CHAPTER 70

MONITORING AND MODELLING ON SHALLOW WATER WAVE PROPAGATIONS IN "EL SALER" BEACH

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ABSTRACT

Physical modelling with 3-D basins have mainly been used in relation with wind wave propagation, which input are irregular and multidirectional trains obtained from a directional system in the prototype, to test harbour structures . Very few applications are been developed to test the spectral propagation over a beach from deep waters to surf zone neither to study the relationship between spectral directional characteristic of time series obtained in prototype and in the basin. The aim of this study has been the study of the propagation of real data obtained in El Saler beach along the beach slope towards the bar and compare these results with real data, employing the 3-D basin , with the real beach profile. These data have been obtained from the Monitoring Campaign developed by CEDEX, partially sponsored by the contract MAST2, CT92-0027, G8M project, on El Saler Beach.

1.-INTRODUCTION

The general aims of the "El Saler" Project were the monitoring of the beach as well as the wind waves to study the beach evolution and the waves propagation. For that two systems to obtain wave climate data were installed at medium deep waters , 50 meters depth, and on the submerged beach, firstly located at 10 meters deep before bars, to be moved after 1 year, towards a surf position, between the bar and the swash zone of the beach.

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The first work developed with the obtained information was the propagation of selected trains by mean two numerical models: a lineal one and a Boussinesq standard model, which results were compared each other. The relationship allowed between them and also taking into account the field data, were not as good as we hoped in the previous step, specially if we compare the longshore variations oh the significant wave with the field data, and also the second order peaks that appeared on the field spectra. Otherwise the relation between shoaling coefficients was so big.

Taking into account the 3-D Basin facilities, a physical model was planned to be used as a final step of this work. The aim of this paper is to show the characteristic of the physical model phase as well as its results .

2.-FIELD DATA AND SPECTRAL ASSIMILATION

The monitoring of "El Saler" beach, located in the Mediterranean spanish coast, incorporated a wide knowledge of the directional waves for no very rough conditions and the bathymetric data.

The field data acquisition survey was developed from February-93 till June-95, with 3 systems located along a perpendicular line to the coast, from 47 meters depth till 3.5, beyond the bar. Yearly bathymetric surveys have been made to study area evolution, from dune (+5 meters) to submerged beach till 10 meters deep. Special focusing was employed on three control profiles, over wich the systems were installed, with 12 surveys profiles, in front of Luis Vives Parador. An idealized profile was obtained as mean profile to get the propagation by mean the physical model as we can see later. The picture 1 shows the study area

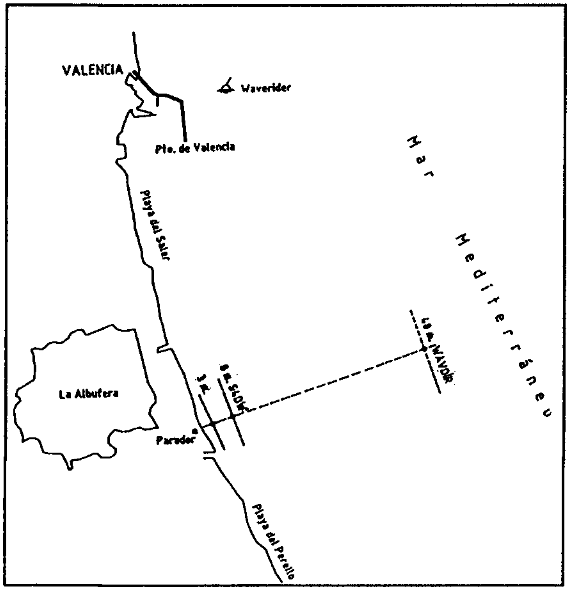

Figure 1:Studied zone with locations of measurement systems.

