CHAPTER 241

SAND BYPASSING TO "PLAYA DE CASTILLA" (HUELVA SPAIN)

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Abstract

The "Sand bypassing to Playa de Castilla" project consists of a sand bypassing from the zone behind Huelva Harbour dike to "Playa de Castilla" beach, situated in the downdrift direction of littoral transport.

The objective of this project is to artificially nourish a 25 Km eroded beach ("Playa de Castilla") as well as to check some coastal engineering theories.

The total volume of sand has been transferred to the updrift extreme of the beach, forming a 2 Km protrusion. The high rate of littoral transport guaranties its quick distribution along the whole beach, following the downdrift direction.

Introduction

The "Sand bypassing to Playa de Castilla" is a recently finished work in the Southwest Coast of Spain (Province of Huelva) (Refer.1).

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The Southwest coast of Spain, between the Guadiana and the Guadalquivir rivers, was created by the large sand sediment supplies coming from those rivers during the last thousand years.

Fig.1.- Situation

This portion of the coastline has been exposed to the oblique incidence of predominant swell.

There are several coastal formations that indicate very clearly the net result direction of littoral transport.

In fact, one can find some important sandy spits along Huelva coastline, like "El Rompido", "Punta Umbría" and "Doñana", all of them associated with wide tidal marshes systems.

This kind of formations provides an idea of the

strength of the littoral processes in the Huelva coastline.

As indicated in the scheme, there is a very clear littoral drift direction from West to East along the whole coastline.

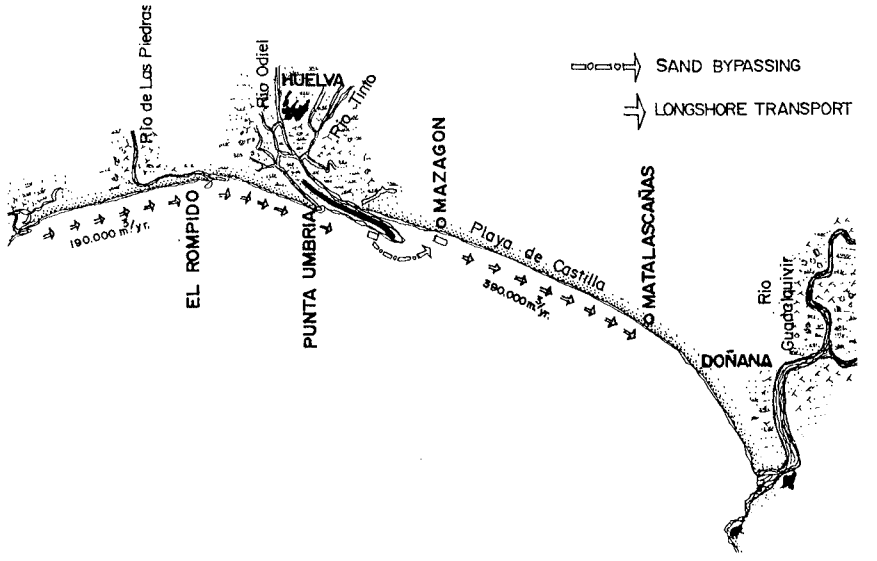

Fig.2.- Huelva Coastline Scheme

Figure 2 shows the coastline is divided into two parts by the Tinto-Odiel Estuary, also called "Ría de Huelva".

The tidal flow along this Estuary has almost acted as an integral barrier to the longshore sand transport.

The rates of the net result for littoral drift are evaluated around 190,000 m3/yr. on the west side (between the Guadiana river and the Tinto-Odiel Estuary), and around 390,000 m3/yr. on the east side (from Tinto-Odiel to Guadalquivir river).

Up to a few hundred years ago, the volume of sand brought to the coast, mainly by the Guadiana river, was enough to determine its progressive shape, but now there is an important shortage of sediment supplies, and this is due to several causes:

- Climatic variations (less rain)

- Physical factors (smoother river profiles)

- Human actions (constructions of dams, littoral barriers, etc...)

So the Huelva coastline is, at present, strongly recessive, and specially on its eastern side.

Firstly, because the coastal alignment makes it more exposed to the oblique incident waves attack.

And secondly, because the natural barrier effect due to the Tinto-Odiel Estuary has been recently reinforced by the construction of the sand contention dike for Huelva Harbour.

