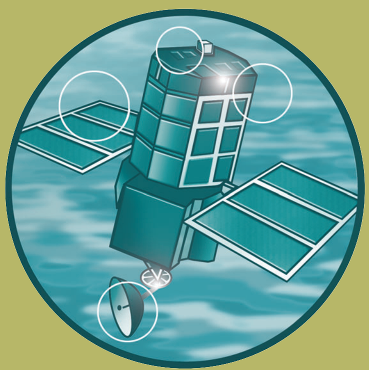
Joint Defra/EA Flood and Coastal Erosion Risk Management R&D Programme

Understanding the lowering of beaches in front of coastal defence structures, Stage 2 Technical Note 6

R&D Project Record FD1927/PR6



Environment Agency

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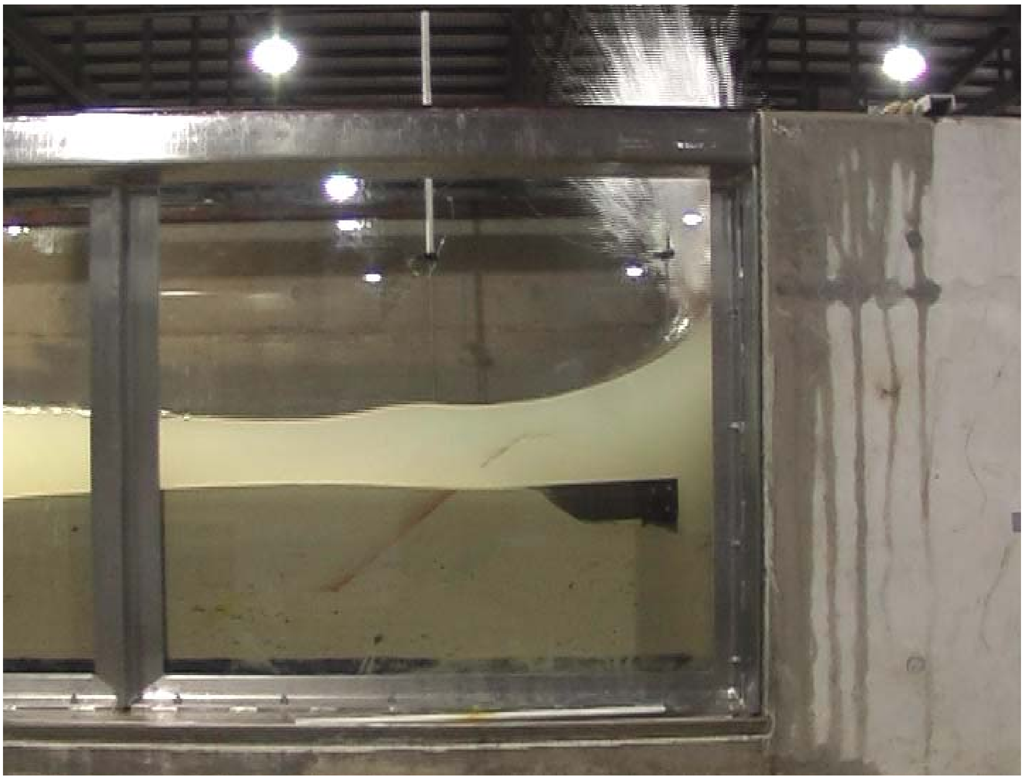
Understanding the Lowering of Beaches in front of coastal defence structures, Phase 2

Medium scale 2D physical model tests of scour at sea walls

Technical Note CBS0726/06



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1. Introduction

HR Wallingford conducted medium scale physical model tests of scour in front of seawalls as part of the Defra funded project Understanding the Lowering of Beaches in front of Coastal Defence Structures, Phase 2 (FD1927). The work was carried out with the assistance of the University of Southampton. The flume experiments provided a set of physical model test results to feed into the development of an improved scour prediction method. This will be used for scour predictions and will provide input to a probabilistic method for assessing the safety of coastal defence structures within the PAMS framework. The data will also be useful for the validation and development of numerical models. The selection of seawall profiles has been informed by interrogation of the NFCDD and an expert review of seawalls and beaches.

During Phase 1 of the research (Sutherland et al., 2003) some shortcomings were identified in the presently available laboratory data for scour prediction in front of seawalls. The shortcomings of previous 2D (flume) tests were addressed by medium scale tests in the laboratory at HR Wallingford. The laboratory tests looked at the longshore-uniform case of normal wave incidence only. The field tests looked at the 3D problem (Sutherland and Pearce, 2005). In some cases both cross-shore and long-shore transport will need to be considered. To extend the laboratory tests to 3D would have meant additional time and costs for construction and running of the tests, plus additional time for analysis. Such tests could be performed at a later date as part of another study, if required. This technical note summarises the test procedures, the experimental set-up, the test conditions and the data obtained.

2. Wave flume test procedure

Tests were performed in the new 45m long wave flumes at HR Wallingford. The internal cross-section of the flume is 1.2m wide by 1.7m high. Waves are generated using a piston-type wavemaker with a maximum stroke of ±0.6m and a maximum operating depth of 1.4m. The wavemaker has an absorption system for absorbing wave energy reflected from the seawalls. The test setup had a 1:30 smooth concrete slope up to an elevation of 0.64m above the flume floor. The test section was a 5.14m long sand bed filled with Redhill 110 sand. The sand bed was 0.3m deep at the offshore end. Tests 1 to 14 all started from a screeded 1:30 slope. The sand bed level at the wall was therefore approximately 0.80m above the flume floor (see Figure 1). Tests 15-34 started from a 1:75 slope where the sand bed level at the wall was approximately 0.7m above the flume floor.

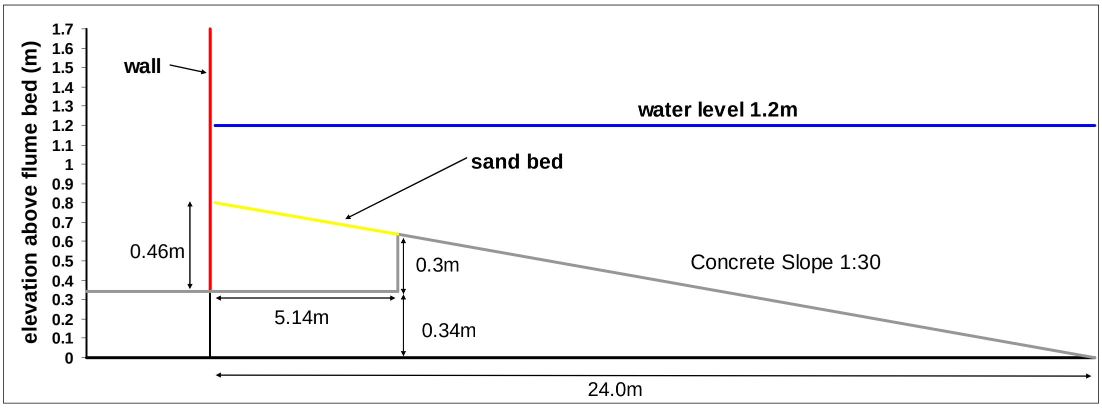


Figure1 Wave flume set-up

2.1 SAND

The sand used was Redhill 110, with typically 98.80% SiO_2, 0.09% Fe_2O_3, 0.21% Al_2O_3 and 0.14% LOI (loss on ignition). The results of a sieve analysis of Redhill 110 are shown in Table 1. Common percentiles are d_{16} = 0.087mm, d_{50} = 0.111mm and d_{84} = 0.154mm where d_n, is the sieve size that *n* percent of the sand by weight would pass through. Settling velocities are also given for d_{10}, d_{50} and d_{90} from the formulae of Soulsby (1997) and van Rijn (1984), assuming fresh water (salinity = 0) at 11ºC, giving density of water ρ = 999.5kgm^{-3} and a kinematic viscosity $\nu = 1.27\times10^{-6}$m^{2}s^{-1}. In addition, a sediment density ρ_s = 2650kgm^{-3} was assumed – appropriate for silica sand. Measured water temperatures were between 8.6ºC and 12.6ºC with an average of 10.8 ºC. Measured temperatures are given in 'filename.xls' in the database.

Table 1 Percent by weight passing sieve and fall velocity of Redhill 110 fine sand

Percent by weight passing sieve			Soulsby	Van Rijn
(%)	(mm)	(Phi)	w_s (ms^{-1})	w_s (ms^{-1})
5	0.0639	3.9691	0.0026	
10	0.0742	3.7529	0.0035	0.0039
16	0.0866	3.5301	0.0048	
25	0.0949	3.3980	0.0057	
50	0.1114	3.1655	0.0077	0.0088
75	0.1347	2.8918	0.0111	
84	0.1539	2.6999	0.0141	
90	0.1667	2.5849	0.0163	0.0160
95	0.1773	2.4955	0.0180	

2.2 WAVE GAUGES

Waves were measured by 10 wave gauges with locations given in Table 2. A group of 4 wave gauges was situated over the flat flume bed before the start of the beach slope and were used to separate out incident and reflected wave spectra using a least-squares technique. A second group of 4 wave gauges was situated at the offshore end of the sand bed to separate out incident and reflected wave spectra over the sand bed. Variations in the standard deviation in the surface elevation at these gauges could also be used to provide information on the partial standing wave pattern in front of the seawall. A further two wave gauges were placed 1.00m and 0.10m in front of the seawall, where local variations in the water level will be greater due to the stronger partial standing wave pattern.

Table 2 Wave gauge locations

wave gauge number	Distance from the wall (m)	Distance from the paddle (m)
1	29.47	12.17
2	28	13.64
3	27.4	14.24
4	27	14.64
5	4.91	36.73
6	4.61	37.03
7	4.23	37.41
8	3.4	38.24
9	1	40.64
10	0.1	41.54

2.3 BED PROFILES

The profile of the sand bed was measured using the touch sensitive, 2D bed profiling system developed at HR Wallingford. The profiler consisted of a probe which moved up and down and was mounted on a carriage which moves horizontally along a support beam (Figure 2). The probe consisted of a 10mm diameter stainless steel tube which had a rack machined along its length. This rack engaged with the gear wheel of a vertical dc servo motor in the carriage and drove the probe up and down. On the bottom of the probe was a sensor which consisted of a lightweight "finger" that moved freely up and down inside a 20mm cylinder. The finger either had a circular foot or rested on top of a lightweight ball. In tests with the small circular foot the probe stepped down the flume, the finger was lowered until the foot rested on the bed, the level was measured and the foot was raised off the bed again, before the profiler was moved along the profiling rail to the next measuring point. In most of the tests the finger rested on the top of a small lightweight ball that was dragged along the bed by a short lever arm mounted on the front of the probe (shown in Figure 3). The bed level was recorded at a set time interval.

The position of the finger relative to the cylinder, and thus the probe relative to the bed, was measured optically. A pulsed infra-red light source was mounted on top of the probe and light was transmitted to the bottom using optical fibres. Another optical fibre transmitted the light reflected back from the top of the finger to a detector which produced a signal that was proportional to the distance between the probe and the bed. The servo electronics controlled the speed of the probe so that the probe-to-bed distance was the same for each measurement. The resolution of the probe was +-1mm in the horizontal direction and +-0.5mm in the vertical direction. However even though the finger was very light it did cause a slight deformation (approximately 1-2mm) of the sand bed (see Figure 3). This meant that the profiler tended to smooth out some the finer features of the bed.

The beam that the profiler was mounted on sagged in the middle. The beam sag was removed by using a floating probe to profile the water surface. The measured changes in elevation were due to beam sag and were subtracted from subsequent profiles.

Figure 2 Bed profilerand wave gauges on the profiling rail.

Each test started from an initial slope of either 1:30 or 1:75 which was achieved using wooden templates installed on each side of the flume. The initial profile was then measured using the bed profiler. Two types of tests were run. The first used a constant wave height, period, and water depth. In these tests a bed profile was taken after 300, 1000, and 3000 waves. Figure 4 shows the sand bed after 3,000 waves. In the second type of test the water depth was varied to simulate part of a tidal cycle and in these tests a new profile was taken after each of the 300 wave bursts.

Figure 3 The bed profiler

Figure 4 An example of the scour pattern at the wall after 3000 waves

2.4 ROCK AMOUR

Tests 20 to 25 were performed with model rock armour. They were all performed with a 1:75 sloping sand bed and a vertical, impermeable sea wall. The armour consisted of limestone chippings with a density of 2710kgm^{-3}. Test 20 was conducted with 2 layers of rock armour sieved between 14 mm and 20 mm, extending 0.5m from the seawall and placed on top of a fine nylon mesh, used to represent a geotextile. Unfortunately, the armour stones appeared to slide rather easily over the material.

Test 21 was conducted with 2 layers of rock, sieved between 17 mm and 26 mm, placed on a piece of geotextile and extending 0.5m from the seawall on the 1:75 sand slope.

Test 22 was conducted with 2 layers of 17 mm – 26 mm stone, placed at an angle of 2:3 (V:H) in a excavated sand pit, which extended to a depth of 0.1m below the top of the sand bed. The pit was dug using a template to ensure a smooth uniform profile and then lined with a geotextile before 2 layers of armour stones were added and the remainder of the excavation was back filled. The template was cut so that the top of the rock armour was at the original beach level at the seawall. The base of the template was flat (at 0.1m below the top of the sand bed) so that the bottom stones of the bottom and top layers were side by side. Test 23 was prepared in the same way as Test 22 except that no geotextile was used.

The armour stone for tests 24 and 25 was prepared by using a rock weighing machine to sort rocks into weight ranges of 300 g to 400 g, 400 g to 500 g and 500 g to 600 g. Equal weights of each category of rock were mixed prior to placement. The following densities were assumed: model water density = 1000 kgm^{-3}, seawater density = 1027 kgm^{-3} and full-scale armour density = 2650 kg m^{-3}. At a scale of 1:20 and making corrections for the relative densities in model and prototype, a full-scale rock of 3 tonnes weight would be modelled as a stone of weight 303g. Similarly 4 tonne rock would have a model weight of 404g while 5 tonne and 6 tonne rock would have model weights of 505g and 605g respectively. The rock armour used for Tests 24 and 25 therefore corresponded to 3 – 6 tonne armour stone at a scale of 1:20. This is a standard rock grading available from many quarries.

The armour stones were positioned in 2 layers, again with the top of the armour at the level of the original (pre-excavation) top of the sand beach. The underlying slope of the sand bed was 2:3 and the toe was 0.1m below the top of the armour. The sand was back-filled before the test started.

3. Test conditions

A total of 34 tests were performed. Details of the test conditions are given in Table 1-3.

- H_s is the target offshore significant wave height;
- h_t is the water depth at the toe of the structure;
- T_p is the target spectral peak wave period;
- N is the total number of waves (of period T_p) in the test;
- $s = 2\pi H_s/(gT_p^2)$ is the wave steepness;
- g is the gravitational acceleration;
- $L_m = gT_m^2/(2\pi)$ is the linear theory deep water wavelength;
- $T_m = 0.781T_p$ is the average wave period for a JONSWAP spectrum;
- $k_p = 2\pi/L_p$ is the linear theory wavenumber calculated for depth h_t and period T_p by a direct solution to the linear theory dispersion relationship $\omega^2 = gk\tanh(kh)$ where $\omega = 2\pi/T_p$.

19 tests were performed with a vertical wall. 13 of these were with a beach slope of 1:30 and 6 were with a beach slope of 1:75. Details of these are given in table 1. A total of 6 scour protection tests were carried out using a vertical wall and a beach slope of 1:75. Details of these can be found in table 2. A sloping wall at 1:2 was used in 9 of the tests with a beach slope of 1:75. Details can be found in table 3. The majority of tests used a constant incident significant wave height, period and depth to measure the time development of scour. However tests 10 17 24 25 and 34 where used to simulate part of a tidal cycle by running short bursts of 300 waves at different depths. Test 10 started with a water depth at the wall close to zero, increasing the depth in steps to a maximum depth of 0.3m then decreasing the depth in steps down to -0.1m at the seawall. However tests 17 24 25 and 34 started from a higher water depth of 0.2m and decreased the depth in steps down to -0.05m. Details of steps used and the number of profiles in each of the each of the tests are given in Appendix 1. Appendix 2 contains the significant incident and reflected wave heights for all of the tests, calculated using the least squares technique using gauges 1-4. The target test conditions are shown on the parametric scour plots in Figure 5.

