ZERO+

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Introduction

Give them a tool

Simone Giostra

If you want to teach people a new way of thinking, don't bother to teach them. Instead, give them a tool.
(Buckminster Fuller)

I discovered CAD software while working on my thesis project over 20 years ago. I had used a sharp pencil to draw a full, 35-board construction set on mylar, a durable plastic substrate that was in vogue at the time among design cognoscenti. Over the course of a reclusive month, I took on retracing every drawing with a mouse, until I had an exact digital copy of the entire set of pencil drawings–and I never went back. My generation was probably the last one to know architecture before the computer–and the first one to enjoy the competitive edge brought by digital tools. Empowered by a very early AutoCad release, I could take on responsibilities, both in the office and on the construction site, that were far beyond the typical duties of a recent graduate.

The so-called digital revolution have empowered each new generation with the tools to design and construct increasingly complex systems since. Interestingly, these new powerful tools are coming to fruition in the midst of an environmental crisis of unprecedented proportions, giving architects the opportunity to play a central role in solving the energy crisis.

Climate change poses an intrinsically multi-scale and cross-disciplinary challenge, one that is difficult to even comprehend, since it unfolds at a slow pace and involves many interrelated scales. Today, digital design tools allow us to detect, measure and visualise the energy forces transforming our environment–forces that were largely invisible to the architect's eye until two decades ago.

The effect of the new digital regime on the profession, however, has been a gradual drifting towards extravagant and often wasteful design propositions. By and large, the flourishing of a new formal vocabulary, enabled by digital tools, rarely translates into buildings that perform better.

With energy efficiency and rational use of resources becoming the overriding concerns in both new construction and retrofits, architects have been gradually marginalised in the design and construction process, as they failed to provide responsible answers to the environmental crisis engulfing the planet. As a result, after more than two decades of environmental policies in place, achievements in energy savings related to the built environment have been disappointingly modest. In fact, most results have been achieved due to factors outside the architectural and the urban design fields, often deploying a plethora of isolated and highly technical solutions.

The projects presented in this book, conducted by students at the Politecnico Graduate School of Architecture in Milan, attempt to recast the on-going debate on sustainability from a pre-eminently architectural position. In most cases, they are the result of individual work in response to a particular site and a environmental challenge chosen by the student. Collectively, they start to identify a specific, measurable relationship between geometry–the traditional domain of the architect–and performance, particularly in the area of energy efficiency and sustainable use of materials in buildings.

Over the past few years, the Zero+ Design Studio has been experimenting with hybrid forms of computational design and traditional form-making, combining various performance analysis with parametric definitions, to inform and support a creative design process. Mapping natural forces shaping the site is often the project's first act, clearly illustrated by the rich, insightful colour-coded maps included in the book. The grain and scale of the architectural structure often reinforce these underlying patterns, as unique and appropriate building components respond to each data point on the map. In many cases, students use rules and algorithms to generate forms, resuming the tradition of form-finding that consumed the best minds of an earlier generation of architects. Some projects supplement a form-finding process with human intuition by creating a feedback loop between analogue and digital domains. Others explore the theoretical limits of a parametric definition to control the shape of a building exclusively based on constrains.

Each project presented here explores the potential for parametric design to construct this one-to-one relation between environmental forces, building form and energy performance.

The Studio is predicated on the support of digital consultants, teaching advanced computational skills to students with no previous experience in algorithmic design. Digital simulation tools that predict the environmental performance associated to a particular building form–such as airflow, daylighting and sun radiation levels–are becoming increasingly more accessible and easier to use, providing an intuitive and inexpensive sketch tool to designers. These tools have a profound impact on the way we design buildings and cities, since they provide invaluable support at a very early stage of the design process, when most decisions are made, as opposed to entering the process at a much later stage, when the designer is less willing to accept changes. Also, they come at a much lower cost, since they replace the kind of quantitative advice traditionally offered by specialised engineering firms.

Needless to say, these tools are extremely controversial within more traditional academic environments, where they tend to be relegated to ancillary functions of primary intellectual processes that still promote ideas over tools. Also, they empower a new generation of young designers and disrupt the current teaching model, which is still largely based on the form-making tradition of the Ecole de Beaux Arts. Outside the school, they are set to transform professional practices as well, as fresh graduate students experiment with new forms of collaboration that bypass the traditional apprenticeship model–a source of cheap labour on which the success of most corporate firms is predicated.

In this context, the support of the school's leadership has been instrumental to the realisation and sustainment of a new studio culture in emergent technologies and computational design at the Politecnico. Students' enthusiasm, however, is the true engine for the impending revolution.

Landscape Narrative: A New Methodology

Hope Strode

The field of landscape offers complementary working methods to the allied professions that are necessary when facing climate change, rapid urban expansion, resource scarcity, and diminishing biodiversity. It mediates diverse scales and serves as a link between the site and its broader urban, regional and territorial context. Additionally, and perhaps most importantly, the landscape approach provides working and representational methods that take into account the dynamics and flows of the immediate and larger context.

The complexity of contemporary urban and environmental challenges necessitates a fundamental shift in how we design and construct the built environment. Conventional architectural design methods, while generally embracing the concept of 'sustainability,' have proven to be largely ill-equipped for responding to the complexity of problems facing the designer today. In part this is an issue of scale: the architectural object itself is relatively limited in its ability to address broader urban relationships, resource flows or ecological systems[1]. But it is also a failure in working method among the design professions that continue to operate in siloed disciplines favouring a top-down, form-based approach to one that is collaborative, open-ended and dynamic in both space and time[2].

Sustainability techniques in architecture tend to be mere add-ons to established building forms that increase performance but rarely impact the formal notion of the object or extend their reach beyond the site confines.

This is not for lack of theoretical thinking around the requisite of cross-disciplinary and collaborative working methods – 'sustainable architecture', 'landscape urbanism,' ecological urbanism' all suggest disciplinary hybrids that challenge customary boundaries and open new operative possibilities – yet in practice the overlap often remains defined by traditional professional hierarchies and working relationships. Urbanists and planners define the site boundaries, architects design the building form, engineers optimize efficiency and landscape architects provide a decorative green veil on and around the building. The result is conventional buildings espousing sustainable features.

Context: Ecological Thinking

"Ecology" as a framework from which we design is an essential component of landscape architecture today. Our understanding of it is not confined to "natural" or "environmental" contexts[3]. Rather it refers to the complexity of agents acting in any environment and their unique interactions. These agents are biotic and abiotic, urban and natural, human and non-human and they produce incremental changes on the broader system over time. For centuries western culture considered nature to be outside of and therefore separate from the city. It was sacred, foreboding, pristine, pure, wild – something that lived independent from and was threatened by the influence of humanity. The city, on the other hand, was the realm of man and technology; it was a canker creeping out into primeval nature. Today we can no longer make this distinction.

As urban areas expand and population growth strains our remaining resources, we are forced to acknowledge humans and their constructions as an active participant in the natural environment.

The architectural design studio Zero Plus, coordinated by Professor Simone Giostra, asks students to design housing that goes beyond the building envelope to include systems of food, energy and waste (i.e. the FEWs). This programmatic precept anchors the design studio in the cross-disciplinary, where landscape is a fundamental component. The FEWs, themselves dynamic and operating in relation to one another (and the human users), place the building and its inhabitants within the ever-changing system of the landscape. Furthermore, the students were asked to choose a disturbed site upon which to intervene. Each site had an existing context – social, geological, ecological, urban, climatic, and political – which became the structuring element for their projects. The food, energy and waste systems, therefore, were intimately tied to the context – or "ecology" – of the site.

Layers and Time: Representing Flows

Starting from this ecological framework, project sites are mapped in the McHargian tradition[4] – separating layers of geology, hydrology, plant communities, topography, solar exposure, urban development, infrastructure, pollution and contamination – and overlapping them to reveal a new site reading. The mapping itself becomes the first critical exercise in the design process. As James Corner puts it in the seminal essay The Agency of Mapping:

> *As a creative practice, mapping precipitates its most productive effects through a finding that is also a founding; its agency lies in neither reproduction nor imposition but rather in uncovering realities previously unseen or unimagined, even across seemingly exhausted grounds.*[5]

More than a simple cut-and-paste of data already available, each layer is drawn to represent a particular intention of the designer. The maps are closely edited for content and clarity; too much information does not allow for a clear reading of the design strategy, while too little information renders the map useless.

Topography is often the starting point for analysis, the ground being the base on which everything else acts. It is also relatively static – let us leave the process of erosion and sedimentation, shifting tectonic plates, lava flows and surface mining for further discussion – until it is activated by dynamic systems such as weather patterns and hydro-

Methodology

logical flows. The intensity of solar exposure, for example, varies significantly across a terrain and becomes an important indicator of where and how to build when considering factors of food and energy production. Flows of wind and water, for example, respond predictably to topography: water flows down hill and accumulates in lowest points, and wind speed is increased as it moves over or around objects in its path. But these flows are not constant; we have to read them as averages, highs and lows, which change throughout the day, across the seasons and over the decades.

It becomes clear that it is not sufficient to represent many of these layers at a fixed point in time. Some layers are relatively stable – geological conditions, for example, would show little change when represented over the course of 100 years. However, a time-based mapping of infrastructure, urban footprint, settlement patterns, contamination or hydrological flows, would uncover great changes over a century. For example, rivers and deltas are mapped over time to understand and demonstrate their unique morphologies. Water flow and accumulation could suggest how contamination might travel and settle across a site. In mapping these changes we not only identify site-specific patterns relative to flows, but they often reveal discontinuities. These interruptions can be anthropogenic – the construction of a dam or the decommissioning of a polluting factory– or they may be natural, such as a major flood or storm. Interestingly, patterns are not recovered after an event; rather, they are rearranged with a new logic and set of dynamics.

Time-based representation of the landscape not only provides and understanding of the existing conditions and patterns, but allows for projective simulations of how the system might respond in the future.
Climate change and its effects necessitate adaptability, resilience, and flexibility. The built environment's failure to be resilient in the face of recent natural disasters makes it clear that the conventional, static approach to landscape, infrastructure and urban development cannot respond adequately to the changing environmental conditions and demands. Furthermore, the cost and time required for landscape interventions at this scale require a long-range phased intervention.

Here the designer engages directly with designing pointed interventions that activate processes and allow them to develop over time.

'The author's hand is not always so apparent," as Bradley Cantrell puts it, "It's based on catalyzing events as opposed to formalizing the results."[6] These processes are neither linear nor mechanistic. They feed back on themselves cyclically, resembling ecological systems, which are not self-contained; they are part of greater social, urban and biotic systems that operate across a range of scales.

The Landscape Palimpsest

The overlapping of the landscape layers, both static and dynamic, frame the project narrative and becomes the basis of the site selection and design intervention. Often as few as three layers are enough to reveal the unique complexities of the site and focus the additional project research. The layering of the landscape, therefore, becomes a political and creative act.' What then can we learn from these layers? How might the designer intervene (or not intervene) to heighten, reinforce or take advantage of existing patterns? Could a project support or improve an existing environmental system through the architectural intervention?

Landscape architects have long use the palimpsest as a metaphor for the richness of the layers embodied in a landscape. Defined by Anita Berritzbeitia as "a series of layers that accumulate on a site over time, that are of different origins – geologic, social, productive – and that leave traces behind," the palimpsest is a "testament of the passage of time and to ongoing cultural processes on the landscape."[8] These layers make visible the complexity and the continuous dynamic processes that act across the landscape.

When we overlap landscape layers we prepare to write a new narrative on the site; one that contains traces and elements of what was already there while envisioning entirely new possibilities. Here and there we will read the hand of the designer, mostly it is the traces of the flows - social, economic, ecological and cultural – that will remain.

The palimpsest is not nostalgic, though it does not deny the intrinsic elements of the past; rather it waits to be constantly re-written.

Notes:

1. See Mohsen Mostafavi "Why Ecological Urbanism? Why Now?" in Mohsen Mostafavi and Gareth Doherty, *Ecological Urbanism* (Baden, Switzerland: Lars Müller Publishers, 2010), 26.
2. See James Corner, "Terra Fluxus," in Charles Waldheim, ed., *The Landscape Urbanism Reader* (New York: Princeton Architectural Press, 2006), 23-28.
3. See James Corner, "Ecology and Landscape as Agents of Creativity," in George F. Thompson and Frederick R. Steiner, eds., *Ecological Design and Planning* (New York: John Wiley & Sons, 1997), 80-108.
4. See Ian McHarg, *Design with Nature*, (Garden City, New York: Published for the American Museum of Natural History by the Natural History Press, 1969).
5. James Corner, "The Agency of Mapping, Speculation Critique and Invention," in Denis Cosgrove, ed. *Mappings* (London: Reaktion Books, 1999), 188.
6. See interview with Bradley Cantrell, in Kristina Hill, "Ecology on Autopilot," *Landscape Architecture Magazine*, vol. 107, no. 6 (June 2017), 110.
7. James Corner, "The Agency of Mapping, Speculation Critique and Invention," in Denis Cosgrove, ed. *Mappings* (London: Reaktion Books, 1999).
8. See Anita Berritzbeitia's essay "On Palimpsest" in George Hargreaves, Landscape Alchemy: The Work of Hargreaves, (Pt. Reyes Station, California: ORO Editions, 2009).

Digital Tinkering: Experiments in Energy Form-finding

Simone Giostra

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After nearly 3 decades since their first appearance in architectural practice, digital design tools are increasingly pervasive in nearly every aspect of the profession and throughout the building life cycle, from project development to construction administration to demolition and recycling. While an integrated approach to building information management is becoming the key to winning projects, the creative attitude of an earlier generation of computational designers is fast replaced by new tools and protocols geared toward achieving efficiency targets and boosting profitability.

The studio takes on a different path toward our shared digital future–one that tries to address the environmental challenge while fostering creative freedom.

Gateway to another world

A claim frequently heard from older colleagues, both at school and in the profession, is that new forms of digital practice–that is, using a machine in the artistic process–stifles creativity and generates anonymous architecture.
In fact, the problem of design is not, and it never was, one of creativity–of enabling the mind to formulate new formal constructs, that is, of 'coming up' with ideas–but quite the opposite:

The creative process desperately needs parameters, limitations, some kind of intellectual friction in order to operate.

Unchecked, the mind is capable of conceiving the wildest shapes, none of which would actually turn into architecture. The first set of limitations comes in the form of a tool enabling thoughts to take shape in some intelligible way. Ideally, a useful design tool would limit the range of expression to only that which can be eventually built. If the tool is too restrictive, you will end up with conservative or conventional design; conversely, if the tool is too loose or unresponsive, you will end up with wild propositions that cannot be built. If architectural drawings are the anticipation of the act of building, then tools are the guardians of the act of anticipating, deciding which line/form/structure has a right to exist in a drawing.

Many older modelling and visualization tools, such as 3ds Max and Cinema 4D, knew no boundaries, since they were created by the film animation industry precisely to 'unbound' the imagination of the designers and to create an imaginary world that needed to exist only on screen: "your gateway to another world" is the promise by a leading developer of 3D software. The evolution of graphic interfaces only meant an increasingly smother transfer mind-mouse-screen that effectively eliminated many, if not all, limits to creating free forms–making the results largely irrelevant to the purpose of building.
The fact that an early generation of architects were being introduced en masse to these tools in the mid-1990s by elite architecture programs at Columbia University in New York, SCI-Arc in Los Angeles or the AA in London, speaks to the opportunistic, disingenuous relationship between architecture and the graphic software industry. By and large, this first generation of 'digital' designers were responsible for stretching, once again, the boundaries of what was considered architecture–and for raising much of the opposition to the so-called 'blob architecture' that is still felt in academic circles today, along with a lingering suspicion toward any new digital tool since.

From the command line

Digital design, however, has many strands. At the opposite end of the spectrum, early CAD tools offered a great deal of resistance in the form of a reduced number of operations, none of which included unforeseen or unimaginable results. A 'command line' implies a master able and willing to spell out orders: here every shape is the result of explicit instructions given in a specific sequence, using a mediating protocol that requires training and some ability. Similar to the visualisation tools discussed earlier, CAD software was developed for the engineering industry, not architecture, and presented its own kind of limitations. For one, it forced the designer to a level of precision that finds no application in architecture, particularly in the early stages of the project. Also, it did not allow for any tolerance, since it demanded that each line should be placed in Eudidean space without ambiguity or hesitation, with the snap function marshalling any wandering line to its designated place. Incidentally, Building Information Modelling (BIM) software belongs to this second lineage of digital design tools.

An intelligent 3D model-based software that involves functional and relational characteristics, BIM represents a more pragmatic and conservative response by the industry to the same disruptive forces transforming all levels of design. In fact, BIM tools are designed to enhance productivity and ultimately profitability–one major player in the market incites architects to "use BIM architectural design software to win more work and retain clients"–at the expense of innovative and risk-taking approaches to design. Contrary to a generalised perception that BIM software should empower the architect and foster design innovation, I am convinced that it will regiment the creative process in favour of delivering normalised, predictable (and profitable) results.
Interestingly, BIM software represents the antithesis to the experimental processes pioneered by early digital artists and the hacker culture that infiltrated many artistic fields over the past 40 years–first electronic music, then video art, interactive design and gaming–and slowly percolated into more traditional design fields such as architecture, with the introduction of graphical algorithm editors like Grasshopper and Processing.

The projects presented here bring back the spirit of this early experimental phase, when algorithms were used to propel as much as disrupt the traditional design practice.

