



Port Infrastructure

Port of Gijón Expansion. Asturias.

MONOGRAPH





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Port installations at Punta Langosteira. A Coruña.



Port
Infrastructure

Introduction

SATO

OHLA is one of the largest international construction and concession groups. It has over a hundred years of experience and an important presence in more than 30 countries across the five continents. It is positioned as one of the largest investors and operators in the transportation infrastructure market and is a leading worldwide contractor.

OHLA has focused on international port projects from the very start. The Alcántara Inner Basin, in the Port of Lisbon, and the West Pier of the Port of Santos, also in Lisbon, were the first contracts awarded to its parent company, Obrascón, in 1912.

The company has maintained its position as a leader in the port infrastructure area through its subsidiary Sociedad Anónima Trabajos y Obras (SATO), which was established in 1935 and which has distinguished itself from the very beginning for its level of specialization.

This, in combination with its strong tradition and dedication to maritime construction, explains SATO's participation in the execution of some of the most technically-challenging projects with the largest budgets that have been carried out in recent years in different ports around Spain.

Since its creation, the company, thanks to its prominent position in the port sector, has executed more than 500 projects in this area totaling:

- More than 30 km of seawalls.
- Close to 30 km of piers.
- 1,000 concrete caissons.
- 20 million cubic meters of concrete in caissons, blocks, and super-structures.
- More than 60 million cubic meters of dredging and
- 40 million cubic meters of filling.







Port of Gijón Expansion. Asturias.



Port installations at Punta Langosteira. A Coruña.



PORT OF GIJÓN EXPANSION

Gijón Port Authority (2005 - 2011)
Budget: 836.4 million €

Construction of a new basin, protecting 145 Ha of water with the creation 140 Ha of new land.

As a summary, the works required:

- 3,793 m of seawall, made up of:
 - 1,433 m Torres Breakwater (rubble mound type)
 - 1,566 m North Breakwater (vertical type)
 - 798 m secondary breakwater
- 1,365 m of pier with a draft of 23 m
- 1,650 m of inner embankments in enclosure esplanade

Principal project units:

- 22,365,000 m³ dredging
- 1,562,000 m³ quarry stones up to 3t
- 117,600 concrete block ≤ 90 t
- 4,060 blocks ≥ 145 t
- 483,214 m³ concrete in caissons (70 units)

NEW INSTALLATIONS AT PUNTA LANGOSTEIRA

A Coruña Port Authority (2005 - 2011)
Budget: 703.7 million €

Construction of a new commercial port in the waters of the Atlantic, with the creation of 150 Ha of esplanades and a basin with 232 Ha of protected water.

All together, the works required:

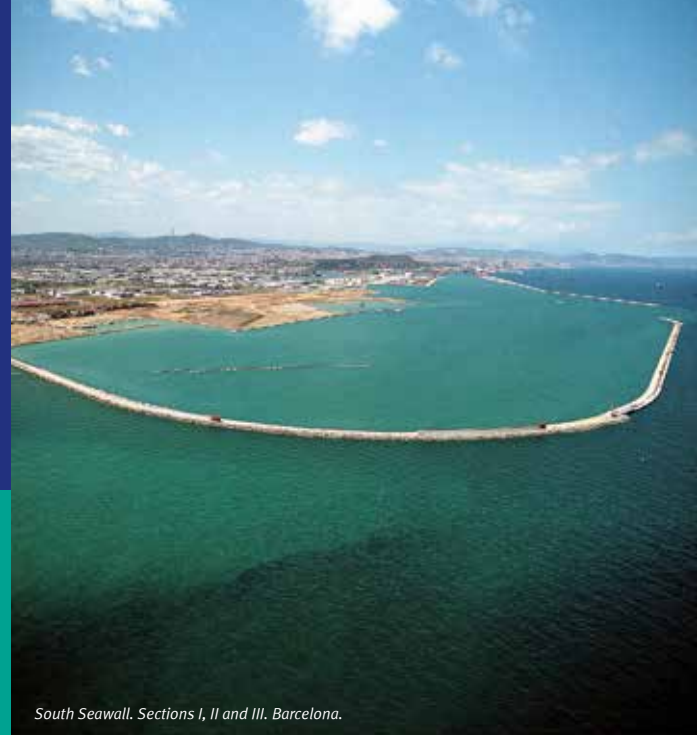
- 3,358 m of rubble mound breakwater
- 532 m of secondary rubble mound
- 461 m of spur breakwater with caissons at a draft of -23 m
- 908 m of quay with caissons with a draft of 22 m

Principal project units:

- 18,600,000 m³ of quarry run
- 16,200,000 m³ of fill in esplanades
- 3,700,000 t of quarry stones ≤ 2 t
- 1,100,000 t of quarry stones ≥ 3 t
- 3,500,000 m³ of concrete
- 148,500 concrete block ≤ 90 t
- 22,700 blocks ≥ 150 t
- 38 reinforced-concrete caissons



Reinforcement of the Punta Lucero Breakwater, Bilbao.