Table 3 Completed vertical wall tests with no scour protection

Vertical Wall	Test number	Initial Beach Slope	H_s (m)	h_t (m)	T_p (s)	s	H_s/L_m	h_t/H_s	$k_p.h_t$
03/11/2005	1	1:30	0.2	0.2	1.55	0.053	0.087	1.0	0.613
07/11/2005	2	1:30	0.2	0.2	1.87	0.037	0.060	1.0	0.499
08/11/2005	3	1:30	0.2	0.2	2.29	0.024	0.040	1.0	0.402
09/11/2005	4	1:30	0.2	0.2	3.24	0.012	0.020	1.0	0.281
11/11/2005	5	1:30	0.2	0.2	4.58	0.006	0.010	1.0	0.197
15/11/2005	6	1:30	0.2	0.0	1.87	0.037	0.060	0.0	N/A
16/11/2005	7	1:30	0.2	0.0	3.24	0.012	0.020	0.0	N/A
17/11/2005	8	1:30	0.2	0.1	1.87	0.037	0.060	0.5	0.346
18/11/2005	9	1:30	0.2	0.4	1.87	0.037	0.060	2.0	0.735
21/11/2005-tidal	10	1:30	0.2	0.2	1.87	0.037	0.060	1.0	0.499
24/11/2005	11	1:30	0.2	0.4	3.24	0.012	0.020	2.0	0.402
25/11/2005	12	1:30	0.2	0.1	3.24	0.012	0.020	0.5	0.197
28/11/2005	13	1:30	0.3	0.2	2.29	0.037	0.060	0.5	0.346
29/11/2005	14	1:75	0.3	0.3	1.87	0.055	0.090	1.0	0.624
30/11/2005	15	1:75	0.2	0.2	1.87	0.037	0.060	1.0	0.499
01/12/2005	16	1:75	0.2	0.2	3.24	0.012	0.020	1.0	0.281
02/12/2005-tidal	17	1:75	0.2	0.2	1.87	0.037	0.060	1.0	0.499
05/12/2005	18	1:75	0.2	0.2	4.58	0.006	0.010	1.0	0.197
06/12/2005	19	1:75	0.2	0.4	3.24	0.012	0.020	2.0	0.402

Table 4 Completed scour protection tests performed with a vertical wall and an initial beach slope of 1:75

Scour Protection	Test number	Rock Size	H_s (m)	h_t (m)	T_p (s)	s	H_s/L_m	h_t/H_s	$k_p.h_t$
07/12/2005	20	14-20mm	0.2	0.2	1.87	0.037	0.060	1.0	0.499
08/12/2005	21	17-26mm	0.2	0.2	3.24	0.012	0.020	1.0	0.281
09/12/2005	22	17-26mm	0.2	0.2	3.24	0.012	0.020	1.0	0.281
12/12/2005	23	17-26mm	0.2	0.2	3.24	0.012	0.020	1.0	0.281
13/12/2005-tidal	24	300-600g	0.2	0.2	1.87	0.037	0.060	1.0	0.499
14/12/2005-tidal	25	300-600g	0.2	0.2	3.24	0.012	0.020	1.0	0.281

Table 5 Completed sloping wall tests all performed with a beach slope of 1:75

Sloping Wall	Test number	H_s (m)	h_t (m)	T_p (s)	s	H_s/L_m	h_t/H_s	$k_p.h_t$
20/12/2005	26	0.2	0.2	1.87	0.037	0.060	1.0	0.499
21/12/2005	27	0.2	0.2	3.24	0.012	0.020	1.0	0.281
22/12/2005	28	0.2	0.2	1.55	0.053	0.087	1.0	0.613
23/12/2005	29	0.2	0.3	1.87	0.037	0.060	1.5	0.624
24/12/2005	30	0.2	0.4	3.24	0.012	0.020	2.0	0.402
03/01/2006	31	0.2	0.0	1.87	0.037	0.060	0.0	N/A
04/01/2006	32	0.2	0.0	3.24	0.012	0.020	0.0	N/A
02/01/2006	33	0.2	0.4	1.87	0.037	0.060	2.0	0.735
05/01/2006-tidal	34	0.2	0.0	3.24	0.012	0.020	0.0	N/A

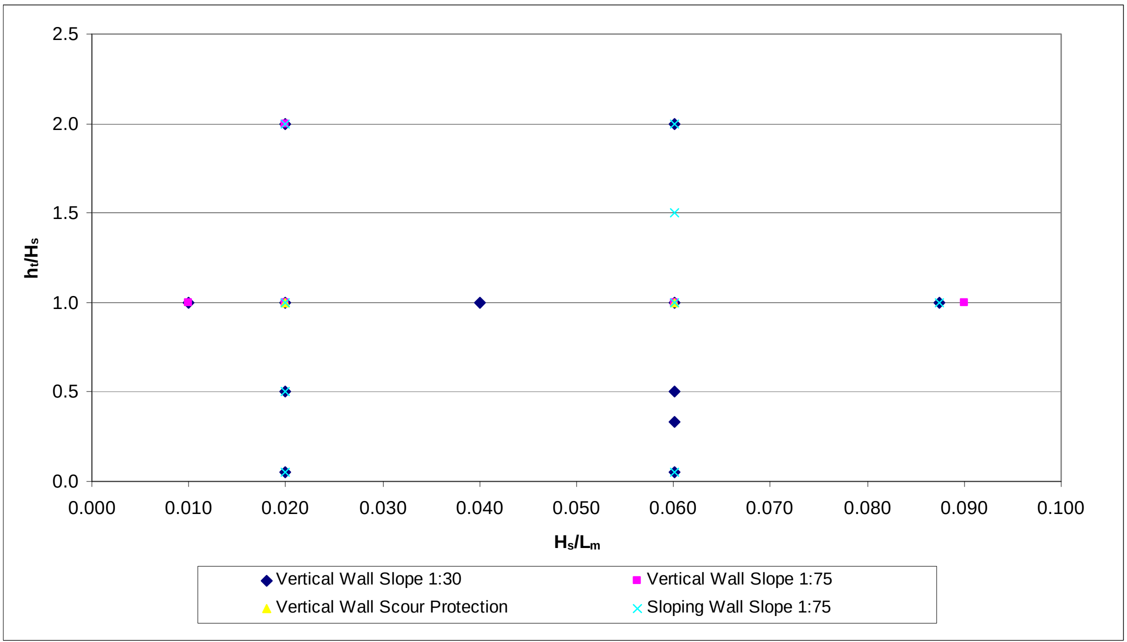


Figure 5 Completed tests on parametric plot axes

4. Bed level plots

Bed level plots showing the time development of bed level during Tests 4, 7, and11 are provided in figures 6-8. These three tests had the same wave period (T_p=3.24s) and wave height (H_s=0.2m) but different water depths (h_t=0m, 0.2m and 0.4m respectively). A comparison has been drawn between these three tests as they resulted in very different breaking wave conditions at the wall and hence different bed profiles. During test 07 the wave tended to break offshore and shoal over the test section which resulted in high levels of energy dissipation. As a result there was a slight accretion at the wall but a general lowering throughout the rest of the profile (Figure 6). However during test 04 the waves tended to break onto the structure and the impacts sent water high up above the seawall (see Figure 9). In these cases water plunging down the face of the seawall to the bed, resulted in lots of suspended sediment transport at the toe, and this appears to be the mechanism for generating the deepest scour depths. Figure 7 shows that the maximum scour occurred at the wall (15.8cm) with significant accretion (5.6cm) occurring 1.3m offshore. In deeper water (test 11, h_t=0.4m) the waves did not break onto the seawall as plunging breakers, but tended to reflect more. The scouring pattern (shown in figure 8) in these cases was closer to the classic Xie type standing wave pattern. Figure 8 shows that the maximum scour of 11.7cm occurred not at the wall but 41cm offshore which significantly less than the plunging breaker case shown in figure 6 (15.8cm). In general the scour depth increased with period but the location of the break point relative to the wall was also important factor in determining the rate of scour at the wall. The bed level plots for all of the tests 1-34 can be found in Appendix 4.

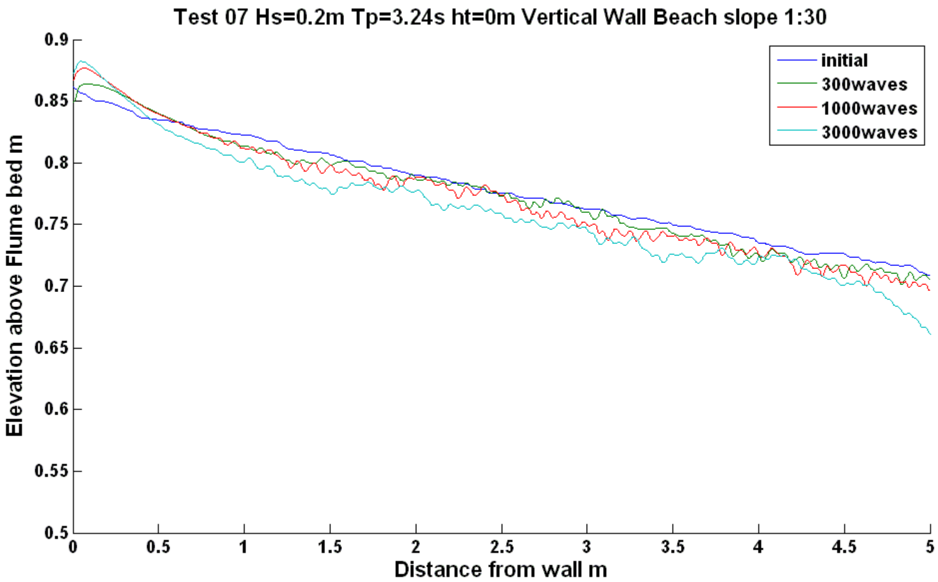


Figure 6 Bed level plot for test 07

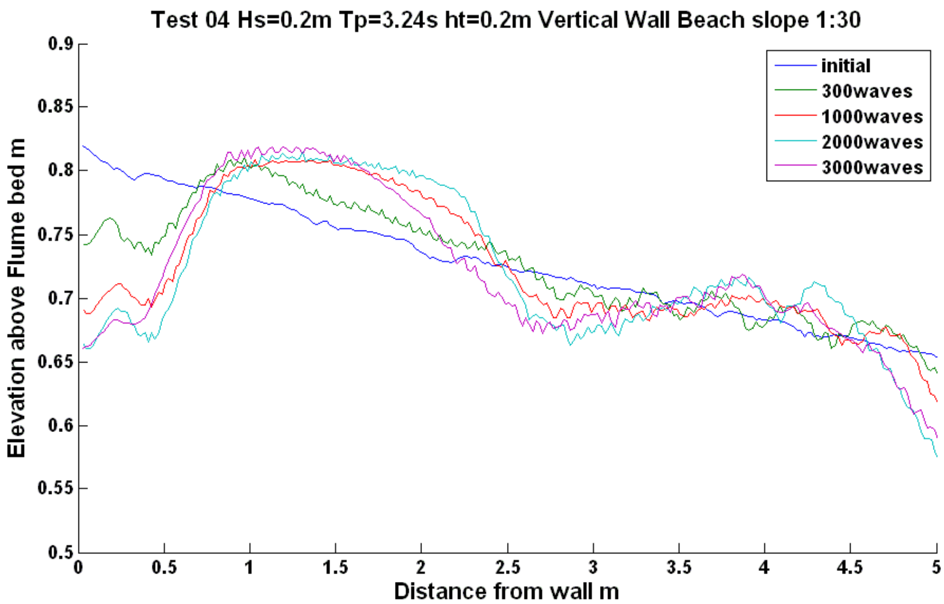


Figure 7 Bed level plot for test 04

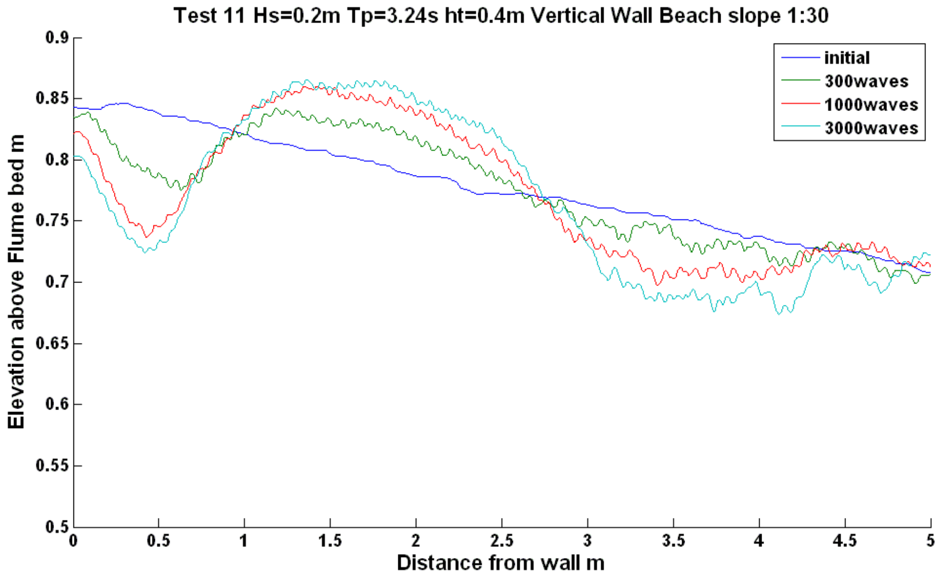


Figure 8 Bed level plot for test 11

Figure 9 An example of a wave breaking directly onto the structure during test 04.

4.1 SCOUR DEPTHS AND SEDIMENT LOSS

Using the bed levels shown in the previous section it is possible to generate scour profiles such as those shown in Figure 10 simply by subtracting the initial profile from each of the subsequent profiles. Then the maximum scour depth (and position), the scour depth at the wall, and the maximum accretion (and position) can then be calculated. A table of all these results calculated after 3000 waves can be found in Appendix 3

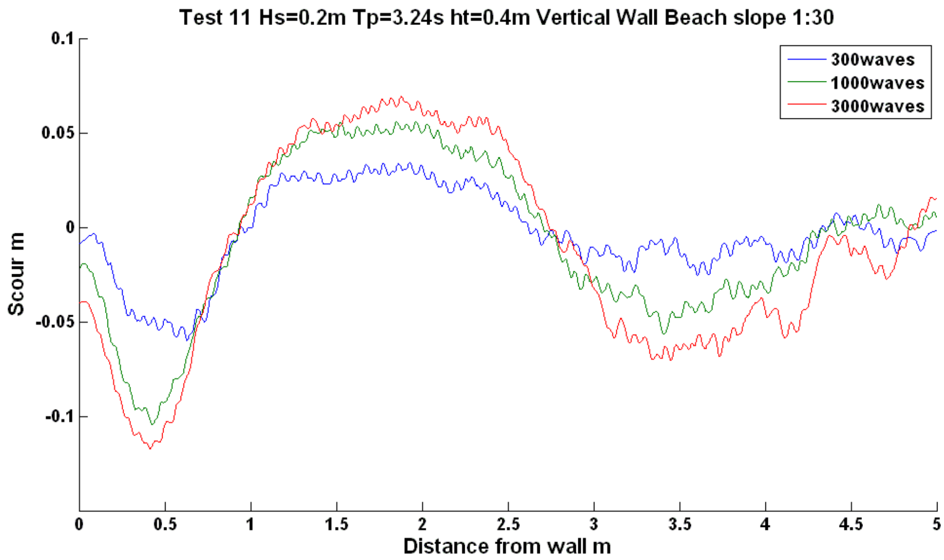


Figure 10 The scour profiles calculate for test 11

The area under the profile, integrated from the seawall to a cross-shore distance of *x* and with a vertical lower limit at the base of the sand bed, was calculated for $0 < x < 5000$mm. The difference between the integrated area before and after each burst of waves for Test 11 is shown in Figure 11 and it shows the pattern of net erosion and accretion. The offshore value at 5m will identify the sediment the net loss to offshore (ignoring the small losses to the inshore side of the seawall) and this value calculated for all the tests is also included in Appendix 3.

