TRELLEBORG

Raise your Level

A GLOBAL GUIDE TO WATERTIGHT WATER INFRASTRUCTURE

Introduction

Access to water is a basic human need. The challenge for our industry is how to fulfil this in an era that faces rising sea levels and a growing population migrating towards urban areas. Whether developed or developing, economies across the globe are facing up to the need to manage this resource effectively, from optimizing domestic and industrial water infrastructure to minimizing flood disruption.

This guide looks at some of the key macro issues impacting water management as well as exploring how cities and communities throughout the world are already tackling water infrastructure development.

THE IMPACT OF A CHANGING CLIMATE

2015 was the warmest year globally ever recorded. Sea levels are rising at an increasing rate, and while the global average sea level rose nearly 7 inches / 18 cm over the last 100 years, it is projected to rise by up to 48 inches / 122 cm by 2100, with significant affects.

High tides and land subsidence will result, increasing the incidence of flooding. 11 of the world's 15 largest cities, including New York, Tokyo and Mumbai, lie along coastal shores, so this will have a dramatic impact on a large portion of the world's population and the world's economy. In fact, the number of people affected by floods is expected to triple to 54 million in less than 15 years, so the need to act now and to prioritize flood prevention schemes is apparent.

A GLOBAL DEMAND FOR WATER

In 2016, the world's population was estimated at 7.4 billion – an all-time high. The United Nations expects this figure to rise to 11.2 billion by 2100 and the overall global demand for water to increase by 55% by 2050. Yet water is a scarce resource and 40% of the planet's population is projected to be living in areas of severe water stress by 2050.

This highlights some of the challenges facing the water industry. There is a need to develop and deliver infrastructure that can supply water over increasingly long distances and sometimes through remote and inhospitable environments and at the same time, to maximize the performance of existing infrastructure and minimize leakage. In both instances, technological advancements are improving durability and ease of installation to make extreme environments more accessible.

URBANIZATION AND THE RISE OF MEGACITIES

Half the world's population – 3.7 billion people – now reside in cities. There is a continuing global shift towards urbanization with 77 million people migrating from rural to urban areas each year with significant implications for water supply, infrastructure and management. Megacities, with their populations of over 10 million, are a growing phenomenon, doubling to 29 throughout the world in the last two decades. These megacities place massive demands on water infrastructure requirements, as well as flood management schemes which is illustrated by the concentrated growth of South East Asian megacities in flood prone areas.

Water optimization and efficiency will be essential areas of focus in the coming decades to meet the needs of these megacities with their mega water demand. Minimizing disruption when expanding water infrastructure or implementing flood prevention programmes is a key consideration due to economic pressures – cities must continue to function throughout any structural work.

THE ECONOMIC COST OF WATER

With annual losses from flooding in the world's biggest coastal cities rising expected to rise from $6 billion a year currently to over $1 trillion by 2050, doing nothing is no longer an option. Flood management programmes need to take into account the effects of changing weather patterns, such as the trend towards heavy, intense rainfall that is already being experienced in the US. While the occurrence of more intense heat waves affects water storage and supply infrastructure.

The ageing nature of existing water infrastructure when planning for future water management cannot be ignored. There is broad recognition that in developed Western economies, investment is required and the 'patch rather than fix' mentality needs to change. Funding remains an issue however and while the American Water Works Association's State of the Water Industry Report 2015 lists renewal and replacement of waste and wastewater infrastructure as the top issue faced by the US water industry. The $1 trillion needed to do so could be a deal-breaker for federal and state level decision-makers.

Protecting Venice

“Trelleborg offered a hassle-free installation process and proven functionality. Its fender systems and bespoke sealing systems provide an ideal solution.”

Diego Zandolin of main contractor, Clodia SpA.

