables is based on expert judgment but should be verified in the field or by a site representative. The information is intended to be used only to narrow the potential structure types.

Other useful information is as follows:

- In newer construction, the columns are often exposed on the exterior of the first story. Inspection of these columns may reveal whether the structure is steel or concrete. Columns covered with a façade material most likely indicate a steel frame. If the frame is concrete, columns are usually exposed and are not covered with a façade.
- Some structures have a combination of shear walls and frames, which are typically observable from the exterior because the shear walls usually extend through the exterior longitudinal wall and are exposed.
- Windows and exterior door openings may sometimes reveal the thickness of the wall. If wall thickness exceeds approximately 12 inches, the wall is most likely unreinforced masonry (URM).
- If smooth exterior walls have vertical joints that are regularly spaced and extend to the full height of the building, the wall is constructed of concrete (S4, C2, or PC2).
- f the building has fewer than four stories, the structure type is most likely either a tilt-up or parged unreinforced or reinforced concrete block (PC1, RM1, or RM2).
- If the building is constructed of brick masonry without header courses (horizontal rows of visible brick ends), and the wall thickness is approximately 8 inches, the structure type is most likely reinforced masonry (RM1 or RM2).
- If the exterior wall has large concrete block units that approximately 8 to 12 inches high and 12 to16 inches long, smooth- or rough-faced, the structure type may be reinforced concrete block masonry (RM1 or RM2).
- If the building is designed for progressive collapse, the structure type is a moment frame design (S1 or C1).

Assumed Structure Types for Pre-1930 Buildings

Original Occupancy	Number of Stories					
	1–2	3	4–6	7–15	16–30	30+
Residential	W URM	W URM	S5 C3 URM	S5 C3		
Commercial	W S4 S5 C1 C2 C3 URM	W S4 S5 C1 C2 C3 URM	W S1 S2 S4 S5 C1 C2 C3 URM	W S1 S2 S4 S5 C1 C2 C3	W S1 S2 S4 S5 C1 C2 C3	
Industrial	W S1 S2 S3 S5 C1 C2 C3 URM	W S1 S2 S5 C1 C2 C3 URM				

Structure Type

ID	Attribute Options	Attribute Options
PF-18 (cont.)	Assumed Structure Types for 1930–1945 Buildings	Assumed Structure Types for Post-1960 Buildings

Assumed Structure Types for 1930–1945 Buildings

Original Occupancy	Number of Stories					
	1–2	3	4–6	7–15	16–30	30+
Residential	W URM	W URM	S1 S2 S5 URM	S1 S2 S5		
Commercial	W S1 S2 S5 C1 C2 C3 RM1 RM2 URM	W S1 S2 S5 C1 C2 C3 RM1 RM2 URM	S1 S2 S5 C1 C2 C3 RM1 RM2 URM	S1 S2 S5 C1 C2 C3	S1 S2 S5 C1 C2 C3	S2 S5
Industrial	S3 S5 C1 C2 C3 RM1 RM2 URM	S3 S5 C1 C2 C3 RM1 RM2 URM	C1 C2 C3			

Assumed Structure Types for 1945–1960 Buildings

Original Occupancy	Number of Stories					
	1–2	3	4–6	7–15	16–30	30+
Residential	W RM URM*	W RM URM*	S1 S2 C1 C2 RM1 RM2 URM	S1 S2 C1 C2	S1 S2 C1 C2	S1 S2 C1 C2
Commercial	W S1 S2 C1 C2 RM1 RM2 URM*	W S1 S2 C1 C2 RM1 RM2 URM*	S1 S2 C1 C2 RM1 RM2 URM*	S1 S2 C1 C2	S1 S2 C1 C2	S1 S2 C1 C2
Industrial	S3 S5 C1 C2 C3 RM1 RM2 URM	S3 S5 C1 C2 C3 RM1 RM2 URM	C1 C2 C3			

Assumed Structure Types for Post-1960 Buildings

Original Occupancy	Number of Stories					
	1–2	3	4–6	7–15	16–30	30+
Residential	W S1 S2 C1 C2 PC2 RM1 RM2 URM	W S1 S2 C1 C2 PC2 RM1 RM2 URM	W S1 S2 C1 C2 PC2 RM1 RM2 URM	S1 S2 C1 C2 PC2 RM1 RM2		
Commercial	W S1 S2 C1 C2 PC1 PC2 RM1 RM2	W S1 S2 C1 C2 PC1 PC2 RM1 RM2	W S1 S2 C1 C2 PC2 RM1 RM2	S1 S2 C1 C2 PC2 RM1 RM2	S1 S2 C1 C2 PC2	S1 S2 C1 C2
Industrial	S1 S2 S3 C1 C2 PC1 PC2 RM1 RM2	S1 S2 C1 C2 PC1 PC2 RM1 RM2	S1 S2 C1 C2 PC2 RM1 RM2	S1 S2 C1 C2 PC2	C1 C2 PC2	

* URM was generally not permitted in California or other high-seismicity locations during this period (1945–1960). URM buildings built during this period are generally only in central and eastern United States.

Structure Type

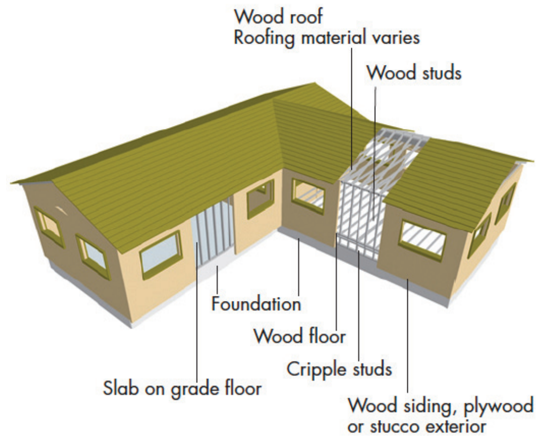
ID	Building Characteristics	Attribute Options
W	Wood Frame	(see figures below)

W — Wood Frame

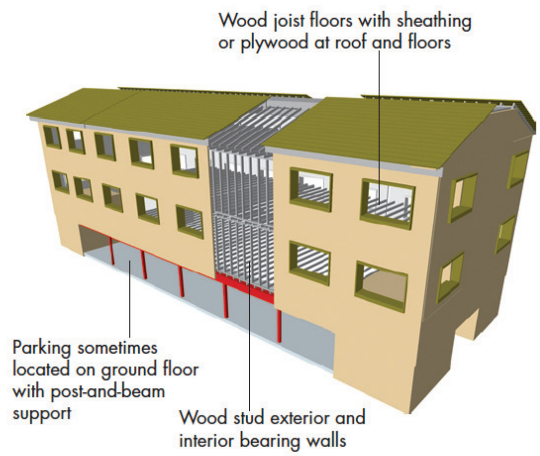
Wood frame structures are usually detached residential dwellings, small apartments, commercial buildings, or one-story industrial structures. They are rarely more than three stories tall, although in rare instances, older buildings are as tall as six stories.

The essential structural feature of wood frame buildings is repetitive framing by wood rafters or joists on wood stud walls. Loads are light and spans are small. The first floor framing is supported directly on the foundation or is raised up on cripple studs and post and beam supports. The foundation consists of spread footings constructed of concrete, concrete masonry block, or brick masonry in older construction.

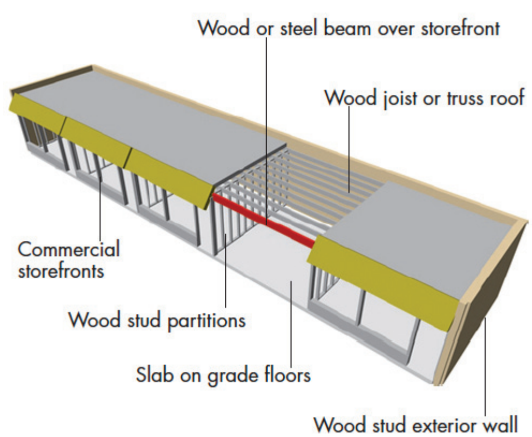
Lateral forces are resisted by wood frame diaphragms and shear walls. Floor and roof diaphragms consist of straight or diagonal wood sheathing, tongue and groove planks, or plywood. Shear walls consist of straight or diagonal wood sheathing, plank siding, plywood, stucco, gypsum board, particle board, or fiber-board. Interior partitions are sheathed with plaster or gypsum board.



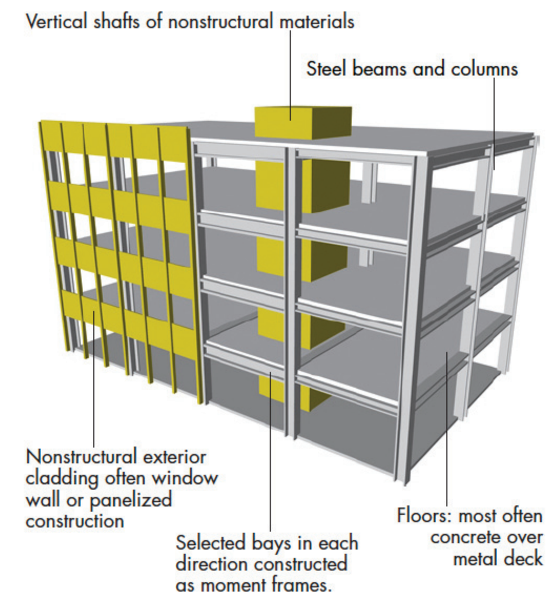
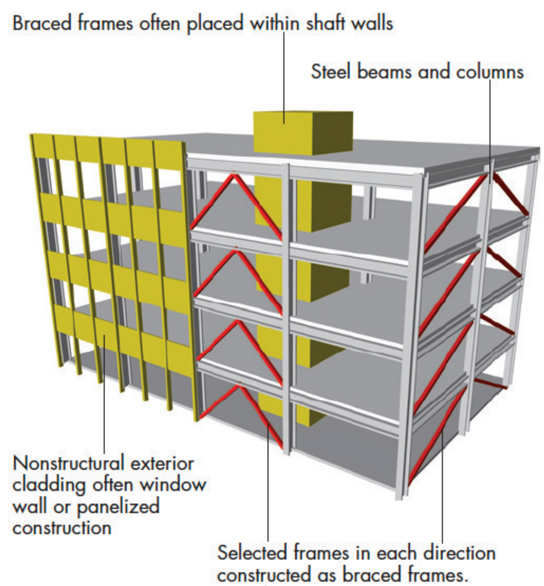
Small residence with wood frame
SOURCE: FEMA 454 (FEMA, 2006)

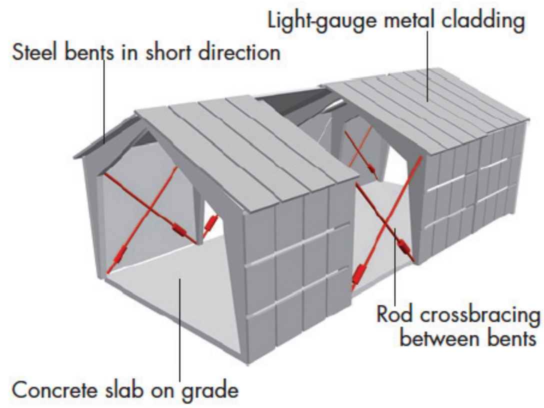
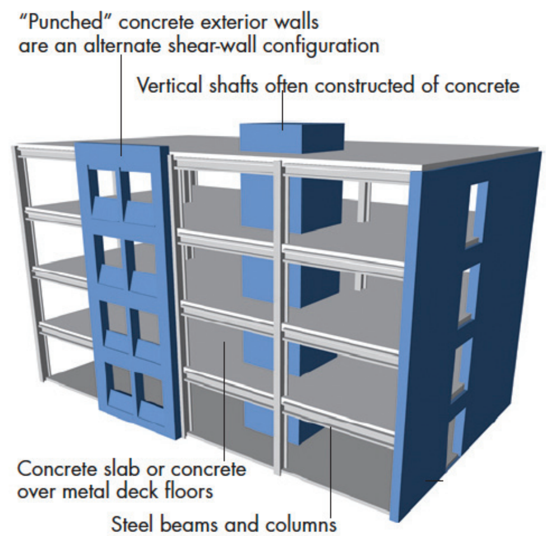
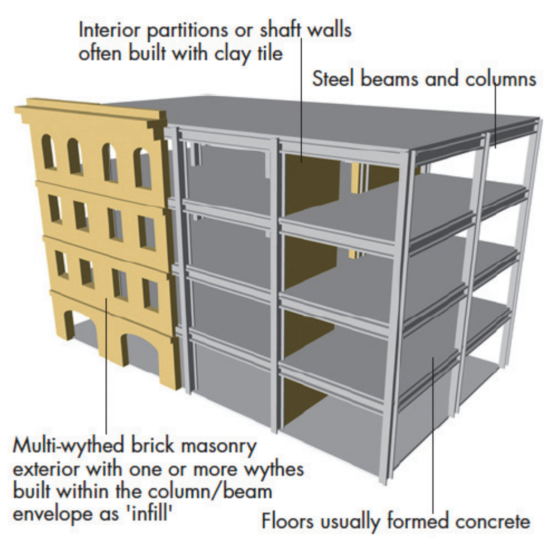


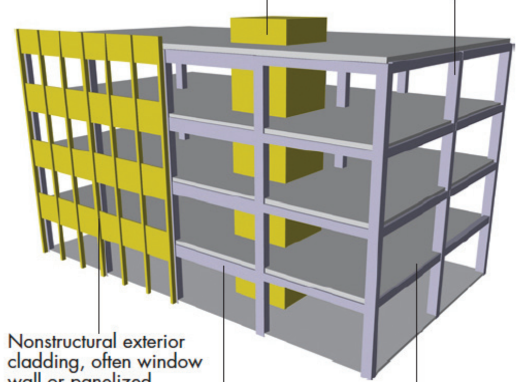
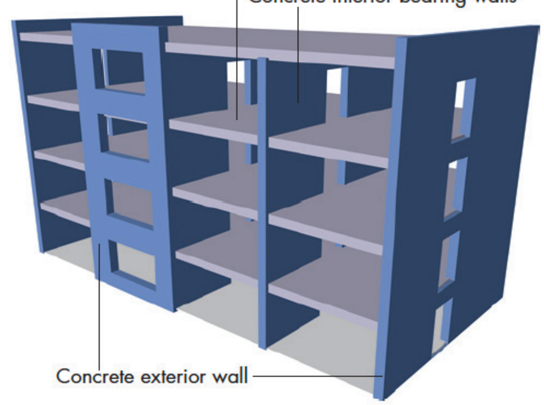
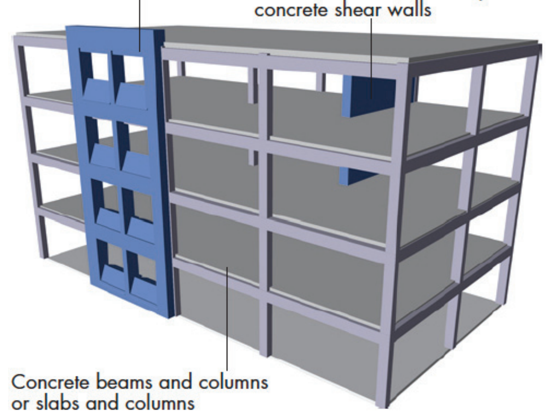
Multi-unit residence wood frame
SOURCE: FEMA 454 (FEMA, 2006)



Commercial and industrial wood frame
SOURCE: FEMA 454 (FEMA, 2006)

Structure Type		
ID	**Building Characteristics**	**Attribute Options**
S1	**Steel Moment Frame** Buildings with a steel moment frame have steel columns and beams with cast-in-place concrete slabs or metal decks with concrete fill supported on steel beams, open web joists, or steel trusses. Lateral forces in steel moment frame buildings are resisted by rigid or semi-rigid beam-column connections. When all of the connections are moment-resisting connections, the entire frame participates in lateral force resistance. When only selected connections are moment-resisting connections, resistance is provided along discrete frame lines. The structure is usually concealed on the outside by exterior nonstructural walls, which can be constructed of almost any material (e.g., curtain walls, brick masonry, precast concrete panels). Walls may consist of metal panel curtain walls, glazing, brick masonry, or precast concrete panels. When the interior of the structure is finished, frames are concealed by ceilings, partition walls, and architectural column furring. Foundations consist of concrete spread footings or deep pile foundations.	 *Steel moment frame* SOURCE: FEMA 454 (FEMA, 2006)
S2	**Steel Braced Frame** Steel braced frame buildings are similar to steel moment frame buildings except that the vertical components of the lateral-force-resisting system are braced frames rather than moment frames. The braced frames resist lateral forces by tension and compression forces in diagonal steel members. Diaphragms consist of concrete or metal deck with concrete fill and are stiff relative to the frames. Walls may consist of metal panel curtain walls, glazing, brick masonry, or precast concrete panels. When the interior of the structure is finished, frames are concealed by ceilings, partition walls, and architectural column furring. Foundations consist of concrete spread footings or deep pile foundations.	 *Steel brace frame* SOURCE: FEMA 454 (FEMA, 2006)

Structure Type		
ID	**Building Characteristics**	**Attribute Options**
S3	**Steel Light Frame** Buildings with a steel light frame are pre-engineered and prefabricated with transverse rigid frames. They have one story, and the roof and walls consist of lightweight metal, fiberglass, or cementitious panels. The roof and walls consist of lightweight panels, usually corrugated metal. The frames are designed for maximum efficiency, often with tapered beam and column sections built up of light steel plates. Lateral forces in the transverse direction are resisted by the rigid frames. Lateral forces in the longitudinal direction are resisted by wall panel shear elements or rod bracing. Diaphragm forces are resisted by un-topped metal deck, roof panel shear elements, or a system of tension-only rod bracing.	 *Steel light frame* SOURCE: FEMA 454 (FEMA, 2006)
S4	**Steel Frame with Cast-In-Place Concrete Shear Walls** Buildings with a steel frame with cast-in-place concrete shear walls consist of an essentially complete frame assembly of steel beams and steel columns. The floors are concrete slabs or concrete fill over metal deck. The buildings feature a significant number of concrete walls acting as shear walls, either as vertical transportation cores, isolated in selected bays, or as perimeter wall systems. The steel column-and-beam system may act only to carry gravity loads or may have rigid connections to act as a moment frame. This structure type is generally used as an alternative to steel moment or braced frames. These buildings are usually mid- or low-rise. *Steel light frame* SOURCE: FEMA 454 (FEMA, 2006)	
S5	**Steel Frame with Unreinforced Masonry Infill Walls** A building with a steel frame with unreinforced masonry infill walls is typically an older building that consists of an essentially complete frame assembly of steel floor beams or trusses and steel columns. Exterior walls, and possibly some interior walls, are constructed of unreinforced solid clay brick, concrete block, or hollow-clay tile masonry infilling the space between columns and beams. Buildings with this structure type feature exposed clay brick masonry on the exterior and are common in commercial areas with retail stores, small offices, and hotels. *Steel frames with infill masonry walls* SOURCE: FEMA 454 (FEMA, 2006)	

Structure Type		
ID	**Building Characteristics**	**Attribute Options**
C1	**Concrete Moment Frame** Concrete moment frame buildings are similar to steel moment frame buildings except that the frames are reinforced concrete. The system consists of beams and columns or columns supporting slabs without gravity beams. Lateral forces are resisted through moment frames that develop rigid connections of the columns and beams placed in a given bay. No structural walls are required in moment frames. Buildings with concrete moment frames can be used for most occupancies listed for steel moment frames but are also used for multistory residential buildings. *Concrete moment frames* SOURCE: FEMA 454 (FEMA, 2006)	
C2	**Concrete Shear Walls** Concrete shear walls are concrete walls that provide lateral stiffness and strength for lateral loads. The two primary types of shear wall buildings are (1) buildings in which the shear walls also carry the gravity loads (with bearing walls) and (2) buildings in which a column-supported framing system carries the gravity loads (with gravity frame). In the bearing wall type, all walls usually act as both bearing and shear walls. This structure type is usually used in mid- and low-rise hotels. It is also used in residential apartment and condo-type buildings. In gravity frame buildings, shear walls are strategically placed around the plan or at the perimeter. Shear-wall systems placed around the entire perimeter must contain windows. Other perimeter openings are called punched shear walls. These buildings were commonly built in the 1950s and 1960s for a wide variety of mostly institutional occupancy types. *Concrete shear walls with bearing walls* SOURCE: FEMA 454 (FEMA, 2006) (TOP) *Concrete shear walls with gravity frames* SOURCE: FEMA 454 (FEMA, 2006) (BOTTOM)	 

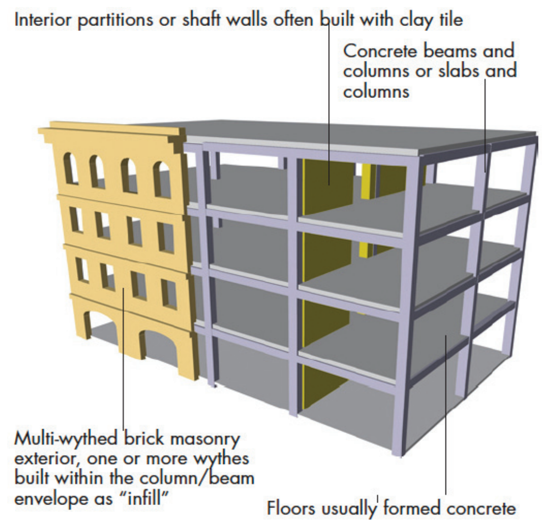
Structure Type

ID	Building Characteristics	Attribute Options

C3 — Concrete Frame with Unreinforced Masonry Infill Walls

Buildings that have a concrete frame with unreinforced masonry infill walls are similar to steel frame buildings with unreinforced masonry infill walls except that the frame is of reinforced concrete. Exterior walls, and possibly some interior walls, are constructed of unreinforced solid clay brick, concrete block, or hollow-clay tile masonry infilling the space between columns and beams.

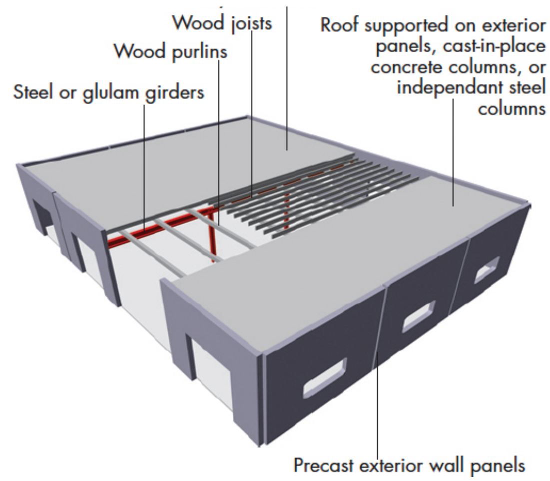
This type of building is often used for industrial and warehouse occupancies.



Concrete frames with infill masonry shear walls
SOURCE: FEMA 454 (FEMA, 2006)

PC1 — Precast Concrete Tilt-Up Walls

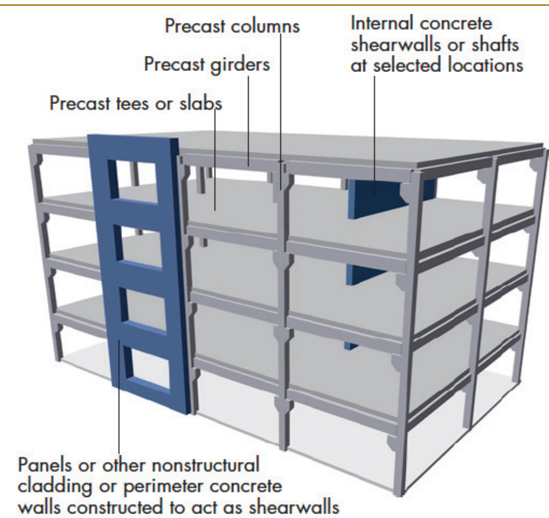
Precast concrete buildings with tilt-up walls are constructed with perimeter concrete walls precast on the site and tilted up to form the exterior of the buildings, support all or a portion of the perimeter roof load, and provide seismic shear resistance. These buildings are commonly one-story with a wood joist and plywood roof or sometimes with a roof of steel joists and metal deck. Two-story tilt-ups usually have a steel-framed second floor with metal deck and concrete and a wood roof. Tilt-up walls that support roof load are very common on the West Coast. Because of economical construction cost, they are used for many occupancies, including warehouses, retail stores, and offices.



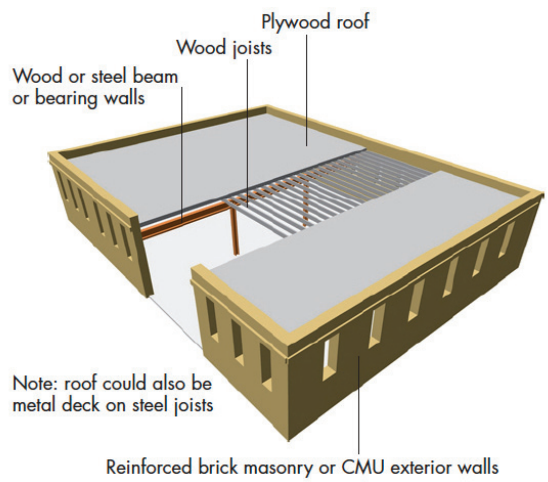
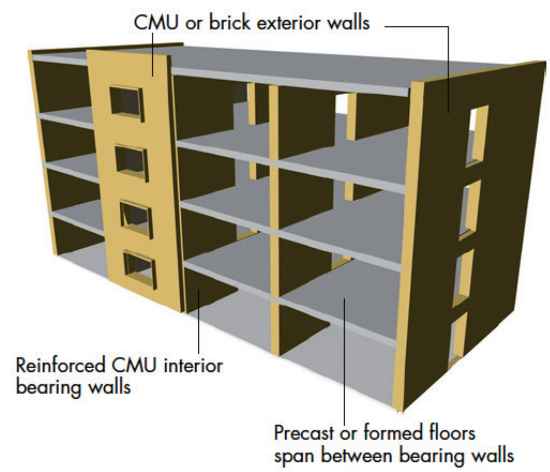
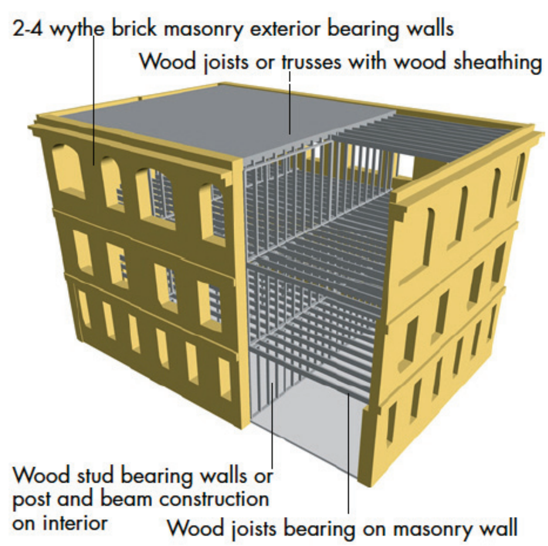
Precast concrete tilt-up SOURCE: FEMA 454 (FEMA, 2006)

PC2 — Precast Concrete Frame with Concrete Shear Walls

Precast concrete frame buildings with concrete shear walls consist of concrete columns, girders, beams, and/or slabs that are precast off the site and erected to form a complete gravity-load system. This structure type has a lateral-force-resisting system of concrete shear walls, usually cast-in place. Many garages have been built using this system. This structure type is most common in moderate and low seismic zones and can be used for different occupancies in those areas.



Precast frames with shear walls
SOURCE: FEMA 454 (FEMA, 2006)

Structure Type		
ID	**Building Characteristics**	**Attribute Options**
RM1	**Reinforced Masonry Bearing Walls with Wood or Metal Deck Diaphragms** Buildings with reinforced masonry bearing walls with wood or metal deck diaphragms take a variety of configurations, but they are characterized by reinforced masonry walls (brick cavity wall or concrete masonry unit [CMU]) with flexible diaphragms such as wood or metal deck. The walls are commonly bearing, but the gravity system often also contains post-and-beam construction of wood or steel. Older buildings of this type are generally small and were used for a wide variety of occupancies and were configured to suit. Recently, this structure type has been commonly used for one-story warehouse-type occupancies similar to tilt-up buildings. *Reinforced masonry walls with wood or metal deck diaphragms* SOURCE: FEMA 454 (FEMA, 2006)	
RM2	**Reinforced Masonry Bearing Walls with Precast Concrete Diaphragms** Buildings with reinforced masonry bearing walls with precast concrete diaphragms consist of reinforced masonry walls and concrete slab floors that are cast-in-place or precast. This structure type is often used for hotel and motels and is similar to the concrete bearing wall. *Reinforced masonry bearing walls with precast concrete diaphragms* SOURCE: FEMA 454 (FEMA, 2006)	
URM	**Unreinforced Masonry Bearing Walls** The unreinforced masonry bearing walls are usually at the perimeter and are usually brick masonry. The floors are wood joists and wood sheathing supported on the walls and on interior post-and-beam construction or wood-stud bearing walls. This structure type is ubiquitous in the United States and was built for a wide variety of uses, from one-story commercial or industrial occupancies, to multistory warehouses, to mid-rise hotels. *Unreinforced masonry bearing walls* SOURCE: FEMA 454 (FEMA, 2006)	

Structure Type		
ID	**Building Characteristics**	**Attribute Options**
MH	**Manufactured Homes** Manufactured housing (also known as prefabricated housing) is largely assembled in factories and then transported. This structure type refers to a house built entirely in a protected environment under a Federal code set by the U.S. Department of Housing and Urban Development. Manufactured homes range from low-quality trailers with weak walls and roofs to high-quality, high-end homes with strong walls and roofs.	

4.4 Step Two: Consequences Assessment

The second step in the DCF is completing the consequences assessment (see Figure 4-4). See Section 1.3.1 for a definition of consequences. Consequences have an impact on stakeholders, and the impact may extend to the community, the region, and the Nation.

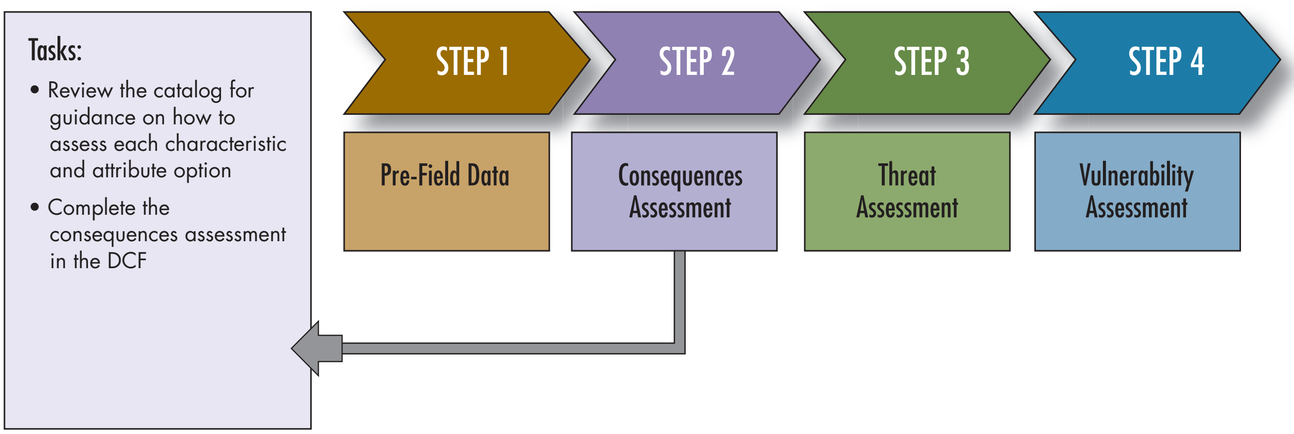


Figure 4-4. Consequences assessment tasks

4.4.1 Consequences Assessment Characteristics

The consequences assessment is intended to capture the impact of a terrorist event or natural disaster in terms of building damage, casualties, and business disruption. The IRVS focuses on human consequences and direct economic consequences. An assessment of all impacts, including indirect and cascading impacts, requires a more detailed analysis.

The building characteristics listed below are assessed in the consequences assessment. Some of the characteristics that contribute to the consequences rating are part of the pre-field data.

- Number of Occupants (PF-1)
- Replacement Value (PF-2)
- Registered Historic Site (PF-3)
- Locality/Density Type (1.1)
- Operational Redundancy (1.2)
- Impact of Physical Loss (1.3)

The information needed to complete the consequences assessment typically comes from the owner or operator, governmental sources, municipalities, people who use of the building, and publicly accessible sources. In manmade hazards, consequences are defined from the perspective of the building stakeholder, not terrorists.

4.4.2 Catalog of Building Characteristics and Attribute Options for the Consequences Assessment

The catalog of consequences characteristics and attribute options is provided in Table 4-3. The catalog is also part of the DCF, which is in the IRVS Database. The ID numbers in the catalog correspond to the numbers in the database. Screeners should use the catalog as a reference, as needed, when selecting attribute options.

Table 4-3. Catalog of Consequences Characteristics

1. Consequences Assessment (Other key characteristics are included in the Pre-Field Questionnaire)		
ID	Building Characteristics	Attribute Options
1.1	**Locality and Density Type** Locality and density type describes the general population density and land use in the area surrounding the building. When determining whether the locality and density type is urban or dense urban, the maximum density should be considered. Maximum density may occur during a particular time of day or period during the year. In a business district in a city, maximum density may occur during the morning rush hour, and during this period, the density may be best described as dense urban.  *d. Urban locality and density type*  *e. Dense urban area*	a. Rural /suburban. Low ratio of inhabitants to open land or an outlying part of a city or town, typically an area with single-family residences. b. Semi-urban/light Industrial. Small town or city with low population density or a mixed use office park, warehouses, or manufacturing. c. Industrial. Heavy manufacturing and warehouses with a lower population density than light industrial. d. Urban. Metropolitan area in a city or large town. e. Dense urban. Densely populated area in a major urban corridor or a major resort corridor with clusters of commercial buildings on congested streets.

1. Consequences Assessment (Other key characteristics are included in the Pre-Field Questionnaire)		
ID	**Building Characteristics**	**Attribute Options**
1.2	**Operational Redundancy (Asset Based)** Operational redundancy refers to the degree to which an organization or building can maintain a reasonable level of service and achieve uninterrupted stability of operations after (and ideally, during) a disaster, rather than simply being able to recover after a disaster. Redundancy is measured by how easily operations can be replaced, be returned to service, or replicated at another location. Redundancy includes the confidence people need to return to the building or to continue their relationship with the business. Option c. is recommended as the default option or baseline. From the baseline, the screener can determine whether there are any factors that would change the baseline option. This characteristic is evaluated differently depending on whether the perspective is of the building owner or tenant. For the building owner, the operational redundancy of the building is evaluated. For tenant, operational redundancy is related to the functions in the building that the tenant uses or that affect the tenant.	a. Very high. Fully able to maintain functions during and after a disaster with redundant back-ups available offsite; almost no interruption of service or function b. High. High capability to maintain functions during or after a disaster with most back-ups available offsite; minor interruption of service or function c. Moderate. Moderate capability to maintain functions during or after a disaster with some back-ups available offsite; moderate interruption of service or function d. Low. Low capability to maintain functions during or after a disaster; significant interruption of service or function e. Very low. Little or no capability to maintain functions during or after a disaster; devastating impact and complete loss of service or function
1.3	**Impact of Physical Loss** The impact of physical loss is the scale of human and direct economic consequences of a terrorist attack or natural disaster. Human consequences refer to loss of life and the extent and severity of injuries. Impact of physical loss includes the impact on public confidence. Direct economic consequences refer to the loss of income, lost business revenue, and cost of restoring functions to pre-event levels. The attribute options define the geographic limit of the human and economic impact of a terrorist event or natural disaster from the local community to the global or international community. For instance, the loss of a Federal building outside Washington, D.C., may have an impact that extends regionally whereas the loss of the headquarters of a multinational corporation may have international implications.	a. Local. Local impact (city or county) b. Statewide. Statewide impact c. Regional. Regional (multi-state) impact d. National. National impact e. International. International impact

4.5 Step Three: Threat Assessment

The third step in the DCF is completing the threat assessment (see Figure 4-5). See Section 1.3.1 for a definition of threat. The purpose of the threat assessment is to identify threats and natural hazards that are a priority concern and that may pose a risk to the building and its assets. The threat assessment is intended to evaluate the likelihood or potential that a manmade or natural hazard will occur.

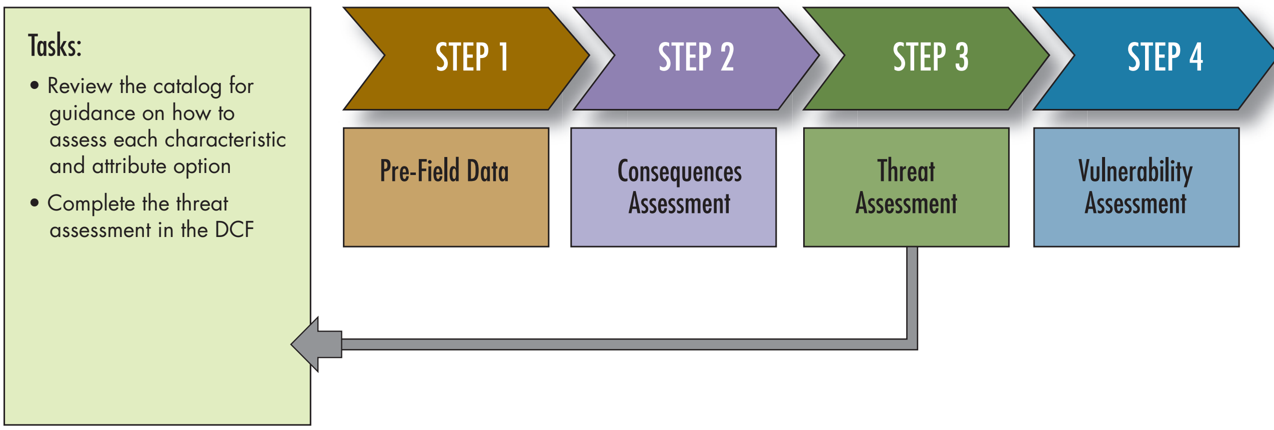


Figure 4-5. Threat assessment tasks

4.5.1 Threat Assessment Characteristics

The first set of building characteristics in the threat assessment relate to manmade threats that have potential to cause loss of or damage to the asset. Determining the probability of manmade threats is difficult because of the small amount of historical and quantitative data compared to the data that exist for natural hazards. Because of the small amount of data for large-scale terrorist attacks on buildings, the threat assessment is based on target attractiveness rather than the probability of a threat. Although some of the building characteristics in the threat assessment are nearly identical to those in the consequences assessment, the threat assessment is from the terrorist's perspective, whereas the consequences assessment is from the owner's or operator's perspective.

The threat assessment for manmade threats is a function of the building characteristics listed below. Some of the characteristics that contribute to the threat rating are part of the pre-field data.

- Number of Occupants (PF-1)
- Occupancy Use (PF-4)
- Target Potential (PF-5)
- Target Density (PF-6)

- Site Population Density (2.1)
- Visibility/Symbolic Value (2.2)
- Overall Site Accessibility (2.3)

The second set of building characteristics relate to three natural hazards. Unlike manmade threats, there is considerable data about natural hazards, which enables the incidence of future events to be expressed as mathematical probabilities. Even with substantial data, natural hazards are only broadly predictable.

In addition, probability statistics may be confusing to the public and decision-makers. The probability of occurrence of earthquakes, flooding, and wind is commonly expressed as “the return period” (or “mean recurrence interval”), which is the average or mean time in years between the expected occurrences of an event of specified intensity. Because the return period expresses mean values over a long period, it tell little about what will happen this year or next year. Therefore, the threat rating for natural hazards in the IRVS is evaluated by a combination of exposure, probability, frequency, and history of events.

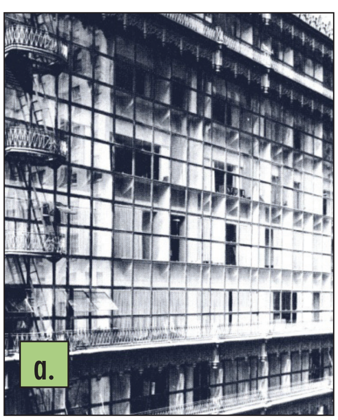
The characteristics listed below are assessed in the threat assessment of natural hazards. All of the characteristics that contribute to the threat rating are part of the pre-field data.

- Seismic Zone (PF-7)
- Geology (Nearby Seismic Faults) (PF-8)
- Floodplain (PF-9)
- Maximum Previous Flood Depth (PF-10)
- Duration of Previous Floods (PF-11)
- Velocity of Floodwaters (PF-12)
- Distance from Flood Sources (PF-13)
- High Wind Speed Zones (PF-14)
- Hurricane Events (PF-15)
- Tornado Events in Region (PF-16)

4.5.2 Catalog of Tunnel Characteristics and Attribute Options for the Threat Rating

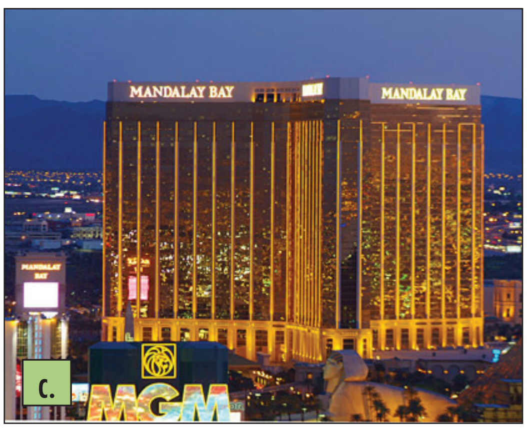
The catalog of threat characteristics and attribute options is provided in Table 4 4. The catalog is also part of the DCF, which is in the IRVS Database. The ID numbers in the catalog correspond to the numbers in the database. Screeners should use the catalog as a reference, as needed, when selecting attribute options.

Table 4-4. Catalog of Threat Characteristics

2. Threat Assessment (Other key characteristics are in the Pre-Field Data)		
ID	**Building Characteristics**	**Attribute Options**
2.1	**Site Population Density** Site population density is the population outside of but near the building (e.g., on the sidewalk, in vehicles, in adjacent or nearby buildings, below ground in pedestrian tunnels or subway train stations). Peak population density should be considered (e.g., during rush hour, during a public gathering).  *d. Sidewalk outside a building with a high population of people (approximately 1 person per 40 square feet)*	a. Very low (1 person per 10,000 square feet) b. Low (1 person per 1,000 square feet) c. Moderate (1 person per 400 square feet) d. High (1 person per 40 square feet) e. Very high (1 person per 10 square feet)
2.2	**Visibility/Symbolic Value** The visibility/symbolic value is the economic, cultural, and symbolic importance of the building to society. Important buildings that are highly recognizable and symbolic may be exploited by terrorists seeking monetary or political gain. This characteristic applies only to manmade threats.  *a. Hallidie Building, San Francisco, 1906 (first true glass curtain wall building in the United States)*	a. Very low. Not recognizable among locals; significance recognized only by experts; no information available to the general public; no media value or symbolism to the general public b. Low. Some recognition but can be confused with other similar facilities; rarely featured in the mass media at any level c. Moderate. Easily recognizable around the State and somewhat regionally; has media value; events at the site are televised regionally and sometimes nationally d. High. Recognizable to State and local residents; featured in the mass media on a regional and sometimes national level; some events are televised internationally e. Very high. Easily recognizable; featured in international mass media; media value guarantees recognition; events at the site are almost always televised nationally and internationally

2. Threat Assessment (Other key characteristics are in the Pre-Field Data)		
ID	Building Characteristics	Attribute Options
2.2 (cont.)		

b. World Market Center in Las Vegas; recognizable to locals and interior designers who go to events there but away from the main tourist area and not well recognized by the general public. SOURCE: PAULETTE NELSON

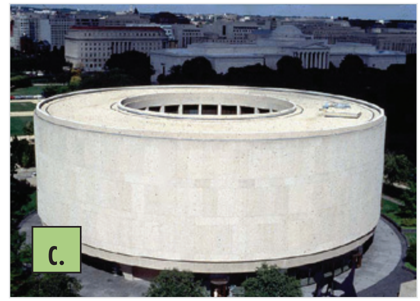


c. Mandalay Bay Casino and Hotel in Las Vegas; shown in the opening sequence of a popular television program that is broadcast internationally.

SOURCE: MANDALAY BAY HOTEL AND CASINO

d. Transamerica Pyramid in San Francisco; generally recognized nationally as a symbol of San Francisco

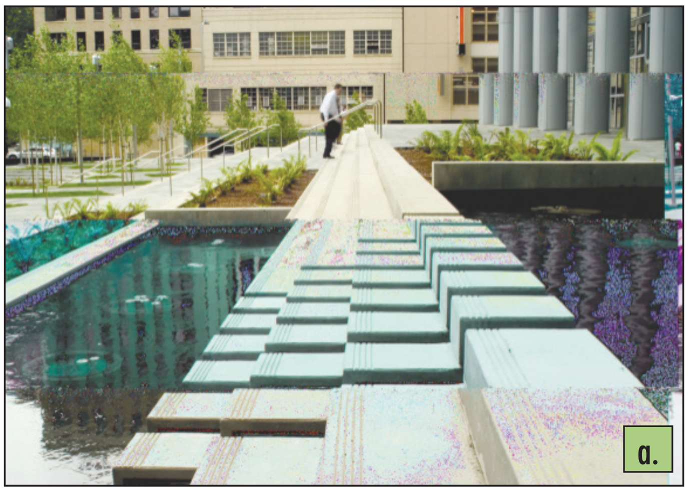
SOURCE: FEMA 455



c. Hirshhorn Museum in Washington, D.C.; well known in the local area; occasional national exposure. SOURCE: CHARLES PHILLIPS

e. Empire State Building in New York city: national historic landmark, featured in films, and recognized as one of the Seven Wonders of the Modern World

SOURCE: IUGUANG WANG

2. Threat Assessment (Other key characteristics are in the Pre-Field Data)		
ID	**Building Characteristics**	**Attribute Options**
2.3	**Overall Site Accessibility** Overall site accessibility includes the effectiveness of the building layout, and the operational security in place to deter or delay a terrorist from become well positioned to execute a major attack against a building. Site in this context refers to everything that is outside the building but on the property. In urban areas, site also includes the sidewalk. Site access by pedestrians and vehicles should both be considered. Landscaping features, parking restrictions, street configuration, sidewalk width, and perimeter security should also be considered.  *a. Inaccessible: Water feature and steps are an effective barrier to vehicles* SOURCE: CHARLES OOMS  *b. Accessible: Easy access to the building security office* SOURCE: FEMA 455	a. Inaccessible b. Accessible Overall site accessibility is heavily weighted.

4.6 Step Four: Vulnerability Assessment

The fourth step in completing the DCF is the vulnerability assessment (see Figure 4-6). See Section 1.3.1 for a definition of consequences. The vulnerability assessment is the most important and in-depth part of the IRVS. The purpose of the vulnerability assessment is to assess the building components that can be affected by a threat or hazard. The assessment covers building functions, systems, and site characteristics.

Unlike consequences and threats, vulnerabilities can be controlled or mitigated by the stakeholder. The vulnerability rating is crucial for determining protective measures and corrective actions that can be designed or implemented to reduce the identified vulnerabilities.

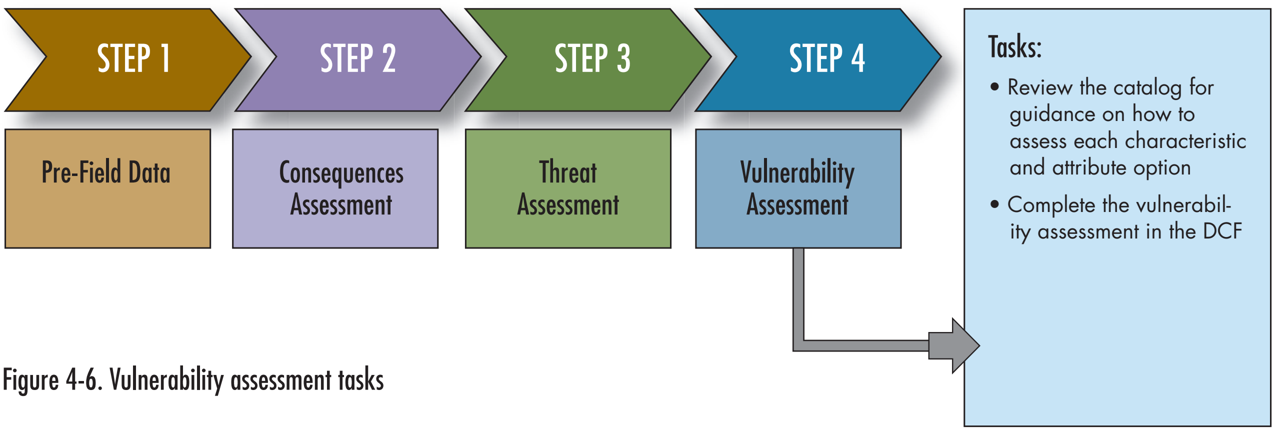


Figure 4-6. Vulnerability assessment tasks

4.6.1 Vulnerability Assessment Characteristics

Vulnerability characteristics are visually observable with a few exceptions. Vulnerability assessment characteristics are as follows:

- Site
- Architecture
- Building enclosure
- Structure
- Mechanical/electrical/plumbing (MEP) systems
- Fire protection systems
- Security
- Cyber/communication infrastructure
- Continuity of operations

4.6.1.1 Site

The site refers to the area between the building and property line. This area may be expansive, such as a large office park with several buildings, or it may be minimal, such as a high-rise building in an urban center.

Security measures in site design are important. Designing a site with effective security can reduce the probability that the building will be attacked and the amount of damage that will be sustained if attacked. For example, if barriers prevent a car from driving up to a building, a car bomb would cause less damage than if the building did not have barriers (see Figure 4-7).

Figure 4-7.
Building site with landscaping features such as trees, bollards, and benches

SOURCE: PETER WALKER AND PARTNERS

Site characteristics are also significant in the building's susceptibility to certain natural hazards. Features such as topography significantly influence wind speeds (and the wind pressure exerted on the building) and the building's susceptibility to flooding.

4.6.1.2 Architecture

Architecture involves the building layout and space design. Space design relates to how public areas of the building are separated from the more secured areas. Features such as the number of entrances, number of levels, service entrances, lobbies, retail space, and integrated/adjacent parking garages are key characteristics of architectural vulnerabilities. For example, the location of publicly accessible areas, such as lobbies and loading docks, in relation to occupied spaces, such as offices and retail locations, is a key concern of architectural vulnerability. The architecture may create vulnerabilities if the main lobby is publicly accessible and is directly below or adjacent to regularly occupied office space.

Other architectural features that are key factors in vulnerability are the height, building configuration, and overhangs (see Figure 4-8).

Figure 4-8.
Exterior architecture

4.6.1.3 Building Enclosure

The building enclosure is the exterior façade of the building (see Figure 4-9). It is the physical separation between the interior and exterior of the building. The building characteristics of concern are the windows, walls, and roof system visible from the building exterior; enclosure connections; and the debris impact protection. All of these characteristics determine the effectiveness and durability of the building enclosure.

Figure 4-9.
Building enclosure with a curtain glass wall

4.6.1.4 Structure

Structure refers to the load-resisting members of the building such as beams, columns, and slabs (see Figure 4-10). The most important characteristic in the vulnerabilities assessment is the structure type, which is addressed in the pre-field assessment and verified onsite (see Section 2.11.4). The other characteristics that are assessed significantly affect building performance in scenarios with extreme loading.

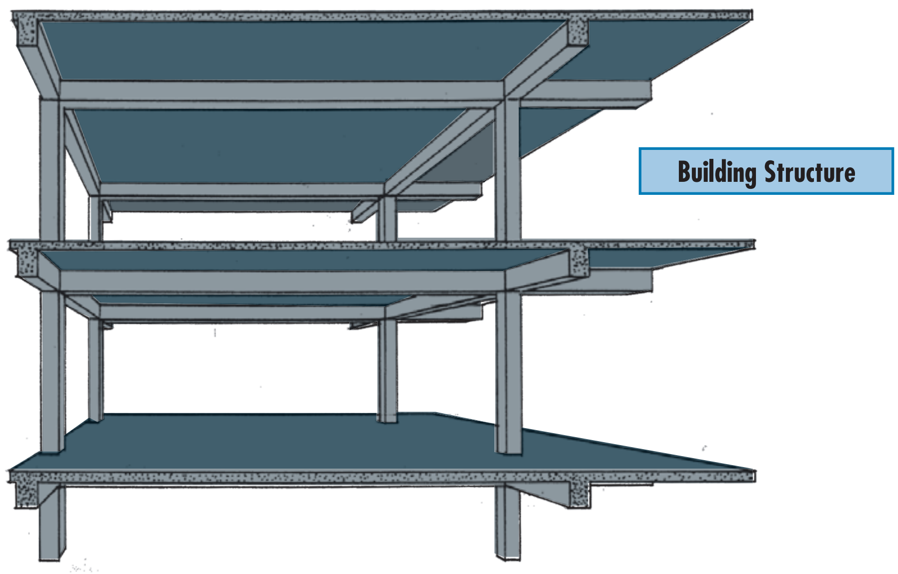


Figure 4-10. Building structure

SOURCE: FEMA 577

The ability of a screener to observe the building structure will be limited by the extent to which the structure is covered by finishes, such as granite on the exterior of the building or tile ceilings in the interior. 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 and 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.
- Arrange for the building engineer to be available for the walk-through and to be questioned during the site visit. When possible, meet with the building engineer who has been at the site the longest and would be knowledgeable about renovations and upgrades.
- Request access to areas of the building where interior finishes are not present, such as interstitial spaces, basements, mechanical rooms, and loading docks.

