Best Available Refuge Area Checklist

FEMA developed the Best Available Refuge Area (BARA) Checklist for the first edition of FEMA P-361 to use in assessing a building's susceptibility to damage from extreme-wind events such as tornadoes and hurricanes. The checklist evaluation process guides registered design professionals (architects and engineers) in identifying potential refuge areas at a site with one or more buildings. The term "best available refuge area**"** (or "BARA") refers to an area in an existing building that has been deemed by a registered design professional as likely to protect building occupants during an extreme-wind event better than other areas in the building when a safe room is not available.

The BARA should be regarded as an interim measure only until a safe room can be available to building occupants. A safe room is a hardened structure specifically designed and constructed to the guidelines specified in FEMA P-320, *Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business* and FEMA P-361, *Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms*

It is important to note that because BARAs are not specifically designed as safe rooms, their occupants may still be injured or killed during an extreme-wind event. However, people in BARAs are less likely to be injured or killed than people in other areas of a building. Selection of these areas is also described in FEMA P-431, *Tornado Protection: Selecting Refuge Areas in Buildings.*

Registered design professionals can use the checklist below to assess the ability of the refuge area to resist forces generated by a tornado or hurricane event. The checklist consists of questions pertaining to structural and non-structural characteristics of a facility. The questions are designed to identify structural and non-structural vulnerabilities to wind-induced damage based on typical building failures. Depending on the type and degree of deficiency, the evaluation may indicate that the structure is unsuitable to serve as a refuge area. The BARA checklist is not a substitute for a detailed engineering analysis, but can assist in the selection of building areas best suited to serve as refuge areas.

The checklist can also be used to rank a group of facilities in a given geographic region. In this case, a scoring system is used in conjunction with the checklist whereby each building deficiency is assigned penalty points according to the level of its vulnerability. Therefore, a high score reflects higher hazard vulnerability, and a low score reflects higher hazard resistance, but only relative to other buildings considered in the scoring system. This evaluation process helps objectively determine which building will perform best under natural hazard conditions. Although the checklist helps identify the areas within buildings that are less vulnerable to damage from extreme winds compared to other buildings, the scoring system does not predict how well the building will withstand tornadoes and hurricanes. To determine the actual level of protection provided by the refuge area, a more detailed assessment is required.

The BARA checklist has five sections: General Building Information, Wind Hazard, Flood Hazard, Structural Seismic Hazard, and Selecting the Refuge Area.

A summary score sheet accompanies the evaluation checklist to compile the evaluation scores for each natural hazard when multiple sites or areas are being considered. A description of common building types and a glossary of terms are presented following the checklist.

BARA CHECKLIST INSTRUCTIONS

The BARA checklist is designed to walk registered design professionals through a step-by-step process and should be filled out in sequence. This process is based on a visual screening methodology and does not involve any destructive testing or detailed engineering calculations. A large portion of the checklist can be filled out using data obtained from design or construction plans. It is important to verify these data during a field inspection and note upgrades (e.g., expect roof replacements on older buildings). If building plans are not available for this evaluation, the accuracy of the checklist may be compromised; worst case scenarios should be assumed for information that cannot be verified. Additional information can be acquired from building specifications, site visits, and interviews with building personnel who can provide historical information on specific problems, repairs, upgrades, and procedures.

Low scores on the BARA checklist indicate structural features that provide considerable levels of protection. Higher scores indicate that a refuge area is more vulnerable to wind damage and less able to provide adequate life-safety protection. The lowest possible cumulative score for Zone IV (region most vulnerable to tornado hazards) is 20. A refuge area with this score would likely provide significant protection from an extreme-wind event; however, it is unlikely that any building would have this score. A pilot study of 10 schools in Wichita (located in Zone IV) resulted in scores ranging from 56 to 161.

General Building Information: This section is for collecting information for reference purposes. All questions relate to the entire building or buildings at the site. The user may need to refer back to the General Building Information section to answer hazard-related questions in other sections. This section is not scored.

Wind Hazard: This section applies only to refuge areas. If more than one area is selected, a separate checklist should be filled out for each area. The glossary starting on page 29 is to help the user with unfamiliar terminology. Answer the questions and determine a score for this hazard.

Flood Hazard: This section applies to both the refuge area and to the entire building. A Flood Insurance Rate Map (FIRM) is required to answer most of the questions in the flood hazard checklist. Answer the questions and determine an acceptable level of risk based upon the potential flooding hazard. Hurricane Refuge evaluations will require hurricane storm surge inundation maps and will not use the flood hazard checklist.

When using the checklists to identify BARA for occupancy during hurricane, it's critically important to select sites that minimize occupant exposure to flood risk. Accordingly, when assessing areas for refuge during hurricanes, the assessor should first follow the flow chart in the Flood Hazard Section to prioritize or eliminate candidate refuge areas based on hurricane flood hazard.

Structural Seismic Hazard: The section for the seismic threat pertains to the entire building. A Uniform Building Code (UBC) Seismic Zone Map is included to help assess the seismic threat. Answer the questions and determine a score for this hazard.

Selecting the BARA: The purpose of the evaluation is to select refuge areas with the best protection from tornado and hurricane events in the absence of a dedicated safe room. The criteria in this section will guide the user toward selecting good refuge areas. Several refuge areas may be needed to have enough usable space for the entire population that requires

protection. A separate checklist should be filled out for each potential refuge area. This section is not scored.

Summary Score Sheet: After answering and scoring all of the questions in the BARA checklist, the Summary Score Sheet should be filled out. The score sheet is used to compile all the scores for each refuge area for comparison. The total scores will then enable the user to rank each building and its potential as a suitable refuge area.

Transfer checklist scores to the Summary Score Sheet to include subscores from the wind section for each refuge area evaluated. The highest Area Total Wind Hazard Score should be placed in the Highest Wind Hazard Score block. The Total Score is the sum of the Highest Wind Hazard Score, Flood Hazard Score, and Seismic Hazard Score. The Total Scores will reflect the expected performance ranking of the buildings when placed in order from lowest to highest score (i.e., least vulnerable to most vulnerable structure).

GENERAL BUILDING INFORMATION

Contact Information			
Site Name:			
Street Address:			
City, State, Zip:			
Contact Person:			
Contact Phone #:			
Potential Refuge Population:			
Typical hours the building is occupied:			
Is the building locked at any time?			
Size/Sq. Footage:		Number of Stories:	
Describe the building configuration:			
General Description of surrounding area:			
Are there any portable/temporary units:		How many:	
Describe the condition of the building (are there cracks in the walls, signs of deterioration, rusting, peeling paint, or other repair needs):			
What are the power or fuel sources for the following utilities (natural gas, oil, electric, LP, etc.)?			
Heating:	Cooling:	Cooking:	
Is there a refuge area or safe room already identified in the building?			
From which hazard is the refuge area supposed to protect?			
Tornado:	Hurricane:	Combined (Tornado/Hurricane):	
If an existing safe room was designed for extreme winds, indicate the design professional and all relevant design parameters, specifically design wind speed:			
Evaluator's Name:		Date of Evaluation:	
Site Name:			

Rough Sketch of the Building:
Additional Comments:

Evaluator's Name:		**Date of Evaluation:**	
Site Name:			

WIND HAZARD

Select the most appropriate answer for each question below. After selecting the appropriate answer, enter the score for that answer (# in the parentheses) into the score block for that question. Evaluation is limited to visual examination. Questions have been grouped into sections based on structural issues, cladding and glazing, envelope protection, and non-structural issues. These questions apply only to the refuge area. **After all questions have been scored, sum the score column and determine the final wind hazard score for the refuge area.**

