Bremen Workshop : Run-Up

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MAST III

THE OPTIMISATION OF
CREST LEVEL DESIGN OF
SLOPING COASTAL STRUCTURES
THROUGH PROTOTYPE
MONITORING AND MODELLING

OPTICREST

MAS3-CT97-0116

REPORT

Bremen Workshop

Run-up

(Comparison between prototype measurements and laboratory measurements)

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October 1999

1 Introduction

The objective of the workshop was a comparison between prototype and laboratory measurements. The emphasis is put on comparison between recorded run-up levels. Three enclosed reports present measurements and results from University of Ghent (UG) / FCCD, Flanders Hydraulics (FH) and Aalborg University (AAU), respectively. These three reports have served as basis for the comparisons carried out during the workshop.

The workshop was held in Bremen, October 11 and 12, 1999, prior to the upcoming OPTICREST meeting at Valencia in November 1999. This has made it possible to draw some conclusions regarding run-up measurements to be rendered at the OPTICREST meeting. From the University of Ghent Peter Troch, Tom Versluys, and Björn Van de Walle presented results obtained from five recorded prototype storms. Marc Willems and Jens Peter Kofoed presented results from 2-D model tests carried out at Flanders Hydraulics. The test series comprised reproduced prototype storms. For comparison, test results from 2D tests with head-on waves carried out at Aalborg University were presented by Flemming Schlütter and Peter Frigaard.

The present report gives a short review of the work carried out at the workshop. A description on how laboratory results correspond with prototype measurements and which discrepancies are seen is given subsequently.

2 Run-up results

In preparation to this workshop, each partner wrote a small document about the measurements, the analysis and the results (see appendices 1, 2 and 3).

- Prototype measurements (UG)

The analysis is performed with a slope of 1:1,3 .

During 1 storm (1999) spiderweb measurements are compared with a step gauge.

For run-up calculations, WRII is used to characterise the sea state.

- 2-D model (FH)

All tests (storms, parametric study and regular waves) are performed and analysed.

During the regular tests, some low frequency waves were present in the flume (caused by standing waves). Also visual observations were carried out to check the run-up measurements.

For reproducing the storms, an iteration has been carried out to obtain a similar wave spectrum at WRII.

While performing all tests, some settlement of the breakwater has been observed.

- 3-D model (AAU)

All 2-D tests with head-on wave conditions have been carried out and analysed for the parametric study. The construction of the model is satisfying and no significant settlement has been observed.

A number of parameters and items are discussed at the workshop:

- length of storm series.
- way of extrapolation of run-up signal.
- distance between the surface and the run-up gauges.
- influence of wind.
- influence of wave rider buoy.
- spray.
- water tongue.
- sea state parameters.
- analysis method.

3 Observed differences in run-up measurements

The results of the analyses of prototype storms measured in Zeebrugge and of data from the model tests reproducing these storm at Flanders Hydraulics were intensively compared. The data from the Zeebrugge measurements showed $Ru_{2\%}$ / H_{m0} ratios around 1.8 while the results from FH showed $Ru_{2\%}$ / H_{m0} ratios around 1.0 for prototype storms. For the parametric study good agreement between the tests at FH and AAU is found.

Storm	$Ru_{2\%}$ / H_{m0}, prototype	$Ru_{2\%}$ / H_{m0}, model (FH)
1: 99.02.07 / Z070F3	1.98 (rank 1)	0.78 (rank 5)
2: 98.01.20 / Z071F4	1.73 (rank 2)	0.82 (rank 4)
3: 98.01.19 / Z072H1	1.71 (rank 3)	1.08 (rank 2)
4: 95.08.28, 2 / Z074H4	1.66 (rank 4)	0.86 (rank 3)
5: 95.08.28, 1 / Z073G6	1.43 (rank 5)	1.28 (rank 1)

Prototype measurements were in general performed using the spiderweb system, but for storm 1 measurements using the run-up was also done. These measurements show very good agreement.

From the above table it can furthermore be seen, that where the largest $Ru_{2\%}$ / H_{m0} ratio in the prototype measurements is found for storm 1 and the smallest ratio is found for storm 5, while for the model tests the vice versa situation is found.

4 Similarities

The methods of analysis used by UG, FH and AAU were checked thoroughly. The calculation method of all important parameters (wave height, wave period, Iribarren number, slope, 2 % run-up) is identical and according to the report on methodology (task 3.1) (Frigaard, P. and Schlütter, F, 1999). Crosschecks were performed.

The prototype data sets used for comparison of results are taken from WRII at Zeebrugge. These consist of 5 time series of approximately 2 hours duration during high water conditions. Emphasis is put on storm 1 for detailed comparison.

It is checked first that H_{mo} and T_{01} derived from these time series are identical. Next it is evaluated if wave height measurements from WRII are underestimating the actual wave height due to the working principle of the wave rider. Higher prototype wave run-up could originate from higher actual wave heights than measured by WRII. This was checked by comparing H_{m0} and T_{01} derived from time series at the position of the IR meter, both in laboratory and in prototype. There is a reasonable good agreement (about 10 % of difference) so it is concluded that the working principle of the wave rider is acceptable and the same wave conditions therefore were present in prototype and laboratory.

Run-down results from Zeebrugge prototype data are not yet available. For one session the number of run-down events below the lowest level of the spiderweb system has been compared between results from UG and FH. The number of run-down events is similar so it is anticipated that run-down results are comparable.

MWL in prototype and model tests differs with only 9 cm.

The method of measuring wave heights and wave run-up in laboratory circumstances is identical. Conventional wave height meters are used for wave measurements at the position of WRII and the IR meter. The same type of meter is used for wave run-up measurements. It is positioned on top of the armour layer as close as possible to the armour units.

Both the spiderweb system and the run-up gauge in prototype lead to the same $Ru_{2\%}$ value, confirming the prototype results.

5 Conclusions and future investigations

The outcome of the discussions during the workshop was as mentioned a clearly observed discrepancy on the run-up measurements for comparable wave situations. An intensive investigation during the workshop verified that data analyses performed by all partners were identical. It is believed that there is a significant difference between the run-up in prototype and model tests.

Three possible reasons for the differences in the run-up results were identified:

1. A difference between measured and visual observed run-up in the models.
2. No modelling of wind effects.
3. Scale-effects, such as a relatively thicker water tongue running up in the models than in prototype.

Within the OPTICREST project University College Cork and Valencia University already have investigated item (1) (J. Murphy, 1998; J.R. Medina and J.A. González, 1999). Nevertheless, it will be further investigated in models at AAU and FH in order to quantify this effect for an Antifer cube type breakwater.

Regarding item (2), investigations performed in Valencia University indicated the influence of wind effect to be in the order of 10 % (J.R. Medina and J.A. González, 1999)

It is believed that items (1) – (2) cannot account for the observed discrepancies.

Hopefully, prototype measurements of overtopping will be possible during the coming winter. It is believed that such overtopping measurements can be correctly modelled in the laboratories (negligible scale effects). In situations with thin water tongues running up viscous effects and surface tension will alter the run-up levels measured in the models. In more dramatic situations with more run-up this effect will not be so dominant in the model. In conclusion laboratory run-up levels are lower than in prototype measurements. This might not be critical because discrepancies mainly will occur for wave situations resulting in very small overtopping rates.

At University of Braunschweig some measurements of the thickness of the run-up have been performed (Oumeraci, H. and Schüttrumpf, H, 1999). It could be interesting to extend these measurements to the small-scale models and the prototype in order to look more thoroughly into this aspect.

The 3-D parametric study giving influence of wave direction and spreading will be performed at AAU during the next months.

References

Medina, J.R., González, J.A., *"Task 4 – Link between prototype and laboratory results."* OPTICREST, MAS3-CT97-0116 Report, 1st version, April 1999.

Murphy, J., *"Subtask 3.2 – Wave run-up measurement techniques."* OPTICREST, MAS3-CT97-0116 Report, October 1998.

Oumeraci, H., Schüttrumpf, H., March 1999. *"Literature Review on Wave Run-up and Wave Run-down velocities."* OPTICREST Research Report, LWI, No. 840.

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University of Ghent
Department of Civil Engineering

Ministry of Flemish Community
Coastal Division

Prototype results

Draft report

October 1999

MAS03/895

Peter Troch
Tom Versluys
Björn Van de Walle

Zeebrugge, prototype results (UG – FC/CD)
GENERAL INFO

The available devices (spiderwebs, run-up gauge, IR meter and pressure sensors) and their characteristics (scaling and offset factor, x and z coordinates) of the 5 analysed storms can be found in the table 1.1 up to 1.3.

Table 2 shows an overview of the several storms and their respectively sea state parameters, based on time domain analysis as well as on frequency domain analysis. Further calculations only take account of the parameters derived from wave rider II.

For each storm a graph can be drawn in which $\frac{Ru_{2\%}}{H_{mo}}$ is plotted in function of the Iribarren number ξ_m (fig. 1a.1, 1b.1, 2.1, 3.1, 4.1 and 5.1). Every dot represents the dimensionless run-up value $\frac{R}{H}$ of a 15 minutes time serie with no overlapping time. The spectral sea state parameters are calculated using windows of 1024 data points and 20% overlap ($\cong$ 204 samples). Likewise $Ru_{2\%} = f(H_{mo})$ is presented for every storm in fig. 1a.2, 1b.2, 2.2, 3.2, 4.2 and 5.2.
Fig. 6 shows the summary of all preceding figures in order to get an idea about the spreading of the obtained results.

$Ru_{2\%}$ is defined as the run-up level exceeded by 2% of the run-up events and Ru is the difference between the run-up level and the mean water level. The Iribarren number is calculated as

$$\xi = \frac{\tan\alpha}{\sqrt{\frac{2\pi H_{mo}}{g T_{0,1}^2}}}$$

with
- $\tan\alpha = \frac{1}{1,3}$
- H_{mo} = significant wave height [m]
- $T_{0,1}$ = mean wave period [s]

The two last parameters are the results of frequency domain analysis of the data of wave rider II. The mean water level is the mean value of the data obtained by the pressure sensor 383 (at the pile) for the storms before 1999 and the IR meter for the storm of 1999. The storm of Feb. 7, 1999 also uses a run-up gauge along the armour units.

The number of run-up events is equal to the number of incident waves. The latter is defined as the length of the considered time serie divided by the mean wave period $T_{0,1}$, based on frequency domain analysis.

The storm of Feb. 7, 1999 is analysed in two different ways, i.e. once by using the data of the spiderweb system and once by using the data of the run-up gauge. The results are quasi the

same for both, so it can be concluded that it doesn't matter whether the run-up gauge or the spiderwebs are used (fig. 7).

Where as previous graphs presented the results of analysing the storm period in 15 minutes time series, fig. 8 ($\frac{Ru_{2\%}}{H_{mo}}$ in function of ξ_m) and 9 ($Ru_{2\%}$ in function op H_{mo}) show the results when the data of the whole storm periods of approximately 2 hours is worked up.
These results are also mentioned in table 3.

In the distribution of the run-up levels (fig. 10), some platforms show up. The explanation for this phenomenon is that once more than two spiderwebs are partly submerged, the computer program calculates the intersection point of the line, determined by the two most landwards wet spiderwebs and the line representing the slope of the breakwater. When this intersection point lies higher then the base of a dry spiderweb, the level of this base is taken as run-up level (fig. 11). This can have some repercussions on the determination of the $Ru_{2\%}$ value because the $Ru_{2\%}$ value can have its representing point in such a platform, which is a truncation to the upper values. Nevertheless this is a 'safe' way of working.

A value for Rd isn't obtained yet because of the problem shown on fig. 12 and 13 : when the slope of the line determined by the two wet spiderwebs is bigger than the slope of the breakwater, the intersection point gives rise to a run-down event, though the actual movement is a run-up event. The software isn't that far yet that it detects this anomaly.

The calculation has also been carried out for a time period of 12 hours with 15 minutes time series for the storm of Aug. 28, 1995 (fig. 14). In figure 15, the influence of the MWL on the $\frac{Ru_{2\%}}{H_{mo}}$ value is clear. When the water depth increases, the run-up values decrease. In general, values of $\frac{Ru_{2\%}}{H_{mo}}$ in the range of 1.5 to 2.5 are obtained.

The comparison with earlier results in which T_m is used, the utilisation of $T_{0,1}$ indicates that higher values of $\frac{Ru_{2\%}}{H_{mo}}$ are produced ($T_{0,1} \cong T_m + 1s$).

It can be seen that the slope doesn't affect much the $\frac{Ru_{2\%}}{H_{mo}}$ value in fig. 16.

Finally, fig. 17, 18 and 19 show an example of a fragment of a time serie of the spiderwebs, the IR meter and the wave riders and the spectrum of the storm of Feb. 7, 1999.

STORM 7 - 2 - 1999

fs [Hz] resolution (bits)
10 12

HW: 16:00 u - 18:00 u

Channel No	Channel Name	scaling a	offset b	Z	X
units units	pressure sensors other sensors	[kPa/bit] [mwc/bit]	[kPa] [mwc]	[m] [m]	[m] [m]
17	run-up	0.00244	0	0	0
18	IR	-0.02439	-0.26	16.81	-30
19	Waverider I (close)	0.00244	-4.9325	0	-150
20	Waverider II (far)	0.00244	-4.9426	0	-215
21	Spiderweb 1	0.00195	-0.1	2.75	-18.45
22	Spiderweb 2	0.00098	-0.1	4.03	-17.84
23	Spiderweb 3	0.00098	-0.1	6.39	-14.82
24	Spiderweb 4	0.00098	-0.1	7.3	-13.34
25	Spiderweb 5	0.00098	-0.1	9.5	-11.4
26	Spiderweb 6	0.00098	-0.1	10.14	-9.44
27	Spiderweb 7	0.00098	-0.1	11.12	-7.26

DAQ CARD
AT-MIO 64 F5
Remarks
Spiderweb 2 onbetrouwbaar

Tabel 1.1

STORM 19,20 - 1 - 1998

fs [Hz] resolution (bits)
10 12
HW 19/1 15:45 u - 18:15 u
HW 20/1 4:15 u - 6:15 u

Channel No	Channel Name	scaling a	offset b	Z	X
units units	pressure sensors other sensors	[kPa/bit] [mwc/bit]	[kPa] [mwc]	[m] [m]	[m] [m]
10	pressure sensor 383	0.06187	-101.068	-0.35	-37.6
15	pressure sensor 137	0.1236	-150.971	1.09	-37.6
16	pressure sensor 138	0.12344	-150.897	2.9	-18.46
17	Testspanning	0.00244	0	0	0
18	Testspanning	0.00244	0	0	0
19	Waverider I	0.00244	-4.76	0	-150
20	Waverider II	0.00244	-5.0005	0	-215
21	Spiderweb 1	0.00195	-0.1	1.5	-20.14
22	Spiderweb 2	0.00195	-0.1	2.79	-18.46
23	Spiderweb 3	0.00098	-0.1	4.26	-16.94
24	Spiderweb 4	0.00098	-0.1	5.89	-14.92
25	Spiderweb 5	0.00098	-0.1	7.22	-13.34
26	Spiderweb 6	0.00098	-0.1	9.57	-11.31
27	Testspanning	0.00244	0	0	0

Tabel 1.2

STORM 28 - 8 - 1995

fs [Hz] resolution (bits)
10 12
HW 3:30 u - 4:45u
HW 14:45 u - 17:00 u

Channel No	Channel Name	scaling a	offset b	Z	X
units	pressure sensors	[kPa/bit]	[kPa]	[m]	[m]
units	other sensors	[mwc/bit]	[mwc]	[m]	[m]
1	Spiderweb 2	0.002	-0.1	2.79	-18.46
2	Spiderweb 3	0.002	-0.1	4.26	-16.46
14	Waverider (far)	0.02505	0	0	-215
15	Waverider (close)	0.025	-0.01	0	-150
18	pressure sensor 383	0.1267	-99.4764	-0.392	-37.6
19	pressure sensor 137	0.2526	-149.024	1.108	-37.6
20	Spiderweb 4	0.002	-0.1	7.22	-13.35
21	Spiderweb 5	0.002	-0.1	9.57	-11.31
22	Spiderweb 1	0.00588	-0.1	1.51	-20.14

Tabel 1.3

Sea state parameters

				Waverider II (used for run-up analysis)				
Storm n°	Datum	Time	MWL [m]	$H_{1/3,WRII}$ [m]	$T_{m,WRII}$ [s]	$H_{mo,WRII}$ [m]	$T_{p,WRII}$ [s]	$T_{01,WRII}$ [s]
1a	7/02/1999(SP)	16h00 - 18h00	4.36	3.00	5.89	3.13	8.53	6.53
1b	7/02/1999(RU)	16h00 - 18h00	4.36	3.00	5.89	3.13	8.53	6.53
2	20/01/98	04h15 - 06h15	4.35	2.87	6.02	3.01	8.53	6.58
3	19/01/98	15h45 - 18h15	4.80	2.83	5.94	2.95	8.53	6.61
4	28/08/95	14h45 - 17h00	5.14	2.55	5.75	2.68	9.31	6.40
5	28/08/95	03h30 - 04h45	5.46	2.74	5.68	2.87	7.31	6.18

	Waverider I				
Storm n°	$H_{1/3,WRI}$ [m]	$T_{m,WRI}$ [s]	$H_{mo,WRI}$ [m]	$T_{p,WRI}$ [s]	$T_{01,WRI}$ [s]
1a	2.96	5.92	3.12	9.31	6.61
1b	2.96	5.92	3.12	9.31	6.61
2	2.75	5.76	2.89	8.53	6.49
3	2.70	5.78	2.84	8.53	6.48
4	2.46	5.78	0	Inf	NaN
5	2.61	5.70	2.72	7.88	6.24

Tabel 2

Wave run-up results

Storm n°	MWL [m]	$H_{mo,WRII}$ [m]	$T_{01,WRII}$ [s]	$R_{u2\%}$ [m]	ξ_m	$R_{u2\%}/H_{mo,WRII}$
1a	4.36	3.13	6.53	6.20	**3.55**	**1.98**
1b	4.36	3.13	6.53	6.13	**3.55**	**1.96**
2	4.35	3.01	6.58	5.22	**3.64**	**1.73**
3	4.80	2.95	6.61	5.04	**3.70**	**1.71**
4	5.14	2.68	6.40	4.43	**3.76**	**1.66**
5	5.46	2.87	6.18	4.11	**3.51**	**1.43**

Tabel 3

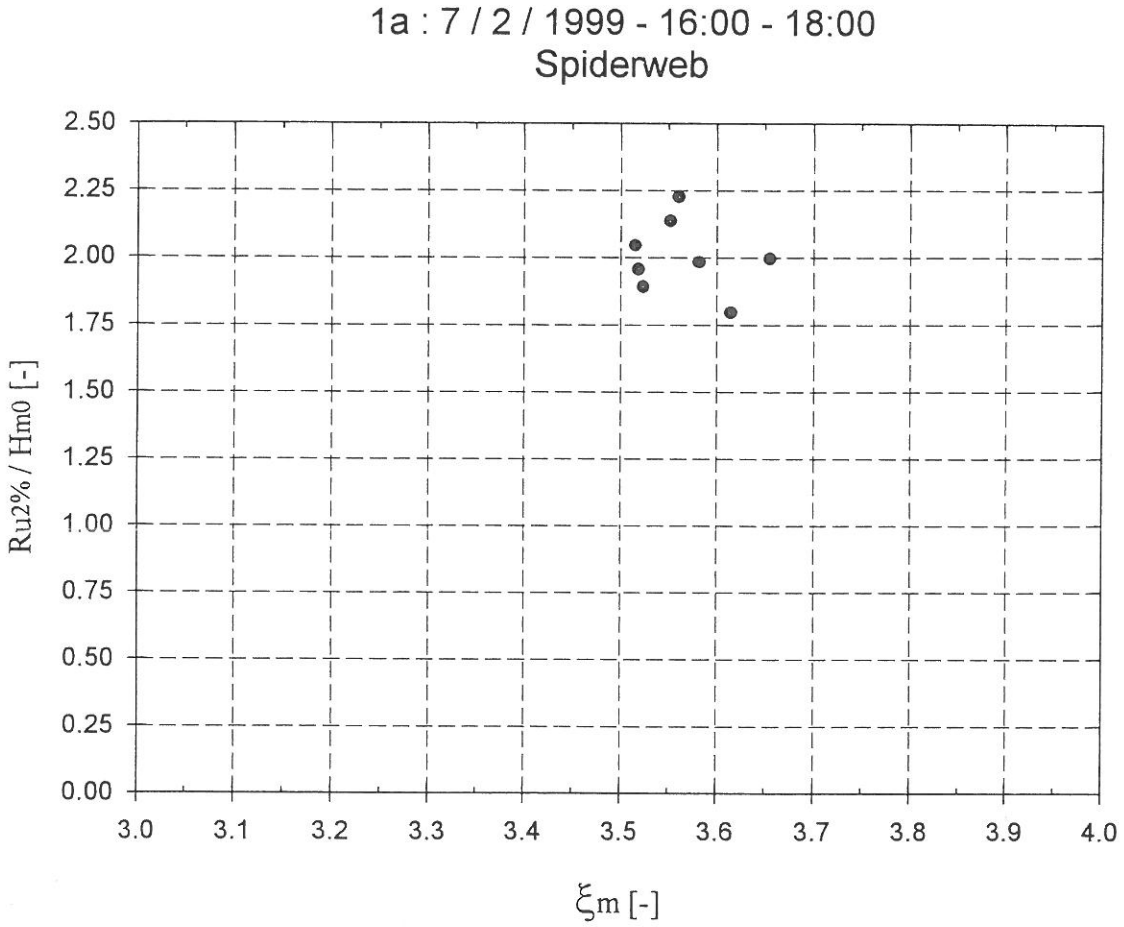

1a : 7 / 2 / 1999 - 16:00 - 18:00
Spiderweb
Ru2% / Hm0 [-]
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
ξm [-]

Figure 1a.1

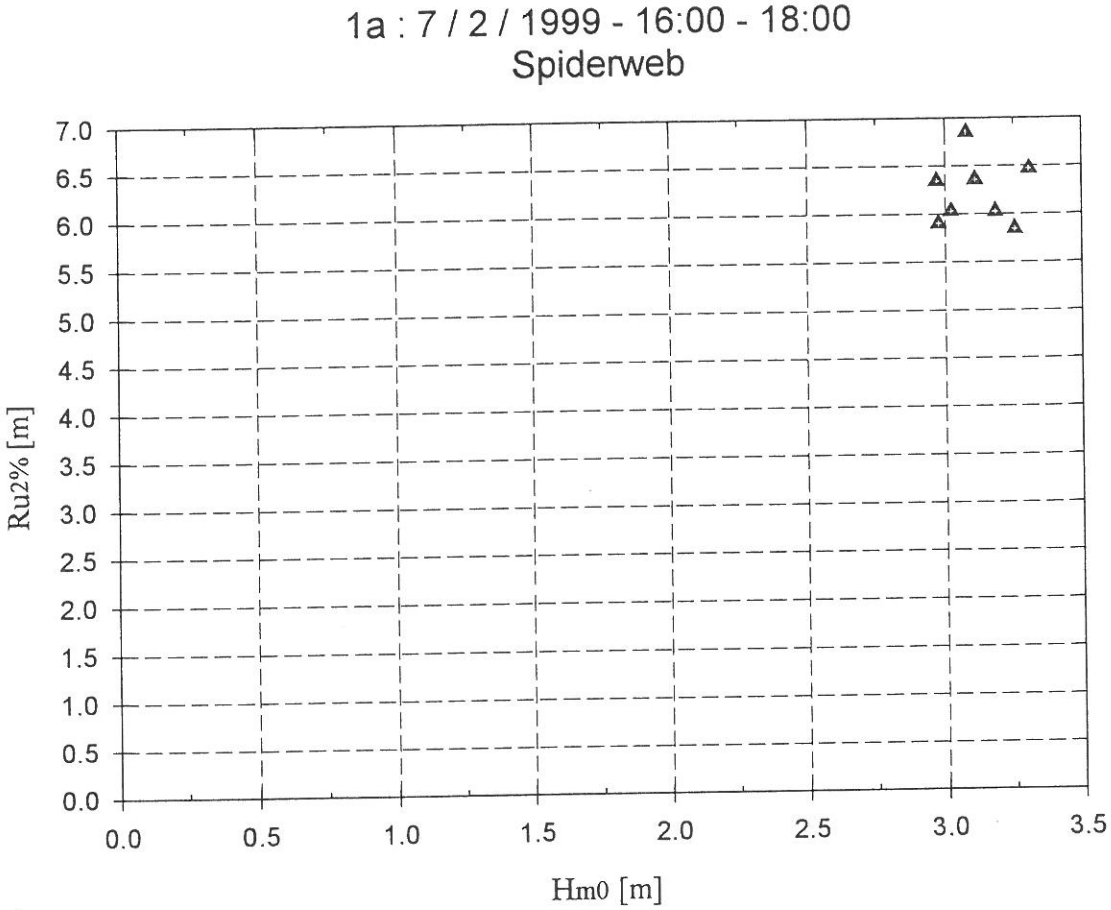

1a : 7 / 2 / 1999 - 16:00 - 18:00
Spiderweb
Ru2% [m]
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Hm0 [m]

Figure 1a.2

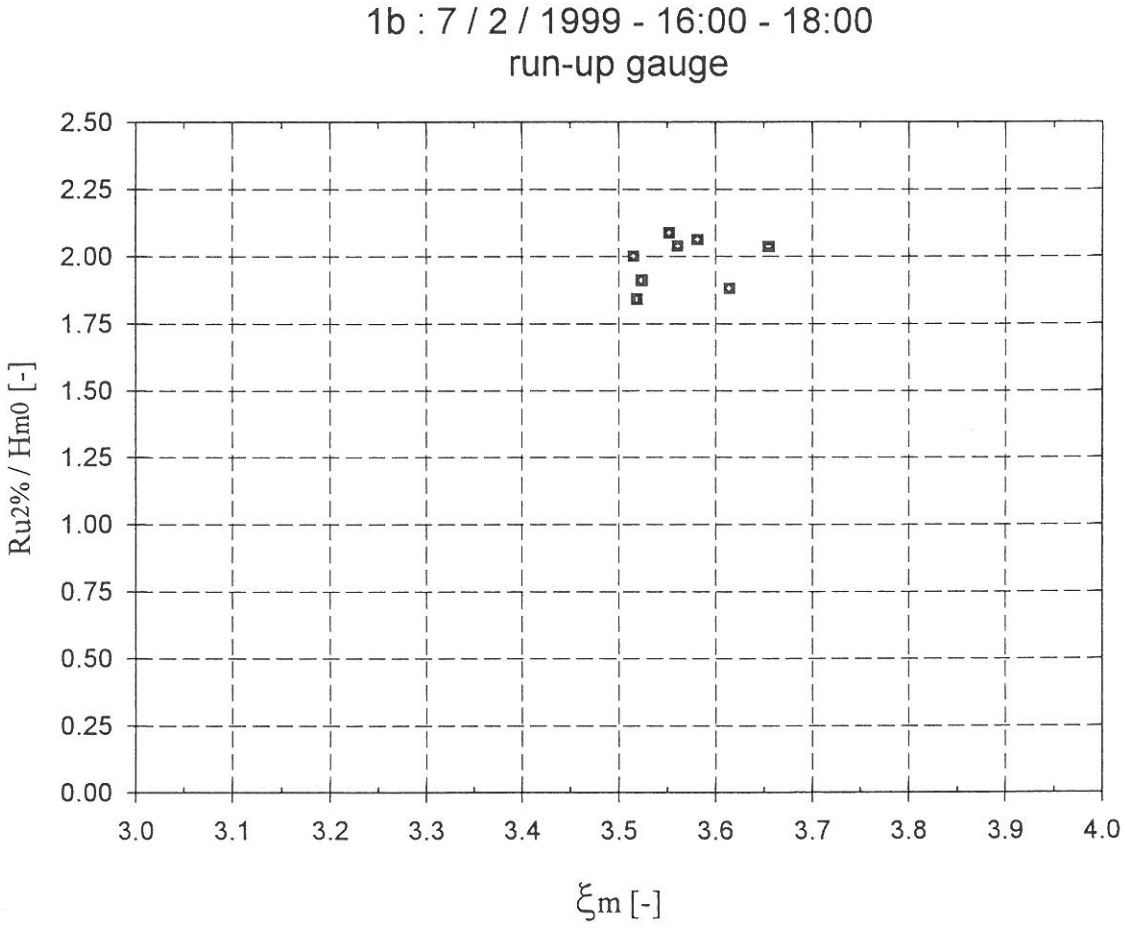

1b : 7 / 2 / 1999 - 16:00 - 18:00
run-up gauge
Ru2% / Hm0 [-]
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
ξm [-]

Figure 1b.1

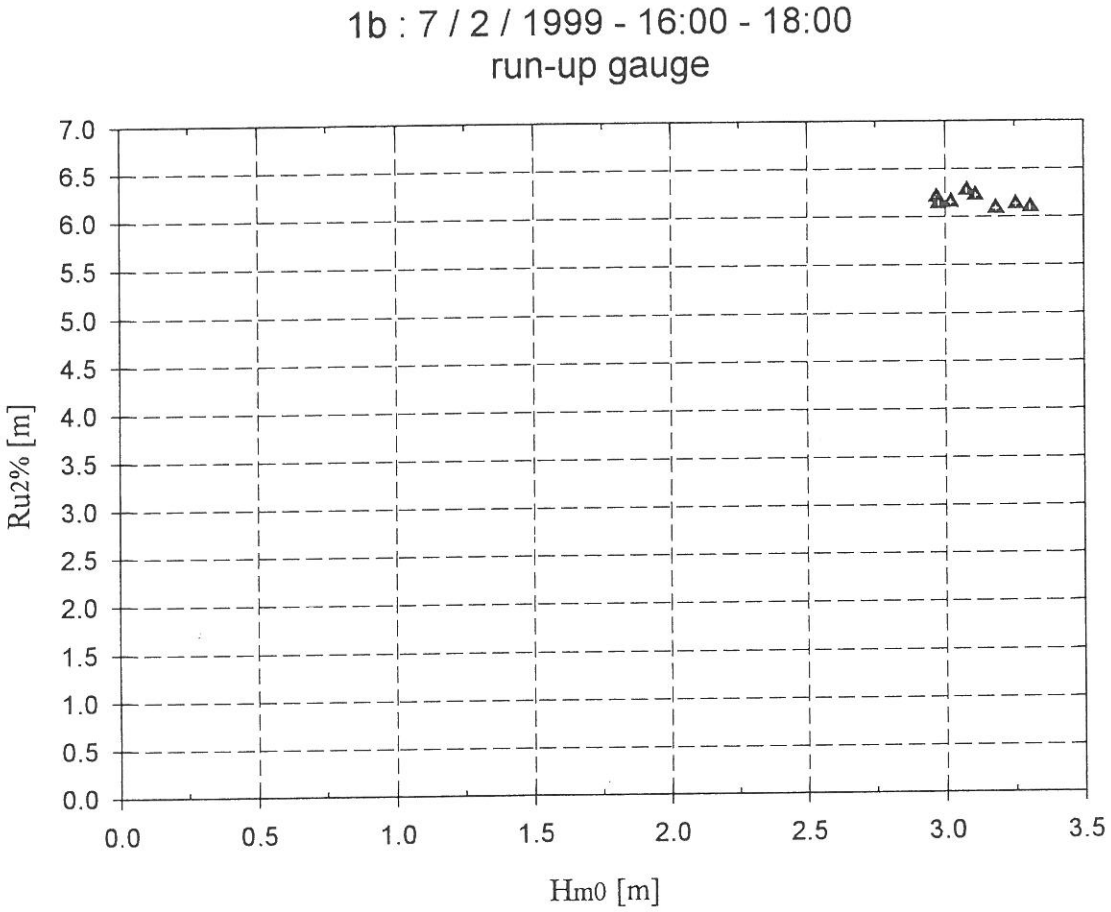

1b : 7 / 2 / 1999 - 16:00 - 18:00
run-up gauge
Ru2% [m]
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Hm0 [m]

Figure 1b.2

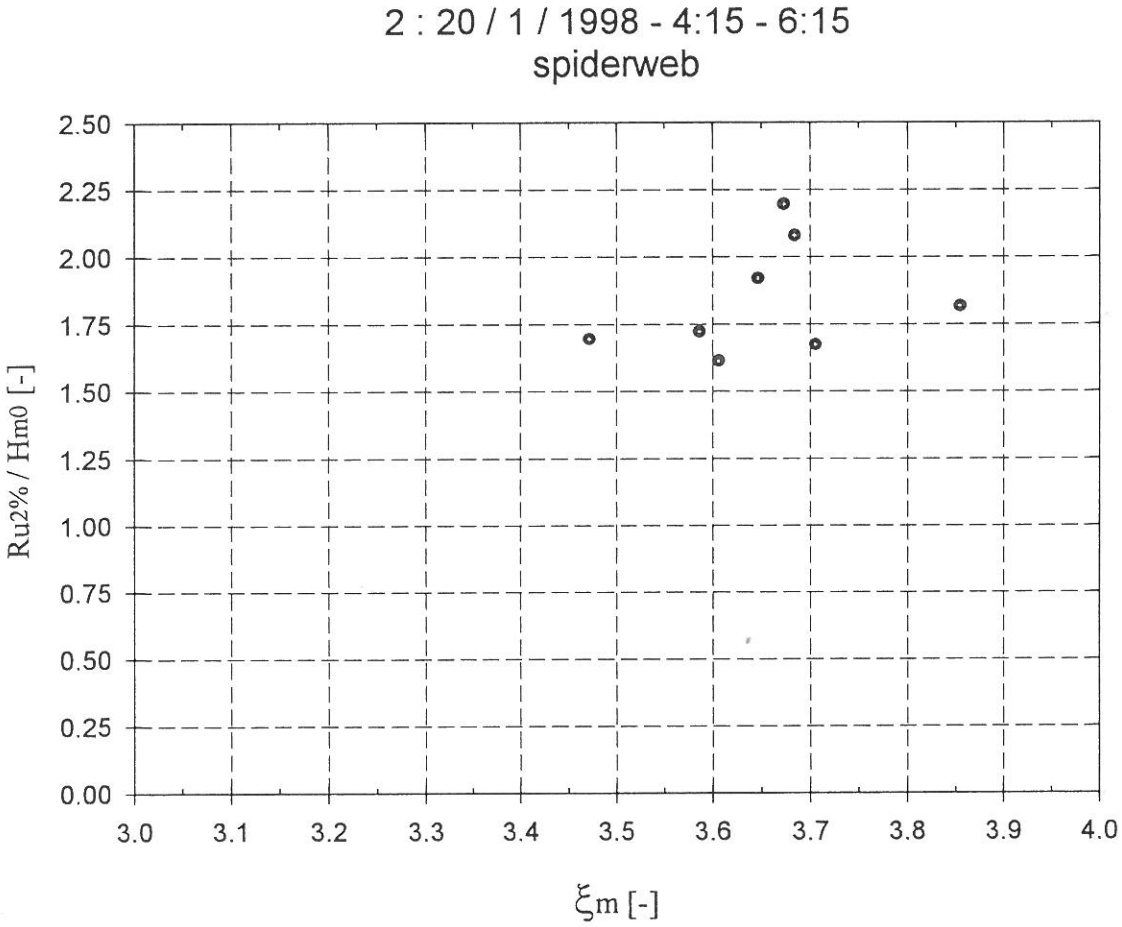

2 : 20 / 1 / 1998 - 4:15 - 6:15
spiderweb
Ru2% / Hm0 [-]
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
ξm [-]

Figure 2.1

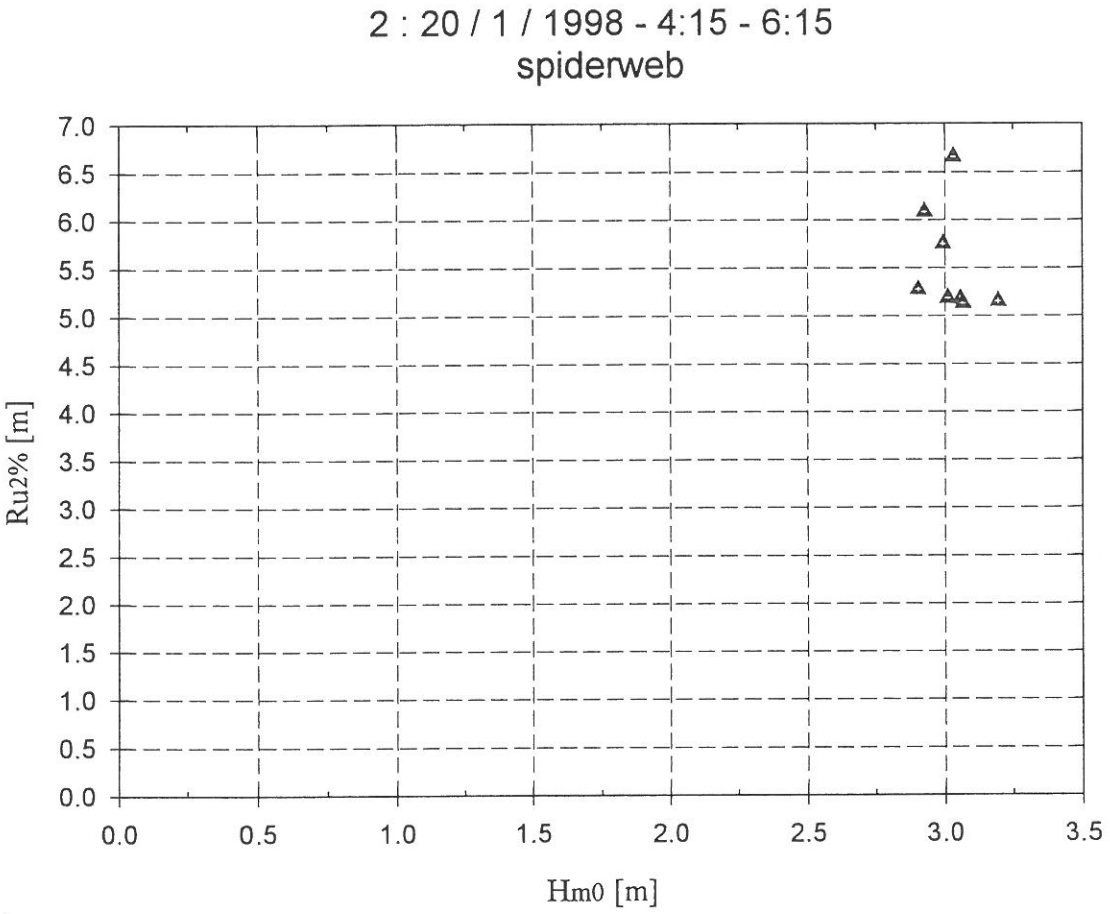

2 : 20 / 1 / 1998 - 4:15 - 6:15
spiderweb
Ru2% [m]
Hm0 [m]
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5

