Coastal Engineering Technical Note

SELECTING CONSTRUCTION PROFILES FOR INITIAL PLACEMENT OF BEACH FILLS

PURPOSE: To present a method for selecting a cross section where initial beach-fill material can be placed with conventional construction equipment so that wave action can distribute the material to the design profile.

GENERAL: When constructing a beach-fill project, placing all of the fill material according to the design beach profile may be impractical. The underwater portion of the equilibrium design profile roughly parallels the existing slopes; thus it may be necessary for the beach-fill profile closure to be located in water too deep for conventional construction equipment to operate. Also, considerably more borrow material than is required for the design profile may have to be placed if the borrow material contains more fines than the native beach sand. These fines will later be lost to winnowing action of the waves; but, initially, the greater volumes will present a placement problem.

The final profile that develops on a particular beach following the placement of fill is, to a large extent, dependent on the grain size distribution of the borrow material (fill) and the wave climate to which the fill materials will be exposed. If the borrow material is comparable with the native beach material, or is made so through the natural sorting action of the waves, discrete particle sizes in the borrow material tend to be redistributed from their original point of deposition to their equilibrium position on the profile. In so doing, the sorted borrow material tends to develop a profile similar to that of the natural beach.

The U.S. Army Engineer District, Wilmington, has developed a method for overbuilding the beach profile and allowing wave action to sort the grain sizes and shape the beach slope to approximate an equilibrium profile (see Figure).

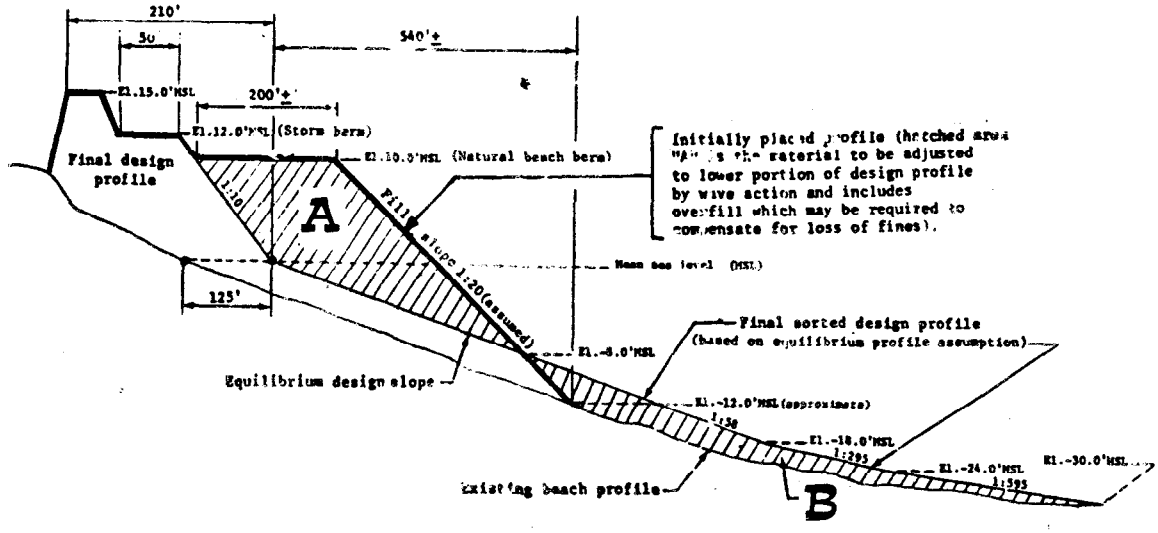

Figure Typical Section

(not to scale)

This method was used for beach-fill construction at Carolina Beach in 1970 and at Wrightsville Beach in 1981 and was also proposed for the design of Yaupon Beach and Long Beach, North Carolina (see reference).

PROCEDURE: The method involves overbuilding the beach fill during initial construction. This is accomplished by using a fill slope that is steeper than the equilibrium design slope on the seaward side of the fill structure, and then compensating for the required volume of fill, not placed on the design profile in deeper water (see area "A" in Figure). The construction berm is set at the elevation of the natural beach berm and the width determined by the volume of fill material required in the overbuilt profile including overfill of fines which would be lost from the final design profile through winnowing action of the waves. By stockpiling all the fill material on the upper portion of the beach, conventional equipment may be used.

During fill operations, the width of the overbuilt fill berm can be altered according to the actual foreshore and nearshore bottom slopes assumed by the fill. Adjustment can then be made as required in the placement operation to attain the required volume of the fill section.

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BACKGROUND: As shown in the Figure, the dune portion of the fill is fronted by a storm berm having a width of 50 feet at elevation, 12 feet above mean sea level; and a gently sloping beach which closes with the existing nearshore bottom at depths of about 30 feet below mean sea level. The project

fill in the final adjusted stage advances the shoreline to a position approximately 125 feet seaward of its original location.

PROBLEM: Since the project fill is designed for closure in a depth of about 30 feet, initial placement along the entire project design profile is not practical. Determine the construction dimension of the profile so that sufficient material is available in the profile to allow for adjustment to the final profile stage.

SOLUTION: Initial placement requires overbuilding the onshore and nearshore portions of the fill (see area "A" on Figure), thereby storing the material for the seaward position of the fill profile in a zone where wave action can, in time, redistribute the material to the seaward portion of the active profile (see area "B" on Figure). Steps in the solution to the problem are:

1. Calculate fill quantities required.
   (a) To obtain project dimensions, initial fill, including a 3-year supply of advance nourishment, requires about 234 cubic yards per lineal foot of the 9-mile project shore. This fill amount was estimated from the quantity of material that is required to obtain the design profile after final sorting.
   (b) With an overfill ratio of 1.3 obtained from comparing grain sizes of borrow material with native beach sand and assuming all the material will be sorted, the initially-placed beach fill averages about 304 cubic yards per lineal foot (234 x 1.3 = 304).
2. Calculate construction profile needed to contain total initial volume (304 cubic yards).
   (a) Choose reasonable construction fill slope (1 vertical to 20 horizontal). Experience on this type of beach has shown that fill slopes can be placed at 1 vertical to 20 horizontal.
   (b) Set maximum elevation of construction berm at the height of the natural beach berm (+10.0 feet, MSL).
   (c) Compute construction berm width which will contain total initial volume. Assuming a foreshore and nearshore bottom slope of 1 vertical to 20 horizontal, the overbuilt fill berm, obtained with this assumed slope and fill per lineal foot, is approximately 200 feet in width (see Figure).

3. Monitor construction profile. Depending on the method of placement, the construction fill slope may not be formed as estimated. The construction profile can then be adjusted, according to the actual fill slope that occurs, in order to maintain the required initial volume of fill.

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ADDITIONAL INFORMATION: For additional information contact the Coastal Engineering Studies Section, Wilmington District (919) 343-4778 or FTS 671-4778.

REFERENCE:

U.S. ARMY ENGINEER DISTRICT, WILMINGTON, "Hurricane-Wave Protection - Beach Erosion Control Brunswick County, N.C., Beach Projects, Yaupon Beach and Long Beach Segments," General Design Memorandum - Phase I, July 1973.