

(Revision, 5/9/2003) State of Florida (Revision, 5/9/2003
Least-Risk Decision Making:
ARC 4496 Hurricane Evacuation Shelter Guidance Summary (“Cheat Sheet”)

Criteria	Revised Rankings		
	Preferred	Less Preferred/ Marginal	Further Investigation / Mitigation Required
1. Storm Surge Inundation	<ul style="list-style-type: none"> - Building is located outside of Category 5 hurricane evacuation zone - Building is not subject to isolation due to Category 5 surge inundation 	<ul style="list-style-type: none"> - Building is located outside of Category 4 hurricane evacuation zone, but inside of areas subject to potential inundation by a Category 5 surge event - Shelter floor is potentially subject to Category 5 surge inundation of up to one (1) foot - Building is subject to isolation due to Category 5 surge inundation 	<ul style="list-style-type: none"> - Building is located inside of Category 4 hurricane evacuation zone, and subject to inundation from a Category 4-5 storm surge event - Shelter floor is potentially subject to Category 5 surge inundation in excess of one (1) foot - Avoid basements if there is any chance of flooding - Avoid buildings located on coastal barrier islands
2. Rainfall Flooding / Dam Safety	<ul style="list-style-type: none"> - Building is located outside of 500-year floodplain - FIRM Zone C or X (unshaded) - Building is not subject to isolation due to 500-year flood event - Building is not subject to flooding or isolation due to dam or reservoir containment failure 	<ul style="list-style-type: none"> - Building is located within the 100-year floodplain, and first floor elevation is at or above BFE - Shelter floor is at or above the BFE - FIRM Zone A, B, or X (shaded) - Building is subject to isolation due to 100-year flood event - Building is subject to still-water flooding of up to one (1) foot, or isolation due to dam or reservoir containment failure 	<ul style="list-style-type: none"> - Building is located within the 100-year floodplain; first floor elevation is below BFE - Shelter floor is below the BFE - FIRM Zones V and AH - Avoid basements if there is any chance of flooding - Building is subject to velocity flooding and/or higher than one (1) foot still-water inundation due to dam or reservoir containment failure
3. Hazmat and Nuclear	<ul style="list-style-type: none"> - Building that does not store certain 	<ul style="list-style-type: none"> - Building that stores certain reportable 	<ul style="list-style-type: none"> - Building that stores certain reportable

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<p>Power Plant Considerations</p> <p>* Always coordinate level of risk from hazmat site to shelter with LEPC and local Emergency Management</p>	<p>reportable types or quantities of hazardous materials</p> <ul style="list-style-type: none"> - Building that is not located within a precautionary zone for facilities that manufacture, use or store hazardous materials - Building is not located within the ten-mile emergency planning zone (EPZ) of a nuclear power plant 	<p>types or quantities of hazardous materials, or</p> <ul style="list-style-type: none"> - Building that is located within a precautionary zone for facilities that manufacture, use or store hazardous materials, and -the hazardous materials facility has been reviewed by LEPC & EM and precautions deemed adequate. - Building is located within the ten-mile emergency planning zone (EPZ) of a nuclear power plant but mitigating procedures have been implemented. per LEPC and local EM. 	<p>types or quantities of hazardous materials, or</p> <ul style="list-style-type: none"> - Building that is located within a precautionary zone for facilities that manufacture, use or store hazardous materials, and -the hazardous materials facility has not been reviewed by LEPC & EM or has been reviewed and precautions deemed inadequate. - Building is located within the ten-mile emergency planning zone (EPZ) of a nuclear power plant, but no mitigating procedures per LEPC and local EM.
<p>4. Lay-down Hazard Exposure</p>	<ul style="list-style-type: none"> - Buildings not exposed to very large/heavy trees or structures that could cause destructive collapse or lay-down impact damage (i.e., envelope breach) - Buildings whose access routes are not tree-lined 	<ul style="list-style-type: none"> - Buildings exposed to very large/heavy trees or structures that could collapse or lay-down and cause minor impact damage, but not considered sufficient to cause significant envelope breach - Buildings whose access routes are tree-lined, and appropriate mitigative measures available (e.g., isolation plan in-place, road debris clearance plan in-place) 	<ul style="list-style-type: none"> - Buildings exposed to very large/heavy trees or structures that could cause destructive collapse or lay-down impact damage, sufficient to cause significant envelope breach and/or crushing injuries to shelter occupants, and problem not mitigated - Buildings whose access routes are tree-lined, but not mitigated.
<p>5. Wind and Debris Exposure</p> <p>Note: If a source of heavy/massive</p>	<ul style="list-style-type: none"> - Buildings located in areas that are sheltered/protected from strong winds - Urban and suburban areas, wooded 	<ul style="list-style-type: none"> - Buildings located in areas subject to strong over-land/ non-coastal wind effects 	<ul style="list-style-type: none"> - Buildings located in areas subject to strong coastal wind effects - Relatively flat, unobstructed areas

