Van der Meer Consulting B.V.
COASTAL ENGINEERING CONSULTANCY & RESEARCH

Hydralab - Flowdike

Influence of wind and current on wave run-up and wave overtopping

Detailed analysis on the influence of current on wave overtopping

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Executive summary

The Flowdike research has been described in the report: "Hydralab - FlowDike. Influence of wind and current on wave run-up and wave overtopping. April 2010".

That overall report gives the background for research, the set-up of the model testing, the data processing and a first analysis of the data. The present report focused on only one aspect, the influence of current on wave overtopping. The analysis, however, goes much deeper than the first analysis in the above mentioned overall report and inclusion of this part in that report would unbalance the structure of that report. It is for that reason that this detailed analysis is given as a separate report. It should be read in conjunction with the above mentioned overall report.

Re-analysis of existing wave overtopping data on oblique wave attack confirmed the validity of an existing formula, showing this influence. Also the Flowdike 1 tests on a slope of 1:3 and the Flowdike 2 tests on a slope of 1:6 confirmed this equation. Therefore this equation was used to investigate the influence of currents on wave overtopping.

Currents may change the wave height, wave period and angle of energy towards the dike slope. The wave height was measured in the model at the toe of the dike. Relative wave periods become shorter if the waves are against the current and longer when they are along with the current. It was analysed whether the influence of currents on wave overtopping could (partly) be described by using this relative wave period. It turned out that this resulted in too large influences for waves against fairly high currents. The wave periods and wave steepnessess to be used where also out of the physical range (too short periods and too large steepnessess). For this reason the influence of change of relative wave period was not taken to describe the influence of currents on wave overtopping.

The last effect is the change of direction of wave energy. Some wave energy will travel along the wave crest. Including the angle of wave energy instead of the generated wave angle resulted in a little too strong influence for the largest generated currents. As it might well be the case that actual currents are a little smaller near the slope of the dike than in the channel, river or sea, there is good reason to decrease the influence of the angle of wave energy a little. Arbitrarily a combined wave angle of $0.5(\beta + \beta_e)$ was chosen and this gave good results for the 1:3 slope as well as the 1:6 slope.

Therefore, the influence of currents on wave overtopping can well be described by using the combined wave angle $0.5(\beta + \beta_e)$ in existing formulae for wave overtopping. The method is given in Chapter 5 with equations 5.8 and 5.9.

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1 Introduction

The Flowdike research has been described in the report:

"Hydralab - FlowDike.
Influence of wind and current on wave run-up and wave overtopping. April 2010.

Authors: Dipl.-Ing. Stefanie Lorke, Dipl.-Ing. Anja Brüning, Dr.-Ing. Antje Bornschein, Dipl.-Ing. Stefano Gilli, cand.-Ing. Nadine Krüger, Univ.-Prof. Dr.-Ing. Holger Schüttrumpf, Prof. Dr.-Ing. habil. Reinhard Pohl, Ing. Miroslav Spano, cand. Ing. Stefan Werk."

That report gives the background for research, the set-up of the model testing, the data processing and a first analysis of the data. The present report focused on only one aspect, the influence of current on wave overtopping. The analysis, however, goes much deeper than the first analysis in the above mentioned overall report and inclusion of this part in that report would unbalance the structure of that report. It is for that reason that this detailed analysis is given as a separate report. It should be read in conjunction with the above mentioned overall report.

As the set-up of the model testing, data processing, etc. has been described in the overall report, this present report starts directly by analysis of the data. The report is a summary of two reports that were written for Deltares in the Netherlands. Those reports were partly in Dutch, for the overall description, and in English with respect to the detailed analysis. The reports focused on Flowdike 1 and Flowdike 2 separately. In this report the analysis has been combined.

Wave current interaction may change the wave height, the angle of energy and may cause a difference between absolute and relative wave period. The wave height and absolute wave period were measured at the toe of the dike. The angle of energy and the relative wave period may be calculated by theory on wave current interaction.

Wave current interaction causes an angle of wave energy which goes along with the current: a wave angle against the current gives an angle of energy that attacks more perpendicular to the structure and along with the current the angle of energy will increase. The relative wave period becomes shorter than the absolute wave period if the wave direction is against the current and longer if along with the current.

The analysis focused on whether a change in angle of wave energy and/or change in wave period should be taken into account in order to describe the influence of the current.

The analysis starts, however, with a re-analysis of existing data on the influence of oblique waves on wave overtopping. Then the data with perpendicular wave attack without current have been analyzed and this part is similar to section 8.4 of the overall report. The influence of oblique waves, but still without currents, have then been analyzed, which is comparable to section 8.3 in the overall report. Existing theory was validated by this analysis, which gave the basis for a further detailed analysis on the influence of current on wave overtopping.

The used test data have been summarized in Appendix 1.

Acknowledgement

This work has been supported by European Community's Sixth Framework Programme through the grant to the budget of the Integrated Infrastructure Initiative HYDRALAB III within the Transnational Access Activities, Contract no. 022441.

2 Re-analysis of influence of oblique wave attack on wave overtopping

A large number of tests has been performed worldwide in wave flumes with perpendicular wave attack without currents, on all kind of structures. The most recent work with a summary of all the tests and applicable formulae is the Overtopping Manual (2007). The equation for overtopping on smooth straight slopes is given by:

$$\frac{q}{\sqrt{g \cdot H_{m0}^3}} = \frac{0.067}{\sqrt{\tan\alpha}} \xi_{m-1,0} \cdot \exp\left(-4.75 \frac{R_C}{\xi_{m-1,0} \cdot H_{m0} \cdot \gamma_\beta}\right) \quad (2.1)$$

with a maximum of: $$\frac{q}{\sqrt{g \cdot H_{m0}^3}} = 0.2 \cdot \exp\left(-2.6 \frac{R_C}{H_{m0} \cdot \gamma_\beta}\right) \quad (2.2)$$

See the Overtopping Manual (2007) for explanation of parameters and the full equation, including surface roughness, berms, etc. Equations 2.1 and 2.2 give straight lines in a log-linear graph, where the coefficients -4.75 and -2.6 give the inclination of the slope and the coefficients 0.067 and 0.2 give the crossing with the x-axis.

Analysis of the tests should focus on comparison with equations 2.1 and 2.2.

The Overtopping Manual (2007) describes the influence of angle of wave attack by the reduction factor γ_β. This influence, however, has only been described for short-crested waves (as present in reality) and not for long-crested waves. The present investigation has been performed with long-crested waves. Van der Meer and De Waal (1993) give the following formula for long-crested waves:

$\gamma_\beta = \cos^2(\beta - 10°)$ with minimum 0.6 (2.3)

The equation itself was established in a different way than the procedure used for Flowdike analysis. Moreover, test results with a 1:6 slope have become available from tests in Canada, see Oumeraci et al. (2001), in this report referenced as LWI 859. This latter work is important, as the present tests also describe a 1:6 slope. The influence of oblique wave attack on wave overtopping (for long-crested waves) was also for the LWI 859 project determined with a different procedure than for the present analysis.

Therefore, a re-analysis was performed on the data of Van der Meer and De Waal (1993) and LWI 859. To start with, the original graphs of both investigations are given here as Figures 2.1 and 2.2. In Figure 2.1 three structure geometries are present, a straight 1:4 slope, a slope 1:4 with a 0.6 m long berm at the still water level, and a straight 1:2.5 slope. Most tests were performed for the 1:4 slope.

In Figure 2.1 the measured wave overtopping was compared with an overtopping equation, not with the found wave overtopping for perpendicular wave attack. This is the reason why influence factors different from 1.0 are found for perpendicular wave attack. The graph shows that in average the 1:4 slope has a factor of 1 for β = 0° and is situated around the curve (equation 2.1). The 1:4 slope with berm is constantly a little lower and the 1:2.5 slope a little higher. But all three slopes follow the trend given by Equation 2.1. It is also clear that beyond 60° there is no further reduction.

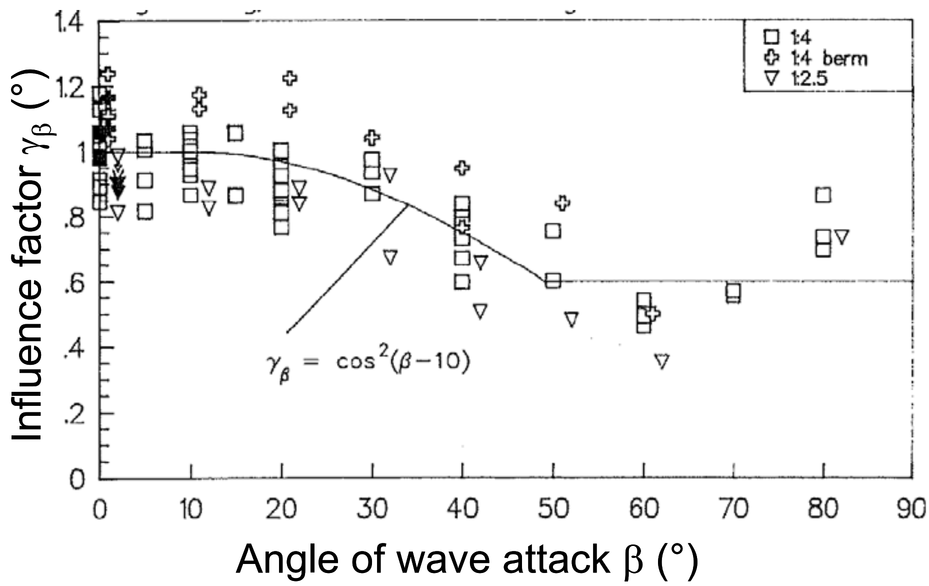


Figure 2.1. Original graph of Van der Meer and De Waal (1993).

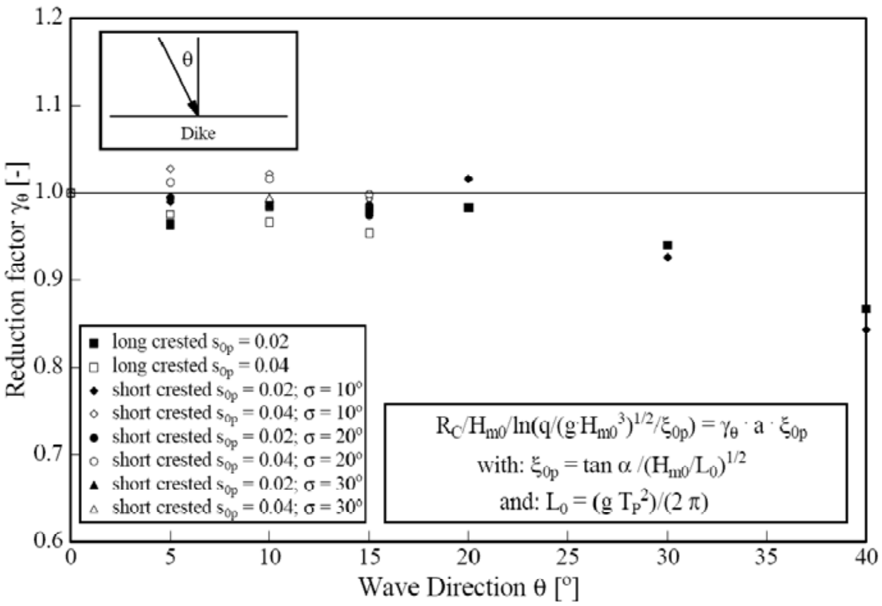


Figure 2.2. Original graph in LWI 859 for a 1: 6 dike.

Long-crested waves in Figure 2.2 (the squares) show most reduction beyond 20° and the reduction for 40° becomes 0.87. This is slightly larger than in Figure 2.1.

Both original data sets have been re-analysed in a similar way as reduction factors were derived in the Overtopping Manual (2007) and this procedure has been described in the overall Flowdike report in section 8.2. Figure 2.3 gives all results of LWI 859 in the usual wave overtopping graph with the following parameter groups for the horizontal and vertical axis:

Breaking waves:
x-axis: $R_c/(H_{m0}\ \xi_{m-1,0})$ y-axis: $q/(gH_{m0}^3)^{0.5}\ (s_{m-1,0}/\tan\alpha)^{0.5}$

Non-breaking waves:
x-axis: R_c/H_{m0} y-axis: $q/(gH_{m0}^3)^{0.5}$

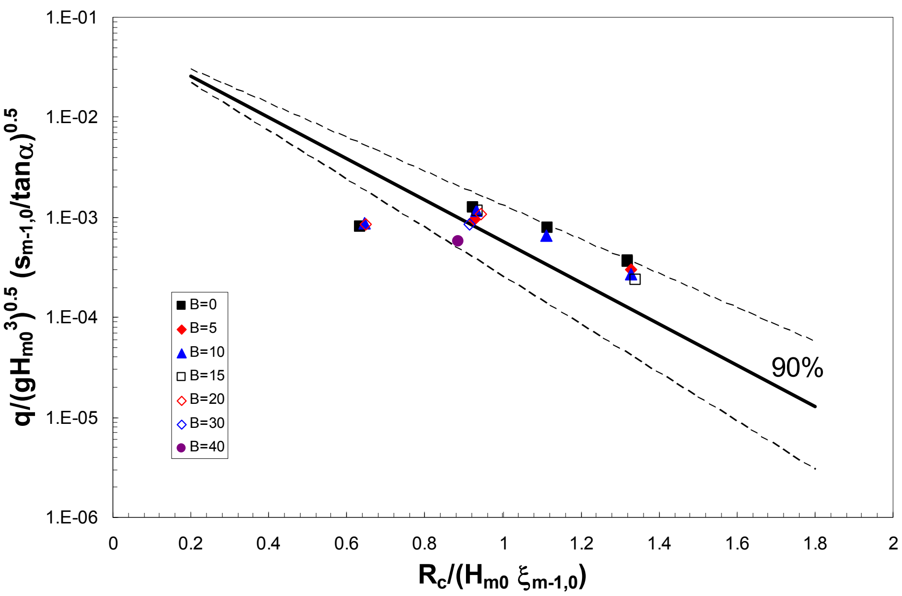


Figure 2.3. Data of LWI 958 for long-crested waves.

For a 1:6 slope only breaking wave conditions are present, which means that non-breaking conditions do not have to be considered. The 90%-confidence interval is also given in Figure 2.1.

Three remarks can be made on basis of Figure 2.3. First of all most data for perpendicular wave attack give a little larger wave overtopping (they are above the line). But the data is within the 90%-confidence interval. Secondly, the data points most to the left are well below the curve, even below the 90% line. These points are for a peak wave period of 2.5 s with a wave height of 0.11 m, i.e. very long waves. The data for this wave period are consistent, however, as the points for 0°, 20° and 40° are very close to each other. The main reason for the deviation from other points is that the peak period in this case with very low wave steepness may not be the correct parameter. It is well possible that a $T_{m-1,0}$ would give results more in line.

The third remark is that data points for each wave period are all close to each other and that in general a larger angle of wave attack gives smaller wave overtopping.

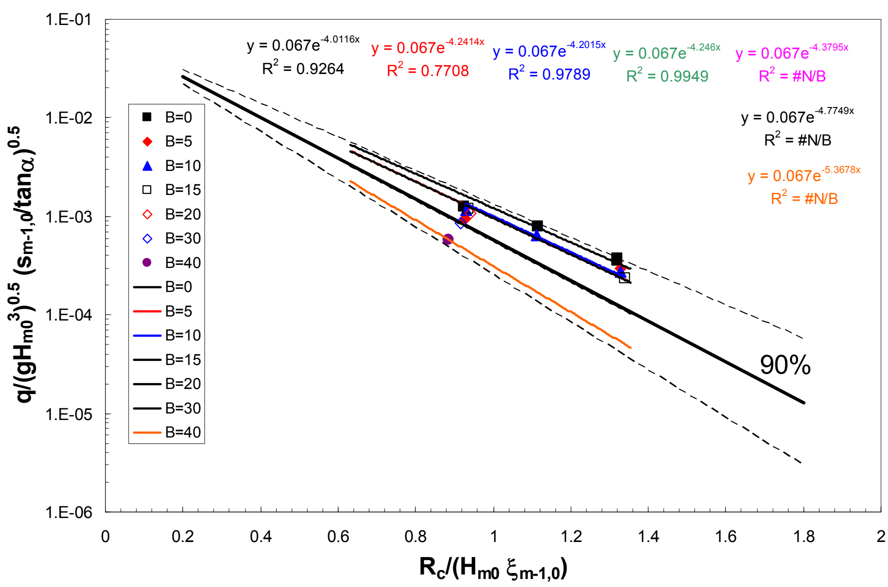


Figure 2.4. LWI 958 data with fitted curves for each test series.

As the large period of 2.5 s falls out of the expected line and not all angles of wave attack were tested with this period, these data points are left out for further analysis. Figure 2.4 gives the resulting data again, but now with the fitted equation to get the right b-factor and eventually, the influence factor γ_β for each test series.

An average trend for a specific data set is found by application of a “trend line” in Excel. Various options are possible for a trend line. Here the exponential function has been chosen, as formulae 2.1 and 2.2 are this type of function. The best fit has been chosen with a fixed crossing with the y-axis. This fixed point is the same as in formula 2.1: 0.067. Fit equations with regression have been given in the Figure 2.4. The resulting influence factors are shown in Table 2.1.

β degr.	b-breaking	γ_β
0	4.012	1.000
5	4.241	0.946
10	4.202	0.955
15	4.246	0.945
20	4.380	0.916
30	4.775	0.840
40	5.368	0.747

Table 2.1. Influence factors for LWI 958 for long-crested waves.

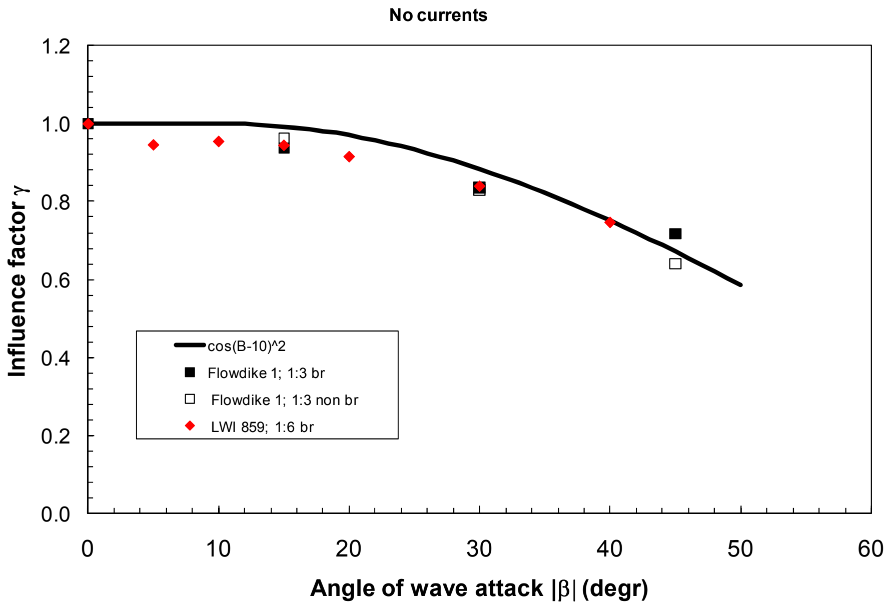


Figure 2.5. Influence factors for LWI 958 and Flowdike 1

Figure 2.5 gives the results together with the Flowdike 1 data for a 1:3 slope and with Equation 2.3. There is an almost perfect match between the LWI 958 data and the Flowdike 1 data, which both validate Equation 2.3.

Data of Van der Meer and De Waal (1993) will be referred to as H638. Figure 2.6 gives the data for perpendicular wave attack for the 1:4 straight slope. The points lay well around the curve with Equation 2.1 and the fitting with the fixed 0.067 y-value gives a b-value of 4.75, which is exactly the same as in Equation 2.1! A fit with two free parameters gives slightly different values, but the curves still are very close. It can be concluded that the data for this slope match very well with prediction formulae.

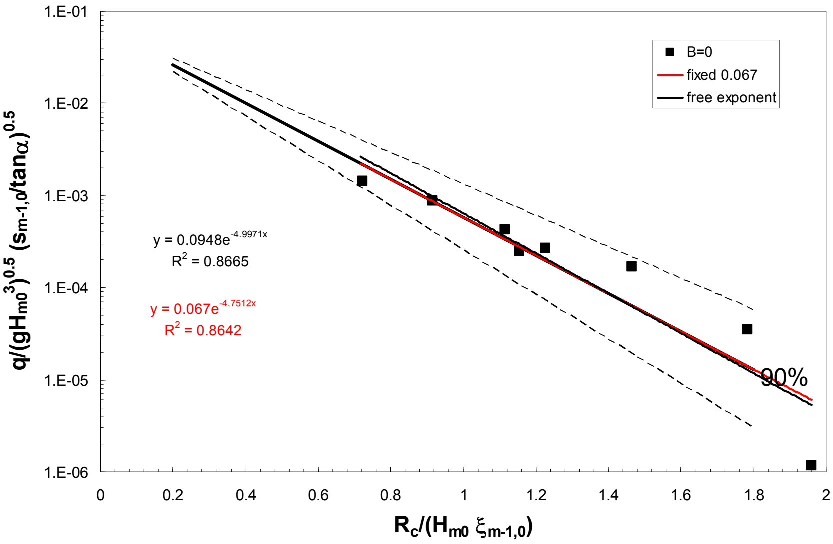


Figure 2.6. Data of H638 for perpendicular and long-crested wave attack; slope 1:4. Breaking wave conditions.

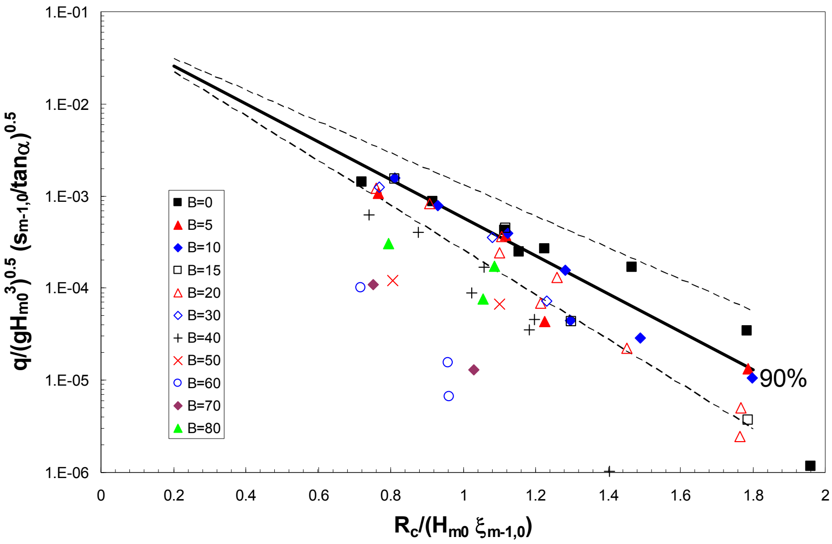


Figure 2.7. All data for H638 1:4 for long-crested waves. Breaking conditions.

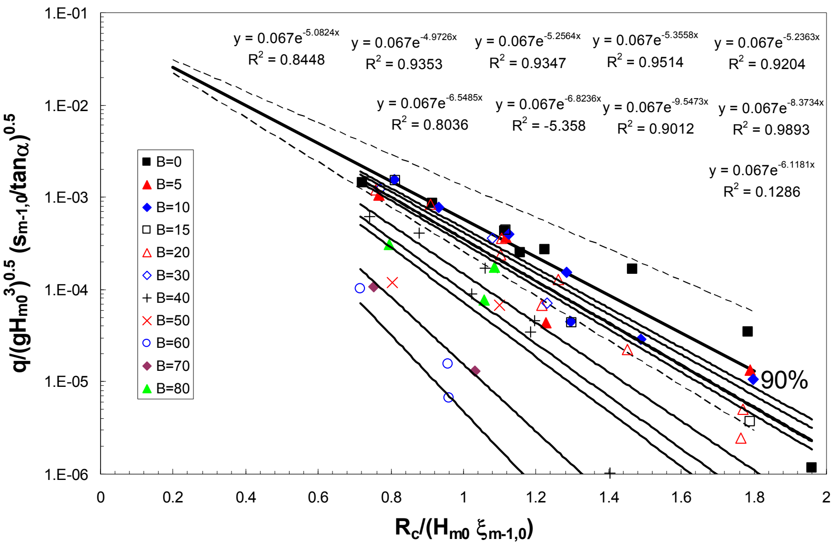


Figure 2.8. All data for H638 1:4 for long-crested waves with curve fitting.

Figure 2.7 shows all data for the 1:4 slope and for breaking conditions. In general wave overtopping becomes smaller for oblique wave attack and small angles of attack are close to perpendicular attack. Figure 2.8 is similar to Figure 2.7, but now the fitted curves are shown, together with fitted equations.

Long wave periods give non-breaking wave conditions for a slope 1:4. These data are shown Figure 2.9 for this 1:4 slope. Perpendicular wave attack is well around the line (Equation 2.2), but for oblique wave attack the reduction seems considerable, certainly for 10° and 20°. Figure 2.10 is similar to 2.9, but now includes the curve fitting with a fixed y-value at 0.2 (see Equation 2.2).

Figure 2.11 shows the data for perpendicular waves of H638, for a 1:4 slope with a 0.6 m berm at the still water level. Of course the data are lower than for the 1:4 slope, which is the influence of the berm. The curve fitting gives a b-value of 7.00 and this value is used as base reference.

Figure 2.12 gives all data for the 1:4 slope with a berm. Figure 2.13 gives the same data as in Figure 2.12, but now with the curve fitting. The data points for 10° and 20° are even a little higher than the average trend for perpendicular wave attack. Figure 2.13 gives the same data as in Figure 2.12, but now with the curve fitting. All b-values and γ_β-values are given in Table 2.2.

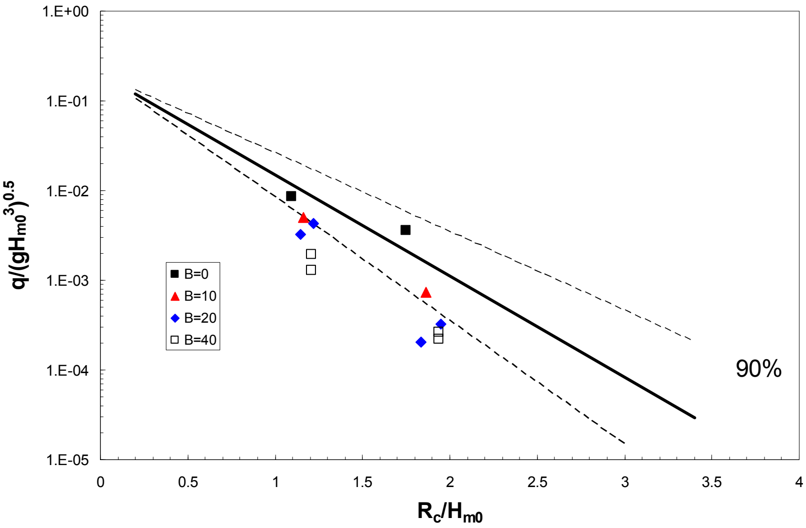


Figure 2.9. Data for H638, 1:4 long-crested waves; non-breaking wave conditions.

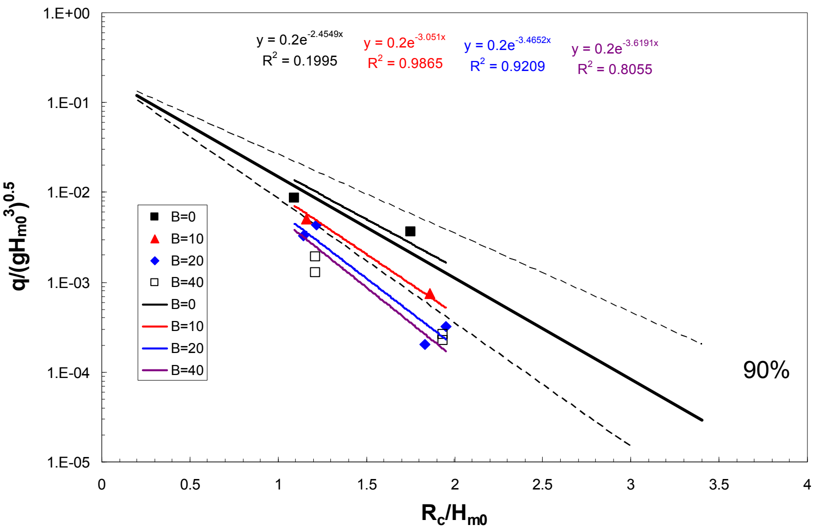


Figure 2.10. Data for H638, 1:4 long-crested waves with curve fitting; non-breaking wave conditions.

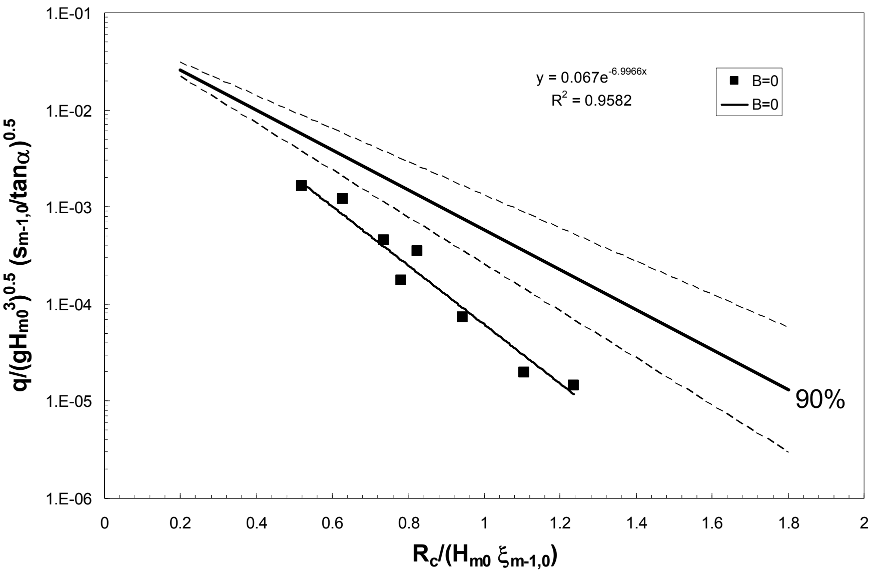


Figure 2.11. Data for H638, 1:4 slope with a berm; perpendicular waves.

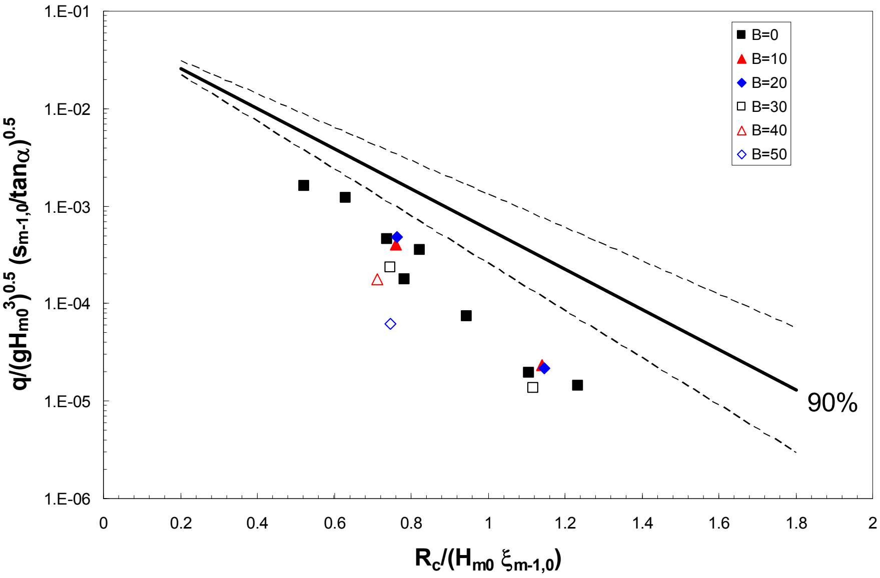


Figure 2.12. Data for H638, 1:4 slope with a berm.

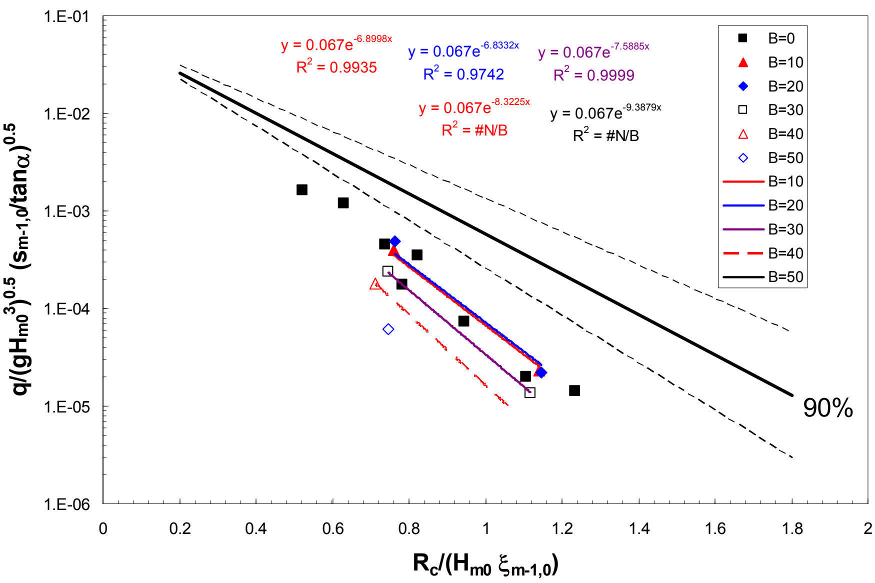


Figure 2.13. Data for H638, 1:4 slope with a berm and curve fitting.

H638 1:4 breaking			H628 1:4 non-breaking			H638 1:4+berm breaking		
β degr.	b-breaking	γ_β	β degr.	b-breaking	γ_β	β degr.	b-breaking	γ_β
0	4.751	1.000	0	2.455	1.000	0	7.000	1.000
5	5.082	0.935	10	3.051	0.805	10	6.900	1.014
10	4.973	0.955	20	3.465	0.709	20	6.833	1.024
15	5.256	0.904	40	3.619	0.678	30	7.589	0.922
20	5.356	0.887				40	8.323	0.841
30	5.236	0.907				50	9.388	0.746
40	6.590	0.721						
50	6.824	0.696						
60	9.547	0.498						
70	8.373	0.567						
80	6.118	0.777						

Table 2.2. Influence factors for H638 for long-crested waves.

Measurements are available for a 1:2.5 slope. There is only one point available for each wave direction, in the breaking or non-breaking conditions, for curve fitting, as the number of tests was limited. This makes it not reliable enough to include the data.

Figure 2.14 shows the influence factors for the Flowdike 1 measurements and LWI 958 data, as in Figure 2.5, but now the data of the 1:4 slope of H638, for breaking waves, has been added. Also the range in angle of wave attack has been increased as angles up to 80° were tested. Just like all the other tests, points for small angles of wave attack are a little below the line, but more or less similar between 5° and 15°. The main reason is that often there are more data points for perpendicular wave attack than for oblique wave attack. The curve fitting, by accident, may give a little higher line for perpendicular wave attack, resulting in a direct decrease of influence factor. The trend in Figure 2.14 is similar to the given curve: first more or less horizontal and then decreasing. The graph also shows that for angles of wave attack larger than 60° there might be more or less a horizontal line. This is the reason why Equation 2.3 has a minimum of 0.6.

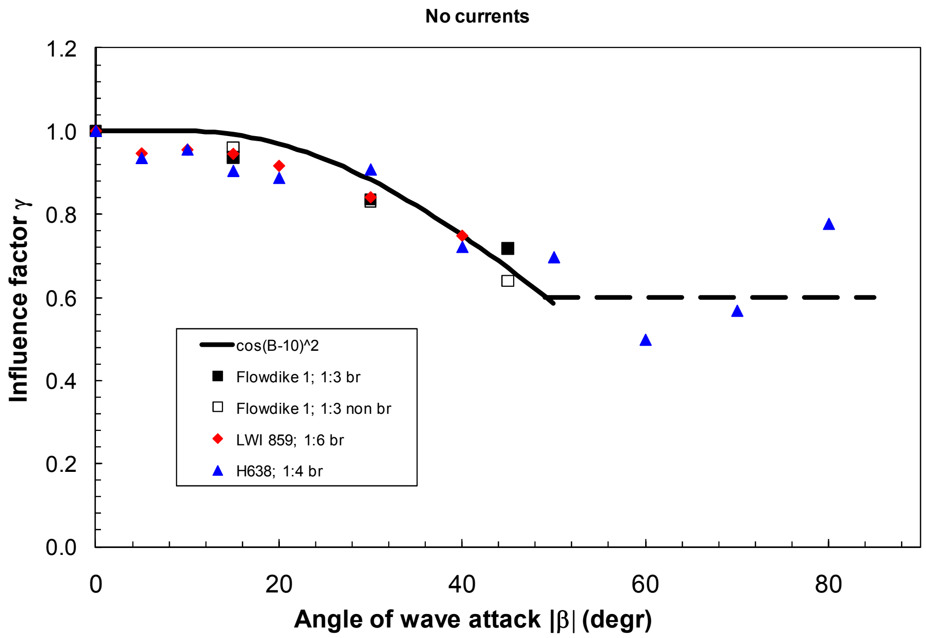


Figure 2.14. Influence factors for Flowdike 1, LWI 958 and the 1:4 slope with breaking conditions of H638.

