



AALBORG UNIVERSITY
DENMARK

Aalborg Universitet

Hydraulic Response of Rubble Mound Breakwaters

scale effects - berm breakwaters

Andersen, Thomas Lykke

Publication date:
2006

Document Version
Publisher's PDF, also known as Version of record

[Link to publication from Aalborg University](#)

Citation for published version (APA):

Andersen, T. L. (2006). *Hydraulic Response of Rubble Mound Breakwaters: scale effects - berm breakwaters*. Hydraulics & Coastal Engineering Laboratory, Department of Civil Engineering, Aalborg University.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal -

Take down policy

If you believe that this document breaches copyright please contact us at vbn@aub.aau.dk providing details, and we will remove access to the work immediately and investigate your claim.

APPENDIX D

Evaluation of Berm Breakwater Overtopping Formula against Dimensionless Parameters

In this appendix is the proposed overtopping formula for berm breakwaters evaluated against some dimensionless parameters, both those included in the formula and other parameters. From the figures the investigated ranges of these parameters could be observed, which are the ranges for having good predictions by the overtopping formula. The following colors are used as a general legend in all figures included in this appendix:

- Present data
- Bolatti Guzzo and Marconi, 1991
- Lissev, 1993
- Viggosson et al., 1993
- Kuhnen, 2000
- Porarinsson, 2004

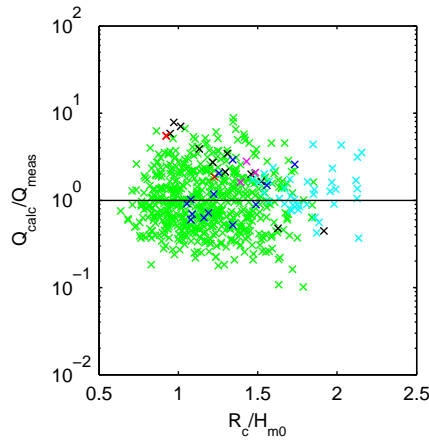


Figure D.1

Variation with dimensionless crest freeboard R_{\star} .

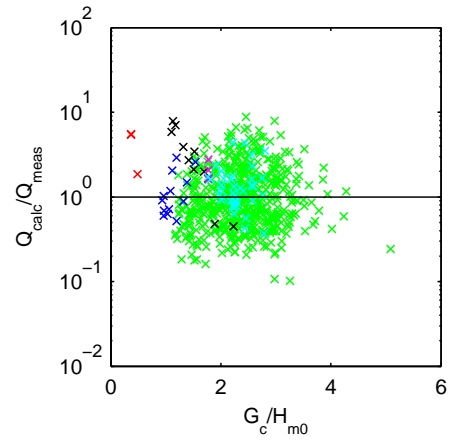


Figure D.2

Variation with dimensionless crest width G_{\star} .

No systematic scatter with dimensionless crest freeboard is observed within the calibrated area being $0.6 < R_{\star} < 2$. However, the Lissev, 1993 and Kuhnen, 2000 data shows increasing deviation between measured and calculated overtopping discharge with decreasing R_{\star} . The same trend is observed with G_{\star} so it can be concluded that for large wave heights these two data sets shows a different trend than the present data and the data of Porarinnsson, 2004. The present data shows no systematic deviations with dimensionless crest width G_{\star} . The data of Kuhnen, 2000 is characterized by a very narrow crest with $G_{\star} \approx 0.4$ which is outside the calibrated area $1 < G_{\star} < 4$. It seems reasonable to conclude that the dimensionless crest freeboard and crest width has been included in a proper way.

The berm width seems to have been included in a proper way as no systematic scatter is with B_{\star} is observed within the calibrated area $0 < B_{\star} < 8$, cf. Fig. D.3. Even for steep structures with no berm the formula gives good predictions. Also for structures with a very wide berm the predictions are good. The berm elevation seems to have been included in a proper way as no systematic scatter with $h_{b\star}$ is observed, cf. Fig. D.4.

