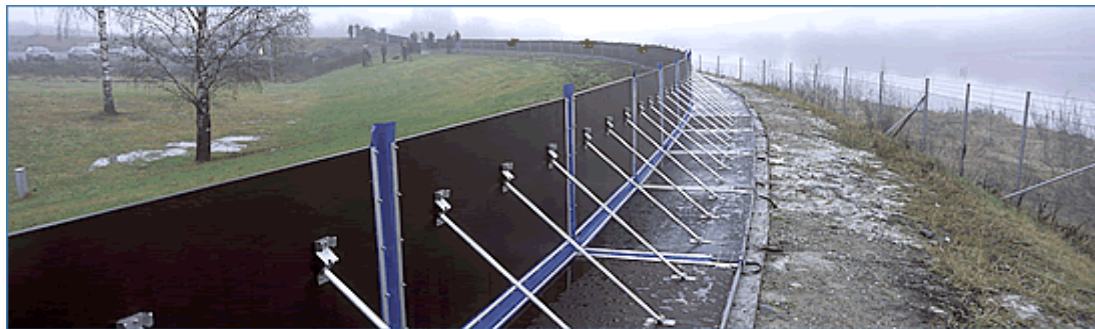




## Mobile Flood Defence System

- simple handling
- fast assembling and dismantling





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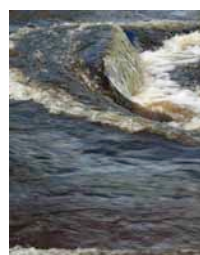
## Performance Certificate AquaFence

### AquaFence Flood Protection Solution Becomes First To Receive New Standards Certification.

*Certification improves insurance possibilities and widens scope for the next generation flood protection solution.*

The Norwegian designed AquaFence demountable flood protection solution has been approved by Hamburg University of Technology - Institute of River & Coastal Engineering, for the Performance Certificate – ‘Standalone Movable Flood Abatement System AquaFence V1200’. This high level approval, with global recognition, was gained over 4 months of intensive, specially designed practical and scientific testing, the first of its kind in the world making AquaFence the first such system to gain this important approval, strengthening its position as a high-quality, next generation flood protection solution.

Testing for the Performance Certificate was done by The Hydraulic Laboratory of the Centre of Climate Adaption Research (KLIFF) and involved the construction of a specially designed 15x12m2 concrete basin for the live water tests. This ensured that the certification would match the conditions set out by the German standards introduced by BWK\_Merkblatt in 2005, the USA FM-Global and the UK BSI PAS II.



## Performance Certificate 08/01

### Standalone Movable Flood Abatement System

### AquaFence V1200

21 METER OF THE AQUAFENCE SYSTEM V1200, MOUNTED TO A CONTINUOUS WALL WITH 2  
CORNER ELEMENTS (90° AND 60°) AND 2 ADAPTERS TO A CONCRETE WALL

HAVE BEEN TESTED WITHIN

THE HYDRAULICS LABORATORY OF CENTRE OF CLIMATE ADAPTATION RESEARCH (KLIFF)

IN THE PERIOD OF

**01.07.2007 – 31.10.2008**

THE FOLLOWING PERFORMANCE INDICATORS HAVE BEEN DETERMINED:

<b>DOCUMENTATION</b>	Complete, clear and consistent with good legibility of the drawings and readability of the text
<b>DEPLOYMENT</b>	<p>completeness of the system at delivery</p> <p>good self-explanatory material for instruction of the workforce</p> <p>workforce requirements: Minimum 4 people 1 skilled instructor 3 assisting persons</p> <p>Deployment time: With workforce of 4 people: 200 min/100 m of wall elements (average)</p> <p>Foundation requirements: Plain and solid (e.g. concrete, asphalt) stable with respect to anchoring components</p> <p>Ease of assembly: Without complicated technical and organizational actions</p>
<b>DURABILITY</b>	<p>Minimum life cycle: 60 deployments for all Aluminium components, canvas and gaskets 100 cycles for the plywood wall</p>
<b>LOAD RESISTANCE</b>	<p>Hydrostatic: Tested for maximum water depth 90 cm</p> <p>Hydrodynamic: Tested for maximum current of 2 m/s and momentum force of 125 KN</p> <p>Debris load: Wooden log of 50x50 cm<sup>2</sup>, 0,4 t weight with maximum approach velocity of 2,4 m/s</p> <p>In all load tests: No permanent deformation elastic deformation less than 4 cm leakage rate: &lt; 65 litre per hour and meter</p>

**HAMBURG, 29.10.2008**

(PROF. DR.-ING. E. PASCHE, HEAD OF INSTITUTE)

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## Description of AquaFence

### General Description

AquaFence is already proven to work.