Question	Score
Structural Issues	
Refuge Area Size Length: Width: Height: Stories:	No Score
Usable square footage for this area	No Score
When was building constructed? Check box below. ☐ Post-2003 (0) ☐ 2003 – 1999 (0) ☐ 1998 – 1995 (0) ☐ 1994 – 1988 (2) ☐ 1987 – 1980 (4) ☐ 1979 – 1970 (6) ☐ 1969 – 1951 (8) ☐ Pre-1950 (10) Date on plans:	
The building was designed according to the following building code: ☐ Uniform Building Code, Year: ☐ International Building Code, Year: ☐ Standard Building Code, Year: ☐ International Residential Code, Year: ☐ National Building Code, Year: ☐ Other Code:	No Score
Were any of the following guidance documents or standards used in the construction of the refuge area or building? ☐ FEMA P-361, year: ☐ ICC-600, year: ☐ SSTD 10, year: ☐ FEMA P-320, year: ☐ ICC-500, year: ☐ ASCE 7, year:	No Score
What is the structural construction material of the refuge area? ☐ Concrete (10) ☐ Pre-Cast Concrete (10) ☐ RM (10) ☐ Engineered/Heavy Steel Frame (12) ☐ Partially Reinforced Masonry (PRM) (15) ☐ Unreinforced Masonry (URM) (20) ☐ Wood or Metal Studs (20) ☐ Light Steel Building/Pre-engineered (20) ☐ Unknown (20)	

Evaluator's Name:		**Date of Evaluation**	
Site Name:			

Question	Score
What building plans are available for the inspection? ☐ As-built plans (including full architectural and structural plans) (0) ☐ Design/construction plans (including full architectural and structural plans) (2) ☐ Structural plans only (3) ☐ Architectural plans only (5) ☐ Partial set of plans (8) ☐ No plans are available (12)	
Vertical and Lateral Load Resisting Systems (select the system that applies) ☐ Moment Resisting Frame or Braced Frame (identify infill wall below) (0) ☐ Concrete Beams/Columns ☐ Precast Concrete Beams/Columns ☐ Steel Beams/Columns (heavy) ☐ Wood Beams/Columns ☐ Steel Beams/Columns (light) ☐ Steel Bar Joist and Concrete or RM Columns	No Score
Shear Wall of Braced Frame; bracing or support is provided by: ☐ Concrete Shear Wall (0) ☐ RM Shear Wall (0) ☐ PRM Shear Wall (2) ☐ URM Shear Wall (5) ☐ Plywood Shear Wall (5) ☐ Other: _____(5)	
☐ Solid Load-Bearing Wall System ☐ Concrete Walls (0) ☐ RM Walls (0) ☐ PRM Walls (4) ☐ URM Walls (10) ☐ Framed Walls (wood or metal stud) (6) ☐ Other: _____ (6)	

Evaluator's Name:		**Date of Evaluation**	
Site Name:			

Question	Score
Elevated Floor or Roof Deck Systems (check all that apply) ☐ Concrete Beams and Slab ☐ Concrete Flat Slab ☐ Precast Concrete Deck ☐ Steel Deck with Concrete ☐ Steel Deck with Insulation Only ☐ Wood Joists/Beams ☐ Diagonal Sheathing ☐ Plywood Sheathing ☐ Concrete Plank ☐ Wood Trusses ☐ Wood Plank ☐ Steel Beam ☐ Concrete Waffle Slab ☐ Open Web Steel Joist	No Score
Do the connections in the structural systems provide a continuous load path for all loads (gravity, uplift, lateral)? ☐ Yes (0) ☐ No (10) ☐ Do not know (10) If YES, identify the following connections:	
Actual connectors of the roof structure and the spacing	No Score
Actual connectors between the roof and wall and the spacing	No Score

Connection Details for Refuge Area (check at least one item in each column)					
	Roof to Roof Structure	Roof Structure to Wall Structure	Within Wall	Walls to Foundation	
Reinforcing Steel	☐ (0)	☐ (0)	☐ (0)	☐ (0)	
Welded (not tack)	☐ (0)	☐ (0)	☐ (0)	☐ (0)	
Bolted	☐ (0)	☐ (0)	☐ (0)	☐ (0)	
Metal Clips/Fasteners	☐ (1)	☐ (1)	☐ (1)	☐ (1)	
Metal Hangers	☐ (1)	☐ (1)	☐ (1)	☐ (1)	
Self Tapping Screws	☐ (1)	☐ (1)	☐ (1)	☐ (1)	
Wire Fastener	☐ (2)	☐ (2)	☐ (2)	☐ (2)	
Nailed	☐ (4)	☐ (4)	☐ (2)	☐ (4)	
Other: (possible tack weld)	☐ (5)	☐ (5)	☐ (5)	☐ (5)	
Gravity connection	☐ (6)	☐ (6)	☐ (6)	☐ (6)	
Unknown	☐ (6)	☐ (6)	☐ (6)	☐ (6)	
If walls are masonry units, are they grouted? Which cells are grouted (every cell, every 4th cell, etc.)?					No Score

Evaluator's Name:		**Date of Evaluation**	
Site Name:			

Question						Score
For all URM, both load-bearing and non-load-bearing, fill in the blanks and answer the following two questions.						No Score
Maximum height:		Longest span:		Thickness:		
Is the maximum wall height/wall thickness (h/t) ratios for URM in excess of those noted in AFM 32-1095, page G-63 (see chart below).						
☐ Yes (5)		☐ No (0)		☐ Not applicable (0)		
Is the maximum wall length/wall thickness (l/t) ratios for URM in excess of those noted in AFM 32-1095, page G-63 (see chart below). (Measure longest span between column or pilaster supports or from end wall to wall opening.)						
☐ Yes (5)		☐ No (0)		☐ Not applicable (0)		

Allowable Value of Height-to-Thickness Ratio of URM Walls in High Wind Regions

Wall Types	Maximum l/t to h/t	
	Solid or Solid Grouted	All Other
Bearing Walls		
Walls of one-story buildings	16	13
First-story wall of multistory building	18	15
Walls in top story of multistory building	13	9
All other walls	16	13
Nonbearing Walls (Exterior and Interior[1])	15	13
Cantilever Walls	3	2
Parapets	2	1 1/2

[1] Interior wall ratio should be the same as the exterior wall ratio due to the risk of internal pressure through breached openings.

Chart from Air Force Manual (AFM) 32-1095: *Structural Evaluation of Existing Buildings for Seismic and Wind Loads*, page G-63.

Question				Score
Does the location of the refuge area require occupants to go outdoors to get to it? ☐ Yes (2) ☐ No (0)				
If the refuge area is a section of a building, are the wall systems separated from the remainder of the building structure with expansion joints? ☐ Yes (0) ☐ No (3)				
Does the refuge area have its own roof system (i.e., the roof does not extend over other sections of the building outside the refuge area or is separated by joints)? ☐ Yes (0) ☐ No (5)				
Evaluator's Name:		**Date of Evaluation**		
Site Name:				

Question	Score
Is the height of the refuge area roof less than 30 feet above ground level? ☐ Yes (0) ☐ No (2)	
Is there a roof span in the refuge area longer than 40 feet from support to support? ☐ Yes (10) ☐ No (0)	
Is the pitch of the roof less than 30° (less than 6/12 pitch)? ☐ Yes (4) ☐ No (0)	
If the building has parapet walls, are they taller than 3 feet (as compared to the adjacent roof level)? Check any of the following that apply. ☐ Structurally attached to the refuge area (2) ☐ Adjacent to egress routes (2) (if parapet walls collapse, egress routes to the refuge area may be blocked)	
Is there a roof overhang that is more than 2 feet wide? ☐ Yes (2) ☐ No (0)	
Structural Issues Subtotal =	

Evaluator's Name:		**Date of Evaluation**	
Site Name:			