Figure 2.2

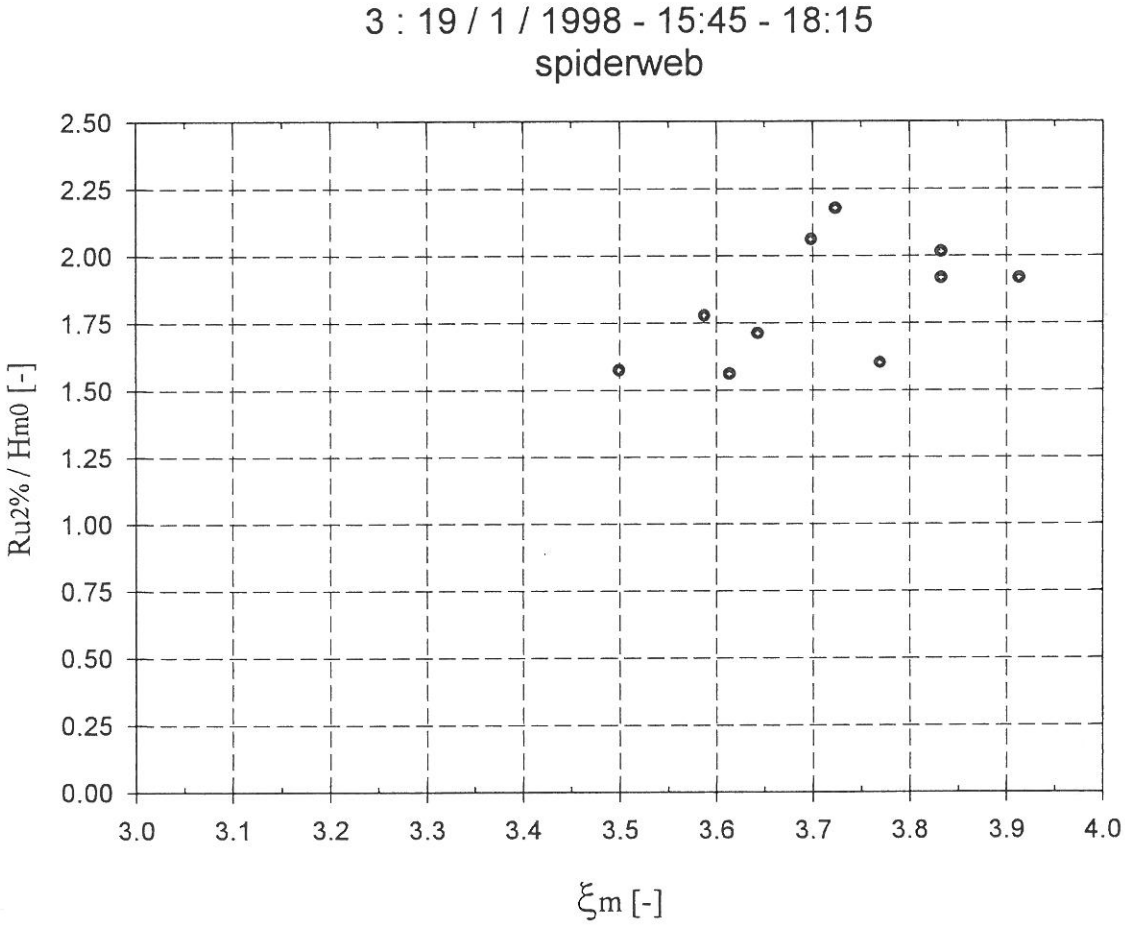

3 : 19 / 1 / 1998 - 15:45 - 18:15
spiderweb
Ru2% / Hm0 [-]
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
ξm [-]

Figure 3.1

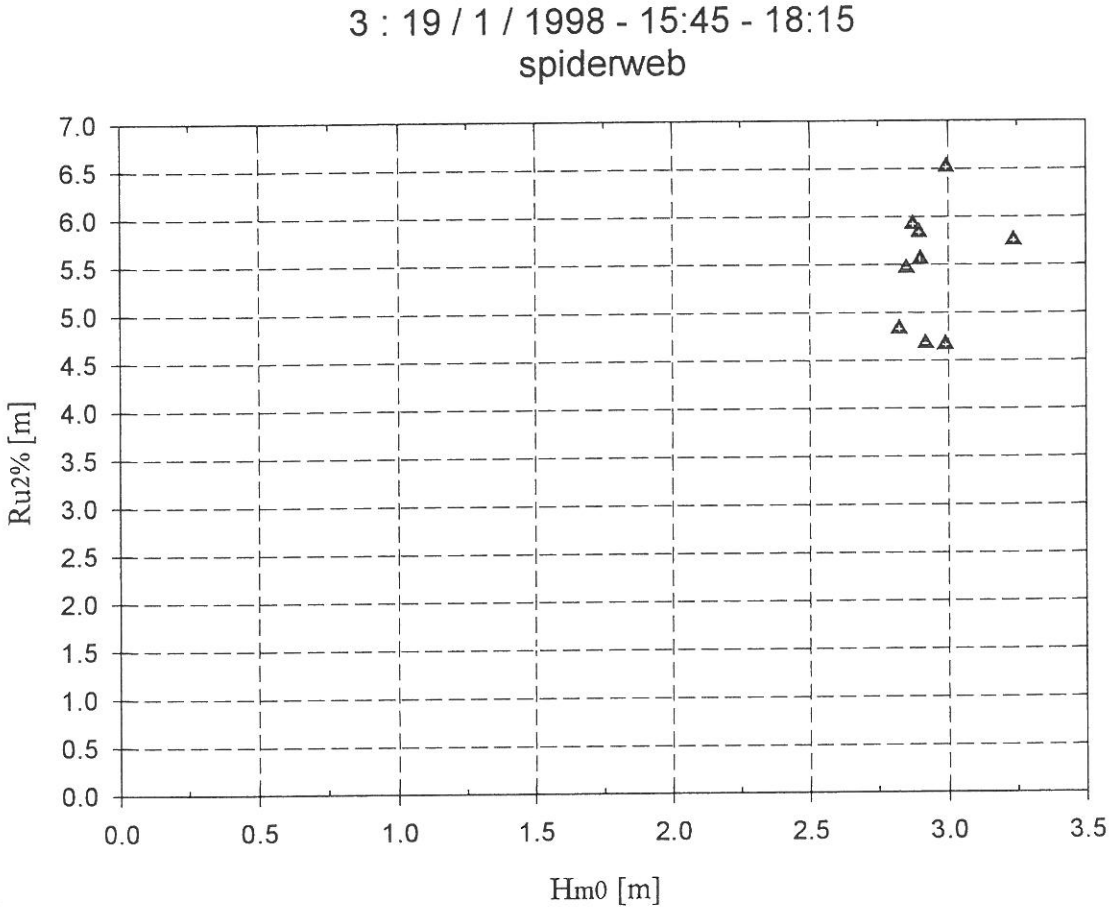

3 : 19 / 1 / 1998 - 15:45 - 18:15
spiderweb
Ru2% [m]
Hm0 [m]
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5

Figure 3.2

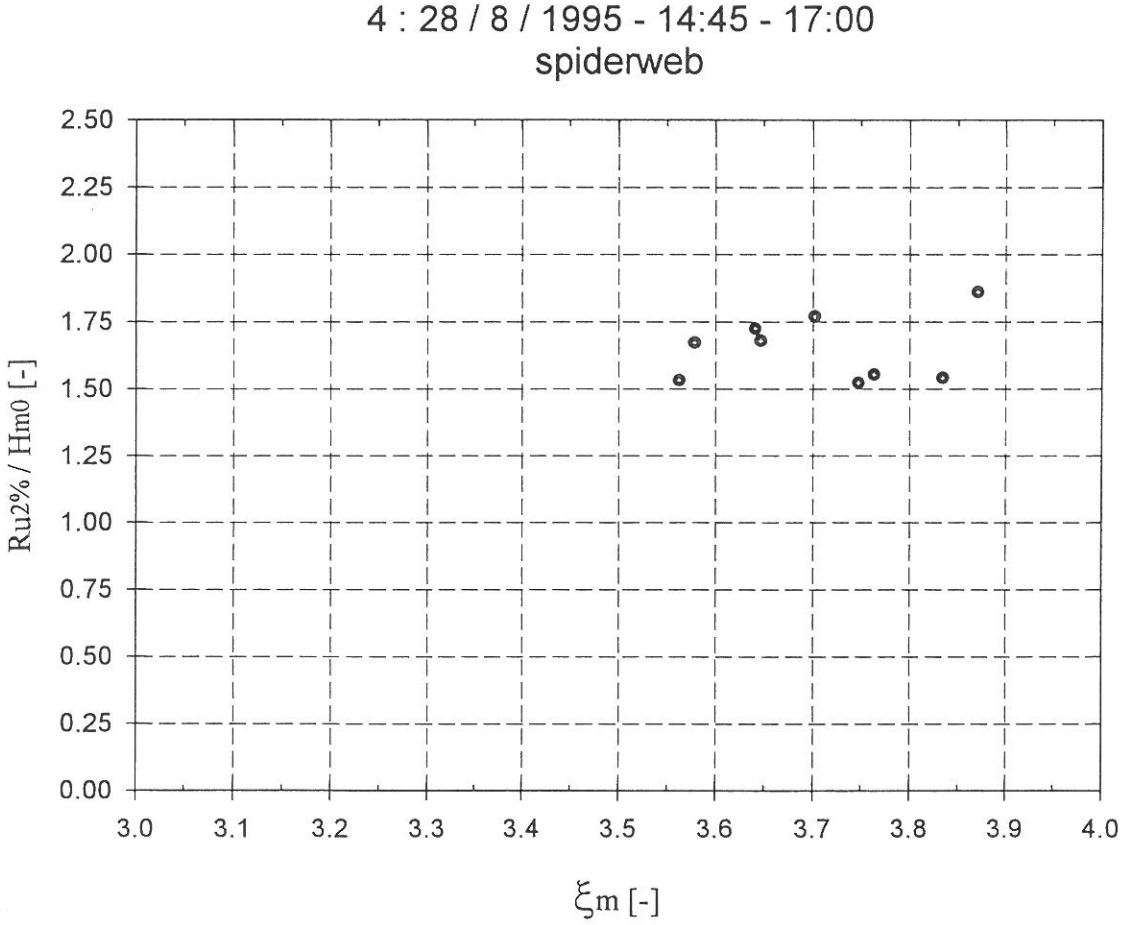

4 : 28 / 8 / 1995 - 14:45 - 17:00
spiderweb
Ru2% / Hm0 [-]
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
ξm [-]

Figure 4.1

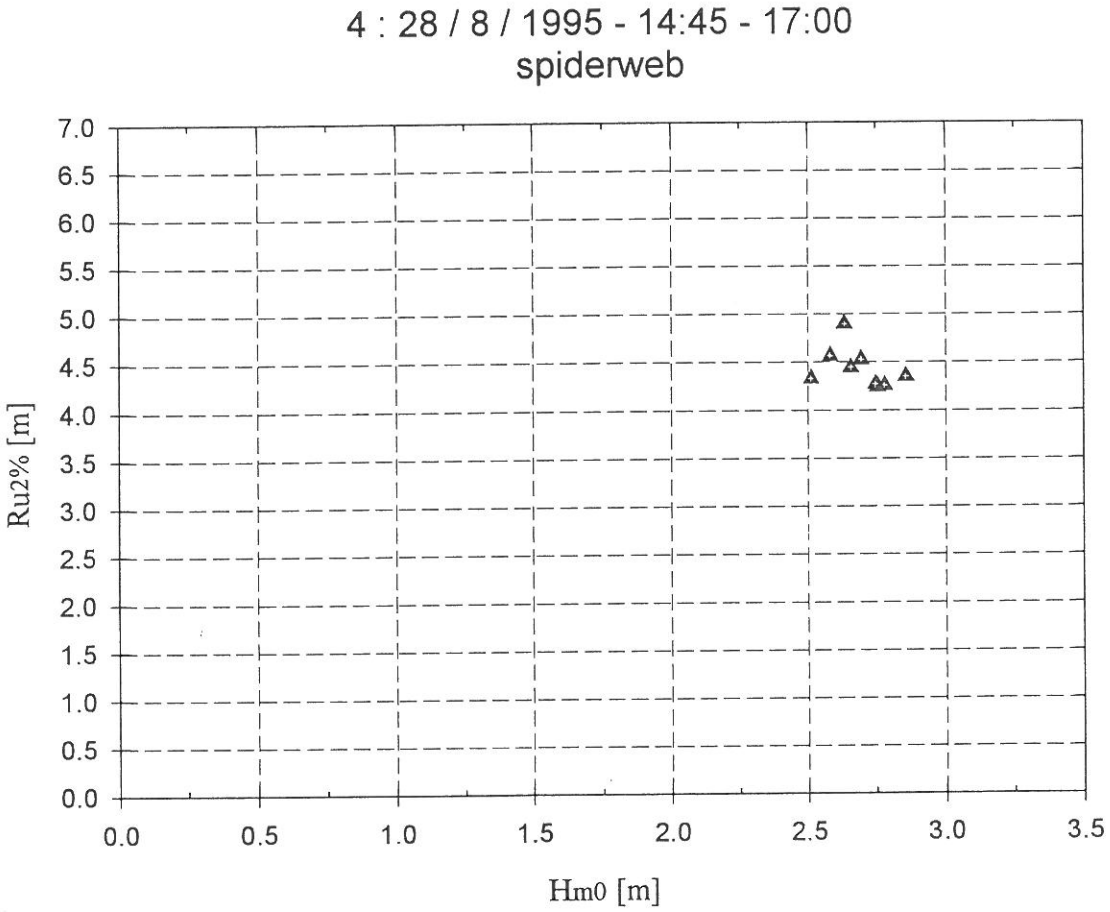

4 : 28 / 8 / 1995 - 14:45 - 17:00
spiderweb
Ru2% [m]
Hm0 [m]
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5

Figure 4.2

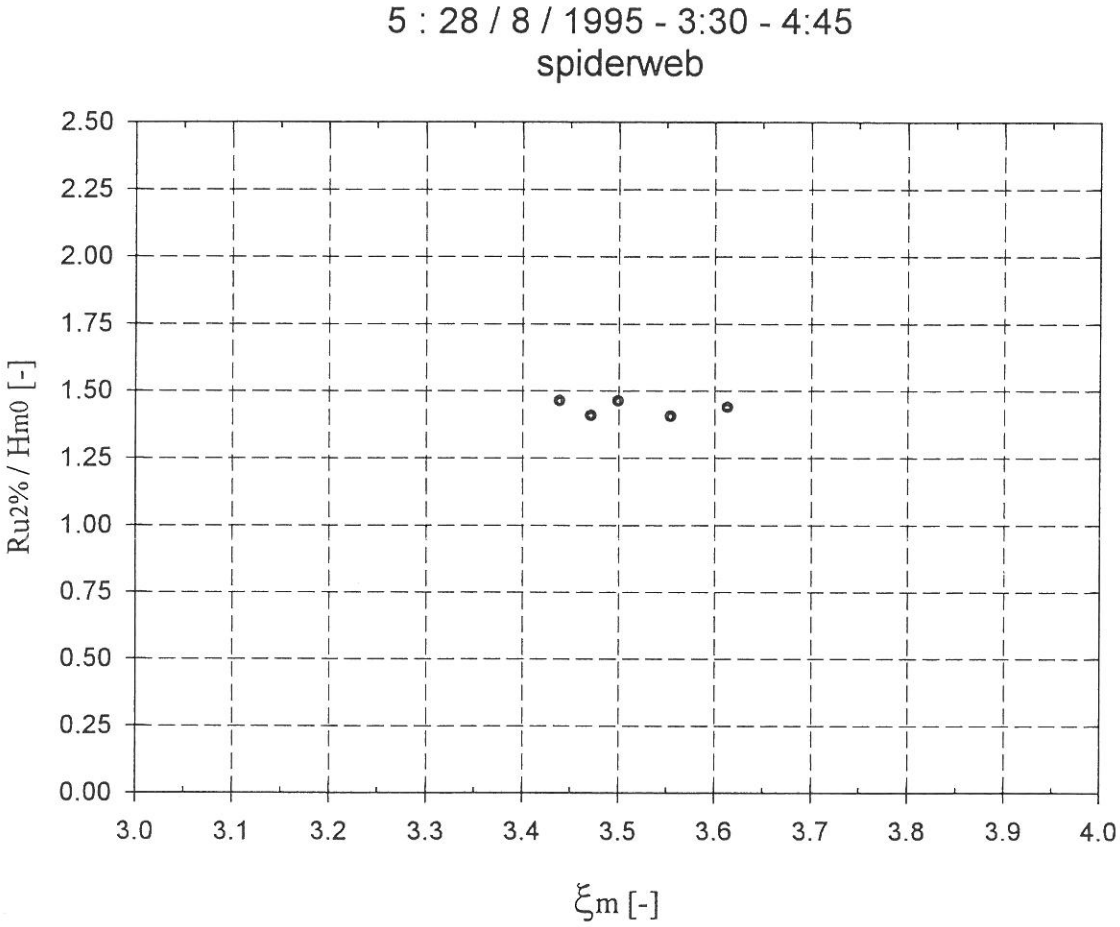

5 : 28 / 8 / 1995 - 3:30 - 4:45
spiderweb
Ru2% / Hm0 [-]
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
ξm [-]

Figure 5.1

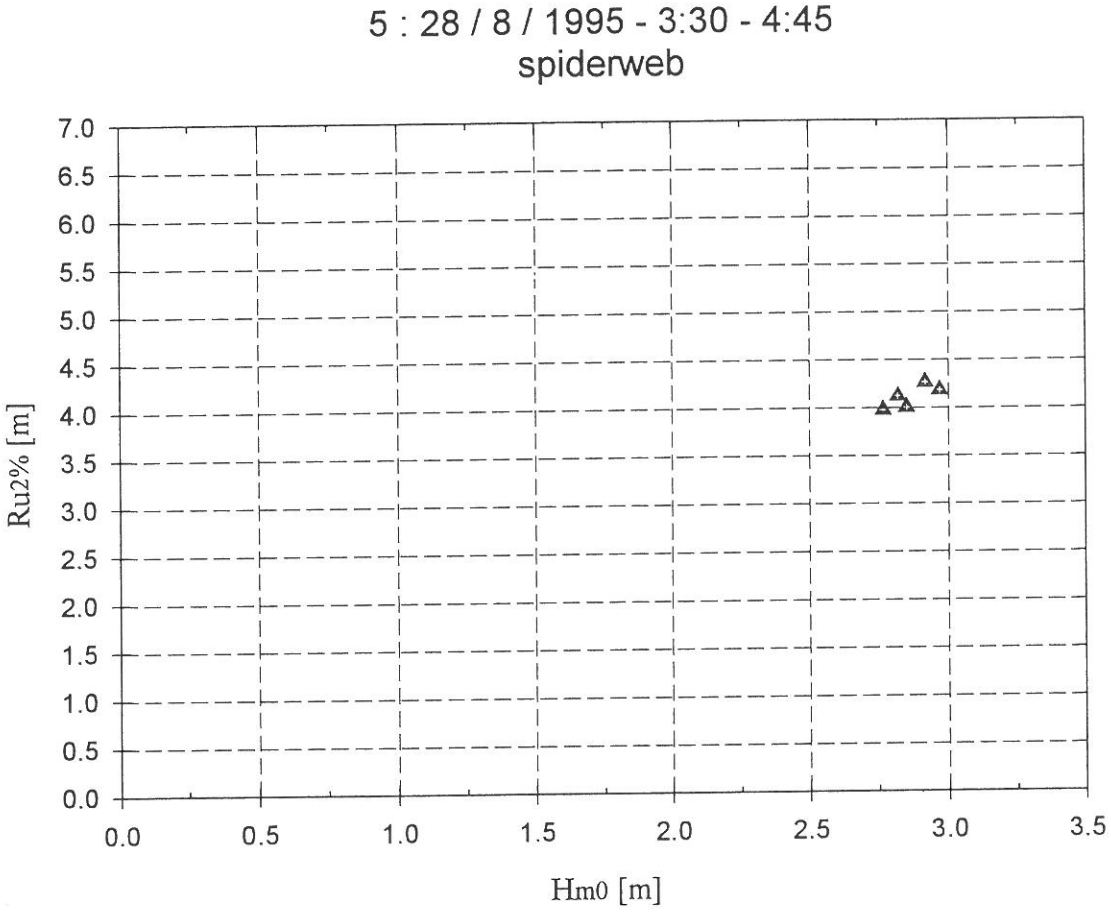

5 : 28 / 8 / 1995 - 3:30 - 4:45
spiderweb
Ru2% [m]
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Hm0 [m]

Figure 5.2

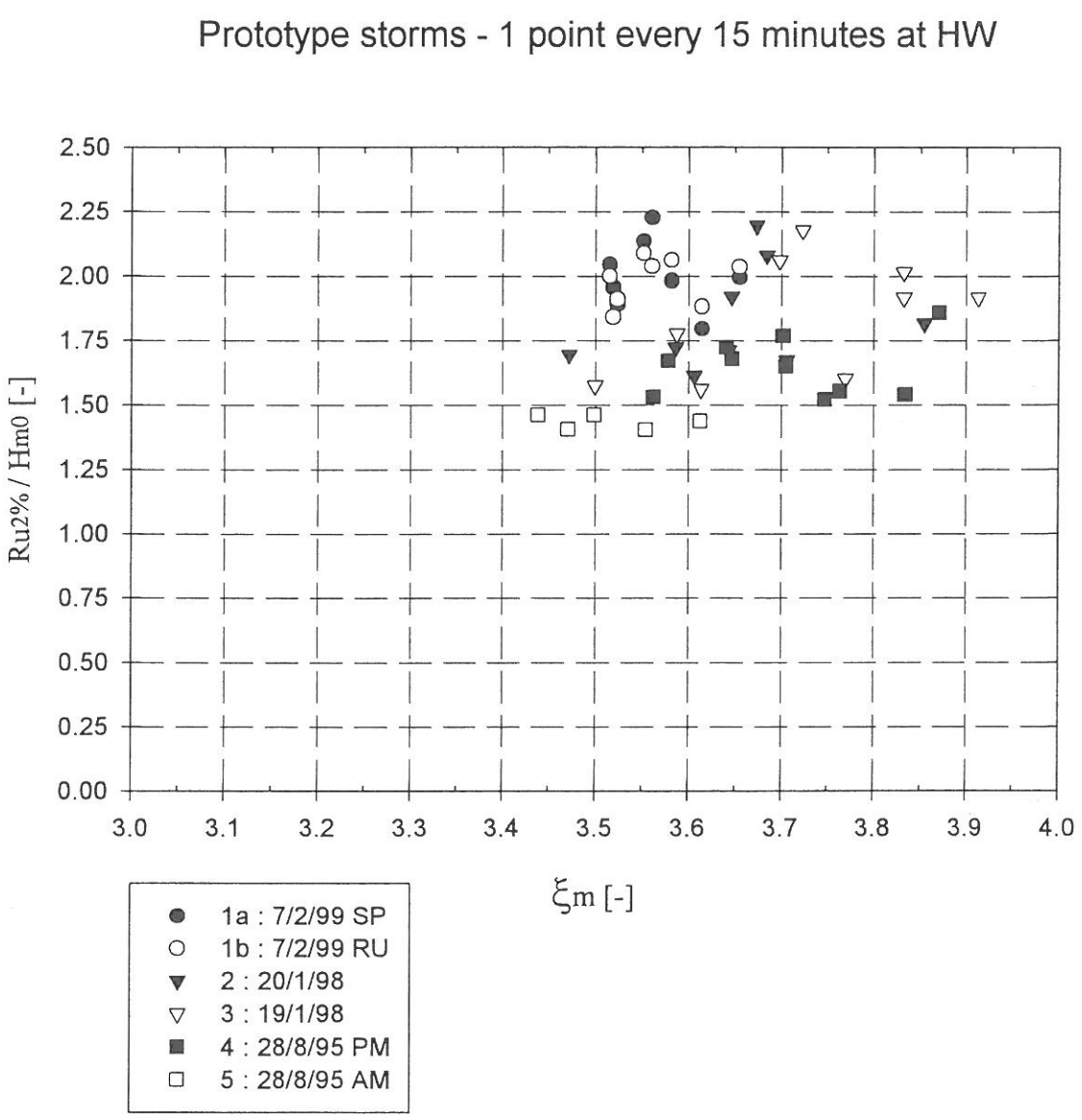

Prototype storms - 1 point every 15 minutes at HW
Ru2% / Hm0 [-]
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
ξm [-]
1a : 7/2/99 SP
1b : 7/2/99 RU
2 : 20/1/98
3 : 19/1/98
4 : 28/8/95 PM
5 : 28/8/95 AM

Figure 6

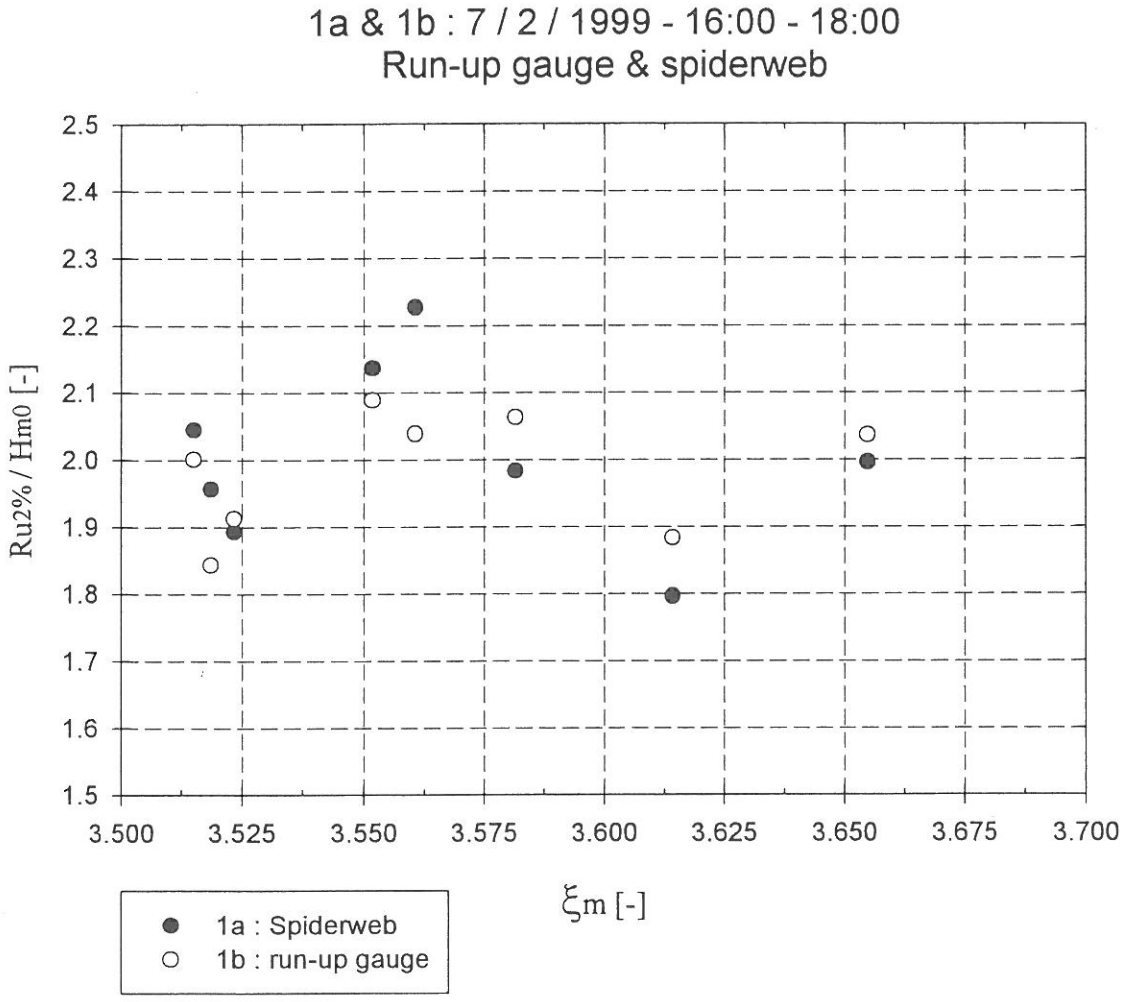

1a & 1b : 7 / 2 / 1999 - 16:00 - 18:00
Run-up gauge & spiderweb
Ru2% / Hm0 [-]
2.5
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
3.500
3.525
3.550
3.575
3.600
3.625
3.650
3.675
3.700
ξm [-]
1a : Spiderweb
1b : run-up gauge

Figure 7

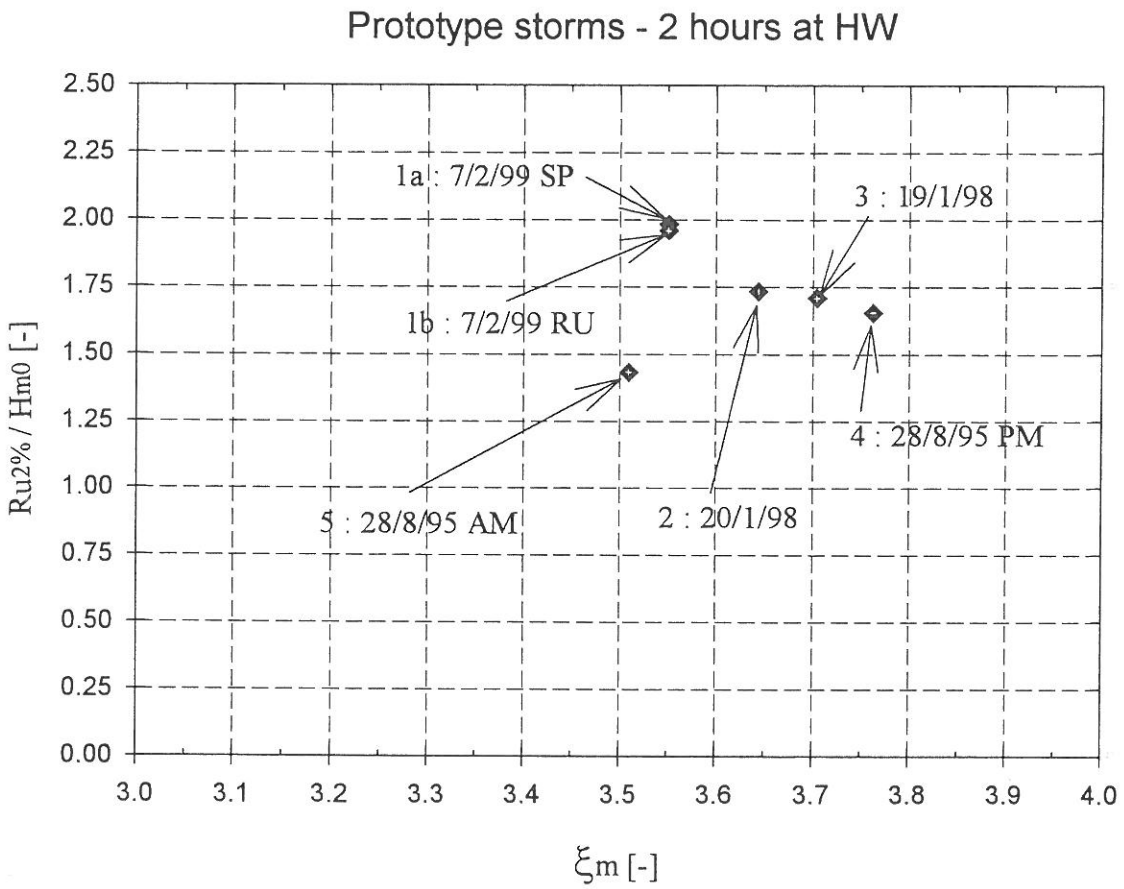

Prototype storms - 2 hours at HW
Ru2% / Hm0 [-]
ξm [-]
1a : 7/2/99 SP
1b : 7/2/99 RU
2 : 20/1/98
3 : 19/1/98
4 : 28/8/95 PM
5 : 28/8/95 AM
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0

Figure 8

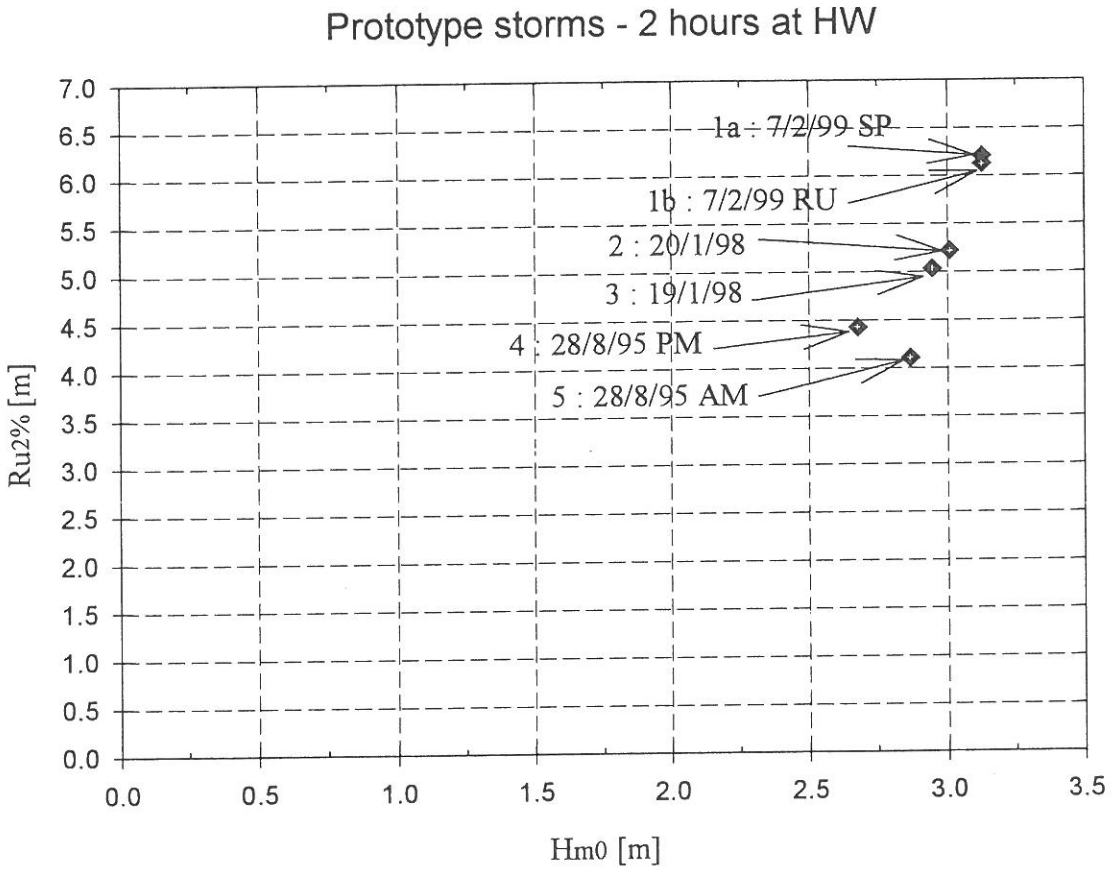

Prototype storms - 2 hours at HW
Ru2% [m]
Hm0 [m]
1a : 7/2/99 SP
1b : 7/2/99 RU
2 : 20/1/98
3 : 19/1/98
4 : 28/8/95 PM
5 : 28/8/95 AM
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0

