

## Dutch Floating Breakwaters & Floating Structure Technology



# Dutch Floating Breakwaters

- Highest degree of protection
- Safe and stable structure
- Maximum comfort
- Multifunctional
- Complete flexibility: easy to construct, move and expand
- Environmentally sound
- Low maintenance, long life (70+ years)
- Durable structure

Protecting harbours against strong wave movement offers comfort and ease to ships sailing in and out. Protected port installations, moored ships, the coast and built-up areas also incur less risk of damage from strong waves.

However, many ports and coastal installations are still unprotected, sometimes because the cost of building permanent breakwaters is too high, and often also because it is technically too complex to build a permanent breakwater, e.g. because the water off the coast is too deep.

With the Dutch Floating Breakwater, FDN Engineering offers a brilliant alternative to permanent coastal and port protection structures. Dutch Floating Breakwaters are built quickly, easily and are cost effective, have little to no impact on the marine environment and function excellently in both deep and shallow waters. Dutch Floating Breakwaters have even more to offer – they can be moved and extended to any required length or configuration.

They can also be multifunctional: for example, Dutch Floating Breakwaters can be used as a marina, port, parking deck or promenade.



High 5m waves in an unprotected harbour in Bonaire



Waves in unprotected Messolonghi harbour, Greece Storm 10Bft



Top view Dutch Floating Breakwaters built in Greece, Messolonghi harbour (2004). Two elements of 100m protecting boats.

# History

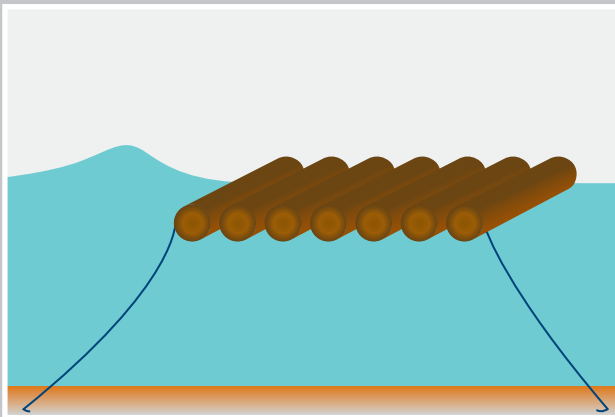
The practical possibilities of floating breakwaters have been known for centuries. However, the technology underlying them has always been weak, making breakwaters less durable or simply unable to perform satisfactorily in their key function: absorbing and reflecting heavy wave movement in a storm.

By using thoroughly tested computer simulation programmes, FDN has succeeded in developing a floating breakwater that is durable, safe and effective.

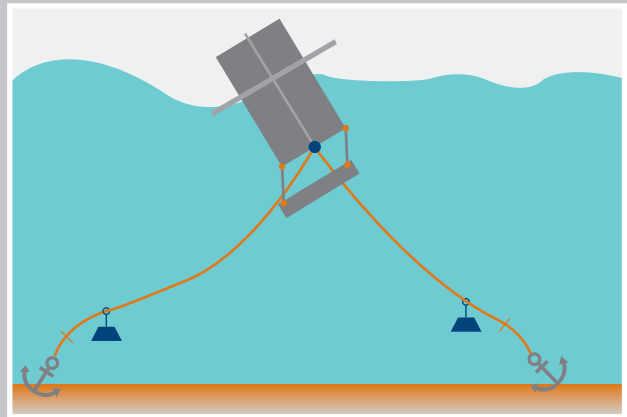
The reinforced concrete modules with a polystyrene core are specially designed so that they absorb and reflect waves, yet themselves remain as stable as possible.

The standard design is fully effective against waves up to 2 meters height. With a tailor-made structure, waves up to 8 meters height can in fact be effectively and economically attenuated.

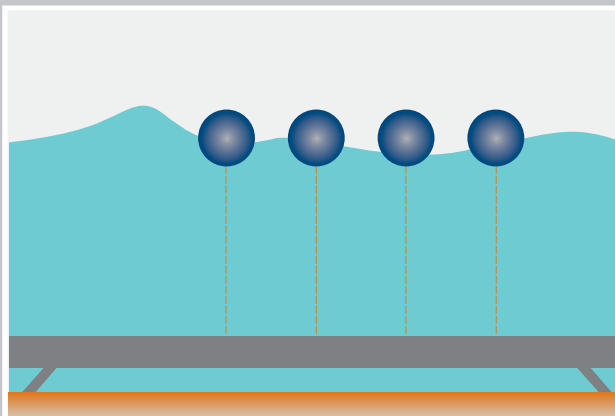
- under normal weather conditions, waves are damped 100%
- in heavy storm conditions, waves are damped 80 to 90%