- Arrange to have a ladder in an unoccupied tenant space to be able to remove a few ceiling tiles in order to see the underside of the structural floor system. It is advisable to do this at the building perimeter and the column line where the exterior façade and its attachment to the structure can be determined.

The above activities should be arranged prior to the site visit to save time. Reviewing the building drawings or questioning the building engineer may be the most effective ways to get information. Site observations may be more time consuming but are highly recommended when building drawings are unavailable. The structural building characteristics that are assessed are expected to be readily identifiable but may be difficult to interpret. For instance, characteristic 6.1, the number of bays in the short building direction, may seem difficult to understand because the screener may not understand what a bay or short building direction is. By reviewing the catalog, the screener will learn that this characteristic involves determining the number of spaces between two columns and that the short building direction refers to the smaller footprint direction. This characteristic is easily evaluated by looking at the outside face of the building. The screener should review the catalog before the walkthrough.

4.6.1.5 Mechanical, Electrical, and Plumbing

Except for air intakes and vents, mechanical, electrical, and plumbing systems are often not readily observable from the building exterior (see Figure 4-11). 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.

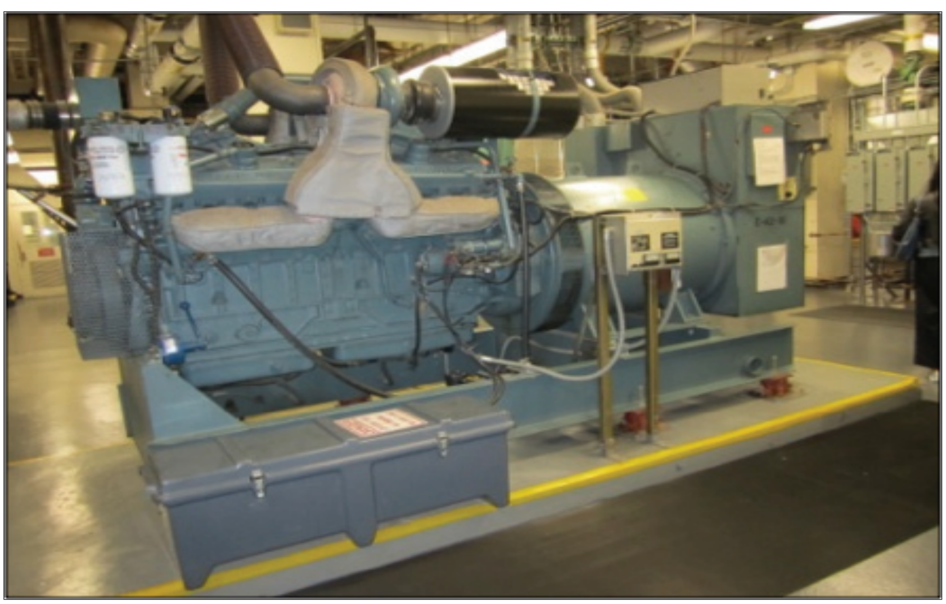


Figure 4-11. Mechanical equipment

4.6.1.6 Fire Protection Systems

Fire protection systems in buildings include fire and smoke detectors, alarms, and fire suppression systems. The goals of a fire protection system are to support life safety by initiating evacuation, by allowing for safe evacuation, and by fighting the fire prior to the arrival of firefighters; to protect the property; and to provide for continuity of operations. Although fire protection systems are designed to perform well during fires, they are not traditionally designed to survive other hazards.

The vulnerabilities of fire protection systems are divided into a list of general characteristics and a list of fire marshal's characteristics. The general list contains the most critical vulnerabilities. The fire marshal's list contains more in-depth characteristics that are meant to be used in combination with a fire inspection or fire department pre-planning. The screener evaluates only one of the lists, depending on what is selected when the threats and hazards are identified.

4.6.1.7 Security

Security consists of the physical measures that are designed to safeguard people; prevent unauthorized access to equipment, installations, material, and documents; and safeguard against terrorist attacks and other motivated adversaries. Security measures prevent, detect, or deter aggressors from accessing and causing harm to a facility and its assets and include the ability to interdict (impede or disrupt) a threat once detected. It is advantageous for the screener to have a basic understanding of security principles. Table 4-5 contains a list of the types of security systems.

Table 4-5. Basic Security Systems

Type of Security System	Equipment / Personnel
Intrusion detection system – Equipment used to detect an aggressor crossing the boundary of a protected area	Exterior intrusion sensors Fence Strain sensitive cables Taut wire sensors Fiber-optic cable sensors Capacitance proximity sensors Buried line Microwave Infrared Interior intrusion sensors Boundary-penetration Piezoelectric transducer Glass-breakage sensors Magnetic switches Volumetric motion Passive infrared motion sensors Microwave motion sensors Dual technology sensors Video analytics
Video surveillance and assessment – Equipment used to monitor and record exterior and interior spaces, personnel, vehicles, and events	Monitored closed circuit television Thermal imagery Digital video recorder Smart camera software Security control center
Security guards – Building personnel or law enforcement used for detecting, deterring, observing, and reporting malicious behavior	Unarmed guard patrols Armed guard patrols Law enforcement patrols Waterside law enforcement patrols if applicable
Security lighting – Lighting provided for site/building illumination and the perimeter to allow security personnel to maintain visual assessment during darkness	Continuous Standby Movable Emergency

Type of Security System	Equipment / Personnel
Access control – Any combination of equipment and guards who can deny entry to unauthorized personnel or vehicles	Biometric devices Implant chip Smart card Proximity card Magnetic-stripe card Photographs, identification cards, and receptionists Mechanical key or combination locks Access control placements Vehicular access controls to the site Vehicular access controls to the building Employee and pedestrian access to building
Asset/interdiction-related communications – Security communication systems that facilitate rapid information gathering, decision-making, and response	Pagers GPS Multi-channeled handheld radios Two-way radios Direct ring-down intercoms Standard telephone landlines Wireless phones Emergency notification alarm
Chemical, biological, radiological, nuclear, or explosive (CBRNE) detection – Variety of technologies and techniques to detect the presence or use of CBRNE weapons in real time	Package screening Personnel/baggage screening Mobile personnel/baggage screening (roving team) Vehicular screening Continuous and portable/handheld CBR Identifiers CBR classifiers Trace detection equipment X-ray screening systems K-9 unit (explosive and/or CBR detection dogs)

Security personnel should be interviewed during the screening, if possible. Security systems documentation may also provide useful information.

Security characteristics apply only to manmade internal threats and to external threats in Zone 1 (within 100 feet of the building). See Section 2.11.2 for information on the external zones. Security building characteristics are also a factor in 5 of the 20 scenarios that are affected by security measures:

- Three scenarios for internal threats (explosive, CBR, and intrusion)
- Two scenarios for external threats (explosive Zone I, and CBR Zone 1)

The vulnerability assessment of security characteristics begins by reviewing the security-related systems available in the building and determining the effectiveness of each system. Effectiveness is independent of the number of systems. Regardless of how many security systems are in place, if they are not effective, they will not be help thwart an attack. The objective is to assess the ability of a given security system to thwart an intrusion or an explosive or CBR threat separately.

The screener records the number and effectiveness of the security systems on the DCR. Tightly controlled sites may have more than one layer of security. For instance, dedicated, unarmed guards may patrol the site while law enforcement do random patrols. 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.

4.6.1.8 Cyber/Communication Infrastructure

Cyber/communication infrastructure includes electronic information, control, and communication systems, and the information contained in these systems. Computer systems, Industrial Control Systems such as Supervisory Control and Data Acquisition (SCADA) systems and Digital Control Systems (DCS), and networks such as the Internet are all part of cyber infrastructure. Information and communication systems are composed of hardware and software that process, store, and communicate data of all types. A cyberthreat can affect the built environment; many of today's facilities systems (e.g., power, heating and cooling, water, telecom), and electronic security systems are accessible from cyberspace and make systems susceptible of cyber-attack. Because of the interconnected nature of the cyber infrastructure, these attacks could spread quickly and have a debilitating effect.

> Cyber-security includes preventing damage to, unauthorized use of, or exploitation of electronic information and communication systems and the information contained therein to ensure confidentiality, integrity, and availability. Cyber-security also includes restoring electronic information and communication systems in the event of a terrorist attack or natural disaster (DHS, 2009).

Cyber security in this methodology is limited to the protection of the built environment. During the screening, information technology personnel should be interviewed. In addition, review of the cyber-security system documentation is recommended.

4.6.1.9 Continuity of Operations

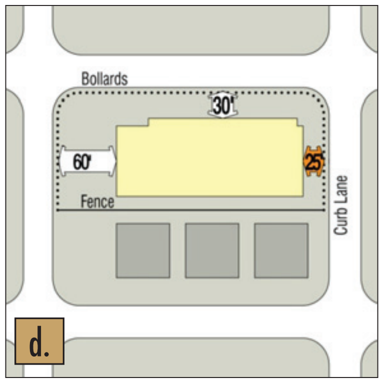
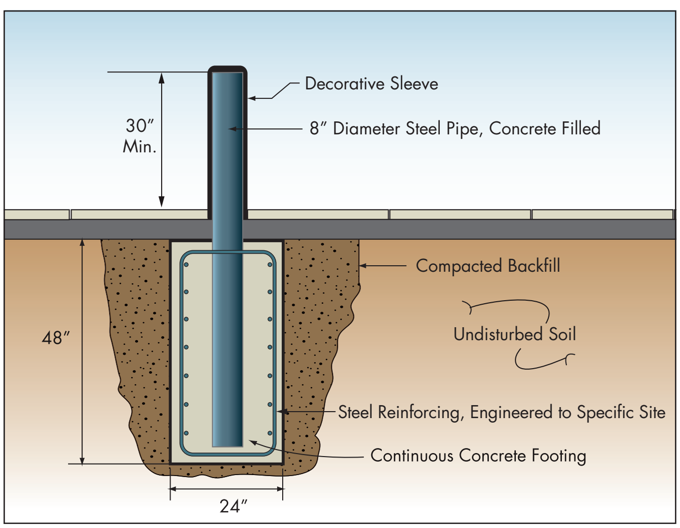
Continuity of operations refers to controls that ensure, when unexpected events occur, the organization's or building's essential infrastructure services (e.g., electricity, water, computer operations) continue without interruption or are promptly resumed through adequate contingency and business recovery plans and exercises. Continuity of operations is closely related to resilience.

Continuity of operations is evaluated based on the robustness, resourcefulness, and recovery of the building. Characteristic include the emergency plan and preparedness, the critical processes and functions of the building (or organization), and the building's ability to maintain operations after an event through redundancy. Redundancy can be an alternate site, onsite backups, or additional equipment.

4.7 Catalog of Building Characteristics and Attribute Options for the Vulnerability Rating

The catalog of vulnerability characteristics and attribute options is provided in Table 4-6. The catalog is also part of the DCF, which is in the IRVS Database. The ID numbers in the catalog correspond to the numbers in the database. Screeners should use the catalog as a reference, as needed, when selecting attribute options.

Table 4-6. Catalog of Vulnerability Characteristics

3. Vulnerability Assessment: Site Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
3.1	**Distance to Potentially Threatening Vehicle** Distance to potentially threatening vehicle is the shortest distance from the building façade to a vehicle that may constitute a threat. The characteristic includes locations that may be accessible to unsecured vehicles, as follows: • Public road • Public parking area • Outside secured perimeter • Dropoff zone  *d. Building with various standoffs; the smallest standoff is 25 feet* SOURCE: DAVID SHAFER	a. ≥ 75 feet b. ≥ 50 feet, < 75 feet c. ≥ 25 feet, < 50 feet d. ≥ 5 feet, < 25 feet e. < 5 feet
3.2	**Perimeter Boundary** The perimeter boundary consists of physical barriers that would prevent a potentially threatening vehicle from accessing the building. If the perimeter boundary is not described well by any of the options, the option that offers a similar level of vulnerability should be selected.  *Bollard design* SOURCE: BIPS 06, REFERENCE MANUAL TO MITIGATE POTENTIAL TERRORIST ATTACKS AGAINST BUILDINGS (FORMERLY FEMA 426)	a. Continuous anti-ram barriers • Continuous (no openings) anti-ram barriers, fencing, or landscape elements on all sides of the perimeter • Active barriers (e.g., retractable bollards, gates) at the vehicle access points that prevent a vehicle from reaching the building b. Semi-continuous anti-ram barriers • Semi-continuous (openings) anti-ram barriers, fencing, or landscape elements on all sides of the perimeter • Active barriers (e.g., retractable bollards, gates) at the vehicle access points • Small vehicles and motorcycles may be able to pass through the openings c. Well-integrated crime prevention through environmental design (CPTED) elements (landscaping and natural elements) • Landscaping that makes gaining entry to the property difficult (e.g., deep ditch, moat, large trees, topography and grade, rock ledges) • Landscaping that enhances surveillance of the surrounding area including providing a "line of sight" to potential criminal activity (e.g., monumental staircase, circular driveway, speed bumps, terraced landscaping, public art strategically placed, large planters that serve as truck traps)

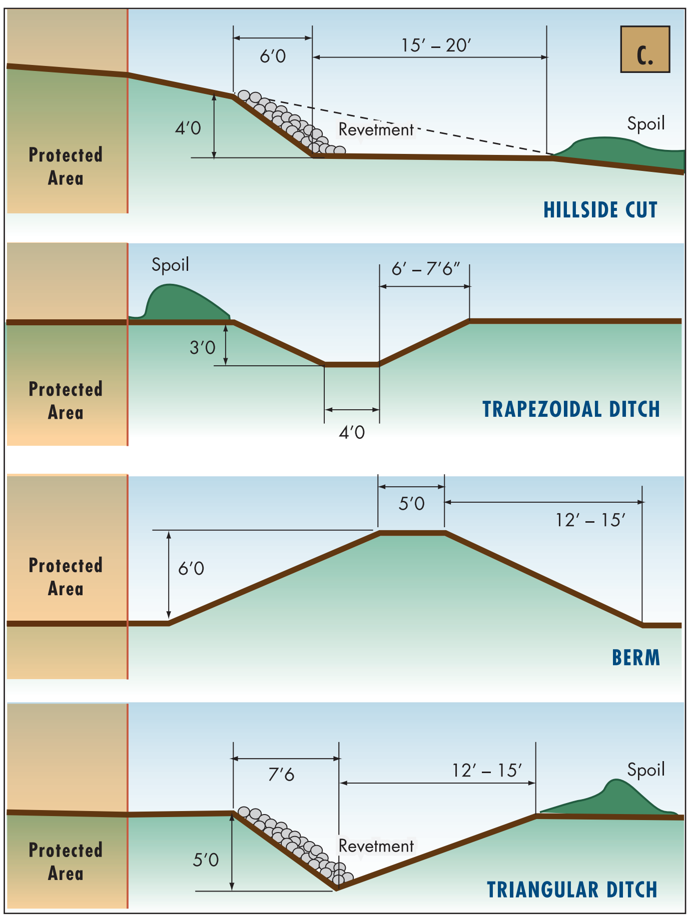
3. Vulnerability Assessment: Site Vulnerabilities

ID	Building Characteristics	Attribute Options

3.2 (cont.)

a. Continuous anti-ram barriers

SOURCE: FEMA 430



c. Examples of CPTED systems

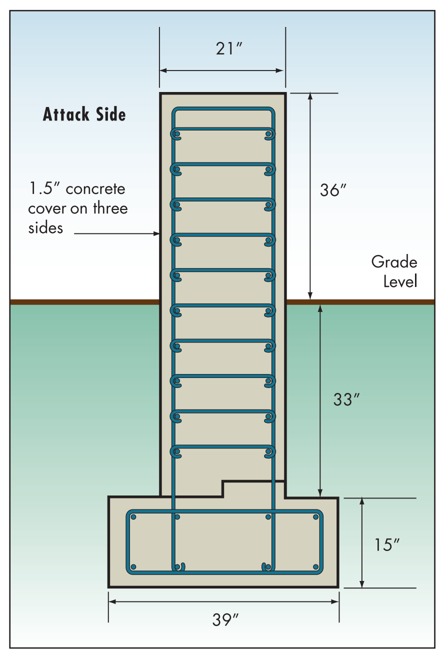
SOURCE: ADAPTED FROM DOD (1999)

d. Ornamental/temporary/anti-climb fence barriers

- Barriers that can be defeated easily by vehicles traveling at low velocities
- Ornamental barriers only (e.g., decorative planters on the sidewalk)
- Temporary barriers only (e.g., jersey barriers, police barricades around the building)
- Parking restrictions only
- Active barrier system that is not activated (i.e., in the "down" position, allowing vehicles to pass through).

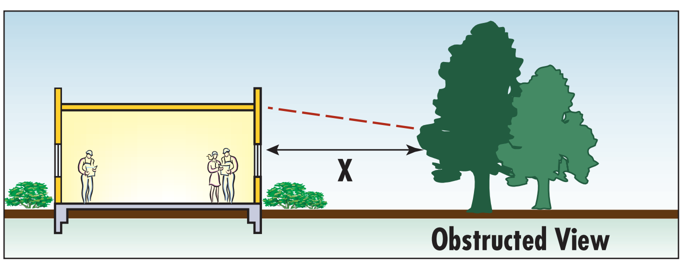
e. No security/discontinuous security

- Locations on the perimeter where vehicles can penetrate the perimeter
- No obstacles to stop the impact of a vehicle penetrating the building
- Only light poles, parking meters, standpipes, and other street furniture



Anti-ram barrier

SOURCE: FEMA 430 (FEMA, 2007B)

3. Vulnerability Assessment: Site Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
3.2 (cont.)	 *d. Ornamental barriers*	
3.3	**Unobstructed View** Unobstructed view is the smallest distance from a building that is available for conducting counter-surveillance on potential criminal activity. It is the view from the building interior to public areas outside. Features that can obstruct views from the building are parked cars, hedges, shrubbery taller than 6 inches, newspaper kiosks, and a lobby security desk located so that the building exterior cannot be seen from the desk. 	a. ≥ 30 feet b. ≥ 20 feet, < 30 feet c. ≥ 10 feet, < 20 feet d. ≥ 5 feet, < 10 feet e. < 5 feet *Line-of-sight with a tree obstructing the view distance (x) from the building*
3.4	**Unsecured Underground Access** Unsecured underground access refers to underground openings that penetrate the building perimeter or basement. Examples are a pedestrian tunnel from an adjoining building or subway, sewer line, culvert, drain pipe, utility tunnel, or conduit. Access requires a 96-square-inch or larger opening and no physical obstructions (e.g., metal bars, metal cages, locking devices) or technology such as contact sensors that would prevent access.	a. None. No possible access to the site or building from underground. All access is too small or blocked or controlled by sensors or other means. b. Utility tunnel or culvert to site. Access does not extend into the building; may be through a manhole cover or other means c. Utility tunnel to building d. Pedestrian tunnel to building. Secured or unsecured pedestrian tunnel that provides access from unsecured areas on or off the site

3. Vulnerability Assessment: Site Vulnerabilities

ID	Building Characteristics	Attribute Options

3.5 Storage of Hazardous Materials

Storage of hazardous materials (HazMat) refers to amounts of solids, liquids, and gases that can harm people, property, or the environment. HazMat are often indicated by diamond-shaped signage. Buildings that store HazMat pose a higher risk from an explosive or chemical attack than buildings without HazMat because of the potential for causing secondary fires, deflagrations, toxic releases, and other unsafe conditions.

The attribute options reflect the types of materials and quantities at a typical commercial office building, light industrial business park, hospital, or heavy industrial manufacturing plant.

Stored diesel fuel for a backup generator

Attribute Options

a. None

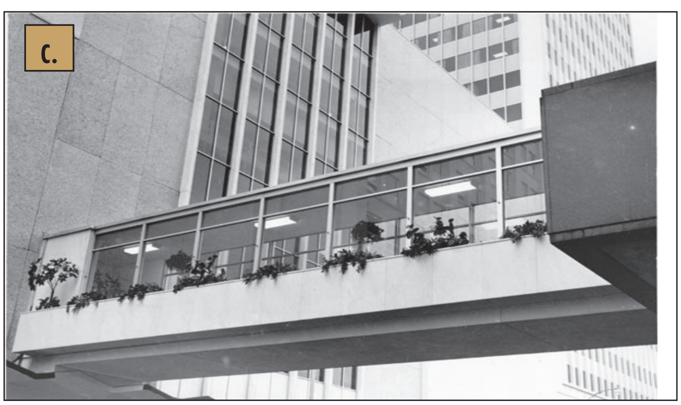
b. Low. Typical HazMat storage locker; 1 to 10 tanks of propane, oxygen, or acetylene; 100 to 500 gallons of fuel oils (55-gallon drums or generator storage tank)

c. Moderate. 10 to 100 pounds of explosive or combustible compounds; 10 to 100 tanks of propane, oxygen, or acetylene; liquid oxygen (LOX) or nitrous oxide (NOX) tanks; 500 to 1,000 gallons of fuel oils; 25 to 100 gallons of liquid chlorine or other toxic/flammable chemicals/gases

d. High. More than 100 pounds of explosive or combustible compounds; more than 100 tanks of propane, oxygen, or acetylene; large LOX or NOX tanks; more than 1,000 gallons of fuel oils; more than100 gallons of liquid chlorine or other toxic/flammable chemicals/gases

3.6 Nearby Structures (Underground or Adjacent)

The nearby structures characteristic is the potential for collateral damage from nearby structures that are not controlled by the owner of the subject building.



c. Elevated walkway connecting two buildings with separate security systems

Attribute Options

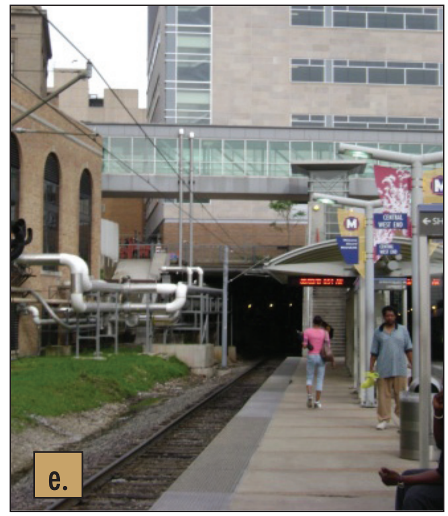
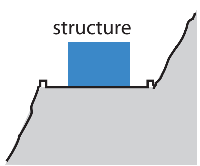
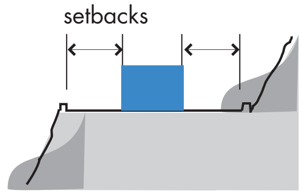
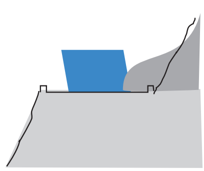
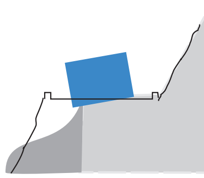
a. None
- No underground tunnels under the site
- High-value targets more than 300 feet from the building

b. Small. Utility tunnel or culvert to the building site

c. Medium
- Above a subway tunnel and near a subway station
- Elevated walkway across a street provides access to the building

d. Major
- Above a subway station
- High-profile or high value target building immediately adjacent to building
- Above-ground public garage next to the building
- Underground public garage in adjacent building

3. Vulnerability Assessment: Site Vulnerabilities

ID	Building Characteristics	Attribute Options
3.6 (cont.)	 *d. Entrance to a train station inside the footprint of a building*	e. Significant. Directly above a major roadway, vehicle tunnel, or primary transportation hub  *e. Light rail tunnel directly under a builfing*
3.7	**Topography: Slope** Slope refers to the slope of the terrain surrounding the building. This characteristic is evaluated during the field visit. Slope failure (landslide) can have disastrous effects on the site and building.  structure on terraced slope  Terrace widened to provide setbacks that buffer structure from damage  upslope landslide Upslope landslides and debris flows can inundate a site with debris, damaging structure cutting utilities, cutting off access and egress and triggering mud flows into buildings.  downslope landslide Downslope slides can undermine building foundations and cut off utilities and access, rendering a facility non-operational and/or structurally unsafe.	a. Flat or terraced with adequate setbacks (equaling the width of the building) b. Light slope c. Moderate slope d. Steep slope Slope is heavily weighted. *Potential effects of slope failure (landslide)* SOURCE: FEMA 454 (FEMA, 2006)

3. Vulnerability Assessment: Site Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
3.8	**Condition of Foundation** The condition of the foundation is the state of maintenance, settlement, and deterioration of the foundation. Signs of distress include rust, cracks, water infiltration, settlements, sagging, and tilt. Cracks that are more than 0.25-inch wide are considered severe. The exterior of the foundation and the load-bearing walls that are supported by the foundation should be inspected for signs of settlement.  *c. Cracked foundation*	a. Excellent. No signs of distress (e.g., cracks, settlement, tilt) b. Medium. Minor cracks that do not affect the stability of the structure c. Poor. • Severe cracks • Signs of settlements
3.9	**Potential Windborne Debris/Missiles** Windborne debris/missiles are objects such as roof aggregate, sheet metal, gutters, rooftop equipment, siding, trees, tree branches, outbuildings, utility poles, and other on- and offsite materials that can become airborne in a high-wind event (such as a hurricane or tornado). Windborne debris/missiles may kill or injure persons and can cause significant damage to the wall and roof components of a building. Windborne debris/missile damage is very common during hurricanes and tornados.  *c. Trees surrounding the site.* SOURCE: FEMA 543	a. Very few b. Some c. Many  *c. Roof aggregate.* SOURCE: FEMA 543

<table>
<tr><th colspan="3">3. Vulnerability Assessment: Site Vulnerabilities</th></tr>
<tr><th>ID</th><th>Building Characteristics</th><th>Attribute Options</th></tr>
<tr><td>3.10</td><td>Nearby Water Structures (Levees, Embankments, Floodwalls, and Upstream Dams)

Nearby water structures such as levees, embankments, floodwalls, and upstream dams should be identified even if they are far from the building and are not readily observable. Although an overtopping failure of a water structure is a low probability event, it can cause unexpected and catastrophic damage because the lands protected by the water structure may not be regulated as flood hazard areas and buildings may not be constructed to withstand floods. The potential effects of a failure of a levee, embankment, floodwall, or upstream dam are not shown on most local flood hazard maps or FIRMs.</td><td>a. No
b. Yes</td></tr>
<tr><td>3.11</td><td>Adequacy of Emergency Exits

Emergency exits or means of egress should be designed for continued operation after a postulated hazardous event. Exit signs should be well placed and secure. They should be placed in a logical location where they are easy to follow and in locations that would not be buried by debris.

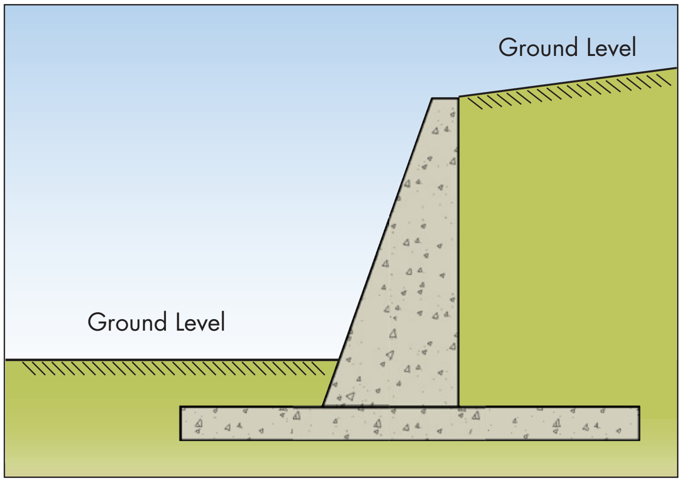
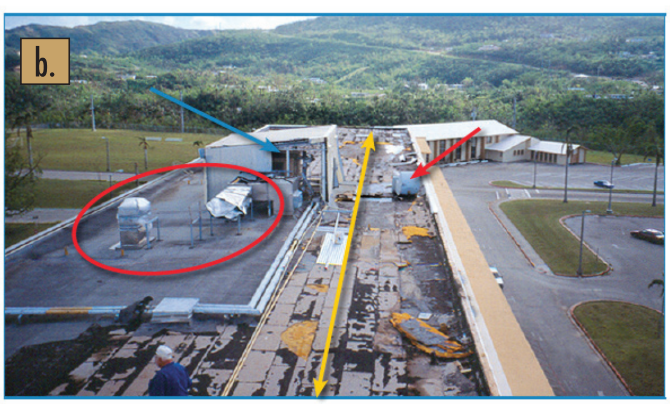
Emergency exits must be adequate in size, illumination, and capacity at all times.</td><td>a. Excellent
• Multiple exits sufficient for the size of the building and number of occupants
• Logically located to efficiently evacuate occupants
• All emergency exits illuminated and clearly marked
b. Moderate
• Multiple exits sufficient for the size of the building and number of occupants
• Exits not logically located or signs not illuminated or clearly marked with signage
c. Poor
• Insufficient exits for the size of the building and number of occupants
• Exits do not provide a clear exit to efficiently evacuate occupants and are not clearly marked with signage and illumination.</td></tr>
<tr><td>3.12</td><td>Retaining Walls

A retaining wall is a structure that resists the lateral pressure of soil and hydrostatic water pressure.

Retaining walls are typically cantilevered from a footing that extends in front of and behind the wall. The wall must resist the lateral pressures generated by loose soils and hydrostatic water pressure.

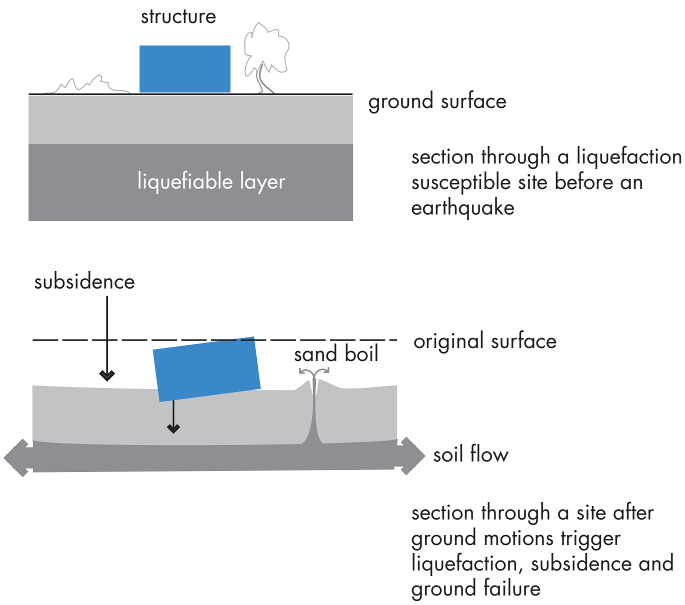
Proper drainage behind and through the wall is critical to the performance of retaining walls. Drainage reduces or eliminates hydrostatic pressure and therefore greatly improves the stability of the soil behind the wall.

Failure of soil-related construction or landscape features can impede emergency activities during or after seismic events. All landscape features must be well anchored to the ground.</td><td>a. None
b. Good condition
• No signs of distress
• Appears to be new or retrofitted
c. Moderate condition
• Minor cracking and spalling that does not impede structural integrity
d. Poor condition
• Not anchored to the soil below or behind
• Shows signs of severe distress (e.g., cracks, spalling, leakage)</td></tr>
</table>

3. Vulnerability Assessment: Site Vulnerabilities		
ID	Building Characteristics	Attribute Options
3.12 (cont.)	 *Cross section of a retaining wall*	
3.13	**Location of Critical Functions and Valuables** The evaluation of the location of critical functions and valuables consists of determining whether they are susceptible to flood and wind events. Examples of critical functions are HVAC equipment, generators, computers, and utility controls. Examples of valuables are vital records for an office or artifacts in a museum. Location of critical functions and valuables is heavily weighted.	
3.13.1	**Exposure to Wind Events** Typical areas where critical functions and valuables are exposed to wind are: • Building interior near windows • Roof • Building exterior, exposed and not braced 	a. No b. Yes Exposure to wind events is heavily weighted. *b. Unprotected equipment on the roof of a building damaged by high winds.* SOURCE: FEMA 543

3. Vulnerability Assessment: Site Vulnerabilities

ID	Building Characteristics	Attribute Options
3.13.2	**Exposure to Flood Events** Typical areas where critical functions and valuables are exposed to flood are: • Basement • Ground floor • On site, not elevated  *b. Unprotected generator that was damaged by flooding and put out-of-service.* SOURCE: FEMA 543	a. No b. Yes  *a. Elevated utility box protected from flooding events.* SOURCE: FEMA 543 Exposure to flooding events is heavily weighted.
3.14	**Potential of Soil Liquefaction** Liquefaction occurs in earthquakes when water-saturated soils, sands, or gravels flow laterally or vertically like a liquid. Earthquake ground motions shake the material until the water pressure increases to the point that friction between particles is lost, and ground flows, losing its strength. Liquefaction is most likely to occur where soils are not consolidated (e.g., near rivers and streams, in basins, near coastlines, in areas of unconsolidated alluvium) and where groundwater is within 9 to 13 feet of the surface. Liquefaction can occur at great depths below the building, resulting in large-scale ground failure that can destroy building foundations. If a building has a deep foundation that reaches the soil bedrock, the potential for soil liquefaction is minimized. The potential for liquefaction can be determined from site geologic investigations and a review of geologic and soil maps. In California, liquefaction potential mapping is part of the California Geological Survey's Earthquake Hazard Mapping program.	a. None • Not in a seismic zone • Soil conditions do not indicate potential for liquefaction b. Low • On liquefiable soil but has a deep foundation that reaches the bedrock (mitigating the effects of liquefaction) c. Medium • On soil with conditions ideal for liquefaction • In a medium seismic zone d. High • In a high seismic zone • In an identified liquefaction zone • Foundation does not reach bedrock

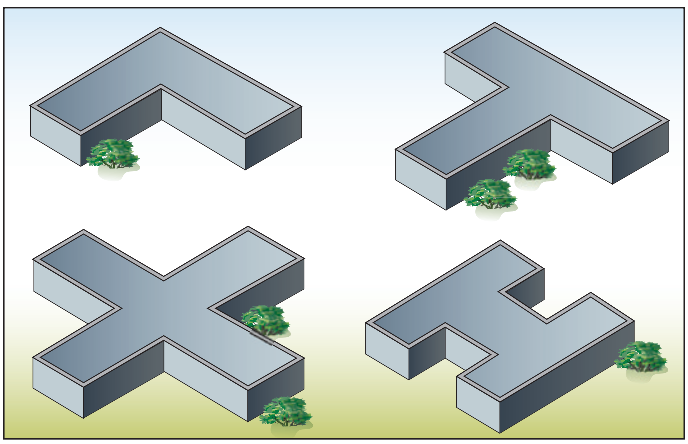
3. Vulnerability Assessment: Site Vulnerabilities		
ID	Building Characteristics	Attribute Options
3.14 (cont.)		*Cross section through a site where liquefaction and subsidence could occur.* SOURCE: FEMA 454 (FEMA, 2006)

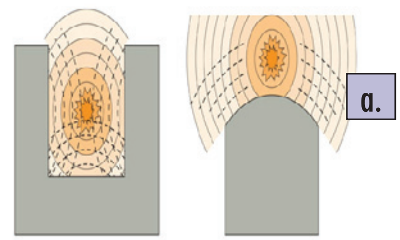
4. Vulnerability Rating: Architectural Vulnerabilities		
ID	Building Characteristics	Attribute Options
4.1	**Building Height** Building height is the height above grade. The height of one story is in general assumed to be approximately 13 feet.  *Façade design can sometimes conceal the number of floors*	a. < 20 feet (1 floor) b. ≥ 20 feet, < 50 feet (2 to 3 floors) c. ≥ 50 feet, < 100 feet (4 to 8 floors) d. ≥ 100 feet, < 150 feet (9 to 12 floors) e. ≥ 150 feet (< 12 floors) f. < 200 feet (12 to 15 floors) g. ≥ 200 feet, < 500 feet (16 to 39 floors) h. ≥ 500 feet, < 800 feet (40 to 60 floors) i. ≥ 800 feet, < 1000 feet (60 to 80 floors) j. > 1,000 feet (> 80 floors)

<table>
<tr><th colspan="3">4. Vulnerability Rating: Architectural Vulnerabilities</th></tr>
<tr><th>ID</th><th>Building Characteristics</th><th>Attribute Options</th></tr>
<tr><td>4.2</td><td>Building Configuration

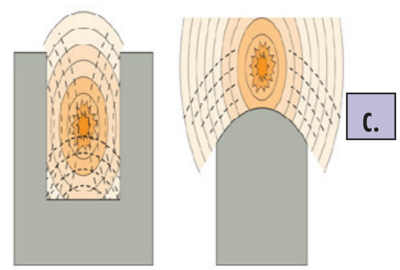
The building configuration (its three-dimensional shape) influences how a shock wave from an explosion imparts load to the structure. Circular and convex shapes tend to shed the air-blast loading better than a flat surface such as a rectangular building. Reentrant corners (buildings with H, L, U, T configurations or combinations of these configurations) and concave surfaces tend to trap the shock wave and amplify the effect of the air blast because of multiple reflections. Sometimes a reentrant corner may be provided by an adjacent building that is offset from the building under configuration.

Configuration issues are significant only up to a height of approximately 50 feet. Therefore, if the shape of the building changes above 50 feet, only the base of the building below 50 feet should be considered.


c. Re-entrant corner configurations.</td><td>a. Circular and convex
b. Rectangular box
c. Re-entrant corners
d. Concave



a. Circular (convex) showing the air blast
SOURCE: DAVID SHAFER



c. Re-entrant corner plan showing multiple reflection condition
SOURCE: DAVID SHAFER</td></tr>
<tr><td>4.3</td><td>Overhang

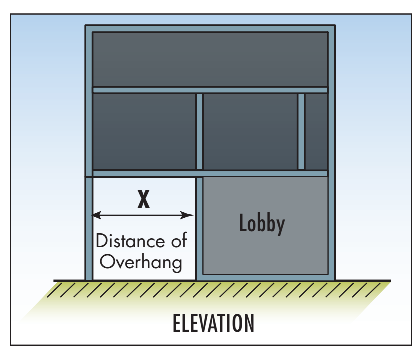
The overhang characteristic pertains to overhangs, cantilevers, or open floors that are up to two stories above the ground level with the underside of the structural framing supporting occupied spaces or critical functions above.

The overhang is the horizontal depth, measured from the inside face of a free-standing column to the face of the exterior enclosure. Overhang can be a critical dimension. If the column spacing along the exterior is less than this depth, the column spacing should determine which option is selected.

Pedestrian bridges are not considered overhangs unless they house office space, other occupied areas, or critical functions.

If the floor above the overhang is not occupied or has critical functions, option a. should be selected.

This characteristic may apply to drive-through structures where the building lobby is accessed from an area that is covered by part of the building.</td><td>a. None
b. < 5 feet
c. ≥ 5 feet, < 10 feet
d. ≥ 10 feet, < 15 feet
e. ≥ 15 feet



Overhang adjacent to lobby entryway</td></tr>
</table>

4. Vulnerability Rating: Architectural Vulnerabilities

ID	Building Characteristics	Attribute Options
4.4	**Lobby/Retail Location**	

4.4 Lobby/Retail Location

Building Characteristics

Public areas of buildings, including the lobby and retail areas, are considered high-risk areas where an explosive or CBR device can be placed undetected. The location of these areas in relation to occupied/critical areas or primary structural framing affects the vulnerability of the building to an explosive attack and also the vulnerability to CBR threats because of the potential for contaminants to be transmitted throughout the building.

If the building does not have a lobby, the screener should select option a.

a. Detached screening lobby

SOURCE: GENSLER ARCHITECTS

Attribute Options

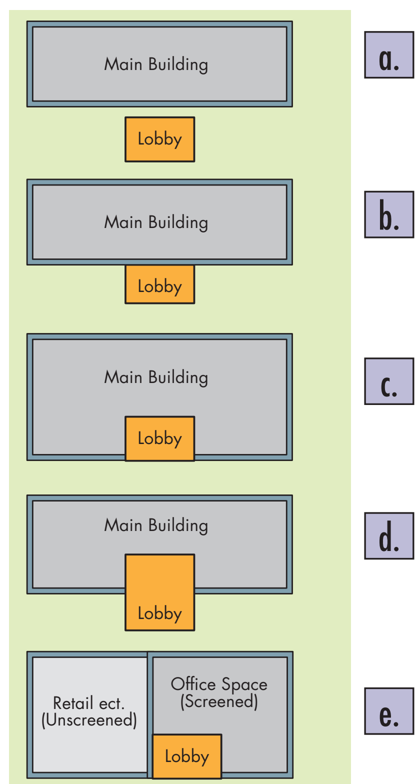
a. Detached. Public areas in a separate building

b. External attached and separated
   - Public areas external to the main footprint of the building and separated from the secured areas by a solid wall with limited openings
   - No routinely occupied areas or critical utilities internal to the lobby

c. External, unscreened. Public areas external to the main footprint of the building but unscreened

d. Within footprint
   - Public areas inside the main footprint of the building but not immediately adjacent to secured areas that are routinely occupied (e.g., hotel rooms, apartments, offices) or contains critical utilities
   - Public areas adjacent to storage areas, restrooms, locker rooms or other support

e. Adjacent to occupied areas. Public areas underneath or next to regularly occupied space



4. Vulnerability Rating: Architectural Vulnerabilities

ID	Building Characteristics	Attribute Options
4.5	Loading Dock and Mail Screening Areas	

4.5 Loading Dock and Mail Screening Areas

The loading dock and mail screening areas are considered high-risk because an explosive or CBR device can be delivered to the building undetected.

The screener should ask a site representative or walk around the exterior of the building to ascertain the location of the loading dock and mail screening areas. If the screener does not have access to the interior, the screener should look for screening equipment on the loading dock and visible from the outside.

b. Loading dock outside the building footprint

e. Loading dock under building

Attribute Options

a. Offsite/none. All deliveries screened in a separate building

b. Exterior to building. Outside the main footprint of the building

c. At perimeter and separated
   - Inside the main footprint of the building
   - Along the building perimeter
   - Not adjacent, under, or over occupied or critical areas

d. Adjacent to occupied space
   - Next to occupied areas or other critical assets
   - Not under or over occupied or critical areas

e. Under building. Under or over occupied or critical areas

<table>
<tr><th colspan="3">4. Vulnerability Rating: Architectural Vulnerabilities</th></tr>
<tr><th>ID</th><th>Building Characteristics</th><th>Attribute Options</th></tr>
<tr><td>4.6</td><td>

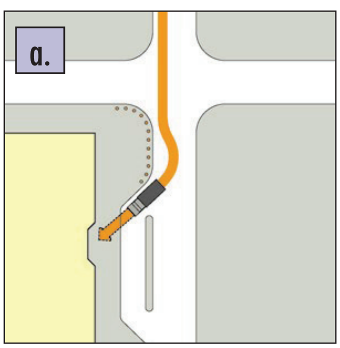
Vehicular Penetration of Exterior Enclosure

Vehicular penetration of the exterior enclosure 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. The site layout, adjacent street configuration, and perimeter security determine how much a vehicle can accelerate prior to impact.

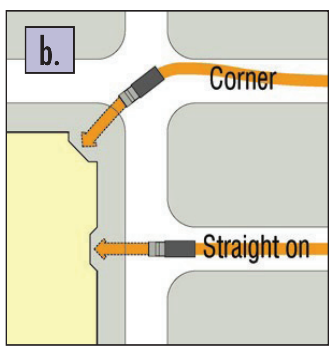
The screener should review vehicle approach paths on roadways and wide walkways and determine the exposure of the building to a high-speed vehicle impact.

a. Minimum standoff but well-defended perimeter



a. Angled approach

SOURCE: DAVID SHAFER



b. Straight-on approach

SOURCE: DAVID SHAFER

</td><td>

a. No potential

- High-speed approach is mitigated by landscaping, anti-ram barriers, terrain, or other methods around the entire perimeter, including vehicle access points
- An oncoming vehicle would need to turn or approach the building from an angle to hit the building on one or more sides

b. Potential for high-speed vehicular impact and penetration into the building. Straight-on approach of a high-speed vehicle is possible on one or more streets, for instance, at street corners or "T" intersections

</td></tr>
</table>

4. Vulnerability Rating: Architectural Vulnerabilities

ID	Building Characteristics	Attribute Options

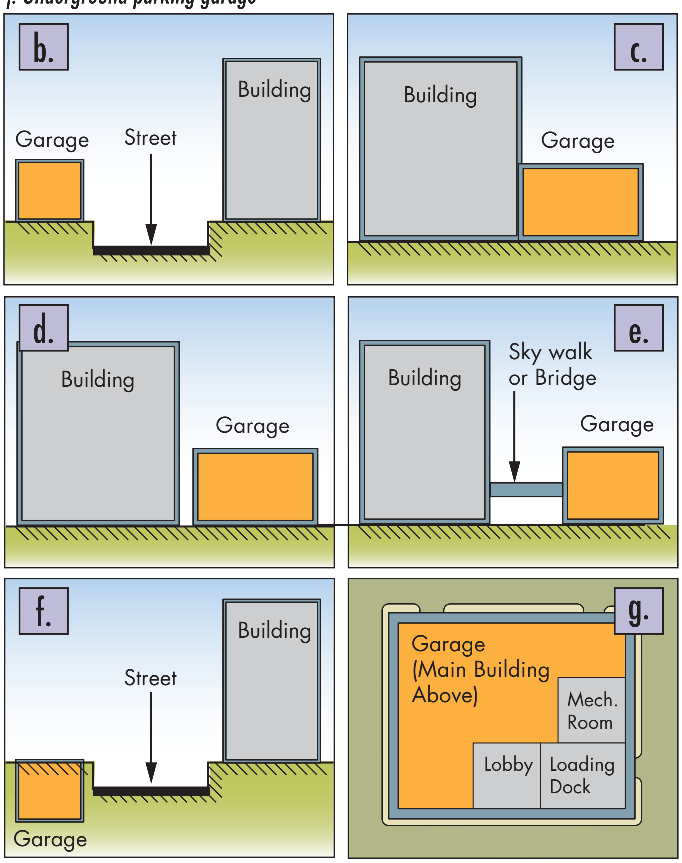
4.7 Garage Location

Building Characteristics

The garage is a high-risk area where an unscreened or screened vehicle could deliver a weapon.

The screener should question the site representative or walk around the exterior of the building to ascertain the location of the parking garage, if any.

j. Underground parking garage



Attribute Options

a. None. No garage in or around the building site

b. Above ground, not adjacent. Above-ground garage that is not immediately next to the building.

c. Adjacent exterior and above ground
   - Garage is above ground and attached to one side of the building
   - Structural systems of the garage and building are intertwined

d. Separate, not physically attached. Garage is adjacent to the building but is a separate building or structure with no attachments

e. Separate, physically attached. Garage is separate from the building but attached by a pedestrian path such as a sky walk or bridge

f. Below ground, not adjacent. Garage is underground but not adjacent to the building

g. Adjacent to critical utilities, above ground. Garage is above ground and either over or next to critical building utilities.

h. Adjacent to critical utilities, below ground. Garage is underground and either next to or below critical building utilities but not immediately under office space or regularly occupied areas; transitory spaces such as lobby, restrooms, storage, or corridors are adjacent

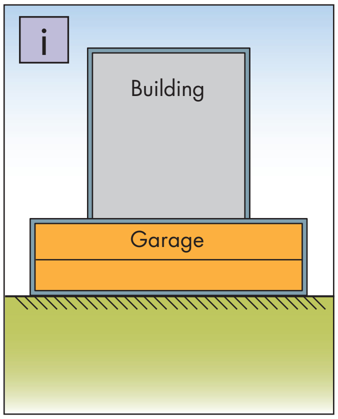
i. Below occupied space. Below office space or regularly occupied areas but not necessarily below grade; may or may not be adjacent to critical utilities

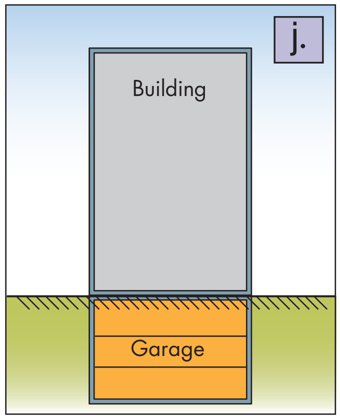
j. Below occupied space, below ground. Garage is both below grade and below office space or regularly occupied areas; may or may not be adjacent to critical utilities

4. Vulnerability Rating: Architectural Vulnerabilities

ID	Building Characteristics	Attribute Options

4.7 (cont.)

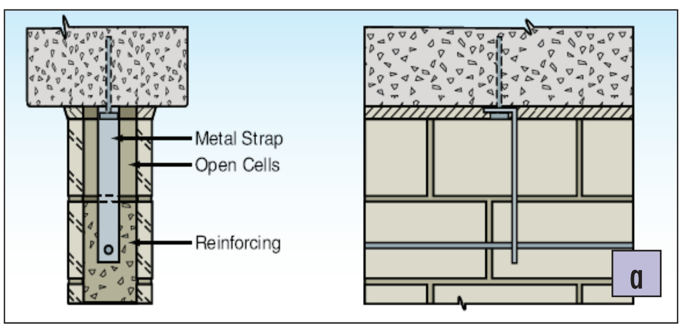




4.8 Partitions

Partitions are nonstructural, non-load-bearing walls that are used to divide a space. Partitions may be concrete, masonry, metal stud, or wood framed.

Partitions must be laterally braced to the structural system of the building to prevent harmful out-of-plane motion and may be susceptible to collapse, especially in seismic conditions, if not properly braced.



a. Adequate bracing of a masonry wall partition to the structure

SOURCE: FEMA 424 (FEMA, 2004)

a. Angle bracing for an interior partition wall

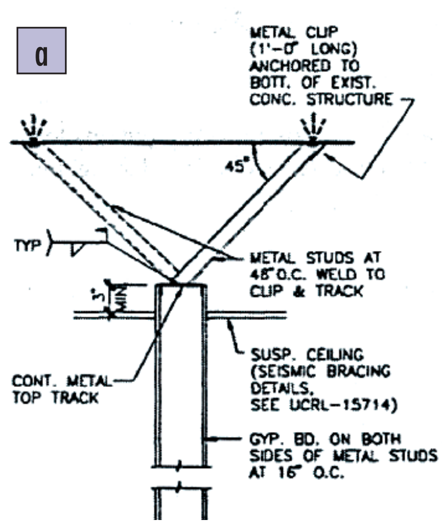
Attribute Options

a. Braced. Anchored to the floor, roof, and other structural elements

b. Not braced, less than 6 feet high. Not anchored to any structural elements and less than 6 feet tall

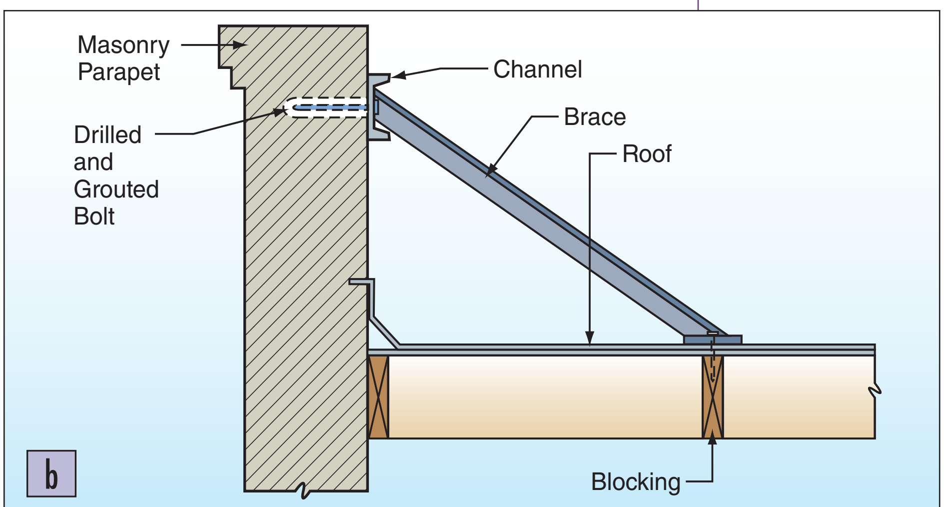
c. Not braced, 6 to 9 feet high. Not braced and between 6 and 9 feet tall

d. Not braced, more than 9 feet high. Not braced and more than 9 feet tall



a. Gypsum wall adequately braced to the structure. SOURCE: FEMA 454

4. Vulnerability Rating: Architectural Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
4.9	**Appendages** Building appendages (chimneys, parapets, ornaments, and similar items) may fall or become detached from the building during an earthquake or explosive event, leading to casualties and damaging the building. Older brick chimneys and stacks are especially vulnerable to horizontal shaking in an earthquake. The screener should look for bracing that connects the building appendage to the building.	a. Not applicable. No appendages that require bracing b. Braced. The chimney, parapet, or building ornament secured to the building c. Not braced. Building appendage not braced to a structural member



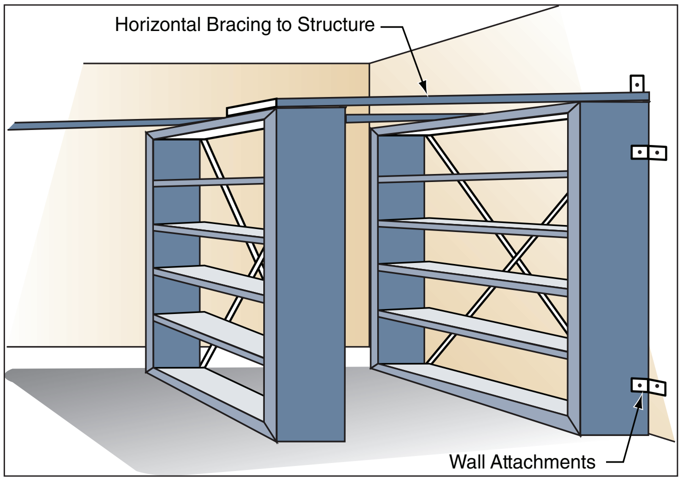
b. Adequately braced parapet

SOURCE: FEMA 424 (FEMA, 2004)

This building characteristic is heavily weighted.

