

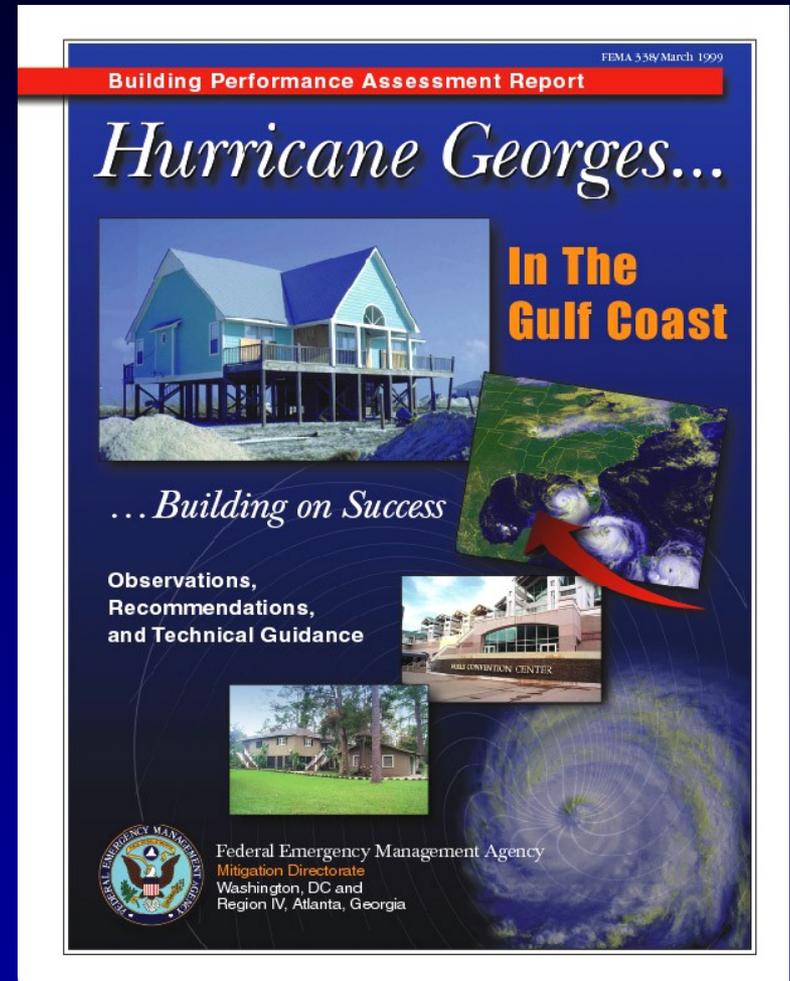
BUILDING PERFORMANCE ASSESSMENT TEAM

Hurricane Georges in the Gulf Coast

OBSERVATIONS, RECOMMENDATIONS, AND TECHNICAL GUIDANCE



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MITIGATION DIRECTORATE





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FEMA Building Performance Assessment Teams

- **Team Members**
 - **Representatives of public and private sectors and expertise in:**
 - **natural hazard engineering**
 - **planning**
 - **coastal geology**
 - **floodplain management**
 - **forensic engineering**

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FEMA Building Performance Assessment Teams

- **Team Objectives - to evaluate**
 - Effectiveness of mitigation initiatives
 - Siting and planning issues
 - Floodplain management issues
 - Impact on the shoreline / beach system
 - Manufactured housing performance in the Florida Keys
- **Make recommendations as necessary**

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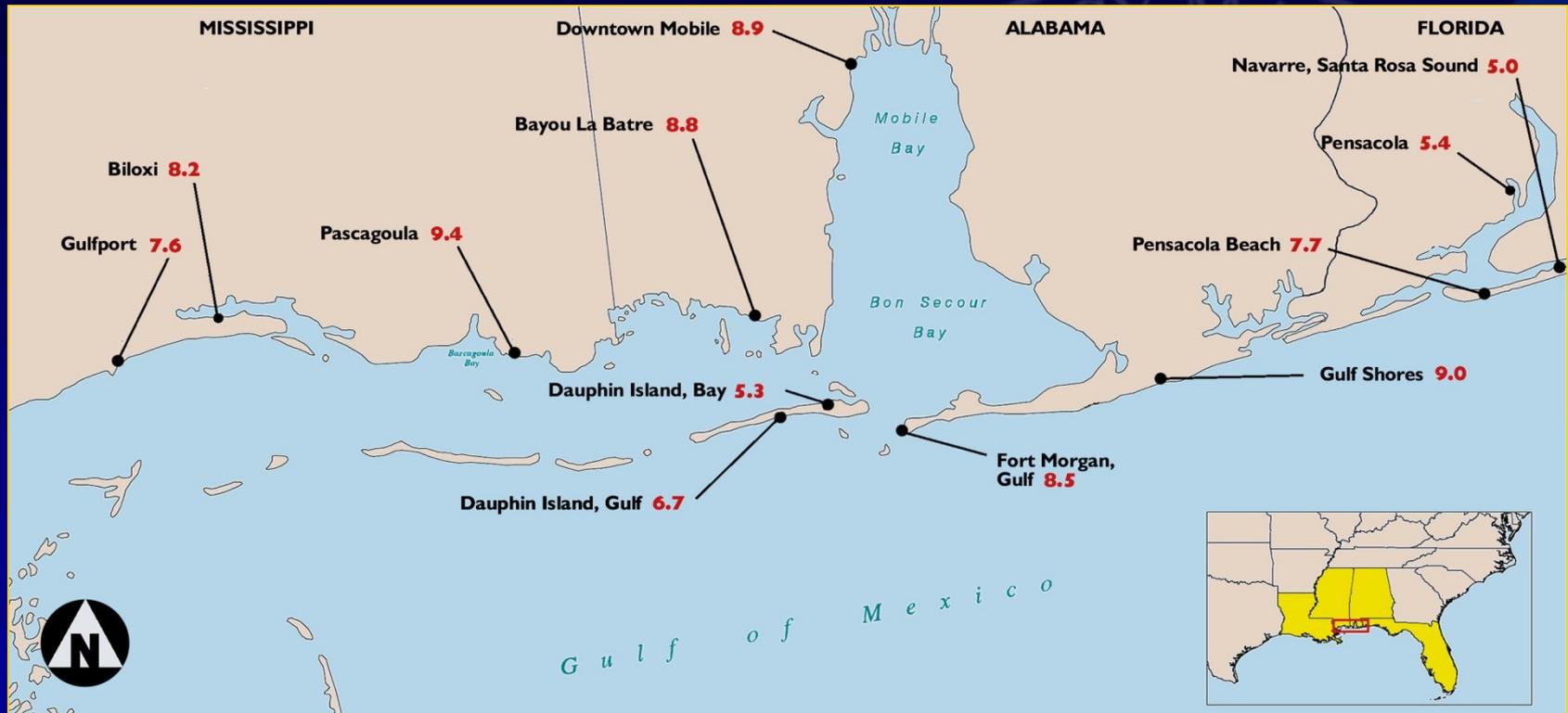
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Background

- **Wind Data**
 - 91-mph sustained at Sombrero Key
 - 61-mph sustained in Gulfport Harbor
 - 117-mph gust at Mississippi Power and Light (Gulfport)