Figure 9

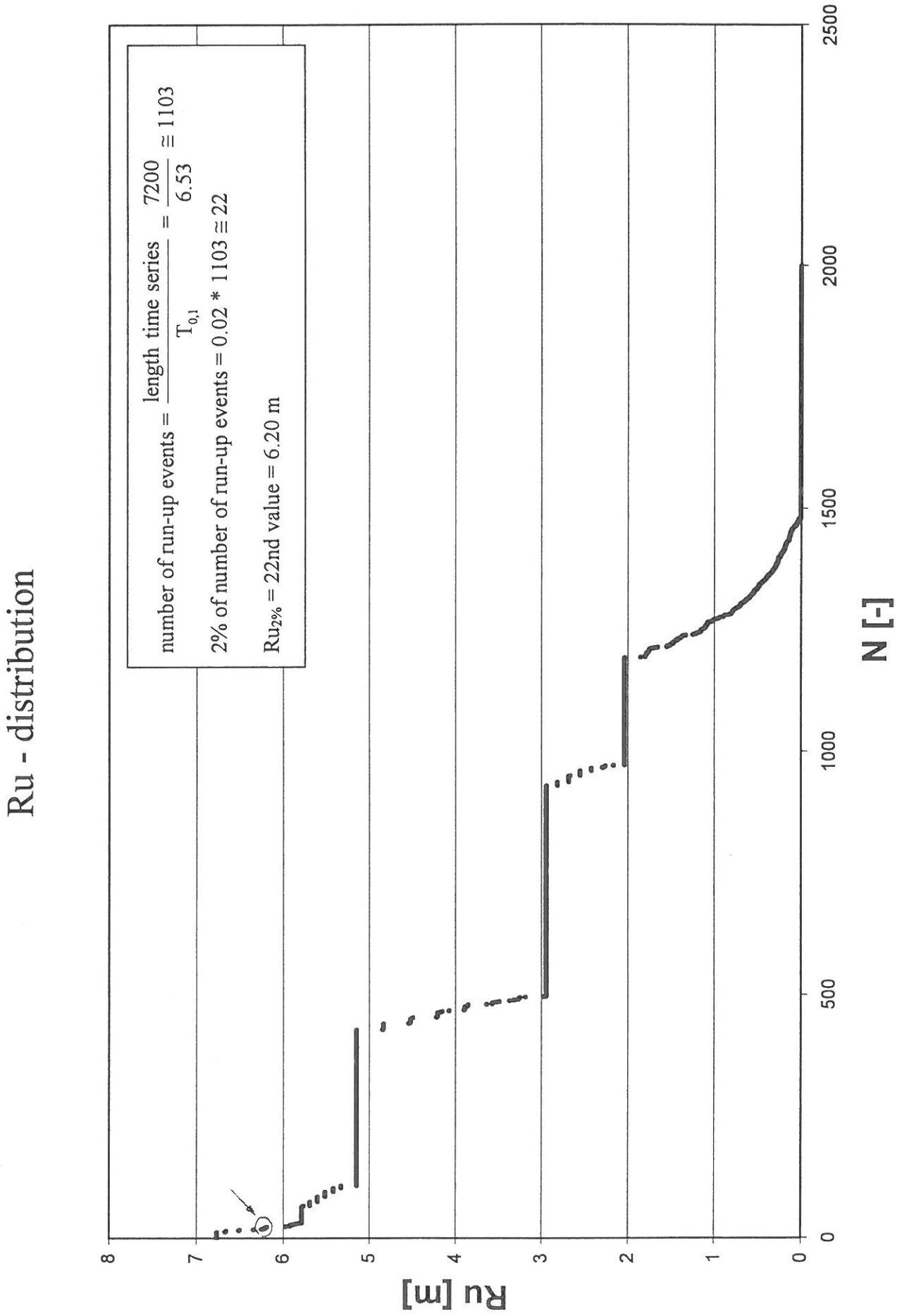
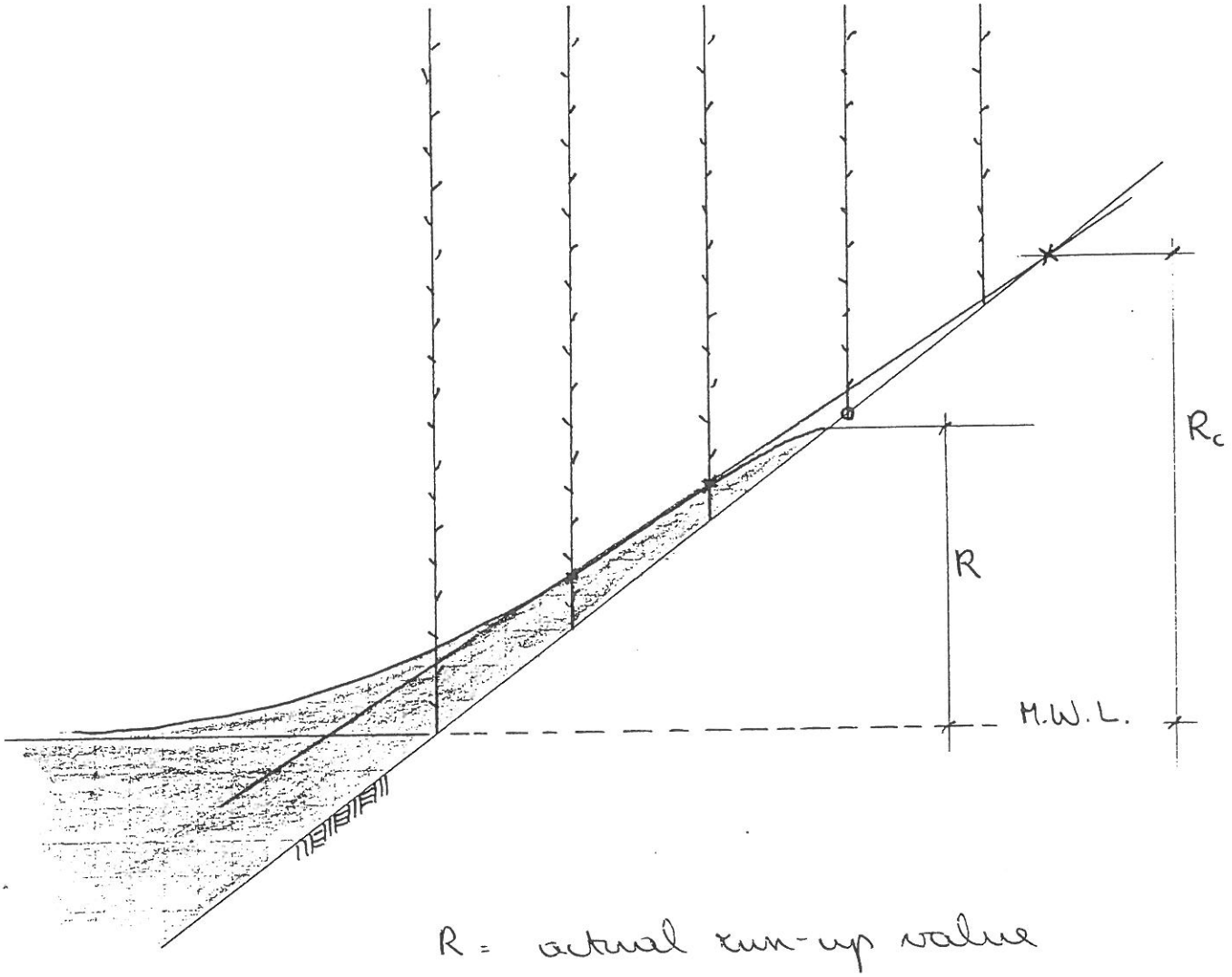

Ru - distribution
number of run-up events = length time series / T0,1 = 7200 / 6.53 ≅ 1103
2% of number of run-up events = 0.02 * 1103 ≅ 22
Ru2% = 22nd value = 6.20 m
Ru [m]
N [-]
0
1
2
3
4
5
6
7
8
0
500
1000
1500
2000
2500

Figure 10



R = actual run-up value

R_c = calculated run-up value

Figure 11

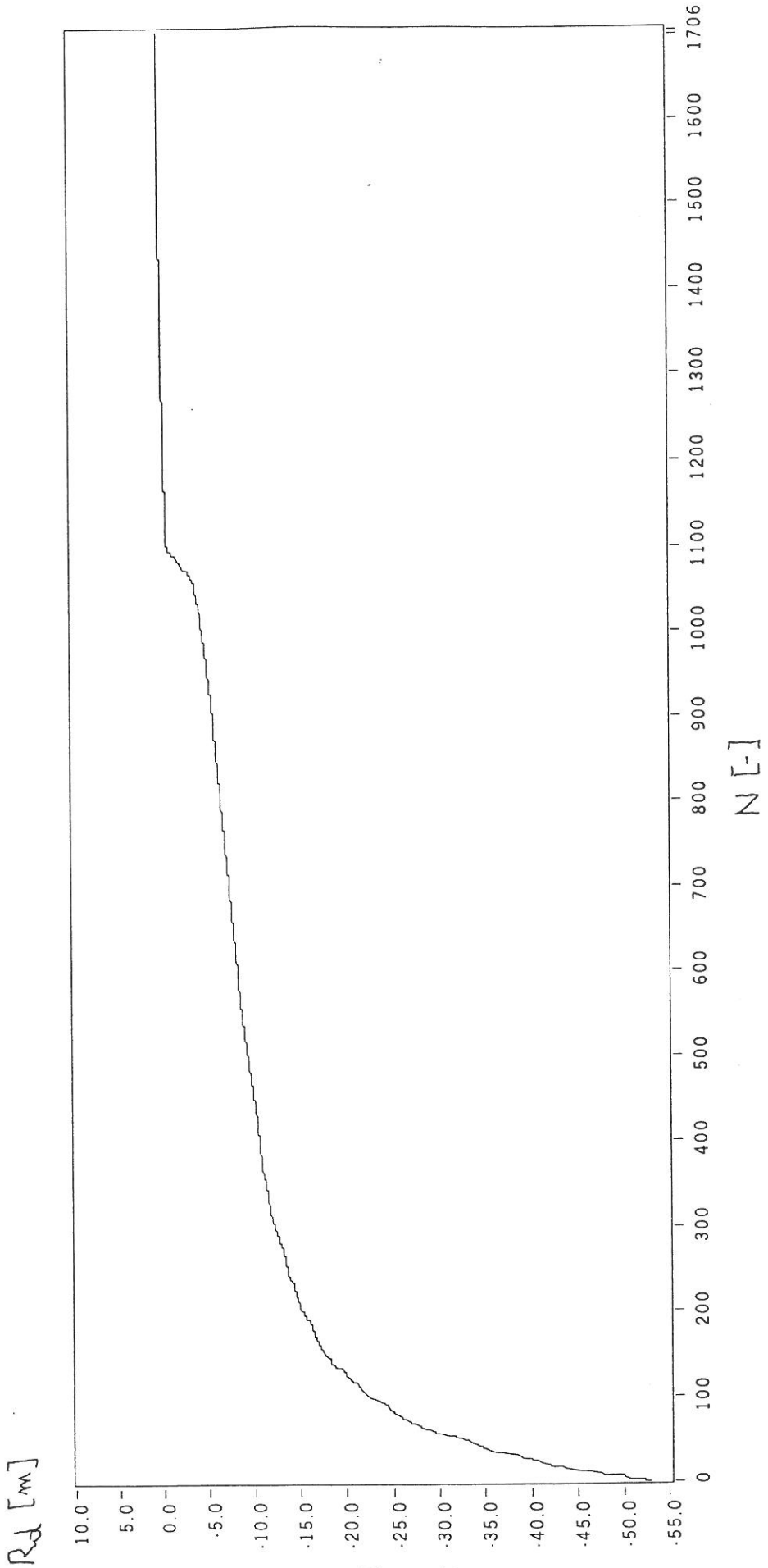
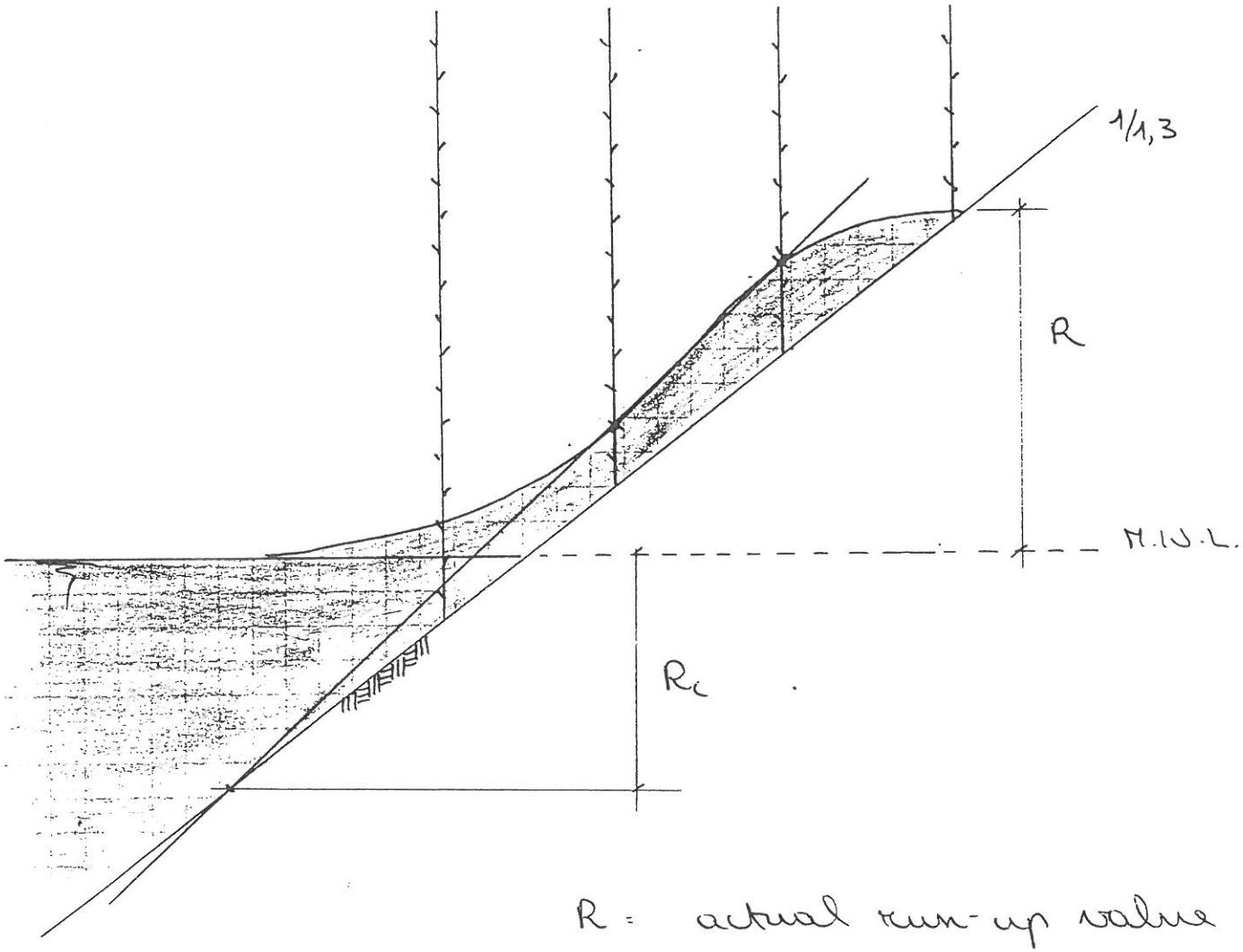

Rd [m]
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
-50.0
-55.0
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1706
N [-]

Figure 12



R = actual run-up value

R_c = calculated run-up value

Figure 13

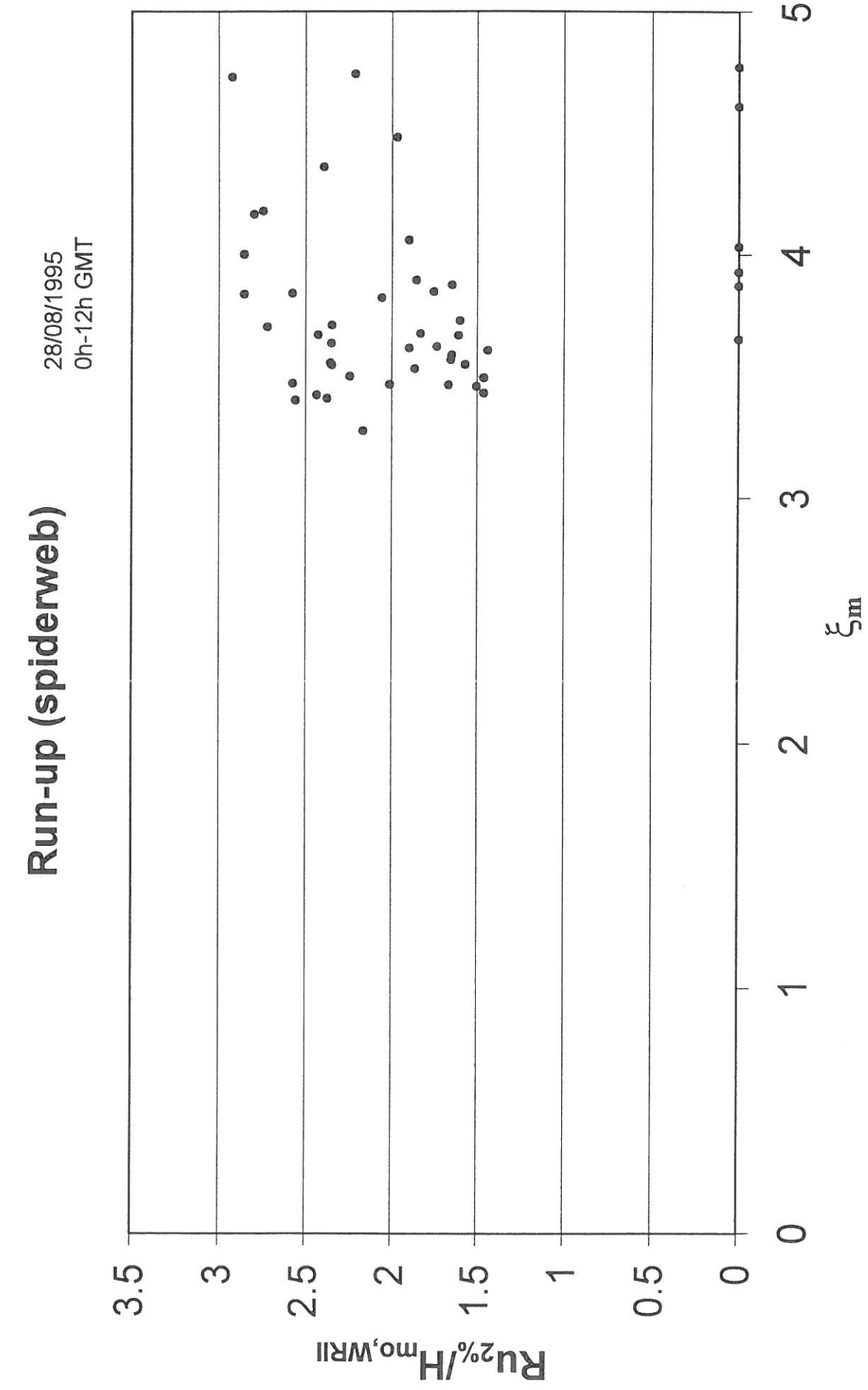

Run-up (spiderweb)
28/08/1995
0h-12h GMT
$Ru_{2\%}/H_{mo,WRII}$
ξ_m
3.5
3
2.5
2
1.5
1
0.5
0
0
1
2
3
4
5

Figure 14

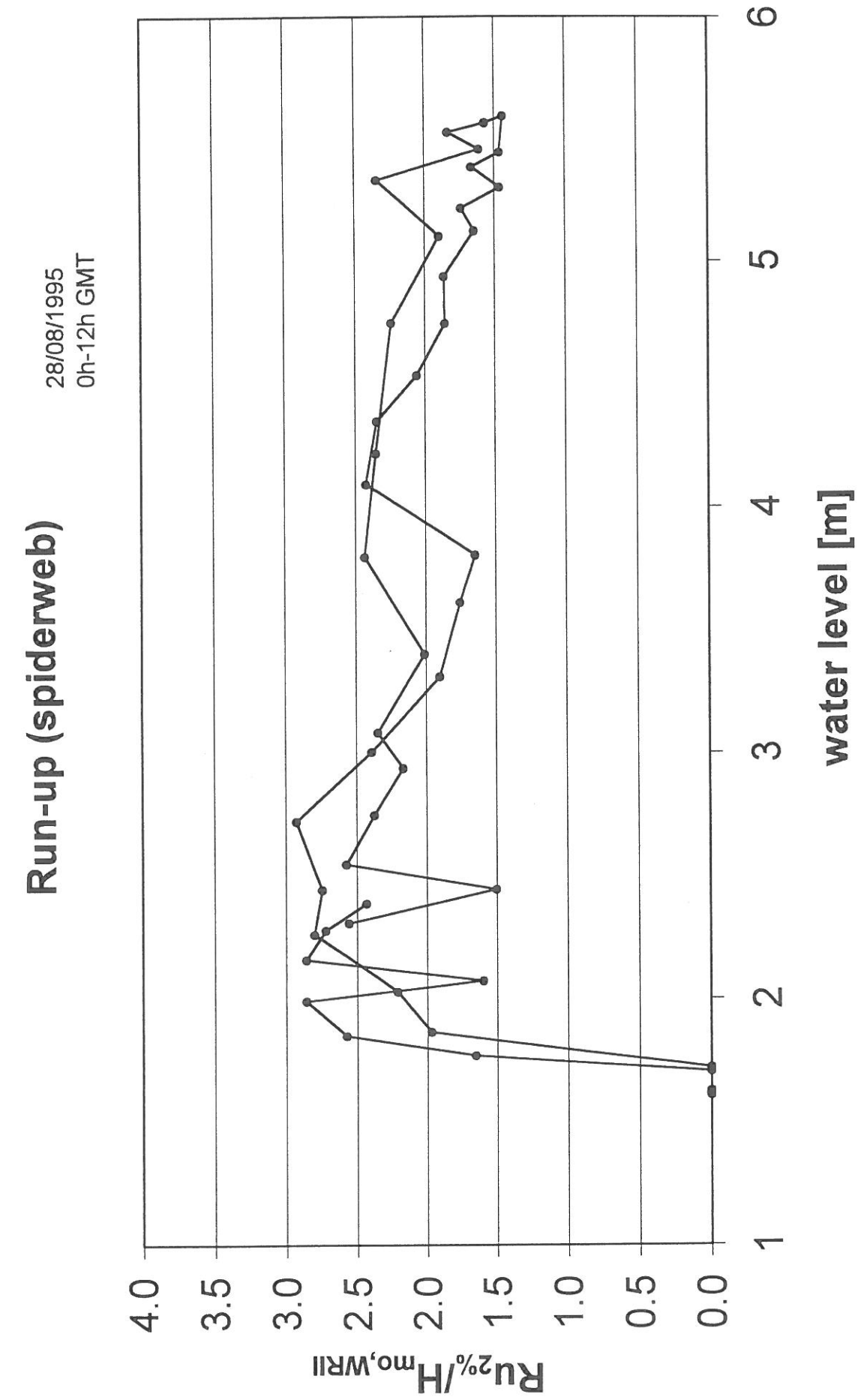
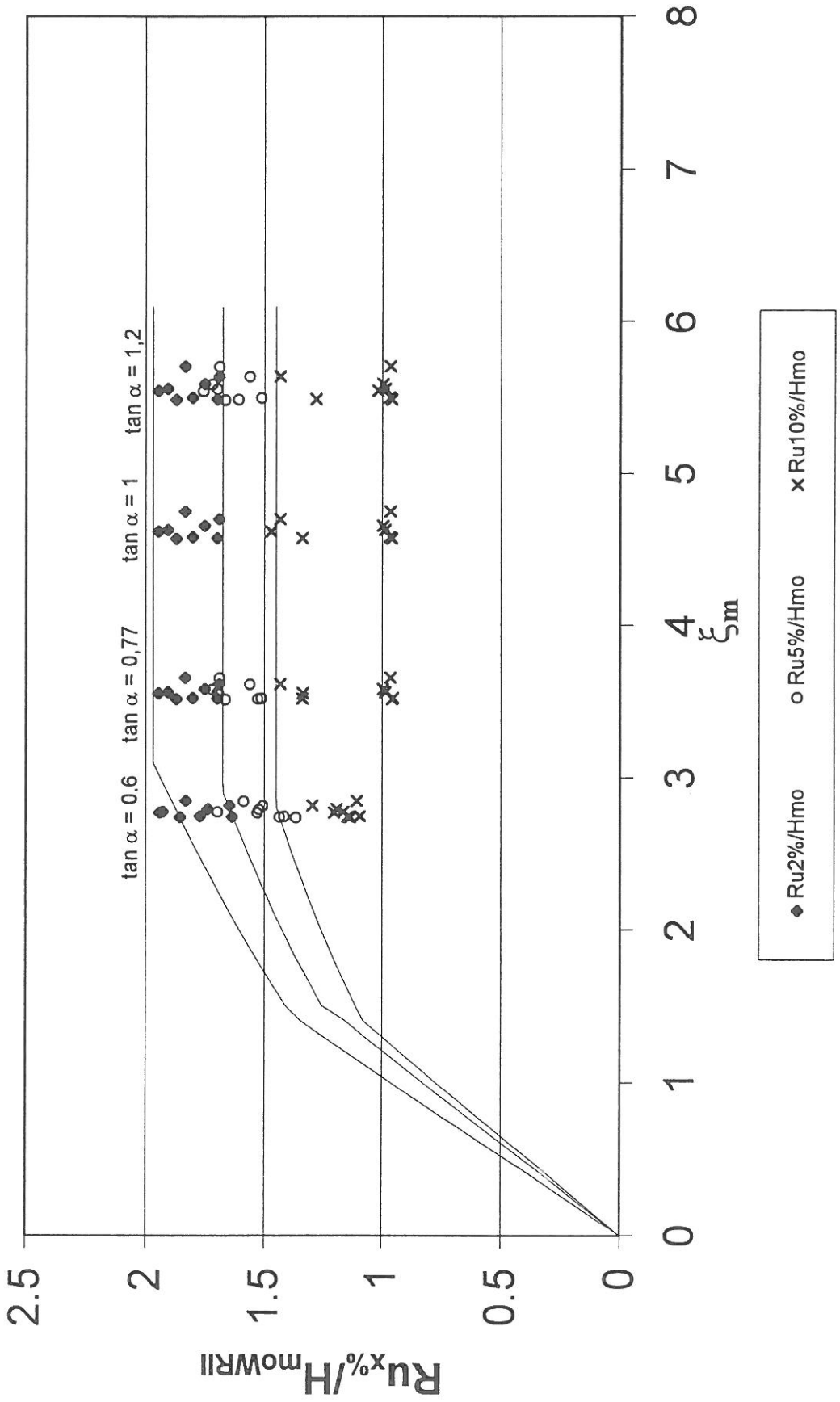

Run-up (spiderweb)
28/08/1995
0h-12h GMT
Ru2%/Hmo,WRII
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
water level [m]

Figure 15


Ru$_{x\%}$/H$_{mowRII}$
2.5
2
1.5
1
0.5
0
0
1
2
3
4
5
6
7
8
ξm
tan α = 0.6
tan α = 0,77
tan α = 1
tan α = 1,2
Ru2%/Hmo
Ru5%/Hmo
Ru10%/Hmo

Figuur 16

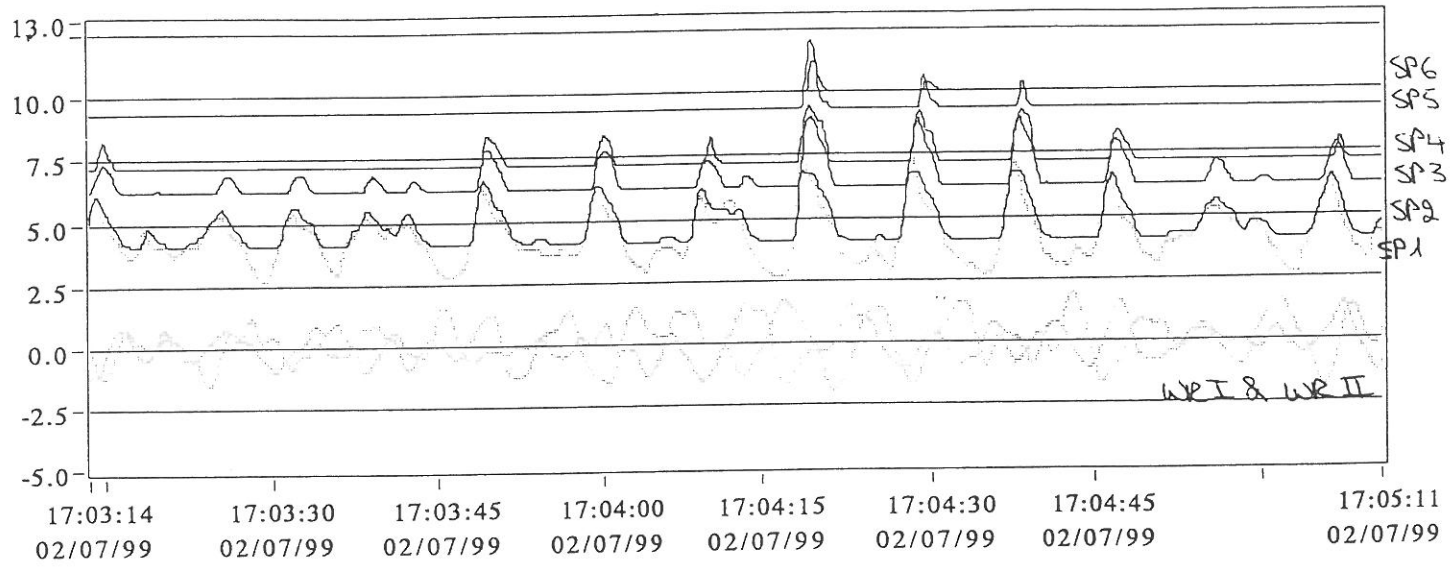


Figure 17

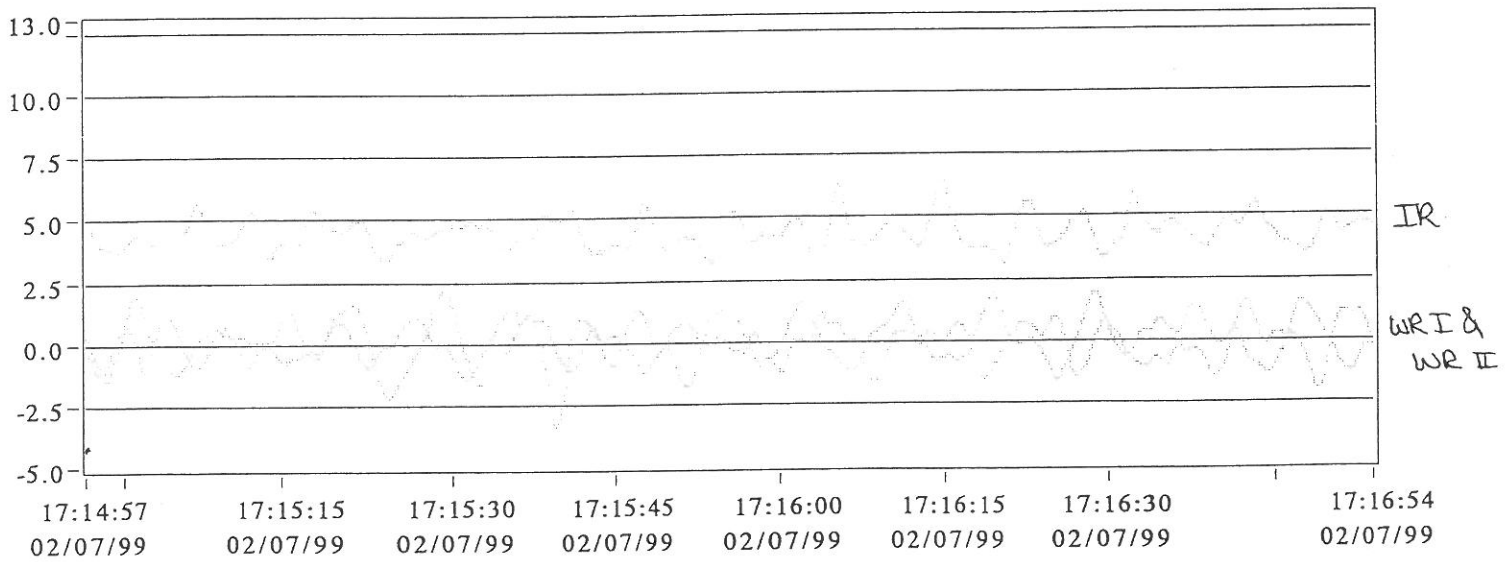


Figure 18

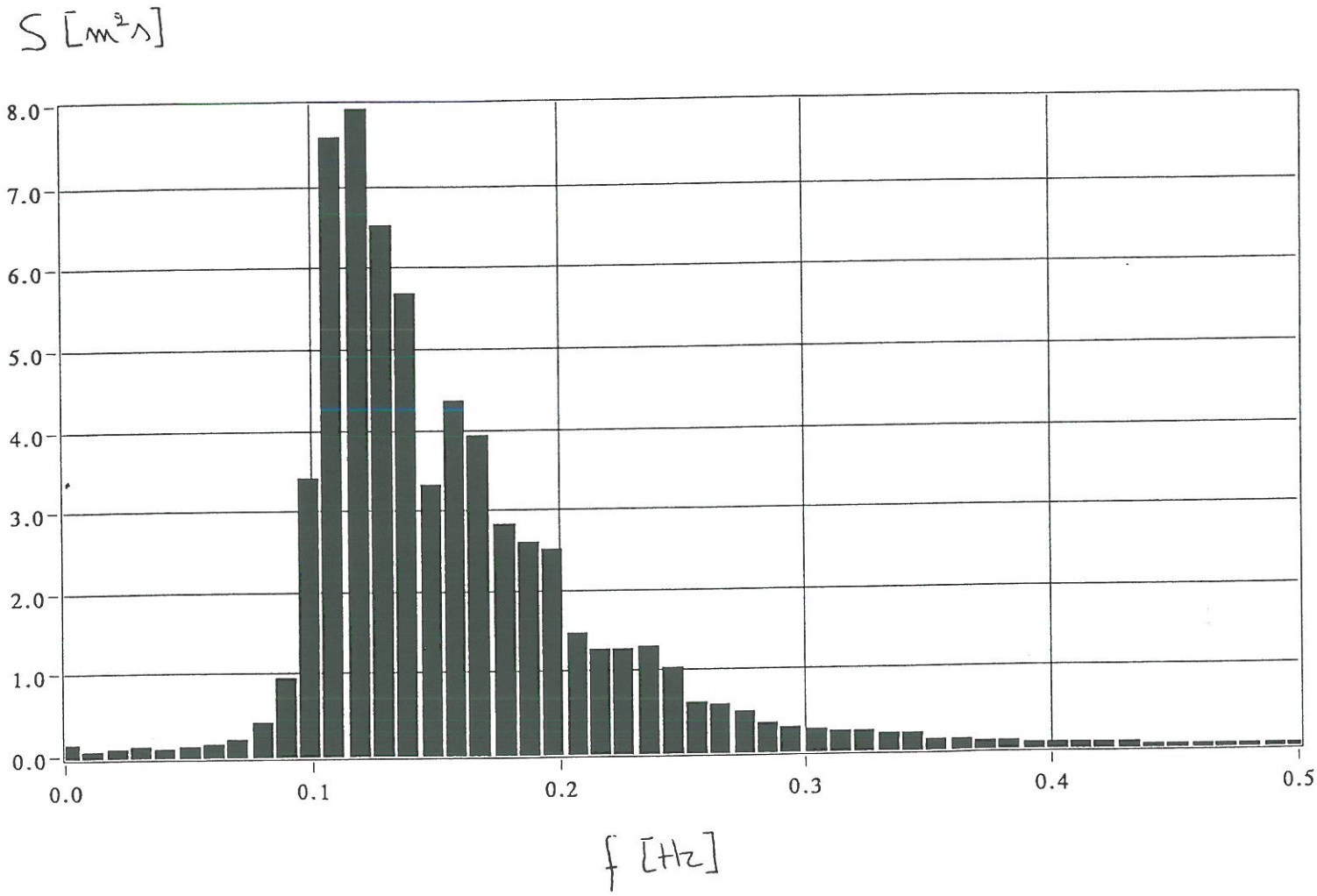


Figure 19

COMMISSION
OF THE EUROPEAN
COMMUNITIES

MAST III

THE OPTIMISATION OF
CREST LEVEL DESIGN OF
SLOPING COASTAL STRUCTURES
THROUGH PROTOTYPE
MONITORING AND MODELLING

OPTICREST

MAS3-CT97-0116

REPORT

Bremen Workshop

Appendix: Laboratory measurements at Flanders Hydraulics

(2-D tests, scale 1:30, of Zeebrugge breakwater)

Jens Peter Kofoed, Aalborg University
Marc Willems, Flanders Hydraulics

October 1999

Graphs, FH Zeebrugge modeltests, 1999

In general

Dimensionless run-up : R/H

Irribarren number : $\xi = \frac{\tan(\alpha)}{\sqrt{\frac{2\pi}{gT^2}H}}$

For the regular waves these definitions can be used directly.

For the tests with irregular waves the following apply:

The $R = R_{u2\%}$ is defined as the run-up level exceeded by 2 % of the run-up events. The total number of run-up events is defined as the length of the recorded time series divided by the mean wave period, defined as given below.

Wave parameters are always based on frequency domain parameters, meaning that:

$T = T_m = T_{0,1}$
$H = H_{m0}$

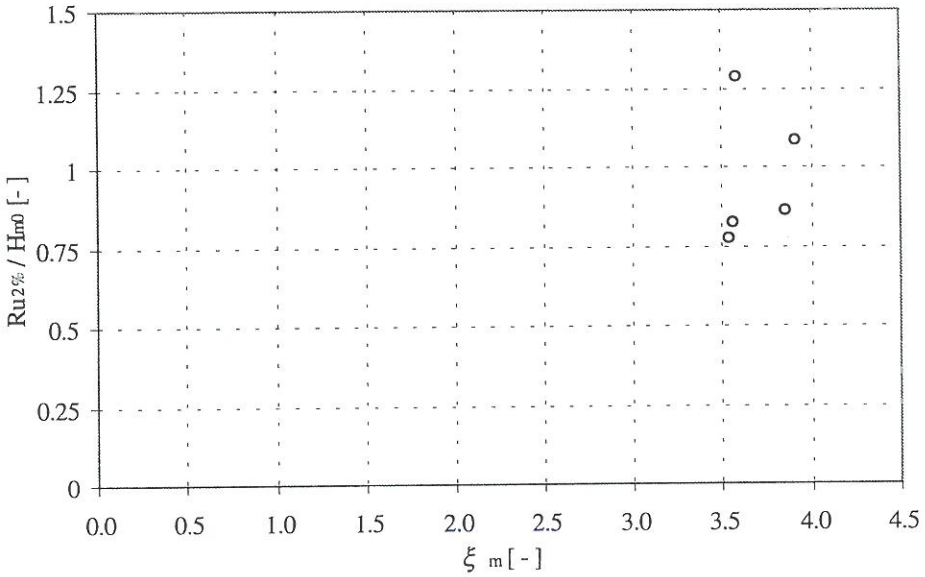
Prototype storms

As the purpose of the reproduction of the prototype storms in the laboratories is to compare the model tests and the prototype measurements, the plots should be based on the type of data available in both prototype and model measurements.

