

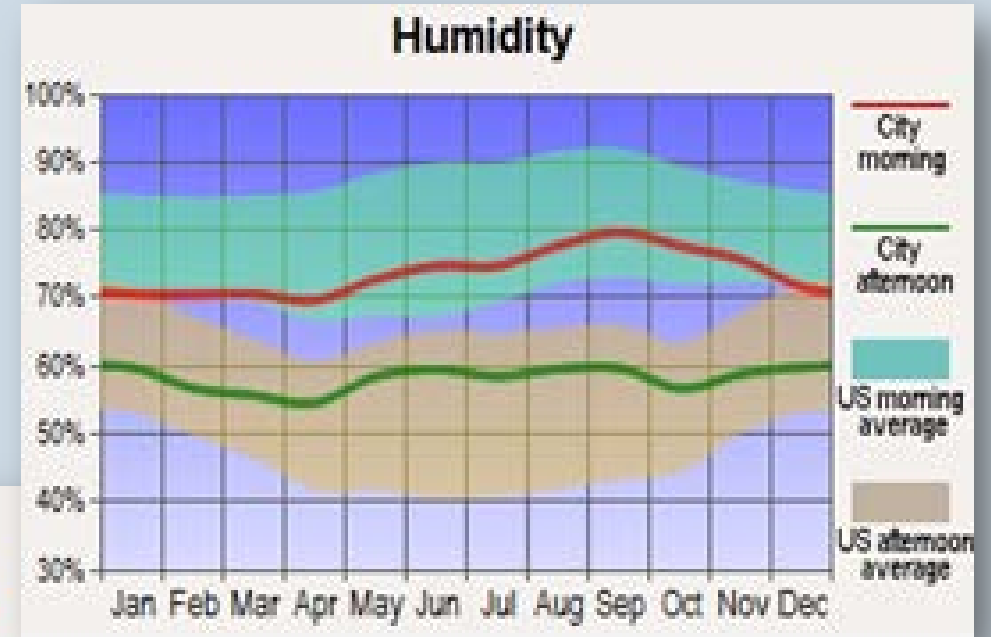
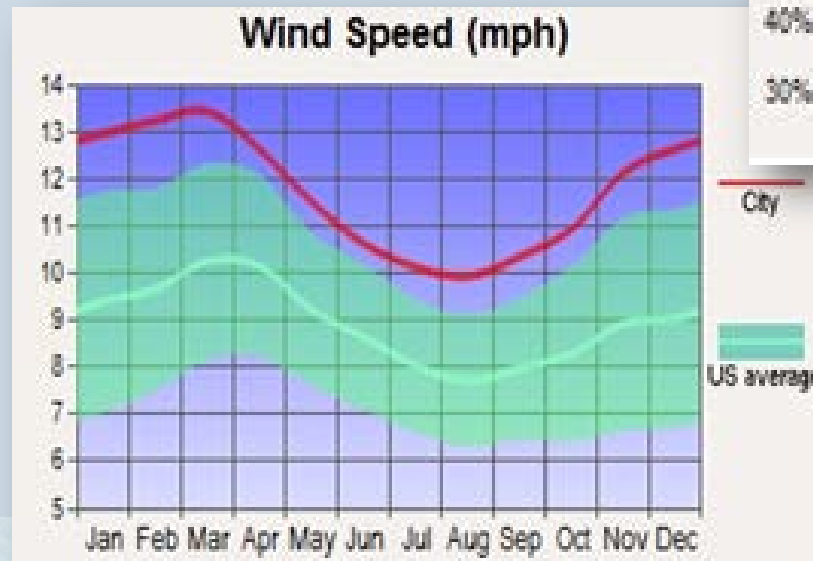
# Project 2: Housing Recommendations for Resiliency

Prepared by:  
**John Kuhlwilm, Steven Chiocchio**  
**Michael McGrath, Helenge Beato**  
**Mercy Cleto, Serah Ally**



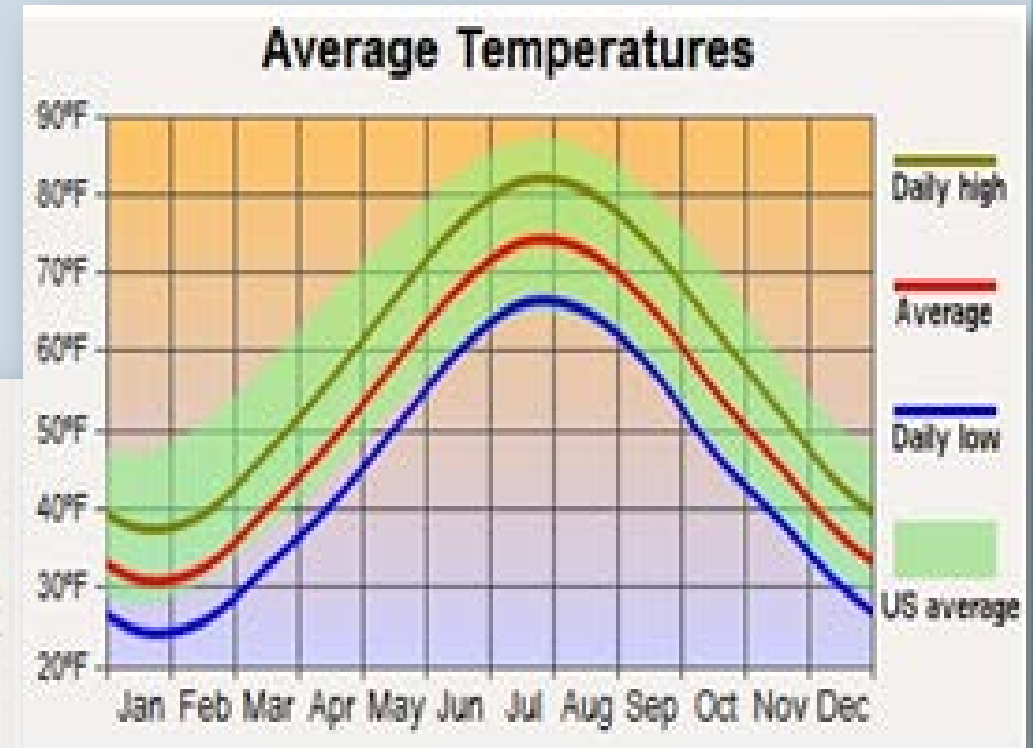
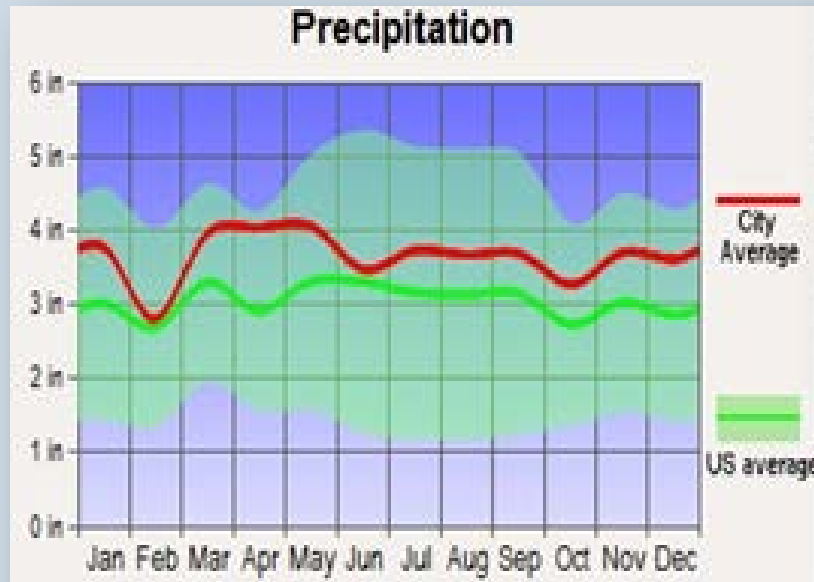
# Environmental Key Issues

