AUGUST 2014

National Institute of BUILDING SCIENCES

An Authoritative Source of Innovative Solutions for the Built Environment

Integrated Rapid Visual Screening of Schools:

A How-to Guide to Mitigate Multihazard Effects Against School Facilities

DRAFT 08/25/14

In partnership with the State of Connecticut School Safety Infrastructure Committee; Katy Texas Independent School District; and St. Clair County, Michigan, Office of Homeland Security and Emergency Management

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In Partnership with:

Connecticut School Safety Infrastructure Committee

Katy Independent School District

Katy, Texas

Homeland Security and Emergency Management

St. Clair County, Michigan

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NOTIFICATION

This DRAFT of *Integrated Rapid Visual Screening of Schools: A How-to Guide to Mitigate Multihazard Effects Against School Facilities*, originally published as a first draft by the Department of Homeland Security (DHS), is in the process of finalization and is being made available by the National Institute of Building Sciences (NIBS) in partnership with the Connecticut School Safety Infrastructure Committee, the Katy Texas Independent School District and the St Clair County Michigan Office of Homeland Security and Emergency Management, solely for the purposes of evaluation of the information and procedures identified within and towards the development of an "IRVS for Safe Schools" software tool. NIBS along with the partners have formed an IRVS for Safe Schools Review Committee, whose members are identified in the Foreword, to assist in the evaluation and development process.

NIBS, its partners, and the Committee are evaluating the I*RVS for Schools: A How-to Guide to Mitigate Multihazard Effects Against School Facilities* and the analytical processes it utilizes for patentability. Any disclosure of any aspect of such information could endanger that evaluation and could result in NIBS, the Committee, or their contractor's inability to patent any aspect of the IRVS for Safe School software or the analytical processes that the application represents.

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Foreword, Scope, and Acknowledgments

This manual provides the information needed to use *Integrated Rapid Visual Screening of Schools: A How-to Guide to Mitigate Multihazard Effects Against School Facilities. IRVS for Schools* comprehensively quantifies the risk and resilience of a single school or a group of school buildings to manmade (as applicable to schools) and selected natural hazards that are capable of causing catastrophic losses in fatalities, injuries, damage, or interruption of operations. The IRVS for School Safety is intended for use in the design of new schools and for the assessment and retrofit of existing ones. The methodology can be implemented relatively quickly and allows the identification of cost effective mitigation measures in an accurate manner.

IRVS for Schools is based on other manuals that are part of the Building Infrastructure Protection Series (BIPS) published by the United States (U.S.) Department of Homeland Security (DHS) Science and Technology Directorate (S&T). The BIPS series serves to advance high performance and integrated design for buildings and infrastructure across all sectors. The overall purpose of this manual is to enhance the resistance of our Nation's schools against multiple undesirable events and meet specific performance requirements at the highest possible level.

> *IRVS for Schools* is intended for use in the design of new schools and for the assessment and retrofit of existing ones.

IRVS for Schools is based on the risk management process identified by the Interagency Security Committee, for federal security professionals responsible for protecting nonmilitary federal facilities in the United States, adapted for school buildings. The complete methodology will be comprised of software and a manual based on the Building Infrastructure Protection Series *Primer to Design Safe School Projects in Case of Terrorist Attacks and School Shootings* (BIPS 07), the *Integrated Rapid Visual Screening: Interagency Security Committee (ISC) Screening Module* (BIPS 11) and the *ISC standards*. The IRVS for School Safety Committee has been established at the National Institute for Building Sciences for the review and preparation of the manual. This committee will be responsible for launching a standardized and categorized methodology, applicable to all schools, to enhance the quality and effectiveness of physical security nationwide. DHS S&T, the School Safety Infrastructure Council (SSIC) from the State of Connecticut and Katy Independent School District from the State of Texas, and NIBS are currently leading this committee.

The major components of the IRVS for School Safety project are:

- **Establishment of a "School Security Level" (SSL)** which provides a baseline level of protection that a school should achieve.
- **Identification of the "Undesirable Events" (UE)** which encompass 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 to schools.
- **Evaluation of the "Level of Protection" (LOP)** which allows the identification of school vulnerabilities for each undesirable event and categorizes and rank measures them to serve as the basis for implementing protective measures for school safety.

The design recommendations contained in this document are applicable to schools only and are not mandatory. Technical audiences for this manual include potential screeners and trained personnel with knowledge of schools, school systems, and security measures but not necessarily with a high level of expertise in building technology.

2.1 Partnerships

For the last year, DHS S&T has been working closely with the State of Connecticut to prepare a risk assessment tool that meets the needs of the educational system; develop guidance that helps the design community to design and build better schools; and set threshold requirement scores that all schools should meet to ensure a safe environment for students and teachers. This partnership emerged after the tragic event that took place at Sandy Hook Elementary School which greatly moved our nation and highlighted the need to better prepare our schools for a whole series of undesirable events. DHS/S&T has testified for both the Sandy Hook Commission and the School Safety Infrastructure Council (SSIC), which was formed by the Connecticut Legislature to set standards for assessing schools for security risks in light of the Sandy Hook shooting incident. Another important partnership has been with the Katy Independent School District (KISD) in Texas. KISD had used the basic IRVS tool, which was designed for commercial buildings, to assess several schools in the District. When DHS/S&T initiated the *IRVS for Schools* Project, KISD decided to join this effort and became a central part of the framework to exchange ideas, approaches and best practices to help determine, in a plausible and realistic manner, the scope and the effective use of the IRVS methodology to evaluate and improve school safety and security. DHS S&T has also worked closely with the NIBS in the development of the manual and formation of the IRVS for School Safety Review Committee to review it and prepare for publication and development of the accompanying IRVS for Schools software.

The major components of the IRVS for School Safety Project are:

- Establishment of a baseline by identifying the School Security Level (SSL)
- Identification of the Undesirable Events (UE
- Evaluation of the Level of Protection (LOP)

2.2 Content and Organization

This manual, when completed, will be organized as follows:

- **Chapter One– Background.** An overview of the *IRVS for Schools* methodology including discussions on the IRVS Series, IRVS Database, IRVS-ISC standards and best practices and the integration of the *IRVS for Schools* into the IRVS methodology.
- **Chapter Two– Introduction to the** *IRVS for Schools* **Screening Process.** An overview of the objective and scope of the *IRVS for Schools* Screening Process and descriptions of the stakeholders, screeners, duration and accuracy of the screening, components of the screening, the Data Collection Form, the *IRVS for Schools* Catalog, and the variables that are considered in the screening.
- **Charper Three– School Security Level (SSL).** School Security Level identifies the criteria and process for determining the baseline for States, Jurisdictions, and Schools to implement protective measures. The *IRVS for Schools* methodology can be also adopted by individual schools. The baseline is established through a prescribed methodology and judgment. SSL criteria can be associated with the consequences of an undesirable event.

- **Chapter Four– Undesirable Events (UE)**. A Selection of Undesirable Events and evaluation of corresponding Option levels that can be performed for each school in a jurisdiction. Undesirable Events include a broad range of events that can adversely impact the security, function, and operations of a school. The list includes natural hazards, man-made hazards, and other threats that compromise school safety.
- **Chapter Five– Level of Protection.** Level of Protection evaluates whether the countermeasures contained in the baseline LOP adequately mitigate known or anticipated risks to the facility determined for each undesirable event. LOP criteria can be associated with vulnerabilities which can be categorized and ranked for implementing protective measures.
- **Chapter Six– Emergency Plans.** The process of risk management comprises the selection of effective cost mitigation, preparedness, and response measures. Users will be guided on how to select and implement cost effective mitigation measures and how to increase resilience in schools settings though appropriate design

Supplemental information is provided in the following appendices:

- **Appendix A – Acronyms**
- **Appendix B – Glossary**

Future drafts of this publication will include an additional chapter titled, Chapter Seven– *IRVS for Schools* Software Instruction and Installation.

Acknowledgements

The material contained in this DRAFT has been prepared through the efforts of the following individuals:

Primary Author:

Mila Kennett, Program Manager, DHS S&T

Authors:

John C. Bremer, Emergency Management Coordinator, Katy Independent School District

Jason Crisco, Executive Assistant, DAS, SSIC Staff

Roger Grant, Program Director, National Institute of Building Sciences

Mohammed Ettouney, Principal, Weidlinger, Inc.

Dr. Mary Ellen Hynes, DHS S&T

Jeffrey A. Friedland, HSEM Director, St. Clair County

Review Committee:

Donald J. DeFronzo, Commissioner, Department of Administrative Service, SSIC Chairman

William P. Shea, Deputy Commissioner DESPP, SSIC Council Member

Craig Russell, Director of School and State Construction Services, DAS/DCS, SSIC Staff

Ronald Jakubowski, Former Assistant Superintendent of Schools for Operations and Facilities, New Britain, CT, SSIC Council Member

Robert Mitchell, Mitchell Architectural Group

Kevin Malloy, Department of Interior Burueau of Indian Affairs

Amy J. Banks, Department of Education

Jeffrey Afman, Federal Emergency Management Agency

Heather King, White House National Security Staff

Taylor Price, DHS, Inter-Governmental Affairs

Amy Rue, DHS Infrastructure Protection

Richard Legault, DHS S&T

Matt Weese, DHS Federal Protective Service

Michael Keane, DHS Counter-Terrorism

Earle Kennett, National Institute of Building Sciences

Kathleen Simpson, American Institute of Architects

Brian Minnich, American Institute of Architects

Terry Ryan, Raytheon, Inc.

Mike Chipley, PMC Group

Jay Brotman, Svigals & Partners Architects

Phillip Santore, DVS Security Consulting & Engineering

Noel Rollins, Construction Manager

Mark Hopkins, Chief Police, Katy Independent School District

Publication Design:

Wanda Rizer, Design4Impact

Table of Contents

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Introduction

In this Chapter:

Chapter 1 explains the concepts of school security and safety and the need to embrace multihazard protection for schools.

This chapter introduces a group of hazards that affects schools almost in a unique manner and introduces preliminary concepts related to risk and resilience.

It also describes preliminary notions about the IRVS and school safety.

Violent attacks on students and teachers in the Nation's schools are extremely rare events, but their effects frequently, and understandably, have far-reaching consequences. Parents' anxieties are not assuaged by statistics showing low probabilities of serious incidents. A targeted shooting incident typically evolves so rapidly that by the time emergency responders arrive, it is either too late or too dangerous to intervene. It is a painful, but nonetheless true fact that once an attacker has entered a targeted school building with the intention of shooting someone, there is very little, if anything, that can be done to avert the attack. Schools typically have limited capability and resources to prevent a hostile intruder from entering and at the same time do not have the capability to intervene before any injuries occur.

> Violent attacks on students and teachers in the Nation's schools are extremely rare events, but their effects have far-reaching consequences. Schools are also impacted by floods, fires, tornadoes, earthquakes, hurricanes, and the effects of sea level rise.

Schools are also impacted by floods, fires, tornadoes, earthquakes, hurricanes, and the effects of sea level rise. Statistics show a significant and increasing number of casualties and damage to schools from these hazards. The decision to introduce protective measures as part of school design is made at various levels of government and school administration. Introducing safety measures as part of school design requires a comprehensive approach to balance many different objectives, such as maintaining open access for students and staff, facilitating proper school functions, reducing risks, strengthening of physical structures beyond the required buildings codes and standards, , and conforming to aesthetic principles.

This Guide focuses on the identification and adoption of effective protective measures as a key factor to reduce vulnerabilities to improve the design of schools and the preparation of thorough risk assessment studies. There are no guarantees that the use of this How-To-Guide or the implementation of the best countermeasures and procedures will resolve all vulnerabilities and protect schools from all potential hazards or threats. This Guide focuses on helping decision makers coordinate, analyze and implement a series of objectives directed at reducing the negative impacts of natural and man-made hazards while, at the same time, maintaining an open and accessible environment conducive to interaction and study, providing a functional and pleasant setting for school activities and fostering a sense of unrestricted safety and security. To achieve this goal, this Guide should be used to enhance the quality and effectiveness of safety and security protective measures.

> This Guide focuses on the identification and adoption of effective protective measures as a key factor to reduce vulnerabilities to improve the design of schools and the preparation of thorough risk assessment studies.

This Guide should be used in conjunction with the DHS S&T *Primer to Design Safe School Projects in Case of Terrorist Attacks and School Shootings* (BIPS 07/FEMA 428); and FEMA 424, *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds.*

1.1 The IRVS Methodology and Schools

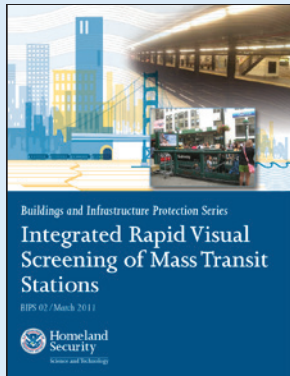
The risk assessment methodology identified here integrates the likelihood or probability of occurrence of natural and man-made hazards and a method to reduce the vulnerabilities and consequences of a particular incident. The IRVS methodology is a rapid and effective way to quantify the risk and resilience of a single school building or a group of buildings. The IRVS for School Safety process is comprised of a How-To Guide and software that allows school decision makers to assess which hazards or threats are capable of causing the largest losses in terms fatalities, injuries, damage, or interruption of school functions. The methodology can be implemented inexpensively and in a user-friendly manner. The IRVS methodology is intended for existing buildings and for the planning and design of new buildings.

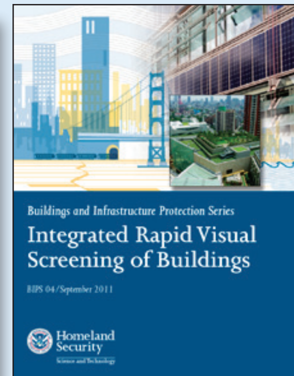
The risk assessment methodology identified here integrates the likelihood or probability of occurrence of natural and man-made hazards and a method to reduce the vulnerabilities and consequences of a particular incident.

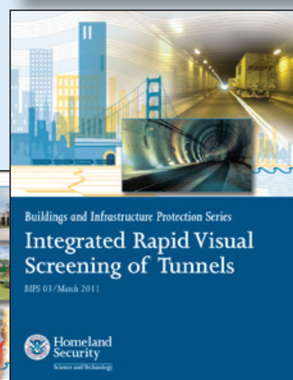
It is expected that the IRVS for School Safety methodology and tool will fill a gap for assessing risk and advancing new design for school facilities nationwide. By using the IRVS methodology, schools will have available a consistent method for evaluating, designing and retrofitting schools against all hazards and state and local government will have at hand reasonable objectives that will allow them to increase the effectiveness of their capital investment projects. The IRVS for School Safety allows the preparation of multiple risk scenarios for each type of hazard or threat.

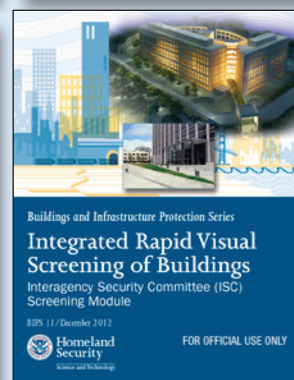
IRVS Publications

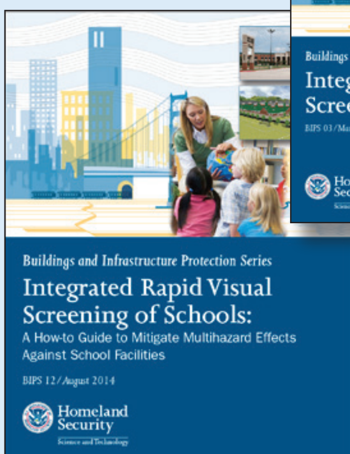
- BIPS 02, Integrated Rapid Visual Screening of Mass Transit Stations
- BIPS 03, Integrated Rapid Visual Screening of Tunnels
- BIPS 04, Integrated Rapid Visual Screening of Buildings
- BIPS 11, Integrated Rapid Visual Screening of Buildings Interagency Security Committee (ISC) Screening Module,(FOUO)
- BIPS 12, Integrated Rapid Visual Screening of Schools: A How-to Guide to Mitigate Multihazard Effects Against School Facilities











1.2 Consideration of New Hazards and Threats

Currently, concerns are increasing with regard to new threats often inherent only for schools. For example, school shootings, after the Sandy Hook and Columbine events, have become a national concern. Statistically, of all the national shootings, the majority of fatalities occur in schools. A number of statistical studies have been conducted on various aspects of crime in schools, including shooting incidents, which give a broad picture of the risks involved. A 2009 study recorded data on shootings in schools, colleges, and universities and the complete data are shown in Table 3-2. The data showed that in the 20 years between 1989 and 2009, 41 shooting incidents in grade schools nationally resulted in 75 dead and 154 injured. Of these attacks, 11 were perpetrated by students and 31 by adults. One attack, Columbine High School in 1999, resulted in 12 deaths; two others resulted in 5 deaths, another in 3 deaths, and the remainder in 1 or 2 fatalities each. Another study for the 2003–2004 school year, summarized in Table 3-3, identified the number and percentage of the nation's schools reporting possession of firearms, explosives, knives and sharp objects. The total number of incidents involving firearm and explosive possession was 7,478, in 4,875 schools, and the number of incidents involving a knife or sharp object was 30,193. The highest possession rates were in high schools located in cities. While the risks of a fatal school-shooting incident are very low, the consequences of even one student's death are significant and far reaching to family members, friends and the whole community.

Threats and circumstances are continuously changing.

Selection can be based on likelihood, research, and risk acceptance

Following are the hazards and threats that are of particular concern to schools today and need to be evaluated to determine the potential threat and corresponding risk to school facilities.

School Shooting/Active Killer. These incidents are characterized by an active shooter(s) engaged in killing or attempting to kill students or teachers in a school or on school grounds, typically through the use of firearms. These incidents can be perpetrated by a single shooter, a team of shooters, a sniper, or team of snipers. The shooter or shooters can be located in an elevated position or ground position and can involve hostage taking. School shootings can involve the use of explosives. The Alcohol, Tobacco and Firearms (ATF) office reports that the most common explosives are built by juveniles and are much more likely to actually function than adult built devices. One reason is that the adult built device is usually more complex allowing for a greater number of failure points.

Man-Made Hazards

- Explosives
- CBR
- Civil Disturbance
- Hostile Surveillance
- Cyber Attacks
- Utility Failure
- Vehicle Ramming
- Arson
- School Violence:
- Bullying, gangs, sexual, food poisoning
- School Shootings
- Abduction
- High Velocity Vehicles in the Vicinity
- Disruption of School Security Systems
- Theft
- Vandalism
- Robbery

In addition, recent events have increased the national concern of the "active killer" which refers to an individual or individuals not carrying a firearm that try to kill another person. Among the most recent events of this kind, is the April 9 attack at Franklin Regional High School in Murrysville Pennsylvania when a 16-year-old stabbed and killed one student and injured 10 and a security guard. Other events include attacks at Spring High School, Piper High School, Jonathan Law High School, Lone Star College and Franklin Regional.

Arson. This is fire caused by an aggressor accessing a school and deliberately setting fire to the facility or to assets within the school. Internal attacks can be perpetrated by using incendiary devices or substances. Many fire marshals agree that arson is more common in in schools than in homes; however, school arson usually does not result in heavy damage to the school. Generally, arson is caused by persons carrying a grudge against a teacher or staff, malicious students who thrive on causing trouble, students wanting to draw attention to themselves for personal problems, people involved in rowdy groups or frustrated persons who are enraged with school or society. In addition, the school building and premises can be collateral damage from a fire occurring in surrounding areas.

School Violence. Violence is the intentional use of physical force or power against another person, group, or community, with the behavior likely to cause physical or psychological harm. School violence is youth violence that occurs on school property, on the way to or from school or school-sponsored events, or during a school-sponsored event. This type of violence does not assume firearm use. School violence can be perpetrated against students and staff members. School violence may include bullying, gang violence, sexting, sexual violence and food poisoning.

Kidnapping. The abduction of an occupant (student or faculty) or visitor from a school facility, including inside secured or outside on the site (e.g. a controlled parking lot). Kidnapping or abduction can be perpetrated both by strangers and family members of the victim.

Drug Abuse. The use of illegal drugs, or the misuse of prescription or over-the-counter drugs in the school setting. School settings are susceptible to drug abuse since large numbers of youth are gathered and that attracts drug dealers. Illicit drug use among teenagers has continued at high rates, largely due to the popularity of marijuana. Marijuana use by adolescents declined from the late 1990s until the mid-to-late 2000s, but has been on the increase since then. In 2012, 6.5 percent of 8th graders, 17.0 percent of 10th graders, and 22.9 percent of 12th graders had used marijuana in the past month—an increase among 10th and 12th graders from 14.2 percent, and 18.8 percent in 2007. Daily use has also increased; 6.5 percent of 12th graders now use marijuana every day, compared to 5.1 percent in 2007. A survey released by the National Center for Addiction reveals that for the sixth consecutive year, 60 percent or more of teens in the survey reported that drugs are used, kept or sold at schools and 52 percent said there's a place on or near school grounds where students go during the day to use drugs, drink or smoke cigarettes.

High Velocity Vehicles in Vicinity. Often schools are located near a high way or high speed road. This poses a threat in spite of the many signs posted in the vicinity of a school for reduced speed. Schools in this situation need to take concerted precautions to avoid accidents.

Sea Level Rise. It is postulated that sea levels are rising due to thermal expansion (as ocean water warms, it expands) and the contribution of land-based ice due to increased melting. The major store of water on land is found in glaciers and ice sheets. This has the potential increase the frequency of coastal storms and magnify the effect, of related flooding. New schools and existing schools that are being retrofitted need to factor this into their design and operations planning.

Cyber Attacks. For schools, cyber-attacks refer to a politically or socially motivated hacking to conduct sabotage or gain critical information about the schools' courses, records, and exams, and to access any school data and electronic control systems.

1.3 Security and Safety

This How-to-Guide closely follows the U.S. Congress Energy Independence and Security Act (EISA) of 2007 and makes a distinction between security and safety. Security is reserved for all man-made hazards including school shootings, arson, ballistics, bullying, and kidnapping. Safety is used in relation to natural hazards, such as earthquakes, floods, winds, wild fires and sea level rise. The Guide does not endorse or identify any particular building codes for schools. It is advisable that schools follow the model building code of their local jurisdiction.

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This How-to-Guide makes a distinction between security and safety.

Security is reserved for all man-made hazards.

Safety is used in relation to natural hazards.

In the U.S., the International Code (IBC) is the model code that is most widely used. A large portion of the International Building Code deals with fire prevention in regards to construction and design. It also deals with access for the disabled and structural stability (in response to wind and earthquakes). Usually if a municipality adopts the IBC, it also adopts those parts of other codes referenced by the IBC such as plumbing, mechanical and electric codes. The U.S. building codes set only minimum requirements, primarily for life safety, in response to major natural hazards. Currently, most schools are not designed or built to sustain the effects of a large natural or manmade disaster event, without sustaining significant property loss and severely compromising the essential educational function of the building. Schools are also not generally designed to withstand the emerging concerns and potential fatalities from mass shooting, school violence and kidnaping among other threats.

The fundamental building attributes affecting security and safety include the following:

High Performance. This manual promotes the use of standards beyond life safety. This means that after a disaster event the school buildings should continue to support basic safety and business functions even under limiting circumstances. The concept of high performance can be associated to the fundamental capacity of a facility to resist disaster events and continue operating in the aftermath of these disruptive events .To achieve this capacity through building codes, the schools or jurisdictions may need to prepare additional requirements to amend the State or local codes. A high performance school takes into account risk, resilience and the effects of natural and manmade hazards against a particular facility.

Multihazard Approach: The IRVS for School Safety consists of an assessment of the risk and resilience of school buildings across a number of natural and man-made hazards. A multihazard approach encompasses all conditions, natural, 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. A multihazard approach takes into account how one hazard has an effect on another and how all combined have an effect on a particular facility. Traditional hazards include the following:

> The fundamental building attributes affecting security and safety include the following:
>
> - High Performance
> - Multihazard Approach
> - Risk Assessment/Risk

Risk Assessment/Risk: Risk assessment is a systematic process to obtain quantitative and/or qualitative measures of risk associated with a recognized threat or hazard, to analyze the magnitude of an identifiable vulnerability, and to ascertain the probability of the loss that will occur for each applicable threat or hazard. Acceptable risk is a risk that is understood and tolerated, usually because the cost or difficulty of implementing an effective countermeasure for the associated vulnerability exceeds the expectation of loss. The management of risk of extreme events that may affect schools involves activities to both identify the risks and respond to them. The process to respond to risk involves the adoption of sound and cost effective mitigation measures, a comprehensive preparedness program and a coordinated and effective response to damaging events.

Risk calculation involves three components:

Risk rating = Consequences x Threat (or Hazard) x Vulnerability

Resilience. Resilience can be 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. Resilience can be characterized by four key features: robustness, resourcefulness, recovery and redundancy. [wanda: I see no mention of a figure 1-1 nor do I see graphics for either of these]

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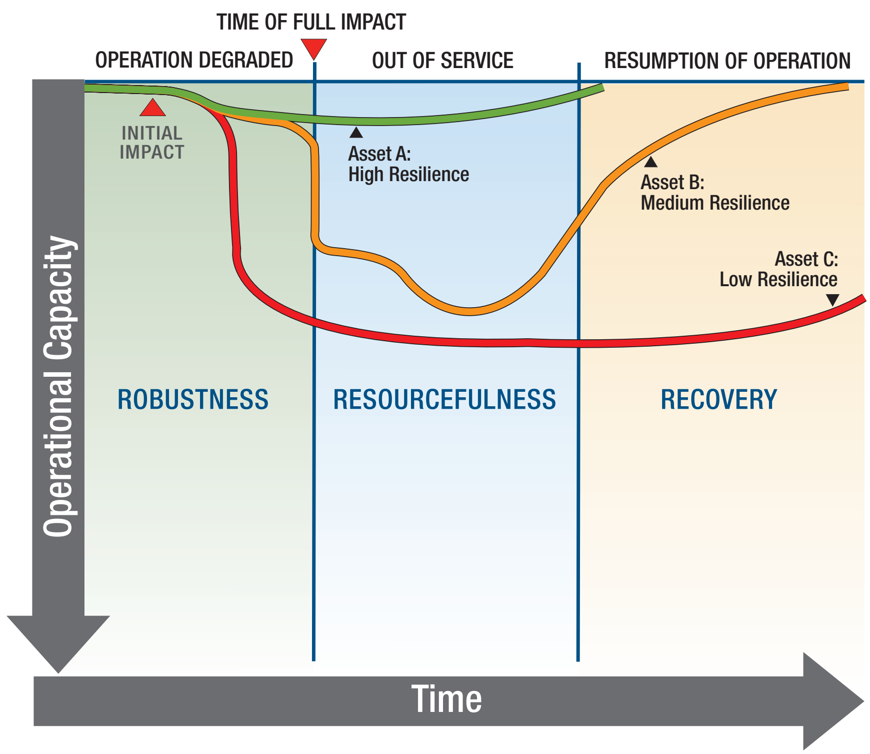
Resilience can be defined as "the ability to resist, absorb, recover from, or successfully adapt to adversity or a change in conditions.



- Robustness (R1) can be 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. It also includes 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 (R2) can be 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 (R3) can be defined as "the ability to return to and/or reconstitute normal operations as quickly and efficiently as possible after a disruption"

- Redundancy (R4) can be defined as additional or alternative systems, sub-systems, assets, or processes that maintain a degree of overall functionality in case of loss or failure of another system, sub-system, asset, or process (DHS, Risk Lexicon 2008)

Resilience for a single asset can be recast as the summation, R= R1, R2, R3, R4. The *IRVS for Schools* adds, to this summation, conditional dependencies (linkages / interactions) among all the R factors and key external considerations and interdependencies.

Crime Prevention through Environmental Design (CPTED). The CPTED approach is particularly applicable to schools, where outdated facilities are common. Most schools in the United States were built 30 to 60 or more years ago. Security issues were almost nonexistent at the time, and technology was dramatically different. As a result, school building designs are not always compatible with today's more security-conscious environment. Throughout this manual, CPTED principles are applied. Employing physical security measures will no doubt increase the level of physical security; however, other undesirable events, particularly for schools, need to be addressed as standalone. In particular, this is the case for the different shades and scales of school violence. The CPTED strategies built into this How-To Guide include the following:

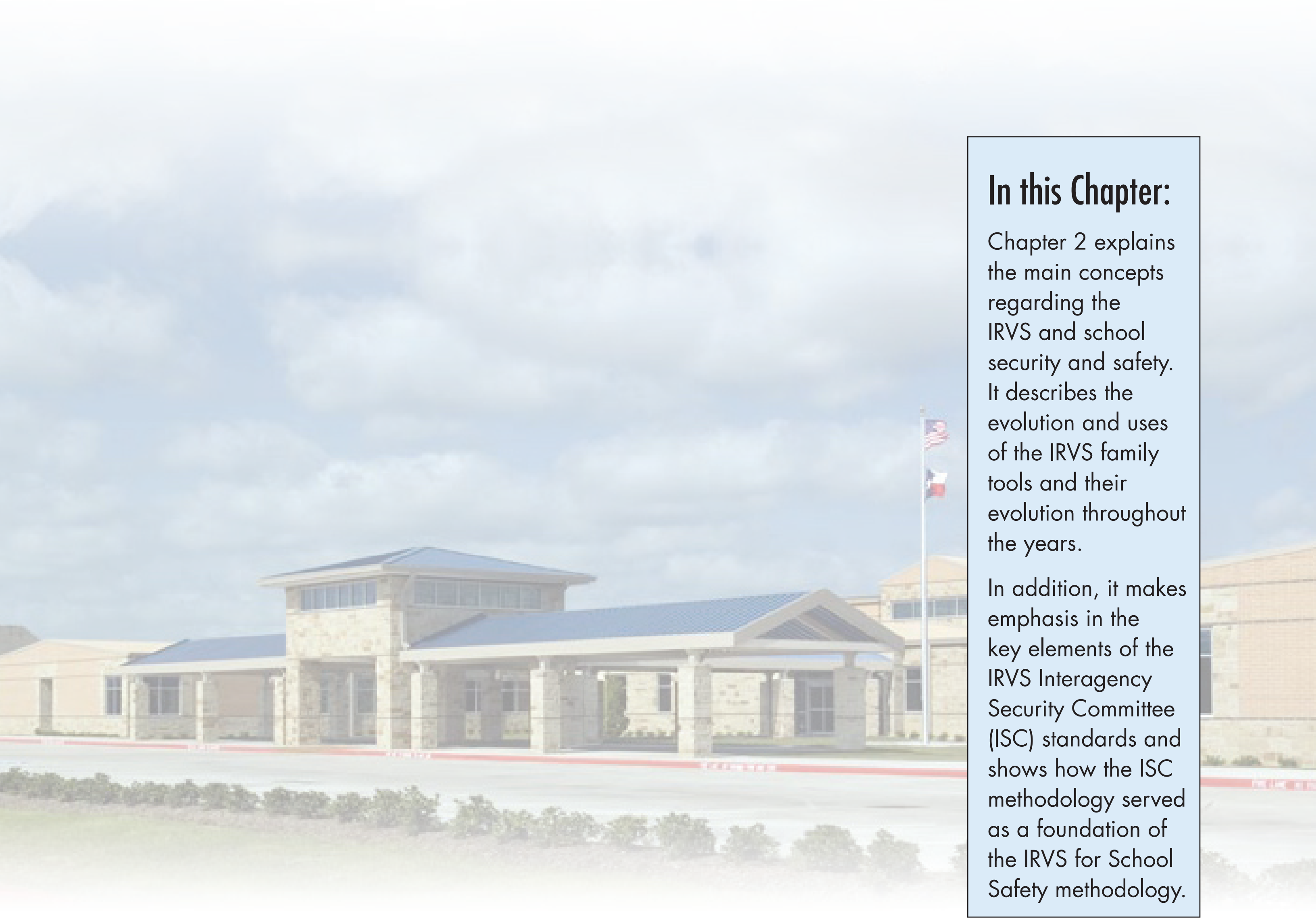
> The CPTED strategies built into this How-To Guide include the following:
>
> - Territoriality
> - Natural Surveillance
> - Access Control

- Territoriality - using buildings, fences, pavement, signage and landscaping to express ownership
- Natural surveillance - placing physical features, activities, and people to maximize visibility
- Access control - the judicial placement of entrances, exits, fencing, landscaping, and lighting

In addition, a CPTED analysis should evaluate crime rates, office-referral data, and school cohesiveness and stability, as well as core design shortcomings of the physical environment (e.g., blind hallways, uncontrolled entries, abandoned areas that attract problem behavior).

2

The IRVS Methodology



In this Chapter:

Chapter 2 explains the main concepts regarding the IRVS and school security and safety. It describes the evolution and uses of the IRVS family tools and their evolution throughout the years.

In addition, it makes emphasis in the key elements of the IRVS Interagency Security Committee (ISC) standards and shows how the ISC methodology served as a foundation of the IRVS for School Safety methodology.

The IRVS methodology is a rapid way to quantify the risk and resilience of a single building, a group of buildings, mass transit stations and tunnels. The IRVS family is designed to assess 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 could include more complex, successive forms of analyses. The methodology can be implemented inexpensively and in a readily approachable manner. The IRVS methodology, intended for evaluation of existing buildings and for the design of new buildings, has become a very popular methodology.

The IRVS methodology is a rapid way to quantify the risk and resilience of a single building, a group of buildings, mass transit stations and tunnels.

The entire IRVS family resides on a single software platform. The purpose of this chapter is to define the objective and scope of the IRVS for School Safety.

2.1 Past and Present

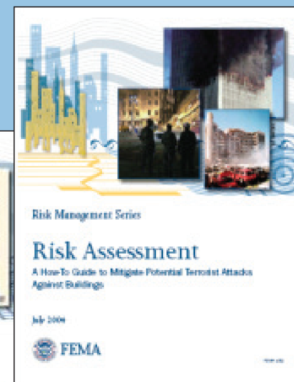
The early versions of the IRVS are part of the FEMA Risk Management Series (RMS), a series of FEMA publication directed at providing design guidance for mitigating multihazard events. The publications devoted to risk assessment were prepared only for man-made hazards. The RMS includes FEMA 424, *A Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings*; FEMA 452, *Risk Assessment: A How-To-Guide to Mitigate Potential Terrorist Attacks Against Buildings;* and FEMA 455, *Handbook for Rapid Visual Screening of Buildings to Evaluate Terrorist Attacks.*

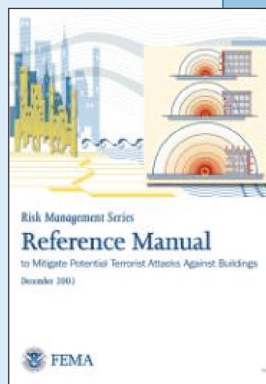
A continuation of the Series was undertaken by the DHS S&T RSD as part of the Building Infrastructure Protection Series (BIPS). BIPS is a series of publications and software tools developed to provide guidance on risk assessment and mitigation against multi-hazard events. The objectives of the publications and software tools are to reduce physical damage to structural and nonstructural components of buildings and critical infrastructure, and to reduce resultant casualties from impact events that include manmade hazards (including explosive blast, and chemical biological, or radiological agents) and natural hazards (including floods, hurricanes, earthquakes and other natural disaster events).

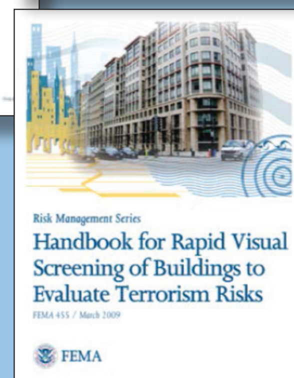
The IRVS family for Risk Assessment is shown in the figure below.

Earlier Risk Management Publications Related to BIPS 12 (FEMA)

- 432, Risk Assessment: A How-To-Guide to Mitigate Potential Terrorist Attacks Against Buildings
- 424, Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings
- 455, Handbook for Rapid Visual Screening of Building to Evaluate Terrorist Attack

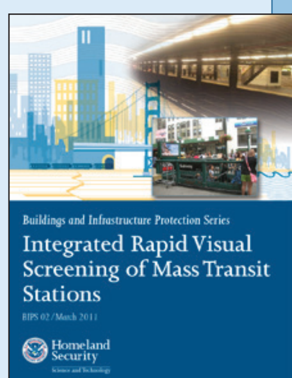


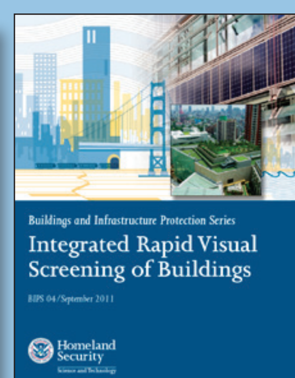


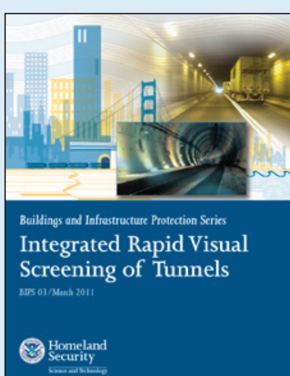


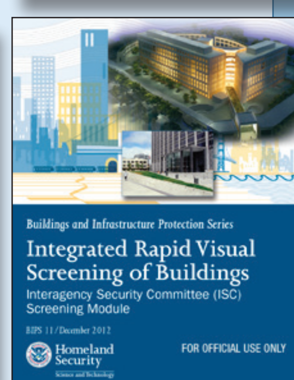
Recent IRVS Risk Management Publications (DHS S&T)

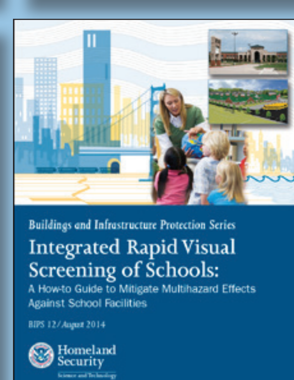
- BIPS 02: Integrated Rapid Visual Screening of Mass Transit Stations
- BIPS 03: Integrated Rapid Visual Screening of Tunnels
- BIPS 04: Integrated Rapid Visual Screening of Buildings
- BIPS 011: Integrated Rapid Visual Screening of Buildings Interagency Security Committee (ISC) Screening Module,(FOUO)
- BIPS 12, Integrated Rapid Visual Screening of Schools: A How-to Guide to Mitigate Multihazard Effects Against School Facilities











2.2 Key Considerations of the IRVS Methodology

The Interagency Security Committee (ISC), the most comprehensive federal facility standards for building security, consists of a) “The Design Basis-Threat (U), 2010; b) the Facility Security Level Determinations for Federal Facilities, 2008); and c) the Physical Security Criteria for federal Facilities, 2010.

The effort to increase safety in a particular school is a combination of understanding which hazards present the major threats, the consequences to the school of being impacted by the hazard, and the time that it takes the facility to recover and be able to provide full or limited functions. All these efforts are directed at decreasing school vulnerability to a natural or man-made hazard. In this How-To-Guide vulnerability can be understood as any physical feature or operational attribute that renders an entity, in this case a building, susceptible to a given hazard (DHS, 2009). The assessment of vulnerabilities includes the identification of building weaknesses that can increase the potential for damage from a manmade or natural disaster. The threats addressed by this methodology are selected natural and man- made hazards and the design guidance and risk assessment methodologies are directed at new and existing school buildings. This How-To-Guide utilizes a number of critical concepts that are vital to improving school safety and the resistance of schools to major hazard events.

> The effort to increase safety is a combination of understanding which hazards present the major threats, the consequences to the school of being impacted by the hazard, and the time that it takes the facility to recover.

2.3 The *IRVS for Schools* Factors

The IRVS for School Safety closely follows the Interagency Security Committee (ISC) methodology for federal buildings. This methodology provides a comprehensive approach to meeting facilities security needs and establishing that the cost of safety and security is commensurate with the risk posed to a facility. The objective of the risk management process is to identify a base line or an achievable Level of Protection (LOP) that is commensurate with -or as close as possible to- the targeted level of risk. In addition, the methodology provides a means to determine the School Security Level (SSL) and the natural and man-made hazards that pose a higher exposure to a particular school. The IRVS for School Safety is a multihazard approach and will provide scores for risk and resilience management.

IRVS for Schools Methodology

All Criteria are Ranked 1-5

School Security Level (SSL)	Undesirable Events (UE)	Level of Protection (LOP)
It directs the user to a set of baseline standards that can be customized to address site-specific conditions of a particular school, school district, region, or State. The SSL is a categorization that serves as the basis for implementing protective measures, it is critical for schools to recognize this characterization as a mean to achieve safety and minimize risk. It can be associated with the consequences of an event.	Includes the traditional natural and man-made hazards and series of undesirable events that can particularly affect schools. Undesirable events can be categorized as a broad range of events and circumstances that can adversely impact the security, function, and operations of a school. It included all parameter that can compromise school safety.	Identifies the criteria and process for determining the baseline for States, jurisdictions, and schools to implement protective measures. it is the degree of security provided by a set of countermeasures determined to be in existence at the facility. The criteria can be associated with existing vulnerabilities. the methodology demand the existing LOP to be juxtaposed with the necessary LOP.

Based on the ISC Methodology, the IRVS for School Safety assessments are based on the following factors:

- **School Security Level (SSL).** Identifies the baseline security level that a school should achieve based on a series of pre-set conditions related to the criticality of a particular school. The baseline is established through a prescribed methodology and judgment which can be used by states, districts, jurisdictions or individual schools to understand and determine a baseline to implement or mandate protective measures for schools under their area of influence. The IRVS for School Safety methodology can be also adopted by individual schools that wish to undertake their own program for risk reduction.
- **Undesirable Events (UE).** Identifies an incident or hazard event that has an adverse impact on the physical aspects of the school building, occupants and visitors. UE include a broad range of events that can adversely impact the safety, security, function, and operations of a

school. UE encompass an incident or 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 to schools.

- **Level of Protection (LOP).** A baseline that evaluates whether the existing mitigation levels of a particular school adequately meet desired security and safety criteria identified in each SSL and mitigate or anticipate risk to the facility for undesirable events. The LOP can be associated with vulnerabilities which can be categorized and ranked according to risk and resilience. The gap between the existing LOP and the highest necessary LOP are the benchmarks that must be implemented unless a deviation (up or down) is justified by the risk assessment.

2.4 The IRVS for School Safety and Performance-Based Design

The ISC Standards and the IRVS for School Safety are performance-based design (PBD) methodologies. PBD is a process used to achieve specific performance goals and objectives in order to reach desirable results for minimization of risk and an increased resilience of a particular school. In the IRVS for School Safety, PBD is based on a number of criteria (building functions or systems) linked to different options identified as LOPs. The selection of a particular LOP reflects the LOP of a specific facility. The SSL is pre-determined score selected by the school decision makers based on a number of criteria provided by the IRVS for School Safety methodology. It is important to note that implicitly, performance based standards endorse the use of higher standards in lieu of the minimum life safety standards included in the U.S. building codes. This approach can allow for innovation and help meet school safety requirements not yet supported by the building codes.

def-ə- **Performance-based design** is a process used to achieve specific performance goals and objectives in order to reach desirable results for minimization of risk and an increased resilience of a particular school.

The core of any performance-based design is the complex interrelationship between the different systems (i.e., structural, architectural, mechanical) of the building, the demands placed on the building (i.e., safety, security, man-made hazards), and the desired level of performance. The desired performance of a school can be associated with the different levels of LOP, that is from the baseline to the highest LOP. Understanding the different levels of LOP can offer a powerful decision-making tool for the users. As such, designers and decision makers can have the following in mind when deciding the performance and operation of the schools.

Levels	LOP Levels	Possible Combinations
Baseline	One level of performance	High risk - low resilience
Improved LOP	Two levels of enhanced performance above the baseline	Medium risk - moderate resilience
Enhanced LOP	Three levels of performance above the baseline	Moderate risk - medium resilience
High LOP	Four levels of performance above the baseline	Low risk - high resilience
Highest LOP	Five levels of performance above the baseline	Very low risk - very high resilience

The ultimate objective when designing schools is to provide for:

- Health, safety, and security.
- Protection against natural hazards
- A learning environment that enhances teaching and learning and accommodates the needs of all students
- Serving as an effective center of the community
- A learning environment that is the result of a planning/design process that involves all stakeholders
- A learning environment that allow for flexibility and adaptability to changing needs
- An effective use of all available resources and minimized waste.
- A design that emphasizes durability
- A design that helps to preserve and conserve natural resources

2.5 Methods of Implementation

This How-To Guide is directed to a person, group, or entity that is invested in the welfare and success of a schools and it students. School stakeholders include superintendents, site administrators, teachers, staff members, students, parents, families, community members, local business leaders and elected officials such as school board members, city councilors and state representatives. Stakeholders may

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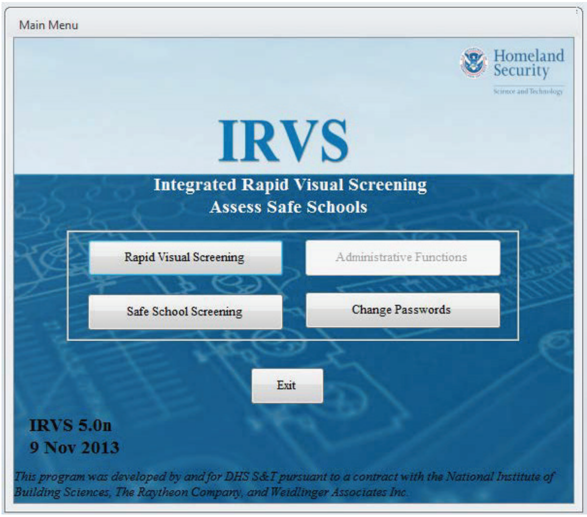
also be collective entities, such as local stakeholders-school board members, businesses, organizations, initiatives, committees, media outlets and cultural institutions. In a word, stakeholders have a "stake" in the school and its students, meaning that they have personal, professional, civic, or financial interest or concern. For this manual the stakeholders understand the need for school building security and have a purpose to resolve all aspects and challenges of school design, construction, renovation, operation, and maintenance.



- **IRVS Catalogue.** The *IRVS for Schools* Catalog contains a description and explanation of the security criteria and input options that are evaluated during the IRVS l for School Safety. The purpose of the catalog is to help screeners (evaluators or assessors), including those without a technical background, complete the data collection for evaluating the criteria accurately. The Catalogue is the backbone of the *IRVS for Schools* methodology.

- **IRVS Database.** The IRVS Database is a standalone application that supports the collection and analysis of data to identify risk and resilience, accept or reject risk, and implement effective mitigation measures. The IRVS for School Safety will include all the key elements of the IRVS for School Safety catalog. Following the catalog closely will ensure consistency when different screeners assess a group of buildings. Screeners should use the catalog during all phases of the screening. The catalog is provideds chapters three through six of this How-To-Guide. The screener can input data into the IRVS database through the data collection form (DCF) using a laptop, tablet computer, or by using a paper version if necessary, however, the electronic version is preferred. If a paper version is used, data must be transferred to the IRVS for School Safety Database. The automated analysis of the criteria can only be conducted if the screening data is in the database. 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 (Master Database) for collecting the results, printing reports, and analyzing the information, 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 included in the IRVS tool in the Appendix of this How-To-Guide.

- **Screeners.** The IRVS process allows for screeners to be non-engineering personnel and others outside the design community however, screeners should be very familiar with and have expertise in school building systems and technology. Screeners can conduct an IRVS for School Safety evaluation with a reasonable level of certainty after brief training, thus reserving technical experts such as engineers and architects for more in-depth assessments. Screeners typically include engineers, architects, law enforcement, school operators and security professionals responsible for protecting schools in the U.S. They may also be building owners (private schools), operators and decision-makers involved with the planning, construction and maintenance of schools

- **Time Required.** One of the strengths of the IRVS for School Safety process is how quickly it can be completed. Pre-field data gathering and setup 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. The post-field process can add another 1-2 hours to complete the evaluation, analyze the results, organize and consolidate documentation and produce reports.

- **Cost-Effectiveness.** The IRVS for School Safety process can be implemented relatively quickly and inexpensively to develop a basic risk profile of a group of schools without the high cost of a detailed analysis of individual buildings by technical experts. The results of the IRVS for School Safety can be used to establish priorities, and the available resources can be focused on action plans and programs that reduce vulnerability, deter threats, and mitigate potential consequences.

- **Accuracy.** The accuracy of the IRVS for School Safety is a function of the quality of the input. The accuracy of the process will be improved if screeners are familiar with the methodology, obtain and review relevant information about the building prior to the field assessment and also review this manual. Reviewing information such as school 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 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. Reliability and confidence in the assessment can also be increased by obtaining information from building representatives who are available for questioning.

- **Subjective Judgments.** The requirement for subjective judgment has been reduced to the extent possible; however, it may still be necessary. Screeners may use subjective judgment when completing data entry and choosing between attribute options for certain characteristics. Information provided in the catalog is intended in part to minimize the number of times the screener must use subjective judgments. When subjective judgment is used, the screener should document the decision using the fields provided in the database.

2.6 Validation

The IRVS for School Safety manual will be thoroughly validated by conducting extensive alpha and beta tests throughout the U.S.. The first objective of the alpha and beta testing is 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
- Variation among results for different facility types
- Consistency of results
- Formatting of reporting or results

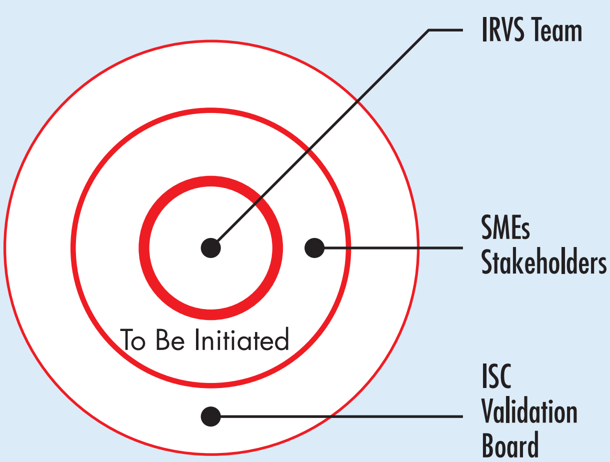
The results of the alpha and beta testing are used as a basis for calibrating the tool to obtain accurate, consistent, and reasonable results for each assessment.

Validation will follow the process described below that integrates the field testing needed to validate the scoring component of IRVS of School Safety with the process of conducting screenings involving all relevant stakeholders.

Three Step Validation Process

Read Teaming Exercise

Conducted by DHS S&T in partnership with first responders, local police, SWAT teams, fire and rescue, teachers, PTS, DOW, FEMA, IP, FRG, White House, AIA



1. IRVS Teams are nationally recognized experts in structural engineering, architects, risk assessments, security, safety, and computer software

2. SMEs typically include the Chief of Security, Chief Architect, Chief Engineers of Federal agencies, Building Operations Managers

3. ISC Validation Review Board is responsible for the certification and validation of risk assessment tools. The entire board is comprised of 56 agencies and organizations.

3

School Security Level (SSL)

In this Chapter:

School Security Level identifies the criteria and process for determining the baseline for States, Jurisdictions, and Schools to implement protective measures. The baseline is established through a methodology and judgment . This criteria can be associated with consequences.

This Chapter is design to help school officials and decision makers to establish the School Security Level (SSL) baseline for their states and jurisdictions which facilitate the adoption or implementation cost effective protective measures for their school facilities. In the US, the school systems is comprise of public and private schools. This How-To Guide, although mostly directed at private schools, can be used for the assessment of private schools facilities.

The main objective of this Chapter is to establish appropriate SSLs for all schools based on the criticality of the specific facility and the consequences that may result from been affected by a undesirable event. The approach recommended for the selection of the SSL in eminently participatory. This manual recommends that the SSL is determined by heavily involving school authorities that are in close contact with community levels.

3.1 Past and Present

In the United States, public schools are usually part of school districts, which are independent special-purpose governments, or dependent school systems under the control of state and local government. The governing body of school districts –which is typically elected by direct popular vote but may be also appointed by other governmental officials—can be called school board, board of trustees, board of education, school committee, or the like. This body appoints a superintendent, usually an experienced public school administrator, to function as the district's chief executive for carrying out day-to-day decisions and policy implementations.

Not all school systems constitute school districts as distinct bodies corporate. A few states have no school systems independent of county or municipal governments. Some States can be run by the county or county-equivalent level (i.e., Maryland). . Other states have both, independent school districts and school systems that are subordinate to cities usually ruled by the Mayor (i.e., New York City). In other cases, the State functions as a single state-wide school district (i.e., Hawaii). Other more singular cases are the District of Columbia Public Schools –that operates district public schools in Washington, DC– and the Puerto Rico Department of Education that operates all public schools in the Commonwealth.

Private schools, also known as independent schools, are used by different social strata groups for education K-12 education. Private schools can be characterized as schools that are not administered by local, state or national governments; thus, retaining many rights that are not available to public schools.

States and local governments, school districts, governments' state-dependent school systems, local-dependent school systems, and private schools, concerned with the design or assessment of schools, are the authorities that will be involved in the selection of the SSL for their particular area or schools of their jurisdiction.

3.2 Methodology

To obtain the SSL of a particular school or school located in a particular jurisdiction, states and local governments may establish the SSL by using the methodology included in this Guide. It is recommended that for this task, a small multi-disciplinary committee is formed with people and authorities who have ample technical skills and knowledge of the day-to-day community issues, capabilities, and resources.

The main goal to obtain an appropriate SSL base line is for school authorities and decision-makers to be able to fully appreciate the criticality of a school facility and understand its capacity to provide services and functions during and after the occurrence of an undesirable event. This general concept is important for all schools; however, it is most critical for schools that provide shelter to the students and the community.

For the SSL determination, a set of well-proven options, included in the SSL matrix, should be considered. The SSL matrix consists of five equally weighted security levels to be evaluated by the decision makers, with corresponding points of 1, 2, 3 or 4 allocated for each level. Each level corresponds to well proven structural, mechanical, and operational system criteria factors. These levels correlate with very low/minimum, low, moderate, high and very high (see table below).

SSL Baseline Option	
SSL	**Desirable Baseline of Protection Options**
5	Very High
4	High
3	Moderate
2	Low
1	Very Low

The steps for the selection of the appropriate SSL are described below.

Criteria	Selection of the Base Line and the SSL
1. Number of Students 2. School Density 3. School Facility Size (Campus) 4. Surrounding Traffic 5. General Condition of the School 6. Population of Schools with Multiple Functions 7. Population of School Shelter Function 8. Operational Redundancy 9. Replacement Value 10. Intangible or Additional Factors 11. Historic Value 12. One of a Kind (or nearly so) 13. Target Potential 14. Target Density 15. Seismicity Zone 16. Floods Maps Zones 17. Hurricanes Frequency 18. Tornadoes Frequency 19. Tidal Waves Exposure 20. Selected Natural Hazards/Climate Change 21. Nearby Water Structures (Levees, Embankments, Floodwalls, and Upstream Dams) 22. Wild Fires Exposure	• States and local governments, school districts, governments-state-dependent school systems, local-dependent school systems, and private schools should be involved in establishing the SSL for their jurisdictions according with their own processes and mandates • It is highly recommended that a small (5-7 people) multi-disciplinary panel is assembled for the selection of the SSL. The formation of this panel is extremely important if the decision of selecting a particular SSL is going to affect large number of schools • The SSL should be selected by using the SSL matrix included in this chapter. • The SSL matrix consists of five equally weighted options will be evaluated by the decision makers, which corresponds to different options or level of protection. • After considering each option and assigning a corresponding numerical factor (1-5) in the SSL matrix, the result will be 23 numerical values. • To select the appropriate SSL base line, the median of all the obtained numerical values should be determined. [The "median" is the "middle" value in the list of numbers]. • In cases where two or more numbers are equally repeated the most, the jurisdiction/administrators would choose the higher number.

3.3 SSL Adjustments

Readjustments of the SSL should be viewed as the last resource. School officials and decision-makers estimate that selected SSL are indicative of certain areas and other not, they should considered analyzing the SSL for smaller jurisdiction or handpicking those communities that due to social and economic vulnerabilities or resilience are at odds with the rest of the grouped schools.

However, if the judgment of schools officials and decision-makers feel that there is a variance in the SSL and does not reflect the reality of the schools being analyzed, they should recheck their analysis and understand what is the problem. If after this process, the SSL needs to be modified, it can be readjusted up and down as needed. However, any variation or divergence should be appropriately documented and explained.