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windborne or falling debris is present, recommend roof and walls be constructed of top & bottom layered reinforced 8 inch or thicker cast-in-place concrete	<p>areas, or other terrain with numerous closely spaced obstructions having the size of single family dwellings or larger</p> <ul style="list-style-type: none"> - Building surroundings can be described as ASCE 7 Exposures A and B - Buildings located more than one (1) mile from a hurricane coastline - No significant sources of small, large, very large/ heavy, roll-over, and/or falling debris sources are within 300 feet of shelter building's perimeter 	<ul style="list-style-type: none"> - Relatively flat open terrain with scattered obstructions having heights generally less than 30 feet above grade for a distance of at least a quarter mile (1,500 feet) - Building surroundings can be described as ASCE 7 Exposure C - Significant sources of small and large debris are present within 300 feet, and/or very large/heavy, roll-over, or falling debris sources are within 100 feet of shelter building's perimeter, but with mitigating factor(s) 	<p>exposed to wind flowing over hurricane coastal shoreline, and/or open water for a distance of at least one (1) mile</p> <ul style="list-style-type: none"> - Building surroundings can be described as ASCE 7 Exposures C and D - Buildings located within one (1) mile of hurricane coastline - Significant sources of small and large debris within 300 feet, and/or very large/heavy, roll-over, or falling debris sources are present within 100 feet of shelter building's perimeter, and with no mitigating factor(s)
6. Wind Design	<ul style="list-style-type: none"> - Certification by a structural engineer to be capable of withstanding wind loads according to ASCE 7 or ANSI A58.1-82 	<ul style="list-style-type: none"> - Engineered structure designed and constructed to SBC or similar wind load criteria; meets other established hurricane shelter safety criteria prescribed in ARC 4496, Rev. January 2002 	<p>Non-engineered or partially engineered structures</p> <p>Pre-1960 construction</p>
<p>7. Construction Type / Definable Continuous Loadpath</p> <p>Note: Unless otherwise indicated, assume masonry wall systems are 8 inch nominal thickness hollow concrete masonry units (CMU) with</p>	<ul style="list-style-type: none"> - Heavy steel or reinforced concrete skeletal frame buildings - 8+ inch reinforced masonry (typical max. vert. rebar spaced @ 4 feet o.c. or less) or cast-in-place reinforced concrete (typical rebar spacing is 18" o.c. or less each way) wall-bearing 	<ul style="list-style-type: none"> - Light steel or glulam wood skeletal frame building - Post-1988 Pre-engineered Metal Buildings designed and constructed to non-ASCE 7 wind criteria, such as, MBMA standards or SBC; bracing present in both wall and roof planes 	<ul style="list-style-type: none"> - All partially engineered (a.k.a., marginally engineered) or non-engineered structures; example: light steel frame w/ unreinforced masonry infill walls - 8 inch unreinforced masonry wall-bearing buildings (typical max. vert. rebar spaced @ 9 feet o.c. or greater, or tie-column and