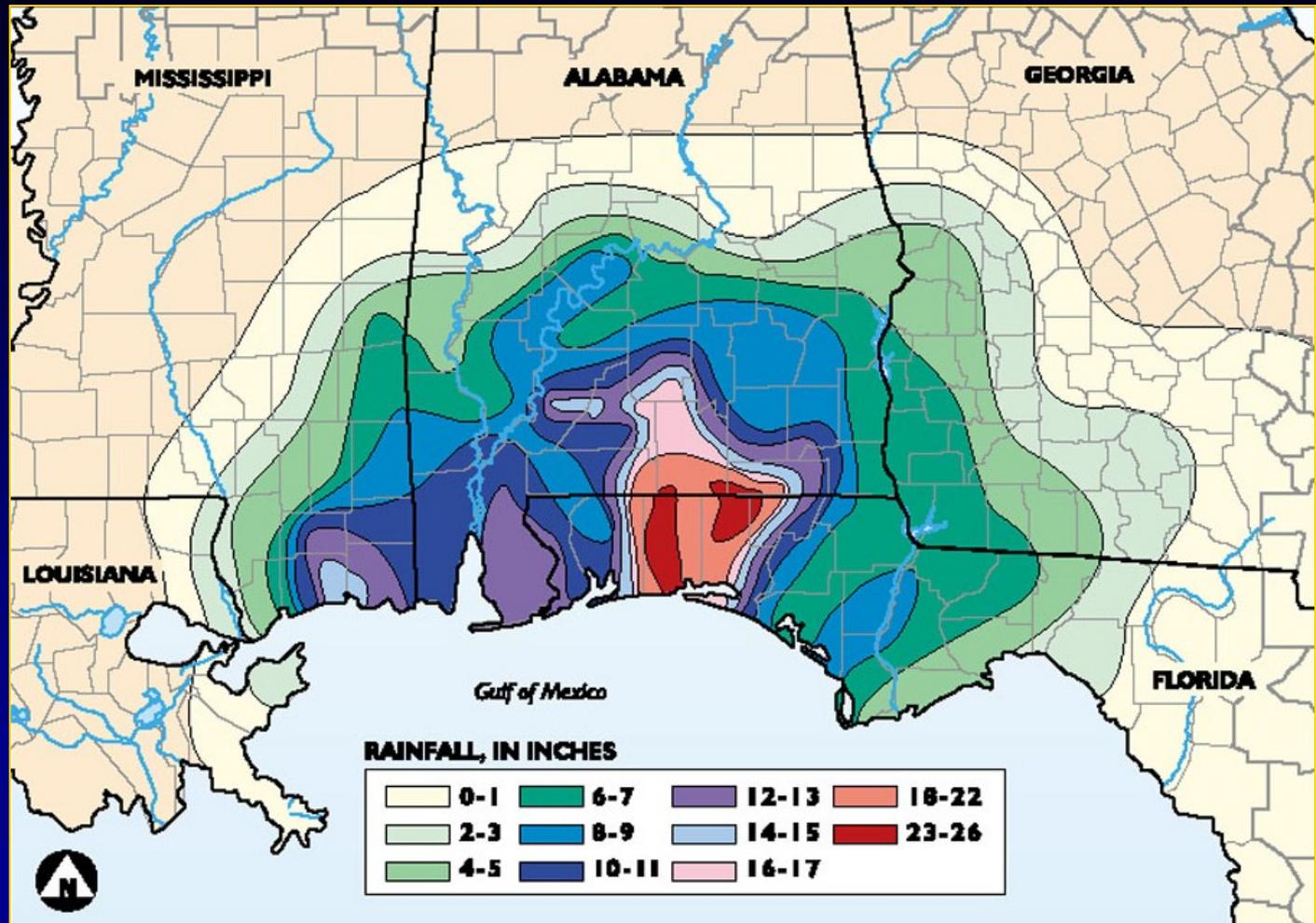
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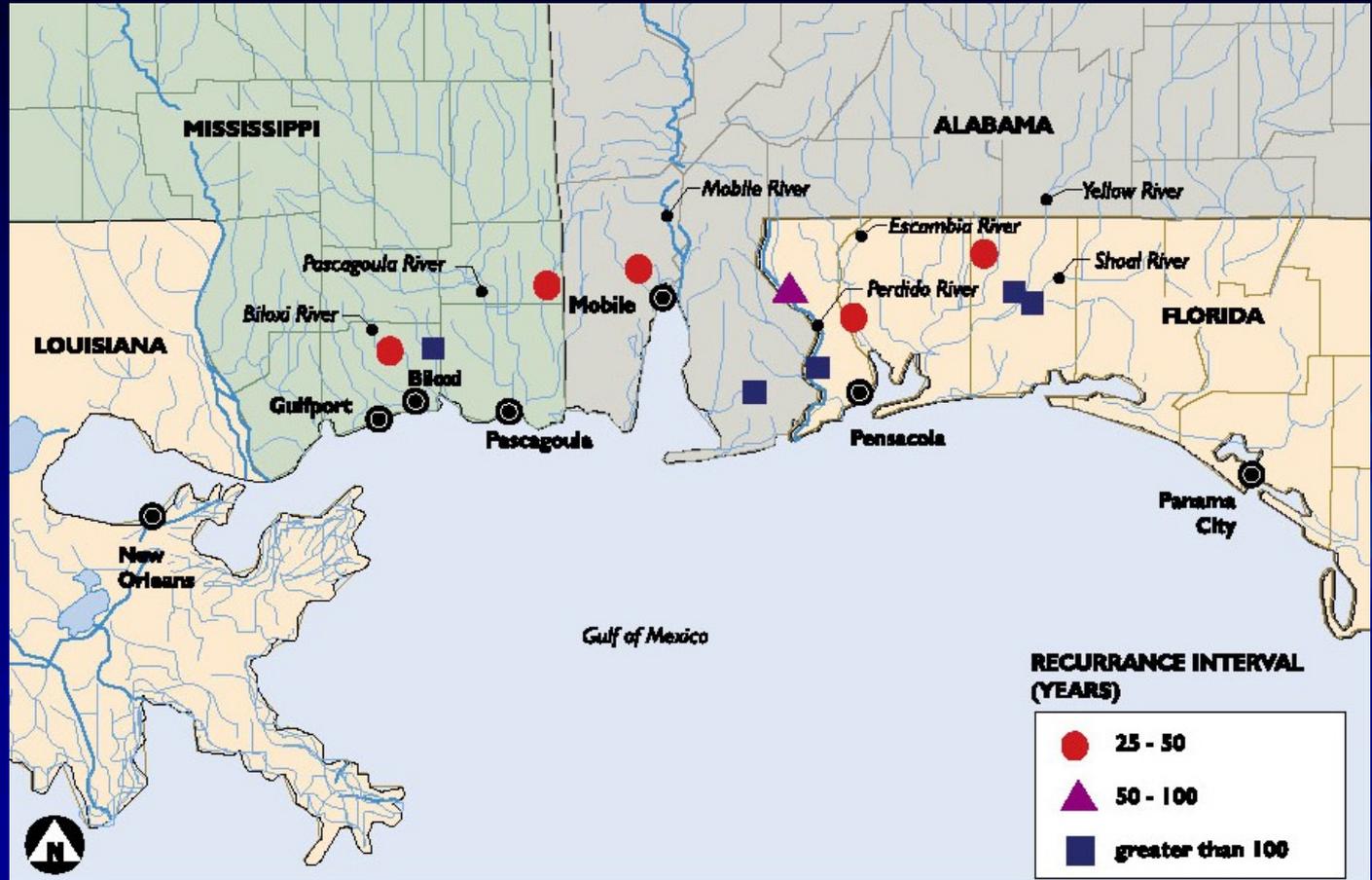
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Observations

- **Observations made separately for**
 - Alabama
 - Florida
 - Mississippi
- **Observations were made in the following areas**
 - Riverine flood damage
 - Coastal surge damage
 - Wind damage

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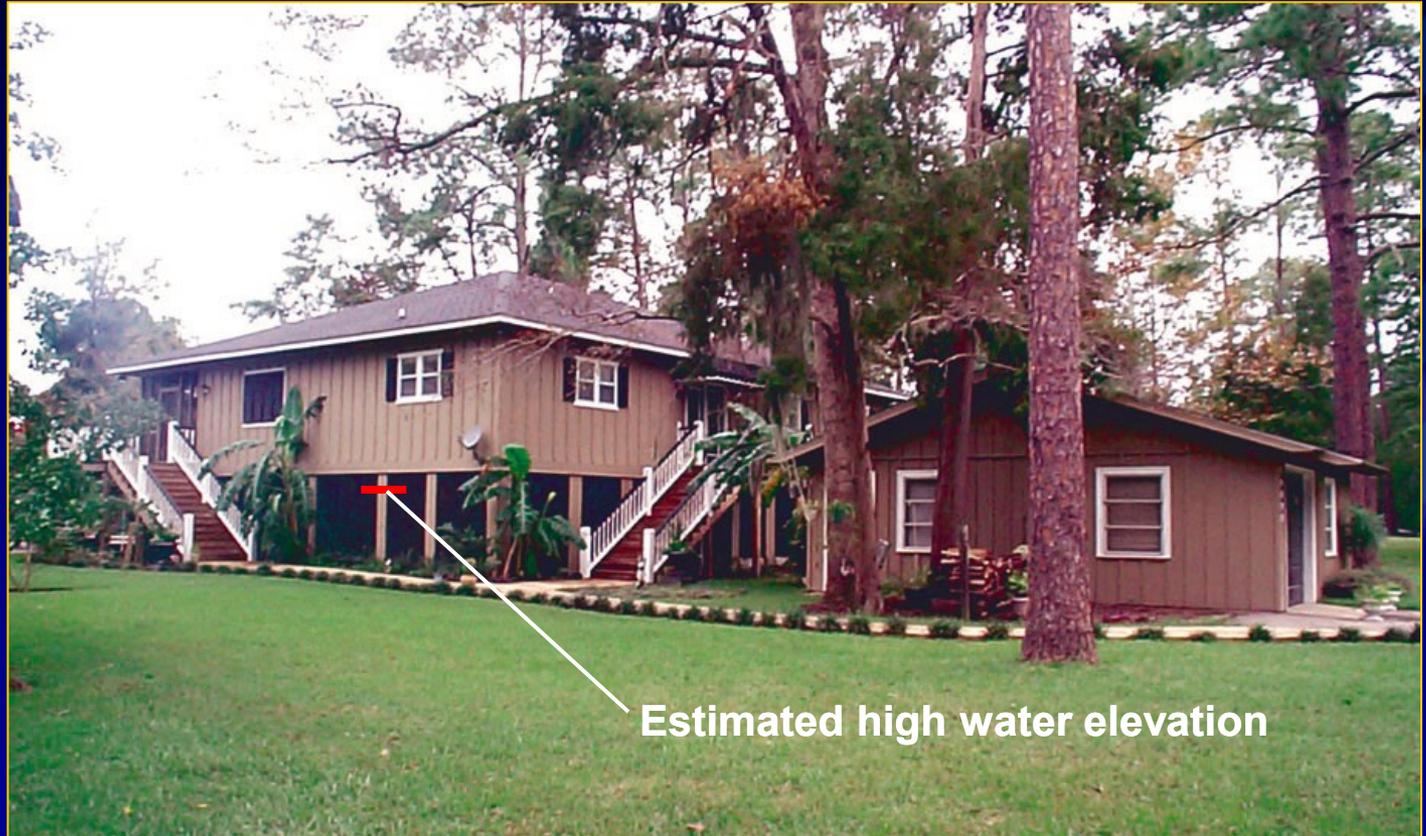


Estimated high water elevation

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Estimated high water elevation