School Security Level Exclusive for Schools (SSL)			
ID	Criteria	Options	SSL
1	**Number of Students** The number of students is an important element of school criticality because of the potential for casualties (injuries and deaths) as a result of an undesirable event. Larger schools can be a more desirable target for school violence, shootings, and terrorist attacks due to the publicity associated with mass casualty. Similarly, for natural disasters, large number of people congregated in a single place may require great consideration due to direct injuries and fatalities resulting from the event of from building damage or partial or progressive collapse. There are different points of view on the relative security of larger or smaller schools. Some of the views indicated that compared to larger schools, students in smaller schools fight less, feel safer, come to school more frequently, and report being more attached to their school. Frequently, small school teachers feel more committed and connected in their work and they report higher job satisfaction and a greater sense of responsibility for ongoing student learning. Other views indicate that larger schools can provide adequate safety because they may have more resources. Students" peak hours should be considered when selecting the appropriate option. In many urban areas, schools can be large facilities, housing 2,000 to 3,000 students. 	a. < 100 =1 b. ≥ 100 - 500 = 2 c. ≥ 501 - 2,000 = 3 d. ≥ 2,001 - 5,000 = 4 e. ≥ 5,001 - 10,000 = 5 f. ≥ 10,001 = 5	

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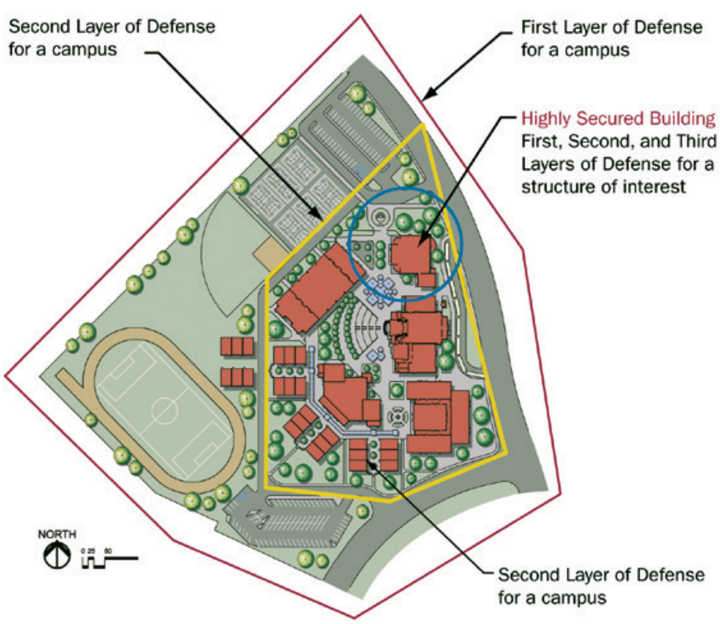
School Security Level Exclusive for Schools (SSL)			
ID	**Criteria**	**Options**	**SSL**
2	**School Density** School density describes the general population density and land use in the area surrounding the school. When considering the type of density to select, the maximum density should be considered. For example, a particular area surrounding a school can be a combination of any of the options from a. – e. If the school is selected in area that is both, industrial and urban, the selection should be d. Maximum density in the surrounding areas 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. This should be carefully assessed. The underlining aspects of school density is that school may be affected by traffic, civil disturbance, violence, etc. that occur outside the perimeter of the school. For example, schools can be a secondary target of explosives is the facility is located near an Embassy, government agency, etc.	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 = 1 b. Semi-urban/light Industrial. Small town or city with low population density or a mixed use office park, warehouses, or manufacturing. Multiple schools buildings campus style = 2, 3, 4 c. Industrial. Heavy manufacturing and warehouses with a lower population density than light industrial. Multiple schools buildings campus style. Area may be or not associated with crime = 2, 3, 4 d. Urban. Metropolitan area in a city or large town. Multiple schools buildings campus style. Area may be or not associated with crime = 2, 3, 4, 5 e. Dense urban. Densely populated area in a major urban corridor or a major resort corridor with clusters of commercial. May or may not include buildings campus style. Area may be or not associated with crime 4, 5	



School Security Level Exclusive for Schools (SSL)			
ID	Criteria	Options	SSL
3	**School Facility Size (Campus)** A school building can be located in a single site but many times, a school has multiple buildings contained within the same perimeter. For this How-To Guide, schools with the later characteristics will be denominated campuses. School campus design varies as well the individual level of protection of each building. In addition, school campus may have open access but individual buildings have different levels of protection. Furthermore, the entire campus may exhibit limited control by employing methods of protection such as fences and entry point and parking control. Many times, high risk buildings (laboratories, hazardous materials, etc.) can be located in a separate area presenting the appropriate protection. The possibilities for school campus are enormous. In a particular campus, multiple schools can be sited and share a number of support facilities such as libraries, laboratories, music rooms, etc. When considering the SSL, school authorities and decision-makers should evaluate each building independently. During the assessment process the following should be considered: • Each site and building should be evaluated independently • Interactions and redundancy of key buildings with those that provide supportive functions can be analyzed as decided by field personnel according to required or essential needs.	a. Not Applicable = 1 b. Small , with no redundancy = 1 c. Medium with limited redundancy = 2, 3 d. Large = with redundancy = 4 e. Very Large with very good redundancy = 5	

School Security Level Exclusive for Schools (SSL)			
ID	Criteria	Options	SSL
4	**Surrounding Traffic** The school may be located in an area of high traffic or close to a highway. Both of these factors can severely increase the potential number of casualties (injuries and deaths) as a result of traffic accidents. Reducing the speed and the number of vehicles that circulate in the vicinity of schools is critical for school safety. It is also of critical importance to prevent high-speed approaches to schools and control the angle of incident. It is also important to have signs that direct traffic and prohibit through traffic to school grounds. In addition, it is important to have clear designation of school entries, routes, and visitor parking lots during school hours and during after-hours. The following is recommended: The vehicle velocity should consider the angle of incidence in conjunction with the distance between the perimeter and the point at which a vehicle would be able to start a run at the perimeter. If a checkpoint is established in case of emergency, schools should have in place the means to control the entrance of vehicles, only allowing the entry of authorized vehicles and one vehicle at a time. The school may want to coordinate these actions with local law enforcement agencies. An outside space beyond the protected perimeter to pull over and inspect cars should also be considered. Street lights, calming features, barriers, and gates to access school grounds should be taken into consideration.	a. Very Low =1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5	
5	**General Condition of the School** Well maintained school buildings and grounds promote civil order and demonstrate ownership of and respect for school property. On the contrary, schools with signs of graffiti, breakage, neglect, or disrepair can be indictors of social problems and school violence.	a. Very Poor =1 b. Poor = 2 c. Moderate = 3 d. High = 4 e. Very High = 5	

School Security Level Exclusive for Schools (SSL)			
ID	Criteria	Options	SSL
6	**Population of Schools with Multiple Functions** Many schools have multiple functions in addition to the regular school operation and hours. They may function as a daycare facility, athletic center, fine arts practice, community college campus, adult education center, and community meeting house among other things. These functions are extremely important considerations since schools are required to maintain a similar level of safety for these additional and after school hour functions. These multiple functions need to be considered carefully. For example, some schools report that they may host six simultaneous events at a high school on a Friday night including a play in the theater, a swim meet in the pool, a softball game on a field, a basketball game in a gym and an academic competition in the library. Some performing arts centers, for example, are built to hold over 1,000 people. Student graduation events can hold as many as 8,000 people. School Indoor and Outdoor Gyms. In many places in the US, school sports can be extremely important community events. Stadiums can hold 15,000 or more with standing room only often available. Some schools host dozens of games per year. Marching band and cheerleading competitions are also important events that can attract thousands of people. In Texas for example, schools host rodeos and stock shows where attendance might be over 4000 in and around the school building and grounds.	a. < 100 =1 b. ≥ 100 - 500 = 2 c. ≥ 501 - 2,000 = 3 d. ≥ 2,001 - 5,000 = 4 e. = 5,001 - ≥ 10,001 = 5	

<table>
<tr><th colspan="4">School Security Level Exclusive for Schools (SSL)</th></tr>
<tr><th>ID</th><th>Criteria</th><th>Options</th><th>SSL</th></tr>
<tr><td>7</td><td>Population of School Shelter Function

In case of hurricanes, schools can function as community shelters. In case of tornados, schools can serve as a refuge for the school population, and in some cases the surrounding population.

In case of extreme weather, schools can provide multiple services to the community. Recently, for example, Katy Independent School District in Texas provided a safer location about 60 miles inland for the US Coast Guard to move command operations of 400-600 personnel when a hurricane threatened the Houston-Galveston area.

The score selected should reflect the maximum capacity of the shelter.

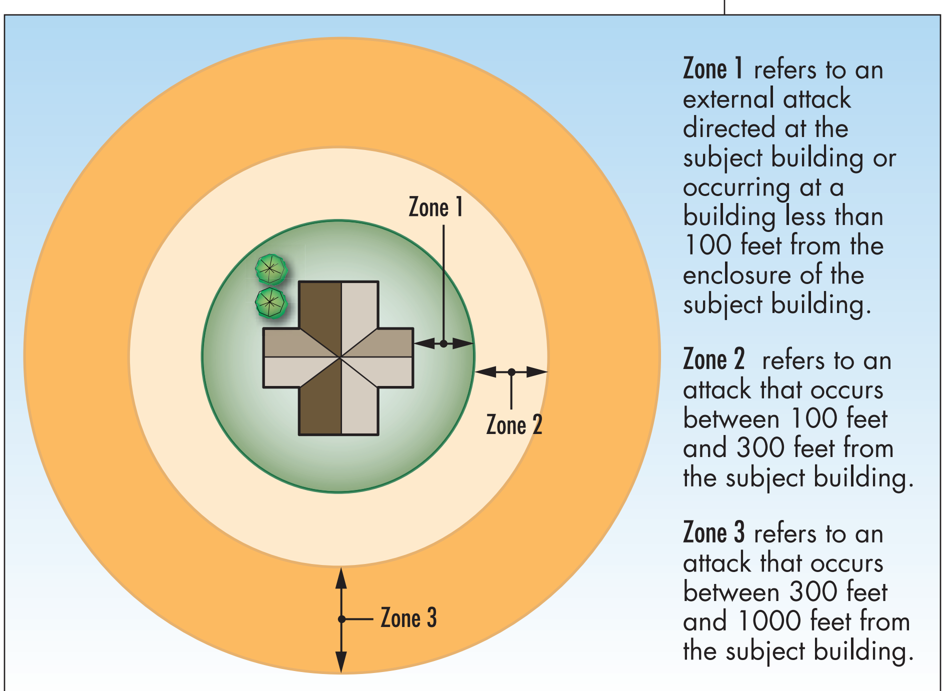
Shelters should comply with FEMA P-320 - Taking Shelter From the Storm: Building a Safe Room</td><td>a. Not applicable
b. < 100 = 1
c. ≥ 100 - 500 = 2, 3
d. ≥ 501 - 1000 = 3
e. ≥ 1001 = 4, 5</td><td></td></tr>
</table>

School Security Level Exclusive for Schools (SSL)			
ID	Criteria	Options	SSL
8	**Operational Redundancy** Operational redundancy refers to the degree to which a school 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 of student and teachers to return to the schools or to continue servicing in other pre-selected areas. 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.	a. Very low. Little or no capability to maintain functions during or after a disaster; devastating impact and complete loss of service or function = 1 b. Low. Low capability to maintain functions during or after a disaster; significant interruption of service or function = 2 c. Moderate. Moderate capability to maintain functions during or after a disaster with some back-ups available offsite; moderate interruption of service or function = 3 d. High. High capability to maintain functions during or after a disaster with most back-ups available offsite; minor interruption of service or function = 4 e. 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 = 5	
9	**Replacement Value** The replacement value of a school 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[s]. Replacement value includes school improvements and contents. Replacement value varies by construction costs within a region, the community type (e.g., downtown urban, outside the urban core), school size (a large school may be less expensive to build per square foot than a small school), and use of the school for other functions (community center, shelters, cultural functions, and other amenities). It is also important to know if the school serves as a shelter in case of emergencies. Insurance coverage limits, published cost guides or cost consultants may be used to provide an estimate,. A rough order of magnitude estimate indicates that schools costs can range from $100-$200 per square foot.	a. < $1,000,000 million m = 1 b. ≥ $1,000,001 - $5,000,000 =2 c. ≥ $5,000,001 - $15,000,000 =3 d. ≥ $15,000,001 - $40,000,000 =4 e. ≥ $40,000,001 = 5	

School Security Level Exclusive for Schools (SSL)			
ID	Criteria	Options	SSL
10	**Historic Value** Historic value relates to the symbolic or landmark status of a school and whether it is on a national, state, local, or nongovernmental historic register. The screener can ask a site representative whether the school is on a historic register or do an Internet search. The National Register of Historic 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 school building indicating its status as an historic property. The score value can be selected by the screener based on degree of historic significance of the building.  Historic School building in Massachusetts	a. No = 1,2,3 b. Yes= 4.5	
11	**Intangible or Additional Factors** This refers to an asset(s) that may not have an obvious physical value but it destruction due to undesirable events can mean a lot to society. Research and development, intellectual property rights, knowledge, name recognition, reputation, prestige associated with particular schools can be included in this category. Typically, intangible assets may add market value to particular school	a. No = 1, 2, 3 b. Yes = 4, 5	

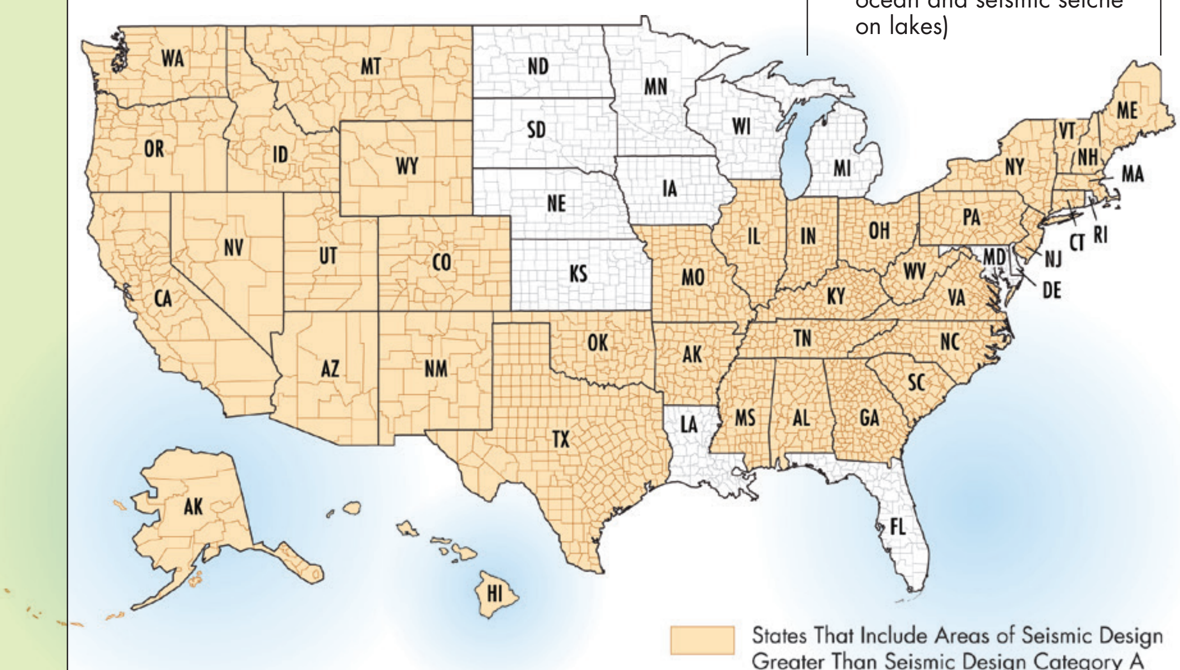
School Security Level Exclusive for Schools (SSL)			
ID	Criteria	Options	SSL
12	**One of a Kind (or nearly so)** Schools, due to specific functions, teaching, valuable can be one of a kind and their losses in case of any type of undesirable can have unique consequences. Also the school can have be symbolic and mean something irreplaceable for the community.	a. No = 1, 2, 3 b. Yes = 4, 5	
13	**Target Potential** Target potential refers to past and present potential that a school may be selected for an attack. It is evaluated by determining whether there are current or previous credible threats. Target potential is based on available information, but judgment may also be required. Additional information relative to other threats in the area can be obtained from local law enforcement officials, 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 Target potential relates to the likelihood that a school will be exposed to: 1. Arson 2. School Shooting 3. Kidnapping 4. Explosive Device – Man-Portable (External and Internal) 5. Explosive Device – External 6. Explosive Device – Mailed or Delivered 7. CBR Release – Internal 8. CBR Release – External 9. CBR Release – Mail Delivered 10. CBR Release – Water Supply 11. Disruption of School Security Systems 12. High Velocity Vehicles in Vicinity 13. Cyber Attack 14. Drug Abuse 15. Vandalism	a. Subjected to 2 threats = 1, 2 b. Subjected to 4 threats = 1, 2 c. Subjected to ≥ 6 threats = 3, 4 d. Subjected to ≥ 8 threats = 4, 5	

School Security Level Exclusive for Schools (SSL)			
ID	Criteria	Options	SSL
14	**Target Density** This criteria addresses both target and non-target schools. A particular school may not be the main object of a particular threat but a high-value target may be a building or another type of structure such as a bridge or dam close to the school. Non-targeted buildings may receive collateral damage in a terrorist attack that varies in severity depending on the hardiness of the building, proximity to the target, and magnitude of the threat. The IRVS methodology identifies three zones to be considered in any evaluation: Zone 1 refers to an external attack directed at the subject school building or occurring at a building less than 100 feet from the enclosure of the school. An event in Zone 1 would be catastrophic. Casualties, damage, and school interruption should be expected Zone 2 refers to an event that occurs between 100 feet and 300 feet from the school building. . An event in Zone 2 is a moderate hazard level, Zone 3 refers to an attack that occurs between 300 feet and 1000 feet from the school building. An event in Zone 3 is a minor hazard level.	a. Potential targets in in zone 3 (≥300 - <1,000 feet) = 1, 2 b. Potential targets in in zone 2 (≥100 – <300 ft.) = 1, 2, 3 c. Potential targets in in zone (< 100) 1 = 4, 5 Buildings and areas close to schools can be poorly maintained showing signs of graffiti, breakage, neglect, and disrepair which typically can be a magnet for crimes. Or, a number of high-value targets within a certain distance of the school, can be in the area, making the school susceptible to collateral damages in case of a terrorist attack. When selecting the score for this criteria, the screener should consider the number and type of threats in the proximity of the building.	



School Security Level Exclusive for Schools (SSL)			
ID	Criteria	Options	SSL
14 (cont.)	Potential targets outside the perimeter of the school are: 1. Agriculture and Food 2. Banking and Finance 3. Chemical 4. Commercial Facilities 5. Communications 6. Critical Manufacturing 7. Dams 8. Defense Industrial Base 9. Emergency Services 10. Energy 11. Government Facilities 12. Healthcare and Public Health 13. Information Technology 14. National Monuments and Icons 15. Nuclear Reactors 16. Material and Waste 17. Postal and Shipping 18. Transportations Systems Water The school can ask local law enforcement agencies about the number and type of crimes committed in the vicinity of the school and the availability of law enforcement patrols in the area. A general point of view is that schools are not likely to be attacked by a terrorist but a particular school may be situated 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. For the IRVS target distances of 100ft, 300ft, and 1000ft are used. These can be determined and viewed with Goggle Earth or another GIS mapping system. Schools may pursue the following actions to reduce impacts: • Engage in community surveillance with the help of school neighbors and passing patrol cars. Schools may want to encourage a volunteer neighborhood watch to help in protecting the school • Identify hidden areas adjacent to the school that might provide potential offenders with "cover" or provide students with a location for illicit activities. Prepare plans to adjust accordingly • Take actions to secure insecure areas by opening them up, exposing them, sealing them off, or other measures as appropriate. Secure field houses and other outbuildings to prevent intruders from gaining entry	In order to identify iconic buildings and structures which can be potential targets for terrorist attacks in the surrounding area of the school, the Key Critical Infrastructure Sectors (DHS 2009) is provided as a reference for evaluating target density. The following links may help you to identify the critical infrastructure in the surrounding areas of that may present a potential risk to the school building and students. http://www.dhs.gov/critical-infrastructure-and-key-resources-support-annex http://www.dhs.gov/critical-infrastructure-sectors Assessors should be aware of CBR releases, explosions, and fires that have occurred in the vicinity and where schools have the potential for collateral damage. These types of events can be related to: • Rail incidents • Highway carrier accidents • Pipeline accidents • Industrial and commercial incidents	

School Security Level Exclusive for Schools (SSL)			
ID	**Criteria**	**Options**	**SSL**
15	**Seismic Zone** Seismic zone indicates the potential frequency and location of earthquakes within a particular area. For the purpose of this How-To-Guide, seismic zones are rated very low, low, moderate, high, and very high. The schools authorities and decision-makers can identify the seismic zone for a particular school building by: Finding the location of the school 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 school and then selecting a value for seismic zone from the list. In terms of tidal waves, earthquake may trigger a tsunami of a magnitude that is very much larger than the magnitude of the earthquake as measured by shorter-period seismic waves. They are particularly dangerous as a large tsunami may arrive at a neighboring coast with little or no warning. A national standard for engineering design for tsunami effects written in mandatory language does not exist. Tsunami risk to coastal zone construction is not explicitly and comprehensively addressed in design. The current situation for the Tsunami Loads and Effects Subcommittee of the ASCE/SEI 7 Standards Committee is anticipated for review in 2014 to b 2013; its review by the by ASCE 7 Main Committee in 201, and its final publication in 2016. (See ID 16 which covers tidal waves.)	a. Very Low b. Low c. Moderate d. High e. Very High 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. Key elements of earthquakes include: • 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)	

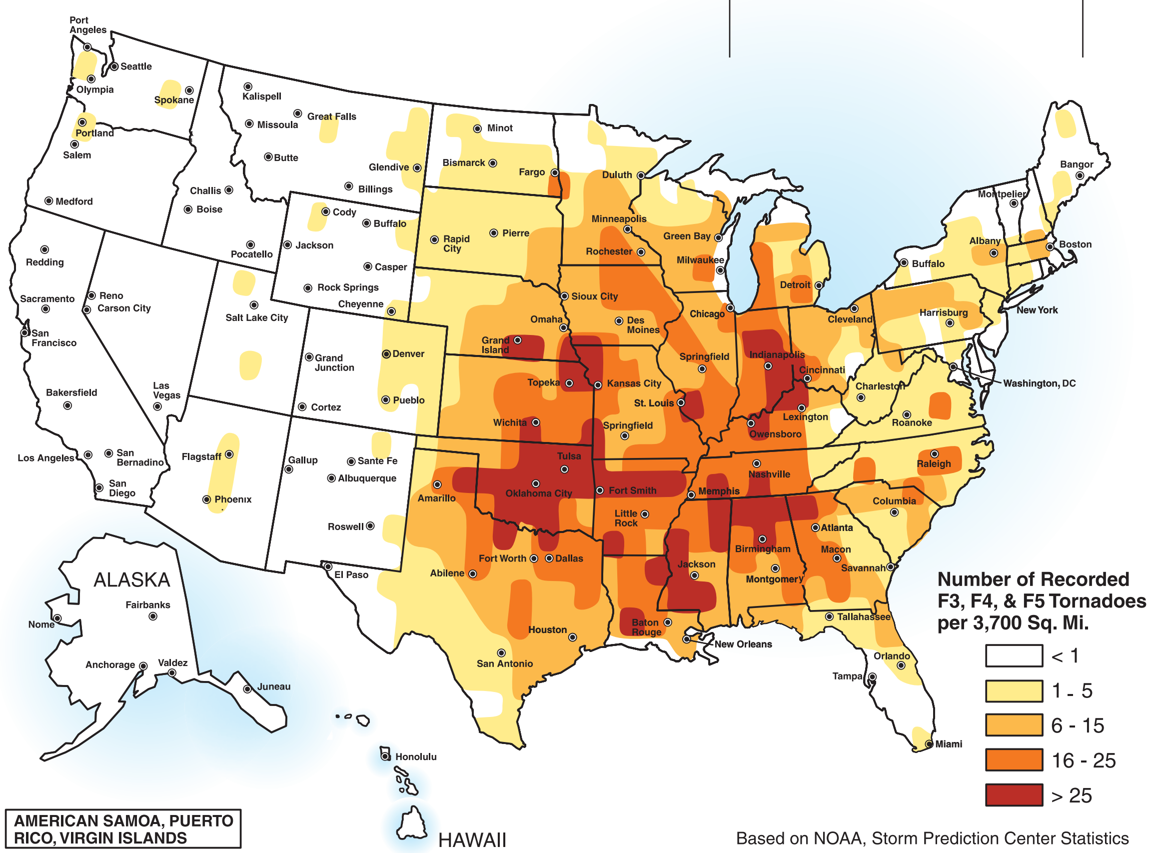


School Security Level Exclusive for Schools (SSL)			
ID	**Criteria**	**Options**	**SSL**
16	**Flood Zones (Flood Risk Maps)** FEMA produces the Flood Insurance Rate Map (FIRM) which can be map product and digital data that can be easily become part of the community plans. Flood risk products are non-regulatory resources that help communities gain a better understanding of flood risk and its potential impacts that FEMA provides in addition to the regulatory Flood Insurance. The FIRM maps have been prepared by FEMA for more than 2,000 communities. The FIRM maps are the most important products for evaluating the SSL for flood since can quickly help school authorities and decision makers to determine their flood risk. In the FIRM, flood hazard areas are identified as a Special Flood Hazard Area (SFHA). SFHA are defined as the area that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 1-percent annual chance flood is also referred to as the base flood or 100-year flood. For the purpose of the School Safety Project, three distinctive zones will be considered Important FIRM Flood Zones: a. Zone A (A1-A30) are subjected to flooding by the base of the 1 percent annual change (100-year) flood, and are considered high risk areas. When a decision is made to build any facility in Zone A , the characteristic of the site and the nature of the flood hazards must be examined prior to making important design decisions. ASCE 24, Flood Resistant Design and Construction specifically require application of the NFIP's V Zone design requirements in Coastal A Zones. b. Zone B: are areas subjected to flooding by the 500-year flood (0.2 percent annual chance) and is a moderate risk area. c. Zone C: Areas considered of low-risk outside of the SFHA and higher than the elevation of the 0.2-percent-annual-chance flood	a. Never; No record floods 1 b. Rare; Zone A = 1, c. Medium; Zone B = 2, 3 d. Frequently and Very Frequently; Zone C = 4, 5	

School Security Level Exclusive for Schools (SSL)			
ID	**Criteria**	**Options**	**SSL**
17	**Hurricane Frequency** 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. Hurricanes can trigger storm surges which is often the greatest threat to life and property from a hurricane. During Hurricane Katrina (2005) at least 1500 persons lost their lives and many of those deaths occurred directly, or indirectly, as a result of storm surge. Storm surge is an abnormal rise of water generated by a storm, over and above the predicted astronomical tides. (See ID 16 which covers tidal waves.)	a. Never. No record of a hurricane in the region = 1 b. Rare. One or two hurricanes in the last 100 years = 2 c. Medium. One or two hurricanes in the last 20 years = 3 d. Frequent. Multiple hurricanes in the last 20 years that significantly affected the region = 4 e. Very frequently = 5	
18	**Tornado Frequency** In the United States, there are two regions with a disproportionately high frequency of tornadoes. Florida is one and "Tornado Alley" in the south-central U.S. is the other. Florida has numerous tornadoes simply due to the high frequency of almost daily thunderstorms. Tornado Alley is a nickname given to an area in the southern plains of the central U.S. that consistently experiences a high frequency of tornadoes each year. Tornadoes in this region typically happen in late spring and occasionally the early fall. The Gulf Coast area has a separate tornado maximum nicknamed "Dixie Alley" with a relatively high frequency of tornadoes occurring in the late fall (October through December). The region from central Texas, northward to northern Iowa and from central Kansas and Nebraska east to western Ohio is often collectively known as Tornado Alley. Overall, most tornadoes (around 77 percent) in the U.S. are considered weak (EF0 or EF1) and about 95 percent of all U.S. tornadoes are below EF3 intensity. The remaining small percentage of tornadoes are categorized as violent (EF3 and above). Of these violent twisters, only a few (0.1 percent of all tornadoes) achieve EF5 status, with estimated winds over 200 mph and nearly complete destruction. However, given that on average over 1000 tornadoes hit the U.S. each year, that means that 20 can be expected to be violent and possibly one might be incredible (EF5).	a. No record of a tornado in the region = 1 b. Wind speed ≥ 130 mph + 1-6 tornadoes = 2 c. Wind speed ≥ 160 mph + 6-10 tornadoes = 3 d. Wind speed ≥ 200 mph + 11-15 tornadoes = 4 e. Wind speed ≥ 250 mph + ≥12 tornadoes = 5 The ICC-500 Wind Speed Map and the FEMA Tornado Activity Map shown below provides a quick method to understand the tornado exposure of a particular school. Both maps together show the areas that are most susceptible to high winds and the areas that are more prone to tornados.	

School Security Level Exclusive for Schools (SSL)

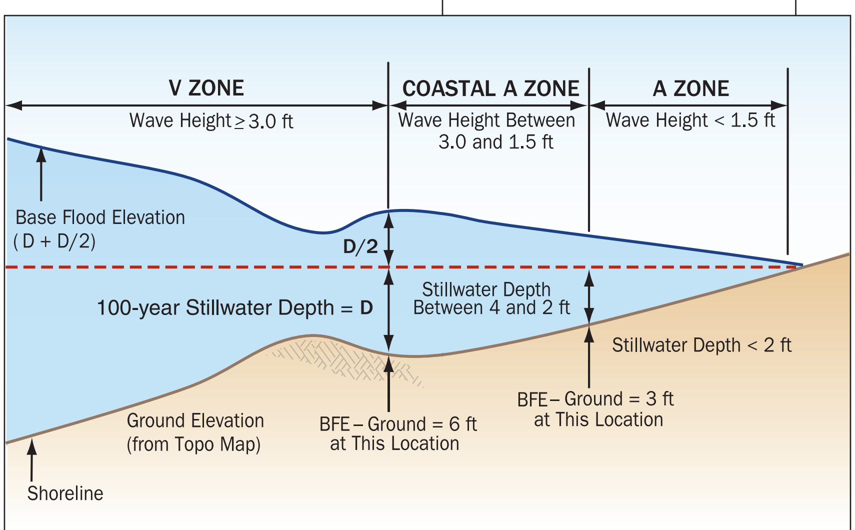
ID	Criteria	Options	SSL
18 (cont.)			



National Climate Data Center Information
Recorded Tornadoes between 1950 and July 31, 2009

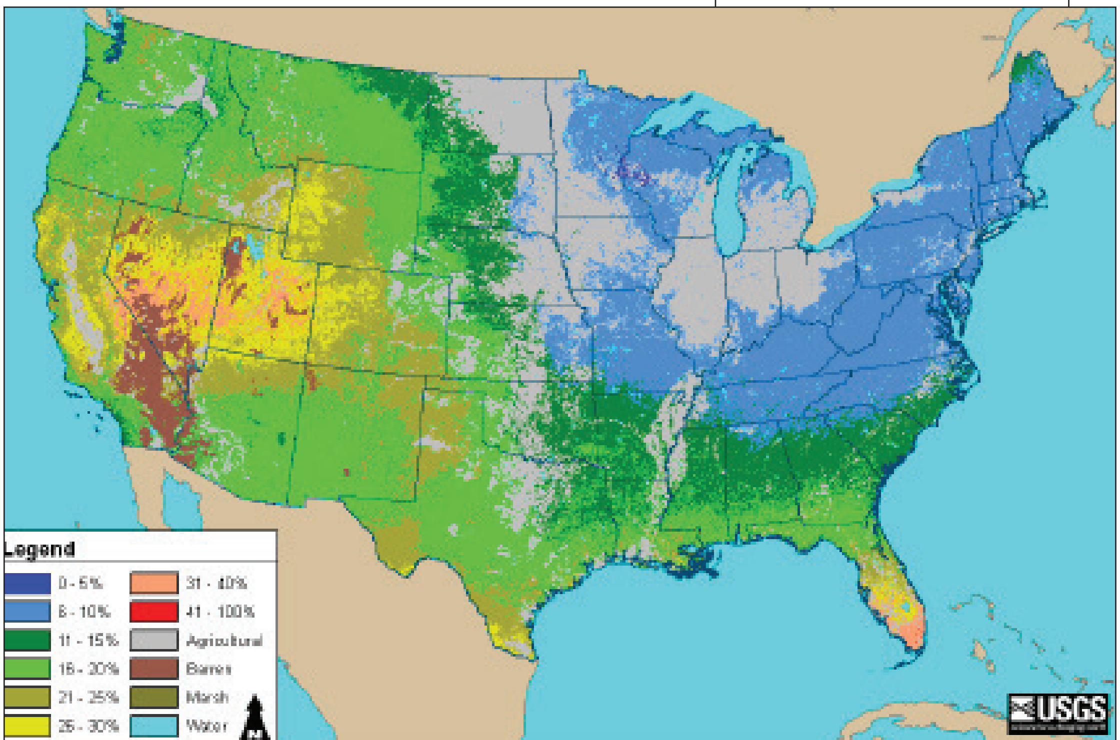
Rank	State	Number of Events
1	Texas	8,049
2	Kansas	3,809
3	Oklahoma	3,443
4	Nebraska	2,595
5	Iowa	2,368
6	Illinois	2,207
7	Missouri	2,119
8	Mississippi	1,972
9	Alabama	1,844

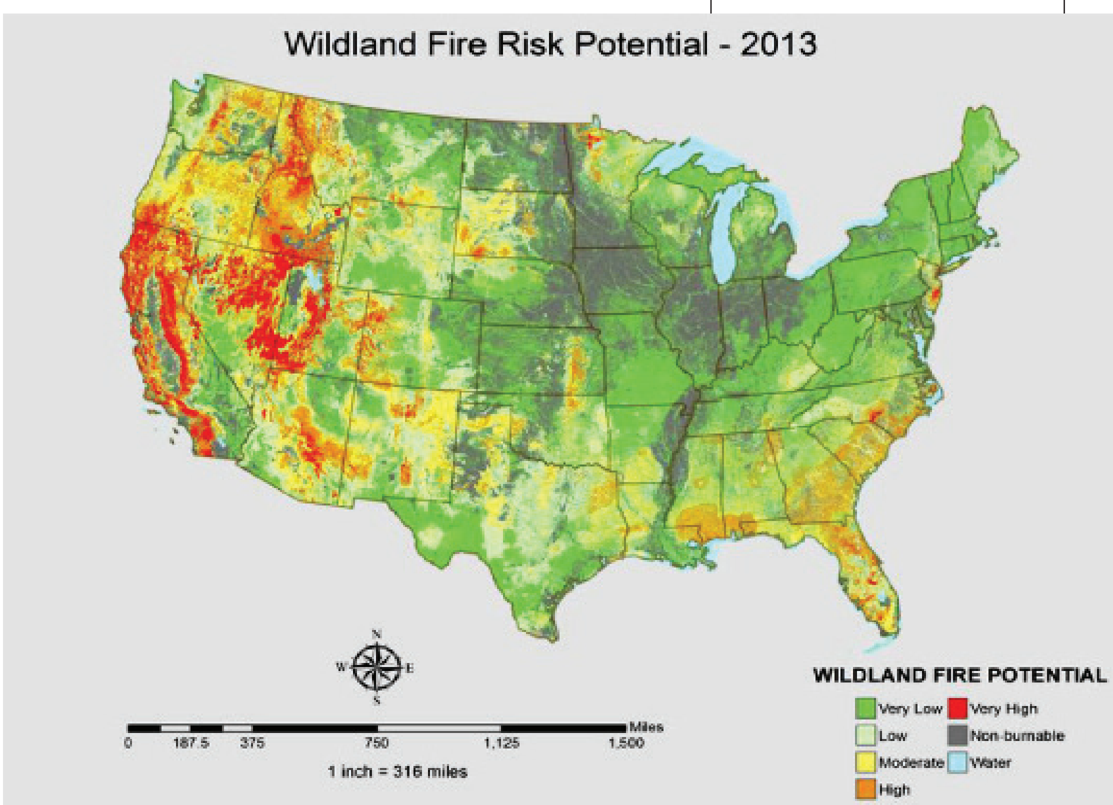
School Security Level Exclusive for Schools (SSL)			
ID	Criteria	Options	SSL
19	**Tidal Waves Exposure** Hydrostatic loads occur when water comes into contact with any elements of the built environment. These hydraulic effects on systems are the result of tidal waves which usually have their origin either in storm surges of tsunamis. Tidal waves are reflected in the FIRM maps as Coastal Zones A and Coastal Zones V. For the purpose of determining the SSL, these two measures will be analyzed and ranked. Coastal Zone A. Zone A occurs where the expected stillwater flood depth is sufficient to support breaking waves 1.5 to 3 feet high. This condition occurs where stillwater depths (vertical distance between the stillwater elevation and the ground) are more than 2 feet deep. One of the factor for such waves to occur is that there are few obstructions between the shoreline and the site. In these areas, the principal sources of flooding are tides, storm surges, seiches, or tsunamis, not riverine flooding. Coastal Zone V: (V1-V30). These areas are found where the Primary Frontal Dunes occurs or wave height or run-up depths are expected to be 3 feet or more. Zones V are relatively narrow areas along open coastlines and some large lake shore that are subject to high-velocity wave action from storms or seismic sources. Zones V can extend from offshore to the inland limit of a primary frontal dune or to an inland limit where the predicted breaking wave height or wave run rump depth drops below 3 feet. Zones V are also known as Coastal High Hazard Areas (CHHA) or special flood hazard areas subject to high velocity wave action NOAA estimates states that as of 2010, "164 million people – a little more than 50 percent of the nation's total population –resided within the coastal watershed counties of the United States and territories." In addition, 58% of 2010 GDP of the US was generated in these coastal regions. While being heavily populated, these regions are also extremely vulnerable to a set of natural disasters not seen by inland regions, namely hurricanes/typhoons and tsunamis. It is estimated that 23% of the world's population lives with 100km of a coastline that is less than 100m below sea level. (Small and Nicholls, 2003) Debris loads and the entire roof-to-foundation load path should be carefully analyzed by structural engineers.	a. Never; No record of tidal waves = 1 b. Zone A = 1, 2 c. Zone V = 3, 4, 5 Designers should determine whether Coastal A Zone conditions are likely to occur at a school site because of the anticipated wave action and loads. This determination is based on an examination of the site and its surroundings, the actual surveyed ground elevations, and the estimated wave heights (calculated using predicted stillwater elevations found in the FIS or derived from elevations shown on the FEMA flood map	



School Security Level Exclusive for Schools (SSL)			
ID	**Criteria**	**Options**	**SSL**
20	**Selected Natural Hazards/Climate Change** Many schools are located in areas that are vulnerable to natural disasters. Their location can affect their functions temporarily or permanently and cause great loss of life. The SSL is directed at identifying the SSL for these hazards. 1. Sea Level Rise 2. Ice Storm 3. Snow Storms 4. Hail	a. Subjected to 1 hazards = 1, b. Subjected to 2 hazards = 2 c. Subjected to 3 hazards = 3 d. Subjected to 4 hazards = 4 e. Subjected to 5 hazards = 5	
21	**Nearby Water Structures (Levees, Embankments, Floodwalls, and Upstream Dams)** Assessors should identify nearby water structures such as: • levees, embankments, floodwalls, and • upstream dams This should be done even if the structures are far from the school 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 schools 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.	a. None or low exposure =1 b. Low-Medium exposure = 2 c. Medium-High exposure = 3 d. High exposure = 4, 5	
22	**Wild Fires** Destruction of schools, homes, and businesses from wildfires affects both existing communities and new ones. In the U.S, the problem is most acute in the western and southern states; however, wildfires fires have also recently destroyed structures in the Mid-Atlantic States and the Pacific Northwest. The maps included below maps included below may help schools to determine their exposure to fire. These maps can be found at: http://www.wfas.net/index.php/large-fire-potential-and-fire-potential-indexes-external-products-107 http://www.firelab.org/fmi/data-products/229-wildland-fire-potential-wfp Schools must learn if they are at risk in terms of wildfires. High risk areas typically have: • A dry season that is more than 3 months • Steep terrain with grades averaging more than 20 percent Forested wild land within 100 feet of the school • Trees that are crowded within 30 feet of the school • Manmade fuels within 30 feet of the school • No fire hydrants • Limited access for fire trucks	a. No exposure = 1 b. Some exposure = 2 c. Exposure = 3 d. Great exposure = 4 e. Severe exposure = 5	

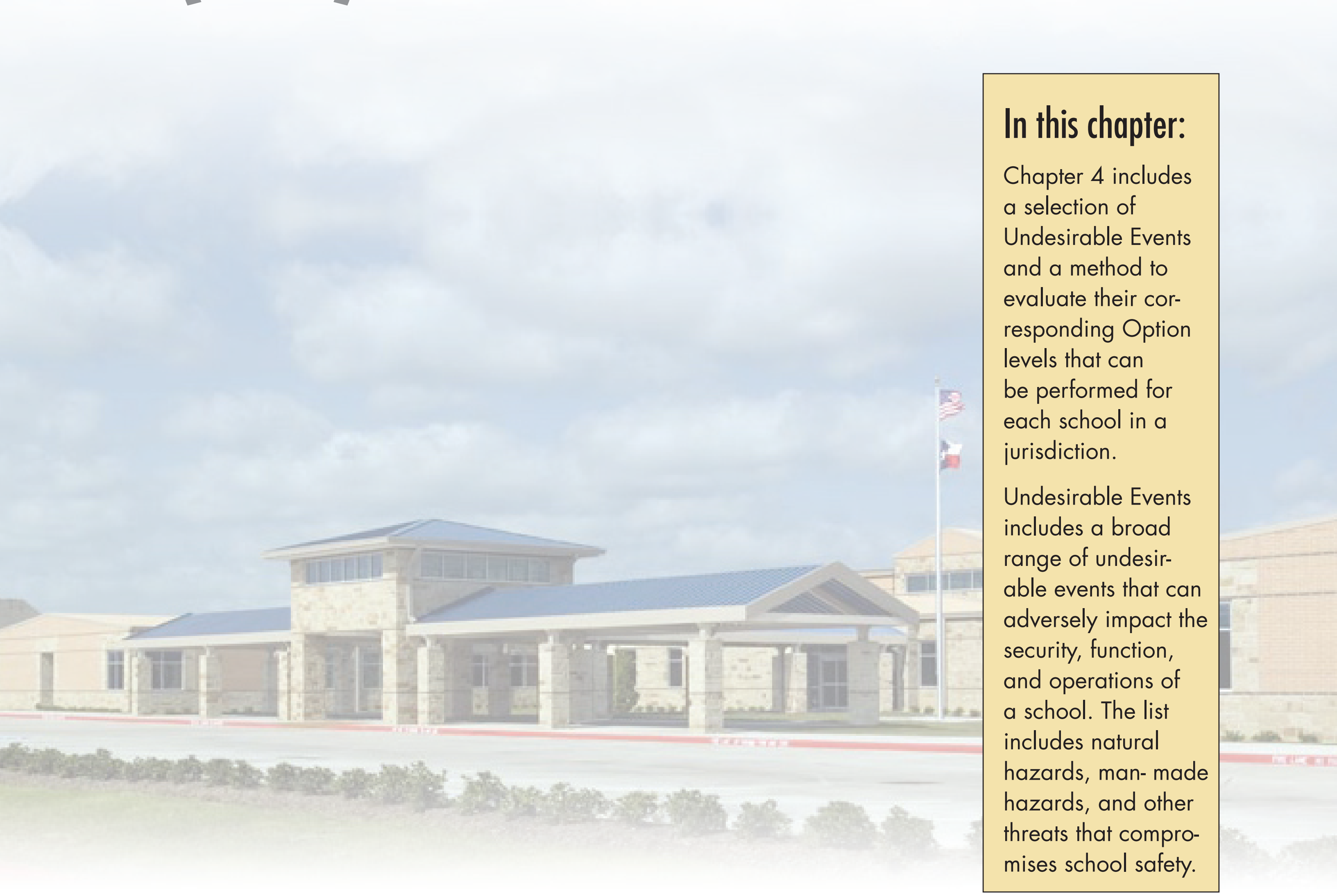
School Security Level Exclusive for Schools (SSL)			
ID	Criteria	Options	SSL
22 (cont.)			





4

Undesireable Events (UE)



In this chapter:

Chapter 4 includes a selection of Undesirable Events and a method to evaluate their corresponding Option levels that can be performed for each school in a jurisdiction.

Undesirable Events includes a broad range of undesirable events that can adversely impact the security, function, and operations of a school. The list includes natural hazards, man- made hazards, and other threats that compromises school safety.

4.1 Background

For this How-To-Guide, a multihazard approach signifies that a selected number of hazards are analyzed to determine their potential likelihood of occurrence; ability to inflict injury, illness, or death to students and teachers; and cause damage or loss of equipment and functions of school services.

For this How-To-Guide, a multihazard approach signifies that a selected number of hazards are analyzed to determine their potential likelihood of occurrence; ability to inflict injury, illness, or death to students and teachers; and cause damage or loss of equipment and functions of school services.

A building system, or the urban or semi-urban environments in which schools can be located, are a complex and closely knit fabric composed of many linkages and interdependencies between activities and services. Given this complexity, the failure of a single component can severely affect the functioning of the whole. On the other hand, due to the interdependencies, an effort to mitigate against a single hazard can be a win-win situation in the global system of the building or social fabric where the school is located. In this sense, the IRVS for School Safety methodology provides a particular consideration of the linkages and interactions that can be exerted upon a school facility in terms of undesirable events, vulnerabilities, and existing and desirable levels of protection. Ignoring these linkages / interactions while performing any type of assessment might lead to erroneous decisions or computations which in turn may lead to costly operations and potential for unintended consequences. This linkages and interaction are considered inside and outside of the school perimeter.

The rationale for undertaking a multihazard approach is simple. Most parts of the U.S. are exposed to multiple hazards, that is, a variety of manmade and natural disasters. The IRVS for School Safety methodology allows for an assessment 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 school characteristics that are evaluated depend on the threats and hazards that are selected for each occasion.

The IRVS for School Safety methodology allows for an assessment based on a single threat or multiple threats, or on a single hazard or multiple hazards.

4.2 Man-Made Hazards

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. 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.

Manmade threats (also known as “human-caused hazards”) refer to potential events caused directly by deliberate or negligent human actions.

Examples of undesirable events in terms of man-made hazards affecting schools are as follows:

- **School Shootings.** Westside Middle School is located several miles west of Jonesboro, Arkansas. Jonesboro is a relatively prosperous city with a population of approximately 55,000. The city is the site of Arkansas State University and is considered a safe haven from big-city crime. The Westside School District consists of an elementary school, middle school and high school that are on one property. In 1998, the district had a total student population of about 1,600 students. The community was small enough that most people knew each other, and many of the teachers had been students in the same district. Two hundred fifty students attended the middle school, half of them in 6th grade and half in 7th grade. On Tuesday, March 24, 1998, two boys, an 11-year-old 6th-grade student and a 13-year-old 7th grade student, did not attend classes. They stole a van and three pistols belonging to one of their parents and then broke into the home of one of their grandparents, where they obtained additional handguns and three rifles. They drove the van, filled with camping gear, food, and the stolen weapons and ammunition to a preplanned parking place about ½ mile northeast of the school. They moved undetected and by foot, heavily armed and wearing camouflage hunting gear, to a site they reportedly scouted the previous day. The site was in a wooded area on the northern edge of the middle school campus. It was about 100 yards from the safe assembly area where the shooters knew students usually gathered during fire drills. One of the shooters walked to the school and pulled the fire alarm and then returned to the position with his weapons, ammunition, and camouflage gear already in place. Eighty seven students and nine staff members filed out the west exit of the middle school. Nothing precluded complete adherence to their well-rehearsed fire drill, and they walked directly into the shooters' planned kill zone. The shooters fired approximately 30 shots from high-powered rifles in less than a minute, probably closer to 15 seconds. Why the shooting stopped is unclear, but a construction employee working on the school's new 5th-grade wing appears to have seen the shooters and yelled at them to stop. They stopped shooting, picked up their weapons and ran away through the woods. They shot 15 people. Four students and one teacher were killed, and nine students and one teacher were injured.

A historical tragic event in term of school shootings, is the Columbine High School tragedy. The Columbine High School building is a large two-story public high school serving approximately 2,000 students. Minutes after 11 a.m. on Tuesday morning, April 20, 1999, two Columbine High School seniors, heavily armed with homemade bombs, and numerous firearms, drove to the school in separate cars and strategically parked their vehicles in parking lots from which they could see two exits from the school cafeteria. They walked into the cafeteria with two bags, each containing a 20-pound propane bomb with timers set to detonate at 11:17 a.m., and left them in the middle of the room, among close to 500 students and staff present at the time. The shooters then walked back to their vehicles and waited, planning to shoot the survivors of the blast when they tried to escape the school. The bombs did not detonate. Realizing that the bombs failed to explode, the shooters dressed in long trench coats that hid their weapons, entered the school together carrying a bag containing more homemade bombs and plenty of ammunition for their weapons: sawed-off shotguns, a 9mm carbine, and a 9mm "Tec 9" handgun. Once inside, they started shooting indiscriminately, and continued in this way throughout the harrowing 46 minutes the attack lasted. They walked along the corridors throwing their handmade bombs and firing their weapons at anyone they encountered. The bombs were made of 6-inch galvanized pipe filled with gunpowder, nails, and BB pellets. The other bombs were comprised of CO^2 containers taped together and filled with gunpowder and BB pellets.

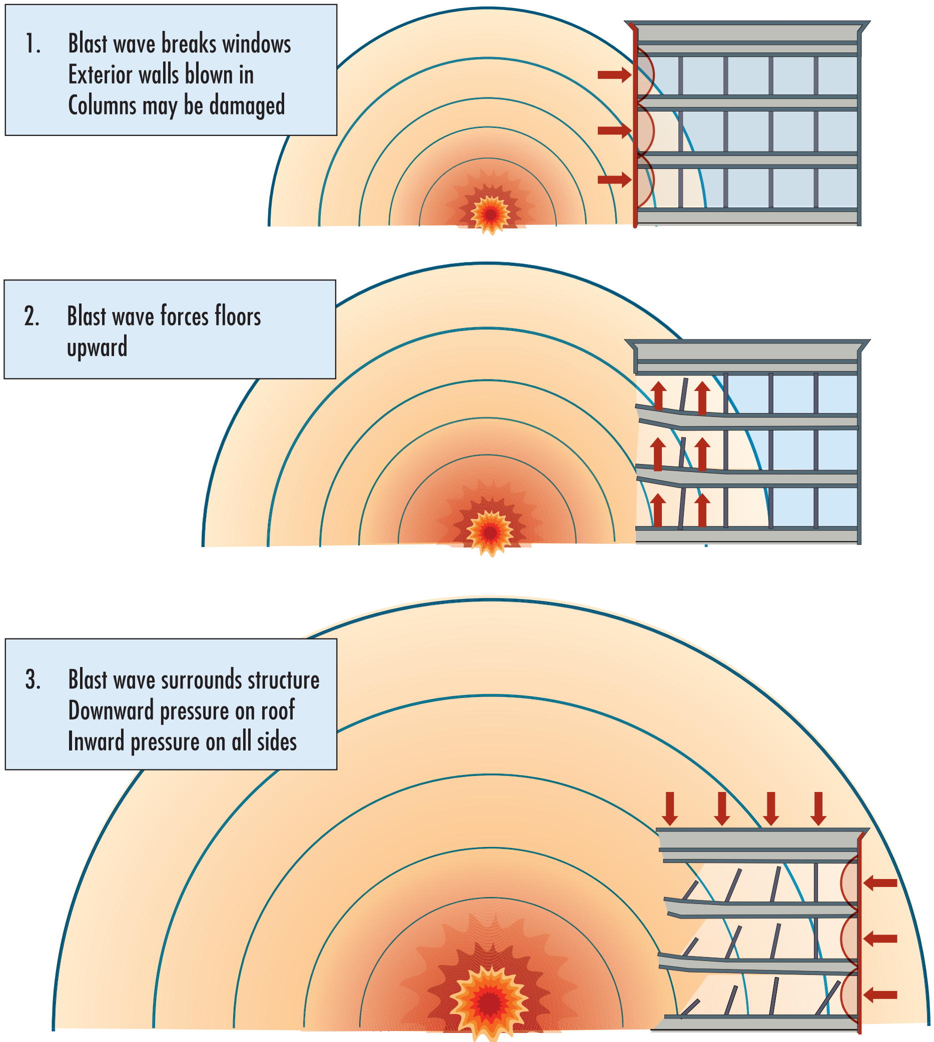
Fortunately, the gunpowder in the bombs was of a "low-order," largely taken from firecrackers. During their initial foray into the school, and during their entire shooting spree, the shooters never entered locked classrooms. They looked into classrooms and observed teachers and students in them, but never attempted to breach the locked doors. The shooting was mainly contained to the hallways, until they entered the library located above the cafeteria, where 56 students, 2 teachers, and 2 library employees were trying to hide under the tables. For the next 7½ minutes, the shooters calmly killed 10 and seriously injured 12 students in the library. They talked with a few students whom they knew and allowed them to leave unharmed. During the library massacre, the shooters reloaded their weapons on at least two occasions and fired out the windows of the library at law enforcement and fire personnel attempting to rescue the students lying wounded outside the school. Back in the cafeteria, the shooters attempted to shoot one of their large propane bombs, but it still did not detonate. Another attempt to detonate the bombs failed but started a fire that triggered the fire alarms and the sprinkler system. The shooters roamed the corridors some more and shot at the police from the library windows before they committed suicide shortly after noon. Officials were not aware of the suicides until 3 hours later when the Strategic Weapons and Tactics (SWAT) team found their bodies and the bodies of their numerous victims in the library. When the incident ended, 15 people were dead: 12 students (2 outside the school and 10 in the library), 1 teacher, and the 2 shooters, and 24 students were injured

On April 16, 2007, an angry and disturbed student shot to death 32 students and faculty at the Virginia Tech campus in Blacksburg, VA. He wounded 17 more and then committed suicide after the first police officers entered the building where he had barricaded himself. The shootings involved two separate incidents, at first thought to be unrelated. This perception allowed the shooter to enter other campus buildings unrestricted where he continued his rampage. He carried two handguns, almost 400 rounds of ammunition (most of which were in rapid loading magazines), a knife, heavy chains, and a hammer. No one reported his behavior as suspicious before the shooting started. He barricaded himself in Norris Hall by putting chains on each of the three main entrances with a note on the inside of one set of chained doors warning that a bomb would go off if anyone tried to remove the chains. Several students noticed the doors chained before the shooting started, but no one called the police or reported it to the university. The chaining successfully delayed response teams from interrupting his plan and also kept his victims from escaping. Prior to starting the shootings, the shooter walked around in the hallway on the second floor poking his head into a few classrooms, some more than once, according to interviews by the police and the Virginia Tech Review Panel. This struck some as odd because it was late in the semester for a student to be lost, but no one raised an alarm. The occupants of the first classroom attacked had little chance to call for help or take cover. After peering into several classrooms, the shooter walked into Room 206, shot and killed the instructor, and continued shooting at random. Of 13 students present in the classroom, 9 were killed and 2 were injured by the shooting, and only 2 survived unharmed. The shooter then went across the hall to Room 207 and shot the instructor and several students near the door, then started down the aisle shooting others. Four students and the instructor ultimately died in this room, and another six were wounded. Students in Room 211 tried to use the instructor's table to barricade the door, but the shooter pushed his way in, shot the professor, and walked down the aisle shooting indiscriminately. A female student was lightly wounded but kept her cell phone line open, spoke quietly as long as she could to the dispatcher. By keeping the line open she helped keep police apprised of the situation. She kept the phone hidden by her head and hair so she could appear dead but not disconnect. The shooter returned to Rooms 207 and 211 for a second time trying to shoot students cowering behind overturned desks. When he tried to enter Room 204, the instructor braced his body against the door and yelled for students to head for the window. Ten of the 16 students present escaped by pushing out the screens and jumping out before the shooter gained access by killing the professor through the door. Two students who were scrambling to leave through the window were also shot. The shooter returned to most of the classrooms more than once and continued shooting. He methodically fired from inside the doorways of the classrooms, and sometimes walked around the classroom. Students had little place to hide other than behind the desks. By taking a few paces inside he could shoot almost anyone in the classroom who was not behind a piece of overturned furniture. Finally, when he realized that the police were closing in on him, he committed suicide by shooting himself in the head. With over 200 rounds left, more than half his ammunition, he almost surely would have continued to kill more of the wounded, and possibly others in the building, had not the police intervened.

- **Terrorism.** This act of terrorism involving schools, which took place September 1, 2004, occurred outside the U.S. Due to its importance it is included in this Guide; it is considered the largest terrorist attack perpetrated against a school. Beslan is a poor largely agricultural and industrial city of about 40,000 people in southwest Russia. The school and campus were surrounded by a fence. The school's staff of approximately 100 supported approximately 1,000 students in grades 1 through 11 (ages 6 to 17). Building No. 1 was originally built in 1889 as a two-story brick structure. September 1 in Russia is the traditional first day of school, families gather together to send off their young relatives, meeting and bringing gifts for the teachers and faculty. At 8:00 a.m. on that day, several thousand people gathered near the school, including terrorists who had infiltrated the crowd. Another group of terrorists had spent the night in a wooded encampment close by. At 8:45 a.m., a troop carrier truck and several smaller vehicles drove into the campus through the west entrance, where the terrorists faced the crowd. One group of terrorists then entered the school to secure it, while the remainder corralled the outdoor crowd toward the school and into the gym. By 9:05 a.m., 1,181 hostages—mostly women and children—were held in the school's gymnasium. The terrorists immediately set out to harden and secure their position. Mobile phones were confiscated from all hostages. To prevent an immediate assault, children were placed in windows as human shields and explosives and booby traps were rigged at all key entry points throughout the building. In the gym, explosives were draped along the walls and basketball backboards, oriented toward the hostages. The terrorists also took immediate measures to demonstrate their authority and will. Some men and boys were ordered to move furniture and equipment to barricade entrances and choke points, and many were later shot after completing their tasks. At least 21 men and boys were executed before the end of the crisis. Windows throughout the school were shattered to increase ventilation and make gas or chemicals less effective. All offers for food and water were denied for fear of poisoning. Among their threats, the terrorists stipulated that 10 hostages would be killed if electricity or communication were cut off. The first contact with officials was made through a video thrown outside by the terrorists at 12:30 p.m. Later in the day, the terrorists made their first demands, the release of 30 Ingush prisoners (related to attacks in June of that year). Conditions in the school were unimaginable, and the treatment of the hostages was extremely harsh and unpredictable. Females were raped—some in front of other hostages in the gym and others in the upstairs auditorium. Hostages were forced to mop blood and dispose of dead bodies. On the second day of siege, the terrorists released some women and small children to the main negotiator, to whom they also presented their new demand: the withdrawal of all Russian troops from Chechnya and recognition of the Republic as an independent state. Efforts at negotiation continued on the third day with talk of permitting terrorists a safe passage to Chechnya. At midday the terrorists agreed to permit four rescue workers to enter the school grounds to collect the dead bodies piled outside the windows. While they worked, two sequential explosions in the gym, the cause of which remains unknown, set off a series of irreversible events. Terrorists on the second floor, confused and cut off from their comrades in the gym, shot two of the rescue workers, while the gym roof caught fire and collapsed, killing or pinning down many hostages. Those still mentally and physically capable fled the gym through the shattered windows and holes created by the explosions. Many hostages were gunned down while crossing the open courtyards. Special Forces reacted to the unexpected event with actions that eventually led to the recapture of the school. Several groups of terrorists attempting to flee were ultimately isolated and killed elsewhere in the town, and one was captured alive by the Special Forces troops. The rest were killed in the action of taking back control of the school. The final toll, which is still disputed, was 31 terrorists, 21 soldiers, and 338 hostages killed. Well over 700 hostages, police, soldiers, and rescue workers were injured.