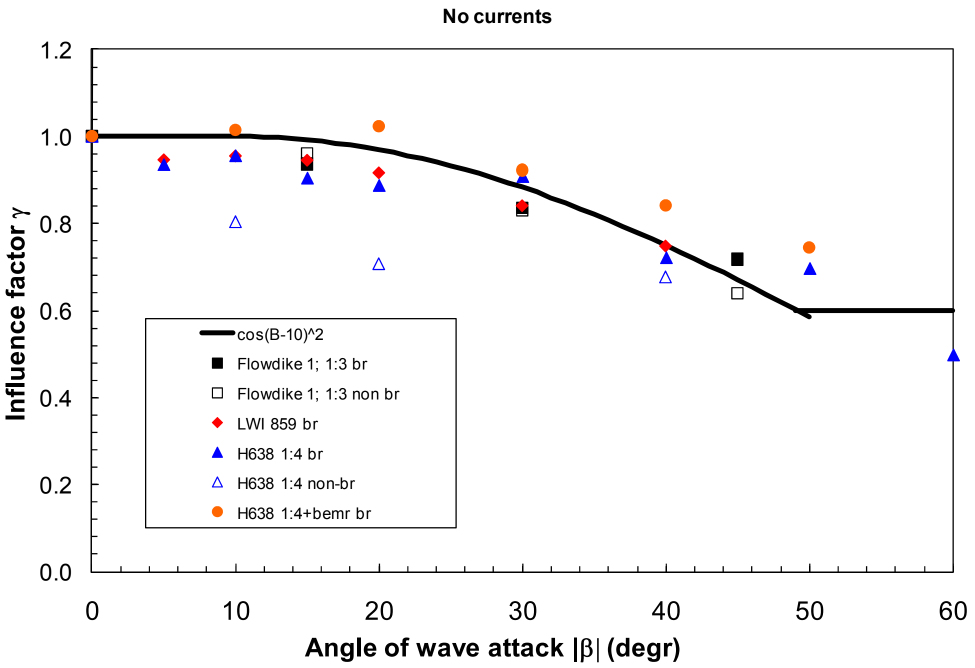


Figure 2.15. Influence factors for all data; long-crested waves.

Finally, Figure 2.15 gives all data. The non-breaking data of the 1:4 slope are indeed very low for 10° and 20°, as noted earlier, but are in line with the other data for 40°. The 1:4 slope with a berm are a little above the line, also for small angles of wave attack.

Overall, it can be concluded that the trend given by Equation 2.3 describes nicely the trend for the other data, all from three different independent sources. It must be noted that the H638 data were of course the basis to establish Equation 2.3, but the Flowdike 1 data and LWI 958 data validate the equation. Equation 2.3 can indeed be used to describe the influence of oblique waves for long-crested waves and can be used in further analysis of Flowdike measurements with current.

3 Analysis on perpendicular wave attack without current

3.1 Flowdike 1, slope 1:3

Formula 2.1 gives breaking waves on a structure and formula 2.2 gives non-breaking or surging waves. First the test results are divided into breaking and non-breaking waves. This is done by calculating the overtopping discharge q for both formulae 2.1 and 2.2, for the given test conditions. The smallest of the two results gives the right condition, breaking or not. Then the dimensionless overtopping discharge is calculated for the right condition.

Figures 3.1 and 3.2 give the results for breaking and non-breaking waves, for the condition with perpendicular wave attack ($\beta = 0°$) and no currents ($u = 0$ m/s). In this analysis the overtopping discharge of each overtopping box is taken and the discharges of the two boxes are not averaged. In the figures it gives a good idea of the scatter or reliability of measuring wave overtopping. Furthermore, wave gauges 5-9 were taken to give the wave heights for the 0.70 m crest and gauges 10-14 for the 0.60 m crest height.

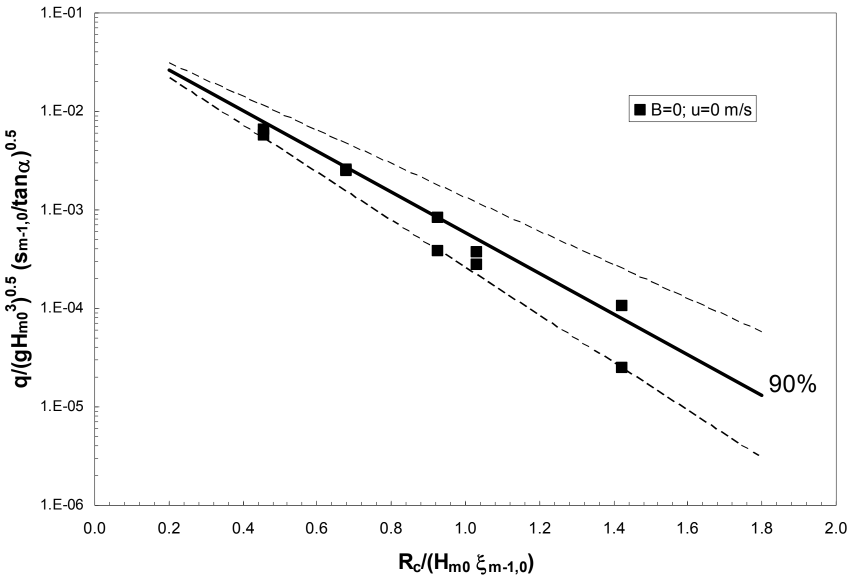


Figure 3.1. Overtopping for perpendicular waves; no currents; breaking waves

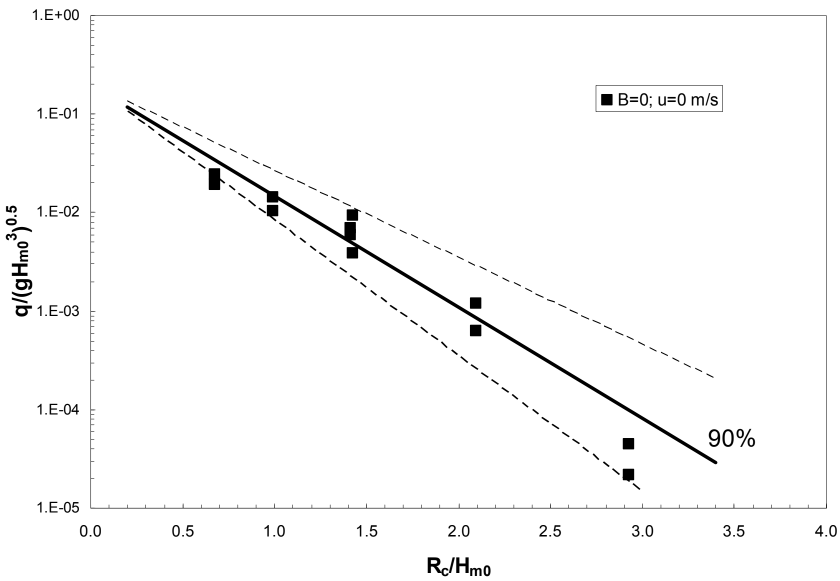


Figure 3.2. Overtopping for perpendicular waves; no currents; non-breaking waves

Both graphs give the test results together with formulae 2.1 and 2.2 and with the 90% confidence interval as given in the Overtopping Manual (2007). Note that the y-axis in both graphs has 5 decades in order to make the results visually comparable. The results fall very well within the 90% confidence interval and the average trend is followed. Only a few points deviate from the average trend and most of them fall below this trend. It means that the actual results in average are slightly lower than predicted by formulae 2.1 and 2.2. Note that in legends of figures B is used for angle β.

The first conclusion is that these formulae are validated well by the present results. As the average trend seems to be a little lower, this trend should be determined as in the following analysis the actual test results should be compared with each other.

An average trend for a specific data set is found by application of a "trend line" in Excel. Various options are possible for a trend line. Here the exponential function has been chosen, as formulae 2.1 and 2.2 are this type of function. At first instance the best fit has been chosen and secondly a fit with a fixed crossing with the y-axis. This fixed point is the same as in formulae 2.1 and 2.2, respectively 0.067 and 0.2. Figures 3.3 and 3.4 give the results. Fitted equations have been given in the graphs.

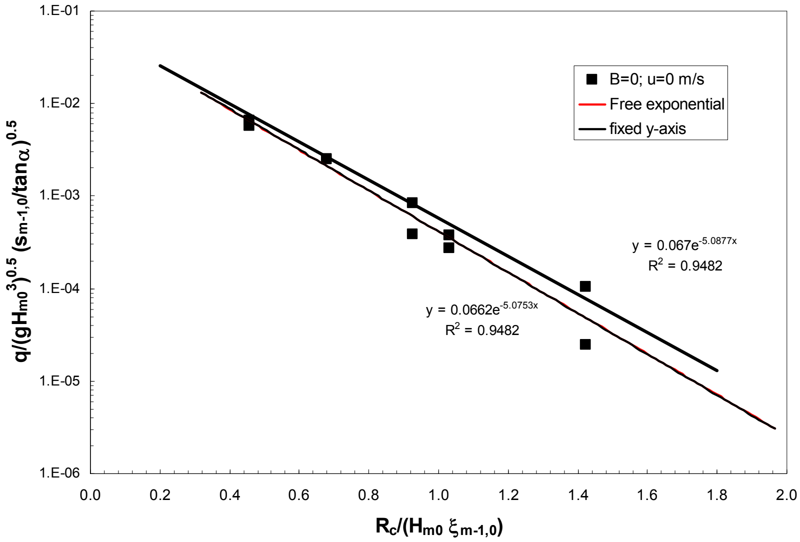


Figure 3.3. Overtopping for perpendicular waves; no currents; breaking waves; trend lines

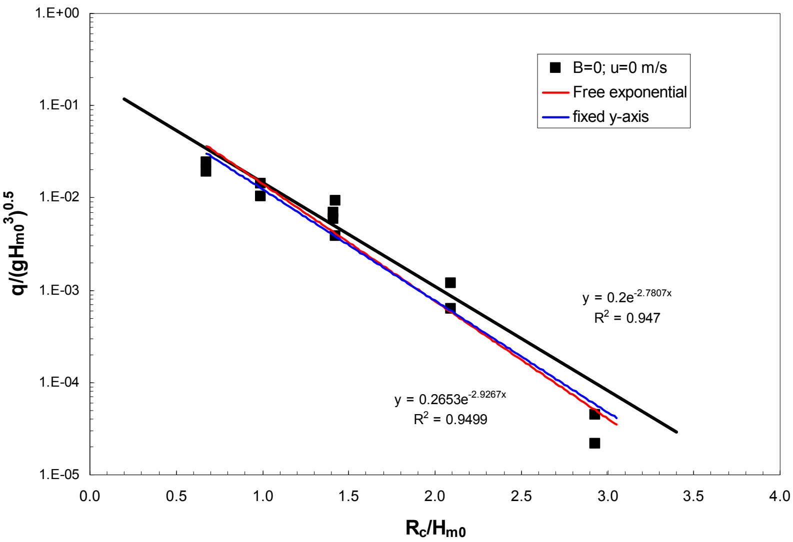


Figure 3.4. Overtopping for perpendicular waves; no currents; non-breaking waves; trend lines

In Figure 3.3 the two trend lines are similar. It means that the crossing with the y-axis remains 0.067. The slope of the line, b, becomes -5.09 in stead of -4.75 (in formulae 2.1). Figure 3.4 gives very small deviations for the two trend lines and also here the crossing with the y-axis can remain at 0.2. The slope of the line becomes b = -2.78 instead of -2.6. It are these slope coefficients that will be used to determine the influence of oblique wave attack and later of currents.

3.2 Flowdike 2, slope 1:6

There are more tests for perpendicular wave attack without flow than first anticipated as testing started with a water depth of 0.5 m, giving only overtopping for the lowest crest and most severe conditions. Later the water depth was increased to 0.55 m and earlier performed test series with the lower water level were repeated with the new level.

Figure 3.5 shows the results for perpendicular wave attack without current. The original LWI 958 data have been included, as this was also for a 1:6 slope. Moreover the Equation 2.1 has been given too, together with the 90% confidence interval. It should be noted that the straight bold line is not a fit on the data, but a prediction!

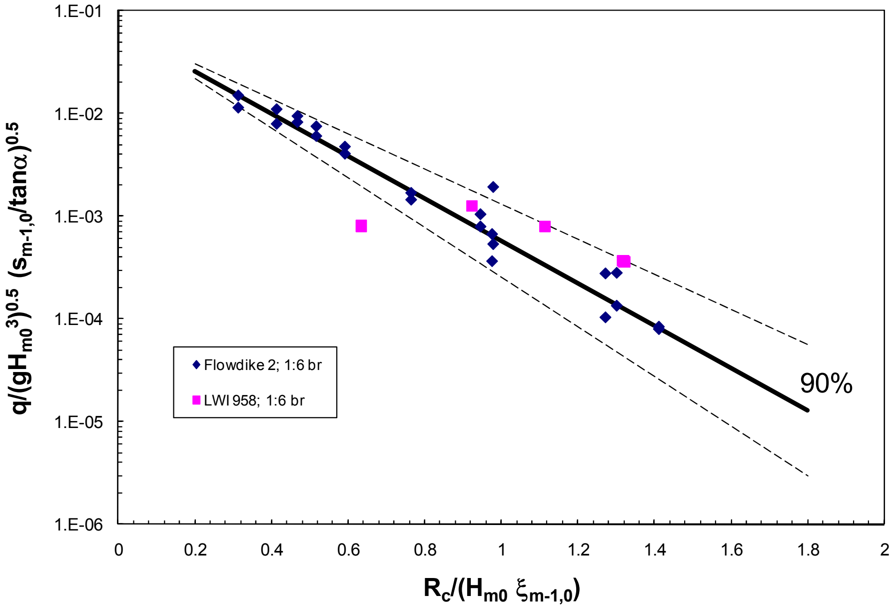


Figure 3.5. Wave overtopping for Flowdike 2 compared with LWI 958 and predictions

It is clear that the data perfectly match the prediction. An exponential fit through the data with a fixed point on the y-axis of 0.067 (see Equation 2.1) gives a b-coefficient of 4.66, where Equation 2.1 gives 4.75.

4 Analysis on oblique wave attack without current

4.1 Flowdike 1, slope 1:3

All test results for oblique wave attack, but without currents, have been given in graphs for breaking and non-breaking waves and the trend lines have been determined for each angle of wave attack. Figures 4.1 and 4.2 give the results. The bold line gives respectively formula 2.1 or 2.2.

For both graphs there is a nice trend that increase of obliqueness results in a reduction of overtopping. The reduction increases for the larger angles of wave attack, ie there is a larger reduction between 30° and 45° than between 0° and 15°.

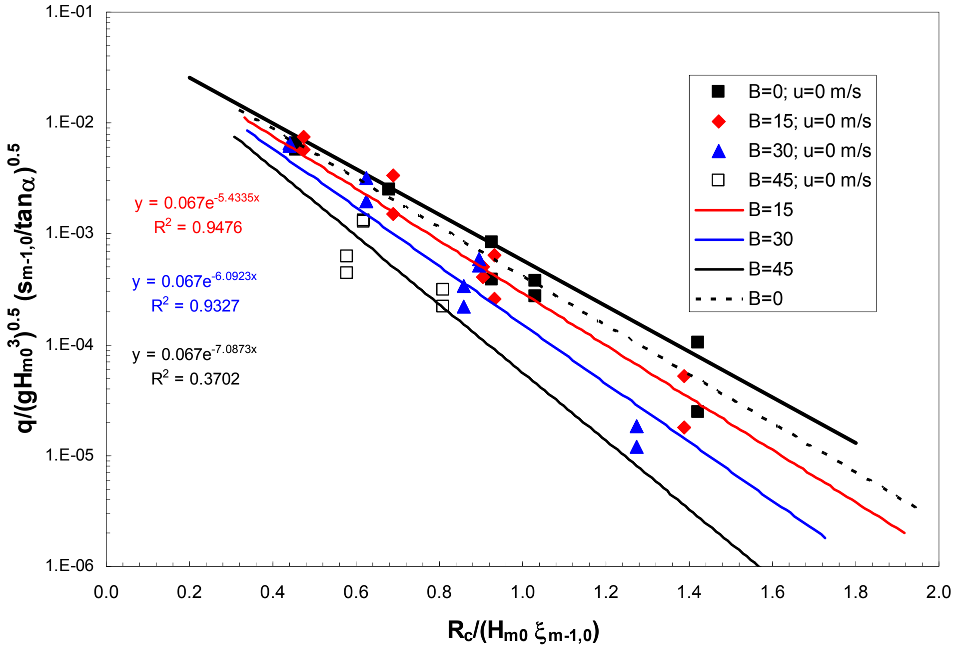


Figure 4.1. Overtopping for oblique waves; no currents; breaking waves; trend lines

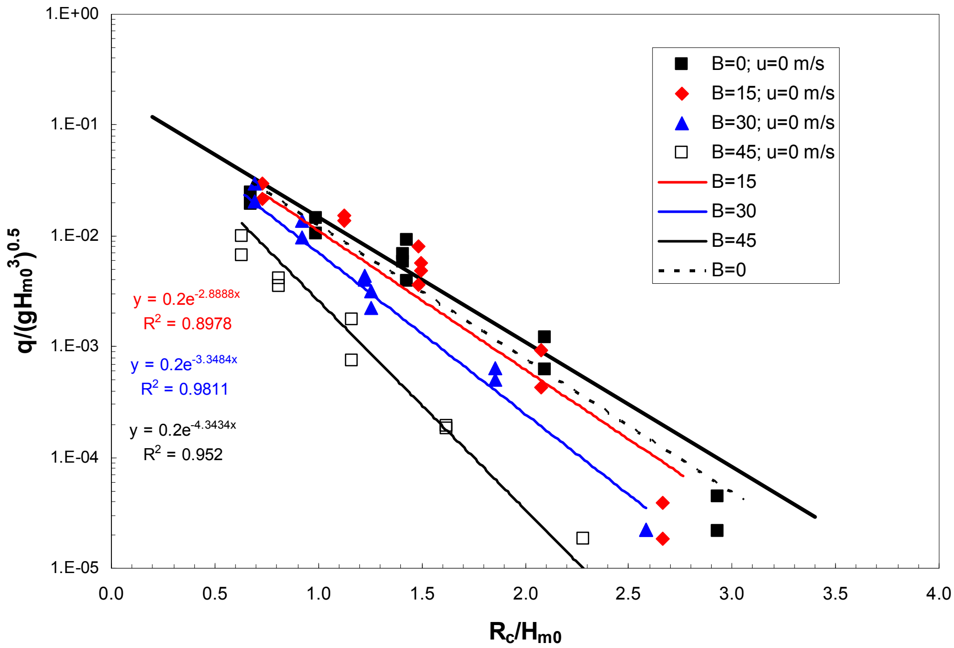


Figure 4.2. Overtopping for oblique waves; no currents; non-breaking waves; trend lines

The trend lines of the sets of tests can be used to determine the reduction factor. This reduction factor is defined by dividing the slope coefficient for perpendicular wave attack (b = 5.09 or 2.78) by the slope coefficient for the considered angle of wave attack. For example the slope coefficient for β = 30° for breaking waves is b = 6.09 and gives a reduction factor of γ_β = 5.09/6.09 = 0.836. All slope coefficients and reduction factors have been given in Table 4.1.

β	u	b-breaking	γ-br	b-non-br	γ-non br
degr.	m/s		g-br u=0 m/s		g-non br u=0 m/s
0	0.00	5.09	1.000	2.78	1.000
15	0.00	5.43	0.937	2.89	0.962
30	0.00	6.09	0.836	3.35	0.830
45	0.00	7.09	0.718	4.34	0.641

Table 4.1 Slope coefficients and reduction factors for tests without current.

Figure 4.3 gives the reduction factors as function of the angle of wave attack, together with formula 2.3. The scatter between breaking and non-breaking waves is small and formula 2.3 gives a nice prediction of the results. It can be concluded that the present results have validated the prediction formula.

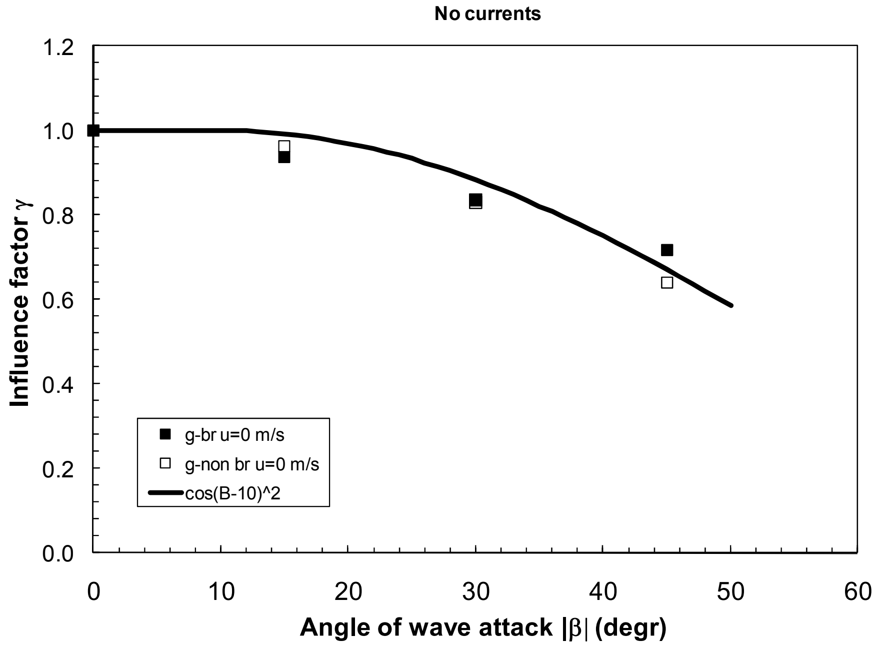


Figure 4.3 Influence of angle of wave attack on wave overtopping, together with theory, no current

4.2 Flowdike 2, slope 1:6

Tests have been performed with 0°; 15° 30° and 45°, without current. The results on overtopping are shown in Figure 4.4. The trend seems present that wave overtopping decreases with increasing angle of wave attack.

In order to establish the influence of angle of wave attack on wave overtopping, exponential trends were fitted to the data with a fixed point on the y-axis of 0.067, as in Equation 2.1. Figure 4.5 gives the fitted curves with the b-coefficients. These coefficients have been summarized in Table 4.2 and finally shown in a graph in Figure 4.6. The data are very similar to those from LWI 958 and validate the prediction by Equation 2.1. Due to this validation it can be concluded that Equation 2.1 can very well be used to study the influence of current on wave overtopping.

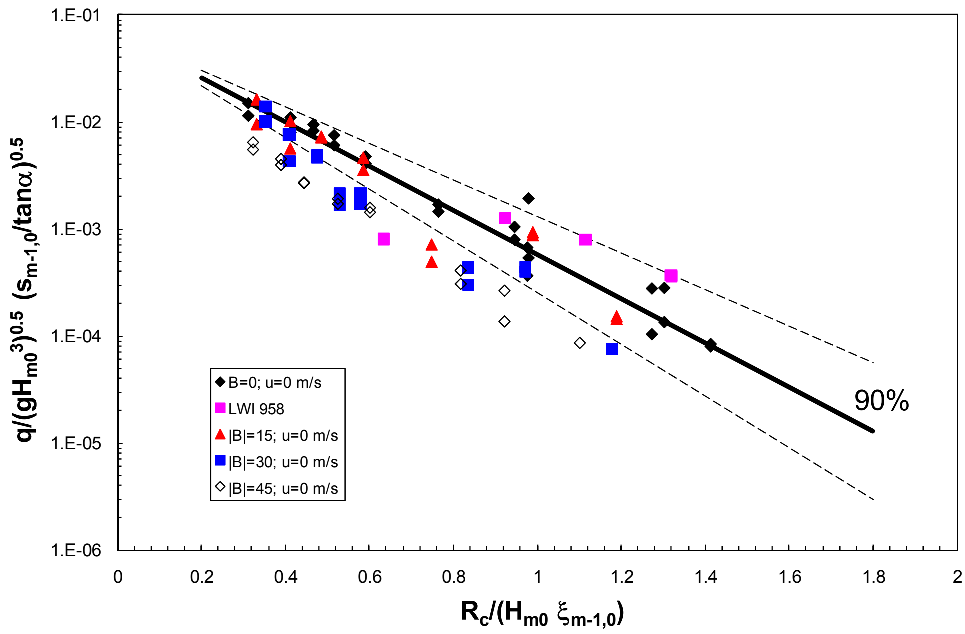


Figure 4.4. Data with oblique wave attack, without current.

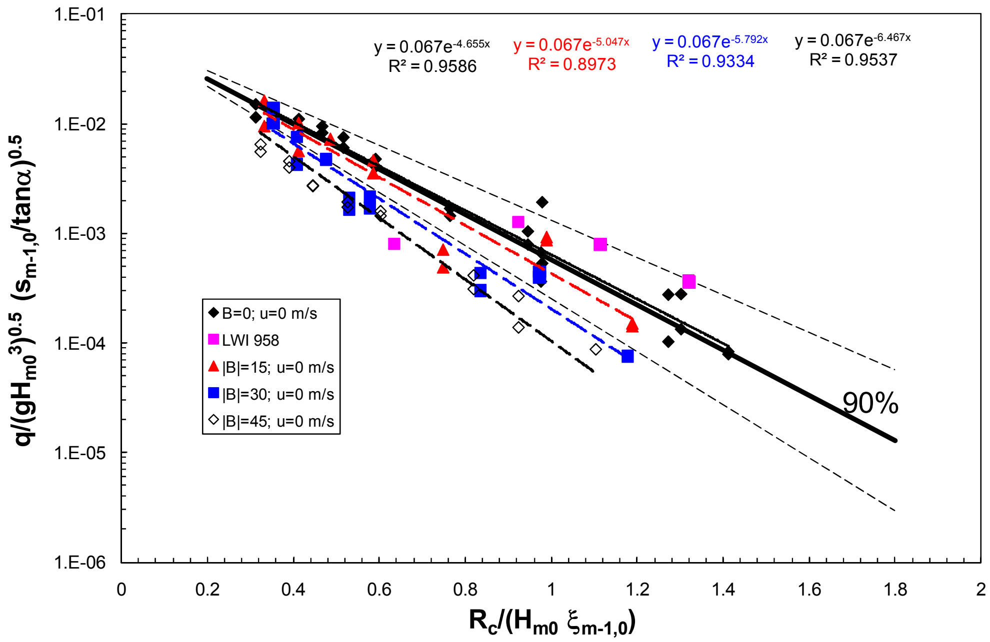


Figure 4.4. Data for oblique wave attack with fitted trends.

β degr.	b-breaking	γ_β
0	4.655	1.000
15	5.047	0.922
30	5.792	0.804
45	6.467	0.720

Table 4.2. Influence factors for oblique wave attack, without current.

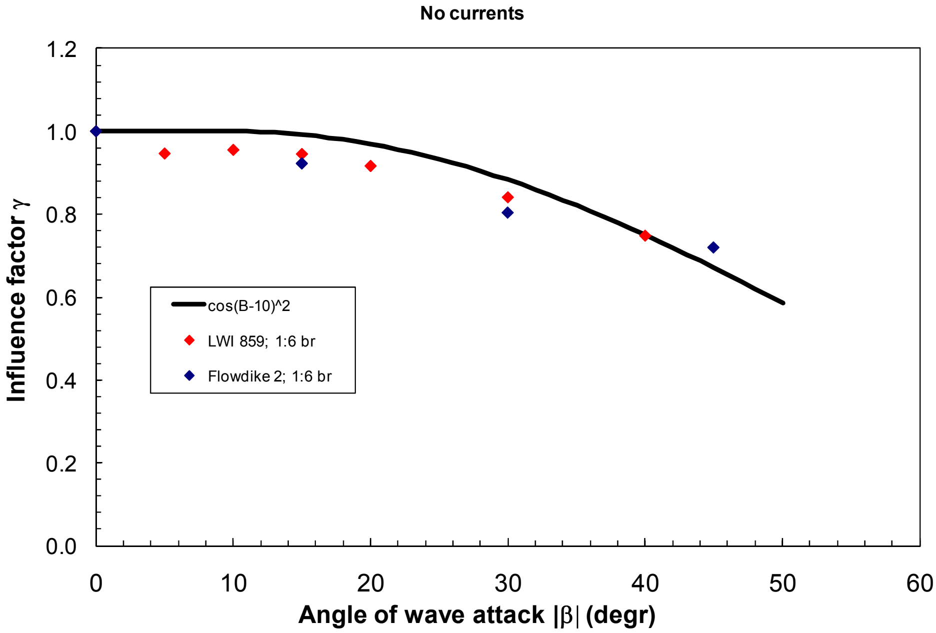


Figure 4.5. Influence factor for oblique wave attack without current

5 Analysis on perpendicular and oblique wave attack with current. Flowdike 1, slope 1:3

The tests on perpendicular and oblique wave attack without currents, as described and analysed above, were mainly performed to validate existing theory and give the basis to analyse the influence of currents on wave overtopping.

The effect of currents on waves is mainly three-fold:

- the wave height changes;
- absolute and relative wave periods differ;
- the angle of wave attack (measured perpendicular to the crest) becomes different from the angle of wave energy.

The wave height near the toe of the slope has been measured, which means that any change of wave height has already occurred and is part of the measurements. Besides that the wave height may change due to currents, it is also possible that wave generation by wind may be different with and without currents. Such an effect is of course not present in the test set-up. The wave heights measured are the waves that cause the wave overtopping and are taken as they have been measured.

The *relative* wave period, measured going along with the current, will be different from the *absolute* wave period. This is the wave period measured in a fixed point, like with a wave gauge. As the wave period is part of formulae 2.1 and 2.2, in the breaker parameter $\xi_{m-1,0}$, this change in wave period may have influence on wave overtopping. In summary, a wave direction against a current gives a shorter relative wave period and a direction along with the currents gives a longer one. The current will change the wave energy direction and is called wave-current refraction. The wave energy direction will change in the direction of the current.

Holthuijsen (2007) describes the wave propagation in an area with constant depth and constant current short and simple (section 7.3.5):

quote

> The first phenomenon (the change in amplitude) has several causes: energy bunching (as in shoaling), current-induced refraction and transfer of energy between wave and current. The second phenomenon (the change in frequency) is closely related to the well-known Doppler effect. The third phenomenon (the change in direction) is refraction, induced by current-related changes in propagation speed. all these phenomena are due to the bodily transport of the wave by the ambient current with a varying speed (horizontally and in time).
>
> If the harmonic wave propagates in an area with *constant* depth across a *constant* ambient current (constant in space and time), the linear theory is still valid in its entirety in a frame of reference moving with the current (the wave doesn't "know" that it moves in an ambient current, it just moves with it as if in a water tank that is carried with the ambient current). In this case, all results of the linear wave theory can therefore be applied in a frame of reference moving with the current. The *frequency* of the wave in this moving frame of reference is called the *relative* or *intrinsic* frequency, denoted as σ, and the relationship with wave number and depth (the dispersion relationship) is retained:
>
> $\sigma^2 = g\,k\,\tanh(kd)$ (7.3.29) (5.1)
>
> In a *fixed* frame of reference (fixed to the stationary bottom), the fre-

quency of the wave is called the *absolute* frequency and denoted as ω (as observed, for instance, with a wave pole fixed to the bottom). It is related to the relative frequency (this follows directly from the bodily transport of the wave by the current) as

$\omega = \sigma + k\,U_n$ (7.3.30) (5.2)

where U_n is the component of the current in the wave direction (i.e., normal to the wave crest). The propagation velocity of the wave *energy* in this fixed frame of reference, i.e., relative to the bottom, $\vec{c}_{g,absolute}$, is obtained by adding as vectors the current velocity $\vec{U}$ to the group velocity to the current, $\vec{c}_{g,relative}$ (see Fig. 7.14):

$\vec{c}_{g,absolute} = \vec{c}_{g,relative} + \vec{U}$ (7.3.31) (5.3)

The direction of wave energy transport is therefore generally not normal to the wave crest in the presence of an ambient current (some energy propagates parallel to the wave crest)

In these circumstances, of a constant current in water with a constant depth, both the relative and the absolute frequencies are constant.

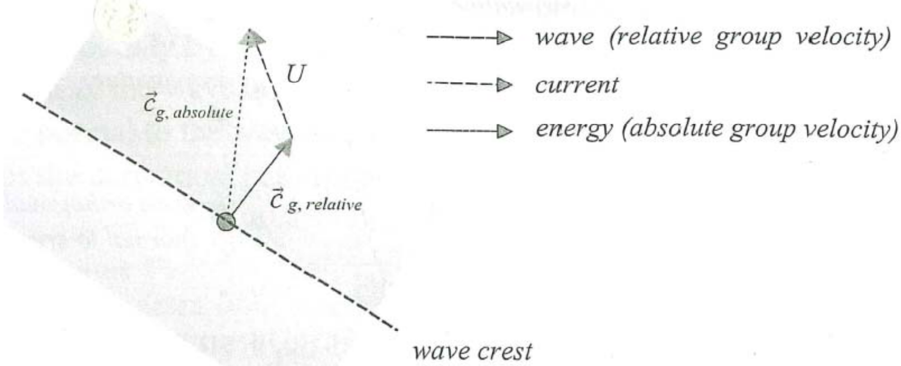


Figure 7.14 The energy propagation speed is the sum of the current vector and the vector of the group velocity (relative to the current). From Holthuijsen (2007).
unquote

In above quote of Holthuijsen (2007) equation numbers 5.1-5.3 have been added. These equations make it possible to calculate relative wave period and change in wave energy direction due to the current. The first analysis should be to calculate these changes and to apply the new wave directions and relative wave periods in the existing equations 2.1 -2.3 for wave overtopping.

Relative wave period, $T_{rel,\,m-1,0}$ and angle of energy β_e
Equation 5.1 substituted in Equation 5.2 yields:

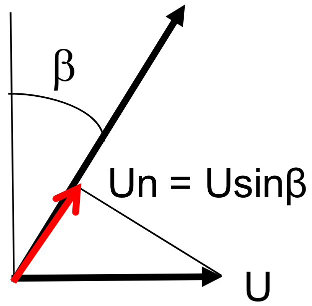
$\omega = (g\,k\,\tanh(kd))^{0.5} + k\,U_n$ (5.4)

The absolute frequency ω can be calculated with the measured $T_{m-1,0} = T_p/1.1$ from the test:

$\omega = 2\pi/T_{m-1,0}$ (5.5)

The current in the tests was along the dike and perpendicular wave attack was also perpendicular to the current. With oblique wave attack U_n can be calculated as (see Figure below):

$$U_n = U \sin\beta \quad (5.6)$$

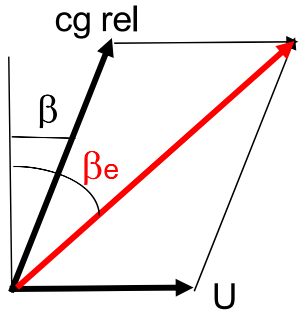


With ω and U_n as known variables, Equation 5.3 becomes an implicit function with k, which has to be solved by iteration. The solved k gives with Equation 5.1 directly the relative frequency σ and the relative period:

$$T_{rel,\,m,-1,0} = 2\pi/\sigma \quad (5.7)$$

The relative group velocity becomes:

$$c_{g,\,relative} = 0.5\sigma/k\ (1 + 2kd/\sinh(2kd)) \quad (5.8)$$



Vector summation shown above gives the required angle of energy (with respect to the normal of the dike, just like the angle of wave attack):

$$\beta_e = \arctan\{(c_{g,\,relative} \sin\beta + U)/(c_{g,\,relative} \cos\beta)\} \quad (5.9)$$

Find
The relative wave period $T_{rel,\,m-1,0}$ and the angle of wave energy β_e

Given
H_{m0} = 0.127 m; T_p = 2.05 s; β = 15° (along with the current); u = 0.30 m/s; water depth 0.5 m

Solution
ω = 3.37 (s^{-1}) - equation 5.5.
U_n = 0.0776 m/s - equation 5.6.
Iterative solving of equation 5.4 gives: k = 1.611 (m^{-1}).
σ = 3.246 s^{-1}

$T_{rel,\,m-1,0}$ = 1.94 s (equation 5.7) and $T_{rel,\,p}$ = 2.13 s.
$c_{g,\,relative}$ = 1.68 m/s - equation 5.8.

β_e = 24.3° - equation 5.9.

The relative peak period of 2.13 s is a little longer than the absolute peak period of 2.05 s. Also the angle of energy β_e = 24.3° is a little larger than the angle of wave atack β = 15°. This period and wave angle can be considered in the wave overtopping equations 2.1 – 2.3. By applying above theory, with changed wave directions and wave periods, it is possible that the influence of currents on wave overtopping will be described in a correct way. Analysis of the test data has to validate this.

At first instance, however, analysis will be performed without modifying wave direction and/or wave period, but just by comparing test results with results without current. Figure 5.1 gives for each test series with a fixed generated angle of wave attack the wave overtopping graphs (for breaking waves left and for non-breaking wave right). Each graph makes a distinction between no current, u = 0.15 m/s and u = 0.30 m/s. The graphs include the two vectors with the correct direction of wave generation and current. Note that a positive wave direction is a wave direction along with the current and a negative direction against the current.

The graphs also include the exponential curve fitting with a fixed point on the y-axis, similar to the procedure described for oblique wave attack without current (chapter 4). The obtained γ_β-values are given in Table 5.1 and they are compared with the results for no current in Figure 5.2. In general the trend is clear and scatter is not significantly large. But it is obvious that results for 0.15 m/s and 0.30 m/s are often consequently on one side of the results for no currents, see for instance the results for -30° and -45°. In those cases the wave overtopping increases if the current increases. Taking into account the influence of changed relative wave angle would shift these points to the right and more in line with the given curve. It seems that the change in wave direction has to be included.

It can be concluded that although the scatter is not significant, this way of analysis does not give theoretically correct results. But if further analysis will not improve the scatter, it might still be an option to consider no influence of currents on wave overtoping.

