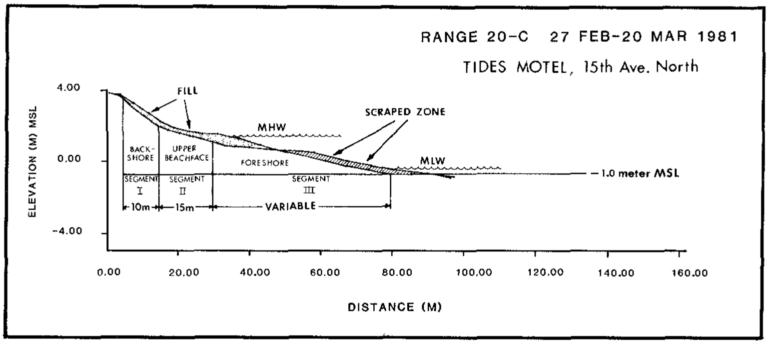

FIGURE 5. Representative reference beach cross-section in the central zone of Myrtle Beach. Principal borrow zones were along Segment III (foreshore) on intertidal ridges. Fill zones were located along Segment I (backshore) at or above the high watermark up to existing dune scarps or shore protection structures.

The backshore (Segment I) consists of a 10-m-wide section of the beach from the base of dunes or shore-protection structures and coincides with the zone of fill near high water. The upper beach face (Segment II) is designated as an arbitrary 15-m-wide zone which generally was undisturbed by scraping or fill. The lowermost segment (III) included the entire low-tide terrace and ridge system extending to the -1.0 m MSL contour. Width of Segment III varied from approximately 60 to 100 m, becoming narrower in the southern portion of the city, and incorporated all borrow zones. Table 1 is a summary of backshore station types over the project area. Note that the northern portion of the shoreline is dominated by dunes or sand fill, whereas the southern district is more commonly armored.

TABLE 1. Distribution of stations (%).

Region	Shoreline Length	No.	Armored	Natural Erosional Scarps	Dunes/ Old Fill
North	6.6 km	17	6%	12%	82%
Central	3.9 km	22	9	37	54
South	4.2 km	15	68	13	19
Overall	14.7 km	54	26%	21%	53%

Mean unit width beach volume from the dune line to the approximate -1.0 m MSL contour is given in Figure 6 for each zone of the project area. Also indicated are the proportion of armored versus natural stations and number of stations for each zone. Note the general decrease in unit beach volume from north to south. There was an average of 20 percent less sand in the reference sections along the more heavily armored southern zone than along the northern zone. All profiles were obtained over a 3-day period in November 1981.

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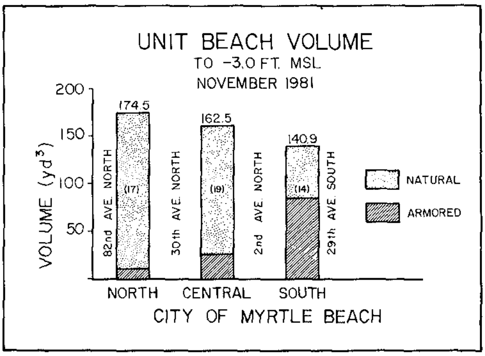

FIGURE 6. Mean unit-width beach volume for reference sections between the base of the dunes or the shoreline structures to the -3.0 ft (approx. -1.0 m) MSL contour. Relative proportion of armored versus unarmored stations and number of stations are indicated on each bar. Note the 20 percent decrease in unit volume from north to south correlating with increase in proportion of armored stations.

ARTIFICIAL BEACH CHANGES

Between March 1981 and May 1982, portions of Myrtle Beach were scraped along the lower beach and backfilled along the upper beach on three occasions. Approximately 25-50 percent of the project shoreline was directly affected by scraping or filling on the first two occasions. In some cases, borrow sections did not correspond to fill sections. This allowed evaluation of stations which were borrowed but not filled and vice versa. Total volume moved was approximately 29,000 m^3 during operations in March and June 1981. During a second-phase plan beginning January 1981, over 80 percent of the shoreline was scraped and filled (estimated volume 75,000 m^3).

PERFORMANCE EVALUATION

PHASE I CHANGES

Soon after the first sections of shoreline were scraped and backfilled, a minor northeast storm on 22 March impacted the Myrtle Beach area. The storm was sufficiently large enough to destroy a section of an ocean pier in the central zone of the project area. Beach measurements before and after the storm allowed evaluation of the effect of scraping and backbeach fill on selected portions of the shoreline. Figure 7 shows pre- and poststorm changes to the reference beach section (Segments I, II, and III, combined) for eight representative stations. All profiles were obtained between 21 and 24 March 1981. Figure 7 shows a trend of increasing erosion from north to south and somewhat higher erosion at armored stations (on average).

