The Building Blocks of Venice

Preserving knowledge of a city's infrastructure and maintenance

AN INTERACTIVE QUALIFYING PROJECT REPORT

WORCESTER POLYTECHNIC INSTITUTE

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Abstract

The ultimate goal of our project was to develop an online repository for Venice's urban infrastructure and the unique techniques used to maintain it. In doing this, we improved accessibility to this information and ultimately preserved this knowledge for posterity. We accomplished our goal by creating 72 interconnected web pages on Venipedia.org, these pages are comprised of pertinent information as well as effective visual diagrams depicting components of all urban elements and their maintenance procedures. In addition to these pages we have created 175 pages of individual canals and 258 pages of individual bridges. The work completed by our group has laid the ground work for a complete knowledge base for the Venice's unique urban infrastructure.

Authorship and Acknowledgments

Authorship

Although the sections of this paper were primarily written individually, recognition for individual sections cannot be appointed to any single team member. This group reviewed and edited this document as a team to ensure cohesion; therefore, every team member shares equal credit and responsibility.

Acknowledgements

We would like to thank the following people for their help and support:

Ing. Lorenzo Bottazzo, Ing. Michele Regini and rest of Insula SpA for their generosity in providing us with their invaluable knowledge and expertise which was instrumental in completing our project.

Our advisors Professor Fabio Carrera and Professor Frederick Bianchi for their support and guidance.

Executive Summary

Venice's urban infrastructure must be functional while simultaneously retaining its historical significance. The iconic infrastructure is composed of various urban elements whose designs are specific to Venice. Some of the oldest and most renowned elements date back hundreds of years. For example the Rialto Bridge was constructed in 1591 and still functions today in its original form.[1] Over time the availability of materials changes however the special techniques applied must remain the same. In order to preserve the historical value of Venice's infrastructure, very unique maintenance techniques must be applied.

Figure 1: Insula's logo

Insula SpA, founded in 1997 as a result of The Special Law of Venice, has been responsible for coordinating the application of these techniques. Insula has implemented methods used over the past century and combined them with modern technology to sustain the functionality of the elements without altering their appearance. Although successful at coordinating restoration projects, Insula future as an organize is in danger. This situation jeopardizes the information Insula collected pertaining to Venice's unique urban infrastructure and maintenance techniques.

The goal of our project was to develop an online repository to improve accessibility and ultimately preserve the knowledge regarding Venice's infrastructure and the techniques and procedures used to maintain it. To do this, we obtained information through many knowledgeable outlets, the primary source being interviews with Insula representatives. We then organized this information into Venipedia, which is a wiki-based website used for storing easily searchable, cross-referenced information pertaining to Venice. Our team also created detailed diagrams to visually aid in understanding the topic at hand.

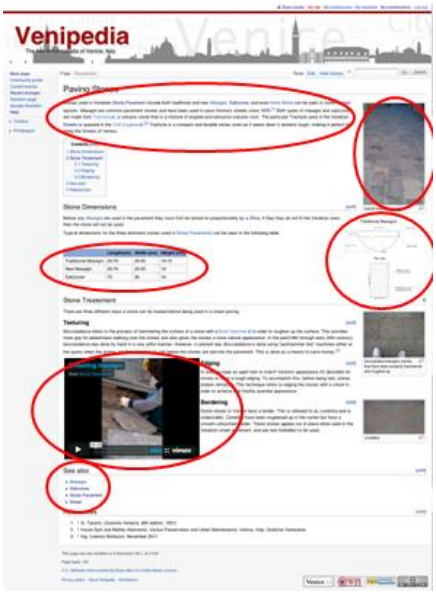

Figure 2: A typical Venipedia page with highlighted componenets

The result of our project can be seen in its entirety in the collection of wiki pages that we created and published on Venipedia. All our research, interviews, and field work resulted in the creation of 72 linked pages describing the streets, canals, and bridges of Venice, as well as their anatomy and the detailed procedures used to maintain them. In addition to these complete pages, we have used the procedure described in appendix H to create 433 pages with complete infoboxes pertaining to individual canals and bridges. The team also produced 36

[2] Sinkhole in Guatemala: Giant Could Get Even Bigger, National Geographic, Last modified June 1, 2010, http://news.nationalgeographic.com/news/2010/06/100601-sinkhole-in-guatemala-2010-world-science/

technical diagrams detailing specific elements of the infrastructure and related maintenance components associated with their respective pages. The pages have numerous links embedded in the text and other relevant pages have been linked under the "see also" header. Visual aid is also given by picture files and measurements either given to us or taken by us.

In the conclusion of our project we recommended that future project groups adopt our methodology to gather the knowledge about the maintenance of all other infrastructure elements of the city of Venice including: docks, sewers, well heads, and so on. Future groups will then be able to create a complete knowledge base for all techniques and procedures regarding the infrastructure of this exceptional city.

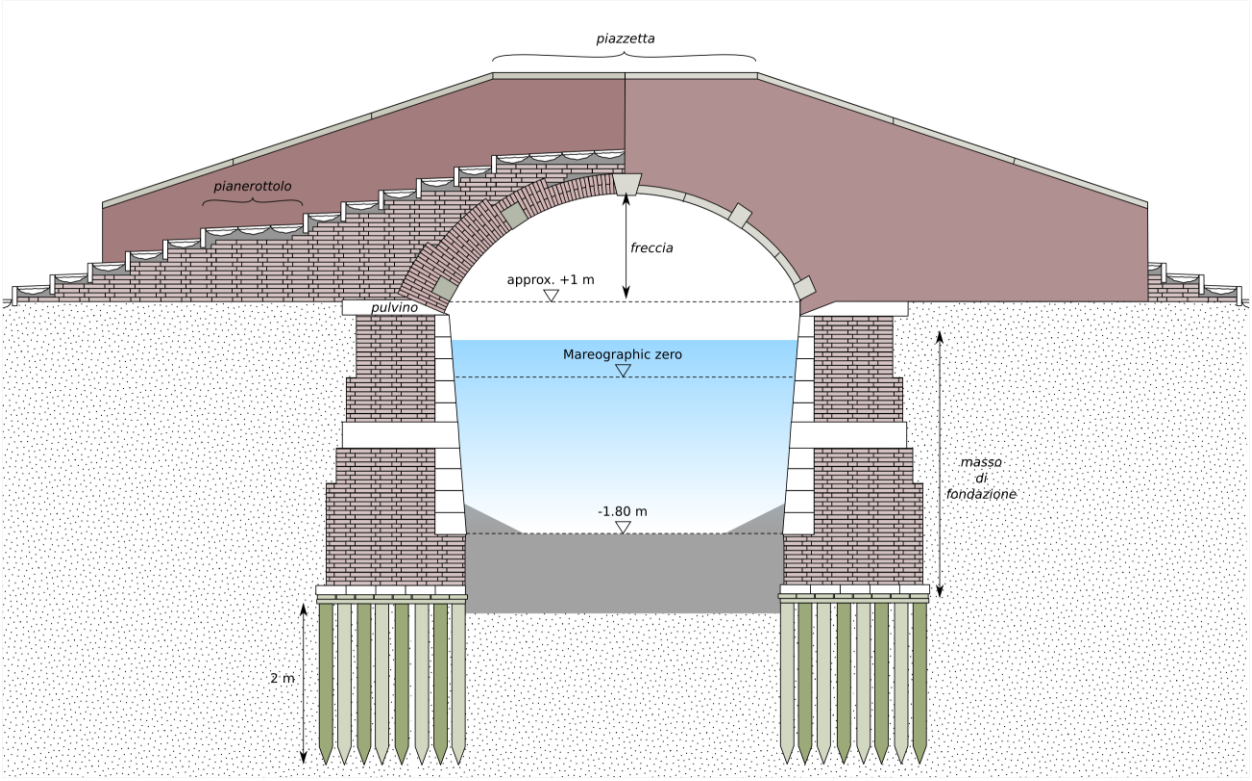

Figure 3: A diagram created by our group depicting a typical masonry bridge

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1. Introduction

Failure and malfunction of urban infrastructures pose serious problems to society, but such failures are entirely preventable if proper maintenance is provided. In the past year alone there have been numerous cases worldwide of infrastructures failing. In June of 2010 a massive sinkhole appeared in Guatemala, swallowing a thirty-story building and killing hundreds.[2] In December of 2010 the roof of the Minnesota Vikings Minneapolis Metrodome collapsed due to a heavy collection of snow.[3] In July of 2011 a bullet train in China derailed, leaving many injured and eleven dead.[4] In all these instances negligence to maintain these structures led to failure, and in some cases unnecessary casualties. Corrosion, weathering from the surrounding environments, human influence, and day-to-day wear and tear all compromise the structural integrity of our infrastructures. The failure of infrastructures is easily preventable with proper and frequent maintenance.

Venice, Italy is a city whose infrastructure suffers drastically due to its unique geographical location and interaction with the surrounding bodies of water.[5] The city, made up of more than a hundred individual islands separated by canals and connected by 433 bridges, is built on a natural lagoon.[6] Frequent fluctuation in the tide level causes the canal walls to erode, and repeated flooding corrodes the city's walkways, bridges, and buildings. This unique situation creates many infrastructure problems specific to Venice and demands careful attention in order to be properly maintained.

Currently, the municipality of Venice funds the private company Insula SpA to coordinate maintenance projects throughout the city. For the last 14 years Insula has been responsible for maintaining all 182 canals, 433 bridges, and the rest of the 2.4 square miles that make up Venice.[7] Over those years Insula has adapted and refined methods to properly maintain each element of Venice's infrastructure. However, with recent cutbacks in their budget, Insula fears that they will be unable to continue applying these methods to effectively maintain the infrastructure. Therefore, documentation and records will need to be compiled and made publicly accessible in order to preserve the knowledge needed to maintain this unique city.

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[2] Sinkhole in Guatemala: Giant Could Get Even Bigger, National Geographic, Last modified June 1, 2010, http://news.nationalgeographic.com/news/2010/06/100601-sinkhole-in-guatemala-2010-world-science/

[3] Top 10 Infrastructure Fails of 2010, The Infrastructurist, http://www.infrastructurist.com/galleries/album/72157625553870783/photo/5294584482/top-10-infrastructure-fails-of-2010-3-the-metrodome-collapses.html

[4] ANOTHER Infrastructure Fail in China, As Bullet Train Derails on a Bridge, Business Insider, Last modified 23 July 2011, http://www.businessinsider.com/bullet-train-derails-in-china-2011-7

[5] Portal: Urban Maintenance, WPI, http://venipedia.org/index.php?title=Portal:Urban_Maintenance

[6] Idem

[7] Who is Insula, Insula, http://www.insula.it/index.php/azienda/manutenzione-e-salvaguardia

The knowledge of how to maintain Venice's infrastructure is held only by those who have been in close contact with the restoration projects specifically Insula Spa. Because of recent cutbacks Insula has been forced to reorganize, splitting up its 75 experience employees.[8] This endangers the collection of knowledge that they've compiled over their existence. This circumstance creates a need for an organized publication of Insula's knowledge. The urban elements of Venice not only have structural value but hold cultural importance as well. In preserving the historic infrastructure of Venice the long and outstanding history of this unique city is safeguarded. For this reason, a collection of this knowledge would be priceless.

Our project rectified this problem by creating a unified set of information that can be easily viewed and searched. Insula SpA, who is dedicated to preserving the city, has provided us with knowledge of Venice's infrastructure and their maintenance procedures. We reviewed past and present maintenance projects to further deepen our understanding of these techniques. Our group conducted first-hand research, including interviews and taking photographs and measurements around the city. All of this collected information has been used to write wiki pages. These pages are published on www.venipedia.org to ensure widespread accessibility of this information. Finally, our group has ensured the continuity of this information by locating people or organizations that are willing to help update this information as needed, and by limiting the people who can edit Venipedia to avoid the presence of spam pages.

[8] "Insula, una riorganizzazione per salvare I posti di lavoro". *Il Gazzettino*, December 8, 2011,

2. Understanding Urban Maintenance in Venice

Venice was founded in the year 421 AD, first populated with a number of small island communities built by refugees from the coastal region of *Venetia*.[9] These fleeing Italians formed villages throughout the lagoon, which served as a protective barrier separating them from the frequent barbarian attacks that they experienced while living on the mainland. As time passed, the civilization eventually expanded to include all of the adjacent islands located in the center of the lagoon, and it was gradually unified into one body. This cluster of islands was first ruled as a unified entity in 726 A.D. when Orso Ipato became the first Doge of Venice.[10] This republic employed a hierarchy with the Doge at the top, a *collegio* or ducal council working under him, a *pragedi* or senate below that, and a *maggior consiglio* or great council forming the base of the government.[11] At this time Venice was referred to as *La Serenissima Repubblica,* or the Most Serene Republic, and by the year 1348 became one of the great naval powers in the Mediterranean Sea.[12]

Figure 4: Open *piazze* and detailed architecture and statuary have long been part of Venetian culture.

The "Serene Republic" began its military conquests by taking part in the first crusades around 1000 A.D. An abundance of art was brought back to the city as spoils of war; the four bronze horses that once guarded the city are a prominent example of the soldiers' findings. (The original horses have been moved to the Museo San Marco; replicas now stand in their places.)[13] Throughout its long history, the republic was able to successfully repel attacks from the Arabs, the French, and the Turks, to name a few. This seemingly indefatigable republic finally fell to Austrian and French rule in 1798 when Napoleon conquered the city.[14] *La Repubblica* attempted to liberate itself from its new rulers in 1848, but it wasn't until 1866 that the republic was finally able to win its independence and join Italy as the city of Venice.[15,16]

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[9] Elizabeth Horodowich, A Brief History of Venice: A New History of the City And its People, The brief history series (Philadelphia, Pa: Running Press, 2009).
[10] Idem.
[11] The Most Serene Republic of Venice, The Center for Range Voting, accessed 21 September 2011, http://rangevoting.org/VenHist.html.
[12] How Venice was Born – a brief outline, VeniceWord International Media Services, accessed 18 September 2011, http://www.veniceword.com/vehistory.html.
[13] Idem.
[14] Margaret Plant, Venice: fragile city, 1797-1997 (China, 2002), 81
[15] Ibid., 138.
[16] Ibid., 161.

Since then, Venice has maintained its rich culture by hosting extravagant events and celebrations and carefully preserving its works of art. In 1895 Venice held its first Biennale, an art exhibition that has grown over the years and now attracts over 370,000 visitors from around the world.[17] In 1902 the city unveiled a new Modern Art Gallery at Ca' Pesaro, and in 1932 the first Venice Film Festival was held. The events of World War Two suspended these events, but they were reinstated by 1950.[18]

The waters of the lagoon have always been threatening to swallow this city and its rich heritage. This fact was punctuated on the night of November 3rd, 1966 when the water rose two meters above the *Punta della Salute* reference point and crippled the city. The flooding caused extensive damage to and loss of various works of art, information archives, and the infrastructure of the city itself.[19] To this day, frequent flooding continues to be a primary cause of concern for Venice, and many of its resources go towards seeking a solution to this problem.

2.1. History of Maintenance After the Fall of the Venice Republic

Over its long and complicated history, many different countries have occupied Venice, and not all of its rulers understood how to keep up with the demands of its environment. Some of its governing nations performed no maintenance at all, and those that did often used methods that had not been tested or proven. The primary issues that confronted the city's infrastructure then were similar to those that need to be dealt with today—namely, sludge buildup in the canals, deterioration of the canal walls, and cracking and shifting of the paving stones, to name a few. Left to fester by apathetic or ignorant governments, these problems often grew worse and made life much more difficult for Venetians.

With maintenance placed on such a low priority, records of any maintenance were often difficult to find if they even existed. The earliest records of significant maintenance work date back to 1799 when Venice was under Austrian rule. The Austrians carried out slow, continuous canal maintenance without interruption until around 1805, when they lost the city to the French. These new rulers had no understanding of the necessity for maintenance, and therefore the city languished. This negligence continued for about ten years until the Austrians reclaimed the city in 1815. The Austrians immediately launched a vast public works program in the same year to combat the decade of French neglect. The Austrians continued day-to-day maintenance work throughout

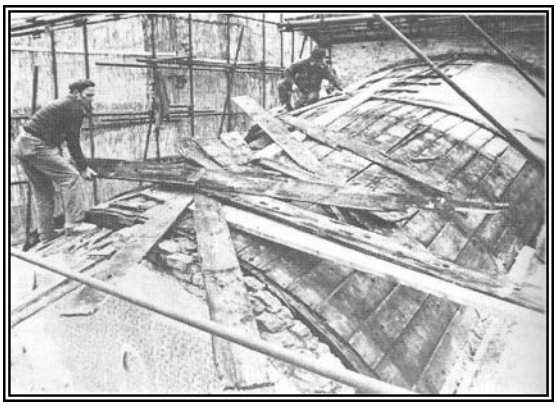

Figure 5: Deterioration of the famous Rialto Bridge c. 1973, before restoration work began.

[17] La Biennale: History of the Venice Biennale, la Biennale di Venezia, accessed 20 September 2011, http://www.labiennale.org/en/biennale/history.
[18] Idem.
[19] Jane Da Mosto and Caroline Fletcher, The Science of Saving Venice (Paul Holberton Publishing, 2004), 9.

the subsequent years and implemented two more substantial maintenance campaigns in 1835 and 1849. For the next twenty years, the city received less attention, most likely due to more pressing domestic issues affecting Austria at the time.[20]

The Kingdom of Italy annexed Venice in 1869, and maintenance began again under the Rational Plan. This grand scheme promised that the government would both restore all of the city's embankments to proper condition and ensure that they remain in this state. The city carried out this restoration of embankments between 1869 and 1875, and in the following years performed regular maintenance to keep them in good condition. Workers resumed large scale dredging in 1892, and over the next year removed about a meter of sludge from all the main Venetian canals.[21] This attention to maintenance of the canals and other pieces of infrastructure remained consistent until the beginning of the World Wars. As would be expected, the Italian government concentrated their funds and put almost all their focus on the war effort, leaving Venice's canals and urban infrastructures neglected. During this time, the city's infrastructure suffered greatly, requiring serious intervention at the end of WWI headed by the local arm of the Italian Ministry of Works, *Magistrato alle Acque*.[22] WWII brought a very similar situation; the canals and other pieces of urban infrastructure in Venice again experienced severe deterioration while the government was focused on the war. This led to maintenance work resuming with great intensity in the mid 1940's; the Special Law for Venice allocated a budget and provided funding and resources for the maintenance needed in this very unique city. In the 70's and 80's maintenance work suffered again, mainly due to priority being given elsewhere and scarcity of resources. A new problem also rose up during this time; Venice had difficulty in disposing of the sludge removed from the canals as a result of the evolution of environmental protective legislation.[23] This pause in maintenance work continued until the early 90's, when laws and protocols where signed and agreed upon between the local governments. Between February 1992 and summer of 1993, the Italian government agreed upon the Special Law of Venice, the protocol of understanding the classification and isolation of sludge, and another preliminary agreement. These classified the maintenance work in the city as structural and stated that its implementation should be employed by means of an integrated project. The main goal being an integrated canal project to be carried out uniformly to ensure technical design homogeneity throughout all the canals, and infrastructure related to the canals.[24] This led into the formation of Insula, who was officially formed in 1997.

