RICE UNIVERSITY

A Waste Water Treatment Plant as a Contemporary Public Space

by

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ABSTRACT

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The piazza is failing as a typology of public space in Florence, Italy due to sprawl, tourism, and the profuse use of the car. However, the city of Florence keeps building new piazzas to act as a public space inside the Centro Storico and in sprawling Florence only to find them empty and unused. Instead of creating new piazzas, the city should be looking towards the successful types of public space which include the parks outside of the historical center.

What if needed infrastructure is used to fund public space? Currently Florence dumps all of its untreated wastewater into the Arno and consequently pays $\frac{1}{2}$ billion euros annually in fines to the European Union. In addition, the Arno floods catastrophically with the last major flood occurring in 1966 causing over 10 billion euros in damage to date. While the city image of Florence is very different than the realities of Florence, even tourists can not escape the consequences of the sewage filled Arno which floods. Building a wastewater treatment plant within the city limits and turning it into a contemporary public park would fulfill the Florentines' needs for communal/public space while also cleaning the water.
I would like to especially thank Grazia Gobbi Sica for spending so much of her free time showing me the realities of Florence, sharing her knowledge of the urban history of Florence, and helping me with my thesis. I also greatly appreciate all of the wonderful professors she introduced me to from the University of Florence such as Benedetto Di Cristina and Marco Massa.

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Most important, Alexandre S. Acemyan shared his photos of Florence with me, accompanied me to my site which is considered very dangerous by even the most adventurous Italians, and he was there during the final hours assisting me with every task.
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INTRODUCTION TO THE THESIS PROJECT

As a consequence of tourism, Florence is more often correlated to Venice and Rome than to the region, Tuscany, in which it is located. As a result, Florence is constantly striving to preserve its ideal city image which tourists expect to encounter when they visit this great city. However, the realities of Florence greatly contrast the touristic image of Florence.

I began my thesis by examining the public spaces in the Centro Storico, and realized the great piazzas no longer function as a public space; yet residents still desire to have communal spaces. At the same time, I discovered that the realities of Florence include flooding rivers, untreated waste water being placed into the Arno, disconnected urban development, heated political problems affecting the built environment, traffic, pollution, and the city becoming unaffordable to Italians.

My goal was to bring the touristic Florence, which generates money for the economy, together with the realities of the city. My project was then heavily influenced by the idea of treating infrastructure as architecture and using it to fund the city's built, social needs. There is plenty of money spent on infrastructure while there is very little money spent on developing new types of public space to fulfill social necessities. The end result was designing a waste water treatment plant for Florence, inside its city limits, and using it to fund needed program such as university housing, art and architecture studios, dog parks, movie theaters, bookstores, etc. The main idea was to convert an area of abused land into a hip, contemporary park which would bring new types of diverse people into an area otherwise used by the poor and elderly with few or no businesses and social infrastructure.
The picturesque areas of Florence that tourists visit only make up about 2% of the entire city. The realities of Florence are depicted above, and they are more depressing and bleak than the ideal city image. A great deal of Florence is made up of post World War II concrete structures, sprawling apartment buildings, high amounts of traffic, big box retail, and disconnected areas of the city.
The top portion of the research board depicts the post card image of Florence which tourists expect to see when they visit the city. However, problems with tourism, the failing piazza, sprawl, catastrophic floods, and especially untreated sewage more accurately describe the city.

**Tourism:** 9 million tourists visit Florence each ear. Moreover, 20% of the city’s income results from the tourism trade (not including individual incomes related to hotels, restaurants, and retail such as Gucci which is mostly bought by tourists). The consequence is that the city must revolve around the tourism trade and the city’s economy is almost completely dependent on it.

**The Piazza is Dead:** Two changes have completely revolutionized the shape and use of the public spaces: the diffuse use of the car and tourism. Piazzas, new and old, inside and outside of the Centro Storico, no longer function as a typology for public space as they are found either completely empty or filled with cars.

**Sprawl:** Florence covers an area of 3,514 sq. km., but most tourists only explore 61.6 sq. km. Florentines are leaving the Centro Storico for the suburbs where they can find lower rents, parking, less traffic, American style grocery stores, and fewer tourists.

**Catastrophic Floods:** 56 catastrophic flood events have been recorded in the last 1,000 years, the last in 1966 with damages estimated at 10,000 billion euros.

