



Baby MOSE protects Chioggia against floods

The Ministry of the infrastructure and interregional transport authority of Veneto Trentino Alto Adige – Friuli Venezia Giulia - in cooperation with the New Venice Consortium is finalizing the mobile barriers at the mouth of the port to protect the environment and the lagoon towns from flooding. The barriers have been built to separate Venice and its lagoons from the sea in the event of high tide alerts. To optimize and improve barrier flexibility and management other protection projects have been deployed to protect local historical town centres from frequent flooding. One example of this is a project called BabyMOSE which has been deployed in Chioggia using the Movicon automation and supervision software engineered by Studio A&S run by Engineer Adriano Angelini.

To protect Venice and other lagoon habitats from floods a row of hidden mobile floodgates are being built at the mouth of the port (inlets

that connect the lagoon to the open sea through which the sea flows to and from Lido, Malamocco and Chioggia) that can

temporarily isolate the Venice lagoon from the Adriatic sea during the event of high tides. The New Venetian Consortium, which is comprised of major Italian construction companies, cooperatives and local companies, was delegated by the **Ministry of Infrastructure and Interregional Transport Authority for the Public works of Veneto – Trentino Alto Adige – Friuli Venezia Giulia**, to realize these interventions in compliance with the 798/84 state intervention legislation act to protect Venice and the lagoon. It involves a vast program of defence activities that has been in operation for some years to protect built-up areas and the lagoon ecosystem against floods and coastal storms. The **Baby MOSE project for Chioggia**, the subject of this article and part of a bigger MOSE project, consists of an autonomous system whose mission is to protect the built-up areas of Chioggia from flooding. Recently completed and now in operation, this system is comprised of two mobile barriers positioned at both the far ends of the Vena Canal running through Chioggia. It takes just a few minutes to raise the barriers to an upright position in order to protect the city centre from floods



1. The mobile floodgate in operation at the Port of Vigo

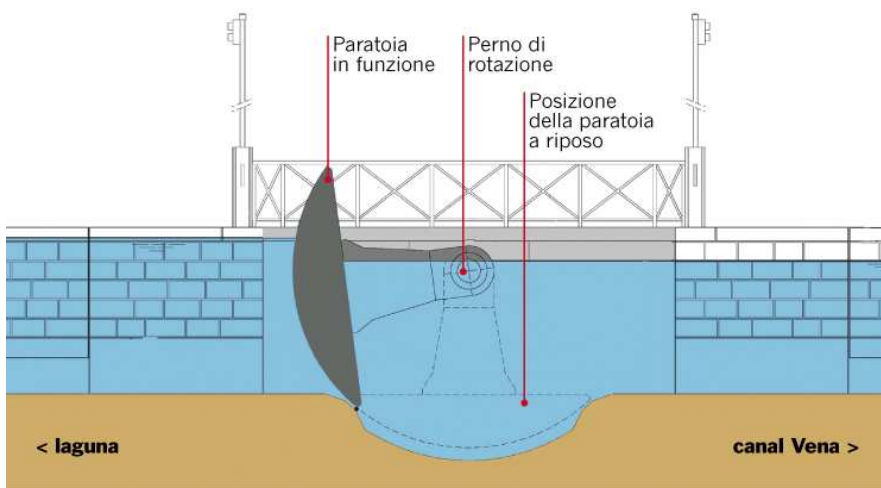
due to frequent high water levels. Baby MOSE is able to protect Chioggia from tides of up to 130 cm together with the help of reinforced canal banks and surrounding built-up areas accomplished a while ago as part of the defence program.

What is the Baby MOSE?

The New Venice Consortium, in liason with **Cantieri Costruzione Cemento SpA** a construction company and Studio A&S, who are a group of design engineers based in Rimini operating who have been operating in machine and process automation and

supervision sector for more than 15 years. And who have greatly contributed to realizing this important and innovative and Geo-Engineer project.

As part of the MOSE intervention program the banks along the Vena Canal in Chioggia have undergone reconstruction and made water proof. Also two independently managed rotating floodgate barriers at Vigo and Santa Maria in the Vena Canal have been installed in correspondence to the "BabyMOSE project.