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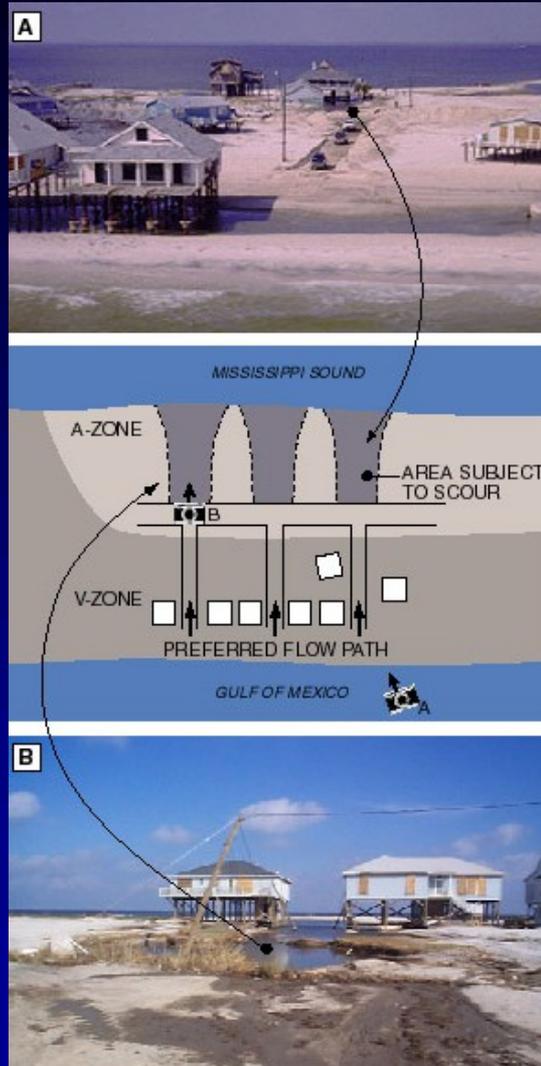


Estimated high water elevation

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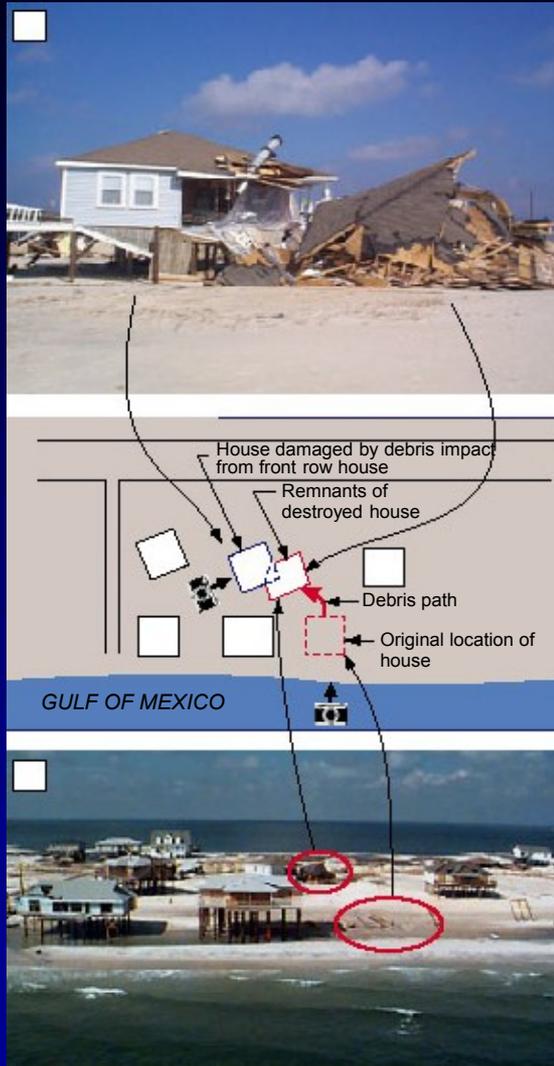
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Debris from adjacent house

Damaged pilings



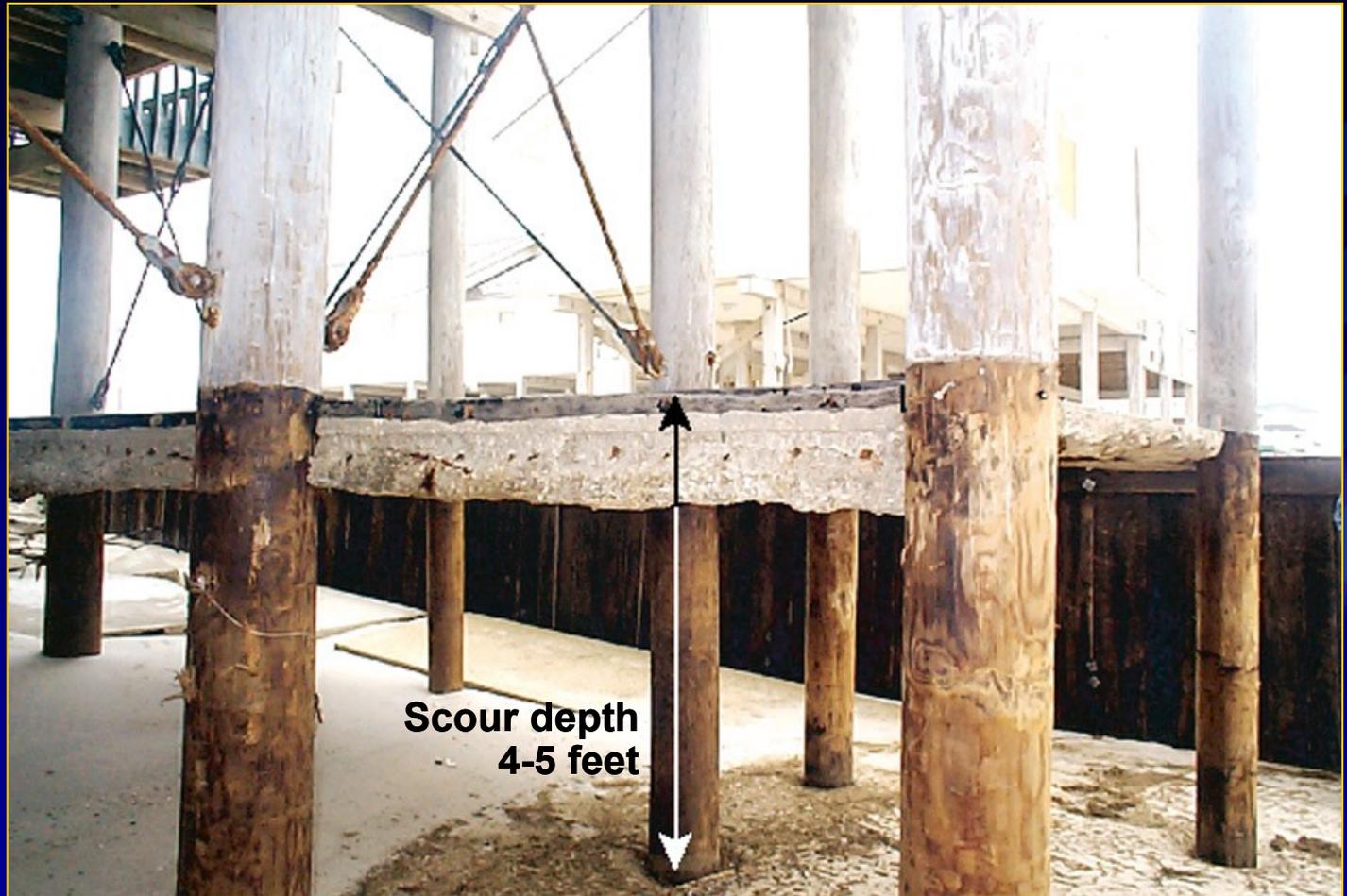
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Properly elevated air
conditioner/heat pump
compressor



