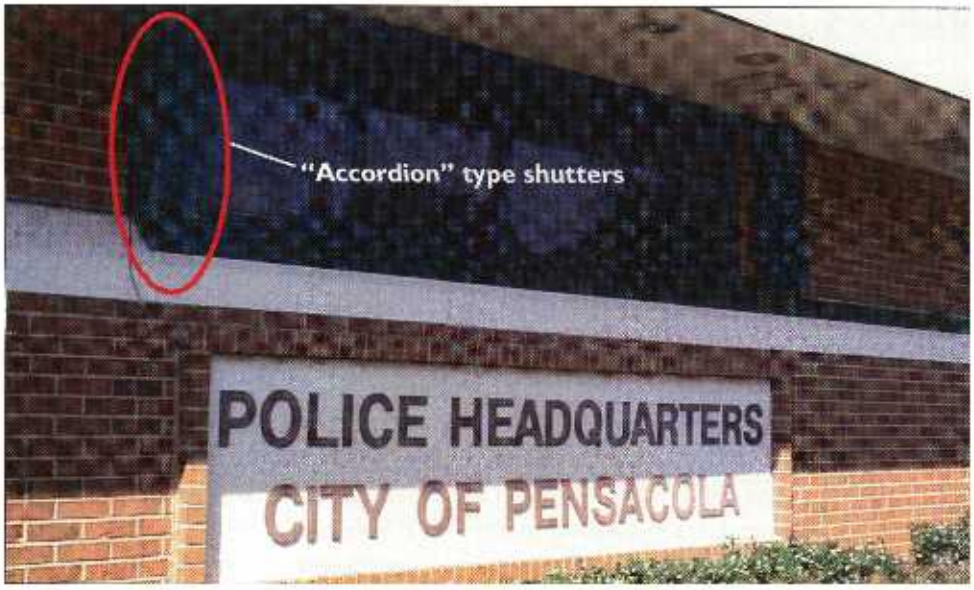

FIGURE 5-15 Window shutters on the Pensacola Police Headquarters.

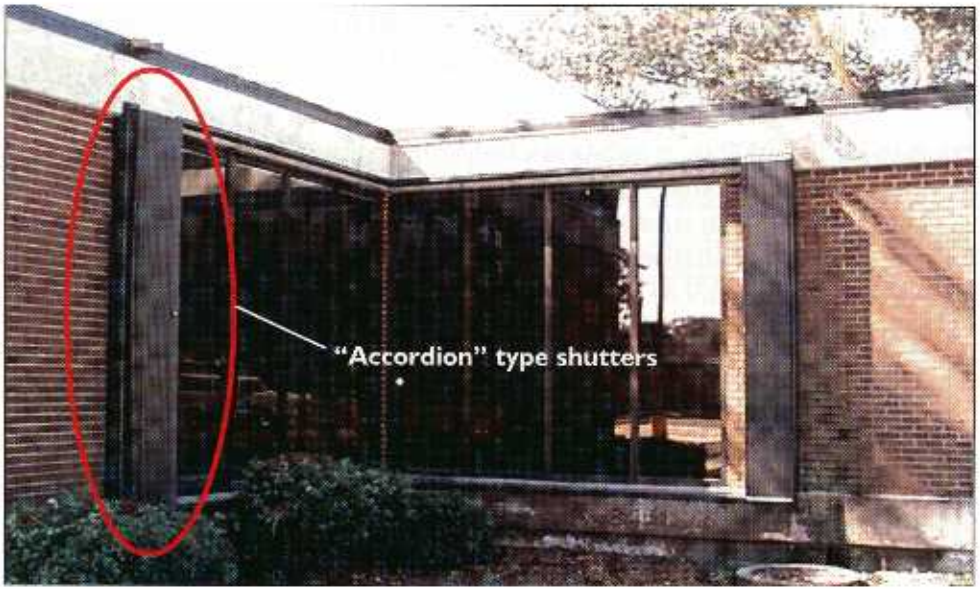

FIGURE 5-16 Window shutters on the Escambia County Administration Building.

5.3 Manufactured Homes in the Florida Keys

On October 11, 1998, damages to manufactured homes on Cudjoe Key, in Monroe County, Florida, were assessed. Wind gusts were estimated at 105-110 mph in this area [NWS 1998]. Hurricane Georges, although not a design event, was a good test of the ability of manufactured homes constructed to current standards to withstand wind damage. Only manufactured homes on Cudjoe Key were assessed; other types of housing (including modular housing) or public buildings were not included in the assessment. Therefore, the discussion that follows only pertains to manufactured housing.