Generative tools

Because of its disruptive potential, a conservative majority still perceives the digital practice in opposition to analogue modes of design, such as hand drawing or model making–a futile distinction at best, serving the entrenched

interests of an older generation. And it's not merely a fight for self-preservation. Some of the most exciting digital tools making their way in the profession are generative in nature, that is, they open up design opportunities that become apparent only to those who practice. As with any other craft, there is no verbal substitute for a digital practice. Most decision makers, in our schools as well as in most traditional industries, simply lack the digital skills to appreciate firsthand the generative potential of these tools.

For centuries, architects have been using scale models to predict the performance of buildings by applying materials and techniques that replicated actual constraints. Physical models, however, cannot test a design solution for structural integrity, as commonly accepted before the discovery of the so-called square/cube law by Galileo in 1638. Interestingly, for over 300 years from the first publication of the 'Two New Sciences', we did not have a reliable analogue method to test structural integrity of buildings in the early phases of design. This is particularly striking if we consider, as Reyner Banham noted, that the history of architecture up until the end of the 20th century is largely an history of space-enclosing structures.[1]

Remarkably, intuitive computer simulation tools provide designers with the unprecedented ability to test early design concepts for structural integrity and energy performance, effectively overcoming a centuries-old limitation.

And there is more: the introduction of accessible parametric tools, such as Grasshopper a decade ago, allows to use rules and algorithms to generate forms, resuming the tradition of form-finding that consumed the best minds of an earlier generation of architects–including Frei Otto's experiments with lightweight structures and Gaudi's analogue force models. Rather than a fictitious opposition between digital and analogue models, then, what's really a stake is a dramatic shift in recent years from form-making to form-finding.

Today, energy considerations are supplanting structural integrity as the main parameter in designing a building. Thanks to advances in computer technology, we are the first generation of architects with the tools to simulate relevant energy indicators from the very early design concept, using inexpensive applications run on our laptops. Of particular interest are tools that produce graphic output in the form of 2D- and 3D-color-coded diagrams, in some case projected directly onto the space being evaluated. I am convinced that the defining challenge for our generation is to do for energy what Frei Otto and Gaudi did for structure: shaping buildings using energy-related constraints–in other words, energy form-finding.

Invisible forces

The problem with parametric design tools is that they require explicit instructions to operate; in other words: they only execute orders. As any architect working on a design problem knows well, much of the creative process in architecture is based on what Malcom McCullough calls 'intrinsic information', that is, information that is embedded in the ambient and come to fruition less through focused attention than by situational awareness.

Creative work does not always involve deliberate thought; a skilful practice, tools as props, habituation–all play a cognitive role in 'coming up' with ideas. As he puts it, "A great deal of knowledge is inarticulable, especially when in use. In music, sports, or many other expertise, you can do things you cannot explain".[2]

While digital tools should not replace the architect's mind in formulating a design concept, they can be very helpful when dealing with information that does not fall within the visible spectrum. In one of his seminal writings, Buckminster Fuller famously declared: "[…] Forms are inherently visible and no longer can 'form follow functions', because the significant functions are invisible".[3] He was referring to natural forces, as well as to material properties that are not detectable by senses or experience, since they result from manipulation at the molecular level that are invisible to the naked eye–yet have a great impact on the built form. Environmental analysis tools can provide critical insights into these invisible functions by widening the architect's gaze in areas of knowledge outside the spectrum of visible light.

There are obvious advantages in giving form to these invisible forces, as they play an increasingly larger role in the built environment. Architects typically resort to highly technical solutions for compliance with ever stricter energy codes–'green gadgets' that come in the form of sophisticated mechanical systems, super-insulation materials or expensive glass treatments–so that they don't have to question a consolidated formal language. Conversely, formal solutions that directly address these invisible forces at a structural level can dramatically improve the performance of buildings by reducing heating and cooling loads, fostering daylighting and natural ventilation, and generally lowering energy demand.

Additionally, a building form that is the result of a form-finding process can manifest information regarding the ambient–prevailing wind direction, solar radiation levels, air flow or pedestrian traffic–in ways that are intuitive and do not require mediation. A classic example of the architect's disconnected design approach to the new energy imperative are the many digital displays showing the amount of energy being produced by solar panels that are hidden away on the roof of buildings. This is particularly relevant in an age of mediated information: as we increasingly rely on screens, large and small, to retrieve useful information on our environment, embedding information in the persistent structure of buildings can have positive effect in learning to navigate our world without depending on a smartphone.

Beauty and survival

This bring us to a final question regarding the use of form-finding strategies and related computational systems predicting the behaviour of buildings. We understand that a form resulting from relevant forces might cope well with these same forces, so that if a building envelope is shaped based on solar radiation levels, for instance, it has a larger potential for energy generation than a building shaped after a crumpled paper bag. But how prominent should the energy radiation potential be among the many factors–such as program, context, budget, historic references or quality of interior space–contributing to the design of a building? The answer depends on the stage of human development in which you find yourself operating.

Cultural values govern the relationship between nature and human actions–a sort of protocol of engagement with our natural environment designed to improve the human specie's competitive advantage and, ultimately, chances of survival. Even abstract notions such as 'beauty', according to Denis Dutton, might be evolutionary determined, so that we consider beautiful that which enhance the survival of the human genes.[4]

By necessity, then, design criteria must be an evolving concept, as our collective success is continuously challenged by changing environmental conditions.

In his book *Collapse*, Jared Diamond argues that with changing environmental conditions, societies face the challenge of identifying which cultural value can be sustained and which one is no longer appropriate to the new set of conditions.[5] For instance, he writes about the choice of Greenland Norse to stick to Christian identity values–refusing to adopt habits and techniques from the indigenous Inuit that were much better adapted to the environment, because deemed culturally inferior–as the main cause of their extinction. Interestingly, he describes how societies on the verge of environmental collapse, such as the Rapa Nui civilisation, stubbornly clings to–and sometime even intensify–the very same practices that are the root cause of their demise. Erecting large ceremonial statues on Easter Island turned into an unsustainable practice toward the end of the 17th century, as it required a disproportionate amount of timber and human labour to sustain, in a context where sources of both trees and proteins were depleted. Interestingly, statues became increasingly larger and more complex, therefore demanding more resources, precisely when resources became more scarce.

Confronted with the progressive depletion of resources and declining quality of our natural environment, we continue erecting monuments to our minor gods.

In the eye of future generations, the irresponsible use of resources to serve the extravagant formalism of some of today's most prominent architecture will bring to mind the excesses of a collapsing civilisation.

And if history is any indication, cultural conservatism is not what will get us back on track. On the contrary, I believe that this is a time for vigorous experimentation and some serious debate on what we collectively can and cannot afford.

Notes:

1. Banham, R. (1984). *The architecture of the well-tempered environment*. Chicago, IL: University of Chicago Press.
2. McCullough, M. (2013). *Ambient Commons: Attention in the Age of Embodied Information*. Cambridge MA: MIT Press.
3. Fuller, B. R., & In Snyder, J. (2010). *Ideas and integrities: A spontaneous autobiographical disclosure*. Baden, Switzerland: Lars Müller Publishers.
4. Dutton, D. (2010). *The art instinct: Beauty, pleasure, & human evolution*. New York, NY: Bloomsbury Press.
5. Diamond, J. (2005). *Collapse: How societies choose to fail or succeed*. New York, NY: Penguin Books.

Syllabus

The House of the FEW

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ZERO+ looks at the transformation of dwelling in the context of climate change and as a result of the new imperatives of the European Challenge 20/20/20: reducing greenhouse gases by 20%, increasing energy efficiency by 20% and reaching 20% of renewable energy by 2020.

The establishment of the City, from its very inception, is the result of a fundamental separation between places of consumption – located within the city limits – and places of production, where enough surpluses of raw materials and food are created to support city development.
The dislocation of production activities has only increased since the industrial revolution: over the past 150 years, the massive loss of natural land to the combined effect of relentless expansion of urban areas, modern infrastructures and extraction of natural resources resulted in a drastic reduction of biodiversity, air and water pollution, and the depletion of natural resources.
As advanced societies become increasingly dependent on the mass production of industrialized agriculture and vast mining operations, the places of production and extraction are being gradually relocated in remote areas of the planet, often outside the control of environmental agencies, away from public scrutiny, and removed from the collective consciousness.

The studio challenges students to rethink existing living models by integrating Farming, Energy production and Waste management systems (FEWs) to the house of the 21st century.

Morphology: Over the next few years, all new construction will have to be nearly Zero Energy Building (Directive 2010/31/EU); however, because of the specific scales of energy production, the traditional size of building lots in the city is not sufficiently large to achieve the Zero Energy mandate. Similarly, current levels of food production and waste processing practices cannot sustain population densities of contemporary cities like Milan without devastating consequences for the environment. In short, the new energy paradigm calls into question the very premise of the city – that is, its high density.
While there is general consensus that cities are indeed a good thing - "our greatest invention", according to Edward Glaeser in The Triumph of the City - we need to find ways of offsetting some of the environmental costs of maintaining today's megalopolises by bringing production and management of energy, food and waste back into the fabric of the city. Accordingly, the studio will promote entirely new strategies of subdividing urban land and using public space in order to reduce environmental degradation and to attain true energy independence.

Typology: While environmental measures are drastically transforming our cities, architects have struggled to find their own voice: by and large, issues of technical feasibility, efficiency and cost reduction alone have been driving the discourse on sustainability and the implementation of the new energy policies to date. The Studio explores the architectural implications of combining an existing typology -single or multi-family housing – with one or more FEWs components.

Hybrid forms of aggregation and synergistic opportunities will emerge from the logic of the FEWs, promoting novel adjacencies, circulation patterns and spatial configurations–and ultimately generating new forms of living.

Technology: The scale of the individual component, particularly within the envelope of the building, offers perhaps the most productive opportunities for implementing environmentally friendly strategies in architecture. The skin of buildings is in direct contact with the surrounding environment, exposed to the forces of nature, and best positioned to harness wind and solar energy, reduce heat loss and condensation, foster daylighting and natural ventilation, and generally promote an efficient and healthy relationship between the building's inside and the outside. Within the time limits of the semester and in the context of a 2nd year master class, the studio will introduce the students to a range of environmental strategies at the scale of individual living units, using the extensive documentation on recent Solar Decathlon events as point of departure.

Language: Historically, technological developments find their first applications in architecture in two seemingly opposite – and often simultaneous - forms: in the first model, the new technical component is hidden within a pre-existing architectural framework, which remain substantially unchanged. In the second model, technology is embraced in its naked form, unmediated by any pre-existing cultural protocol, and celebrated in all its ugliness – for all original forms are ugly by default – as a beacon of modernity. Similarly, in today's architecture the new environmental technologies used for energy production, farming, composting and recycling are being pushed to the forefront and celebrated as icons of modernity or, alternatively, hidden in basements and attics, in underground facilities and secluded areas outside the city. In either case, they still lack a language.

The program explores the spatial, programmatic, and formal potentials of the FEWs, using industrial processes of production and disposal of food, energy and waste to propel the next architectural revolution.

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Iro Karountzou

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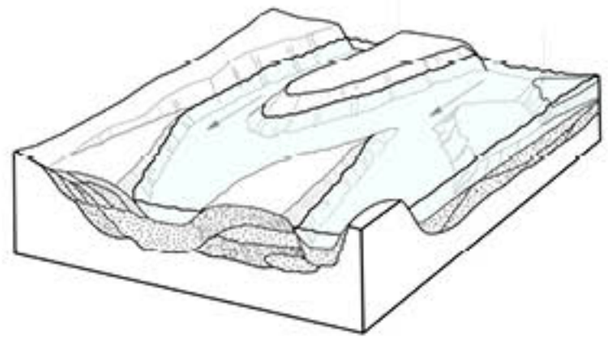
REVERSE DESERTIFICATION
Marios Messios

PROJECT-Y
Milan, Italy

As we approached the given area, we became interested in the river and its contribution to the wider topography.
We proceeded with extensive research on the floodplains, and the different soils that compose the geography of Forlanini and we began to look at ways to use them for the general benefit of the area.
Redirecting the water was the main method that allowed us to take full advantage of the river. Studying the morphology of rivers and the various grids of different cities, we arrived to the design of a new delta that would expand and contract within designated areas.
In the new landscape, river water finds an alternative route that prevents overflowing, while also naturally irrigating the fields, creating quite fertile grounds that can benefit the agricultural life of the city.
Afterwards, we began designing a perforated platform, that can be reproduced and be placed above the crossroads of the river delta, connecting the parcels together. The platform is a lightweight, reversible construction that respects the nature of the area, with sporadic breaks on its surface that allow for vegetation to grow.
Finally, we placed on the platform housing units and also a market, both using renewable energy sources such as solar panels, water cooling and heating systems, placed at elevations that offer protection from the water's activity.
These units can eventually be inhabited by people and families that work on the fields giving them the opportunity to directly place their production at the market without the need of an intermediary.
Our proposal creates a landscape of unique beauty, a self-sufficient, autonomous community that can benefit the economy of the region, but most importantly will give birth to a new agricultural life that respects the environment.

Elina Akiozoglou, Iro Karountzou

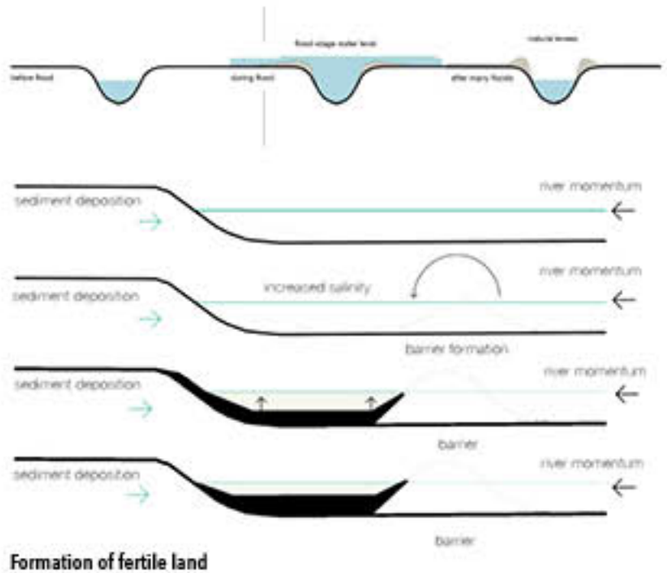


Wetlands
A wetland is a low-lying area where water covers the soil for much of the year.
Also known as swamp, bog, or marsh, a wetland provides habitat to a wide range of plants and animals.

Floodplain
A floodplain is a flat, low-lying area along the river that gets covered with water when the river overflows. Building in floodplains can be dangerous, because of the risk of frequent flooding.

Riverbank
The land immediately along the river is the riverbank. They are constantly changing, sculpted by the flowing river. The trees and other vegetation there provide important habitat for birds and other wild life.

Phases of delta river formation



Formation of fertile land

River delta: analogue simulation of water flow

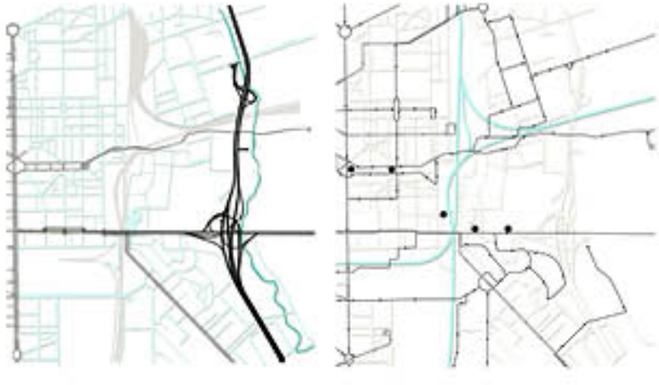
Flood Benefits:
- Water quality maintenance
- Groundwater recharge
- Biological productivity
- Habitat for a variety of fish and wildlife
- Recreational opportunities
- Open space

Flood risks

Soil Composition is an important aspect of nutrient management. While soil minerals and organic matter hold and store nutrients, soil water is what readily provides nutrients for plant uptake. The basic components of soil are minerals, organic matter, water and air.

Fertility

Street grid morphology / The connection of roads at the west part of the area defines the circulation for vehicles and Pedestrians, since it is a residential area. In the central part of the area, Corso XXII Marzo connects city center of Milan with Linate Airport. As we get at the east part of the area, the road grid becomes undefined so the access is more difficult.



Design Strategy: creating paths and connections in order to distribute the water equally along the valley and, at the same time, dividing the land into tassels or fields.