During the ensuing months, considerable natural recovery occurred. To illustrate how several representative stations responded, backbeach (Segment I) unit volume changes are given in Figure 8 for the period February-November 1981. The data represent short-term

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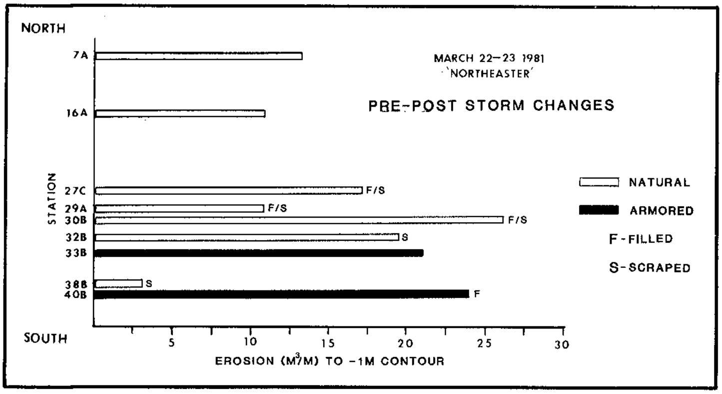

FIGURE 7. Pre- and poststorm beach changes at Myrtle Beach for 8 representative stations. Erosion is measured as the unit-width volume change (m^3/m) for a reference cross-section from the base of dunes or armor walls to the −1.0 m MSL contour.

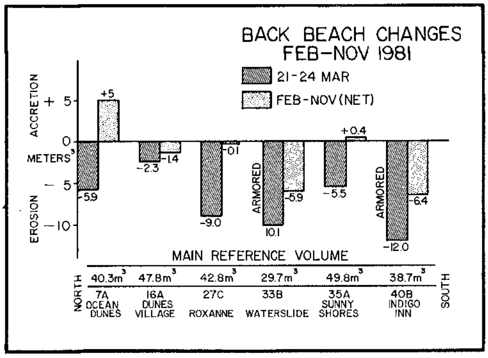

FIGURE 8. Representative poststorm (21-24 March) and six-month (February-November) backbeach volumetric changes for six variously armored, scraped, or filled stations along the project area. See Table 2 for status of each station.

erosion after the minor NE storm on 22 March 1981, and the net back-beach volumetric change along the landwardmost 15 m of beach. Profile data indicated were obtained on 27 February, 21 March, 24 March, and 8 November 1981. Table 2 gives the status of each station.

The zone that is compared in Figure 8 is the recreational back-beach area (Segment I). The response at each station varied, but several trends were obvious. All stations eroded along the backbeach between 21-24 March; losses being greatest at the two armored stations (33B and 40B). At Station 7A, the fill placed in June accounts for much of the observed recovery after the storm. But at the other

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TABLE 2. Status of each station given in Figure 8.

STATION) LOCALITY:	NOTES
7A) Ocean Dunes Hotel:	Scraped and backfilled with 8.5 m^3/m in June 1981; natural beach and dune system.
16A) Dunes Village:	Not scraped or filled; natural beach and dune.
27C) Roxanne Motel:	Filled with 8.5 m^3/m on 13 March before storm, but not scraped; Pleistocene scarp.
33B) Waterslide:	Not scraped or filled; vertical concrete bulkhead.
35A) Sunnyshores Motel:	Scraped and filled on 12 March before storm; natural scarp, no armoring.
40B) Indigo Inn:	Filled with 10 m^3/m on 20 March, but not scraped; vertical concrete bulkhead.

five stations, no fill was placed after the storm of 22 March. The response of these stations varied in large part as a function of the backshore armoring. Armored stations, 33B and 40B, eroded more during the storm (21-24 March volume change) and recovered less between March and November. On the other hand, unarmored stations generally eroded less and recovered to approximately their prestorm volumes. These trends were generally consistent for the entire data set of 54 profiles.

CHANGES THROUGH MAY 1982

Beach surveys were completed on ten occasions between February 1981 and May 1982 before, during, and after the three scraping and beach fill projects. Figure 9 summarizes the results, giving mean unit volume changes by zone (north, south, and entire shoreline); by beach segment (backbeach, upper heach face, and foreshore as defined in Figure 5); and by shoreline type (armored vs unarmored). Mean unit volumes were computed for each category for a particular survey and compared with the preceding survey to give the average change. Major trends of this data set include:

1) Erosion from February to April 1981 (pre- and poststorm of 22 March).