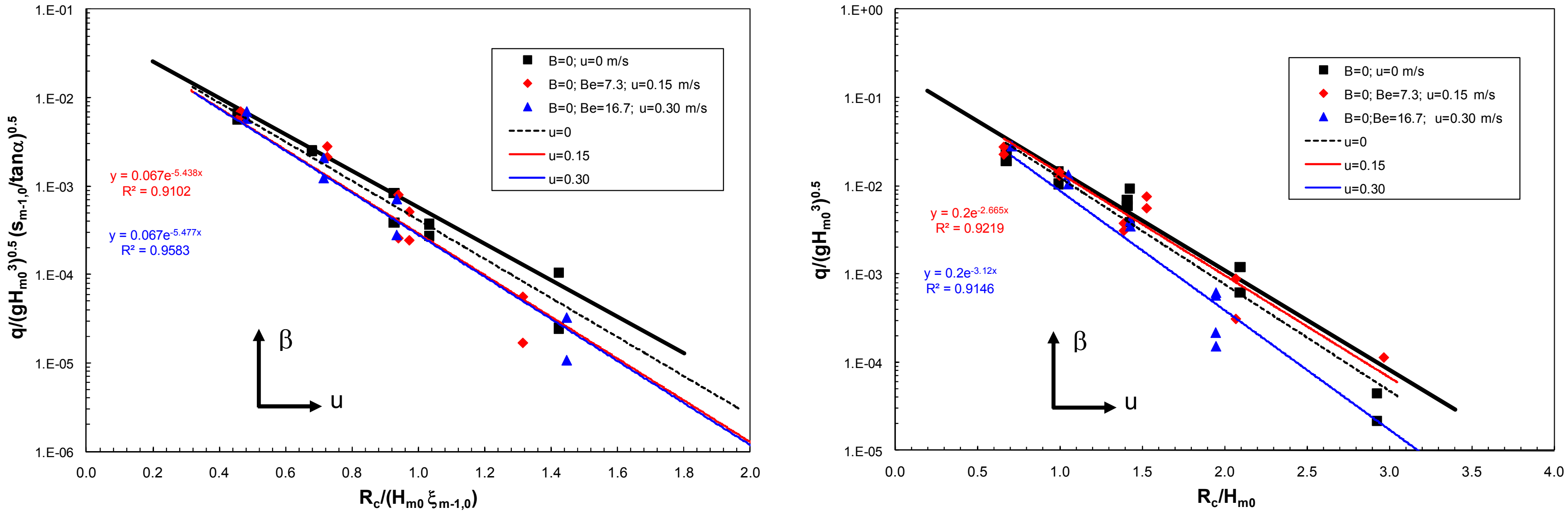


Figure 5.1a Direct comparison of results on currents with results without currents; β= 0°

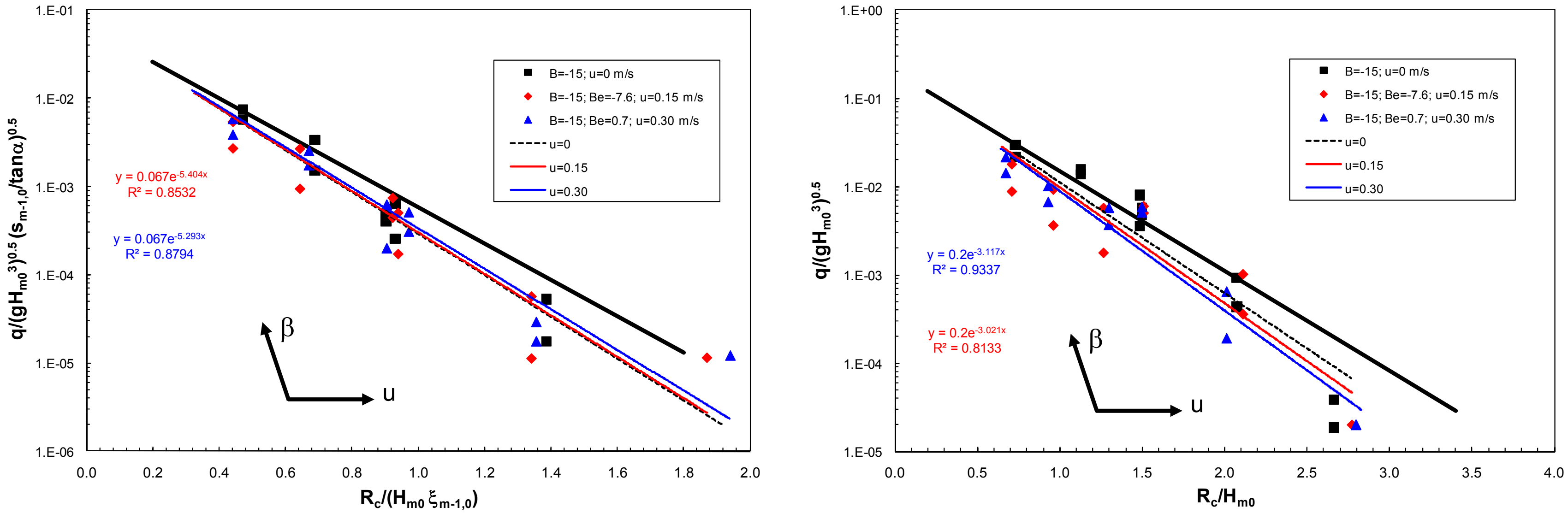


Figure 5.1b Direct comparison of results on currents with results without currents; β= -15°

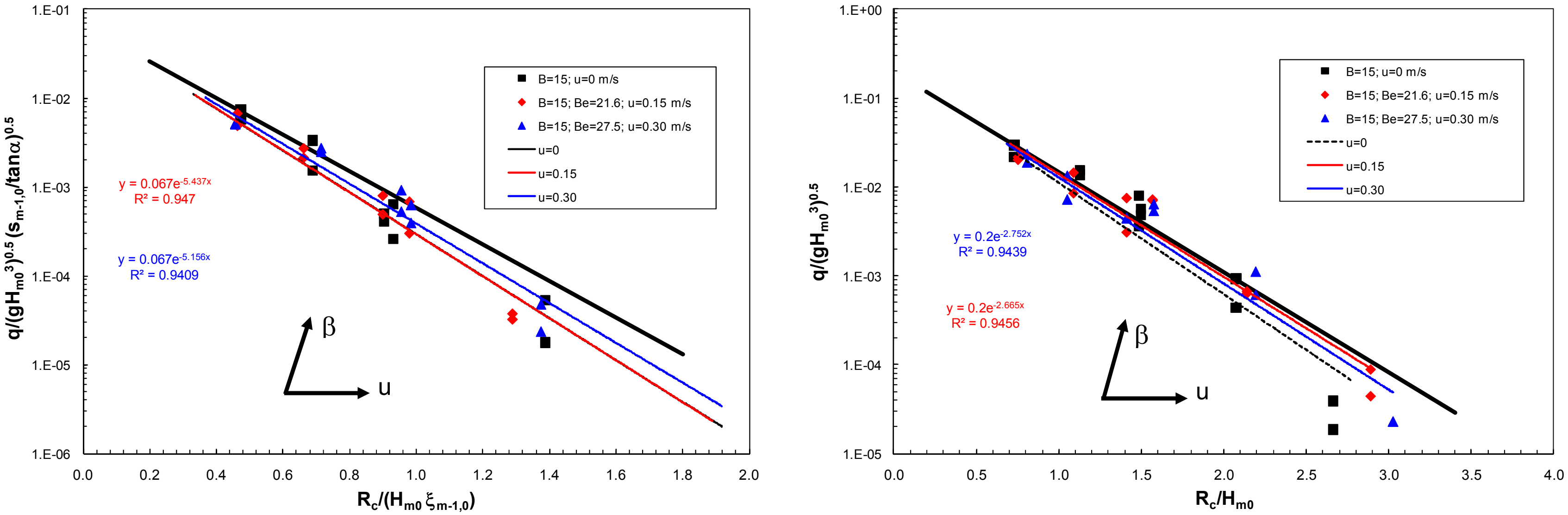


Figure 5.1c Direct comparison of results on currents with results without currents; β= 15°

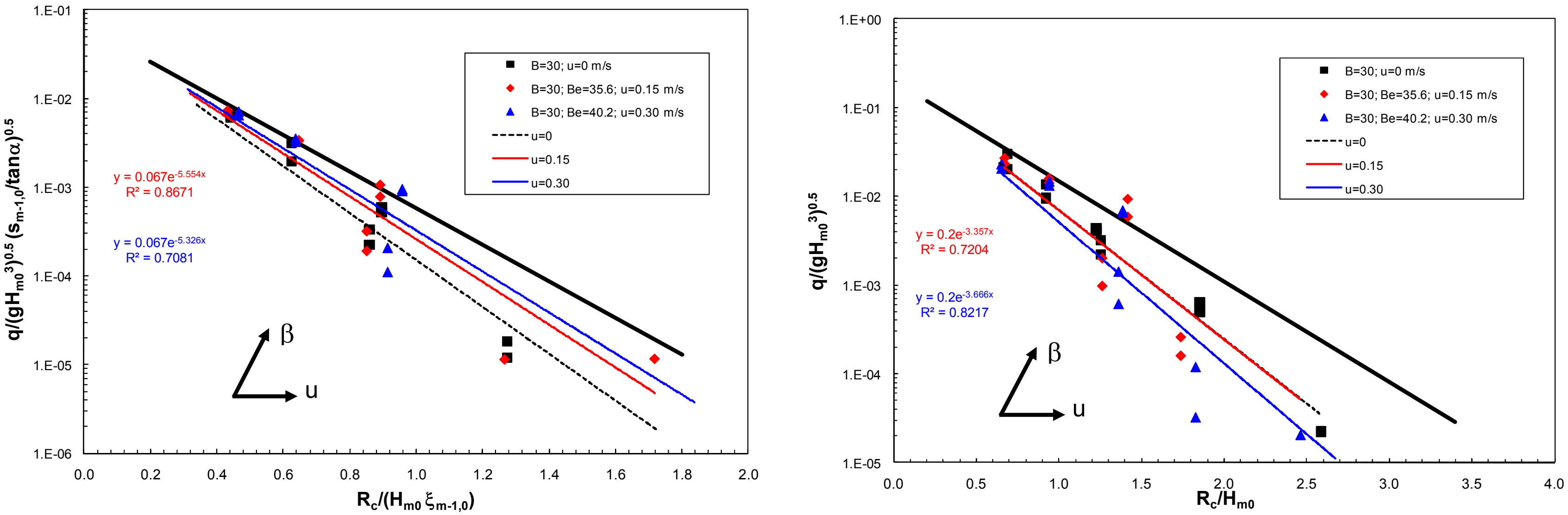


Figure 5.1d Direct comparison of results on currents with results without currents; β= 30°

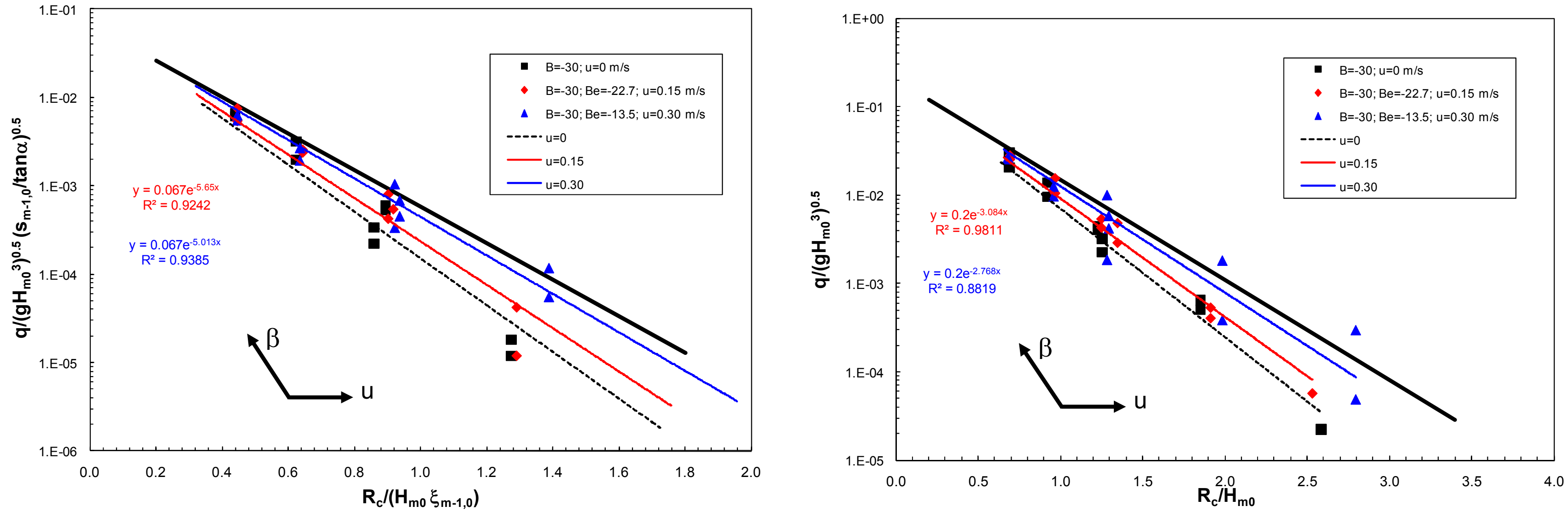


Figure 5.1e Direct comparison of results on currents with results without currents; β= -30°

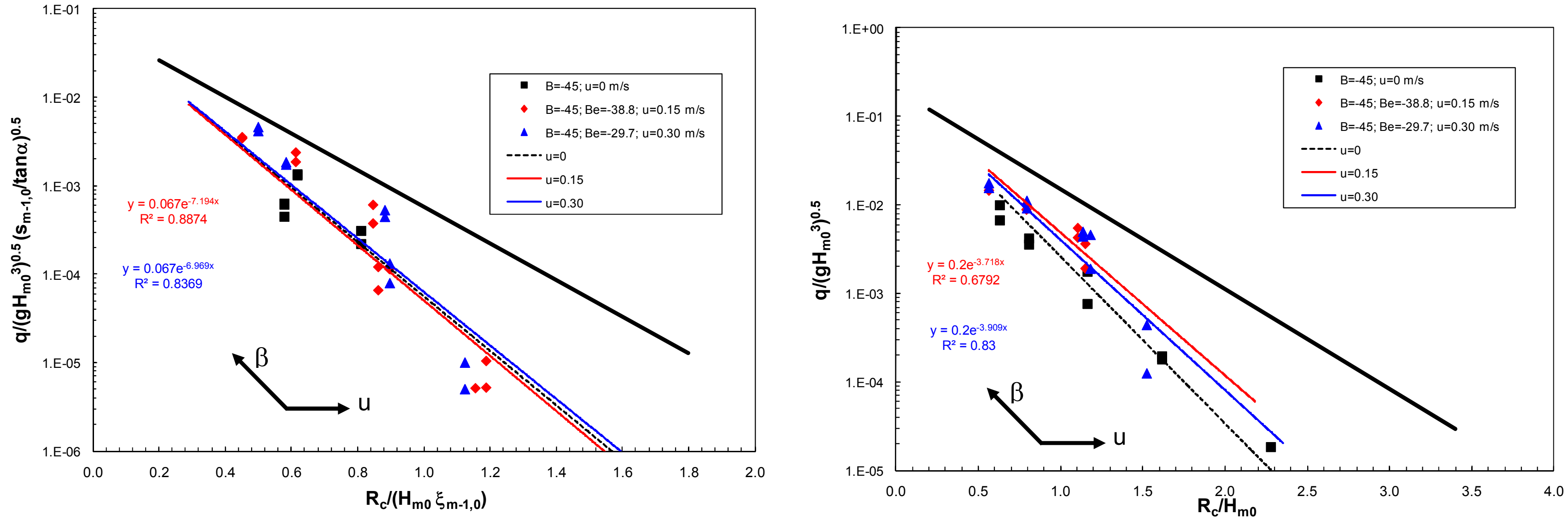


Figure 5.1f Direct comparison of results on currents with results without currents; β= -45°

β degr.	u m/s	β_e degr.	$\|\beta_e\|$ degr.	b-breaking	γ-br	b-non-br	γ-non br
0	0.00	0.0	0.0	5.09	1.000	2.78	1.000
15	0.00	15.0	15.0	5.43	0.937	2.89	0.962
30	0.00	30.0	30.0	6.09	0.836	3.35	0.830
45	0.00	45.0	45.0	7.09	0.718	4.34	0.641
0	0.15	7.3	7.3	5.44	0.936	2.66	1.045
0	0.30	16.7	16.7	5.48	0.929	3.12	0.891
-15	0.15	-7.6	7.6	5.40	0.943	3.02	0.921
-15	0.30	0.7	0.7	5.29	0.962	3.12	0.891
15	0.15	21.6	21.6	5.44	0.936	2.66	1.045
15	0.30	27.5	27.5	5.16	0.986	2.75	1.011
-30	0.15	-22.7	22.7	5.65	0.901	3.08	0.903
-30	0.30	-13.5	13.5	5.01	1.016	2.77	1.004
30	0.15	35.6	35.6	5.55	0.917	3.36	0.827
30	0.30	40.2	40.2	5.33	0.955	3.67	0.757
-45	0.15	-38.8	38.8	7.19	0.708	3.72	0.747
-45	0.30	-29.7	29.7	6.97	0.730	3.91	0.711

Table 5.1 Slope coefficients and reduction factors for all test results (no consideration of effects of currents).

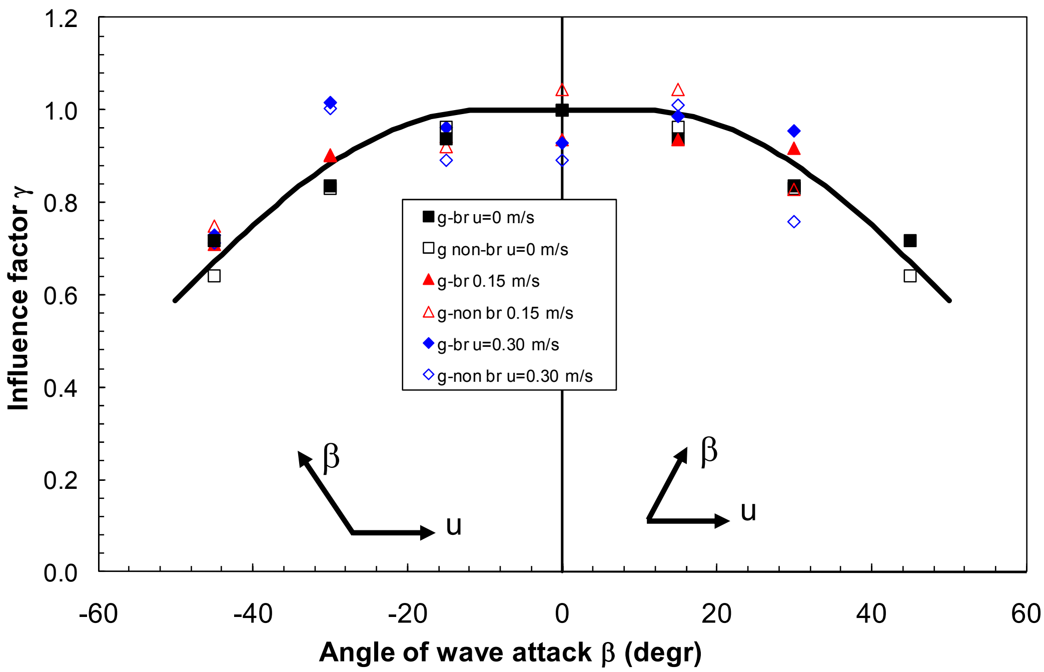


Figure 5.2. Direct comparison of results with currents, without consideration of change in wave direction and wave period.

For further analysis the relative wave period $T_{rel, m-1,0}$ (equations 5.3 - 5.7) and the angle of energy have been calculated (equations 5.8 and 5.9). These new parameters have been used to make new overtopping graphs. These graphs have been given in Figure 5.3 and are similar to Figure 5.1, but now include the new relative wave period instead of the absolute wave period. Note that the wave period for β = -45° becomes so short that non-breaking waves do not any longer exist (no data points in the right graphs of Figure 5.3f.

Besides the new fitting curves, the graphs also include the average angle of energy β_e for each subset of tests. The new reduction factors γ_β and the average angles of energy have been given in Table 5.2.

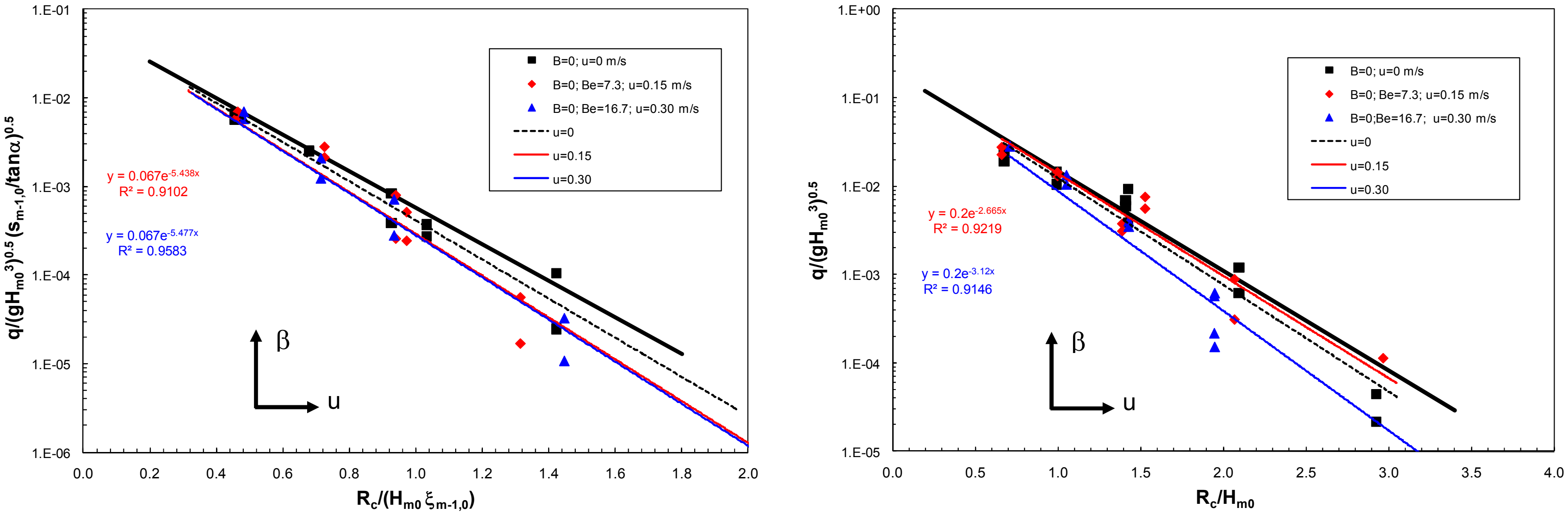


Figure 5.3a Comparison of results on currents, including change of wave direction and relative wave period; β= 0°

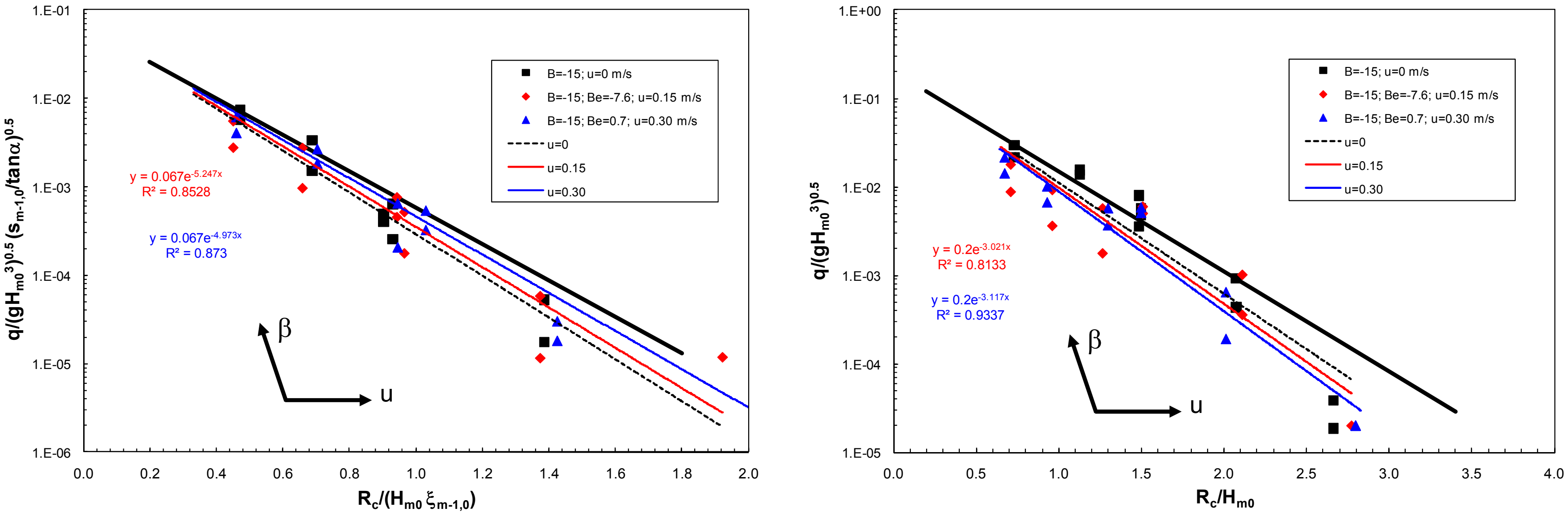


Figure 5.3b Comparison of results on currents, including change of wave direction and relative wave period; β= -15°

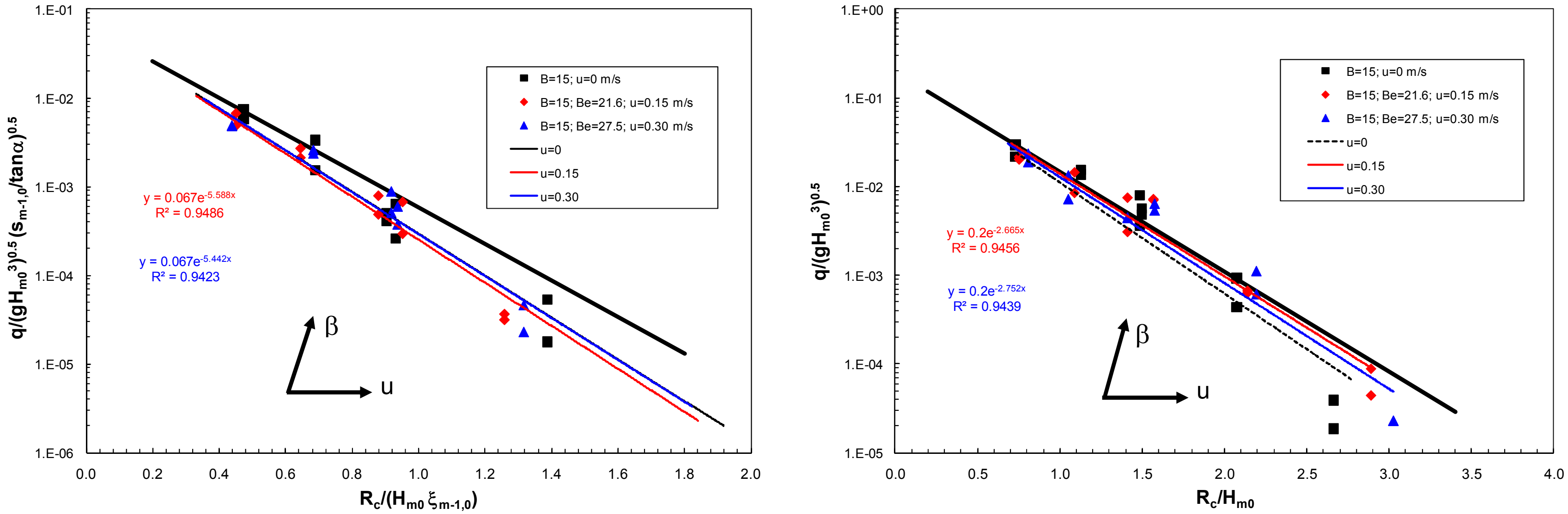


Figure 5.3c Comparison of results on currents, including change of wave direction and relative wave period; β= 15°

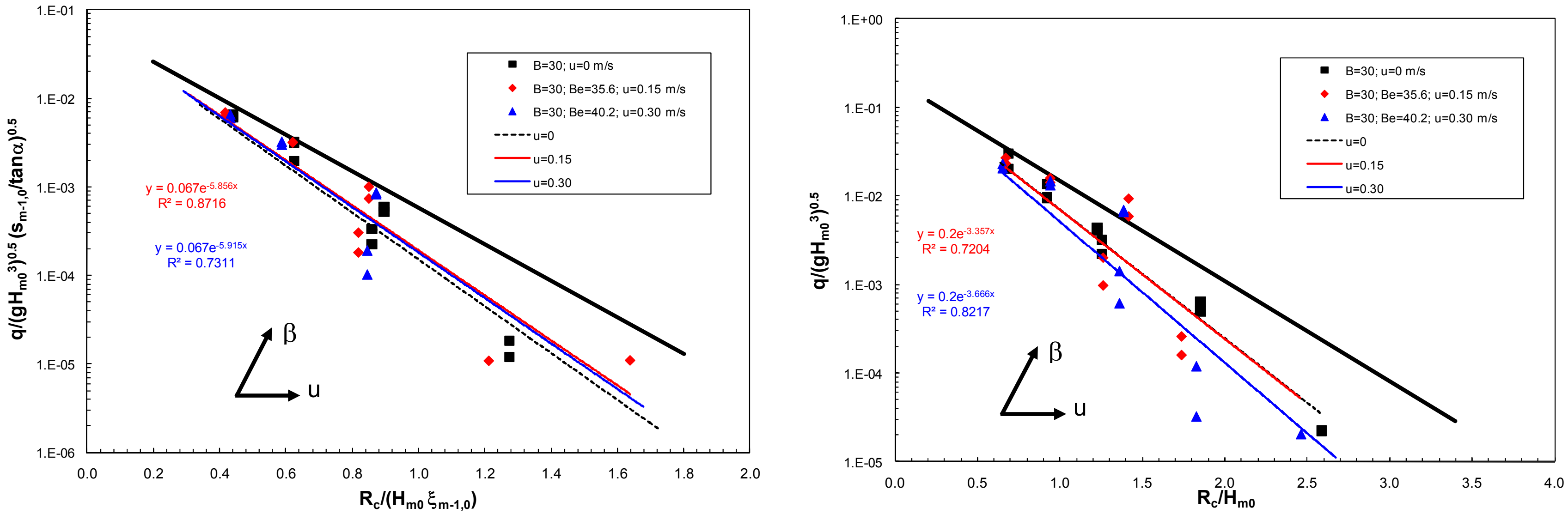


Figure 5.3d Comparison of results on currents, including change of wave direction and relative wave period; β= 30°

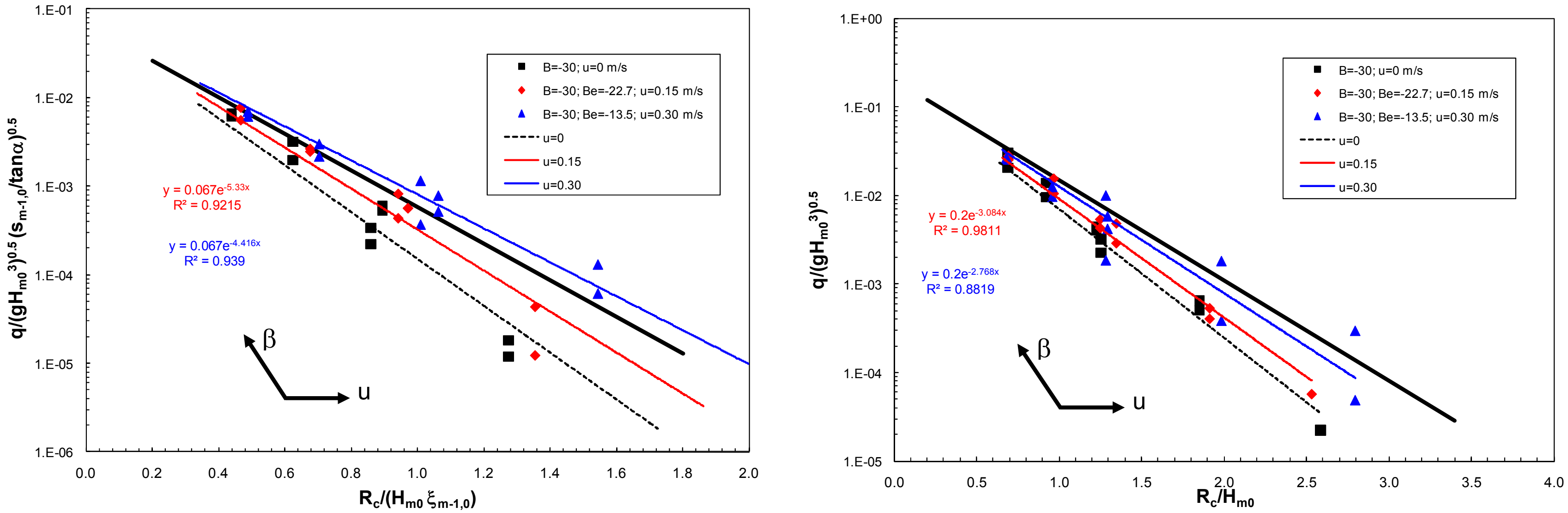


Figure 5.3e Comparison of results on currents, including change of wave direction and relative wave period; β= -30°

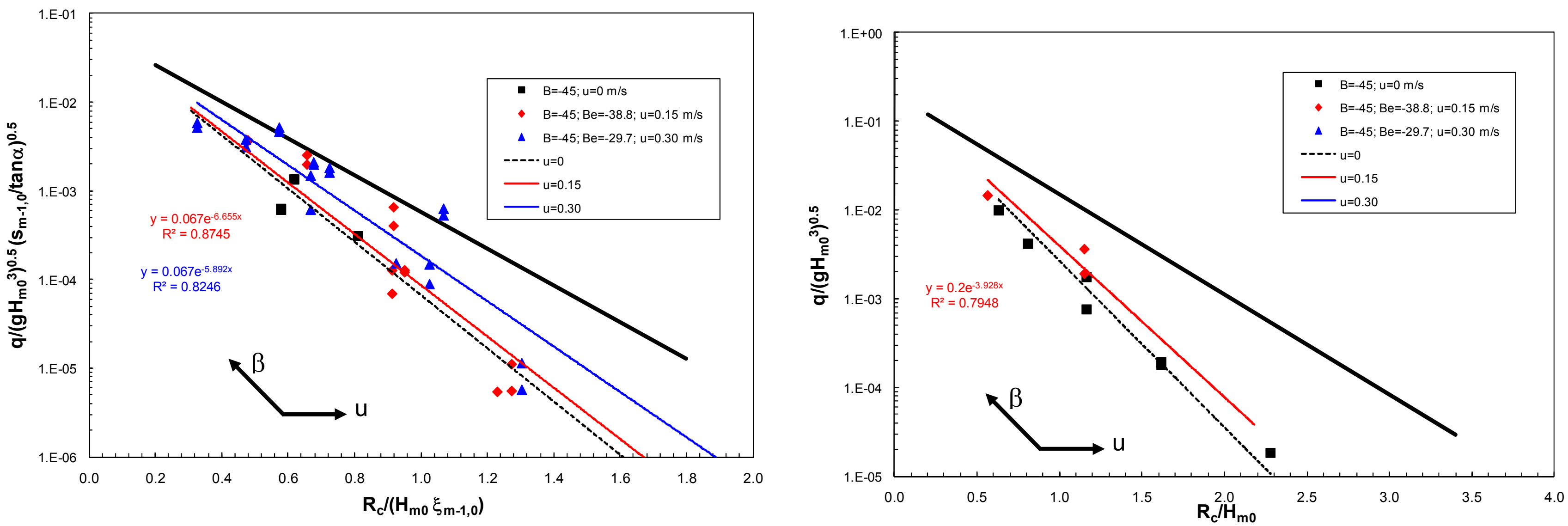


Figure 5.3f Comparison of results on currents, including change of wave direction and relative wave period; β= -45°

β	u	β_e	$\|\beta_e\|$	b-breaking	γ-br	b-non-br	γ-non br
degr.	m/s	degr.	degr.				
0	0.00	0.0	0.0	5.09	1.000	2.78	1.000
15	0.00	15.0	15.0	5.43	0.937	2.89	0.962
30	0.00	30.0	30.0	6.09	0.836	3.35	0.830
45	0.00	45.0	45.0	7.09	0.718	4.34	0.641
0	0.15	7.3	7.3	5.35	0.952	2.66	1.045
0	0.30	16.7	16.7	5.48	0.929	3.12	0.891
-15	0.15	-7.6	7.6	5.25	0.970	3.12	0.892
-15	0.30	0.7	0.7	4.97	1.024	3.02	0.920
15	0.15	21.6	21.6	5.59	0.911	2.66	1.045
15	0.30	27.5	27.5	5.44	0.935	2.75	1.011
-30	0.15	-22.7	22.7	5.33	0.955	3.08	0.903
-30	0.30	-13.5	13.5	4.42	1.153	2.77	1.004
30	0.15	35.6	35.6	5.86	0.869	3.36	0.827
30	0.30	40.2	40.2	5.92	0.861	3.67	0.757
-45	0.15	-38.8	38.8	6.66	0.765	3.93	0.708
-45	0.30	-29.7	29.7	5.89	0.864	-	-

Table 5.2 Slope coefficients and reduction factors for all test results, including effects of currents

The general effect of a current is that the direction of wave energy changes along with the current and that relative wave periods reduce if the waves go against the current and increase if they go along with the current. This is also seen in Figures 5.4 and 5.5.

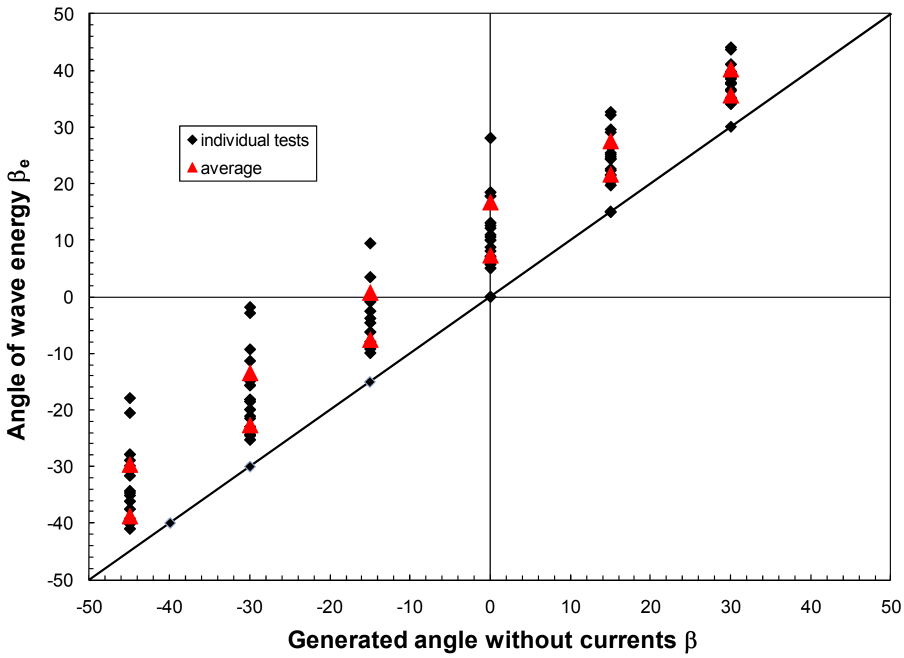


Figure 5.4. Change of wave direction due to currents.