Cladding and Glazing Issues	Score
What percentage of the exterior wall surface is covered by windows and doors on the outer perimeter of the refuge area? ☐ No windows/protected doors (0) ☐ No windows/unprotected doors (1) ☐ 0% – 1% (1) ☐ 2% (2) ☐ 3% – 4% (4) ☐ 5% – 6% (6) ☐ 7% or more (10)	
Are ALL windows, doors, and openings protected from impacts from wind-borne debris? If no, enter a score of 10 in the column to the right. If so, identify the level of protection offered by the system. The windows, doors, or openings of this space are protected from debris impact by systems that have been tested to resist the appropriate missile at the site as defined by: ☐ The FEMA P-361 or ICC-500 Tornado Missile Criteria (15-lb 2x4 board @ at 100-80 mph) (0) ☐ The FEMA P-361 Hurricane Missile Criteria (9-lb 2x4 board @ at 128-80 mph) (2) ☐ The ICC-500 Hurricane Missile Criteria (9-lb 2x4 board @ at 102-64 mph) (4) ☐ ASTM E 1996 for Critical Facilities Criteria (9-lb 2x4 board @ at 55 mph) (6) ☐ ASTM E 1996 for Critical Facilities Criteria (9-lb 2x4 board @ at 34 mph) (7) ☐ No criteria or a level of protection that does not meet any of the above criteria (10)	
Are doors to the refuge area secured at top and bottom with connections to resist suction effects that may pull the doors open (3-point latches)? ☐ Yes (0) ☐ No (10)	
Are there skylights or overhead atrium glass or plastic? ☐ Yes (5) ☐ No (0)	
What is the roof covering on the refuge area? NOTE: If more than one material type is used on the roof, choose the one with the highest penalty. ☐ Storm-resistant shingles (0) (greater than 100 mph rating) ☐ Wood shingles and shakes (2) ☐ Clay tile (2) ☐ Built-up roof, with stone ballast (2) ☐ Single-ply membrane with ballast (2) ☐ Built-up roof, without ballast (1) ☐ Single-ply membrane without ballast (1) ☐ Traditional metal roofing (1) ☐ Asphalt/metal shingles (1) ☐ Material other than those listed above (2) ☐ No roof covering (0)	
Cladding and Glazing Issues Subtotal =	

Evaluator's Name:		**Date of Evaluation**	
Site Name:			

Envelope Protection	Score
What are the debris hazards (choose all that apply): ☐ Large light towers (such as for an athletic field) and/or antennas within 300 feet of the structure? (2) ☐ Portable classrooms/trailers, small light frame buildings, HVAC units within 300 feet of the structure? (4) ☐ Unanchored fuel tanks within 300 feet of the structure? (5)	
☐ Are there buildings with roof gravel within 300 feet of the structure? (including the building site itself) (2) ☐ Are there debris-generating sources (e.g., lumber yards, nurseries, and junk yards) within 300 feet of the structure? (4) ☐ Is the refuge area vulnerable to trees, telephone poles, light poles, and other potential missiles? (4)	
What is the material on the exterior walls of the refuge area (excluding window and door systems)? ☐ Concrete (0) ☐ RM (0) ☐ PRM (4) ☐ Brick and block composite wall with reinforcing steel @4 feet on center (o.c.) (6) ☐ 3-wythes of solid masonry brick (6) ☐ URM (8) ☐ Metal/vinyl siding (10) ☐ Metal panels (pre-engineered metal building) (10) ☐ Combination (other than EIFS) (12) ☐ EIFS (on substrate other than concrete or RM) (15)	
What is the material of the roof deck/elevated floor at the refuge area? ☐ Reinforced concrete at least 6 inches thick (0) ☐ Metal deck at least 14 gauge (0) ☐ Reinforced concrete at least 3 inches thick (2) ☐ Metal deck at least 20 gauge (4) ☐ Wood panels at least 1 inch thick (4) ☐ Cement fiber board/deck (tectum) (6) ☐ Metal deck 22 gauge or higher (8) ☐ Wood panels at least ½ inch thick (8) ☐ Other _____ (10)	

Evaluator's Name:		**Date of Evaluation**	
Site Name:			

Envelope Protection	Score
Will the structure adjacent to the refuge area or surrounding it pose a threat if subject to collapse (structural components become debris that creates impact loads on the refuge area)? Specify: _____ ☐ Yes (5) ☐ No (0)	
Are there large, roll-down or garage type doors (metal, wood, plastic) on the exterior of the refuge area? ☐ Yes (5) ☐ No (0)	
For tornado and combined hazard safe rooms, identify what wind zone region the building is located in based on the Wind Zones Map provided in Figure 1. ☐ Zone I [130 mph] (4) ☐ Zone II [160 mph] (6) ☐ Zone III [200 mph] (8) ☐ Zone IV [250 mph] (10) Or For hurricane hazard safe rooms, identify the wind speed contour for the site (if the site is between contour lines, select the highest wind speed contour) provided in Figure 2. ☐ 160-170 (6) ☐ 180-190 (7) ☐ 200-225 (8) ☐ 225 + (10)	
Envelope Protection Subtotal =	

Evaluator's Name:		**Date of Evaluation**	
Site Name:			