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running bond, type M or S mortar, and continuous horizontal joint reinforcement spaced every 16 inches vertically; intermediate bondbeam(s) recommended for walls that are 13.5 feet in height or greater; stack bond rebar spacings are half those of running bond	<p>building</p> <ul style="list-style-type: none"> - Certified buildings that do not exceed 60 feet in height above grade -Pre-engineered Metal Building Hybrids certified to ASCE 7 wind design criteria. 	<ul style="list-style-type: none"> - 8 inch partially reinforced masonry (typical max. vert. rebar spaced up to @ 8 feet o.c.), or 12-inch partially reinforced masonry (typical max. vert. Rebar spaced up to 11 feet o.c.) or precast reinforced concrete panel wall-bearing building - Certified buildings that do exceed 60 feet in height above grade - Masonry wall-bearing systems equivalent to partially reinforced masonry (for 8" CMU with typical tie-column and tie-beam spacing no greater than 13.5 feet o.c. or 12" CMU with typical spacila up to 16 feet o.c.) - Engineered light wood or metal-stud wallbearing building 	<p>tie-beam spacing greater than 14 feet o.c.)</p> <ul style="list-style-type: none"> - Partially engineered or non-engineered light wood or metal-stud wall-bearing building - Uncertified high-rise buildings that exceed 60 feet in height above grade - Uncertified Pre-1988 Pre-engineered Metal Building
8. Building Condition / Wind Damage History	<ul style="list-style-type: none"> - Building is in good condition with no observable or known structural or cladding deterioration - Building or interior shelter core area (if applicable) is approximately as sound as it was when new 	<ul style="list-style-type: none"> - Building or interior shelter core area (if applicable) has minor structural and/or cladding deterioration; deterioration does not appear to significantly jeopardize wind-resistance 	<ul style="list-style-type: none"> - Building or interior shelter core area (if applicable) has major deterioration of structural and/or cladding components and assemblies; deterioration appears to significantly jeopardize wind-resistance
9. Exterior Wall Construction * - 8 inch high bondbeams are not	<ul style="list-style-type: none"> - 4+ inches of reinforced concrete (rebar spacing is 12 inches o.c. or less) 	<ul style="list-style-type: none"> - Wall construction assemblies “deemed to comply” with FBC (ref: s. 1626.4) 	<ul style="list-style-type: none"> - Wall construction assemblies that do not meet “deemed to comply” criteria of FBC (ref: s. 1626.4)

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<p>recommended for reinforcement spacings that exceed six (6) feet o.c.; 12+ inch bondbeams are acceptable</p> <p>Note: Unless otherwise indicated, assume masonry wall systems are 8 inch nominal thickness hollow concrete masonry units (CMU) with running bond, type M or S mortar, and continuous horizontal joint reinforcement spaced every 16 inches vertically; intermediate bondbeam(s) recommended for walls that are 13.5 feet in height or greater; stack bond spacings are half those of running bond</p>	<ul style="list-style-type: none"> - 8+ inch reinforced masonry (typical max. vert. rebar spaced @ 4 feet o.c.) w/ masonry or stucco veneer (anchored @ 24" o.c. max. each way) - 20 gauge or thicker metal wall panels w/ no veneer - 22 to 24 gauge metal wall panels w/ masonry or stucco veneer (anchored @ 24" o.c. max. each way) - Less than 1% of any exterior wall area is softspot; no direct exposure to shelter area(s) 	<ul style="list-style-type: none"> - 5/8 inch or thicker CD grade plywood w/ masonry or stucco veneer (anchored @ 24" o.c. max. each way) - 2 inches of reinforced concrete (rebar spacing is 18 inches o.c. or less, or wire-welded mesh reinforced) - 8+ inch partially reinforced masonry (typical max. vert. rebar spaced @ 8* feet o.c.) with or without veneer - 8 inch masonry wall systems equivalent to partially reinforced masonry: typical tie-column and tie-beam spacing no greater than 13.5* feet o.c.), 12-inch CMU tie-column and tie-beam spacing up to 16 feet o.c.: with or without veneer -2 wythe 4-inch brick cavity walls up to 10 feet between vertical rebars and up to about 13 feet between horizontal bond beams. -22- 24 gauge metal wall panels w/ no veneer (*check impact testing for 24 gauge) - 2 to 5% of any exterior wall area softspot; no direct exposure to shelter area(s) - 5/8 inch or thicker CD grade 	<ul style="list-style-type: none"> - Wall systems that, at a minimum, do not meet "marginal ranking" - 26 gauge or thinner metal wall panels w/ no impact resistant veneer - EIFS wall system on substrate other than reinforced masonry or concrete, or 5/8"+ plywood - Gypsum wall board sheathing over metal or wood studs, with or without brick or stucco veneer - 8 inch masonry tie-beam and tie-column wall systems that exceed 14 feet o.c. spacings - 6+ % exterior wall area is comprised of softspot, or direct exposure of softspot to shelter area(s)