HOW THE MOSE FLOOD DEFENSE PROJECT BECAME A REALITY

Protecting one of the world’s most iconic cities, Venice, from ever-rising tides required an ambitious and iconic storm surge solution. The MOSE project to safeguard Venice is an innovative feat of engineering consisting of 78 mobile flood gates. Trelleborg has been involved in this high-profile water infrastructure project from the outset, providing tailor-made sealing solutions and multiple fender systems within a one package and one point of contact solution.

WHAT IS THE MOSE PROJECT?

The MOSE project will provide flood protection to Venice, the Venetian Lagoon and its neighboring cities through the installation of 78 mobile barriers at the Lido San Nicolò, Malamocco and Chioggia inlets, the gaps through which the tide enters the lagoon. These surge barriers will be activated when the tide reaches 110 centimeters inside the 500-square-kilometer Venetian Lagoon, effectively separating it from the Adriatic Sea to prevent flooding. The total cost of the project which completes in 2018 is estimated to be 5.5 billion euros.

ABOUT THE STORM SURGE BARRIERS

The flood defense scheme consists of a total of 78 mobile flood gates which can be raised at high tide to create four temporary flood barriers at three points. At the Lido inlet, the widest point, two rows of gates made up of 21 and 20 barriers respectively, are linked by an artificial island which houses the technical buildings and the system operating plant. The smaller Malamocco inlet has one row of 19 gates and there are 18 at the Chioggia inlet. The gates are connected to concrete housing structures with hinges, the technological heart of the system which allows them to move.

GLOBAL EXPERTISE, CUSTOMIZED SOLUTIONS

When not in use the gates rest on special housings at the bottom of the lagoon, completely out of sight. Sourcing a reliable sealing system that would stand the test of time and support the long-term integrity of the structure was therefore a key consideration. Trelleborg’s ability to deliver a tailor-made solution on a large-scale and within a demanding timeframe saw it become involved in the project from the outset. Working with the design team in the very early stages, Trelleborg’s global expertise was used to ensure the best possible sealing solution was designed, manufactured and installed for the project.

VENICE FLOOD DEFENSE FACTS

78 mobile barriers will make up Venice's flood defense system

The barriers extend over 1.5km

More than 31 Gina gaskets and 93 Omega Seals will be used in its construction

WATERTIGHT SEALING SOLUTIONS

Trelleborg's Gina gasket will be mounted on each of the 78 foundations, acting as a dynamic seal to ensure watertight protection. The Gina-type seal was the preferred sealing solution as it is able to withstand very high hydrostatic pressures and for the MOSE project was manufactured out of natural rubber to increase its resilience against possible seismic activity.

Trelleborg's Omega seal is then used to act as a secondary seal between the sectional elements of the mobile barriers. The Omega seal's unique combination of being able to withstand high water pressure while allowing large gap movement in all directions made it an ideal sealing solution for this submerged barrier infrastructure.

ABOUT THE GINA GASKET

Trelleborg Gina-type seals are often used to provide a seal between two concrete segments or for sealing temporary bulkheads at the end of tunnels. These seals are often subjected to high hydrostatic pressures. The seal can be manufactured with a soft rubber nipple on the sealing face to ensure a watertight seal under low contact pressures on the irregular surface. This nipple is designed to assist during positioning of the two concrete elements.

'In this instance, Trelleborg's Gina gaskets were produced from natural rubber due to the material's high resilience in case of seismic activity.'

Saving St Petersburg

HOLDING BACK THE BALTIC SEA

The St Petersburg storm flood barrier is a feat of engineering. Protecting the city and its treasures from the rising waters of the Baltic Sea, the complex water infrastructure project consists of a 25-kilometer dam, two navigation channels and the longest undersea road tunnel in Russia. Trelleborg was involved in designing and providing the sealing systems for the entire 1.2km roadway part of the defense system.

DEFENDING ST. PETERSBURG

Prone to almost annual flooding and home to over 4.5 million inhabitants, the need for a flood defense system to protect St Petersburg against frequent storm surges was never in doubt. Designed and constructed over several decades, the now complete system consists of a dam extending for 25.4 miles with two large openings for shipping that can be closed when floods threaten. A tunnel, 17 meters under the flood gates and 1.2 kilometers long, was fundamental to the project, allowing traffic to circulate under the main channel and effectively completing the St Petersburg ring road.

