Trouble on the Texas Coast

Figure 1 - The Galveston seawall. Note absence of beach.
Photograph by W.T. Lee, USGS Photo Library, Denver, CO.

The Texas coast, like much of the Atlantic margin and Gulf Coast of the United States, is rimmed with barrier islands and barrier peninsulas. The area is particularly vulnerable to alteration by natural forces because it is frequently subject to severe storms, which are accompanied by elevated tides (storm surges, commonly several meters or more above normal high tides), strong winds, and high waves. Over the last century, an average of one tropical storm a year has made landfall somewhere along the Texas coast, and a hurricane has struck more than once every five years. A particularly fierce storm hit Galveston, Texas, in 1900, washing away two-thirds of the city's buildings and causing six thousand deaths. Modern meteorological monitoring and improved communications have greatly reduced the number of hurricane deaths in recent decades, but the shifting shoreline poses a continuing challenge to structures.

A period of quiet weather in the 1950s was accompanied by a rush of development along the Texas coast; another period of accelerated building occurred in the 1970s. The number of structures at risk continues to grow. Meanwhile, the landward retreat of the beaches also continues, at an average rate of 2 to 7 meters (6 to 23 feet) per year. In some especially unstable areas, shoreline changes of more than 20 meters per year have been recorded.

As in other dynamic environments, stabilization efforts have had mixed results. In 1902, in response to the devastation of the 1900 hurricane, the Galveston seawall (figure 1) was built. The nearly 16-kilometer-long, 6-meter-high structure, built at a cost of $15.5 million (including the cost of raising houses by as much as 4 meters behind the seawall), has offered valuable protection to structures on land, especially during subsequent storms. However, it has also demonstrated some of the permanent changes that can result from seawall construction.

As noted in the chapter, a portion of wave energy is reflected back from smooth-faced seawalls, so the sand in front of them is more actively eroded than it might be in the absence of the wall. Longshore currents are commonly strengthened along a seawall, and the seawall cuts off the supply of sand from any dunes at the back of the beach to the area in front of the seawall. The result, typically, is gradual loss of the sandy beach in front of the seawall within fifty years of its construction. The beach in front of the Galveston seawall, once up to several hundred meters wide, is virtually gone now. Moreover, the unprotected area at either end of the seawall is being eroded very rapidly. Changes caused by the seawall have made it likely that the seawall will eventually have to be replaced by another, larger, more expensive structure.

Beach replenishment has not often been practiced on the Texas coast, partly for lack of funds and partly for lack of suitable replacement sand. Such an effort was undertaken at Corpus Christi, however, using sand from a nearby river. It has succeeded in the sense that a sandy beach has been preserved there. On the other hand, the river sand is much coarser-grained than the original beach sand. It has stabilized at a steeper slope angle, both above and below the waterline, than characterized the original beach, and the beach has consequently become less suitable for use by small children. Also, of course, the replenishment efforts must continue if the new beach is not to be eroded away in its turn. The vulnerability of the area is illustrated by the breaching of sandy barrier islands by sand washout during storms.

Beach-replenishment efforts in barrier-island regions elsewhere on the east coast of the United States have been rather less successful. If "beach life span" is defined as the length of time required for 50% of the new sand to be lost, that life span has been estimated at less than two years in 40% of cases, 2 to 5 years in nearly 50% of cases, and more than five years in only 12% of cases. Such observations have led one investigator to conclude that "(1) the parameters used to design beaches don't work, (2) predictions of beach durability are *always* wrong, and (3) nobody in the coastal engineering community evaluates past projects, so no progress has been made in understanding beach replenishment. In addition the public is unaware of the uncertainties of beach replenishment and, consequently, the taxpayers take it on the chin" (Pilkey 1989 p. 308). Whether or not this is overly pessimistic, experience certainly supports the general truth of two principles: first, that shoreline engineering permanently alters the shoreline, and second, that once shoreline engineering is begun, it must be continued unless structures or beaches are ultimately to be abandoned.