Venice has a long history of on-and-off maintenance; maintenance has only seemed to be a priority either when the sanitation problems become unbearable or there is extreme deterioration in the elements of urban

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[20] Caroline Fletcher and Tom Spencer, Flooding and Environmental Challenges for Venice and its Lagoon: State of Knowledge (Cambridge, UK: Cambridge University Press, 2005), 162.
[21] Idem
[22] Idem
[23] Ibid., 164.
[24] Idem.

infrastructure. When funds are concentrated in other areas, and there are more urgent problems on the government's agenda, maintenance is forgotten.

2.2. Insula SpA

Figure 6: Insula's logo

Insula was created on July 10, 1997 as a result of the Special Law of Venice No. 139 of 1992, which made the structural maintenance of the city mandatory. Routine urban maintenance should be performed to ensure uniformity in the design phase, implementation phase, and financial accounting phase. The founders of Insula include the Venice City council (with 52 % share capital) and the operators of the four underground utilities: ASPIV, Italgas, Ismes, and Telecom Italy (with equal 12% shares). On October 6th, 1997, the Venice City council signed a ten-year contract with Insula that outlined the rights and obligations of its members. The shareholders of Insula remained mostly the same until 2007 when Insula became entirely public. Today, Insula consists of the members of the Municipality of Venice (72.13% stake), Veritas spa (26.73%), and the Veneto Region (1.14%). Insula also merged with Edilvenezia, a company focusing on heritage management and maintenance of public housing, in January of 2009.[25]

"Insula aims to program designs, procure and coordinate the execution of works and urban maintenance and construction services for the City of Venice."[26] As Venice's sole operational arm in charge of Maintenance, Insula has been diligent in their work. Insula deals with development studies in order to better understand and therefore predict required maintenance of the city.[27] The company also plans and executes contracts to repair the urban infrastructure. Insula prides itself on ensuring the completion of needed maintenance while minimizing the inconvenience to the citizens. The company organizes renovations and repairs in a general area to be constructed at the same time so as not to disturb local Venetians.[28]

Insula is responsible for 4 broad areas of the infrastructure; buildings, urban infrastructure, land management, and management of public housing. Renovations and repairs of buildings include schools, churches, government houses, and sports buildings.[29] Insula's maintenance of these buildings is planned based on timely inspections in an attempt to ensure safety and keep the buildings and utilities up to date.

[25] "Chi è Insula," Insula SpA, 2010, http://www.insula.it/index.php/azienda/chi-e-insula.
[26] Who is Insula, Insula, http://www.insula.it/index.php/azienda/manutenzione-e-salvaguardia
[27] Activities and Service, Insula, http://www.insula.it/index.php/azienda/manutenzione-e-salvaguardia
[28] Idem
[29] Idem

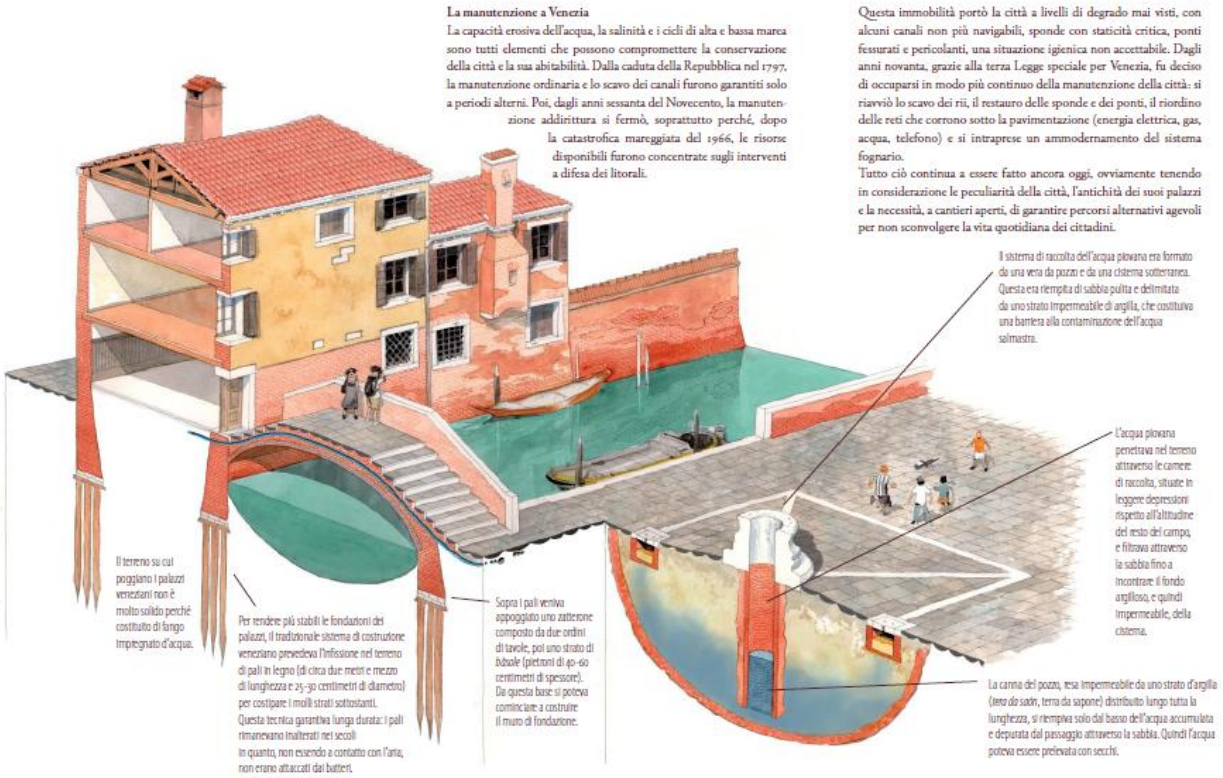

Figure 7: An example of a publication by Insula. Depicted are elements characteristic to Venice that require constant maintenance.

Venice's urban infrastructure includes the city's canals, canal walls, walkways, handrails, bridges, docks, sewer system, and pavements. The goal in maintaining these elements is to ensure safe and easy transportation for citizens whether on foot or by boat. One of Insula's biggest undertakings was to reinstitute dredging of the canals. After World War Two government spending was concentrated towards the war effort therefore public spending was cut and as a result Venice halted its canal dredging project. In 1990, after thirty years of neglect, Insula was given the task of dredging all the canals.[30] By the year 2000, half of the canals were dredged, and almost 180,000 cubic meters of sludge was removed.[31] Another infrastructure problem specific to Venice is a result of the frequent floods. In 1966 a major flood damaged much of Venice's infrastructure as well as a vast amount of priceless art and archives.[32] Hoping to avoid any future tragedies of this kind, Insula is systematically raising the entire city's pavement.

[30] Gary R. Marvin, Robert C. Davis. Venice, the Tourist Maze. (Los Angeles: University of California Press, 2004), 189
[31] Ibid, 189
[32] How Venice was Born – a brief outline, VeniceWord International Media Services, http://www.veniceword.com/vehistory.html

Insula's management of the land in Venice includes repairing pavements, railings, drains and then maintaining such elements. Such projects are undertaken either because of citizens reporting an anomaly or damage to the elements was noticed during a periodic survey.[33]

Lastly Insula is in charge of managing Venice's 5000 public housing properties. This makes Insula responsible for managing tenants and maintaining the properties. Insula is required to lease out the properties, collect rent, and monitor the inhabitants to prevent unnecessary damage. Maintenance of such properties is determined by an assessment of the degree of urgency by Insula and if necessary action is taken.[34] This is an additional responsibility acquired upon Insula's merge with Edilvenezia.

An additional task Insula is concerned with is the organization of maintenance information and records. Keeping records and data organized saves time and money. Trying to keep processes organized, Insula began computerizing their data and implementation of works done.[35] Insula's records are also organized by location, broken up into the provinces of Venice (*Cannaregio, Castello, Dorsoduro, San Marco district, San Polo, Santa Croce, Giudecca Sacca Fisola, Mazzorbo, Lido, Murano, Pellestrina, and Mestre*).[36] Further information systems have also been designed; for example, in 2002, Insula created its own GIS Portal for Venice. This program is a 3-dimensional representation of the city and includes information about maintenance records since Insula took over these operations.[37]

Insula also attempts to make its findings and operations known to the public. Insula keeps the rest of the world informed by publishing friendly brochures that include basic information about Venice's infrastructure. Insula has produced many informational videos, as well as publishing books containing their involvement with Venice.

After being appointed as the sole operation arm of Venice Insula has not slowed in keeping the city structurally sound or preserving its historical value. By initiating organization the company has had success in maintaining the many elements that make up Venice's infrastructure. In the past decade, Insula has dredged 71% of the canals and restored 57% of the embankments, 34% of the pavements, and 55% of the bridges.[38]

2.3. Insula's Future

Due to recent government funded for the MOSE project Insula encountered a budget cut from 40 to 17.2 million Euros over the past year.[39] Due to the limitation of funds Insula's involvement in maintaining the city has decreased dramatically. As of Friday December 2nd, 2011 funding for Insula has been

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[33] Activities and Service, Insula, http://www.insula.it/index.php/azienda/manutenzione-e-salvaguardia
[34] Idem
[35] Idem
[36] Construction work, Insula, http://www.insula.it/index.php/azienda/manutenzione-e-salvaguardia
[37] Know the Territory, Insula, http://www.insula.it/index.php/azienda/manutenzione-e-salvaguardia
[38] "Dieci anni di Insula," Insula Informa, March 2008, http://www.insula.it/images/pdf/resource/informapdf/informa36.pdf.
[39] Insula: un future per Venezia, Insula SpA, last modified September 23, 2011, http://www.insula.it/index.php/bilancio-2010.

cut completely.[40] The company is being terminated however in an effort to preserve jobs and the invaluable experience of its workers the Municipality of Venice is dispersing Insula's 75 employees to various companies. All of these companies are involved in urban upkeep, particularly utility services, construction, and sewers. With the relocation of Insula's jobs the experience they've gained is in danger of being lost. Therefore there is a need for a repository of the various techniques, procedures and knowledge acquired by Insula and its workers over its 14 year existence.

PARTECIPATE Deciderà il consiglio comunale

Insula, una riorganizzazione per salvare i posti di lavoro

Non è una liquidazione, ma una riorganizzazione completa sicuramente sì. Importante tappa, ieri pomeriggio, per il futuro di Insula, la società che si occupa della manutenzione urbana cittadina che rischia il collasso per assenza di finanziamenti della Legge speciale. Nel corso di una riunione del consiglio di amministrazione con l'assessore alle Società partecipate Antonio Paruzzolo si è fatto il quadro della situazione in cui versa l'azienda che ha alle sue dipendenze 75 persone. È emersa la volontà dell'amministrazione di salvaguardare i posti di lavoro, ma la contestuale necessità, alla luce della drastica riduzione dei fondi, di riassettare i settori di intervento. Sulle modalità di attuazione del percorso sarà però il consiglio comunale a doversi pro nunciare e a ratificare l ipotesi prospettate. «È stat data notizia dell'arrivo degl stanziamenti del 2011 - ar nuncia il presidente di Insul Paolo Sprocati - che orm serviranno per l'attività d 2012. C'è il desiderio dell'ar ministrazione di non dispe dere le competenze speci che accumulate in questi ni di esperienza - prosegu e saranno studiate varie ipo si per il futuro dei lavorat Si punta a una diversifica ne delle attività in altre so tà partecipate. Ad esemp sarà chi si occuperà dell'e zia privata e delle prat dei condoni, chi dei se del sottosuolo in accord Veritas, chi potrà intrat re i rapporti con gli inq degli immobili di pro pubblica. Ora che Equi

Figure 8: Newspaper article on reorganization of Insula

[40] "Insula, una riorganizzazione per salvare I posti di lavoro". *Il Gazzettino*, December 8, 2011,

3. Methodology

The goal of our project was to develop an online repository to preserve knowledge of Venice's urban elements and the maintenance techniques and procedures used to maintain them.

We accomplished this goal by completing the following objectives:

1. To obtain general knowledge of each element of urban infrastructure in Venice as well as successful maintenance techniques used to preserve them.
2. To create a publicly accessible repository of this knowledge.
3. To preserve this knowledge, and ensure it is updated and readily available for future use.

The information we were concerned with were the procedures established and used by Insula over their successful fourteen-year existence. Insula has adopted and improved upon all successful maintenance techniques of the past; therefore, their list of procedures may be considered the most complete.

We collaborated with our sponsors, and based on our time restrictions and their concerns, we focused on the following urban elements: bridges, canals, and pavements. We focused on collecting general information and maintenance methods regarding these elements located in historical Venice. Methods include protocol and techniques used for restoration.

3.1. Gathering knowledge

The first step in accomplishing our end goal was to obtain information to complete the repository. We were interested in acquiring general knowledge and maintenance procedures pertaining to each of the three elements of urban infrastructure. Over their existence, Insula has adopted and evolved many specific techniques to maintain Venice's unique and historical urban infrastructure. We needed to learn about the importance and functions of each of these urban elements in order to fully understand these techniques.

First we reviewed existing literature on maintenance techniques used in Venice. Because this did not require us to be in Venice we began to accomplish this task before being on-site. We reviewed the educational pamphlets that Insula produced, web portals that Insula created, and Insula's general website. The pamphlets gave us a basic insight as to how the urban elements of infrastructure are maintained. The web portals accessible through Insula's webpage provided specific maintenance information of recently finished projects. Lastly Insula's general website provided us with a lot of general information about each element of urban infrastructure. Other basic online and literature research was done for more general information.

The second way we obtained knowledge was by conducting biweekly interviews with representatives from Insula. Our main source was Insula representative Ing. Lorenzo Bottazzo. During each interview, Ing. Bottazzo would describe a specific urban element along with its restoration procedures using hand-drawn

diagrams as a visual aid. He also provided us with documentation of past restoration projects to better illustrate the complex procedures. When information was not readily available, Ing. Bottazzo would consult his colleagues to provide us with the necessary information.

Thirdly, Ing. Bottazzo provided us with access to current restoration projects. By viewing these projects personally we developed a clear understanding of the process and our recordings served as an accurate primary source of information. This included pictures and videos to help strengthen our data.

Fourthly, outside of organized visits to Insula's construction sites, we conducted field work that consisted of taking photographs and measurements of certain urban elements.

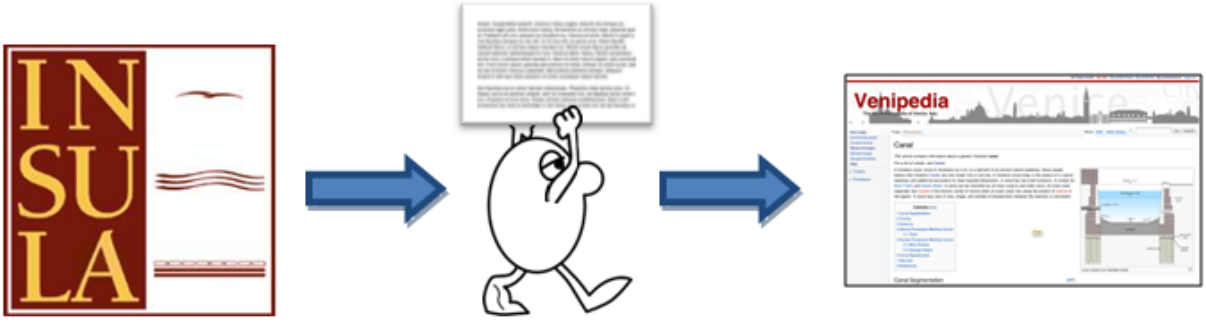

Figure 9: Capturing maintenance knowledge

3.2. Creating a repository

We chose Venipedia as the location for hosting this information because it already contains a great deal of information regarding the city of Venice, and this project is poised to complement that knowledge. Generally, each type of urban infrastructure shared three main pages, titled as the singular and plural tense of the element in addition to a maintenance page. These pages include links to more detailed pages with specialized information, including technical knowledge that would need to be defined for the layperson. We aimed to keep a consistent template for the three main pages with detailed information located on other pages. In doing this we ensured uniformity in the main pages therefore allowing someone browsing the pages to quickly locate other related information.

Plural	Singular	Maintenance
• Infobox • History • Statistics • GIS Map • Navbox	• Function • Anatomy • Classification • Processes affecting	• Overview • Maintenance techniques

Table 1: Three main page to describe each element of urban infrastructure

The "qualitative" information that we collected may be expressed in text however; due to the fact that this information relies heavily on a visual understanding of the infrastructure elements involved, our group created diagrams, based on sketches drawn by Ing. Bottazzo. These diagrams, drawn in Inkscape[41], demonstrate each urban element and the processes used to maintain them. An example of one of these diagrams can be seen below.

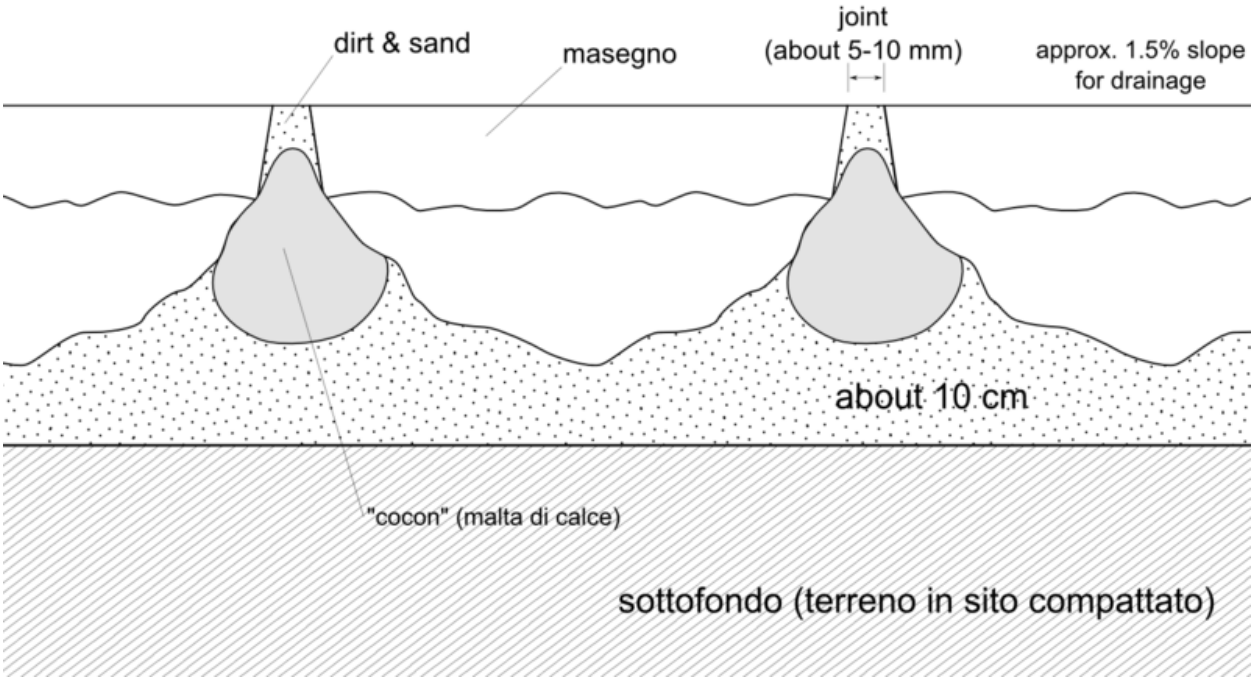

Figure 10: A cross section of stone pavement

To accompany the diagrams, we included pictures, videos, and measurements taken from our field work and our experiences visiting restoration projects.

