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CREST LEVEL ASSESSMENT OF
COASTAL STRUCTURES BY
FULL-SCALE MONITORING,
NEURAL NETWORK PREDICTION
AND HAZARD ANALYSIS
ON PERMISSIBLE WAVE OVERTOPPING

CLASH

EVK3-CT-2001-00058

REPORT

Workpackage 4

Laboratory measurements on the Zeebrugge breakwater

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1 Introduction

The international CLASH project of the European Union (Crest Level Assessment of coastal Structures by full scale monitoring, neural network prediction and Hazard analysis on permissible wave overtopping, www.clash-eu.org) under contract no. EVK3-CT-2001-00058 is focussing on wave overtopping for different structures in prototype and in laboratory. The main scientific objectives of CLASH are (i) to solve the problem of possible scale effects for wave overtopping and (ii) to produce a generic prediction method for crest height design or assessment. Therefore, wave overtopping events are measured at three coastal sites in Europe, namely at (i) the Zeebrugge rubble mound breakwater (Belgium), (ii) a rubble mound breakwater protecting a marina in Ostia (Italy) and (iii) a seawall in Samphire Hoe (United Kingdom). Those measured storm events had been simulated by laboratory tests and / or by numerical modelling and had been compared with the actual measured events. This led to conclusions on scale effects and how to deal with these effects. Workpackage 4 of CLASH is aiming at the performance of model tests of these breakwaters. Partners in WP4 had performed both reproduction tests from observed storms in prototype and parametric tests to support analysis of the former and to give additional data for the database of CLASH.

Within WP4 laboratory investigations for the Zeebrugge rubble mound breakwater have started in the wave flume of Leichtweiß-Institute for Hydraulic Engineering of the Technical University of Braunschweig (hereafter LWI) and in the wave flume of the Universidad Politécnica de Valencia (hereafter UPVLC). In order to check any influence that is typical for laboratory measurements and to identify possible causes for differences in results, identical tests will be carried out in the two laboratories (LWI and UPLVC).

This report describes the laboratory facilities at LWI and UPVLC and the results of LWI and UPVLC parametric tests as well as the UPVLC and LWI reproduction of storms and tests with wind conditions. The results of these tests will already give an indication for (i) scale effects to be expected; (ii) differences of various types of measurement techniques; (iii) model effects; (iv) relative importance of analysis methods and (v) wind effects; and (vi) magnitude of forces on persons induced by overtopping waves (hazards).

In chapter 2 the background of the work within Workpackage 4 of CLASH is explained whereas chapter 3 summarises the previous research on the issues which are dealt with in this report. To obtain the aforementioned objectives the wave flume and the measuring devices for model investigations at LWI and UPVLC are described in chapter 4. The test programme for the Zeebrugge breakwater as it will be used for this analysis is given in chapter 5 both for LWI and UPVLC. Chapter 6 discusses the analysis and the results of the tests performed so far and compares these results with previous analyses from earlier OPTICREST tests at UPLVC and first prototype overtopping data provided by UGent. Chapter 7 summarises the findings and gives an overview of future work to be done.

2 Background of project

2.1 Introduction

One of the major objectives of the CLASH project is to find and guide on possible scale effects between model and prototype measurements of wave overtopping. For this purpose small-scale and large-scale model investigations have been performed for three different structures in Europe one of which is the Zeebrugge rubble mound breakwater. The experience for the Zeebrugge breakwater goes however back to the previous EU funded research project OPTICREST (Optimisation of Crest Level Design of Sloping Coastal Structures Through Prototype Monitoring and Modelling, MAS3-CT97-0116-002), see De Rouck et al. (2001), where wave run-up was investigated. The background of this research together with available information is briefly described in the following.

UPVLC performed run-up and overtopping laboratory tests on a Zeebrugge breakwater model "section jetty" during the OPTICREST project. The 1:30 scale model of the NW Zeebrugge breakwater was built in the UPVLC Wind and Wave Test Facility to examine the effects of onshore wind under regular and irregular wave action. Tests reproducing two storms measured in the prototype were conducted under windless conditions and the results were compared to the full scale measurements and the results of other laboratories.

During OPTICREST, 234 experiments were carried out (regular and irregular tests corresponding to the test matrix, some additional regular and irregular tests and two prototype measured storms). Wind velocities of 0, 3, 5 and 7 m/s were considered in the OPTICREST tests, see Medina et al. (2001). A summary of the different tests and variability of the parameters considered is given in Table 1.

Table 1: OPTICREST wave flume tests on wave run-up and overtopping

MONOCHROMATIC WAVES (110 tests)		
Water level (m)	Wave height (m)	Period (s)
3 to 5	2 to 6	5.6 to 11

IRREGULAR WAVES (114 tests)				
Water level (m)	Wave height (m)	Period (s)	Spectrum	γ
3, 4, 5	2 to 7	5 to 11	JONSWAP	1 3.3 7

PROTOTYPE STORMS (10)		
Water level (m)	Wave height (m)	Period (s)
3 to 5.3	3 to 4.5	5.5 to 6.5

During the experiments of OPTICREST, not only run-up but also overtopping rates were measured. The parametric study generated enough overtopping measurements as to propose a NN model and an empirical formula which was presented in Medina et al. (2002). The OPTICREST physical model constructed by UPVLC ("jetty section") was that corresponding to the section in which the run-up prototype measurement systems were located in the Zeebrugge breakwater, while prototype overtopping rates were measured in a different section ("tank section").

CLASH is focused on wave overtopping rather than wave run-up. Therefore, the section in which the overtopping measurement system is located ("tank section") has been scaled. Also the positioning of the armour elements has been taken into consideration during the CLASH experiments. However, the CLASH experimental set-up at both institutes (LWI and UPVLC) follows as close as possible the methodology used during OPTICREST. Some changes of the characteristics of the cross section and positioning of armour elements has been considered to adapt the new physical model to the characteristics of the place in which the prototype overtopping measurement system is located ("tank section"). The test matrix (parametric tests) used for the CLASH experiments has some coincidences with the test matrix used during OPTICREST in order to verify the influence of cross section and positioning of armour elements on overtopping (see chapter 5).

2.2 Zeebrugge rubble mound breakwater

The Zeebrugge breakwater is a conventional rubble mound breakwater with a relatively low-crested superstructure. Figure 1 shows the Zeebrugge breakwater with the overtopping section.

The armour layer consists of grooved (Antifer) concrete cubes (25 t). The breakwater core consists of quarry run (2-300 kg). The filter layer is composed of rock (1-3 t). Design conditions for the breakwater are: return period R_p = 1:500 years, significant wave height H_s = 6.20 m, period T_p = 9.0 s and design water level DWL = Z + 6.75 m (Z + 0.00 m is chart datum). The cross section at the location of the overtopping measurements is shown in Figure 2. An overall plan view of the location of wave and overtopping measurements is shown in Figure 3.

Wave characteristics are measured by 2 wave rider buoys, one is directional, at respective distances of 150 m and 215 m from the breakwater. The water level just in front of the breakwater is determined by an infrared wave height meter placed on a measurement jetty as described in Troch et al. (1998). Waves overtopping the breakwater's crest are captured in a concrete overtopping tank (Figure 4) with dimensions 7.4 m / 2.0 m / 2.0 m (length/width/height). The volume of overtopping water is determined by continuous water level measurements by pressure transducers at the bottom of the tank. Outflow of the tank is controlled by a calibrated weir. The water level measurements and the weir's calibration formula allow calculating overtopping discharges.

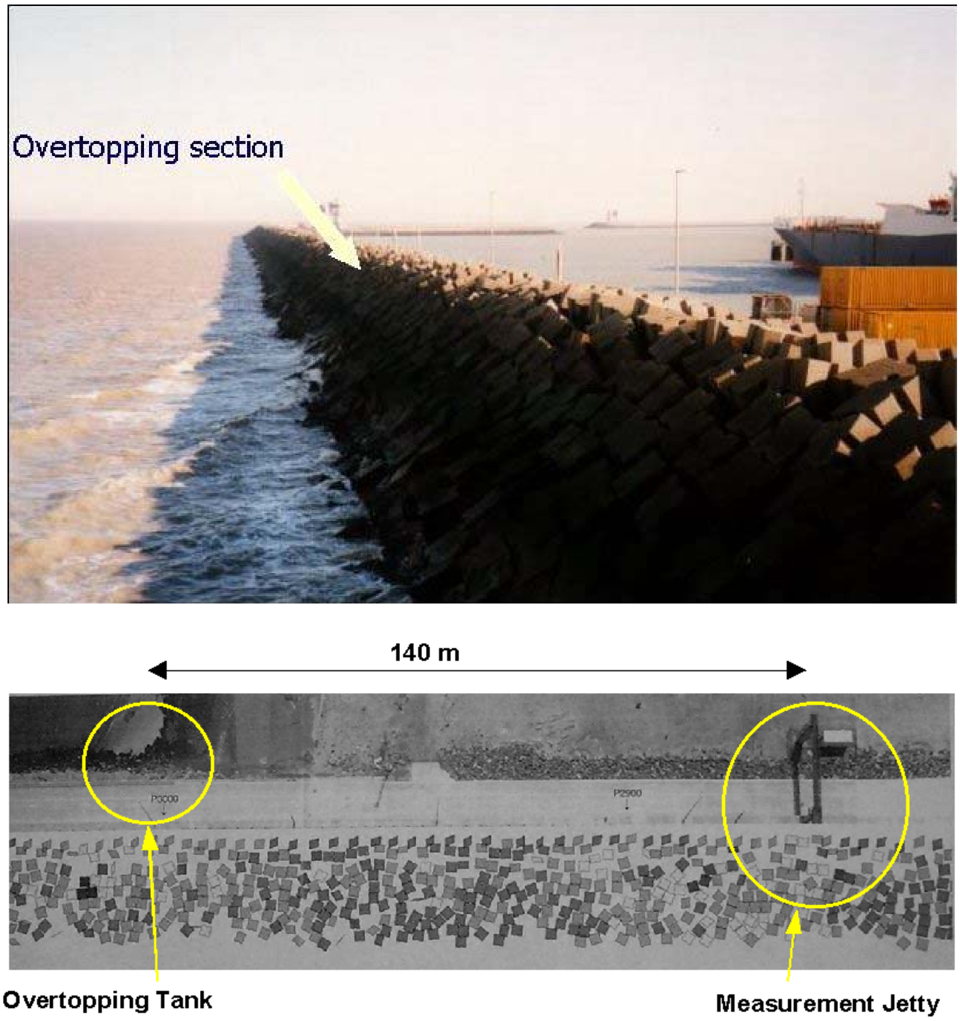


Figure 1: The Zeebrugge breakwater (above: overview looking to the sea, below: top view of measurement jetty and overtopping tank section)

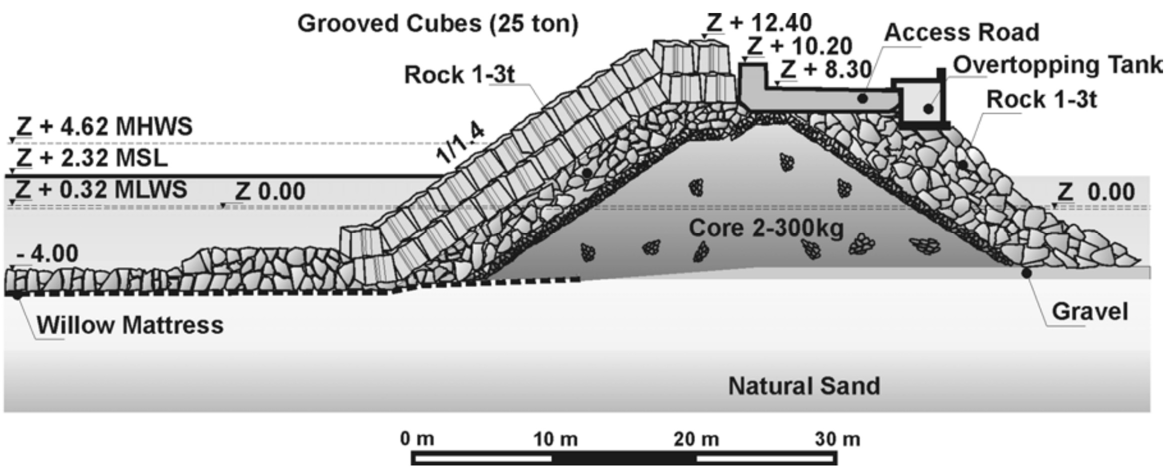


Figure 2: Cross section of Zeebrugge rubble mound breakwater, Troch et al. (2004)

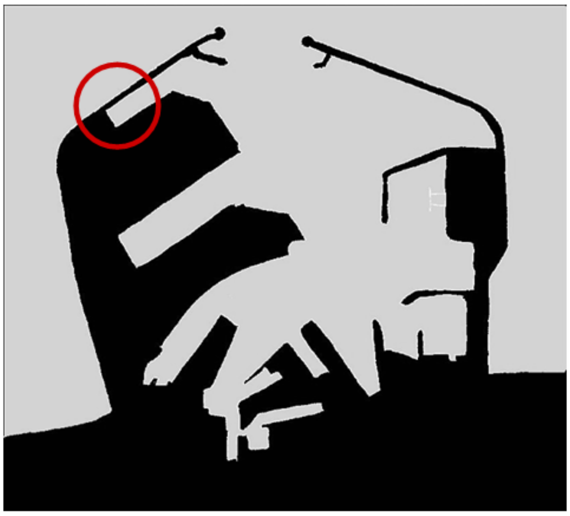


Figure 3: Layout of Zeebrugge harbour

Figure 4: Overtopping container behind crest

For measuring the forces on persons three dummies were installed on the crown wall of the breakwater as shown in Figure 5. Two of these dummies are located directly on top of the crown wall behind the Antifer cubes whereas the third dummy is located behind the access road. All dummies are equipped with load sensors which measure positive and negative forces up to 1000 kg each. For more details on the measurements and calculations see Geeraerts et al. (2003) and Geeraerts & Boone (2004).

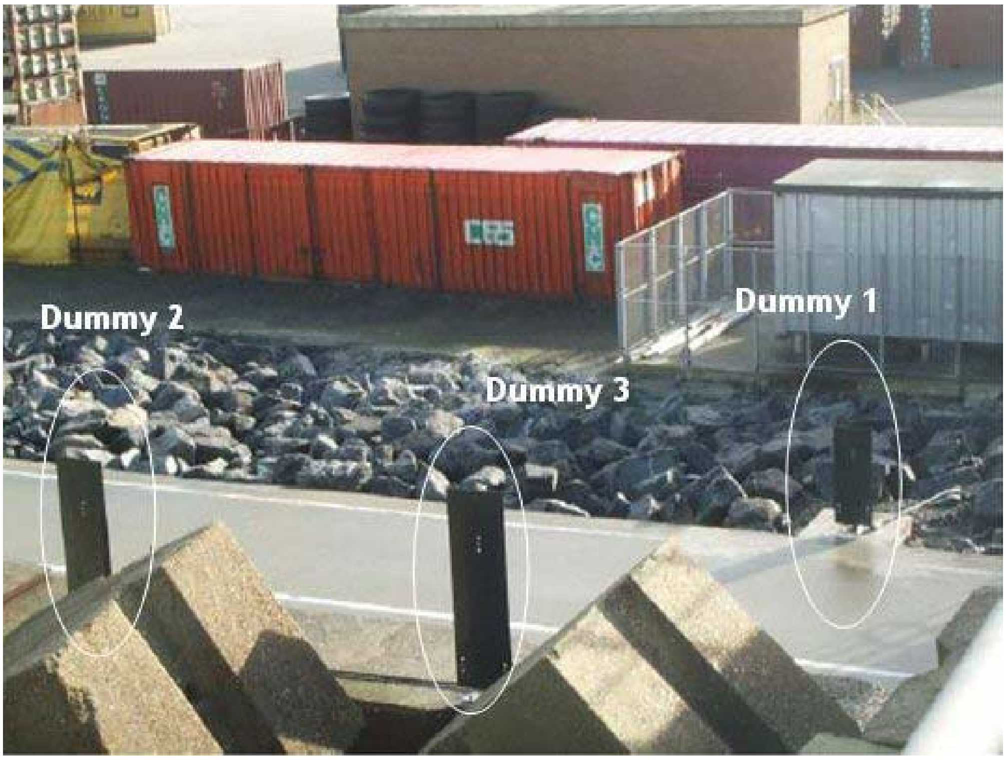


Figure 5: Position of dummies on the crown wall of the Zeebrugge breakwater adopted from N.N. (2003)

2.3 Prototype storms

From 1999 to mid 2004, 11 storm events with wave overtopping have been measured at Zeebrugge. Wave heights H_{m0} vary between 2.60 m and 3.86 m, while wave periods T_p range between 7.3 s and 10.3 s. Crest freeboards A_c vary between 4.9 and 6.0 m. Characteristics for the storm with the highest measured average overtopping rate, q = 0.86 l/s/m, were H_{m0} = 3.86 m, T_p = 8.6 s and A_c = 7.42 m. Full scale measurement data including detailed analysis of these data are found in Geeraerts & Boone (2004). Comparison of full scale data to literature prediction formulas are presented and discussed in detail in Troch et al. (2004). Table 2 gives an overview of these storms together with the measured mean overtopping discharges.

Table 2: Overview of storms with overtopping measurements at Zeebrugge

Date	Time	MWL (Z+…) [m]	H_{m0} [m]	$T_{m-1,0}$ [s]	A_c [m]	A_c/H_{m0} [-]	q [$m^3/(s\cdot m)$]
6.11.1999	11:30-13:30h	5,28	3,04	6,88	6,74	2,217	5,709E-05
7.11.1999	23:45-01:45h	5,11	2,60	6,93	6,91	2,658	2,211E-05
8.11.2001	16:15-18:15h	5,01	3,47	8,41	7,01	2,020	3,310E-04
26.2.2002	13:30-14:00h	4,21	2,63	6,49	7,78	2,958	1,010E-05
27.10.2002	17:00-18:00h	4,40	3,74	7,50	7,62	2,037	5,158E-04
27.10.2002	18:00-19:00h	4,60	3,86	7,64	7,42	1,922	8,585E-04
27.10.2002	19:00-20:00h	4,35	3,71	7,98	7,67	2,067	7,036E-04
29.1.2003	10:00-12:00h	4,71	3,16	7,28	7,31	2,313	9,620E-05
7.10.2003	12:00-14:00h	4,77	3,23	7,00	7,25	2,245	8,920E-05
22.12.2003	00:00-02:00h	5,26	3,03	7,33	6,76	2,231	6,680E-05
8.2.2004	14:45-16:45h	5,32	3,59	7,37	6,70	1,866	5,910E-04

3 Previous research

This chapter summarises some achievements in literature or previous projects. The following sections are not complete in the sense of a full literature review but try to highlight the essential information which has been found relevant for the research described in this report. Further reading for the various aspects is however provided.

3.1 Wave run-up

The wave run-up height R_u is defined as the vertical distance from the still water level until the highest point of the wave run-up. Wave run-up is usually generated by the waves breaking in front of the structure. The run-up height is depending on the significant wave height in front of the structure, the steepness of the waves and the reflection properties of the structure itself. Furthermore, the slope angle, the roughness of the slope, and the porosity may have an influence. Wave run-up is strongly linked to wave overtopping; thus it is very essential to summarise the key findings for wave run-up in this section as well. Conclusions for wave run-up may later be used for wave overtopping, too.

3.1.1 Empirical formulas

A large number of wave run-up formulas have been developed over the last years which will not be discussed in detail here. A review of these formulas together with results obtained from the measurements on the Zeebrugge breakwater is given in Van de Walle (2003). In this report wave run-up will only be mentioned in relation to results from previous projects. Therefore, only the formula by Van der Meer (1998) is given here:

$$\frac{R_{u2\%}}{H_s} = 1,6 \cdot \gamma_f \cdot \gamma_\theta \cdot \gamma_b \cdot \xi \qquad (1)$$

with a maximum of

$$\frac{R_{u2\%}}{H_s} = 3,2 \cdot \gamma_f \cdot \gamma_\theta \qquad (2)$$

where $R_{u2\%}$ is the wave run-up height only exceeded by 2% of the waves, H_s is the significant wave height at the toe of the structure, ξ is the Iribarren number and γ are reduction factors accounting for roughness of the slope (γ_f), angle of wave attack (γ_θ) and the influence of berms (γ_b). The formula for the maximum is only valid for non-breaking waves. It should however be noted that this formula has been updated in TAW (2002) using wave parameters from spectral analysis H_{m0} and $T_{m-1,0}$.

For calculating the run-up velocity and the layer thickness of the wave run-up tongue there is only limited information available. In this report the method described in Schüttrumpf (2001) will be used which originally has been developed for sea dikes:

$$v_A = \frac{0.75 \cdot \pi \cdot H_{m0}}{T_{m-1,0}} \cdot \xi \cdot m \cdot \sqrt{\frac{R_{u,2\%} - z_A}{H_{m0}}} \quad \text{[m/s]} \qquad (3)$$

where m is the slope [-]; $R_{u,2\%}$ is the wave run-up height [m]; ξ is the Iribarren number [-]; and z_A is the height above still water level for which the velocity needs to be calculated [m].

The layer thickness of water running up the slope can be calculated according to Schüttrumpf (2001) as follows:

$$h_A = c_2^* \cdot \left(R_{u,2\%} - z_A\right) \quad \text{[m]} \qquad (4)$$

where $c_2{}^* = 0{,}168$ is a factor to yield the mean layer thickness $h_{A,50}$ which is exceeded by 50% of all waves.

3.1.2 OPTICREST results

Within OPTICREST wave run-up tests for Zeebrugge were performed in three different laboratories: Aalborg University (hereafter AAU), Flemish Community Flanders Hydraulics (hereafter FCFH) and UPVLC. All results were plotted using Eq. (1) but for H_{m0} instead of H_s. The analysis resulted in different values for the three laboratories and the prototype investigation (Figure 6).

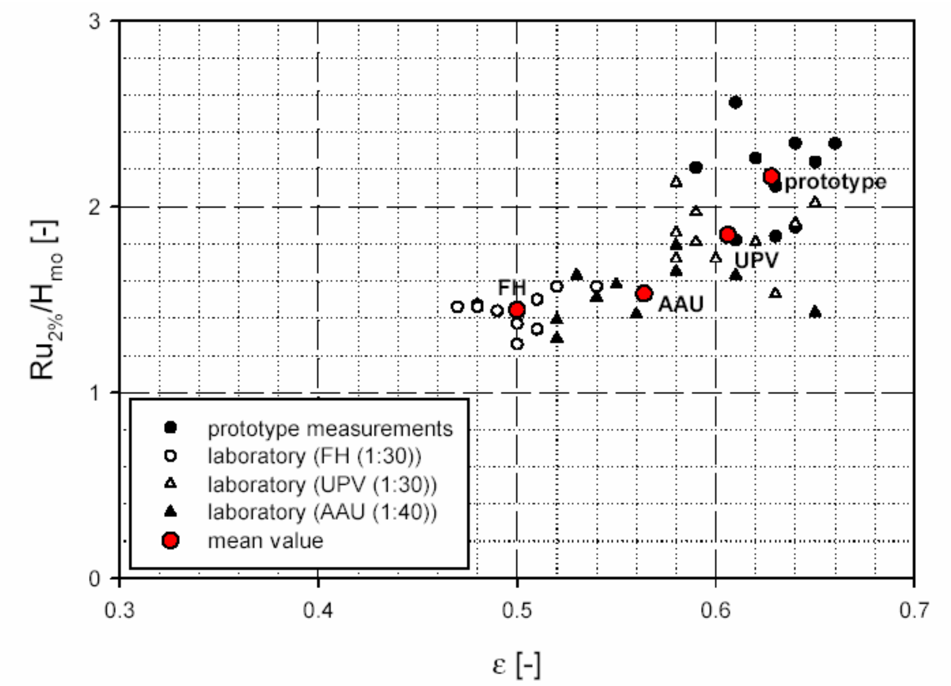


Figure 6: Comparison of small-scale wave run-up tests with prototype investigations after De Rouck et al. (2000)

Results showed that average values varied in between 1.46 (FCFH) to 1.79 (UVPLC) together with a large scatter of the data points around the mean values. Furthermore, the spectral width parameter ε and the wave height H_{m0} were observed to be different in the tests thus resulting in different wave run-up heights. These differences can be due to differences between the spectra in the model and the field which was also observed by Willems & Kofoed (2001) during their tests. The spectral width parameter ε is defined as follows:

$$\varepsilon = \sqrt{1 - \frac{m_2^2}{m_0 \cdot m_4}} \tag{5}$$

Small values of ε characterise a small frequency band like swell waves whereas values of ε which are closer to ε = 1.0 represent a broader frequency band like wind waves. Figure 6 shows that the wave run-up height is increasing with increasing ε values. Further results from the OPTICREST project may be summarised as follows:

- Relative wave run-up heights seemed to be dependent on the water level where increasing water level resulted in lower relative wave run-up heights $R_{u,2\%}/H_{m0}$. A different observation was however made in one of the laboratories so that the conclusions cannot be generalised and may be influenced by other parameters.
- The Antifer cubes of the lower armour layer were placed regularly on the filter layer. It was assumed that sedimentation may have led to a lower porosity in prototype so that wave run-up would be higher. Tests at AAU and FCFH have led to up to 30% higher values of relative wave run-up heights when porosity was decreased in the model by filling sand in the pores. This sand was however washed out during the tests.
- Currents in front of the structure were tested in the 3D basin of AAU where the highest relative wave run-up heights were found for the highest current velocities. This was found to be contradictory to the prototype where lower run-up heights were found for higher water levels.
- The influence of wind was tested in the wind and wave facility of UPVLC where only a small influence of wind on wave run-up was found.
- Differences in between model results may have resulted from different foreshore geometries at FCFH and AAU where the latter have not modelled a bar which is located about 500 m from the breakwater axis in a water depth of approx. 13 m under storm conditions. Due to the large water depth the influence of this bar is however questionable.

The results of measuring wave run-up in both prototype and model have shown that there are a lot of different factors which might have an influence on wave run-up. Additionally, detailed investigations on the influence of the armour layer layout have not taken place in OPTICREST so that at least this key parameter needs further investigation within CLASH. Since all the related processes have not been looked into in much detail within OPTICREST it can be expected that similar problems will occur for wave overtopping investigations and that final conclusion can only be drawn when all these processes are fully understood.

3.2 Wave overtopping

Wave overtopping is defined as the volume of water which flows over the crown of a coastal structure. It is strongly related to wave run-up since wave overtopping only occurs when wave run-up reaches the crown of the structure and therefore exceeds the freeboard R_c.

3.2.1 Empirical formulas

A large number of empirical formulas have been developed over the recent years for different structures and based on different amount of (model) data. A summary of these formulas for different structures is available in Burcharth & Hughes (2002), Environment Agency (1999), and Schüttrumpf (2001). Furthermore, within CLASH a summary of available formulas is provided by González-Escrivá & Medina (2004).

In CLASH the standard wave overtopping formula as suggested by Van der Meer (1998) is widely used for comparing the prototype and model results to. Therefore it will be given as an example here. The relative wave overtopping discharge for non-breaking waves can therefore be calculated according to:

$$\frac{q}{\sqrt{g \cdot H_{m0}^3}} = 0.2 \cdot \exp\left(-2.6 \cdot \frac{R_c}{H_{m0}} \cdot \frac{1}{\gamma_r \cdot \gamma_\theta \cdot \gamma_b}\right) \quad \text{for } \xi_{op} > 2.0 \ [-] \tag{6}$$

where R_c is the crest freeboard (up to the crest of the crown wall) and the γ values are the same as for Eq. (1). Breaking waves can be excluded for the Zeebrugge breakwater due to its steep slope.

3.2.2 OPTICREST results

a) Regular waves

No significant overtopping was observed for any combination of wave heights and periods for water levels +3.0 m and +4.0 m. Wave breaking processes were limiting the waves at the structure. Irregular waves with much less intensity were able to produce significant overtopping rates because specific combinations of wave heights and periods could generate large run-up and overtopping events.

b) Irregular waves and prototype storms

Laboratory and prototype overtopping measurements were analyzed to propose a NN model and an empirical formula presented in Medina et al. (2002). An evolutionary strategy was used to calculate a chain of two pruned NN models able to classify "significant" overtopping events ($q_{prot} > 10^{-4.5}$ m^3/m.s, $Q = q/[g\ H_{m0}^3]^{0.5} > 10^{-5.5}$) and to estimate overtopping discharges. This NN methodology proved to be effective for analysing a small number of data (only 113 cases). Using the complete NN model as a simulator, thousands of virtual tests were obtained from which conventional empirical formulas were obtained.

Using the classical dimensionless overtopping variable $Q = q/[g\ H_{m0}^3]^{0.5}$, an exponential formula agreed with the results using the following dependent variables: R_c/H_{m0} [-], Ir [-], R_c/D_n [-] and U [m/s]. More than 80% of the overtopping estimates have fallen in the half-twice interval of the observed overtopping rates which is not as good as the NN model but very good for most practical applications (Figure 7). The empirical formula given by Eq. (7) was determined using the NN simulations.

$$Q = \frac{q}{\sqrt{gH_{m0}^3}} = \exp\left[-2.8 - 3.4\left(\frac{Rc}{H_{m0}}\right) + 1.8\left(Ir - 4\right) - 0.9\left(\frac{Rc}{Dn} - 3\right) + 0.07\left(U\right)^{1.5}\right] \tag{7}$$

where q [m^3/m·s] is the mean overtopping discharge per meter of crest and per second, g [m/s^2] is the gravity acceleration, H_{mo} [m] is the height of the wave in deep water, R_c [m] is the crest freeboard in reference to the MWL measured in a predefined position in the wave flume, Ir [-] is the Iribarren number, D_n [m] is the nominal diameter of the elements (D_n = 2180 mm, see Table 5), and U [m/s] is the dimensional nominal wind speed used in the laboratory experiments.

The comparison with prototype overtopping measurements was inconclusive because of the lack of proper scaling laws for wind speed in the laboratory and the lack of moderate or high overtopping measurements in the prototype.

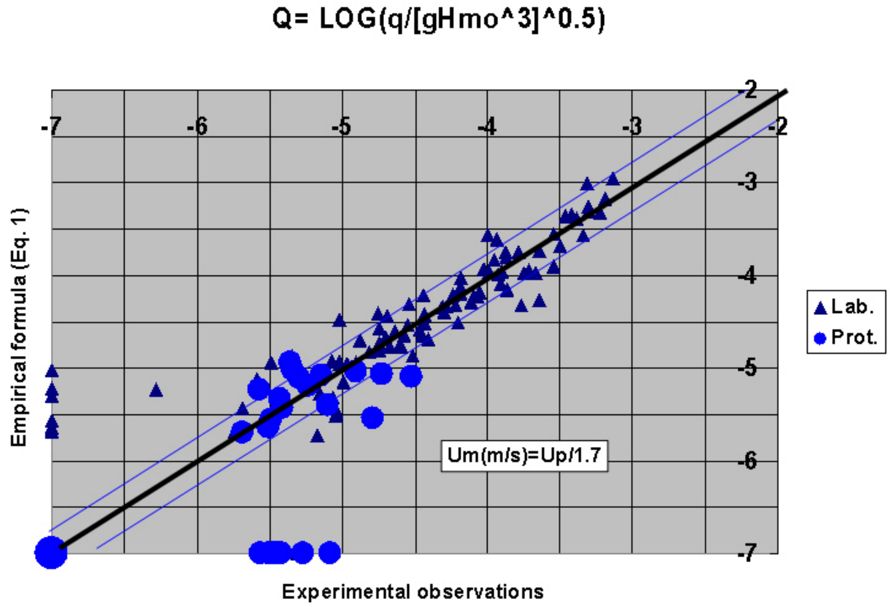


Figure 7: Comparison of estimations (Eq. (7)) and overtopping measurements during OPTICREST project

Table 2 contains information on the measured storms at Zeebrugge together with the mean overtopping discharges. Using Eq. (7) these storm events can be hindcasted taking into consideration the different wind speeds in the model from v = 0 m/s to v = 7 m/s (Table 3). The measured wave overtopping discharge in prototype $q_{prot.}$ is also given.

Table 3: Application of Eq. (7) for mean overtopping discharges to all storm events including influence of wind

Storms [dd.mm.yy]	duration [-]	H_{mo} [m]	R_c [m]	$T_{m-1,0}$ [s]	L_{m0} [m]	Ir [-]	$q_{prot.}$ [$m^3/s \cdot m$]	$q_{v=0}$ [$m^3/s \cdot m$]	$q_{v=3}$ [$m^3/s \cdot m$]	$q_{v=5}$ [$m^3/s \cdot m$]	$q_{v=7}$ [$m^3/s \cdot m$]
06.11.1999	11:30-13:30h	3,04	4,92	6,88	73,9	3,52	5,71E-05	3,40E-03	4,89E-03	7,43E-03	1,24E-02
07.11.1999	23:45-01:45h	2,60	5,09	6,93	75,0	3,84	2,21E-05	1,39E-03	2,00E-03	3,04E-03	5,08E-03
08.11.2001	16:15-18:15h	3,47	5,19	8,41	110,4	4,03	3,31E-04	1,40E-02	2,02E-02	3,07E-02	5,13E-02
26.02.2002	13:30-14:00h	2,63	5,96	6,49	65,8	3,57	1,01E-05	2,15E-04	3,10E-04	4,71E-04	7,87E-04
27.10.2002	17:00-18:00h	3,74	5,80	7,50	87,8	3,46	5,16E-04	3,64E-03	5,23E-03	7,96E-03	1,33E-02
	18:00-19:00h	3,86	5,60	7,64	91,1	3,47	8,59E-04	5,92E-03	8,52E-03	1,29E-02	2,16E-02
	19:00-20:00h	3,71	5,85	7,98	99,4	3,70	7,04E-04	4,93E-03	7,09E-03	1,08E-02	1,80E-02
29.01.2003	10:00-12:00h	3,16	5,49	7,28	82,7	3,66	9,62E-05	2,41E-03	3,47E-03	5,28E-03	8,82E-03
07.10.2003	12:00-14:00h	3,23	5,43	7,00	76,5	3,48	8,92E-05	2,24E-03	3,23E-03	4,91E-03	8,20E-03
22.12.2003	00:00-02:00h	3,03	4,94	7,33	83,9	3,76	6,68E-05	4,93E-03	7,09E-03	1,08E-02	1,80E-02
08.02.2004	14:45-16:45h	3,59	4,88	7,37	84,8	3,47	5,91E-04	9,77E-03	1,41E-02	2,14E-02	3,57E-02

Table 3 shows that the prediction for all storm events gives values which are one or two orders of magnitude higher than the prototype measurements (even for no wind). It has however to be considered that measurements where Eq. (7) has been derived from were performed for a different cross section and a different armour layer layout of the same breakwater.

3.2.3 Influence of wind

Differences between the various wind speeds as compared to no wind (v = 0 m/s) in Table 3 can mathematically be derived from Eq. (7) for the relative overtopping discharge as follows:

$$f_U = \exp\left[0.07\left(U\right)^{1.5}\right] \quad [-] \tag{8}$$

where f_U is the factor of wind influence for the wind speed U [-] and U is the wind speed in the model as above [m/s]. Eq. (8) yields $f_U = 1.4$ for U = 3 m/s to $f_U = 3.7$ for U = 7 m/s and shows that the influence of wind in this formula is significantly lower than one order of magnitude. Furthermore, it is surprising that the influence of wind seems to remain constant for all wave overtopping discharges whereas it could have been expected that the influence of wind is less important for high overtopping rates.

The latter problem does not occur when the suggestion by SPM (1984) is used where all overtopping rates are multiplied by a factor k' which is dependent on the slope of the structure, the freeboard and the run-up height, thus leading to higher factors for lower wave overtopping rates. The formula does suggest values which are usually in the range of 1.0 to 1.55, therefore suggesting that the maximum increase of wave overtopping is in the range of 55%. This seems rather low in comparison to Eq. (8) and will be more or less negligible for usual variations of wave overtopping discharges. More details on this formula can also be found in González-Escrivá & Medina (2004).

Ward et al. (1994) and Ward et al. (1996) have investigated the influence of wind on wave run-up and overtopping. They found that there is hardly any increase in wave run-up for winds up to 6.5 m/s (less than 10%) on different smooth and rough slopes tested (1:1.5; 1:3 and 1:5). More significant influence can be found for wind speeds of 12 m/s and 16 m/s where the key process for increasing run-up seems to be the increased wave height H_s at the toe of the structure. For steep rough slopes (1:1.5) additional wind effects have been observed for wind speeds larger than 12 m/s leading to an increase of wave run-up heights up to a factor of 2.0.

For wave overtopping similar results were obtained: wind speeds of 6.5 m/s only have negligible effects on wave overtopping whereas stronger winds of 12 m/s and 16 m/s both increase the wave height and the set-up in front of the structure and therefore the wave overtopping. Factors for wave overtopping may increase up to one or two orders of magnitude for these strong winds. However, the scaling law of wind remains unsolved whereas several processes are discussed which may lead to the increase of wave run-up and overtopping (change of wave height, change of breaker type, support in pushing the waves to run-up, decrease the effect of downwash, advection of splash and spray).

Medina (1998) indicated from Neural Network investigations that only wind speeds larger than 8.0 m/s in the lab had some slight influence on wave overtopping. This result was in line with the results reported from Ward et al. (1996) whereas differences were found in wave overtopping suggesting that there is a stronger effect on wave overtopping also for lower wind speeds. Both these results were however concluded from the behaviour of the Neural Network prediction and were not quantified or verified against individual tests.

González-Escrivá et al. (2002) have investigated the influence of wind on wave run-up and overtopping for the Zeebrugge breakwater. They found a negligible increase for wave run-up in the range of 5% only. More significant influence of wind for wave overtopping has been found also for lower overtopping rates up to one order of magnitude. The formula derived in Eq. (8) is based on the same data and therefore represents the average factors for different wind speeds. It should be noted that some significant wave set-up was also observed in the tests which increased with the wind speed and seemed to have reached up to 10-15% of the water depth in the flume. There is however no conclusion on how much the wave set-up has influenced the overtopping discharges.

3.3 Wave-induced forces on persons

Only few publications are available which investigate the hazards to persons on top of a breakwater. One of the key papers that has looked into the forces on dummy persons on top of a breakwater has been published by Endoh & Takahashi (1994). The authors investigated persons on vertical breakwaters by means of model and prototype tests. Two principal balance models were developed (tumbling and slipping type) where for the latter wave velocities of about 1.6 m/s and forces in the range of 140 kN were regarded critical. Critical balance of the dummies were also related to wave overtopping discharges where a mean overtopping discharge of $q = 4 \cdot 10^{-5}$ was found to be critical for persons falling over and $q = 6 \cdot 10^{-3}$ was observed for persons being washed into the sea. However, it has to be considered that wave overtopping behaviour is very different in between vertical structures and rubble mound breakwaters. Therefore, the numbers given in Endoh & Takahashi (1994) need to be analysed and compared very carefully. Furthermore, all tests were performed with dummies which were facing the overtopping waves. There are no hints on how much the preparedness of persons may influence the results and how much the temperature of water plays a role.

4 Test facilities

4.1 LWI

The small wave flume of LWI is about 100 m long, 2 m wide and 1.25 m deep (Figure 8). The side walls and the bottom of the flume are made of concrete. Three windows are located at the models position to observe and to video the cross section, the breaking of the waves and the wave overtopping.

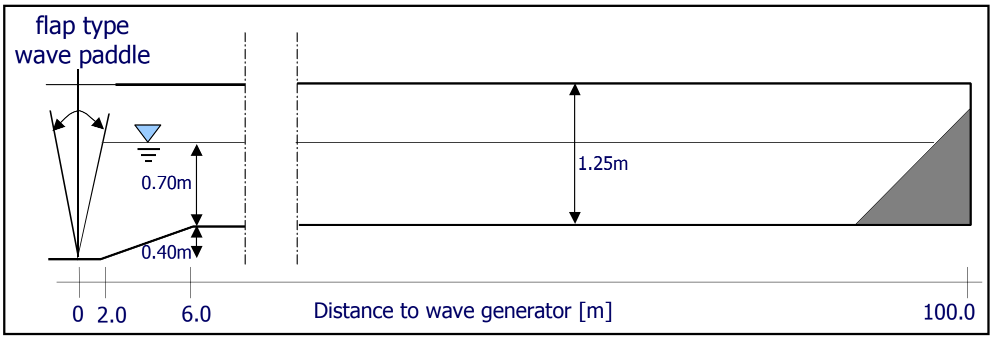


Figure 8: Cross section of the LWI wave flume

At the end of the flume a wave absorbing rubble mound is installed (Figure 9). Within the tests described in this report this mound was used to minimise reflections in the flume during some first tests which were performed when the foreshore was already constructed but the rubble mound structure was not.

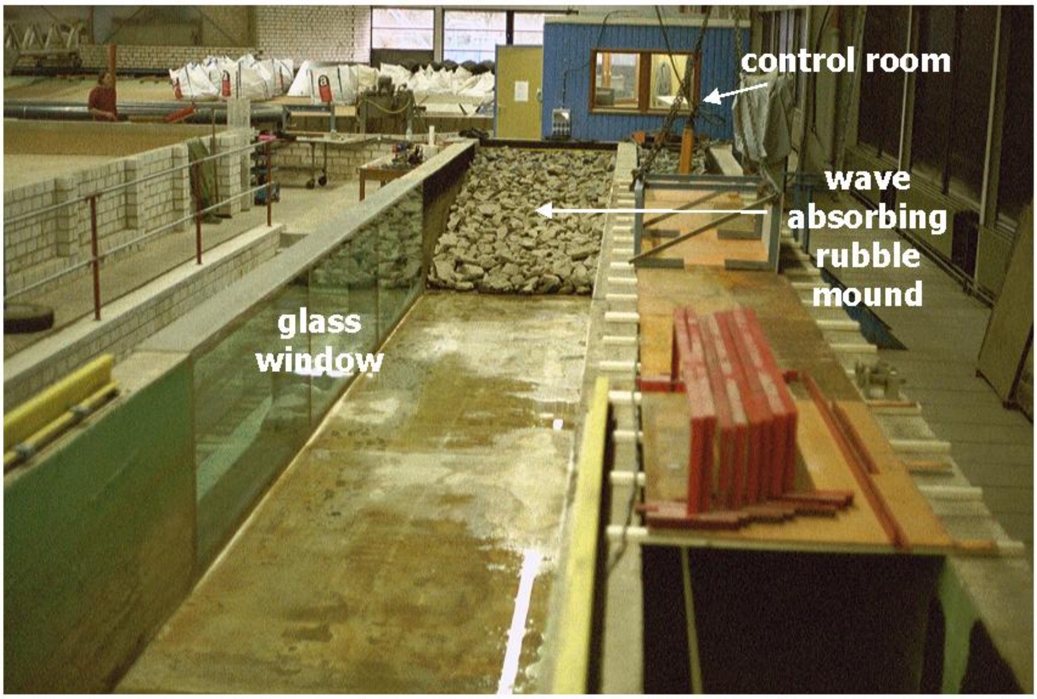


Figure 9: Control room, wave absorbing rubble mound and glass window for observation of model tests in the wave flume at LWI

4.1.1 Wave generation

Waves are generated by a flap type wave paddle that is capable to produce regular and irregular waves (theoretical wave spectra and natural wave spectra) with wave heights up to 0.25 m and wave periods up to 6.0 s for water depths between d = 0.60 m and 0.80 m. There is no active absorption available for the LWI wave flume (Figure 10).

Capabilities:

- regular waves
- theoretical wave spectra
- natural wave spectra
- no active absorption

Generated wave parameter:

- water depth up to 0.80 m
- wave heights up to 0.25 m
- wave periods up to 6.0 s

Figure 10: Wave generation capabilities and range of generated wave parameters in the LWI wave flume

4.1.2 Measurement devices

Model tests on coastal structures usually require information on the incoming waves, the waves directly in front of the structure, wave breaking, wave run-up and wave overtopping (discharges, velocities, individual volumes), and pressures at the front face of structures. Different measurement devices could be used to get all the required information. The general measurement possibilities in the LWI-flume are:

- wave gauges: typical resistance gauges
- wave run-up gauges: digital step gauge, run-up gauge
- pressure cells
- velocity propellers
- wave detection and velocities of overtopping waves: layer thickness gauges
- overtopping measurement: container on weighing cells or with wave gauge or pressure cells
- video analysis: cameras for observing wave run-up, wave breaking and wave overtopping

These measurement devices are described in more detail in the following sections.

a) Water surface elevation

For the determination of wave heights and wave periods typical resistance type wave gauges are applied (Figure 11). A precision of ±5% can be achieved with these wave gauges.

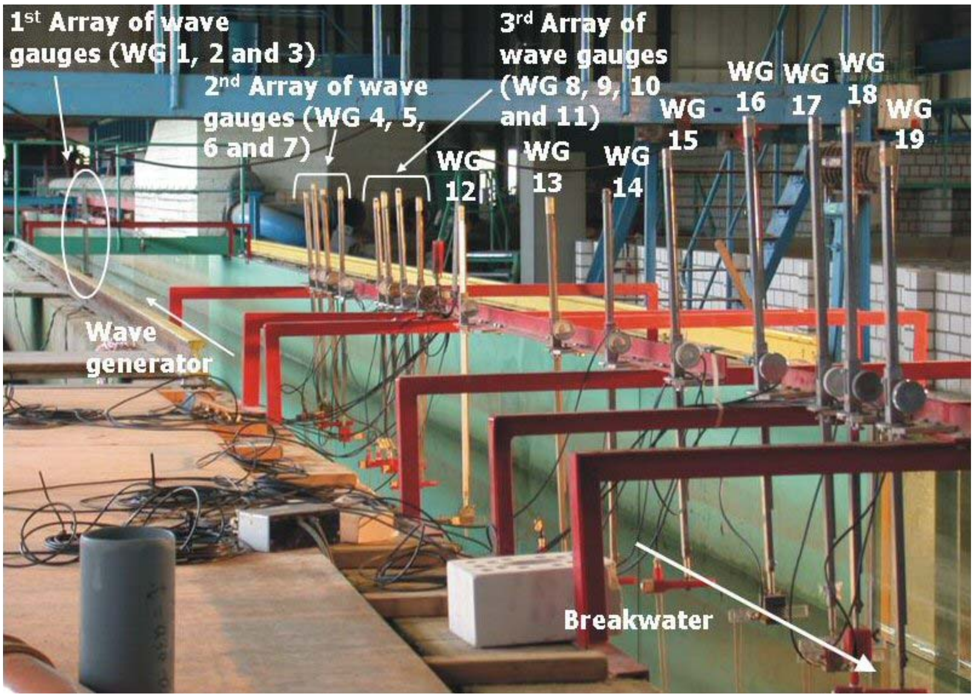


Figure 11: Wave gauges in the wave flume for determination of wave parameters

An array of wave gauges (Figure 11) is used for reflection analysis at three different positions of the flume. These wave gauges are required for the analysis of incident and reflected waves with the least square method after Mansard & Funke (1980). Further wave gauges are applied to measure the wave transformation and the reflection directly in front and at the toe of the structure. The positions of wave gauges used throughout the tests are given in Table 4 and are also shown in Figure 45 on page 44.

b) Wave overtopping

Behind the crest of the structure an overtopping container is installed. This container ($V \approx 0.186\ m^3$) is positioned on weighing cells. The three HOTTINGER BALDWIN (HBM) Z6 weighing cells, with a nominal load of 100 kg, are used to weigh the overtopping volume collected in an overtopping tank (see Figure 12).

The weighing cells are automatically equalised in a conduit box (HBM VKK 2) and subsequently amplified (HBM MVD 2510 amplifier). Alternatively it is possible to measure the overtopping water by a wave gauge or pressure cells in the tank rather than using weighing cells. However, due to the water movement in the tank and some inaccuracies for small overtopping discharges these measurements are believed to be less suitable to measure overtopping discharges as compared to the weighing system.

Due to the expected very low overtopping rates for some of the storms in some tests overtopping water was collected by a measuring jug and afterwards weighed on a much more sensitive letter scales.

Table 4: Position of wave gauges in the LWI flume

No.		x-position [m]	y-position [m]
1		61.67	0.0
2	Reflection analysis gauges 1	61.87	0.0
3		62.15	0.0
4		78.45	0.087
5	Reflection analysis gauges 2	78.65	0.087
6		78.93	0.087
7		80.12	0.169
8	Reflection analysis gauges 3	80.32	0.172
9		80.60	0.177
10		81.62	0.21
11		82.82	0.276
12		83.39	0.306
13		83.95	0.306
14		84.52	0.306
15		84.88	0.306
16		85.03	0.306
17		85.23	0.306

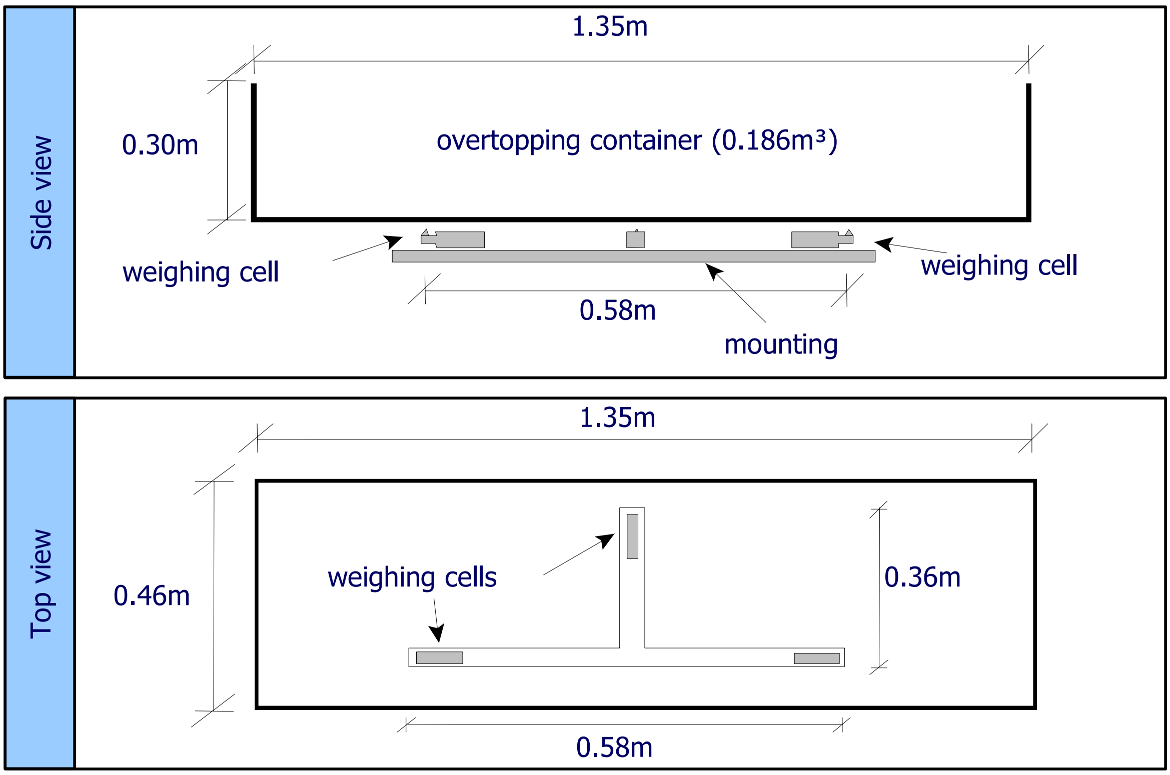
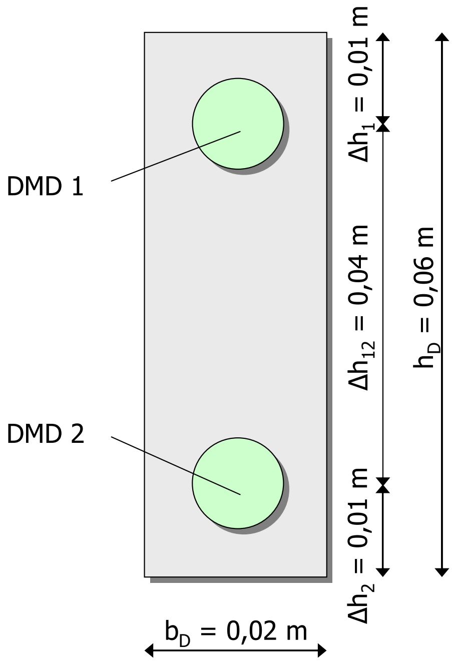


Figure 12: Weighing system with overtopping tank

c) Pressures

Pressure cells with different capacities (from 0.075 to 5.0 bar) are available at LWI. The NATEC pressure cells have a natural frequency of 2 kHz. They are used to measure pressure on the surface of a structure or within the structure. For the tests described in this report they have been installed in the overtopping tank and to measure pressures on a dummy person on top of the breakwater (Figure 13). Pressure signals are amplified by pressure amplifiers and are usually not filtered before stored to hard disk.

a) Dummy with pressure cells



b) Dummy with dimensions

Figure 13: Dummy on top of Zeebrugge breakwater in the LWI model, a) Pressure cells b) dimensions of dummy

Calculation of the total force on the dummy was performed using a simple integration procedure as follows:

$$F_{Dummy} = 0.5 \cdot b_D \cdot h_D \cdot \left[p_1 + \frac{\Delta p_{12}}{\Delta h_{12}} \cdot \left(\Delta h_1 + \Delta h_2 \right) + p_2 \right] \quad \text{[kN]} \qquad (9)$$

where geometrical parameters can be taken from Figure 13b and p_1 and p_2 [kPa] are the pressures measured at the pressure cells DMD 1 and DMD 2, respectively. The pressure difference between both pressure cells is denoted as Δp_{12} [kPa].

d) Velocity propellers

Two types of velocity propellers can be used to determine wave run-up and wave overtopping velocities, micro propellers with a head diameter of 15 mm and mini propellers with a head diameter of 22 mm (Figure 14). The SCHILDKNECHT propellers can measure velocities up to 5 m/s or 10 m/s, respectively.

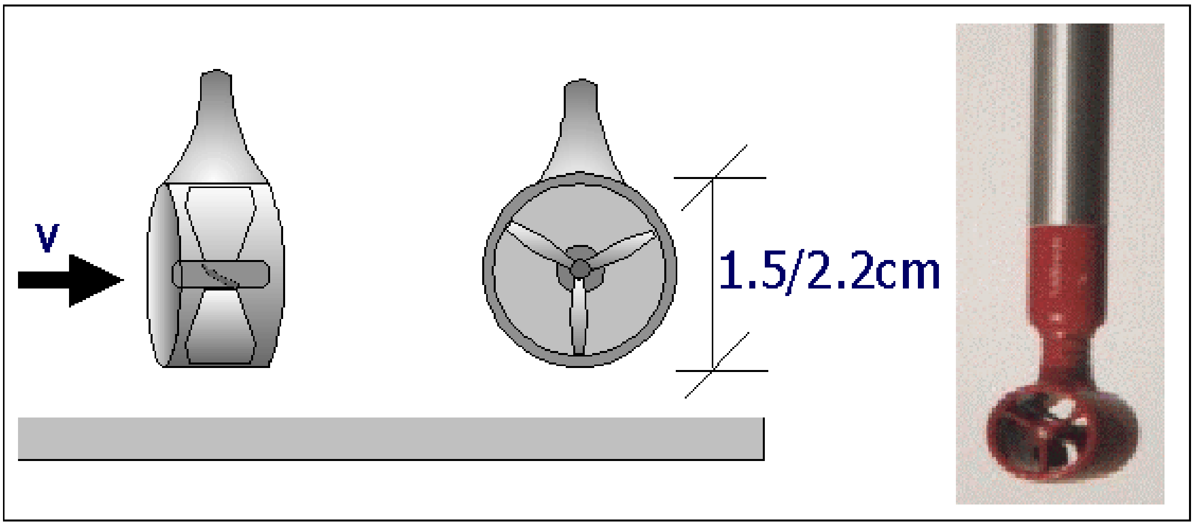


Figure 14: Schematic sketch and photo of velocity propellers used at LWI

During the Zeebrugge tests these propellers have not been used since they are unable to measure small overtopping discharges where only a relatively thin layer of water with some amount of air overtops the breakwater.

e) Video observation

All model tests will be recorded by at least one video camera. The camera is usually positioned on the side of the flume in order to document the breaking of the waves and the wave overtopping. Another position of the camera is above the flume to get an overall view of the investigated structure and wave overtopping.

f) Data sampling and storage

All measurement devices are sampled with a constant sampling frequency of 20 Hz (500 Hz as soon as pressure measurements of the dummy were included) and will be stored on a PC. A 64 channel analogous NATIONAL INSTRUMANTS ATMIO-64 card with a sum sampling frequency of maximum 500 kHz is used. The raw data are stored using amplified voltage values in a binary integer format. Additionally, there is an ASCII file with information about the test parameters (water level, generated wave parameters, length of test, etc.), positions of measurement devices and calibration coefficients. Generally, no filters are applied when sampling the data.

Within the tests of the Zeebrugge breakwater measurements of waves, mean overtopping discharges, velocities of overtopping waves and pressures on a dummy "person" (rectangular plate) on top of the crown wall were performed.

4.1.3 Scale of the model

a) Geometric scale

The model of the Zeebrugge breakwater has been constructed in a 1:30 scale (Froude). Reasons for selecting this scale were:

- **Comparability:** this scale was also used in former model tests of the Zeebrugge breakwater in other laboratories. For comparison of the new data measured at LWI with data from the OPTICREST project (Willems & Kofoed (2001)) and to get information about the differences of the test facilities this model scale would be required;
- **Availability of Antifer cubes:** Antifer cubes in this scale were still available from tests during the OPTICREST project and were sent to LWI by FCFH. Due to the wider LWI flume the number of cubes was still not sufficient and about 100 extra cubes had to be built at LWI. This was however much less effort than to build cubes in a different scale than 1:30;
- **Water levels and wave generation in the LWI wave flume:** waves at LWI can be generated for water depths between 0.60 m and 0.80 m. The water depth in front of the breakwater in prototype is about 19 m, in model scale (1:30 assumed) about 0.65 m and the crest height is 27.39 m above the deepest point of the foreshore. In model scale (1:30) the crest is 0.913 m above the bottom of the wave flume. Wave heights of up to 7,0 m in prototype (parametric tests) correspond to 0,23 m in the model, wave periods of up to 11.5 s in prototype correspond to 2,1 s in the model. These values lie within the ranges of the possibilities at LWI. A larger scale would therefore cause problems in generating the waves.

b) Scale of core material

Figure 15 shows a cross section of the Zeebrugge breakwater where the various materials of the breakwater need to be scaled according to the Froude law using the length scale of 1:30.

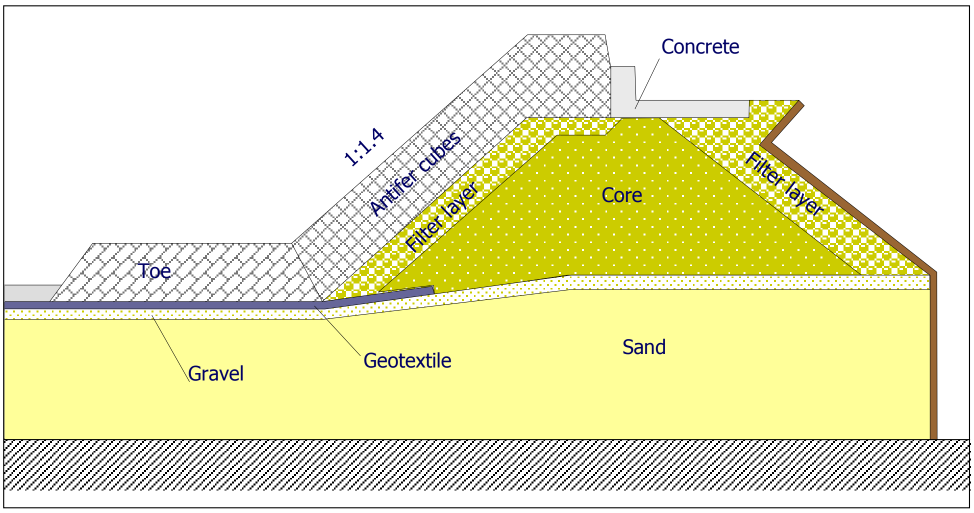


Figure 15: Cross-section of the Zeebrugge breakwater

Due to the small scale the core material will be too small to reproduce the velocity of water flow correctly. Therefore, in OPTICREST a different method was used to scale the core material (Burcharth et al. (1999)) which downscales the size of the core material according to comparable flow velocities in prototype and the model. This method has been used here as well resulting in a length of about 1:20 for the core material. An overview of the material required for use in 1:30 tests is given in Table 5; the analysis of the mean diameter of available material at LWI is also given.

Table 5: Material characteristics of Zeebrugge breakwater adapted from Frigaard & Schlütter (1999) and Willems & Kofoed (2001)

Layer	Prototype		Model (1:30 scale)		LWI	d_{85}/d_{15}
	Weight	d_{50}	Weight	D_{50}	d_{50}	
	[kg]	[mm]	[g]	[mm]	[mm]	
Core	2-300	230	0.25-37.5	11.5	12.0	3.0
Antifer cubes	25000	2180	926	72.67	73.0	-
Filter	1000-3000	950	37-111	31.67	32.0	1.4
Filter (rear side)	1000-3000	950	37-111	31.67	32.0	1.4
Toe	3000-6000	1200	111-222	0.42	n.a.	1.2
Seabed protection	80-300	380	2.96-11.11	12.67	n.a.	1.5

4.1.4 Construction of the model

The planning of model set-up for the Zeebrugge breakwater is based on the description of model set-up and methodology given in the OPTICREST project by Frigaard & Schlütter (1999) and Willems & Kofoed (2001) for the Zeebrugge breakwater. The model set-up is modified with respect to the overtopping measurement because the investigation of wave overtopping is the main objective of the model tests within CLASH.

The foreshore was simulated as shown in Figure 16. It was first built out of sand with a geotextile on top or of concrete for the lower part of the profile (Figure 17). In the second phase of tests for which the breakwater was re-built in the flume only concrete was used. The foreshore was constructed without the reef (dashed line in Figure 16) since the prototype wave spectra are measured at positions closer to the front of the breakwater. Simulation of the wave spectra at these positions is best achieved without the reef.

The Antifer cubes at the seaside were placed in two layers. The cubes in the under layer will be regularly placed with 0.115 blocks/m² (prototype) and the top layer will be placed according to the actual position of the cubes in prototype as provided by WP3 (Figure 18). The overtopping measurement is placed about 140 m seawards the measurement jetty where wave run-up is measured (Figure 3).

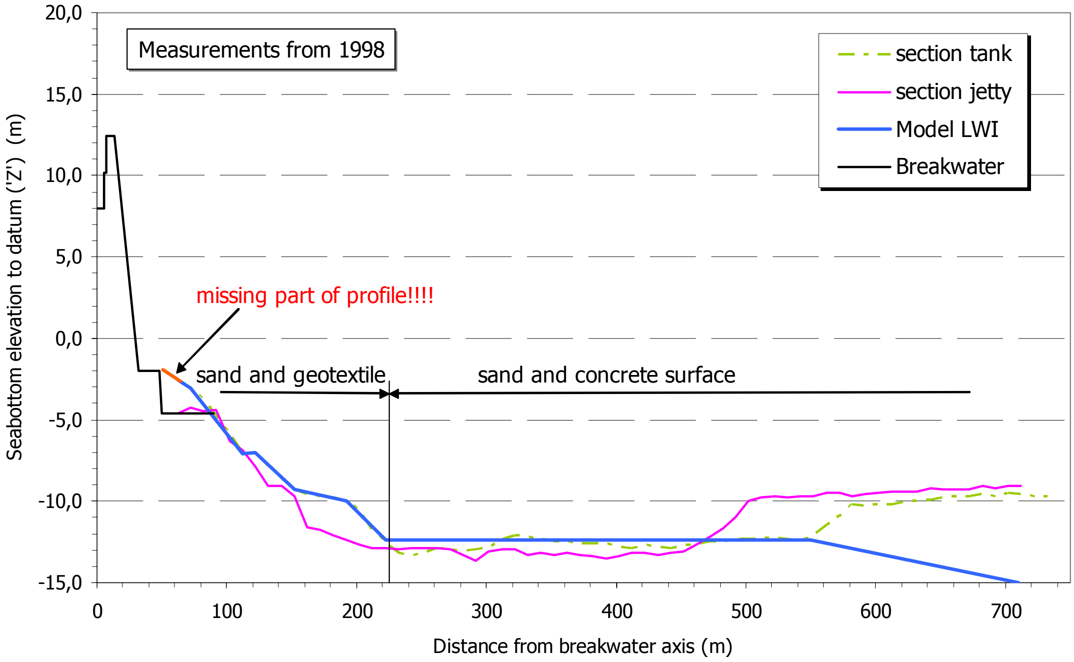


Figure 16: Foreshore in front of the Zeebrugge breakwater in model and in prototype (distances in prototype scale)

Figure 17: Photos of the construction of the model at LWI: foreshore construction (left) and breakwater toe (right)

The Antifer cubes in the model will be placed according to the placement in the corresponding areas in prototype. A survey of the actual placement in prototype has been performed and photos were taken. These photos were then used to identify the position of the Antifer cubes in the model. However, for these tests no sophisticated method was used to reproduce the position of cubes in prototype. Therefore, the accuracy of the position is not very high for the tests analysed in the first phase of the tests. Further tests at LWI used a more accurate method for the upper layer and results with regard to wave overtopping were compared.

Figure 18: Construction of the top layer of the model at LWI: first layer (left) and top layer (right)

The wave gauges will be located in front of the structure according to the positions in prototype with additional gauges in between (Figure 19). The wave gauges in prototype correspond to a group of three wave gauges in the model tests. The distances of the wave gauges are taken from the positions in the OPTICREST model tests performed by FCFH as reported in Willems & Kofoed (2001). There was also an array of wave gauges at the toe of the structure corresponding to the infra-red sensor IR in prototype at the jetty section. Additionally, an array of wave gauges was installed in the middle of the flume for additional reflection analysis.

