

ARINAGA SEWAGE OUTFALL (CANARY ISLANDS – SPAIN)

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Summary

The new Arinaga sewage outfall (Gran Canaria Island, Spain) goes through the existing infrastructure in the port in order to reach a great depth to avoid exposing the pipe to wave action. This is achieved thanks to an ingenious idea that allows the pipe to pass through the precast caisson. The rest of the pipeline was placed safely on the seabed at a significant depth.

Keywords

Outfall, sewage, breakwater, HDPE

Background

Taking into account the future expansion of the Port of Arinaga (Gran Canaria Island, Spain), Las Palmas Port Authority reached an agreement with the Municipalities of Southeastern Gran Canaria to move the existing outfall to the north of the port.

The project consisted of constructing a new outfall (of HDPE, 900 mm outer diameter) for the sewage treatment plant to prevent the direct discharge of sewage water inside the harbour after the future expansion of the Port, as can be seen in the following figure:



Figure 1. Sketch of the initial outfall position and the future port expansion

Once the project was drawn up by the Port Authority, it was bid out and awarded to the Spanish Company “FCC Construcción”. Increa was the Consulting Company that prepared a new project which added several improvements to the original one. Moreover, Increa provided advice on the construction processes and in particular, on the sinking of the pipeline.

Original project and new proposal

The original project (which served as the basis for the construction tender) situated the outfall pipe on the outside berm of the existing breakwater, directly placed on the armour stone. This solution created a hazardous situation due to the great turbulence generated by the waves hitting against the breakwater which could lead to displacements of

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the pipe or its damage. Furthermore, it raised the price of the work since it depended on the sea state and required working in an aggressive marine environment.

Running parallel to the breakwater (see figures 2 and 3) on the berm created several disadvantages:

- Positioning the pipe in the surf zone and the intense battering of the sea.
- The need to use maritime resources for a greater length.
- The integrity of the outfall depends on other infrastructure (the rubble mound breakwater).

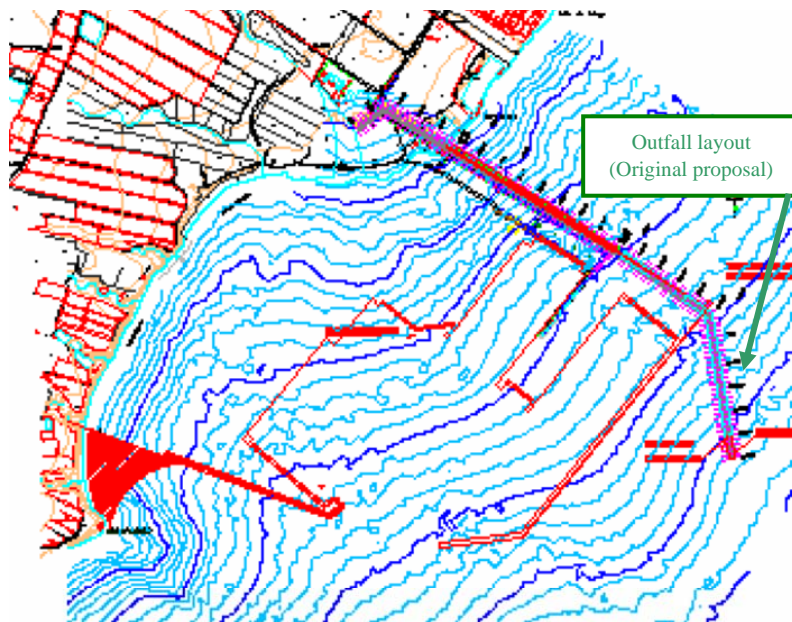


Figure 2. Outfall layout in the original project

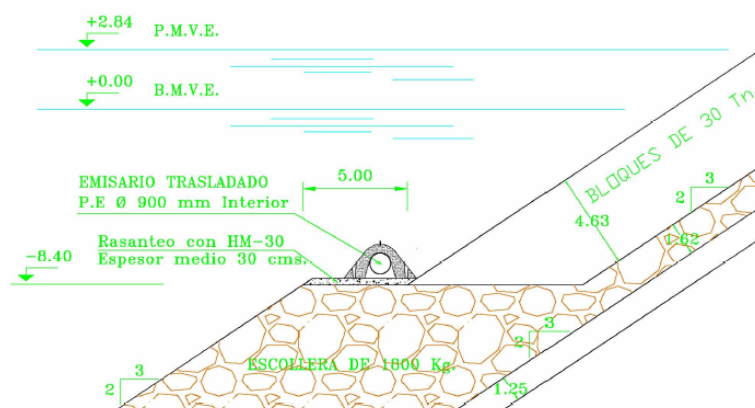


Figure 3. Typical section of the outfall in the original project

Once all of the disadvantages this project would generate were considered and after a combined effort between FCC Construcción, its Technical Services and INCREA, this consulting company finally drew up a project which included significant improvements.