3.3. Maintaining our Pages

As a result of our project people worldwide will be able to view and appreciate the detailed maintenance procedures of Venice as well as inform themselves on the general knowledge of Venice's unique collection of urban elements. In order to avoid spam[42], we limited who can edit our pages to the most qualified and willing candidates. In addition to WPI students we planned to delegate Insula responsible for updating and editing Venipedia pages. However with the recent reorganization this is not possible, for the time being further updates and editing will be solely by future WPI students.

[41] A vector-drawing program available at www.inkscape.org.
[42] Incorrect, harmful data that will compromise accuracy of information

Our intention is that by setting up templates on bridges, canals, and street paving, well informed individuals will continue to build upon our Venipedia pages. In collaboration with Insula we formed a detailed online updatable repository to preserve the knowledge of urban elements and maintenance techniques used to preserve Venice's historically significant urban infrastructure.

4. Streets

The Venetians seem to have as many words for sidewalks as the Eskimo have for snow: a pedestrian route may have a different name depending on its location, history, or function. However diverse they may be, Venice's streets all face the same environmental attacks. The paving stones, called *masegni*, are made out of a particular type of volcanic rock called trachyte. Trachyte was chosen because its surface remains rough even after years of being worn down by passing feet. Venetians have been using *masegni* since the 17th century. Despite their strengths, these stones are not invincible. The humidity in the air and the constant splashing of the saltwater during *acqua alta* break apart the structure of the stones while the footfalls of millions of tourists wear down the tops.[43]

Figure 11: The *masegni*, or historic paving stones of the city.

Because of frequent flooding from *acqua alta*, when a section of pavement needs to be restored, it is raised a few more centimeters above sea level.[44] This is a relatively modern decision; the traditional solution for keeping feet dry is to roll out *passerelle*, temporary sidewalks that are placed in high-volume routes during flooding.[45]

Figure 12: Map of all of Venice's streets.

[43] Insula SpA, Venice Backstage: How does Venice work?, n.d., http://vimeo.com/21688538.
[44] Idem.
[45] Robert C. Davis and Garry R. Marvin, Venice, the Tourist Maze: A Cultural Critique of the World's Most Touristed City, 1st ed. (University of California Press, 2004), 191.

4.1. Street Pages in Venipedia

We have created 35 pages and 18 diagrams related the streets of Venice. These pages contain a vast amount of information pertaining to streets including, but not limited to, the denominations of streets, paving stone dimensions, and the tedious step-by-step procedure for restoring a walk way. All 35 pages are interconnected with links both embedded in the text and located in the "see also" section of each Venipedia page. A screen shot of every page is located in appendix B and all diagrams relating to these pages are found in appendix A. References for all information are found on their respective Venipedia pages.

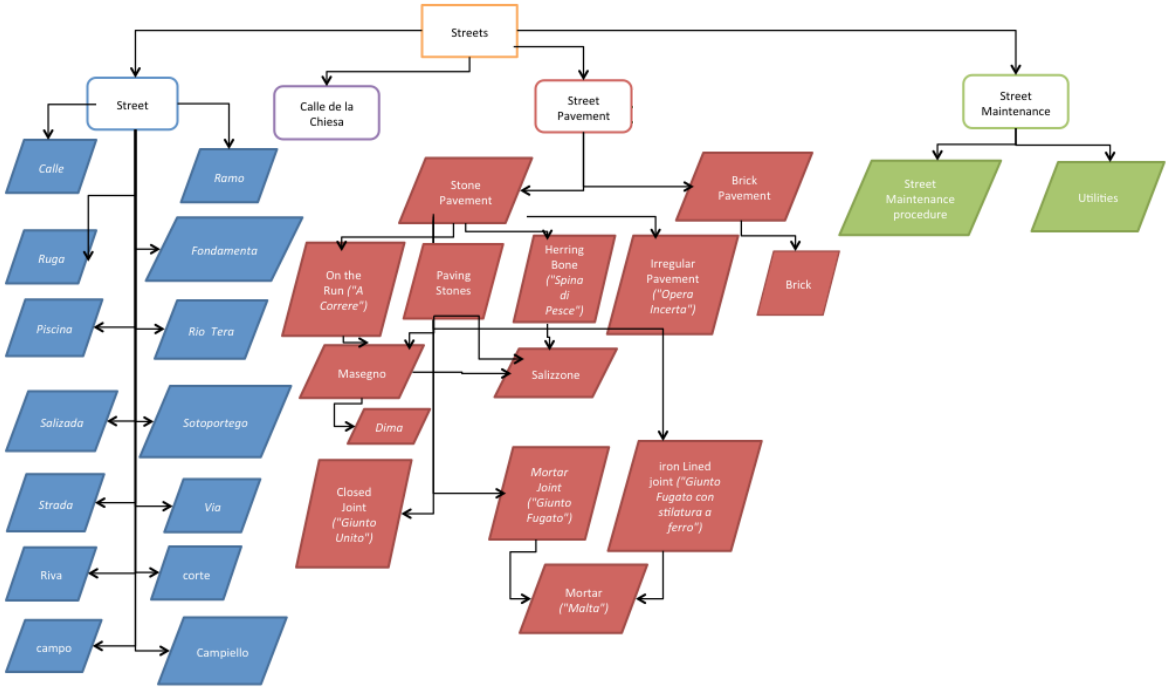

Figure 13: Organization chart for "street" pages.

4.1.1. Streets[46]

The streets page is a quantification of all the streets in Venice. The page includes a brief history as well as an interactive GIS map making it possible to preview information of every street with the click of a button. A navbox was created providing links to all the streets. The infobox used on this page was created to be present on every plural element page (canals, streets, bridges etc.). The page also includes links to lists of the top 10 longest, shortest, and greatest surface area streets.

[46] http://www.venipedia.org/index.php?title=Streets

4.1.2. Street[47]

This page contains an introduction describing a typical Venetian street, its functions, and general composition. Following the introduction is a section on the 14 different denominations of a street. Links are included.

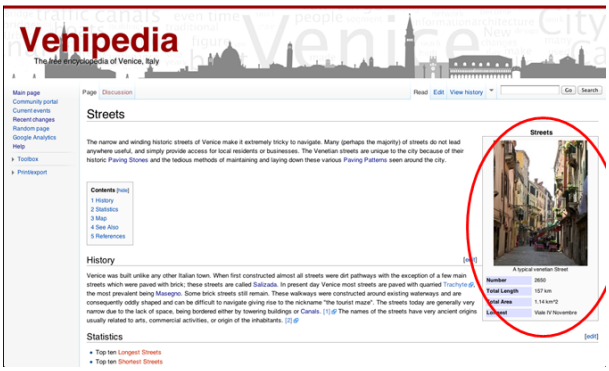

Figure 14: screen shot of "streets" page, infobox highlighted

4.1.3. Street Denominations

We created 14 pages dedicated to explaining the different denominations of street names in Venice. Each page includes a derivation of the name and characteristics pertaining to that denomination. A navbox is included at the bottom of each page to aid quick navigation through these pages. Our group is responsible for the pictures found on these pages. (*calle* is an example of one of these pages).

4.1.4. Street Pavement

On this page is information pertaining to the materials used to pave streets in Venice. This page functions primarily as a portal page[48], providing brief descriptions and links to brick and stone pavement.

4.1.5. Stone Pavement

This page includes the anatomy of a typical stone pavement, the various pavement layouts, the process of laying down stones, and jointing techniques. There is a video taken by our group that shows the process of laying down stones. Two diagrams created by our group are also on the page (see appendix A.1. and A.12.).

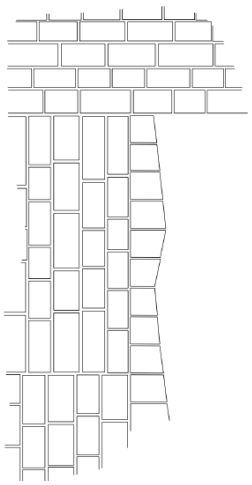
Figure 15: diagram of generic stone pavement layout

4.1.6. Pavement Layouts

There are three pages dedicated to the three most prominent pavement layouts found in Venetian streets. Each of these pages describes the layout and includes a diagram and a picture of the layout, both of which were generated by our group. (*A correre* is an example of one of these pages). (See appendix A.6, A.7, and A.8 for diagrams).

4.1.7. Joint Types

There are three pages dedicated to the three types of jointing techniques used when paving. The pages include a description of the joint's dimensions, material used, and what pavement style the particular joint is applied to. Each page also has a picture, diagram and video where appropriate. All of which were created by our project. (Closed joints is an example of one of these pages). (See appendix A.9, A.10, and A.11 for diagrams)

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[47] http://www.venipedia.org/index.php?title=Street

[48] Portal page: a page that functions as an intermediate page: providing brief summaries and links to appropriate pages.

4.1.8. Mortar (Malta)

The mortar page was created to offer a more complete understanding of how Venetian mortar differs from typical mortar found elsewhere. The different mixtures/types of mortar used in Venice are listed with descriptions as well as in what joints mortar is used.

4.1.9. Paving Stones

The paving stones page is dedicated to the unique stones used in paving streets in Venice. The page includes a description of these stones unique characteristics and origins as well as the different shape and dimension for each stone. Stone treatment techniques are included on this page along with a video showing one of these techniques. All three pictures found on this page were taken by our group.

4.1.10. Stones

There are two pages (*masegni* and *salizzone*) dedicated to the three different stones which represent the majority of stones used in paving streets. The two pages have descriptions of the stones as well a diagram which was created as a result of our project. (See appendix A.13. A.14. and A.15 for diagrams).

4.1.11. Dima for Masegni

This page was created in order to thoroughly explain the *dima*, a measuring tool unique to Venetian paving projects. The page describes how this tool is used to test the proportionality of stones. All three diagrams found on this page are the result our project (see appendix A.16. A.17. and A.18.).

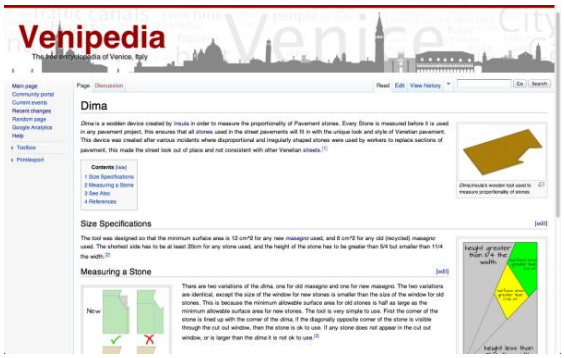

Figure 16: Screen shot of the "dima" wiki page

4.1.12. Brick Pavement

Although the majority of pavement found in Venice is stone a small minority are the remains of historic brick pavements. This page was created to account for this small percentage of brick paved streets remaining in Venice. The page includes a brief history of brick pavement in Venice.

4.1.13. Brick

Although the term brick is universal a page was created in order to explain the unique dimensions of the Venetian brick as well as its functions in Venice's infrastructure.

4.1.14. Street Maintenance[49]

This page was created as the main page for information pertaining to street maintenance. The page includes a brief description of maintenance techniques but serves primarily as a portal page to pages

[49] http://www.venipedia.org/index.php?title=Street_Maintenance

containing more in-depth descriptions. An interactive maintenance map can be found on this page which was linked from Insula's Ramses database.

4.1.15. Street Maintenance Procedure

This page was created to thoroughly explain the tedious procedure related to all street restoration projects. The nine step procedure was created by Insula in order to preserve each streets historical significance. A step-by-step process is found on this page along with appropriate photographs.

4.1.16. Utilities

Because the utility grid lines run underneath the streets this page was created in order to display the different access points for each utility. All four pictures found on this page are the result of our project.

4.1.17. Calle de la Chiesa

The Calle de la Chiesa page is an outlined example for future IQP groups to base individual street pages off of. The page has a brief history of the street including the derivation of its name. Maintenance history and a Google map pinpointing its location in Venice are included on the page. The infobox used on this page was generated by our group. The infobox includes relevant information pertaining to the street such as length, stone type and a picture taken by our group.

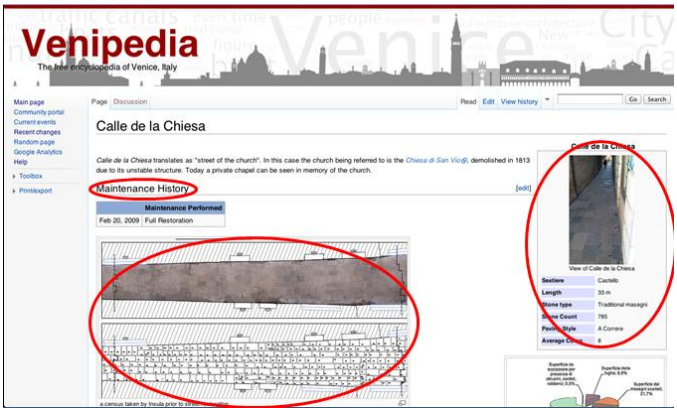

Figure 17: Calle de la Chiesa page highlighting important aspects of page

4.2. Recommendations

Use the procedure explained in appendix E along with collected data for all streets to create infoboxes for all streets in Venice. Follow the outline of the Calle de la Chiesa page to structure the rest of the pages generated by executing this procedure. The "top ten" pages linked off of the "streets" page need to be completed with collected data as well. In addition the page *caditoia* must be completed with text and pictures of each different drain type.

5. Canals

Venice is very picturesque, attracting tourists from all over the world. The city, located in a lagoon, is made of more than a hundred small islands all separated by over 182 canals varying in size. When Venice was first civilized, its canals were natural channels between each island. As the need for land grew, citizens built canal walls to be used as additional foundation for structures.[50]

These altered waterways are natural pieces of art, but also provide practical functions for the city such as transportation and wastewater disposal. The canals primarily function as a means for transportation in the city. Where most cities have asphalt pavement for cars, Venice has slim waterways to accommodate various boats. Most of Venice's population walks on foot to reach their destinations, however a quick boat ride is a convenient alternative.

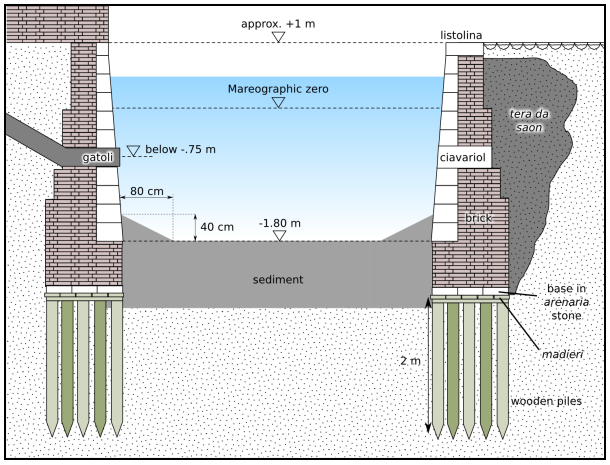

Figure 18: A diagram created by our group showing the cross section of a canal

The gondola boats, initially used for nautical transportation in the city, have been replaced by more modern boats. Tourists are now the largest group of gondola riders; Venetians currently tend to use more practical, motorized boats .[51] Typical examples of public boats are called *motoscafi* and *vaporetti*. *Vaporetti* travel along the Grand Canal or to surrounding islands, while *motoscafi* serve more as water taxis and are traditionally slim boats used for private transportation. Service boats such as delivery barges, postal service delivery boats, rubbish collection, and emergency vehicles also add to canal traffic.[52] In addition, some Venetians own their own private boats, and cruise ships tour the city daily.

Besides the Grand Canal, most of the waterways are narrow, leaving room for one or two boats at a time. These canals are not only slim but also relatively shallow; depths typically vary between 10 and 15 feet.[53] The canals are bounded by two canal walls and a natural floor. The walls are made up of two components, Istria stone and brick. The canal floor is composed of a natural layer of firm clay followed by a layer of silt, sand and gravel.[54] Eroded canal wall remains also contribute to the buildup; deterioration of the

[50] Canals of Venice, goparoo travel guide,http://www.goparoo.com/europe/italy/veneto/venice/attractions/canals/
[51] Idem
[52] Everyday Boats in Venice, Italy Heaven, http://www.italyheaven.co.uk/veneto/venice/boats.html
[53] Canals of Venice, goparoo travel guide,http://www.goparoo.com/europe/italy/veneto/venice/attractions/canals/
[54] Anatomy of a Canal, WPI, http://venipedia.org/index.php?title=Anatomy_of_a_Canal

canals can be attributed to weather, tide changes, boat wakes, and sewage. Over time layers of sediment and sludge build up over the clay, creating a need for regular maintenance in the form of dredging.

The increase in water level at high tide, known as *acqua alta*, briefly exposes the usually dry parts of the canal wall to the corrosive salt water.[55] After becoming soaked with salt water from high tide these stones are again exposed to the air. This constant exposure to the corrosive salt water causes damage and deterioration to the walls.

The canals also function as a conduit for wastewater. Household and industrial waste drain into the canals and are washed out twice a day by the tides. Recently, the strength of the tides have decreased, leaving more waste and sediment to accumulate in the city's canals, increasing the need for dredging.[56]

Figure 19: Map of Venice's internal canals.

5.1.1. Canal walls

For each canal in Venice there are two canal walls; these walls are divided into segments depending on the shape and length of the canal. The canal walls serve a very basic purpose: to contain the water in the canals, and support the walkways and buildings above.

The canal walls are made up of five main elements. Wood poles are driven into the bed of the canal supporting crossed wood planks, forming the foundation of the wall.[57] Istria stone, a non-porous white stone, forms the next layer of the canal wall.[58,59] Istria stone's characteristic ability to reject water makes it perfect as

[55] Canals of Venice, goparoo travel guide, http://www.goparoo.com/europe/italy/veneto/venice/attractions/canals/
[56] Idem
[57] Anatomy of a Canal, WPI, http://venipedia.org/index.php?title=Anatomy_of_a_Canal
[58] Borrelli, Crawford, Horstick, Ozbas (1999). Quantification of Sediment Sources in the City of Venice, Italy. WPI.
[59] Maintaining Venice's Canals, Venice for Visitors, http://europeforvisitors.com/venice/articles/maintaining_venices_canals.htm

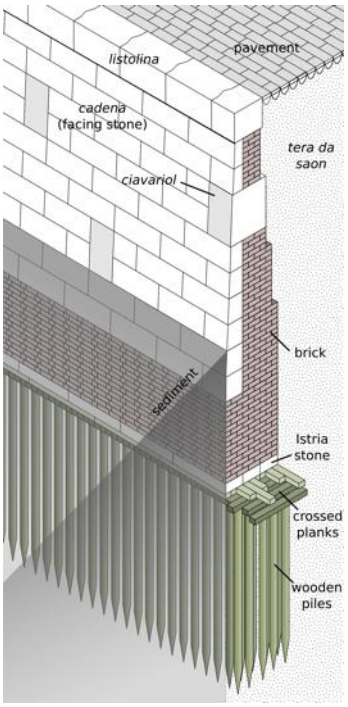

Figure 20: Parts of a typical canal wall.

a strong building block in the canal walls. After the Istria stone, bricks are laid and usually covered in plaster or clay in order to make them less permeable.[60]

These canal walls are constantly exposed to salt water from the canal. The salt water from the canals acts as a disintegrating solvent between the bricks, bond, and stones.[61] The breaking down of the stones, bricks, and mortar compromises the stability of the walls and reduces the resistivity to water. Once the bonds begin to break down, the wall deteriorates rapidly. Boats traveling through the canals at high speeds create large wakes, a condition called *moto ondoso*. These wakes create a turbulent flow in the canals, causing the water to smash against the canal walls, dislodging the already-weakened components. Weak canal walls compromise the integrity of the city's foundations, resulting in a need for constant maintenance.