- **Explosive Blast.** 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. Improvised explosive devices (IEDs) and vehicle-borne improvised explosive devices) have increased since 9/11. An IED attack is conducted with a homemade bomb and/or destructive device to destroy, incapacitate, harass, or distract. Criminals, vandals, terrorists, suicide bombers, and insurgents use IEDs. Because they are improvised, IEDs can come in many forms, ranging from a small pipe bomb to a sophisticated device capable of causing massive damage and loss of life. IEDs and can be carried or delivered in a vehicle (VBIEDs); carried, placed, or thrown by a person; delivered in a package; or concealed on the roadside. Many commonly available materials, such as fertilizer, gunpowder, and hydrogen peroxide, can be used as explosive materials in IEDs. Explosives must contain a fuel and an oxidant, which provides the oxygen needed to sustain the reaction. 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 school building.

A blast or explosive threat is one of the most common types of terrorist attack.



- **Chemical, Biological, and Radiological Threats.** 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.

> There are hundreds of chemical, infectious, and radiological agents that can be used in a terrorist chemical, biological, or radiological (CBR) attack.

Information on the effects of blast and CBR attacks on school buildings and occupants is readily available because government agencies and many private organizations have long studied the effects of toxic and other noxious substances, as well as explosives, on people and buildings. For example, it is known that a quantity of explosive material detonated at a certain distance will produce air pressures sufficient to kill people and cause damage to structures. Similarly, information on the effects of exposure to various toxic substances or radiation is also available and can be used in estimating the potential consequences of an attack with a particular type of weapon.

- **Fire Threats.** 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.

4.3 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. Among the main natural hazards are:

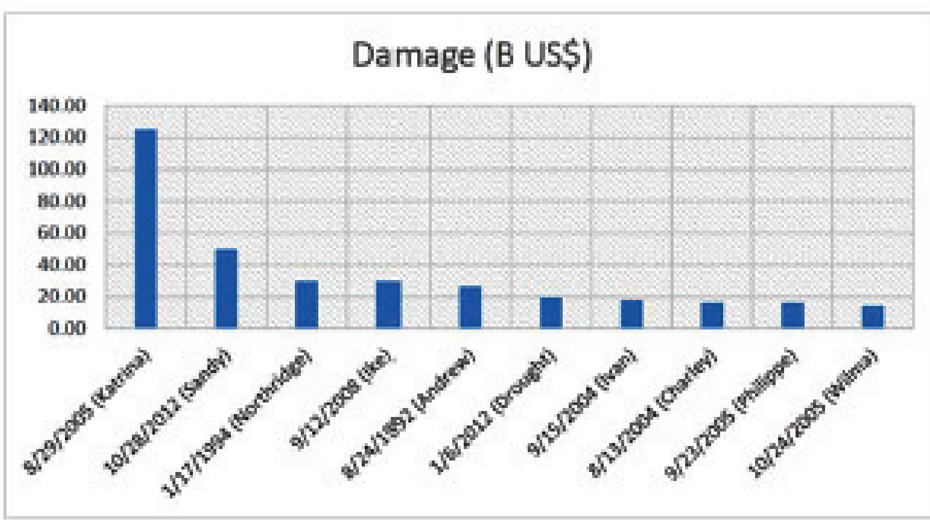


Figure 1 - Damages from Recent Natural Disaster in the US. Names of natural hazard follow the year of occurrence. Souce EM-DAT (2014). The name of the natural hazard is shown between quotes.

- **Earthquakes.** 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 can also be caused by volcanic activity, landslides, mine blasts, and nuclear experiments.

  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)

High School heavily damaged by the 1933 earthquake

Collapse of Jefferson High School during 1933 Long Beach Earthquake

In the early evening hours on March 10, 1933, the Newport-Inglewood fault ruptured giving pass to an earthquake. The Magnitude 6.4 earthquake caused extensive damage (approximately $50 million in 1933 dollars) throughout the City of Long Beach. More than 230 school buildings were either destroyed (70 completely destroyed), suffered major damage, or were judged unsafe to occupy. The earthquake caused 120 fatalities. A month after the Long Beach earthquake in 1933, the State Legislature enacted the Field Act which set guidelines for the design and construction of public school buildings. The

Field Act authorizes the Division of the State Architect (DSA) to review and approve all public school plans and specifications and to furnish general supervision of the construction work. The California Geological Survey assists the DSA by reviewing geologic hazards affecting schools subject to the Field Act. Since the enforcement of the Field Act, no school has collapsed because of a seismic event, and there has been no loss of life.

- **Hurricanes. 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 school facilities, 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

The primary wind storm types are straight-line winds, down-slope winds, thunderstorms, downbursts, Nor'easters, hurricanes, and tornadoes.

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 flooding. Economic losses are estimated to be in excess of $150 billion and insured losses of $40 billion. The New Orleans school district had 60,000 students before Hurricane Katrina hit. Katrina severely destroyed 47 of the 128 New Orleans public schools and 38 more schools had moderate damage. The children who survived the storm were displaced to other states for the rest of the school year. It is estimated that close to 400,000 students from Katrina-ravaged areas had to move in order to attend school. Congress has given final approval to a measure that provides $235 million to schools educating students displaced by Hurricanes Katrina and Rita and extends the deadline for schools to decide how to spend the money.

Hurricane Sandy also known as "Superstorm Sandy" was the deadliest and most destructive hurricane of the 2012 Atlantic hurricane season, as well as the second-costliest hurricane in United States history. Sandy was a Category 2 storm off the coast of the northeastern United States. The storm became the largest Atlantic hurricane on record (as measured by diameter, with winds spanning 1,100 miles (1,800 km)). Estimates as of March 2014 assess damage to have been over $68 billion (2013 USD), a total surpassed only by Hurricane Katrina. At least 286 people were killed along the path of the storm in seven countries. A number of schools were severely damaged during this storm. Storm damage forced the closure of 102 schools for more than a week after Sandy hit, displacing nearly 75,000 kids. In New Jersey, 135 schools were damaged at a cost of $37.1 billion statewide, including $13.6 billion in direct physical and economic damage, plus $23.5 billion in remediation costs. New York was also severely affected by Hurricane Sandy. In New York City, 57 schools serving 34,000 of the city's approximately 1 million students were located in buildings so damaged that students had to be reassigned elsewhere temporarily. The ripple effects from Hurricane Sandy were felt far and wide by the schools of Staten Island as well as in parts of Brooklyn, Queens and Manhattan. Dozens of school buildings were flooded or damaged, and tens of thousands of students were displaced.

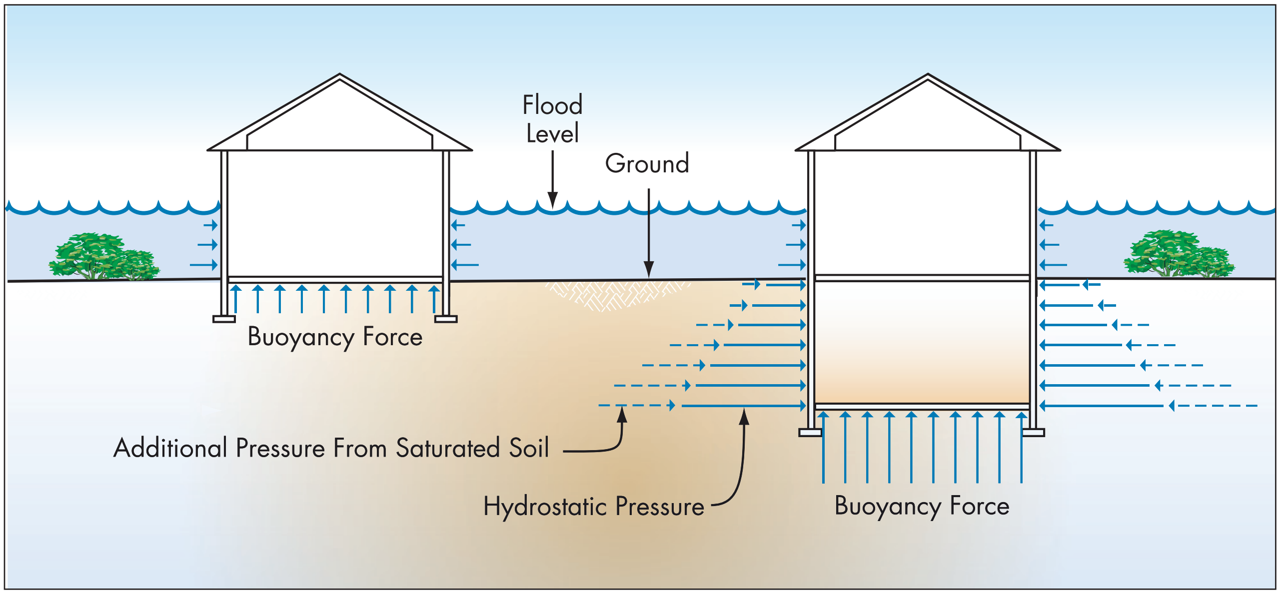
- **Tornadoes.** Tornadoes are the most devastating hazard for schools nationwide. In regions where they occur, they can happen at any hour of the day and any time of the year, though they are most common in the spring, especially during May and June. About 1,200 tornadoes strike the United States each year, killing an average of 60 people, reports NOAA. The most notoriously affected region in the United States, called "Tornado Alley," includes the Great Plains states of Oklahoma, Kansas, Nebraska, and the Dakotas, as well as parts of Texas. Moist air from the Gulf of Mexico tends to collide there with dry air from the Southwest, making especially powerful tornadoes. More tornadoes with deaths in schools have occurred in the Southeastern United States than any other region (23 events or over half the national total). Four of the top ten death toll events occurred in the Southeast. Relatively few school fatality tornado events have occurred in the area with the highest frequency of strong tornadoes, the Great Plains (Tornado Alley); only a single event occurred after warnings began being issued. This is likely due primarily to three reasons: the low population density, greater tornado awareness (and better visibility affording more warning), and the time of year and of day that most tornadoes strike the Great Plains. The state with the most tornado deaths throughout history is Illinois, with 90. The largest school death toll from a tornado was 69 during the Tri-State Tornado, which also struck Illinois and significantly raised that state's death toll. The greatest death toll at a single school also occurred during the Tri-State tornado, when it killed 33 at a school in De Soto, also in Illinois. The state with the highest number of tornadoes with deaths at schools is Alabama at 8 events. Illinois is second with 6 tornadoes. Missouri and Oklahoma are tied for third with 5 tornadoes. Fifth is Georgia with 3 tornadoes. Sixth are Texas, Tennessee, Indiana, Nebraska, Mississippi, and Arkansas, each with 2 events. One school fatality tornado event has occurred in Ohio, Louisiana, Iowa, Colorado, Kansas, South Carolina, Maryland, Virginia, North Carolina, Minnesota, and Florida (the probable downburst in New York is not included).

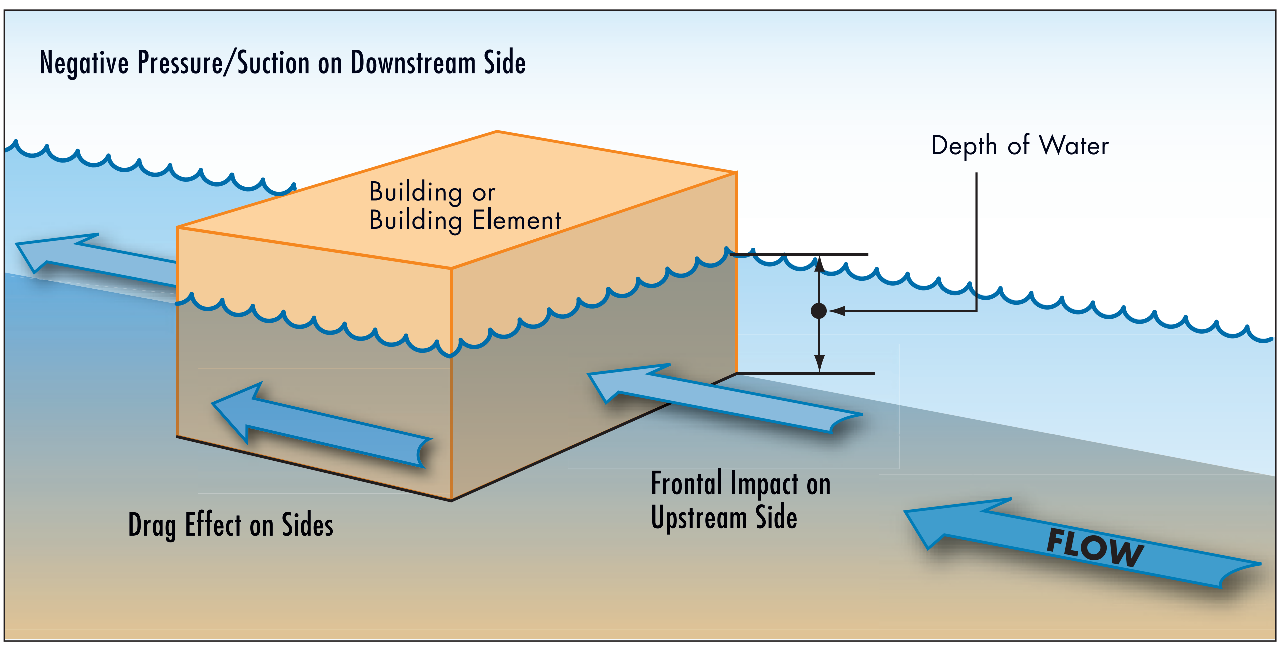
- **Flooding.** Flooding is the most common natural hazard in the United States, affecting more than 20,000 local jurisdictions and representing more than 70 percent of Presidential disaster declarations. Evaluations have estimated that 7 to 10 percent of the Nation’s land area is subject to flooding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

Flooding is 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

Flooding is the most common natural hazard in the United States.

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.





4.4 Assessing Undesirable Events

Undesirable events will be established following the ISC methodology and calculations will be made using the *IRVS for Schools* software. Calculations will be made to achieve the necessary level of protection for the school facilities against undesirable events. The *IRVS for Schools* Catalog contains a description and explanation of the undesirable events and options to evaluate the school facility during the screening process. The purpose of the catalog is to help screeners, including those without a technical background, complete the data collection for evaluating the criteria accurately. The content of the catalog is drawn from relevant sections of the three core ISC documents:

- *Design Basis-Threat (U)*, 2012.
- *Facility Security Level Determinations for Federal Facilities*, 2008
- *Physical Security Criteria for Federal Facilities*, 2010

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 an integral part of the *IRVS for Schools* software. It is accessed directly through the Help system built into the software or can be opened from a dropdown menu of resources. Chapter 7 of this How-To Guide provides a full description on how to use the catalog and the *IRVS for Schools* software.

A baseline rating for each undesirable event of very low, low, moderate, high, and very high must be established for the school. Baseline ratings should be set by the appropriate authority having jurisdiction over the school safety/security evaluation process. When more specific results are obtained for a particular facility, the screener can adjust the baseline threat rating for any undesirable event where appropriate; however, modifications must be supported with a comment/justification in the IRVS Database. A “Summary of Comments” screen will appear after making deviations to the base line threat level rating for one or more undesirable events. Screeners can enter additional comments, modify previously entered comments, or revert all values to default using this screen.

<table>
<tr><th colspan="3">Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events</th></tr>
<tr><th>ID</th><th>Event</th><th>Options</th></tr>
<tr><td>23</td><td> Arson (Internal Fire)
Arson is fire caused by an aggressor accessing a school and deliberately setting fire to the facility or to assets within the school. Internal attacks can be perpetrated by using incendiary devises or substances.
Generally, arson is caused by persons carrying a grudge against a teacher or staff, malicious students , students wanting to draw attention to themselves, people involved in rowdy groups, or frustrated individuals enraged with school or society. In addition, the school building and premises can be collateral damage of a fire occurring in surrounding areas.
According to Alliant Insurance Services, property damage caused by arson costs school districts approximately $600 million annually. Below are some interesting facts about arson and arsonists:
55% of arson events occur on weekdays between the hours of 8 am and 5 pm and only 22% occur on weekends.
Arson events usually occur during the school day to create commotion and are predominantly started by students.
According to the Woodlands Association, 25% of arson acts are done by children between the ages of 10-14 and 50% are under the age of 18, with 9 out of 10 being male and 3 out of 4 being Caucasian.
Schools can potentially reduce fire damage by installing compartmentalization (fire stops in the roof ceiling voids), adding additional fire walls and doors during renovation, installing automatic fire sprinklers and installing a fire detection system (and having it tested regularly). A security system can be another valuable tool for fire protection and to reduce potential vandalism from occurring. Have a zero tolerance policy for prosecuting vandals. Use the civil court to go after the parents if the arsonist is a child, and check with local law enforcement for any reports on arsonists living in the area. </td>
<td> a. Very Low = 1
b. Low = 2
c. Moderate = 3
d. High = 4
e. Very High = 5
Some preventive measures Include:

Identify vulnerable areas
Design the building so there are no hidden areas and provide additional lighting in dark areas
Place a fence around the campus perimeter
Have local law enforcement increase patrols
Contact the local fire department and have them survey the school site
Arrange a neighborhood watch program with local residents
Train staff to watch for potential arson exposures
Reduce potential fire exposures by placing recycle/ trash bins at least 20 feet away from the school building and by keeping them locked
Keep storage areas locked especially areas or classrooms containing flammable liquids and gases
Provide surveillance of school grounds, and eliminate piles of brush, paper, leaves and other combustibles on and around the property.
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<tr><th colspan="3">Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events</th></tr>
<tr><th>ID</th><th>Event</th><th>Options</th></tr>
<tr>
<td>24</td>
<td>School Violence

Violence is the intentional use of physical force or power against another person, group, or community, with the behavior likely to cause physical or psychological harm.

School violence is youth violence that occurs on school property on the way to or from school or school-sponsored events, or during a school-sponsored event. This type of violence does not assume necessary firearm use. Attacks can be perpetrated using:

• Firearms
• Knives
• Hammers
• Any other object that can be used as a weapon.

In 2003-2004 the number of firearm incidents and explosive possessions was 7,478 in 4,875 schools. The number of incidents involving a knife or sharp object was 30,193.

In general, school violence refers to any unwanted physical contact between one or more students and the victim. The attacks can also be perpetrated by intruders. This threat encompasses:

• Bullying
• Gang violence
• Sexual violence
• Food poisoning
• Violence perpetrated on teachers and staff members

Bullying and gang violence can also take place in the school ground's surroundings.

School violence may be related to the location of the school. Schools in high crime areas are more likely to face threats of assault and similar violent crimes. Locations with remote parking lots, close proximity to high crime or neglected neighborhoods, areas frequented by transients, etc., present a higher threat environment.

School facilities should avoid concealment places where bullying can be perpetrated within the school facilities. It is important to identify if school bullying involving students of the school occurs on the premises as well as at some distance from the school .</td>
<td>a. Very Low = 1
b. Low = 2
c. Moderate = 3
d. High = 4
e. Very High = 5

Bullying, if left unaddressed, can have devastating effects on the school's entire community. To help respond to bullying behavior it is necessary to create a safe learning climate that allows all students to thrive. Bullying can take place in the form of students who are being bullied, students who bully others and students who are bystanders to bullying. Although infrequent, bullying can be perpetrated by teachers and the school system itself.

Bullying is characterized by persistent and pervasive harassment and mistreatment. Examples of physical bullying include: punching, pushing, shoving, kicking, inappropriate touching, tickling, headlocks, school pranks, teasing, spreading false rumors, fighting and use of available objects as weapons. Bullying can also be emotional (psychological abuse), verbal abuse, cyber, sexual and homophobic.

Schools should have enforceable plans in place to prevent bullying.</td>
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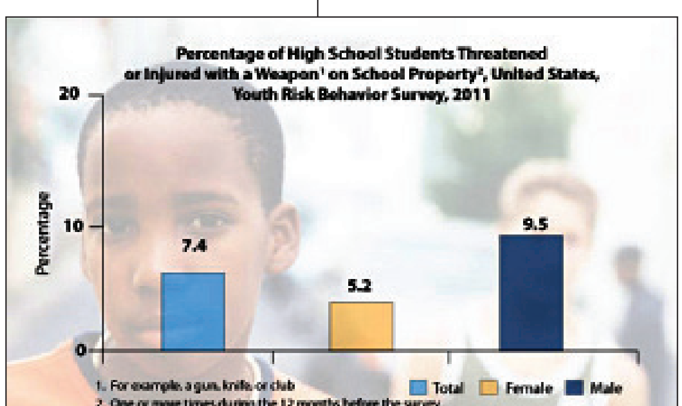
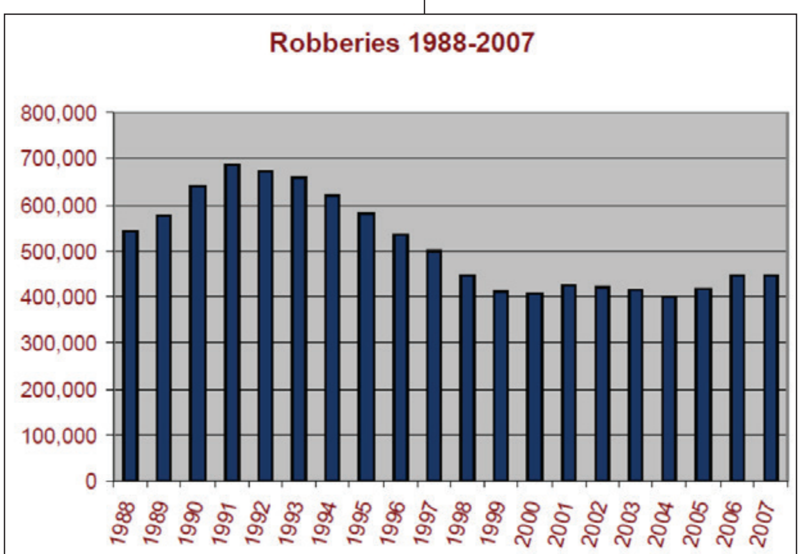
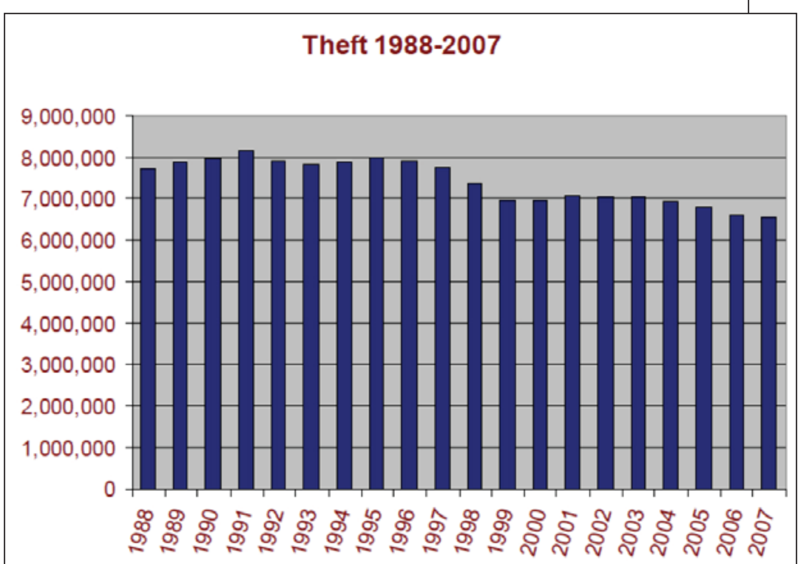


Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	Event	Options
25	**School Shootings** School shooting incidents are characterized by an active shooter(s) engaged in killing or attempting to kill students or teachers in a school or on school grounds, typically through the use of firearms. These incidents can be perpetrated by: • A single shooter • A team of shooters • A sniper • A team of snipers The shooter or shooters can be located in an elevated position or ground position and can involve hostage taking. School shootings can involve the use of explosives. The most common weapons used in shootings are rifles and handguns.	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5
26	**Kidnapping or Abduction** The abduction of an occupant or visitor from a school facility, including inside secured or outside on the site (e.g. a controlled parking lot). Kidnapping or abduction can be perpetrated both by strangers and family members	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5
27	**Civil Disturbance** Deliberate and planned acts of violence and destruction stemming from organized demonstrations on school grounds or near a Federal property or a highly symbolic building. Schools and specific Federal facilities can be the scenes of protests related to academic, social, environmental, and political causes. This type of event can include student walkouts, protests at or near schools and intentional traffic disruption.	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5
28	**High Velocity Vehicles in the Vicinity** Many times schools are located close to a high way or high speed roads. This poses a threat in spite of the many signs posted in the vicinity of a school for reduced speed. Schools in this situation need to take real concerted precautions to restrict students from exiting the school without appropriate oversight.	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5

Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	**Event**	**Options**
29	**Vehicle Ramming** Driving a vehicle in an attempt to penetrate a school (e.g., lobby or loading dock) or breach a defined perimeter. Using a vehicle to deliberately ram a school facility is an infrequent event. However, when a ramming does occur, it typically involves a single individual attempting to obtain justice for a self-perceived cause. Conversely, the attack may be aimed at a specific students or teachers within a school. School facilities with limited acceleration areas or serpentine approaches reduce the potential approach speed of a ramming vehicle and likely face a lower threat of this type of event.	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5
30	**Robbery and Unauthorized Entry- Forced** Robbery occurs when an outsider or a student takes school-owned property or personal property belonging to faculty or students by force or threat of force. These events can take place inside school property or school grounds and can be accompanied by forced entry without permission. Robbery and Unauthorized Entry-Forced are most often related to general theft of assets, such as computers or other valuable office equipment. Crime rates vary significantly from location to location, and should be considered when characterizing this threat at a specific facility. Random robberies may be related to the location of the school. Schools in high-crime areas are more likely to face threats of robbery and similar violent crime perpetrated against employees and visitors, generally as they approach or depart the facility. Approximately 70 percent of robberies take place on the street, at residences, banks, convenience stores, and gas stations. Only 30 percent take place at other locations, including commercial businesses and schools. Locations with remote parking lots, proximity to high crime or neglected neighborhoods, areas frequented by transients, etc., present a higher threat environment.	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5



Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	Event	Options
31	**Theft** Unauthorized removal of school-owned or personal property from a school facility. Crime rates vary significantly from school to school and should be considered when characterizing this threat at a specific school facility. Random criminal actions, particularly thefts from vehicles or pick-pocketing and purse-snatching may be related to the location of the school facility. Theft can occur inside or outside of a school facility. It can also occur when students try to gain access to upcoming exam tests and grading systems School facilities in high-crime areas are more likely to face threats of this nature perpetrated against employees and visitors, generally as they approach or depart the facility. Often the perpetrator is an individual or a student who is able to gain access to the property through casual means. Internal thefts, perpetrated by persons with authorized access (including authorized visitors) are also often crimes of opportunity. Of particular risk are unsecured office spaces, especially systems furniture (cubicle) environments where security of the space cannot be achieved. Locations with remote parking lots, proximity to high crime or neglected neighborhoods, areas frequented by transients, etc., present a higher threat environment for theft from vehicles.	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5



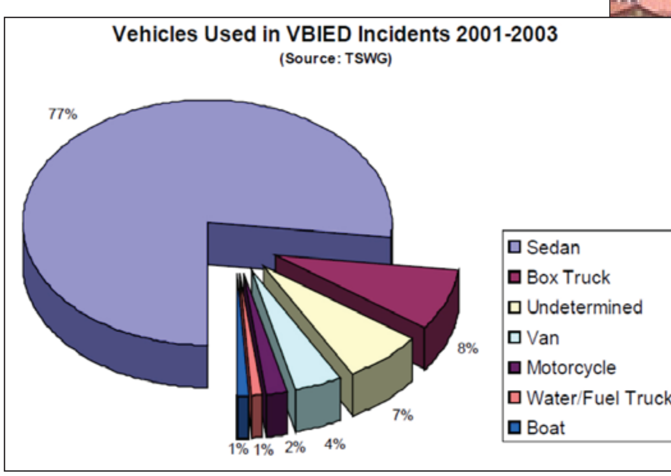
Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	**Event**	**Options**
32	**Vandalism** This entails the destruction, damage, or defacing of school-owned or personal property or assets. Crime rates vary significantly from location to location, and should be considered when characterizing this threat at a specific facility. Random acts of vandalism may be related to the location of the school. Schools in high-crime areas are more likely to be subject to random damage or destruction of property, generally along public paths of travel around the facility. Additionally, facilities in areas where gang activity is high may be subject to "tagging" by gang members. Vandalism can be associated with social, political, environmental, and economic issues. Vandalism is a frequent tactic used by special interest extremist groups to express beliefs about the nature of operations at a particular school. Vandalism of garbage cans, seating, tables or other amenities have frequently occurred in many schools. These elements should be designed for easy maintenance and be vandalism resistant. Within reason, these features should also be designed to be attractive. Areas that can be abused by skateboarders should be considered.	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5
33	**School Drug Abuse at School Premises or Areas of Close Proximity to the School** Drug abuse continues to be an important public health problem. The Monitoring the Future (MTF) organization measures use of illicit drugs and related attitudes among 8th, 10th, and 12th graders. Findings reveal that Illicit drug use among teenagers has continued at high rates, largely due to the popularity of marijuana. Marijuana use by adolescents declined from the late 1990s until the mid-to-late 2000s, but has been on the increase since then. In 2012, 6.5 percent of 8th graders, 17.0 percent of 10th graders, and 22.9 percent of 12th graders used marijuana in the past month—an increase among 10th and 12th graders of 14.2 percent, and 18.8 percent from 2007. Daily use has also increased - 6.5 percent of 12th graders now use marijuana every day, compared to 5.1 percent in the 2007. Some of the signs of drug/alcohol abuse are: aggressive classroom behavior, sudden shifts in or secretiveness about activities, lack of interest in school and recreation, academic failure, poor social coping skills, avoiding communication with teachers, belligerence or defensiveness and sleepiness in the classroom. The most promising prevention approaches target students during the beginning of adolescence and teach drug resistance skills and norm setting, either alone, or in combination with general personal and social skills. School programs that are age-specific, developmentally appropriate and culturally sensitive should be repeated throughout the grades and re-enforced by youth, parent and community prevention efforts. School settings are particularly well suited for both the implementation and testing of drug abuse prevention programs because they offer reasonably efficient access to large numbers of youth during the years that many begin to experiment with tobacco, alcohol, marijuana and other drugs.	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5 

Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	**Event**	**Options**
34	**Disruption of Schools & Security Systems** This entails physically accessing a school building or its security system for the purpose of disrupting or manipulation of the system. The unpredictable nature of the motivations of a student or a lone wolf adversary makes it difficult to determine what specific factors will make a particular school an attractive target. Schools should coordinate with local authorities and prepare plans cataloging points of critical infrastructure such as utility and energy facilities, bridges, dams, and national monuments and icons. These plans will help to safely evacuate students in case of an emergency.	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5
35	**Utility Failure** This is related to any complete or partial failure of utilities. Continuous or frequent losses of the following utilities may present a threat to student health. These failures can be caused by natural or man-made disaster events. If the school functions as a shelter in case of disasters, this should be rated very highly. The systems most exposed to failure include: • Power failure • Loss of water pressure • Water contamination • Sewerage failures and wastewater overflows • Gas (natural or liquefied petroleum) leaks or loss of pressure • Communication technology (including land telephone, VOIP, cell phone service, wide area network and concurrent critical control systems • HVAC failure • Fire sprinklers and fire detection failure • Plumbing system failure	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5

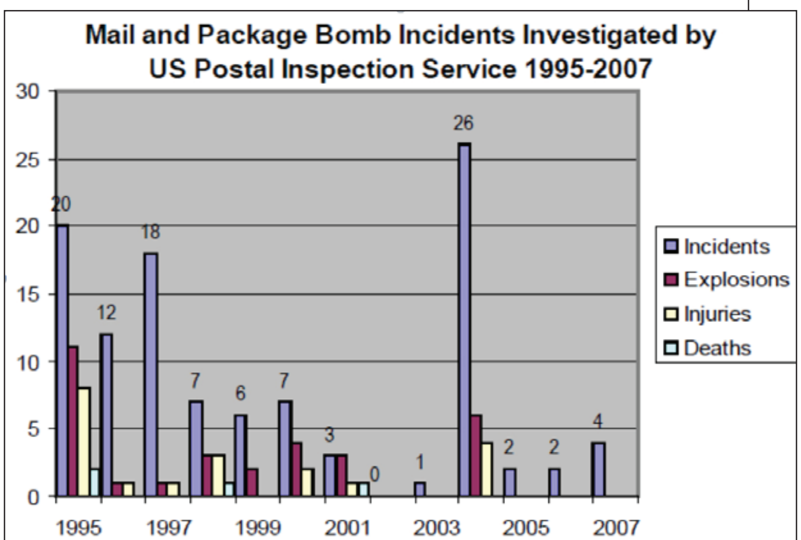
Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	**Event**	**Options**
36	**Explosive Device – Man-Portable (External and Internal)** This entails an explosive device carried into the building by a student or an intruder and left to detonate after the intruder departs or that is set to detonate with the carrier (suicide bomber). On April 20, 1999 two Columbine High School seniors, heavily armed and with homemade bombs walked into the cafeteria with two bags, each containing a 20-pound propane bomb with timers set to detonate at 11:17 a.m., and left them in the middle of the room among close to 500 students and staff present at the time. The bombs were not discovered but fortunately they did not detonate. During the ensuing attack of the school, the shooters indiscriminately walked the corridors throwing handmade bombs and firing their weapons. An explosive device can be carried into the facility by an adversary with the intent of reaching a specific target or area. Explosives can also be left outside the building to impact students in vulnerable areas. According to ATF statistics from 2004 to 2007, California consistently had the highest number of bombing incidents, three to four times higher than states with the next most frequent incidents. In a terrorist document on suicide bombing recovered in 2005, a suicide bomber planning an attack in the United States may choose a target that is easily accessible, allowing the individual to enter quickly and self-detonate before security and potential victims can react.	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5

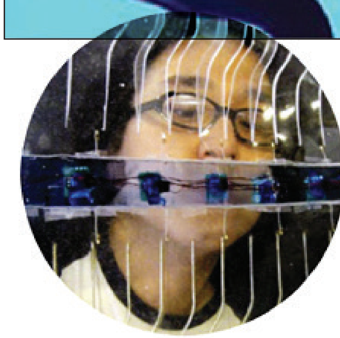
<table>
<tr><th colspan="3">Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events</th></tr>
<tr><th>ID</th><th>Event</th><th>Options</th></tr>
<tr><td>37</td><td> Explosive Device – External
The use of explosives against schools perpetrated by terrorist is a rare event. Although this event is of small probability is has very high potential consequences.
An Explosive Device External imposes four types of threats:

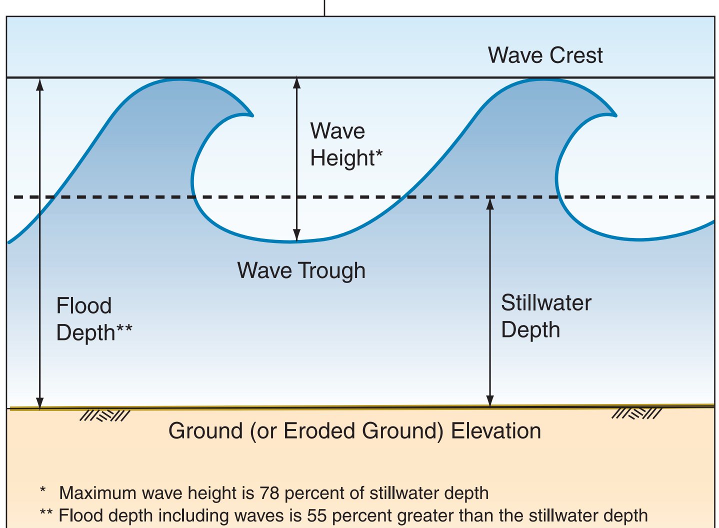
An explosive device placed outside of a school property or within school premises and left to detonate after the adversary departs.
An attack against the school utilizing a vehicle to deliver an improvised explosive device.
An explosive attack to a facility in the surrounding areas
An unintentional explosion in the school or in surrounding areas

The unpredictable nature of the motivations of a student or a lone wolf adversary makes it difficult to determine what specific factors will make a school, or federal or iconic buildings in the adjacent area, a target for this type of attacks.
When tied to a Vehicle Borne Improvised Explosive Device (VBIED) attack, well-defended prestige targets (very high profile and symbolic facilities) with substantial standoff have a higher threat of this event.
According to ATF statistics from 2004 to 2007, California consistently had the highest number of bombing incidents, three to four times higher than states with the next most frequent incidents.

</td>
<td> a. Very Low = 1
b. Low = 2
c. Moderate = 3
d. High = 4
e. Very High = 5
One well known terrorist attack on schools occurred in Beslan, a largely agricultural and industrial city of about 40,000 in North Ossetia-Albania. The attack occurred on September 2004 on School No.1 during a 3-day siege. One group of terrorists then entered the school to secure it, while the remainder corralled the outdoor crowd toward the school and into the gym. By 9:05 a.m., 1,181 hostages—mostly women and children—were held in the school's gymnasium. The attack left over 300 dead and over 700 injured. Most of the victims were children. This attack involved shootings and the use of explosives.
</td></tr>
</table>

Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	**Event**	**Options**
38	**Explosive Device – Mailed or Delivered** An explosive device sent to the facility through US Mail or a commercial delivery service, including an unknowing courier. A study of bomb-related offenders by the FBI identified nine primary motives of adversaries. The two motives most applicable to sending a letter or package bomb are ideology (against a specific activity or function of a particular facility) and revenge against society or individuals. School with controversial policies may face a higher threat of this event. Mail-handling facilities and employees, while not necessarily the target of a package bomb, may be unintentional victims due to premature detonation since they are intended to intercept such a device. As such, the threat to the facility is considerably higher.	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5
39	**CBR Release – Internal** This entails three type of events: The intentional release of CBR agent carried into the facility, including general interior space (lobbies) or into specific rooms or systems (HVAC rooms) Unauthorized access to hazardous materials stored onsite with the intent to release/disburse such materials to harm personnel or damage the school. Accidental releases Some schools may have labs that use hazardous materials for experiments. Intentional or unintentional releases can occur.	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5
40	**CBR Release – External** This entails the intentional or unintentional releases of a CBR agent into a school facility. When CBR releases are intentional, the release can take advantage of exposed access points, such as; air intakes, windows, or doorways, from outside the facility. Unintentional events can take place when releases occur close to a school, making such a school collateral damage. Schools close to facilities which house high-profile officials or closely tied to controversial environmental or personal freedom issues may face a higher threat of this event. An alternative to carrying hazardous materials to a site for an attack that may be considered by adversaries is to attack other facilities in close proximity to a facility. Thus, schools in close proximity to hazardous storage or transportation sites face this additional variation on this threat.	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5

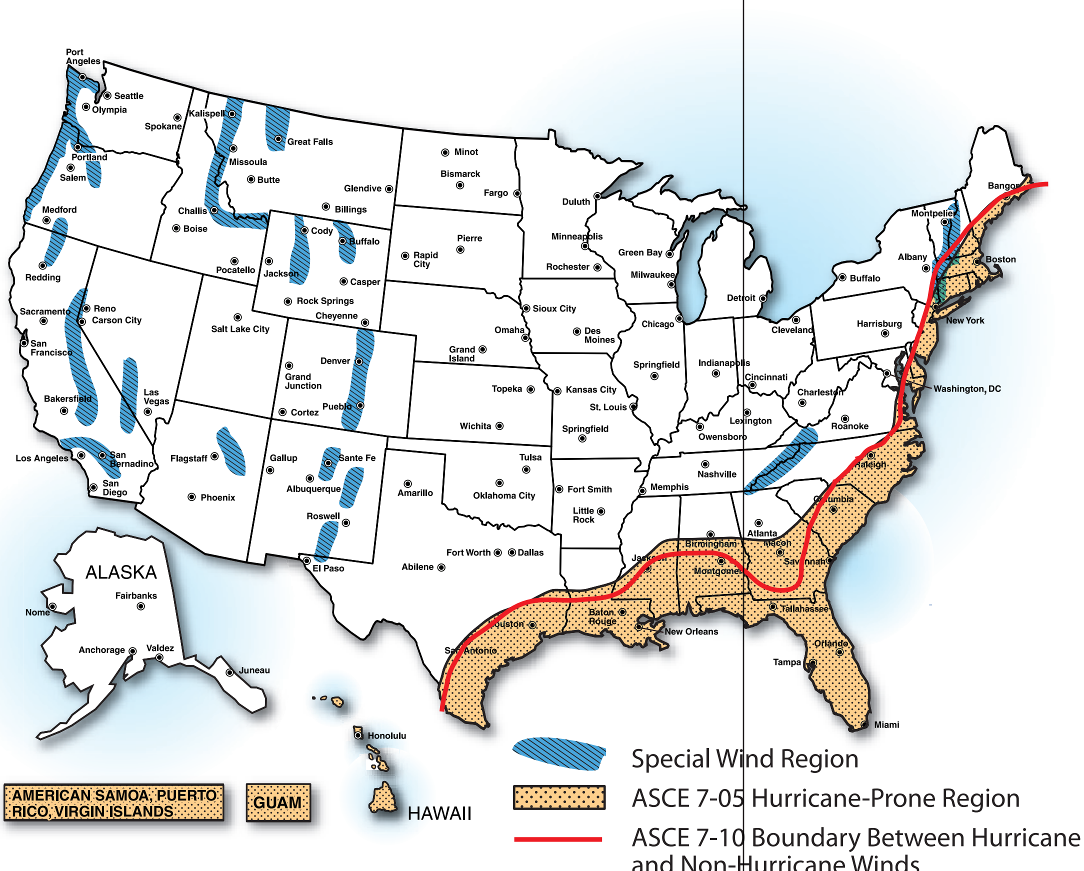
Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	Event	Options
41	**CBR Release – Mailed or Delivered** A CBR substance or dispersal device may be sent to a school through US Mail or a commercial delivery service, including an unwitting courier. Chances are scarce that an event of this nature will affect schools. Mailing quantities of a CBR agent is unlikely to result in mass casualties, thus it is unlikely that this type of tactic will be used by international/national terrorist organizations against schools. 	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5
42	**CBR Release – Water Supply** Intentional release of a CBR agent into a school building's potable water supply, from a location outside the school. Facilities that utilize water reservoirs or large water storage tanks likely face a higher threat of a denial of service or simple contamination event. Schools which are close to facilities housing high-profile officials can be exposed to this threat, primarily as an indirect target.	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5

Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	Event	Options
43	**Cyber Attacks** For schools, cyber-attacks refer to a politically or socially motivated hacking to conduct sabotage or gain critical information about the schools' courses, records, and exams, and to access any school data and electronic control systems. Schools can be affected by forcibly inserted tasks, dramatically increasing demands on a system, or denying availability of needed resources such as communication systems or water for firefighting which can result in serious consequences. These actions can divert attention, consume resources, and displace capability making other portions of both physical and cyber critical infrastructure systems more vulnerable. Disruption and denial of service results in making resources unavailable to the teachers and students who need them, when they need them. Methods for mitigation and averting disruption involve constantly chasing the techniques of those who constitute a threat. However, the basic science and technology for existing, and near-term threats is usually known. Protection against cyber-attacks involves: • Ensuring that protective identification, confirmation and authorization access measures are rigorous and well managed. • Providing redundancy, re-routing options, or self- sustaining attributes to rapidly re-store, or at least provide a minimum level of service until recovery actions can be implemented, for both cyber and physical systems. • Having procedures in place to minimize the shifting of vulnerability by diverting detection systems, security and law enforcement personnel and response teams to less optimal configurations, thus leaving certain locations less well protected. • Schools should look forward to the next-generation security for Internet protocol-based process control systems and services.	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5  
44	**Seismicity - 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 particular school. 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 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. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5

Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	**Event**	**Options**
45	**Flooding - 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 school is in a flood prone 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 particular school. All bodies of water are flooding sources, but not all contribute to the determination of a floodplain on a FEMA Flood Insurance Rate Map (FIRM).	a. Far >1 mile from a flooding source = 1 b. Within 1 mile of a flooding source = 2 c. Close within 1,000 feet of a flooding source = 3 d. Adjacent within 300 feet of a flooding = 4, 5
46	**Flooding - 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 particular school. Flood depth is a critical factor in school 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. 	a. No previous flooding = 1 b. 1 feet = 2 c. 2 - 3 feet = 3 d. 4 – 5 feet = 4 e. Above 6 feet = 5

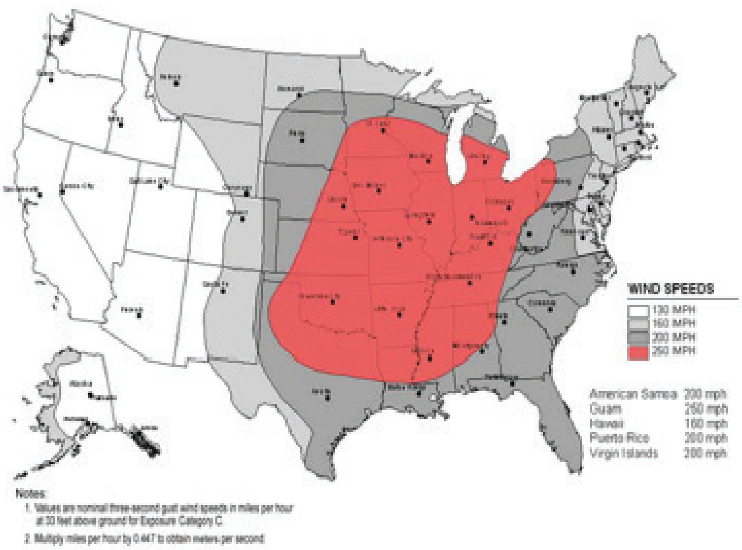
Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	**Event**	**Options**
47	**Flooding - Flood Duration** Flood duration refers to approximately how long the water level remains above the normal level. The screener should use the maximum duration of past flooding events. 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 = 1 b. Short few hours, flash flood = 2 c. Medium up to 1 day = 3 d. Long up to 1 week = 4 e. Very long more than a week = 5
48	**Flooding - 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 = 1 b. < 5 feet per second [fps]. = 2 c. 5 to 10 fps = 3 d. 10 to 15 fps 4 e. >15 fps = 5

Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	**Event**	**Options**
49	**Hurricane Speed Zone** The United States averages about 1,000 recorded tornadoes every year. A tornado can last for more than one hour and produce wind speeds of over 300 miles per hour. 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. None/Very Low = 1 b. Zone with winds of low to moderate speeds – winds below 75 mph peak gust, Low = 2 c. Medium zone exposed to strong winds between 75 and 111 mph peak gust, Moderate = 3 d. High zone subjected to damaging winds with speeds of greater than 111 mph, generally in hurricane-prone or tornado-prone zones, High/Very High = 4, 5



Hurricane-prone Regions and Special Wind Regions
Source: FEMA

Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	**Event**	**Options**
50	**Tornado Speed Zones** 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. No record of a tornado affecting the region, None = 1 b. One or two tornadoes in the last 10 years, Low/Moderate = 2 c. Three to five tornadoes in the last 10 years, High = 3 d. Six or more tornados in the last 10 years, Very High = 4, 5 Historical information on tornado events is available at: http://www.tornadoproject.com/ http://www.weather.com/encyclopedia/tornado/history.html

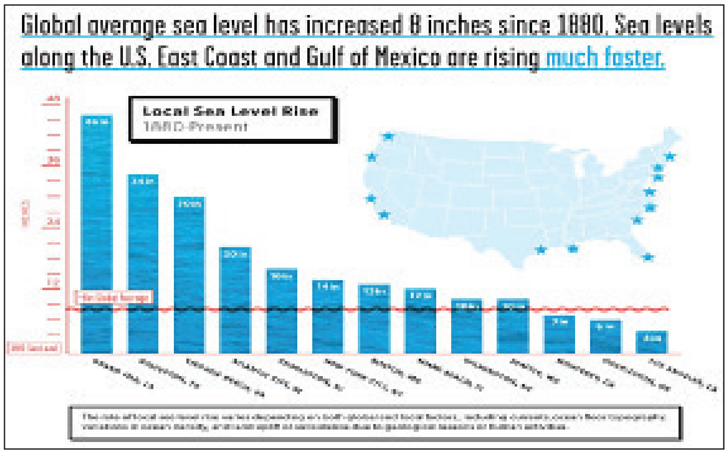
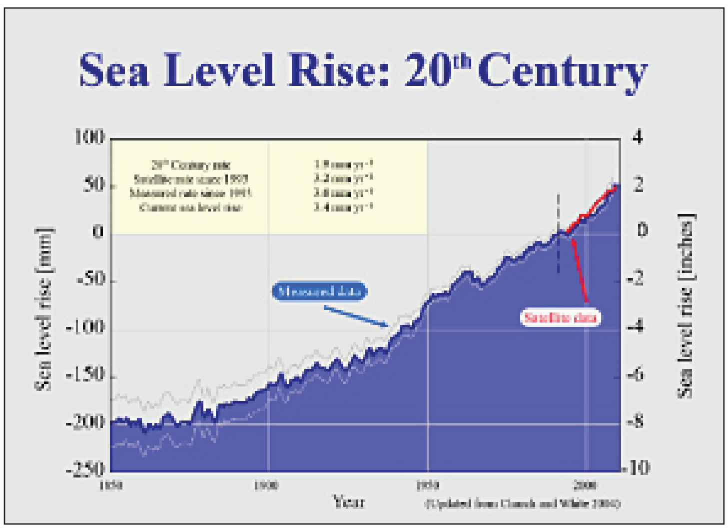


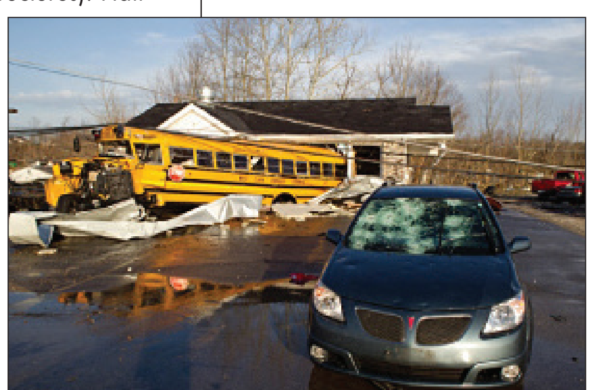
Scale	Estimated Wind Speed	Potential Damage
EF0	65 – 85 mph	Low damage
EF1	86 – 110 mph	**Moderate damage.** The lower limit is the beginning of hurricane wind speed; surface peeled off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads; attached garages may be destroyed.
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.

Enhanced Fajita Scale

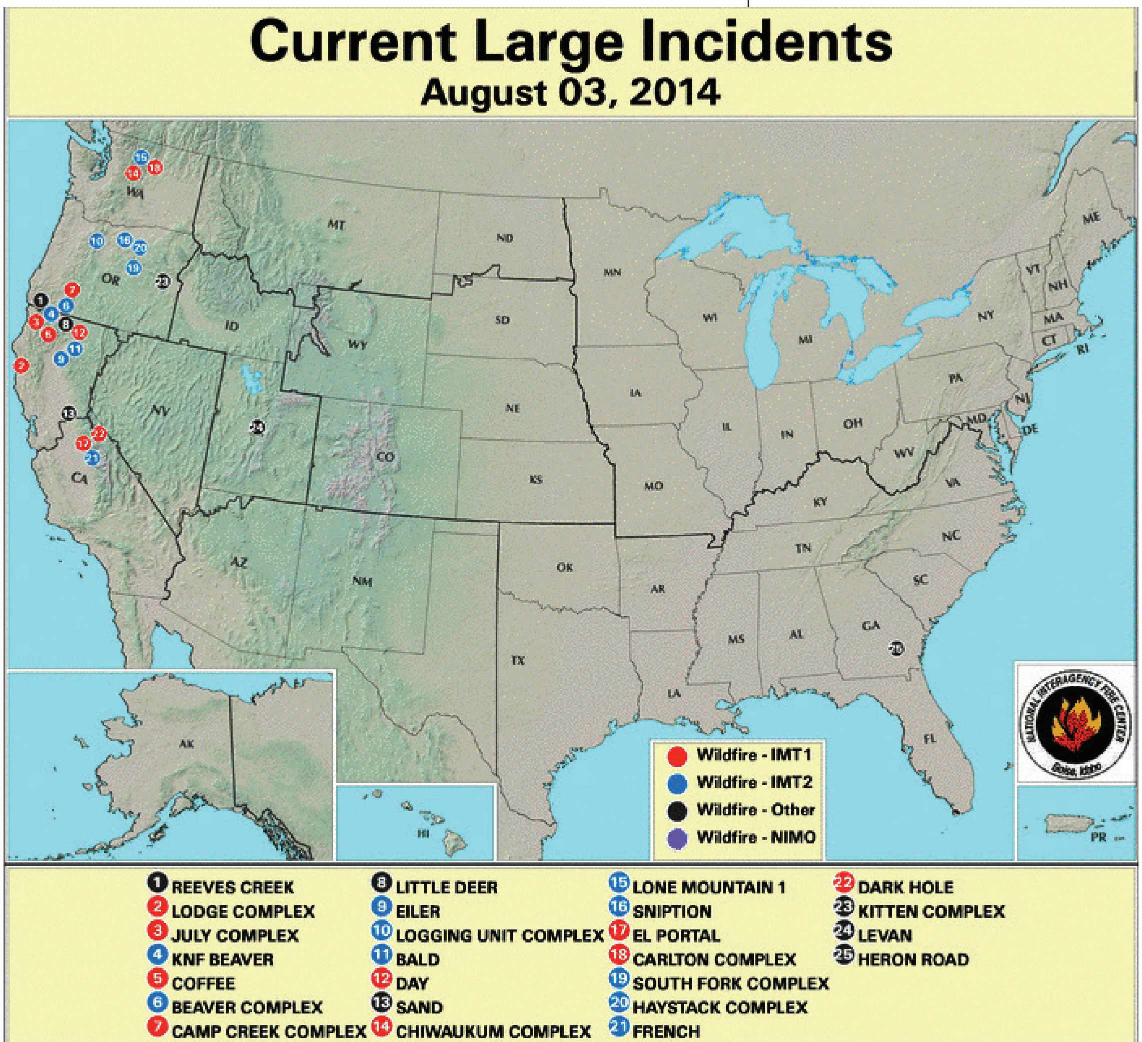
Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	**Event**	**Options**
51	**Tidal Waves** Tidal waves can be the result of tsunami (caused by an earthquake) or a storm surge (caused by a hurricane). Many in the scientific community do not refer to tsunamis as tidal waves since the behavior of storm surges and tsunamis are different. However, for the purpose of this Guide, the major consideration will be areas exposed to high waves. Storm surge is an abnormal rise of water generated by a storm, over and above the predicted astronomical tides. This rise in water level can cause extreme flooding in coastal areas particularly when storm surge coincides with normal high tide, resulting in storm tides reaching up to 20 feet or more in some cases. Storm surge is produced by water being pushed toward the shore by the force of the winds moving cyclonically around the storm. The impact on surge of the low pressure associated with intense storms is minimal in comparison to the water being forced toward the shore by the wind. The maximum potential storm surge for a particular location depends on a number of different factors. Storm surge is a very complex phenomenon because it is sensitive to the slightest changes in storm intensity, forward speed, size (radius of maximum winds-RMW), angle of approach to the coast, central pressure (minimal contribution in comparison to the wind), and the shape and characteristics of coastal features such as bays and estuaries. Other factors which can impact storm surge are the width and slope of the continental shelf. A shallow slope will potentially produce a greater storm surge than a steep shelf. For example, a Category 4 storm hitting the Louisiana coastline, which has a very wide and shallow continental shelf, may produce a 20-foot storm surge, while the same hurricane in a place like Miami Beach, Florida, where the continental shelf drops off very quickly, might see an 8 or 9-foot surge. A tsunami is a series of ocean waves generated by sudden displacements in the sea floor, landslides, or volcanic activity. In the deep ocean, the tsunami wave may only be a few inches high. The tsunami wave may come gently ashore or may increase in height to become a fast moving wall of turbulent water several meters high. A large tsunami may feature multiple waves arriving over a period of hours, with significant time between the wave crests.	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5 Designers should determine whether Coastal A Zone conditions are likely to occur at a school site because of the anticipated wave action and loads. This determination is based on an examination of the site and its surroundings, the actual surveyed ground elevations, and the estimated wave heights (calculated using predicted stillwater elevations found in the FIS or derived from elevations shown on the FEMA flood map. The best way to avoid the impact of tidal waves is to avoid areas of risk; however it is important to note the following statistics: • From 1990-2008, population density increased by 32% in Gulf coastal counties, 17% in Atlantic coastal counties, and 16% in Hawaii (U.S. Census Bureau 2010) • Much of the United States' densely populated Atlantic and Gulf Coast coastlines lie less than 10 feet above mean sea level • Over half of the Nation's economic productivity is located within coastal zones • 72% of ports, 27% of major roads, and 9% of rail lines within the Gulf Coast region are at or below 4 ft elevation (CCSP, SAP 4-7) • A storm surge of 23 ft has the ability to inundate 67% of interstates, 57% of arterials, almost half of rail miles, 29 airports, and virtually all ports in the Gulf Coast area (CCSP SAP 4-7)

Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	**Event**	**Options**
51 (cont.)	Tsunami waves do not resemble normal sea waves, because their wavelength is far longer. Rather than appearing as a breaking wave, a tsunami may instead initially resemble a rapidly rising tide, and for this reason they are often referred to as tidal waves. Tsunamis generally consist of a series of waves with periods ranging from minutes to hours, arriving in a so-called "wave train".[4] Wave heights of tens of meters can be generated by large events. Although the impact of tsunamis is limited to coastal areas, their destructive power can be enormous and they can affect entire ocean basins. Tsunamis cause damage by two mechanisms: the smashing force of a wall of water travelling at high speed, and the destructive power of a large volume of water draining off the land and carrying a large amount of debris with it, even with waves that do not appear to be large. Major areas of current research include trying to determine why some large earthquakes do not generate tsunamis while other smaller ones do; trying to accurately forecast the passage of tsunamis across the oceans; and also to forecast how tsunami waves would interact with specific shorelines For this How-To Guide the exposure to tsunami can be measured by being in FEMA defined V Zones (V-1-30) and / or a school built within the Primary Frontal Dunes.	
52	**Sea level Rise (SLR)** The elevation and proximity to shoreline determines impact. SLR results in coastal flooding, salt water inundation, and can contribute to disruption of transportation and utilities. Other variables may also be involved such as geological uplifting or subsidence. For the construction of new schools and retrofit of old ones, the impact of sea level rise should be considered. EPA has identified the following key projections: • Average global temperatures are expected to increase by 2°F to 11.5°F by 2100, depending on the level of future greenhouse gas emissions, and the outcomes from various climate models. • By 2100, global average temperature is expected to warm at least twice as much as it has during the last 100 years. • Ground-level air temperatures are expected to continue to warm more rapidly over land than oceans. • Some parts of the world are projected to see larger temperature increases than the global average. According to EPA, patterns of precipitation and storm events, including both rain and snowfall are likely to change. Some of these changes are less certain than the changes associated with temperature. Projections show that future precipitation and storm changes will vary by season and region. Some regions may have less precipitation, some may have more precipitation, and some may have little or no change. The amount of rain falling in heavy precipitation events is likely to increase in most regions, while storm tracks are projected to shift pole-ward. Climate models are available that project precipitation and storm changes	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5

Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	Event	Options
52 (cont.)	 	

Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	**Event**	**Options**
53	**Ice/Snow Storms** An ice storm is a type of winter storm characterized by freezing rain, also known as a glaze event or, in some parts of the United States, as a silver thaw. The U.S. National Weather Service defines an ice storm as a storm which results in the accumulation of at least 0.25-inch (6.4 mm) of ice on exposed surfaces. From 1982 to 1994, ice storms were more common than blizzards and averaged 16 per year. The freezing rain from an ice storm covers everything with heavy, smooth glaze ice. In addition to hazardous driving or walking conditions, branches or even whole trees may break from the weight of ice. Falling branches can block roads and tear down power and telephone lines, making the transportation of students impossible. Ice storms can affect electrical power as the ice itself can easily snap power lines. Damage from ice storms is highly capable of shutting down entire metropolitan, semi-rural, and rural areas.  Contingency plans for Ice storms should be prepared and implemented during and after the event in order to preserve schools and equipment safely. Ice storms can cause damage to the school facility and school buses. Usually schools are closed when ice storms occur.	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5
54	**Hail** Hail is a form of solid precipitation. It consists of balls or irregular lumps of ice, each of which is called a hailstone. Any thunderstorm which produces hail that reaches the ground is known as a hailstorm. Hail has a diameter of 5 millimeters (0.20 in.) or more. Hailstones can grow to 15 centimeters (6 in) and weigh more than 0.5 kilograms (1.1 lb.). Hail can cause serious damage to school busses and school buildings (especially to skylights and glass-roofed structures). Hail damage to roofs often goes unnoticed until further structural damage is seen, such as leaks or cracks. It is hardest to recognize hail damage on shingled roofs and flat roofs, but all roofs have their own hail damage detection problems. Metal roofs are fairly resistant to hail damage, but may accumulate cosmetic damage in the form of dents and damaged coatings. 	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5

Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	Event	Options
55	**Wildfires** A wildfire is an uncontrolled fire in an area of combustible vegetation that occurs in the countryside or a wilderness area. A wildfire differs from other fires by its extensive size, the speed at which it can spread out from its original source, its potential to change direction unexpectedly, and its ability to jump gaps such as roads, rivers and fire breaks. Wildfires are characterized in terms of the cause of ignition, their physical properties such as speed of propagation, the combustible material present, and the effect of weather on the fire NIST has developed a WUI fire and ember exposure scale (WUI-scale) to help quantify the expected severity of WUI fire events based on measures, or scales, of expected ember and fire exposure. The concept is based on quantifying expected fire and ember exposure throughout an existing WUI community. The proposed WUI-scale can be used to explicitly identify WUI areas that have a fire problem, as opposed to areas that meet housing density or wildland vegetation requirements as is frequently done. The scale can therefore be used to provide the boundaries where specific land use and/or building construction regulations would apply. Finally, the exposure scale can be used for both new and existing WUI communities. WUI fire events, unlike other natural disasters such as hurricanes, tornadoes and earthquakes, do not weaken with distance away from a well-defined epicenter. Fire behavior in the wildlands and the WUI is a function of fuel (vegetative and structural), topography and local weather during the event. The WUI scale, therefore, provides account for local and transient variations in fuel, topography and local weather. Schools at high risk need to plan for a survivable space which is an area of reduced fuels between the school and the wild land. This space provides enough distance between the school and a wildfire to ensure that the school can survive without extensive effort from either occupants or the fire department. For more information on the exposure of your school to wild fires access the following information: http://nvlpubs.nist.gov/nistpubs/TechnicalNotes/NIST.TN.1748.pdf 	a. Very low exposure = 1 b. Low exposure = 2 c. Medium exposure = 3 d. High exposure = 4 e. Very high exposure = 5

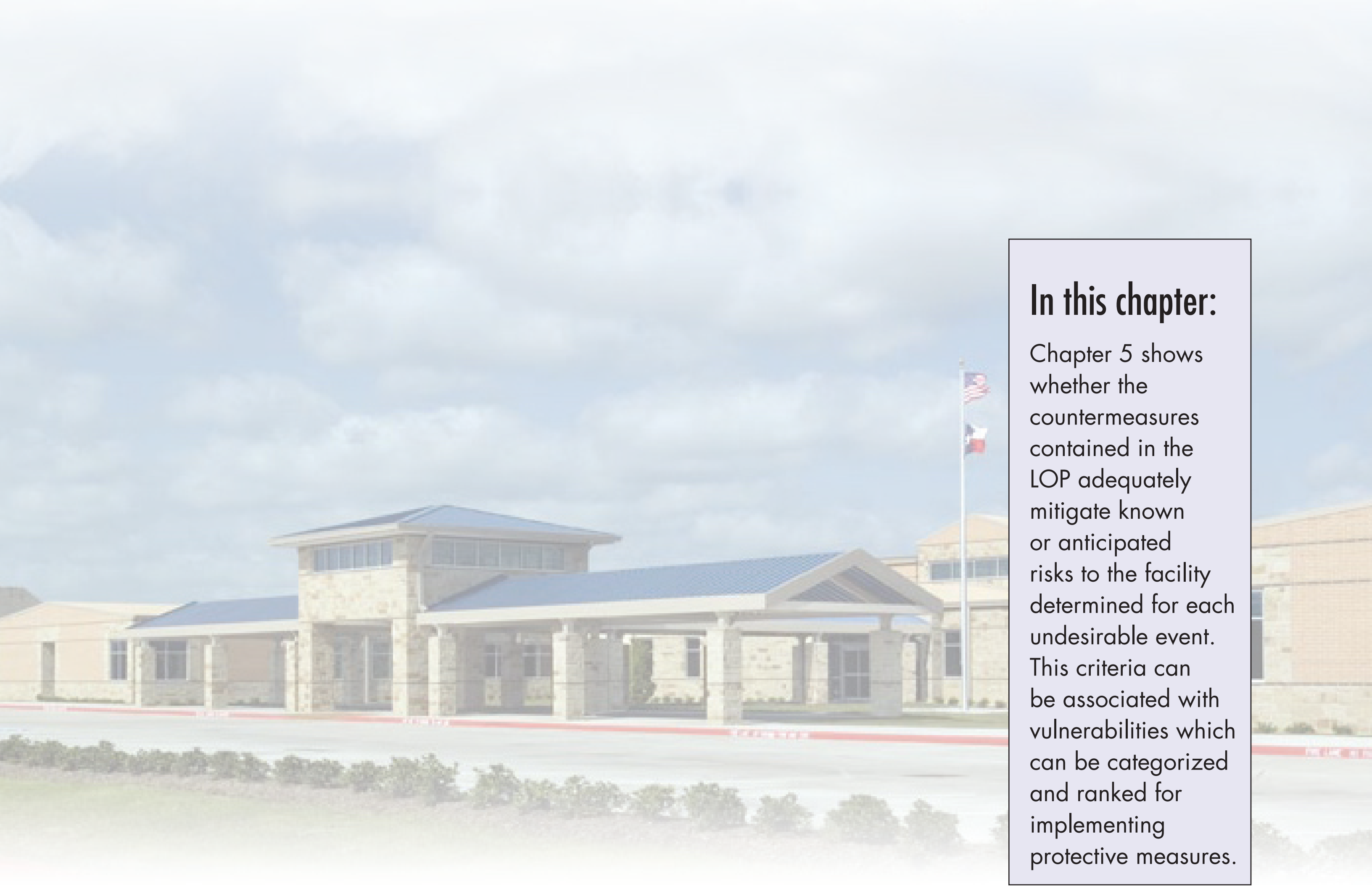
Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	Event	Options
55 (cont.)		

Undesirable Events, Natural Hazard Events, School Exclusive Undesirable Events		
ID	**Event**	**Options**
56	**Disease, Disease Vector and Pandemic** A pandemic is an epidemic of infectious disease that can spread through human populations across a large region; for instance, multiple continents, or even worldwide. A widespread endemic disease that is stable in terms of how many people are getting sick from it is not a pandemic. Further, flu pandemics generally exclude recurrences of seasonal flu. Throughout history there have been a number of pandemics, such as smallpox and tuberculosis. More recent pandemics include the HIV pandemic and the H1N1 pandemics of 1918 and 2009. The most current risk is to the Avian Influenza A (H5N1). Risk to disease and disease vector includes: • Rabid animals (i.e., annual migration of bats, small animals, and rats) • Epidemic or pandemic respiratory-spread diseases such as influenza, meningitis, TB and pneumococcal diseases	a. Very Low = 1 b. Low = 2 c. Moderate = 3 d. High = 4 e. Very High = 5

Phases	Description
One	No animal influenza virus circulating among animals has been reported to cause infection in humans.
Two	An animal influenza virus circulating in domesticated or wild animals is known to have caused infection in humans and is therefore considered a specific potential pandemic threat.
Three	An animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people, but has not resulted in human-to-human transmission sufficient to sustain community-level outbreaks.
Four	Human-to-human transmission of an animal or human-animal influenza reassortant virus able to sustain community-level outbreaks has been verified.
Pandemic	
Five	The same identified virus has caused sustained community level outbreaks in two or more countries in one WHO region.
Six	In addition to the criteria defined in Phase 5, the same virus has caused sustained community level outbreaks in at least one other country in another WHO region.
Post-peak	Levels of pandemic influenza in most countries with adequate surveillance have dropped below peak levels.
Possible new wave	Level of pandemic influenza activity in most countries with adequate surveillance rising again.
Seasonal influenza	
Post-pandemic	Levels of influenza activity have returned to the levels seen for seasonal influenza in most countries with adequate surveillance.

5

Level of Protection (LOP)



In this chapter:

Chapter 5 shows whether the countermeasures contained in the LOP adequately mitigate known or anticipated risks to the facility determined for each undesirable event. This criteria can be associated with vulnerabilities which can be categorized and ranked for implementing protective measures.

The Level of Protection (LOP) is the inherent performance – achieved through the original design or by past retrofits – of each particular school. The LOP is directly related to how the school performs in relation to the School Security Level (SSL) baseline (criticality and consequences) and how it meets the demands associated with the potential impact of Undesirable Events (exposure and likelihood). The LOP can be associated with vulnerabilities. Its correct identification allows users to select the most appropriate and cost-effective mitigation measures.

This Chapter helps the user identify the LOP and make reasonable decisions in terms of selection of LOP level; provide information regarding selecting a LOP that is acceptable or achievable; establish informed comparisons between the "existing" and the "necessary" LOPs; and helps decision-makers to identify cost effective mitigation measures that are feasible to implement.

When identifying the LOP, the school may not meet the requirements of the SSL and the anticipated Undesirable Events (UE) for many reasons. The facility may be old and built pre-current codes and standards; the sites may have multiple deficiencies such as poor location and soils; the original functions and the surrounding structures may have changed over time thus exacerbating vulnerabilities and risks. New schools may still manifest some LOP deficiencies. A new school may be constructed based on minimum codes and standards leaving uncovered an entire gamut of hazards and risks that are not addressed in the model codes. In addition, school\ could have been built under fiscal limitation making it difficult for decision-makers to adopt an all-hazard approach.

This Chapter helps the user identify the LOP and make reasonable decisions in terms of selection of LOP level; provide information regarding selecting a LOP that is acceptable or achievable; establish informed comparisons between the "existing" and the "necessary" LOPs; and helps decision-makers to identify cost effective mitigation measures that are feasible to implement.

5.1 Identification of the LOP

The existing LOP may be determined by using the Catalogue included in this Section and the IRVS software. However, for more precise results, assessors may be required to organize site visits, surveys, interviews, reviews of policies and procedures, and "red team" and tabletop exercises.

For this How-To-Guide, there are five LOP levels established for specific site and building components and systems. These five levels correspond to the inherit performance of a particular school in terms of the demands associated with the SSL and the relevant UEs. The Level of Protection has been grouped into categories as follows: architectural, building enclosure, structural, mechanical, fire protection, security systems, cyber infrastructure and continuity of operations. For each system single and aggregated vulnerabilities and performances have been identified in order to establish their relationship with selected SSL and UEs. The association between the LOPs, the SSL and UEs are described in the table below.

For this How-To-Guide, there are five LOP levels established for specific site and building components and systems.

Relationship Between SSL, UE, and LOP		
SSL	**UE**	**LOP**
5	Very High	**Very High**
4	High	High
3	Moderate	Moderate
2	Low	Low
1	Very Low	Very Low

5.2 Considerations to Determine the LOP

The identification of the LOP needs to be carefully considered by assessors and decision-makers and should be done using the *IRVS for Schools* software for accuracy and simplification. The "existing" LOP is the current capacity of school to perform according to the identified SSL in order to meet the demands of the expected UEs. When the identified necessary LOP does not meet the necessary requirements, a timetable for implementation must identified and evaluated as soon as possible.

In many cases, when designing or retrofitting a school, multiple competing requirements, standards and priorities cannot always be reconciled. In some circumstances, assessors and/or decision-makers may be confronted with having a lower LOP than required and need to readjust the LOP up or down. For example, in a particular district for

The identification of the LOP needs to be carefully considered by assessors and decision-makers and should be done using the *IRVS for Schools* software for accuracy and simplification.

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which the same SSL has been established, decision-makers may want to increase LOP for a selected number of schools due to the fact that these schools are surrounded by buildings, factories, industries or infrastructure which are perceived negatively by the public or because a group of schools are too close to embassies or government buildings that have been threatened in the past. Conversely, decision-makers may want to lower the LOP due to existing budget constraints or a protracted time-table for project implementation.

The LOP is directly related to how the school performs relative to the SSL baseline and to meeting the demands from the potential impact of undesirable events.

In addition, decision-makers may be faced with the fact that the LOP can be unachievable in spite of the willingness to provide a safer environment. Some of the reasons can be that the identified mitigation measures are above the current value of the school, that the lifecycle of the asset has almost expired, and that there are budget constraints and a difficult time table that interferes with implementing complex retrofit projects. In these cases, the selection of the "necessary" may not be feasible.

The methodology provided in this How-To-Guide allows these adjustments to be made but this should only be done when it is absolutely necessary and should be appropriately documented. At all times, decision-makers should strive to select the highest possible LOP that meets all the requirements. The selection of the LOP can involve hard choices. This may involve identifying an alternate location where the necessary LOP can be achieved (including the possibility of a new construction or expanding the delineated area) or putting in place interim countermeasures that temporarily mitigate risk.

The LOP is directly related to how the school performs relative to the SSL baseline (criticality and consequences) and to meeting the demands from the potential impact of undesirable events (exposure and likelihood). The LOP can be associated with vulnerabilities and its correct identification allows users to select the most appropriate and cost-effective mitigation measures. The gap between "existing" and "necessary" (achievable or unachievable) LOPs can be perceived as the actual performance versus the required performance.

There is no rule of thumb when identifying the LOP. However, the following provides general guidance:

- If the adoption of a higher LOP requires that the implementation of mitigation measures will be postponed for a long period of time (i.e., due to schedule and funding) the immediately achievable LOP should be considered.

- If the identified LOP is not achievable –due to budgetary restriction and cost considerations– the highest achievable LOP must be considered.
- If the necessary LOP is not immediately achievable, the delayed implementation must be planned and interim countermeasures should be implemented to temporarily mitigate the risks.
- If alternative locations are available they must be evaluated to determine if any different risks are inherent to the new location.
- If the alternate location is not feasible, some risk will have to be accepted, and a lower LOP must be considered.

5.3 LOP, Risk, and Resilience

The gap between the "existing" and "necessary" (achievable or unachievable) LOPs must always be guided by using a risk decision. Risk can be defined as the potential for an unwanted outcome resulting from an incident, event, or occurrence, as determined by its likelihood and the associated consequences. It is measured based upon the value of the asset in relation to the hazards or threats and the vulnerabilities associated with it. Consequences can be conceived as a degree of debilitating impact that would be caused by the incapacity or destruction of an asset; vulnerability by any weakness that may be exacerbated by the impact of natural events or any weakness that can be exploited by an aggressor to make an asset susceptible to damage; and threats (mostly reserved for manmade events) and hazards (mostly reserved for natural disaster events) are defined as any indication, circumstances, or events with the potential to cause loss of, or damage to, an asset. A risk assessment is the product of three factors for a given threat scenario:

> def-ə
>
> **Risk** can be defined as the potential for an unwanted outcome resulting from an incident, event, or occurrence, as determined by its likelihood and the associated consequences.

The key components of the School Safety Methodology are the SSLs, UEs, and LOPs which are respectively associated to consequences, threats/ hazards, and vulnerabilities.

It is important to stress that the type of risk function depends on the desired degree of complexity of risk analysis. For this How-to Guide which is based on a rapid screening process (FEMA 452, FEMA 455 and S&T BIPS 04), risk is influenced by the nature and magnitude of the selected SSL and LOPs and the magnitude of the UEs. This methodology provides a risk profile which defines which schools are more at risk within a region or area and which elements of a particular school facility are more vulnerable (i.e., site, architecture or mechanical features and systems).Within this risk profile a comparison can be established between C,T,V and SSL, UEs, and LOPs in order to prioritize mitigation efforts and decrease direct damages that may be exerted to an asset, public health, security, safety, fatalities, injuries, illness, and direct and indirect economic losses.

To establish a risk profile the following factors should be taken into consideration:

- Always try to aim at selecting the highest LOP or at least the "necessary" LOP in order to minimize risk
- When this is not possible, consider transferring risk by relocation of the school facility and/or buying insurance if applicable
- Accept risk If this is not attainable, the project documentation must clearly reflect the reason why the necessary or the highest possible LOP cannot be achieved.

School Safety Risk Profiles		
Traditional Risk Factors	Risk Influenced	Risk Decision
Consequences	SSL	• Achievable or unachievable thresholds • Threat or hazard difficult or not difficult to remove • Mitigation easy or difficult to implement • Budget constraints and cost considerations • Reasonable or unreasonable interruptions • Consider alternative locations • Consider potential to transfer risk to insurance • Accept risk
Threats/ Hazards	UE	
Vulnerabilities	LOP	

Once the customized LOP is established, the assessors and or decision-makers can determine appropriate and cost effective measures using the *IRVS for Schools* software. The IRVS software is developed to assist decision-makers in the implementation of cost effective mitigation projects. These projects can be directed at improving the resilience of some or all of the Resilience 4Rs (Robustness, Resourcefulness, Recovery, Redundancy) described in Chapter 2 of this Guide. For this purpose, the IRVS software will include a number of suitable and cost effective mitigation projects that will allow the users to review potential candidate improvement projects. For project evaluation and prioritization efforts, factors, such as cost, benefits, project scale and life cycle consideration will be provided.

Resilience and Mitigation Measures	
Resilience Key Elements	**Risk Influenced**
Robustness	Site Architectural Building enclosure Structural Mechanical, electrical and plumbing Fire, protection Security systems
Resourcefulness	Emergency evacuation, operation and continuity of operations plans Shelter (if applicable) operation plans MOUs with local authorities
Recovery	Drills, red teaming, table top exercises, and pertinent inspections and maintenance Identification of financial resources for recovery
Redundancy	Capacity for temporary and long-term relocation of the school facility Backup for most important school records

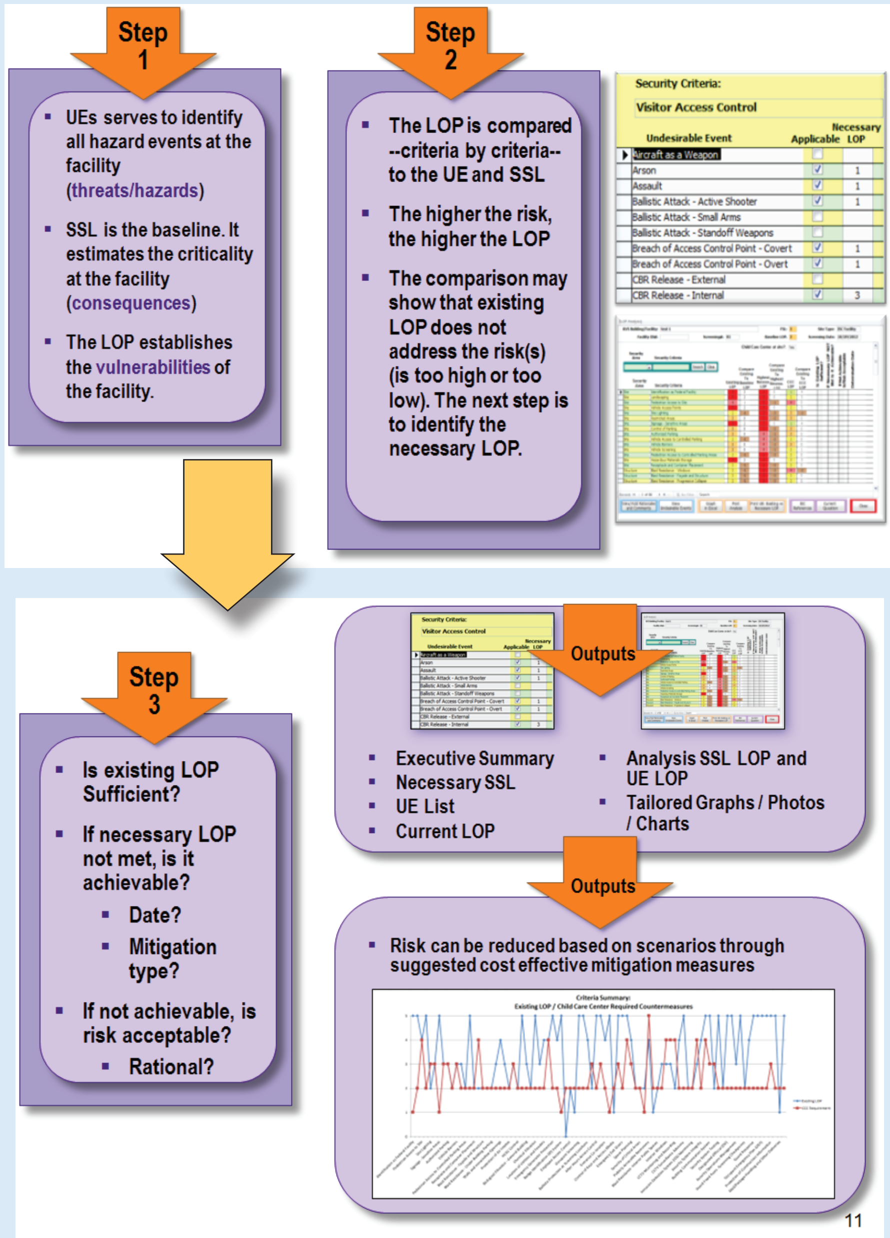
5.4 LOP Steps

The LOP analysis is key to improve the resilience and performance of the school facility. The difference from the "existing" versus the "necessary" LOPs will indicate where the criteria did not meet the necessary requirements and, as well, major areas of vulnerabilities and risk. If the existing LOP does not sufficiently address the risks, shortfalls must be identified and countermeasures to address those vulnerabilities must be considered for implementation. This method allows decision-makers to thoroughly recognize all vulnerabilities related to their facility and embark on resilience improvement efforts.

The LOP analysis is key to improve the resilience and performance of the school facility.

The figure below highlights the main steps involved in the identification of the LOP:

IRVS Steps for the Identification of the LOP



5.5 Project Prioritization

Mitigation project prioritization efforts are a difficult task. To be effective, appropriate mitigation measures need to consider multiple factors which include but are not limited to costs, benefits, project scale, and life cycle considerations need to be taken into account. The IRVS Schools Safety is designed to help decision makers with this task. The *IRVS for Schools* methodology considers the following:

> The *IRVS for Schools* methodology considers the following:
>
> - Project Costs
> - Project Scale
> - Life Cycle Considerations

- **Project Costs:** Project costs include two types: direct and indirect costs. Direct costs are related to costs of improving each deficient LOP. Indirect costs include cost of management and incidentals required to make the improvements. The sum of both cost sources is referred to as capital cost.
- **Project Scale:** Projects vary in scale as measured by either total costs or total benefits. Costs, benefits and scale need to be consistent. For example a project costing $100 and resulting in an overall LOP improvement of 1.5 (on an LOP scale of 1-5) is more efficient than a project costing $80 and improving LOPs by a mere 0.2.
- **Life Cycle Considerations:** Capital costs should not be the only cost criteria used for prioritizing projects. The life cycle cost performance needs to be also considered. In considering life cycle costs, the user needs to provide appropriate estimation of discount rates as well as the needed time of performance for the project.
  The *IRVS for Schools* software accommodates all of the above factors in an interactive and simple manner which starts by identifying mitigation measures for deficient LOPs. As discussed earlier, for each LOP criteria, the software identifies the level of deficiency of pertinent LOP. The user of the software can choose from a convenient list of built-in mitigation measures to eliminate the LOP deficiency and improve it to the necessary LOP level. Each mitigation measure will have a cost assigned to it. The total mitigation cost will be the total cost for bringing all deficient LOPs to the Necessary LOP levels. Figure *1 shows an example of the process. Four deficient LOP criteria with their Existing LOP levels, their Necessary LOPs and the new (upgraded) LOPs for each criteria are shown. In addition, the figure shows the chosen mitigation measure for each LOP (which is built-in the software amongst several other mitigation methods for each LOP criteria). The software also computes the capital cost for each chosen mitigation method, its life cycle cost, and some information regarding the construction type of the mitigation method (whether

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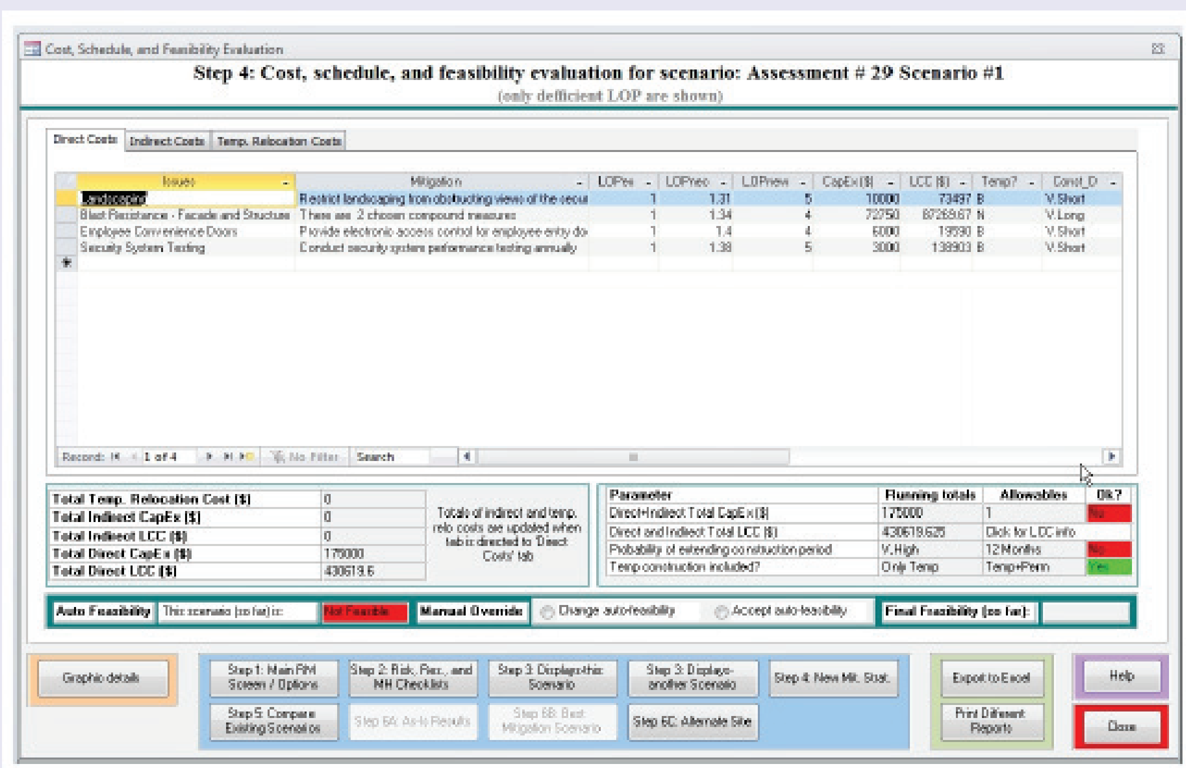
it is a temporary or permanent solution and the estimated construction duration). The software also allows the user to provide for their own mitigation solutions and adjust costs manually if they decide to override the built-in mitigation solutions and costs.

As the user of the software chooses mitigation measures for different deficient LOP criteria, the software sums the direct costs (both capital and life cycle). Also, if desired, indirect costs can also be computed by the user of the software. Thus a total capital and life cycle costs are available for any scenario of a particular mitigation project.

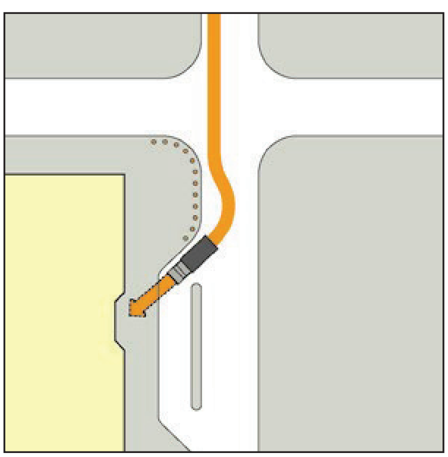
The user of the software can of course experiment with as many mitigation projects as needed (called 'scenarios' by the software). A comparison of these projects (scenarios) can then be made as shown in figure *2 which shows the summary of three mitigation projects (scenarios). The comparison of different scenarios are made using 1-capital costs, 2-life cycle costs, 3-benefits (described by reductions in risk and or improvements in LOP). The project scale comparison, is implied in the overall costs (both capital and life cycle), and in the overall risk reductions or LOP improvements. Finally, the user can then let the software prioritize mitigation projects using any of these criteria, or the user can override the software and use a prioritization list based on the information that is provided in the project dashboard.

Illustration of the IRVS for Schools Using Deficiencies In The LOP to Determine Different Mitigation Solutions



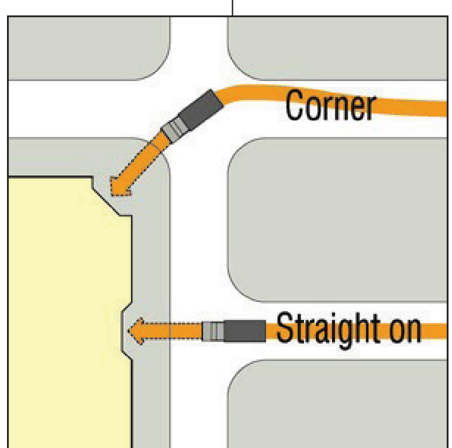
To determine the "Existing" LOP and the "Necessary" LOP, the screener/assessor must review and complete the evaluation of existing condition and necessary protection for the relevant LOP in the following list. This catalogue provides additional information to support the LOP evaluation process. All entries should be done directly into the IRVS for Schools Database.

Level of Protection – Site				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
57	**High Velocity Vehicles in School Perimeter Area** Vehicle access refers to the area immediately outside the school grounds. The areas to secure include outside perimeter area, entries to school public parking, and school drop-off zones. The school entry points should be designed to prevent high-speed approaches and put in place deterring elements that avoid direct entrances of vehicles to schools. The following should be considered: • Reduce and/or control the number of vehicle access points to the school • Use calming features in school perimeter to control speed of approaching vehicles • Control the angle of entry by not providing direct or straight-line access to school building(s) • Control the distance at which a potentially threatening vehicle can park in relation to school grounds and building(s) [from vehicle to the school façade]	a. Very low security from traffic in the area surrounding the school = 1 b. Low security from traffic in the area surrounding the school = 2 c. Moderate security from traffic in the area surrounding the school = 3 d. High security from traffic in the area surrounding the school = 4 e. Very high security from traffic in the area surrounding the school = 5		



Angled approach

SOURCE: DAVID SHAFER



Straight-on approach

SOURCE: DAVID SHAFER

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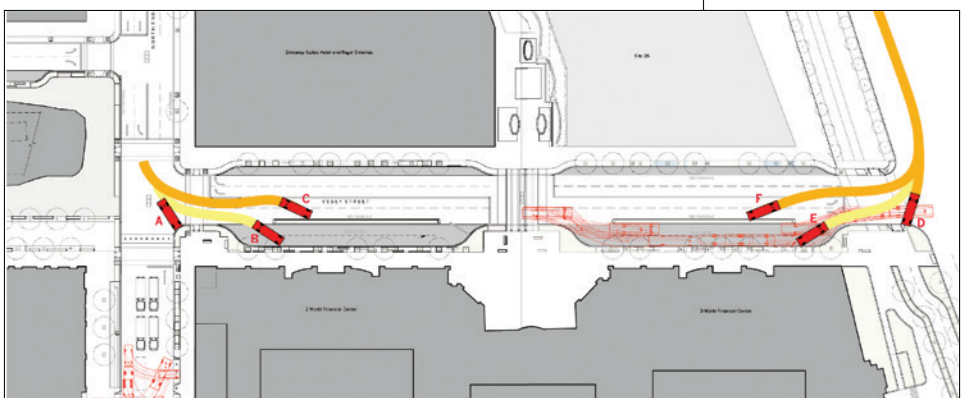
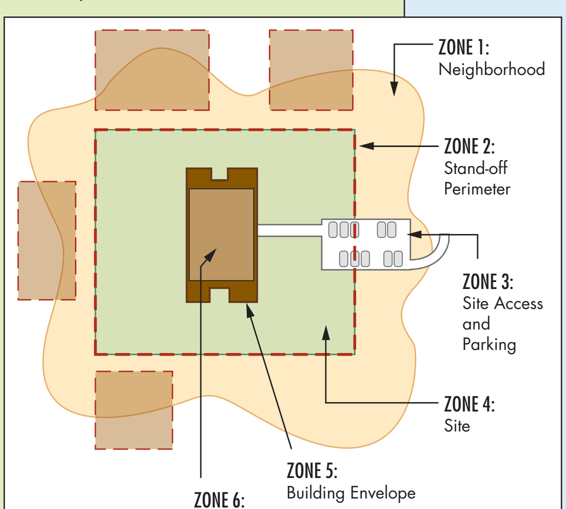
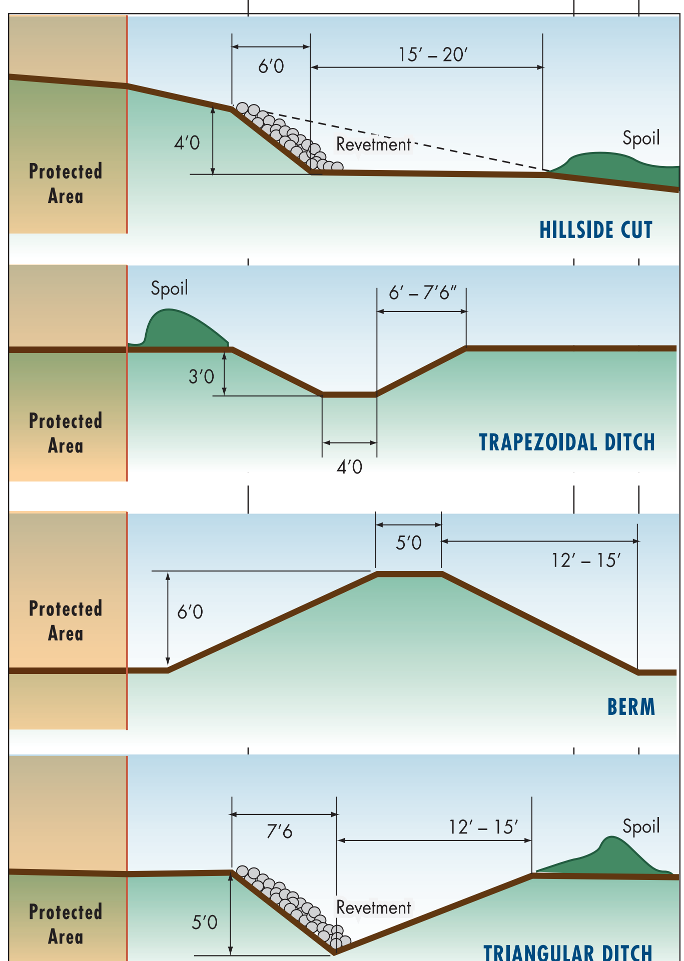
Level of Protection – Site				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
57 (cont.)	This figure shows a portion of an analysis of threat vehicle approach speed, which is used to determine the alignment and curvature of access roads to a large school facility. The objective is to force the vehicle to impact the barrier at reduced speed and at a shallow angle. This method of analyzing vehicle approaches and speeds also can be used to increase pedestrian safety.			
	(see figure and table below)	GSA has a similar approach to site security using the concept of six zones of security. The site security zones follow from the outside (Zone 1) to the inside of the building (Zone 6). Each zone offers opportunities to increase site security and enhance site appearance and function (GSA 2007). The above figure compares FEMA's three layers of defense(FEMA 430) to the GSA concept of six zones of security for a building site, in which the sixth "zone" is management and operations		



GSA Zones of Security	FEMA Layers of Defense
1. Neighborhood	1. First or Outer Layer
2. Standoff Perimeter	2. Second or Middle Layer
3. Site Access and Parking	3. Third or Inner Layer
4. Site	
5. Building Envelope	
6. Management and Building Operations	



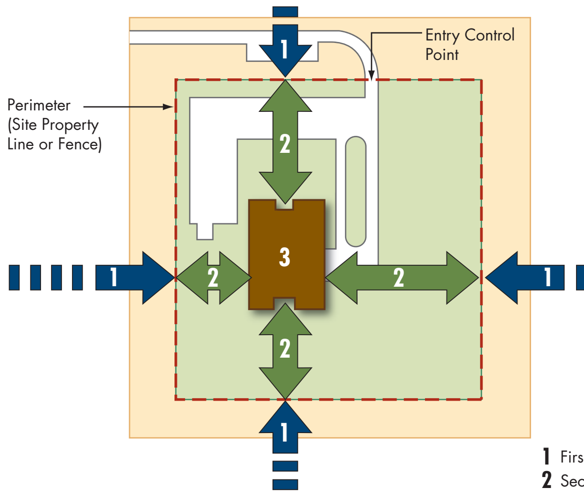
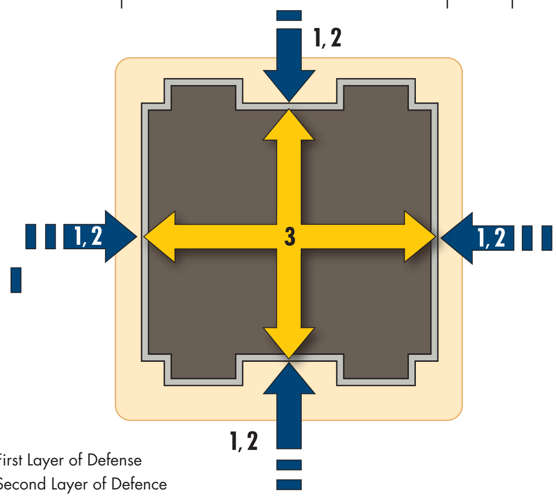
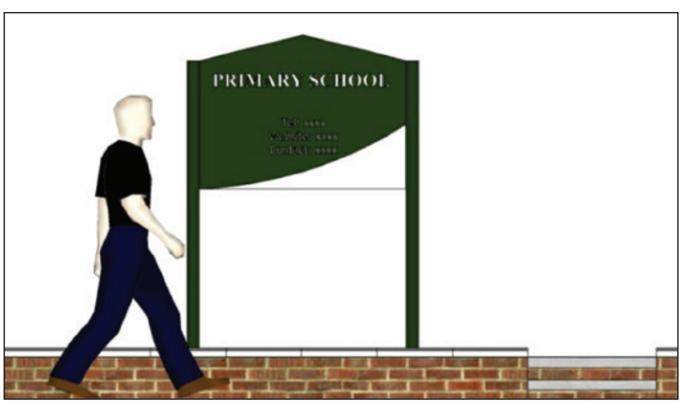
Level of Protection – Site				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
58	**Application of CPTED Principles** Principles of Crime Prevention Through Environmental Design (CPTED) should be applied when appropriate. CPTED is a crime prevention strategy that uses architectural design, landscape planning, security systems, and visual surveillance to create a potentially crime-free environment by influencing human behavior. CPTED usually involves the following principles: • Natural Surveillance (by placing physical features, activities, lighting and people to preclude blind spots or hiding spots to keep intruders easily observable) • Territorial Reinforcement (using buildings, fences, different paving material, changes in street elevation, signs, and other landscaping to express ownership by distinguishing to potential offenders private spaces from public spaces) • Natural Access Control (strategic placement of entrances, exits, fencing, landscaping, and lighting to create in potential offenders a perception of risk) • Target Hardening (use of features that prohibit entry or access, such as perimeter boulders/large rocks, streetscape furniture, art ornaments, etc.).	a. Implementation of 1 CPTED principle = 1 b. Implementation of 2 CPTED principles = 2 c. Implementation of 3 CPTED principles = 3 d. Implementation of 4 or more CPTED principles = 4 and 5		



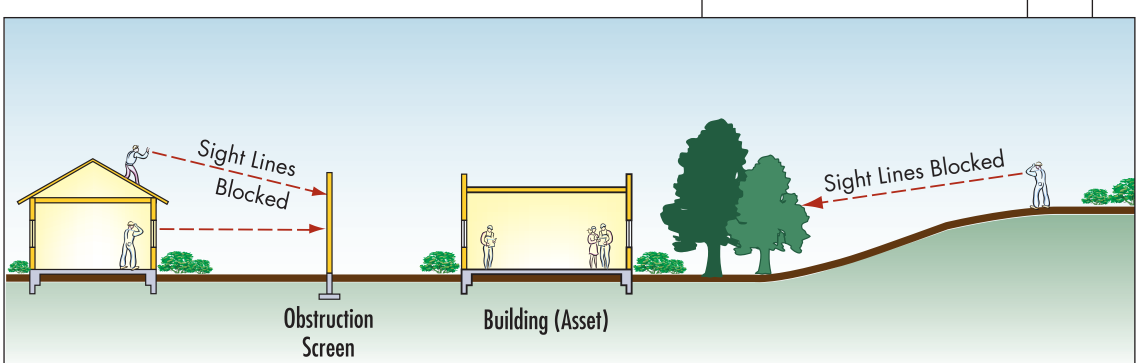
Example of CPTED Systems

SOURCE: FEMA 430 (DECEMBER 2007)

Level of Protection – Site				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
59	**Entry Control Points to School Ground** Control entry points serve to prevent unauthorized people and vehicles to enter school grounds. Schools usually have many entry points. Entrance to school grounds and building(s) should be minimized by using the least possible number of pedestrian entry points and should be monitored by school staff, natural or man-made barricades, and CCTV. Schools may need to block entry to control points that cannot be monitored at a given time. Unintended access points that penetrate the school building perimeter or basement (i.e., pedestrian tunnel from an adjoining building or subway, sewer line, culvert, drain pipe, utility tunnel, or conduit) should be secured and locked. Ideally, schools should use CCTV or other monitoring systems to provide views to all entry points. In general, CCTV is not a replacement for direct staff supervision but a way to cover some less easily monitored spaces (the bottom of stairs recessed from the corridor for example) or to monitor when staff is engaged in teaching (between class changes). Based on the level of threat cameras may be limited to exit doors and key locations or they may be placed so the entire corridor system is covered.` The following may be observed: • Entry points should observed/monitored during normal hours and during special school events. • If possible, entry points should be positioned so that one individual or staff member can monitor as many entries as possible • Entry points to the site should be kept to a minimum • As possible, vehicle circulation routes to service and delivery areas, visitors' entry, bus drop-off, student parking, and staff parking should be separated • Unsupervised site entrances should be secured during low-use times for access control purposes • When tall fences have been installed, gates should be available to provide, as necessary, a controlled access or exit to the school premises • Any kind of physical feature protecting schools should be commensurate with the need to allow pedestrian access and organized access to school.	a. Not applicable b. Public entry points are kept to a minimum, clearly indicated by signs = 1 c. Public entry points are monitored by the school staff, unattended non-public entry points are blocked to prevent unauthorized access = 2, 3 d. Public entry points are monitored clearly by signage, school staff, and effective barriers are used at unattended non-public entry points to prevent unauthorized access = 4 e. All entry points are monitored by school personnel, signage, and effective barriers are used at unattended non-public entry points to prevent unauthorized access. CCTV is used to monitor main entry points to school grounds and unattended locations (i.e., pedestrian tunnel from an adjoining building or subway, sewer line, culvert, drain pipe, utility tunnel, or conduit) = 5		

Level of Protection – Site				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
59 (cont.)	 *School Entry Control Points with Standoff*	 **1** First Layer of Defense **2** Second Layer of Defence **3** Third Layer of Defence *School Entry Points in an Urban context without standoff*		
60	**Pedestrian Control in School Ground** The movements of pedestrians on school grounds should begin by controlling entrance during normal school hours and during school special events. Pedestrian movement on school grounds should be directed and monitored by signage, school staff, barriers, and CCTV. Hiding places should be minimized or eliminated along pedestrian routes. When necessary, hiding places can be exposed by trimming landscaping, improving lighting, removing solid fencing, or installing convex mirrors. 	a. Not applicable b. No special measures required = 1 c. Use natural or human surveillance to monitor pedestrian access to school grounds and buildings and minimize areas of concealment = 2, 3 d. Use natural or human surveillance and CCTV to monitor pedestrian access to school grounds and building(s) and eliminate areas of concealment. Level = 4,5		

Level of Protection – Site				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
61	**Landscaping** Typically, landscaping is an activity directed at improving the aesthetic appearance of a specific area by changing its contours, adding ornamental features, or planting trees and shrubs. However, landscaping is an important security feature and is a main CPTED principle that can be used to protect students from aggressions and violence. Landscaping can be also used to deter the impact of natural hazards. Designers and school authorities must achieve a balance between the aesthetic appearance of the landscaping and security and safety needs and should consider the following: • Provide a clear and an unobstructed view for surveillance to all roadways and paths • Eliminate hidden spaces and zones that cannot be naturally surveyed and can become areas to conceal school violence and criminal activities • Plant trees far enough away from the school building, exits, access roads, equipment, utilities and emergency refuge areas to ensure that, if they blow over or lose large branches, they will not affect these areas. • Help to minimize flooding by doing appropriate groundwork design • Eliminate the accumulation of bushes and other combustible materials in close areas of the school in order to minimize the risk of fire. • Use trees to define sidewalks or drives, provide a natural direction to pedestrian, and to limit or deny access to particular areas of the school site. • As possible, use natural vegetation boulders/large rocks, streetscape furniture, art ornaments, as landscape features.	a. Not applicable b. Main roadways and paths can be monitored by natural surveillance; hidden places are difficult to access, and security landscaping against perpetrators and natural hazard and fires is taken into consideration and it is mildly efficient = 1 c. All roadways and paths can be monitored by security staff or CCTV; hidden places are blocked, and security landscaping against perpetrators and natural hazard and fires is efficient = 2, 3 d. All roadways and paths are monitored either by security staff or CCTV; hidden places are not accessible, and security landscaping against perpetrators and natural hazard and fires is very efficient = 4, 5		



Level of Protection – Site				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
62	**Outdoor Student Gathering Points** Outdoor student gathering points are designed or can already exist and spontaneously trigger the gathering of students in a single place, typically before classes or during recess. Gathering points should be carefully considered since they can be used to serve illicit transactions (i.e., purchase or sale of drugs). There rare possibility that gathering points can be observed and be susceptible to snipers, schools shooters, or explosive attacks. Student gathering points should be subjected to some type of surveillance. All students gathering places should have setbacks from streets, driveways, and parking areas by at least 50 feet. 	a. Not applicable b. Controlling the gathering point with visual surveillance. = 1, 2, 3 c. Controlling the gathering point with visual surveillance and with CCTV = 4, 5		

Level of Protection – Site				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
63	**Playgrounds** Especially when in use, playgrounds should be observed at all times. Playgrounds and play equipment areas should be attended vigilantly by personnel or CCTV. Playgrounds should be protected against traffic, intruders with malicious intent (i.e., kidnapping, snipers/shooters), student bullying, and drug distribution. Playgrounds can vary extensively. Their design will depend on: • The size of the school • Location (urban vs rural) • Functions (design for elementary, middle, or high school) In elementary schools, play grounds can be designed for children pre-kindergarten, kindergarten, and first grade separated from other students. This creates more security for younger children. Fences and other barriers can be used to protect the playground from traffic or for students leaving the school without authorization. Abduction is a main concern when it comes to playground safety. The following safety features should be considered: • Use fencing and landscaping to prevent unauthorized entries and exits to the playground. Fencing and landscaping can also prevent students from having accidents when chasing balls or other play equipment. When necessary, install emergency egress gates to facilitate evacuation in case of an emergency • Locate the playground away from public and vehicles access from streets and parking lots. However, consider easy access for emergency and maintenance vehicles 	a. Not applicable b. Playground is located away from vehicles and walkways and pathways to other areas are controlled by staff. Warning signs against violence and landscaping safety features are in place = 1 c. Playground is located away from vehicles and walkways and pathways to other areas are controlled by staff. Playground is controlled by staff and or CCTV. Warning signs against violence are in place = 2, 3 d. Playground is located away from vehicles and walkways and pathways to other areas are controlled by staff and CCTV. Playground is designed to prevent the risk of child abduction. Safety comfort features for teachers are designed for surveillance. Strong warning signs against violence are in place = 4, 5		

Level of Protection – Site				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
63 (cont.)	• Design playgrounds in such a manner that a potential abductor would necessarily be seen when traveling back to his or her car. This will allow time for intervention to stop the abduction • Install a short (4 foot) inner fence around playgrounds for young children. This will serve as a double protection and will slow down any potential abductor • Place teacher comfort features such as shaded seats or park benches in key areas around the playground. Install more than one set of these features to encourage teachers not to congregate in only one area and thereby improve natural surveillance. This will deter adductions, school fights, and school bullying • Allow the control of walkways and pathways to and from the school building to playgrounds and other areas by staff or CCTV • Use warning signs against violence or other threats Protective surfaces should extend a minimum of 6 feet horizontally in all directions from play equipment. For swings, surfacing should extend in back and front twice the height of the suspending bar Children in playgrounds can be prone to accidents. Swings, slides, climbing frames, metal bars and merry-go-round are equipment that can cause accidental injuries. More than 200,000 children in the United States go to emergency rooms annually with playground equipment injuries, mostly involving falling. This may need to be recognized in the design and assessments of schools For more information on playground accidents, please access the CPSC standards for playground design: http://www.cpsc.gov/PageFiles/122149/325.pdf 			

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<tr><th>ID</th><th>Criteria</th><th>LOP Options</th><th>Existing LOP</th><th>Nec. LOP</th></tr>
<tr><td>64</td><td>

Outdoor Athletics

Outdoor athletics need to be designed to protect the students and to accommodate the public participating in a sport event. Outdoor athletics need to be guarded against traffic, intruders with malicious intent, student bullying, and drug distribution.

Outdoor athletics should be built in a protected area. Security measures should be strictly correlated to the size and the capacity of the outdoor athletic area. When in use and if possible, at all times, outdoor athletics should be attended by personnel or observed by CCTV.

Considerations include:

- Outdoor athletics should be monitored at all times by school staff and/or CCTV.
- Athletic grounds should have a generous setback which makes it harder for intruders to sell drugs to students, lure them off campus, or victimize them with drive-by shootings.
- Sport areas should be well separated from vehicular traffic
- Fences should be installed as a means of establishing a physical protective barrier to protect a control area
- Walkways and pathways from the school building to sport areas should be controlled by staff or CCTV.
- Sport events areas should be well protected from existing site roadways and vehicles using the visitors parking during special vents.
- Clear signage should be available to indicate to visitors where to park and where the sport event is taking place
- Emergency and maintenance vehicles should have easy access to sport areas
- Access to non-emergency vehicles should be restricted by fencing, bollards, gates, landscaping, or other features
- Emergency escape exits and gates should be clearly indicated.

</td><td>

a. Not applicable

b. When in use, the athletic area is monitored by staff, separated from vehicular traffic and has appropriate setbacks to avoid intruders and school violence. Staff surveillance is use to monitor roadways and pathways to the athletic area. Emergency escape exits and gates are clearly indicated. = 1, 2

c. When in use, the athletic area is monitored by staff or CCTV. Setbacks, pathways, and roadways and traffic patterns are well designed to prevent accidents and are monitored to prevent crime and violence. Emergency features are in place and are designed to handle a medium size emergency egress. Clear signage should be available to indicate to visitors where to park and where is the sport event taking place = 3

d. Athletic area is well controlled and monitored mostly by CCTV at all times and also by staff when necessary. Setbacks, pathways, and roadways and traffic patterns are illuminated and very well designed for traffic and to prevent accidents, crime, and violence. Emergency features are in place and are designed to handle massive emergency egress. Clear signage is available providing ample information to visitors for parking and the athletic facility = 4, 5

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<tr><th>ID</th><th>Criteria</th><th>LOP Options</th><th>Existing LOP</th><th>Nec. LOP</th></tr>
<tr><td>65</td><td>Fencing

Higher levels of protection for schools located in areas of high risk (i.e. located near an iconic building or in areas of high crime rates) are achieved using anti-climb fences or razor/barbed wire. There are pros and cons to the decision to install a fence around the school grounds. Considerations include the following:

• A stone or concrete block wall can be an effective barrier against bullets but can block surveillance and attract graffiti
• Wire mesh fencing is relatively easy to vandalize but often the most economical option
• Wire mesh fencing may provide foot holds, making it easy to climb over
• Smaller gauge wire mesh may deter climbing
• Powder-coated wire mesh fencing can be more aesthetically pleasing
• Wrought iron fencing is low maintenance, vandal resistant, without blocking surveillance or providing foot holds
• A short fence can establish territoriality but is of limited value for controlling access
• Tall, continual fencing can significantly restrict access, but may also block a pedestrian path requiring students to take a longer route where they are more exposed to traffic and crime.
• If continual fencing is used, installing lockable gates at selected locations will be necessary. The downfall of this approach is that a locked barrier may create an unexpected barrier for a student trying to escape to or from the sitez

The unfenced and unprotected school grounds allowed the two shooters of the Jonesboro shooting secret and unimpeded access to, and egress from, the site of the shooting.

The Westside Middle School consists of an elementary school, middle school, and high school on one property. When they approached school grounds an 11-year-old 6th grade and a 13-year-old 7th grade student moved undetected and by foot, heavily armed and wearing camouflage hunting gear. They shot 15 people. Four students and one teacher were killed.

