Chapter IV
Site Visit

4.0 General

With the completion of Part One of the survey checklist, the Emergency Manager can now decide which of the potential HES buildings to concentrate on with the surveyors. The following procedures include a preliminary “drive-by”, analysis of technical drawings for structural details, and collection of the key structural details on Part Two of the survey checklist.

4.1 Windshield Drive-By

This step consists of a simple drive-by of the potential HES buildings, preferably with a local emergency manager representative along:

- Why? To get a quick view of the potential HES buildings and their surroundings.

- In some cases this survey will reveal major flaws that push a particular building to a lower priority or even eliminate it from selection.
  
  - For example, a drive-by may reveal that the building’s condition is so deteriorated that further efforts would not be cost-effective.

  - Another example is the presence of tall trees all around and immediately next to the potential HES buildings, presenting a major lay down threat.

- Another advantage is that the surveyor gets a good mental picture of the specified buildings.
  
  - It is not uncommon that modifications to buildings may not be shown in available technical drawings - the drive-by allows an accurate observation of what has actually been built.

  - In some cases the technical drawings available indicated a wooden building, yet the drive-by showed a masonry building was actually built.

4.2 Plans & Specifications Review

At this point the surveyor should be concentrating on the technical/structural details of the building - in particular those details answering the Part Two questions.

- Use AS-BUILT technical drawings if available - Preliminary drawings may or may not be
accurate.

- Locate the pertinent specifications as well as technical drawings - details such as the reinforcement in the walls are often only stated in the specifications, especially in older buildings.

- Recommend for documentation the photocopying of the page(s)/or parts of pages with the following technical details:
  - Site Plan
  - Foundation Plan/Sections
  - Typical Wall Details
  - Roof Framing Plan
  - Structural Plans showing load-bearing frames/walls
  - Details showing typical roof-wall connections
  - Details showing typical roof system construction
  - Floor Plans

4.3 Facility Visit

Use the technical drawings/specifications to answer as many of the Part Two checklist items as feasible. Once this is done the next step is an on-site review of the specified facility.

4.3.1 Complete Survey Checklist During On-Site Review

- Next complete those items on the survey checklist that you could not complete from the technical drawings.

- Also verify the information from the survey checklist (as much as feasible with non-destructive evaluation procedures).

- Use the survey checklist to ensure that you gather all the information you need the first time you visit the site.

- Note that certain “YES” and “NO” answer boxes are shaded on the survey checklist. This was done as a convenience for the surveyors. Any check in a shaded box indicates that a potential problem exists in this area and that further investigation may be warranted. A scan of a completed checklist for “checked” shaded boxes should quickly identify the key problem areas of a building.

- Blank samples of the pertinent sections from the survey checklist are provided in each section for reference.
Part Two:

4.3.1.1 Section 0 - Identification

- **Item 0.1** - Clearly identify the specific building being surveyed.

In many cases, the building being surveyed may consist of multiple sections with significantly different structural characteristics. For example, a building may have an original section built in 1969, with additions built in 1986 and 1994. The original could have been unreinforced masonry construction, with partially reinforced masonry construction in one addition (1986), and with fully reinforced masonry construction in the other (1994). It is important to examine how these additions are attached to the other sections. If they can be isolated or "compartmentalized", then that particular section should be evaluated as a separate building. For example, if the 1994 addition is separated by an expansion joint, roof and walls systems, and is thus, structurally, a separate building, it should be identified individually, and evaluated on its own characteristics. If the 1969 section is identified as Building 01a, then the additions could be identified as Buildings 01b and 01c. The key point is that the section is structurally separated from the other sections (i.e., it can stand on its own if the others should collapse).

- **Item 0.2** - Use a Global Positioning System (GPS) or, if one is unavailable, measurements from a USGS map to determine the latitude-longitude of the building

  - Often after a major hurricane has passed most if not all local road signs are gone or destroyed - making it difficult for emergency responders from out-of-area to locate specific buildings.

  - An accurate latitude-longitude will enable emergency units equipped with GPSs to quickly locate the shelter after a hurricane has passed through.

  - Latitude-Longitude collected previously by other parties may or may not be accurate, be sure to verify them.

- **Items 0.3-0.5** Self-explanatory.

- **Item 0.6** - Attempt to use at least one custodian/building manager who works at the building as a contact - preferably one with an extensive knowledge of the building's history.
• **Item 0.7 -** Identify the surveyor and date of survey - for future contact if necessary.

<table>
<thead>
<tr>
<th>SECTION 0 - IDENTIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 Facility Name:</td>
</tr>
<tr>
<td>0.2 Latitude:</td>
</tr>
<tr>
<td>0.2 Longitude:</td>
</tr>
<tr>
<td>0.3 County:</td>
</tr>
<tr>
<td>0.4 Owner:</td>
</tr>
<tr>
<td>Public ☐</td>
</tr>
<tr>
<td>Private ☐</td>
</tr>
<tr>
<td>0.5 Facility Type:</td>
</tr>
<tr>
<td>☑ vital - ☐ shelter - ☐ utility</td>
</tr>
<tr>
<td>☑ other:</td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>0.7 Surveyor’s Name:</td>
</tr>
<tr>
<td>0.8 Comments:</td>
</tr>
</tbody>
</table>

### 4.3.1.2 Section 4 - Lay Down Hazard Exposure

This section specifically identifies any nearby trees or structures that could fall down on the HES building.

• **Items 4.1-4.1.2 -** Lay-Down range is defined as close enough that a tree or structure falling flat to the ground at a right angle to its base would strike the HES building with sufficient force to breach the building’s envelope. The danger is that a falling
tree or structure would damage the building/or its envelope enough to allow access into the interior by hurricane force winds, windborne debris and rain, resulting in subsequent interior damage and roof system failures.

- **Item 4.1.3** - Identify any potential roll-over threats to the building. Look for portable buildings that could be rolled over into the building, for nearby parking lots, where cars could be parked (and rolled into the building under hurricane conditions), and nearby HVAC units not anchored down. Look for roll-over threats within 100 feet of the building.

- **Item 4.1.4** - Also note whether there is at least one access route to the site that is not tree-lined. Tree-lined routes are likely to be blocked by fallen trees during and immediately after hurricanes.

- **Item 4.1.5** - Comments: In some cases smaller trees/structures may not threaten the building with sufficient force in a single strike, but because of a close proximity would repeatedly batter against the building - these should also be noted as threats.

  - Consider also the damage that may be done to a building by the root system of a tree immediately next to a building if it is blown over during a hurricane.

  - Note the locations and general numbers of lay-down threats for consideration for mitigation actions -- if only one or two trees, removal may be feasible, however, if numerous trees present threats, then it may be more cost-effective to look elsewhere.

<table>
<thead>
<tr>
<th>SECTION 4 - LAY DOWN HAZARD EXPOSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>YES</strong></td>
</tr>
<tr>
<td><strong>NO</strong></td>
</tr>
<tr>
<td>4.1.1</td>
</tr>
<tr>
<td>4.1.2</td>
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<tr>
<td>4.1.3</td>
</tr>
<tr>
<td><strong>Describe:</strong></td>
</tr>
<tr>
<td>4.1.4</td>
</tr>
</tbody>
</table>
4.3.1.3 - Section 5 - Wind and Debris Exposure

This section captures the building’s vulnerability to wind and debris.

- **Item 5.1** - How exposed is the building to the full force of hurricane winds?
  - Walk around the building and observe on each of the sides the type of terrain surrounding it.
  - USGS quadrangle maps and recent aerial photographs (that are to scale) can be used to assess wind exposure.
    - USGS quadrangle (topographic) maps will provide an estimate of the elevation and the terrain’s relative profile.
    - The aerial photographs can be used to estimate the shielding capability of the building’s surroundings.
      - With photographs on table, use a scale or measuring tape to estimate the perimeter of a circle one-mile distant from the potential HES site.
      - Observe the type and relative density of obstructions in all directions from the site.
      - Based on the wind exposure categories below, identify the worst-case exposure for the building.
      - Repeat these steps for the topographic (USGS) maps.
      - The worst case condition of the terrain and topographic categories is the wind exposure category for the surveyed building.
      - In borderline situations, provide a degree of additional
weighting to the direction of the open ocean.

- If the maps/photographs are not available, a field evaluation of assessable areas will provide limited information.

- **Item 5.1.1 -** Sheltered Exposure: The building is located in surroundings that offer protection from all directions. The surroundings can be characterized as urban, suburban, or wooded setting, or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger for a mile or greater in all directions. The building cannot be within one mile of the ocean or other large body of water, nor within a quartermile of an open area.

- **Limited Exposure:** A building located in an open area that extends less than a quartermile in any direction with sheltered exposure beyond the open area.

- **Unsheltered Exposure:** All other terrain that is flatter, more open, or less sheltered than sheltered or limited exposures, including flat, open country, grasslands, or with scattered obstructions with heights of 30 feet or less. This exposure includes topography that can be characterized as open hill (elevated 15 feet or more above surrounding terrain) or promontory. Buildings in areas located within one mile of the ocean or other large body of water will be considered unsheltered exposure.

- **Item 5.1.1.1 -** Provides four choices for the type of topography at the site:
  
  - Flat - For a building set in a flat terrain;
  
  - Sheltered - For a building set in a valley, sheltered by surrounding hills; a building sheltered by surrounding buildings, obstructions, etc.; see definition Item 5.1.1 above.
  
  - Hill - For a building set on top of or on the side of a hill (more exposed than those above).
  