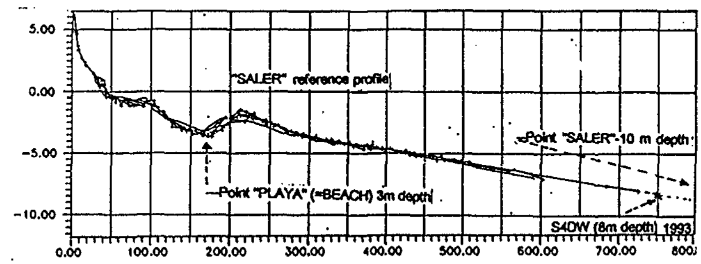

Figure 2: Studied profile with the EMCM installation points

The basic equipment used into this project has been composed by :
-A **Datawell Waverider Directional buoy** (which will be called WavDir in this report) deployed in depth water (50 meters), linked to the shore station , composed by a receiver , a PC and a recording system, by RF . The buoy location has been kept watch on by the Argos System . (@Argos CLS.)
-**Two Interocean Electro-Magnetic Current-Meters**, S4ADW, instrumented with a high resolution pressure cell. These systems were located on the control profile, 0.8 meters over the bottom, in points of 8 and 3 meters deep respectively, with a special rig to sink to maintain the equipment near the bottom. These systems provided data concerning the characterization of the Waves Sea Climate in the Inshore Zone as well as near the bar , figure 2 .

The Waves Data acquisition was made attending the following items:
-Time series duration: approximately 20 minutes (wav-Dir) and 35 for S4DW,
-Sampling period of 0.78(Dir.-Wav) and 0.5 sec. (S4DW)
-Repetition period of 3 hours.
-Time series length: 1560 data points for Waverider Directional buoy and 4200 for EMCM's.

Characteristics of the Raw Data Process

The spectral process has been made with 6 blocks of 256 points and averaging the 6 spectra obtained (degrees of freedom : dof=12) for the Wav-Dir data and using 16 blocks of 128 points to obtain (dof= 32) EMCM's prototype spectra. The process allow us to obtain statistical and spectral usual results for heave (according the IAHR recommendations) as well as directional parameters for directional distribution functions.

As the EMCM Raw Data are absolute pressures and velocities in N-S direction and E-W direction, they have to be transformed to instantaneous water column height. The mean level which is eliminated in the spectral process, is taken to calculate the hydrodynamic attenuation. Also a correction taking into account non linear terms is used (proposed by Grace, 1977). Some calculations has been made in order to evaluate the effect of different possible incoming directions for waves and currents. The relative error for u= .25, Tz < 2s and d = 3m (limiting conditions in these deployments) is less that 5% .

Data sets selection and Spectral parametrization

A set of data records was chosen to fit their S(f) and G(f,θ) spectral forms to parametric Jonswap Spectrum and Gaussian Distribution Functions. Four sea states were selected in order to study the propagation with the 3-D basin. The employed criteria were:

-Existence of simultaneous data in the three systems,

-Medium sea climate conditions,

-Narrow One-Peak spectral form and low directional dispersion.

A bigger number of sea states were employed for the propagations made by numerical modelling, because its ease for change initial conditions.

The parameters used to generate the waves were:

-Jonswap data : f_p, γ , Hs , σ

-Directional distribution function: Th_Tp, σ(Th_Tp) for f=fp and f=1.5fp.

As the s-Misuyatsu parameter is used to generate the wave train, the relation $\sigma^2(Th\_Tp,f_p)=2/(s+0.5)$ was used.

3.-PHYSICAL MODEL CHARACTERISTICS

The Multidirectional Wave Tank of CEDEX, Cepyc, is 34 x 26 x 1.6 m.. The generator is endowed with 72 independent piston paddles (1.3x0.4 meters) with a total front of 28.8 meters. It is managed by modular computers controlled and connected to a VAX computer by an Ethernet network. The 3-D basin uses the GEDAP software, Hyd. Inst, NRC of Canada(3) to generate and analyze the waves.The duration of every test was 30 minutes taking 16400 data points. The method used for the generation is single summation method.