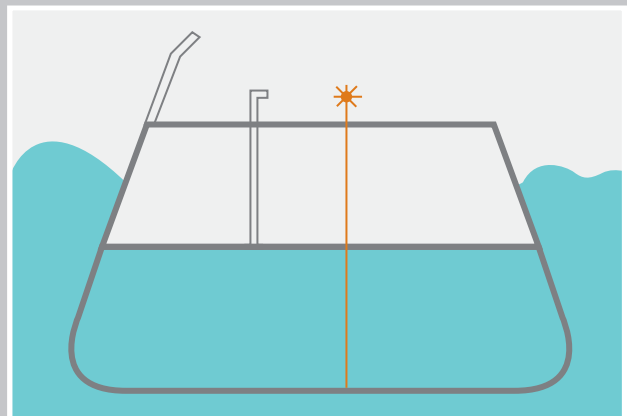
**Floating tree log mat**  
(a very old experiment of a floating breakwater)  
A wave energy absorbing and turbulent floating breakwater.



**Wave barrier (steel structure with counter weight)**  
Wave energy absorber and turbulent floating breakwater experiment.



**Floating balls**  
Balls are connected to the seabed by a flexible rod. Turbulent and wave energy absorbing floating breakwater experiment.



**Joly's breaker**  
Wave energy absorbing floating breakwater, the low natural frequency of the floating breakwater is created by the large mass of the structure with water filled compartments.

# Dutch Design

It should come as no surprise that it was a Dutch engineering firm that responded to the challenge of developing a floating breakwater that produces the right performance.

With renowned institutions as the Technical University of Delft and the Hydraulics Laboratory, the Dutch possess a powerful cluster of knowledge in the area of hydraulic engineering. This Dutch knowledge cluster is supported by SenterNovem, an agency of the Ministry of Economic Affairs that supports targeted innovation projects.

With the support and encouragement of SenterNovem, FDN has cooperated closely with Prof. J.A. Pinkster of the Technical University of Delft and the Hydraulics Laboratory (amongst others) in designing and building the Dutch Floating Breakwaters.

The result of this collaboration is clear to see: technically perfect floating breakwaters for all possible applications the world over.

## TECHNICAL DATA

Dutch Floating Breakwaters –  
U-shaped standard module U-Block

Length:	25 m/82 ft
Width:	4.5 m/14.8 ft
Height:	4 m/13.1 ft
Weight:	135 tons
Connections:	Pre-stressed FDN connectors
Main materials used:	Concrete B35 (35N/mm <sup>2</sup> ) Polystyrene (0.15 kN/m <sup>3</sup> )



FDN design modules with varying dimensions can be tailor-made per project.