- Very High Flood Risk.
- Very High Surge Risk.
- Very High Wind Speeds.
- The site is located in Flood Zone AE.



# Environmental Key Issues

- Snowfall is about 27 inches a year
- Rainfall is about 42 inches a year
- The highest temperature is reached in July.
- The lowest temperature is reached in January.



# List of Recommendations Based on ASTM UNIFORMAT II

Foundation	<ul style="list-style-type: none"><li>• Elevate low-rise building</li><li>• Improve Site Drainage</li></ul>
Electrical	<ul style="list-style-type: none"><li>• Electrical Service and Distribution</li></ul>
Plumbing	<ul style="list-style-type: none"><li>• Sanitary Waste and Prevent Wall Penetrations</li></ul>
Exterior Closure	<ul style="list-style-type: none"><li>• Storm Shutter</li></ul>
Energy Efficiency	<ul style="list-style-type: none"><li>• Use a Correct Insulation</li></ul>
Fire Protection	<ul style="list-style-type: none"><li>• Increase Home's Fire Rating</li></ul>
Roofing	<ul style="list-style-type: none"><li>• Hurricane Straps</li></ul>
Exterior and Interior Finishes	<ul style="list-style-type: none"><li>• Flood-Damage Resistant Materials</li></ul>

# Recommendation 1

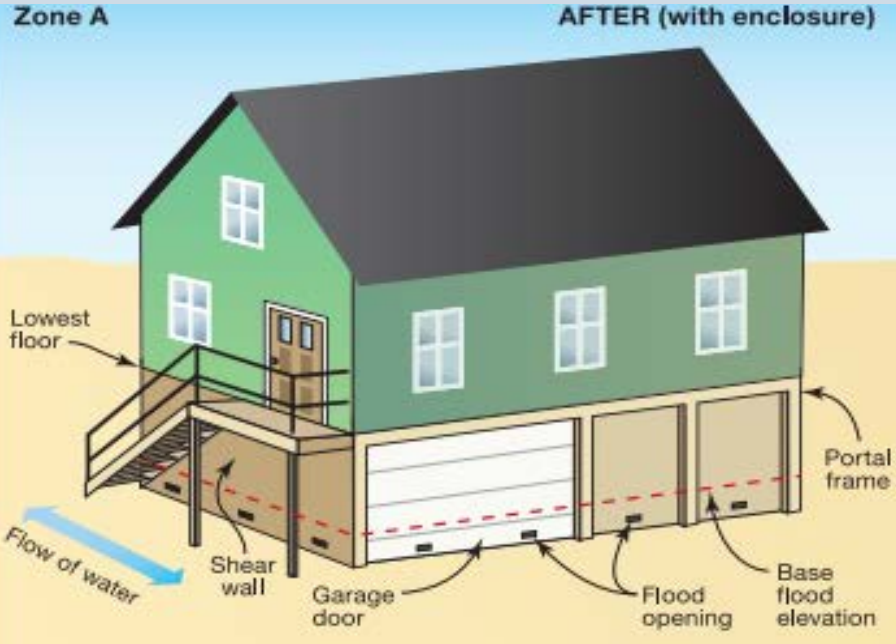
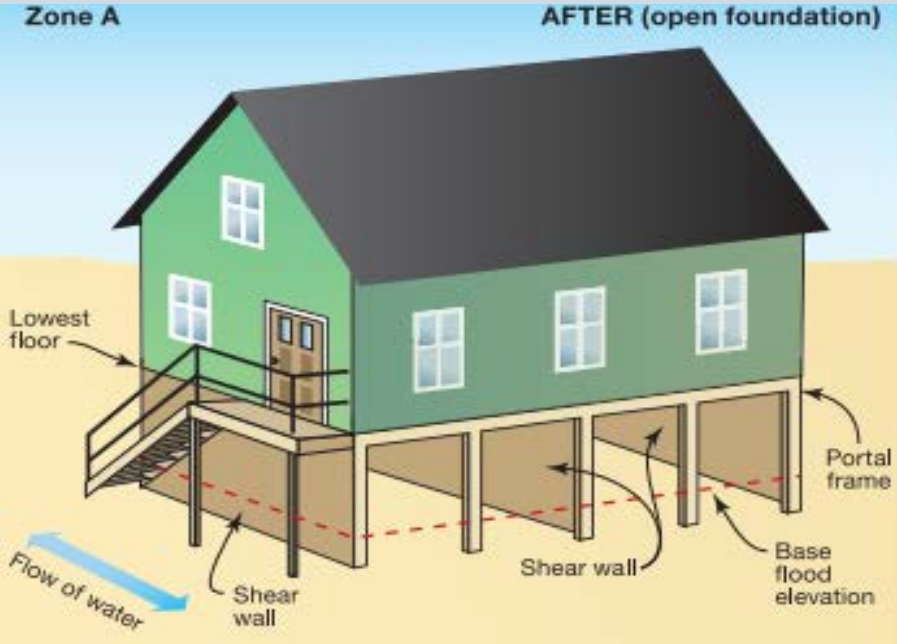
## Elevate existing low-rise building