Evaluation of Berm Breakwater Overtopping Formula against Dimensionless Parameters

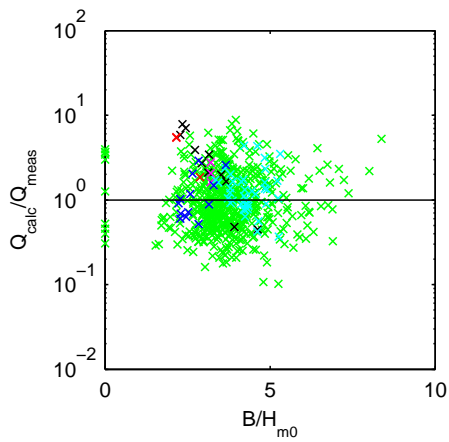


Figure D.3

Variation with dimensionless berm width B_{\star} .

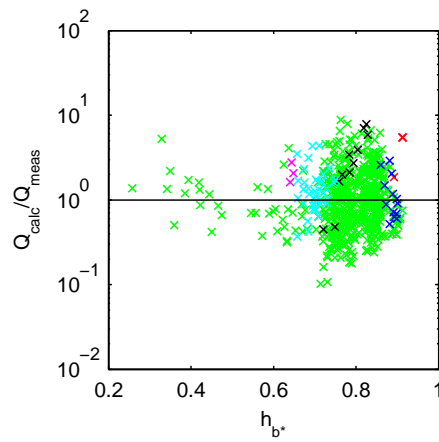


Figure D.4

Variation with dimensionless berm elevation h_{b^*} .

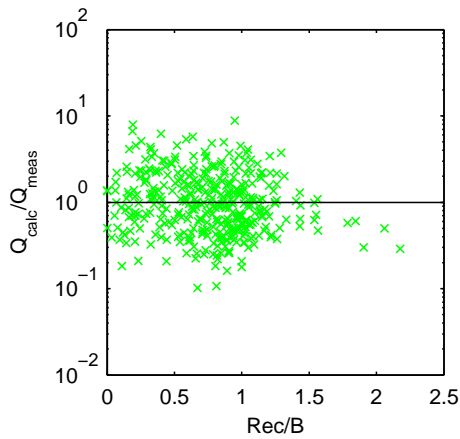


Figure D.5

Variation with dimensionless recession of berm Rec/B .

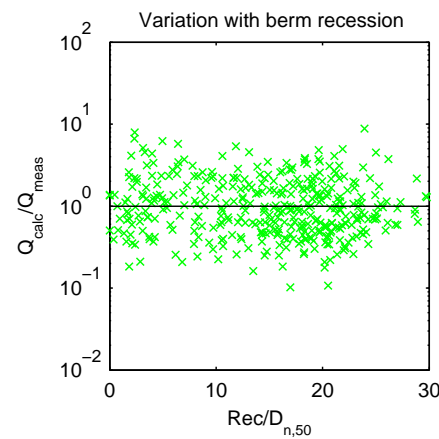


Figure D.6

Variation with dimensionless recession of berm $Rec/D_{n,50}$.

No reshaped geometrical parameters were included in the overtopping formula. To describe the influence of reshaping the f_{H0} parameter introduced in chapter 4 was included. This seems valid as no systematic scatter with Rec/B and

$Rec/D_{n,50}$ is observed at least in the relevant area $Rec/B < 1.0$, cf. Fig. D.5 and D.6. For very large values of Rec/B , which will say greater than 1.5, there is a tendency of a slightly underestimation of overtopping discharges.

No systematic scatter is observed with H_0T_0 and s_{op} , cf. Fig. D.7 and D.8.

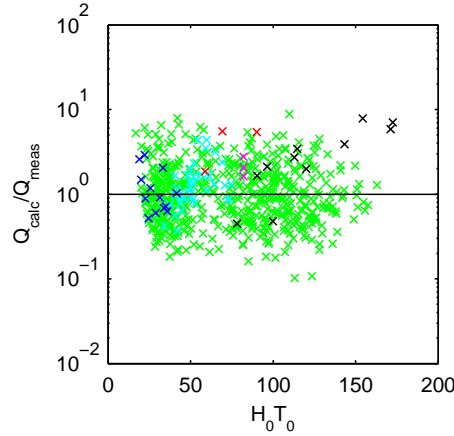


Figure D.7

Variation with stability index H_0T_0 .