The modelled area reproduces, with a undistorted scale 1:50, the El Saler beach from coast to 30 meters depth, with an averaged profile obtained from field data. A regularization zone between the -30.0m to paddles existed. The employed measurement equipment was:

-2 six wave-probes platforms and 2 EMCM as directional systems, located alternatively along the test points: the perpendicular line to coast at 10,8,6,4 and 3.5 (beyond the bar) meters depth plus a platform always located at 30 m in front of the paddles system.

-Also 19+19 test points along parallel lines to coast were employed with 19 probes at same depths, figure 3.

The layout of the modelled profile is shown in the figure 4. The characteristics of the modelled sea states were specified on the Table.

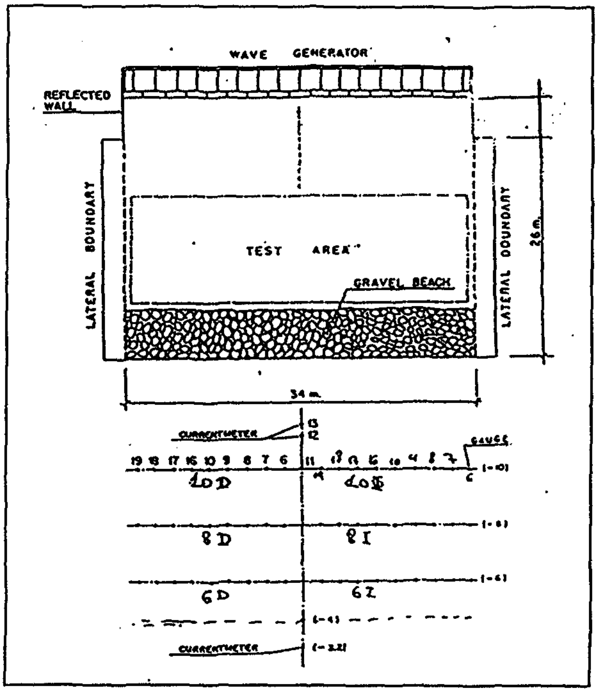

Figure 3 : layout of physical model

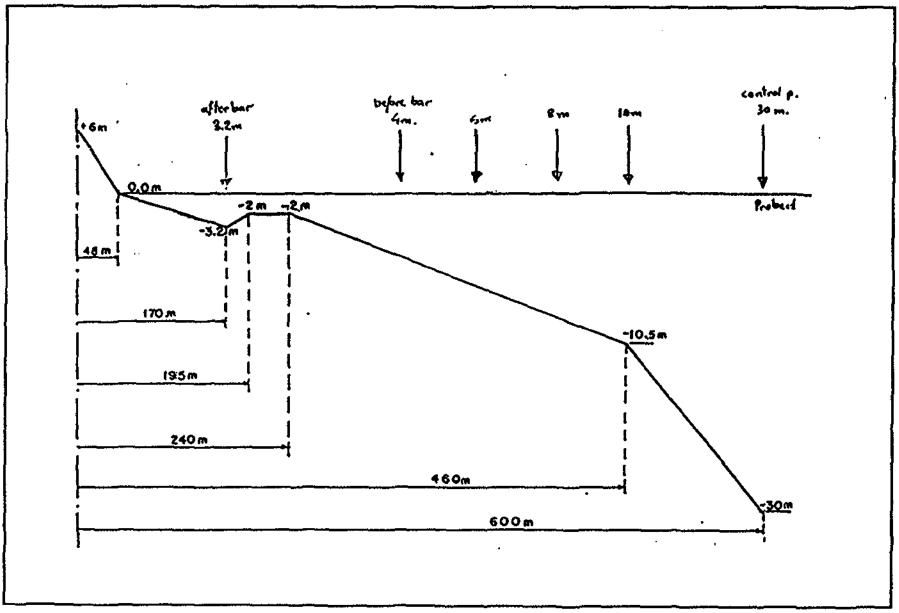

Figure 4: Profile used along the axis of the model.