Description of the Sand Bypassing Project

The "Playa de Castilla" beach, that extends for 25 Km between Mazagón and Matalascañas tourist resorts, is situated on this part of the coast.

Field data obtained during the last 30 years indicate that the coastline recession has reached a mean of 1.5 m/year.

Through the sand bypassing project, an artificial nourishment of that eroded beach was carried out nearly a year ago.

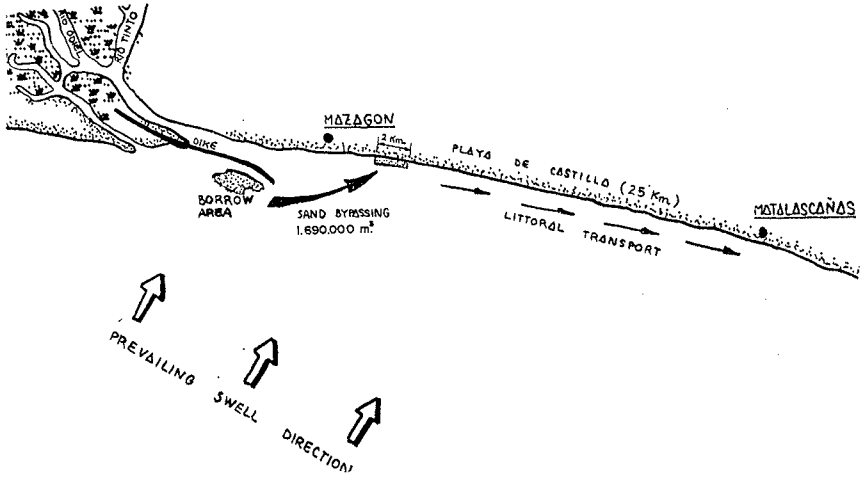

Fig.3.- Sand Bypassing Scheme

The work consisted of a sand bypassing from the zone behind Huelva Harbour dike to the "Playa de Castilla", situated on the other side of the Tinto-Odiel Estuary.

As mentioned before, the increasing of the barrier effect of the Tinto-Odiel Estuary (that it is due to the construction of the sand contention dike) has produced a large sand accumulation on the beach formed on its west side.

Figure 4 shows the sand contention dike for Huelva Harbour. The photograph was taken in 1.985, a few years after the construction of the dike. As one can see, there is a large sand accumulation in the beach formed on the updrift side of the dike:

Fig.4.- Beach Behind the Sand Contention Dike (Huelva Harbour)

The volume of sand moved from the accumulative area to the eroded beach was 1,690,000 m3, and the cost was $5,800,000, what means $3.4 per m3.

The sand was dredged by a trailing suction hopper dredger, then transported to the fill zone, that is situated out of the dike's shadow area, and pumped to the beach through a 2 Km long steel submerged pipeline.

The nourishment length is 25 Km.

The total volume of sand was transferred to the updrift extreme of the beach, forming a protruding area of about 2 Km length by 115 m width (Fig.5):

Fig.5.- Aerial View of the Protruding Area

The high rate of littoral transport guaranties the nourishment of the whole beach by the borrowed sand, that it is moved along it following the downdrift direction.

The chosen system to keep the beach stable was a "complete artificial nourishment", without any other kind of works and constructions.

This system implies that only periodic beach filling has to be carried out.

Another system could have been to built groynes, detached breakwaters, etc..., together with the beach nourishment.

Using this system it would not be necessary to make regular filling, but the coastline would have too many groynes and other hard coastal constructions.

It is hoped that the right decision was made regarding the system chosen, as the preliminary studies have indicated it was cheaper, more effective and clearly softer alternative.

It has been calculated that a sand bypassing like this would be needed every 4-5 years. However, more precise data will be available once the field investigation is finished.

Some of the First Results

In order to show the beach behaviour in the protruding area, in the next figures we can see some of the first data and results obtained after the sand bypassing works.

Several samples of the native sand were taken along many profiles of the beach, each one from a certain depth. As it is shown, the expected sand sorting along the beach profile is clearly indicated by the native sand lines.

Characteristics samples of borrowed sand were taken on the dredger during the works.

As one can see in Fig.6, the borrowed sand is coarser than the native sand.

