

**dutch dam<sup>®</sup> - delta**

**the standby folding flood defence**

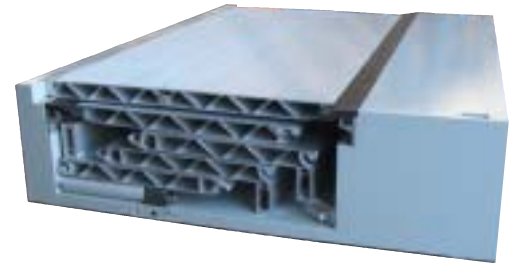


The use of the Dutchdam-Delta on a large scale on the quay of the Waal in Nijmegen, Holland, shows the political support and the broad-based technology involving hydraulic load-bearing surfaces that are available in The Netherlands (Cobouw 30-11-04).

**the emergency flood barrier with backbone  
and 5 ground-breaking new techniques**

## 5 ground-breaking new techniques

- 1- **immediate deployment**
- 2- no nuts or bolts
- 3- self-locking panels
- 4- coupled sections
- 5- shock-absorbent



The folded Dutchdam-Delta is sunk into the surrounding area or can be incorporated into a quay wall.

Because the flood barrier is installed complete on the site at the point of need, significant savings can be made on the costs of storage and logistics in comparison with partitioned defence walls like panel barriers.

### What is even more important is that the Dutchdam can be deployed immediately.

As a result of the changing climate it is now necessary to take into account the greater amount of rainfall in a shorter space of time. This makes the water table rise more quickly than in the past. Because the Dutchdam is immediately available it means that it is possible to determine more precisely the right moment for deployment. This avoids the unnecessary deployment involved with partitioned defence walls, which is a result of the long time needed to construct them. Rapid deployability is therefore of great importance and an extra safety feature.

### The housing construction

The Dutchdam Delta is unique in its construction, in that during the erection of the system the cover plate is integrated into the unfolded defence wall. In this way the cover plate becomes a longitudinal support that provides the tubular-shaped base, so valuable for the Dutchdam. This guarantees high stability along the full length of the flood defence; see the load-bearing diagrams on p.7.



**The cover plate, which works as a longitudinal support over the full length of the flood defence, ensures that the Dutchdam directly under the water line is practically impregnable to any kind of object which could come over the edge of the quay or the permanent foundation construction.**

Furthermore, the Dutchdam-Delta makes an important contribution to environmental protection and safety in areas prone to flooding and it can also produce big savings in the cost of raising the height of the existing infrastructure on location.

The Dutchdam has been developed and tested according to the best Dutch hydraulic engineering traditions and is produced exclusively by reputable ISO-certified firms.

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Perhaps the most surprising technical solution which the Dutchdam offers is the way in which it is constructed. It is not constructed with nuts and bolts, girders or assembly panels. The elements of this folding flood defence are all produced in such a way that when they are actually assembled they combine to make a very stable construction. The connecting links are all encased and their load-bearing capacity is very high.

Erecting the Dutchdam, even in unfavourable weather conditions, is a simple task, as there are no nuts and bolts. In contrast to the situations where partitions have to be put in place, the Dutchdam can be erected over a great distance in a short space of time by a very small group of people.

The coupling together of the parts of the Dutchdam works in one way only. This is an important control mechanism. The Dutchdam has storm-proof safeguards and has a high load-bearing capacity. **The strength of the Dutchdam lies in its simplicity.**



### Progressively rising water levels

The maximal high-water levels to be expected are calculated for a number of years. Because of the expected climate change, rainfall is going to increase and the sea level will rise even further. The high-water levels calculated will keep pace with this and become higher. With an adjustment now in the length of the stanchion, the Dutchdam can grow with the problem.

### Durable

The materials employed are durable in nature. The housing construction is made of prestressed concrete elements and the defence wall, stanchion, and cover plate/support are made of high quality aluminium containing magnesium AlMgSi-0.5, as it has been applied in this alloy for the last 50 years without any problems.

The aluminium is resistant to salt in case of icy road conditions.

The Dutchdam can be produced with an integrated alarm system which works when it is in the folded and in the unfolded position.

### No subsidence

Because the concrete housing construction is placed on a dam wall no subsidence occurs. This means that it is designed to function over a long period of time. There will be many decades without any expensive repairs.