Figure 19: Wave gauges in front of the model at LWI: before (left) and during tests (right)

Wave overtopping was measured by a container positioned on three weighing cells. This system is described in section 4.1.2b). The water was collected behind the concrete superstructure in the model (in prototype: behind the street) by a 0.233 m wide channel that corresponds to 7.0 m width of the overtopping tank in prototype. A top view of the breakwater and the overtopping tank in prototype has been shown in Figure 3 and Figure 4 already.

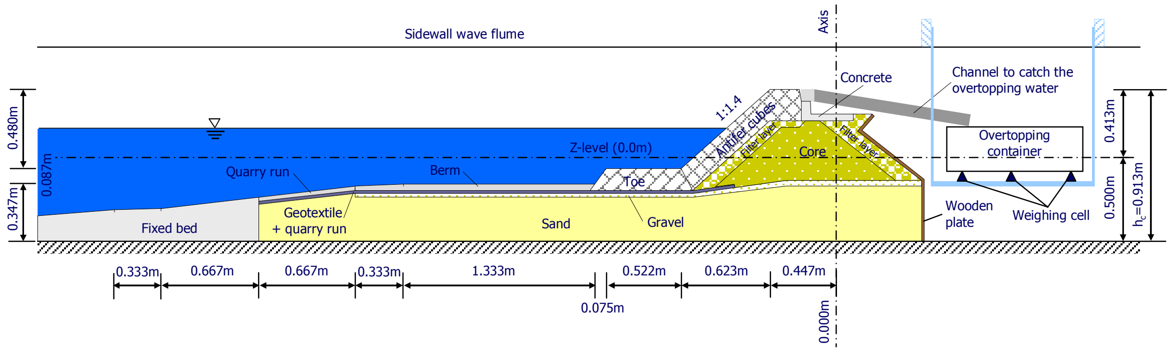


Figure 20: Cross section and top view of the planned model set-up of the Zeebrugge breakwater in the LWI wave flume

The model tests were extended to include measurements of pressures and forces on model dummies and velocities of individual overtopping volumes. For the former pressure cells as described in section 4.1.2c) were used and mounted on a very stiff metal which was then fixed to the crown wall of the breakwater (Figure 21). The velocity measurements were obtained by using layer thickness gauges where the time difference of waves passing various gauges in a certain distance was measured at high frequencies (Figure 21). Velocity propellers as described in section 4.1.2d) could not be used since the overtopping volumes were too small to give reliable results.

Figure 21: Velocity measurements of individual overtopping volumes by means of layer thickness gauges (left) and pressure measurements on a dummy “person” (right) at LWI model

4.2 UPVLC

The Wind and Wave Test Facility of the Laboratory of Ports and Coasts at the UPVLC is 30 m long, 1.2 m wide and 1.2 m deep (Figure 22).

Figure 22: General view of the UPVLC wind and wave test facility

The side walls are made of steel modular plates and steel structural beams, except at the test section where glass windows are placed instead the steel plates. The bottom of the flume at the wind tunnel (within the air intake and the blower) is 25 cm higher than it is at the wave maker by mean of a steel transitional slope and reinforced plates; this false bottom produce a recirculation of water when MWL rises at the end of the flume, and prevents some wave breaking at the wave maker compared to flumes with constant water depth (Figure 23).

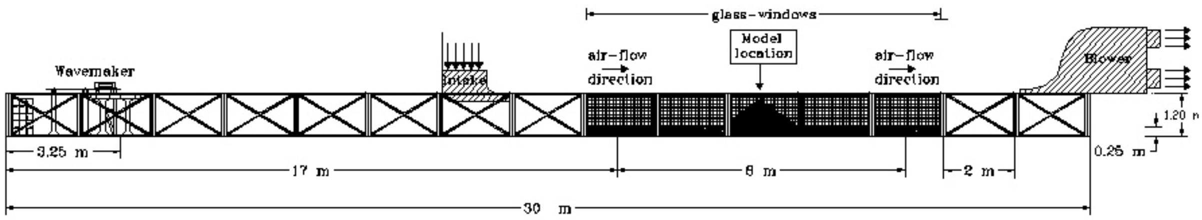


Figure 23: Longitudinal cross section of the UPVLC wind and wave test facilities

4.2.1 Wave and wind generator

a) Wave generator

Regular and irregular waves were generated by a piston-type wave maker with a maximum stroke of 80 cm with no active absorption. The compressor consists of a pump and a pressure room, which works at 10 MPa. The movement of the piston is steered by a servo-valve which displacements are controlled by a computer and position sensor. The piston movements are corrected in real time (see Figure 24).

Figure 24: Wave generation system of the UPVLC wind and wave test facilities

The generation of the waves by the paddle is controlled by a computer program, which uses data of a prepared theoretical sequence. By use of the corresponding transfer function by Goda (1985), together with an additional linear transfer function in the time domain to prevent unnatural accelerations of the paddle at the beginning and end of each test, the wave data are translated in movements of the paddle that are sent to the hydraulic system through electrical signals. There is no active absorption implemented at the wave paddle.

b) Wind generator

Wind is generated by exhaust blowers located opposite to the wave maker. Air is pulled into the tunnel through a vertically-adjustable intake forced by the depression caused by the blowers into the tunnel. Wind speed, which is measured between the air intake and the model, is fixed manually.

Wind tunnel has a variable length depending on the position of the air intake on the flume. The length planned for CLASH experiments is 18 m. The wind tunnel is formed within the air intake and the blowers by covering the flume with a roof of plywood plates (see Figure 25a and Figure 25b).

Figure 25a: General view of the wind generation system of the UPVLC Wind and Wave Test facilities

Figure 25b: Air intake and blowers of the Wind Generation System (UPVLC)

4.2.2 Model set-up

The model set-up of the UPVLC Zeebrugge scale model for the CLASH experiments was constructed using a similar methodology as described in Garrido et al. (2001), reproducing the tank section where overtopping is measured in the prototype. The tank section used for the CLASH experiments is located about 140 m away from the jetty section where runup is measured in the prototype of the OPTICREST project. Although Froude similarity was assumed and a 1:30 scale was applied, the scale of the core was lowered (1:20) to achieve a better modelling of the viscous effects, following Burcharth et al. (1999). Figure 26 shows the break-water cross section while Table 6 provides the characteristics of the materials placed in the section.

The armour layer has two parts: the lower armour layer, which is homogeneous in the model (equally spaced, 44% porosity) and unknown in the prototype. The upper armour layer was constructed by placing each block according to the existing prototype data which were up-dated and improved within the project. Two different upper armour layers were tested. The first upper armour layer was constructed following a plan view of the armour layer and photographs, illustrating the tank area with a slope 1:1.3. The second upper armour layer was constructed by placing each block just us the coordinates of the prototype tank section and follow-ing a slope of 1:1.4 which was found to be more accurate than that existing in the prototype. A specific methodology for placing the units of the upper armour layer in the model described in Garrido et al. (2001) was used to reproduce the armour layer as closely as possible to that of the prototype. Almost every single cube was placed taking into account its position in all three dimensions.

During OPTICREST, it was shown that sand contamination of the core in prototype was unstable near the armour layer as it was washed away (Medina et al. (2001)). As a result, sand contamination has not been considered in the CLASH scale model of the Zeebrugge breakwater.

The slope of the prototype Zeebrugge breakwater varies from 1:1.3 to 1:1.5. Within the CLASH project, a modification of the slope angle was considered from 1:1.3 to 1:1.4, and therefore the positioning of the cubes in the armour layers according to new and more accurate prototype data.

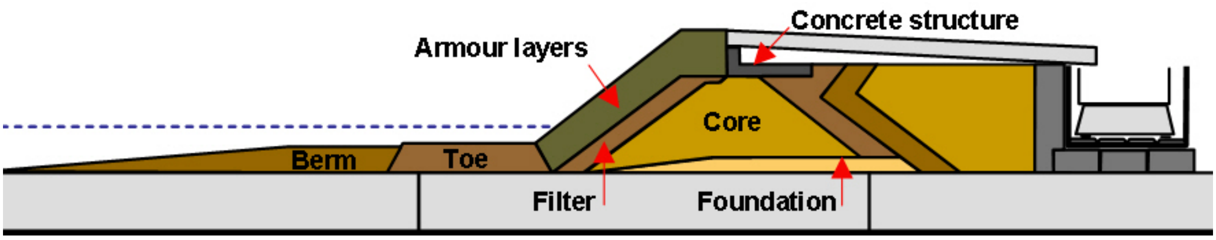


Figure 26: Characteristics of the materials of the Zeebrugge scale model

Table 6: Characteristics of the materials used in the scale model

LAYER	Prototype			Model			d_{85}/d_{15}
	Weight (Kg)		d_{50} (mm)	Weight (g)		d_{50} (mm)	
Core	2	300	230	0.25	37.5	11.5	3
Antifer Cubes	25000		2180	926		72.67	-
Filter	1000	3000	950	37.04	111.1	31.67	1.4
Filter (rear side)	1000	3000	950	37.04	111.1	31.67	1.4
Concrete structure	concrete			concrete			-
Toe	3000	6000	1200	111.1	222.2	40	1.2
Seabed protection	2	80		0.074	2.963		-
Seabed protection	80	300	380	2.963	11.11	12.6667	1.5
Foundation sand			0.2			0.067	-
Berm	1000	3000	950			31.6667	1.4

a) Foundation, geotextiles and foreshore

The foreshore in the UPVLC Zeebrugge scale model (Figure 27) replicated up to 250 m of prototype foreshore using a rough sand floor in addition to the model materials described above. Figure 28 shows the foreshore in the tank section (CLASH-overtopping) and the jetty section (OPTICREST-run-up).

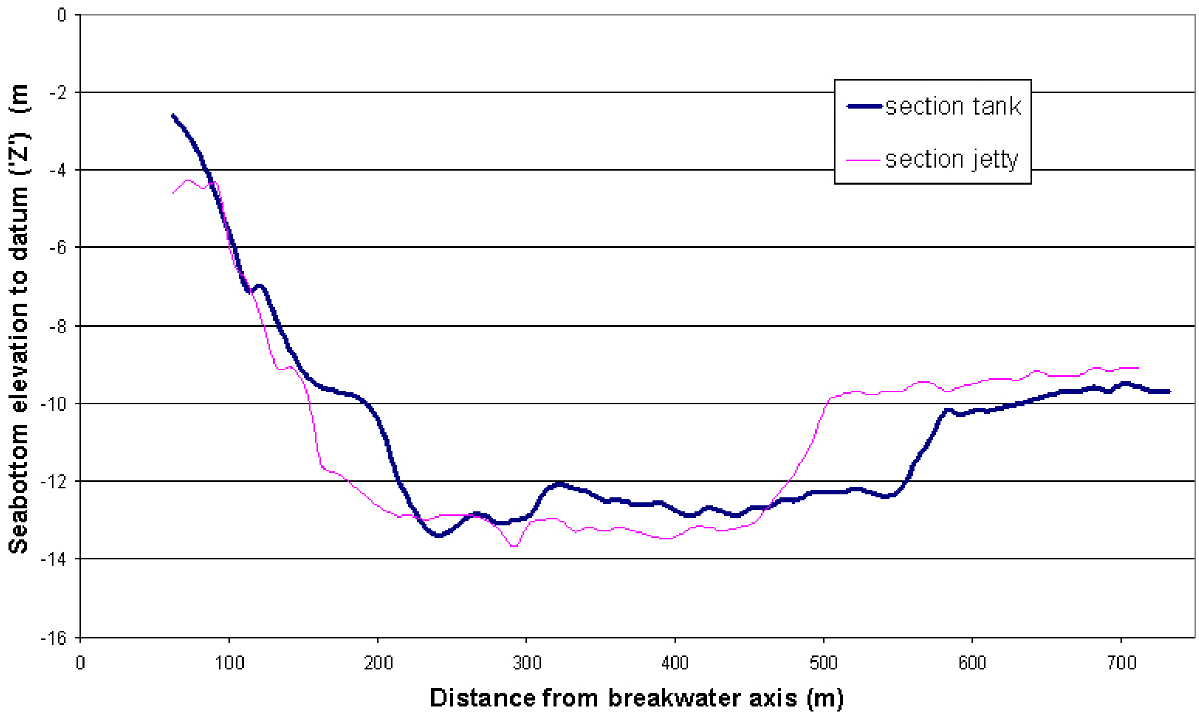


Figure 27: Comparison of the prototype foreshore in the tank section and in the jetty section

Figure 28: CLASH foreshore in the UPVLC Zeebrugge scale model

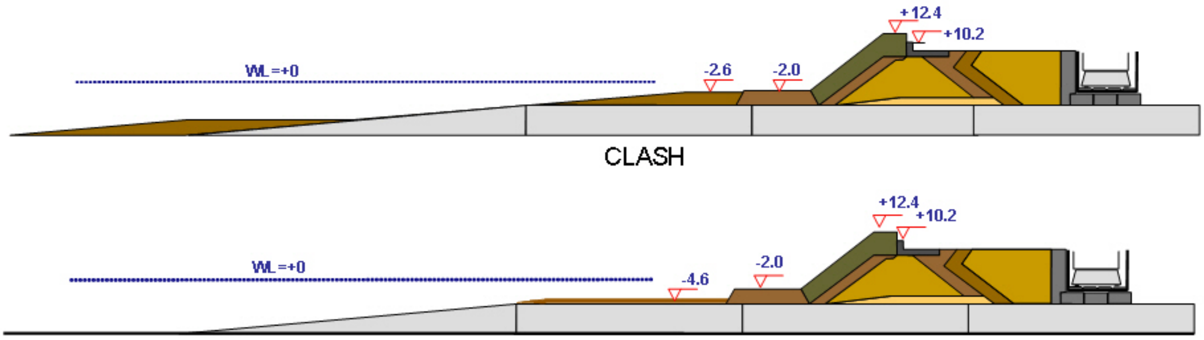


Figure 29: Cross section of the Zeebrugge scale model

b) Core and filter layers

Deviations from Prototype: 1) Core material is heterogeneous in prototype. 2) Material shown in Table 6 is used in scale model. Neither stratification nor sand infiltration is considered in scale model.

c) Lower armour layer and toe

Deviation from Prototype: Figure 30 shows the pattern of the armour units in the lower armour layer, which is homogeneous in the model (equally-spaced, 44% porosity) and unknown in prototype.

Figure 30: Lower armour layer construction

d) Upper armour layer

Two different upper layers of the armour were tested. The first upper layer was constructed following an armour plan view and photos of the tank area (slope 1:1.3). The second upper armour layer was constructed by placing each block with the coordinates of the prototype tank section (slope 1:1.4). Almost every single cube was placed taking into account its position in all three dimensions (Figure 31).

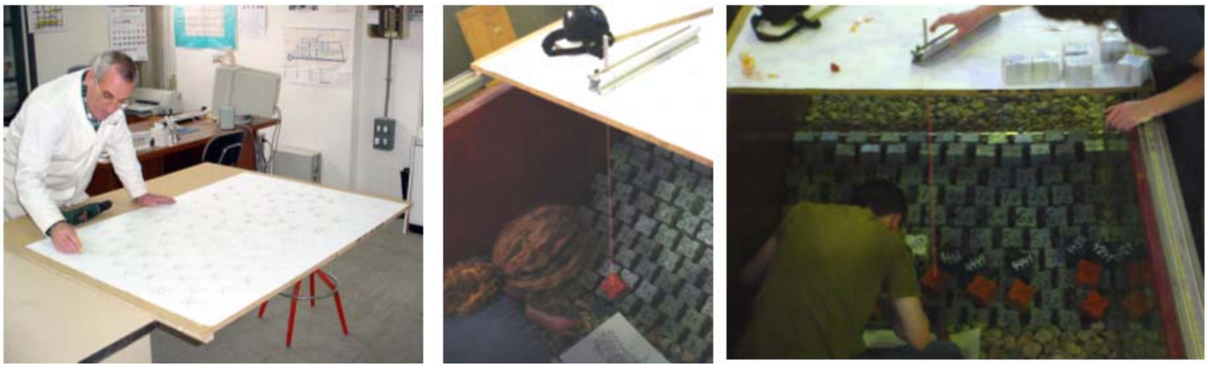


Figure 31: Upper armour layer construction (positioning methodology)

The model was constructed following as closely as possible the prototype instructions so as to build a scale model very similar to the prototype breakwater in the area where the overtopping discharge is measured. Figure 32 shows a rear view of the breakwater crest in the prototype and in the model without the crown wall.

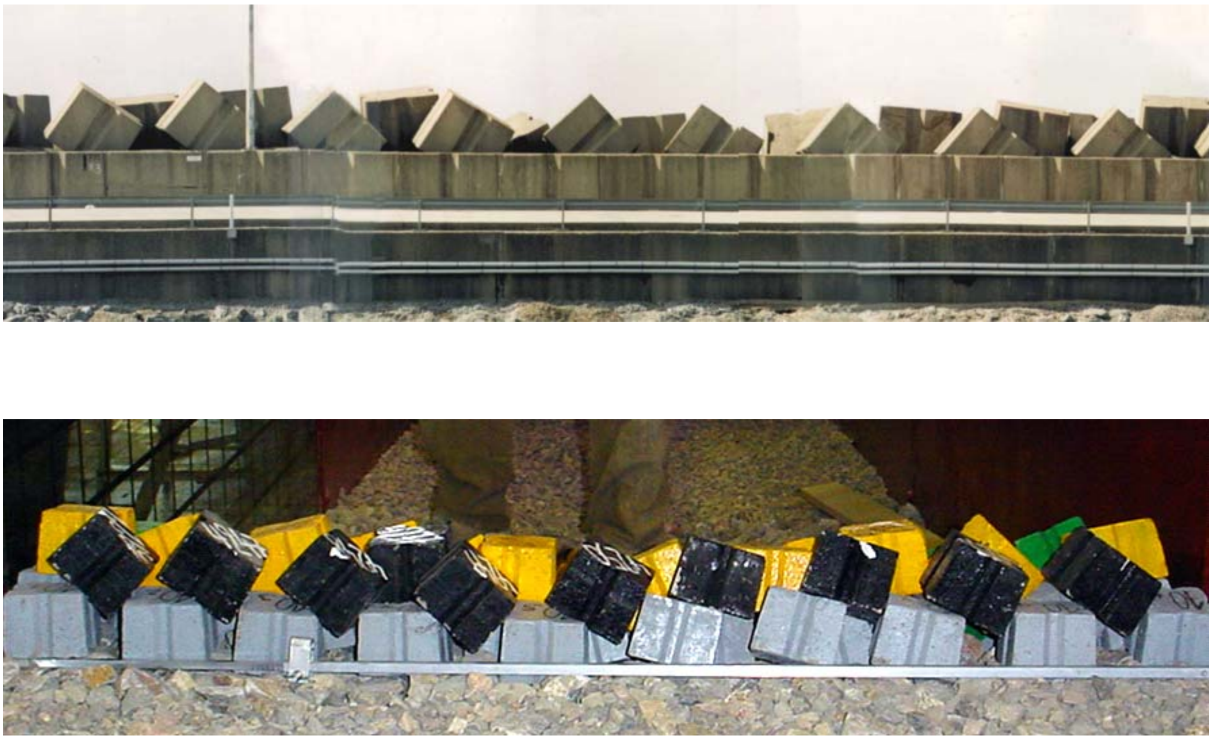


Figure 32: Rear view of the breakwater crest in the prototype (above) and in the model (below)

e) Rear fill and concrete structure

To finish the model construction the wave screen on top of the breakwater is placed, together with a canal leading the overtopped water to the overtopping tank (Figure 33).

Figure 33: Rear fill and concrete structure

4.2.3 Measurement instruments

The instrumentation used in the UPVLC tests provided measurements of water levels, overtopping rates and wind velocities within the UPVLC wave and wind test facilities. The general measurement frequency was 20 Hz.

a) Capacitance wave gauges set-up

Waves and water levels were measured in the laboratory using capacitance wave gauges. Figures 34 and 35 illustrate the positions while Table 7 gives the distances and depths of the capacitance wave gauges (dimensions in cm) used to measure waves and water levels along the wave flume.

The wave gauge at position S5 corresponded to a waverider buoy (WR1) in the prototype, while the wave gauge S9 corresponded to an infrared wave gauge at the toe of the breakwater in the prototype. The WR1 wave characteristics, H_{m0} and Ir, were calculated from the zero and first spectral moments (m_0 and m_1) of the total waves measured at S5. The wave characteristics at the toe of the structure were calculated from the average of measurements taken at S8, S9 and S10 because measurements at S9 were found to be quite unstable due to wave breaking.

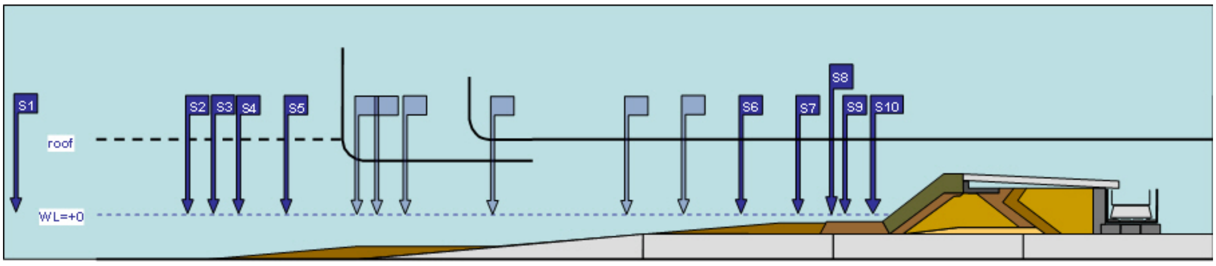


Figure 34: Capacitance Wave gauges location in the 2D wind and wave facility of the UPVLC

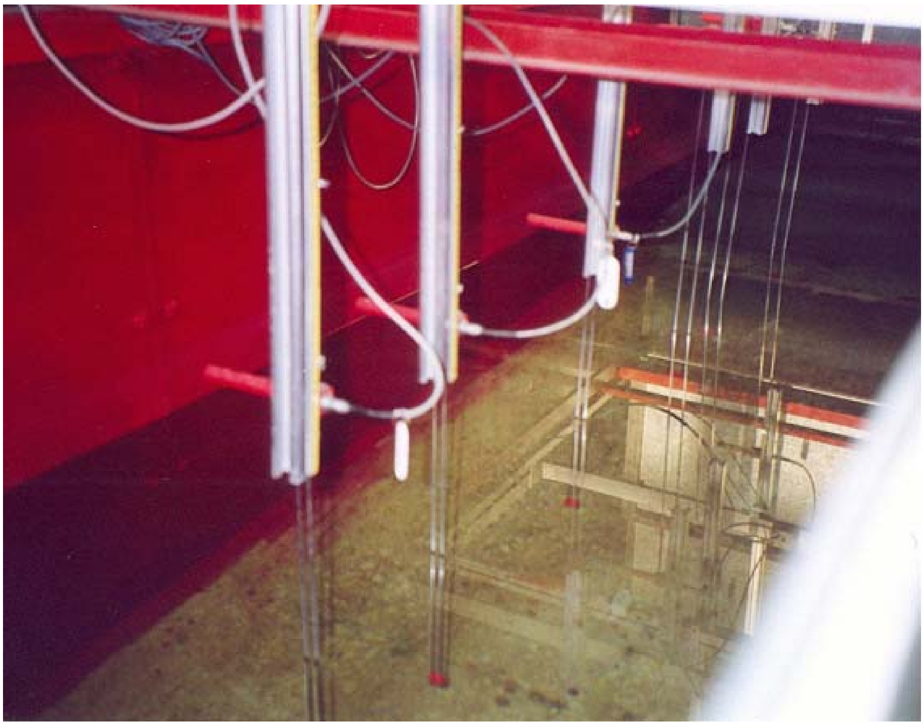


Figure 35: Capacitance wave gauges in the UPVLC wave and wind test facility

Table 7: Position of the wave gauges at UPVLC

Wave gauges	Distance form Breakwater axis	Water depth (from Z = 0)
	(cm)	(cm)
S1	1500	-44.3
S2	799	-44.3
S3	779	-44.3
S4	751	-41.9
S5 (WR1)	703	-37.9
S6	248.5	-11.8
S7	191.5	-8.6
S8	156	-6.6
S9	141	-6.6
S10	121	-6.6

b) Overtopping tank, channel and scale

Overtopping discharges are measured (Figure 36) using a channel of 25 cm width leading the water to an overtopping tank placed over a submergible scale. The overtopping scale is connected both to a display and to the computer so as to obtain the time series of overtopped volume during the experiments (sampling frequency 1 Hz). Additionally, a capacitance gauge was used to measure the overtopping discharges (sampling frequency 20 Hz). The observed advantage of weighing the water was the accuracy, although the wave gauge provided a reasonable good estimation of overtopping discharges.

Figure 36: Overtopping measurement setup at the UPVLC

Very good repeatability has been observed during CLASH with overtopping errors of the order of 10% to 15% (CoV ≈ 10%), similar to results achieved in OPTICREST. Therefore, any relative difference in mean overtopping discharge larger than 30% should be considered a significant difference due to any of the numerous structural and storm characteristics affecting overtopping.

c) Wind

In order to know the air velocity airflow static pitot tubes are used (see Figure 37). The pitot tubes measure the velocity by mean of the difference between the dynamic pressure and the static pressure registered. A digital converter translates dynamic and static pressures and displays air velocities.

Figure 37: Pitot tube and digital transductor instrument

5 Test programme

5.1 LWI

There will be three kinds of tests at Leichtweiß-Institute for the Zeebrugge breakwater:

- parametric tests on wave overtopping;
- variation of measurement analysis and investigation of model effects;
- reproduction of wave overtopping of measured storms

These tests and also some additional tests are described in more detail below.

5.1.1 Parametric tests

The results of the parametric tests have supplemented the overtopping database with additional information. For the parametric tests the parameters of the measured spectra where wave overtopping occurred were varied to run similar tests than in the previous OPTICREST project. Furthermore, the tests needed to be comparable to the observed storms at Zeebrugge. Table 8 shows the test matrix of the investigations at LWI.

Table 8: Test matrix of parametric tests for the Zeebrugge breakwater at LWI

d [mNN]	Hs [m]	Tp [s] 8,0	9,0	9,3	9,8	10,0	10,3	10,8	11,0	11,2	11,6
3,00	4,50					Z020					
	5,00			Z008							
	5,50	Z034	Z034a Z067 Z068		Z009		Z010				
	6,00							Z011			
	6,50									Z012	
	7,00										Z013
4,00	4,50										
	5,00										
	5,50		Z038						Z044		
5,00	4,50										
	5,00										
	5,50		Z039						Z045		
6,00	4,00		dummy						dummy		
	5,00		dummy						dummy		
	6,00										

(dark green) = not tested at LWI

(light green) = used for tests with model dummies

5.1.2 Variation of measurement analysis

For quantification of differences due to measurement accuracy it is required to repeat tests in one wave flume with identical wave conditions, see Kortenhaus et al. (2002). For analysing differences due to model set-up and position or type of measurement devices it is also required to repeat tests and vary:

- the position of wave gauges,
- the position of overtopping measurement,
- the width of overtopping tray collecting the overtopping water and
- the measuring devices (overtopping: water volume in container by wave gauges, by weighing cells or by pressure cells at the bottom of the tank)

These variations together with some additional tests to check repeatability and other influences have been performed during the tests described in this report and are listed below:

(1)	Repetition of tests	57 tests
(2)	Different generation of wave paddle movements	33 tests
(3)	Number of waves (test length)	36 tests
(4)	Analysis of different time windows for wave analysis	determined by analysis only
(5)	Different type of armour layer	21 tests
(6)	Accuracy of measurements	
	- Change position of wave gauges: 3 positions	permanently during all tests
	- Change position of overtopping tray: 2 positions	5 tests
	- Change tray width: 2 widths	17 tests

- Measurement devices for wave overtopping: during 1st phase of tests

5.1.3 Prototype storms

One main objective of CLASH is to reproduce measured storms in laboratory focusing on wave overtopping to draw conclusions on model and scale effects. The measured storms have already been summarised in Table 2. At LWI all these storms have been reproduced in the second test phase in 2004 after re-building the model in the flume.

The iteration procedure which was used for reproduction of the prototype spectra is shown in Figure 38. All tests started with an "iteration 0" which was the direct reproduction of the spectrum obtained from the field by using Froude scale. Results from the model were then compared to the scaled field spectrum and corrected usually by superimposing a factor to the spectrum in those areas where the energy density was not properly reflected by the flume tests.

This appeared to be the case for all storms for a certain range of frequencies ($f > 0.5$ Hz) so that wave heights H_{m0} were obtained which were generally too low and wave periods $T_{m-1.0}$ were generally too long. Therefore, correction factors (generally $f_S = 1.25$) were applied for $f > 0.5$ Hz with a smooth linear transition for $f = 0.5$ Hz ($f_S = 1.0$) to $f = 0.6$ Hz ($f_S = 1.25$). Overall, for all storm events only one iteration was found to be necessary. However, there was still a remaining difference in between energy densities from the model and the field for frequencies larger than $f = 0.90$ Hz which could not be resolved by further iteration loops due to the limitation of the wave generator in the LWI flume. The resulting spectra for each of the storms (iteration 0 and iteration 1) are given in Annex C[1].

[1] Note: storm reproduction for storm 27 Oct, 18-19u was not successful due to limitations of the wave generator at LWI

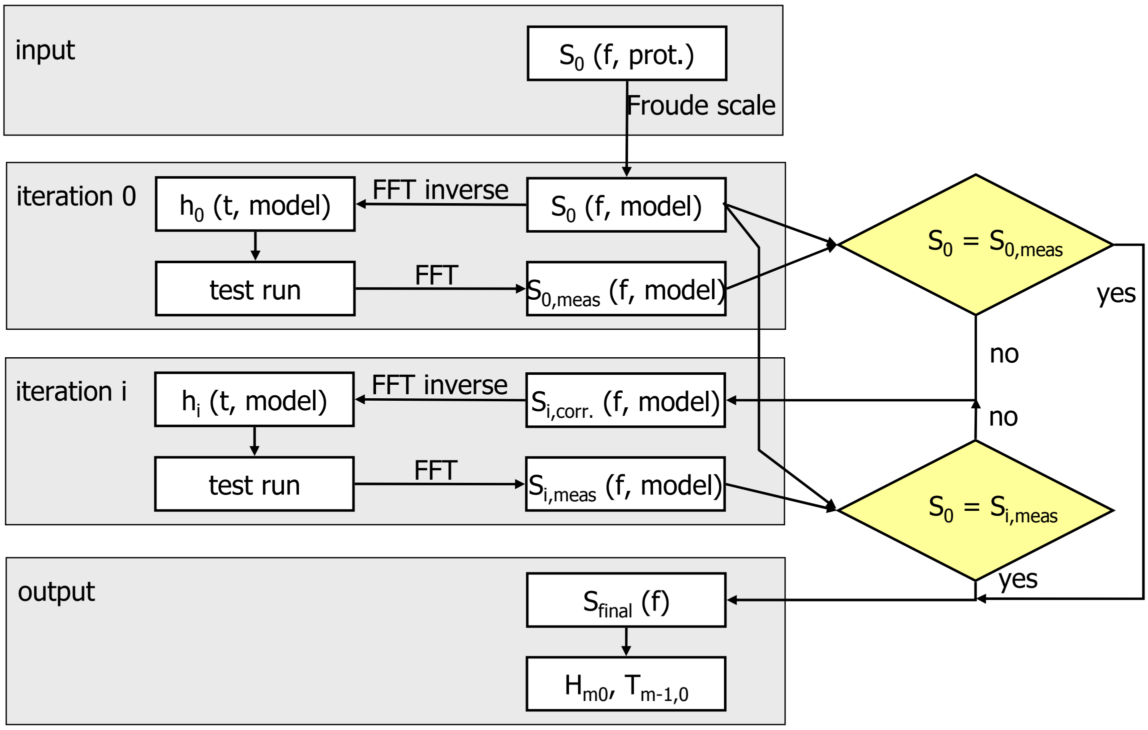


Figure 38: Iterative procedure for modelling a measured spectrum at LWI

5.2 UPVLC

5.2.1 Parametric tests

Within the CLASH project, a set of parametric irregular tests, generated by a theoretical JONSWAP spectrum with γ=1, 3.3 and 7, was carried out (46 tests: 14 tests with slope 1:1.3 and 32 tests with slope 1:1.4) covering different water levels (WL=+3m, +4m and +5m), different wave heights and peak periods (2.5<Hs(m)<5 and 7<Tp(s)<12). Several parametric irregular tests with wind speeds 0.0 m/s and 5.0 m/s were also carried out. Tests with wind speed 3.0 m/s did not give significant differences with tests without wind, and were therefore not all repeated. Additional tests with wind speed 7.0 m/s were done. Table 9 shows the parametric tests carried out during the CLASH project in the UPVLC wind and wave test facility.

Table 9: CLASH parametric tests at UPVLC

TEST	Wind	Testmatrix (Slope 1:1.3)				
		WL	Tp	Hs	Spectrum	γ
	(m/s)	(m)	(s)	(m)		
ZE03_0108	0	3	9.3	4.5	JONSWAP	3.3
ZE03_0109	0	3	9.8	5.0	JONSWAP	3.3
ZE03_0110	0	3	10.3	5.5	JONSWAP	3.3
ZE03_0111	0	3	10.8	6.0	JONSWAP	3.3
ZE03_0112	0	3	11.2	6.5	JONSWAP	3.3
ZE03_0113	0	3	11.6	7.0	JONSWAP	3.3
ZE03_0120	0	3	10.0	4.0	JONSWAP	3.3
ZE03_0134	0	3	8.0	5.0	JONSWAP	3.3
ZE03_0167	0	3	9.0	5.0	JONSWAP	1
ZE03_0168	0	3	9.0	5.0	JONSWAP	7
ZE04_0138	0	4	9.0	5.0	JONSWAP	3.3
ZE04_0144	0	4	11.0	5.0	JONSWAP	3.3
ZE05_0139	0	5	9.0	5.0	JONSWAP	3.3
ZE05_0145	0	5	11.0	5.0	JONSWAP	3.3

TEST	Wind	Testmatrix (Slope 1:1.4)				
		WL	Tp	Hs	Spectrum	γ
	(m/s)	(m)	(s)	(m)		
ZE03_0108	0, 3 & 5	3	9.3	4.5	JONSWAP	3.3
ZE03_0109	0, 3 & 5	3	9.8	5.0	JONSWAP	3.3
ZE03_210	0, 3 & 5	3	10.3	5.5	JONSWAP	3.3
ZE03_211	0, 3 & 5	3	10.8	6.0	JONSWAP	3.3
ZE03_212	0, 3 & 5	3	11.2	6.5	JONSWAP	3.3
ZE03_213	0, 3 & 5	3	11.6	7.0	JONSWAP	3.3
ZE03_0120	0, 3 & 5	3	10.0	4.0	JONSWAP	3.3
ZE03_234	0 & 5	3	8.0	5.0	JONSWAP	3.3
ZE03_0167	0 & 5	3	9.0	5.0	JONSWAP	1
ZE03_0168	0 & 5	3	9.0	5.0	JONSWAP	7
ZE04_0103	0,3,5 & 7	4	6.2	2.0	JONSWAP	3.3
ZE04_0104	0,3,5 & 7	4	7.0	2.5	JONSWAP	3.3
ZE04_0105	0,3,5 & 7	4	7.6	3.0	JONSWAP	3.3
ZE04_0106	0,3,5 & 7	4	8.2	3.5	JONSWAP	3.3
ZE04_0117	0 & 5	4	7.9	2.5	JONSWAP	3.3
ZE04_0127	0 & 5	4	5.0	3.0	JONSWAP	3.3
ZE04_0128	0 & 5	4	6.0	3.0	JONSWAP	3.3
ZE04_0129	0 & 5	4	10.0	3.0	JONSWAP	3.3
ZE04_0130	0 & 5	4	11.0	3.0	JONSWAP	3.3
ZE04_0138	0 & 5	4	9.0	5.0	JONSWAP	3.3
ZE04_0144	0 & 5	4	11.0	5.0	JONSWAP	3.3
ZE05_0103	0, 5 & 7	5	6.2	2.0	JONSWAP	3.3
ZE05_0104	0, 5 & 7	5	7.0	2.5	JONSWAP	3.3
ZE05_0105	0, 5 & 7	5	7.6	3.0	JONSWAP	3.3
ZE05_0106	0, 5 & 7	5	8.2	3.5	JONSWAP	3.3
ZE05_0117	0 & 5	5	7.9	2.5	JONSWAP	3.3
ZE05_0127	0 & 5	5	5.0	3.0	JONSWAP	3.3
ZE05_0128	0 & 5	5	6.0	3.0	JONSWAP	3.3
ZE05_0129	0 & 5	5	10.0	3.0	JONSWAP	3.3
ZE05_0130	0 & 5	5	11.0	3.0	JONSWAP	3.3
ZE05_0239	0, 5 & 7	5	9.0	5.0	JONSWAP	3.3
ZE05_0339	0	5	9.0	5.0	JONSWAP	3.3
ZE05_0439	0	5	9.0	5.0	JONSWAP	3.3
ZE05_0539	0	5	9.0	5.0	JONSWAP	3.3
ZE05_0639	0	5	9.0	5.0	JONSWAP	3.3
ZE05_0245	0 & 5	5	11.0	5.0	JONSWAP	3.3
ZE05_0445	0	5	11.0	5.0	JONSWAP	3.3
ZE05_0545	0	5	11.0	5.0	JONSWAP	3.3
ZE05_0645	0	5	11.0	5.0	JONSWAP	3.3

5.2.2 Prototype storms

On October 27th 2002, a major storm with significant overtopping rate ($q>10^{-4}$ $m^3/m{\cdot}s$) was recorded in the prototype (see Table 2) and experiments reproducing this storm have been carried out in the UPVLC wind and wave test facility by fitting the measured spectra. The spectrum adjustment iterative procedure is described in Figure 39 One single iteration was usually enough to fit the prototype spectrum.

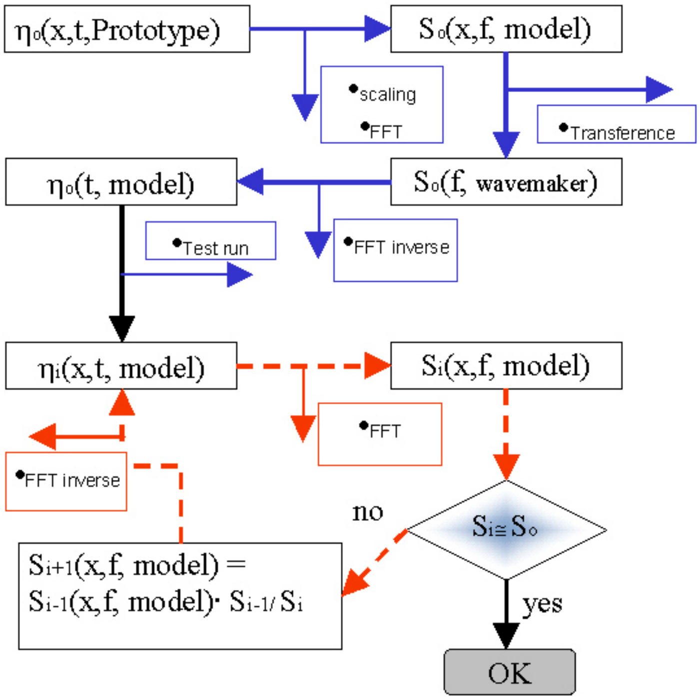


Figure 39: Iterative procedure for modelling a measured spectrum at UPVLC

Table 10 shows the prototype storms reproduced during CLASH in UPVLC wind and wave test facility. The reproduction of the spectra is given in Annex D.

Table 10: Prototype storm, October 27th, 2002

TEST	Wind	Storm October 27th, 2002				
		WL	Tp	Hs	Spectrum	□
	(m/s)	(m)	(s)	(m)		
17:00-18:00	0, 5 & 7	4.4	8.57	3.74	STORM	
18:00-19:00	0, 5 & 7	4.6	8.57	3.86	STORM	
19:00-20:00	0, 5 & 7	4.35	8.57	3.71	STORM	

5.2.3 Foreshore changes and variability

a) Foreshore changes

The “Jetty section” for the OPTICREST project is located 140 m from the “tank section” for the CLASH project. The differences in the foreshore between the “jetty section” and the “tank section” are shown in Figure 40.

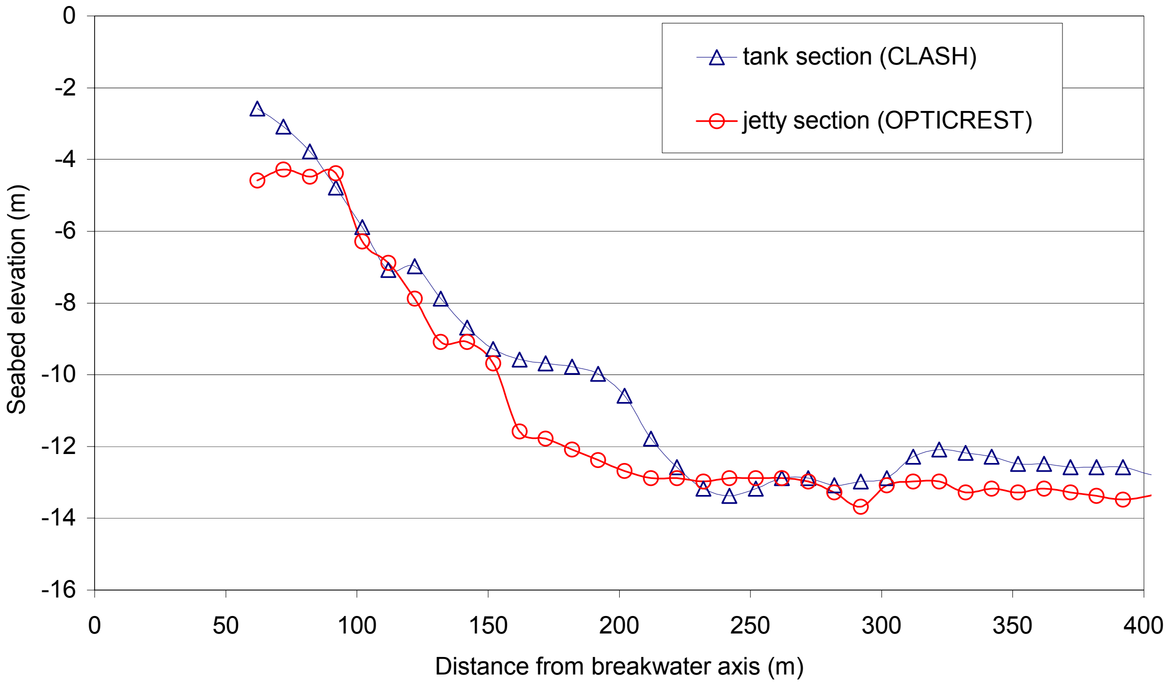


Figure 40: Foreshore of the Zeebrugge prototype in tank section (CLASH) and jetty section (OPTICREST)

The foreshore of the CLASH model was removed to compare the original foreshore of the CLASH model (Figure 41) with the same foreshore that was modelled in OPTICREST (Figure 42)

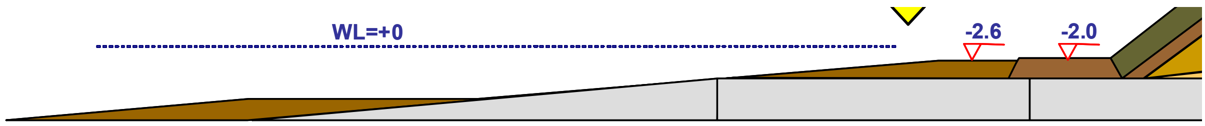


Figure 41: Foreshore of the CLASH model (tank section)

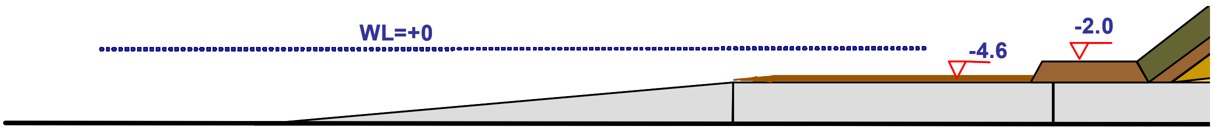


Figure 42: Foreshore of the OPTICREST model (jetty section)

b) Spatial Variability

Additional tests were completed to quantify effects of spatial variability on overtopping discharges. Changes in the position of the armour units placed in the breakwater crest were introduced. Several tests were performed considering rotations, displacement of a single armour unit and groups of armour units. The tests were designed 1) starting at the initial position, to rotate a single armour unit along its vertical axis (test CC01), 2) to rotate two armour units along the vertical axis (test CC02) and 3) to change slightly its relative position with small displacements of five armour units near the crest structure (tests CC03 and CC04). Finally, more position changes affecting several armour units near the Mean Water Level (MWL) (tests CC05, CC06 and CC07). The positions of the armour units corresponding to the spatial variability tests are specified in Figure 43.

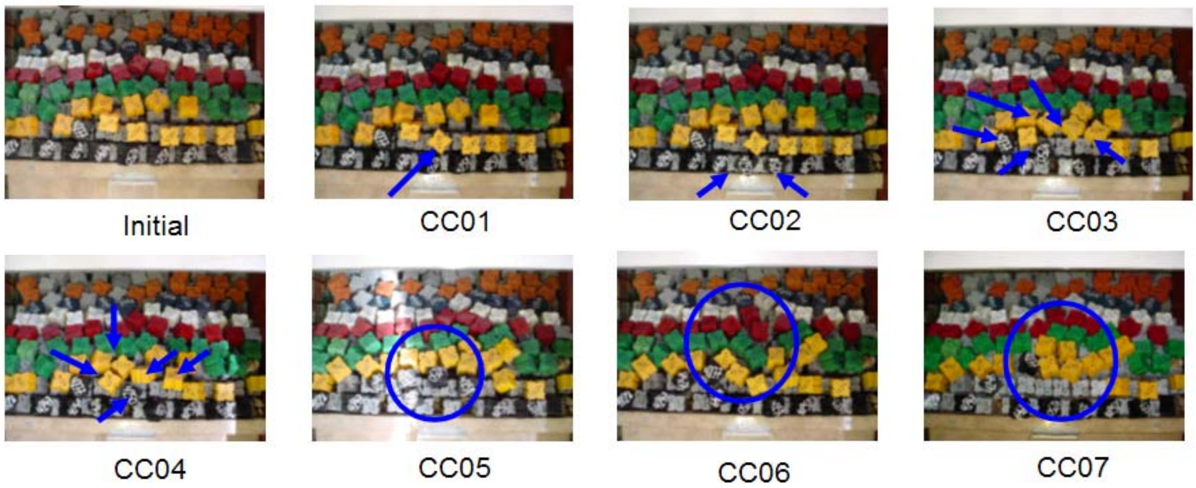


Figure 43: Spatial variability changes in the upper armour layer before the foreshore change

When the foreshore was changed, new spatial variability tests (BC01, BC02, BC03 and BC04) were conducted carried out introducing changes in the positions of the armour units reproduced (Figure 44).

Figure 44: Spatial variability changes in the upper armour layer after the foreshore change

6 Analysis and results

6.1 LWI

6.1.1 Wave analysis

a) Analysis method

The position of all wave gauges used in the tests was given in Tab. 4 already. Wave gauges nos. 1, 2, and 3 were set up to be used for reflection analysis of waves at a point where wave measurements in nature were also performed. Wave gauges nos. 4-6 (second phase: nos. 4-7) were used for the same purpose but over the foreshore of the construction. The same holds true for wave gauges nos. 7-9 (second phase: nos. 8-11). Figure 45 shows a cross section of the LWI flume with the position of the wave gauges used for the first phase of the experiments.

The analysis was performed in three steps:

- *determination of time window for the analysis:* this step was required since the generation software creates each spectrum a certain number of times which will be defined before the start of the tests. During the CLASH experiments this factor was set as 1.5 so that each time series contains a 1.5 times representation of the required spectrum. The time window is therefore set to the number of waves generated in one cycle of the spectrum multiplied by the wave period

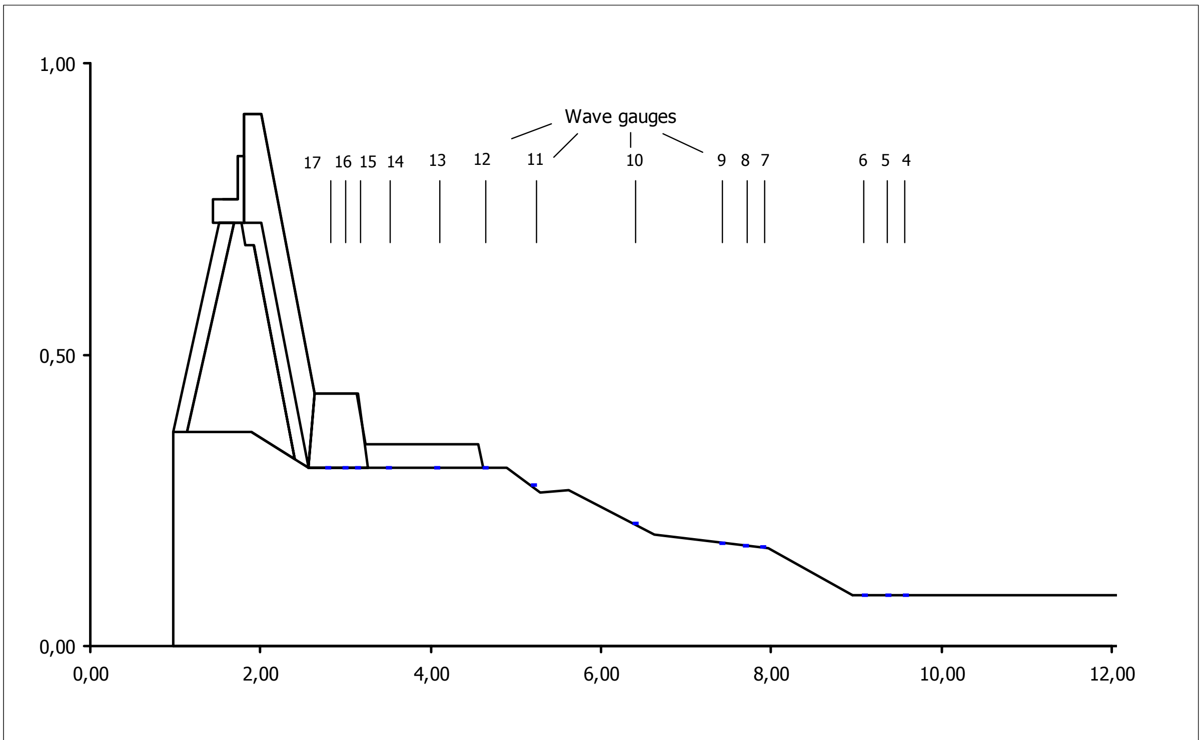


Figure 45: Position of wave gauges in the LWI flume during CLASH experiments (first phase)

- *reflection analysis:* the analysis was then performed using the reflection analysis after Mansard & Funke (1980). This method only requires three wave gauges in a certain distance from each other which is usually dependent on the wave period. In order to optimise results and check results four wave gauges have been used during the second phase and reflection analysis was performed for all four combinations of wave gauges. If there is only little difference in results of these analyses a mean value for all resulting parameters is used. Occurrence of a value which varies completely from the other three values was not taken into consideration.
- *time series and frequency domain analysis of individual wave gauges:* for all wave gauges in the tests both a time series analysis and a frequency domain analysis for the individual wave gauges are performed. Results do not account for the reflecting waves in the wave trains and are not used for further analysis yet.

The results for all tests are saved to test specific files which then have been collated and key results (H_{m0}, T_p, $T_{m-1.0}$, H_s, etc.) were written to an Excel spreadsheet for further analysis. Determination of wave heights H_{m0} and wave period $T_{m-1.0}$ were performed as follows:

$$H_{m0} = 4 \cdot \sqrt{m_0} \quad [\mathrm{m}] \tag{10}$$

$$T_{m-1,0} = \frac{m_{-1}}{m_0} \quad [\mathrm{s}] \tag{11}$$

where m_{-1} and m_0 are moments of the energy spectrum defined as follows:

$$m_n = \int_0^\infty S(f) \cdot f^n \, df \qquad \text{with } n = 0, 1, 2, \ldots \tag{12}$$

For all further plots the wave heights at the toe of the structure were used. Since there was no wave array available at this point the wave parameters were averaged for wave gauges 11, 12, and 13 (see Figure 45, for the second test phase the corresponding wave gauges were nos. 13, 14, and 15). However, wave spectra from the field tests were provided about 240 m from the breakwater axis. This corresponds to wave gauges 7, 8, and 9 (or 8, 9, 10, and 11 in the second test phase) in Figure 45 so that the wave parameters and the spectra resulting from reflection analysis at these wave gauges were taken to compare to the field data.

b) Results

Results with regard to wave analysis can be distinguished within the following reasons for measurement uncertainties:

- **Reflection analysis vs. preconstruction tests:** tests have been performed before the construction of the breakwater only with the foreshore installed in the flume. For these tests the same test matrix as shown in Table 8 was used. Results have indicated that despite the absorption installed at the end of the flume reflection coefficients for the tests were up to 20% (whereas they were about 30% for the tests with the breakwater). These results suggested that wave analysis from preconstruction tests cannot be used as incident wave information for later tests with the breakwater installed. Therefore, for all tests analysed for this study, reflection analysis as described in section 4.1.2a) was used.
- **Repeatability of tests:** some tests were repeated several times directly after each other. Care was taken that no water level changes took place in between the measurements so that all parameters were identical between tests. Only these tests were taken into account. Overall results are presented in Table 11 showing that the mean CoV is very good for wave parameters (less than 3%) whereas CoV for overtopping discharges may reach up to 13%.

Table 11: Overview of results concerning uncertainties and model effects for waves and wave overtopping in the LWI tests

			mean factor	Std.-dev.	Coeff. of var.		
					min	mean	max
repeatability of tests	H_{m0}	[m]		4,75E-03	0,37%	3,0%	10,1%
	T_{m-10}	[s]		5,00E-03	0,04%	0,3%	1,30%
	q	[m^3/m·s]		4,45E-06	2,01%	12,9%	35,8%
different generation files	H_{m0}	[m]		1,02E-02	2,72%	6,1%	12,1%
	T_{m-10}	[s]		1,65E-02	0,04%	0,3%	1,30%
	q	[m^3/m·s]		2,13E-06	1,34%	33,0%	141,8%
number of waves	H_{m0}	[m]		8,67E-03	2,00%	5,3%	8,2%
	T_{m-10}	[s]		1,89E-02	0,09%	1,2%	4,4%
	q	[m^3/m·s]		8,62E-06	8,63%	50,5%	127,3%
analysis of storm events	H_{m0}	[m]					
	T_{m-10}	[s]					
	q	[m^3/m·s]		-	5,61%	22,1%	45,1%
tray position	H_{m0}	[m]					
	T_{m-10}	[s]					
	q	[m^3/m·s]		1,84E-05	18,86%	18,9%	18,9%
tray width doubled	H_{m0}	[m]					
	T_{m-10}	[s]					
	q	[m^3/m·s]		2,43E-06	8,53%	22,7%	29,4%
construction of armour layer	H_{m0}	[m]					
	T_{m-10}	[s]					
	q	[m^3/m·s]		2,01E-05	18,80%	53,0%	102,3%
Influence wind u = 0-3 m/s	H_{m0}	[m]	0,79	4,03E-02		5,1%	
	T_{m-10}	[s]	0,92	2,49E-02		2,7%	
	q	[m^3/m·s]	0,48	3,65E-01		76,6%	
Influence wind u = 0-5 m/s	H_{m0}	[m]	0,87	1,25E-01		14,4%	
	T_{m-10}	[s]	0,95	5,17E-02		5,4%	
	q	[m^3/m·s]	5,66	7,00E+00		123,6%	
Influence wind u = 0-7 m/s	H_{m0}	[m]	1,03	9,58E-03		0,9%	
	T_{m-10}	[s]	1,01	3,89E-03		0,4%	
	q	[m^3/m·s]	23,9	3,06E+01		127,9%	

- **Generation of paddle movement:** the movement of the paddle by the control software is amongst others depending on the type of spectrum and a random number generator. Assuming, that the type of spectrum is identical for the parametric tests (theoretical spectra only), the random number generator will generate different time series of waves which will eventually form an identical spectrum. The different generation mechanisms which will be randomly generated when performing lab experiments have been tested by performing identical tests, but with different wave generation files. Results of this analysis have been also summarised in Table 11.
- **Number of waves in a spectrum:** the number of waves in a spectrum will usually be determined by the need of the respective investigation. If statistical information is required from those tests, the number of waves should certainly exceed 1000, better 2000 waves. If regular waves are generated just 10 or 20 waves would be

sufficient. In the parametric tests performed here, the standard number of waves was 1000, which was then varied to 200 waves in order to obtain information on different results (Table 11).

- **Different time windows for analysis:** if control software allows for a repetition factor of the spectrum then the whole spectrum information is repeated after the required number of waves has been performed. The repetition factor at LWI was 1.5, so that different time windows for analysis could be used for wave and wave overtopping analysis.

Table 11 summarises all results by giving mean and relative values of the uncertainties. For each group of tests the mean values of H_{m0}, T_{Hm0} and q were calculated and the coefficient of variation CoV has been derived from those mean values and the standard deviation. The minimum and maximum values for the CoV are also given. These numbers should indicate how much the parameter varies with regard to the different sources of uncertainty.

For the wave analysis performed in the LWI tests Table 11 indicates that wave parameters are only affected by about 3% in average ranging from about 0.4% to 10%. If different wave generation files are used the mean CoV of wave heights becomes about 6% whereas the CoV of the wave period remains below 1%. The CoV for wave overtopping discharges is much higher when tests are repeated and goes up to 13% for direct repetition and to 33% for different wave generation files. The number of repeated tests is however not very high so that results only give an indication of uncertainties.

With that background the influence of the number of waves is not as high as the numbers seem to indicate. Since different numbers of waves require different wave generation files as well, the CoVs for waves and overtopping discharges are only slightly higher than the ones resulting from different wave generation files.

The tray width and position as well as the armour layer layout seem to result in more variations (larger CoV). The armour layer layout will therefore be dealt with in more detail within this section.

Wave analysis methods have been varied analysing the tests by using wave analysis methods and software provided by AAU as described in Frigaard & Schlütter (1999). The comparison of results has shown that differences between the analysis methods are negligible.

6.1.2 Wave overtopping

a) Analysis method

The mean overtopping rate is determined from the time series of the weighing cells underneath the overtopping container or the wave gauge in the overtopping container, respectively. For this purpose the same time window t_1 to t_2 defined for the wave analysis will be used (see section 6.1.1a)). The mean overtopping rate will be obtained by dividing the weight difference measured at the start and the end of the time window by the difference t_2-t_1 and the width of the overtopping tray as follows

$$q = \frac{V_2 - V_1}{t_2 - t_1} \cdot \frac{1}{B_{tray}} \quad [m^3/m \cdot s] \qquad (13)$$

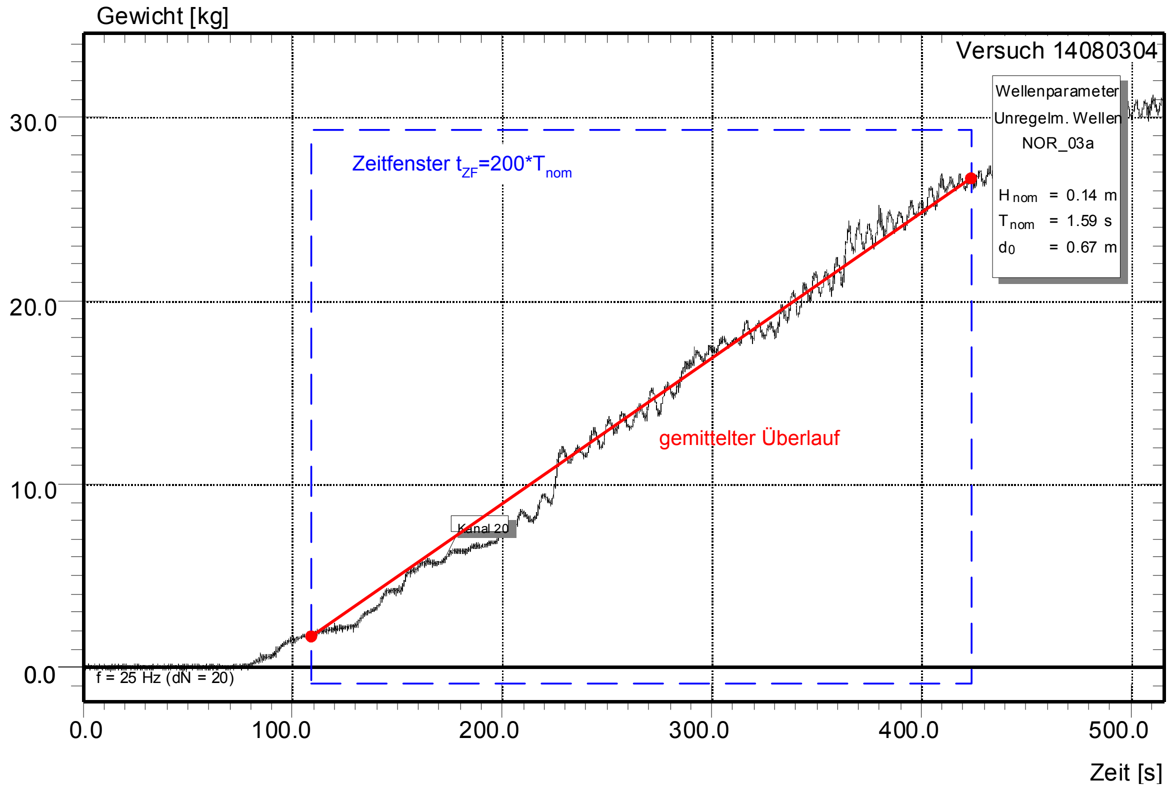


Figure 46: Typical procedure to determine the wave overtopping rate for a test

For tests with large overtopping rates the use of pumps is required to control the filling volume of the overtopping tank. In the later analysis of these tests the period of time where the pump was operating was removed from the analysis.

Table 11 has already summarised results for wave analysis with respect to various measurement uncertainties. During all tests of the first test phase at LWI measurements of overtopping were performed using a wave gauge, two pressure transducers at the bottom of the overtopping tank and the weighing cells. Results of the analysis are not yet completed but it has confirmed that weighing cells are the most accurate solution to measure wave overtopping discharges. Figure 47 indicates that using wave gauges and pressure transducers may deviate from these results by up to100% for small overtopping discharges.

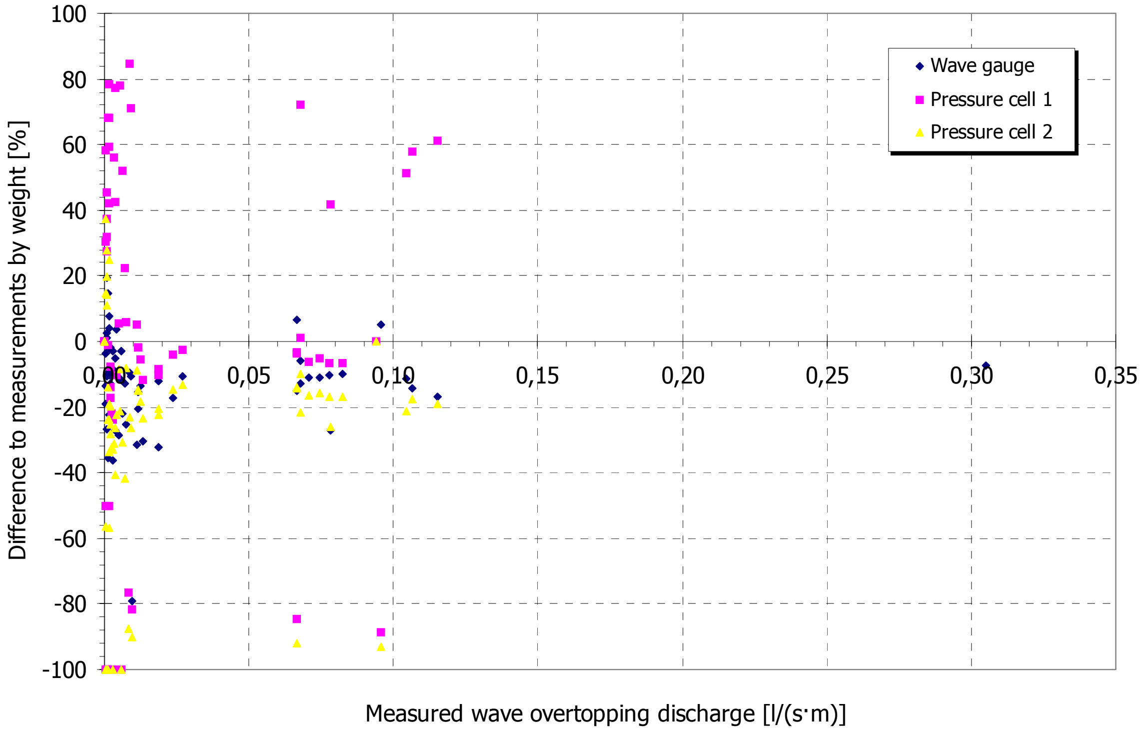


Figure 47: Differences of measurements in wave overtopping with respect to measurement technique as a function of magnitude of mean overtopping discharges (numbers are in model scale)

b) Presentation of overtopping results

In Figure 48 all overtopping results at LWI are plotted together as relative mean overtopping rate against the relative freeboard A_c/H_s. Eq. (6) for non-breaking waves and a roughness factor of $\gamma_r = 0.60$ and $\gamma_r = 0.45$, respectively, were also plotted. Results of eleven prototype storm events at Zeebrugge breakwater as provided by UGent were also given in the same figure.

