NO STANDARD LOCK GATES FOR THE NEW SEA LOCK IN IJMUIDEN, THE LARGEST LOCK IN THE WORLD

by

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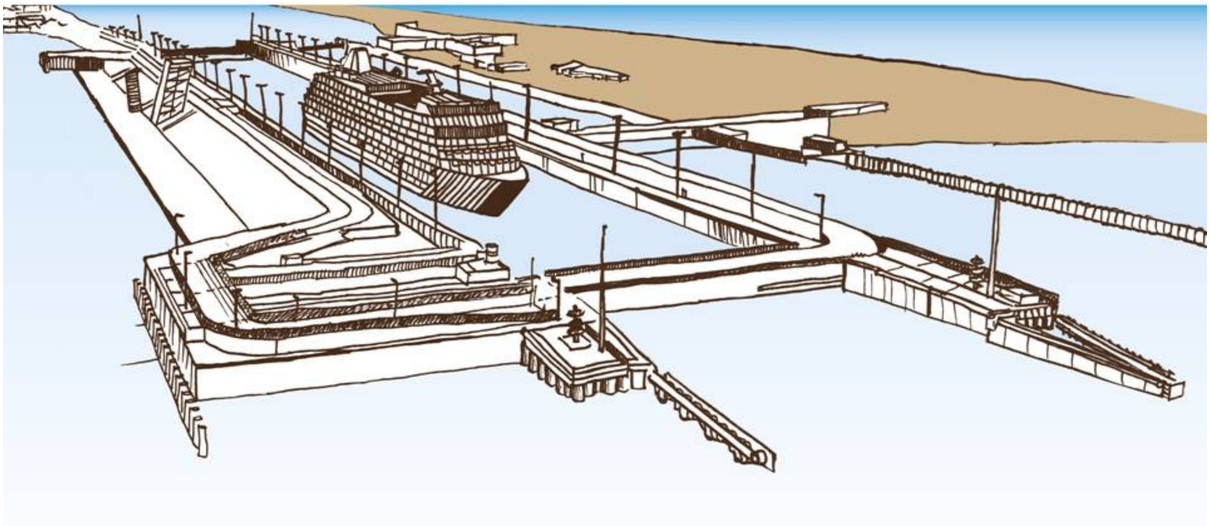

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INTRODUCTION

The new sea lock in IJmuiden will be in terms of length (500 meters) and width (70 meters) the largest sea lock in the world. With these dimensions, it allows passage to the world's largest ships, who will be able to pass through the lock (regardless of the tide) which will strengthen the international competitiveness of the port of Amsterdam. At the same time the new sea lock is built ‘future-proof’. At an altitude of 8.85 meters above sea level, the Netherlands are protected from the rising sea water for the next two centuries.

A UNIQUE DESIGN

The functionality of a navigational lock is particularly determined by the lock gates and drive mechanism. Because the set of requirements and the spatial boundary conditions vary per lock, each lock requires a specific gate design and a standard solution is not available. This also applies to the new IJmuiden sea lock, where the design of the rolling gates, measuring 72 meters in length and 11 meters in width, is governed by the required robustness and RAMS performance, the environmental conditions, and the limited construction space. The new sea lock is built between the existing locks, which will largely remain open to shipping and road traffic during construction.

The limited width for the new lock heads and the rolling gates proved to be a difficult design challenge. A sufficiently reliable concept had to be developed, requiring minimal maintenance effort. The three rolling gates are designed according to the 'wheelbarrow principle'. The gate rests on a lower roller carriage on the lock chamber side and on an upper roller carriage on the gate recess side. The upper roller carriage also serves as a road surface by means of which onshore traffic can drive on and off, across the gate.

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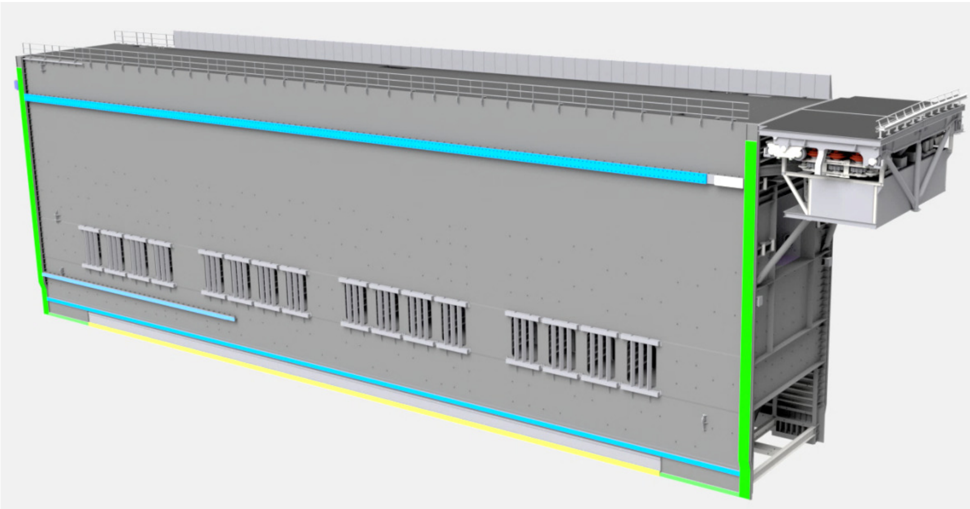
GATE STRUCTURE

The lock gates hold water on both sides and comprises two retaining shell sheets, with horizontal sheeting sections in between, which requires minimal use of steel. In fact, the gate structure could be described as a girder resting on two supporting points and bending around the vertical axis. The gate will only start to bear down upon the concrete sill in the event of extremely high water levels.