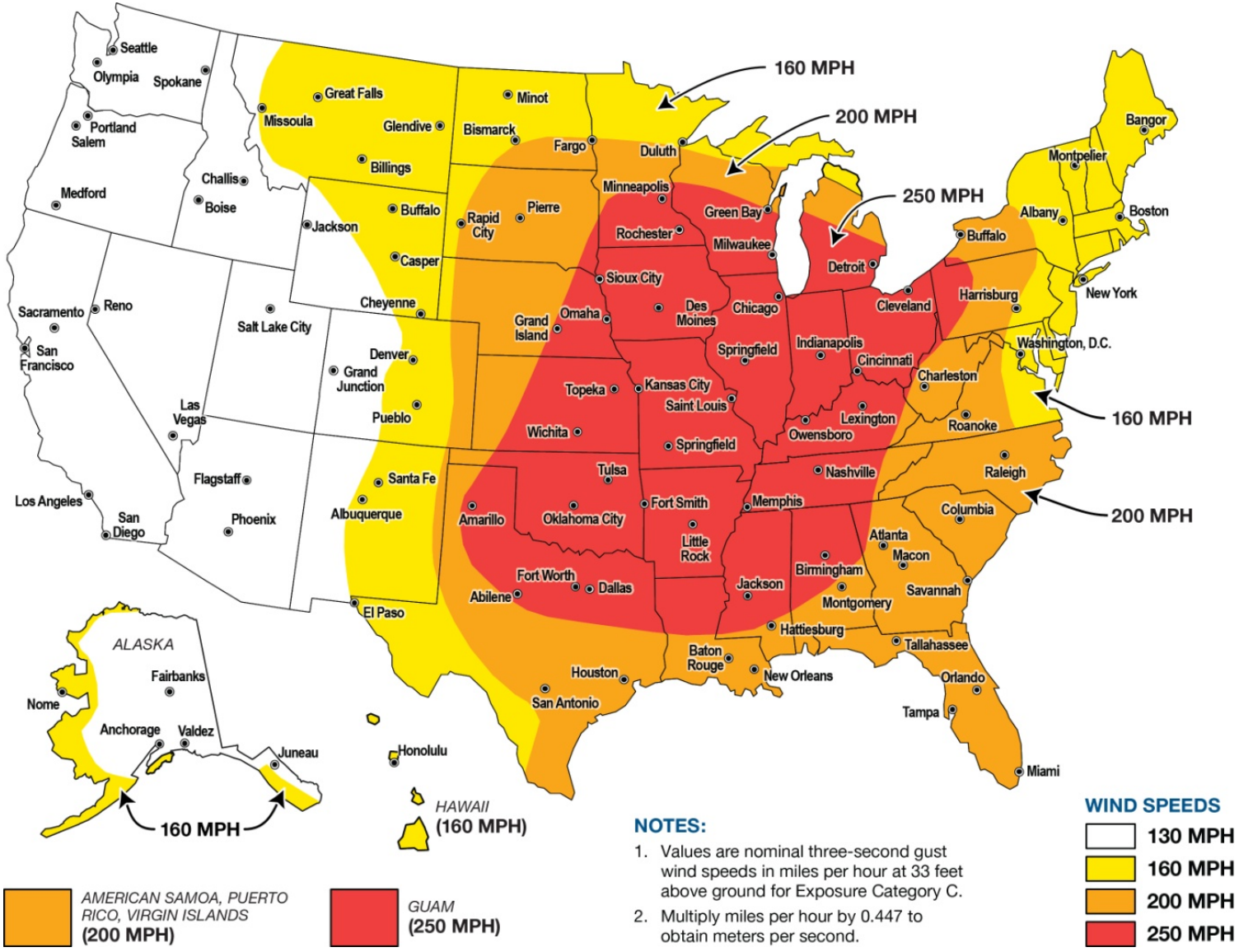


Figure 1: Wind Zones Map

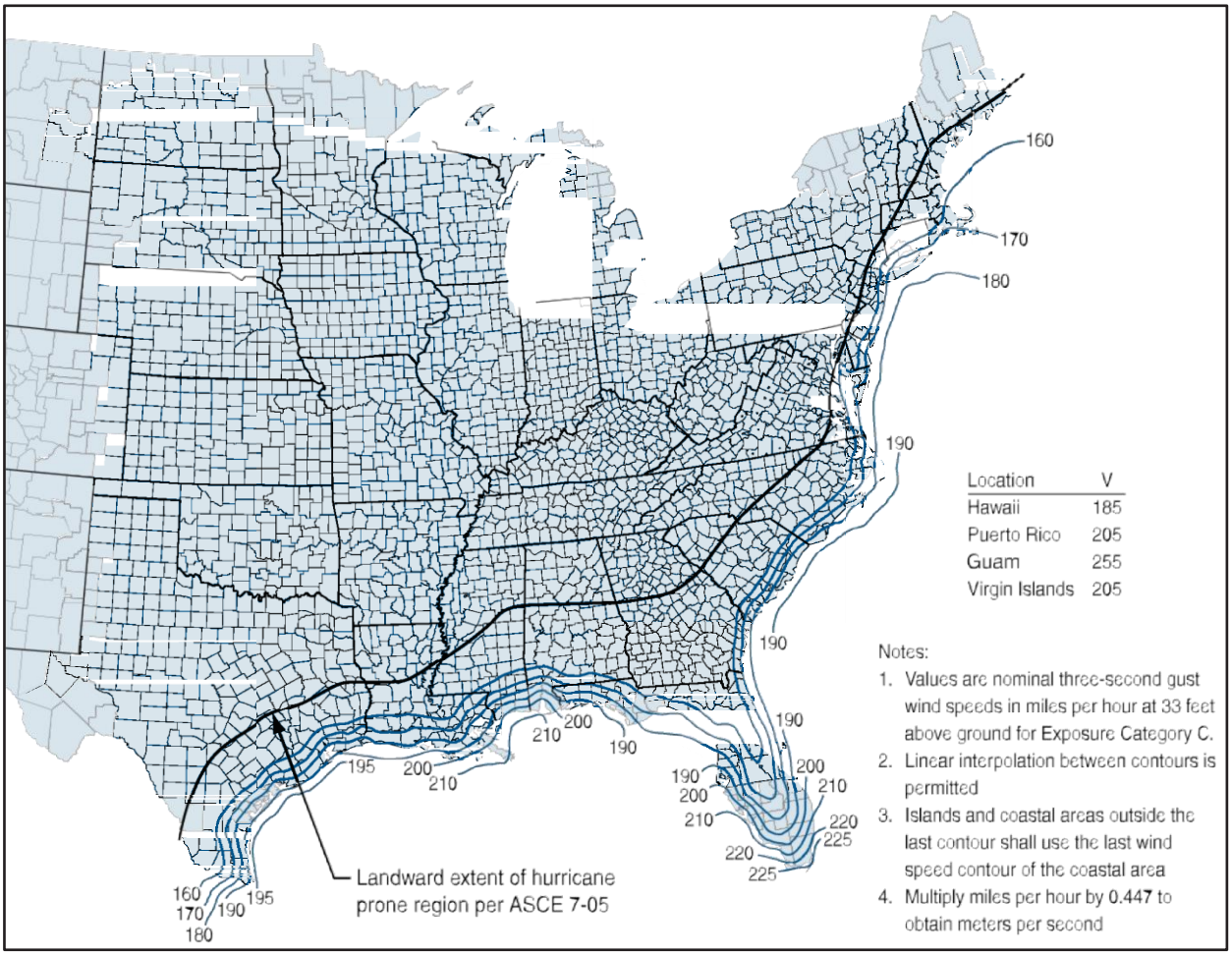


Figure 2: Hurricane Safe Room Design Wind Speed Map from the ICC-500

SOURCE: ICC/NSSA STANDARD for THE DESIGN AND CONSTRUCTION OF STORM SHELTERS (ICC-500). COPYRIGHT 2014, WASHINGTON, DC: INTERNATIONAL CODE COUNCIL. REPRODUCED WITH PERMISSION. ALL RIGHTS RESERVED. WWW.ICCSAFE.ORG < HTTP://WWW.ICCSAFE. ORG >.

Non-Structural Issues	Score
Does a combustible gas line run through the refuge area? ☐ Yes (10) ☐ No (0) ☐ Unknown (10)	
Is there a stand-by power source/generator? ☐ Yes (0) ☐ No (8) If yes, what is the power source: ☐ Battery powered (0) ☐ Other power (indicate fuel type) _____ (2) Is there an automatic transfer switch? ☐ Yes (0) ☐ No (2) What is the duration of lighting under the back-up power source? ☐ 0-2 hours (2) ☐ 3-6 hours (1) ☐ 7 or more hours (0)	
If the stand-by power supply is not within the refuge area, is it in a place where it will be protected during an extreme-wind event (in an interior room, or below grade)? ☐ Yes (0) ☐ No (5) ☐ Not Applicable (0)	
Is there a back-up communications system (if yes, list type)? ☐ Yes (0) ☐ No (2)	
Are bathrooms accessible within the refuge area? ☐ Yes (0) ☐ No (2)	
Is the refuge area ADA accessible? ☐ Yes (0) ☐ No (2)	

Evaluator's Name:		**Date of Evaluation**	
Site Name:			

Non-Structural Issues	Score
Is an operations plan in place for evacuation to a refuge area during an extreme-wind event? ☐ Yes (0) ☐ No (8)	
If yes, answer the following questions:	
Does the evacuation plan include practice drills? ☐ Yes (0) ☐ No (2) What type of warning signal is used to indicate a tornado drill? _____ Does it differ from a fire drill alarm? ☐ Yes (0) ☐ No (1) Can all occupants reach the candidate refuge area within 5 minutes? ☐ Yes (0) ☐ No (2) ☐ Unknown (2) List time: _____	
Non-Structural Subtotal =	
Total Wind Hazard Score =	

