

New Developments on Coastal Protection along the Belgian Coast

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ABSTRACT

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Beach, and particularly profile nourishment is not a universally accepted solution for coastal protection. Its cost has been criticized; its temporary remedial nature emphasized. However, no better, less expensive solution has been proposed. Let nature take its course is indeed the simplest approach but one that in many instances does not face up to economic realities. Belgium's coastline is short and its occupation is intensive. Politically and economically it cannot be left to evolve without intervention. Traditionally groins have been constructed to hold off the assault of the sea and retain sand for the beaches. This approach has proven to be unsatisfactory, even damaging. A major beach nourishment program was undertaken at the eastern end; at that time, it was the largest such program ever carried out and absolutely necessary to save the touristic nature of the area. The results have been generally praised. New problems developed in the coast's central part. The situation is far from redressed in Ostend; trouble spots appeared at the very western end and intensive erosion has occurred in Bredene, near Ostend, a situation already described ten years ago. But it was De Haan (a.k.a. Le Coq-sur-mer) that immediate action became necessary and an apparently successful artificial nourishment has just been completed. This paper briefly recapitulates the work undertaken at Knokke-Heist; the proposals made for Ostend describes the present situation in Bredene and provides a detailed account of the completed program at De Haan.

ADDITIONAL INDEX WORDS: *Beach profile, beach nourishment, groin, shore protection, coastal engineering.*

INTRODUCTION

Though the approach has been used with increasing frequency, beach and profile nourishment are still not unanimously accepted as the best solution to counter coastal erosion. The soft solution which espouses nature's ways has its protagonists, but defenders of seawalls, groins, tribars and similar structures still believe that, in the long run and regardless of some negative aspects of this type of coastal engineering, they remain preferable.

Cases where a mixed solution has been proposed appear to be an advantage in specific situations. Beach dewatering has been suggested as an "alternative" remedy to protect retreating coasts, also gravity drainage, bypassing-backpassing, beach-scraping and beach-building.

OBJECTION TO NOURISHMENT

Undoubtedly artificial nourishment is not a once-and-forever cure. Monitoring and upkeep

are required. Nor is this remedy to erosion inexpensive; the cost has been criticized and the temporary nature underscored. Nevertheless it has proven successful, but hard structures require upkeep and constant repair. At the Hilton Head International Coastal Symposium (June 6-11, 1993), five papers dealt with artificial beach nourishment and no less than another five included it as a topic. The number of beach nourishment projects, some Federal and others State or locally sponsored, is quite impressive and their magnitude varies from small to very large.

The history of coastal protection in the United States provides a comprehensive dossier of a continuous fight against encroachment of the sea in areas where only touristic values are at stake and in others where an entire portuary, industrial and commercial infrastructure is threatened. Finally, some second residences on coastal islands may have to be sacrificed.

A few years ago, the U.S. decided in some instances to "let nature take its course", at least where that solution was economically tenable. In many sites such an approach is unthinkable; that is the case for the Belgian coast.