  - Promontory - For a building set out on a promontory and thus fully exposed to hurricane winds.
• **Item 5.1.1.2** - Asks for the type of surrounding terrain on each of four sides. Some choices are self-explanatory. Others are explained below:

- **Water** - Building set close (within 1,500 feet) to water, where there is an open expanse of at least one mile of water.
- **Open** - Building is set in an area with scattered trees/house/etc. Basically, little or no resistance to the wind.
- **Wooded** - Heavy, dense woods around the building, providing some wind resistance.
- **Residential** - The building is surrounded by low-rise buildings and houses.

• **Items 5.1.1.3 - 5.1.1.4** - Nearby open areas/large bodies of water can allow stronger/faster winds to assail the building.

• **Items 5.2 - 5.2.5** - Under hurricane conditions, windborne debris often impacts nearby buildings resulting in subsequent damage. If the windborne debris breaches windows or doors, then hurricane force winds and rains can enter into the building's interior. This could result in overpressurization and subsequent roof system failures.
Definitions for Types of Debris Generated in a Hurricane

Small Debris: Objects that weigh less than five pounds and have the potential of becoming windborne. The debris is small, but under hurricane conditions able to travel a great distance and do serious damage to windows or lightweight wall systems. Small debris materials may include small tree branches, gravel, and pieces of asphalt shingles.

Large Debris: Building materials (wall framing studs, plywood sheets, roof tiles, etc.), potted plants, tree branches, patio furniture, garbage containers, etc., with a weight range of six-20 pounds.

Roll-over Debris: Unanchored (or inadequately anchored) objects that may become partially airborne, pushed, or rolled along the ground surface by hurricane force winds. Potential “roll-over” debris sources include trailers, portable structures, vehicles, unanchored HVAC units, and empty fuel tanks.

Lofted Heavy Debris: Lofted heavy debris means massive objects that become windborne as nearby structures fail catastrophically. As the structure(s) disintegrates, large pieces of heavy debris in excess of 20 pounds are generated that loft, or arc, for a short distance. This type of debris can be extremely hazardous to other more wind-resistant buildings located in close proximity. Potential “lofted heavy” debris materials include large portions of roof, bond beams, porticos, and walkways. Also included under this definition are debris materials generated from tall buildings, such as wall and roof materials, HVAC units, and ventilators.

- Item 5.2 - Address the level of exposure for the building to potential windborne debris.

** Minimal Exposure:** Surroundings with negligible quantities of small and/or large debris. No concentrated debris sources near to large areas of unprotected fenestrations or softspots. Only debris materials located with 300 feet of the building should be considered. There must not be any significant roll-over, lay-down, or lofted heavy debris sources with 100 feet of the building.

** Limited Exposure:** Surroundings with scattered small and/or large debris materials. The terrain can be generalized as having less than 20 percent ground area coverage of potential debris sources within 300 feet, such as roofing materials, gravel or shell driveways, trees, fencing, and construction materials. There is no concentrated source of debris in close proximity to large areas of unprotected fenestrations or softspots of the building. There also must not be any significant roll-over, lay-down, or lofted heavy debris sources within 100 feet of the building.
• **High Exposure**: Surroundings with significant quantities of small and/or large debris materials. The terrain can be generalized as having greater than 20 percent ground area of debris in close proximity to large areas of unprotected fenestrations or softspots of the building. There also may be significant roll-over, lay-down, or lofted heavy debris sources within 100 feet of the building.

• **Item 5.2.1** - Identify the presence of potential sources of windborne gravel near to the building.

• **Item 5.2.2** - Identify the presence of nearby buildings with loose cladding or materials which could supply windborne debris.

• **Item 5.2.3** - Identify the presence of nearby debris sources, such as lumberyards, nurseries, trees, etc.

• **Item 5.2.4** - Relocatables are trailers or moveable structures. Such structures have historically performed poorly under hurricane conditions, often being destroyed and generating windborne debris. Such lightweight structures should be securely anchored.

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**SECTION 5 - WIND AND DEBRIS EXPOSURE**

**5.1 Will the Facility site be exposed to the full force of hurricane winds?**

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1.1 What is the degree of wind exposure for the Facility?</td>
<td></td>
</tr>
<tr>
<td>☐ Sheltered Exposure ☐ Limited Exposure ☐ Unsheltered Exposure</td>
<td></td>
</tr>
<tr>
<td>5.1.1.1 What is the type of topography? ☐ Flat ☐ Sheltered ☐ Hill ☐ Promontory</td>
<td></td>
</tr>
<tr>
<td>5.1.1.2 What is the surrounding terrain?</td>
<td></td>
</tr>
<tr>
<td>North: ☐ Flat ☐ Hilly ☐ Low Lying (marsh) ☐ Open ☐ Wooded (heavily - lightly) ☐ Rural ☐ Residential ☐ Lake/Pond ☐ Commercial Dist. (shopping - manufacturing) ☐ Many tall trees ☐ Other:</td>
<td></td>
</tr>
<tr>
<td>South: ☐ Flat ☐ Hilly ☐ Low Lying (marsh) ☐ Open ☐ Wooded (heavily - lightly) ☐ Rural ☐ Residential ☐ Lake/Pond ☐ Commercial Dist. (shopping - manufacturing) ☐ Many tall trees ☐ Other:</td>
<td></td>
</tr>
<tr>
<td>East: ☐ Flat ☐ Hilly ☐ Low Lying (marsh) ☐ Open ☐ Wooded (heavily - lightly) ☐ Rural ☐ Residential ☐ Lake/Pond ☐ Commercial Dist. (shopping - manufacturing) ☐ Many tall trees ☐ Other:</td>
<td></td>
</tr>
</tbody>
</table>
4.3.1.4 Section 6 - Wind Design Verification

- Item 6.1 - The first guideline described in ARC 4496's structural considerations is a requirement for a certification by a structural engineer indicating that a building conforms to ASCE 7-88 or ANSI A58 (1982). ASCE 7-88 or ANSI A58 (1982), Minimum Design Loads for Buildings and other Structures, have some of the most stringent wind load requirements available, especially with respect to wind effects on components and cladding.

- Certification by a professional engineer that a building meets this standard indicates the building is in compliance with the best wind design standard currently available.

- A building complying with either of these standards generally should perform well under hurricane conditions. However, it must be noted that such a building may still need retrofitting with respect to protection of fenestrations or other softspots.
- Buildings built in 1996, or thereafter, may comply with ASCE 7-95, which is the latest revision of the ASCE 7-88 Standard.

- With the exception of tall buildings that are greater than 60-feet in height, the vast majority of buildings that will be evaluated as a potential HES will not conform to ASCE 7.

- Instead, low- and mid-rise structures will conform to a locally adopted wind code, such as the SBC. Post-1986 model codes use wind design procedures based upon ASCE 7 but permit the use of reduced pressure coefficients at the high pressure zones of buildings.

- It is unlikely that any building built prior to 1982 will meet the preferred design criteria of ARC 4496. Therefore, a structural engineer will often only provide a "certification" or other statement as to the degree of compliance of the building with current wind codes and standards.

- Consequently, the HES evaluation procedure in this guidance manual focuses on an alternative to ASCE 7-88 or ANSI A58 (1982) certification, ranking the proposed HES based upon historical wind performance data and sound engineering judgement.

- Items 6.1.1-6.1.2.2 - Buildings built higher (mean height) than 60 feet must be in compliance with ASCE 7-88. Generally buildings built 60 feet or lower will not comply with ASCE 7-88.

- Items 6.2-6.2.6 - Help to rank the building, assuming that the building was not built to ASCE 7-88 or ANSI A58.

- Item 6.2 - This should be indicated on the technical drawings. The attention of a professional architect or structural engineer should, generally, result in a better designed building.

- Item 6.2.1 - Identify the availability of technical drawings. If it is not certain whether the drawings are Preliminary or As-Built, then assume Preliminary.

- Item 6.2.2 - Buildings constructed prior to 1987 probably have only
limited or no vertical reinforcements in the walls (rebar). More recently designed buildings are generally designed to higher wind standards than pre-1987 buildings.

- **Item 6.2.3** - Major additions to buildings are generally designed to higher wind standards than older buildings. Such additions may provide "core" areas that potentially could serve as shelter areas.

- **Item 6.2.4** - Addresses what wind resistance code was probably used at the time of design of the surveyed building.

** Determine the year(s) of design and construction; the years of design and construction are not always the same. The wind codes used by the structural engineer or architect for design purposes often will be noted on construction drawings in "general notes." The date the drawings were prepared also will be provided on every page, typically in a "revision log," title block, or similar information entry. If construction drawings are not available, and site inspection is the only available option, a monument or dedication plate may be attached to the building that provides the construction date.

** Based upon information provided locally, determine which wind code(s) were in effect during the relevant time frame.

** The dates of design and construction will significantly affect the wind resistance of the building; earlier codes are less stringent than more modern codes.

** The following table will provide a procedure for ranking a potential HES building. This table reflects the historical milestones at which major changes in wind design and construction standards were adopted by the listed model codes. For example, all other factors being equal, a structure built using the SBC in 1992 is designed to a more stringent wind standard than one built in 1979.
The construction drawings should be reviewed, specifically looking for design features that are relevant to good wind-resistant construction practice.

If possible, the building should be certified to meet, or substantially meet, current codes and standards.

If certification is not possible, the evaluator should take note of systems, components, and connections utilized by the building's designer to resist wind loads for comparison to current code requirements.

All wind-resistant construction details derived from the construction drawings must be field verified.