2) Accretion for the period May through October 1981.

3) Erosion between October 1981 and February 1982.

4) Net erosion for the entire period for armored stations.

5) Little net change for the period along unarmored stations.

6) Greater net change in the southern zone compared with the northern zone.

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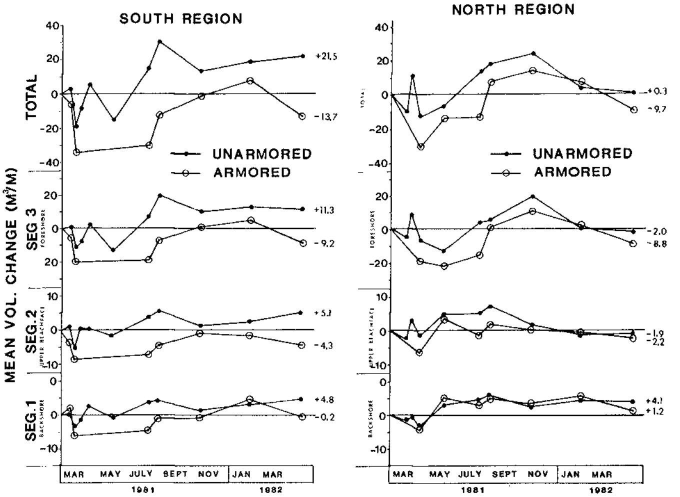

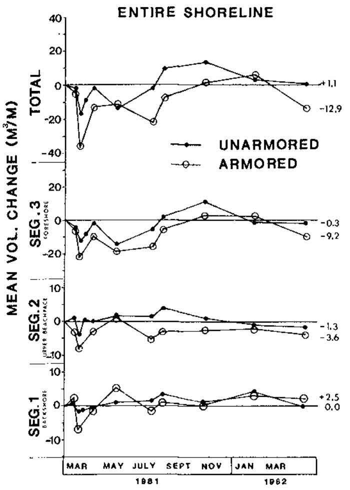

FIGURE 9. Mean unit volume beach change (m^3/m) between successive surveys by region (zone), shoreline type (armored vs unarmored) and beach segments; (-) erosion; (+) accretion. In almost every case, armored stations eroded more than unarmored stations during a March 1981 storm and recovered less during the course of the study.

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Note that in almost every division of the data, armored shorelines showed greater losses, although erosion/deposition patterns were similar in form between successive time periods.

Comparative profile plots in Figures 10 and 11 illustrate two extremes between a northern station (16A) backed by a natural dune field and a southern station (40B) backed by a vertical bulkhead. In the case of Station 16A, fill placed along the backbeach was aided by buildup of a low-tide ridge (June-November 1981) which provided additional sand to the profile and reduced the threat of erosion at high tide. This station had a higher-than-average beach cross-section. Station 40B, however, had a lower-than-average beach cross-section to begin with and a poorly developed, low-tide ridge. Despite the addition of fill on two occasions from an updrift source (i.e., the lower beach at that station was not scraped), the station continued to erode at a high rate. Empirical evidence suggests the higher erosion rate was at least partly due to the presence of a vertical wall at the station which was exposed to wave action at high tide.

There was considerable deviation from the mean in net volumetric beach change from one station to another for the period. Figure 12 gives the variation in unit beach volume change proportioned about the mean by zone for the entire data set. Banded areas indicate stations which were armored or responded like armor stations [such as cohesive mud scarps (Station 12A)]. In general, there is a correlation between net erosion and the presence of vertical walls or scarps. The greatest variation occurs between Stations 32A and 35A which are affected by a minor swash inlet and an exposed rock outcrop along the lower beach.

SIGNIFICANCE TESTING AND DISCUSSION

Numerous comparisons were made between portions of the data set by Svetlichny (1982) to determine the significance of the observed changes in profile volume. Various combinations of station types and scrape/fill status were tested using standard statistical procedures to evaluate difference of the means (Ostle and Mensing, 1975). Figures 13 and 14 give two results.

Figure 13 shows overall means by beach segment for armored versus unarmored stations. For the indicated time period, the backshore and foreshore segments were significantly different at the 90 percent confidence level applied to a t-test supporting the notion that erosion was greater along armored stations.