2. A functional diagram of the Chioggia floodgates

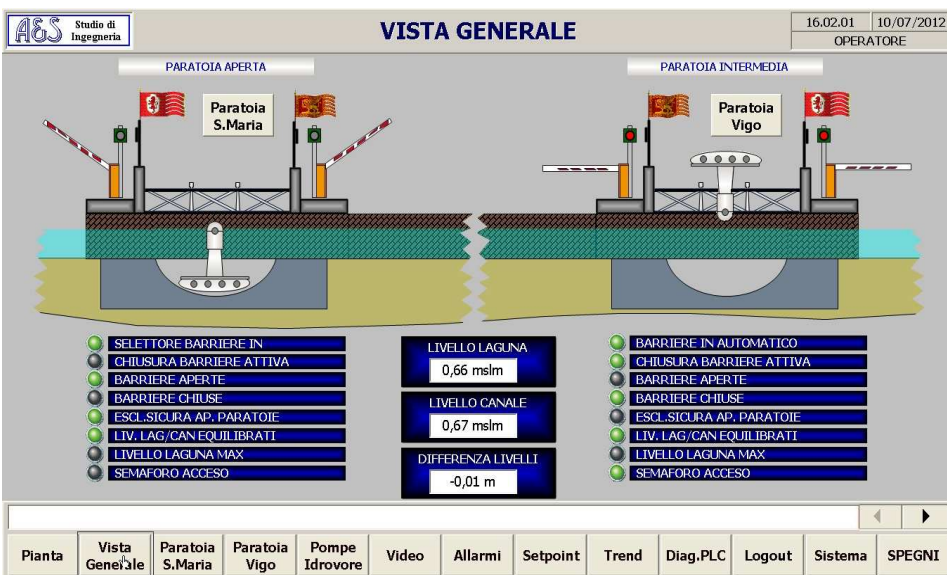
The barriers have been designed to rise in the event of high tides to isolate the canals from the lagoon. This will prevent water from entering the inlets and bursting canal banks to consequently flood the surrounding built-up areas.

The flood barriers have been installed at both ends of the Vena Canal that runs from north to south through the historical centre. One gate is located at the Santa Maria port and the other is located at the opposite end near piazza Vigo. The barriers that cross the canal are 18 meters long and 3.3 meters wide. Their structure consists of a row of hinged crest gates which lay submerged at the bottom on the canal. In the event of high water alerts these gates rotate upwards on their hinges to an upright position. This type of barrier was chosen from a number of differing alternatives

proposed. It proved to be the best solution in terms of performance, size and easy maintenance consisting of simple dry routine checks. Furthermore, its structure was the least cumbersome and discretely suited the architectural surroundings best. Ultimately it also ensures access to the quaysides, situated along the Vena Canal, while the floodgates are in operation. The floodgates are activated by an automatic management system in the event of high water alerts detected by system that monitors various tide gauges placed inside and outside the canal. When the gates are not in use, they are submerged and rest horizontally on the canal bed to enable normal public transit and water flow along the canals. Each gate takes eight minutes to open and close. Before they are opened and closed a security and an alert system are activated. This system implements the use of traffic lights, sirens and barriers to close off overwater traffic. Warning lights and close circuit video cameras have



3. The Movicon supervisor of the BabyMOSE system shows the geomap of the Canal Vena where the floodgates have been installed: the Vigo and Santa Maria floodgates.



4. A Movicon Supervision screen graphics showing a general layout of the floodgates.

been placed in the vicinity of the two Santa Maria and Vigo barriers. These cameras are connected to an electro-hydraulic control unit installed along the Vena Canal. Each barrier has two of these cameras in fixed positions that point up and downstream.

This allows the areas overlooking the water traffic transit zones and gates to be monitored while the gates are being opened and closed by a remote control system using a transmitter device connected to a local network and online with HDSL.

Work carried out under the supervision of the Baby MOSE project involved a series of complementary work such as reinforcing the Vena Canal banks, adapting rainwater collection and disposal systems and re-organizing sewage collection. This work has now been left in charge of the Val da rio wastewater purification plant. In addition work is still underway to build a footbridge for the disabled south of the Vena Canal.