Figure 5.4 shows the change in direction of wave energy. Every single test has been given in the graph. The horizontal axis gives the generated wave direction, where the vertical axis gives the changed angle of wave energy. In all cases the wave angle reduces, which means a change in the direction of the current. The points on the line are the tests without currents. The average angle of wave energy for each subset is given by a red triangle, the highest for 0.30 m/s current and the lowest for 0.15 m/s. In average there is about 7° change for 0.15 m/s and 15° for 0.30 m/s current, but the change is larger if the generated angle is more against the current.

Figure 5.5 gives the change in wave period, where the horizontal axis gives the absolute (generated) peak period T_p and the vertical axis the relative peak wave period as changed by the currents, $T_{rel\ p}$. The points below the line give the tests with a wave angle against the current (the the relative wave period decreases) and above the line the tests with a wave angle along the current. Changes in wave periods are not large, but enough to change the overtopping graphs, compare Figure 5.1 with Figure 5.3.

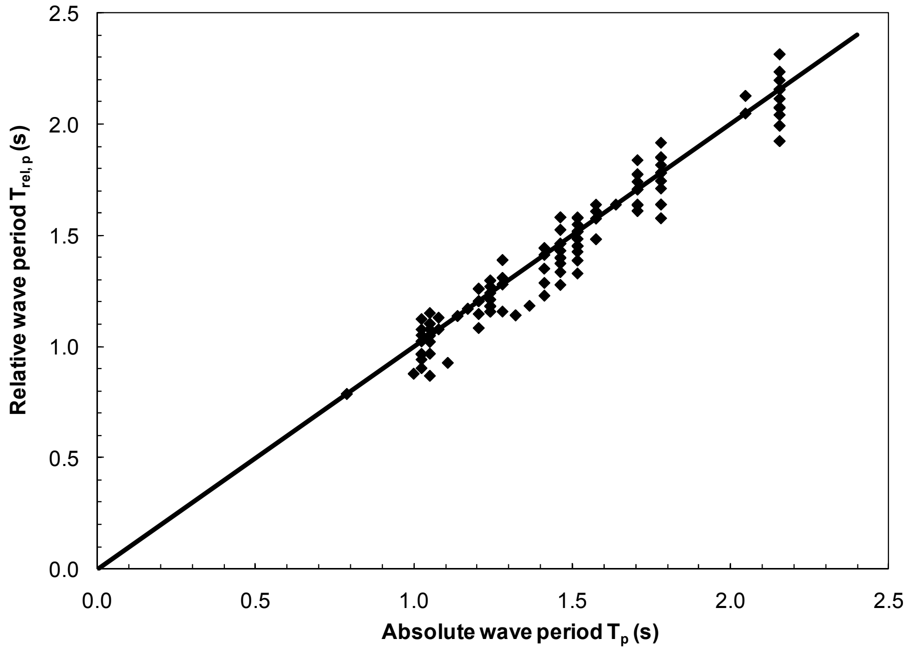


Figure 5.5 Change in wave period due to current

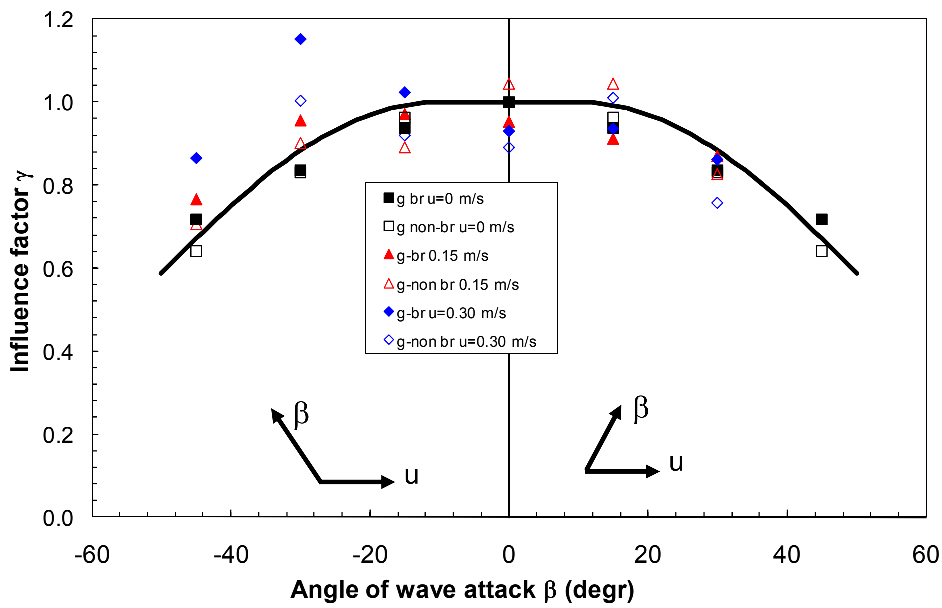


Figure 5.6. Influence of currents on wave overtopping, without effect of change of wave angle

Figure 5.6 gives the influence of the currents on wave overtopping, but only considering the use of the relative wave period, not the angle of wave attack. Again the picture is not consistent as the points at -30° and -45° are consequently too large. One point is even very high, caused by the small relative wave periods if the wave direction is against the current. For positive angles the data points are close to the curve.

Another graph is made if only the change in angle of wave energy is taken into account, not considering the change in relative wave period. This graph is shown in Figure 5.7. The left hand side gives most points below the curve, but that was also the case without currents (the black squares). At the right hand side a few points are quite far above the curve. Including the change in wave period will result in points at the left side going up and at the right side in going down (effect of smaller and larger wave period on wave overtopping, respectively). But by not considering the change in wave period, the high point in Figure 5.6 does not appear in Figure 5.7.

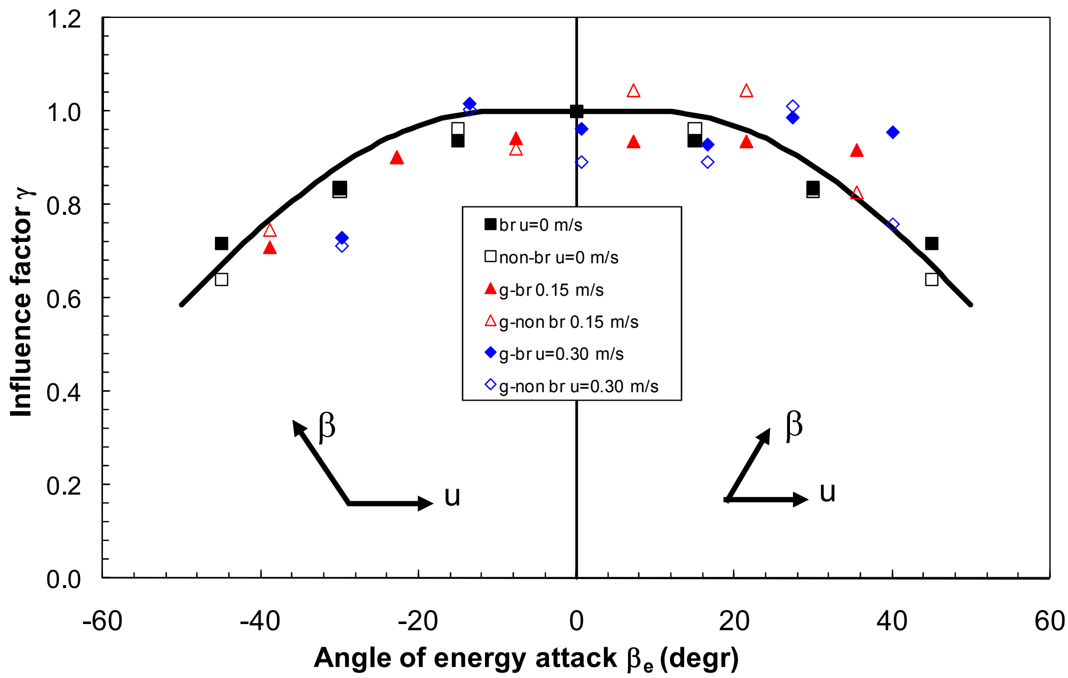


Figure 5.7. Influence of currents on wave overtopping, only including the change in angle of wave energy.

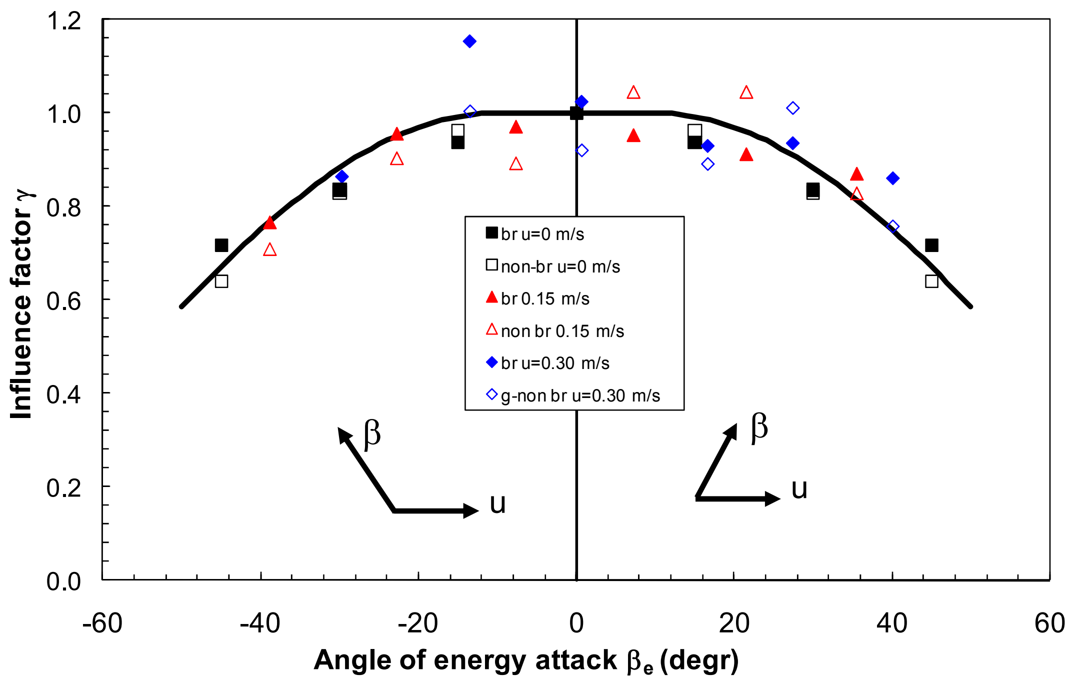


Figure 5.8. Influence of currents on wave overtopping.

The final comparison is given in Figure 5.8. This figure takes into account the change in wave direction and the change in wave period by using the relative wave period. Now results without and with currents are around the line, without having consistent deviations. Only the high point remains due to the changed wave period. There is some scatter, but the general trend is consistent and more or less equal for negative and positive angles of wave attack.

Overall it can be concluded that by taking into account the effects of currents on wave direction and wave period, the existing formulae on wave overtopping can be used.

Another way, however, is not to include the change in wave period (by using the relative period). It is not certain that this change has to be taken into account and it does lead to unexpected high coefficients if the waves are against the current. In that case the wave periods may become short and wave steepnessess become larger than physically possible. For example, for a current of 0.30 m/s wave steepnessess are calculated of $s_{rel\ m-1,0}$ = 0.084, where without currents a wave steepness larger than 0.06 is physically not possible and will break on steepness. In such cases the wave overtopping equations are applied out of their range.

The currents are quite uniform in the channel, but they may become lower in the area from the toe of the structure/dike upwards to the water level. This is the area where the wave breaks and runs up to the crest. Figure 5.9 gives the graph where the absolute wave period has been used (no change in wave period) and where only half of the change in wave direction has been taken into account. The wave direction has been obtained as 0.5(β + β_e).

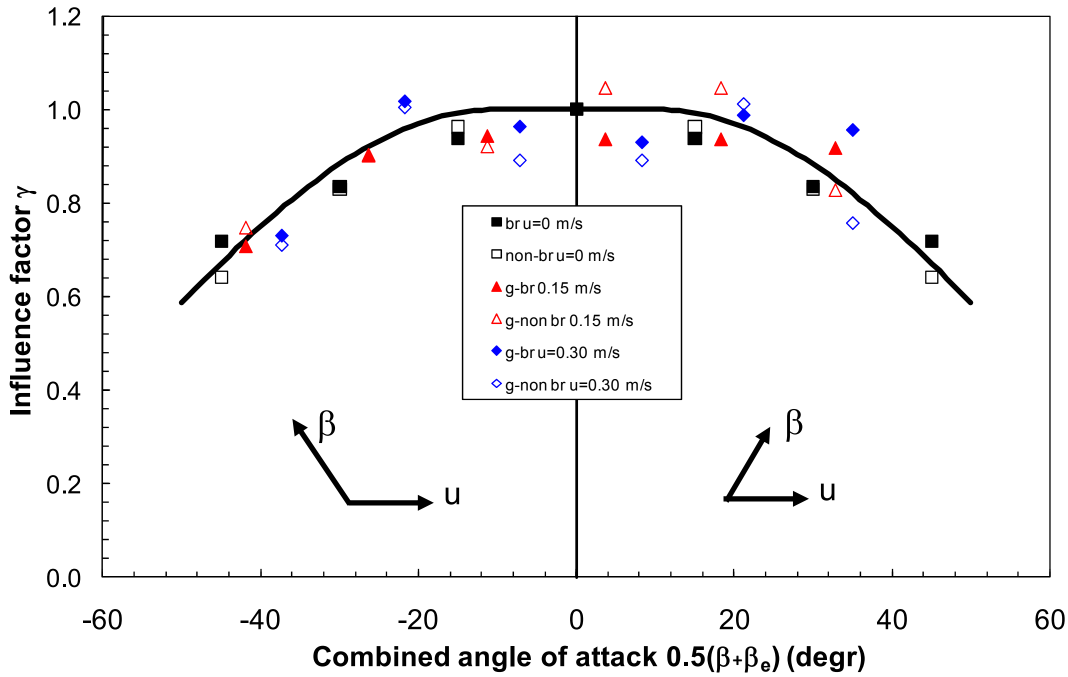


Figure 5.9. Results with only a combined angle of attack.

Also in this figure the points are nicely around the given curve. Further tests on the 1:6 slope should give a more decisive analysis, see the next chapter.

6 Analysis on perpendicular and oblique wave attack with current. Flowdike 2, slope 1:6

At first instance analysis will be performed without modifying wave direction and/or wave period, but just by comparing test results with results without current. Figures 6.1 - 6.6 give for each test series with a fixed generated angle of wave attack the wave overtopping graphs. A 1:6 slope gives only breaking waves. Each graph makes a distinction between no current, u = 0.15 m/s; u = 0.30 m/s and u = 0.40 m/s. The graphs include the two vectors with the correct direction of wave generation and current. Note that a positive wave direction is a wave direction along with the current and a negative direction against the current.

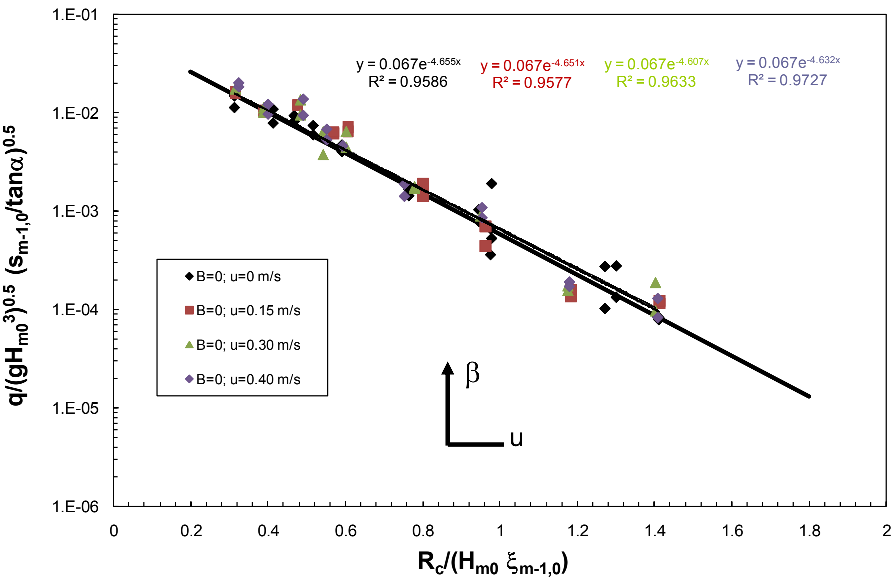


Figure 6.1. Direct comparison of results on currents without currents; β = 0°

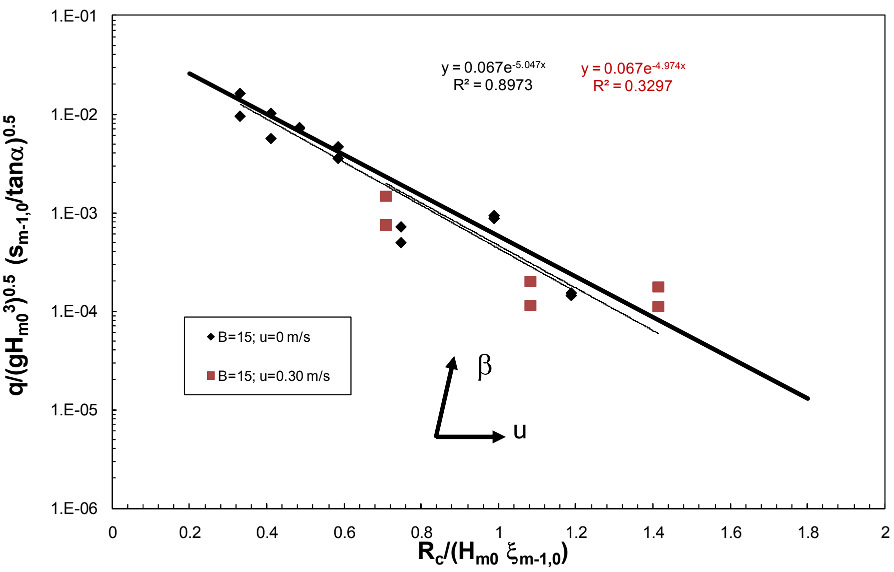


Figure 6.2. Direct comparison of results on currents without currents; β = 15°

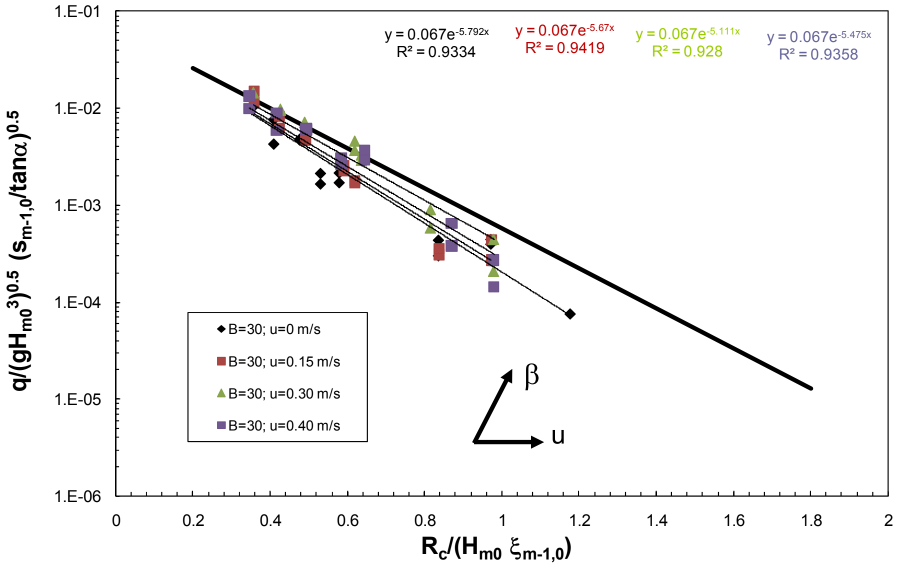


Figure 6.3. Direct comparison of results on currents without currents; β = 30°

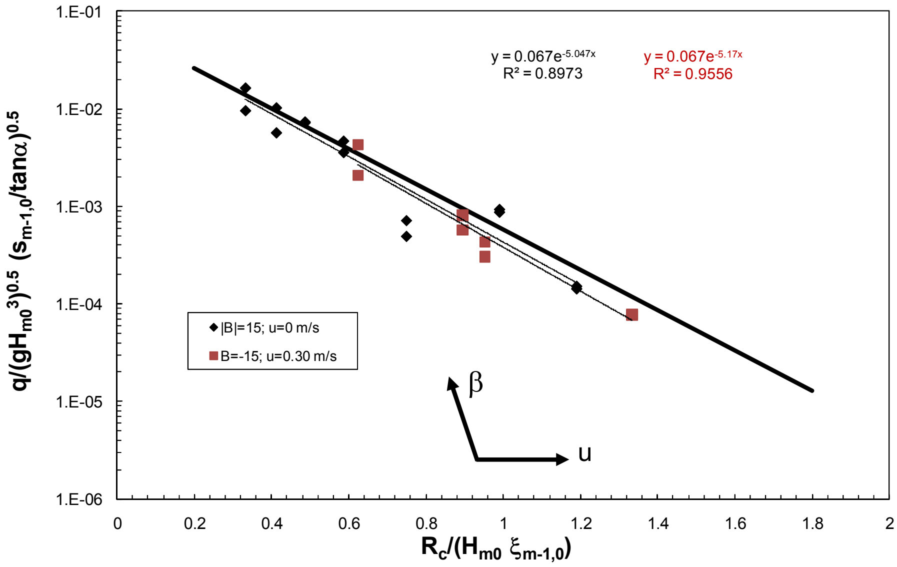


Figure 6.4. Direct comparison of results on currents without currents; β = -15°

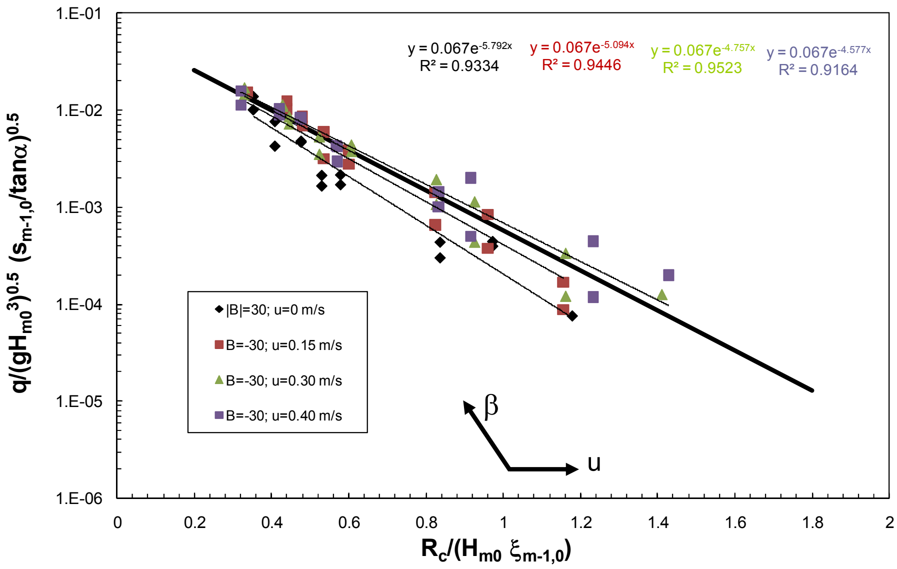


Figure 6.5. Direct comparison of results on currents without currents; β = -30°

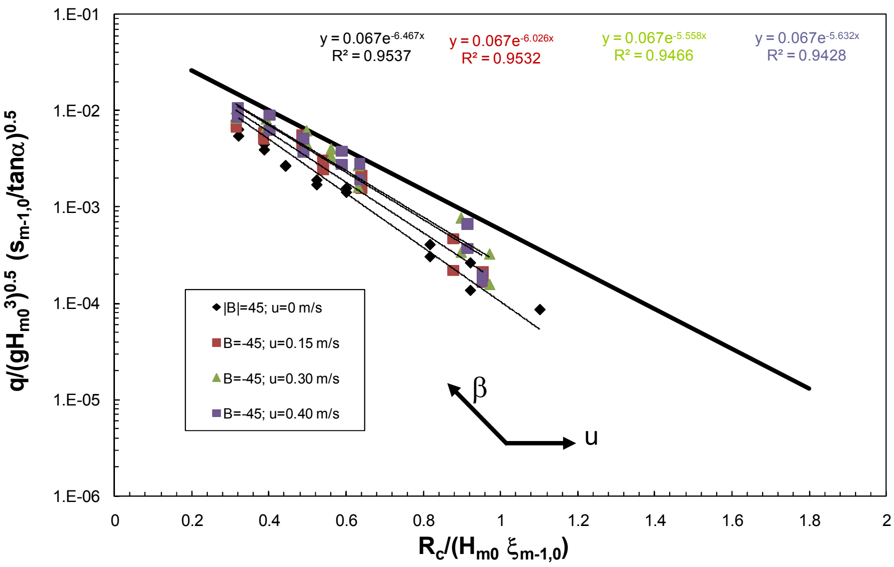


Figure 6.6. Direct comparison of results on currents without currents; β = -45°

The graphs also include the exponential curve fitting with a fixed point on the y-axis, similar to the procedure described for oblique wave attack without current (chapter 5). The obtained γ_β-values are given in Table 5.1 and they are compared with the results for no current in Figure 6.7. In general the trend is clear and scatter is not significantly large. But it is obvious that results for 0.15 m/s; 0.30 m/s and 0.40 m/s are often consequently on one side of the results for no currents, see for instance the results for -30° and -45°. A wave direction against a current gives increased overtopping. It can be concluded that although the scatter is not significant, this way of analysis does not give correct results.

β degr.	u m/s	β_e degr.	$\lvert\beta_e\rvert$ degr.	b-breaking	γ-br
0	0.00	0.0	0.0	4.66	1.000
15	0.00	0.0	0.0	5.05	0.922
30	0.00	0.0	0.0	5.79	0.804
45	0.00	0.0	0.0	6.47	0.720
0	0.15	6.4	7.3	4.65	1.001
0	0.30	12.5	12.5	4.61	1.010
0	0.40	16.3	16.3	4.63	1.005
15	0.30	24.6	24.6	4.97	0.936
-15	0.30	-3.1	3.1	5.17	0.900
30	0.15	35.1	35.1	5.67	0.821
30	0.30	39.2	39.2	5.11	0.911
30	0.40	41.6	41.6	5.48	0.850
-30	0.15	-23.9	23.9	5.09	0.914
-30	0.30	-16.5	16.5	4.76	0.979
-30	0.40	-10.4	10.4	4.58	1.017
-45	0.15	-39.7	39.7	6.03	0.772
-45	0.30	-32.1	32.1	5.56	0.838
-45	0.40	-24.6	24.6	5.63	0.827

Table 6.1. Average results for each subset of tests, not including any effect of current

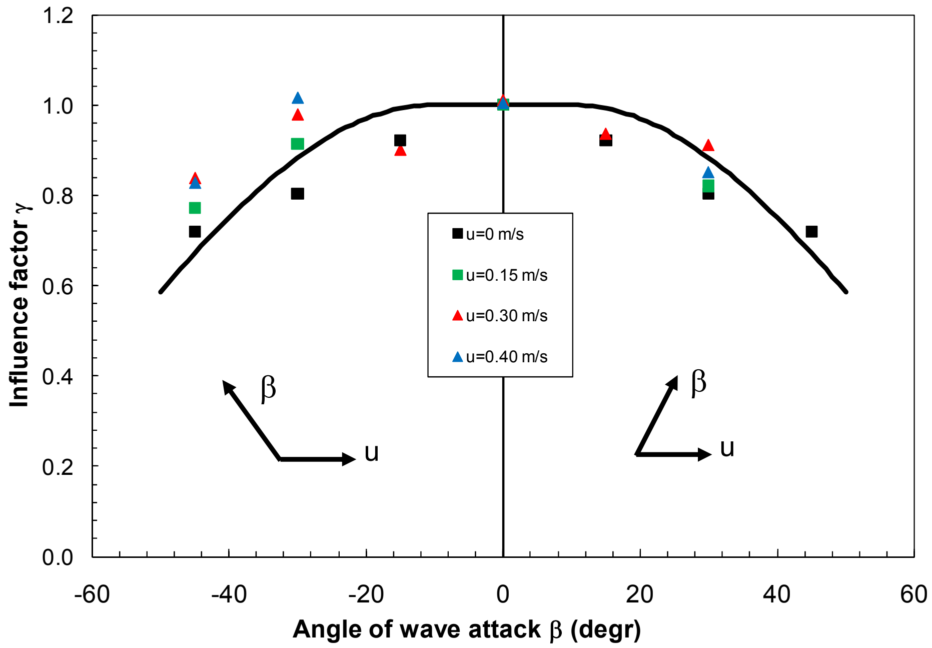


Figure 6.7. Direct comparison of results with currents, without consideration of change in wave direction and wave period.

For further analysis the relative wave period $T_{rel,\, m-1,0}$ and the angle of energy β_e have been calculated. The relative wave period has been used to make new overtopping graphs. These graphs have been given in Figures 6.8 - 6.13 and are similar to Figures 6.1 - 6.6.

The average angle of energy β_e has been determined for each subset of tests. The new reduction factors γ_β and the average angles of energy have been given in Table 6.2. The final graph, including change in wave period and in angle of energy attack, is given in Figure 6.14.

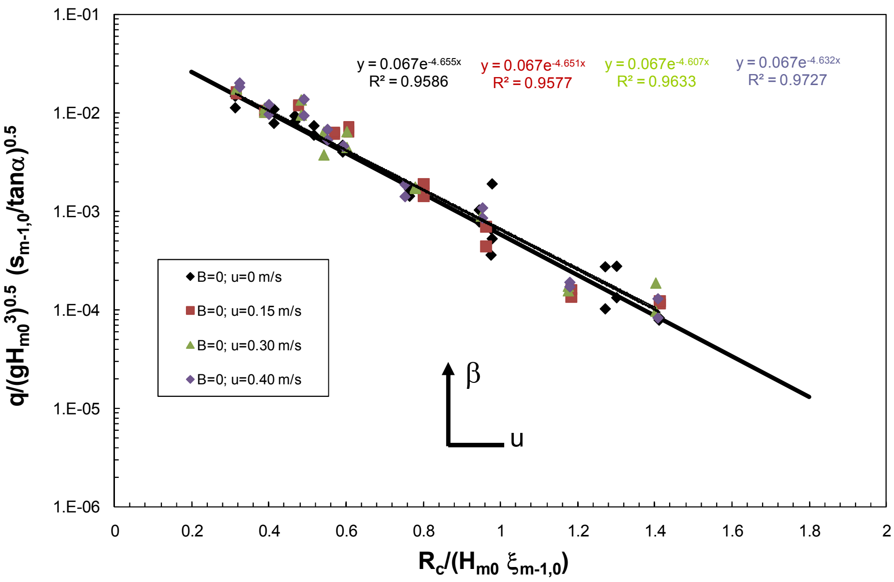


Figure 6.8. Results on currents, including the change in relative wave period; β = 0°

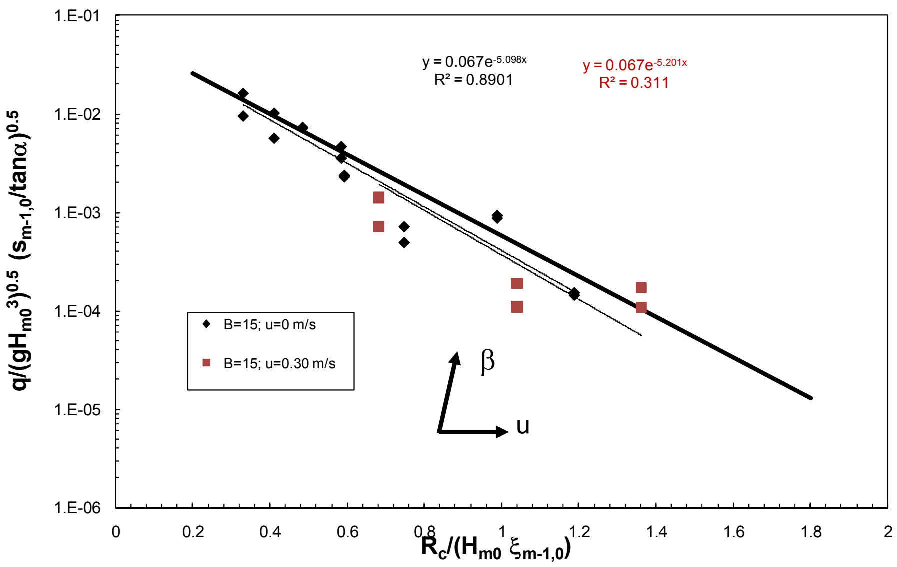


Figure 6.9. Results on currents, including the change in relative wave period; β = 15°

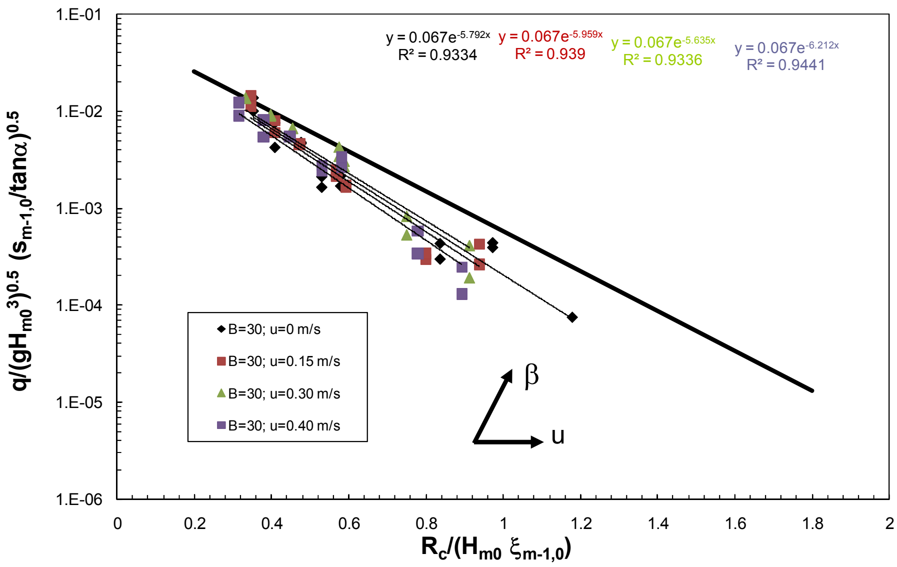


Figure 6.10. Results on currents, including the change in relative wave period; β = 30°

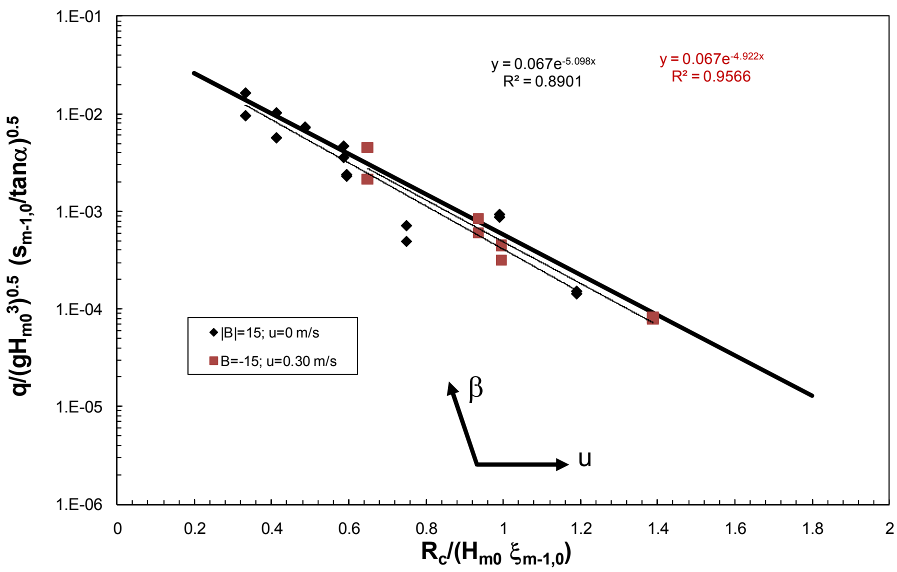


Figure 6.11. Results on currents, including the change in relative wave period; β = -15°

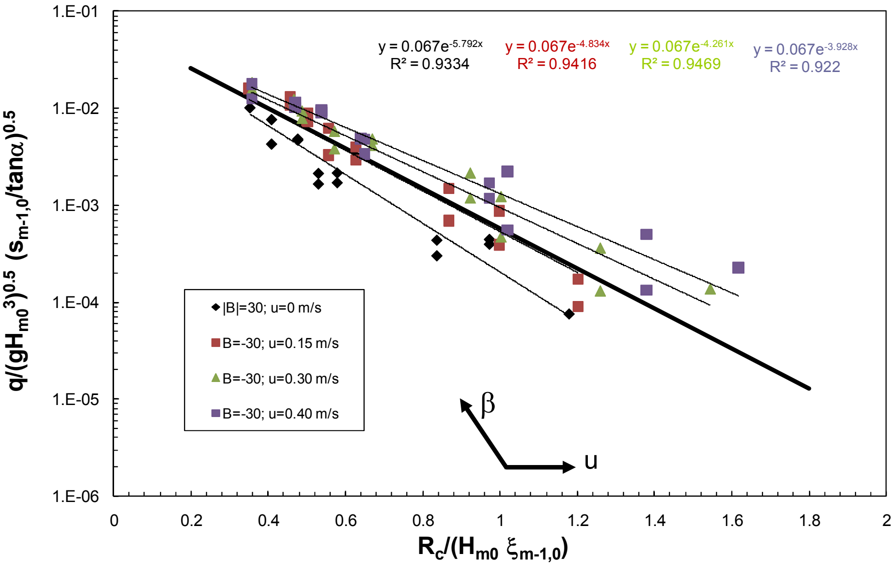


Figure 6.12. Results on currents, including the change in relative wave period; β = -30°

