Country / City	Switzerland, Mendrisio
University / School	Università della Svizzera italiana - Accademia di Architettura di Mendrisio
Academic year	2018/2019
Title of the project	“Project for an acqueduct”
Authors	Dario Biscaro

TECHNICAL DOSSIER

Title of the project: Project for an acqueduct
Authors: Dario Biscaro
Title of the course: Atelier Nunes e Gomes da Silva - Sardegna : Paesaggi Minerari
Academic year: 2018/2019
Teaching Staff: Prof. João Nunes and João Gomes da Silva, Asst. Teresa Figueiredo Marques, Angela Palmitessa
Department/Section/Program of belonging: Design studio - Architecture
University/School: Università della Svizzera italiana - Accademia di Architettura di Mendrisio

Written statement, short description of the project in English, no more than 250 words

The San Giovanni abandoned mining park counts a thick net of galleries, excavated at various altitudes on a mountain. The Groundwater of the area has been constantly polluted by the mining industry, making it not suitable for human use anymore. Due to the high level of humidity and the large temperature gap within the outside, the moist contained in the air constantly condense inside the galleries during both summer and winter.
In this project, I imagined eight of the mouths of those mine galleries to be equipped with a humidity harvesting system, made out of a steel frame wrapped with a specifically designed net. Through the usage of eight independent pipes the so collected water can then be transported to the valley, along the same path and till the same place minerals used to do to be loaded into trains.
In 'Project for an aqueduct' I tried to recover some of the signs and scars left in the area by the mining industry by retracing and turning them again into places of a new production. WATER PRODUCTION..

For further information
Máster d'Arquitectura del Paisatge -DUOT - UPC

T: + 34 93 401 64 11 / +34 93 552 0842
Contact via email at: biennal.paisatge@upc.edu

Máster d'Arquitectura del Paisatge -DUOT - UPC
ETSAB- Escola Tècnica Superior
d'Arquitectura de Barcelona
Avenida Diagonal, 649 piso 5
08028 Barcelona-Spain