</td><td>a. Not applicable

b. School has no fences. = 1

c. School is partially fenced and fence is relatively easy to defeat. = 2

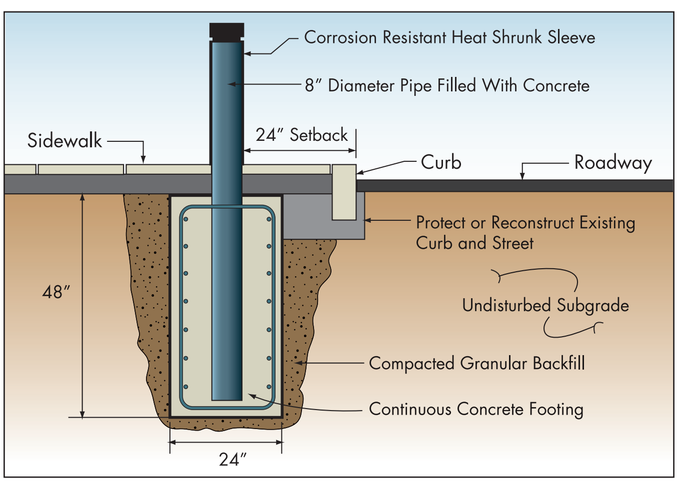
d. School fenced with a low fence adequate to slow an intruder or a student leaving the campus. = 3

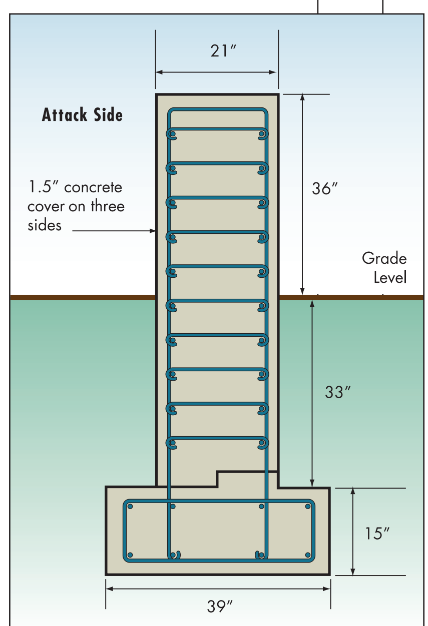
e. School is fenced with tall continual fencing to restrict access. = 4

f. School is fenced with a tall vehicle resistant fence to restrict access. = 5</td><td></td><td></td></tr>
</table>

Level of Protection – Site

ID	Criteria	LOP Options	Existing LOP	Nec. LOP
66	**Vehicle Barriers** In schools at high risk, vehicle barriers can be considered as a complement to school fencing. If a particular school decides to use perimeter barriers, these barriers should be capable of stopping most types of vehicles. As necessary, the following options can be considered to protect the school perimeter: • Use vehicle barriers on all sides of the perimeter to secure from unauthorized vehicle entry. • Use semi continuous barriers as a complement to fencing in areas requiring high levels of protection(e.g., retractable bollards) In urban sites, when fencing is not possible, vehicle barriers can be used to stop vehicles before reaching the school building. Anti-ram protection should be able to stop the threat vehicle size/weight at the speed attainable by the vehicle at impact. If anti-ram protection cannot be used by the school, speed bumps can be used to limit speed of vehicles coming in contact with school. Note that small vehicles and motorcycles may be able to pass through the openings created between bollards. In semi urban or rural schools, vehicle barriers can be a complement to fencing placed at certain strategic areas **Recommendations:** If vehicle barriers are used, they must be certified to meet performance requirements for vehicle size and speed specific to the facility under ASTM F 2656, Standard Test Method for Vehicle Crash Testing of Perimeter Barriers, or SD-STD-02.01, Revision A, Test Method for Vehicle Crash Testing of Perimeter Barriers and Gates. Maximum clear spacing between vehicle barriers should be 4 feet. Minimum barrier height should be 30 inches.	a. Not applicable. b. Provide vehicle barriers to support fencing at most critical points. = 1, 2 c. Provide vehicle barriers to support fencing at most critical points and to protect pedestrian entrances from penetration by a vehicle. = 3,4 d. Provide anti-ram barriers to protect pedestrian entrances from penetration by a vehicle and or support fencing at most critical points. = 5		





Anti-ram barrier
(FOR ILLUSTRATION ONLY)

Section view of typical bollard
(SOURCE: DOS) (FOR ILLUSTRATION ONLY)

Level of Protection – Site				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
67	**Outdoors School Fountains and Vending Machines** Water fountains should be located on an accessible path. Push-bar or lever designs work well. Vending machines should in a secure area. As possible, these areas should be under natural or CCTV surveillance. • Provide water fountains that are vandal-resistant based on materials and placement, solidly mounted, and well secured • Outside drinking fountains should also be vandal-resistant by design, such as by being wall-mounted and made of durable materials • Secure vending machines adequately for local conditions • If necessary, enclose vending machines in a recessed area that can be closed off by a roll-down security grill or in wire cages with hand openings for operating the machines. Wire cages can look menacing, however, and should be used as a last resort; it is preferable to temporarily remove or relocate machines to a location easier to control.  The water spout for water fountains should be at most 36 inches off the floor, with at least 27 inches of clearance for wheelchair users' legs beneath the apron of the fountain. Avoid foot-operated fountains, which don't work for wheelchair users	a. Water fountains and vending machines are accessible. = 1, 2 b. Water fountains and vending machines are accessible and protected against vandalism. = 3, 4 c. Water fountains and vending machines are in a secure area, protected against vandalism, and monitored by CCTV = 5		

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<tr><th>ID</th><th>Criteria</th><th>LOP Options</th><th>Existing LOP</th><th>Nec. LOP</th></tr>
<tr><td>68</td><td>Receptacle and Dumpster Placements

Receptacles and containers create potential concealment for explosives. Outdoor containers in which explosives can be hidden (such as garbage cans, mailboxes, and recycling or newspaper bins) should be kept at least 30 feet from the building and away from student and teacher gathering places.

The containers should be designed to restrict the size of objects placed inside them or to expose their contents (e.g., by using steel mesh instead of solid walls)

Dumpsters should be either enclosed in a designated service area or surrounded on three sides by a high wall, preferably a see-through, climbing-resistant fence, and provided with a securable gate. Bollards should be used to keep dumpsters from being pushed closer to the building and to prevent trash haulers from accidentally colliding into the building.

Dumpsters and their enclosures should be positioned so that they cannot be used as ladders for gaining access to the school roof. Dumpsters and trash cans should not be below building overhangs.

In 2010 Katy ISD prepared a major full scale drill based on an explosion in a trash receptacle near a glass wall outside the cafeteria at a middle school. Katy ISD chose the scenario based on a report about a junior high principal who found one of four devices placed in or near trashcans in California. The bomb squad calculated that a backpack size device (10 lbs.) would cause injury over a very large area because of reflected pressure from the three sides of the courtyard.</td><td>a. Trash containers, dumpsters and other similar fixtures are away from classroom door overhangs; windows and glass walls; unreinforced block walls; electrical, gas or mechanical systems; and other crowded areas where students and the public may gather. = 1, 2

b. Trash containers have a restricted size so bombs and other type of weapons cannot be concealed inside them. Enclosed dumpsters in a designated service area or surrounded on three sides by a high see-through wall which should be a climbing-resistant fence, and provided with a securable gate. = 3, 4

c. Trash containers have a restricted size so bombs and other type of weapons cannot be concealed inside them and are blast resistant. Dumpsters are located in a designated in service area or surrounded on three sides by a high see-through wall which should be a climbing-resistant fence. Dumpsters have a securable gate or are protected by bollards to keep them from being pushed closer to the building or prevent trash haulers from accidentally colliding into the building = 5</td><td></td><td></td></tr>
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<tr><th>ID</th><th>Criteria</th><th>LOP Options</th><th>Existing LOP</th><th>Nec. LOP</th></tr>
<tr><td>69</td><td>Protection of Critical Equipment

Site planning should include locating critical systems away from vulnerable locations and restricting access to unauthorized people.

All critical equipment could be very vulnerable to earthquake, floods, winds, earthquakes, blast and CBR and exposed to vandalism if they are not properly anchored, located, and protected.

Considerations include the following:
• Air intakes below grade or at ground level can be very susceptible to flood, CBR, and explosives detonations
• HVAC equipment, generators, utility controls, and other similar equipment can be susceptible to a wide range of undesirable events. Typical areas where critical equipment can be exposed to floods are basement, ground floor, and on site- or not elevated, thus becoming vulnerable to flooding.
• Critical systems such as HVAC can be located on the roof thus becoming susceptible to high winds and earthquakes.
• HVAC equipment, generators, utility controls, and other similar equipment can be susceptible to vandalism, sabotage, and terrorist attacks. All outdoor areas containing this type of utility controls and equipment should be made a site restricted area and safety considerations should be put in place for their protection

Certain pieces of equipment are critical to maintain school function and protect the lives of students and teachers during normal and emergency times. Critical Equipment include the following:
• HVAC equipment
• Electrical service including transformers
• Gas meters (Gas meters, back flow preventers, and light standards are the items not connected to the alarm systems)
• Natural gas or diesel generators
• School district owned water plants
• Above ground water service (backflow preventers) Emergency power supplies
• Utility controls
• Hazardous-materials storage
• Telecom and IT rooms and resources.
• FDCs and fire sprinkler valves
• Athletic field light
• Flood control ponds
• Power distribution
• Alarm systems

In addition to proper location, this critical equipment should also be protected by using anti-climb fences or razor/barbed wire. Lower levels of protection can be achieved using shrubbery, decorative fencing, or knee walls.</td><td>a. Critical equipment is properly anchored and elevated, and or protected by shrubbery, knee walls or decorative fences = 1, 2

b. Critical equipment is properly anchored and elevated and protected by fences, walls, gates or other barriers to prevent unauthorized access to restricted areas. = 3, 4

c. Critical equipment is properly anchored, properly elevated, and protected by climbing-resistant fences, reinforced anti vandalism walls, gates or other barriers to prevent unauthorized access to restricted areas. They can be monitored by CCTV and or have an alarm system to provide notification in case of trespassing. = 5</td><td></td><td></td></tr>
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Level of Protection – Site				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
70	**School Buses and Parents Drop-off Areas** School buses are a key element of the system and need to be safe in many ways. It is highly recommended that background checks are performed periodically and before hiring a bus driver. School buses should be driven by drivers that provide a guarantee to student safety and that are trained to react quickly to emergencies. When school needs to combine school transportation with public transportation, schools should consider the route from the school to the point of public transportation access reasonably safe due to good natural surveillance, traffic safety features, and other factors. School should make all the necessary preparation for unexpected bad weather. Students should always be required to walk in front of the bus or other traffic to move between the bus and the school. Major safety features include the following: • Buses should drop off and pick up students directly from a designated, marked loading and unloading zone near a designated and supervised school entrance, in full view of designated school staff • Areas where students congregate while waiting for buses should be adequately designed to avoid overcrowding and accidents; and protected from potential snipers, bullying and drug abuses. • Busses should be able to back up to turn instead of parking in double rows • Parent drop-off areas should be separated from other vehicular traffic and bus loading and unloading areas • School buses need to be protected and parked in safe areas when not in use to prevent vandalism, theft or effects of by bad weather and flooding.  	a. Not Applicable b. Drop-off and pick up areas are adequately located to prevent accidents and other undesirable events and monitored by staff. Buses have reasonable protection for driving in bad weather and they are parked in a moderately protected area. = 1,2. c. Drop-off and pick up areas are adequately well located to prevent accidents and other undesirable events and monitored by staff. Buses have good protection for driving in bad weather and are parked in a moderately protected area. = 3,4 d. Drop-off and pick up areas are very well located to prevent accidents and other undesirable events and monitored by staff and CCVT. Buses have very good protection for driving in bad weather and are parked in a very safe area. = 5  		

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<tr><th>ID</th><th>Criteria</th><th>LOP Options</th><th>Existing LOP</th><th>Nec. LOP</th></tr>
<tr><td>71</td><td>Control of Parking

Parking is a major feature in schools used by staff members and visitors; and in high schools, by students driving to school in their own cars. In very large schools, parking can be a critical feature as it can receive thousands of visitors attending sporting events and other school functions. Parking has several key issues:
1. Access to parking from the street
2. Safe location, away from major street and away from school pathways
3. Parking entrances and uses (i.e., staff, students, and the public)
4. Need for surveillance for the parking lot and roadways and from the parking lot to main school facilities
5. Good lighting
6. Good signage for visitors

Based on these 6 critical points, the following is recommended:
• All school parking should have an appropriate setback distance.
• Natural surveillance or the use of CCTV is required. As possible, parking areas should be within view of the main office or monitored by staff or surveillance cameras.
• Where there are roadways through the site, they should be serpentine or otherwise indirect or include traffic calming features, with gates or barriers as needed to protect students and prevent direct access to school buildings.
• Access to parking areas should be limited by curbs, fencing gates, and a minimum number of entry points
• Signage and directions should be available for visitors parking and school entrances. "No Parking" signage should be posted and arranged for towing of unauthorized vehicles.
• Directions for the public on how to gain access to assembly facilities should be clear.
• For large events and large event venues, team and band buses can be placed at the stadium to buffer and separate the participant entry points from public entry points.
• Separated parking areas for students, teachers and visitors are desirable in terms of safety. Staff can park near a secondary entry where they can use proximity cards to gain access. Staff parking entry may not need to be supervised.
• In high schools, parking spaces should be numbered and marked for the designated users: students, faculty, staff, and visitors. Unassigned parking spaces should be minimized, especially in student parking zones.</td><td>a. Not applicable.

b. Limited setback from street to parking and from parking to major school facilities. Surveillance for parking lot, roadways and pathways from parking to major school facilities is provided by staff during peak hours. Parking for staff, visitors or students is not clearly demarcated. Lighting and signage are limited. = 1, 2

c. Access to parking from street and setbacks from street to parking and from parking to major school facilities are reasonable. Surveillance for parking lot, roadways and pathways from parking to major school facilities is provided by staff during peak hours and during major events. Parking for staff, visitors or students is well indicated. Lighting and signage are reasonable. = 3</td><td></td><td></td></tr>
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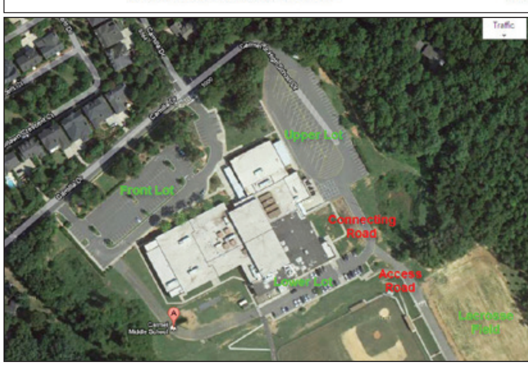
<tr><th>ID</th><th>Criteria</th><th>LOP Options</th><th>Existing LOP</th><th>Nec. LOP</th></tr>
<tr><td>71 (cont.)</td><td>

- Handicapped parking should be located on the shortest route from adjacent parking via an accessible path to an accessible entrance.
- Panic button or intercom call boxes should be used in parking areas, at entry points, in isolated areas, or along the building perimeter as needed.
- As needed to delineate parking areas, anti-ram protection may be provided by adequately strengthened bollards, street furniture, sculpture, landscaping, walls, and fences.
- Controlled access to unnecessary parking entrances during low-use times should be enforced. Gates can be closed off during this period of time
- Bicycle parking areas should be sheltered, securable, and readily observable from inside the school. Rack designs should be provided to make it possible to use U-locks or other effective locking devices.

On April 20, 1999, two Columbine High School seniors, heavily armed, with homemade bombs and numerous firearms, drove to the school in separate cars and strategically parked their vehicles in parking lots from which they could see two exits of the school cafeteria. They walked into the cafeteria deposited bombs in the middle of the room and walked back to their vehicles and waited, planning to shoot the survivors of the blast when they tried to escape from the school   Luckily, the bombs did not denote but 500 student and staff present at the cafeteria did not notice the bombs or the movements of the two students.



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d. Access to parking from street and setbacks from street to parking and from parking to major school facilities are well designed. Surveillance for parking lot, roadways and pathways from parking to major school facilities is provided by staff or CCTV during peak hours and during major events. Parking for staff, visitors or students is separated. Lighting is good and signage provides good explanation to the public. = 4

e. Access to parking from street and setbacks from street to parking and from parking to major school facilities are very well designed. Surveillance for parking lot, roadways and pathways from parking to major school facilities is provided by staff or CCTV at all times and carefully monitored during major events. Parking for staff, visitors or students is very well separated. Lighting is very good and signage provides very good explanation to the public. = 5

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Level of Protection – Site				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
72	**Signage** Signs should be simple, readable, well lit, written in all relevant languages, located at all entry points onto the property and at all entry points into the school, and easy to read from an appropriate distance, such as from a car window when approaching the site. Signage may include the following: • Signs and postings should direct all visitors to the main site entry points to gain permission to enter. • Other entry points should be clearly marked with Illustrations, such as a map with arrows showing visitors the route to the main entry. • A marquee or other sign visible from beyond school property that clearly identifies the school by name should be used. • Visitors parking should be identified with signs and clear information directing them to the main office or area to obtain a parking permit. • School shelters and other special rooms (i.e., auditoriums) should be clearly designated. • Boundaries between joint-use areas and school exclusive areas should be marked. Examples of property line markers include fencing, landscaping, natural geographic features, ground surface treatments, sculpture, architectural features, signs, or changes in elevation. • Signs should not block visual surveillance. • Reflective or lighted markings are ideal. Clear identification of buildings and areas greatly aids emergency response and rescue efforts.  Bright colours combined with chalkboard font are ideal for primary schools giving a friendly feel.  	a. Provide information to pedestrians and to teachers, students, and the public accessing the school in vehicles. = 1 b. Provide information to pedestrian and teachers, students, and the public who access the school in vehicles. Students and visitors are swayed away from unauthorized areas. Clear signs are available to direct the public to school events. = 2 c. Signs and maps provide information to pedestrian and teachers, students, and the public accessing the school by vehicles. Students and visitors are naturally swayed away from unauthorized areas. Clear signs are available to direct the public to school events. = 3, 4 d. Signs and maps provide information to pedestrian and teachers, students, and the public accessing the school by vehicles. Clear signs are available to direct the public to school events. Signage clearly marks restricted areas and indicate methods of enforcement. = 5		

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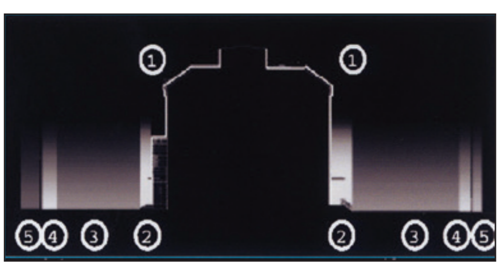
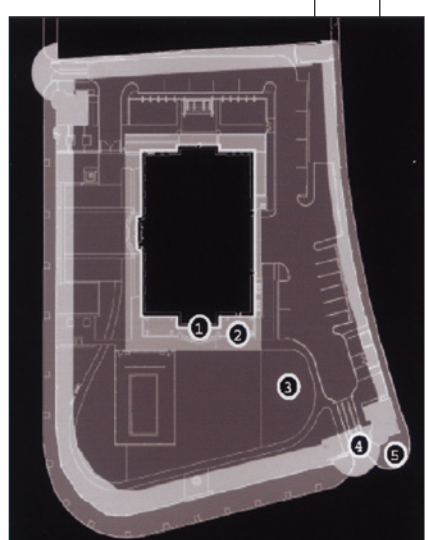
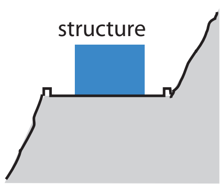
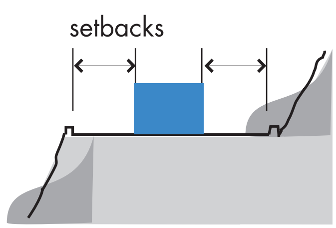
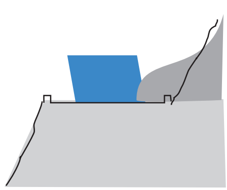
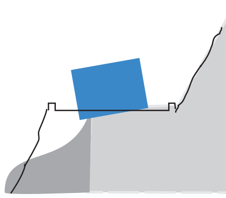
Level of Protection – Site				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
73	**Site Lighting** Lighting should be sufficient to illuminate potential areas of concealment and enhance any observation area such as parking areas, streets, alleyways and around the school facility. If possible, site lighting should be coordinated with the closed-circuit television (CCTV) system. Some considerations are as follows: • Exterior lighting controls should be centrally accessed from the main administration area. • Security lighting should be directed at the building if the building is to be patrolled from the exterior. • Lighting should illuminate the grounds if the building is to be patrolled from the interior, without compromising surveillance by creating glare for the observer. • Exterior lighting scheme should be effective for enhancing natural surveillance, discouraging trespassing, and preventing school vandalism. • Practice either the "full lighting" or the "dark campus" approach after hours. The dark campus approach discourages trespassing inside the building at night (intruders' lights are readily visible) and saves on electricity. • Lighting fixtures should be designed to avoid providing handholds for climbing onto the building. • Exterior lighting fixtures should be vandal resistant, located beyond easy reach (at least 12 to 14 feet off the ground), maintainable and built with break-resistant lenses or protected by cages or other means. • Lighting fixtures should be well maintained by the school. • Reflective or lighted markings are ideal. Clear identification of buildings and areas greatly aids emergency response and rescue efforts. 	a. Lighting fixtures are well maintained and help to enhance natural surveillance. = 1 b. Lighting fixtures are well maintained, help to enhance natural surveillance and are designed to avoid providing handholds. = 2 c. Lighting fixtures are installed at entrances exits, parking lots, garages, and walkways, are well maintained, help to enhance natural surveillance and are designed to avoid providing handholds. = 3 - 4 d. Lighting fixtures are controlled centrally, installed at entrances, exits, parking lots, garages, and walkways, are well maintained, help to enhance natural surveillance and are designed to avoid providing handholds. = 5 		

Level of Protection – Site

ID	Criteria	LOP Options	Existing LOP	Nec. LOP
74	**Soil Type** Soil type, a major factor in the seismic resiliency of a school, is the type of soil/rock on which a school 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. Poor soils (i.e., unstable, saturated or altered) and drainage can be also an important consideration for flooding, landslide, and scour. Soils, like silt and clay can quickly absorb large amounts of water, can cause school buildings to crack and buckle and soils to dislodge from foundations. When building or retrofitting a school, an important step is to determine the site characteristics and flood hazards. The best available information should be examined, including flood hazard maps, records of historical flooding, storm surge maps and advice from local experts. When site modifications are considered and flood hazard has been identified, planners and designers may want to evaluate the feasibility to certain site modification in order to provide an increased level of protection such as elevations, earthen fill, excavation, earthen levee, floodwall, continuous perimeter walls, and stem wall foundations.	a. No special measures required = 1 b. Poor = 1 c. Medium = 2, 3 d. Best = 4 - 5 Note: See Soil table below for soil type ranks. If there is no basis for classifying the soil type, the screener should select Option "c" (medium). Sites with high water tables typically indicate unstable soil conditions and should be rated as Option "b" (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

Level of Protection – Site				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
75	**Topography and Slope** Landslide is a natural process which occurs and recurs in certain geologic settings under certain conditions. Potential for ground failure and landslides is determined by soil type, water content (degree of saturation), gradient (slope angle), and increase in water content resulting from irrigation or storm run-off). Interactions between landslide and many other hazards can be of great concern. Continuous rainfall, snowmelt, and ground movements can cause widespread landslides and flooding. Landslides can be triggered by heavy rain (hurricane related or not), exacerbated by floods, ground movements (tectonic earthquakes or volcanic eruptions), tsunamis and/or excavations that upset site equilibrium. In addition, to mudflow, landslides can be accompanied by rock fall. Landslides commonly are characterized by high velocity and can produce fatal consequences. Although all 50 states are subject to landslide activity, the Rocky Mountain, Appalachian, and Pacific Coast regions generally suffer the greatest landslide losses. For landslide planning, the USGS has available landslide hazards maps and studies.  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. Not applicable b. Very high possibility = 1 c. High possibility = 2 d. Moderate possibility = 3 e. Low possibility = 4 f. Very low possibility = 5		

Level of Protection – Site				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
75 (cont.)	Careful considerations should be taken when the school grounds and are located in a slope terrain. GIS and satellite images are extremely useful to understand landslide susceptibility. To plan a new design of a school or retrofit an existing one, designers can use geotechnical investigations of the site and surrounding terrain, zoning and thematic maps, GIS and remote sensing and risk studies. This type of information is usually available from the USGS, especially at State or local level jurisdictions. Careful considerations should be taken when the school grounds and are located in a slope terrain. GIS and satellite images are extremely useful to understand landslide susceptibility. To plan a new design of a school or retrofit an existing one, designers can use geotechnical investigations of the site and surrounding terrain, zoning and thematic maps, GIS and remote sensing and risk studies. This type of information is usually available from the USGS, especially at State or local level jurisdictions. The State of California has available the following GIS maps: A Landslide Hazard Map indicates the possibility of landslides occurring throughout a given area. A hazard map may be as simple as a map that uses the locations of old landslides to indicate potential instability, or as complex as a quantitative map incorporating probabilities based on variables such as rainfall thresholds, slope angle, soil type, and levels of earthquake shaking. An ideal landslide hazard map shows not only the chances that a landslide may form at a particular place, but also the chance that it may travel downslope a given distance. (From http://www.usgs.gov/faq/list_faq_by_category/get_answer.asp?id=315) Landslide Susceptible Maps rank slope stability of an area into categories that range from stable to unstable. Susceptibility maps show where landslides may form. Many susceptibility maps use a color scheme that relates warm colors (red, orange, and yellow) to unstable and marginally unstable areas and cool colors (blue and green) to stable areas. (From http://www.usgs.gov/faq/list_faq_by_category/get_answer.asp?id=314) Landslide Inventory Maps show the locations and outlines of landslides. A landslide inventory is a data set that may present a single event, a regional event or multiple events. Small-scale maps may show only landslide locations whereas large-scale maps may distinguish landslide sources from deposits and classify different kinds of landslides and show other pertinent data. (From http://www.usgs.gov/faq/list_faq_by_category/get_answer.asp?id=313) Landslide Risk Maps show the expected annual cost of landslide damage throughout an area. Risk maps combine the probability information from a landslide hazard map with an analysis of all possible consequences (property damage, casualties, and loss of service). (From http://www.usgs.gov/faq/list_faq_by_category/get_answer.asp?id=316)			

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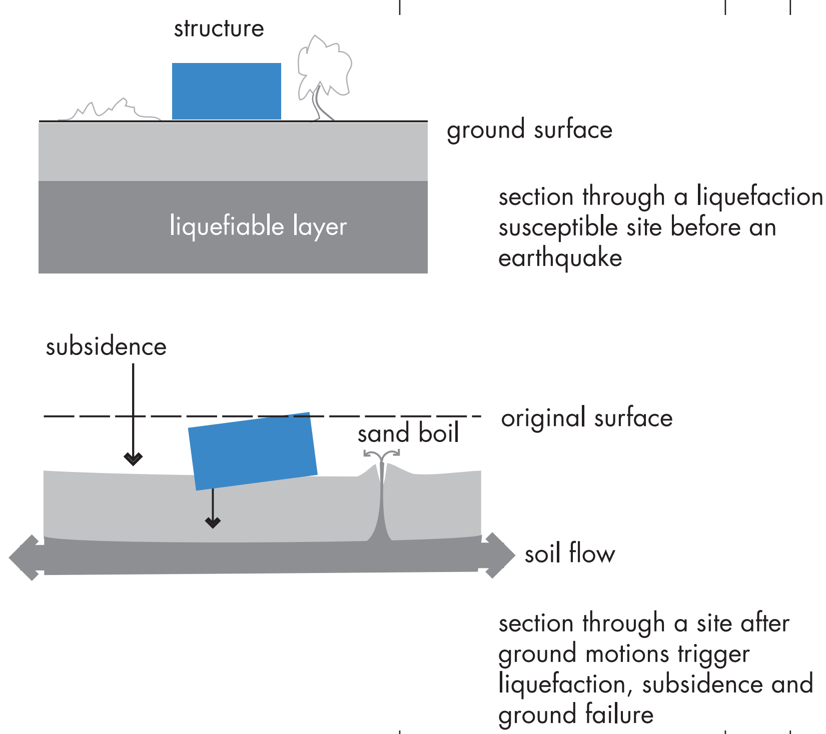
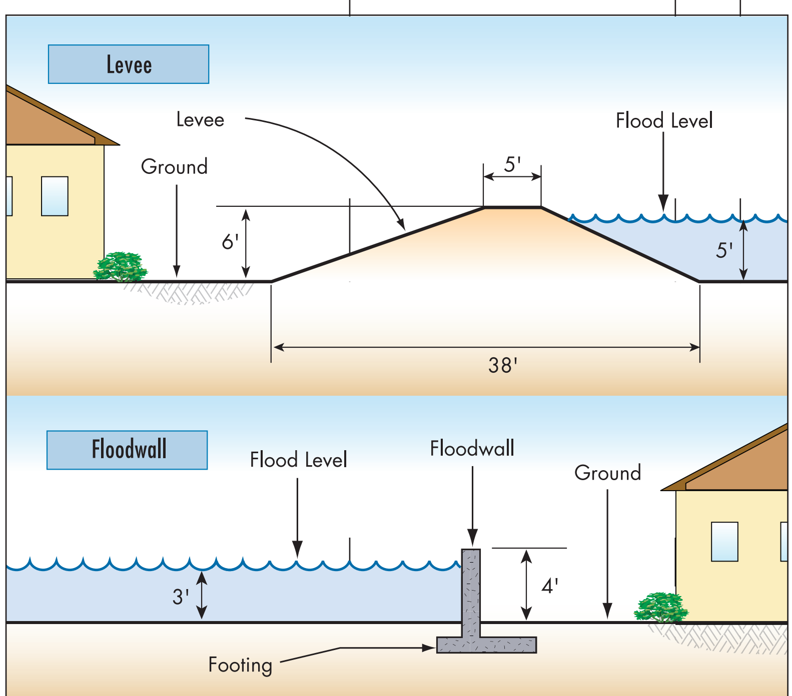
Level of Protection – Site				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
76	**Potential of Soil Liquefaction** Liquefaction occurs in earthquakes when water-saturated soils, sands, or gravels flow laterally or vertically like a liquid. Earthquake ground motions shake the material 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 a school 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 Surveys Earthquake Hazard Mapping program. Liquefaction Maps are available from USGS. These maps are designed to give the general public as well as land-use planners, utilities and lifeline owners, and emergency response officials, new and better tools to assess their risk from earthquake damage. The maps also contribute to the California Geological Survey's Seismic Hazard Zone maps.	a. Not applicable b. Very high possibility = 1 c. High possibility = 2 d. Moderate possibility = 3 e. Low possibility = 4 f. Very low possibility = 5		

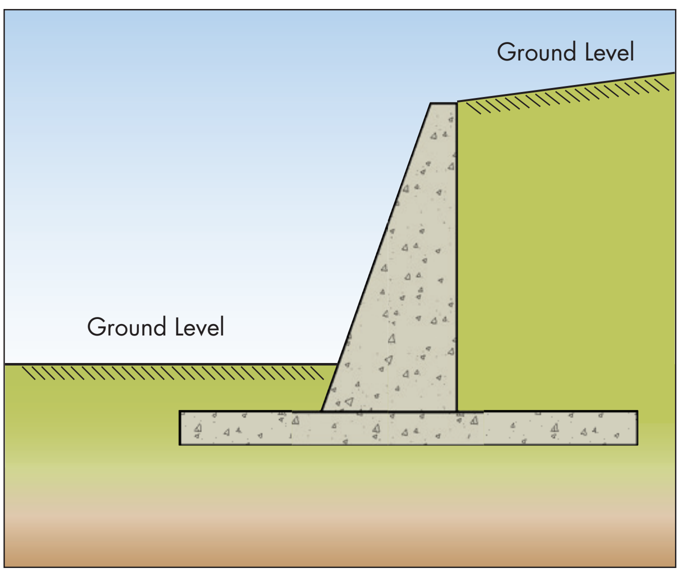


Cross section through a site where liquefaction and subsidence could occur.

Level of Protection – Site				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
77	**Erosion and Localized Scour** Erosion generally refers to a lowering of the ground surface as a result of a flood event. Erosion may occur in riverine and coastal flood hazard areas. In coastal areas, erosion may affect the general ground surface and may cause a short-term or long-term recession of the shoreline. Erosion should be considered during load calculations, because it increases the local flood depth, which in turn influences load calculations. In areas subject to gradual erosion of the ground surface, additional foundation embedment depth can mitigate the effects. However, where waterways are prone to changing channels and where shoreline erosion is significant, engineered solutions are unlikely to be effective. Avoidance of sites in areas subject to active erosion is the safest and most cost-effective course of action. Determining potential scour is critical in the design of foundations to ensure that failure during and after flooding does not occur as a result of the loss in either bearing capacity or anchoring resistance around the posts, piles, piers, columns, footings, or walls. Scour determinations require knowledge of the flood depth, flow conditions, soil characteristics, and foundation type. Localized scour results from turbulence at the ground level around foundation elements. Scour occurs in both riverine and coastal flood hazard areas, especially in areas with erodible soils. At some locations, soil at or below the ground surface can be resistant to localized scour, and calculated scour depths based on unconsolidated surface soils below will be excessive. In instances where the designer believes the underlying soil at a site will be scour-resistant, the assistance of a geotechnical engineer or geologist should be sought. In case local zoning maps for identifying erosion and scour are not available, FEMA FIRMs can be used. In this case, 'A" zones are found along riverine bodies of water (river, streams, creeks, etc.).	a. Not applicable b. Very high possibility = 1 c. High possibility = 2 d. Moderate possibility = 3 e. Low possibility = 4 f. Very low possibility = 5		

Level of Protection – Site				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
78	**Flood Site Modifications** If the site is occupied by an existing school or one to be designed is affected by flood hazard, some modification to the terrain can improve and increase level of protection. Major site modifications include the following: • Excavation: Excavation alone rarely results in significantly altering the floodplain on a given parcel of land. Excavation that modifies a site is more commonly used in conjunction with fill in order to offset or compensate for the adverse impacts of fill. • Earthen fill: Fill can be placed in the flood hazard area for the purpose of elevating a site above the design flood elevation. Fill is a less effective elevation method in flood hazard areas exposed to wave action, such as the banks of wide rivers, back bays, or Coastal A Zones. • Earthen levee: A levee is a specially designed barrier that modifies the floodplain by keeping the water away from certain areas. This measure requires detailed, site-specific geotechnical investigations and engineering analyses. • Floodwall: A floodwall is a significant structure that is designed to hold back water of a certain depth based on the design flood for the site. Generally, due to design factors, floodwalls are most effective in areas with relatively shallow flooding and minimal wave action. As with levees, designs must accommodate interior drainage on the land side, and maintenance and operations are critical for adequate performance. It may be difficult for those without an architectural/ engineering background to assess the presence of lateral systems. However this is a very important question for evaluating most hazards. In case of difficulties, the screener should consult the facility manager, the building design documents or consult with a structural engineer or other design or construction professional with experience.	a. Not applicable or required b. Very large modifications = 1 c. Large modifications = 2 d. Moderate modifications = 3 e. Small modifications = 4 f. Very small modifications = 5 **A Zones:** Flood hazard areas designated as A Zones on FIRMs are areas where significant wave action is not expected. A Zones are found along riverine bodies of water (rivers, streams, creeks, etc.), landward of V Zones, and on some open coastlines that do not have map V Zones		



Level of Protection – Site				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
79	**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.  	a. Not applicable b. Shows signs of severe distress (e.g., cracks, spalling, leakage) = 1 c. Poor condition; not anchored to the soil below or behind = 2 d. Moderate condition; minor cracking and spalling that does not impede structural integrity = 3 e. No special measures required = 4 f. Good condition; no signs of distress/ appears to be new or retrofitted = 5		

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Level of Protection – Architectural

ID	Criteria	LOP Options	Existing LOP	Nec. LOP
80	**Space Planning** Space planning refers to the interior layout and design of the schools. This usually reflects the complexity, range of functions and activities, and adequacy of safety provisions. Traditionally city schools have been one to three stories in height consisting of rows of classroom on either side. However they can differ based on location density. For example, they can be located in high density urban, urban, semi-rural or rural areas. Suburban school construction also maintains the fundamental design of classrooms along double-loaded corridors. The following should be considered for space planning: • Site Characteristics • Number of Students and visitors • Number of parking/type of parking areas • Life safety issues • Evacuation in case of an emergency. • School Density (urban, rural, semirural) • School Facility Size (Campus) • Surrounding Traffic • Functions/Multifunction • Shelter Function • Operational Redundancy • Replacement Value • Number of Classrooms • Number of Special Education Rooms • Laboratory Types • Athletics capacity • Library • Size of cafeteria/kitchen • Size and location of Bathrooms/ shower rooms • Refuge area in case of shootings • Sacrificial Areas (areas that could buffer the critical function areas)	a. Very low Complexity = 1 b. Low Complexity = 2 c. Moderate Complexity = 3 d. High Complexity = 4 e. Very High Complexity = 5		

Helistop. When considering space planning for the building(s) and site, the designer should have in mind the availability of open flat ground that can function as a helistop for medical or police helicopters. Sports facilities and empty parking lots are usually identified as the best spaces for this function. Any part of the school that is identified as a preferred helistop should be made free from materials that could be dangerous when blown by the rotor wash.

Level of Protection – Architectural

ID	Criteria	LOP Options	Existing LOP	Nec. LOP
81	**School Building Height** Building height is the height of the school building above grade. The height of one story is in general assumed to be approximately 13 feet. Typical city schools are one to three stories in height. 	a. < 20 feet (1 floor) = 1 b. ≥ 20 feet, < 50 feet (2 to 3 floors) = 2, 3 c. ≥ 50 feet (more than 3 floors) = 4, 5		
82	**Horizontal Configurations and Irregularities** Configurations issues are of extreme importance primarily for blast and earthquake resistance. Blast: The school configuration, and its three-dimensional shapes, 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. For blast, configuration issues are significant up to a height of approximately 50 feet. West Anchorage Alaska High School after the 1964 earthquake. The photo shows damage to the notch of this splayed L-shape building. Note that the heavy walls have attracted large forces. A short column effect is visible at the column between the two bottom windows which have suffered classic X –shaped shear-failure cracking and the damage at the top where this highly stressed region has been weakened by the insertion of windows. 	a. Irregular and reentrant corners = 1,2 b. No irregularity/ circular and convex or rectangular = 3,4,5		

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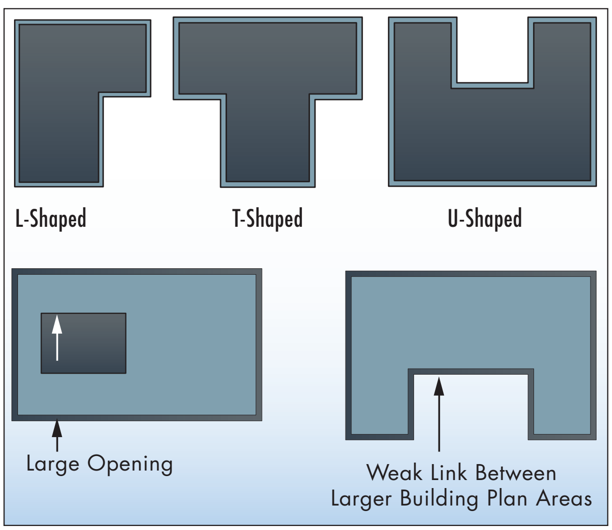
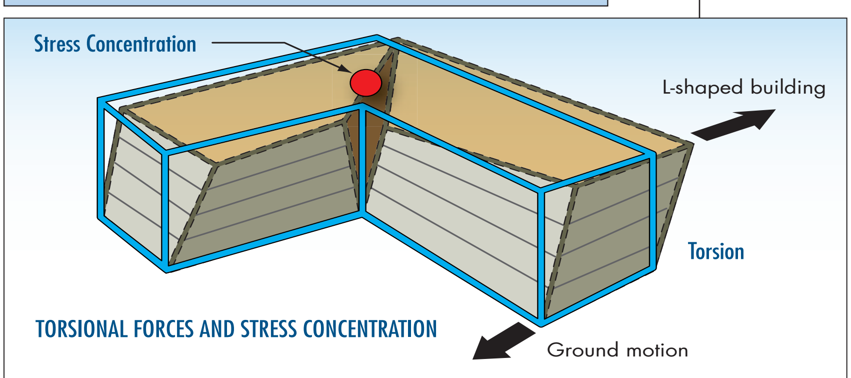
Level of Protection – Architectural

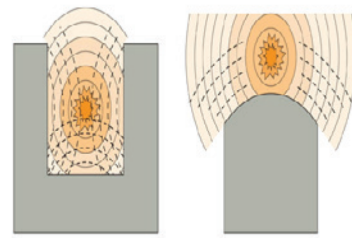
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
82 (cont.)	Earthquakes: In earthquake zones, there are two problems that result from irregular shape types. The first is that they tend to produce differential motions between different wings of the building that, result in local stress concentrations at the re-entrant corner, or "notch", because of stiff elements that tend to be located in this region,			

The second problem is torsion which is caused because the center of mass and the center of rigidity in irregular shape types cannot geometrically coincide for all possible earthquake directions. The result is rotation. The resulting forces are very difficult to analyze and predict. The stress concentration at the "notch" and the torsional effects are interrelated. The magnitude of the forces and the severity of the problems will depend on:

- The characteristics of the ground motion
- The mass of the school building
- The type of structural systems
- The length of the wings and their aspect ratios (length to width proportion)
- The height of the wings and their height/depth ratios

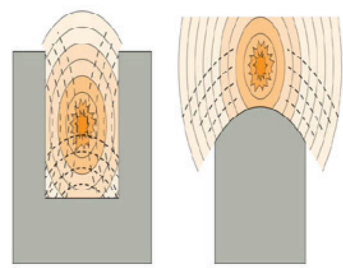






Circular (convex) showing the air blast

SOURCE: DAVID SHAFER



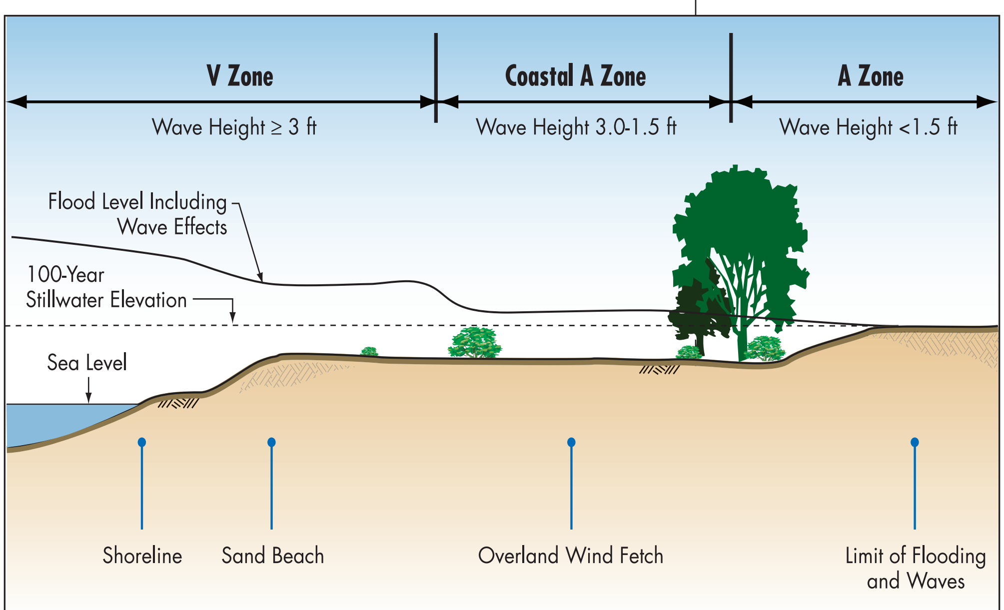
Re-entrant corner plan showing multiple reflection condition

SOURCE: DAVID SHAFER

Re-entrant corner plan forms are a useful set of building shapes for urban sites, particularly for residential apartments and hotels, which enable large plan areas to be accommodated in relatively compact form, yet still provide a high percentage of perimeter rooms with access to air and light.

Torsion occurs when building configuration is geometrically regular and symmetrical but nonetheless irregular for seismic design purposes. If a building presents a wide variation in strength and stiffness around the perimeter, the center of mass will not coincide with the center of resistance, and torsional forces will tend to cause the building to rotate around the center of resistance.

Level of Protection – Architectural				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
83	**School Flood Elevation** FEMA has prepared a series of flood hazard maps depicting areas subjected to flooding. Land that is on one side of the line is "in" the mapped flood hazard area, while the other side of the line is "out." Although the delineation may be an approximation, having hazard areas shown on a map facilitates avoiding such areas to the maximum extent practical. When a decision is made to build a new school on a site that is affected by flooding, the characteristics of the site and the nature of the flooding must be examined prior on the highest available ground. Positioning the buildings, parking lots, and athletic field is influenced by identification of all site constraints, which include such factors as presence of flood hazard areas, wetlands, poor soils, steep slope, sensitive habitant, mature tree stands, and other important environmental factors. Schools should not be built in a V Zone. If there is a plan to build a school in an A Zone, school officials should carefully evaluate all of the benefits and all of the costs related to long-term acceptable risks and to develop appropriate plans for design and construction of a new facility. The NFIP regulations and the building codes require the elevation of the bottom of the lowest horizontal structural member of the lowest floor (including basement) to be at or above the DFE (Design Flood Elevation) (plus freeboard, where required). Given the importance of schools, elevation to or above the 0.2-percent-annual-chance flood (500-year) elevation is appropriate and strongly recommended.	a. Not applicable b. Minimum DFE and elevation of utility systems, No site modifications = 1 c. Moderate freeboard and elevation of utility systems, Minimum site modifications = 2,3 d. Adequate freeboard and elevation of utility systems, Appropriate site modifications = 4 e. Very good flood mitigation measures. Excellent freeboard and elevation of utility systems, Very good site modifications = 5		



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Level of Protection – Architectural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
83 (cont.)	**Key Flood Design Considerations** **DFE – Freeboard.** Schools should check with the appropriate regulatory authority to determine the minimum flood elevation to be used in site planning and design. Elevations can be established by examining each particular case and the cost of implementation of various design options (see FEMA 424 – Design Guide for Improving School Safety in Earthquake, Floods, and High Winds). Most common methods include: slab-on grade foundation on structural fill; stem wall foundation; columns or shear wall foundation (open foundation); and continuous perimeter wall (enclosed foundations with crawlspace); and pier support for manufactured and portable units. **Elevation of Utility Systems.** Utilities may be protected either by elevation or special design and installation measures. Utility systems and equipment are best protected when elevated above the DFE (plus freeboard, if required). Plumbing conduits, water supply lines, gas lines, and electric cables that must extend below the DFE should be located, anchored, and protected to resist the effects of flooding. **Site Modification to Reduce Flood Impact.** Site modifications can be added to minimize the impact of flooding (see FEMA 424 – *Design Guide for Improving School Safety in Earthquake, Floods, and High Winds*): • Earth berm; earthen levee – Engineering structures designed to keep water away from land area and buildings • Permanent floodwall – Permanent engineering structure designed to prevent encroachment of floodwaters • Mobilized floodwall - Are fully engineered flood protection structures and features that require human intervention when a flood is predicted. **V Zone.** Flood hazard areas designated as "V Zones" on FIRMs are relatively narrow areas along open coasts and lake shores where the base flood conditions are expected to produce 3-foot or higher waves. V Zones are found on the Pacific, Gulf, and Atlantic coasts, and around the Great Lakes. All efforts should be made to locate schools outside of a V Zone. This is particular true in coastal areas subject to hurricane related flooding **A Zones.** Flood hazard areas designated as A Zones on FIRMs are areas where significant wave action is not expected. A Zones are found along riverine bodies of water (rivers, streams, creeks, etc.), landward of V Zones, and on some open coastlines that do not have mapped V Zones. Special consideration should be taken when a school is built in an A Zone in terms of site design, the presence of flood hazard areas, wetlands, poor soils, steep slopes, sensitive habitats, mature tree stands, and the environmental requirements set by the various regulatory authorities and the agency that approves development plans. **Freeboard.** Freeboard is a factor of safety usually expressed in feet above a flood level. Freeboard compensates for the many unknown factors that could contribute to flood heights, such as wave action, constricting bridge openings, and the hydrological effect of urbanization of the watershed. A freeboard from 1 to 3 feet should be applied when designing schools in high risk flood areas **Base Flood Elevation (BFE).** The BFE is the predicted water surface elevation (in feet above datum). **The Design Flood Elevation.** The DFE establishes the minimum level of flood protection that must be provided. The DFE, as used in the model building codes, is defined as either the BFE determined by the NFIP and shown on FIRMs, or the elevation of a design flood designated by the community, whichever is higher. The DFE will always be at least as high as the BFE			

Level of Protection – Architectural				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
83 (cont.)	(see nested table below)			

ASCE/SEI 24-05 provisions related to the elevation of critical facilities		Category III	Category IV
Elevation of Lowest Floor or Bottom of Lowest Horizontal Structural Member	A Zone: elevation of lowest floor	BFE +1 ft or DFE, whichever is higher	BFE +2 ft or DFE, whichever is higher
	V Zone and Coastal A Zone: where the lowest horizontal structural member is parallel to direction of wave approach	BFE +1 ft or DFE, whichever is higher	BFE +1 ft or DFE, whichever is higher
	V Zone and Coastal A Zone: where the lowest horizontal structural member is perpendicular to direction of wave approach	BFE +2 ft or DFE, whichever is higher	BFE +2 ft or DFE, whichever is higher
Elevation Below which Flood-Damage-Resistant Materials Shall be Used	A Zone	BFE +1 ft or DFE, whichever is higher	BFE +2 ft or DFE, whichever is higher
	V Zone and Coastal A Zone: where the lowest horizontal structural member is parallel to direction of wave approach	BFE +2 ft or DFE, whichever is higher	BFE +2 ft or DFE, whichever is higher
	V Zone and Coastal A Zone: where the lowest horizontal structural member is perpendicular to direction of wave approach	BFE +3 ft or DFE, whichever is higher	BFE +3 ft or DFE, whichever is higher
Minimum Elevation of Utilities and Equipment	A Zone	BFE +1 ft or DFE, whichever is higher	BFE +2 ft or DFE, whichever is higher
	V Zone and Coastal A Zone: where the lowest horizontal structural member is parallel to direction of wave approach	BFE +2 ft or DFE, whichever is higher	BFE +2 ft or DFE, whichever is higher
	V Zone and Coastal A Zone: where the lowest horizontal structural member is perpendicular to direction of wave approach	BFE +3 ft or DFE, whichever is higher	BFE +3 ft or DFE, whichever is higher
Dry Floodproofing	A Zone: elevation to which dry floodproofing extends	BFE +1 ft or DFE, whichever is higher	BFE +2 ft or DFE, whichever is higher
	V Zone and Coastal A Zone: dry floodproofing not allowed	Not applicable	Not applicable

ID	Criteria	LOP Options	Existing LOP	Nec. LOP
84	**Wild Fires and School Buildings** Wildland-urban interface (WUI) is most acute in the western and southern states followed by areas in the Mid-Atlantic states and the Pacific Northwest. However, the risk for forest fires spreading increases year by year as communities continue to grow and more and more people build in forested areas. In 2007, the WUI occupied 9 % of the surface and contained approximately 39 % of all housing units within the conterminous US. It has been established that 45 million homes in 70000 communities are at risk of WUI fires—which have destroyed an average of 3000 structures annually over the last decade—and this risk is rapidly increasing. WUI encompasses many different structures, including schools, that are either co-located or abut wildland vegetation and forest. WUI affects both existing communities and new construction. Major causes of WUI fires include the upsurge of structures in the WUI, long-term drought, climate change, and build-up of wildland fuel. In the last 100 years, 6 of the top 10 fire loss incidents occurred in WUI areas (5 of the 6 occurred in California).	a. Not applicable. b. Exposure 4 - High Hardening Construction Requirements = 1 c. Exposure 2 - Low Hardening Construction Requirements. = 2,3 d. Exposure 3 - Intermediate Hardening Construction Requirements. = 4 e. Exposure 1 - Normal Construction Requirements = 5		

Level of Protection – Architectural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
84 (cont.)	While there are a number of strategies in place to address wildland fires, including rapid fire containment and suppression and fuels management, wildfire mitigation strategies do not necessarily target WUI communities. An approach to mitigating WUI fires has been to improve the fire resistance or harden the structures. The National Fire Protection Association (NFPA), the International Code Council (ICC), and ASTM International have developed building codes and standards for WUI communities. However, the range of actual exposures possible under different conditions has not been fully characterized or quantified. For this Guide, the NIST scale will be utilized for those schools within the WUI areas.			

NIST Fire Scale

For this Guide, the NIST scale will be utilized for those schools within the WUI areas.

Exposure 1 = Normal Construction Requirements:

- Maintained Landscaping
- Local AHJ-Approved Access for firefighting equipment

Exposure 2 = Low Construction Hardening Requirements:

- Treated combustibles allowed on structure
- Attached treated combustibles allowed
- Treated combustibles allowed around structure
- Low flammability plants
- Irrigated and well maintained Landscaping
- Local AHJ-Approved Access for firefighting equipment

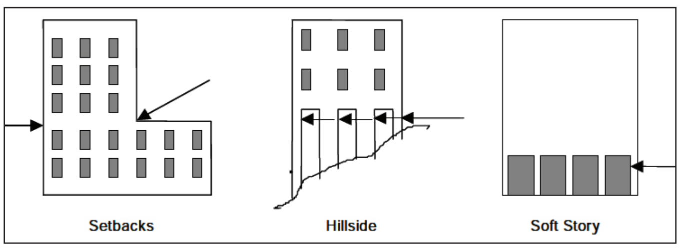
Exposure 3 = Intermediate Construction Hardening Requirements:

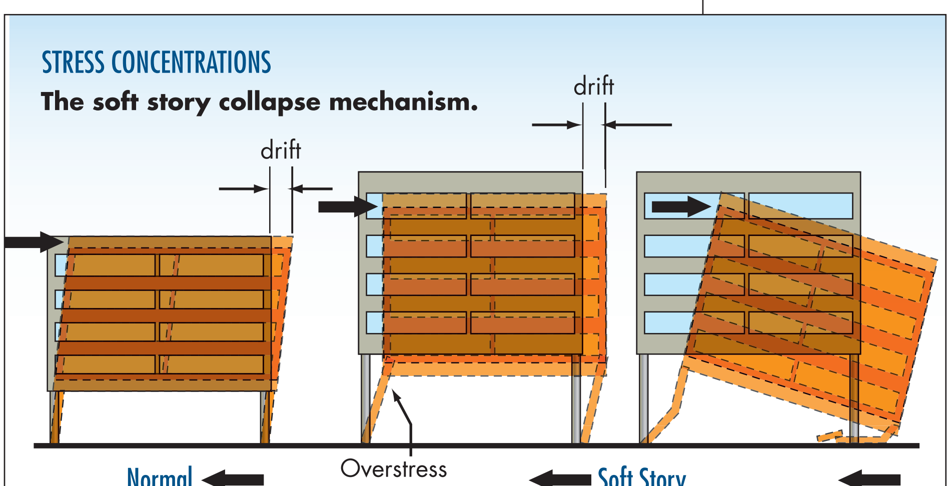
- No exposed combustibles on structure
- Combustibles placed well away from structure
- Low flammability plants
- Irrigated and well maintained landscaping
- Local AHJ-Approved Access for firefighting equipment

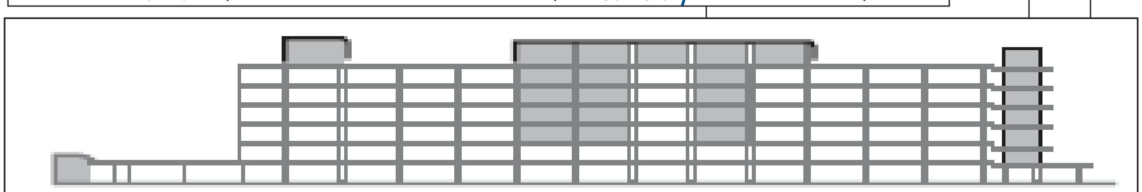
Exposure 4 = High Construction Hardening Requirements:

- No exposed combustibles
- All vents, opening must be closed
- Windows and doors must be covered with insulated non-combustible coverings.
- Irrigated and well maintained low flammability landscaping
- Local AHJ-Approved Access for firefighting equipment

Level of Protection – Architectural				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
85	**Soft Stories and Vertical Irregularities in Earthquake Areas** Vertical irregularities are very critical in the case of earthquake hazards, explosives and to a lesser degree winds. A soft story is an area on the lower floors of a multistory school 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. Soft story buildings are vulnerable to collapse in a moderate to severe earthquake in a phenomenon known as soft story collapse. Three typical conditions create a soft first story: • The vertical structure between the first and second floor is significantly more flexible than the that of the upper floors • The vertical framing elements do not continue to the foundation but rather are terminated at the second floor to increase the openness at ground level	a. Not Applicable b. Vertical irregularities very high = 1 c. Vertical irregularities moderate = 2, 3 d. Vertical irregularities minimal = 4. 5 Shear walls are design to receive lateral forces from diaphragms. To be effective, they must run from the top of the building to the foundation with no offsets and a minimum of openings When shear walls form the main lateral resistant element of a structure, and there is not a continuous load path through the walls from roof to the foundation, the result can be serious overstressing at the points of discontinuity. This discontinuous shear wall condition represents a special, but common, case of soft-first story.		







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<table>
<tr><th colspan="5">Level of Protection – Architectural</th></tr>
<tr><th>ID</th><th>Criteria</th><th>LOP Options</th><th>Existing LOP</th><th>Nec. LOP</th></tr>
<tr><td>86</td><td>Main Entrance, and Front Desk Access Control

Very few actions can take place to stop an armed shooter or a person carrying a bomb who has already entered the school. The front desk is the main area where these intruders can be stopped and access prevented to classrooms and other areas of the school.

Keeping away from school armed students and intruders that to cause harm is critical. Depending on the size, location, and vulnerability of the school some levels of intrusion detection, access control and immediate video surveillance should be incorporated into the design of the school lobby or retrofit measures.

The main entrance should be conducive to maintain the openness and welcoming ambiance require in the reception area while providing additional safety for the staff. Staff that works in the front desk is at high risk in case of a school shooting event or other type of violence. As possible, this area should be hardened and have panic/duress alarms or call buttons available.

The following are recommended considerations:

• As much as possible force all visitors (pedestrians) entering the school building to use the main entrance.
• The main entrance should be visible, monitored by staff or CCTV and controllable from the front desk or a remote location such as the administrative office.
• An intercom/video call box should be located outside the school. This should be the first check point for school entrance. This way the front desk can screen a guest via this system while the guest is still outside.
• The front desk should have a communication system in place which allows this office to communicate any emergency to the rest of the school.
• The front desk staff should have the capability to allow students that are outside the school if an emergency takes place and the school is in lockup mode to gain re-entry. One effective way to address this problem is to install proximity card readers on exterior doors so that for building security they are locked, but those caught outdoors can get back into the school quickly when necessary.
• The front desk staff should have the capability to notify students that are outside the school not to enter the school if a life threatening emergency is taking place inside the school.

