

**THE LOCKS OF THE MARTESANA CANAL IN MILAN.
FROM LEONARDO'S STUDIES TO THE CULTURAL ENHANCEMENT
PROJECT ENTITLED "SLIDING DOORS"**

PhD student. Claudio Cali

Politecnico di Milano,

ABSTRACT

This paper presents an example of historical research for investigating a couple of old locks used for raising and lowering watercraft between stretches of water of different levels on one of the waterways of Milan (Italy), better known as "*Navigli*". The "*Navigli*" canals wooden locks, which nowadays are preserved in the National Museum of Science and Technology "Leonardo da Vinci" of Milan (MUST), are considered an excellence of 15th century Lombard cultural heritage. A current historical analysis was mandatory given to the cultural value of the artefact. The research was carried out in close collaboration with the Department of Leonardo Arte and Science of MUST. The research's objectives were the reconstruction of the chronological stages and the site identification of the locks. The lock device was the hydraulic tool that allowed a continuous navigation across the Milanese *Navigli* network and a consequent trading enhancement. In his first Milanese stay from 1482 to 1499, Leonardo da Vinci studied the *Navigli* hydraulic engineering and he provided technical improvements for the waterways. The most important studies on this subject are kept in the sheets of the *Codex Atlanticus* preserved in the *Veneranda Biblioteca Ambrosiana* of Milan.

Keywords: Leonardo da Vinci., cultural heritage, design, art, Milan, waterways, *Navigli*, museum, history.

INTRODUCTION

On 21 May 2015, through the official bulletin, *Lombardy Region* decrees to approve a call for research aimed at enhancing the regional cultural heritage financed by the

European Union and the Lombardy Region, according to the Regional Operational Program Ob.2 - European Social Fund - POR Ob. 2 - ESF 2007 - 2013 - Axis IV Human Capital D.d.s May 21, 2015 - n. 4136 and SS.MM.II. The call is open only to universities in Lombardy with the aim of promoting applied research projects for the enhancement of the tangible and intangible cultural heritage of Lombardy by the year 2015. Each University that submits its application to the call is required to set up a system of partnership with the body or the cultural bodies that possess or have in their availability a cultural heritage to be valued or that have on it functions of protection and supervision. [1]

The project "*Sliding Doors - 600 anni di eccellenza tecnologica lombarda*" is aimed at enhancing the cultural heritage of *Milan's canals*, considered to be a profound example of the region's cultural and technological excellence. The object of the research was to initiate a multi-disciplinary scientific investigation on a pair of original wooden doors of the canal lock that represent one of the traces of the historical legacy of Milan's "*Navigli*". The two wooden doors are located at the deposit of the *National Museum of Science and Technology "Leonardo da Vinci" in Milan*, awaiting restoration for future exhibition relocation. The doors of the locks of the "*Naviglio Martesana*" represent a fundamental example of excellence in the field of Lombard hydraulic engineering. In fact, the doors follow Leonardo da Vinci's drawings and can be considered his most important contribution to the Milanese Navigli system. [2]

With the aim to fulfil all the project objectives the partnership was designed in order to cover all the aspects of the project. The partnership was formed by an important consortium consisting of 6 partners and 3 of these coming from strong Milanese universities. The project partners were: National Museum of Science and Technology "Leonardo da Vinci" – MUST, Università degli Studi Milano Bicocca – UNIMIB, Politecnico di Milano – POLIMI, Università Statale di Milano – UNIMI, Fondazione CIFE, Arteria Safe-Tech.

In this article, however, it is decided to describe the only historical survey I edited in collaboration with the museum concerning the two closed doors. The historical analysis was useful because it was developed in parallel with the diagnostic study campaign carried out on the hatch doors, thus offering moments of support and comparison among experts.

The historical research

The ligneous lock from the canals in Milan, housed in the National Museum of Science and Technology "Leonardo da Vinci" (MUST) in Milan, is one of the Excellences of the Lombardy cultural patrimony - the Renaissance. It is a clear testimony to the efficiency of the technique of hydraulics in the fifteenth century, able to undertake its function of a crucial junction in the Milanese waterway system for over five hundred years maintaining the late 14th century design criteria unchanged.

Parallel to the diagnostic scientific activity, the artistic value of the work has also initiated a historical analysis of the object. The prefixed objectives of the project were to re-build the unravelled chronological steps of the artefact in order to arrive at a coherent identification. The work, carried out in strict collaboration with Claudio Giorgione, curator of the Leonardo Art and Science Department of the Museum, can be divided into three distinct phases: the first phase involving archive investigation, the second dedicated to the hands-on study of the work and the third phase consisting of a summary of confrontation and synthesis.