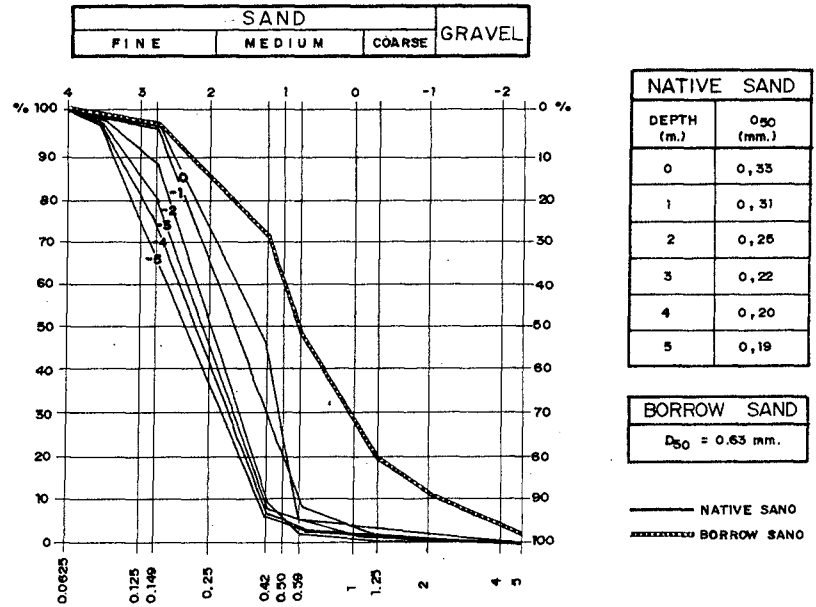

Fig.6.- Native and Borrow Sand

Fig.7 shows the evolution of the bathimetric line +2m:

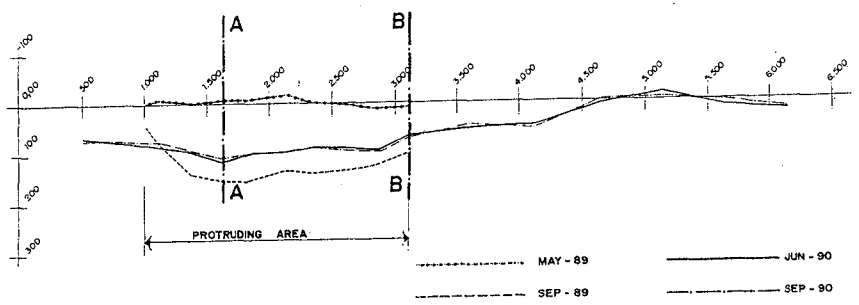

Fig.7 Evolution of Bathimetric Line +2 m

Fig.8 indicates the evolution of the bathimetric line 0 m:

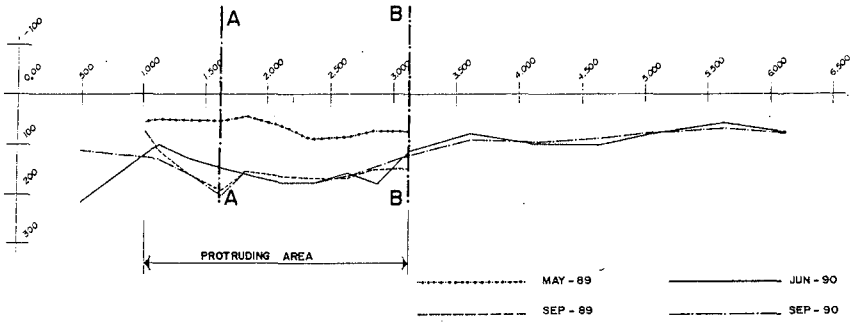

Fig.8.- Evolution of Bathimetric Line 0 m

As was expected, the recession of bathimetric +2 m in the protruding area after the sand fill, is clearer than the recession of bathimetric 0 m.

As is indicated the recession in the protruding area is made in benefit of the downdrift beach.