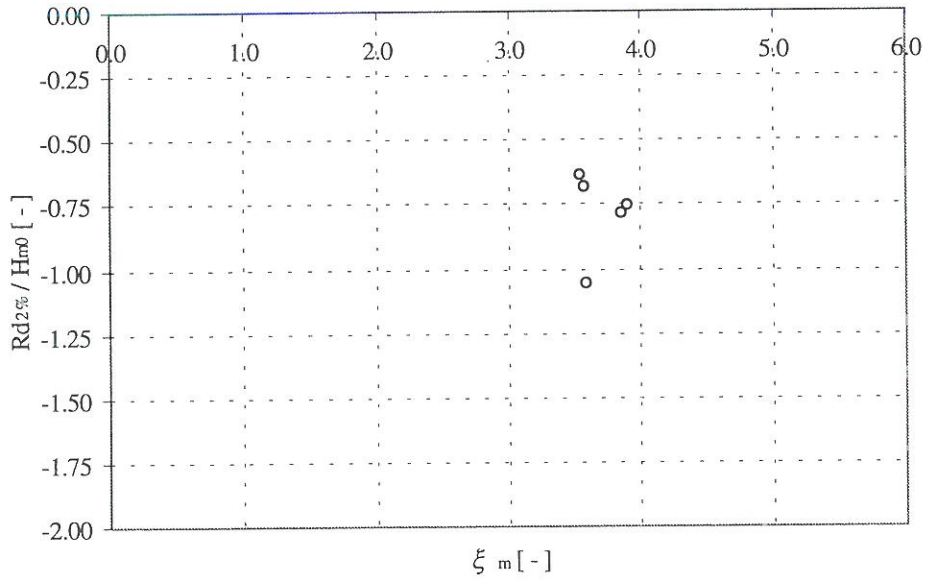
The run-up time series are zero-adjusted by use of the MWL calculated from wave measurements made by Ze7 in the model tests, as this corresponds to the measurements made by either IR-meter or pressure gauge at the pile in the prototype setup.

The wave parameters are calculated from the measurements made by Ze1 (total signal, not calculated incident wave), as this corresponds to taking the data from WR2 in the prototype set-up. This also includes the mean period used to calculate the total number waves/run-up events necessary to calculated the $R_{u2\%}$.

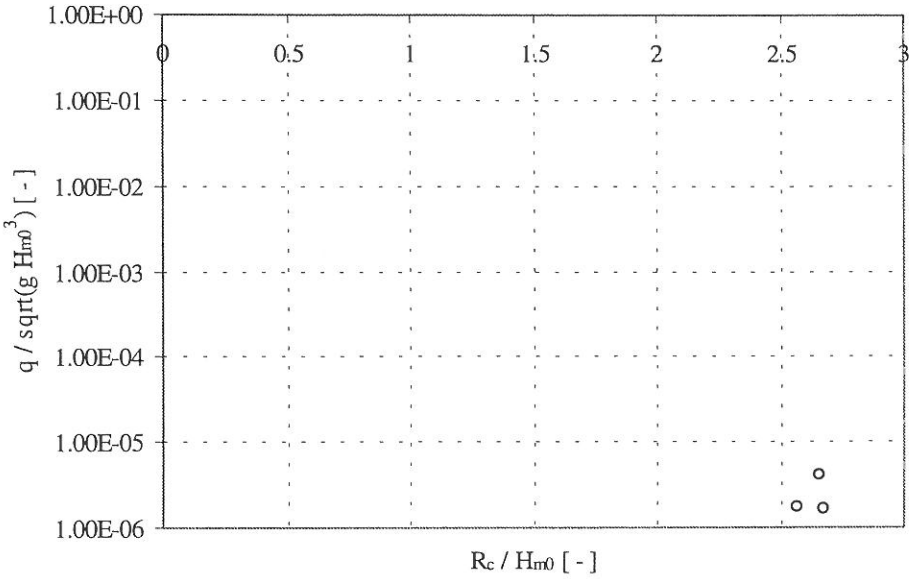
Graphs:



Graph showing the normalised 2 % run-up, as a function of the surf similarity parameter ξ_m (based on the mean wave period T_{m01}), for the model tests reproducing the prototype storms. The wave parameters used in the normalisation and the surf similarity parameter are based on frequency domain analyses of the wave signals measured at the location of WR2 by one wave gauge (total signal, not incident wave signal). The reference of the run-up measurements is the MWL measured at the pile.



Graph showing the normalized 2 % run-down, as a function of the surf similarity parameter xm (based on the mean wave period Tm01), for the modeltests reproducing the prototype storms. The wave parameters used in the normalization and the surf similarity parameter is based on frequency domain analyses of the wave signals measured at the location of by one wave gauge (total signal, not incident wave signal). The reference of the run-down measurements is the MWL measured at the pile.

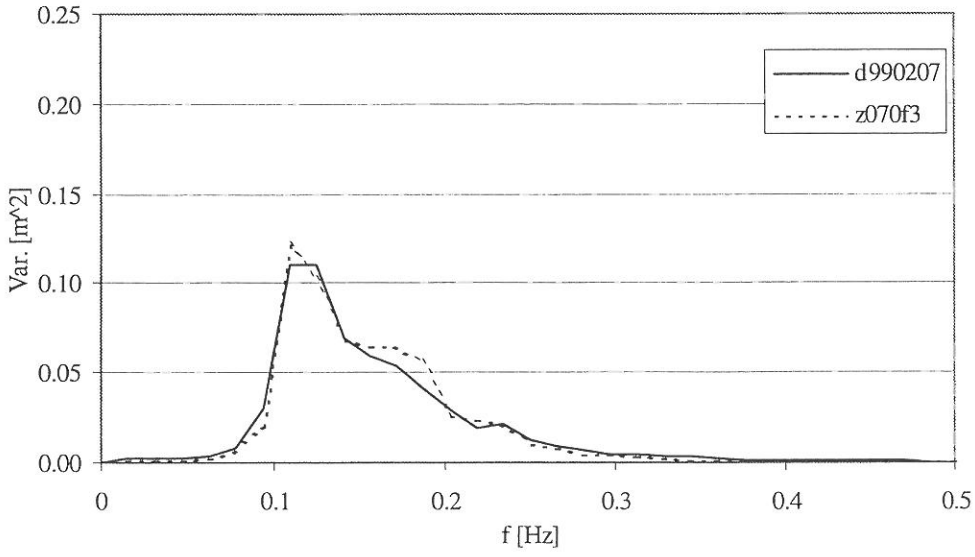


Graph showing the normalized mean overtopping rate, as a function of the relative crest freeboard, for the modeltests reproducing the prototype storms. The wave parameters used in the normalization are based on frequency domain analyses of the wave signals measured at the location of by one wave gauge Ze1 (total signal, not incident wave signal). The crest freeboard is taken relative to the MWL measured at the pile.

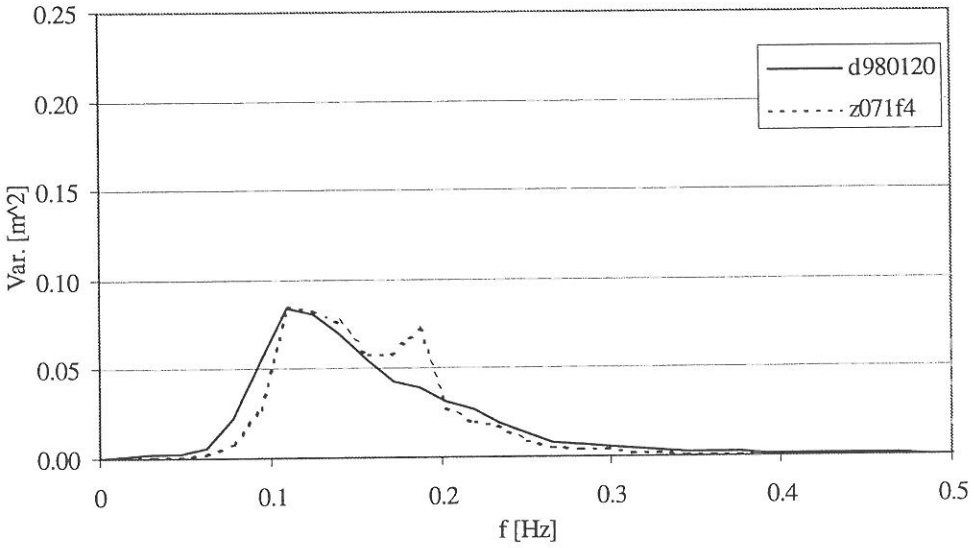
Reproduction of storms measures in prototype

The reproduction in the model of the storm measured in prototype has been performed by repeating and calibrating the generation of the waves, until good similarity between the target spectrum (the spectrum found by analysing the wave signal measured in prototype) and the spectrum of the wave signal recorded in the model was obtained. Furthermore, it has been required that the difference between the variance of the target spectrum and the spectrum measured in the model should be less than 5 %.

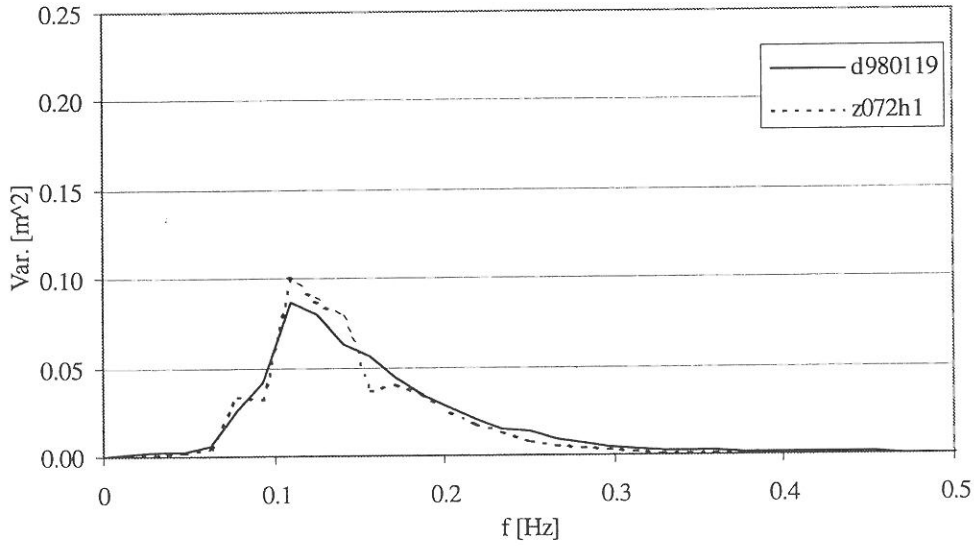
Storm	Test	H_{m0}, prototype [m]	Hm0, model [m]	Difference [%]
99.02.07	Z070F3	3.14	3.14	0.0
98.01.20	Z071F4	3.08	3.04	1.3
98.01.19	Z072H1	2.99	2.94	1.7
95.08.28 / 1	Z073G6	2.89	2.80	2.4
95.08.28 / 2	Z074H4	2.69	2.79	3.6



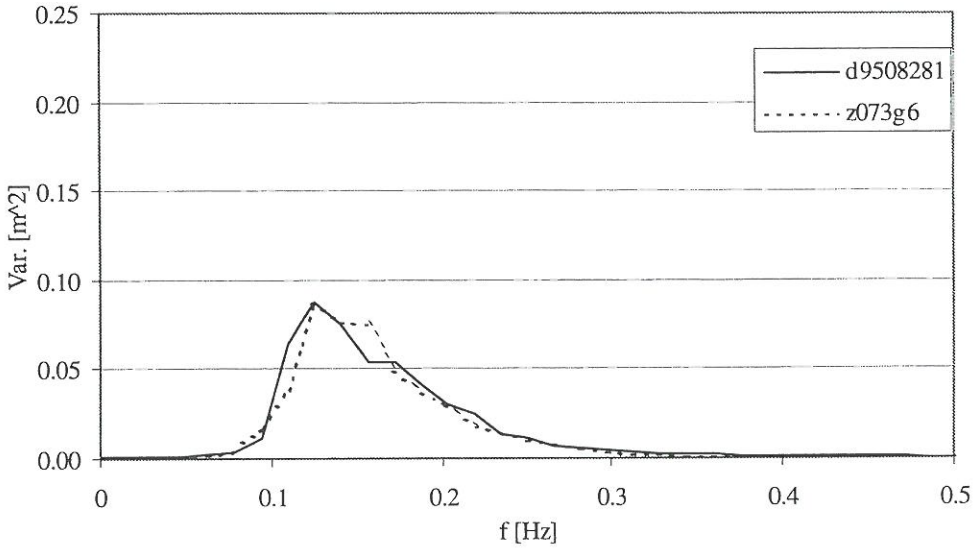
Variance spectrum of wave signals recorded in prototype (by wave rider bouy) and in model test (by one wave gauge) at the location of WR2 for storm at 99.02.07.



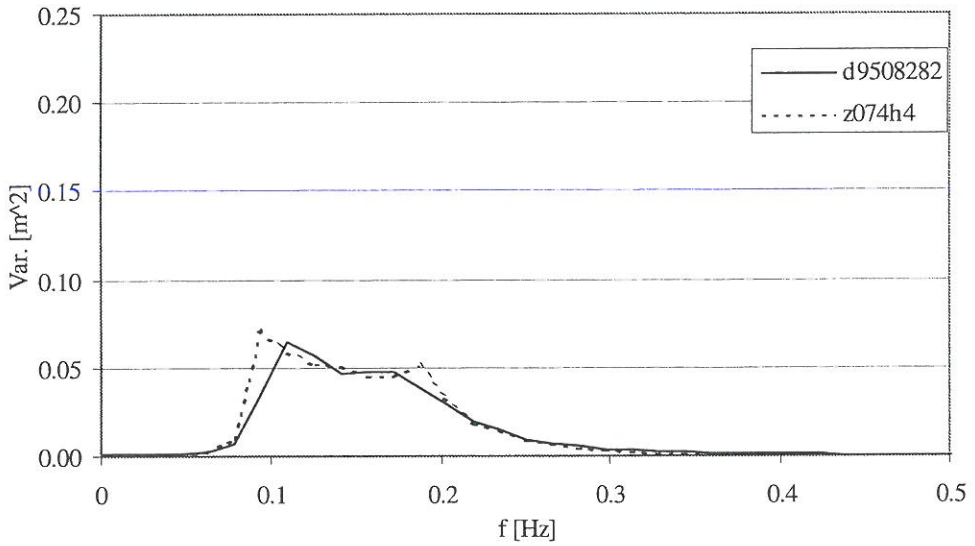
Variance spectrum of wave signals recorded in prototype (by wave rider bouy) and in model test (by one wave gauge) at the location of WR2 for storm at 98.01.20.



Variance spectrum of wave signals recorded in prototype (by wave rider bouy) and in model test (by one wave gauge) at the location of WR2 for storm at 98.01.19.



Variance spectrum of wave signals recorded in prototype (by wave rider bouy) and in model test (by one wave gauge) at the location of WR2 for storm at 95.08.28 / 1.



Variance spectrum of wave signals recorded in prototype (by wave rider bouy) and in model test (by one wave gauge) at the location of WR2 for storm at 95.08.28 / 2.

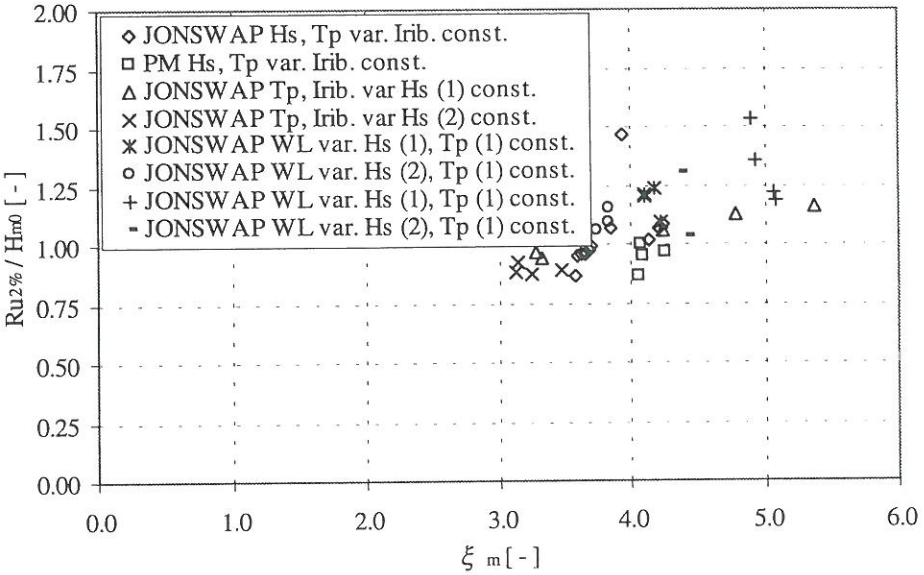
Other tests (parametric study)

As the purpose of the other tests is to performed comparisons with other more general run-up expressions the plots of the results from these tests should be based on the type of data that is generally used.

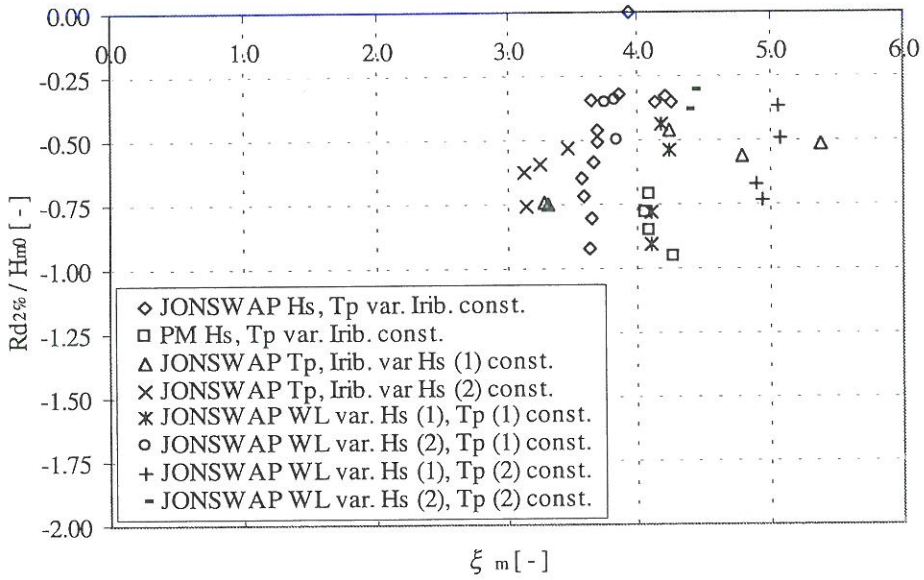
The run-up time series are zero-adjusted by use of the MWL calculated from wave measurements made by Ze1 in the model tests, as this is not influenced by set-up at the breakwater and in general will be close to the SWL.

The wave parameters are calculated from the calculated incident waves, using Ze1, Ze2 and Ze3,as this is considered the best estimation of the "off shore" sea state often used in run-up expressions. This also includes the mean period used to calculate the total number waves/run-up events necessary to calculated the $R_{u2\%}$..

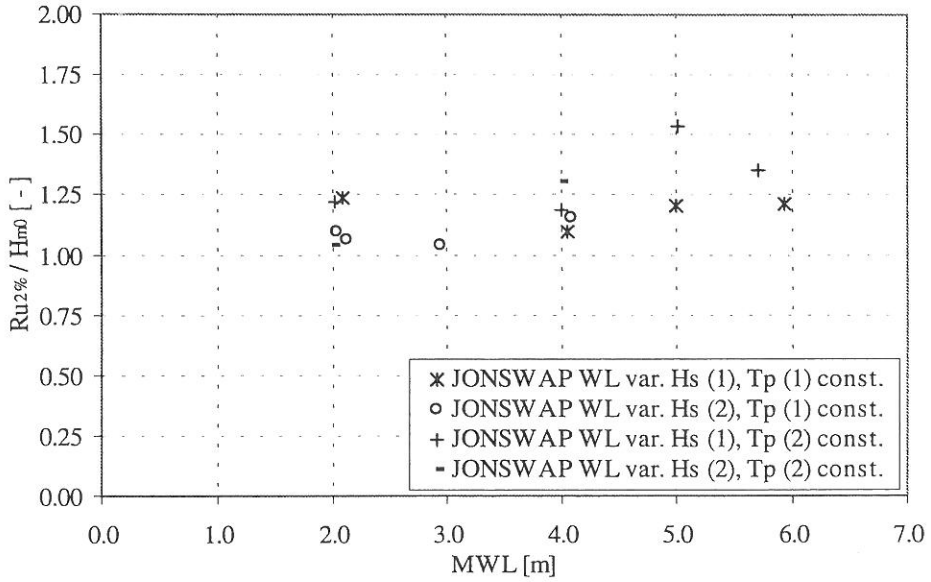
Graphs



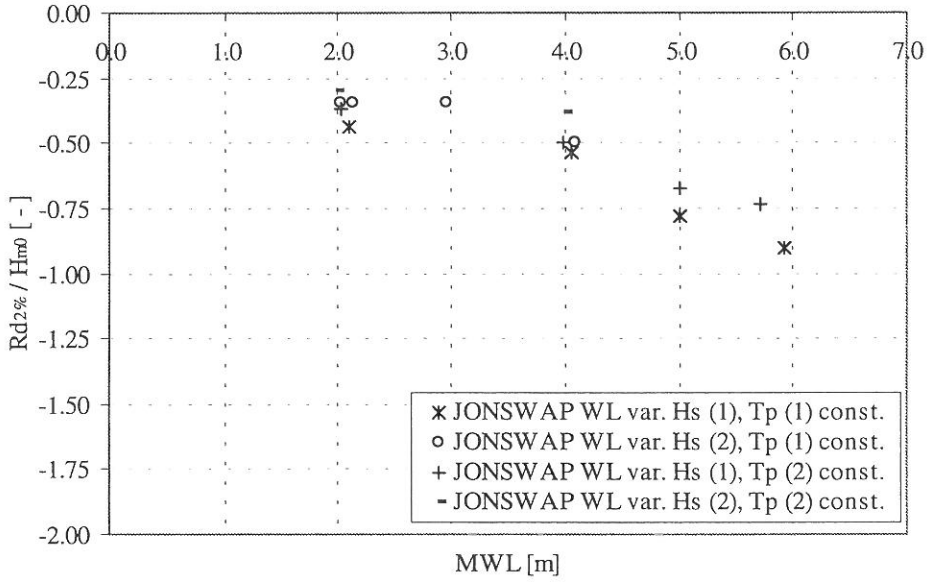
Graph showing the normalised 2 % run-up, as a function of the surf similarity parameter ξ_m (based on the mean wave period T_{m01}), for the modeltests used in the parametric study. The wave parameters used in the normalisation and the surf similarity parameter are based on frequency domain analyses of the incident wave signals calculated using wave gauges located at the position of WR2. The reference of the run-up measurements is the MWL off shore (no set-up).



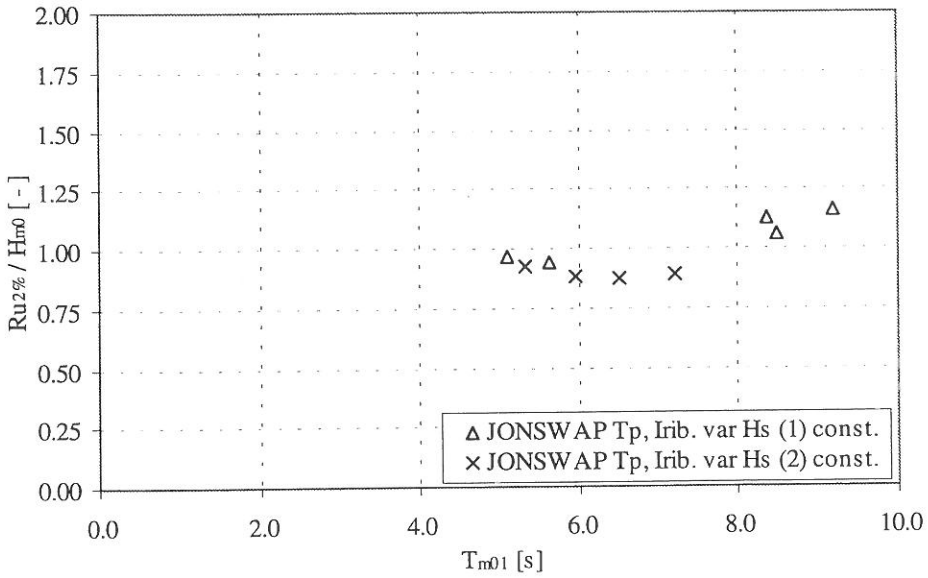
Graph showing the normalized 2 % run-up, as a function of the surf similarity parameter xm (based on the mean wave period Tm01), for the modeltests used in the parametric study. The wave parameters used in the normalization and the surf similarity parameter is based on frequency domain analyses of the incident wave signals calculated using wave gauges located at the position of WR2. The reference of the run-up measurements is the MWL off shore (no set-up).



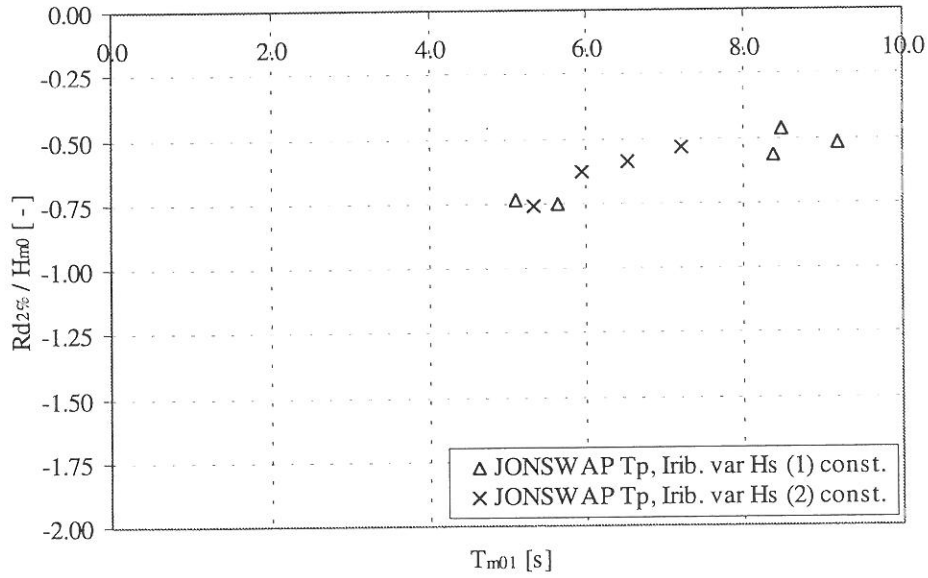
Graph showing the normalised 2 % run-up, as a function of the mean water level (MWL) off shore. The wave parameter used in the normalisation is based on frequency domain analyses of the incident wave signals calculated using wave gauges located at the position of WR2. The reference of the run-up measurements is the MWL off shore (no set-up).



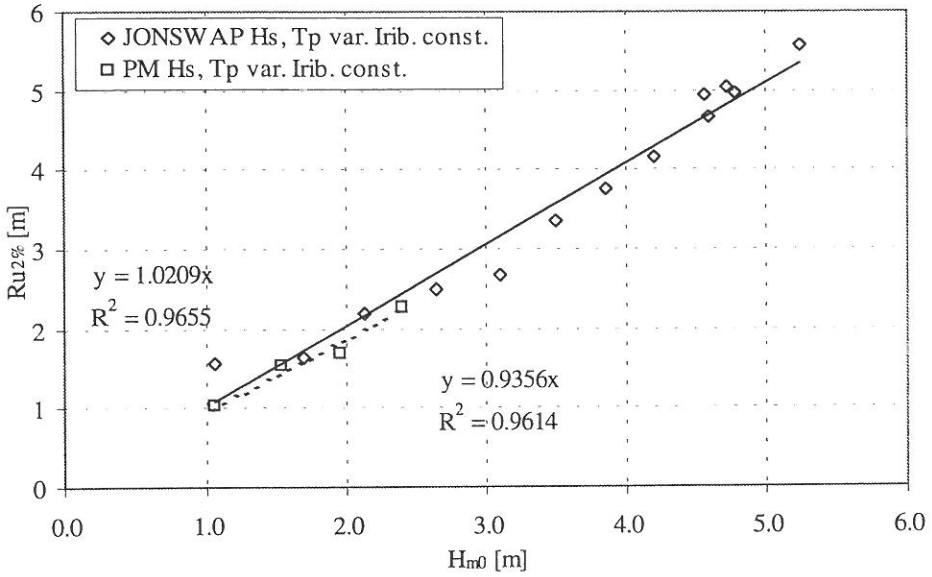
Graph showing the normalised 2 % run-down, as a function of the mean water level (MWL) off shore. The wave parameter used in the normalisation is based on frequency domain analyses of the incident wave signals calculated using wave gauges located at the position of WR2. The reference of the run-down measurements is the MWL off shore (no set-up).



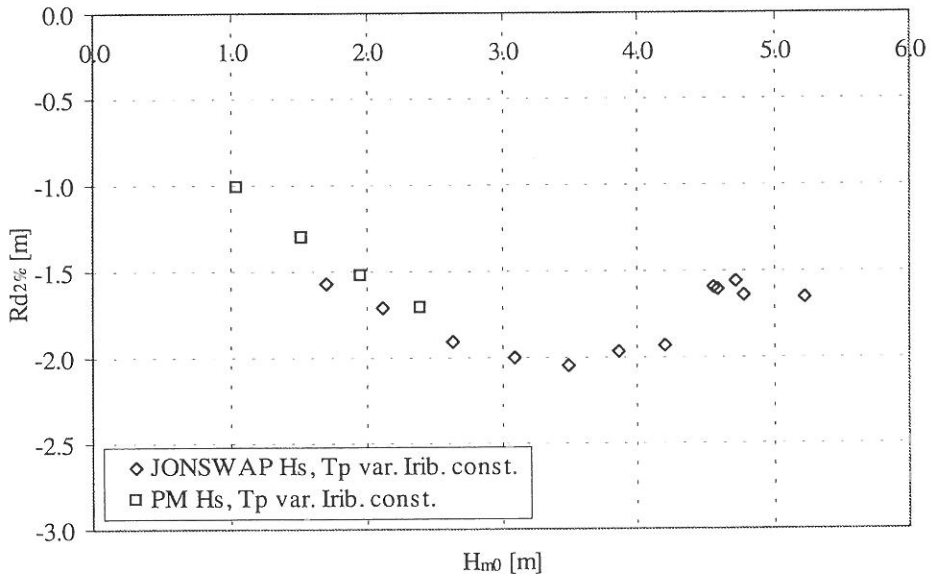
Graph showing the normalized 2 % run-up, as a function of the mean wave period. The used wave parameters are based on frequency domain analyses of the incident wave signals calculated using wave gauges located at the position of WR2. The reference of the run-up measurements is the MWL off shore (no set-up).



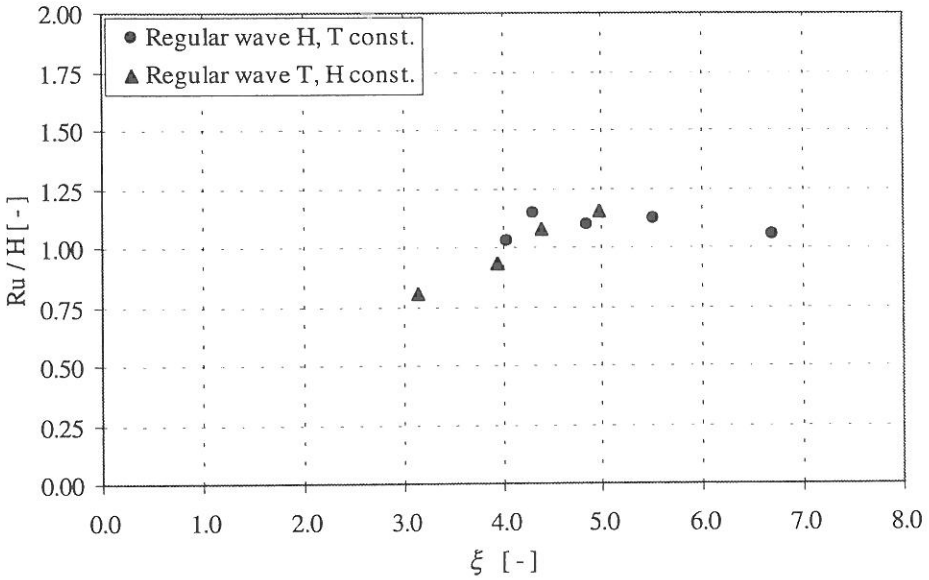
Graph showing the normalized 2 % run-down, as a function of the mean wave period. The used wave parameters are based on frequency domain analyses of the incident wave signals calculated using wave gauges located at the position of WR2. The reference of the run-down measurements is the MWL off shore (no set-up).



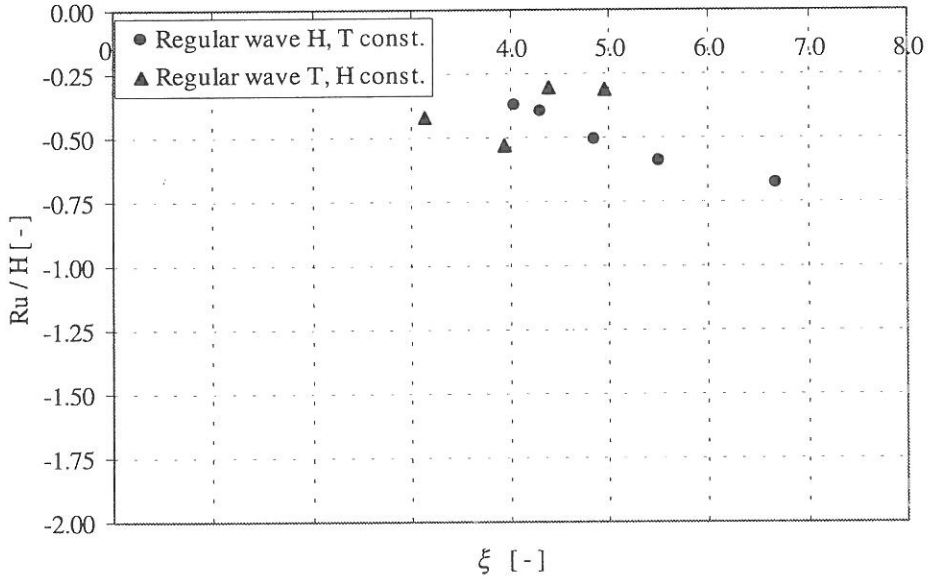
Graph showing the 2 % run-up, as a function of the significant wave height based on frequency domain analyses of the incident wave signals calculated using wave gauges located at the position of WR2. The reference of the run-up measurements is the MWL off shore (no set-up).



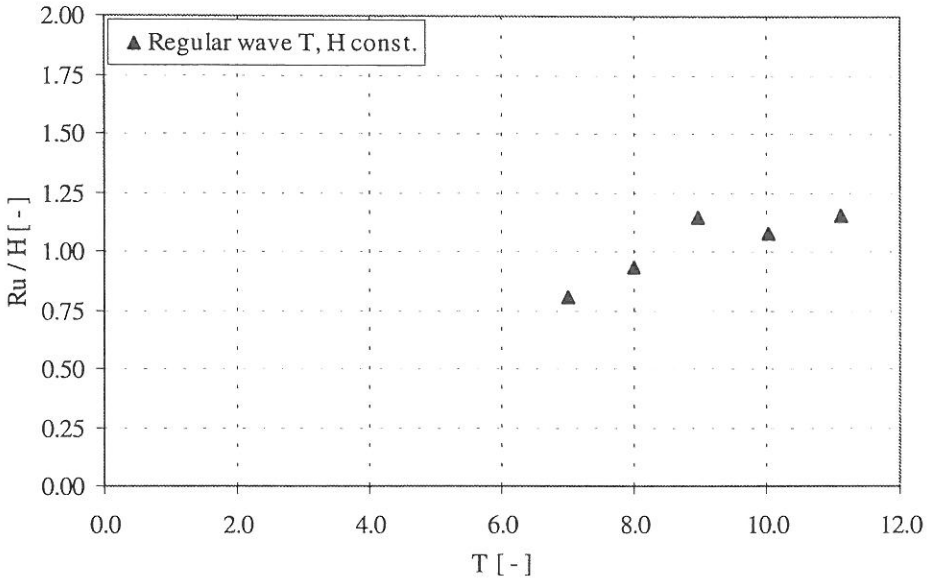
Graph showing the 2 % run-down, as a function of the significant wave height based on frequency domain analyses of the incident wave signals calculated using wave gauges located at the position of WR2. The reference of the run-down measurements is the MWL off shore (no set-up).



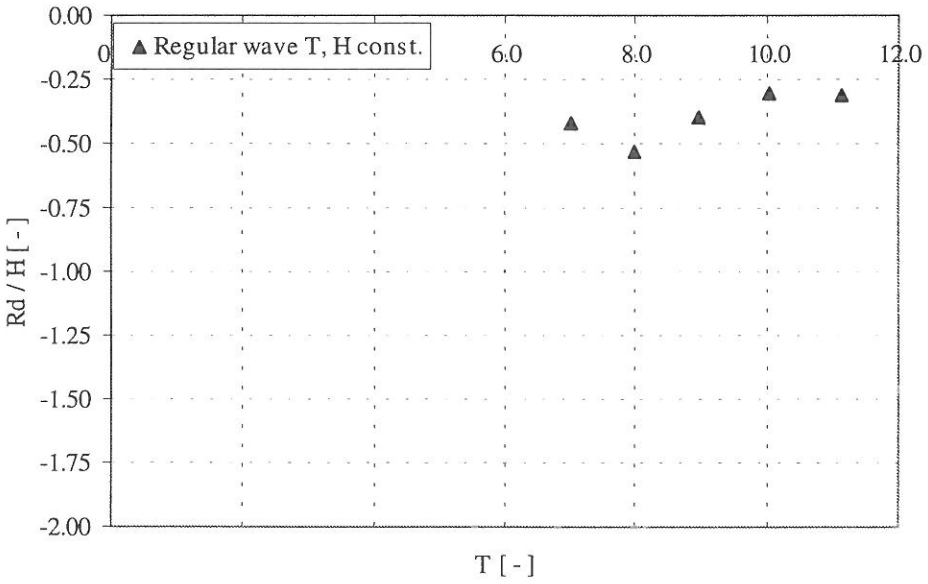
Graph showing the normalized run-up, as a function of the surf similarity parameter xm, for the modeltests with regular waves. The wave parameters used in the normalization and the surf similarity parameter is based on frequency domain analyses of the incident wave signals calculated using wave gauges located at the position of WR2. The reference of the run-up measurements is the MWL off shore (no set-up).