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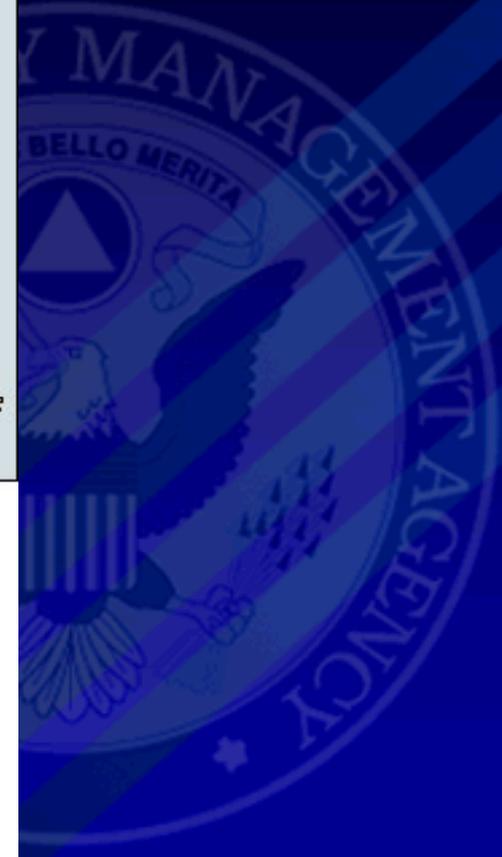
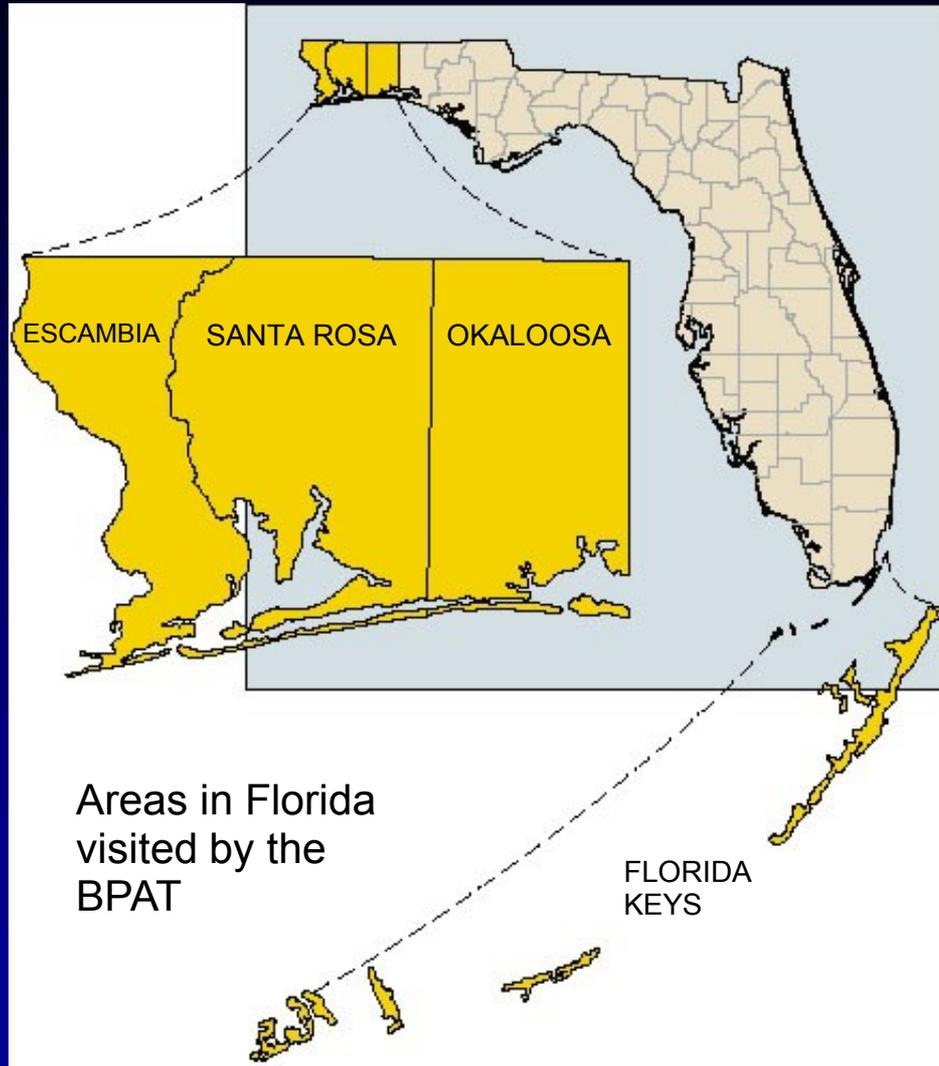
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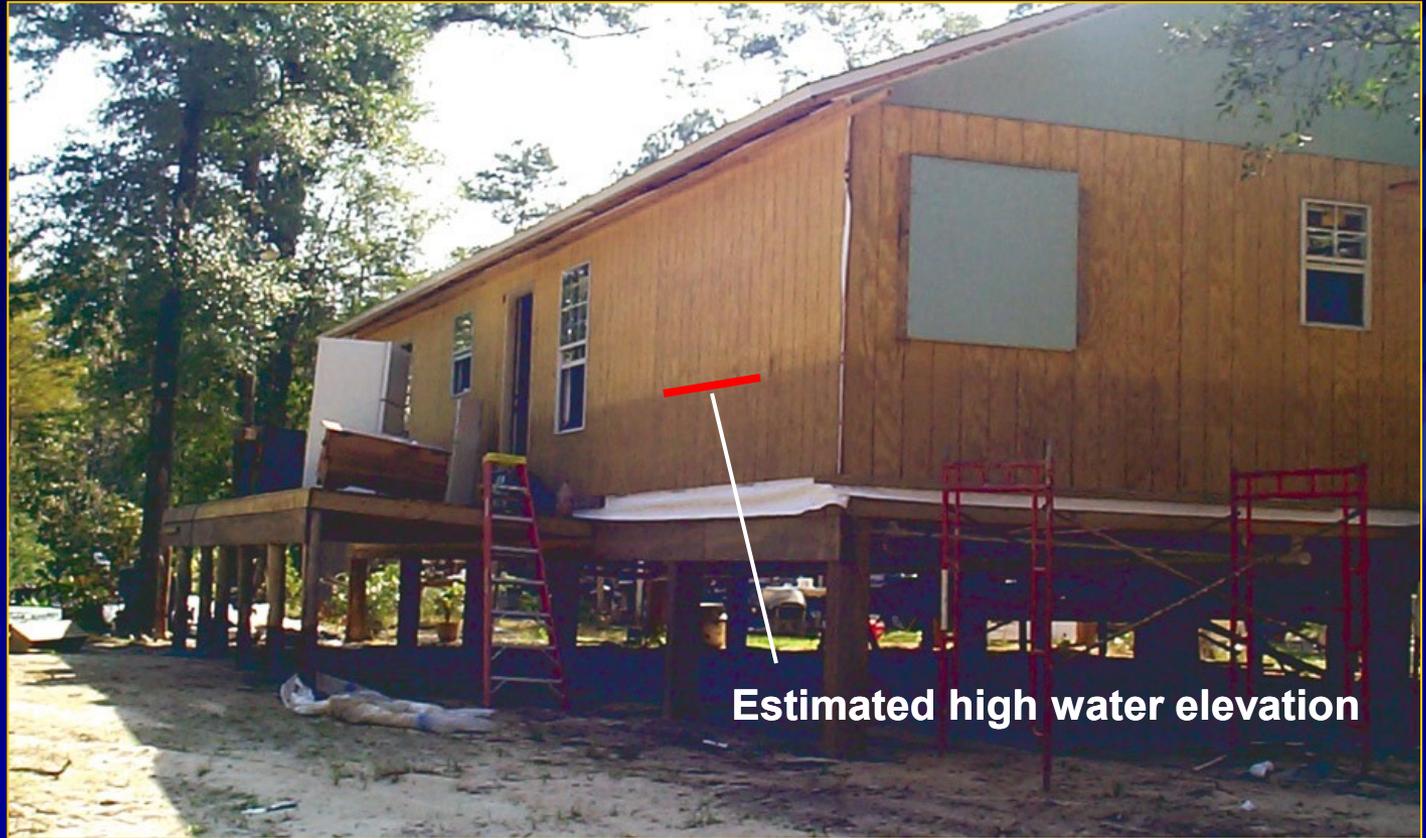
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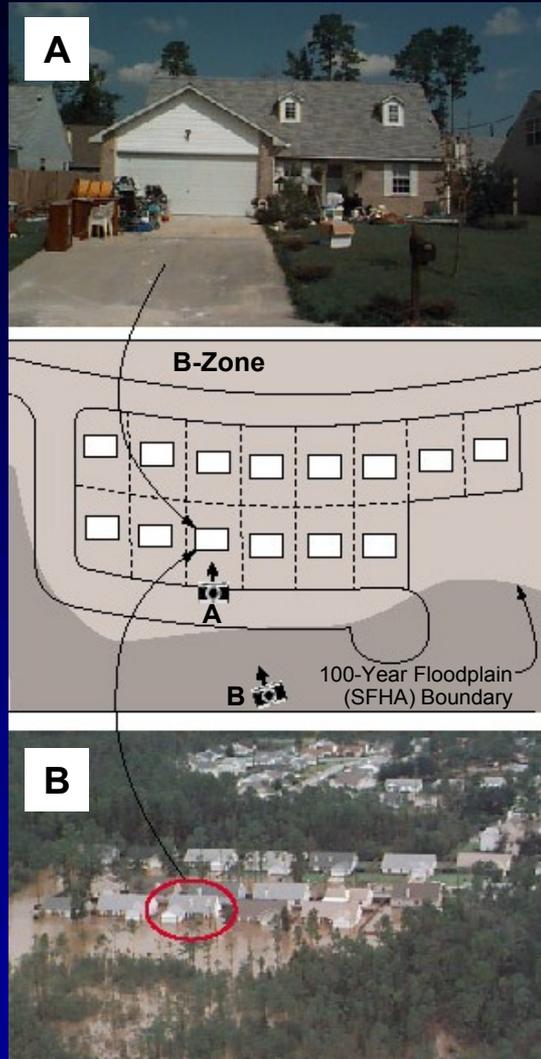
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BEFORE



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AFTER



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Estimated high water elevation

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Observations

- **Assessment of Manufactured Housing on Cudjoe Key, Florida**
 - evaluate ability of homes to withstand wind forces

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Observations

- **Successful performance of new manufactured homes is attributed to:**
 - **Manufactured homes built after 1994 are built to resist higher wind speeds**
 - **State of Florida, Monroe County's standards and enforcement**