AquaFence flood protection system consists of fences composed of a number of inter-linked, foldable elements. The fences are readily assembled and disassembled. The erection of the fences requires only limited manpower. The fences are formed in such a way that the application of floodwater pressure consolidates and strengthens the fencing rather than weakening it. The AquaFence is built for simple construction, flexibility, robustness and cost effectiveness.

The flood protection system basically consists of two lengths of boarding rigidly locked together by a system of brackets. The sections/modules arrive at the scene of the flood in the form of compact flat packages, which are simple to fold out and install. The system utilizes the innate force of the flood water to stabilize it. The foundation either consists of concrete or of some other kind of solid base. A geo-membrane may be included in the delivery. This prevents water from leaking under the barrier through the ground. The foundation is furnished with attachment points, which the individual sections are then fastened to.





The surface of the foundation is on a level with the surrounding terrain thus allowing free passage for pedestrians, cyclists or for car traffic when the flood barrier is not in use. Alternative kinds of foundation such as tarmac or stone paving may also be used. AquaFence can be installed extremely quickly in the event of flooding. The transportable sections are simply fetched and mounted on the foundation. An installation team of six to eight people can manage to put up a length of 100 meters of barrier in the course of one hour. The standard edition of AquaFence is constructed to accommodate floods of up to 120 centimeters or 4 feet in height. This flood barrier can also be used in coastal areas to cope with waves, currents and high tides. AquaFence is easy to combine with other traditional kinds of flood protection such as dikes.


### The main constituents of each section/module are:

- Marine laminated plywood 9-15 mm thick.
- Fortified PVC sheeting, quality 0,9kg/m<sup>2</sup>.
- Metal parts in aluminum or stainless steel.
- Seals between sections and foundations consisting of polythene foam plastic.



## Advantages AquaFence

Advantages AquaFence	Description
<ul style="list-style-type: none"> <li>Extremely rapid setup</li> </ul> 	<p>In Fargo, USA, 25 non-trained people put up AquaFence in 1.5 hours</p> <p>6-8 people need 1 hour for setting up 100 meter of AquaFence in any standard height (0.75 m to 1.80 m).</p> <p>Build-in clamp tracks in the ground surface can facilitate and speed up this process.</p> <p>Professionals like THW in Germany or US Army Corps confirmed the easiness, speed and relatively low labor work compared to other systems or sandbags</p> <p>The system is very easy and self explaining designed. It must be possible to put up the system under worst conditions like, cold, wind and darkness.</p> <p>Simple construction and setup routines can be worked out. AquaFence has experience and has certified guidelines available.</p>
<ul style="list-style-type: none"> <li>Rapid deployment, disassembly, and storage</li> </ul> 	<p>AquaFence needs approx. same time for deployment. This is extremely motivating to all helpers involved in this service. No tubes that have to be emptied and dried, no sand, dirt or contaminated residual substances.</p> <p>Maintenance is very easy, most of the build-in components are standard parts and can be purchased from AquaFence as well as from most industrial suppliers or even DIY stores in the various countries. AquaFence puts lots of attention that high quality and standard parts are used e.g. EN-Norm or DIN</p> <p>Simple deployment routines can be worked out. AquaFence has experience and give guidance.</p>
<ul style="list-style-type: none"> <li>Flexible design and components that can be adapted to many different situations</li> </ul>	<p>AquaFence can be installed as a flood-defense system for re-occurring floods at the same place. Using small foundations with membrane in the soil preventing undermining water and clamp-tracks makes the system fast and reliable. Asphalt or concrete plugs that can be closed are a good alternative.</p> <p>AquaFence also can be put up on uneven ground, lawns etc, using earth-screws, a second gasket and maybe clay.</p> <p>Side-adopters, 45° and 90° corners allow setting up the system at narrow space or around objects.</p>