100 YEARS OF WATERTIGHT SEALING

A key part of the water infrastructure project was the construction of the road tunnel beneath the main channel as this would allow traffic to flow even when the flood gates were closed. Trelleborg was engaged to find a solution to seal the fifteen tunnel sections that had been constructed, but not connected.

The global provider designed a sealing system that met the challenge of securely connecting the tunnel sections while at the same time allowing them to move.

"The seals are sufficiently resistant to protect the tunnel from water under high pressure. At the same time, they are flexible enough to allow movement by the tunnel sections."

The 40 meter-wide, seven meter-high seals were made to the highest standards of quality. Once laid, the seals provide resistance for a hundred years with no maintenance requirement – this also meant that Trelleborg's installation experience was a determining factor in their appointment, installation had to be right first time.

A FIRST FOR OMEGA SEALS

This was an innovative project in several ways. Omega and Gina seals were used in a 'cut-and-cover' tunnel, which is one where the tunnel is constructed section by section, and then covered in. It was also the first time that a double sealing system was used in a tunnel. The length, depth and inaccessibility of the tunnel infrastructure called for a superior sealing solution consisting of outer and inner Omega and Gina seals, one which Trelleborg could provide.

Keeping California moving

PROTECTING LOS ANGELES' VITAL ROAD INFRASTRUCTURE

The city of Los Angeles was a pioneer in the development of the freeway and today boasts an extensive road system which ranks second in the US in terms of overall lane mileage. Maintaining this vital transport link both within urban centers and across the state as a whole is a key priority for the Department of Transport for California. Trelleborg works with the department on an ongoing basis to exclusively supply its Omega seals.

IF THE SEAL FITS...

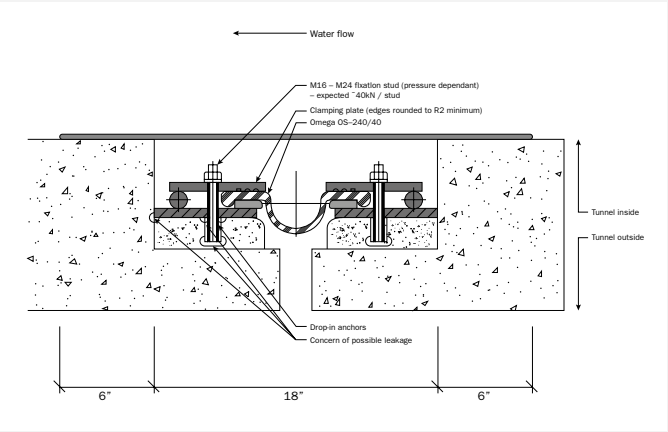
Los Angeles is a densely populated coastal city and therefore vulnerable to flooding. Part of its flood prevention actions involve minimizing the possibility of water entering the city's extensive road system. Trelleborg's Omega seals are part of this solution and are being used throughout Los Angeles to prevent water, such as excessive rainfall or swell, entering its road infrastructure.

In fact, Trelleborg now supplies the design for, and manufactures, all the Omega seals for the Department of Transport in the state of California exclusively.

'Trelleborg exclusively designs and manufactures all the Omega seals for the Department of Transport in the state of California.'

CERTIFIED AND CUSTOMIZED

Trelleborg's technology and design expertise were a key factor in its involvement in this project. Trelleborg designed the best clamping method for the seal to ensure both maximum lifetime expectancy and a leak-free solution were achieved for the Department of Transport. Multiple authorities then reviewed and approved the methodology drawings which were added as a 'Reference of Materials' section on the shop drawing. Finally, the structural engineer of the Department of Transport certified the Omega as fit for use and the material was certificated that it meets the required performance criteria for compression, expansion and hydrostatic pressure.