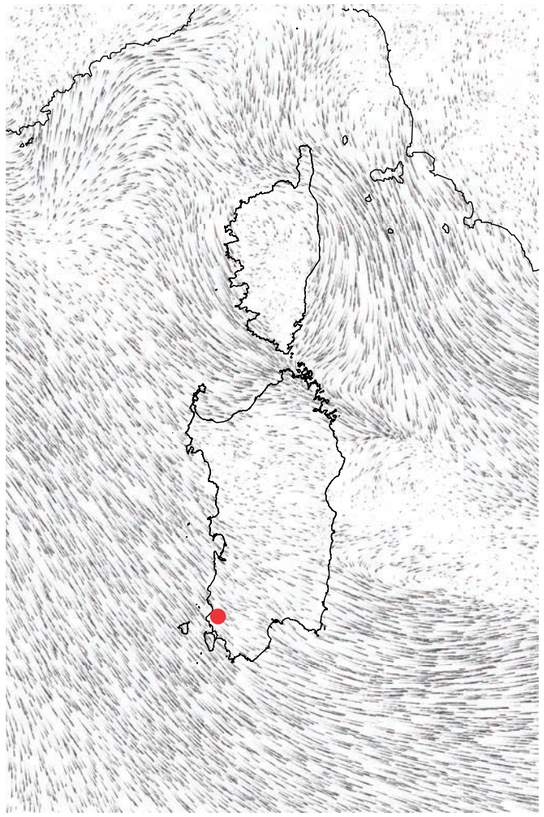
CLIMATE CHANGE AGAIN

11th International Biennial Landscape Barcelona

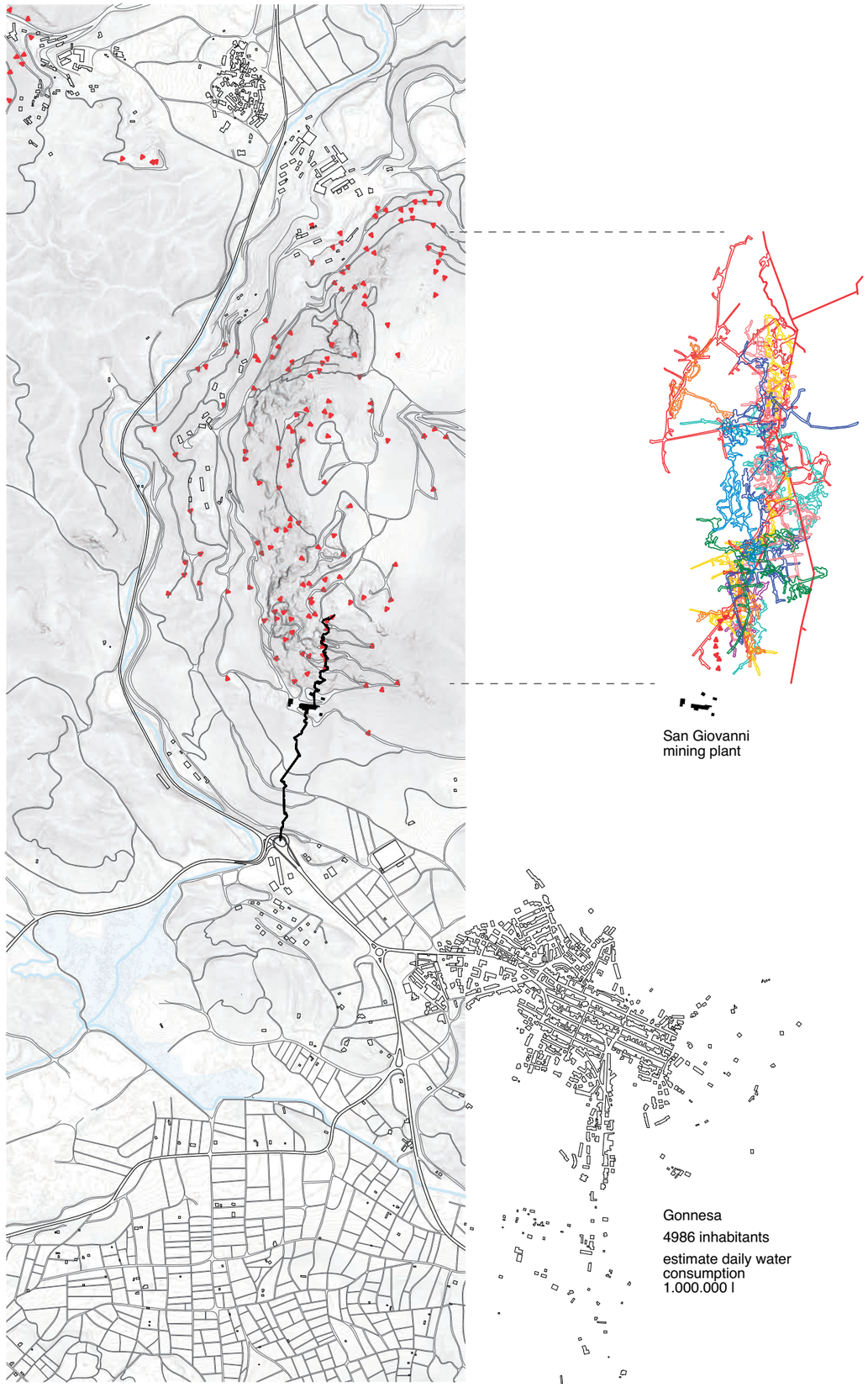
Barcelona September 2020

SCHOOL PRIZE

territorial context - Sardinia - avarage wind intensity and direction



site plan 1:2000 - Mount st.Giovanni, 420 m. - 5 km away from the sea



Each of the red marks visible on the site plan represent one of the mine mouths of the abandoned mount St. Giovanni mining plant, a point of contact between the inside and the outside on the ground, two different climates.

