

**EVALUATION OF FUNCTIONAL BEHAVIOR OF SHORE  
STRUCTURES AND RELATED SHORELINE PROCESSES IN  
SUPPORT OF PLANNED 1985 BEACH NOURISHMENT  
AT ATLANTIC CITY**

Robert M. Sorenson

Professor of Civil Engineering  
LeHigh University

J. Richard Weggel

Associate Professor of Civil Engineering  
Drexel University

Introduction

Atlantic City occupies the northern half of Absecon Island, an 8.2 mile long barrier island having a northeast-southwest orientation, and is located about 40 miles north of the lower tip of Cape May. Features of interest are shown in Figure 1. Absecon Inlet is partially controlled by the Oriental Avenue jetty at Atlantic City and the Brigantine jetty. Since construction of the Brigantine jetty (1952-66) a fillet/shoal has formed inside the channel and connected to the jetty. In addition to the famed boardwalk there are four piers and several stone and wood groins. For more detail on the shoreline structures and their history see McCann (1981). FitzGerald (1981) discusses the recent geomorphic history of Absecon Inlet and the adjacent Atlantic City shoreline.

The beach at Atlantic City has been nourished in 1948, 1962, and 1970. A beach fill project is scheduled for 1985 with the sand to come from Absecon Inlet. Recently, the Oriental Avenue jetty and three of the groins have been modified. This paper reports on a study currently being conducted by the co-authors to evaluate the effect of these recent structure modifications on potential fill stability and to propose any desirable structure changes; to recommend the best source for beach fill; and to recommend the volume and location of fill placement in 1985. Some tentative recommendations are made - final, more detailed recommendations will be made in a later report.

Civil Works at Atlantic City

From February to May 1963, after the devastating March 1962 storm, 600,000 cubic yards of sand were taken from the inlet fillet and channel and placed on the beach over a distance of 3800 ft southwest of the Oriental Avenue jetty. In June and July 1970 320,000 cubic yards of