**Untreated Sewage in the Arno:** Currently waste from 400,000 permanent residents and nine million annual tourists goes straight into the Arno, directly contravening E.U. directives on water quality.
While the piazzas no longer function as a successful public space, the amount of public space in Florence has actually increased from the 19th century to present. Public spaces now include museums, cafes in big box retail such as IKEA, shopping outlets, and parks inside the Centro storico and in the suburbs.
Damage from the 1966 flood is still being repaired. Consequently, walls have been erected along the river inside the Centro Storico, a series of dams have been built, and other flood control measures have been implemented such as not building within 10 meters of the river and requiring the banks to be covered with natural vegetation. However, the city seems to be waiting for another catastrophic flood to occur at any time, and many do not feel enough has been done to prevent extensive flooding.
Sewage and storm water enters the Arno directly through two smaller rivers: the Greve and Mugnone. The Greve and Mugnone flow throughout the Centro Storico as sewage pipes from buildings place the black water into them. The mouths of these two smaller rivers are located on the western side of Florence within a kilometer of one another. Locating the waste water treatment plant between the mouths of the two rivers is ideal so that the water can be intercepted before entering into the Arno.
An analysis of Florence's current conditions

An analysis of the site chosen for Florence’s first waste water treatment plant
The site is about 1 sq. km, which is similar to the size of Rice University's campus, and it is smaller than the Cascine Park located in Florence, Italy.
Documentation of the area San Bartalo a Centoia located next to the selected site.
The selected site is currently abused by the city, because everything Florence does not want within its city limits is placed on this piece of land.
My initial concept was to place a strip of concentrated program on the site and then to create a dialogue between the strip and remainder of the space.

Placing the strip along the Arno would develop the area along the river similar to Cascine Park, and it follows the historical development of Florence. However, the Ponte Dell' Indiano would become a threshold, there would be no relationship to San Bartalò a Centoia, and the whole site would not be engaged or it would be divided into two zones.

Placing the strip in order to continue the city fabric would result in a site which would be divided more so than the other options, and the resulting strip would be too wide and short. It was decided at this time to embrace the fact that the site is a blank slate; in other words, it is such a rare opportunity within a historical city in which one could take a stand against the current conditions.

Placing the strip along the Ponte Dell' Indiano would once again conform to the existing infrastructure. Furthermore, the site would result in three distinct zones rather than a coherent whole, and awkward conditions would result regarding circulation and existing roads.

Placing the strip along the ancient Roman irrigation ditch takes a stand against the current conditions. Then if the reeds cut through the strip there is the potential to create a dialogue between all parts of the site. It was also decided at this time to let the roads define the strip and keep the natural "green" conditions along the river so that there is a soft border to the site while also following the city's anti-flood measures.
The program selected for the project is a combination of current uses of the land and new program that is either needed by the existing community, would attract new people to the area, bring in tourists to help support the economy, and/or is dependent and the waste water treatment plant.

**PLANT MATERIALS ON SITE**

- farms / orti
- reeds
- poppies / wild flowers
- orchards
- grass

**ADDITIONAL EXPLANATION OF SOME PROGRAM**

**waste water treatment center**: would clean the city's water

**dog park, cafe, & veterinary office**: continues current dog boarding and rehabilitation program; also attracts new people to the area because there are very few dog services and boarding options in the city

**garden center**: retail where everything is under one roof is very popular in Florence; also would serve the needs of the sites' gardeners and offer supplies to maintain the reed beds

**community farms / gardens**: a way to make the current illegal farms "legal" in an organized manner

**swimming pool / wading pool**: the waste water treatment plant's clean water store can also be used for recreation and a water source for the site's plants and vegetation

**contemporary art museum**: needed by the city; will attract tourists to area and reduce tourist load in the Centro Storico

**outdoor cafes & restaurants**: currently absent in surrounding suburbs; park amenity / attractor

**library & bookstore**: attract new people into the area; needed by students and faculty for university

**student & faculty housing**: Florence is very short on its university housing

**art & architecture studios**: provide studio space; currently does not exist at the University of Florence

**abundant parking**: support the use of the automobile

**outdoor theater / movie theater**: attract new people to the area; makes park attractive to the young and hip
THREE PROGRAMMATIC CONDITIONS
The park is first and foremost a waste water treatment plant. Therefore, the required infrastructure will be treated as sculptures in the gardens. The social program is secondary to the waste water treatment components, and the architecture must reflect this idea. Therefore, the social program will be embedded into the earth on the strip, and any remaining program, not placed on the concentrated strip, is to be placed on pilotti sitting in the reed beds.