1 - Design Area

2 - Flood risks

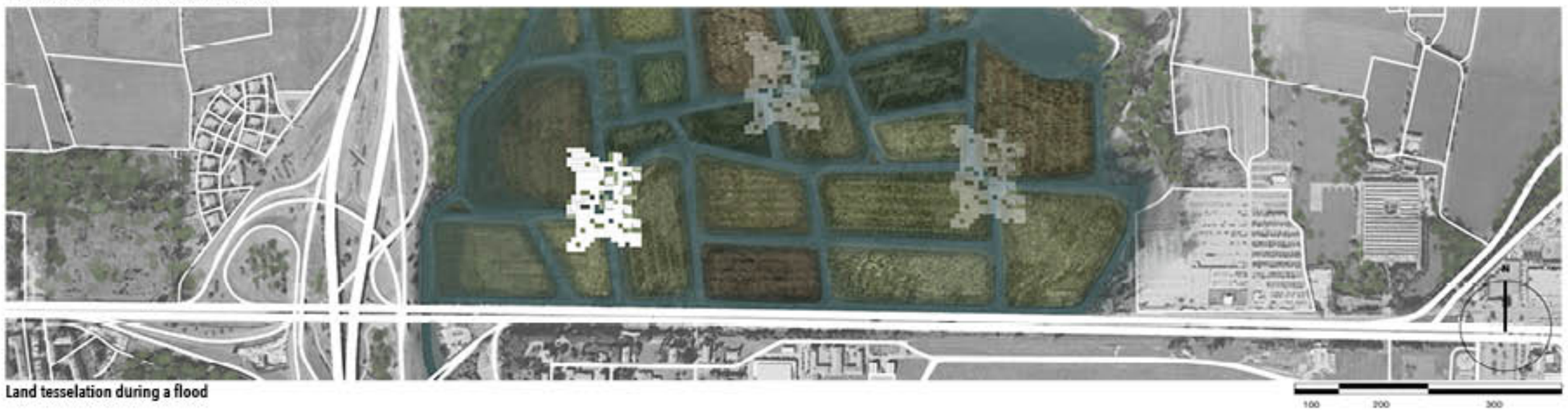
/ PROJECT Y / Design strategy: a new water network

3 - Soil composition

4 - The final land formation

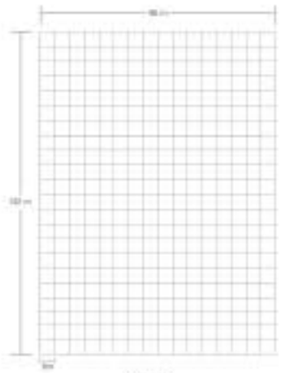
5 - Path and connections

Land tesselation in normal circumstances

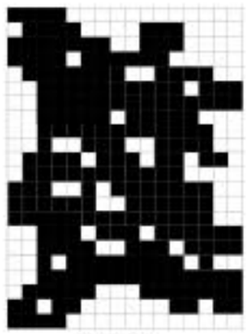


Land tesselation during a flood

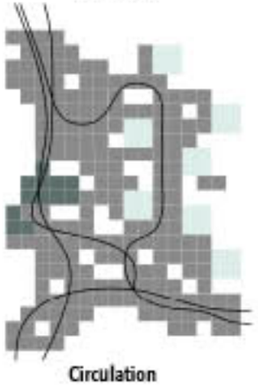
Water network
The proposal integrates water canals and related flood areas as dynamic systems that transform over time and adjust to weather and seasonal conditions. The infrastructure is designed to integrate with the water management system in various configurations and under extreme conditions (see lower image).



Grid

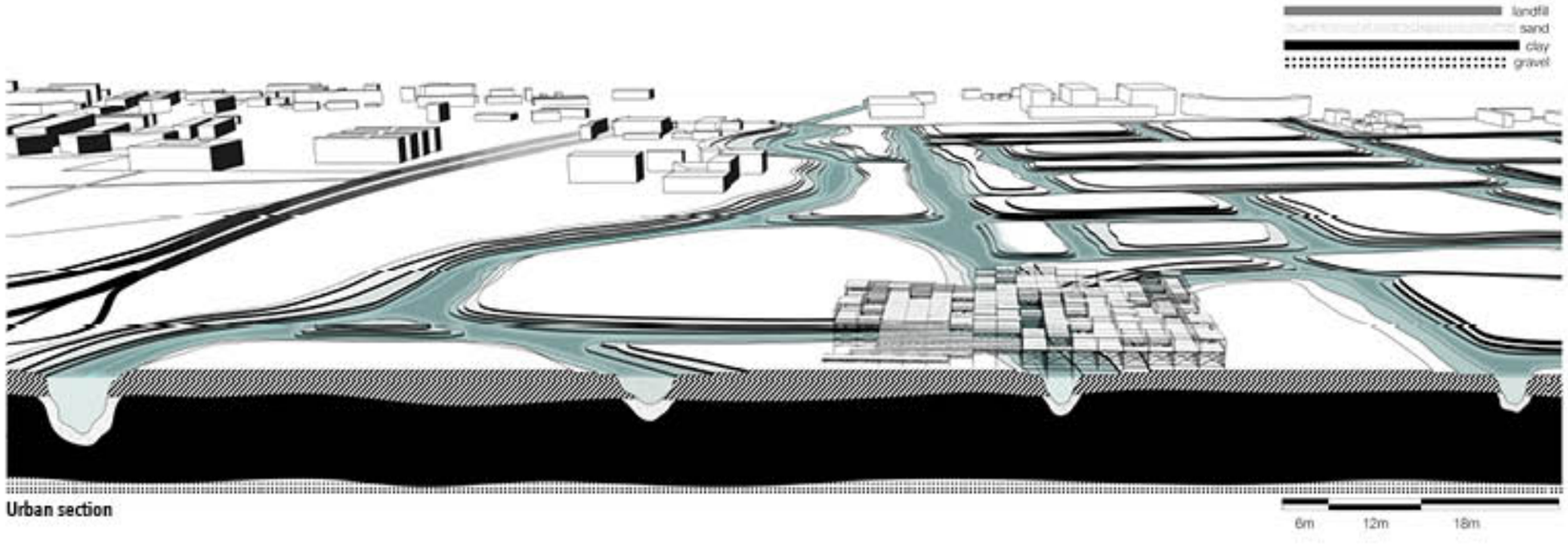


Program

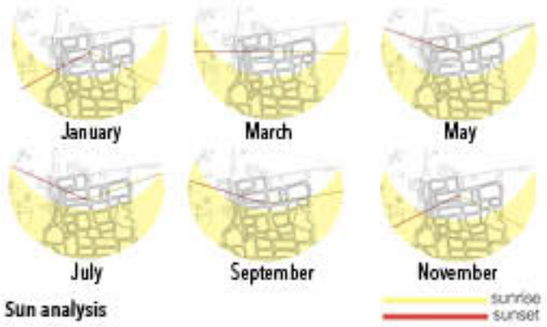


Circulation

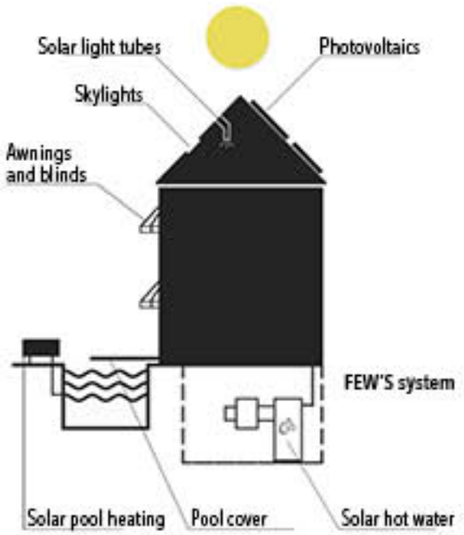
Master plan



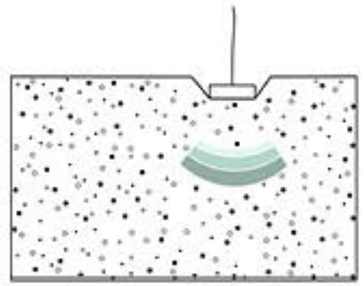
Urban section



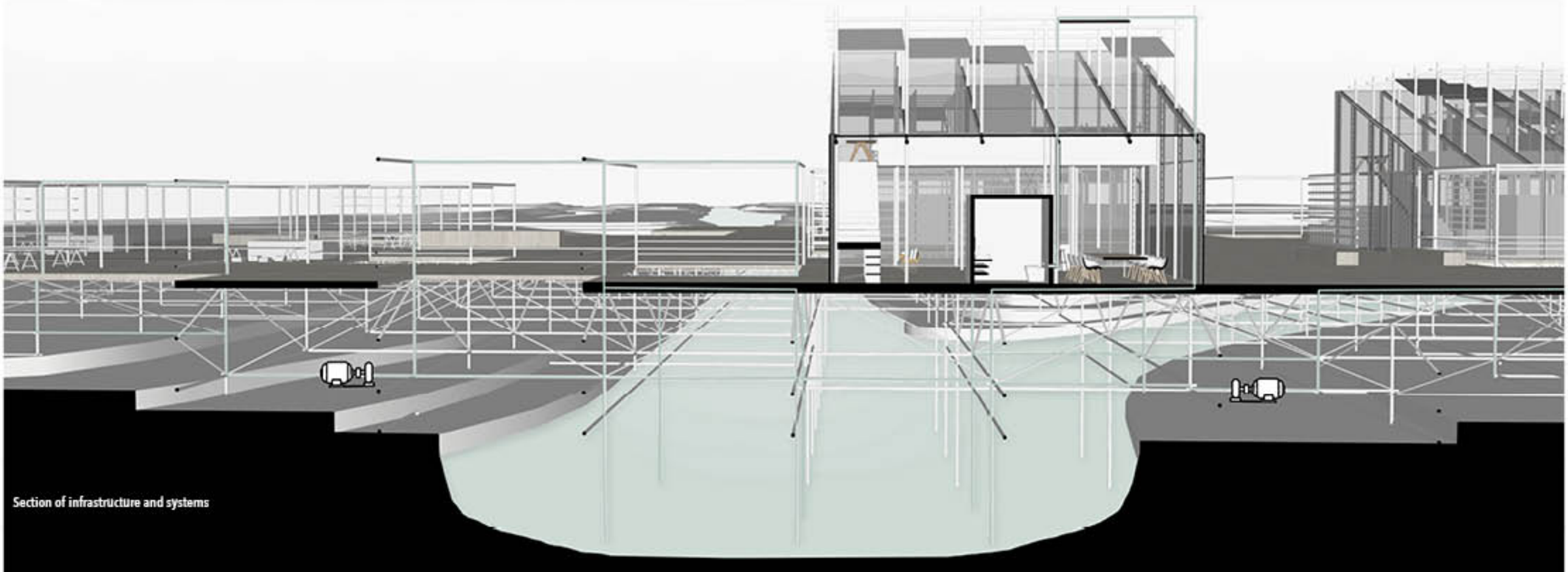
Sun analysis



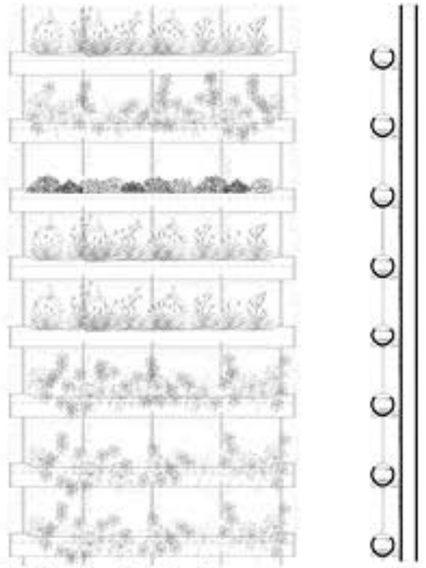
/ PROJECT Y / Infrastructure and systems



Dynamic compaction / The process inwolves dropping a heavy weight on the surface of the ground to compact soils. This method is used to reduce foundation settlements, reduce seismic subsidence and liquefaction potential, permit construction on fills, density garbage dumps, improve mine spoils, and reduce settlements in collapsible soils. Dynamic compaction is most effective in permeable, granular soils.

