2.3.1 Erosion and Scour

Where sand dunes existed before Hurricane Opal, significant loss of dune height and width was observed. Many dunes were breached or flattened (see Figure 2-3). Those that remained after the storm were scarped and weakened. Duneface retreat of 75 feet to 100 feet was observed in several locations. Overwash of eroded dune sediments was common, sometimes extending over 500 feet inland and causing burial of roads and at-grade construction by 1 to 4 feet of sand.

In some cases, an estimated 10 to 20 feet of vertical relief was lost at the seaward edge of high dune and bluff areas. Many structures atop high dunes or bluffs collapsed because of a loss of support, either from the undermining of slab foundations or from inadequate pile embedment (see Figure 2-4).

Ground levels at many front-row elevated structures that survived Hurricane Opal were typically reduced 3 to 7 feet, or more. In addition, local scour depressions were observed at the bases of many piles, indicating that 6 to 12 inches of additional soil was lost immediately adjacent to the piles. Scour during the storm probably rendered greater than 6 to 12 inches of soil around the piles unsupporting.

Large scour depressions were observed where large volumes of water flowed during the storm. Depressions measuring 10 to 40 feet in length and width and 2 to 4 feet in depth were observed around some pile-supported structures and near the corners of some at-grade construction. Structures that seemed particularly vulnerable included the following:

- structures at the landward termination of roads and driveways that funneled floodwaters toward the structures
- structures between drainage basins or lakes and larger bodies of water
- structures near locations where floodwaters crossed or breached the barrier islands

2.3.2 Debris

Small debris was widespread, ranging from household items to construction materials. These items did not cause structural damage to buildings, foundations, or other building components. Evidence of much larger debris shifted by floodwaters was also observed, including pier piles and braces, concrete slabs, dumpsters, automobiles, boats, and collapsed houses (see Figure 2-5). Many of these objects washed into buildings, and some caused structural damage.

2.3.3 Slab Foundations

Many slab failures were noted in all types of structures (see Figure 2-6). The major reason for these failures was the loss of support coupled with a lack of reinforcing in the slabs. Welded reinforcing wire fabric was observed in many slabs but did not prevent failure of the slabs once they were undermined.

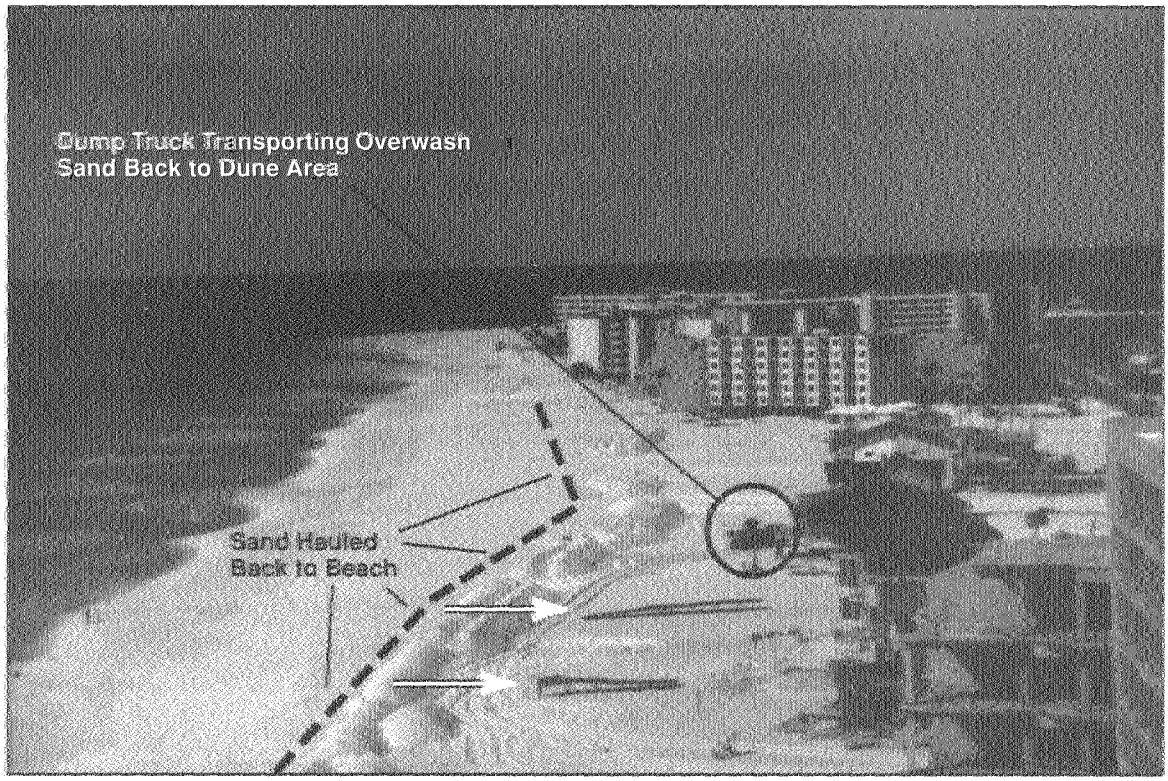

Figure 2-3 *Beach erosion eliminated protection for structures. It is important that the beach and dunes be rebuilt as soon as possible. Arrows point to walkways used to traverse dune that has been washed away.*

Figure 2-4 *Erosion such as this took place along the gulf coast, causing structures to be undermined and resulting in damage.*