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		plywood w/ masonry or stucco (with metal lathe) veneer (anchored @ 24" o.c. max. each way)	
10. Fenestrations / Window Protection	<p>-- Testing Protocols (must pass one or more of the following): SBCCI SSTD 12; ASTM E 1886 & ASTM E 1996; and/or SFBC 201, 202 & 203 (<i>Protected window and door assemblies must meet high wind missile testing protocols: 9 lb 2x4 wood plank striking on-end at 34 mph</i>)</p> <p>- Less than 1% of any exterior wall area comprised of unprotected glass; no direct exposure to shelter area(s)</p>	<p>- Protected window and door assemblies that can not be certified to meet high wind missile testing protocols, but will provide effective barrier to envelope breach effects</p> <p>- 5/8"+ thick CD grade plywood (shutters) with adequate sub-framing and anchorage</p> <p>- 2 to 5% of any exterior wall area comprised of unprotected glass; no direct exposure to shelter area(s)</p>	<p>- Unprotected window and door assemblies, or "protective" assemblies that can not be certified to meet high wind missile testing protocols and will not provide an effective barrier to envelope breach effects</p> <p>- 6+ % exterior wall area comprised of unprotected glass, or unprotected glass with direct exposure to shelter area(s)</p>
11. Roof Construction / Roof Slope	<p>- Building with a heavy concrete roof system; assume a self-weight greater than 50 psf</p> <p>- 4+ inches of reinforced concrete (rebar spacing is 12 inches o.c. or less, or wire-welded mesh reinforced on 22 gauge or thicker metal deck)</p> <p>- Light or moderate weight roof deck</p>	<p>- 3 inches (+/-) of reinforced concrete (rebar spacing is 18 inches o.c. or less, or wire-welded mesh reinforced on 22 gauge or thicker metal deck)</p> <p>- Light or moderate weight roof deck with a flat or moderate roof slope less than 30° (2/12-7/12 pitch)</p> <p>- Braced gable-end roof or hipped roof</p>	<p>- Roof systems with unverifiable or inadequate loadpath connections</p> <p>- Unbraced gable-end roof geometry</p> <p>- Non-metal or non-wood deck assemblies***</p> <p>- Uncertified roof eave or overhangs that extend more than 2 feet from exterior envelope cladding</p>

** - Per ASCE 7-98, section 6.2, the area of potential roof openings must not exceed 1% of the shortest length wall face's area. This only applies to the story immediately below the roof.

*** - Fiber-based formboard, insulation or cementitious panels; typically

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<p>installed in bulb-tee subframing.</p> <p>Note: If a source of heavy/massive windborne or falling debris is present, FEMA 361 recommends roof and walls be constructed of top & bottom layered reinforced 8 inch or thicker cast-in-place concrete.</p>	<p>with a steep roof slope greater than 30° (7/12 pitch) and hipped geometry</p> <ul style="list-style-type: none"> - Certified roof eave or overhangs that do not extend more than 2 feet from exterior envelope cladding - Structural 20 gauge or thicker metal deck - No unanchored roof appendages - Negligible breach potential, less than 1% ** 	<p>geometry</p> <ul style="list-style-type: none"> - Roof assemblies "deemed to comply" with FBC (ref: s. 1626.4); e.g., 2 inches of reinforced concrete, 5/8" CD plywood sheathing, etc. - 5/8" CD plywood sheathing w/impact resistant veneer - Certified roof eaves or overhangs that do extend more than 2 feet from exterior envelope cladding - Structural 22-24 gauge metal deck, or structural 26 gauge w/ structural fill - Lightweight unanchored roof appendages present - Moderate breach potential, 2-5% ** - Uncertified roof eave or overhangs that do not extend more than 2 feet from exterior envelope cladding 	<ul style="list-style-type: none"> - Structural 26 gauge or thinner metal deck w/o structural concrete fill - Heavyweight Unanchored roof appendages - Significant breach potential (6+ %**)
12. Roof Open Span	<ul style="list-style-type: none"> - Building with a max span of 40 feet or less 	<ul style="list-style-type: none"> - ASCE 7 certified building with a span longer than 40 feet 	<ul style="list-style-type: none"> - Uncertified building with a span longer than 40 feet
13. Roof Drainage / Ponding	<ul style="list-style-type: none"> - See ASCE 7-98, section 8.2 & FBC, s. 1503.4; 100-year, 1-hour rainfall rate 	<ul style="list-style-type: none"> - Building with roof drainage confining parapet walls or curbs; flow capacity of overflow scuppers is not less than 	<ul style="list-style-type: none"> - Building with roof drainage confining parapet walls or curbs; unknown flow capacity, or flow capacity of overflow