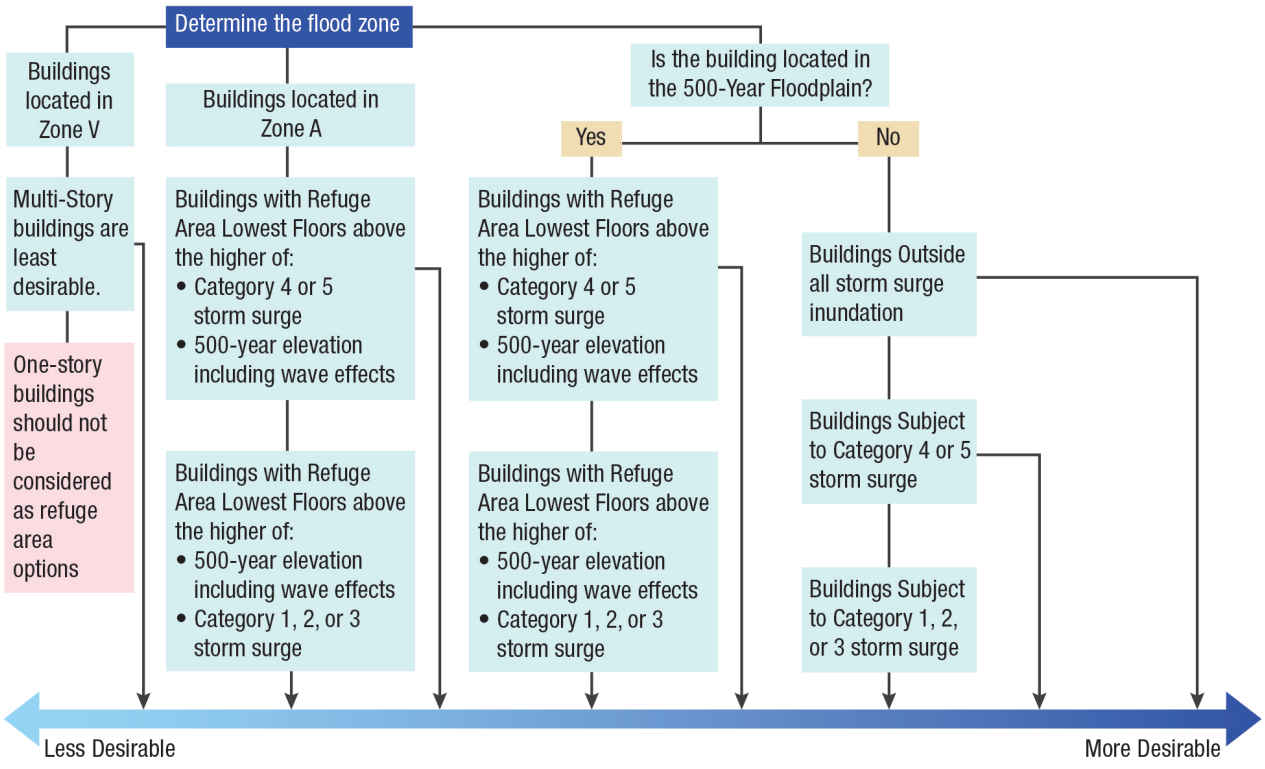
Evaluator's Name:		**Date of Evaluation**	
Site Name:			

FLOOD HAZARD

Instructions for Evaluating Areas for Hurricane Refuge: Use the flowchart below to determine relative flood risk for candidate refuge areas (less to more desirable) or whether the site should be removed from the list of potential sites altogether. This flow chart eliminates the need to score the flood hazard section of the checklist based upon hurricane storm surge. Although this flow chart does not result in a building score, it should help users prioritize which buildings provide viable refuge areas for further consideration. In addition to the FIRM users will also need the Flood Insurance Study for the site in question as well as storm surge inundation maps from the State or local emergency management agency.

Instructions for Evaluating Areas for Tornado Refuge: Select the most appropriate answer for each question below. After selecting the appropriate answer, enter the score for that answer (# in the parentheses) into the score block for that question. Evaluation is limited to visual examination. Elevations are only required if a flood hazard has been identified at the building site. If no flood hazard exists at the site, answer flood-related questions with "not applicable." After all questions have been scored, sum the score column and determine the final flood hazard score for the building/structure.

Flood Risk Prioritization of Building Areas Utilized for Hurricane Refuge



Question	Score
Flood Hazard Issues	
Community Panel No.:_____ Date Revised: _____ Flood Hazard Zone: _____ What is the base flood elevation (BFE) at the building site?* _____ What is the 500-year flood elevation at the building site?** _____ ☐ Not applicable (Explain): _____	No Score
Is the site located in a mapped storm surge inundation zone? ☐ Yes ☐ No (0) If yes, what is the source used to verify this? _____ If the site is located in a storm surge inundation zone, which category is it in? ☐ Category 1-2 (10) ☐ Category 3 (8) ☐ Category 4-5 (6)	
Is the site located in any of the following areas? ☐ The Coastal High Hazard Area (Zone VE) or other areas known to be subject to high-velocity wave action (10) ☐ Areas seaward of the Limit of Moderate Wave Action (LiMWA) where mapped, also referred to as the Coastal A Zone in ASCE 24-05 (10) ☐ Floodways (10) (Note: if the selected refuge area is located in any of the areas listed above, the use of the selected area should be seriously considered. The areas listed above should not be used for occupant protection.)	
Is there a history of floods at the building site? ☐ Yes (5) ☐ No (0) ☐ Unknown (5) ☐ Not applicable (0)	
Is there a history of drains (storm or sanitary) backing up due to flooding? ☐ Yes (2) ☐ No (0) ☐ Unknown (2) ☐ Not applicable (0)	
Does the surrounding topography contribute to flooding in low-lying areas? Are there poor drainage patterns, basement stairwells, etc.? ☐ Yes (5) ☐ No (0)	

Evaluator's Name:		**Date of Evaluation**	
Site Name:			

Question	Score
Are access roads to the building site sufficiently elevated and expected to be accessible during periods of high water (based on local flooding history and/or FIRM panel information)? ☐ Yes (0) ☐ No (2)	
If the building is within a 500-year floodplain or storm surge inundation zone, complete the following. If not, STOP HERE and skip to page 22 for THE STRUCTURAL SEISMIC HAZARD.	

* BFEs are shown on the Flood Insurance Rate Map (FIRM) for the community.
** 500-year flood elevations are not shown on the FIRM; they are provided in the Flood Insurance Study (FIS) report for the community.

Structural Issues***	Score
What is the building/structure type? ☐ Concrete (0) ☐ RM (2) ☐ Steel (2) ☐ PRM (5) ☐ URM (8) ☐ Wood (10) ☐ Unknown (10)	
What is the elevation of the lowest floor/level of the building being used for refuge?	
Is this elevation: ☐ Above the 100-year flood elevation (0) ☐ Less than 2 feet above the BFE (4) ☐ Below the BFE or unknown (8) ☐ Not applicable (0)	
Is this elevation: ☐ Above the 500-year stillwater flood elevation (0) ☐ Less than the 500-year stillwater flood elevation (10) ☐ Not applicable (0)	
Is this elevation: ☐ Above the lowest floor elevation required by the community's floodplain ordinance (0) ☐ Below the lowest floor elevation required by the community's floodplain ordinance (10) ☐ Not applicable (0)	
If the site is in a mapped Zone D (or has not been evaluated as part of an NFIP flood study), is this elevation: ☐ Above the highest recorded flood elevation in the area (0) ☐ Below the highest recorded flood elevation in the area (10) ☐ Not applicable (0)	

Evaluator's Name:		**Date of Evaluation**	
Site Name:			