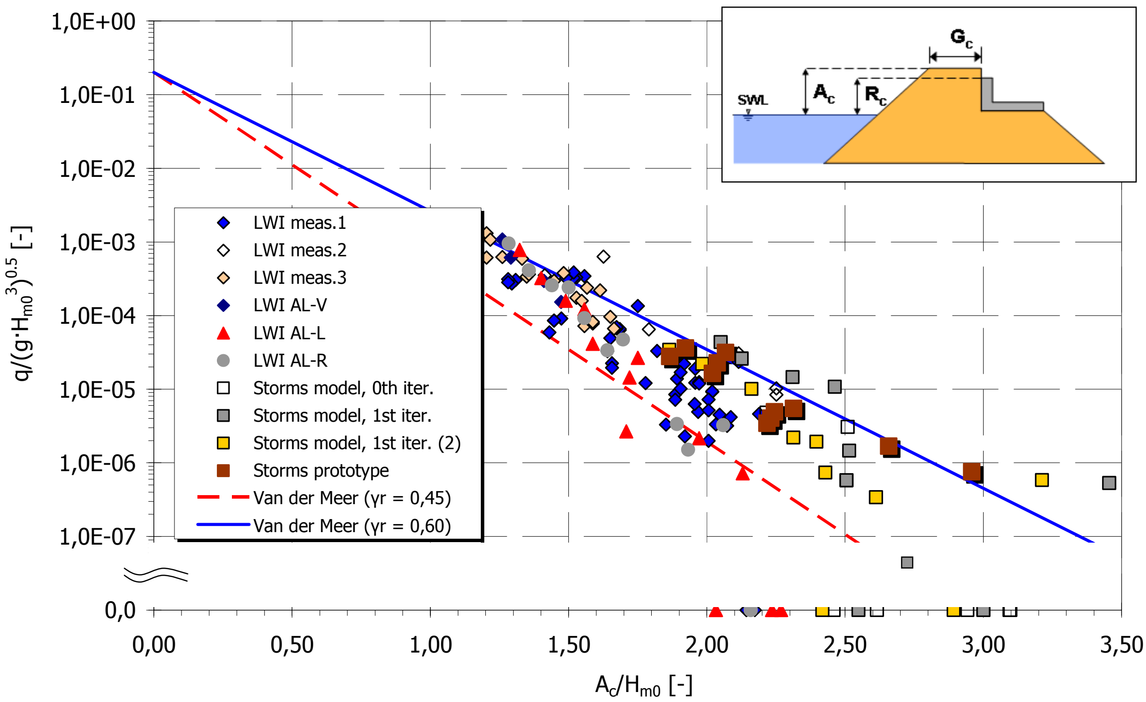


Figure 48: Relative mean overtopping discharges from LWI tests plotted against the relative freeboard with comparison to Van der Meer formula and prototype results

The results in Figure 48 show a relative good agreement between the curves, most of the data points and the prototype storms. Variations and scatter of the data will be explained in the following sections where first all model effects and then the reproduction of storms will be discussed in more detail.

c) Model effects

From more detailed analysis of the test results on wave overtopping, it became clear that model effects needed to be investigated in much more detail. Therefore, analysis was extended to quantify principal model effects from the tests. Analysis and results are discussed in the subsequent sections.

Repeatability of tests

To study the repeatability of tests the same approach is used as already described in section 6.1.1. Results have been presented in Table 11 showing that repeatability of tests is usually very good (CoV around 3% for wave heights, 0.3% for wave periods, and 13% for wave overtopping discharges). However, these results have been obtained for tests performed during the first test phase at LWI. Later, during the second test phase, the complete model has been re-built and tests have been repeated as well.

Figure 49 compares relative wave overtopping rates from the first test phase for two armour layer layouts (visual layout: AL-V and laser method: AL-L) with results from the second test phase (CLASH_2) where tests with theoretical wave spectra were repeated. Some details of the tests plotted in Figure 49 are given in Table 12.

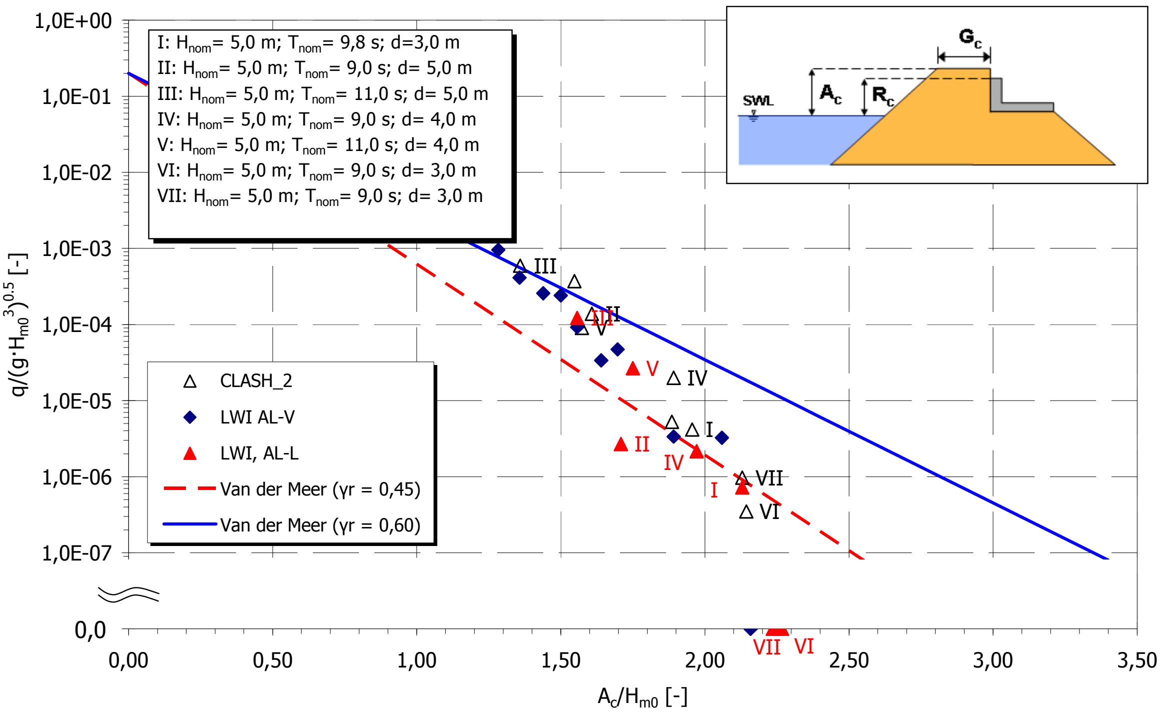


Figure 49: Comparison of model tests from first phase (AL-V, AL-L) and second phase (CLASH_2)

Table 12: Repetition of selected tests with theoretical spectra from first phase at LWI

Gen. file	Clash, AL-L				Clash_2			
	Test no.	H_{m0}	$T_{m-1,0}$	q	Test no.	H_{m0}	$T_{m-1,0}$	q
[-]	[ddmmyyno]	[m]	[s]	[m³/s/m]	[ddmmyyno]	[m]	[s]	[m³/s/m]
017-18z009	10040306	4,41	9,29	7,53E-05	23080401	4,35	9,79	1,37E-04
017-16z039	09040301	4,29	8,53	4,01E-04	23080402	4,11	8,97	4,26E-03
017-20z045	09040302	4,74	10,37	3,93E-03	23080403	4,71	10,87	2,34E-02
017-16z038	10040301	4,26	8,61	5,93E-05	24080401	3,96	9,09	5,85E-04
017-20z044	10040302	4,80	10,34	8,76E-04	24080402	5,16	10,39	3,48E-03
017-16z34a	10040303	4,62	9,34	0,00E+00	24080403	4,50	8,59	1,00E-05
017-16z68	10040305	4,14	8,51	0,00E+00	24080404	4,44	8,60	2,82E-05

Table 12 shows that there are differences both in wave parameters and wave overtopping discharges. Changes of wave heights and wave periods are in the range of less than 10% whereas the wave overtopping rates are generally higher in the second phase, factors are varying in between 4.0 and one order of magnitude.

Possible reasons for these differences were checked before further tests were performed. The following parameters have influenced the test results:

- *Water level:* wave overtopping rates are very sensitive to changes of the water level. Small differences in the water level can cause different overtopping rates, especially for low overtopping.
- *Armour layer:* The armour layout of the two breakwaters compared here was constructed using the laser method. Whilst this was believed to be the most accurate

method to build the armour layer it has been found that placement of the armour stones was not always easy and very much depending on the layout of the lower layer which was assumed regular. Both armour layers were visually checked by means of photos and were found to be very similar, see Kleidon (2004). Differences of stone positions can however not be excluded so that at least some parts of the differences in these tests could have resulted from this source, see Kniewel (2003).

- *Overtopping tray:* the width of the overtopping tray was different in both tests. While for the former tests the same size as in prototype was used the tray was widened in the second phase of the tests (CLASH_2) by almost a factor of 4.0. This may have led to a better collection of water overtopping the breakwater so that the overtopping rate increases.
- *Bends in wooden crown wall:* the crown wall in the model was made from wood which has bent over the last months in the range of 1.5 cm in the middle of the flume. Calculations have shown that a difference in the crown wall of 1.5 cm would lead to about 1.7 higher wave overtopping rates at the maximum. The crown wall in the case of Zeebrugge is protected by the Antifer cubes so that the real effect of this smaller freeboard is believed to be even less significant. Again, this does not explain a factor of up to one order of magnitude.

These points have been carefully checked before further tests were performed. It was concluded that differences for wave overtopping rates less than one order of magnitude is still acceptable for relatively low discharges so that tests could be continued. Main reason for differences probably was the difference in setting up the armour layer of the breakwater.

Position and width of overtopping tray

The results in Figure 48 show that data points measured as 'LWI meas. 2' are relatively high as compared to the other data plots. These measurements were performed with the wider tray (two times the width of the standard tray[2]) and partly with the overtopping tray closer to the side wall of the flume. Together with high water levels in the flume this has sometimes caused extremely high values for some tests which are up to a factor of 100 times higher than the 'mean' values performed with normal tray width and a tray position in the middle of the flume. Detailed analysis has shown that this must be due to the position of the tray mainly since doubling the width of the tray has only limited effect as reported in Timpelan (2004).

Armour layer layout

Three different armour layers have been used at LWI to study the influence of the top layer on wave overtopping. For this purpose the armour layer of the breakwater was built in three different ways:

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[2] Note: the overtopping tray was widened two times during the tests, first by a factor of 2.0 during LWI meas. 1, 2, 3 and AL-V, AL-L and AL-R, second by a factor of about 4.0 during CLASH_2

- *visual construction (AL-V):* the armour layer was constructed using a plan view of the breakwater where the centres of each stone were drawn together with a set of photos from the section in front of the breakwater
- *laser method (AL-L):* the laser method used a laser pointer as an indicator to point out the accurate position of the centres of the Antifer cubes. For this purpose a wooden plate was constructed and mounted horizontally over the breakwater. This plate had holes in it representing the vertical projection of the centre of each cube. The laser pointer was then positioned above the holes in the plate and then indicated the position of the cubes at the breakwater. The cubes were then placed manually by dropping them in the right position just closely above the lower layer of the breakwater. A very similar method was used at UPVLC as well.
- *random method (AL-R):* all Antifer cubes were placed randomly at the breakwater in this method. No plan of the breakwater was used, all stones were just placed so that a random pattern was generated and they were more or less randomly distributed over the total area of the breakwater.

A couple of tests with different water levels and sea state parameters were performed and repeated for the various armour layers. The test results were then plotted in the same way as previously done for all other wave overtopping results together with the prototype test results (Figure 50).

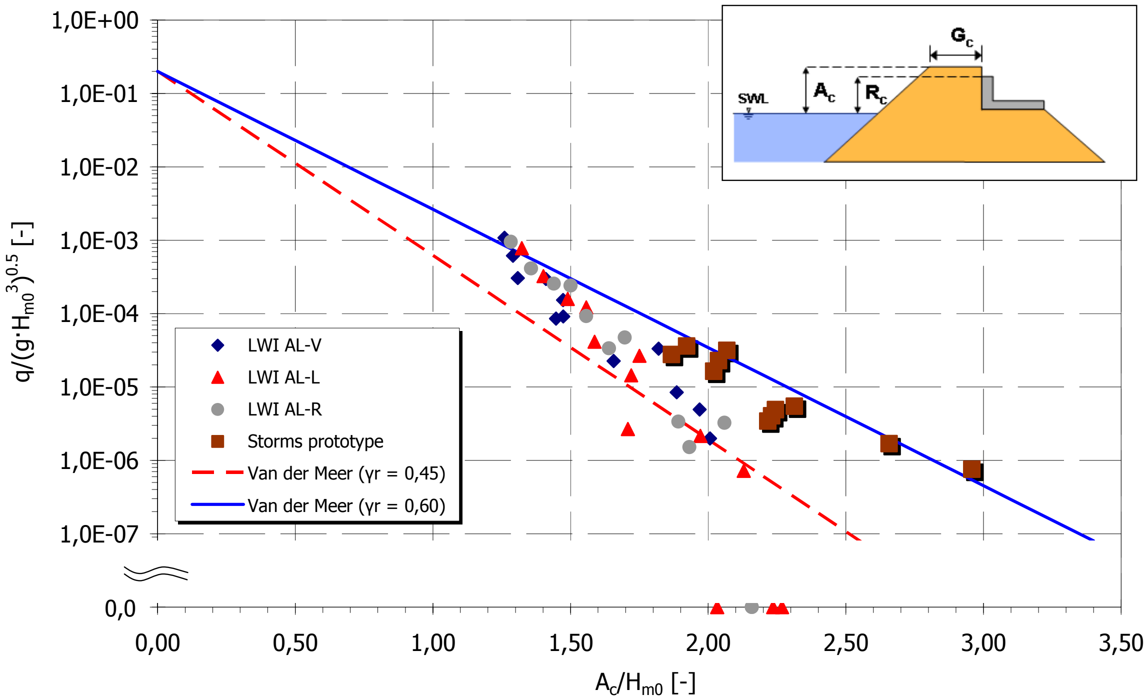


Figure 50: Comparison of wave overtopping results for different layout of the armour layer of the Zeebrugge breakwater

It can be seen from Figure 50 that there is a difference in wave overtopping rates between the visual armour layer (LWI AL-V) and both the random armour layer (LWI AL-R) and the laser method (LWI AL-L). The differences in wave overtopping were in the range of a factor of

5.0 in between the laser and the other methods where the laser method resulted in the lowest overtopping rates. It should be noted that for these tests generally the small overtopping tray was used so that it was assumed that the key influence of the armour layer results from the orientation and location of the two Antifer cubes just in front of the tray. This will be further investigated below. The differences in wave heights and wave periods of the relevant tests were also compared but differences smaller than 3-4% were observed as reported in Kniewel (2003).

A further analysis of these results has looked into the porosity of the armour layer in front of the overtopping tray. This part of the layer was photographed and the number of cubes was counted. Figure 51 shows the three different armour layers in front of the overtopping tray and the water levels investigated in the model together with the width of the overtopping tray (white boxes).

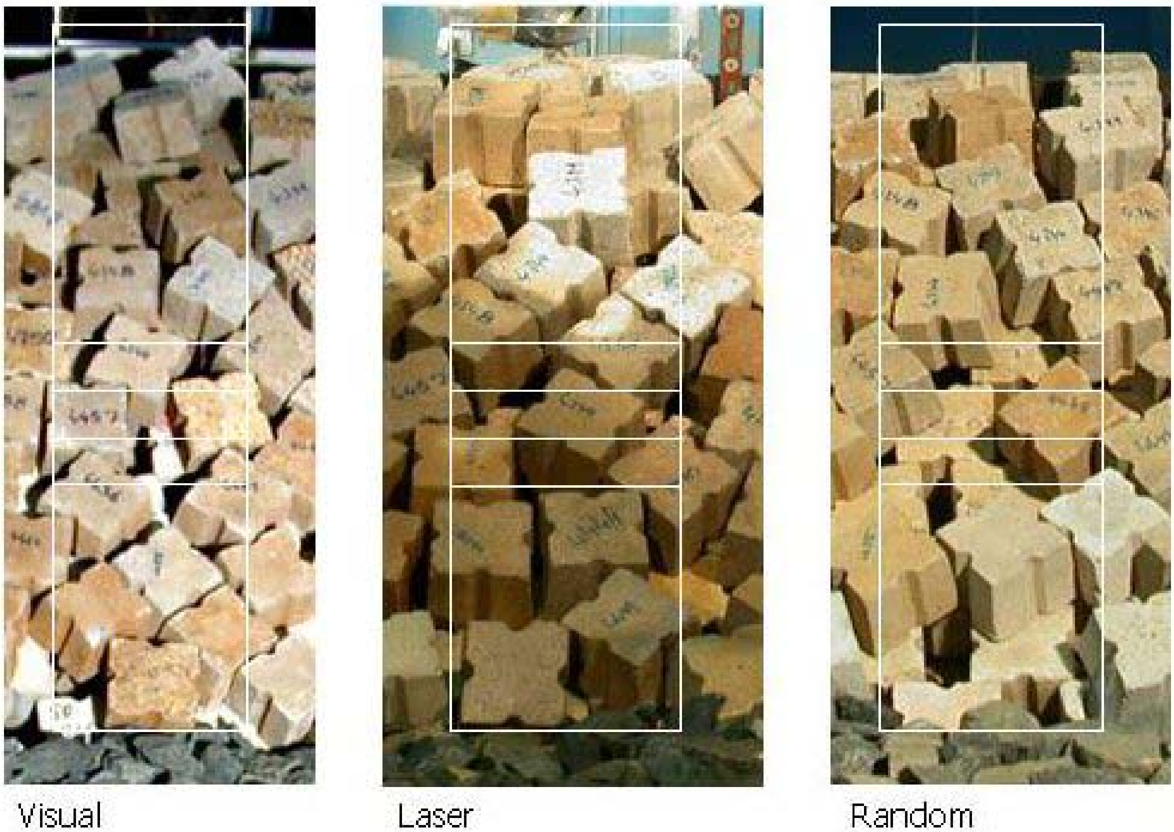


Figure 51: Photos of different armour layers tested at LWI, together with the different water levels and the width of the overtopping tray (indicated by white boxes)

Figure 51 shows that the pattern of the Antifer cubes above the design water level (second highest white line in boxes) is different from each other. Following the assumption that these patterns represent the run-up resistance (friction) of the armour layer it could be expected that the number of cubes in the upper boxes play a major role for the amount of wave overtopping. Thus, all cubes were counted in these areas and compared to overtopping rates of the tests performed. Table 13 shows the result of this analysis.

Table 13: Overview of analysis of number of blocks and resulting wave overtopping rates for selected LWI tests

	Test no.			LWI AL-V	LWI AL-L	LWI AL-R
above NN+6,0m			No. Cubes	6	8	8,5
Hs = 5,01; Tp = 8,98	-	q	[m³/s/m]	0,00893998	0,00442011	0,00750976
Hs = 5,01; Tp = 10,02	-	q	[m³/s/m]	0,02116861	0,00987966	0,01320345
Hs = 5,01; Tp = 11,01	-	q	[m³/s/m]	0,03867038	0,02592341	0,03317807
above NN+5,0m			No. Cubes	7	8,5	9
Hs = 5,01; Tp = 8,98	Z039	q	[m³/s/m]	0,0030772	0,00040077	0,00100752
Hs = 5,01; Tp = 10,02	-	q	[m³/s/m]	0,00536277	0,00130023	0,00297966
Hs = 5,01; Tp = 11,01	Z045	q	[m³/s/m]	0,01278732	0,00393135	0,00821391
above NN+4,0m			No. Cubes	9	9	10
Hs = 5,01; Tp = 8,98	Z038	q	[m³/s/m]	0,00080508	5,9342E-05	9,8473E-05
Hs = 5,01; Tp = 11,01	Z044	q	[m³/s/m]	0,00388291	0,00087574	0,00162517
above NN+3,0m			No. Cubes	9,5	9	11
Hs = 5,01; Tp = 8,98	Z034a	q	[m³/s/m]	0,00016102	0	0
Hs = 5,01; Tp = 8,98	Z067	q	[m³/s/m]	0,00121657	0	5,0742E-05
Hs = 5,01; Tp = 8,98	Z068	q	[m³/s/m]	6,2975E-05	0	0
Hs = 5,01; Tp = 9,80	Z009	q	[m³/s/m]	0,00029505	2,0881E-05	9,8928E-05

Table 13 shows the number of blocks above each of the investigated water levels which are indicated in the white boxes in Figure 51. Furthermore, for each of these water levels the tests are indicated which caused wave overtopping and the overtopping rates for each of the armour layer layouts are shown. As a result it can be seen that generally the visual layout (LWI AL-V) shows the fewest cubes but the highest overtopping rates. This is not true any more if it comes to lower water levels. Here the number of cubes between the visual and the laser layout method is comparable but still the visual layout gives the highest overtopping rates. From Figure 51 it can be concluded that it is not only the porosity but also the number of cubes 'blocking' the run-up and overtopping and which can be interpreted as roughness of the slope. Overall, both parameters (porosity and roughness) seem to have some effect on the overall result so that a very accurate way of constructing the model is needed.

This seems to be confirmed by a recent study by Yagci & Kapdasli (2003) where the influence of four different armour layer layouts on the stability of the breakwater has been investigated. This study has used Antifer cubes as well and has shown that the porosity of the armour layer is very significant for its stability. Although the main objectives of this study was to investigate the stability of the breakwater results have also shown that only in one of the four cases wave overtopping was observed. This happened when the porosity and the roughness of the armour layer was lowest[3]. This may lead to the conclusion that higher porosity and roughness will lead to lower run-up and thus lower overtopping rates.

3 the layout with the highest run-up and some overtopping was named ‚inclined wall' and was built of Antifer cubes just besides each other with no space in between

Additional data from small-scale model (1:70) tests at UGent (Figures 52) have also been used to investigate the difference for different armour layer layouts.

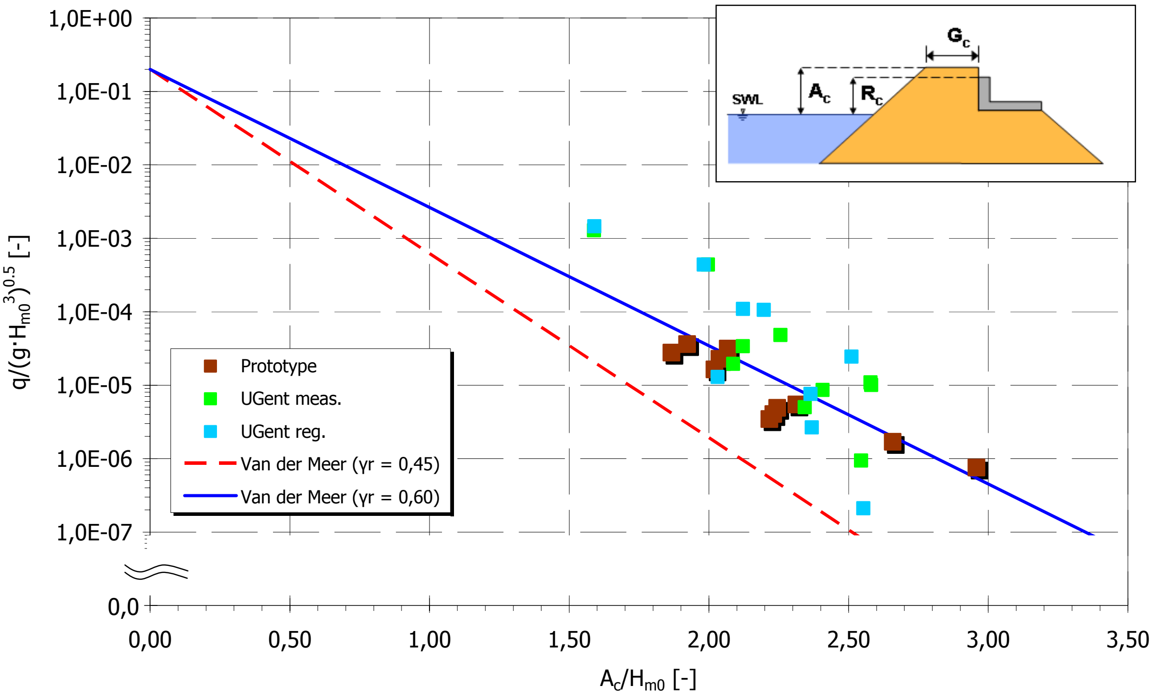


Figure 52: Mean overtopping rates for two different armour layer layouts in small-scale tests at UGent

Figure 52 shows the test results for two different armour layer layouts performed at UGent, one of which was a regular pattern for the upper layer (UGent reg.) and the second was the standard visual method of constructing the armour layer (UGent meas.). Results indicate that porosity and roughness did not play any role in these tests since results are comparable to each other and in relatively good agreement. However, the photo analysis has shown that the number of cubes is higher for the regular pattern (less porosity, higher overtopping) but the roughness seems higher as well (lower porosity) so that these effects may equalise each other. Comparison of random layout with the visual layout at LWI in Figure 50 has given almost the same results as well so that it is more likely that for the Zeebrugge case not the pattern of the whole slope but more the elements near the overtopping tray have the largest influence.

Definition of crest level

A further parameter has not been yet considered in detail which is the definition of the crest level. This has been set to z+12.02 m in prototype and has not been changed throughout the LWI tests and analysis. Therefore, all data plots have been generated using this crest level which is in between taking R_c or A_c (0.38 m smaller than A_c and 1.82 m larger than R_c). Figure 53 shows a plot where this reference has been changed from this standard value for Zeebrugge to the A_c value for small-scale model tests (scale of 1:70) at UGent.

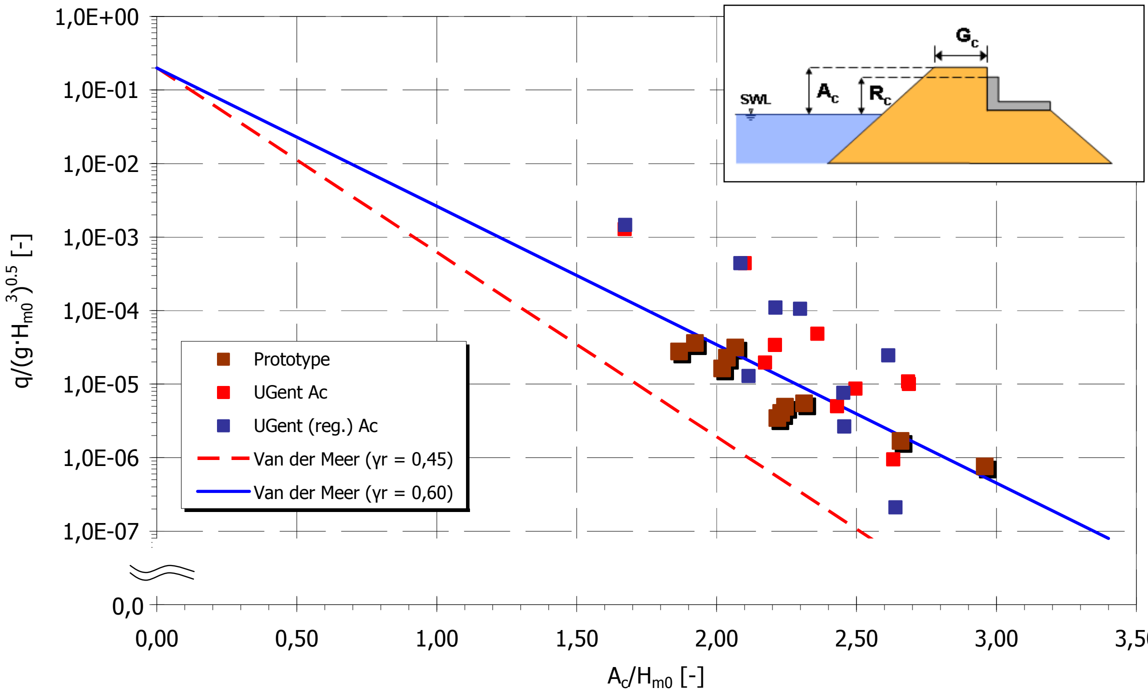


Figure 53: Comparison of data at UGent (scale: 1:70) comparing reference crest level of z+12,02 m and crest level using A_c for Zeebrugge breakwater

Results show that the data points are above the comparison curves (Van der Meer, $\gamma_r = 0.45$ and $\gamma_r = 0.60$). It therefore shows that the definition of the crest level plays an important role for the analysis of the wave overtopping rate and therefore should be carefully set when performing and analysing model tests and comparing them to prototype results and empirical formulas. The difference to the standard values of A_c for the Zeebrugge breakwater is actually not very large but it shifts the data points to the right whereas the curves remain the same in all the graphs. From visual analysis Figure 51 would certainly result in different crest levels, regardless of the value taken into account (A_c or method proposed for Zeebrugge crest level after Geeraerts (2002)).

Wind effects

The influence of wind cannot be investigated in the wave flume at LWI but only in the wave and wind facility of UPVLC. Therefore, the results obtained during these tests as described in section 5.2 will be discussed here to analyse the potential influence of wind on wave overtopping rates.

In Figure 54 the wave overtopping rates measured in all tests at UPVLC are plotted against the relative crest freeboard A_c/H_{m0}. Additionally, the prototype storms and the Van der Meer curves for $\gamma_r = 0.45$ and $\gamma_r = 0.60$ are also plotted. The series referred to as 'UPVLC nat. sp.' contains all tests performed with natural spectra from the storms and all wind speeds from 0.0 m/s to 7.0 m/s. All other series are using theoretical wave spectra with different wind conditions as indicated in the legend.

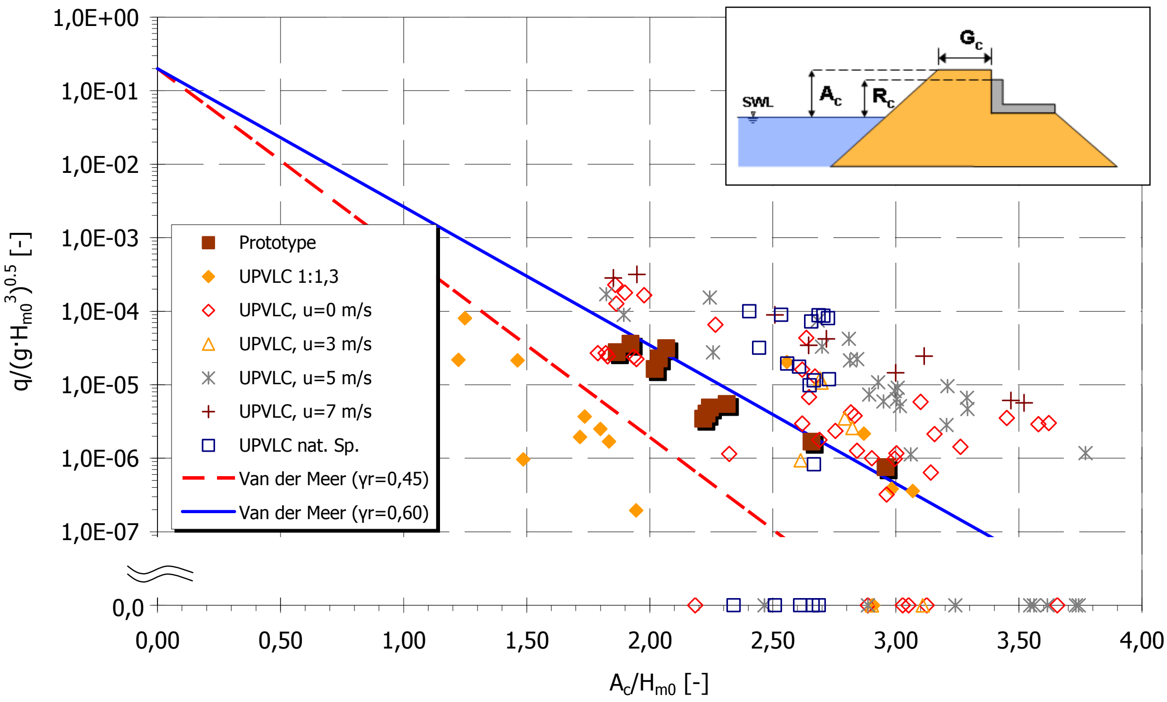


Figure 54: Wave overtopping rates over relative crest freeboard for all tests performed at UPVLC with and without wind

Figure 54 shows that there is a significant difference between the model tests using a different slope ('UPVLC 1:1.3' and 'UPVLC, u=0 m/s', the latter using a slope of 1:1.4). Reasons for this difference have not been investigated any further since a slope of 1:1.3 does not represent the correct reproduction of the prototype model. Rebuilding the model with a different slope means that the armour layer has changed so that differences in wave overtopping rates may have been caused not by the slope alone (see effect of different armour layers and repeatability of tests above).

Tests for u = 0.0 m/s and u = 3.0 m/s show a reasonable scatter (up to about one order of magnitude) but are all lying in the same range of the graph so that the influence of a 3.0 m/s wind is in the range of measurement accuracy. For higher wind speeds (u = 5 m/s and u = 7 m/s) the overtopping rates are much higher than for no wind conditions. Factors are in the range of one order of magnitude.

It should be noted here that besides wind conditions other parameters were changed as well. Tests with u = 3.0 m/s have only be performed at a water level of z+3.0 m whereas wind speeds u = 7.0 m/s were conducted at z+5.0 m. Generally, these water level differences should not generate any differences in a plot like in Figure 54 but to analyse tests in more detail tests with identical water level have been marked in Figure 55.

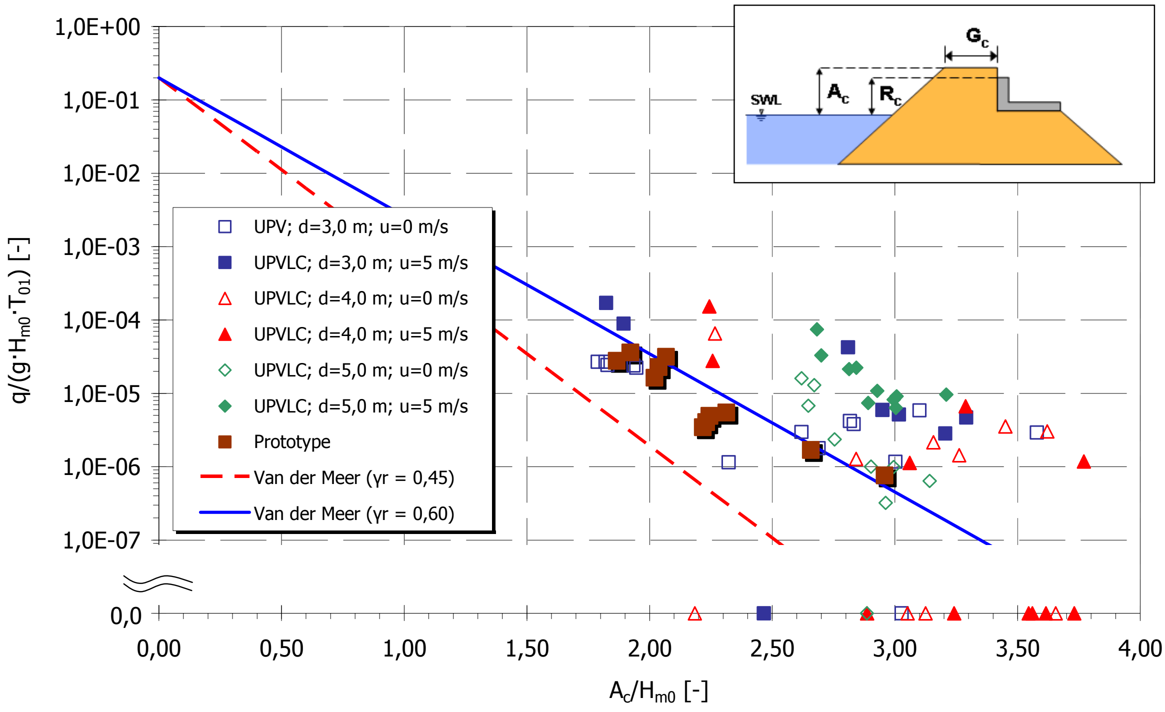


Figure 55: Wave overtopping rates over relative crest freeboard for tests at UPVLC with u = 5.0 m/s and without wind for different water levels

Figure 55 shows that still differences occur in the range of close to one order of magnitude (d = 5.0 m) but for some cases there are hardly any differences with and without wind (d = 4.0 m). There are some reasons for this range of results such as:

- Stronger winds may cause different wave breaking at the structure, also influenced by the water level;
- Results are superimposed by measurement uncertainties;
- Processes due to wind play different roles for different water levels. For example, waves could break earlier in lower water levels, generating spray which is then transported over the structure whereas for higher water levels the waves do not break but wind 'pushes' the water over the crest.

The storm reproduction tests with v = 0.0 m/s have only given wave overtopping for one storm whereas for all other storm reproductions with no wind no overtopping was measured in the tests. For higher wind speeds wave overtopping occurred. Referring to Figure 54 this may have several reasons:

- Wind should be modelled in the laboratory as well and will increase wave overtopping by 'pushing' more water over the crest;
- Position of symbols for storm reproduction on the 'zero' axis shows that wave heights in the model are all lower than for the prototype storms (symbols are slightly shifted to the right of the axis). This may result from an incorrect reproduction of the natural spectra (see sections 6.1.2d) and section 6.2.6).

This will be further discussed in section 6.1.2d) when the reproduction of storms for the LWI tests is analysed.

Further model effects

Further model effects on wave overtopping have been investigated most of which are presented in Table 11. Some of the details are listed in the following:

- **Generation of paddle movement:** approach is identical to the one explained in section 6.1.1; results are presented in Table 11
- **Number of waves in a spectrum:** approach is identical to the one explained in section 6.1.1; results are presented in Table 11
- **Position of overtopping tray:** the position of the overtopping tray in the flume has changed between two positions. The standard position was in the middle of the flume, the alternative position was closer to the right side wall. Identical tests were then performed to identify the influence of these measurements; results are presented in Table 11.
- **Width of overtopping tray:** the width of the overtopping tray was first set to match the width of the overtopping tank in prototype. Alternatively, it has then been checked whether different results would be achieved if the size of the tray was doubled. Results are also presented in Table 11.

Results in Table 11 illustrate that variability of overtopping results are much larger than for wave parameters. Even identical tests in the analysis of repeatability of tests have shown that the mean differences are about 10% of the mean value. Maximum absolute differences can easily reach 60% of the mean. Results of UPVLC in Medina et al. (2003) have indicated variations of less than 5% only.

d) Reproduction of prototype storms

The procedure of how prototype storms have been reproduced in the model is already explained in section 5.1.3. All prototype storms are summarised in Table 2. Table 14 shows the wave conditions for the measured storms in Zeebrugge which have been modelled at LWI in the first test phase[4]. None of these tests performed at LWI did show any wave overtopping.

[4] During the first test phase not all prototype storms were available. Therefore only some of the storms were tested. Furthermore, only the 0^{th} iteration was performed (compare Figure 38).

Table 14: Overview of tests performed at LWI to hindcast storms measured at Zeebrugge in 2002 (overtopping rates can be taken from Table 2)

Storm data					**Model tests**				
Storm [date & time]	**MWL (z+…) [m]**	**H_{m0} [m]**	**T_p [s]**	**$T_{m-1,0}$ [s]**	**Test no. [ddmmyyno]**	**d [m]**	**H_{m0} [m]**	**T_p [s]**	**$T_{m-1,0}$ [s]**
Feb. 26th, 2002 13.30-14.00	4.21	2.54	7.91	6.58	14050301	4.20	2.64	7.02	7.71
					19060301	4.20	1.95	7.68	7.16
					24060301	4.20	1.95	7.68	6.95
Oct. 27th, 2002 17.00-18.00	4.40	3.74	8.57	7.50	14050302	4.41	3.60	8.52	8.12
Oct. 27th, 2002 18.00-19.00	4.60	3.86	8.57	7.64	14050304	4.59	3.66	8.74	8.13
Oct. 27th, 2002 19.00-20.15	4.35	3.71	8.57	7.98	14050303	4.35	3.54	8.89	7.60
					19060302	4.35	2.88	8.63	8.69
					24060302	4.35	2.91	8.27	8.69
Jan. 29th, 2003 10.00-12.00	4.71	3.16	7.91	7.28	14050305	4.71	3.00	8.14	7.60

After the first test phase it was concluded that the results needed to be reproduced again for all storms in the second test phase since the wave heights in the model tests were too low to produce any wave overtopping. Therefore, the procedure sketched in Figure 38 was used to reproduce the prototype storms. Figure 56 shows a typical reproduction of an energy spectrum in the LWI model. All spectra for the prototype storms and their reproduction in the LWI model are plotted in Annex C.

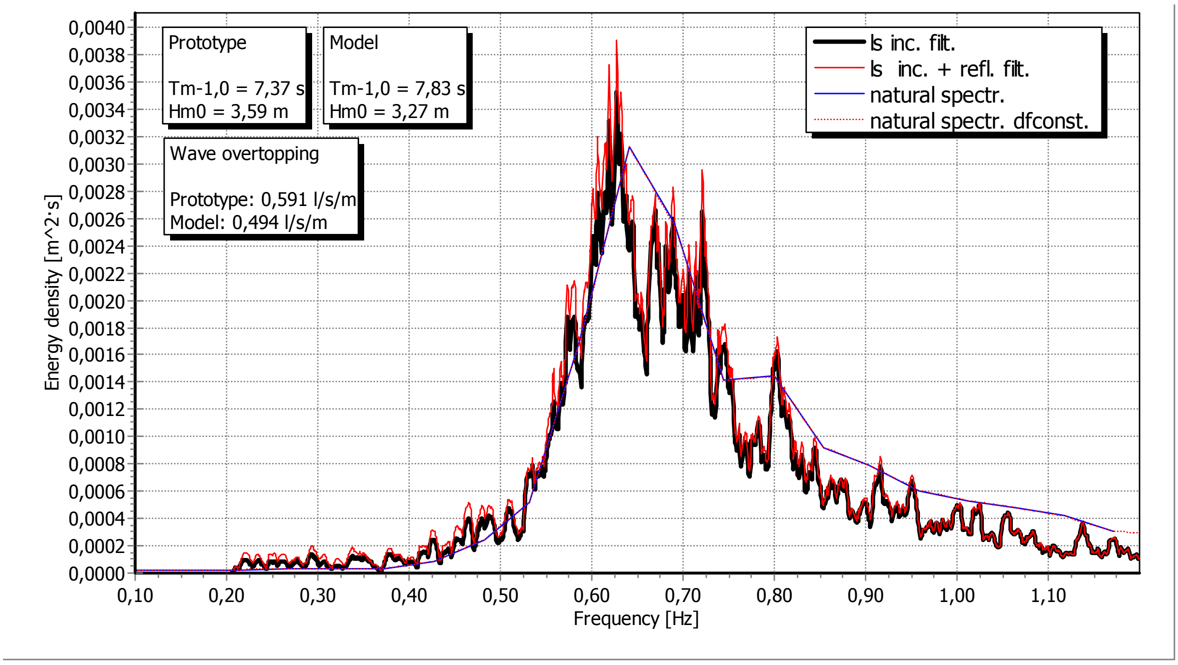


Figure 56: Typical reproduction of a prototype storm spectrum in the LWI model for storm 8 Feb. 2004 (1st iteration)

Figure 56 shows that the reproduction of the left part of the spectrum (long waves) is usually very good whereas the right part (short waves) slightly underestimates the prototype curve. This leads to slightly lower wave heights H_{m0} in the model which do not seem to have a big effect since the reproduction of the storms is relatively good. Figure 57 shows all storm reproductions during the second test phase at LWI together with the prototype results.

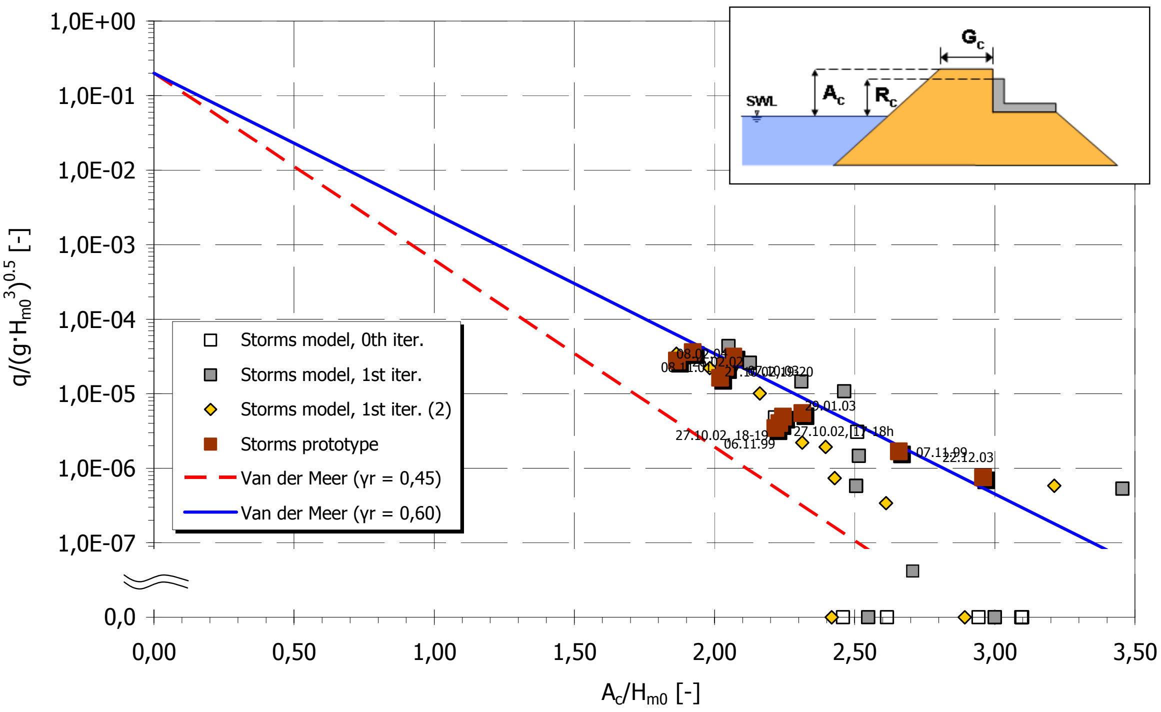


Figure 57: Reproduction of storms in the LWI model during second test phase (all iterations and repetitions)

The figure shows that reproductions of storms are generally in line with the prototype results. The data points from the model are often slightly to the right since wave height in the model is a little lower than in the prototype since the spectra are not reproduced perfectly (see section 6.1.2d)). This holds true especially for the storm of 26 Febr. 2002 (very right in figure) where the two reproductions gave about the same amount of wave overtopping but wave heights were different from the prototype so that both data points are considerably right of the prototype point. Keeping in mind that very low overtopping rates were measured, the reproduction is very good and can be described using Eq. (6) with a roughness factor $\gamma_r = 0.60$.

e) Conclusions on model effects

Despite different wave spectra (theoretical and natural/prototype spectra) the mean overtopping discharges under prototype conditions seem to fit reasonably well with the results from the flume tests at LWI (Figure 48). If the coefficients of variations are considered resulting from the measurement uncertainties with respect to overtopping, some parts of the scatter around the prediction line can already be explained. Additionally, the reproduction of prototype tests in the lab has shown that results are comparable with what was measured in prototype (Figure 57). It is therefore concluded that differences between prototype and model are mainly due to model effects, where the strongest influence results from the layout of the armour layer, the width of the overtopping tray and wind influences. With that background it will be very difficult, if not impossible, to detect and quantify any scale effects for this type of breakwaters and for very low wave overtopping rates.

6.1.3 Forces on dummies

a) Analysis method

To analyse the forces, the two pressure transducers mounted at the dummy person were integrated over the rectangular area of the dummy to yield an overall force of the dummy person. Pressure distributions were extrapolated to the corners of the dummy as described in section 4.1.2c).

First test phase

In the first phase of the tests individual wave overtopping events have been identified and forces have been integrated from the pressure measurements (two pressure cells at the dummy) by using the trapezoidal method. Velocities have been calculated from signals of the layer thickness probes installed in front of the overtopping tank (dummy and velocity measurements are not exactly in line in the flume). Velocities of overtopping waves and forces on dummies have been investigated using selected tests at a higher water level than the previous parametric tests. The higher water level (see test matrix in Table 8) was necessary to get reasonable overtopping amounts and meaningful readings from the measurement devices. Figure 58 gives an overview of an analysis procedure which is discussed in more detail in the following.

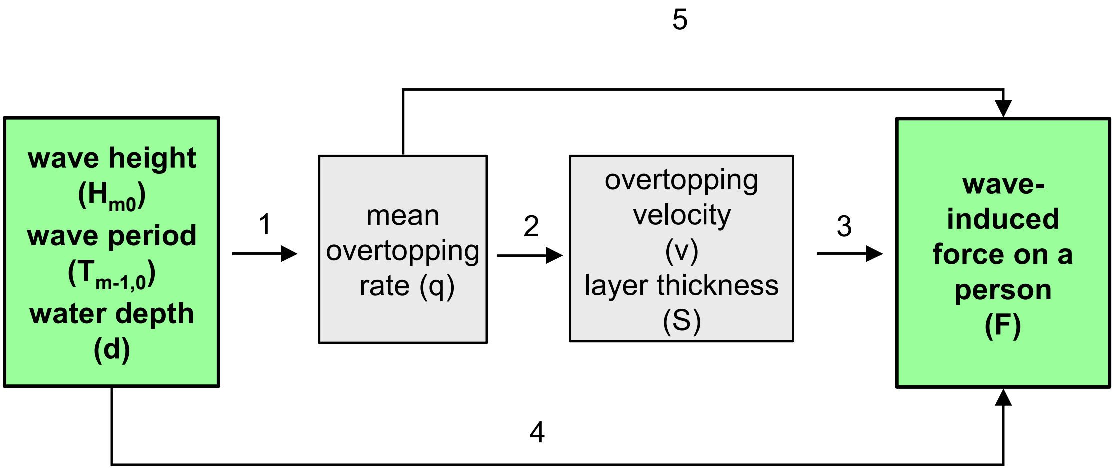


Figure 58: Procedure for analysis of forces on dummies in relation to overtopping waves

Figure 58 describes the steps needed to express dependencies between various parameters which have been measured during the tests as follows:

- Step 1: mean overtopping rate as a function of water level and sea state parameters (this step can be described using one of the well-known overtopping formulas)
- Step 2: relation between overtopping velocity/layer thickness and the mean overtopping rate
- Step 3: wave induced forces on the dummy as a function of the overtopping velocities and the layer thickness
- Steps 4 and 5: if detailed relations cannot be described properly a more 'direct' way can be used by directly relating the forces and the sea state parameters or the mean overtopping rate

Second test phase

In the second test phase a different concept was followed using a statistical analysis of the data. In this approach the pressure transducers were analysed statistically so that different statistical pressure values were available for each of the pressure cells mounted to the dummy. These values were then used for calculation of the statistical dummy force using the same trapezoidal integration formulas as within the first test phase. Therefore, the dummy forces are not obtained from statistical analysis of the force history but from integrating the statistical pressure values.

b) Results

Pressure measurements on the dummy have been sampled at 500 Hz and then integrated to give the overall forces. The highest forces of each test have been used for analysis where the repeatability of tests has been checked first. Results have shown that deviations may reach up to 60% differences which may be due to the type of loading where a mixture of water and air hitting the dummy has been observed during the tests. More details are given by Medina et al. (2003) and Kniewel (2003). The results of the investigations of individual events during the first test phase have suggested that:

- highest velocity of the waves (up to 50 m/s) was reached for wave heights H_{m0} in between 4.50 m and 5.00 m; higher waves seem to break in front of the structure and therefore result in lower velocities
- highest velocities do not result in highest wave forces. Very high wave forces were obtained from events with much lower velocities ($v \approx 10$ m/s). This effect was explained by a very high air entrainment of waves travelling at maximum speed. Due to the high air content the waves do not induce very high pressures at the dummy.
- highest velocities are obtained when the mean overtopping discharge is very low (supporting the theory that overtopping waves contain a lot of air in that case)

However, no quantitative conclusions could be drawn from that analysis since either the number of events analysed was too low or, even more likely, the measurements of velocities was not reliable enough. The latter is however very difficult to overcome since high speed overtopping events are much localised and therefore very difficult to measure in a 2.0m wide flume.

For these reasons, it was decided to follow the statistical approach as described in the previous section. In a first step, all pressures were plotted over the wave height H_{m0} at the toe of the structure (Figure 59).

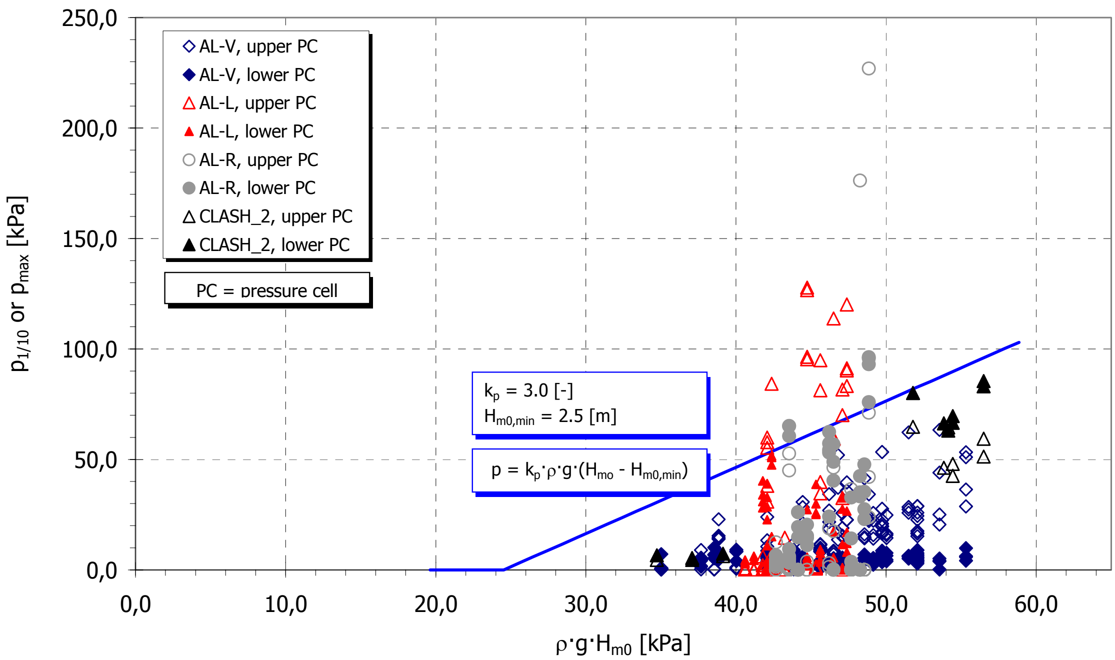


Figure 59: Pressures on a dummy person as a function of the wave height H_{m0} at the toe of the structure

Figure 59 shows that the wave pressure increases with increasing wave heights and starting from a minimum wave height $H_{m0,min}$ below which no wave loading of the dummies could be measured. Both the results from the first and second test phase have been plotted in the figure. It should be noted that the results from the first test phase (series AL-V, AL-L, and AL-R) contain maximum pressures for each test since individual events were analysed. Results from the second test phase (series CLASH_2) are statistical $p_{1/10}$ values which is the average of the 10% highest pressures of a pressure cell. A simple upper boundary formula was also plotted in Figure 59 which does however not contain the maximum values of the first test phase.

In Figure 60 a similar graph is shown but for the total force on the dummy as a function of the wave height H_{m0}. A simple upper boundary formula is also plotted using a minimum wave height $H_{m0,min}$ again. Wave forces F_{Dummy} for CLASH_2 series are different from wave forces for series AL-V, AL-L, and AL-R since the latter also contain maximum forces for specific events. To illustrate these differences, maximum forces for CLASH_2 were also plotted for both the tests with theoretical spectra and the ones with prototype storm spectra. For comparison the results from the latest storm measurements were plotted as series 'Prototype, dummy 2' and 'Prototype, dummy 3' as well.

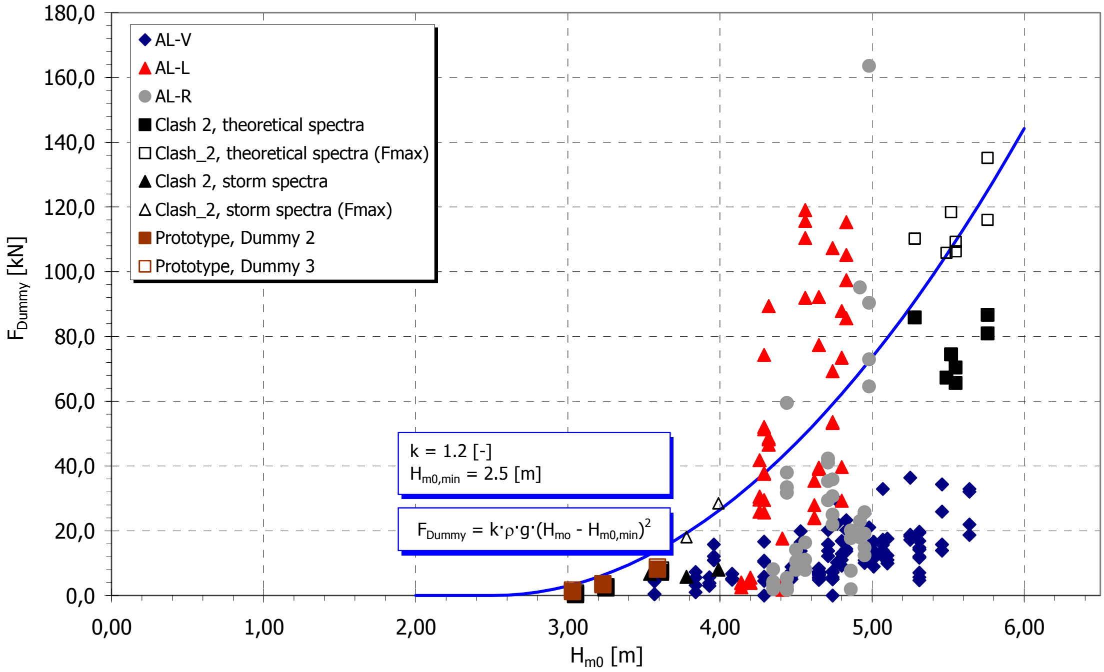


Figure 60: Total forces on the dummy person as a function of the wave height H_{m0} at the toe of the structure

It can be seen from Figure 60 that prototype results are very low and just above the minimum wave height where measurements of pressures and forces start. They seem to fit quite well to the data obtained from the lab tests which are however more in the region of higher wave heights. Again the upper boundary formula does not cover the maximum dummy forces but the statistical $F_{1/10}$ values resulting from the respective pressures.

Results of measurements obtained during the reproduction tests of the storms also fit quite well to the prototype values; but plotting the maximum forces as well shows that there is a difference between $F_{1/10}$ and F_{max} of about 4.0 to 5.0, so that forces in the model are higher than from the field. Due to the high variability of factors involved (3D effects, different measurement types in the field and the model, different analysis methods, no wind in the model, localisation of pressures due to overtopping waves, etc.) this difference seems to be very good.

It should be noted from the literature study performed that the critical value of 140 kN reported in Endoh & Takahashi (1994) is only reached once during the model tests so that no situation (even beyond design conditions) is reached here where people are washed away. It should however be noted that tests from Endoh & Takahashi (1994) were performed for vertical breakwaters which might not necessarily be transferable to rubble mound structures.

Forces on the dummy person were also plotted against the mean overtopping discharge in Figure 61 to verify whether higher forces occur together with higher wave overtopping rates. Overtopping rates were plotted on a logarithmic scale to ease distinction of data points.

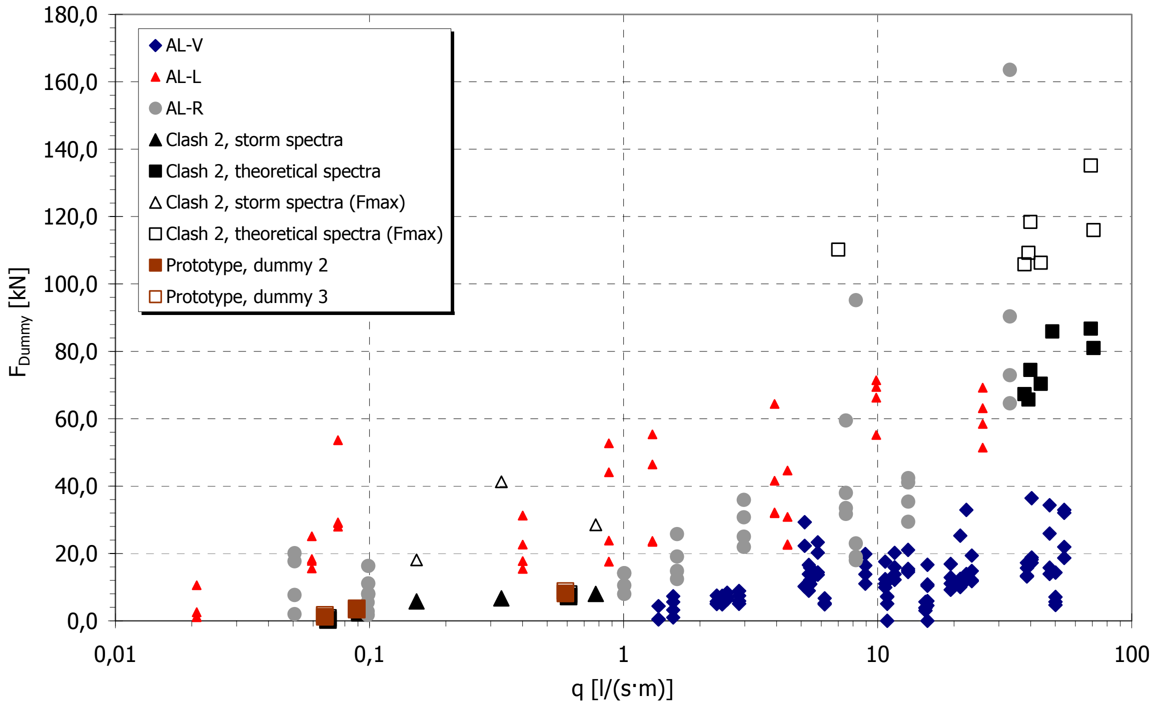


Figure 61: Total forces on the dummy person as a function of the wave overtopping rate q

Figure 61 suggests that there is indeed a direct relation between the dummy force and the logarithmic wave overtopping rate log(q). It also shows that overtopping rates up to 1.0 l/s·m can already cause dummy forces up to about 50 kN whereas only overtopping rates of $q > 10$ l/s·m seem to be very dangerous so that people may fall over. It has already been discussed in section 3.3 that there are a couple of factors which will still influence this result and which should be further investigated:

- size and weight of people
- preparedness of people
- contact of people on the breakwater

- position of people on the breakwater
- orientation of people towards the wave
- type of breakwater (vertical, rubble mound, etc.)

6.2 UPVLC

6.2.1 Introduction

The slope of the model was changed from 1:1.3 to 1:1.4 according to new prototype topographic data. At the same time, the armour layer was reconstructed more precisely, using exact coordinates.

The recommendations of the General Methodology Report (Final Version) in Boone et al. (2002) were used for wave generation and measurement of wave height and overtopping. In addiction to the 3-point least squares method Mansard & Funke (1980) and the SIRW method Frigaard & Brorsen (1995), the LASA method Medina (2001) was used to separate incident and reflected wave because the linear methods were limited in the vicinity of the model. Prototype overtopping rates are represented in the following figures. Froude's similitude has been used to transform laboratory to prototype overtopping rates.

To compare the CLASH results and OPTICREST results, the empirical formula given by Medina et al. (2002) based on OPTICREST results is used. Eq. (7) is the result of the OPTICREST overtopping analysis using neural networks. The dimensionless overtopping value Q is calculated using the following dependent variables: q is average overtopping in prototype values ($m^3/m/s$), R_c/H_{m0}, Ir, Rc/Dn and U(m/s). R_c is the crest freeboard, H_{m0} is the significant wave height in the buoy WR1, Ir the Iribarren number, Dn the D_{50} of the armour layer and U the dimensional wind speed in m/s. The formula is not reliable for insignificant values ($Q < 10^{-5.5}$).

6.2.2 Repeatability

Test ZE05_0x39 (slope 1:1.4) was repeated six times to verify the repeatability of the experiments. The values did not differ more than 13% from the mean value (CoV ≈ 10%). Table 15 shows the results of the repeatability tests.

Table 15: Repeatability tests at UPVLC

		q	Hm0	Q	difference from mean value
Slope	Test	[m3/m/s]	[m]	[-]	%
1:1.4	ZE05_0239	6.56E-04	4.99	1.88E-05	9.3%
	ZE05_0339	6.38E-04	4.86	1.90E-05	10.7%
	ZE05_0439	5.73E-04	4.82	1.73E-05	0.8%
	ZE05_0539	5.18E-04	4.78	1.58E-05	-7.9%
	ZE05_0639	4.80E-04	4.72	1.49E-05	-12.9%
	ZE05_1039	6.25E-04	4.93	1.82E-05	5.1%
1:1.3	ZE05_0139	9.41E-04	4.83	2.83E-05	64.7%

6.2.3 Sope change

During CLASH experiments, the slope of the UPVLC model was changed from 1:1.3 to 1:1.4, according to new prototype data. At the same time, the armour layer was reconstructed more precisely, using exact coordinates at the tank section (instead of the jetty section used in OPTICREST). Eleven (ZE03_0108, ZE03_0109, ZE03_0110, ZE03_0111, ZE03_0120, ZE03_0134, ZE03_0167, ZE04_0138, ZE04_0144, ZE05_0139, ZE05_0145) were carried out with slopes 1:1.3 and 1:1.4. Figure 62 shows the comparison of results.

