
ENGINEERING DESIGN **PUERTO SAN ANTONIO** OUTER HARBOR PROJECT



Puerto de Chile
Puerto de Todos



PROJECT DESIGN DATA DESIGN CRITERIA: BREAKWATER

Seismic design:
9.0 Richter scale.

Wave height:
8,5 m.

Return Period:
475 years.

Rise due to Climate Change:
30 cm average sea level.

DESIGN VESSEL CLASS E

Length:
397,7 m.

Beam:
56,4 m.

Draft:
15,5 m.

Capacity:
14.700 TEU.



SUMMARY OF OUTER HARBOUR WORKS PHASE 0. INVITATION FOR COMPANIES STATING INTEREST IN PARTICIPATING

Common works: Considers the set of works to be developed by Puerto San Antonio as traditional public works, consisting in works within common areas which will be used by both terminal concessionaires.

Design Criteria: A seismic design criteria of 9.0 magnitude with epicenter in the vicinity of the port was considered for the entire project. A considerable **wave height** of 8.5 with an equivalent return period of 475 was established for ocean waves. Under these design conditions, less than 10% damage is predicted for such events. The **design vessel** is an E-Class container ship with a length of 397.7 m, a beam of 56.4 m, a draft of 15.5 m and a capacity of 14,700 TEUs. The **climate change** criteria applied for the project considers the condition of 30 cm average sea level rise, according with a pessimistic scenario (RCP8.5) as determined by IPCC (Intergovernmental Panel on Climate Change) for year 2065.

Breakwater: The main works of the project consist of the construction of a breakwater approximately 4,000 m long, with a variable height, ranging from +4.4 m NRS to +5.5 m NRS, a variable width (measured at the base of the breakwater) of approximately 100 m to 200 m and a depth that will depend on the section of the breakwater with an average of ~20 m, beginning at beach level (with capital dredging down to 6 m in depth), up to approximately -40 m NRS depth in the section near the head section. It also considers the construction of a concrete **parapet wall**

along its entire length, the geometry of which changes as the breakwater advances towards deeper waters, having an upper elevation varying from +6.5 m NRS to +12.85 m NRS. For the construction of the breakwater, it is necessary to extract rock material from **two quarries** located in the San Juan sector (Javer and Román). Approximately 16 MM m³ of rock will have to be extracted and transported for the construction of the breakwater and enclosing rockfill, which will be hauled from the quarries to the port by means of a combined transport solution of trucks and rail. In addition, the breakwater needs protective armor, consisting of **concrete cubes** of different tonnages per unit (10, 40, 50, 60 and 80 tons). Approximately 42,250 cube units are required in total, which means an amount of approximately 665,300 m³ of concrete. These cubes are placed on the side of the slope exposed to the waves and are essential for providing stability to the structure against the hydraulic stress of the waves.

General dredging: The purpose of these works is to deepen the seabed of the maneuvering areas where vessels will make use of the berthing fronts of the port. The dredging will be executed in different areas, namely, the access channel, turning basin and dock.

BREAKWATER

Length:
4 km.

Maximum width:
200 m.

Maximum depth:
-40 m NRS.

Maximum Height:
5,5 m NRS.

PARAPET WALL

Height 6,5 – 12,8 m NRS.

CONCRETE CUBES

42.000 units.
665.300 m³ of concrete.

BREAKWATER

16.0 millones de m³ of material.
14.8 millones de m³ of core.
1.2 millones de m³ for rockfill.



The **access channel** is the navigation area through which the ships will enter and exit the dock, including an area of 50 ha and a depth to be dredged of -24 m NRS. The **turning basin** is a circle of 800 m in diameter (approximately 50.25 ha) and is located at the port opening area, allowing the turning maneuvers and entry of the ships to the berthing fronts. This area should be dredged to a depth of -18.5 m NRS.

The **dock** is approximately 1,730 m long by 450 m wide (approximately 77.9 ha) and will correspond to the sheltered part of the port sector, with facilities enabled for the berthing, undocking and stay of ships. The minimum depth of the dock shall be -18.5 m NRS. In total, an approximate amount of 10.5 MM m³ of general dredged material is considered, which will be 100% used as part of the backfill for the esplanades of Terminals 1 and 2. One hundred percent of the general dredging material will be used for the project's rock filling requirements.

Preliminary Dredging: These works correspond to necessary dredging for the construction of the breakwater and enclosing rock wall, which are required as part of the improvement of the rockfill foundation. Dredging considered for this purpose involves a variable depth between 3 m and 6 m from the seabed, from where it begins to be filled with rock material, according with design profiles. It is estimated that an approximate quantity of 5.5 MM m³ will be extracted. The use of 100% of the material from the preliminary dredging is considered for the project's backfilling requirements.

Enclosing Rockwall: Simultaneously with

the construction of the breakwater, approximately 3.1 MM m³ of rock is required to build the enclosing rock wall, forming enclosures that will be filled with dredged material and on which the future esplanades of the port terminals will be built.

Port Esplanades: The port terminals will be built by means of enclosures that will be filled with material from both general dredging and preliminary dredging. The edges of these enclosures will correspond to the works of the breakwater and enclosing rock wall. A requirement of 17.4 MM m³ of backfilling material for dredging purposes has been estimated. On the enclosures filled in the previous phase, the concessionaires of the port terminals must execute treatment of the soil to build the port esplanades and pavements, considering foundations to operate the port equipment.

