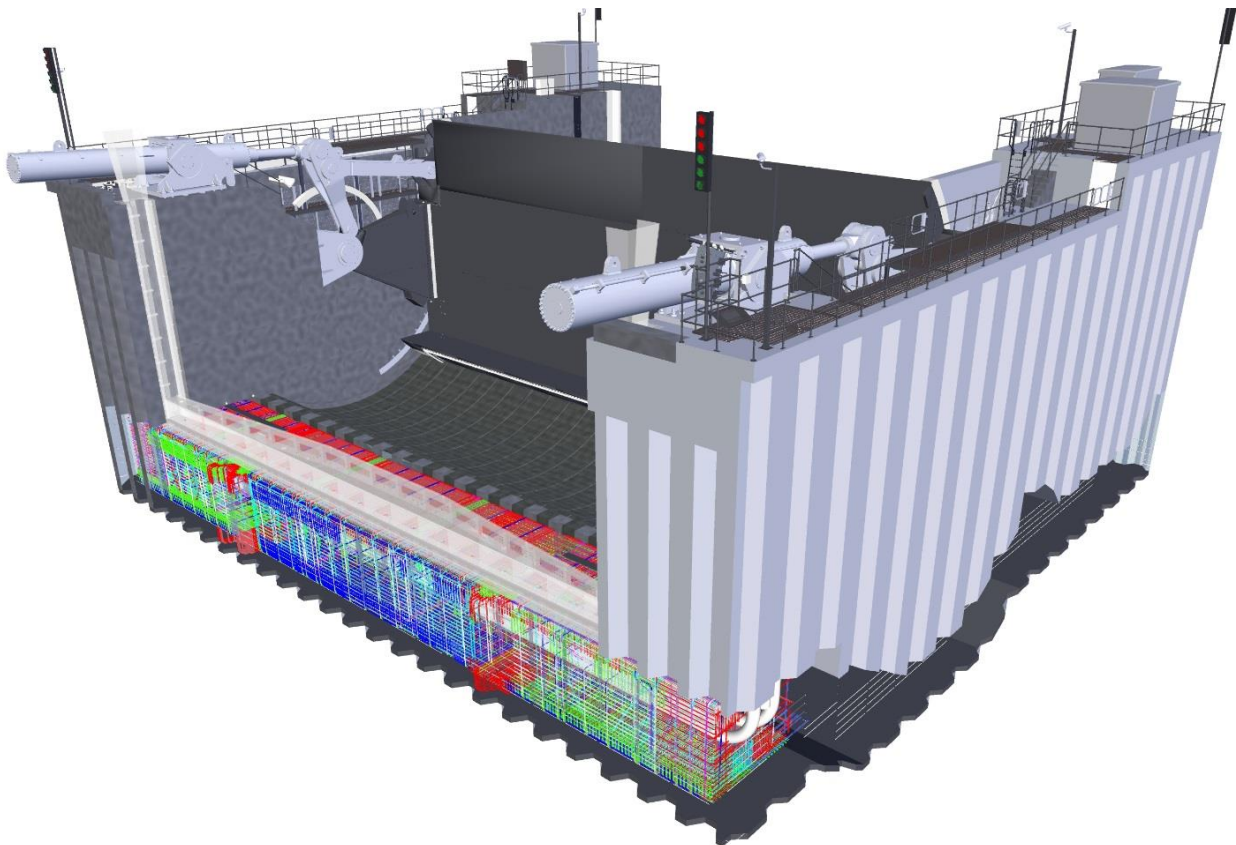


Rising ocean levels and increased storm surges threaten coastal cities worldwide. The town of Boston on the East coast of England, UK, located approximately 150 km North of London, has been repeatedly affected by storm flooding, with the most severe event in December 2013. The Environment Agency commissioned BAM Nuttall Mott MacDonald Joint Venture (BMMJV) to design and build the "Boston Barrier" to protect the town of Boston from tidal surges, coming from the North Sea via the Haven tidal river. The BMMJV selected Hunger Hydraulic to design, manufacture and supply the two hydraulic cylinders to raise and lower the gate as well as a spare cylinder due to the criticality of this piece of infrastructure.



Flood protection system with radial gate and hydraulic cylinders

Source: Bam Nuttall

The flood barrier consists of a 25 m wide radial gate which is raised to block the whole width of the Haven river. In its open condition the radial gate is completely submerged and positioned in a recess at the base of the barrier keeping the navigational channel open and allowing water to flow freely. In a tidal surge event the 370 ton radial gate will be raised, using two hydraulic cylinders, until the river is completely blocked. The incoming tidal surge is then prevented from progressing into Boston protecting over 14,000 homes and businesses. When the gate is deployed in a tidal surge event the fluvial discharges from the two up-stream systems will be temporarily held for a short period until the storm surge has passed and the gate can be opened again. This requires a high reliability and a 100% availability of the electro-hydraulic drive and control systems for the radial gate.

The two hydraulic cylinders have a piston diameter of 860 mm and a piston rod diameter of 400 mm. Each hydraulic cylinder can generate a pulling force of 950 ton over a stroke of 8,015 mm. The net weight of one hydraulic cylinder is approximately 53 ton. When the radial gate is open (lowered) both hydraulic cylinder rods are exposed to the weather. To protect the extended piston rods against corrosion and mechanical damage they are coated with a protective ceramic coating, Hunger Ceraplate ([Hunger coatings](#)). This coating provides protection from corrosion for at least 20 times longer, compared with a double hard chrome layer, and in addition has a much higher surface hardness. Corrosion, wearing and damage of the piston rod are also significantly reduced with the use of the Hunger Ceraplate coating.



Hydraulic cylinders in open gate position

Source: Environment Agency

The attachment of the hydraulic cylinders to the gate at the rod end side is by maintenance free spherical bearings in stainless steel and on the cylinder body a gimbal is used to mount the assembly to the civil infrastructure. Using a gimbal mounting gives the cylinder all the degrees of freedom required to move the radial gate and to compensate for civil and structural tolerances. For position control and synchronisation of the cylinder stroke each cylinder has an integrated, electronic linear position sensor. The position signals are used in a controller to generate the control signals for the proportional valves for each hydraulic cylinder.



Hydraulic manifold blocks are mounted on each cylinder for load control and over-pressure protection. Even with a burst hydraulic pipeline the load of the radial gate would be held safely. In addition, the hydraulic cylinders are calculated and designed to hold and move the radial gate using only one cylinder in an emergency situation. To manage this the manifold blocks on the cylinder contain a special set-up which isolates the damaged cylinder in a pressure less condition and allows the remaining cylinder to work at an increased operating pressure.



Boston-Barrier Hydraulic cylinders, ready for shipment

*Source: Hunger*

The engineering design was carried out according to DIN 19704 and DIN 18800 and the complete manufacturing of the two hydraulic cylinders as well as one spare cylinder was done by Hunger Hydraulik in Lohr am Main, Germany. Project management and design interfaces were managed by the local Hunger Hydraulic UK team.

In 2020 the cylinders were installed on site and the BMMJV team completed commissioning and handed over this incredible piece of infrastructure to the Environment Agency. Hunger Hydraulic are privileged to be part of the team to deliver the Boston Barrier and protect Boston and the surrounding area from future floods.

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