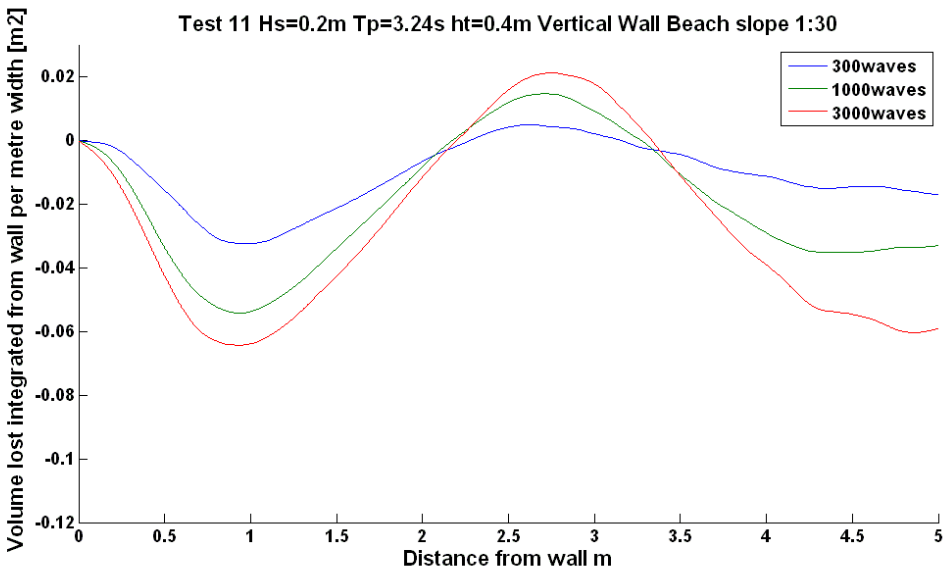


Figure 11 The volume lost integrated from the wall per metre width of the flume (m^2)

5. Comparison to existing scour predictors

Two of the most common scour predictors are those of Fowler (1992) and Sumer and Fredsøe (2000). The results from the HR Wallingford test results are shown in Figure 12 with the results from Fowler (1992), the Supertank experiment (Kraus and Smith, 1994) and Xie (1981). Figure 12 shows that the Fowler curve generally over predicts the measured scour for low relative depths (which is the range it is calibrated for) while Sumer and Fredsøe (2000) significantly over predicts the scour depths at relatively high water depths (which is the range it was calibrated for). The latter is to be expected as Sumer and Fredsøe (2000) generally used regular waves and noted that scour depths for irregular waves were considerably lower.

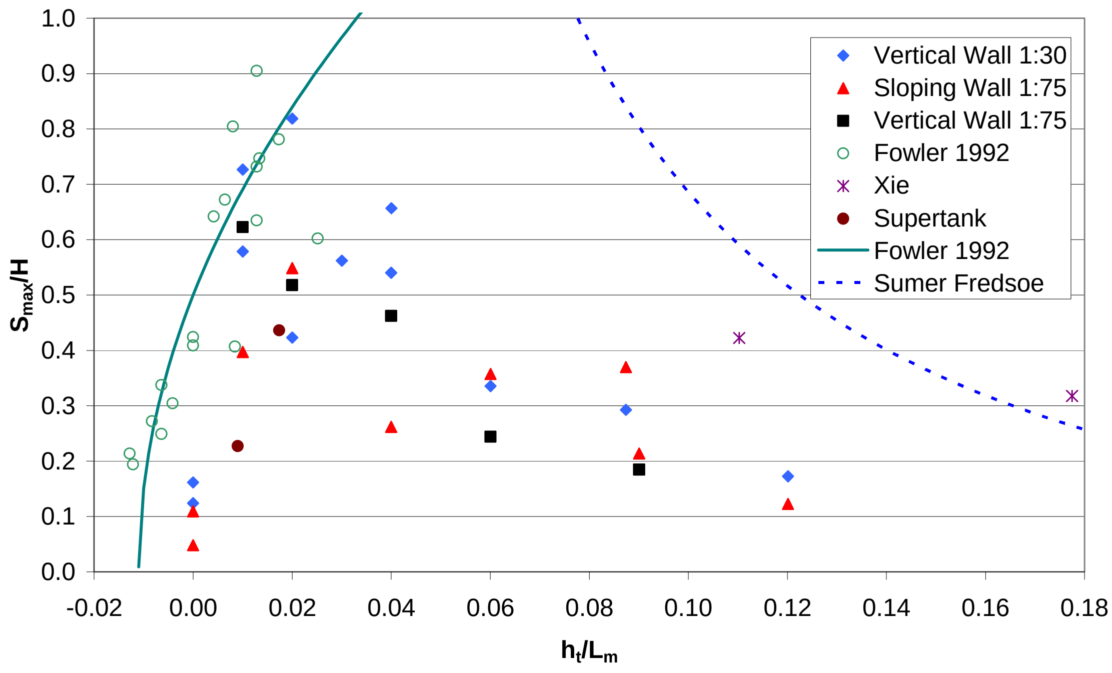


Figure 12 Experimental results plotted against prediction curves of Fowler and Sumer & Fredsøe

6. Data archive

A data CD has been produced for those wishing to use the data further. It contains plots similar to figs 6, 7, 8 and 10 for all of the tests. It also has a series of spreadsheets which contain the bed profiles for all of the tests. Each test has a separate spreadsheet and the number of columns in each spreadsheet depends on the number of profiles taken for that particular test. The table in Appendix 1 shows when and how many profiles were taken in each test. The values given are elevation above the flume bed measured in metres. The profiles have a spatial resolution of 1mm and an extent of 0- 5m. The only exception are tests 1-5 in which a slightly different probe was used. For these tests the profile starts 3cm from the wall. However in order to keep the format of the spreadsheets the same for all of the tests the first 30 point have been padded with zeros for tests 1-5 only. A spreadsheet called filenames.xls contains a list of all the test conditions, filenames and also comments noted throughout the tests such as breaking wave conditions.

7. References

Fowler, J.E. (1992) *Scour problems and methods for prediction of maximum scour at vertical seawalls.* Technical Report CERC-92-16, U.S. Army Corps of Engineers, Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS.

HR Wallingford 2005. Design of physical model scour tests. HR Wallingford Technical Note TN CBS0726/02

Kraus, N.C. and Smith, J.M. (editors), (1994) *SUPERTANK Laboratory data collection project. volume 1: Main text*. Technical report CERC-94-3, US Army Corps of Engineers Waterways Experiment Station, Coastal Engineering Research Center, Vicksburg. Miss.

Sumer, B.M. and Fredsøe, J. (2000) Experimental study of 2D scour and its protection at a rubble-mound breakwater. *Coastal Engineering*, vol 40. 5-87. Elsevier Science.

Xie, S-L. (1981) *Scouring patterns in front of vertical breakwaters and their influence on the stability of the foundations of the breakwaters*. Department of Civil Engineering, Delft University of Technology, Delft, The Netherlands, 61p.

Appendices

Appendix 1 Details of the number of steps used in each of the tests, the number of profiles and the number of waves in each burst

DATE	RUN NO.	TEST NO.	H_s (m)	T_p (s)	h_t (m)	profile no.	no. waves
						profile 1	initial
02/11/2005	1	1	0.2	1.55	0.2	profile 2	300
02/11/2005	2	1	0.2	1.55	0.2	profile 3	700
02/11/2005	3	1	0.2	1.55	0.2		700
03/11/2005	1	1	0.2	1.55	0.2	profile 4	300
03/11/2005	2	1	0.2	1.55	0.2	profile 5	1000
03/11/2005	3	1	0.2	1.55	0.2	profile 6	3000
03/11/2005	4	1	0.2	1.55	0.2	profile 7	4000
04/11/2005	1	1	0.2	1.55	0.2	profile 8	5000
04/11/2005	2	1	0.2	1.55	0.2	profile 9	5000
						profile10	initial
07/11/2005	1	2	0.2	1.87	0.2	prfile11	300
07/11/2205	2	2	0.2	1.87	0.2	prfile12	700
07/11/2005	3	2	0.2	1.87	0.2	prfile13	1000
08/11/2005	1	2	0.2	1.87	0.2	prfile14	1000
						prfile15	initial
08/11/2005	2	3	0.2	2.29	0.2	prfile16	300
08/11/2005	3	3	0.2	2.29	0.2	prfile17	700
08/11/2005	4	3	0.2	2.29	0.2	prfile18	1000
08/11/2005	5	3	0.2	2.29	0.2	prfile19	1000
						prfile20	initial
09/11/2005	1	4	0.2	3.24	0.2	prfile21	300
09/11/2005	2	4	0.2	3.24	0.2	prfile22	700
09/11/2005	3	4	0.2	3.24	0.2	prfile23	1000
10/11/2005	1	4	0.2	3.24	0.2	prfile24	1000
						prfile25	initial
11/11/2005	2	5	0.2	4.58	0.2	prfile26	300
12/11/2005	1	5	0.2	4.58	0.2	prfile27	700
14/11/2005	2	5	0.2	4.58	0.2	prfile28	1000
14/11/2005	3	5	0.2	4.58	0.2	prfile29	1000
						prfile30	initial
16/11/2005	1	6	0.2	1.87	0	prfile31	300
16/11/2005	2	6	0.2	1.87	0	prfile32	700
16/11/2005	3	6	0.2	1.87	0	prfile33	2000
				.		prfile34	initial
16/11/2005	4	7	0.2	3.24	0	prfile35	300
17/11/2006	1	7	0.2	3.24	0	prfile36	700
17/11/2006	2	7	0.2	3.24	0	prfile37	2000
						prfile38	initial
17/11/2006	3	8	0.2	1.87	0.1	prfile39	300
17/11/2006	4	8	0.2	1.87	0.1	prfile40	700
18/11/2005	1	8	0.2	1.87	0.1	prfile41	2000
						prfile42	initial
18/11/2005	2	9	0.2	1.87	0.4	prfile43	300
18/11/2005	3	9	0.2	1.87	0.4	prfile44	700

DATE	RUN NO.	TEST NO.	H_s (m)	T_p (s)	h_t (m)	profile no.	no. waves
18/11/2005	4	9	0.2	1.87	0.4	prfile45	2000
						prfile46	initial
21/11/2005	1	10	0.2	1.87	0.05	prfile47	300
21/11/2005	2	10	0.2	1.87	0.1	prfile48	300
21/11/2005	3	10	0.2	1.87	0.15	prfile49	300
21/11/2005	4	10	0.2	1.87	0.2	prfile50	300
21/11/2005	5	10	0.2	1.87	0.25	prfile51	300
22/11/2005	6	10	0.2	1.87	0.3	prfile52	300
21/11/2005	7	10	0.2	1.87	0.25	prfile53	300
21/11/2005	8	10	0.2	1.87	0.2	prfile54	300
22/11/2005	1	10	0.2	1.87	0.15	prfile55	300
22/11/2005	2	10	0.2	1.87	0.1	prfile56	300
22/11/2005	3	10	0.2	1.87	0.05	prfile57	300
22/11/2005	4	10	0.2	1.87	0	prfile58	300
22/11/2005	5	10	0.2	1.87	-0.05	prfile59	300
22/11/2005	6	10	0.2	1.87	-0.1	prfile60	300
23/11/2005	1	10	0.2	1.87	-0.08	prfile61	300
23/11/2005	2	10	0.2	1.87	-0.09	prfile62	300
						prfile63	initial
24/11/2005	1	11	0.2	3.24	0.4	prfile64	300
24/11/2005	2	11	0.2	3.24	0.4	prfile66	700
24/11/2005	3	11	0.2	3.24	0.4	prfile67	2000
						prfile68	initial
25/11/2005	1	12	0.2	3.24	0.1	prfile69	300
25/11/2005	2	12	0.2	3.24	0.1	prfile70	700
25/11/2005	3	12	0.2	3.24	0.1	prfile71	2000
						prfile72	initial
28/11/2005	1	13	0.3	2.29	0.15	prfile73	300
28/11/2005	2	13	0.3	2.29	0.15	prfile74	700
28/11/2005	3	13	0.3	2.29	0.15	prfile75	2000
						prfile76	initial
29/11/2005	1	14	0.3	1.87	0.3	prfile77	300
29/11/2005	2	14	0.3	1.87	0.3	prfile78	700
29/11/2005	3	14	0.3	1.87	0.3	prfile79	2000
						prfile80	initial
30/11/2005	1	15	0.2	1.87	0.2	prfile81	300
30/11/2005	2	15	0.2	1.87	0.2	prfile82	700
30/11/2005	3	15	0.2	1.87	0.2	prfile85	2000
						prfile86	initial
01/12/2005	1	16	0.2	3.24	0.2	prfile87	300
01/12/2005	2	16	0.2	3.24	0.2	prfile88	700
01/12/2005	3	16	0.2	3.24	0.2	prfile89	2000
						prfile90	initial
01/12/2005	4	17	0.2	1.87	0.2	prfile91	1000
01/12/2005	5	17	0.2	1.87	0.1	prfile92	300
02/12/2005	1	17	0.2	1.87	0.05	prfile93	300
02/12/2005	2	17	0.2	1.87	-0.02	prfile94	300
02/12/2005	3	17	0.2	1.87	-0.04	prfile95	300
02/12/2005	4	17	0.2	1.87	-0.05	prfile96	300
						prfile97	initial
02/12/2005	5	18	0.2	4.58	0.2	prfile98	300

DATE	RUN NO.	TEST NO.	H_s (m)	T_p (s)	h_t (m)	profile no.	no. waves
05/12/2005	1	18	0.2	4.58	0.2	prfile99	700
05/12/2005	2	18	0.2	4.58	0.2	prfile100	2000
						prfile101	initial
06/12/2005	1	19	0.2	3.24	0.4	prfile102	300
06/12/2005	2	19	0.2	3.24	0.4	prfile103	700
06/12/2005	3	19	0.2	3.24	0.4	prfile104	2000
						pfile105	initial
07/12/2005	1	test aborted	0.2	1.87	0.2		
						pfile106	initial
07/12/2005	2	20	0.2	1.87	0.2	pfile107	300
07/12/2005	3	20	0.2	1.87	0.2	pfile108	700
07/12/2005	4	20	0.2	1.87	0.2	pfile109	2000
						pfile110	initial
08/12/2005	1	21	0.2	3.24	0.2	pfile111	300
08/12/2005	2	21	0.2	3.24	0.2	pfile112	700
09/12/2005	1	21	0.2	3.24	0.2	pfile113	2000
						pfile114	initial
12/12/2005	1	22	0.2	3.24	0.2	pfile115	300
12/12/2005	2	22	0.2	3.24	0.2	pfile116	700
12/12/2005	3	22	0.2	3.24	0.2	pfile117	2000
						pfile118	initial
12/12/2005	4	23	0.2	3.24	0.2	pfile119	300
12/12/2005	5	23	0.2	3.24	0.2	pfile120	700
13/12/2005	1	23	0.2	3.24	0.2	pfile121	2000
13/12/2005	2	23	0.2	3.24	0.1	pfile122	1000
						pfile123	initial
13/12/2005	3	24	0.2	1.87	0.2	pfile124	300
13/12/2005	4	24	0.2	1.87	0.2	pfile125	700
14/12/2005	1	24	0.2	1.87	0.2	pfile126	2000
14/12/2005	2	24	0.2	1.87	0.1	pfile127	300
14/12/2005	3	24	0.2	1.87	0.05	pfile128	300
14/12/2005	4	24	0.2	1.87	0	pfile129	300
14/12/2005	5	24	0.2	1.87	-0.05	pfile130	300
						pfile131	initial
14/12/2005	6	25	0.2	3.24	0.2	pfile132	300
14/12/2005	7	25	0.2	3.24	0.2	pfile133	700
15/12/2005	1	25	0.2	3.24	0.2	pfile134	2000
15/12/2005	2	25	0.2	3.24	0.1	pfile135	300
15/12/2005	3	25	0.2	3.24	0	pfile136	300
15/12/2005	4	25	0.2	3.24	-0.05	pfile137	300
						pfile138	initial
20/12/2005	1		0.2	1.87	0.2	pfile139	300
20/12/2005	2	test aborted	0.2	1.87	0.2	prfile140	700
						pfile141	initial
20/12/2005	3	26	0.2	1.87	0.2	pfile142	300
20/12/2005	4	26	0.2	1.87	0.2	pfile143	700
20/12/2005	5	26	0.2	1.87	0.2	pfile144	2000
						pfile145	initial
21/12/2005	1	27	0.2	3.24	0.2	pfile146	300