The aim of the proposal by the FCC Technical Department and INCREA was to make the pipe run onshore as much as possible. For this purpose, the pipeline route was situated in the port esplanade until it reached the external area of the port at significant depths. This way, the execution process of this part of the outfall was simpler and did not depend on the sea condition. The outfall was led into open-sea through a caisson of the vertical breakwater at a considerable depth (-15m). The position and design of the diffuser section were not modified so as not to alter the discharge conditions which had already been heavily studied.

This solution offered the following advantages, among others:

- Less offshore length which meant:
 - Easier construction
 - Greater pipe security in the installation and service phase
 - A lower number of ballast weights
 - Less maintenance
 - A lower cost
- Avoiding a transition zone: significant depths are reached from the very start (-15 m).
- Secondary ballast weights are eliminated and only used in the first phase, which reduces the number of offshore operations.
- A shallow onshore trench.
- A lower total length.

Uniqueness of the project - surge tank under the crown wall

The uniqueness of the project lies in using a cell from the breakwater caisson as an outlet chamber. (See figure 4).

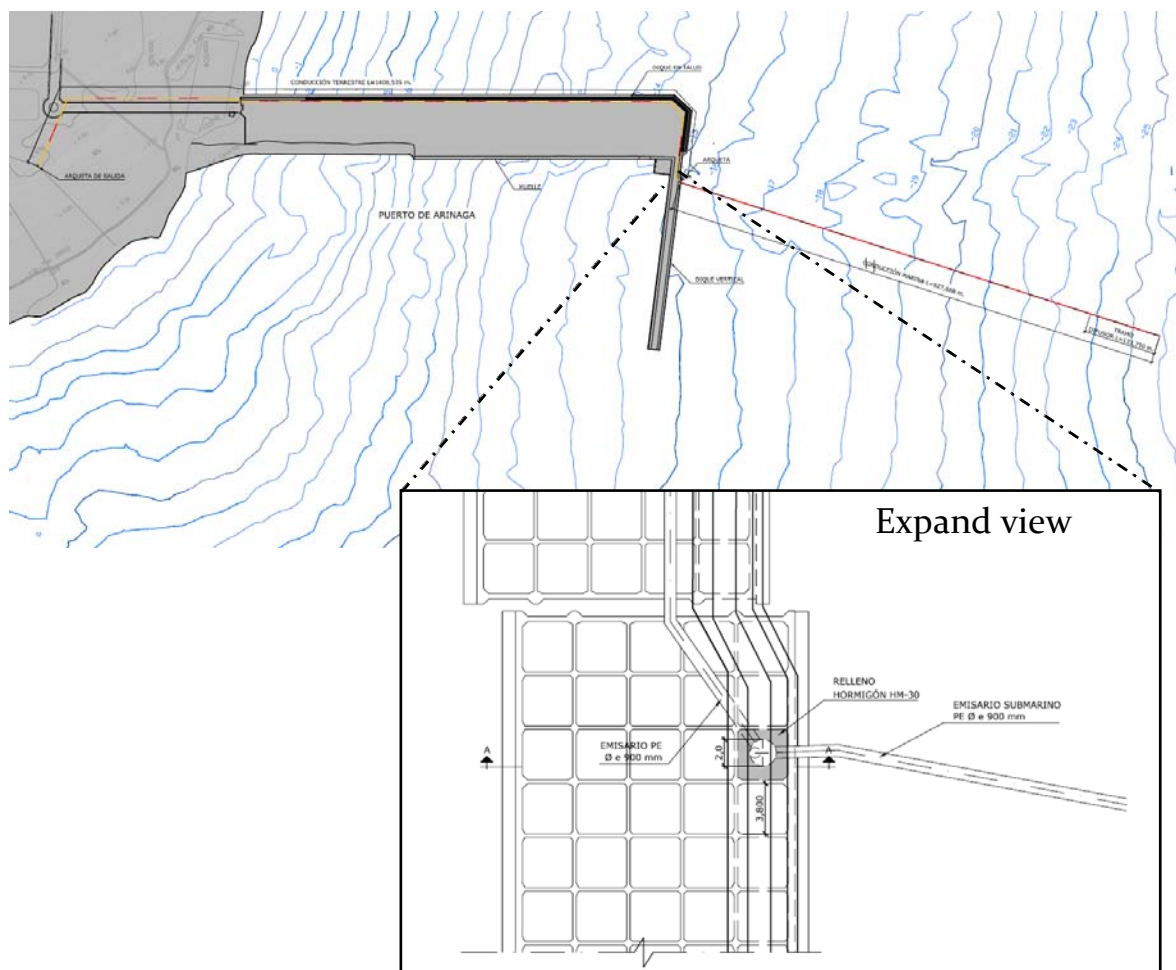


Figure 4. Typical section of the outfall in the original project

Onshore, the pipeline had a very small slope and was situated in a very shallow trench in order to need less excavation when creating trenches, less disturbance to the surface of the port and a small quantity of demolishing of caisson cells. Thus, the first part of the outfall operates as a free surface flow most of the time, making it compulsory to install venting valves all along the pipeline which would eliminate any clogged air.