mine mouth in mt. S.Giovanni - avarage size 2x2.2 m. - 4.4 m²

	surface conditions		underground conditions		thermal and humidity shock	
	T.C°	R.H. %	T. C°	R.H. %	Δ T. C°	Δ R.H. %
J	10.2	83	17	100	6.8	17
F	10.4	79	17	100	6.6	21
M	11.6	78	16	100	4.4	22
A	13.6	74	16	100	2.4	26
M	17.2	71	16	100	1.2	29
J	20.9	65	15	100	5.9	35
J	23.8	61	14	100	9.8	39
A	24.4	59	14	100	10.4	41
S	22.1	68	15	100	7.1	32
O	18.3	77	16	100	2.3	23
N	14.1	82	16	100	1.9	18
D	11.2	85	17	100	5.8	15

Climate

In Sardinia, the climate is Mediterranean, with mild, fairly rainy winters and hot summers. Rainfall is not abundant and follows the Mediterranean pattern, that is, it is more common in autumn and winter, it gradually decreases during spring, and hits a low in summer, when it almost never rains.

Sardinia is a windy island, especially from October to April. This happens because of the Maestrale, the northwest wind which blows from France.

Mining activities in the area

This particular area of Sardia has been since the early times interested in frequent mining activities, which have strongly shaped the landscape and the culture of the population who lived here. Many different technologies and knowledge have been applied, at any cost, in the attempt to maximize the efficiency of the excavations. Even though every kind of extraction activity has nowadays stopped, the signs and the infrastructures left by its presence are still visible and affecting the lives of people living there.

Empty holes scattered everywhere throughout the territory, production residues landfills, unstable debris deposits and ground pollution are what is now left in the area of Sulcis-Inglesiente.

Condensation

While the surface climate is subjected to seasonal variations, the levels of temperature and relative humidity inside the ground are steady during the whole year. Due to the high level of humidity and the large temperature gap within the outside, the moist contained in the air is constantly condensing inside the galleries during both summer and winter.

The efficiency of this natural phenomenon does not only depend on pressure, humidity and temperature values, but it can be artificially increased by offering further surface for the water to condense.