Structural Issues***	Score
If the site is in a mapped coastal storm surge inundation zone, is this elevation: ☐ Above the maximum stillwater elevation associated with any modeled hurricane and/or above the wave crest elevation having a 0.2 percent annual chance of being equaled or exceeded (0) ☐ Below the maximum stillwater elevation associated with a Category 5 hurricane and/or below the wave crest elevation having a 0.2 percent annual chance of being equaled or exceeded (10) ☐ Not applicable (0)	
Is the elevation above the highest of the applicable requirements listed in the last 5 questions? ☐ Yes (0) ☐ No (10) ☐ Not applicable (0)	
If the lowest floor of the building is susceptible to flooding, are there openings in the walls to allow water to pass through the wall, thus avoiding pressure buildup on the foundation and first floor walls? ☐ Yes (0) ☐ No (5) ☐ Not applicable (0)	
Is any space below the applicable flood criteria used for classroom or office space? (If this area is used only for storage, access, and parking, answer "No"). ☐ Yes (2) ☐ No (0) ☐ Not applicable (0)	
Is the building material located at the susceptible parts of the base of the structure constructed of entirely flood-resistant material? ☐ Yes (0) ☐ No (2) ☐ Not applicable (0)	
Facility and Utility Issues	**Score**
Are the heating, electrical, and other utilities located in a basement or on a slab area that is below the BFE? ☐ Yes (4) ☐ No (0) ☐ Not applicable (0)	
Is there a method of removing floodwater from the building (e.g., sump pump)? What is the size and capacity of the pump? _____ ☐ Yes (0) ☐ No (4) ☐ Not applicable (0)	
Total Flood Hazard Score =	

*** Ensure that all elevations that are compared to BFEs are defined on the vertical datum that is stated on the FIRM panel. (Do not compare local benchmarks to mean sea level [MSL], National Geodetic Vertical Datum of 1929 [NGVD 29], etc.)

Evaluator's Name:		**Date of Evaluation**	
Site Name:			

STRUCTURAL SEISMIC HAZARD

Select the most appropriate answer for each question below. After selecting the appropriate answer, enter the score for that answer (# in the parentheses) into the score block for that question. Evaluation is limited to visual examination and availability of plans. (NOTE: This section is based on the guidelines set forth in the FEMA 154 publication, *Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook* [2nd Edition, March 2002]. One significant difference is the scoring procedure used herein. Do not compare a building scored in this section with a building scored from FEMA 154. The comparison will not be valid.)

After all questions have been scored, sum the structural seismic hazard score column and determine the final score for the building/structure.

For additional guidance on the design and construction of buildings subject to seismic hazards, see FEMA 454, *Designing for Earthquakes: A Manual for Architects* (December 2006), and FEMA 232, *Homebuilder's Guide to Earthquake-Resistant Design and Construction* (June 2006).

Question	Score
See the Seismic Zone Map of the United States (Figure 3 on page 24) to determine the region of seismicity (low, medium, or high) of the building locale.	
Is the building located in a region of low seismicity and was it designed by a design professional? ☐ Yes (0) If yes, further seismic inspection. STOP HERE. Is the building located in a region of medium or high seismicity? ☐ Yes (0) If yes, complete all remaining questions in this section.	
What is the building/structure type? ☐ Wood (10) ☐ RM and PRM (12) ☐ Steel (12) ☐ Concrete (14) ☐ Pre-cast " Tilt-up" Concrete (15) ☐ URM (17) ☐ Unknown (20)	

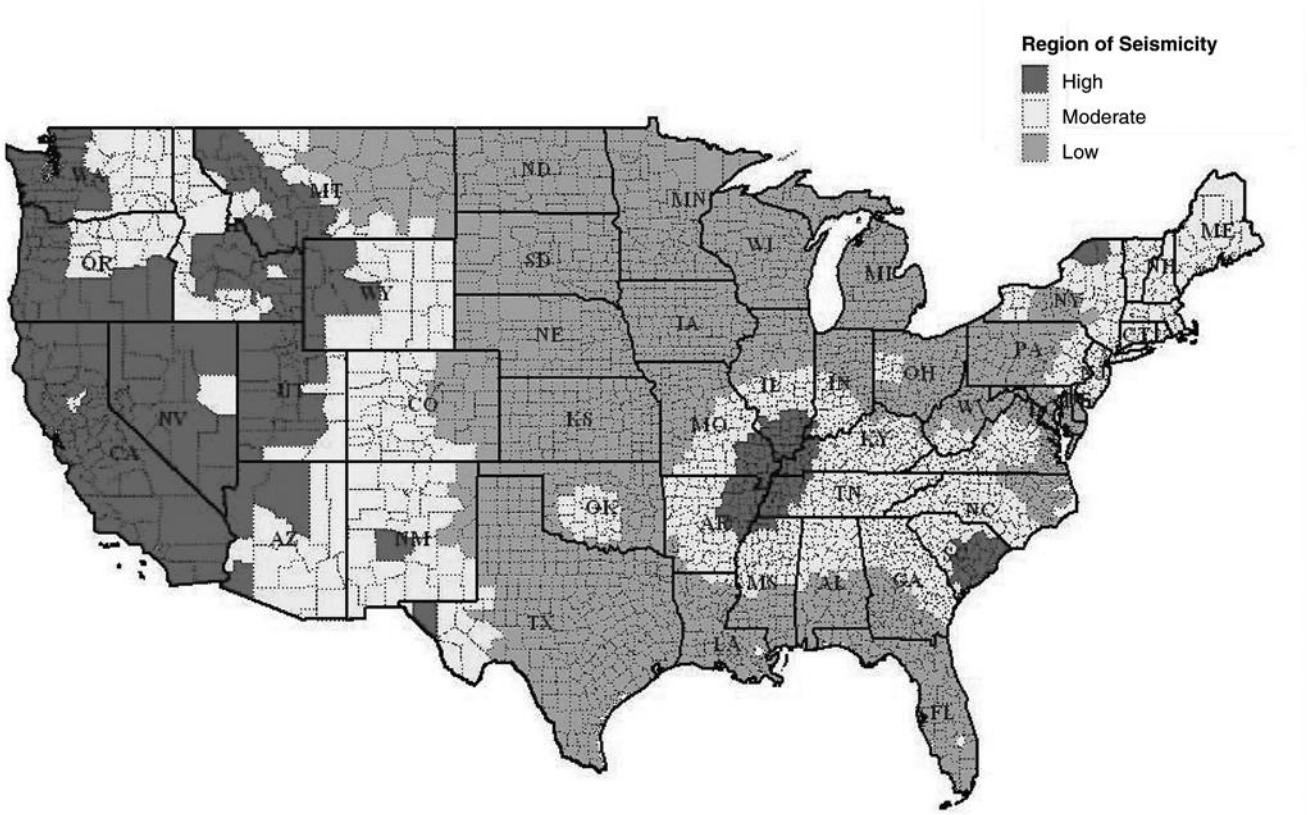
Evaluator's Name:		**Date of Evaluation**	
Site Name:			

Question	Score
Add penalty points for deficiencies noted during the inspection. Select one column below based on the building type determined in the previous question. Under each column, circle the penalty points if they apply for the criterion listed. (Use descriptions provided on the following page when filling out the matrix below.) When complete, sum the penalties that have been circled and place that total in the score box.	

Building Characteristic	RM and PRM	URM	Steel	Wood	Concrete	Pre-cast	Unknown
High Rise	1.0	0.5	1.0	N/A	1.0	0.5	1.0
Poor Condition	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Vertical Irregularity	0.5	0.5	0.5	0.5	1.0	1.0	1.0
Soft Story	2.0	2.0	2.0	1.0	2.0	2.0	2.0
Plan Irregularity	2.0	2.0	1.5	2.0	1.5	2.0	2.0
Pounding	N/A	N/A	0.5	N/A	0.5	0.5	0.5
Large (and Heavy) Cladding	N/A	N/A	N/A	N/A	1.0	1.0	1.0
Post Benchmark	2.0	N/A	2.0	2.0	2.0	2.0	2.0

Total Structural Seismic Hazard Score =	

Evaluator's Name:		**Date of Evaluation**	
Site Name:			



Note:
(1) Based on NEHRP B-C soil type.
(2) The seismicity at any site is calculated based on the highest seismicity at any point in a country. More accurate information on any site can be obtained from the USGS site. (http:\\usgs.gov)

Figure 3: Seismic Zone Map of the United States (FEMA 154, March 2002)

EXPLANATION OF BUILDING CHARACTERISTICS

High-Rise:

For the purposes of the BARA checklist, a wood-frame structure will not be considered a high-rise building. For buildings constructed of masonry units (i.e., brick, block, etc.), if the building is five stories or taller, it is considered a high-rise. For all other building types, the building must be eight stories or taller to be considered a high-rise building. If the building is determined to be a high-rise, assess a penalty.