DATE	RUN NO.	TEST NO.	H_s (m)	T_p (s)	h_t (m)	profile no.	no. waves
21/12/2005	2	27	0.2	3.24	0.2	pfile147	700
21/12/2005	3	27	0.2	3.24	0.2	pfile148	2000
						pfile149	initial
22/12/2005	1	28	0.2	1.55	0.2	pfile150	300
22/12/2005	2	28	0.2	1.55	0.2	pfile151	700
22/12/2005	3	28	0.2	1.55	0.2	pfile152	2000
						pfile153	initial
22/12/2005	4	29	0.2	1.87	0.3	pfile154	300
22/12/2005	5	29	0.2	1.87	0.3	pfile155	700
22/12/2005	6	29	0.2	1.87	0.3	pfile156	2000
						pfile157	initial
23/12/2005	1	30	0.2	3.24	0.4	pfile158	300
23/12/2005	2	30	0.2	3.24	0.4	pfile159	700
23/12/2005	3	30	0.2	3.24	0.4	pfile160	2000
						pfile161	initial
03/01/2006	1	31	0.2	1.87	0	pfile162	300
03/01/2006	2	31	0.2	1.87	0	pfile163	700
03/01/2006	3	31	0.2	1.87	0	pfile164	2000
						pfile165	initial
03/01/2006	4	32	0.2	3.24	0	pfile166	300
04/01/2006	1	32	0.2	3.24	0	pfile167	700
04/01/2006	2	32	0.2	3.24	0	pfile168	2000
						pfile169	initial
04/01/2006	3	33	0.2	1.87	0.4	pfile170	300
04/01/2006	4	33	0.2	1.87	0.4	pfile171	700
05/01/2006	1	33	0.2	1.87	0.4	pfile172	2000
						pfile173	initial
05/01/2006	2	34	0.2	3.24	0.1	pfile174	3000
05/01/2006	3	34	0.2	3.24	0.1 to -0.07	pfile175	

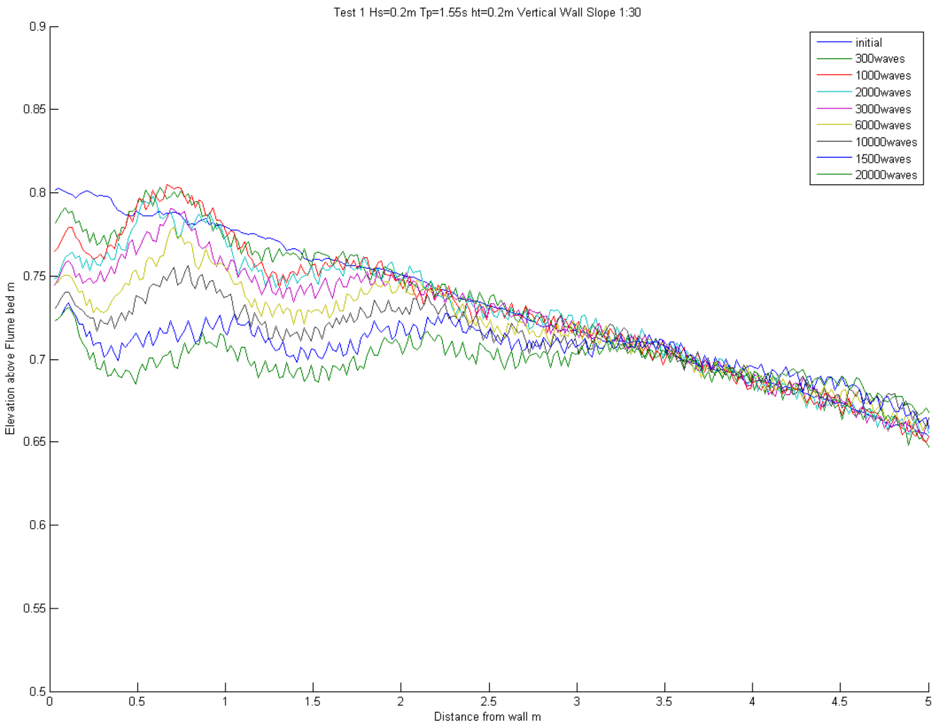
Appendix 2 The significant incident and reflected wave height for all of the test calculated used the least square technique and data from wave gauges 1-4

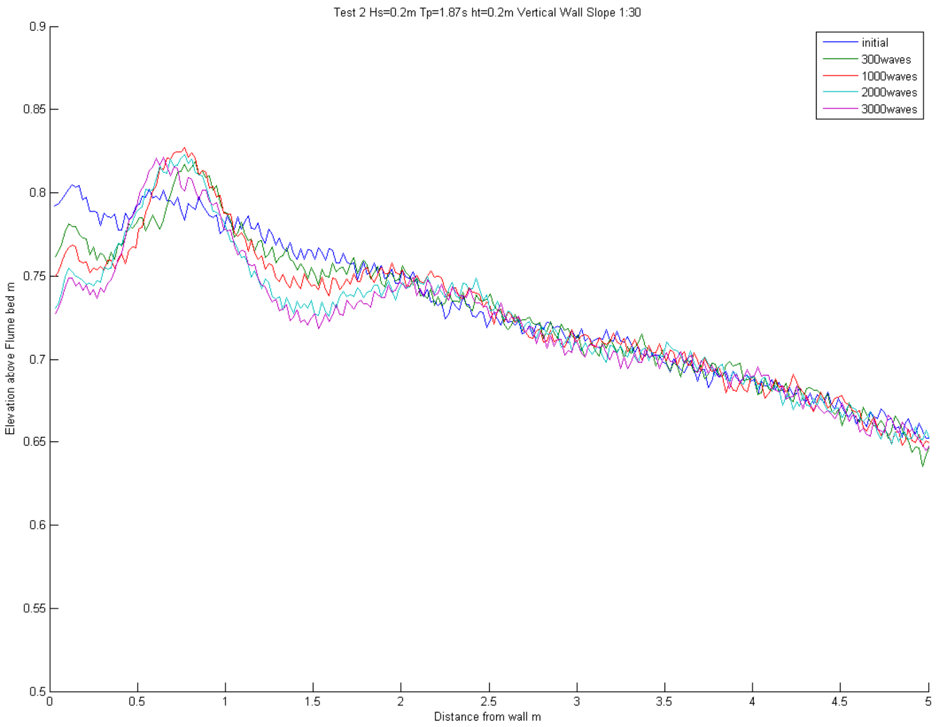
Date	test no.	Beach Slope	H_s inc (m)	H_s ref (m)	Reflection Coeff	h_t (m)	T_p (s)
Vertical Wall							
03/11/2005	1	1:30	0.193	0.097	0.504	0.2	1.55
07/11/2005	2	1:30	0.193	0.094	0.486	0.2	1.87
08/11/2005	3	1:30	0.198	0.092	0.467	0.2	2.29
09/11/2005	4	1:30	0.194	0.089	0.464	0.2	3.24
11/11/2005	5	1:30	0.197	0.088	0.445	0.2	4.58
15/11/2005	6	1:30	0.204	0.017	0.086	0.0	1.87
16/11/2005	7	1:30	0.196	0.026	0.133	0.0	3.24
17/11/2005	8	1:30	0.197	0.050	0.255	0.1	1.87
18/11/2005	9	1:30	0.202	0.166	0.824	0.4	1.87
21/11/2005-tidal	10	1:30	0.195	0.068	0.308	0.2	1.87
24/11/2005	11	1:30	0.217	0.183	0.835	0.4	3.24
25/11/2005	12	1:30	0.197	0.054	0.274	0.1	3.24
28/11/2005	13	1:30	0.295	0.082	0.277	0.2	2.29
29/11/2005	14	1:75	0.280	0.136	0.488	0.3	1.87
30/11/2005	15	1:75	0.196	0.079	0.405	0.2	1.87
01/12/2005	16	1:75	0.197	0.076	0.386	0.2	3.24
02/12/2005-tidal	17	1:75	0.193	0.030	0.156	0.1	1.87
02/12/2005	18	1:75	0.191	0.071	0.374	0.2	4.58
06/12/2005	19	1:75	0.215	0.166	0.771	0.4	3.24
07/12/2005	20	1:75	0.573	0.079	0.415	0.2	1.87
08/12/2005	21	1:75	0.196	0.077	0.391	0.2	3.24
09/12/2005	22	1:75	0.191	0.074	0.388	0.2	3.24
12/12/2005	23	1:75	0.194	0.069	0.298	0.2	3.24
13/12/2005-tidal	24	1:75	0.193	0.048	0.248	0.2	1.87
14/12/2005-tidal	25	1:75	0.199	0.054	0.277	0.2	3.24
Sloping Wall							
20/12/2005	26	1:75	0.190	0.059	0.312	0.2	1.87
21/12/2005	27	1:75	0.192	0.070	0.364	0.2	3.24
22/12/2005	28	1:75	0.194	0.055	0.283	0.2	1.55
22/12/2005	29	1:75	0.241	0.123	0.490	0.3	1.87
23/12/2005	30	1:75	0.243	0.154	0.639	0.4	3.24
03/01/2006	31	1:75	0.201	0.014	0.069	0.0	1.87
04/01/2006	32	1:75	0.206	0.024	0.118	0.0	3.24
02/01/2006	33	1:75	0.192	0.097	0.502	0.4	1.87
05/01/2006	34	1:75				0.0	3.24
05/01/2006-tidal	34a	1:75				0.8 to 0.63	3.24

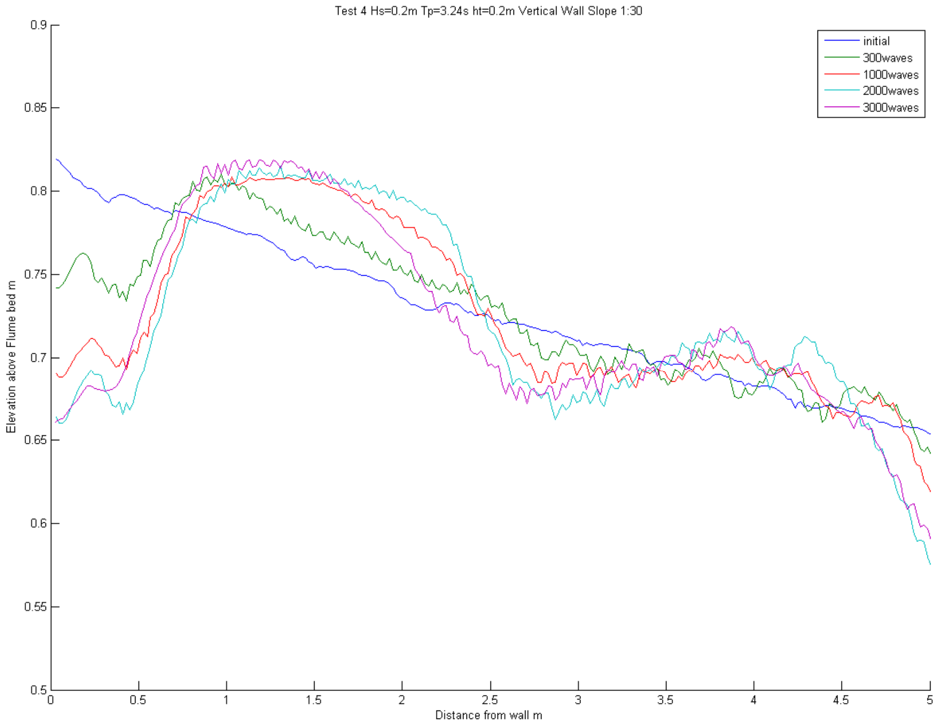
Appendix 3 Calculated scour depths and positions for all the tests calculated after 3000 waves

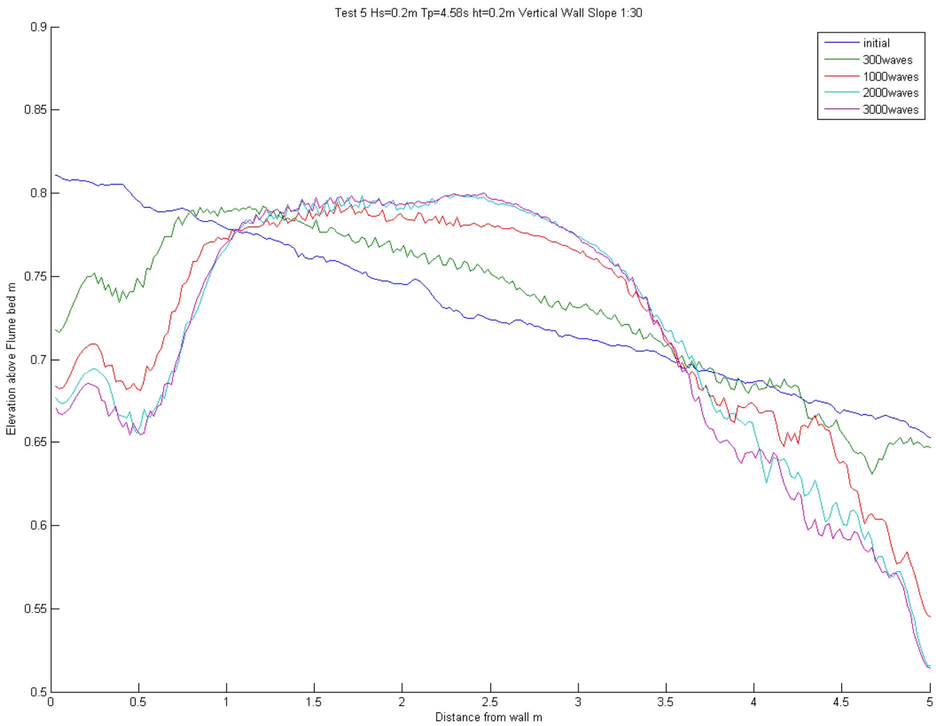
test no. Vertical	Scour at wall (m)	Max Scour (m)	Location (m)	Max Accretion (m)	Location (m)	Net loss (m2)
1	-0.057	-0.057	0.031	0.006	0.660	-0.042
2	-0.065	-0.065	0.031	0.023	0.680	-0.038
3	-0.130	-0.130	0.031	0.044	0.950	-0.040
4	-0.158	-0.158	0.031	0.056	1.369	-0.043
5	-0.140	-0.143	0.049	0.073	2.449	-0.086
6	0.031	-0.025	0.731	0.033	0.016	-0.053
7	0.011	-0.032	1.513	0.026	0.082	-0.084
8	-0.110	-0.111	0.006	0.009	0.731	-0.063
9	0.013	-0.035	0.327	0.013	0.009	-0.048
10	-0.067	-0.067	0.001	0.001	4.077	-0.045
11	-0.040	-0.117	0.414	0.069	1.881	-0.059
12	-0.088	-0.114	0.469	0.030	2.106	-0.103
13	-0.093	-0.125	0.415	0.013	1.925	-0.152
14	-0.036	-0.052	0.354	0.027	1.005	-0.074
15	-0.027	-0.048	0.295	0.009	2.085	-0.046
16	-0.089	-0.102	0.404	0.022	1.342	-0.096
17	-0.014	-0.034	0.191	0.004	3.617	-0.021
18	-0.062	-0.119	0.495	0.055	2.662	-0.111
19	-0.050	-0.100	0.417	0.067	1.901	-0.036
20	0.002	-0.030	1.432	0.012	0.501	-0.041
21	-0.006	-0.086	0.713	0.004	4.023	-0.079
22	-0.019	-0.127	0.387	0.013	1.663	-0.081
23	-0.031	-0.125	0.427	0.027	1.506	-0.073
24	-0.001	-0.046	0.374	0.010	2.292	-0.041
25	-0.010	-0.135	0.231	0.022	1.335	-0.074
Sloping						
26	0.063	-0.068	0.165	0.010	4.590	-0.043
27	0.104	-0.105	0.232	0.024	3.729	-0.095
28	0.062	-0.072	0.155	0.009	3.565	-0.040
29	0.063	-0.052	0.203	0.014	3.232	-0.030
30	0.043	-0.064	0.124	0.055	3.652	-0.045
31	-0.001	-0.010	2.480	0.015	0.488	0.004
32	-0.066	-0.023	2.640	0.068	0.069	0.020
33	0.014	-0.024	0.066	0.014	3.384	0.001
34	0.069	-0.079	0.201	0.006	2.682	-0.057
34a	0.074	-0.081	0.210	0.002	2.642	-0.060