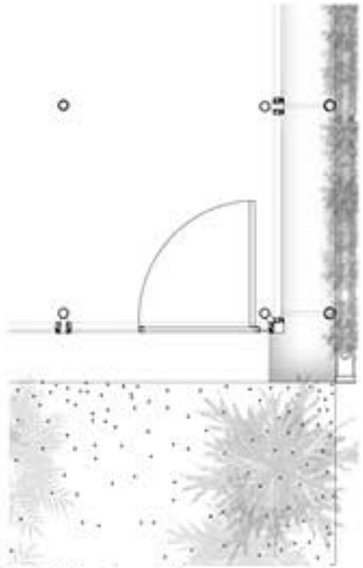


Section of infrastructure and systems

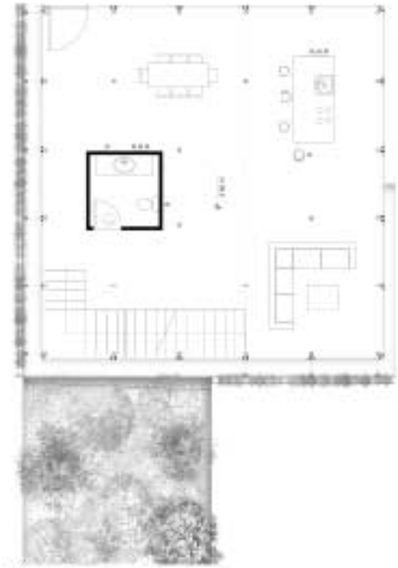


Elevation of vertical farming

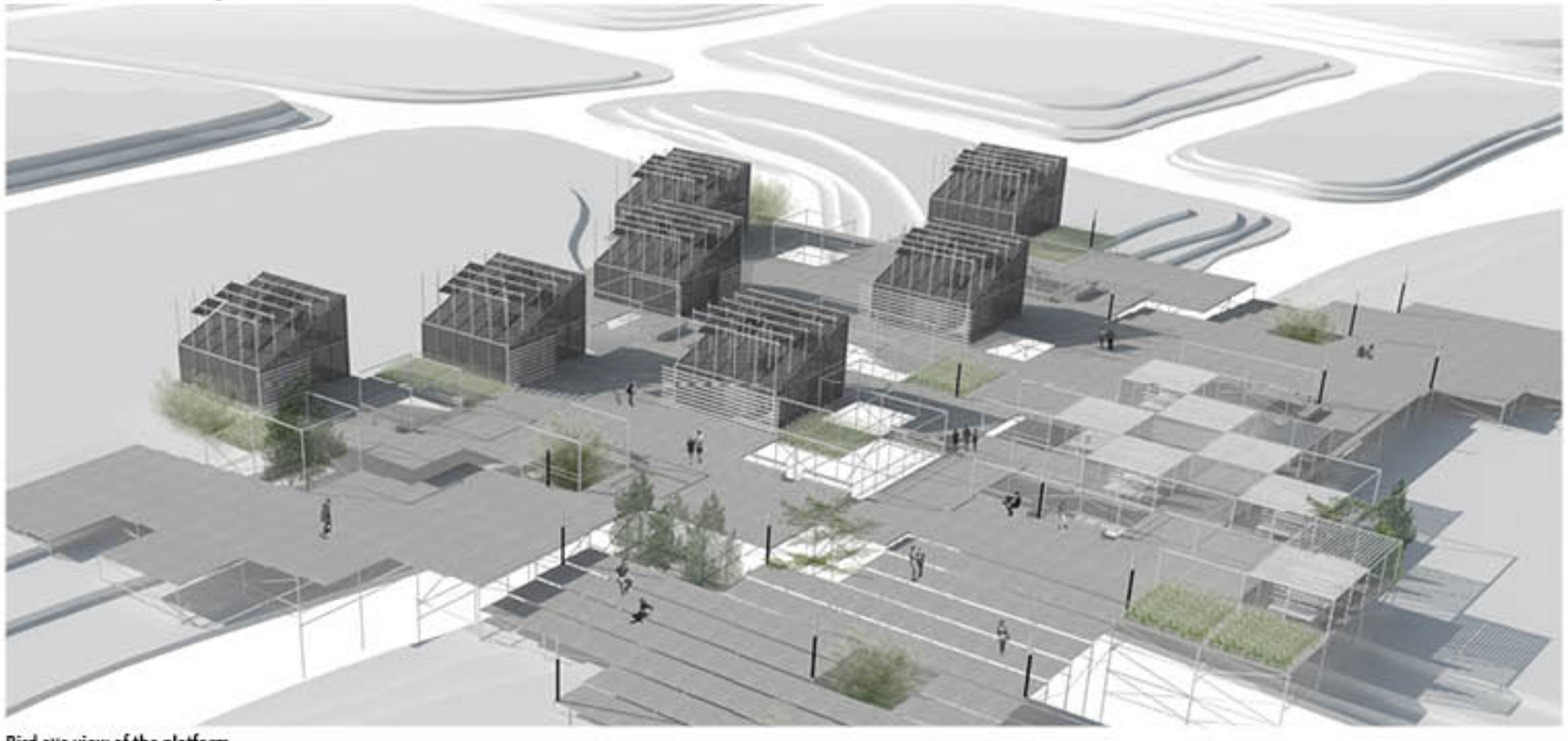
View of vertical farming



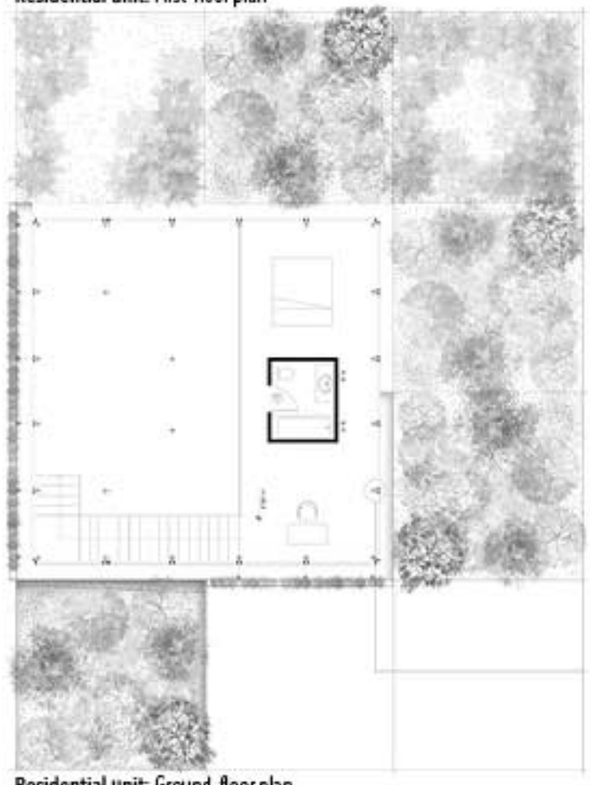
Detail of corner solution



Residential unit: First floor plan



Bird eye view of the platform

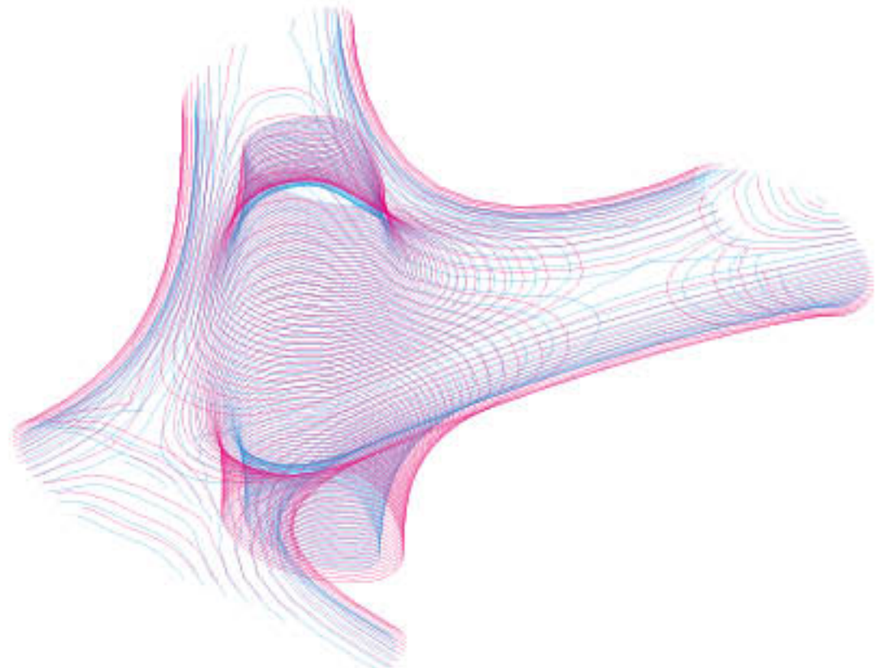


Residential unit: Ground floor plan

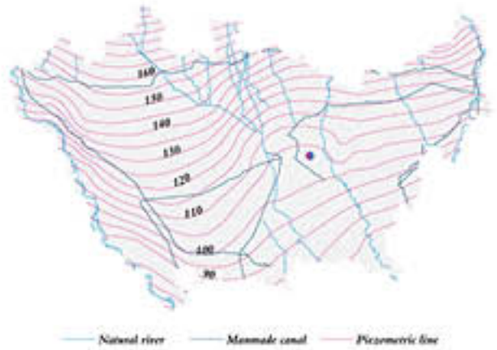
ARCA
Milan, Italy

ARCA is a project that reflects upon contemporary human condition in relation to surrounding ecosystems.
As the practice of resources decentralization is becoming increasingly common, the result is a widening division, both physical and conceptual, between places of production and places of consumption. The phenomenon directly affects the role of humans, which can be easily abstracted as mere consumers, standing on the edge between resources and waste. Buildings themselves are only conceived as comfort producers, the performance of which depends exclusively on extensive infrastructures running both in and out of our dwellings.
ARCA acknowledges the critical issues of contemporary architecture's aim and methods and proposes an inverted system, diverging from the concept of "in and out". The project embodies two clear intentions: to design a comprehensive system of housing, food and energy production, together with waste management concerns, and to implement a complete separation between human environment and nature as wilderness.
ARCA is designed as a uniform layer that evenly spreads on Earth's surface.
However, an obsessive geometrical repetition of the upper part is balanced by high specialization of the lower one.
Its vertical composition can be identified in three layers: the housing units and greenhouses for the food production are hosted on the upper level, the middle level is a continuous public space where all kind of social interactions and exchanges occur, while the lower level adapts and changes based on ground typology such as a pisciculture tank in presence of water, anaerobic composting or geothermal energy generators on hard terrain.
The system is composed of two elements which are made by distinct materials: a circular central steel truss which runs vertically across the floors, creating an opening allowing the light to penetrate inside the housing units, and an exterior continuous curved porous concrete skin which protects and divide.
The only glazed part is the roof, an opening towards the sky, a view towards hope.

Arim Alia



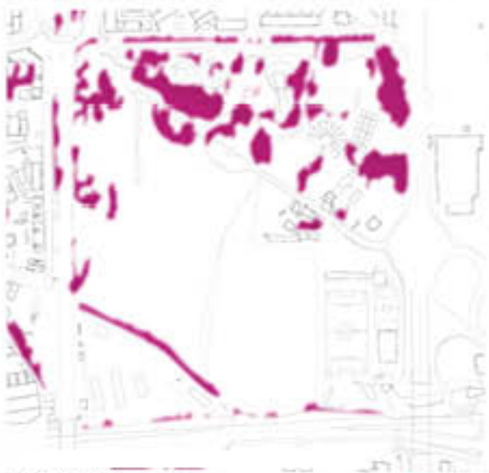
/ ARCA / Site mapping: permeability, green, circulation



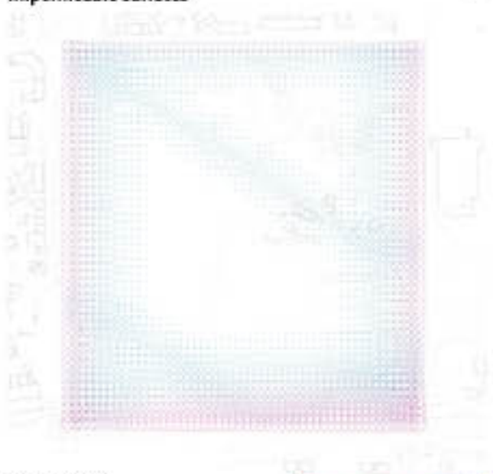
Underground water system
A series of variables are setting the rules for the intervention, based on accurate mapping of natural resources located on site, including natural and artificial water lines. Elevation of ground water is particularly relevant as the project makes use of geothermal systems.

Permeable surfaces

Impermeable surfaces

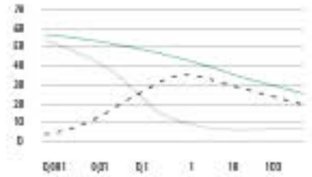


Vertical green



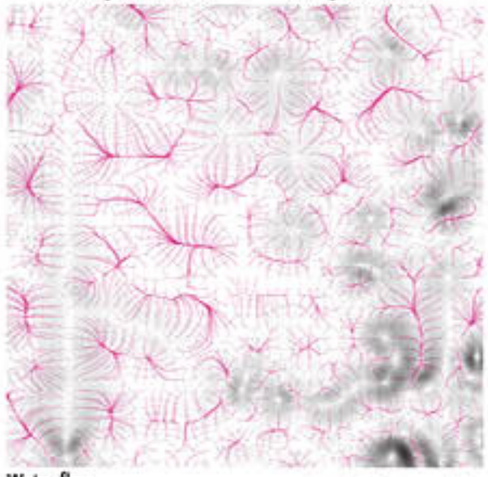
Flow density

/ ARCA / Site mapping: topography, water flow



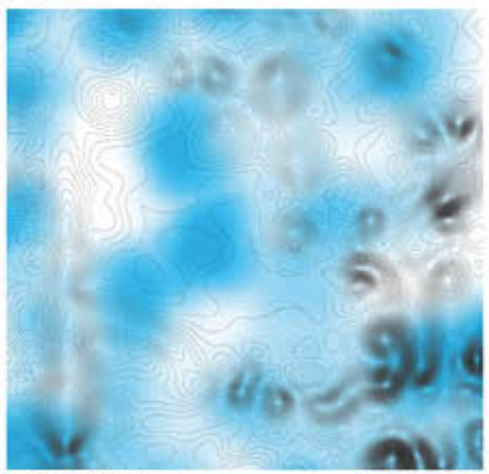
Sandy skeletal characteristics | Sandy skeletal / 1 | Sandy skeletal / 2 | Sandy skeletal / 3

Contours 0.1 m



Water flow

Channels' flood

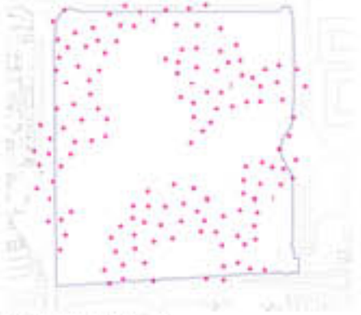


Water accumulation

/ ARCA / Site tesselation

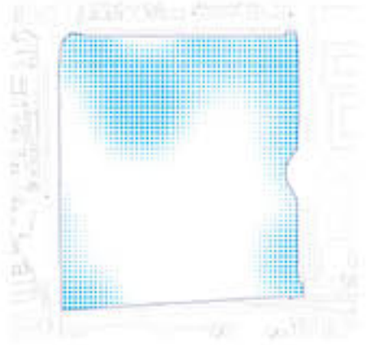
Parcels and Paths
The site is subdivided by a tesselation logic that interpolates data points pertaining to water management in the area, under normal conditions as well as with exceptional rainfall levels.

Water accumulation simulation



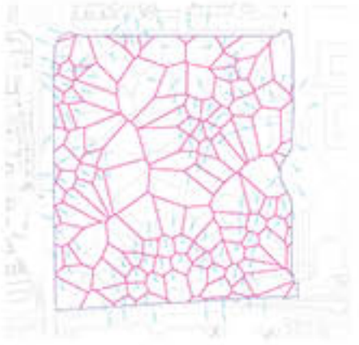
Point cloud derivation

First Voronoi pattern



Canal overflowing simulation

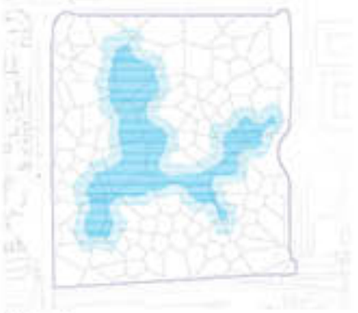
River overflowing as variable



Second Voronoi pattern

/ ARCA / FEW's allocation

Maps of FEWs
Different functions are associated to each tassel based on its potential to provide a specific ecosystem service.



Floated area

Landfill areas

Uncover canal area

Water - related parcels

Landfill - related parcels

Canal - related parcels

Parcel 1

Parcel 1: Water flows

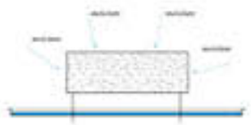
Parcel 1: Paths / FEW's interaction

Parcel 2

Parcel 2: Water flows

Parcel 2: Patch / FEW's interaction

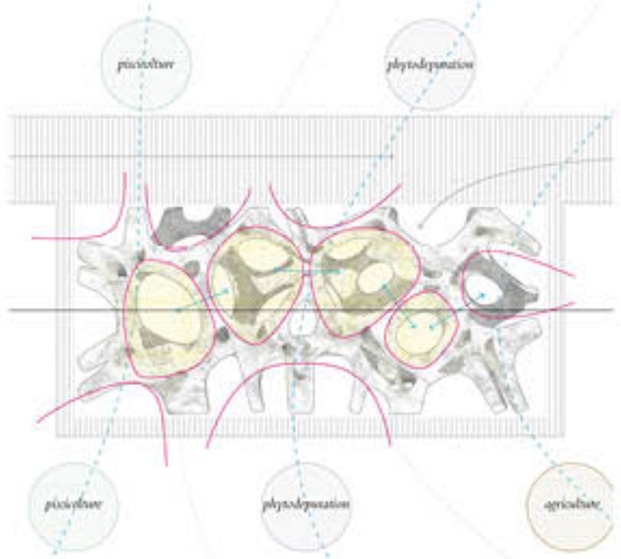
Rain water collector



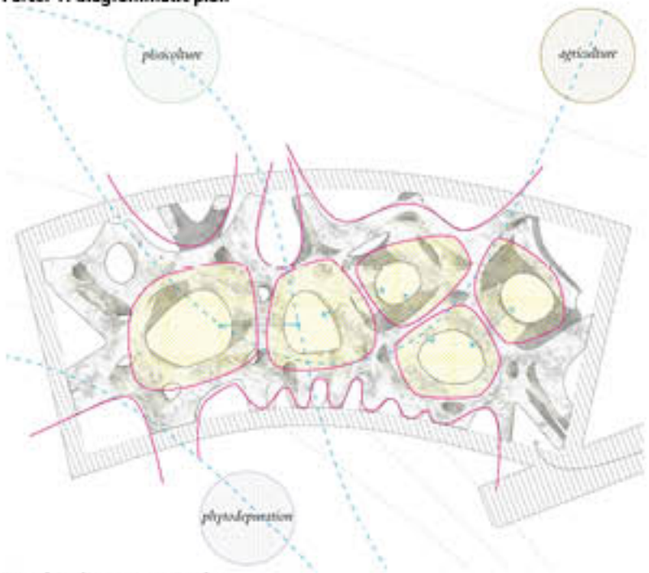
Porosity

FEW'S Hub

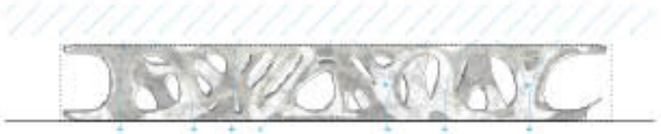
1% of the area



Parcel 1: diagrammatic plan

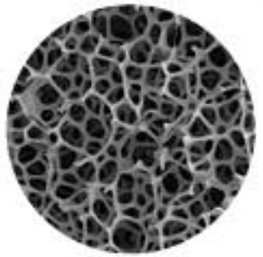


Parcel 2: diagrammatic plan



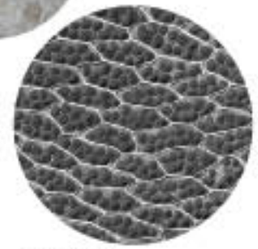
Parcel 2: diagrammatic section

Sponge cell aggregation



Sponge typology

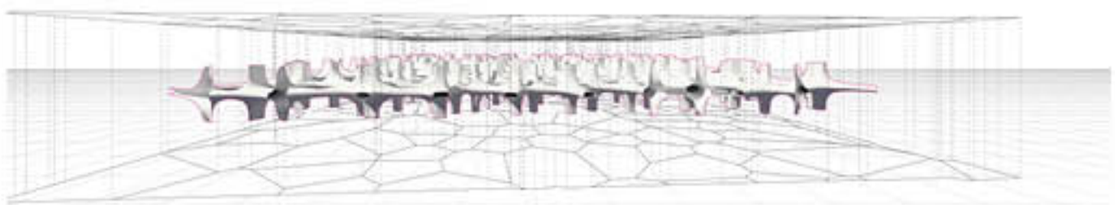
Sponge detail



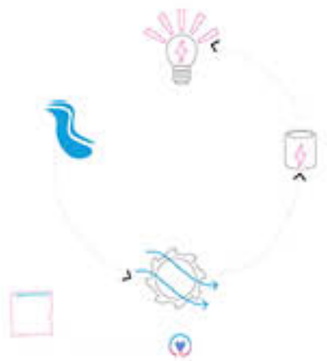
Moss detail

Endless house, Friedrick Kiesler, 1950

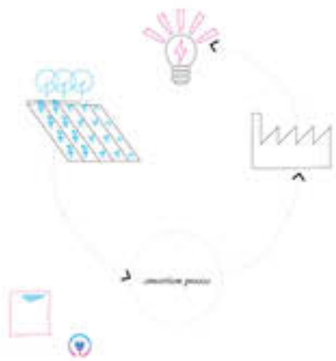
Masterplan / overview of the implemented site