Fig.9 shows the beach transect AA in the middle of the protruding area:

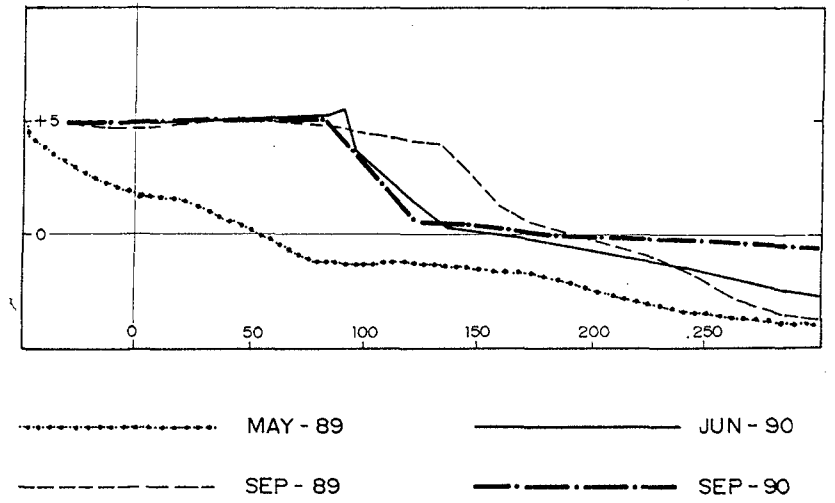

Fig.9.- Cross Section of the Beach in Transect AA

Fig.10 shows the beach transect BB at the downdrift extreme of the protruding area:

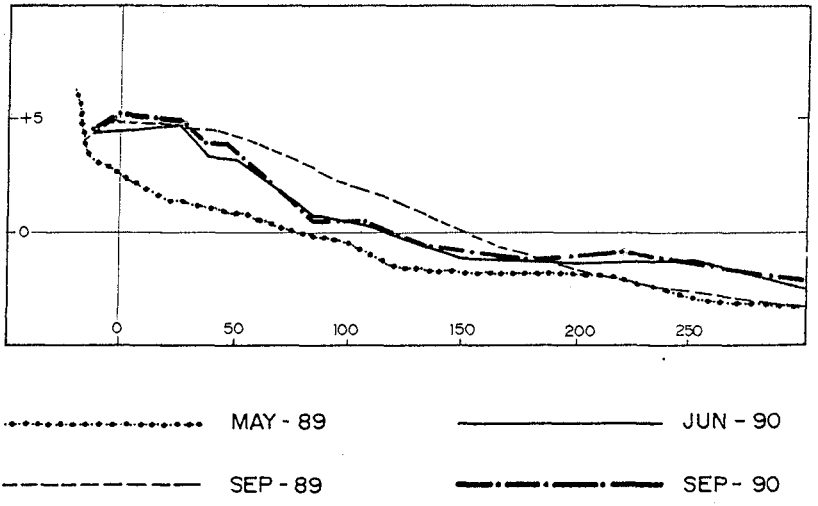

Fig.10.- Cross Section of the Beach in Transect BB

As one can see, the evolution of the beach shape after the sand fill seems to follow the behaviour described by Hallermeier.

Field Measurement Program

After having finished the works a field measurement program is being carried out in order to obtain the needed data to check different coastal engineering theories related to sediment transport, shaping of active profiles, planform of beach fill, sediment sorting and distribution, etc...

The main objective of this checking of theories is to obtain applicable results for beach improvement policy, particularly in the Huelva coastline.

The scheduled field measurement program has only recently started. Therefore, any kinds of results or conclusions would not be able to be presented at this point.

Interesting results are expected in the space of one year, in time to present them at the 23rd ICCE in Venice.

The main parameters that are being taken are:

Daily:

* Visual observations: Two measurements.
  - Wave direction in shallow water.
  - Breaking width.
  - Wave period and wave height within the surf zone.
* Wave recording by a buoy gauge.

Monthly:

* Beach transects each 500 m along "Playa de Castilla" beach.
* Sand samples at different depths in each transect.
* Sand analysis.

Since the results of the definitive current field measurement program are not available, conclusions about the scheduled checking of some coastal engineering theories cannot be presented.

However, visual observations of the beach planform evolution, have so far indicated a positive benefit of the downdrift adjacent coastline, which was the main goal.

Acknowledgements

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References

1.- FERNANDEZ, J. "Proyecto de Trasvase de arenas a la Playa de Castilla" (Huelva, 1.987).