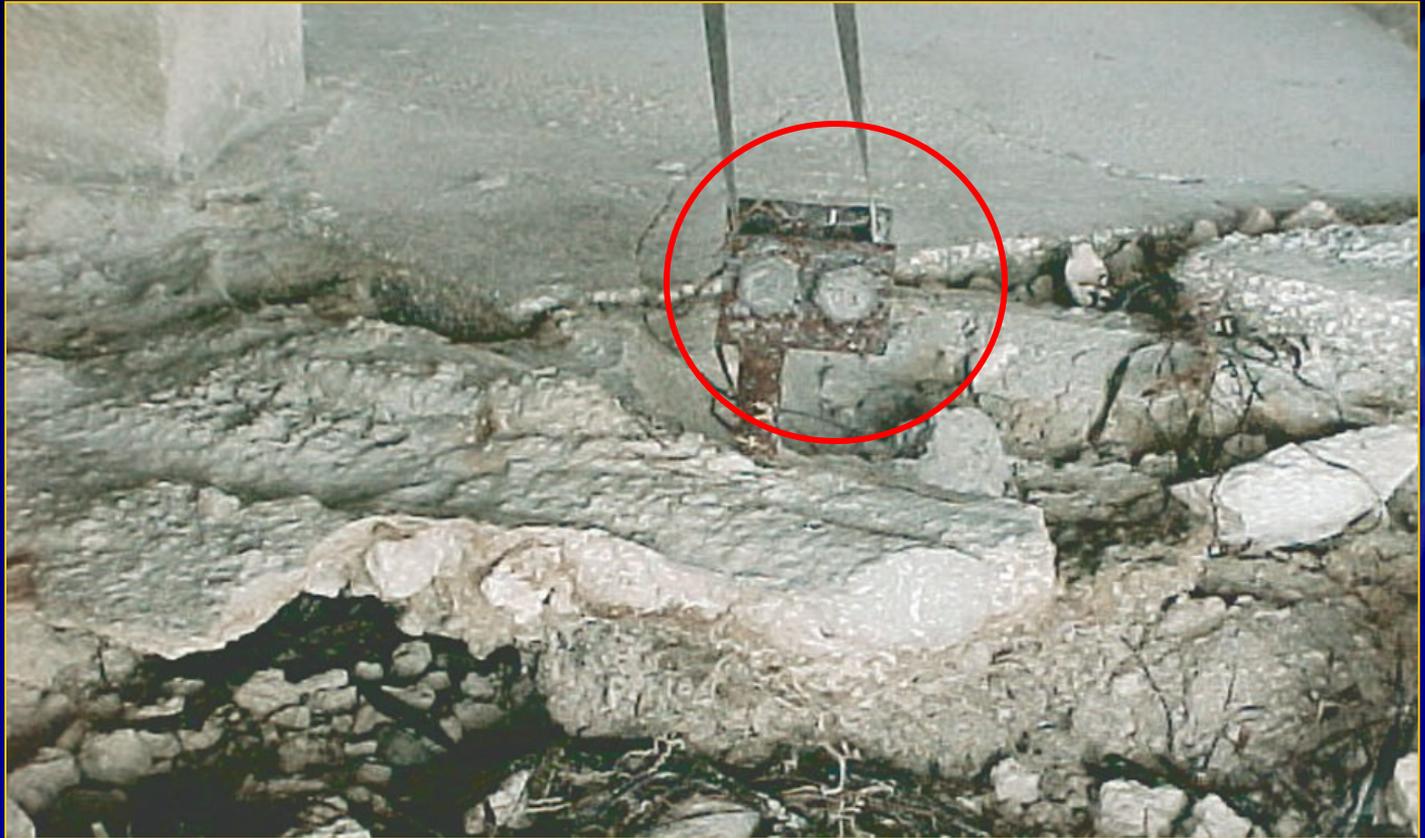
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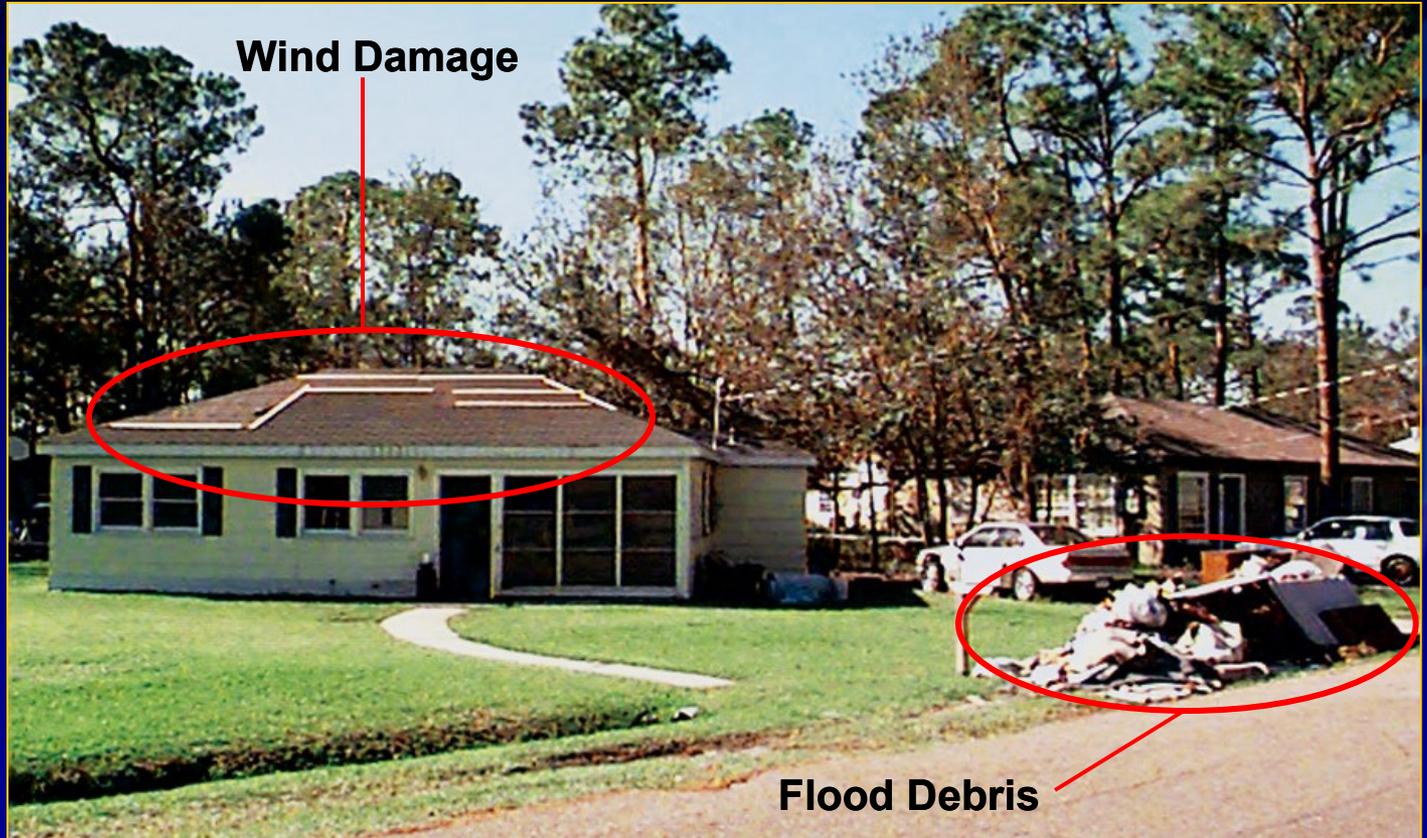
Areas in
Mississippi
visited by the
BPAT



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Conclusions

- **Factors that contributed to successful building performance and building damage**

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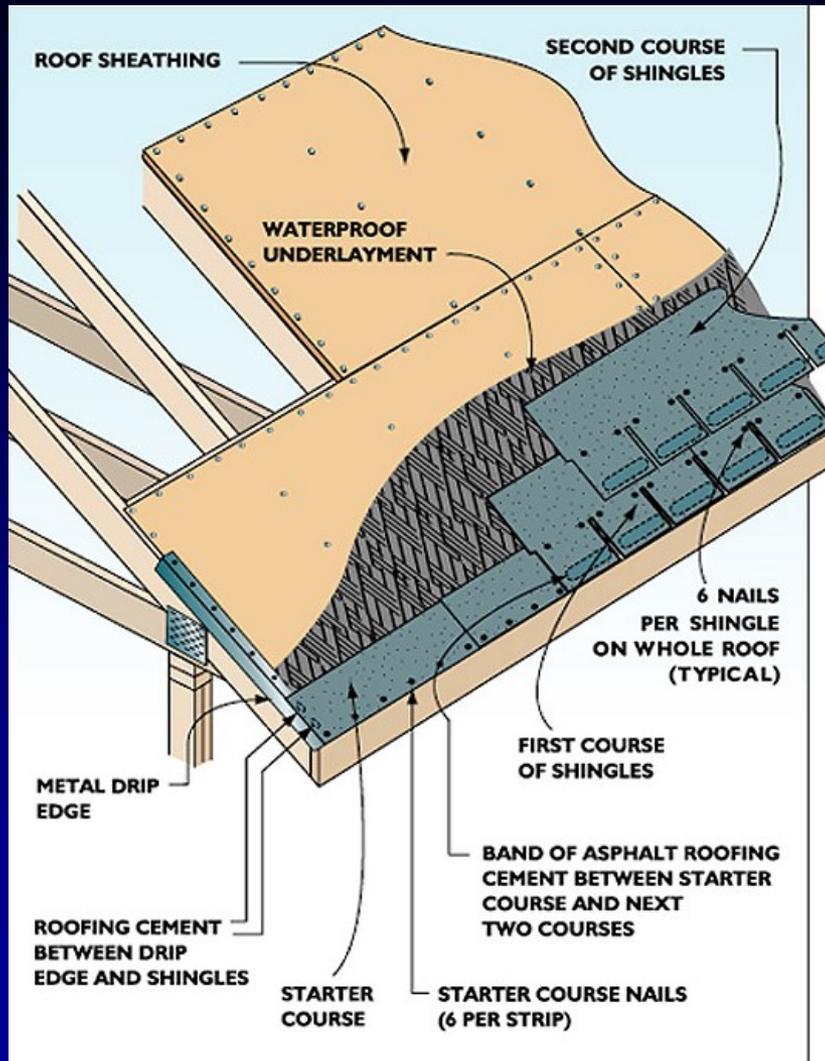


Conclusions

- **Factors that contributed to successful building performance**
 - adherence to building codes and standards
 - community hazard-specific requirements



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Conclusions

- **Factors that contributed to successful building performance**
 - manufactured home foundations
 - specialized building materials
 - publicly financed flood mitigation projects had a positive impact

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Conclusions

- **Factors that contributed to building damage**
 - **flooding in some areas exceed 100-year levels**
 - **inadequate pile embedment depth on coastal structures**
 - **inadequate designs for concrete slabs below coastal buildings**



Conclusions

- **Factors that contributed to building damage**
 - waterborne debris impact
 - corrosion of hurricane straps
 - attachments to manufactured homes
 - improperly installed manufactured home anchors



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Recommendations

- **Flood Mitigation Programs and Planning**
 - promote hazard mitigation plans
 - publicly-financed mitigation projects should continue