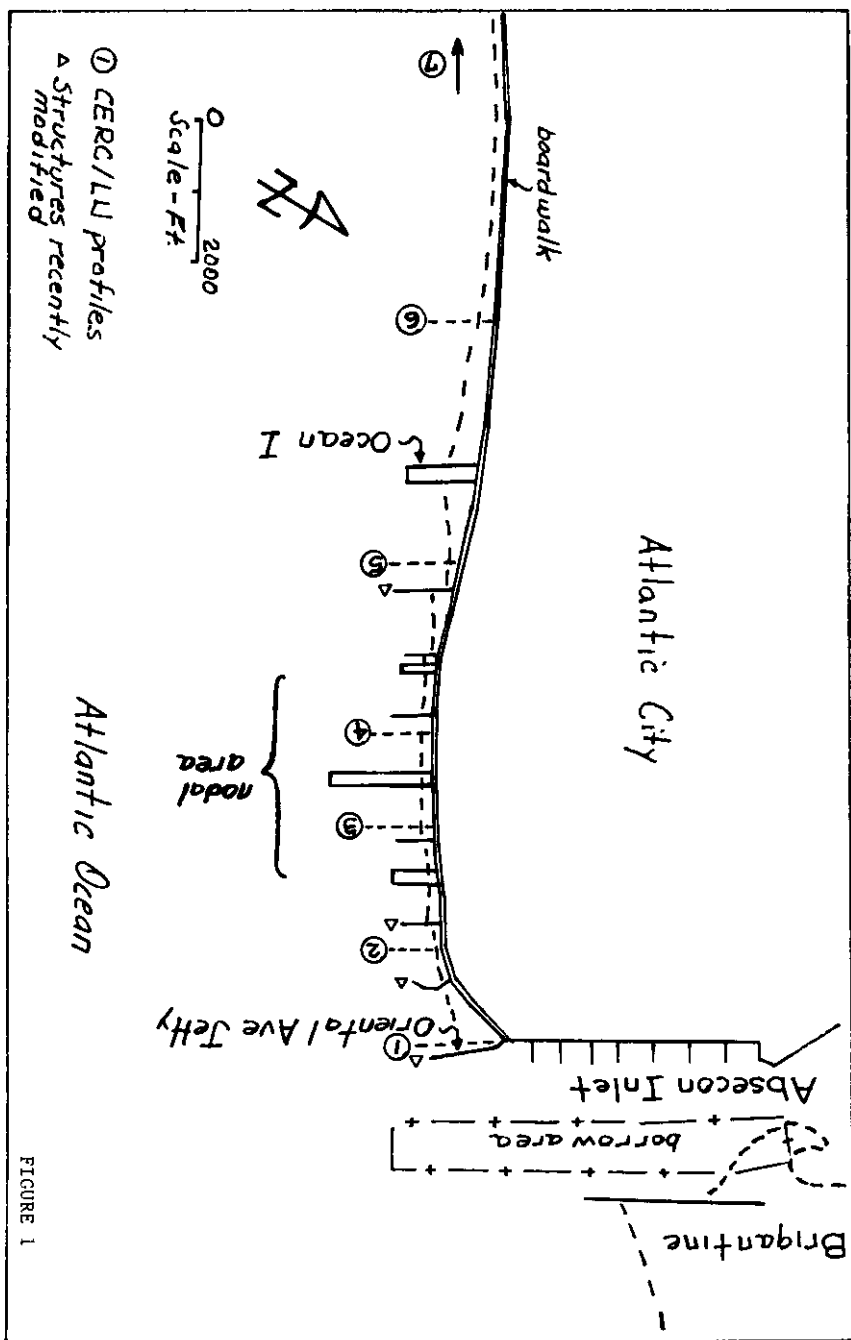


FIGURE 1

sand were taken from the inlet fillet and channel and placed over 4800 ft of the beach southwest of the jetty. Each time, in the filled sections, the berm was widened to extend approximately 300 ft out from the boardwalk. Everts, et al. (1974), using profile data collected by the Coastal Engineering Research Center (see McCann, 1981) have documented the rapid removal of this fill. Most of the sand was carried southwest to naturally nourish beaches downdrift of the fill area. However, much of the sand moved offshore and some sand must have been carried over the Oriental Avenue jetty; both actions causing a net loss of beach sand above MSL at Atlantic City.

Using funding authorized under the 1977 New Jersey Beaches and Harbors Bond Act, four of the structures at Atlantic City were upgraded (see Figure 1). The crest elevation of the 1180 ft long Oriental Avenue jetty was raised from +7 ft MLW to +11 ft MLW. The next structure to the south, a dog-leg shaped groin, was extended 200 ft resulting in a C-shaped plan form. The third structure south of the inlet, a straight stone groin, was rebuilt at its outer end. And, an existing wooden groin just north of the Ocean I pier was extended 300 ft. The first three structures are north of the usual diverging drift nodal zone which is typically located between Garden Pier and Central Pier; while the other structure is to the south.

A 1983 New Jersey Shore Protection Bond Issue will provide funds, which should be available in 1985, for renourishment of the beach at Atlantic City. The State has requested permit authority to place 2.6 million cubic yards of sand on the beach to form a 300 ft wide berm from the Oriental Avenue jetty south to Ocean I pier. The berm is then to taper from 300 ft to 200 ft over the next 1500 ft of beach fill, and then to taper into the existing berm width of 200 ft within the next 1500 ft of beach. The sand would be taken from the proposed borrow area (Figure 1) in the inlet. The borrow section would stay at least 400 ft from the Brigantine jetty to preclude possible undermining of the structure, and sand would be dredged to depths of 25 ft below MLW.

#### Field Data Available

A wide variety of field data are available for evaluating conditions at Atlantic City. Sand size analyses are available for Absecon Island beaches (Ramsey and Galvin, 1977) as are wave gage data collected at the Steel Pier (Thompson, 1977) from 1962 to 1969 and wave hindcast data for 1956 to 1975 (Jensen, 1983). Historic charts of the inlet and Atlantic City shore dating back to the mid-1800's as well as recent hydrographic surveys of these areas made by the State of New Jersey and the Philadelphia District, Corps of Engineers are available. The State of New Jersey has also taken frequent air photographs of the study area since the 1962 storm. The usual wind and tide data are available. And, the Corps of Engineers (1974) has documented the history of civil works at the inlet and Atlantic City.

A most useful data set consists of periodic beach profiles, taken approximately monthly from November 1962 to April 1973, at seven locations (see Figure 1) by the Coastal Engineering Research Center (McCann, 1981). The profiles extend from the boardwalk out to wading depth. The survey period encompasses the 1963 and 1970 beach fills.

To supplement available field data, the authors will collect and analyze

sand samples from the inlet within the proposed borrow area. We are also collecting beach profile data at the seven C.E.R.C. profile lines plus an additional line between profile 5 and Ocean I pier.

#### Behavior of 1970 Beach Fill

In 1970, 830,000 cubic yards of sand were dredged from the inlet near the fillet and pumped to the beach face. The dredged sand had a median diameter of about 0.3 mm. The native beach sand median diameter decreased from average values of 0.35 mm at CERC profile 2 to 0.23 mm at profile 6 (Ramsey and Galvin, 1977). Thus the fill and native sands were essentially the same. The berm crest elevation after the fill was at around +8 ft MSL and the berm width was about 300 ft at profiles 2, 3 and 4. The berm width at profile 1 was over 600 owing to the shoreline plan form and the jetty. The fill section extended from the jetty to just south of profile 4.