The Chioggia intervention

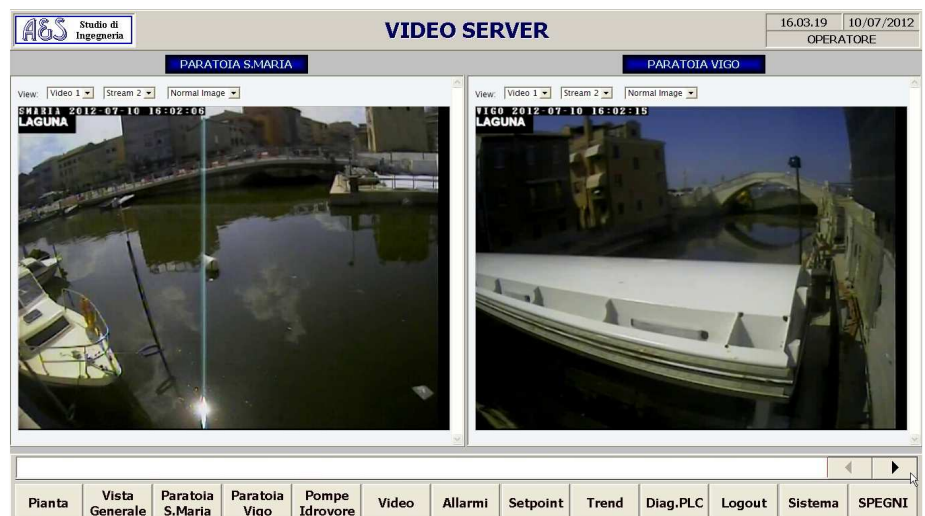
Work carried out under the supervision of the Baby MOSE project complete a program of interventions for protection against floods and the urban and environmental upgrading of Chioggia by the Interregional Authority of Chioggia for the Public works of Veneto – Trentino Alto Adige – Friuli Venezia Giulia together with the local council administration. As a result of a public policy plan adopted by both institutions, the protection interventions and shoreline reinforcement against high tides a responsibility charged to the Interregional Transport Authority of Public Works of Veneto Veneto – Trentino Alto Adige – Friuli Venezia Giulia), the occasion arose for other work to make improvements on the area as a whole. This involved the reorganization of public areas (roads, paving, green spaces, street furniture and bridges) and the underground infrastructure (i.e. sewers and underground utilities). In some cases the plan of action taken by the Interregional Authority of Public Works of Veneto – Trentino Alto Adige

– Friuli Venezia Giulia/Chioggia community also involved other competent authorities for specific activities in the Veneto Region and the Provinces of Venice and Padova as well as neighbouring municipalities. In addition to the Baby MOSE project, and as part of the major work carried out in Chioggia as initially planned, other projects have been finalized to reopen the Perottoto Canal which was filled in after WW2, make improvements to the piazzale Penzo, rebuild and modernize the functional structure of the long bridge.

The automation and supervision system

The project engineered by Studio A&S is designed on an architecture to automate and supervise the barriers using hardware and software components provide by Schneider Electric and Progea. The Studio A&S, in coordination with Site Engineer Management and close relations with those companies involved in realizing this project, has committed its efforts directly in engineering and realization the automation system's Remote Control system of the two barriers in Chioggia.

This system is comprised of two mobile barriers with submerged floodgates at both far ends of the Vena Canal that runs through the historical centre of Chioggia. Each one of the barriers has two hydraulic motors controlled by an automatic system configured with two redundant TSX57HS Premium PLCs, a series of Advantys remote IOs and a 15" Magelis HMI control panel to provide local



4. IP Cameras fixed on each floodgate to view the surrounding overwater transit areas by remote control.

control in the event of additional maintenance or in the absence of LAN connection to the remote station. The control panels of both the barriers are connected to each other and the remote control room, located in the Ravagnan building, using WiFi. The control room houses the Supervision Server developed with the SCADA/HMI Movicon 11 platform designed and produced by Progea. The supervisor system enables the operator to control and manage the two barriers and keep constant check of the functional status of both the barrier automation systems using remote control. Due to the critical circumstances respect to the water traffic circulating on the Vena canal, all the commands used to move the barriers are protected with user passwords which require double confirmation before activating. Each command event executed by the operator is recorded by the system so that each operation performed can be traced.

Furthermore all the collected analogue values, such as those concerning barrier levels and positions, are stored on a SQL Database and displayed using onscreen graphics showing historical trends. This information is also made available to the Tide Monitoring and Forecast Centre so that they can perform statistics based on mathematical modules to enable lagoon tide forecasts.

Conclusion

The Baby MOSE is fully operational since 2012 protecting the historical city center of Chioggia against flooding from high tides up to +130 cm above average sea level.

The control and supervision system architecture is based on a mixed copper, fibre and Ethernet network with Wi-Fi. This enables the system to connect to the other control units using TCP Modbus protocol. The redundant PLCs have CPUs in Hot Stand-By mode, to guarantee restoration of the barrier control logic in '1 cycle time' mode providing intrinsic security. The system supervision run with Movicon provides local and remote control with very intuitive management for operators to effectively monitor alarms, levels, commands and set-points. The historical data management is



5. At work installing the Santa Maria floodgate in Chioggia.

another essential feature of the supervision system for recording and storing data on a relational Ms SQL Server database. This enables daily reports to be generated with the support of simulation algorithms and mathematical modules from the Tide Monitoring and Forecast Centre. Movicon also provides a very efficient and performing DB feature to record all the data needed to analyse geo-marine conditions. The supervision system provides an additional Movicon Web Client functionality that will enable direct data access to authorized users to manage and monitor the running of whole hydraulic automation system, realized in Chioggia, over the web using smartphones and tablets. In addition, the Alarm Notification function can also be implemented to alert on call duty operators to promptly carry out emergency maintenance and to control and restore any anomalous conditions that may occur.

Ing. Adriano Angelini
Studio A&S
Automazione & Sistemi