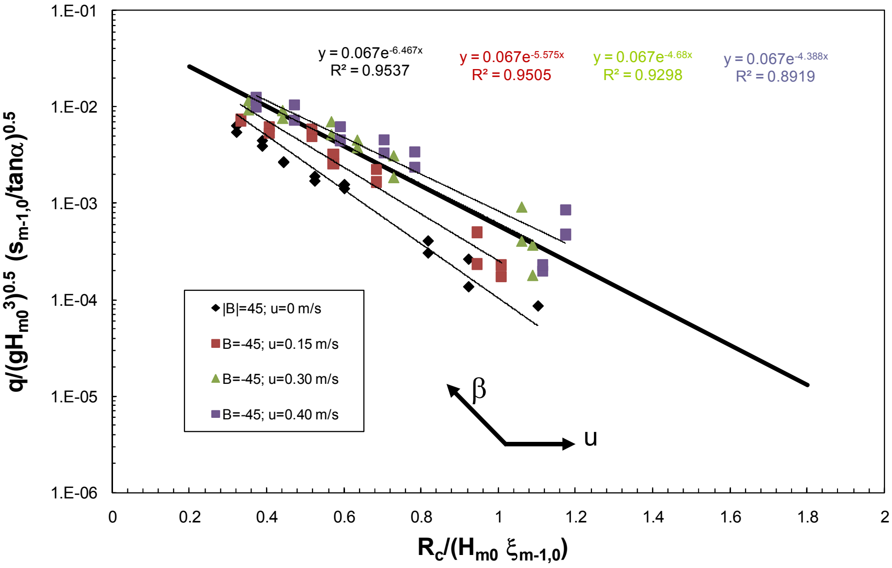


Figure 6.13. Results on currents, including the change in relative wave period; β = -45°

β degr.	u m/s	β_e degr.	$\|\beta_e\|$ degr.	b-breaking	γ-br
0	0.00	0.0	0.0	4.66	1.000
15	0.00	0.0	0.0	5.05	0.922
30	0.00	0.0	0.0	5.79	0.804
45	0.00	0.0	0.0	6.47	0.720
0	0.15	6.4	7.3	4.65	1.001
0	0.30	12.5	12.5	4.61	1.010
0	0.40	16.3	16.3	4.63	1.005
15	0.30	24.6	24.6	5.20	0.895
-15	0.30	-3.1	3.1	4.92	0.946
30	0.15	35.1	35.1	5.96	0.781
30	0.30	39.2	39.2	5.64	0.826
30	0.40	41.6	41.6	6.21	0.749
-30	0.15	-23.9	23.9	4.83	0.963
-30	0.30	-16.5	16.5	4.26	1.092
-30	0.40	-10.4	10.4	3.93	1.185
-45	0.15	-39.7	39.7	5.58	0.835
-45	0.30	-32.1	32.1	4.68	0.995
-45	0.40	-24.6	24.6	4.39	1.061

Table 6.2. Average results for each subset of tests

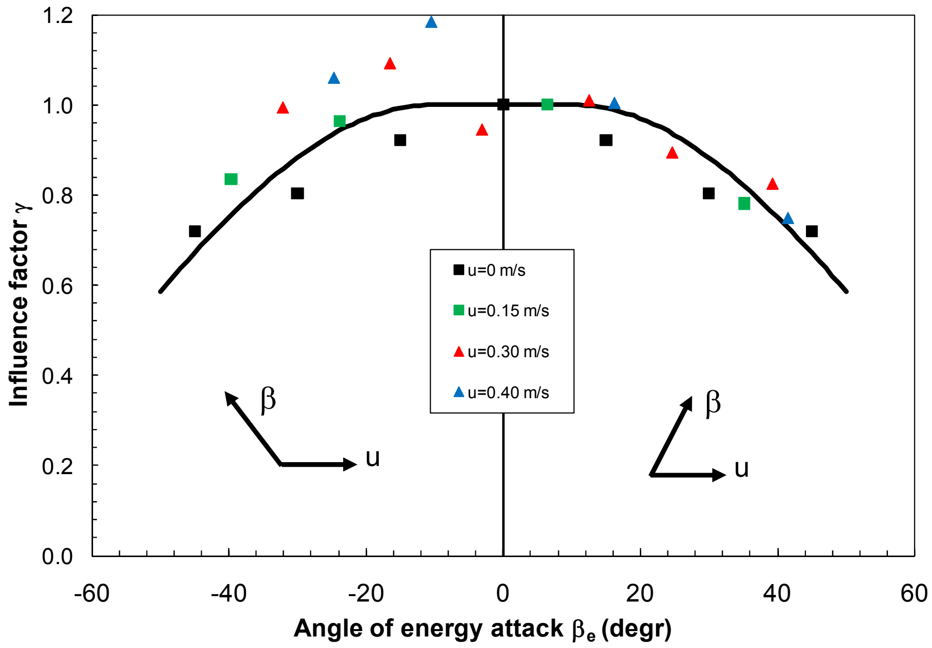


Figure 6.14. Influence of currents on wave overtopping, including change of wave period and angle of wave energy

The right hand side of Figure 6.14 is very nice and points are closely around the given curve. But this is not the case for the left hand side, where the wave direction was against the current. The data points for a current of 0.30 m/s and 0.40 m/s give points far above the curve. These data points were received for generated wave angles of -30° and -45°. By including the angle of wave energy the points shift to the right (and closer to the curve), but they remain too high.

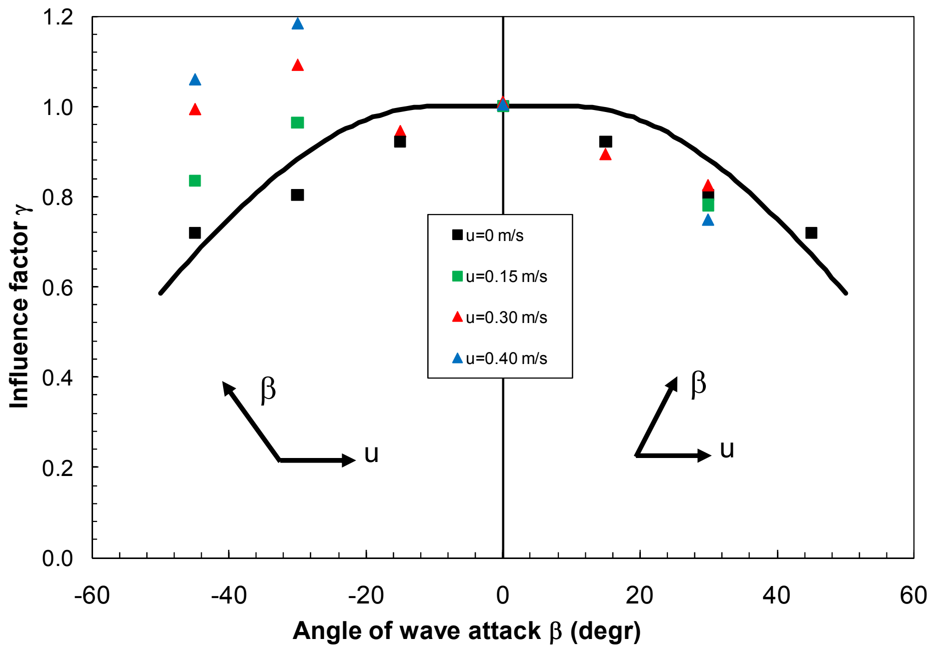


Figure 6.15. Influence of currents on wave overtopping, only including change of wave period

Figures 6.15 and 6.16 give the separate influence of the change in wave period and in angle of wave energy, respectively. It is very clear that the change of relative period for β = -30° and -45° leads to a large deviation from the curve, see the left hand side of Figure 6.15. The relative wave period becomes so short that the dimensionless overtopping and crest freeboard become much smaller, resulting in "measured" overtopping that is too large, even larger than for perpendicular wave attack. See also Figures 6.12 and 6.13, where the data points and trend lines are well above the bold curve for perpendicular wave attack. If only the change in angle of wave energy is taken into account, see Figure 6.16, the data points are nicely around the curve.

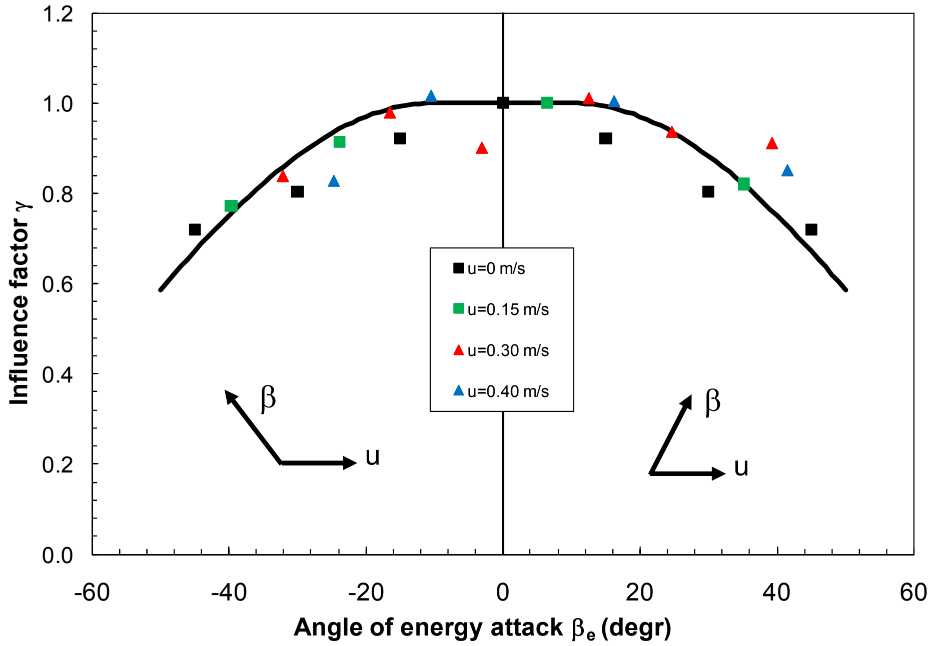


Figure 6.16. Influence of currents on wave overtopping, only including change of angle of wave energy

7 Discussion on final method

It is clear that if waves are against the current, the wave overtopping increases with current velocity. For example Figures 6.5 and 6.6 give the data points and trends for wave angles of -30° and -45°. Also the coefficient b is given for each current. Considering a dimensionless freeboard of $R_c/(H_{m0}\xi_{m-1,0})$ = 1.0 (a value of 1 on the horizontal axis in Figures 6.5 and 6.6) gives the following increases in wave overtopping:

Slope 1:6; β = -30°		*relative*
Dimensionless overtopping for 0 m/s:	$2.05\ 10^{-4}$	100%
Dimensionless overtopping for 0.15 m/s:	$4.11\ 10^{-4}$	200%
Dimensionless overtopping for 0.30 m/s:	$5.76\ 10^{-4}$	291%
Dimensionless overtopping for 0.40 m/s:	$6.89\ 10^{-4}$	336%

Slope 1:6; β = -45°		*relative*
Dimensionless overtopping for 0 m/s:	$1.04\ 10^{-4}$	100%
Dimensionless overtopping for 0.15 m/s:	$1.62\ 10^{-4}$	156%
Dimensionless overtopping for 0.30 m/s:	$2.58\ 10^{-4}$	248%
Dimensionless overtopping for 0.40 m/s:	$2.40\ 10^{-4}$	231%

Figure 5.1e for the Flowdike 1 results gives:

Slope 1:3; β = -30°		*relative*
Dimensionless overtopping for 0 m/s:	$1.52\ 10^{-4}$	100%
Dimensionless overtopping for 0.15 m/s:	$2.36\ 10^{-4}$	155%
Dimensionless overtopping for 0.30 m/s:	$4.46\ 10^{-4}$	293%

For these angles of wave attack against the current, the wave overtopping increases a factor 1.5-2 if a current of 0.15 m/s is introduced; a factor of 2.5-3 with a current of 0.30 m/s; and a factor of 2.5-3.5 with a current of 0.40 m/s. This is also clear in Figure 6.15.

From this point of view a correction has to be made to bring the data more in line with the situation without current (the given curve in Figures 5.2; 5.6 - 5.9; 6.7 and 6.14 - 6.16). Introducing the angle of wave energy will make the points to shift horizontally to the right (Figures 5.8 and 6.16). This gives quite an improvement compared to Figure 6.17, but now some points for a current of 0.40 m/s (for β_e = -25° and 42°) are quite far on the right side of the given curve. Maybe the influence of change of energy direction is a little too strong, as the current might be a little less near the dike slope than in the channel.

Considering the relative period instead of the absolute period leads to very short periods if the wave angle is against the current and this leads to even further increased data points, see the left side of Figure 6.15. Also the angle of -30° for the 1:3 slope in Flowdike 1 gave similar results, see Figure 5.6. Coefficients (much) larger than 1.0 are physically not correct. From this point of view it may be stated that probably the change in wave period does not have to be taken into account to describe the influence of currents on wave overtopping. It would lead to erroneous results.

If the absolute wave period is taken and not the relative period and the current close to the slope of the dike could be a little smaller than in the channel/river or at sea, it might be an option to include only part of the effect of changed angle of energy. Arbitrarily it is chosen to take the average of the wave angle and angle of energy, $0.5(\beta + \beta_e)$. Figures 7.1 and 7.2 give the results for the 1:3 slope of Flowdike 1 and the 1:6 slope of Flowdike 2, respectively.

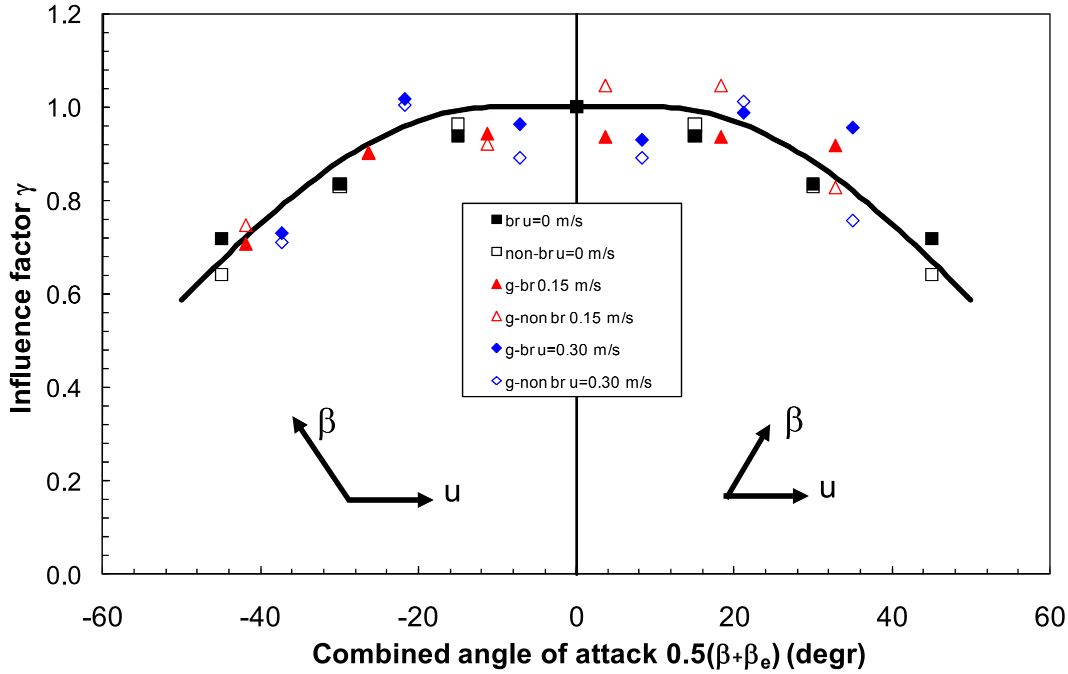


Figure 2.36. Results for a combined angle of attack; Slope 1:3 Flowdike 1

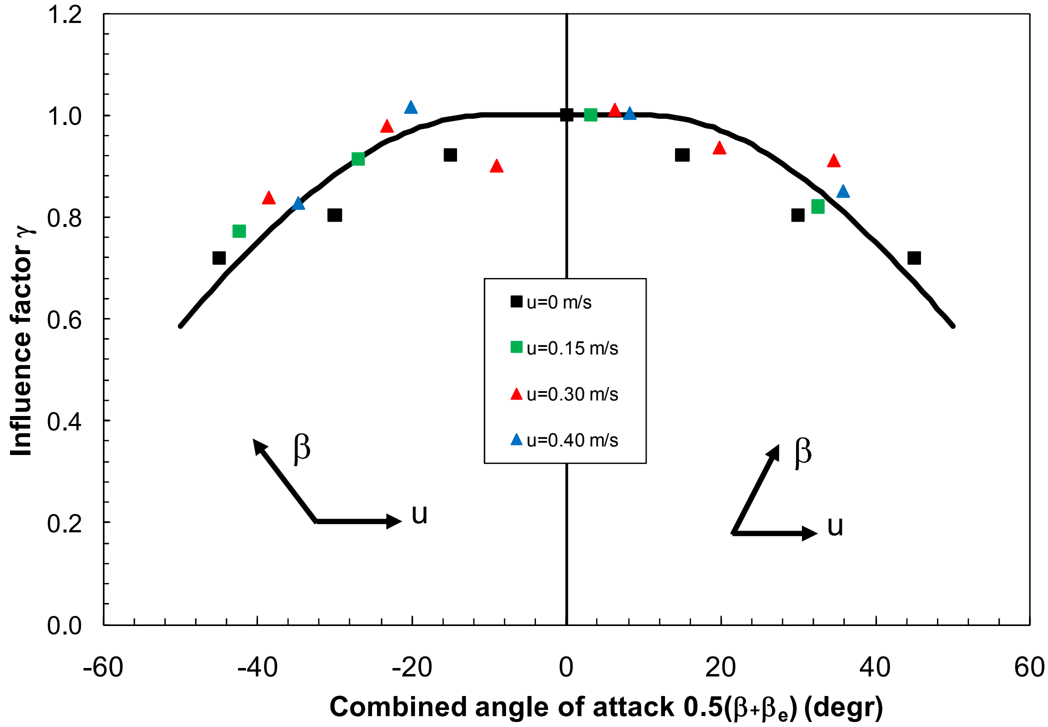


Figure 2.37. Results for a combined angle of attack; Slope 1:6 Flowdike 1

Both figures give the data points nicely around the given curve and these figures can be considered as the final outcome of the analysis on the influence of current on wave overtopping.

8 Conclusions

Re-analysis of existing wave overtopping data on oblique wave attack confirmed the validity of Equation 2.3. Also the Flowdike 1 tests on a slope of 1:3 and the Flowdike 2 tests on a slope of 1:6 confirmed this equation. Therefore this equation was used to investigate the influence of currents on wave overtopping.

Currents may change the wave height, wave period and angle of energy towards the dike slope. The wave height was measured in the model at the toe of the dike. Relative wave periods become shorter if the waves are against the current and longer when they are along with the current. It was analysed whether the influence of currents on wave overtopping could (partly) be described by using this relative wave period. It turned out that this resulted in too large influences for waves against fairly high currents. The wave periods and wave steepnessess to be used where also out of the physical range (too short periods and too large steepnessess). For this reason the influence of change of relative wave period was not taken to describe the influence of currents on wave overtopping.

The last effect is the change of direction of wave energy. Some wave energy will travel along the wave crest. Including the angle of wave energy instead of the generated wave angle resulted in a little too strong influence for the largest generated currents. As it might well be the case that actual currents are a little smaller near the slope of the dike than in the channel, there is good reason to decrease the influence of the angle of wave energy a little. Arbitrarily a combined wave angle of $0.5(\beta + \beta_e)$ was chosen and this gave good results for the 1:3 slope as well as the 1:6 slope.

Therefore, the influence of currents on wave overtopping can well be described by using the combined wave angle $0.5(\beta + \beta_e)$ in existing formulae for wave overtopping. The method is given in Chapter 5 with equations 5.8 and 5.9.

References

De Waal, J.P. and J.W. van der Meer, 1992. Wave run-up and overtopping on coastal structures. ASCE, proc. 23rd ICCE, Venice, Italy, pp. 1758-1771.

Holthuijsen, L. H., 2007. Waves in oceanic and coastal waters. Cambridge University Press.

Oumeraci, H., C. Zimmermann, H. Schüttrumpf, K.-F. Daemrich, J. Möller and N. Ohle, 2001. Influence of oblique wave attack on wave run-up and wave overtopping - 3D model tests at NRC/Canada with long and short-crested waves. LWI Report No. 859 / FI Report No. 643.

Overtopping Manual, 2007. EurOtop; Wave Overtopping of Sea Defences and Related Structures – Assessment Manual. UK: N.W.H. Allsop, T. Pullen, T. Bruce. NL: J.W. van der Meer. DE: H. Schüttrumpf, A. Kortenhaus. *www.overtopping-manual.com.*

Appendix 1

Test data for Flowdike 1 and 2

Date	Set-up	Test series	duration (MikeZero) [min]	Test no.	file-name set-up/test/current/ wave/direction	wave direction [°]	current [m/s]	wind [m/s] 10 m/s≈49 Hz 5 m/s≈25 Hz	wave testno.
05. Feb.	1	T1.1	24	144	s1_01_00_w1_00	0	0	0	w1
	1	T1.2	17	145	s1_01_00_w2_00	0	0	0	w2
	1	T1.3	28	146	s1_01_00_w3_00	0	0	0	w3
	1	T1.4	20	147	s1_01_00_w4_00	0	0	0	w4
	1	T1.5	34	148	s1_01_00_w5_00	0	0	0	w5
	1	T1.6	25	149	s1_01_00_w6_00	0	0	0	w6
06. Feb.	1	T11.1	24	162	s1_11_15_w1_00	0	0.15	0	w1
	1	T11.2	17	163	s1_11_15_w2_00	0	0.15	0	w2
	1	T11.3	28	164	s1_11_15_w3_00	0	0.15	0	w3
	1	T11.4	20	165	s1_11_15_w4_00	0	0.15	0	w4
	1	T11.5	34	166	s1_11_15_w5_00	0	0.15	0	w5
	1	T11.6	25	167	s1_11_15_w6_00	0	0.15	0	w6
02. Feb.	1	T3.1	24	114	s1_03_30_w1_00	0	0.3	0	w1
	1	T3.2	17	115	s1_03_30_w2_00	0	0.3	0	w2
	1	T3.3	28	116	s1_03_30_w3_00	0	0.3	0	w3
	1	T3.4	20	117	s1_03_30_w4_00	0	0.3	0	w4
	1	T3.5	34	119	s1_03_30_w5_00	0	0.3	0	w5
	1	T3.6	25	120	s1_03_30_w6_00	0	0.3	0	w6
06. Feb.	1	T12.1	24	156	s1_12_00_w1_00_-15	15	0	0	w1
	1	T12.2	17	157	s1_12_00_w2_00_-15	15	0	0	w2
	1	T12.3	28	158	s1_12_00_w3_00_-15	15	0	0	w3
	1	T12.4	20	159	s1_12_00_w4_00_-15	15	0	0	w4
	1	T12.5	34	160	s1_12_00_w5_00_-15	15	0	0	w5
	1	T12.6	25	161	s1_12_00_w6_00_-15	15	0	0	w6
09. Feb.	1	T13.1	24	168	s1_13_15_w1_00_-15	15	0.15	0	w1
	1	T13.2	17	169	s1_13_15_w2_00_-15	15	0.15	0	w2
	1	T13.3	28	170	s1_13_15_w3_00_-15	15	0.15	0	w3
	1	T13.4	20	171	s1_13_15_w4_00_-15	15	0.15	0	w4
	1	T13.5	34	172	s1_13_15_w5_00_-15	15	0.15	0	w5
	1	T13.6	25	173	s1_13_15_w6_00_-15	15	0.15	0	w6
03. Feb.	1	T19.1	24	124	s1_19_30_w1_00_-15	15	0.3	0	w1
	1	T19.2	17	125	s1_19_30_w2_00_-15	15	0.3	0	w2
	1	T19.3	28	126	s1_19_30_w3_00_-15	15	0.3	0	w3
	1	T19.4	20	127	s1_19_30_w4_00_-15	15	0.3	0	w4
	1	T19.5	34	128	s1_19_30_w5_00_-15	15	0.3	0	w5
	1	T19.6	25	129	s1_19_30_w6_00_-15	15	0.3	0	w6
11. Feb.	2	T2.1	24	180	s2_02_00_w1_00_-30	30	0	0	w1
	2	T2.2	17	181	s2_02_00_w2_00_-30	30	0	0	w2
	2	T2.3	28	182	s2_02_00_w3_00_-30	30	0	0	w3
	2	T2.4	20	183	s2_02_00_w4_00_-30	30	0	0	w4
	2	T2.5	34	184	s2_02_00_w5_00_-30	30	0	0	w5
	2	T2.6	25	185	s2_02_00_w6_00_-30	30	0	0	w6
12. Feb.	2	T20.1	24	192	s2_20_15_w1_00_-30	30	0.15	0	w1
	2	T20.2	17	193	s2_20_15_w2_00_-30	30	0.15	0	w2
	2	T20.3	28	194	s2_20_15_w3_00_-30	30	0.15	0	w3
	2	T20.4	20	195	s2_20_15_w4_00_-30	30	0.15	0	w4
	2	T20.5	34	196	s2_20_15_w5_00_-30	30	0.15	0	w5
	2	T20.6	25	197	s2_20_15_w6_00_-30	30	0.15	0	w6
12. Feb.	2	T4.1	24	202	s2_04_30_w1_00_-30	30	0.3	0	w1
	2	T4.2	17	203	s2_04_30_w2_00_-30	30	0.3	0	w2
	2	T4.3	28	204	s2_04_30_w3_00_-30	30	0.3	0	w3
	2	T4.4	20	205	s2_04_30_w4_00_-30	30	0.3	0	w4
	2	T4.5	34	206	s2_04_30_w5_00_-30	30	0.3	0	w5
	2	T4.6	25	207	s2_04_30_w6_00_-30	30	0.3	0	w6
09. Feb.	1	T15.1	24	174	s1_15_15_w1_00_+15	-15	0.15	0	w1
	1	T15.2	17	175	s1_15_15_w2_00_+15	-15	0.15	0	w2
	1	T15.3	28	176	s1_15_15_w3_00_+15	-15	0.15	0	w3
	1	T15.4	20	177	s1_15_15_w4_00_+15	-15	0.15	0	w4
	1	T15.5	34	178	s1_15_15_w5_00_+15	-15	0.15	0	w5
	1	T15.6	25	179	s1_15_15_w6_00_+15	-15	0.15	0	w6

Date	Set-up	Test series	duration (MikeZero) [min]	Test no.	file-name set-up/test/current/ wave/direction	wave direction [°]	current [m/s]	wind [m/s] 10 m/s≈49 Hz 5 m/s≈25 Hz	wave testno.
04. Feb.	1	T16.1	24	131	s1_16_30_w1_00_+15	-15	0.3	0	w1
	1	T16.2	17	132	s1_16_30_w2_00_+15	-15	0.3	0	w2
	1	T16.3	28	133	s1_16_30_w3_00_+15	-15	0.3	0	w3
	1	T16.4	20	134	s1_16_30_w4_00_+15	-15	0.3	0	w4
	1	T16.5	34	135	s1_16_30_w5_00_+15	-15	0.3	0	w5
	1	T16.6	25	136	s1_16_30_w6_00_+15	-15	0.3	0	w6
18. Feb.	3	T21.1	24	234	s3_21_15_w1_00_+30	-30	0.15	0	w1
	3	T21.2	17	235	s3_21_15_w2_00_+30	-30	0.15	0	w2
	3	T21.3	28	236	s3_21_15_w3_00_+30	-30	0.15	0	w3
	3	T21.4	20	237	s3_21_15_w4_00_+30	-30	0.15	0	w4
	3	T21.5	34	238	s3_21_15_w5_00_+30	-30	0.15	0	w5
	3	T21.6	25	239	s3_21_15_w6_00_+30	-30	0.15	0	w6
19. Feb.	3	T5.1	24	222	s3_05_30_w1_00_+30	-30	0.3	0	w1
	3	T5.2	17	223	s3_05_30_w2_00_+30	-30	0.3	0	w2
	3	T5.3	28	224	s3_05_30_w3_00_+30	-30	0.3	0	w3
	3	T5.4	20	225	s3_05_30_w4_00_+30	-30	0.3	0	w4
	3	T5.5	34	226	s3_05_30_w5_00_+30	-30	0.3	0	w5
	3	T5.6	25	227	s3_05_30_w6_00_+30	-30	0.3	0	w6
18. Feb.	3	T18.1	24	215	s3_18_00_w1_00_+45	-45	0	0	w1
	3	T18.2	17	216	s3_18_00_w2_00_+45	-45	0	0	w2
	3	T18.3	28	217	s3_18_00_w3_00_+45	-45	0	0	w3
	3	T18.4	20	218	s3_18_00_w4_00_+45	-45	0	0	w4
	3	T18.5	34	220	s3_18_00_w5_00_+45	-45	0	0	w5
	3	T18.6	25	-	s3_18_00_w6_00_+45	-45	0	0	w6
19. Feb.	3	T17.1	24	240	s3_17_15_w1_00_+45	-45	0.15	0	w1
	3	T17.2	17	241	s3_17_15_w2_00_+45	-45	0.15	0	w2
	3	T17.3	28	242	s3_17_15_w3_00_+45	-45	0.15	0	w3
	3	T17.4	20	243	s3_17_15_w4_00_+45	-45	0.15	0	w4
	3	T17.5	34	244	s3_17_15_w5_00_+45	-45	0.15	0	w5
	3	T17.6	25	245	s3_17_15_w6_00_+45	-45	0.15	0	w6
20. Feb.	3	T14.1	24	228	s3_14_30_w1_00_+45	-45	0.3	0	w1
	3	T14.2	17	229	s3_14_30_w2_00_+45	-45	0.3	0	w2
	3	T14.3	28	230	s3_14_30_w3_00_+45	-45	0.3	0	w3
	3	T14.4	20	231	s3_14_30_w4_00_+45	-45	0.3	0	w4
	3	T14.5	34	232	s3_14_30_w5_00_+45	-45	0.3	0	w5
	3	T14.6	25	233	s3_14_30_w6_00_+45	-45	0.3	0	w6
20.Feb.	3	T23.3	28	246	s3_23_00_w3_00_+30MD	-30	0	0	w3
	3	T23.5	34	247	s3_23_00_w5_00_+30MD		0	0	w5
05. Feb.	1	T6b.1	24	150	s1_06b_00_w1_25	0	0	5	w1
	1	T6b.2	17	151	s1_06b_00_w3_25	0	0	5	w3
	1	T6b.3	28	152	s1_06b_00_w5_25	0	0	5	w5
05. Feb.	1	T6.1	20	153	s1_06_00_w1_49	0	0	10	w1
	1	T6.2	34	154	s1_06_00_w3_49	0	0	10	w3
	1	T6.3	25	155	s1_06_00_w5_49	0	0	10	w5
04. Feb.	1	T8b.1	24	137	s1_08b_30_w1_25	0	0.3	5	w1
	1	T8b.3	28	138	s1_08b_30_w3_25	0	0.3	5	w3
	1	T8b.5	34	140	s1_08b_30_w5_25	0	0.3	5	w5
03. Feb.	1	T8.1	24	121	s1_08_30_w1_49	0	0.3	10	w1
	1	T8.2	28	122	s1_08_30_w3_49	0	0.3	10	w3
	1	T8.3	34	123	s1_08_30_w5_49	0	0.3	10	w5
11. Feb.	2	T7b.1	24	186	s2_07b_00_w1_25_-30	30	0	5	w1
	2	T7b.2	28	187	s2_07b_00_w3_25_-30	30	0	5	w3
	2	T7b.3	34	188	s2_07b_00_w5_25_-30	30	0	5	w5
11. Feb.	2	T7.1	24	189	s2_07_00_w1_49_-30	30	0	10	w1
	2	T7.2	28	190	s2_07_00_w3_49_-30	30	0	10	w3
	2	T7.3	34	191	s2_07_00_w5_49_-30	30	0	10	w5
13. Feb.	2	T9b.1	24	208	s2_09b_30_w1_25_-30	30	0.3	5	w1
	2	T9b.3	28	209	s2_09b_30_w3_25_-30	30	0.3	5	w3
	2	T9b.5	34	210	s2_09b_30_w5_25_-30	30	0.3	5	w5
13. Feb.	2	T9.1	24	211	s2_09_30_w1_49_-30	30	0.3	10	w1
	2	T9.3	28	212	s2_09_30_w3_49_-30	30	0.3	10	w3
	2	T9.5	34	213	s2_09_30_w5_49_-30	30	0.3	10	w5