South Seawall. Sections I, II and III. Barcelona.

REINFORCEMENT OF THE PUNTA LUCERO BREAKWATER

Bilbao Port Authority (1980 - 1985)
Budget: 65.1 million €

Height increased of the crown wall and reinforcing of the outer breakwater of the port of Bilbao, along its entire length of 2,400 m.

Principal project units:

- 1,315.00 m³ quarry run up to 4 t
- 9,450 stone quarry weighing 14 t
- 15,700 stone blocks weighing 20 t
- 500 blocks concrete weighing 85 t
- 9,800 blocks concrete weighing 150 t
- 410,000 m³ of concrete in the elevation of the crown wall

SOUTH BREAKWATER. SECTION I, II and III

Barcelona Port Authority (2001 - 2008)
Budget: 316.0 million €

Construction of a new breakwater at the southern end of the Port of Barcelona, with a total length of 4,850 m, and execution of areas for future backfilling covering an area of 58 Ha.

The breakwater is made up of three distinct sections:

- Section I. Rubble mound 2,001 m long
- Section II. Vertical breakwater 1,699 m long
- Section III. Embankment breakwater 1,150 m long

Principal project units:

- 2,850,000 m³ dredging
- 15,000,000 m³ of quarry run
- 4,075,000 t of quarry stones
- 409,000 m³ of concrete in blocks ≤ 60 t
- 50 reinforced-concrete caissons



Port of Alicante Expansion. Alicante.



Large ship berths western piers. Baleares Islands.

PORT OF ALICANTE EXPANSION

Alicante Port Authority (2003 - 2009)
Budget: 156.3 million €

Construction of breakwater works of the Port of Alicante expansion, with the creation of 30 Ha of esplanades (16 Ha completely developed) and 33 Ha of sheltered water. The basin has 3 lines of commercial quays and a ferry berth.

As a summary, the works required:

- 1,127 m of rubble mound
- 442 m of secondary breakwater
- 1,236 m of piers with caissons
- 245 m of ro-ro berth for ferries
- 160,000 m² of paved esplanade
- 1,986 m of railway track

LARGE SHIP BERTHS WESTERN PIERS

Baleares Islands Port Authority (2011 - 2012)
Budget: 39.1 million €

Extension of the western pier with a permeable structure made up of caissons and reinforced-concrete slabs to allow long cruise ships to dock. The existing alignment was extended 50 m and a new alignment 362 m long was constructed.

Principal project units:

- 16,850 m³ dredging
- 133,000 t quarry stones in foundation bed
- 31,487 m³ concrete in caissons (18 units)
- 95,100 m³ of caisson filling
- 15,370 m³ concrete in superstructure and slabs



ISLA VERDE PORT DEVELOPMENT

Algeciras Harbor Port Authority (2000 - 2010)
Budget: 219.1 million €

This port development includes five different actions for the formation of 95 Ha of new port area and 2,250 m of new piers. All of this new area was consolidated using the pre-load procedure with vertical drains to reduce the consolidation time. At the southern end, the embankment that encloses the esplanade was extended by 250 m.

The five actions carried out over the course of 10 years were:

- Phase 1. Esplanade outside the breakwater (in the year 2000)
- Phase 2. 1st Action: Quay adjacent to breakwater (2001/04)
- Phase 2. 2nd Action: Quay, closure dam, and adjacent esplanade (2003/08)
- Phase 3. 3rd Action: Extension southern closure and expansion of esplanade (2007/09)
- Phase 3. 4th Action: Expansion of the esplanade (2008/10)

Main project units in this infrastructure:

- 3,910,000 m³ of dredging on foundation trenches and backfill
- 5,100,000 m³ of material for land backfill
- 1,200,000 m³ of quarry run
- 1,040,000 m³ quarry stones up to 6 t
- 122,600 m³ concrete in quay caissons (33 units)
- 4,206 m³ of piles Ø 1.800 mm in quay formation
- 43,800 m³ concrete in quay superstructure
- 2,282 m gravel columns ground improvement
- 2,450,000 m of vertical drains
- 1,165 m³ accropodes of 6.3 m³



Navío quay. Algeciras.