project plan 1:2000 - acqueduct path

project plan 1:1000 - mine mouths locations in detail

+ 420 m a.s.l.
Mt. S.Giovanni summit

1 + 406 m a.s.l.
mine mouth

2 + 394 m a.s.l.
mine mouth

3 + 382 m a.s.l.
mine mouth

4 + 343 m a.s.l.
mine mouth

5 + 326 m a.s.l.
mine mouth

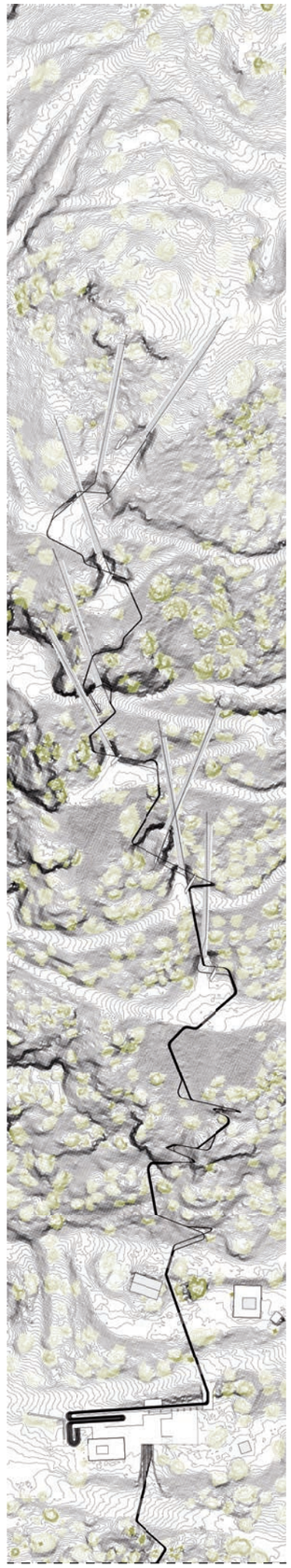
6 + 301 m a.s.l.
mine mouth

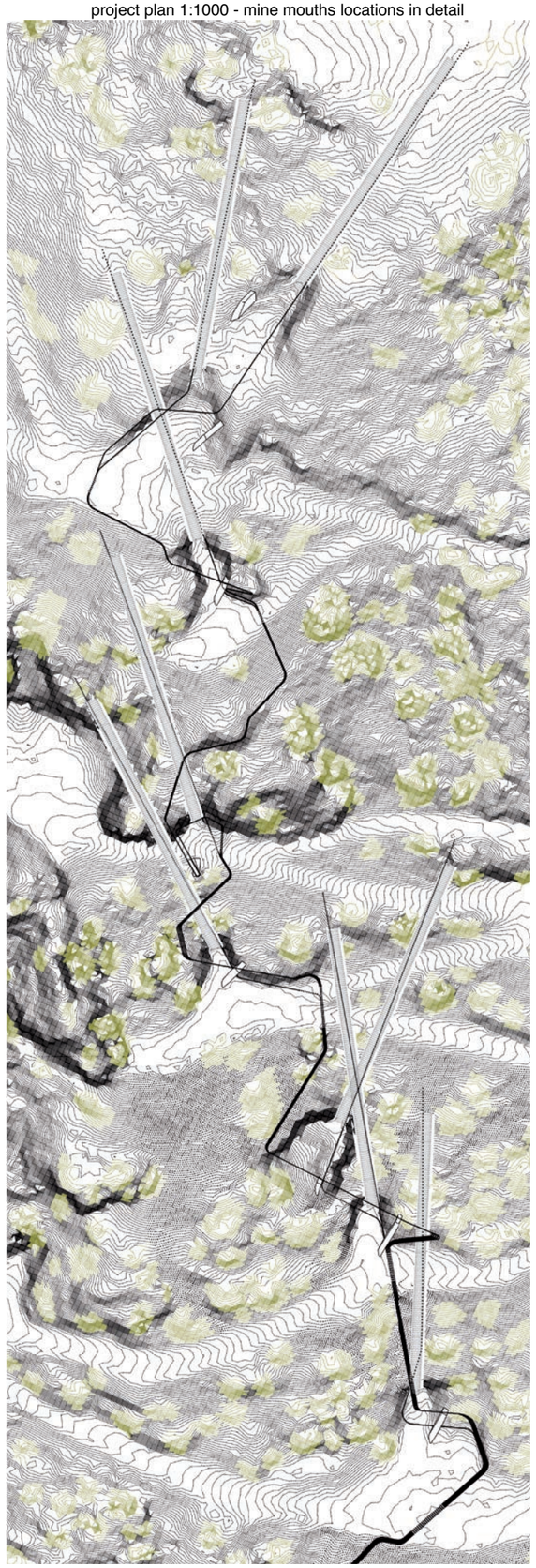
7 + 294 m a.s.l.
mine mouth

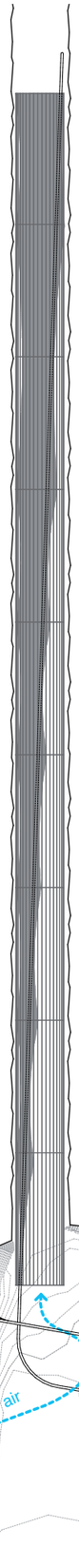
8 + 275 m a.s.l.
mine mouth

+ 181 m a.s.l.
old S.Giovanni mine plant

to be reconverted in a
water treatment plant

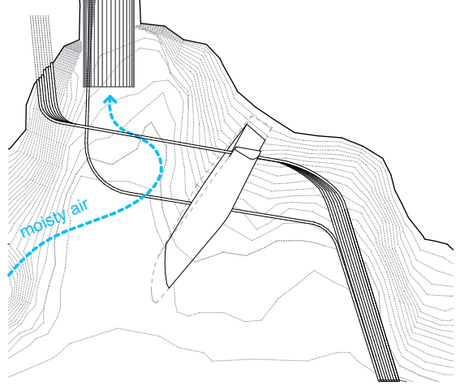




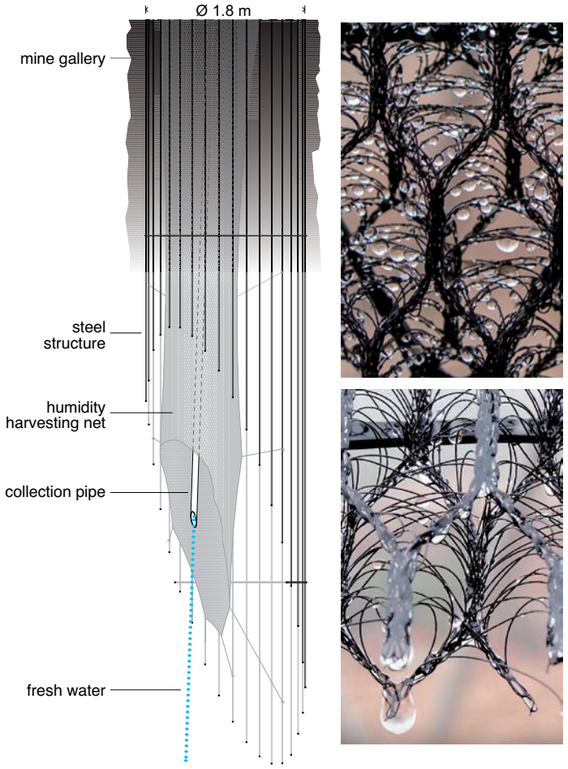


Dew point
reached after

— +50 m. August
— +48 m. February
— +46 m. January
— +42 m. July
— +40 m. June
— +38 m. December
— +34 m. September
— +32 m. October
— +30 m. March
— +31 m. November
— +29 m. April
— +27 m. May



The **dew point** is the temperature to which air must be cooled to become saturated with water vapor. When cooled further, the airborne water vapor will condense to form liquid water. When air cools to its dew point through contact with a surface that is colder than the air, water will condense on the surface.



Estimate water extraction in march

Amount of air passing through a gallery each second:
Gallery section area: 2.2m x 2m= **4.4 m²**
Volumetric flow: 4.4m x 5.5m/s= **24.4 m³/s, 88000 m³/h**

Grams of water contained in a kg of wet air flowing through a gallery each second:
Y vap: p.p./a.p. **= 0.01985 m.vap/m.mix** *cN.= (ρ.air x V)/p.m. =* **1100 mol/s**
moles mass: (y vap. x n.tot.) x m.w. water = **393 ml/s; 0,393 l/s; 1414.8 l/h**

Wet air conditions once it gets in equilibrium with the galleryes conditions:
N. vap.= y vap. x n tot. = **19.8 moles vap/s**
M = N vap. x m.w. water = **356.4 g/s ;356 ml/s; 1283 l/h**

Qty. of water that air needs to lose when equilibrium its reached:
Δ water: 393 ml/s - 356.4 ml/s = 36.6 ml/s; 131.76 l/h x 8 galleries = **1054 l/h;**