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The Dutchdam-Delta has a special coupling and catch construction. This results in a flood barrier with characteristics which strongly promote the safety of emergency flood defences. The components of the flood barrier system form both vertically and horizontally one complete construction. This coupling is as unique as it is important. It avoids the situation where, during incidents of flooding, panels can be forced out of place. It also gives the defence wall not only great stability but also a high measure of reliability.



The parts of the Dutchdam-Delta are provided with a groove on the upper side. With a horizontal revolving movement there is only one way in which the underside of the part above fits into this groove. This produces a strong coupling of the parts together.

**One great difference between the technique used for partition walls and that of the Dutchdam is that in the latter all the parts are completely connected to each other centimetre by centimetre over the full length of the defence wall. Parts cannot be removed. Only after it has been unlocked and after it has been tilted in the direction of the water can the uppermost part be taken out. The bars are contained within the tubular casing of the parts and are out of reach of unauthorised persons.**

By contrast a partition wall consists of a stack of loose planks which lie in the grooves of the H-profiled stanchions. They have no fixed connection either with each other or with the upright. Clips have to hold the stacked planks in place.

## 5 ground-breaking new techniques

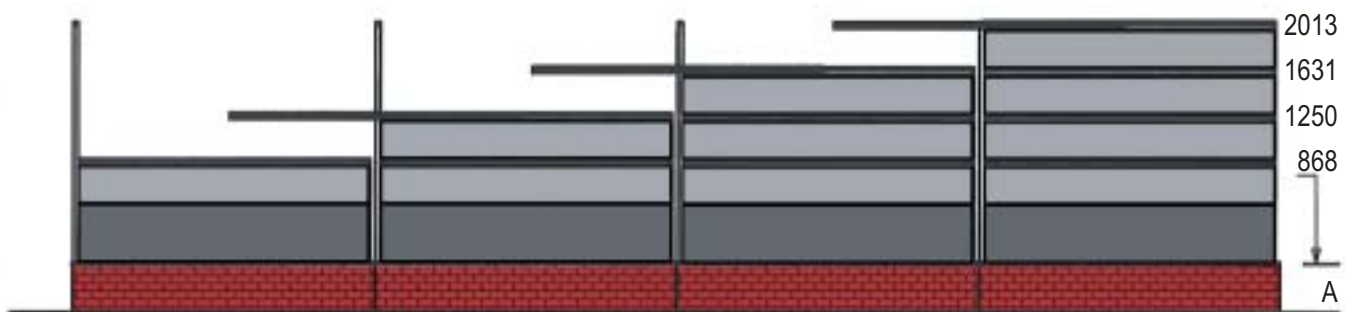
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### The backbone

Locking the adjacent sections to each other.

Just as unique as the vertical coupling of the parts to each other is the horizontal locking of the successive sections.

A heavy bar slides out of the tubular casing on the land side of the panels through the vertical stanchion into the tubular casing of the adjacent panel. This bar sees to it that in exceptional circumstances, for example after a collision, the different sections of the flood barrier are held in a defensive position. This solution satisfies an important requirement of the Dutch Ministry of Transport, Public Works, and Water Management. Until now no other system has met this requirement. This has also resulted in a vandal-proof flood barrier.



### The flood barrier with a backbone.

A= the (existing) quay wall or ground level



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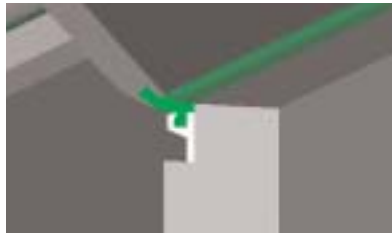
### The safety of an emergency flood barrier.

In the construction of the Dutchdam-Delta several totally new connection techniques have been applied.

### For use in dynamic surroundings.

Compared with partition defence walls the Dutchdam-Delta is also an important innovation with radical improvements. Not only the cover-plate, which serves as the horizontal support in the unfolded position, but also the vertical coupling of the parts and the horizontal coupling between the sections are technical solutions which make the Dutchdam suitable for areas at risk, such as in and around towns and near industrial and harbour areas.