TABLE I

Test number	Hm0 (50)	Hm0 (30)	Tp	γ	θ (aver)	σ(θ)	s	α	φ
15	1.82	1.63	12.5	2.61	67	12	10	-3	18
17	1.40	1.32	11.1	1.86	67	13	9	-3	20
21a	1.20	0.70	7.7	1.44	68.5	21	5	-1.5	35
21b	0.52	0.47	7.7	1.44	68.5	21	5	-1.5	35

As the buoy was installed in 47 meters depth, and the deepest point of the physical model is 30, a previous lineal propagation by numerical model was employed, and the Hs(30)meters was obtained . These both data appear in the table.

The Peak period and Gamma were deduced from the fitting. The Incoming Direction θ, and its spreading were deduced from the data. The angle α is the difference between the normal to coast and θ .The angle φ is the propagation angle.

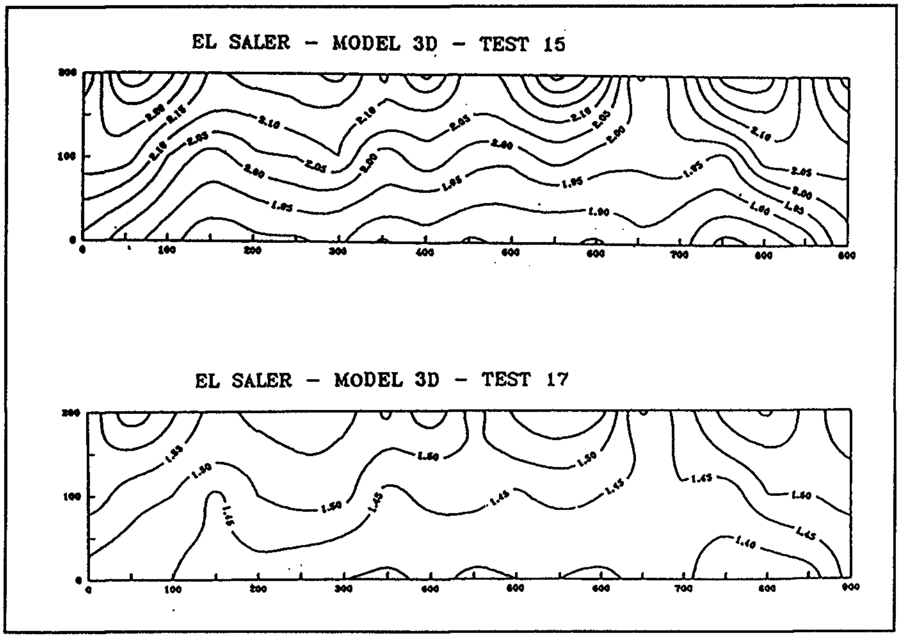

Figure5 : long shore variation of Hs, test 15th and 17th : Edge waves

4.-DATA OBTAINED FROM THE MODEL

The Directional distribution functions for f=fp, f=1.5 fp, mean direction and its spreading versus frequency were obtained. From the EMCM system also the current spectra (longshore and cross shore) were taken. Only the scalar spectra were recorded for the measurement points with wavestaff

Every test was ran 6 times and the spectral characteristics were compared between them, also between the different tests, and between 3-D results and prototype. The directional spectra were obtained only along the model axis and the heave spectra for all the test points.Obtained results, statistics and spectral, have been studied to characterize wave propagation and its evolution as the depth decrease and for both sides from the axis. The more relevant items founded are:

4.1.-**Significant wave height variations in parallel lines**

In relation with the local variability of Hs along the measurement area, it was obtained a pattern with the Hs contour line that was compared with field dada. A modulation appeared that could be produced by edge waves. The aspect of that is shown in the picture 5.

