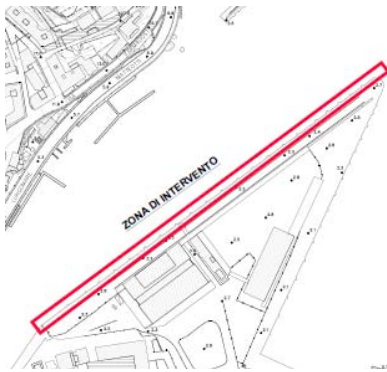


## Technical and economic feasibility Project for the deepening of “8-9-10” Cruise Terminal Quay at Savona Harbor (Savona - Italy)

### General data

- ✓ *Years: 2016*
- ✓ *Customer: Harbor Authority of Savona (APS)*
- ✓ *Works value: € 6.802.200*

*Project of technical and economic feasibility of deepening “8-9-10” dock in Savona Harbor for berthing cruise adjustment - APS Project n. 720*



Works area in Savona Harbor in correspondence of Berths 8-9-10 currently dedicated to Cruising traffic. Current sea bottom at -9.0 m will be deepened to -11.0 m

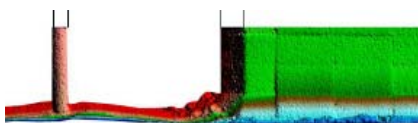


Image from the bathymetric survey in correspondence of 8-9 berths



View of the current 8-9-10 berths

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### Characteristics of the works

Savona Basin currently allows the berthing of cruise ships in n. 3 berths, of which the principal is the quay called “8-9-10”, adjacent to Palacrociere. As is also the case for other types of vessels, larger ships than those currently in service are under construction, or design and which require deeper waters to operate.

In order to maintain the cruise traffic also for the future and, if possible, to increase it, it is therefore necessary to deepen the seabed in front of the quay 8-9-10, in order to ensure a greater operational functionality and also reduce costs of maintenance. The present project has for objective the identification of a technical solution to deepen 8-9-10 dock, so that it could be compatible with the required capacity, reduce as much as possible the time for work execution and, at the same time, is sustainable from the economic and environmental points of view. The current quay “8-9-10” is in total about 435 m long and it is composed by parts built at different times with different technological solutions.

In particular, sections 9-10 measure in total approximately 350 m and consist of big conglomerate blocks based at about -9.0 m; the superstructure top surface is to about 2.2-2.3 m. The basic block is 6 m long with a front bracket of 1 m, to improve the stability of the overall dock.

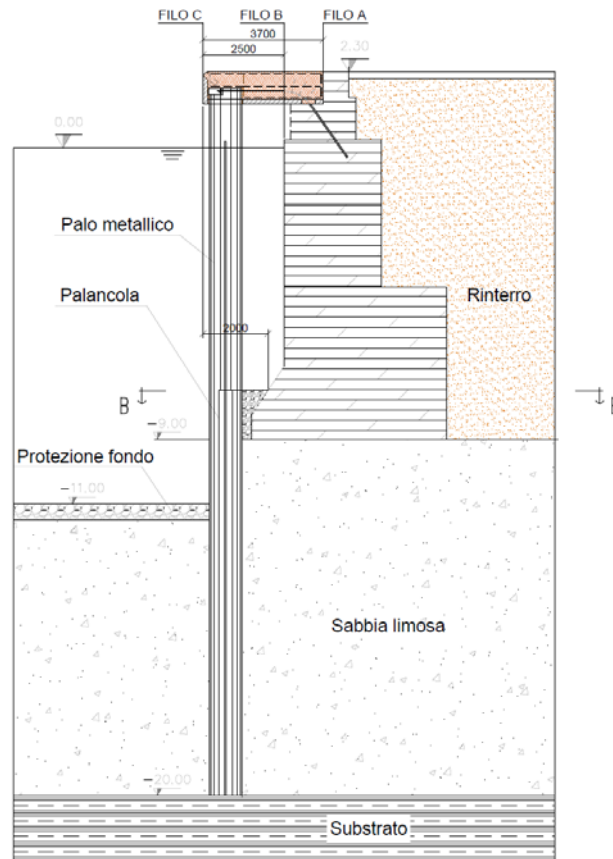
For the final selection of the technical solution to be adopted for the deepening of the dock, some alternatives have been analyzed and compared, including:

- a) the use of piles through the concrete blocks to increase quay stability and to improve the geotechnical characteristics of the foundation ground;
- b) vibro piling of a combined wall (composed of piles and sheet piles) with local soil improvement in front of the quay, by the use of interconnected columns of jet grouting;
- c) vibro piling of a combined wall (composed of piles and sheet piles) connected to the quay superstructure at its top; the edge of the current superstructure will be suitably re-profiled by controlled demolition and additional reinforced concrete castings.

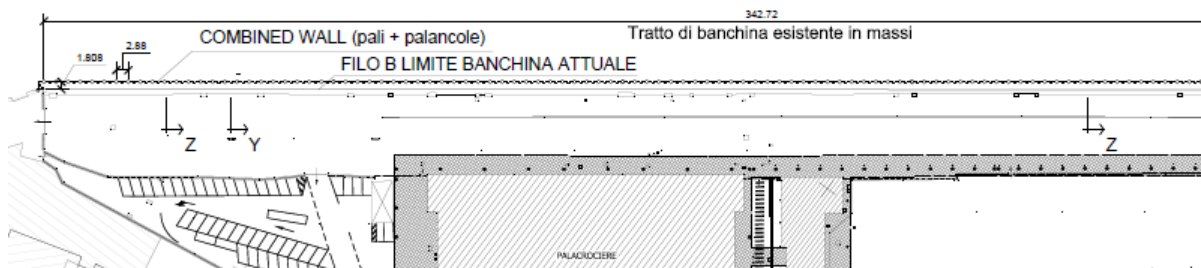
The final selection (see figures on next page) has been formulated on the basis of the following viewpoints:

- Operational / realization
- Structural Efficiency
- Durability
- Economy
- Execution Times
- Environmental impacts

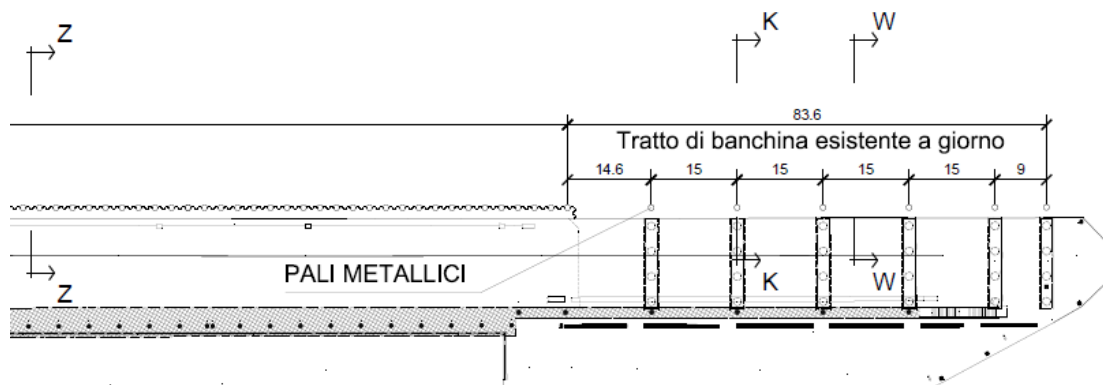
Solution c) is adopted since, in addition to ensuring satisfactory performance from a structural point of view and of the durability, it is more economical, simple and faster to be built, and definitely with less impact on the environment. The preliminary structural analysis of the different solutions was performed with special programs dedicated to geotechnical applications, such as Paratie Plus (Harpaceas), and FEM codes (SAP2000) able to model structural elements and with elastic-plastic soil behavior (Mohr-Coulomb, Drucker-Prager).



Typical cross section of the quay with deepening from -9.0 m to -11.0 m bottom protection consisting of concrete guardian blocks and stone quarry



Plan of the deepened quay – Berths 10-9



Plan of the deepened quay – Berth 8