Table 1 . Foundation Styles in Coastal Areas

Foundation Style	Zone V	Coastal A Zone (LIMWA)	Zone A
Open/deep	Acceptable	Acceptable	Acceptable
Open/shallow	Not permitted	Acceptable <sup>(a)</sup>	Acceptable
Closed/shallow	Not permitted	Not recommended	Acceptable
Closed/deep	Not permitted	Not recommended	Acceptable

### Open Foundation:

- allows water to pass through the foundation of an elevated building.
- reducing the lateral flood loads the foundation must resist.
- less susceptible than closed foundations to damage from flood-borne.



# Recommendation 2

## Improve Site Drainage

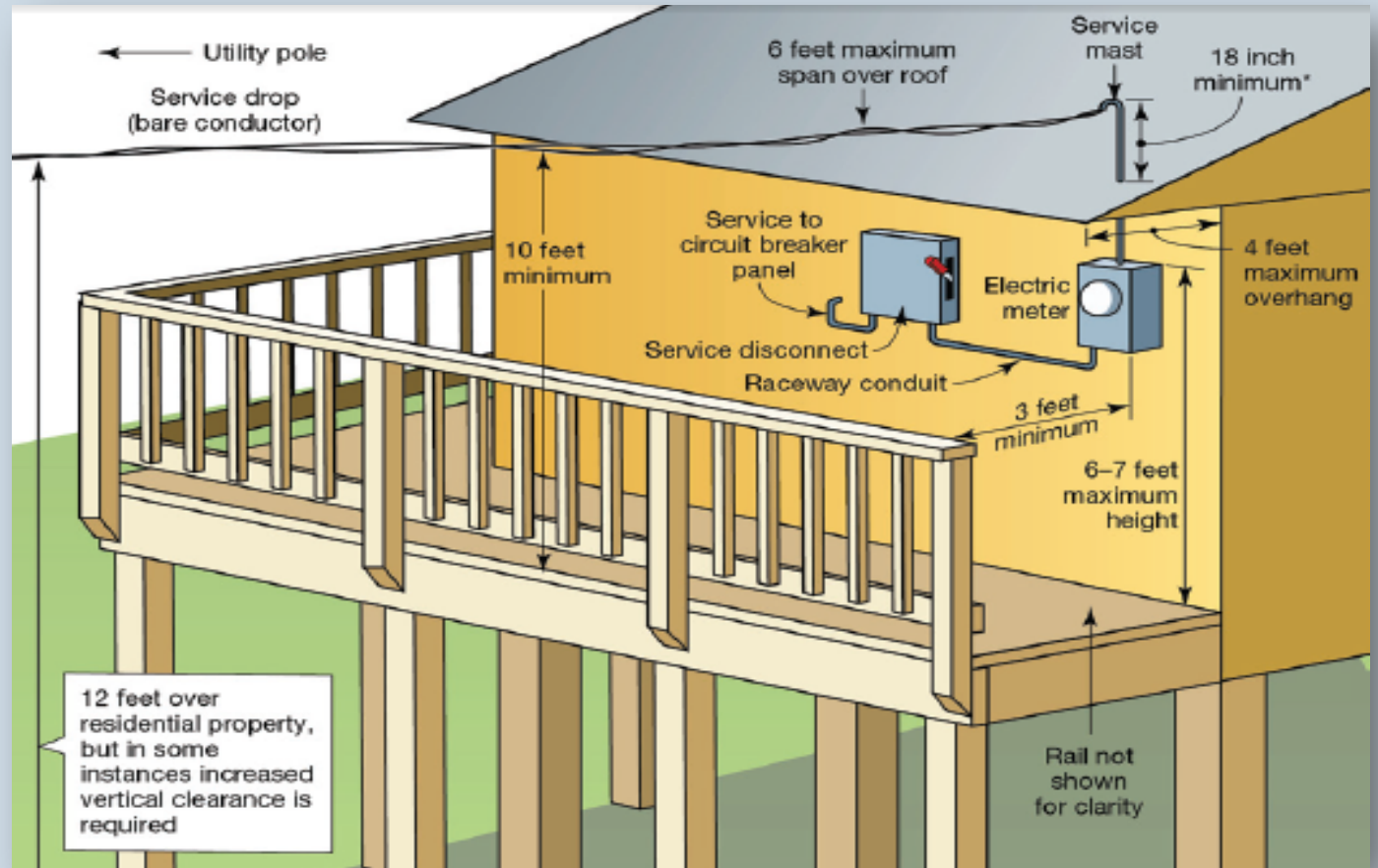
**Table 2 . Considerations for Using Drainage Improvement**

<b>Advantages</b>	<b>Disadvantages</b>
<ul style="list-style-type: none"><li>▪ Can increase a stream's carrying capacity through overflow channels, channel straightening, restrictive crossing replacements, or rainfall/runoff storage.</li><li>▪ Minor projects may be fundable under FEMA mitigation grant programs.</li></ul>	<ul style="list-style-type: none"><li>▪ May help one area but create new problems upstream or downstream of the proposed improvements.</li><li>▪ Channel straightening increases the capacity to accumulate and carry sediment, thereby potentially adversely affecting the surrounding areas and the stream system's equilibrium.</li><li>▪ There can be difficulty in setting culverts of a sufficient size in a stream to convey the 100-year flood discharge, unless weir flow over the road surface is considered.</li></ul>

# Recommendation 3

## Electrical Recommendation

The NEC prevents contact with conductors and energized lines. All of these clearance requirements must be maintained when elevated above the flooding elevation.





## Recommendation 3

### Electrical Recommendation

- Main circuit breaker that is mounted with electrical service panel board is most commonly used to disconnect the service.
- Separate enclosed circuit breakers or separate fused disconnect switches mounted between the electrical meters and the electrical panel board.



# Recommendation 4 Plumbing Recommendation

There are two ways of preventing or eliminating these hazards.

- Prevent sewage back.
- Prevent physical damage to system components.