It has a load-bearing capacity of over 100kN/m<sup>2</sup> around the water line and/or collision zone to 45 kN/m<sup>2</sup> on the upper edge, which indicates an exceptional performance. The calculations do not even take into account the shock-absorbent nature of the construction, nor the way in which the horizontal locking integrates the structure. In addition to this the calculations only account for some 70% of the strength of the material. This means there is a hidden reserve of around 50%.

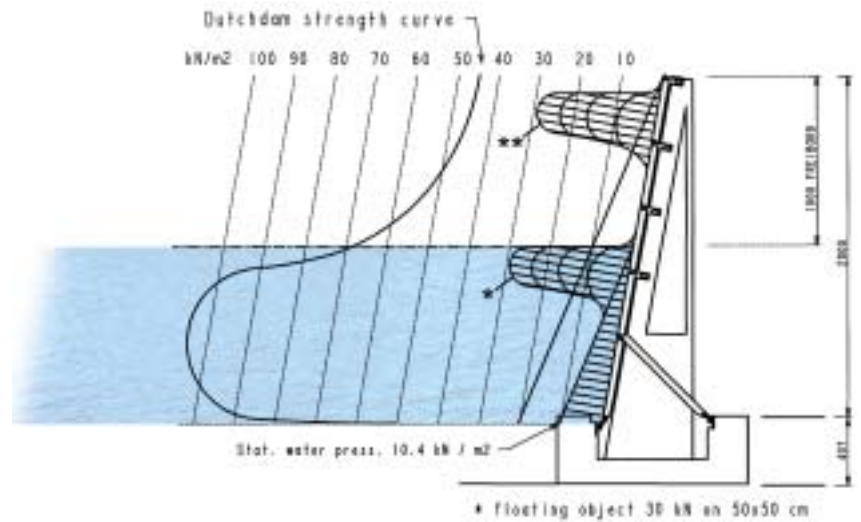


### Shock-absorbent

The heavy rubber hinges of the Dutchdam absorb the shock to the flood barrier if an incident occurs.

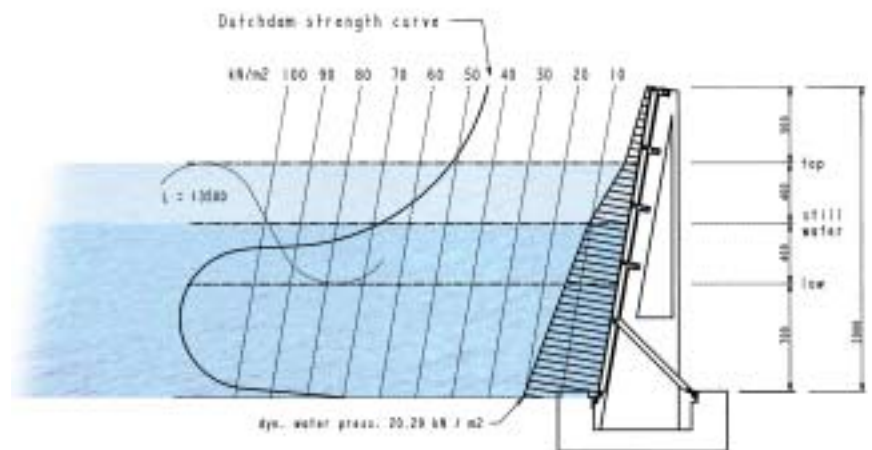
## The Dutchdam with a high load-bearing capacity

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*Dutchdam-Delta at static water pressure, with a water height of 104 cm and a floating object of 30kN (3 m/s at an angle of 31-45 degrees) calculated according to the BWK-Gelbdruck-DE norm.*

*\*\* the roughly estimated load on the upper edge of the water defence far exceeds the usual maximal high-water level calculated and shows the exceptional stability of the Dutchdam, even in theoretical extremes.*



*Dutchdam-Delta at dynamic water pressure. The still water line at 154 cm and a wave of 80 cm, calculated according to the TAW guideline-Dutch standard.*

### Strong wherever needed

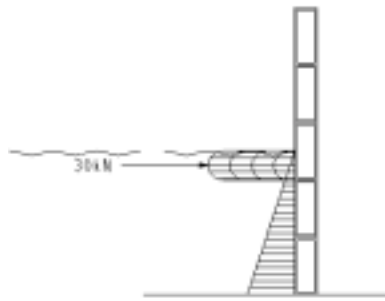
The graphics above visualise the high loads the Dutchdam can absorb. The shaded area alongside the defence walls indicates the static and dynamic water pressure on the defence wall. The curve on the left shows the strength of the Dutchdam and indicates that there is a safety margin of many hundred per cent.