Poor Condition:

A building is considered to be in poor condition if the building condition for the appropriate building type has been observed. Assess a penalty if:

- Masonry Joints: The mortar can be easily scraped away from the joints by hand with a metal tool and/or there are significant areas of eroded mortar.
- Masonry Units: There is visible deterioration of large areas of masonry units (e.g., significant cracking in the mortar joints, cracks through the masonry blocks themselves, voids or missing blocks or units).
- Deterioration of Steel: Significant visible rusting, corrosion, tearing, or other deterioration in any of the steel elements in the vertical or lateral force-resisting system.
- Deterioration of Wood: Wood members show signs of decay, shrinkage, splitting, fire damage, or sagging, or the metal accessories are deteriorated, broken, or loose. Wood members also showing signs of insect infestation.
- Deterioration of Concrete: Visible deterioration of concrete (e.g., cracking, spalling, crumbling) or significant exposure of reinforcing steel in any of the frame elements.
- Concrete Walls: Diagonal cracks in the wall element that are ¼ inch or greater in width are found in numerous locations and/or form an X pattern.
- Boundary Columns: Diagonal cracks wider than ⅛ inch in concrete columns on any level of the structure.

Vertical Irregularity:

Are there “steps” in the building’s elevation? Are some floors set back or do they extend outward from the footprint of the building? Are all of the walls of the building vertical or are there walls that slope inward or outward as viewed from the base of the building? Is the building located atop a small hill? If so, there are vertical irregularities; assess a penalty.

Soft Story:

Does one story in a building have substantially less shear resistance (resistance to lateral deformation or story drift) than other stories above or below it? This condition usually occurs on the ground-floor level between a rigid foundation system and a stiff upper level system. Tall, open ground floors are common architectural features in large buildings. If the presence of a soft story is suspected (open floor plan, extensive glazing, taller ceilings than other floors, etc.), check whether that story has sufficient peripheral bracing (additional or stiffer columns, moment

frames or similar) or a rigid braced interior core. Assess penalty points according to the level and adequacy of story shear resistance (bracing).

Plan Irregularity:

Does the building have a highly irregular floorplan? Is the floorplan of the building in the shape of an "L," "E," "H," "+," "T," or other such irregular configuration? Is the building long and narrow with a length-to-width ratio greater than 2:1? If so, there are plan irregularities; assess a penalty.

Pounding:

How close is the next adjacent building? Are the floors of two adjacent buildings at different elevations? An adjacent building presents a threat of pounding if the lateral distance between the two buildings is less than 4 feet times the number of stories of the smallest building. For example, if a 10-story building and a 4-story building are adjacent to one another, there is a potential pounding problem if the buildings are not more than 16 inches apart (4" x 4 stories = 16" of separation required); assess a penalty.

Large (and Heavy) Cladding:

Is the exterior of the building covered in large concrete or stone panels? If large panels exist, were the connections that secure these panels designed for seismic requirements? If it cannot be positively determined that the connections were designed for seismic requirements, assume that they were not. If large panels are present and they have been determined to be connected with non-seismic connectors, cladding deficiencies exist; assess a penalty.

Post-Benchmark:

A building is considered to be "post-benchmark" if it was designed after modern seismic provisions were accepted by the local building code or the code that has been specified by the local jurisdiction. If the building was not designed for seismic requirements or it is not known if the building was designed for seismic requirements, it is not post-benchmark; assess a penalty.

SELECTING THE REFUGE AREA

Identify potential refuge areas and answer the following questions for each one.

On basis of this information, select the best potential refuge areas (interior spaces that provide the best protection). Explain the selection and rank the refuge areas from most desirable to least desirable.

The recommended square footage (RSF) used for refuge must be calculated depending on the hazard type:

- For Tornado Use, RSF = Total Population x 5 square feet.
- For Hurricane Use, RSF = Total Population x 20 square feet.

Does the potential refuge area have excessive glazing (more than 6% of exterior wall surface covered by windows) or long unsupported walls and roof spans (longer than 40 feet)?

Is the potential refuge area susceptible to damage from collapsing nearby heavy structures or other objects (e.g., concrete towers, telephone or power poles, antenna towers, chimneys, trees)?

Is the potential refuge area accessible to all building occupants, including the disabled?

If a potential refuge area is cluttered, can materials be easily moved to create additional usable space?

How much usable space exists?

Recommended square footage (RSF, calculated above) = _____

Available square footage (ASF) = _____

Usable square footage (USF) = _____

Is USF ≥ to RSF?

The USF is determined by subtracting the floor area of excluded spaces, partitions and walls, columns, fixed or movable objects, furniture, equipment, or other features that cannot be removed or stored during use as a safe room.

[Note: as an alternate method, the following values can be used to calculate USF: for safe room areas with concentrated furnishings or fixed seating, reduce by a minimum of 50%; for safe room areas with unconcentrated furnishings (removable tables, etc.) and without fixed seating, reduce by a minimum of 35%; for safe room areas with open space, reduce by a minimum of 15%.]

Evaluator's Name:		**Date of Evaluation**	
Site Name:			

Sketch building layout with refuge areas and show access routes (an existing floorplan may be marked up and attached in lieu of the sketch):
Additional Comments:

Evaluator's Name:		**Date of Evaluation**	
Site Name:			

COMMON BUILDING TYPES AND GLOSSARY OF TERMS

The following is a guide for selecting the type of building/type of construction of the building evaluated. The primary designations that the building types are divided into are Wood, Steel, Concrete, Pre-Cast Concrete, Reinforced Masonry, Partially Reinforced Masonry, and Unreinforced Masonry.

Braced Frame

A building frame system in which all vertical and lateral forces are resisted by shear and flexure in the members, joints of the frame itself, and walls or bracing systems between the beams and columns. A braced frame is dependent on bracing, infill walls between the columns, or shear walls between the columns to resist lateral loads.

Concrete

These buildings have walls and/or frames constructed of reinforced concrete columns and beams. Walls will be seen as smooth surfaces of finished concrete. If this is a concrete frame, concrete masonry units (CMUs) are often used as shear (internal) walls placed between the columns and the beams.

Engineered Steel (Heavy)

These buildings are constructed of steel beams and columns and use either moment or braced frame systems. These buildings are designed specifically for that site and are not a "pre-engineered" or "pre-fabricated" building.

Load-Bearing Wall System

A building structural system in which all vertical and lateral forces are resisted by the walls of the building. The roof structure will be attached to the walls of the building and any forces in the roof system will be transferred to the walls through this roof/wall connection.

Moment Frame

A building frame system in which all vertical and lateral forces are resisted by shear and flexure in members and joints of the frame itself. A moment frame will not utilize bracing, infill walls between the columns, or shear walls between the columns to resist lateral loads.