# Recommendation 5

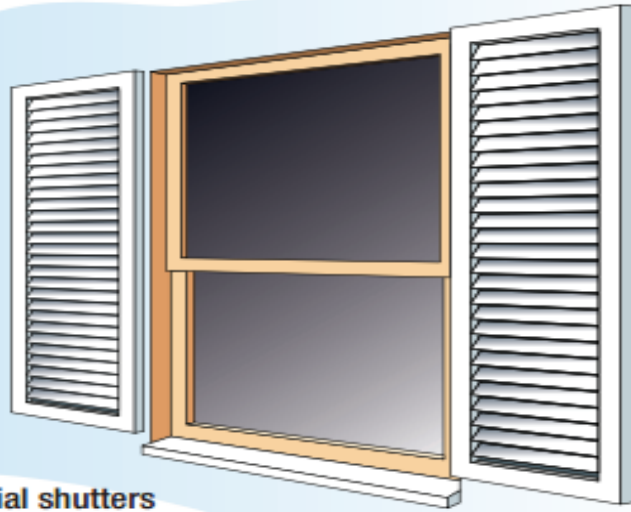
## Storm Shutters

### Shutter Type Cost Advantages

Shutter Type	Cost	Advantages	Disadvantages
Wood structural panels	Low	Inexpensive	Must be installed and taken down every time they are needed; must be adequately anchored to prevent blow-off; difficult to install on upper levels; storage space is needed.
Metal or polycarbonate panels	Low/ Medium	Easily installed on lower levels	Must be installed and taken down every time they are needed; difficult to install on upper levels; storage space is needed.
Accordion, manual closing	Medium/ High	Always in place; ready to be closed	Always in place; ready to be closed. Must be closed manually from the outside; difficult to access on upper levels.
Permanent, motor-driven	High	Easily opened and closed from the inside	Expensive. (It is important to find a motorized shutter that allows the shutter to be manually raised in order to allow the interior to vent following the storm and prior to electrical power restoration.)

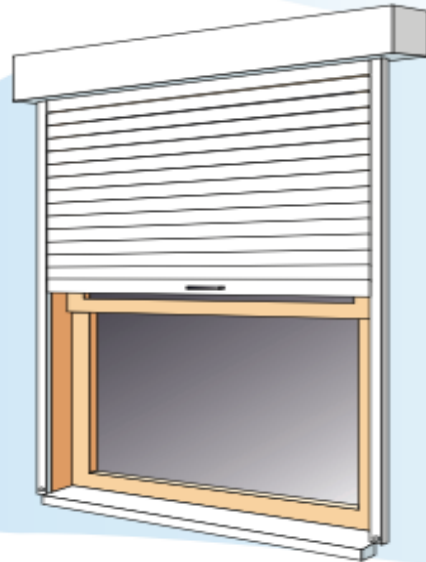
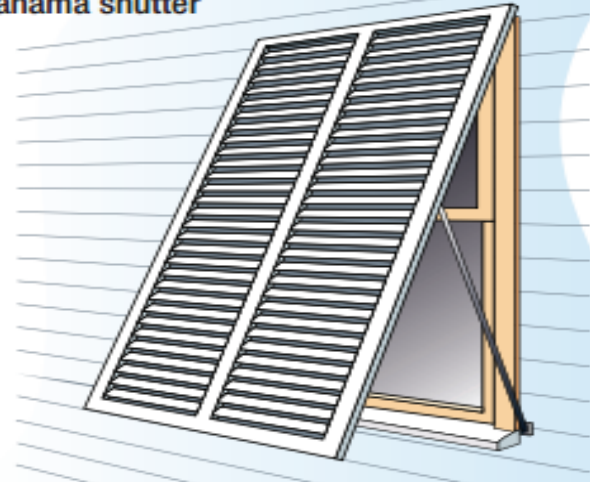
## Shutter Styles

Shutter styles include colonial, Bahama, roll-up, and accordion.