	<p>The special design of the AquaFence elements allow building up defense lines following tracks incl. curves etc. Each element allows an angle of 5° horizontal and vertical.</p>
<ul style="list-style-type: none"> <li>Minimal disturbance to communities</li> </ul>	<p>Depending on the way of fixation, no or just little marks in the ground, like plugs or clamp-tracks will be seen. Everything else is stored in the storage and does not affect landscape architectures, view etc.</p>
<ul style="list-style-type: none"> <li>Green product</li> </ul>	<p>Taking into consideration, that AquaFence will be used as flood defense not regularly and maybe once a year or less, it is important considering the environmental impacts of the materials used for such a system:</p> <ul style="list-style-type: none"> <li>- Wood from certified cuts and forestry</li> <li>- Some aluminum and stainless steel</li> <li>- Low CO2 consumption while produced</li> </ul>
<ul style="list-style-type: none"> <li>Patented and certified system</li> </ul>	<p>AquaFence is patented.</p> <p>AquaFence is certified and tested by the technical University Hamburg with requirements according to the German BWK, English kitemark and BSI and US FM-Global.</p> <p>Special emphasis is given, that the total system and its behavior in different and typical flood-water scenes are certified and not just some components used! It is the only system available, certified to those conditions.</p>
<ul style="list-style-type: none"> <li>Cost-effective – long life-cycle</li> </ul>	<p>Cost equivalent to one flood fight with sandbags</p>
<ul style="list-style-type: none"> <li>Weight of water, used as a tool</li> </ul>	<p>Depending on the ground and conditions, little or no leaks will occur.</p>
<ul style="list-style-type: none"> <li>AquaFence has worldwide representatives</li> </ul>	<p>AquaFence has partners and projects / references in all major parts of the world incl. USA, Thailand, Australia and of course most of the European countries incl. Romania. References are e.g. in Scandinavia, USA, Hungary, Thailand, securing roads, clinics, production companies and offices, world larges intervention corn storage</p>
<ul style="list-style-type: none"> <li>Other use of AquaFence</li> </ul>	<p>AquaFence is a mobile flood defense system. However, the same elements can be used as water-storages for drinking water, fire-fighting water, cooling water, sedimentation basin for productions and even for storage of contaminated water e.g. for nuclear power stations.</p>

**Comparison AquaFence with other mobile flood defense systems**

Criteria / Systeme	<b>AquaFence</b> - Mobile - Semi-mobile - Emergency With and without ground preparation	<b>Air inflatable Systems (e.g. Ecotec)</b>	<b>Typical time wise stationary systems (e.g. big bags)</b>	<b>Typical time limited assembled structures (e.g. pallet systems, AquaBarrier, IBS K- System, Thyssen Aqua Damm System)</b>	<b>Aluminum dam beam system (e.g. IBS, GOH, Thyssen, Aqua Stop)</b>
<b>General system criteria</b>					
<b>Certification (international)</b>	√√√	--	---	√	√
<b>Safety against vandalism</b>	√√ All parts are covered in water, canvas can be repaired easily	-- Weak material, leaking water can be stopped, not air	√√	(√) depending on system, parts can be take, structure weakened during application	(√) Parts get stolen during installation (e.g. Köln) or out of storage, due to value of material (Mosel)
<b>few components</b>	√√√	√	√√√	√	-
<b>Even ground</b>	√√√	√√	√	√√	√√√
<b>Uneven ground</b>	√√ with 2nd gasket and maybe clay very good performance	√	(√) Need measurements to even the ground	(√) high leakage	---
<b>Installation in water</b>	√√ depending on height of water, but it is possible and was exercised successfully	(?)	(√)	(√)	(√) if main columns have been installed before water arises, single beams can be put up in rising water

Criteria / Systeme	AquaFence - Mobile - Semi-mobile - Emergency With and without ground preparation	Air inflatable Systems (e.g. Ecotec)	Typical time wise stationary systems (e.g. big bags)	Typical time limited assembled structures (e.g. pallet systems, AquaBarrier, IBS K- System, Thyssen Aqua Damm System)	Aluminum dam beam system (e.g. IBS, GOH, Thyssen, Aqua Stop)
installation / functioning during freezing periods	√√√	(√) Material stiff	(-) Slips away on freezing ground, sand too stiff to join	√	-  Aluminum beam take in water, if it freezes, structure might be weakened.  Aluminum reacts with structural changes, when temperature is changing (e.g. hot sun from backside, spring-water in front
<b>Before the flood</b>					
Speed of installation	√√√	(√)	(√)	√	--
Access to protected area or object during installation, e.g. accessing factories, offices ...	√√√ After the AquaFence line has been build up, elements for accessing the object can be taken out, until water comes	---	(√)	(√) Depending on system, mostly not possible	(√)  Major bearing must be build-up, which might allow access areas of limited widths. Aluminum beams will be installed when water arises