The change of the slope (1:1.3 to 1:1.4) did not significantly affect the overtopping rates (Figure 62).

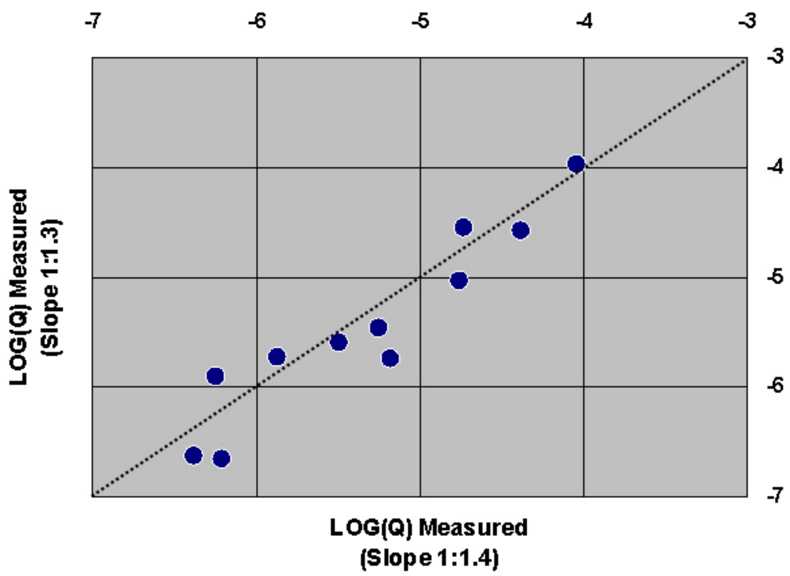


Figure 62: Overtopping rates measured with slope 1:1.3 vs the empirical formula results with slope 1:1.3

The results using the slope 1:1.3 fitted reasonably well to the OPTICREST results (represented by the empirical formula for [log Q] > -5.5) (Figure 63).

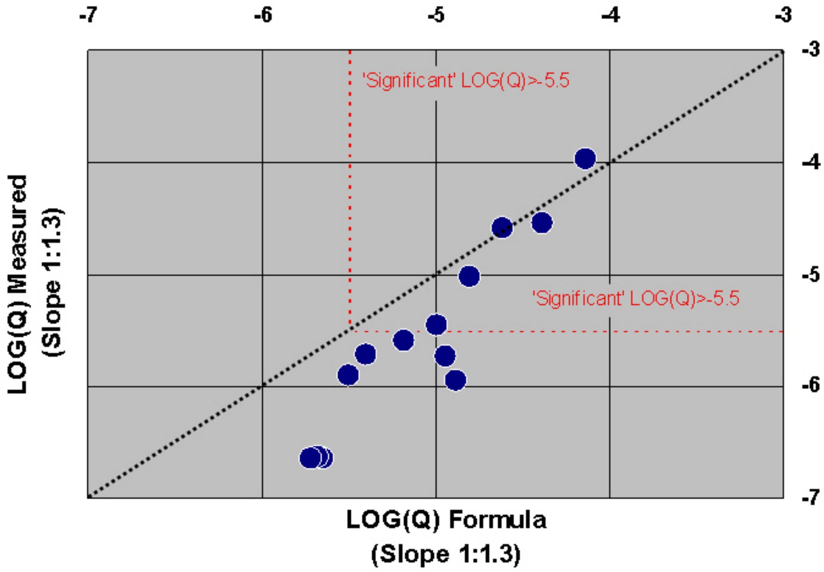


Figure 63: Overtopping rates measured vs empirical results by the OPTICREST formula (Medina et al. (2002))

6.2.4 Spatial variability and foreshore influence

Figure 64 shows results from tests on the spatial variability and foreshore influence on overtopping discharges. A comparison was made between the overtopping rates measured (triangle) with the empirical results obtained by the formula Eq. (1) (circle) and the Van der Meer formula (line) with γ_r=0.45, where γ_r is the roughness factor after Van der Meer & Janssen (1995).

The OPTICREST formula and the Van der Meer formula include all the standard variables except spatial variability and for the evaluated tests, results of both formula lead to almost the same estimation.

Test ZE05_0x39 was repeated up to six times reproducing standard conditions for the CLASH experiments and provided similar to overtopping results than the OPTICREST estimated re-sults by formula in Eq. (1).

Changes in the position of the armour units described in section 6.2 significantly influence the overtopping discharges with no clear tendency. Also, when removing part of the foreshore, the influence on overtopping measurements is of relevance, generally leading to higher overtop-ping discharges.

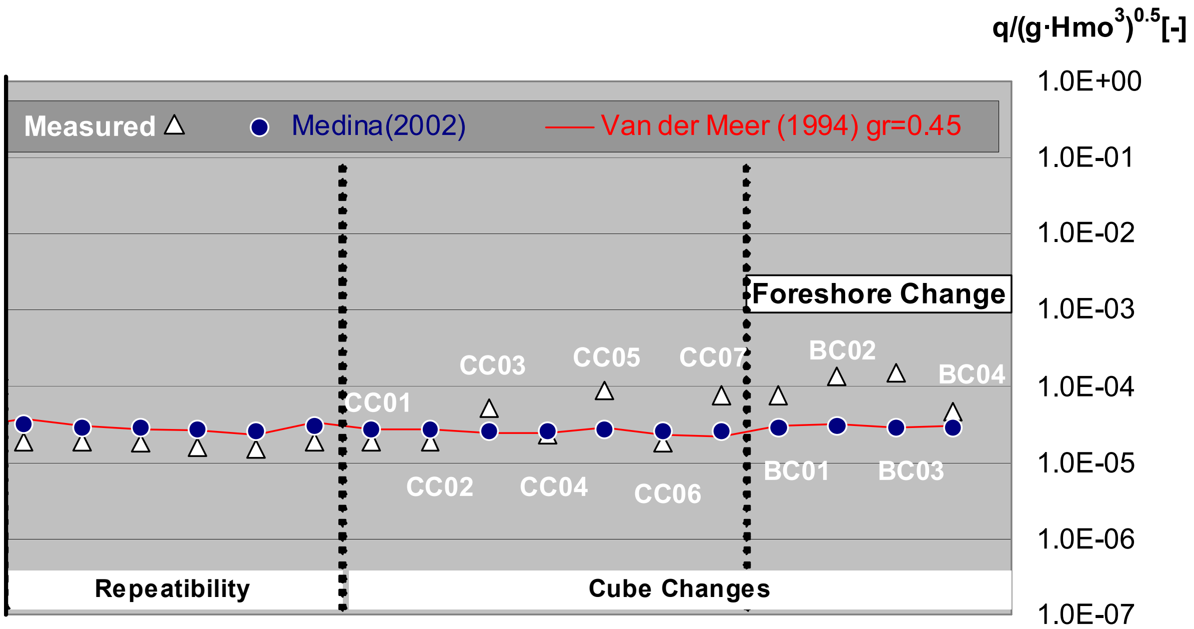


Figure 64: Overtopping rates measured vs OPTICREST formula and Van der Meer formula (γ_r=0.45)

6.2.5 Wind conditions

The parametric tests results show higher overtopping values for high wind speeds in most experiments, and this confirms previous results. In Figure 65, tests with wind speeds 0.0 m/s, 5.0 m/s and 7.0 m/s are compared.

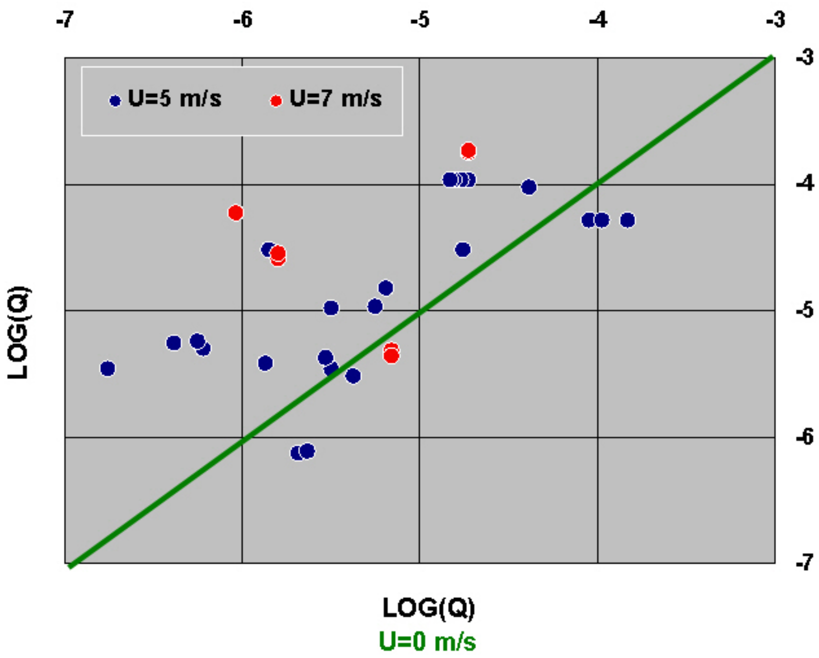


Figure 65: Influence of wind (parametric tests)

6.2.6 Prototype storms

Overtopping measurements recorded in prototype and in laboratory are shown in Figure 66 where the overtopping prediction using Eq. (7) is plotted on the x-axis and the measured data are plotted on the y-axis (see Table 16 for prototype data).

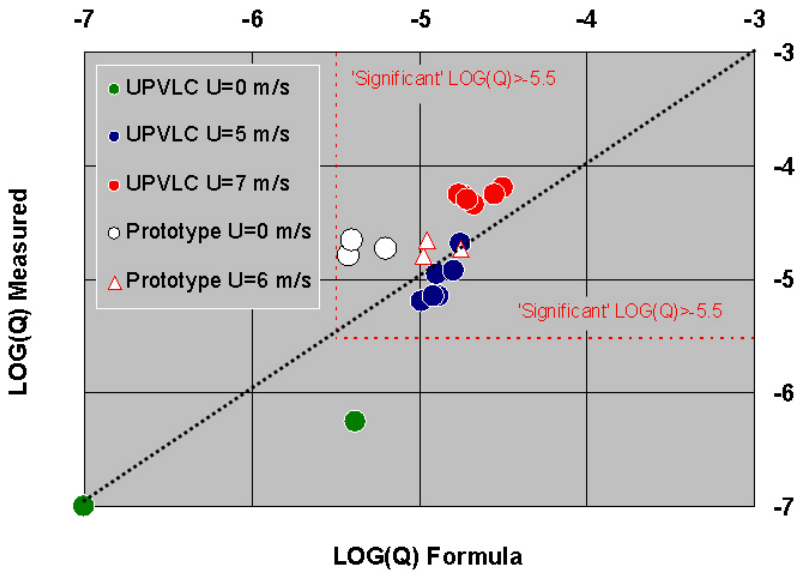


Figure 66: CLASH prototype and laboratory overtopping rates compared to OPTICREST formula

Laboratory overtopping rates of prototype storms using U = 0.0 m/s were almost insignificant (the OPTICREST empirical formula is not reliable). Laboratory overtopping rates of prototype storms using U = 5.0 m/s and 7.0 m/s reasonably fit the OPTICREST formula. Finally, prototype observations of overtopping rates were higher (between 2 and 3 times) than predicted by the OPTICREST formula using U = 0.0 m/s; the best fit to the OPTICREST formula is obtained using U = 6.0 m/s.

Table 16: Overview of storms tested at UPVL

TEST	Wind	Prototype Registered			q	log(Q)	WRI			
		WL	Tp	Hs			Hmo	Ir	Tp	T01
	(m/s)	(m)	(s)	(m)	(m3/s·ml)		(m)		(s)	(s)
17:00-18:00	0	4.4	8.57	3.74	0.00E+00	0.00	3.83	3.03	8.53	7.04
18:00-19:00	0	4.6	8.57	3.86	0.00E+00	0.00	3.89	3.02	8.63	7.07
19:00-20:00	0	4.35	8.57	3.71	0.00E+00	0.00	3.87	3.06	8.63	7.19
17:00-18:00	5	4.4	8.57	3.74	2.76E-04	-4.96	3.99	2.99	8.53	7.10
18:00-19:00	5	4.6	8.57	3.86	5.27E-04	-4.69	4.07	2.97	8.63	7.10
19:00-20:00	5	4.35	8.57	3.71	1.76E-04	-5.16	4.01	3.03	8.63	7.26
17:00-18:00	7	4.4	8.57	3.74	1.29E-03	-4.27	3.86	3.04	8.53	7.10
18:00-19:00	7	4.6	8.57	3.86	1.69E-03	-4.19	4.11	2.96	8.63	7.14
19:00-20:00	7	4.35	8.57	3.71	1.12E-03	-4.34	3.96	3.06	8.63	7.30
17:00-18:00	0	4.4	8.57	3.74	1.25E-05	-6.26	3.75	3.06	8.53	7.03
18:00-19:00	0	4.6	8.57	3.86	0.00E+00	0.00	3.80	3.06	8.63	7.06
19:00-20:00	0	4.35	8.57	3.71	0.00E+00	0.00	3.85	3.07	8.63	7.20
17:00-18:00	5	4.4	8.57	3.74	1.51E-04	-5.19	3.82	3.05	8.53	7.07
18:00-19:00	5	4.6	8.57	3.86	3.01E-04	-4.92	4.00	2.98	8.63	7.07
19:00-20:00	5	4.35	8.57	3.71	1.76E-04	-5.14	3.93	3.05	8.63	7.23
17:00-18:00	7	4.4	8.57	3.74	1.32E-03	-4.25	3.82	3.05	8.53	7.08
18:00-19:00	7	4.6	8.57	3.86	1.40E-03	-4.25	3.99	3.01	8.63	7.13
19:00-20:00	7	4.35	8.57	3.72	1.19E-03	-4.30	3.88	3.09	8.63	7.28

7 Summary and conclusions

CLASH focuses on investigations of wave overtopping for different structures in prototype and in laboratory. The Zeebrugge breakwater has been modelled in small-scale in the wave flume of Leichtweiß-Institute (LWI) at a scale of 1:30 and in the wind and wave test facility of the Universidad Politécnica de Valencia (UPVLC). The model investigations have concentrated on parametric tests on wave overtopping (LWI, UPVLC) and the analysis of measurement uncertainties and model effects (LWI, UPVLC) as well as the reproduction of storms (LWI, UPVLC), the influence of wind effects (UPVLC) and the positioning of armour elements (LWI, UPVLC).

At LWI results regarding overtopping discharges for parametric tests, velocities of overtopping waves and forces on model dummies on top of the breakwaters crown wall were achieved. Altogether 226 tests have been performed; many of them were focussing on various uncertainty measurements such as repeatability, influence of position of the overtopping tray, position of wave gauges, and various analysis methods. Furthermore, the influence of the armour layer of the rubble mound was tested by exchanging the layer two times and performing the same tests.

At UPVLC most of the experiments are referring to the tank section with 1:1.4 slope and precise positioning of armour elements in the upper layer, including 53 parametric tests with and without wind, 17 repeatability and variability tests without wind, and 18 prototype tests with and without wind. Additionally, 11 tests have been carried out using the slope 1:1.3 and a less precise armour element positioning.

The analysis of results of tests at both institutes provides the following conclusions with respect to overtopping:

Uncertainty of measurements:

- Overtopping rates measured in CLASH experiments are similar than those measured in OPTICREST, although small differences have been found depending on wave and wind characteristics;
- Repeatability of tests with respect to wave parameters was found to be very good (CoV for waves ≈ 3%) in both flumes. Regarding overtopping, mean differences were found to be slightly higher at LWI (CoV ≈ 13%) as compared to UPVLC (CoV ≈ 10%). Both values increase when different wave generation files are used (for details see Table 11).
- Different wave analysis (different time windows) and wave generation methods (different time series from the same spectrum file) have no significant influence on the measured wave parameters (CoV ≈ 3%)
- The number of waves generated in the flume has some effect on wave overtopping measurements, a comparison of 200 to 1000 waves has led to 20% differences in wave overtopping, although this is accompanied by using different wave generation files which has caused differences in results of the same order of magnitude;

Model effects:

- Significant differences were found in overtopping measurements when the overtopping tray is moved (CoV ≈ 20%) as compared to prototype. This may either result from a different pattern of armour layer stones in front of the tray or the influence of the side wall of the flumes;
- Widening of the tray collecting the overtopping water has led to differences in overtopping in the same range of test repeatability (CoV ≈ 10%). The widening was limited to a factor of 2.0 at LWI (first test phase) for which the former results were obtained. For tests in the second test phase (reproduction of storms) the tray was widened up to 1.0 m in the model which seemed to have a larger influence than 10%.
- Elimination of the CLASH foreshore berm generated significant changes in the overtopping rates (up to five times higher overtopping) at UPVLC.
- Positioning of the armour units significantly affects the overtopping rates. Small changes in the positioning of armour elements may change the overtopping rate by a factor of 2.0 and more.
- Wind influences were investigated in detail by UPVLC and resulted in differences of up to one order of magnitude when wind speeds up to 7.0 m/s were compared with no wind in the model. It is however still unclear how wind can be scaled from prototype to the model.
- Further differences in overtopping measurements in Zeebrugge may result from the unknown permeability of the bottom armour layer (rectangular pattern in the models) and long waves in prototype, which have not been varied in the model.

Scale effects:

- The comparison between model and prototype results has shown some small differences for low overtopping rates which could be explained by a couple of model effects as discussed in this report. However, generally the measurements of both model and prototype are in relatively good agreement, considering the uncertainties and model effects as given above.

Overtopping velocities and forces on a dummy person have been measured in model tests at LWI. Results have been in good agreement with the prototype although the latter measurements represent very small forces. Variations of forces are believed to be very large. Simple formulas have been plotted for statistically derived forces, not accounting for the maximum forces on the dummy (Figure 60). Furthermore, a simple relation between dummy forces and wave overtopping rates has been derived suggesting a range of forces depending on the wave overtopping rate (Figure 61).

References

Boone, C.; Geeraerts, J.; De Rouck, J. (2002): General methodology report. CLASH - Crest Level Assessment of Coastal Structures, deliverable D5, final version, Gent, Belgium, 129 pp.

Burcharth, H.F.; Hughes, S.A. (2002): Fundamentals of design. *In: Hughes, S.A. (ed.): Coastal Engineering Manual*, Washington D.C., USA, Part VI, Design of Coastal Project Elements, Chapter VI-5, Engineer Manual 1110-2-1100, U.S. Army Corps of Engineers, 319 pp.

Burcharth, H.F.; Liu, Z.; Troch, P. (1999): Scaling of core material in rubble mound breakwater model tests. *Proceedings 5th International Conference on Coastal and Port Engineering in Developing Countries (COPEDEC)*, Cape Town, South Africa, pp. 1518-1528.

De Rouck, J.; Boone, C.; Van de Walle, B. (2001): The optimisation of crest level design of sloping coastal structures through prototype monitoring and modelling. Final Report, MAST III, OPTICREST Project: The optimisation of Crest Level Design of Sloping Coastal Structures Through Prototype Monitoring and Modelling, Ghent, Belgium, 127 pp.

De Rouck, J.; Troch, P.; Van de Walle, B.; Van der Meer, J.; Van Damme, L.; Medina, J.R.; Willems, M.; Frigaard, P. (2000): Wave run-up on a rubble mound breakwater: prototype measurements versus scale model tests. *Proceedings 27th International Conference Coastal Engineering (ICCE)*, ASCE, Sydney, Australia, 14 pp.

Endoh, K.; Takahashi, S. (1994): Numerically modeling personnel danger on a promenade breakwater due to overtopping waves. *Proceedings 24th International Conference Coastal Engineering (ICCE)*, ASCE, Volume 1, Kobe, Japan, pp. 1017-1029.

Environment Agency (1999): Overtopping of seawalls: design and assessment manual. Report Environment Agency, no. W178, 37 pp., 5 tables.

Frigaard, P.; Brorsen, M. (1995): A time-domain method for separating incident and reflected irregular waves. Elsevier, *Coastal Engineering*, vol. 24, pp. 202-215.

Frigaard, P.; Schlütter, F. (1999): Laboratory investigations - methodology. Research Report, MAST III, OPTICREST Project: The optimisation of Crest Level Design of Sloping

Coastal Structures Through Prototype Monitoring and Modelling, Aalborg, Denmark, 35 pp.

Garrido, J.; González-Escrivá, J.A.; Medina, J.R. (2001): Scale model tests for measuring overtopping in breakwaters (in Spanish). *VI Jornadas Españolas de Ingeniería de Costas y Puertos*, Fundación para el fomento de la ingeniería del agua, pp. 78-88.

Geeraerts, J. (2002): Methodology on prototype measurements: Zeebrugge site. CLASH - Crest Level Assessment of Coastal Structures, CLA 127/105, Gent, Belgium, 19 pp.

Geeraerts, J.; Boone, C. (2004): CLASH: Full scale measurements on the Zeebrugge breakwater- second winter season. CLASH - Crest Level Assessment of Coastal Structures, Internal report, Gent, Belgium.

Geeraerts, J.; De Rouck, J.; Troch, P.; Van Damme, L.; Pullen, T. (2003): Hazards resulting from wave overtopping - field measurements. *Proceedings Coastal Structures 2003*, Portland, Oregon, USA.

Goda, Y. (1985): Random seas and design of maritime structures. Tokyo: University of Tokyo Press, 323 pp.

González-Escrivá, J.A.; Medina, J.R. (2004): Report on generic prediction method. CLASH - Crest Level Assessment of Coastal Structures, Deliverable D11, Workpackage 8, Valencia, Spain, 28 pp.

González-Escrivá, J.A.; Medina, J.R.; Garrido, J.; De Rouck, J. (2002): Wind effects on runup and overtopping: influence on breakwater crest design. *Proceedings International Conference Coastal Engineering (ICCE)*, ASCE, vol. 28, Volume II, Cardiff, U.K., pp. 2251-2263.

Kleidon, P. (2004): Modelluntersuchungen zum Wellenüberlauf eines geschütteten Wellenbrechers und zur überlaufinduzierten Gefährdung von Personen auf dem Kronenbauwerk. *Diplomarbeit am Leichtweiß-Institut für Wasserbau, Fachbereich Bauingenieurwesen, Technische Universität Braunschweig*, Braunschweig, Germany.

Kniewel, M. (2003): Einfluss des Deckschichtenaufbaus eines geschütteten Wellenbrechers auf den Wellenüberlauf und die überlaufinduzierte Gefährdung von Personen auf dem Bauwerk. *Entwurf am Leichtweiß-Institut für Wasserbau, Abteilung Hydromechanik und Küsteningenieurwesen, Technische Universität Braunschweig*, Braunschweig, Germany, 75 S.; 3 Anlagen.

Kortenhaus, A.; Möller, J.; Oumeraci, H. (2002): Methodology on quantification of measurement errors, model and scale effects (1st draft). CLASH - Crest Level Assessment of Coastal Structures, Workpackage 7, Braunschweig, Germany, 27 pp.

Mansard, E.P.D.; Funke, E.R. (1980): The measurement of incident and reflected spectra using a least square method. *Proceedings 17th International Conference Coastal Engineering (ICCE)*, ASCE, Volume 1, Sydney, Australia, pp. 154-172.

Medina, J.R. (1998): Wind effects on runup and breakwater crest design. *Proceedings 26th International Conference Coastal Engineering (ICCE)*, ASCE, Volume 1, Copenhagen, Denmark, pp. 1068-1081.

Medina, J.R. (2001): Estimation of incident and reflected waves using simulated annealing. ASCE, *Journal of Waterway, Port, Coastal and Ocean Engineering*, vol. 127, pp. 213-221.

Medina, J.R.; González-Escrivá, J.A.; Garrido, J. (2001): Zeebrugge Model Tests performed in UPV. Report, MAST III, OPTICREST Project: The optimisation of Crest Level Design of Sloping Coastal Structures Through Prototype Monitoring and Modelling (MAS3-CT97-0116), Laboratory of Ports and Coasts, Universidad de Politecnica de Valencia, Spain.

Medina, J.R.; González-Escrivá, J.A.; Garrido, J. (2003): Laboratory measurements - Zeebrugge model tests by UPVLC - 1st draft. CLASH - Crest Level Assessment of Coastal Structures, Workpackage 4, Valencia, Spain, 22 pp., Annexes.

Medina, J.R.; González-Escrivá, J.A.; Garrido, J.; De Rouck, J. (2002): Overtopping analysis using neural network. *Proceedings 28th International Conference Coastal Engineering (ICCE)*, ASCE, Volume II, Cardiff, U.K., pp. 2165-2177.

N.N. (2003): Full scale measurements on the Zeebrugge breakwater. CLASH - Crest Level Assessment of Coastal Structures, Workpackage 3, Ghent, Belgium, 41 pp.

Schüttrumpf, H. (2001): Wellenüberlaufströmung bei Seedeichen - experimentelle und theoretische Untersuchungen. Fachbereich Bauingenieurwesen, Technische Universität Braunschweig. Ph.D. thesis, *Mitteilungen Leichtweiß-Institut für Wasserbau der Technischen Universität*, Braunschweig, Germany, S. 1-124.

SPM (1984): Shore protection manual, vol. II. Vicksburg, Mississippi, USA, 800 pp.

TAW (2002): Wave run-up and overtopping at dikes. Technische Adviescommissie voor de Waterkeringen (TAW), Den Haag, The Netherlands, 63 pp.

Timpelan, L. (2004): Quantifizierung von Messungenauigkeiten und Modelleffekten bei Wellenauflauf und -überlauf eines geschütteten Wellenbrechers im kleinmaßstäblichen Modell. *Entwurf am Leichtweiß-Institut für Wasserbau, Fachbereich Bauingenieurwesen, Technische Universität Braunschweig*, Braunschweig, Germany.

Troch, P.; de Rouck, J.; van Damme, L. (1998): Instrumentation and prototype measurements at the Zeebrugge rubble mound breakwater. Elsevier, *Coastal Engineering*, vol. 35, pp. 141-166.

Troch, P.; Geeraerts, J.; Van de Walle, B.; De Rouck, J.; Van Damme, L.; Allsop, N.W.H.; Franco, L. (2004): Full scale wave overtopping measurements on the Zeebrugge rubble mound breakwater. Elsevier, *Coastal Engineering*, vol. 51, pp. 609-628.

Van de Walle, B. (2003): Wave run-up on rubble mound breakwaters. Ph.D. thesis, *Ghent University*, Afdeling Weg- en Waterbouwkunde, Ghent, Belgium, 344 pp.

Van der Meer, J.W. (1998): Wave run-up and overtopping. *In: Pilarczyk, K.W. (ed.): Dikes and revetments*, Rotterdam/Brookfield: A.A. Balkema, pp. 145-160.

Van der Meer, J.W.; Janssen, J.P.F.M. (1995): Wave run-up and wave overtopping at dikes and revetments. *Wave forces on inclined and vertical wall structures*, New York, USA, pp. 1-27.

Ward, D.L.; Widner, C.G.; Zhang, J.; Edge, B.L. (1994): Wind effects on runup and overtopping. *Proceedings 24th International Conference Coastal Engineering (ICCE)*, ASCE, Volume 2, Kobe, Japan, pp. 1687-1699.

Ward, D.L.; Zhang, J.; Widner, C.G.; Cinotto, C.M. (1996): Wind effects on runup and overtopping of coastal structures. *Proceedings 25th International Conference Coastal Engineering (ICCE)*, ASCE, Volume 2, Orlando, Florida, USA, pp. 2206-2215.

Willems, M.; Kofoed, J.P. (2001): Laboratory investigations. Two dimensional testing. The Zeebrugge breakwater. Task 3.3. OPTICREST research report on Task 3.3.

Yagci, O.; Kapdasli, S. (2003): Alternative placement technique for antifer blocks used on breakwaters. Elsevier Science Ltd., *Ocean Engineering*, vol. 30, no. 11, pp. 1433-1451.

Annex A: Test results by LWI

d [mNN]	H_s [m]	T_p [s] 8,0	9,0	9,3	9,8	10,0	10,3	10,8	11,0	11,2	11,6
3,00	4,50					Z020					
	5,00			Z008							
	5,50	Z034	Z034a Z067 Z068		Z009		Z010				
	6,00							Z011			
	6,50									Z012	
	7,00										Z013
4,00	4,50										
	5,00										
	5,50		Z038						Z044		
5,00	4,50										
	5,00										
	5,50		Z039						Z045		
6,00	4,00		dummy						dummy		
	5,00		dummy						dummy		
	6,00										

(green) = not tested at LWI
(light green) = used for tests with model dummies

d [mNN]	H_s [m]	T_p [s] 8,0	9,0	9,3	9,8	10,0	10,3	10,8	11,0	11,2	11,6
3,00	4,50					18120204					
	5,00			18120201							
	5,50		17120205 17120203 17120204		18120203						
	6,00										
	6,50										
	7,00										
4,00	4,50										
	5,00										
	5,50		20120201						20120202		
5,00	4,50										
	5,00										
	5,50		23120201						23120203		
6,00	4,00		10020303						10020304		
	5,00		10020305						10020306		
	6,00										

(blue) = not tested at LWI
(light green) = used for tests with model dummies

Test no. [ddmmyyno]	Descr. [-]	Test [-]	Date of Storm	Gen. file [-]	H_{nom} [m]	T_{nom} [s]	No. waves [-]	Repetition [-]	fsam [Hz]	Tray width [m]	Tray pos. [-]	$H_{m0\ deep}$ [m]	$T_{p\ deep}$ [s]	$T_{m\ deep}$ [s]	$T_{m-1,0\ deep}$ [s]	$h_{\ deep}$ [m]	m [-]	β degr	h [m]	$H_{m0\ toe}$ [m]	$T_{p\ toe}$ [s]	$T_{m\ toe}$ [s]	$T_{m-1,0\ toe}$ [s]	h_t [m]
04110201	Theor. Spek.	Z008		015-17z008	4,50	9,31	1000		20			3,96	9,00	11,00	8,76	3,00	20	0	7,59	4,17	10,00	7,74	8,68	5,01
04110202	Theor. Spek.	Z009		017-18z009	5,01	9,80	1000		20			4,47	9,67	11,10	9,33	3,00	20	0	7,59	4,56	10,11	7,95	9,06	5,01
04110203	Theor. Spek.	Z020		013-18z020	3,99	10,02	1000		20			3,66	10,55	11,40	9,38	3,00	20	0	7,59	3,81	10,08	8,17	9,22	5,01
05110201	Theor. Spek.	Z034		017-15z034	5,01	8,00	1000		20			4,05	7,93	9,83	7,85	3,00	20	0	7,59	4,05	8,74	7,00	7,71	5,01
05110202	Theor. Spek.	Z067		017-16z67	5,01	5,48	1000		20			4,74	9,63	10,95	9,93	3,00	20	0	7,59	5,01	9,32	8,33	9,27	5,01
05110203	Theor. Spek.	Z068		017-16z68	5,01	8,98	1000		20			4,38	9,46	10,26	8,58	3,00	20	0	7,59	4,50	9,26	7,54	8,45	5,01
05110204	Theor. Spek.	Z034a		017-16z34a	5,01	8,98	1000		20			4,41	9,49	10,76	8,58	3,00	20	0	7,59	4,53	9,08	7,54	8,42	5,01
05110205	Theor. Spek.	Z008		015-17z008	4,50	9,31	1000		20			4,11	10,35	10,76	8,80	3,00	20	0	7,59	4,29	9,92	7,75	8,68	5,01
05110206	Theor. Spek.	Z008		z008	4,50	9,31	1000		20			4,11	9,61	10,34	8,80	3,00	20	0	7,59	4,23	9,94	7,71	8,66	5,01
07110201	Theor. Spek.	Z038		017-16z038	5,01	8,98	1000		20			4,38	8,61	10,78	8,65	3,99	20	0	8,58	4,53	9,23	7,80	8,65	6,00
07110202	Theor. Spek.	Z044		017-20z044	5,01	11,01	1000		20			4,71	11,51	12,67	10,42	3,99	20	0	8,58	4,74	10,80	8,76	10,15	6,00
07110203	Theor. Spek.	Z039		017-16z039	5,01	8,98	1000		20			4,41	8,75	11,08	8,52	5,01	20	0	9,60	4,32	8,75	7,80	8,50	7,02
07110204	Theor. Spek.	Z045		017-20z044	5,01	11,01	1000		20			4,74	11,20	11,98	10,36	5,01	20	0	9,60	4,68	11,23	8,90	10,09	7,02
07110205	Theor. Spek.	Z045		z045	5,01	11,01	1000		20			4,71	10,80	12,32	10,38	5,01	20	0	9,60	4,65	11,62	8,89	10,12	7,02
11110201	Theor. Spek.	Z039		Z039	5,01	8,98	1000		20			4,26	8,69	11,78	8,60	5,01	20	0	9,60	4,20	9,33	7,77	8,49	7,02
11110202	Theor. Spek.	Z008		Z008	4,50	9,31	1000		20			4,08	8,73	10,60	8,74	3,00	20	0	7,59	4,05	9,02	7,75	8,67	5,01
11110203	Theor. Spek.	Z009		Z009	5,01	9,80	1000		20			4,59	9,04	10,22	9,27	3,00	20	0	7,59	4,56	9,94	7,96	9,03	5,01
11110204	Theor. Spek.	Z020		Z020	3,99	10,02	1000		20			3,75	10,34	11,74	9,39	3,00	20	0	7,59	3,75	10,07	8,22	9,20	5,01
12110201	Theor. Spek.	Z034		Z034	5,01	8,00	1000		20			4,02	8,06	9,97	7,81	3,00	20	0	7,59	4,02	7,91	7,04	7,76	5,01
12110202	Theor. Spek.	Z067		Z067	5,01	8,98	1000		20			4,11	8,72	10,31	8,50	3,00	20	0	7,59	4,20	8,97	7,50	8,46	5,01
12110203	Theor. Spek.	Z068		Z068	5,01	8,98	1000		20			4,41	9,13	10,23	8,66	3,00	20	0	7,59	4,50	9,04	7,60	8,41	5,01
12110204	Theor. Spek.	Z034a		Z034a	5,01	8,98	1000		20			4,32	8,99	10,44	8,62	3,00	20	0	7,59	4,38	8,99	7,53	8,42	5,01
12110205	Theor. Spek.	Z008		Z008	4,50	9,31	1000		20			4,02	9,61	10,52	8,77	3,00	20	0	7,59	4,11	9,29	7,72	8,64	5,01
12110206	Theor. Spek.	Z067		017-16z67	5,01	8,98	1000		20			4,68	9,63	11,32	9,88	3,00	20	0	7,59	4,83	9,25	8,40	9,34	5,01
12110207	Theor. Spek.	Z068		017-16z68	5,01	8,98	1000		20			4,35	9,46	10,17	8,59	3,00	20	0	7,59	4,35	9,16	7,56	8,44	5,01
12110208	Theor. Spek.	Z034a		017-16z34a	5,01	8,98	1000		20			4,35	9,46	10,45	8,63	3,00	20	0	7,59	4,35	9,26	7,56	8,44	5,01
13110201	Theor. Spek.	Z038		Z038	5,01	8,98	1000		20			4,29	8,64	10,64	8,56	3,99	20	0	8,58	4,29	8,97	7,71	8,46	6,00
13110202	Theor. Spek.	Z044		Z044	5,01	11,01	1000		20			4,59	12,09	12,29	10,40	3,99	20	0	8,58	4,68	11,10	8,74	10,09	6,00
17120203	meas. 1	Z067		017-16z67	5,01	8,98	1000		20	0,233	middle	5,25	9,61	11,29	9,89	3,00	20	0	7,59	5,16	10,49	8,21	9,33	5,01
17120204	meas. 1	Z068		017-16z68	5,01	8,98	1000		20	0,233	middle	4,83	8,65	10,48	8,73	3,00	20	0	7,59	4,68	8,90	7,46	8,50	5,01
17120205	meas. 1	Z034a		017-16z34a	5,01	8,98	1000		20	0,233	middle	4,89	9,46	10,52	8,74	3,00	20	0	7,59	4,77	9,12	7,49	8,53	5,01
18120201	meas. 1	Z008		015-17z008	4,50	9,31	1000		20	0,233	middle	4,53	8,63	10,37	8,96	3,00	20	0	7,59	4,50	9,80	7,69	8,75	5,01
18120202	meas. 1	Z008		015-17z008	4,50	9,31	1000	1	20	0,233	middle	4,56	9,35	10,68	8,94	3,00	20	0	7,59	4,50	9,79	7,68	8,71	5,01
18120203	meas. 1	Z009		017-18z009	5,01	9,80	1000		20	0,233	middle	5,01	8,75	11,15	9,48	3,00	20	0	7,59	4,98	9,97	7,95	9,24	5,01
18120204	meas. 1	Z020		013-18z020	3,99	10,02	1000		20	0,233	middle	4,23	9,69	11,57	9,54	3,00	20	0	7,59	4,29	10,32	8,17	9,34	5,01
18120205	meas. 1	Z008		z008	4,50	9,31	1000	2	20	0,233	middle	4,62	9,65	10,54	8,91	3,00	20	0	7,59	4,59	9,65	7,67	8,74	5,01
18120206	meas. 1	Z008		z005	4,50	9,31	1000	3	20	0,233	middle	4,59	8,63	10,49	8,89	3,00	20	0	7,59	4,62	9,79	7,70	8,73	5,01
19120201	meas. 1	Z009		z009	5,01	9,80	1000	1	20	0,233	middle	5,07	9,72	10,93	9,49	3,00	20	0	7,59	5,28	10,50	7,96	9,22	5,01
19120204	meas. 1	Z067		z067	5,10	8,98	1000	1	20	0,233	middle	4,71	9,87	9,89	8,70	3,00	20	0	7,59	4,89	10,23	7,52	8,63	5,01
19120205	meas. 1	Z068		z068	5,01	8,98	1000	1	20	0,233	middle	5,04	9,68	10,22	8,75	3,00	20	0	7,59	5,07	9,68	7,48	8,48	5,01
19120206	meas. 1	Z034a		z034a	5,04	8,98	1000	1	20	0,233	middle	4,92	9,68	10,41	8,73	3,00	20	0	7,59	4,98	10,36	7,48	8,56	5,01
19120207	meas. 1	Z008		015-17z008	4,50	9,31	1000	4	20	0,233	middle	4,65	9,05	10,41	8,87	3,00	20	0	7,59	4,80	9,65	7,65	8,72	5,01
19120208	meas. 1	Z020		z020	3,99	10,02	1000	1	20	0,233	middle	4,26	10,26	11,22	9,53	3,00	20	0	7,59	4,53	10,38	8,11	9,25	5,01
20120201	meas. 1	Z038		017-16z038	5,04	8,98	1000		20	0,233	middle	4,89	8,54	10,56	8,76	3,99	20	0	8,58	5,07	9,45	7,70	8,66	6,00
20120202	meas. 1	Z044		017-20z044	5,01	11,01	1000		20	0,233	middle	5,28	11,23	12,46	10,70	3,99	20	0	8,58	5,70	11,23	8,87	10,34	6,00
20120203	meas. 1	Z038		z038	5,10	8,98	1000	1	20	0,233	middle	4,86	8,80	10,87	8,70	3,99	20	0	8,58	5,07	9,61	7,61	8,56	6,00
20120204	meas. 1	Z044		z044	5,01	11,01	1000	1	20	0,233	middle	5,28	11,32	12,23	10,76	3,99	20	0	8,58	4,80	11,32	8,96	10,55	6,00
23120201	meas. 1	Z039		017-16z039	5,01	8,98	1000		20	0,233	middle	4,83	8,83	10,42	8,74	5,01	20	0	9,60	5,10	9,87	7,76	8,62	7,02
23120202	meas. 1	Z039		017-16z039	5,01	8,98	1000	1	20	0,233	middle	4,83	8,83	10,49	8,70	5,01	20	0	9,60	5,10	9,22	7,77	8,62	7,02
23120203	meas. 1	Z045		017-20z045	5,01	11,01	1000		20	0,233	middle	5,13	12,56	12,38	10,59	5,01	20	0	9,60	5,64	11,91	9,07	10,40	7,02
23120204	meas. 1	Z045		017-20z045	5,01	11,01	1000	1	20	0,233	middle	5,16	12,56	12,28	10,57	5,01	20	0	9,60	5,70	11,89	9,08	10,41	7,02
23120205	meas. 1	Z045		z045	5,01	11,01	1000	2	20	0,233	middle	5,22	10,78	12,21	10,61	5,01	20	0	9,60	5,76	11,39	9,06	10,43	7,02
23120206	meas. 1	Z045		z045	5,01	11,01	1000	3	20	0,233	middle	5,25	10,78	12,34	10,64	5,01	20	0	9,60	5,76	11,39	9,05	10,42	7,02
23120207	meas. 1	Z039		z039	5,01	8,98	1000	2	20	0,233	middle	4,86	9,28	10,99	8,68	5,01	20	0	9,60	5,16	10,05	7,78	8,65	7,02
13010301	meas. 1	Z045		z045	5,01	11,01	1000	4	20	0,233	middle	4,14	10,78	12,80	10,54	5,01	20	0	9,60	4,74	11,62	9,06	10,43	7,02
13010302	meas. 1	Z045		z045	5,01	11,01	1000	5	20	0,233	middle	4,20	11,51	12,83	10,55	5,01	20	0	9,60	4,83	11,61	9,02	10,43	7,02
13010303	meas. 1	Z045		z045	5,01	11,01	1000	6	20	0,233	middle	4,23	10,78	12,74	10,55	5,01	20	0	9,60	4,86	10,42	9,00	10,40	7,02
13010304	meas. 1	Z039		z039	5,01	8,98	1000	3	20	0,233	middle	3,96	9,28	10,94	8,69	5,01	20	0	9,60	4,38	9,36	7,70	8,58	7,02
13010305	meas. 1	Z039		z039	5,01	8,98	1000	4	20	0,233	middle	3,96	9,28	11,04	8,69	5,01	20	0	9,60	4,38	9,36	7,70	8,62	7,02
13010306	meas. 1	Z039		z039	5,01	8,98	1000	5	20	0,233	middle	3,99	9,28	10,93	8,66	5,01	20	0	9,60	4,41	9,36	7,67	8,61	7,02
13010307	meas. 1	Z039		z039	5,01	8,98	1000	6	20	0,233	middle	3,99	9,28	10,84	8,64	5,01	20	0	9,60	4,41	9,20	7,67	8,60	7,02
13010308	meas. 1	Z038		z038	5,01	8,98	1000	2	20	0,233	middle	4,05	8,80	10,87	8,68	3,99	20	0	8,58	4,44	9,75	7,55	8,53	6,00
14010301	meas. 1	Z038		z038	5,01	8,98	1000	3	20	0,233	middle	3,96	8,80	10,59	8,67	3,99	20	0	8,58	4,29	10,07	7,55	8,54	6,00
14010302	meas. 1	Z038		z038	5,01	8,98	1000	4	20	0,233	middle	3,87	8,80	11,16	8,64	3,99	20	0	8,58	4,26	9,52	7,53	8,51	6,00
14010303	meas. 1	Z037		z038	5,01	8,98	1000		20	0,233	middle	3,99	8,80	11,01	8,62	3,99	20	0	8,58	4,26	9,80	7,53	8,48	6,00
20010301	meas. 1	Z045		z04_b	5,01	11,01	200	7	20	0,506	middle	4,11	10,13	12,54	10,63	5,01	20	0	9,60	4,86	11,98	9,07	10,61	7,02
20010302	meas. 1	Z039		z039_b	5,01	8,98	200	7	20	0,506	middle	3,99	9,11	10,26	8,71	5,01	20	0	9,60	4,47	9,55	7,68	8,61	7,02
20010303	meas. 1	Z038		z038_b	5,01	8,98	200	5	20	0,506	middle	3,90	9,11	10,22	8,68	3,99	20	0	8,58	4,29	9,75	7,65	8,58	6,00
20010304	meas. 1	Z038		z038_b	5,01	8,98	200	6	20	0,506	middle	3,99	8,93	10,45	8,74	3,99	20	0	8,58	4,38	9,94	7,64	8,59	6,00
20010305	meas. 1	Z038		z038_b	5,01	8,98	200	7	20	0,506	middle	4,02	8,93	10,42	8,75	3,99	20	0	8,58	4,41	9,94	7,62	8,58	6,00
20010306	meas. 1	Z009		z009_b	5,01	9,80	200	2	20	0,506	middle	4,20	9,57	10,34	9,39	3,00	20	0	7,59	4,65	10,12	7,91	9,24	5,01
20010307	meas. 1	Z009		z009_b	5,01	9,80	200	3	20	0,506	middle	4,23	9,57	10,58	9,41	3,00	20	0	7,59	4,65	9,57	7,91	9,25	5,01
20010308	meas. 1	Z009		z009_b	5,01	9,80	200	4	20	0,506	middle	4,32	9,57	10,92	10,78	3,00	20	0	7,59	4,68	10,12	7,94	9,25	5,01
20010309	meas. 1	Z034a		z034a-b	5,01	8,98	200	2	20	0,506	middle	4,08	9,06	10,52	8,59	3,00	20	0	7,59	4,38	9,11	7,34	8,43	5,01
20010310	meas. 1	Z034a		z034a-b	5,01	8,98	200	3	20	0,506	middle	4,11	9,06	10,64	8,62	3,00	20	0	7,59	4,38	8,96	7,30	8,40	5,01
20010311	meas. 1	Z034a		z043a_b	5,01	8,98	200	4	20	0,506	middle	4,11	9,06	10,63	8,57	3,00	20	0	7,59	4,35	8,96	7,34	8,45	5,01
21010301	meas. 1	Z009		z009_b	5,01	9,80	200	5	20	0,223	middle	4,17	9,57	10,37	9,42	3,00	20	0	7,59	4,68	10,63	7,94	9,23	5,01
21010302	meas. 1	Z034a		Z034a_b	5,01	8,98	200	5	20	0,223	middle	4,05	9,06	10,53	8,65	3,00	20	0	7,59	4,32	9,32	7,34	8,42	5,01
21010303	meas. 1	Z038		Z038 _b	5,01	8,98	200	8	20	0,223	middle	4,05	8,93	10,04	8,73	3,99	20	0	8,58	4,41	9,94	7,65	8,59	6,00
21010304	meas. 1	Z045		z045_b	5,01	11,01	200	8	20	0,223	middle	4,26	11,04	12,34	10,65	5,01	20	0	9,60	4,95	12,86	9,05	10,57	7,02
21010305	meas. 1	Z039		Z039 _b	5,01	8,98	200	8	20	0,223	middle	4,05	9,11	10,16	8,65	5,01	20	0	9,60	4,50	9,55	7,76	8,68	7,02
22010301	meas. 1	Z045		z045_b	5,01	11,01	200	9	20	0,506	right	3,96	9,11	10,48	8,74	3,99	20	0	8,58	4,32	9,88	7,76	8,70	6,00
22010302	meas. 1	Z039		z039_b	5,01	8,98	200	9	20	0,506	right	4,02	9,11	10,22	8,68	5,01	20	0	9,60	4,44	9,55	7,70	8,63	7,02
22010303	meas. 1	Z038		z038_b	5,01	8,98	200	9	20	0,506	right	3,96	8,93	10,26	8,74	3,99	20	0	8,58	4,32	9,88	7,70	8,65	6,00
22010304	meas. 1	Z038		z038_b	5,01	8,98	200	10	20	0,506	right	3,99	8,93	10,52	8,76	3,99	20	0	8,58	4,32	9,56	7,67	8,63	6,00
22010305	meas. 1	Z045		z045_b	5,01	11,01	200	10	20	0,506	right	4,29	10,75	12,58	10,57	5,01	20	0	9,60	5,01	12,12	9,11	10,61	7,02
22010306	meas. 1	Z045		z045_b	5,01	11,01	200	11	20	0,506	right	4,26	10,13	12,63	10,57	5,01	20	0	9,60	4,98	11,98	9,13	10,64	7,02
22010307	meas. 1	Z038		z038_b	5,01	8,98	200	11	20	0,506	right	3,93	9,11	9,46	8,73	3,99	20	0	8,58	4,29	10,05	7,61	8,56	6,00
22010309	meas. 1	Z009		z009_b	5,01	9,80	200	6	20	0,506	right	4,17	9,57	10,61	9,34	3,00	20	0	7,59	4,56	10,12	7,94	9,28	5,01
22010310	meas. 1	Z034a		z034a-b	5,01	8,98	200	6	20	0,506	right	4,05	9,06	10,58	8,65	3,00	20	0	7,59	4,29	9,11	7,38	8,46	5,01
27010301	meas. 2	Z009		z009-b	5,01	9,80	200	7	20	0,506	right	4,02	9,57	10,91	9,49	3,00	20	0	7,59	4,44	10,19	7,90	9,23	5,01
27010302	meas. 2	Z009		z009-b	5,01	9,80	200	8	20	0,506	right	4,05	9,57	10,58	9,42	3,00	20	0	7,59	4,44	9,57	7,90	9,23	5,01
27010303	meas. 2	Z034a		z034_ab	5,01	8,98	200	7	20	0,506	right	3,99	9,06	10,26	8,66	3,00	20	0	7,59	4,17	9,51	7,38	8,49	5,01
27010304	meas. 2	Z034a		z034_ab	5,01	8,98	200	8	20	0,506	right	3,96	9,06	10,28	8,64	3,00	20	0	7,59	4,17	9,20	7,37	8,51	5,01
30010301	meas. 2	Z045		z045_b	5,01	11,01	200	12	20	0,506	middle	4,62	10,13	12,43	10,47	5,01	20	0	9,60	5,22	11,98	9,15	10,57	7,02
10020301	meas. 2	-		d70_R013-16	3,99	8,98	200		20	0,506	middle	3,36	9,31	11,01	8,57	6,00	20	0	10,59	3,57	9,36	8,01	8,64	8,01
10020302	meas. 2	-		d70_R013-20	3,99	11,01	200		20	0,506	middle	3,42	10,63	13,07	10,48	6,00	20	0	10,59	3,93	11,31	9,40	10,45	8,01
10020303	meas. 3	-		d70_R013-20	3,99	11,01	200		500	0,506	middle	3,75	11,38	12,15	10,40	6,00	20	0	10,59	4,29	11,67	9,37	10,38	8,01
10020304	meas. 3	-		d70_R013-16	3,99	8,98	200		500	0,506	middle	3,57	9,16	10,34	8,53	6,00	20	0	10,59	3,84	9,24	7,87	8,56	8,01
10020305	meas. 3	-		d70_R017-16	5,01	8,98	200		500	0,506	middle	4,41	10,20	11,19	8,68	6,00	20	0	10,59	4,74	9,56	7,78	8,61	8,01
10020306	meas. 3	-		d70_R017-20	5,01	11,01	200		500	0,506	middle	4,65	11,72	13,45	10,48	6,00	20	0	10,59	5,31	12,17	9,25	10,51	8,01
25030301	meas. 3	-		R017-20-70	5,01	11,01	1000		500	0,233	middle	4,53	11,37	12,29	10,69	6,00	20	0	10,59	5,31	11,13	9,15	10,53	8,01
26030301	meas. 3	-		R017-20-70	5,01	11,01	1000		500	0,233	middle	4,53	10,66	12,57	10,65	6,00	20	0	10,59	5,25	11,12	9,26	10,56	8,01
26030302	meas. 3	-		R020-18-70	6,00	10,02	1000		500	0,233	middle	5,04	10,22	11,78	9,78	6,00	20	0	10,59	5,64	10,17	8,50	9,60	8,01
26030303	AL-V	-		R017-18-70	5,01	10,02	1000		500	0,233	middle	4,38	10,03	11,81	9,60	6,00	20	0	10,59	4,95	9,79	8,58	9,59	8,01

Test no. [ddmmyyno]	Bt [m]	γf [-]	cot αd [-]	cot αu [-]	cot αex [-]	cot αncl [-]	Rc [m]	B [m]	hb [m]	tan αB [-]	Bh [m]	Ac [m]	Gc [m]	RF [-]	CF [-]	q [m3/s/m]	q [perc] [%]	pmax [kPa]	Dummy1 p1/10 [kPa]	p1/3 [kPa]	pmax [kPa]	Dummy2 p1/10 [kPa]	p1/3 [kPa]	Fmax [kN]	F_{Dummy} F1/10 [kN]	F1/3 [kN]
17120203	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			1,22E-03										
17120204	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			6,30E-05										
17120205	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			1,61E-04										
18120201	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			8,63E-05										
18120202	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			1,25E-04										
18120203	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			2,95E-04										
18120204	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			1,28E-04										
18120205	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			1,38E-04										
18120206	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			1,04E-04										
19120201	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			4,59E-04										
19120204	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			7,76E-05										
19120205	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			1,18E-04										
19120206	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			2,50E-04										
19120207	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			2,07E-04										
19120208	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			9,62E-05										
20120201	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			8,05E-04										
20120202	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			3,88E-03										
20120203	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			6,98E-04										
20120204	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			4,44E-03										
23120201	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			3,08E-03										
23120202	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			3,10E-03										
23120203	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,28E-02										
23120204	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,16E-02										
23120205	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,35E-02										
23120206	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,22E-02										
23120207	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			2,16E-03										
13010301	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,11E-02										
13010302	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,10E-02										
13010303	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,09E-02										
13010304	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,82E-03										
13010305	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,89E-03										
13010306	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,95E-03										
13010307	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			2,02E-03										
13010308	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			4,08E-04										
14010301	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			3,40E-04										
14010302	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			3,43E-04										
14010303	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			3,29E-04										
20010301	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,29E-02										
20010302	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,46E-03										
20010303	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			5,29E-04										
20010304	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			6,34E-04										
20010305	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			2,94E-04										
20010306	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			2,89E-04										
20010307	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			2,93E-04										
20010308	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			2,29E-04										
20010309	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			0,00E+00										
20010310	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			0,00E+00										
20010311	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			0,00E+00										
21010301	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			1,64E-04										
21010302	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			0,00E+00										
21010303	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			4,93E-04										
21010304	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,12E-02										
21010305	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			9,85E-04										
22010301	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			1,89E-02										
22010302	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,49E-03										
22010303	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			1,18E-03										
22010304	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			9,08E-04										
22010305	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,71E-02										
22010306	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,75E-02										
22010307	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			6,32E-04										
22010309	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			1,01E-03										
22010310	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			2,37E-04										
27010301	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			6,86E-04										
27010302	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			9,00E-04										
27010303	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			2,24E-04										
27010304	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			2,74E-04										
30010301	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,31E-02		0,33	0,33	0,33	0,00	0,00	0,00	5,07	5,07	5,07
10020301	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			1,37E-03		0,03	0,03	0,02	0,00	0,00	0,00	0,46	0,46	0,31
10020302	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			1,54E-02		0,15	0,15	0,15	0,02	0,02	0,02	2,70	2,70	2,70
10020303	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			1,57E-02		0,81	0,81	0,63	0,37	0,31	0,26	19,74	18,56	14,81
10020304	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			1,57E-03		0,30	0,30	0,30	0,19	0,07	0,05	8,36	5,99	5,59
10020305	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			1,09E-02		0,59	0,59	0,56	0,25	0,20	0,11	14,00	13,01	10,77
10020306	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			5,01E-02		0,78	0,77	0,52	0,41	0,35	0,28	20,07	18,73	13,51
25030301	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			#DIV/0!		0,96	0,70	0,50	0,42	0,32	0,27	23,03	17,07	13,01
26030301	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			4,04E-02		2,08	1,13	0,65	0,39	0,29	0,24	39,64	23,08	14,72
26030302	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			5,42E-02		1,78	1,05	0,66	0,38	0,30	0,25	34,84	22,05	15,07
26030303	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			2,12E-02		1,38	0,80	0,52	0,30	0,23	0,17	27,11	16,83	11,34