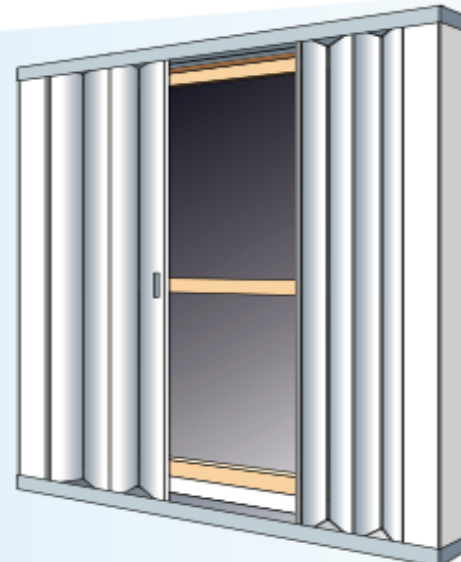


Colonial shutters

Bahama shutter



Roll-up shutter



Accordion shutter

# Recommendation 6 Energy Efficiency



# Recommendation 7 Increasing Home's Fire Rating

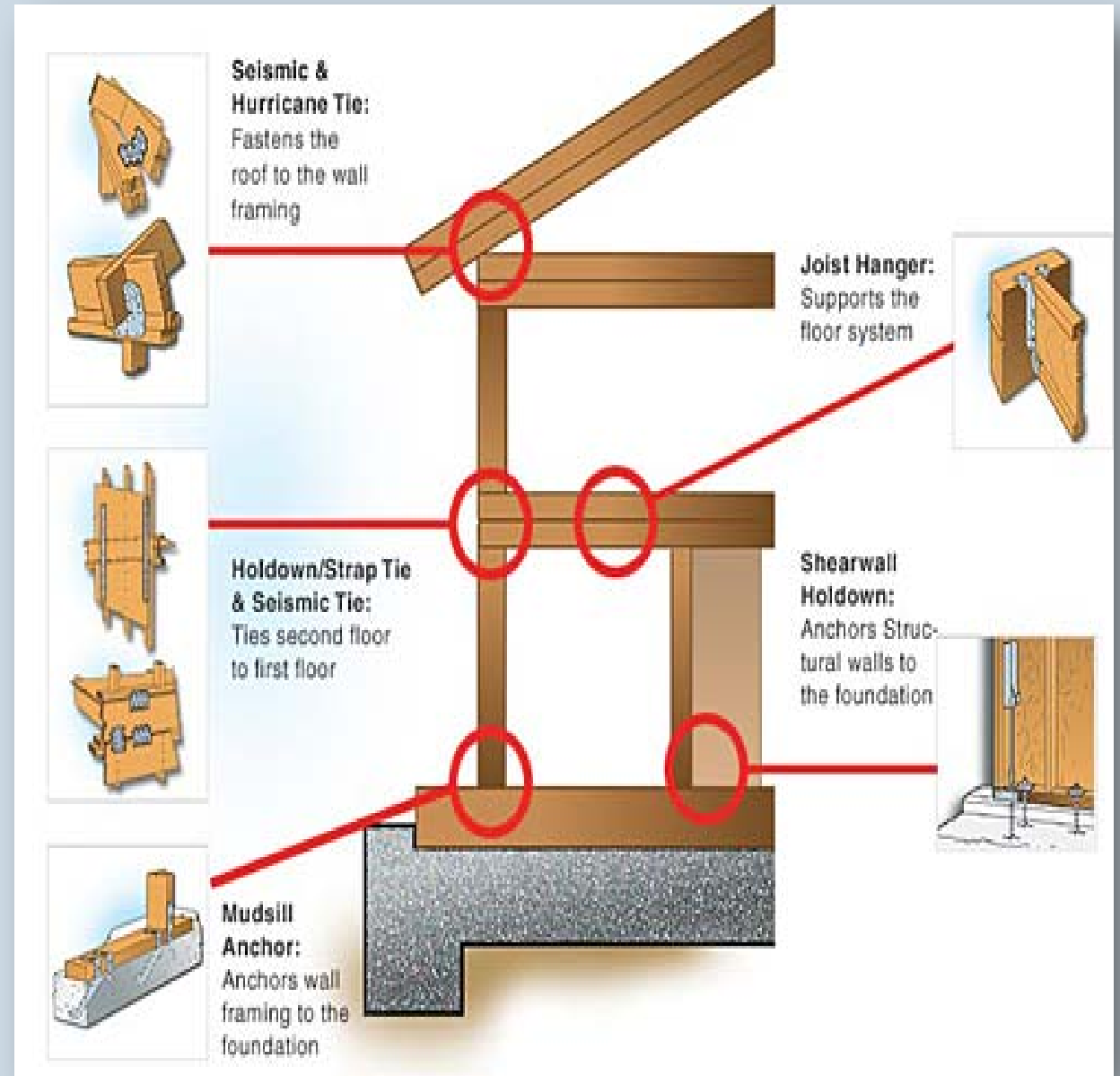


# Recommendation 8

## Roof Protection

### Hurricane Straps

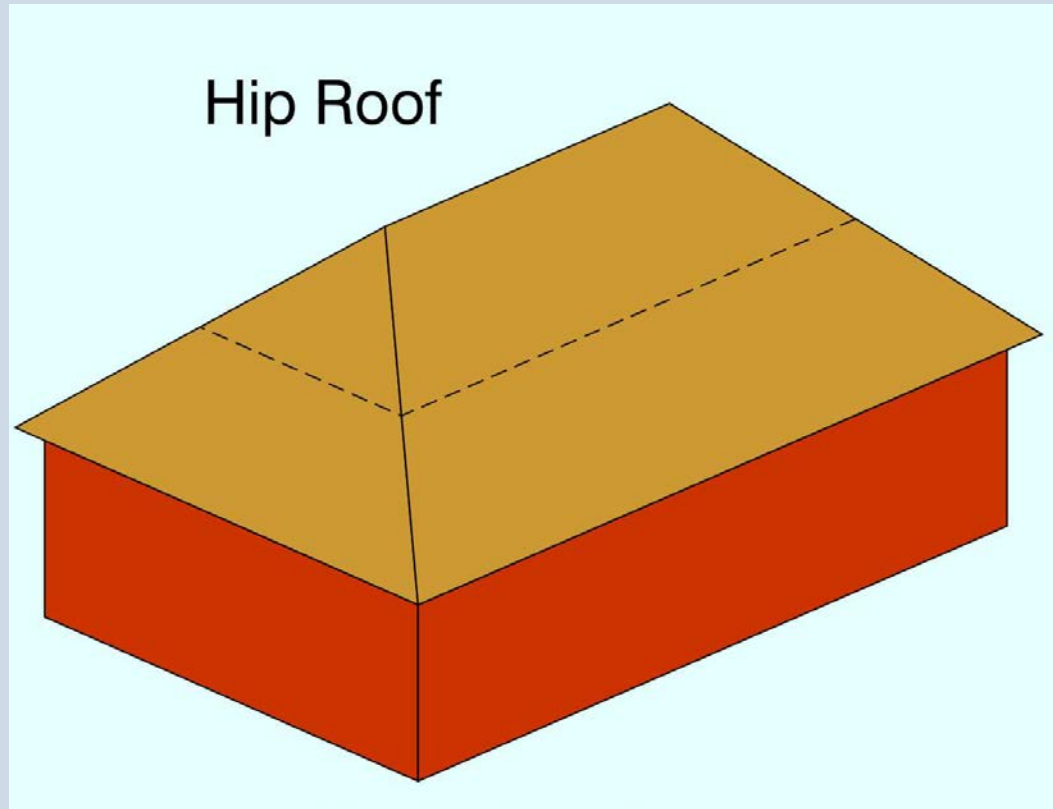
- Tie attaches to roof tiles to keep them from blowing off a roof.
- Aids to protect buildings from damage resulting from high wind.
- Provides continuous structural load path from the top of a building to foundation.



