



# Hard seawall (Super) storm-proof

**Along the north-western edge of Maasvlakte 2, where the ships enter the port of Rotterdam via the approach channel and where there is, consequently, limited room for a seawall, the new port area will be defended by a hard seawall. Maasvlakte 2's hard seawall will be 3.5 km long and will have a crown height of approximately 14 m +NAP.**

The design is called a 'stony dune with block dam' and is unique in the Netherlands. The core of this seawall consists of sand. Fist-sized stones with an average diameter of 8 cm will be deposited on the seaward side. At the foot of the structure, 40-ton concrete blocks measuring 2.5 x 2.5 x 2.5 m will be positioned in the sea. The soft seawall – a dune and beach with a length of 7.5 km – will be constructed to the south of the hard seawall.

#### **BASIC PRINCIPLES**

The design of the hard seawall is unique in the Netherlands. During the development, the PUMA building consortium (Boskalis & Van Oord) followed a sustainable approach to costs: in its considerations, it not only took construction expenses into account, but also the costs of 50 years of maintenance. The construction of the total seawall is calculated to weather a super storm that occurs once every 10,000 years and is based on the philosophy of 'soft where soft is an option and hard where we need hard'. This approach relates to the relatively high costs of a hard seawall.

#### **MARITIME SAFETY**

The location and the form of the hard seawall are such that there

will not be any negative current effects, so that no unsafe situations will develop for the shipping traffic. Indeed, compared to the present situation at the entrance, the current and wave patterns will actually improve.

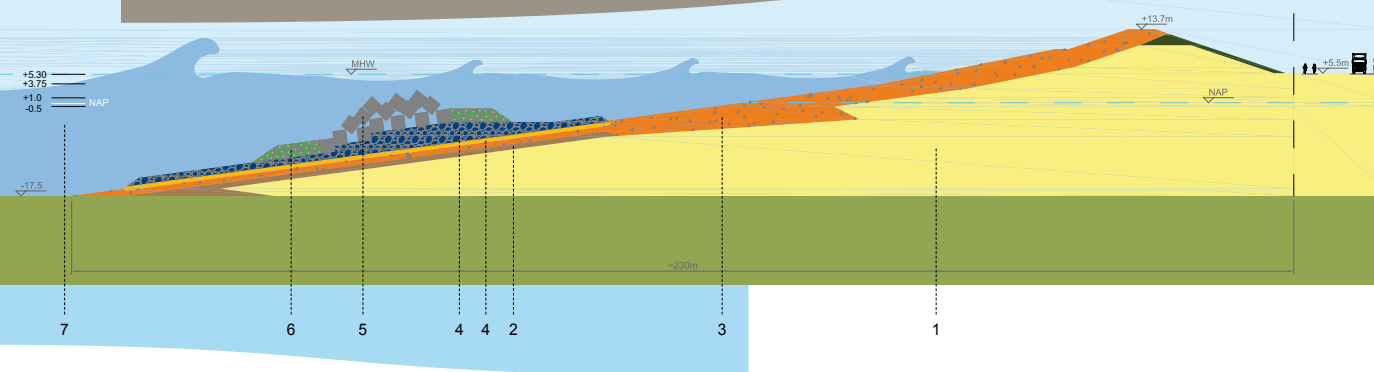
#### **MODEL TESTS**

To be able to prove the stability of the hard seawall in everyday and extreme circumstances (water level and onslaught of waves), researchers conducted extensive model studies in various hydrodynamic laboratories in Europe. The results of these tests were used to optimise the seawall further and further, in order to keep the total construction and maintenance costs as low as possible and at the same time guarantee safety.

#### **FACTS AND FIGURES**

- 3.5 km of hard seawall on the north-western edge.
- 7.5 km of soft seawall on the western and southern edges.
- No or modest effects on the coastline of the Netherlands compared to the current situation in terms of the tidal movement, wave heights and transport of silt.
- Safe and speedy access for sea-going vessels via the Yangtzehaven.

# Hard seawall



## 1. Sand (yellow)

The core of the hard seawall consists of different layers of sand. It was decided to use relatively coarse sand under the rocks (minimal size 370 mu), which will prevent the finer sand (ca. 150 mu) that lies deeper in the seawall from washing away.

## 2. Gravel (brown)

It is also important to lock in the sand: that is why the sand under the block dam has been covered with a layer of gravel (3-35 mm).

## 3. Cobblestones (orange)

The 'stony dune', i.e. the rocky beach that is part of the seawall, will soon consist of an approximately 4-m thick layer of cobblestones with a diameter of 20-135 mm. This cobblestone beach is more dynamic than a standard seawall, as the stones move along with the current and the waves. But to keep the deformation within bounds, the cobblestone beach should not be too steep. That is why it was decided to construct a relatively gentle slope of approximately 1:7.5. This slope is more or less the same as the slope that develops during a heavy storm. The 'stony dune' will require only limited maintenance, thanks to the inclusion of a breakwater made from concrete blocks (5).

## 4. Quarystone (blue and dark yellow)

The various layers of stone on top of the cobblestones have been designed in such a way that every layer is locked in by the overlying layer. If this weren't the case, material would wash away under the influence of the waves, and the block dam would collapse. The quarystone placed under the concrete blocks (5) is 150-800 kg a piece (blue) and 5-70 kg a piece (dark yellow).

## 5. Concrete blocks (grey)

Approximately 20,000 blocks of the existing block dam of the current Maasvlakte will be recycled in the new seawall. This solution is both economical and sustainable. The block dam protects the cobblestone beach. The waves will only pass over the block dam in the event of a storm, at which point the cobblestone beach will be attacked. The landward side of the hard seawall will be covered with grass on a layer of clay.

## 6. Toe construction (green dots)

The toe construction, which consists of stones weighing 1 to 10 tons, will close in the large concrete blocks so that they cannot roll or shift from their intended position. Without both toe constructions, the concrete block formation, which is under heavy pressure in hydraulic terms (due to their large size, the blocks are less stable under water), would collapse into a heap during an extremely heavy storm.

## 7. Water levels

NAP = Normal Amsterdam Water Level  
 Average high water level NAP + 1.0 m  
 Average low water level NAP - 0.5 m  
 The North Sea flood of 1953 NAP + 3.75 m  
 Rising sea level 2060 NAP + 5.30 m \*

\* In 2010, the average water level is approximately NAP 0 m. The seawall has been designed to weather a storm that statistically speaking, occurs once every 10,000 years. The Port of Rotterdam Authority has established this protection standard for the new seawall of Maasvlakte 2 in consultation with Rijkswaterstaat. A storm condition of 1:10,000 years can be paired with a water level of NAP + 5.0 m and a wave height of 8 m. The strength of the seawall was tested in the model study for the year 2060, with a storm water level of NAP + 5.30 m, taking into account a rise in the sea level of 0.30 m for the next 50 years. For the following 50 years, space has been reserved for raising the crown of the seawall by another 0.50 m.

## Maasvlakte 2

North Sea



## The Netherlands

Rotterdam  
Port Area



## Europa

The Netherlands



## ROTTERDAM MAINPORT DEVELOPMENT PROJECT

The construction of the new port area, Maasvlakte 2, is part of the Rotterdam Mainport Development Project (PMR). This project also includes environmental compensation measures connected to the construction, the development of a 750 ha area for nature and recreation and improvements to the Existing Rotterdam Area. PMR is a partnership between national and regional government and the Port of Rotterdam Authority. For further information, please visit [www.mainport-pmr.nl](http://www.mainport-pmr.nl).

## MORE INFORMATION?

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