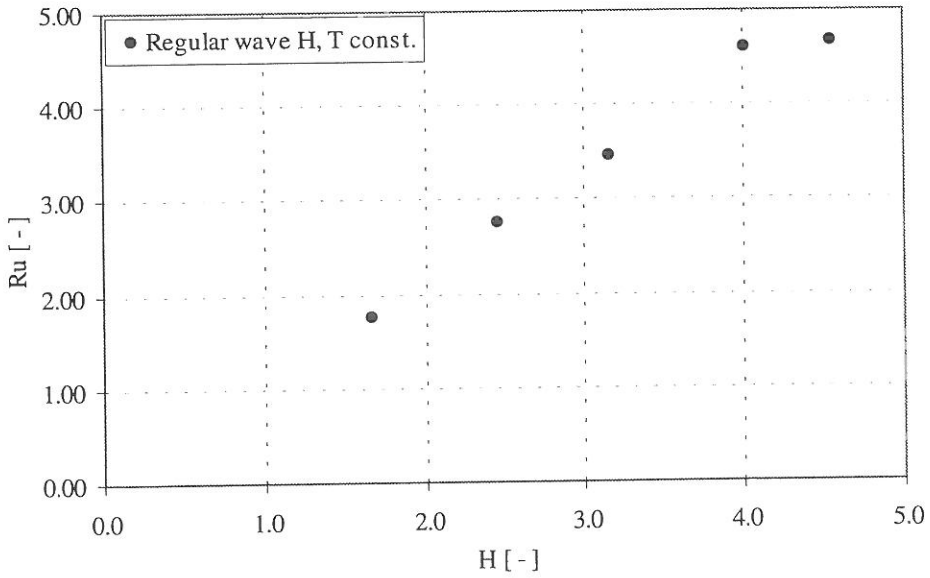
Graph showing the normalized run-down, as a function of the surf similarity parameter xm, for the modeltests with regular waves. The wave parameters used in the normalization and the surf similarity parameter is based on frequency domain analyses of the incident wave signals calculated using wave gauges located at the position of WR2. The reference of the run-up measurements is the MWL off shore (no set-up).



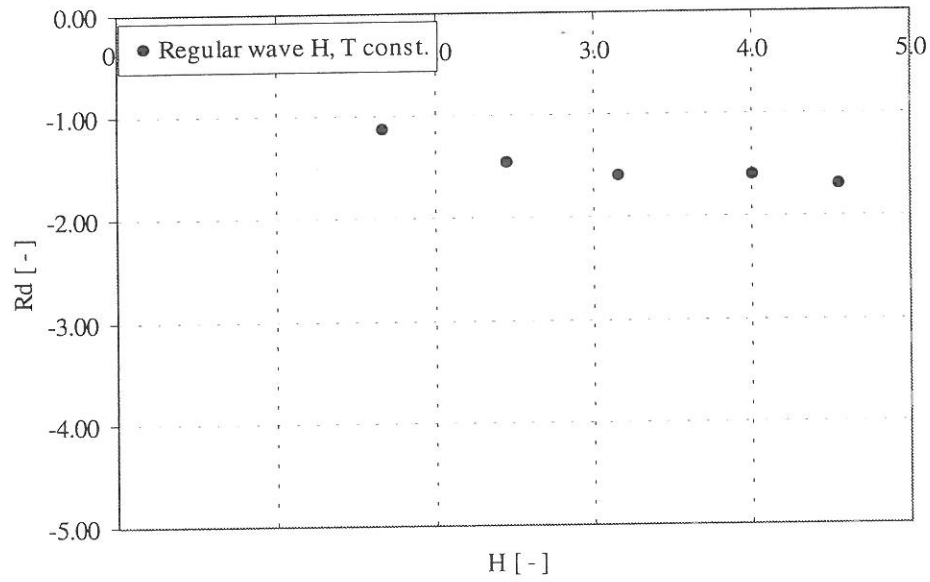
Graph showing the normalized run-up, as a function of the wave period for the modeltests with regular waves. The wave parameters are based on frequency domain analyses of the incident wave signals calculated using wave gauges located at the position of WR2. The reference of the run-up measurements is the MWL off shore (no set-up).



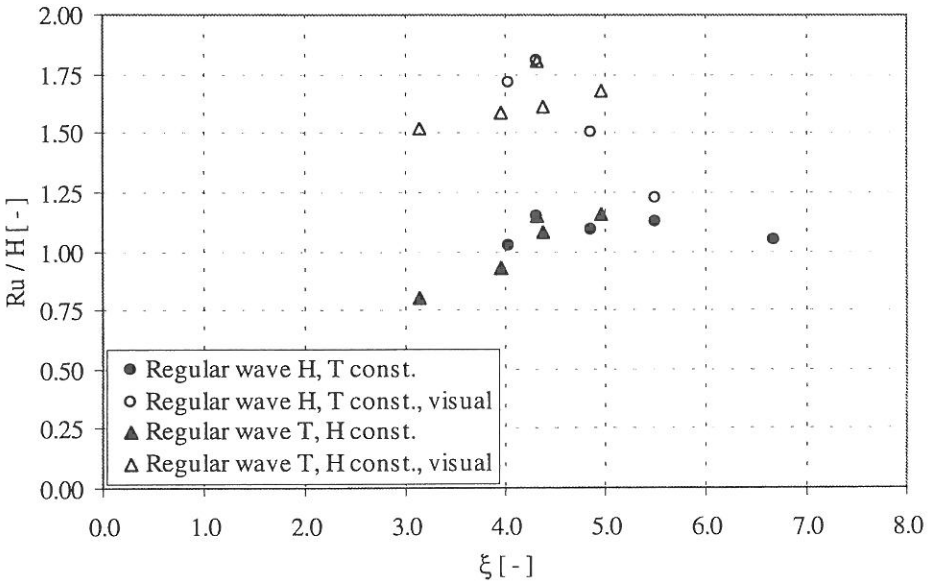
Graph showing the normalized run-down, as a function of the wave period for the modeltests with regular waves. The wave parameters are based on frequency domain analyses of the incident wave signals calculated using wave gauges located at the position of WR2. The reference of the run-up measurements is the MWL off shore (no set-up).



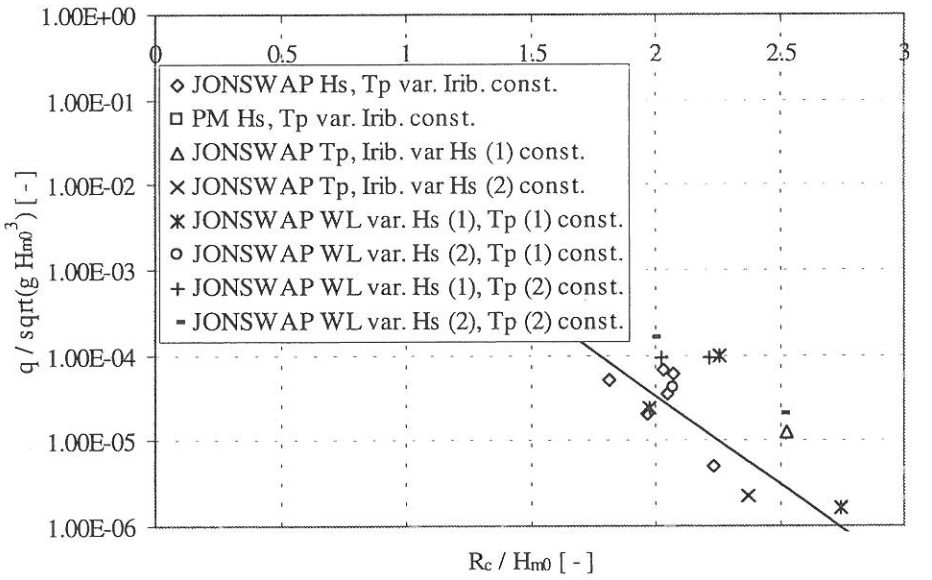
Graph showing the run-up, as a function of the wave height for the modeltests with regular waves. The wave parameter is based on frequency domain analyses of the incident wave signals calculated using wave gauges located at the position of WR2. The reference of the run-up measurements is the MWL off shore (no set-up).



Graph showing the run-down, as a function of the wave height for the modeltests with regular waves. The wave parameter is based on frequency domain analyses of the incident wave signals calculated using wave gauges located at the position of WR2. The reference of the run-up measurements is the MWL off shore (no set-up).



Graph showing the normalized run-up (measured by run-up gauge and visual observation, respectively), as a function of the surf similarity parameter xm, for the modeltests with regular waves. The wave parameters used in the normalization and the surf similarity parameter is based on frequency domain analyses of the incident wave signals calculated using wave gauges located at the position of WR2. The reference of the run-up measurements is the MWL off shore (no set-up).



Graph showing the normalized mean overtopping rate, as a function of the relative crest freeboard, for the modeltests used in the parametric study. The wave parameters used in the normalization are based on frequency domain analyses of the incident wave signals calculated using wave gauges located at the position of WR2. The crest freeboard is taken relative to the MWL off shore (no set-up). Line corresponds to A = 0.5 and B = 4.8.

List of model tests

Test	JONSWAP Hs, Tp var. Irib. const.	PM Hs, Tp var. Irib. const.	JONSWAP Tp, Irib. var Hs (1) const.	JONSWAP Tp, Irib. var Hs (2) const.	JONSWAP WL var. Hs (1), Tp (1) const.	JONSWAP WL var. Hs (2), Tp (1) const.	JONSWAP WL var. Hs (1), Tp (2) const.	JONSWAP WL var. Hs (2), Tp (2) const.	Prototype storms	Regular waves H, T const.	Regular wave T, H const.
Z001F400	X										
Z002F200	X										
Z003F000	X										
Z004F000	X										
Z005F000	X										
Z006F000	X										
Z007F000	X										
Z008F000	X										
Z009F000	X					X					
Z010F000	X										
Z011F000	X										
Z012F000	X										
Z013F000	X										
Z014F000		X									
Z015F000		X									
Z016F000		X									
Z017F000		X									
Z020F000			X								
Z027F000			X								
Z028F000			X								
Z029F000			X								
Z030F100			X								
Z031F000				X							
Z032F000				X							
Z033F000				X							
Z034F000				X							
Z037F000					X						
Z037F100						X					
Z037F200						X					
Z038F000					X						
Z038F100						X					
Z039F000					X						
Z040F000					X						
Z043F000							X				
Z043F200								X			
Z044F000							X				
Z044F100								X			
Z045F000							X				
Z046F000							X				
Z070F300									X		
Z071F400									X		
Z072H100									X		
Z073G600									X		
Z074H400									X		
Z075F000										X	
Z076F000										X	
Z077F000										X	
Z078F000										X	X
Z079F000										X	
Z080F000											X
Z081F000											X
Z083F000											X
Z084F000											X

Results of model tests

	Measured, Ze1				Incident, Gr. A (WR2)				Run-up, relative to MWL at pile			Run-up, relative to MWL off shore				Overtopping
Test	Hm0 [m]	Tp [s]	Tm01 [s]	Irib._m [-]	Hm0 [m]	Tp [s]	Tm01 [s]	Irib._m [-]	Ru2% [m]	Rd2% [m]	MWL [m]	Ru2% [m]	Rd2% [m]	MWL [m]		q [m^3/s/m]
Z001F400	1.163	4.57	4.09	3.647	1.059	4.61	4.21	3.934			3.039	1.554		3.047		0.0000000
Z002F200	1.791	5.57	4.82	3.464	1.699	5.57	4.92	3.630	1.827	-1.565	3.029	1.827	-1.566	3.033		0.0000000
Z003F000	2.219	6.40	5.41	3.493	2.125	6.40	5.53	3.648	2.187	-1.712	3.020	2.190	-1.711	3.024		0.0000000
Z004F000	2.790	6.56	5.97	3.437	2.644	6.56	6.07	3.590	2.504	-1.900	3.014	2.502	-1.903	3.011		0.0000000
Z005F000	3.240	8.00	6.48	3.462	3.098	6.92	6.54	3.573	2.881	-1.993	3.007	2.867	-2.005	2.989		0.0000000
Z006F000	3.746	8.13	6.97	3.463	3.503	8.39	7.11	3.653	3.366	-2.020	2.998	3.349	-2.047	2.959		0.0000000
Z007F000	4.106	9.48	7.49	3.555	3.868	9.14	7.55	3.692	3.762	-1.934	2.990	3.767	-1.964	2.937		0.0000000
Z008F000	4.500	9.48	7.83	3.550	4.212	8.98	7.89	3.697	4.188	-1.878	2.977	4.163	-1.926	2.917		0.0001385
Z009F000	5.053	9.31	8.24	3.525	4.779	8.98	8.29	3.647	4.955	-1.809	2.957	4.970	-1.644	2.910		0.0006647
Z010F000	5.452	10.89	8.84	3.641	5.233	10.67	9.17	3.855	5.720	-1.687	2.857	5.570	-1.656	2.888		0.0018833
Z011F000	4.839	11.38	8.97	3.921	4.599	10.45	9.23	4.139	4.856	-1.580	2.970	4.675	-1.606	2.944		0.0010802
Z012F000	4.815	11.38	9.11	3.992	4.570	11.64	9.44	4.247	4.948	-1.600	2.901	4.944	-1.598	2.905		0.0018279
Z013F000	4.950	11.64	9.18	3.968	4.729	11.64	9.53	4.214	5.145	-1.596	2.774	5.034	-1.554	2.821		0.0021603
Z014F000	1.149	4.57	4.43	3.974	1.059	4.92	4.56	4.261	1.082	-1.029	3.150	1.024	-1.013	3.208		0.0000000
Z015F000	1.633	6.02	5.10	3.838	1.531	5.75	5.25	4.080	1.588	-1.308	3.152	1.535	-1.306	3.209		0.0000000
Z016F000	2.062	7.21	5.79	3.878	1.951	7.21	5.89	4.055	1.880	-1.546	3.146	1.690	-1.523	3.196		0.0000000
Z017F000	2.541	7.21	6.40	3.861	2.399	7.01	6.59	4.092	2.269	-1.721	3.059	2.275	-1.710	3.097		0.0000000
Z020F000	3.875	9.85	8.38	4.094	3.694	10.67	8.48	4.243	3.910	-1.715	3.067	3.914	-1.714	3.070		0.0002770
Z027F000	2.324	5.22	5.03	3.173	2.241	5.22	5.10	3.276	2.198	-1.910	3.030	2.165	-1.656	3.108		0.0000000
Z028F000	2.788	6.02	5.52	3.179	2.662	6.17	5.63	3.318	2.485	-2.015	3.032	2.514	-1.998	3.106		0.0000000
Z029F000	2.953	9.85	8.26	4.622	2.837	10.67	8.37	4.779	3.230	-1.618	3.049	3.203	-1.604	3.069		0.0000000
Z030F100	2.897	11.64	8.96	5.062	2.711	10.67	9.20	5.373	3.159	-1.391	2.986	3.152	-1.398	2.978		0.0000000
Z031F000	2.779	5.63	5.26	3.034	2.659	5.63	5.33	3.143	2.454	-2.015	2.977	2.462	-2.016	3.028		0.0000000
Z032F000	3.505	6.02	5.86	3.010	3.349	6.17	5.95	3.127	2.980	-2.127	2.978	2.965	-2.096	3.031		0.0000000
Z033F000	3.890	7.11	6.47	3.155	3.724	7.11	6.52	3.249	3.250	-2.194	2.946	3.249	-2.200	2.982		0.0000000
Z034F000	4.163	7.11	7.06	3.328	3.988	7.11	7.20	3.467	3.570	-2.126	2.942	3.562	-2.119	2.958		0.0000554
Z037F000	3.187	9.48	7.53	4.056	3.038	9.48	7.58	4.182	3.787	-1.334	2.103	3.763	-1.337	2.098		0.0000000
Z037F100	4.249	9.48	7.83	3.653	4.138	10.24	7.93	3.749	4.500	-1.474	2.133	4.398	-1.441	2.167		0.0000000
Z037F200	4.141	9.48	7.83	3.700	3.965	10.24	7.94	3.835	4.424	-1.427	2.035	4.329	-1.361	2.087		0.0000000
Z038F000	3.250	9.48	7.59	4.049	3.038	9.48	7.67	4.232	3.305	-1.813	4.050	3.316	-1.637	4.020		0.0000277
Z038F100	4.242	9.31	7.89	3.684	3.997	9.48	7.98	3.838	4.832	-1.965	4.092	4.603	-1.996	4.045		0.0010525
Z039F000	3.493	9.14	7.59	3.905	3.265	9.48	7.71	4.103	3.857	-2.546	4.999	3.926	-2.552	4.952		0.0018003
Z040F000	3.518	8.98	7.59	3.891	3.268	9.31	7.71	4.101	3.840	-3.047	5.927	3.973	-2.966	5.867		0.0004431
Z043F000	3.244	11.91	8.93	4.768	3.090	10.89	9.25	5.060	3.889	-1.191	2.029	3.772	-1.128	2.098		0.0000000
Z043F200	4.285	11.91	8.98	4.172	4.123	10.89	9.32	4.414	5.182	-1.397	2.033	4.271	-1.247	2.202		0.0005262
Z044F000	3.363	10.89	9.06	4.751	3.100	10.89	9.30	5.080	3.652	-1.504	3.990	3.677	-1.534	3.952		0.0000000
Z044F100	4.491	11.38	9.05	4.107	4.199	11.38	9.31	4.369	5.447	-1.788	4.018	5.465	-1.613	3.968		0.0042929
Z045F000	3.638	10.67	9.04	4.558	3.330	10.67	9.29	4.896	4.703	-2.178	5.004	5.115	-2.241	4.927		0.0018003
Z046F000	3.636	11.13	9.06	4.569	3.303	11.13	9.33	4.937	4.352	-2.397	5.706	4.465	-2.429	5.629		0.0017726
Z070F300	3.134	9.14	6.52	3.542	2.907	9.14	6.70	3.779	2.429	-2.003	4.274	2.454	-1.994	4.263		0.0000000
Z071F400	3.002	9.14	6.43	3.569	2.775	5.57	6.56	3.767	2.470	-2.061	4.353	2.470	-2.064	4.349		0.0000259
Z072H100	2.909	9.14	6.94	3.913	2.784	8.53	7.38	4.253	3.146	-2.193	4.707	3.993	-2.225	4.663		0.0000622
Z073G600	2.759	6.74	6.19	3.584	2.710	8.26	6.62	3.867	3.540	-2.912	5.342			5.303		0.0000249
Z074H400	2.758	10.67	6.66	3.857	2.535	10.67	6.80	4.107	2.382	-2.176	4.938	2.457	-2.170	4.900		0.0000000
	H [m]	T [s]	-	Irib. [m]	H [m]	T [s]	-	Irib. [m]	Ru [m]	Rd [m]	MWL [m]	Ru [m]	Rd [m]	MWL [m]	Vis. Ru [m]	
Z075F200	1.735	8.98		6.557	1.667	8.98		6.688				1.752	-1.128	3.008	1.75	
Z076F000	2.495	8.98		5.467	2.456	8.98		5.510				2.751	-1.463	2.927	3.00	
Z077F000	3.282	8.98		4.767	3.162	8.98		4.856				3.453	-1.608	2.840	4.75	
Z078F000	4.102	8.98		4.264	4.014	8.98		4.311				4.601	-1.605	2.701	7.25	
Z079F200	5.008	8.98		3.859	4.552	8.98		4.047				4.660	-1.703	2.920	7.80	
Z080F000	4.903	7.01		3.044	4.605	7.01		3.142				3.695	-1.947	3.098	7.00	
Z081F000	4.660	8.00		3.564	3.789	8.00		3.952				3.521	-2.016	2.970	6.00	
Z083F000	4.477	10.04		4.563	4.839	10.04		4.389				5.221	-1.464	3.068	7.80	
Z084F000	5.264	11.13		4.665	4.639	11.13		4.969				5.345	-1.432	2.860	7.80	

COMMISSION
OF THE EUROPEAN
COMMUNITIES

MAST III

THE OPTIMISATION OF
CREST LEVEL DESIGN OF
SLOPING COASTAL STRUCTURES
THROUGH PROTOTYPE
MONITORING AND MODELLING

OPTICREST

MAS3-CT97-0116

Task X.X

ZEEBRUGGE MODELS
LABORATORY INVESTIGATIONS

Flemming Schlütter
Peter Frigaard

DRAFT VERSION

September 1999

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1 Introduction

In its present form this report serves as a status report for the first set of tests carried out at the Hydraulics and Coastal Engineering Laboratory at Aalborg University. Planning of the construction of the Zeebrugge model started all ready in the start of this year, whereas the test presented in this report have been carried out during July and August 1999. The planning and construction phase of the modelling was used to ensure that the two models at Aalborg University and Flanders Hydraulics corresponds closely to the prototype in Zeebrugge.

The following paragraphs presents the 3D-model as it has been constructed and subsequently presents the model testing and preliminary results from the tests. So far tests with 2D head on waves has been carried out. These tests overlap the tests carried out at Flanders Hydraulics on the 2D model at scale 1:30. These tests can thus be closely compared, whereas further tests with 3D wave conditions can only be compared with the prototype.

2 Model set-up

The model layout corresponds the layout described in the report: "Laboratory Investigations – Methodology" (final version, June 1999) subtask 3.1.

2.1 Test facility

The tests have been carried out at the Hydraulics & Coastal Engineering Laboratory at Aalborg University. The model is constructed in the 3D shallow water basin. The basin is 12 by 18 meters and is fitted with a newly installed 3D wavemaker. The wavemaker allows for water depths up till approximately 60 cm water depth. The wavemaker has 25 paddels, each 50 cm wide. The paddles are hinged at the moving arms in such a way that the paddle fronts gives a "snakelike" movement when generation 3D waves or oblique waves. A photo of the wave make r can be seen in figure 1.

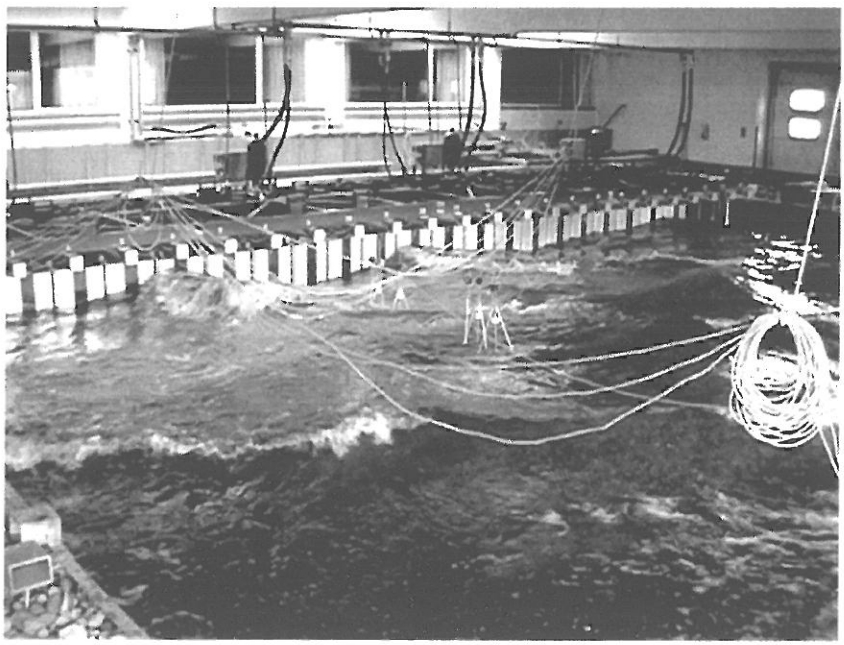


Figure 1: Photo showing 3D wave maker.

2.2 Description of the model

2.2.1 Scale

The general model scale used for the 3D model is 1:40. This scale makes it feasible to construct a model in the basin, where it is possible to generate a useable wave field in front of the model.

In order to model the hydrodynamic flow within the breakwater corresponding to the prototype it has been chosen to scale the core material of the breakwater in another scale than 1:40. Application of a method developed by prof. Burcharth suggests a scaling of the core material of 1:24. This entails that the materials should correspond to the data shown in table 1.

MATERIAL	Scale	Range	D_{n50}	D_{n85} /D_{n15}
Core	1:40	2.3 - 12 mm	5.8 mm	3.0
Core	1:24	3.8 - 20 mm	9.6 mm	3.0
Filter	1:40	18 - 26 mm	23.8 mm	1.4
Toe	1:40	26 - 33 mm	30 mm	1.2
Berm	1:40	18 - 26 mm	23.8 mm	1.4
Seabed	1:40	7.8 - 12 mm	9.5 mm	1.5

Table 1: Target values for scaled sizes of materials used for model 1:40.

The core material was mixed from two different sources of stone materials. The filter and berm material consists of grey granite stones where the smallest fraction below 18 mm was sorted out. For the toe a new material was procured. Armour units in scale 1:40 were provided by Flanders Hydraulics.

2.2.2 Lay-out

As the available space in the 3D basin is limited and because the area where a proper 3D wave field can be established also is limited there are some restrictions on the model layout. The extent of the changing foreshore can be seen on figure 11 in the report of subtask 3.1. The part of the foreshore reaching out till app. 210 meters from breakwater axis is modelled in the 3D model. Through some discussions and investigations including measurements of the topography of the berm and the slope of the breakwater the cross-section of the prototype has been established. The constructed cross-section in the 3D basin is shown in figure 2.

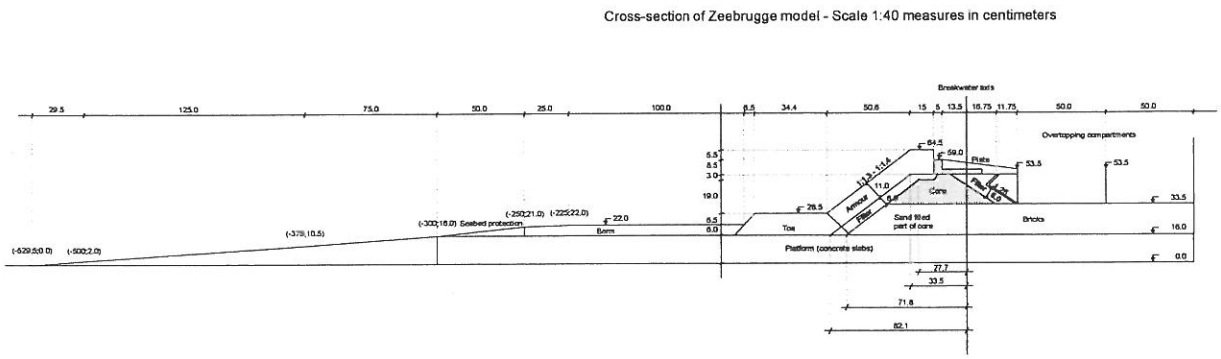


Figure 2: Cross section of the Zeebrugge breakwater model in scale 1:40.

As it was discovered that the slope of the breakwater in Zeebrugge is slightly steeper at the measuring cross-section it was chosen to model the changing slope in the 3D model. This entails the applied slopes seen in table 2.

Location	*Range*	*Estimated breakwater slope*
- 40 m	- 35 m → - 45 m	1:1.4047
- 30 m	- 25 m → - 35 m	1:1.4452
- 20 m	- 15 m → - 25 m	1:1.4377
- 10 m	- 5 m → - 15 m	1:1.4060
0 m	- 5 m → + 5 m	1:1.2792
+ 10 m	+ 5 m → + 15 m	1:1.4465
+ 20 m	+ 15 m → + 25 m	1:1.4447
+ 30 m	+ 25 m → + 35 m	1:1.5189
+ 40 m	+ 35 m → + 45 m	1:1.4086

Table 2: Measured breakwater slopes at Zeebrugge.

The model has been placed in the basin as seen on figure 3.

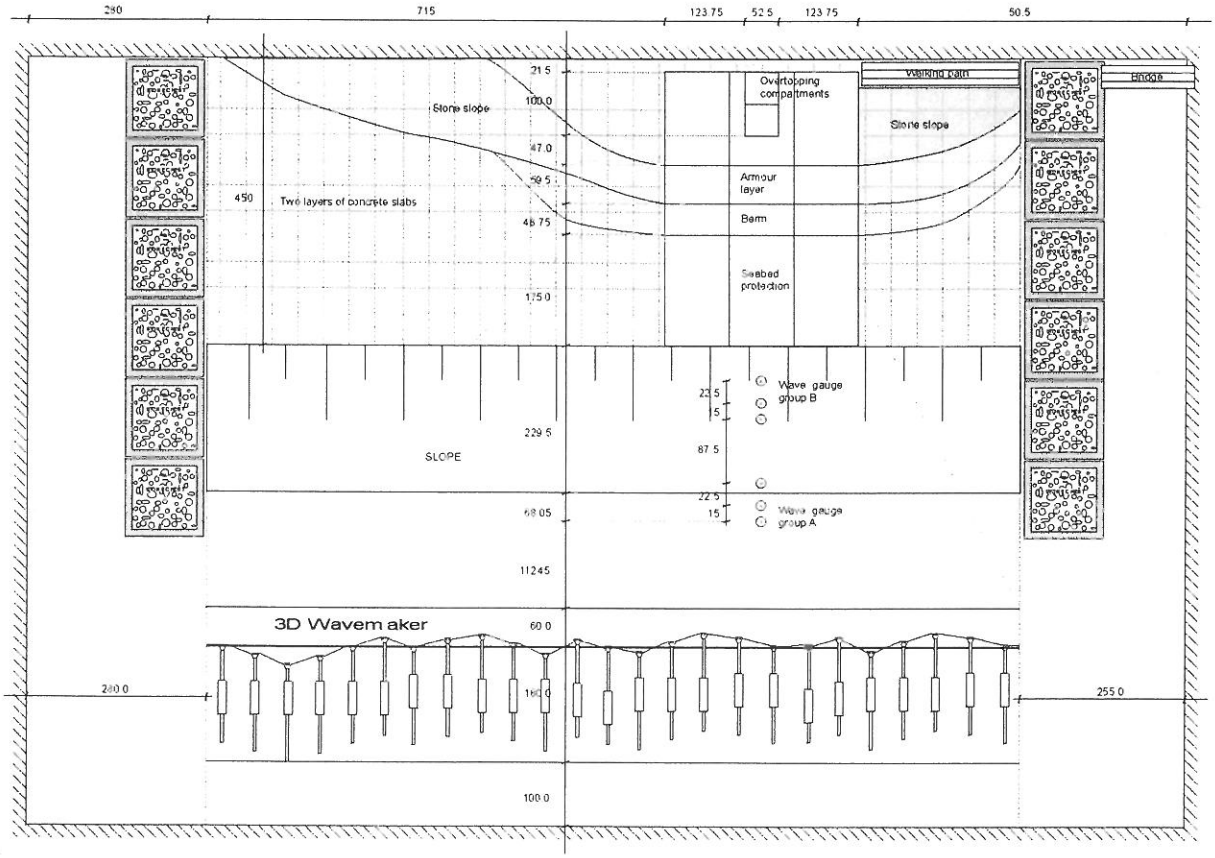
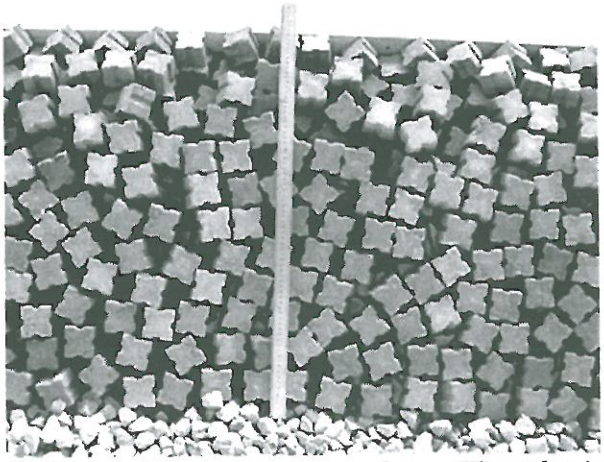


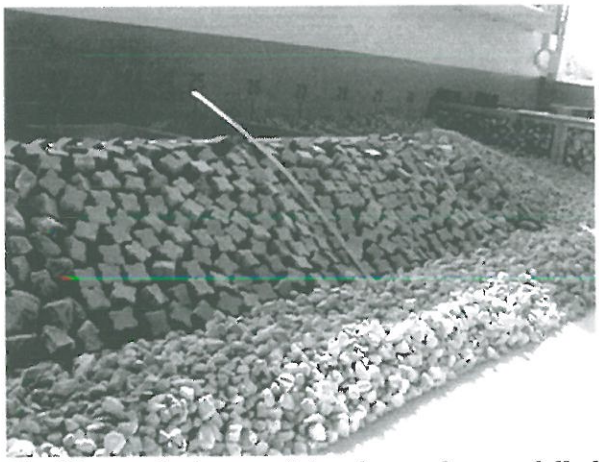
Figure 3: Layout of the Zeebrugge model in the 3D basin.

As seen on figure 3 the model has not been placed in the center in front of the wavemaker. Placing the model to one side results in better possibilities for generating oblique waves at the model location. The stone crests at the sides serves as adsorption. They seem to work effectively as waves quickly dissipates when wave generation is terminated. The photos below show the model. It is possible to see the depression where the armour slope is steepest.

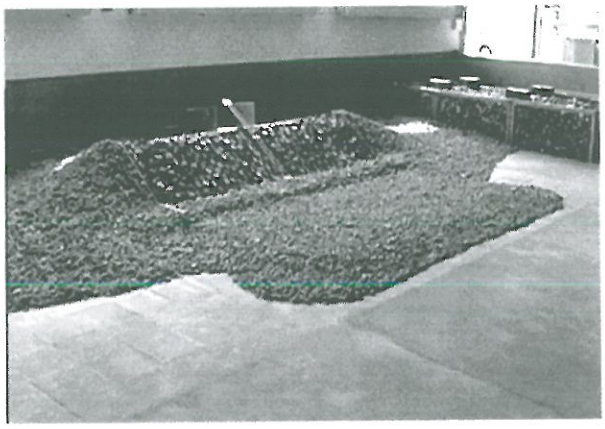
A) Breakwater model during construction.



B) Photo of the upper armour layer. The ruler is in the location of the pier.



C) View of the model where the modelled changing slope of the breakwater can be seen.



D) Finished 3D-model.

2.2.3 Instrumentation

Wave generation is carried out using the PROFWACO wave generation software (AAU, 199?). The program generates steering signals to the 25 servo controllers controlling the hydraulic motors. The wave maker is described in detail by Frigaard (199?)

The main instrumentation consists of wave gauges (resistance type), a resistance type run-up gauge and an overtopping barrel. A run-up step-gauge is furthermore going to be installed although it has not been applied during the first sets of tests. Table 3 shows a list of the gauges connected to the channels of the acquisition equipment.

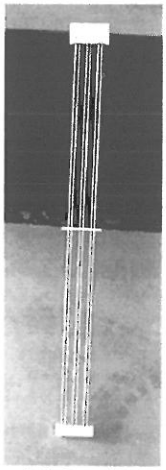
Gauge	*Channel*
Wave gauge ze1	1
Wave gauge ze2	2
Wave gauge ze3	3
Wave gauge ze4	4
Wave gauge ze5	5
Wave gauge ze6	6
Wave gauge ze7	7
Run-up gauge zr1	8
Run-up gauge zr2	9
Run-up gauge zr3	10
Step gauge Sum	11
Step gauge Max	12

Table 3: Instrumented channels for the 3D model.

As seen in table 3 there is an extra wave gauge included compared with the six gauges stated in the report of subtask 3.1. This seventh gauge is located in the same place as the pile in the prototype enabling easier comparison with prototype storms. The step gauge outputs two analogue signals. The *Sum* signal indicates how many sensors are wet at any given time. The *Max* signal yields the position of the highest located **wet** sensor.

The signals are transferred through a zero setting, and an analogue 8 Hz filter before being logged by a Data Translation 2811 AD board in a PC. Calibration of the sensors are carried out every test-day as changing salinity and temperature may change calibration factors slightly.

Below is seen some photos of the different sensors used.



Run-up gauge with its three sensors.

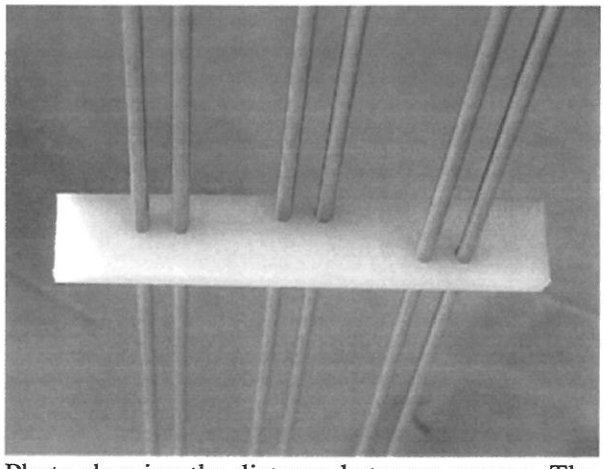
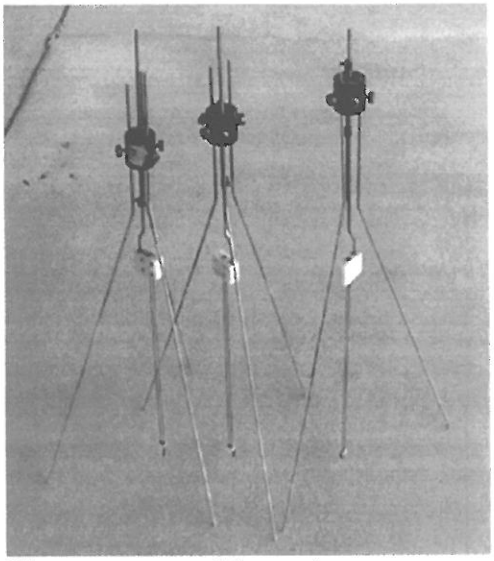


Photo showing the distance between sensors. The sensors are not placed "on top of each other" in order to avoid signal interference.



Run-up step gauge.

Wave gauges used for testing.

3 Test programme

Table 4 shows the set of test carried out by August 1999. All the tests are test with 2D wave conditions and a head on direction of the waves. Remaining are tests with measured storms, oblique wave conditions and 3D wave conditions. Before these tests starts it is necessary to adapt the instrumentation and install the new step gauge for run-up.