# Recommendation 8

## Roof Protection

### Design Considerations



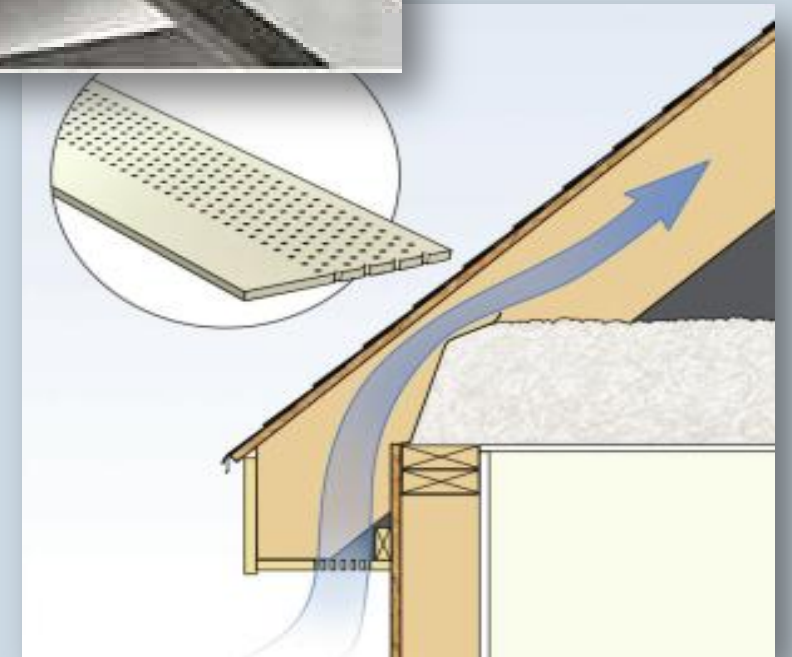
- A home with a square floor plan (or better a hexagonal or octagonal plan) with a multiple-panel roof (4 or more panels) was found to have reduced wind loads.
- Roofs with multiple slopes such as a hip roof (4 slopes) perform better under wind forces than gable roofs (2 slopes). A 30-degree roof slope has the best results.



# Recommendation 8 Roof Protection

## Baffled Ridge & Soffit Vents

- Used to minimize the number of roof penetrations.
- Prevents airflow and wind driven rain from entering attic.



# Recommendation 9 & 10

## Exterior and Interior Finishes

NFIP	Class	Class Description
ACCEPTABLE	5	Highly resistant to floodwater <sup>1</sup> damage, including damage caused by moving water. <sup>2</sup> These materials can survive wetting and drying and may be successfully cleaned after a flood to render them free of most harmful pollutants. <sup>3</sup> Materials in this class are permitted for partially enclosed or outside uses with essentially unmitigated flood exposure.
	4	Resistant to floodwater <sup>1</sup> damage from wetting and drying, but less durable when exposed to moving water. <sup>2</sup> These materials can survive wetting and drying and may be successfully cleaned after a flood to render them free of most harmful pollutants. <sup>3</sup> Materials in this class may be exposed to and/or submerged in floodwaters in interior spaces and do not require special waterproofing protection.
UNACCEPTABLE	3	Resistant to clean water <sup>4</sup> damage, but not floodwater damage. Materials in this class may be submerged in clean water during periods of flooding. These materials can survive wetting and drying, but may not be able to be successfully cleaned after floods to render them free of most <sup>3</sup> harmful pollutants.
	2	Not resistant to clean water <sup>4</sup> damage. Materials in this class are used in predominantly dry spaces that may be subject to occasional water vapor and/or slight seepage. These materials cannot survive the wetting and drying associated with floods.
	1	Not resistant to clean water <sup>4</sup> damage or moisture damage. Materials in this class are used in spaces with conditions of complete dryness. These materials cannot survive the wetting and drying associated with floods.

### Classification of Flood Damage-Resistant Materials

Types of Building Materials	Uses of Building Materials		Classes of Building Materials				
	Floors	Walls/ Ceilings	Acceptable		Unacceptable		
			5	4	3	2	1
<b>Structural Materials (floor slabs, beams, subfloors, framing, and interior/exterior sheathing)</b>							
Preservative-treated, Borate <sup>2</sup>	■	■	■				
Exterior grade/Exposure 1 (WBP – weather and boil proof)	■	■		■			
All other types	■	■					■
<b>Recycled plastic lumber (RPL)</b>							
Commingled, with 80-90% polyethylene (PE)	■		■				
Fiber-reinforced, with glass fiber strands	■		■				
High-density polyethylene (HDPE), up to 95%	■		■				
Wood-filled, with 50% sawdust or wood fiber	■				■		
<b>Stone</b>							
Natural or artificial non-absorbent solid or veneer, waterproof grout	■	■	■				
All other applications		■				■	
<b>Structural Building Components</b>							
Floor trusses, wood, solid (2x4s), decay-resistant or preservative-treated	■	■		■			
Floor trusses, steel <sup>3</sup>	■		■				
Headers and beams, solid (2x4s) or plywood, exterior grade or preservative-treated		■		■			
Headers and beams, OSB, exterior grade or edge-swell resistant		■				■	
Headers and beams, steel <sup>3</sup>		■	■				
I-joists	■						■
Wall panels, plywood, exterior grade or preservative-treated		■		■			
Wall panels, OSB, exterior grade or edge-swell resistant		■				■	
Wall panels, steel <sup>3</sup>		■		■			