Test no.	Descr.	Test	Date of Storm	Gen. file	H_{nom}	T_{nom}	No. waves	Repetition	fsam	Tray width	Tray pos.	$H_{m0\ deep}$	$T_{p\ deep}$	$T_{m\ deep}$	$T_{m-1,0\ deep}$	$h_{\ deep}$	m	β	h	$H_{m0\ toe}$	$T_{p\ toe}$	$T_{m\ toe}$	$T_{m-1,0\ toe}$	h_t
[ddmmyyno]	[-]	[-]		[-]	[m]	[s]	[-]	[-]	[Hz]	[m]	[-]	[m]	[s]	[s]	[s]	[m]	[-]	degr	[m]	[m]	[s]	[s]	[s]	[m]
27030301	meas. 3	-		R013-18-70	3,99	10,02	1000		500	0,233	middle	3,54	10,23	11,30	9,44	6,00	20	0	10,59	4,08	9,67	8,53	9,40	8,01
27030302	meas. 3	-		R020-16-70	6,00	8,98	1000		500	0,233	middle	4,77	9,36	10,67	8,86	6,00	20	0	10,59	5,31	9,38	7,90	8,79	8,01
27030303	meas. 3	-		R017-16-70	5,01	8,98	1000		500	0,233	middle	4,20	8,86	10,84	8,66	6,00	20	0	10,59	4,71	9,70	7,82	8,65	8,01
27030304	meas. 3	z039		017-16z039	5,01	8,98	1000		500	0,233	middle	4,26	8,83	10,00	8,69	5,01	20	0	9,60	4,74	9,87	7,67	8,56	7,02
27030305	AL-V	-		R017-18	5,01	10,02	1000		500	0,233	middle	4,44	10,14	11,24	9,67	5,01	20	0	9,60	5,01	9,84	8,45	9,59	7,02
28030301	meas. 3	z045		017-20z45	5,01	11,01	1000		500	0,233	middle	4,41	10,81	12,47	10,55	5,01	20	0	9,60	5,10	10,93	9,02	10,38	7,02
31030301	meas. 3	-		017-16z039	5,01	8,98	1000		500	0,233	middle	4,17	8,83	10,10	8,65	5,01	20	0	9,60	4,65	9,22	7,65	8,57	7,02
01040301	meas. 3	z039		017-16z039	5,01	8,98	1000		500	0,233	middle	4,17	8,83	10,11	8,69	5,01	20	0	9,60	4,65	9,22	7,73	8,63	7,02
01040302	meas. 3	z039		017-16z039	5,01	8,98	1000		500	0,233	middle	4,20	8,83	10,05	8,62	5,01	20	0	9,60	4,65	10,04	7,74	8,61	7,02
01040303	meas. 3	-		R017-18	5,01	10,02	1000		500	0,233	middle	4,35	9,55	11,96	9,66	5,01	20	0	9,60	4,83	9,90	8,43	9,56	7,02
02040301	meas. 3	z039		017-16z039	5,01	8,98	1000		500	0,233	middle	4,14	8,83	10,16	8,65	5,01	20	0	9,60	4,47	9,22	7,72	8,60	7,02
02040302	meas. 3	-		R017-18	5,01	10,02	1000		500	0,233	middle	4,29	10,14	12,05	9,63	5,01	20	0	9,60	4,77	9,94	8,42	9,55	7,02
02040304	meas. 3	z045		017-20z45	5,01	11,01	1000		500	0,233	middle	4,44	10,80	11,82	10,59	5,01	20	0	9,60	4,98	10,34	9,02	10,37	7,02
02040305	AL-V	-		R017-20-70	5,01	11,01	1000		500	0,233	middle	4,50	10,66	12,54	10,64	6,00	20	0	10,59	5,07	10,66	9,26	10,58	8,01
02040306	meas. 3	-		R020-18-70	6,00	10,02	1000		500	0,233	middle	4,98	10,22	12,24	9,81	6,00	20	0	10,59	5,46	9,88	8,51	9,61	8,01
02040307	meas. 3	-		R017-18-70	5,01	10,02	1000		500	0,233	middle	4,32	10,65	12,05	9,64	6,00	20	0	10,59	4,80	9,56	8,52	9,56	8,01
03040301	meas. 3	-		R013-18-70	3,99	10,02	1000		500	0,233	middle	3,48	10,23	11,13	9,34	6,00	20	0	10,59	3,96	9,92	8,54	9,43	8,01
03040302	meas. 3	-		R020-16-70	6,00	8,98	1000		500	0,233	middle	4,68	8,39	10,57	8,86	6,00	20	0	10,59	5,07	9,32	7,91	8,80	8,01
03040303	AL-V	-		R017-16-70	5,01	8,98	1000		500	0,233	middle	4,14	9,33	10,81	8,63	6,00	20	0	10,59	4,53	9,19	7,78	8,64	8,01
09040301	AL-L	Z039		017-16z039	5,01	8,98	1000		20	0,233	middle	4,47	8,83	10,35	8,63	5,01	20	0	9,60	4,32	9,22	7,62	8,53	7,02
09040302	AL-L	Z045		017-20z045	5,01	11,01	1000		20	0,233	middle	4,68	10,80	11,77	10,42	5,01	20	0	9,60	4,74	10,34	8,98	10,37	7,02
09040303	AL-L	Z039		017-16z039	5,01	8,98	1000	09040301	20	0,233	middle	4,47	8,83	9,89	8,69	5,01	20	0	9,60	4,29	9,22	7,65	8,53	7,02
10040301	AL-L	Z038		017-16z038	5,01	8,98	1000		20	0,233	middle	4,53	8,54	10,61	8,68	3,99	20	0	8,58	4,26	9,45	7,60	8,61	6,00
10040302	AL-L	Z044		017-20z044	5,01	11,01	1000		20	0,233	middle	4,83	10,75	11,73	10,52	3,99	20	0	8,58	4,80	10,75	8,85	10,34	6,00
10040303	AL-L	Z034a		017-16z34a	5,01	8,98	1000		20	0,233	middle	4,56	8,39	10,42	8,63	3,00	20	0	7,59	4,20	9,70	7,45	8,55	5,01
10040304	AL-L	Z067		017-1667	5,01	8,98	1000		20	0,233	middle	4,83	9,36	11,33	9,91	3,00	20	0	7,59	4,62	10,23	8,16	9,34	5,01
10040305	AL-L	Z068		017-16z68	5,01	8,98	1000		20	0,233	middle	4,53	8,65	10,44	8,62	3,00	20	0	7,59	4,14	9,72	7,40	8,51	5,01
10040306	AL-L	Z009		017-18z009	5,01	9,80	1000		20	0,233	middle	4,65	8,75	11,03	9,46	3,00	20	0	7,59	4,41	9,98	7,96	9,29	5,01
11040301	AL-L	-		R017-16-70	5,01	8,98	1000		20	0,233	middle	4,38	9,33	11,14	8,67	6,00	20	0	10,59	4,29	9,14	7,71	8,62	8,01
11040302	AL-L	-		R017-20-70	5,01	11,01	1000		20	0,233	middle	4,74	10,66	12,16	10,53	6,00	20	0	10,59	4,83	11,12	9,12	10,48	8,01
11040303	AL-L	-		R017-18-70	5,01	10,02	1000		20	0,233	middle	4,53	9,85	11,75	9,50	6,00	20	0	10,59	4,56	9,56	8,42	9,48	8,01
11040304	AL-L	-		R017-18	5,01	10,02	1000		20	0,233	middle	4,62	9,55	11,49	9,62	5,01	20	0	9,60	4,65	9,94	8,38	9,51	7,02
15040301	AL-R	-		R017-16-70	5,01	8,98	1000		20	0,233	middle	4,26	8,99	10,53	8,69	6,00	20	0	10,59	4,44	9,65	7,63	8,59	8,01
15040302	AL-R	-		R017-20-70	5,01	11,01	1000		20	0,233	middle	4,62	10,66	12,35	10,55	6,00	20	0	10,59	4,98	10,66	9,04	10,45	8,01
15040303	AL-R	-		R017-18-70	5,01	10,02	1000		20	0,233	middle	4,44	10,65	11,83	9,52	6,00	20	0	10,59	4,71	9,79	8,36	9,49	8,01
15040304	AL-R	-		R017-18	5,01	10,02	1000		20	0,233	middle	4,50	10,14	11,77	9,60	5,01	20	0	9,60	4,74	9,94	8,33	9,54	7,02
15040305	AL-R	Z045		017-20z045	5,01	11,01	1000		20	0,233	middle	4,62	10,80	11,63	10,51	5,01	20	0	9,60	4,92	10,34	8,92	10,37	7,02
15040306	AL-R	Z039		017-16z039	5,01	8,98	1000		20	0,233	middle	4,35	9,42	9,82	8,67	5,01	20	0	9,60	4,50	9,22	7,56	8,54	7,02
16040301	AL-R	Z044		017-20z044	5,01	11,01	1000		20	0,233	middle	4,71	10,75	12,43	10,53	3,99	20	0	8,58	4,95	10,67	8,77	10,33	6,00
16040302	AL-R	Z038		017-16z038	5,01	8,98	1000		20	0,233	middle	4,41	8,54	10,51	8,68	3,99	20	0	8,58	4,44	9,45	7,53	8,64	6,00
16040303	AL-R	Z009		017-18z009	5,01	9,80	1000		20	0,233	middle	4,53	8,75	11,39	9,42	3,00	20	0	7,59	4,56	9,97	7,97	9,32	5,01
17040301	AL-R	Z068		017-16z68	5,01	8,98	1000		20	0,233	middle	4,44	9,02	10,51	8,70	3,00	20	0	7,59	4,35	9,89	7,36	8,51	5,01
17040302	AL-R	Z067		017-16z67	5,01	8,98	1000		20	0,233	middle	4,74	9,36	11,22	9,90	3,00	20	0	7,59	4,86	10,08	8,11	9,32	5,01
17040303	AL-R	z034a		017-16z34a	5,01	8,98	1000		20	0,233	middle	4,47	9,19	10,35	8,67	3,00	20	0	7,59	4,35	10,57	7,38	8,53	5,01
28040301		Z009_b		unknown	5,01	9,80	1000		20	0,233	middle	4,50	9,57	10,73	9,44	3,00	20	0	7,59	4,62	10,17	7,95	9,30	5,01
28040302		-		d70-R017-16	5,01	8,98	1000		500	0,233	middle	4,26	8,97	10,83	8,65	6,00	20	0	10,59	4,44	9,35	7,54	8,49	8,01
30040301		Z039_b		unknown	5,01	8,98	1000		500	0,233	middle	4,35	9,11	10,45	8,63	5,01	20	0	9,60	4,62	9,23	7,74	8,64	7,02
30040302		-		R-017-18	5,01	10,02	1000		500	0,233	middle	4,56	10,14	11,49	9,62	5,01	20	0	9,60	4,89	10,43	8,32	9,50	7,02
30040303		Z009_c		017-17z-39	5,01	8,98	1000		500	0,233	middle	4,41	9,42	10,17	8,64	5,01	20	0	9,60	4,62	9,22	7,54	8,53	7,02
30040304		Z045_a		017-20z-45	5,01	11,01	1000		500	0,233	middle	4,62	10,80	11,79	10,48	5,01	20	0	9,60	4,47	11,97	8,97	10,53	7,02
30040305		-		R017-16-70	5,01	8,98	1000		500	0,233	middle	4,32	9,33	11,00	8,64	6,00	20	0	10,59	4,59	9,14	7,62	8,59	8,01
30040306		Z044_a		017-20z-044	5,01	11,01	1000		500	0,233	middle	4,77	11,23	12,15	10,64	3,99	20	0	8,58	5,10	11,23	8,77	10,33	6,00
08050301		-		R017-16-70	5,01	8,98	1000		500	0,233	middle	4,62	8,99	11,01	8,66	6,00	20	0	10,59	4,71	9,22	7,60	8,57	8,01
08050302		-		R017-18-70	5,01	10,02	1000		500	0,233	middle	4,77	10,03	11,91	9,57	6,00	20	0	10,59	4,95	9,79	8,34	9,46	8,01
08050303		-		R017-20-70	5,01	11,01	1000		500	0,233	middle	4,98	10,66	12,16	10,51	6,00	20	0	10,59	5,25	10,66	9,03	10,47	8,01
08050304		-		R020-16-70	6,00	8,98	1000		500	0,233	middle	5,28	9,36	10,97	8,87	6,00	20	0	10,59	5,31	9,03	7,70	8,70	8,01
12050301		-		R017-18-70	5,01	10,02	1000		500	0,233	middle	3,99	10,23	13,55	10,71	6,00	20	0	10,59	4,95	10,12	8,36	9,48	8,01
12050302		-		R017-20-70	5,01	11,01	1000		500	0,233	middle	4,47	10,66	14,61	12,21	6,00	20	0	10,59	5,25	11,12	9,02	10,45	8,01
13050301		Z045_b		017-20z-45	5,01	11,01	1000		500	0,233	middle	5,34	10,80	12,42	10,51	5,01	20		9,60	5,13	11,98	8,91	10,34	7,02
13050302		Z039_c		017-16z-39	5,01	8,98	1000		500	0,233	middle	5,04	8,83	10,47	8,71	5,01	20	0	9,60	4,68	9,87	7,56	8,54	7,02
14050301	nat. spect.	-	26.02.02	64-009-1.44	2,70	7,89	1000		20	0,233	middle	2,85	6,60	10,89	7,83	4,20	20	0	8,79	2,70	7,54	7,17	7,81	6,21
14050302	nat. spect.	-	27.10.02, 17-18	65-013-1,57-3.53	3,75	8,60	1000		20	0,233	middle	3,84	8,52	10,14	8,08	4,41	20	0	9,00	3,57	9,46	7,13	8,02	6,42
14050303	nat. spect.	-	27.10.02, 19-20	65-012-1,57	3,72	8,54	1000		20	0,233	middle	3,84	8,88	10,56	8,06	4,35	20	0	8,94	3,57	9,55	7,10	8,01	6,36
14050304	nat. spect.	-	27.10.02, 18-19	65-013-1,57-3,28	3,87	8,60	1000		20	0,233	middle	3,93	8,74	10,20	8,06	4,59	20	0	9,18	3,66	9,65	7,08	8,02	6,60
14050305	nat. spect.	-	29.01.02, 10-12	66-011-1,44	3,15	7,89	1000		20	0,233	middle	3,24	7,84	9,89	7,50	4,71	20	0	9,30	2,97	7,87	6,84	7,53	6,72
19060301	nat. spect.	-	26.02.02	260202	2,58	7,94	1000		20	0,233	middle	1,95	7,89	8,98	7,10	4,20	20	0	8,79	2,01	7,38	6,52	7,22	6,21
19060302	nat. spect.	-	27.10.02, 19-20	270202_19_20	3,72	8,54	1000		20	0,233	middle	2,97	8,63	10,73	8,71	4,35	20	0	8,94	3,00	9,73	7,60	9,08	6,36
24060301	nat. spect.	-	26.02.02	260202	2,58	7,94	1000		20	0,506	middle	2,01	7,30	8,74	7,04	4,20	20	0	8,79	1,89	7,53	6,46	7,13	6,21
24060302	nat. spect.	-	27.10.02, 19-20	270202_19_20	3,72	8,54	1000		20	0,506	middle	3,00	8,27	10,57	8,60	4,35	20	0	8,94	2,94	9,52	7,56	9,04	6,36
17080402	Theor. Spek.	Repetition		017-18z009	5,01	9,80	1000		20	1,000	middle	4,83	10,22	11,00	9,46	3,00	20	0	7,59	4,98	10,22	8,14	9,44	5,01
17080403	Theor. Spek.	Repetition		017-16z039	5,01	8,98	1000		20	1,000	middle	4,62	8,86	10,26	8,70	5,01	20	0	9,60	4,77	9,86	7,94	8,81	7,02
17080404	Theor. Spek.	Repetition		017-20z045	5,01	11,01	1000		20	1,000	middle	5,10	11,78	12,03	10,63	5,01	20	0	9,60	5,70	11,21	9,16	10,45	7,02
23080401	Theor. Spek.	Repetition		017-18z009	5,01	9,80	1000		20	1,000	middle	4,56	7,70	11,12	9,27	3,00	20	0	7,59	4,80	10,85	8,07	9,49	5,01
23080402	Theor. Spek.	Repetition		017-16z039	5,01	8,98	1000		20	1,000	middle	4,38	8,85	10,29	8,54	5,01	20	0	9,60	4,59	9,97	7,87	8,75	7,02
23080403	Theor. Spek.	Repetition		017-20z045	5,01	11,01	1000		20	1,000	middle	4,80	10,97	11,95	10,46	5,01	20	0	9,60	5,43	10,84	9,10	10,38	7,02
24080401	Theor. Spek.	Repetition		017-16z038	5,01	8,98	1000		20	1,000	middle	4,35	8,54	10,41	8,58	3,99	20	0	8,58	4,44	9,90	7,74	8,80	6,00
24080402	Theor. Spek.	Repetition		017-20z044	5,01	11,01	1000		20	1,000	middle	4,80	11,23	12,32	10,51	3,99	20	0	8,58	5,34	11,23	8,92	10,40	6,00
24080403	Theor. Spek.	Repetition		017-16z34a	5,01	8,98	1000		20	1,000	middle	4,38	9,46	10,14	8,47	3,00	20	0	7,59	4,38	9,52	7,44	8,63	5,01
24080404	Theor. Spek.	Repetition		017-16z68	5,01	8,98	1000		20	1,000	middle	4,41	9,37	10,36	8,45	3,00	20	0	7,59	4,41	10,26	7,42	8,58	5,01
24080405	storm	canceled	06.11.99	6nov99.prn	5,01	8,98	1000		20	1,000	middle	0,00	0,00	0,00	0,00	5,28	20	0	9,87	0,00	0,00	0,00	0,00	7,29
24080406	storm	0. Iteration	06.11.99	6nov99.prn	3,06	7,36	1000		20	1,000	middle	2,61	7,45	9,37	7,30	5,28	20	0	9,87	2,73	7,24	6,91	7,74	7,29
24080407	storm	0. Iteration	07.11.99	7nov99.prn	2,62	7,34	1000		20	1,000	middle	2,25	8,01	9,27	7,48	5,10	20	0	9,69	2,37	8,52	7,05	8,05	7,11
24080408	storm	0. Iteration	27.11.02	27oct02_19_20.prn	3,73	8,54	1000		20	1,000	middle	3,30	8,61	10,46	8,62	4,35	20	0	8,94	3,45	8,86	7,75	9,20	6,36
25080401	storm	0. Iteration	22.12.03	22dec03.prn	3,07	8,54	1000		20	1,000	middle	2,58	8,42	9,54	7,94	5,25	20	0	9,84	2,73	10,32	7,33	8,45	7,26
25080402	storm	0. Iteration	08.02.04	8feb04.prn	3,62	8,54	1000		20	1,000	middle	2,82	8,79	9,74	7,71	5,31	20	0	9,90	2,88	8,27	7,11	7,97	7,32
25080403	storm	0. Iteration	08.11.01	8nov01.prn	3,53	10,31	1000		20	1,000	middle	2,91	11,54	11,46	9,02	5,01	20	0	9,60	3,33	10,92	8,34	9,54	7,02
25080404	storm	0. Iteration	07.10.03	7oct03.prn	3,26	7,93	1000		20	1,000	middle	2,40	8,02	9,85	7,21	4,77	20	0	9,36	2,46	7,35	6,76	7,41	6,78
25080405	storm	0. Iteration	29.01.03	29jan03.prn	3,19	7,93	1000		20	1,000	middle	2,52	8,03	9,78	7,68	4,71	20	0	9,30	2,61	10,17	7,11	8,12	6,72
25080406	storm	0. Iteration	27.10.02	27oct02_18_19.prn	3,89	8,54	1000		20	1,000	middle	2,49	8,49	9,91	7,84	4,59	20	0	9,18	2,52	8,56	7,19	8,17	6,60
25080407	storm	0. Iteration	27.10.02	27oct02_17_18.prn	3,77	8,54	1000		20	1,000	middle	3,15	8,50	9,84	7,96	4,41	20	0	9,00	3,18	8,50	7,31	8,34	6,42
26080401	storm	0. Iteration	26.02.02	26feb02.prn	2,58	7,94	1000		20	1,000	middle	1,98	7,68	8,86	6,84	4,20	20	0	8,79	2,10	7,45	6,45	7,18	6,21
27080401	storm	1. Iteration	08.02.04	8feb04_a.prn	3,92	8,54	1000		20	1,000	middle	3,27	9,05	10,01	7,83	5,31	20	0	9,90	3,33	8,30	7,22	8,11	7,32
27080402	storm	1. Iteration	22.12.03	22dec03_a.prn	3,25	7,93	1000		20	1,000	middle	2,70	8,42	9,42	7,86	5,25	20	0	9,84	2,85	10,57	7,22	8,36	7,26
27080403	storm	1. Iteration	07.11.99	7nov99_a.prn	2,77	7,35	1000		20	1,000	middle	2,28	8,79	9,27	7,42	5,10	20	0	9,69	2,43	8,56	6,96	7,92	7,11
28080401	storm	1. Iteration	06.11.99	6nov99_a.prn	3,27	7,35	1000		20	1,000	middle	2,64	7,39	9,55	7,31	5,28	20	0	9,87	2,79	7,45	6,88	7,60	7,29
28080402	storm	1. Iteration	07.10.03	7oct03_a.prn	3,63	7,93	1000		20	1,000	middle	2,97	8,00	9,92	7,34	4,77	20	0	9,36	3,03	7,27	6,82	7,53	6,78
28080403	storm	1. Iteration	29.01.03	29jan03_a.prn	3,49	7,93	1000		20	1,000	middle	2,70	8,34	10,28	7,68	4,71	20	0	9,30	2,82	7,65	7,17	8,11	6,72
31080401	storm	1. Iteration	08.11.01	8nov01_a.prn	3,78	10,31	1000		20	1,000	middle	3,18	11,52	10,91	9,13	5,01	20	0	9,60	3,60	10,72	8,36	9,59	7,02
31080402	storm	1. Iteration	27.10.02	27oct02_17_18_a.prn	4,01	8,54	1000		20	1,000	middle	3,21	8,86	9,72	7,93	4,41	20	0	9,00	3,24	8,56	7,25	8,33	6,42
31080403	storm	1. Iteration	27.10.02	27oct02_19_20_a.prn	4,02	8,55	1000		20	1,000	middle	3,36	8,82	10,95	8,48	4,35	20	0	8,94	3,48	10,91	7,66	9,00	6,36
31080404	storm	1. Iteration	26.02.02	26feb02_a.prn	2,87	7,93	1000		20	1,000	middle	2,22	6,40	8,75	6,86	4,20	20	0	8,79	2,37	7,22	6,46	7,18	6,21
01090401	storm	Wdh. 1. Iter.	08.02.04	8feb04_a.prn	3,92	8,54	1000		500	1,000	middle	3,45	8,66	9,64	7,99	5,31	20	0	9,90	3,57	8,11	7,22	8,11	7,32
02090401	storm	Wdh. 1. Iter.	08.11.01	8nov01_a.prn	3,78	10,30	1000		500	1,000	middle	3,45	11,24	11,09	9,17	5,01	20	0	9,60	3,96	10,69	8,35	9,51	7,02
02090402	storm	Wdh. 1. Iter.	27.10.02	27oct02_19_20_a.prn	5,01	8,55	1000		500	1,000	middle	3,45	8,27	10,42	8,42	4,35	20	0	8,94	3,72	11,48	7,66	9,05	6,36

																			Dummy1			Dummy2			F_{Dummy}	
Test no.	Bt	γf	cot αd	cot αu	cot αex	cot αncl	Rc	B	hb	tan αB	Bh	Ac	Gc	RF	CF	q	q [perc]	pmax	p1/10	p1/3	pmax	p1/10	p1/3	Fmax	F1/10	F1/3
[ddmmyyno]	[m]	[-]	[-]	[-]	[-]	[-]	[m]	[m]	[m]	[-]	[m]	[m]	[m]	[-]	[-]	[m3/s/m]	[%]	[kPa]	[kPa]	[kPa]	[kPa]	[kPa]	[kPa]	[kN]	[kN]	[kN]
27030301	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			6,18E-03		0,28	0,26	0,18	0,28	0,24	0,19	9,83	8,73	6,52
27030302	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			2,35E-02		0,96	0,72	0,54	0,31	0,24	0,20	20,86	15,80	12,24
27030303	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			1,17E-02		1,14	1,14	0,85	0,32	0,25	0,20	23,82	22,44	17,00
27030304	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			2,33E-03		0,29	0,29	0,28	0,24	0,19	0,16	9,19	8,20	7,46
27030305	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			5,36E-03		0,86	0,86	0,56	0,24	0,19	0,16	17,94	16,96	11,76
28030301	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,07E-02		0,83	0,60	0,45	0,26	0,23	0,20	17,88	13,75	10,86
31030301	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			2,56E-03		0,38	0,34	0,28	0,22	0,15	0,08	10,18	8,18	5,88
01040301	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			2,45E-03		0,00	0,00	0,00	0,21	0,15	0,09	4,15	2,96	1,78
01040302	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			2,58E-03		0,39	0,35	0,29	0,19	0,09	0,04	9,74	7,15	5,24
01040303	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			5,81E-03		1,32	1,32	1,01	0,28	0,18	0,12	25,80	23,82	17,88
02040301	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			2,85E-03		0,40	0,40	0,30	0,30	0,18	0,11	12,07	9,70	6,78
02040302	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			5,17E-03		1,73	1,73	1,18	0,25	0,18	0,12	31,50	30,12	20,49
02040304	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,32E-02		1,14	0,86	0,61	0,24	0,17	0,13	22,24	16,56	11,93
02040305	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			3,87E-02		0,92	0,66	0,49	0,29	0,24	0,19	19,85	14,87	11,28
02040306	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			4,75E-02		2,11	1,47	0,75	0,37	0,26	0,21	39,71	27,71	15,66
02040307	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			1,94E-02		0,86	0,63	0,47	0,31	0,21	0,15	19,33	13,82	10,18
03040301	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			5,43E-03		0,76	0,76	0,59	0,33	0,23	0,13	18,19	16,21	11,63
03040302	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			2,23E-02		1,78	1,78	0,81	0,33	0,24	0,19	33,85	32,07	16,19
03040303	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			8,94E-03		1,02	0,98	0,70	0,29	0,20	0,12	21,39	19,00	13,12
09040301	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			7,53E-05		2,81	2,81	2,81	1,72	1,71	1,51	77,11	76,91	72,96
09040302	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			3,93E-03		3,79	3,79	2,59	1,23	1,21	1,08	82,49	82,09	61,10
09040303	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			4,01E-04		1,93	1,93	1,93	1,09	0,97	0,79	51,16	48,79	45,24
10040301	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			5,93E-05		0,20	0,11	0,07	1,34	1,34	1,06	29,53	28,15	22,00
10040302	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			8,76E-04		2,72	2,72	2,72	1,08	0,97	0,78	63,09	60,92	57,17
10040303	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			0,00E+00		0,04	0,04	0,03	0,20	0,16	0,14	4,56	3,77	3,22
10040304	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			0,00E+00		0,08	0,06	0,04	1,29	1,14	0,54	26,70	23,43	11,28
10040305	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			0,00E+00		0,09	0,06	0,04	0,15	0,09	0,05	4,34	2,70	1,60
10040306	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			2,09E-05		0,49	0,49	0,49	0,17	0,10	0,06	10,88	9,50	8,71
11040301	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			4,42E-03		2,00	2,00	1,70	1,30	1,22	0,99	56,38	54,80	45,65
11040302	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			2,59E-02		4,00	3,52	2,65	1,18	1,02	0,91	84,72	74,19	58,66
11040303	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			9,88E-03		4,26	4,26	4,24	1,15	1,09	0,90	88,12	86,94	82,88
11040304	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,30E-03		3,16	3,16	2,94	0,89	0,83	0,66	66,10	64,91	58,18
15040301	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			7,51E-03		1,75	1,75	1,67	2,17	2,17	1,86	69,72	69,72	62,37
15040302	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			3,32E-02		7,56	7,56	7,56	3,21	3,10	2,54	179,47	177,30	166,24
15040303	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			1,32E-02		1,81	1,81	1,81	2,08	1,92	1,29	68,86	65,70	53,26
15040304	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			2,98E-03		1,54	1,54	1,24	1,89	1,89	1,29	60,96	60,96	44,51
15040305	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			8,21E-03		5,87	5,87	5,87	1,42	1,23	0,98	118,18	114,43	109,49
15040306	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,01E-03		0,87	0,87	0,87	0,87	0,52	0,21	30,54	23,63	17,51
16040301	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			1,63E-03		0,46	0,46	0,46	1,59	1,59	1,03	38,46	38,46	27,40
16040302	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			9,85E-05		0,05	0,04	0,03	0,31	0,15	0,08	6,89	3,58	2,04
16040303	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			9,89E-05		0,49	0,49	0,49	0,68	0,48	0,33	20,95	17,00	14,04
17040301	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			0,00E+00		0,09	0,09	0,07	0,22	0,22	0,20	5,73	5,73	5,02
17040302	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			5,07E-05		1,22	1,22	1,22	1,09	0,37	0,14	40,26	26,04	21,50
17040303	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			0,00E+00		0,42	0,42	0,42	0,19	0,13	0,11	10,20	9,02	8,62
28040301	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			#DIV/0!		0,13	0,13	0,13	0,61	0,61	0,60	14,04	14,04	13,84
28040302	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			#DIV/0!		1,77	1,77	1,77	1,07	1,07	0,95	48,31	48,31	45,94
30040301	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			7,84E-04		1,46	1,46	0,78	0,66	0,54	0,44	35,45	33,08	20,67
30040302	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			2,11E-03		4,15	4,15	3,08	2,09	1,51	1,11	104,99	93,54	69,21
30040303	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			6,78E-04		1,94	1,94	1,11	1,93	1,41	0,77	67,90	57,63	32,25
30040304	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			7,09E-03		7,73	7,66	4,74	2,03	1,62	1,23	158,78	149,61	97,07
30040305	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			5,40E-03		7,98	7,98	4,70	1,80	1,47	1,16	158,08	151,57	95,08
30040306	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			1,44E-03		3,66	3,66	3,15	1,95	1,52	0,97	94,70	86,21	67,52
08050301	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			5,39E-03		3,65	3,43	2,46	2,41	2,13	1,76	103,63	94,73	72,53
08050302	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			1,07E-02		8,28	8,28	5,78	2,97	2,00	1,58	185,79	166,64	119,95
08050303	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			3,17E-02		7,87	5,91	4,40	3,31	2,46	1,90	186,21	139,33	105,08
08050304	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			1,57E-02		8,26	8,26	4,08	2,64	1,76	1,36	178,97	161,59	89,51
12050301	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			1,08E-02		6,45	5,91	3,74	2,51	1,74	1,29	148,60	125,11	82,90
12050302	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06			2,92E-02		8,26	7,22	4,60	3,43	2,27	1,73	194,56	155,69	104,80
13050301	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			6,09E-03		8,31	8,31	4,91	2,39	1,97	1,58	174,80	166,51	106,59
13050302	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			5,96E-04		3,41	3,41	2,94	1,33	1,15	0,57	78,62	75,07	56,40
14050301	15,66	0,50	1,40	1,40	1,40	1,40	6,00	0,00	0,00	0,00	0,00	8,19	6,06			#DIV/0!		0,04	0,04	0,03	0,40	0,30	0,20	8,51	6,54	4,41
14050302	15,66	0,50	1,40	1,40	1,40	1,40	5,79	0,00	0,00	0,00	0,00	7,98	6,06			#DIV/0!		0,13	0,13	0,13	0,33	0,33	0,33	8,51	8,51	8,51
14050303	15,66	0,50	1,40	1,40	1,40	1,40	5,85	0,00	0,00	0,00	0,00	8,04	6,06			#DIV/0!		0,08	0,08	0,06	0,18	0,17	0,16	4,78	4,58	4,08
14050304	15,66	0,50	1,40	1,40	1,40	1,40	5,61	0,00	0,00	0,00	0,00	7,80	6,06			#DIV/0!		0,12	0,12	0,12	0,25	0,25	0,23	6,78	6,78	6,38
14050305	15,66	0,50	1,40	1,40	1,40	1,40	5,49	0,00	0,00	0,00	0,00	7,68	6,06			#DIV/0!		0,03	0,03	0,03	0,09	0,05	0,04	2,24	1,45	1,25
19060301	15,66	0,50	1,40	1,40	1,40	1,40	6,00	0,00	0,00	0,00	0,00	8,19	6,06			0,00E+00		0,05	0,05	0,04	0,19	0,18	0,17	4,52	4,32	3,97
19060302	15,66	0,50	1,40	1,40	1,40	1,40	5,85	0,00	0,00	0,00	0,00	8,04	6,06			0,00E+00		0,06	0,05	0,05	0,39	0,39	0,36	8,62	8,47	7,88
24060301	15,66	0,50	1,40	1,40	1,40	1,40	6,00	0,00	0,00	0,00	0,00	8,19	6,06			0,00E+00		0,04	0,04	0,04	0,02	0,00	-0,02	1,01	0,61	0,22
24060302	15,66	0,50	1,40	1,40	1,40	1,40	5,85	0,00	0,00	0,00	0,00	8,04	6,06			3,02E-05		0,14	0,14	0,14	0,46	0,46	0,44	11,23	11,23	10,84
17080402	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			1,84E-04										
17080403	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			1,21E-02										
17080404	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			#DIV/0!										
23080401	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			1,37E-04										
23080402	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			4,26E-03										
23080403	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			2,34E-02										
24080401	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			5,85E-04										
24080402	15,66	0,50	1,40	1,40	1,40	1,40	6,21	0,00	0,00	0,00	0,00	8,40	6,06			3,48E-03										
24080403	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			1,00E-05										
24080404	15,66	0,50	1,40	1,40	1,40	1,40	7,20	0,00	0,00	0,00	0,00	9,39	6,06			2,82E-05										
24080405	15,66	0,50	1,40	1,40	1,40	1,40	4,92	0,00	0,00	0,00	0,00	7,11	6,06			#DIV/0!										
24080406	15,66	0,50	1,40	1,40	1,40	1,40	4,92	0,00	0,00	0,00	0,00	7,11	6,06			0,00E+00										
24080407	15,66	0,50	1,40	1,40	1,40	1,40	5,10	0,00	0,00	0,00	0,00	7,29	6,06			0,00E+00										
24080408	15,66	0,50	1,40	1,40	1,40	1,40	5,85	0,00	0,00	0,00	0,00	8,04	6,06			2,70E-04										
25080401	15,66	0,50	1,40	1,40	1,40	1,40	4,95	0,00	0,00	0,00	0,00	7,14	6,06			0,00E+00										
25080402	15,66	0,50	1,40	1,40	1,40	1,40	4,89	0,00	0,00	0,00	0,00	7,08	6,06			0,00E+00										
25080403	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			9,16E-05										
25080404	15,66	0,50	1,40	1,40	1,40	1,40	5,43	0,00	0,00	0,00	0,00	7,62	6,06			0,00E+00										
25080405	15,66	0,50	1,40	1,40	1,40	1,40	5,49	0,00	0,00	0,00	0,00	7,68	6,06			0,00E+00										
25080406	15,66	0,50	1,40	1,40	1,40	1,40	5,61	0,00	0,00	0,00	0,00	7,80	6,06			0,00E+00										
25080407	15,66	0,50	1,40	1,40	1,40	1,40	5,79	0,00	0,00	0,00	0,00	7,98	6,06			5,45E-05										
26080401	15,66	0,50	1,40	1,40	1,40	1,40	6,00	0,00	0,00	0,00	0,00	8,19	6,06			0,00E+00										
27080401	15,66	0,50	1,40	1,40	1,40	1,40	4,89	0,00	0,00	0,00	0,00	7,08	6,06			4,94E-04										
27080402	15,66	0,50	1,40	1,40	1,40	1,40	4,95	0,00	0,00	0,00	0,00	7,14	6,06			8,73E-06										
27080403	15,66	0,50	1,40	1,40	1,40	1,40	5,10	0,00	0,00	0,00	0,00	7,29	6,06			0,00E+00										
28080401	15,66	0,50	1,40	1,40	1,40	1,40	4,92	0,00	0,00	0,00	0,00	7,11	6,06			0,00E+00										
28080402	15,66	0,50	1,40	1,40	1,40	1,40	5,43	0,00	0,00	0,00	0,00	7,62	6,06			2,41E-05										
28080403	15,66	0,50	1,40	1,40	1,40	1,40	5,49	0,00	0,00	0,00	0,00	7,68	6,06			6,38E-07										
31080401	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			9,35E-04										
31080402	15,66	0,50	1,40	1,40	1,40	1,40	5,79	0,00	0,00	0,00	0,00	7,98	6,06			1,97E-04										
31080403	15,66	0,50	1,40	1,40	1,40	1,40	5,85	0,00	0,00	0,00	0,00	8,04	6,06			2,95E-04										
31080404	15,66	0,50	1,40	1,40	1,40	1,40	6,00	0,00	0,00	0,00	0,00	8,19	6,06			6,09E-06										
01090401	15,66	0,50	1,40	1,40	1,40	1,40	4,89	0,00	0,00	0,00	0,00	7,08	6,06			4,65E-04										
02090401	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06			8,45E-04										
02090402	15,66	0,50	1,40	1,40	1,40	1,40	5,85	0,00	0,00	0,00	0,00	8,04	6,06			2,26E-04										

Test no. [ddmmyyno]	Descr. [-]	Test [-]	Date of Storm	Gen. file [-]	H_{nom} [m]	T_{nom} [s]	No. waves [-]	Repetition [-]	fsam [Hz]	Tray width [m]	Tray pos. [-]
02090403	storm	Wdh. 1. Iter.	06.11.99	6nov99_a.prn	3,27	7,35	1000		20	1,000	middle
02090404	storm	Wdh. 1. Iter.	22.12.03	22dec03_a.prn	3,25	7,93	1000		20	1,000	middle
03090401	storm	Wdh. 1. Iter.	07.11.99	7nov99_a.prn	2,77	7,35	1000		20	1,000	middle
03090402	storm	Wdh. 1. Iter.	07.10.03	7oct03_a.prn	3,63	7,93	1000		20	1,000	middle
03090403	storm	Wdh. 1. Iter.	29.01.03	29jan03_a.prn	3,49	7,93	1000		20	1,000	middle
03090404	storm	Wdh. 1. Iter.	27.10.02	27oct02_17_18_a.prn	4,01	8,54	1000		20	1,000	middle
03090405	storm	Wdh. 1. Iter.	26.02.02	26feb02_a.prn	2,87	7,93	1000		20	1,000	middle
07090401	storm		08.02.04	8feb04_a.prn	3,92	8,54	1000		500	1,000	middle
07090402	storm		08.11.01	8nov01_a.prn	3,78	10,30	1000		500	1,000	middle
07090403	storm		27.10.02	27oct02_19_20_a.prn	4,02	8,55	1000		500	1,000	middle
08090401	JONSWAP			th_700_200_164.prn	6,00	8,98	1000		500	0,233	middle
08090402	JONSWAP			th_700_200_164.prn	6,00	8,98	1000		500	0,233	middle
08090403	JONSWAP			th_700_167_183.prn	5,01	10,02	1000		500	0,233	middle
08090404	JONSWAP			th_700_167_183.prn	5,01	10,02	1000		500	0,233	middle
08090405	JONSWAP			th_700_167_201.prn	5,01	11,01	1000		500	0,233	middle
08090406	JONSWAP			th_700_167_201.prn	5,01	11,01	1000		500	0,233	middle

Test no. [ddmmyyno]	$H_{m0\ deep}$ [m]	$T_{p\ deep}$ [s]	$T_{m\ deep}$ [s]	$T_{m-1,0\ deep}$ [s]	h_{deep} [m]	m [-]	β degr	h [m]	$H_{m0\ toe}$ [m]	$T_{p\ toe}$ [s]	$T_{m\ toe}$ [s]	$T_{m-1,0\ toe}$ [s]	h_t [m]
02090403	2,76	7,55	9,06	7,29	5,28	20	0	9,87	2,94	7,43	6,94	7,70	7,29
02090404	2,76	9,21	9,55	7,76	5,25	20	0	9,84	2,94	10,50	7,24	8,30	7,26
03090401	2,34	8,80	8,78	7,38	5,10	20	0	9,69	2,52	8,72	6,98	8,00	7,11
03090402	3,06	8,02	10,12	7,38	4,77	20	0	9,36	3,18	7,13	6,84	7,59	6,78
03090403	2,76	8,46	10,08	7,60	4,71	20	0	9,30	2,94	7,19	7,15	8,13	6,72
03090404	3,33	8,50	10,51	7,88	4,41	20	0	9,00	3,45	8,33	7,22	8,26	6,42
03090405	2,34	7,07	8,94	6,76	4,20	20	0	8,79	2,55	7,09	6,45	7,07	6,21
07090401	3,39	8,54	9,83	7,81	5,31	20	0	9,90	3,54	8,59	7,19	8,07	7,32
07090402	3,42	11,24	10,50	9,02	5,01	20	0	9,60	3,99	10,69	8,33	9,54	7,02
07090403	3,57	8,57	10,52	8,42	4,35	20	0	8,94	3,78	10,91	7,64	9,02	6,36
08090401	5,07	9,11	11,07	8,68	6,00	20	0	10,59	5,52	9,77	8,06	8,97	8,01
08090402	5,07	9,11	11,14	8,70	6,00	20	0	10,59	5,49	9,77	8,08	8,98	8,01
08090403	4,83	8,02	11,33	9,17	6,00	20	0	10,59	5,55	9,88	8,77	9,67	8,01
08090404	4,77	9,85	11,39	9,44	6,00	20	0	10,59	5,55	9,88	8,77	9,68	8,01
08090405	4,86	11,35	12,32	10,49	6,00	20	0	10,59	5,76	11,00	9,35	10,56	8,01
08090406	4,83	11,14	12,79	10,50	6,00	20	0	10,59	5,76	10,53	9,35	10,58	8,01

Test no. [ddmmyyno]	Bt [m]	γf [-]	cot αd [-]	cot αu [-]	cot αex [-]	cot αncl [-]	Rc [m]	B [m]	hb [m]	tan αB [-]	Bh [m]	Ac [m]	Gc [m]	RF [-]	CF [-]
02090403	15,66	0,50	1,40	1,40	1,40	1,40	4,92	0,00	0,00	0,00	0,00	7,11	6,06		
02090404	15,66	0,50	1,40	1,40	1,40	1,40	4,95	0,00	0,00	0,00	0,00	7,14	6,06		
03090401	15,66	0,50	1,40	1,40	1,40	1,40	5,10	0,00	0,00	0,00	0,00	7,29	6,06		
03090402	15,66	0,50	1,40	1,40	1,40	1,40	5,43	0,00	0,00	0,00	0,00	7,62	6,06		
03090403	15,66	0,50	1,40	1,40	1,40	1,40	5,49	0,00	0,00	0,00	0,00	7,68	6,06		
03090404	15,66	0,50	1,40	1,40	1,40	1,40	5,79	0,00	0,00	0,00	0,00	7,98	6,06		
03090405	15,66	0,50	1,40	1,40	1,40	1,40	6,00	0,00	0,00	0,00	0,00	8,19	6,06		
07090401	15,66	0,50	1,40	1,40	1,40	1,40	4,89	0,00	0,00	0,00	0,00	7,08	6,06		
07090402	15,66	0,50	1,40	1,40	1,40	1,40	5,19	0,00	0,00	0,00	0,00	7,38	6,06		
07090403	15,66	0,50	1,40	1,40	1,40	1,40	5,85	0,00	0,00	0,00	0,00	8,04	6,06		
08090401	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06		
08090402	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06		
08090403	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06		
08090404	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06		
08090405	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06		
08090406	15,66	0,50	1,40	1,40	1,40	1,40	4,20	0,00	0,00	0,00	0,00	6,39	6,06		

			Dummy1			Dummy2				F_{Dummy}	
Test no. [ddmmyyno]	q [m3/s/m]	q [perc] [%]	pmax [kPa]	p1/10 [kPa]	p1/3 [kPa]	pmax [kPa]	p1/10 [kPa]	p1/3 [kPa]	Fmax [kN]	F1/10 [kN]	F1/3 [kN]
02090403	0,00E+00										
02090404	1,17E-05										
03090401	0,00E+00										
03090402	3,43E-05										
03090403	5,37E-06										
03090404	4,42E-05										
03090405	7,41E-06										
07090401	3,31E-04		0,72	0,15	0,00	1,53	0,22	0,00	41,26	6,68	0,00
07090402	7,78E-04		0,54	0,21	0,00	1,03	0,24	0,00	28,52	7,99	0,00
07090403	1,53E-04		0,41	0,18	0,00	0,60	0,15	0,00	18,07	5,76	0,00
08090401	4,00E-02		2,43	2,15	0,00	4,11	2,10	0,00	118,42	74,48	0,00
08090402	3,79E-02		2,46	1,54	0,00	3,45	2,21	0,00	105,84	67,28	0,00
08090403	3,93E-02		2,24	1,42	0,00	3,79	2,22	0,00	109,22	65,64	0,00
08090404	4,39E-02		2,61	1,60	0,00	3,36	2,32	0,00	106,31	70,38	0,00
08090405	7,08E-02		2,57	1,71	0,00	3,87	2,77	0,00	115,97	80,95	0,00
08090406	6,91E-02		3,86	1,98	0,00	3,85	2,85	0,00	135,16	86,68	0,00

Annex B: Test results by UPVLC

u = 0 m/s

d	H_s	T_p [s]																	
[mNN]	[m]	5,0	6,0	6,2	7,0	7,2	7,6	7,9	8,0	8,2	9,0	9,3	9,8	10,0	10,3	10,8	11,0	11,2	11,6
3,00	4,00													x					
	4,50											x							
	5,00								x		x		x						
	5,50														x				
	6,00															x			
	6,50																	x	
	7,00																		x
4,00	2,00			x															
	2,50				x			x											
	3,00	x	x				x							x			x		
	3,50									x									
	4,00																		
	4,50																		
	5,00										x						x		
	5,50																		
5,00	2,00		x																
	2,50				x			x											
	3,00	x	x				x							x			x		
	3,50									x									
	4,00																		
	4,50																		
	5,00										x						x		
	5,50																		

u = 3 m/s

d	H_s	T_p [s]																	
[mNN]	[m]	5,0	6,0	6,2	7,0	7,2	7,6	7,9	8,0	8,2	9,0	9,3	9,8	10,0	10,3	10,8	11,0	11,2	11,6
3,00	4,00													x					
	4,50											x							
	5,00																		
	5,50														x				
	6,00															x			
	6,50																	x	
	7,00																		x

u = 5 m/s

d	H_s	T_p [s]																	
[mNN]	[m]	5,0	6,0	6,2	7,0	7,2	7,6	7,9	8,0	8,2	9,0	9,3	9,8	10,0	10,3	10,8	11,0	11,2	11,6
3,00	4,00													x					
	4,50											x							
	5,00								x		x		x						
	5,50														x				
	6,00															x			
	6,50																	x	
	7,00																		
4,00	2,00			x															
	2,50				x			x											
	3,00	x	x				x							x			x		
	3,50									x									
	4,00																		
	4,50																		
	5,00										x						x		
	5,50																		
5,00	2,00			x															
	2,50							x											
	3,00	x	x											x			x		
	3,50									x									
	4,00																		
	4,50																		
	5,00										x								
	5,50																		

u = 7m/s

d	H_s	T_p [s]																	
[mNN]	[m]	5,0	6,0	6,2	7,0	7,2	7,6	7,9	8,0	8,2	9,0	9,3	9,8	10,0	10,3	10,8	11,0	11,2	11,6
5,00	2,00			x															
	2,50				x														
	3,00						x												
	3,50									x									
	4,00																		
	4,50																		
	5,00										x								
	5,50																		

TEST	Slope	Wind	Test matrix					q	log(Q)	REGISTERED TOE								
										frequency domain					time domain			
			WL	Tp	Hs	Spectrum	γ			Hmo	Ir	Tp	T01	e	H1/3	H1/10	TH1/3	Tm
		(m/s)	(m)	(s)	(m)			(m3/s·ml)		(m)		(s)	(s)		(s)	(s)	(s)	(s)
ZE03_0108	1:1.3	0	3	9.3	4.5	JONSWAP	3.3	6.11E-06	-6.65	2.78	2.74	6.34	5.63	0.46	3.11	3.76	8.01	6.70
ZE03_0109			3	9.8	5.0	JONSWAP	3.3	5.78E-05	-5.72	2.87	2.72	8.54	5.73	0.48	3.31	3.92	8.53	7.01
ZE03_0110			3	10.3	5.5	JONSWAP	3.3	8.82E-05	-5.59	2.94	2.70	8.74	5.77	0.50	3.39	4.15	8.55	7.05
ZE03_0111			3	10.8	6.0	JONSWAP	3.3	1.37E-04	-5.46	3.02	2.70	10.02	5.88	0.51	3.43	4.19	8.89	7.23
ZE03_0112			3	11.2	6.5	JONSWAP	3.3	7.36E-05	-5.74	3.03	2.73	11.81	6.02	0.53	3.58	4.23	9.10	7.54
ZE03_0113			3	11.6	7.0	JONSWAP	3.3	4.25E-04	-5.03	3.05	2.76	12.34	6.17	0.56	3.60	4.32	9.64	7.83
ZE03_0120			3	10.0	4.0	JONSWAP	3.3	5.68E-06	-6.63	2.62	2.84	6.57	5.69	0.47	2.97	3.61	8.06	6.83
ZE03_0134			3	8.0	5.0	JONSWAP	3.3	0.00E+00	0.00	2.87	2.70	6.58	5.63	0.42	3.12	3.71	7.35	6.57
ZE03_0167			3	9.0	5.0	JONSWAP	1	6.31E-06	-6.65	2.80	2.72	6.98	5.60	0.44	3.13	3.77	7.95	6.61
ZE03_0168			3	9.0	5.0	JONSWAP	7	3.79E-05	-5.90	2.79	2.71	6.97	5.54	0.46	3.16	3.80	8.13	6.77
ZE04_0138			4	9.0	5.0	JONSWAP	3.3	3.79E-05	-5.95	3.30	2.68	6.67	5.88	0.45	3.63	4.35	8.07	6.95
ZE04_0144			4	11.0	5.0	JONSWAP	3.3	8.61E-04	-4.58	3.18	2.77	9.39	6.04	0.50	3.71	4.47	8.57	7.47
ZE05_0139			5	9.0	5.0	JONSWAP	3.3	9.41E-04	-4.55	3.46	2.73	9.06	6.03	0.45	3.73	4.53	7.92	6.99
ZE05_0145			5	11.0	5.0	JONSWAP	3.3	3.37E-03	-3.98	3.26	2.89	8.99	6.30	0.50	3.71	4.63	8.80	7.52
ZE03_0108	1:1.4	0	3	9.3	4.5	JONSWAP	3.3	0.00E+00	0.00	2.76	2.55	7.89	5.61	0.48	3.07	3.76	7.97	6.69
ZE03_0109			3	9.8	5.0	JONSWAP	3.3	4.38E-05	-5.87	2.85	2.53	8.42	5.71	0.49	3.27	3.99	8.79	7.02
ZE03_210			3	10.3	5.5	JONSWAP	3.3	1.34E-04	-5.49	2.94	2.55	10.48	5.92	0.53	3.50	4.12	9.01	7.50
ZE03_211			3	10.8	6.0	JONSWAP	3.3	2.52E-04	-5.25	2.95	2.56	11.43	5.98	0.54	3.48	4.12	9.33	7.62
ZE03_212			3	11.2	6.5	JONSWAP	3.3	3.21E-04	-5.18	3.02	2.59	12.71	6.22	0.56	3.58	4.20	9.99	8.12
ZE03_213			3	11.6	7.0	JONSWAP	3.3	8.62E-04	-4.75	3.12	2.60	11.29	6.43	0.58	3.66	4.32	10.07	8.23
ZE03_0120			3	10.0	4.0	JONSWAP	3.3	9.75E-06	-6.38	2.48	2.72	8.32	5.73	0.49	2.87	3.52	7.90	6.68
ZE03_234			3	8.0	5.0	JONSWAP	3.3	5.35E-06	-6.75	2.77	2.55	7.93	5.58	0.44	3.09	3.66	7.80	6.75
ZE03_0167			3	9.0	5.0	JONSWAP	3.3	1.62E-05	-6.21	2.62	2.60	7.81	5.56	0.46	2.99	3.55	7.26	6.68
ZE03_0168			3	9.0	5.0	JONSWAP	3.3	1.72E-05	-6.24	2.69	2.55	8.30	5.51	0.47	3.07	3.69	8.25	6.78
ZE04_0103			4	6.2	2.0	JONSWAP	3.3	7.52E-05	-5.16	1.96	2.99	6.42	5.23	0.31	1.94	2.43	5.78	5.20
ZE04_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.19	2.96	6.98	5.57	0.35	2.24	2.78	6.44	5.59
ZE04_0105			4	7.6	3.0	JONSWAP	3.3	2.72E-05	-5.79	2.44	2.84	7.48	5.71	0.39	2.51	3.10	6.86	5.95
ZE04_0106			4	8.2	3.5	JONSWAP	3.3	1.89E-05	-6.04	2.62	2.75	8.06	5.73	0.42	2.83	3.53	7.22	6.27
ZE04_0117			4	7.9	2.5	JONSWAP	3.3	3.92E-05	-5.57	2.24	2.93	6.30	5.60	0.39	2.19	2.73	6.43	5.67
ZE04_0127			4	5.0	3.0	JONSWAP	3.3	3.12E-05	-5.68	2.25	2.63	5.34	4.80	0.26	2.24	2.73	5.06	4.84
ZE04_0128			4	6.0	3.0	JONSWAP	3.3	1.73E-05	-5.97	2.50	2.68	6.03	5.32	0.31	2.55	3.19	5.86	5.40
ZE04_0129			4	10.0	3.0	JONSWAP	3.3	0.00E+00	0.00	2.24	3.10	10.25	6.16	0.47	2.41	3.13	8.07	6.90
ZE04_0130			4	11.0	3.0	JONSWAP	3.3	0.00E+00	0.00	2.23	3.20	8.67	6.49	0.49	2.47	3.27	8.63	7.40
ZE04_0138			4	9.0	5.0	JONSWAP	3.3	0.00E+00	0.00	3.21	2.50	8.90	5.81	0.46	3.57	4.24	7.68	6.96
ZE04_0144			4	11.0	5.0	JONSWAP	3.3	1.37E-03	-4.38	3.17	2.59	11.10	6.12	0.52	3.68	4.57	8.96	7.48
ZE05_0103			5	6.2	2.0	JONSWAP	3.3	2.51E-05	-5.64	2.07	3.00	6.19	5.30	0.30	2.04	2.58	5.80	5.26
ZE05_0104			5	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.32	2.97	7.01	5.65	0.34	2.35	2.92	6.42	5.70
ZE05_0105			5	7.6	3.0	JONSWAP	3.3	4.08E-05	-5.63	2.56	2.89	7.43	5.82	0.37	2.58	3.20	6.63	5.99
ZE05_0106			5	8.2	3.5	JONSWAP	3.3	1.89E-05	-6.05	2.79	2.80	8.10	5.93	0.40	2.93	3.69	7.36	6.24
ZE05_0117			5	7.9	2.5	JONSWAP	3.3	1.31E-05	-6.04	2.28	3.01	6.93	5.69	0.37	2.23	2.74	6.40	5.68
ZE05_0127			5	5.0	3.0	JONSWAP	3.3	6.25E-05	-5.37	2.35	2.64	5.39	4.84	0.25	2.38	2.98	5.14	4.92
ZE05_0128			5	6.0	3.0	JONSWAP	3.3	5.19E-05	-5.49	2.60	2.70	6.07	5.37	0.28	2.65	3.28	5.77	5.47
ZE05_0129			5	10.0	3.0	JONSWAP	3.3	4.64E-05	-5.52	2.54	2.74	6.15	5.39	0.29	2.58	3.17	5.78	5.48
ZE05_0130			5	11.0	3.0	JONSWAP	3.3	2.35E-05	-5.85	2.25	3.40	10.79	6.83	0.47	2.42	3.20	8.77	7.53
ZE05_0239			5	9.0	5.0	JONSWAP	3.3	6.56E-04	-4.73	3.37	2.57	8.70	6.00	0.45	3.75	4.63	8.28	7.10
ZE05_0339			5	9.0	5.0	JONSWAP	3.3	6.38E-04	-4.72	3.31	2.59	8.71	5.98	0.46	3.62	4.45	7.99	6.96
ZE05_0439			5	9.0	5.0	JONSWAP	3.3	5.73E-04	-4.76	3.29	2.59	8.71	5.98	0.45	3.65	4.42	7.86	6.98
ZE05_0539			5	9.0	5.0	JONSWAP	3.3	5.18E-04	-4.80	3.21	2.63	8.93	5.99	0.45	3.42	4.10	8.00	6.89
ZE05_0639			5	9.0	5.0	JONSWAP	3.3	4.80E-04	-4.83	3.19	2.63	8.67	5.97	0.45	3.39	4.09	7.89	6.83
ZE05_0245			5	11.0	5.0	JONSWAP	3.3	2.91E-03	-4.04	3.23	2.72	10.44	6.40	0.51	3.67	4.76	9.09	7.55
ZE05_0445			5	11.0	5.0	JONSWAP	3.3	5.25E-03	-3.83	3.33	2.67	10.41	6.33	0.51	3.77	4.74	9.21	7.55
ZE05_0545			5	11.0	5.0	JONSWAP	3.3	3.98E-03	-3.93	3.27	2.69	10.45	6.31	0.51	3.74	4.66	9.05	7.58
ZE05_0645			5	11.0	5.0	JONSWAP	3.3	3.46E-03	-3.97	3.14	2.75	11.10	6.34	0.50	3.58	4.41	8.87	7.54
ZE33_0108		3	3	9.3	4.5	JONSWAP	3.3	0.00E+00	0.00	2.66	2.62	7.89	5.67	0.48	2.93	3.58	7.90	6.70
ZE33_0109			3	9.9	5.0	JONSWAP	3.3	6.36E-05	-5.73	2.73	2.62	8.72	5.77	0.50	3.14	3.72	8.63	7.14
ZE33_0110			3	10.3	5.5	JONSWAP	3.3	4.63E-05	-5.85	2.71	2.62	8.79	5.77	0.50	3.11	3.79	8.70	6.99
ZE33_0111			3	10.8	6.0	JONSWAP	3.3	2.05E-04	-5.31	2.88	2.61	10.02	6.05	0.53	3.27	3.96	9.56	7.41
ZE33_0112			3	11.2	6.5	JONSWAP	3.3	2.33E-04	-5.26	2.88	2.65	11.50	6.20	0.55	3.35	3.89	9.50	7.83
ZE33_0113			3	11.6	7.0	JONSWAP	3.3	1.88E-05	-6.41	3.10	2.59	9.68	6.37	0.57	3.62	4.25	9.97	8.15
ZE33_0120			3	10.0	4.0	JONSWAP	3.3	0.00E+00	0.00	2.54	2.69	6.37	5.75	0.49	2.92	3.50	8.14	6.80
ZE53_0108		5	3	9.3	4.5	JONSWAP	3.3	1.34E-04	-5.35	2.69	2.61	7.89	5.71	0.48	2.95	3.58	7.91	6.67
ZE53_0109			3	9.8	5.0	JONSWAP	3.3	1.27E-04	-5.42	2.79	2.58	8.72	5.77	0.49	3.18	3.77	8.70	7.05
ZE53_0110			3	10.3	5.5	JONSWAP	3.3	3.85E-04	-4.98	2.84	2.58	8.74	5.87	0.52	3.26	4.01	9.34	7.18
ZE53_0111			3	10.8	6.0	JONSWAP	3.3	3.97E-04	-4.96	2.81	2.60	8.74	5.88	0.52	3.25	3.81	8.75	7.19
ZE53_0112			3	11.2	6.5	JONSWAP	3.3	6.31E-04	-4.82	2.91	2.63	7.93	6.18	0.54	3.38	4.11	10.02	7.64
ZE53_0112			3	11.2	6.5	JONSWAP	3.3	1.44E-03	-4.52	3.02	2.64	9.80	6.43	0.57	3.49	4.10	10.00	8.08
ZE53_0120			3	10.0	4.0	JONSWAP	3.3	1.42E-04	-5.26	2.52	2.70	8.56	5.74	0.49	2.83	3.47	8.27	6.71
ZE53_0134			3	8.0	5.0	JONSWAP	3.3	1.03E-04	-5.47	2.76	2.55	7.75	5.57	0.43	3.00	3.47	7.23	6.57
ZE53_0167			3	9.0	5.0	JONSWAP	3.3	1.48E-04	-5.30	2.71	2.57	8.92	5.61	0.46	3.03	3.64	8.13	6.64
ZE53_0168			3	9.0	5.0	JONSWAP	3.3	1.83E-04	-5.24	2.70	2.58	6.90	5.61	0.47	2.98	3.59	7.99	6.64
ZE54_0103			4	6.2	2.0	JONSWAP	3.3	0.00E+00	0.00	2.02	2.92	6.42	5.18	0.33	2.04	2.57	5.76	5.11
ZE54_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.22	2.90	6.78	5.49	0.37	2.26	2.76	6.23	5.48
ZE54_0105			4	7.6	0.3	JONSWAP	3.3	0.00E+00	0.00	2.45	2.82	7.48	5.66	0.39	2.58	3.17	6.73	5.86
ZE54_0106			4	8.2	3.5	JONSWAP	3.3	0.00E+00	0.00	2.61	2.75	8.06	5.72	0.42	2.84	3.45	7.17	6.23
ZE54_0117			4	7.9	2.5	JONSWAP	3.3	0.00E+00	0.00	2.29	2.88	6.30	5.55	0.40	2.28	2.81	6.39	5.57
ZE54_0127			4	5.0	3.0	JONSWAP	3.3	1.15E-05	-6.14	2.26	2.63	5.22	4.84	0.27	2.25	2.70	5.08	4.89
ZE54_0128			4	6.0	3.0	JONSWAP	3.3	0.00E+00	0.00	2.41	2.70	6.19	5.27	0.31	2.50	3.10	5.81	5.35
ZE54_0129			4	10.0	3.0	JONSWAP	3.3	7.95E-05	-5.35	2.21	3.10	8.55	6.09	0.47	2.39	3.16	8.34	6.65
ZE54_0130			4	11.0	3.0	JONSWAP	3.3	5.39E-03	-3.51	2.21	3.21	8.67	6.42	0.50	2.46	3.22	8.50	7.11
ZE54_0138			4	9.0	5.0	JONSWAP	3.3	5.81E-04	-4.79	3.13	2.55	8.90	5.88	0.46	3.46	4.14	8.21	6.90
ZE54_0144			4	11.0	5.0	JONSWAP	3.3	3.25E-03	-4.03	3.12	2.63	8.91	6.19	0.52	3.58	4.40	9.04	7.46
ZE55_0103			+5	6.2	2.0	JONSWAP	3.3	0.00E+00	0.00	2.11	2.97	6.19	5.27	0.31	2.10	2.63	5.73	5.19
ZE54_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.36	2.93	7.01	5.61	0.35	2.35	2.88	6.29	5.56
ZE55_0105			4	7.6	3.0	JONSWAP	3.3	1.50E-05	-6.12	2.69	2.82	7.43	5.83	0.38	2.72	3.32	6.72	5.92
ZE55_0106-1			+5	8.2	3.5	JONSWAP	3.3	0.00E+00	0.00	2.77	2.79	7.80	5.87	0.41	2.85	3.47	7.01	6.27
ZE55_0117			5	7.9	2.5	JONSWAP	3.3	2.88E-05	-5.71	2.25	2.99	6.28	5.59	0.38	2.26	2.81	6.36	5.54
ZE55_0127			+5	5.0	3.0	JONSWAP	3.3	4.59E-05	-5.53	2.30	2.68	5.34	4.85	0.25	2.33	2.85	5.14	4.94
ZE55_0128			+5	6.0	3.0	JONSWAP	3.3	5.71E-05	-5.46	2.57	2.73	6.07	5.40	0.29	2.59	3.18	5.82	5.42
ZE55_0129			+5	10.0	3.0	JONSWAP	3.3	6.81E-05	-5.37	2.53	2.75	6.14	5.39	0.29	2.60	3.17	5.80	5.40
ZE55_0130			+5	11.0	3.0	JONSWAP	3.3	5.23E-04	-4.52	2.21	3.38	10.79	6.65	0.49	2.34	3.09	8.63	6.94
ZE55_0139			+5	9.0	5.0	JONSWAP	3.3	4.04E-03	-3.98	3.40	2.56	9.05	6.02	0.46	3.76	4.57	8.26	7.04
ZE55_0145			+5	9.0	5.0	JONSWAP	3.3	1.99E-03	-4.28	3.40	2.56	9.05	6.02	0.46	3.76	4.57	8.26	7.04
ZE75_0103		7	+5	6.2	2.0	JONSWAP	3.3	5.54E-05	-5.32	2.18	2.87	6.42	5.16	0.33	2.19	2.68	5.73	5.03
ZE75_0104			+5	7.0	2.5	JONSWAP	3.3	1.63E-04	-4.96	2.44	2.84	7.01	5.50	0.36	2.46	3.00	6.27	5.41
ZE75_0105			+5	7.6	3.0	JONSWAP	3.3	4.65E-04	-4.60	2.65	2.80	7.45	5.73	0.38	2.77	3.42	6.81	5.81
ZE75_0139			+5	9.0	5.0	JONSWAP	3.3	6.57E-03	-3.76	3.34	2.58	8.93	6.03	0.46	3.64	4.29	7.73	7.01
ZE75_0203			+5	6.2	2.0	JONSWAP	3.3	5.03E-05	-5.36	2.21	2.83	6.42	5.12	0.33	2.21	2.68	5.58	5.00
ZE75_0204			+5	7.0	2.5	JONSWAP	3.3	2.61E-04	-4.75	2.44	2.86	7.01	5.57	0.36	2.44	2.97	6.25	5.45
ZE75_0205			+5	7.6	3.0	JONSWAP	3.3	5.48E-04	-4.54	2.69	2.79	7.48	5.74	0.38	2.81	3.47	6.86	5.84
ZE75_0206			+5	8.2	3.5	JONSWAP	3.3	1.31E-03	-4.23	2.77	2.77	8.10	5.81	0.41	2.90	3.50	6.93	6.12
ZE75_0239			+5	9.0	5.0	JONSWAP	3.3	6.82E-03	-3.74	3.34	2.59	8.93	6.03	0.46	3.64	4.27	7.70	7.00