Item 6.2.5 - This can often be gotten from technical drawings or the specifications. ARC 4496 assumes that buildings generally resist wind forces up to the wind speed that they are designed to handle.
### SECTION 6 - WIND DESIGN VERIFICATION

<table>
<thead>
<tr>
<th>YES</th>
<th>6.1.2 Does the building have more than one story?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

6.1.2.1 How many stories does the building have?  □ One  □ Two  □ Three  □ Four-Five  □ Six +

6.1.2.2 What is the overall height of the building?  □ 0-30 feet  □ 31-59 feet  □ 60+ feet

<table>
<thead>
<tr>
<th>YES</th>
<th>6.2 Was this building designed by a professional architect or structural engineer?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>□ Unknown</td>
</tr>
</tbody>
</table>

6.2.1 What type(s) of technical design drawings were available for the survey?
- □ Architectural □ Full □ Preliminary □ Structural □ Full □ Preliminary
  - □ Partial □ As-Built □ Partial □ As-Built
  - □ None □ None

- □ Drawings do NOT furnish a high level of detail; □ Drawings are more representative of residential drawings.
- □ Truss anchors and/or reinforcement in masonry was not addressed.

6.2.2 The building was designed in what year?  ________________  □ Actual  □ Estimated

6.2.3 In what year(s) were major addition(s) built?  ________________

6.2.4 What type of wind resistance code was utilized (or prevalent) at the time of design?
- □ Model Building Code (☐ SBC - ☑ SFBC - ☐ Other: ________________ )
- □ Custom Code  □ MBMA  □ Unknown  □ None

6.2.5 To what wind speed was the building designed?  __ __ mph  __ __ importance factor  □ Unknown

6.2.6 Comments:  ____________________________

4.3.1.5 Section 7 - Construction Type/Loadpath Verification

- **Item 7.1** - The most important aspect of the HES evaluation process is the identification of a definable and continuous load path for resistance to wind-induced loads.

- The primary focus is on the building's "Main Wind Force Resisting System" (MWFRS) and exterior envelope and their ability to transfer effectively all wind loads to the foundation. A single break, or discontinuity, in the system may be capable of initiating progressive and
possibly catastrophic failure. The primary source of information will be in construction drawings.

- Using the construction drawings, the HES evaluator should identify all vertical structural components that are designed and/or capable of transferring tensile (uplift) forces to the foundation. This may include columns of structural frames, reinforced pilasters in bearing walls, vertical reinforcement in grouted masonry wall cells, metal rods, and cables or straps.

- Identify the major structural components or systems that transfer floor and roof loads to the vertical structural components. There must be a clearly defined path between these components and the foundation. In many buildings, there is a combination of these systems, especially if there are changes in construction type due to differing floor functions, renovations, or later additions to a building.

- There cannot be a "connection" that relies on gravity, grout/friction, or withdrawal reactions to resist uplift or tensile loads. These fastening methods do not provide a substantial connection and, therefore, do not provide a continuous loadpath.

- The weakest link in the loadpath is likely to be the building's limiting factor when subjected to extreme windloading.

- With the vertical load path established, the components or systems that produce lateral stability must be identified. The MWFRS must be capable of resisting racking, overturning, and translational (sliding) effects.

- The most common lateral stabilizing system found in potential HES buildings include shear wall/diaphragm systems, though semi-rigid or rigid framing and bracing systems are less commonly used.

- As in the vertical load-resisting system, there cannot be a "connection" that relies on gravity, grout/friction, or withdrawal reactions.

- The apparent lack of a significant lateral stabilizing system is sufficient to deem a building noncompliant.
The configuration of the Main Wind Force Resisting System (MWFRS) is also important. If the structural capacity of the MWFRS is not uniformly distributed throughout the building, a torsional imbalance or open side may exist. A torsional imbalance or open side may significantly increase the wind vulnerability of a building.

**Torsional Imbalance**

**Shear Wall Footage:**
North-South = 140 feet  
East-West = 65 feet

**Open sided?** Yes, less than 50 percent of one side's footage is composed of shear wall (south side).

**Torsional Imbalance?** (Difference of at least 50 percent between parallel side’s wall percentages.)
West vs. East: 100% vs 60% = 40%  
No torsional imbalance.  
North vs. South: 56% vs 0% = 56%  
Yes.
Similarly, all exterior envelope components must be connected/fastened via primary (beams, columns, and loadbearing walls) or secondary (light wood or metal framing) elements to the MWFRS to resist both positive and negative pressures. The presence of lightweight claddings and softspot materials (e.g., EIFS, light-gauge metal, and glazed panels) which typically perform poorly under high wind conditions may be sufficient to deem a building non-compliant with ARC 4496.

The building construction type of a potential HES can have a significant impact upon its wind resistance.

- A building that is constructed to impart an inherent surplus structural capacity, or a high factor-of-safety, generally will perform better under conditions that exceed the building's design wind code requirements.

- Multistory buildings typically possess redundant structural capacity, as do monolithically poured reinforced concrete frame and heavy steel frame buildings.

- If the exterior envelope is not weak, and all other factors being equal, these types of structures should be given preference over single-story buildings.

- Low- and mid-rise buildings with a fully reinforced masonry MWFRS also perform well.

- Single-story structures that are "fine tuned" to reduce surplus structural capacity should be avoided.

- The table provided below can be used to rank the MWFRS of a building.
<table>
<thead>
<tr>
<th>Relative Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strongest</strong></td>
</tr>
<tr>
<td>high-rise heavy concrete or steel frame</td>
</tr>
<tr>
<td>multistory braced heavy steel frame</td>
</tr>
<tr>
<td>multistory heavy concrete* or steel frame with fully reinforced shear walls</td>
</tr>
<tr>
<td>multistory heavy concrete* or steel frame with partially reinforced shear walls</td>
</tr>
<tr>
<td>multistory fully reinforced masonry wall bearing</td>
</tr>
<tr>
<td>single-story heavy concrete* frame with fully reinforced shear walls</td>
</tr>
<tr>
<td>single-story fully reinforced masonry wallbearing</td>
</tr>
<tr>
<td>single-story tilt-up or precast concrete wallbearing panels</td>
</tr>
<tr>
<td>multistory partially reinforced masonry wallbearing</td>
</tr>
<tr>
<td>multistory unreinforced masonry wall bearing with pilaster-bond beam</td>
</tr>
<tr>
<td>single-story heavy concrete* frame with partially reinforced shear walls</td>
</tr>
<tr>
<td>single-story pinned steel frame with partially reinforced masonry shear walls</td>
</tr>
<tr>
<td>single-story partially reinforced masonry wall bearing</td>
</tr>
<tr>
<td>single-story unreinforced masonry wall bearing with pilaster-bond beam</td>
</tr>
<tr>
<td>light-wood or metal stud wall framing with plywood sheathing (SSTD 10-93)</td>
</tr>
<tr>
<td>Preengineered Metal Buildings with light-gauge metal cladding (MBMA 1986 or more recent)</td>
</tr>
<tr>
<td>light wood or metal stud wall framing with non-plywood sheathing (SSTD 10-93)</td>
</tr>
<tr>
<td>pinned steel frame with light stud or unreinforced masonry shear walls (NONCOMPLIANT)</td>
</tr>
<tr>
<td>pinned/precast concrete frame with light stud or unreinforced masonry shear walls (NONCOMPLIANT)</td>
</tr>
<tr>
<td>unreinforced masonry wall bearing (NONCOMPLIANT)</td>
</tr>
</tbody>
</table>

| Weakest |

* - For purposes of this table, Heavy Concrete Frame means a monolithically poured reinforced concrete frame capable of resisting overturning moments.

- **Item 7.1.1** - This is the roof system that directly supports the roof deck.

- **Item 7.1.2** - This is the system that supports the roof system and connects it to the foundation.

- **Item 7.1.3** - Historically, many of the failures in building structures began at connection points. This has been especially true between the roof and supporting walls.

- **Item 7.1.4** - It is also important to determine how the loadbearing systems are connected to the foundation. Since destructive investigation is not within the scope of this survey, you often will be forced to rely on foundation/structural plans to ascertain this information.
Item 7.2 - ARC 4496 recommends avoiding pre-engineered (steel prefabricated) buildings built before the mid-1980s.

- PEMBs are considered "fine-tuned" structures, and as such have a limited surplus structural capacity. This fine-tuned design process makes PEMBs susceptible to wind damage whenever wind speeds exceed their design requirements. Many catastrophic failures of PEMBs have been documented in hurricanes.

- PEMBs should be avoided unless extraordinary wind design and construction criteria are included in the design specifications.

- If this type of building must be used as an HES, it should be evaluated by a structural engineer to verify conformance with high wind zone design and construction criteria. At a minimum, the PEMB should have the characteristics described below:

---

**Hurricane Evacuation Shelter Selection Criteria for Preengineered Metal Buildings**

Due to their fine-tuned design procedures, Preengineered Metal Buildings (PEMB) should be avoided when selecting potential HES facilities. If other local building-stock options are limited, PEMBs should be evaluated using the guidelines described in this manual and the criteria provided below:

1. PEMB shall be designed and constructed to high wind zone requirements as established in MBMA (1986) or a more recent edition.

2. Exterior wall and roof cladding must be 22-gauge or greater thickness galvanized steel (recommend reinforced masonry exterior wall or frame infill envelope).

3. The condition of the building must be considered good; loadpath connections and cladding fasteners are surveyed for deterioration or construction irregularities.

4. Cross-bracing must be installed in every third bay and at the wall and roof on both sides of structure.

5. All fenestrations must be protected; no combination of large apertures (greater than eight feet in width) can exceed one percent of the exterior wall surface area.