At the location of the roller carriages, the gate will be positioned centrically on rubber bearings. These allow the gate to move horizontally causing the gate to be pressed against its buffers in the event of a differential head load without exerting a horizontal load on the roller carriages and rails. During opening and closing, the gate will be guided horizontally by means of polyethylene guide strips fitted at different elevations on both long sides of the gate and also in the rail beam structure at sill level of the gate bay.

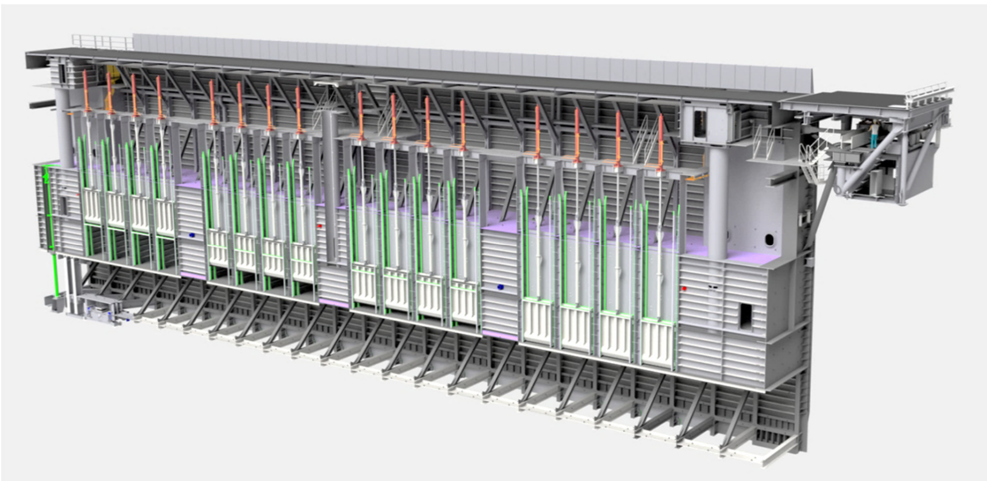


BUOYANCY SYSTEM

To limit the load on the roller carriages and rail structures, the gate will be equipped with a large rectangular buoyancy system with air chambers over the entire length and width of the gate. There are special ballast tanks to compensate for marine growth and sedimentation. All ballast tanks can be emptied in the event of a gate change, which causes the gate to float upwards and allowing transportation.

LEVELLING SYSTEM

Below the flotation system there are sixteen levelling openings that can be closed by means of hydraulically powered steel gate valves. The decision to incorporate levelling through the gate instead of through short culverts was again the result of limited space in combination with the vulnerability of the existing adjacent lock structure.



ROBUSTNESS

The gates were designed to be more collision-resistant than required by the client. In the event of ship collisions up to a determined impact energy, the gate structures will undergo plastic deformation in a way that cracking does not occur in the shell sheeting. Computational analyses that simulated various collision scenarios demonstrated that the lock gate is sufficiently robust.

All hydraulic and electrical installations in the gates have been placed outside the collision-sensitive zone. For the same reason, the 16 levelling valves, each with their own hydraulic cylinder, have been placed at the center of the gates to prevent the slide guides from sustaining deformation in the event of a collision. The air chambers have been compartmentalized to limit loss of buoyancy in the event of a leak. In such a situation, the lock gate will still be able to fulfil its operational function, and allow navigation through the lock.

ENVIRONMENTAL CONDITIONS

The presence of floating debris, marine growth and sedimentation can lead to accelerated wearing of the rail tracks, thus impairing the availability of the lock. To prevent this as much as possible, special facilities have been incorporated in the lock gate. At the front of the lower roller carriage a bull bar and dirt scraper have been fitted to the gate structure so as to push any obstacles encountered on the rail structure and on the guide beam into a collector well as the gate moves forwards. Additionally, a jet pipe will blow sand and sedimentation from the rail track.

To avoid that the lower roller carriage becomes overloaded due to accelerated marine growth or sedimentation as time passes, it is provided with a load sensor that will be continuously monitored. If there is an increase in the serviceable weight, it is possible to respond rapidly and compensate weight by pressing water out of the ballast tanks.

DRIVE MECHANISM

The upper roller carriage houses the machine room for the transmission drive. The gate will be moved by six hydraulically powered pinions and two pin tracks on each side of the gate recess. Due to the major differences in navigable levels, the recess walls can undergo horizontal deformation by several centimeters. The drive trains are pressed against the pin tracks by a central pressure bar with spring buffers. The hydraulic drive system behaves like a differential with six output axles, three on both sides.