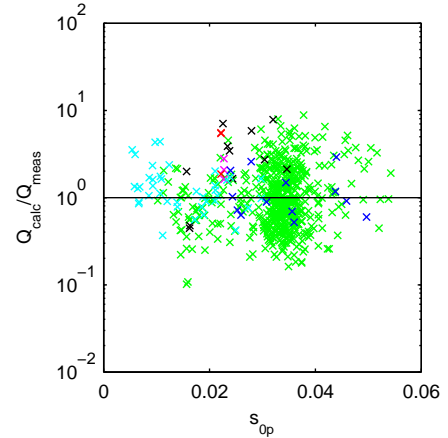


Figure D.8

Variation with peak wave steepness s_{op} .

Because overtopping is a very non-linear phenomenon one could expect a large influence of the wave height distribution on overtopping. However, this is as shown in Fig. D.9 not the case. There seems to be some influence, but not a major one, which was the reason for including only H_{m0} in the formula, as this parameter is very common given. Moreover including $H_{1/100}$ instead of H_{m0} resulted in a worse fit. Rayleigh distributed waves yields $H_{1/100}/H_{1/3} = 1.66$ corresponding to approximately the highest values observed in the present tests. For $H_{1/100}/H_{m0} < 1.4$ there is a tendency to overprediction of overtopping discharges.

The wave groupiness factor was not included in the formula, but has some influence on the average overtopping discharge, as there is a tendency to increasing overtopping with increasing groupiness factor, cf. Fig. D.10. Nothing was done to generate waves with little or high wave groupiness, so the different wave groupiness factors is due to sample variability only. A more systematic study is needed to cover the influence of wave groupiness.

Evaluation of Berm Breakwater Overtopping Formula against Dimensionless Parameters

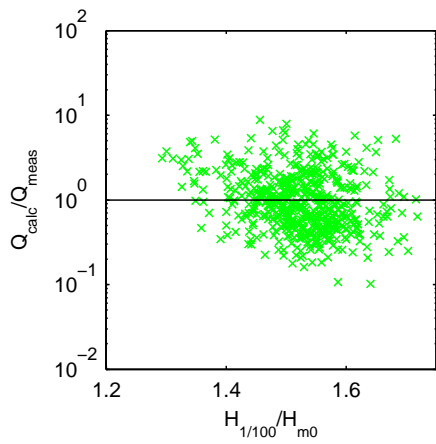


Figure D.9
Variation with wave height distribution $H_{1/100}/H_{m0}$.

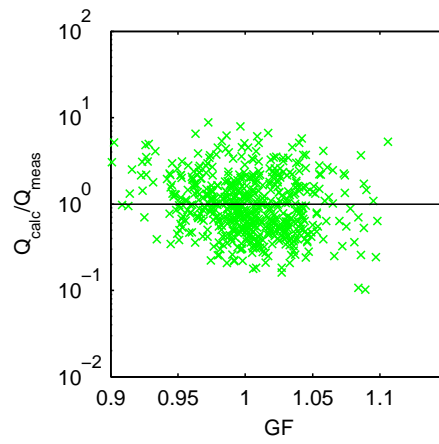


Figure D.10
Variation with wave groupiness GF .

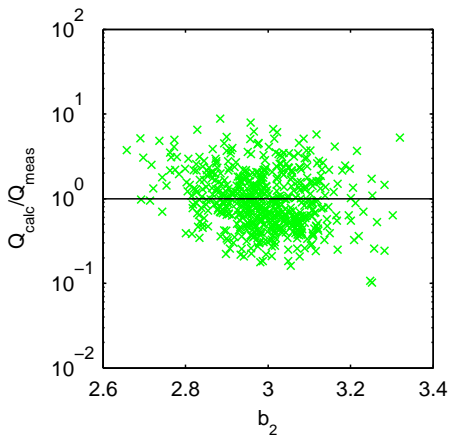


Figure D.11
Variation with kurtosis b_2 .