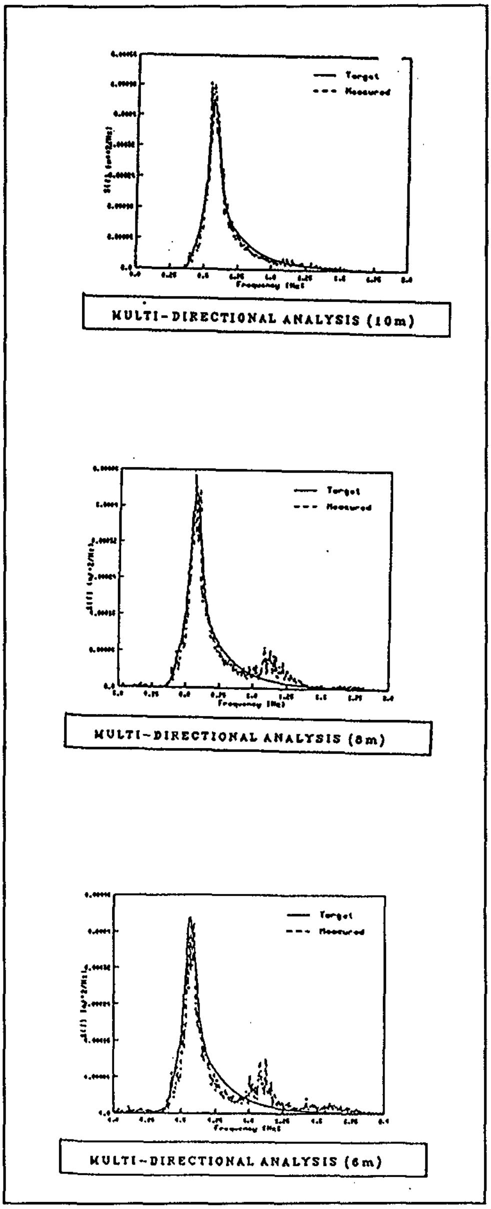

Figure 6: Wave spectra along the axis of the model: 2nd order peaks.

4.2.-Peaks from the 2nd order interactions

La interaction between bands produces 2nd order peaks, as for short frequencies (Long Wave band), named as f_-, as in high frecquencies (Short Wave band), named as f_+ . This last peak grows up as the depth decreases, and it disappears after the breaking point, figure 6.

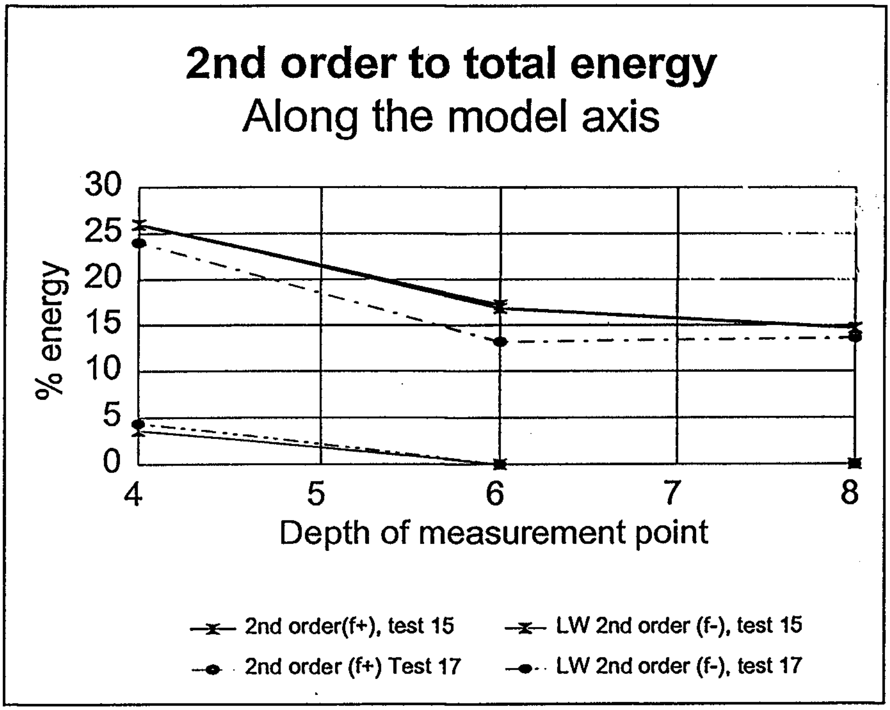

Figure 7

The central frequency of these 2nd order bands are approximately double and half , respectively , of the primary spectra, f_p .