Test	Nominal wave parameters				Wave gauges 9-5							Wave gauges 14-10							
no.	Hs	Tp	duration	no. of	Hm0	T01	T02	Tp	Cr	Hmax	Tz	Hm0	T01	T02	Tp	Cr	Hmax	Tz	N
	[m]	[s]	waves [min]	waves [-]	[m]	[s]	[s]	[s]	-	[m]	[s]	[m]	[s]	[s]	[s]	-	[m]	[s]	-
144	0.07	1.474	23	1021	0.068	1.26	1.20	1.46	0.498	0.150	1.22	0.071	1.28	1.22	1.46	0.457	0.155	1.25	1114
145	0.07	1.045	16	1002	0.065	0.96	0.92	1.05	0.320	0.132	0.94	0.059	0.94	0.90	1.05	0.339	0.124	0.93	1019
146	0.10	1.760	27	1004	0.095	1.49	1.41	1.78	0.535	0.209	1.46	0.101	1.51	1.44	1.78	0.433	0.213	1.49	1138
147	0.10	1.243	19	1001	0.095	1.10	1.06	1.20	0.308	0.196	1.07	0.092	1.11	1.07	1.28	0.306	0.182	1.09	1077
148	0.15	2.156	33	1002	0.140	1.73	1.61	2.16	0.568	0.294	1.68	0.148	1.75	1.63	2.16	0.398	0.309	1.72	1230
149	0.15	1.529	24	1027	0.141	1.33	1.27	1.52	0.322	0.280	1.30	0.145	1.36	1.30	1.52	0.275	0.280	1.34	1108
162	0.07	1.474	23	1021	0.067	1.24	1.19	1.41	0.477	0.150	1.21	0.065	1.24	1.18	1.46	0.505	0.141	1.21	1123
163	0.07	1.045	16	1002	0.066	0.95	0.92	1.02	0.289	0.138	0.93	0.067	0.95	0.92	1.05	0.312	0.135	0.93	1019
164	0.10	1.760	27	1004	0.097	1.48	1.39	1.78	0.517	0.203	1.46	0.100	1.50	1.41	1.78	0.528	0.217	1.48	1136
165	0.10	1.243	19	1001	0.099	1.10	1.07	1.28	0.275	0.192	1.08	0.091	1.07	1.04	1.20	0.342	0.181	1.06	1091
166	0.15	2.156	33	1002	0.144	1.72	1.60	2.16	0.584	0.315	1.70	0.151	1.76	1.64	2.16	0.502	0.327	1.72	1242
167	0.15	1.529	24	1027	0.137	1.31	1.25	1.52	0.327	0.265	1.28	0.140	1.33	1.27	1.52	0.347	0.281	1.31	1125
114	0.07	1.474	23	1021	0.054	1.00	0.98	1.14	0.366	0.114	0.98	0.051	1.01	0.98	1.17	0.404	0.112	0.98	1313
115	0.07	1.045	16	1002	0.050	0.77	0.76	0.79	0.260	0.107	0.78	0.047	0.77	0.76	0.79	0.314	0.099	0.77	1178
116	0.10	1.760	27	1004	0.103	1.35	1.28	1.58	0.418	0.221	1.32	0.095	1.33	1.27	1.64	0.437	0.201	1.31	1401
117	0.10	1.243	19	1001	0.103	1.02	1.00	1.14	0.250	0.195	1.01	0.100	1.03	1.00	1.17	0.246	0.202	1.01	1274
119	0.15	2.156	33	1002	0.140	1.72	1.61	2.16	0.597	0.284	1.67	0.141	1.75	1.63	2.16	0.486	0.275	1.68	1394
120	0.15	1.529	24	1027	0.139	1.32	1.26	1.52	0.317	0.256	1.30	0.130	1.31	1.25	1.52	0.332	0.254	1.28	1239
156	0.07	1.474	23	1021	0.075	1.26	1.20	1.46	0.480	0.161	1.22	0.067	1.22	1.18	1.46	0.509	0.140	1.20	1133
157	0.07	1.045	16	1002	0.072	0.95	0.93	1.02	0.301	0.150	0.95	0.073	0.96	0.94	1.05	0.303	0.151	0.97	991
158	0.10	1.760	27	1004	0.096	1.41	1.34	1.71	0.570	0.207	1.41	0.089	1.39	1.31	1.71	0.505	0.198	1.39	1205
159	0.10	1.243	19	1001	0.100	1.10	1.06	1.20	0.330	0.198	1.07	0.101	1.10	1.07	1.20	0.314	0.211	1.09	1063
160	0.15	2.156	33	1002	0.133	1.63	1.52	2.16	0.673	0.263	1.57	0.137	1.68	1.56	2.16	0.494	0.256	1.59	1365
161	0.15	1.529	24	1027	0.149	1.34	1.28	1.52	0.369	0.273	1.30	0.136	1.29	1.23	1.52	0.340	0.246	1.26	1143
168	0.07	1.474	23	1021	0.069	1.24	1.19	1.41	0.590	0.153	1.22	0.071	1.25	1.20	1.41	0.519	0.151	1.21	1119
169	0.07	1.045	16	1002	0.071	0.97	0.95	1.05	0.349	0.151	0.95	0.070	0.96	0.93	1.02	0.366	0.146	0.94	996
170	0.10	1.760	27	1004	0.094	1.41	1.34	1.78	0.604	0.198	1.40	0.092	1.41	1.33	1.71	0.536	0.210	1.39	1197
171	0.10	1.243	19	1001	0.103	1.11	1.08	1.28	0.354	0.222	1.08	0.104	1.11	1.08	1.24	0.327	0.216	1.08	1059
172	0.15	2.156	33	1002	0.128	1.63	1.52	2.16	0.631	0.252	1.52	0.133	1.65	1.53	2.16	0.594	0.256	1.55	1373
173	0.15	1.529	24	1027	0.139	1.31	1.25	1.58	0.401	0.264	1.27	0.142	1.31	1.25	1.52	0.382	0.273	1.28	1149
124	0.07	1.474	23	1021	0.066	1.24	1.19	1.46	0.588	0.145	1.22	0.071	1.27	1.22	1.46	0.524	0.150	1.23	1120
125	0.07	1.045	16	1002	0.069	0.97	0.95	1.05	0.374	0.150	0.95	0.069	0.96	0.94	1.02	0.371	0.153	0.94	1003
126	0.10	1.760	27	1004	0.091	1.44	1.37	1.78	0.627	0.198	1.43	0.095	1.45	1.38	1.71	0.615	0.204	1.44	1168
127	0.10	1.243	19	1001	0.096	1.10	1.08	1.24	0.362	0.196	1.08	0.094	1.10	1.07	1.20	0.365	0.189	1.06	1084
128	0.15	2.156	33	1002	0.127	1.66	1.55	2.05	0.589	0.260	1.56	0.124	1.62	1.51	2.05	0.646	0.252	1.53	1354
129	0.15	1.529	24	1027	0.133	1.31	1.26	1.52	0.396	0.278	1.28	0.146	1.34	1.29	1.52	0.393	0.286	1.30	1153
180	0.07	1.474	23	1021	0.077	1.24	1.19	1.46	0.592	0.172	1.24	0.082	1.26	1.21	1.46	0.630	0.174	1.27	1093
181	0.07	1.045	16	1002	0.081	0.967	0.950	1.078	0.410	0.171	0.97	0.079	0.97	0.95	1.05	0.467	0.173	0.96	976
182	0.10	1.760	27	1004	0.108	1.47	1.39	1.78	0.605	0.237	1.46	0.108	1.44	1.36	1.71	0.680	0.240	1.46	1116
183	0.10	1.243	19	1001	0.111	1.11	1.07	1.24	0.395	0.223	1.09	0.109	1.11	1.08	1.28	0.506	0.210	1.11	1061
184	0.15	2.156	33	1002	0.159	1.72	1.60	2.16	0.545	0.308	1.68	0.145	1.65	1.53	2.05	0.700	0.307	1.62	1260
185	0.15	1.529	24	1027	0.164	1.33	1.27	1.52	0.389	0.285	1.32	0.156	1.34	1.29	1.52	0.512	0.299	1.33	1116
192	0.07	1.474	23	1021	0.084	1.28	1.25	1.52	0.456	0.168	1.28	0.071	1.23	1.19	1.52	0.706	0.171	1.25	1087
193	0.07	1.045	16	1002	0.081	1.00	0.98	1.08	0.337	0.184	0.99	0.079	0.98	0.96	1.05	0.447	0.175	0.98	973
194	0.10	1.760	27	1004	0.115	1.46	1.40	1.71	0.514	0.237	1.45	0.106	1.47	1.40	1.78	0.640	0.218	1.42	1181
195	0.10	1.243	19	1001	0.120	1.14	1.11	1.20	0.342	0.234	1.11	0.108	1.11	1.07	1.24	0.478	0.218	1.09	1048
196	0.15	2.156	33	1002	0.159	1.69	1.58	2.16	0.461	0.319	1.66	0.149	1.69	1.56	2.16	0.621	0.317	1.68	1256
197	0.15	1.529	24	1027	0.167	1.35	1.30	1.52	0.390	0.288	1.32	0.149	1.33	1.26	1.58	0.520	0.306	1.29	1141
202	0.07	1.474	23	1021	0.081	1.30	1.27	1.46	0.435	0.167	1.28	0.072	1.28	1.24	1.46	0.663	0.158	1.26	1084
203	0.07	1.045	16	1002	0.075	1.03	1.01	1.05	0.362	0.162	0.99	0.072	0.99	0.98	1.02	0.462	0.184	0.97	976
204	0.10	1.760	27	1004	0.109	1.49	1.43	1.71	0.493	0.233	1.45	0.106	1.51	1.44	1.78	0.578	0.212	1.41	1187
205	0.10	1.243	19	1001	0.112	1.17	1.15	1.28	0.358	0.216	1.11	0.105	1.13	1.10	1.28	0.441	0.220	1.09	1048
206	0.15	2.156	33	1002	0.147	1.67	1.58	2.16	0.435	0.280	1.65	0.153	1.71	1.59	2.16	0.556	0.318	1.74	1216
207	0.15	1.529	24	1027	0.156	1.37	1.32	1.46	0.399	0.278	1.33	0.150	1.34	1.28	1.46	0.505	0.290	1.28	1148
174	0.07	1.474	23	1021	0.072	1.25	1.20	1.46	0.534	0.153	1.22	0.079	1.28	1.24	1.46	0.403	0.164	1.25	1114
175	0.07	1.045	16	1002	0.072	0.96	0.94	1.05	0.319	0.156	0.95	0.072	0.97	0.95	1.05	0.297	0.159	0.96	988
176	0.10	1.760	27	1004	0.095	1.42	1.35	1.78	0.603	0.223	1.41	0.104	1.45	1.39	1.78	0.418	0.215	1.45	1192
177	0.10	1.243	19	1001	0.101	1.11	1.08	1.24	0.320	0.203	1.09	0.109	1.13	1.10	1.24	0.256	0.210	1.13	1062
178	0.15	2.156	33	1002	0.133	1.65	1.54	2.16	0.665	0.280	1.60	0.141	1.67	1.57	2.16	0.421	0.268	1.63	1353
179	0.15	1.529	24	1027	0.142	1.32	1.26	1.52	0.394	0.268	1.30	0.154	1.34	1.29	1.52	0.280	0.264	1.34	1107

Test	Nominal wave parameters				Wave gauges 9-5							Wave gauges 14-10							
no.	Hs	Tp	duration	no. of	Hm0	T01	T02	Tp	Cr	Hmax	Tz	Hm0	T01	T02	Tp	Cr	Hmax	Tz	N
	[m]	[s]	waves [min]	waves [-]	[m]	[s]	[s]	[s]	-	[m]	[s]	[m]	[s]	[s]	[s]	-	[m]	[s]	-
131	0.07	1.474	23	1021	0.071	1.27	1.22	1.52	0.482	0.151	1.22	0.077	1.29	1.24	1.46	0.485	0.164	1.26	1106
132	0.07	1.045	16	1002	0.071	0.96	0.94	1.02	0.322	0.147	0.95	0.070	0.96	0.94	1.02	0.334	0.144	0.95	993
133	0.10	1.760	27	1004	0.099	1.45	1.38	1.71	0.505	0.212	1.43	0.107	1.48	1.42	1.71	0.441	0.231	1.46	1167
134	0.10	1.243	19	1001	0.099	1.12	1.08	1.24	0.323	0.189	1.09	0.101	1.13	1.10	1.24	0.335	0.219	1.12	1042
135	0.15	2.156	33	1002	0.133	1.67	1.57	2.16	0.625	0.263	1.63	0.149	1.72	1.62	2.16	0.404	0.281	1.68	1314
136	0.15	1.529	24	1027	0.148	1.35	1.30	1.52	0.333	0.267	1.33	0.156	1.37	1.31	1.52	0.300	0.275	1.36	1097
234	0.07	1.474	23	1021	0.079	1.23	1.19	1.41	0.575	0.160	1.21	0.080	1.26	1.22	1.46	0.566	0.160	1.24	1111
235	0.07	1.045	16	1002	0.086	0.99	0.97	1.02	0.431	0.170	0.96	0.079	0.98	0.96	1.02	0.413	0.160	0.98	961
236	0.10	1.760	27	1004	0.105	1.40	1.33	1.78	0.604	0.219	1.40	0.103	1.42	1.35	1.71	0.577	0.215	1.41	1193
237	0.10	1.243	19	1001	0.116	1.13	1.10	1.20	0.424	0.224	1.11	0.109	1.13	1.10	1.24	0.401	0.217	1.12	1029
238	0.15	2.156	33	1002	0.148	1.67	1.55	2.16	0.645	0.284	1.68	0.144	1.67	1.56	2.16	0.515	0.288	1.65	1237
239	0.15	1.529	24	1027	0.149	1.34	1.28	1.52	0.454	0.283	1.32	0.152	1.35	1.29	1.52	0.408	0.260	1.34	1097
222	0.07	1.474	23	1021	0.072	1.27	1.23	1.41	0.661	0.161	1.23	0.077	1.27	1.23	1.46	0.548	0.165	1.23	1100
223	0.07	1.045	16	1002	0.073	1.00	0.98	1.00	0.512	0.156	0.99	0.076	1.00	0.98	1.02	0.441	0.154	0.98	954
224	0.10	1.760	27	1004	0.101	1.47	1.40	1.78	0.698	0.221	1.43	0.104	1.45	1.38	1.78	0.555	0.212	1.40	1171
225	0.10	1.243	19	1001	0.099	1.15	1.12	1.20	0.476	0.207	1.12	0.105	1.15	1.12	1.28	0.405	0.205	1.12	1022
226	0.15	2.156	33	1002	0.156	1.76	1.65	2.16	0.617	0.314	1.78	0.147	1.69	1.58	2.16	0.496	0.298	1.72	1153
227	0.15	1.529	24	1027	0.142	1.39	1.33	1.52	0.494	0.265	1.37	0.152	1.38	1.33	1.52	0.387	0.274	1.36	1065
215	0.07	1.474	23	1021	0.088	1.24	1.19	1.52	0.637	0.185	1.21	0.097	1.26	1.22	1.46	0.396	0.183	1.25	1133
216	0.07	1.045	16	1002	0.095	0.99	0.97	1.02	0.487	0.193	0.99	0.096	1.00	0.99	1.05	0.315	0.179	1.00	952
217	0.10	1.760	27	1004	0.124	1.43	1.36	1.78	0.578	0.261	1.43	0.124	1.40	1.34	1.71	0.420	0.230	1.42	1160
218	0.10	1.243	19	1001	0.127	1.12	1.09	1.24	0.466	0.232	1.11	0.126	1.14	1.11	1.20	0.329	0.216	1.13	1039
220	0.15	2.156	33	1002	0.172	1.67	1.55	2.16	0.528	0.302	1.55	0.159	1.63	1.52	2.16	0.426	0.267	1.56	1307
-	0.15	1.529	24	1027															
240	0.07	1.474	23	1021	0.098	1.28	1.24	1.46	0.651	0.203	1.23	0.090	1.28	1.23	1.52	0.584	0.189	1.22	1100
241	0.07	1.045	16	1002	0.092	1.01	1.00	1.02	0.580	0.203	1.01	0.088	1.01	0.99	1.05	0.559	0.195	1.01	942
242	0.10	1.760	27	1004	0.129	1.44	1.37	1.71	0.663	0.269	1.42	0.126	1.46	1.39	1.71	0.516	0.240	1.44	1192
243	0.10	1.243	19	1001	0.128	1.16	1.13	1.24	0.553	0.236	1.15	0.120	1.16	1.13	1.24	0.476	0.245	1.14	1006
244	0.15	2.156	33	1002	0.173	1.68	1.56	2.16	0.635	0.322	1.55	0.178	1.71	1.60	2.16	0.436	0.307	1.67	1301
245	0.15	1.529	24	1027	0.140	1.41	1.36	1.58	0.617	0.280	1.35	0.138	1.42	1.37	1.58	0.454	0.276	1.38	1076
228	0.07	1.474	23	1021	0.096	1.31	1.26	1.37	0.608	0.227	1.24	0.088	1.30	1.25	1.41	0.628	0.205	1.24	1082
229	0.07	1.045	16	1002	0.085	1.05	1.03	1.11	0.551	0.206	1.03	0.081	1.04	1.02	1.05	0.544	0.194	1.02	919
230	0.10	1.760	27	1004	0.131	1.47	1.41	1.78	0.648	0.269	1.40	0.126	1.49	1.42	1.78	0.578	0.252	1.43	1171
231	0.10	1.243	19	1001	0.126	1.20	1.17	1.32	0.551	0.269	1.17	0.117	1.18	1.15	1.32	0.523	0.252	1.16	990
232	0.15	2.156	33	1002	0.169	1.70	1.58	2.16	0.665	0.358	1.65	0.177	1.73	1.61	2.16	0.462	0.324	1.70	1252
233	0.15	1.529	24	1027	0.150	1.43	1.38	1.52	0.547	0.290	1.39	0.130	1.43	1.37	1.46	0.520	0.270	1.38	1057
246	0.10	1.76	27	1004															
247	0.15	2.156	33	1002															
150	0.07	1.474	23	1021	0.068	1.27	1.22	1.46	0.506	0.147	1.24	0.070	1.30	1.24	1.46	0.457	0.149	1.27	1089
151	0.10	1.760	27	1004	0.094	1.49	1.41	1.78	0.547	0.205	1.48	0.100	1.52	1.45	1.78	0.433	0.210	1.51	1096
152	0.15	2.156	33	1002	0.137	1.72	1.61	2.16	0.579	0.294	1.69	0.147	1.75	1.64	2.16	0.407	0.308	1.74	1210
153	0.07	1.474	23	1021	0.068	1.27	1.22	1.46	0.496	0.151	1.24	0.069	1.30	1.25	1.46	0.441	0.149	1.25	1102
154	0.10	1.760	27	1004	0.094	1.49	1.41	1.78	0.550	0.213	1.49	0.099	1.53	1.46	1.78	0.424	0.208	1.52	1094
155	0.15	2.156	33	1002	0.137	1.72	1.61	2.16	0.575	0.294	1.71	0.146	1.75	1.64	2.16	0.410	0.307	1.74	1200
137	0.07	1.474	23	1021	0.069	1.25	1.20	1.46	0.446	0.144	1.22	0.064	1.23	1.18	1.52	0.479	0.138	1.21	1118
138	0.10	1.760	27	1004	0.096	1.47	1.39	1.78	0.536	0.201	1.47	0.095	1.48	1.40	1.71	0.509	0.198	1.48	1121
140	0.15	2.156	33	1002	0.142	1.73	1.61	2.16	0.607	0.305	1.70	0.142	1.76	1.64	2.16	0.485	0.305	1.73	1229
121	0.07	1.474	23	1021	0.051	1.06	1.01	1.24	0.406	0.104	1.01	0.050	1.07	1.02	1.20	0.441	0.107	1.02	1273
122	0.10	1.760	27	1004	0.095	1.46	1.38	1.78	0.501	0.202	1.44	0.094	1.47	1.39	1.71	0.512	0.205	1.47	1325
123	0.15	2.156	33	1002	0.142	1.74	1.62	2.16	0.582	0.297	1.71	0.144	1.77	1.65	2.16	0.494	0.298	1.72	1403
186	0.07	1.474	23	1021	0.076	1.24	1.20	1.46	0.614	0.168	1.26	0.081	1.26	1.21	1.46	0.609	0.173	1.27	1080
187	0.10	1.760	27	1004	0.107	1.48	1.40	1.78	0.610	0.239	1.47	0.108	1.44	1.36	1.71	0.679	0.239	1.46	1113
188	0.15	2.156	33	1002	0.158	1.72	1.60	2.16	0.553	0.311	1.69	0.144	1.65	1.53	2.05	0.698	0.308	1.64	1230
189	0.07	1.474	23	1021	0.075	1.25	1.21	1.46	0.607	0.168	1.25	0.081	1.26	1.22	1.46	0.587	0.169	1.26	1085
190	0.10	1.760	27	1004	0.106	1.49	1.41	1.78	0.620	0.244	1.48	0.107	1.44	1.37	1.71	0.660	0.238	1.46	1111
191	0.15	2.156	33	1002	0.157	1.73	1.61	2.16	0.560	0.309	1.69	0.144	1.66	1.54	2.05	0.682	0.300	1.65	1222
208	0.07	1.474	23	1021	0.082	1.31	1.28	1.46	0.433	0.167	1.27	0.072	1.28	1.24	1.41	0.663	0.162	1.27	1080
209	0.10	1.760	27	1004	0.110	1.49	1.44	1.71	0.490	0.232	1.44	0.106	1.51	1.45	1.78	0.579	0.213	1.42	1188
210	0.15	2.156	33	1002	0.147	1.67	1.57	2.16	0.434	0.278	1.66	0.152	1.71	1.60	2.16	0.555	0.328	1.75	1217
211	0.07	1.474	23	1021	0.081	1.31	1.27	1.46	0.427	0.167	1.27	0.072	1.28	1.24	1.41	0.655	0.160	1.27	1080
212	0.10	1.760	27	1004	0.110	1.49	1.44	1.71	0.490	0.231	1.44	0.106	1.52	1.45	1.78	0.575	0.211	1.42	1180
213	0.15	2.156	33	1002	0.147	1.67	1.57	2.16	0.432	0.283	1.65	0.152	1.71	1.60	2.16	0.550	0.321	1.75	1217

Test	Run-up	Overtopping				Flow velocities 2%				Flow depths 2%			
no.	2% [	q70-37	q70-39	q60-41	q60-43	v70-33-l	v70-34-s	v60-35-l	v60-36-s	h70-15-l	h70-16-s	h70-17-l	h60-18-s
	[m]	l/s per m	l/s per m	l/s per m	l/s per m	m/s	m/s	m/s	m/s	m	m	m	m
144	0.198	0.0012	0.0025	0.3485	0.408	no data	0.808	1.294	no data	no data	no data	0.0170	0.0263
145	0.160	-0.0018	0	0.0478	0.0354	0.859	0.576	no data	no data	no data	0.0037	0.0151	no data
146	0.292	0.0574	0.1107	1.4388	1.0522	0.610	1.163	1.569	no data	0.0128	0.0185	0.0276	0.0387
147	0.230	0.0058	0.0248	0.6039	0.6199	0.2188	0.88872	1.49871	no data	0.0063	0.0107	0.0191	0.0267
148	0.437	0.6362	1.5236	4.3908	3.4169	1.196	1.528	2.054	no data	0.0282	0.0462	0.0517	0.0671
149	0.361	0.1696	0.3692	2.9798	2.5997	0.939	1.334	1.993	no data	0.0168	0.0266	0.0356	0.0484
162	0.221	0	0.0062	0.2939	0.3981	no data	no data	0.980	1.105	no data	no data	0.0145	0.0245
163	0.169	0	0	0.0744	0.0354	0.468	0.448	no data	no data	0.0056	0.0070	no data	no data
164	0.310	0.0292	0.0836	1.3061	1.4345	no data	0.884	1.470	1.585	no data	0.0204	0.0249	0.0381
165	0.247	0.0044	0.0146	0.4828	0.636	no data	0.86031	1.20771	1.26507	0.0055	0.0078	0.0166	0.0222
166	0.463	0.532	0.6463	5.1216	4.2199	1.152	1.026	1.880	2.202	0.0218	0.0408	0.0494	0.0694
167	0.379	0.1108	0.3427	2.6988	3.0547	1.845	0.955	1.834	2.142	0.0149	0.0289	0.0333	0.0490
114	0.147	0	0	0.0209	0.0079	no data	no data	no data	no data	0.0051	0.0059	no data	no data
115	0.095	0	0	0	0	-	-	-	-	0.0001	0.0001	no data	0.0001
116	0.288	0.0156	0.0633	0.9605	1.2201	no data	0.015	no data	0.143	0.0103	0.0161	0.0173	0.0306
117	0.237	0.0026	0.0079	0.5052	0.2997	no data	0.01411	no data	0.14052	no data	no data	0.0133	0.0202
119	0.433	0.6586	0.5706	4.6864	4.6638	no data	0.017	no data	0.148	0.0269	0.0401	0.0428	0.0701
120	0.367	0.1224	0.312	2.3851	2.8664	no data	0.016	no data	0.147	0.0160	0.0241	0.0265	0.0465
156	0.229	0.0025	0.0012	0.4353	0.1959	no data	0.742	0.962	1.084	no data	no data	0.0123	0.0189
157	0.181	0	0	0.1009	0.0407	0.779	0.581	no data	no data	0.0071	0.0108	no data	no data
158	0.290	0.0407	0.0867	1.2788	1.1336	0.512	0.875	1.289	1.433	0.0102	0.0166	0.0202	0.0346
159	0.252	0.0044	0.0131	0.8417	0.3836	no data	0.74197	1.15808	1.34786	no data	0.0070	0.0158	0.0240
160	0.383	0.7329	0.8614	3.429	4.6666	1.196	1.135	1.852	2.010	0.0261	0.0450	0.0398	0.0670
161	0.337	0.1881	0.2331	3.1702	2.424	0.823	1.012	1.686	1.777	0.0163	0.0236	0.0268	0.0403
168	0.214	0.0025	0.005	0.4427	0.1823	no data	no data	1.064	1.122	no data	no data	0.0145	0.0209
169	0.176	0	-0.0018	0.1009	0.0443	no data	no data	0.701	0.974	0.0070	0.0097	no data	no data
170	0.263	0.0595	0.0564	1.2638	0.7385	no data	0.931	1.395	1.461	0.0115	0.0185	no data	0.0292
171	0.247	0.0088	0.0102	0.7279	0.5718	no data	0.84138	1.32951	1.42291	no data	0.0069	0.0158	0.0257
172	0.352	1.005	1.0309	3.0645	3.289	1.845	1.054	1.759	1.878	0.0232	0.0421	0.0341	0.0573
173	0.337	0.2238	0.3634	3.0113	2.187	1.854	0.983	1.899	2.035	0.0158	0.0275	0.0304	0.0413
124	0.161	0.0012	0.0012	0.2592	0.2617	no data	0.666	1.032	1.101	no data	no data	0.0132	0.0224
125	0.127	0	-0.0018	0.0903	0.0567	no data	0.524	1.054	no data	0.0267	0.0317	no data	no data
126	0.219	0.0522	0.0951	1.2168	0.657	no data	0.964	1.592	1.756	0.0125	0.0192	no data	no data
127	0.185	0.0058	0.0117	0.6331	0.5776	no data	0.860	1.158	1.391	0.0084	0.0089	0.0155	0.0250
128	0.290	0.7539	0.8979	3.1721	2.5538	1.250	1.121	1.716	1.878	0.0254	0.0398	no data	no data
129	0.279	0.2181	0.3796	2.3203	2.2927	1.054	1.059	1.801	1.971	0.0182	0.0281	0.0319	0.0417
180	0.225	0.0015	0.0015	0.2956	0.3205	no data	no data	0.698	0.720	no data	no data	0.0127	0.0189
181	0.154	0.000	0.000	0.102	0.090	no data	0.004	0.511	no data	0.0001	no data	0.0104	0.0137
182	0.310	0.056	0.072	1.537	1.070	0.752	0.941	1.185	1.458	0.0116	0.0177	0.0216	0.0330
183	0.239	0.0034	0.0052	0.923	0.5679	no data	0.77037	1.13846	1.22762	no data	0.0073	0.0163	0.0227
184	0.435	0.4442	0.6376	5.1917	3.5031	1.188	1.324	1.509	1.825	0.0180	0.0312	0.0395	0.0544
185	0.357	0.1144	0.1729	3.0031	3.1883	0.992	1.177	1.574	1.722	0.0135	0.0215	0.0276	0.0425
192	0.153	0	0	0.5502	0.3468	no data	no data	0.951	1.155	no data	0.0081	0.0204	no data
193	0.142	0	0	0.1818	0.1337	no data	0.004	0.764	1.023	no data	no data	0.0114	0.0162
194	0.255	0.0197	0.032	1.5425	1.7315	0.370	0.884	no data	1.573	no data	0.0124	0.0234	0.0362
195	no data	0	0.0034	0.9243	0.9157	no data	0.775	no data	1.407	no data	no data	0.0259	no data
196	0.374	0.1938	0.3988	4.8512	4.2058	1.836	1.230	no data	1.889	0.0156	0.0288	0.0456	0.0614
197	0.276	0.0994	0.1661	3.5034	3.2044	1.836	1.045	no data	1.812	0.0117	0.0194	0.0309	0.0378
202	no data	0.0015	0	0.3966	0.4171	no data	0.008	0.330	no data	0.0001	0.0000	0.0146	0.0217
203	no data	-0.0021	-0.0021	0.1379	0.1442	no data	no data	no data	0.97167	0.0000	0.0001	0.0103	0.0160
204	no data	0.0037	0.0136	1.4155	1.575	no data	0.785	no data	1.492	no data	0.0104	0.0207	0.0339
205	no data	0	0	0.8968	0.9691	no data	no data	0.560	no data	0.0325	0.0410	no data	no data
206	no data	0.108	0.2494	3.8287	4.2699	1.828	1.035	no data	1.825	0.0139	0.0254	0.0410	0.0616
207	no data	0.0517	0.0967	2.9268	3.2107	1.854	0.927	no data	1.842	0.0107	0.0179	no data	0.0394
174	0.235804	0	0.0012	0.3956	0.1228	no data	no data	0.949	1.145	no data	no data	0.0136	0.0180
175	0.174	0	0	0.0779	0.0266	0.6543	0.58103	no data	no data	0.0269	0.0301	no data	no data
176	0.298	0.0324	0.0919	0.9668	0.3792	0.450	0.931	1.295	1.575	0.0114	0.0166	0.0220	0.0312
177	0.254	0.0029	0.0146	0.7473	0.2626	no data	no data	no data	0.910	no data	0.0080	0.0152	0.0228
178	0.390	0.7539	0.8988	2.9564	1.4516	1.801	1.054	1.354	1.607	0.0216	0.0430	0.0399	0.0551
179	0.334	0.1973	0.33	2.6104	1.3067	1.836	0.983	1.240	1.640	0.0145	0.0277	0.0286	0.0387

Test	**Run-up**	**Overtopping**				**Flow velocities 2%**				**Flow depths 2%**			
no.	2% [	q70-37	q70-39	q60-41	q60-43	v70-33-l	v70-34-s	v60-35-l	v60-36-s	h70-15-l	h70-16-s	h70-17-l	h60-18-s
	[m]	l/s per m	l/s per m	l/s per m	l/s per m	m/s	m/s	m/s	m/s	m	m	m	m
131	0.206765	0.0012	0.0012	0.3869	0.248	1.312	0.751	1.121	no data	0.0061	no data	0.0164	0.0221
132	0.151	0	0	0.0761	0.046	no data	0.35382	0.88501	no data	0.0056	0.0101	no data	no data
133	0.261	0.0188	0.0637	1.1276	0.7427	0.361	0.884	1.459	1.639	0.0103	0.0147	0.0230	0.0347
134	0.227	0.0044	0.0073	0.6593	0.4522	no data	0.841	1.223	1.479	0.0053	0.0067	0.0165	0.0255
135	0.372	0.7822	0.9031	3.8898	2.5679	1.090	1.125	1.782	2.048	0.0271	0.0444	0.0447	0.0568
136	0.330	0.0923	0.2896	2.8749	1.8971	0.752	0.950	1.559	1.768	0.0158	0.0233	0.0321	0.0470
234	0.236	0	0.004	0.306	0.383	no data	no data	0.815	0.942	no data	0.0062	0.0163	0.0205
235	0.190	0	0	0.09	0.09	no data	0.196	0.754	no data	no data	no data	0.0117	0.0140
236	0.314	0.0431	0.0567	1.0959	1.6166	0.645	0.699	1.087	1.164	0.0078	0.0133	0.0223	0.0320
237	0.256	0.0034	0.012	0.7126	0.661		0.524	0.923	1.091	0.0055	0.0105	0.0189	0.0254
238	0.426	0.8684	0.52	4.8153	4.3449	1.801		1.443	1.616	0.0190	0.0300	0.0423	0.0619
239	0.372	0.196	0.3703	2.5577	3.5569	1.214	0.799	1.368	1.573	0.0129	0.0206	0.0309	0.0414
222	0.198	0.0176	0.0029	0.2795	0.3863		0.761	0.764	0.908			0.0150	0.0201
223	0.136	0	0	0.0731	0.1107		0.766	0.539	0.763	0.0002	0.0001	0.0113	0.0146
224	0.274	0.18	0.0382	1.302	1.0124			0.989	1.262		0.0160	0.0210	0.0329
225	0.210	0.0293	0.0138	0.5439	0.7522		0.295	1.082			0.0050	0.0176	0.0240
226	0.401	1.9016	0.3524	4.4395	4.6321	1.952	1.163	1.480	1.646	0.0242	0.0367	0.0463	0.0619
227	0.332	0.4697	0.1511	2.6547	3.0236	1.952	0.998	1.316	1.518	0.0133	0.0210	0.0269	0.0381
215	no data	0.0015	0	0.1815	0.1302	no data	0.766	0.698	0.886	no data	0.0078	0.0136	0.0182
216	no data	0	0	0.0648	0.046	no data	0.004	0.487	0.801	0.0001	0.0000	0.0107	0.0132
217	no data	0.0259	0.0247	0.567	0.4807	0.539	0.912	1.012	1.121	0.0066	0.0138	0.0188	0.0253
218	no data	0	-0.0017	0.4165	0.4062	0.610	0.317	0.937	no data	no data	0.0044	0.0166	0.0217
220	no data	0.3917	0.1686	1.9492	1.3247	1.054	1.244	1.185	1.313	0.0143	0.0282	0.0262	0.0436
-													
240	0.205	0.0015	0	0.3629	0.4639	no data	0.004	0.914	1.036	no data	no data	0.0166	0.0225
241	0.163	0	0	0.071	0.1149	no data	0.264	0.754	no data	no data	no data	0.0122	0.0161
242	0.256	0.0542	0.0296	1.4103	1.2354	0.797	no data	1.129	1.309	0.0087	0.0178	0.0226	0.0307
243	0.201	0.0017	0.0034	0.568	0.7246	no data	no data	0.998	1.087	no data	0.0034	0.0184	0.0251
244	0.345	0.4351	0.8218	3.3877	3.3756	1.881	1.073	1.316	1.513	0.0169	0.0323	0.0331	0.0512
245	0.258	0.0545	0.0517	1.5261	1.5733	0.699	0.711	1.284	no data	0.0071	0.0144	0.0241	0.0317
228	0.227	0	0	0.3615	0.4083	no data	no data	0.796	0.963	no data	0.0083	0.0171	0.0247
229	0.174	0	0	0.0773	0.0919	no data	0.073	0.703	no data	0.0154	0.0190	no data	no data
230	0.288	0.0185	0.0653	1.287	1.5618	1.810	0.865	1.148	1.339	0.0109	0.0166	0.0249	0.0378
231	0.247	0.0034	0.0017	0.5474	0.5818	no data	0.813	0.904	1.112	no data	0.0092	0.0188	0.0258
232	0.379	0.4139	1.0034	3.6647	4.1455	1.916	1.173	1.377	1.560	0.0197	0.0308	0.0330	0.0530
233	0.303	0.0368	0.0613	1.6133	1.7911	1.872	0.927	1.190	1.275	0.0113	0.0182	0.0255	0.0354
246													
247													
150	0.183	0.0025	0.0037	0.3448	0.3435	no data	0.789	1.491	no data	no data	no data	0.0170	0.0261
151	0.278	0.0512	0.1577	1.3759	0.9655	no data	1.149	1.803	no data	no data	0.0180	0.0270	0.0409
152	0.435	0.5835	1.8077	4.6155	3.4745	1.099	1.443	2.193	no data	no data	0.0431	0.0529	0.0676
153	0.172	0.0012	0.005	0.3435	0.3175	no data	0.761	0.670	0.920	no data	no data	-0.0182	0.1395
154	0.263	0.0512	0.1964	1.3902	0.8805	no data	4.997	1.233	1.493	0.0105	0.0179	0.0262	0.0396
155	0.435	0.5667	1.7329	4.327	3.0374	1.125	4.983	1.871	1.980	0.0260	0.0447	0.0532	0.0665
137	0.223	0	0.0037	0.2604	0.2406	no data	0.747	1.212	1.324	no data	no data	0.0102	0.0202
138	0.301	0.0292	0.1024	1.2076	1.3532	no data	0.950	1.596	1.606	0.0103	0.0172	0.0209	0.0366
140	0.446	0.7484	0.7026	4.8252	4.8021	1.072	1.140	2.320	2.419	0.0260	0.0417	0.0454	0.0717
121	0.145	0	0	0.0615	0.0079	no data	1.078	no data	3.726	0.0266	0.0277	no data	no data
122	0.566	0.0275	0.0844	1.1768	1.2667	no data	9.995	2.263	2.702	no data	0.0302	0.0452	0.0742
123	0.452	0.7668	0.6924	5.0719	4.6257	1.143	4.997	1.960	2.176	no data	0.0404	0.0487	0.0724
186	0.230	0.0044	0.0029	0.2502	0.2561	no data	no data	0.731	0.963	no data	no data	0.0124	0.0186
187	0.305	0.0666	0.0715	1.5223	1.0032	0.690	0.993	1.129	1.441	no data	0.0165	0.0219	0.0329
188	0.425	0.5144	0.6378	5.0663	3.3932	1.196	1.282	1.537	1.650	0.0168	0.0321	0.0378	0.0538
189	0.223	0.0044	0.0044	0.3512	0.3205	no data	1.002	0.792	1.040	no data	no data	0.0127	0.0193
190	0.301	0.106	0.085	1.6186	1.0535	0.743	2.058	1.167	1.356	no data	0.0170	0.0221	0.0338
191	0.437	0.6247	0.677	5.0982	3.4159	1.188	1.457	1.490	1.816	0.0171	0.0308	0.0374	0.0534
208	no data	0	-0.0015	0.4156	0.4185	no data	0.004	no data	1.108	no data	no data	0.0143	0.0209
209	no data	0.0049	0.0197	1.4137	1.5616	no data	0.837	no data	1.449	no data	0.0102	0.0209	0.0332
210	no data	0.1161	0.2665	3.8457	4.2479	1.001	1.040	0.351	no data	0.0126	0.0254	0.0411	0.0615
211	no data	0	-0.0015	0.4434	0.4375	no data	0.365	no data	no data	no data	no data	0.0138	0.0216
212	no data	0.0099	0.032	1.4321	1.5641	no data	3.677	no data	1.424	0.0051	0.0107	0.0183	0.0335
213	no data	0.1565	0.2857	3.8075	4.2388	1.001	3.705	1.504	1.791	no data	0.0265	0.0392	0.0597