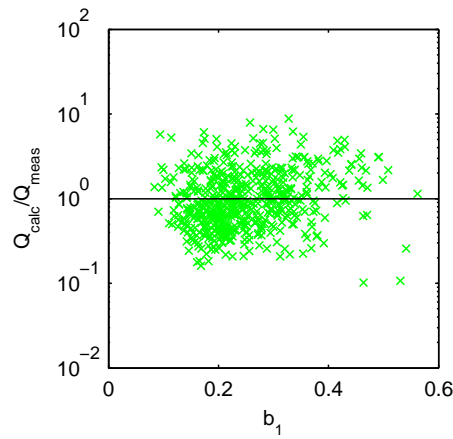


Figure D.12
Variation with skewness b_1 .

The kurtosis of the surface elevation is another measure for the wave height distribution. There is observed some systematic deviation with the kurtosis, similar to what was found for $H_{1/100}/H_{m0}$.

The wave skewness was found to have some influence on the stability of a berm breakwater. Nevertheless, the parameter seems not to have any significant influence on the overtopping discharge, and was therefore not included in the formula.

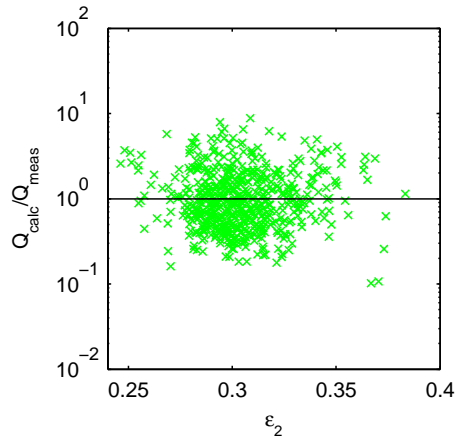


Figure D.13

Variation with spectral width parameter ϵ_2 .

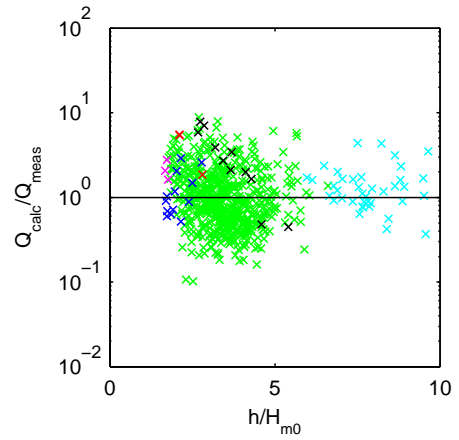


Figure D.14

Variation with dimensionless water depth h/H_{m0} .

In the OPTICREST project was found increasing wave run-up heights with increasing spectral width (see Fig. 9.3). In the present test programme was only included tests generated from the JONSWAP spectra with a peak enhancement factor (γ) of 3.3. Therefore, it could be difficult to conclude anything on influence of spectral width on overtopping of berm breakwaters, as the variations in spectral width parameter is mainly due to shoaling and breaking. In the tests of Lissev, 1993 a Pierson-Moskowitz spectra was used which is wider than the spectra tested in the present tests. If the findings in the OPTICREST project also applies to overtopping Lissev, 1993 should have measured more overtopping, but they measured less than predicted by the formula. To give clear recommendations on influence of the spectral width, a systematic study with different spectra is needed.

For very shallow water conditions there is an influence of the water depth, which was not included in the overtopping formula. This is due to wave breaking which influences the wave height distribution. For flatter foreshores the influence of the water depth will start for higher values of h/H_{m0} . The main part of the present tests were performed with non-breaking waves on the foreshore and only one foreshore slope was tested. Thus the validity of the formula needs to be verified

Evaluation of Berm Breakwater Overtopping Formula against Dimensionless Parameters

for cases where heavy wave breaking is not taking place on the foreshore. In cases with heavy wave breaking the formula seems to give conservative results as expected.