waste water treatment infrastructure as sculpture in the garden

social program embedded in the strip's surface

off-strip program placed on pilotti in the reed beds
FROM THE RIVERS TO THE PUMP

a) Water will be collected at the mouth of the small, sewage-carrying rivers.

b) So that the rivers are not completely drained dry, they will act as natural reservoirs. In the summer they will have low levels of water and in the winter they will be high. (The photos illustrate examples already present in Florence where a smaller river which feeds into the Arno has its waterflow controlled by a man-made barrier or where it is completely cut off all together.)

c) Pipe is cheap. The mouths of the river, or collection points, will be connected to the sites’ pumps by underground pipe.

d) Once the water is pumped up to ground level on-site, gravity will pull the water through its clarification process naturally as there is a slight grade to the site.

Once the water reaches the site of the waste water treatment plant, it must go through a series of nine steps in order to be clean enough to drink or be placed into the Arno. The first three steps involve removing objects from the black water through a series of filters and settling. Next, the water goes through a system of reed beds which dewater the solids in a confined area. Reed beds require a great amount of space, and the dewatering occurs through evaporation, plant transpiration, and decantation. Decanted water seeps through layers of sand and gravel into the underdrains traveling back to the waste water treatment plant for secondary treatment. At this time the water goes through the secondary clarifier pulling out any remaining solids. Last the water is treated with ultra violet radiation in order to kill any bacteria or organisms before it is oxygenated and stored until the Arno is ready to accept more water. The process chosen does not rely on chemicals and produces significantly less waste than other waste water treatment options. Furthermore, since the site is slightly sloping towards the Arno, only one pump is needed on the entire site as gravity can pull the water naturally from one process to the next.
CLARIFYING THE WASTE WATER TREATMENT PROCESS

a) What **components** make up a **waste water treatment system**? b) How will the **water flow** through the site? c) Which components are **passive, semi-active, and active**? d) Last, which areas of the site will **not be accessible to the public**?
CLARIFYING DESIGN

My design process was guided by a **logical set of rules** developed by looking at the site's **environment** and by following my **intuition**.

1) **Visually and physically connected** the **two rivers** which carry the waste water by creating a **concentrated strip** of **program** and **waste water treatment components**. Corrected existing roads which also now define the strip.

2) **Weaved** surfaces **together** on central strip. Filled rest of site with **reed beds** in order to engage entire site.
3) Established **two axis** for the **waste water treatment** (WWT) components to be placed along. The only surface they were placed on are the poppies.

4) Established **circulation** by following the strip's **weaved surfaces**. Off-strip circulation can be **loose** and **flowing throughout the reed beds**. So that the **strip does not divide** the site into three sections, the **reed beds cut through** creating a **dialogue** between all of the parts.

5) Placed the **program** and **grounded it heavily in the terrain** unlike the WWT components which are **objects and sculptures in the garden**.
CLARIFYING THE PROGRAM

What makes up the program funded by the infrastructure?

What program is on the strip vs. off of the strip?

All of the program is "public," but what areas are monitored/controlled the most?

Last, what program will be used frequently during the day....

and at night?
SYSTEM OF LAYERS
The end result of the design is a system of layers that were determined and shaped by the entire programmatic system.

Individual layers shown to the left and listed from top to bottom: strip of surfaces, waste water treatment components, roads, and program.
An early working model which focuses on planted surfaces, the relationship of the site to San Bartalo a Centoia and Le Piagge, vehicle circulation, and the placement of buildings on and off the strip.
FINAL SITE DRAWING

The final plan resulted in a design where all of the roads on the site were redesigned in addition to the entry and exit ramps to the Ponte Dell’Indiana. The waste water treatment components were placed on two main axis within the wild flower portions of the strips. The pedestrian circulation follows the two main axis in addition to the woven plant materials. As for the on-strip program, it is embedded into the earth, placed directly off the main axis where two different planting strips meet, and the program acts as a stitch to pull everything together. All program off-strip was placed on pilotti adjacent to both the strip and roads, and there is extensive parking located underneath the strip to serve the on-strip and off-strip program. Weaving pathways can be found within the reeds except on the reed beds which act as distribution chambers for the waste water. Last, the site is surrounded by a green, existing band of vegetation which acts as a soft border to the open spaces.
ON-STRIP PROGRAM