Vopak maritime terminal. Algeciras.

BREAKWATER ALIGNMENT AND EXPANSION OF THE NAVÍO QUAY IN ALGECIRAS

Algeciras Bay Port Authority (1996 - 1999)
Budget: 47.0 million €

This project included three clearly distinct actions:

- Extension of the seawall by 480 m by constructing and sinking 13 caissons to a depth of -22 m to provide protection for the new piers
- Extension of the existing piers in the Container Terminal, with two alignments of 292 m and 343 m, respectively, as well as the creation of 14.4 Ha of new land at the rear, with the corresponding earth loading consolidation procedure. The piers were extended by sinking 15 caissons to a depth of -16 m
- Dredging, between the depths of -16 m and -18 m, of the new basin, between the extensions of the breakwater and the piers, in an area covering 30 Ha

MARITIME TERMINAL IN THE PORT OF ALGECIRAS

ECOLAIRE ESPAÑA S.A. (2011 - 2012)
Budget: 34.5 million €

Construction of a new Maritime Terminal for loading and unloading hydrocarbons, with two independent berths:

- North Dock.- For ships of up to 225,000 DWT
- South Dock.- For ships of up to 80,000 DWT.

Principal project units:

- 57,000 m³ dredging
- 276,000 m³ of quarry run and quarry stone in foundation bases
- 28,900 m³ concrete in caissons (11 units)
- 7,015 m³ of concrete in superstructures
- 135 m of bridge for vehicle access
- 95 m of pedestrian walkway



Port Development Ría de Avilés. Avilés.



Expansion of the Puerto de la Estaca. Santa Cruz de Tenerife.



Extension of the Reina Sofía Breakwater. Las Palmas.



Marqués de Comillas quay. Cádiz

PORT DEVELOPMENT OF PHASE 2 ON THE RIGHT BANK OF THE RÍA DE AVILÉS

Avilés Port Authority (2010 - 2012)
Budget: 43.4 million €

Construction of a new pile-supported quay 495 m long, with a draft of -14 m, and formation of a 12 Ha esplanade behind it, completely developed.

EXTENSION OF REINA SOFIA BREAKWATER

Las Palmas Port Authority (1991 - 1995)
Budget: 37.1 million €

Extension of the seawall of the Port of Las Palmas by 957 m. The seawall was designed as a vertical breakwater for use as a berth. It is made up of a total of 33 reinforced concrete caissons.

EXPANSION OF THE PUERTO DE LA ESTACA (EL HIERRO ISLAND)

Port Authority of Santa Cruz de Tenerife (2002 - 2006)
Budget: 29.4 million €

Extension of the seawall by 400 m and the creation of a new marina harbor equipped with floating docks for 150 craft. Preparation of 15,000 m² area for port services.

EXPANSION OF THE MARQUÉS DE COMILLAS QUAY

Cádiz Harbor Port Authority (2005 - 2008)
Budget: 31.3 million €

Construction of three new pier alignments (233 m, 203 m, and 116 m), by sinking 22 caissons. Creation of a new esplanade covering 55,800 m² in the area inside these three alignments, with the existing quays and breakwaters.



Ore pier in the Musel Port. Gijón.



Llanes inner Port. Asturias.



Cubipod stockpile in the Port of Málaga.



Príncipe de Asturias breakwater. Gijón.

EXTENSION OF THE ORE PIER IN THE MUSEL PORT

Gijón Port Authority (2000 - 2004)
Budget: 25.6 million €

Extension of the Marcelino León pier by 200 m, which required the removal of the existing secondary breakwater, reconstructing it 255 m from the previous one, with a length of 475 m. A new dock measuring 124 m was built in the area inside the new inner breakwater.

SAN ANDRÉS BASIN AND OUTER BREAKWATER IN THE PORT OF MÁLAGA

Málaga Port Authority (2011 - 2013)
Budget: 16.9 million €

The project consisted of the removal of 200 m of the old eastern breakwater and the construction of the breakwater of the future fishing port (270 m long). The outer surface of this new breakwater is made up of 6t and 15t cubipods. An esplanade was created behind the breakwater, covering

13,300 m² and the first 100 m of the future Fishing Pier were built.