Geometric concept



Micro - hydro system



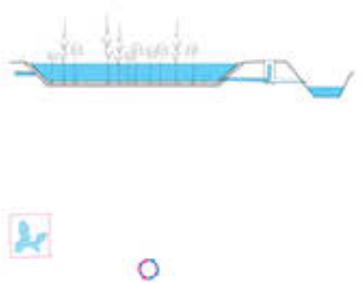
Biofuel

Landfill

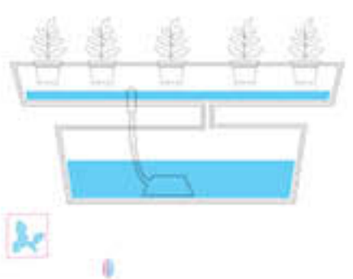
Organic compost

Agriculture

Rainwater harvesting



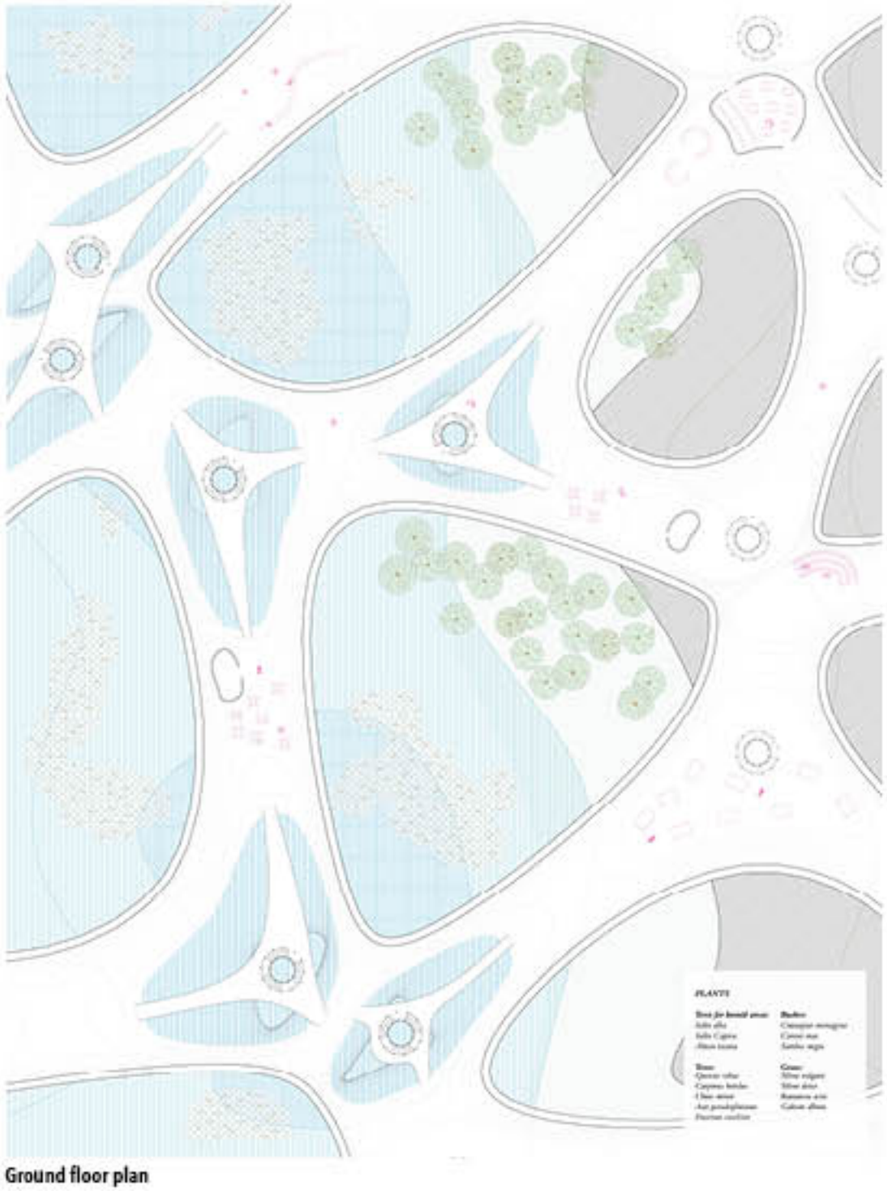
Phytodepuration



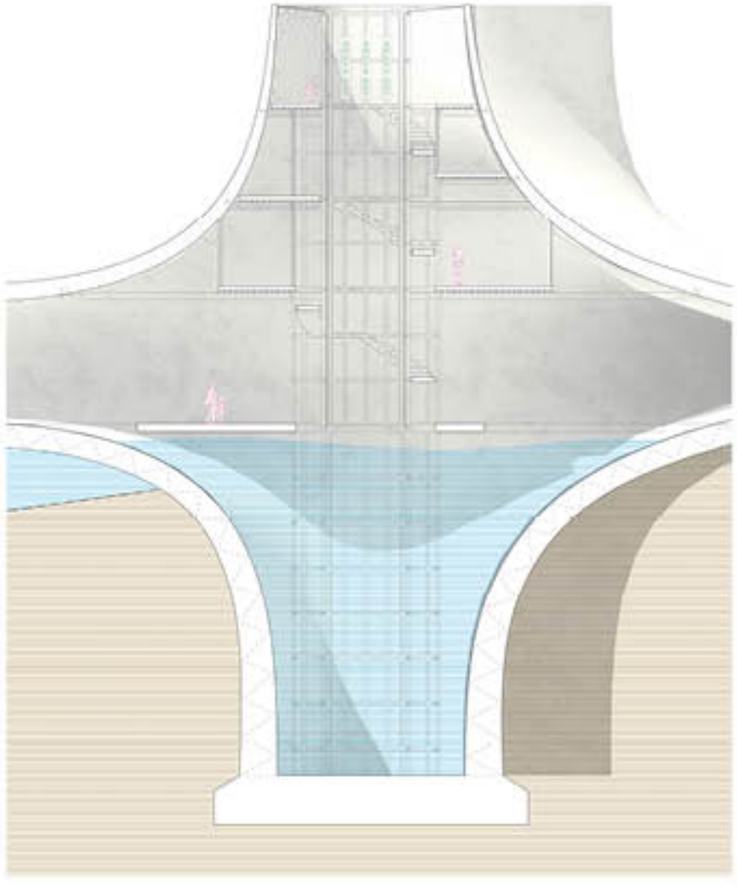
Hydroponic

Pisciculture

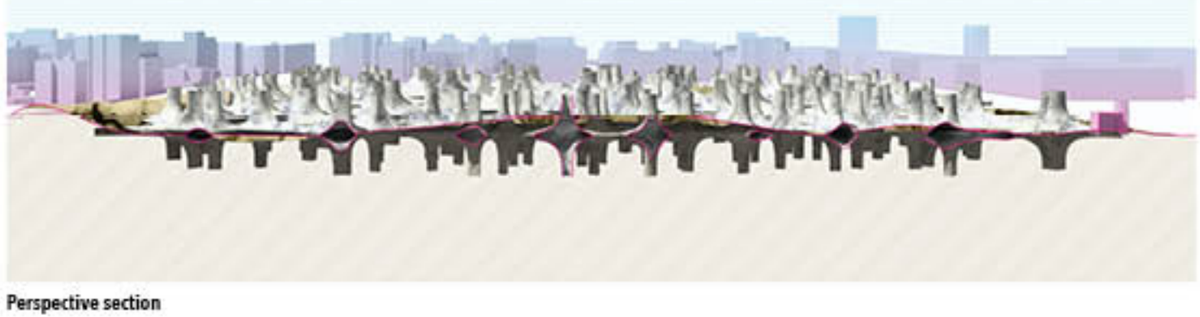
Trees for humid areas:
Salix alba
Salix Caprea
Alnun incana
Trees:
Quercus robus
Carpinus betulus
Ulnus minor
Acer pseudoplatanus
Fraxinus excelsior
Bushes:
Crataegeus monogyna
Cornus mas
Sambus migra
Grass:
Silene vulgaris
Silene doica
Ranuncus acris
Galium album



Ground floor plan



Section / The system is composed of two elements, which are made by distinct materials: a circular central steel truss running vertically across the floors, creating an opening allowing the light to penetrate inside the housing units, and an exterior continuous curved porous concrete skin which protects and divide. The only glazed part is the roof, an opening towards the sky, a view towards hope.



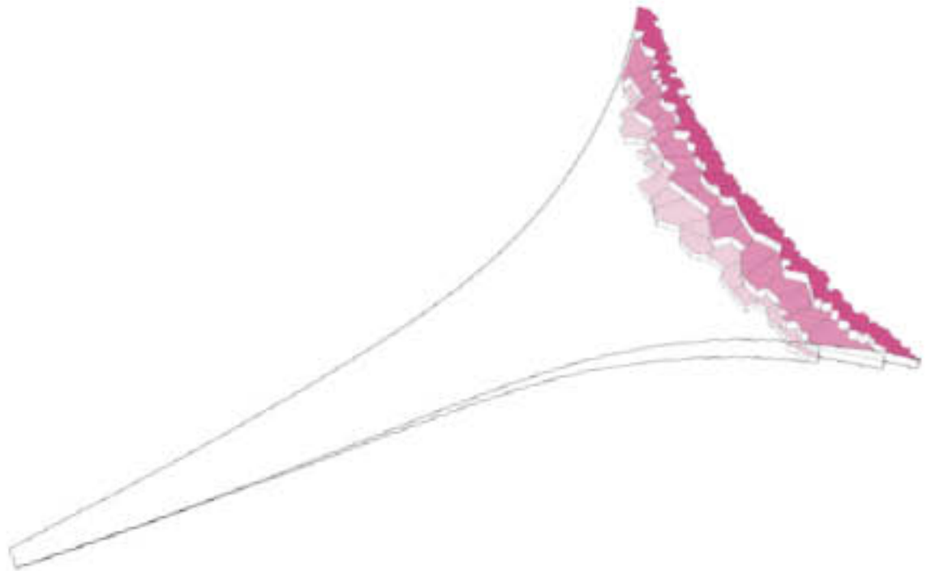
Perspective section

Birdeye view / ARCA is designed as a uniform layer that evenly spreads on Earth's surface.

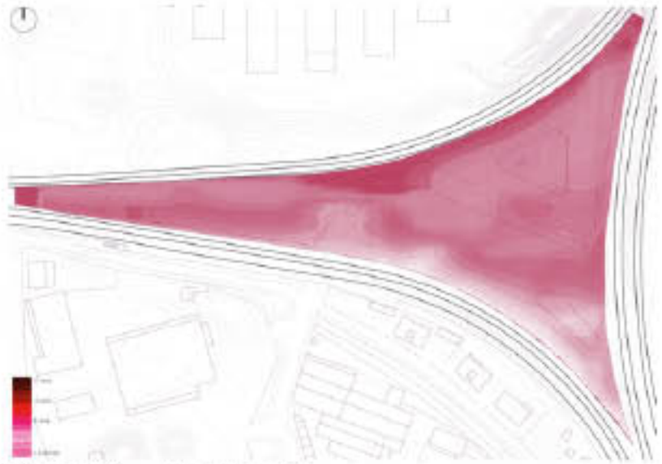
ZERO ENERGY WALL
Milan, Italy

Zero Energy Wall is a residential complex in the center of Milan. The area has a triangular shape surrounded by two different rail routes. The aim of the project is to transform a problem as the noise of the train in an opportunity considering the high quantity of wind produced by its passage. The first step has been to analyze the FEWs and environmental situation considering two aspects: noise of the area and quantity of the wind. Noise caused by the passage of cars was first considered, then the one produced by the passage of trains. Different noise-reduction strategies like artificial or natural barrier have been examined while looking for the best architectural shape and the most effective plants. Regarding wind analysis, different software like Ladybug and Flowdesign have been used to understand which points of the area were suitable to place wind turbines. These two aspects have been combined in an architectural shape using a 3D Voronoi tessellation.
Each parcel has a different attitude that can potentially accommodate residential, agricultural, or wind turbine energy functions. The architectural result is a structure with 3 layers that aspires to be a new urban wall inside the formal city.

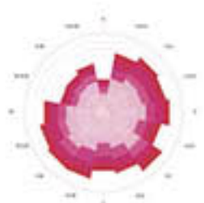
Massimo D'Alessio



Location / The chosen site is an interstitial area located between an highway crossing and a busy railroad, with exposure to heavy noise and wind generated by passing cars and trains.
Accordingly, noise and wind become the main drivers of the design solution, harnessing wind to generate power and developing a unique morphology in response to noise reduction requirements.

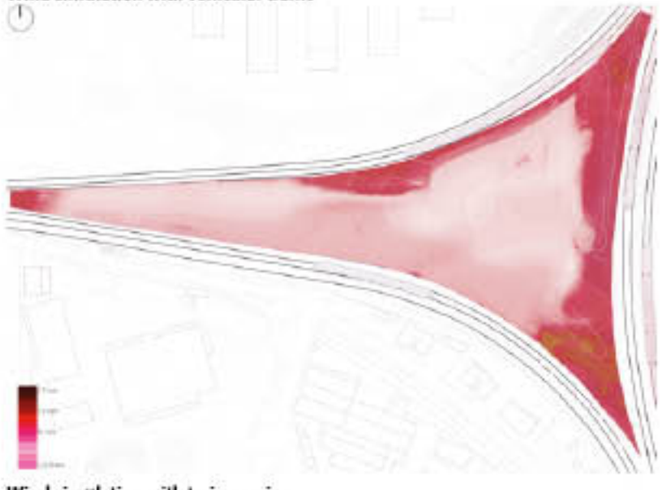


Wind simulation with vehicular traffic

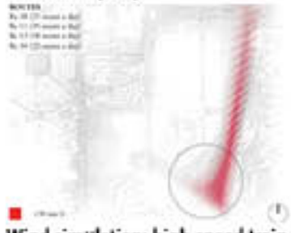


Wind Rose (C°)

Wind Rose (m/s)



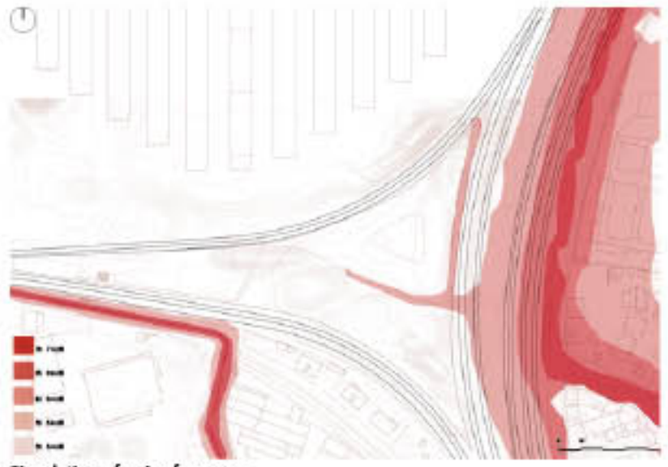
Wind simulation with train passing



Wind simulation: high-speed train

Wind simulation: local train

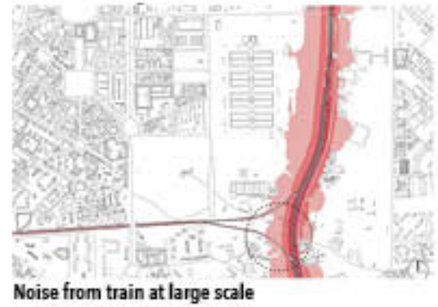
Noise as opportunity
Simulations show that noise on site reaches critical levels and requires a radical, yet modulated response by using a physical infrastructure that responds point-by-point to the noise map. Likewise, wind generated by traffic can be a meaningful source of energy by placing micro-turbine following the wind simulation map.



Simulation of noise from cars

Noise from cars at large scale

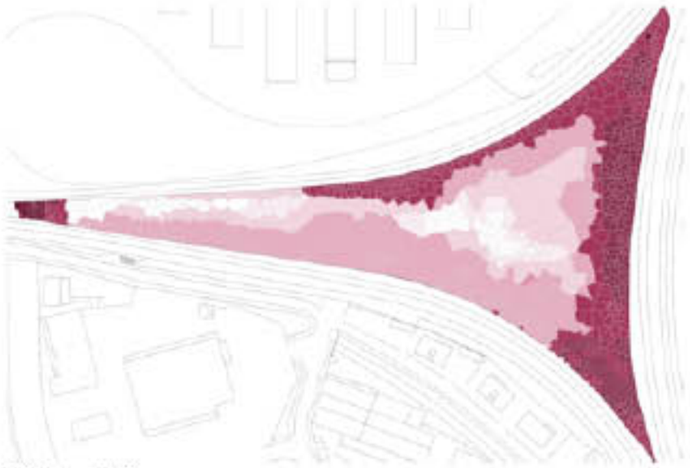
Simulation of noise from trains



Noise from train at large scale

/ ZERO ENERGY WALL / Tesselation

Points from water flow | Points from highest wind speed | Points from highest noise | Final Voronoi tesselation

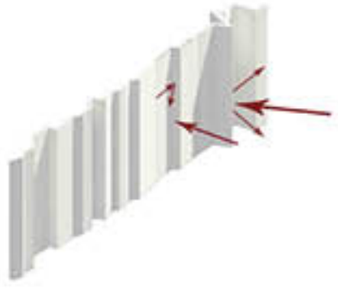


Wind tessellation

Noise tessellation

Tesselation / Noise and wind gradients are overlaid on the Voronoi tesselation to identify tassels that provide suitable locations for sound barriers and wind turbines. A hierarchy emerges as prevailing functions are allocated to each land unit.

Artificial edge wind simulation

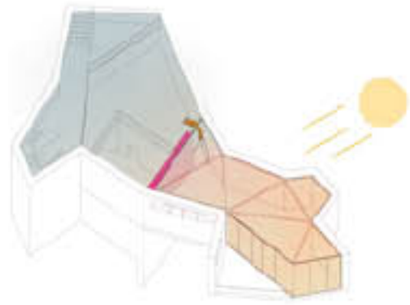


Noise barrier principle

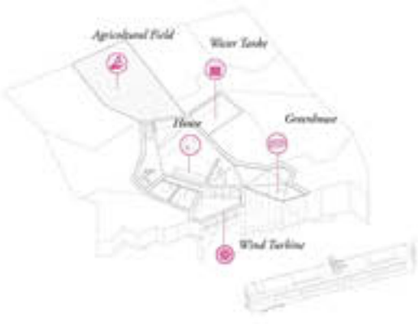
/ ZERO ENERGY WALL / Program allocation

Program allocation / A hierarchy emerges as program is allocated to each land unit based on prevailing function.