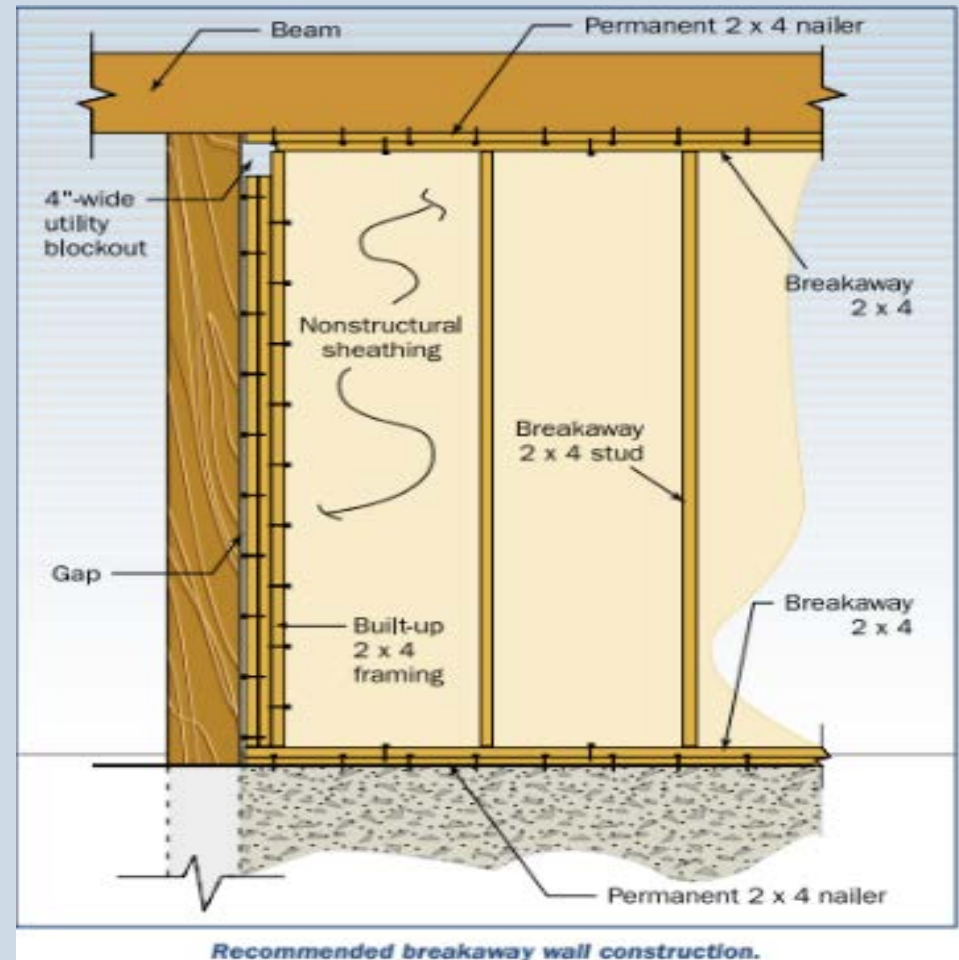
Types of Building Materials	Uses of Building Materials		Classes of Building Materials				
	Floors	Walls/ Ceilings	Acceptable		Unacceptable		
			5	4	3	2	1
<b>Structural Materials (floor slabs, beams, subfloors, framing, and interior/exterior sheathing)</b>							
Asbestos-cement board		■	■				
Brick							
Face or glazed		■	■				
Common (clay)		■		■			
Cast stone (in waterproof mortar)		■	■				
Cement board/fiber-cement board		■	■				
Cement/latex, formed-in-place	■			■			
Clay tile, structural glazed		■	■				
Concrete, precast or cast-in-place	■	■	■				
Concrete block <sup>1</sup>		■	■				
<b>Gypsum products</b>							
Paper-faced gypsum board		■			■		
Non-paper-faced gypsum board		■		■			
Greenboard		■				■	
Keene's cement or plaster		■			■		
Plaster, otherwise, including acoustical		■				■	
Sheathing panels, exterior grade		■			■		
Water-resistant, fiber-reinforced gypsum exterior sheathing		■		■			
<b>Hardboard (high-density fiberboard)</b>							
Tempered, enamel or plastic coated		■					■
All other types		■					■
Mineral fiberboard		■					■
<b>Oriented-strand board (OSB)</b>							
Exterior grade	■	■					■
Edge swell-resistant OSB	■	■					■
All other types	■	■					■
Particle board	■						■
<b>Plywood</b>							
Marine grade	■	■	■				
Preservative-treated, alkaline copper quaternary (ACQ) or copper azole (C-A)	■	■		■			

Types of Building Materials	Uses of Building Materials		Classes of Building Materials				
			Acceptable		Unacceptable		
	Floors	Walls/ Ceilings	5	4	3	2	1
<b>Structural Materials (floor slabs, beams, subfloors, framing, and interior/exterior sheathing)</b>							
Wood							
Solid, standard, structural (2x4s)		■		■			
Solid, standard, finish/trim		■			■		
Solid, decay-resistant <sup>4</sup>	■	■	■				
Solid, preservative-treated, ACQ or C-A		■		■			
Solid, preservative-treated, Borate <sup>2</sup>		■		■			
<b>Finish Materials (floor coverings, wall and ceiling finishes, insulation, cabinets, doors, partitions, and windows)</b>							
Asphalt tile <sup>5</sup>							
With asphaltic adhesives	■				■		
All other types	■						■
Cabinets, built-in							
Wood		■				■	
Particle board		■					■
Metal <sup>3</sup>		■		■			
Carpeting	■						■
Ceramic and porcelain tile							
With mortar set	■	■		■			
With organic adhesives	■	■				■	
Concrete tile, with mortar set	■		■				
Corkboard		■				■	
Doors							
Wood, hollow		■				■	
Wood, lightweight panel construction		■				■	
Wood, solid		■				■	
Metal, hollow <sup>3</sup>		■		■			
Metal, wood core <sup>3</sup>		■		■			
Metal, foam-filled core <sup>3</sup>		■		■			
Fiberglass, wood core		■		■			
Epoxy, formed-in-place	■		■				

Types of Building Materials	Uses of Building Materials		Classes of Building Materials				
			Acceptable		Unacceptable		
	Floors	Walls/ Ceilings	5	4	3	2	1
<b>Finish Materials (floor coverings, wall and ceiling finishes, insulation, cabinets, doors, partitions, and windows)</b>							
Glass (sheets, colored tiles, panels)		■		■			
Glass blocks		■	■				
Insulation							
Sprayed polyurethane foam (SPUF) or closed-cell plastic foams	■	■	■				
Inorganic – fiberglass, mineral wool: batts, blankets, or blown	■	■			■		
All other types (cellulose, cotton, open-cell plastic foams, etc.)	■	■				■	
Linoleum	■						■
Magnesite (magnesium oxychloride)	■						■
Mastic felt-base floor covering	■						■
Mastic flooring, formed-in-place	■		■				
Metals, non-ferrous (aluminum, copper, or zinc tiles)		■			■		
Metals							
Non-ferrous (aluminum, copper, or zinc tiles)		■			■		
Metals, ferrous <sup>3</sup>		■		■			
Paint							
Polyester-epoxy and other oil-based waterproof types		■		■			
Latex		■		■			
Partitions, folding							
Wood		■				■	
Metal <sup>3</sup>		■		■			
Fabric-covered		■					■
Partitions, stationary (free-standing)							
Wood frame		■		■			
Metal <sup>3</sup>		■		■			
Glass, unreinforced		■		■			
Glass, reinforced		■		■			
Gypsum, solid or block		■					■