CONDITIONING OF THE LLANES INNER PORT

Asturias. Department for Development, Territorial organization, and the Environment (2010 - 2011)
Budget: 4.4 million €

Construction of a gate to protect against storms to guarantee the berthing in the inner harbor and the installation of new moorings throughout the inner harbor.

RESTORATION OF THE SLOPES OF THE PRÍNCIPE DE ASTURIAS BREAKWATER

Gijón Port Authority (1993 - 1996)
Budget: 10.0 million €

Reinforcement of the outer surface of the Príncipe de Asturias breakwater with 90 and 120 t blocks along its final 1,120 m.

Outfalls

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Berria outfall. Cantabria.



Berria outfall of the Baix de Llobregat water treatment plant.



Besos outfall. Barcelona.



BERRIA OUTFALL

Hydrographic Confederation of the North (2005 - 2008)
Budget: 25.6 million €

Execution of a principal outfall 3,525 m long, of which, the first 505 m were jacked (to the level of -10m), with the remaining 3,020 m corresponding to the underwater section (to a depth of -35 m). The final section is equipped with 20 diffusers for effluent discharge. The emergency outfall, 505 m long, runs parallel to the principal outfall in the entire jacked section.

OHLA was recognized for this project with the European Environmental Award to a Company in the Spanish Section, 2009-2010, making it the leading technical reference in the Group in the construction of underwater projects.

This award-winning project was the first to be received by a Spanish construction company due to its unique construction development.

OUTFALL OF THE BAIX DE LLOBREGAT WATER TREATMENT PLANT

Water Treatment Plant of Baix de Llobregat, S.A.
(2000 - 2002)
Budget: 28.1 million €

Construction of an outfall 3,770 m long to discharge the effluents from the Baix de Llobregat WWTP, with a land section 570 m long and an underwater section 3,200 m long, which discharges at a depth of -60 m. The outfall was constructed using reinforced-concrete pipe with a sheet-metal liner, with an interior \varnothing of 2.40 m.

BESOS OUTFALL

Empresa Metropolitana de Sanejament, S.A. (1994 - 1995)
Budget: 31.1 million €

Construction of a pumping station and outfall 3,302 m long to discharge effluents from the Besos WWTP. The outfall is constructed with reinforced-concrete pipe with a sheet metal liner and interior \varnothing of 2.10 m, installed by towing from a pontoon. The outfall has a discharge capacity of 12.4 m³/s.





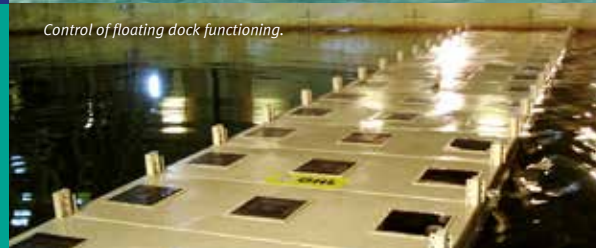
SATOGrab clamp.



Computerized maritime project management. Caisson.



Research on floating dock.



Control of floating dock functioning.

TECHNOLOGICAL DEVELOPMENTS FOR THE CONSTRUCTION OF MARITIME PROJECTS

The company considers R&D&I activities as one of the fundamental pillars of its strategy due to its contribution to increased productivity and competitiveness.

Throughout its history, SATO has considered the use of technology in its construction processes to be a priority, and it has applied innovations and taken on challenges at the highest technological levels, making it a leading reference in the area of maritime works, solving someones with great success thanks to the application of specific technological developments.

The work done in recent years has been focused on the following areas:

- Computerized and online geometric control and management of the execution of maritime works
- Cubipod. A new armour element for the construction of breakwater
- Floating dock. Research on design and application
- SATOGrab. Recovery of blocks in seawalls

- New floating dock for caisson fabrication. Control and optimization of functioning:
- Sinking caissons process in unprotected waters. Limits of viability
- Armour stability in breakwaters based on ocean climate
- Platform for monitoring the life-cycle of maritime work