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<p>Note: 100-year, 1-hour rainfall rate per Figure 1106.1, FBC Plumbing indicates approx. 4.4 to 5.0” per hour for Florida</p>	<ul style="list-style-type: none"> - Building with no roof drainage confining parapet walls or curbs - No evidence of ponding that exceeds 2 inches in accumulation 	<ul style="list-style-type: none"> primary drains, and/or mitigating factor(s) present - No evidence of ponding that exceeds 5 inches in accumulation 	<ul style="list-style-type: none"> scuppers is less than primary drains - Evidence of ponding that exceeds 5 inches in accumulation
<p>14. Interior Safe Space</p> <p>Note: An interior safe space/core area is not required if the proposed hurricane shelter building, as a whole or in part, meets ARC 4496 guidelines/ standards</p>	<ul style="list-style-type: none"> - Interior safe space must independently meet ARC 4496 guidelines - At a minimum, all “preferred” criteria apply - Example: 8+ inch reinforced masonry or 4+ inch reinforced concrete perimeter wall panels with cast-in-place 4+ inch reinforced concrete roof/ceiling slab; windows and doors meet high wind debris impact resistance requirements - Structural separation from surrounding building(s) is required (i.e., expansion, control or slip-joints) -In the case where the surrounding building meets ARC 4496- this is not applicable. 	<ul style="list-style-type: none"> - Interior safe space must independently meet ARC 4496 guidelines - At a minimum, all criteria ranked as “marginal” apply - Example: 8+ inch partially reinforced masonry (vert. rebar @ 8 feet o.c., or tie-column & beam @ 13.5 feet o.c.) or 2+ inch reinforced concrete panel perimeter walls with cast-in-place 2+ inch reinforced concrete roof/ceiling slab or min. 24 gauge metal deck (or concrete & metal decks combined); no windows or doors w/ glass with direct exposure to shelter space - Roof of shelter framed separately from surrounding building, but complete structural separation not required -In the case where the surrounding building meets ARC 4496- this is not applicable. 	<p>In the case where the surrounding building does not meet ARC 4496, and the interior safe space (i.e. corridor) does not meet ARC 4496- specify why it does not.</p> <ul style="list-style-type: none"> - Interior spaces that can not independently meet ARC 4496 guidelines - Unreinforced masonry walls - Gypsum wall board on metal or wood stud walls - Windows or doors present w/ glass (larger than a small view window) with direct exposure to shelter space(s) - Significant very large/heavy or falling debris, lay-down, and/or structural collapse hazards - Roof/ceiling of interior space is not framed separately from surrounding building (i.e., roof support members are continuous through or over interior space

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			partitions -In the case where the surrounding building meets ARC 4496- this is not applicable.
15. Life Safety / Emergency Power	<ul style="list-style-type: none"> - Building must be in compliance with all local building and fire codes - Building and/or hurricane shelter space(s) with an emergency back-up generator capable of supporting critical fire and life-safety systems, ventilation systems, adequate shelter lighting and special needs requirements - Generator must be independent of off-site utilities/ infrastructure (e.g., water, fuel, etc.), with a minimum of 24-hour on-site fuel supply (72 hours recommended) - Generator and ancillary equipment must be adequately protected from major hurricane effects 	<ul style="list-style-type: none"> - Building must be in compliance with all local building and fire codes - No provision for emergency back-up power - Or, generator present but dependent upon one or more off-site utilities/ infrastructure (e.g., water, fuel, etc.), or generator and ancillary equipment are not adequately protected from major hurricane effects 	<ul style="list-style-type: none"> - Building that is not in compliance with all local building and fire codes
Notes:			