Partially Reinforced Masonry (PRM)

These buildings have perimeter, bearing walls of reinforced brick or CMU and the vertical wall reinforcement is spaced at more than 8 inches apart and a maximum spacing of 72 inches apart. Reinforcing for these walls will not be evident when viewing the walls; this information may be attained by using reinforcement locating devices or from reviewing project plans. Roof systems will typically be constructed of wood members, steel frames and trusses, or concrete. They may also have roofs and floors composed of precast concrete.

Pre-cast (Including Tilt-up Construction) Concrete

These buildings typically have pre-cast and tilt-up concrete that will run vertically from floor to ceiling/roof. These buildings often have pre-cast or cast-in-place concrete roof systems, but may

have very large wood or metal deck roof systems. These buildings could also be pre- cast concrete frames with concrete shear walls, containing floor and roof diaphragms typically composed of pre-cast concrete.

Reinforced Masonry (RM)

These buildings have perimeter bearing walls of reinforced brick or CMU and the vertical wall reinforcement is spaced at a maximum spacing of 8 inches apart; if the reinforcement is in CMU walls, every cell must contain reinforcing steel and grout. Reinforcing for these walls will not be evident when viewing the walls; this information may be attained by using reinforcement locating devices or from reviewing project plans. Roof systems will typically be constructed of wood members, steel frames and trusses, or concrete. They may also have roofs and floors composed of pre-cast concrete.

Steel (Light/Pre-engineered)

These buildings, at a minimum, will have a frame of steel columns and beams. These buildings may be constructed with braced frames. These buildings may be "pre-engineered" and/or "prefabricated" with transverse rigid frames. Interior shear walls may exist between the columns and beams of the frame. In addition, exterior walls may be offset from the exterior frame members, wrap around them, and present a smooth masonry exterior with no indication of the steel frame.

Unreinforced Masonry (URM)

These buildings have perimeter bearing walls of unreinforced brick or concrete-block masonry. Roof systems will typically be constructed of wood members, steel frames and trusses, or concrete. They may also have roofs and floors composed of pre-cast concrete. Most masonry wall systems that were constructed prior to the 1970s are unreinforced masonry.

Wood

These buildings are typically single or multiple family dwellings of one or more stories. Wood structures may also be commercial or industrial buildings with a large floor area and with few, if any, interior walls. Typically, all walls and roof systems are constructed of timber frames.

The following is a glossary of terms that has been provided to ensure clarity and provide definitions for terminology used in the BARA checklist.

Base Flood

The flood having a 1-percent probability of being equaled or exceeded in any given year; also referred to as the 100-year flood.

Base Flood Elevation (BFE)

This height of the base flood in relation to the National Geodetic Vertical Datum of 1929 (or other vertical datum as specified). These elevations can be found on a Flood Insurance Rate Map (FIRM). The elevation of the lowest floor of a structure must be above the BFE to qualify for most forms of federal flood insurance.

Continuous Load Path

A continuous load path can be thought of as a "chain" running through a building. The "links" of the chain are structural members, connections between members, and any fasteners used in the connections (such as nails, screws, bolts, welds, etc.). To be effective, each "link" in the continuous load path must be strong enough to transfer loads without breaking. Because all applied loads (gravity, dead, live, uplift, lateral, etc.) must be transferred to the foundation, the load path must connect to the foundation.

An exterior insulation finishing system (EIFS) is a multi-layered exterior wall system used on both commercial buildings and homes (see Figure 4). It comprises an insulation board mounted to a substrate. The insulation is protected by a plastic finish coat. Mesh reinforcing may be used to strengthen the system. Mesh reinforcing is located in a base coat that is between the insulation board and the finish coat.

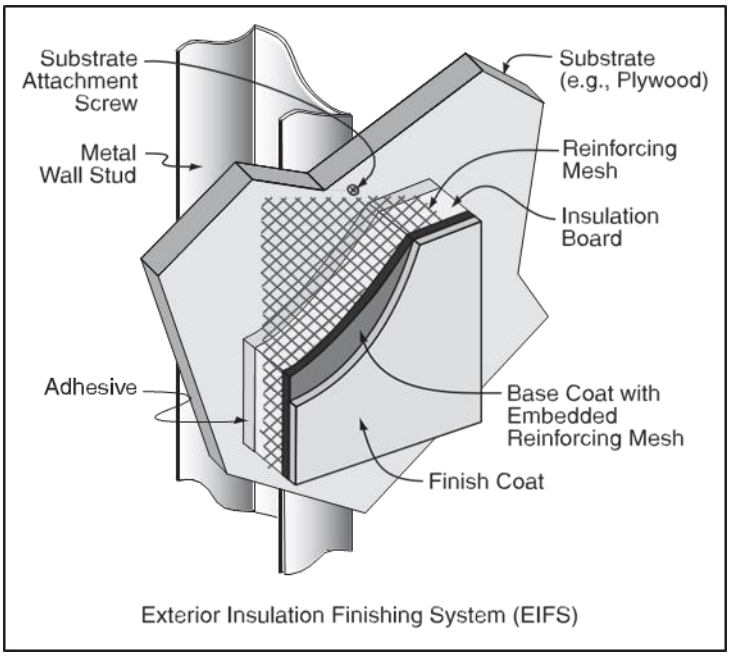


Figure 4. EIFS Wall Construction

Flood Insurance Rate Map (FIRM)

An insurance and floodplain management map issued by FEMA that identifies areas of a 100-year flood hazard in a community. In areas studied by detailed analyses, the FIRM also shows BFEs and 500-year floodplain boundaries and, occasionally, floodway boundaries.

Flood-Resistant Material

Any building material capable of withstanding direct and prolonged contact with floodwaters without sustaining significant damage. The term "prolonged contact" means at least 72 hours, and the term "significant damage" means any damage requiring more than low-cost cosmetic repair (such as painting).

Masonry Wall: Height to Thickness Ratio (H/T)

Height to thickness refers to the height of a masonry wall compared to the thickness of the wall. The height of the wall should be measured from the foundation up to the point at which the wall is laterally supported. In a one-story building, the maximum height will typically be found at the point at which a wall extends to the highest roof support. In a multi-story building, the tallest floor height will indicate the height of the wall. Inspection of a doorway section in a masonry wall will allow an evaluator to determine the thickness of the wall. The largest ratio that is found is the most critical.

Masonry Wall: Length to Thickness Ratio (L/T)

Length to thickness refers to the length of a masonry wall compared to the thickness of the wall. The length of the wall is typically measured from a wall corner to the next adjacent wall corner. Wall spans, however, can be quite long. If there are any vertical columns in a wall, the length will then be measured from column to column or from vertical support to vertical support. Inspection of a doorway section in a masonry wall will allow an evaluator to determine the thickness of the wall. The largest ratio that is found is the most critical.

Parapet

A parapet is a small wall located atop a building that extends above the roof level. Parapets are typically located along a wall face at the top of the roof. They are most commonly seen on flat roofs and are usually a few feet tall and will be a minimum of 8 inches thick. They are often constructed of unreinforced masonry and are susceptible to damage by lateral forces caused by wind and seismic forces.

Tack Weld

A small weld intended only to secure a building element (i.e., roof deck) in place during construction. If the type of weld cannot be determined, it should be considered no better than a tack weld and “Other” should be selected.

SUMMARY SCORE SHEET

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10
WIND HAZARD SCORE										
Area 1 Total										
Structural										
Cladding/Glazing										
Envelope										
Non-structural										
Area 2 Total										
Structural										
Cladding/Glazing										
Envelope										
Non-structural										
Area 3 Total										
Structural										
Cladding/Glazing										
Envelope										
Non-structural										
Area 4 Total										
Structural										
Cladding/Glazing										
Envelope										
Non-structural										
Area 5 Total										
Structural										
Cladding/Glazing										
Envelope										
Non-structural										
Highest Wind Hazard Score										
Flood Hazard Score										
Seismic Hazard Score										
TOTAL SCORE										

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