The esplanade of Terminal TS1 (on the ocean side) has an average width of 443.5 m and an average length of 1,962.5 m. The esplanade of Terminal TS2 (land side) has an average width of 388.5 m and an average length of 2,000 m.

Breakwater Pedestrian Walkway: With the purpose of integrating the port and city of San Antonio, the project includes an urban development of the starting section of the breakwater on the parapet wall, to enable a low-traffic pedestrian walkway equipped with terraces, observation windows and explanatory milestones of the works, port activity, and the environment, in an approximate length for 1,500 m from the beginning of the breakwater to the bend section.

Road and Rail Access within the Port Area:

These works correspond to connectivity solutions for the port terminals within the port's common areas. These are designed as the connection between solutions developed by the Ministry of Public Works (MOP) and the State Railway Company (EFE) at the entrance to the port area with the access area to the terminals. The road access

includes 2 tracks in each direction, while the railway access considers a double-track solution for 1,250 m long trains with double-stowage railcars.

GIS electrical substation: Lastly, the installation of a GIS type electrical substation for electrical supply to the port terminals is included in this set of works.

CONSTRUCTION WORKS:

FOR THE EXECUTION OF THE COMMON WORKS DESCRIBED ABOVE, THE CONSTRUCTION OF A SERIES OF PREVIOUS WORKS IS REQUIRED TO ENABLE THE DEVELOPMENT OF THE WORKSITE FACILITIES. AS FOLLOWS EACH OF THESE WORKS ARE DESCRIBED.

Railway Unloading Station: Considers two approximately 580 m long tracks (unloading sector) for the unloading of material from the railway to the areas by means of overturning carts. Front-end loaders will be available for material distribution at the stacking sites of the worksite facilities.

Installation of Main Work Facilities: Considers the installation of facilities required for the construction of common works and will be located around the protected area of Lagunas de Lollole, fitted with protection elements for the ecosystem of lagoons, such as acoustic screening, rainwater evacuation system, fauna crossings, etc. It will include temporary facilities, buildings, road and rail connections, and material storage areas, which will be used to support the construction of the different phases of the

port.

Concrete Plant: The concrete plant is an ancillary facility located in the main work site, which will exclusively service the execution of construction works (concrete cubes, parapet wall, etc.) and PE's operational growth (pier slabs, retaining walls, etc.). It considers an aggregate material collection sites and water and cement supplies. With the purpose of feeding the sites, a transfer area in which the trucks will deposit classified material per size has been considered, whilst a front-end loader will transport the material to the corresponding site. With regards of the concrete plant, two plants of 150 m³/h each will be installed, which effective joint production guarantees maintaining a net production of 180 m³/h (0.6x300 m³/h) to meet the required production level (1,440 m³/day).



Quarries: For the construction of the breakwater, rock material must be extracted from two quarries located in the San Juan sector (Javer and Román). During the construction phase, approximately 16 MM m³ of rock will be extracted and transported for the construction of the breakwater and enclosing rock-work, and approximately 5.5 MM m³ is considered for the operation phases (construction of slopes, piers and rock-fill). These will have areas for worksite facilities and areas for material stocking during the exploitation activities. The extracted materials will be transported to the port by means of a mix solution of trucks and rail, requiring road and rail connectivity for transportation logistics of material from the quarries towards the port.

Railway Transfer Station: It considers a station allowing material transfer from the quarries via rail to the Outer Harbor. It is an area of approximately 6.75 hectares for the installation of 4 train tracks approximately 400 m long. In addition, it considers inner roads which will allow the trucks to unload the material, to be further loaded on the train by means of overturning and front-end loaders.

Quarries Connecting Road: The quarries will be connected to the transfer station via the R-66 Route (known as the Fruit Route), currently under construction. Construction of new roads to enter and exit Rout R-66 has been considered.

OTHER WORKS: The development of parks and sports areas, as well as other items related to environmental and citizen commitments, are foreseen.

PHASES 1 AND 2. PORT CONCESSIONS PORT TERMINAL WORKS

Docks: These correspond to the structures where the ships will dock and loading and unloading of containers will be executed. The Outer Harbor considers the construction of 2 docks, one for each terminal, approximately 1,730 m long and 41 m wide each, equivalent to a total area of approximately 14 ha. Each pier consists of a reinforced concrete platform (slab), in an approximate height of. +4.83 m NRS. This slab is approximately 35 cm thick and 1,730 m long by 41 m wide, supported by steel piles of 1.2 m in diameter and variable lengths between 33 m and 42 m, distributed in a sequence of three and five alternating piles and separated by 3.75 m between axes.

Equipment: Each terminal includes electrical equipment with 17 STS cranes, 88 semi-automatic ASC cranes, 5 RMG cranes for the railway terminal, in addition to 48 Shuttle Carriers and 20 Terminal Trucks.

Buildings: Operational Buildings, Customs, SAG (Spanish acronym for the Agricultural and Livestock Service), etc.



SCHEDULE

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	
Construction Works					Construction of Enabling Works											
Protection (sheltering) Works							Construction of Breakwater and Dredging									
Sea Terminal												Construction of Sea Terminal START of Operation SEPT 2036				

PROJECT GENERAL LAYOUT



PUERTO EXTERIOR

Necesario y Sostenible



PUERTO
SAN
ANTONIO

Puerto de Chile
Puerto de Todos