Test	*Hs*	*Tp*	*Spectrum*	*Gamma*	*WL*	*Current*	*Direction*	*Spreading*	*Laboratory*
	[m]	[sec.]			[m]	[m/sec]	[deg]	[deg]	
Z001	1.00	4.40	JONSWAP	3.3	3	0	0	0 (2D)	FC/AAU
Z002	1.50	5.40	JONSWAP	3.3	3	0	0	0 (2D)	FC
Z003	2.00	6.20	JONSWAP	3.3	3	0	0	0 (2D)	FC/AAU
Z004	2.50	7.00	JONSWAP	3.3	3	0	0	0 (2D)	FC
Z005	3.00	7.60	JONSWAP	3.3	3	0	0	0 (2D)	FC/AAU
Z006	3.50	8.20	JONSWAP	3.3	3	0	0	0 (2D)	FC
Z007	4.00	8.80	JONSWAP	3.3	3	0	0	0 (2D)	FC/AAU
Z008	4.50	9.30	JONSWAP	3.3	3	0	0	0 (2D)	FC
Z009	5.00	9.80	JONSWAP	3.3	3	0	0	0 (2D)	FC/AAU
Z010	5.50	10.30	JONSWAP	3.3	3	0	0	0 (2D)	FC
Z011	6.00	10.80	JONSWAP	3.3	3	0	0	0 (2D)	FC/AAU
Z012	6.50	11.20	JONSWAP	3.3	3	0	0	0 (2D)	FC
Z031	5.00	5.00	JONSWAP	3.3	3	0	0	0 (2D)	FC/AAU
Z032	5.00	6.00	JONSWAP	3.3	3	0	0	0 (2D)	FC
Z033	5.00	7.00	JONSWAP	3.3	3	0	0	0 (2D)	FC
Z034	5.00	8.00	JONSWAP	3.3	3	0	0	0 (2D)	FC/AAU
Z075	2.00	9.00	Regular		3	0	0	0 (2D)	FC/AAU
Z076	3.00	9.00	Regular		3	0	0	0 (2D)	FC/AAU
Z077	4.00	9.00	Regular		3	0	0	0 (2D)	FC/AAU
Z078	5.00	9.00	Regular		3	0	0	0 (2D)	FC/AAU
Z079	6.00	9.00	Regular		3	0	0	0 (2D)	FC/AAU
Z080	5.00	7.00	Regular		3	0	0	0 (2D)	FC/AAU
Z081	5.00	8.00	Regular		3	0	0	0 (2D)	FC/AAU
Z082	5.00	9.00	Regular		3	0	0	0 (2D)	FC/AAU
Z083	5.00	10.00	Regular		3	0	0	0 (2D)	FC/AAU

Z084	5.00	11.00	Regular		3	0	0 0 (2D)	FC/AAU

Table 4: Test matrix for the tests carried out at Aalborg University.

As seen in the test matrix also a few tests which were not originally supposed to be carried out at Aalborg University has indeed been carried out. This has, however, only been done as the model setup and instrumentation did not need changes for these test series and these series will supply a few more points on the various plots.

4 Analysis of test results

Before presenting results from the tests, the next paragraph repeats and clarifies some of the requirements stipulated in the report of subtask 3.1.

4.1 Parameters

Definitions of the parameters used for analysing and presenting the results:

- Characteristic **slope angle**: based on the slope 1:1.3.
- Characteristic **wave period**: as stipulated in report 3.1 and as agreed upon during the second OPTICREST meeting $T_{0,1} = m_0/m_1$ will be used.
- Characteristic **wave height**: H_{m0} obtained by wave gauges group A.
- Run-up signal :
- Run-up signals are bandpass filtered in the same way as the wave gauge signals. Subsequently the calculated MWL either at ZE7 for the prototype storms or at ZE1 for the parametric tests (to be able to compare with conclusions of previous tests). In order to have a link between prototype simulations and results of the parametric study, we suggest analysing the storm tests also with the MWL of ZE1.

- Number of incident waves: duration / $T_{0,1}$.

- Dimensionless run-up : $R_{u2\%}/H_{m0}$

- Irribarren number : $$\xi = \frac{\tan(\alpha)}{\sqrt{\frac{2\pi}{gT_{0,1}^{\ 2}} H_{m0}}}$$

  with : $T = T_{0,1}$
  $H = H_{m0}$ of ZE1 for parametric tests
  $H = H_{m0}$ of ZE7 for storms

Analysis software used at Flanders Hydraulics and AAU has continuously been compared to ensure that analysis results are the same when the same data sets are analysed.

4.2 *Irregular "head on" wave conditions*

These wave conditions comprise test series, which have also been carried out at Flanders hydraulics. Thus, they are aimed at comparison between the laboratories as well as with general results from the prototype. The tests included in this paragraph are Z001 - Z012 and Z031- Z034. The results of the analysis can be seen in the Appendix.

All the tests dealt with in this paragraph were carried out at a water depth of z = +3 m in prototype. This gives at deepest water depth of 41 cm in the basin.

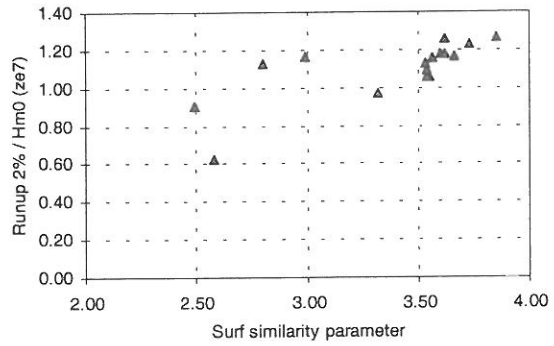
Observations during the tests showed that for very small wave heights the waves break directly on the slope of the breakwater. When increasing the wave heights the waves start breaking on the foreshore and when generation of very high waves (H_{m0} > 5m) are aimed at wave breaking occurs also in front of the wave paddles. When increasing the wave period a little overtopping may occur, but at a certain point more severe overtopping starts. With regard to overtopping visual observations indicated that a tongue of water may reach further up than the run-up gauge detects due to the inevitable distance between the armour units and the gauge caused by the rough surface plane of the slope. Observations also showed that the steeper slope at the location of the run-up gauge tends to focus the waves and thus the run-up. This is very clearly seen during tests with regular waves. More systematic visual observation will be carried out when the step-gauge is installed.

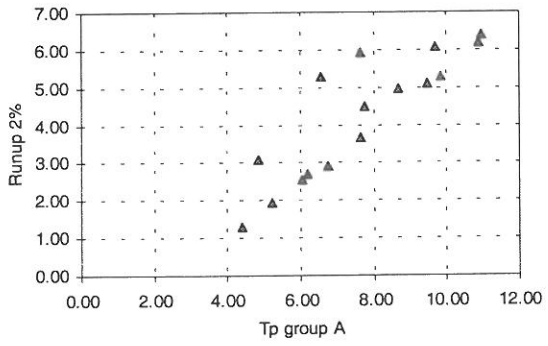
4.2.1 Run-up

Run-up and run-down can be plotted in various ways. The plots below show some of the possibilities. The run-up measurements are related to the MWL and not the SWL. This is done by subtracting the difference in MWL calculated at gauge Ze1 and Ze7, i.e.

$$Runup = Measured\ signal - (MWL_{Ze7} - MWL_{Ze1})$$

As proposed in the methodology report (subtask 3.1) three gauges have been used and subsequently an extrapolated run-up is calculated based on the three signals. This has, however, not turned out to be a reliable process. For some reasons extrapolated run-up clearly yields too small levels. It is believed that the run-up gauge located closest to the slope is the most reliable. This will be investigated further during tests where it is possible to compare with the step-gauge.





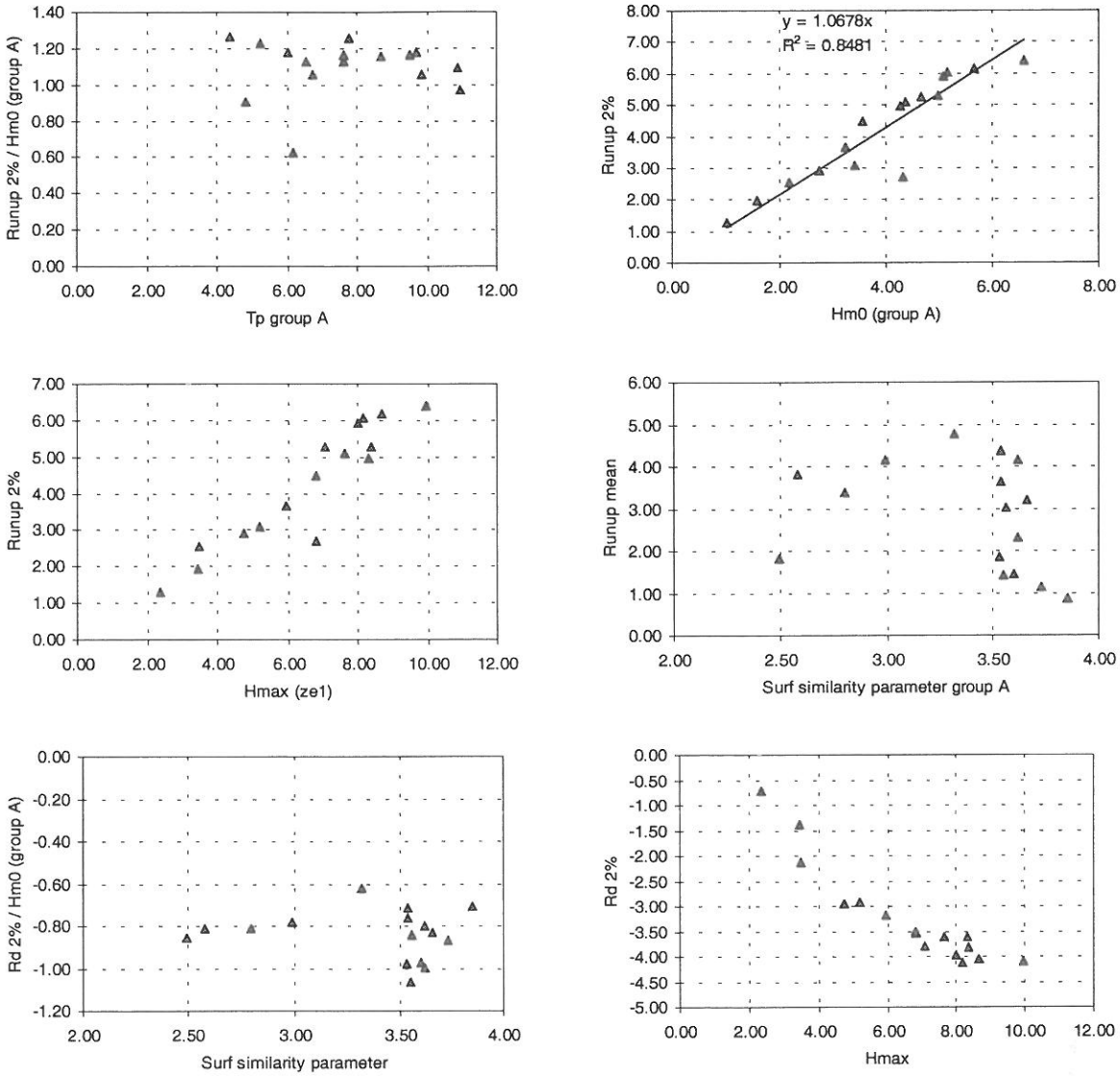


Figure 4: Various plots of run-up and run-down results.

4.2.2 Overtopping

The overtopping occurs when the waves run over the crest of the breakwater. From the position of the road on top of the Zeebrugge breakwater a plate with side-walls is installed in the model. This means that the overtopping flows on this plate and into the first compartment of the overtopping barrel. Another compartment for overtopping is placed further back (see figure 2 and 3). During the test no overtopping managed to reach the rear compartment. The amount of overtopping was measured by emptying the overtopping compartment into a 2 litres graduated cylinder.

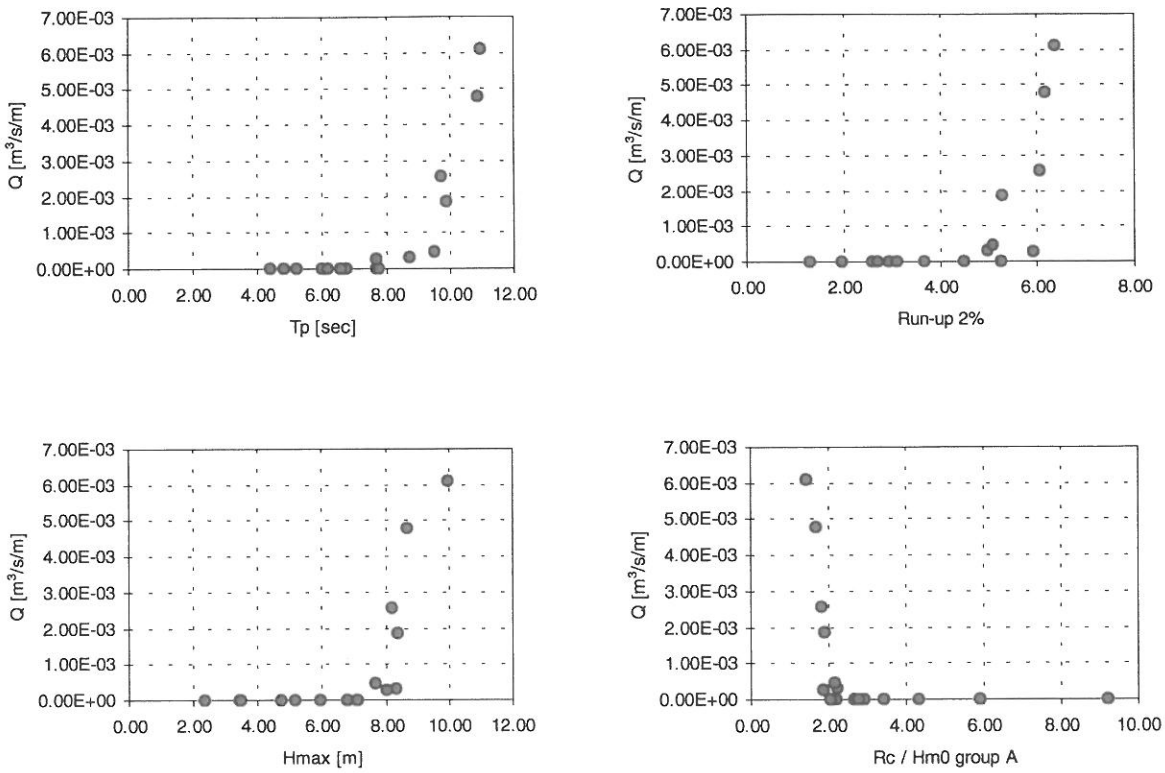


Figure 5: Results from overtopping measurements.

As seen on figure 5 the overtopping starts rapidly when the wave heights or wave period reaches a certain level.

4.3 Prototype storms

In this paragraph a description of how the prototype storms were reproduced in laboratory and the following analysis is given.

Incoming waves : measured by wave gauges group A.
Total waves : measured by wave gauge ZE1 (ZE1 corresponds with the position of the wave rider).

4.4 Regular wave conditions

Regular wave conditions do not occur at the prototype breakwater in Zeebrugge, so the reason for carrying out regular tests is for the sake of comparison between laboratories. Some results from the regular tests can be seen in the three plots below.

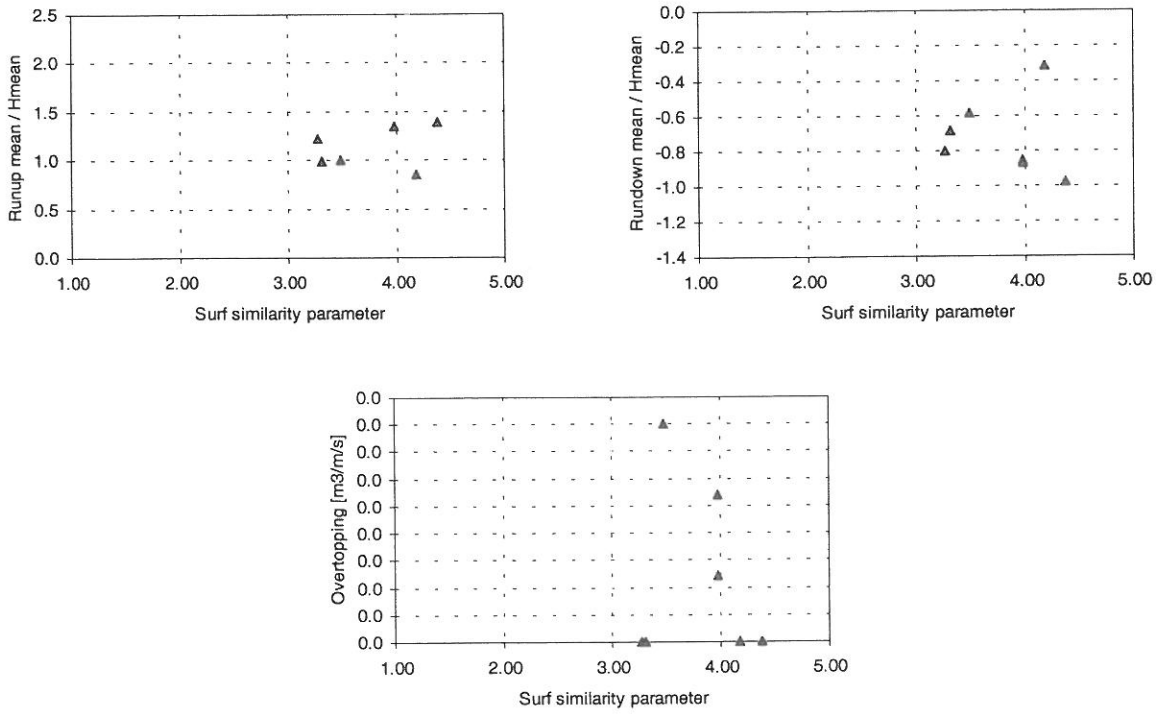


Figure 6: Plots showing results from tests with regular waves.

4.5 Oblique wave conditions

4.6 3D wave conditions

4.7 Wave conditions influenced by current

5 Conclusions

The test series comprising wave conditions with "head on" wave direction has been carried out. The results appear consistent and if quick comparisons are made with results obtained at Flanders Hydraulics the results seem to be close to each other with regard to run-up.

6 Acknowledgements

7 References

Profwaco

Bølgemaskine

Appendix Analysis results

The following pages contain print outs of the result files from the analysis software. Data and software will also be placed on a CD so that various plots of signals, spectra, and distribution of wave heights and run-up can be shown and printed.

Analysis performed: 08-09-99 16:01:41													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z001.dat												
Testname.....:	Z001												
Data scale.....:	1:1												
Date and time.....:	7-29-99 13:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	1												
Target peak period (Tp).....[sec]:	4.4												
Target Spectrum.....:	JCNSWAP												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0												
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	19.920												
Total reflection at wave gauge group A...:	370.212												
Total reflection at wave gauge group B...:	406.544												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	0.0756	0.0745	0.0788	0.0709	0.0777	0.0691	0.0515	0.1475	0.1628	0.1445	0.1326	0.0645	0.0602
First moment.....m1 :	0.0188	0.0185	0.0195	0.0176	0.0192	0.0171	0.0127	0.0341	0.0382	0.0336	0.0312	0.016	0.0149
Second moment.....m2 :	0.0049	0.0048	0.005	0.0045	0.0049	0.0044	0.0033	0.0081	0.0093	0.008	0.0076	0.0041	0.0038
Wave height.....Hm0 :	10.996	10.919	11.225	10.653	11.151	10.518	0.9073	15.362	16.138	15.207	14.564	10.160	0.9816
Peak period.....Tp :	46.732	42.837	45.491	42.837	43.936	42.837	46.732	42.837	45.491	42.837	42.837	43.936	43.936
Average wave period.....T01 :	40.171	40.255	40.376	40.410	40.408	40.356	40.422	43.228	42.589	43.002	42.510	40.348	40.481
Deep water wave length.....L0 :	251.953	253.008	254.534	254.954	254.938	254.272	255.108	291.762	283.199	288.708	282.148	254.181	255.858
Surf similarity parameter.....SSPop.:	36.821	37.028	36.630	37.632	36.780	37.822	40.788	33.524	32.224	33.516	33.858	38.474	39.272
No. of waves (Duration/T01).....:	1761	1758	1752	1751	1751	1753	1750	1637	1661	1645	1664	1754	1748
Spectral width.....:	0.1979	0.1967	0.1984	0.1979	0.1954	0.1992	0.2303	0.1788	0.1846	0.1674	0.1917	0.1951	0.194
Groupiness factor.....:	10.759	10.418	11.026	10.542	10.830	10.482	10.321	0.8938	0.9651	0.849	0.7513	0	0
Significant wave height.....Hs :	10.856	10.781	11.061	10.495	10.938	10.282	0.8743	14.935	15.531	14.518	13.791	-	-
Average wave height.....Hmean :	0.6826	0.6806	0.695	0.6684	0.6799	0.6556	0.5656	0.983	10.110	0.967	0.9518	-	-
Maximum wave height.....Hmax :	23.519	19.182	25.050	22.005	21.426	20.188	19.131	25.711	28.692	24.620	21.081	-	-
Significant wave period.....Ts :	41.890	41.790	42.299	42.335	42.047	42.045	42.591	44.841	44.577	44.404	43.873	-	-
Average wave period.....Tmean :	40.232	40.381	40.704	40.625	40.497	40.641	40.286	43.349	42.311	42.388	42.332	-	-
Maximum wave period.....Tmax :	41.914	42.654	41.763	37.339	39.707	40.640	44.038	43.394	45.088	43.418	42.627	-	-
Number of waves.....:	1758	1751	1737	1741	1746	1739	1755	1631	1671	1668	1669	-	-
Mean water level.....MWL :	0.0015	-0.0056	-0.0097	-0.0164	-0.0098	-0.0082	0.006	0.3092	0.5099	0.1523	-0.2854	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	13.006	0	0.8981	0.4872	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	0.8718	11.685	0.6439	0.2468	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	12.876	15.255	10.483	0.5454	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	15.937	19.082	12.932	0.6939	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-0.7347	0	-0.6839	-11.394	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-0.2837	-0.2608	-0.3724	-0.8298	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-0.7206	-0.6581	-0.8967	-12.239	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-10.284	-11.166	-12.438	-14.627	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	1631	1671	1668	1669	-	-

Analysis performed: 08-09-99 16:03:07													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z002.dat												
Testname.....:	Z002												
Data scale.....:	1:1												
Date and time.....:	7-29-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	1.5												
Target peak period (Tp).....[sec]:	5.4												
Target Spectrum.....:	JONSWAP												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0												
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	281.597												
Total reflection at wave gauge group B...:	325.889												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	0.1769	0.1741	0.1777	0.1665	0.1718	0.163	0.161	0.3767	0.4556	0.3643	0.2784	0.1577	0.146
First moment.....m1 :	0.0367	0.0362	0.0368	0.0344	0.0355	0.0336	0.0327	0.074	0.0896	0.0715	0.0564	0.0322	0.0296
Second moment.....m2 :	0.008	0.008	0.0081	0.0075	0.0078	0.0073	0.0071	0.0152	0.0184	0.0146	0.0122	0.0069	0.0063
Wave height.....Hm0 :	16824	16688	16861	16323	16579	16151	16052	24550	27000	24142	21106	15883	15286
Peak period.....Tp :	54.468	57.528	52.245	54.468	52.245	52.245	52245	52.245	52.245	52.245	52.245	52.245	52245
Average wave period.....T01 :	48.262	48.138	48.288	48.413	48.329	48.548	49.293	50.881	50.822	50.921	49.357	48.935	49.255
Deep water wave length.....L0 :	363.669	361.800	364.052	365.946	364.671	367.992	379.362	404.199	403.274	404.836	380.360	373.882	378.787
Surf similarity parameter.....SSPop.:	35.764	35.817	35.744	36.422	36.077	36.718	37.395	31.212	29.729	31.500	32.655	37.322	38.292
No. of waves (Duration/T01).....:	1.466	1.470	1.466	1.462	1.464	1.458	1.436	1.391	1.393	1.390	1.434	1.446	1.437
Spectral width.....:	0.2426	0.244	0.242	0.2431	0.2453	0.2438	0.2565	0.2144	0.2037	0.1994	0.2576	0.2222	0.2224
Groupiness factor.....:	10378	10301	10894	10385	10601	10304	10210	0.8915	0.9081	0.8635	0.8546	0	0
Significant wave height.....Hs :	16.415	16.354	16.705	16.044	16.225	15.900	15.867	23794	26414	23182	19902	-	-
Average wave height.....Hmean :	10.486	10.514	10.459	10.263	10.437	10.213	10207	15.874	17.096	15.414	13.769	-	-
Maximum wave height.....Hmax :	34344	30155	30245	30981	32049	29098	26838	45225	46.089	41548	37952	-	-
Significant wave period.....Ts :	51.285	51.115	51.492	51.363	51.897	51.457	52.947	53.342	53.089	52.895	52.878	-	-
Average wave period.....Tmean :	47.970	48.196	48.256	48.297	48.838	48.913	50.284	50.706	49.988	50.095	49.813	-	-
Maximum wave period.....Tmax :	48.101	52.495	51.450	48.817	47.017	50.386	55.278	51.221	52.248	52.193	51.743	-	-
Number of waves.....:	1.474	1.467	1.465	1.464	1.448	1.446	1.406	1.393	1.413	1.410	1.418	-	-
Mean water level.....MWL :	0.007	0	-0.0127	-0.0166	-0.0096	-0.0078	0.0107	0.3323	0.5149	0.1646	-0.2606	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	15952	21148	12705	0.6309	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	11.427	14636	0.9	0.3893	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	19455	22.433	16373	0.9121	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	24.933	26.386	21.947	16129	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-10.664	-12.479	-11.660	-15022	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-0.5598	-0.5407	-0.674	-10.538	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-13785	-13924	-15441	-18074	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-21387	-20162	-20170	-22.023	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	1.393	1.413	1.410	1.418	-	-

Analysis performed: 08-09-99 16:03:54													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z003.dat												
Testname.....:	Z003												
Data scale.....:	1:1												
Date and time.....:	7-29-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	2												
Target peak period (Tp).....[sec]:	6.2												
Target Spectrum.....:	JONSWAP												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0												
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	245.020												
Total reflection at wave gauge group B...:	295.940												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	0.321	0.3106	0.3385	0.3257	0.3179	0.3075	0.2903	0.7371	0.8325	0.6909	0.5613	0.2968	0.2835
First moment.....m1 :	0.0588	0.0574	0.0621	0.0597	0.0583	0.0566	0.054	0.1274	0.1452	0.12	0.0992	0.0536	0.0512
Second moment.....m2 :	0.0115	0.0113	0.0122	0.0117	0.0114	0.0112	0.0108	0.0232	0.0265	0.0218	0.0188	0.0102	0.0097
Wave height.....Hm0 :	22664	22294	23272	22827	22554	22182	21551	34343	36497	33249	29968	21793	21300
Peak period.....Tp :	64.810	57.528	60.235	60.235	65.641	60.952	60235	60.235	60.235	60.235	60.235	60.235	60235
Average wave period.....T01 :	54.577	54.153	54.474	54.555	54.505	54.365	53.777	57.851	57.327	57.565	56.572	55.333	55.419
Deep water wave length.....L0 :	465.062	457.856	463.300	464.686	463.840	461.449	451.520	522.534	513.099	517.371	499.687	478.025	479.526
Surf similarity parameter.....SSPop.:	34.845	34.860	34.322	34.706	34.884	35.085	35.210	30.005	28.842	30.344	31.411	36.026	36.499
No. of waves (Duration/T01).....:	1.297	1.307	1.299	1.297	1.298	1.302	1.316	1.223	1.235	1.229	1.251	1.279	1.277
Spectral width.....:	0.2546	0.2658	0.2635	0.2631	0.2642	0.2699	0.2722	0.2286	0.2179	0.2134	0.2646	0.2322	0.235
Groupiness factor.....:	0.9245	0.9346	0.9746	0.9609	0.9734	10042	0.9577	0.8884	0.8285	0.8556	0.9489	0	0
Significant wave height.....Hs :	21.931	21.713	22.846	22.267	22.107	21.893	21.346	33593	35917	32171	28481	-	-
Average wave height.....Hmean :	14.453	14.283	14.879	14.603	14.416	13.991	13981	22.336	23.801	21.434	19.122	-	-
Maximum wave height.....Hmax :	34676	37922	40690	38422	37115	40646	35543	56884	56.260	53767	52253	-	-
Significant wave period.....Ts :	58.695	58.515	58.523	58.670	58.591	58.968	58.594	60.588	59.874	60.001	60.452	-	-
Average wave period.....Tmean :	54.226	54.016	54.864	54.994	54.865	54.550	55.398	57.787	56.994	56.948	56.718	-	-
Maximum wave period.....Tmax :	56.582	61.300	62.015	55.527	55.796	52.988	55.229	66.455	66.221	66.553	66.670	-	-
Number of waves.....:	1.303	1.308	1.288	1.285	1.288	1.297	1.277	1.224	1.241	1.242	1.247	-	-
Mean water level.....MWL :	0.0042	-0.0023	-0.0139	-0.0188	-0.0108	-0.0101	0.0053	0.3398	0.4889	0.1836	-0.1845	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	20751	24497	17957	11786	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	14.445	17463	12133	0.6923	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	25562	28.245	24753	20694	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	33.459	35.693	31.860	28990	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-15.870	-15.613	-15.834	-18276	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-0.8756	-0.8342	-0.9571	-12.441	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-21156	-18814	-19838	-22172	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-26432	-24575	-24484	-27.287	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	1.224	1.241	1.242	1.247	-	-

Analysis performed: 08-09-99 16:04:31													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z004.dat												
Testname.....:	Z004												
Data scale.....:	1:1												
Date and time.....:	7-29-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	2.5												
Target peak period (Tp).....[sec]:	7												
Target Spectrum.....:	JONSWAP												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0												
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	242.651												
Total reflection at wave gauge group B...:	276.055												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	0.5494	0.5673	0.4806	0.4786	0.4627	0.4315	0.3605	12154	10559	11137	12586	0.4762	0.4149
First moment.....m1 :	0.0903	0.093	0.0791	0.0781	0.076	0.0706	0.0637	0.185	0.1631	0.1715	0.1943	0.0777	0.0669
Second moment.....m2 :	0.0158	0.0162	0.0139	0.0136	0.0135	0.0124	0.0122	0.0296	0.0265	0.0277	0.0317	0.0134	0.0114
Wave height.....Hm0 :	29648	30128	27730	27674	27210	26276	24017	44097	41102	42214	44874	27603	25764
Peak period.....Tp :	70.137	77.576	67.368	77.576	64.000	70.137	64000	77.576	77.576	77.576	77.576	67.368	64000
Average wave period.....T01 :	60.858	61.000	60.756	61.305	60.862	61.130	56.583	65.697	64.756	64.926	64.772	61.293	62.025
Deep water wave length.....L0 :	578.255	580.962	576.327	586.788	578.337	583.448	499.869	673.867	654.714	658.148	655.035	586.552	600.643
Surf similarity parameter.....SSPop.:	33.972	33.779	35.069	35.421	35.464	36.247	35.093	30.070	30.701	30.373	29.389	35.460	37.141
No. of waves (Duration/T01).....:	1.163	1.160	1.165	1.154	1.163	1.158	1.251	1.077	1.093	1.090	1.093	1.155	1.141
Spectral width.....:	0.2515	0.2444	0.2632	0.2559	0.2777	0.2653	0.289	0.2244	0.2252	0.2223	0.2363	0.2354	0.2416
Groupiness factor.....:	0.8794	0.8626	0.8739	0.912	0.8943	0.9199	0.9568	0.8442	0.7883	0.834	0.9099	0	0
Significant wave height.....Hs :	28.617	28.917	26.760	27.043	26.502	25.709	23.513	42704	40023	40449	42821	-	-
Average wave height.....Hmean :	19.320	19.733	18.256	17.973	17.818	17.010	15795	28.372	27.001	26.990	28.026	-	-
Maximum wave height.....Hmax :	47348	48856	45283	41901	43281	41919	38824	72330	65.358	68793	74639	-	-
Significant wave period.....Ts :	64.735	65.207	65.062	66.001	65.507	65.553	61.544	69.153	67.839	68.159	68.554	-	-
Average wave period.....Tmean :	61.408	61.674	62.106	61.345	61.792	61.626	58.750	63.156	62.708	62.487	62.212	-	-
Maximum wave period.....Tmax :	62.729	60.516	60.490	62.016	65.316	65.527	63.020	69.115	68.311	68.451	68.558	-	-
Number of waves.....:	1.151	1.146	1.138	1.153	1.144	1.147	1.204	1.119	1.127	1.131	1.136	-	-
Mean water level.....MWL :	-0.0134	-0.0348	0.015	-0.0166	-0.0131	-0.0258	-0.0421	0.0271	0.0734	0.0643	0.043	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	22139	21776	22406	23857	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	14.205	14461	14264	14287	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	29144	27.454	29994	33224	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	36.622	34.738	38.095	42290	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-22.979	-19.998	-20.049	-21322	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-14096	-12558	-12830	-13.823	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-29425	-24878	-24557	-25855	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-36880	-30620	-30698	-32.349	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	1.119	1.127	1.131	1.136	-	-

Analysis performed: 08-09-99 16:05:07													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z005.dat												
Testname.....:	Z005												
Data scale.....:	1:1												
Date and time.....:	7-30-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	3												
Target peak period (Tp).....[sec]:	7.6												
Target Spectrum.....:	JONSWAP												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0												
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	238.755												
Total reflection at wave gauge group B...:	266.662												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	0.7375	0.7673	0.6914	0.7058	0.6605	0.5901	0.4175	18963	14811	17225	21749	0.6565	0.5927
First moment.....m1 :	0.112	0.1163	0.105	0.1063	0.0996	0.0894	0.0726	0.2659	0.2105	0.2444	0.3098	0.0992	0.0885
Second moment.....m2 :	0.0181	0.0187	0.0169	0.0171	0.016	0.0145	0.014	0.0393	0.0316	0.0366	0.0469	0.0158	0.014
Wave height.....Hm0 :	34352	35038	33260	33605	32510	30727	25847	55082	48680	52497	58991	32411	30796
Peak period.....Tp :	76.418	76.418	76.418	76.418	76.418	76.418	60952	76.418	76.418	76.418	76.418	76.418	76418
Average wave period.....T01 :	65.830	65.984	65.873	66.391	66.338	66.001	57.542	71.325	70.369	70.471	70.210	66.185	66.956
Deep water wave length.....L0 :	676.607	679.777	677.499	688.197	687.090	680.131	516.960	794.273	773.120	775.376	769.632	683.932	699.961
Surf similarity parameter.....SSPop.:	34.139	33.882	34.718	34.811	35.364	36.191	34.402	29.210	30.655	29.563	27.785	35.336	36.673
No. of waves (Duration/T01).....:	1.075	1.073	1.074	1.066	1.067	1.072	1.230	992	1.006	1.004	1.008	1.069	1.057
Spectral width.....:	0.2517	0.251	0.2497	0.2559	0.2601	0.2603	0.3361	0.2354	0.2411	0.2377	0.2499	0.2351	0.2369
Groupiness factor.....:	0.883	0.8716	0.9043	0.9435	0.9355	0.9364	10314	0.7743	0.7597	0.7827	0.821	0	0
Significant wave height.....Hs :	32.875	33.433	32.073	32.547	31.351	29.956	25.522	52447	46506	49499	56068	-	-
Average wave height.....Hmean :	22.325	22.838	21.449	21.590	20.644	19.704	16923	36.093	32.413	34.082	37.595	-	-
Maximum wave height.....Hmax :	59627	56122	55359	55745	49995	49867	45719	79462	72.540	76224	84622	-	-
Significant wave period.....Ts :	70.139	70.341	70.525	70.828	71.269	70.725	64.590	75.774	74.675	73.904	74.074	-	-
Average wave period.....Tmean :	66.778	67.093	66.517	67.594	66.355	66.328	61.259	69.955	69.472	69.404	69.065	-	-
Maximum wave period.....Tmax :	63.210	65.745	69.075	70.698	70.605	69.800	54.473	81.028	81.731	81.228	80.986	-	-
Number of waves.....:	1.058	1.053	1.063	1.046	1.064	1.065	1.154	1.011	1.018	1.019	1.024	-	-
Mean water level.....MWL :	-0.0197	-0.0347	0.0127	-0.0173	-0.0139	-0.0323	-0.0551	0.041	-0.044	0.066	0.2064	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	28986	25057	29142	35623	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	18.533	16226	18290	21857	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	36626	32.385	36746	43166	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	43.041	40.537	44.905	53704	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-27.346	-24.174	-23.038	-23836	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-17614	-16215	-15623	-16.118	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-31738	-28334	-26497	-27803	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-36421	-33220	-31320	-32.737	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	1.011	1.018	1.019	1.024	-	-