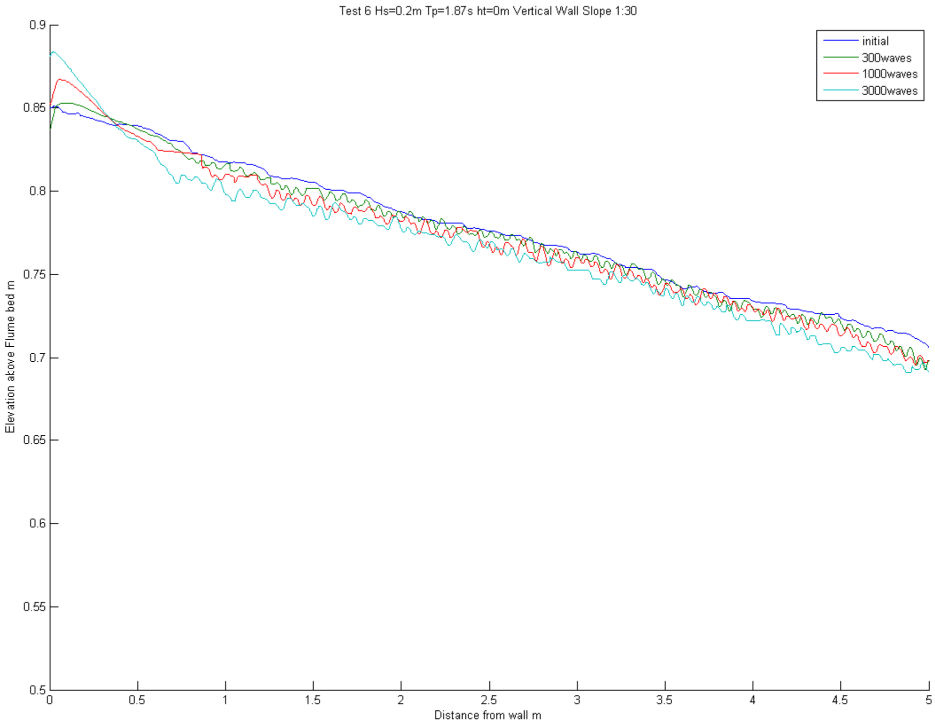
Appendix 4 Bed profiles for tests 1-34

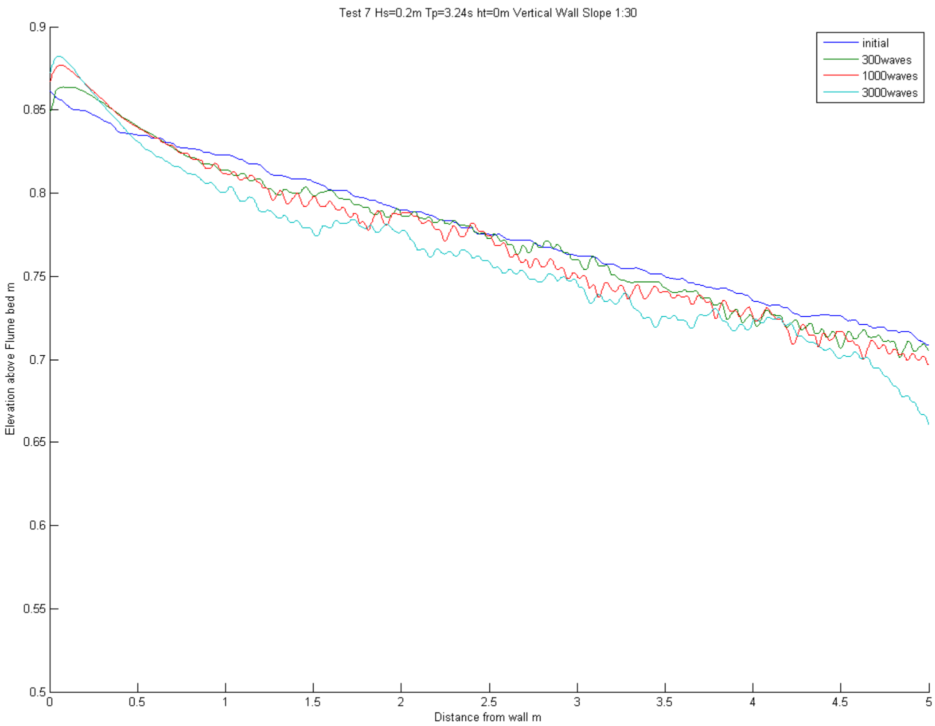


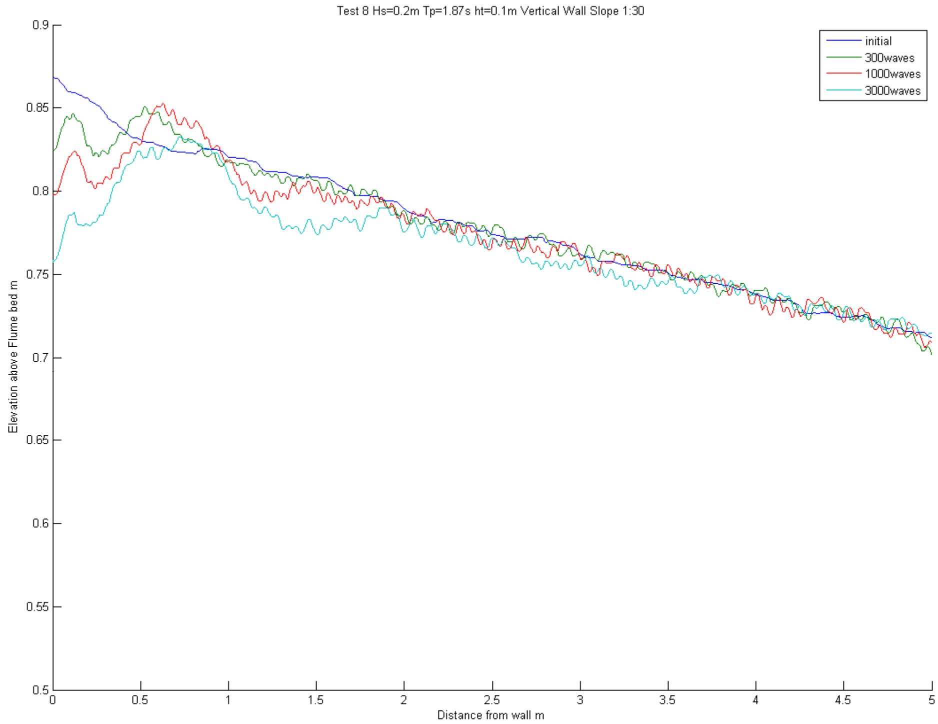


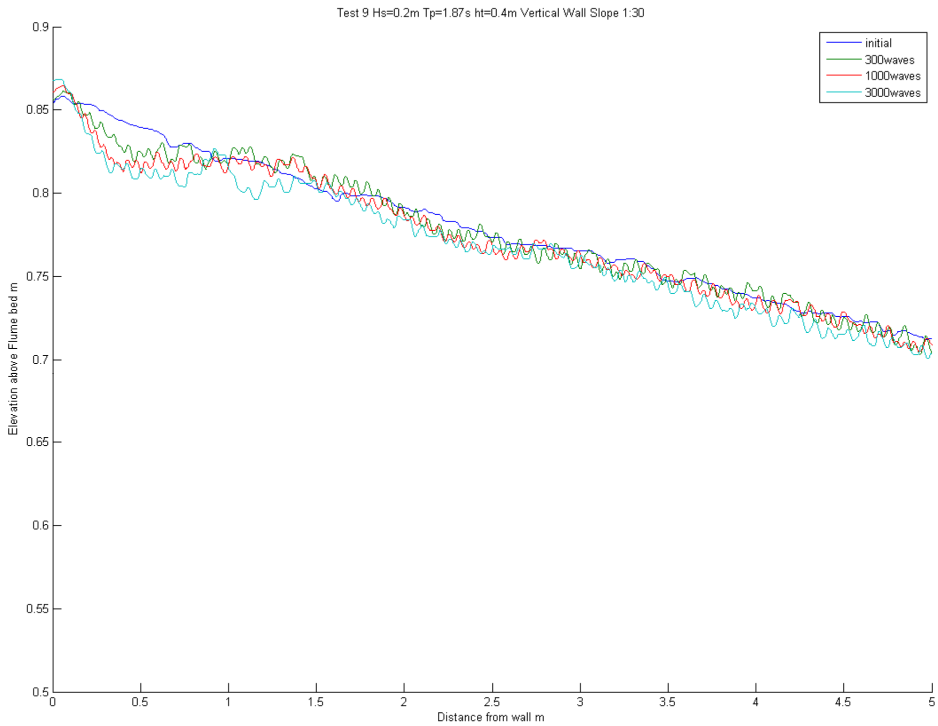

Test 4 Hs=0.2m Tp=3.24s ht=0.2m Vertical Wall Slope 1:30
initial
300waves
1000waves
2000waves
3000waves
Elevation above Flume bed m
Distance from wall m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

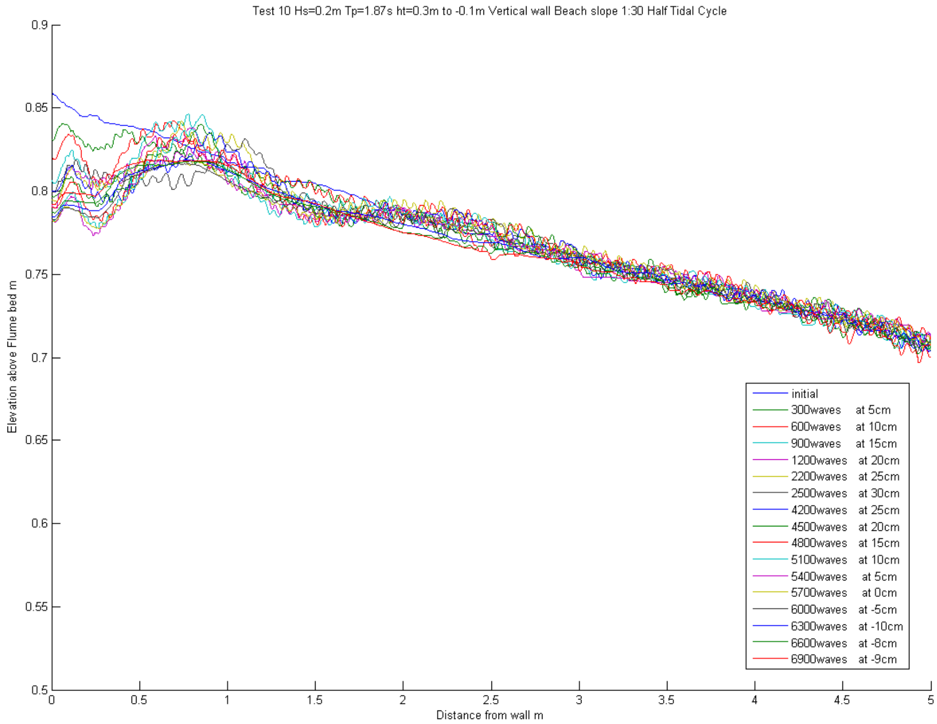

Test 5 Hs=0.2m Tp=4.58s ht=0.2m Vertical Wall Slope 1:30
initial
300waves
1000waves
2000waves
3000waves
Elevation above Flume bed m
Distance from wall m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

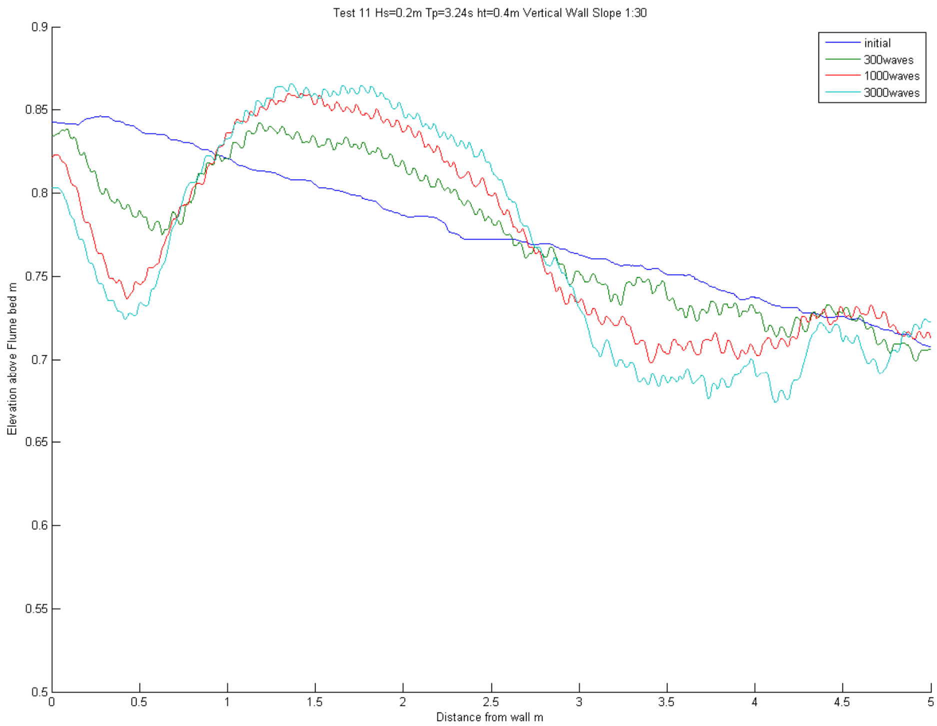

Test 6 Hs=0.2m Tp=1.87s ht=0m Vertical Wall Slope 1:30
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m

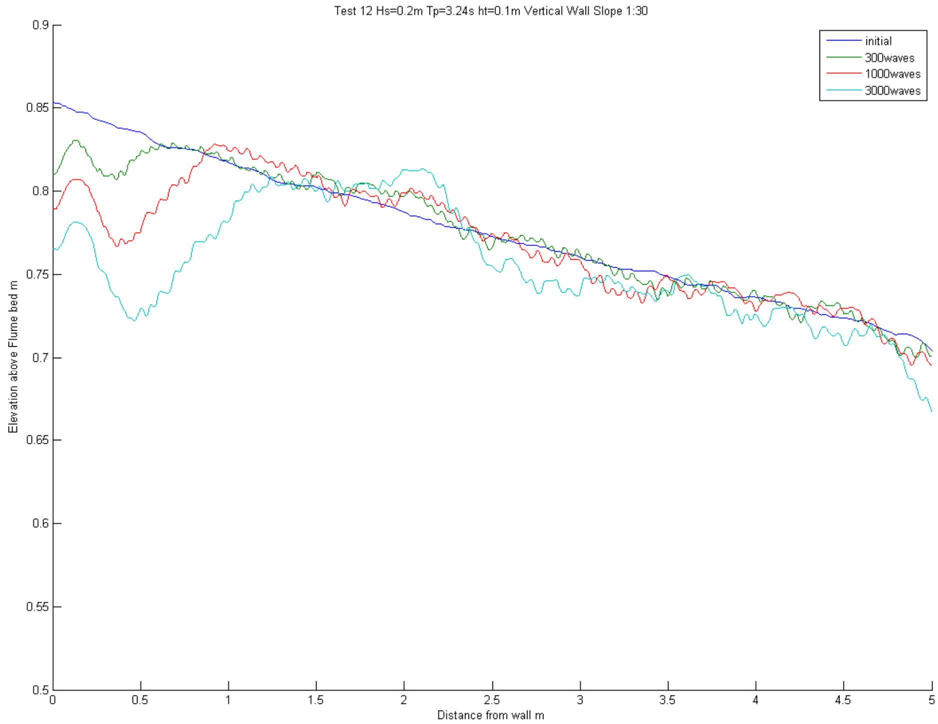

Test 7 Hs=0.2m Tp=3.24s ht=0m Vertical Wall Slope 1:30
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m