For information on high-security locks, refer to UL Standard 437, Key Locks, American National Standards Institute (ANSI) Standard A156.30-2003, American National Standard for High Security Cylinders, and ANSI Standard 156.5-2001, American National Standard for Auxiliary Locks and Associated Products.</td><td>a. There is more than one entrance and all entrances are not monitored by CCTV. Buildings are not securely locked. Visitors are not scrutinized after they reach the Front Desk. Panic bottoms are not available. None or very limited = 1, 2

b. CCTV is available to scrutinize visitors before arriving to the Front Desk and the Front Desk is able to control entry to main school building. There is one single main entrance but a few public areas are within the reach of visitors = 3

c. Front Desk is controlled by CCTV and can be monitored from a remote location. Intercom and CCTV are located outside the main entry door = 4

d. Front Desk is controlled by CCTV and can be monitored from a remote location. Visitors can be scrutinized before entering the Front Desk. The main door and the entry point that communicates with the Front Desk with the rest of school are secure. Panic bottoms are available and students outside are able to hear warnings made over the school's public address system = 5</td><td></td><td></td></tr>
</table>

Level of Protection – Architectural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
86 (cont.)	• The front desk, in addition to the primary access, should have a secondary entry point that connects with the rest of the school. Visitors granted access through the primary entrance should be required to wait in the front desk area until entry to the school is authorized. The secondary entrance should remain locked at all times except during students' arrival or dismissal. • Arrival and dismissal times require a lower security posture due to the volume of student and staff movement. Properly trained and equipped staff must be assigned to monitor activities during these periods. Staff should be equipped with radios and/or phones to communicate with building/office staff. • Access to school when students are arriving in the morning should be carefully monitored in order to avoid intruders attempting to tag along. • As much as possible, schools with several buildings or entries should force visitors (pedestrians) entering the school building to use the main entrance to receive authorization to enter the school. If this is not possible, other control entry security systems should be in place in each building. Buildings that are not in use should remain securely locked. • Access to non-public areas should be restricted and appropriately enforced. Where appropriate, warning signs in a friendly but firm way should be posted about trespassing and illicit behavior and applicable laws and regulations should be cited. • Panic buttons should also be available at different critical locations. • At least the main school entrance and front desk door that communicates with the rest of the school should be bullet-proof and hand-made bomb resistant. This door should be difficult to barricade using small objects like pliers and chains. • Exterior doors should be numbered to assist first responders making entry at the best possible locations in case of an emergency. • Hinge pins located on the unsecured side of perimeter and critical interior doors must be designed to preclude door removal. • Access by unauthorized individuals during school hours should be carefully monitored and access only provided after proper identification • Schools should consider granting entry only via supervised staff or through the use of proximity cards, keys, coded entries, or other devices • As possible and necessary, front entrances should be protected with bollards or other appropriate obstructions.			

On Tuesday, March 24, 1998, two boys, an 11-year-old 6th-grade student and a 13-year-old 7th grade student, did not attend classes at their Westside Middle School in Jonesboro, Arizona. They stole a van and reached school grounds with pistols, handguns, and rifles. They drove the van to a preplanned parking place about ½ mile from the school and they moved undetected and by foot wearing camouflage hunting gear. One of the shooters walked to the school and pulled the fire alarm and then returned to his former position. Eighty seven students and nine staff members gathered near one of the exits close to the shooters. The shooters fired approximately 30 shots from high-powered rifles in less than a minute, probably closer to 15 seconds. Why the shooting stopped is unclear, but a construction employee working on the school's new 5th-grade wing appears to have seen the shooters and yelled at them to stop. They stopped shooting, picked up their weapons and ran away through the woods where they were captured later on. They shot 15 people. Four students and one teacher were killed, and nine students and one teacher were injured.

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Level of Protection – Architectural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
87	**Classrooms** Classrooms are the most important spaces in school buildings. Classroom should has natural or forced air ventilation and be large enough to accommodate the number of students scheduled in the class comfortably. The size of the classroom and interior areas, the colors of the walls, the type of furniture and flooring, the amount of light, and the room arrangement all influence how students learn and also have a strong influence on health and school safety. Classrooms should also have appropriate light for teaching and for teachers to monitor student behavior even when lights are dimmed for presentation purposes. Hard-surface play areas should be located far enough from classrooms to protect windows and avoid being a classroom distraction. Classrooms should be designed to reduce the risk of students becoming trapped in a fire, structural collapse, or violent attack. Classrooms should be able to minimize the impact of a chemical or other CBR release. Security considerations include the following: • All classrooms should be appropriately supervised and/or monitored by CCTV. Emphasis in CCTV installation should be placed on arranging the room so that there are no hidden spaces that the teacher cannot observe (this should be guided to prevent violent or sexual misbehavior too) • Schools should develop the ability to lock and isolate sections of the building in an effort to contain life threating events. • Classroom doors should be easy to lock up during certain emergencies (i.e., school shooting) and quickly to release for others (i.e., fire and earthquakes). This type of locks should not constitute a hazard during normal operation times. Installing double cylinder locks that allow doors to be locked from inside the classroom should be considered. • Classroom doors should be equipped with windows to allow those passing through the door to see if anyone is on the other side and for insiders to check who is at the door. • Classroom doors should be fire resistant which will also make them heavier and harder to break through should a violent intruder encounter a locked door. • Classroom should have windows that can open from inside for emergency egress. These windows should be burglar resistant or alarmed. • Two classroom doors that can be opened in different directions are very helpful and should be used in hurricane areas.	a. Classrooms are supervised by staff, classroom and intruders roaming in the hall can enter the classroom easily. Classroom doors are not equipped with windows = 1, 2 b. Classrooms are supervised by staff and CCTV and classroom doors can be locked from inside. Classroom doors are not equipped with windows. Classroom windows can be opened from inside the classroom in case of emergency = 3, 4 c. Classrooms are supervised by staff and CCTV and all students are visible. Classroom doors are not equipped with windows. In case of emergency all classroom doors can be locked down automatically = 5		

Level of Protection – Architectural				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
	• Trees should be located far enough away from classrooms and special rooms. They should be trimmed appropriately to avoid providing roof, window, or second story access, damage from falling limbs in case of strong winds or a fire hazard in areas at risk of forest or brush fires. • Emergency lighting should be available. • Electrical outlets should be protected by ground fault circuit interrupters (GFCIs) to guard against electrical shock. • Suspended lighting equipment and cabling should be safe. • Screens or other heavy objects should be secured from falling due to student misbehavior or natural disasters.	**Recommendation:** Classroom doors provide a minimum of 32 inches of clear opening and swing open to at least 90 degrees (in schools with a higher risk of fire doors should wing in the direction of egress).		

Level of Protection – Architectural				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
88	**Special Rooms** This category includes special education rooms, science and laboratory rooms, music rooms, dance rooms, and pottery and craft rooms. Special room security consideration are as follows: • As needed, they should be appropriately supervised or monitored by CCTV and appropriate alarm systems. • A secure and fireproof storage should be available for equipment, props, costumes, and tools. • Special rooms with hazardous supplies should be locked at all times when they are not in use. At all times, hazardous materials, such as combustible paint, lead glaze for ceramics, silica clays, and art materials that can be used by students as inhalants, should not be left unlocked. • Kilns should be located in separate rooms with adequate exhaust fans or ducts that vent directly to the outside. In this type of room, no other stored goods should be allowed. • Appropriate ventilation should be available in areas where spraying and photographic developing takes place. • Dressing rooms should be safe and easy to supervise • Dance rooms should have suspended wood floors or other resilient floor-covering system that reduces impact injuries. • Mirrors in the dance room should be shatterproof. • Hard-surface play areas and trees should be located far enough away to protect special classroom windows. **Recommendation:** The following agencies and organizations have developed codes and standards (minimum requirements) affecting the design of auditoriums. • Americans with Disabilities Act (ADA) • Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) • GSA, Facilities Standards for the Public Buildings Service, P100 • International Building Code	a. Not applicable. b. Appropriate ventilation provided, doors are easily locked, equipment is moderately secure and safe, and operable windows. = 1 c. Good ventilation provided, doors that provide vision to the corridor and are easily locked, equipment is moderately secure and safe, operable windows are present, and fire resistant construction. = 1,2 d. Improved ventilation provided, doors that provide vision to the corridor, and are easily locked, equipment is highly secure and safe, operable windows are present, and fire resistant construction. = 3, 4 e. Enhanced ventilation provided including separate control for HVAC, doors that provide vision to the corridor, and are easily locked, equipment is highly secure and safe, operable windows are present, and fire resistant construction. = 5		

Level of Protection – Architectural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
89	**Schools with Multiple Functions** Schools should be evaluated base on the number of participants in the multiple functions at the school and within the school buildings. Many schools are open to the public for many community functions. They function as schools during the day but after school hours they may serve a completely different function. Security measures specified for normal school hours should be maintained during the period that the schools serve the community and fire and natural hazard drills should be provided. Afterhours functions may include the following: • Daycare centers with a higher student to staff ratio and lower levels of professional support for the children's caregivers. • Athletic and fine arts practice facilities with lower levels of student supervision and often greater un-monitored access to the building. • Athletic and fine arts event venues changing from an educational occupancy to an assembly occupancy • Community college campuses, adult education centers, community meeting houses, churches (rental use) and similar non-child and non-instructional uses • Emergency services serving as mass shelters, emergency operations centers, points or dispensing for public health emergencies, or locations for distribution of post disaster assistance. Playgrounds and athletic fields may often serve as the public parks within the community. When this occurs, the following should be considered: • Involve the community in protecting school grounds and property • Add signs asking the community to report crime or other problems (crime stoppers signs, or see-something say-something signs). • Provide instruction and school security signs indicating when the school grounds are reserved for school only and when the public is welcome. • Create community awareness programs to prevent school to be vandalized, destroying playground equipment or initiate a fire • If playgrounds and athletic fields are usued frequently and by large numbers of people, provide some type of public restroom facilities • Provide signs to "clean after your dog" • Organize consistent cleaning of the site in order to collect any broken glass, cigarettes, and other waste in order to provide a safe environment for the students	a. < 100 =1 b. ≥ 100 - 200 and adequate isolation of public from school uses = 2 c. ≥ 201 - 500 and improved isolation of public from school uses = 3 d. ≥ 501 - 800 and enhanced isolation of public from school uses = 4 e. ≥ 801 and complete isolation of public from school uses = 5		

Level of Protection – Architectural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
89 (cont.)	• Strategies to manage crowds during normal times and during emergencies should be in place. These strategies should be reviewed periodically and practiced frequently. • Access to catwalks, scaffolding, and upper level platforms should be limited and controlled. • A secure and fireproof storage should be available for equipment, props, costumes and tools. • Dressing rooms should be safe and easy to supervise. • Risers or raised platforms for choral singing should designed for safety concerns. • Kilns should be located in separate rooms with adequate exhaust fans or ducts that vent directly to the outside. No other stored goods should be allowed in this room other than clay products • Hard-surface play areas and trees should be located far enough to protect special classroom windows • Access to hazardous materials such as combustible paint, lead glaze for ceramics, silica clays, and art materials that can be used by students as inhalants should be controlled at all times. • Expensive instruments should be secured and locked at all times. • Music sheets should be well protected as they can become a fire hazard. • Tall storage units are a hazard in earthquakes and should be secured.			
90	**Gyms** Gyms can be an indoor auditorium or an outdoor sport event place. The design of a gym and safety issues varies from school to school depending primarily on the size, type and if the gym is designed as multipurpose space. When used for competitive sports it becomes a large event venue with the important crowd control and evacuation issues. When a gym is used as a shelter special considerations are required (below). Determining the type of security for the gym should be done based on its functions (elementary, middle or a high school),and the population and size of the school. This will also be influenced by main sport(s) to be practiced and primary functions. When designing a gym area maximizing space to get the most from its multiple functions should be considered. Key safety considerations include the following: Identify if the gym will serve as a shelter before and after natural and man-made disasters. Gyms should be monitored by staff and CCTV, if possible, at all times. Alarm systems should be available. When not in used, they should be locked and secured. Gyms should have a separate, secure, controllable entrance. Unauthorized entrance to the rest of the school should be limited or not permitted.	a. Not applicable. b. Provide access/ egress controls, evacuation and crowd control and natural surveillance. Provide security for locker rooms and ensure designated doors are locked. Provide parking control, access for emergency services, and entrance control to gym. = 1, 2		

Level of Protection – Architectural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
90 (cont.)	• In case of an event, directions to the public on how to access the gym should be clear and signage and directions should be available for visitors coming from authorized parking and for pedestrians. • Visitor parking for events taking place in the gym should be planned and enforced. • Communication/access between the gym and the rest of the school should be considered and enforced if necessary. • Gyms should be well protected against theft, vandalism, high winds, floods, earthquake, fire, explosives, and potential CBR attacks. • Windows and doors should be bulletproof and also resistant to all hazards. • Ingress and egress in assembly occupancy needs to be considered carefully and designed appropriately. The need to evacuate in case of emergency should be accommodated. Emergency exits should be clearly marked. • Install equipment according to all current regulations and safety guidelines. • Exterior walls of the gym should be protected from vehicle collisions by bollards and stand-off distance. 	c. Provide improved access/egress controls, evacuation and crowd control and natural and CCTV surveillance. Provide improved security for locker rooms and ensure designated doors are locked. Provide improved parking control, access for emergency services, and improved entrance control to gym. =3, 4 d. Provide high level of access/ egress controls, evacuation and crowd controls and natural and CCTV surveillance. Provide high level of security for locker rooms and ensure designated doors are locked. Provide high level parking control, access for emergency services, and high level of entrance control to gym. = 5		

Enforce the CPTED principle for the following:

Gyms can be susceptible to several types of crimes, such as bullying and assaults. The CPTED principle of natural surveillance should be applied to the design of school gyms.

The space under the bleachers is often accessible and used as a place to hide misbehavior or to hide contraband. CPTED surveillance is necessary to implement to prevent any crimes.

The bleacher may or may not have defined aisles and so it may be difficult to respond to disturbances in the bleachers. CPTED logical circulation and adequate circulation space should be provided.

Level of Protection – Architectural				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
90 (cont.)	• Entry points to the gym should be protected. This area may also have concessions which need the same protections for food and money as any concession or food service areas. • Gyms should be able to rapidly be locked down. In case of emergency, students should be confined securely. • Locker rooms should be strictly under surveillance. In addition to CCTV, the area should be monitored by school staff. Technology (cameras) cannot be used as a substitute for direct staff supervision. Frequent crimes include bullying, fights, assaults, cyber bullying, and sexting. • Gyms doors that provide access to locker rooms should remain close during sport events. Make sure all doors, including entry and corridor doors are locked. • Gym doors are sometimes chained closed, the reason is usually related to having double doors with a removable center mullion that can no longer provide adequate security; be aware that these chains can delay emergency egress • An elevated position for school staff to observe the entire gym should be provided in order to control any emergency or prevent any school violence.  			

Level of Protection – Architectural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
90 (cont.)	Many schools have moveable bleachers that telescope in and out. When fully closed they should not provide hand and foot holds for climbing, when fully open they should lock in place to prevent accidental entrapment of student's limbs. For powered systems the controls should be located so that the operator can watch for students both on the bleachers and behind (under) the bleachers. Gyms also provide a challenge from the standpoint of noise. As such, the fire alarm and public address systems should be both loud and provide enough sound fidelity so that emergency warnings and instructions can be heard. Note that acoustic/ sound reduction features in older gyms may have been painted over causing a significant loss in their sound deadening quality. Competition gyms often have wood floors and in some older facilities these floors are built on a wood framework that creates a small or sometimes large air space beneath the floor. This condition can lead to rapid fire spreadAll gyms should have adequate means of egress. Certain types of high intensity lights can become superheated and should a bilb break the potential to start the wood floor on fire instantly exists. Some lights do not provide adequate illumination and other types 'flicker' which can, in some persons with seizure disorders, actually induce a seizure. As this is an assembly area the light color, lamp temperature, and cycle should all be considered.			
91	**Schools as Emergency Shelters** School emergency shelters are designed to keep people safe especially from extreme weather conditions such as hurricanes and floods. It is a place for people to live temporarily. Schools often function as emergency shelters due to the fact that schools are widely distributed in populated areas, they are designed for large assembly occupancies with many inherent mass care features (e.g., adequate quantity of toilets, dining/feeding areas, etc.), and access to them can be coordinated through a single local agency. The areas of school buildings that are potentially appropriate for use as public shelters are primarily the gymnasiums, cafeterias, and any multipurpose areas outdoors or indoor within the confine of the school. The use of tents or other temporary structures are commonly used to add emergency shelter functions to the school. Schools intended to serve as emergency shelters need to be planned carefully with respect to the provision of water, sanitation, and livelihoods. They also need to be prepared to perform quick repairs in case that they are damaged during the event.	a. Not applicable b. Moderate damage is expected. Capacity to provide shelter for hurricanes of Category 1 (winds speeds ranging from 74mph to 95 mph). Damage from surrounding trees can be expected. Backup power is very limited and only available for 1 or 2 days. = 1		

<table>
<tr><th colspan="5">Level of Protection – Architectural</th></tr>
<tr><th>ID</th><th>Criteria</th><th>LOP Options</th><th>Existing LOP</th><th>Nec. LOP</th></tr>
<tr>
<td>91 (cont.)</td>
<td>Emergency plans should be in place for providing shelter to students and teachers, and the general public; and for post disaster efforts to bring the school back to normal operations. Emergency plans that include, among other things, communications, staff instructions, family information, evacuation of school site, preparation of emergency kits, shelter in place drills, emergency shelter planning, protocol for missing children, and protocol for dealing with the public and the press should be in place.

When seeking refuge from a natural or man-made disaster event, precautions should be taken with regards to the following spaces:

• Corridors that allow straight access to exterior doors and glass or with a wind tunnel effect configuration.
• Mechanical rooms, power rooms and areas under heavy equipment.
• Areas that are concentrated with heavy equipment above and/or large concentrations of utilities within the space, such as mechanical rooms and power rooms and areas under large roof top equipment such as chillers, rooftop heating systems and chimneys
• Sometimes areas that appear to be good protection areas can be misleading. An example of this would be locker rooms, which many may assume they would offer protection, because of large concentrations of internal walls, short spans structurally and no windows in the internal spaces. However, these areas often are located around gymnasiums or areas of high walls that could create a collapse situation on top of the locker areas.


</td>
<td>c. Moderate damage is expected. Capacity to provide shelter for hurricanes of Category 2 (winds speeds ranging from 96 mph to 110 mph). Damage from surrounding trees can be expected. Near-total power loss is expected with outages that could last from several days to weeks. Backup power can be available for up to a week = 2

c. Moderate damage is expected. Capacity to provide shelter for hurricanes of Category 3 (winds speeds ranging from 111 mph to 129 mph). Minor damage from surrounding trees are expected. Backup for electricity and water will be available until emergency supplies arrive = 3

d. Moderate damage is expected. Capacity to provide shelter for hurricanes of Category 4 (winds speeds ranging from 130 mph to 156 mph). Minor damage from surrounding trees are expected. Backup for electricity and water will be available until emergency supplies arrive = 4</td>
<td></td>
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</tr>
</table>

Level of Protection – Architectural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
91 (cont.)	The ICC 500-compliant safe room/storm shelter in new K-12 schools is prepared for areas where shelter design wind speed is 250mph. The ICC/NSSA Standard for the Design and Construction of Storm Shelters, ICC-500-2008, is the national standard. The ICC-500 contains requirements for design and construction of both tornado and hurricane shelters (depending on your geographical location), and residential and community shelters (depending on the number of people for which your shelter is planned). For more information please access the following website: http://shop.iccsafe.org/icc-500-2008-icc-nssa-standard-for-the-design-and-construction-of-storm-shelters-2.html **Design Wind Speed and Wind Pressure Criteria** In the State of Florida, district public schools (K-12) are the primary source of public hurricane evacuation shelter space, accounting for about 97 percent of current capacity. Florida Division of Emergency Management has placed online a complete guide for the design, retrofit and management of emergency shelters. The material can be accessed at: http://www.floridadisaster.org/Response/engineers/library.htm http://www.myflorida.com/myflorida/cabinet/adcom/supportingdocs/20120508/item1.pdf Florida ICC/NSSA Standard for the Design and Construction of Storm Shelters can be found at: http://aln.coe.ttu.edu/nssa-new/ICC-NSSA%20FUTURE%20STANDARDS.php The wind pressure criteria specify how strong the safe room must be. The design wind speed is the major factor in determining the magnitude of the wind pressure that the building is designed to withstand. In FEMA's safe room publications and ICC-500, the same wind speed hazard maps are used to recommend design wind speeds ranging from 130 to 255 mph. The 2009 International Residential Code and the 2009 International Building Code, which establish the minimum requirements for residential and other building construction, include design wind speeds ranging from 90 to 150 mph throughout most of the country. Table 1 provides a comparison of safe room/shelter design criteria options.	e Very small damage is expected. Capacity to provide shelter for hurricanes of Category 5 (winds higher than 157 mph). Minor damage from surrounding trees are expected.Backup for electricity and water will be available until emergency supplies arrive = 5		

Level of Protection – Architectural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
91 (cont.)				

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74-95 mph 64-82 kt 119-153 km/h	**Very dangerous winds will produce some damage:** Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110 mph 83-95 kt 154-177 km/h	**Extremely dangerous winds will cause extensive damage:** Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3 (major)	111-129 mph 96-112 kt 178-208 km/h	**Devastating damage will occur:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (major)	130-156 mph 113-136 kt 209-251 km/h	**Catastrophic damage will occur:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (major)	157 mph or higher 137 kt or higher 252 km/h or higher	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Level of Protection – Architectural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
92	**School Tornado Shelters** Facilities compliant with the current International Building Code (IBC) can be susceptible to significant building damage and disruption if struck by strong or violent tornadoes. Most of newer schools are built with very strong construction techniques; however to overcome the forces of an F-4 or F-5 tornado, construction of a particular shelter needs to meet very specific criteria. To protect students from tornado hazards, the following criteria are important: • Tornado Refuge Area: Describes any location in the school where students and teacher seek cover during a tornado. Refuge areas may have been constructed with continuous load paths, bracing, or other features that increase resistance to wind loads. It is important for people to know that such an area may not be a safe place to be when a tornado strikes and they still may be injured or killed during a tornado event. • Best available Refuge Areas. An existing area in a school building that has been deemed by a qualified architect or engineer to offer the greatest safety for building occupants during a tornado. It is important to note that, because these areas were not specifically designed as tornado safe rooms, their occupants may be injured or killed during a tornado. However, people in "best available refuge areas" are less likely to be injured or killed than people in other areas of a building (FEMA P-431, Tornado Protection: Selecting Refuge Areas in Buildings [October 2009]).	a. Not applicable b. A moderaly safe refuge area is available = 1, 2 c. A hardeneed and good refuge is available = 3 d. A tornado shelter is available = 4, 5		

Tornado Damage at Moore Elementary School

The 2013 Moore tornado was an EF5 tornado that struck Moore, Oklahoma and adjacent areas on the afternoon of May 20, 2013, with peak winds estimated at 210 miles per hour (340 km/h), killing 23 people (+2 indirectly) and injuring 377 others. The tornado was part of a larger weather system that had produced several other tornadoes over the previous two days. Seven children were killed when their elementary school was hit by the EF5 tornado which stayed on the ground for 39 minutes.

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Level of Protection – Architectural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
92 (cont.)	Hardened Areas. These are designed and constructed to provide some level of protection, but do not necessarily meet International Code Council (ICC) / National Storm Shelter Association (NSSA) Standard for the Design and Construction of Storm Shelters (ICC 500) criteria or FEMA guidelines. These areas are commonly referred to by builders and homeowners as shelters. Storm Shelters. These provide life-safety protection; they are designed and constructed to meet ICC 500 criteria. Safe rooms provide near-absolute life-safety protection; they are designed and constructed to meet the guidelines provided in FEMA 361, Design and Construction Guidance for Community Safe Rooms (2008a) or FEMA 320, Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business (2008c).			

Tornado Damage at Briarwood Elementary School

For information on how to build shelters for tornadoes please access the following information:

http://shop.iccsafe.org/icc-500-2008-icc-nssa-standard-for-the-design-and-construction-of-storm-shelters-2.html

http://www.fema.gov/safe-room-resources/fema-p-361-design-and-construction-guidance-community-safe-rooms

Level of Protection – Architectural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
93	**Corridors/Hallways** It is strongly recommended that CPTED concepts as well as fire codes are applied in the design of hallways. Fire codes should strictly apply and the spaces should use fire-resistance-rated construction materials and methods. Particularly, in older schools, built without fire sprinkler systems and with less fire resistant construction, the possibility of having large numbers of students trapped in corridors with visibility obscured by smoke in a fire situation, merits serious considerations. Location of the fire extinguisher cabinet should be very visible and accessible. Corridors should be designed in such a way that so that air flows through the hall from high to low pressure sides. In a corridor that runs the entire length of the building with a set of exterior glass doors, one door can be under high pressure and the other one under low. This pressure is often enough to drop the suspended ceiling materials on top of the sheltered students causing serious injury. All elements on the walls should be secure and properly anchored if necessary. In many schools, elevation changes along corridors with stairs or ramps as part of the corridor system (not stairs leading to an upper or lower floor but just different levels on the same floor). Students and staff should be given visual warning of the changes in elevation throughout the corridor. The surface of the corridor should as clear as possible from materials and patterns that make it difficult to see a step or change in floor angle at the top or bottom of a ramp. In addition, schools should search for methods to protect the bulbs in hallway light fixtures against vandalism and breakage Safety and security requirements for corridors can consist of the following items: • Corridors should well designed and monitored by CCTV. For schools, the threats and behaviors that need to be monitored th most usually occur inside the school. Having cameras in the appropiate place is of particular importance to prevent child abduction, arson, bullying, and drug abuse. • In addition to CCTV, staff monitoring is essential. School staff should monitor passing time or the time between classes. The presence of staff members in the hallways can greatly minimize potential crimes and acts of violence. Teachers should be encouraged to spend this time in the doorways of classrooms, greeting students as they pass by or enter the classrooms	a. Not applicable b. Hallways and corridors are monitored by staff, provide low security as a refuge, emergency lighting is inadequate, and have few directional signs. = 1 c. Hallways and corridors are monitored by staff or CCTV, provide moderate security as a refuge, emergency lighting is moderately adequate and signs provide moderate information for directions. = 2 d. Hallways and corridors are monitored by staff or CCTV, security as a refuge is good, emergency lighting is good and signs provide good information for directions. All doors in hallways should have a number. = 3 e. As necessary, hallways and corridors are monitored by staff and CCTV and almost all spaces can be monitored. Spaces have been hardened and provide a very good area for refuge against most hazards. Emergency lighting and signage are very good and backup power for emergency lighting is available. All doors in hallways should have a number = 4		

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Level of Protection – Architectural				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
93 (cont.)	Hallways should be designed as one or the best refuges available in the school in case of the occurrence of hazardous events, such as tornadoes, earthquakes, school shootings (hiding places), and to deter kidnapping, bullying, and drug abuse. When corridors and hallways are intended to be used as a protection area, they should be hardened to be multihazard resistant (beyond life safety codes). This level of protection needs to be guided by appropriate engineering practices. Corridors designed for shelters in case of wind events should not have skylights or windows. All doors in hallways should have a number in order to help first responders in case of emergency and be properly designed for fast evaluations. For the construction of new schools and when retrofitting existing one, devices may be designed that could stop or contain the free roaming of shooters. Such devices could include secondary operable deployable doors that could separate corridors to and from main entrances and from the school lobby and be able to contain the shooters. All corridors should have clear signage and provide easy to understand directions to different areas of the school. In a school with a large and/or complex corridor (many schools have been built and then repeatedly expanded which usually leads to a very confusing corridor system) navigation aids should be used. A color coded system or a numbering and lettering system may be used and should include "you are here" maps to help guide those unfamiliar with the school. In hallways, at least one side should stay completely clear of any obstructions so staff and students could follow the wall to an exterior door and so escape even in a smoke filled hallway where visibility is very poor. Lighting and emergency lighting are important to help students evacuate in case of emergency and for responders attending an emergency. Corridors and hallways may use floor level exit lighting. If used, it should be clearly marked with illuminated exit signs at a reasonable height. All schools should have backup emergency lighting to run emergency lights.	f. As necessary, hallways and corridors are monitored by staff and CCTV and all spaces are visible. They have been hardened and provide a very good area for refuge against most hazards. Emergency lighting and signage are very good and backup power for emergency lighting is available. All doors in hallways should have a number. School has anti-shooter roaming devices (i.e., deployable doors that could separate corridors to from main entrance) = 5		
		Cleveland Police released this picture showing student walking the hallways with guns in-hand, moments before going on shooting rampage.		

Level of Protection – Architectural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
93 (cont.)	Cleveland Police released this picture showing student walking the hallways with guns in-hand, moments before going on shooting rampage. On Wednesday, October 10, 2007 the shooter entered the SuccessTech Academy, an alternative high school at Cleveland, Ohio. The shooter was armed with two handguns (.22-caliber revolver and .38-caliber revolver), a box of additional rounds of ammunition and three folding knives. According to fellow students and teachers, the shooter had apparently been the target of bullying by students at the school for his Goth-styled appearance and had made threats of violence in front of students and teachers the week before the shooting. The shooting began at approximately 1:06 p.m. on the fourth floor of the building after a 14-year-old punched the shooter in the face for bumping into him. When the student walked away the shooter shot him in the abdomen. The student shot another 17-year old student who was in the hallway and a social studies teacher inside the teacher's classroom. Another teacher was shot while in a hallway trying to evacuate students to safety. The shooting ended very quickly when the shooter shot himself in the right side of his head. The school was placed on lockdown shortly after the shooting. Fortunately, nobody was killed during this shooting. During the Virginia Tech incident, attempts were made by a few students to escape from classrooms and down the hall in the earliest stage of the incident. But after some of them were shot in the hall, no one else tried that route. During the incident, the shooter walked around in the hallway on the second floor poking his head into several classrooms, some more than once. The shooter looked into classrooms and observed teachers and students in them, but never attempted to breach the locked doors. The shootings were mainly contained to hallways which the roamed almost freely. The shooter carried CO2 containers bombs, taped together and filled with gunpowder and BB pellets. The main shooting took place in the Library where the shooter calmly killed 10 students and seriously injured 12 others. The 2013 Moore tornado was an EF5 tornado that struck Moore, Oklahoma and adjacent areas on the afternoon of May 20, 2013, with peak winds estimated at 210 miles per hour (340 km/h). On Plaza Towers Elementary School, a first-grade teacher herded her students into a hallway and told them to crouch down in front of a wall and cover their heads and necks. The school didn't have a safe room, so safety procedures required teachers to take students into the hallway during a tornado. By the time the storm arrived, only nine of the 22 students of this particular first grade were at the hallway. The other students' parents had pulled them out of school early out of concern over the weather. As the tornado approached, skylights begin to shatter and fall into the hallway. Moments later, the wall where her students were crouched began to disappear. The teacher shoved the first-graders away into a nearby bathroom. The teacher climbed on top of first-graders shielding them with her body, and told them to hang on. All nine students survived the tornado. Seven children were found drowned at a tornado-flattened elementary school where rescuers were searching through the night for survivors as parents kept a heart-breaking vigil. View of a school corridor after passage of a violent tornado (Oklahoma 1999) The 2013 Moore tornado was an EF5 tornado that struck Moore, Oklahoma, and adjacent areas on the afternoon of May 20, 2013, with peak winds estimated at 210 miles per hour (340 km/h). On Plaza Towers Elementary School, a first-grade teacher herded her students into a hallway and told them to crouch down in front of a wall in and cover their heads and necks. The school didn't have a safe room, so safety procedures required teachers to take students into the hallway during a tornado. By the time the storm arrived, only nine of the 22 students of this particular first grade were at the hallway. The other students' parents had pulled them out of school early out of concern over the weather. As the tornado approached, skylights begin to shatter and fall into the hallway. Moments later, the wall where her students were crouched began to disappear. The teacher shoved the first-graders away into a nearby bathroom. The teacher climbed on top of first-graders shielding them with her body, and told them to hang on. All nine students survived the tornado. Seven children were found drowned at a tornado-flattened elementary school where rescuers were searching through the night for survivors as parents kept a heart-breaking vigil.			

Level of Protection – Architectural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
93 (cont.)	 *View of a school corridor after passage of a violent tornado (Oklahoma 1999)*			

Resources for hurricane and tornado shelters:

ICC 500: ICC/NSSA Standard for the Design and Construction of Storm Shelters can be found at:

http://shop.iccsafe.org/icc-500-2008-icc-nssa-standard-for-the-design-and-construction-of-storm-shelters-2.html

For space planning access the following information:

http://www.nfpa.org/safety-information/for-consumers/escape-planning

For hurricane and tornado shelters access the following information:

http://shop.iccsafe.org/icc-500-2008-icc-nssa-standard-for-the-design-and-construction-of-storm-shelters-2.html

http://www.fema.gov/safe-room-resources/fema-p-361-design-and-construction-guidance-community-safe-rooms

http://aln.coe.ttu.edu/nssa-new/ICC-NSSA%20FUTURE%20STANDARDS.php

For escape planning please access the following information:

http://www.nfpa.org/safety-information/for-consumers/escape-planning

For hurricane and tornado shelter you could access the following information:

http://shop.iccsafe.org/icc-500-2008-icc-nssa-standard-for-the-design-and-construction-of-storm-shelters-2.html

http://www.fema.gov/safe-room-resources/fema-p-361-design-and-construction-guidance-community-safe-rooms

http://aln.coe.ttu.edu/nssa-new/ICC-NSSA%20FUTURE%20STANDARDS.php

Level of Protection – Architectural				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
94	**Controlled Hiding Places** School shootings may happen very quickly and only last a few seconds. They also can last longer where the shooter or shooters can roam the schools. Many students and teachers during those short seconds or minutes desperately look for a place to hide. Schools should create a protective place for students and teachers to hide students in case of a shooting. This area should be rapidly accessible. In new construction, controlled hiding places should become an integral part of school design and they should also be considered when retrofitting existing schools. Controlled hiding places should be available primarily in: • Classrooms • Hallways and corridors • Gyms • Cafeterias • Libraries • Other critical areas Schools should contemplate having built-in and rapidly deployable doors that isolate corridors and classrooms in case of emergency and could assist with protecting students from intruders. In new schools, these areas for sheltering should be an integrated part of the design of the project. Students should be able to open classroom windows as a method of escaping from fire and shooters. Hiding places and capability to escape using windows should not be in opposition to any security measure adopted to control theft, drug abuse, bullying or any other violent crime. Schools may designate a number of classrooms as safe rooms which can serve as refuges in case of shooting and/for different hazards. Traveling distances between these safe rooms and other classrooms should be strictly considered in terms of safety. Increasing levels of protection are as follows: • Well designated and prepared safe rooms. • Built-in rapidly deployable doors to isolate corridors and classrooms. • Built-in rapidly deployable doors to isolate corridors and classrooms with places to hide. • A hiding place in each classroom which should be easy to lock and bullet proof. • A hiding place in each classroom which should be easy to lock, bullet proof, and resistant to explosives. • Special hiding places for very young children and children with disabilities who cannot run fast enough to hide. Training and simulation exercises should be conducted frequently to stimulate quick reaction by teachers and students to move to the area of refuge. In tornado states, classrooms should be located near a storm shelter.	a. Not available = 1 b. Provide well designated and prepared safe rooms. = 2 c. Provide dedicated hiding places in classrooms, hallways and other critical areas that are easy to lock and bullet proof. Provide special hiding places for very young children and children with disabilities. = 3, 4 d. Provide dedicated hiding place in classrooms, hallways and other critical areas that are easy to lock, bullet proof and explosive proof. Provide special hiding places for very young children and children with disabilities. Provide built-in rapidly deployable doors to isolate corridors and classrooms. = 5		

Level of Protection – Architectural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
94 (cont.)				

Recommendation: There is significant evidence that just providing an adequate hiding place for students and teachers can save lives. The following provides good a examples of the need for hiding places:

During the Virginia Tech attack the shooter went across the hall to Room 207 and shot the instructor and several students near the door. When the shooter moved to Room 211, students tried to barricade the door, but the shooter pushed his way in and shot the professor and continued shooting indiscriminately. The shooter returned to most of the classrooms more than once. He methodically fired from inside the doorways of the classrooms and sometimes walked around the classroom. Students had little place to hide other than behind the desks. By taking a few paces inside the classroom, the shooter could shoot almost anyone in the classroom who was not behind a piece of overturned furniture. In classroom 204, the instructor braced his body against the door and yelled for students to head for the window. Ten of the 16 students present escaped by pushing out the screen and jumping out before the shooter grained access by killing the professor through the door. Many students became safe by jumping through the windows. However, two students who were scrambling to leave the classroom through the window were also shot.

During the Sandy Hook Shooting, the shooter entered a first-grade classroom while the teacher was trying to hide students in a bathroom. The teacher and most of the students in her class were killed. In another first-grade class, the teacher had concealed five children in a closet and some of the other students were hiding under desks. The teacher was walking back to the classroom door to lock it when the shooter entered the classroom and saw the children under the desks and shot them. Several students died in this classroom however, 6 of the children that ran out of the classroom escaped. The teacher was killed. When the police arrived, they found the five children hidden in the closet unharmed.. .

During the Columbine shootings, the shooters never entered locked classrooms. They looked into classroom and observed teacher and student in there, but never attempted to breach the locked doors. The shooting was mainly contained to the hallways and the library.

Level of Protection – Architectural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
95	**Hazardous Materials Storage** Hazardous materials storage should comply with applicable regulations regarding storage and safety requirements. Depending on the nature of the HAZMAT, measures may need to be designed to prevent access to, release of, or unauthorized removal of, the HAZMAT from the site.	a. Not applicable or no special measures taken = 1 b. Minimal HAZMAT protection measures provided = 2 c. Moderate HAZMAT protection measures provided = 3, 4 d. High HAZMAT protection measures provided = 5		
96	**Restrooms and Related Spaces** The restroom layouts for pre-kindergarten, kindergarten, and first grade can be quite different from the rest of K-2 to K-10. Washing of hands is a condition closely related to disease transmission. The availability of hand washing facilities is needed in classrooms for young children (Pre-K and K) and for classrooms with students with functional needs. For all classrooms reasonable access to sinks with soap and hand drying facilities is a key to disease prevention. All restrooms and showers should be designed to prevent fire, fights, bullying, and drug abuse. Hiding places for drugs and other contraband should be eliminated. False ceilings should be eliminated wherever possible. Since monitoring cameras cannot be placed in restrooms, they should be placed just outside entrances. Equally important is placement of smoke detectors, in order to avoid false alarms (by students using aerosol sprays to trigger alarms), they should be placed just outside entrances. Plans should exist to identify which restroom facilities will be available for public use and how to isolate them from public access to the rest of the school.	a. Surveillance and smoke detectors in place and hiding places are not easily accessible. Public access is limited. = 1 b. Improved surveillance and smoke detectors in place and hiding places are denied. Public access is well controlled = 2, 3 c. CCTV surveillance and smoke detectors at entrances, hiding places are denied and suspended ceiling are not allowed. Public access is controlled and monitored = 4, 5		

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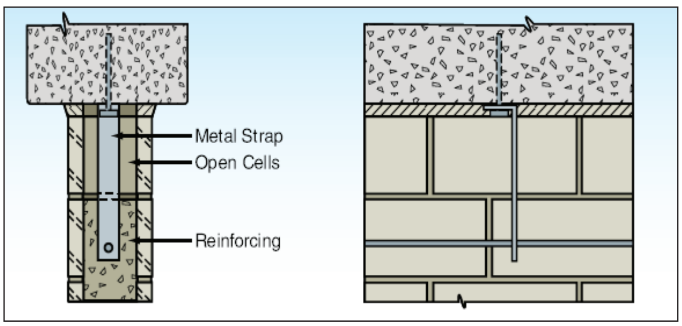
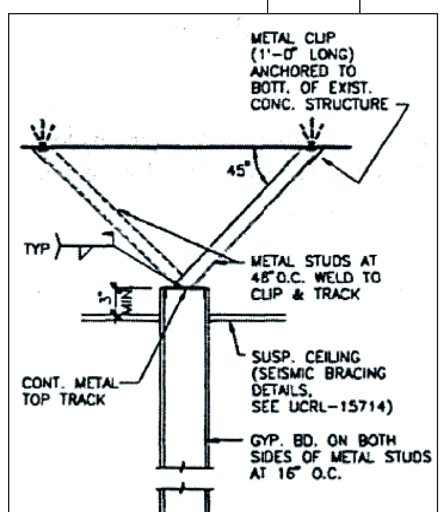
Level of Protection – Architectural

ID	Criteria	LOP Options	Existing LOP	Nec. LOP
97	**Partitions** Partitions are nonstructural, non-load-bearing walls that are used to divide a space. Partitions may be made of 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. Not braced = 1 b. Not braced, more than 9 feet high. = 2 c. Not braced and between 6 and 9 feet tall = 3 d. Not braced, less than 6 feet high. Not anchored to any structural elements and less than 6 feet tall = 4 e. Braced. Anchored to the floor, roof, and other structural elements = 5		



Adequate bracing of a masonry wall partition to the structure
SOURCE: FEMA 424 (FEMA, 2004)

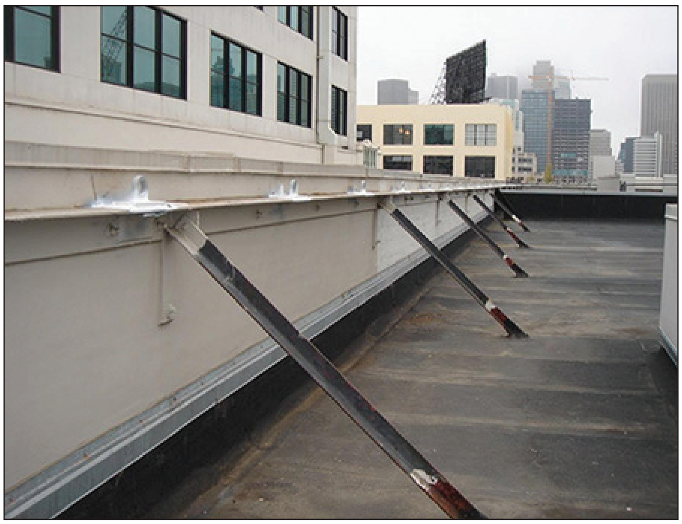
Angle bracing for an interior partition wall



Gypsum wall adequately braced to the structure.

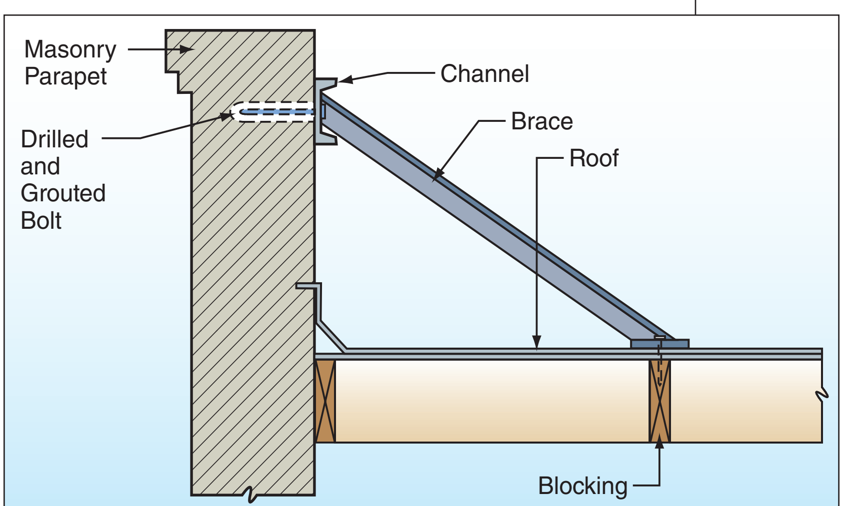
SOURCE: FEMA 454

Level of Protection – Architectural				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
98	**Appendages** School building appendages may consist of chimneys, parapets, ornaments, and other similar items. Appendages 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. They can be also vulnerable to strong winds. The screener should look for bracing that connects the building appendage to the school building.	a. Not applicable = 1 b. No appendages that require bracing = 1 c. Not braced. Building appendage not braced to a structural member = 1 d. Braced. The chimney, parapet, or building ornament secured to the building = 2 - 5		



Adequately braced parapet

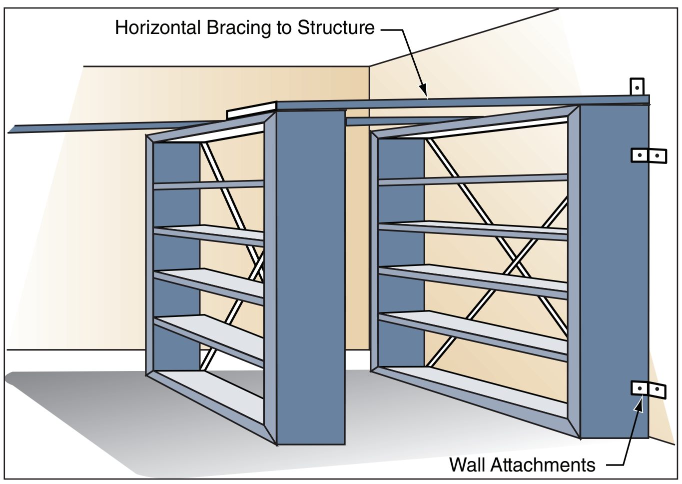
SOURCE: FEMA 424 (FEMA, 2004)



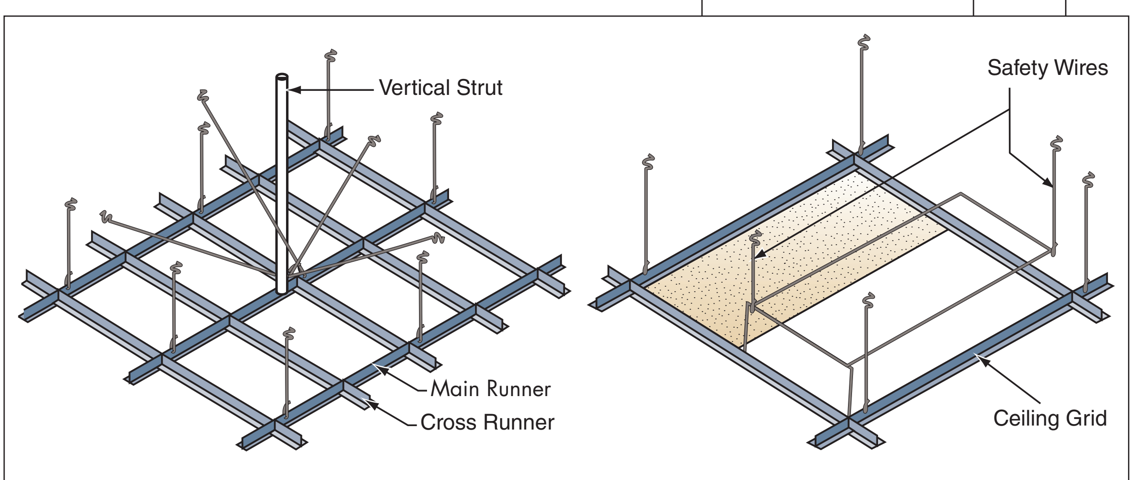
Adequately braced parapet

SOURCE: FEMA 424 (FEMA, 2004)

Level of Protection – Architectural				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
99	**Nonstructural Component Anchoring** Nonstructural components (e.g., light, suspended grid ceilings; heavy, tall, or rolling furniture; heavy plaster suspended ceilings) can become detached from the walls or ceilings in case of a natural disaster or explosive event and injure building students and teachers. Over thirty inch tall bookshelves should be anchored to prevent overturning – this should occur whether or not there is an earthquake hazards as students may accidentally overturn the shelves. TV stands and other tall furniture or fixtures should likewise be designed to resist overturning. The screener should look for the connections of nonstructural components to structural members such as walls and floors. Proper anchoring is extremely important for earthquake, tornado and hurricane.	a. NA = 1 b. Very poorly anchored = 1 c. Poorly anchored = 2 d. d. Moderatally anchored = 3 e. Well anchored = 4 f. Very well anchored = 5		



Bracing for heavy furniture such as large bookshelves
SOURCE: FEMA 424 (FEMA, 2004)



Bracing for a suspended grid ceiling SOURCE: FEMA 424 (FEMA, 2004)

Level of Protection – Building Enclosure				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
100	**Windows and All Hazards** A curtain wall is any exterior wall that is attached to the building structure and which does not carry the floor or roof loads of the building. This includes heavy wall types such as brick veneer and precast concrete panels. In common usage, curtain walls are often defined as thin, usually aluminum-framed walls containing in-fills of glass, metal panels, or thin stone. The building envelope can contain structural and nonstructural components. It consist of roofs, shear walls, columns, windows, curtain walls, cladding panels of different materials (e.g., concrete, stone, metal), and masonry or stone veneer, etc. Windows can be protected with anti-shatter film (ASF), "shatter-resistant window film" (SRWF), or security film. These materials consist of a laminate that will improve post-damage performance of existing windows. Applied to the interior face of glass, ASF holds the fragments of broken glass together in one sheet, thus reducing the projectile hazard of flying glass fragments. Window framing systems and their anchorages must be capable of transferring the blast loads to the surrounding walls. Unless the frames and anchorages are competent, the effectiveness of the attached films will be limited. Windows that open should provide a reasonable seal when closed to prevent air and moisture transmission. The resistance to many undesirable events depends primarily on the type of glass and the window support characteristics – that is, the manner in which typical windows in a building are connected to the exterior envelope and structure. In general, the window system shall be of balanced design where the glazing will fail prior to the window framing and anchorage, or the windows and window frames and anchorages shall meet the performance condition that makes the window resistant to an all hazards approach. Windows in doors shall meet the same specification as the windows in the building or not fail before the door under blast loading. Major concerns in terms of windows are the following hazards: 1. Fire 2. Earthquakes 3. High Winds 4. Ballistics 5. Explosives 6. Rain infiltration 7. Burglary 8. Noise Most frequently, mitigation measures that help to mitigate one hazard help to mitigate other hazards. For example, windows installed to mitigate high winds may help also for ballistics and blast. However, for fire, this is not the case. For fires, it is very desirable to have windows that open and shatter easily to help fire fighters to get into the building, help with emergency evacuations and rescue fire victims. For earthquakes, the desirable window type is that which uses a glass that shatters easily and when collapsing does not cause injuries.	a. Windows designed / retrofitted for ≥ 3 hazards = 1 b. Windows designed / retrofitted for ≥ 4 hazards = 2 c. Windows designed / retrofitted for ≥ 5 hazards = 3 d. Windows designed / retrofitted for ≥ 6 hazards = 4 e. Windows designed / retrofitted for ≥ 7 hazards = 5		

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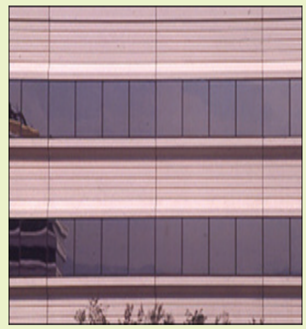
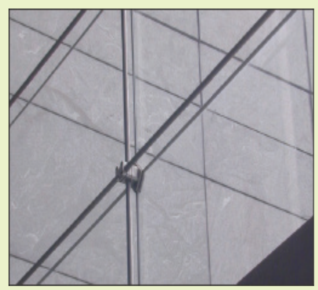
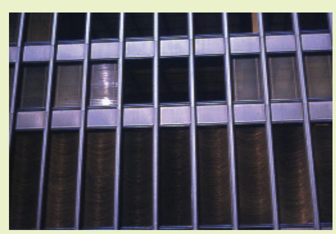
Level of Protection – Building Enclosure				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
100 (cont.)	**Window Support Types** When a school building has multiple types of windows, the most vulnerable location and type should be closely assessed. For instance, the typical window type on the school building side closer to a public street this may be the most vulnerable one. On the other hand, if the standoff distance is comparable on all sides of the school building, the most vulnerable window type on all sides should be the focus. There are many types of windows. Some offer more protection than others. Punched windows 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 school buildings Glass and metal framing/curtain walls can be found in urban schools which were constructed after the 60s while point supported windows can be found at schools with large meeting places. The framing system for ribbon windows 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. These types of windows can be found in many suburban and new schools of one or two stories. Sometimes the supports for point-supported windows 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.	Window Types  Punched Windows  Ribbon Windows  Glass with point-supported cables  Glass and Metal Framing		

Level of Protection – Building Enclosure				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
101	**Total Percentage of Window Area** Schools need windows for natural light and ventilation. They can also serve to evacuate the school in case of emergency. However, in general, walls are assumed to provide greater protection than windows. The total percentage of window area is the ratio of the window area to the total school wall area. If they are not hazard resistant, they can pose a great risk in terms of fire, earthquakes, high winds, ballistics and explosives. Depending on their opening mechanism, they can also pose a risk for burglary and kidnapping. Estimates can be based on the typical area of the school building between two column lines (e.g., one window bay width).	a. > 80% = 1 b. ≥ 70% = 1 c. ≥ 50% = 2 d. ≥ 40%, = 3 e. ≥ 30% = 4,5		

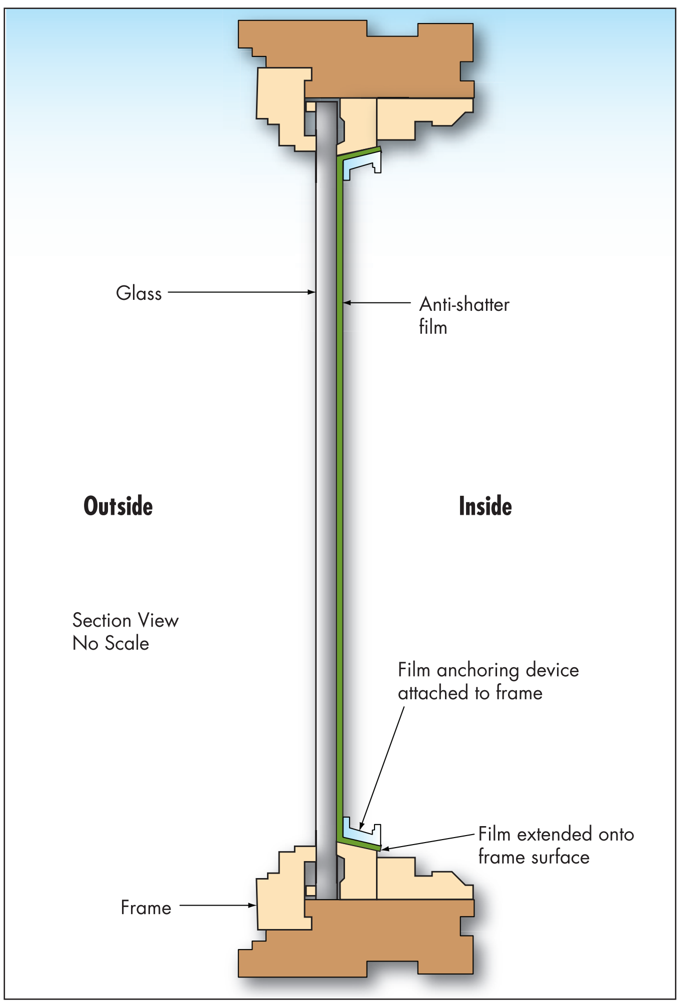
Prior to 1900, windows in the U.S. were predominantly wood frame, with some custom metal windows (iron, bronze, steel) in institutional construction. Around 1900, some British manufacturers of custom metal windows adopted the technology of rolled steel shapes to produce special rail profiles for windows. Two of the more prominent British steel window companies opened U.S. manufacturing companies to produce rolled steel windows. The fire resistance of steel windows with wire glass helped popularize steel window use in the U.S. in the early 1900's. Catastrophic fires in Baltimore, Boston, Chicago and San Francisco led to the development of building regulations that restricted the use of combustible materials in many types of construction. After World War II, the technology of extruding aluminum frames developed and aluminum windows began to gain popularity. By the 1990's, aluminum-framed windows accounted for approximately 65% of the commercial window market. Wood, vinyl and steel-framed windows comprise most of the remaining 35% of the market.

Greater than or equal to 30%, less than 50%1

Level of Protection – Building Enclosure				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
102	**Glass Type (General)** The attribute options offer five types of glass for typical windows. For schools 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 than using unlaminated glass. 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. 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 b. Security Film Installing security film on the inside of window glass is a common retrofit used 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. 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 school facility 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 has been used in school facilities built during the last 30 years or that have large glass panes. b. Annealed Glass Annealed glass is typical in school buildings built before 1960 (refer to age of building).	a. Annealed glass = 1 • Weakest type of glass • Creates shards when broken • Common in non-retrofitted glazing in older buildings (pre-1960s) b. Heat-strengthened glass. Most common type of glass in modern commercial office buildings = 2 c. Thermally tempered glass. =3 • 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. Security film. = 4 • 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 e 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 = 5		

Level of Protection – Building Enclosure				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
102 (cont.)	 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			

Level of Protection – Building Enclosure				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
103	**Windows and Blast** In schools at high risk, high blast windows may be required. Other schools may consider using reduced requirements. The following may be considered: • Preferred glazing systems: thermally tempered heat strengthened or annealed glass with a fragment retention film installed on the interior surface and attached to the frame; laminated thermally tempered, laminated heat strengthened, or laminated annealed glass. • Acceptable glazing systems: thermally tempered glass; and thermally tempered, heat strengthened or annealed glass with fragment retention film installed on the interior surface (edge to edge, wet glazed, or daylight installations are acceptable). • Unacceptable systems: untreated monolithic annealed or heat strengthened glass; and wire glass.	a. Minimum requirements – minimum insulating glazing = 1 b. Acceptable fragment retention film, or an acceptable glazing system to reduce the glass fragmentation hazard. = 2 c. Acceptable fragment retention film, or preferred glazing systems to reduce the glass fragmentation hazard.= 4, 3 d. Combination of protected setback and window glazing or treatments to achieve maximum performance conditions in accordance to GSA or ASTM* = 5 *[GSA Standard Test Method for Glazing and Window Systems Subject to Dynamic Loadings or Very Low Hazard ASTM F 1642, Standard Test Method for Glazing or Glazing Systems Subject to Air Blast Loading].		