SURFACE AND MAIN FLOOR PLANS

All of the program was placed so that it is adjacent to and facing the strip's two main axes. Furthermore, all of the buildings bridge the location where two surface zones meet acting as a stitch to create a coherent whole among all of the various surfaces which are weaved together. The pathways which follow the perimeter of each surface continue uninterrupted as they pass over or under the program. The program is embedded into the ground further accentuating how the waste water treatment plant's components are the dominant objects in the landscape; the park is first and foremost a waste water treatment plant.
LIBRARY & BOOKSTORE
This building pushes up on the ground above it so that the pedestrian walking by is aware of its presence. Meanwhile, the walkway pushes down into the space creating an exterior area to bridge the two distinct pieces of program. The library and bookstore were placed strategically near the art and architecture studios and across from the student and faculty housing. Punctures in the ground allow sunlight into the spaces below so that a light and airy feel is created despite the fact that it is below ground.

PRIMARY CLARIFIER
The clarifier has a shiny exterior surface similar to Anish Kapoor's Cloud Gate in Millennium Park. This surface material accentuates the idea that the clarifier is a sculpture in the garden which has visual dominance over the social program found on-strip.

GARDEN CENTER, UNDERGROUND PARKING, & DOG PARK
Only one of the two floors which make up the garden center are below ground due to the accessibility and movement requirements of the heavy items that will be used throughout the site and acquired by shoppers. However, the garden center structure does push up the walkway which seems to cradle it to the earth's surface. To the north of the garden center is the dog park, cafes, and veterinary offices. All of this program is below grade so that natural walls are formed to keep the dogs in the park while the cafe hovers above for the observers. The veterinary offices are along the edges of the dog park and are tucked into the edges of the earth which continue past its boarders to create a shaded area.
CONTEMPORARY ART MUSEUM, CAFE, & SECONDARY CLARIFIER
The contemporary art museum is similar to the bookstore & library in that it is completely submerged below the strip's ground level. In this case, the sidewalk does not dip down below grade but the access to the museum does and is parallel to the walkway. Moreover, skylights highlight where the structure stops and starts and circular sky lights fill the exhibition spaces below with light. As for the secondary clarifier, this one is pushed below ground so that its top can be used as a hard surface in the park for markets, and other gatherings.

FRESH WATER STORE & STEPS LEADING DOWN TO THE ARNO
In case the Arno is at its maximum capacity, a large freshwater store was created in order to hold the clean water. The fresh water store can also be used for swimming, wading in the cool water, and to water all of the farms and gardens on the strip. In order to create a connection between the pool and the Arno, steps were designed to accommodate the steep slope, and dry areas could also be used for picnics, sun bathing, and relaxing along the river.

VISITORS' CENTER, UV RADIATION SYSTEM, & FRESH WATER STORE
Since the visitors' center has the greatest correlation to the waste water treatment center's programmatic requirements, it is the structure which is the least embedded into the earth's surface. The ramping structure is pushed down by the sidewalk which crosses over it. This allows for the diverse program contained inside to be comfortably separated into two zones.
SCENES IN THE PARK
ALONG THE PEDESTRIAN PATHS

community gardens and a field of poppies; pedestrian circulation creates a boundary between the two surface types

the pedestrian pathway separates the library & bookstore while creating a more intimate public space; primary clarifier located in the background

dog park & cafe
the secondary clarifier located in the poppy fields; used as a hard surface for park activities

a walk in the reed beds located off-strip

the Farnsworth House was inserted into the reed beds for this photomontage to illustrate that the off-strip program will be on pilotti whether the structure is short or tall; architecture that was clearly not designed by the author of this thesis was chosen to illustrate the concept
pedestrians walking from the area of Le Piagge to the central strip while passing through the reed beds

off-strip faculty and student housing; placed on pilotti in the reed beds
While there is no chance that Florence will ever see a waste water treatment plant within its city limits, the project acts as an offering to the city regarding its future development. It is possible to place needed infrastructure within the limits of a historic city if one was to treat architecture as infrastructure (Richard Ingersoll talks about this concept throughout his book Sprawltown). Such actions and decisions would allow Florence’s urban development to evolve so that it can become a dynamic functioning city in the 21st century and break away from its stagnant ideal city image preserved for tourists.
A NOTE ABOUT REFERENCES

Richard Ingersoll's *Sprawltown: Looking for the City on its Edges* heavily influenced many ideas within this thesis as noted throughout the text. All of the factual information within this document was found in Italian newspapers or obtained from the city of Florence. All photographs, drawings, and diagrams are original and property of the author Claudia Jeanne Ziegler.