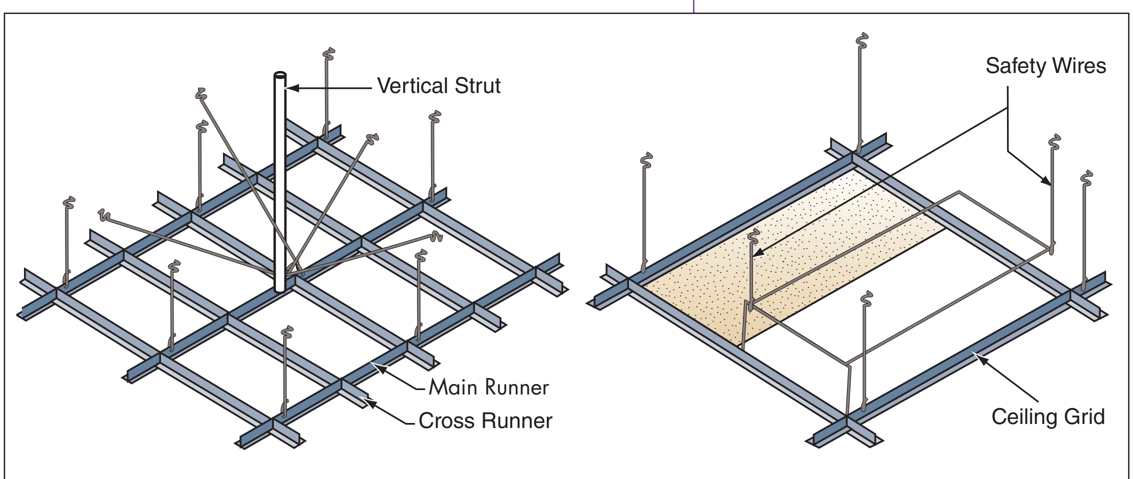
b. Adequately braced parapet. SOURCE: FEMA 424 (FEMA, 2004)

4. Vulnerability Rating: Architectural Vulnerabilities		
ID	Building Characteristics	Attribute Options
4.10	**Nonstructural Component Anchoring** Nonstructural components in a building (e.g., light, suspended grid ceilings; heavy, tall, or rolling furniture; heavy plaster suspended ceilings) can become detached from the walls or ceilings in a natural disaster or explosive event and injure building occupants. The screener should look for the connections of nonstructural components to structural members such as walls and floors.	a. More than 90%. More than 90% of the nonstructural components are anchored to structural members b. 60 to 90%. Between 60 and 90% of the nonstructural components are anchored to structural members c. 30 to 60%. Between 30 and 60% of the nonstructural components are anchored to structural members d. Less than 30%. Less than 30% of the nonstructural components are anchored to structural members



Bracing for heavy furniture such as large bookshelves

SOURCE: FEMA 424 (FEMA, 2004)

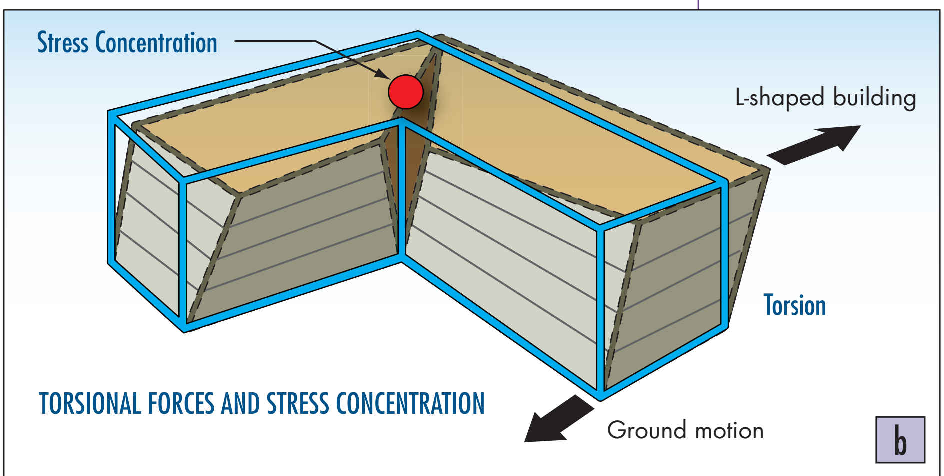


Bracing for a suspended grid ceiling

SOURCE: FEMA 424 (FEMA, 2004)

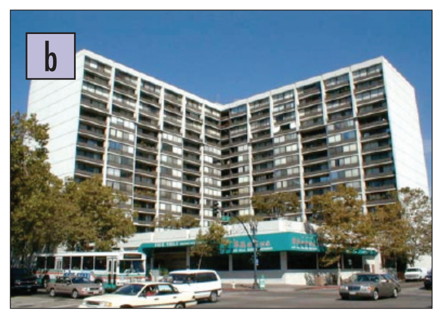
4. Vulnerability Rating: Architectural Vulnerabilities

ID	Building Characteristics	Attribute Options
4.11	**Horizontal (Plan) Irregularity** Horizontal irregularity (also known as plan irregularity) includes buildings with re-entrant corners. Buildings with re-entrant corners include those with long wings that are E, L, T, U, or + shaped. Horizontal irregularity may cause a building to have good lateral-load resistance in one direction but not in the other and/or major stiffness eccentricities in the lateral-force-resisting system, which may cause twisting (torsion) around a vertical axis.	a. No. No horizontal irregularities b. Yes. One or more horizontal irregularities



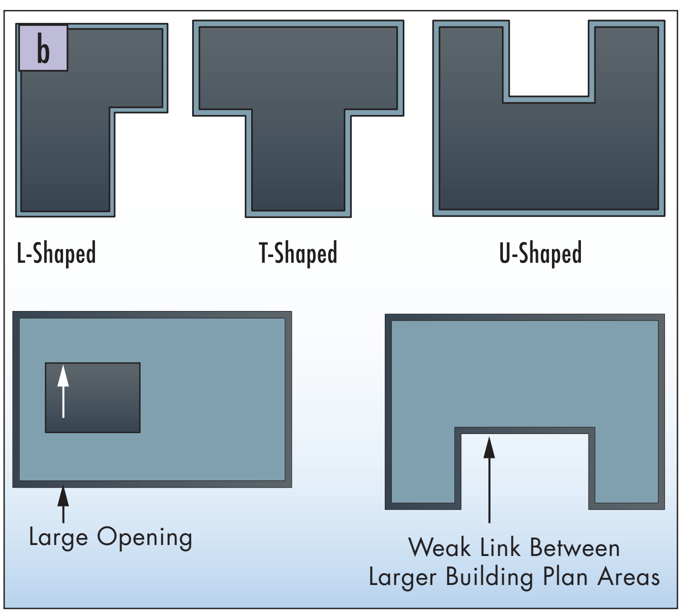
b. Torsional forces and stresses form horizontal irregularity

SOURCE: FEMA 577 (FEMA, 2007)



b. "L" shaped building representing horizontal irregularity

SOURCE: FEMA 154

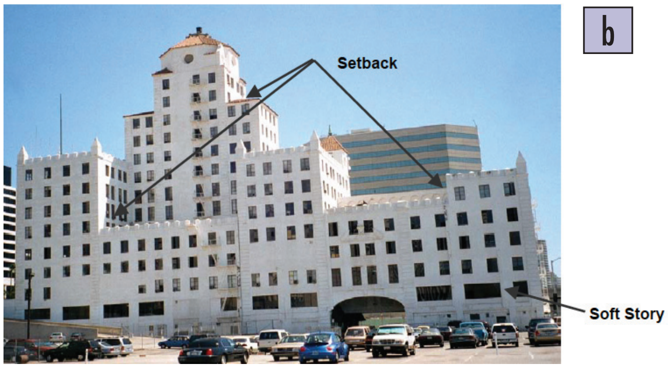


b. Horizontal irregularities

<table>
<tr><th colspan="3">4. Vulnerability Rating: Architectural Vulnerabilities</th></tr>
<tr><th>ID</th><th>Building Characteristics</th><th>Attribute Options</th></tr>
<tr><td>4.12</td><td>

Vertical Irregularity

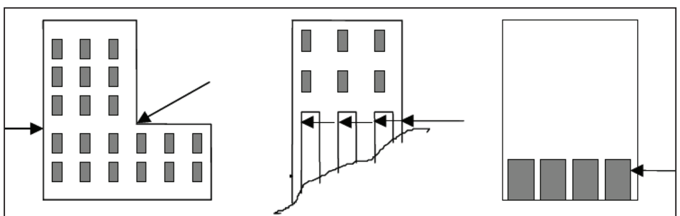
Irregular vertical and horizontal configurations, such as re-entrant corners and soft first stories (see ID 4.13), may lead to significant stress concentrations.



b

b. Building with numerous setbacks and a soft story, creating vertical irregularities

SOURCE: FEMA 154 (FEMA, 2002)



b. Vertical irregularities

SOURCE: FEMA 154 (FEMA, 2002)

</td><td>

a. No. No vertical irregularities

b. Yes. One or more vertical irregularities

</td></tr>
<tr><td>4.13</td><td>

Soft Story

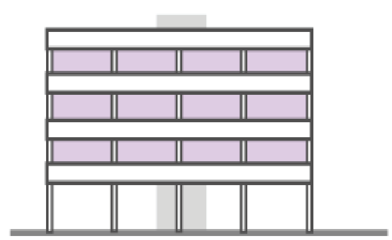
A soft story is an area on the lower floors of a multistory building that is more open or has less support than upper stories. Building motions from events can create excessive forces on the supports in soft stories on lower floors. Soft stories are especially at risk in earthquakes because they cannot resist the loads placed on the building when it sways during an earthquake.

In many commercial buildings, the first story is soft because of large window openings for display purposes. If one story is particularly tall or has windows on all sides, and if the stories above it have fewer windows, it is probably a soft story. If only half of the floor is a soft story, "yes" should be selected.

</td><td>

a. No. No soft stories

b. Yes. One or more soft stories



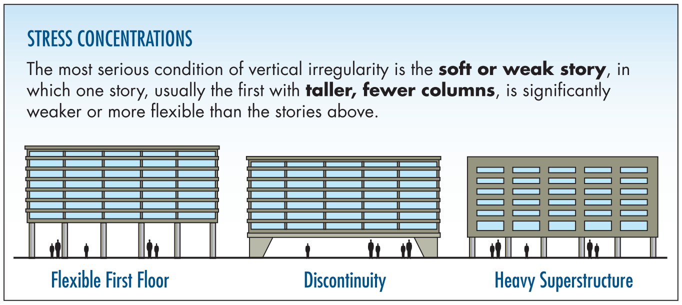
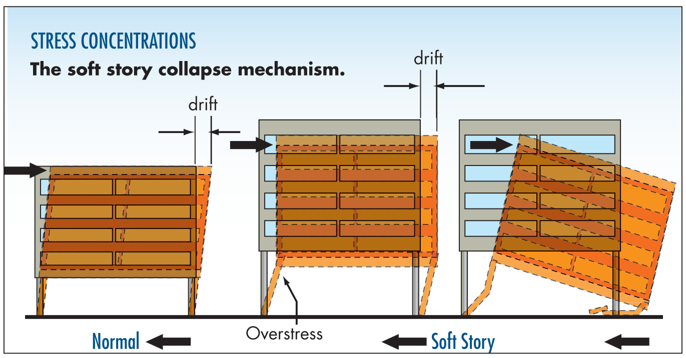
b. Soft story

SOURCE: FEMA 454

</td></tr>
</table>

Types of soft story structures

SOURCE: FEMA 577, (FEMA, 2007)

4. Vulnerability Rating: Architectural Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
4.13 (cont.)	 	*Types of soft story structures* SOURCE: FEMA 577, (FEMA, 2007) *Soft story collapse mechanism* SOURCE: FEMA 577, (FEMA, 2007)
4.14	**Elevated Tanks, Bins, Vessels, or Trussed Towers (Especially on the Roof)** Failure of tanks during seismic events can cause unwanted effects on a building and its inhabitants. Any elevated tanks, such as water tanks, are especially vulnerable to horizontal seismic shaking and sloshing.  *c. Several elevated tanks on the roof of a high-rise building*	a. None. No elevated tanks, bins, or vessels on or near the building b. Some. One or two elevated tanks, bins, or vessels on or near the building c. Several. Three or more elevated tanks, bins, or vessels on or near the building

<table>
<tr><th colspan="3">5. Vulnerability Rating: Building Enclosure Vulnerabilities</th></tr>
<tr><th>ID</th><th>Building Characteristics</th><th>Attribute Options</th></tr>
<tr><td>5.1</td><td>

Window Support Type

The window support type characteristic refers to the manner in which typical windows in a building are connected to the exterior enclosure and structure.

The windows on the lower floors and at the building entrance are often different from the typical windows on upper floors and should not be used to determine the window support type. Larger windows on one or two floors at the top of the building or on another floor should also not be used to determine the window support type except if critical assets are located these larger windows.

When a building has 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 should be used if it is more vulnerable than a window type on other sides of the building. On the other hand, if the standoff distance is comparable on all sides of the building, the most vulnerable window type should be used.

Punched windows (Option b) are considered less vulnerable than other window types because the frame is attached directly to the wall on at least two sides. This connection is generally of more robust construction than other window support types. Punched windows are common in older masonry buildings and residences.

The framing system for ribbon windows (Option d) tends to be less robust than punched windows. The wall span is often horizontal and attached only to each floor instead of spanning vertically and being secured to a lower and upper floor. This framing system is economical and a common type of façade.

Sometimes the supports for point-supported windows (Option e) include cables at the corners that look more like brackets, or there is sturdy metal framing but only on the interior. The panes are typically separated by a clear or translucent polymer material instead of metal framing (referred to as “butt glazed”).

A system that supports glazing with tensioned cables is more resilient and performs better than a typical point-supported system.

</td><td>

a. No windows. No windows or very few windows (e.g., warehouses, big box stores, data centers, telecommunications facilities)

b. Punched windows
- Two panes that slide open vertically (double-hung)
- Two panes that open like a door or a pivot mechanism (casement or awning)
- Intermediate framing between several window panes with a horizontal orientation

c. Glass and metal framing/curtain wall. A significant part of the building exterior is covered with windows supported by aluminum or steel framing

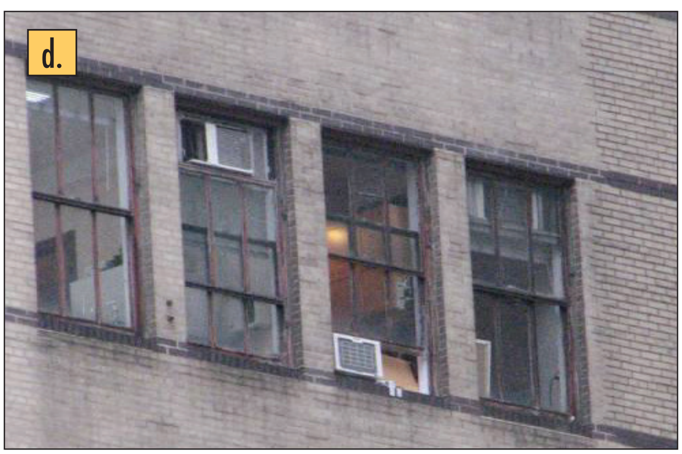
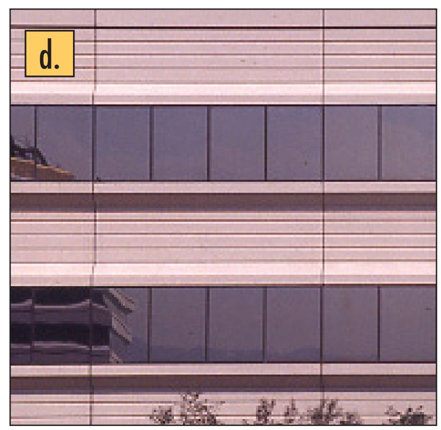
d. Ribbon windows. Thin vertical metal framing separates the individual panes and is supported by the wall at the top and bottom

e. Point-supported. Point-supported windows are usually held in place by a system of metal cables behind the windows that are connected to the glass at points near the corner

a. Older building without windows

SOURCE: FEMA 455

</td></tr>
</table>

5. Vulnerability Rating: Building Enclosure Vulnerabilities		
ID	Building Characteristics	Attribute Options
5.1 (cont.)	 *b. Punched windows.* SOURCE: FEMA 455  *c. Glass and metal framing; floor-to-ceiling glass with the floor structure concealed by metal paneling.* SOURCE: FEMA 455  *d. Common type of ribbon window with alternating horizontal bands of window and spandrel (space between the top of the window in one story and the sill of the window in the story above)* SOURCE: FEMA 455	 *d. Common type of ribbon window with alternating horizontal bands of window and spandrel (space between the top of the window in one story and the sill of the window in the story above)* SOURCE: FEMA 455  *d. Ribbon windows in an older building* SOURCE: FEMA 455  *e. Glass with point-supported cables* SOURCE: FEMA 455

5. Vulnerability Rating: Building Enclosure Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
5.2	**Total Percentage of Window Area**	

5.2 Total Percentage of Window Area

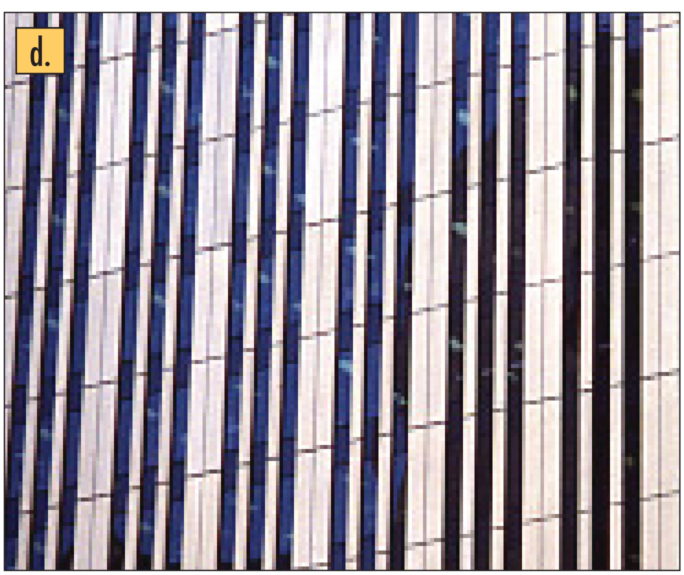
The total percentage of window area is the ratio of the window area to the total wall area. Walls are assumed to provide greater protection than windows. The exposure of building occupants to window glass provides increased risk of a serious hazard in the event of a failure.

Estimates can be based on the typical area of the building between two column lines (e.g., one window bay width).

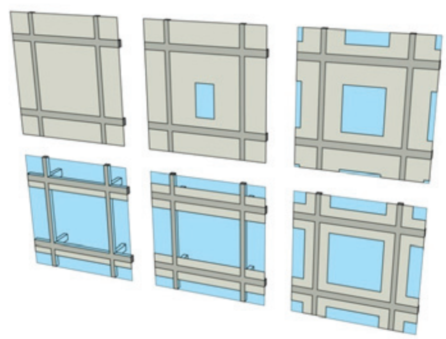
a. < 10%
b. ≥ 10%, < 30%
c. ≥ 30%, < 50%
d. ≥ 50%, < 70%
e. ≥ 70%

Total percentage of window area is heavily weighted.

c. Greater than or equal to 30%, less than 50%
SOURCE: FEMA 455



d. Greater than or equal to 50%, less than 70%. SOURCE: FEMA 455



Top row (left to right):
Option a: < 10%
Option b: ≥ 10%, < 30%
Option c: ≥ 30%, < 50%

Bottom row (left to right):
Option e: > 70%
Option d: ≥ 50%, < 70%
Option c: ≥ 30%, < 50%

SOURCE: DAVID SHAFER

<table>
<tr><th colspan="3">5. Vulnerability Rating: Building Enclosure Vulnerabilities</th></tr>
<tr><th>ID</th><th>Building Characteristics</th><th>Attribute Options</th></tr>
<tr><td>5.3</td><td>Glass Type

The attribute options offer five types of glass for typical windows. For buildings with a variety of glass types, the screener should select the type that is likely to be the most hazardous, considering factors such as window size, number of windows of that type, location, and number of occupants. The screener should use the "worst-reasonable-case standard" approach.

a. Laminated Glass
In low-impact conditions, the laminate holds the glass in the frame, preventing the glass fragments from being thrown from the window. In high-impact conditions, the glass pieces adhere to the laminate, forming clumps of glass that exit the frame. Both conditions are safer if laminate glass is not used.

Laminated glass is relatively uncommon in conventional construction. However, it is often used in 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.

In insulated glass (two glass panels separated by a small air gap), typically only the inner pane is laminated.

Laminated glass can be determined by:
• Reviewing as-built or construction drawings or specifications
• Consulting the building manager

Laminated glass, also called safety glazing, is certified by the Safety Glazing Certification Council (SGCC) and identified by a permanent label affixed to the product. A typical label includes 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

b. Security Film
Installing security film on the inside of window glass is a common retrofit used for office buildings when manmade hazards are a concern. In daylight, the film may be detected along the window edges. Older film retrofits may peel, have air bubbles, or be clouded. The film may be attached to the framing using metal plates or battens. Solar film, which typically is 2 mil thick, is thinner than security film and does not qualify as security film. Knowledge of retrofit is needed to select this option (see ID 6.9).</td><td>a. Laminated glass. Two or more glass panels connected or glued together with layers of polyvinyl butryal (PVB); used most commonly as safety glass for skylights or in glass panels that are near the floor and could be broken through impact

b. Security film
• Varies from 4 mil to about 20 mil in thickness
• Thicker than solar film or glare film
• Access needed to confirm that security film has been added to windows

c. Thermally tempered glass.
• Like laminated glass, considered safety glass
• May be used where impact is a concern (e.g., skylights, lobbies)
• When impacted, breaks into small cubes rather than sharp shards like other types of unlaminated glass

d. Heat-strengthened glass. Most common type of glass in modern commercial office buildings

e. Annealed glass
• Weakest type of glass
• Creates shards when broken
• Common in non-retrofitted glazing in older buildings (pre-1960s)
• May be used in residential buildings</td></tr>
</table>

5. Vulnerability Rating: Building Enclosure Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
5.3 (cont.)	**c. Tempered Glass** Sometimes tempered glass is used for all or some glass panes at the ground floor so that firefighters and other first responders can safely gain access to the building in case of emergency. Like laminated glass, tempered glass has a label in the corner of the pane. Tempered glass is relatively uncommon in typical vision panels above the ground floor. **d. Heat-Strengthened Glass** Heat-strengthened glass may be identified easily if the glass has been tinted. Heat-strengthened glass can be assumed to have been used in high-rise commercial buildings built during the last 30 years or that have large glass panes. **e. Annealed Glass** Annealed glass is typical in buildings built before 1960 (refer to age of building), but it is still often used for: • Single-family residences • Smaller multi-family apartment buildings Commercial buildings constructed before 1940 or with multi-pane windows also have annealed glass.	
5.4	**Wall Type** Wall type is the composition of the exterior walls (façade). The screener can determine the wall type through site observation, by reviewing as-built drawings, if available, or by asking a site representative or facility engineer. If the wall type cannot be determined, the screener should select the option that is the closest. For Option e (light frame or slender unreinforced masonry), finished brick, stone, or ceramic tile is often used as a veneer over a sheet backing that is attached to a wood, steel, or concrete frame structure. Other features of brick veneer buildings are as follows: • Brick layers are not staggered • Windows are larger than in traditional brick buildings • Small keystones over arches are used for decoration • Building has more than five stories	a. Cast-in-place reinforced concrete • Solid appearance with punched windows • Often used in monumental construction or high-seismic or high-wind-load areas • Usually has an architectural textured finish or an applied veneer of natural stone b. Curtain wall/metal framing • Façade consisting of glass panels supported by metal framing • Instead of windows, there may light, insulated, metal panels c. Precast panels/reinforced masonry • 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 • Vertical and horizontal seams between the panels or stacked reinforced masonry blocks • Typically used in smaller office or government buildings

5. Vulnerability Rating: Building Enclosure Vulnerabilities

ID	Building Characteristics	Attribute Options

5.4 (cont.)

a. Cast-in-place reinforced concrete

b. Glass curtain wall concealing the floor structure

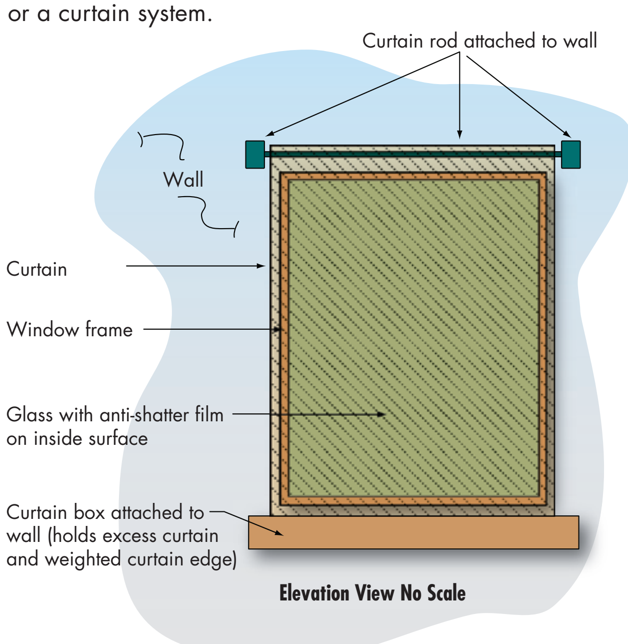
d. Massive unreinforced masonry
- Older unreinforced masonry buildings with multi-wythe brick walls and a height-to-thickness ratio of less than or equal to 10:1
- May have brick that is covered with stucco or other material that disguises the brick
- Often used in older civic buildings

e. Light frame or slender unreinforced masonry
- Smaller brick residential or commercial buildings with a height-to-thickness ratio of more than 10:1
- Wood or metal-stud construction with a light weight exterior wall such as gypsum board covered with stucco or a single wythe of brick
- Unreinforced masonry unit (concrete block) or tile backed with plaster and lath

e. Unreinforced masonry (brick) residential apartment row

c. Reinforced masonry building

d. Massive unreinforced masonry building

5. Vulnerability Rating: Building Enclosure Vulnerabilities		
ID	Building Characteristics	Attribute Options
5.4 (cont.)	 e. Unreinforced masonry (brick) residential apartment row	
5.5	**Windborne Debris Impact Protection** The windborne debris impact protection characteristic refers to the benchmark year (the year windborne debris impact protection codes were adopted). Window screens used to resist windborne debris impact can also provide protection from the impact of an explosive. Buildings constructed prior to the benchmark year may be retrofitted to meet standards by using shutters, storm windows, or a curtain system.  	a. Post-benchmark year • Building designed after the benchmark year • Building with window screens that meet benchmark year windborne debris impact standards b. All other buildings *Window screen that will resist the impact from an explosive* SOURCE: FEMA 453

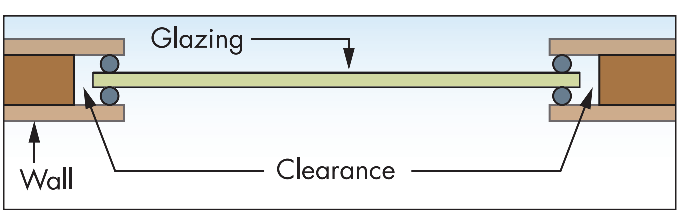
5. Vulnerability Rating: Building Enclosure Vulnerabilities

ID	Building Characteristics	Attribute Options
5.5 (cont.)	Benchmark year for localities in the United States where windborne debris impact is a concern	

State	Locality	Benchmark Year
Alabama	City of Mobile and possibly some smaller communities	2001
Connecticut	Jurisdictions of East Lyme, North Stonington, Ledyard, Old Lyme, New London, and Stonington	2007
Delaware	Sussex County east of the Lewes and Rehoboth Canal (within 1 mile from the coast)	2005
Florida	Panhandle: 1 mile inland from the coast	2002
	In all counties except Dade, Broward, and Palm Beach: 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 1 mile of the coast excluding Boston	2005
New Jersey	Within 1 mile of the coast	2003
New York	All of Long Island east of Riverhead and within 1 mile from the north and south coasts of Long Island (possibly except New York City)	2003
North Carolina	1,500 feet inland from the Atlantic Ocean	2006
Rhode Island	South of U.S. Highway 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 U.S. Highway 77 and U.S. Highway 59	2003
Virginia	Within 1 mile of the coast, excluding Chesapeake Bay	2005

5.6 Glazing Frame: In-Plane Seismic Clearance

Providing adequate clearance between the glazing and supporting frame can be acceptable as a seismic mitigation measure because it allows for relative movement of the glazing and frame without imparting any seismic demands on the glazing. Allowing the glazing to move laterally (side to side) may prevent it from shattering in an earthquake.



Plan view of glazing frame showing the seismic clearance

SOURCE: FEMA 453

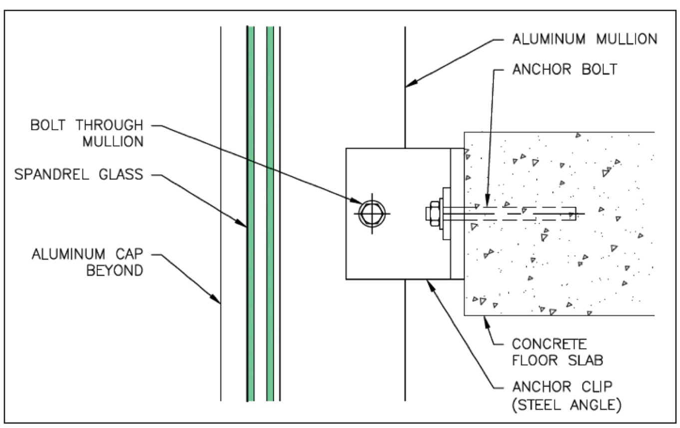
Attribute Options:

a. Not applicable. Building is in a low seismic zone

b. Yes. Adequate in-plane clearance

c. No. Inadequate in-plane clearance

5. Vulnerability Rating: Building Enclosure Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
5.7	**Veneer Condition** The veneer condition refers to the condition of the veneer or nonstructural external layer that makes up the building enclosure. The innermost element of the building enclosure is usually structural. The attachments of veneer to underlying wall must be adequate to prevent movement under wind and earthquake loads.	a. Not applicable b. Excellent. • No signs of distress (cracking or spalling) • Adequately connected to the structure c. Moderate • A few signs of distress but nothing significant • Adequately connected to the structure d. Poor. • Severe signs of distress • Inadequately connected to the structure
5.8	**Enclosure–Structure Connections** The envelop–structure connection characteristic refers to how well the building enclosure is attached to the structure. Glazing can be attached to the supporting frame with a rigid connection achieved by using sealant to join the two constructs or clearance between the glazing and frame can be provided to permit relative movement during seismic events. Frames are flexible and cladding must be detailed to accommodate calculated drifts and deformations. The condition of the connection between the wall and the supporting structural system must be in good condition for it to perform as designed. **One sign of poor condition is a water leak stain.**	a. Excellent b. Moderate c. Poor

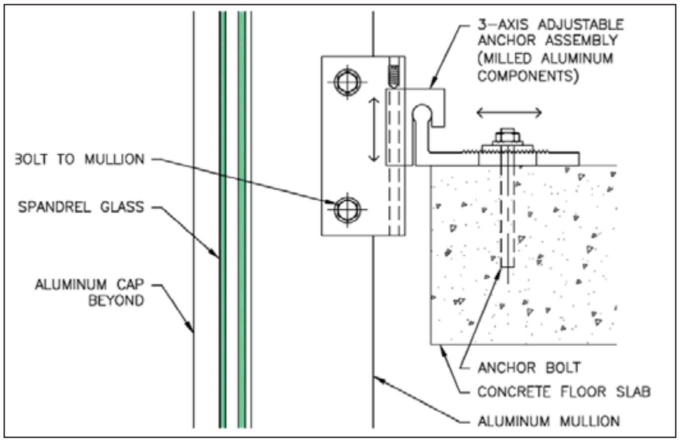
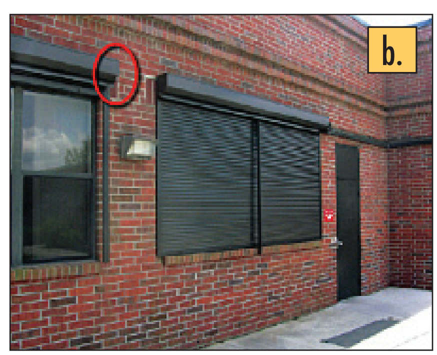


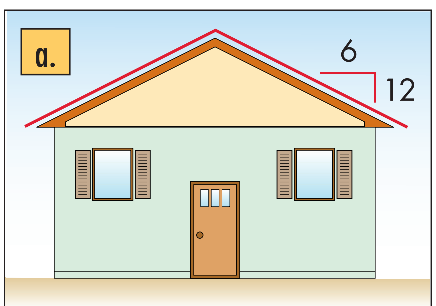
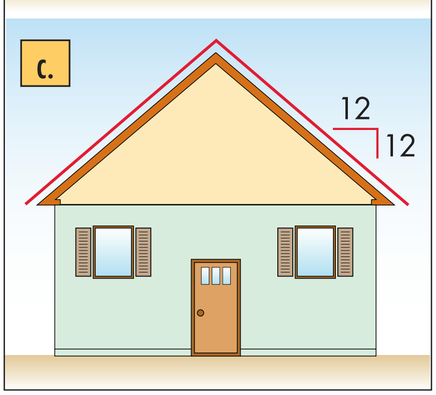
Detail of an enclosure connection to building structure using a simple clip-angle anchor

SOURCE: JOE VALANCIUS

Enclosure connection to structure using a clip-angle anchor

SOURCE: JOE VALANCIUS

5. Vulnerability Rating: Building Enclosure Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
5.8 (cont.)	 *Detail of an enclosure connection to a building structure using a 3-way adjustable anchor* SOURCE: JOE VALANCIUS	
5.9	**Special Building Enclosure Geometries** Special building enclosure geometries include building enclosures with irregular geometries such as atriums, multistory walls, architectural glazing systems, and exotic enclosure designs. Special enclosure geometries require special treatment because they are not covered in design codes or guidelines. Regular geometries are single-story, flat-faced enclosures.	a. Regular b. Irregular
5.10	**Shutters** Shutters are window and door opening covers that provide protection during high-wind events that carry windborne debris that can cause damage. Aesthetic shutters are not included. In some parts of the United States, shutters are required by code or insurance. If the building is not in a high wind speed zone and shutters are not provided, the screener should select Option a.  *b. School with horizontal slide shutters.* SOURCE: FEMA 424	a. Not applicable. Building is not in a high wind speed zone or has laminated glass (thus not requiring shutters) b. Yes. Building is in a high wind speed zone and has shutters c. No. Building is in a high wind speed zone and does not have shutters  *b. Building with roll-down shutters.* SOURCE: FEMA 424

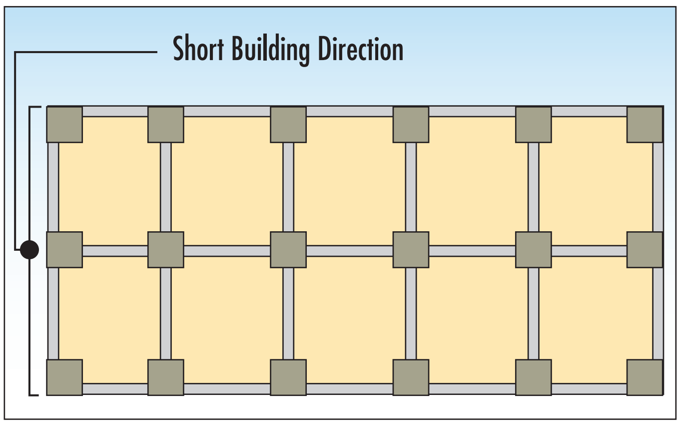
5. Vulnerability Rating: Building Enclosure Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
5.11	**Roof Construction** Roof construction refers to the type of roof decking or covering on the building. The roof system (roof covering and the decking that supports the covering) is often the most vulnerable building component in natural hazard events. When the building has more than one type of roof decking or covering, the screener should select the attribute option that is more vulnerable. Skylights are vulnerable and a serious hazard from glass breakage. Brittle roof surfaces can become windborne debris in high-wind areas if other debris strikes the roof and breaks the brittle roof covering.	a. Solid. Poured-in-place reinforced concrete and steel frames with a concrete or metal deck slab b. Skylights. Glass windows on roof of the building c. Brittle surface. Slate, tile, metal plates, or post-tensioned systems d. Aggregates or cementitious boards. Rock or gravel that can become windborne debris
5.12	**Roof Configuration/Pitch** Roof pitch is the slope of a roof. Roof pitch is the vertical rise divided by the horizontal span. In the United States, slope is typically given as a ratio of inches per 12 inches. Roof pitch is one of the primary determinants of high wind pressure. Flat roofs experience high edge and corner wind uplift pressure on the roof. A 5:12 to 6:12 pitch minimizes roof pressures. A steep slope such as 12:12 behaves like a wall and experiences windward or positive pressure on the roof surface.  *a. A 6:12 pitched roof minimizes roof pressures from high winds*  *c. A 12:12 pitched roof experiences high pressures in high winds*	a. 5:12 to 6:12 b. Flat c. 12:12

6. Vulnerability Rating: Structural Vulnerabilities

ID	Building Characteristics	Attribute Options
6.1	**Number of Bays in the Short Direction**	a. ≥ 5 bays b. 3 or 4 bays c. < 3 bays

"Bay" refers to the space between columns. In most cases, the building footprint is wider in one direction than in the other. The "short direction" is the smaller direction. The number of bays in the short direction is an indication of the building's ability to remain standing after the loss of a primary supporting member such as a column. The more bays in the short direction, the higher the probability the building will withstand the loss of a column or other primary load-carrying element.

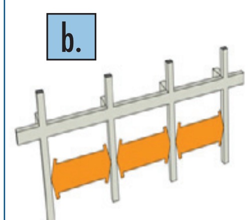
The screener should observe the interior of the building because the number of bays on the exterior and interior may be different. The option should be based on the least number of bays between the interior and exterior.

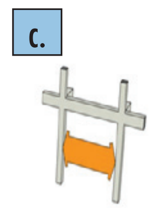


Short direction

c. Building with one bay in the short direction

a. Building with seven bays in the short direction





b. 3 bays

C. 1 bay

SOURCE: JOE VALANCIUS

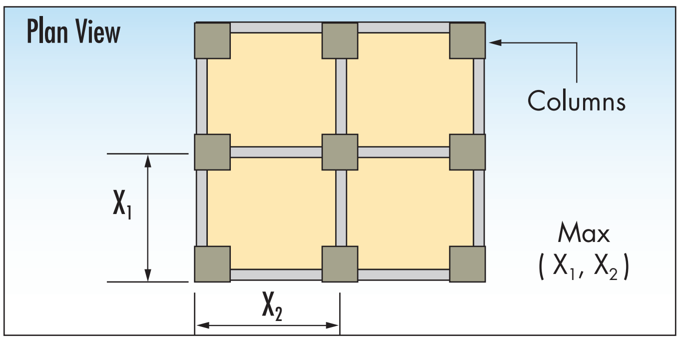
6. Vulnerability Rating: Structural Vulnerabilities

ID	Building Characteristics	Attribute Options

6.2 Column Spacing

Column spacing (structural bay size) is the distance between column centerlines or bearing walls in each principal direction (traverse and axial direction; see figure). Building columns or bearing walls that are spaced farther apart (meaning longer spans) are more vulnerable than closely spaced columns

The screener should determine the typical spacing between columns/bearing walls in each principal direction and select the maximum value.



Attribute Options:

a. < 15 feet
b. ≥ 15 feet, < 25 feet
c. ≥ 25 feet, < 40 feet
d. ≥ 40 feet, < 60 feet
e. ≥ 60 feet

Plan view of a building illustrating the column spacing (the lines represent the principal directions)

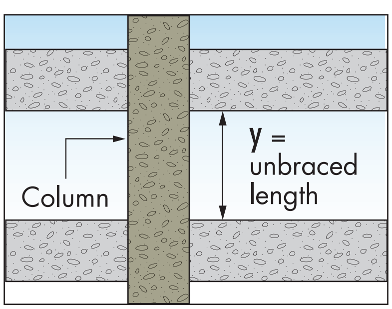
6.3 Unbraced Column Height

Unbraced column height refers to the height of a column that is not braced by a floor system or by beams in two directions. Columns in the lobby or on the building exterior are often taller than columns in typical floors.

Column height is an indication of the stability of the structure. Taller columns, particularly if they are slender, have a higher probability of failing in an explosion or earthquake than shorter or stouter columns.

The screener should select the tallest column supporting the highest number of floor levels.

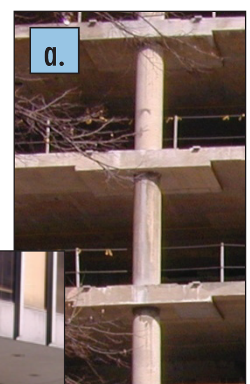
The option should not be based on tall columns that are not under the main footprint of the building and that support only a few floor levels. The option should be based on the tallest column supporting the building.



Detail illustrating the unbraced height of a column

Attribute Options:

a. < 12 feet
b. ≥ 12 feet, < 24 feet
c. ≥ 24 feet, < 36 feet
d. ≥ 36 feet



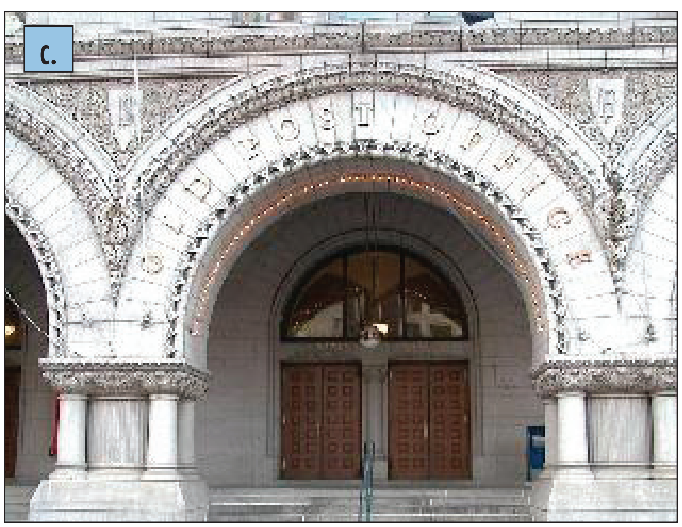
a. Column height of less than 12 feet

b. Column height between 12 and 24 feet

6. Vulnerability Rating: Structural Vulnerabilities

ID	Building Characteristics	Attribute Options
6.4	**Publicly Accessible Column** The amount of exposure of a publicly accessible column to explosive loading depends on the weapon (delivered in a car or by a person) and the load on the column. Slender columns are more common on modern and/or steel buildings, and massive columns are more common on older and/or concrete buildings.	a. No publicly accessible columns b. Yes, protected. Behind and separated from the building façade and enclosed by an architectural cover that extends at least 6 inches from the face of column c. Yes, massive. Height-to-width ratio of less than 5 d. Yes, slender. Height-to-width ratio of more than 5

b. Protected columns in the basement of a concrete building



c. Publicly accessible slender column

6. Vulnerability Rating: Structural Vulnerabilities

ID	Building Characteristics	Attribute Options
6.5	Transfer Girder Conditions	

6.5 Transfer Girder Conditions

Transfer girders are typically long-span beams that support a discontinuous column above. They typically span high volume areas such as a main lobby, loading dock, or auditorium.

Transfer girders that support an upper-story column may be more hazardous if they support disproportionately large loads on several levels compared to girders that support floor areas on only one level. The failure of a transfer girder or a column that supports it could initiate a progressive collapse if the structural design does not otherwise provide a means to resist such a failure.

The conditions of interior transfer girders are the most challenging to identify. A very long, clear span in the lobby of a building may indicate that there is a transfer girder carrying loading from additional columns above the ground floors. To verify this, the screener could look at the above ground floor levels to see whether the long span exists everywhere or just on the ground level.

d. Transfer girder to create wide service entry at building exterior

> Transfer girder conditions are heavily weighted.

Attribute Options

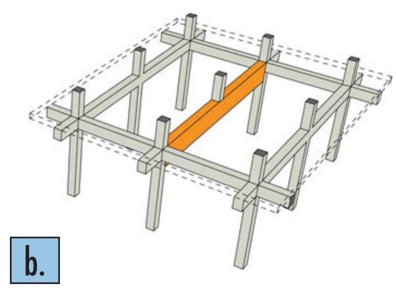
a. None. All columns are continuous from roof to foundation

b. Interior girder supporting one column. The girder spans an interior space and supports one column above

c. Interior girder supporting more than one column. The girder spans an interior space and supports more than one column above

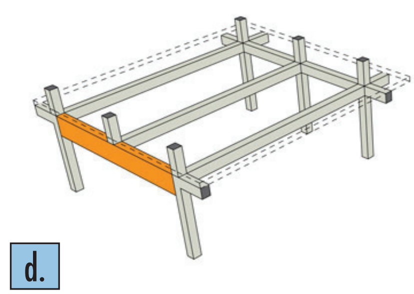
d. Exterior girder supporting one column. The girder is along the perimeter of the building and supports one column above

e. Exterior girder supporting more than one column. The girder is along the perimeter of the building and supports more than one column above



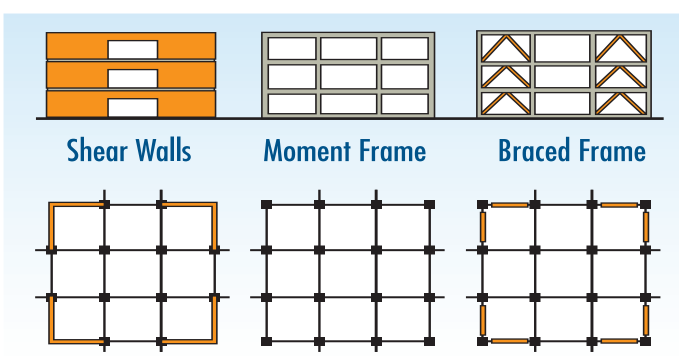
b. Interior girder supporting one column

SOURCE: JOE VALANCIUS



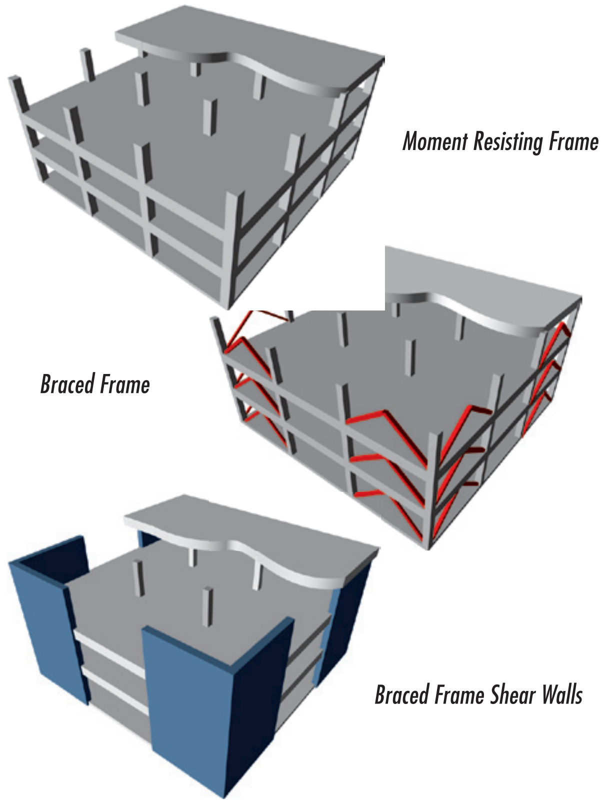
d. Exterior girder supporting one column

SOURCE: JOE VALANCIUS

6. Vulnerability Rating: Structural Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
6.6	**Structural Enhancements and Weaknesses** Structural enhancements improve the performance of a structural system or individual elements (e.g., slabs, beams, columns), and structural weaknesses downgrade the performance. Enhancements and weaknesses can be obtained from an engineer who has reviewed the structural drawings or from a site representative. If neither is possible, the screener should select Option c. unless the building is older (over 30 years old) and has not been maintained as evidenced by cracked or broken exterior elements. If the building is older or poorly maintained, the screener should select Option d. or Option (e). Some public buildings built after 1993 in New York City, Washington, D.C., and other cities have undergone some level of required hardening.	a. Hardened. Designed to resist the effects of an explosive attack b. Robust. Designed or retrofit to meet current extreme loading conditions related to high levels of hurricane or earthquake loads or designed to resist progressive collapse c. None. No structural enhancements or weaknesses described in the other attribute options (most common) d. Marginal • Designed using versions of codes that are no longer considered acceptable for meeting serviceability conditions • Designed using materials or connections that have been shown to perform poorly in abnormal loading situations • Building is not well maintained (e.g., corrosion or large cracks are visible) e. Substandard. Designed to a level that has little, if any, reserve strength to withstand any abnormal loads without catastrophic failure
6.7	**Number of Lateral Systems (Redundancy)** Lateral systems are the structural members that transfer lateral forces. Lateral systems are usually associated with stairwells, elevator shafts, and any large vertical chase such as large steam shafts. The three types of lateral load resisting systems are: • Shear walls • Moment frames • Brace frames The screener should evaluate this characteristic by counting the number of continuous shear walls and/or braced frames. Moment frames should be evaluated as Option a. because moment-framed buildings have numerous moment connections.  	a. Greater than four b. Four c. Three d. Two e. One *Basic types of lateral force resisting systems* SOURCE: CHRIS ARNOLD AND TONY ALEXANDER

6. Vulnerability Rating: Structural Vulnerabilities

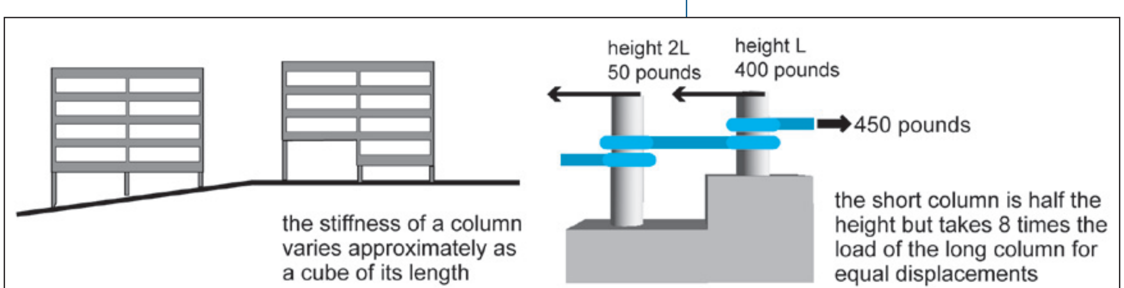
ID	Building Characteristics	Attribute Options
6.7 (cont.)		



b. Building core with four shear walls

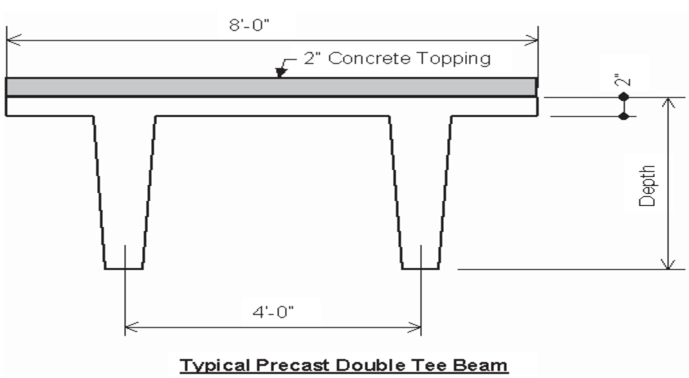
Exposed steel bracing

ID	Building Characteristics	Attribute Options
6.8	**Short Columns or Walls** Short columns or walls refer to columns or shear walls with different unbraced heights on the same floors. Short columns or walls are susceptible to significant stresses during an earthquake. The earthquake causes horizontal movements, which short columns and walls are not able to withstand well and may crack and collapse.	a. None b. Few (1 or 2) in single floor c. Several (more than 2) in single floor d. Few (1 or 2) in several floors e. Several (more than 2) in several floors



The short column problem

SOURCE: FEMA 454 (FEMA, 2006)

6. Vulnerability Rating: Structural Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
6.9	**Seismic Design/Retrofit** The building has or has not been designed or retrofit for seismic events, which can be determined by talking to the building engineer or reviewing the local building codes.	a. No b. Yes
6.10	**Roof Span** Roof span refers to the longest horizontal distance between two sides of the roof. Long span roof members have frequently failed in uplift in high winds because the bottom chord of metal bar joists or trusses designed for tension in roof assemblies are subjected to compression when the roof lifts up. Unless specifically designed for this condition, long span roof members may fail in high winds.	a. ≤20 feet b. > 20 feet, < 40 feet c. ≥ 40 feet
6.11	**Topping Slabs** Topping slabs are nonstructural floor coverings (typically concrete) over the structural slab or components.  *Concrete topping slab.* SOURCE: SUNY DELHI	a. Present b. Missing
6.12	**Adjacent Building Separation** Adjacent building separation refers to the separation between the subject building and adjacent buildings, if any. Adjacent buildings can affect each other during an earthquake if the separation between them is too small.	a. No adjacent buildings b. Adequate (more than 6 inches) c. Not adequate (less than 6 inches)

6. Vulnerability Rating: Structural Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
6.13	**Flood-Resistant Building Components** Any part of the building below the base flood elevation (BFE) must be flood resistant in order to minimize damage from floodwaters. Floods can lead to deterioration of building materials such as wood and other porous materials. Mold growth is often enhanced by high moisture levels, especially in wall cavities with enclosed fiberglass insulation. Records of actual flood events are the best indicator of potential duration. The FIS often contains background information on historical floods. The structure below the BFE should be designed using flood-resistant materials. Flood-resistant material is defined by the National Flood Insurance Program as "any building product [material, component or system] capable of withstanding direct and prolonged contact with floodwaters without sustaining significant damage." "Prolonged contact" means at least 72 hours, and "significant damage" means any damage requiring more than cosmetic repair. "Cosmetic repair" includes cleaning, sanitizing, and resurfacing the material (e.g., sanding, repairing joints, repainting). Examples of flood resistant materials are: • Pressure-treated or naturally decay-resistant lumber • Sulfate-resisting cement • Plastics, synthetic, and closed-cell foam insulation • Coated structural steel to resist corrosion The existence of flood-resistant measures below the BFE must be considered when determining the vulnerability of the building to possible flood damage.	a. Not applicable. The building is not subject to flooding. b. Yes c. No

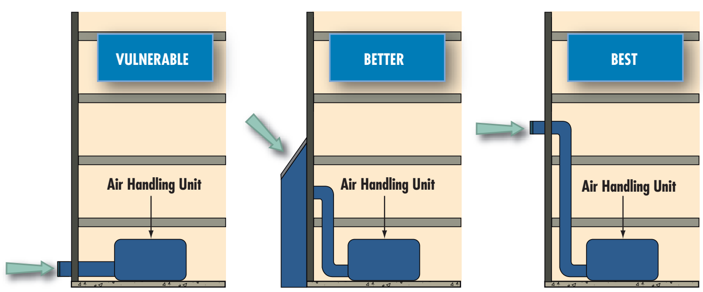
7. Vulnerability Rating: Mechanical, Electrical, and Plumbing System Vulnerabilities

ID	Building Characteristics	Attribute Options
7.1	**Primary External Air Intake Location**	a. >30 feet above ground level or on roof. On the roof, at the third-floor level, or higher. b. > 10 feet, ≤30 feet above ground level • Covered with a protective louver or grate with a minimum slope of 45 degrees c. Between ground level and ≤10 feet above ground level • Covered with a protective louver or grate with a minimum slope of 45 degrees • Protected by security fencing maintaining access at least 30 feet from the air intake louver d. At ground level. In a public area with surveillance as a means of deterring delivery of a CBR contaminant e. Below grade or at ground level with unrestricted access

The likelihood that a CBR contaminant will be introduced into a building's air system depends on accessibility to the building's external air intake.