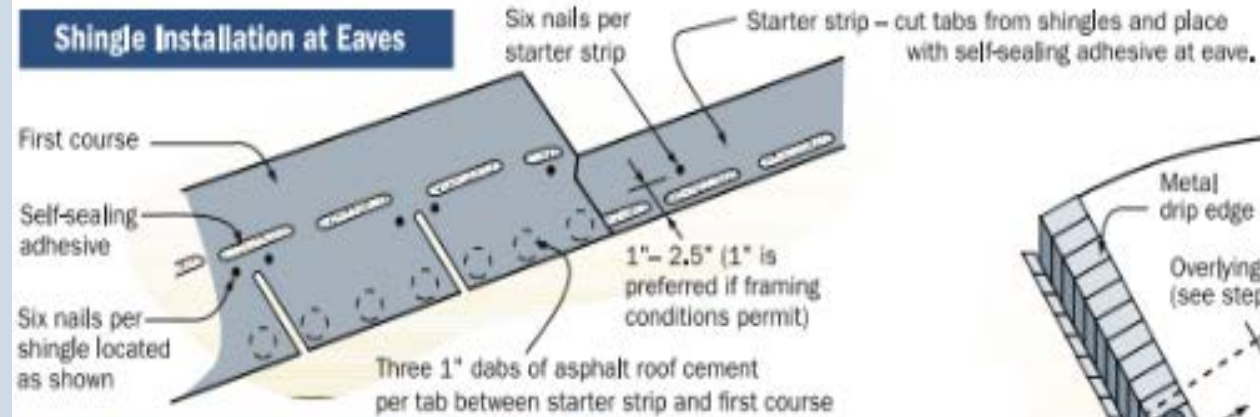
# Tool Base Technologies

Technological advances and practices have been designed to further protect homes near coastal regions. The first place that needs to be flood resistant is the basement or crawl space. Sump pumps will help to direct water away from entering the basement/crawlspace and it help protect the foundation. It is installed under the foundation with an opening towards the basement floor.



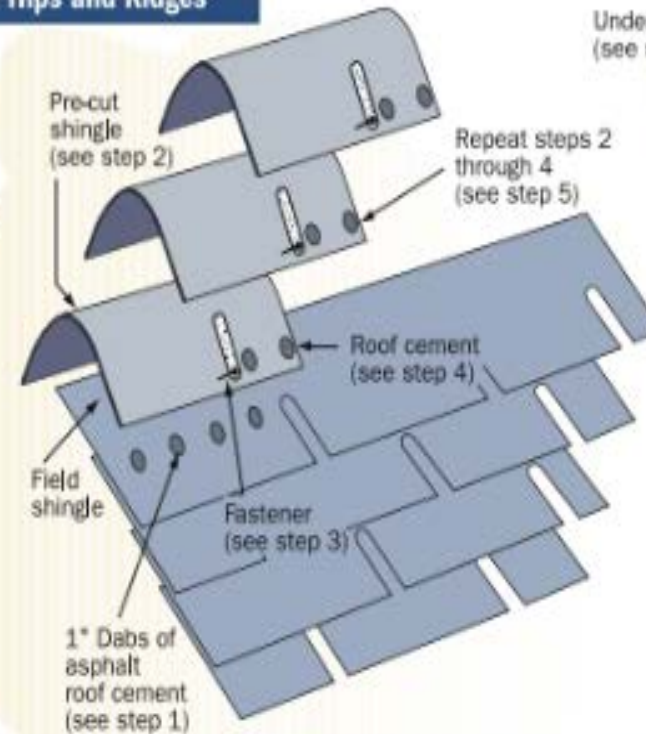
# Tool Base Technologies

## Shingle Installation at Eaves

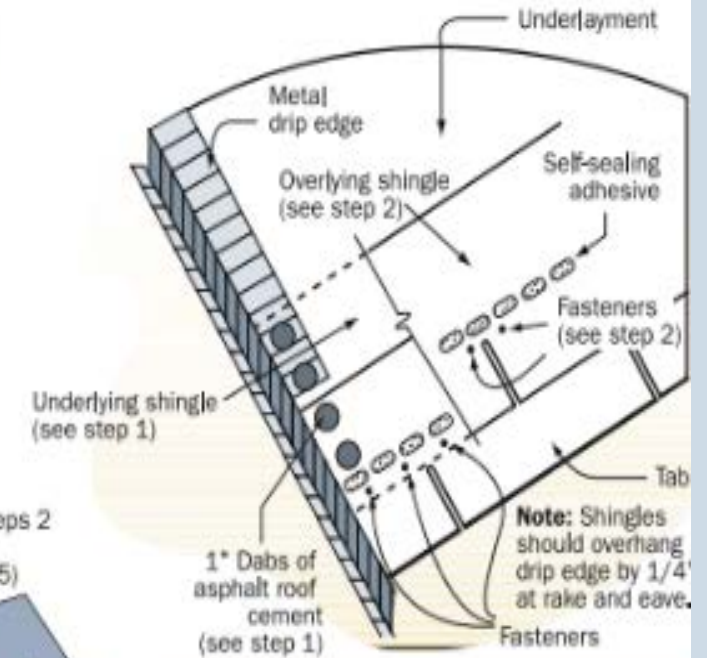


## Shingle Installation at Hips and Ridges

1. Apply four 1-inch dabs of roof cement to field shingle.
2. **Set pre-cut shingle in place and press down in dabs of roof cement before installing fasteners.**
3. Install fastener on each side of ridge. Note: Because of extra thickness of shingles at hips and ridges, longer nails may be needed.
4. Apply two 1-inch dabs of roof cement to shingle where shown.
5. Repeat steps 2 through 4.



Enhanced shingle securement



## Shingle Installation at Rakes

1. Apply two 1-inch dabs of asphalt roof cement on underlying shingle, and two 1-inch dabs on metal drip edge as shown.
2. Set overlying shingle in place and install fasteners except for last fastener at rake.
3. **Press shingle down to set in dabs of asphalt cement before installing final fastener.**
4. Install final fastener at rake edge.
5. Repeat steps for each course.

# Final Conclusion

- Raise the building to prevent damage.
- Modify site channels to provide a greater moving of floodwaters.
- Raise all electrical equipment above the base flood elevation.
- Prevent waste backup by using a sewage effluent ejector pump.
- Protect the plumbing equipment such as the various tanks.
- Use storm shutters to protect windows from being damaged.
- To make the house more energy efficient add one inch of rigid foam to the wall.
- To increase the fire protection of the building use residential fire sprinklers.
- Use hurricane straps on all the roof joists and reduce overhangs.
- Use flood resistant material to prevent water damage.

THANK YOU  
FOR YOUR ATTENTION