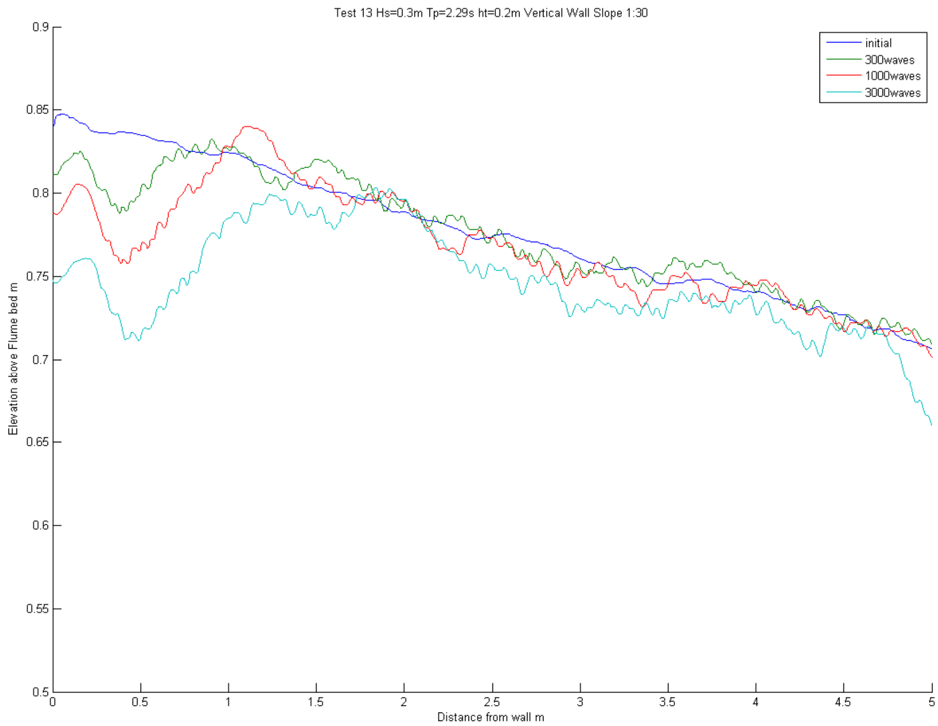

Test 8 Hs=0.2m Tp=1.87s ht=0.1m Vertical Wall Slope 1:30
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m

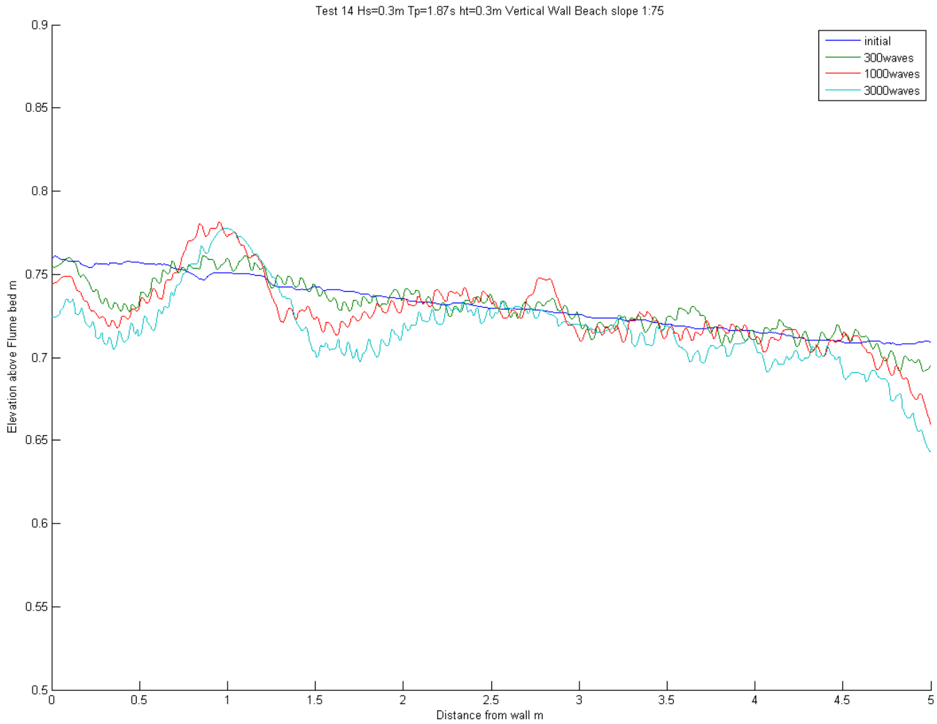

Test 9 Hs=0.2m Tp=1.87s ht=0.4m Vertical Wall Slope 1:30
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m

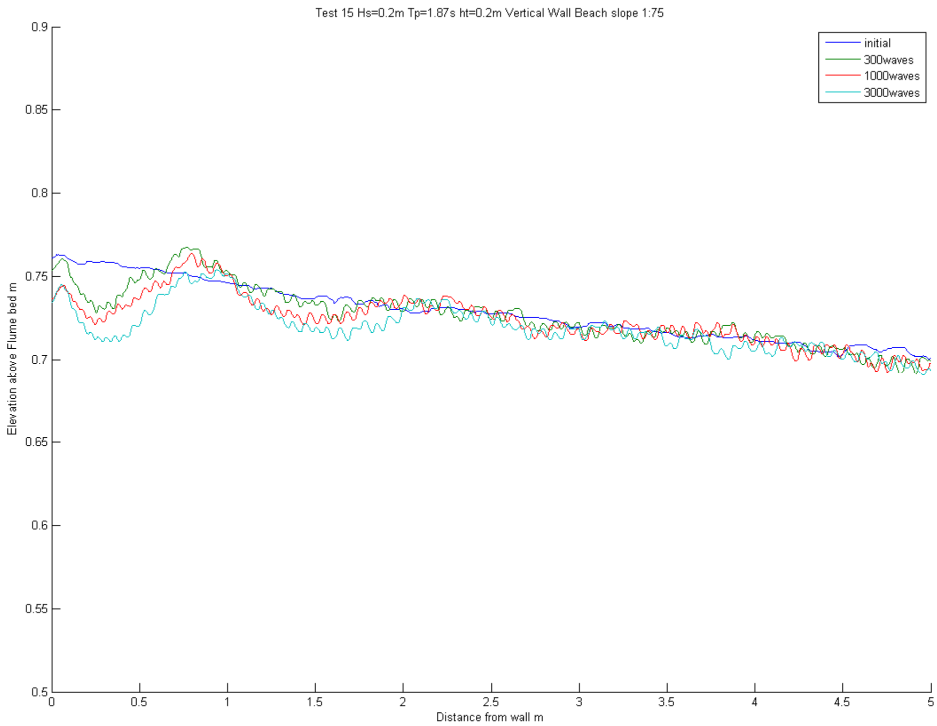

Test 10 Hs=0.2m Tp=1.87s ht=0.3m to -0.1m Vertical wall Beach slope 1:30 Half Tidal Cycle
Elevation above Flume bed m
Distance from wall m
initial
300waves at 5cm
600waves at 10cm
900waves at 15cm
1200waves at 20cm
2200waves at 25cm
2500waves at 30cm
4200waves at 25cm
4500waves at 20cm
4800waves at 15cm
5100waves at 10cm
5400waves at 5cm
5700waves at 0cm
6000waves at -5cm
6300waves at -10cm
6600waves at -8cm
6900waves at -9cm

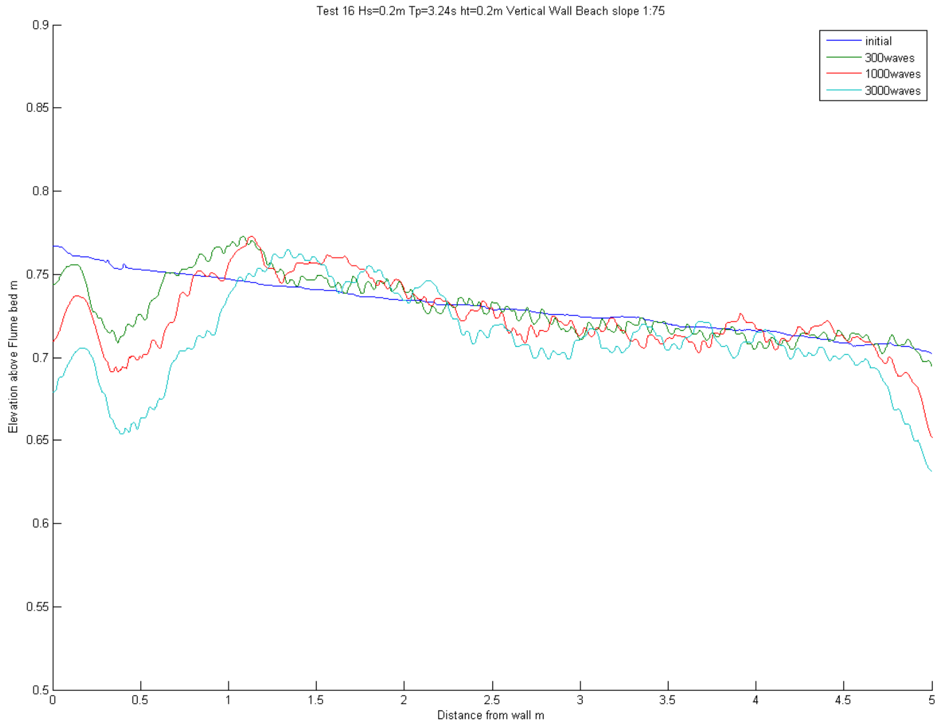

Test 11 Hs=0.2m Tp=3.24s ht=0.4m Vertical Wall Slope 1:30
Elevation above Flume bed m
Distance from wall m
initial
300waves
1000waves
3000waves

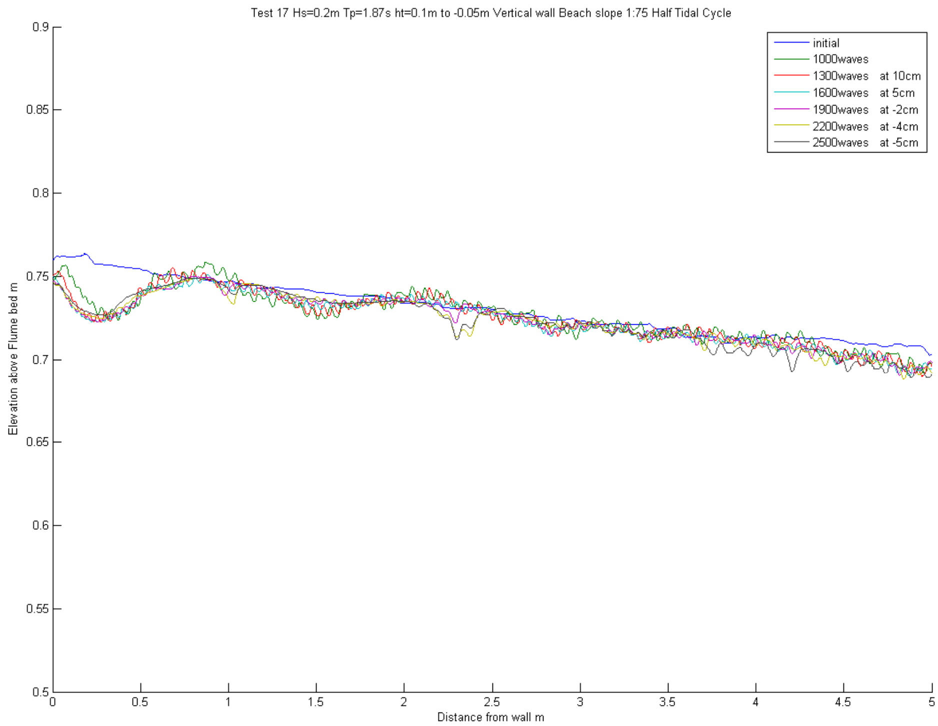

Test 12 Hs=0.2m Tp=3.24s ht=0.1m Vertical Wall Slope 1:30
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

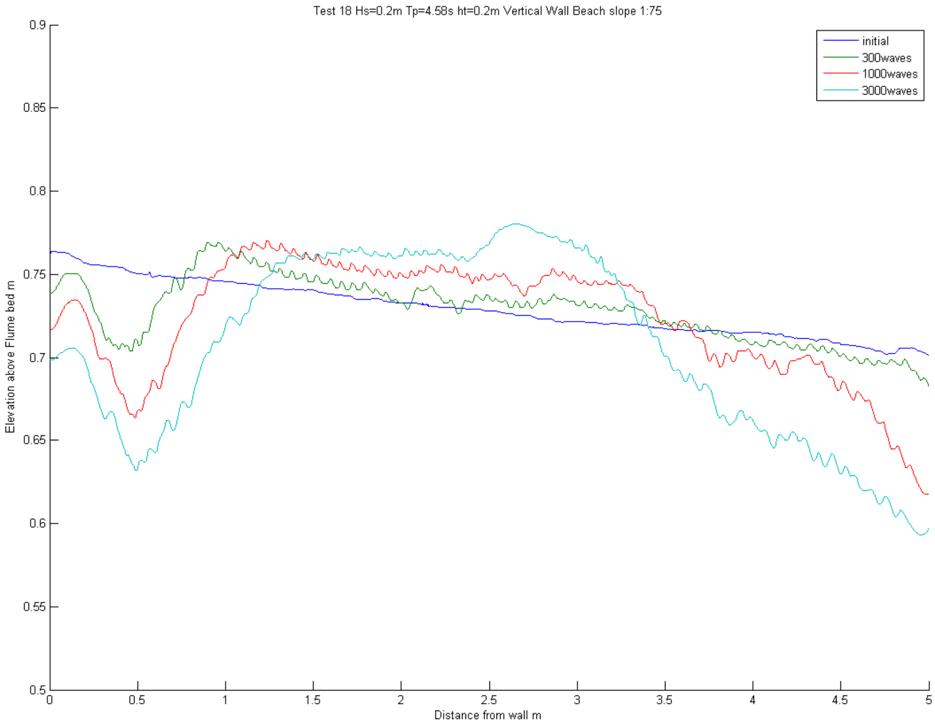

Test 13 Hs=0.3m Tp=2.29s ht=0.2m Vertical Wall Slope 1:30
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

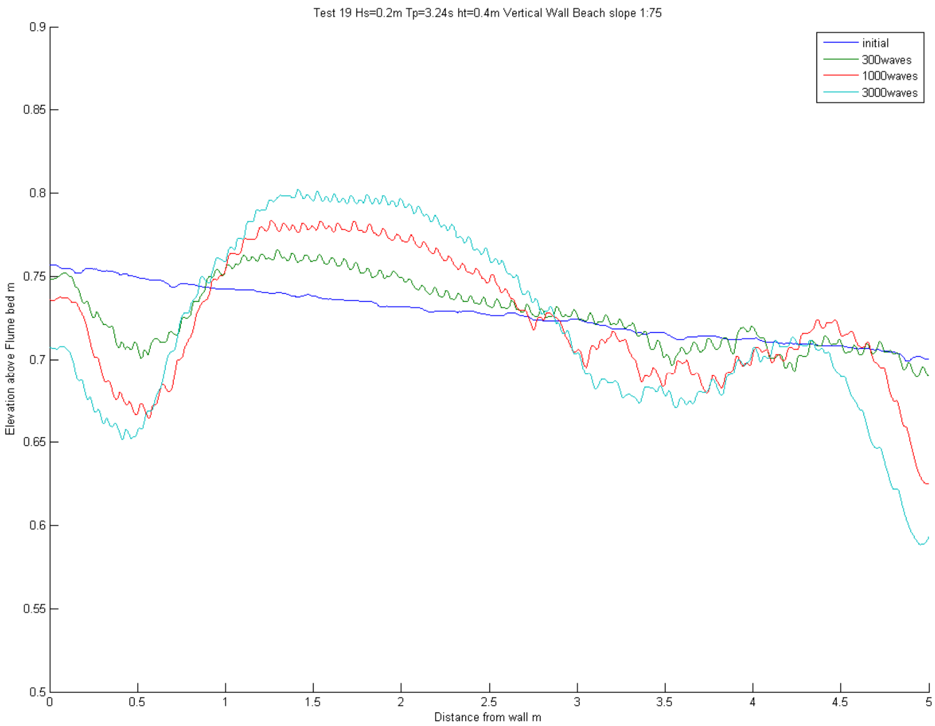

Test 14 Hs=0.3m Tp=1.87s ht=0.3m Vertical Wall Beach slope 1:75
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m