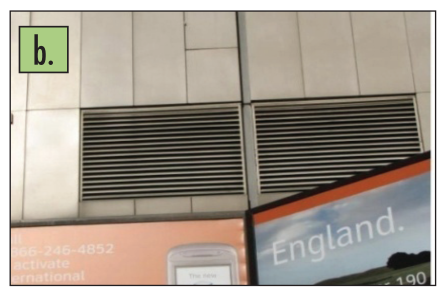
Air intakes are often at ground level because mechanical rooms and garages are at or below ground level. Air intakes that are below grade with sidewalk grates over them are the most vulnerable if they are in public areas. However, some air intakes at ground level service the garage but not critical equipment or occupied spaces and should therefore not be used in the evaluation. Wall-mounted air intakes are usually covered with louvers and are 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 the introduction of CBR into a building's air-intake system depends on variables such as the location of the air intake, building height, prevailing winds, distance from the release, air-pressure differential between inside and outside, and air tightness of the façade.



Location of external air intakes

SOURCE: CDC/NIOSH (2002)



b. Air intake about 15 feet above ground

c. Air intake above ground level but less than 10 feet from ground level

7. Vulnerability Rating: Mechanical, Electrical, and Plumbing System Vulnerabilities

ID	Building Characteristics	Attribute Options
7.2	Return Air Intake System	

7.2 Return Air Intake System

A ducted return air is less vulnerable than an unducted air system that is under the floor, above ceilings, or through corridors. The screener can ascertain whether the return air intake system is ducted or unducted by asking a site representative or facility engineer.

Attribute Options

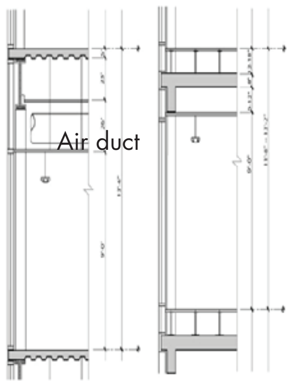
a. Ducted secured. Ducted and inaccessible in secure locations under surveillance

b. Ducted accessible. Ducted and accessible to the public

c. Unducted

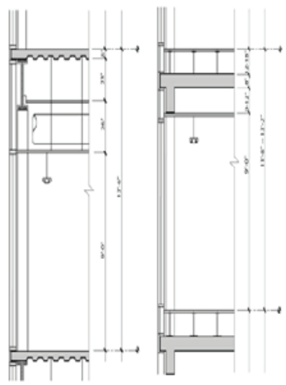
d. Subject to buoyancy. Building is above a tunnel or subway station (e.g., subway tunnel)

b.

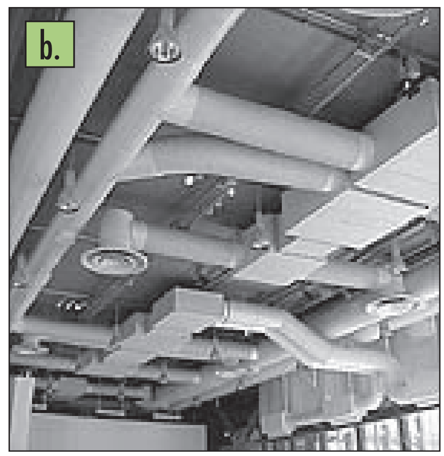


b. Ducted air return system

c.

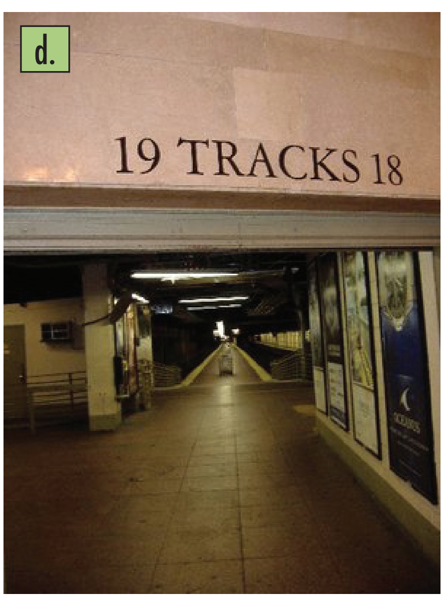


c. Unducted air system



b. Ducted accessible air return system

Buoyancy (Option d) relates mainly to connecting tunnels. For example, in a building that is connected to a subway tunnel by a tunnel, buoyancy-driven flows would transport contaminants from the subway into the building under certain conditions. Buoyancy typically pertains to buildings with a train station under the building.



d. Building subject to buoyancy

c. Unducted floor air return

7. Vulnerability Rating: Mechanical, Electrical, and Plumbing System Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
7.3	**Internal Air Distribution System** High-risk areas such as lobbies, loading docks, mailrooms, and retail spaces in a building create potential for the introduction of a CBR contaminant into the internal air distribution system. The screener can obtain information from a site representative or facility engineer on the design of the internal air system.	a. High-risk, separated. High-risk areas have their own dedicated air distribution systems and are maintained with positive pressure to less secured areas of the building b. Multi-zoned/single system, ducted. High-risk areas are included in one ducted air distribution system serving the entire building c. Single system/unducted. High-risk areas are included in one unducted air distribution system serving the entire building
7.4	**Proximity of Critical Utilities to High-Risk Areas** Protecting critical utilities serves to mitigate post-event hazards, such as fire, and expedites evacuation and search and rescue efforts. Critical utilities include: • Emergency generators including fuel systems, day tank, fire sprinkler, and water supply • Normal fuel storage • Main switchgear • Telephone distribution and main switchgear • Fire pumps • Building control centers • Uninterrupted power supply systems controlling critical functions • Main refrigeration systems if critical to building operation • Elevator machinery and controls • Shafts for stairs, elevators, and utilities • Critical distribution feeders for emergency power The screener can ascertain the location of critical utilities by asking the site representative or facility engineer.	a. No exposure to potential threat. Critical utilities are at least 50 feet 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 the floor framing at top and bottom) b. Exposure to potential threat, hardened. Critical utilities are within 50 feet of high-risk areas and are separated by a hardened partition wall c. Yes, not hardened. Critical utilities are within 50 feet of high-risk areas and are not separated by a hardened partition wall  *c. Main power feed to a building exposed outside and protected only by a chain link fence*

<table>
<tr><th colspan="3">7. Vulnerability Rating: Mechanical, Electrical, and Plumbing System Vulnerabilities</th></tr>
<tr><th>ID</th><th>Building Characteristics</th><th>Attribute Options</th></tr>
<tr><td>7.5</td><td>

Mechanical/Electrical/Plumbing (MEP) System Anchoring

MEP systems should be well anchored to provide a clear lateral load path from the components to the supporting structural system or to the ground.

This characteristic is evaluated based on the approximate percentage of the MEP components that are anchored in the lateral load path,

MEP systems include:

- Air-side HVAC fans, air handlers, air conditioning units, cabinet heaters, air distribution boxes, and other mechanical components constructed of sheet metal framing
- Wet-side HVAC, boilers, furnaces, atmospheric tanks and bins, chillers, water heaters, heat exchangers, evaporators, air separators, manufacturing or process equipment, and other mechanical components constructed of highly deformable materials
- Engines, turbines, pumps, compressors, and pressure vessels
- Suspended-vibration-isolated equipment including in-line duct devices and suspended internally isolated components, and manufacturing or process conveyo

Mechanical equipment with proper seismic angle bracing

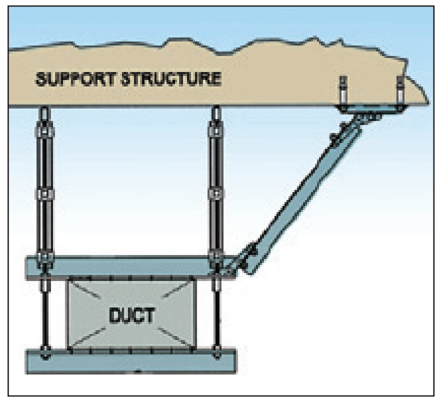
</td><td>

a. > 90%

b. > 60%, < 90%

c. > 30%, < 60%

d. < 30%



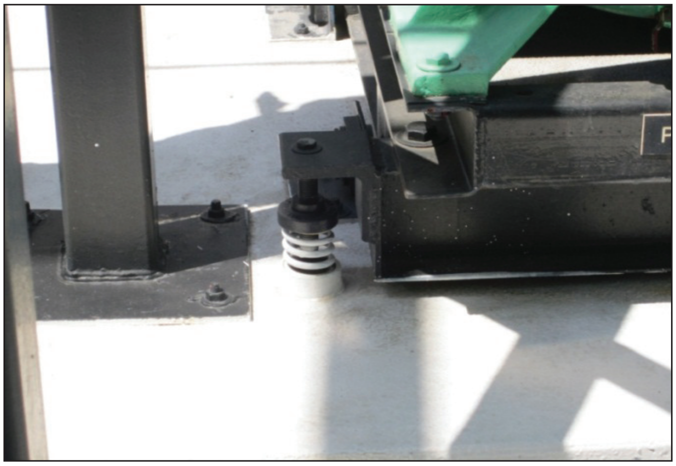
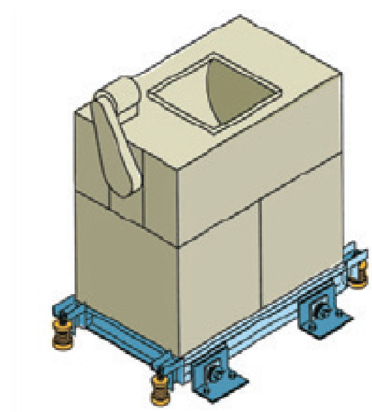
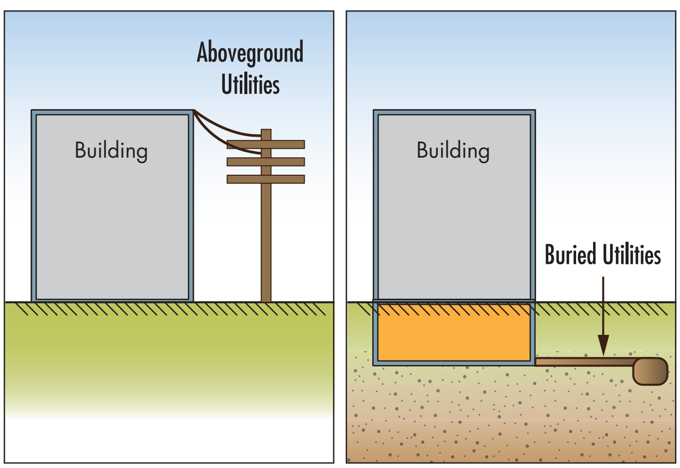
Typical duct bracing

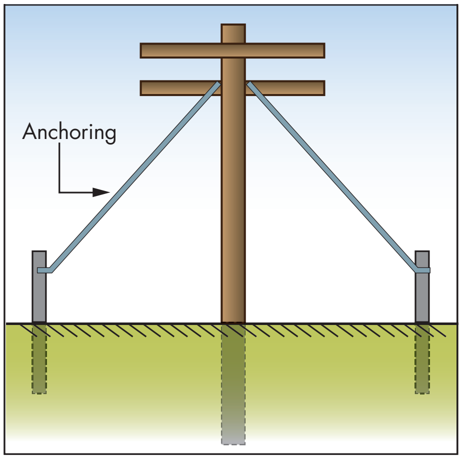
SOURCE: FEMA 577 (FEMA, 2007)

Anchorage of pipes

SOURCE: FEMA 577 (FEMA, 2007)

</td></tr>
</table>

7. Vulnerability Rating: Mechanical, Electrical, and Plumbing System Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
7.6	**Adequacy of Seismic Isolation Systems** A seismic isolation system is intended to decouple units (equipment) from a building or nonbuilding structure.  *Close-up of an isolation "snubber" or spring*	a. Adequate b. Not adequate  *Isolation with "snubbers"* SOURCE: FEMA 577, (FEMA, 2007)
7.7	**Elevation of Utility Lines** Elevation of utility lines refers to whether the utility lines (gas, water, electric, cable, communication, and telephone) are buried on the site or above ground. Below grade utilities are typically less susceptible to flood, wind, blast, or debris.  *Aboveground and underground utilities*	a. Below ground b. Above ground

7. Vulnerability Rating: Mechanical, Electrical, and Plumbing System Vulnerabilities		
ID	Building Characteristics	Attribute Options
7.8	**Above Ground Utility Anchoring** Aboveground utilities include electric, cable, telecommunications and telephone poles, fire pumps, water and gas valves, electric meters, transformers, and emergency generators. Water and gas pipes can also be aboveground. Such systems need to be well anchored to prevent breaking or overturning, which could be hazardous and result in a loss of service.  *Anchorage of above ground utilities*	a. Not applicable (no above ground utilities) b. > 67% well anchored c. ≥ 33% , ≤67% well anchored d. < 33% well anchored
7.9	**MEP System Support by Structural System** In MEP system support by the structural system, positive attachments include welded or bolted attachments. Friction-type attachments such as those using gravity loads for supports are not considered adequate. A seismically adequate load path includes well-designed anchors and ductile-reinforced masonry walls. Non-reinforced masonry walls are not considered appropriate as supporting equipment.  *MEP equipment securely attached to and supported by the structure (shear wall)*	a. ≥ 90% well supported b. ≥ 60%, < 90% well supported c. ≥ 30%, < 60% well supported d. < 30% well supported  *Large pipe well supported by a structural roller support*

7. Vulnerability Rating: Mechanical, Electrical, and Plumbing System Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
7.10	**Soil Spread Potential (Underground Systems)** Soil spread is defined as lateral displacement or ground deformation of gently sloping ground. Lateral spreading can have a significant impact on underground utilities.	a. Not applicable b. Low c. Medium d. High
7.11	**Clearances for Pipe Penetrations** Clearances for pipe penetrations where they pass through a wall or floor require a flexible interface to permit adequate relative motion between the pipe and the wall or floor. Flexible fittings are needed to ensure safe relative motion between the pipe and the walls or floors. If such flexibility is not provided, there may be a risk of damage to the pipe during seismic events.  *b. Pipe passes through a wall where a flexible putty provides adequate clearance for the pipe and allows for relative motion without causing damage to the wall or piping system*	a. Not applicable b. Excellent. Pipes have flexible fittings allowing for relative motion without causing damage c. Medium. Pipes have some clearance but do not have flexible fitting d. Poor. Pipes have no clearance or have non-flexible interface to fill voids

8a. Vulnerability Rating: Fire Protection System Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
8a.1	**Upgraded to Meet Current Code/Governing Standard** The screener must determine whether the building has been upgraded since construction to be in compliance with the current code or governing standard. This characteristic can be evaluated by talking to the building engineer or by reviewing building documentation. Upgrading to meet current code/ governing standard is heavily weighted.	a. Yes b. No
8a.2	**Backup Power for Life Safety Equipment** Life safety equipment is automatically connected to a backup (redundant or secondary) power supply if the primary power supply is disrupted in an emergency.	a. Yes b. No
8a.3	**Fire Command Center** A fire command center is a room in a building that serves as a command center for life safety systems. The room provides a central location for emergency and building personnel to communicate with each other and with building occupants and emergency personnel en route to and at the site. Fire command centers generally include: • A fire alarm system control panel with a digital annunciator, status indicating lights, and audible signals • Building communications panels • Elevator control panels • The fire command center should be accessible from the interior and also directly from the exterior of the building at ground level with a "FIRE COMMAND CENTER" sign on the door.	a. Not applicable b. Yes c. No  *Fire control panel located in the fire command center of a building.* SOURCE: THOMAS BARNUM
8a.4	**Automatic Fire Detection System** An automatic fire detection system is designed to detect the unwanted presence of fire by monitoring environmental changes associated with combustion. Automatic fire alarm systems can be used to notify people to evacuate in the event of a fire or other emergency, to summon emergency services, and to prepare the structure and associated systems to control the spread of fire and smoke.	a. Yes b. No

8a. Vulnerability Rating: Fire Protection System Vulnerabilities		
ID	Building Characteristics	Attribute Options
8a.5	**Activation of the Automatic Fire Detection System: Automatically Shut Down of HVAC Systems** When the automatic fire detection system is activated, the HVAC system may or may not be automatically shut down.	a. Not applicable. The building does not have an automatic detection system b. Yes, the HVAC systems are automatically shut down c. No, the HVAC systems are not automatically shut down
8a.6	**Automatic Fire Sprinkler System** An automatic fire sprinkler is an active fire protection measure consisting of a water supply system that provides adequate pressure and flow rate to a water distribution piping system. Sprinklers are connected to the water supply system. Fire sprinkler systems are installed in both commercial and residential buildings. They are usually on the ceiling and are connected to a reliable water source, most commonly municipal water. A typical sprinkler system operates when heat at the site of a fire causes a glass component in the sprinkler head to fail, thereby releasing the water from the sprinkler head. Only a sprinkler head at the fire location operates (not all sprinklers). Sprinkler systems help limit the spread of a fire, thereby increasing life safety and limiting structural damage.	a. Yes b. No  *Sprinkler head* SOURCE: THOMAS BARNUM
8a.7	**Standpipe System** A standpipe system is a type of rigid water piping system that is built into multistory buildings in a vertical position. Fire hoses can be connected to a standpipe system, allowing manual application of water to the fire. Standpipes inside buildings serve the same purpose as fire hydrants.	a. Not applicable. The building size (single story) does not require standpipes b. Yes c. No
8a.8	**Fire Drill** Fire drills are regular exercises that the local fire department conducts to practice evacuation of a building for a fire or other emergency.	a. Yes b. No
8a.9	**Fire Safety Training** Training occupants/tenants in fire safety and emergency operations is essential because it is the engagement and decision-making of these individuals that will determine the success of emergency preparedness and response. Training should be provided to all occupants/tenants. Objectives for training are: • To develop occupants/tenants awareness of potential threats or hazards. Employees should be able to recognize, report, and appropriately respond to suspicious items. • To develop an understanding of the responses and protective actions and what should be done for each possible protective action.	a. Yes b. No

8a. Vulnerability Rating: Fire Protection System Vulnerabilities		
ID	Building Characteristics	Attribute Options
8a.10	**Emergency Evacuation and Shelter-In-Place Plan** An emergency evacuation plan refers to a procedure for immediately and rapidly moving people out of the building because of a threat or hazard. Emergency evacuation plans are developed to ensure the safest and most efficient evacuation of all people in the building. An effective plan uses multiple exits and technologies to ensure full and complete evacuation. A shelter-in-place plan refers to a procedure for immediately and rapidly moving people into interior areas of the building that provide higher levels of protection and that are sealed off from outside hazards (typically the lobby, stairwells, and interior conference rooms that are away from exterior walls and windows).	a. Yes b. No

8b. Vulnerability Rating: Fire Protection System Vulnerabilities (Fire Marshal)		
ID	Building Characteristics	Attribute Options
8b.1	**Met Code/Governing Standard at Time of Construction** The screener must determine whether the building met the code/governing standard at the time of construction? This characteristic can be evaluated by talking to the building engineer or by reviewing building documentation. Upgrading to meet current code/governing standard is heavily weighted.	a. Yes b. No
8b.2	**Upgraded to Meet Current Code/Governing Standard** The screener must determine whether the building has been upgraded since construction to be in compliance with the current code or governing standard. This characteristic can be evaluated by talking to the building engineer or by reviewing building documentation.	a. Yes b. No
8b.3	**Inspection by Code Enforcement Officials within the Last 12 Months** The screener must determine whether code enforcement officials have visited the building within the last 12 months to evaluate the buildings compliance with current codes and/or standards.	a. Yes b. No

8b. Vulnerability Rating: Fire Protection System Vulnerabilities (Fire Marshal)		
ID	Building Characteristics	Attribute Options
8b.4	**Positive Pressurization of Stair Towers** Positive pressure is pressure within a system that is greater than the environment surrounding the system. Positive pressure ensures there is no ingress of the environment into the closed system. Positive pressure is used in stairwells to drive smoke and heat away to allow for safe evacuation and to facilitate the firefighter's job.	a. Not applicable b. Yes c. No
8b.5	**Backup Power for Life Safety Equipment** Life safety equipment is automatically connected to a backup (redundant or secondary) power supply if the primary power supply is disrupted in an emergency.	a. Yes b. No
8b.6	**Fire Command Center** A fire command center is a room in a building that serves as a command center for life safety systems. The room provides a central location for emergency and building personnel to communicate with each other and with building occupants and emergency personnel en route to and at the site. Fire command centers generally include: • A fire alarm system control panel with a digital annunciator, status indicating lights, and audible signals • Building communications panels • Elevator control panels The fire command center should be accessible from the interior and also directly from the exterior of the building at ground level with a "FIRE COMMAND CENTER" sign on the door.	a. Not applicable b. Yes c. No
8b.6.1	**Publicly Accessible Location** If the building has a fire command center, the screener must determine whether it is publicly accessible.	a. Not applicable b. Yes, publicly accessible c. No, not publicly accessible
8b.7	**Automatic Fire Detection System** An automatic fire detection system is designed to detect the unwanted presence of fire by monitoring environmental changes associated with combustion. Automatic fire alarm systems can be used to notify people to evacuate in the event of a fire or other emergency, to summon emergency services, and to prepare the structure and associated systems to control the spread of fire and smoke.	a. Yes b. No
8b.7.1	**Automatic Fire Detection System Report** When the automatic detection system senses a fire based on certain changes in the environment of the building, it may alert people to the danger through fire alarms or transmit the information to emergency services outside the building	a. Not applicable b. Fire department c. Offsite monitoring company d. Fire control panel e. No one (local alarm)

8b. Vulnerability Rating: Fire Protection System Vulnerabilities (Fire Marshal)		
ID	**Building Characteristics**	**Attribute Options**
8b.8	**Activation of the Fire Detection System** When a detection system is activated, it can be programmed to carry out other actions such as the following.	
8b.8.1	**Evacuation of Building Alert** When the automatic fire detection systems are triggered, the alarm may or may not alert occupants to evacuate the building immediately.	a. Not applicable b. Yes, publicly accessible c. No, not publicly accessible
8b.8.2	**Automatically Recall Elevators** When the fire detection system is triggered, the elevators may or may not automatically recall to a certain floor. When elevators are automatically recalled, when an alarm has been activated, the elevator goes to the fire recall floor. However, if the alarm was activated on the fire recall floor, the elevator recalls to an alternate floor. When the elevator is recalled, it proceeds to the recall floor and stops with its doors open. The elevator no longer responds to calls or moves in any direction. A fire service key switch is located on the fire recall floor. The fire service key switch can be used to turn fire service off, turn fire service on, or to bypass fire service.	a. Not applicable b. Yes, publicly accessible c. No, not publicly accessible
8b.8.3	**Automatically Release Security Control Devices** Security-controlled devices (such as access-controlled doors) in the building may or may not pertain to first responders.	a. Not applicable b. Yes, publicly accessible c. No, not publicly accessible
8b.8.4	**Automatically Shut Down HVAC System** The HVAC system may or may not automatically shut down with activation of the fire detection system.	a. Not applicable b. Yes, publicly accessible c. No, not publicly accessible
8b.8.5	**Automatically Interlock with Any Critical Systems and Shut Them Down** Any critical system (e.g., computers, manufacturing equipment, processing equipment) is interlocked with the fire detection system. Activation of the fire detection system may or may not automatically shut down critical systems.	a. Not applicable b. Yes, publicly accessible c. No, not publicly accessible
8b.9	**Smoke Dampers** Smoke dampers are passive fire protection products used in air conditioning and ventilation ductwork to prevent the spread of smoke inside the ductwork where the ductwork penetrates fire-resistance-rated walls and floors. Smoke dampers are installed by sheet metal contractors inside the ducting.	a. Not applicable b. Yes, publicly accessible c. No, not publicly accessible

8b. Vulnerability Rating: Fire Protection System Vulnerabilities (Fire Marshal)		
ID	**Building Characteristics**	**Attribute Options**
8b.10	**Pull Stations** A fire alarm pull station is an active fire protection device mounted to the interior walls that when activated, initiates the fire alarm system. With the most common type, the user activates it by pulling a handle down, which completes a circuit and locks the handle in the activated position, sending an alarm to the fire alarm control panel.	a. Not applicable b. Yes, publicly accessible c. No, not publicly accessible  *Pull station with a protective covering* SOURCE: TOMAS BARNUM
8b.11	**Inspection, Testing, and Maintenance of all Fire Detection Equipment** The screener must determine whether the fire detection equipment has been inspected and tested and has had typical maintenance in the last 12 months.	a. Not applicable b. Yes, publicly accessible c. No, not publicly accessible
8b.12	**Automatic Fire Sprinkler System** An automatic fire sprinkler is an active fire protection measure consisting of a water supply system that provides adequate pressure and flow rate to a water distribution piping system. Sprinklers are connected to the water supply system. Fire sprinkler systems are installed in both commercial and residential buildings. They are usually on the ceiling and are connected to a reliable water source, most commonly municipal water. A typical sprinkler system operates when heat at the site of a fire causes a glass component in the sprinkler head to fail, thereby releasing the water from the sprinkler head. Only a sprinkler head at the fire location operates (not all sprinklers). Sprinkler systems help limit the spread of a fire, thereby increasing life safety and limiting structural damage.	a. Yes b. No
8b.13	**Building Coverage** The sprinkler system may cover the building completely or partially.	a. Not applicable b. Yes, publicly accessible c. No, not publicly accessible

8b. Vulnerability Rating: Fire Protection System Vulnerabilities (Fire Marshal)		
ID	**Building Characteristics**	**Attribute Options**
8b.13.1	**Type of Automatic Fire Sprinkler System** The types of automatic fire sprinkler systems are as follows: • Combination. Consists of sprinkler heads and standpipe hose outlets attached to a common riser. Combination systems may be either "wet" or "dry." • Deluge. Systems in which all sprinklers connected to water piping system are open because there is no heat-sensing element. Water is not present in the piping until the system operates. The deluge valve is opened when signaled by a fire alarm system. The type of alarm-initiating device (e.g., smoke detectors, heat detectors, optical flame detectors) is selected based on the nature of the hazard. • Dry. Water is not present in the piping until the system operates. Piping is filled with air below the water supply pressure. When one or more of the automatic sprinklers is exposed for a sufficient time to a temperature at or above the temperature rating, it opens, allowing the air in the piping to vent from that sprinkler. Each sprinkler operates individually. As the air pressure in the piping drops, the pressure differential across the dry pipe valve changes, allowing water to enter the piping system. Water flow from sprinklers needed to control the fire is delayed until the air is vented from the sprinklers. • Wet. Using an automatic alarm check valve, a water supply provides water under pressure to the system piping. When an automatic sprinkler is exposed for a sufficient time to a temperature at or above the temperature rating, the heat-sensing element (glass bulb or fusible link) releases, allowing water to flow from that sprinkler.	a. Not applicable. The building does not have an automatic sprinkler system b. Combination c. Deluge d. Dry e. Wet
8b.14	**Standpipe System** A standpipe is a type of rigid water piping system that is built into multistory buildings in a vertical position. Fire hoses can be connected to a standpipe, allowing manual application of water to the fire. Standpipes inside buildings serve the same purpose as fire hydrants.	a. Not applicable b. Yes, publicly accessible c. No, not publicly accessible
8b.14.1	**Class of Standpipe System** The three classes of standpipes are as follows: • Class I. Intended to be used by the fire department and equipped with a valve and a 2.5-inch hose connection at each location. The water supply is designed for 500 gallons per minute (gpm) for the first connection, plus 250 gpm for each additional connection, up to a maximum of 1,250 gpm. • Class II. Intended to be used by the occupants of the building (like a fire extinguisher) that is equipped with a valve and 1.5inch hose connection at each location; designed for 100gpm water flow. • Class III. Combination of Classes I and II, using both sizes of hose connections and Class I water supply requirements.	a. Not Applicable. The building does not have standpipes b. Class I c. Class II d. Class III

8b. Vulnerability Rating: Fire Protection System Vulnerabilities (Fire Marshal)		
ID	Building Characteristics	Attribute Options
8b.15	**Publicly Accessible Locations of Shutoff Valves** The outside stem and yoke (OS&Y), post indicator valve (PIV), and other types of valve shutoffs are sprinkler and standpipe system controls. These shutoff values may or may not be easily accessible by first responders and the public.  *b. OS&Y valve shutoff in a back room (not publicly accessible).* SOURCE: THOMAS BARNUM	a. Yes, publicly accessible b. No, not publicly accessible  *a. Remote PIV in a publicly accessible location onsite* SOURCE: THOMAS BARNUM
8b.16	**Publicly Accessible Valve House Locations** The valve houses may or may not be easily accessible to first responders and the public. The valve house is a control point to shut off or turn on the water supply to the building.	a. Yes, publicly accessible b. No, not publicly accessible

8b. Vulnerability Rating: Fire Protection System Vulnerabilities (Fire Marshal)		
ID	**Building Characteristics**	**Attribute Options**
8b.17	**Fire Pumps/Jockey Pumps** A fire pump is a part of a fire sprinkler system's water supply and can be powered by electricity, diesel, or steam. The pump intake is either connected to the public underground water supply piping or to a static water source (e.g., tank, reservoir, lake). The pump provides water flow at a higher pressure to the sprinkler system risers and hose standpipes. A jockey pump is a small pump connected to a fire sprinkler system that is intended to maintain pressure in a fire-protection piping system at an artificially high level so the operation of a single fire sprinkler will cause a pressure drop that will be sensed by the fire pump automatic controller, causing the fire pump to start. The jockey pump is essentially a portion of the fire pump's control system.  *Fire and jockey pump*	a. Automatic b. Manual c. No fire or jockey pumps
8b.17.1	**Publicly Accessible Locations** Fire pumps/jockey pumps may or may not be accessible to the public and first responders.	a. Yes, publicly accessible b. No, not publicly accessible c. No fire or jockey pumps
8b.18	**Type of Supervision Coverage for All Valves** The type of supervision coverage for valves refers to how a valve is monitored to ensure it is functioning properly and will activate. Valves can be electronically monitored or manually monitored and secured.	a. Central station proprietary or remote-station signaling service b. Local signaling service c. Locks d. Sealing located within fenced enclosure under control of owner

8b. Vulnerability Rating: Fire Protection System Vulnerabilities (Fire Marshal)		
ID	**Building Characteristics**	**Attribute Options**
8b.19	**Type of Alternate Automatic Extinguishing Systems** Alternate automatic extinguishing systems refer to fire-suppression agents other than water used in water-sensitive areas of the building. Extinguishing agents are typically used to extinguish fires in special hazards in which fire sprinklers are not adequate. Extinguishing agents are also used when water may cause excessive collateral damage or interrupt operations. Water in some areas can cause as much property damage as the fire (e.g., rooms with IT, electrical, communications equipment; building occupancies such as museums with priceless valuables). The types of alternate automatic extinguishing systems are: • Wet-chemical system. Potassium acetate, carbonate, or citrate extinguishes the fire by forming a soapy foam blanket over the burning oil and cooling oil below its ignition temperature. • Dry-Chemical System. Powder-based agent extinguishes the fire by separating the four parts of the fire tetrahedron. It prevents the chemical reaction between heat, fuel, and oxygen and halts the production of fire sustaining free radicals, thus extinguishing the fire. • Carbon dioxide/halon • Clean-agent/commercial/water-mist	a. Wet-chemical system b. Dry-chemical system c. Carbon dioxide/halon d. Clean-agent/commercial/water-mist e. None
8b.20	**Smoke Control Systems** Smoke control systems are designed to control smoke during a fire to allow for safe evacuation of the building and to control the threat to life safety.	a. Yes b. No
8b.21	**Smoke and Heat Vents** Smoke and heat vents are operable openings in a roof designed to allow heat and smoke to escape the building either automatically or manually in the event of a fire.  *a. An automatic smoke and heat vent on the roof of a building* SOURCE: THOMAS BARNUM	a. Yes b. No

8b. Vulnerability Rating: Fire Protection System Vulnerabilities (Fire Marshal)		
ID	**Building Characteristics**	**Attribute Options**
8b.22	**Deflagration Venting Systems** Deflagration is combustion that propagates through a gas or along the surface of an explosive at a rapid rate driven by the transfer of heat. Deflagration venting systems are designed to detect and contain explosions from spreading to interconnected equipment and other locations within the facility. See NFPA 68 (NFPA, 2007). The two approaches to eliminating deflagration are: • Chemical suppression system. The pressure wave is detected by a sensitive press sensor that instructs a chemical suppression agent to be discharged into the pipeline, mitigating the passage of flame down the pipeline. • Mechanical isolation system. The pressure wave is detected by a sensitive press sensor that is measured by a control unit, which instructs a valve to close forming a barrier, stopping the flame from traveling further down the pipeline.	a. Yes b. No
8b.23	**Fire Extinguishers** Fire extinguishers are an active fire protection device used to extinguish or control small fires often in emergency situations.	a. Yes b. No
8b.24	**Current Inspection, Testing, and Maintenance of All Fire-Suppression Equipment** The screener must determine whether the fire-suppression equipment has been inspected and tested and has had typical maintenance in the last 12 months. Examples of fire-suppression systems in buildings are: • Automatic fire extinguishing systems • Automatic sprinkler systems • Carbon dioxide extinguishing systems • Heat or smoke detectors, control systems, or vents • Fire pumps • Standpipes To get an idea of when the fire-suppression system or equipment was last inspected, the screener should check the date of the last certification on the fire extinguishers if available.	a. Yes b. No
8b.25	**Publicly Accessible Fire Department Connections** A fire department connection consists of a brass body with inlets to which the fire department connects hoses. Generally, water is pumped into the connection to supplement the building's fire sprinkler or standpipe system. In most cases, each inlet has its own clapper or check valve that only allows water to move in one direction into the building. Connections are exposed, flush mount, or free standing.	a. Yes b. No

8b. Vulnerability Rating: Fire Protection System Vulnerabilities (Fire Marshal)		
ID	**Building Characteristics**	**Attribute Options**
8b.26	**Locking Caps on Fire Department Connections** Locking caps are secure covers on the fire department connections (FDCs) that protect fire sprinkler connections from accidental damage, vandalism, and physical attack. Locking FDC caps ensure sprinkler reliability and building safety by preventing foreign objects from entering the sprinkler system.	a. Yes b. No  *b. FDC with one locked cap and one missing cap* SOURCE: THOMAS BARNUM
8b.27	**Fire Department Service** Local fire departments can consist of career or volunteer firefighters or a combination.	a. Combination. The fire department consists of both career and volunteer firefighters b. Career. The fire department consists of full-time paid firefighters who have been trained extensively and primarily to put out hazardous fires and to provide emergency services. c. Volunteer. The fire department consists of volunteers who are part-time and work organized shifts to perform fire suppression and other related emergency services for the local jurisdiction.
8b.28	**Fire Department Pre-Planning** The local fire department may or may not have conducted a walkthrough of the building to develop emergency plans and operations for the specific building.	a. Yes b. No
8b.29	**Fire Department Drills** The fire department may or may not conduct exercises at the building.	a. Yes b. No

8b. Vulnerability Rating: Fire Protection System Vulnerabilities (Fire Marshal)		
ID	**Building Characteristics**	**Attribute Options**
8b.30	**Fire Apparatus Access Roads** Access roads or emergency access roads for fire apparatus are provided to meet the needs of fire officials. Access roads provide access by fire apparatus and other emergency response vehicles to the building. Entrances to and from the site must be in operation during and after a disaster. Routes that are near retaining walls, natural soil slopes, bridges, tunnels, or other vulnerable facilities that are susceptible to failure can impede emergency activities. At least one access road should remain passable at all times primarily for emergency vehicles. A driveway should be at least 12 feet wide to accommodate fire control equipment.	a. Sufficient b. Insufficient
8b.31	**Knox Box** A knox box is a small, wall-mounted safe that holds building keys that firefighters and emergency medical technicians can retrieve in emergencies. Local fire companies may have master keys to all such boxes in their response area so their personnel can quickly enter a building without having to force entry or have to find keys in the building.  *a. Knox box in a building* SOURCE: JOESEPH BARIALLARI	a. Yes b. No
8b.32	**Building Staffed 24/7** The building may or may not be continuously occupied by staff such as maintenance and security.	a. Yes b. No
8b.32	**Fire Brigade Apparatus** Personal protective equipment and fire equipment may or may not be available in the building.	a. Yes b. No

8b. Vulnerability Rating: Fire Protection System Vulnerabilities (Fire Marshal)		
ID	**Building Characteristics**	**Attribute Options**
8b.33	**Source of Water Supply for Firefighting Operations** The water for firefighting operations may come from a municipal or private source or a combination.	a. Yes b. No
8b.34	**Water Supply for Firefighting Operations** The water supply may or may not be adequate for firefighting operations.	a. Municipal b. Private c. Combination
8b.35	**Water Supply for Firefighting Operations** The water supply may or may not be adequate for firefighting operations.	a. Adequate b. Inadequate
8b.36	**Inspection, Testing, and Maintenance of Fire Hydrant Systems** The screener must determine whether fire hydrants at the building site have been inspected and tested and has had typical maintenance in the last 12 months.	a. Yes b. No
8b.37	**Fire Safety Training for Occupants/Tenants** Training occupants/tenants in fire safety and emergency operations is essential because it is the engagement and decision-making of these individuals that will determine the success of emergency preparedness and response. Training should be provided to all occupants/tenants. Objectives for training are: • To develop occupants/tenants awareness of potential threats or hazards. Employees should be able to recognize, report, and appropriately respond to suspicious items. • To develop an understanding of the responses and protective actions and what should be done for each possible protective action.	a. Yes b. No
8b.37.1	**Refresher Fire Safety Training** Review courses aimed at reinforcing fire safety training.	a. Yes b. No
8b.37.2	**Frequency of Fire Safety Training** How often the fire safety training reoccurs.	a. Weekly b. Monthly c. Quarterly d. Semi-annually e. Annually or longer

8b. Vulnerability Rating: Fire Protection System Vulnerabilities (Fire Marshal)		
ID	**Building Characteristics**	**Attribute Options**
8b.38	**Tenant Safety Organization** A tenant safety organization (TSO) is a group of employees who have volunteered and have had special training to assist occupants during an emergency evacuation. Each TSO typically contains the following members: • Facility/building manager • Agency control director • Floor marshals • Floor searchers • Floor wardens The TSO assists in the orderly evacuation of employees and visitors during regularly scheduled fire drills and actual evacuations. In the event of an actual emergency, these volunteers are a vital, lifesaving link between those who occupy the facilities and the fire safety personnel. The TSO is set up for the sole purpose of ensuring a safe and orderly evacuation of all employees and visitors in the event of an emergency. Members of the TSO do not attempt to fight fires or search for bombs.	a. Yes b. No
8b.38.1	**TSO Training** The members of the TSO may or may not have received special training to assist occupants during an emergency evacuation.	a. Yes b. No
8b.38.2	**TSO Refresher Training** Review courses aimed at reinforcing TSO training.	a. Yes b. No
8b.38.3	**Frequency of TSO Training** How often the TSO training reoccurs.	a. Weekly b. Monthly c. Quarterly d. Semi-annually e. Annually or longer
8b.39	**Fire Drills** Fire drills consist of practice evacuations of a building for a fire or other emergency. Many jurisdictions require regular fire drills at elementary and middle schools, high schools, and other places. Often the frequency of drills and any special actions that must be taken during drills are listed in the statute.	a. Yes b. No
8b.39.1	**Frequency of Fire Drills** How often the fire drills occur.	a. Weekly b. Monthly c. Quarterly d. Semi-annually e. Annually or longer

8b. Vulnerability Rating: Fire Protection System Vulnerabilities (Fire Marshal)		
ID	**Building Characteristics**	**Attribute Options**
8b.40	**Emergency Evacuation Plan and Shelter-In-Place** An emergency evacuation plan refers to a procedure for immediately and rapidly moving people out of the building because of a threat or hazard. Emergency evacuation plans are developed to ensure the safest and most efficient evacuation of all people in the building. An effective plan uses multiple exits and technologies to ensure full and complete evacuation. A shelter-in-place plan refers to a procedure for immediately and rapidly moving people into interior areas of the building that provide higher levels of protection and seal off from outside hazards, typically the lobby, stairwells, and interior conference rooms that are away from exterior walls and windows.	a. Yes b. No
8b.41	**Emergency Evacuation and Shelter-In-Place Plans Publicly Accessible** The building's procedures for safe evacuation and shelter-in-place may or may not be prominently posted in the building.	a. Yes b. No

9. Vulnerability Rating: Security Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
9.1	**Internal Threat: Intrusion** Intrusion refers to entering or breaking into a building by a person or persons with the intent of attacking or causing harm to the building assets, including people.	
9.1.1	**Number of Security Systems** Detection systems are designed to prevent, detect, deter, and respond to threats, including intrusion. Redundant detection systems (multiple detection layers) are highly desirable. Types of security systems for intrusion detection include: • Intrusion detection • Video surveillance • Security guards • Security lighting • Access control • Asset/interdiction-related communications	a. 3 or more systems b. 2 systems c. 1 system d. None
9.1.2	**Security System Effectiveness** Regardless of how many security systems are provided, if they are not effective, they will not help thwart intrusion. This characteristic is intended to capture the collective effectiveness of the systems.	a. Highly effective b. Effective c. Moderate d. Ineffective e. No security

9. Vulnerability Rating: Security Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
9.2	**Internal Threat: Explosion** An internal explosion refers to the detonation of an explosive device within the interior of the building.	
9.2.1	**Number of Security Systems** Detection systems are designed to prevent, detect, deter, and respond to threats, including internal explosion. Redundant detection systems are highly desirable. Types of security systems for explosive detection include: • Explosion detection equipment • Personnel screening • Video surveillance • Security guards • Access control • Asset/interdiction-related communications	a. 3 or more systems b. 2 systems c. 1 system d. None
9.2.2	**Security System Effectiveness** Regardless of how many security systems are provided, if they are not effective, they are will not helpful thwart internal explosive attacks. This characteristic is intended to capture the collective effectiveness of the systems.	a. Highly effective b. Effective c. Moderate d. Ineffective e. No security
9.3	**Internal: CBR** An internal CBR threat refers to the release of a CBR agent inside the building.	
9.3.1	**Number of Security Systems** Detection systems are designed to prevent, detect, deter, and respond to threats, including an internal CBR release. Redundant detection systems are highly desirable. Types of security systems for an internal CBR release include: • CBR detection or filtration equipment • Video surveillance • Security guards • Access control	a. 3 or more systems b. 2 systems c. 1 system d. None
9.3.2	**Security System Effectiveness** Regardless of how many security systems are provided, if they are not effective, they are will not help thwart an internal CBR release attacks. This characteristic is intended to capture the collective effectiveness of the systems.	a. Highly effective b. Effective c. Moderate d. Ineffective e. No security
9.4	**External Threat (Zone 1): Explosion** An explosive threat from outside the building within 100 feet of the building.	

9. Vulnerability Rating: Security Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
9.4.1	**Number of Security Systems** Detection systems are designed to prevent, detect, deter, and respond to threats, including external explosions. Redundant detection systems are highly desirable. Types of security systems for external explosions include: • Video surveillance • Security patrols • Mobile search and screening (e.g., K-9 unit) • Vehicle screening	a. 3 or more systems b. 2 systems c. 1 system d. None
9.4.2	**Security System Effectiveness** Regardless of how many security systems are provided, if they are not effective, they will not help thwart an external explosive attacks. This characteristic is intended to capture the collective effectiveness of the systems.	a. Highly effective b. Effective c. Moderate d. Ineffective e. No security
9.5	**External Threat (Zone 1): CBR** A CBR release outside the building within 100 feet of the building.	
9.5.1	**Number of Security Systems** Detection systems are designed to prevent, detect, deter, and respond to threats, including an external CBR release. Redundant detection systems are highly desirable. Types of security systems for external CBR releases include: • Video surveillance • Security patrols • Mobile search and screening (e.g., K-9 unit)	
9.5.2	**Security System Effectiveness** Regardless of how many security systems are provided, if they are not effective, they are will not help thwart external CBR attacks. This characteristic is intended to capture the collective effectiveness of the systems.	

10. Vulnerability Rating: Cyber Infrastructure Vulnerabilities		
ID	**Building Characteristics**	**Attribute Options**
10.1	**Effectiveness of Cyber Security Plan** The effectiveness of the cyber security plan for protecting in-place cyber security systems is evaluated in this characteristic. Cyber security systems include the electronic security system and systems such as the supervisory control and data acquisition (SCADA) and utility monitoring and control systems (UMCS), which monitor and control utilities in a building. Many building operation systems use the Internet to perform these functions, so cyber security should be a priority because the systems are accessible to all attackers with access to a computer and the Internet. The best protection for these systems is to remove them from the Internet. When that is not feasible, other protective features should be put in place.	a. High b. Medium c. Low d. None
10.2	**Effectiveness of Training Programs** The screener must determine the effectiveness of the in-place programs to train building management employees on the cyber security measures.	a. High b. Medium c. Low d. None
10.3	**Security of Communication Systems** The screener must determine the level of protection of the communications system equipment, including main distribution centers, wiring closets, data centers, routers, and servers.	a. Secured b. Medium c. Marginal d. No security
10.4	**Redundancy of Communications Systems** Redundant communications systems are intended to keep the communications systems operating if the primary system is compromised. The screener must determine whether the communications systems are redundant. The building should have a second telephone service connected directly to the local commercial telephone switch offsite (not in the building) to maintain communications or a base radio communications system with antenna.	a. Yes b. No
10.5	**Power Supply Security** The power supply ensures that all communications and security measures are functioning, so its security is essential. The screener must determine the effectiveness of the in-place measures to protect the power supply to the building.	a. Secured b. Medium c. Marginal d. No security
10.6	**Effectiveness of Wide Area Network (WAN), Local Area Network (LAN), Wireless, Radio, and Satellite Systems During Emergencies** The screener must determine the effectiveness of communication mode functions in delivering important messages to and from the building if other systems are compromised.	a. High (regional) b. Medium (within jurisdiction) c. Low (system only)

11. Resiliency Rating: Continuity of Operations		
ID	**Building Characteristics**	**Attribute Options**
11.1	**Emergency Operations Center and Incident Command System** The screener must determine whether the building has a physical location where the coordination of information and resources to support incident management (on-scene operations) activities would normally take place. An Emergency Operations Center (EOC) may be a temporary facility or it may be located in a more central or permanently established facility, perhaps at a higher level of organization within a jurisdiction. EOCs may be organized by major functional disciplines (e.g., fire, law enforcement, medical services), by jurisdiction (e.g., Federal, State, regional, tribal, city, county), or by some combination. An Incident Command System (ICS) is a standardized, on-scene, all-hazards incident management approach that: • Allows for the integration of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure. • Enables a coordinated response among various jurisdictions and functional agencies, both public and private. • Establishes common processes for planning and managing resources.	a. Yes b. Partial c. No
11.2	**Plans, Policies, and Procedures for Disaster Recovery and Business Continuity Processes** The screener must determine whether the organization (stakeholder, tenant, or building owner) has a business continuity and recovery plan that identifies stakeholders who need to be notified in a disaster; critical and time-sensitive applications; alternative work sites; vital records, contact lists, processes, and functions that must be maintained; and personnel, procedures, and resources that are needed while the entity is recovering. The recovery plan should provide for restoration of functions, services, resources, facilities, programs, and infrastructure.	a. Yes b. Partial c. No

11. Resiliency Rating: Continuity of Operations		
ID	**Building Characteristics**	**Attribute Options**
11.3	**Risk Assessment and Business Impact Analysis** The screener must determine whether the organization (stakeholder, tenant, or building owner) has conducted a risk assessment and business impact analysis (BIA) to identify strategies for prevention and mitigation and to gather information to develop plans for response, continuity, and recovery for the following: • Natural hazards (geological, meteorological, and biological) • Human-caused events (accidental and intentional) • Technologically caused events (accidental and intentional) Risk assessment is a process for identifying hazards and their relative probability of occurrence, identifying assets at risk, assessing the vulnerability of the assets at risk by the identified hazards, and quantifying the potential impact of the hazard on the assets. Many potential hazards should be reassessed periodically because the entity and hazards may change. The assessment should include a BIA to identify critical business functions and the impact of losing those functions. The screener must determine whether the organization has had a BIA that identifies the functions, processes, and applications that are critical to the entity and the point when the interruption or disruption becomes unacceptable. The BIA, sometimes called a business interruption study (BIS), provides an assessment of how key disruption risks could affect an entity's operations and identifies capabilities that are required to manage them. The business purpose and process is understood by conducting a business process analysis, which identifies the lines of process flow (i.e., material flow, information flow, people movement, cash flow) and time constraints. In the public sector, continuity of operations plans might use a BIA to identify critical governmental functions.	a. Yes. The building has had a risk assessment and BIA b. Partial. The building has had either a risk assessment or a BIA c. No. A risk assessment or BIA has not been conducted on the building
11.4	**Mutual Aid Agreements** The screener must determine whether the building's security and emergency management plans are coordinated with local and regional first responders. A mutual-aid agreement should be established between the building management and entities in the area that would be called on to supplement resources in an emergency. The collaboration should include: • Coordinated exercises with both entities for emergency preparedness and response • Sharing of emergency response and security protocols • Information sharing capabilities (e.g., contacts, procedures, resource inventories) • Interoperable communications systems with first responders • Communications procedures • Contact information, including emergency contact outside the anticipated hazard area • Accounting for persons affected, displaced, or injured by the incident	a. Yes b. Partial c. No

<table>
<tr><th colspan="3">11. Resiliency Rating: Continuity of Operations</th></tr>
<tr><th>ID</th><th>Building Characteristics</th><th>Attribute Options</th></tr>
<tr><td>11.5</td><td colspan="2">Disaster/Emergency Management: Continuity of Operations

The intent of this characteristic to evaluate the critical processes and functions in the subject building and the ability to maintain operations after an event. Continuity of operations includes the concept of redundancy, which could be an alternate site or additional equipment. The option selected should be supported by the emergency plans and resources and recovery plans of each building or function being assessed. Critical processes and functions are outlined for six types of buildings: general, government, medical, school, financial/business, and retail.