Figure 14 provides a comparison between scraped, filled, and unaltered stations for the generally accretional period, March-November 1981. Combining means for armored and unarmored stations by each division of the data, it was found that there was no significant difference (at the 90 percent confidence level) between scraped and filled stations compared with unaltered stations. However, stations scraped but not filled eroded significantly more than unaltered stations or stations which were scraped and filled. The data of Figure 14 compare changes during an overall accretionary period and indicate the backbeach (Segment I) changes were dwarfed by natural changes along the

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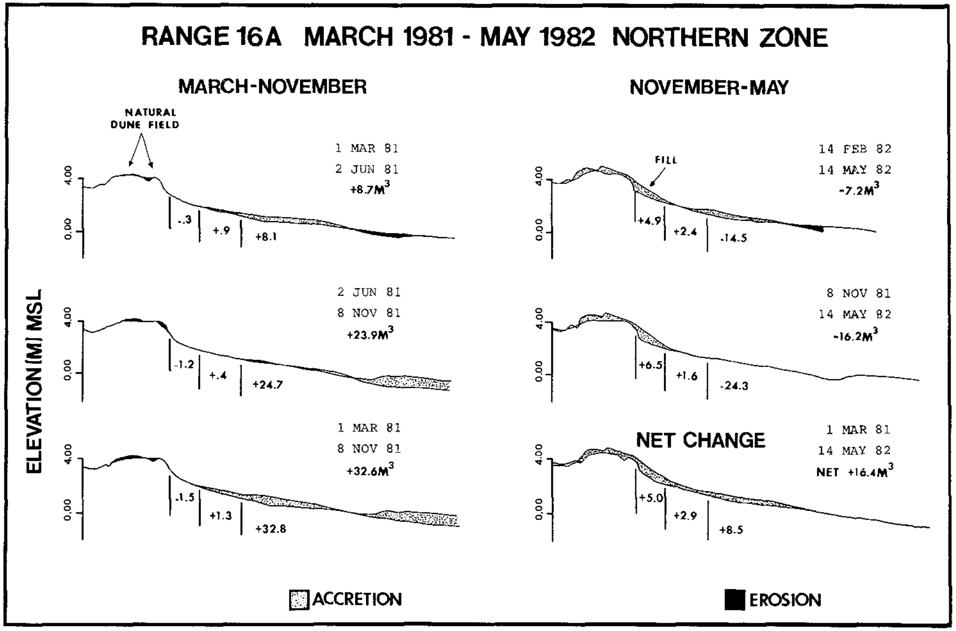

FIGURE 10. Comparative profiles for station 16A in the northern zone between 1 March 1981 and 14 May 1982. This station was backed by a natural dune field and developed a sizable, low-tide ridge during summer and early fall 1981. The lower beach was scraped and the backbeach filled with approximately 8 m^3/m in March 1981. Net accretion for the study period was double this amount.

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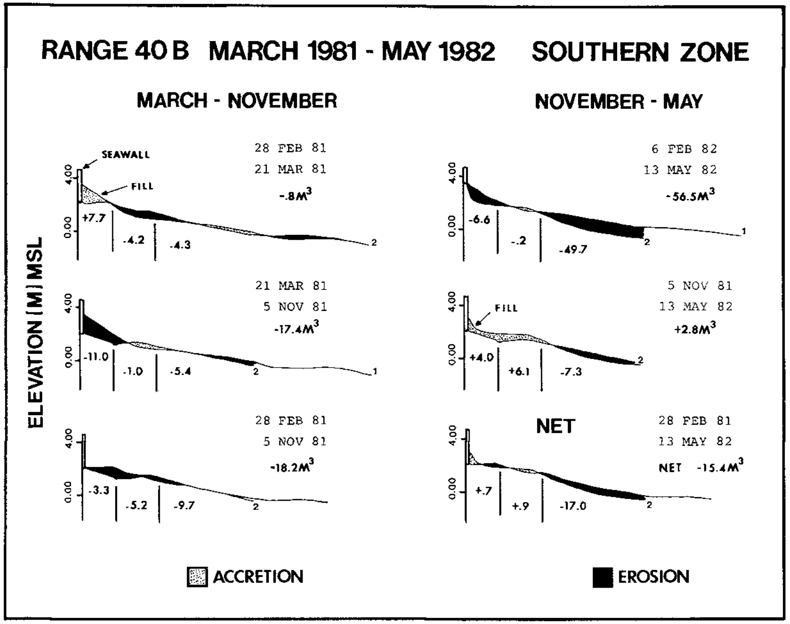

FIGURE 11. Comparative profiles for an armored station (40B) in the southern zone. This station was filled, but not scraped on two occasions, in March 1981 and February 1982. Note erosion of fill as well as the lower beach. Despite the addition of over 10 m^3/m from updrift sources, the station lost 15 m^3/m during the study period.

