Building Better

New Building Code & Upgraded Power System

On September 18, 1989, Hurricane Hugo, a powerful Category 4 storm, passed over the Virgin Islands with maximum sustained winds of 130 miles per hour, leaving near total devastation in its wake.

Case Studies

U.S. VIRGIN ISLANDS

A Presidential disaster declaration was signed on September 20, 1989. Losses of $1.5 billion (mostly concentrated on St. Croix) included damage or destruction of 95 percent of the buildings and 90 percent of the power supply system. Nearly every public building on the island, including the hospital, schools, housing projects and shelters, sustained major damage or were destroyed.

All communications with Puerto Rico and the mainland were severed, and the airport control tower was destroyed, interfering with the emergency shipment of personnel, supplies and equipment. The low-lying areas of Christiansted and Fredericksted were pounded by a combination of a ten-foot tidal surge and heavy seas. All port facilities, marinas, and approximately 100 boats were damaged or destroyed.

FEMA and the Government of the Virgin Islands began an immediate effort to identify measures to mitigate damage from future storms. Mitigation measures included developing projects to harden the power grid, upgrade the building codes and the building practices of the island, and institute public education programs to show residents the value of mitigation measures.

House on right was built after previous hurricane beyond the building code standards that were adopted by the VI Government. Recommended mitigation measures were used throughout the house.

Building Better Buildings

With FEMA support, a new building code was written and implemented. This code requires anchoring systems, hurricane clips, shutters and other measures intended to hold buildings together and prevent flying debris during storms. Piers, water production, distribution facilities, and oil storage facilities were strengthened. A massive public education effort was carried out to inspectors, contractors, and owners about proper building practices and other mitigation strategies.

St. Croix's Central High School students walk to the gymnasium that was part of an initiative to strengthen the roofs of public buildings on the island to withstand sustained winds of 110 mph.

Following Hurricane Marilyn in September 1995, the Governor's office initiated a comprehensive program to repair damaged roofs. The Home Protection Roofing Program provided nearly 350 homeowners with roofs designed to stay on through a Category 2 storm. Many of the homes damaged by Hurricane Marilyn still had temporary roofs when Hurricane Bertha hit ten months later in July 1996. Additional mitigation funding was made available to expand the roofing program following Hurricane Bertha.

Hurricane Georges, in September 1998, put these measures to the test with excellent results. Georges generated sustained winds of 100 mph on St. Croix. Public and private efforts had retrofitted or rebuilt most of the structures on the island by September 1998. Damage to homes was limited to less than two percent of the private homes on the island. All hotels survived with little or no damage. Power was interrupted to 15 percent of the island but was almost fully restored within three weeks. Schools and other public structures provided safe havens for residents.

Designing buildings to withstand a Category 2 storm or 110 mph winds will not protect the island in the event of a higher-level storm, but it will prevent major damage in 87 percent of the storms. Some day, a major hurricane with winds of more than 110 mph will hit the islands, but until that day, minimal damage can be expected. Even then, damage will be considerably less than it would be without the mitigation measures of the past decade.

Upgrading the Power System

An even more critical need was to upgrade the electrical distribution system to make it weather resistant. Without power, the island could hardly begin the long and tedious process of reconstruction and recovery.

The high winds accompanying Hurricane Hugo (September 1989) and Marilyn (September 1995) caused a total disruption of the power system. High winds damaged electric poles and downed power lines. In addition, the failure of roofs and structures caused a large volume of flying debris that caused further destruction of the transmission system components. Most power plants and substations sustained major damage. Power poles in some areas had a 60 percent failure rate. Supplies of fuel to the generating plants were interrupted. In some areas, power was not restored for up to eight months following Hurricane Hugo.

Raymond L. George, Executive Director of the Virgin Islands Water and Power Authority talks about the power system upgrade which included hardening of the power grid. Due to the system damage reduction measures, the power outages were limited to only 15% of the island.

After Hurricane Marilyn, the power distribution system was knocked out in St. Thomas. Approximately 30 percent of the poles surveyed were down. Of the downed poles, about half were broken and the rest were either leaning or on the ground. The most damage to major feeder circuits and primary lines occurred in the downtown area of Charlotte Amalie. About 50-60 percent of the poles were not working in that area, because the poles supported two power circuits, large joint communications cables, and larger power conductors and transformers, which significantly increased the transverse wind loading.

U.S. Virgin Islands

In the wake of these hurricanes, a concerted planning effort was undertaken. The problems included exposed generating plants and substations, a centralized system with little redundancy, and a high rate of power pole failure.

Using Public Assistance and Hazard Mitigation Grant Program (HMGP) funding, the Government of the Virgin Islands began a series of major projects to remedy these problems:

Denise Joselyn, Manager, Coakley Bay Condominiums, rebuilt her rental property to exceed building codes.

- To ensure reliable transmission of power, procedures were instituted to ensure burial of poles to proper depths and to ensure that they would not be overloaded with multiple lines and other equipment. An undersea cable to St. John was constructed to ensure that power could be provided to that island. Power lines within major urban areas and to critical facilities were buried.
- The power grid was decentralized by building new substations. Smaller areas could be re-energized and a failure in the area would no longer take down the whole system.
- The generation and distribution facilities were enclosed to ensure that power could be produced.
- A new pier to accommodate oil barges in St. Croix and new oil storage tanks to provide additional storage capacity were built to ensure the supply of fuel to generation plants.

After Hurricane Georges (September 1998), power was interrupted to 15 percent of the island of St. Croix but was fully restored within three weeks. Very few poles were down. All of the substations and other projects built since Hurricane Hugo survived undamaged. In fact, most of the time taken to restore power was needed to inspect portions of the power grid before re-energizing the system. This achievement can be attributed to MITIGATION projects that were undertaken and completed after Hurricanes Hugo and Marilyn. The Virgin Islands Water and Power Authority (WAPA) decentralized their power generation system and diversified their fuel sources.

Business owner, Robert A. Armstrong, points out how proper building practices implemented in his hotel's new structure can help strengthen the buildings and also keep his 300-year old Buccaneer Hotel open for business.