6. There cannot be a roof overhang.
### SECTION 7 - CONSTRUCTION TYPE/LOAD PATH VERIFICATION

<table>
<thead>
<tr>
<th></th>
<th>7.1 Is there a definable and continuous load path from the building's roof to its foundations?</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>7.1.1 What is the primary roof support system?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>☐ Reinforced Concrete ☐ Steel Beam</td>
</tr>
<tr>
<td></td>
<td>☐ Steel Truss ☐ Open Web Steel Joist ☐ Tapered Steel Beam ☐ Wood Truss ☐ Unknown</td>
</tr>
<tr>
<td></td>
<td>☐ Glue Laminated Wood Beam ☐ Other:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>7.1.2 What is the primary load-bearing structure of the building?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>☐ Wood Frame</td>
</tr>
<tr>
<td></td>
<td>☐ Unreinforced Masonry Walls ☐ Reinforced Concrete Frame ☐ Heavy Steel Frame</td>
</tr>
<tr>
<td></td>
<td>☐ Tapered Steel Frame ☐ Reinforced Masonry Walls ☐ Heavy Timber Frame</td>
</tr>
<tr>
<td></td>
<td>☐ Laminated Beam Frame ☐ Unknown ☐ Other:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>7.1.3 How is the primary roof support system connected to the primary load-bearing system?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Description:</td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>7.1.4 How is the primary load-bearing system connected to the foundation?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Description:</td>
</tr>
<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>7.2 Is the building a Pre-engineered (steel pre-fabricated) building built or designed prior to the mid 1980's?</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>(Specify year built/designed:</td>
</tr>
<tr>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

### 4.3.1.6 Section 8 - Building Condition/Wind Damage History

- This section captures the observed overall condition of the building. The condition of a building’s MWFRS and exterior envelope can play a significant role in determining the wind vulnerability of a potential HES. A building with major deterioration of critical loadpath components, or exterior envelope walls or cladding, will have lost any excess structural capacity that may have been present in the original structure.

- The building’s owner or facility manager should be able to provide information on wind damage history, which may offer valuable information concerning the vulnerability of a building.
Wind damage initiated by a weak storm, relative to a major hurricane, may indicate construction workmanship problems, or other possible design and construction flaws. Special attention should be given to the previous failure mode(s) when performing the building's field survey.

The building's condition and the effectiveness of wind damage repairs can only be verified during the field survey. Based upon findings from the field survey, determine if the potential HES's condition is suitable for use.

Use the following guidelines for defining the condition of the building:

**Good Condition:**

• A building has no apparent signs of deterioration. The building is approximately as sound as it was when new, and the structure shows none of the signs of deterioration indicated in the minor or major deterioration categories.

• The building generally looks as if it is well maintained in other non-structural respects; it is not in obvious need of painting, does not have broken windows, weeds are not growing in roof gutters, etc.

**Minor Deterioration:**

• A field survey indicates there are some cracks in walls and other signs of slight deterioration that do not appear to significantly impact on wind resistance.

• One or more of the following signs may be present:

  **Cracks in Concrete or Masonry** - Cracks in walls, columns, beams, or slabs that are not slabs-on-grade. The cracks are less than a 1/16 inch in width and do not extend for more than a few feet in a continuous line. Cracks in slabs-on-grade are considered only insofar as they indicate foundation settlement, which is separately described below.

  **Deterioration** - Masonry mortar joints may be somewhat soft or eroded, but mortar cannot be removed easily with a key or similar metal object. The building has hairline crack(s) in masonry walls that run diagonally up the wall without cracking CMUs and...
without any indication of significant yielding of joint reinforcement.

**Corrosion** - There is rusting of steel members but not to the point that a cross section of a metal member is reduced significantly. Rust stains on the concrete indicate rusting reinforcing bars may be present but only in occasional places and only to a slight degree.

**Spalling** - There are pebble-size pieces of concrete, smaller than a golf ball, broken away. Reinforcing bars are not significantly exposed or the cross sections of members are not significantly compromised.

**Rot** - There is some rotting or degradation of wooden members, but not to the extent that a key or similar metal object can penetrate easily.

**Foundation Settlement** - Signs of about an inch or less of foundation settlement.

**Major Deterioration:**

- A field survey indicates there is observable deterioration of the facility's superstructure that may impact on wind resistance.

- One or more of the following types of deterioration is observable and there are at least two instances noted (two cracks, two areas of a brick wall with mortar deterioration, one major crack and one case of major post rotting, etc.).

**Cracks in Concrete or Masonry** - There are cracks in walls, columns, beams, or slabs that are not slabs-on-grade. The cracks are more than a 1/16 inch in width or extend for several feet in a continuous line. There are diagonal cracks at the ends of beams or extending through the story height of a wall.

**Deterioration** - Masonry mortar joints are soft or eroded. The mortar can be removed easily with a key or similar metal object. There are hairline crack(s) in masonry walls that run diagonally up the wall. Cracking of CMUs may also be present, indicating significant yielding of joint reinforcement.
Corrosion - There is rusting of structural steel members to the point where the cross section is reduced significantly. Rust stains on the concrete indicate rusting reinforcing bars may be present in numerous places and to a substantial degree.

Spalling - Golf ball- or larger-size chunks of concrete have broken away. Reinforcing bars are exposed significantly, or the member's cross section has been compromised significantly.

Rot - There is significant rotting or degradation of wooden members, such as sills, post bases, and wall framing, to the extent that a key or similar metal object can penetrate the wood easily.

Foundation Settlement - Signs of about an inch or more of foundation settlement; walls or columns are out of plumb more than one inch in a story height.

### SECTION 8 - BUILDING CONDITION/ WIND DAMAGE HISTORY

8.1 From observation, what is the overall condition of the building?

- Good Condition
- Minor Deterioration
- Major Deterioration

8.2 Is there any history of damage from high winds, or storms at this building?  
- YES
- NO

8.3 Comments: (Specify damage history):

<table>
<thead>
<tr>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
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</tbody>
</table>

4.3.1.7 Section 9 - Exterior Wall Construction

Items 9.1-9.1.3. address the ability of the exterior walls to resist wind loads and windborne debris impact.

- **Item 9.1.1 - Unreinforced Masonry Buildings:** Under hurricane conditions, wind uplift and/or flexural bending can create tensile forces in un-reinforced masonry. Though strong in compression, unreinforced masonry is incapable of resisting tensile forces, often leading to catastrophic failure. Loadbearing unreinforced masonry walls are particularly vulnerable to catastrophic failures. Unreinforced masonry also may be susceptible to perforations caused by large windborne debris impact.
The term “ unreinforced masonry,” as referred to in ARC 4496, is commonly defined as masonry (CMU, clay tile, clay or concrete brick, etc.) without vertical steel reinforcement (rebar), or with vertical reinforcement spaced at distances greater than eight feet on-center.

As a rule of thumb, if the building was designed and constructed prior to 1987, assume the masonry is unreinforced unless there is definitive evidence from construction drawings and specifications that contradict this assumption.

For loadbearing masonry walls with reinforced pilaster and bond-beam flexural systems, the unreinforced masonry panel dimensions shall not exceed 12 feet vertically or horizontally (13'-3" on-center pilaster spacing).

Buildings with loadbearing solid unreinforced clay brick walls (eight inches or greater in thickness) will be considered unreinforced, regardless of wall thickness.

To determine the spacing of reinforcement in a masonry wall, review the construction drawings at both the foundation plan, first-floor plan, and typical upper-floor plan (if applicable).

• The CMU cells the designer intends to have reinforced will be darkened or shaded.

• If there are no cells shaded, and the building was constructed prior to 1987, assume the walls are unreinforced.

• If the wall was designed and constructed after 1987, or the reinforced cells are spaced eight feet on center or closer, the masonry wall will be considered fully or partially reinforced (as appropriate).

Item 9.1.1.1 - Various wall types have different levels of wind load and impact resistance.

Fully reinforced masonry (which is a preferred exterior wall system) is defined in ACI 530.

• Generally, if a masonry wall has #5 rebar or larger at four feet on center or closer vertically, with rebar at the corners and around windows and doors it will meet the ACI 530 definition.
- Partially reinforced concrete masonry is defined in NCMA TEK 63-1975.
  - Generally, it is masonry wall construction designed as unreinforced masonry, except that vertical reinforcement is provided in some portions spaced no more than eight feet apart, with vertical bars at wall corners, wall intersections, and on each side of window and door openings. Horizontal reinforcing must be present at roof and floor levels and above and below window or door openings.

- If pilasters are present that contain a minimum of four #5 or greater diameter rebar, arranged in a rectangular or square pattern, check the spacing of the pilasters.
  - If the pilaster spacing is no greater than 13'-3" on center, check an appropriate wall cross-section to determine if the bond-beam vertical spacing(s) are less than 13'-3" on-center. If the pilaster wall system conforms to this requirement, and the nominal thickness of the masonry is greater than or equal to eight inches, the masonry’s wind resistance will be similar to that of partially reinforced masonry (generally a marginal wall system).

- Wood and metal stud wall systems should comply with SBC SSTD 10-93 (or a more recent version).

Example of wood stud connections from roof to foundation.

- **Item 9.1.1.2** - Past performance indicates that metal panels/sheets thinner than 22 gage may have insufficient impact and cyclical fatigue resistance under hurricane conditions.

- **Item 9.1.2** - A brick or stone veneer will provide an exterior wall with
additional debris impact resistance.

Typical EIFS Components

- **Item 9.1.3** - EIFS system have historically proved vulnerable to hurricane force winds and windborne debris impact.

- **Item 9.1.4** - A cantilevered wall is a wall that is supported/connected only at the base. Such walls are vulnerable to windload forces and present softspots in the building exterior.