The screener should determine the recovery objectives of each critical process or function. Recovery is the period during which functions must continue to operate after an event or outage. The screener should determine based on the objectives whether the capabilities of the building for redundancy would allow for the building to meet these goals.

For example, a hurricane may knock out the primary power supply. If the organization has established goals to maintain operation for 3 days to avoid a negative impact on the business and a backup generator is available that can supply the building with power for a week, then the goals are fully met.

All systems in the entire building should be assessed. For only part or one or more floors of a building, the screener should focus primarily on the systems that affect that portion of the building. However, the systems in the entire building should be considered as applicable.

Selecting the attribute options will be aided by:
• Existing emergency plans and resource and recovery plans
• Established goals for continuity of operations
• Established maximum acceptable downtimes

If these three items are non-existent, the screener should use best judgment or choose Option d., the most conservative option.

Option a. indicates that a function is either non-existent or is not related to the assessment.</td></tr>
<tr><td>11.5.1</td><td>Water Supply/Storages

The screener must determine how effectively the utility systems will continue to provide water to the building to maintain services such as business services, cooling towers, drinking water, and fire protection systems. Fire protection systems include pump rooms, water storage tanks, and equipment such as valves and pipes.</td><td>a. Not applicable
b. Fully meets goals
c. Partially meets goals
d. Does not meet goals or has not established goals</td></tr>
<tr><td>11.5.2</td><td>Power Supplies

The screener must determine how effectively the electrical systems will maintain power to essential building services, which include electrical rooms, equipment such as electrical panels, generators, transformers and surge protectors, and wiring.</td><td>a. Not applicable
b. Fully meets goals
c. Partially meets goals
d. Does not meet goals or has not established goals</td></tr>
<tr><td>11.5.3</td><td>Heating and Cooling Systems

The screener must determine how effectively heating and cooling systems will continue to provide safe, healthy, and comfortable air conditions in a building by regulating temperature and humidity. Heating and cooling systems include physical plants; equipment such as cooling towers; and electrical, oil, and gas lines.</td><td>a. Not applicable
b. Fully meets goals
c. Partially meets goals
d. Does not meet goals or has not established goals</td></tr>
</table>

11. Resiliency Rating: Continuity of Operations		
ID	**Building Characteristics**	**Attribute Options**
11.5.4	**Generator/Backup Power** The screener must determine how effectively emergency and standby generators will continue to provide electricity for building operations if the primary source of power is knocked out.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.5	**Waste Water Systems** The screener must determine how effectively the sewer services will continue to provide a means of waste disposal.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.6	**Supplies/Inventories** The screener must determine what level of goods and materials are in stock.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.7	**Deliveries/Loading Dock** The screener must determine how effectively the loading docks will continue to operate? A loading dock is a recessed bay in a building or facility where trucks are loaded and unloaded.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.8	**Elevators** The screener must determine how effectively elevators in high-rise buildings and special facilities such as hospitals will continue to efficiently transport occupants.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.9	**Data/Telecom** The screener must determine how effectively the distribution room will continue to maintain data and the telecom cables/wires that facilitate communications functions.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.10	**IT/Computers** The screener must determine how effectively computers and software will continue to securely convert, store, protect, process, transmit, input, output, and retrieve information for daily business operations.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals

11. Resiliency Rating: Continuity of Operations		
ID	**Building Characteristics**	**Attribute Options**
11.5.11	**Utility Control Center** The screener must determine how effectively the control center will continue to monitor and operate power supply, water, heating, and cooling functions.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.12	**Emergency Operations** The screener must determine how effective the EOC is. The EOC is a central command and control facility responsible for carrying out the principles of emergency preparedness and emergency management, or disaster management functions at a strategic level in an emergency situation, and for ensuring the continuity of operation of a company, political subdivision, or other organization.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.13	**Janitorial/Housekeeping** The screener must determine how effectively the janitorial, custodial, or housekeeping staff will continue interior cleaning and maintenance. A standardized cleaning system provides a scientific approach to cleaning , better property asset management, and a healthy workplace.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.14	**Archives/Vital Records** The screener must determine how effectively the historical documents or critical information are stored in the building (physically or digitally on a network).	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.15	**Special Collections/Valuables** The screener must determine how effectively the special collections are protected and stored in the building.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.16	**Hazardous/Potentially Hazardous Materials** The screener must determine how safe the solids, liquids, and gases necessary for building functions but potentially harmful are stored.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.17	**Critical Vehicle and Equipment Bays/Garages** The screener must determine the availability of vehicles and equipment in garages for continued use?	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals

11. Resiliency Rating: Continuity of Operations		
ID	**Building Characteristics**	**Attribute Options**
11.5.18	**Short-term Shelter/In-Place** The screener must determine the reliability of a safe haven or secure area of the building where occupants can go for immediate protection from physical attacks or natural hazards until it is safe to evacuate.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.19	**Long-term Shelter/Community Shelter** The screener must determine the reliability of a safe haven for a community (e.g., a school gym or auditorium) during and after a manmade hazard. The shelter requires adequate supplies for a large number of people for an extended period.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.20	**Holding/Detention Cells** The screener must determine the reliability of the confined area where prisoners are held in law enforcement buildings.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.21	**Laboratory** The screener must determine the reliability of a laboratory that provides controlled conditions in which scientific research, experiments, and measurement may be performed.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.22	**Pharmacy** The screener must determine the reliability of the pharmacy practice, which includes traditional roles such as compounding and dispensing medications and modern services related to health care, including clinical services, reviewing medications for safety and efficacy, and providing drug information.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or /has not established goals
11.5.23	**Emergency Department (Medical)** The screener must determine the reliability of a facility in a hospital specializing in the acute care of patients who arrive without appointment either by their own means or by ambulance. Emergency departments are usually in a hospital or other primary care center. Because of the unplanned nature of patient attendance, the department must be able to provide initial treatment for a broad spectrum of illnesses and injuries, some of which may be life-threatening and require immediate attention. Emergency departments of most hospitals operate 24 hours day.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.24	**Operating Room** The screener must determine the reliability of the operating room in a hospital. Operating rooms are typically part of the operating suite that forms a distinct section with a healthcare facility.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals

11. Resiliency Rating: Continuity of Operations		
ID	**Building Characteristics**	**Attribute Options**
11.5.25	**X-Ray** The screener must determine the reliability of equipment in medical facilities for taking x-rays.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.26	**Rehabilitation Clinic** The screener must determine the reliability of the rehabilitation clinic for maintaining care.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.27	**Outpatient Clinic** The screener must determine the reliability of the outpatient clinic for maintaining diagnostic and treatment services to patients.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.28	**In-patient Wards** The screener must determine the reliability of the in-patient wards to continue providing care.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.27	**Medical Gases** The screener must determine how effectively medical gases, including oxygen, nitrous oxide, nitrogen, carbon dioxide, and medical air will be provided to various parts of the hospital.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.30	**Liquid Oxygen Storage** The screener must determine the safety of the gases that are necessary for life-saving functions and stored in the building.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals
11.5.31	**Other Critical Functions** The screener must determine how effectively any other critical function specific to the building and not included in the list of functions for the IRVS will continue to function. The screener should describe the function in the comments tab.	a. Not applicable b. Fully meets goals c. Partially meets goals d. Does not meet goals or has not established goals

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A

Acronyms

BFE	base flood elevation
BIA	business impact analysis
BIPS	Buildings and Infrastructure Protection Series
BIS	business interruption study
C	consequences
CBR	chemical, biological, and radiological
CBRNE	chemical, biological, radiological, nuclear, explosive
CIKR	Critical Infrastructure and Key Resources
CMU	concrete masonry unit
CPTED	crime prevention through environmental design
DCF	Data Collection Form
DHS	Department of Homeland Security
EOC	Emergency Operations Center
FDC	fire department connection
FEMA	Federal Emergency Management Agency

FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
fps	feet per second
gpm	gallons per minute
HazMat	hazardous materials
HSPD	Homeland Security Presidential Directorate
HVAC	heating, ventilation, and air conditioning
IDD	Infrastructure Protection and Disaster Management Division
IRVS	integrated rapid visual screening for mass transit stations
IT	Information Technology
LOX	liquid oxygen
MEP	mechanical/electrical/plumbing
MS	Microsoft
NIPP	National Infrastructure Protection Plan
NOAA	National Oceanic and Atmospheric Administration
NOX	nitrous oxide
OS&Y	outside stem and yoke
PIV	post indicator valve
S&T	Science and Technology Directorate
SCADA	supervisory control and data acquisition
SGCC	Safety Glazing Certification Council
T	threat
TSO	tenant safety organization
USGS	U.S. Geological Survey
V	vulnerabilities
WTC	Word Trade Center

B

Glossary

100-year flood. See base flood.

Access control. Any combination of barriers, gates, electronic security equipment, and guards that can prevent the entry of unauthorized personnel or vehicles.

Aggressor. Any person seeking to compromise a function or structure.

All-hazards. All conditions, environmental or manmade, that have the potential to cause injury, illness, or death; damage to or loss of equipment, infrastructure services, or property; or social, economic, or environmental functional degradation.

Assessment. Evaluation and interpretation of measurements and other information to provide a basis for decision-making.

Asset. Person, structure, facility, information, material, or process that has value.

Asset-related communications. Systems that facilitate rapid information gathering, decision-making, and response (action taking).

Attack. Hostile action resulting in injury or death in the civilian population or damage or destruction to public or private property.

Attribute. Subcategory of characteristic. For example, structure type is a characteristic, and wood frame is an attribute.

Base flood. The flood with a 1 percent chance of being equaled or exceeded in any given year, commonly referred to as the "100-year flood." The base flood is the national standard used by the National Flood Insurance Program and all Federal agencies for the purpose of requiring the purchase of flood insurance and regulating new development.

Biological agent. Bacteria, viruses, fungi, and other microorganisms that cause disease or harm to humans, animals, or plants or cause deterioration of material. Biological agents may be in liquid droplets, aerosols, or dry powders.

Bracing. Diagonal members that connect components of a structural frame or equipment in a way so as to resist lateral forces.

Business continuity. Ability of an organization to continue to function during and after a disaster.

Catalog. List of building characteristics and attributes that are assessed in the IRVS of buildings. Includes guidance on selecting attributes.

Characteristic. Physical component, functionality, or operation that relates to consequences, threat, or vulnerability.

Chemical agent. Toxic substance developed or selected for use in warfare to kill or incapacitate people.

Closed circuit television. Electronic system of cameras, control equipment, recorders, and related apparatus used for surveillance or alarm assessment.

Collateral damage. Injury or damage to assets that are not the primary target of an attack.

Consequence. Effect of an event, incident, or occurrence. Consequences are divided into four categories: public health and safety, economic, psychological, and governance/mission impacts.

Consequences rating. Degree of impact that would result from the incapacitation or destruction of the building's assets (occupants, critical functions, and infrastructure) as a result of a catastrophic event causing fatalities, social and economic losses, and/or business disruption.

Continuity of operations. See business continuity.

Control system. Computer-based system used in many types of infrastructure and in many industries to monitor and control sensitive processes or physical functions.

Crime prevention through environmental design (CPTED). Crime prevention strategy based on evidence that the design and form of the built environment can influence human behavior. CPTED is usually based on the principles of natural surveillance, natural access control, and territorial reinforcement.

Critical infrastructure. Vital system or asset, either physical or virtual, that the incapacitation or destruction of which may have a debilitating impact on the security, economy, public health or safety, environment, or any combination, across a Federal, State, regional, territorial, or local jurisdiction.

Cyber security. Protection that is intended to prevent damage to, unauthorized use of, or exploitation of, and if needed, restoration of electronic information and communications systems. Includes protection of information networks and wireline, wireless, satellite, public safety answering points, and communication and control systems. In the IRVS methodology, cyber security is limited to the protection of the built environment.

Data Collection Form. Form containing the building characteristics and attribute options that is used in the IRVS of buildings.

Deterrence. Inhibition of criminal behavior by fear, especially of punishment.

Diaphragm. A horizontal or nearly horizontal structural element designed to transmit lateral forces to the vertical elements of a seismic force resisting system.

Direct economic loss. Cost to rebuild, respond, and recover from an event.

Disaster. Natural catastrophe, technological accident, or human-caused event that results in deaths, multiple injuries, or severe property damage.

Downtime. Disruption of a service that is the result of an event, incident, or occurrence.

Earthquake. Sudden motion or vibration in the earth caused by the abrupt release of energy in the earth's lithosphere.

Emergency. Any natural or human-caused situation that results in or may result in substantial injury or harm to the population or substantial damage to or loss of property.

Fault. Fracture in the earth's crust accompanied by displacement of one side of the fracture with respect to the other in a direction parallel to the fracture.

First responder. Local police, fire, or emergency medical personnel who arrive first on the scene of an incident and take action to save lives, protect property, and meet basic human needs.

Flash floods. Floodwater levels that rise and fall rapidly.

Flood Insurance Rate Map (FIRM). The official map of a community on which FEMA has delineated both the special hazard areas and the risk premium zones applicable to the community.

Flood. Temporary, partial, or complete inundation of normally dry land from overflow of inland or tidal waters, unusual or rapid accumulation or runoff of surface waters, or mudslides/mudflows caused by accumulation of water.

Floodway. The channel and the portion of the floodplain that is reserved to convey the base flood to prevent the water surface elevation from increasing more than a designated height.

Flood Insurance Study (FIS). Engineering study performed by FEMA to identify flood hazard areas, flood insurance risk zones, and other flood data in a community; used in the development of the FIRM.

Floodplain. Any land area, including the watercourse, that is susceptible to partial or complete inundation by water from any source.

Glazing. Glass or a transparent or translucent plastic sheet used in windows, doors, and skylights.

Ground failure. Physical changes to the ground surface such as lateral spreading, landslides, and liquefaction that are produced by an earthquake.

Function. Service, process, capability, or operation performed by an asset, system, network, or organization.

Hazard. Natural or manmade source or cause of harm or difficulty.

Hazardous material. Any substance or material that, when involved in an accident and released in sufficient quantities, poses a risk to people's health, safety, and/or property. Includes explosives, radioactive materials, flammable liquids or solids, combustible liquids or solids, poisons, oxidizers, toxins, and corrosive materials.

Hurricane. A tropical cyclone formed in the atmosphere over warm ocean areas in which wind speeds reach 74 miles per hour or more and blow in a large spiral around a relatively calm center or "eye."

Hurricane-prone region. Area vulnerable to hurricanes. In the United States and its territories, the U.S. Atlantic Ocean and Gulf of Mexico coasts, where the basic wind speed is greater than 90 miles per hour, and Hawaii, Puerto Rico, Guam, U.S. Virgin Islands, and American Samoa.

Hydrodynamic load. Load imposed by water flowing against and around an object or structure, including the impacts of debris and waves.

Hydrostatic load. Load (pressure) imposed on an object or structure by a standing mass of water; the deeper the water, the greater the load or pressure against the object or structure.

Incident Command System. Standardized organizational structure used to command, control, and coordinate the use of resources and personnel who have responded to the scene of an emergency.

Indirect economic loss. Downstream costs resulting from disruption of the service after an event.

Infrastructure. Framework of interdependent networks and systems comprising identifiable industries, institutions (including people and procedures), and distribution capabilities that provide a reliable flow of products and services essential to the defense and economic security of the United States.

Integrated rapid visual screening. Quick and simple procedure to assess the risk and resiliency of a building.

Interdependency. Mutually reliant relationship between entities (objects, individuals, or groups). The degree of interdependency is not necessarily equal in both directions.

Intrusion detection system. Combination of sensors, control units, transmission lines, and monitor units integrated to operate in a specified manner.

Key resource. Publicly or privately controlled resource essential to the minimal operation of the economy and government.

Liquefaction. Conversion of a solid into liquid by heat, pressure, or violent motion; sometimes occurs to the ground in earthquakes.

Manmade hazard. Human-caused hazard that is either technological or terrorism. Distinct from a natural hazard primarily in that it originates in human activity.

Mass transit station. Structure acting as a terminal, typically underground or elevated, serving a mode of transportation for a mass transit system.

Mutual Aid Agreement. Pre-arranged agreement developed between two or more entities to render assistance to the parties of the agreement.

Mitigation. Ongoing and sustained action to reduce the probability of or lessen the impact of an adverse incident.

Moment frame. Space frame in which members and joints are capable of resisting lateral forces by bending and along the axis of the members.

National Infrastructure Protection Plan (NIPP). DHS document that provides the structure for integrating existing and future Critical Infrastructure and Key Resources (CIKR) protection and resilience strategies into a single national program.

National Flood Insurance Program (NFIP). Federal program to identify flood-prone areas nationwide and make flood insurance available for properties in communities that participate in the program.

Natural hazard. Naturally occurring event such as a flood, earthquake, tornado, tsunami, coastal storm, landslide, or wildfire that strikes a populated area and has the potential to harm people or property.

Natural protective barrier. Mountain, desert, cliff, ditch, water obstacle, or other terrain feature that is difficult to traverse.

Network. Group of components that interact or share information to perform a function.

Operational redundancy. Degree to which an organization or building can maintain a reasonable level of service and achieve uninterrupted stability of operations after (and ideally, during) a disaster, rather than simply being able to recover after a disaster.

Owner/operator. Entity responsible for day-to-day operation and investment in a particular asset or system.

Partition. Interior or exterior wall that does not provide support for vertical loads other than its own weight.

Physical security. Measures/concepts designed to safeguard personnel; prevent unauthorized access to equipment, installations, material, and documents; and safeguard them against espionage, sabotage, damage, and theft.

Prioritization. Process of using risk assessment results to identify where risk reduction or mitigation efforts are most needed and to determine which protective actions should be implemented in order to have the greatest effect.

Progressive collapse. Chain reaction failure of structural members to an extent disproportionate to the original localized damage. Such damage may result in upper floors collapsing onto lower floors.

Protective measure. Element of a protective system that protects an asset against a threat. Protective measures are either defensive or detection measures.

Radiation. High-energy particles or gamma rays that are emitted by an atom as the substance undergoes radioactive decay. Particles can either be charged alpha or beta particles or neutral neutron or gamma rays.

Recovery. Long-term activities beyond the initial crisis period and emergency response phase of disaster operations that focus on returning all systems in the community to a normal status or on reconstituting the systems to a new condition that is less vulnerable.

Replacement value. Current market cost to construct the asset.

Resilience. Ability to resist, absorb, recover from, or successfully adapt to adversity or a change in conditions.

Resilience score. Numerical value that describes the ability of a building to resist, absorb, and recover from a potentially disruptive event at a building.

Response. Execution of a plan to preserve and protect life and property and to provide services to the surviving population.

Risk. Potential for an unwanted outcome resulting from an incident, event, or occurrence, as determined by its likelihood and the associated consequences.

Risk score. Numerical value obtained from the IRVS that describes the risk to a building for a terrorist attack or natural disaster.

Recovery. Return to or reconstitute normal operations after a disruption.

Resourcefulness. Ability to skillfully prepare for, respond to, and manage a crisis or disruption as it unfolds.

Robustness. Ability to maintain critical operations and functions in a crisis.

Scour. Removal of soil or fill material by the flow of floodwaters. Frequently used to describe storm-induced, localized erosion around pilings at building corners and other foundation supports where the obstruction flow increases turbulence.

Secondary hazard. Threat whose potential is realized by a triggering event that is an emergency (e.g., fire associated with an earthquake).

Sector. Logical collection of assets, systems, or networks that provide a common function to the economy, government, or society.

Seismic. Related to, subject to, or caused by an earthquake or earth vibration.

Seismic zone. Area defined on a map within which seismic design requirements are constant.

Shear wall. Wall designed to resist lateral forces parallel to the plane of the wall.

Stakeholder. Person, group, or entity that holds an interest or benefits from the IRVS.

Stand-off distance. Distance between a building and the potential location for an explosive detonation or other threat.

Stillwater flood depth. Elevation that the surface of floodwaters would assume in the absence of waves.

Stress. Applied load per unit area or internal resistance within a material that opposes deforming force.

Subway. Underground railroad, generally in a large city. Considered heavy rail because it operates on a dedicated track.

Target density. Number of potential high-value targets around a building.

Terrorism. Unlawful use of force and violence against persons or property to intimidate or coerce a government, civilian population, or any segment thereof in furtherance of political or social objectives.

Threat. Natural or manmade occurrence, individual, entity, or action that has or indicates the potential to harm life, information, operations, the environment, or property.

Tornado. Local atmospheric storm, generally of short duration, formed by winds rotating at very high speeds, usually in a counter-clockwise direction. The vortex, up to several hundred yards wide, is visible to the observer as a whirlpool-like column of winds rotating about a hollow cavity or funnel.

Torsion. Twisting of a structural member along its vertical axis.

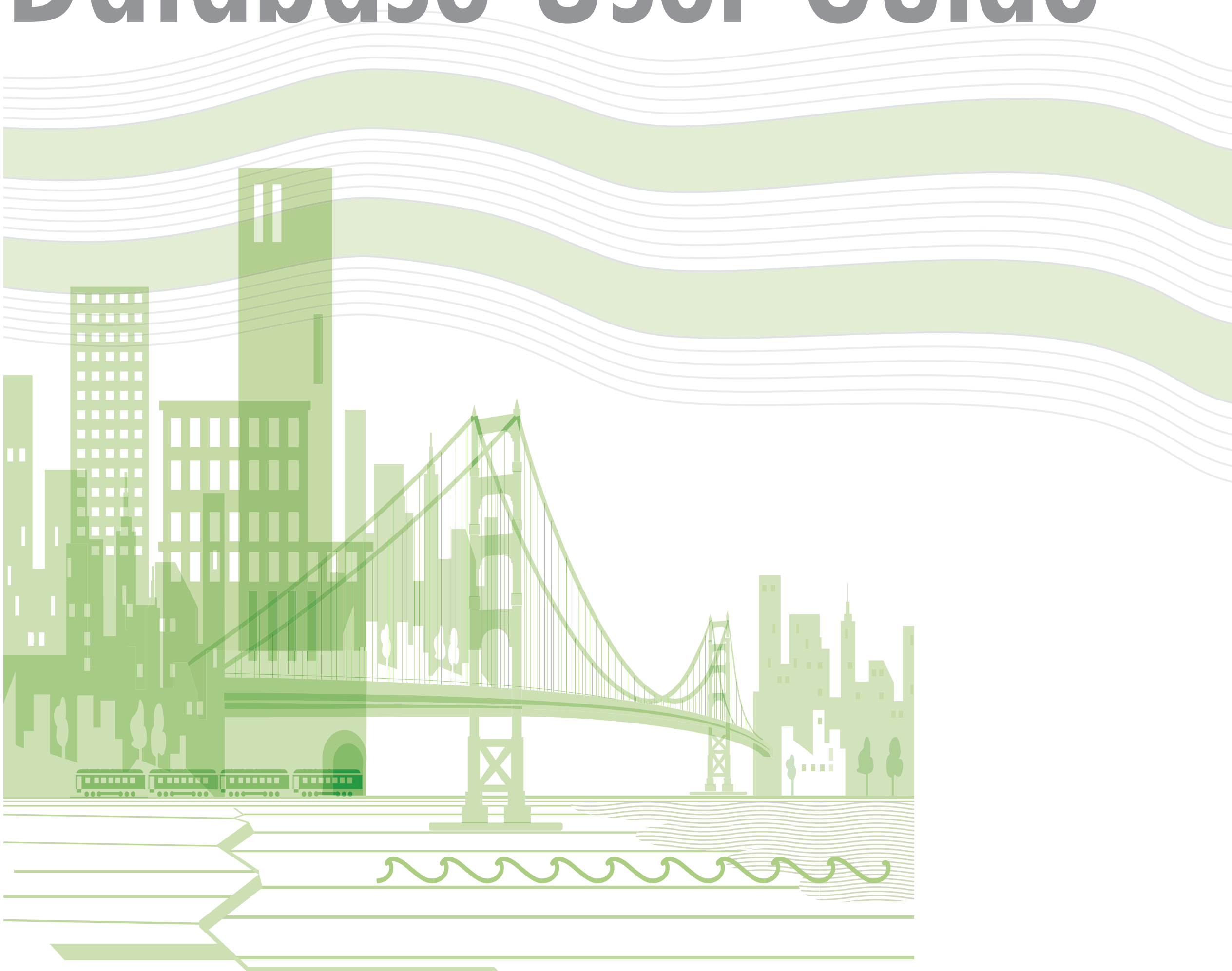
Threat rating. Likelihood or potential of the occurrence of manmade or natural hazard.

Vulnerability. Physical feature or operational attribute that renders an entity open to exploitation or susceptible to a given hazard.

Vulnerability rating. Weakness of functions, systems, and sites in regard to a particular threat/hazard.

C

Integrated Rapid Visual Screening (IRVS) Database User Guide



IRVS Database User Guide Table of Contents

Section 1

1. Introduction

The Integrated Rapid Visual Screening (IRVS) Database is part of the IRVS methodology for screening mass transit stations, buildings, and tunnels.

The IRVS Database is a standalone application that can be used to record, store, and manage data. The types of data that can be stored include screening data, digital photos, site plans, floor plans, emergency plans, and GIS products. The database can also be used to generate risk and resilience scores. Managers can use the database to store, search, and analyze data from multiple screenings and generate a variety of reports.

The IRVS Database is a standalone application that is both a data collection tool and a data management tool.

This user guide provides instructions on installing the database, using the database to conduct screenings, and performing administrative functions.

The user guide or a catalog reference can be opened by pressing the F1 key on the keyboard or by selecting **Help [F1]** or **Current Question Help [F1]** (the help function will open up the catalog to the exact location of the characteristics that are being evaluated).

2. Field Database and Master Database

The IRVS Database that is used in the field by the screening team is referred to as the Field Database. The data that are collected during the screening and stored temporarily in the Field Database are later transferred to the Master Database at an organization's headquarters. The instructions in this user guide apply to both the Field Database and Master Database unless otherwise indicated.

The Field Database, which is on a laptop, can be used to perform the following functions:

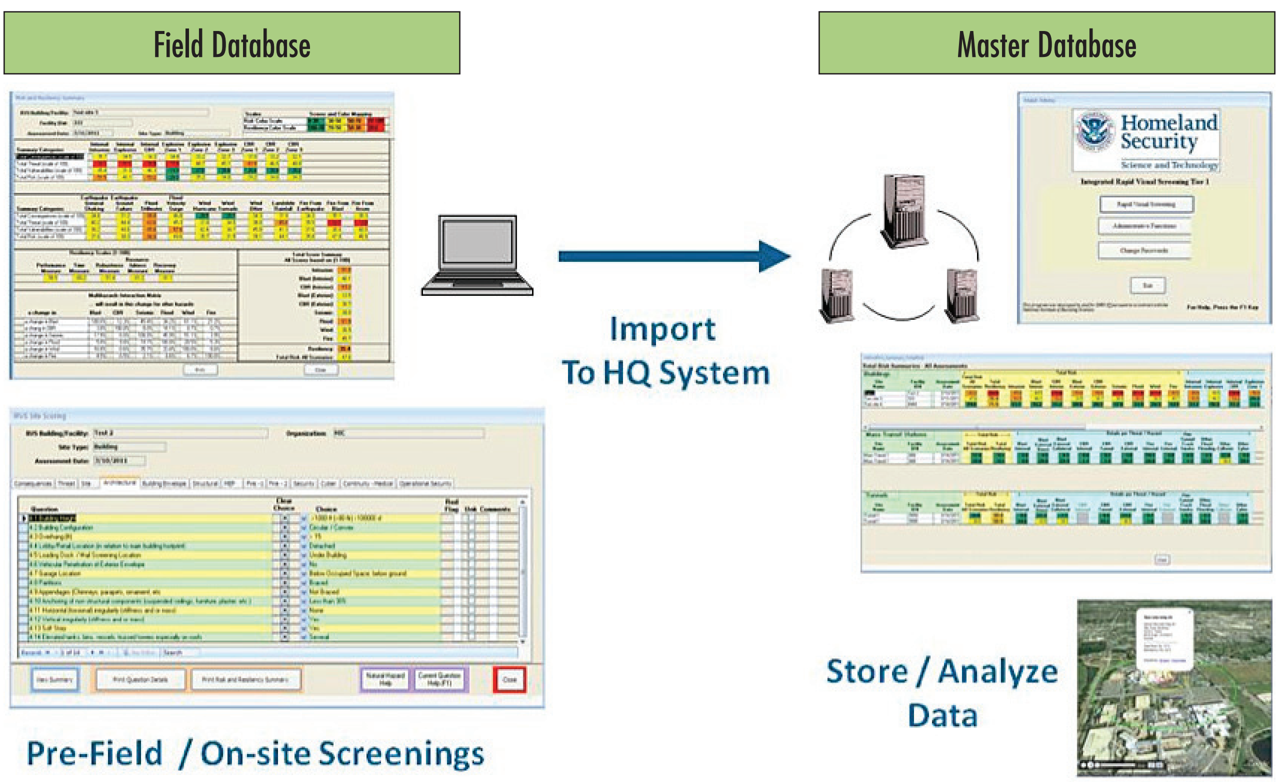
- Create a screening record, which includes site identification, address, sector and subsector identification, facility importance, and geographical coordinates
- Plot and display screening sites using a mapping program
- Enter the pre-field data: hazards, answers to pre-field questions, and structure type
- Enter site evaluation data
- Display the site's risk and resilience scores
- Create an Executive Summary of the screening
- Record the site points of contact (POCs)
- Record the members of the screening team
- Add digital photos, site plans, floor plans, emergency plans, and GIS products
- Transfer the collected screening data to the organization's Master Database
- Purge the collected data from the Field Database and prepare the database for subsequent screenings

The Master Database can be used by managers to store, search, print, display, and analyze data collected from multiple screenings. The Master Database can be used to perform the following functions:

- Import screening data and relevant information (e.g., photos) from Field Databases
- Plot and display screening sites using a mapping program

The Master Database can be used by managers to store, search, print, display, and analyze data collected from multiple screenings.

- Store, search, and analyze data on multiple screenings
- Display and print a variety of reports
- Create a duplicate of an IRVS record for mitigation analysis or “what if” impacts resulting from changes to consequences, threats, vulnerabilities, or resilience
- Generate reports
- Export reports as MS Word documents or PDFs for editing or formatting
- Export screening risk data to MS Excel spreadsheets for editing
- Filter or sort screening records by site identification, address, sector or subsector identification, or facility importance
- Display the total risk summary for one or more sites
- Store, display, and print digital photos, site plans, floor plans, emergency plans, GIS products, and miscellaneous information collected during screenings
- Perform administrative functions



3. System Requirements

Section 3

The system requirements for the IRVS Database are as follows:

- Pentium 4 or equivalent processor
- Windows XP or later
- MS Access Runtime or MS Access 2007 or later
- MS Excel 2007 or later
- 256 MB of RAM
- Adobe Reader

The database has a plotting function that displays site coordinates and IRVS information on a digital map if the computer has an external mapping program that is capable of displaying a Keyhole Markup Language (KML) file. KML is an XML-based language that is used to display three-dimensional spatial data in mapping programs such as Google Earth.

4. Installation

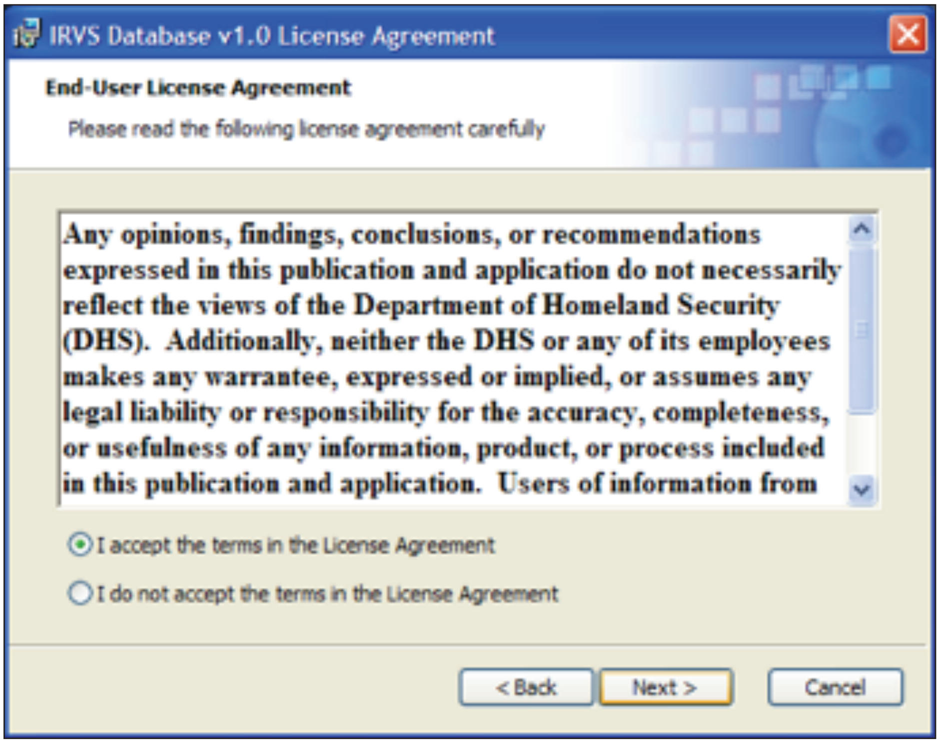
Section 4

The database should be installed on a computer at the organization's headquarters (this copy will become the Master Database) and also on a laptop that will be used in the field (this copy will become the Field Database).

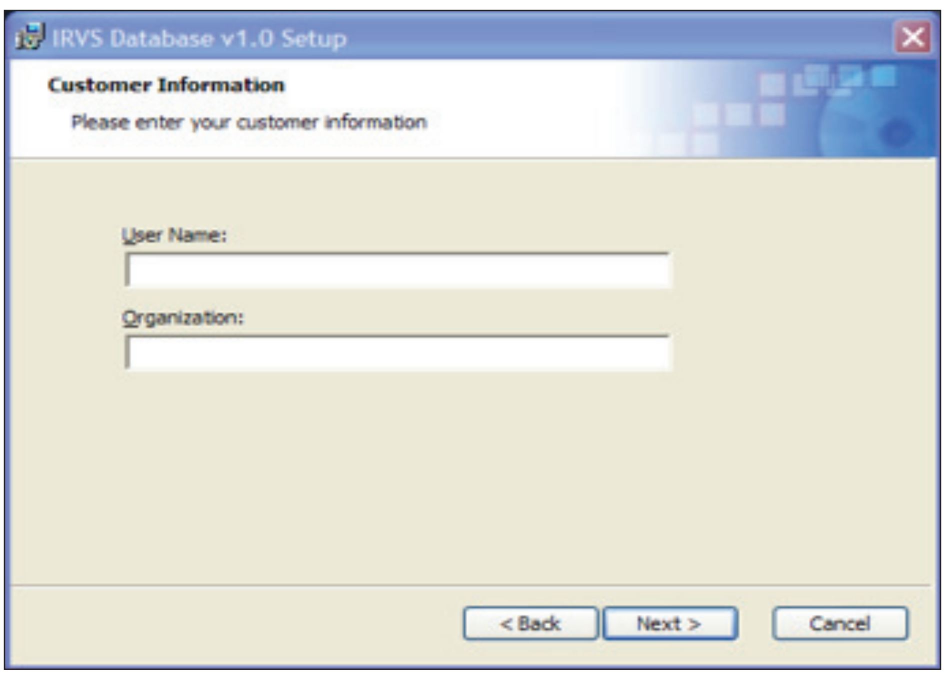
The installation steps are as follows:

1. If you have already downloaded the software, find the SETUP.EXE file by selecting **Start** at the bottom left of the Windows screen, then selecting **Run**, and then typing the location of the SETUP.EXE file (i.e., CD, C:/Temp, or another location on the hard drive). When you have found the SETUP.EXE file, skip to Step #3. If you have not downloaded the program, go to Step #2.
2. Go to the DHS Web site at http://www.dhs.gov/files/programs/scitech-bips-tools.shtm and follow the instructions for downloading the software.
3. **Close** all other programs and double click on the SETUP.EXE file.
4. The IRVS Database Setup Wizard will appear. Select **Next**.

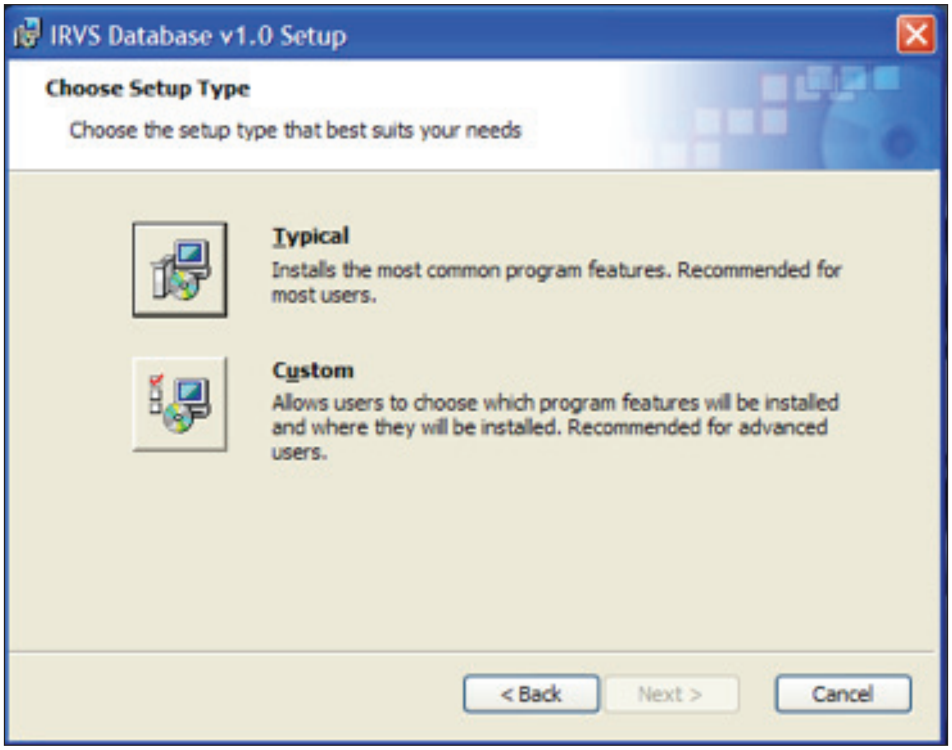
5. A screen showing the End User License Agreement will appear. Read the agreement, select **I Accept the terms of the License Agreement** and **Next**.



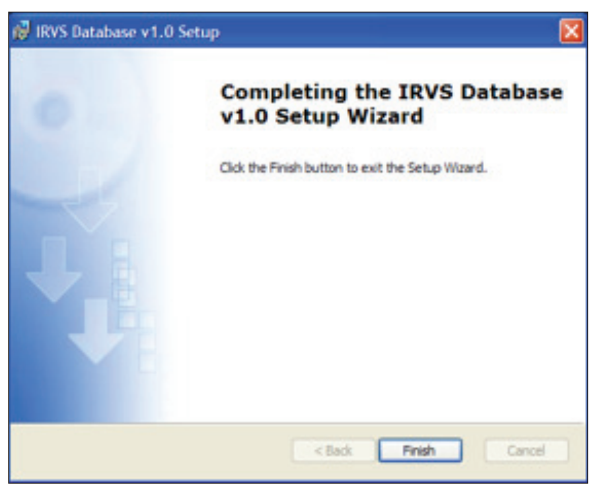
6. The Customer Information menu will appear. Fill in the user name and organization. Select **Next**.



7. The Choose Setup Type menu will appear. In most cases you should follow the Typical Installation. The Custom Installation allows the user to change the file name and/or file location. This may be a requirement under an organization's security policy. Check with your System Administrator as needed. Select **Typical** or on Custom, as directed by your system administrator, which will make Next selectable, and then select **Next.**



8. The Ready to **Install** menu will appear. Select Install. The amount of time required for the installation depends on the computer.
9. When the installation is complete, the screen below will appear. Select **Finish**.

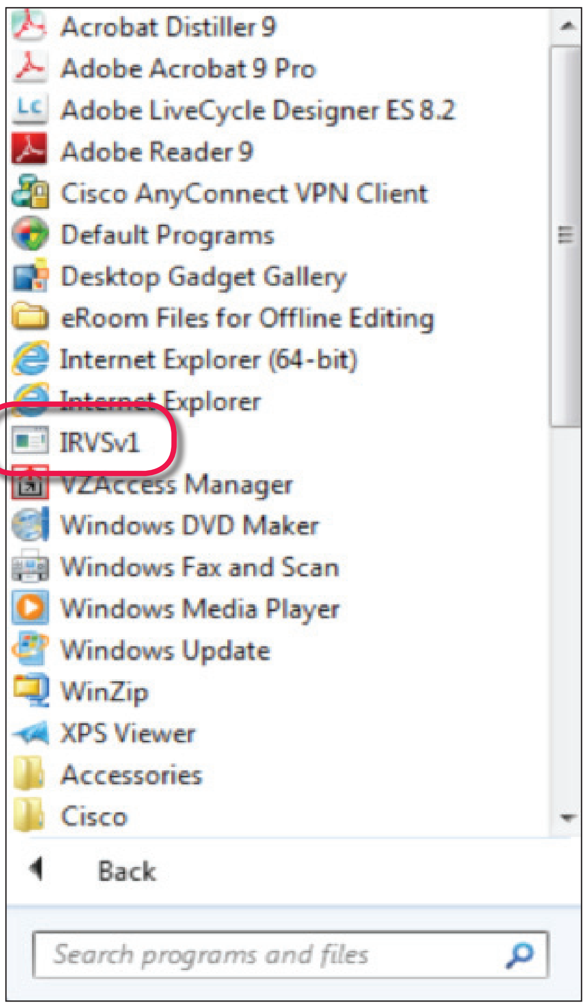


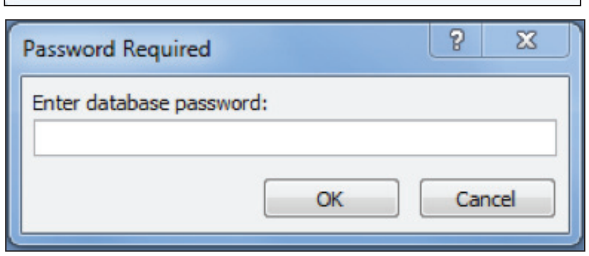
Section 5

5. Logging On

This section explains how to log on using a preloaded or assigned user name and password. Assigning user names is an administrative function that is available only to those with permission to access administrative functions. See Section 10.6.2 for instructions on assigning user names.

1. Double click on the desktop icon for the IRVS Database that was created during the installation or click the **Start button** and then **All Programs/IRVS Database**. The database may also be opened by double clicking the database file (file name: iRVSv1b.accdr) in the newly created IRVS folder. Note: this is a MS Runtime file so it cannot be opened after starting MS Access.





2. The database may also be opened by double clicking the database file (file name: **iRVSv1b.accdr**) in the newly created IRVS folder. Note: this is a MS Runtime file so it cannot be opened after starting MS Access.

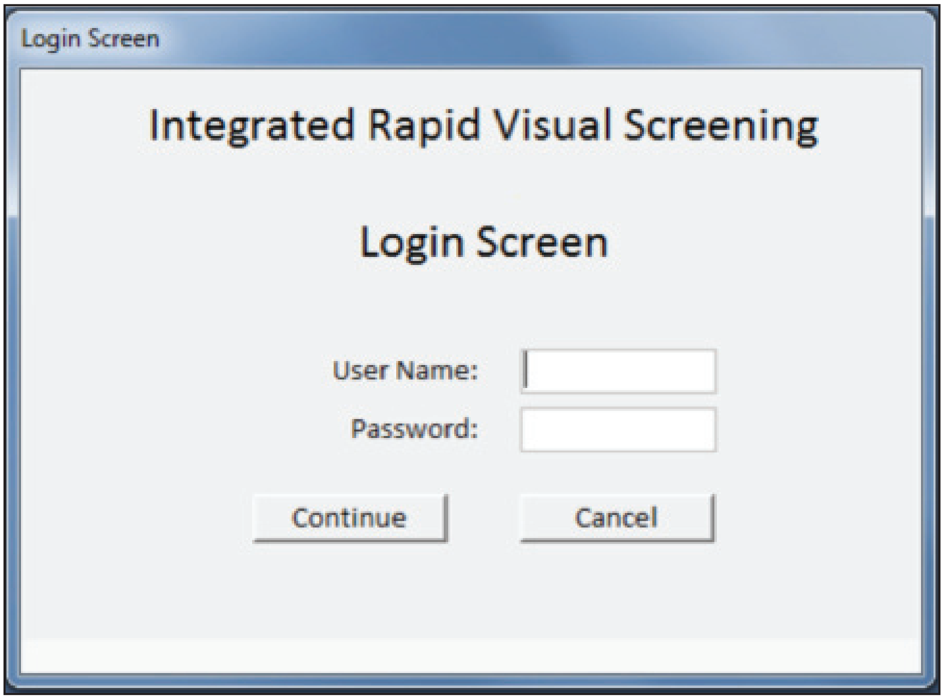
   Reminder: the generic database password is: **IRVS2011.**

   After entering the database password select **OK**., and the Login Screen displays.

3. In the **Logon** menu, if you don't have an assigned user name, skip to Step #4. If you have an assigned user name, enter it. Leave the password blank. Select OK. You will be asked to create a password. Follow the instructions in Steps #5 and #6 below). Create the password and skip to Section 7.

4. If you don't have an assigned user name, use one of the following preloaded user names and passwords:

User Name	Password
Administrator	Administrator
Assessor	Assessor
Editor	Editor
Reader	Reader



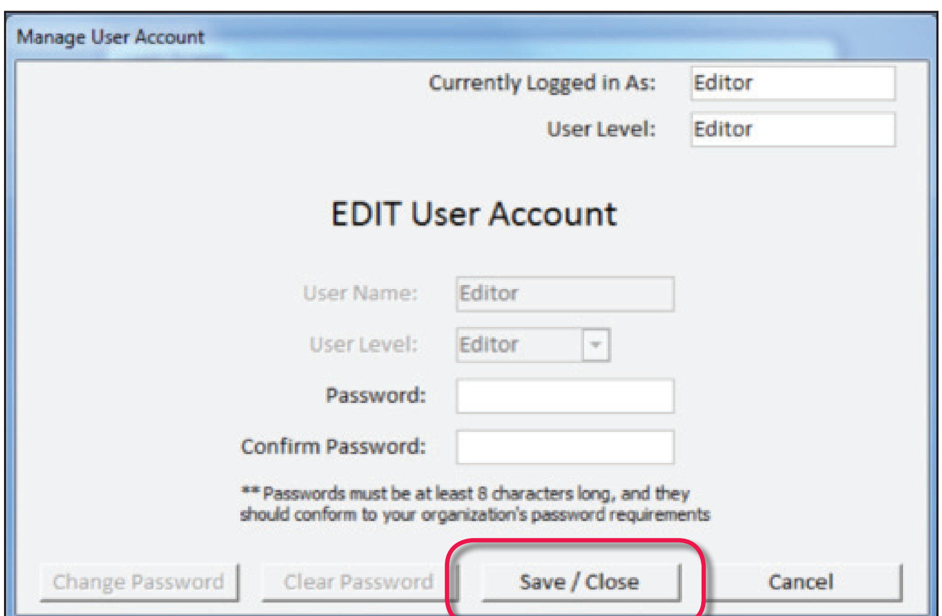
The Administrator user name/password allows you to access the administrative functions, which include establishing new user accounts and passwords. See Section 9 for information on administrative functions. You must have permission to log on as an Administrator.

5. Select **Continue**.

6. The **Main Menu** of the database will appear. Select **Change Passwords**, and the **EDIT User Account screen will appear**.

7. In the **EDIT User Account** screen, the user name you used will be populated in the **Currently Logged in AS**: field. Also displayed will be your user level. Select **Change Password.**

8. In the new **EDIT User Account** screen, enter a new password in the **Password** field, following the instructions at the bottom of the screen. Retype the new password in the **Confirm Password** field. To cancel, select **Cancel**. To set the password, select **Save / Close**. After setting the password, you will be prompted to login using the new password.



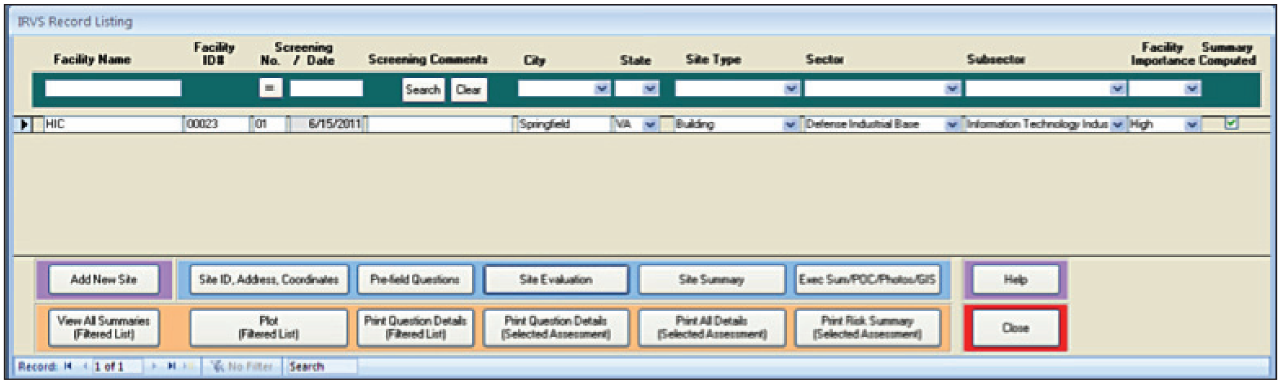
Section 6

6. Creating and Editing Screening Records

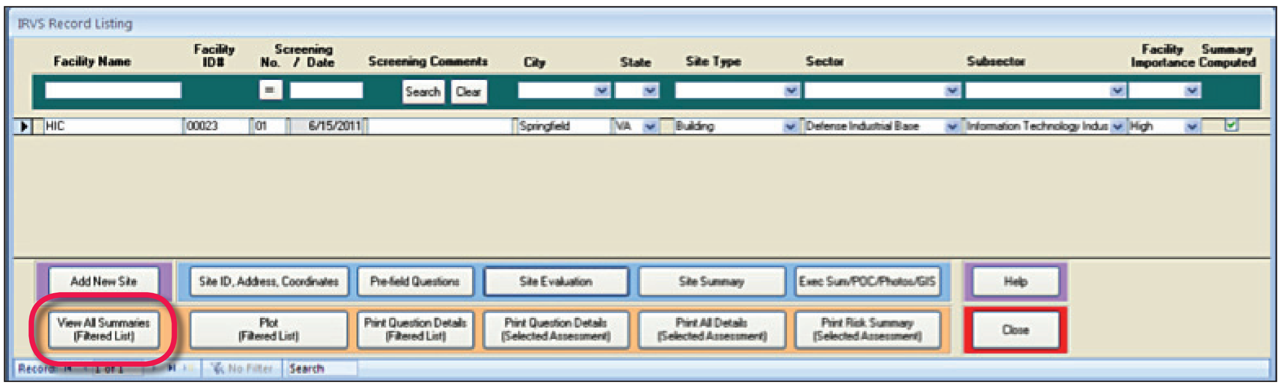
1. From the **Main Menu**, select **Rapid Visual Screening.**

   The **IRVS Record Listing** screen will appear (shown on next page). The screening records that are already in the database, if any, will be listed. You can use the **IRVS Record Listing** screen to create an IRVS screening record and review or edit existing records. Screening records can be deleted only by users with access to administrative functions (see Section 9.2).

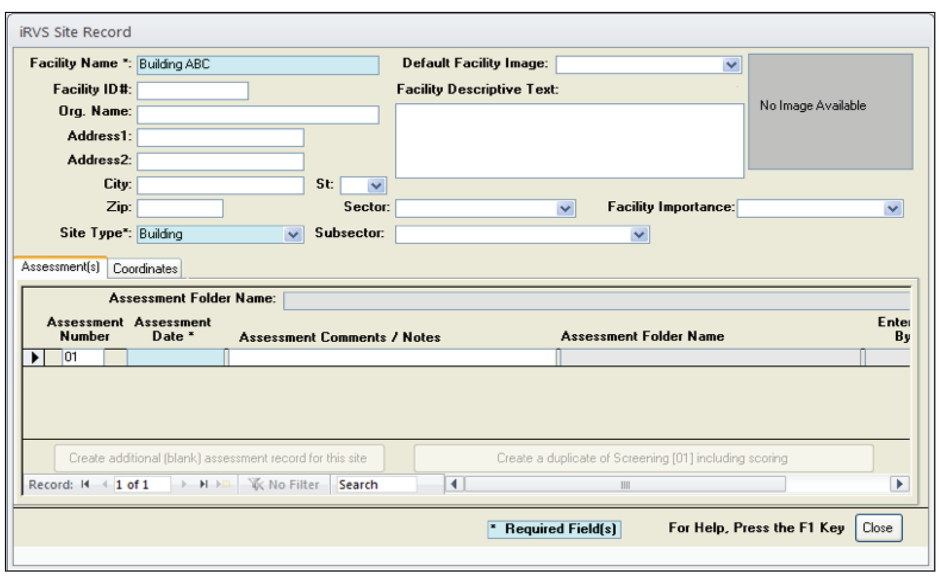
   A screening record includes the facility name, facility identification, address, site type, sector and subsector, facility importance, and geographical coordinates.



