

In the eye of the storm

The International Network for Storm Surge Barriers helps its members deal with common challenges to facilitate continuous improvement in the design, management, maintenance and performance of Storm Surge Barriers around the world

Right: The Bayou Bienvenue Sector Gate is part of the Hurricane and Storm Damage Risk Reduction System that protects New Orleans. The system was built by the US Army Corps following Hurricane Katrina in 2005. It is maintained and operated by the South Louisiana Flood Protection Authority East



Below: Boston Barrier is a single rising sector gate that protects the town of Boston, Lincolnshire (UK). The barrier became operational in 2020 with the remaining parts of the project due to complete in 2022



ESTABLISHED IN 2006, THE International Network for Storm Surge Barriers (I-STORM) is the result of a conversation between two Storm Surge Barrier managers - Andy Batchelor (from the Thames Barrier in England) and Marc Walraven (Maeslantkering in the Netherlands). They realised that whilst responsible for vastly different assets, many of the challenges they faced they also held in common. Thus, over two pints of Guinness, the foundations for I-STORM were laid.

Since its formation, I-STORM has evolved to become a global organisation. Operated by two governance boards and a coordination team, I-STORM consists of 29 member organisations (as of January 2021) from countries including the UK, Netherlands, US, Italy and Singapore, amongst others. Member organisations include those responsible for maintaining and operating Storm Surge Barriers, alongside those with expertise in improving the performance of such assets, including contractors, consultants, universities and partner organisations. Any organisation that has a role to play in achieving reliable Storm Surge Barriers can join I-STORM and membership currently includes, amongst others, Consorzio Venezia Nuova (Italy), the Environment Agency (UK), Rijkswaterstaat (Netherlands) and the United States Army Corps Engineers.

I-STORM's vision is to bring Storm Surge Barrier professionals together to continuously improve standards of operation, management and

performance, in order to reduce the risk of severe flooding of people, property and places around the world. By facilitating knowledge exchange and collaboration, I-STORM enables its members to:

- Improve the performance of existing assets.
- Assist with the concept, design and construction of new Storm Surge Barriers.
- Optimise assets in conjunction with other flood risk management systems.
- Understand the likely impacts of environmental factors on Storm Surge Barrier assets.

The Structures

Members of I-STORM are responsible for numerous Storm Surge Barriers around the world, each a unique design to reflect the unique environment and circumstances in which they are located.

Built across a 520m span of the river Thames between Silvertown on the North and Charlton on the South, the Thames Barrier consists of six rising sector and four falling radial gates. Commissioned after the devastating 1953 East Coast floods, the structure became operational in 1983 and has since operated 195 times (as of January 2021), to protect London from high tides and river levels. The Thames Barrier is owned by the Environment Agency and is part of the wider Thames Tidal Defences - the system responsible for protecting over 420,000 properties,



Left: Maeslant Barrier - The Maeslant Barrier is located on the Nieuwe Waterweg and protects the Port and City of Rotterdam and its hinterlands in the Netherlands

over £300 billion capital value assets, internationally important cultural heritage and environmental sites and 1.3 million people who live and work below the average high tide level.

Like the UK, the Netherlands face storm surges from the North Sea, but despite this commonality the Maeslantkering - one of the largest moving structures in the world - is an entirely different asset. Located on the Nieuwe Waterweg, the Maeslant Barrier is part of the Delta Works. It has two 210m long gates, each held by a 237m long gate arm, which close off the 360m wide main waterway to the Port of Rotterdam.

Opened in 1997, the structure is owned by Rijkswaterstaat, the Dutch Directorate for Public Works and Water Management, who are a founding member of I-STORM. Operationally, the Maeslant Barrier is controlled by a computer system, which monitors forecast data and begins to operate the structure when a surge level of over 3m is forecast for Rotterdam. Trained operational staff monitor the closing process on location and intervene when necessary. The structure has twice operated against storm surge tides, once in 2007 and again in 2018.

Flooding from storm surges is not just an issue for countries bordering the North Sea. The Hurricane and Storm Damage Risk Reduction System (HSDRRS) in New Orleans was constructed following the historic flooding caused by Hurricane Katrina, which devastated the area of South East Louisiana in 2005. The South Louisiana Flood Protection Authority East is responsible for maintaining and operating the system and has been a member of I-STORM since 2016.

The Seabrook Barrier Complex and Lake Borgne Surge Barrier Complex include two sector gates, three vertical lift gates and a concrete barge gate to facilitate marine vessel traffic. Together, they make up