TEST	Slope	Wind	Test matrix					q	log(Q)	INCIDENT (AAU) TOE frequency domain (M&F)			INCIDENT (AAU) TOE time domain (SIRW)				Cr	
			WL	Tp	Hs	Spectrum	γ			Hmo	Tp	T01	H1/3	H1/10	TH1/3	Tm	fd	td
		(m/s)	(m)	(s)	(m)			(m3/s·ml)		(m)	(s)	(s)	(s)	(s)	(s)	(s)		
ZE03_0108	1:1.3	0	3	9.3	4.5	JONSWAP	3.3	6.11E-06	-6.65	4.64	9.67	6.92	4.63	5.30	8.73	7.47	0.24	0.61
ZE03_0109			3	9.8	5.0	JONSWAP	3.3	5.78E-05	-5.72	4.92	9.67	7.19	4.89	5.56	9.23	7.83	0.25	0.64
ZE03_0110			3	10.3	5.5	JONSWAP	3.3	8.82E-05	-5.59	5.02	10.78	7.61	4.94	5.72	9.98	8.33	0.27	0.63
ZE03_0111			3	10.8	6.0	JONSWAP	3.3	1.37E-04	-5.46	5.20	10.78	7.66	4.89	5.55	10.43	8.66	0.27	0.69
ZE03_0112			3	11.2	6.5	JONSWAP	3.3	7.36E-05	-5.74	5.26	11.68	8.04	4.93	5.75	10.97	9.13	0.29	0.70
ZE03_0113			3	11.6	7.0	JONSWAP	3.3	4.25E-04	-5.03	3.53	11.68	8.51	3.61	4.18	10.80	8.54	0.25	0.56
ZE03_0120			3	10.0	4.0	JONSWAP	3.3	5.68E-06	-6.63	2.94	9.67	7.20	2.98	3.47	9.09	7.67	0.25	0.62
ZE03_0134			3	8.0	5.0	JONSWAP	3.3	0.00E+00	0.00	3.11	8.25	6.23	3.15	3.62	7.64	6.70	0.19	0.65
ZE03_0167			3	9.0	5.0	JONSWAP	1	6.31E-06	-6.65	3.03	10.38	7.02	2.89	3.28	8.38	7.26	0.21	0.58
ZE03_0168			3	9.0	5.0	JONSWAP	7	3.79E-05	-5.90	3.15	8.76	6.57	3.15	3.62	8.46	6.96	0.20	0.71
ZE04_0138			4	9.0	5.0	JONSWAP	3.3	3.79E-05	-5.95	5.40	9.36	6.57	5.62	6.44	8.68	7.55	0.24	0.82
ZE04_0144			4	11.0	5.0	JONSWAP	3.3	8.61E-04	-4.58	5.49	11.22	7.81	5.49	6.34	10.37	8.70	0.28	0.61
ZE05_0139			5	9.0	5.0	JONSWAP	3.3	9.41E-04	-4.55	5.75	9.36	6.99	6.02	6.97	8.66	7.56	0.27	0.55
ZE05_0145			5	11.0	5.0	JONSWAP	3.3	3.37E-03	-3.98	5.63	11.22	8.31	6.15	7.15	10.02	8.47	0.32	0.47
ZE03_0108	1:1.4	0	3	9.3	4.5	JONSWAP	3.3	0.00E+00	0.00	3.13	9.67	6.85	3.08	3.53	8.84	7.50	0.42	0.65
ZE03_0109			3	9.8	5.0	JONSWAP	3.3	4.38E-05	-5.87	3.28	9.67	7.11	3.24	3.69	9.31	7.90	0.42	0.67
ZE03_210			3	10.3	5.5	JONSWAP	3.3	1.34E-04	-5.49	3.41	10.38	7.36	3.22	3.73	10.41	8.70	0.43	0.73
ZE03_211			3	10.8	6.0	JONSWAP	3.3	2.52E-04	-5.25	3.38	10.78	7.58	3.16	3.66	10.87	8.98	0.44	0.75
ZE03_212			3	11.2	6.5	JONSWAP	3.3	3.21E-04	-5.18	3.45	11.68	7.79	3.27	3.80	11.61	9.57	0.44	0.76
ZE03_213			3	11.6	7.0	JONSWAP	3.3	8.62E-04	-4.75	3.43	11.68	8.48	3.58	4.18	10.90	8.39	0.46	0.55
ZE03_0120			3	10.0	4.0	JONSWAP	3.3	9.75E-06	-6.38	2.87	10.38	7.33	2.94	3.38	9.35	7.88	0.42	0.59
ZE03_234			3	8.0	5.0	JONSWAP	3.3	5.35E-06	-6.75	3.05	8.01	6.20	3.09	3.52	7.79	6.86	0.40	0.69
ZE03_0167			3	9.0	5.0	JONSWAP	3.3	1.62E-05	-6.21	3.02	9.67	6.74	2.98	3.41	8.29	7.12	0.41	0.61
ZE03_0168			3	9.0	5.0	JONSWAP	3.3	1.72E-05	-6.24	3.11	9.06	6.57	3.14	3.59	8.43	7.15	0.43	0.69
ZE04_0103			4	6.2	2.0	JONSWAP	3.3	7.52E-05	-5.16	1.90	6.23	5.17	2.08	2.63	5.75	4.93	0.29	0.44
ZE04_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.20	7.01	5.79	2.38	2.99	6.56	5.70	0.33	0.50
ZE04_0105			4	7.6	3.0	JONSWAP	3.3	2.72E-05	-5.79	2.54	8.01	6.18	2.73	3.33	7.04	6.20	0.36	0.50
ZE04_0106			4	8.2	3.5	JONSWAP	3.3	1.89E-05	-6.04	2.83	8.01	6.31	3.05	3.69	7.56	6.62	0.38	0.56
ZE04_0117			4	7.9	2.5	JONSWAP	3.3	3.92E-05	-5.57	2.33	8.01	6.05	2.46	3.05	6.92	6.05	0.35	0.48
ZE04_0127			4	5.0	3.0	JONSWAP	3.3	3.12E-05	-5.68	2.22	5.29	4.73	2.49	3.07	5.02	4.54	0.26	0.49
ZE04_0128			4	6.0	3.0	JONSWAP	3.3	1.73E-05	-5.97	2.46	6.10	5.36	2.67	3.35	5.81	5.40	0.26	0.50
ZE04_0129			4	10.0	3.0	JONSWAP	3.3	0.00E+00	0.00	2.63	10.38	7.73	2.76	3.32	9.24	7.98	0.45	0.48
ZE04_0130			4	11.0	3.0	JONSWAP	3.3	0.00E+00	0.00	2.57	10.38	8.21	2.76	3.39	10.22	8.87	0.45	0.52
ZE04_0138			4	9.0	5.0	JONSWAP	3.3	0.00E+00	0.00	3.68	9.36	6.81	3.73	4.24	8.62	7.50	0.43	0.62
ZE04_0144			4	11.0	5.0	JONSWAP	3.3	1.37E-03	-4.38	3.54	11.22	8.17	3.83	4.50	9.96	8.26	0.45	0.48
ZE05_0103			5	6.2	2.0	JONSWAP	3.3	2.51E-05	-5.64	1.96	6.10	5.30	2.22	2.84	5.80	5.34	0.29	0.43
ZE05_0104			5	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.32	7.01	5.79	2.68	3.37	6.56	5.84	0.31	0.44
ZE05_0105			5	7.6	3.0	JONSWAP	3.3	4.08E-05	-5.63	2.68	7.38	6.18	3.10	3.82	7.09	6.33	0.35	0.43
ZE05_0106			5	8.2	3.5	JONSWAP	3.3	1.89E-05	-6.05	3.03	8.01	6.53	3.52	4.25	7.74	6.85	0.38	0.42
ZE05_0117			5	7.9	2.5	JONSWAP	3.3	1.31E-05	-6.04	2.34	8.50	6.13	2.50	3.10	7.04	6.14	0.36	0.44
ZE05_0127			5	5.0	3.0	JONSWAP	3.3	6.25E-05	-5.37	2.27	5.01	4.77	2.57	3.19	5.06	4.52	0.28	0.51
ZE05_0128			5	6.0	3.0	JONSWAP	3.3	5.19E-05	-5.49	2.50	6.10	5.37	2.76	3.47	5.71	5.36	0.26	0.47
ZE05_0129			5	10.0	3.0	JONSWAP	3.3	4.64E-05	-5.52	2.48	5.72	5.38	2.70	3.40	5.75	5.40	0.26	0.46
ZE05_0130			5	11.0	3.0	JONSWAP	3.3	2.35E-05	-5.85	2.61	11.22	8.67	2.90	3.59	10.15	8.70	0.47	0.44
ZE05_0239			5	9.0	5.0	JONSWAP	3.3	6.56E-04	-4.73	3.93	9.06	6.88	4.13	4.73	8.74	7.68	0.44	0.58
ZE05_0339			5	9.0	5.0	JONSWAP	3.3	6.38E-04	-4.72	3.86	9.06	6.86	4.08	4.72	8.70	7.59	0.43	0.57
ZE05_0439			5	9.0	5.0	JONSWAP	3.3	5.73E-04	-4.76	3.84	9.06	6.87	4.04	4.66	8.68	7.63	0.44	0.57
ZE05_0539			5	9.0	5.0	JONSWAP	3.3	5.18E-04	-4.80	3.63	9.36	6.96	3.72	4.25	8.60	7.58	0.44	0.57
ZE05_0639			5	9.0	5.0	JONSWAP	3.3	4.80E-04	-4.83	3.61	9.36	6.94	3.71	4.27	8.52	7.50	0.44	0.57
ZE05_0245			5	11.0	5.0	JONSWAP	3.3	2.91E-03	-4.04	3.77	11.22	8.30	4.19	4.90	9.88	8.45	0.47	0.46
ZE05_0445			5	11.0	5.0	JONSWAP	3.3	5.25E-03	-3.83	3.78	11.22	8.19	4.08	4.69	10.03	8.40	0.47	0.49
ZE05_0545			5	11.0	5.0	JONSWAP	3.3	3.98E-03	-3.93	3.70	11.22	8.22	4.00	4.64	9.97	8.31	0.47	0.49
ZE05_0645			5	11.0	5.0	JONSWAP	3.3	3.46E-03	-3.97	3.56	11.22	8.21	3.88	4.46	9.75	8.27	0.47	0.49
ZE33_0108		3	3	9.3	4.5	JONSWAP	3.3	0.00E+00	0.00	3.11	9.67	6.79	2.90	3.37	8.90	7.50	0.45	0.73
ZE33_0109			3	9.9	5.0	JONSWAP	3.3	6.36E-05	-5.73	3.23	9.67	7.04	3.01	3.46	9.36	7.85	0.45	0.74
ZE33_0110			3	10.3	5.5	JONSWAP	3.3	4.63E-05	-5.85	3.20	9.67	7.08	2.99	3.43	9.36	7.92	0.45	0.73
ZE33_0111			3	10.8	6.0	JONSWAP	3.3	2.05E-04	-5.31	3.35	10.78	7.51	3.01	3.46	10.68	8.64	0.46	0.78
ZE33_0112			3	11.2	6.5	JONSWAP	3.3	2.33E-04	-5.26	3.35	11.68	7.89	2.98	3.45	11.11	9.00	0.46	0.77
ZE33_0113			3	11.6	7.0	JONSWAP	3.3	1.88E-05	-6.41	3.46	11.68	8.40	3.59	4.13	10.68	8.46	0.46	0.56
ZE33_0120			3	10.0	4.0	JONSWAP	3.3	0.00E+00	0.00	2.90	10.38	7.13	2.89	3.32	9.15	7.62	0.43	0.65
ZE53_0108		5	3	9.3	4.5	JONSWAP	3.3	1.34E-04	-5.35	3.02	9.67	6.84	2.90	3.35	8.82	7.40	0.44	0.69
ZE53_0109			3	9.8	5.0	JONSWAP	3.3	1.27E-04	-5.42	3.12	9.67	7.07	3.07	3.51	9.32	7.89	0.44	0.70
ZE53_0110			3	10.3	5.5	JONSWAP	3.3	3.85E-04	-4.98	3.21	10.38	7.37	3.00	3.45	9.94	8.23	0.44	0.72
ZE53_0111			3	10.8	6.0	JONSWAP	3.3	3.97E-04	-4.96	3.18	10.38	7.35	2.97	3.39	10.03	8.31	0.44	0.73
ZE53_0112			3	11.2	6.5	JONSWAP	3.3	6.31E-04	-4.82	3.35	11.68	7.80	3.05	3.49	10.91	8.89	0.45	0.73
ZE53_0112			3	11.2	6.5	JONSWAP	3.3	1.44E-03	-4.52	3.37	11.68	8.47	3.50	4.03	10.76	8.56	0.46	0.56
ZE53_0120			3	10.0	4.0	JONSWAP	3.3	1.42E-04	-5.26	2.81	10.38	7.10	2.84	3.26	9.22	7.62	0.43	0.65
ZE53_0134			3	8.0	5.0	JONSWAP	3.3	1.03E-04	-5.47	3.01	8.01	6.12	3.02	3.44	7.64	6.63	0.41	0.70
ZE53_0167			3	9.0	5.0	JONSWAP	3.3	1.48E-04	-5.30	3.00	9.67	6.69	2.90	3.29	8.35	7.28	0.42	0.66
ZE53_0168			3	9.0	5.0	JONSWAP	3.3	1.83E-04	-5.24	3.08	8.76	6.60	3.03	3.44	8.58	7.37	0.44	0.73
ZE54_0103			4	6.2	2.0	JONSWAP	3.3	0.00E+00	0.00	1.88	6.23	5.13	2.09	2.64	5.76	4.78	0.30	0.46
ZE54_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.15	6.84	5.74	2.34	2.91	6.44	5.62	0.34	0.52
ZE54_0105			4	7.6	0.3	JONSWAP	3.3	0.00E+00	0.00	2.48	7.58	6.09	2.68	3.29	6.95	6.00	0.37	0.56
ZE54_0106			4	8.2	3.5	JONSWAP	3.3	0.00E+00	0.00	2.78	8.01	6.27	2.94	3.49	7.58	6.57	0.40	0.58
ZE54_0117			4	7.9	2.5	JONSWAP	3.3	0.00E+00	0.00	2.27	8.50	6.07	2.42	2.97	6.92	6.13	0.37	0.49
ZE54_0127			4	5.0	3.0	JONSWAP	3.3	1.15E-05	-6.14	2.13	5.01	4.77	2.43	2.99	5.09	4.45	0.26	0.51
ZE54_0128			4	6.0	3.0	JONSWAP	3.3	0.00E+00	0.00	2.26	5.96	5.32	2.45	3.05	5.77	5.21	0.27	0.53
ZE54_0129			4	10.0	3.0	JONSWAP	3.3	7.95E-05	-5.35	2.44	10.38	7.72	2.56	3.11	9.13	7.86	0.45	0.51
ZE54_0130			4	11.0	3.0	JONSWAP	3.3	5.39E-03	-3.51	2.50	11.68	8.12	2.58	3.16	10.09	8.72	0.45	0.56
ZE54_0138			4	9.0	5.0	JONSWAP	3.3	5.81E-04	-4.79	3.56	9.36	6.79	3.51	3.99	8.51	7.55	0.44	0.66
ZE54_0144			4	11.0	5.0	JONSWAP	3.3	3.25E-03	-4.03	3.58	11.68	7.79	3.45	3.97	10.29	8.75	0.46	0.65
ZE55_0103			+5	6.2	2.0	JONSWAP	3.3	0.00E+00	0.00	1.88	6.10	5.32	2.02	2.57	5.78	5.18	0.30	0.48
ZE54_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.22	7.01	5.81	2.41	3.05	6.52	5.69	0.33	0.51
ZE55_0105			4	7.6	3.0	JONSWAP	3.3	1.50E-05	-6.12	2.62	7.38	6.24	2.86	3.56	7.03	6.17	0.36	0.50
ZE55_0106-1			+5	8.2	3.5	JONSWAP	3.3	0.00E+00	0.00	2.85	8.50	6.47	3.07	3.68	7.60	6.82	0.40	0.53
ZE55_0117			5	7.9	2.5	JONSWAP	3.3	2.88E-05	-5.71	2.19	8.50	6.09	2.35	2.94	6.91	6.10	0.37	0.48
ZE55_0127			+5	5.0	3.0	JONSWAP	3.3	4.59E-05	-5.53	2.14	5.01	4.74	2.41	2.99	5.00	4.09	0.28	0.54
ZE55_0128			+5	6.0	3.0	JONSWAP	3.3	5.71E-05	-5.46	2.33	5.96	5.39	2.54	3.22	5.79	5.31	0.27	0.51
ZE55_0129			+5	10.0	3.0	JONSWAP	3.3	6.81E-05	-5.37	2.38	6.10	5.36	2.55	3.17	5.77	5.38	0.27	0.50
ZE55_0130			+5	11.0	3.0	JONSWAP	3.3	5.23E-04	-4.52	2.50	11.22	8.60	2.73	3.38	10.18	8.75	0.48	0.46
ZE55_0139			+5	9.0	5.0	JONSWAP	3.3	4.04E-03	-3.98	3.86	9.06	6.85	3.89	4.43	8.66	7.71	0.45	0.64
ZE55_0145			+5	9.0	5.0	JONSWAP	3.3	1.99E-03	-4.28	3.71	11.22	8.28	4.00	4.59	10.11	8.64	0.47	0.49
ZE75_0103		7	+5	6.2	2.0	JONSWAP	3.3	5.54E-05	-5.32	2.03	6.38	5.05	2.18	2.70	5.68	4.74	0.31	0.49
ZE75_0104			+5	7.0	2.5	JONSWAP	3.3	1.63E-04	-4.96	2.34	7.01	5.67	2.49	3.08	6.50	5.47	0.34	0.51
ZE75_0105			+5	7.6	3.0	JONSWAP	3.3	4.65E-04	-4.60	2.66	7.38	6.12	2.85	3.48	7.04	6.16	0.36	0.51
ZE75_0139			+5	9.0	5.0	JONSWAP	3.3	6.57E-03	-3.76	3.80	9.36	6.90	3.83	4.34	8.71	7.67	0.45	0.60
ZE75_0203			+5	6.2	2.0	JONSWAP	3.3	5.03E-05	-5.36	2.00	5.96	5.05	2.15	2.68	5.61	4.64	0.31	0.51
ZE75_0204			+5	7.0	2.5	JONSWAP	3.3	2.61E-04	-4.75	2.26	7.01	5.76	2.51	3.12	6.50	5.58	0.35	0.51
ZE75_0205			+5	7.6	3.0	JONSWAP	3.3	5.48E-04	-4.54	2.59	7.38	6.15	2.87	3.53	6.98	6.09	0.37	0.50
ZE75_0206			+5	8.2	3.5	JONSWAP	3.3	1.31E-03	-4.23	2.80	8.01	6.30	3.14	3.72	7.51	6.57	0.39	0.53
ZE75_0239			+5	9.0	5.0	JONSWAP	3.3	6.82E-03	-3.74	3.61	9.36	6.90	3.81	4.36	8.69	7.62	0.44	0.56

TEST	Slope	Wind	Test matrix					q	log(Q)	INCIDENT (LASA) TOE frequency domain					time domain				Cr	
			WL	Tp	Hs	Spectrum	γ			Hmo	Ir	Tp	T01	e	H1/3	H1/10	TH1/3	Tm	fd	td
		(m/s)	(m)	(s)	(m)			(m3/s/m)		(m)		(s)	(s)		(s)	(s)	(s)	(s)		
ZE03_0108			3	9.3	4.5	JONSWAP	3.3	8.11E-08	-8.85	3.39	2.88	12.09	7.19	0.48	3.28	3.78	9.52	8.39	38%	37%
ZE03_0109			3	9.8	5.0	JONSWAP	3.3	5.78E-05	-5.72	3.63	2.80	10.68	7.34	0.47	3.51	3.94	9.38	8.49	34%	33%
ZE03_0110			3	10.3	5.5	JONSWAP	3.3	8.82E-05	-5.59	3.82	2.82	10.48	7.77	0.48	3.70	4.18	10.19	9.30	39%	39%
ZE03_0111			3	10.8	6.0	JONSWAP	3.3	1.37E-04	-5.48	4.00	2.79	13.72	7.95	0.48	3.85	4.31	10.59	9.60	41%	39%
ZE03_0112			3	11.2	6.5	JONSWAP	3.3	7.38E-05	-5.74	4.02	2.85	13.76	8.32	0.50	3.89	4.34	10.91	9.93	44%	44%
ZE03_0113			3	11.8	7.0	JONSWAP	3.3	4.25E-04	-5.03	5.78	2.59	13.81	9.87	0.38	5.27	8.09	10.88	9.78	23%	24%
ZE03_0120			3	10.0	4.0	JONSWAP	3.3	5.88E-08	-8.83	6.04	2.33	13.76	8.32	0.50	5.85	8.54	10.95	9.88	44%	44%
ZE03_0134	1:1.3	0	3	8.0	5.0	JONSWAP	3.3	0.00E+00	0.00	3.28	2.77	8.08	8.58	0.40	3.09	3.44	8.03	7.53	34%	34%
ZE03_0167			3	9.0	5.0	JONSWAP	1	8.31E-08	-8.85	3.29	2.85	10.58	8.95	0.44	3.18	3.84	8.95	7.98	37%	37%
ZE03_0168			3	9.0	5.0	JONSWAP	7	3.79E-05	-5.90	3.44	2.77	10.58	8.87	0.45	3.38	3.81	9.45	8.37	35%	34%
ZE04_0138			4	9.0	5.0	JONSWAP	3.3	3.79E-05	-5.95	3.97	2.78	9.43	7.21	0.42	3.73	4.23	9.21	8.20	39%	40%
ZE04_0144			4	11.0	5.0	JONSWAP	3.3	8.81E-04	-4.58	4.14	2.89	11.48	8.14	0.47	4.14	4.74	10.41	9.54	43%	41%
ZE05_0139			5	9.0	5.0	JONSWAP	3.3	9.41E-04	-4.55	4.12	2.78	10.20	7.08	0.42	3.94	4.47	8.79	8.08	37%	38%
ZE05_0145			5	11.0	5.0	JONSWAP	3.3	3.37E-03	-3.98	4.18	3.01	11.13	8.32	0.47	4.18	4.81	10.35	9.55	43%	44%
ZE03_0108			3	9.3	4.5	JONSWAP	3.3	0.00E+00	0.00	3.44	2.73	11.87	7.82	0.44	3.30	3.83	9.38	8.58	34%	34%
ZE03_0109			3	9.8	5.0	JONSWAP	3.3	4.38E-05	-5.87	3.69	2.69	13.31	7.91	0.45	3.50	3.99	9.98	9.02	38%	37%
ZE03_210			3	10.3	5.5	JONSWAP	3.3	1.34E-04	-5.49	3.98	2.60	10.48	7.90	0.47	3.81	4.25	10.58	9.53	38%	38%
ZE03_211			3	10.8	6.0	JONSWAP	3.3	2.52E-04	-5.25	3.97	2.65	13.58	8.20	0.48	3.79	4.18	10.92	9.78	38%	37%
ZE03_212			3	11.2	6.5	JONSWAP	3.3	3.21E-04	-5.18	4.04	2.69	13.76	8.59	0.49	3.90	4.35	11.41	10.24	40%	40%
ZE03_213			3	11.8	7.0	JONSWAP	3.3	8.62E-04	-4.75	4.14	2.71	12.48	8.87	0.50	4.05	4.53	11.85	10.47	42%	43%
ZE03_0120			3	10.0	4.0	JONSWAP	3.3	9.75E-08	-8.38	3.19	2.90	10.84	7.92	0.45	3.24	3.81	10.03	8.98	38%	37%
ZE03_234			3	8.0	5.0	JONSWAP	3.3	5.35E-08	-8.75	3.37	2.55	7.74	8.83	0.41	3.13	3.47	8.47	7.83	35%	35%
ZE03_0167			3	9.0	5.0	JONSWAP	3.3	1.62E-05	-8.21	3.21	2.79	11.81	7.48	0.43	3.09	3.55	8.78	8.13	33%	33%
ZE03_0168			3	9.0	5.0	JONSWAP	3.3	1.72E-05	-8.24	3.54	2.50	8.75	8.72	0.43	3.37	3.81	8.87	7.71	32%	30%
ZE04_0103			4	8.2	2.0	JONSWAP	3.3	7.52E-05	-5.18	1.89	3.30	5.73	5.92	0.23	1.78	2.18	8.13	5.98	24%	28%
ZE04_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.21	3.23	8.47	8.51	0.25	2.10	2.50	8.77	8.61	27%	27%
ZE04_0105			4	7.8	3.0	JONSWAP	3.3	2.72E-05	-5.79	2.80	3.09	7.10	8.93	0.28	2.42	2.88	7.37	8.88	28%	27%
ZE04_0106			4	8.2	3.5	JONSWAP	3.3	1.89E-05	-8.04	2.98	2.93	10.38	7.12	0.33	2.80	3.35	8.03	7.33	28%	27%
ZE04_0117			4	7.9	2.5	JONSWAP	3.3	3.92E-05	-5.57	2.37	2.88	10.48	8.97	0.31	2.18	2.82	7.41	8.70	27%	29%
ZE04_0127			4	5.0	3.0	JONSWAP	3.3	3.12E-05	-5.68	2.25	2.74	5.24	5.09	0.20	2.08	2.48	5.23	5.12	28%	28%
ZE04_0128			4	8.0	3.0	JONSWAP	3.3	1.73E-05	-5.97	2.49	2.84	5.14	5.84	0.22	2.33	2.77	8.00	5.88	22%	22%
ZE04_0129			4	10.0	3.0	JONSWAP	3.3	0.00E+00	0.00	2.89	3.25	10.43	8.32	0.39	2.74	3.38	9.78	8.88	37%	35%
ZE04_0130			4	11.0	3.0	JONSWAP	3.3	0.00E+00	0.00	3.00	3.35	11.48	9.08	0.40	2.90	3.54	10.88	9.78	42%	41%
ZE04_0138		0	4	9.0	5.0	JONSWAP	3.3	0.00E+00	0.00	4.04	2.59	11.50	7.48	0.40	3.73	4.22	9.08	7.99	33%	33%
ZE04_0144			4	11.0	5.0	JONSWAP	3.3	1.37E-03	-4.38	4.31	2.71	11.13	8.58	0.48	4.15	4.81	10.55	9.34	45%	43%
ZE05_0103			5	8.2	2.0	JONSWAP	3.3	2.51E-05	-5.84	2.15	3.15	8.42	5.84	0.22	2.04	2.47	8.04	5.90	27%	27%
ZE05_0104			5	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.54	3.07	7.01	8.41	0.24	2.42	2.95	8.70	8.45	27%	28%
ZE05_0105			5	7.8	3.0	JONSWAP	3.3	4.08E-05	-5.83	2.98	2.95	7.90	8.82	0.25	2.80	3.32	7.12	8.84	27%	28%
ZE05_0106			5	8.2	3.5	JONSWAP	3.3	1.89E-05	-8.05	3.41	2.88	8.03	7.28	0.27	3.18	3.83	7.71	7.29	27%	27%
ZE05_0117			5	7.9	2.5	JONSWAP	3.3	1.31E-05	-8.04	2.80	3.18	10.13	8.84	0.29	2.42	2.91	7.28	8.88	29%	29%
ZE05_0127			5	5.0	3.0	JONSWAP	3.3	8.25E-05	-5.37	2.87	2.51	4.23	4.94	0.19	2.48	2.93	5.09	5.03	24%	23%
ZE05_0128			5	8.0	3.0	JONSWAP	3.3	5.19E-05	-5.49	2.84	2.89	5.53	5.89	0.21	2.72	3.27	5.87	5.77	24%	23%
ZE05_0129			5	10.0	3.0	JONSWAP	3.3	4.84E-05	-5.52	2.78	2.74	5.89	5.73	0.22	2.68	3.21	5.92	5.79	25%	24%
ZE05_0130			5	11.0	3.0	JONSWAP	3.3	2.35E-05	-5.85	2.91	3.48	11.13	8.87	0.41	2.83	3.55	10.37	9.57	44%	48%
ZE05_0239			5	9.0	5.0	JONSWAP	3.3	8.58E-04	-4.73	4.21	2.58	9.14	7.18	0.42	4.03	4.87	9.12	8.11	38%	40%
ZE05_0339			5	9.0	5.0	JONSWAP	3.3	8.38E-04	-4.72	4.21	2.58	9.14	7.18	0.42	4.03	4.87	9.12	8.11	38%	40%
ZE05_0439			5	9.0	5.0	JONSWAP	3.3	5.73E-04	-4.78	4.08	2.68	9.14	7.55	0.40	3.90	4.53	9.34	8.48	32%	33%
ZE05_0539			5	9.0	5.0	JONSWAP	3.3	5.18E-04	-4.80	3.97	2.71	11.50	7.51	0.39	3.71	4.15	9.04	8.32	31%	32%
ZE05_0639			5	9.0	5.0	JONSWAP	3.3	4.80E-04	-4.83	3.94	2.73	10.20	7.58	0.39	3.69	4.21	9.08	8.37	31%	32%
ZE05_0245			5	11.0	5.0	JONSWAP	3.3	2.91E-03	-4.04	4.18	2.81	11.19	8.38	0.48	4.17	4.79	10.48	9.58	44%	45%
ZE05_0445			5	11.0	5.0	JONSWAP	3.3	5.25E-03	-3.83	4.58	2.77	11.13	8.81	0.45	4.41	5.01	10.68	9.68	45%	44%
ZE05_0545			5	11.0	5.0	JONSWAP	3.3	3.08E-03	-3.93	4.41	2.80	11.11	8.71	0.48	4.35	5.08	10.97	9.77	45%	47%
ZE05_0645			5	11.0	5.0	JONSWAP	3.3	3.48E-03	-3.97	4.30	2.89	11.48	9.04	0.43	4.15	4.87	10.70	9.93	45%	48%
ZE33_0108			3	9.3	4.5	JONSWAP	3.3	0.00E+00	0.00	3.47	2.71	11.87	7.58	0.44	3.28	3.78	9.17	8.48	35%	35%
ZE33_0109			3	9.9	5.0	JONSWAP	3.3	8.38E-05	-5.73	3.72	2.69	11.78	7.99	0.48	3.61	4.22	10.57	9.11	40%	41%
ZE33_0110			3	10.3	5.5	JONSWAP	3.3	4.63E-05	-5.85	3.65	2.72	13.81	7.97	0.45	3.48	3.97	9.87	9.04	39%	38%
ZE33_0111		3	3	10.8	6.0	JONSWAP	3.3	2.05E-04	-5.31	4.11	2.68	13.72	8.58	0.49	3.48	3.97	9.87	9.04	48%	38%
ZE33_0112	1:1.4		3	11.2	6.5	JONSWAP	3.3	2.33E-04	-5.28	4.19	2.71	13.76	8.98	0.50	4.07	4.58	11.44	10.28	52%	49%
ZE33_0113			3	11.8	7.0	JONSWAP	3.3	1.88E-05	-8.41	4.50	2.67	11.72	9.34	0.50	4.40	4.89	12.33	10.55	55%	53%
ZE33_0120			3	10.0	4.0	JONSWAP	3.3	0.00E+00	0.00	3.30	2.87	13.60	8.03	0.45	3.19	3.65	9.77	9.13	37%	37%
ZE53_0108			3	9.3	4.5	JONSWAP	3.3	1.34E-04	-5.35	3.48	2.65	10.58	7.30	0.44	3.28	3.71	9.20	8.54	34%	34%
ZE53_0109			3	9.8	5.0	JONSWAP	3.3	1.27E-04	-5.42	3.68	2.64	10.68	7.80	0.45	3.48	3.95	10.21	9.04	34%	34%
ZE53_0110			3	10.3	5.5	JONSWAP	3.3	3.85E-04	-4.98	3.84	2.68	10.48	8.08	0.48	3.28	3.71	9.20	8.54	38%	34%
ZE53_0111			3	10.8	6.0	JONSWAP	3.3	3.97E-04	-4.98	3.72	2.68	10.48	7.92	0.48	3.52	3.97	10.35	9.43	38%	38%
ZE53_0112			3	11.2	6.5	JONSWAP	3.3	8.31E-04	-4.82	3.92	2.71	11.93	8.50	0.48	3.78	4.23	11.70	9.98	43%	40%
ZE53_0112			3	11.2	6.5	JONSWAP	3.3	1.44E-03	-4.52	4.04	2.74	11.38	8.91	0.49	3.91	4.30	11.83	10.31	48%	45%
ZE53_0120			3	10.0	4.0	JONSWAP	3.3	1.42E-04	-5.28	3.22	2.81	10.68	7.58	0.47	3.15	3.58	9.70	8.73	35%	38%
ZE53_0134			3	8.0	5.0	JONSWAP	3.3	1.03E-04	-5.47	3.30	2.58	8.08	8.57	0.41	3.08	3.39	8.17	7.59	28%	30%
ZE53_0167			3	9.0	5.0	JONSWAP	3.3	1.48E-04	-5.30	3.28	2.68	10.58	7.08	0.44	3.13	3.58	9.38	8.12	31%	33%
ZE53_0168			3	9.0	5.0	JONSWAP	3.3	1.83E-04	-5.24	3.45	2.59	8.75	8.98	0.44	3.29	3.71	9.22	8.28	31%	31%
ZE54_0103			4	8.2	2.0	JONSWAP	3.3	0.00E+00	0.00	2.02	3.14	8.42	5.79	0.25	1.90	2.27	8.12	8.21	24%	28%
ZE54_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.31	3.08	7.18	8.28	0.30	2.18	2.60	8.89	8.61	28%	40%
ZE54_0105			4	7.8	0.3	JONSWAP	3.3	0.00E+00	0.00	2.68	2.98	7.90	8.58	0.34	2.51	2.98	7.37	7.10	30%	30%
ZE54_0106			4	8.2	3.5	JONSWAP	3.3	0.00E+00	0.00	3.03	2.82	8.00	8.75	0.38	2.87	3.35	7.98	7.44	30%	30%
ZE54_0117			4	7.9	2.5	JONSWAP	3.3	0.00E+00	0.00	2.48	3.08	7.11	8.58	0.35	2.30	2.75	7.53	6.99	29%	32%
ZE54_0127		5	4	5.0	3.0	JONSWAP	3.3	1.15E-05	-8.14	2.29	2.70	5.41	5.07	0.22	2.15	2.48	5.29	5.32	23%	24%
ZE54_0128			4	8.0	3.0	JONSWAP	3.3	0.00E+00	0.00	2.45	2.80	8.74	5.83	0.28	2.31	2.74	5.97	5.93	23%	23%
ZE54_0129			4	10.0	3.0	JONSWAP	3.3	7.95E-05	-5.35	2.80	3.21	10.43	7.89	0.43	2.73	3.38	9.84	9.15	38%	38%
ZE54_0130			4	11.0	3.0	JONSWAP	3.3	5.39E-03	-3.51	2.88	3.31	11.13	8.51	0.44	2.78	3.38	10.83	9.59	40%	39%
ZE54_0138			4	9.0	5.0	JONSWAP	3.3	5.81E-04	-4.79	3.94	2.58	10.20	7.18	0.42	3.68	4.18	9.19	8.28	34%	35%
ZE54_0144			4	11.0	5.0	JONSWAP	3.3	3.25E-03	-4.03	4.14	2.73	11.48	8.39	0.48	3.98	4.50	10.47	9.77	41%	40%
ZE55_0103			+5	8.2	2.0	JONSWAP	3.3	0.00E+00	0.00	2.08	3.20	8.42	5.80	0.24	1.94	2.33	8.10	5.98	25%	27%
ZE54_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.38	3.18	7.01	8.38	0.27	2.28	2.69	8.80	8.62	28%	29%
ZE55_0105			4	7.8	3.0	JONSWAP	3.3	1.50E-05	-8.12	2.87	2.98	7.90	8.87	0.31	2.87	3.18	7.44	7.11	29%	32%
ZE55_0106-1			+5	8.2	3.5	JONSWAP	3.3	0.00E+00	0.00	3.14	2.98	8.42	7.25	0.33	2.95	3.47	8.01	7.63	35%	37%
ZE55_0117			5	7.9	2.5	JONSWAP	3.3	2.88E-05	-5.71	2.39	3.24	8.40	8.85	0.33	2.24	2.70	7.37	6.99	29%	30%
ZE55_0127			+5	5.0	3.0	JONSWAP	3.3	4.59E-05	-5.53	2.33	2.75	5.08	5.08	0.21	2.18	2.55	5.23	5.25	28%	27%
ZE55_0128			+5	8.0	3.0	JONSWAP	3.3	5.71E-05	-5.48	2.58	2.85	8.70	5.73	0.24	2.42	2.89	8.01	5.93	23%	24%
ZE55_0129			+5	10.0	3.0	JONSWAP	3.3	8.81E-05	-5.37	2.48	2.90	8.70	5.75	0.24	2.40	2.83	5.97	5.94	25%	24%
ZE55_0130			+5	11.0	3.0	JONSWAP	3.3	5.23E-04	-4.52	2.90	3.49	11.08	8.87	0.41	2.81	3.49	10.72	9.87	43%	49%
ZE55_0139			+5	9.0	5.0	JONSWAP	3.3	4.04E-03	-3.98	4.28	2.54	10.20	7.21	0.41	4.00	4.52	9.09	8.27	35%	35%
ZE55_0145			+5	9.0	5.0	JONSWAP	3.3	1.99E-03	-4.28	4.28	2.54	10.20	7.21	0.41	4.00	4.52	9.09	8.27	35%	35%
ZE75_0103			+5	8.2	2.0	JONSWAP	3.3	5.54E-05	-5.32	2.13	3.11	8.42	5.70	0.25	2.01	2.39	8.03	5.98	28%	29%
ZE75_0104			+5	7.0	2.5	JONSWAP	3.3	1.63E-04	-4.98	2.47	3.05	7.01	8.22	0.29	2.30	2.73	8.88	8.31	28%	35%
ZE75_0105			+5	7.8	3.0	JONSWAP	3.3	4.65E-04	-4.80	2.81	2.98	7.48	8.54	0.33	2.83	3.13	7.29	8.80	30%	30%
ZE75_0139			+5	9.0	5.0	JONSWAP	3.3	8.57E-03	-3.78	4.18	2.58	10.20	7.14	0.42	3.92	4.44	8.78	8.02	37%	38%
ZE75_0203		7	+5	8.2	2.0	JONSWAP	3.3	5.03E-05	-5.38	2.15	3.09	8.42	5.89	0.25	2.00	2.39	8.09	5.88	27%	30%
ZE75_0204			+5	7.0	2.5	JONSWAP	3.3	2.81E-04	-4.75	2.43	3.08	7.01	8.22	0.29	2.27	2.89	8.84	8.38	29%	31%
ZE75_0205			+5	7.8	3.0	JONSWAP	3.3	5.48E-04	-4.54	2.79	2.98	7.48	8.52	0.33	2.83	3.09	7.34	6.95	30%	30%
ZE75_0206			+5	8.2	3.5	JONSWAP	3.3	1.31E-03	-4.23	3.05	2.89	7.97	8.73	0.37	2.88	3.38	7.89	7.20	32%	31%
ZE75_0239			+5	9.0	5.0	JONSWAP	3.3	8.82E-03	-3.74	4.07	2.59	10.20	7.18	0.41	3.80	4.29	8.71	7.98	38%	35%

TEST	Slope	Wind	Test matrix					q	log(Q)	REGISTERED WRI frequency domain					REGISTERED WRI time domain			
			WL	Tp	Hs	Spectrum	γ			Hmo	Ir	Tp	T01	e	H1/3	H1/10	TH1/3	Tm
		(m/s)	(m)	(s)	(m)			(m3/s·ml)		(m)		(s)	(s)		(s)	(s)	(s)	(s)
ZE03_0108			3	9.3	4.5	JONSWAP	3.3	6.11E-06	-6.65	4.21	3.23	8.76	7.51	0.39	4.12	5.01	8.66	7.38
ZE03_0109			3	9.8	5.0	JONSWAP	3.3	5.78E-05	-5.72	4.57	3.21	10.43	7.92	0.41	4.36	5.29	9.09	7.89
ZE03_0110			3	10.3	5.5	JONSWAP	3.3	8.82E-05	-5.59	4.93	3.20	10.43	8.33	0.42	4.85	6.00	9.90	8.38
ZE03_0111			3	10.8	6.0	JONSWAP	3.3	1.37E-04	-5.46	5.37	3.14	10.73	8.68	0.43	5.24	6.38	10.23	8.80
ZE03_0112			3	11.2	6.5	JONSWAP	3.3	7.36E-05	-5.74	5.47	3.15	10.84	8.81	0.44	5.47	6.76	10.68	8.99
ZE03_0113			3	11.6	7.0	JONSWAP	3.3	4.25E-04	-5.03	5.93	3.08	11.36	9.06	0.46	6.03	7.19	11.19	9.47
ZE03_0120	1:1.3	0	3	10.0	4.0	JONSWAP	3.3	5.68E-06	-6.63	3.91	3.51	10.43	8.06	0.40	3.69	4.58	9.16	7.84
ZE03_0134			3	8.0	5.0	JONSWAP	3.3	0.00E+00	0.00	4.35	2.96	7.74	6.80	0.35	4.30	5.29	7.47	6.83
ZE03_0167			3	9.0	5.0	JONSWAP	1	6.31E-06	-6.65	4.30	3.04	10.58	7.03	0.39	4.25	5.15	8.04	7.02
ZE03_0168			3	9.0	5.0	JONSWAP	7	3.79E-05	-5.90	4.51	3.12	8.75	7.55	0.37	4.39	5.34	8.61	7.49
ZE04_0138			4	9.0	5.0	JONSWAP	3.3	3.79E-05	-5.95	4.86	3.01	8.70	7.45	0.37	4.79	5.83	8.53	7.46
ZE04_0144			4	11.0	5.0	JONSWAP	3.3	8.61E-04	-4.58	4.81	3.39	10.36	8.78	0.42	4.69	5.80	10.39	8.70
ZE05_0139			5	9.0	5.0	JONSWAP	3.3	9.41E-04	-4.55	4.83	3.05	8.50	7.47	0.38	4.70	5.79	8.53	7.50
ZE05_0145			5	11.0	5.0	JONSWAP	3.3	3.37E-03	-3.98	4.71	3.45	10.36	8.73	0.43	4.63	5.77	10.39	8.73
ZE03_0108			3	9.3	4.5	JONSWAP	3.3	0.00E+00	0.00	4.35	2.96	8.76	7.55	0.39	4.23	5.11	8.55	7.46
ZE03_0109			3	9.8	5.0	JONSWAP	3.3	4.38E-05	-5.87	4.73	2.93	10.43	7.93	0.41	4.56	5.54	9.30	7.93
ZE03_210			3	10.3	5.5	JONSWAP	3.3	1.34E-04	-5.49	5.62	2.83	10.43	8.54	0.42	5.54	6.67	9.78	8.86
ZE03_211			3	10.8	6.0	JONSWAP	3.3	2.52E-04	-5.25	5.91	2.81	10.61	8.82	0.42	5.76	6.95	10.31	9.11
ZE03_212			3	11.2	6.5	JONSWAP	3.3	3.21E-04	-5.18	6.24	2.77	10.61	8.96	0.44	6.34	7.53	10.99	9.55
ZE03_213			3	11.6	7.0	JONSWAP	3.3	8.62E-04	-4.75	6.25	2.82	14.02	9.23	0.45	6.33	7.42	10.92	9.86
ZE03_0120			3	10.0	4.0	JONSWAP	3.3	9.75E-06	-6.38	3.83	3.30	10.46	8.09	0.41	3.73	4.61	9.23	7.78
ZE03_234			3	8.0	5.0	JONSWAP	3.3	5.35E-06	-6.75	4.54	2.72	8.68	6.93	0.35	4.50	5.55	7.68	7.09
ZE03_0167			3	9.0	5.0	JONSWAP	3.3	1.62E-05	-6.21	4.15	2.88	10.58	7.03	0.39	4.20	5.11	7.95	7.03
ZE03_0168			3	9.0	5.0	JONSWAP	3.3	1.72E-05	-6.24	4.53	2.90	8.75	7.56	0.37	4.41	5.39	8.63	7.56
ZE04_0103			4	6.2	2.0	JONSWAP	3.3	7.52E-05	-5.16	2.29	3.08	6.42	5.27	0.30	2.27	2.79	5.74	5.23
ZE04_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.64	3.14	7.11	5.84	0.33	2.61	3.23	6.51	5.78
ZE04_0105			4	7.6	3.0	JONSWAP	3.3	2.72E-05	-5.79	3.08	3.05	7.48	6.20	0.35	3.04	3.74	6.91	6.12
ZE04_0106			4	8.2	3.5	JONSWAP	3.3	1.89E-05	-6.04	3.50	3.04	8.51	6.67	0.37	3.40	4.26	7.56	6.54
ZE04_0117			4	7.9	2.5	JONSWAP	3.3	3.92E-05	-5.57	2.79	3.17	8.56	6.11	0.36	2.70	3.35	6.84	5.98
ZE04_0127			4	5.0	3.0	JONSWAP	3.3	3.12E-05	-5.68	2.81	2.52	5.55	4.75	0.22	2.80	3.47	4.92	4.83
ZE04_0128			4	6.0	3.0	JONSWAP	3.3	1.73E-05	-5.97	2.98	2.73	5.98	5.34	0.27	3.00	3.74	5.69	5.36
ZE04_0129			4	10.0	3.0	JONSWAP	3.3	0.00E+00	0.00	3.14	3.72	10.27	8.20	0.39	3.02	3.77	9.39	7.80
ZE04_0130			4	11.0	3.0	JONSWAP	3.3	0.00E+00	0.00	3.07	3.95	10.36	8.84	0.41	2.94	3.62	10.25	8.48
ZE04_0138		0	4	9.0	5.0	JONSWAP	3.3	0.00E+00	0.00	4.90	2.79	8.70	7.47	0.37	4.80	5.85	8.45	7.55
ZE04_0144			4	11.0	5.0	JONSWAP	3.3	1.37E-03	-4.38	4.79	3.14	10.36	8.73	0.43	4.71	5.83	10.14	8.85
ZE05_0103			5	6.2	2.0	JONSWAP	3.3	2.51E-05	-5.64	2.29	3.09	6.42	5.28	0.30	2.26	2.82	5.75	5.16
ZE05_0104			5	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.67	3.13	7.01	5.84	0.33	2.62	3.25	6.44	5.80
ZE05_0105			5	7.6	3.0	JONSWAP	3.3	4.08E-05	-5.63	3.14	3.06	7.43	6.25	0.35	3.07	3.80	6.94	6.17
ZE05_0106			5	8.2	3.5	JONSWAP	3.3	1.89E-05	-6.05	3.58	3.03	8.51	6.70	0.36	3.47	4.28	7.61	6.75
ZE05_0117			5	7.9	2.5	JONSWAP	3.3	1.31E-05	-6.04	2.77	3.21	8.43	6.13	0.36	2.65	3.29	6.88	5.92
ZE05_0127			5	5.0	3.0	JONSWAP	3.3	6.25E-05	-5.37	2.80	2.53	4.88	4.75	0.22	2.76	3.41	4.90	4.77
ZE05_0128			5	6.0	3.0	JONSWAP	3.3	5.19E-05	-5.49	2.97	2.74	5.87	5.34	0.27	2.97	3.70	5.67	5.32
ZE05_0129			5	10.0	3.0	JONSWAP	3.3	4.64E-05	-5.52	2.90	2.78	5.89	5.35	0.27	2.91	3.60	5.71	5.35
ZE05_0130			5	11.0	3.0	JONSWAP	3.3	2.35E-05	-5.85	3.03	4.02	10.11	8.81	0.40	2.91	3.68	10.02	8.48
ZE05_0239			5	9.0	5.0	JONSWAP	3.3	6.56E-04	-4.73	4.99	2.80	8.50	7.52	0.37	4.82	5.94	8.50	7.48
ZE05_0339			5	9.0	5.0	JONSWAP	3.3	6.38E-04	-4.72	4.86	2.84	8.50	7.49	0.37	4.71	5.81	8.58	7.40
ZE05_0439			5	9.0	5.0	JONSWAP	3.3	5.73E-04	-4.76	4.82	2.84	8.50	7.47	0.38	4.67	5.76	8.30	7.40
ZE05_0539			5	9.0	5.0	JONSWAP	3.3	5.18E-04	-4.80	4.78	2.84	8.50	7.42	0.38	4.65	5.68	8.51	7.45
ZE05_0639			5	9.0	5.0	JONSWAP	3.3	4.80E-04	-4.83	4.72	2.86	8.50	7.42	0.38	4.58	5.59	8.47	7.37
ZE05_0245			5	11.0	5.0	JONSWAP	3.3	2.91E-03	-4.04	4.68	3.22	10.36	8.75	0.43	4.60	5.77	10.10	8.65
ZE05_0445			5	11.0	5.0	JONSWAP	3.3	5.25E-03	-3.83	5.02	3.10	11.08	8.74	0.43	4.93	6.12	10.15	8.81
ZE05_0545			5	11.0	5.0	JONSWAP	3.3	3.98E-03	-3.93	4.91	3.13	10.48	8.72	0.44	4.80	5.94	10.42	8.60
ZE05_0645			5	11.0	5.0	JONSWAP	3.3	3.46E-03	-3.97	4.72	3.17	10.36	8.63	0.43	4.64	5.76	10.15	8.72
ZE33_0108			3	9.3	4.5	JONSWAP	3.3	0.00E+00	0.00	4.52	2.90	8.76	7.56	0.39	4.43	5.39	8.54	7.17
ZE33_0109			3	9.9	5.0	JONSWAP	3.3	6.36E-05	-5.73	4.90	2.88	10.43	7.93	0.40	4.74	5.77	9.03	7.63
ZE33_0110			3	10.3	5.5	JONSWAP	3.3	4.63E-05	-5.85	4.80	2.91	10.43	7.93	0.41	4.67	5.72	9.25	7.44
ZE33_0111		3	3	10.8	6.0	JONSWAP	3.3	2.05E-04	-5.31	5.65	2.85	10.61	8.69	0.43	5.58	6.77	10.17	8.50
ZE33_0112	1:1.4		3	11.2	6.5	JONSWAP	3.3	2.33E-04	-5.26	5.71	2.86	10.84	8.81	0.44	5.76	7.08	10.45	8.76
ZE33_0113			3	11.6	7.0	JONSWAP	3.3	1.88E-05	-6.41	6.22	2.78	11.36	9.03	0.45	6.36	7.61	11.04	9.13
ZE33_0120			3	10.0	4.0	JONSWAP	3.3	0.00E+00	0.00	4.04	3.22	10.43	8.10	0.40	3.90	4.83	9.06	7.27
ZE53_0108			3	9.3	4.5	JONSWAP	3.3	1.34E-04	-5.35	4.49	2.92	8.76	7.58	0.38	4.44	5.37	8.42	6.66
ZE53_0109			3	9.8	5.0	JONSWAP	3.3	1.27E-04	-5.42	4.87	2.90	10.43	7.96	0.40	4.76	5.78	8.98	7.24
ZE53_0110			3	10.3	5.5	JONSWAP	3.3	3.85E-04	-4.98	5.20	2.89	10.43	8.33	0.43	5.13	6.25	9.40	7.60
ZE53_0111			3	10.8	6.0	JONSWAP	3.3	3.97E-04	-4.96	5.15	2.90	10.43	8.33	0.43	5.08	6.20	9.37	7.59
ZE53_0112			3	11.2	6.5	JONSWAP	3.3	6.31E-04	-4.82	5.62	2.89	10.84	8.82	0.44	5.63	6.87	10.21	8.31
ZE53_0112			3	11.2	6.5	JONSWAP	3.3	1.44E-03	-4.52	6.14	2.80	11.36	9.04	0.46	6.27	7.54	11.02	8.69
ZE53_0120			3	10.0	4.0	JONSWAP	3.3	1.42E-04	-5.26	4.07	3.21	10.43	8.12	0.39	3.98	4.89	9.16	6.99
ZE53_0134			3	8.0	5.0	JONSWAP	3.3	1.03E-04	-5.47	4.53	2.70	7.58	6.85	0.34	4.61	5.60	7.53	6.43
ZE53_0167			3	9.0	5.0	JONSWAP	3.3	1.48E-04	-5.30	4.49	2.77	10.58	7.06	0.39	4.55	5.49	7.92	6.48
ZE53_0168			3	9.0	5.0	JONSWAP	3.3	1.83E-04	-5.24	4.69	2.85	8.75	7.58	0.37	4.69	5.77	8.57	6.92
ZE54_0103			4	6.2	2.0	JONSWAP	3.3	0.00E+00	0.00	2.37	3.05	6.42	5.32	0.30	2.55	3.09	5.63	4.54
ZE54_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.73	3.09	6.78	5.86	0.33	2.84	3.49	6.31	4.88
ZE54_0105			4	7.6	0.3	JONSWAP	3.3	0.00E+00	0.00	3.19	3.01	7.48	6.24	0.35	3.32	4.05	6.80	5.44
ZE54_0106			4	8.2	3.5	JONSWAP	3.3	0.00E+00	0.00	3.63	3.00	8.06	6.72	0.36	3.63	4.56	7.33	5.74
ZE54_0117			4	7.9	2.5	JONSWAP	3.3	0.00E+00	0.00	2.96	3.10	8.56	6.16	0.36	3.06	3.78	6.58	5.31
ZE54_0127		5	4	5.0	3.0	JONSWAP	3.3	1.15E-05	-6.14	2.93	2.48	4.91	4.77	0.23	3.13	3.80	4.94	4.41
ZE54_0128			4	6.0	3.0	JONSWAP	3.3	0.00E+00	0.00	2.96	2.76	5.98	5.39	0.27	3.12	3.86	5.66	4.81
ZE54_0129			4	10.0	3.0	JONSWAP	3.3	7.95E-05	-5.35	3.19	3.70	10.43	8.21	0.38	3.19	3.97	8.93	6.58
ZE54_0130			4	11.0	3.0	JONSWAP	3.3	5.39E-03	-3.51	3.14	3.94	10.36	8.92	0.39	3.09	3.87	9.90	6.91
ZE54_0138			4	9.0	5.0	JONSWAP	3.3	5.81E-04	-4.79	5.07	2.75	8.70	7.48	0.37	5.08	6.19	8.41	6.81
ZE54_0144			4	11.0	5.0	JONSWAP	3.3	3.25E-03	-4.03	5.00	3.08	10.36	8.75	0.43	4.97	6.17	9.88	7.68
ZE55_0103			+5	6.2	2.0	JONSWAP	3.3	0.00E+00	0.00	2.40	3.06	6.42	5.35	0.29	2.61	3.19	5.65	4.64
ZE54_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.77	3.09	7.01	5.88	0.32	2.96	3.63	6.33	5.06
ZE55_0105			4	7.6	3.0	JONSWAP	3.3	1.50E-05	-6.12	3.40	2.98	7.43	6.34	0.34	3.49	4.27	6.78	5.38
ZE55_0106-1			+5	8.2	3.5	JONSWAP	3.3	0.00E+00	0.00	3.77	2.98	8.51	6.76	0.36	3.78	4.67	7.43	5.77
ZE55_0117			5	7.9	2.5	JONSWAP	3.3	2.88E-05	-5.71	2.81	3.18	8.43	6.13	0.36	2.88	3.59	6.40	4.73
ZE55_0127			+5	5.0	3.0	JONSWAP	3.3	4.59E-05	-5.53	2.89	2.49	5.55	4.75	0.22	3.05	3.70	4.90	4.20
ZE55_0128			+5	6.0	3.0	JONSWAP	3.3	5.71E-05	-5.46	3.05	2.72	5.55	5.38	0.27	3.28	4.03	5.59	4.55
ZE55_0129			+5	10.0	3.0	JONSWAP	3.3	6.81E-05	-5.37	2.98	2.76	5.57	5.38	0.27	3.23	3.96	5.61	4.55
ZE55_0130			+5	11.0	3.0	JONSWAP	3.3	5.23E-04	-4.52	3.12	3.96	10.11	8.81	0.40	3.05	3.90	9.13	6.12
ZE55_0139			+5	9.0	5.0	JONSWAP	3.3	4.04E-03	-3.98	5.31	2.72	8.50	7.54	0.37	5.33	6.43	8.47	6.86
ZE55_0145			+5	9.0	5.0	JONSWAP	3.3	1.99E-03	-4.28	5.31	2.72	8.50	7.54	0.37	5.33	6.43	8.47	6.86
ZE75_0103			+5	6.2	2.0	JONSWAP	3.3	5.54E-05	-5.32	2.39	3.06	6.42	5.35	0.29	2.60	3.16	5.61	4.23
ZE75_0104			+5	7.0	2.5	JONSWAP	3.3	1.63E-04	-4.96	2.81	3.08	7.01	5.91	0.32	2.97	3.67	6.23	4.68
ZE75_0105			+5	7.6	3.0	JONSWAP	3.3	4.65E-04	-4.60	3.26	3.04	7.43	6.34	0.34	3.35	4.11	6.67	5.03
ZE75_0139			+5	9.0	5.0	JONSWAP	3.3	6.57E-03	-3.76	5.24	2.74	8.50	7.54	0.37	5.22	6.33	8.26	6.75
ZE75_0203		7	+5	6.2	2.0	JONSWAP	3.3	5.03E-05	-5.36	2.40	3.05	6.42	5.34	0.29	2.62	3.17	5.61	4.34
ZE75_0204			+5	7.0	2.5	JONSWAP	3.3	2.61E-04	-4.75	2.82	3.08	7.09	5.91	0.32	3.01	3.71	6.29	4.76
ZE75_0205			+5	7.6	3.0	JONSWAP	3.3	5.48E-04	-4.54	3.35	3.01	7.48	6.36	0.34	3.41	4.20	6.84	5.22
ZE75_0206			+5	8.2	3.5	JONSWAP	3.3	1.31E-03	-4.23	3.72	3.01	8.51	6.80	0.35	3.74	4.64	7.34	5.62
ZE75_0239			+5	9.0	5.0	JONSWAP	3.3	6.82E-03	-3.74	5.26	2.74	8.50	7.55	0.37	5.20	6.31	8.29	6.80

TEST	Slope	Wind	Test matrix					q	log(Q)	INCIDENT (AAU)								
										WRI							Cr	
										frequency domain (M&F)			time domain (SIRW)					
			WL	Tp	Hs	Spectrum	γ			Hmo	Tp	T01	H1/3	H1/10	TH1/3	Tm	fd	td
		(m/s)	(m)	(s)	(m)			(m3/s·ml)		(m)	(s)	(s)	(s)	(s)	(s)	(s)		
ZE03_0108	1:1.3	0	3	9.3	4.5	JONSWAP	3.3	6.11E-06	-6.65	3.32	9.67	7.77	3.75	4.61	8.71	7.56	0.24	0.39
ZE03_0109			3	9.8	5.0	JONSWAP	3.3	5.78E-05	-5.72	3.51	9.67	8.14	3.99	4.84	9.19	7.97	0.25	0.40
ZE03_0110			3	10.3	5.5	JONSWAP	3.3	8.82E-05	-5.59	3.71	10.78	8.54	4.25	5.12	9.68	8.37	0.27	0.42
ZE03_0111			3	10.8	6.0	JONSWAP	3.3	1.37E-04	-5.46	4.04	10.78	8.87	4.43	5.30	10.11	8.70	0.27	0.41
ZE03_0112			3	11.2	6.5	JONSWAP	3.3	7.36E-05	-5.74	4.19	11.22	9.19	4.60	5.47	10.53	9.14	0.29	0.41
ZE03_0113			3	11.6	7.0	JONSWAP	3.3	4.25E-04	-5.03	5.28	11.68	9.69	5.46	6.35	10.54	9.44	0.25	0.26
ZE03_0120			3	10.0	4.0	JONSWAP	3.3	5.68E-06	-6.63	3.43	9.67	8.20	3.63	4.47	9.17	7.89	0.25	0.28
ZE03_0134			3	8.0	5.0	JONSWAP	3.3	0.00E+00	0.00	3.99	8.25	7.03	4.22	5.22	7.51	6.87	0.19	0.23
ZE03_0167			3	9.0	5.0	JONSWAP	1	6.31E-06	-6.65	3.93	9.67	7.26	4.15	5.07	7.84	6.94	0.21	0.26
ZE03_0168			3	9.0	5.0	JONSWAP	7	3.79E-05	-5.90	4.01	8.76	7.81	4.25	5.21	8.46	7.54	0.20	0.24
ZE04_0138			4	9.0	5.0	JONSWAP	3.3	3.79E-05	-5.95	4.43	9.35	7.67	4.66	5.64	8.29	7.44	0.24	0.28
ZE04_0144			4	11.0	5.0	JONSWAP	3.3	8.61E-04	-4.58	4.29	11.22	9.06	4.46	5.44	10.15	8.82	0.28	0.30
ZE05_0139			5	9.0	5.0	JONSWAP	3.3	9.41E-04	-4.55	4.28	9.35	7.66	4.48	5.51	8.32	7.47	0.27	0.30
ZE05_0145			5	11.0	5.0	JONSWAP	3.3	3.37E-03	-3.98	4.21	11.22	9.09	4.35	5.37	10.15	8.82	0.32	0.34
ZE03_0108	1:1.4	0	3	9.3	4.5	JONSWAP	3.3	0.00E+00	0.00	4.61	9.67	8.21	5.03	6.19	8.75	8.00	0.36	0.43
ZE03_0109			3	9.8	5.0	JONSWAP	3.3	4.38E-05	-5.87	4.94	9.67	8.64	5.36	6.51	9.37	8.43	0.38	0.44
ZE03_210			3	10.3	5.5	JONSWAP	3.3	1.34E-04	-5.49	5.74	10.38	9.24	6.21	7.40	9.91	9.29	0.36	0.42
ZE03_211			3	10.8	6.0	JONSWAP	3.3	2.52E-04	-5.25	6.10	10.78	9.54	6.54	7.76	10.26	9.53	0.35	0.41
ZE03_212			3	11.2	6.5	JONSWAP	3.3	3.21E-04	-5.18	6.61	11.68	9.99	6.92	7.92	10.83	10.18	0.36	0.42
ZE03_213			3	11.6	7.0	JONSWAP	3.3	8.62E-04	-4.75	6.67	11.68	10.28	6.95	7.93	11.23	10.37	0.37	0.43
ZE03_0120			3	10.0	4.0	JONSWAP	3.3	9.75E-06	-6.38	3.97	9.67	8.69	4.40	5.43	9.42	8.45	0.38	0.45
ZE03_234			3	8.0	5.0	JONSWAP	3.3	5.35E-06	-6.75	4.55	8.01	7.48	5.17	6.40	7.84	7.45	0.35	0.42
ZE03_0167			3	9.0	5.0	JONSWAP	3.3	1.62E-05	-6.21	4.35	9.67	7.67	4.83	5.92	8.20	7.43	0.36	0.44
ZE03_0168			3	9.0	5.0	JONSWAP	3.3	1.72E-05	-6.24	4.58	8.76	8.16	5.12	6.31	8.61	8.00	0.35	0.42
ZE04_0103			4	6.2	2.0	JONSWAP	3.3	7.52E-05	-5.16	2.10	5.96	5.29	2.29	2.85	5.75	5.12	0.23	0.33
ZE04_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.44	7.01	5.97	2.65	3.33	6.49	5.78	0.24	0.26
ZE04_0105			4	7.6	3.0	JONSWAP	3.3	2.72E-05	-5.79	2.81	7.58	6.38	3.04	3.76	7.00	6.20	0.25	0.27
ZE04_0106			4	8.2	3.5	JONSWAP	3.3	1.89E-05	-6.04	3.16	8.01	6.80	3.42	4.23	7.54	6.54	0.25	0.27
ZE04_0117			4	7.9	2.5	JONSWAP	3.3	3.92E-05	-5.57	2.51	8.01	6.21	2.74	3.44	6.91	5.94	0.25	0.27
ZE04_0127			4	5.0	3.0	JONSWAP	3.3	3.12E-05	-5.68	2.57	5.10	4.67	2.87	3.47	4.90	4.52	0.21	0.42
ZE04_0128			4	6.0	3.0	JONSWAP	3.3	1.73E-05	-5.97	2.80	6.23	5.31	3.06	3.71	5.65	5.04	0.22	0.35
ZE04_0129			4	10.0	3.0	JONSWAP	3.3	0.00E+00	0.00	2.76	10.38	8.23	2.93	3.63	9.14	7.88	0.30	0.31
ZE04_0130			4	11.0	3.0	JONSWAP	3.3	0.00E+00	0.00	2.68	10.38	9.09	2.81	3.49	10.05	8.69	0.31	0.32
ZE04_0138			4	9.0	5.0	JONSWAP	3.3	0.00E+00	0.00	4.48	9.35	7.67	4.69	5.70	8.29	7.47	0.24	0.27
ZE04_0144			4	11.0	5.0	JONSWAP	3.3	1.37E-03	-4.38	4.30	11.22	9.05	4.47	5.50	10.15	8.85	0.28	0.30
ZE05_0103			5	6.2	2.0	JONSWAP	3.3	2.51E-05	-5.64	2.11	6.38	5.31	2.30	2.84	5.76	5.04	0.25	0.35
ZE05_0104			5	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.52	7.01	5.88	2.73	3.38	6.42	5.67	0.26	0.35
ZE05_0105			5	7.6	3.0	JONSWAP	3.3	4.08E-05	-5.63	2.89	7.38	6.34	3.10	3.81	7.01	5.99	0.26	0.35
ZE05_0106			5	8.2	3.5	JONSWAP	3.3	1.89E-05	-6.05	3.24	8.01	6.76	3.53	4.30	7.47	6.44	0.27	0.35
ZE05_0117			5	7.9	2.5	JONSWAP	3.3	1.31E-05	-6.04	2.51	7.38	6.09	2.73	3.41	6.74	5.69	0.27	0.38
ZE05_0127			5	5.0	3.0	JONSWAP	3.3	6.25E-05	-5.37	2.55	5.10	4.70	2.89	3.49	4.91	4.44	0.23	0.45
ZE05_0128			5	6.0	3.0	JONSWAP	3.3	5.19E-05	-5.49	2.79	6.10	5.30	3.05	3.74	5.59	5.03	0.23	0.36
ZE05_0129			5	10.0	3.0	JONSWAP	3.3	4.64E-05	-5.52	2.71	5.96	5.32	3.01	3.72	5.64	5.05	0.23	0.36
ZE05_0130			5	11.0	3.0	JONSWAP	3.3	2.35E-05	-5.85	2.73	11.22	9.11	2.93	3.67	10.13	8.81	0.34	0.35
ZE05_0239			5	9.0	5.0	JONSWAP	3.3	6.56E-04	-4.73	4.53	9.05	7.61	4.91	6.04	8.26	7.32	0.27	0.35
ZE05_0339			5	9.0	5.0	JONSWAP	3.3	6.38E-04	-4.72	4.41	9.05	7.58	4.79	5.88	8.23	7.31	0.27	0.34
ZE05_0439			5	9.0	5.0	JONSWAP	3.3	5.73E-04	-4.76	4.39	9.05	7.57	4.75	5.84	8.27	7.27	0.27	0.35
ZE05_0539			5	9.0	5.0	JONSWAP	3.3	5.18E-04	-4.80	4.30	9.35	7.56	4.62	5.69	8.21	7.18	0.27	0.36
ZE05_0639			5	9.0	5.0	JONSWAP	3.3	4.80E-04	-4.83	4.25	9.35	7.55	4.57	5.61	8.23	7.19	0.27	0.35
ZE05_0245			5	11.0	5.0	JONSWAP	3.3	2.91E-03	-4.04	4.29	11.22	9.09	4.61	5.70	10.20	8.68	0.31	0.34
ZE05_0445			5	11.0	5.0	JONSWAP	3.3	5.25E-03	-3.83	4.52	11.22	9.06	4.82	5.92	10.16	8.67	0.30	0.35
ZE05_0545			5	11.0	5.0	JONSWAP	3.3	3.98E-03	-3.93	4.37	11.22	9.06	4.64	5.68	10.16	8.65	0.31	0.35
ZE05_0645			5	11.0	5.0	JONSWAP	3.3	3.46E-03	-3.97	4.28	11.22	9.04	4.57	5.67	10.07	8.60	0.31	0.35
ZE33_0108		3	3	9.3	4.5	JONSWAP	3.3	0.00E+00	0.00	4.10	9.67	7.79	4.29	0.17	8.60	7.64	0.21	0.26
ZE33_0109			3	9.9	5.0	JONSWAP	3.3	6.36E-05	-5.73	4.33	9.67	8.18	4.52	0.18	9.13	7.97	0.23	0.27
ZE33_0110			3	10.3	5.5	JONSWAP	3.3	4.63E-05	-5.85	4.25	9.67	8.18	4.44	0.18	9.14	7.91	0.23	0.28
ZE33_0111			3	10.8	6.0	JONSWAP	3.3	2.05E-04	-5.31	4.94	10.78	8.89	4.98	0.20	9.94	8.82	0.23	0.26
ZE33_0112			3	11.2	6.5	JONSWAP	3.3	2.33E-04	-5.26	5.07	11.22	9.19	5.13	0.20	10.35	9.11	0.24	0.27
ZE33_0113			3	11.6	7.0	JONSWAP	3.3	1.88E-05	-6.41	5.53	11.68	9.69	5.66	0.22	10.69	9.51	0.25	0.27
ZE33_0120			3	10.0	4.0	JONSWAP	3.3	0.00E+00	0.00	3.57	10.38	8.22	3.74	0.15	9.21	8.00	0.25	0.28
ZE53_0108		5	3	9.3	4.5	JONSWAP	3.3	1.34E-04	-5.35	3.64	9.35	7.54	3.59	4.42	8.23	7.21	0.29	0.41
ZE53_0109			3	9.8	5.0	JONSWAP	3.3	1.27E-04	-5.42	3.77	9.67	7.88	3.74	4.58	8.83	7.37	0.29	0.40
ZE53_0110			3	10.3	5.5	JONSWAP	3.3	3.85E-04	-4.98	3.97	10.38	8.16	3.85	4.70	9.21	7.88	0.30	0.43
ZE53_0111			3	10.8	6.0	JONSWAP	3.3	3.97E-04	-4.96	3.90	10.38	8.16	3.80	4.64	9.22	7.87	0.30	0.43
ZE53_0112			3	11.2	6.5	JONSWAP	3.3	6.31E-04	-4.82	4.42	11.68	8.79	4.17	5.01	10.18	8.75	0.31	0.42
ZE53_0112			3	11.2	6.5	JONSWAP	3.3	1.44E-03	-4.52	4.86	11.68	8.93	4.56	5.31	10.37	8.96	0.31	0.43
ZE53_0120			3	10.0	4.0	JONSWAP	3.3	1.42E-04	-5.26	3.13	9.67	7.94	3.12	3.86	8.94	7.49	0.30	0.40
ZE53_0134			3	8.0	5.0	JONSWAP	3.3	1.03E-04	-5.47	3.78	8.01	6.91	3.75	4.66	7.26	6.52	0.27	0.41
ZE53_0167			3	9.0	5.0	JONSWAP	3.3	1.48E-04	-5.30	3.74	8.25	7.08	3.71	4.57	7.56	6.64	0.29	0.41
ZE53_0168			3	9.0	5.0	JONSWAP	3.3	1.83E-04	-5.24	3.70	8.76	7.63	3.68	4.52	8.31	7.28	0.29	0.40
ZE54_0103			4	6.2	2.0	JONSWAP	3.3	0.00E+00	0.00	2.11	6.10	5.29	2.39	3.00	5.67	5.05	0.26	0.43
ZE54_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.30	7.01	5.95	2.38	3.01	6.38	5.64	0.28	0.25
ZE54_0105			4	7.6	0.3	JONSWAP	3.3	0.00E+00	0.00	2.70	7.58	6.30	2.70	3.38	6.77	5.84	0.28	0.26
ZE54_0106			4	8.2	3.5	JONSWAP	3.3	0.00E+00	0.00	3.03	8.01	6.66	3.04	3.79	7.41	6.24	0.28	0.26
ZE54_0117			4	7.9	2.5	JONSWAP	3.3	0.00E+00	0.00	2.47	8.01	6.12	2.49	3.15	6.59	5.74	0.29	0.26
ZE54_0127			4	5.0	3.0	JONSWAP	3.3	1.15E-05	-6.14	2.54	5.10	4.72	3.29	4.12	4.95	4.54	0.22	0.55
ZE54_0128			4	6.0	3.0	JONSWAP	3.3	0.00E+00	0.00	2.68	5.96	5.32	3.11	3.87	5.57	4.89	0.24	0.45
ZE54_0129			4	10.0	3.0	JONSWAP	3.3	7.95E-05	-5.35	2.46	10.38	7.99	2.60	3.12	8.96	7.50	0.32	0.37
ZE54_0130			4	11.0	3.0	JONSWAP	3.3	5.39E-03	-3.51	2.47	11.68	8.80	2.43	3.01	9.94	8.51	0.36	0.41
ZE54_0138			4	9.0	5.0	JONSWAP	3.3	5.81E-04	-4.79	4.13	9.35	7.46	4.10	5.04	8.12	7.16	0.29	0.37
ZE54_0144			4	11.0	5.0	JONSWAP	3.3	3.25E-03	-4.03	4.00	11.22	8.70	3.86	4.74	9.96	8.51	0.33	0.41
ZE55_0103			+5	6.2	2.0	JONSWAP	3.3	0.00E+00	0.00	2.12	6.10	5.28	2.40	3.05	5.66	4.96	0.27	0.42
ZE54_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.36	7.01	5.95	2.45	3.06	6.37	5.60	0.28	0.26
ZE55_0105			4	7.6	3.0	JONSWAP	3.3	1.50E-05	-6.12	2.85	7.38	6.33	2.89	3.58	6.89	6.01	0.28	0.26
ZE55_0106-1			+5	8.2	3.5	JONSWAP	3.3	0.00E+00	0.00	3.11	8.01	6.68	3.17	3.90	7.42	6.31	0.29	0.27
ZE55_0117			5	7.9	2.5	JONSWAP	3.3	2.88E-05	-5.71	2.35	7.01	6.09	2.39	3.01	6.59	5.70	0.29	0.27
ZE55_0127			+5	5.0	3.0	JONSWAP	3.3	4.59E-05	-5.53	2.48	5.10	4.70	3.19	3.95	4.89	4.55	0.23	0.50
ZE55_0128			+5	6.0	3.0	JONSWAP	3.3	5.71E-05	-5.46	2.70	5.96	5.32	3.13	3.88	5.56	5.01	0.24	0.42
ZE55_0129			+5	10.0	3.0	JONSWAP	3.3	6.81E-05	-5.37	2.72	5.72	5.31	3.15	3.88	5.55	5.04	0.24	0.42
ZE55_0130			+5	11.0	3.0	JONSWAP	3.3	5.23E-04	-4.52	2.53	11.22	8.82	2.45	3.10	9.97	8.40	0.37	0.42
ZE55_0139			+5	9.0	5.0	JONSWAP	3.3	4.04E-03	-3.98	4.31	9.05	7.52	4.37	5.35	8.20	7.50	0.29	0.36
ZE55_0145			+5	9.0	5.0	JONSWAP	3.3	1.99E-03	-4.28	4.12	11.22	8.77	4.07	4.99	10.02	8.56	0.34	0.40
ZE75_0103		7	+5	6.2	2.0	JONSWAP	3.3	5.54E-05	-5.32	2.18	6.38	5.36	2.38	2.97	5.81	5.11	0.24	0.35
ZE75_0104			+5	7.0	2.5	JONSWAP	3.3	1.63E-04	-4.96	2.58	7.01	6.05	2.72	3.38	6.53	5.80	0.25	0.26
ZE75_0105			+5	7.6	3.0	JONSWAP	3.3	4.65E-04	-4.60	2.95	7.38	6.46	3.12	3.85	7.01	6.27	0.25	0.27
ZE75_0139			+5	9.0	5.0	JONSWAP	3.3	6.57E-03	-3.76	4.69	9.35	7.72	4.92	6.01	8.34	7.63	0.25	0.29
ZE75_0203			+5	6.2	2.0	JONSWAP	3.3	5.03E-05	-5.36	2.21	6.38	5.33	2.41	3.00	5.81	5.05	0.24	0.35
ZE75_0204			+5	7.0	2.5	JONSWAP	3.3	2.61E-04	-4.75	2.61	7.01	6.04	2.72	3.41	6.52	5.76	0.25	0.25
ZE75_0205			+5	7.6	3.0	JONSWAP	3.3	5.48E-04	-4.54	3.02	7.38	6.47	3.19	3.93	7.05	6.27	0.25	0.26
ZE75_0206			+5	8.2	3.5	JONSWAP	3.3	1.31E-03	-4.23	3.35	8.01	6.85	3.53	4.33	7.57	6.67	0.25	0.27
ZE75_0239			+5	9.0	5.0	JONSWAP	3.3	6.82E-03	-3.74	4.73	9.35	7.72	4.95	6.06	8.33	7.56	0.25	0.29