A good indication of the response of the fill placed at and above MSL is given by the beach profiles plotted in Figures 2 to 5. The profiles are for CERC profile lines 1 to 4. Survey dates are: May 18, 1970, just prior to fill placement; August 26, 1970, just after fill placement; April 12, 1971, one year after start of fill placement; April 10, 1972, two years after start of fill placement; and May 29, 1984, fourteen years after fill placement.

The most dramatic beach change can be demonstrated by comparing the May 70 and August 70 profiles to see the amount of fill placed and then the August 70 and April 71 profiles to see how much of that fill was lost during the first winter. Some of the fill placed on top of the berm at profile 1 was likely lost over the jetty which had a crest elevation of about +5 ft MSL prior to its upgrading, or lost by wave overtopping of the jetty which washed sand off the berm to the offshore area. Much of the sand lost from the beach face at profiles 1, 2 and 3 was undoubtedly permanently lost offshore but much of it also moved alongshore. At profile 4 the net change during the first winter was small, as sand was lost to offshore but gained from longshore transport of sand from the profiles further updrift (northeast).

Comparison of the April 71 and May 84 profiles at lines 1, 2 and 3 indicates that as much (or more) of the fill was lost from this section of beach during the first winter than was lost during the following thirteen years. Of course, much of this sand was transported south and provided a benefit to beaches further down Absecon Island.

#### Tentative Recommendations

With a fixed amount of funds for beach nourishment at Atlantic City over the next several years, it appears to be more desirable to place a volume of fill that is only a portion of the proposed 2.6 million cubic yards and to fill the beach at more frequent intervals (e.g. every two or three years) than approximately once per decade as has been done since the 1948 fill. In this way the total volume of fill placed on the beach should remain for a longer period of time. Beach users will experience more uniform beach conditions over a period of years which will have a more favorable impact in the long run. The nourishment program would essentially be a periodic sediment bypassing operation

PROFILE 1 - 50 FT. SOUTH OF ORIENTAL AVE. JETTY

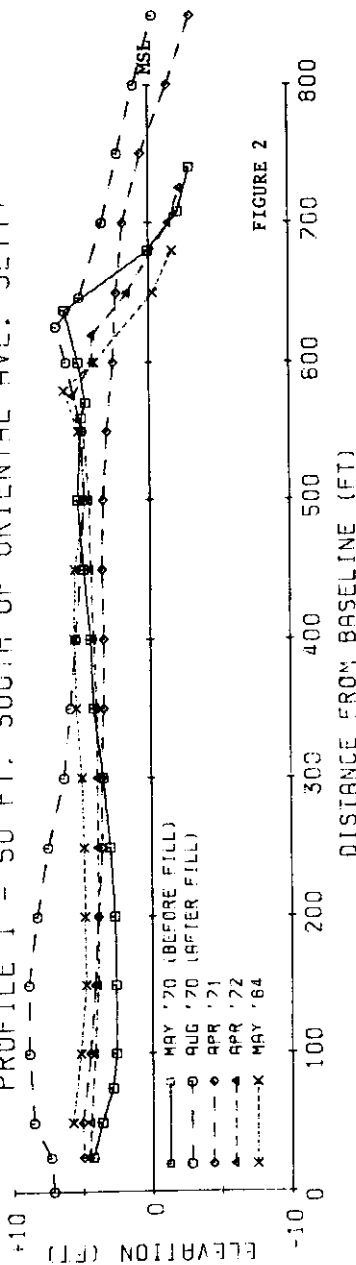


FIGURE 2

PROFILE 2 - RHODE ISLAND AVE.