The U.S. Department of Housing and Urban Development (HUD) regulates construction of manufactured homes (HUD-labeled homes), except modular units and units with the chassis removed and installed on permanent foundations. HUD regulations stipulate construction standards for manufactured homes that vary depending on the wind exposure where the home will be installed. Manufactured homes built after July 13, 1994 for Wind Zones II and III, and that are to be installed in the NFIP V-Zone within 1,500 feet of the coast, are required to have an increase in structural resistance to wind meeting American Society of Civil Engineers (ASCE) 7 Exposure D. Further provisions regarding wind-resistant doors and windows are required for manufactured homes built after January 17, 1995.

The State of Florida, Department of Highway Safety and Motor Vehicles regulates the installation of manufactured homes, except modular units which are built and installed to meet the requirements of the Standard Building Code. The state regulations are enforced at the state, county, and/or municipal level.

In addition to HUD and State regulations, the NFIP requires participating communities to adopt and enforce regulations that require that new manufactured homes and manufactured homes in SFHAs that have been substantially damaged to be elevated to the BFE and anchored to resist flotation, collapse, or lateral movement. In existing manufactured home parks or subdivisions, such as those in the area the BPAT assessed, replacement homes are only required to be elevated on a permanent foundation, and to a height of 36 inches or to the BFE, whichever is lower. If a manufactured home in an existing manufactured home park is substantially damaged by a flood, then any future manufactured homes on that lot must be elevated to the BFE.

The NFIP regulations are adopted and enforced by Monroe County as part of its floodplain management ordinance. HUD and state installation requirements for new manufactured homes are also enforced by Monroe County. In addition to the enforcement of these requirements, Monroe County has adopted provisions into its building code for foundation systems and installation of used manufactured homes.

Wind and coastal storm surge damages were evaluated on Cudjoe Key. Elevated homes were exposed to only limited storm surge; most damage was attributed to wind. In general, manufactured homes built after implementation of the new HUD and state regulations (July 1994) performed much better than older (pre-1994) manufactured homes. Damage to the newer homes was superficial and often could be attributed to an attached awning or the impact of airborne debris from an adjacent structure. The manufactured home in Figure 5-17 was located directly in the path of the storm just to the east of the eye and received maximum wind exposure. The home itself sustained only ancillary damage as a result of the awning being torn away.

FIGURE 5-17 This home suffered damage when its awning blew off. The lot next door contained an older manufactured home that was completely destroyed by high winds and coastal surge.

The successful performance of new manufactured homes installed in the Florida Keys can be attributed to four major factors:

- Manufactured homes constructed after July 13, 1994, are built to resist higher wind speeds and Exposure D and are therefore more solidly built and installed.
- The State of Florida has strong installation standards, which include a manufactured home installer education, testing, and certification program for the HUD homes;
- Monroe County's enforcement of NFIP, HUD, and state requirements; and
- The public and local governments are well educated about the new building standards.

Foundation systems for the manufactured homes installed during the past four years were typically reinforced concrete or reinforced masonry piers (Figure 5-18). These homes were at or above the coastal storm surge elevation experienced during Hurricane Georges. Most of these homes experienced only non-structural damage to lower area skirting. In some cases, water damage occurred to insulation below the floor.

FIGURE 5-18 Reinforced masonry pier foundation system under a newer manufactured home that performed well. The air conditioner compressor (circled) washed under the home provides evidence of the coastal surge at this location.

Homes generally appeared to be well anchored to the foundation piers. Many had steel plates attached to the piers and secured to the frame with large bolts (Figure 5-19). There were usually at least three connections per beam under the home. The minimum number observed was two, located at the ends of each beam.

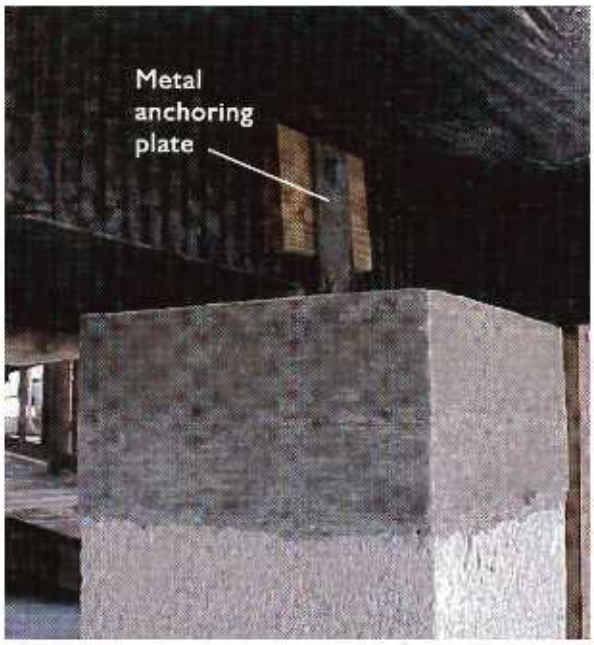

FIGURE 5-19 Reinforced masonry pier with metal anchoring plate.