TEST	Slope	Wind	Test matrix					q	log(Q)	INCIDENT (LASA) WRI frequency domain					time domain				Cr	
			WL	Tp	Hs	Spectrum	γ			Hm0	Ir	Tp	T01	e	H1/3	H1/10	TH1/3	Tm	fd	td
		(m/s)	(m)	(s)	(m)			(m3/s·m)		(m)		(s)	(s)		(s)	(s)	(s)	(s)		
ZE03_0108	1:1.3	0	3	9.3	4.5	JONSWAP	3.3	6.11E-06	-6.65	3.79	3.59	9.41	8.16	0.28	3.53	4.18	8.78	8.21	23%	23%
ZE03_0109			3	9.8	5.0	JONSWAP	3.3	5.78E-05	-5.72	4.28	3.42	9.57	8.30	0.32	3.93	4.69	8.99	8.32	21%	19%
ZE03_0110			3	10.3	5.5	JONSWAP	3.3	8.82E-05	-5.59	4.28	3.56	10.43	8.83	0.32	3.95	4.65	9.75	9.00	28%	27%
ZE03_0111			3	10.8	6.0	JONSWAP	3.3	1.37E-04	-5.46	4.71	3.40	10.73	9.20	0.32	4.27	5.03	10.07	9.14	27%	26%
ZE03_0112			3	11.2	6.5	JONSWAP	3.3	7.36E-05	-5.74	4.86	3.48	10.84	9.39	0.34	4.46	5.30	10.30	9.41	26%	26%
ZE03_0113			3	11.6	7.0	JONSWAP	3.3	4.25E-04	-5.03	5.76	3.25	11.72	9.87	0.36	5.27	6.09	10.88	9.78	23%	24%
ZE03_0120			3	10.0	4.0	JONSWAP	3.3	5.68E-06	-6.63	3.66	3.81	9.75	8.88	0.29	3.35	4.03	9.34	8.59	25%	26%
ZE03_0134			3	8.0	5.0	JONSWAP	3.3	0.00E+00	0.00	4.18	3.18	7.74	7.32	0.28	3.88	4.59	7.71	7.33	21%	21%
ZE03_0167			3	9.0	5.0	JONSWAP	1	6.31E-06	-6.65	4.10	3.30	8.75	7.62	0.30	3.79	4.44	8.16	7.47	23%	23%
ZE03_0168			3	9.0	5.0	JONSWAP	7	3.79E-05	-5.90	3.44	3.35	8.78	6.87	0.45	3.36	3.81	9.45	8.37	35%	34%
ZE04_0138			4	9.0	5.0	JONSWAP	3.3	3.79E-05	-5.96	4.68	3.22	8.70	7.96	0.27	4.28	5.03	8.49	7.85	24%	25%
ZE04_0144			4	11.0	5.0	JONSWAP	3.3	8.61E-04	-4.58	4.66	3.61	11.08	9.46	0.31	4.26	5.13	10.32	9.39	28%	27%
ZE05_0139			5	9.0	5.0	JONSWAP	3.3	9.41E-04	-4.55	4.58	3.30	8.50	8.03	0.27	4.18	4.98	8.58	8.00	27%	27%
ZE05_0145			5	11.0	5.0	JONSWAP	3.3	3.37E-03	-3.98	4.59	3.70	11.08	9.47	0.31	4.23	5.14	10.44	9.53	31%	31%
ZE03_0108	1:1.4	0	3	9.3	4.5	JONSWAP	3.3	0.00E+00	0.00	4.27	3.15	9.41	8.16	0.29	3.89	4.64	8.77	8.16	20%	20%
ZE03_0109			3	9.8	5.0	JONSWAP	3.3	4.38E-05	-5.87	4.52	3.15	9.57	8.54	0.30	4.12	4.90	9.33	8.62	21%	21%
ZE03_210			3	10.3	5.5	JONSWAP	3.3	1.34E-04	-5.49	5.20	3.01	10.43	8.88	0.33	4.75	5.56	9.82	9.06	22%	22%
ZE03_211			3	10.8	6.0	JONSWAP	3.3	2.52E-04	-5.25	5.55	2.98	10.61	9.17	0.32	5.01	5.84	10.17	9.39	21%	20%
ZE03_212			3	11.2	6.5	JONSWAP	3.3	3.21E-04	-5.18	5.87	2.91	11.68	9.25	0.35	5.46	6.18	10.61	9.72	22%	21%
ZE03_213			3	11.6	7.0	JONSWAP	3.3	8.62E-04	-4.75	5.88	2.95	11.87	9.46	0.36	5.46	6.27	10.62	9.82	22%	21%
ZE03_0120			3	10.0	4.0	JONSWAP	3.3	9.75E-06	-6.38	3.63	3.56	9.51	8.88	0.30	3.40	4.10	9.30	8.64	23%	23%
ZE03_234			3	8.0	5.0	JONSWAP	3.3	5.35E-06	-6.75	3.35	3.08	8.08	6.62	0.41	3.12	3.46	8.25	7.80	27%	26%
ZE03_0167			3	9.0	5.0	JONSWAP	3.3	1.62E-05	-6.21	4.03	3.07	8.08	7.54	0.30	3.80	4.50	8.09	7.55	19%	20%
ZE03_0168			3	9.0	5.0	JONSWAP	3.3	1.72E-05	-6.24	4.30	3.09	8.75	8.00	0.27	3.92	4.71	8.55	7.90	18%	18%
ZE04_0103			4	6.2	2.0	JONSWAP	3.3	7.52E-05	-5.16	2.19	3.39	6.42	5.74	0.21	2.06	2.49	5.91	5.65	20%	20%
ZE04_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.52	3.43	7.11	6.34	0.23	2.39	2.91	6.64	6.23	22%	21%
ZE04_0105			4	7.6	3.0	JONSWAP	3.3	2.72E-05	-5.79	2.92	3.42	7.48	6.93	0.24	2.74	3.28	7.29	6.89	23%	22%
ZE04_0106			4	8.2	3.5	JONSWAP	3.3	1.89E-05	-6.04	3.35	3.35	8.08	7.41	0.25	3.12	3.77	7.79	7.39	22%	22%
ZE04_0117			4	7.9	2.5	JONSWAP	3.3	3.92E-05	-5.57	2.68	2.69	7.11	6.69	0.27	2.47	2.94	7.30	6.78	23%	22%
ZE04_0127			4	5.0	3.0	JONSWAP	3.3	3.12E-05	-5.68	2.75	2.98	5.05	4.97	0.17	2.50	2.95	5.08	5.04	18%	18%
ZE04_0128			4	6.0	3.0	JONSWAP	3.3	1.73E-05	-5.97	2.88	2.92	6.17	5.65	0.21	2.74	3.29	5.78	5.57	18%	18%
ZE04_0129			4	10.0	3.0	JONSWAP	3.3	0.00E+00	0.00	2.89	3.94	10.43	8.40	0.38	2.72	3.35	9.66	8.77	37%	36%
ZE04_0130			4	11.0	3.0	JONSWAP	3.3	0.00E+00	0.00	3.00	4.04	10.36	8.97	0.42	2.92	3.60	10.57	9.69	43%	41%
ZE04_0138			4	9.0	5.0	JONSWAP	3.3	0.00E+00	0.00	4.79	2.96	8.70	7.97	0.28	4.40	5.15	8.53	7.97	21%	21%
ZE04_0144			4	11.0	5.0	JONSWAP	3.3	1.37E-03	-4.38	4.71	3.32	11.08	9.90	0.32	4.30	5.19	10.28	9.39	25%	24%
ZE05_0103			5	6.2	2.0	JONSWAP	3.3	2.51E-05	-5.64	2.00	3.62	6.42	5.85	0.22	1.90	2.29	6.06	5.90	26%	27%
ZE05_0104			5	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.32	3.66	7.01	6.46	0.26	2.21	2.67	6.83	6.47	26%	26%
ZE05_0105			5	7.6	3.0	JONSWAP	3.3	4.08E-05	-5.63	2.98	3.37	7.48	6.82	0.25	2.80	3.32	7.12	6.84	27%	26%
ZE05_0106			5	8.2	3.5	JONSWAP	3.3	1.89E-05	-6.05	3.17	3.39	8.42	7.15	0.33	3.00	3.59	7.98	7.43	30%	30%
ZE05_0117			5	7.9	2.5	JONSWAP	3.3	1.31E-05	-6.04	2.41	3.77	8.56	6.89	0.32	2.27	2.75	7.63	7.04	29%	30%
ZE05_0127			5	5.0	3.0	JONSWAP	3.3	6.25E-05	-5.37	2.34	2.93	5.55	5.04	0.21	2.22	2.65	5.19	5.24	27%	27%
ZE05_0128			5	6.0	3.0	JONSWAP	3.3	5.19E-05	-5.49	2.55	3.17	6.17	5.76	0.24	2.42	2.92	6.03	5.94	25%	25%
ZE05_0129			5	10.0	3.0	JONSWAP	3.3	4.64E-05	-5.52	2.49	3.21	5.69	5.78	0.23	2.42	2.93	6.02	5.92	24%	24%
ZE05_0130			5	11.0	3.0	JONSWAP	3.3	2.35E-05	-5.85	3.08	4.16	11.13	9.39	0.38	2.93	3.66	10.78	10.09	44%	44%
ZE05_0239			5	9.0	5.0	JONSWAP	3.3	6.58E-04	-4.73	4.20	3.05	9.14	7.49	0.40	3.99	4.57	8.90	8.49	33%	33%
ZE05_0339			5	9.0	5.0	JONSWAP	3.3	6.38E-04	-4.72	4.20	3.05	9.14	7.49	0.40	3.99	4.57	8.90	8.49	33%	33%
ZE05_0439			5	9.0	5.0	JONSWAP	3.3	5.73E-04	-4.76	4.09	2.99	9.14	7.17	0.42	3.95	4.58	9.13	8.24	36%	39%
ZE05_0539			5	9.0	5.0	JONSWAP	3.3	5.18E-04	-4.80	3.95	3.06	9.43	7.24	0.40	3.69	4.13	8.87	8.12	37%	38%
ZE05_0639			5	9.0	5.0	JONSWAP	3.3	4.80E-04	-4.83	3.93	3.09	9.43	7.30	0.40	3.68	4.12	9.06	8.24	38%	37%
ZE05_0245			5	11.0	5.0	JONSWAP	3.3	2.91E-03	-4.04	4.37	3.38	11.13	8.87	0.45	4.33	5.05	11.06	9.86	44%	44%
ZE05_0445			5	11.0	5.0	JONSWAP	3.3	5.25E-03	-3.83	4.32	3.25	11.19	8.38	0.46	4.25	4.87	11.01	9.62	44%	46%
ZE05_0545			5	11.0	5.0	JONSWAP	3.3	3.98E-03	-3.93	4.25	3.31	11.19	8.48	0.46	4.21	4.79	11.02	9.68	44%	45%
ZE05_0645			5	11.0	5.0	JONSWAP	3.3	3.46E-03	-3.97	4.07	3.41	11.13	8.58	0.44	3.98	4.53	10.96	9.62	44%	45%
ZE33_0108		3	3	9.3	4.5	JONSWAP	3.3	0.00E+00	0.00	4.39	3.09	9.41	8.11	0.29	4.03	4.78	8.69	8.09	19%	19%
ZE33_0109			3	9.9	5.0	JONSWAP	3.3	6.38E-05	-5.73	4.68	3.09	9.57	8.49	0.30	4.25	5.06	9.18	8.52	21%	20%
ZE33_0110			3	10.3	5.5	JONSWAP	3.3	4.63E-05	-5.86	4.59	3.11	9.57	8.48	0.30	4.19	4.95	9.25	8.55	21%	20%
ZE33_0111			3	10.8	6.0	JONSWAP	3.3	2.05E-04	-5.31	5.41	3.02	10.61	9.18	0.34	4.19	4.95	9.25	8.55	20%	20%
ZE33_0112			3	11.2	6.5	JONSWAP	3.3	2.33E-04	-5.28	5.49	3.03	10.84	9.34	0.34	5.09	6.06	10.38	9.65	22%	20%
ZE33_0113			3	11.6	7.0	JONSWAP	3.3	1.88E-05	-6.41	6.02	2.92	11.36	9.48	0.36	5.56	6.43	10.83	9.77	22%	21%
ZE33_0120			3	10.0	4.0	JONSWAP	3.3	0.00E+00	0.00	3.82	3.47	10.43	8.70	0.29	3.51	4.23	9.27	8.58	23%	22%
ZE53_0108		5	3	9.3	4.5	JONSWAP	3.3	1.34E-04	-5.35	4.40	3.07	9.41	8.06	0.29	4.03	4.79	8.61	8.07	19%	20%
ZE53_0109			3	9.8	5.0	JONSWAP	3.3	1.27E-04	-5.42	4.68	3.07	9.57	8.43	0.31	4.28	5.08	9.14	8.55	21%	20%
ZE53_0110			3	10.3	5.5	JONSWAP	3.3	3.85E-04	-4.98	4.92	3.06	10.43	8.71	0.33	4.03	4.79	8.61	8.07	22%	20%
ZE53_0111			3	10.8	6.0	JONSWAP	3.3	3.97E-04	-4.98	4.89	3.08	10.43	8.75	0.33	4.47	5.36	9.43	8.72	22%	22%
ZE53_0112			3	11.2	6.5	JONSWAP	3.3	6.31E-04	-4.82	5.41	3.03	10.84	9.24	0.34	5.03	5.99	10.16	9.48	21%	20%
ZE53_0112			3	11.2	6.5	JONSWAP	3.3	1.44E-03	-4.52	5.92	2.94	11.36	9.45	0.36	5.46	6.30	10.87	9.75	21%	20%
ZE53_0120			3	10.0	4.0	JONSWAP	3.3	1.42E-04	-5.26	3.86	3.44	10.43	8.66	0.30	3.53	4.25	9.35	8.53	22%	22%
ZE53_0134			3	8.0	5.0	JONSWAP	3.3	1.03E-04	-5.47	4.45	2.84	8.14	7.26	0.26	4.12	4.90	7.67	7.25	17%	17%
ZE53_0167			3	9.0	5.0	JONSWAP	3.3	1.48E-04	-5.30	4.37	2.96	8.75	7.57	0.30	4.04	4.79	8.14	7.51	20%	20%
ZE53_0168			3	9.0	5.0	JONSWAP	3.3	1.83E-04	-5.24	3.45	3.14	8.78	6.98	0.44	3.29	3.71	9.22	8.28	31%	31%
ZE54_0103			4	6.2	2.0	JONSWAP	3.3	0.00E+00	0.00	2.34	3.27	6.42	5.72	0.21	2.21	2.68	5.94	5.68	20%	20%
ZE54_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.66	3.32	6.78	6.28	0.23	2.53	3.06	6.54	6.29	22%	21%
ZE54_0105			4	7.6	0.3	JONSWAP	3.3	0.00E+00	0.00	3.08	3.24	7.48	6.68	0.26	2.91	3.50	7.05	6.60	22%	21%
ZE54_0106			4	8.2	3.5	JONSWAP	3.3	0.00E+00	0.00	3.52	3.16	8.06	7.05	0.27	3.27	3.96	7.53	7.04	21%	20%
ZE54_0117			4	7.9	2.5	JONSWAP	3.3	0.00E+00	0.00	2.66	3.31	7.11	6.53	0.28	2.64	3.23	6.92	6.48	22%	21%
ZE54_0127			4	5.0	3.0	JONSWAP	3.3	1.15E-05	-6.14	2.93	2.56	5.05	4.92	0.19	2.71	3.17	5.04	5.07	18%	18%
ZE54_0128			4	6.0	3.0	JONSWAP	3.3	0.00E+00	0.00	2.95	2.87	6.17	5.62	0.21	2.83	3.43	5.74	5.60	19%	18%
ZE54_0129			4	10.0	3.0	JONSWAP	3.3	7.96E-05	-5.36	3.05	3.94	10.43	8.73	0.27	2.80	3.40	9.28	8.53	27%	27%
ZE54_0130			4	11.0	3.0	JONSWAP	3.3	5.39E-03	-3.51	3.03	4.15	10.48	9.43	0.29	2.77	3.39	10.19	9.24	28%	27%
ZE54_0138			4	9.0	5.0	JONSWAP	3.3	5.81E-04	-4.79	4.99	2.88	8.70	7.90	0.28	4.56	5.36	8.42	7.92	21%	21%
ZE54_0144			4	11.0	5.0	JONSWAP	3.3	3.25E-03	-4.03	4.84	3.24	11.08	9.26	0.33	4.49	5.43	10.05	9.23	26%	25%
ZE55_0103			+5	6.2	2.0	JONSWAP	3.3	0.00E+00	0.00	2.38	3.28	6.42	5.74	0.22	2.22	2.69	5.90	5.73	22%	22%
ZE54_0104			4	7.0	2.5	JONSWAP	3.3	0.00E+00	0.00	2.38	3.58	7.01	6.38	0.27	2.26	2.69	6.80	6.62	26%	29%
ZE55_0105			4	7.6	3.0	JONSWAP	3.3	1.50E-05	-6.12	3.29	3.20	7.48	6.79	0.25	3.07	3.63	7.09	6.79	22%	21%
ZE55_0106-1			+5	8.2	3.5	JONSWAP	3.3	0.00E+00	0.00	3.62	3.18	8.51	7.17	0.27	3.37	4.05	7.59	7.15	23%	22%
ZE55_0117			5	7.9	2.5	JONSWAP	3.3	2.88E-05	-5.71	2.72	3.45	8.43	6.63	0.28	2.51	3.06	7.04	6.46	24%	23%
ZE55_0127			+5	5.0	3.0	JONSWAP	3.3	4.59E-05	-5.53	2.84	2.59	5.05	4.91	0.19	2.60	3.05	5.03	4.97	20%	19%
ZE55_0128			+5	6.0	3.0	JONSWAP	3.3	5.71E-05	-5.46	3.02	2.88	6.17	5.65	0.20	2.86	3.45	5.77	5.63	19%	19%
ZE55_0129			+5	10.0	3.0	JONSWAP	3.3	6.81E-05	-5.37	2.93	2.93	5.57	5.70	0.21	2.82	3.40	5.88	5.61	21%	20%
ZE55_0130			+5	11.0	3.0	JONSWAP	3.3	5.23E-04	-4.52	3.06	4.18	11.08	9.45	0.29	2.81	3.51	10.25	9.21	31%	30%
ZE55_0139			+5	9.0	5.0	JONSWAP	3.3	4.04E-03	-3.98	5.20	2.88	8.50	7.95	0.28	4.75	5.59	8.48	7.99	23%	23%
ZE55_0145			+5	9.0	5.0	JONSWAP	3.3	1.99E-03	-4.28	5.20	2.88	8.50	7.95	0.28	4.75	5.59	8.48	7.99	23%	23%
ZE75_0103		7	+5	6.2	2.0	JONSWAP	3.3	5.54E-05	-5.32	2.38	3.25	6.42	5.67	0.22	2.21	2.67	5.87	5.57	21%	21%
ZE75_0104			+5	7.0	2.5	JONSWAP	3.3	1.63E-04	-4.96	2.74	3.27	7.01	6.23	0.24	2.58	3.12	6.54	6.16	22%	21%
ZE75_0105			+5	7.6	3.0	JONSWAP	3.3	4.65E-04	-4.60	3.16	3.21	7.48	6.65	0.26	2.98	3.57	7.02	6.60	22%	21%
ZE75_0139			+5	9.0	5.0	JONSWAP	3.3	6.57E-03	-3.76	5.06	2.87	8.50	7.83	0.28	4.60	5.49	8.39	7.68	22%	21%
ZE75_0203			+5	6.2	2.0	JONSWAP	3.3	5.03E-05	-5.36	2.37	3.24	6.42	5.68	0.22	2.24	2.70	5.86	5.61	22%	21%
ZE75_0204			+5	7.0	2.5	JONSWAP	3.3	2.61E-04	-4.75	2.78	3.25	7.01	6.24	0.24	2.62	3.21	6.54	6.13	21%	21%
ZE75_0205			+5	7.6	3.0	JONSWAP	3.3	5.48E-04	-4.54	3.23	3.22	7.48	6.77	0.24	3.02	3.62	7.08	6.69	22%	22%
ZE75_0206			+5	8.2	3.5	JONSWAP	3.3	1.31E-03	-4.23	3.59	3.22	8.51	7.25	0.25	3.32	4.00	7.66	7.22	23%	21%
ZE75_0239			+5	9.0	5.0	JONSWAP	3.3	6.82E-03	-3.74	5.10	2.85	8.50	7.82	0.28	4.65	5.55	8.26	7.70	22%	21%

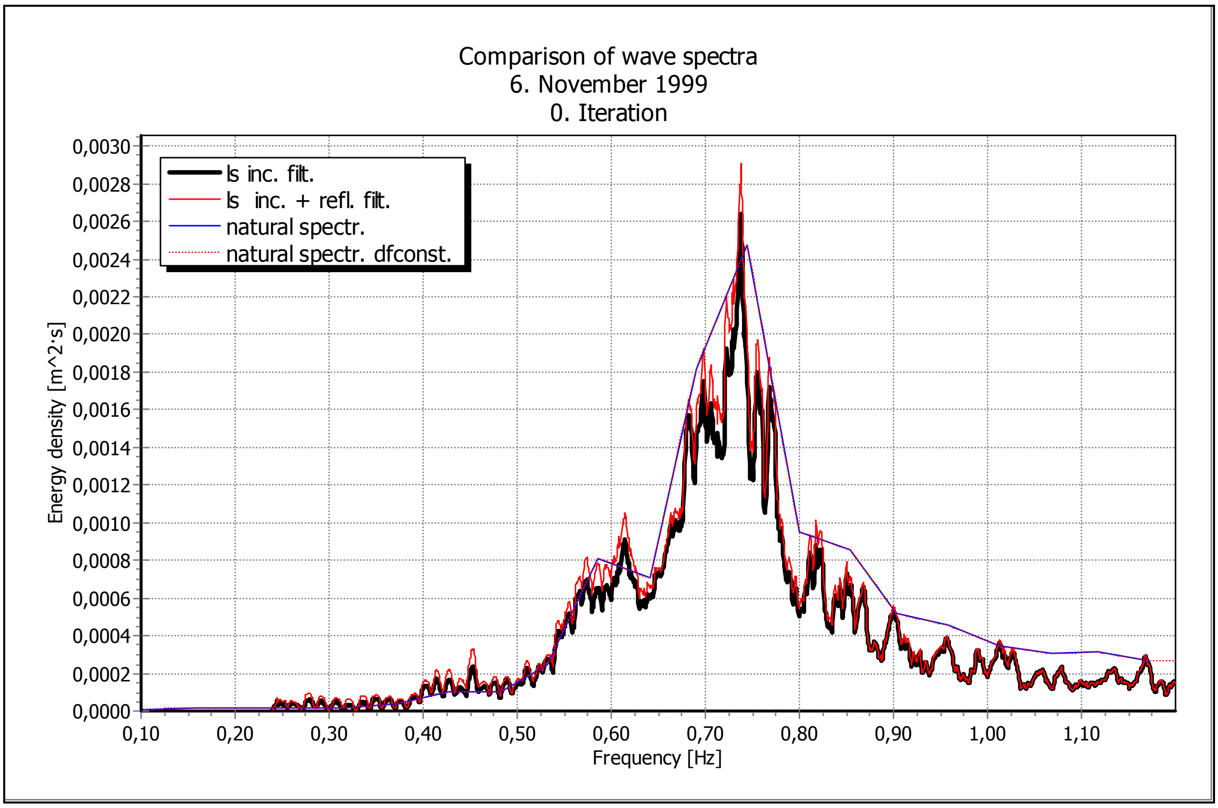
TEST	Slope	Wind	Test matrix					q	log(Q)	INCIDENT (AAU)								
										WRI							Cr	
										frequency domain (M&F)			time domain (SIRW)					
			WL	Tp	Hs	Spectrum	γ			Hmo	Tp	T01	H1/3	H1/10	TH1/3	Tm	fd	td
		(m/s)	(m)	(s)	(m)			(m3/s·ml)		(m)	(s)	(s)	(s)	(s)	(s)	(s)		
STORM October 27th 2002 (01)																		
17:00-18:00		0	4.4	8.57	3.74	STORM		0.00E+00	0.00	3.38	8.50	7.05	3.55	4.37	7.77	6.68	0.26	0.30
18:00-19:00		0	4.6	8.57	3.86	STORM		0.00E+00	0.00	3.72	8.50	7.16	3.80	4.68	7.89	6.99	0.26	0.29
19:00-20:00		0	4.35	8.57	3.71	STORM		0.00E+00	0.00	3.44	8.50	7.30	3.59	4.51	8.06	6.81	0.26	0.29
17:00-18:00		5	4.4	8.57	3.74	STORM		2.76E-04	-4.96	3.43	8.50	7.27	3.62	4.48	7.76	6.86	0.24	0.28
18:00-19:00	1:1.4	5	4.6	8.57	3.86	STORM		5.27E-04	-4.69	3.50	8.50	7.32	3.66	4.54	7.87	6.92	0.25	0.28
19:00-20:00		5	4.35	8.57	3.71	STORM		1.76E-04	-5.16	3.43	8.76	7.31	3.58	4.50	8.11	6.80	0.26	0.29
17:00-18:00		7	4.4	8.57	3.74	STORM		1.29E-03	-4.27	3.54	8.50	7.26	3.38	4.21	7.64	6.78	0.32	0.29
18:00-19:00		7	4.6	8.57	3.86	STORM		1.69E-03	-4.19	3.52	8.50	7.35	3.70	4.58	7.88	6.93	0.25	0.28
19:00-20:00		7	4.35	8.57	3.71	STORM		1.12E-03	-4.34	3.39	8.76	7.32	3.54	4.42	8.12	6.78	0.25	0.28
STORM October 27th 2002 (02)																		
17:00-18:00		0	4.4	8.57	3.74	STORM		1.25E-05	-6.26	3.31	8.50	7.03	3.48	4.26	7.79	6.78	0.26	0.30
18:00-19:00		0	4.6	8.57	3.86	STORM		0.00E+00	0.00	3.41	8.50	7.14	3.55	4.42	7.83	6.79	0.26	0.29
19:00-20:00		0	4.35	8.57	3.71	STORM		0.00E+00	0.00	3.43	8.50	7.28	3.56	4.48	8.11	6.69	0.26	0.29
17:00-18:00		5	4.4	8.57	3.74	STORM		1.51E-04	-5.19	3.39	8.50	7.04	3.52	4.31	7.74	6.74	0.25	0.28
18:00-19:00	1:1.4	5	4.6	8.57	3.86	STORM		3.01E-04	-4.92	3.63	8.50	7.33	3.52	4.37	7.84	6.93	0.30	0.30
19:00-20:00		5	4.35	8.57	3.71	STORM		1.76E-04	-5.14	3.36	8.76	7.28	3.52	4.39	8.13	6.89	0.26	0.28
17:00-18:00		7	4.4	8.57	3.74	STORM		1.32E-03	-4.25	3.27	8.50	7.09	3.42	4.23	7.70	6.81	0.25	0.27
18:00-19:00		7	4.6	8.57	3.86	STORM		1.40E-03	-4.25	3.62	8.50	7.34	3.53	4.36	7.82	7.02	0.30	0.29
19:00-20:00		7	4.35	8.57	3.72	STORM		1.19E-03	-4.30	3.32	8.76	7.30	3.46	4.29	8.06	6.87	0.26	0.27
Spatial Variability																		
ZE05_1039		0	5	8.8	5.1	JONSWAP	3.3	6.25E-04	-4.74	4.43	9.05	7.71	4.59	5.66	8.29	7.32	0.27	0.31
ZE05_1139		0	5	8.8	5.1	JONSWAP	3.3	6.07E-04	-4.74	4.36	9.05	7.71	4.54	5.60	8.33	7.43	0.27	0.31
ZE05_1239		0	5	8.8	5.1	JONSWAP	3.3	6.00E-04	-4.74	4.33	9.05	7.71	4.51	5.55	8.34	7.50	0.27	0.31
ZE05_1339		0	5	8.8	5.1	JONSWAP	3.3	1.71E-03	-4.28	4.29	9.05	7.72	4.47	5.49	8.32	7.52	0.28	0.31
ZE05_1439		0	5	8.8	5.1	JONSWAP	3.3	7.65E-04	-4.63	4.31	9.05	7.74	4.48	5.51	8.30	7.49	0.28	0.31
ZE05_1539	1:1.4	0	5	8.8	5.1	JONSWAP	3.3	2.96E-03	-4.05	4.37	9.05	7.74	4.54	5.59	8.34	7.41	0.28	0.31
ZE05_1639		0	5	8.8	5.1	JONSWAP	3.3	5.56E-04	-4.76	4.29	9.05	7.74	4.45	5.48	8.33	7.48	0.28	0.31
ZE05_1739		0	5	8.8	5.1	JONSWAP	3.3	2.34E-03	-4.13	4.26	9.05	7.72	4.44	5.48	8.35	7.57	0.28	0.31
ZE05_2039		0	5	8.8	5.1	JONSWAP	3.3	2.50E-03	-4.13	4.41	9.05	7.72	4.60	5.63	8.32	7.55	0.31	0.34
ZE05_2139		0	5	8.8	5.1	JONSWAP	3.3	4.47E-03	-3.88	4.41	9.05	7.72	4.58	5.61	8.34	7.51	0.31	0.34
ZE05_2239		0	5	8.8	5.1	JONSWAP	3.3	5.04E-03	-3.82	4.37	9.05	7.72	4.54	5.56	8.33	7.55	0.31	0.34
ZE05_2339		0	5	8.8	5.1	JONSWAP	3.3	1.60E-03	-4.32	4.38	9.05	7.72	4.56	5.58	8.31	7.54	0.31	0.34

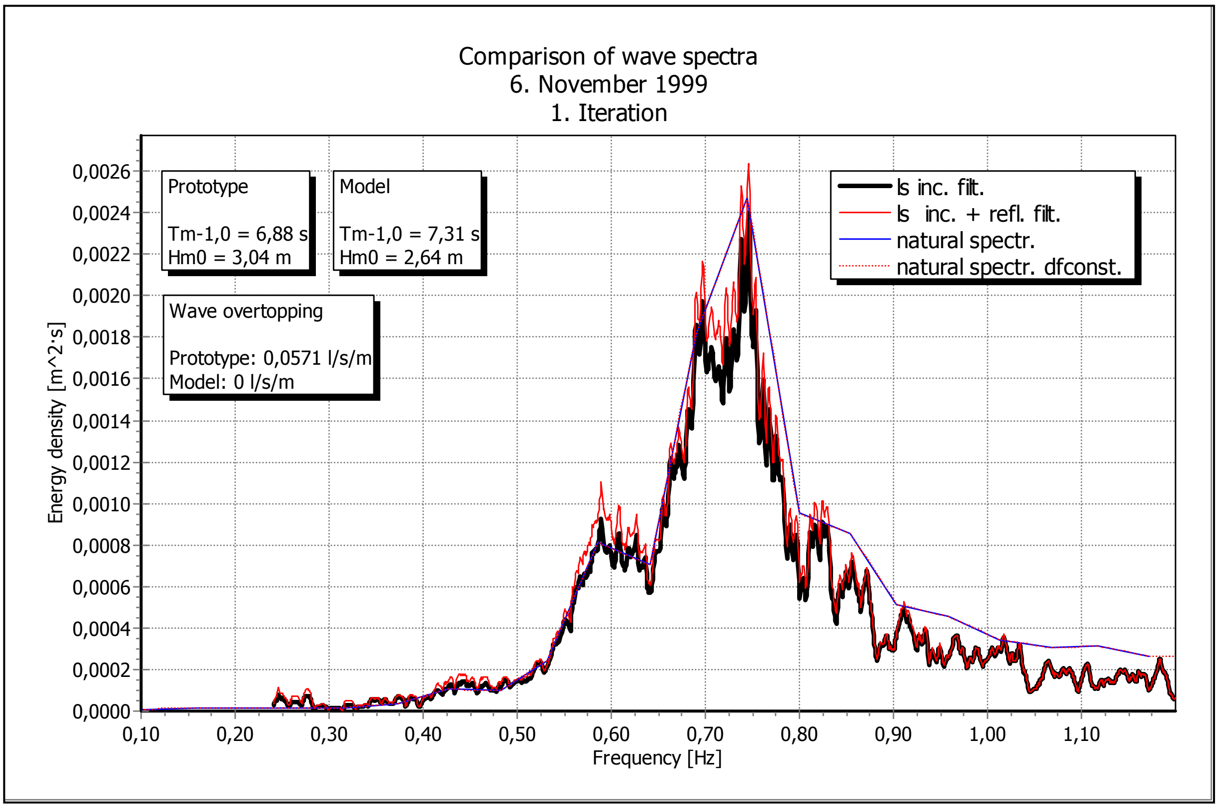
TEST	Slope	Wind	Test matrix					q	log(Q)	INCIDENT (AAU)								
										TOE							Cr	
										frequency domain (M&F)			time domain (SIRW)					
			WL	Tp	Hs	Spectrum	γ			Hmo	Tp	T01	H1/3	H1/10	TH1/3	Tm	fd	td
		(m/s)	(m)	(s)	(m)			(m3/s·ml)		(m)	(s)	(s)	(s)	(s)	(s)	(s)		
STORM October 27th 2002 (01)																		
17:00-18:00		0	4.4	8.57	3.74	STORM		0.00E+00	0.00	2.92	8.50	6.53	3.11	3.80	7.88	6.68	0.40	0.54
18:00-19:00		0	4.6	8.57	3.86	STORM		0.00E+00	0.00	3.17	8.76	6.69	3.31	3.90	7.88	7.09	0.42	0.54
19:00-20:00		0	4.35	8.57	3.71	STORM		0.00E+00	0.00	2.88	8.50	6.68	3.11	3.73	8.17	7.28	0.42	0.57
17:00-18:00		5	4.4	8.57	3.74	STORM		2.76E-04	-4.96	2.93	8.50	6.49	3.15	3.77	7.85	6.86	0.41	0.56
18:00-19:00	1:1.4	5	4.6	8.57	3.86	STORM		5.27E-04	-4.69	3.04	8.50	6.56	3.23	3.83	7.90	6.86	0.42	0.58
19:00-20:00		5	4.35	8.57	3.71	STORM		1.76E-04	-5.16	2.88	8.76	6.72	3.07	3.63	8.04	6.99	0.43	0.57
17:00-18:00		7	4.4	8.57	3.74	STORM		1.29E-03	-4.27	2.82	8.50	6.42	3.03	3.62	7.94	6.94	0.42	0.56
18:00-19:00		7	4.6	8.57	3.86	STORM		1.69E-03	-4.19	3.09	8.50	6.52	3.27	3.88	7.87	7.09	0.42	0.59
19:00-20:00		7	4.35	8.57	3.71	STORM		1.12E-03	-4.34	2.89	8.76	6.60	3.06	3.62	8.05	7.09	0.43	0.59
STORM October 27th 2002 (02)																		
17:00-18:00		0	4.4	8.57	3.74	STORM		1.25E-05	-6.26	2.86	8.50	6.56	3.09	3.76	7.88	7.15	0.40	0.54
18:00-19:00		0	4.6	8.57	3.86	STORM		0.00E+00	0.00	2.96	8.50	6.63	3.14	3.81	7.90	6.97	0.41	0.54
19:00-20:00		0	4.35	8.57	3.71	STORM		0.00E+00	0.00	2.86	8.76	6.73	3.04	3.64	8.16	7.03	0.42	0.56
17:00-18:00		5	4.4	8.57	3.74	STORM		1.51E-04	-5.19	2.88	8.50	6.45	3.10	3.72	7.84	7.01	0.41	0.56
18:00-19:00	1:1.4	5	4.6	8.57	3.86	STORM		3.01E-04	-4.92	2.90	8.50	6.58	3.11	3.68	7.91	7.08	0.43	0.57
19:00-20:00		5	4.35	8.57	3.71	STORM		1.76E-04	-5.14	2.81	8.76	6.74	3.00	3.55	8.15	7.08	0.43	0.57
17:00-18:00		7	4.4	8.57	3.74	STORM		1.32E-03	-4.25	2.84	8.50	6.42	3.02	3.63	7.78	6.67	0.41	0.57
18:00-19:00		7	4.6	8.57	3.86	STORM		1.40E-03	-4.25	2.93	8.50	6.49	3.13	3.67	7.86	7.20	0.43	0.58
19:00-20:00		7	4.35	8.57	3.72	STORM		1.19E-03	-4.30	2.82	8.76	6.61	2.98	3.53	8.10	7.06	0.43	0.59
Spatial Variability																		
ZE05_1039		0	5	8.8	5.1	JONSWAP	3.3	6.25E-04	-4.74	3.71	9.05	6.84	3.84	4.45	8.58	7.50	0.44	0.59
ZE05_1139		0	5	8.8	5.1	JONSWAP	3.3	6.07E-04	-4.74	3.65	9.05	6.85	3.79	4.40	8.59	7.56	0.44	0.59
ZE05_1239		0	5	8.8	5.1	JONSWAP	3.3	6.00E-04	-4.74	3.62	9.05	6.86	3.77	4.39	8.48	7.56	0.44	0.59
ZE05_1339		0	5	8.8	5.1	JONSWAP	3.3	1.71E-03	-4.28	3.60	9.05	6.88	3.76	4.39	8.49	7.61	0.44	0.58
ZE05_1439		0	5	8.8	5.1	JONSWAP	3.3	7.65E-04	-4.63	3.59	9.05	6.90	3.74	4.37	8.54	7.58	0.44	0.58
ZE05_1539	1:1.4	0	5	8.8	5.1	JONSWAP	3.3	2.96E-03	-4.05	3.61	9.05	6.86	3.77	4.43	8.62	7.62	0.44	0.59
ZE05_1639		0	5	8.8	5.1	JONSWAP	3.3	5.56E-04	-4.76	3.56	9.05	6.88	3.73	4.36	8.50	7.48	0.44	0.58
ZE05_1739		0	5	8.8	5.1	JONSWAP	3.3	2.34E-03	-4.13	3.54	9.05	6.87	3.70	4.31	8.53	7.54	0.44	0.58
ZE05_2039		0	5	8.8	5.1	JONSWAP	3.3	2.50E-03	-4.13	3.84	9.05	7.01	4.09	4.84	8.42	7.51	0.43	0.55
ZE05_2139		0	5	8.8	5.1	JONSWAP	3.3	4.47E-03	-3.88	3.86	9.05	7.00	4.08	4.83	8.46	7.44	0.43	0.55
ZE05_2239		0	5	8.8	5.1	JONSWAP	3.3	5.04E-03	-3.82	3.82	9.05	6.99	4.04	4.82	8.42	7.50	0.44	0.56
ZE05_2339		0	5	8.8	5.1	JONSWAP	3.3	1.60E-03	-4.32	3.83	9.05	6.98	4.05	4.85	8.45	7.48	0.43	0.56

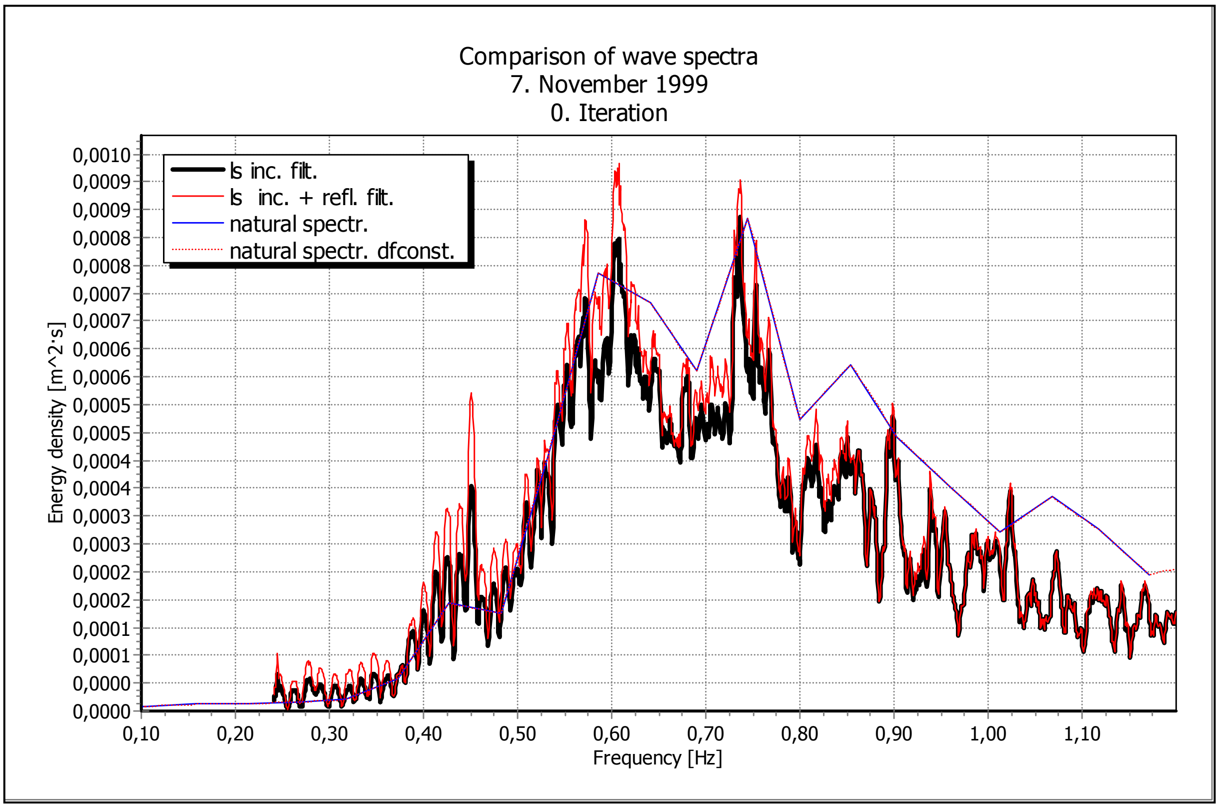
TEST	Slope	Wind	Test matrix					q	log(Q)	INCIDENT (LASA)										
										WRI									Cr	
										frequency domain					time domain				fd	td
			WL	Tp	Hs	Spectrum	γ			Hmo	Ir	Tp	T01	e	H1/3	H1/10	TH1/3	Tm		
		(m/s)	(m)	(s)	(m)			(m3/s·m)		(m)		(s)	(s)		(s)	(s)	(s)	(s)		
STORM October 27th 2002 (01)																				
17:00-18:00		0	4.4	8.57	3.74	STORM		0.00E+00	0.00	3.65	3.31	8.53	7.66	0.24	3.41	4.02	8.06	7.71	25%	22%
18:00-19:00		0	4.6	8.57	3.86	STORM		0.00E+00	0.00	3.62	3.20	8.63	7.53	0.27	3.51	4.20	7.89	7.56	26%	25%
19:00-20:00		0	4.35	8.57	3.71	STORM		0.00E+00	0.00	3.69	3.33	8.66	7.81	0.27	3.39	4.03	8.26	7.90	26%	26%
17:00-18:00		5	4.4	8.57	3.74	STORM		2.78E-04	-4.98	3.71	3.24	8.53	7.54	0.25	3.50	4.13	7.99	7.56	25%	26%
18:00-19:00	1:1.4	5	4.6	8.57	3.86	STORM		5.27E-04	-4.69	3.88	3.18	8.63	7.56	0.27	3.56	4.23	7.96	7.59	27%	26%
19:00-20:00		5	4.35	8.57	3.71	STORM		1.78E-04	-5.18	3.79	3.27	8.01	7.75	0.28	3.48	4.10	8.25	7.91	26%	25%
17:00-18:00		7	4.4	8.57	3.74	STORM		1.29E-03	-4.27	3.58	3.32	8.53	7.57	0.25	3.38	4.03	7.99	7.70	29%	29%
18:00-19:00		7	4.6	8.57	3.86	STORM		1.69E-03	-4.19	3.95	3.17	8.63	7.60	0.26	3.59	4.28	7.95	7.67	25%	25%
19:00-20:00		7	4.35	8.57	3.71	STORM		1.12E-03	-4.94	3.74	3.29	8.63	7.74	0.27	3.42	4.02	8.10	7.72	25%	26%
STORM October 27th 2002 (02)																				
17:00-18:00		0	4.4	8.57	3.74	STORM		1.25E-05	-8.28	3.52	3.33	8.53	7.53	0.25	3.34	3.92	7.94	7.65	26%	25%
18:00-19:00		0	4.6	8.57	3.86	STORM		0.00E+00	0.00	3.69	3.26	8.63	7.54	0.27	3.39	4.00	7.91	7.55	27%	27%
19:00-20:00		0	4.35	8.57	3.71	STORM		0.00E+00	0.00	3.71	3.30	8.01	7.74	0.27	3.40	3.97	8.23	7.79	26%	26%
17:00-18:00		5	4.4	8.57	3.74	STORM		1.51E-04	-5.19	3.55	3.34	8.53	7.62	0.25	3.39	4.05	8.00	7.69	26%	26%
18:00-19:00	1:1.4	5	4.6	8.57	3.86	STORM		3.01E-04	-4.92	3.81	3.24	8.63	7.66	0.26	3.45	4.04	8.00	7.52	26%	26%
19:00-20:00		5	4.35	8.57	3.71	STORM		1.78E-04	-5.14	3.69	3.32	8.63	7.78	0.27	3.39	3.99	8.24	7.83	27%	26%
17:00-18:00		7	4.4	8.57	3.74	STORM		1.32E-03	-4.25	3.51	3.34	8.53	7.55	0.26	3.34	4.03	7.98	7.62	26%	26%
18:00-19:00		7	4.6	8.57	3.86	STORM		1.40E-03	-4.25	3.77	3.24	8.63	7.59	0.26	3.45	4.08	7.95	7.56	27%	27%
19:00-20:00		7	4.35	8.57	3.72	STORM		1.19E-03	-4.30	3.65	3.35	8.66	7.81	0.27	3.33	3.95	8.32	7.88	26%	26%
Spatial Variability																				
ZE05_1039		0	5	8.8	5.1	JONSWAP	3.3	8.25E-04	-4.74	4.77	2.94	9.14	7.83	0.28	4.35	5.28	8.27	7.74	22%	21%
ZE05_1139		0	5	8.8	5.1	JONSWAP	3.3	6.07E-04	-4.74	4.63	2.98	8.50	7.80	0.28	4.22	5.08	8.38	7.71	23%	22%
ZE05_1239		0	5	8.8	5.1	JONSWAP	3.3	6.00E-04	-4.74	4.62	2.99	8.50	7.85	0.28	4.21	5.08	8.31	7.76	23%	23%
ZE05_1339		0	5	8.8	5.1	JONSWAP	3.3	1.71E-03	-4.28	4.54	3.02	8.50	7.84	0.28	4.17	5.05	8.32	7.79	24%	22%
ZE05_1439		0	5	8.8	5.1	JONSWAP	3.3	7.65E-04	-4.63	4.50	3.01	8.50	7.78	0.29	4.11	4.97	8.35	7.69	23%	23%
ZE05_1539	1:1.4	0	5	8.8	5.1	JONSWAP	3.3	2.98E-03	-4.05	4.60	2.98	8.50	7.77	0.29	4.18	5.04	8.34	7.73	24%	23%
ZE05_1639		0	5	8.8	5.1	JONSWAP	3.3	5.58E-04	-4.78	4.50	3.03	8.50	7.82	0.28	4.10	4.95	8.43	7.79	23%	22%
ZE05_1739		0	5	8.8	5.1	JONSWAP	3.3	2.34E-03	-4.13	4.50	3.02	8.50	7.79	0.29	4.09	4.93	8.33	7.71	24%	23%
ZE05_2039		0	5	8.8	5.1	JONSWAP	3.3	2.50E-03	-4.13	4.64	2.99	9.14	7.80	0.28	4.25	5.08	8.38	7.74	26%	26%
ZE05_2139		0	5	8.8	5.1	JONSWAP	3.3	4.47E-03	-3.88	4.68	2.98	8.99	7.83	0.28	4.28	5.10	8.43	7.76	27%	26%
ZE05_2239		0	5	8.8	5.1	JONSWAP	3.3	5.04E-03	-3.82	4.60	3.00	8.99	7.82	0.28	4.21	5.05	8.40	7.76	26%	26%
ZE05_2339		0	5	8.8	5.1	JONSWAP	3.3	1.60E-03	-4.32	4.63	2.99	8.99	7.79	0.28	4.23	5.13	8.34	7.84	27%	26%

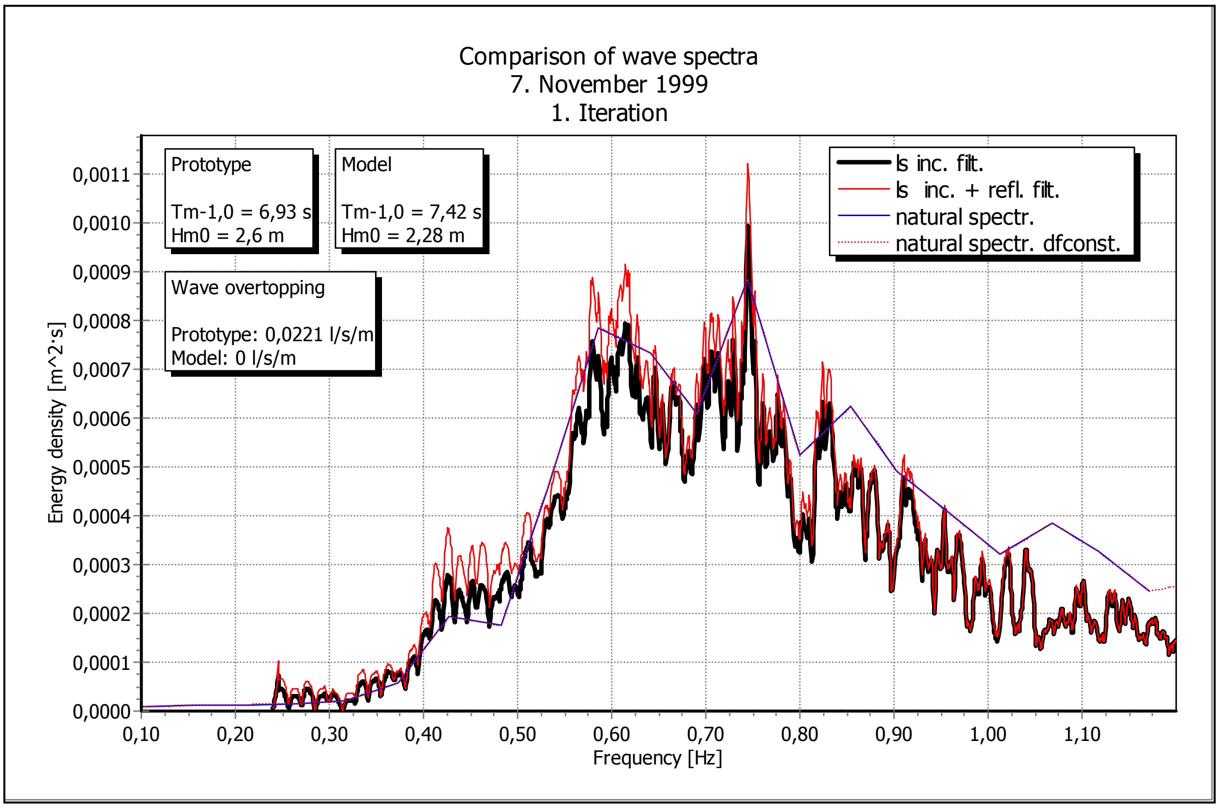
TEST	Slope	Wind	Test matrix					q	log(Q)	INCIDENT (LASA)										
										TOE									Cr	
										frequency domain					time domain				fd	td
			WL	Tp	Hs	Spectrum	γ			Hmo	Ir	Tp	T01	e	H1/3	H1/10	TH1/3	Tm		
		(m/s)	(m)	(s)	(m)			(m3/s·m)		(m)		(s)	(s)		(s)	(s)	(s)	(s)		
STORM October 27th 2002 (01)																				
17:00-18:00		0	4.4	8.57	3.74	STORM		0.00E+00	0.00	3.14	2.88	8.53	6.98	0.38	3.05	3.54	8.26	7.79	31%	32%
18:00-19:00		0	4.6	8.57	3.86	STORM		0.00E+00	0.00	3.38	2.78	8.63	7.02	0.39	3.18	3.69	8.21	7.68	36%	36%
19:00-20:00		0	4.35	8.57	3.71	STORM		0.00E+00	0.00	3.26	2.84	10.43	7.13	0.40	3.09	3.62	8.53	8.05	38%	38%
17:00-18:00		5	4.4	8.57	3.74	STORM		2.78E-04	-4.98	3.17	2.84	8.63	6.93	0.39	3.09	3.59	8.32	7.77	35%	36%
18:00-19:00	1:1.4	5	4.6	8.57	3.86	STORM		5.27E-04	-4.69	3.41	2.77	8.63	7.01	0.40	3.19	3.70	8.39	7.94	36%	36%
19:00-20:00		5	4.35	8.57	3.71	STORM		1.78E-04	-5.18	3.26	2.83	10.43	7.11	0.41	3.09	3.58	8.58	8.11	36%	36%
17:00-18:00		7	4.4	8.57	3.74	STORM		1.29E-03	-4.27	3.02	2.90	8.63	6.91	0.39	2.98	3.42	8.46	7.75	36%	35%
18:00-19:00		7	4.6	8.57	3.86	STORM		1.69E-03	-4.19	3.44	2.75	8.63	6.97	0.39	3.19	3.67	8.30	7.67	35%	36%
19:00-20:00		7	4.35	8.57	3.71	STORM		1.12E-03	-4.94	3.29	2.82	10.43	7.11	0.41	3.07	3.58	8.52	7.78	38%	38%
STORM October 27th 2002 (02)																				
17:00-18:00		0	4.4	8.57	3.74	STORM		1.25E-05	-8.28	3.06	2.87	8.53	6.87	0.39	3.04	3.58	8.18	7.76	35%	35%
18:00-19:00		0	4.6	8.57	3.86	STORM		0.00E+00	0.00	3.29	2.82	8.63	7.04	0.39	3.09	3.70	8.36	7.78	36%	36%
19:00-20:00		0	4.35	8.57	3.71	STORM		0.00E+00	0.00	3.24	2.83	10.43	7.06	0.41	3.12	3.60	8.46	8.10	38%	37%
17:00-18:00		5	4.4	8.57	3.74	STORM		1.51E-04	-5.19	2.99	2.89	8.63	6.82	0.39	2.98	3.44	8.21	7.82	34%	35%
18:00-19:00	1:1.4	5	4.6	8.57	3.86	STORM		3.01E-04	-4.92	3.30	2.82	8.63	7.02	0.39	3.05	3.51	8.35	7.69	35%	36%
19:00-20:00		5	4.35	8.57	3.71	STORM		1.78E-04	-5.14	3.23	2.85	10.43	7.11	0.41	3.03	3.50	8.52	8.03	37%	36%
17:00-18:00		7	4.4	8.57	3.74	STORM		1.32E-03	-4.25	3.06	2.87	8.53	6.88	0.39	2.99	3.47	8.33	7.72	33%	33%
18:00-19:00		7	4.6	8.57	3.86	STORM		1.40E-03	-4.25	3.31	2.79	8.63	6.92	0.40	3.09	3.52	8.48	7.76	36%	36%
19:00-20:00		7	4.35	8.57	3.72	STORM		1.19E-03	-4.30	3.20	2.88	10.43	7.13	0.41	3.03	3.47	8.67	7.98	37%	36%
Spatial Variability																				
ZE05_1039		0	5	8.8	5.1	JONSWAP	3.3	8.25E-04	-4.74	4.16	2.53	10.20	7.10	0.41	3.92	4.48	8.73	7.90	36%	34%
ZE05_1139		0	5	8.8	5.1	JONSWAP	3.3	6.07E-04	-4.74	4.10	2.55	10.20	7.13	0.41	3.86	4.47	8.78	7.90	36%	34%
ZE05_1239		0	5	8.8	5.1	JONSWAP	3.3	6.00E-04	-4.74	4.09	2.56	10.20	7.13	0.41	3.86	4.48	8.63	7.90	35%	34%
ZE05_1339		0	5	8.8	5.1	JONSWAP	3.3	1.71E-03	-4.28	4.05	2.57	10.20	7.13	0.41	3.81	4.43	8.80	7.85	36%	34%
ZE05_1439		0	5	8.8	5.1	JONSWAP	3.3	7.65E-04	-4.63	4.04	2.59	9.99	7.20	0.40	3.79	4.38	8.74	7.92	36%	34%
ZE05_1539	1:1.4	0	5	8.8	5.1	JONSWAP	3.3	2.98E-03	-4.05	4.09	2.55	10.20	7.09	0.41	3.84	4.47	8.69	7.85	37%	35%
ZE05_1639		0	5	8.8	5.1	JONSWAP	3.3	5.58E-04	-4.78	4.02	2.58	9.14	7.16	0.41	3.77	4.39	8.74	7.88	35%	34%
ZE05_1739		0	5	8.8	5.1	JONSWAP	3.3	2.34E-03	-4.13	4.01	2.58	9.14	7.14	0.40	3.75	4.38	8.79	7.88	36%	35%
ZE05_2039		0	5	8.8	5.1	JONSWAP	3.3	2.50E-03	-4.13	4.25	2.57	9.99	7.30	0.38	3.97	4.61	8.68	7.91	37%	35%
ZE05_2139		0	5	8.8	5.1	JONSWAP	3.3	4.47E-03	-3.88	4.27	2.58	9.99	7.26	0.38	3.99	4.63	8.67	7.95	37%	36%
ZE05_2239		0	5	8.8	5.1	JONSWAP	3.3	5.04E-03	-3.82	4.24	2.58	9.99	7.24	0.38	3.97	4.62	8.65	7.89	37%	35%
ZE05_2339		0	5	8.8	5.1	JONSWAP	3.3	1.60E-03	-4.32	4.25	2.57	9.99	7.31	0.38	3.97	4.61	8.67	7.92	37%	35%

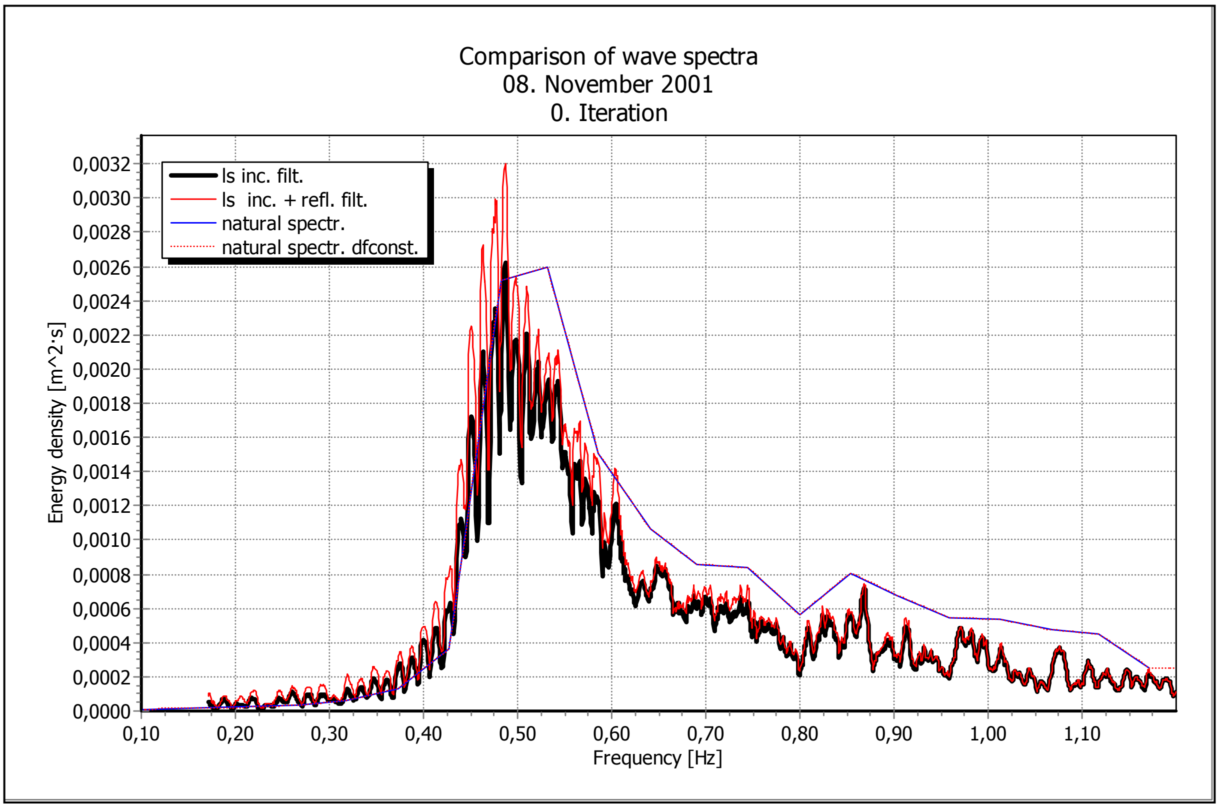
Annex C: Storm spectra LWI

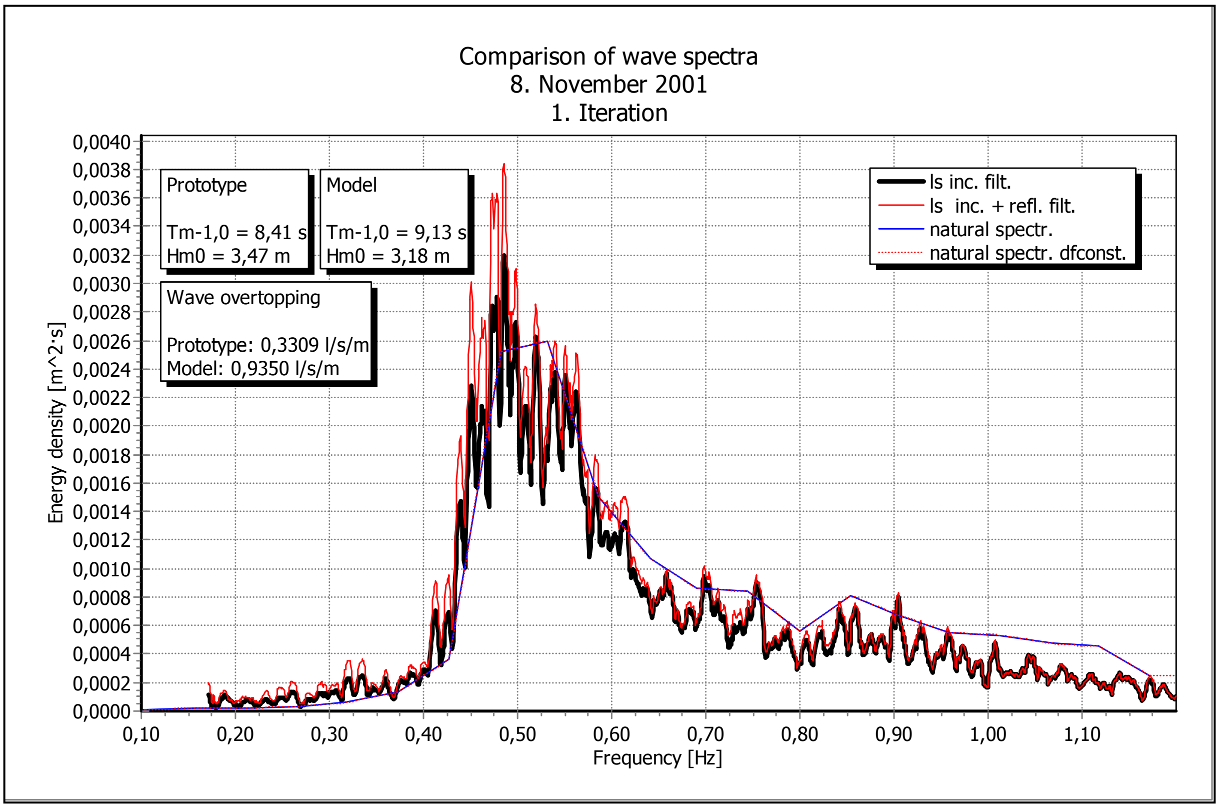

Comparison of wave spectra
6. November 1999
0. Iteration
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
Frequency [Hz]