Residential units within noise barrier infrastructure



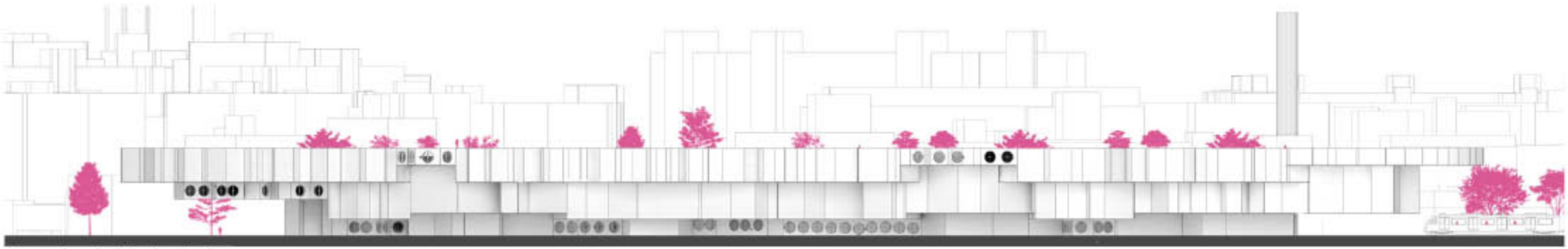
Self-regulating temperature



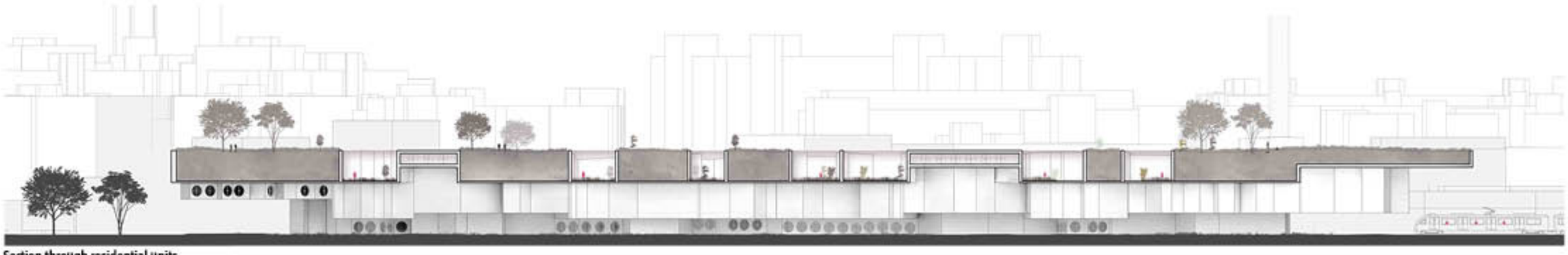
Program gradient distribution

/ ZERO ENERGY WALL / Elevation and sections

Wind analysis on the new facade



The new urban edge facing the railroad



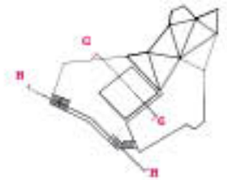
Section through residential units

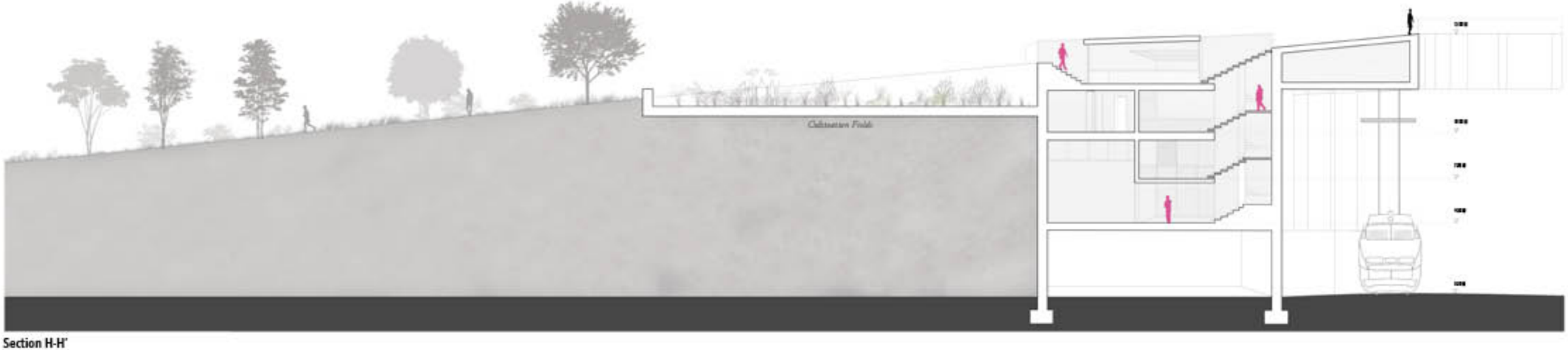
Plan +13,00 m

Plan +10,00 m

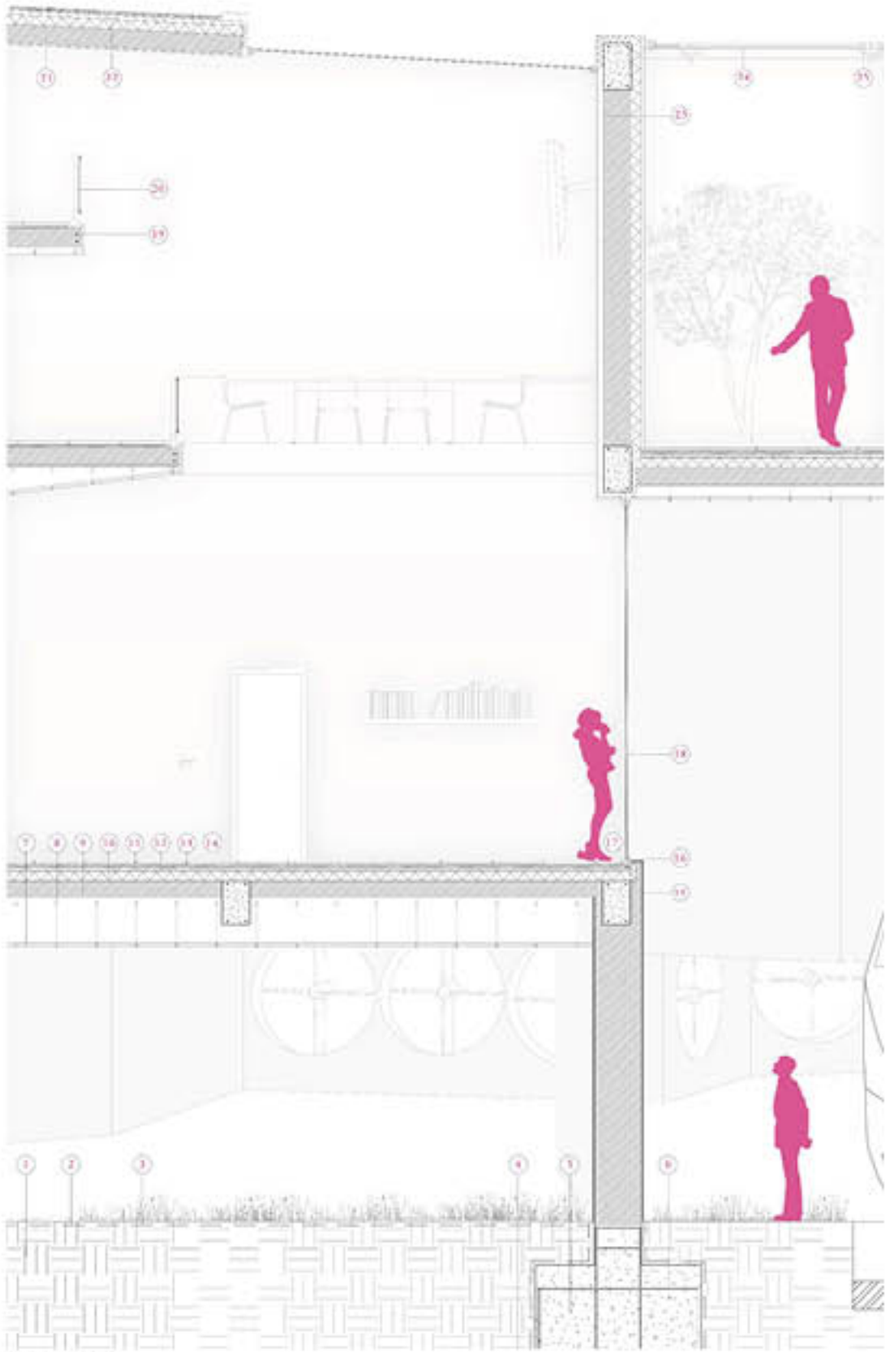
/ ZERO ENERGY WALL / Residential units

Plan +4,50 m





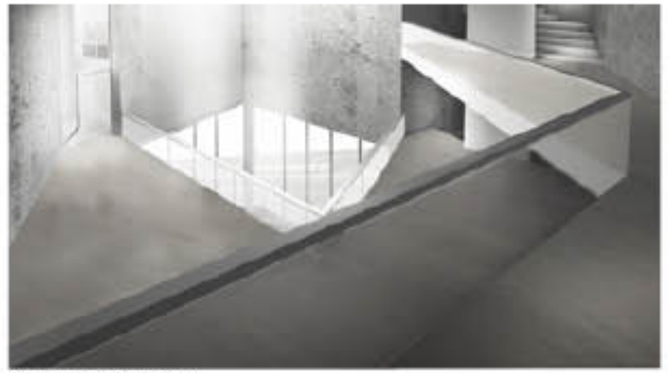
Section H-H'



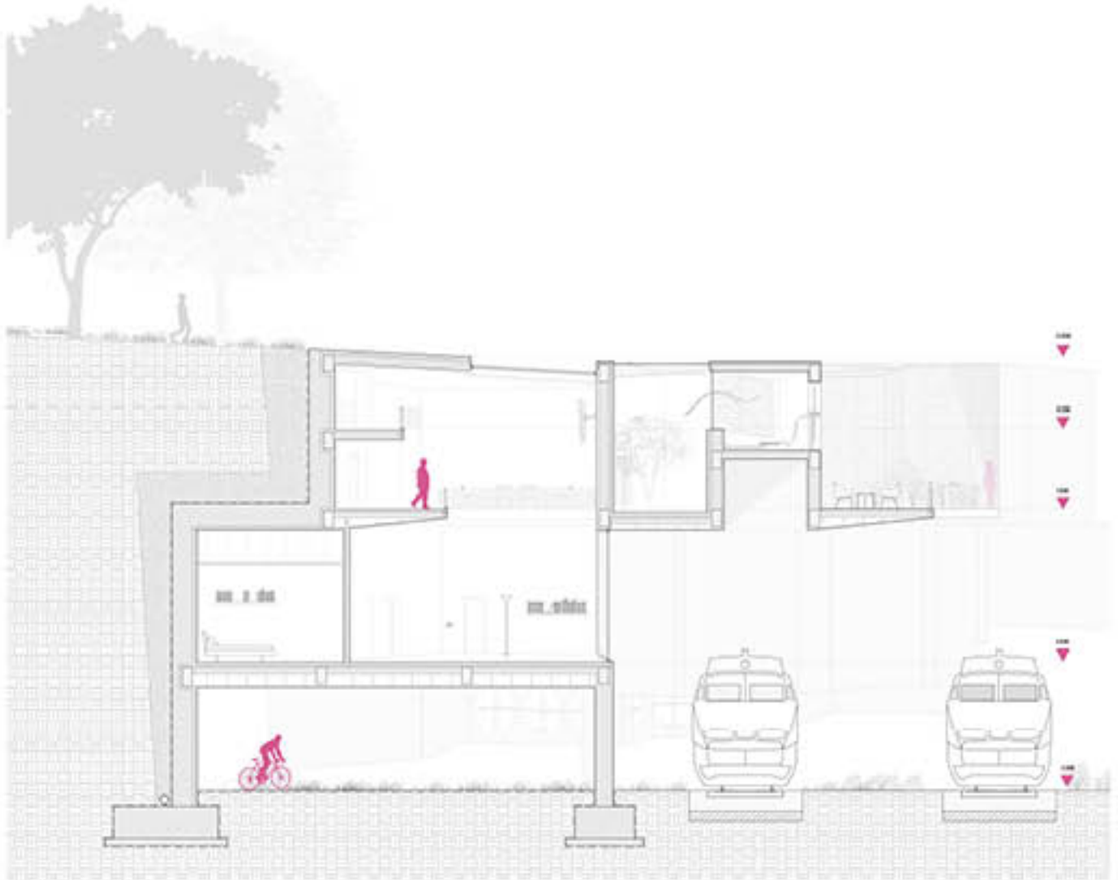
1 Ground
2 Waterproofing
3 Grass
4 Concrete slab
5 Foundation
6 Framework
7 Suspended Ceiling
8 Ceiling structure
9 Concrete
10 Insulation
11 Vapor Barrier
12 Radiant Panel
13 Screed
14 Paver
15 Plaster
16 Window Frame
17 Concrete Beam
18 Glass
19 Framework slab
20 Parapet
21 Gravel
22 Waterproofing
23 Air layer for conduits
24 Glass Covering
25 Spider

Detail section

Light well concept



Light well visualization



Building section

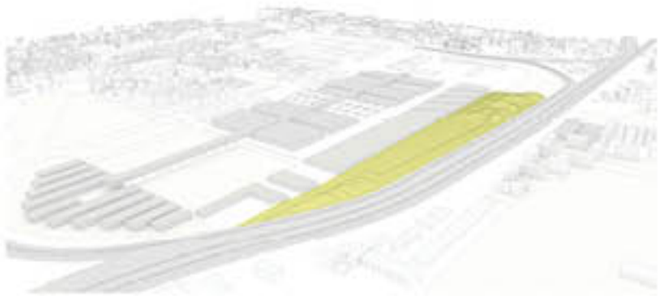
/ ZERO ENERGY WALL / A new urban edge

The Zero Energy wall / The new urban wall facing the railroad, with residential units and wind turbines integrated into a compelling new architectural language. The folded geometry of the building's front refracts the noise generated by passing trains, while the innovative cladding material absorbs excessive sound before reaching the building's interior.

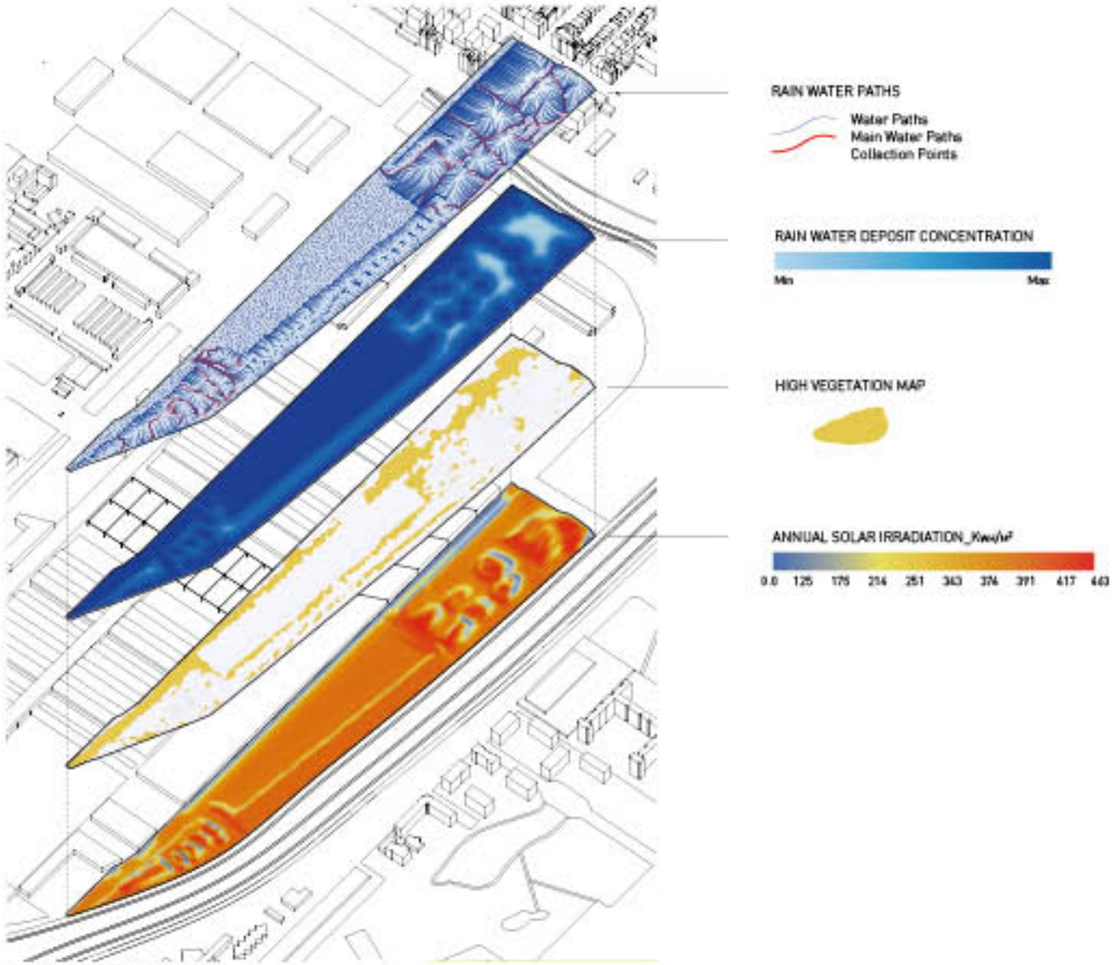
W-TANK HOUSE
Milan, Italy

The project starts from the idea of reverting the common relation between the house and a rain-water collection system. While usually the water is collected in tanks or ponds as separated entities from the house, wTank House collects water into multiple pockets embedded into the roof. Moreover, the optimized topography of the surroundings and the volumetric development of the roof itself creates a channelling system which drastically increases the amount of collected water. In the project, water is the main component in a wider, comprehensive system that makes the housing unit a zero-energy building. The blue system is coupled and closely interwoven with a green system, where acquaponics and terraced agriculture guarantees food production, an integrated pythodepuration system provides clean water, while trees as sound barrier next to the railway and scented flowers guarantees a nicer and more livable environment. The house is integrated in a wider strategy at the site scale, which builds on the idea of evenly distributing natural resources and spaces in a site which is narrow and characterized by different external inputs. The masterplan takes those elements, such as waste from the Ortomercato, noise from the railway and sloping landscape, and exploit them as resources. The waste is integrated in a system of composting, sound protecting and agricultural activities, turning a huge problem of the area into a key element for the new neighborhood.
The existent hilly morphology has been treated and optimized for collecting water, sun exposure for agricultural purposes and protecting and giving privacy to the housing units.