- **Item 9.1.5** - Here look for areas such as bricked up windows, tall window systems that have been replaced with stucco or vinyl coverings, etc.
### SECTION 9 - EXTERIOR WALL CONSTRUCTION

<table>
<thead>
<tr>
<th>YES</th>
<th>9.1 Are the exterior walls relatively wind and debris impact resistant?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>YES</td>
<td>9.1.1 Does the building have unreinforced masonry walls on its exterior?</td>
</tr>
<tr>
<td></td>
<td>□ Unreinforced Masonry or</td>
</tr>
<tr>
<td></td>
<td>□ Rebar Spacings Unknown</td>
</tr>
<tr>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

9.1.1.1 If no, what is the Exterior Wall Construction type?  *(Check only one)*

- □ Reinforced Masonry (Rebar @ 4 ft. centers or closer)
- □ Partial Reinforced Masonry (Rebar @ 8 ft. centers to 4 ft. centers)
- □ Partial Reinforced Masonry (Four-bar Pilasters 13 feet on center or less)
- □ Reinforced Concrete or Precast Concrete Panels
- □ Other: __________________________________________

9.1.2 If Metal Sheets or Panels (e.g. PEMB structures), what is the gage of the metal sheets or panels?

- □ Thinner than 22 gage (26 gage, etc.)
- □ 22 gage or thicker (18 gage, 16 gage, etc.)
- □ Not Applicable

9.1.2.1 Do the exterior walls have a brick or stone veneer (3 to 4 inches thick)?

- □ YES
- □ NO

9.1.3 Do the exterior walls have an Exterior Insulating and Finish System (EIFS)?

- □ YES
- □ NO

9.1.4 Are there cantilevered walls (walls connected/supported at the base/foundation, but not at the roof) on the exterior of the building?

- □ YES
- □ NO

Describe: ________________________________________

9.1.5 Are there any other softspots noted in the building's exterior wall/roof?

- □ YES
- □ NO

Describe: ________________________________________

### 4.3.1.8 Section 10 - Fenestrations/Window Protection

- **Item 10.1** - Unshuttered/Unprotected windows can be softspots in a building's envelope. Once breached by wind loads or wind borne debris impact, the window opening will allow access by hurricane force winds and rain into the building interior. This can result in overpressurization, interior damage, and subsequent roof system failures.

- **Item 10.1.1** - Generally, more than five percent of the exterior walls is considered excessive glazing, if unprotected.
• **Item 10.1.2** - These are large softspots in the exterior walls that are very vulnerable to windborne debris.

• **Item 10.1.3** - Different types of glass have different degrees of wind load and debris impact resistance.

• **Item 10.1.4** - If only some of the windows are protected, then the unprotected windows still present softspots for the building. If only part of the building is to be used as a shelter, and that part is sealed off from the rest of the building, and all the windows in that part are shuttered/protected, then answer yes and explain in Item 10.4 below.

• **Item 10.1.5** - There are numerous shutter/protective system products available. These two standards (or subsequent versions) are the ones available at this time.

• **Items 10.1.6 - 10.1.6.3** - There may be many shutter/protective systems already installed that might meet the standards listed above but have not been tested. These items are intended to help estimate the general adequacy of such systems. Use documents provided by the manufacturer to answer these items, if possible.

• **Item 10.2** - Overhead doors or other large doors (i.e., eight feet or wider) have historically performed poorly under hurricane conditions and present large softspots in the building’s envelope.

• **Item 10.2.1** - In some cases the overhead/large doors may have been modified to resist high wind loads. Be sure that the frame was also modified.

• **Item 10.3** - Skylights and overhead glass or plastic windows have performed poorly under hurricane conditions. Once breached they allow access by hurricane force winds and rain into the building’s interior, leading to subsequent and probably catastrophic roof system failures.

• **Item 10.4** - Are there areas that have been walled in with unreinforced masonry, plywood, drywall, etc.? If yes, specify.

• **Item 10.5** - This a sketch page for a quick sketching of the building floorplan and locations of windows/doors and other points of interest.
## SECTION 10 - FENESTRATIONS/WINDOW PROTECTION

### 10.1 Are all the windows in the building adequately protected by shutters/protective systems?

**YES**

**NO**

### 10.1.1 What is the percentage of glass in the exterior walls?

- [ ] 0% to 1%
- [ ] 2% to 5%
- [ ] 6%+

\[
\text{Percentage of Glass} = \left( \frac{\text{sq. ft. of glazings}}{\text{sq. ft. of exterior walls}} \times 100 \right)\]

### 10.1.2 Are there "store-front", atrium, or clerestory sections of glazing in the exterior walls?

- [ ] YES
- [ ] NO

### 10.1.3 What type of glass is utilized in the exterior walls?

- [ ] Unknown
- [ ] Fully Tempered
- [ ] Laminated Glass
- [ ] Other

### 10.1.4 Are all the windows in the exterior walls of the building shuttered/protected against windborne debris?

- [ ] YES
- [ ] NO
- [ ] Not Applicable
- [ ] Unknown

### 10.1.5 Has the shuttering/protective system used to protect the windows been certified to meet the windload and impact resistance standards in the Dade County version of the South Florida Building Code (Sections 2314.1, 2314.5, and 2315.1-2315.4), or SBC Standard SSTD 12-94?

- [ ] YES
- [ ] NO
- [ ] Not Applicable
- [ ] Unknown

### 10.1.6 If there is a shuttering/protective system in use but it is not certified to the standards in 10.1.5 above, is there documentation indicating the system was designed to transfer impact and wind loads to the building walls?

- [ ] YES
- [ ] NO
- [ ] Not Applicable
- [ ] Unknown

### 10.1.6.1 Does it appear that the system was installed per the manufacturers' design documentation?

- [ ] YES
- [ ] NO
- [ ] Not Applicable
- [ ] Unknown

### 10.1.6.2 Is the shuttering/protective system frame directly anchored into the wall around the window?

- [ ] YES
- [ ] NO
- [ ] Not Applicable
- [ ] Unknown

### 10.1.6.3 If a film protective system is used, does the film cover the entire glazing (exposed glass and portions embedded in the frame)?

- [ ] YES
- [ ] NO
- [ ] Not Applicable
- [ ] Unknown

### 10.2 Are there overhead/large door(s) in the building?

- [ ] YES
- [ ] NO

### 10.2.1 Have the overhead/large door(s) and framing been modified with additional bracing to resist high wind loads?

- [ ] YES
- [ ] NO
- [ ] Not Applicable
- [ ] Unknown

### 10.3 Are there skylights or overhead atrium glass or plastic?

- [ ] YES
- [ ] NO

Describe:

### 10.4 Comments:


---

4-31

October 1997
### SECTION 10 - FENESTRATIONS/WINDOW PROTECTION

10.5 Draw "footprint" sketch of building showing overall dimensions & window location.

<table>
<thead>
<tr>
<th>Window/Door Types and sizes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Size ___ x ___ - Type _______</td>
</tr>
<tr>
<td>B Size ___ x ___ - Type _______</td>
</tr>
<tr>
<td>C Size ___ x ___ - Type _______</td>
</tr>
<tr>
<td>D Size ___ x ___ - Type _______</td>
</tr>
</tbody>
</table>

### 4.3.1.9 Section 11 - Roof Construction/ Slope

- **Item 11.1** - A heavy reinforced concrete roof deck can provide substantial resistance to the uplift forces present under hurricane conditions.

- Precast Concrete Panels can provide relatively wind-resistant roofs, if they are securely anchored into the support system (walls, frame, etc.). Often, in older buildings, they are gravity loaded with grouting only, or welded to embedded metal plates for shear. Historically, such unanchored or inadequately anchored roofs have performed poorly under hurricane conditions.
Examples of precast concrete roof tees moved and dropped inside of buildings by hurricane effects.
• Item 11.1.1 - Past performance indicates that metal panels/sheets thinner than 22 gage may have insufficient impact and cyclical fatigue resistance under hurricane conditions.

• Item 11.2 - The definition of "lightweight roof" is not provided in ARC 4496 but generally can be defined as the roof deck, and integral support elements, that have a combined weight less than the basic building code uplift pressure requirements. This uplift pressure varies with the building's height and the basic wind speed zone of the local jurisdiction; therefore, for the purposes of this procedure, a weight of 25 pounds per square foot (psf) or less will be assumed to mean lightweight.

• Typical roof materials that are classified as lightweight include wood boards, plywood, precast cement-fiber planks, fiberboard, gypsum board, metal decking, wire-fabric, or other similar material, with or without poured gypsum or insulating (lightweight) concrete.

• Historical data from previous hurricanes indicates that lightweight roof decks often fail at their connections with supporting roof trusses or joists.

• The roof covering also is damaged and removed by clean-off, or erosion, effects of the wind; therefore, roof covering materials should generally not be included in the dead weight estimate.

• Only the dead-weight of the roof's structural plate-like layer should be
used to compare the potential HES's roof weight to the 25 psf lightweight roof criteria.

- If the HES evaluator has a high degree of confidence that the roof deck, covering, and support members will remain intact during an extreme wind event, the weight of these elements can be added to the roof deck when determining total dead weight.

- The weight of clay or concrete roof tiles can be included in the calculations if they have been fastened to a roof deck with a nail and full mortar bed, as prescribed by the product manufacturer for high-wind areas.

- Poured gypsum or insulating concrete may be included in the dead-weight calculations if applied directly to the structural deck (i.e., not on top of rigid insulation boards).