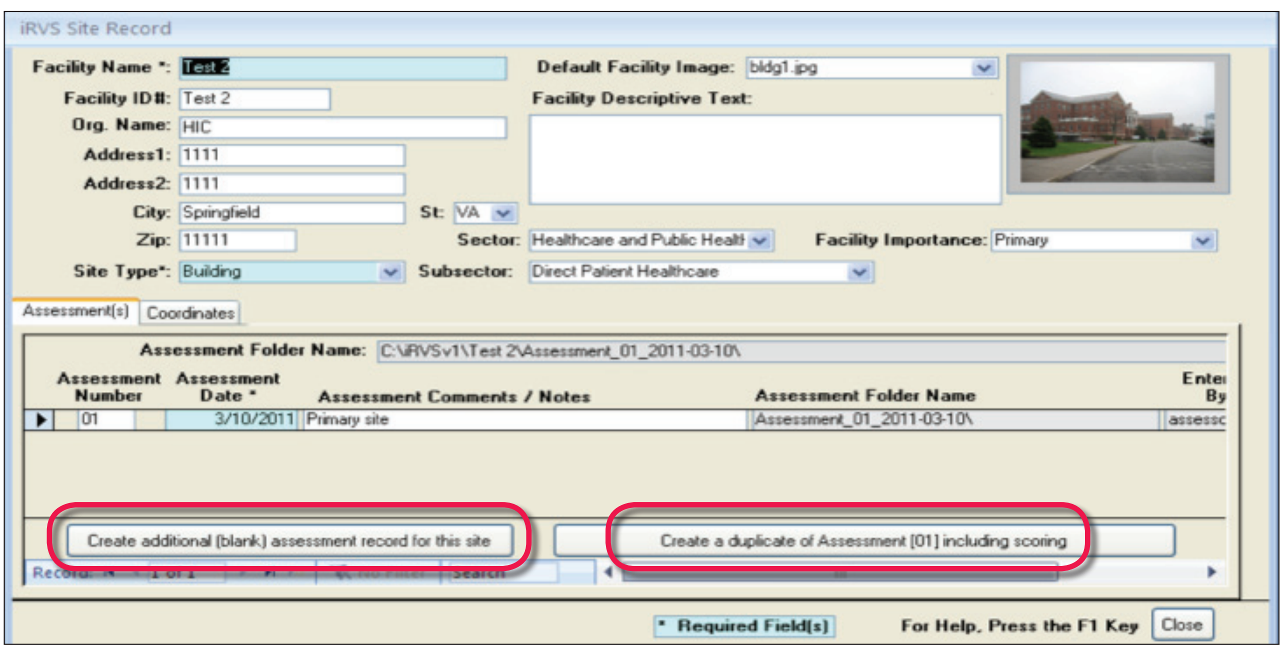
2. To create a screening record, select **Add New Site**, which will bring up the **IRVS Site Record** screen.



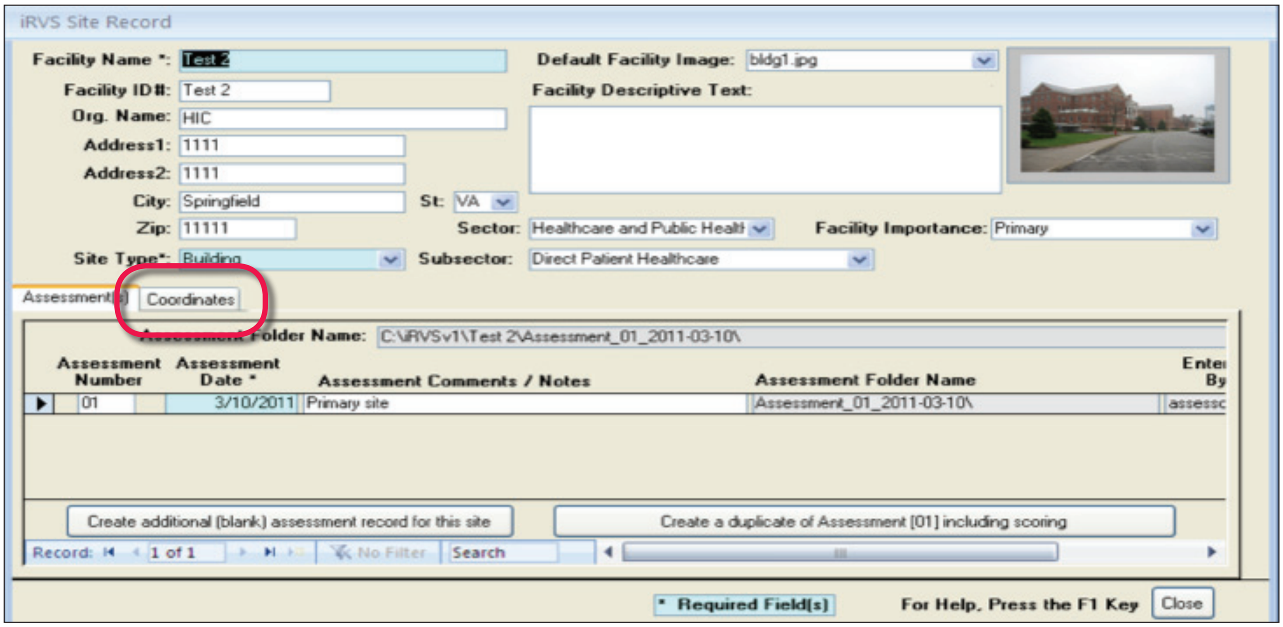
3. In the **IRVS Site Record screen**, complete the following fields: **Facility Name** (required), **Facility ID#** (if applicable), **Org. Name** (name of the organization that owns the facility), **Address**, **City**, and **Zip**. For **State**, select the two-letter abbreviation from the dropdown menu or type in the two-letter abbreviation.



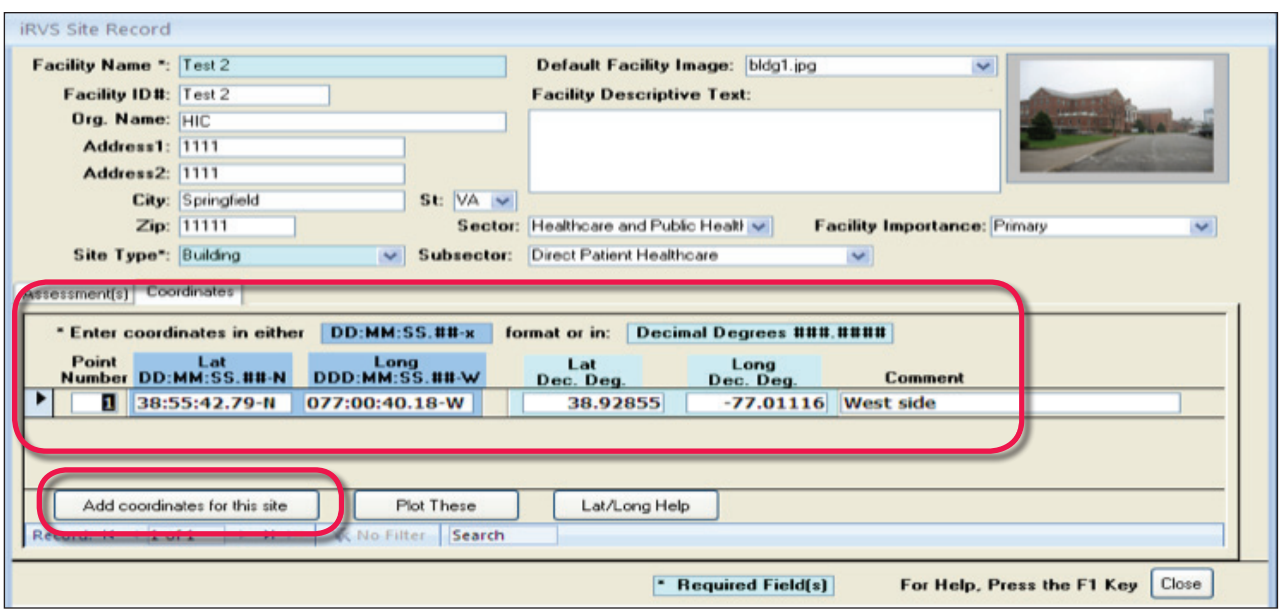
4. For the **Default Facility Image**, select a photo from the dropdown list of photos in the database for this site, if any. The photo will display on this screen when the record is opened. See Section 7.7 for instructions on adding photos.
5. Describe the facility under **Facility Descriptive Text** (e.g., Building ABC is a three-story commercial office property. The first floor has a lobby and offices for building management. The second and third floors have office space that is leased to several organizations.).
6. Select a **Sector** and **Subsector** from the dropdown lists.
7. Select the **Facility Importance** from the dropdown list (High, Medium, Low). There are no predefined criteria for this ranking. This field simply provides an additional way to filter screening records.
8. Select the **Site Type** (required) from the dropdown list (Building, Mass Transit Station, Tunnel).
9. Type in the **Assessment Date** (required) and assessments notes as needed.
10. Select **Create additional (blank) assessment record for this site** to create a new blank record for this site.
11. Select **Create a duplicate of Assessment [number] including scoring** to create a duplicate record that includes evaluation data for use in analysis or a "what if" investigation. For example, an organization may conduct a screening and based on the results, want to decide whether to implement protective measures. The duplicate assessment can be used to predict how the protective measures would affect the risk scores by changing the relevant attributes.



12. Select **Coordinates** to record the coordinates of the screening site and to plot them on a mapping program. Your computer must have an installed mapping program that can read KML files, such as Google Earth, to plot the coordinates on a map. The mapping tool not only enhances the screening evaluation process but also supports risk analysis and post-screening mitigation planning.



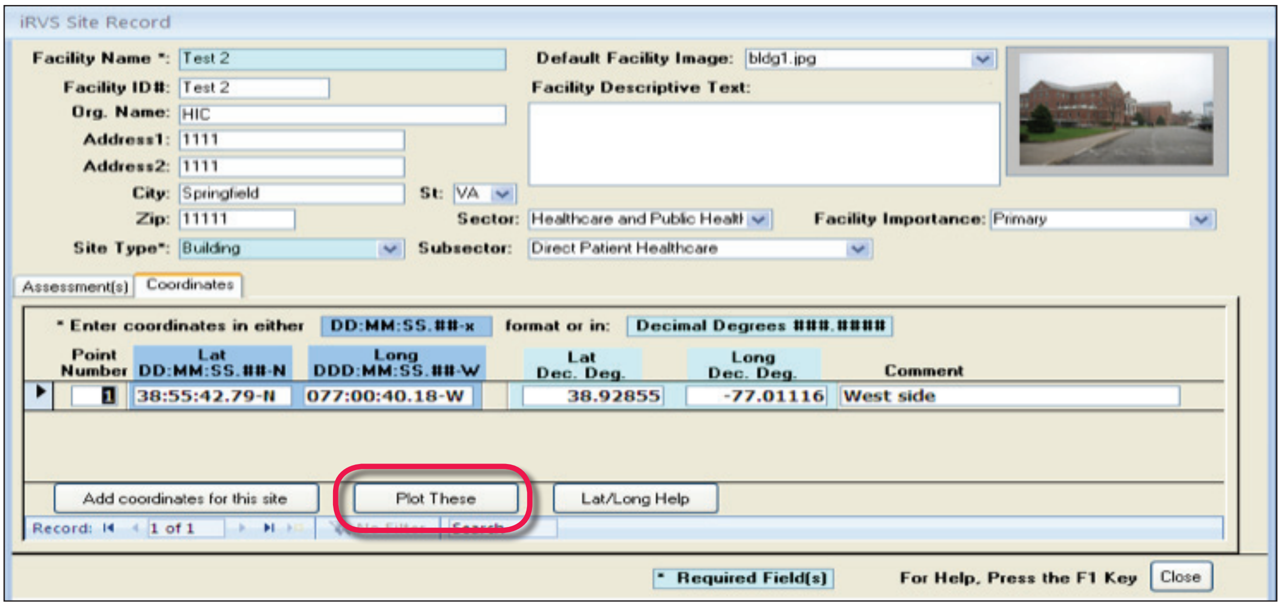
13. Enter the site's latitude and longitude coordinates, as explained below. You can add multiple plot points by selecting **Add coordinates for this site.** The database automatically assigns a point number to each plot.



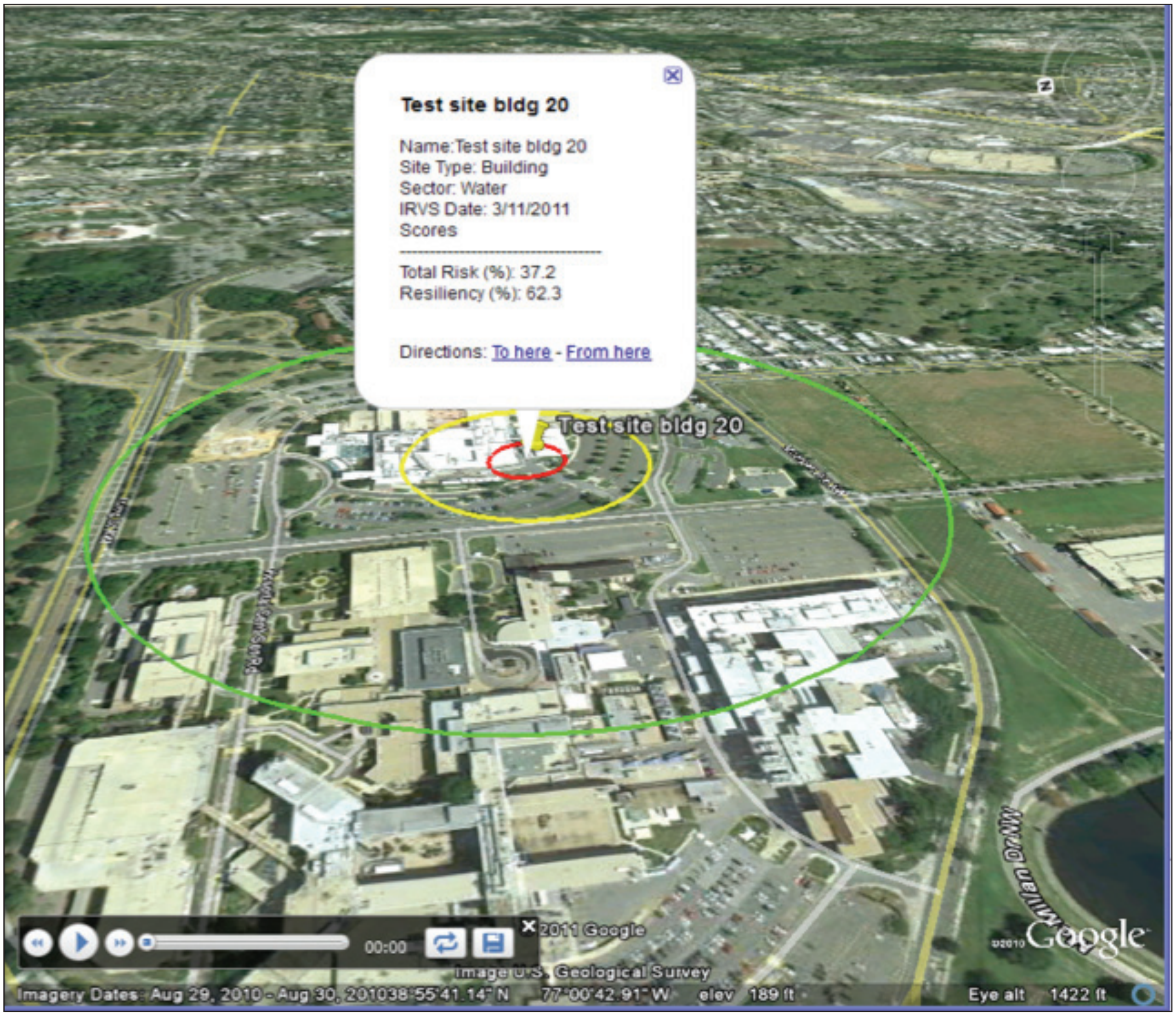
Enter the coordinates in one of the following formats:

- Degrees-minutes-seconds (first two boxes). The decimal-degree equivalents will automatically populate the second two boxes. Values in the decimal-degree format are used to create the KML file for display in Google Earth or other visualization program.
- Decimal-degree values (second two boxes).

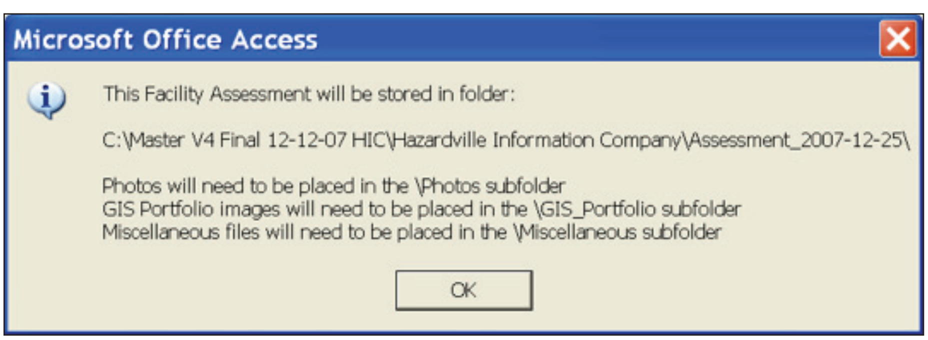
14. Select **Plot These** to create a map showing the location of the screening site. As noted above, the map can be created only if your computer has an installed mapping program that can read KML files.



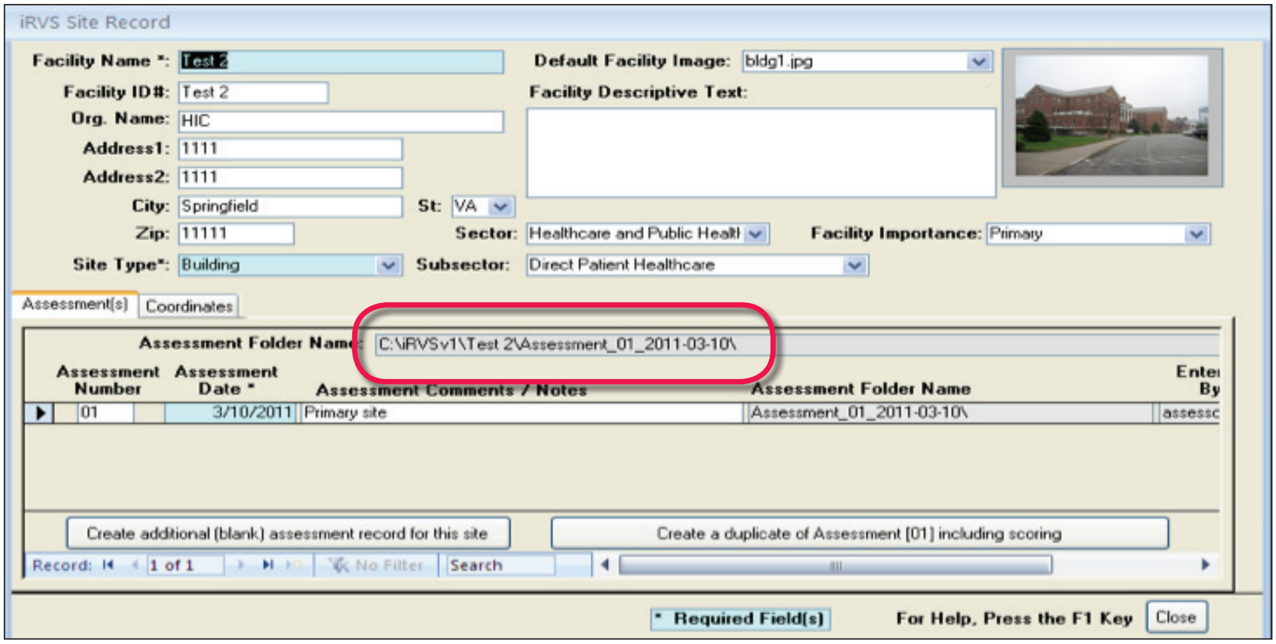
The map will display 100-foot, 300-foot, and 1,000-foot rings (to visualize the target zones) around the site and the screening information that is shown in the map below. Mass transit stations and tunnels are evaluated using only 300-foot and 1000-foot target zones. Risk and resiliency scores will not display until the scores have been calculated.



15. When you have finished entering the information for the screening record, select **Close** on the bottom right of the **IRSV Site Record** screen. Information about where the record will be stored will appear in the message box shown below. Note the information about the three subfolders (Photos, GIS_Portfolio, and Miscellaneous). If you changed the program's location using Custom Installation, note the file path of these subfolders because you will need the file path to load and link the contents of the subfolders to other copies of the database.



16. Select **OK**. The file path will be listed in the **Assessment Folder Name** field, which you will see the next time you open the record.



17. Select **Close** to return to the previous screen.

7. Conducting a Screening

Section 7

After you have created an IRVS site record, you are ready to start the screening. The steps in the screening are as follows:

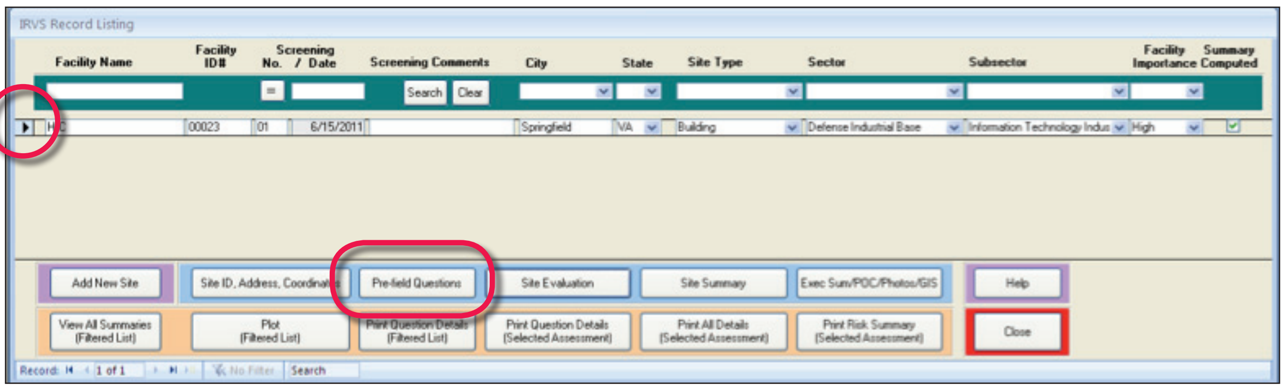
- Entering the pre-field data
- Conducting the onsite evaluation
- Generating the risk and resiliency scores
- Creating an executive summary
- Adding points of contact
- Adding the Assessment Team Members
- Adding GIS images (optional)
- Adding miscellaneous information (optional)
- Exporting the screening data to transfer media from the Field Database
- Erasing the screening record from the Field Database

7.1 Entering the Pre-Field Data

Pre-field data include basic information about the site and its target density. Screeners should try to obtain as much pre-field data as possible to ensure that the risk and resiliency scores are as accurate possible. Pre-field data can be obtained on the Internet and from various private sources.

1. In the **IRVS Record Listing** screen, select the record of the site to be screened by clicking the far left column in the row with the record.

2. Select **Pre-Field Questions** to open the **IRVS Site Scoring** screen.



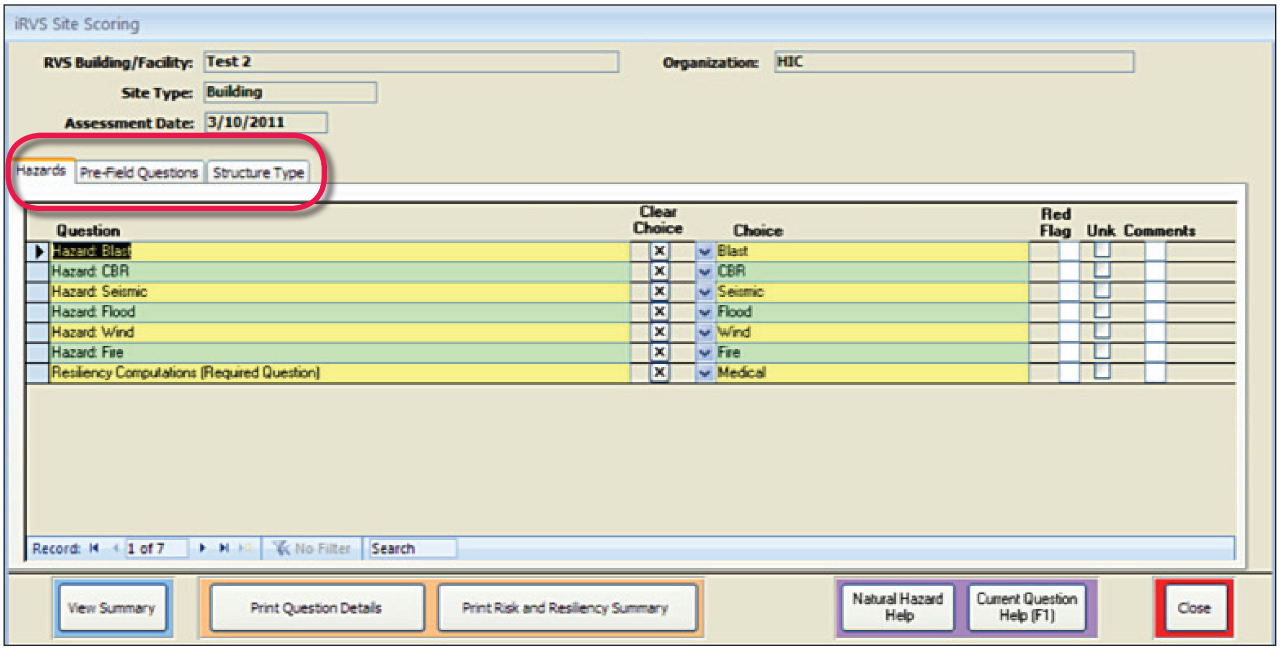
Pre-field data differ according to the site type, as follows:

- For buildings, the **Pre-Field Questions** screen has questions under three tabs: **Hazards, Pre-Field Questions, and Structure Type** (as shown below). For more information about these tabs, see Sections 7.1.1, 7.1.2, and 7.1.3.

- For mass transit stations and tunnels, the **Pre-Field Questions** screen has only one tab: the Pre-Field Questions tab. For more information about the Pre-Field Questions tab, see Section 7.1.1.

3. For each question in the **Question** column, select the appropriate choice by selecting one of the choices in the dropdown list in the **Choice** column. If you want to change your answer, select **X** in the **Clear Choice** column to your clear your answer. Clearing an answer will not affect the **Red Flag, Unk** (unknown), or **Comments** columns.

4. If you need more information about a question, select **Current Question Help [F1]** on the bottom right of the screen, and for more information about a natural hazard, select **Natural Hazard Help** on the bottom right of screen.



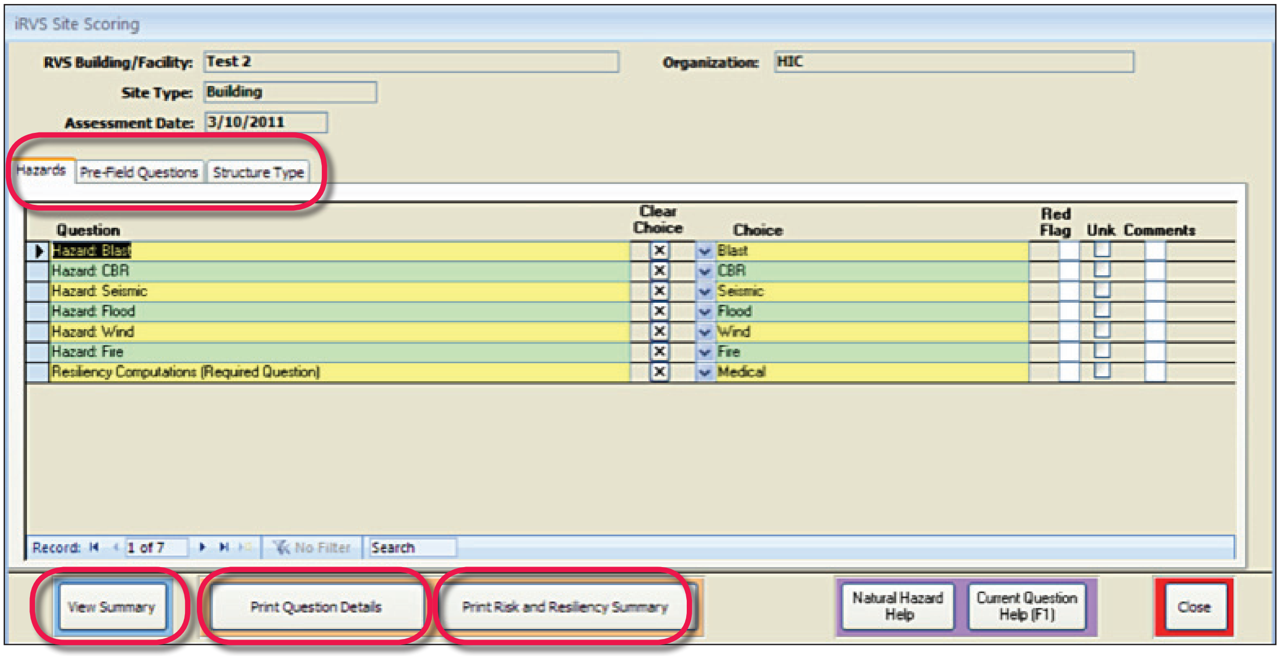
5. If you think there's a concern that requires immediate attention, click the box under the **Red Flag** column. You will be asked to enter a comment that supports your decision to red flag the item. Type in the comment and select **Save**. To remove a red flag, select the red flag.

6. If you don't know the answer, click the box under the **Unk** (unknown) column. You can add the information when you obtain it. To remove a checkmark, select the checkmark.

7. If you want to add information (e.g., about an unusual circumstance), select the box in the **Comment** column to add information. When you select the box, a comment box will appear. Enter your comments and select **Save**. To remove a comment, select the box in the Comment column. Delete the comment and select **Save**. The box will no longer be marked.

8. Answer as many questions as possible. For buildings, answer the questions under all three tabs (**Hazards, Pre-Field Questions, and Structure Type**). For more information about the tabs, see Sections 7.1.1, 7.1.2, and 7.1.3.

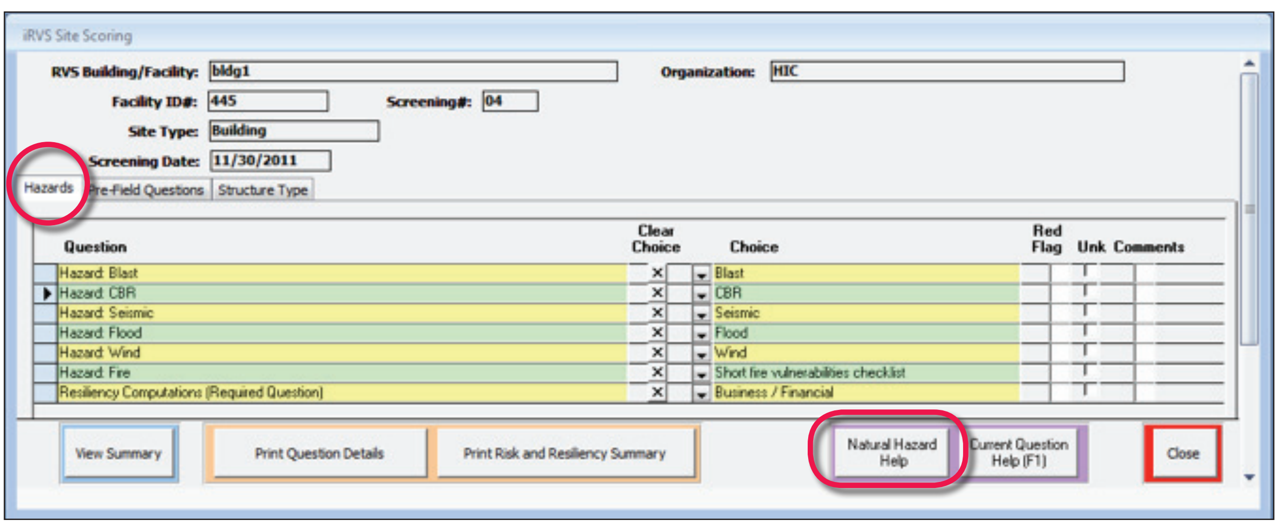
9. For a printable version of the answers to the pre-field data questions, select **Print Question Details**. Select **Print** at the top left to print the answers and **Close Print Preview** at the top right to return to the previous menu.



10. Select **Close** to return to the previous menu.

7.1.1 Hazards Tab (Building Site Type Only)

The hazards that you select for a building affect the questions in the **Pre-Field Questions** tab and the hazards that included in the risk analysis. Complete the questions in the Hazards tab before completing the other two tabs for a building site type.



For information about natural hazards, select **Natural Hazard Help** at the bottom of the **IRVS Site Scoring** screen and select the hazard you need information about in the dialog box that appears.

1. In the **IRVS Site Scoring** screen, select the **Hazards** tab and select the hazards that may affect the building you are screening by selecting the hazard from the dropdown menu in the Choice column. The possible hazards are blast; chemical, biological, and radiological (CBR); seismic; flood; wind; and fire. Under the question column, left click on the row of a Hazard you want to use in the process and the arrowhead on the left side of the form moves to that row and the row is designated for change. Then select the down arrowhead in the Choice column to produce a drop down list of possible answers. Select the name of the hazard to include it in the screening or select on the blank row to not include it in the screening. The IRVS screening is adjusted based on which Hazards are selected. At the completion of this form, the database automatically tailors the IRVS question set and grays out un-needed questions. Only those hazards selected are included in the risk analysis.

   The sixth hazard listed, **Hazard: Fire** has additional choices to tailor the IRVS screening. The three choices for this hazard are listed below:

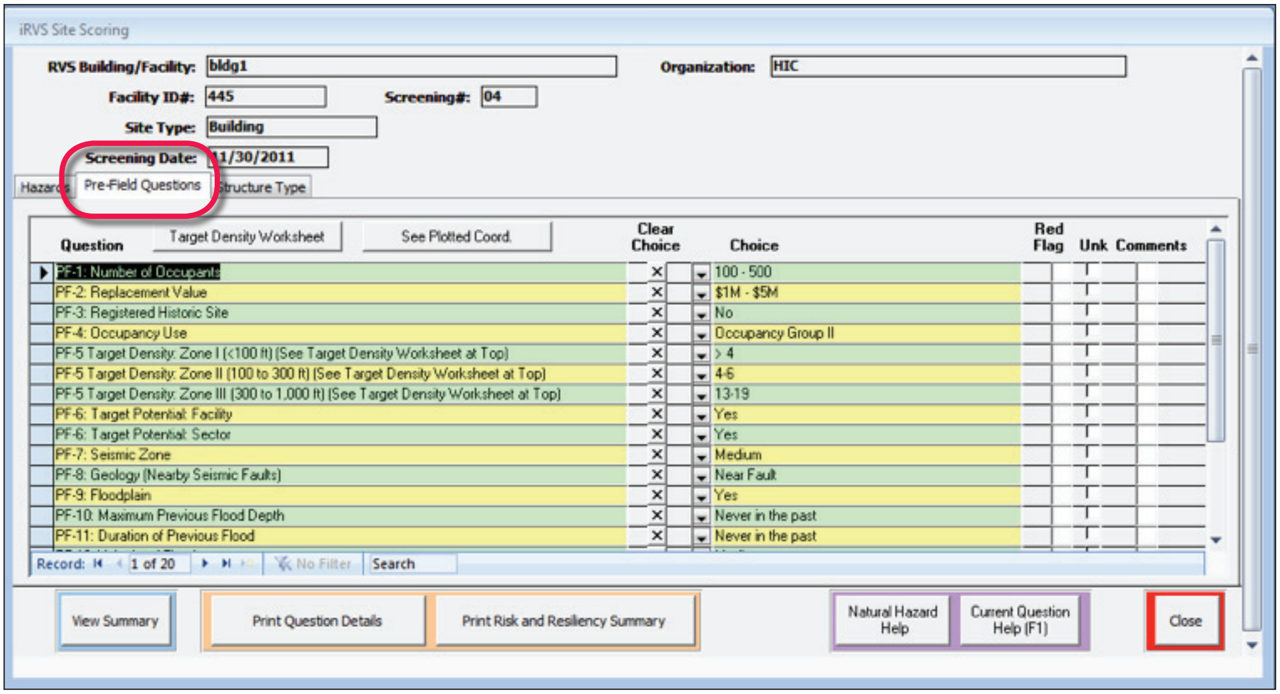
   - **Short fire vulnerabilities checklist.** Fire Tab 1, which has a few fire-related questions, will be displayed in the site evaluation if this is selected.
   - **Fire marshal's list – Longer list – includes all short list attributes.** Fire Tab 2 will be displayed in the site evaluation if this is selected and has more fire-related questions than the short fire vulnerabilities checklist. Choose this selection if you want the longer list of questions.
   - **Blank space.** Choose this selection if you do not want to include the fire hazard in the screening.

2. For **Resiliency Computations (Required Question)**, select one of the options listed below, which refer to the type of facility being screened. Each option provides a form in the site evaluation for Continuity of Operations.

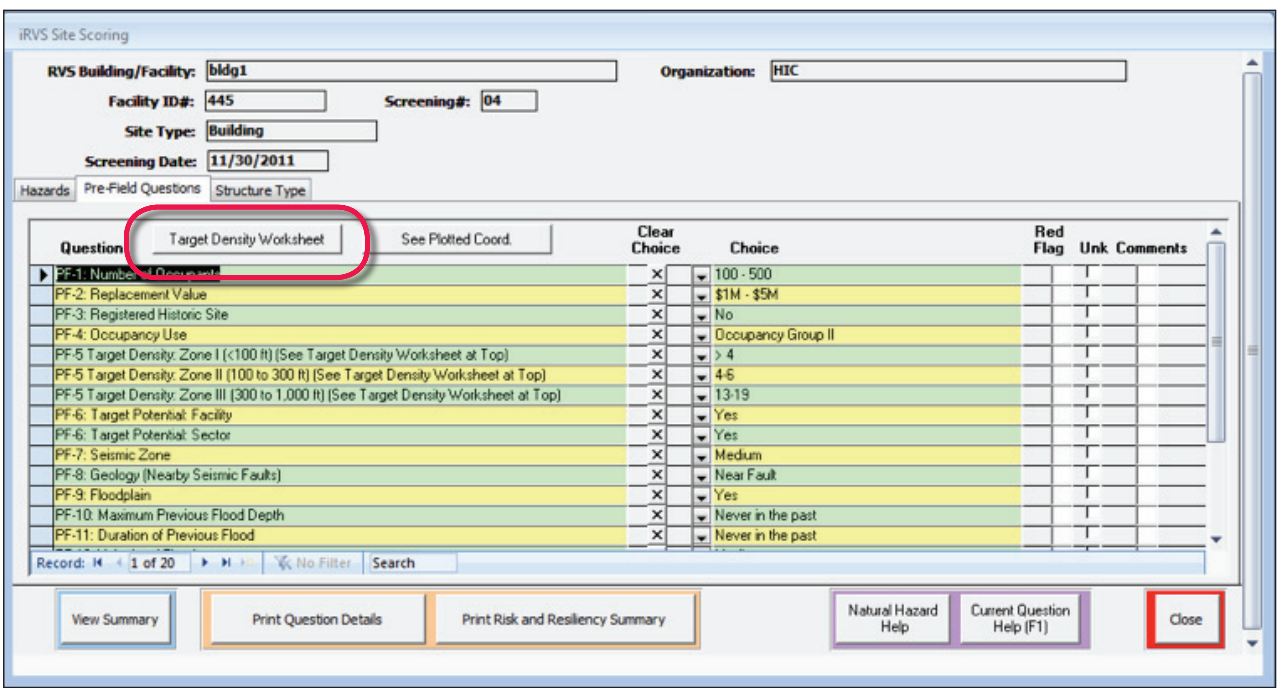
- **No resiliency computations are needed.** If you select this answer, resiliency will not be scored. Choose this if stakeholders are not concerned about the continuity of operations after a disaster.
- **General.** If you select this answer, the resilience section (Continuity of Operations) will be tailored to screen general facilities such as commercial, agricultural, educational, and industrial. A Continuity – General tab will appear during the scoring.
- **Government.** If you select this answer, the resilience section (Continuity of Operations)will be tailored to screen government facilities such as offices, police stations, fire stations, and emergency operations centers. A Continuity – Government tab will appear during the scoring.
- **Medical.** If you select this answer, the resilience section (Continuity of Operations) will be tailored to screen medical facilities. A Continuity – Medical tab will appear during the scoring.
- **Schools (K-12).** If you select this answer, the resilience section (Continuity of Operations) will be tailored to screen school facilities. A Continuity – School (K-12) tab will appear during the scoring.
- **Business/Financial.** If you select this answer, the resilience section (Continuity of Operations) will be tailored to screen business/ financial facilities. A Continuity – Finance/Business tab will appear during the scoring.
- **Retail.** If you select this answer, the resilience section (Continuity of Operations) will be tailored to screen retail facilities. A Continuity – Retail tab will appear during the scoring.

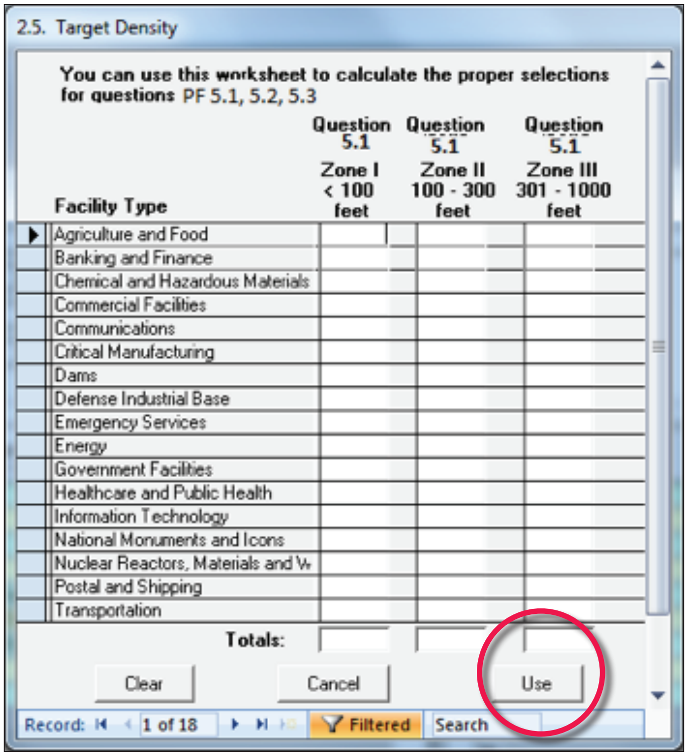
7.1.2 Pre-Field Questions Tab (All Site Types)

1. In the **IRVS Site Scoring** screen, select the **Pre-Field Questions** tab. A list of questions based on the site type (mass transit station, building, or tunnel) will appear. For the building site type only, pre-field questions depend on which hazards were selected under the Hazards tab. The pre-field questions that are not needed will be grayed out and will not be included in the risk analysis.
2. The Pre-Field Tab contains a special Help button labeled Target Density Worksheet at the top of the question list. This Help button is specific to three questions on the Tab
   - Pre-Field Question 5: Target Density Zone I (<100ft)
   - Pre-Field Question 5: Target Density Zone II (100 to 300ft)
   - Pre-Field Question 5: Target Density Zone III (300 to 1,000ft)



Responses to these three questions can either be entered from the drop-down menu of each question or the assessor can use the Target Density Zone Worksheet to answer the questions.





Select the **Target Density Worksheet** button at the top of the question list and a table labeled Target Density will pop-up. The assessor can use the worksheet to calculate the proper selections for questions PF-5, and enter the exact number of facilities for each category and zone into the table. After completing the table, select the **Use** button to automatically populate the answers to the three questions.

3. Complete the answers to the pre-field questions.

7.1.3 Structure Type Tab (Building Site Type Only)

1. In the **IRVS Site Scoring** screen, select the **Structure Type** tab. This tab will appear only when screening a building. This tab has only one question, **Building Type**, and it is a critical question for the IRVS methodology.

2. Answer the question by selecting one of the choices from the drop-down menu. For help, refer to the catalog, which can be accessed by selecting **Current Question Help [F1]** on the bottom right of the screen.

7.2 Conducting the Onsite Evaluation

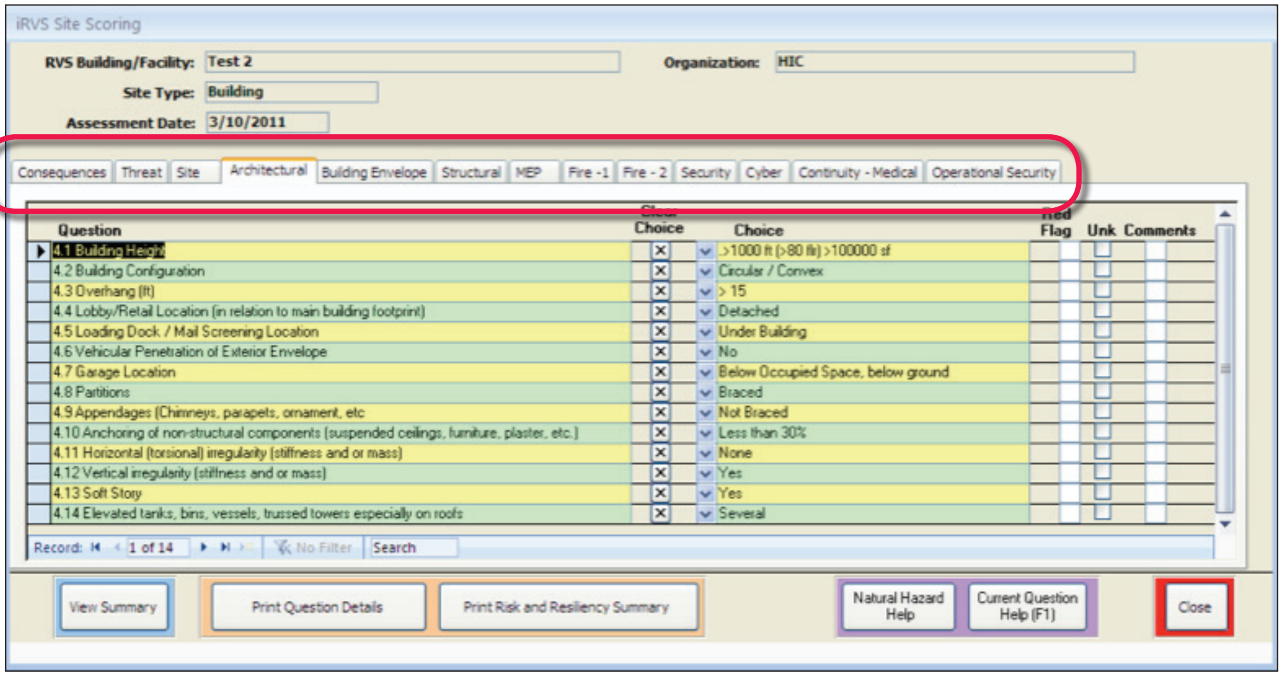
After you have answered the **Pre-Field Questions**, you are ready to record the onsite evaluation data.

1. In the **IRVS Recording Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.

2. Select **Site Evaluation** to open the **IRVS Site Scoring** screen. The screen will have 11 to 14 tabs, depending on the site type, hazards, and resiliency selection. Questions that are not needed will be grayed out and will not be included in the risk analysis.

3. Answer the questions under each tab, using the procedure that you followed to enter the pre-field data (see Section 7.1). For help with any of the questions, select **Current Question Help [F1]** on the bottom right of the screen.

4. Select each of the Vulnerability tab (e.g., **Site, Architectural, Building Enclosure, Structural…**) and answer the questions.



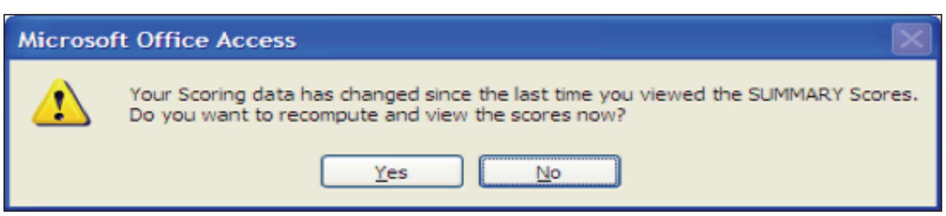
7.3 Generating the Risk and Resiliency Scores

After completing the **Pre-Field Questions** and **Site Evaluation**, you are ready to generate the risk and resiliency scores. Resilience scores will not be generated if you selected **No resiliency computations are needed** in the **Hazards** tab.

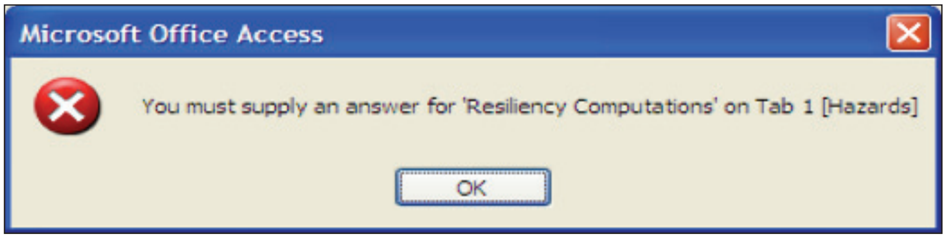
1. In the **IRVS Recording Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.

2. Select the **Pre-Field Questions** tab or **Site Evaluation** tab to open the **IRVS Site Scoring** screen.

3. Select **View Summary** to open the Risk and **Resiliency Summary** screen. If data have changed since the last time you opened **View Summary**, the message below will appear. Select **Yes**.

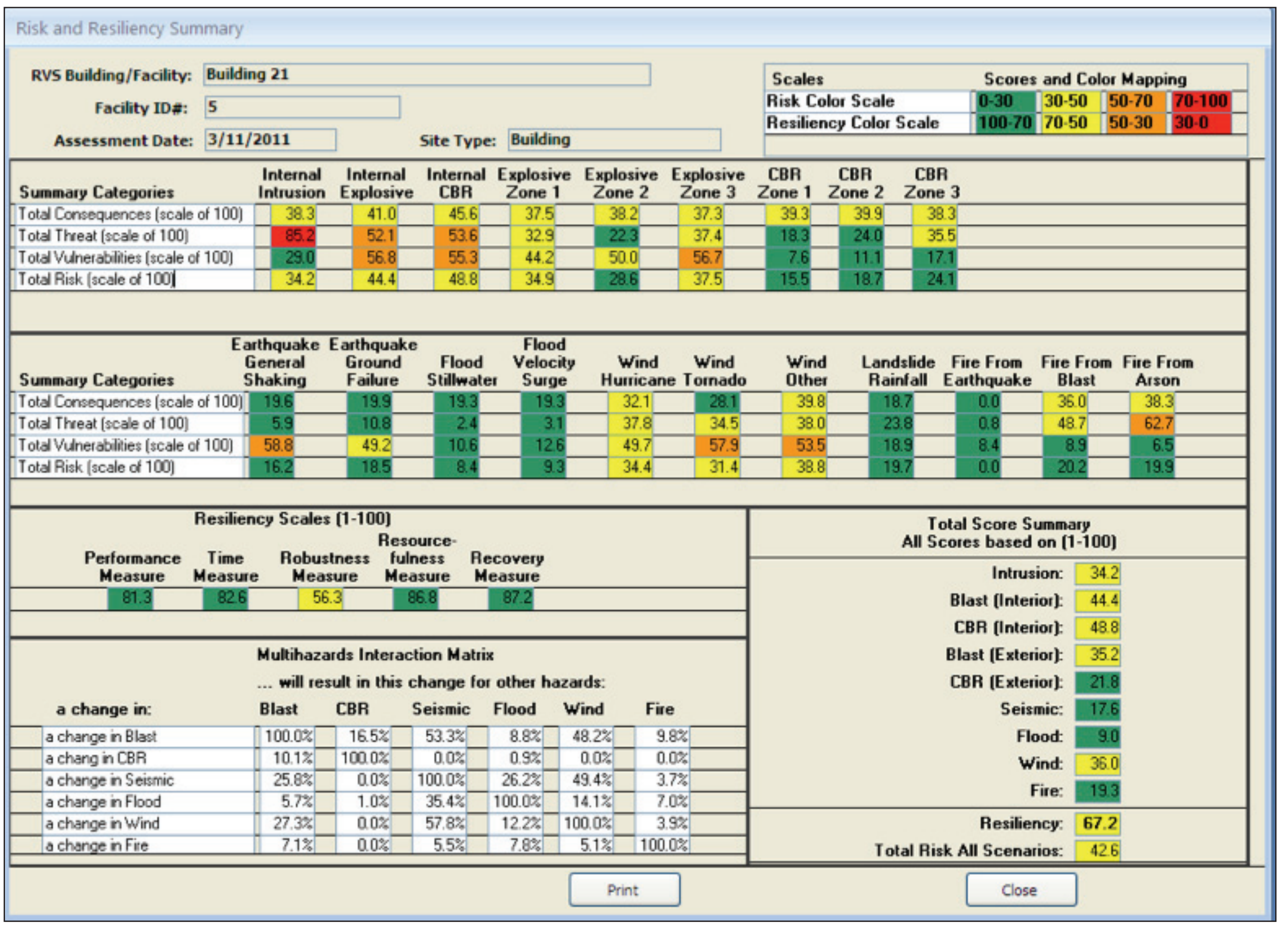


4. If required answers are missing, the risk and resiliency scores cannot be calculated, and a message such as the one below will appear. Select **Yes** and fill in the missing answers.



5. If MS Excel is open on your computer, the risk and resiliency scores cannot be calculated, and you will be prompted to close Excel.