5.1.2. Handrails and Fences

Parapets are wall-like barriers typically found on walkways, roofs, balconies, bridges, etc. originally used to defend buildings against military attack. The Venetian term *parapetto stradale* refers to the handrails found along the canal walls. These structures consist of horizontal metal rails supported by vertical *colonnine* ("little columns"). The *colonnine* are made of Istria stone and are placed along canal walls to support various styles of metal fences and rails that prevent pedestrians from falling into the canals.

The compound makeup of these rails is a major contributor to their deterioration. Where iron and stone meet, they often corrode and break away, causing red stains and missing pieces of stone at the joint.

5.2. Canal Pages in Venipedia

There are a total of 24 pages and 14 diagrams created to thoroughly describe canals and the role they play in Venice's urban infrastructure. These 24 pages are interconnected through links embedded in the text as well as in the "see also" section of each page. The three main pages include "canals", "canal", and "canal maintenance". Specialized pages are then linked off these three main pages to create a complete understanding of terms and procedures. In addition to these complete pages we generated 175 individual canal pages which include an infobox and description in Italian. Screen shots of all pages can be seen in appendix D and all diagrams are found in appendix C. All references are included on their respective Venipedia pages.

[60] Borrelli, Crawford, Horstick, Ozbas (1999). Quantification of Sediment Sources in the City of Venice, Italy. WPI.
[61] Restoration of the walls of the bank, Insula, http://www.insula.it/index.php/azienda/manutenzione-e-salvaguardia

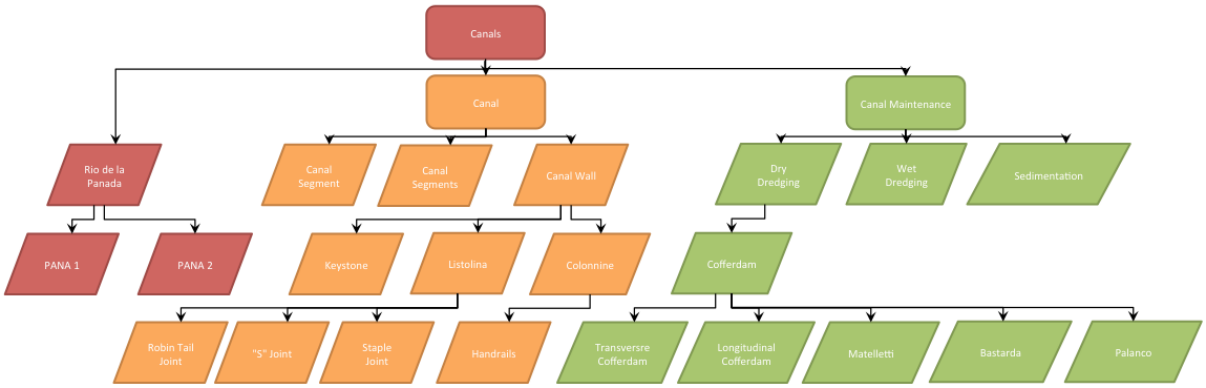

Figure 21: Organization chart for "canal" pages.

5.2.1. Canals[62]

The canals page is a quantification of all the canals present in Venice. This page includes a brief history of the canals as well as an interactive GIS map making it possible to preview information of every canal with the click of a button. A navbox was created providing links to all the canals organized first by *sestiere* then alphabetically. The infobox used on this page was created to be present on every plural element page (canals, streets, bridges etc.). The page also includes links to "top 10" lists of the shortest, longest, and greatest surface area canals.

5.2.2. Canal[63]

The canal page was created to include information on a typical Venetian canal. The page includes a brief description revealing the differences between a canal and canal segment as well as the coding applied to a canal for research and organizational purposes. The page also includes the anatomy of a canal and the various reasons why canals require routine maintenance. There is a diagram on the page which depicts a cross-sectional view of a canal (see appendix C.1).

5.2.3. Canal Segment

The canal segment page was created in order to further clarify the difference between a canal and a canal segment. The anatomy is consistent with a canal however coding for research purposes varies.

5.2.4. Canal Segments

The canal segments page is a simple quantification of how the 182 canals present in Venice break down into 367 smaller canal segments. An interactive GIS map is included to visually aid as well as offer information on each canal segment.

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[62] http://www.venipedia.org/index.php?title=Canals
[63] http://www.venipedia.org/index.php?title=Canal

5.2.1. Individual Canal Pages

Using the procedure described in appendix H and information provided from past IQP groups we were able to generate infoboxes for 175 of the182 canal pages. A brief description is also included in Italian. Other than the infoboxes and the description the pages are empty.

5.2.2. Rio de la Panada

Rio de la Panada is a page dedicated to the canal *Rio de la Panada*. This page was created to be an example for additional canal pages to be created by future IQP groups. The page includes an imported Google map of the canals location in Vencie. Two navboxes are found on this page; one serves as a portal to the three segments of *Rio de la* Panada, the other links you to all 182 canals. The navbox's are a result of our project. The infobox on this page has been enhanced by our group to include all information needed to properly describe a specific canal.

5.2.3. PANA Segments

There are two pages (PANA 1 and PANA 2) dedicated to the first two canal segments that make up *Rio de la Panada*. Each page is intended to be an example for future IQP groups. These pages are intended to contain relevant information such as maintenance history, hydrodynamics, traffic and a still map highlighting the segment. The infobox seen on this page was not created by our group but has been edited and can be found on the Rio de la Panada page as well. The map seen on these pages are images created by our group.

Figure 22: PANA 1 page highlighting infobox and map

5.2.4. Canal Wall

The canal wall page includes a brief history of how canal walls came about and why they were constructed. A canal wall's complex anatomy is also described in text and aided with two diagrams produced as a result of our project. The natural and human processes which lead to a need for maintenance are also listed on the page. (The two diagrams are listed in appendix C as C.2. and C.3.).

5.2.5. Listolina

Because *listolina*[64] are an important component in canal walls a separate page was created and dedicated to explaining their function both in canal walls and bridges. *Listonlina* are a good example of how Venice's infrastructure is a web of elements. The page includes dimensions of these stones that were acquired by our team through fieldwork measurements. The picture on this page is a result of our project.

[64] *Listolina*: a type of stone seen lining the top of canal walls and bridge walls.

5.2.6. Listolina Joint Types

There are three pages dedicated to the three types of *listolina* joints. Measurements and an image of the joints are included on each page. The measurements and pictures are a result of our groups fieldwork. (Robin Tail is an example of one of these pages). There are two diagrams found among these pages; the diagrams were created by our group (C.4. and C.5.).

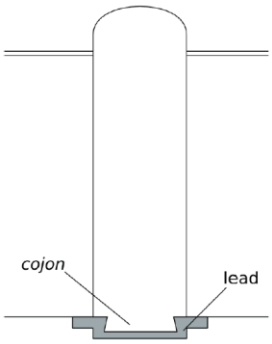

Figure 23: diagram depicting a colonnina

5.2.7. Colonnine

The *colonnine* page is dedicated to the description of the "little columns" that are seen lining the canals. The function of this element is included on this page as well as dimensions which were acquired as a result of fieldwork measurements. The diagrams and picture seen on this page are also a result of our project. (Diagram C.6. C.7.). This element can also be categorized under the bridge sections.

5.2.8. Handrails

This handrails page describes the functions and process of how the handrails in Venice are installed. A brief explanation of why these handrails require maintenance is also included on this page. All three diagrams as well as the pictures found on this page are a result of our project. (for diagrams see appendix C.8. C.9. C.10.)

5.2.9. Sedimentation

A page dedicated to the sedimentation build up present in Venice existed prior to our group however we made significant changes and additions. This page is used to explore the different factors that attribute to the sediment as well as how sediment flows through the canals with the natural tides. The page also has a brief description of how excavated sediment is disposed of after canal maintenance.

5.2.10. Canal Maintenance[65]

The canal maintenance page is the main page dedicated to maintenance techniques and procedures prevalent to canals. The page has a brief explanation of why canals degrade and the different dredging techniques used to rectify this problem. A section on canal specifications is included on this page. This section is dedicated to describing the dimensions a canal must meet after being restored. The diagram seen in this section depicts a canal cross section and is a result of our project (appendix C.1.).

[65] http://www.venipedia.org/index.php?title=Canal_Maintenance

5.2.11. Dredging Techniques

There are two pages (dry dredging and wet dredging) dedicated to the two types of dredging techniques. Each page includes a brief description of the process as well as when each technique is used and pictures where appropriate.

5.2.12. Cofferdam

The cofferdam page was created to describe the general construction of a cofferdam used in dry dredging. This page offers general information but serves primarily as a portal page to the two different types of cofferdams used contingent upon the maintenance project.

5.2.13. Types of Cofferdams

There are two pages (longitudinal and transverse) dedicated to each type of cofferdam used in canal maintenance. As an extension of the general cofferdam page these pages include a more complex description of how each cofferdam is constructed as well as what kind of canal maintenance each is used for. The diagrams found on these pages are the result of our project (see appendix C.12. and C.13.).

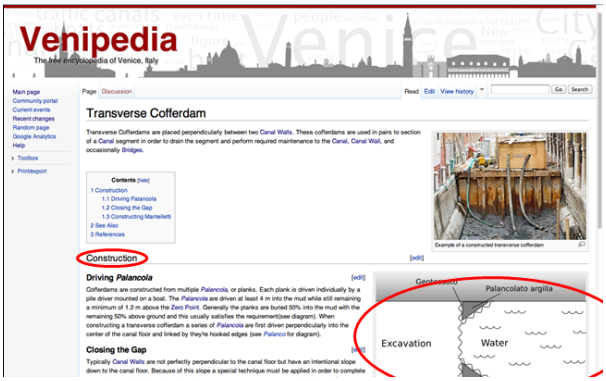

Figure 24: Transverse cofferdam page highlighting diagram

5.2.14. Components of a Cofferdam

There are three pages dedicated to three different components used to construct a cofferdam. The pages are *palancola*[66], *mantelletti*[67], and *bastarda*. These pages describes the function and dimensions of each component. There are two diagrams seen on the *palacola* page which are a result of our project. (see appendix C.11 and C.14).

5.3. Conclusions and Recommendations

As seen in section 6.2.7. we have generated pages for 175 canals. Besides the infoboxes and the description in Italian the pages are blank and will need to be completed with the same type of information and layout as seen on Rio de la Panada. It is recommended that the Italian description is simply translated to English. We also recommend that future groups gather additional information to add to the dry and wet dredging pages as well as the sedimentation page. Contact Dr. Lucca Zaggia, representative for ISMAR in order to complete the sedimentation page.

[66] *Palancola*: Italian for "pile" or "plank"
[67] *Mantelletti*: Italian for "cape". This is a component used in cofferdams.

6. Bridges

Venice, known as the "City of Bridges", consists of 355 bridges that unify the 118 islands that make up the city.[68] Venetian bridges are a symbol of Venice and its unique history and architecture throughout the years. Having no cars, Venice is one of the few places where pedestrian circulation and vehicular traffic never intersect. The bridges of wood, masonry, and metal also serve as public art that attracts tourists from across the globe. The four bridges that cross over the Grand Canal are the Ponte di Rialto, Ponte dell' Accademia, Ponte degli Scalzi, and the Ponte della Costituzione. Venice would not have the magical atmosphere and functionality it has today if it weren't for its bridges.[69]

Figure 25: A Venetian footbridge.

Before the construction of bridges, the numerous islands of the lagoon were separate communities with separate churches, stores, and way of life. The first sign of bridges in Venice appeared when small planks of wood were laid down for pedestrians to walk across from island to island. Some landowners even charged a small fee for people to cross the plank. During the 13th century, the first Venetian bridge was constructed. These bridges allowed Venice, for the first time ever, to become one cohesive union.

In Venice the bridges are mainly for pedestrian traffic but are also utilized for cargo and utility transportation. Cargo transportation is specifically important to Venice because there are no cars. The cargo is brought by boat and then delivered on dollies to the various markets. From small footbridges to the longer and more intricate bridge designs passing over the Grand Canal, travelers use them all to get from one point to another. Not only do the bridges carry pedestrians, but the utility companies use them to hide water, electricity, gas, and communications conduits as they cross from island to island.

Only a limited number of bridges in Venice are completely handicapped-accessible. Some of these include elevators or ramps alongside the bridge. The city is working on improving access for handicapped individuals.

Bridges over the years suffer a certain amount of decay: loss of plaster under the surface of the vault, broken alignment of the *voussoirs*, cracking, and loss of consistency. So that each and every bridge is functioning at its best, there is a need for routine maintenance.[70]

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[68] Nautica On Line - Charter a Venezia, navigando fra i canali della laguna veneta." Nautica On Line - Barche nuove e usate, gommoni, prove di navigazione, patenti e documenti. http://www.nautica.it/charter/venezia.htm (accessed October 4, 2011).
[69] In Venice Today. "Rialto Bridge, Venice." Venice Italy guide: cheap Venice apartments, accommodation and hotels. http://www.invenicetoday.com/art-tour/bridges/rialto.htm (accessed October 4, 2011).
[70] "Bridges - Venipedia." Main Page - Venipedia. http://venipedia.org/index.php?title=Bridges (accessed October 4, 2011).

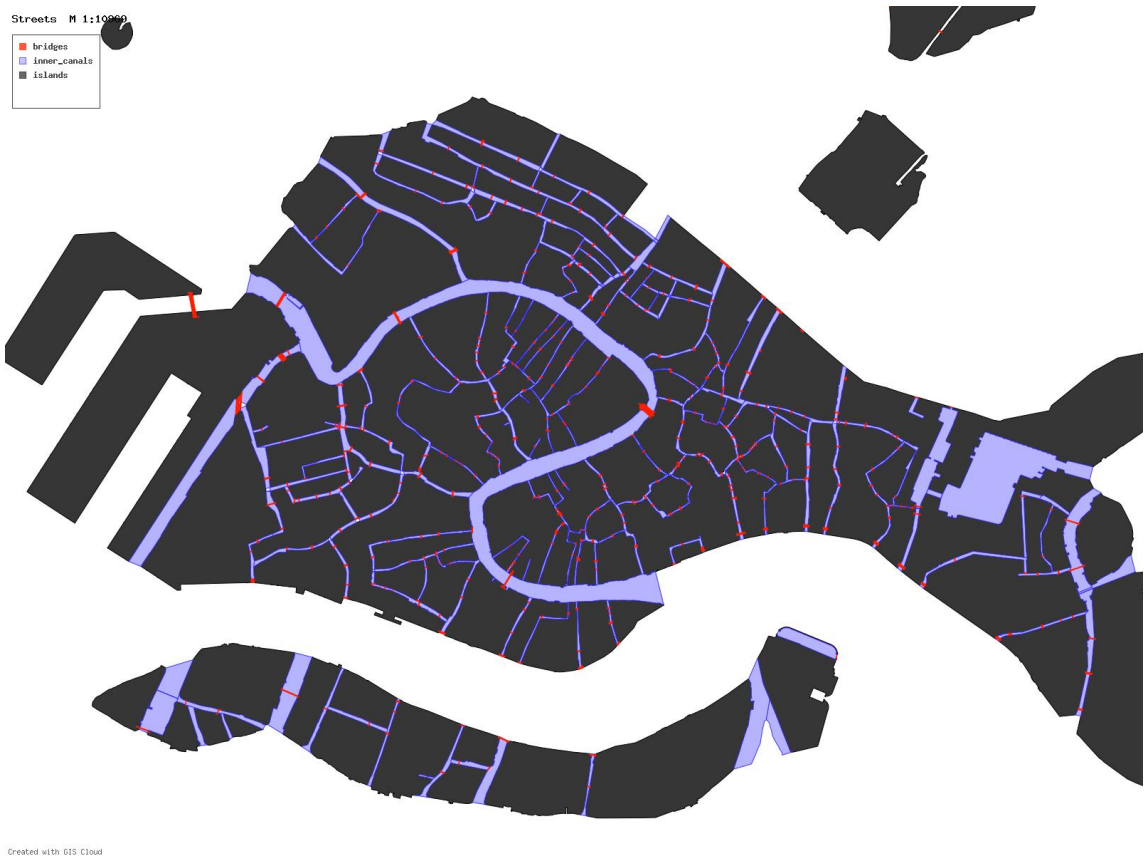

Figure 26: Map of Venice's bridges.

6.1. Bridge Pages in Venipedia

Our group created 13 pages and 4 diagrams associated with bridges. These 13 pages are interconnected through links embedded in the text as well as in the "see also" section of each page. The three main pages include "bridges", "bridge", and "bridge maintenance". Specialized pages are then linked off these three main pages to create a complete understanding of components of the various bridge styles in Venice. In addition to the 13 complete pages we created 258 pages of individual bridges in Venice. These pages are comprised solely of a completed infobox. Screen shots of all pages can be seen in appendix F and all diagrams are found in appendix E. All references are included on their respective Venipedia pages.

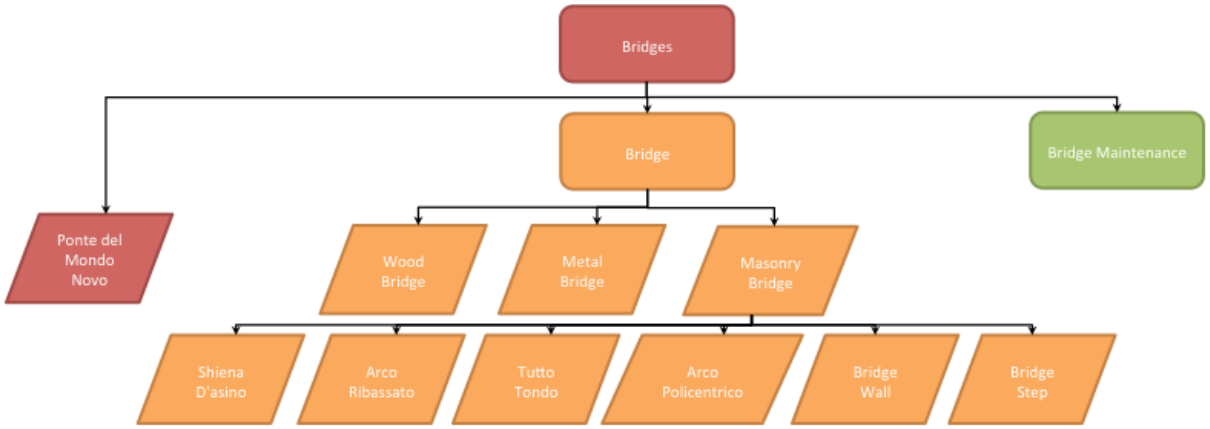

Figure 27: Organization chart of "bridges" pages.