The relationship between the energies of these 2nd order peaks and the first order peak, m_0 , have been calculated for the shallow waters between 8 to 4 meters depth, figure 7 .

4.3.-Currents spectra

The directions X and Y have been chosen in the way that OX is the coast line and OY is normal towards sea. The spectra obtained form the central line, at 8 and 4 meters are shown in the figure 8.

The peaks of the f_+ band (short wave), only appears in the cross shore spectra. The opposite appends with the f_-, Long Wave band, that only appears in the long shore spectra. This could be seen by comparison between the same kind of spectra, V_y or V_x, in function of deep.

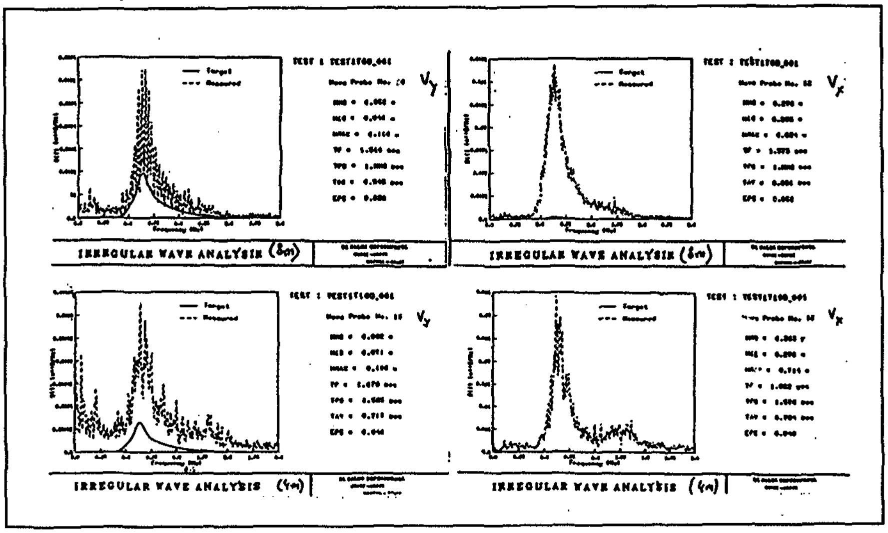

Figure 8 : Cross shore spectra (Vy) and Long shore spectra (Vx) .

5.-CONCLUSIONS

The employed methodology reproduces quite well the evolution that has been obtained in the prototype, better that the numerical model before used (2). The test points located along the axis show the appearance of 2 second order peaks as well as for higher frequencies (double that the primary peak fp) as for lower frequencies, long wave band, approximately at fp/2 . This effect was detected into the prototype.

The energy of these 2 nd order peaks increases as the depth decreases . Also a modulation along the coast line is found with a length of wave function of the characteristics of the incoming wave train. This effect was not reproduced by the used numerical models (2)

The currents spectra near the bar show that the contribution of the long wave band is more important in cross shore direction, while the long shore has an important contribution of the short wave spectra.

The spectra of waves look like 'pink' noise after the bar, instead of the direction keeps income wave characteristics showing a few wider spreading.

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DEFINITIONS OF THE USED SYMBOLS:

η : heave

(u, v) : velocity components , N-S and E-W respectively.

Tp: peak period of spectral estimation, (integrated all the directions).

Hs or Hm0 : Significant Wave Height =4 times the squared root of m0,

Th or θ : incoming direction of waves

Th_Tp or θ_p: Peak period band direction

Ds(Tp) or σ(Th_Tp) : Standard gaussian dispersion for the peak period band

γ, σ : Jonswap peakness parameter

S(f,θ) : spectral densities for the prototype directional spectrum ,

S(f) : spectral densities for the scalar spectrum ; S'(f) : JONSWAP fitted spectrum

G(f,θ) : Normalized Directional Spreading distribution for S(f,Th),

dof : number of freedom degrees

d: depth