WHY OMEGA?

Omega seals can withstand high water pressure in combination with relatively large displacements in all directions. They can also withstand temperatures ranging from minus 30 degrees Celsius to plus 70 degrees Celsius.

Controlling Korea's rising rivers

MANAGING THE FLOOD THREAT OF THE NAKDONG RIVER

The Nakdong River is the longest river in South Korea, passing through major cities such as Daegu and Busan. The flood threat in South Korea is not from the sea, but from the rivers themselves. Building the 300 meter long Nakdong storm surge barrier was therefore designed to manage the water flow of the river better to prevent flooding. Trelleborg provided the sealing systems for this landmark project.

CHANGING CURVATURE

The core function of this storm surge barrier was to control the flow of the river better by redirecting excess water away from the main channel through increased drainage capacity. Whereas flood defense systems often protect habitats from rising sea levels and tidal surges, the big difference with the Nakdong barrier project is that the threat is from the river itself. This means that the barrier's curvature was designed to turn towards the sea, not away from it. Extra drainage facility was also needed due to deal with the heavy sedimentation in the river's feeder channels.

'The flood threat in South Korea is from its rivers, not the sea.'

SEALING SUCCESS

As a global expert in water infrastructure projects, Trelleborg provided a range of sealing solutions to this storm surge project. Self-activating seals were used due to their inherent flexibility as well as compression seals, which are highly resistant to deterioration from exposure to weather, sunlight, oils and impact, to provide a comprehensive seal to the expansion joints. Trelleborg's inflatable gaskets, designed to seal a gap after installation through inflation with either water or air, were also used on the project to provide improved sealing capacity.

The storm surge barrier was commissioned by K-water, part of the Korean Directorate for public works and water management, and when working at its full potential the structure provides improvements to ecology and irrigation as well as flood-water safety for local residents.

WHY INFLATABLE GASKETS?

This gasket is designed to seal a gap after being inflated and is therefore often used as a sealing solution where there are large movements or variations in the sealing face. Inflatable by either air or water, this gasket also has ridges on the upper and lower contact area to improve sealing capacity.

Conclusion

WHY TRELLEBORG?

Trelleborg Engineered Products is the partner of choice for customized sealing solutions for water management projects across the globe.

Our tried-and-tested sealing systems are already working hard in high profile projects worldwide. From storm surge barriers to dry docks and lock systems and from ship lifts to aqueducts, Trelleborg is able to provide a reliable, stable and high quality sealing solution whatever the demands of the environment.

EVERYDAY INGENUITY

Trelleborg collaborates closely with its partners at an early stage in a project to make sure the most appropriate and fully reliable water infrastructure management solution is engineered. To meet the needs of today's economies, water infrastructure is required in increasingly challenging environments. Trelleborg uses technology to develop innovative applications that advance the capability of sealing solutions to meet the needs of these complex situations. Advanced modelling and testing are a key part of this process, ensuring that a risk-free, high quality sealing solution is developed that delivers full protection and enhances safety.

EVERYDAY RELIABILITY

Many of today's water infrastructure management projects are high profile and have high expectations. Trelleborg combines high quality materials with in-depth understanding of how different compounds work to produce reliable and stable solutions you can rely on.

Our products deliver this long-term stability through an improved ability to handle movement and ageing, and better resistance against temperature and chemical erosion. This also reduces the need for maintenance, an increasingly important criteria given the remoteness of some infrastructure.

All Trelleborg Engineered Products sealing systems and products are fully certified to ISO standards.

SCROLL OVER BELOW

Mose Project | Russia (St. Petersburg) | Radial Floodgate | Inflatable Seal Product | Mose Project

TRELLEBORG

Trelleborg is a world leader in engineered polymer solutions that seal, damp and protect critical applications in demanding environments. Our innovative engineered solutions accelerate performance for customers in a sustainable way. The Trelleborg Group has local presence in over 40 countries around the world.

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