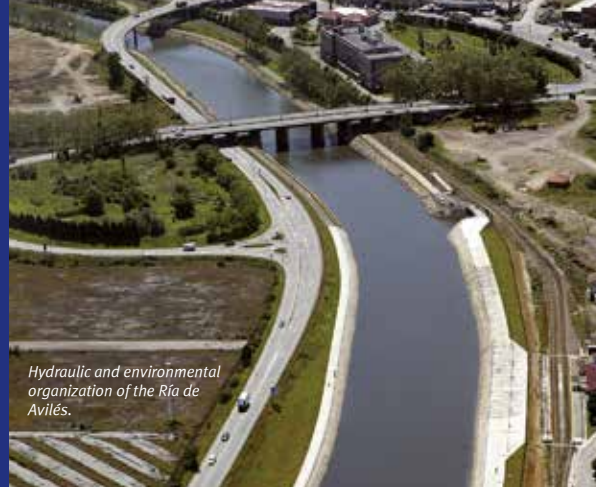
The company's well-known R&D&I work has received important recognition. These include the ones received at the International Exhibition of Inventions of Geneva (2011), where SATO received the gold medal in the construction division with honorable mention for the Cubipod, and the silver medal for the SATOGrab clamp, as well as the award for the best Spanish invention.

Also, the Málaga Port Authority in Spain received the National Innovation Award (2011) from the Ministry of Science and Innovation for carrying out the first application of the Cubipod in a project.





Construction of the Roda de Bara marina. Tarragona.



Hydraulic and environmental organization of the Ría de Avilés.



Improvement and conditioning of the Port of Chipiona. Cádiz.



Poniente Beach Nourishment. Gijón.

Other
References

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WALKWAY ON SCENIC OVERLOOK ON THE LEVANTE BREAKWATER

Alicante Port Authority (2008)
Budget: 2.3 million €

Construction of an elevated walkway-over the Levante breakwater, 370 m long.

CONSTRUCTION OF THE RODA DE BARA MARINA

Nova Dársena Esportiva de Bara, S.A. (2006 - 2008)
Budget: 37.0 million €

Construction of a new Marina to house 647 moorings, with all of the necessary services for proper operation.

IMPROVEMENT AND CONDITIONING OF THE PORT OF CHIPIONA

Regional Government of Andalusia. Department of Public Works and Transportation (1991 - 1993)
Budget: 12.5 million €

Construction of a new Marina to house 350 moorings, with all of the necessary services for proper operation.

HYDRAULIC AND ENVIRONMENTAL ORGANIZATION OF THE RÍA DE AVILÉS

Asturias. Department of Development, Territorial Organization, and the Environment (2003 - 2005)
Budget: 11.2 million €

Channeling of the Avilés river in a section approximately 1,900 m long and treatment of the extracted contaminated sludge.

PONIENTE BEACH NOURISHMENT

Gijón Port Authority (1993 - 1995)
Budget: 12.5 million €

Poniente and Arbeyal beaches Nourishment, and construction of a seaside walkway 650 m long.





Sato Levante floating dock and SATO Esparteña. Pontoon.



SATO Baleares Hopper Barge.

Machinery



SATO Galicia Hopper Barge.



SATO Algeciras Pontoon.

SATO LEVANTE FLOATING DOCK

Total length	60.0 m
Width of alignment (ext.)	43.2 m
Interior width	36.0 m
Pontoon deck height	4.4 m

CAISSON PONTOON SATO ASTURIAS

Length	35.0 m
Width	25.0 m
Height	2.5 m

HOPPER BARGES

· SATO GALICIA	1.000 m ³ hopper capacity
· SATO TENERIFE	704 m ³ hopper capacity
· SATO GRAN CANARIA	704 m ³ hopper capacity
· SATO BALEARES	600 m ³ hopper capacity
· CESEA V	250 m ³ hopper capacity

PONTONAS

· SATO ALGECIRAS (self-propelled)	34.0 m x 27.0 m
· EMILITA (self-propelled)	32.0 m x 9.0 m
· MARILEN (self-propelled)	32.0 m x 9.0 m
· SATO ESPARTEÑA	58.0 m x 16.0 m
· SATO PERDIGUERA	58.0 m x 16.0 m

OTROS EQUIPOS

- A. GAUDÍ TUGBOAT 30 t towing capacity
- SATO CANTABRIA MULTIPURPOSE VESSEL 20.1 m x 8.0 m
- BARLOVENTO DREDGE 280 m³ hopper capacity
- SUPPORT SHIPS
- LIEBHERR HS 895 DH 200 t CRANE
- LINK BELT 75 t CRANE
- MANTSINEN 100 t BACKHOE
- CLAWS FOR QUARRY STONE HANDLING
- CLAWS FOR BLOCKS HANDLING



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