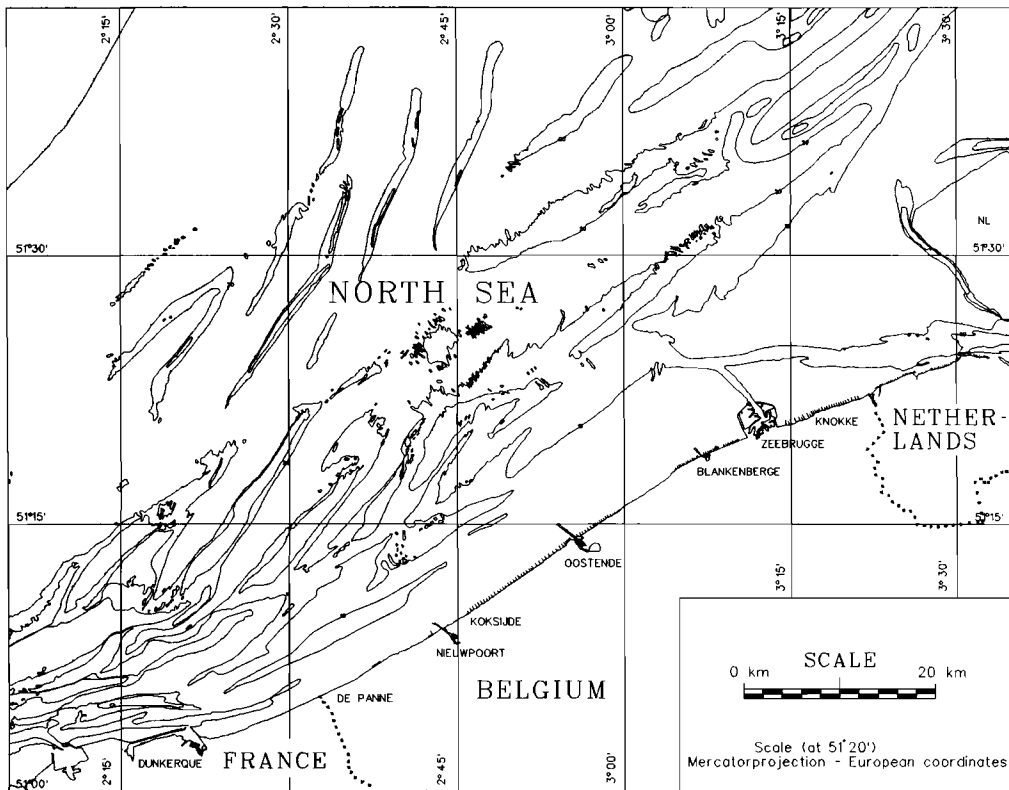


Figure 1. Location map. Main towns and continental shelf along the North Sea coast of Belgium.

THE BELGIAN COASTLINE

The coast of Belgium, along the North Sea is short, about 67 km (\pm 42 miles) long (Figure 1), but its modest size is strongly balanced by its intensive occupation and major economic significance. A policy of letting nature take its course is ruled out here. The shoreline has been substantially modified during the historical period and towns that once existed have long ago been engulfed.

Protection works were undertaken as early as the 14th century with, *e.g.*, the construction of Count John's dyke. Except for the harbor of Ostend and some small fishing ports, the economic activity of the coastal zone was principally geared towards agriculture and husbandry in the low-lying polders protected by a string of dunes.

A new economic scene unfolded in the second half of the nineteenth century when resorts developed; the railroads reached the coastal towns,

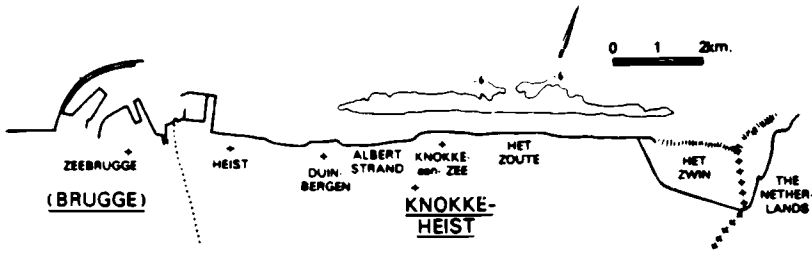
a narrow-gauge line paralleled the coast, and access to Ostend was eased by steamship connection to Dover. Development had its negative effects; dunes were destroyed, beaches shrank.

