

BEACH DRAINAGE INSTALLATIONS WORLD-WIDE

Beach Drain Module	Project	Year Installed	Length of system	Tidal range	Initial Beach Slope	Sand Grain Size (d ₅₀ / U)	Pump Capacity	Drain Materials - Installation Method		Design Consultant: Hans Vesterby	Comments
1	Hirtshals W, Denmark	1981	200 m	~1.5 m	1:20	0.26/1.7	400 m ³ /h	a-1		Y	25,000 m ³ sand harvested each year to renourish other beaches (ref: Footprints01 for summary report)
2	Hirtshals E, Denmark	1983	200 m	~1.0 m	1:25	0.2/1.3	100 m ³ /h	a-1		Y	Width maintained (back-ground erosion rate: 7 m/year).
3	Thorsminde, Denmark	1985	500 m	1.5 m	1:25	0.35/1.7	700 m ³ /h	a-1		Y	Experimental system, width increased by 25 m (ref: Footprints02 for summary report)
4	Sailfish Point, Florida, USA	1988	177 m	0.8 m	1:25	0.3/3	340 m ³ /h	b-1		Y	Width increased by 20-25 m during operation. Ceased operation following neighboring nourishment program.
5	Englewood Beach, Florida, USA	1993	200 m								Experimental well-point system. Damaged by storm events & not reinstated.
6	Enoe Strand, Denmark	1994	600 m	0.5-1.0 m	1:15	0.25/2.3	300 m ³ /h	c-2		Y	Width increased by 3 m August 1996. Maintained.
7	Towan Bay, U.K.	1994	180 m	7 m	1:45	0.2/1.7	200 m ³ /h	d-1		Y	Improved amenity (dry low tide). Exposed seawall footing safeguarded (ref. www.beachdrainage.com > Case Studies).
8	Codfish Park Nantucket I, MA, USA	1994	357 m	1.0-1.5 m	1:45	1.5/4.2	700 m ³ /h	e-3			Decreased in shoreline width due to storm events. Shoreline erosion rate in the treated areas has been reduced compared to untreated areas.
9	Lighthouse S Nantucket I, MA, USA	1994	309 m	1.0-1.5 m	1:06	0.8/3.2	1400 m ³ /h	e-3			
10	Lighthouse N Nantucket I, MA, USA	1994	405 m	1.0-1.5 m	1:06	0.4/3.7	1400 m ³ /h	e-3			
11	Holme Beach, Norfolk, U.K.	1996	200 m	3.5 m							Temporary trial system at remote nature reserve (ref. www.beachdrainage.com > Case Studies).
12	Chigasaki-Naka Beach, Japan	1996	180 m	1.6 m	1:10	0.5/4	500 m ³ /h	f-3		Y	Temporary shut down due to typhoon damage. Repaired and reactivated. Shore-line stabilized. Beach level increased.
13	Riumar I, Ebro Delta, Spain	1996	300 m	0.2-0.4 m	1:20	0.2/1.4	290 m ³ /h	g-1		Y	Width maintained after severe storm event in Oct 97.
14	Hornbaek W, Denmark	1996	450 m	0.2-0.4 m	1:10	0.3/2	170 m ³ /h	g-2		Y	Width increased by 0-5 m, May 1997. Seasonal fluctuations reduced.
15	Hornbaek E, Denmark	1996	530 m	0.2-0.4 m	1:20	0.3/2	325 m ³ /h	g-2		Y	
16	Ystad, Sweden	1998	200 m	~1.0 m	1:15	0.3/3	240 m ³ /h	g-2		Y	Beach width increased 10-15 m on the lea side of the 90 metres long groyne 1999.
17	Branksome Chine, Dorset, UK	1998	100 m	~2.0 m	1:18	0.25/1.6	65 m ³ /h	g-4			Experimental system. Increased beach level (ref. www.beachdrainage.com)

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18 & 19	Hitotsumatsu Beach, Japan	1998	800 m	~2.0 m	1:20	0.25/2	2 x 300 m ³ /h	g-3		Y	Accretionary trend. Beach level increased. 200 metres foreshore treated by 4 drain structures in parallel.
20	Les Sables d'Olonne, France	1999	300 m	~6 m	1:70	0.25/3	250 m ³ /h	g-3		Y	Accretionary trend and substantial foreshore dry up in the drain zone.
21	Riumar II, Ebro Delta, Spain	1999	300 m	0.2-0.4 m	1:20	0.25/1.6	400 m ³ /h	g-1		Y	Beach width increased 6-8 m. 2000
22	Markgrafenheide, Germany	2000	300 m	~0.3 m	1:30	0.7/2.6	300 m ³ /h	g-3		Y	Width increased by 8-10 m in October 2000.
23	Lido di Ostia I, Italy	2000	115 m	~0.3 m	1:40	0.25/2	140 m ³ /h	g-2		Y	Beach width increased approximately 10 m. September 2001.
24	Lido di Ostia II, Italy	2000	90 m	~0.3 m	1:40	0.25/2	140 m ³ /h	g-2		Y	Beach width increased approximately 10 m February 2001. Drain pipe exposed April 2001 due to storm event. Reinstalled September 2001. Beach width increased to initial position.
25	Lido di Ostia III, Italy	2000	175 m	~0.3 m	1:40	0.25/2	140 m ³ /h	g-2		Y	Beach width increased approximately 15 m. September 2001.
26	Kota Bharu I, Malaysia	2002	500 m	~0.6 m	1:7	0.4/1.5	1000 m ³ /h	h-1		Y	Storm damage following pump commissioning delay.
27	Kota Bharu 2, Malaysia	2002	500 m	~0.6 m	1:10	0.4/1.5	1000 m ³ /h	h-1		Y	Pump commissioning delay.
28	Les Sables d'Olonne (II), France	2002	600 m	~6 m						Y	Scientific monitoring by the University of Nantes.
29-32	Procida Island II, Italy	2003									Scientific monitoring by the Bari University.
33	Villers sur Mer, France	2003	300 m	~7 m						Y	Scientific monitoring by the University of Caen.
CONFIRMED PROJECTS (currently being designed or installed):											
34	Saint Raphaël, France	2004	600 m	~0.4 m						Y	Scientific monitoring by the University of Aix/Marseille.
35	Port Dickson, Malaysia	2004	400 m	~1.6 m	1:15	0.22	400 m ³	h-4		Y	Installation in progress.
36	Morib, Malaysia	2004	200 m				200 m ³	h-1		Y	Installation in progress.
37	Ravenna, Italy	2004									satus unknown

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NOTES

A beach drain module is defined as a drainage system leading to a unique pumping facility.

U (Sand Grain Size) = Uniformity Coefficient, d_{60}/d_{10}

Drain Materials

- a** Epoxy cemented filter sand around PVC perforated pipe
- b** Horizontal well points with epoxy cemented sand filter attached to PVD pipe
- c** Flexible perforated corrugate pipe with filter saled and geotextile cover (at bottom side)
- d** Perforated PVC pipe with gravel wrapped in geotextile
- e** Flexible PE perforated corrugated pipe with geotextile stocking
- f** Flexible perforated corrugated pipe with filter gravel 90 m and without filter gravel 90 m
- g** Flexible perforated corrugated pipe with geotextile stocking and filter gravel
- h** 'rib-lock' uPVC with geotextile sock

Installation Method

- 1** Backhoe /well points
- 2** Plough
- 3** Trench machine
- 4** Backhoe