Analysis performed: 08-09-99 16:05:35													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z006.dat												
Testname.....:	Z006												
Data scale.....:	1:1												
Date and time.....:	7-30-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	3.5												
Target peak period (Tp).....[sec]:	8.2												
Target Spectrum.....:	JONSWAP												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0												
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	236.818												
Total reflection at wave gauge group B...:	255.863												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	0.9221	0.9167	0.7756	0.8013	0.7555	0.7177	0.4238	26315	20198	23612	29918	0.7915	0.7103
First moment.....m1 :	0.1301	0.1299	0.1105	0.1126	0.1064	0.1009	0.0739	0.3436	0.267	0.3122	0.3972	0.1115	0.0988
Second moment.....m2 :	0.0196	0.0197	0.0168	0.017	0.0161	0.0152	0.0147	0.0476	0.0376	0.044	0.0564	0.0167	0.0146
Wave height.....Hm0 :	38411	38298	35227	35806	34768	33888	26039	64888	56848	61465	69187	35585	33712
Peak period.....Tp :	77.576	77.576	77.576	77.576	77.576	83.934	60952	83.934	83.934	83.934	83.934	77.576	77576
Average wave period.....T01 :	70.857	70.565	70.206	71.133	71.009	71.162	57.383	76.580	75.636	75.623	75.331	70.998	71.904
Deep water wave length.....L0 :	783.887	777.446	769.554	790.010	787.246	790.645	514.103	915.623	893.203	892.879	886.001	787.021	807.235
Surf similarity parameter.....SSPop.:	34.750	34.658	35.953	36.132	36.603	37.156	34.180	28.896	30.491	29.318	27.527	36.175	37.641
No. of waves (Duration/T01).....:	999	1.003	1.008	995	997	995	1.233	924	936	936	940	997	984
Spectral width.....:	0.2606	0.2629	0.2627	0.2731	0.2779	0.2677	0.3805	0.2478	0.2545	0.2549	0.2651	0.2485	0.2533
Groupiness factor.....:	0.9251	0.9013	0.8925	0.9247	0.9234	0.9434	11091	0.7773	0.7858	0.7905	0.8088	0	0
Significant wave height.....Hs :	37.583	37.227	34.113	35.095	33.960	33.308	25.932	62834	54864	58442	66790	-	-
Average wave height.....Hmean :	25.188	25.156	22.973	23.312	22.416	21.618	17143	42.634	37.626	39.833	44.756	-	-
Maximum wave height.....Hmax :	68003	69057	57333	56703	56035	57795	44590	87767	76.836	82995	90443	-	-
Significant wave period.....Ts :	76.607	76.510	75.777	76.865	76.360	75.736	67.803	81.830	81.526	81.039	81.039	-	-
Average wave period.....Tmean :	72.401	71.887	71.240	72.097	71.410	71.048	63.112	74.466	73.999	73.923	73.616	-	-
Maximum wave period.....Tmax :	71.446	72.130	67.385	76.196	78.201	74.521	57.939	73.171	76.025	73.696	72.310	-	-
Number of waves.....:	976	983	991	980	990	995	1.120	950	956	957	961	-	-
Mean water level.....MWL :	-0.034	-0.0514	-0.0092	-0.0363	-0.0316	-0.0486	-0.0903	0.0751	-0.0183	0.1012	0.2541	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	36537	31183	36051	42979	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	23.109	19680	22746	27310	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	44813	40.810	45517	54144	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	49.025	47.003	50.421	59140	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-30.275	-26.733	-25.117	-26582	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-19751	-17914	-17226	-17.849	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-35382	-31402	-29309	-32129	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-42515	-37071	-35457	-36.337	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	950	956	957	961	-	-

Analysis performed: 08-09-99 16:05:09													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z007.dat												
Testname.....:	Z007												
Data scale.....:	1:1												
Date and time.....:	7-30-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	4												
Target peak period (Tp).....[sec]:	8.8												
Target Spectrum.....:	JONSWAP												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0.00032125												
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	224.589												
Total reflection at wave gauge group B...:	228.048												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	13337	13293	11049	11938	11350	10611	0.4911	38369	29548	34686	43883	11489	10710
First moment.....m1 :	0.1755	0.1745	0.1451	0.1546	0.1482	0.1389	0.0861	0.4714	0.3678	0.4321	0.548	0.1498	0.138
Second moment.....m2 :	0.0247	0.0244	0.0203	0.0214	0.0208	0.0197	0.0174	0.0615	0.0489	0.0575	0.0734	0.0207	0.0189
Wave height.....Hm0 :	46194	46117	42045	43705	42614	41203	28032	78353	68758	74496	83793	42874	41396
Peak period.....Tp :	80.000	86.780	86.780	94.815	86.780	86.780	70137	93.091	93.091	93.091	93.091	86.780	94815
Average wave period.....T01 :	76.008	76.156	76.166	77.202	76.603	76.382	57.053	81.396	80.341	80.267	80.079	76.715	77.628
Deep water wave length.....L0 :	901.999	905.528	905.757	930.558	916.171	910.911	508.211	1.034.410	1.007.770	1.005.920	1.001.210	918.849	940.864
Surf similarity parameter.....SSPop.:	33.991	34.086	35.703	35.495	35.667	36.168	32.753	27.950	29.449	28.266	26.590	35.611	36.672
No. of waves (Duration/T01).....:	1.181	1.178	1.178	1.162	1.171	1.175	1.573	1.102	1.117	1.118	1.121	1.170	1.156
Spectral width.....:	0.2643	0.2577	0.2594	0.2632	0.279	0.2854	0.3906	0.248	0.2591	0.2618	0.2685	0.2476	0.2564
Groupiness factor.....:	0.9348	0.9227	0.9301	0.9617	0.9711	0.9713	11856	0.6728	0.7195	0.706	0.7032	0	0
Significant wave height.....Hs :	44.503	44.507	40.774	42.866	41.834	40.735	28.872	71962	64821	68065	76729	-	-
Average wave height.....Hmean :	29.880	30.227	27.474	28.249	27.484	27.056	18478	52.498	46.667	49.353	55.864	-	-
Maximum wave height.....Hmax :	83149	84265	75983	80748	78867	72862	49885	92093	87.568	88719	97328	-	-
Significant wave period.....Ts :	82.299	81.697	81.929	82.641	82.120	82.074	69.064	87.841	87.330	86.857	87.488	-	-
Average wave period.....Tmean :	77.172	78.209	77.593	77.731	77.674	78.842	63.573	81.042	80.967	80.459	80.388	-	-
Maximum wave period.....Tmax :	81.506	73.032	72.690	80.303	81.343	80.966	73.374	81.865	93.032	86.899	88.535	-	-
Number of waves.....:	1.161	1.147	1.156	1.153	1.154	1.137	1.410	1.105	1.106	1.113	1.114	-	-
Mean water level.....MWL :	-0.0558	-0.0859	-0.0447	-0.0718	-0.0634	-0.0835	-0.1313	0.1291	0.0284	0.1934	0.3972	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	43700	38944	44230	51644	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	30.216	25915	30226	36331	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	49579	47.128	50939	57794	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	56.305	55.663	57.769	64661	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-31.849	-28.987	-26.705	-28092	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-22404	-20466	-19294	-20.001	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-36074	-33673	-30887	-32045	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-43318	-41036	-38395	-37.330	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	1.105	1.106	1.113	1.114	-	-

Analysis performed: 08-09-99 16:06:44													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z008.dat												
Testname.....:	Z008												
Data scale.....:	1:1												
Date and time.....:	7-30-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	4.5												
Target peak period (Tp).....[sec]:	9.3												
Target Spectrum.....:	JONSWAP												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0.00048187												
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	216.089												
Total reflection at wave gauge group B...:	216.717												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	13489	13392	11613	12601	11976	11523	0.5156	41041	32167	37252	46307	11941	11695
First moment.....m1 :	0.1713	0.1697	0.1469	0.1563	0.1488	0.1435	0.0919	0.4889	0.3894	0.4505	0.5599	0.15	0.1433
Second moment.....m2 :	0.0234	0.0231	0.02	0.0209	0.0199	0.0194	0.0193	0.0624	0.0509	0.0588	0.0732	0.0201	0.0188
Wave height.....Hm0 :	46456	46290	43106	44901	43774	42938	28723	81034	71741	77203	86077	43709	43257
Peak period.....Tp :	91.429	91.429	85.333	94.815	96.604	85.333	51717	93.091	93.091	93.091	93.091	94.815	96604
Average wave period.....T01 :	78.729	78.903	79.063	80.627	80.500	80.302	56.134	83.948	82.609	82.682	82.702	79.595	81.636
Deep water wave length.....L0 :	967.741	972.013	975.974	1.014.970	1.011.770	1.006.800	491.974	1.100.290	1.065.480	1.067.370	1.067.880	989.138	1.040.530
Surf similarity parameter.....SSPop.:	35.109	35.249	36.602	36.572	36.982	37.248	31.836	28.345	29.645	28.602	27.094	36.593	37.727
No. of waves (Duration/T01).....:	1.140	1.137	1.135	1.113	1.115	1.117	1.599	1.069	1.086	1.085	1.085	1.127	1.099
Spectral width.....:	0.2711	0.2695	0.2781	0.2769	0.2814	0.2974	0.4253	0.2667	0.2809	0.2812	0.2844	0.2581	0.2663
Groupiness factor.....:	0.9731	0.9659	0.9692	0.973	0.9747	0.9838	12180	0.6743	0.7359	0.7146	0.7009	0	0
Significant wave height.....Hs :	44.752	44.522	41.530	43.827	42.724	42.072	29.865	73716	67742	70329	77901	-	-
Average wave height.....Hmean :	29.795	29.354	27.496	28.945	28.143	27.876	18794	54.515	48.719	51.515	57.638	-	-
Maximum wave height.....Hmax :	76406	74303	70911	71509	69809	74020	46548	90400	89.522	85943	92592	-	-
Significant wave period.....Ts :	86.647	86.122	86.689	88.061	87.599	88.008	70.595	91.531	91.558	91.245	91.261	-	-
Average wave period.....Tmean :	79.771	79.066	80.439	82.148	81.626	83.288	64.319	84.918	84.200	84.517	84.438	-	-
Maximum wave period.....Tmax :	84.668	73.213	90.386	86.348	84.083	85.377	53.799	89.038	100.112	99.868	102.136	-	-
Number of waves.....:	1.124	1.134	1.114	1.091	1.099	1.077	1.393	1.056	1.065	1.061	1.062	-	-
Mean water level.....MWL :	-0.0589	-0.1005	-0.0683	-0.0863	-0.0778	-0.0984	-0.1372	0.1487	0.0597	0.2196	0.4152	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	45590	42192	46418	52732	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	31.858	27988	31873	37348	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	50888	50.082	52982	59227	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	56.309	56.587	58.366	64425	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-31.659	-28.980	-26.515	-27787	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-22534	-20631	-19262	-19.864	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-36207	-33793	-30469	-32228	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-40945	-39717	-37158	-37.359	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	1.056	1.065	1.061	1.062	-	-

Analysis performed: 08-09-09 16:07:17													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z009.dat												
Testname.....:	Z009												
Data scale.....:	1:1												
Date and time.....:	7-30-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	5												
Target peak period (Tp).....[sec]:	9.8												
Target Spectrum.....:	JONSWAP												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0.0018632												
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	202.688												
Total reflection at wave gauge group B...:	194.645												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	17235	17278	15319	16569	15751	15285	0.6329	50074	40948	45842	54654	15586	15658
First moment.....m1 :	0.2132	0.2128	0.186	0.1986	0.1889	0.1827	0.1126	0.5821	0.4857	0.5426	0.6448	0.1895	0.1853
Second moment.....m2 :	0.0286	0.0284	0.0243	0.0257	0.0246	0.0237	0.0238	0.0726	0.0624	0.0695	0.0823	0.0246	0.0236
Wave height.....Hm0 :	52513	52578	49508	51488	50201	49453	31823	89509	80943	85643	93513	49937	50053
Peak period.....Tp :	88.276	88.276	98.462	98.462	98.462	98.462	55054	98.462	98.462	98.462	98.462	98.462	98462
Average wave period.....T01 :	80.859	81.188	82.382	83.442	83.364	83.666	56.194	86.022	84.300	84.481	84.760	82.261	84.497
Deep water wave length.....L0 :	1.020.810	1.029.150	1.059.630	1.087.080	1.085.040	1.092.920	493.033	1.155.350	1.109.540	1.114.200	1.121.690	1.056.530	1.114.730
Surf similarity parameter.....SSPop.:	33.915	34.032	35.587	35.345	35.762	36.162	30.278	27.636	28.480	27.747	26.641	35.382	36.302
No. of waves (Duration/T01).....:	1.110	1.105	1.089	1.075	1.076	1.073	1.597	1.043	1.064	1.062	1.059	1.091	1.062
Spectral width.....:	0.2901	0.2874	0.2738	0.2854	0.2906	0.2925	0.4346	0.2701	0.2891	0.2872	0.285	0.2633	0.2724
Groupiness factor.....:	0.9511	0.9289	0.9393	0.9453	0.9517	0.9376	11979	0.6215	0.6958	0.6631	0.6388	0	0
Significant wave height.....Hs :	51.146	50.832	47.715	50.030	48.943	48.376	32.829	77377	74351	74537	79651	-	-
Average wave height.....Hmean :	34.289	34.140	32.036	33.322	32.569	32.568	20604	60.616	56.127	57.973	62.892	-	-
Maximum wave height.....Hmax :	83620	82155	80435	79822	80804	79503	55179	92647	90.161	88459	91869	-	-
Significant wave period.....Ts :	89.668	90.452	89.963	92.033	92.286	92.178	70.475	93.087	92.814	92.737	93.381	-	-
Average wave period.....Tmean :	83.715	83.484	84.265	85.391	85.550	87.216	63.621	89.554	89.374	89.265	88.580	-	-
Maximum wave period.....Tmax :	82.236	81.501	80.537	86.372	90.322	94.314	60.547	88.916	92.566	90.308	90.547	-	-
Number of waves.....:	1.071	1.074	1.064	1.050	1.048	1.027	1.410	1.001	1.003	1.004	1.012	-	-
Mean water level.....MWL :	-0.03	-0.1291	-0.1002	-0.1209	-0.1124	-0.1315	-0.1473	0.2184	0.1448	0.2791	0.443	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	48244	47636	49279	53061	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	36.368	33663	36395	40396	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	52500	53.338	54233	57665	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	57.625	60.343	59.490	61739	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-32.968	-30.454	-28.181	-29599	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-24236	-22300	-21034	-21.947	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-38192	-35623	-33218	-33780	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-42519	-40140	-36938	-40.091	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	1.001	1.003	1.004	1.012	-	-

Analysis performed: 08-09-99 16:07:51													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z010.dat												
Testname.....:	Z010												
Data scale.....:	1:1												
Date and time.....:	8-2-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	5.5												
Target peak period (Tp).....[sec]:	10.3												
Target Spectrum.....:	JONSWAP												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0.00257	(8.0 1/25 min. I lab.)											
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	19.920												
Total reflection at wave gauge group A...:	183.874												
Total reflection at wave gauge group B...:	179.569												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	18146	16956	17669	19774	19005	18708	0.728	62481	58317	53965	51043	16550	18641
First moment.....m1 :	0.2135	0.1985	0.2061	0.2244	0.2155	0.2112	0.1261	0.7026	0.6638	0.6175	0.5899	0.194	0.2119
Second moment.....m2 :	0.0272	0.0252	0.0262	0.0276	0.0266	0.0259	0.0267	0.0862	0.0829	0.0777	0.0754	0.0247	0.0262
Wave height.....Hm0 :	53882	52086	53169	56248	55143	54711	34128	99985	96596	92922	90371	51458	54612
Peak period.....Tp :	109.372	109.372	102.810	114.233	114.233	114.233	52454	102.810	102.810	102.810	102.810	96.990	96990
Average wave period.....T01 :	85.004	85.420	85.748	88.118	88.198	88.586	57.720	88.929	87.849	87.394	86.523	85.321	87.982
Deep water wave length.....L0 :	1.128.140	1.139.210	1.148.000	1.212.320	1.214.520	1.225.250	520.163	1.234.740	1.204.930	1.192.470	1.168.830	1.136.580	1.208.580
Surf similarity parameter.....SSPop.:	35.198	35.975	35.743	35.712	36.100	36.403	30.031	27.032	27.168	27.556	27.664	36.152	36.187
No. of waves (Duration/T01).....:	1.056	1.050	1.046	1.018	1.017	1.013	1.555	1.009	1.021	1.027	1.037	1.052	1.020
Spectral width.....:	0.2914	0.2901	0.2996	0.2903	0.296	0.2965	0.4688	0.3007	0.3109	0.315	0.3262	0.2934	0.2974
Groupiness factor.....:	0.9674	0.938	0.97	0.9692	0.9662	0.9513	11557	0.6371	0.6526	0.6822	0.7298	0	0
Significant wave height.....Hs :	53.696	51.437	52.541	55.954	54.932	54.062	34.968	85935	83681	80338	82109	-	-
Average wave height.....Hmean :	35.801	34.787	34.983	37.744	36.710	36.284	21830	67.323	65.298	62.340	62.374	-	-
Maximum wave height.....Hmax :	81612	77361	80158	84233	85013	84462	52291	103927	101.731	96780	105841	-	-
Significant wave period.....Ts :	93.761	94.300	95.666	97.780	98.648	99.185	72.843	97.931	97.990	97.121	97.962	-	-
Average wave period.....Tmean :	87.893	88.461	88.380	92.142	91.577	91.253	63.585	92.571	92.380	91.907	91.345	-	-
Maximum wave period.....Tmax :	84.536	85.178	95.903	101.904	97.290	91.626	68.433	87.493	95.205	88.967	89.634	-	-
Number of waves.....:	1.020	1.013	1.014	973	979	982	1.410	968	970	975	981	-	-
Mean water level.....MWL :	-0.0652	-0.0912	-0.0534	-0.1041	-0.0675	-0.0816	-0.1319	0.3241	0.2492	0.3715	0.5228	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	55050	53194	54368	56716	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	41.412	39630	40606	42218	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	60451	58.697	59666	62461	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	64.377	63.249	63.371	67052	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-34.916	-34.343	-29.404	-28747	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-25087	-24853	-21096	-19.395	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-41192	-40709	-35352	-35588	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-49325	-51097	-41892	-41.117	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	968	970	975	981	-	-

Analysis performed: 08-09-99 16:08:21													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z011.dat												
Testname.....:	Z011												
Data scale.....:	1:1												
Date and time.....:	8-2-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	6												
Target peak period (Tp).....[sec]:	10.8												
Target Spectrum.....:	JONSWAP												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0.0048026												
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	184.380												
Total reflection at wave gauge group B...:	171.536												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	22812	21027	21483	24298	23611	22975	0.7959	66061	63093	56936	51949	20029	22306
First moment.....m1 :	0.2628	0.2407	0.2449	0.2708	0.2633	0.2554	0.1327	0.72	0.6921	0.6308	0.5862	0.2285	0.2469
Second moment.....m2 :	0.0333	0.0302	0.0306	0.0331	0.0323	0.0312	0.0276	0.0863	0.0838	0.0774	0.0739	0.0284	0.0297
Wave height.....Hm0 :	60414	58002	58628	62352	61464	60630	35686	102809	100473	95445	91170	56610	59741
Peak period.....Tp :	108.936	108.936	108.936	108.936	108.936	108.936	55054	108.936	108.936	108.936	108.936	108.936	108936
Average wave period.....T01 :	86.791	87.354	87.736	89.743	89.662	89.951	59.970	91.752	91.159	90.259	88.615	87.644	90.351
Deep water wave length.....L0 :	1.176.080	1.191.390	1.201.830	1.257.440	1.255.190	1.263.270	561.509	1.314.370	1.297.440	1.271.960	1.226.050	1.199.310	1.274.550
Surf similarity parameter.....SSPop.:	33.939	34.863	34.828	34.544	34.762	35.112	30.513	27.504	27.642	28.081	28.209	35.406	35.530
No. of waves (Duration/T01).....:	1.034	1.027	1.023	1.000	1.001	998	1.496	978	984	994	1.013	1.024	993
Spectral width.....:	0.3157	0.3123	0.3134	0.3111	0.3153	0.3136	0.4991	0.3163	0.3214	0.3276	0.3418	0.2993	0.2969
Groupiness factor.....:	10049	0.9666	0.9905	0.9705	0.9703	0.9488	11229	0.6354	0.6413	0.6748	0.7358	0	0
Significant wave height.....Hs :	61.598	58.466	59.290	62.279	61.168	59.864	35.671	86605	84929	81076	81438	-	-
Average wave height.....Hmean :	40.305	38.553	38.935	41.395	40.969	40.398	22471	68.657	67.046	63.855	63.223	-	-
Maximum wave height.....Hmax :	86580	79457	82498	83722	82822	82496	54407	104292	103.558	96044	99621	-	-
Significant wave period.....Ts :	98.065	98.987	99.817	101.980	101.569	101.085	76.274	103.161	102.867	102.948	103.844	-	-
Average wave period.....Tmean :	91.853	91.945	92.615	94.377	95.083	94.776	64.470	96.167	95.352	95.147	95.144	-	-
Maximum wave period.....Tmax :	95.116	81.978	99.561	81.631	90.396	90.873	59.967	98.564	100.737	125.186	98.604	-	-
Number of waves.....:	976	975	968	949	942	945	1.391	932	940	942	942	-	-
Mean water level.....MWL :	-0.093	-0.1375	-0.108	-0.1484	-0.0914	-0.1146	-0.1307	0.3833	0.3979	0.4471	0.4968	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	56742	55164	55512	56920	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	43.772	42330	42571	43373	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	61612	60.284	60553	61735	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	68.145	66.324	67.878	70185	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-34.503	-34.280	-29.452	-28236	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-24378	-24078	-20688	-19.078	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-40411	-41021	-34734	-33350	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-51014	-52536	-47232	-52.865	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	932	940	942	942	-	-

Analysis performed: 08-09-99 16:08:58													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z012.dat												
Testname.....:	Z012												
Data scale.....:	1:1												
Date and time.....:	8-2-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	6												
Target peak period (Tp).....[sec]:	10.8												
Target Spectrum.....:	JONSWAP												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	6.12E-03	(16.0 1/21 min. I lab.)											
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	19.920												
Total reflection at wave gauge group A...:	183.756												
Total reflection at wave gauge group B...:	188.188												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	29945	28996	30222	30899	29322	29582	0.701	68954	67173	59737	53212	27228	28017
First moment.....m1 :	0.3407	0.3284	0.3404	0.3393	0.3222	0.3245	0.0901	0.724	0.7073	0.6369	0.5798	0.3066	0.3048
Second moment.....m2 :	0.0433	0.0415	0.0428	0.0413	0.0393	0.0395	0.0134	0.084	0.0824	0.0755	0.0708	0.0382	0.0364
Wave height.....Hm0 :	69218	68113	69538	70313	68495	68798	33490	105036	103671	97765	92271	66003	66953
Peak period.....Tp :	109.372	109.372	107.093	109.372	109.372	109.372	138932	114.233	114.233	114.233	114.233	109.372	109372
Average wave period.....T01 :	87.897	88.297	88.771	91.059	90.997	91.161	77.763	95.236	94.965	93.797	91.777	88.802	91.929
Deep water wave length.....L0 :	1.206.240	1.217.260	1.230.350	1.294.610	1.292.840	1.297.490	944.131	1.416.100	1.408.040	1.373.610	1.315.090	1.231.210	1.319.460
Surf similarity parameter.....SSPop.:	32.112	32.519	32.356	33.007	33.419	33.406	40.843	28.245	28.349	28.834	29.040	33.223	34.148
No. of waves (Duration/T01).....:	843	839	835	814	814	813	953	778	780	790	807	804	806
Spectral width.....:	0.3432	0.3418	0.3412	0.3309	0.3334	0.3307	0.3934	0.3243	0.327	0.3343	0.3484	0.325	0.3135
Groupiness factor.....:	10192	0.9865	0.9766	0.9531	0.9529	0.9364	10969	0.612	0.6053	0.641	0.7081	0	0
Significant wave height.....Hs :	73.814	71.307	72.123	73.041	70.564	70.568	37.103	88216	86836	82595	82102	-	-
Average wave height.....Hmean :	48.413	47.366	48.603	49.961	48.419	49.000	23386	73.045	71.853	68.177	66.431	-	-
Maximum wave height.....Hmax :	99599	91885	103896	97209	95757	98323	57229	105428	104.950	100488	101624	-	-
Significant wave period.....Ts :	102.543	102.963	103.990	105.373	106.061	105.392	82.575	110.430	109.903	110.409	109.674	-	-
Average wave period.....Tmean :	95.161	95.160	96.904	99.851	99.175	100.182	67.319	101.903	101.343	101.068	99.977	-	-
Maximum wave period.....Tmax :	117.625	101.655	94.866	105.396	109.927	107.505	70.441	101.736	109.722	100.771	98.907	-	-
Number of waves.....:	778	778	764	741	746	738	1.100	726	730	732	740	-	-
Mean water level.....MWL :	-0.1773	-0.1885	-0.2677	-0.2372	-0.0773	0.1064	18979	0.4713	0.5669	0.5433	0.4939	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	59603	58903	58523	58753	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	47.720	47227	47011	46560	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	63794	63.366	62526	63891	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	69.785	68.852	67.676	67509	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-34.789	-34.055	-29.949	-28619	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-24526	-23899	-20842	-19.532	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-41000	-40871	-36147	-33948	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-47773	-47459	-39950	-39.489	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	726	730	732	740	-	-

Analysis performed: 08-09-99 16:09:34													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z031.dat												
Testname.....:	Z031												
Data scale.....:	1:1												
Date and time.....:	8-3-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	5												
Target peak period (Tp).....[sec]:	5												
Target Spectrum.....:	JONSWAP												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0												
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	246.401												
Total reflection at wave gauge group B...:	238.178												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	0.8345	0.8072	0.8139	0.7092	0.6834	0.6448	0.6491	16934	17107	14450	12531	0.7327	0.6282
First moment.....m1 :	0.1767	0.1706	0.1717	0.1486	0.1428	0.1333	0.13	0.3202	0.3234	0.2724	0.2398	0.1528	0.1291
Second moment.....m2 :	0.0394	0.0379	0.0381	0.0329	0.0315	0.029	0.0279	0.0633	0.0634	0.0532	0.0484	0.0331	0.0276
Wave height.....Hm0 :	36540	35938	36087	33686	33068	32120	32226	52052	52317	48084	44776	34238	31703
Peak period.....Tp :	46.972	48.762	48.302	51.200	58.182	48.302	56889	55.652	55.652	55.652	55.652	48.302	50693
Average wave period.....T01 :	47.234	47.315	47.391	47.715	47.855	48.374	49.929	52.893	52.891	53.052	52.246	47.946	48.654
Deep water wave length.....L0 :	348.338	349.534	350.651	355.468	357.559	365.359	389.225	436.807	436.772	439.435	426.187	358.922	369.597
Surf similarity parameter.....SSPop.:	23.750	23.990	23.978	24.988	25.295	25.943	26.733	22.283	22.226	23.254	23.732	24.906	26.265
No. of waves (Duration/T01).....:	1.498	1.496	1.493	1.483	1.479	1.463	1.418	1.338	1.338	1.334	1.355	1.476	1.455
Spectral width.....:	0.229	0.2274	0.224	0.2352	0.2392	0.2317	0.2686	0.2133	0.1914	0.1883	0.2342	0.2001	0.202
Groupiness factor.....:	0.7984	0.778	0.7767	0.85	0.8336	0.853	0.7999	0.7143	0.6467	0.6839	0.7905	0	0
Significant wave height.....Hs :	34.339	33.547	33.712	32.088	31.245	30.505	30.062	48678	47815	44263	42298	-	-
Average wave height.....Hmean :	23.710	23.328	23.309	21.837	21.429	20.712	21333	34.536	34.704	31.663	29.265	-	-
Maximum wave height.....Hmax :	51851	51529	48324	50612	44084	45436	45861	66133	67.337	61933	63682	-	-
Significant wave period.....Ts :	49.617	49.678	49.784	50.229	50.208	50.765	53.906	55.154	55.080	54.917	54.590	-	-
Average wave period.....Tmean :	47.969	47.874	47.801	48.860	49.270	49.442	52.190	52.975	52.699	52.817	52.534	-	-
Maximum wave period.....Tmax :	50.961	48.862	51.172	51.016	47.405	50.802	55.413	57.909	45.903	59.104	59.717	-	-
Number of waves.....:	1.474	1.477	1.480	1.447	1.436	1.430	1.355	1.334	1.341	1.338	1.346	-	-
Mean water level.....MWL :	-0.0561	-0.0414	-0.0412	-0.0321	-0.0237	-0.0429	-0.03	0.0701	-0.0555	0.1129	0.3267	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	26539	23822	24948	27657	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	18.107	16403	16839	18096	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	30909	27.662	29124	32746	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	37.728	37.632	37.138	39541	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-25.553	-26.562	-22.136	-18646	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-16543	-18301	-14954	-11.680	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-29252	-30147	-26057	-22888	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-34520	-34363	-32257	-30.187	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	1.334	1.341	1.338	1.346	-	-

Analysis performed: 08-09-99 16:10:04													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z032.dat												
Testname.....:	Z032												
Data scale.....:	1:1												
Date and time.....:	8-3-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	5												
Target peak period (Tp).....[sec]:	6												
Target Spectrum.....:	JONSWAP												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0												
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	229.645												
Total reflection at wave gauge group B...:	223.489												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	12922	12414	13313	12845	12269	11943	0.9329	31580	28847	26997	27029	11707	11472
First moment.....m1 :	0.2361	0.2257	0.2402	0.2314	0.2219	0.2144	0.1729	0.5158	0.4747	0.4426	0.4486	0.2093	0.2033
Second moment.....m2 :	0.0461	0.0437	0.046	0.0446	0.043	0.041	0.035	0.0884	0.0819	0.0759	0.079	0.0392	0.0378
Wave height.....Hm0 :	45470	44567	46153	45335	44306	43714	38634	71083	67938	65723	65762	43279	42843
Peak period.....Tp :	54.468	61.687	61.687	59.535	59.535	61.687	61687	61.687	61.687	61.687	61.687	61.687	61687
Average wave period.....T01 :	54.726	54.995	55.433	55.511	55.292	55.706	53.968	61.223	60.772	60.997	60.252	55.927	56.435
Deep water wave length.....L0 :	467.596	472.216	479.760	481.106	477.321	484.494	454.738	585.227	576.624	580.905	566.804	488.357	497.270
Surf similarity parameter.....SSPop.:	24.668	25.039	24.801	25.059	25.248	25.609	26.391	22.072	22.410	22.869	22.583	25.840	26.207
No. of waves (Duration/T01).....:	1.293	1.287	1.277	1.275	1.280	1.271	1.311	1.156	1.165	1.160	1.175	1.265	1.254
Spectral width.....:	0.2596	0.2554	0.2472	0.2655	0.2685	0.2546	0.3046	0.2213	0.2209	0.2131	0.2482	0.2206	0.2228
Groupiness factor.....:	0.8082	0.8079	0.8294	0.8551	0.8448	0.827	0.8018	0.6424	0.6142	0.6321	0.698	0	0
Significant wave height.....Hs :	42.704	41.934	43.664	43.630	42.064	41.483	36.316	66336	62376	60535	61815	-	-
Average wave height.....Hmean :	29.439	29.112	29.876	29.495	28.893	28.720	26409	47.812	46.162	43.909	43.545	-	-
Maximum wave height.....Hmax :	67979	58356	63338	63797	63214	61781	53289	86507	86.557	82884	82737	-	-
Significant wave period.....Ts :	58.624	58.923	59.250	59.763	59.764	59.013	59.652	64.197	63.911	63.760	63.830	-	-
Average wave period.....Tmean :	55.508	56.304	56.252	56.899	56.992	57.402	57.944	60.431	60.483	60.276	59.917	-	-
Maximum wave period.....Tmax :	59.268	63.215	59.531	68.853	61.958	61.027	58.093	61.504	60.430	61.494	73.843	-	-
Number of waves.....:	1.274	1.256	1.257	1.243	1.240	1.231	1.220	1.170	1.169	1.173	1.180	-	-
Mean water level.....MWL :	-0.1006	-0.0899	-0.1234	-0.0823	-0.0722	-0.0925	-0.053	0.2014	0.0448	0.2619	0.5362	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	38182	33593	36867	41915	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	26.890	23795	25912	29606	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	44772	39.281	42240	47232	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	50.857	47.331	48.996	57735	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-31.823	-31.765	-26.950	-23803	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-21432	-22339	-18436	-14.983	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-35229	-35464	-30430	-27631	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-39413	-39484	-35569	-34.483	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	1.170	1.169	1.173	1.180	-	-

Analysis performed: 08-09-99 16:10:33													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z033.dat												
Testname.....:	Z033												
Data scale.....:	1:1												
Date and time.....:	8-3-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	5												
Target peak period (Tp).....[sec]:	7												
Target Spectrum.....:	JONSWAP												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0												
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	219.861												
Total reflection at wave gauge group B...:	230.768												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	15506	14494	14659	15135	14352	13659	0.7526	44215	38280	37175	38838	13623	13323
First moment.....m1 :	0.2484	0.2318	0.2339	0.2403	0.2303	0.2186	0.1345	0.6577	0.5563	0.5412	0.5732	0.2168	0.2101
Second moment.....m2 :	0.0426	0.0397	0.0398	0.0409	0.04	0.0377	0.0268	0.0967	0.085	0.0829	0.0902	0.0367	0.0352
Wave height.....Hm0 :	49810	48156	48430	49210	47920	46748	34702	84110	78262	77124	78830	46687	46170
Peak period.....Tp :	70.137	69.189	75.294	75.294	65.641	70.137	69189	76.418	76.418	76.418	76.418	65.641	69189
Average wave period.....T01 :	62.413	62.518	62.678	62.973	62.315	62.493	55.959	69.334	68.812	68.697	67.757	62.839	63.425
Deep water wave length.....L0 :	608.195	610.236	613.357	619.146	606.274	609.743	488.904	750.545	739.303	736.820	716.801	616.518	628.081
Surf similarity parameter.....SSPop.:	26.879	27.383	27.375	27.285	27.361	27.781	28.873	22.979	23.643	23.776	23.196	27.953	28.372
No. of waves (Duration/T01).....:	1.134	1.132	1.129	1.124	1.136	1.133	1.265	1.021	1.029	1.030	1.045	1.126	1.116
Spectral width.....:	0.2659	0.2681	0.2588	0.2662	0.289	0.2797	0.3387	0.2266	0.2278	0.2296	0.2583	0.2528	0.2536
Groupiness factor.....:	0.8699	0.8593	0.8601	0.8828	0.8893	0.9056	0.9565	0.6112	0.6071	0.615	0.6584	0	0
Significant wave height.....Hs :	48.347	46.746	47.089	48.401	47.024	46.030	34.032	76323	70292	68565	71491	-	-
Average wave height.....Hmean :	32.827	31.875	31.592	32.227	31.567	30.573	23702	56.466	52.664	51.299	52.773	-	-
Maximum wave height.....Hmax :	70808	70226	66909	73371	67309	64888	50736	97376	93.996	90173	92937	-	-
Significant wave period.....Ts :	66.908	67.095	66.960	67.641	67.504	67.539	63.538	72.801	71.963	72.041	73.060	-	-
Average wave period.....Tmean :	63.807	63.983	62.957	64.142	64.662	64.131	61.124	68.079	67.947	67.947	67.558	-	-
Maximum wave period.....Tmax :	72.572	66.138	65.391	59.849	71.511	63.745	59.683	76.099	68.621	83.838	78.418	-	-
Number of waves.....:	1.108	1.105	1.123	1.103	1.093	1.101	1.156	1.038	1.040	1.040	1.046	-	-
Mean water level.....MWL :	-0.1069	-0.112	-0.1517	-0.1121	-0.1034	-0.1223	-0.0909	0.3438	0.1305	0.3796	0.7029	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	47087	40690	44573	51103	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	34.002	28993	32438	38126	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	52671	46.862	49860	56615	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	62.157	58.997	59.610	66225	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-33.927	-33.595	-28.145	-25030	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-23456	-23839	-19593	-16.234	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-37954	-38070	-32372	-29533	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-44320	-44127	-38663	-35.487	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	1.038	1.040	1.040	1.046	-	-

Analysis performed: 08-09-99 16:11:16													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z034.dat												
Testname.....:	Z034												
Data scale.....:	1:1												
Date and time.....:	8-3-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	5												
Target peak period (Tp).....[sec]:	8												
Target Spectrum.....:	JONSWAP												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	2.87E-04	(0.75 1/21 MIN. I LAB.)											
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	191.845												
Total reflection at wave gauge group B...:	216.063												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	18390	17445	17437	17706	16262	15633	0.6435	58879	50228	43866	50805	16153	15566
First moment.....m1 :	0.2652	0.2509	0.2513	0.2558	0.2363	0.2279	0.1172	0.7733	0.6546	0.6488	0.6856	0.2304	0.222
Second moment.....m2 :	0.041	0.0385	0.0387	0.0399	0.0373	0.0362	0.0251	0.1079	0.0937	0.0919	0.1001	0.0349	0.0339
Wave height.....Hm0 :	54243	52832	52820	53226	51010	50013	32087	97060	89646	88423	90159	50837	49906
Peak period.....Tp :	76.418	76.418	76.418	76.418	76.418	71.111	61687	76.418	76.418	76.418	76.418	76.418	76418
Average wave period.....T01 :	69.333	69.533	69.384	69.226	68.830	68.596	54.904	76.139	75.579	75.317	74.101	70.112	70.132
Deep water wave length.....L0 :	750.527	754.875	751.630	748.222	739.673	734.651	470.657	905.126	891.855	885.673	857.305	767.489	767.941
Surf similarity parameter.....SSPop.:	28.613	29.077	29.018	28.841	29.292	29.482	29.461	23.490	24.263	24.345	23.720	29.888	30.175
No. of waves (Duration/T01).....:	1.021	1.018	1.020	1.022	1.028	1.032	1.289	930	936	940	955	1.009	1.009
Spectral width.....:	0.2659	0.2613	0.2633	0.2839	0.2939	0.3016	0.4195	0.2502	0.2562	0.2578	0.2866	0.2467	0.2652
Groupiness factor.....:	0.8636	0.8499	0.855	0.907	0.9018	0.9043	11461	0.5682	0.5756	0.5923	0.6357	0	0
Significant wave height.....Hs :	52.596	51.205	51.167	52.738	50.608	49.438	32.881	85286	79600	76900	80656	-	-
Average wave height.....Hmean :	35.924	34.907	34.976	35.363	34.118	33.383	21364	66.590	61.746	59.681	61.702	-	-
Maximum wave height.....Hmax :	79912	75630	78172	80271	78765	71097	51442	101313	94.893	91115	98469	-	-
Significant wave period.....Ts :	74.796	74.767	74.646	74.702	74.725	74.530	66.812	80.830	80.031	80.198	81.613	-	-
Average wave period.....Tmean :	71.870	71.652	71.220	72.007	72.154	72.375	61.398	76.944	76.781	76.284	75.629	-	-
Maximum wave period.....Tmax :	72.827	72.319	71.878	76.367	73.896	70.730	63.403	81.914	87.881	82.035	80.220	-	-
Number of waves.....:	983	986	992	982	980	976	1.152	918	920	926	934	-	-
Mean water level.....MWL :	-0.1207	-0.1143	-0.181	-0.1313	-0.1187	-0.1477	-0.1407	0.4232	0.1876	0.4491	0.7914	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	54674	48652	52198	58739	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	41.422	35895	39253	45125	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	59183	53.427	56990	63816	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	66.175	60.769	64.669	70246	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-35.652	-35.865	-29.366	-26891	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-25574	-26170	-20992	-18.118	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-39679	-40653	-33667	-30682	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-44026	-45550	-39102	-34.166	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	918	920	926	934	-	-