6. If you have answered all required questions and MS Excel is not open, the database will generate the **Risk and Resiliency Summary**, as shown below. The time required to generate the summary will depend on your computer.



Risk and Resiliency Summary

RVS Building/Facility: Building 21
Facility ID#: 5
Assessment Date: 3/11/2011
Site Type: Building

Scales	Scores and Color Mapping			
Risk Color Scale	0-30	30-50	50-70	70-100
Resiliency Color Scale	100-70	70-50	50-30	30-0

Summary Categories	Internal Intrusion	Internal Explosive	Internal CBR	Explosive Zone 1	Explosive Zone 2	Explosive Zone 3	CBR Zone 1	CBR Zone 2	CBR Zone 3
Total Consequences (scale of 100)	38.3	41.0	45.6	37.5	38.2	37.3	39.3	39.9	38.3
Total Threat (scale of 100)	85.2	52.1	53.6	32.9	22.3	37.4	18.3	24.0	35.5
Total Vulnerabilities (scale of 100)	29.0	56.8	55.3	44.2	50.0	56.7	7.6	11.1	17.1
Total Risk (scale of 100)	34.2	44.4	48.8	34.9	28.6	37.5	15.5	18.7	24.1

Summary Categories	Earthquake General Shaking	Earthquake Ground Failure	Flood Stillwater	Flood Velocity Surge	Wind Hurricane	Wind Tornado	Wind Other	Landslide Rainfall	Fire From Earthquake	Fire From Blast	Fire From Arson
Total Consequences (scale of 100)	19.6	19.9	19.3	19.3	32.1	28.1	39.8	18.7	0.0	36.0	38.3
Total Threat (scale of 100)	5.9	10.8	2.4	3.1	37.8	34.5	38.0	23.8	0.8	48.7	62.7
Total Vulnerabilities (scale of 100)	58.8	49.2	10.6	12.6	49.7	57.9	53.5	18.9	8.4	8.9	6.5
Total Risk (scale of 100)	16.2	18.5	8.4	9.3	34.4	31.4	38.8	19.7	0.0	20.2	19.9

Resiliency Scales (1-100)

Performance Measure	Time Measure	Robustness Measure	Resource-fulness Measure	Recovery Measure
81.3	82.6	56.3	86.8	87.2

Multihazards Interaction Matrix

... will result in this change for other hazards:

a change in:	Blast	CBR	Seismic	Flood	Wind	Fire
a change in Blast	100.0%	16.5%	53.3%	8.8%	48.2%	9.8%
a chang in CBR	10.1%	100.0%	0.0%	0.9%	0.0%	0.0%
a change in Seismic	25.8%	0.0%	100.0%	26.2%	49.4%	3.7%
a change in Flood	5.7%	1.0%	35.4%	100.0%	14.1%	7.0%
a change in Wind	27.3%	0.0%	57.8%	12.2%	100.0%	3.9%
a change in Fire	7.1%	0.0%	5.5%	7.8%	5.1%	100.0%

Total Score Summary
All Scores based on (1-100)

Intrusion:	34.2
Blast (Interior):	44.4
CBR (Interior):	48.8
Blast (Exterior):	35.2
CBR (Exterior):	21.8
Seismic:	17.6
Flood:	9.0
Wind:	36.0
Fire:	19.3
Resiliency:	67.2
Total Risk All Scenarios:	42.6

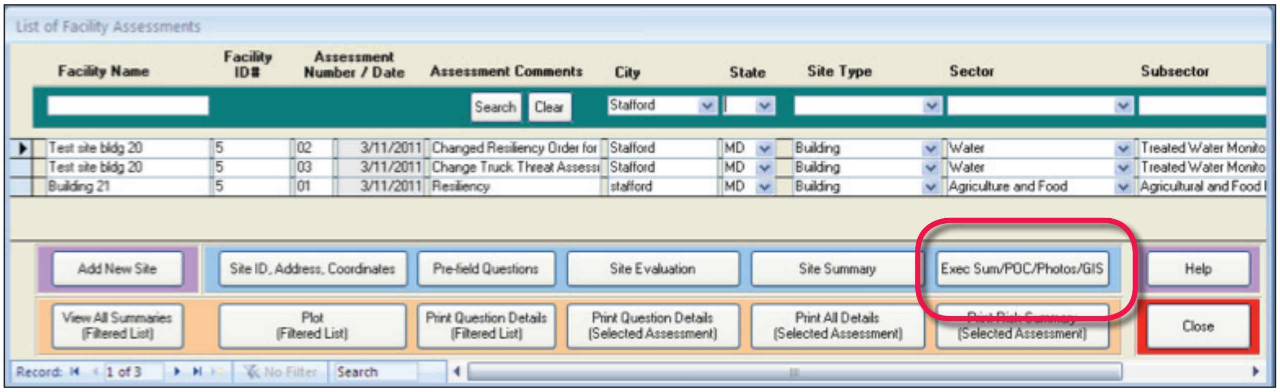
Print　Close

7. Select **Close** to return to the previous screen.

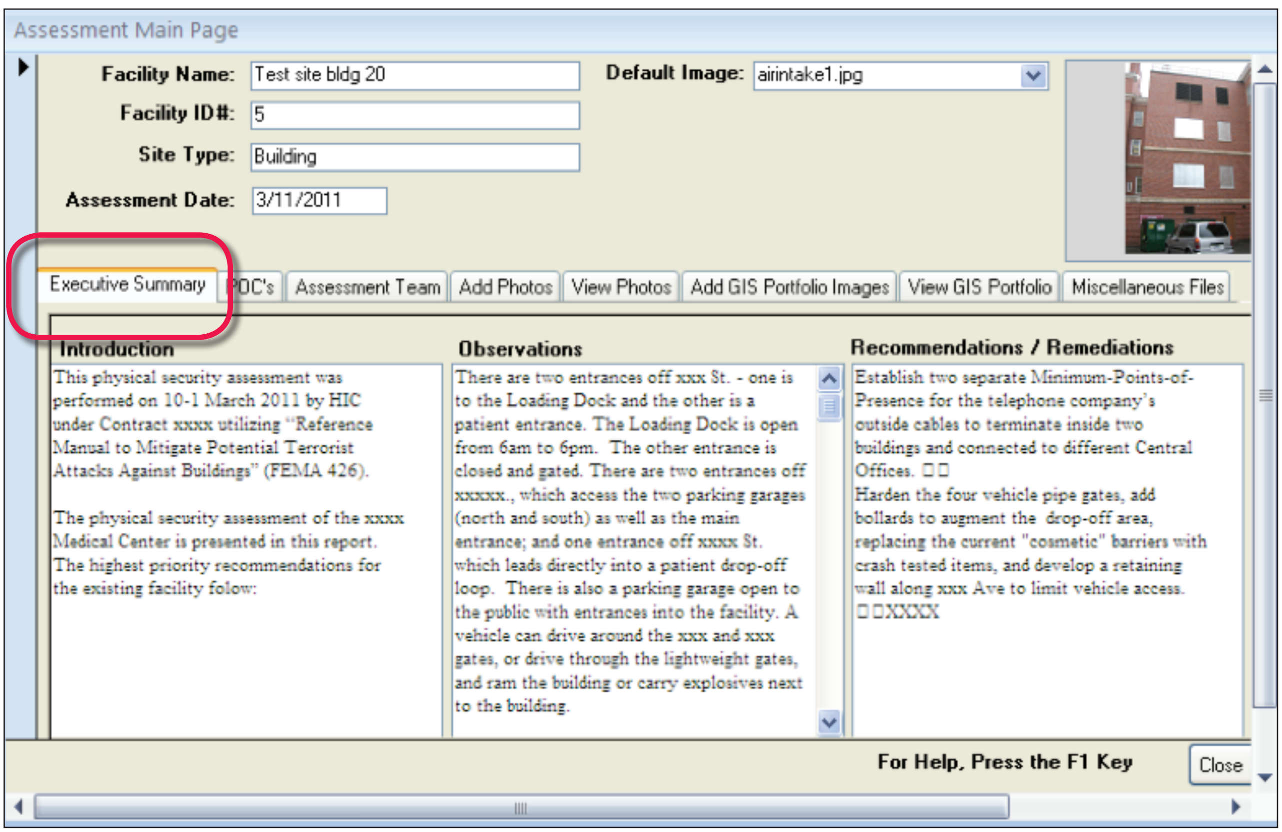
7.4 Creating an Executive Summary

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.

2. Select **Exec Sum/POC/Photos/GIS**.



3. Select the **Executive Summary** tab if the three sections of the Executive Summary don't automatically appear.



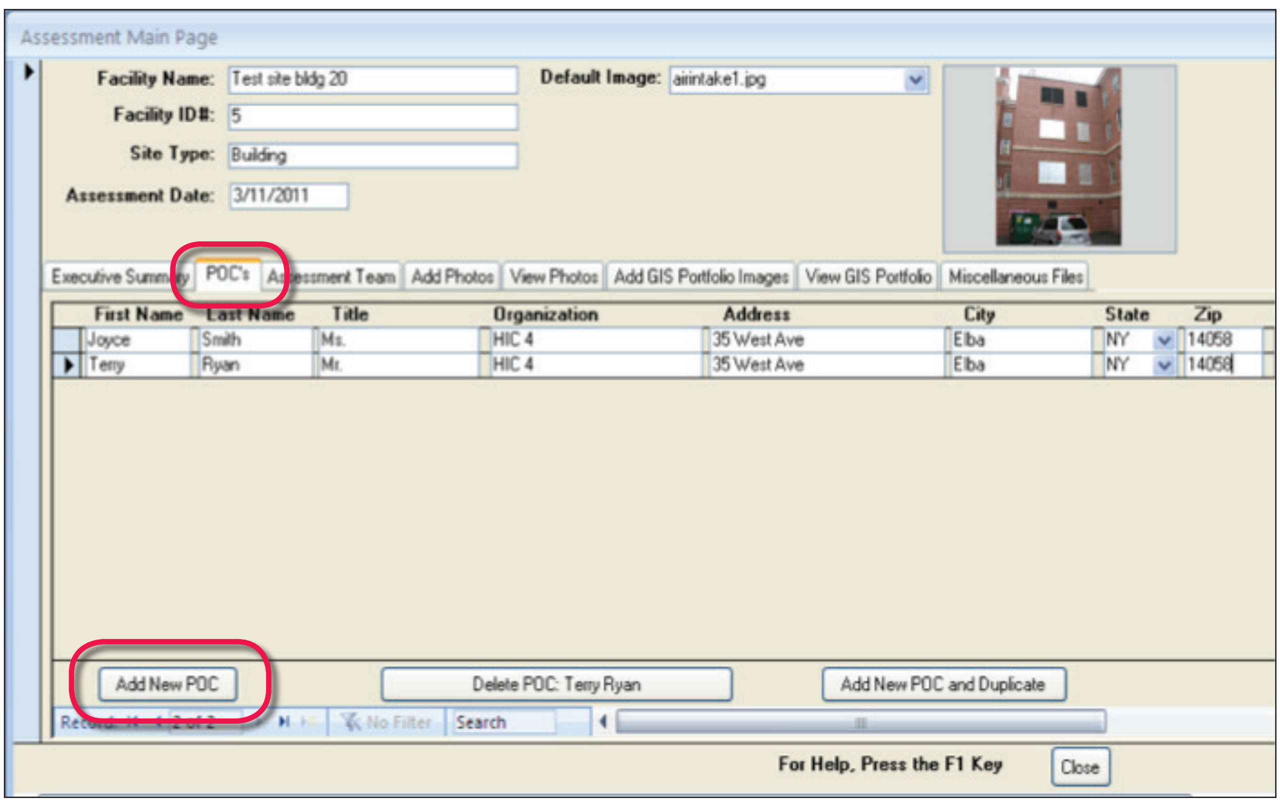
4. Enter information in the **Introduction, Observations, and Recommendations/Remediation** sections. The introduction usually contains the facility name, facility location, screening date, and other relevant background information.

   Select **Close** to return to the **IRVS Record Listing** screen form or select another tab.

7.5 Adding Points of Contact

Points of contact (POCs) are people you identified or met during the screening and who may need to be contacted later for more information.

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
2. Select **Exec Sum/POC/Photos/GIS**.
3. Select the **POCs** tab.
4. To add a POC, select the **Add New POC** tab.



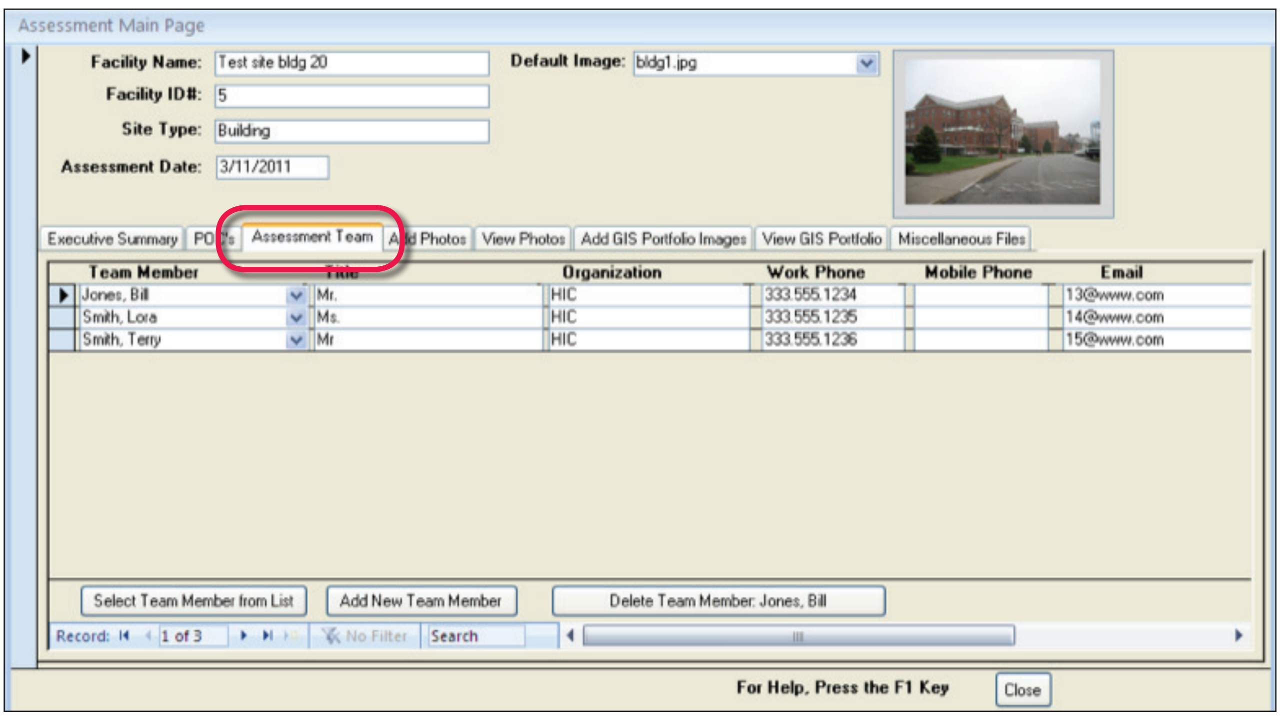
5. Enter information in the fields (**First Name, Last Name, Title, Organization, Address, City, State, Zip, Work Phone, Mobile Phone,**

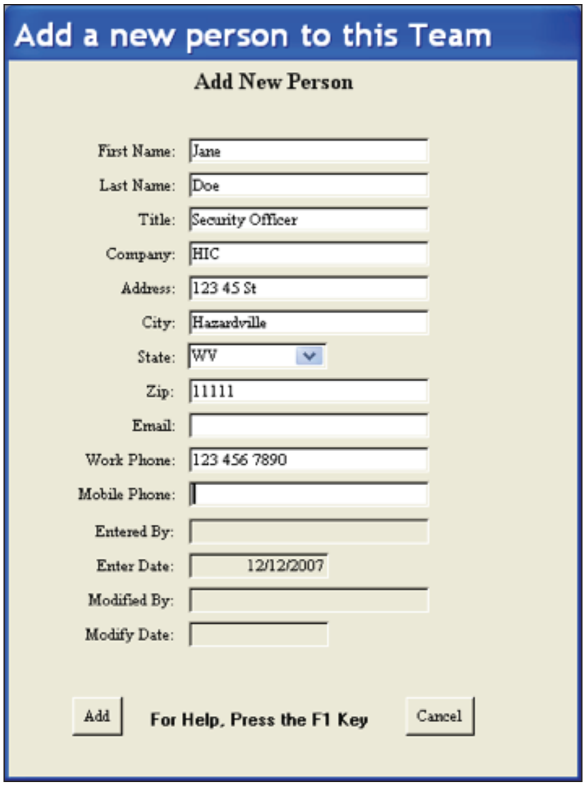
Email). If not all of the fields are visible, slide the bar at the bottom of the screen or use the keyboard arrows to see the remaining fields.

6. Press **Enter** or **Tab** on your keyboard to add the information to the database.
7. To edit the information for a POC, click the far left column in the row with the record and edit the information.
8. To delete a POC, select the POC by clicking the far left column in the row with the record and then selecting **Delete POC: [Name]**.
9. Since some POCs may have the same business address, you can duplicate an existing POC and use the information for the new POC that is the same for the existing POC. Click the left column of the POC with the address to be copied and then select **Add New POC and Duplicate**.
10. When you are finished adding, editing, and deleting POCs, select **Close** to return to the **IRVS Record Listing** screen or select another tab.

7.6 Adding Assessment Team Members

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
2. Select **Exec Sum/POC/Photos/GIS**.
3. Select the **Assessment Team** tab.





4. Select **Add New Team Member** and complete the information.

5. To select a Team Member from a list of team members in other records, select **Select Team Member from List**. The user must add at least one new team member before using this function.

6. To delete a Team Member, select the Team Member by clicking the far left column in the row with the record and then selecting **Delete Team Member: [Name]**.

7. After completing the Team Member information, select **Add** to return to the previous screen. The information that you have entered should appear. Use the bar slide or keyboard arrows to see the off-screen information.

8. When you are finished adding or deleting team members, select **Close** to return to the **IRVS Record Listing** screen or select another tab.

7.7 Adding Photos, Setting the Default Image, Deleting Photos, and Viewing Photos

7.7.1 Adding Photos

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.

2. Select **Exec Sum/POC/Photos/GIS**.

3. Select the **Add Photos** tab.

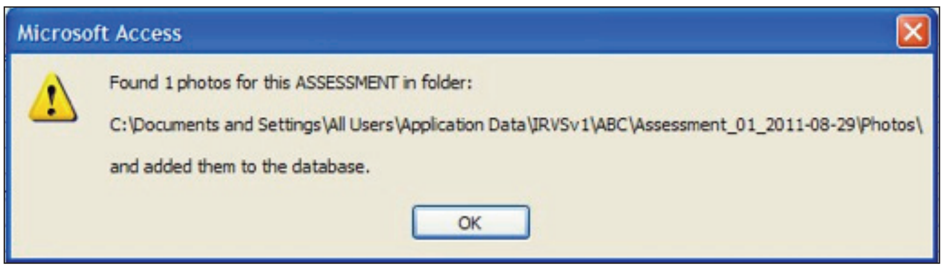
4. To add a single photo to the database, select **Copy only the selected image** if it is not already selected and select **Browse for a file**. Select the photo you want to add and select **Open**. Select **Yes** in the next menu, which lists the file name of the photo and the file path where it will be saved. The database recognizes any type of file in the "Miscellaneous" folder but only files with a "jpg," "gif," or "bmp" file extension in the "Photo" folder.

5. To add all the photos in a folder, select **Copy ALL from the folder** and select **Browse for a file**. Select the folder with the photos you want to

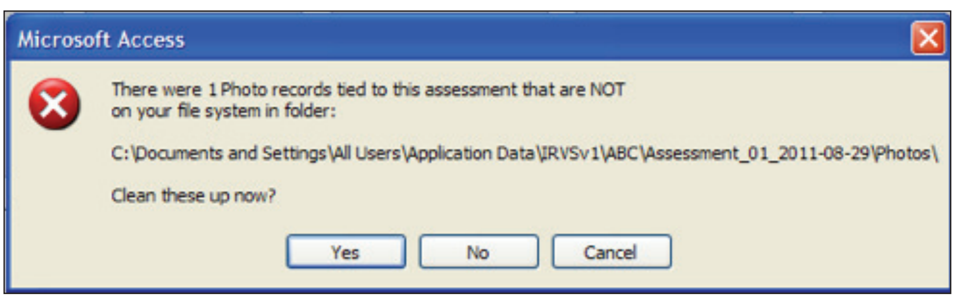
add and select **Open**. Select any file from the folder and select **Open**. Select **Yes** in the next menu, which lists the file name of the photo and the file path where it will be saved.

When the **Add Photo** or **View Photos** tabs are opened, the list of photos in the database is automatically updated after reopening the database if the photos in the subfolders that have been added to the database have changed (e.g., if you use the file manager folder where the photos for the database have been stored to modify current photos, delete photos, or add new photos; the next time you reopen the database, the list of photos will be updated).. See Section 7.7.4 for information on viewing photos.

If you add a photo using the file manager, the message below will appear. Select **OK**.



If you delete a photo using the file manager, the message below will appear. Select **Yes**.



7.7.2 Setting the Default Image

Once selected, the default image for a particular site will appear on various screens in the top right corner. The default image generally shows the screening site. It could be a photo of the building or a sign showing the name of the site. See Section 6, Step #11, for an example of a default image.

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.

2. Select the **Site ID, Address, Coordinates** tab.

3. Select one of the photos you have added in the dropdown menu in the **Default Facility Image** field at the top of the screen. The image will appear in the box at the top right of the screen.

7.7.3 Deleting Photos

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.

2. Select the **Site ID, Address, Coordinates** tab.

3. Select the **Add Photos** tab to see the list of photos in the database.

4. Select the photo you want to delete by clicking the far left column in the row with the photo. Select **Delete Photo**.

5. You will be asked to confirm that you want to delete the photo. Select **Yes**.

7.7.4 Viewing Photos

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.

2. Select the **Site ID, Address, Coordinates** tab.

3. Select the **View Photos** tab. Thumbnails of the photos will appear.

4. To enlarge a photo, click the thumbnail of the photo and select **Zoom** or **Clip** for different view of the photo. Select **Open File** to open the Windows Picture and Fax Viewer, which allows you to rotate, enlarge, print, and save the photo.

5. If there are more than five photos in the database, use the arrows under the thumbnails to scroll through the thumbnails of the photos.

7.8 Adding GIS Images

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.

2. Select the **Site ID, Address, Coordinates** tab.

3. Select the **Add GIS Portfolio Images** tab.

4. Follow Steps #4 and #5 in Section 7.7.1.

7.8.1 Deleting GIS Images

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
2. Select the **Site ID, Address, Coordinates** tab.
3. Select the **Add GIS Portfolio Images** tab to see the list of GIS images in the database.
4. Select the image you want to delete by clicking the far left column in the row with the photo. Select Delete GIS Portfolio Image.
5. You will be asked to confirm that you want to delete the photo. Select **Yes**.

7.8.2 Viewing GIS Portfolio Images

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
2. Select the **Site ID, Address, Coordinates** tab.
3. Select the **View GIS Portfolio** tab. Thumbnails of the images will appear.
4. To enlarge an image, click the thumbnail of the image and select **Zoom** or **Clip** for different view of the image. Select **Open File** to open the Windows Picture and Fax Viewer, which allows you to rotate, enlarge, print, and save the image.
5. If there are more than five GIS image in the database, use the arrows under the thumbnails to scroll through the thumbnails of the image.

7.9 Adding and Deleting Miscellaneous Information

7.9.1 Adding Miscellaneous Information

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
2. Select the **Site ID, Address, Coordinates** tab.
3. Select the **Miscellaneous Files** tab.
4. Follow Steps #4 and #5 in Section 7.7.1.
5. To view the file, click on the file name.

7.9.2 Deleting Miscellaneous Files

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
2. Select the **Site ID, Address, Coordinates** tab.
3. Select the **Miscellaneous Files** tab.
4. Select the file you want to delete by clicking the far left column in the row with the file. Select Delete File.
5. You will be asked to confirm that you want to delete the photo. Select **Yes**.

7.10 Exporting Screening Data

After a screening has been completed, the screening data in the Field Database must be copied and imported into the Master Database, which are administrative functions. See Section 10.

7.11 Emptying the Database

The final task in conducting a screening is to delete the screening data from the Field Database after the data have been transferred to the Master Database. This task is an administrative function. See Section 10.5.

Section 8

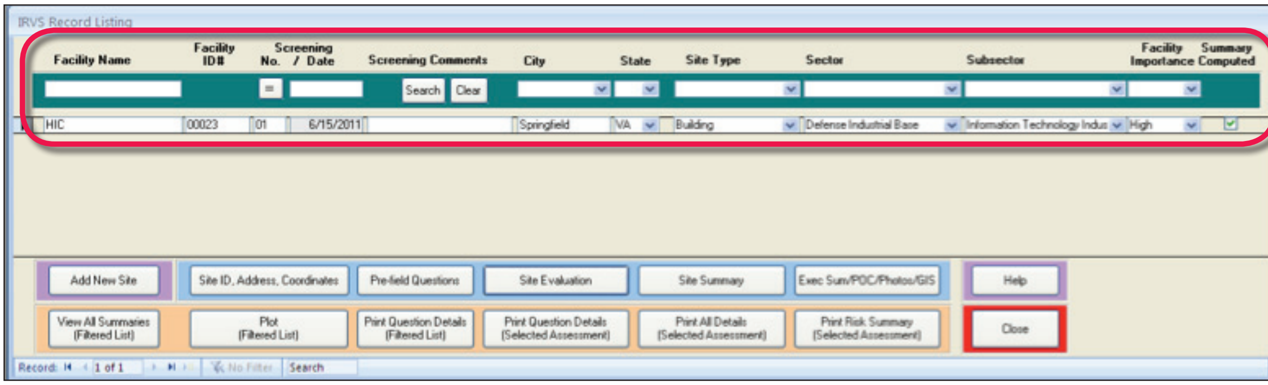
8. Filtering Records

Records can be filtered using the categories of information in a record (e.g., site type, location, sector, facility importance). After you create a filtered list of records, you can view all of the summaries of the records in the filtered list (see Section 8.1) and plot the sites of the records in the filtered list (see Section 8.2).

To filter the records in the database, follow these steps.

1. After logging on to the database, select **Rapid Visual Screening** from the **Main Menu** to open the **IRVS Record Listing** screen.
2. It is assumed that the database already contains more than one record. To filter the list of records, enter a search term or select a term from the dropdown menu in one or more of the fields at the top of the screen. For a range of dates before, after, or on a specific date, use “<” , “>” or “=.”For example, if the screener wants to observe all the assessments before June 16,2011, the screener would use “<” by selecting the box to the left of the date input and selecting 6/16/2011 on the pop up calendar.

3. **Select Search.** The records that match the search will be listed.

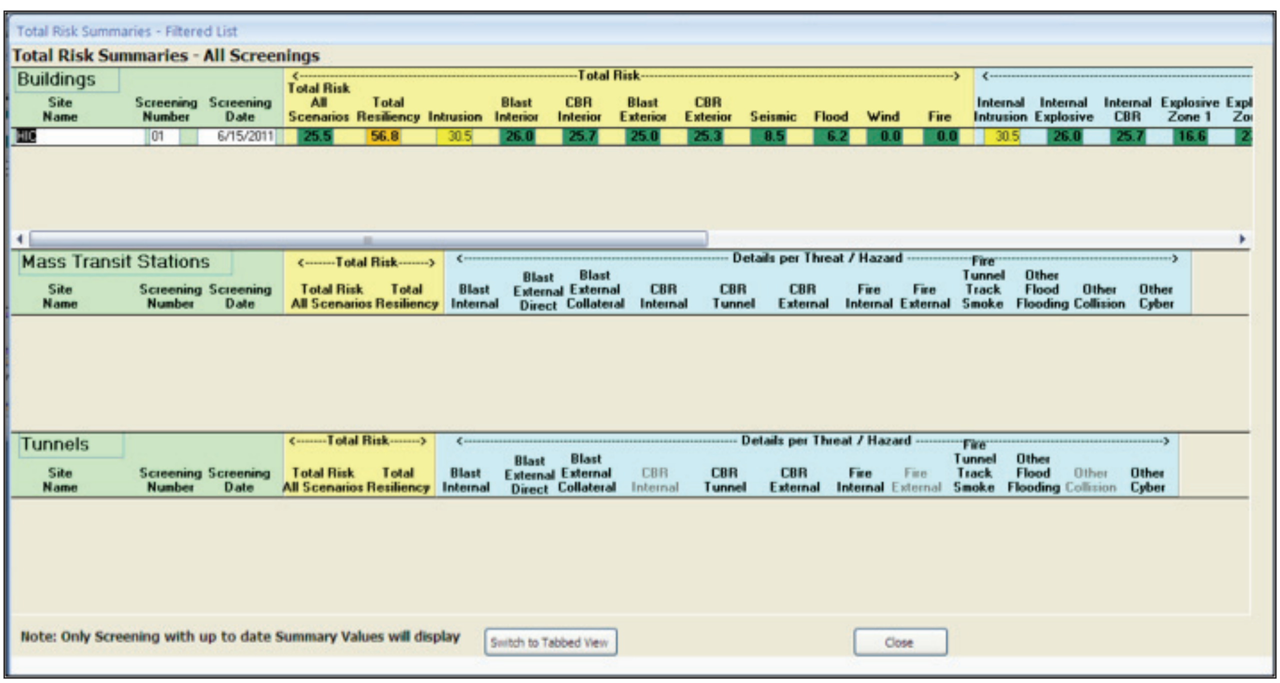


4. To clear the search, select **Clear**.

8.1 Viewing All Summaries

1. After you have created a filtered list, select **View All Summaries (Filtered List)** at the bottom of the screen to display the **Total Risk Summary – Filtered List** screen. If the screener does not filter the records, all the summaries in the database can be seen at the same time. The information that will be displayed is the same as the information that is displayed if you select **Site Summary** for one record except that you get a summary of more than one record. The summaries are grouped by site type.

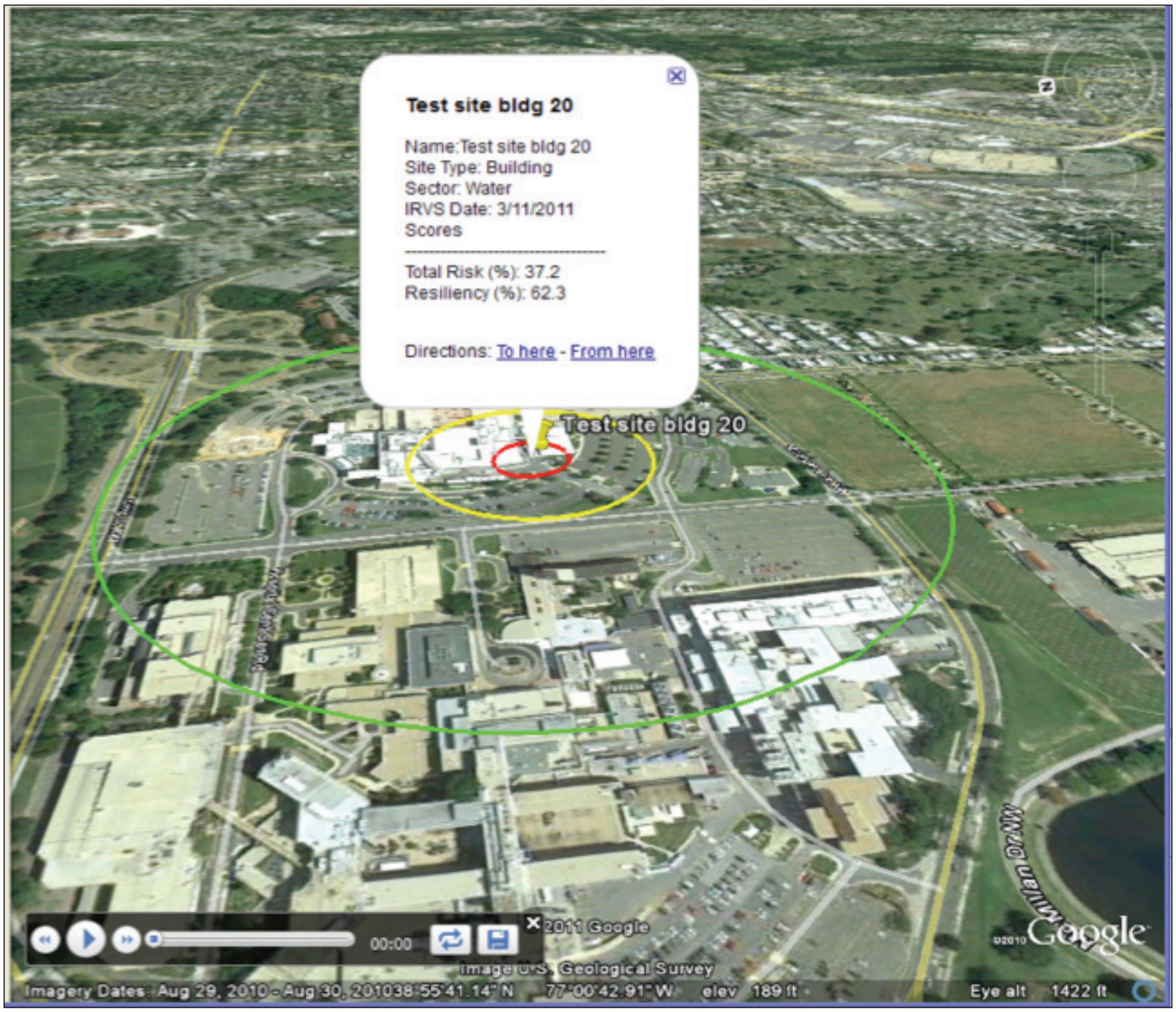
2. To see the summaries for only one site type, select **Switch to Tabbed View**.



8.2 Plotting a Filtered List

If you have entered the coordinates for the screening sites and your computer has an installed mapping program that can read KML files, you can plot the records in a filtered list.

1. After you have created a filtered list, select **Plot (Filtered List)** to plot the sites that are in the filtered list.



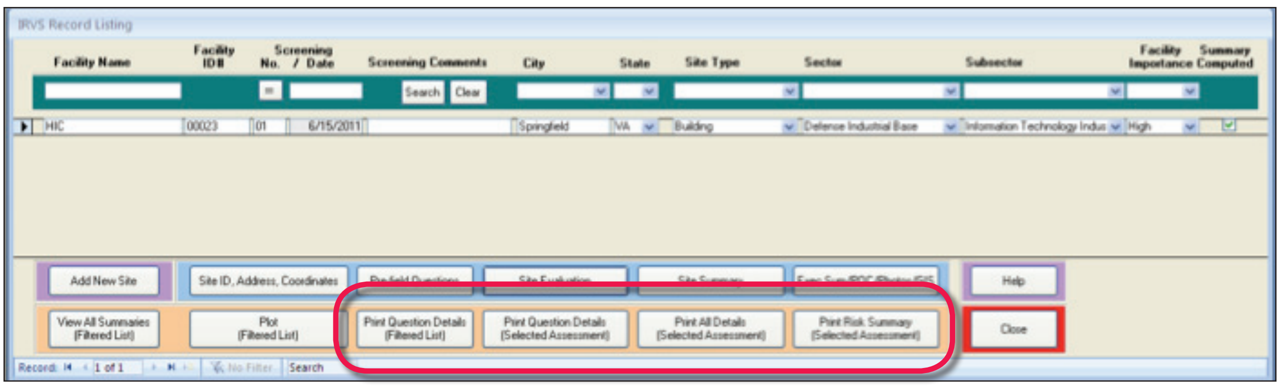
9. Generating and Printing Reports

Section 9

The **IRVS Record Listing** screen has four options for generating and printing reports:

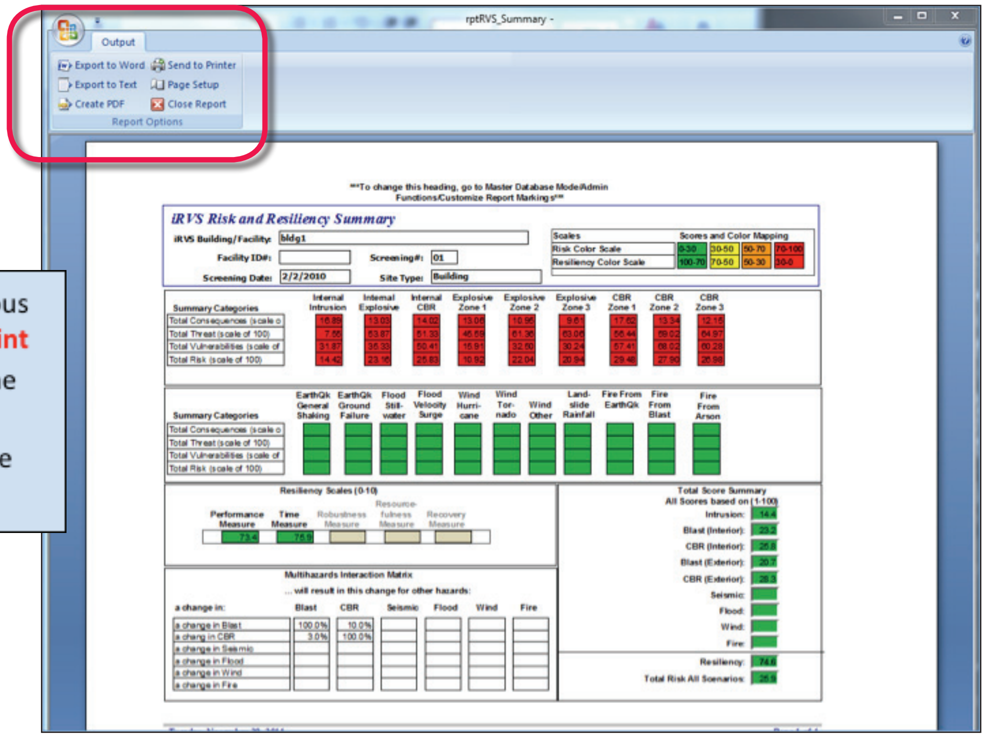
- Print Question Details (Filtered List)
- Print Question Details (Selected Screening Record)
- Print All Details (Selected Screening Record)
- Print Risk Summary (Selected Screening Record)

For all four options, you can print the information or export it as a MS Word document, or Text document, or PDF for editing or formatting by using the Output TAB. After selecting an option, to return to the previous screen, select **Close Report**. If you use the "**X**" on the upper right corner of the screen, you will close the database.



1. To generate and print a list of the answers to the pre-field and site evaluation questions for each record in the filtered list, you must first create a filtered list (see Section 8). Then select **Print Question Details (Filtered List)**. The risk and resiliency scores and other details (e.g., POCs, Assessment Team members, Executive Summary) will not be included.
2. To generate and print a list of the answers to the pre-field and site evaluation questions for a single record, first select a record on the **IRVS Record Listing** screen by clicking the far left column in the row with the record. Then select **Print Question Details (Selected Screening Record)**. The risk and resiliency scores and other details (e.g., POCs, Assessment Team members, Executive Summary) will not be included.
3. To generate and print an expanded amount of data for a single record, first select a record on the **IRVS Record Listing** screen by clicking the far left column in the row with the record. Then select **Print All Details (Selected Screening Record)**. The risk and resiliency scores will not be included.

4. To generate a risk and resilience summary for a single record, first select a record on the **IRVS Record Listing** screen by clicking the far left column in the row with the record. Then select **Print Risk Summary (Selected Screening Record)**.



To return to the previous screen, select **Close Print Preview**. Do not use the "X" in the upper right corner, or you will close the database.

Section 10

10. Administrative Functions

Administrative functions are not available to all users. You must have permission to log on as an Administrator, or your user name must include permission to access administrative functions. The administrative functions are as follows:

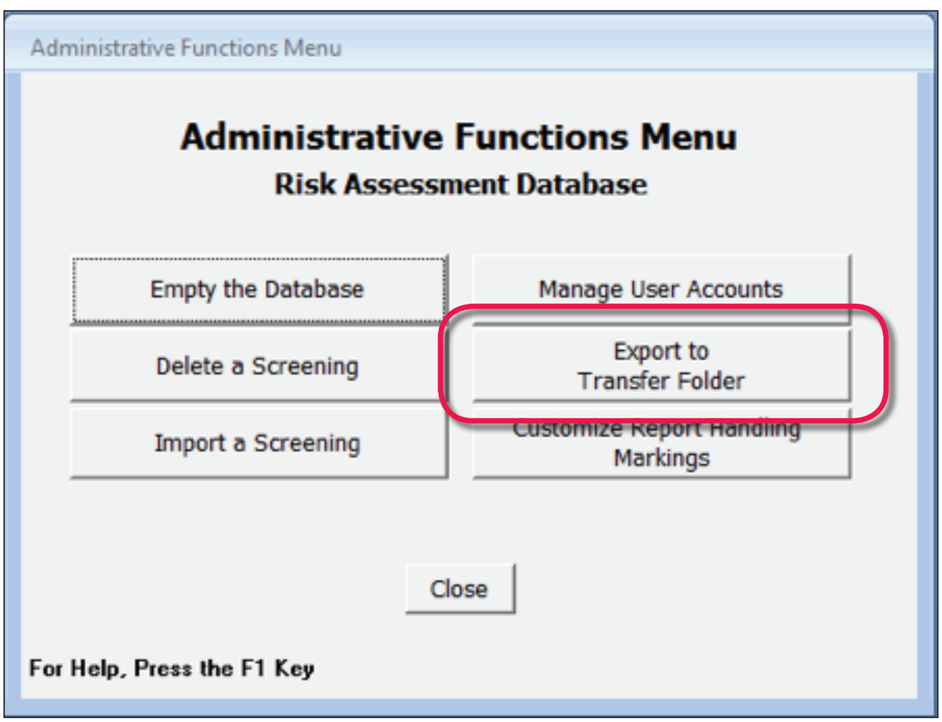
- Exporting screening data from the Field Database to transfer media
- Importing screening data into the Master Database from transfer media
- Importing screening data into the Master Database directly from the Field Database
- Deleting a single screening record
- Emptying the database
- Managing user accounts
- Customizing report handling markings

10.1 Exporting Screening Data from the Field Database to Transfer Media

After a screening has been completed, the screening data must be transferred from the Field Database to the Master Database. The transfer can be accomplished in two ways: (1) copying the data to a USB drive, CD, DVD, or other type of transfer media and (2) importing the data directly from the Field Database into the Master Database.

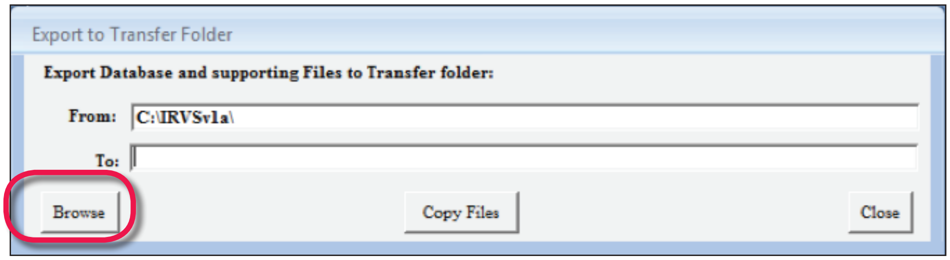
Exporting screening data to transfer media is described in this section. For instructions on transferring data from the transfer media to the Master Database, see Section 10.2. For information on importing data directly into the Master Database from the Field Database, see Section 10.3.

1. Log on to the database or, if you are in the database, close the screens until you are back to the **Main Menu**.
2. Select **Administrative Functions**.
3. Select **Export to Transfer Folder**.
4. In the **Export to Transfer Folder** screen, the **From** field (location of the data to be copied) should be populated. Select **Browse** to identify the file path where you want the data to be copied.



5. Select the folder where you want to copy the data and then select **Open**.

6. Select **Copy Files**. You will be asked to confirm that you want to copy the files. Select **Yes**.



7. A message will appear indicating that the transfer is complete. Select **OK** and then **Close** to return to the **Administrative Functions** menu.

8. Give the transfer media containing the data to the Master Database operator (usually the IRVS Program Manager) who will copy the data to a temporary location on his or her computer until the data can be transferred to the Master Database. See Section 10.2 for instructions on importing screening data into the Master Database from transfer media.

10.2 Importing Screening Data into the Master Database from Transfer Media

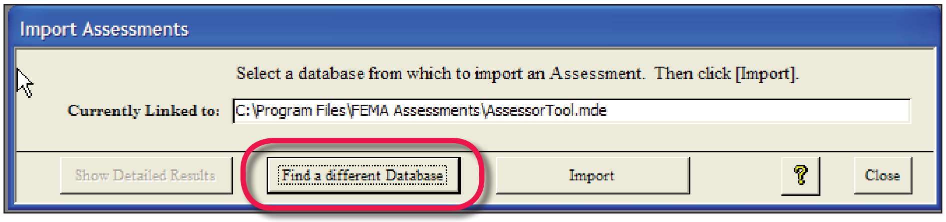
1. Follow the instructions in Section 10.1 for transferring data from the Field Database to transfer media.

2. Insert the transfer media into the computer with the Master Database.

3. Select **Administrative Functions** from the **Main Menu** of the Master Database.

4. In the **Administrative Functions Menu**, select **Import Assessor Database**. This imports the database files with an mdb or mde extension that contain the screening data on the Field Database. The field for **Currently Linked to** in the **Import Assessments** screen will be populated with the last database file the Master Database was linked to.

5. To find a different database file to import, select **Find a different Database**.



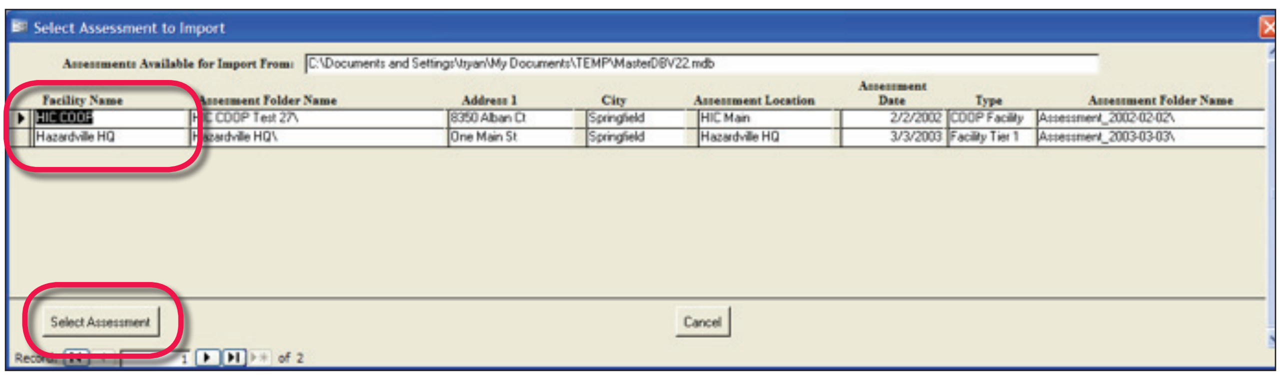
6. When you have found the database file you want to import into the Master Database, select file and then select **Open**, which will take you back to the **Import Assessments** screen.

7. Select **Import**.

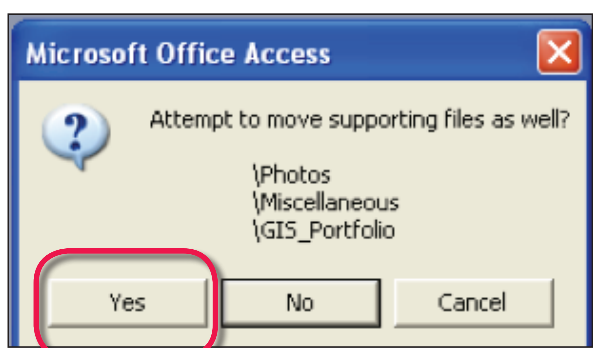
8. You will be asked to confirm that you want to import the database file. Select **Yes**.

9. A message will appear confirming that the file has been imported. Select **OK**.

10. The **Select Assessment to Import** screen will appear. Select the assessment to be imported and select **Select Assessment**.



11. You will be asked if you also want to transfer the supporting files (e.g., photos) that are tied to the assessment. Select **Yes** if you want to transfer the files. If there are no supporting files, you will get a message to that effect.



12. You will be asked to confirm that you want to transfer the files now. Select **Yes**.

13. Select **OK** to finish.

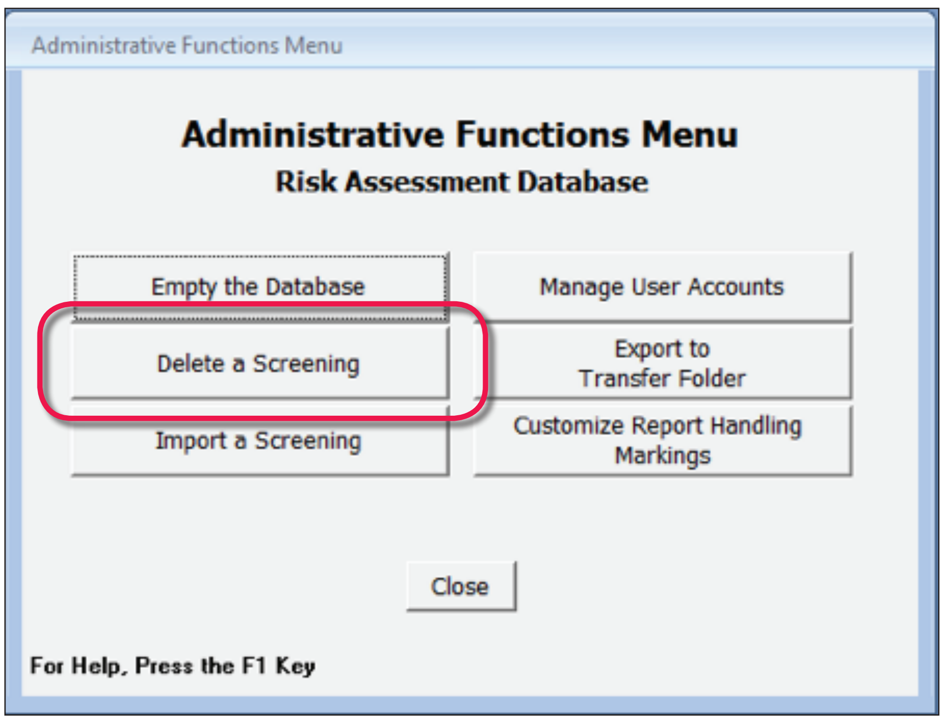
10.3 Importing Screening Data Directly into the Master Database from the Field Database

1. Connect the Field Database laptop to the computer with the Master Database using a USB cable or through a network.
2. Follow Step #3 through Step #13 in Section 10.2.

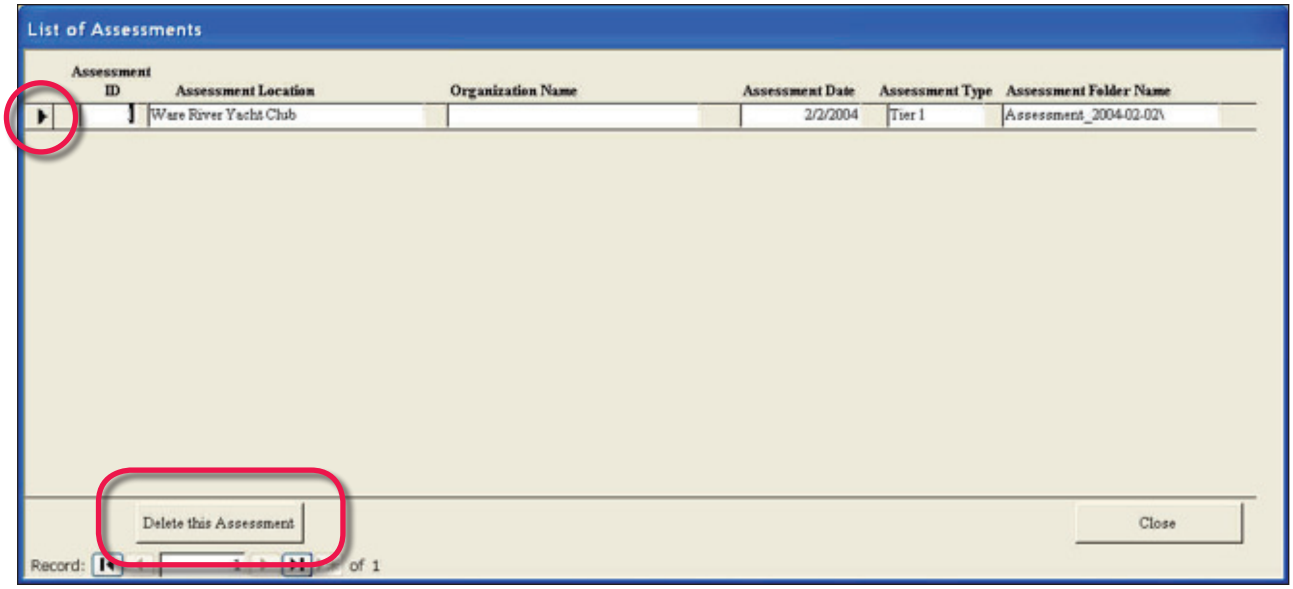
10.4 Deleting a Single Screening Record

If you have permission to access administrative functions, you can delete screening records permanently. Deleted data can't be restored.

1. Log on to the database or, if you are in the database, close the screens until you are back to the **Main Menu**.
2. Select **Administrative Functions**.
3. Select **Delete a Screening**.