To determine if a roof system is lightweight, review the construction drawings and take note of typical roof cross-sections. A sample procedure for estimating the dead weight of a lightweight roof system is provided below:
Procedure to Estimate the Dead Weight of a Lightweight Roof System

To determine the dead weight of a lightweight roof system, identify the materials that combine to create the structural plate-like layer of a roof deck. As an example, the roof cross-section shown below includes open-web steel joist (CWSJ) support members, a ½-inch gypsum formboard, two inches of poured gypsum, and a built-up roof covering with gravel. The weight of the OWSJ should not be included, as the connections between the gypsum formboard and joist are likely to fail with this type of system in a high-wind event. The gravel is likely to be cleaned off by high winds, as is the roof covering; therefore, they also should not be included in the dead-weight calculation.

This leaves the gypsum formboard and two-inch poured gypsum deck to contribute to the dead weight that will be resisting wind uplift forces. To determine their combined dead weight, turn to Appendix E of this manual. Locate the entries for each respective material, and note the weight given in psf. Note that the weights given in Appendix E are in psf per inch of depth unless otherwise indicated. The poured gypsum deck has a weight of four psf per inch of depth, therefore a dead weight of eight psf. Sum this weight with the two psf given for the formboard, and the total deck weight is 10 psf. As 10 psf is less than the 25 psf lightweight roof criteria, the roof is considered lightweight.

![Diagram of Lightweight Roof System]

<table>
<thead>
<tr>
<th>Material</th>
<th>Weight (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built-up Roofing</td>
<td>N/A</td>
</tr>
<tr>
<td>Poured Gypsum Deck</td>
<td>8.0</td>
</tr>
<tr>
<td>½&quot; Gypsum Board</td>
<td>2.0</td>
</tr>
<tr>
<td>Steel Joist</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Total Dead Weight Used 10.0 psf
To calculate the dead weight of a concrete roof system use the procedure below:

**Procedure to Estimate the Dead Weight of a Concrete Roof System**

To determine the dead weight of a concrete roof system, identify the materials that combine to create the structural plate-like layer of a roof deck and any monolithically connected roof support. As an example, the roof cross-section shown below includes tapered concrete joist support members, monolithically poured with a three inch reinforced concrete deck. A built-up roof covering with gravel is not shown for clarity, because it is likely to be cleaned-off by high winds; therefore, the covering should not be included in the dead-weight calculation. This leaves the poured concrete joists and 3-inch poured deck to contribute to the dead weight that will be resisting wind uplift forces. To determine their combined dead weight, turn to Appendix E of this manual and locate the entry for medium weight structural concrete. Note the weight given is in psf, in this case, approximately 11 psf. Note the weights given in Appendix E are in psf per inch of depth unless otherwise indicated. The poured concrete deck has a weight of 11 psf per inch of depth and, therefore, a dead weight of 33 psf. Calculate the adjusted weight of the joist by following the procedure given below. Sum this adjusted joist weight with the 33 psf weight given the deck, and the total roof weight is 55 psf. As 55 psf is greater than the 50 psf heavyweight roof criteria, the roof is considered heavyweight.

To adjust the weight of the joists to account for spacing, take the average thickness of the joists and multiply by their depth (excluding deck thickness). This gives the cross-sectional area of the joist itself. Divide the area by the center spacing distance of the joists to average the area over the full span; this gives the adjusted depth of concrete for the joists. Multiply the adjusted depth of joist concrete by the weight per inch to calculate the added weight for the roof due to the presence of the joists.

To calculate adjusted weight of concrete joist, use the following formula:

\[
\text{Depth} \times \text{(Avg. Width)} \times \text{weight/inch} = \text{Adjusted Weight}
\]

<table>
<thead>
<tr>
<th>Material</th>
<th>Weight (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built-up Roofing</td>
<td>N/A</td>
</tr>
<tr>
<td>Poured Concrete Deck</td>
<td>33.0 psf</td>
</tr>
<tr>
<td>Poured Concrete Joist</td>
<td>22.0 psf</td>
</tr>
<tr>
<td>Total Dead Weight</td>
<td>55.0 psf</td>
</tr>
</tbody>
</table>

- **Item 11.3** - Hipped roofs are relatively wind-resistant due to their inherent structural reinforcing. Basically this is a roof system with a center ridge and slopes down all four sides.
• **Item 11.4** - Flat roofs are very vulnerable to uplift forces present under hurricane conditions. Such roofs have historically performed poorly under hurricane conditions. ARC 4496 recommends avoiding buildings with flat roofs. A flat roof is one with a roof slope of one degree or less.

![SECTION]

**Wind pressures on flat roof**

Similarly, shallow slope roofs (slopes greater than one degree and less than 11 degrees) are very vulnerable to uplift forces. The steeper the slope, the less uplift force the roof is subjected to.

• **Item 11.5** - Gable-ended - A sloped roof with a ridge and flat, gable ends. Check to ensure that such roofs have "X" bracing in the roof to brace the flat gable ends against wind forces acting directly against them.

![GABLE ROOF]

Two Sloped Sides

**Shed System** - A sloped roof (lean-to appearance) with one side higher than the other.

![SHED ROOF]
• **Item 11.5.1** Gable-ends have proven vulnerable to hurricane winds unless braced to resist the wind loads on the gable ends. Here look for either cross-bracing, truss-bracing, or for masonry gable ends with reinforcements from foundation up through the gable ends to the roof.

Gable End Bracing

- **Item 11.6 -** Buildings with steep-pitched roofs should be preferred for use as an HES, as wind uplift forces are reduced significantly.
  - The term “steep-pitched,” as referred to in ARC 4496, commonly is defined as a roof having a slope of greater than 30 degrees. A roof with this slope will have a downward acting wind force on the windward side of the building instead of an uplift force.
  - A roof with a moderate slope of 11 to 30 degrees has a reduced vulnerability when compared to flat- or low- slope roofs but still has an uplift force on both the windward and leeward sides of the building.
  - The steeper the roof slope of a moderately sloped roof system, the lesser the uplift force.
  - As buildings with moderate sloped roofs are less vulnerable to wind uplift damage than flat- or shallow-sloped roof systems, there may be some flexibility in their use as an HES.
  - Roof slopes can generally be found in roof section drawings. If not, use
the table below to determine roof slopes.

<table>
<thead>
<tr>
<th>Height/Width (ratio)</th>
<th>Slope (degrees)</th>
<th>Pitch (inches height/inches width)</th>
</tr>
</thead>
<tbody>
<tr>
<td>.0208</td>
<td>1</td>
<td>1/4&quot;/12</td>
</tr>
<tr>
<td>.083</td>
<td>5</td>
<td>1/12</td>
</tr>
<tr>
<td>.17</td>
<td>10</td>
<td>2/12</td>
</tr>
<tr>
<td>.25</td>
<td>14</td>
<td>3/12</td>
</tr>
<tr>
<td>.33</td>
<td>18</td>
<td>4/12</td>
</tr>
<tr>
<td>.42</td>
<td>23</td>
<td>5/12</td>
</tr>
<tr>
<td>.5</td>
<td>27</td>
<td>6/12</td>
</tr>
<tr>
<td>.5833</td>
<td>30</td>
<td>7/12</td>
</tr>
</tbody>
</table>

To determine roof slope by field dimensions, measure the height of the roof ridge from the roof trusses' bottom chord. Then measure the length of the bottom chord, including overhang length. Use the following formula to determine the height-to-width ratio (h/w ratio).

\[
\text{Roof Ridge Height, ft} / \text{Bottom Chord Length, ft} / 2 = \text{h/w ratio}
\]

With the h/w ratio calculated, compare the calculated h/w ratio to the standard h/w ratio in the left-hand column above. Note the h/w ratio from the table that most closely matches the calculated value. The roof slope that corresponds to the noted h/w ratio is the approximate roof slope.

- **Item 11.6.1** - Shallow slope roofs are subject to strong uplift forces. The steeper the slope, the less uplift force the roof is subject to.

- **Item 11.7** - A large overhang can act as a wind sail and catch hurricane force winds. This results in additional uplift forces acting on the roof system from below and can severely test the roof to wall/frame connections.
Wind Effects on a Building Overhang

- If construction drawings are available, turn to the roof framing plan. If the building has exterior loadbearing walls, the outline of the walls typically will be shaded gray. The overhang will clearly be present extending beyond the walls’ outer faces.

- For loadbearing frames, the exterior wall may not be present on the drawings. However, support beams or trusses should be indicated, with columns below. Again, the overhang will clearly be present extending beyond the support beam or truss.

- Using a scale, or directly reading the dimension off the drawings, identify the width the overhang extends beyond its support.

- If the overhang’s width dimension varies, note the widest length if it is present for at least 20 percent of a side’s perimeter dimension or if it is located at an outside corner.

- If construction drawings are not available, the overhang’s width can be measured at the site.

- If a roof’s overhang is greater than one foot in width, it will significantly increase uplift forces on the roof.

- If the building was constructed prior to 1987, the building codes and standards did not reflect the amplified uplift pressures that are
present at overhangs.

- Therefore, buildings that are constructed prior to 1987 and have overhangs that exceed one foot should be avoided.

- Buildings constructed after 1987 with overhangs that do not exceed three feet provide for some flexibility.

- Determine if the overhang is an extension of the roof system or is an independent architectural feature. If the overhang structurally is independent of the roof, damage to the overhang will have a negligible impact upon the roof system.

- Check wall sections in the architectural drawings to confirm the overhang’s construction and attachment method to wall, frame and/or roof system. The overhang’s construction materials and connection type should be noted.

- **Item 11.8** - Different roof covering types indicate different vulnerabilities to wind forces and debris impact. Use the technical drawings to determine the covering types, but verify on-site if possible.

- **Item 11.9** - Generally an older roof will be more vulnerable to wind forces. Age can be determined by the technical drawings, but should be verified by the building custodian.

- **Items 11.10-11.10.1** - Mechanical equipment mounted on the roof can be exposed to the strong winds present under hurricane conditions.