COASTAL PROTECTION

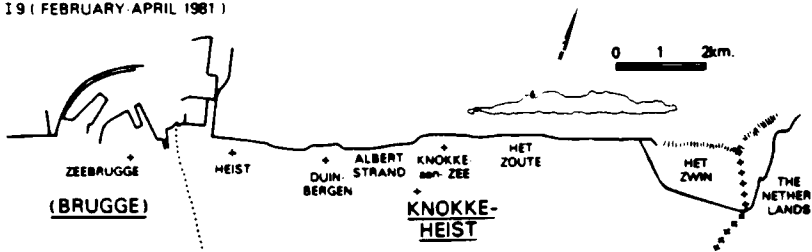
As beaches had to be protected, sometimes notwithstanding ill-advised strong objections of top civil servants in Brussels, who denied any "danger to the coastline", engineers turned to the traditional approach of the times (XIXth and XXth centuries), and a series of parallel groins, placed perpendicular to the coast, were implanted. Effects of coastal protection by means of groins has been widely discussed in literature. They occurred in Belgium as well as many other places.

Groins could not be kept-up under German occupation during the Second World War, and in the "fifties" and "sixties" the area of dry sand on many beaches was either reduced at high tide to

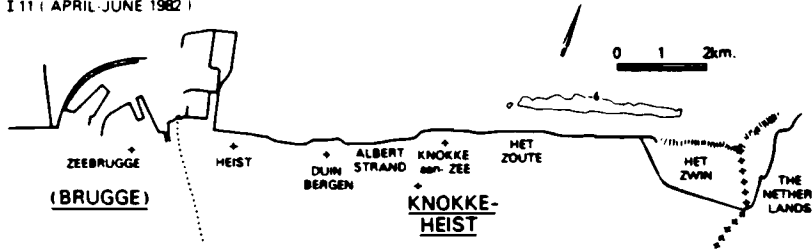
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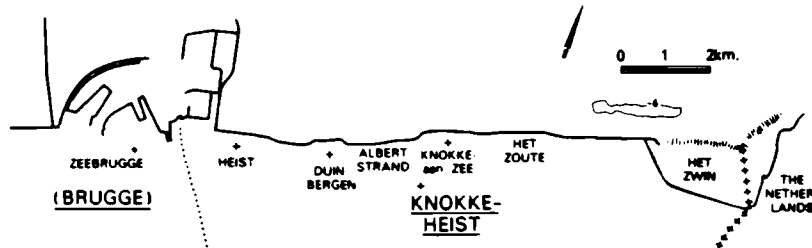


Figure 2. Evolution of "Appelzak" gully.