4. The **List of Assessments** screen will appear. Select the screening record to erase and then select **Delete This Assessment**.
5. You will be asked to confirm that you want to permanently erase the selected screening record. Select **Yes**. **Warning: The screening record will be erased from the database permanently!**



10.5 Deleting All Screening Records from the Field Database

After the screening records have been transferred from the Field Database to the Master Database, the screening records should be deleted from the Field Database. The records will be deleted permanently and can't be restored. **Before deleting the records, confirm that the records have been successfully transferred to the Master Database.**

1. Log on to the Field Database or, if you are in the database, close the screens until you are back to the **Main Menu**.
2. Select **Administrative Functions**.
3. Select **Empty the Database**.
4. You will be asked to confirm that you want to permanently erase all screening records. Select **Yes** to continue or No or Cancel to cancel.
5. If you selected **Yes**, you will receive a warning that the action is non-reversible. Select **Yes** to continue or **No** or **Cancel** to cancel.
6. If you selected **Yes**, you will receive a final warning asking if you want to delete all files and folders. Select **Yes** to continue or **No** or **Cancel** to cancel.
7. If you selected **Yes**, the records will be deleted, and you will receive a message to that effect. Select **OK**.

Before deleting the records, confirm that the records have been successfully transferred to the Master Database.

8. You will be given the option to keep your customized system defaults or to reset the labels to their original listings. Select the option you prefer and select **Continue with these choices**.

9. Select **OK**. The database will close. The next time you open the database, you will get a message that the **Database** will be re-set. The purged database will have no screening records.

10.6 Managing User Accounts

The **Manage User Accounts** function enables an administrator to add a user, delete a user, and assign a user to one of three user groups. The user group determines the permission level.

The database is preloaded with the following four user names and passwords.

User Name	Password
Administrator	Administrator
Assessor	Assessor
Editor	Editor
Reader	Reader

10.6.1 User Groups

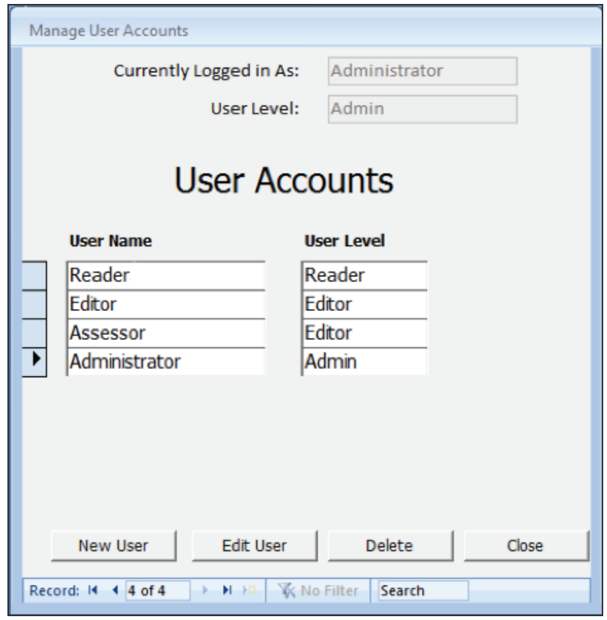
Three user groups are available in the database: Administrators (Admins), Full Data Users, and read-only users (Readers).

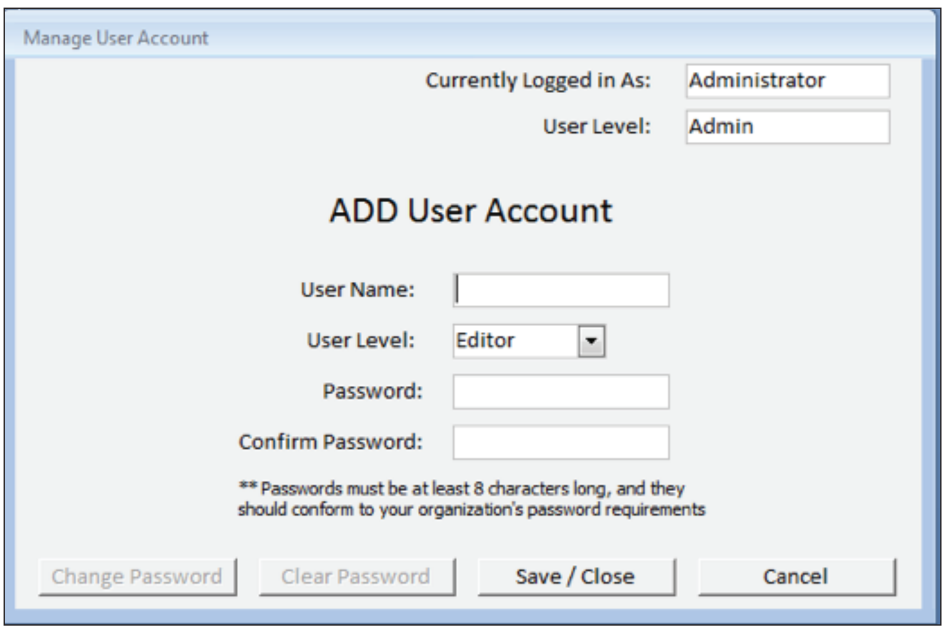
- **Admins** have full access to the database, including the administrative functions. The database starts with two users in this group, **Administrator** and **Assessor**.
- **Full Data Users** can view, record, and update data but not perform administrative functions. The database starts with one user in this group, **Editor**.
- **Readers** can only view data. The database starts with one user in this group, **Reader.**

The password and permission level for the four preloaded user names (Administrator, Assessor, Editor, and Reader) can be changed, but cannot be deleted. This is a safety feature to prevent users from erasing all Administrators from the program.

10.6.2 Add a User

1. From the **Main Menu**, select **Administrative Functions**.
2. From the **Administrative Functions Menu**, select **Manage User Accounts**.
3. From the **Manage User Accounts** screen, select **New User.**
4. From the A**dd a New User Account** screen, type in the new user name.
5. Under User Level select a user group from the dropdown menu.
6. Select **Save/Close**.
7. Select **OK**.





10.6.3 Delete a User

1. From the **Main Menu**, select **Administrative Functions**.
2. From the Administrative Functions Menu, select **Manage User Accounts**.
3. From the **List of Users and the Group to which they belong** screen, select one of the existing users by left clicking on the far left column.
4. Select **Delete.**

5. You will be asked to confirm the deletion. Select **Yes** to confirm or No or Cancel to cancel the action.
6. Select **OK**.

10.6.4 Change the User Level

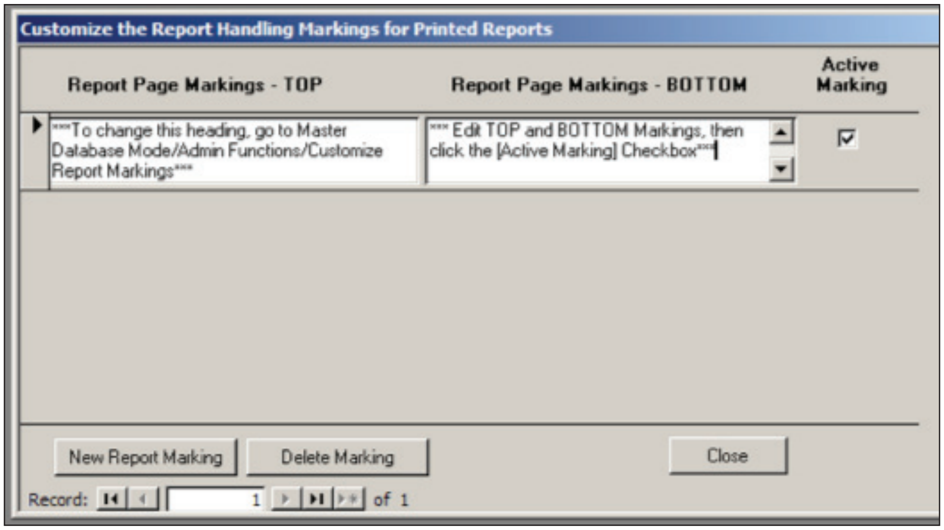
You want need to change the user level that a particular user belongs to.

1. From the **Main Menu**, select Administrative Functions.
2. From the Administrative Functions Menu, select **Manage User Accounts**.
3. From the **User Accounts** screen, select one of the existing users by left clicking on the far left column.
4. Select **Edit User**.
5. Select a level from a dropdown menu.
6. Select **Save/Close** to continue or **Cancel** to cancel the action.

10.7 Customizing Report Handling Markings

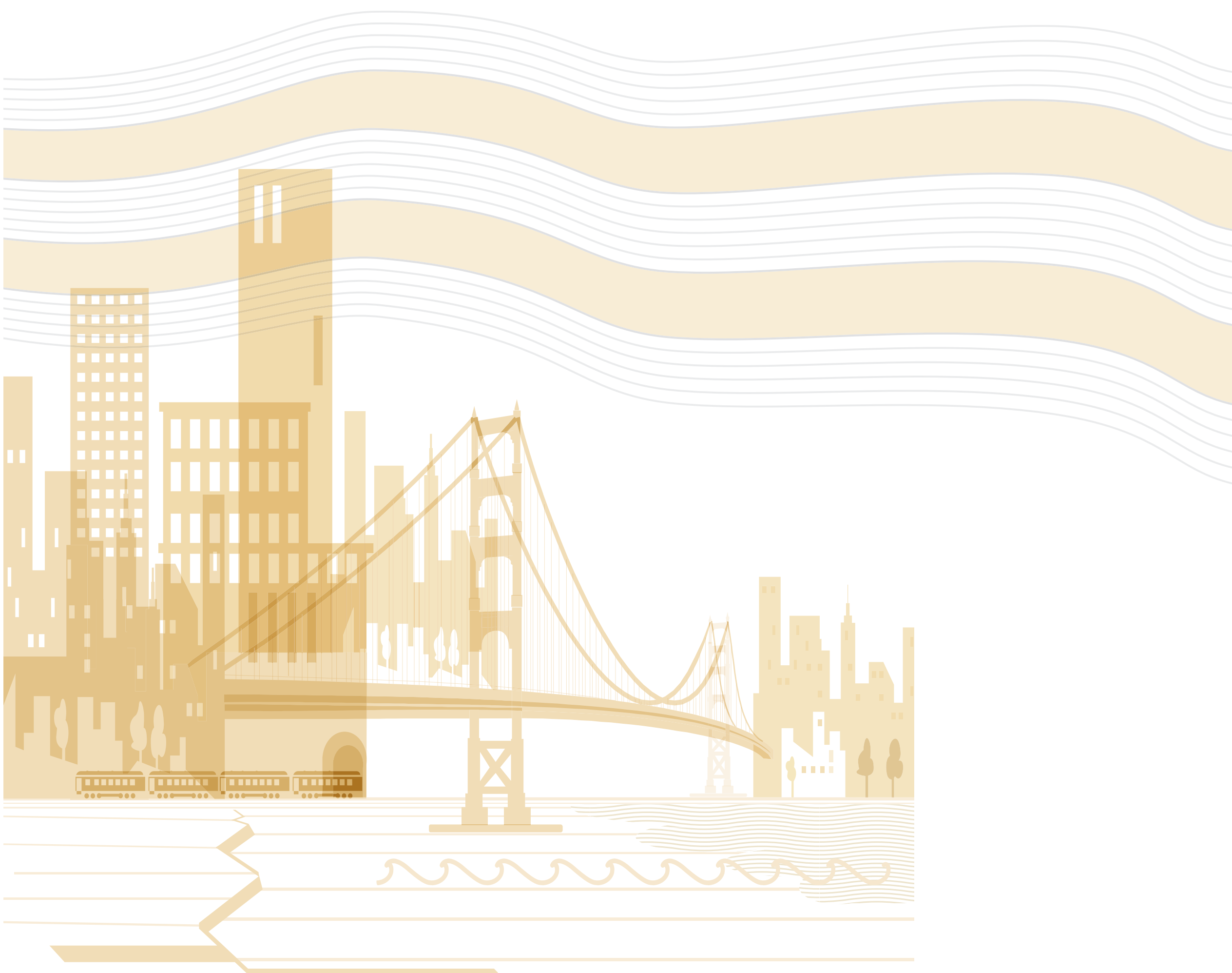
The database administrator can establish customized report handling markings that will be automatically printed on the top and bottom of all reports.

1. From the **Main Menu**, select **Administrative Functions**.
2. From the A**dministrative Functions Menu**, select **Customize Report Handling Markings**.
3. **The Customize Report Handling Markings for Printed Reports** screen will appear. Edit the default marking or type in the desired text under **Report Page Markings – TOP and Report Page Markings – BOTTOM**.
4. Add top and bottom markings by selecting **New Report Marking**. Select the marking you want to be used when reports are printed by selecting the marking in the **Active Marking** column.
5. Delete top and bottom markings by selecting **Delete Marking**.
6. Select **Close** to return to the previous screen.


Customize the Report Handling Markings for Printed Reports
Report Page Markings - TOP
Report Page Markings - BOTTOM
Active Marking
To change this heading, go to Master Database Mode/Admin Functions/Customize Report Markings
*** Edit TOP and BOTTOM Markings, then click the [Active Marking] Checkbox***
New Report Marking
Delete Marking
Close
Record: 1 of 1

D

Data Collection Form: Paper Version



Pre-Field Information

Complete the information on this page before the field assessment, using additional sheets as needed.

Facility name / identification ______________________________

Organization Name ______________________________

Address / intersection ______________________________

City______________ State__________ Zip Code __________

GIS Coordinates ______________________________

Sector__________________ Subsector ______________

Year built __________________ Number of Occupants __________

Total Area (in square feet)__________ Footprint (in square feet) __________

Number of Floors/Building Height ______________________________

Facility Importance ______________________________

Replacement Value ______________________________

Critical Functions ______________________________

Tenants ______________________________

Facility Description ______________________________

____

____

____

____

Retrofit Description (if applicable) ______________________________

____

____

____

Target Density. Number of potential high-value / CIKR targets / buildings within 100, 300, and 1000 feet of the Building Enclosure.

	Distance		
CIKR Sector	< 100 feet	≥ 100 ft. and < 300 ft.	≥ 300 ft. and ≤1000 ft.
Agriculture and Food			
Banking and Finance			
Chemical			
Commercial Facilities			
Communications			
Critical Manufacturing			
Dams			
Defense Industrial Base			
Emergency Services			
Energy			
Government Facilities			
Healthcare and Public Health			
Information Technology			
National Monuments / Icons			
Nuclear Reactors, Materials, and Waste			
Postal and Shipping			
Transportation Systems			
Water			
TOTAL			

Pre-Field Information (cont.)

Critical Infrastructure and Key Resources (CIKR) Information

Critical Functions ______________________________

Operational Redundancy ______________________________

Hazardous Materials Kept on Site______________________________

Credible threats to this facility ______________________________

____

Soil Type ______________________________

Seismic Zone ______________________________

Nearby Seismic Fault ______________________________

Potential for Soil Liquefaction ______________________________

Soil Spread Potential ______________________________

Floodplain ______________________________

Depth of Previous Flood ______________________________

Velocity of Floodwaters ______________________________

Distance from Flood Sources ______________________________

Wind Speed Zone ______________________________

Hurricane Events ______________________________

Tornado Events ______________________________

Other Wind Events ______________________________

Hazards Identified For Analysis:

- ❑ Blast
- ❑ Chemical, Biological, and Radiological
- ❑ Seismic
- ❑ Flood
- ❑ Wind
- ❑ Fire
  - ❑ General
  - ❑ Fire Marshal's

Resilience Computations:

- ❑ No Resiliency computations are needed
- ❑ General
- ❑ Government
- ❑ Medical
- ❑ School K12
- ❑ Business / Financial
- ❑ Retail

Structure Type:

- ❑ Wood Frame
- ❑ Steel Moment Frame
- ❑ Steel Braced Frame
- ❑ Steel Light Frame
- ❑ Steel Frame with Cast-in-Place Concrete Shear Walls
- ❑ Steel Frame with Unreinforced Masonry Infill Walls
- ❑ Concrete Moment Frame
- ❑ Concrete Shear Walls
- ❑ Concrete Frame with Unreinforced Masonry Infill Walls
- ❑ Precast Concrete Tilt-Up Walls
- ❑ Precast Concrete Frames with Concrete Shear Walls
- ❑ Reinforced Masonry Bearing Walls with Wood or Metal Deck Diaphragms
- ❑ Reinforced Masonry Bearing Walls with Precast Concrete Diaphragms
- ❑ Unreinforced Masonry Bearing Walls
- ❑ Manufactured Homes

Pre-Field Questionnaire

Building Characteristic			Attribute Options (a) / (f)	(b) / (g)	(c) / (h)	(d) / (i)	(e) / (j)	Red Flag	Comments
PF-1	Number of Occupants		< 100	≥ 100, < 500	≥ 500, < 2,000	≥ 2,000, < 5,000	≥ 5,000, < 10,000		
			≥ 10,000, < 12,500	≥ 12,500, < 15,000	≥ 15,000, <17,500	≥ 17,500, < 20,000	> 20,000		
PF-2	Replacement Value		< $1 million (m)	≥ $1 m, < $5 m	≥ $5 m, < $10 m	≥ $10 m, < $15 m	≥ $15 m, < $20 m		
			≥ $20 m, < $150 m	≥ $150 m, < $400 m	≥ $400 m, < $750 m	≥ $750 m, < $1 billion (b)	> $1 b		
PF-3	Historic Site		No	Yes	—	—	—		
PF-4	Occupancy Use		Group I	Group II	Group III	—	—		
PF-5	Target Potential (Credible Threats)	**PF-5.1** Target Potential: Building	No	Yes	—	—	—		
		PF-5.2 Target Potential: Sector	No	Yes	—	—	—		
PF-6	Target Density	**PF-6.1** Target Density: Zone I	0	1	2	3	4 or more		
		PF-6.2 Target Density: Zone II	0	1	2	3	4 or more		
		PF-6.3 Zone III	0	1	2	3	4 or more		
PF-7	Seismic Zone		Low	Medium	High	—	—		
PF-8	Proximity to an Active Seismic Fault		Farther than 10 miles from a fault (active or inactive) or within 10 miles of an inactive fault	Within 10 miles of an active fault	—	—	—		
PF-9	Floodplain		No	Yes	—	—	—		
PF-10	Maximum Flood Depth		No previous flooding	Low	Medium	High	—		

Pre-Field Questionnaire (cont.)

Building Characteristic		Attribute Options					Red Flag	Comments
		(a) / (f)	(b) / (g)	(c) / (h)	(d) / (i)	(e) / (j)		
PF-11	Flood Duration	No previous flooding	Short	Medium	Long	Very long		
PF-12	Floodwater Velocity	No previous flooding	Low	Medium	High	Extreme		
PF-13	Distance from a Flooding Source	Far	Medium	Close	Adjacent	—		
PF-14	High Wind Speed Zone	Low	Medium	High	—	—		
PF-15	Hurricane Frequency in the Region	Never	Rare	Medium	Frequent	—		
PF-16	Tornado Frequency in the Region	Never	Rare	Medium	Frequent	—		
PF-17	Soil Type	Hard rock	Medium	Poor	—	—		

Building Characteristic		Attribute Options								Red Flag	Comments
PF-18	Structure Type	W	S1	S2	S3	S4	S5	C1	C2		
		C3	PC1	PC2	RM1	RM2	URM	MH	—		

1. Consequence Rating

Building Characteristics		Attribute Options (a)	(b)	(c)	(d)	(e)	Red Flag	Comments
1.1	Locality and Density Type	Rural / suburban	Semi-urban/ light industrial	Industrial	Urban	Dense urban		
1.2	Operational Redundancy (Asset Based)	Very high	High	Moderate	Low	Very low		
1.3	Impact of Physical Loss	Local	Statewide	Regional	National	International		

2. Threat Rating

Building Characteristics		Attribute Options (a)	(b)	(c)	(d)	(e)	Red Flag	Comments
2.1	Site Population Density	Very low	Low	Moderate	High	Very high		
2.2	Visibility / Symbolic Value	Very low	Low	Moderate	High	Very high		
2.3	Overall Site Accessibility	Inaccessible	Accessible	—	—	—		

3. Vulnerability Rating: Site

Building Characteristics		Attribute Options (a)	(b)	(c)	(d)	(e)	Red Flag	Comments
3.1	Distance to Potentially Threatening Vehicle	≥ 75 feet	≥ 50 feet, < 75 feet	≥ 25 feet, < 50 feet	³ 5 feet, < 25 feet	< 5 feet		
3.2	Perimeter Boundary CPTED = crime prevention through environmental design	Continuous anti-ram barriers	Semi-continuous anti-ram barriers	Well-integrated CPTED elements (landscaping and natural elements)	Ornamental/ temporary/ anti-climb fence barriers	No security / discontinuous security		

3. Vulnerability Rating: Site (cont.)

Building Characteristics			Attribute Options (a)	(b)	(c)	(d)	(e)	Red Flag	Comments
3.3	Unobstructed View		≥ 30 feet	≥ 20 feet, < 30 feet	≥ 10 feet, < 20 feet	≥ 5 feet, < 10 feet	< 5 feet		
3.4	Unsecured Underground Access		None	Utility tunnel or culvert to site	Utility tunnel to building	Pedestrian tunnel to building	—		
3.5	Storage of Hazardous Materials		None	Low	Moderate	High	—		
3.6	Nearby Structures (Underground or Adjacent)		None	Small	Medium	Major	Significant		
3.7	Topography: Slope		Flat or terraced with adequate setbacks (equaling the width of the building)	Light slope	Moderate slope	Steep slope	—		
3.8	Condition of Foundation		Excellent	Medium	Poor	—	—		
3.9	Potential Windborne Debris/ Missiles		Very few	Some	Many	—	—		
3.10	Nearby Water Structures (Levees, Embankments, Floodwalls, and Upstream Dams)		No	Yes	—	—	—		
3.11	Retaining Walls		None	Good condition	Moderate condition	Poor condition	—		
2.12	Retaining Walls		None	Good condition	Moderate condition	Poor condition	—		
3.13	Location of Critical Functions and Valuables	**3.13.1** Exposure to Wind Events	No	Yes	—	—	—		
		3.13.2 Exposure to Flood Events	No	Yes	—	—	—		
3.14	Potential of Soil Liquefaction		None	Low	Medium	High	—		

4. Vulnerability Rating: Architectural

Building Characteristic		Attribute Options					Red Flag	Comments
		(a) / (f)	(b) / (g)	(c) / (h)	(d) / (i)	(e) / (j)		
4.1	Building Height	< 20 feet (1 floor)	≥ 20 feet, < 50 feet (2 to 3 floors)	≥ 50 feet, < 100 feet (4 to 8 floors)	≥ 100 feet, < 150 feet (9 to 12 floors)	≥ 150 feet (< 2 floors)		
		< 200 feet (12 to 15 floors)	≥ 200 feet, < 500 feet (16 to 39 floors)	≥ 500 feet, < 800 feet (40 to 60 floors)	≥ 800 feet, < 1000 feet (60 to 80 floors)	> 1,000 feet (> 80 floors)		
4.2	Building Configuration	Circular and convex	Rectangular box	Re-entrant corners	Concave	—		
4.3	Overhang	None	< 5 feet	≥ 5 feet, < 10 feet	≥ 10 feet, < 15 feet	≥ 15 feet		
4.4	Lobby / Retail Location	Detached	External attached and separated	External, unscreened	Within footprint	Adjacent to occupied areas		
4.5	Loading Dock and Mail Screen-ing Areas	Offsite / none	Exterior to building	At perimeter and separated	Adjacent to occupied space	Under building		
4.6	Vehicular Penetration of Exterior Enclosure	No potential	Potential for high-speed vehicular impact and penetration into the building	—	—	—		
4.7	Garage Location	None	Above ground, not adjacent	Adjacent exterior and above ground	Separate, not physically attached	Separate, physically attached		
		Below ground, not adjacent	Adjacent to critical utilities, above ground	Adjacent to critical utilities, below ground	Below occupied space	Below occupied space, below ground		

4. Vulnerability Rating: Architectural (cont.)

Building Characteristic		Attribute Options					Red Flag	Comments
		(a) / (f)	(b) / (g)	(c) / (h)	(d) / (i)	(e) / (j)		
4.8	Partitions	Braced	Not braced, less than 6 feet high	Not braced, 6 to 9 feet high	Not braced, more than 9 feet high	—		
4.9	Appendages	Not applicable	Braced	Not braced	—	—		
4.10	Nonstructural Component Anchoring	> 90%	60% to 90%	30% to 60%	< 30%	—		
4.11	Horizontal (Plan) Irregularity	No	Yes	—	—	—		
4.12	Vertical Irregularity	No	Yes	—	—	—		
4.13	Soft Story	No	Yes	—	—	—		
4.14	Elevated Tanks, Bins, Vessels, or Trussed Towers (Especially on the Roof)	None	Some	Several	—	—		

5. Vulnerability Rating: Building Enclosure

Building Characteristic		Attribute Options					Red Flag	Comments
		(a)	(b)	(c)	(d)	(e)		
5.1	Window Support Type	No windows	Punched windows	Glass and metal framing/ curtain wall	Ribbon win-dows	Point-sup-ported		
5.2	Total Percentage of Window Area	< 10%	≥ 10%, < 30%	≥ 30%, < 50%	≥ 50%, < 70%	≥ 70%		
5.3	Glass Type	Laminated glass	Security film	Thermally tem-pered glass	Heat-strength-ened glass	Annealed glass		
5.4	Wall Type	Cast-in-place reinforced concrete	Curtain wall / metal fram-ing	Precast panels / reinforced masonry	Massive unreinforced masonry	Light frame or slender unreinforced masonry		
5.5	Windborne Debris Impact Pro-tection	Post-bench-mark year	All other buildings	—	—	—		
5.6	Glazing Frame: In-Plane Seismic Clearance	Not applicable	Yes	No	—	—		
5.7	Veneer Condition	Not applicable	Excellent	Moderate	Poor	—		
5.8	Enclosure-Structure Connections	Excellent	Moderate	Poor	—	—		
5.9	Special Building Enclosure Geometries	Regular	Irregular	—	—	—		
5.10	Shutters	Not applicable	Yes	No	—	—		
5.11	Roof Construction	Solid	Skylights	Brittle surface	Aggregates or cementitious boards	—		
5.12	Roof Configuration / Pitch	5:12 to 6:12	Flat	12:12	—	—		

6. Vulnerability Rating: Structural

Building Characteristic		Attribute Options					Red Flag	Comments
		(a)	(b)	(c)	(d)	(e)		
6.1	Number of Bays in the Short Direction	> 5 bays	3 or 4 bays	< 3 bays	—	—		
6.2	Column spacing	< 15 feet	≥ 15 feet, < 25 feet	≥ 25 feet, < 40 feet	≥ 40 feet, < 60 feet	³ 60 feet		
6.3	Unbraced Column Height	< 12 feet	≥ 12 feet, < 24 feet	≥ 24 feet, < 36 feet	≥ 36 feet	—		
6.4	Publicly Accessible Column	No publicly accessible columns	Yes, protected	Yes, massive	Yes, slender	—		
6.5	Transfer Girder Conditions	None	Interior girder supporting one column	Interior girder supporting more than one column	Exterior girder supporting one column	Exterior girder supporting more than one column		
6.6	Structural Enhancements and Weaknesses	Hardened	Robust	None	Marginal	Substandard		
6.7	Number of Lateral Systems (Redundancy)	Greater than four	Four	Three	Two	One		
6.8	Short Columns or Walls	None	Few (1 or 2) in single floor	Several (more than 2) in single floor	Few (1 or 2) in several floors	Several (more than 2) in several floors		
6.9	Seismic Design/Retrofit	No	Yes	—	—	—		
6.10	Roof Span	≤20 feet	> 20 feet, < 40 feet	≥ 40 feet	—	—		
6.11	Topping Slabs	Present	Missing	—	—	—		
6.12	Adjacent Building Separa-tion	No adjacent buildings	Adequate (more than 6 inches)	Not adequate (less than 6 inches)	—	—		
6.13	Flood-Resistant Building Components	Not applicable	Yes	No	—	—		

7. Vulnerability Rating: Mechanical, Electrical, and Plumbing

Building Characteristic		Attribute Options (a)	(b)	(c)	(d)	(e)	Red Flag	Comments
7.1	Primary External Air Intake Location	>30 feet above ground level or on roof	> 10 feet, £ 30 feet above ground level	Between ground level and ≤10 feet above ground level	At ground level	Below grade or at ground level with unrestricted access		
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 system, ducted	Single system/ unducted	—	—		
7.4	Proximity of Critical Utilities to High-Risk Areas	No exposure to potential threat	Exposure to potential threat, hardened	Yes, not hardened	—	—		
7.5	Mechanical/ Electrical/Plumbing (MEP) System Anchoring	> 90%	> 60%, < 90%	> 30%, < 60%	< 30%	—		
7.6	Adequacy of Seismic Isolation Systems	Adequate	Not adequate	—	—	—		
7.7	Elevation of Utility Lines	Below ground	Above ground	—	—	—		
7.8	Above Ground Utility Anchoring	Not applicable (no above ground utilities)	> 67% well anchored	3³ 33% , £ 67% well anchored	< 33% well anchored	—		
7.9	MEP System Support by Structural System	≥ 90% well supported	≥ 60%, < 90% well supported	≥ 30%, < 60% well supported	< 30% well supported	—		
7.10	Soil Spread Potential (Underground Systems)	Not applicable	Low	Medium	High	—		
7.11	Clearances For Pipe Penetrations	Not applicable	Excellent	Medium	Poor	—		

8a. Vulnerability Rating: Fire Protection Systems (General)

The screener should evaluate 8a or 8b but not both.

Building Characteristic		Attribute Options					Red Flag	Comments
		(a)	(b)	(c)	(d)	(e)		
8a.1	Upgraded to Meet Current Code/ Governing Standard	Yes	No	—	—	—		
8a.2	Backup Power for Life Safety Equipment	Yes	No	—	—	—		
8a.3	Fire Command Center	Not applicable	Yes	No	—	—		
8a.4	Automatic Fire Detection System	Yes	No	—	—	—		
8a.5	Activation of the Automatic Fire Detection System: Automatically Shut Down HVAC Systems	Not applicable.	Yes	No	—	—		
8a.6	Automatic Fire Sprinkler System	Yes	No	—	—	—		
8a.7	Standpipe System	Not applicable	Yes	No	—	—		
8a.8	Fire Drill	Yes	No	—	—	—		
8a.9	Fire Safety Training	Yes	No	—	—	—		
8a.10	Emergency Evacuation and Shelter-In-Place Plan	Yes	No	—	—	—		

8b. Vulnerability Rating: Fire Protection Systems (Fire Marshal)

The screener should evaluate 8a or 8b but not both.

Building Characteristic			Attribute Options (a)	(b)	(c)	(d)	(e)	Red Flag	Comments
8b.1	Met Code/Governing Standard at Time of Construction		Yes	No	—	—	—		
8b.2	Upgraded to Meet Current Code/ Governing Standard		Yes	No	—	—	—		
8b.3	Inspection by a Code Enforcement Official within the Last 12 Months		Yes	No	—	—	—		
8b.4	Positive Pressurization of Stair Towers		Not applicable	Yes	No	—	—		
8b.5	Backup Power for Life Safety Equipment		Yes	No	—	—	—		
8b.6	Fire Command Center		Not applicable	Yes	No	—	—		
8b.6.1	Publicly Accessible Location		Not applicable	Yes, publicly accessible	No, not publicly accessible	—	—		
8b.7	Automatic Fire Detection System		Yes	No	—	—	—	—	
8b.7.1	Automatic Fire Detection System Report		Not applicable	Fire department	Offsite monitoring company	Fire control panel	No one (local alarm)		
8b.8	Activation of the Fire Detection System	**8b.8.1** Evacuation of Building Alert	Not applicable	Yes	No	—	—		
		8b.8.2 Automatically Recall Elevators	Not applicable	Yes	No	—	—		
		8b.8.3 Automatically Release Security Control Devices	Not applicable	Yes	No	—	—		
		8b.8.4 Automatically Shut down HVAC System	Not applicable	Yes	No	—	—		
		8b.8.5 Automatically Interlock with Any Critical Systems and Shut Them Down	Not applicable	Yes	No	—	—		

8b. Vulnerability Rating: Fire Protection Systems (Fire Marshal) (cont.)

The screener should evaluate 8a or 8b but not both.

Building Characteristic		Attribute Options					Red Flag	Comments
		(a)	(b)	(c)	(d)	(e)		
8b.9	Smoke Dampers	Not applicable	Yes	No	—	—		
8b.10	Pull Stations	Not applicable	Yes	No	—	—		
8b.11	Inspection, Testing, and Maintenance of All Fire Detection Equipment	Not applicable	Yes	No	—	—		
8b.12	Automatic Fire Sprinkler System	Yes	No	—	—	—		
8b.13	Building Coverage	Not applicable	Completely	Partially	—	—		
8b.13.1	Type of Automatic Fire Sprinkler System	Not applicable	Combination	Deluge	Dry	Wet		
8b.14	Standpipe System	Not applicable	Yes	No	—	—		
8b.14.1	Class of Standpipe System	Not applicable	Class I	Class II	Class III	—		
8b.15	Publicly Accessible Locations of Shutoff Valves	Yes, publicly accessible	No, not publicly accessible	—	—	—		
8b.16	Publicly Accessible Valve House Locations	Yes, publicly accessible	No, not publicly accessible	—	—	—		
8b.17	Fire Pumps / Jockey Pumps	Automatic	Manual	No fire or jockey pumps	—	—		
8b.17.1	Publicly Accessible Locations	Yes, publicly accessible	No, not publicly accessible	No fire or jockey pumps	—	—		
8b.18	Type of Supervision Coverage for All Valves	Central station proprietary or remote-station signaling service	Local signaling service	Locks	Sealing located within fenced enclosure under control of owner	—		

8b. Vulnerability Rating: Fire Protection Systems (Fire Marshal) (cont.)

The screener should evaluate 8a or 8b but not both.

Building Characteristic		Attribute Options					Red Flag	Comments
		(a)	(b)	(c)	(d)	(e)		
8b.19	Type of Alternate Automatic Extinguishing Systems	Wet-chemical system	Dry-chemical system	Carbon dioxide / halon	Clean-agent / commercial / water-mist	—		
8b.20	Smoke Control Systems	Yes	No	—	—	—		
8b.21	Smoke and Heat Vents	Yes	No	—	—	—		
8b.22	Deflagration Venting Systems	Yes	No	—	—	—		
8b.23	Fire Extinguishers	Yes	No	—	—	—		
8b.24	Current Inspection, Testing, and Maintenance of All Fire-Suppression Equipment	Yes	No	—	—	—		
8b.25	Publicly Accessible Fire Department Connections	Yes	No	—	—	—		
8b.26	Locking Caps on Fire Department Connections	Yes	No	—	—	—		
8b.27	Fire Department Service	Combination	Career	Volunteer	—	—		
8b.28	Fire Department Pre-Planning	Yes	No	—	—	—		
8b.29	Fire Department Drills	Yes	No	—	—	—		
8b.30	Fire Apparatus Access Roads	Sufficient	Insufficient	—	—	—		
8b.31	Knox Box	Yes	No	—	—	—		
8b.32	Building Staffed 24/7	Yes	No	—	—	—		
8b.33	Fire Brigade Apparatus	Yes	No	—	—	—		

8b. Vulnerability Rating: Fire Protection Systems (Fire Marshal) (cont.)

The screener should evaluate 8a or 8b but not both.

Building Characteristic		Attribute Options					Red Flag	Comments
		(a)	(b)	(c)	(d)	(e)		
8b.34	Source of Water Supply for Firefighting Operations	Municipal	Private	Combination	—	—		
8b.35	Water Supply for Firefighting Operations	Adequate	Inadequate	—	—	—		
8b.36	Inspection, Testing, and Maintenance of Fire Hydrant Systems	Yes	No	—	—	—		
8b.37	Fire Safety Training for Occupants/ Training	Yes	No	—	—	—		
8b.37.1	Refresher Fire Safety Training	Yes	No	—	—	—		
8b.37.2	Frequency of Fire Safety Training	Weekly	Monthly	Quarterly	Semi-annually	Annually or longer		
8b.38	Tenant Safety Organization	Yes	No	—	—	—		
8b.38.1	TSO Training	Yes	No	—	—	—		
8b.38.2	TSO Refresher Training	Yes	No	—	—	—		
8b.38.3	Frequency of Training	Weekly	Monthly	Quarterly	Semi-annually	Annually or longer		
8b.39	Fire Drills	Yes	No	—	—	—		
8b.39.1	Frequency of Fire Drills	Weekly	Monthly	Quarterly	Semi-annually	Annually or longer		
8b.40	Emergency Evacuation Plan and Shelter-In-Place	Yes	No	—	—	—		
8b.41	Emergency Evacuation Plan and Shelter-in-place Publically Accessible	Yes	No	—	—	—		

9. Vulnerability Rating: Security Systems

Building Characteristic			Attribute Options					Red Flag	Comments
			(a)	(b)	(c)	(d)	(e)		
9.1	Internal Threat: Intrusion	**9.1.1** Number of Security Systems	3 or more systems	1 system	2 systems	None	—		
		9.1.2 Security System Effectiveness	Highly effective	Effective	Moderate	Ineffective	No security		
9.2	Internal Threat: Explosion	**9.2.1** Number of Security Systems	3 or more systems	1 system	2 systems	None	—		
		9.2.2 Security System Effectiveness	Highly effective	Effective	Moderate	Ineffective	No security		
9.3	Internal Threat: CBR	**9.3.1** Number of Security Systems	3 or more systems	1 system	2 systems	None	—		
		9.3.2 Security System Effectiveness	Highly effective	Effective	Moderate	Ineffective	No security		
9.4	External Threat (Zone I): Explosion	**9.4.1** Number of Security Systems	3 or more systems	1 system	2 systems	None	—		
		9.4.2 Security System Effectiveness	Highly effective	Effective	Moderate	Ineffective	No security		
9.5	External Threat (Zone I): CBR	**9.5.1** Number of Security Systems	3 or more systems	1 system	2 systems	None	—		
		9.5.2 Security System Effectiveness	Highly effective	Effective	Moderate	Ineffective	No security		

10. Vulnerability Rating: Cyber/Communication Infrastructure Vulnerabilities

Building Characteristic			Attribute Options					Comments
			(a)	(b)	(c)	(d)	(e)	
10.1	Effectiveness of Cyber Security Plan	High	Medium	Low	None	—		
10.2	Effectiveness of Training Programs	High	Medium	Low	None	—		
10.3	Security of Communication Systems	Secured	Medium	Marginal	No security	—		
10.4	Redundancy of Communications Systems	Yes	No	—	—	—		
10.5	Power Supply Security	Secured	Medium	Marginal	No security	—		
10.6	Effectiveness of Wide Area Network (WAN), Local Area Network (LAN), Wireless, Radio, and Satellite Systems During Emergencies	High (regional)	Medium (within jurisdiction)	Low (system only)	—	—		

11. Vulnerability Rating: Continuity of Operations

Building Characteristic		Attribute Options					Comments
		(a)	(b)	(c)	(d)	(e)	
11.1	Emergency Operations Center and Incident Command System	Yes	Partial	No	—	—	
11.2	Plans, Policies, and Procedures for Disaster Recovery and Business Continuity Process	Yes	Partial	No	—	—	
11.3	Risk Assessment and Business Impact Analysis	Yes	Partial	No	—	—	
11.4	Mutual Aid Agreements	Yes	Partial	No	—	—	

11. Vulnerability Rating: Continuity of Operations (cont.)

Building Characteristic			Attribute Options					Comments
			(a)	(b)	(c)	(d)	(e)	
11.5	Disaster/ Emergency Management: Continuity of Operations	**11.5.1** Water Supply/ Storages	Not Applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.2 Power Supplies	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.3 Heating and Cooling Systems	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals		
		11.5.4 Generator/ Backup Power	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.5 Waste Water Systems	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.6 Supplies/Inventories	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.7 Deliveries/Loading Dock	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.8 Elevators	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.9 Data/Telecom	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.10 IT/Computers	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.11 Utility Control Center	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.12 Emergency Operations	Not applicable	Fully Meets Goals	Partially meets goals	Does not meet goals or has not established goals	—	

11. Vulnerability Rating: Continuity of Operations (cont.)

Building Characteristic			Attribute Options					Comments
			(a)	(b)	(c)	(d)	(e)	
11.5	Disaster/ Emergency Management: Continuity of Operations (cont.)	**11.5.13** Janitorial/ Housekeeping	Not Applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.14 Archives/ Vital Records	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.15 Special Collections/Valuables	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals		
		11.5.16 Hazardous/ Potentially Hazardous Materials	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.17 Critical Vehicle and Equipment Bays/ Garages	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.18 Short-term Shelter-In-Place	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.19 Long-term Shelter/ Community Shelter	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5. 20 Holding/Detention Cells	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.21 Laboratory	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.22 Pharmacy	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.23 Emergency Department (Medical)	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.24 Operating Room	Not applicable	Fully Meets Goals	Partially meets goals	Does not meet goals or has not established goals	—	

11. Vulnerability Rating: Continuity of Operations (cont.)

Building Characteristic			Attribute Options					Comments
			(a)	(b)	(c)	(d)	(e)	
11.5	Disaster/ Emergency Management: Continuity of Operations	**11.5.25** X-Ray	Not Applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.26 Rehabilitation Clinic	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.27 Outpatient Clinic	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals		
		I11.5.28 In-patient Wards	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.29 Medical Gases	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.30 Liquid Oxygen Storage	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	
		11.5.31 Other Critical Functions	Not applicable	Fully meets goals	Partially meets goals	Does not meet goals or has not established goals	—	

E

DHS Infrastructure Taxonomy

Infrastructure Taxonomy[1]

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 can be used as a reference for tabulating the target density information provided on page 1 of the Data Collection Form).

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

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

- 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

- 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
- Community Organization Facilities
    - Religious Organization Facilities
    - Social Advocacy Organization Facilities
    - Civic and Social Organization Facilities
    - Political Organization Facilities
- Other Commercial Facilities
    - Weather Forecasting Services

Communications

- Wired Communications
- Wireless Communications
- Satellite Communications
- Internet
- Information Services
- Next Generation Networks
- Regulatory, Oversight, and Industry Organizations
- Other Communication Facilities

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
    - 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
  - National Aeronautics and Space Admnistration (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
  - 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

Nuclear Reactors, Materials and Waste

- Nuclear Power Plants
- Research, Training, and Test Reactors
- Nuclear Fuel Cycle Facilities
- Radioactive Waste Management
- Nuclear Materials Transport
- Deactivated Nuclear Facilities
- Radioactive Source Production and Distribution Facilities
- Regulatory, Oversight, and Industry Organizations
- Other Nuclear Facilities

Postal and Shipping

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

Transportation Systems

- 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

F

Input – Output Interaction Matrices

The following matrices illustrate the relationship among the inputs (characteristics) and outputs (risk and resilience score) of the IRVS methodology for buildings. The matrices list the characteristics vertically in the far left columns and the outputs horizontally in the upper row. The matrices are organized following the characteristics contributing to the consequence rating, threat rating, and vulnerability rating similar to the DCF.

For the risk score, the matrices describe the relationship between the characteristics and the threat/hazards evaluated in the risk assessment. The boxes marked with an "**X**" indicate that the characteristic is relevant to that specific threat or hazard. For the resilience score, the matrices describe the relationship between the characteristics and the quality and time measure (components of the resilience score).

These matrices can be used to gain a better understanding of which specific characteristics are contributing the risk and resilience score.

These matrices can be used to gain a better understanding of which specific characteristics are contributing the risk and resilience score.

1. Consequences Rating

Building Characteristic		Risk Score						Resilience Score	
		Blast	CBR	Seismic	Flood	Wind	Fire	Quality Measure	Time Measure
PF-1	Number of Occupants	X	X	X	X	X	X	X	X
PF-2	Replacement Value	X	X	X	X	X	X	X	X
PF-3	Historic Site	X	X	X	X	X	X		
1.1	Locality and Density Type	X	X	X	X	X	X	X	X
1.2	Operational Redundancy (Asset Based)	X	X	X	X	X	X	X	X
1.3	Impact of Physical Loss	X	X	X	X	X	X		X

2. Threat Rating

Building Characteristic			Risk Score						Resilience Score	
			Blast	CBR	Seismic	Flood	Wind	Fire	Quality Measure	Time Measure
PF-1	Number of Occupants		X	X					X	X
PF-4	Occupancy Use		X	X				X	X	X
PF-5	Target Potential (Credible Threats)	PF-5.1 Target Potential: Building	X	X				X		
		PF-5.2 Target Potential: Sector	X	X				X		
PF-6	Target Density	PF-6.1 Target Density: Zone I	X	X				X	X	X
		PF-6.2 Target Density: Zone II	X	X					X	X
		PF-6.3 Zone III	X	X					X	X
PF-7	Seismic Zone				X			X	X	
PF-8	Proximity to an Active Seismic Fault				X			X	X	
PF-9	Floodplain					X			X	X
PF-10	Maximum Flood Depth					X			X	X
PF-11	Flood Duration					X			X	X
PF-12	Floodwater Velocity					X			X	X
PF-13	Distance from a Flooding Source					X			X	X
PF-14	High Wind Speed Zone						X		X	X
PF-15	Hurricane Frequency in the Region						X		X	X
PF-16	Tornado Frequency in the Region						X		X	X
2.1	Site Population Density		X	X				X	X	X
2.2	Visibility / Symbolic Value		X	X				X	X	X
2.3	Overall Site Accessibility		X	X				X	X	X

3. Vulnerability Rating: Site

Building Characteristic			Risk Score						Resilience Score	
			Blast	CBR	Seismic	Flood	Wind	Fire	Quality Measure	Time Measure
PF-8	Proximity to an Active Seismic Fault				X				X	
PF-9	Floodplain				X	X	X		X	X
PF-10	Maximum Flood Depth				X	X	X		X	X
PF-17	Soil Type				X				X	
3.1	Distance to Potentially Threatening Vehicle		X					X	X	
3.2	Perimeter Boundary		X	X				X	X	
3.3	Unobstructed View (ft.)		X	X				X		
3.4	Unsecured Underground Access		X	X				X	X	
3.5	Storage of Hazardous Materials		X		X	X	X	X	X	
3.6	Nearby Structures (Underground or Adjacent)		X		X	X	X	X	X	
3.7	Topography / slopes		X		X	X	X		X	X
3.8	Condition of foundation				X	X			X	
3.9	Potential Wind-borne Debris/Missiles						X	X	X	
3.10	Nearby Water Structures (levees, dams, embankments)				X	X	X		X	X
3.11	Adequacy of emergency exits		X	X	X	X	X	X		
3.12	Retaining walls				X	X	X		X	X
3.13	Location of Critical Functions and Valuables	3.13.1 Exposure to Wind Events					X			
		3.13.2 Exposure to Flood Events				X				
3.14	Potential of Soil Liquefaction				X				X	X

4. Vulnerability Rating: Architectural

Building Characteristic		Risk Score						Resilience Score	
		Blast	CBR	Seismic	Flood	Wind	Fire	Quality Measure	Time Measure
4.1	Building Height	X	X	X	X	X		X	X
4.2	Building Configuration	X		X		X		X	
4.3	Overhang	X	X	X		X	X	X	
4.4	Lobby / Retail Location	X	X				X	X	
4.5	Loading Dock and Mail Screening Location	X	X				X	X	X
4.6	Vehicular Penetration of Exterior Enclosure	X					X	X	
4.7	Garage Location	X	X				X	X	
4.8	Partitions			X	X	X			
4.9	Appendages	X		X		X		X	
4.10	Nonstructural Component Anchoring	X		X	X	X	X	X	
4.11	Horizontal (Plan) Irregularity			X	X	X		X	
4.12	Vertical Irregularity			X	X	X		X	
4.13	Soft Story	X		X	X	X		X	
4.14	Elevated Tanks, Bins, Vessels, or Trussed Towers (Especially on the Roof)	X		X		X		X	

5. Vulnerability Rating: Building Enclosure

Building Characteristic		Risk Score						Resilience Score	
		Blast	CBR	Seismic	Flood	Wind	Fire	Quality Measure	Time Measure
5.1	Window Support Type	X		X		X		X	
5.2	Total Percentage of Window Area	X	X	X		X		X	X
5.3	Glass Type	X		X		X		X	
5.4	Wall Type	X	X	X	X	X		X	X
5.5	Windborne Debris Impact Protection	X				X		X	X
5.6	Glazing Frame: In-Plane Seismic Clearance			X		X		X	
5.7	Veneer Condition			X		X		X	X
5.8	Enclosure-Structure Connections	X		X	X	X		X	
5.9	Special Building Enclosure Geometries			X		X		X	
5.10	Shutters					X		X	
5.11	Roof Construction					X		X	X
5.12	Roof Configuration / Pitch					X		X	

6. Vulnerability Rating: Structural

Building Characteristic		Risk Score						Resilience Score	
		Blast	CBR	Seismic	Flood	Wind	Fire	Quality Measure	Time Measure
PF- 18	Structure Type	X		X	X	X		X	X
6.1	Number of Bays in the Short Direction	X		X		X		X	X
6.2	Column spacing	X		X		X		X	X
6.3	Unbraced Column Height	X		X	X	X		X	X
6.4	Publicly Accessible Column	X					X	X	X
6.5	Transfer Girder Conditions	X		X		X		X	X
6.6	Structural Enhancements and Weaknesses	X		X	X	X		X	X
6.7	Number of Lateral Systems (Redundancy)	X		X	X	X		X	X
6.8	Short Columns or Walls			X		X		X	X
6.9	Seismic Design/Retrofit	X		X		X		X	X
6.10	Roof Span					X		X	X
6.11	Topping Slabs			X		X		X	X
6.12	Adjacent Building Separation			X				X	X
6.13	Flood-Resistant Building Components				X			X	X

7. Vulnerability Rating: Mechanical, Electrical, and Plumbing (MEP)

Building Characteristic		Risk Score						Resilience Score	
		Blast	CBR	Seismic	Flood	Wind	Fire	Quality Measure	Time Measure
7.1	Primary External Air Intake Location		X		X			X	
7.2	Return Air Intake System		X					X	
7.3	Internal Air Distribution System		X					X	
7.4	Proximity of Critical Utilities to High-Risk Areas	X						X	
7.5	Mechanical/ Electrical/Plumbing (MEP) System Anchoring	X		X	X	X		X	
7.6	Adequacy of Seismic Isolation Systems			X			X	X	
7.7	Elevation of Utility Lines	X		X	X	X	X	X	X
7.8	Above Ground Utility Anchoring	X		X	X	X	X	X	X
7.9	MEP System Support by Structural System	X		X	X	X		X	X
7.10	Soil Spread Potential (Underground Systems)			X				X	X
7.11	Clearances For Pipe Penetrations			X			X	X	

8a. Vulnerability Rating: Fire Protection Systems (General)

Building Characteristic		Risk Score						Resilience Score	
		Blast	CBR	Seismic	Flood	Wind	Fire	Quality Measure	Time Measure
8.1a	Upgraded to Meet Current Code/Governing Standard						X	X	X
8.2a	Backup Power for Life Safety Equipment						X	X	X
8.3a	Fire Command Center						X	X	X
8.4a	Automatic Fire Detection System						X	X	X
8.5a	Activation of the Automatic Fire Detection System: Automatically Shut Down HVAC Systems						X	X	X
8.6a	Automatic Fire Sprinkler System						X	X	X
8.7a	Standpipe System						X	X	X
8.8a	Fire Drill						X	X	X
8.9a	Fire Safety Training						X	X	X
8.10a	Emergency Evacuation and Shelter-In-Place Plan						X	X	X

8b. Vulnerability Rating: Fire Protection Systems (Fire Marshal's)

Note: Same Input interactions as 8a: Vulnerability Rating: Fire Protection Systems (General)

9. Vulnerability Rating: Security Systems

Building Characteristic			Risk Score						Resilience Score	
			Blast	CBR	Seismic	Flood	Wind	Fire	Quality Measure	Time Measure
9.1	Internal Threat: Intrusion	9.1.1 Number of Security Systems	X						X	X
		9.1.2 Overall System Effectiveness	X						X	X
9.2	Internal Threat: Explosion	9.2.1 Number of Security Systems	X						X	X
		9.2.2 Overall System Effectiveness	X						X	X
9.3	Internal Threat: CBR	9.3.1 Number of Security Systems		X						
		9.3.2 Overall System Effectiveness		X						
9.4	External Zone I Threat: Explosion	9.4.1 Number of Security Systems	X						X	X
		9.4.2 Overall System Effectiveness	X						X	X
9.5	External Zone I Threat: CBR	9.5.1 Number of Security Systems		X						
		9.5.2 Overall System Effectiveness		X						

10. Vulnerability Rating: Cyber/Communication Infrastructure

Building Characteristic		Risk Score						Resilience Score	
		Blast	CBR	Seismic	Flood	Wind	Fire	Quality Measure	Time Measure
10.1	Effectiveness of Cyber Security Plan	X						X	X
10.2	Effectiveness of Training Programs	X						X	X
10.3	Security of Communication Systems	X					X	X	X
10.4	Redundancy of Communications Systems	X					X	X	X
10.5	Power Supply Security	X					X	X	X
10.6	Effectiveness of Wide Area Network (WAN), Local Area Network (LAN), Wireless, Radio, and Satellite Systems During Emergencies	X	X	X	X	X	X	X	X

11. Vulnerability Rating: Continuity of Operations

Note: These characteristics all contribute to only the resilience score.