## PRODUCT RANGE FOR DIFFERENT WAVE CONDITIONS:

T-Block



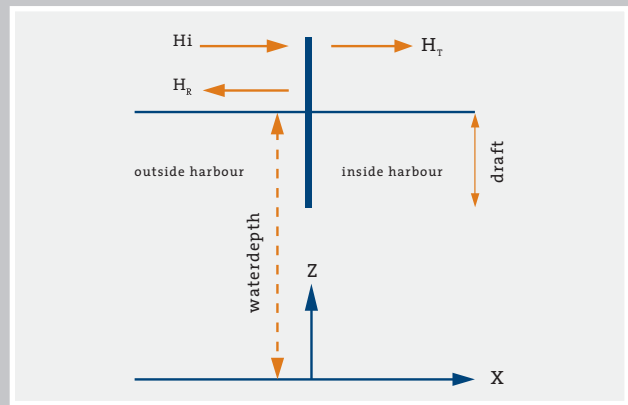
U-Block/  
Heavy Duty  
U-Block



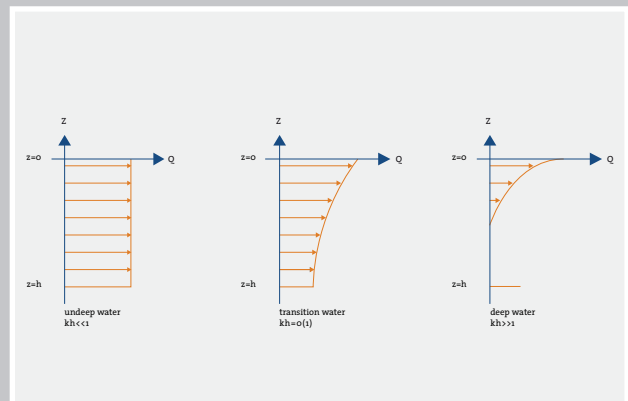
Double concrete  
U-Block



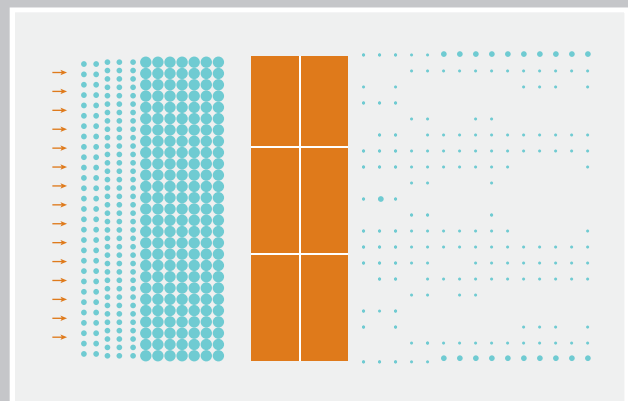
Catamaran



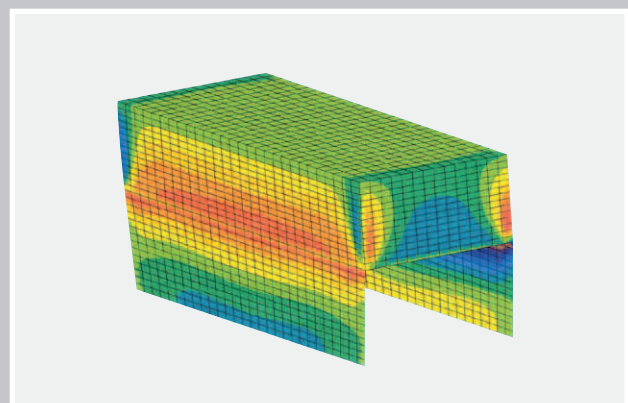
Incoming waveheight  $H_i$ , reflected waveheight  $H_r$  and transmitted waveheight  $H_t$



Horizontal velocity component of the water particles of a cylindrical wave from waterlevel to seabed



Computer simulation of a Dutch Floating Breakwater damping incoming waves



Simulation of stresses induced by breaking waves on a Dutch Floating Breakwater element (U-Block)



# Construction on site

The modules required for building a Dutch Floating Breakwater are built locally on shore, eliminating complex transportation problems and ensuring that the entire project is completed at high speed. You can also call on your preferred building contractors in consultation. We would be happy to discuss your plans with you in person, and see how we can best be of service to you.

The Dutch Floating Breakwater is constructed from fixed shape modules such as the T-Blocks and the U-Blocks, allowing any configuration and length to be achieved. Very large modules have to be constructed in a dock.

The modules are linked to each other with special steel-reinforced, rubber connectors designed by FDN capable of resisting considerable forces.

Expert engineers from FDN will always visit the location to see whether the Dutch Floating Breakwater is the right solution for you. Variations in design are extensively tested before being applied, both by computer simulation and in the laboratory.

The anchorage of the Dutch Floating Breakwater elements consists of anchor chains or cables fixed to the seabed with concrete weights or steel anchors.



Concrete pouring top wall Dutch Floating breakwater elements



Standard U-Blocks (Dutch floating Breakwaters) 135 tons lifted by crane



Turning U-Blocks (Dutch floating Breakwaters) in the water



Connecting elements with the FDN designed flexible connectors



Damping of waves by U-block (Dutch Floating Breakwaters) during a storm 10 Bft (90% damping)



# Floating Structure Technology

FDN Engineering can build 'custom-made' durable floating structures for your specific needs. FDN's engineers have been studying and designing floating structures from as early as 1996. Floating structures have advantages above standard structures as they are more flexible for varying water levels and are easily transportable. The floating structure can be built in a dock under perfect building conditions and be transported to its final location. FDN enjoys the confidence of many major customers in this regard.

Some examples of projects executed by FDN:

- floating bridges,
- floating piers,
- floating boulevards
- floating car parks
- floating cycle paths
- floating jacht harbours
- floating buildings
- floating houses
- floating boathouses
- floating breakwaters

FDN Engineering is a Dutch engineering firm with activities worldwide. FDN specialises in civil technology: infra-structure and construction, foundation technology, hydraulics, and floating structures. Our specialisation in hydraulics and floating structures has resulted in the development of the Dutch Floating Breakwater.

“FDN's Dutch Floating Breakwaters stand head and shoulders above the rest”

An extensive floating breakwater is being planned for the coast of the Caribbean island of Bonaire, intended to protect the marina of a luxury resort currently under construction. The project developer is clear as to his choice of FDN's Dutch Floating Breakwaters. “There are competitors and we have had a good look at them as well. But the choice is easy: FDN's Dutch Floating Breakwaters stand head and shoulders above the rest as far as technology, construction and costs are concerned.”

## INFORMATION

Interested in our product? Please contact us.

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