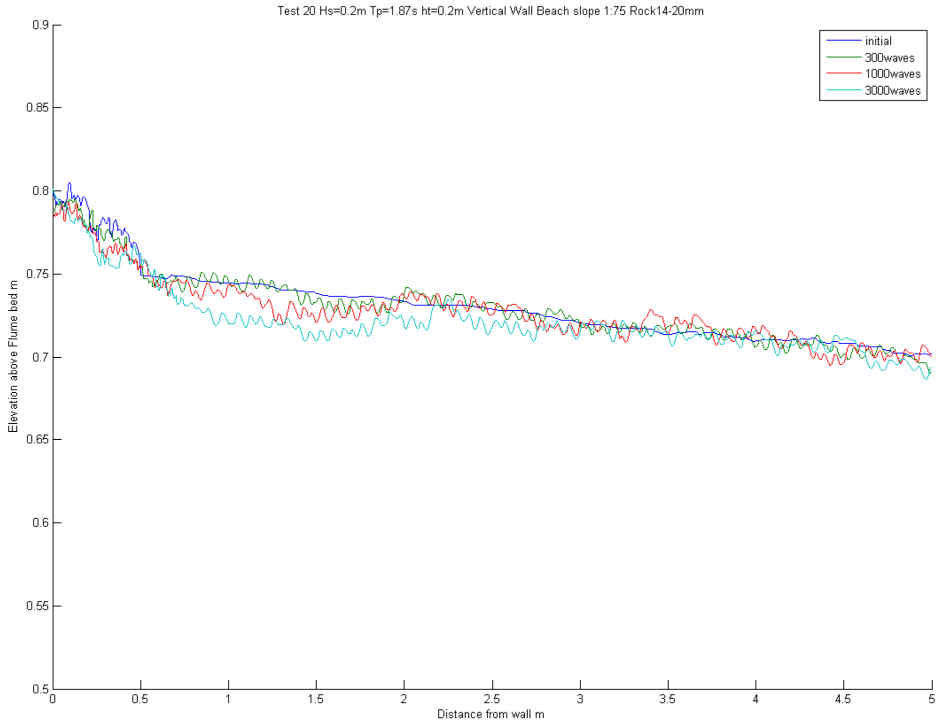

Test 15 Hs=0.2m Tp=1.87s ht=0.2m Vertical Wall Beach slope 1:75
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m

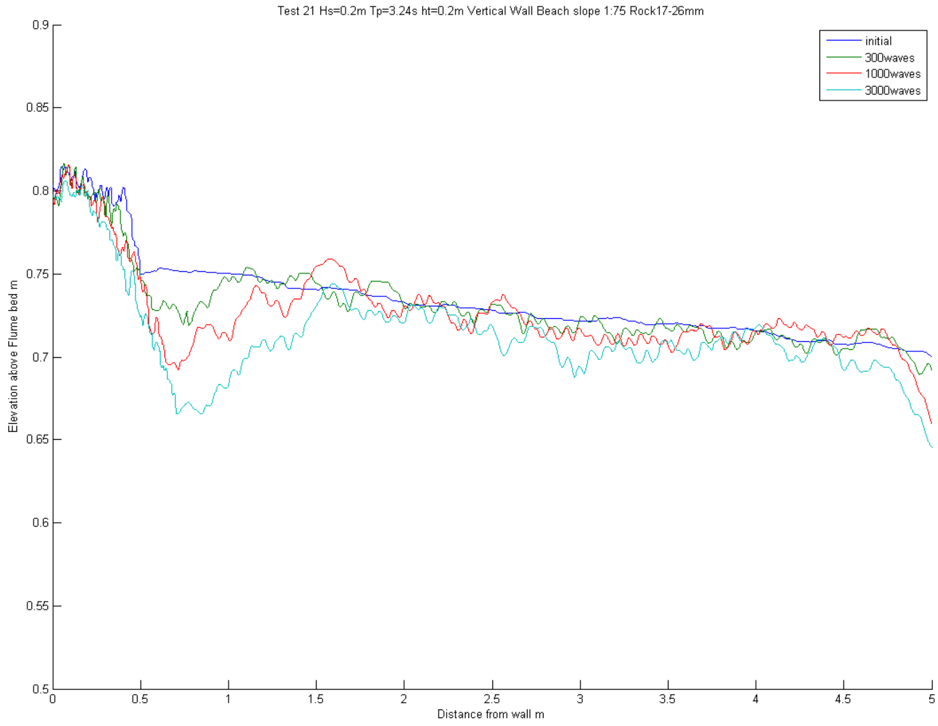

Test 16 Hs=0.2m Tp=3.24s ht=0.2m Vertical Wall Beach slope 1:75
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

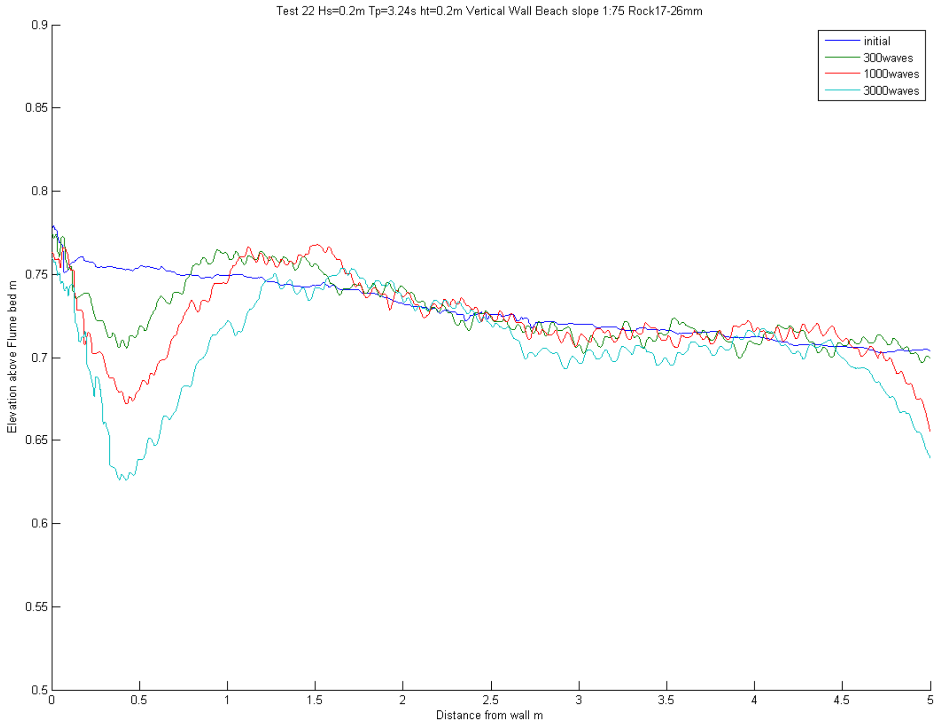

Test 17 Hs=0.2m Tp=1.87s ht=0.1m to -0.05m Vertical wall Beach slope 1:75 Half Tidal Cycle
initial
1000waves
1300waves at 10cm
1600waves at 5cm
1900waves at -2cm
2200waves at -4cm
2500waves at -5cm
Elevation above Flume bed m
Distance from wall m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

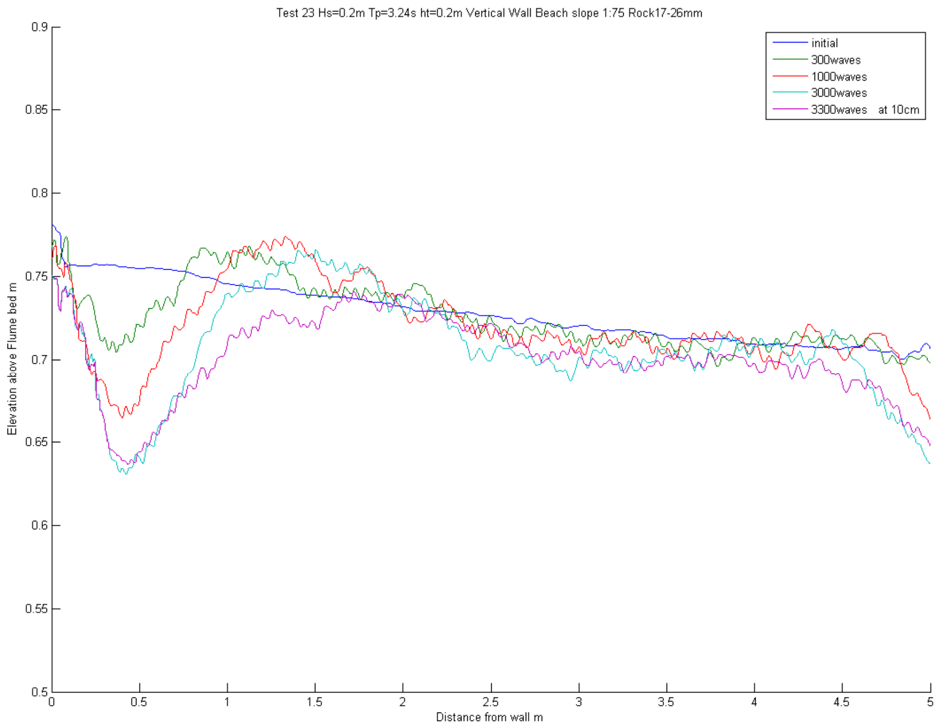

Test 18 Hs=0.2m Tp=4.58s ht=0.2m Vertical Wall Beach slope 1:75
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m

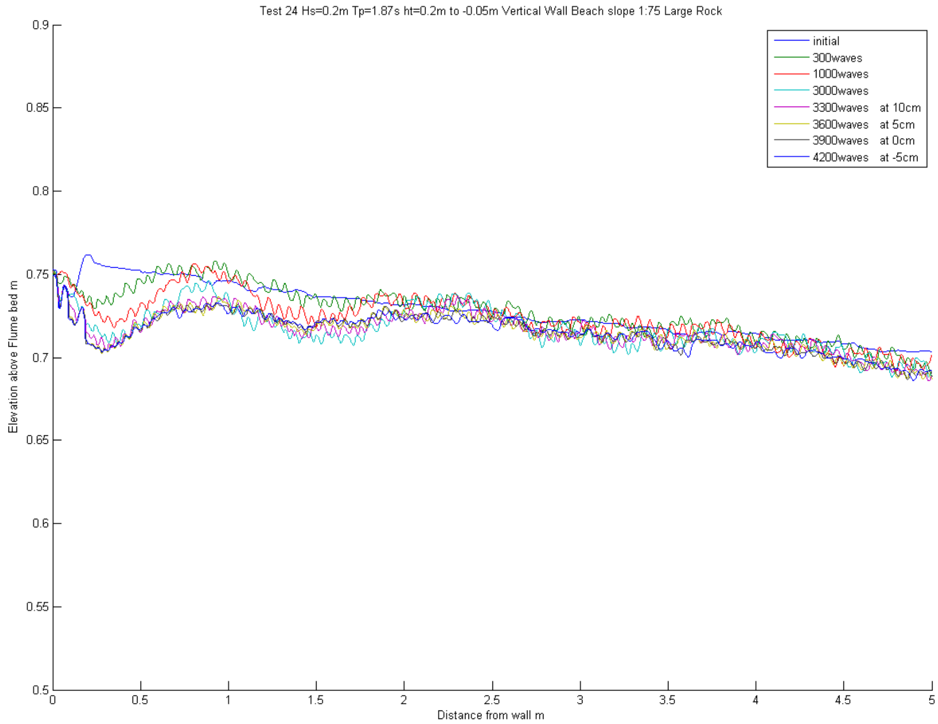

Test 19 Hs=0.2m Tp=3.24s ht=0.4m Vertical Wall Beach slope 1:75
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m

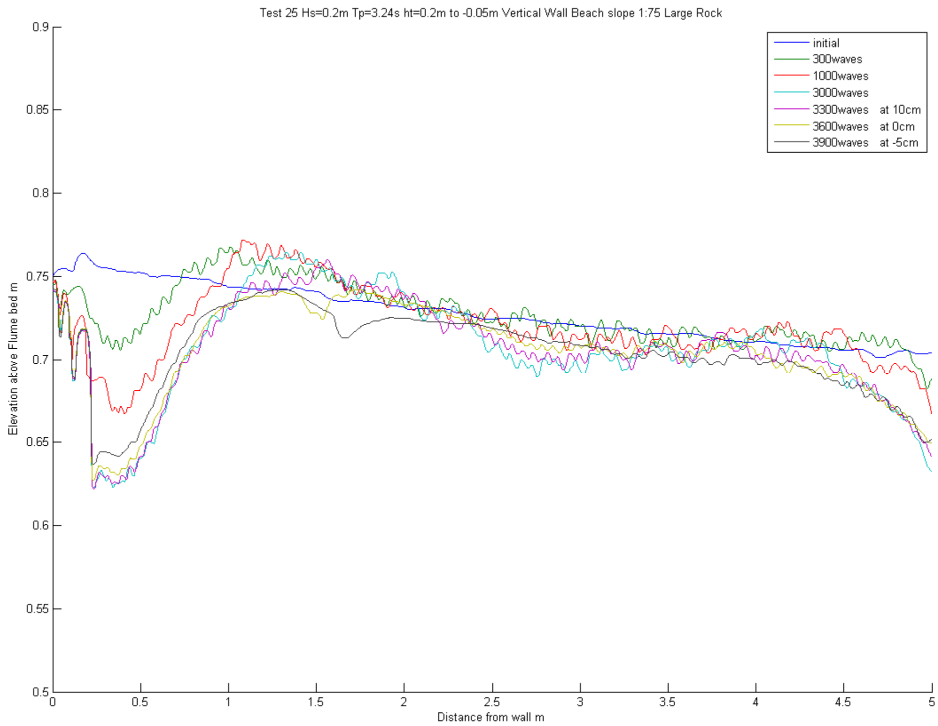

Test 20 Hs=0.2m Tp=1.87s ht=0.2m Vertical Wall Beach slope 1:75 Rock14-20mm
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m

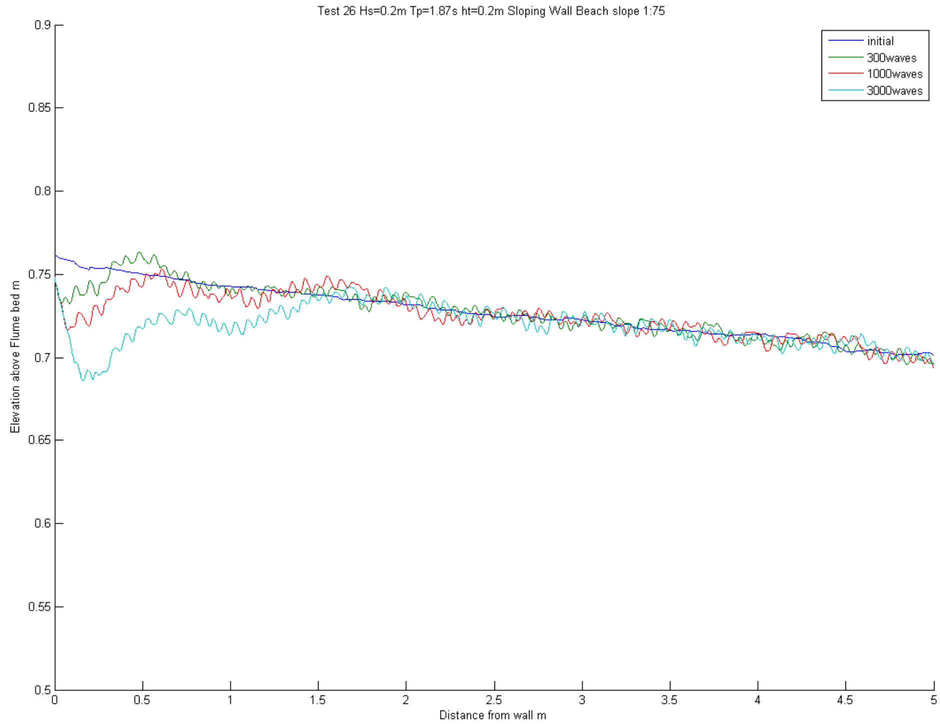

Test 21 Hs=0.2m Tp=3.24s ht=0.2m Vertical Wall Beach slope 1:75 Rock17-26mm
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m


Test 22 Hs=0.2m Tp=3.24s ht=0.2m Vertical Wall Beach slope 1:75 Rock17-26mm
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