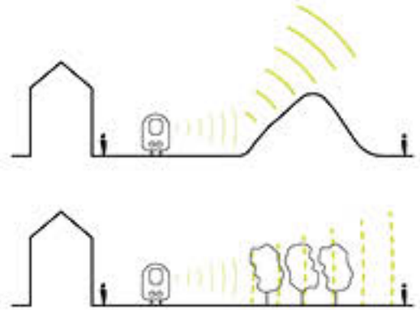
Luca Breseghello



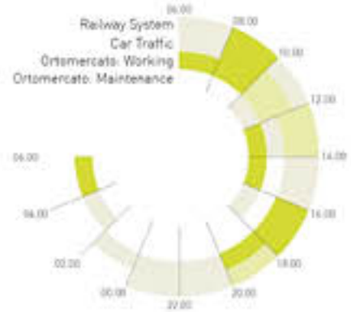
Site location
The project takes on a residual parcel of land next to the Ortomercato, presenting numerous challenges: from reducing noise and air pollution related to nearby vehicular traffic and railroad, to processing organic waste generated by the fruit and vegetables market, to collecting rainwater and minimizing land erosion, to name but a few. The initial step in the design process includes detailed simulations highlighting potentials of the site to collect water runoff and solar radiation.



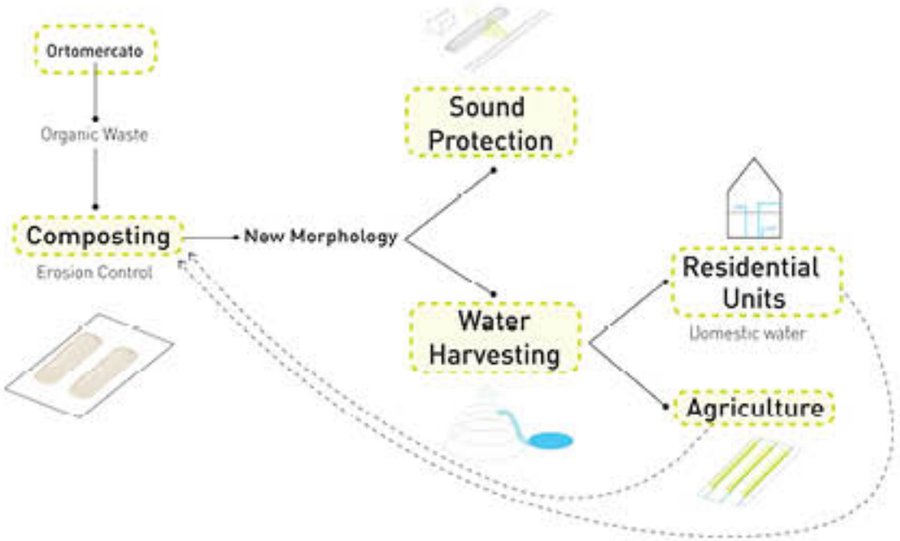
Environmental analysis



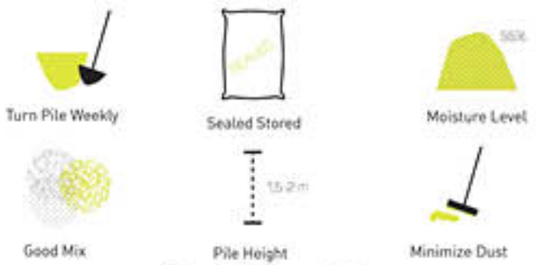
Typologies of sound barriers
Although sound propagates in ways that are extremely complex, deflection and absorption are two well-understood strategies for noise reduction. Each method implies a specific infrastructure: physical barriers with a large mass have the effect of deflecting sound waves, while porous, fragmented surfaces can reduce sound intensity. The project deploys both technics.



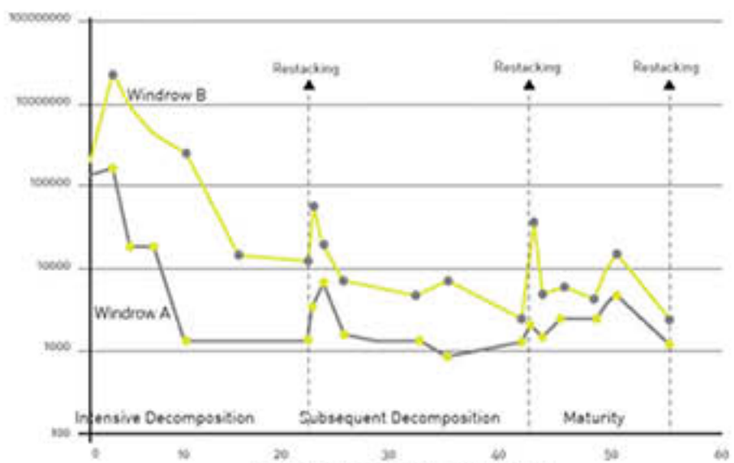
Noise analysis



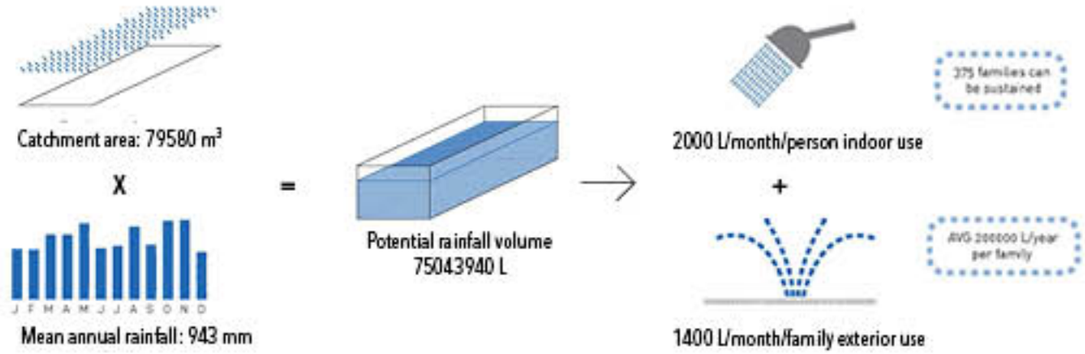
Composting components



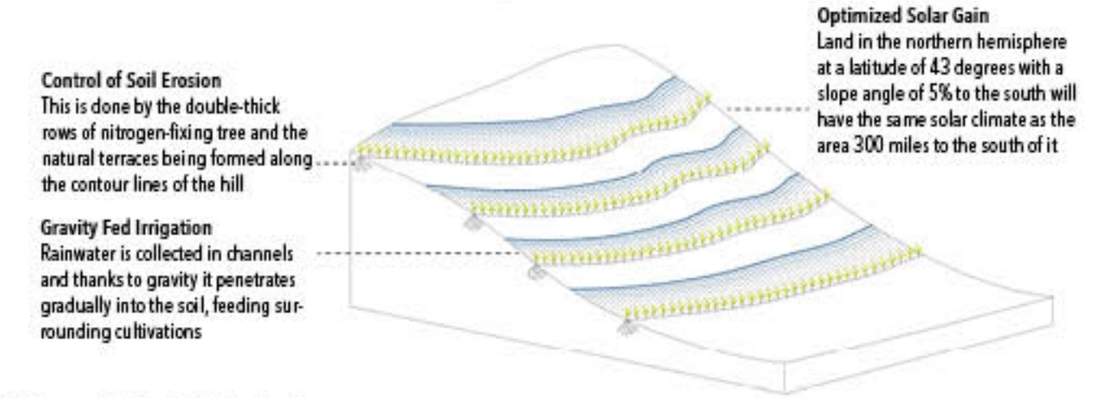
Odor minimizing methods



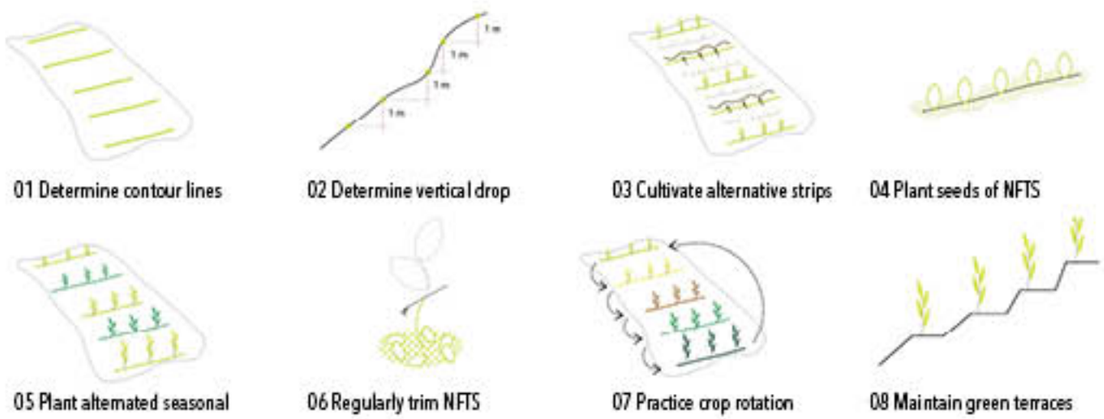
Odor load (y) / Decomposition age (x)



Water harvesting potential

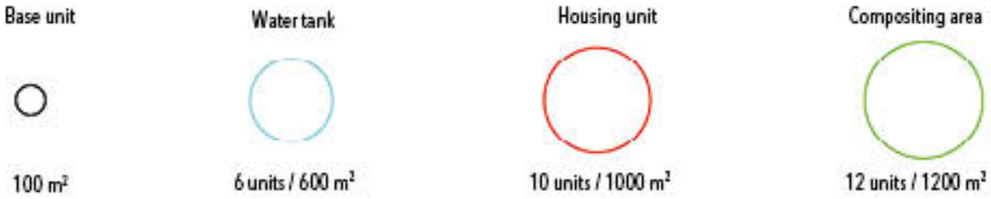


Sloping agriculture land technology

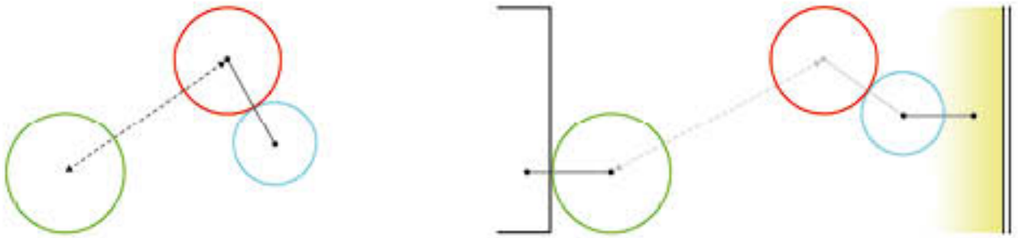


Rules and process

/ W-TANK HOUSE / Circle packing and tesselation

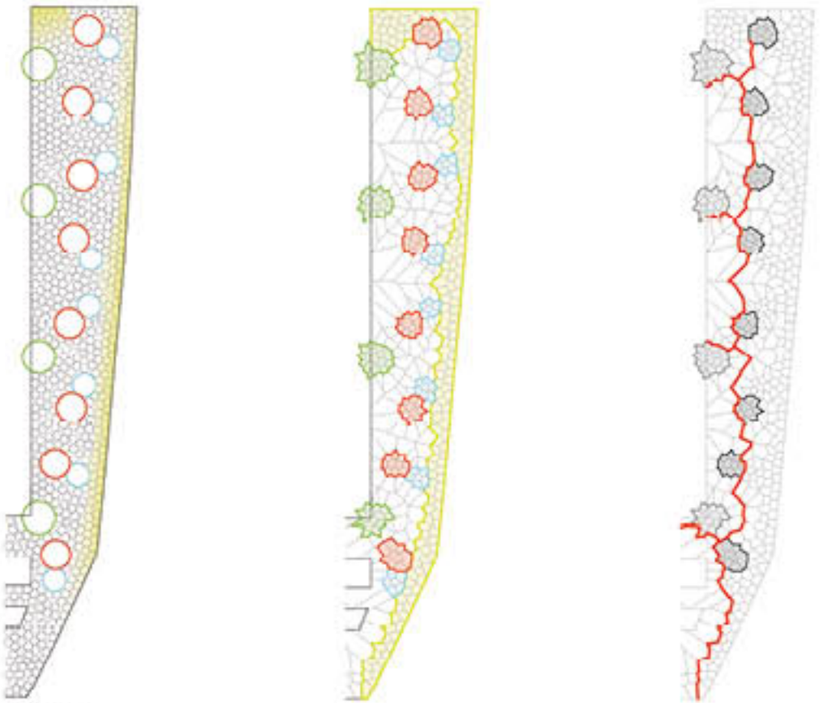


Elements and rules



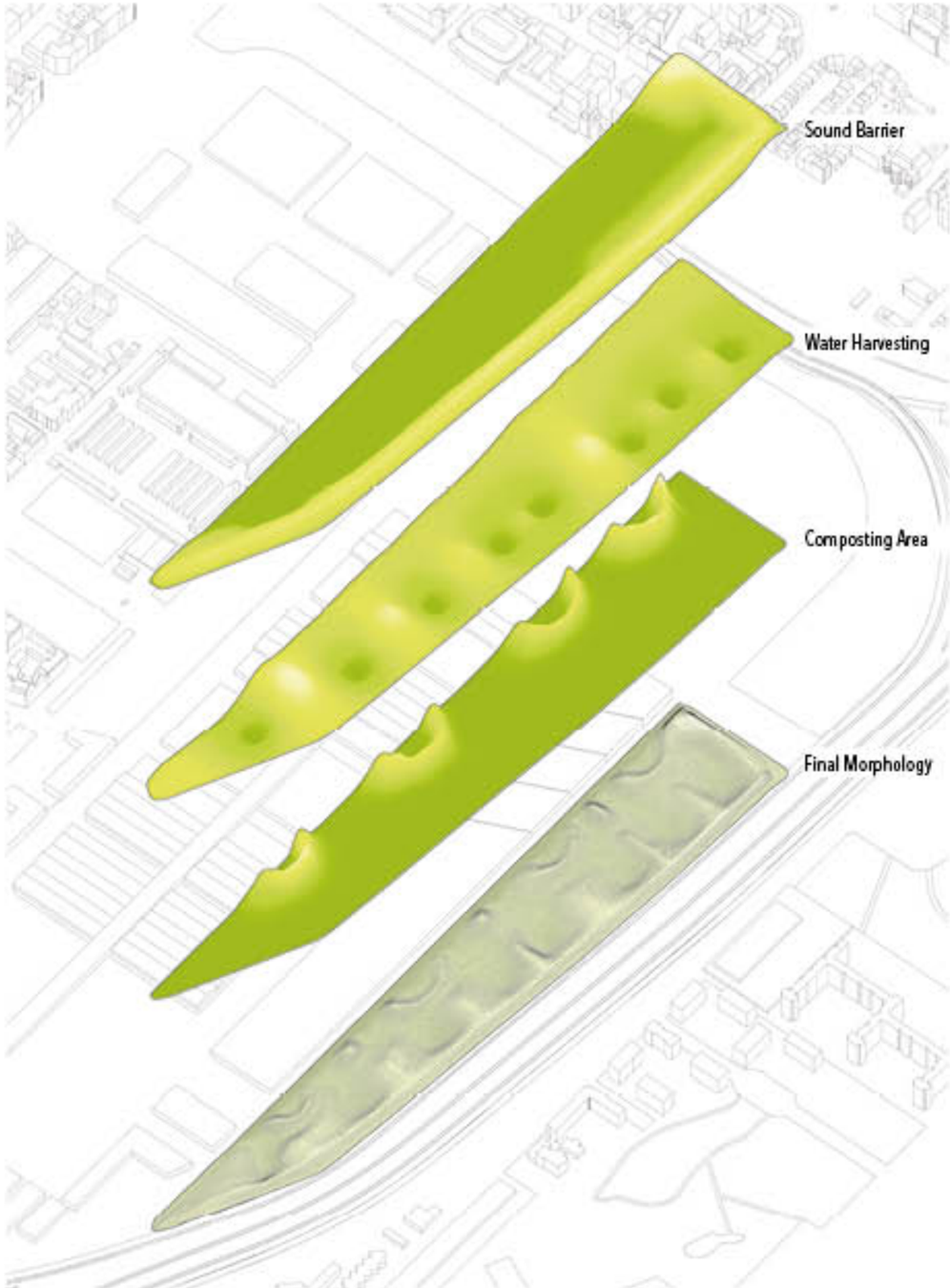
Compost and housing repulsion / Housing and water attraction

Ortomercato and compost attraction / Water and sound attraction

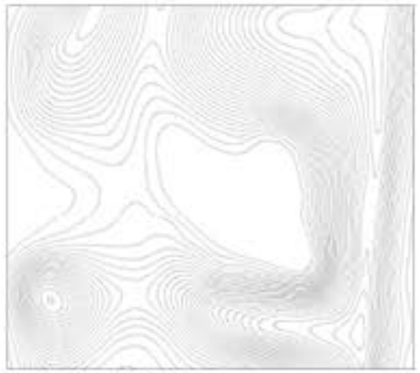


Circle packing and tesselation

/ W-TANK HOUSE / Topographic manipulation

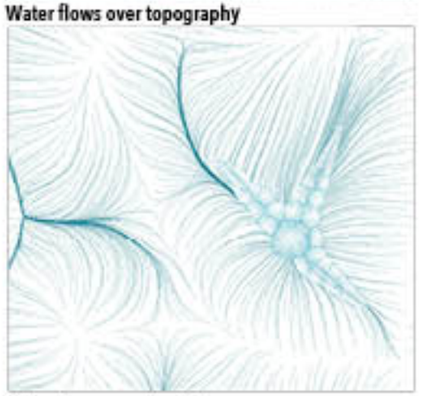


Process of 3d morphology



Contour lines (0,30 m)