What is striking about the strength curve of the Dutchdam is that it exhibits an enormous reserve precisely in the area where this is necessary. This strength and stability are the consequence of the design principle of the Dutchdam. Because there are no nuts and bolts there are no weak spots.

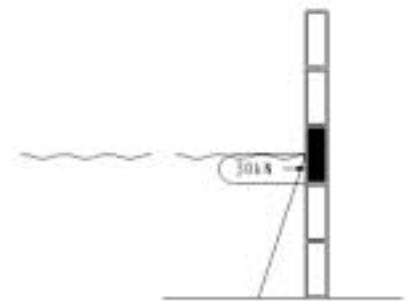
## The difference

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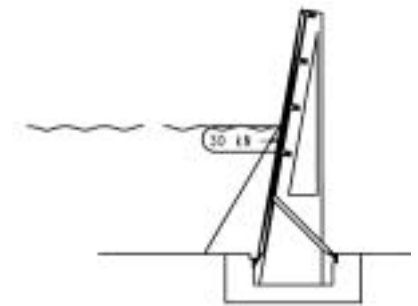
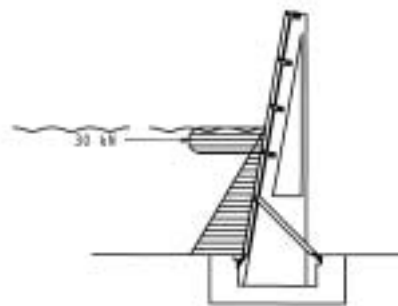
the moment of action



the moment of reaction



**Partitions:** a single panel has to bear all the load of a collision



### The Dutchdam:

the load of the collision is spread over the entire defence wall.

The Dutchdam is constructed with parts coupled to each other in three directions. A collision of 30kN can then be considered a very limited incident, certainly in view of the total strength of the Dutchdam.

### The Dutchdam-Delta

All the Dutchdam flood barriers are installed complete on the quayside wall or along the bank.

The Delta can be delivered in various heights: 125 cm, 163 cm or 201 cm on the basis of the standard model with a modular construction (all defence wall heights are composed of the same parts).

The length of the vertical stanchion can vary. The breadth and composition can be adjusted so that the Delta can be deployed in more severe conditions, such as where breaking waves are involved.

The maximal defence wall height is at present 201 cm above the housing construction. The housing construction can be applied above ground level to add to the defence wall height or to make the river bank fit in with urban architecture or rural situations. In addition to this, placing the Dutchdam on location simplifies the annual servicing.

The effects of a collision on the Dutchdam are much smaller than on a partitioned defence wall. There a single panel has to bear all the load of a collision. This can lead to a deformation of the individual partitions. As a result, the clamping of the vertical stacking of the partitions may change, which causes a dangerous situation to develop. The strength of the stanchions is in this instance not significant.



The Dutchdam-Duplo is winner of the "Dutch Design Prize 2004"

## Dutchdam-Duplo

The Dutchdam-Duplo is a folding flood defence, which is produced with its own housing construction and in which the complete flood defence system is accommodated in a folded position. The complete construction can be integrated into quay walls or defence walls. For installation on or beside a public highway the Dutchdam is capable of carrying traffic. The Dutchdam-Duplo can be supplied in various defence wall heights up to 50 cm and 80 cm.



The Dutchdam-Duplo can be recognised by two elements of its defence wall, which are connected to each other lengthwise in the water defence with a hinging facility. Both are again movably connected to the housing construction, in which the complete defence wall is stored on standby. When the Dutchdam-Duplo is in a closed position, the defence wall element serves as a cover plate.

All the aluminium parts of which the Dutchdam flood defence systems are constructed are produced using extrusion tools developed by Dutchdam. For each production series a test certificate EN 101204 3.1B is available.



*The Dutchdam-Duplo 80 as applied in 8 places in the city centre in Dublin, Ireland, in lengths of 5, 8 and 12 metres.*



Dutchdam installation (at 8 locations) Dublin city - 2004

Winner of the Dutch Design Prize 2004



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concrete construction

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