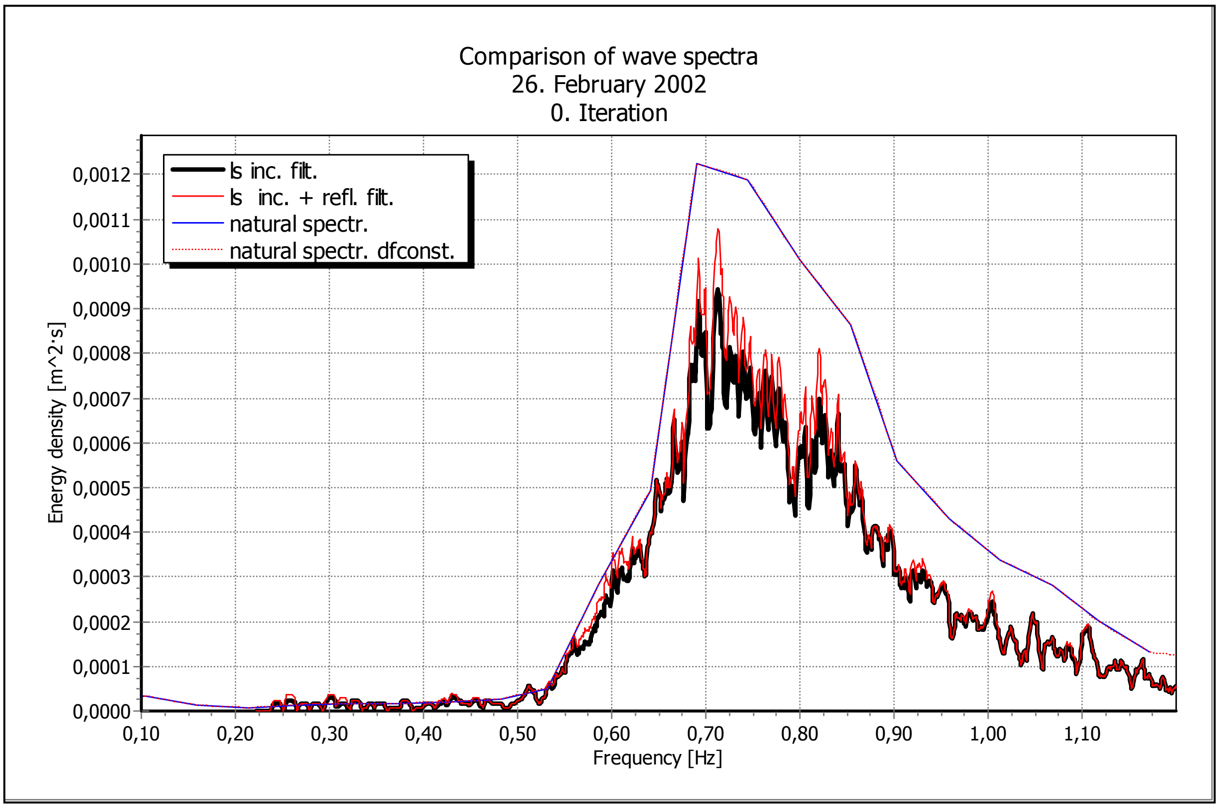

Comparison of wave spectra
6. November 1999
1. Iteration
Prototype
Tm-1,0 = 6,88 s
Hm0 = 3,04 m
Model
Tm-1,0 = 7,31 s
Hm0 = 2,64 m
Wave overtopping
Prototype: 0,0571 l/s/m
Model: 0 l/s/m
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
Frequency [Hz]

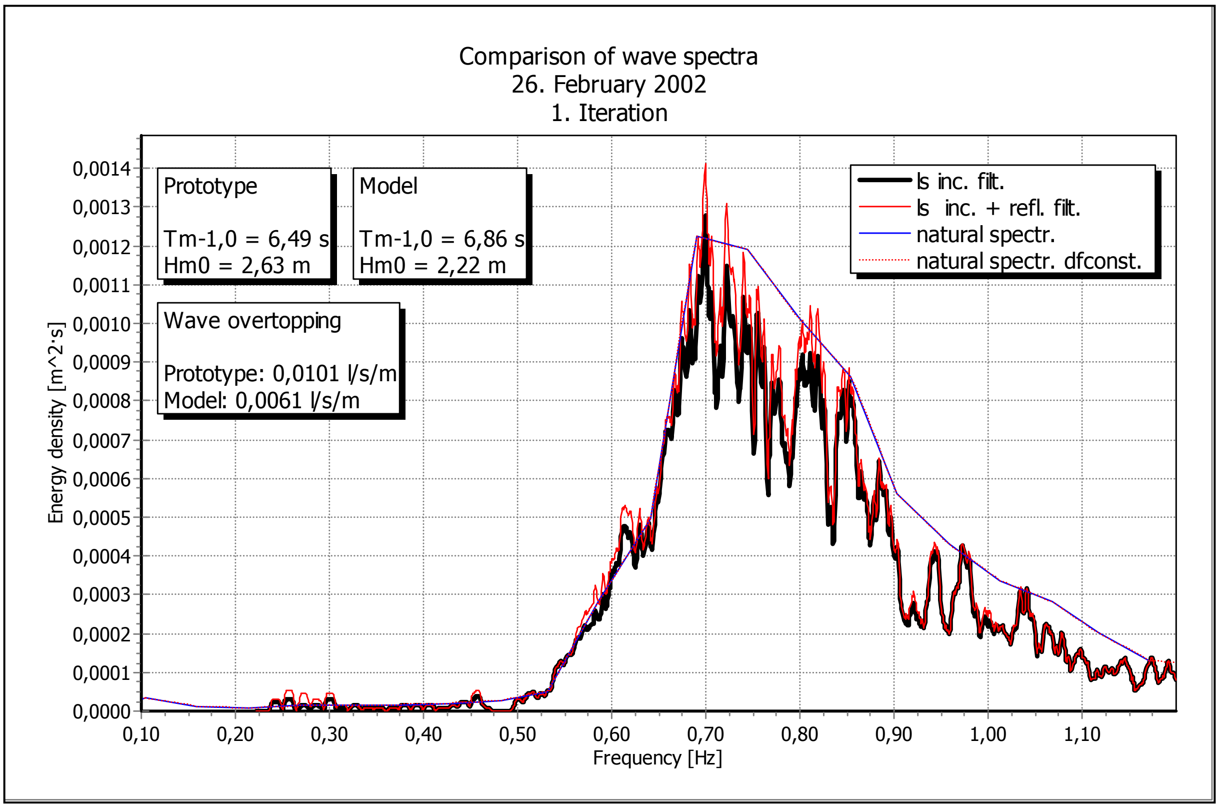

Comparison of wave spectra
7. November 1999
0. Iteration
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
Frequency [Hz]
0,0010
0,0009
0,0009
0,0008
0,0008
0,0007
0,0007
0,0006
0,0006
0,0005
0,0005
0,0004
0,0004
0,0003
0,0003
0,0002
0,0002
0,0001
0,0001
0,0000
0,0000
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00
1,10

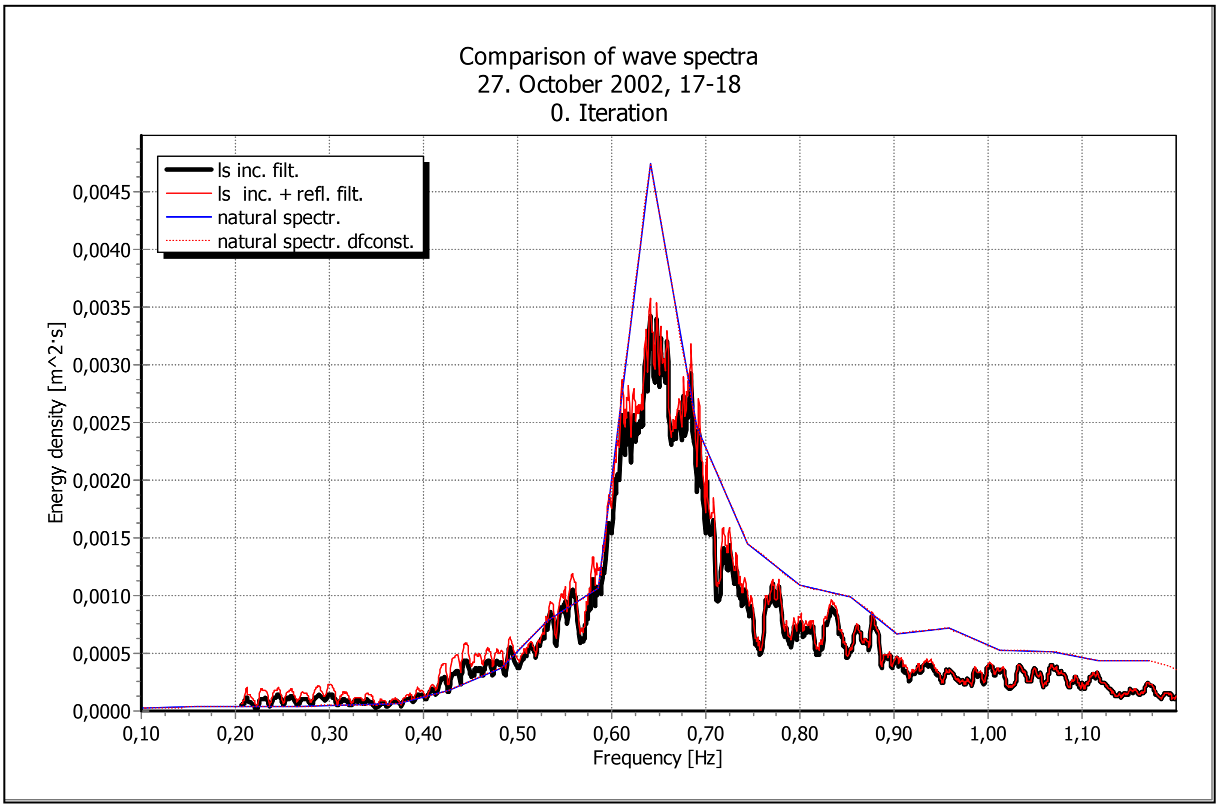

Comparison of wave spectra
7. November 1999
1. Iteration
Prototype
Tm-1,0 = 6,93 s
Hm0 = 2,6 m
Model
Tm-1,0 = 7,42 s
Hm0 = 2,28 m
Wave overtopping
Prototype: 0,0221 l/s/m
Model: 0 l/s/m
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
Frequency [Hz]
0,0011
0,0010
0,0009
0,0008
0,0007
0,0006
0,0005
0,0004
0,0003
0,0002
0,0001
0,0000
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00
1,10

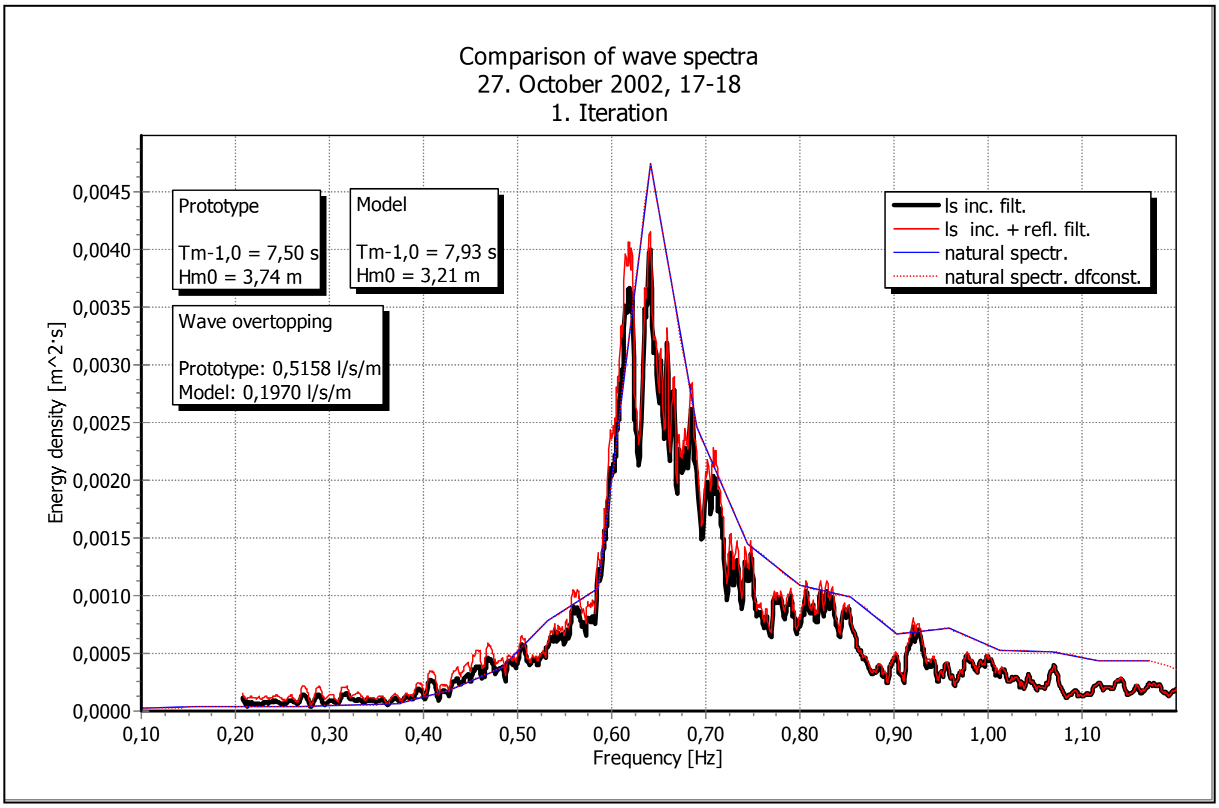

Comparison of wave spectra
08. November 2001
0. Iteration
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
0,0000
0,0002
0,0004
0,0006
0,0008
0,0010
0,0012
0,0014
0,0016
0,0018
0,0020
0,0022
0,0024
0,0026
0,0028
0,0030
0,0032
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00
1,10
Frequency [Hz]

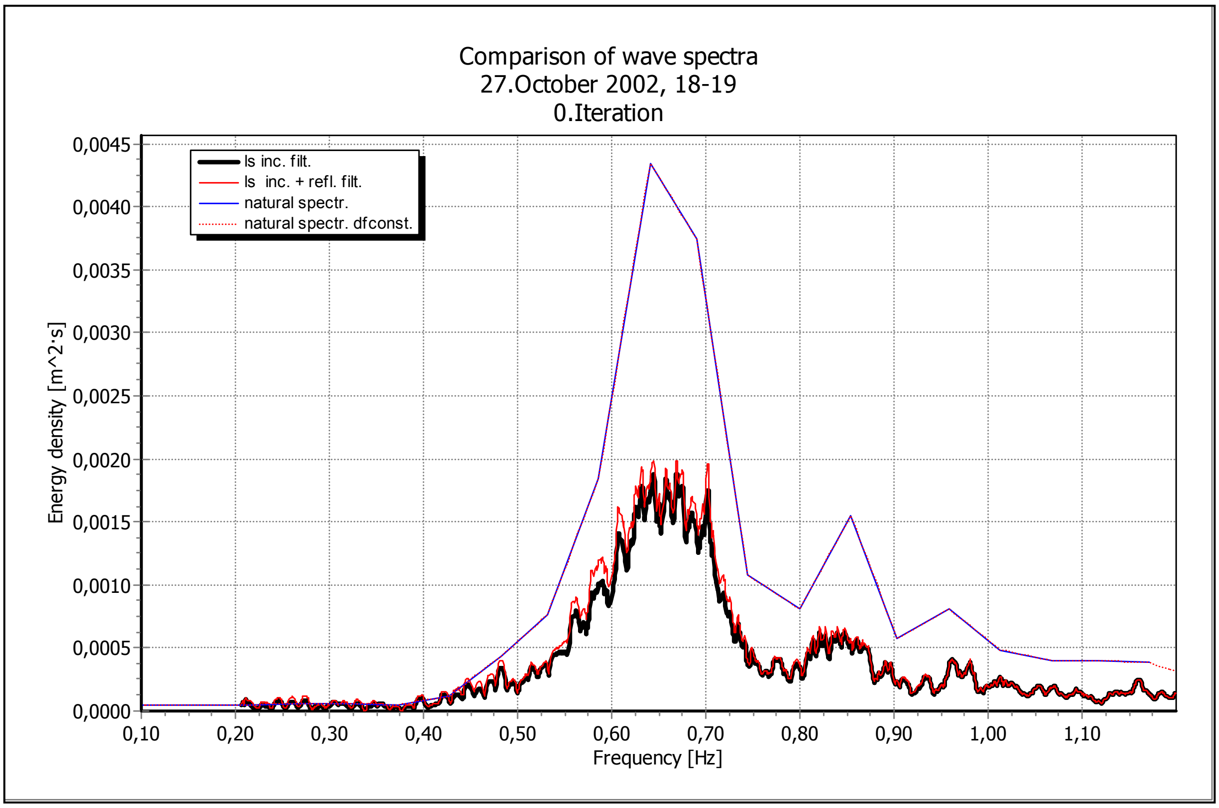

Comparison of wave spectra
8. November 2001
1. Iteration
Prototype
Tm-1,0 = 8,41 s
Hm0 = 3,47 m
Model
Tm-1,0 = 9,13 s
Hm0 = 3,18 m
Wave overtopping
Prototype: 0,3309 l/s/m
Model: 0,9350 l/s/m
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
0,0000
0,0002
0,0004
0,0006
0,0008
0,0010
0,0012
0,0014
0,0016
0,0018
0,0020
0,0022
0,0024
0,0026
0,0028
0,0030
0,0032
0,0034
0,0036
0,0038
0,0040
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00
1,10
Frequency [Hz]

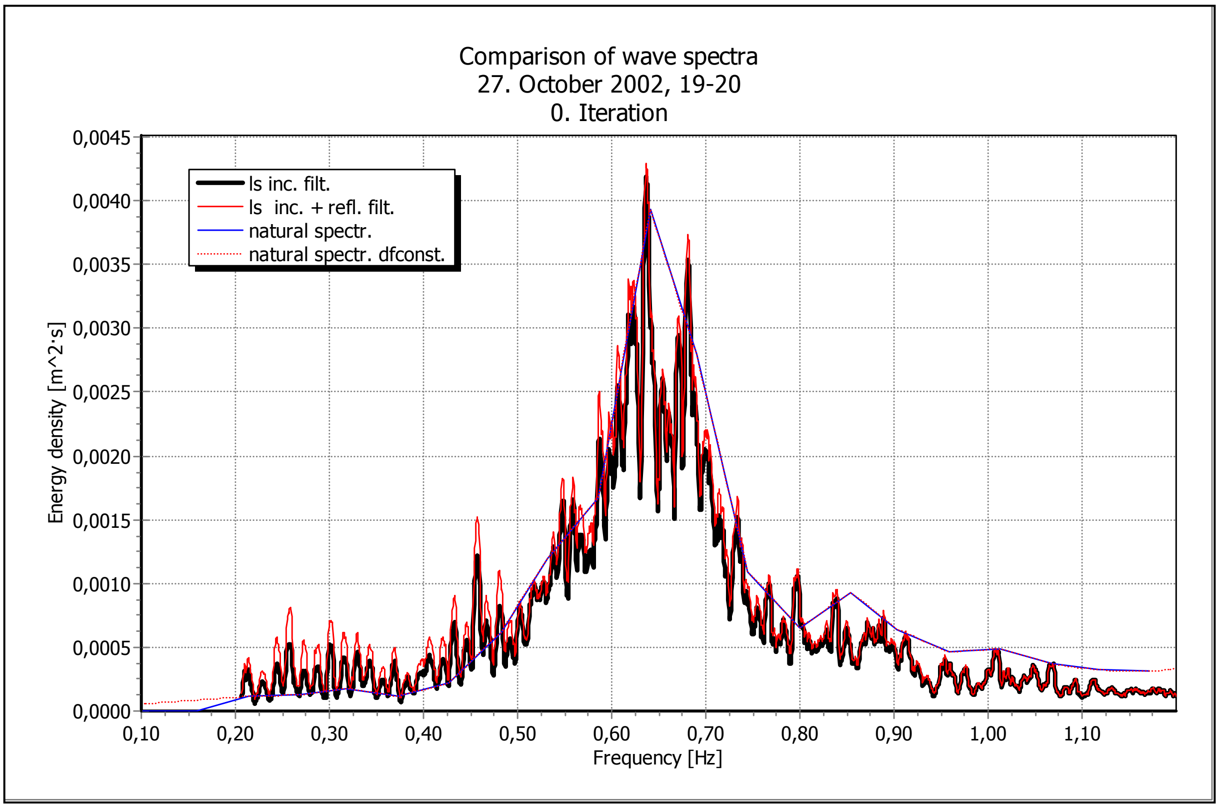

Comparison of wave spectra
26. February 2002
0. Iteration
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
Frequency [Hz]

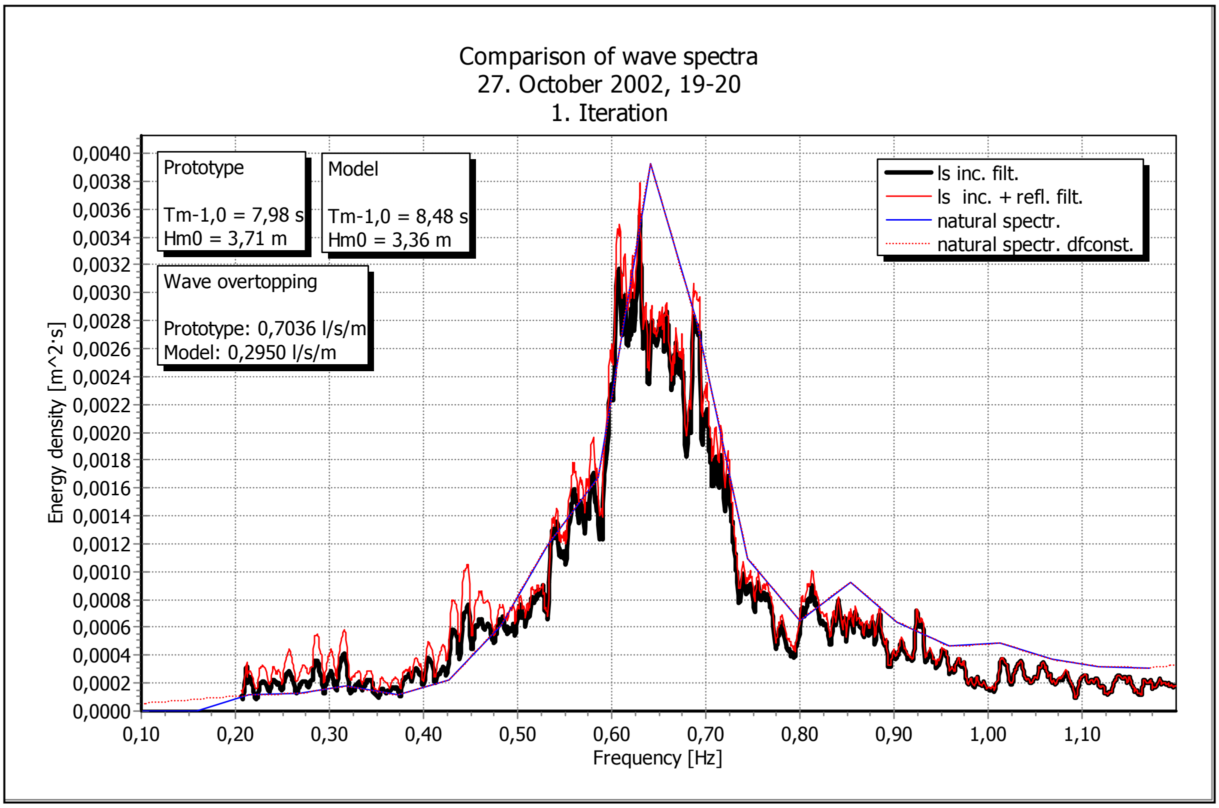

Comparison of wave spectra
26. February 2002
1. Iteration
Prototype
Tm-1,0 = 6,49 s
Hm0 = 2,63 m
Model
Tm-1,0 = 6,86 s
Hm0 = 2,22 m
Wave overtopping
Prototype: 0,0101 l/s/m
Model: 0,0061 l/s/m
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
Frequency [Hz]

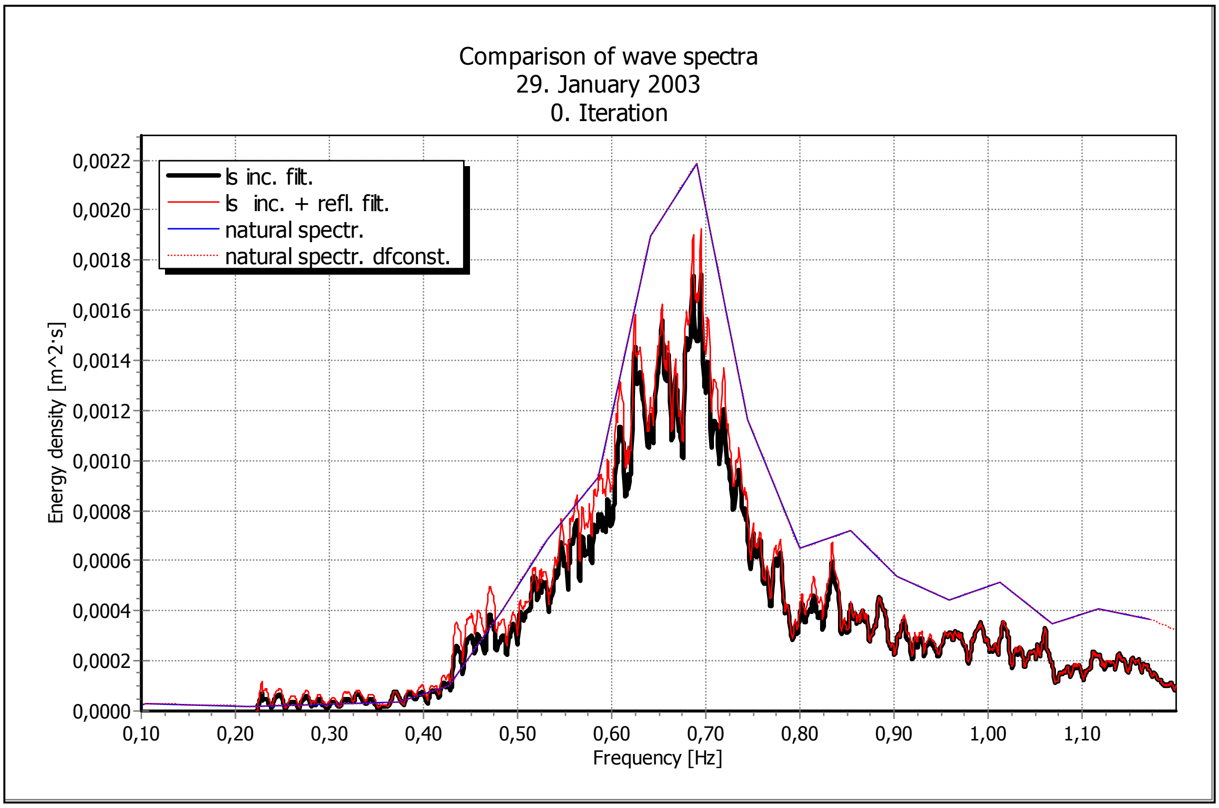

Comparison of wave spectra
27. October 2002, 17-18
0. Iteration
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
0,0045
0,0040
0,0035
0,0030
0,0025
0,0020
0,0015
0,0010
0,0005
0,0000
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00
1,10
Frequency [Hz]

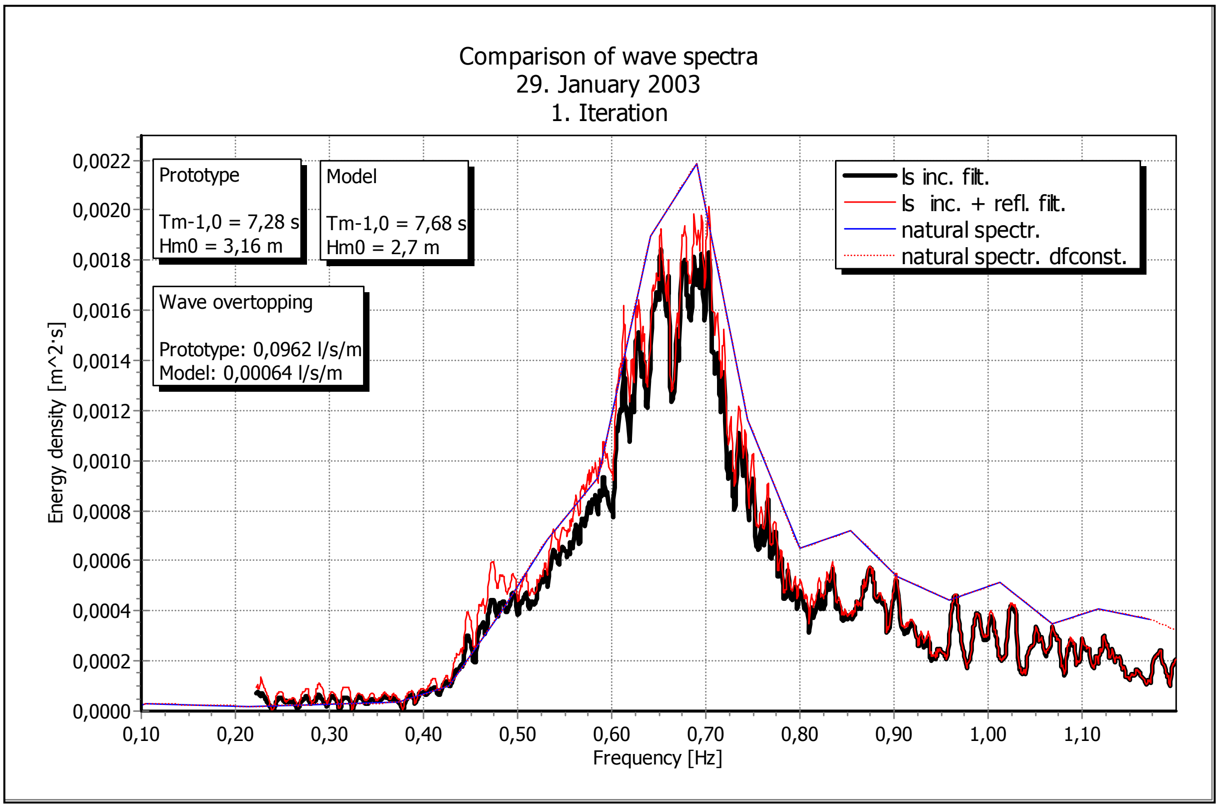

Comparison of wave spectra
27. October 2002, 17-18
1. Iteration
Prototype
Tm-1,0 = 7,50 s
Hm0 = 3,74 m
Model
Tm-1,0 = 7,93 s
Hm0 = 3,21 m
Wave overtopping
Prototype: 0,5158 l/s/m
Model: 0,1970 l/s/m
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
0,0045
0,0040
0,0035
0,0030
0,0025
0,0020
0,0015
0,0010
0,0005
0,0000
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00
1,10
Frequency [Hz]

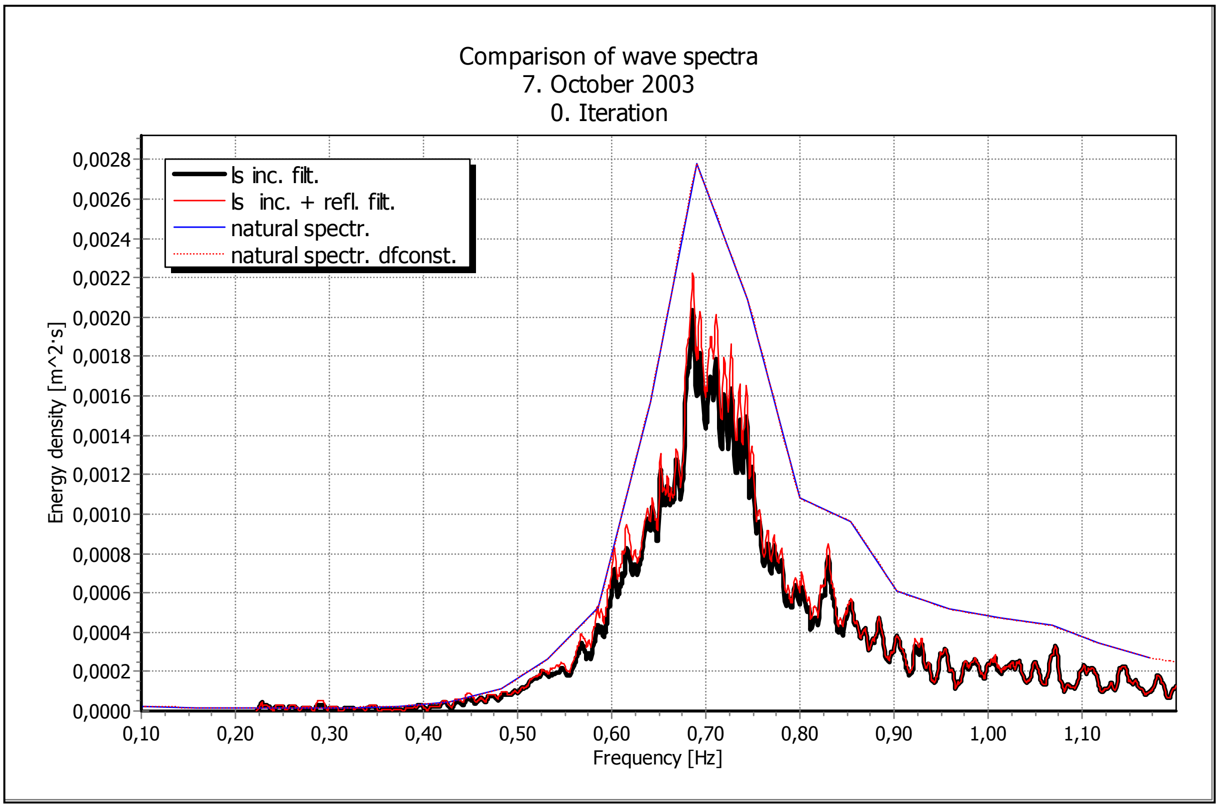

Comparison of wave spectra
27.October 2002, 18-19
0.Iteration
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
0,0045
0,0040
0,0035
0,0030
0,0025
0,0020
0,0015
0,0010
0,0005
0,0000
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00
1,10
Frequency [Hz]

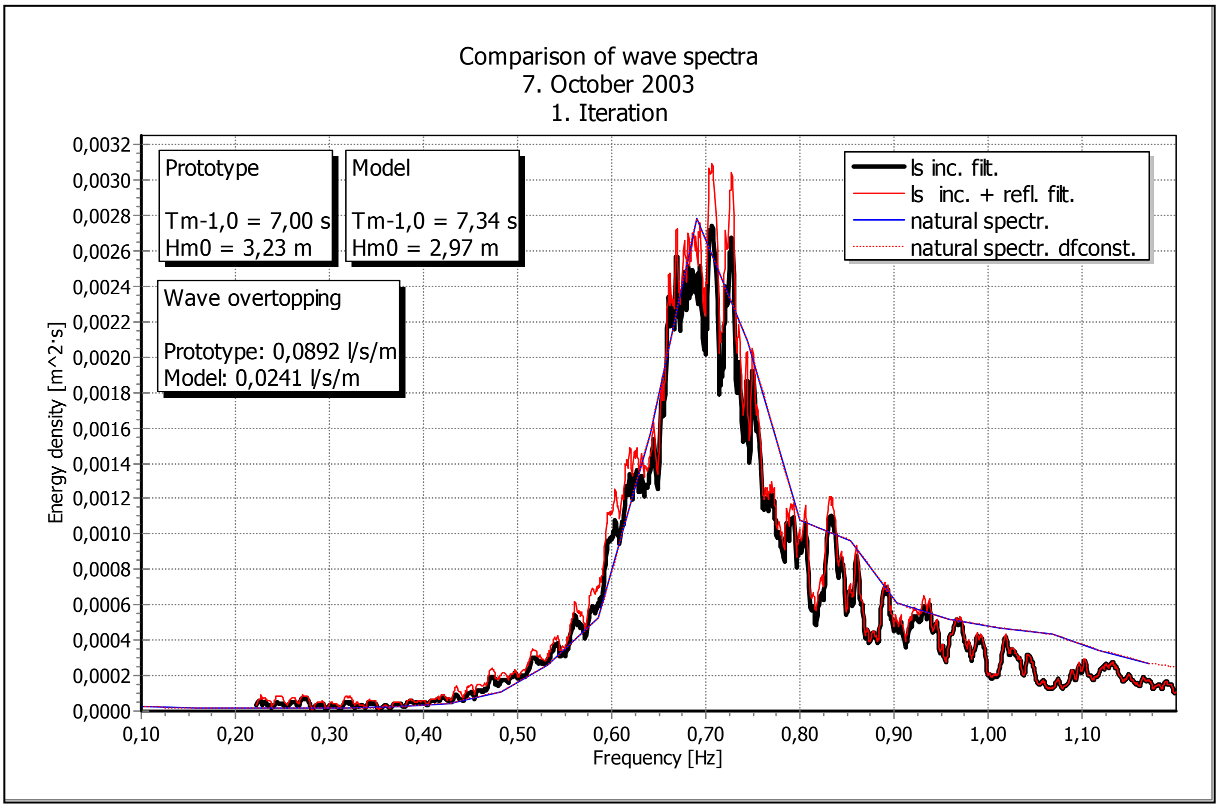

Comparison of wave spectra
27. October 2002, 19-20
0. Iteration
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
0,0045
0,0040
0,0035
0,0030
0,0025
0,0020
0,0015
0,0010
0,0005
0,0000
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00
1,10
Frequency [Hz]

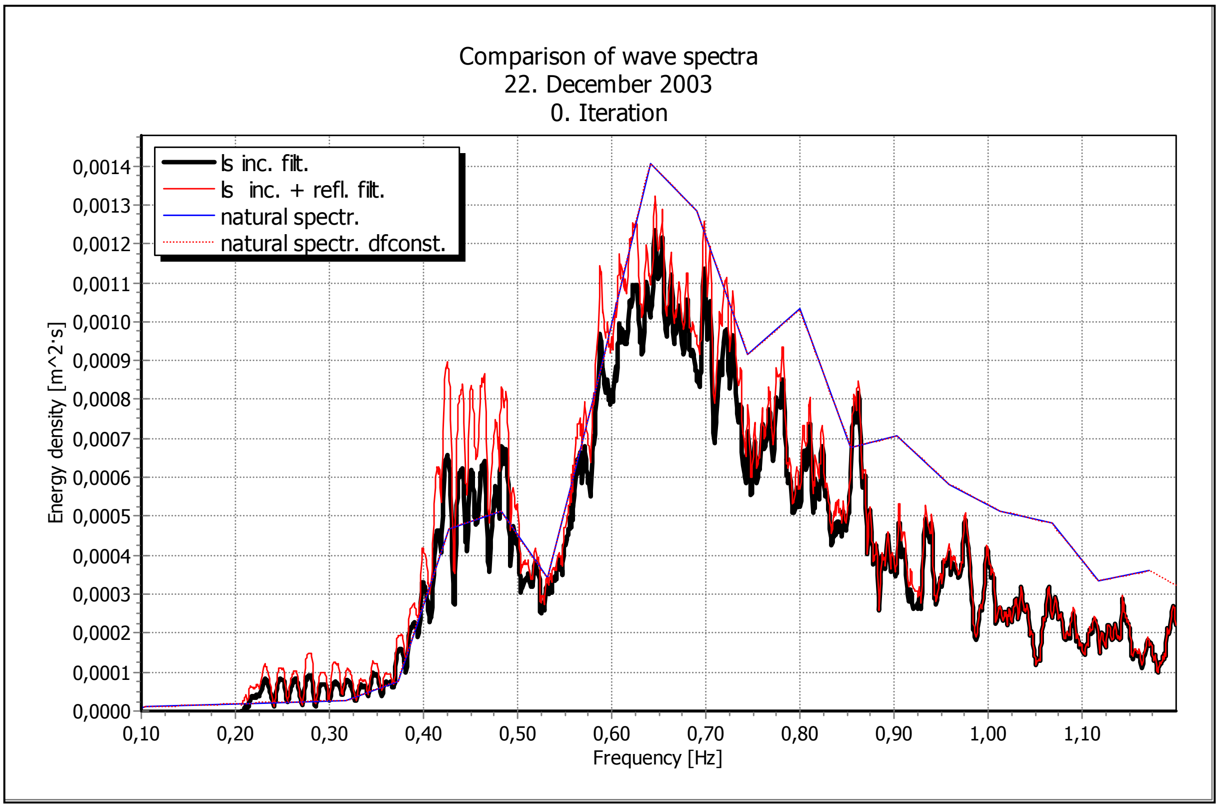

Comparison of wave spectra
27. October 2002, 19-20
1. Iteration
Prototype
Tm-1,0 = 7,98 s
Hm0 = 3,71 m
Model
Tm-1,0 = 8,48 s
Hm0 = 3,36 m
Wave overtopping
Prototype: 0,7036 l/s/m
Model: 0,2950 l/s/m
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
0,0040
0,0038
0,0036
0,0034
0,0032
0,0030
0,0028
0,0026
0,0024
0,0022
0,0020
0,0018
0,0016
0,0014
0,0012
0,0010
0,0008
0,0006
0,0004
0,0002
0,0000
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00
1,10
Frequency [Hz]

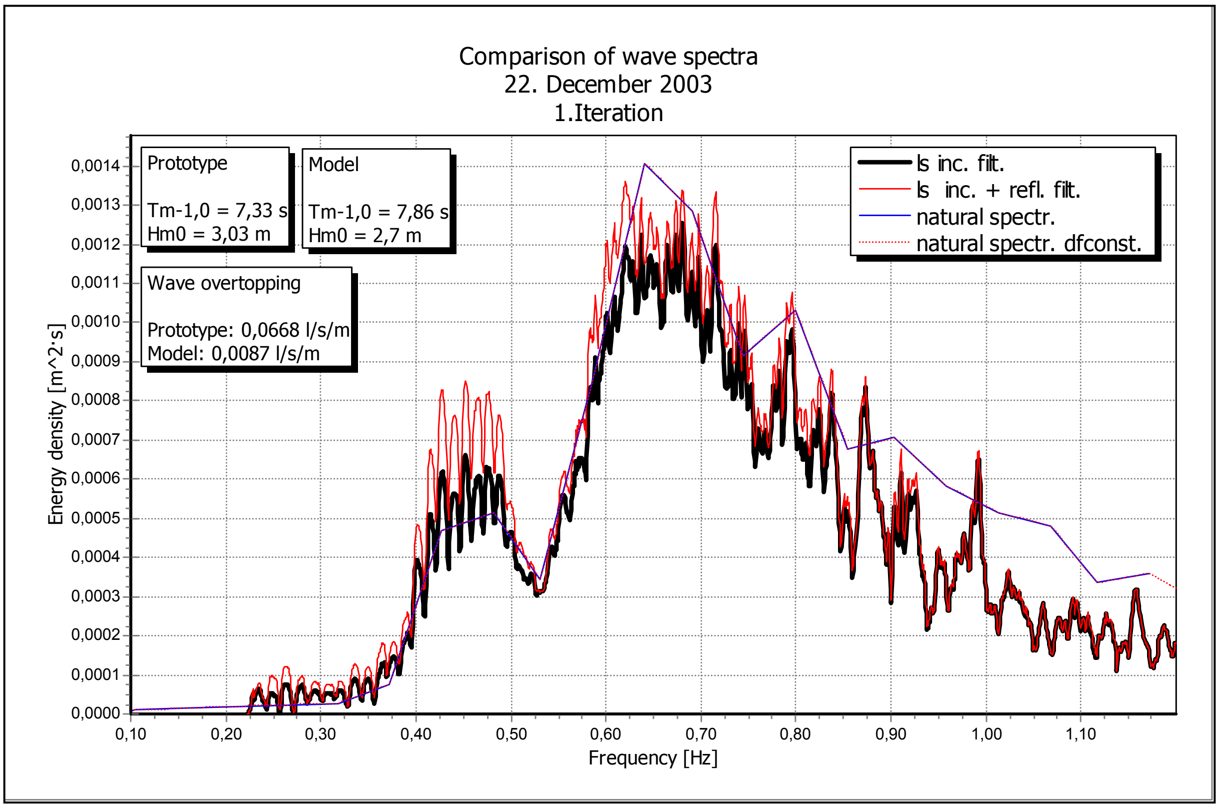

Comparison of wave spectra
29. January 2003
0. Iteration
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
Frequency [Hz]
0,0000
0,0002
0,0004
0,0006
0,0008
0,0010
0,0012
0,0014
0,0016
0,0018
0,0020
0,0022
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00
1,10

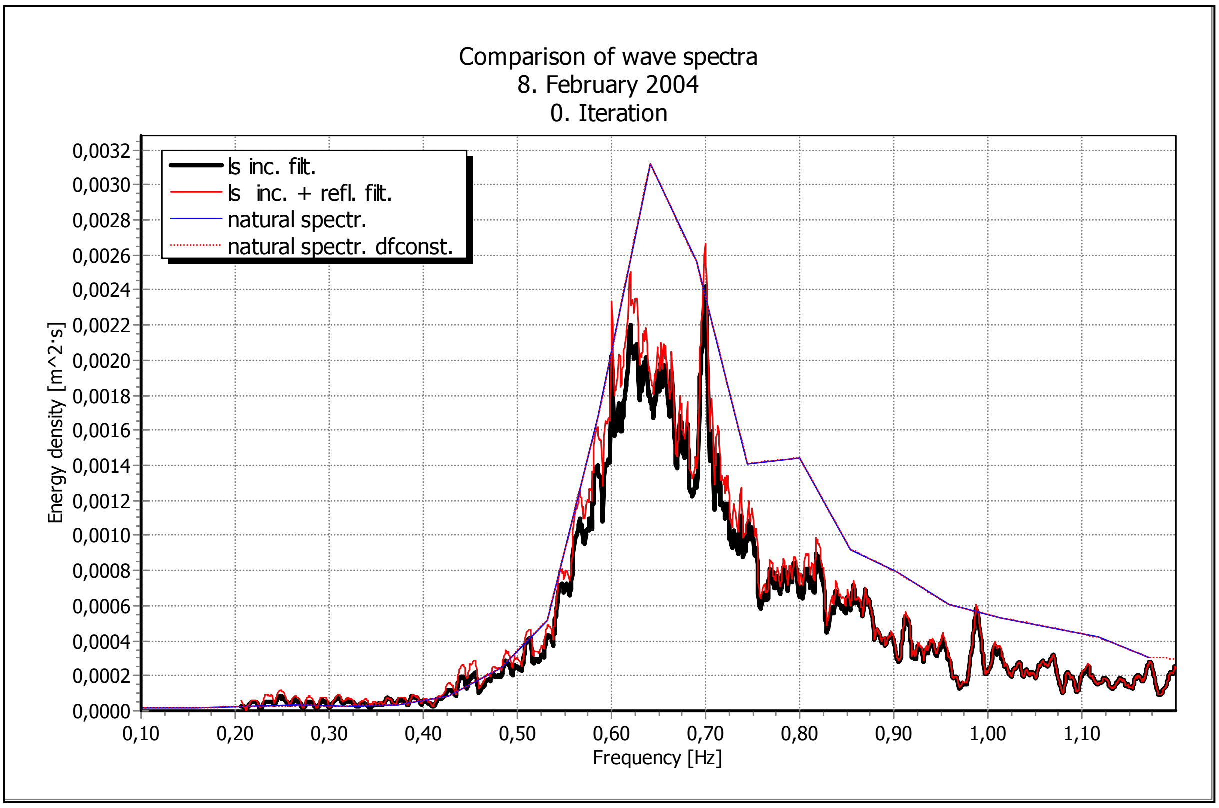

Comparison of wave spectra
29. January 2003
1. Iteration
Prototype
Tm-1,0 = 7,28 s
Hm0 = 3,16 m
Model
Tm-1,0 = 7,68 s
Hm0 = 2,7 m
Wave overtopping
Prototype: 0,0962 l/s/m
Model: 0,00064 l/s/m
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
Frequency [Hz]
0,0000
0,0002
0,0004
0,0006
0,0008
0,0010
0,0012
0,0014
0,0016
0,0018
0,0020
0,0022
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00
1,10

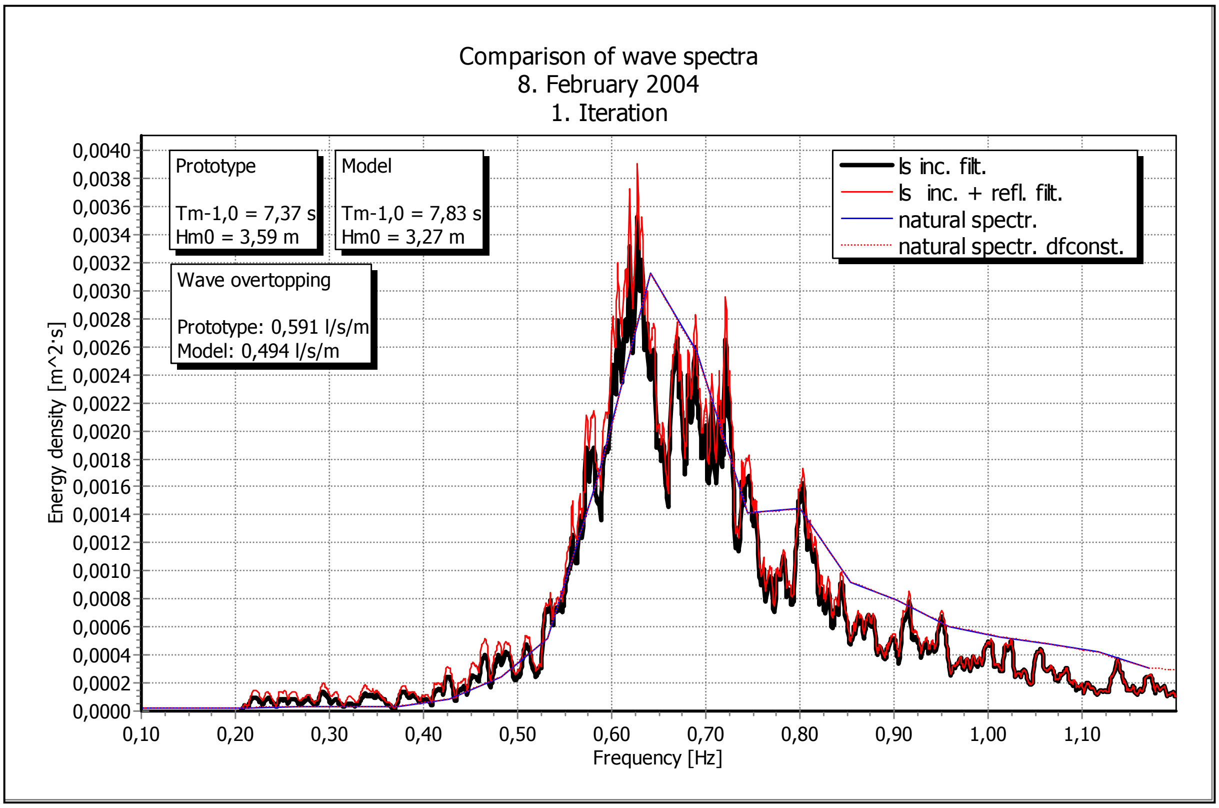

Comparison of wave spectra
7. October 2003
0. Iteration
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
Frequency [Hz]
0,0000
0,0002
0,0004
0,0006
0,0008
0,0010
0,0012
0,0014
0,0016
0,0018
0,0020
0,0022
0,0024
0,0026
0,0028
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00
1,10


Comparison of wave spectra
7. October 2003
1. Iteration
Prototype
Tm-1,0 = 7,00 s
Hm0 = 3,23 m
Model
Tm-1,0 = 7,34 s
Hm0 = 2,97 m
Wave overtopping
Prototype: 0,0892 l/s/m
Model: 0,0241 l/s/m
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
Frequency [Hz]
0,0000
0,0002
0,0004
0,0006
0,0008
0,0010
0,0012
0,0014
0,0016
0,0018
0,0020
0,0022
0,0024
0,0026
0,0028
0,0030
0,0032
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00
1,10


Comparison of wave spectra
22. December 2003
0. Iteration
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
Frequency [Hz]
0,0000
0,0001
0,0002
0,0003
0,0004
0,0005
0,0006
0,0007
0,0008
0,0009
0,0010
0,0011
0,0012
0,0013
0,0014
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00
1,10

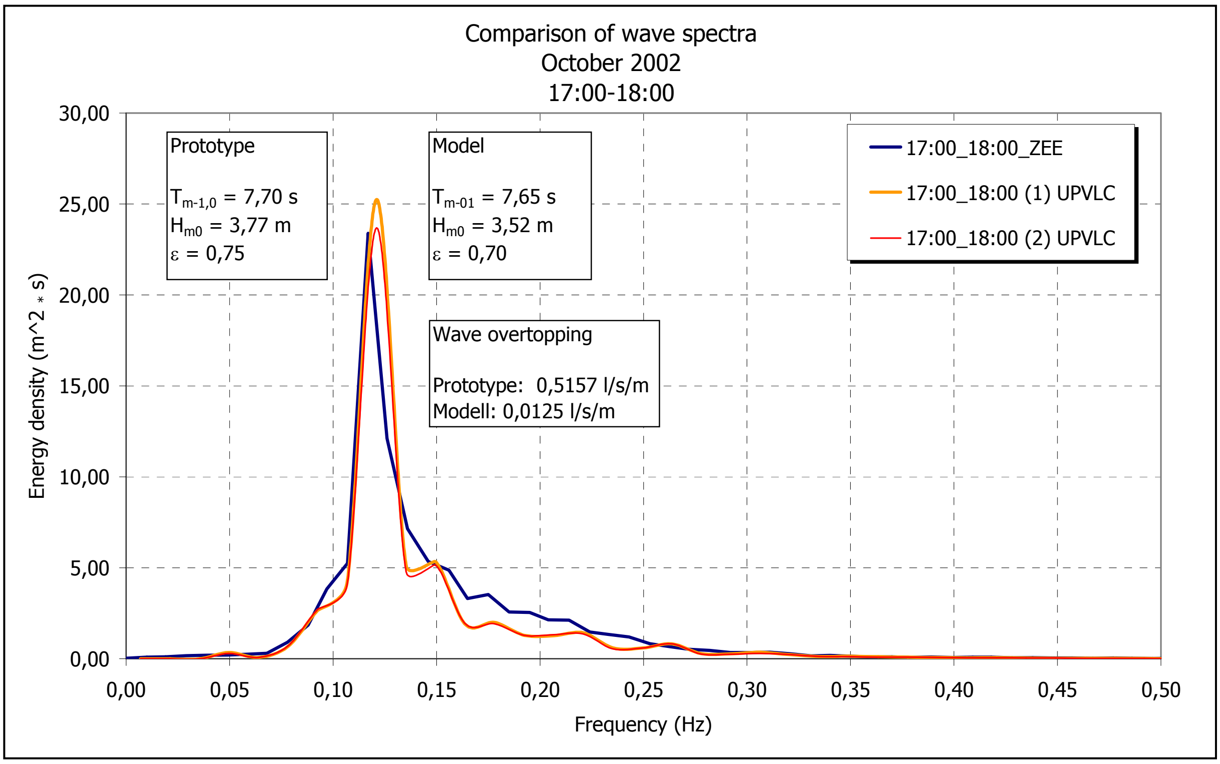

Comparison of wave spectra
22. December 2003
1.Iteration
Prototype
Tm-1,0 = 7,33 s
Hm0 = 3,03 m
Model
Tm-1,0 = 7,86 s
Hm0 = 2,7 m
Wave overtopping
Prototype: 0,0668 l/s/m
Model: 0,0087 l/s/m
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
Frequency [Hz]
0,0000
0,0001
0,0002
0,0003
0,0004
0,0005
0,0006
0,0007
0,0008
0,0009
0,0010
0,0011
0,0012
0,0013
0,0014
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00
1,10

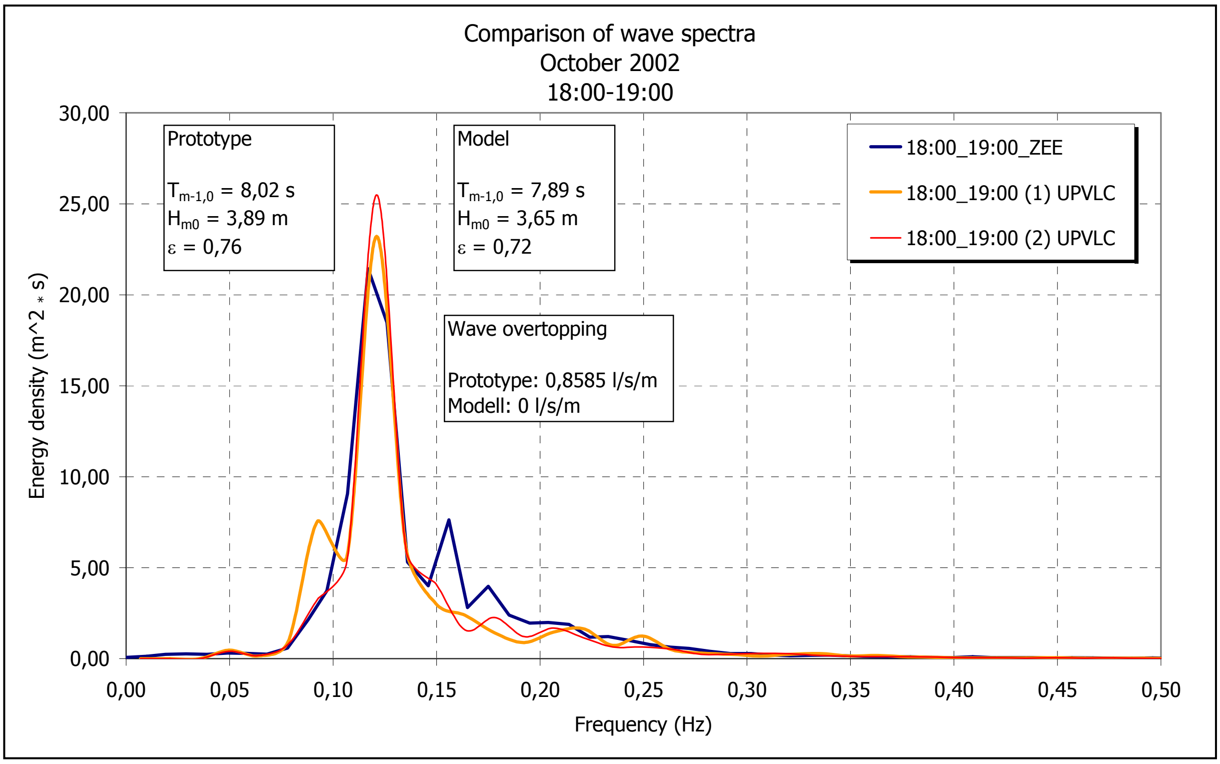

Comparison of wave spectra
8. February 2004
0. Iteration
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
Frequency [Hz]
0,0000
0,0002
0,0004
0,0006
0,0008
0,0010
0,0012
0,0014
0,0016
0,0018
0,0020
0,0022
0,0024
0,0026
0,0028
0,0030
0,0032
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00
1,10

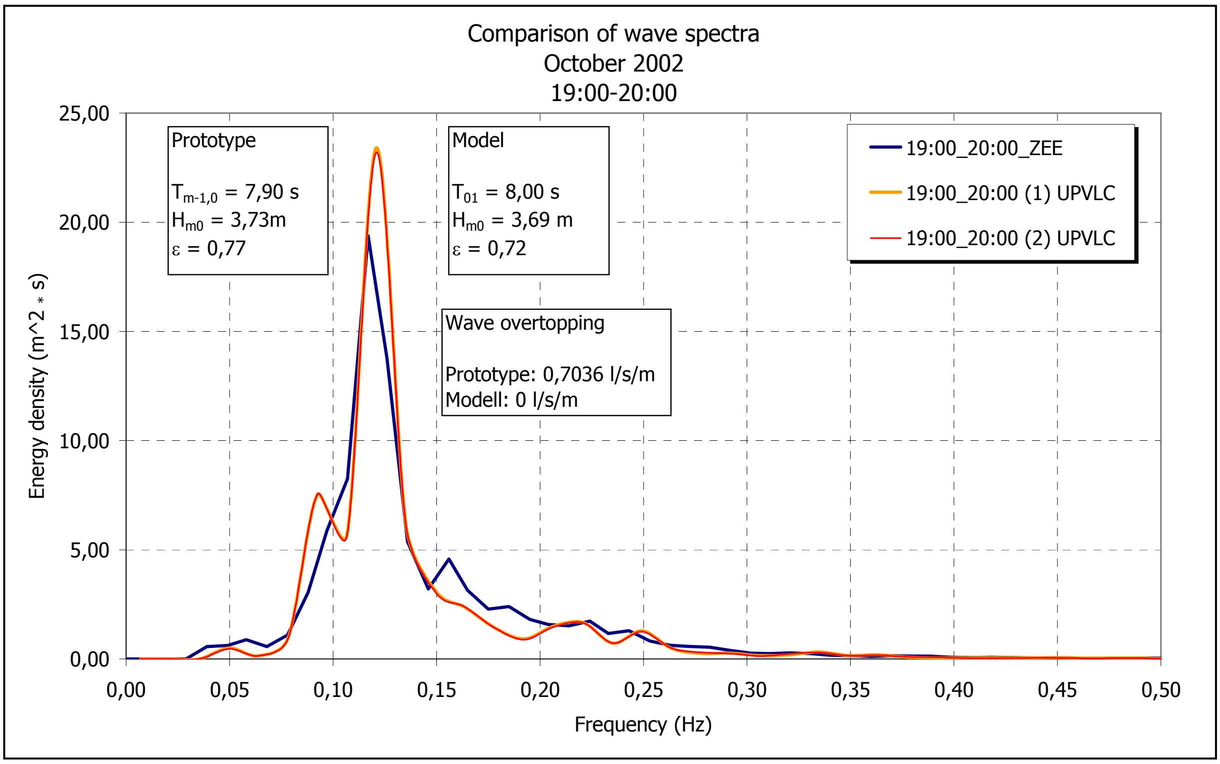

Comparison of wave spectra
8. February 2004
1. Iteration
Prototype
Tm-1,0 = 7,37 s
Hm0 = 3,59 m
Model
Tm-1,0 = 7,83 s
Hm0 = 3,27 m
Wave overtopping
Prototype: 0,591 l/s/m
Model: 0,494 l/s/m
ls inc. filt.
ls inc. + refl. filt.
natural spectr.
natural spectr. dfconst.
Energy density [m^2·s]
Frequency [Hz]
0,0000
0,0002
0,0004
0,0006
0,0008
0,0010
0,0012
0,0014
0,0016
0,0018
0,0020
0,0022
0,0024
0,0026
0,0028
0,0030
0,0032
0,0034
0,0036
0,0038
0,0040
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,90
1,00
1,10

Annex D: Storm spectra UPVLC

Storm [-]	data source [-]	H_{m0} [m]	$H_{m0, mean}$ [m]	$T_{m-1.0}$ [s]	$T_{m-1,0, mean}$ [m]	ε [-]	ε_{mean} [-]
27.10.2002 17:00-18:00	Zeebrugge	3,77	3,77	7,70	7,70	0,75	0,75
	UPVLC (1)	3,56	3,52	7,65	7,65	0,70	0,70
	UPVLC (2)	3,48		7,65		0,69	
27.10.2002 18:00-19:00	Zeebrugge	3,89	3,89	8,02	8,02	0,76	0,76
	UPVLC (1)	3,68	3,65	8,00	7,89	0,72	0,72
	UPVLC (2)	3,62		7,78		0,71	
27.10.2002 19:00-20:00	Zeebrugge	3,73	3,73	7,90	7,90	0,77	0,77
	UPVLC (1)	3,70	3,69	8,00	8,00	0,72	0,72
	UPVLC (2)	3,68		8,00		0,72	




Comparison of wave spectra
October 2002
18:00-19:00
Prototype
$T_{m-1,0}$ = 8,02 s
H_{m0} = 3,89 m
ε = 0,76
Model
$T_{m-1,0}$ = 7,89 s
H_{m0} = 3,65 m
ε = 0,72
Wave overtopping
Prototype: 0,8585 l/s/m
Modell: 0 l/s/m
18:00_19:00_ZEE
18:00_19:00 (1) UPVLC
18:00_19:00 (2) UPVLC
Energy density (m^2 * s)
Frequency (Hz)
30,00
25,00
20,00
15,00
10,00
5,00
0,00
0,05
0,10
0,15
0,20
0,25
0,30
0,35
0,40
0,45
0,50


Comparison of wave spectra
October 2002
19:00-20:00
Prototype
$T_{m-1,0}$ = 7,90 s
H_{m0} = 3,73m
ε = 0,77
Model
T_{01} = 8,00 s
H_{m0} = 3,69 m
ε = 0,72
Wave overtopping
Prototype: 0,7036 l/s/m
Modell: 0 l/s/m
19:00_20:00_ZEE
19:00_20:00 (1) UPVLC
19:00_20:00 (2) UPVLC
Energy density (m^2 * s)
Frequency (Hz)
25,00
20,00
15,00
10,00
5,00
0,00
0,05
0,10
0,15
0,20
0,25
0,30
0,35
0,40
0,45
0,50