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<b>Changing protection line before water arrives, in order to react on changes, e.g. dyke breakage upstream, water coming differently, etc.</b>	√√√ AquaFence line, easily can be changed, deployed and installed at another line or area – until water has arrived. It is even possible to deploy AQF in water e.g. 70 cm.	(√) Air-systems: partly, Water filled systems: no	---	(√) Demanding with many parts	---
<b>Preparation ground</b>	(√) Depending on use: Reoccurring installation at same place with preparation, no preparation needed when used as emergency system	√√	√√	(√)	---  As above, very comprehensive preparation and maintenance. Reacts sensitive to earth-quakes or changes in earth structure
<b>Behavior in wind / storm</b>	√√ Up to 10 beaufort	--- When air-filled	√√√	--	√√√
<b>During flood</b>					
<b>Creeping strengths</b>	√√	- e.g. wind, stream, waves	√	(-) moves without fixation	√√√

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<b>Safety against undercut by water</b>	√√ Due to fixation, pressing gasket to the ground	-	-	(√) without fixation	√√√
<b>Safety against tilting</b>	√√	-	√	(√)	√√√
<b>simple handling - installing</b>	√√√	(√) Air pumps etc.	(√) Heavy, sand, dirt	(-) Depending on system, many parts, tools	-- Sophisticated logistic
<b>simple handling - deployment</b>	√√√	-- Taking out air or water, drying, rolling together	--- Heavy, contaminated and wet sand, dirt	(-) Depending on system, many parts, tools	-- Sophisticated logistic
<b>Leakage rate</b>	√√	-	---	√	√√√
<b>Behavior when hit by floating objects, waves, stream</b>	√√√ With shield, no problem with 400 kg logs. Hit element does not affect the other elements, but they support a damaged element  Certification tests successfully performed	---	(√)	√	√ High damage potential – high costs

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	even without shield				
<b>Repair during flood</b>	√√√ Easy all standard parts	---	√√√	-	--
<b>Costs</b>					
<b>Cost of system</b>	√ Reusability many times, low maintenance costs	√	√√ Price might rise enormously during flood times	(√)	---
<b>Cost of installation</b>	√√√ Fast, limited number of people	√	√ Experience shows that vehicles for filling sand are not available	√	--- Comprehensive logistic
<b>Cost of deployment</b>	√√√ Fast, limited number of people, no components	(√)	--- Very time consuming, labor intense, dirt, contaminated material has to be specially disposed / incinerated, Sand has to be transported back	(√) Many components	--- Comprehensive logistic



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Cost of storage	(√) Container, or standard storage, dry and ventilated	(√) Dry	--- Bags can be max. stored 2 years, sand takes place	(√)	--- Comprehensive logistic
Cost of maintenance	(√) Yearly inspection, maybe change of gaskets	- Regular un-rolling and inflating	√	(-)	-- Comprehensive logistic
Cost of preparation of ground	√ Depending on use, no preparation at all or small foundation with clamp-track	√√	√√	(√)	--- 20 meter deep foundation, concrete, steel, very exact construction
Examples					

**AquaFence 1800 - 1,80 meter height**

AquaFence also offers a 1,80 height flood defense system. The functioning is the same as for the versions 1.20 m or 0.85 m. But the widths of the elements are only 1.30 m and in total 4 stabilizers are securing the element at various points in 2 different heights of the element.



Adony flooding 2010





## Selected References

### Thailand, Bangkok 2011

more than 500 meters protecting 3 areas, of which one already was flooded. AquaFence was built into to the water, fixed with few sandbags, and the encased water was pumped out.



### Fargo and Mount Vernon, USA 2010 and 2011

More than 500 meters protecting town, objects, clinic







**Exercises** with THW in Dessau, water authorities of Romania in Tirgu Mures, Hallig Hooge in the North sea and Swedish Road authorities

Sweden 2011

Along motorway and example of pool



Tirgu Mures 2011

Connecting AquaFence to Hidrobaraje



Hallig Hooge December 2010  
(more than 8 Bft wind)



THW exercise Dessau, 4/2010

AquaFence was fastest and easiest system in installation as well as deployment





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