Test series	Test no.	file-name	wave direction [°]	current [m/s]	wind speed [m/s] 10 m/s ≈ 49 Hz 5 m/s ≈ 25 Hz	wave number	water depth [m]	Nominal wave parameters Hs [m]	Tp [s]	no. of waves [-]
Set-up 4										
s4_01	425	s4_01_00_w1_00_00	0	0.00	00	w1	0.50	0.07	1.474	1021
s4_01	427	s4_01_00_w2_00_00	0	0.00	00	w2	0.50	0.07	1.045	1002
s4_01	426	s4_01_00_w3_00_00	0	0.00	00	w3	0.50	0.10	1.760	1004
s4_01	428	s4_01_00_w4_00_00	0	0.00	00	w4	0.50	0.10	1.243	1001
s4_01	429	s4_01_00_w5_00_00	0	0.00	00	w5	0.50	0.15	2.156	1002
s4_01	430	s4_01_00_w6_00_00	0	0.00	00	w6	0.50	0.15	1.529	1027
s4_01a	451	s4_01a_00_w1_00_00	0	0.00	00	w1	0.55	0.09	1.670	1097
s4_01a	452	s4_01a_00_w2_00_00	0	0.00	00	w2	0.55	0.09	1.181	1108
s4_01a	453	s4_01a_00_w3_00_00	0	0.00	00	w3	0.55	0.12	1.929	1120
s4_01a	454	s4_01a_00_w4_00_00	0	0.00	00	w4	0.55	0.12	1.364	1104
s4_01a	456	s4_01a_00_w5_00_00	0	0.00	00	w5	0.55	0.15	2.156	1093
s4_01a	457	s4_01a_00_w6_00_00	0	0.00	00	w6	0.55	0.15	1.525	1116
s4_02	418	s4_02_00_w1_25_00	0	0.00	25	w1	0.50	0.07	1.474	1021
s4_02	419	s4_02_00_w3_25_00	0	0.00	25	w3	0.50	0.10	1.760	1004
s4_02	421	s4_02_00_w5_25_00	0	0.00	25	w5	0.50	0.15	2.156	1002
s4_03a	464	s4_03a_00_w1_49_00	0	0.00	49	w1	0.55	0.09	1.670	1097
s4_03a	465	s4_03a_00_w3_49_00	0	0.00	49	w3	0.55	0.12	1.929	1120
s4_03a	466	s4_03a_00_w5_49_00	0	0.00	49	w5	0.55	0.15	2.156	1093
s4_04a	458	s4_04a_30_w1_00_00	0	0.30	00	w1	0.55	0.09	1.670	1097
s4_04a	459	s4_04a_30_w2_00_00	0	0.30	00	w2	0.55	0.09	1.181	1108
s4_04a	460	s4_04a_30_w3_00_00	0	0.30	00	w3	0.55	0.12	1.929	1120
s4_04a	461	s4_04a_30_w4_00_00	0	0.30	00	w4	0.55	0.12	1.364	1104
s4_04a	462	s4_04a_30_w5_00_00	0	0.30	00	w5	0.55	0.15	2.156	1093
s4_04a	463	s4_04a_30_w6_00_00	0	0.30	00	w6	0.55	0.15	1.525	1116
s4_05	412	s4_05_30_w1_49_00	0	0.30	49	w1	0.50	0.07	1.474	1021
s4_05	413	s4_05_30_w3_49_00	0	0.30	49	w3	0.50	0.10	1.760	1004
s4_05	414	s4_05_30_w5_49_00	0	0.30	49	w5	0.50	0.15	2.156	1002
s4_06	415	s4_06_30_w1_25_00	0	0.30	25	w1	0.50	0.07	1.474	1021
s4_06	416	s4_06_30_w3_25_00	0	0.30	25	w3	0.50	0.10	1.760	1004
s4_06	417	s4_06_30_w5_25_00	0	0.30	25	w5	0.50	0.15	2.156	1002
s4_07	467	s4_07_15_w1_00_00	0	0.15	00	w1	0.55	0.09	1.670	1097
s4_07	468	s4_07_15_w2_00_00	0	0.15	00	w2	0.55	0.09	1.181	1108
s4_07	469	s4_07_15_w3_00_00	0	0.15	00	w3	0.55	0.12	1.929	1120
s4_07	470	s4_07_15_w4_00_00	0	0.15	00	w4	0.55	0.12	1.364	1104
s4_07	471	s4_07_15_w5_00_00	0	0.15	00	w5	0.55	0.15	2.156	1093
s4_07	472	s4_07_15_w6_00_00	0	0.15	00	w6	0.55	0.15	1.525	1116
s4_08	473	s4_08_15_w1_49_00	0	0.15	49	w1	0.55	0.09	1.670	1058
s4_08	474	s4_08_15_w3_49_00	0	0.15	49	w3	0.55	0.12	1.929	1086
s4_08	475	s4_08_15_w5_49_00	0	0.15	49	w5	0.55	0.15	2.156	1093
s4_10	480	s4_10_40_w1_00_00	0	0.40	00	w1	0.55	0.09	1.670	1097
s4_10	481	s4_10_40_w2_00_00	0	0.40	00	w2	0.55	0.09	1.181	1108
s4_10	482	s4_10_40_w3_00_00	0	0.40	00	w3	0.55	0.12	1.929	1120
s4_10	483	s4_10_40_w4_00_00	0	0.40	00	w4	0.55	0.12	1.364	1104
s4_10	484	s4_10_40_w5_00_00	0	0.40	00	w5	0.55	0.15	2.156	1093
s4_10	485	s4_10_40_w6_00_00	0	0.40	00	w6	0.55	0.15	1.525	1116
s4_11	488	s4_11_40_w1_49_00	0	0.40	49	w1	0.55	0.09	1.670	1058
s4_11	489	s4_11_40_w3_49_00	0	0.40	49	w3	0.55	0.12	1.929	1086
s4_11	490	s4_11_40_w5_49_00	0	0.40	49	w5	0.55	0.15	2.156	1093
s4_32	432	s4_32_30_w1_00_15m	15	0.30	00	w1	0.50	0.07	1.474	1021
s4_32	433	s4_32_30_w2_00_15m	15	0.30	00	w2	0.50	0.07	1.045	1002
s4_32	434	s4_32_30_w3_00_15m	15	0.30	00	w3	0.50	0.10	1.760	1004
s4_32	435	s4_32_30_w4_00_15m	15	0.30	00	w4	0.50	0.10	1.243	1001
s4_32	437	s4_32_30_w5_00_15m	15	0.30	00	w5	0.50	0.15	2.156	1002
s4_32	438	s4_32_30_w6_00_15m	15	0.30	00	w6	0.50	0.15	1.529	1027
s4_33	440	s4_33_30_w3_00_15p	-15	0.30	00	w3	0.50	0.10	1.760	1004
s4_33	441	s4_33_30_w4_00_15p	-15	0.30	00	w4	0.50	0.10	1.243	1001
s4_33	442	s4_33_30_w5_00_15p	-15	0.30	00	w5	0.50	0.15	2.156	1002
s4_33	443	s4_33_30_w6_00_15p	-15	0.30	00	w6	0.50	0.15	1.529	1027
s4_34	444	s4_34_00_w1_00_15m	15	0.00	00	w1	0.55	0.09	1.670	1097
s4_34	445	s4_34_00_w2_00_15m	15	0.00	00	w2	0.55	0.09	1.181	1108
s4_34	447	s4_34_00_w3_00_15m	15	0.00	00	w3	0.55	0.12	1.929	1120
s4_34	448	s4_34_00_w4_00_15m	15	0.00	00	w4	0.55	0.12	1.364	1104
s4_34	449	s4_34_00_w5_00_15m	15	0.00	00	w5	0.55	0.15	2.156	1093
s4_34	450	s4_34_00_w6_00_15m	15	0.00	00	w6	0.55	0.15	1.525	1116
s4_35	476	s4_35_15_wi_00_00	0	0.15	00	w1	0.55	0.09	1.670	1097
s4_35	477	s4_35_15_wi_00_00	0	0.15	00	w2	0.55	0.09	1.181	1108
s4_36	486	s4_36_40_wi_00_00	0	0.40	00	w1	0.55	0.15	1.525	1116
s4_36	487	s4_36_40_wi_00_00	0	0.40	00	w2	0.55	0.09	1.181	1108

Test series	Test no.	file-name	wave direction [°]	current [m/s]	wind speed [m/s] 10 m/s ≈ 49 Hz 5 m/s ≈ 25 Hz	wave number	water depth [m]	Nominal wave parameters Hs [m]	Tp [s]	no. of waves [-]
Set-up 5										
s5_13	511	s5_13_00_w1_00_30m	30	0.00	00	w1	0.55	0.09	1.670	1097
s5_13	512	s5_13_00_w2_00_30m	30	0.00	00	w2	0.55	0.09	1.181	1108
s5_13	513	s5_13_00_w3_00_30m	30	0.00	00	w3	0.55	0.12	1.929	1120
s5_13	514	s5_13_00_w4_00_30m	30	0.00	00	w4	0.55	0.12	1.364	1104
s5_13	515	s5_13_00_w5_00_30m	30	0.00	00	w5	0.55	0.15	2.156	1093
s5_13	516	s5_13_00_w6_00_30m	30	0.00	00	w6	0.55	0.15	1.525	1116
s5_15	536	s5_15_00_w1_49_30m	30	0.00	49	w1	0.55	0.09	1.670	1097
s5_15	537	s5_15_00_w3_49_30m	30	0.00	49	w3	0.55	0.12	1.929	1120
s5_15	538	s5_15_00_w5_49_30m	30	0.00	49	w5	0.55	0.15	2.156	1093
s5_16	501	s5_16_40_w1_00_30m	30	0.40	00	w1	0.55	0.09	1.670	1097
s5_16	502	s5_16_40_w2_00_30m	30	0.40	00	w2	0.55	0.09	1.181	1108
s5_16	503	s5_16_40_w3_00_30m	30	0.40	00	w3	0.55	0.12	1.929	1120
s5_16	504	s5_16_40_w4_00_30m	30	0.40	00	w4	0.55	0.12	1.364	1104
s5_16	505	s5_16_40_w5_00_30m	30	0.40	00	w5	0.55	0.15	2.156	1093
s5_16	506	s5_16_40_w6_00_30m	30	0.40	00	w6	0.55	0.15	1.525	1116
s5_17	508	s5_17_40_w1_49_30m	30	0.40	49	w1	0.55	0.09	1.670	1097
s5_17	509	s5_17_40_w3_49_30m	30	0.40	49	w3	0.55	0.12	1.929	1120
s5_17	510	s5_17_40_w5_49_30m	30	0.40	49	w5	0.55	0.15	2.156	1093
s5_19	517	s5_19_30_w1_00_30m	30	0.30	00	w1	0.55	0.09	1.670	1097
s5_19	518	s5_19_30_w2_00_30m	30	0.30	00	w2	0.55	0.09	1.181	1108
s5_19	519	s5_19_30_w3_00_30m	30	0.30	00	w3	0.55	0.12	1.929	1120
s5_19	520	s5_19_30_w4_00_30m	30	0.30	00	w4	0.55	0.12	1.364	1104
s5_19	521	s5_19_30_w5_00_30m	30	0.30	00	w5	0.55	0.15	2.156	1093
s5_19	522	s5_19_30_w6_00_30m	30	0.30	00	w6	0.55	0.15	1.525	1116
s5_20	523	s5_20_30_w1_49_30m	30	0.30	49	w1	0.55	0.09	1.670	1097
s5_20	524	s5_20_30_w3_49_30m	30	0.30	49	w3	0.55	0.12	1.929	1120
s5_20	525	s5_20_30_w5_49_30m	30	0.30	49	w5	0.55	0.15	2.156	1093
s5_22	530	s5_22_15_w1_00_30m	30	0.15	00	w1	0.55	0.09	1.670	1097
s5_22	531	s5_22_15_w2_00_30m	30	0.15	00	w2	0.55	0.09	1.181	1108
s5_22	532	s5_22_15_w3_00_30m	30	0.15	00	w3	0.55	0.12	1.929	1120
s5_22	533	s5_22_15_w4_00_30m	30	0.15	00	w4	0.55	0.12	1.364	1104
s5_22	534	s5_22_15_w5_00_30m	30	0.15	00	w5	0.55	0.15	2.156	1093
s5_22	535	s5_22_15_w6_00_30m	30	0.15	00	w6	0.55	0.15	1.525	1116
Set-up 6										
s6_25	613	s6_25_00_w1_00_45p	-45	0.00	00	w1	0.55	0.09	1.670	1097
s6_25	614	s6_25_00_w2_00_45p	-45	0.00	00	w2	0.55	0.09	1.181	1108
s6_25	615	s6_25_00_w3_00_45p	-45	0.00	00	w3	0.55	0.12	1.929	1120
s6_25	616	s6_25_00_w4_00_45p	-45	0.00	00	w4	0.55	0.12	1.364	1104
s6_25	617	s6_25_00_w5_00_45p	-45	0.00	00	w5	0.55	0.15	2.156	1093
s6_25	618	s6_25_00_w6_00_45p	-45	0.00	00	w6	0.55	0.15	1.525	1116
s6_26	607	s6_26_15_w1_00_30p	-30	0.15	00	w1	0.55	0.09	1.670	1097
s6_26	608	s6_26_15_w2_00_30p	-30	0.15	00	w2	0.55	0.09	1.181	1108
s6_26	609	s6_26_15_w3_00_30p	-30	0.15	00	w3	0.55	0.12	1.929	1120
s6_26	610	s6_26_15_w4_00_30p	-30	0.15	00	w4	0.55	0.12	1.364	1104
s6_26	611	s6_26_15_w5_00_30p	-30	0.15	00	w5	0.55	0.15	2.156	1093
s6_26	612	s6_26_15_w6_00_30p	-30	0.15	00	w6	0.55	0.15	1.525	1116
s6_27	601	s6_27_15_w1_00_45p	-45	0.15	00	w1	0.55	0.09	1.670	1097
s6_27	602	s6_27_15_w2_00_45p	-45	0.15	00	w2	0.55	0.09	1.181	1108
s6_27	603	s6_27_15_w3_00_45p	-45	0.15	00	w3	0.55	0.12	1.929	1120
s6_27	604	s6_27_15_w4_00_45p	-45	0.15	00	w4	0.55	0.12	1.364	1104
s6_27	605	s6_27_15_w5_00_45p	-45	0.15	00	w5	0.55	0.15	2.156	1093
s6_27	606	s6_27_15_w6_00_45p	-45	0.15	00	w6	0.55	0.15	1.525	1116
s6_28	625	s6_28_30_w1_00_30p	-30	0.30	00	w1	0.55	0.09	1.670	1097
s6_28	626	s6_28_30_w2_00_30p	-30	0.30	00	w2	0.55	0.09	1.181	1108
s6_28	627	s6_28_30_w3_00_30p	-30	0.30	00	w3	0.55	0.12	1.929	1120
s6_28	628	s6_28_30_w4_00_30p	-30	0.30	00	w4	0.55	0.12	1.364	1104
s6_28	629	s6_28_30_w5_00_30p	-30	0.30	00	w5	0.55	0.15	2.156	1093
s6_28	630	s6_28_30_w6_00_30p	-30	0.30	00	w6	0.55	0.15	1.525	1116
s6_29	619	s6_29_30_w1_00_45p	-45	0.30	00	w1	0.55	0.09	1.670	1097
s6_29	620	s6_29_30_w2_00_45p	-45	0.30	00	w2	0.55	0.09	1.181	1108
s6_29	621	s6_29_30_w3_00_45p	-45	0.30	00	w3	0.55	0.12	1.929	1120
s6_29	622	s6_29_30_w4_00_45p	-45	0.30	00	w4	0.55	0.12	1.364	1104
s6_29	623	s6_29_30_w5_00_45p	-45	0.30	00	w5	0.55	0.15	2.156	1093
s6_29	624	s6_29_30_w6_00_45p	-45	0.30	00	w6	0.55	0.15	1.525	1116
s6_30	637	s6_30_40_w1_00_30p	-30	0.40	00	w1	0.55	0.09	1.670	1097
s6_30	638	s6_30_40_w2_00_30p	-30	0.40	00	w2	0.55	0.09	1.181	1108
s6_30	639	s6_30_40_w3_00_30p	-30	0.40	00	w3	0.55	0.12	1.929	1120
s6_30	640	s6_30_40_w4_00_30p	-30	0.40	00	w4	0.55	0.12	1.364	1104
s6_30	641	s6_30_40_w5_00_30p	-30	0.40	00	w5	0.55	0.15	2.156	1093
s6_30	642	s6_30_40_w6_00_30p	-30	0.40	00	w6	0.55	0.15	1.525	1116
s6_31	631	s6_31_40_w1_00_45p	-45	0.40	00	w1	0.55	0.09	1.670	1097
s6_31	632	s6_31_40_w2_00_45p	-45	0.40	00	w2	0.55	0.09	1.181	1108
s6_31	633	s6_31_40_w3_00_45p	-45	0.40	00	w3	0.55	0.12	1.929	1120
s6_31	634	s6_31_40_w4_00_45p	-45	0.40	00	w4	0.55	0.12	1.364	1104
s6_31	635	s6_31_40_w5_00_45p	-45	0.40	00	w5	0.55	0.15	2.156	1093
s6_31	636	s6_31_40_w6_00_45p	-45	0.40	00	w6	0.55	0.15	1.525	1116

	Measured parameters																				
Test	Gauges 9-5 at wave maker							Gauges 14-10 at 0.60 m							Gauges 55-51 at 0.70 m							
no.	Hm0	T01	T02	Tp	Cr	Hmax	Tz	Hm0	T01	T02	Tp	Cr	Hmax	Tz	Hm0	T01	T02	Tp	Cr	Hmax	Tz	N
	[m]	[s]	[s]	[s]	-	[m]	[s]	[m]	[s]	[s]	[s]	-	[m]	[s]	[m]	[s]	[s]	[s]	-	[m]	[s]	-
425	0.070	1.24	1.17	1.42	0.210	0.138	1.14	0.066	1.26	1.19	1.51	0.220	0.130	1.14	0.066	1.25	1.18	1.51	0.215	0.129	1.13	1240
427	0.065	0.92	0.88	1.02	0.234	0.127	0.83	0.061	0.91	0.88	1.02	0.192	0.118	0.85	0.063	0.93	0.90	1.02	0.202	0.123	0.87	1210
426	0.102	1.47	1.37	1.71	0.201	0.201	1.37	0.100	1.49	1.40	1.71	0.214	0.191	1.36	0.097	1.47	1.38	1.71	0.223	0.194	1.33	1259
428	0.099	1.09	1.05	1.22	0.199	0.183	1.04	0.087	1.09	1.04	1.22	0.208	0.181	1.03	0.095	1.10	1.06	1.28	0.201	0.188	1.05	1157
429	0.152	1.74	1.61	2.13	0.202	0.316	1.64	0.154	1.74	1.61	2.13	0.200	0.307	1.72	0.145	1.69	1.56	2.13	0.217	0.292	1.61	1270
430	0.142	1.29	1.23	1.51	0.214	0.285	1.25	0.137	1.35	1.28	1.51	0.206	0.265	1.30	0.136	1.33	1.26	1.60	0.223	0.247	1.26	1194
451	0.093	1.40	1.32	1.71	0.200	0.188	1.30	0.090	1.42	1.33	1.71	0.191	0.175	1.30	0.087	1.41	1.32	1.60	0.202	0.166	1.28	1333
452	0.091	1.02	0.98	1.16	0.192	0.162	0.99	0.080	1.02	0.98	1.22	0.185	0.153	0.99	0.085	1.04	1.00	1.22	0.182	0.151	1.01	1242
453	0.123	1.56	1.45	1.97	0.196	0.233	1.45	0.122	1.61	1.50	1.83	0.191	0.237	1.49	0.116	1.58	1.47	1.83	0.201	0.213	1.46	1386
454	0.119	1.17	1.11	1.35	0.192	0.214	1.13	0.110	1.19	1.14	1.35	0.186	0.207	1.15	0.112	1.19	1.14	1.28	0.198	0.203	1.15	1253
456	0.152	1.72	1.59	2.13	0.191	0.299	1.62	0.157	1.76	1.63	2.13	0.192	0.323	1.70	0.144	1.70	1.57	2.13	0.201	0.297	1.60	1362
457	0.147	1.30	1.23	1.51	0.197	0.271	1.26	0.141	1.35	1.28	1.51	0.188	0.267	1.30	0.139	1.33	1.26	1.51	0.205	0.253	1.28	1261
418	0.069	1.24	1.18	1.42	0.196	0.144	1.18	0.065	1.26	1.20	1.51	0.207	0.128	1.18	0.066	1.25	1.20	1.51	0.195	0.124	1.17	1210
419	0.099	1.45	1.37	1.71	0.194	0.199	1.38	0.096	1.50	1.41	1.71	0.204	0.189	1.41	0.095	1.47	1.39	1.71	0.206	0.189	1.37	1201
421	0.153	1.75	1.62	2.13	0.202	0.318	1.68	0.155	1.76	1.63	2.13	0.199	0.317	1.76	0.145	1.71	1.57	2.13	0.215	0.289	1.66	1205
464	0.093	1.42	1.35	1.60	0.188	0.182	1.37	0.088	1.46	1.39	1.71	0.169	0.172	1.39	0.087	1.43	1.36	1.60	0.173	0.167	1.36	1263
465	0.123	1.58	1.47	1.97	0.186	0.226	1.51	0.121	1.65	1.56	1.83	0.188	0.232	1.57	0.114	1.60	1.49	1.83	0.195	0.211	1.52	1341
466	0.153	1.74	1.61	2.13	0.181	0.295	1.67	0.157	1.79	1.67	2.13	0.186	0.321	1.76	0.143	1.73	1.60	2.13	0.192	0.292	1.68	1306
458	0.089	1.38	1.30	1.71	0.213	0.172	1.28	0.081	1.39	1.31	1.71	0.223	0.159	1.28	0.085	1.39	1.31	1.60	0.210	0.166	1.27	1350
459	0.090	1.03	0.98	1.16	0.184	0.160	0.99	0.085	1.04	1.00	1.16	0.181	0.151	1.00	0.086	1.04	1.00	1.22	0.187	0.157	1.00	1266
460	0.125	1.59	1.48	1.97	0.213	0.236	1.46	0.119	1.63	1.52	1.97	0.206	0.237	1.50	0.118	1.61	1.50	1.97	0.196	0.229	1.48	1375
461	0.121	1.17	1.12	1.35	0.189	0.223	1.12	0.106	1.17	1.12	1.35	0.189	0.198	1.12	0.114	1.20	1.15	1.35	0.196	0.212	1.14	1258
462	0.157	1.75	1.62	2.13	0.213	0.304	1.62	0.154	1.78	1.65	2.13	0.188	0.318	1.69	0.154	1.77	1.64	2.13	0.188	0.323	1.68	1359
463	0.148	1.30	1.23	1.51	0.202	0.277	1.25	0.131	1.32	1.25	1.51	0.191	0.246	1.26	0.141	1.33	1.27	1.51	0.196	0.275	1.27	1276
412	0.070	1.25	1.20	1.42	0.171	0.139	1.19	0.062	1.23	1.18	1.42	0.210	0.119	1.15	0.067	1.25	1.21	1.51	0.183	0.122	1.19	1207
413	0.097	1.45	1.38	1.71	0.184	0.197	1.40	0.090	1.47	1.40	1.71	0.195	0.173	1.41	0.091	1.46	1.39	1.71	0.193	0.173	1.39	1182
414	0.145	1.74	1.62	2.13	0.183	0.298	1.70	0.141	1.74	1.62	2.13	0.184	0.275	1.75	0.140	1.73	1.61	2.13	0.190	0.263	1.73	1175
415	0.071	1.25	1.19	1.42	0.184	0.140	1.16	0.062	1.23	1.17	1.42	0.214	0.117	1.14	0.067	1.25	1.19	1.51	0.194	0.122	1.15	1237
416	0.097	1.45	1.36	1.71	0.203	0.195	1.35	0.091	1.47	1.39	1.83	0.206	0.168	1.36	0.091	1.45	1.37	1.71	0.206	0.176	1.34	1245
417	0.146	1.73	1.61	2.13	0.195	0.310	1.64	0.142	1.74	1.61	2.13	0.190	0.291	1.72	0.141	1.72	1.60	2.13	0.198	0.280	1.69	1224
467	0.088	1.39	1.30	1.60	0.215	0.190	1.27	0.084	1.41	1.33	1.60	0.205	0.163	1.30	0.084	1.39	1.31	1.60	0.223	0.164	1.27	1351
468	0.089	1.03	0.98	1.22	0.188	0.157	0.99	0.080	1.02	0.98	1.16	0.184	0.153	0.99	0.085	1.04	0.99	1.16	0.189	0.161	1.00	1246
469	0.121	1.58	1.47	1.97	0.216	0.243	1.44	0.120	1.64	1.53	1.97	0.193	0.236	1.51	0.116	1.61	1.49	1.97	0.208	0.216	1.46	1392
470	0.117	1.17	1.12	1.35	0.197	0.209	1.12	0.104	1.17	1.12	1.35	0.187	0.199	1.12	0.113	1.20	1.14	1.35	0.199	0.209	1.15	1259
471	0.153	1.75	1.62	2.13	0.207	0.296	1.60	0.156	1.79	1.66	2.13	0.180	0.314	1.72	0.150	1.76	1.63	2.13	0.197	0.304	1.66	1375
472	0.143	1.30	1.23	1.51	0.201	0.271	1.25	0.135	1.33	1.27	1.51	0.184	0.250	1.28	0.139	1.32	1.26	1.51	0.201	0.253	1.27	1292
473	0.088	1.40	1.33	1.60	0.187	0.180	1.34	0.084	1.43	1.35	1.60	0.185	0.164	1.34	0.084	1.41	1.34	1.60	0.196	0.157	1.34	1284
474	0.121	1.60	1.50	1.97	0.199	0.236	1.53	0.120	1.65	1.54	1.97	0.176	0.229	1.56	0.116	1.63	1.53	1.97	0.185	0.216	1.54	1312
475	0.153	1.77	1.65	2.13	0.192	0.301	1.69	0.156	1.79	1.67	2.13	0.169	0.310	1.76	0.150	1.78	1.66	2.13	0.177	0.308	1.74	1297
480	0.088	1.39	1.32	1.71	0.200	0.170	1.29	0.079	1.38	1.31	1.71	0.222	0.142	1.26	0.086	1.41	1.33	1.60	0.207	0.161	1.28	1361
481	0.090	1.03	0.99	1.16	0.185	0.158	1.00	0.083	1.05	1.01	1.22	0.178	0.150	1.00	0.086	1.05	1.01	1.16	0.190	0.159	0.99	1273
482	0.123	1.59	1.48	1.97	0.205	0.231	1.46	0.113	1.62	1.51	1.97	0.214	0.218	1.47	0.117	1.60	1.50	1.97	0.205	0.221	1.45	1388
483	0.119	1.18	1.13	1.42	0.192	0.219	1.13	0.109	1.18	1.14	1.35	0.186	0.205	1.14	0.114	1.19	1.15	1.35	0.192	0.212	1.14	1281
484	0.155	1.75	1.62	2.13	0.202	0.303	1.62	0.148	1.77	1.64	2.13	0.199	0.309	1.67	0.153	1.76	1.64	2.13	0.193	0.311	1.65	1359
485	0.146	1.30	1.24	1.51	0.204	0.277	1.25	0.128	1.31	1.25	1.51	0.198	0.243	1.25	0.139	1.33	1.27	1.51	0.198	0.253	1.27	1274
488	0.088	1.40	1.33	1.60	0.177	0.169	1.34	0.079	1.40	1.33	1.71	0.201	0.147	1.33	0.086	1.42	1.35	1.60	0.187	0.162	1.34	1297
489	0.123	1.60	1.50	1.97	0.190	0.233	1.51	0.113	1.64	1.54	1.97	0.200	0.216	1.54	0.116	1.62	1.53	1.97	0.190	0.216	1.52	1335
490	0.155	1.77	1.65	2.13	0.190	0.302	1.68	0.148	1.79	1.67	2.13	0.194	0.302	1.75	0.153	1.78	1.67	2.13	0.177	0.305	1.72	1304
432	0.067	1.27	1.22	1.51	0.225	0.126	1.18	0.065	1.29	1.23	1.42	0.196	0.135	1.18	0.066	1.29	1.25	1.42	0.218	0.141	1.18	1185
433	0.063	0.97	0.95	1.02	0.191	0.123	0.94	0.058	0.97	0.95	1.07	0.206	0.117	0.94	0.059	0.98	0.96	1.02	0.212	0.113	0.95	1044
434	0.090	1.42	1.34	1.71	0.237	0.190	1.29	0.082	1.41	1.33	1.71	0.205	0.147	1.27	0.089	1.46	1.39	1.71	0.235	0.179	1.34	1311
435	0.093	1.11	1.07	1.28	0.197	0.171	1.07	0.086	1.12	1.08	1.28	0.199	0.162	1.08	0.090	1.13	1.10	1.22	0.207	0.169	1.09	1092
437	0.141	1.72	1.60	2.13	0.238	0.324	1.63	0.124	1.63	1.51	2.13	0.213	0.251	1.54	0.125	1.63	1.52	2.13	0.246	0.267	1.53	1337
438	0.143	1.32	1.26	1.51	0.222	0.277	1.27	0.135	1.34	1.28	1.51	0.195	0.247	1.27	0.137	1.35	1.29	1.51	0.219	0.239	1.28	1172
440	0.103	1.46	1.38	1.71	0.209	0.192	1.35	0.105	1.51	1.44	1.71	0.174	0.207	1.41	0.099	1.50	1.42	1.71	0.209	0.188	1.38	1232
441	0.100	1.12	1.09	1.22	0.190	0.203	1.08	0.093	1.14	1.10	1.28	0.192	0.194	1.11	0.094	1.13	1.10	1.22	0.195	0.196	1.09	1086
442	0.143	1.66	1.54	2.13	0.245	0.286	1.55	0.158	1.73	1.62	2.13	0.179	0.288	1.68	0.138	1.67	1.56	2.13	0.237	0.256	1.57	1309
443	0.156	1.33	1.27	1.51	0.195	0.303	1.29	0.154	1.38	1.32	1.51	0.182	0.275	1.34	0.144	1.36	1.30	1.51	0.199	0.250	1.31	1131
444	0.089	1.40	1.32	1.60	0.212	0.168	1.30	0.079	1.38	1.30	1.60	0.219	0.158	1.27	0.089	1.43	1.35	1.71	0.211	0.169	1.31	1342
445	0.087	1.06	1.03	1.16	0.170	0.169	1.01	0.084	1.07	1.04	1.22	0.169	0.165	1.04	0.082	1.07	1.04	1.22	0.178	0.159	1.02	1204
447	0.116	1.58	1.47	1.97	0.231	0.240	1.46	0.106	1.58	1.47	1.97	0.227	0.209	1.45	0.114	1.59	1.49	1.97	0.232	0.225	1.44	1405
448	0.117	1.20	1.15	1.35	0.186	0.226	1.14	0.109	1.19	1.14	1.35	0.185	0.216	1.14	0.109	1.21	1.16	1.28	0.191	0.214	1.16	1235
449	0.153	1.77	1.63	2.13	0.236	0.351	1.67	0.139	1.75	1.62	2.13	0.223	0.290	1.70	0.141	1.71	1.58	2.13	0.225	0.281	1.60	1362
450	0.147	1.31	1.26	1.51	0.197	0.302	1.27	0.130	1.30	1.24	1.51	0.195	0.240	1.26	0.140	1.35	1.29	1.51	0.202	0.256	1.29	1246
476	0.070	1.21	1.14	1.51	0.206	0.132	1.11	0.064	1.23	1.15	1.51	0.199	0.119	1.13	0.068	1.23	1.16	1.42	0.215	0.128	1.14	1271
477	0.070	0.91	0.87	1.02	0.181	0.126	0.89	0.065	0.92	0.89	1.02	0.174	0.127	0.90	0.066	0.92	0.89	1.02	0.180	0.125	0.89	1106
486	0.072	1.24	1.18	1.42	0.190	0.130	1.16	0.064	1.22	1.16	1.42	0.210	0.117	1.12	0.068	1.24	1.17	1.51	0.201	0.128	1.10	1345
487	0.070	0.92	0.89	1.02	0.177	0.128	0.89	0.065	0.94	0.91	1.02	0.180	0.123	0.89	0.067	0.94	0.91	1.02	0.192	0.135	0.88	1144

	Measured parameters																					
Test	Gauges 9-5 at wave maker							Gauges 14-10 at 0.60 m							Gauges 55-51 at 0.70 m							
no.	Hm0	T01	T02	Tp	Cr	Hmax	Tz	Hm0	T01	T02	Tp	Cr	Hmax	Tz	Hm0	T01	T02	Tp	Cr	Hmax	Tz	N
	[m]	[s]	[s]	[s]	-	[m]	[s]	[m]	[s]	[s]	[s]	-	[m]	[s]	[m]	[s]	[s]	[s]	-	[m]	[s]	-
511	0.088	1.46	1.39	1.71	0.236	0.170	1.35	0.085	1.46	1.39	1.71	0.240	0.170	1.39	0.080	1.43	1.36	1.71	0.218	0.154	1.31	1317
512	0.079	1.10	1.07	1.16	0.164	0.155	1.05	0.074	1.09	1.07	1.16	0.166	0.136	1.06	0.079	1.10	1.08	1.16	0.158	0.157	1.06	1169
513	0.117	1.61	1.52	1.97	0.251	0.236	1.50	0.107	1.60	1.51	1.97	0.259	0.203	1.49	0.117	1.66	1.57	1.97	0.197	0.234	1.54	1363
514	0.105	1.23	1.19	1.35	0.177	0.199	1.17	0.103	1.24	1.20	1.42	0.170	0.192	1.22	0.101	1.22	1.18	1.35	0.173	0.182	1.18	1211
515	0.136	1.74	1.62	2.13	0.236	0.285	1.62	0.123	1.68	1.57	2.13	0.261	0.260	1.61	0.146	1.78	1.66	2.13	0.201	0.320	1.75	1379
516	0.134	1.36	1.30	1.51	0.189	0.269	1.31	0.135	1.37	1.32	1.51	0.182	0.252	1.34	0.126	1.35	1.30	1.51	0.172	0.246	1.31	1217
536	0.085	1.47	1.42	1.71	0.214	0.160	1.43	0.082	1.48	1.42	1.71	0.203	0.159	1.44	0.078	1.45	1.38	1.71	0.199	0.150	1.37	1254
537	0.115	1.64	1.56	1.97	0.233	0.222	1.58	0.104	1.62	1.55	1.97	0.233	0.191	1.56	0.113	1.68	1.59	1.97	0.187	0.222	1.61	1295
538	0.137	1.75	1.65	2.13	0.220	0.287	1.69	0.123	1.70	1.60	2.13	0.244	0.255	1.67	0.145	1.78	1.68	2.13	0.189	0.307	1.81	1306
501	0.074	1.42	1.38	1.60	0.234	0.152	1.34	0.070	1.48	1.43	1.71	0.236	0.130	1.34	0.085	1.51	1.47	1.71	0.227	0.158	1.44	1292
502	0.078	1.14	1.12	1.16	0.244	0.159	1.09	0.068	1.13	1.11	1.16	0.220	0.134	1.06	0.071	1.13	1.11	1.16	0.217	0.143	1.07	1165
503	0.102	1.62	1.54	1.97	0.236	0.208	1.53	0.104	1.68	1.60	1.97	0.242	0.230	1.60	0.116	1.67	1.61	1.97	0.214	0.234	1.64	1348
504	0.105	1.25	1.22	1.35	0.235	0.199	1.18	0.092	1.25	1.22	1.35	0.202	0.181	1.16	0.104	1.28	1.25	1.35	0.220	0.225	1.22	1204
505	0.126	1.77	1.66	2.13	0.230	0.286	1.72	0.128	1.77	1.67	2.13	0.268	0.320	1.78	0.144	1.73	1.64	2.13	0.241	0.307	1.81	1285
506	0.126	1.33	1.29	1.51	0.219	0.257	1.26	0.112	1.37	1.32	1.60	0.217	0.239	1.26	0.135	1.41	1.37	1.51	0.221	0.245	1.34	1282
508	0.075	1.43	1.38	1.60	0.228	0.151	1.36	0.070	1.50	1.45	1.71	0.213	0.134	1.40	0.086	1.52	1.47	1.71	0.224	0.160	1.44	1258
509	0.103	1.62	1.54	1.97	0.232	0.214	1.54	0.103	1.68	1.61	1.97	0.236	0.238	1.65	0.117	1.68	1.61	1.97	0.209	0.232	1.64	1342
510	0.128	1.78	1.67	2.13	0.226	0.286	1.74	0.127	1.78	1.69	2.13	0.271	0.313	1.82	0.145	1.73	1.64	2.13	0.236	0.304	1.81	1290
517	0.077	1.43	1.38	1.60	0.228	0.160	1.35	0.071	1.45	1.39	1.60	0.230	0.130	1.34	0.082	1.51	1.46	1.71	0.219	0.156	1.44	1296
518	0.074	1.12	1.10	1.16	0.220	0.155	1.09	0.071	1.12	1.10	1.22	0.225	0.143	1.05	0.069	1.12	1.09	1.16	0.199	0.143	1.07	1172
519	0.103	1.60	1.52	1.97	0.214	0.199	1.51	0.099	1.63	1.55	1.97	0.239	0.209	1.53	0.114	1.68	1.61	1.97	0.201	0.232	1.63	1360
520	0.107	1.25	1.22	1.35	0.220	0.206	1.19	0.095	1.24	1.21	1.35	0.207	0.180	1.16	0.101	1.26	1.23	1.42	0.200	0.198	1.21	1201
521	0.125	1.74	1.64	2.13	0.223	0.262	1.67	0.121	1.73	1.62	2.13	0.253	0.298	1.70	0.144	1.75	1.65	2.13	0.220	0.305	1.82	1326
522	0.132	1.34	1.29	1.51	0.216	0.262	1.28	0.114	1.35	1.30	1.60	0.205	0.226	1.26	0.132	1.39	1.35	1.51	0.204	0.259	1.34	1250
523	0.077	1.43	1.38	1.60	0.215	0.155	1.38	0.071	1.46	1.41	1.60	0.209	0.131	1.38	0.083	1.51	1.47	1.71	0.213	0.160	1.46	1245
524	0.103	1.61	1.53	1.97	0.205	0.198	1.53	0.099	1.65	1.57	1.97	0.222	0.205	1.59	0.114	1.68	1.61	1.97	0.192	0.230	1.65	1310
525	0.125	1.75	1.65	2.13	0.213	0.263	1.71	0.121	1.74	1.64	2.13	0.242	0.292	1.76	0.144	1.75	1.66	2.13	0.213	0.304	1.84	1299
530	0.082	1.45	1.38	1.71	0.220	0.156	1.34	0.078	1.44	1.38	1.60	0.231	0.156	1.33	0.078	1.48	1.42	1.71	0.200	0.154	1.37	1286
531	0.074	1.10	1.07	1.16	0.183	0.157	1.06	0.073	1.11	1.08	1.16	0.183	0.151	1.06	0.069	1.10	1.07	1.16	0.173	0.143	1.05	1166
532	0.110	1.61	1.52	1.97	0.217	0.207	1.50	0.100	1.59	1.50	1.97	0.242	0.187	1.46	0.114	1.69	1.60	1.97	0.184	0.232	1.61	1392
533	0.106	1.24	1.20	1.42	0.194	0.201	1.19	0.100	1.23	1.20	1.35	0.189	0.190	1.19	0.097	1.23	1.19	1.35	0.175	0.198	1.18	1200
534	0.130	1.73	1.62	2.13	0.230	0.275	1.62	0.119	1.67	1.56	2.13	0.250	0.281	1.61	0.146	1.78	1.67	2.13	0.198	0.314	1.79	1377
535	0.137	1.35	1.30	1.51	0.198	0.280	1.31	0.127	1.36	1.31	1.51	0.193	0.264	1.31	0.129	1.37	1.32	1.51	0.179	0.255	1.32	1222
	5.544	5.54	5.54	5.54	5.544	5.544	5.54	5.544	5.54	5.54	5.54	5.544	5.544	5.54	5.544	5.54	5.54	5.54	5.544	5.544	5.54	5.544
613	0.077	1.46	1.40	1.71	0.235	0.163	1.39	0.087	1.52	1.47	1.71	0.200	0.179	1.49	0.086	1.53	1.47	1.71	0.246	0.173	1.42	1229
614	0.075	1.13	1.11	1.16	0.155	0.162	1.10	0.070	1.14	1.11	1.22	0.145	0.160	1.12	0.074	1.12	1.10	1.22	0.178	0.150	1.08	1144
615	0.112	1.66	1.58	1.83	0.217	0.266	1.59	0.119	1.69	1.62	1.97	0.186	0.223	1.65	0.133	1.74	1.67	1.97	0.219	0.270	1.68	1280
616	0.104	1.25	1.22	1.35	0.167	0.236	1.22	0.106	1.28	1.25	1.35	0.140	0.237	1.27	0.102	1.25	1.22	1.35	0.203	0.214	1.21	1162
617	0.141	1.80	1.69	2.13	0.205	0.331	1.76	0.147	1.77	1.68	2.13	0.188	0.289	1.83	0.162	1.83	1.73	2.13	0.228	0.311	1.81	1267
618	0.128	1.34	1.30	1.51	0.184	0.281	1.32	0.138	1.40	1.35	1.60	0.148	0.234	1.39	0.134	1.40	1.35	1.60	0.184	0.255	1.37	1204
607	0.087	1.45	1.39	1.60	0.264	0.178	1.34	0.084	1.45	1.38	1.71	0.231	0.163	1.36	0.089	1.44	1.37	1.71	0.250	0.171	1.32	1272
608	0.081	1.11	1.09	1.16	0.192	0.166	1.07	0.076	1.10	1.07	1.16	0.165	0.168	1.07	0.083	1.11	1.08	1.22	0.183	0.179	1.07	1153
609	0.118	1.64	1.55	1.97	0.245	0.261	1.53	0.108	1.62	1.53	1.83	0.274	0.212	1.50	0.121	1.64	1.55	1.97	0.265	0.231	1.49	1347
610	0.110	1.24	1.21	1.42	0.208	0.213	1.21	0.107	1.24	1.20	1.35	0.163	0.212	1.21	0.119	1.25	1.21	1.35	0.189	0.239	1.21	1164
611	0.156	1.80	1.69	2.13	0.238	0.351	1.74	0.135	1.74	1.63	2.13	0.275	0.289	1.69	0.150	1.76	1.65	2.13	0.260	0.304	1.70	1313
612	0.143	1.36	1.31	1.51	0.199	0.283	1.32	0.134	1.36	1.31	1.51	0.175	0.254	1.34	0.142	1.36	1.31	1.51	0.202	0.245	1.32	1204
601	0.084	1.50	1.45	1.71	0.271	0.166	1.41	0.082	1.53	1.47	1.71	0.209	0.171	1.44	0.088	1.51	1.45	1.71	0.318	0.178	1.40	1224
602	0.070	1.14	1.12	1.16	0.232	0.150	1.10	0.067	1.13	1.11	1.16	0.196	0.150	1.09	0.073	1.13	1.11	1.16	0.255	0.155	1.09	1126
603	0.112	1.66	1.58	1.97	0.296	0.232	1.53	0.121	1.73	1.65	1.97	0.190	0.229	1.67	0.125	1.71	1.63	1.97	0.344	0.226	1.59	1313
604	0.103	1.28	1.25	1.35	0.215	0.225	1.23	0.094	1.27	1.23	1.35	0.190	0.198	1.23	0.106	1.28	1.25	1.42	0.260	0.208	1.22	1158
605	0.138	1.80	1.69	2.13	0.253	0.312	1.70	0.155	1.85	1.75	2.13	0.187	0.307	1.85	0.151	1.81	1.71	2.13	0.323	0.322	1.77	1294
606	0.132	1.39	1.34	1.51	0.213	0.263	1.35	0.130	1.41	1.36	1.51	0.167	0.250	1.39	0.140	1.41	1.37	1.51	0.253	0.281	1.36	1182
625	0.088	1.48	1.42	1.60	0.253	0.187	1.36	0.087	1.48	1.42	1.71	0.233	0.181	1.40	0.088	1.45	1.39	1.60	0.261	0.168	1.33	1286
626	0.078	1.13	1.11	1.16	0.247	0.172	1.09	0.075	1.12	1.09	1.16	0.199	0.160	1.09	0.083	1.11	1.09	1.16	0.211	0.185	1.07	1145
627	0.121	1.66	1.57	1.97	0.254	0.267	1.56	0.113	1.65	1.57	1.83	0.270	0.227	1.55	0.120	1.66	1.57	1.97	0.246	0.249	1.52	1325
628	0.111	1.26	1.23	1.35	0.228	0.222	1.22	0.104	1.26	1.22	1.35	0.205	0.200	1.23	0.113	1.24	1.21	1.35	0.225	0.217	1.20	1180
629	0.163	1.82	1.71	2.13	0.243	0.346	1.77	0.141	1.77	1.66	2.13	0.284	0.283	1.69	0.161	1.82	1.70	2.13	0.234	0.322	1.74	1291
630	0.145	1.37	1.33	1.51	0.205	0.293	1.34	0.137	1.39	1.35	1.60	0.191	0.240	1.37	0.139	1.36	1.31	1.51	0.224	0.248	1.32	1202
619	0.088	1.55	1.50	1.71	0.324	0.182	1.44	0.076	1.52	1.46	1.71	0.331	0.151	1.41	0.094	1.55	1.50	1.71	0.309	0.187	1.44	1215
620	0.065	1.17	1.15	1.22	0.345	0.166	1.12	0.064	1.15	1.13	1.16	0.268	0.154	1.11	0.067	1.15	1.13	1.22	0.303	0.154	1.10	1121
621	0.119	1.69	1.61	1.97	0.314	0.252	1.58	0.117	1.74	1.66	1.97	0.263	0.237	1.64	0.121	1.70	1.63	1.97	0.381	0.207	1.57	1303
622	0.101	1.30	1.27	1.35	0.300	0.220	1.24	0.096	1.29	1.26	1.35	0.249	0.188	1.25	0.106	1.31	1.28	1.35	0.271	0.215	1.25	1136
623	0.146	1.82	1.72	2.13	0.302	0.292	1.72	0.155	1.88	1.78	2.13	0.245	0.293	1.84	0.146	1.82	1.72	2.13	0.396	0.297	1.71	1282
624	0.136	1.42	1.37	1.60	0.288	0.268	1.37	0.124	1.41	1.36	1.51	0.256	0.237	1.37	0.146	1.45	1.40	1.51	0.275	0.255	1.39	1161
637	0.088	1.50	1.44	1.60	0.266	0.183	1.41	0.085	1.49	1.44	1.60	0.248	0.175	1.40	0.087	1.47	1.41	1.71	0.282	0.179	1.32	1349
638	0.075	1.14	1.11	1.16	0.293	0.170	1.09	0.074	1.13	1.11	1.16	0.225	0.156	1.08	0.081	1.11	1.09	1.16	0.250	0.168	1.04	1283
639	0.125	1.68	1.60	1.97	0.255	0.266	1.59	0.119	1.68	1.60	1.83	0.254	0.221	1.56	0.124	1.69	1.60	1.83	0.254	0.265	1.52	1349
640	0.111	1.28	1.24	1.35	0.248	0.235	1.23	0.106	1.28	1.24	1.42	0.208	0.208	1.23	0.109	1.25	1.22	1.35	0.254	0.204	1.18	1246
641	0.165	1.83	1.72	2.13	0.244	0.349	1.75	0.149	1.81	1.71	2.13	0.268	0.290	1.72	0.164	1.85	1.74	2.13	0.240	0.316	1.74	1282
642	0.145	1.38	1.34	1.51	0.227	0.291	1.34	0.136	1.40	1.36	1.51	0.200	0.238	1.37	0.136	1.38	1.33	1.51	0.247	0.249	1.32	1211
631	0.087	1.57	1.52	1.71	0.374	0.178	1.44	0.079	1.54	1.48	1.60	0.379	0.157	1.41	0.091	1.55	1.50	1.71	0.363	0.174	1.37	1298
632	0.061	1.18	1.16	1.22	0.393	0.164	1.12	0.062	1.16	1.14	1.16	0.332	0.146	1.11	0.067	1.18	1.16	1.22	0.359	0.176	1.08	1242
633	0.122	1.72	1.65	1.97	0.332	0.258	1.59	0.111	1.74	1.66	1.97	0.339	0.228	1.61	0.124	1.71	1.64	1.97	0.378	0.252	1.53	1359
634	0.098	1.32	1.28	1.35	0.368	0.213	1.25	0.095	1.31	1.27	1.35	0.303	0.190	1.25	0.108	1.32	1.29	1.35	0.312	0.224	1.23	1157
635	0.155	1.85	1.75	2.13	0.315	0.310	1.76	0.150	1.89	1.79	2.13	0.317	0.285	1.80	0.152	1.84	1.75	2.13	0.417	0.289	1.68	1308
636	0.136	1.44	1.39	1.51	0.326	0.280	1.38	0.128	1.43	1.38	1.51	0.284	0.228	1.37	0.144	1.45	1.40	1.51	0.306	0.240	1.35	1184