Temporarily dismantling of the crown wall was necessary for the construction work and allowed for access to the cell closest to the sea. Upon rebuilding the crown wall, a vented manhole was integrated into the structure allowing air to escape easily (as seen in the following figure).

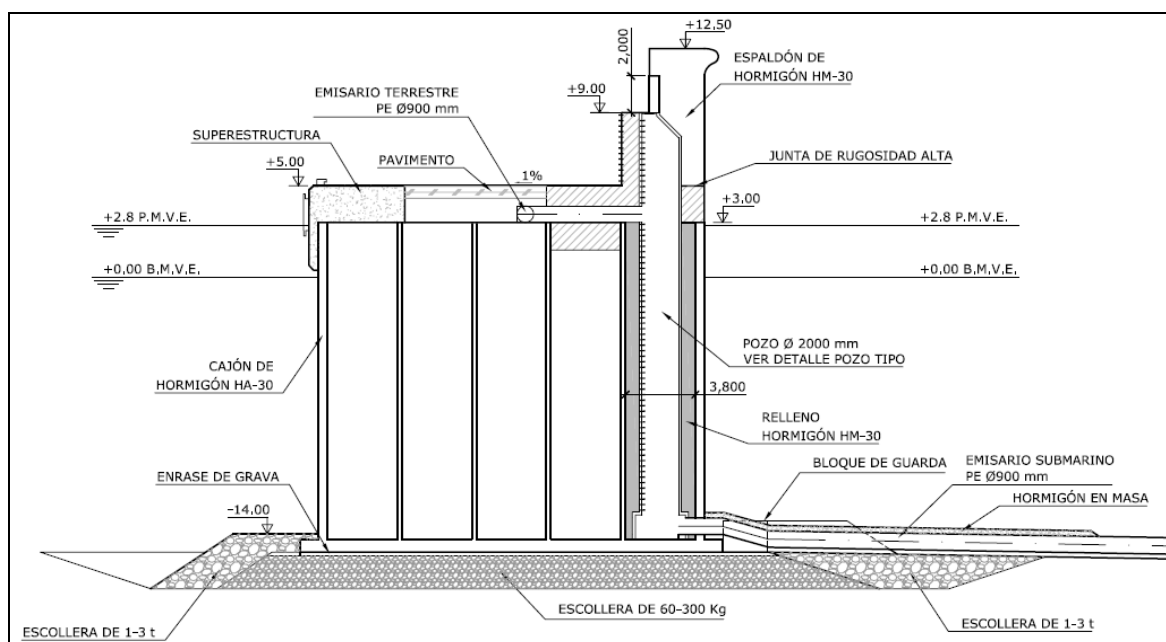


Figure 5. Typical section of submarine outfall caisson, chamber and outflow

Outfall construction

The pipe was protected with concrete in low-covered areas onshore. This section was executed with due caution without causing any additional problems. The most delicate part completed using onshore resources was demolishing the crown wall and creating the surge tank in the cell. These actions were carried out with due caution. A backhoe with a long arm was initially used to empty the caisson cell, but the results were very limited. A bivalve crane was later used with much better results.



Photograph 1: Start of the demolition of the breakwater crown wall



Photograph 2 Excavation of the caisson chamber

One of the most complex jobs was opening the caisson cell in the submerged area to create a sea exit into for the underwater pipe. The crown wall protection blocs had been previously removed. This task was done with specialised divers. The cell was perforated 2x2 m. A photograph is shown below.



Photograph 3: Caisson perforation in the submerged area

The pipe was welded at facilities on the port and it was stored there. Despite this, two storms occurred while the pipe was being stored at the port which damaged it. One of the sections even sunk to the seabed and; therefore, the pipe had to be refloated and repaired, removing all of the existing ballast weights. Despite these disadvantages, the polyethylene proved to be a very suitable material as it is resistant and adapts to the construction requirements.



Photograph 4: Sinking the outfall

The process of taking the pipes to their final position was done via controlled sinking and progressive flooding. With this process, all of the phases the pipe must go through must be adequately calculated in order to guarantee its structural resistance.



Photograph 5: Positioning the outfall for sinking

The delicate process of sinking the pipe and connecting it to the intake caisson was successfully completed thanks to the Increa's careful calculations and the construction personnel's great skill. The project was completed to the customer's full satisfaction and with good understanding and coordination between the parties involved.