The operative efficiency of the Canals (Naviglio Grande, Naviglio Martesana, Naviglio Interno) was made possible thanks to the use of a system of moveable gates to overcome the sharp gradient along the waterways known as locks. 1440 was the year that coincided with the construction of the first basin or rather a dock with a pair of doors, one at each end. This was the Lombard prototype that had been influenced by a theory developed by *Leon Battista Alberti* and described in the *De Re Aedificatoria*. Other six followed the *basin of Viarenna* over the next 60 years. The Duke of Milan desire was to give Milan a series of uninterrupted waterways that flowed from west to east connecting the city to Lake Maggiore and Lake Como. To finish the project the infrastructure planned to join the Martesana with the Interno Naviglio. During the latter part of the 14th century the difference in levels between the two canals was overcome with the construction of two important basins, the *Incoronata* and the *San Marco*.

The construction of these basins is profoundly linked to the figure of Leonardo. As is already known, the artist had been very interested in the Naviglio and hydraulics from the beginning of his stay in Milan in 1482. Even if it is difficult to fix his role in the executive phase of the Milanese locks, there do remain in his manuscripts a vast repertoire of studies on the subject with examples of weirs and canalization. [3]

The concept of "*Da Vinci gates*" leads to the idea of a hypothesis that Leonardo was the creator of new architectural models of the basins. This type of weir, with its hydraulic and structural characteristics, has resisted time and has become, with due evolution, a founding example for modern locks. [4] The direct referral is the well-known drawing found in f. 656 r-a, (ex 240r) in the Codex Atlanticus, dated between 1493 and 1495, represents the transversal section of the San Marco basin. [5] It appears to be a type of manual that should guide the stages of the construction of the basin, illustrating how the project should look when completed. [6]

Such precise construction details have reinforced the conviction that this is, above all, a design for the project ordered by *Ludovico Sforza*. It is, therefore, wise to include Leonardo's contribution as a series of improvements to solutions already in use in the Duchy of Milan.

If Leonardo's interest in the system of canals was so well known by scholars, the practice of maintenance of the system itself was less evident. By studying the

documentation in the State Archives in Milan, there is concrete proof of a vast repertoire of files dating from the second half of the 15th to the end of the 16th centuries, testifying to the running and controlling of the canals. This inedited page of history has reached us through varying written and graphic testimonials by different authors that all have the same interest - the health of the Canals. These papers document ordinary and extraordinary intervention and maintenance, the idea of projects for new basins, the restoration of areas that were prone to infiltration and repairs of both the walls and wooden parts for both the levees and the locks. An interesting discovery has been one of the methods of repair of the wooden parts of the lock. The damaged parts were replaced preferably with undamaged parts from other locks or construction sites in order to save money. Most of these parts were already cut to shape. As we will see later, this information has offered an interpretative key for researchers in the scientific area of artefacts in the museum.

From the second half of the 18th century, gradual and incessant decadence was evident in the great system of canals in Milan, following a worsening in the hygienic conditions in the areas around the canals. The proposed urbanization approved by the council administration redesigned the centre of the city with new roads where there were once canals. The work was quickly carried out and by the end of the 1930s the Naviglio Interno was completely covered, followed by the *Vettabbia canal* and the *Redefossi canal*. Thirty years later in 1969, after about ten years of construction sites, the city part of the Naviglio of the Martesana to the *Basin of Cascina dei Pomi* were definitely covered over.

According to documents in the Archives, the artefact now found in the museum was joined by one of the basins along the Naviglio Martesana. During work on covering the canals, both council and Royal supervision moved to receive ministerial authorization necessary to safeguard the Martesana lock, considered to be of historical interest. In 1935 the gates of San Marco were removed and put away safely whilst in 1967 the same was done to the *basin of Cascina dei Pomi*.

The first nucleus was given to the *Civica Siloteca Cormio Museum* whilst the second went to the *Civic Didactic Naval Museum*. [7] Between 1955 and 1970 the collections of the two civic museums were housed in via San Vittore next to the MUST including the gates from the two institutes. In consequence, the artefacts coming from different collections were placed in the same structure and could not be identified with certainty. They were not moved until 2007, as verified by a recovered document. The same year, the building housing the two couples of gates entered into an ambitious project of repair and re-qualification causing the transfer of the objects to the nearby deposit of the MUST.