  - Air conditioner units and large vents are very vulnerable to damage, unless securely fastened to the roof structure. If torn off these units can cause breaches of the building roof envelope, leading to subsequent interior damage and roof failures.

  - Use the technical drawings to determine if the equipment is attached directly to the supporting frame or roof structure.

  - Verify on-site whether the equipment is currently attached to a frame. It is not uncommon for equipment not to be completely reattached when returned after repairs (i.e., the equipment is simply placed back on the frame without replacing some or all the bolts).
- Items 11.10.2-11.10.3 - Lightweight rooftop structures are very vulnerable to
damage from hurricane force winds and windborne debris impact.

### SECTION 11 - ROOF CONSTRUCTION/ROOF SLOPE

11.1 What is the Roof Construction type of the Building?

- [ ] Cast-in-place Reinforced Concrete
  (standard wgt concrete, 4” min.)
- [ ] Precast Concrete Panels
  ("T’s", "Double T’s", Planks, etc.)
- [ ] Metal Decking w/standard wgt
  concrete (3” min.) on metal joist,
  truss, or beam (spacing: _______)
- [ ] Other Metal Decking Systems
  (insulating concrete and/or rigid
  insulation or other light coverings)
- [ ] Other: ____________________________

- [ ] Plywood on wood or metal
  joist or truss (spacing: _______)
- [ ] Wood boards or T & G deck
  on wood joist or truss (spacing: _______)
- [ ] Fiberboard or Cementitious
  fiber planks on wood or metal joist
  or truss (spacing: _______)
- [ ] Poured Gypsum on Formboard
  Decking on wood or metal
  joist or truss (spacing: _______)

11.1.1 If a Metal Decking System, what is the gage of the metal decking?

- [ ] Thinner than 22 gage (26 gage, etc.)
- [ ] 22 gage or thicker (18 gage, 16 gage, etc.)
- [ ] Not Applicable

<table>
<thead>
<tr>
<th>YES</th>
<th>11.2 Does the building have a heavyweight roof system?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YES</th>
<th>11.3 Does the building have a hipped roof system?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YES</th>
<th>11.4 Does the building have a flat roof system?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

11.5 If not a hipped or flat roof system, what is the roof geometry of the Building?

- [ ] Gable-ended
- [ ] Shed System
- [ ] Other: ____________________________

11.5.1 If Gable-ended, are the gable-ends braced against collapse?  
- [ ] Yes  
- [ ] No  
- [ ] Not Applicable  

If Yes, describe: ____________________________________________

<table>
<thead>
<tr>
<th>YES</th>
<th>11.6 Is the Roof Slope steep-pitched (greater than 30 degrees (7:12))?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

11.6.1 What is the roof pitch?

- [ ] flat slope (0-1 degrees)
- [ ] shallow slope (2-10 degrees)
- [ ] moderate slope (11-29 degrees)
- [ ] steep slope (30+ degrees)
**SECTION 11 - ROOF CONSTRUCTION/ROOF SLOPE**

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.7 What is the width of the roof overhang?</td>
<td>feet</td>
</tr>
<tr>
<td>11.8 What type of roof covering is used?</td>
<td></td>
</tr>
<tr>
<td>- Built-up roofing (✓ with gravel; ☐ without gravel)</td>
<td></td>
</tr>
<tr>
<td>- Single-ply membrane with gravel or pavers</td>
<td></td>
</tr>
<tr>
<td>- Shingles</td>
<td></td>
</tr>
<tr>
<td>- Standing Seam Metal roof</td>
<td></td>
</tr>
<tr>
<td>- Tile Roof</td>
<td></td>
</tr>
<tr>
<td>- Slate Roof</td>
<td></td>
</tr>
<tr>
<td>- Metal Panels</td>
<td></td>
</tr>
<tr>
<td>- Single-Ply membrane mechanically fastened or fully adhered</td>
<td></td>
</tr>
<tr>
<td>- Unknown</td>
<td></td>
</tr>
<tr>
<td>- Other</td>
<td></td>
</tr>
<tr>
<td>11.9 What is the age of the roof covering?</td>
<td></td>
</tr>
<tr>
<td>- Less than 5 years</td>
<td></td>
</tr>
<tr>
<td>- 5-10 years</td>
<td></td>
</tr>
<tr>
<td>- 11-15 years</td>
<td></td>
</tr>
<tr>
<td>- 16-20 years</td>
<td></td>
</tr>
<tr>
<td>- Greater than 20 years</td>
<td></td>
</tr>
<tr>
<td>- Unknown</td>
<td></td>
</tr>
<tr>
<td>11.10 Are there structures on the roof top vulnerable to high wind forces?</td>
<td></td>
</tr>
<tr>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>11.10.1 What mechanical equipment is on the roof (i.e., air conditioners, ventilators, etc.)?</td>
<td></td>
</tr>
<tr>
<td>- air conditioners</td>
<td></td>
</tr>
<tr>
<td>- air handling units</td>
<td></td>
</tr>
<tr>
<td>- large vents</td>
<td></td>
</tr>
<tr>
<td>- Not Applicable</td>
<td></td>
</tr>
<tr>
<td>- Other</td>
<td></td>
</tr>
<tr>
<td>11.10.1.1 Is the mechanical equipment on the roof securely fastened to the roof structure?</td>
<td>Yes  No</td>
</tr>
<tr>
<td>11.10.2 Are there lightly constructed structures or penthouses on the roof?</td>
<td>Yes  No</td>
</tr>
<tr>
<td>Describe:</td>
<td></td>
</tr>
<tr>
<td>11.10.3 Are there any stacks, antennas or lights on the roof?</td>
<td>Yes  No</td>
</tr>
<tr>
<td>Describe:</td>
<td></td>
</tr>
<tr>
<td>11.11 Comments:</td>
<td></td>
</tr>
</tbody>
</table>

4.3.1.10 **Section 12 - Roof Open Span**

- **Item 12.1** - Historically, long open-span roofs have performed poorly in major hurricanes. Such roofs are generally light in weight and, therefore, cannot resist wind uplift forces effectively. Further, these roofs undergo excessive deflections, reverse bending, and vibrations. Inadequately connected roof framing systems may slip from their bearing points or may shear off bearing connections provided on the supporting walls.

- **Item 12.1.1** - The term “long- or open-span roof,” as referred to in ARC 4496,
commonly is defined as an unsupported span of 40 feet or greater.

Not Open Span because the largest span is 30 feet between vertical supports.

Open Span (70 feet between vertical supports)

To determine if a building has a long-span roof, review the construction drawings for the roof framing plan.

- Buildings with a structural frame, columns, and beams typically are laid out in bays. A bay means a space defined either by bearing walls or columns.

- The maximum distance spanned between columns is the length that is compared to the 40-foot long-span criteria; if the maximum span is greater than 39'-11", a long-span condition is present.

- For wallbearing buildings, the loadbearing walls typically will be shaded, indicating a connection and bearing point for the roof support system. Any sheer walls should be considered boundaries.

- Some buildings may be a combination of structural frame and wallbearing systems. The same procedure applies as
described previously.

- If construction drawings are not available, and site inspection is the only available option, care must be taken to identify all loadbearing components.

- It is common for interior partition walls to extend above the ceiling line, but walls will only be nominally attached to roof framing members or deck to provide lateral support for the partition. Roof support members (beams, joists, etc.) also may extend through walls, and the walls sealed around the member with a smoke and fire resistant barrier, but the joists will not be supported by the wall. There must be a bearing plate and/or framed connection to a bearing wall, beam, or column at both ends of the roof support to establish the span distance.

- Measure the distance with a measuring tape, or count ceiling tiles, or other uniformly spaced material to determine the span distance. Then compare the measured distance to the 40-foot span criteria to determine if a long span exists.

- For buildings that have both long-span and short-span areas, the HES evaluator should determine if failure (including catastrophic failure) of the long-span area will impact short-span areas.

- In situations where the long-span area is separated structurally (compartmentalized) by bearing walls, and roof support systems of the long- and short-span areas are independent, the short-span area may comply with ARC 4496.

- Care must be taken to assure that progressive failure, which may be initiated by damage to the long-span roof area, will not significantly increase the risks to persons in the HES area(s).

- Item 12.1.2 - Here list the actual spans and where they are located: “55' span over kitchen,” “65' span over gym area,” etc.

- Item 12.1.3 - Hipped roofs with moderate to steep slopes are inherently more wind resistant than flat roofs and may permit longer spans up to 50 feet. Also, lightweight and medium weight roofs with moderate to steep slopes may permit longer spans up to 50 feet.
Section 12 - Roof Open Span

12.1 Does the building have a long or open roof span?
   (A long or open span is a roof span of greater than 40 feet between vertical supports.)

12.1.1 Is there a span greater than 40 feet between vertical supports? □ YES □ NO

12.1.2 List the areas with span(s) greater than 40 feet: ____________________________

12.1.3 If under a hipped roof system with moderate to steep slope, or a lightweight/medium weight roof system with moderate to steep slopes, is there a span greater than 50 feet between vertical supports?
   □ YES □ NO □ Not Applicable

12.1.3.1 List the areas with span(s) greater than 50 feet: ____________________________

12.1.4 Comments: ____________________________

4.3.1.11 Section 13 - Roof Drainage/Ponding Information

- **Item 13.1** - This is the height of the parapet above the roof. This height impacts roof drainage and to some degree on protection of roof mounted equipment from wind forces. Generally, a parapet wall less than four inches high will not trap enough water on the roof to cause a roof system failure.

- **Item 13.2** - Scuppers serve to supplement roof drains on roofs with parapet walls. An absence of scuppers may indicate a greater vulnerability to roof ponding.