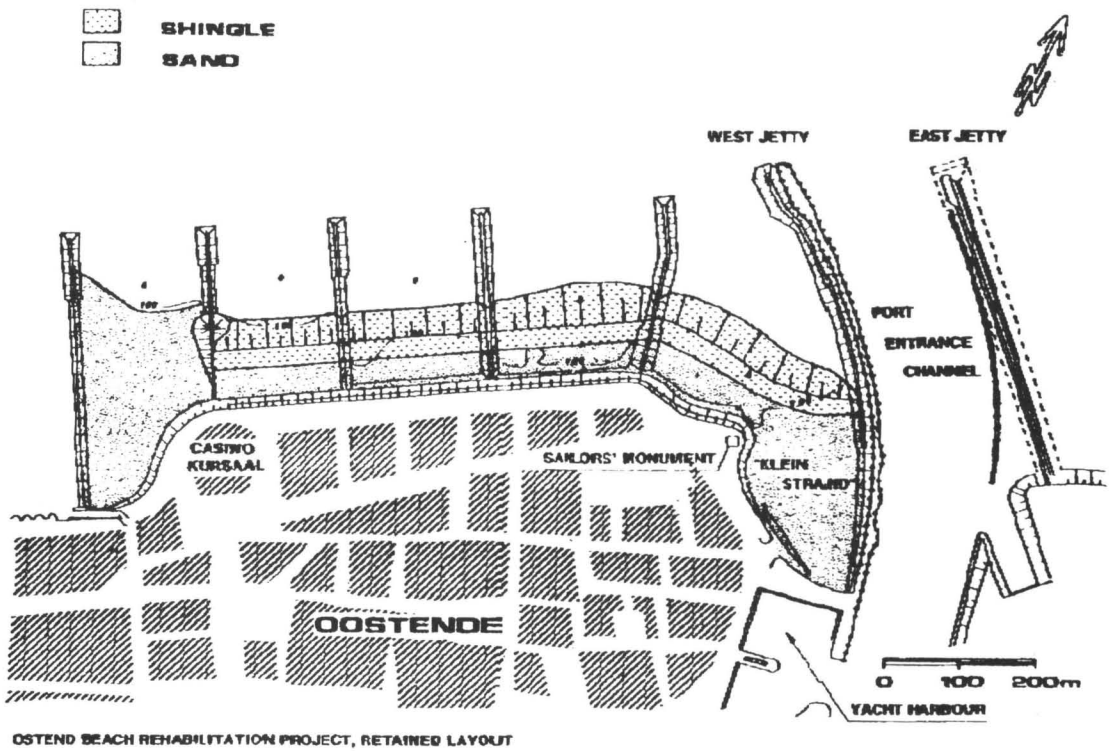


Figure 3. Retained layout of the beach rehabilitation project at Oostende, Belgium.

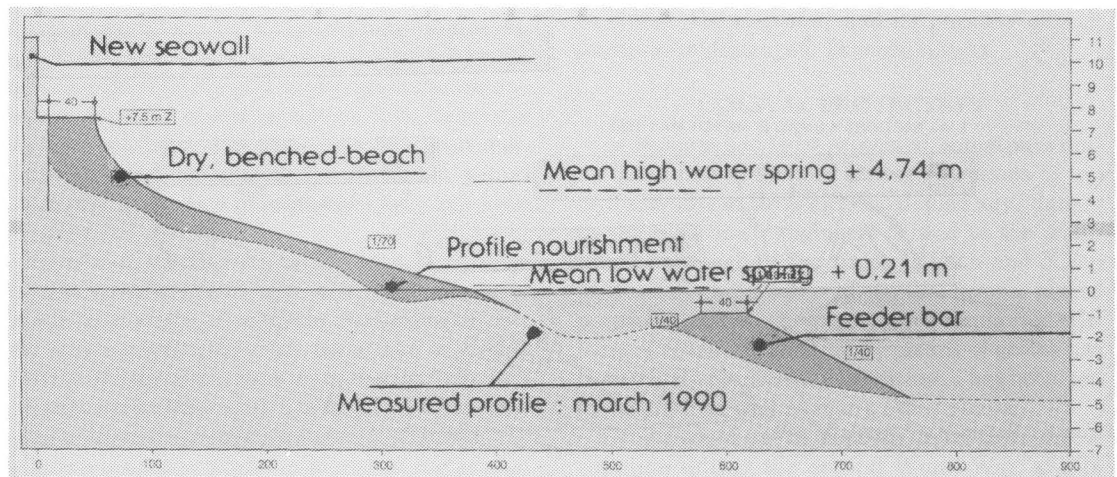


Figure 4. Relative position of feeder bar, beach and dry benched beach (De Haan, Belgium).



Figure 5. De Haan, Belgian coast, beach prior to artificial nourishment.

a few square meters (Knokke) or was non-existent (Heist). The eastern sector was the most severely affected by beach erosion.

However erosion problems have spread, or grown, in other spots along the coast. De Moor has for many years warned about a serious deterioration of the beach at Bredene. Modest remediation works have been undertaken at the western end of the shore in De Panne-Coxyde (Koksijde), and in Ostend the seawall was damaged while the beach shrank in several spots.

ARTIFICIAL NOURISHMENT

A unique opportunity to try a different approach to coastal protection was afforded by the expansion of the port of Zeebrugge. The works included dredging of huge quantities of sand, off-

shore, and it was decided to use these in a rebuilding program of the beaches east of the enlarged harbor. Hence, the largest artificial nourishment scheme ever to be undertaken was carried out. The operation has been described and discussed in the literature by the authors of this paper and by numerous other writers. The results of the program have been generally praised.