Test	**Run-up**			**Overtopping**				**Flow velocities 2%**			
no.	2% [	Pov-70	Pov-60	q70-37	q70-39	q60-41	q60-43	v70-33-l	v70-34-s	v60-35-l	v60-36-s
	[m]	[m]	[m]	l/s per m	l/s per m	l/s per m	l/s per m	m/s	m/s	m/s	m/s
425	0.094	no data	1.29	0.000	0.000	0.000	0.000	no data	no data	no data	no data
427	0.072	no data	0.17	0.000	0.000	0.000	0.000	no data	no data	no data	no data
426	0.157	0.08	68.78	0.000	0.000	0.167	0.091	no data	no data	0.550	0.236
428	0.104	no data	2.33	0.000	0.000	0.000	0.000	no data	no data	0.126	0.012
429	0.246	7.95	no data	0.060	0.126	0.415	0.414	no data	0.110	1.377	0.799
430	0.175	0.50	23.53	0.000	0.000	0.314	0.239	no data	no data	0.692	0.379
451	0.140	no data	11.63	0.000	0.000	1.341	1.667	no data	no data	0.835	0.504
452	0.092	no data	2.90	0.000	0.000	0.240	0.206	no data	no data	0.503	0.264
453	0.185	1.80	0.00	0.032	0.085	3.575	2.578	0.172	no data	1.219	0.741
454	0.130	no data	48.28	0.000	0.000	1.022	0.873	no data	no data	0.863	0.545
456	0.258	47.72	0.00	0.239	0.859	7.274	5.540	0.530	0.369	1.613	0.971
457	0.178	0.63	128.87	0.024	0.026	2.907	2.538	no data	no data	1.127	0.733
418	0.089	no data	1.40	0.000	0.000	0.000	0.000	no data	0.069	no data	no data
419	0.151	0.08	0.00	0.000	0.000	0.000	0.000	no data	no data	0.507	0.258
421	0.244	0.00	no data	0.078	0.139	0.114	0.294	no data	no data	1.447	0.845
464	0.072	no data	0.32	0.000	0.000	1.337	0.613	no data	no data	0.837	0.522
465	0.128	0.07	5.22	0.067	0.123	3.465	2.400	no data	no data	1.244	0.797
466	0.198	1.76	0.00	0.341	0.886	7.321	5.609	no data	0.413	1.772	1.080
458	0.094	no data	1.48	0.000	0.000	0.756	1.291	no data	0.001	0.836	0.531
459	0.049	no data	0.08	0.000	0.000	0.246	0.254	no data	no data	0.456	0.262
460	0.143	0.15	41.09	0.058	0.052	3.459	3.812	no data	0.072	1.296	0.808
461	0.089	no data	0.72	0.000	0.000	0.926	1.338	no data	no data	0.797	0.509
462	0.202	2.06	75.72	0.424	0.426	8.289	8.419	no data	0.413	1.777	1.054
463	0.132	no data	6.43	0.030	0.058	2.729	3.889	no data	0.027	1.213	0.751
412	0.058	no data	0.08	0.000	0.000	0.000	0.000	0.043	no data	no data	no data
413	0.108	no data	3.13	0.000	0.000	0.000	0.000	0.024	15.141	0.503	0.255
414	0.248	no data	no data	0.000	0.000	0.000	0.000	no data	no data	1.322	0.815
415	0.053	no data	0.08	0.000	0.000	0.000	0.000	no data	0.029	no data	no data
416	0.111	no data	6.67	0.000	0.000	0.000	0.000	no data	no data	0.493	0.269
417	0.195	1.63	0.00	0.000	0.000	0.000	0.000	no data	0.159	1.355	0.794
467	0.086	no data	0.89	0.000	0.000	1.200	1.235	no data	no data	0.894	0.614
468	0.048	no data	0.08	0.000	0.000	0.193	0.257	no data	no data	0.482	0.296
469	0.134	0.07	13.43	0.045	0.053	3.576	3.431	0.203	15.638	1.272	0.811
470	0.103	no data	2.07	0.000	0.000	1.317	1.465	no data	no data	0.887	0.595
471	0.201	2.04	25.09	0.204	0.323	7.864	7.515	0.579	15.822	1.697	1.060
472	0.124	no data	4.18	0.035	0.037	3.601	3.510	0.183	15.475	1.206	0.773
473	0.078	no data	0.39	0.000	0.000	1.189	1.195	no data	no data	0.881	0.592
474	0.178	0.69	0.00	0.069	0.082	3.572	3.479	no data	no data	1.331	0.853
475	0.248	0.00	no data	0.379	0.536	8.408	7.539	no data	no data	1.903	1.136
480	0.096	no data	1.62	0.000	0.000	1.034	1.325	no data	15.391	0.796	0.491
481	0.053	no data	0.08	0.000	0.000	0.275	0.208	no data	no data	0.482	0.288
482	0.155	0.07	52.23	0.064	0.057	3.115	3.912	0.214	15.606	1.268	0.803
483	0.088	no data	1.17	0.000	0.000	0.992	0.980	no data	no data	0.821	0.543
484	0.198	3.75	128.40	0.511	0.403	8.300	9.111	0.667	0.481	1.738	1.060
485	0.128	no data	5.73	0.026	0.040	2.622	3.835	0.099	no data	1.115	0.719
488	0.087	no data	0.85	0.000	0.000	0.757	0.867	no data	no data	0.802	0.530
489	0.149	no data	0.00	0.091	0.093	3.051	3.779	no data	no data	1.306	0.844
490	0.197	1.69	0.00	0.544	0.471	9.131	9.029	no data	0.455	1.969	1.181
432	0.108	no data	2.87	0.000	0.000	0.000	0.000	no data	no data	no data	no data
433	0.070	no data	0.10	0.000	0.000	0.000	0.000	no data	no data	no data	no data
434	0.134	no data	42.11	0.000	0.000	0.041	0.023	no data	no data	0.359	0.123
435	0.114	no data	8.70	0.000	0.000	0.000	0.000	no data	no data	no data	no data
437	0.197	1.87	0.00	0.068	0.043	0.284	0.556	no data	0.067	0.934	0.615
438	0.157	0.26	0.00	0.000	0.000	0.192	0.177	no data	no data	0.628	0.343
440	0.091	no data	1.46	0.000	0.000	0.113	0.080	no data	no data	0.459	0.234
441	0.058	no data	0.09	0.000	0.000	0.000	0.000	no data	no data	0.050	no data
442	0.162	0.31	48.74	0.033	0.034	2.121	1.016	no data	0.047	1.054	0.669
443	0.111	no data	3.45	0.000	0.000	0.275	0.194	no data	no data	0.598	0.351
444	0.126	no data	19.00	0.000	0.000	0.661	0.865	no data	no data	0.782	0.459
445	0.104	no data	8.47	0.000	0.000	0.107	0.074	no data	no data	0.379	0.165
447	0.185	0.93	0.00	0.047	0.050	1.728	3.118	0.148	0.036	1.193	0.754
448	0.136	0.08	81.78	0.000	0.000	0.511	0.492	no data	no data	0.735	0.423
449	0.235	7.42	0.00	0.383	0.408	4.143	7.073	0.609	0.431	1.541	0.952
450	0.169	0.32	0.00	0.000	0.000	2.061	2.097	no data	no data	0.955	0.628
476	0.10044	no data	6.14	0.000	0.000	0.272	0.317	no data	no data	0.538	0.352
477	0.07216	no data	0.09	0.000	0.000	0.034	0.041	no data	no data	0.187	0.092
486	0.10656	no data	4.54	0.000	0.000	0.262	0.270	no data	no data	0.495	0.290
487	0.07044	no data	0.17	0.000	0.000	0.042	0.026	no data	no data	no data	no data

Test	Run-up			Overtopping				Flow velocities 2%			
no.	2% [	Pov-70	Pov-60	q70-37	q70-39	q60-41	q60-43	v70-33-l	v70-34-s	v60-35-l	v60-36-s
	[m]	[m]	[m]	l/s per m	l/s per m	l/s per m	l/s per m	m/s	m/s	m/s	m/s
511	0.136	no data	43.28	0.000	0.000	0.452	0.352	no data	no data	0.890	0.521
512	0.091	no data	0.86	0.000	0.000	0.038	0.055	no data	no data	0.433	0.169
513	0.175	0.51	183.42	0.000	0.025	2.363	1.320	0.136	no data	1.355	0.918
514	0.129	no data	80.10	0.000	0.000	0.365	0.460	no data	no data	0.840	0.458
515	0.233	5.51	no data	0.180	0.202	5.302	3.874	0.759	0.408	1.884	1.200
516	0.164	0.08	0.00	0.000	0.000	1.430	1.397	no data	no data	1.326	no data
536	0.077	no data	0.24	0.000	0.000	0.495	0.334	no data	0.050	0.900	0.538
537	0.128	0.08	29.81	0.026	0.040	2.411	1.286	no data	no data	1.444	0.960
538	0.170	0.69	0.00	0.210	0.221	5.436	3.562	no data	0.413	1.962	1.235
501	0.052	no data	0.08	0.000	0.000	0.463	0.530	no data	no data	0.999	0.616
502	0.029	no data	no data	0.000	0.000	0.044	0.075	no data	no data	0.500	0.229
503	0.113	no data	4.30	0.000	0.000	1.757	2.648	no data	no data	1.376	0.908
504	0.066	no data	0.08	0.000	0.000	0.672	0.528	no data	no data	1.017	0.615
505	0.153	no data	87.00	0.064	0.122	3.907	5.334	0.485	0.178	1.916	1.179
506	0.094	no data	1.17	0.000	0.000	1.564	1.600	no data	no data	1.357	0.895
508	0.055	no data	0.08	0.000	0.000	0.592	0.447	no data	no data	1.020	0.631
509	0.106	no data	5.59	0.000	0.000	2.346	2.270	no data	no data	1.467	0.944
510	0.150	no data	20.39	0.120	0.195	4.507	5.544	no data	no data	2.017	1.246
517	0.063	no data	0.15	0.000	0.000	0.758	0.609	no data	no data	1.013	0.608
518	0.024	no data	no data	0.000	0.000	0.113	0.073	no data	no data	0.600	0.235
519	0.119	0.07	23.38	0.000	0.000	2.699	2.776	no data	no data	1.514	0.973
520	0.056	no data	0.08	0.000	0.000	0.612	0.541	no data	no data	1.026	0.580
521	0.175	0.15	54.22	0.093	0.198	5.477	5.397	0.636	0.266	2.097	1.266
522	0.088	no data	0.56	0.000	0.000	1.884	1.897	no data	0.001	1.430	0.901
523	0.068	no data	0.08	0.000	0.000	0.602	0.537	no data	no data	0.998	0.638
524	0.112	no data	8.17	0.000	0.031	2.493	2.623	no data	no data	1.555	0.977
525	0.173	0.31	80.14	0.146	0.261	5.359	5.572	no data	0.293	2.123	1.306
530	0.075	no data	0.39	0.000	0.000	0.466	0.409	no data	no data	0.928	no data
531	0.031	no data	0.09	0.000	0.000	0.039	0.044	no data	no data	0.414	no data
532	0.121	no data	4.96	0.000	0.020	2.383	1.804	no data	no data	1.509	no data
533	0.065	no data	0.08	0.000	0.000	0.352	0.337	no data	no data	1.040	no data
534	0.184	2.40	0.00	0.123	0.200	5.526	4.300	0.674	0.357	2.004	1.117
535	0.095	no data	1.47	0.000	0.000	1.356	1.321	no data	no data	1.342	0.731
	5.544	5.54	5.54	5.544	5.544	5.544	5.544	5.544	5.544	5.544	5.544
613	0.108	no data	4.15	0.000	0.000	0.414	0.371	no data	no data	0.741	0.341
614	0.084	no data	0.17	0.000	0.000	0.038	0.051	no data	no data	0.269	no data
615	0.140	no data	46.80	0.033	0.000	1.533	1.344	0.181	no data	1.030	0.577
616	0.110	no data	8.69	0.000	0.000	0.298	0.329	no data	no data	0.698	0.259
617	0.175	0.08	46.57	0.134	0.070	2.934	2.514	0.692	0.327	1.244	0.733
618	0.137	no data	272.26	0.000	0.000	0.874	0.861	no data	no data	1.072	no data
607	0.093	no data	0.94	0.000	0.000	0.660	1.249	no data	no data	0.858	no data
608	0.044	no data	0.09	0.000	0.000	0.085	0.181	no data	no data	0.411	no data
609	0.125	0.15	12.10	0.058	0.030	2.970	3.604	no data	no data	1.240	no data
610	0.083	no data	0.43	0.000	0.000	0.587	0.806	no data	no data	0.816	no data
611	0.170	0.53	0.00	0.392	0.175	6.491	6.396	0.673	0.447	1.592	0.931
612	0.110	no data	4.57	0.000	0.000	2.034	2.519	no data	no data	1.156	0.660
601	0.074	no data	0.08	0.000	0.000	0.495	0.622	no data	no data	0.877	0.387
602	0.021	no data	no data	0.000	0.000	0.025	0.053	no data	no data	0.379	no data
603	0.112	no data	4.87	0.000	0.000	2.055	1.755	0.118	no data	1.122	0.673
604	0.051	no data	0.09	0.000	0.000	0.288	0.389	no data	no data	0.806	0.324
605	0.138	no data	79.98	0.078	0.102	3.424	3.269	0.754	0.382	1.373	0.825
606	0.078	no data	0.17	0.000	0.000	1.313	1.586	no data	no data	1.102	no data
625	0.074	no data	0.31	0.000	0.000	0.767	1.163	no data	0.526	0.813	0.40516
626	0.032	no data	0.09	0.000	0.000	0.137	0.248	no data	no data	0.401	no data
627	0.242	no data	18.79	0.116	0.042	3.350	3.467	0.588	0.186	2.403	1.31508
628	0.071	no data	0.08	0.000	0.000	0.776	0.906	no data	no data	0.749	no data
629	0.166	0.46	57.63	0.573	0.219	6.370	7.525	0.644	0.449	1.656	0.9123
630	0.099	no data	1.91	0.039	0.000	2.324	2.767	no data	no data	1.093	0.50833
619	0.086	no data	0.49	0.000	0.000	0.633	0.756	no data	no data	0.895	0.47341
620	0.033	no data	0.09	0.000	0.000	0.037	0.084	no data	no data	0.339	no data
621	0.117	no data	3.99	0.000	0.028	2.271	2.733	no data	no data	1.210	0.7504
622	0.071	no data	0.09	0.000	0.000	0.303	0.508	no data	no data	0.833	0.39325
623	0.156	0.23	71.92	0.072	0.148	4.012	4.992	0.674	0.323	1.514	0.90198
624	0.102	no data	2.07	0.000	0.000	1.234	1.680	no data	no data	1.117	0.62262
637	0.069	no data	0.15	0.000	0.000	0.851	0.847	no data	0.517	0.772	no data
638	0.019	no data	0.08	0.000	0.000	0.127	0.182	no data	0.181	0.340	no data
639	0.106	no data	6.89	0.147	0.039	2.876	3.291	0.378	0.763	1.137	no data
640	0.061	no data	0.24	0.000	0.000	0.652	0.921	no data	0.506	0.715	no data
641	0.167	0.62	0.00	1.024	0.255	5.193	7.384	0.798	1.013	1.564	no data
642	0.093	no data	2.06	0.060	0.000	2.398	2.520	0.121	0.679	0.957	no data
631	0.081	no data	0.39	0.000	0.000	0.505	0.692	no data	no data	0.836	0.44167
632	0.024	no data	no data	0.000	0.000	0.039	0.070	no data	no data	0.270	no data
633	0.117	0.07	4.27	0.000	0.000	1.982	2.873	no data	no data	1.197	0.68611
634	0.068	no data	0.17	0.000	0.000	0.361	0.521	no data	no data	0.825	no data
635	0.169	0.38	73.24	0.080	0.092	4.015	5.005	0.513	no data	1.460	0.83214
636	0.093	no data	1.52	0.000	0.000	1.048	1.445	no data	no data	no data	no data

Test	Flow depths 2%						Flow depths 2% pressures			
no.	h70-15-l	h70-16-s	h70-56 sl	h70-17-l	h60-18-s	h60-57 sl	ps58 - 70cm	ps59 - 70cm	ps60 - 60cm	ps61 -60cm
	m	m	m	m	m	m	m	m	m	m
425	no data	no data	no data	0.004	0.008	0.010	no data	no data	0.054	0.107
427	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
426	no data	no data	no data	0.011	0.020	0.021	no data	no data	0.094	0.137
428	no data	no data	no data	0.005	0.010	0.011	no data	no data	0.054	0.107
429	0.011	0.004	0.023	0.026	0.041	0.044	0.060	0.040	0.134	0.177
430	0.002	no data	no data	no data	no data	0.028	0.050	0.030	0.104	no data
451	no data	no data	no data	0.019	0.031	0.038	0.006	99.000	0.022	0.032
452	no data	no data	no data	0.013	0.018	0.030	no data	no data	0.020	0.037
453	0.009	0.014	0.018	0.027	0.035	0.056	0.010	0.003	0.020	0.032
454	no data	no data	0.006	0.020	0.026	0.042	0.005	99.000	0.022	0.033
456	0.023	0.033	0.035	0.038	0.051	0.071	0.010	0.010	0.026	0.038
457	0.004	0.011	0.015	0.025	0.036	0.058	0.010	0.005	0.023	0.033
418	no data	no data	no data	0.003	0.005	0.010	no data	no data	0.044	0.077
419	no data	no data	no data	0.011	0.020	0.022	no data	no data	no data	0.127
421	0.010	0.005	0.023	0.025	0.045	0.048	0.012	0.009	0.034	0.047
464	0.002	no data	no data	0.018	0.028	0.039	0.005	0.002	0.023	0.039
465	0.008	0.010	0.014	0.027	0.040	0.055	0.007	0.005	0.028	0.046
466	0.021	0.030	0.031	0.037	0.052	0.070	0.020	0.012	0.039	0.061
458	no data	no data	no data	0.021	0.030	0.042	0.006	0.003	0.030	0.054
459	no data	no data	no data	0.012	0.016	0.031	no data	no data	0.019	0.032
460	0.010	0.015	0.018	0.030	no data	0.058	0.006	0.003	0.026	0.036
461	no data	no data	0.006	0.020	0.029	0.044	0.004	0.002	0.023	0.035
462	0.021	0.029	0.032	0.038	0.057	0.079	0.008	0.006	0.026	0.041
463	0.008	0.013	0.016	0.030	0.043	0.060	0.005	0.004	0.024	0.036
412	no data	no data	no data	no data	0.007	0.011	no data	no data	no data	0.247
413	no data	no data	no data	0.010	0.020	0.024	no data	no data	no data	0.167
414	0.012	0.006	0.020	0.025	0.045	0.048	0.100	0.060	0.214	0.377
415	no data	no data	no data	no data	0.008	0.010	no data	no data	0.064	0.127
416	no data	no data	no data	0.011	0.020	0.023	no data	no data	0.114	0.167
417	0.011	no data	0.022	0.026	0.045	0.050	0.100	0.110	0.214	0.277
467	no data	no data	0.007	0.021	0.033	0.046	0.006	0.002	0.026	0.040
468	no data	no data	no data	0.013	0.020	0.034	no data	no data	0.021	0.033
469	0.011	0.015	0.019	0.030	0.045	0.062	0.006	0.003	0.030	0.040
470	0.002	0.003	0.005	0.021	0.032	0.050	0.005	no data	0.024	0.039
471	0.021	0.029	0.035	0.042	0.062	0.082	0.010	0.006	0.039	0.056
472	0.009	0.015	0.019	0.028	0.044	0.061	0.005	0.004	0.030	0.042
473	0.005	no data	no data	0.021	0.035	0.047	no data	no data	0.030	0.046
474	no data	0.013	0.018	0.031	0.047	0.066	0.014	0.007	0.036	0.056
475	0.021	0.029	0.034	0.042	0.060	0.081	0.020	0.012	0.044	0.061
480	0.004	no data	0.005	0.020	0.074	0.032	0.006	0.002	0.025	0.048
481	no data	no data	no data	0.013	0.049	0.025	no data	no data	0.020	0.034
482	0.011	0.015	0.020	0.031	0.089	0.048	0.008	0.004	0.028	0.042
483	no data	0.004	0.004	0.019	0.058	0.037	0.005	no data	0.024	0.034
484	0.023	0.030	0.035	0.048	0.084	0.073	0.012	0.006	0.034	0.046
485	0.009	0.012	0.018	0.028	0.055	0.050	0.006	0.005	0.026	0.042
488	0.004	no data	no data	0.019	0.039	0.033	no data	0.003	0.027	0.046
489	0.011	0.013	0.019	0.032	0.061	0.053	0.014	0.010	0.032	0.051
490	0.022	0.029	0.036	0.044	0.076	0.071	0.020	0.014	0.044	0.066
432	no data	no data	no data	0.002	0.004	0.010	no data	no data	0.016	0.032
433	no data	no data	no data	no data	no data	no data	no data	no data	no data	0.032
434	no data	no data	no data	0.009	0.016	0.018	no data	no data	0.019	0.035
435	no data	no data	no data	0.004	0.009	0.012	no data	no data	0.018	0.035
437	0.010	0.005	0.018	0.017	0.033	0.037	0.010	0.006	0.023	0.038
438	0.002	no data	no data	0.013	0.024	0.029	0.004	0.001	0.020	0.037
440	no data	no data	no data	0.012	0.021	0.024	no data	no data	0.020	0.036
441	no data	no data	no data	0.005	0.009	0.013	no data	no data	0.019	0.033
442	0.006	0.003	0.017	0.023	0.039	0.045	0.006	0.004	0.026	0.036
443	no data	no data	no data	0.013	0.025	0.029	0.004	99.000	0.021	0.035
444	no data	no data	no data	0.015	0.027	0.035	no data	99.000	0.019	0.036
445	no data	no data	no data	0.010	0.017	0.026	no data	no data	0.020	0.034
447	0.010	0.016	0.019	0.025	0.041	0.053	0.015	0.005	0.024	0.036
448	no data	no data	no data	0.014	0.025	0.037	no data	no data	0.022	0.033
449	0.021	0.030	0.034	0.036	0.056	0.072	0.015	0.010	0.024	0.036
450	0.005	0.010	0.013	0.020	0.034	0.048	0.010	0.004	0.024	0.037
476	no data	no data	no data	0.016	0.023	0.033	no data	no data	0.022	no data
477	no data	no data	no data	0.008	0.013	0.021	no data	no data	0.019	0.035
486	no data	no data	no data	0.013	0.043	0.022	no data	no data	0.025	0.040
487	no data	no data	no data	0.008	0.026	0.017	no data	no data	0.020	0.035

Test	Flow depths 2%						Flow depths 2% pressures			
no.	h70-15-l	h70-16-s	h70-56 sl	h70-17-l	h60-18-s	h60-57 sl	ps58 - 70cm	ps59 - 70cm	ps60 - 60cm	ps61 -60cm
	m	m	m	m	m	m	m	m	m	m
511	no data	no data	no data	0.016	0.024	0.035	no data	no data	0.020	0.032
512	no data	no data	no data	0.009	0.010	0.024	no data	no data	0.016	0.029
513	0.010	0.006	0.017	0.021	0.031	0.049	0.010	0.006	0.019	0.030
514	no data	no data	no data	0.014	0.024	0.036	no data	no data	0.021	0.033
515	0.021	0.010	0.033	0.033	0.043	0.061	0.014	0.008	0.026	0.034
516	no data	no data	0.011	0.020	0.036	0.046	no data	0.003	0.022	0.037
536	no data	no data	no data	0.015	0.028	0.036	no data	no data	0.026	0.040
537	0.011	no data	0.017	0.021	0.037	0.050	0.014	no data	0.032	0.046
538	0.021	0.010	0.028	0.030	0.046	0.067	0.018	0.011	0.039	0.053
501	no data	no data	no data	0.015	0.024	0.036	no data	no data	0.024	0.032
502	no data	no data	no data	0.010	0.014	0.024	no data	no data	0.022	0.032
503	no data	0.002	0.013	0.023	0.033	0.053	0.007	0.002	0.026	0.038
504	no data	no data	no data	0.015	0.022	0.035	no data	no data	0.024	0.035
505	0.018	0.010	0.025	0.037	0.042	0.065	0.010	0.006	0.030	0.046
506	no data	0.002	0.009	0.021	0.030	0.047	no data	no data	0.026	0.041
508	no data	no data	no data	0.014	0.023	0.035	no data	no data	0.023	0.042
509	no data	no data	0.012	0.023	0.034	0.053	0.008	no data	0.026	0.046
510	0.018	0.009	0.024	0.036	0.042	0.066	0.016	0.010	0.036	0.056
517	no data	no data	no data	0.016	0.031	0.052	no data	no data	0.025	0.039
518	no data	no data	no data	0.010	0.017	0.036	no data	no data	0.020	0.034
519	0.005	0.003	0.017	0.027	0.036	0.054	0.008	0.004	0.030	0.038
520	no data	no data	no data	0.014	0.023	0.034	no data	no data	0.022	0.035
521	0.017	0.009	0.028	0.038	0.045	0.063	0.010	0.005	0.029	0.040
522	0.004	0.002	0.012	0.021	0.032	0.045	0.007	0.003	0.028	0.039
523	no data	no data	no data	0.015	0.026	0.037	no data	no data	0.024	0.034
524	0.008	no data	0.017	0.026	0.039	0.056	0.012	no data	0.034	0.044
525	0.020	0.009	0.030	0.036	0.047	0.065	0.020	0.010	0.044	0.051
530	no data	no data	no data	0.015	0.033	0.038	no data	99.000	0.026	0.044
531	no data	no data	no data	0.009	0.017	0.023	no data	no data	0.021	0.032
532	no data	no data	0.016	0.024	0.043	0.052	0.012	no data	0.034	0.041
533	no data	no data	no data	0.014	0.029	0.036	no data	no data	0.026	0.037
534	0.021	0.011	0.028	0.035	0.046	0.065	0.024	0.012	0.049	0.046
535	no data	no data	0.011	0.019	0.030	0.044	no data	0.002	0.032	0.043
	5.544	5.544	5.544	5.544	5.544	5.544	5.544	5.544	5.544	5.544
613	no data	no data	no data	0.014	0.022	0.028	no data	no data	0.021	0.032
614	no data	no data	no data	0.009	0.011	0.016	no data	no data	0.020	0.031
615	0.006	no data	0.016	0.019	0.030	0.035	0.010	0.003	0.017	0.031
616	no data	no data	no data	0.013	0.019	0.024	no data	no data	0.021	0.037
617	0.016	0.003	0.025	0.026	0.042	0.047	0.010	0.006	0.024	0.037
618	no data	99.007	0.010	0.017	0.028	0.033	0.006	no data	0.024	0.037
607	0.001	no data	no data	0.017	0.027	0.034	0.015	no data	0.026	0.041
608	no data	no data	no data	0.011	0.013	0.020	no data	no data	0.021	0.036
609	0.011	0.006	0.019	0.025	0.039	0.047	0.020	no data	0.032	0.051
610	no data	no data	no data	0.017	0.025	0.033	no data	no data	0.026	0.041
611	0.022	0.013	0.031	0.038	0.057	0.072	0.020	0.008	0.039	0.056
612	0.007	0.005	0.014	0.024	0.039	0.048	0.020	0.004	0.032	0.047
601	0.002	no data	no data	0.016	0.024	0.029	no data	no data	0.024	0.039
602	no data	no data	no data	0.008	0.011	0.017	no data	no data	0.020	0.037
603	0.011	0.006	0.017	0.022	0.034	0.042	0.020	0.004	0.028	0.046
604	no data	no data	no data	0.014	0.020	0.026	no data	no data	0.023	0.037
605	0.022	0.010	0.026	0.026	0.042	0.051	0.016	0.007	0.030	0.046
606	0.003	no data	0.007	0.017	0.028	0.036	0.006	0.002	0.027	0.043
625	no data	0.001	0.005	0.017	0.029	0.036	no data	0.002	0.023	0.038
626	no data	no data	no data	0.011	no data	0.015	no data	no data	0.020	0.037
627	0.022	0.005	0.037	0.052	0.086	0.094	0.025	0.009	0.059	0.093
628	0.002	no data	no data	0.016	0.028	0.033	no data	0.001	0.024	0.039
629	0.022	0.009	0.033	0.040	0.063	0.068	0.010	0.007	0.034	0.056
630	0.006	no data	0.011	0.024	0.037	0.043	0.006	0.003	0.026	0.045
619	no data	no data	no data	0.017	0.027	0.034	no data	no data	0.023	0.039
620	no data	no data	no data	0.009	0.012	0.019	no data	no data	0.020	0.035
621	0.007	0.003	0.014	0.023	0.038	0.046	0.015	0.003	0.028	0.046
622	no data	no data	no data	0.015	0.023	0.030	no data	no data	0.023	0.039
623	0.018	0.007	0.024	0.030	no data	0.058	0.012	0.006	0.030	0.046
624	0.004	0.002	0.010	0.019	0.029	0.041	0.006	0.003	0.024	0.040
637	no data	0.002	0.010	0.016	0.025	0.031	0.004	0.003	0.025	0.040
638	no data	no data	no data	0.010	0.013	0.021	no data	no data	0.022	0.038
639	0.014	0.007	0.024	0.027	0.042	0.046	0.005	0.006	0.028	0.046
640	no data	no data	0.003	0.017	0.024	0.031	no data	99.000	0.025	0.039
641	0.026	0.016	0.041	0.042	0.058	0.065	0.010	0.008	0.034	0.051
642	0.005	0.003	0.016	0.024	0.033	0.042	0.015	0.003	0.026	0.043
631	no data	no data	no data	0.017	0.026	0.030	no data	no data	0.025	0.040
632	no data	no data	no data	0.008	0.010	0.016	no data	no data	0.020	0.037
633	no data	no data	0.013	0.023	0.037	0.041	0.010	0.003	0.030	0.044
634	no data	no data	no data	0.015	0.020	0.027	no data	no data	0.023	0.039
635	0.017	0.007	0.022	0.030	0.041	0.051	0.010	0.008	0.034	0.051
636	no data	no data	0.009	0.020	0.028	0.036	no data	no data	no data	no data