6.1.1. Bridges[71]

The bridges page informs the reader that there are exactly 433 bridges in Venice and includesa GIS map of their exact locations throughout the city. There is also a brief history on the very first bridges and how they have evolved over time. The bridges page also provides interesting statistics such as the top ten oldest, newest, longest, and shortest bridges. There is a navbox at the bottom of the page for one click access to any particular bridge. Like all other plural pages the infobox, created by our group and seen on this page, includes general information of the bridges in Venice.

6.1.2. Bridge[72]

The bridge page starts off with the Italian term for bridge, *ponte*, and generic information about a typical Venetian bridge. It gives a brief introduction of the importance of bridges and describes the basic elements that all bridge structures consist of. There's a classification section which provides links each of the three types of bridge in Venice. Both human and natural processes affect bridges over time is further explained in the bridge page.

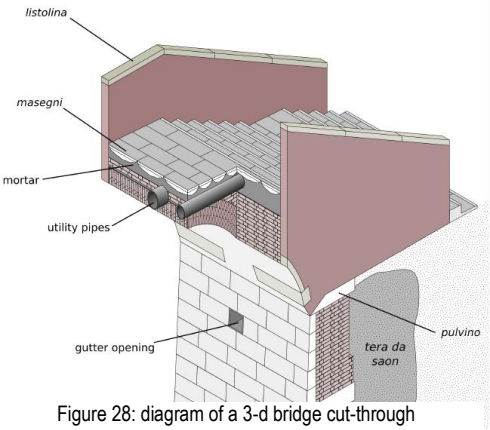

Figure 28: diagram of a 3-d bridge cut-through

6.1.3. Bridge Types

There are three pages dedicated to the three different kinds of bridges found in Venice: masonry, metal, and wood. Each page provides information on the basic structure of the bridge as well as the material(s) it's made of. The pictures found on these pages are a result of our project. There

[71] http://www.venipedia.org/index.php?title=Bridges
[72] http://www.venipedia.org/index.php?title=Bridge

are three diagrams found on the masonry page created by our group. (see appendix E.1. E.2. E.4.)

6.1.4. Bridge Arches

There are 4 pages dedicated to the four bridge arch designs found in Venice. A brief description of each archway and its general geometry is included on the page. Each page also has a diagram further illustrating the complex geometry. These diagrams were created by our group. (The polycentric arch is an example of one of these pages). (for diagrams see appendix E.4)

6.1.5. Bridge Wall

A bridge wall is an important component of any bridge. There are two brief sections describing the two types of bridge walls: stone and railing. There are two pictures found on the page that were taken by our group.

6.1.6. Bridge Step

The bridge step page provides the exact dimensions of the steps found on a masonry bridge as well as its anatomy. There is a diagram created by our group that depicts the cross section of a step. (see appendix E.3.)

6.1.7. Bridge maintenance[73]

The bridge maintenance gives a brief introduction on the frequent pedestrian traffic and weather conditions that cause degradation on the bridges. The Bridge maintenance techniques are described in detail. There is also a short description on why bridge maintenance is necessary and the materials needed to complete this maintenance.

6.1.8. Individual Bridge Pages

Using the procedure described in appendix G and information provided from past IQP groups we were able to generate infoboxes for 258 of the 433 bridge pages. Other than the infoboxes the pages are empty.

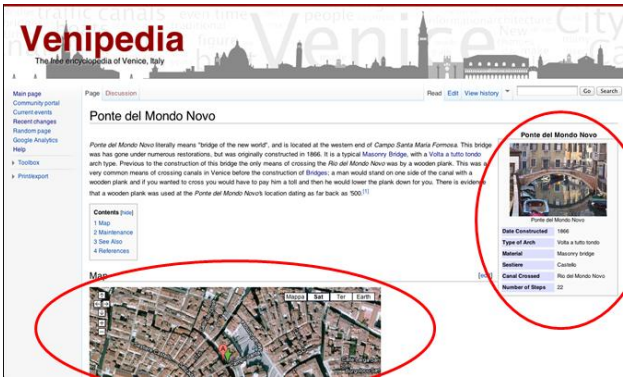

Figure 29: Ponte del Mondo Novo page highlighting infobox and map

6.1.9. Ponte del Mondo Novo

The Ponte del Mondo Novo page is an example of a single bridge page we created as a template for future projects. The page includes an infobox created by our group that contains all necessary information for an individual bridge in Venice as well as a picture of the bridge. There is a

[73] http://www.venipedia.org/index.php?title=Bridge_Maintenance

map on the page that pinpoints its exact location as well as a navbox to provide easy navigation to the other 433 bridge pages.

6.2. Conclusions and Recommendations

As seen in section 7.2.9. we have generated infoboxes for 258 individual bridges. Besides the infoboxes the pages are blank and will need to be completed with the same type of information and layout as seen on Ponte del Mondo Novo. Information can be found in *Ponte per Ponte* (Gianpietro Zucchetta, *Venezia, ponte per ponte* (Verlag stamperia di Venezia, 1992)) and *I Ponti di Venezia* (Tiziano Rizzo, *I Ponti di Venezia* (Newton Compton Editri, 1983)). These books can be found in the Venice Project Center. In addition to completing these pages the "top ten" pages linked off the "bridges" page can be completed using data from past IQP's. Lastly a more detailed procedure for bridge maintenance should be added to the bridge maintenance page in order to provide a more complete understanding.

7. Conclusion and Recommendations

Of all the prominent urban elements present in Venice we created complete pages covering all the maintenance information for the three most important: pavements, canals, and bridges. We laid the groundwork to eventually have a complete record of all urban elements and maintenance techniques. We recommend that using our project work as an example future project groups finish the remaining urban elements. Due to readily available information at the VPC, it is recommended to start with docks and well heads. It's our hope that with the help of future IQP groups we can have a complete knowledge base of urban infrastructure for the entire city.

Figure 30: Collage depicting complete and incomplete urban elements

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Figure 4—"Storia di Venezia," Venezia.net, February 25, 2009, http://www.venezia.net/blog-eventi/storia/

Figure 5—*The Rialto Bridge: Deterioration of the Wooden Structure Before Restoration*. UNESCO, Venice Restored, 86.

Figure 6—Insula: un future per Venezia. Insula SpA. Last modified September 23, 2011. http://www.insula.it/

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Figure 8—"Insula, una riorganizzazione per salvare I posti di lavoro". *Il Gazzettino*, December 8, 2011,

Figure 11—Insula SpA, Masegni, accessed 24 September 2011, http://www.venicebackstage.org/en/218/masegni/.

Figure 12— GIS Cloud, http://www.giscloud.com/app

Figure 19— GIS Cloud, http://www.giscloud.com/app

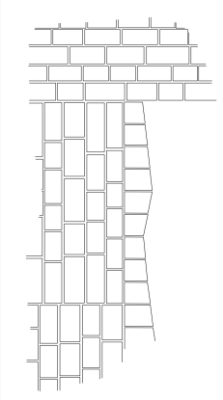
Figure 25—Venetian footbridge. Venipedia. Accessed October 1, 2011. http://venipedia.org/index.php?title=File:Venetian_Bridge.jpg

Figure 26— GIS Cloud, http://www.giscloud.com/app

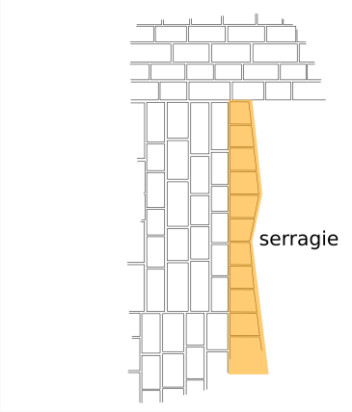
Appendix A – Street Diagrams

*All diagrams were drawn using the downloadable program **inkscape**.*

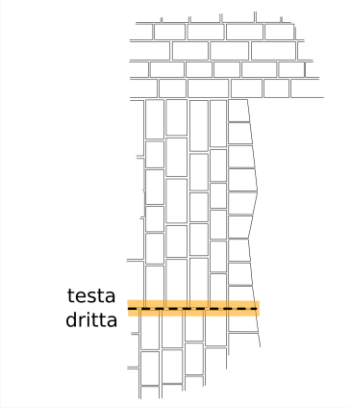
A.1. General street layout



A.2. Serragie



A.3. Testa dritta



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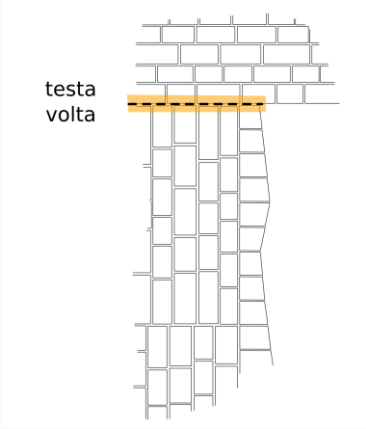
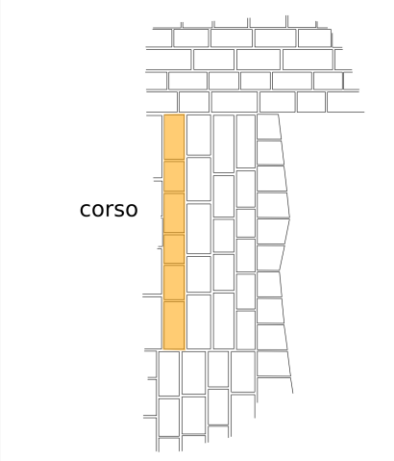
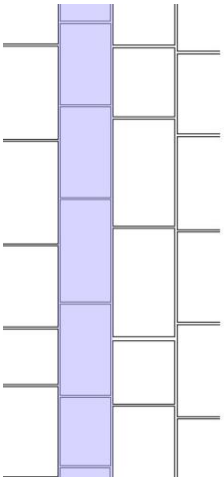


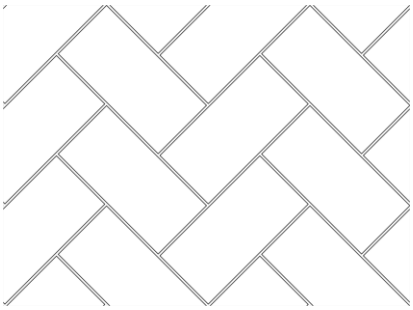
A.5. Corso



A.6. A correre

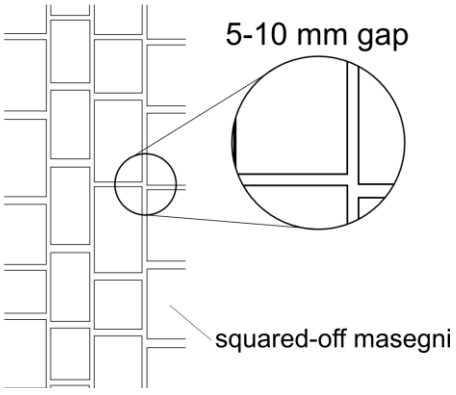


A.7. Herring bone

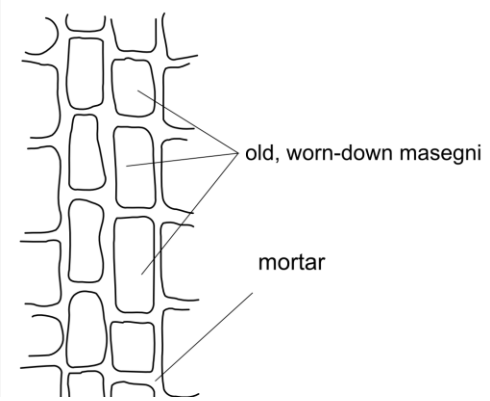


A.8. Irregular

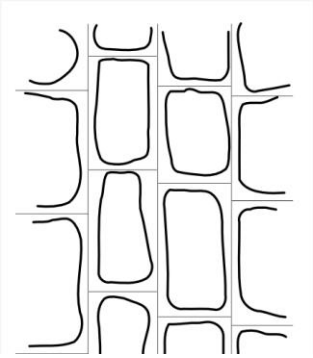
A.9. Giunto unito



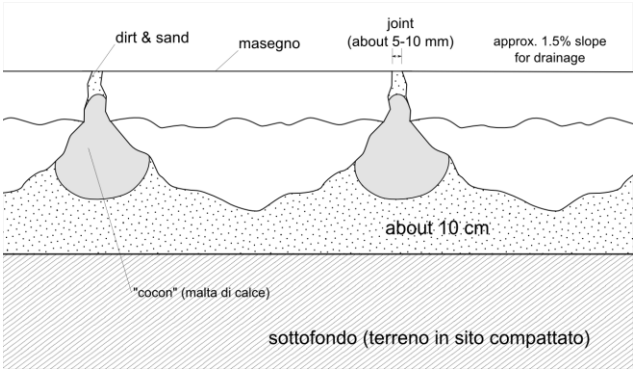
A.10. Giunto fugato



A.11. Giunto fugato con stilatura a ferro



A.12. Posa



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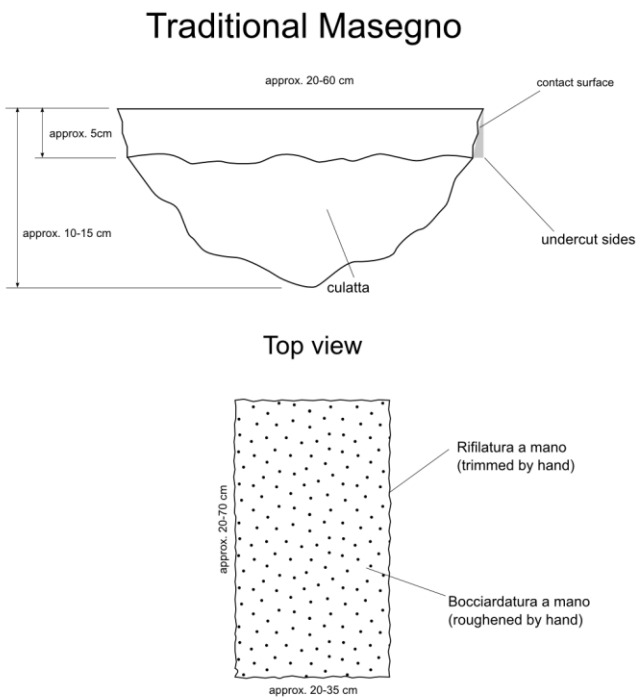
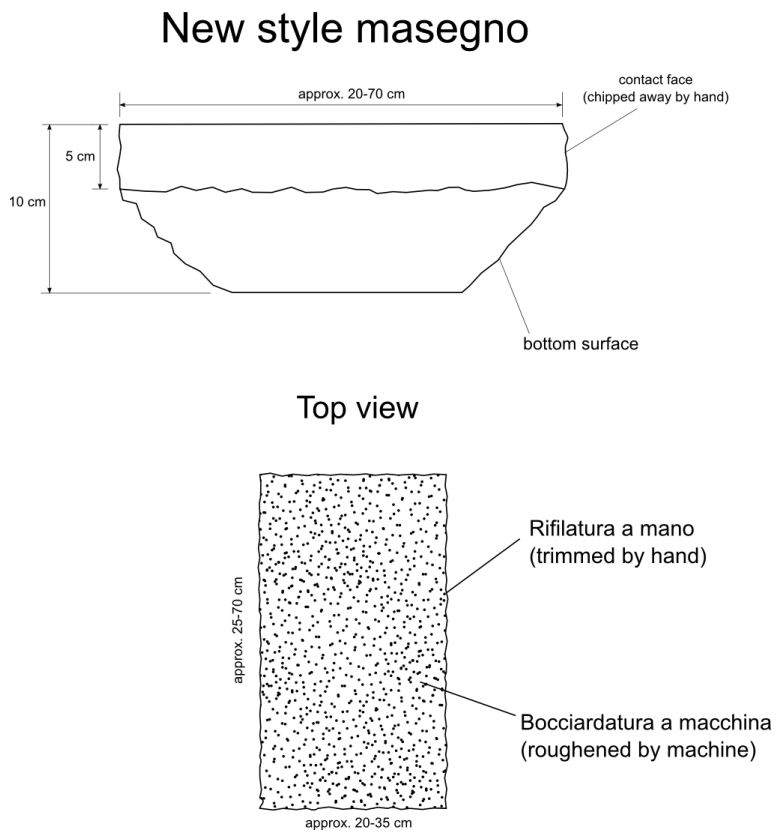
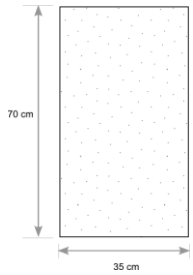


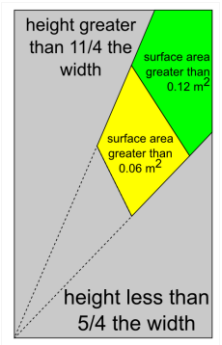
A.14. New masegno



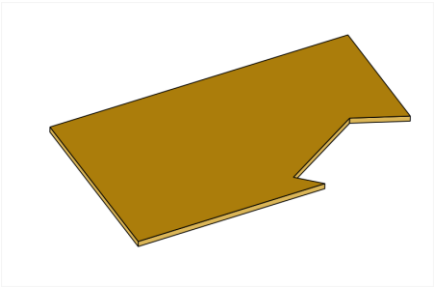
A.15. Salizzone



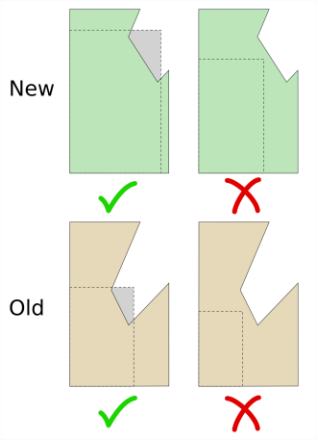
A.16. Dima for masegno specifications



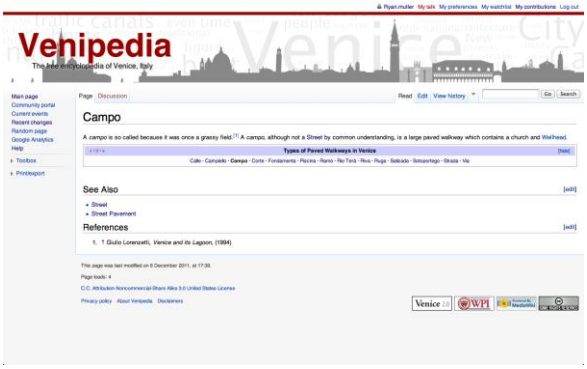
A.17. Dima for masegno

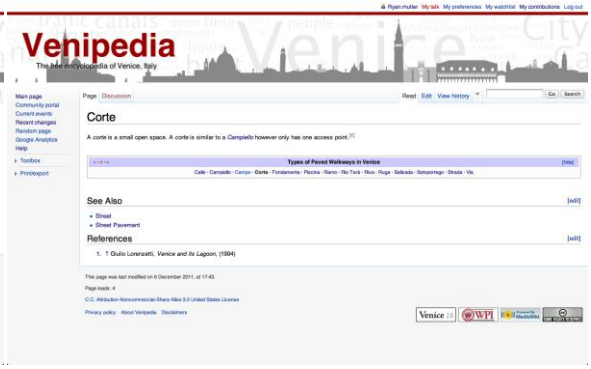


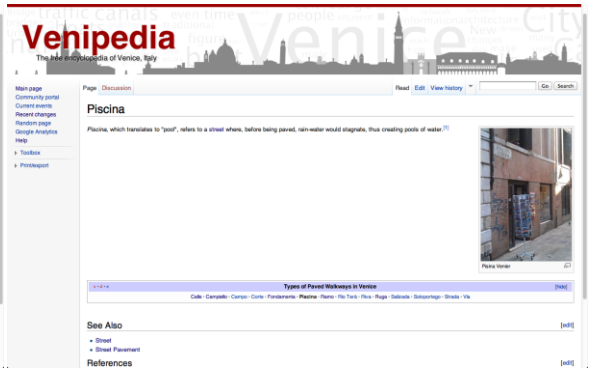
A.18. Dima for masegno in use



Appendix B – Street Pages








Venipedia
The free encyclopedia of Venice, Italy
Ramo
Ramo means "branch". Streets named ramo refer to a smaller street branching off of a larger street. These Streets usually lead to a dead end (Canal). Often times a ramo will include the name of the Street it is branched off of in its name. Ramo was one of the earliest types of street names used in Venice.
Types of Paved Walkways in Venice