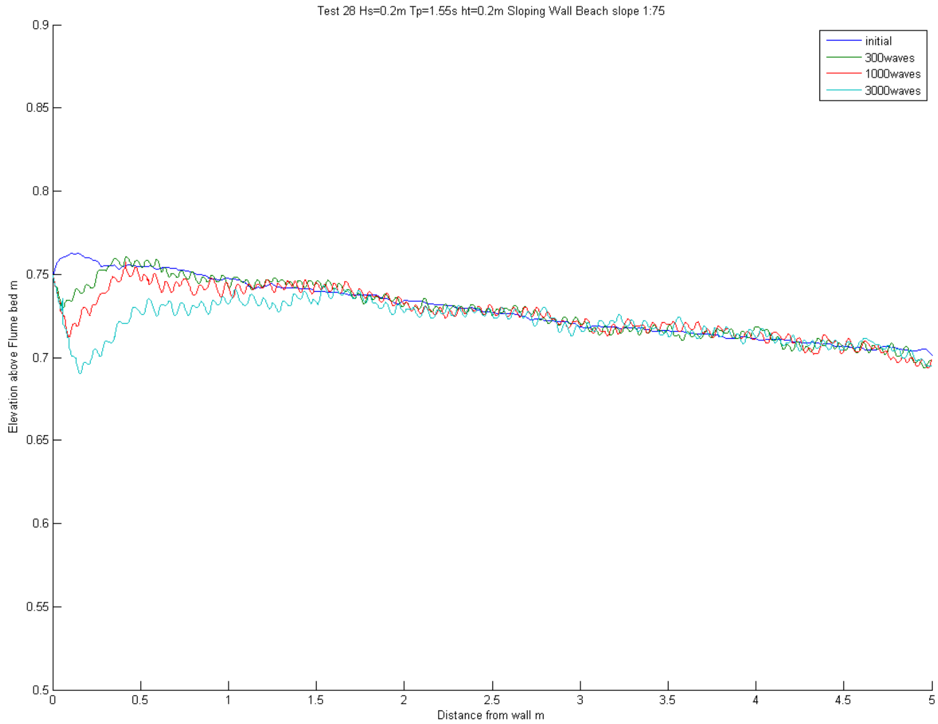

Test 23 Hs=0.2m Tp=3.24s ht=0.2m Vertical Wall Beach slope 1:75 Rock17-26mm
initial
300waves
1000waves
3000waves
3300waves at 10cm
Elevation above Flume bed m
Distance from wall m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

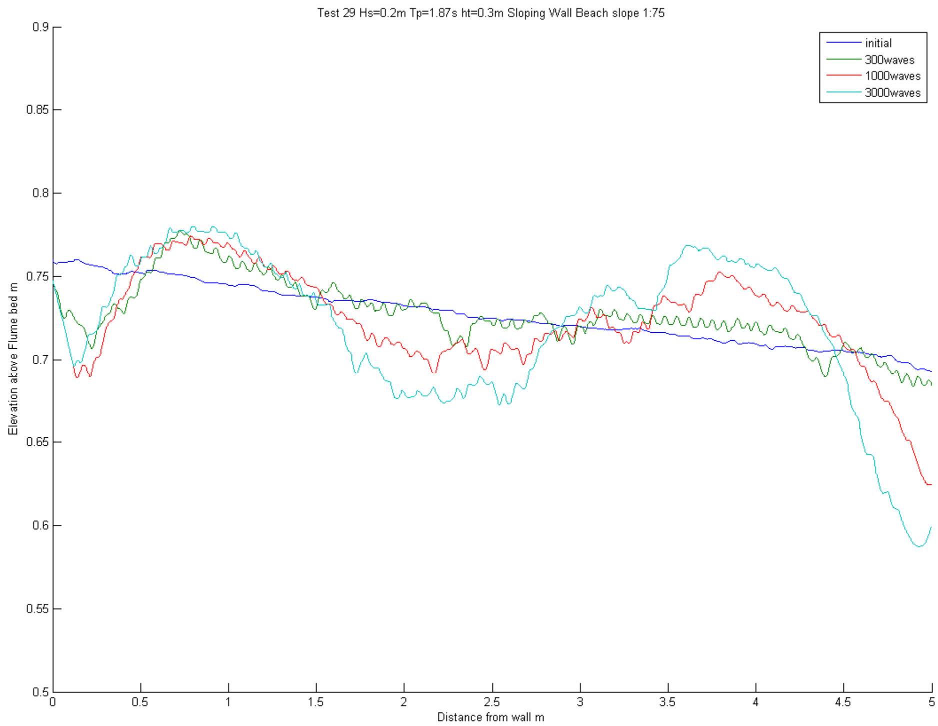

Test 24 Hs=0.2m Tp=1.87s ht=0.2m to -0.05m Vertical Wall Beach slope 1:75 Large Rock
initial
300waves
1000waves
3000waves
3300waves at 10cm
3600waves at 5cm
3900waves at 0cm
4200waves at -5cm
Elevation above Flume bed m
Distance from wall m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

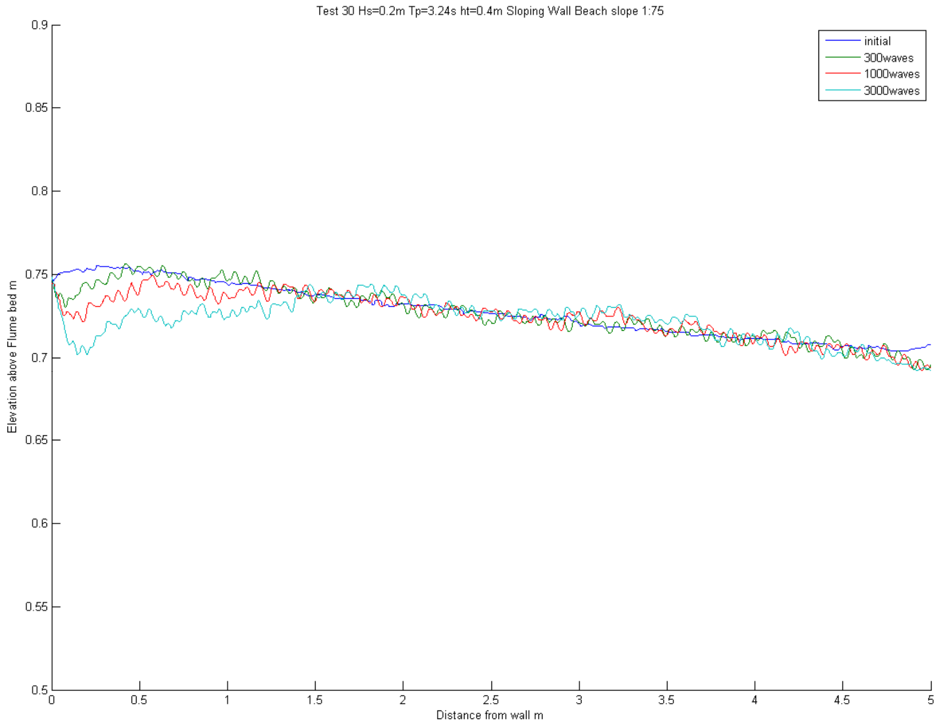

Test 25 Hs=0.2m Tp=3.24s ht=0.2m to -0.05m Vertical Wall Beach slope 1:75 Large Rock
initial
300waves
1000waves
3000waves
3300waves at 10cm
3600waves at 0cm
3900waves at -5cm
Elevation above Flume bed m
Distance from wall m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

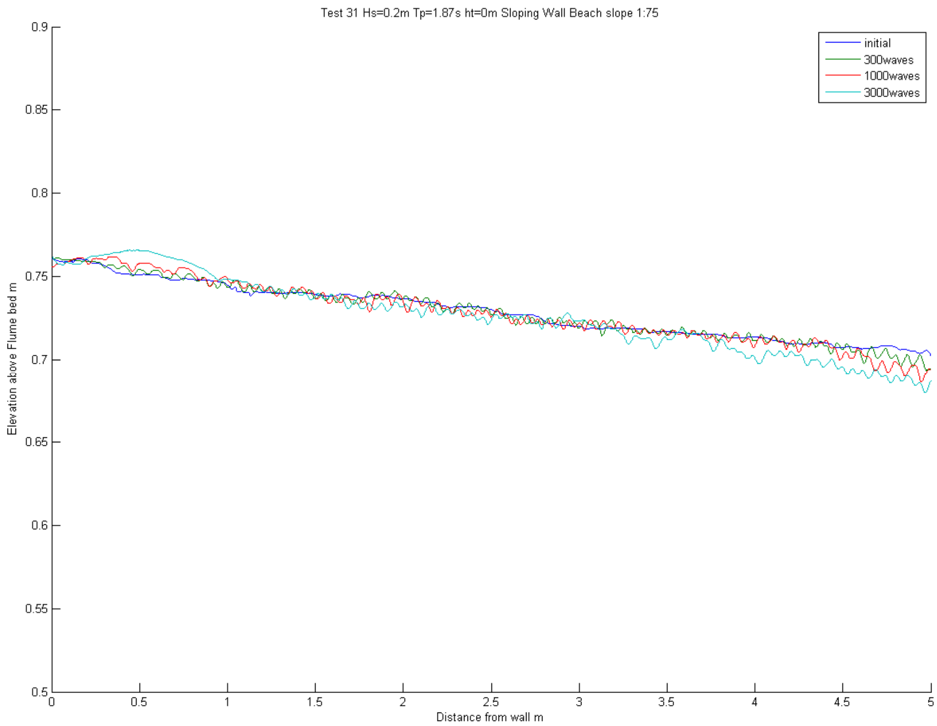

Test 26 Hs=0.2m Tp=1.87s ht=0.2m Sloping Wall Beach slope 1:75
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m

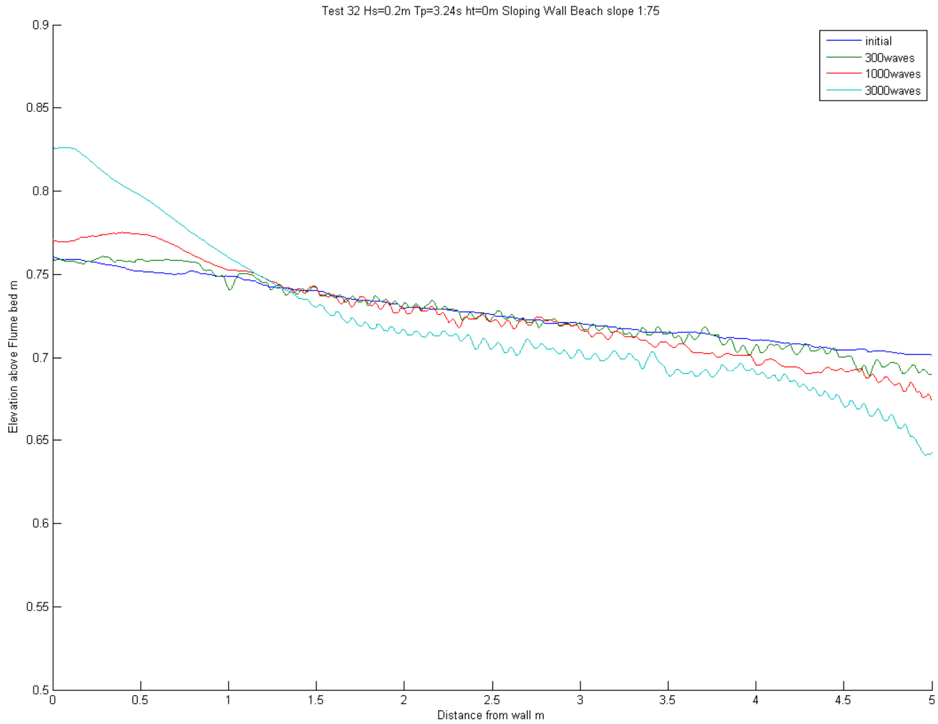

Test 27 Hs=0.2m Tp=3.24s ht=0.2m Sloping Wall Beach slope 1:75
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m

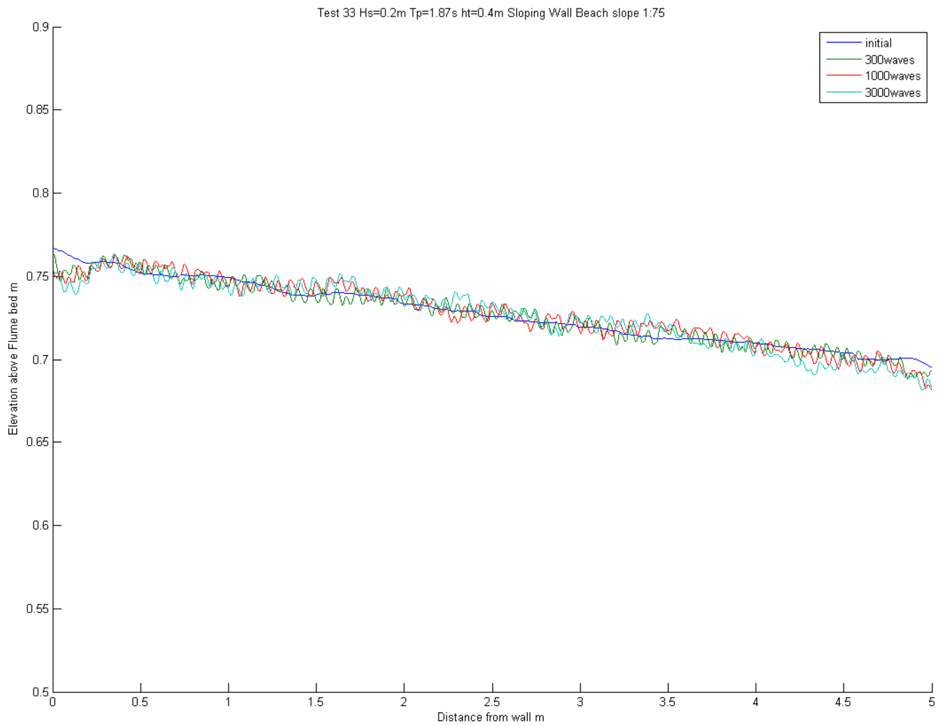

Test 28 Hs=0.2m Tp=1.55s ht=0.2m Sloping Wall Beach slope 1:75
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

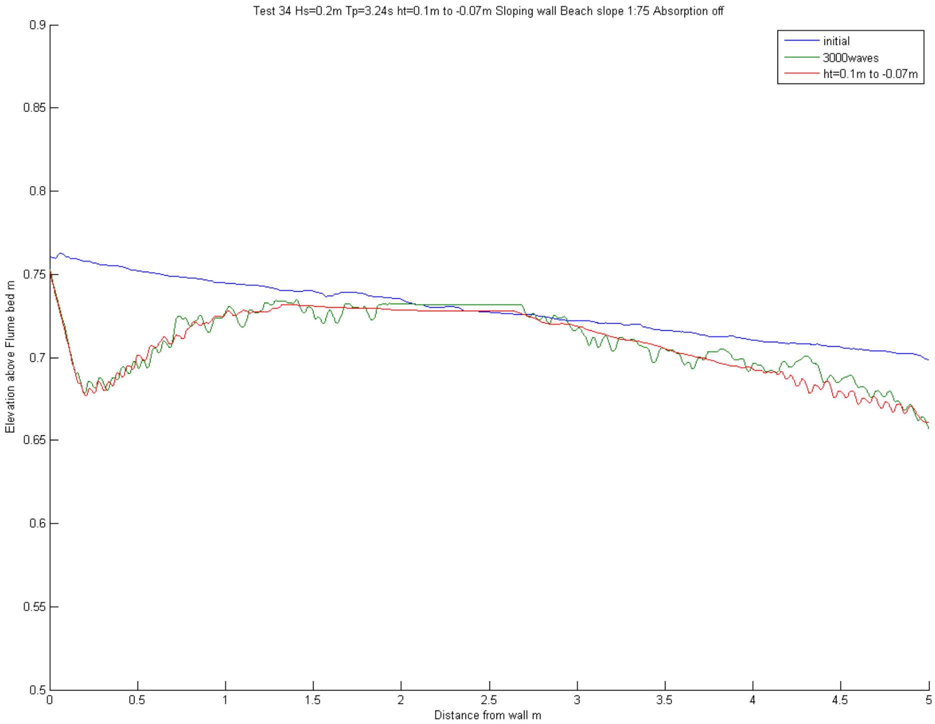

Test 29 Hs=0.2m Tp=1.87s ht=0.3m Sloping Wall Beach slope 1:75
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5


Test 30 Hs=0.2m Tp=3.24s ht=0.4m Sloping Wall Beach slope 1:75
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5


Test 31 Hs=0.2m Tp=1.87s ht=0m Sloping Wall Beach slope 1:75
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5


Test 32 Hs=0.2m Tp=3.24s ht=0m Sloping Wall Beach slope 1:75
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5


Test 33 Hs=0.2m Tp=1.87s ht=0.4m Sloping Wall Beach slope 1:75
initial
300waves
1000waves
3000waves
Elevation above Flume bed m
Distance from wall m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5


Test 34 Hs=0.2m Tp=3.24s ht=0.1m to -0.07m Sloping wall Beach slope 1:75 Absorption off
initial
3000waves
ht=0.1m to -0.07m
Elevation above Flume bed m
Distance from wall m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5