As stated earlier, most of observed damages were to older manufactured homes that were not constructed to the current HUD code or installed to the current standards that are being enforced by Monroe County. Aside from the home construction standards, deficiencies in older manufactured homes include a lack of adequate elevation, the use of un-reinforced piers (dry stacked blocks), inadequate anchors, and attached site-built additions. Although these issues are addressed in the current regulations enforced by the county, it is important to mention them in this report.

Older manufactured homes were typically elevated 1 to 2 feet on dry stacked blocks. These homes were damaged and sometimes destroyed by a combination of wind and coastal storm surge (Figure 5-20).

FIGURE 5-20 Older, non-elevated manufactured home with an addition that sustained substantial damage.

Some of the anchoring and installation problems observed on older homes included poorly attached anchors, lack of corrosion resistant materials, and homes not anchored tightly against support piers (Figures 5-21 to 5-23). Another anchoring problem observed was improperly attached tie-down straps (Figure 5-24). Figure 5-25 shows a correct strap installation that was observed.

FIGURE 5-21 This anchor is only encased on the edge of the concrete fill pad and could easily be dislodged when the home is subjected to more severe wind or flood loads.

FIGURE 5-22 Inadequate turnbuckle anchor installed by homeowner on this older manufactured home. The home was severly damaged due to the lack of elevation, an unreinforced foundation system, and poor anchoring.

FIGURE 5-23 Rusted anchor under an older manufactured home. The State of Florida mandated galvanized anchors after January 1, 1999.

FIGURE 5-24 Improper strap installation. The buckle should be positioned where the strap wraps around the beam as shown in Figure 5-25.

FIGURE 5-25 Proper strap installation.

Manufactured homes that sustained the most damage appeared to be older homes with attached decks, porches, and awnings (Figure 5-26) Although undamaged during this storm, the manufactured home in Figure 5-27 could sustain significant damage if hurricane-force winds or storm surges were to get under the deck and pull it away from the building. It should be noted that site-built, attached additions to manufactured homes are no longer permitted after March 1997.

FIGURE 5-26 The addition to this manufactured home was destroyed, causing considerable damage to the rest of the home.

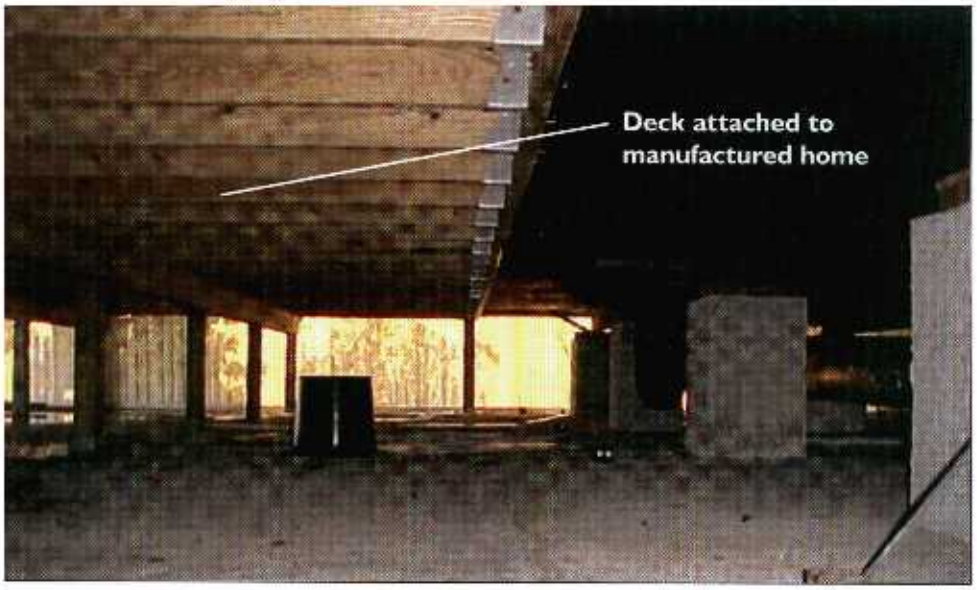

FIGURE 5-27 The underside of a deck that has been attached to the sidewall of a new manufactured home. The deck is not anchored as well as the home.