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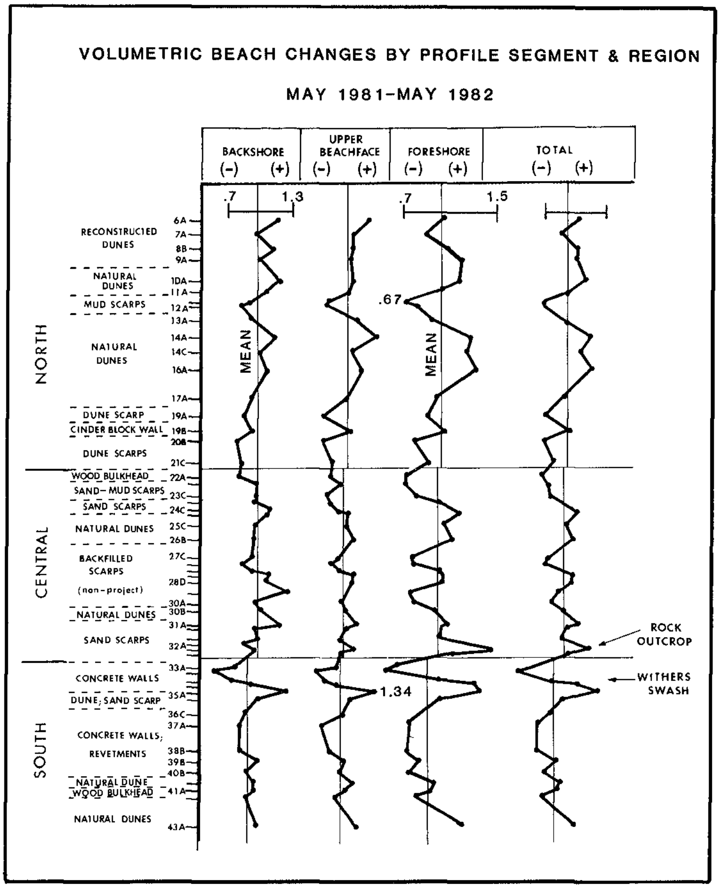

FIGURE 12. Mean unit volumes for 54 stations plotted as a ratio about the mean regional volumes for the northern, central, and southern zone. The left column describes the backshore configuration. Note that positive values generally occur where dune systems exist. Negative values generally correspond to shore protection structures or cohesive mud scarps.

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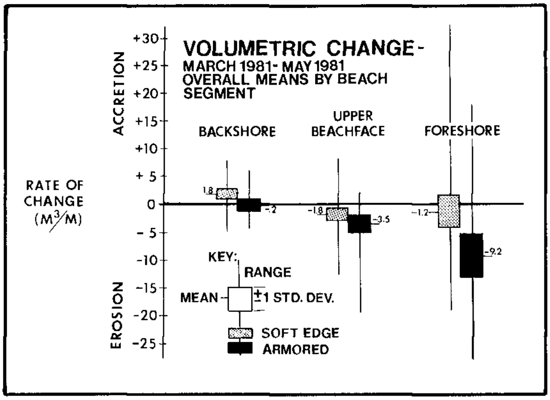

FIGURE 13. Bar graphs depicting the average rate of unit volume beach change between armored and unarmored stations for the study period. The differences are significant at the 90 percent confidence level for backshore (Segment I) and foreshore (Segment III).

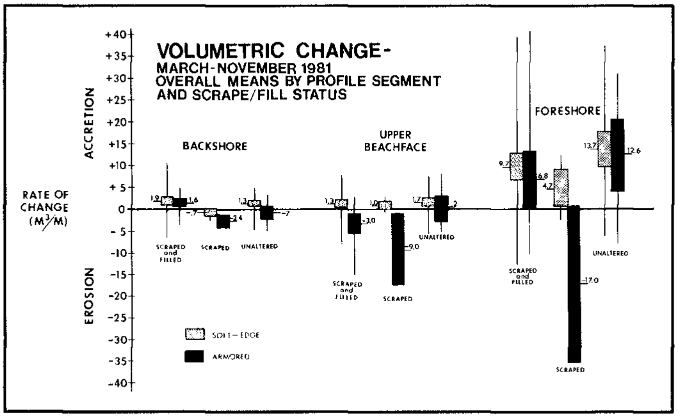

FIGURE 14. The average rate of changed by scrape-and-fill status. See text for explanation.

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