instances the floodwall foundations gave way prior to the floodwalls' overtopping.

Primarily because of subsidence over the past 35 years, flood protection structures along the Inner Harbor Navigation Canal (IHNC) were also below their original design and construction elevations. Because most of the floodwall failures in the IHNC resulted from instability caused by overtopping and scour on the back side of the walls, their lower elevations likely contributed to overtopping and the resultant scour and breaching.

Although flood control structures in St. Bernard and Plaquemines Parishes were subject to the same issues of elevation measurement discrepancies and subsidence as those in Orleans Parish, these issues were not found to be significant factors in the structures' performance, as Katrina's surge and wave levels far exceeded their design criteria anyway.

Lessons Learned

In summary, elevation surveys and methodology need to be

- coordinated and standardized among all agencies involved in design, construction and maintenance of the hurricane protection system
- expanded to accurately monitor subsidence and water levels, upon which correct evaluations of flood control and hurricane protection elevations rely
- verified on the ground to confirm accuracy
- updated frequently
- adequately documented

The team issuing Volume II of the IPET report further recommended that a partnership between USACE and NOAA be established to develop routine, accurate monitoring of protective structure and surface drainage elevations and significantly improve baseline elevation data for near-term and long-term risk/reliability assessments of hurricane protection in the region.

For more information on this topic, please refer to Volume II of the IPET Report.

IPET Report Summaries

Geodetic Vertical and Water Level Datums

The Interagency Performance Evaluation Task Force (IPET) was established to provide scientific and engineering answers to questions concerning the hurricane protection system in the greater New Orleans area following Hurricane Katrina on August 29, 2005. Because the analysis of the breaches of levees and floodwalls is critically dependent on ascertaining the depth of the water and the height of the structures, a team composed of personnel from the U.S. Army Corps of Engineers (USACE) and the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) updated the elevations of the reference points, or bench marks, for the region's geodetic and water level reference datums. Previously the design, construction and maintenance of the hurricane protection system's structures had been based on the incorrect datums. Using the new reference points, the current elevations of the existing hurricane protection system

structures were accurately determined. The team's account forms Volume II of the nine-volume IPET draft final report released on June 1, 2006.

Overview

The team defined and evaluated a vertical reference framework for the IPET to use in modeling Katrina's surge and wave conditions and the performance of the hurricane protection system's components in response to those conditions. The IPET's surveying support accurately determined the elevations of levees, floodwalls and pump stations to use in the modeling. Further, the team evaluated the elevation information and the assumptions used to design and construct the flood control and protection structures.

To reconstruct storm events and determine how the hurricane protection system performed, the IPET needed accurate elevations for calculating

- heights of waves and storm surge
- heights of existing levees and floodwalls
- extent and depth of flooding
- water levels relative to structure heights at the time of breaching
- heights for associated structures such as pumping stations

The Importance of Accurate Measures

The area of New Orleans experiences rapid and variable subsidence, making it very difficult to maintain up-to-date knowledge of the heights of structures relative to water levels. Maintaining current reference datums for both land (geodetic) and water has been a continuing challenge for the region.

Flood control structures were designed, modeled and authorized relative to mean sea level (water level reference datum) but built relative to a terrestrial measure (geodetic vertical datum).

The terrestrial measure was incorrectly assumed to be equivalent to the water level datum. Using the terrestrial-based measure instead of the water level reference datum for design and construction caused some structures to be built too low.

Consequences of Inconsistent Measures

In the Lake Pontchartrain Lakefront Outfall Canals in Orleans and Jefferson Parishes (London Avenue, Orleans Avenue and 17th Street Outfall Canals), structures were built one to two feet lower than intended. Land subsiding, or sinking, since construction added to loss of protection.

Failures at 17th Street Canal and London Avenue Canal, however, were not caused by floodwall elevations falling short of design specifications. In these

For the complete report, visit https://ipet.wes.army.mil