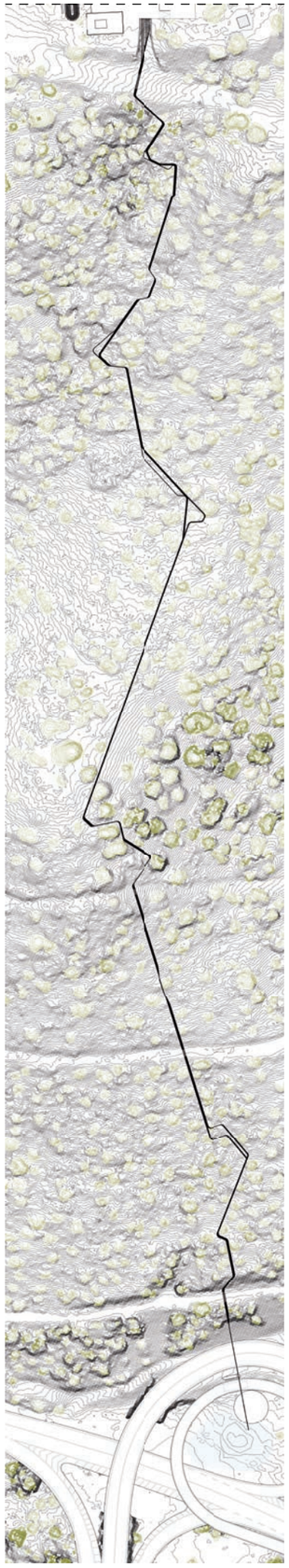
For a total estimate production of 43419 liters of water by day

Data used in the calcultions:

Temperature: 12 C°	Specific Volume: 0.89 m³/kg
Wind velocity: 14.8 km/h	Atmospheric pressure: 0.989 bar
Relative humidity: 78%	Partial vapor pressure: 0.0196 bar
Dew point: 20C°	air density ρ : 1.29 kg/m³
Air density: 1.29 kg/m³	wet air mol. weight Pm: 28.26 g/mol
Humidity ratio: 0.015 kg/kg	water mole weight: 18 g/mol

located misalignment of the pipes

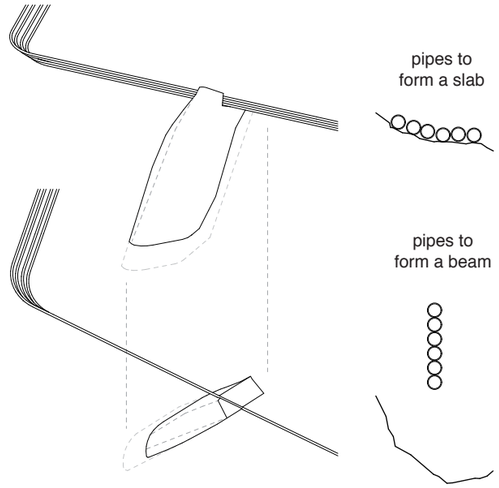
a way to absorb and divide the impact and to slow down the water



+ 20 m a.s.l.
location of the old S.Giovanni mine train station

to be converted in a water storage and collection point

mine mouth no. 4 -1:50 model



The acqueduct and the terrain

At each mine mouth, a particularly shaped concrete element acts as a wind deflector. Their aim is to help the wind flow to hit and enter the mine mouth from the right direction. They are manufactured using the unstable debris deposits left at the entrance each gallery, and their shape and position are studied to be helping both in case of pushing or dragging wind flow. They also provide support for the pipes.

Once collected the water needs to be transported till the valley, not far from the city of Gonnesa.
I imagined an aqueduct made out of eight independent pipes, each one of them starting from the inside of a different mine mouth.
The first pipe, the highest one, starts his run alone, but as during the descent it meets the others, it puts beside them.

As while descending the mountain the aqueduct starts carrying more water, it gets also stronger:
By their juxtaposition the pipes are able to form either a horizontal slab or a vertical beam. This feature helps the aqueduct to adapt to the course of the soil making it able to overcome natural obstacles and steep and unstable slopes.