- **Item 13.3 -13.4** - Here you are looking for indications of roof problems. If such problems exist under non-hurricane conditions, then it is reasonable to assume the problems will be exaggerated under hurricane conditions.

Section 13 - Roof Drainage / Ponding Information

13.1 What is the height of the parapet wall around the roof’s perimeter?
   □ Four inches or less □ Greater than four inches □ No parapet wall

13.2 Are there scuppers in all the parapet walls? □ YES □ NO □ Not Applicable

If some but not all walls, describe which walls have scuppers.
### SECTION 13 - ROOF DRAINAGE / PONDING INFORMATION

<table>
<thead>
<tr>
<th>Question</th>
<th>YES</th>
<th>NO</th>
<th>Describe</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.3 Is there evidence of roof covering degradation or interior water damage on the top floor of the building?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.4 Is there evidence of ponding on the roof?</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

13.5 Comments: ______________________

### 4.3.1.12 Section 14 - Interior Safe Space

- **Item 14.1.1** - Provide the actual square footage of the interior corridor/rooms. Obtain from the technical drawings or on-site measurements.

- **Item 14.1.2** - Determine from structural drawings the construction type of the corridor walls. ARC 4496 recommends against using rooms attached to, or immediately adjacent to, unreinforced masonry walls.

- **Item 14.1.3** - Determine this from on-site observation. The information may be available in the technical drawings, but doors may have been changed since the technical drawings were used in a project.

- **Item 14.1.4** - Same as above. Large glass areas in exterior doors can be a softspot and allow access of hurricane force winds into an interior corridor, if breached by windborne debris.

- **Item 14.1.5** - Drawbolts can increase the wind resistance of the exit doors. If some exit doors have them, and others do not, then comment in Item 14.1.8.

- **Item 14.1.6** - Concrete slabs, or metal decking, if properly attached to the corridor walls, can seal off the interior corridor and help provide a "core" area inside a building. Determine this from technical drawings and verify on-site.

- **Item 14.1.7** - If the decking or slab is resting on the interior corridor walls with only grouting as a connection, then mark "Gravity loaded". If anchored or bolted to the interior corridor walls, then "Anchored". If there is no decking or slab, then mark "Not Applicable".
**Items 14.2-14.2.3-** Here identify the actual usable space in the HES building.

### SECTION 14 - INTERIOR SAFE SPACE

<table>
<thead>
<tr>
<th>YES</th>
<th>14.1 Does the building have an interior corridor(s) or interior rooms that could be used as hurricane evacuation shelter space?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

14.1.1 What is the square footage of the interior corridor(s) or interior rooms in the building?

- square feet

14.1.2 What is the Interior Corridor Wall Construction type? *(Check only one)*

- Reinforced Masonry (Rebar @ 4 ft. centers or closer)
- Partial Reinforced Masonry (Rebar @ 8 ft. centers to 4 ft. centers)
- Unreinforced Masonry or Rebar spacings unknown
- Reinforced Concrete or Precast Concrete Panels
- Light Wood or Metal Stud w/ light non-plywood sheathing
- Other: __________________________

- Light Wood or Metal Stud w/ 1/2 inch or thicker plywood
- Partial Reinforced Masonry (Four-bar Pilasters 13 feet on center or less)
- Large Panel Glass or other
- Glazed Panel or Block System
- Metal Sheets or Panels or other
- Light Architectural Panel Systems
- Not Applicable/ No Interior Corridor

14.1.3 What type of door(s) open onto the interior corridor from inside the building?

- Hollow Metal Door, no windows
- Hollow Metal Door, view window
- Metal Door, large window
- Glass Door, metal frame
- Other: __________________________

- Wood Door, no windows
- Wood Door, view window
- Wood Door, large window
- None

14.1.4 What type of door(s) open onto the interior corridor from outside the building?

- Metal Door, no windows
- Metal Door, view window
- Metal Door, large window
- Glass Door, metal frame
- Other: __________________________

- Wood Door, no windows
- Wood Door, view window
- Wood Door, large window
- None

14.1.5 Are there drawbolts on the top and bottom of the interior corridor exit doors? *(YES NO Not Applicable)*
SECTION 14 - INTERIOR SAFE SPACE

14.1.6 What type of ceiling deck or cap is over the interior corridor? (This is not the drop ceiling but a structural decking that seals off the corridor from the roof system)

- Normal-weight Concrete Deck/Slab
- Poured Gypsum Decking
- Metal Decking
- Precast Concrete Slab
- Concrete Tees
- No corridor decking, just drop ceiling and building roof decking above.
- Not Applicable
- Other: __________________________________________

14.1.7 If there is a ceiling deck or cap, how is it connected to the interior corridor walls?

- Gravity loaded
- Anchored
- Not Applicable
- Other: __________________________________________

14.1.8 Comments: __________________________________________

14.2 What is the total floor (footprint) area of the building? ___________________________ square feet

14.2.1 What is the total floor area available (in the building) for use as shelter area (exclude interior corridors)?

(This is the total square footage of those rooms or areas to be used as shelter areas

As-Is: __________ square feet

Additional Area After Minor Retrofit: __________ square feet

Additional Area After Major Retrofit: __________ square feet

14.2.2 Excluding walking area and areas with immovable furniture, how much of the shelter floor area is actually usable for personal shelter space? (Note: show shelter space on building sketch maps)

__________________________ square feet

14.2.3 Comments: __________________________________________

4.3.1.13 Section 15 - Life Safety/ Emergency Power

- **Item 15.1** - ARC 4496 guidelines state: "Buildings must be in compliance with all local building and fire codes." Check with local building officials and determine if there are any known life safety/fire code violations in the specified building. If possible have a life safety/fire code inspection done on the potential HES building.

- **Items 15.2-15.2.14** - Address the potential for emergency power at the site. Commercial electrical power is often disrupted, sometimes
for extended periods, during hurricanes.

**SECTION 15 - LIFE SAFETY/EMERGENCY POWER**

<table>
<thead>
<tr>
<th>YES</th>
<th>15.1 At the time of the survey, is the building known to be noncompliant with any life safety or fire codes?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td></td>
</tr>
</tbody>
</table>

15.1.1 If yes, describe area(s) of non-compliance: ________________________________________________

<table>
<thead>
<tr>
<th>YES</th>
<th>15.2 Is there a survivable on-site emergency power system?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

15.2.1 Is there an emergency power supply generator on-site? ☐ YES ☐ NO  (If No, go to section 15.2.13)

15.2.2 If yes, what are its ratings? ☐ Not Applicable

☐ KW, ☐ Amperes, ☐ / ☐ Volts; ☐ Single Phase ☐ Three Phase

☐ Three-Wire ☐ Four-Wire Configuration; Brand Name: __________________________________________

15.2.3 Is the generator storm hazard protected? ☐ YES ☐ NO ☐ Not Applicable

Describe: ______________________________________________________________________________

15.2.4 Is the generator securely anchored? ☐ YES ☐ NO ☐ Portable Generator ☐ Not Applicable

Describe: ______________________________________________________________________________

15.2.5 Is the generator regularly maintained? ☐ YES ☐ NO ☐ Unknown ☐ Not Applicable

Describe: ______________________________________________________________________________

15.2.6 What is the fuel type of the generator? ☐ Not Applicable ☐ Gasoline ☐ Diesel ☐ LP

☐ Natural Gas ☐ Other: __________________________________________________________________

15.2.7 What is the on-site fuel storage capacity (size of tank)? ___________ gallons; ☐ Not Applicable

15.2.8 What is the type of fuel tank? ☐ Not Applicable ☐ Above ground ☐ Below ground

☐ Portable ☐ Anchored/Fixed ☐ Heavy Steel ☐ Concrete ☐ Lightweight metal

☐ Other: ________________________________________________________________________________

15.2.9 Is the fuel tank storm hazard protected? ☐ YES ☐ NO ☐ Not Applicable

Describe: ______________________________________________________________________________

15.2.10 What building(s) are connected to the emergency power generator system? ☐ Not Applicable

☐ All on-site ☐ Specify: __________________________________________________________________

---

4-51 October 1997
4.3.2 Confirm Pre-Survey Data

- In those cases where some information was provided from other sources (i.e., Part One of the survey checklist), the surveyor/local emergency management agency should verify the data provided. This is especially true in the cases of Storm Surge Inundation (Section 1) and Rainfall Flooding/Dam Consideration (Section 2). In the case of Hazmat & Nuclear Power Plant Considerations (Section 3), most surveyors/local emergency management agencies will need to rely on the expertise of local hazmat experts but at least a quick check of the pertinent 302/312 hazardous material facilities reports is recommended.

- In the case of Storm Surge Inundation and Rainfall Flooding/Dam Consideration, it is recommended that photocopied pages of the pertinent Surge Atlas plate and FIRM map panel, with the location of the HES building clearly marked, be attached to the survey checklist. Be sure that the identification of the Surge Atlas plate and FIRM map shows clearly on the photocopied page. This will simplify verification and provide supporting documentation if needed.

- Regarding the Hazmat & Nuclear Power Plant Considerations, a quick check of the pertinent 302/312 hazardous material facilities reports should show if any known vulnerability zones intersect the HES building location. Also, any potential hazmat facilities in or around the building that are spotted during the site visit should be noted. In both these cases, the potential threat to the HES building should be evaluated specifically by the
local hazmat experts and addressed in the pertinent survey checklist/LRDM table. If there is any question about a threat presented by a hazardous material facility to the HES, have the local hazmat experts address it specifically in writing.

- For verification procedures see Chapter III, Items 3.4.1 - 3.4.4