Venipedia
The free encyclopedia of Venice, Italy
Rio Terà
A Rio Terà is street that was once a Canal. At one point in time the Canal was filled in with landfill and Paved to transform it into a pedestrian walk way.
Types of Paved Walkways in Venice


Venipedia
The free encyclopedia of Venice, Italy
Riva
Riva, which translates "river", can refer to a Street that runs along a Canal.
Types of Paved Walkways in Venice
See Also
Street
Street Pavement
References
Venice 2.0


Venipedia
The free encyclopedia of Venice, Italy
Ruga
A ruga originates from the french word for "street". This is the most ancient of Street names in Venice and originally described a street that had buildings along the sides. Today these Streets are populated by shops and street vendors. These streets usually have a lot of traffic from both tourist and the local population.
Types of Paved Walkways in Venice


Venipedia
The free encyclopedia of Venice, Italy
Salizada
A Salizada refers to the first paved streets in Venice, while other walk ways were still dirt and mud. Streets were first paved in 1264 with Brick.
Types of Paved Walkways in Venice
See Also
Street
Streets
References

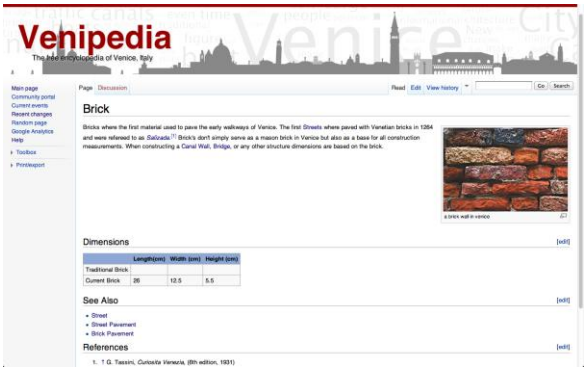

Venipedia
The free encyclopedia of Venice, Italy
Sotoportego
A Sotoportego is a short covered Street that goes through or under a building at Street level. It's typical of these passages to have low ceilings, often at times less than 2 meters high.
Types of Paved Walkways in Venice
See Also
Street
Streets
References
1. ↑ Venice Backstage. http://www.venicebackstage.org/en/glossario/
Giulio Lorenzetti, Venice and its Lagoon, page 16, (1994)


Venipedia
The free encyclopedia of Venice, Italy
Strada
A strada is Italian for "road". Strada Nova is the only Street that falls under this street name. It is a very wide street by Venetian terms and is lined with shops which attract lots of foot traffic from locals as well as tourists. These Streets are popular sites for street vendors and tourist shops.
Types of Paved Walkways in Venice
See Also
Street
Streets
References

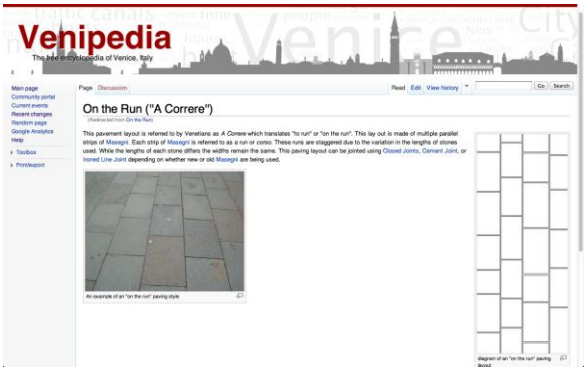

Venipedia
The free encyclopedia of Venice, Italy
Via
Via, with the exception of Venice, is what Italian towns and cities refer to as a general Street. Via Giuseppe Garibaldi is the only Via found in Venice. This street is similar to Strada Nova because it is also a very wide and long street lined with shops on either side.
Types of Paved Walkways in Venice
See Also
Street
Street Pavement
References
Venice 2.0

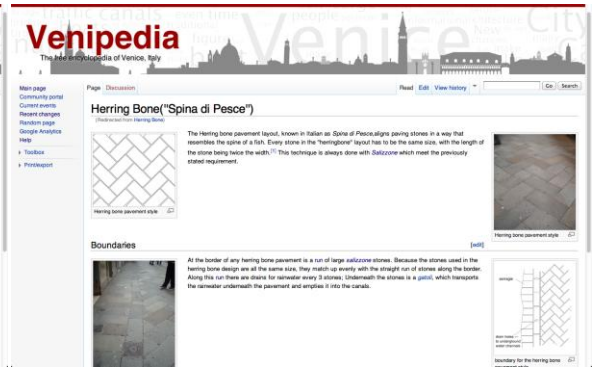

Venipedia
The free encyclopedia of Venice, Italy
Street Pavement
Brick Pavement
Stone Pavement
See Also
References


Venipedia
The free encyclopedia of Venice, Italy
Brick Pavement
See Also
Reference

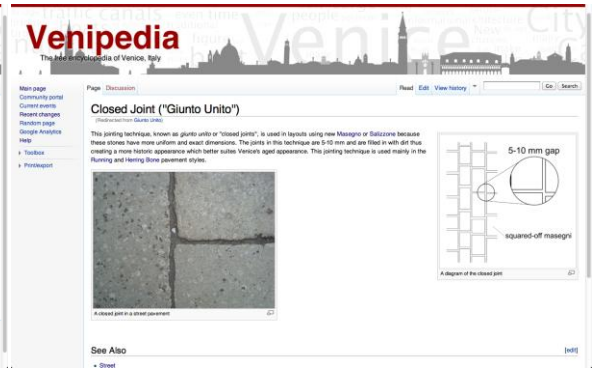

Venipedia
The free encyclopedia of Venice, Italy
Brick
Dimensions
See Also
References


Venipedia
The free encyclopedia of Venice, Italy
Stone Pavement
Anatomy


Venipedia
The free encyclopedia of Venice, Italy
On the Run ("A Correre")


Venipedia
The free encyclopedia of Venice, Italy
Herring Bone("Spina di Pesce")
Boundaries


Venipedia
The free encyclopedia of Venice, Italy
Irregular Pavement ("Opera incerta")
See Also
References


Venipedia
The free encyclopedia of Venice, Italy
Closed Joint ("Giunto Unito")
5-10 mm gap
squared-off masegni
See Also

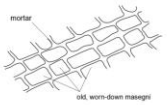
Venipedia

The free encyclopedia of Venice, Italy

Mortar Joint ("Giunto Fugato")

(Redirected from Giunto Fugato)

This joint was introduced in the 1930s as a means to save money and use fewer stones. This jointing technique is used in paving styles that use traditional Masegno. These stones have been worn down over the centuries of use, creating larger gaps between stones and a need for it to be filled with mortar. This joint uses Venetian mortar instead of dirt to fill the gaps between stones. The gaps in between stones must be between 1-5 cm.



See Also

- Street Pavement
- Giunto Unito
- Giunto Fugato con Stilatura a Ferro

References

Ing. Lorenzo Bottazzo, Nov 3, 2011

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Iron Line Joint ("Giunto Fugato con Stilatura a Ferro")

(Redirected from Giunto Fugato con Stilatura a Ferro)

This jointing technique is almost identical to the *Giunto Fugato*. *Con Stilatura a Ferro* literally means "with an iron stylist" and this is the only difference. Venetian Mortar is used to fill the gaps but the joints appear more squared off because there is a line drawn in the Mortar with an iron tool. This jointing technique is used in the Running paving style.

Diagram of the Giunto Fugato con Stilatura a Ferro joint

An example of an ironed line joint

See Also

- Giunto Unito
- Giunto Fugato
- Street
- Street Pavement

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Masegni

(Redirected from Masegno)

There are two types of *masegni* stones used in paving Streets. Traditional *masegni* have been used since 1676 and hold great historical value to the city.[1] Newer *masegni* stones are used in some Street Pavement and are used to replace unusable traditional stones. Both stones are made from quarried Trachyte di from the Euganean Hills di.

Contents [hide]
1 Traditional
2 New
3 See Also
4 References

Traditional

These are original stones that where first introduced in the 18th century.[2] The sides of the traditional *masegno* go straight down for 5cm then slant inward to the bottom of the stone, this slant allows stones to be removed much faster during Street Maintenance. (For typical traditional *masegni* dimensions see Paving Stones.)

Traditional Masegno stone

New

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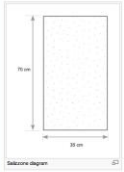
Salizzone



Salizzone diagram

Salizzone is a Venetian term, when translated to English literally means paved street. In reality, *salizzone* are pavement stones made from trachyte di, a volcanic stone quarried in the Colli Euganei, this is the same material used to make Masegno.[1] *Salizzone* and *Masegno* are very similar, the only differences being the size of the stones and the fact that all *salizzone* are new stones while most *Masegno* date back to the 18th and 19th century. *Salizzone* have a larger surface area than *Masegno* and are made to be only 2 specific sizes; the majority of *salizzone* are 35cm by 70cm, while a less common size is 28cm by 56cm.[2] Due to the fact that *salizzone* stones are all uniform in size they are always used for the Herring bone pavement layout.[3] *Salizzone* are made with slanted edges on the bottom, which allows faster and easier removal during Street Maintenance.

These are all *salizzone* arranged in the Herring Bone pavement style

See Also

- Masegno

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Mortar("Malta")

(Redirected from Mortar)

Many of the street pavements in Venice are made up of traditional Masegno stones joined together with mortar. The jointing processes known as Giunto Fugato and Giunto Fugato con Stilatura a Ferro both use mortar to fill in gaps (known in Italian as fugat and join the stones together after they have been properly laid down. In general mortar is made up of a mixture of mostly sand and water with small amounts of other additives.

Contents [hide]
1 Malta di Calce
2 Malta bastardo
3 Malta di Calce Idraulica
4 Cement
5 See Also
6 References

Mortar being poured to join stones in the Street Pavement[1]

Malta di Calce

This is mortar with a lime based powder additive.[2]

Malta bastardo

This is a mixture of a couple different types of mortar.[3]

Malta di Calce Idraulica

This is the most commonly used mortar when laying Pavement in Venice. This particular mortar is designed to set even when water is present, making it ideal for the constantly flooded streets of Venice.[4]

Cement

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Utilities

Venice's utility grid is composed of electricity, public lighting, gas, and cable lines that travel though out the city under the Pavement and Bridges. Each utility is accessible through individual pavement stones that can be seen on almost every Street in the city.

Contents [hide]
1 Electricity
2 Public Lighting
3 Gas
4 Cable
5 See Also
6 References

Electricity

The Electricity grid lines are accessible through pavement stones marked "EN".

Electricity grid pavement stone

Public Lighting

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Street Maintenance

With Venice's local population and the addition of thousands of tourist a day traveling by foot on the calli of Venice, the street pavements can Deteriorate, be displaced, and in some cases suffer complete cracks. Paving Stones can also be displaced by constant Utility access. For these reasons constant maintenance is necessary in order to ensure that the historical importance of Venice's ancient Streets is sustained.

Contents [hide]
1 Pavement Restoration
2 Raising the Pavement
3 Maintenance Map
4 See Also
5 References

Masegni replacement of Calle Larga Contarina

Pavement Restoration

Pavement can be restored simply by removing damaged or sunken Masegni. Since these large stones, like everything in Venice, have historical significance the existing Masegni are reused and not replaced unless its completely necessary. Insula has constructed an in depth procedure of the Process in order to maintain the Streets appearance. Some areas of the city are paved with porphyry, cement or asphalt. When these areas are restored, the materials are replaced with more appropriate materials that closely match the appearance of the rest of the Streets in Venice.

Raising the Pavement

It is one of Insula's projects to raise the pavements of Venice to avoid further drastic flooding of the city. This plan is first concerned with raising the lowest areas of the city's pavement which flood most often. Ideally Insula plans to have raised all pavements to a consistent 120 cm above the zero tide level measurement. While raising the pavements is a top priority, maintaining the original appearance of the walls, entrance to homes, public spaces, and the walkways themselves is of greater importance. For this reason the existing usable Masegni stones are reused in the raising process. is an existing Masegni stone is deemed unusable new stones are made out of quarried Trachyte di stone.

Maintenance Map

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Street Maintenance Procedure

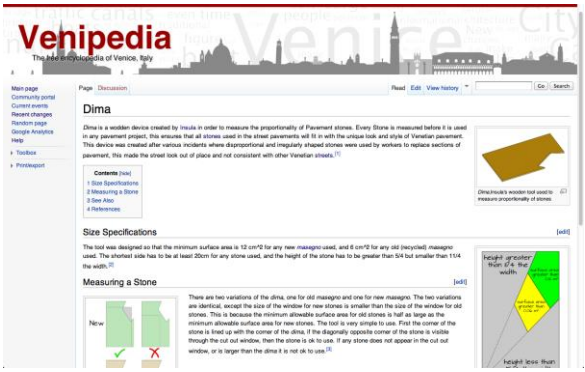
Venice's ancient walk ways and historical Masegni stones hold an invaluable amount of cultural and historical value. It is for this reason that the restoration process of Venice's Streets has a very tedious and methodical procedure to ensure that the heritage is sustained during the maintenance process. The restoration process created by Insula has 8 steps that must be followed rigorously by contracted companies taking on restoration work. After the restoration has been done all data regarding the project is compiled into an in depth stone registration report. This report includes the registration of every stone present on the street, all stones reused, discarded as well as a project overview.

Contents [hide]
1 Census
2 Numbering and Scarifying of Joints
3 Measurements
4 Removal of Masegni
5 Packaging and Storing
6 Stone Inspection
7 Packaging and Disposal
8 Prosa
9 Mortar and Boccatura
10 Registration Report
11 References
12 See Also

Paving restoration of Calle Large Contarina

Census

The first step in the restoration process takes place in Insula offices, before contracting the work, or even receiving the necessary grants to perform the restoration. An aerial picture is taken and an exact blue print type diagram is generated. This diagram has the exact measurement and shape of each stone present on the street in intervention. Each Masegno stone is then given a registration number. The stones numbers are by Corso number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Measuring a Stone


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Calle de la Chiesa
Traffic
Maintenance History


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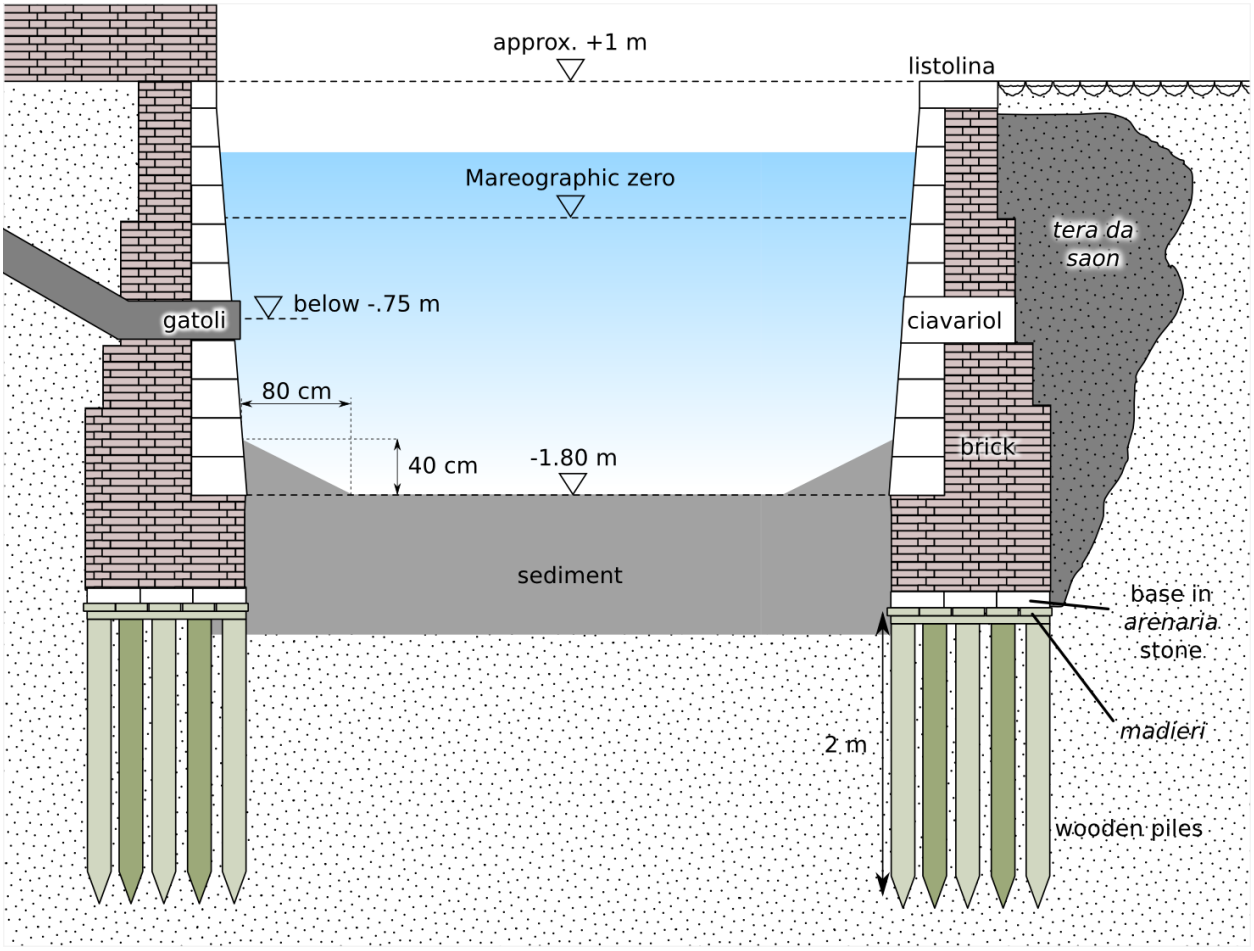
Paving Stones
Stone Dimensions