The Appelzak trough has gradually extended itself to within 500 m (550 yds) of the seawall extending from Het Zoute to the harbor of Zeebrugge. The "pier" or "mole" of the port hampered sand transport and by deflecting longshore currents had a starving effect upon the beaches situated to the east. Roovers, Kerckaert and others have described the beach nourishment project in detail. Coastal changes and beach evolution are being monitored (Figure 2). The Appelzak trough



Figure 6. De Haan, Belgium, beach extension after completion of the works.

or gully acted as a trap for the sediments removed from the beaches; it has been reduced in size and the westerly segment is doomed to disappear. Currently a wide beach of some 100 m (330 ft) has been built and is being described as "stable".

New problems developed however in the other—central and western—sectors of the coast. Near the French border (De Panne, Koksijde) precautionary and remedial actions have been carried out over the last several years. This paper, however, addresses principally the central part. Here beach erosion is taking its toll. The situation is far from redressed in Ostend where "layer" nourishment, *viz.* gravel and coarse sand layering, has been proposed. In Ostend the normal sand transport was seriously disturbed when a fort was constructed at the turn of the century. Groins

were implanted but did not cure the situation. The erosion remains strong and is enhanced by refraction-induced wave-energy concentration and storm tides. Yet, large scale beach nourishment is excluded, because a navigation channel must be kept open and beach slopes cannot be extended too far seaward. The site needs reduction of overtopping by waves and containment of sedimentation resulting from coastal defense works, protection of the recreational role of the beach, and limitation of the project within present groin structure. The mixed use of sand and gravel in a nourishment project seems to provide a dynamically stable coastal protection scheme (Figure 3).

Near Ostend, as well, intensive erosion has been observed at Bredene, a trouble spot signaled ten years ago, and assessed in January 1993 by the

authors. But it is at De Haan (also known as Le Coq-sur-mer) that immediate action became necessary.

The De Haan project has three aims: keeping navigation channels open in what is labeled the busiest sea-highway in the world and guarantying access to the coastal harbours, providing flood protection on the shore and to the adjoining hinterland, and addressing the needs of tourism and recreation.

Dredged sand has been recently pumped onto the beach at De Haan, a move justified officially as "aiming at increasing the potential for recreational tourism and maintaining—even improving by deepening—the shipping lanes". "High quality" sand was used to carry out a beach profile nourishment. The second phase of the operation encompasses the positioning of additional sand, retrieved from navigation channels, to build an offshore underwater bar that will act as a source area to feed the beach, thereby maintaining it.

Figure 4 shows the relative position of the feeder (underwater) bar, the beach and the upper beach berm (dry benched beach). High and low spring tides are respectively (means) 4.74 (15.6 ft) and 0.21 (0.95 ft) m.

The undertaking does not exclude the "participation" of the seawall in the protection scheme. The hard structure will act mainly, in harmony with the coastal dunes, to defend the hinterland against flooding.

Completed works will have resulted in a beach on the average one meter (\pm 40 inches) higher than the pre-existing one. Furthermore a berm will have been constructed on the upper beach, against the new seawall; 40 m (\pm 13.5 ft) wide, the berm is 3 m (10 ft) high (Figures 5 and 6). Figures 5 and 6 show beach extension before and after works are completed.

CONCLUSION

The experiment conducted at the eastern end of the Belgian coast appears to have successfully proven that "soft" beach protection can be efficient and economically bearable. The effects of artificial nourishment can be durable. Techniques have been improved since the Knokke-Heist works were initiated. Further refinements may well be implemented with the proposed Ostend remedial plan. Profile nourishment and imitation of nature's own "feeding" processes have been followed in connection with the De Haan works. As the Belgian coast is short, it provides a unique natural laboratory situation, and several of the soft protection approaches are simultaneously implemented.

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