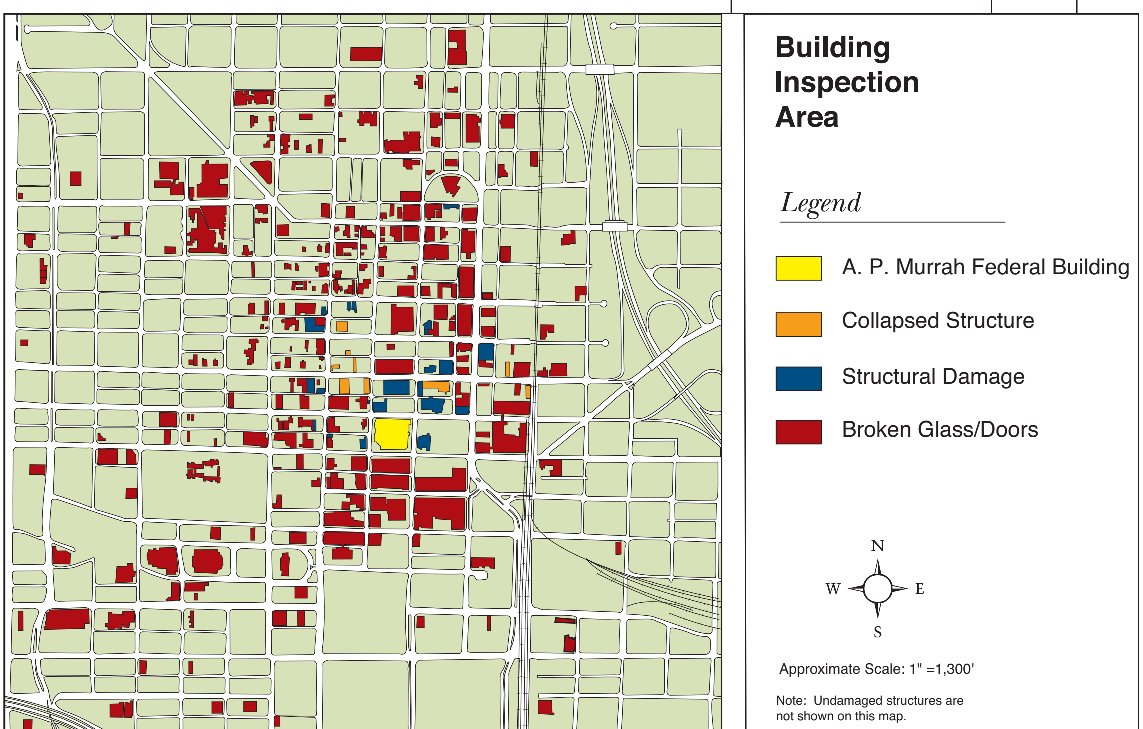


Mechanically attached fragment retention film

SOURCE: FEMA 453

Level of Protection – Building Enclosure

ID	Criteria	LOP Options	Existing LOP	Nec. LOP
103 (cont.)	The conversion of existing construction to provide blast-resistant protection requires upgrades to the most fragile or brittle elements of the building envelope. The glazed portion of the façade represents the greatest hazard to the occupants. It is recommended that, when appropriate, glazed elements of the façade are protected with anti-shatter film. These types of films consist of a laminate that will improve post-damage performance of existing windows. Applied to the interior face of glass, these type of films hold the fragments of broken glass together in one sheet, thus reducing the projectile hazard of flying glass fragments. Most of these films are made from polyester-based materials and coated with adhesives. Most films are designed with solar inhibitors to screen out ultraviolet (UV) rays and are available treated with an abrasion-resistant coating that can prolong the life of tempered glass. However, over time, the UV absorption damages the film and degrades its effectiveness.			



The Oklahoma City bombing was a domestic terrorist bomb attack on the Alfred P. Murrah Federal Building in downtown Oklahoma City on April 19, 1995. The bombing claimed 168 lives[1] and injured more than 680 people. The blast destroyed or damaged 324 buildings within a 16-block radius, destroyed or burned 86 cars, and shattered glass in 258 nearby buildings, causing at least an estimated $652 million worth of damage.

Level of Protection – Building Enclosure				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
104	**Windows and Ballistics** Bulletproof glass (also known as ballistic glass) is a type of strong but optically transparent material that is particularly resistant to being penetrated when struck by bullets, but like all other known materials, is not completely impenetrable. It is usually made from a combination of two or more types of glass, one hard and one soft. The softer layer makes the glass more elastic, so it can flex instead of shatter. The index of refraction for both of the glasses used in the bulletproof layers must be almost the same to keep the glass transparent and allow a clear, undistorted view through the glass. Bulletproof glass varies in thickness from three-quarter inch to three inches (19mm to 76mm). The thicker the glass the greater the level of protection. Bullet proof/resistant glass can be obtained by using security laminates film on the inner surface of ordinary glass. This, when bonded with the application of a pressure sensitive adhesive and cured fully, also provides a protection similar to the multi-layered bullet-resistant glass. The optical clarity is much better and tint-free, thickness and weight are reduced as much as 50–70%, and the process can be done as a retrofit on existing windows Additional information is available in State Department Standard DOS SD-STD-01.01, Revision G, Certification Standard - Forced Entry and Ballistic Resistance of Structural Systems. Additional solutions may include bars, or wire mesh window systems. Also the following standards categorize ballistic resistance. • U.S. Department of Defense specifications for purchase of transparent armor – includes standards for bullet resistance (ATPD 2352P). • U.S. National Institute of Justice (NIJ) standard for ballistic resistant protective materials (NIJ Standard 0108.01).	a. Bullet proof glass is not used = 1 b. Security laminates film on the inner surface of ordinary glass in key areas. 2. 3 c. Bulletproof glass of medium thickness is used in key areas = 4 d. Meeting DOS, DOJ or DoD Standards is used in key areas = 5		
105	**Windows and Burglary** Refers to forced entry protection of exterior windows. Schools should maintain CEPTED principles and provide appropriate maintenance. Put in place the principle that refers to the "Broken Windows Theory". The idea that one broken window will entice vandals to break another. A vandalized school becomes more inviting to higher levels of crime. A well –maintained school will reduce crime and provide safety as well as pride. Forced entry resistance should be uniform around the perimeter and the façade of the school. Utilize a balanced approach to the installation of windows which resist forced entry comparable to the windows and doors of the facility and secure areas. The degree of penetration resistance should be commensurate with the delay necessary to protect assets while security and law enforcement personnel are notified and can respond. Additional information is available in State Department Standard DOS SD-STD-01.01, Revision G, Certification Standard - Forced Entry and Ballistic Resistance of Structural Systems. Additional solutions may include burglary-resistant bars and wire mesh window systems	a. Lock all operable ground floor windows. = 1, 2 b. No operable windows on ground floor level. = 3 c. No operable windows within 16 feet of the ground or other access point. = 4 d. Design exterior windows in publicly accessible locations to resist burglary entry. = 5		

Level of Protection – Building Enclosure				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
106	**Windows and Seismic** The vast majority of damage and resulting loss of building functionality during recent damaging earthquakes in the US has been the result of damage to nonstructural components and systems. The biggest cause of injury in earthquakes is the result of flying glass from shattering windows. An earthquake can shatter windows and send flying debris for feet. Since schools have many windows in the most populated areas, an earthquake can put large numbers of students and teachers in danger of serious injury within the first few seconds of impact. Another way to improve the performance of windows in case of earthquakes is providing adequate clearance between the glazing and supporting frame 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. To reduce the potential of injuries from shattering glass, schools located in earthquake prone areas can use window film which is a thin but strong plastic adhesive sheet that can be applied to both sides of a window, binding the pane so that it remains in position even if the glass is shattered.	Not applicable b. Windows and frames have many limitations in terms of their design for seismic zones = 1 c. Windows and frames have minor limitation in terms of their design for seismic zones = 2 d. Windows and frames have minor limitation in terms of their design for seismic zones = 3 e. Windows and frames have very minor limitation in terms of their design for seismic zones = 4 f. Windows and frames are designed for seismic hazards according to seismic zone = 5		

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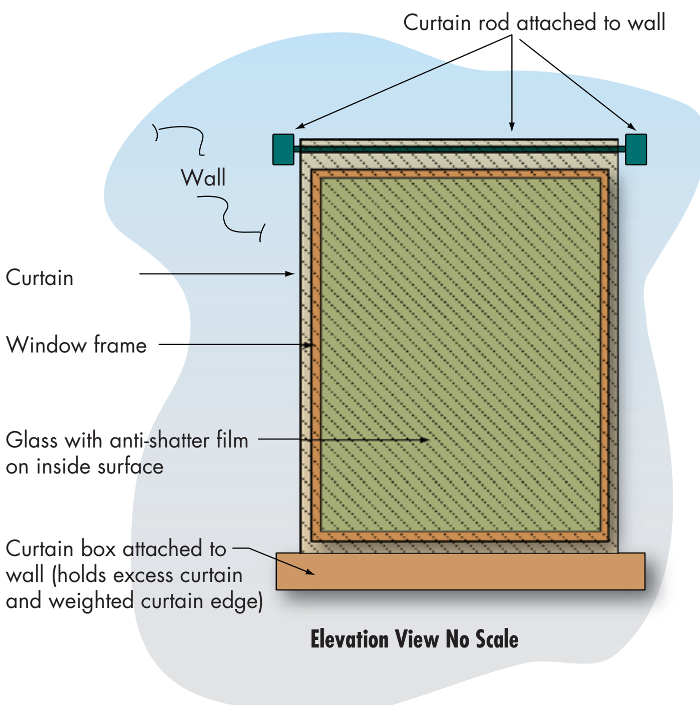
Level of Protection – Building Enclosure				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
107	**Windows and Hurricanes** Windows in older facilities may possess inadequate resistance to wind pressure. Window failures are typically caused by windborne debris, however, glazing or window frames may fail as a result of wind pressures. Failure can be caused by inadequate resistance of the glazing, inadequate anchorage of the glazing to the frame, failure of the frame itself, or inadequate attachment of the frame to the wall. For older school buildings exposed to wind storms, upgraded window assembly is recommended. In addition, some older windows may have sufficient strength to resist the design pressure but are inadequate to resist wind-driven rain. With broken windows, a substantial amount of water can be blown into a school building, and the internal air pressure can be greatly increased which may damage the interior partitions and ceilings. It is recommended that all non-impact –resistant, exterior glazing located in hurricane prone region (with a basic wind speed of 100 mph or greater) be replaced with impact-resistant glazing or be protected with shutters.	a. Not applicable b. Windows and frames are designed for hurricane to sustain wind speeds of 74-95 mph (category 1) = 1 c. Windows and frames are designed for hurricane to sustain wind speeds of 96-110 mph (category 2) = 2 d. Windows and frames are designed for hurricane to sustain wind speeds of 111-129 mph (category 3) = 3 e. Windows and frames are designed for hurricane to sustain wind speeds of 130-156 mph (category 4) = 4 Windows and frames are designed for hurricane to sustain wind speeds of 157 mph or higher (category 5) = 5		

Level of Protection – Building Enclosure				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
108	**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 "Not applicable."  **Elevation View No Scale**  *School with horizontal slide shutters*	a. Not applicable. b. Building is not in a high wind speed zone and has shutters = 1 c. Building is in a high wind speed zone and has shutters = 2, 3, 4, 5		

Level of Protection – Building Enclosure				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
109	**Windows and Fire** The NFPA and local codes provide the necessary information for windows and fire. Fire code inspections are widely and strictly enforced in the US. For this How-To Guide, the fire requirement will be assessed in terms of first responders and if windows allow: a) first responders to enter the school, and b) students and teachers to evacuate the school building in case of emergency. It is important to indicate that although windows can be part of a school escape plan, it is important to remember that windows that can be opened pose a potential hazard, especially to unsupervised, young children. Designers need to consider the protection of windows against fire in conjunction with other hazards. One of the most important issues in terms of fire and windows is that widows should allow access by first responders. This need for access in fire hazard is that windows are breakable. Some hazards, such as hurricanes, tornadoes, blast, and ballistics require windows that are very resistant to different types of loads. Designers and schools should consider this issue carefully and evaluate the necessary level of protection according to the most significant risks. The best way to help ensure a safe escape is to plan and practice. The NFPA offers an entire series of classroom aids. Ensuring that windows can be easily opened by children and other occupants during a fire escape is a crucial part of fire safety. The ICC and the National Safety Council provides a series of kids' activity sheets on how to escape in case of fire. Additional information can be found at: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&ved=0CDMQFjAA&url=http%3A%2F%2F211.69.3.6%3A8001%2Fuaspx_madl%2FDownload.aspx%3Fsid%3D1%26dcode%3DXXSTANDARD%26fileid%3D96380&ei=_mlmUrvlGJWssQSE7IHYAQ&usg=AFQjCNE-KgqZt1daELMuU13BnpfhrcXg7g and also http://www.safti.com/emails/The-IBC-and-Exterior-Fire-Rated-Openings.html	a. Windows are not easily accessible from outside by first responders in case of fire and do not present a way to evacuate students and teachers in case of emergency = 1 b. Windows are very moderately accessible from outside by first responders in case of fire but do not present a way to evacuate students and teachers in case of emergency = 2 c. Windows are moderately accessible from outside by first responders in case of fire and it is possible to evacuate students and teachers in case of emergency = 3, 4 d. Windows are moderately accessible from outside by first responders in case of fire and may be opened from inside to evacuate students and teachers in case of emergency =5		

Level of Protection – Building Enclosure				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
110	**Windborne Debris** For envelope or cladding systems, the governing design criterion is windborne debris, commonly referred to as missiles. The windows and glazing in exterior doors, of conventional buildings are not required to resist windborne debris; the exception is when the buildings are located within windborne debris regions, where openings must have impact-resistant glazing systems or protection systems. Impact-resistant systems can be laminated glass, polycarbonate glazing, or shutters. The ASCE 7-05 missile criteria were developed to minimize property damage and improve building performance; they were not developed to protect occupants, and notably do not require walls and roof surfaces to be debris impact-resistant. To protect occupants to a life-safety level of protection, the criteria used in designing safe rooms include greater resistance to penetration from windborne debris. The August 2008 release of the FEMA 320 and 361 safe room guidance documents and the ICC-500 storm shelter standard is a significant milestone in standardizing criteria for structures providing life-safety protection from tornadoes and hurricanes. With the incorporation of the ICC-500 into the 2009 IBC and IRC, most of the FEMA safe room criteria used since the 1990s have now been codified. Potential Debris/Missiles include the following: In Case of Hurricane: Windborne debris/missiles are objects such as roof aggregate, sheet metal, gutters, rooftop equipment, siding 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, windows, and roof components of a building. Windborne debris/missile damage is very common during hurricanes and tornados. The impact of debris/missiles should be considered when preparing for wind events. In Case of Earthquakes: Failure of elevated tanks, bins, vessels, or trussed towers, especially on the roof can cause unwanted effects on a school, students, and teachers. Any elevated tanks, such as water tanks, are especially vulnerable to horizontal seismic shaking and sloshing In Case of Blast: A detonation involves supersonic combustion of an explosive material and formation of a shock wave. The three parameters that primarily determine the characteristics and intensity of blast loading are the weight of explosives, the type of explosives, and the distance from the point of detonation. Almost any type of explosion close to a building can produce severe damage and send hundreds of flying debris to the surrounding area.	a. Not applicable b. No special measures for protection from windborne debris = 1 c. Low measures for protection from windborne debris = 2 d. Moderate measures for protection from windborne debris = 3 e. Good measures for protection from windborne debris = 4 f. Very good measures for protection from windborne debris = 5		

Level of Protection – Building Enclosure				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
110 (cont.)	To help to understand if a particular school is or not susceptible to windborne debris the table below is offered. Schools constructed prior to the benchmark year may be retrofitted to meet standards by using shutters, storm windows, or a curtain system. Screeners should consult the table below to obtain the benchmark year for their state (f listed) then select the score based on when their school was constructed relative to the benchmark year, unless modifications override the year. Schools in a state not identified in the table should be scored with a or b unless they have windborne debris impact screens or designs.			

Benchmark Years for Localities in the US Where Windborne Debris 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 wind speed contour	2005
Texas	All areas seaward of the Inter-coastal Waterway (mostly Barrier Islands)	1998
	First tier coastal counties: all of Calhoun, Chambers, and Galveston Counties; other 11 counties seaward of the 120 mph wind speed 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

Level of Protection – Building Enclosure				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
111	**Exterior Doors** School doors should be designed to provide school safety against all natural hazards, man-made events, school shootings, fire, and theft. A lockdown is an emergency protocol used to protect students and teachers from getting hurt by an intruder or from a dangerous external event. The following considerations are important: • School main entry should be monitored by CCTV and a staff person should be responsible for providing access to the school building after proper identification. • At least, the main school door should be bullet-proof, made bomb resistant, and monitored by CCTV. • This door should be difficult to barricade using small objects like pliers and chains. • If the school has adopted a generalized lockdown system, this should be centrally activated immediately after any perceived threat and an alert should be sent to local police regarding the school lockdown mode. • Exterior doors should be burglary-resistant and may include bars to prevent forced entry • Hinge pins located on the unsecured side of perimeter and critical interior doors must be designed to preclude door removal. • Magnetic locks should have at least 1,200 pounds of shear holding power. • Electric strikes should meet all specifications of Underwriters Laboratory (UL) Standard 1034, Burglary-Resistant Electric Locking Mechanisms. For information on high-security locks, refer to UL Standard 437, Key Locks, American National Standards Institute (ANSI) Standard A156.30-2003, American National Standard for High Security Cylinders, and ANSI Standard 156.5-2001, American National Standard for Auxiliary Locks and Associated Products. Information on exterior doors can be found at Department Standard DOS SD-STD-01.01, Revision G, Certification Standard - Forced Entry and Ballistic Resistance of Structural Systems. Additional solutions may include bars, or wire mesh window systems	a. No special measures = 1 b. Provide hardened doors for fire resistance with easy locking hardware. Provide exterior doors that are burglar resistant. = 2 c. Provide fire resistant hardened doors and bullet proof doors with easy locking hardware. Provide exterior doors that are burglar resistant. Provide hurricane resistant exterior doors. = 3 d. Provide fire resistant hardened doors and bullet proof doors with easy locking hardware. Provide hurricane resistant exterior doors and monitor with CCTV system. Provide exterior doors that are burglar resistant. Provide system for general door lockdown. Provide secondary lobby door system for security. = 4		

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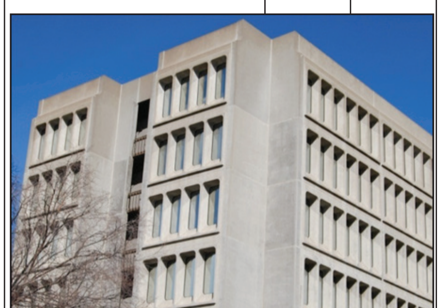
Level of Protection – Building Enclosure				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
111 (cont.)	The Virginia Tech shooter carried two handguns, almost 400 rounds of ammunition, a knife, heavy chains, and a hammer. The shootings involved two incidents. During the second incident the shooter entered and barricaded himself in Norris Hall by putting a chain on each of the three main entrances with a note on the inside of one set of chained doors warning that a bomb would go off if anyone tried to remove the chains. When the police arrived 3 minutes after the call, they failed to break in through the chained doors. By the time they reached the second floor, where most of the shooting occurred, the shooting had ended. Since the shooter used two different caliber weapons that sounded different, officials initially assumed more than one shooter was inside the building. In Room 207 the shooter shot the instructor and several students near the door. When the shooter tried to enter Room 204, the instructor braced his body against the door. He was killed as well as 10 other students. An instructor in a third-floor classroom led his students to safety in a small room, locked them inside, and went to investigate the gunfire in the second floor. He was shot and killed, but those who found refuge in the locked room all survived. The Columbine shooters never entered or attempted to enter locked classrooms. They looked into classrooms and observed teachers and students in them. As such, the carnage was contained to the hallways and the library. During the library massacre, the shooters reloaded their weapons on at least two occasions. The Columbine shooters attempted twice to explode their hand made bomb which fortunately did not detonate.	e. Provide fire resistant hardened doors and bullet proof doors with easy locking hardware. Provide exterior doors that are burglar resistant. Provide hurricane resistant exterior doors and monitor with CCTV system. Provide system for general door lockdown. Provide secondary lobby door system for security = 5		

Level of Protection – Building Enclosure				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
112	**Exterior Wall Type** The exterior walls are the first real defense against the effects of all hazards and are typically the weakest components subjected to all load pressures. Ideally, exterior walls should be able to withstand the all loads that are directly applied to them and accept the blast loads that are directly applied and transferred by the windows. They should be resistant to all hazards such as earthquakes, floods, high winds, ballistics, fire, explosives, and CBR. The expectation is that by protecting against one hazard, protection against the other hazards will be provided to some extent. All building materials and types acceptable under model building codes are allowed. Design detailing is required for material such as pre-stressed concrete, pre-cast concrete, and masonry to adequately respond to the design loads. Unreinforced masonry is unacceptable. Pre-stressed concrete is not very ductile and may not be appropriate where load reversals may occur. Major concerns in terms of windows are the following hazards: 1. Fire 2. Earthquakes 3. High Winds 4. Ballistics 5. Explosives 6. Moisture infiltration and seepage 7. Burglary 8. Noise 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 The screener can determine the wall type and resistant to natural and man-made hazards through site observation, by reviewing as-built drawings or by asking a site representative or facility engineer.	a. Exterior walls designed / retrofitted for ≥ 3 hazards = 1 b. Exterior walls designed / retrofitted for ≥ 4 hazards = 2 c. Exterior walls designed / retrofitted for ≥ 5 hazards = 3 d. Exterior walls designed / retrofitted for ≥ 6 hazards = 4 e. Exterior walls designed / retrofitted for ≥ 7 hazards = 5		

Level of Protection – Building Enclosure				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
112 (cont.)	In case of a hurricane, brick veneer, exterior insulation finish systems, stucco, metal wall panels, and aluminum and vinyl siding have often exhibited poor wind performance. Veneers (such as ceramic tile and stucco) over concrete, stone veneer, and cement-fiber panels and siding have also blown off. Wood siding and panels rarely blow off. Although precast walls have failed during wind storms, precast wall panels attached to steel or concrete framed buildings typically offer excellent wind performance. In earthquake zones, brick and other heavy veneers need to be properly anchored when used. In terms of blast, the building envelope system needs to be designed to resist the direct shock wave, rebound, and any reflection off of neighboring buildings, all of which will occur within a matter of milliseconds. Ballistic resistant design involves both the blocking of the sightlines to conceal the occupant and the use of ballistic-resistant materials to minimize the effectiveness of a weapon. In terms of ballistics and blast resistance, bearing and non-bearing walls should be designed using established methods and approaches for determining dynamic loads, structural detailing, and dynamic structural response. Design and analysis approaches should be consistent with U.S. Department of the Army Technical Manuals. Response limits shall follow U.S. Army Corps of Engineers PDC-TR 06-08, "Single Degree of Freedom Structural Response Limits for Antiterrorism Design." Floodproofed walls constructed on permeable soils require additional design attention, because they are susceptible to hydrostatic pressure from below. Exterior walls must also be designed to prevent infiltration of water, whether through the wall itself or through any openings, including where utility lines penetrate the envelope. References: • Schools can be designed or retrofitted using as a minimum life safety codes in compliance with ASCE 7 and ASCE 24 and local codes. It is recommended that high performance solutions are considered by designers and decision-makers in order to design the school beyond current code and standards for as many hazards as possible. • The fire resistance rating for exterior walls can be based on construction type, occupancy and fire separation distance as defined in Section 6 of the IBC. • NFPA 80 Standard for Fire Doors and Fire Windows establishes the criteria for qualifying an approved fire rated window. http://www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=80			

Level of Protection – Building Enclosure				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
112 (cont.)	• Bullet resistance can also have a high priority for school buildings. Additional information is available in State Department Standard DOS SD-STD-01.01, Revision G, Certification Standard - Forced Entry and Ballistic Resistance of Structural Systems. Additional solutions may include bars, or wire mesh window systems. http://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&ved=0CCkQFjAA&url=http%3A%2F%2Fwww.delagostti-industries.com%2FAssets%2FSD-STD-01.01.pdf&ei=VGImUqWMMImrsAS0roGYBw&usg=AFQjCNEqle_RaYK1onWQURuzPpeMV7VNpw&bvm=bv.51495398,d.dmg In addition, the Canadian Masonry Research Institute and the Royal Canadian Mounted Police have good information which can be found at the following site: http://www.ccmpa.ca/BulletinBoard_Items.asp?BBId=32  On November 16, 1989, seven schoolchildren were killed when a violent storm tore through a cafeteria wall at East Coldenham Elementary in the town of Newburgh, about 60 miles north of New York City. Students were eating lunch when a wall, approximately 30 feet high and 50 feet wide (a brick, cinder-block, and glass wall), imploded onto a group of first, second and third graders. In addition to the seven killed, 18 children were injured. All of the injured were between 6 and 9 years old.	 *Massive unreinforced masonry*  *Reinforced masonry facility*  *Reinforced masonry building*  *Glass curtain wall concealing the floor structure*		

Level of Protection – Building Enclosure				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
113	**Overhang** The overhang is the horizontal depth, measured from the inside face of a free-standing column to the face of the exterior enclosure. Overhangs are subjected to wind uplift forces which can trigger a collapse of the facility or provoke serious roof damage. Overhangs can add volume and create spaces to particular building thus expanding the aesthetics and enhancing possibilities of the façade. Designing for safety and security requires sometimes a series of trade-offs. Overhangs can be very appealing but they can also be vulnerable to earthquakes, hurricanes, tornadoes, and explosive blast. In highly critical areas, and when cost is a concern, large overhangs should be avoided. In the case of a hurricane, large roof overhangs are another source of wind intrusion and can cause costly damage to schools. Overhangs can turn into flying debris causing damage to people and surrounding buildings. During a hurricane, high winds blast against the side walls and push upward on the overhang toward the roof causing considerable pressures that will damage the roof. The larger the overhang of the roof, the easier it is for the wind to push through the soffit. Many designers only accept 12 inches in hurricane prone areas, others up to 20 inches. Soffits, depending on the wind direction, can experience either positive or negative pressure which can be damaged or fly as projectiles causing property damage and injury. In case of earthquake and blast, heavy overhangs can be heavily damaged and create falling and flying debris. Some overhangs can support occupied spaces above. Special attention should be required if the floor above the overhang is occupied or has critical functions. 	a. Not applicable (outside earthquake and high wind zones) b. ≥ 15 feet = 1 c. ≥ 10 feet, < 15 feet = 2 d. ≥ 5 feet, < 10 feet = 3 e. < 5 feet = 4 f. None = 5 (in earthquake or wind zones but has no overhang)		

Level of Protection – Building Enclosure				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
114	**Special Building Enclosure Geometries** Special building envelope geometries include school enclosures with irregular geometries such as atriums, multistory walls, architectural glazing systems, and exotic envelope designs. Special envelope geometries require special treatment because they are not covered in design codes or guidelines. Regular geometries are single-story, flat-faced envelopes.	a. Not applicable. b. Irregular, not designed for postulated hazards = 1, 2 c. Irregular, designed for postulated hazards = 3, 4 d. Regular and designed for postulated hazards = 5		

Art School in California

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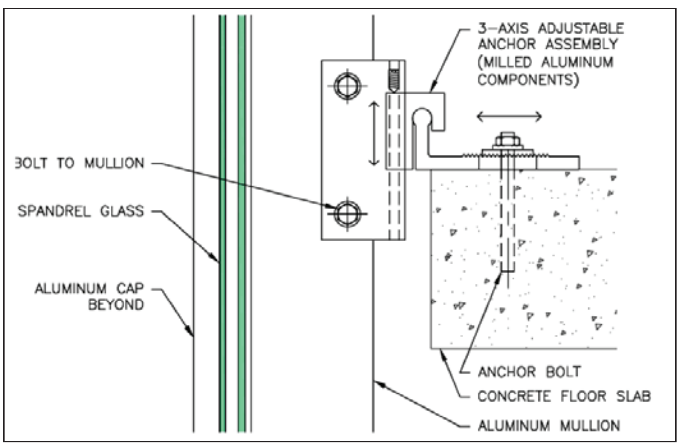
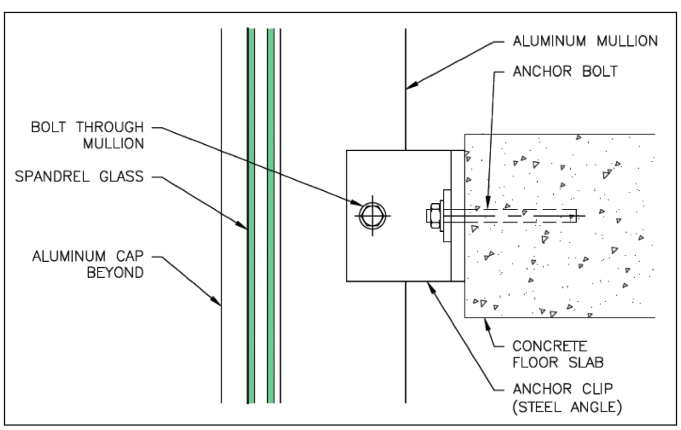
Level of Protection – Building Enclosure				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
115	**Enclosure–Structure Connections** The envelop–structure connection characteristic refers to how well the school building envelope is attached to the structure. Glazing can be attached to the 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. The veneer condition refers to the condition of the veneer or nonstructural external layer that makes up the building envelope. The innermost element of the building envelope is usually structural. The attachments of veneer to underlying wall must be adequate to prevent movement under wind and earthquake loads.	a. Poor = 1 • Severe signs of distress Inadequately connected to the structure • Adequately connected to the structure b. Moderate = 2,3 • A few signs of distress but nothing significant • Adequately connected to the structure c. Excellent. = 4, 5 • No signs of distress (cracking or spalling)		



Enclosure connection to structure using a clip-angle anchor

SOURCE: JOE VALANCIUS



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

SOURCE: JOE VALANCIUS

Level of Protection – Building Enclosure				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
116	**Roof** The roof system (roof covering and the decking that supports the covering) is often the most vulnerable building component in natural hazard events. Roofs are a very important element of the building envelope systems and it should be protected against all hazards. Major damage to roof systems is caused by heavy winds and flying debris. Roof systems can be vulnerable also to blast and earthquakes. For both, any large roof system needs to be properly framed and anchored. Skylights are vulnerable and a serious hazard from glass breakage. Strong connections between the roof and the walls and the entire structure are necessary. Structural failure is often progressive where the failure of one structural element triggers the failure of another, leading to a total collapse. Connections are generally vulnerable but can be inexpensively strengthened. Most common roof systems include the following: • **Shingles:** Architectural (dimensional) shingles are created by bonding two asphalt shingles together, giving them a distinct three-dimensional appearance. The fiberglass-base shingles are more fire and wind resistant and have longer life. With proper nailing (minimum 6 nails each straight & flush with shingle and 1" deck penetration), they easily resist winds of between 90 and 120 mph. • **Concrete Tiles:** Recent developments have improved this type of roof option. Tiles can sustain winds in excess of 125 miles. • **Metal Roofs:** Metal roofs are considered to be the most resistant roofing material and are the most expensive. Depending on design and color, metal roofs can be very energy efficient due to their reflective qualities. Metal roofing products are available in a wide range of metals including steel, aluminum, copper, zinc, stainless steel, and titanium. There is no standard fastening system for metal roofs due to the wide variety of options. Practically all metal panels feature overlapping seams for strength and water protection. Double locking seams provide the highest level of both.	a. Not applicable b. Minimum design for wind and blast. Heavy equipment on the roof = 1 c. Moderate design for wind and blast. Small equipment present on the roof (ie. Satellite dishes) = 2, 3 d. Good design for wind and blast. All equipment on the roof are properly anchored = 4 e. Very good design for wind and blast. There is almost no equipment on the roof, or those present are very well anchored = 5		

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<tr><th colspan="5">Level of Protection – Building Enclosure</th></tr>
<tr><th>ID</th><th>Criteria</th><th>LOP Options</th><th>Existing LOP</th><th>Nec. LOP</th></tr>
<tr><td>116 (cont.)</td><td>Roof Systems and Winds

Roof covering damage has historically been the most frequent and the costliest type of wind damage. Several prescriptive performance requirements pertaining to wind resistance of roof coverings have been incorporated into the model codes.

The roof deck is the roofing material layer between the primary structural components (trusses and joists) and either insulation layers or weatherproofing layers in a typical roof system. In locations exposed to wind events and severe rain, roof systems should avoid water infiltration from wind-borne debris. Insulation and gypsum roof board can absorb missile energy. If the primary membrane is punctured or blown off during a storm, the secondary membrane should provide watertight protection unless the roof is hit with missiles of very high momentum that penetrate the insulation and secondary membrane. The roof deck should be inspected periodically in order to determine existing deck attachment, spot checking the structural integrity, and evaluating the integrity of the beams and joists.

Roof Systems and Blast

Flat roof systems are exposed to the incident blast pressures that diffuse over the top of the building. Blast effects may cause severe damage to roof systems and make lightweight roof systems susceptible to uplift effects. The best systems include: slab systems for reinforced concrete construction and metal deck with reinforced concrete fill for steel frame construction. Both of these roof systems provide the required mass, strength, and continuity to resist all phases of blast loading. The performance of conventional precast concrete plank systems depends to a great extent on the connection details, and these connections need to be detailed to provide continuity. Flat slab and flat plate construction requires continuous bottom reinforcement in both directions to improve the integrity and special details at the columns to prevent a punching shear failure. Post-tensioned slab systems are particularly problematic because the cable profile is typically designed to resist the predominant patterns of gravity load and the system is inherently weak in response to load reversals

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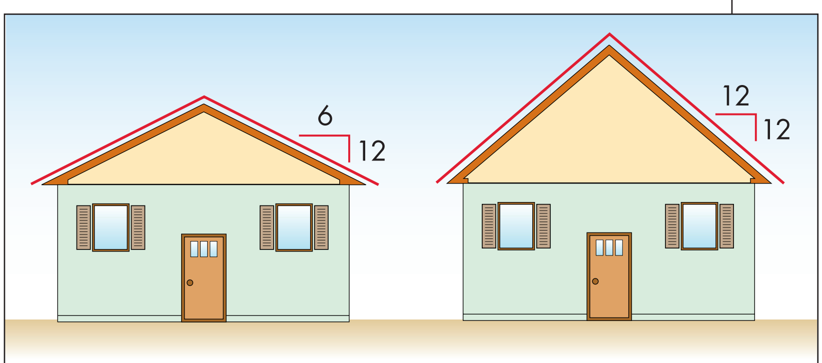
Level of Protection – Building Enclosure				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
117	**Roof Configuration / Pitch** Roof pitch is one of the primary determinants of high wind pressure. Roof pitch is the slope of a roof. In the United States, slope is typically given as a ratio of inches per 12 inches. Flat roofs can experience high edge and corner wind uplift pressures. 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. The following considerations should be taken into account when designing in areas of extreme winds. • Certain areas of the building such as the ridge of a roof, corners and eaves are normally subject to higher wind pressures. A connection to balance pressures can lead to a significant reduction in the roof's wind loads. • Roofs with multiple slopes such as a hip roof (4 slopes) perform better under wind forces than gable roofs (2 slopes). Gable roofs are generally more common because they are cheaper to build. A 30-degree roof slope has the best results. • Wind forces on a roof tend to be uplift forces. During a hurricane, roofs can be blown off. Connecting roofs appropriately to walls is critical. Stapled roofs were banned following Hurricane Andrew in Florida in 1993.			



A 6:12 pitched roof minimizes roof pressures from high winds

A 12:12 pitched roof experiences high pressures in high winds

Level of Protection – Building Enclosure				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
118	**School Access to the Roof and Protection of Building Systems** Access to the roof should be denied. Where roof access allows entry to critical building or air intakes, CCTV monitoring and recording should be used in conjunction with locking and detection devices. Access of authorized personnel to the roof building systems (e.g., utility, mechanical, electrical, telecom rooms) should be secured. Hinge pins located on the unsecured side of perimeter and critical interior doors must be designed to preclude door removal. • Magnetic locks should have at least 1,200 pounds of shear holding power. • Electric strikes should meet all specification of Underwriters Laboratory (UL) Standard 1034, Burglary-Resistant Electric Locking Mechanisms. • For information on high-security locks, refer to UL Standard 437, Key Locks, American National Standards Institute (ANSI) Standard A156.30-2003, American National Standard for High Security Cylinders, and ANSI Standard 156.5-2001, American National Standard for Auxiliary Locks and Associated Products.	a. Not applicable. b. Secure utility, mechanical, electrical, and telecom rooms, and access to interior space from the roof with locks = 1 c. Secure utility, mechanical, electrical, and telecom rooms, and access to interior space from the roof with high-security locks = 2 d. Secure utility, mechanical, electrical, and telecom rooms, and access to interior space from the roof using locks and IDS = 3 e. Secure utility, mechanical, electrical, and telecom rooms, and access to interior space from the roof using electronic access control and IDS = 4 f. Secure utility, mechanical, electrical, and telecom rooms, and access to interior space from the roof using locks, IDS, and CCTV monitoring = 5		

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Level of Protection – Structural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
119	**Progressive Collapse** Progressive collapse is a chain reaction failure of building members to an extent disproportionate to the original localized damage. Such damage may result in upper floors of a building collapsing onto lower floors. Hazards that present a potential damage to progressive collapse includes: explosive blast, earthquakes, and tornadoes. Progressive collapse has been a concern for earthquake, tornadoes, and explosive blast primarily. As a result of the 1933 Long Beach earthquake, around 230 school buildings were either destroyed, suffered major damage, or were judged unsafe to occupy. This event triggered the preparation of the Field Act which was passed by the California State Legislature mandating that school buildings must be earthquake-resistant. It is important to indicate, that California has in place codes and standards to mitigate potential earthquake damage to the physical environment. However, in other parts of the US, schools are very vulnerable to earthquakes and are not designed or retrofitted to be earthquake resistant. Strong winds, specifically tornadoes, can precipitate the entire collapse of a school building. In recent tornadoes, 24 elementary school children have died underneath a collapsed school building at Plaza Towers Elementary School in Oklahoma City. In the case of explosive blast, setback or stand-off distance is the single most important factor in determining the extent of damage for a given-size weapon. The intensity of blast loading depends on the distance and orientation of the blast waves relative to the protected space. In general, if the distance is doubled, the blast loading is reduced by a factor of 3 to 8, based upon the distance to the building and the TNT equivalent weight, with the smaller reduction applicable to smaller distances. In order to minimize the potential for progressive collapse a combination of site planning, setbacks and façade and structural hardening need to be in place Analysis for progressive collapse shall follow GSA's Progressive Collapse Analysis and Design Guidelines for New Federal Office Buildings and Major Modernization Projects. The Department of Defense has developed the criteria "Design of Buildings to Resist Progressive Collapse" (UFC 4-023-03). Both can be found at: • http://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=2&ved=0CC8QFjAB&url=http%3A%2F%2Fwww.wbdg.org%2Fccb%2FDOD%2FUFC%2FARCHIVES%2Fufc_4_023_03_2005.pdf&ei=lbgXUpeVK8aE2QWrroGQAw&usg=AFQjCNEPQavxVfifX0Y2_mtV1uwWr49bmg • https://www.google.com/#fp=f0cd3a2186644081&q=GSA+Progressive+Collapse+Analysis+and+Design+Guidelines+for+New+Federal+Office+Buildings+and+Major+Modernization+Projects&spell=1	a. Minimum against progressive collapse. Setbacks, if needed, are inappropriate = 1 b. Limited preparation against progressive collapse. Setbacks, if needed, offer low protection = 2 c. Moderate preparation against progressive collapse. Setbacks, if needed, offer moderate protection = 3 d. Good preparation against progressive collapse. Setbacks, if needed, offer good protection = 4 e. Very good preparation against progressive collapse. Setbacks, if needed, offer very good protection = 5		

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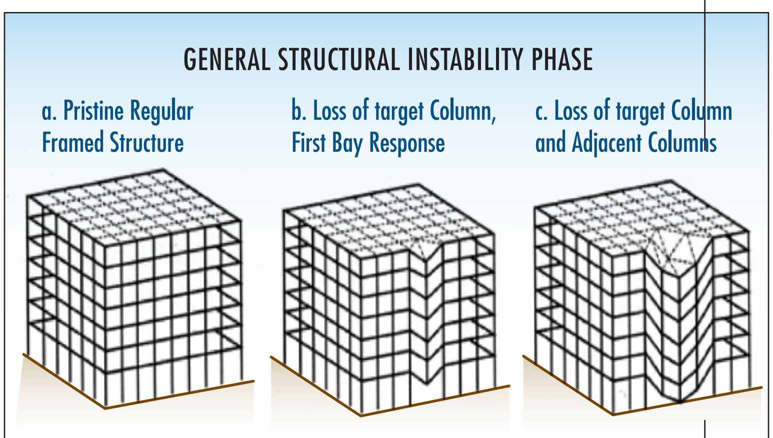
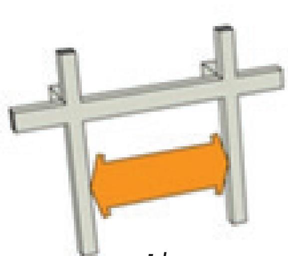
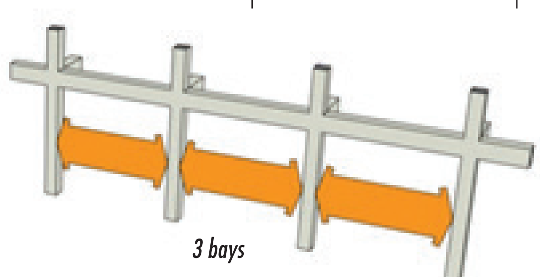
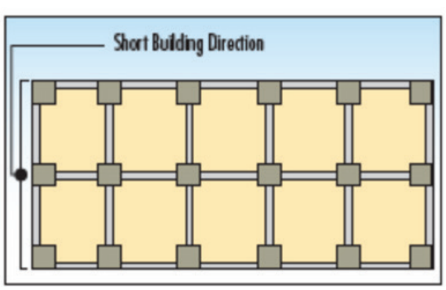
Level of Protection – Structural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
119 (cont.)	It is highly recommended that schools are prepared against progressive collapsed triggered by the postulated hazards enclosed in this Manual. For this this How-To Guide, the following considerations should be taken into account. • Use construction materials which have inherent ductility and which are better able to respond to load reversals (e.g., cast in place reinforced concrete column construction). • For buildings higher than three stories, use a combination of setback, site planning, façade hardening, and structural measures to prevent progressive collapse from the postulated threat or the loss of any single exterior column or load-bearing wall, whichever is lower. • For buildings higher than three stories, use a combination of setback, site planning, façade hardening, and structural measures to prevent progressive collapse from the postulated threat or the loss of any single exterior column or load-bearing wall, whichever is lower. Interior columns also shall be considered in buildings with an uncontrolled lobby. For all buildings, regardless of number of stories, use a combination of setback, site planning, façade hardening, and structural measures to prevent progressive collapse from the postulated threat or the loss of any single column, whichever is higher.			



Level of Protection – Structural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
120	**Condition of the 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. 	a. No special measures required. b. Poor; severe cracks and signs of settlements. = 1 c. Medium; minor cracks that do not affect the stability of the structure. = 2 d. Excellent. No signs of distress (i.e., cracks, settlement, tilt). = 3 - 5		
121	**Number of Bays in the Short Direction** "Bay" refers to the space between columns. In most cases, the school 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 school will withstand the loss of a column or other primary load-carrying element. The screener should observe the interior of the school 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	a. Progressive collapse design condition not known and < 3 bays = 1 b. Progressive collapse design condition not known and 3 or 4 bays = 2 c. Progressive collapse design condition not known and ≥ 5 bays = 3 d. Designed for progressive collapse. = 4, 5		

Level of Protection – Structural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
121 (cont.)	 *1 bay*  *3 bays*  *High School with multiple bays*			
122	**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.  *Columns spaced less than 15 feet apart*	a. 60 feet = 1 b. ≥ 40 feet, < 60 feet = 2 c. ≥ 25 feet, < 40 feet =3 d. ≥ 15 feet, < 25 feet = 4 e. < 15 feet = 5		

Level of Protection – Structural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
123	**Unbraced Column Height** Unbraced columns refer to the height of a column that is not braced by a floor system or by beams in two directions. They are a structural concerned for all hazards but especially for earthquakes and blast and to a lesser degree for high winds. If the column is properly braced, the height is not a problem; when it becomes a concern is when both, height and lack of bracing are present. Column height can be 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. Note that columns in the lobby or on the building exterior are often taller than columns in typical floors. 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.	a. Unbraced and ≥ 36 feet = 1, 2 b. Unbraced and ≥ 24 feet, < 36 = 3 c. Unbraced and ≥ 12 feet, < 24 feet = 4 d. Unbraced and < 12 feet = 5		

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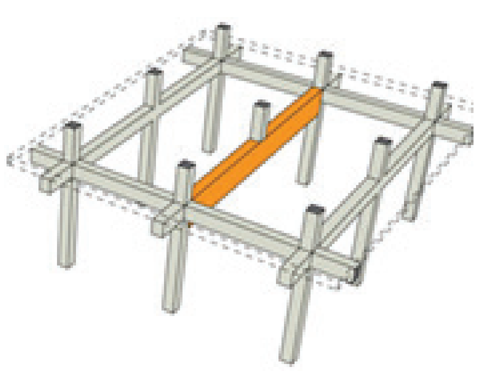
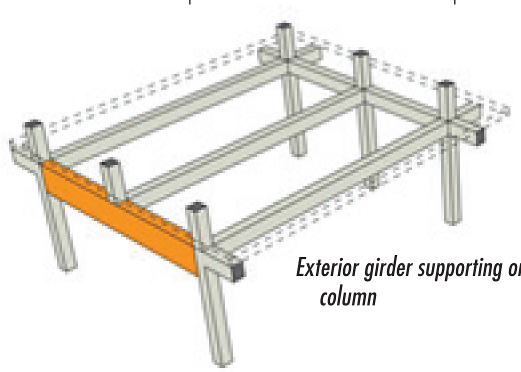
Level of Protection – Structural

ID	Criteria	LOP Options	Existing LOP	Nec. LOP
124	**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.	a. Exterior girder supporting more than one column. The girder is along the perimeter of the building and supports more than one column above = 1 b. Exterior girder supporting one column. The girder is along the perimeter of the building and supports one column above = 2 c. Interior girder supporting more than one column. The girder spans an interior space and supports more than one column above = 3 d. Interior girder supporting one column. The girder spans an interior space and supports one column above = 4 e. None. All columns are continuous from roof to foundation = 5		

Interior girder supporting one column

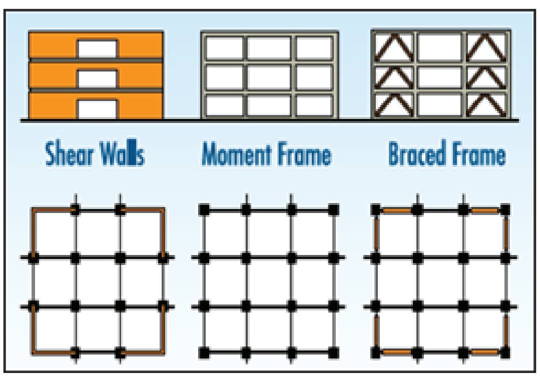




Exterior girder supporting one column

Level of Protection – Structural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
126	**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 school buildings built after 1993 in New York City, Washington, D.C., and other cities have undergone some level of required hardening.	a. Building is not well maintained (e.g., corrosion or large cracks are visible). Substandard. Designed to a level that has little, if any, reserve strength to withstand any abnormal loads without catastrophic failure = 1 b. 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 = 2 c. None. No structural enhancements or weaknesses described in the other attribute options (most common) = 3 d. Hardened: Designed or retrofitted to resist the effects of all postulated hazards including blast, hurricanes, earthquakes, progressive collapse, etc. = 4, 5		

Level of Protection – Structural				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
127	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. This may be difficult for those without an architectural/ engineering background to assess the presence of lateral systems. However this is a very important question for evaluating most hazards. In case of difficulties, the screener should consult the facility manager, the building design document or consult with a structural engineer or other design or construction professional with experience.	a. One = 1 b. Two = 2 c. Three = 3 d. Four = 4 e. Greater than four = 5		



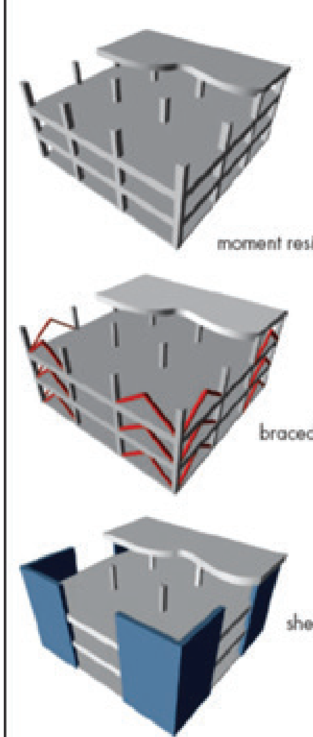
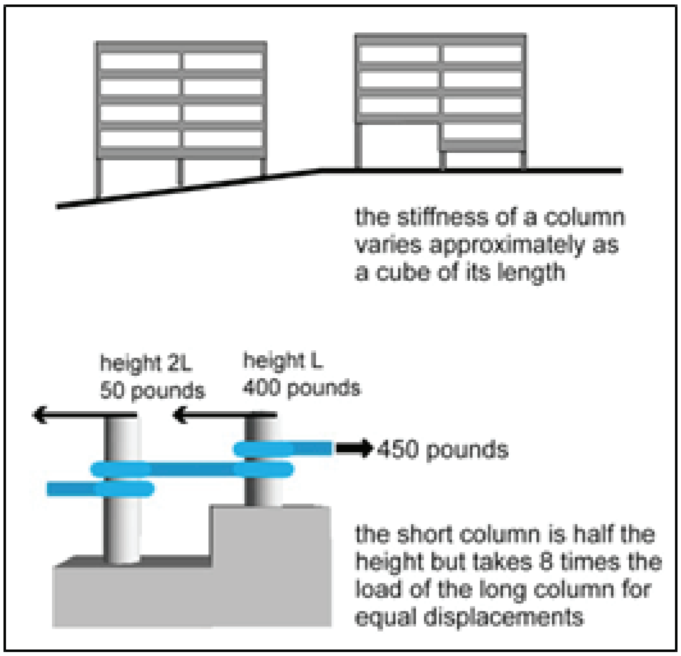


Figure 5-4
The optimiz
architecture

Level of Protection – Structural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
128	**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. Several (more than 2) in several floors = 1 b. Few (1 or 2) in several floors = 2 c. Several (more than 2) in single floor = 3 d. Few (1 or 2) in single floor = 4 e. None = 5		
129	**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. ≥ 40 feet = 1 b. 20 feet, < 40 feet = 2 c. 20 feet = 3 - 5		

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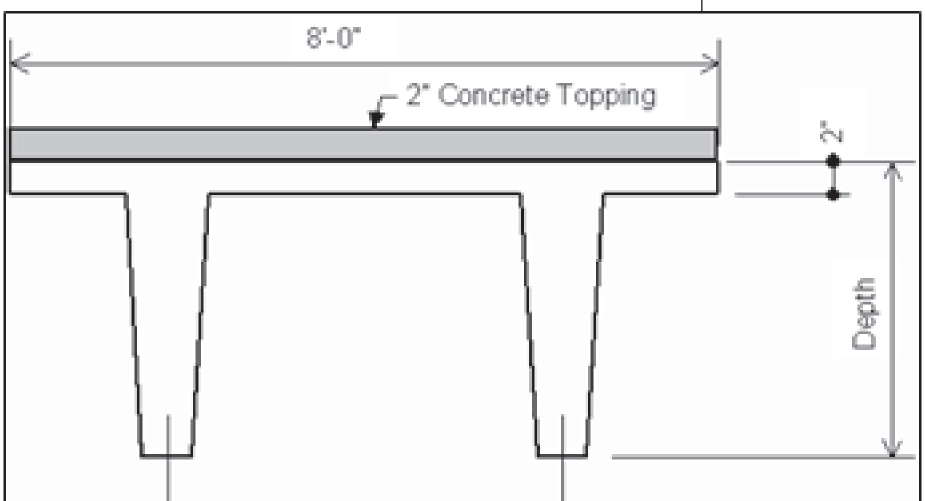
<table>
<tr><th colspan="5">Level of Protection – Structural</th></tr>
<tr><th>ID</th><th>Criteria</th><th>LOP Options</th><th>Existing LOP</th><th>Nec. LOP</th></tr>
<tr><td>128</td><td>

Topping Slabs

Topping slabs are nonstructural floor coverings (typically concrete) over the structural slab or components.

Concrete topping slab

This may be difficult for those without an architectural/engineering background to assess the presence of lateral systems. However this is a very important question for evaluating most hazards. In case of difficulties, the screener should consult the facility manager, the building design document or consult with a structural engineers or other design or construction professional with experience



Concrete topping slab. Typical Precast Double Tee Beam

</td><td>a. Low seismic demand. Missing = 1
b. Present = 2 - 5</td><td></td><td></td></tr>
<tr><td>129</td><td>

Adjacent Building Separation

Adjacent building separation refers to the separation between the school and adjacent buildings. Adjacent buildings can affect each other during an earthquake if the separation between them is too small. This phenomena is usually known as pounding. Pounding is commonly observed in many earthquakes.