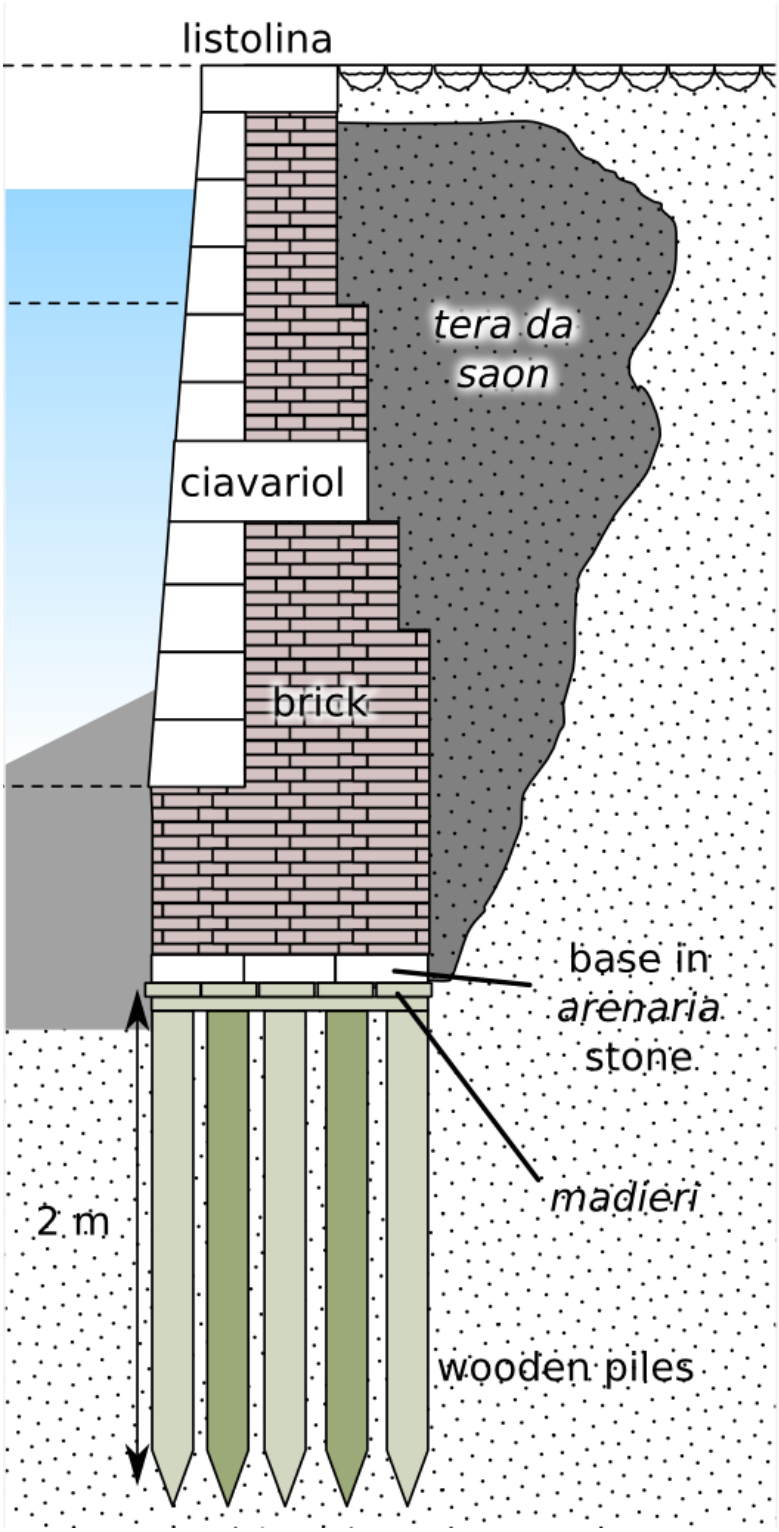
Appendix C – Canal Diagrams

*All diagrams were drawn using the downloadable program **inkscape**.*

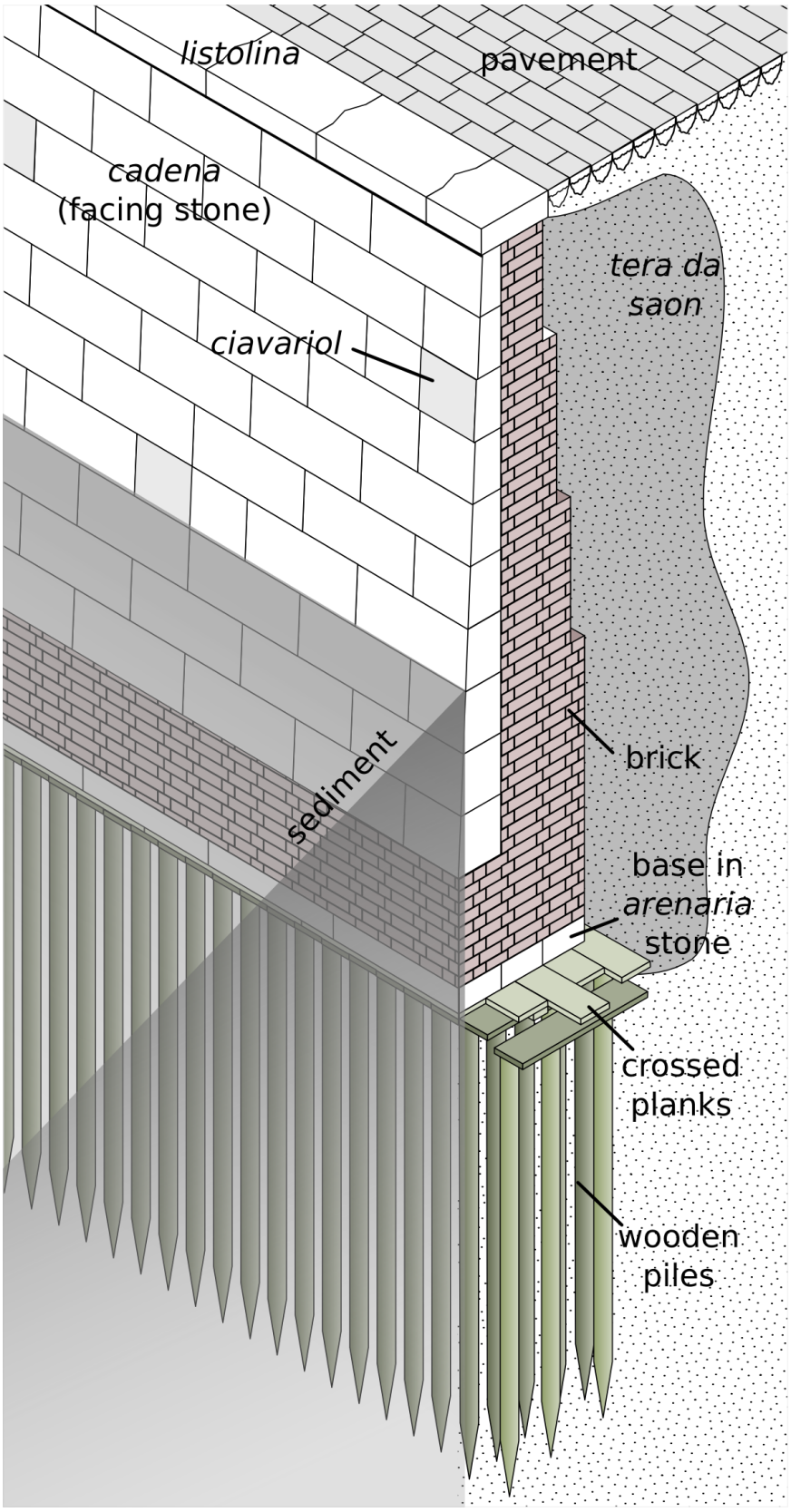
C.1. Canal cross section



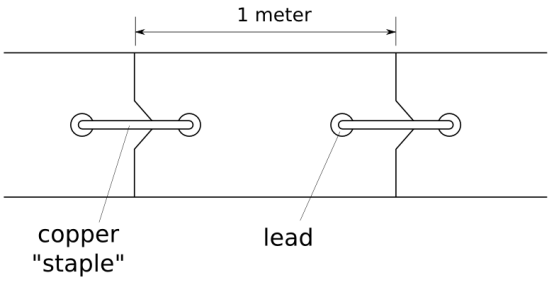
C.2. Canal wall



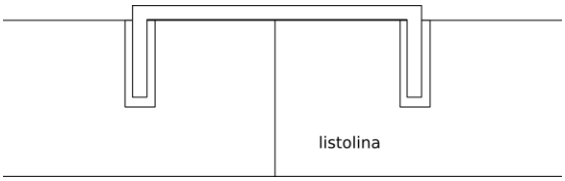
C.3. Canal wall 3-d



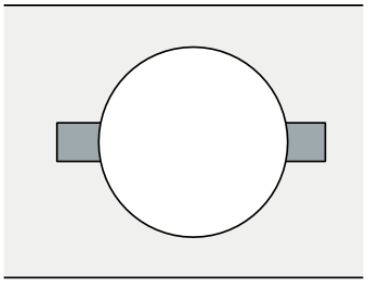
C.4. *Listolina*



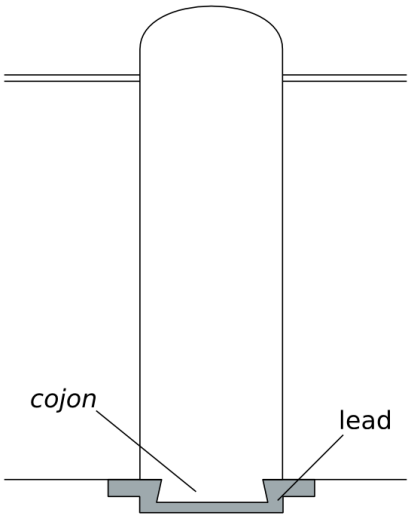
C.5. *Listolina arpese*



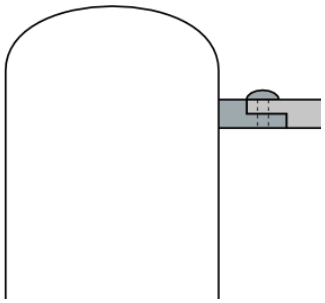
C.6. *Colonnine* top view



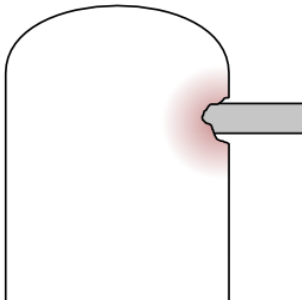
C.7. *Colonnine* side view



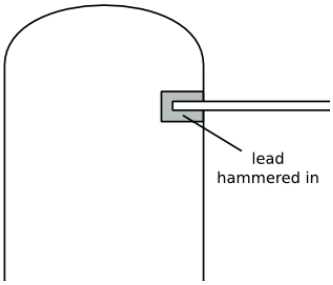
C.8. Handrail joint



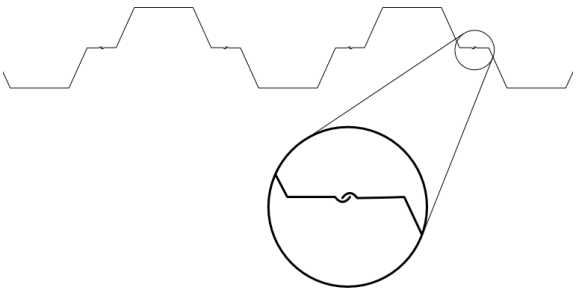
C.9. Corroded handrail



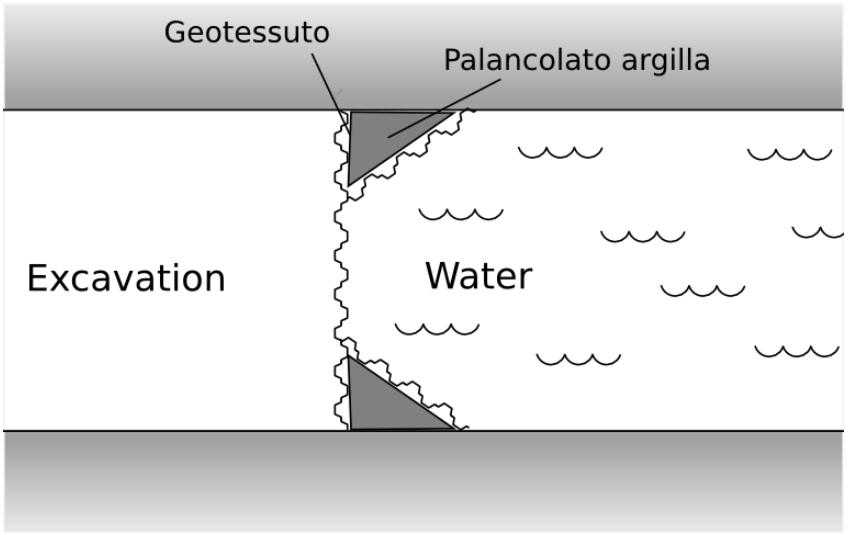
C.10. Leaded hand rail



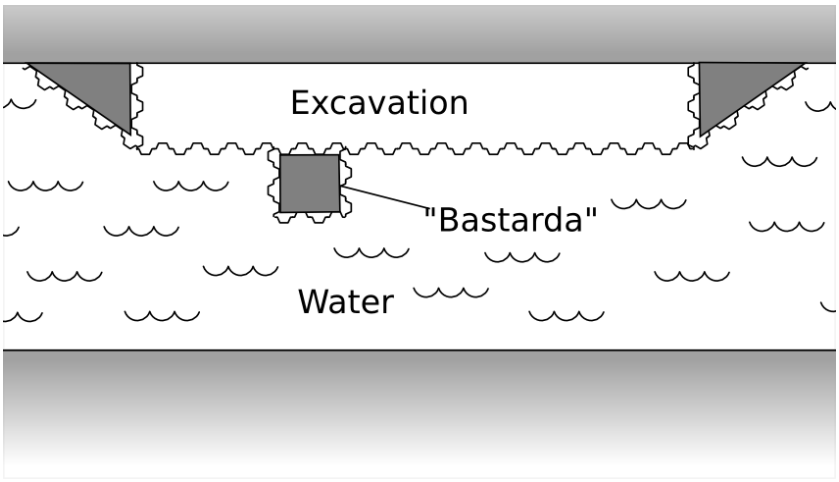
C.11. Cofferdam top view



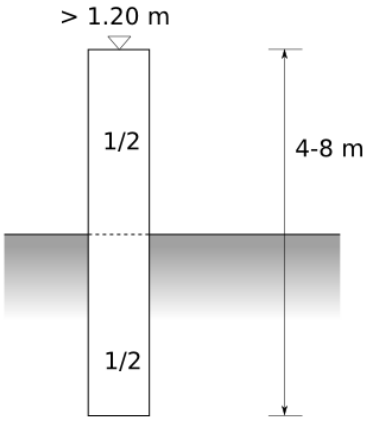
C.12. Transverse cofferdam



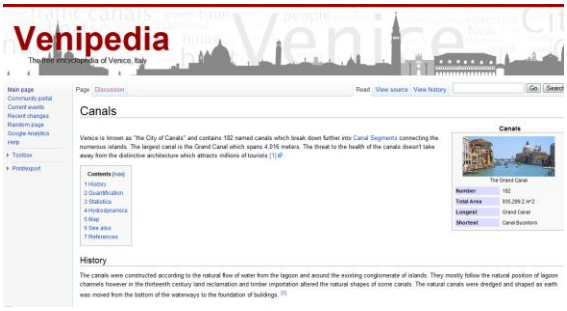
C.13. Longitudinal cofferdam

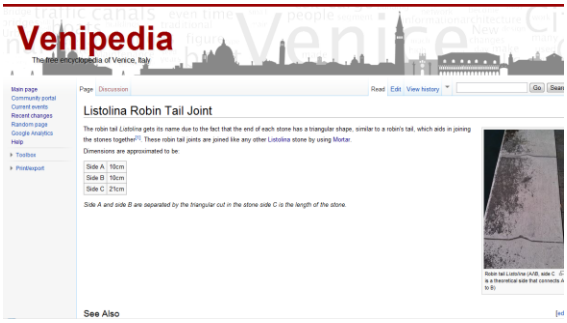


C.14. *Poloncola*



Appendix D – Canal Pages



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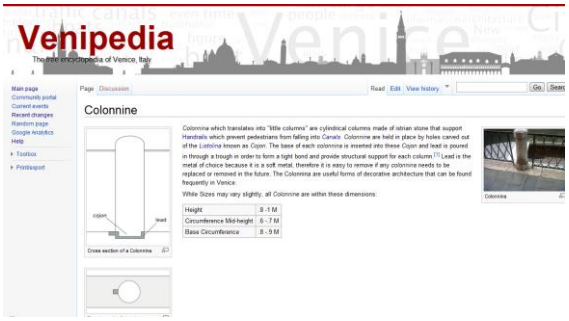
Listolina Staple Joint
See Also
Reference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Colonnine


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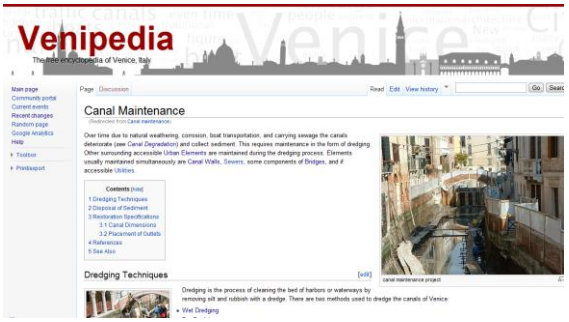
Handrails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Palancolato argilla


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Longitudinal Cofferdam
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"Bastarda"
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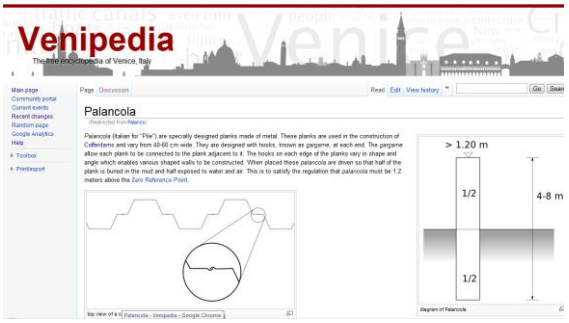
Construction
Driving Palancola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Palancola
> 1.20 m
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4-8 m
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Mantelletti
See Also
Reference


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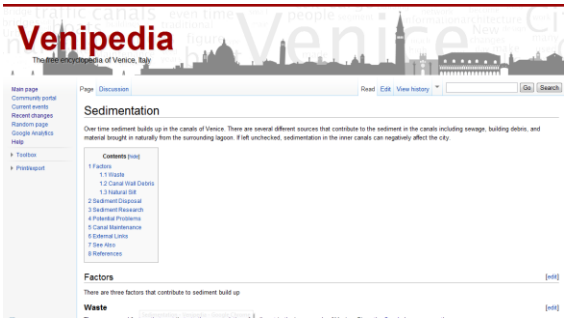
Bastarda
See Also
References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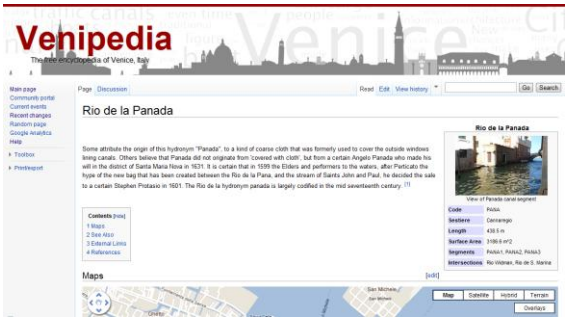
Sedimentation
Factors
Waste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Rio de la Panada: PANA 1
Map