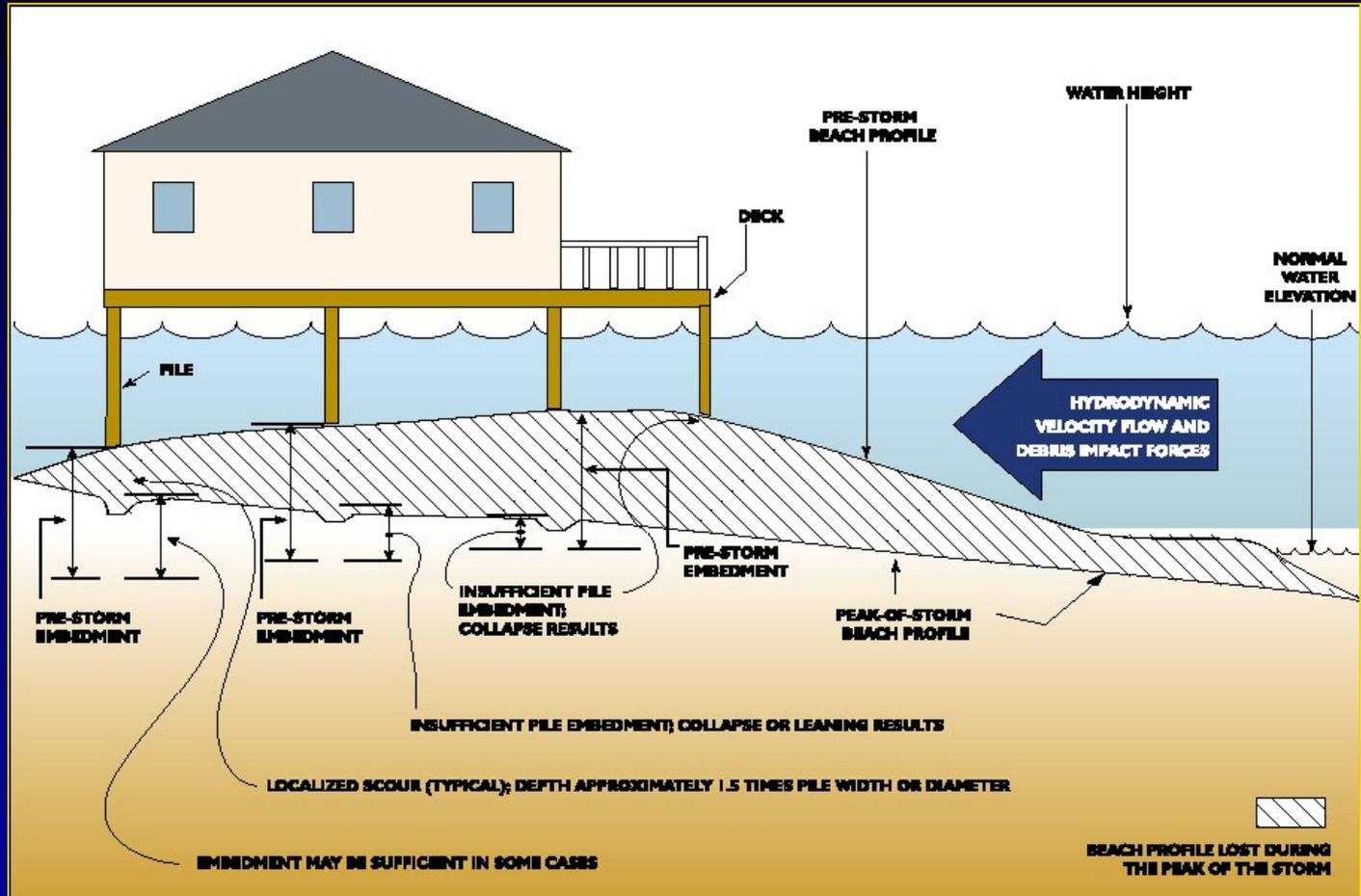
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Recommendations

- **Mitigating Residual Flood Risk**
 - Structures should be built higher than the 100-year flood elevation
 - Replacement manufactured homes should be elevated above the 100-year flood elevation

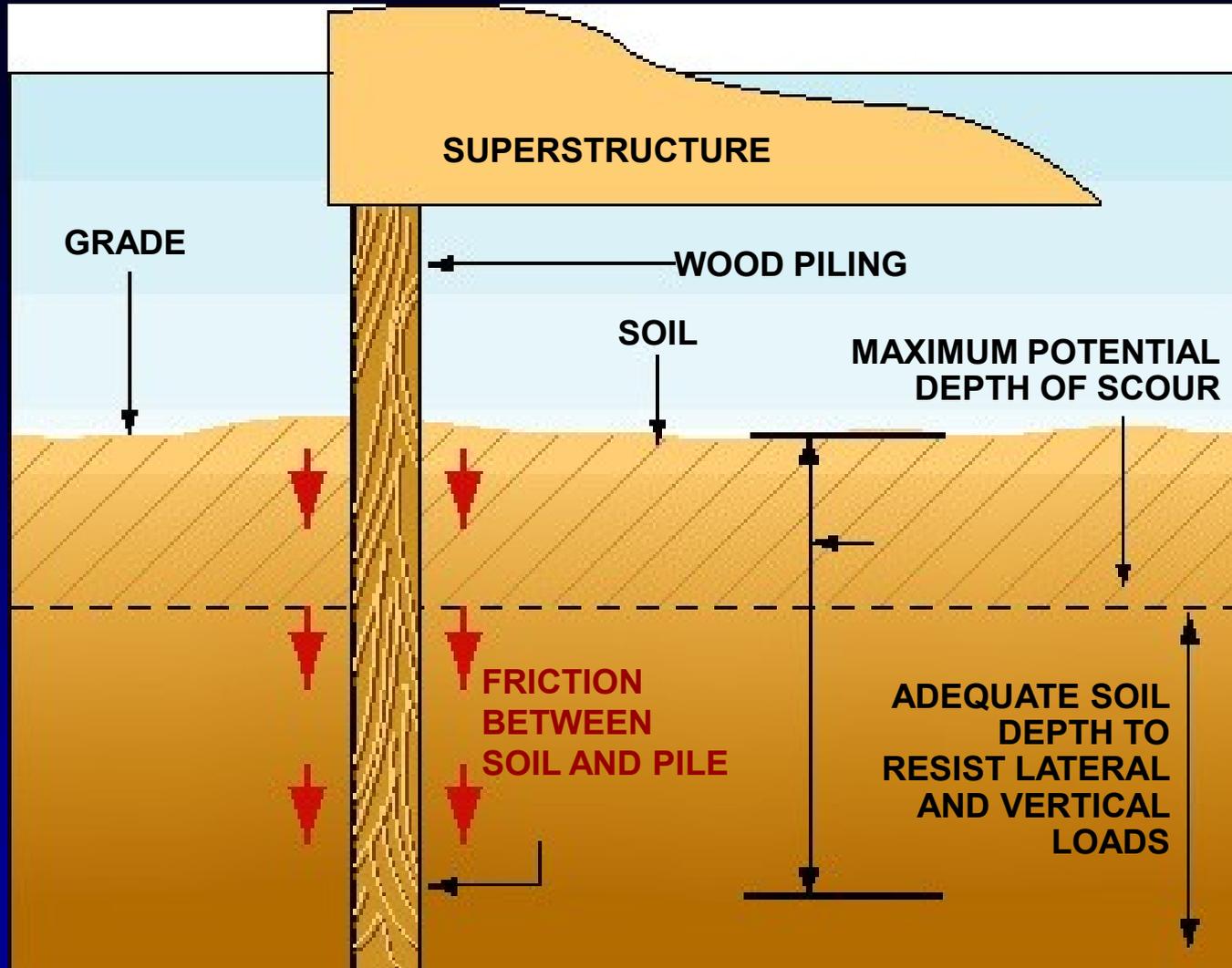


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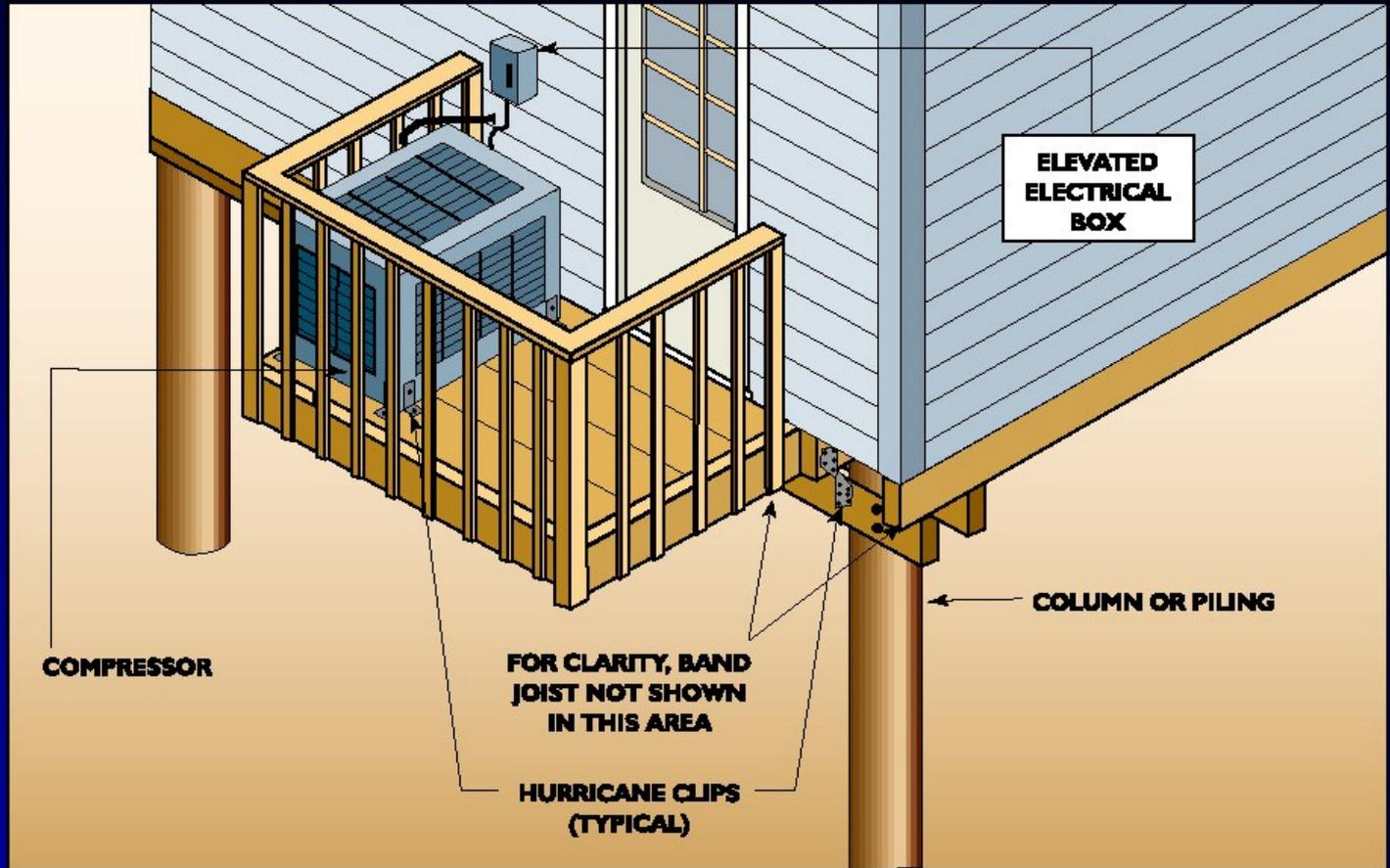