In addition the distance between structures is very important for fire prevention. Numerous significant fires involving multiple buildings over occur frequently. Fire codes can be found at:

http://www.nfpa.org/

</td><td>a. Low seismic demand. No adjacent buildings. Not adequate separation (less than 6 inches) = 1
b. Adequate (more than 6 inches) = 2- 5</td><td></td><td></td></tr>
</table>

Level of Protection – Structural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
130	**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 72hours, 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 b. The building is subject to flooding. Minimum flood resistant components = 1 c. The building is subject to flooding. Moderate flood resistant components = 2 d. The building is subject to flooding. Good flood resistant components = 3,4 e. The building is subject to flooding = 5		
131	**Windborne Debris Impact Protection Zones** 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 device. Schools constructed prior to the benchmark year may be retrofitted to meet standards by using shutters, storm windows, or a curtain system. Screeners should consult the table below to obtain the benchmark year for their state (f listed) then select the score based on when their school was constructed relative to the benchmark year, unless modifications override the year. Schools in a state not identified in the table should be scored with a b unless they have windborne debris impact screens or designs.	a. Not applicable. Before benchmark years = 1, 2 b. Post-benchmark year = 3 - 5		

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Level of Protection – Structural				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
132	**Manufactured Homes** Many schools have manufactured homes that functions as classrooms (also known as prefabricated housing) which are 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	a. Not applicable b Manufactured homes are abundant and no secured for UEs = 1 c. A few manufactured homes are in existence and they are moderately secured for UEs = 2 d. Very few manufactured homes are in existence and they are moderately secured for UEs = 3 e. Very few manufactured homes are in existence but they are fairly secured for UEs = 4 f. None = 5		

Level of Protection – Mechanical, Electrical, and Plumbing Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
133	**HVAC and MEP Systems** MEP systems include primarily, mechanical, electrical and plumbing (MEP) systems. Mechanical systems also include heating, ventilating, and air-conditioning (HVAC) systems. These systems are vital to maintain functionality and provide services for schools pre and post disaster events. The resiliency and safety of the MEP and HVAC systems depends in great part on the location, hardness and protection of the systems; the correct anchoring; and the capacity to separate/isolate parts of the systems in case of emergency. Having in place plans for maintaining operation and managing the systems in case of emergency are also important. MEP and HVAC systems can be damaged by earthquakes, hurricanes, tornadoes, floods, explosives, and fires. They can also be vandalized by students or outsiders and their failure can trigger school violence and chaotic situations. One of the critical functions of electrical systems is to provide and maintain power/backup for school essential services at all times – especially those required for life safety and evacuation. In addition, it is essential to provide lighting and power for surveillance equipment and power for emergency communications. HVAC systems are essential to contain a Chemical, Biological, Radiological (CBR) attack or unintended hazardous material spill. In case of HVAC systems, it is essential to have in place appropriate shut-down procedures. A "one-step shut-off" is a mechanism that requires only a single action by an individual (e.g., engineer or security personnel) to initiate the immediate shut down of all air handling equipment in the school. Special air-filtration systems designed to continue to operate in a contaminated environment to enable the continuity of service are also critical.	a. Minimum requirements – systems are not easily accessible in case of emergency, secured or appropriately anchored. Emergency power is available for a short period of time = 1 b. Very moderate requirements – systems are accessible in case of emergency but security and anchoring is minimal = 2 c. Moderate requirements – systems are accessible in case of emergency and security and anchoring is moderate. = 3 d. Good requirements – systems are accessible in case of emergency; they are adequately anchored and placed in a secure location. = 4 e. Very good requirements – systems are accessible in case of emergency; they are well anchored and placed in a secure location. HVAC systems can be shut off in one single step and emergency and normal power distribution is well located and protected = 5		

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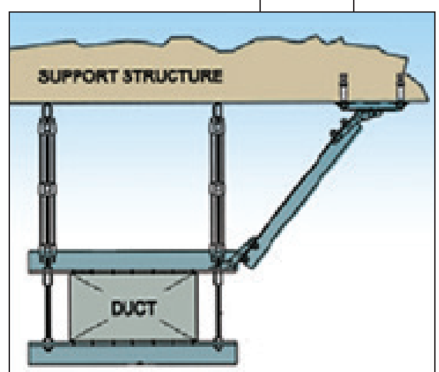
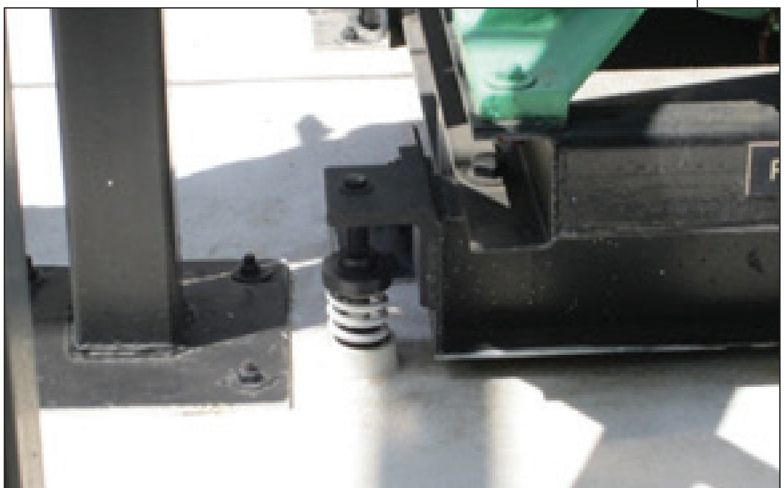
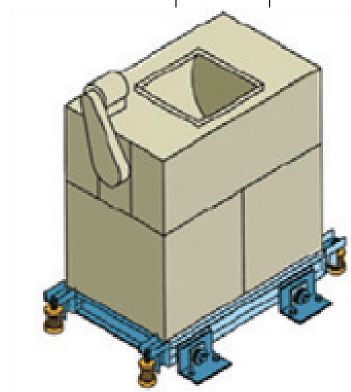
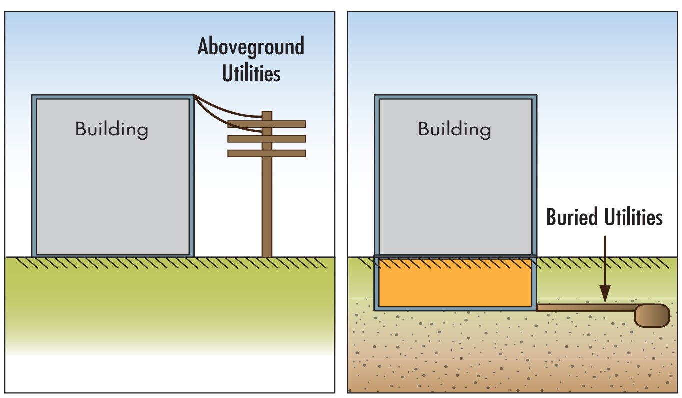
Level of Protection – Mechanical, Electrical, and Plumbing Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
133 (cont.)	Protection for fuel tanks, especially where the fuel tanks are above ground, should be the same as for the emergency generator, including the separation of the generator from the fuel tanks, so that a single event does not disable both assets. Fire-rated, hardened enclosures for fuel tanks and generators should be considered. Where fuel tanks are located far from the generator, such as in a high-rise building, systems that use jockey pumps activated by pressure drop alone to maintain pressure in the fuel piping system should be avoided. If jockey pumps are used, additional control measures are required; such as a confirmation signal that the generator is running as the reason for the pressure drop, or use of the level sensors in the generator day tank to indicate refilling is required. The additional sensors should also link to a pressure drop alarm, such that this alarm activates when the other sensor is not activated, indicating a pressure drop from a leak. Fire safety requirements (fire stopping), air infiltration and leakage requirements (sealing and smoke stopping), and sound transmission requirements (sound proofing) should be observed wherever system components penetrate a roof, ceiling, wall, or floor. Plumbing systems include water distribution, water storage, sanitation systems, storm water drainage, water heaters and softeners, and onsite treatment, as well as distribution of natural gas, laboratory gases, and medical gases. For this How-To-Guide six critical consideration will be taken into account to rate these systems: • If these systems are accessible for emergency • If they located are in a secure area • If they are appropriately anchored and protected against hazardous events (earthquake, hurricanes, tornadoes, floods, explosives, and fire) • If a one one-step shut-off is in place (a single action by an individual to shut down the HVAC systems) • If emergency and normal power distribution are separated and are not located in the same vault If emergency generators and transformers are well protected and located			

Level of Protection – Mechanical, Electrical, and Plumbing Systems				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
134	**MEP and Earthquake** Historically, the seismic performance of MEP systems and components has received limited attention from designers. The 1971 San Fernando earthquake alerted designers to the issue' mainly because well-designed building structures were able to survive damaging earthquakes while MEP and other nonstructural components suffered severe damage. It became obvious that much more attention had to be paid to the design of these systems' components. Some investigators have postulated that MEP and nonstructural system/component failure may lead to more injury and death in the future than structural failure. MEP systems are often very flexible in contrast to the relatively rigid building structure. This flexibility often leads to a much higher level of excitation than the building's primary structure. There are a number of objects that can directly cause either death or injury if they are not properly designed for restraint. These injuries are generally due to falling hazards. There are also indirect threats to life and injury due to nonstructural failures. These might include the inability of occupants to safely exit a building due to damaged materials strewn across the stairs in exit stair¬wells.  *Mechanical equipment with proper seismic angle bracing*	a. Not applicable b. Very low resistance = 1 c. Low resistance = 2 d. Moderate resistance = 3 e. High resistance = 4 f. Very high resistance = 5  *Typical duct bracing*  *Anchorage of pipes*		

Level of Protection – Mechanical, Electrical, and Plumbing Systems				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
	 *Close-up of an isolation "snubber" or spring*	 *Isolation and anchoring of equipment*		
135	**MEP and Wind** Exterior-mounted mechanical and elec¬trical equipment are often damaged during high winds. Damaged equipment can impair the operation of the facility, the equipment can detach and become wind-borne missiles and water can enter the facility where equipment was mounted. The most common problems typically relate to inadequate equipment anchorage, inadequate strength of the equipment itself, and corrosion. Information on loads on rooftop equipment was first introduced in the 2002 edition of ASCE 7. For guidance on load calculations, see "Calculating Wind Loads and Anchorage Requirements for Rooftop Equipment" (ASHRAE, 2006). A minimum safety factor of 3 is recommended for critical facilities. Loads and resistance should also be calculated for heavy pieces of equipment since the dead load of the equipment is often inadequate to resist the de¬sign wind load.	a. Not applicable b. Very low resistance = 1 c. Low resistance = 2 d. Moderate resistance = 3 e. High resistance = 4 f. Very high resistance = 5		

Level of Protection – Mechanical, Electrical, and Plumbing Systems				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
136	**MEP and Flood** Utility systems and equipment are best protected when elevated above the Design Flood Elevation (DFE) (plus freeboard, if required). Inside the Floodplain. MEP equipment should be located inside protective flood-proofed enclosures, which will not adversely affect the equipment. Designers should pay particular attention to under floor utilities and ductwork to ensure that they are properly elevated. Plumbing conduits, water supply lines, gas lines and electric cables that must extend below the DFE should be located, anchored, and protected to resist the effects of flooding. Outside the Floodplain. Equipment that is outside of an elevated building also must be elevated: • In A Zones, equipment may be affixed to raised support structures or mounted on platforms that are attached to or cantilevered from the primary structure. • In V Zones and Coastal A Zones, equipment may be affixed to raised support structures designed for flood conditions (waves, debris impact, erosion, and scour) or mounted on platforms that are attached to or cantilevered from the primary structure. If an enclosure is constructed under the elevated building, the designer must take care that utilities and attendant equipment are not mounted on or pass through walls that are intended to break away.  *Aboveground and underground utilities*	a. Not applicable b. Very low resistance and no free board = 1 c. Low resistance and minimum freeboard = 2 d. Moderate resistance and moderate freeboard = 3 e. High resistance = and adequate freeboard =4 f. Very high resistance and very adequate freeboard = 5 A Zones: (also called "unnumbered A Zones" or "approximate A Zones"). This designation is used for flood hazard areas where engineering analyses have not been performed to develop detailed flood elevations. Base flood elevations (BFEs) are not provided. Additional engineering analyses and site-specific assessments usually are required to determine the design flood elevation. The DFE establishes the minimum level of flood protection that must be provided. The DFE, as used in the model building codes, is defined as either the BFE determined by the National Flood Insurance Program (NFIP) and shown on Flood Insurance Rate Maps (FIRMs), or the elevation of a design flood designated by the community, whichever is higher "Freeboard" is a factor of safety usually expressed in feet above a flood level. Freeboard compensates for the many unknown factors that could contribute to flood heights, such as wave action, constricting bridge openings and the hydrological effect of urbanization of the watershed. A freeboard from 1 to 3 feet is often applied to critical facilities.		

Level of Protection – Mechanical, Electrical, and Plumbing Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
137	**MEP and Blast** MEP systems can be severely damaged during an explosive attack. The duration of a blast event is very short which differs from earthquakes and wind gusts. The intensity of the pressures acting on a MEP system can be several orders of magnitude greater than other hazards such as hurricane and earthquakes. Vulnerabilities of the MEP system to blast effects can be characterized as follows: • MEP rooms should be massive to have a strong mitigation effect. • A minimum 50-foot (15-meter) separation should be provided between utility service entrances; primary and backup equipment for the same building system; primary and backup distribution for system cabling and piping; and between critical system components and high-risk areas. • Explosive pressure decays extremely rapidly with distance from the source. Hardening MEP rooms and establishing adequate standoff can minimize the damage. • Rooms for primary and backup systems should be hardened to improve their resilience. • Fixtures, equipment, and piping should not be mounted on the inside of exterior walls, but on a separate wall at least 6 inches (15 centimeters) from the exterior wall face. • When MEP is enclosed, the utility room should have two or more service entrances, sufficiently separated so that one incident does not disable all service to the building. • Equipment, fixtures, conduits, and piping should not be suspended from the ceiling, unless supported and braced in accordance with seismic design requirements that also take into account additional blast loads. • Vibration isolators should be installed on rotating equipment and flexible piping connections. • Sufficient storage capacity for fuel, oil, water, and other materials should be provided to allow the building to operate as long as required.	a. Not applicable b. Very low resistance = 1 c. Low resistance = 2 d. Moderate resistance = 3 e. High resistance = 4 f. Very high resistance = 5		

Level of Protection – Mechanical, Electrical, and Plumbing Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
138	**HVAC Systems** In order to ensure that HVAC system operation cannot be disrupted by someone physically accessing the controls, HVAC equipment should be located in a secure area with access limited to security and engineering staff. HVAC systems are a very important part of school security and occupant health. HVAC systems, if not properly designed, can be a main conduit of pandemic diseases and other infections. In case of a CBR attack or an unintended hazardous material spill, HVAC plays a central role in the dissemination of the hazard. HVAC systems regulate school temperature and humidity. They provide ventilation, reduce air infiltration, and maintain pressure relationships between spaces. HVAC can be executed in individual buildings or other enclosed spaces. The likelihood that a CBR contaminant will be introduced into a school building depends on accessibility to the school's external air intake, 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. In areas of high risk, some CBR hazards can be identified using automatic detectors or sensory detection. Detectors may be located inside HVAC systems, within critical areas or locations susceptible to CBR release, or outside the building on the site. Detectors should provide sufficient advanced warning to allow emergency shutdown, evacuation, and/or shelter-in-place actions to be implemented • Primary External Air Intake Location – CBR. Air intakes are often at ground or below ground levels. They can also be below grade with sidewalk grates over them and exposed to public areas. 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. Securing air intakes makes the building ventilation system less accessible and therefore less vulnerable to threats that might introduce contaminates directly into the intakes. When choosing secure locations for intakes in urban areas, take into consideration the vantage points offered to perpetrators from nearby buildings and roofs. • Isolated Ventilation Systems. A building having multiple HVAC zones, with each zone separated and served by its own air-handling unit and duct system has an isolated system. Isolating the separate HVAC zones minimizes the potential spread of an airborne hazard released internally by reducing the volume of space and therefore the number of people exposed. In case of an emergency, it is essential that HVAC controls should allow for emergency shutdown either centrally or in the classroom.	a. No special measures required. = 1 b. Air intakes are below grade or at ground level with unrestricted access. = 2 c. Air intakes are not accessible and are secured. HVAC systems for lobbies, loading docks, and mailrooms are separated. Air return is ducted. = 3 d. Air intakes are well secured. HVAC systems for lobbies, loading docks, and mailrooms are separated. Air return is ducted. HEPA filters or functional equivalent are serving critical areas. = 4, 5		

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<table>
<tr><th colspan="5">Level of Protection – Mechanical, Electrical, and Plumbing Systems</th></tr>
<tr><th>ID</th><th>Criteria</th><th>LOP Options</th><th>Existing LOP</th><th>Nec. LOP</th></tr>
<tr><td>138 (cont.)</td><td>In addition to the systems being separate from the rest of the facility, HVAC systems serving lobbies, mailrooms, and loading docks should not share a return-air system with each other.

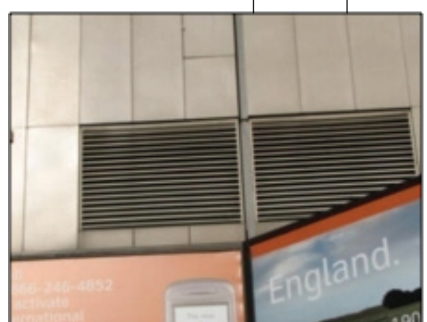
The areas served by a dedicated exhaust system should be maintained at a negative pressure relative to the rest of the building, but at a positive pressure relative to the outdoors.

Physical isolation of these areas (well-sealed floor to roof-deck walls, sealed wall penetrations) is critical to maintaining the pressure differential and requires special attention to ensure airtight boundaries between these areas and adjacent spaces.

• Return Air Intake System. A ducted return air system is less vulnerable than an un-ducted 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 un-ducted by asking a school site representative or facility engineer.

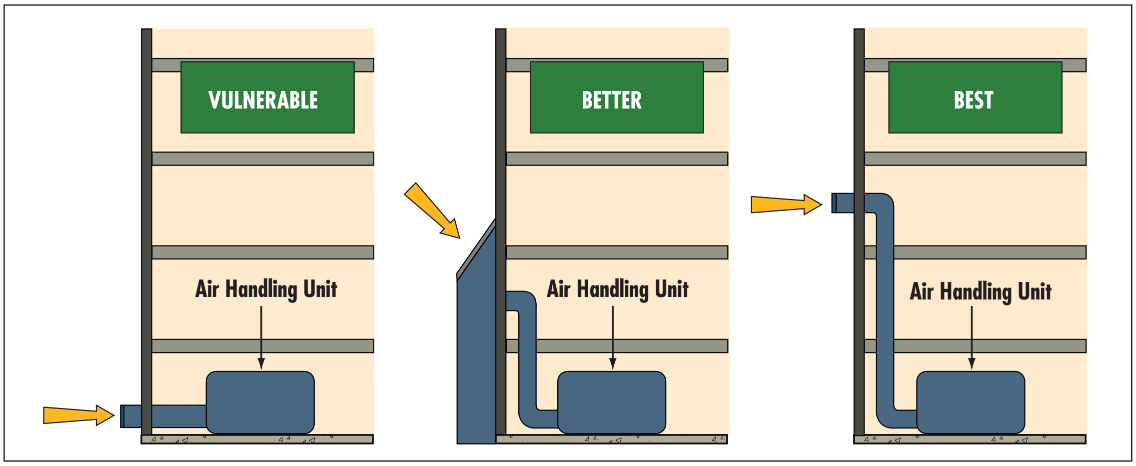
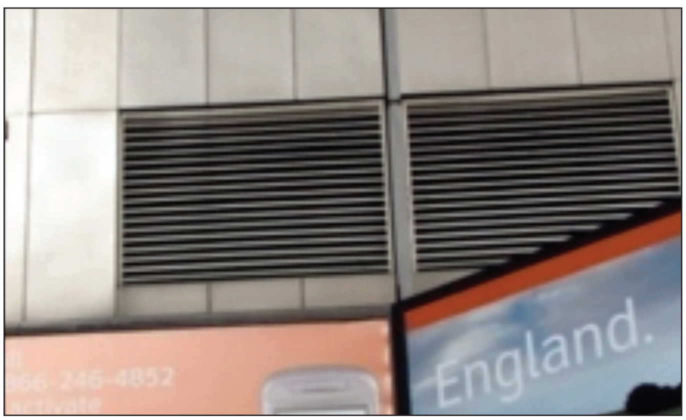
• Internal Air Distribution System. High-risk areas such as lobbies, loading docks, mailrooms, and retail spaces in a building create potential for the introduction of a CBR contaminant into the internal air distribution system. The screener can obtain information from a site representative or facility engineer on the design of the internal air system

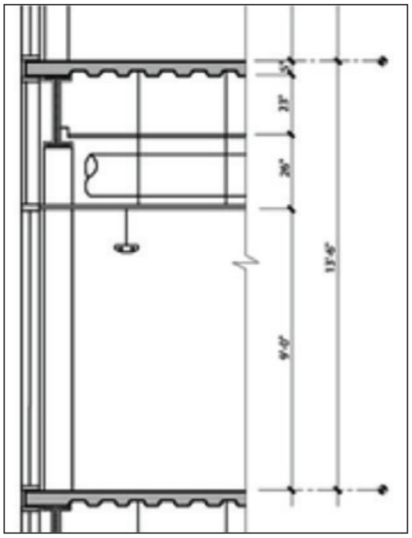
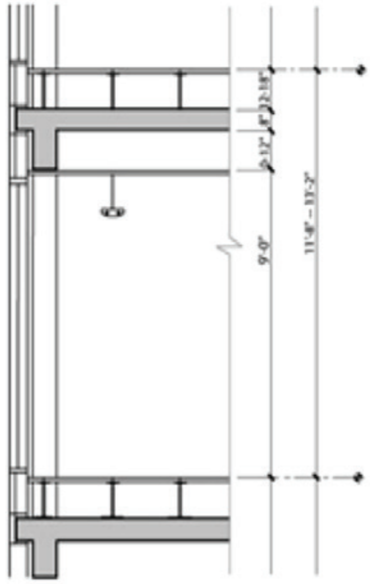
• Biological Filtration – General Building. Refers to air purification through the use of filters throughout the building to protect against biological contaminants. Among the various approaches for protecting buildings from CBR attack, high-efficiency air purification provides the highest level of protection against outdoor releases. Air purification on a continuous basis is the only protective measure that provides a high level of protection against a covert, remote outdoor release

</td><td>

Air intake about 15 feet above ground

Poor location of critical utilities</td><td></td><td></td></tr>
</table>

Level of Protection – Mechanical, Electrical, and Plumbing Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
138 (cont.)	 *Location of external air intakes* SOURCE: CDC/NIOSH (2002)  *Air intake about 15 feet above ground*  *Ducted accessible air return system*  *Air intake about 15 feet above ground*  *Un-ducted floor air return*			

Level of Protection – Mechanical, Electrical, and Plumbing Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
138 (cont.)	 *Ducted air return system*  *Unducted air return system*			
139	**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. 	f. Very Poor = 1 g. Poor = 2 h. Moderate = 3 i. Good = 4 j. Very Good = 5 *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*		

Level of Protection – Fire Protection Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
140	**Fire Governing Standard** The school building must meet the fire code/governing standard that was in place at the time of construction. If this is not the case, it is essential that the schools upgrade to current codes to be in compliance with codes or governing standards. These characteristics can be evaluated by talking to the school engineer or by reviewing school documentation.	a. School does not meet current governing standards = 1 b. Schools compliance with current governing standards is limited = 2 c. Schools compliance with current governing standards is good = 3 d. School complies with current governing standards very well = 4, 5		
141	**Inspection by Fire Code Enforcement Officials** Schools should be inspected by fire code officials regularly and frequently. Fire code enforcement officials should have visited the school within the last 12 months to evaluate the school compliance with current codes and/or standards. Equally important is for the fire detection equipment to have been inspected and tested and have had typical maintenance in the last 12 months. Records indicating when the fire-suppression system or equipment was last inspected should be available to verify the last date and frequency of inspection. 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	Code officials have not visited the school in the last 12 months and equipment is not upgraded to current fire code = 1 Code officials have not visited the school in the last 12 months and equipment has minimum compliance with fire codes = 2, 3 Fire code official have visited the school within the last 12 months and equipment is in full compliance with or above current fire codes = 4, 5		

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Level of Protection – Fire Protection Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
142	**Backup Power for Life Safety Equipment** Life safety equipment needs to be automatically connected to a backup (redundant or secondary) power supply if the primary power supply is disrupted in an emergency.	a. Life safety equipment t is not automatically connected to backup power. = 1, 2, 3 b. Life safety equipment is automatically connected to backup power. = 4, 5		
143	**Fire Command Center** A fire command center is a room in a school that serves as a command center for life safety systems. The room provides a central location for emergency and school 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. Entrance to the fire command center should be controlled and denied to unauthorized individuals  *Fire control panel located in the building fire command center (courtesy Thomas Barnum)*	a. Not applicable = 1 b. Fire command center not available = 2 c. Fire command center available but incomplete = 3 d. Fire command center available and complete = 4, 5		

Level of Protection – Fire Protection Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
144	**Automatic Fire Detection System and Fire Alarm** An automatic fire detection system is available to detect the unwanted presence of fire by monitoring environmental changes associated with combustion. Automatic fire alarm systems can be used to notify staff and students 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. Fire detection can be monitored by: • Local fire department • Offsite company • Fire control panel • No one (local alarm)	a. Fire detection system is not available or monitored. School evacuation is poorly organized. = 1 b. Fire detection system is available and controlled by a fire command panel. School evacuation plans are well organized. = 2, 3 c. A fire detection system is available, and monitored by an outside company and/or the fire department. School evacuation plans are very good and evacuation drills are periodically scheduled and conducted = 4, 5		
145	**Fire and 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 to prevent the spread of smoke and the provision of fresh air to the fire location.	a. Not applicable = 1 b. The HVAC systems are not automatically shut down in response to a fire alarm. = 2. 3 c. The HVAC systems are automatically shut down in response to a fire alarm. = 4, 5		

Level of Protection – Fire Protection Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
146	**Automatic Fire Sprinkler System** An automatic fire sprinkler system 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. Sprinklers are usually overhead 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. Typically only sprinkler heads at the fire location operate (not the entire system). Sprinkler systems help limit the spread of a fire, thereby increasing life safety and limiting structural damage. It is important to know if the sprinkler system covers the building completely or partially. 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. Automatic fire sprinkler system is not available. = 1 b. Automatic fire sprinkler systems is available but only partially covers the school building = 2, 3 c. Automatic fire sprinkler system is available and covers the entire school building. = 4, 5  *Sprinkler head* SOURCE: THOMAS BARNUM		

Level of Protection – Fire Protection Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
147	**Standpipe System** A standpipe system is a type of rigid water piping system that is built into a building in a vertical position. Fire hoses can be connected to a standpipe system, allowing manual application of water to the fire. Standpipes inside school buildings serve the same purpose as fire hydrants. 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 1.5 inch hose connection at each location; designed for 100 gpm 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 size (single story) does not require standpipes. b. The building size (more than single story) does require standpipes but the standpipes are not placed correctly to cover the building area. = 1, 2 c. The building size (more than single story) does require standpipes and the standpipes are placed correctly to cover the building area.= 3, 4, 5		
148	**Fire Drill** Fire drills are regular exercises that the local fire departments conduct to practice evacuation of a school 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 local statute.	a. Fire drills are not conducted = 1 b. Fire drills are not regularly scheduled= 2, 3 c. Fire drills are regularly and thoroughly conducted = 4, 5		
149	**Fire Safety Training** Training school staff 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 teachers, staff and students. Objectives for training are: • Develop awareness of potential threats or hazards. Staff and teachers should be able to recognize, report, and appropriately respond to suspicious items. Develop an understanding of the responses and protective actions and what should be done for each possible protective action.	a. Safety training has not been provided to teachers and staff = 1, 2 b. Safety training has been provided to teachers and staff = 3, 4, 5		

Level of Protection – Fire Protection Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
150	**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. School has not been adequately pressurized = 1, 2 c. School has been adequately pressurized = 3, 4, 5		
151	**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. Elevators are not automatically recalled when alarm is activated = 1, 2, 3 c. Elevators are automatically recalled when alarm is activated = 4, 5		
152	**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. Not interlocked = 1, 2, 3 c. Interlocked = 4, 5		
153	**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. No smoke dampers in ductwork = 1, 2, 3 c. Smoke dampers present in ductwork = 4, 5		

Level of Protection – Fire Protection Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
154	**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. No pull stations = 1, 2 b. Pull stations present = 3, 4, 5		
155	**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 fighters 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.  *Typical wall mounted knox box*	a. School keys are not easily available to firefighters = 1, 2 b. School keys are easily available to firefighters = 3, 4, 5		

Level of Protection – Fire Protection Systems				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
156	**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 pumps / jockey pumps may or may not be accessible to the public and first responders.  *Fire and jockey pump*	a. Fire or jockey pumps are not available = 1 b. Fire or jockey pumps are available but difficult to access to firefighters = 2, 3 c. Fire or jockey pumps are automatic and easy to access by firefighters = 4, 5 *Fire and jockey pump*		
157	**Valve Monitoring** 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. 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. Effective = 1, 2 b. Very Effective = 3, 4 C. Excellent = 5		

Level of Protection – Fire Protection Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
158	**Type of Alternate Automatic Extinguishing Systems** Fire extinguishers are an active fire protection device used to extinguish or control small fires often in emergency situations. 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. Not effective = 1 b. Effective = 2 c. Very Effective = 3, 4 d. Excellent = 5		
159	**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. Smoke control system is ineffective = 1 b. Smoke control system is moderately effective = 2, 3 c. Smoke control system is effective = 4 d. Smoke control system is very effective = 5		

Level of Protection – Fire Protection Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
160	**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. Smoke and Heat Vents are not present= 1, 2 b. Smoke and Heat Vents are present = 3, 4, 5 *An automatic smoke and heat vent on the roof of a building (courtesy Thomas Barnum)*		
161	**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. Fire department connections not available = 1, 2 b. Fire department connections available = 3, 4, 5		
162	**Fire Apparatus Access Roads** Access roads or emergency access roads for fire apparatus should be provided to meet the needs of fire officials. Access roads provide access by fire apparatus and other emergency response vehicles to the school building(s). Entrances to and from the site must be in operation during and after an emergency. 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. Not applicable = 1 b. Insufficient = 2 c. Sufficient = 3 d. Good = 4 e. Very good = 5		

Level of Protection – Fire Protection Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
163	**Water Supply for Firefighting Operations** Schools should make sure that water supply is adequate for firefighting operations. The screener must determine whether fire hydrants at the school building site have been inspected and tested and have had typical maintenance in the last 12 months.	a. Inadequate = 1 b. Limited = 2 c. Moderate = 3 d. Adequate = 4 e. Excellent = 5		

Level of Protection – Security Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
164	**Internal Instruction: Number of Security Systems** Intrusion refers to a person or persons entering or breaking into a school building with the intent of attacking or causing harm to the students, teachers or assets. Security systems in schools cover the following undesirable events: • School Shootings • Kidnapping • Robbery • Theft • Vandalism • Drug abuse • Explosives • CBR Detection systems are designed to prevent, detect, deter and respond to undesirable events. Redundant detection systems (multiple layered detection layers) are highly desirable. Types of security systems for intrusion detection include: 1. Video surveillance 2. Security guards 3. Security lighting 4. Access control 5. Asset/interdiction-related communications	a. None = 1 b. One system = 2, 3 c. Two systems = 4 d. Three or more systems = 5		
165	**Internal Instruction: 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 for detecting and warning of a potential intrusion.	a. No security = 1 b. Ineffective = 1, 2 c. Moderate = 3 d. Very Effective = 4 e. Highly effective = 5		

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Level of Protection – Security Systems				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
166	**External Intrusion Zones** External Intrusion will be evaluated using the Concepts described in Target Potential (Undesirable Events ID #13) to address the following hazards and threats: 1. Arson 2. School Shooting 3. Kidnapping 4. Explosive Device – Man-Portable (External and Internal) 5. Explosive Device – External 6. Explosive Device – Mailed or Delivered 7. CBR Release – Internal 8. CBR Release – External 9. CBR Release – Mail Delivered 10. CBR Release – Water Supply 11. Disruption of School Security Systems 12. High Velocity Vehicles in Vicinity 13. Cyber Attack 14. Drug Abuse 15. Vandalism • Zone 1 refers to an external attack directed at the subject school building or occurring at a building less than 100 feet from the enclosure of the school. An event in Zone 1 would be catastrophic. Casualties, damage, and school interruption should be expected. • Zone 2 refers to an event that occurs between 100 feet and 300 feet from the school building. . An event in Zone 2 is a moderate hazard level. • Zone 3 refers to an event that occurs between 300 feet and 1000 feet from the school building. An event in Zone 3 is a minor hazard level. To determine the best response, local policies and records should be consulted to assess the history and potential occurrence of arson, kidnapping, drug abuse and vandalism. In addition, credible threats for school shootings, explosives, CBR, and cyber-attacks should be evaluated. Evaluation of these criteria requires the application of judgment to determine the best response.	a. Subjected to more than 4 threats in zone 1; subjected to more than 8 threats in zone 3; and subjected to more than 5 threats in zone 12 = 1, 2 b. Subjected to more than 3 threats in zone 1; subjected to more than 4 threats in zone 3; and subjected to more than 5 threats in zone 5 = 3, 4 d. Subjected to more than 2 threats in zone 1; subjected to more than 3 threats in zone 3; and subjected to more than 5 threats in zone 4 = 5		

Level of Protection – Security Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
167	**External Intrusion -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. This evaluation addresses the immediate perimeter around the school (less than 100 feet): Types of security systems for explosive detection include: • Explosion detection equipment • Personnel screening • Video surveillance • Security guards • Access control • Asset/interdiction-related communications	a. None = 1 b. One system = 2, 3 c. Two systems = 4 d. Three or more systems = 5		
168	**External Intrusion -Securtity Systems 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 for detecting and warning of a potential intrusion.	a. No security = 1 b. Ineffective = 1, 2 c. Moderate = 3 d. Very Effective = 4 e. Highly effective = 5		

Level of Protection – Security Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
168	**Security Communication and Alerts for Natural Hazard** This criterion relates to schools early warning systems. Warning systems include the following: • The National Weather Service/NOAA Weather Radio • Director information for the Emergency Operation Centers • Cable News and Local Weather Station • Smart Phones Typically, security communication and alerts for natural hazards work the following way: National Oceanographic and Aeronautics Administration (NOAA) National Weather Service (NWS) operated "all-hazards" emergency alert radio which covers weather and other hazards including Amber Alerts (child abduction), Blue Alerts (officer abduction or endanger) and Silver Amber Alerts (endangered elder alerts). Many – but certainly not all – schools contract for weather alerts with a commercial provider such as Weather Bug, Accu-Weather or Impact Weather. Many schools also use lightning detectors which are pocket-size devices which detect even small lightning strikes, usually out to about 25 miles. The device reports lightning and distance, which often is related to the standards set by the local governing bodies. In such cases, school sports must be cleared. From a best practice standpoint, for other hazards, schools should coordinate closely with the local emergency operations center (EOC). This might mean allowing tornado sirens to be installed on school grounds. This also applies to county or city calls for hurricane evacuation – to coordinate school closing so students are not in school when they should be evacuating and to consider traffic impacts for buses, pickup and student and staff drivers. This precaution may also apply to other hazards such as river flooding in some areas. In addition, local EOCs provide information using several systems including social media and even emergency am radio stations. Schools should also establish communication with local fire and police agencies so that they are warned about wildland fires or hazardous materials leaks early and also about violent threats or other police situations.	a. One system = 1 b. Two systems = 2 c. Three systems = 3 d. Four systems = 4, 5 e. Five or more systems = 5		

Level of Protection – Security Systems				
ID	**Criteria**	**LOP Options**	**Existing LOP**	**Nec. LOP**
169	**Security Communication for Emergency Response: Number of Security Systems** This criterion addresses the communication systems and their effectiveness for communicating with local authorities and first responders in case of an emergency. It is desirable for schools to have agreements and communication protocols in place with local authorities that cover how they will respond to emergencies from natural disasters or man-made hazards. Communications systems can include: • 911 Calls • Radios • Smart Phones • Panic Buttons	a. School emergency communication systems are very limited = 1 b. School emergency communication systems are limited = 2 c. School emergency communication systems are moderate = 3 d. School emergency communication systems are good = 4 e. School emergency communication systems are very good = 5		
170	**Security Communication for Emergency Response: Security Systems 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 for detecting and warning of a potential intrusion.	a. No security = 1 b. Ineffective = 1, 2 c. Moderate = 3 d. Very Effective = 4 e. Highly effective = 5		
Cyber Security				
171	**Security of Cyber Communication Systems** The level of protection of the communications system equipment, including main distribution centers, wiring closets, data centers, routers, and servers for preventing unauthorized physical and remote (cyber) access should be evaluated.	a. No security = 1 b. Medium security = 2 c. Moderate security = 3 d. High security = 4 e. Very high security = 5		

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Level of Protection – Security Systems				
ID	Criteria	LOP Options	Existing LOP	Nec. LOP
172	**Redundancy of Cyber Communications Systems** Redundant communications systems are intended to keep communications systems operating if the primary system is compromised. Whether the communications systems are redundant should be determined. 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. No = 1, 2 b. Yes = 3, 4, 5		
173	**Power Supply Security** The power supply ensures that all communications and security measures are functioning, so its security is essential. The effectiveness of the in-place measures to protect the power supply to the building should be evaluated.	a. No security = 1 b. Medium security = 2 c. Moderate security = 3 d. High security = 4 e. Very high security = 5		
174	**Effectiveness of Wide Area Network (WAN), Local Area Network (LAN), Wireless, Radio, and Satellite Systems During Emergencies** The effectiveness of communication mode functions in delivering important messages to and from the building if other systems are compromised should be evaluated.	a. Low (system only) = 1 b. Medium (within jurisdiction) = 2, 3 c. High (regional) = 4, 5		

Emergency Operations Planning Process

In this Chapter:

Chapter 6 is based on the "Guide for Developing High-Quality School Emergency Plans" published by the U.S. Department of Education with participation from U.S. Department of Health and Human Services, U.S. Department of Homeland Security, U.S. Department of Justice, Federal Bureau of Investigation and Federal Emergency Management Agency. The main purpose of this section is to help schools prepare an Emergency Operation Plan (EOP).

Schools need to have appropriate plans available that can be implemented during different emergencies. These plans need to be updated periodically and the involvement of relevant staff in their preparation is critical. The goals of these plans are to continue providing essential services during an emergency and to recover quickly. The plan should include elements such as school staff that need to be involved/notified in case of an emergency; 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 school is recovering. The recovery plan should identify a clear path for restoration of functions and funding for short, middle, and long term recovery operations. Schools that have a hurricane shelter or provide other emergency support operations, during or in the aftermath of disasters, need to have a detailed plan and to identify the courses of action necessary for its execution.

Schools need to have appropriate plans available that can be implemented during different emergencies. These plans need to be updated periodically and the involvement of relevant staff in their preparation is critical. The goals of these plans are to continue providing essential services during an emergency and to recover quickly.

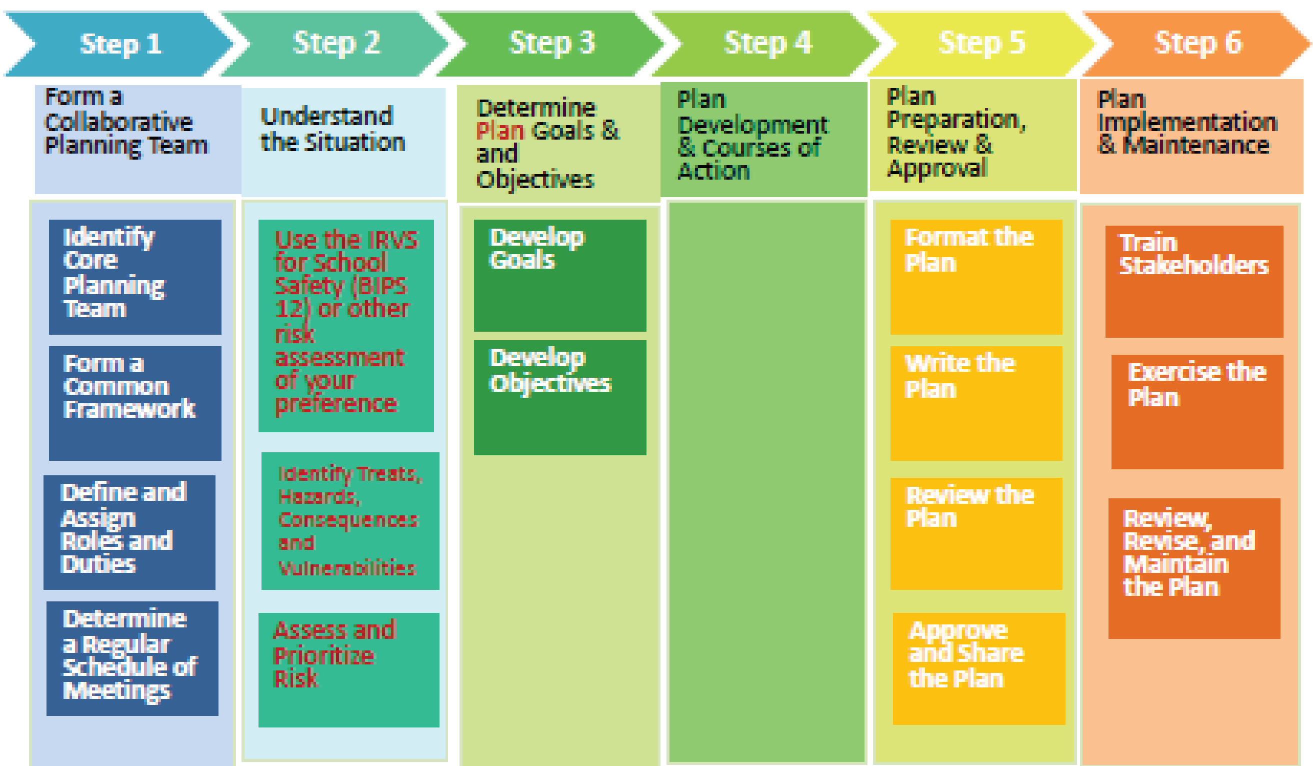
This section is based on the "Guide for Developing High-Quality School Emergency Plans"[1] published by the U.S. Department of Education with participation from U.S. Department of Health and Human Services, U.S. Department of Homeland Security, U.S. Department of Justice, Federal Bureau of Investigation and Federal Emergency Management Agency. The schools may adopt this approach for emergency plan preparation and implementation on a voluntary basis. The main purpose of this section is to help schools –in collaboration with their local government and community partners– prepare an Emergency Operation Plan (EOP). The process outlined below has six core steps for establishing effective emergency management planning and ensuring the seamless integration of first responders when a school is impacted by a catastrophic event.

National preparedness efforts, including planning, are now informed by Presidential Policy Directive (PPD) 8, which was signed by the president in March 2011 and describes the nation's approach to preparedness.

1 U.S. Department of Education, Office of Elementary and Secondary Education, Office of Safe and Healthy Students, Guide for Developing High-Quality School Emergency Operations Plans, Washington, DC, 2013. Download online at Office of Safe and Healthy Students, 2013. Emergency Planning Webpage. Available at http://www2.ed.gov/admins/lead/safety/emergencyplan/index.html, or Readiness and Emergency Management for Schools (REMS) Technical Assistance (TA) Center, 2013. Available at http://rems.ed.gov/EOPGuides.

This directive represents an evolution in our collective understanding of national preparedness, based on the lessons learned from terrorist attacks, hurricanes, school incidents, and other experiences. PPD-8 defines preparedness around five mission areas: Prevention, Protection, Mitigation, Response, and Recovery.

The "Guide for Developing High-Quality School Emergency Plans" establishes that effective plans should be based on the results of a risk assessment and consistently address major undesirable events (UE) (natural and man-made hazards), required school safety level (SSL) (criticality of the school grounds and building and consequences of a catastrophic event) and existing and necessary level of protection (LOP) (identified vulnerabilities). The *IRVS for Schools* methodology offers procedures to assess risk and define UE, SSL and LOP in a consistent manner, and can be introduced as part of step 2 of the "Guide for Developing High-Quality School Emergency Plans" as indicated in the graphic below.



The "Guide for Developing High-Quality School Emergency Plans" describes five critical elements of disaster planning as follows:

- Prevention, means the capabilities necessary to avoid, deter, or stop an imminent crime or threatened or actual mass casualty incident.
- Prevention is the action schools take to prevent a threatened or actual incident from occurring.
- Protection means the capabilities to secure schools against acts of violence and manmade or natural disasters. Protection focuses on ongoing actions that protect students, teachers, staff, visitors, networks, and property from a threat or hazard.
- Mitigation means the capabilities necessary to eliminate or reduce the loss of life and property damage by lessening the impact of an event or emergency. In this document, "mitigation" also means reducing the likelihood that threats and hazards will happen.
- Response means the capabilities necessary to stabilize an emergency once it has already happened or is certain to happen in an unpreventable way; establish a safe and secure environment; save lives and property; and facilitate the transition to recovery.
- Recovery means the capabilities necessary to assist schools affected by an event or emergency in restoring the learning environment.

The detailed steps for preparing a plan include forming a collaborative team; understanding the situation; determining plan goals and objectives; plan development and courses of action; plan preparation, review and approval; and plan implementation and maintenance. These six steps are represented in the graphic above.

The "Guide for Developing High-Quality School Emergency Plans" makes strong emphasis in reaching compliance with the Americans with Disabilities Act. For more information on how to prepare a school emergency plan for grades K-12, visit: http://www.dhs.gov/sites/default/files/publications/REMS%20K-12%20Guide%20508_0.pdf

> The detailed steps for preparing a plan include forming a collaborative team; understanding the situation; determining plan goals and objectives; plan development and courses of action; plan preparation, review and approval; and plan implementation and maintenance.

6.1 The *IRVS for Schools* Methodology and the Guide for Developing High-Quality School Emergency Plans

For this How-To Guide, there are two main types of emergency plans that will be evaluated: Continuity of Operations and Cyber Security Plans. These plans will be evaluated in terms of a) customization (at building levels); b) effectiveness in meeting expected goals; c) periodic updates; and d) training. It is assumed that the plans developed for the schools are prepared through a collaborative process in order to receive the appropriate acceptance from teachers, students, parents, law enforcement and first responders, and the community.

For this How-To Guide, there are two main types of emergency plans that will be evaluated: Continuity of Operations and Cyber Security Plans.

One of the first steps to prepare a School Emergency Plan is to identify the core planning team. This team should include school personnel, such as administrators, educators, school psychologists, nurses, facilities managers, transportation managers, food personnel, and family services representatives. It should also include student and parent representatives, and individuals and organizations that serve and represent the interests of students, staff, and parents with disabilities, and others with access and functional needs, as well as racial minorities and religious organizations, so that specific concerns are included in the early stages of planning. In addition, the core planning team should include community partners such as first responders, local emergency management staff, and others who have roles and responsibilities in school emergency management before, during, and after an incident. This includes local law enforcement officers, emergency medical services (EMS) personnel, school resource officers, fire officials, public and mental health practitioners, and local emergency managers. Their expertise will inform the development, implementation and refinement of the School Emergency Plan. The planning team should be small enough to permit close collaboration with first responders and other community partners, yet large enough to be representative of the school, its families and its community. It should also be large enough as to not place an undue burden on any single person.

Equally important is to establish the goals and objectives of the plan. For plan preparation, the planning team should select at least three goals for addressing each threat or hazard (though the planning team may want to identify more). Those three goals should indicate the desired outcome of the plan before, during, and after the occurrence of UEs.

As well, it should provide how to protect schools, resources, students, teachers, and visitors, how to guarantee an emergency response from law enforcement, firefighters and medical services. It should also identify major vulnerabilities related to the schools (e.g., structure, equipment, information technology (IT) or electrical systems, grounds, and surrounding area).

Finally, the plan should be reviewed and approved when the planning team feels that they have achieved a good draft. The team should pursue official approval of the plan, and it should be shared with community partners such as first responders, local emergency management officials, staff, and stakeholders. Note that for plan approval, an official Signature Page may be required. The document or page should contain a signed statement formally recognizing and adopting the school emergency plan. It gives both the authority and the responsibility to school officials to perform their tasks before, during, or after an incident, and therefore should be signed by the school administrator or another authorizing official.

Additional guidance on developing an emergency plan can be obtained from the Guide for Developing High Quality School Emergency Plans publication cited above.

Evaluation of Emergency Plan – General Plans			
ID	**Criteria**	**Options**	**Ranking**
175	**Emergency, Response, and Recovery Plans** Schools need to have to have a number of plans that can be implemented during different emergencies. These plans need to be completed and signed by school officials. In addition, the plans need to be reviewed and updated periodically and need to be living documents to be shared with students, teachers, parents, first responders, and the community.	Plans are not completed or signed = 1 Plans are completed and signed but they are not reviewed frequently. The plans were done with limited participation from the community = 2, 3 Plans were prepared with moderate participation from the community, they are signed by school authorities and they are reviewed from time to time = 4 Plans were prepared with ample participation from the community, they are signed by school authorities and they are reviewed frequently = 5	
176	**Mutual Aid Agreements** Schools plans need to be coordinated with local and regional first responders. Staff will be assigned specific roles in the plan and positions supporting the Incident Command System (ICS) that will require special skills, such as first aid, threat assessment, and provision of personal assistance services for students with disabilities, and others with access and functional needs. Also, substitute teachers must be trained on the plan and their roles in the plan. A mutual-aid agreement should be established between the school and entities in the area that would be called on to supplement resources in an emergency. The collaboration should include: • Coordinated exercises 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	The plan does not consider mutual aid agreements = 1, 2 The plan does include mutual aid agreements = 3, 4, 5	

Evaluation of Emergency Plan – General Plans			
ID	Criteria	Options	Ranking
177	**School Staff Roles and Responsibilities** Everyone staff, teachers, student, parent, and local authorizes need to know their roles and responsibilities before, during and after an emergency. For this reasons the following should be observed: • Hold a meeting. At least once a year, hold a meeting to educate all parties on the plan. Go through the plan to familiarize these stakeholders with it. • Visit evacuation sites. Show involved parties where evacuation sites are located as well as where other specific areas, such as reunification areas, media areas, and triage areas will be located. • Give involved parties appropriate and relevant literature on the plan, policies, and procedures. It may also be helpful to provide all parties with quick reference guides that remind them of key courses of action. • Post key information throughout the building. It is important that students and staff are familiar with and have easy access to information such as evacuation routes and shelter-in-place procedures and locations. Ensure that information concerning evacuation routes and shelter-in-place procedures and locations is effectively communicated to students, staff, and parents of students with disabilities as well as others with access and functional needs, such as by distributing the materials by e-mail in an accessible format. • Familiarize students, staff and community partners with the plan. Bringing community partners (e.g., law enforcement officers, fire officials, and EMS personnel) that have a role into the school to talk about the plan will make students and staff feel more comfortable working with these partners.	a. Staff understanding of their emergency roles and responsibilities before, during and after an UE is very poor = 1 b. Staff understanding of their emergency roles and responsibilities before, during and after an UE is poor = 2 c. Staff understanding of their emergency roles and responsibilities before, during and after an UE is moderate = 3 d. Staff understanding of their emergency roles and responsibilities before, during and after an UE is good = 4 e. Staff understanding of their emergency roles and responsibilities before, during and after an UE is very good = 5	

<table>
<tr><th colspan="4">Evaluation of Emergency Plan – General Plans</th></tr>
<tr><th>ID</th><th>Criteria</th><th>Options</th><th>Ranking</th></tr>
<tr><td>178</td><td>Training and Exercises

Staff, teachers, student, parent, and local authorities require training on how to take care and respond to critical activities before, during, and after an UE. Exercises provide opportunities to practice with community partners (e.g., first responders, local emergency management personnel), as well as to identify gaps and weaknesses in the plan. The following training and exercises are recommended:

• Tabletop exercises: Tabletop exercises are small-group discussions that walk through a scenario and the courses of action a school will need to take before, during, and after an emergency to lessen the impact on the school community. This activity helps assess the plan and resources and facilitates an understanding of emergency management and planning concepts.
• Drills: During drills, school personnel and community partners (e.g., first responders, local emergency management staff) use the actual school grounds and buildings to practice responding to a scenario.
• Functional exercises: Functional exercises are similar to drills but involve multiple partners; some may be conducted district-wide. Participants react to realistic simulated events (e.g., a bomb threat, or an intruder with a gun in a classroom), and implement the plan and procedures using the ICS.
• Full-scale exercises: These exercises are the most time-consuming activity in the exercise continuum and are multiagency, multijurisdictional efforts in which all resources are deployed. This type of exercise tests collaboration among the agencies and participants, public information systems, communications systems, and equipment. An Emergency Operations Center (EOC) is established by either law enforcement or fire services, and the ICS is activated.

Before making a decision about how many and which types of exercises to implement, a school should consider the costs and benefits of each, as well as any state or local requirements.</td><td>a. Tabletop exercises are conducted no more than once a year = 1
b. Tabletop exercises and drills are conducted no more than once a year = 2
c. Tabletop exercises, drills, and functional exercises are conducted at least once a year = 3
d. Tabletop exercises, drills, and functional exercises are conducted often and as needed = 4
e. Tabletop exercises, drills, and functional and full-scale exercises are conducted often and as needed = 5</td><td></td></tr>
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Evaluation of Emergency Plan – General Plans			
ID	Criteria	Options	Ranking
179	**Major Functional Annexes - Evacuation** The Plan should contain functional annexes to focus on critical operational functions and the courses of action developed to carry them out. These functional actions are the backbone of plan implementation and should be observed and practiced frequently. This annex describes how to safely move students and visitors to designated assembly areas from classrooms, outside areas, cafeterias, and other school locations; how to evacuate when the primary evacuation route is unusable; how to evacuate students who are not with a teacher or staff member; and how to evacuate individuals with disabilities (along with service animals and assistive devices, e.g., wheelchairs) and others with access and functional needs, including language, transportation, and medical needs.	a. Evacuation is planned very poorly = 1 b. Evacuation is planned poorly = 2 c. Evacuation is planned appropriately = 3 d. Evacuation is planned well = 4 e. Evacuation is planned very well = 5	
180	**Major Functional Annexes - Recovery** This annex describes how schools will recover from an emergency. Recovery includes academic recovery, physical recovery, fiscal recovery, and psychological and emotional recovery. As an example, fiscal recovery should include the sources the school may access for emergency relief funding. Physical recovery should address how to document school assets, including physically accessible facilities and recover school records in case of damage.	a. Recovery is planned very poorly = 1 b. Recovery is planned poorly = 2 c. Recovery is planned appropriately = 3 d. Recovery is planned well = 4 e. Recovery is planned very well = 5	
181	**Major Functional Annexes - Lockdown** This annex focuses on the action directed at securing school buildings and grounds during incidents that pose an immediate threat of violence.	a. Lockdown is planned very poorly = 1 b. Lockdown is planned poorly = 2 c. Lockdown is planned appropriately = 3 d. Lockdown is planned well = 4 e. Lockdown is planned very well = 5	

Evaluation of Emergency Plan – General Plans			
ID	**Criteria**	**Options**	**Ranking**
182	**Shelter in Place** The shelter in place or safe room will protect students, teachers and staff from a variety of hazards, including debris impact, accidental or intentional explosive detonation and accidental or intentional release of a toxic substance into the air. FEMA 453 has detailed information on how to designate and manage a shelter in place. A shelter in place should sustain the hazard for which it was designed. Nothing would be more dangerous students, teachers, and staff than to seek refuge in area incapable of performing to resist loads, vapors or impact(s) or a particular hazard for which they are seeking protection.	a. Shelter in place is planned very poorly = 1 b. Shelter in place is planned poorly = 2 c. Shelter in place is planned appropriately = 3 d. Shelter in place is planned well = 4 e. Shelter in place is planned very well = 5	
183	**Hurricane Shelters/Tornado Shelters/Community Shelters/Accounting for All Persons/Family Reunification** These shelters can accommodate people for a short or long period of time. The design and resistance necessary to sustain during hurricanes, tornadoes, and CBR attacks among other hazards is described in the Chapter 4.. A plan for emergency shelter will depend on the capacity of the shelter and school to provide basic services and food. Beyond regulating the capacity of the shelter and receiving, accommodating, and accounting for people in the shelter, a plan for shelter should include a "Shelter Maintenance Plan". This plan should include an inventory checklist of the emergency supplies; information concerning the availability of emergency generators; and schedule of regular maintenance of the shelter before, during, and after the event. The plan for this criteria should include as a minimum the identification of following personnel: • Site coordinator • Site coordinator for emergency assignments • Equipment management coordinator • Notification management coordinator • Emergency provisions coordinator • Family affairs coordinator • Sanitation Management coordinator • Communication Equipment managements coordinator • Donation management coordinator	a. Not Applicable b. Shelter is planned very poorly = 1 c. Shelter is planned poorly = 2 d. Shelter is planned appropriately = 3 e. Shelter is planned well = 4 f. Shelter is planned very well = 5	

Evaluation of Emergency Plan – General Plans			
ID	Criteria	Options	Ranking
184	**Public Health, Medical, and Mental Health** A plan for public health should serve to improve academic achievement and prevent students from becoming involved in school violence and illicit activities. The plan should provide school teachers and parents with the tools that are fundamental for high academic achievement and ensure that all students in kindergarten through high school receive high-quality health education instruction, providing students with the knowledge, skills, and confidence to lead healthy lives.	a. Public health, medical, and mental health are planned very poorly = 1 b. Public health, medical, and mental health are planned an poorly = 2 c. Public health, medical, and mental health are planned appropriately = 3 d. Public health, medical, and mental health are planned well = 4 e. Public health, medical, and mental health are planned very well = 5	

Evaluation of Emergency Plan – General Plans			
ID	Criteria	Options	Ranking
Continuity of Operations			
185	**Continuity of Operations** The intent of this plan is to evaluate the processes and functions of schools and their ability to maintain operations after an event The concept of continuity of operation needs to establish according to a goal the as minimum, includes the following: • Resources available • Maximum acceptable downtimes • Redundancy Such goals be determine at least for the following: • Water Supply/Storages • Power Supplies • Heating and Cooling Systems • Generator/Backup Power • Waste Water Systems • Supplies/Inventories • Deliveries/Loading Dock • Data/Telecom • IT/Computers • Utility Control Center • Emergency Operations • Janitorial/Housekeeping • Archives/Vital Records • Special Collections/Valuables/Equipment • Hazardous / Potentially Hazardous Materials • Critical Vehicle and Equipment Bays/Garages • Shelter in Place • Short Term Shelters • Long Term Shelters • Laboratories • Liquid Oxygen Storage • Other Critical Functions	a. Continuity of operations is planned very poorly = 1 b. Continuity of operations is planned poorly = 2 c. Continuity of operations is planned appropriately = 3 d. Continuity of operations is planned well = 4 e. Continuity of operations is planned very well = 5	
186	Continuity of Operations - Water Supply/ Storages How effectively the utility systems will continue to provide water to the building to maintain services such as daily school business or shelter activities, cooling towers, drinking water, and fire protection systems must be determined by evaluating the plan that is in place.	a. Does not meet goals or has not established goals = 1 b. Has established goals but are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	

Evaluation of Emergency Plan – General Plans			
ID	**Criteria**	**Options**	**Ranking**
187	**Power Supplies** 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 must be determined by evaluating the plan that is in place.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	
188	**Heating and Cooling Systems** How effectively heating and cooling systems will continue to provide safe, healthy, and comfortable air conditions in the school building by regulating temperature and humidity must be determined by evaluating the plan that is in place. Heating and cooling systems include physical plants; equipment such as cooling towers; and electrical, oil, and gas lines.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	
189	**Generator/Backup Power** How effectively emergency and standby generators will continue to provide electricity for school building operations if the primary source of power is knocked out must be determined by evaluating the plan that is in place.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	
190	**Waste Water Systems** The screener must determine how effectively the sewer services will continue to provide a means of waste disposal must be determined by evaluating the plan that is in place.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are no well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	

Evaluation of Emergency Plan – General Plans			
ID	Criteria	Options	Ranking
191	**Waste Water Systems** How effectively the sewer services will continue to provide a means of waste disposal must be determined by evaluating the plan that is in place.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	
192	**Supplies/Inventories** What level of goods and materials are in stock must be determined by evaluating the plan that is in place. This becomes dramatically important if the school functions as a shelter.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	
193	**Deliveries/Loading Dock** How effectively the loading docks will continue to operate must be determined by evaluating the plan that is in place.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	
194	**Data/Telecom** How effectively the distribution room will continue to maintain data and the telecom cables/wires that facilitate communications functions must be determined by evaluating the plan that is in place.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	

Evaluation of Emergency Plan – General Plans			
ID	Criteria	Options	Ranking
195	**IT/Computers** How effectively computers and software will continue to securely convert, store, protect, process, transmit, input, output, and retrieve information for daily business operations must be determined by evaluating the plan that is in place.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	
196	**Utility Control Center** How effectively the control center will continue to monitor and operate power supply, water, heating, and cooling functions must be determined by evaluating the plan that is in place.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	
197	**Emergency Operations** 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 school, agency, institution, political subdivision, or other organization. This is important for schools. Depending how effective these operations are, a better response in case of emergency can be expected.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	
198	**Janitorial/Housekeeping** How effectively the janitorial, custodial, or housekeeping staff will continue interior cleaning and maintenance must be determined by evaluating the plan that is in place.. This is of particular importance if the school functions as a shelter in the aftermath of a disaster event.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	

Evaluation of Emergency Plan – General Plans			
ID	**Criteria**	**Options**	**Ranking**
200	**Archives/Vital Records** How effectively the historical documents or critical information are stored in the building (physically or digitally on a network) must be determined by evaluating the plan that is in place.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	
201	**Special Collections/Valuables/Equipment** How effectively the special collections, equipment, and instruments are protected and stored in the school must be determined by evaluating the plan that is in place.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	
202	**Hazardous / Potentially Hazardous Materials** How safe the solids, liquids, and gases necessary for school functions but potentially harmful are stored must be determined by evaluating the plan that is in place..	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	
203	**Critical Vehicle and Equipment Bays/Garages** The availability of school busses and other vehicle to operate after a disaster event must be determined by evaluating the plan that is in place.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	

Evaluation of Emergency Plan – General Plans			
ID	Criteria	Options	Ranking
204	**Short-term Shelter/In-Place** 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 must be determined by evaluating the plan that is in place..	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	
205	**Long-term Shelter/Community Shelter** The reliability of the school as a safe haven for a community (e.g., a school gym or auditorium) during and after a manmade hazard must be determined by evaluating the plan that is in place. The shelter requires adequate supplies for a large number of people for an extended period.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	
206	**Laboratory** The reliability of a laboratory that provides controlled conditions in which scientific research, experiments, and measurement may be performed must be determined by evaluating the plan that is in place.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	
207	**Liquid Oxygen Storage** The safety of the gases that are necessary for life-saving functions and stored in the building must be determined by evaluating the plan that is in place.	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	
208	**Other Critical Functions** 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 must be determined by evaluating the plan that is in place.. The function should be described in the comments accompanying the assessment/ screening (in the appropriate tab in the IRVS software if it is being used)..	a. Does not meet goals or has not established goals = 1 b. Has established goals but they are not well met = 2 c. Partially meets goals = 3 d. Meets the goals well = 4 e. Fully meets goals = 5	

Evaluation of Emergency Plan – General Plans			
ID	**Criteria**	**Options**	**Ranking**
Cyber Security			
209	**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. None = 1 b. Medium = 2 c. Moderate = 3 d. High = 4 e. Very High = 5	
210	**Effectiveness of Cyber Training Programs** The effectiveness of programs to train building management employees on the cyber security measures must be determined by evaluating the plan that is in place.	a. None = 1 b. Medium = 2 c. Moderate = 3 d. High = 4 e. Very High = 5	