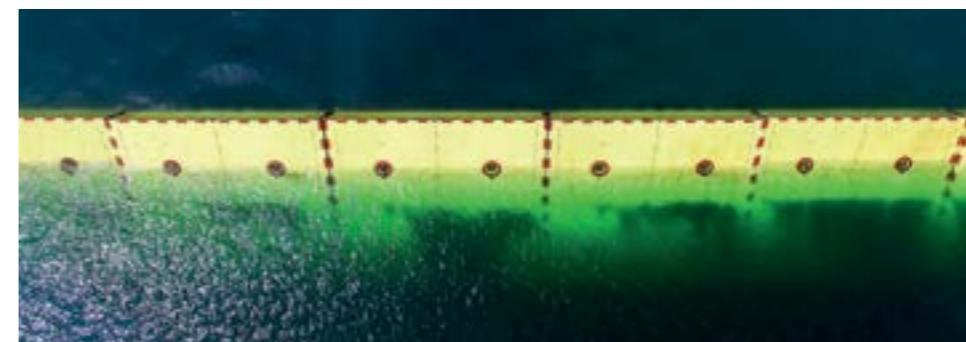
over 3.2km of the 241km HSDRRS system which is responsible for protecting over one million residents in the New Orleans Metropolitan area from flooding from Storm Surges. In 2020 alone, the region saw 12 named storms and hurricanes make landfall in the contiguous US, breaking the record of nine set in 1916, making the 2020 Atlantic Hurricane season the most active and seventh costliest hurricane season on record.

The historic city of Venice has long been embroiled in a fight against Acqua Alta - when the Adriatic Sea rises over 90cm, flooding the city. The Mose System is a network of mobile gates and is one of the newest barriers within I-STORM. Located at the inlets of Lido, Malamocco and Chioggia, the system has a total of 78 gates, housed in caissons on the bed of the lagoon. To operate, the gates are filled with compressed air, emptying the water that usually fills them so that they rise up and block the flow of the incoming tide into the lagoon.

As with many Storm Surge Barriers, the Mose System is part of a wider flood defence system, designed to attenuate the effects of Acqua Alta. I-STORM has been involved throughout the construction phase of the Mose System, as the team were one of the first network members. With work beginning in 2003 the system, although not fully completed, saw its first full operational activity in 2020.

The challenge

Unique circumstances mean unique structures and in turn, a unique set of challenges. Storm Surge Barriers require personnel with specific, specialist knowledge to operate and maintain them. This brings the challenge of personnel changes, which then brings the very real risk of losing tacit knowledge. As the assets age, maintenance challenges grow, and



Left: The Mose System protects the city of Venice, Italy. In construction since 2003, the system saw its first full operational activity in 2020

Below: Ramspol Barrier - The Ramspol, operational since 2002, is located in the north-east of the Netherlands. It is an inflatable dam to protect against high water from the IJssel lake



Right: Operational since 1983, the Thames Barrier is located in south-east London to protect the UK capital from storm surges



with asset management an evolving field, it makes knowledge exchange at an international level not just a nice-to have – it's now a necessity to ensure these critical assets continue to provide optimal performance.

In a changing climate, there is growing pressure on barriers to operate more frequently and more countries are considering Storm Surge Barriers as a way to protect communities in the future. As a solution that can be designed and constructed to the specific requirements of the area, I-STORM now regularly sees interest from organisations and countries who have not previously seen barriers as a potential solution – such as Denmark. Not only can members assist with new barriers, they can also learn from them, as they can apply the new and innovative technologies to their own structures as and when modification is required due to ageing.

Knowledge exchange

Dr Ivan Haigh, Associate Professor in Coastal Oceanography at the University of Southampton in the UK, is an active member of the I-STORM network. His work studying rising tides, assessing the rates of acceleration currently being observed and the range of likely implications were the topic of a webinar hosted by I-STORM in 2020. For members, it was an opportunity to hear about the research and understand how the findings may relate to their Storm Surge Barriers in the future.

Webinars such as these are a key tool for I-STORM – especially during COVID-19 – as a method of facilitating knowledge exchange. We've hosted webinars on a variety of topics, including discussions on Drone Use for Asset Inspections and Working Practices in a Pandemic, as well as more informative

sessions, including an update on the Coastal Texas Project from USACE and the Texas GLO – a project that I-STORM has been involved with for some time.

Another key product of the I-STORM network is peer review. Based on the process developed by the World Association of Nuclear Operators (WANO), they provide a host barrier with a bespoke assessment of the performance of their asset and management organisation. Identifying strengths, best practice and areas for improvement, peer reviews support process development, standardisation and collaboration across barrier management organisations and importantly, provide an opportunity for barrier practitioners to exchange knowledge and expertise as well as develop strong working relationships with their peers for the future. I-STORM has so far carried out five full peer reviews on structures including the Eastern Scheldt in the Netherlands and New Orleans barriers in the US.

To achieve its aims, I-STORM also circulates a bi-monthly newsletter which highlights key activity to members. We operate a LinkedIn group as a question and discussion platform for members and we also host our annual meeting – an opportunity for all members to meet in person, visit at least one Storm Surge Barrier asset and collaborate on key topics.

I-STORM prides itself on its informal nature – we don't instruct or give advice, we only discuss and share our experience with other members to help them achieve reliability on their structure.

By facilitating knowledge exchange, resource development and collaboration between our members, I-STORM is helping them deal with common challenges at an international level and enable the continuous improvement in design, management, maintenance and performance of Storm Surge Barriers internationally. ●



For more information

www.i-storm.org

Right: Attendees of the 2019 I-STORM Annual Meeting in Venice. The photo was taken on a site visit to the Mose System