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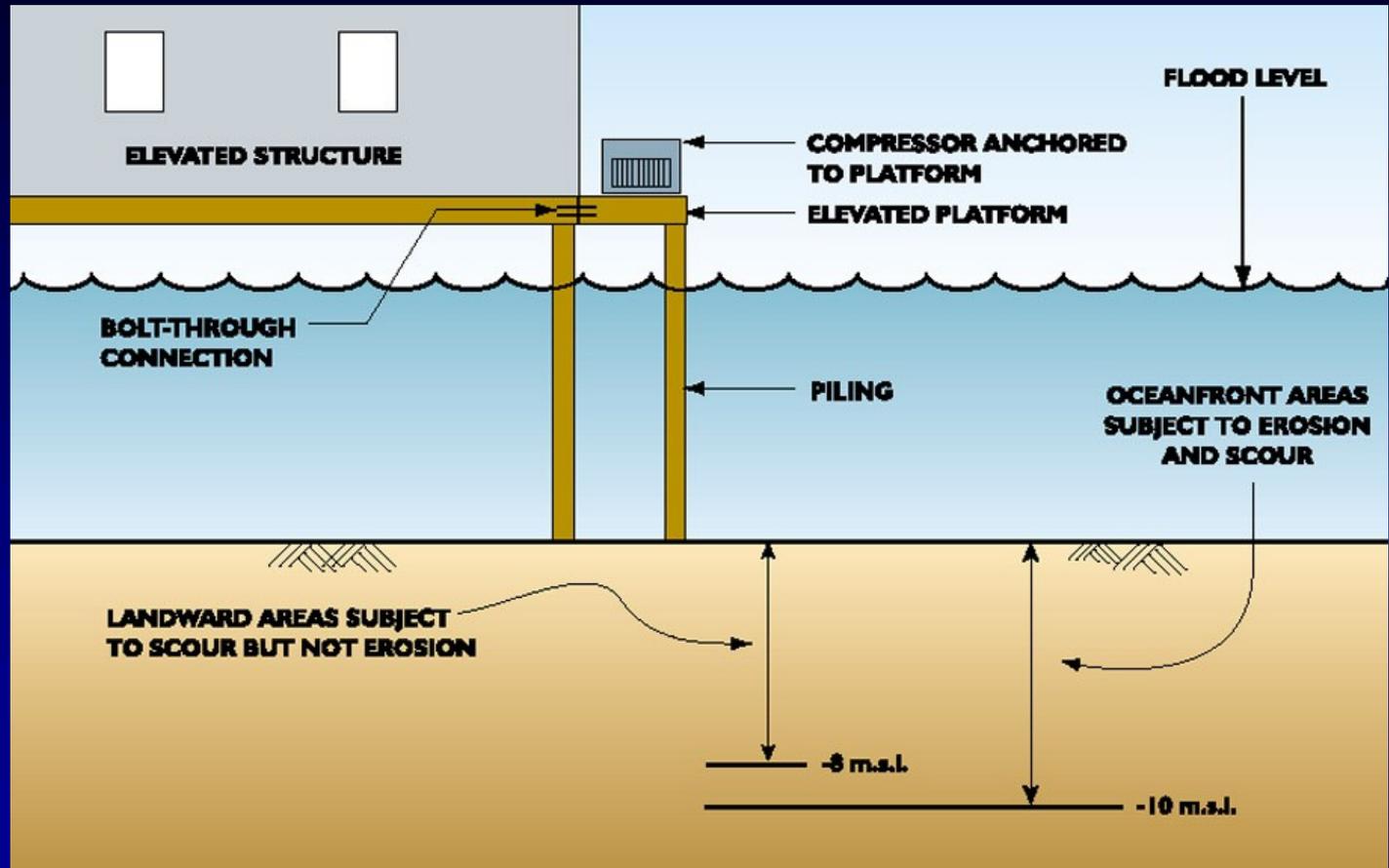


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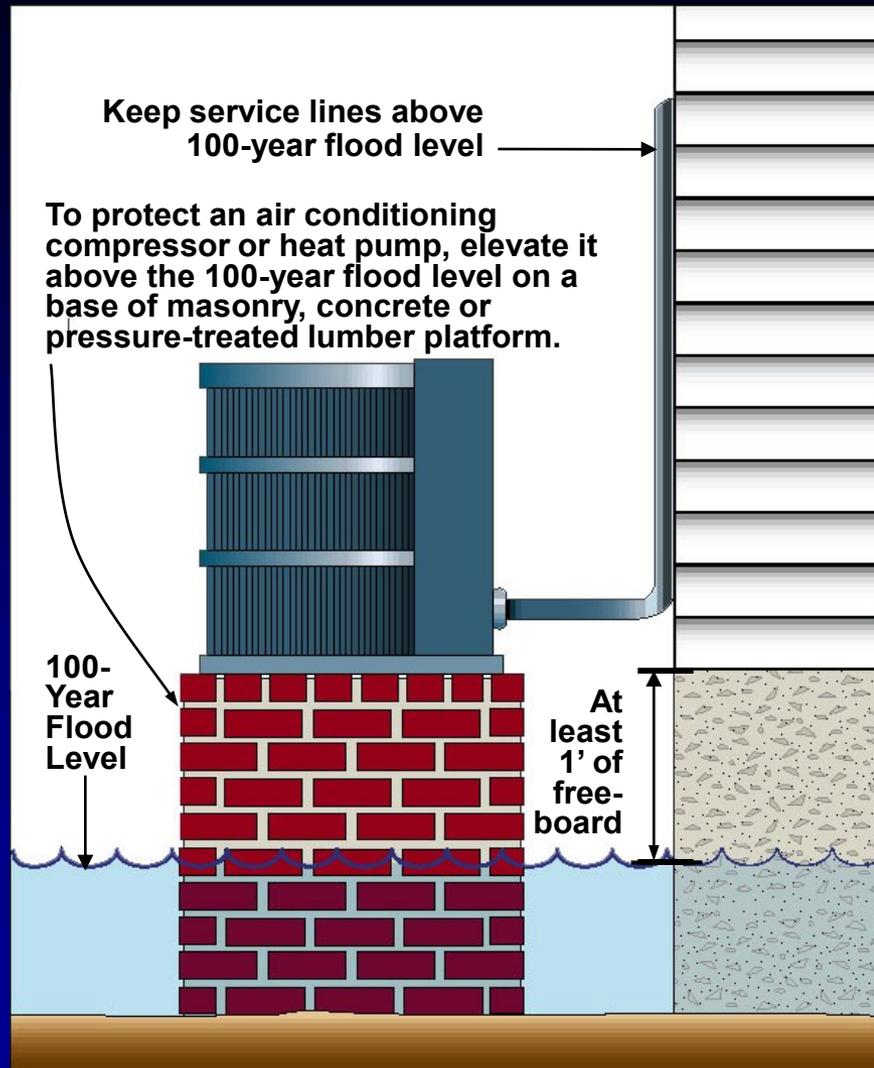


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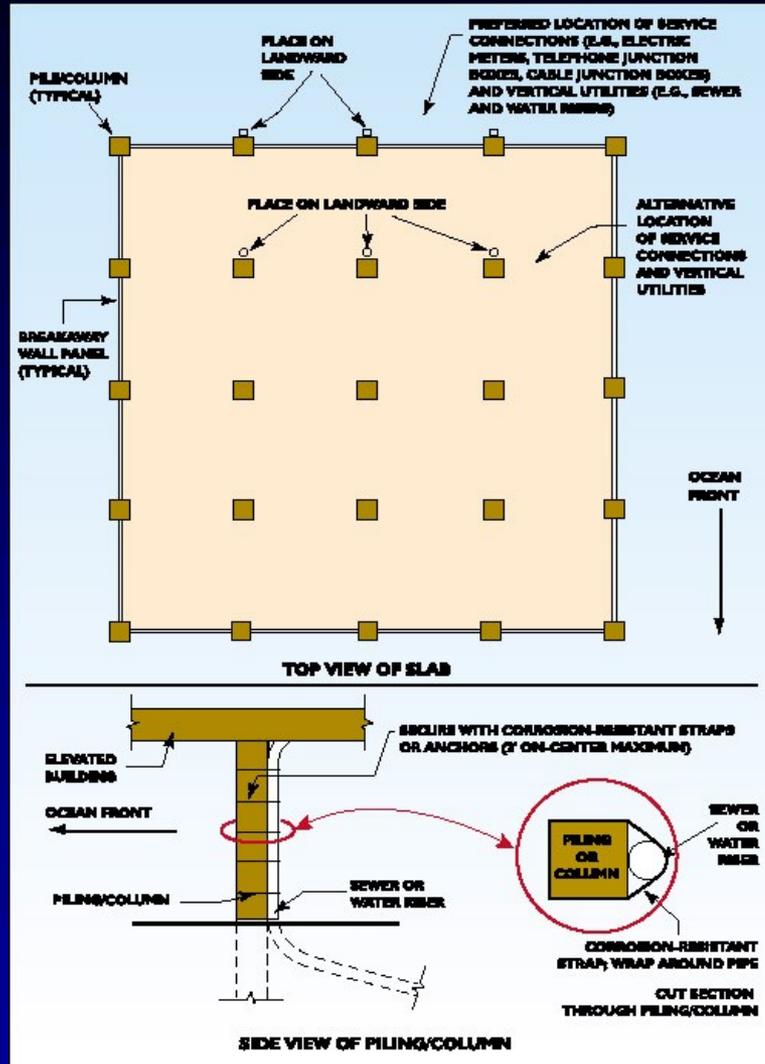