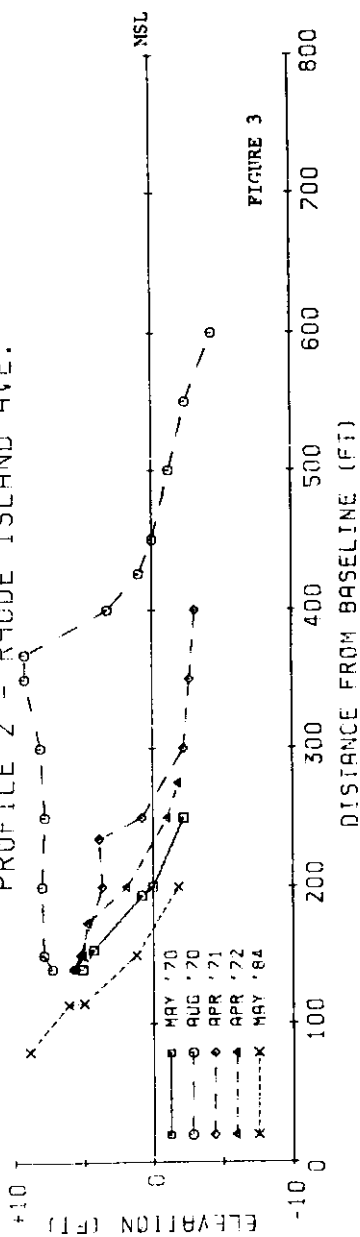
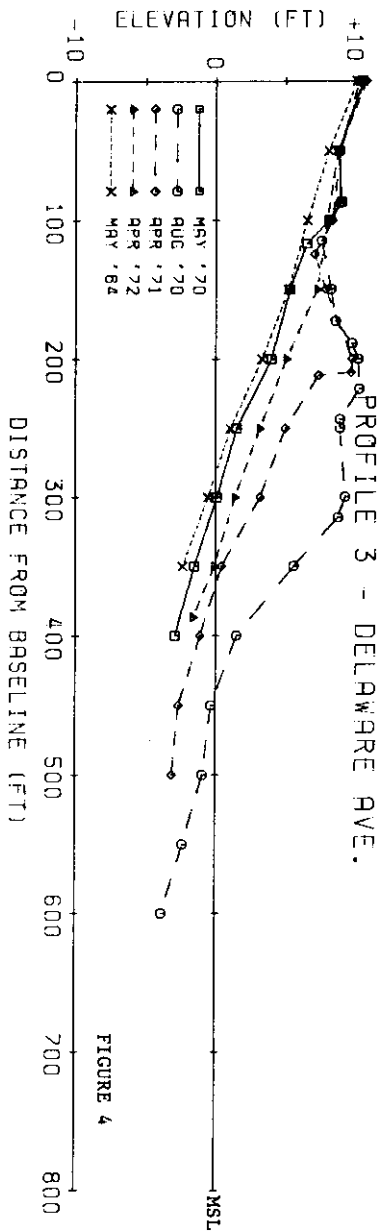
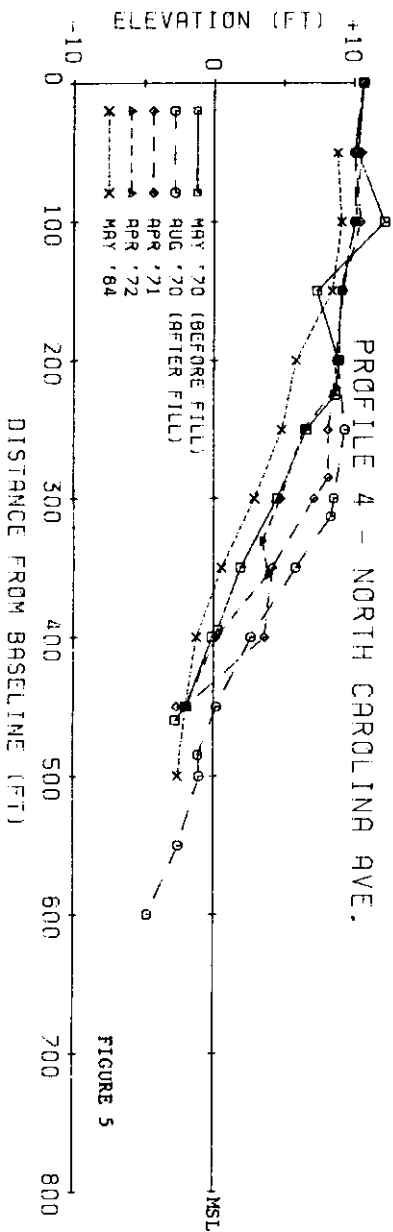


FIGURE 3



entailing removal of the southerly transport that deposits in Absecon Inlet and placement of it on Absecon Island for continued transport south with minimal loss offshore.

Based on the still incomplete analysis of sand samples from the inlet borrow area, it may prove worthwhile to take sand primarily from the inlet bar (at the outer ends of the jetties). This would be so if the sand from the bar is sufficiently coarser than the 0.3 mm median diameter sand previously used and thus have a greater retention time to wave action on the beach face. The growth of Atlantic City and the concomitant increase in vessel traffic into the inlet may require dredging of sand from the bar to maintain adequate navigation depths.

The raised Oriental Avenue jetty should have a positive effect in holding sand on the adjacent beach. However, modification of some of the groins might have a salutary effect on the beaches. Groins limit longshore transport and thus will hold sand in the area of greatest need (in the more active recreational areas) where the shoreline bulges seaward creating the diverging nodal zone. However, this means that sand is less able to transport alongshore and is exposed for a longer time to storm attack and loss offshore. Each of the major structures is being evaluated to ascertain its most useful geometry in light of these considerations.

#### Conclusion

Limited funding is available to nourish eroded beaches at Atlantic City, so this study is being conducted to optimize the planned nourishment project. A thorough study of the history of previous fills and the impact of existing structures on local shore processes is being carried out. Recommendations will be made on the best location for borrow material, the volume and location of fill placement, and any shore structure modifications that should prove beneficial.

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