Analysis performed: 08-09-99 16:11:45													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z075.dat												
Testname.....:	Z075												
Data scale.....:	1:1												
Date and time.....:	8-4-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	2												
Target peak period (Tp).....[sec]:	9												
Target Spectrum.....:	Regular												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0												
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	234.592												
Total reflection at wave gauge group B...:	317.336												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	0.4363	0.4778	0.4303	0.5002	0.5416	0.4513	0.0665	25250	21158	20725	21879	0.3202	0.3172
First moment.....m1 :	0.0498	0.0547	0.0496	0.0587	0.0617	0.0524	0.0096	0.2957	0.2468	0.2435	0.2664	0.0364	0.0364
Second moment.....m2 :	0.0058	0.0064	0.0058	0.0072	0.0071	0.0063	0.0016	0.0358	0.0299	0.0296	0.0348	0.0042	0.0042
Wave height.....Hm0 :	26420	27649	26240	28289	29437	26872	10318	63560	58183	57584	59167	22634	22529
Peak period.....Tp :	88.276	88.276	88.276	88.276	88.276	88.276	88276	88.276	88.276	88.276	88.276	88.276	88276
Average wave period.....T01 :	87.593	87.270	86.843	85.146	87.826	86.073	69.603	85.400	85.728	85.124	82.134	87.911	87.183
Deep water wave length.....L0 :	1.197.930	1.189.110	1.177.490	1.131.930	1.204.310	1.156.710	756.399	1.138.700	1.147.460	1.131.350	1.053.270	1.206.640	1.186.740
Surf similarity parameter.....SSPop.:	51.797	50.447	51.529	48.658	49.201	50.469	65.863	32.559	34.161	34.096	32.455	56.165	55.830
No. of waves (Duration/T01).....:	664	666	669	683	662	675	835	681	678	683	708	661	667
Spectral width.....:	0.1112	0.1226	0.1442	0.1953	0.1044	0.1736	0.437	0.1825	0.1947	0.1909	0.2723	0.0956	0.1347
Groupiness factor.....:	0.1464	0.165	0.1994	0.275	0.1222	0.2288	0.7859	0.2675	0.2303	0.2793	0.3989	0	0
Significant wave height.....Hs :	19.374	21.062	19.796	21.097	21.613	20.791	1	49156	43460	43772	47504	-	-
Average wave height.....Hmean :	18.975	20.601	19.445	20.757	21.341	20.045	0.8902	48.530	43.016	43.231	46.427	-	-
Maximum wave height.....Hmax :	20142	21573	20389	21668	22135	22576	0.9621	50281	44.066	44685	49287	-	-
Significant wave period.....Ts :	89.985	89.992	89.981	89.978	89.979	90.008	89.965	89.985	90.001	89.992	89.982	-	-
Average wave period.....Tmean :	90.006	90.005	90.009	90.009	90.007	90.011	90.006	90.009	90.009	90.009	90.009	-	-
Maximum wave period.....Tmax :	89.871	89.819	89.851	89.729	89.614	89.767	89.756	90.186	89.938	90.018	89.963	-	-
Number of waves.....:	644	645	645	644	644	644	645	644	644	644	644	-	-
Mean water level.....MWL :	-0.0073	-0.0248	-0.0435	-0.0421	-0.0279	-0.0454	-0.1072	0.0677	0.0094	0.0288	0.0643	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	27172	22476	24136	28976	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	26.701	22115	23674	28023	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	27493	22.692	24391	29660	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	27.758	22.846	24.811	29933	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-22.272	-21.315	-19.864	-18809	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-21829	-20901	-19557	-18.404	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-22585	-21660	-20091	-19070	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-23126	-22078	-20345	-19.516	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	644	644	644	644	-	-

Analysis performed: 08-09-99 16:12:18													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z076.dat												
Testname.....:	Z076												
Data scale.....:	1:1												
Date and time.....:	8-4-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	2												
Target peak period (Tp).....[sec]:	9												
Target Spectrum.....:	Regular												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0												
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	226.159												
Total reflection at wave gauge group B...:	278.508												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	0.8262	0.9174	0.8293	0.9653	10198	0.8232	0.1282	53399	43429	41588	42822	0.6179	0.6288
First moment.....m1 :	0.0939	0.1054	0.0963	0.1122	0.1175	0.0961	0.02	0.6208	0.512	0.4875	0.5095	0.0702	0.072
Second moment.....m2 :	0.0108	0.0123	0.0115	0.0134	0.014	0.0116	0.0038	0.0741	0.0632	0.0591	0.0639	0.008	0.0084
Wave height.....Hm0 :	36358	38312	36426	39301	40394	36293	14319	92433	83358	81573	82774	31443	31720
Peak period.....Tp :	88.276	88.276	88.276	88.276	88.276	88.276	88276	88.276	88.276	88.276	88.276	88.276	88276
Average wave period.....T01 :	87.971	87.055	86.138	86.045	86.772	85.671	64.169	86.010	84.827	85.301	84.040	88.082	87.340
Deep water wave length.....L0 :	1.208.290	1.183.240	1.158.460	1.155.950	1.175.570	1.145.920	642.900	1.155.010	1.123.460	1.136.040	1.102.710	1.211.330	1.191.000
Surf similarity parameter.....SSPop.:	44.345	42.749	43.380	41.718	41.497	43.224	51.543	27.192	28.240	28.707	28.076	47.745	47.135
No. of waves (Duration/T01).....:	1.236	1.249	1.262	1.264	1.253	1.269	1.694	1.264	1.282	1.275	1.294	1.234	1.245
Spectral width.....:	0.0966	0.1393	0.1789	0.1709	0.1749	0.1912	0.4805	0.1631	0.2164	0.1827	0.2323	0.0851	0.1344
Groupiness factor.....:	0.1222	0.1966	0.231	0.2407	0.181	0.2555	0.9199	0.239	0.269	0.2702	0.3287	0	0
Significant wave height.....Hs :	27.541	28.895	28.204	29.826	30.831	26.618	12.676	70154	60232	58821	63218	-	-
Average wave height.....Hmean :	26.516	28.171	26.525	28.866	29.983	26.013	0.9689	68.889	59.249	57.892	61.637	-	-
Maximum wave height.....Hmax :	28971	29825	30553	31744	31973	27902	14281	73853	62.993	61951	67047	-	-
Significant wave period.....Ts :	90.935	90.250	90.614	90.549	90.490	89.883	90.034	89.915	89.947	89.981	90.006	-	-
Average wave period.....Tmean :	90.006	90.005	90.006	90.007	90.006	90.006	69.241	90.007	90.007	90.007	90.007	-	-
Maximum wave period.....Tmax :	90.601	91.494	90.596	91.405	91.895	90.219	89.836	89.924	90.172	90.029	90.053	-	-
Number of waves.....:	1.207	1.207	1.207	1.206	1.206	1.206	1.569	1.206	1.206	1.206	1.206	-	-
Mean water level.....MWL :	-0.0154	-0.0329	-0.019	-0.0351	-0.015	-0.0434	-0.165	0.1228	0.1138	0.1839	0.2621	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	39808	33580	36060	40730	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	39.133	32923	35463	39870	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	40778	34.430	37072	41546	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	41.220	34.894	37.540	42332	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-30.740	-26.957	-23.012	-22888	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-29756	-26326	-22429	-21.767	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-31692	-27595	-23774	-24008	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-32639	-28456	-24557	-24.996	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	1.206	1.206	1.206	1.206	-	-

Analysis performed: 08-09-99 16:12:54													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z077.dat												
Testname.....:	Z077												
Data scale.....:	1:1												
Date and time.....:	8-4-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	4												
Target peak period (Tp).....[sec]:	9												
Target Spectrum.....:	Regular												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0												
Distance from slope to Zr3.....[m]:	0.06												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	195.171												
Total reflection at wave gauge group B...:	268.710												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	16243	17020	15256	17801	17907	13327	0.2275	98338	84331	83715	87185	12303	11494
First moment.....m1 :	0.1859	0.1958	0.1759	0.2097	0.2086	0.157	0.0417	11442	0.9841	0.9733	10114	0.1415	0.1346
Second moment.....m2 :	0.0216	0.0232	0.0207	0.0258	0.0251	0.0193	0.009	0.1373	0.1183	0.1161	0.1202	0.0167	0.0165
Wave height.....Hm0 :	50980	52184	49405	53368	53528	46178	19079	125436	116159	115734	118108	44368	42885
Peak period.....Tp :	88.276	88.276	88.276	88.276	88.276	88.276	88276	88.276	88.276	88.276	88.276	88.276	88276
Average wave period.....T01 :	87.395	86.910	86.734	84.876	85.838	84.902	54.549	85.942	85.696	86.008	86.203	86.935	85.388
Deep water wave length.....L0 :	1.192.500	1.179.310	1.174.550	1.124.740	1.150.390	1.125.440	464.575	1.153.180	1.146.600	1.154.960	1.160.200	1.180.000	1.138.370
Surf similarity parameter.....SSPop.:	37.204	36.568	37.506	35.314	35.661	37.975	37.958	23.324	24.168	24.300	24.109	39.670	39.632
No. of waves (Duration/T01).....:	665	669	670	685	677	685	1.065	676	678	676	674	669	681
Spectral width.....:	0.1341	0.1655	0.1454	0.2097	0.1821	0.2068	0.4214	0.1777	0.1749	0.1623	0.1573	0.1538	0.2126
Groupiness factor.....:	0.1534	0.1731	0.1986	0.2892	0.2281	0.2546	10562	0.2328	0.2525	0.2377	0.2497	0	0
Significant wave height.....Hs :	39.912	40.911	35.660	40.152	41.835	35.807	17.787	93506	90525	84910	87595	-	-
Average wave height.....Hmean :	39.063	40.083	34.854	39.415	41.102	35.060	15685	92.356	88.826	83.787	86.278	-	-
Maximum wave height.....Hmax :	41314	42401	36701	41574	42868	37007	20615	95606	92.448	87442	89631	-	-
Significant wave period.....Ts :	90.027	90.006	90.003	90.021	90.009	90.000	88.497	89.985	89.997	89.994	90.014	-	-
Average wave period.....Tmean :	90.010	90.004	90.008	90.009	90.004	90.010	81.989	90.009	90.009	90.009	90.009	-	-
Maximum wave period.....Tmax :	90.327	90.134	89.790	90.020	89.546	89.976	55.293	89.692	90.197	90.275	90.101	-	-
Number of waves.....:	645	645	645	644	644	644	707	645	645	645	645	-	-
Mean water level.....MWL :	-0.0498	-0.0714	-0.0966	-0.0649	-0.0436	-0.0897	-0.2942	0.3491	0.3273	0.3582	0.3971	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	54983	54009	53016	53583	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	54.168	52704	52176	52551	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	55685	55.085	53863	54399	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	55.911	55.360	54.614	55263	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-38.994	-36.868	-32.233	-34684	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-38188	-36121	-31611	-33.727	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-39634	-37430	-32746	-35727	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-40442	-37825	-33858	-36.402	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	645	645	645	645	-	-

Analysis performed: 08-09-99 16:13:18													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z078.dat												
Testname.....:	Z078												
Data scale.....:	1:1												
Date and time.....:	8-17-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	3.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	5												
Target peak period (Tp).....[sec]:	9												
Target Spectrum.....:	Regular												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0.010792	(21.5 1/16 min. I lab.)											
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	162.499												
Total reflection at wave gauge group B...:	255.227												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	25419	25606	22382	30068	31377	22346	0.6168	136998	122649	122705	126951	19530	20089
First moment.....m1 :	0.2914	0.292	0.2583	0.3492	0.3667	0.2605	0.115	15837	14139	14196	14819	0.2236	0.234
Second moment.....m2 :	0.034	0.0337	0.0304	0.0416	0.0443	0.0314	0.0251	0.188	0.1667	0.1681	0.1783	0.0259	0.0281
Wave height.....Hm0 :	63774	64007	59842	69361	70855	59794	31416	148053	140085	140117	142521	55900	56694
Peak period.....Tp :	88.276	88.276	88.276	88.276	88.276	88.276	88276	88.276	88.276	88.276	88.276	88.276	88276
Average wave period.....T01 :	87.225	87.705	86.638	86.111	85.566	85.785	53.645	86.507	86.747	86.434	85.670	87.360	85.842
Deep water wave length.....L0 :	1.187.880	1.200.990	1.171.940	1.157.730	1.143.120	1.148.980	449.305	1.168.390	1.174.880	1.166.420	1.145.900	1.191.550	1.150.520
Surf similarity parameter.....SSPop.:	33.199	33.321	34.041	31.427	30.897	33.720	29.091	21.609	22.277	22.194	21.812	35.515	34.653
No. of waves (Duration/T01).....:	632	628	636	640	644	642	1.027	637	635	637	643	631	642
Spectral width.....:	0.1282	0.1088	0.145	0.1632	0.183	0.1836	0.4162	0.164	0.1514	0.1538	0.176	0.1178	0.1703
Groupiness factor.....:	0.1722	0.1233	0.2078	0.2374	0.2642	0.2473	0.9831	0.1995	0.1908	0.2144	0.2599	0	0
Significant wave height.....Hs :	48.364	48.778	43.338	50.907	53.825	46.162	28.474	105462	100282	100111	104324	-	-
Average wave height.....Hmean :	47.237	47.219	42.453	49.985	52.791	45.278	22260	103.887	98.600	98.559	101.355	-	-
Maximum wave height.....Hmax :	49472	50376	44601	52145	55187	47987	31646	107541	104.679	102087	111179	-	-
Significant wave period.....Ts :	89.999	89.995	89.988	89.999	90.020	89.990	80.284	90.000	89.979	89.966	89.928	-	-
Average wave period.....Tmean :	90.012	90.009	90.008	90.009	90.010	90.009	64.706	90.015	90.015	90.015	90.016	-	-
Maximum wave period.....Tmax :	90.161	89.863	89.878	89.888	89.689	89.901	89.766	89.541	89.802	89.861	89.968	-	-
Number of waves.....:	611	611	611	611	611	610	850	610	610	610	610	-	-
Mean water level.....MWL :	-0.1405	-0.1525	-0.1038	-0.1146	-0.0896	-0.135	-0.4339	0.5644	0.6361	0.6892	0.7288	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	65379	63802	66000	69791	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	63.710	61858	64367	67737	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	66173	64.726	67076	71404	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	66.659	66.823	67.664	72614	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-41.978	-38.149	-35.765	-36065	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-40177	-36742	-34193	-33.618	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-42892	-39110	-36783	-38458	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-44223	-40146	-37445	-41.118	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	610	610	610	610	-	-

Analysis performed: 08-09-99 16:13:42													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER													
Laboratory.....:	AAU												
Filename raw data.....:	Z079.dat												
Testname.....:	Z079												
Data scale.....:	1:1												
Date and time.....:	3-17-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	5												
Target peak period (Tp).....[sec]:	9												
Target Spectrum.....:	Regular												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0.016062	(32.0 l/ 16 min. I lab.)											
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	143.948												
Total reflection at wave gauge group B...:	214.014												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	43530	39970	31699	44045	41697	29271	0.3792	134330	127400	121546	118098	32899	30187
First moment.....m1 :	0.5038	0.4559	0.366	0.5249	0.4985	0.3599	0.0791	15712	14911	14310	14101	0.3774	0.3651
Second moment.....m2 :	0.0597	0.0525	0.0433	0.0657	0.063	0.0478	0.019	0.1933	0.1841	0.1781	0.1795	0.044	0.0468
Wave height.....Hm0 :	83455	79970	71217	83947	81679	68436	24630	146604	142772	139454	137462	72553	69498
Peak period.....Tp :	88.276	88.276	88.276	88.276	88.276	88.276	44522	88.276	88.276	88.276	88.276	88.276	88276
Average wave period.....T01 :	86.400	87.681	86.602	83.908	83.651	81.339	47.942	85.494	85.438	84.940	83.752	87.172	82.682
Deep water wave length.....L0 :	1.165.500	1.200.330	1.170.960	1.099.260	1.092.510	1.032.980	358.856	1.141.190	1.139.710	1.126.460	1.095.160	1.186.430	1.067.360
Surf similarity parameter.....SSPop.:	28.747	29.802	31.192	27.836	28.133	29.886	29.362	21.462	21.734	21.862	21.712	31.107	30.146
No. of waves (Duration/T01).....:	635	626	633	654	656	674	1.144	642	642	646	655	629	663
Spectral width.....:	0.1565	0.0979	0.1536	0.2252	0.2375	0.2827	0.39	0.2279	0.2339	0.239	0.2571	0.1234	0.2449
Groupiness factor.....:	0.228	0.1475	0.212	0.3346	0.3424	0.4317	11769	0.2504	0.2599	0.2853	0.3338	0	0
Significant wave height.....Hs :	63.189	59.978	53.300	63.956	62.466	54.781	25.953	100607	98865	95611	99730	-	-
Average wave height.....Hmean :	61.507	58.280	51.921	62.687	61.428	53.737	15360	97.631	96.407	92.611	95.564	-	-
Maximum wave height.....Hmax :	64651	61784	54971	66440	64520	56813	42226	105970	103.106	101152	107235	-	-
Significant wave period.....Ts :	89.981	89.969	89.981	89.985	89.958	89.985	66.264	89.956	89.984	90.050	90.063	-	-
Average wave period.....Tmean :	90.009	90.009	90.007	90.010	90.007	90.008	49.113	90.007	90.007	90.008	90.009	-	-
Maximum wave period.....Tmax :	90.078	90.186	90.142	90.064	89.951	90.005	53.668	90.208	89.018	90.577	90.684	-	-
Number of waves.....:	608	608	608	608	609	609	1.116	609	609	609	609	-	-
Mean water level.....MWL :	-0.1553	-0.1934	-0.1529	-0.1276	-0.1088	-0.1701	-0.4408	0.8889	10110	10343	10290	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	63308	62519	63165	65740	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	61.876	61081	61478	62925	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	64467	63.530	64348	68444	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	65.507	64.824	65.101	69780	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-38.100	-37.115	-33.301	-35366	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-35751	-35325	-31129	-32.632	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-39890	-38279	-35463	-37815	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-42674	-40987	-37827	-41.434	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	609	609	609	609	-	-

Analysis performed: 08-09-99 16:14:15													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z080.dat												
Testname.....:	Z080												
Data scale.....:	1:1												
Date and time.....:	8-17-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	5												
Target peak period (Tp).....[sec]:	7												
Target Spectrum.....:	Regular												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0												
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	184.834												
Total reflection at wave gauge group B...:	231.081												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	20987	22729	19318	20284	11131	17090	11960	80009	66441	66453	72945	17626	18732
First moment.....m1 :	0.325	0.3346	0.2838	0.309	0.1677	0.2525	0.1986	11821	0.9808	0.9903	11181	0.2611	0.276
Second moment.....m2 :	0.0533	0.0504	0.0424	0.0494	0.0264	0.0382	0.0367	0.1796	0.1487	0.1518	0.1808	0.0396	0.0414
Wave height.....Hm0 :	57948	60305	55596	56969	42202	52291	43745	113143	103105	103114	108034	53106	54746
Peak period.....Tp :	69.189	69.189	69.189	69.189	69.189	69.189	69189	69.189	69.189	69.189	69.189	69.189	69189
Average wave period.....T01 :	64.576	67.922	68.080	65.651	66.360	67.691	60.212	67.683	67.745	67.105	65.240	67.500	67.861
Deep water wave length.....L0 :	651.079	720.300	723.642	672.940	687.555	715.399	566.052	715.240	716.544	703.062	664.534	711.380	718.992
Surf similarity parameter.....SSPop.:	25.784	26.585	27.752	26.438	31.049	28.452	27.671	19.341	20.279	20.086	19.078	28.154	27.877
No. of waves (Duration/T01).....:	900	856	854	885	876	859	965	859	858	866	891	861	856
Spectral width.....:	0.2438	0.1507	0.1353	0.2223	0.2063	0.1549	0.3349	0.1684	0.164	0.1686	0.2339	0.1498	0.1365
Groupiness factor.....:	0.3713	0.1741	0.1648	0.3257	0.2772	0.1967	0.5389	0.1876	0.1847	0.2496	0.3428	0	0
Significant wave height.....Hs :	43.581	46.683	40.330	42.482	33.390	41.033	35.581	87626	80695	78048	82721	-	-
Average wave height.....Hmean :	42.434	45.268	39.224	40.761	32.396	39.509	33581	85.674	77.969	75.448	79.781	-	-
Maximum wave height.....Hmax :	45357	48685	41685	44665	34932	42914	38572	91634	86.244	82354	86589	-	-
Significant wave period.....Ts :	69.996	69.994	69.999	70.005	69.964	70.015	70.009	70.019	70.028	69.996	70.064	-	-
Average wave period.....Tmean :	70.005	70.007	70.008	70.007	70.009	70.009	70.012	70.011	70.012	70.012	70.012	-	-
Maximum wave period.....Tmax :	69.966	69.961	69.871	69.906	69.924	69.673	69.614	70.508	69.477	70.043	69.946	-	-
Number of waves.....:	829	829	828	829	829	829	828	829	829	829	829	-	-
Mean water level.....MWL :	-0.1139	-0.1332	-0.1264	-0.1466	-0.1935	-0.1699	-0.1871	0.423	0.3931	0.5771	0.7839	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	53102	48618	52172	58940	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	51.916	46983	50488	56837	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	53917	49.890	53141	60302	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	55.249	51.080	53.796	61894	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-35.338	-32.546	-26.414	-24707	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-33757	-30985	-24960	-22.944	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-37046	-33968	-27760	-25835	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-38222	-35643	-29773	-26.540	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	829	829	829	829	-	-

Analysis performed: 08-09-99 16:14:45													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z081.dat												
Testname.....:	Z081												
Data scale.....:	1:1												
Date and time.....:	8-17-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	5												
Target peak period (Tp).....[sec]:	8												
Target Spectrum.....:	Regular												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0												
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	293.717												
Total reflection at wave gauge group B...:	244.988												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	35041	31089	16849	24816	14997	12323	0.7834	95762	71368	73182	83296	21003	19543
First moment.....m1 :	0.4491	0.4027	0.2264	0.3217	0.1921	0.1649	0.1294	12326	0.9211	0.9498	11005	0.2703	0.2494
Second moment.....m2 :	0.0582	0.0532	0.0321	0.0426	0.0249	0.0232	0.0245	0.1613	0.1216	0.126	0.1511	0.0353	0.0321
Wave height.....Hm0 :	74877	70528	51921	63013	48984	44403	35405	123782	106859	108208	115444	57969	55919
Peak period.....Tp :	78.769	78.769	78.769	78.769	78.769	78.769	78769	78.769	78.769	78.769	78.769	78.769	78769
Average wave period.....T01 :	78.032	77.208	74.432	77.153	78.063	74.735	60.562	77.689	77.481	77.051	75.686	77.704	78.351
Deep water wave length.....L0 :	950.684	930.711	864.979	929.387	951.438	872.040	572.645	942.353	937.305	926.924	894.373	942.715	958.474
Surf similarity parameter.....SSPop.:	27.409	27.944	31.397	29.542	33.901	34.089	30.936	21.224	22.782	22.514	21.411	31.020	31.847
No. of waves (Duration/T01).....:	745	753	781	753	745	778	960	748	750	754	768	748	742
Spectral width.....:	0.1088	0.1406	0.2357	0.1476	0.1043	0.2282	0.3834	0.1295	0.1503	0.1491	0.1974	0.1193	0.0844
Groupiness factor.....:	0.1356	0.2039	0.3359	0.1978	0.1391	0.3348	0.7256	0.1697	0.181	0.2289	0.2945	0	0
Significant wave height.....Hs :	55.887	52.409	40.140	45.270	36.712	33.678	30.837	93269	82660	81982	90230	-	-
Average wave height.....Hmean :	53.976	51.465	39.364	44.268	35.420	32.759	27265	90.417	79.724	78.986	86.185	-	-
Maximum wave height.....Hmax :	58807	54308	42059	47176	38098	34823	35044	97118	86.064	85323	94983	-	-
Significant wave period.....Ts :	80.002	79.995	79.984	79.979	79.997	80.007	79.940	79.982	79.998	79.983	79.951	-	-
Average wave period.....Tmean :	80.007	80.006	80.006	80.007	80.007	80.008	73.702	80.010	80.009	80.008	80.008	-	-
Maximum wave period.....Tmax :	79.991	79.817	80.000	79.938	79.838	79.849	80.010	79.917	79.569	80.039	79.800	-	-
Number of waves.....:	725	726	726	725	725	725	787	726	726	726	726	-	-
Mean water level.....MWL :	-0.1192	-0.1507	-0.1663	-0.1478	-0.1984	-0.21	-0.3167	0.303	0.2858	0.3873	0.5015	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	55173	49500	52029	57798	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	53.418	47164	49863	55005	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	56363	50.758	53713	59739	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	57.333	51.555	54.705	60876	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-38.707	-33.721	-30.478	-33083	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-36998	-32559	-29123	-31.180	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-39692	-34714	-31563	-34112	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-40867	-37450	-32341	-35.541	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	726	726	726	726	-	-

Analysis performed: 08-09-99 16:15:12													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z082.dat												
Testname.....:	Z082												
Data scale.....:	1:1												
Date and time.....:	8-17-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	5												
Target peak period (Tp).....[sec]:	9												
Target Spectrum.....:	Regular												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0.0048438	(9.65 1/16 min. I lab.)											
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	175.595												
Total reflection at wave gauge group B...:	262.596												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	24785	25570	23014	28668	30507	22258	0.5809	138540	122876	123369	128410	19083	19171
First moment.....m1 :	0.2842	0.2918	0.2666	0.3318	0.3552	0.2581	0.1059	15983	14134	14215	14902	0.2186	0.2224
Second moment.....m2 :	0.0332	0.0337	0.0317	0.0393	0.0425	0.0308	0.0226	0.1891	0.1662	0.1671	0.1774	0.0254	0.0264
Wave height.....Hm0 :	62973	63963	60682	67727	69865	59676	30487	148884	140215	140496	143337	55256	55384
Peak period.....Tp :	88.276	88.276	88.276	88.276	88.276	88.276	88276	88.276	88.276	88.276	88.276	88.276	88276
Average wave period.....T01 :	87.196	87.638	86.324	86.408	85.898	86.243	54.860	86.680	86.934	86.789	86.168	87.313	86.211
Deep water wave length.....L0 :	1.187.070	1.199.150	1.163.460	1.165.720	1.152.000	1.161.270	469.888	1.173.080	1.179.970	1.176.040	1.159.260	1.190.260	1.160.420
Surf similarity parameter.....SSPop.:	33.398	33.306	33.682	31.913	31.236	33.933	30.199	21.592	22.315	22.255	21.876	35.702	35.211
No. of waves (Duration/T01).....:	667	663	673	673	677	674	1.059	671	669	670	674	666	674
Spectral width.....:	0.1317	0.1133	0.1601	0.1518	0.1704	0.1706	0.4162	0.1606	0.1488	0.1422	0.1604	0.1176	0.1594
Groupiness factor.....:	0.1755	0.1296	0.2199	0.2215	0.2475	0.2191	0.9605	0.1857	0.1765	0.1911	0.2318	0	0
Significant wave height.....Hs :	48.551	48.726	43.810	49.905	53.167	46.200	27.462	106089	100256	100276	104770	-	-
Average wave height.....Hmean :	47.313	47.981	43.088	48.950	52.087	45.407	20842	104.761	98.790	99.047	102.176	-	-
Maximum wave height.....Hmax :	50215	49928	45099	51257	54680	47543	30958	108596	103.398	102318	108851	-	-
Significant wave period.....Ts :	89.999	89.992	89.989	89.985	90.010	89.980	79.784	89.931	89.958	89.997	89.955	-	-
Average wave period.....Tmean :	90.009	90.007	90.008	90.008	90.008	90.009	61.605	90.014	90.014	90.014	90.013	-	-
Maximum wave period.....Tmax :	89.609	89.917	89.890	89.874	90.422	90.005	88.589	89.751	89.469	90.242	90.178	-	-
Number of waves.....:	644	644	644	645	645	645	941	645	645	645	645	-	-
Mean water level.....MWL :	-0.1928	-0.199	-0.1737	-0.1677	-0.1401	-0.1833	-0.4604	0.5582	0.5783	0.6818	0.7889	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	65295	62710	65511	70233	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	63.735	61364	64396	68558	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	66459	63.958	66470	71595	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	67.549	65.291	67.461	73264	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-42.433	-38.773	-35.867	-35643	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-41026	-37427	-34651	-33.618	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-43359	-39646	-36591	-37429	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-44132	-40382	-37230	-38.720	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	645	645	645	645	-	-

Analysis performed: 08-09-99 16:15:40													
PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z083.dat												
Testname.....:	Z083												
Data scale.....:	1:1												
Date and time.....:	8-18-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	5												
Target peak period (Tp).....[sec]:	10												
Target Spectrum.....:	Regular												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	0.01197148	(23.85 l/16 min. I lab.)											
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	277.016												
Total reflection at wave gauge group B...:	258.553												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	11726	12271	22845	17218	14070	20714	0.5976	114844	96252	96013	101366	20502	25134
First moment.....m1 :	0.136	0.1352	0.2426	0.1875	0.1553	0.2286	0.1226	12400	10512	10503	11190	0.2198	0.2684
Second moment.....m2 :	0.0173	0.016	0.0268	0.0217	0.0185	0.027	0.0287	0.1417	0.1234	0.1226	0.1322	0.0247	0.03
Wave height.....Hm0 :	43314	44309	60459	52486	47447	57569	30922	135555	124098	123944	127352	57274	63415
Peak period.....Tp :	98.462	98.462	98.462	98.462	98.462	98.462	49709	98.462	98.462	98.462	98.462	98.462	98462
Average wave period.....T01 :	86.209	90.766	94.173	91.810	90.617	90.628	48.726	92.619	91.562	91.418	90.586	93.273	93.629
Deep water wave length.....L0 :	1.160.360	1.286.280	1.384.670	1.316.040	1.282.070	1.282.380	370.691	1.339.330	1.308.950	1.304.610	1.281.170	1.358.330	1.368.690
Surf similarity parameter.....SSPop.:	39.814	41.446	36.813	38.518	39.986	36.305	26.633	24.179	24.982	24.958	24.398	37.461	35.737
No. of waves (Duration/T01).....:	674	640	617	633	641	641	1.193	628	635	636	642	623	621
Spectral width.....:	0.3142	0.2696	0.2017	0.2509	0.2817	0.2663	0.3758	0.2412	0.2738	0.2597	0.2652	0.2201	0.2155
Groupiness factor.....:	0.5223	0.4131	0.2893	0.3779	0.408	0.4085	12157	0.3309	0.3447	0.384	0.4342	0	0
Significant wave height.....Hs :	32.972	35.304	45.535	40.428	36.328	46.496	34.258	97361	90506	90426	98193	-	-
Average wave height.....Hmean :	32.092	34.379	44.488	39.417	35.495	44.939	18475	94.977	87.609	87.031	93.945	-	-
Maximum wave height.....Hmax :	34388	36843	47309	42059	38248	49565	41953	102138	97.617	96672	106919	-	-
Significant wave period.....Ts :	99.972	99.977	99.982	99.981	99.968	100.001	58.738	99.962	99.969	100.025	100.047	-	-
Average wave period.....Tmean :	100.003	100.007	100.006	100.003	100.003	100.004	50.004	100.016	100.017	100.017	100.016	-	-
Maximum wave period.....Tmax :	99.360	99.085	99.803	100.371	99.439	100.604	53.501	100.408	99.721	99.694	99.917	-	-
Number of waves.....:	580	580	580	580	580	580	1.160	579	579	579	579	-	-
Mean water level.....MWL :	-0.3336	-0.3354	-0.2864	-0.3455	-0.352	-0.3298	-0.4439	0.2373	0.2527	0.3446	0.4402	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	64142	60056	63248	68307	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	62.151	57437	60297	64641	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	66238	62.947	66593	71766	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	67.725	64.573	67.496	75587	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-34.052	-31.500	-28.091	-31127	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-32826	-30172	-26734	-29.305	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-35259	-32621	-29431	-32483	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-36051	-34641	-30123	-33.537	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	579	579	579	579	-	-

PROTOTYPE DATAFILE FOR LABORATORY TESTS WITH THE ZEEBRUGGE BREAKWATER 1999													
Laboratory.....:	AAU												
Filename raw data.....:	Z084.dat												
Testname.....:	Z084												
Data scale.....:	1:1												
Date and time.....:	8-18-19 0:00												
Breakwater slope 1/tan(alpha).....:	1.3												
Water depth above berm (dberm).....[m]:	5												
Crest height above seabed.....[m]:	17												
Crest freeboard (Rc).....[m]:	9.4												
Width of armour berm at crest (Gc)....[m]:	6												
Target wave height (Hs).....[m]:	5												
Target peak period (Tp).....[sec]:	11												
Target Spectrum.....:	Regular												
Target peak enhancement factor (gamma)...:	3.3												
Target Water level (Z-level).....[m]:	3												
Target Current.....[m/s]:	0												
Target wave direction.....[deg]:	0												
Target spreading.....[deg]:	0												
Measured mean overtopping rate...[m3/s/m]:	1.20E-02	(0.0 1/16 min. I lab)											
Distance from slope to Zr3.....[m]:	0.08												
Distance from slope to Zr2.....[m]:	0.2												
Distance from slope to Zr1.....[m]:	0.4												
Water depth at Ze1.....[m]:	16.4												
Water depth at Ze4.....[m]:	14.9												
Distance from Ze1 to Ze2.....[m]:	6												
Distance from Ze1 to Ze3.....[m]:	15												
Distance from Ze4 to Ze5.....[m]:	6												
Distance from Ze4 to Ze6.....[m]:	15												
CALCULATED RESULTS:													
Sample frequency.....:	20.000												
Total reflection at wave gauge group A...:	186.953												
Total reflection at wave gauge group B...:	174.035												
Parameter.....:	Ze1	Ze2	Ze3	Ze4	Ze5	Ze6	Ze7	RU1	RU2	RU3	XRU	INA	INB
Zero moment.....m0 :	44112	40997	33453	40839	45940	50687	0.4871	66250	62658	57656	53564	31176	37282
First moment.....m1 :	0.4426	0.4091	0.3368	0.405	0.4464	0.4921	0.0925	0.6806	0.6397	0.5961	0.5648	0.3156	0.3653
Second moment.....m2 :	0.0475	0.0437	0.0364	0.0427	0.0452	0.0498	0.0203	0.0759	0.0708	0.0674	0.066	0.0343	0.0375
Wave height.....Hm0 :	84011	80991	73161	80835	85735	90055	27918	102956	100126	96047	92575	70627	77235
Peak period.....Tp :	106.667	106.667	106.667	106.667	106.667	106.667	54468	106.667	106.667	106.667	106.667	106.667	106667
Average wave period.....T01 :	99.660	100.222	99.320	100.842	102.923	102.999	52.653	97.347	97.946	96.722	94.834	98.794	102.071
Deep water wave length.....L0 :	1.550.720	1.568.250	1.540.150	1.587.710	1.653.930	1.656.350	432.844	1.479.570	1.497.820	1.460.640	1.404.150	1.523.880	1.626.660
Surf similarity parameter.....SSPop.:	33.049	33.849	35.294	34.091	33.786	32.990	30.289	29.161	29.752	29.998	29.958	35.731	35.302
No. of waves (Duration/T01).....:	583	580	585	576	565	564	1.104	597	593	601	613	588	569
Spectral width.....:	0.2644	0.2663	0.2724	0.2499	0.2057	0.2053	0.3939	0.2919	0.2906	0.3069	0.3285	0.2717	0.2187
Groupiness factor.....:	0.4105	0.3938	0.4177	0.3756	0.3096	0.3072	11050	0.4638	0.4456	0.483	0.5469	0	0
Significant wave height.....Hs :	64.854	62.414	57.301	62.280	64.258	67.300	30.323	77212	74979	70498	69684	-	-
Average wave height.....Hmean :	64.031	61.670	56.275	61.294	63.384	66.421	17762	74.898	72.908	68.494	66.619	-	-
Maximum wave height.....Hmax :	66771	63706	58813	64365	65950	68894	35827	81741	77.570	73689	76273	-	-
Significant wave period.....Ts :	109.982	109.962	110.001	109.974	109.984	110.010	60.310	110.168	109.925	109.846	109.790	-	-
Average wave period.....Tmean :	110.007	110.007	110.011	110.006	110.010	110.009	54.634	110.008	110.005	110.006	110.008	-	-
Maximum wave period.....Tmax :	110.076	110.195	110.375	109.353	109.992	109.724	55.012	112.544	109.990	109.629	110.883	-	-
Number of waves.....:	527	527	527	527	527	528	1.062	527	527	527	527	-	-
Mean water level.....MWL :	-0.3098	-0.3359	-0.3407	-0.3397	-0.3109	-0.3036	-0.1852	0.5838	0.5501	0.5972	0.6567	-	-
Significant wave run-up.....RUs :	-	-	-	-	-	-	-	56729	54998	54085	55407	-	-
Average wave run-up.....RUmean :	-	-	-	-	-	-	-	54.871	53171	52023	52274	-	-
2% wave run-up.....RU02 :	-	-	-	-	-	-	-	57821	55.992	55339	57624	-	-
Maximum wave run-up.....RUmax :	-	-	-	-	-	-	-	59.464	57.981	56.448	59959	-	-
Significant wave run-down.....RDs :	-	-	-	-	-	-	-	-21.851	-21.156	-17.663	-15695	-	-
Average wave run-down.....RDmean :	-	-	-	-	-	-	-	-20027	-19737	-16471	-14.345	-	-
2% wave run-down.....RD02 :	-	-	-	-	-	-	-	-23146	-22095	-18574	-16838	-	-
Maximum wave run-down.....RDmax :	-	-	-	-	-	-	-	-24753	-22581	-19421	-19.358	-	-
Number of waves (Runup).....:	-	-	-	-	-	-	-	527	527	527	527	-	-