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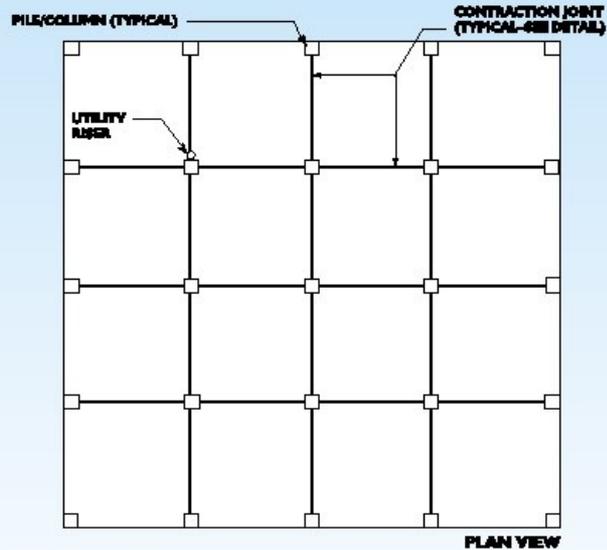


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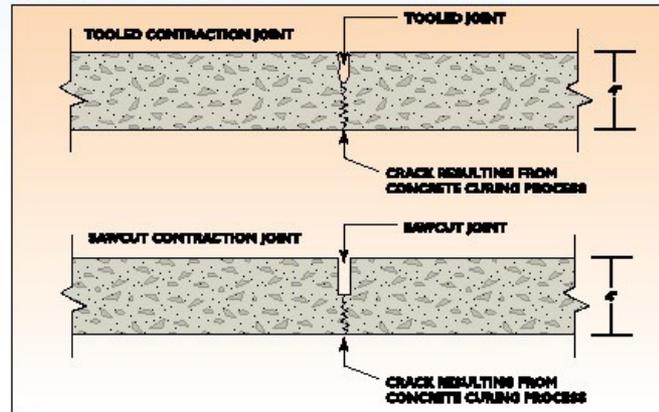




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DETAIL - SECTION THROUGH SLAB



NOTE: INSTALL EXPANSION AND ISOLATION JOINTS AS APPROPRIATE IN ACCORDANCE WITH STANDARD PRACTICE OR AS REQUIRED BY STATE AND LOCAL CODES.

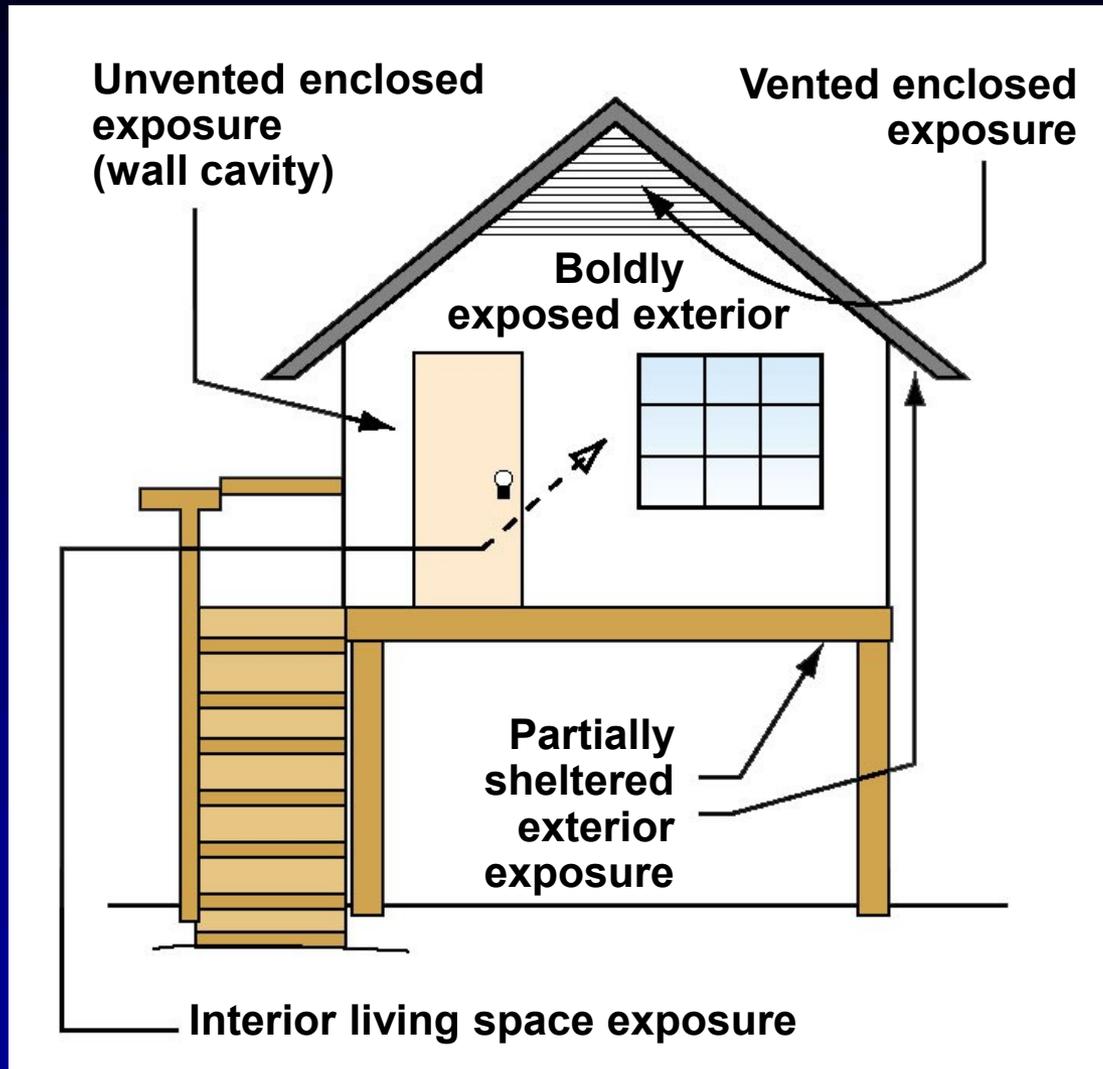


Recommendations

- **Reduce Waterborne Debris Impacts**
 - buildings, stairs, walkways and utilities should have adequate foundations
 - limit the size and placement of components below the first floor
 - regulate the size and placement of docks, fishing piers and accessory buildings



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Recommendations

- **Attachments to Manufactured Homes**
 - **decks, porches, or awnings should be minimized for manufactured homes in Special Flood Hazard Areas**



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**BUCKLE MUST BE CONNECTED
AGAINST THE TOP OF THE CHASSIS
MEMBER**

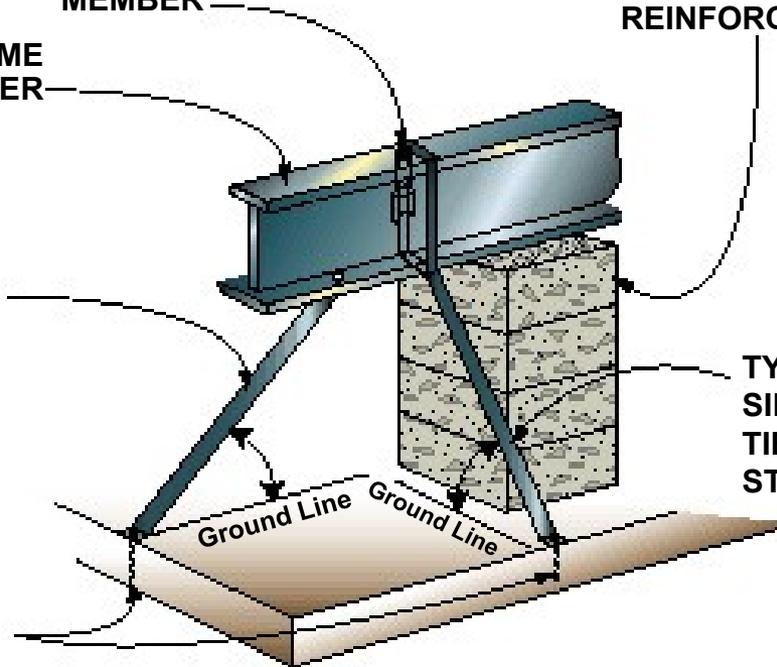
**MANUFACTURED HOME
CHASSIS MEMBER**

**CONCRETE OR MASONRY
REINFORCED PIER**

**TYPICAL END
TIEDOWN STRAP**

**TYPICAL
SIDE
TIEDOWN
STRAP**

**STRAPS CAN BE
CONNECTED TO
ANCHORS IN THE
CONCRETE SLAB
FOUNDATION OR TO
GROUND ANCHORS**



**NOTE: Proper angle of the straps in relation
to the ground is 40-60 degrees**