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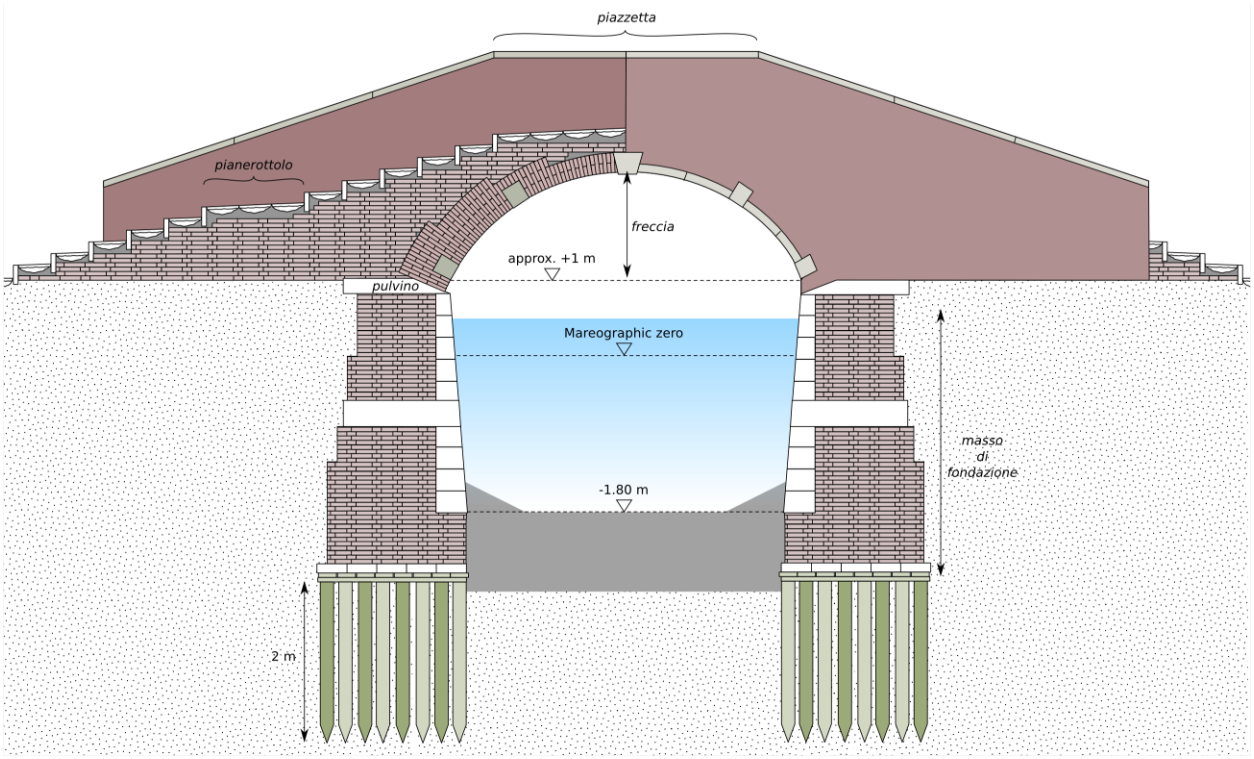
Rio de la Panada: PANA 2

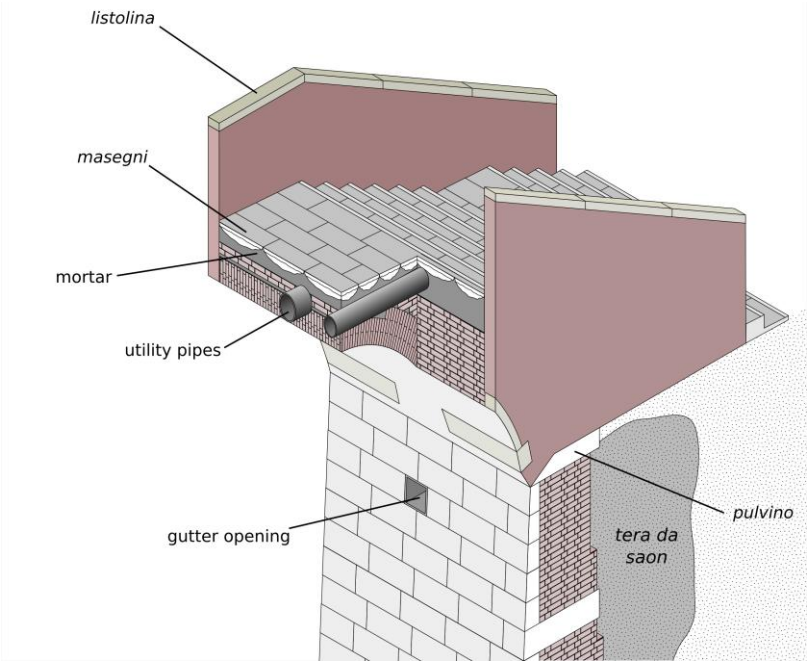
Appendix E – Bridge Diagrams

*All diagrams were drawn using the downloadable program **inkscape**.*

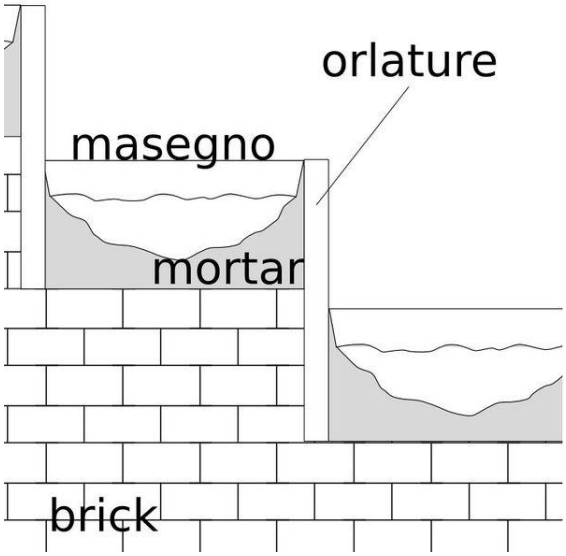
E.1. Masonry bridge



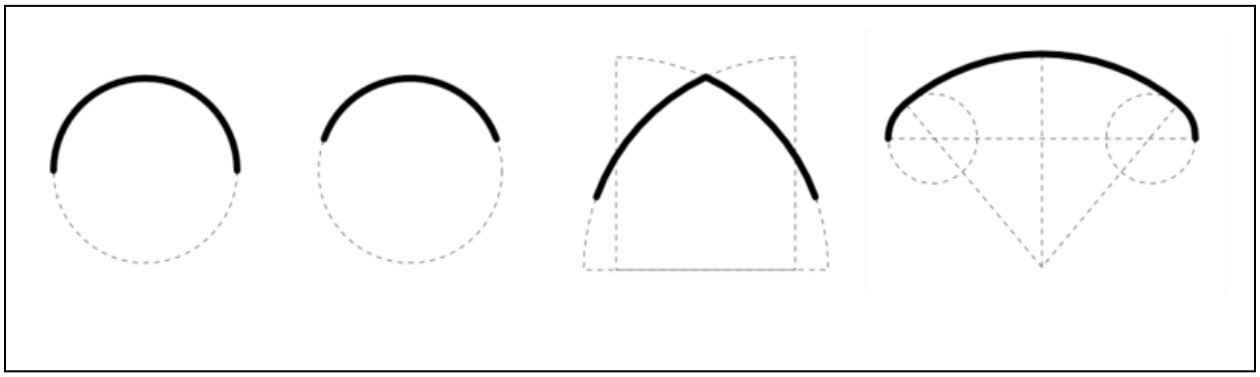
E.2. Masonry bridge 3-d cut-through



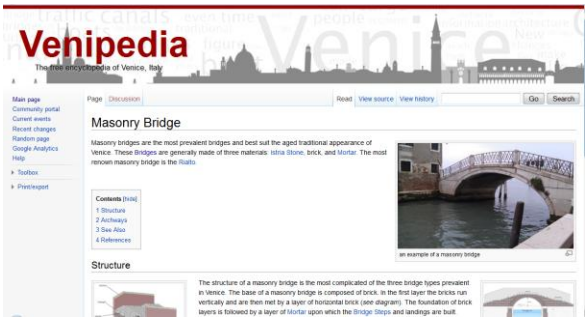
E.3. Bridge step

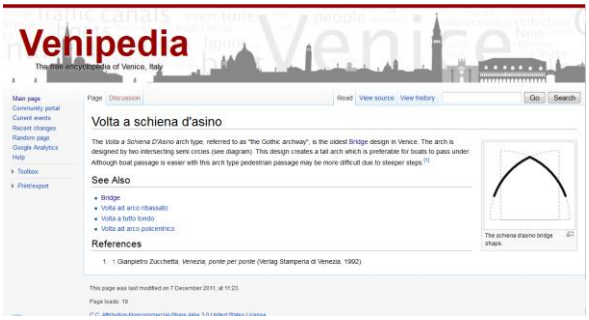


E.4. Bridge arches



Appendix F – Bridge Pages



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Volta ad arco policentrico
See Also
References


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Bridge Step
orlature
masegno
mortar
brick
Masonry Bridge Step Structure
See Also


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Bridge Wall
Masonry Bridge Wall


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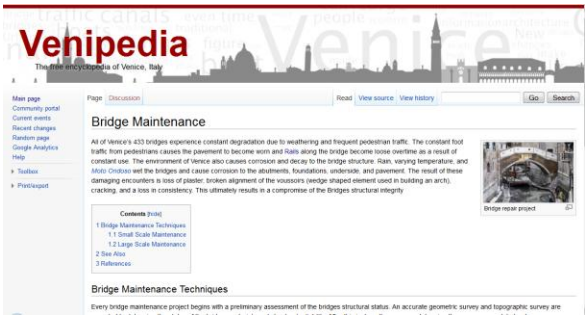
Ponte del Mondo Novo
Map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Bridge Maintenance
Bridge Maintenance Techniques

Appendix G – Measurements

	A	B	C	D	E	F
1		**Location**	**Stone#**	**Length (M)**	**width(M)**	**depth(M)**
2	**Listolina ("s" joint)**	Fondamenta Giacinto Gallina	1	0.98	0.58	0.15
3		Fondamenta Giacinto Gallina	2	1.14	0.58	0.15
4		Fondamenta Giacinto Gallina	3	1.51	0.58	0.15
5		Campo S. Vio	1	1.52	0.57	0.13
6		Campo S. Vio	2	1.35	0.49	0.15
7		Campo S. Vio	3	1.22	0.57	0.1
8		Campo S. Vio	4	2.5	0.57	0.15
9		Campo S. Vio	5		0.73	
10		Fondamenta Venier Dai Leoni	1	2.1	0.49	0.17
11		Fondamenta Ospedaleto	1	1.11	0.49	0.16
12		Fondamenta Ospedaleto	2	0.54	0.49	0.16
13			*Average Size:*	1.397	0.558181818	0.147
14	**Listolina (Robins tail)**	Zattere Agli Incurabili	1	1.14	0.8	0.32
15		Zattere Agli Incurabili	2	2.06	0.8	0.32
16		Zattere Agli Incurabili	3	1.45	0.8	0.32
17			*Average Size:*	1.55	0.8	0.32
18		**Location**	**tail #**	**side A(M)**	**Side B(M)**	**Side C(M)**
19	**Robin tail**	Zattere Agli Incurabili	1	0.11	0.1	0.21
20		Zattere Agli Incurabili	2	0.1	0.11	0.21
21		Zattere Agli Incurabili	3	0.1	0.12	0.21
22			*Average Size:*	0.103333333	0.11	0.21
23		**Location**	**Colonnine #**	**Hieght(M)**	**Base Circumferance(M)**	**midhieght Circumferance(M)**
24	**Colonnine**	Fondamenta Giacinto Gallina	1	0.98	0.87	0.64
25		Fondamenta Giacinto Gallina	2	0.98	0.84	0.63
26		Fondamenta Giacinto Gallina	3	0.99	0.83	0.62
27		Fondamenta Venier Dai Leoni	*1*	0.91	0.79	0.69
28		Fondamenta Venier Dai Leoni	2	0.88	0.8	0.69
29		Fondamenta Ospedaleto	1	0.89	0.8	0.72
30			*Average Size:*	0.938333333	0.821666667	0.665
31		**Location**	**type of rail**	**length between each Colonnine(M)**	**Hieght from pavement(M)**	
32	**Handrails**	Fondamenta Giacinto Gallina	straight rails+circles	1.61	0.9	
33		Fondamenta Giacinto Gallina		1.65	0.9	
34		Fondamenta Giacinto Gallina		1.62	0.9	
35			*Average:*	1.626666667	0.9	
36		Fondamenta Venier Dai Leoni	1 horizontal rail	2.2	0.82	
37		Fondamenta Venier Dai Leoni		2.01	0.81	
38		Fondamenta Venier Dai Leoni		2.02	0.78	
39			*Average:*	2.076666667	0.803333333	
40		Fondamenta Ospedaleto	horizontal and vertical rails	2.05	0.82	
41		Fondamenta Ospedaleto		2.06	0.81	
42		Fondamenta Ospedaleto		2.04	0.81	
43			*Average:*	2.05	0.813333333	

Appendix H – Creating Individual Pages (QwikiWiki)

Our group had access to large amounts of data pertaining to the bridges and canals of Venice. To handle all of this data, and to convert it into a human-readable format, we developed a computer application called QwikiWiki to move all of this data from a database onto Venipedia pages.

History and approach

Using databases to mass-generate wiki pages has long been a part of Venipedia. In the past, groups have used the CSVImport extension to create large groups of wiki pages based on Excel spreadsheets. However, this has several caveats. For instance, the CSV file needs to be formatted in precisely the manner that the CSVImport extension can understand. Furthermore, the CSVImport extension has no method for compiling data from multiple teams into the same page; when one team creates a set of pages, they risk destroying the changes to the pages that other teams have made. For example, this year's "Maintenance" team had data about every single canal, including length, surface area, and history. In addition, the "Hydrodynamic" team collected data about the speed at which each canal flowed. In the past, if the Hydrodynamic team wanted to update their pages, they'd have to collaborate extensively with the Maintenance team in order to ensure that no data was destroyed. This contradicts the very principles on which wikis were invented—for the sole purpose of enabling multiple people or groups of people to collaborate on the creation of a set of pages.

The new method of mass page creation uses a two-pronged approach. First, a custom set of PHP scripts sits on the server, waiting for connections. Second, a custom client application sits on the user's computer, connecting to these scripts and completing requests where possible. This double program enables finely tuned control over the output, and ensures quality of the resulting wiki pages, while removing the requirement for multiple teams to email files back and forth. The QwikiWiki program enables true collaboration such as MediaWiki was designed for while at the same time enables the dynamic generation of pages based on database tables.

Page creation with QwikiWiki

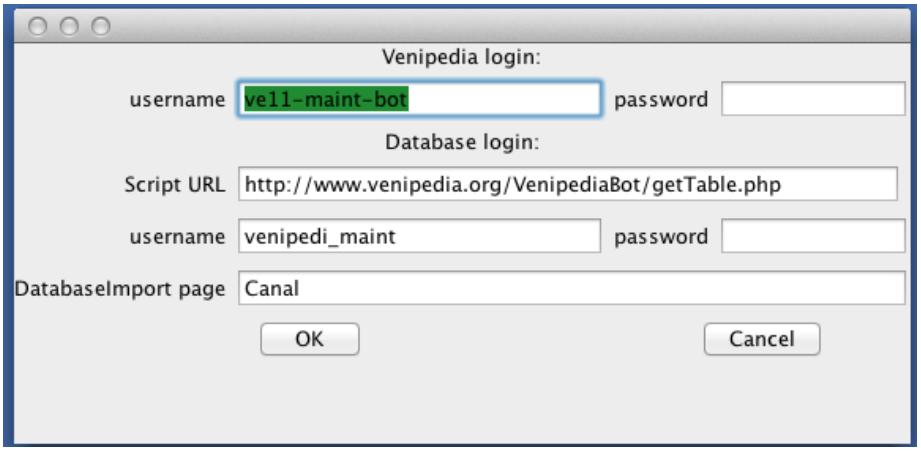
DatabaseImport:Canal

Advanced

```
{"table":"Canals",
 "template":"Page Canal",
 "title":"name",
 "db":"venipedi_maint",
 "fields":
  {"name":"name",
   "number":"insulaNumber",
   "codice":"code",
   "length":"length",
   "surfaceArea":"surfaceArea",
   "description":"description"
   }}
```

A sample JSON specification for a data import.

In order to create a set of pages, the software needs to have a dataset to draw from. The information used to compile this dataset is stored in a page in the "DatabaseImport" namespace on the wiki in a JSON format. The above figure illustrates an example of the JSON format required in the specification page. The QwikiWiki software presents the user with a dialog, shown below, in which is collected usernames and passwords for Venipedia and the MySQL database where the information is stored, as well as the name of the wiki page where the import information has been saved. The software then connects to the database and uses a Java library to create articles based on the information contained therein. The program uses the information contained in the database columns to fill in predefined page templates to enable easy browsing of the given data within Venipedia.



The import dialog as it appears on the Mac OS X operating system.

This approach to mass page creation allows for collaboration the way that MediaWiki was intended to permit. Instead of collecting data from a CSV file, as the current method requires, the QwikiWiki program allows multiple groups to make edits to a single "DatabaseImport" page and a single template, therefore enabling pages to incorporate elements important to both groups while removing the necessity for file sharing

or other similar activity between the groups. No communication is needed besides the knowledge of which wiki templates to use.

Development

At first, the QwikiWiki software was developed using only Java to create a client application. This was extremely limited, as the data transfer capabilities of the application were entirely restricted by the capabilities of the JDBC-ODBC bridge used to connect with the MySQL database. After a point this ceased to work; this was likely due to a settings change on the server. In order to ensure quality of service, the software needed to employ a more robust method.

After learning PHP, I created a set of web apps that, when queried, would return the results for specific data tables located on the local MySQL server. I then modified the Java program to work together with these web apps. The result was astounding: A section of code which took three weeks to write using the old method was completely rewritten using the new method in one day.

Currently, the QwikiWiki application consists of the same two parts. The client, sitting on the user's machine, is capable of uploading data tables from CSV format as well as converting MySQL tables into wiki pages. This is performed with the help of the server applications, which process requests to update and download tables in JSON format. Each works in sync with the other to ensure that pages are created in a consistent format.

Caveats and warnings

- When CSV files are uploaded, the final column can never contain an empty value. In other words, the last column in the table has to have some value for every cell. This is due to a bug in the programming of unknown origin. The fix for this is easy: include a final column with a meaningless title, and which has the same value for all rows; e.g., with title "filler" and with content "*".
- The import specification page needs to have a precise format, dictated by the JSON filetype specification located at www.json.org. When typed by hand, there are frequently syntax errors which can prevent the program from completing its purpose.

Code and further information

The code for the QwikiWiki project is available on the CD for this project, as it is on qwiki-wiki.googlecode.com.