To identify the artefact today housed in the museum research bases its studies on an important historical date: the locks of San Marco from the Siloteca Cormio were put on

display in the exhibition "Waterways from Milan to the Sea" organized in Milan in 1963. [8] With the help of some original photographs, there began a comparison between the locks on display and those housed at the museum. The analysis led to the identification of the unequivocal details from both gates.

To consolidate the reality of the thesis a second dimensional analysis was carried out. The measurements of the gates in the museum were compared to some road information undergone in 1935 by the Technical Office of the Milan Council before beginning the work of covering the area of San Marco. The comparison revealed a coherent similarity even in this second case.

Studies have shown that it is most likely that the lock in the museum is similar to that removed from the support of San Marco. The concept of a "Leonardo heritage" and an excellent history of the artefact is further heightened by ideally relating the real object with the lock represented and described by Leonardo in f. 656 r-a in the Codex Atlanticus.

Conclusion

The results of historical research have been useful for enhancing and comparing the investigations of the research team involved in scientific studies. The main dissemination activity of the project took place through two days of meetings with the public. The first was organized by the Cultural Heritage Group of the Milano Bicocca University in the form of a technical *workshop on 4th February 2016*. The second event was a *conference organized at the National Museum of Science and Technology on 3rd May 2016*. On this important occasion the results of the "Sliding doors" project and of historical research on locks in parallel to the main project were exposed to the public and to the main cultural authorities in the field of CH. From reading the press release, among the main guests were: *Fiorenzo Galli, Director General of the National Museum of Science and Technology; Claudio A. M. Salsi, Director of the Superintendence of the Castle, Archaeological Museums and Historical Museums; Cristina Messa, Rector University of Milan Bicocca; Cristina Cappellini, Councilor for Cultures, Identities and Autonomies, Lombardy Region; prof. Pietro C. Marani, Polytechnic of Milan, Ente Raccolta Vinciana*. Acts and notes on the conference can be consulted at the MUST Archive and Press Office. An other opportunity to disseminate the project was on the *Researchers' Night on 30th September 2016*. Some members of the research team presented the locks and studies carried out on them directly, in situ, at the MUST warehouse. Furthermore, as witnessed during the conference of the 3rd May 2015, all the diagnostic phases of the project were recorded through the audio and video support by an operator dedicated to documentary purposes and for a public restitution. *The two videos are available online on the Youtube channel of the MUST. Both videos were uploaded on 12th January 2018*. [9]

REFERENCES

- [1] BURL 22. 2015, May 29. Lombardy Region, Italy, p.72, 2015. Retrieved from: http://www.regione.lombardia.it/wps/wcm/connect/1f86188d-46a9-4632-801b-da674c14a58a/estratto_burl_22_29_05_2015.pdf?MOD=AJPERES&CACHEID=1f86188d-46a9-4632-801b-da674c14a58a
- [2] Curti O., *Il Museo Nazionale Della Scienza e Della Tecnica Leonardo Da Vinci*, Banca popolare di Milano, Milan, Italy, 1972.
- [3] Cali C., *Leonardo e l'acqua tra scienza e pratica a Milano*, edited by Cali C. and Capurro R., catalogue of the exhibition, Milan, Italy, p.30, 2015.
- [4] Marani P. C., and Cordera P., *Macchine per l'architettura e il territorio. Disegni di Leonardo dal Codice Atlantico*, Novara, Italy, 2010.
- [5] Capurro R., *Studi sulle acque. Disegni di Leonardo dal Codice Atlantico*, Novara, Italy, p. 23, 2015.
- Roberts J., *A dictionary of Michelangelo's Watermarks*, Milan, Italy, 1998.
- [6] Pedretti C., *Leonardo Architetto*, Milan, Italy, 2007.
- [7] Banfi E., *La Siloteca Cormio*, Milano, Italy, 1987.
- [8] *Vie d'acqua da Milano al mare*, catalogue of the exhibition, Officine Graphic printer IGap, Milano, Italy, p.56, 1963.
- [9] MUST. [Museo Nazionale Scienza e Tecnologia Leonardo da Vinci] (2018, January 12). Studio dei portelli di chiusa. Campagna diagnostica (documentazione) | Museoscienza. [Video file]. Retrieved from: <https://www.youtube.com/watch?v=1KDkAoKOCXg>; MUST. [Museo Nazionale Scienza e Tecnologia Leonardo da Vinci] (2018, January 12). Studio dei portelli di chiusa. La movimentazione (documentazione) | Museoscienza. [Video file]. Retrieved from: <https://www.youtube.com/watch?v=KfQbLkHxlyg&t=4s>