Water flows over topography



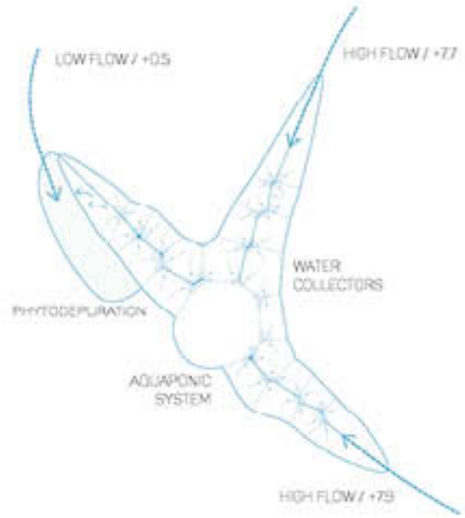
Water flows over the house

01 Space definition

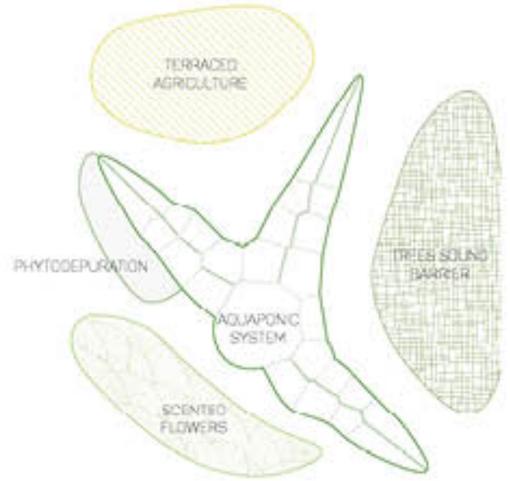
02 Aggregation along major flows axis

03 Interpolate, offset and cut

04 Pull and Inflate



Blue system



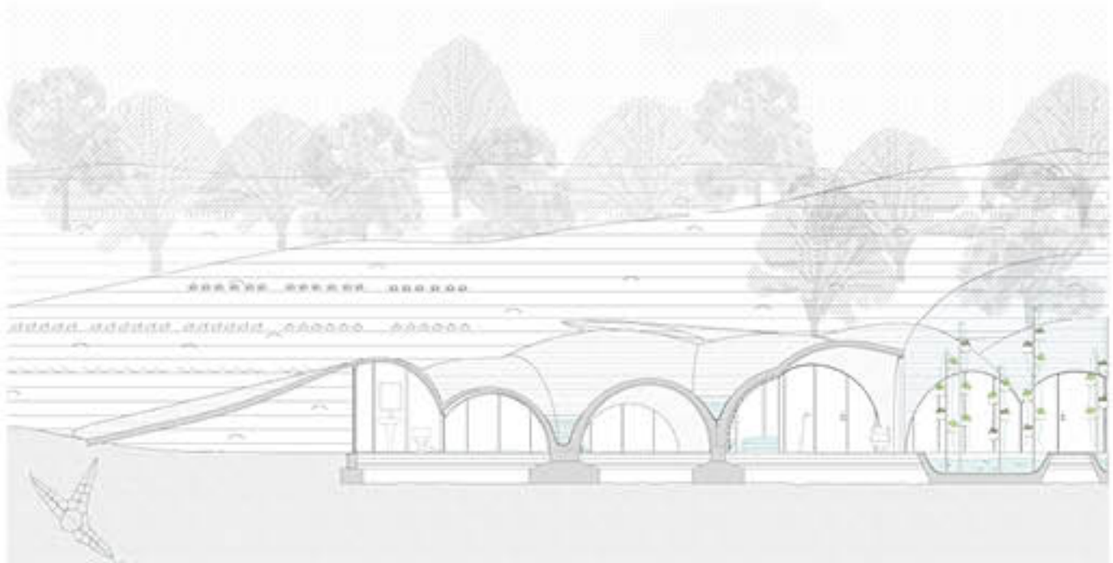
Green system

Axonometric view of the parcel

/ W-TANK HOUSE / Interior view and section

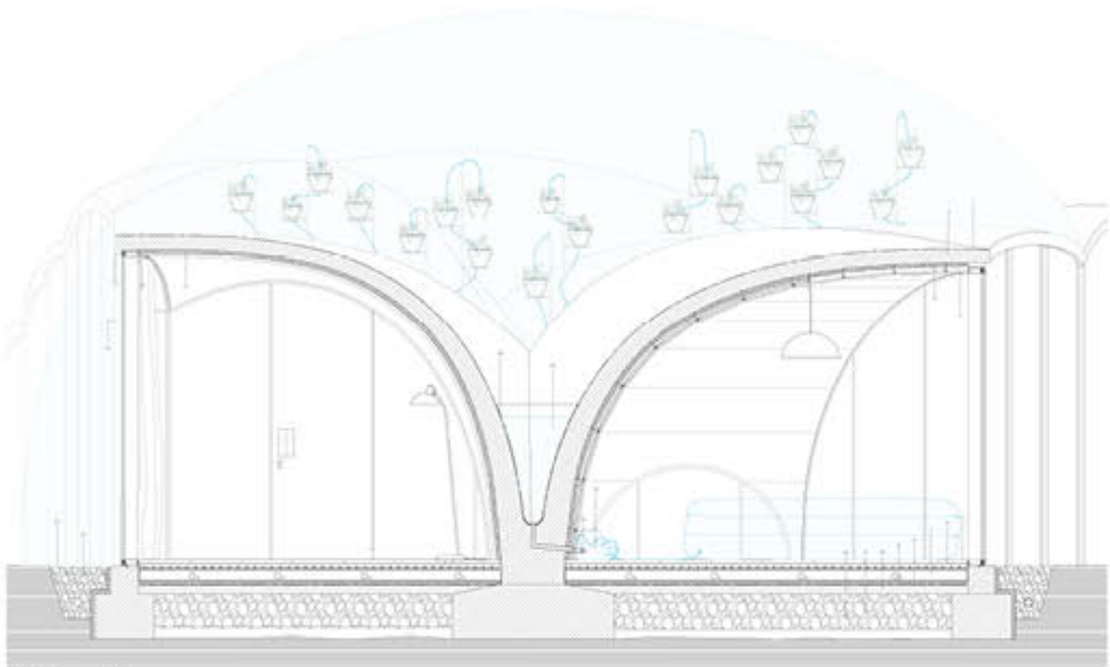
View from the living room

View from the hill



Longitudinal section

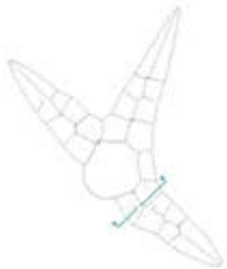
Building plan

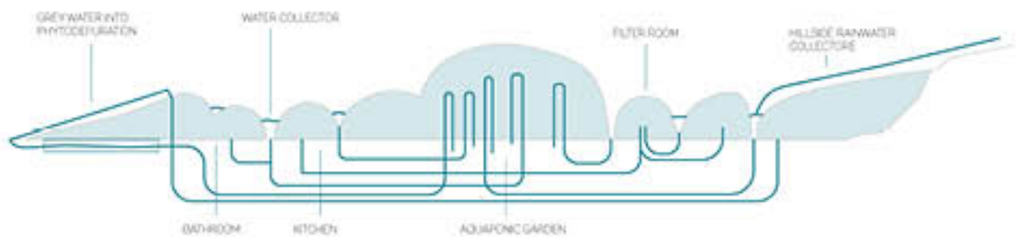


Building section

KEY

1 / 1mm Waterproofing Membrane
2 / 15-55cm Reinforced Concrete
3 / 45mm Insulating Mortar
4 / 20mm Fake Ceiling Wooden Panels
5 / 25mm Wooden Finishing, 10 mm Glue
6 / 60+40+40mm Radiant Floor
7 / 16cm Ducts
8 / 50mm Insulating Mortar
9 / 1mm Waterproofing Membrane
10 / 10cm Concrete Slab
11 / 60 cm Gravel
12 / Big Slim
13 / Pressure Sack for water distribution
14 / 49mm Water Pipe
15 / Water Collector
16 / Double Waterproofing Membrane
17 / 20mm Plaster
18 / Curtain
19 / 5mm Stainless Steel Sheet
20 / 15mm Paving
21 / Drainage Gravel
22 / 20mm Wooden Deck



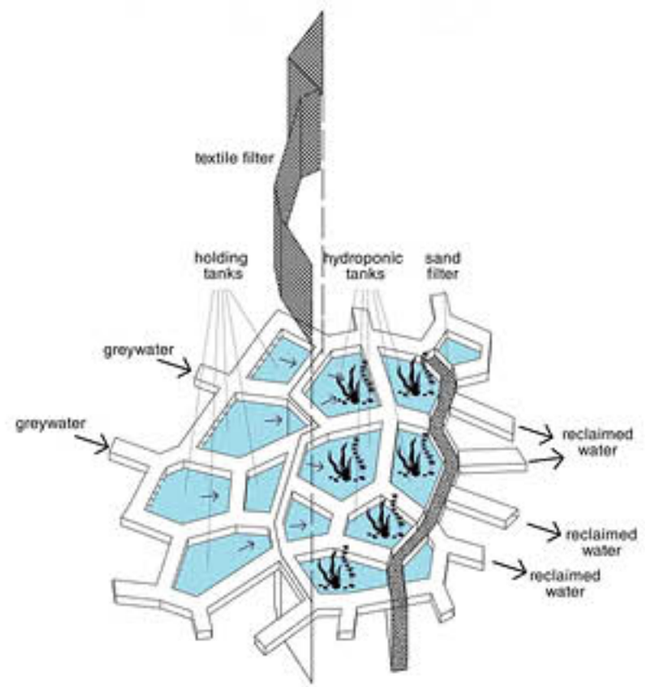


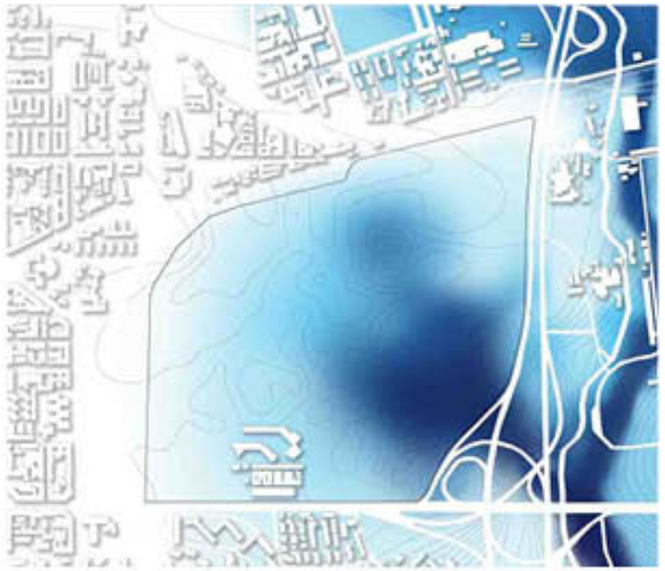
Functional scheme

WATERWAYS
Milan, Italy

Natural conditions are the first concern while designing a sustainable project. Hydraulic risk on the site provided an opportunity to deal with water and use it as a resource rather than a threat.
Large amounts of energy are needed to provide water for agricultural and residential use. If we can collect water on site in a natural way, shouldn't we make use of it? According to statistics, more than half of the total water consumption goes into agriculture and around one third of indoor water may be not drinkable. The project's main concern was designing a natural water cleaning system serving both the river and the residential units. The project founds an answer in the system of pools that let water pass from one to the next cleaning stage, such as hydroponic cleaning, filtering with sand, textile, UV sterilizer, etc. Furthermore, treatment can be more effective if wastewater flows are segregated from the beginning.
The project proposes modular blocks that are separating waste water streams and are inserted in the foundation, connecting it with the landscape, while water channels carry the water into filtering loops, including as walkways. The design also pays attention to standardized components in order to decrease the cost of construction. Along with water purification, solar thermal panels are integrated into the skin of the building. They are located in areas that show maximum solar radiation, providing shade and the opportunity of a roof garden. The main challenge of the project was to see building's performance as part of the whole experience.

Nadia Safronova





Flood risk analysis

Hydrological study of the plot
Due to the close presence of the Lambro river, hydraulic risk on the site is rather high. Moreover, in the southern part of the site there are underground aquifers.
Any building in the areas would be subject to floods, and therefore would not be recommended. The design strategy takes into account these requirements by providing a large water cleaning infrastructure that can work as a protection system in case of flood.

Typical 4-story residential building

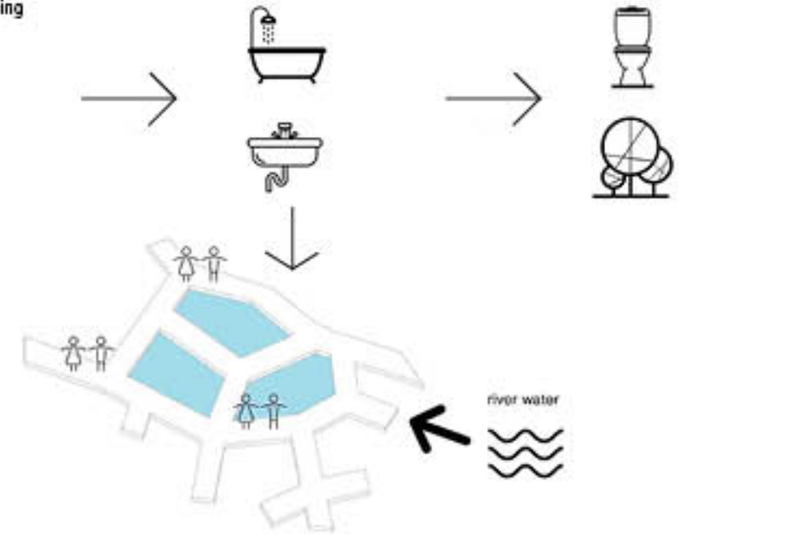
Grey water cycle

- 4 200 m2 area of the roof
- 0.8 m- minimal monthly precepitation in Milan

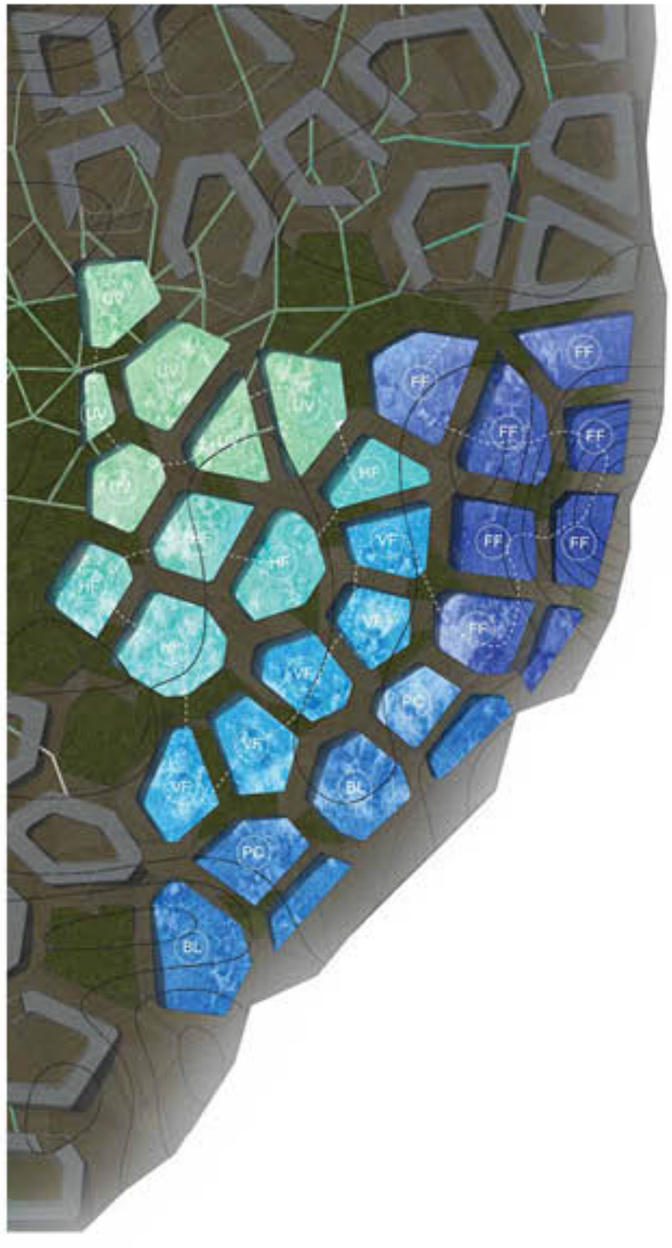
3 360 litres of water per month

- around 200 people
- around 20 000 litres of grey water

20 000 litres of grey water per month

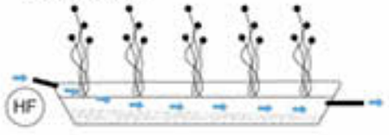


System of water storage and cleaning

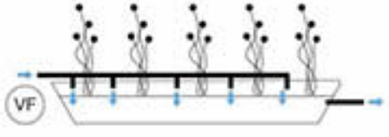


Grey water cleaning
A large part of the pollutants contained in wastewater are nutrients that can be removed in wastewater treatment plants by reproducing natural self purification processes. Conventional treatment plants, like activated sludge plants, enforce biological organisms with energy-intensive mechanical equipment to decompose complex compounds, to incorporate the nutrients in biomass and finally to separate that biomass from the purified water. Thus such plants are energy intensive reactors with relatively small area demand that are suitable for centralized wastewater treatment. Classified within treatment process constructed wetlands are usually applied as secondary treatment for mechanically pretreated wastewater.

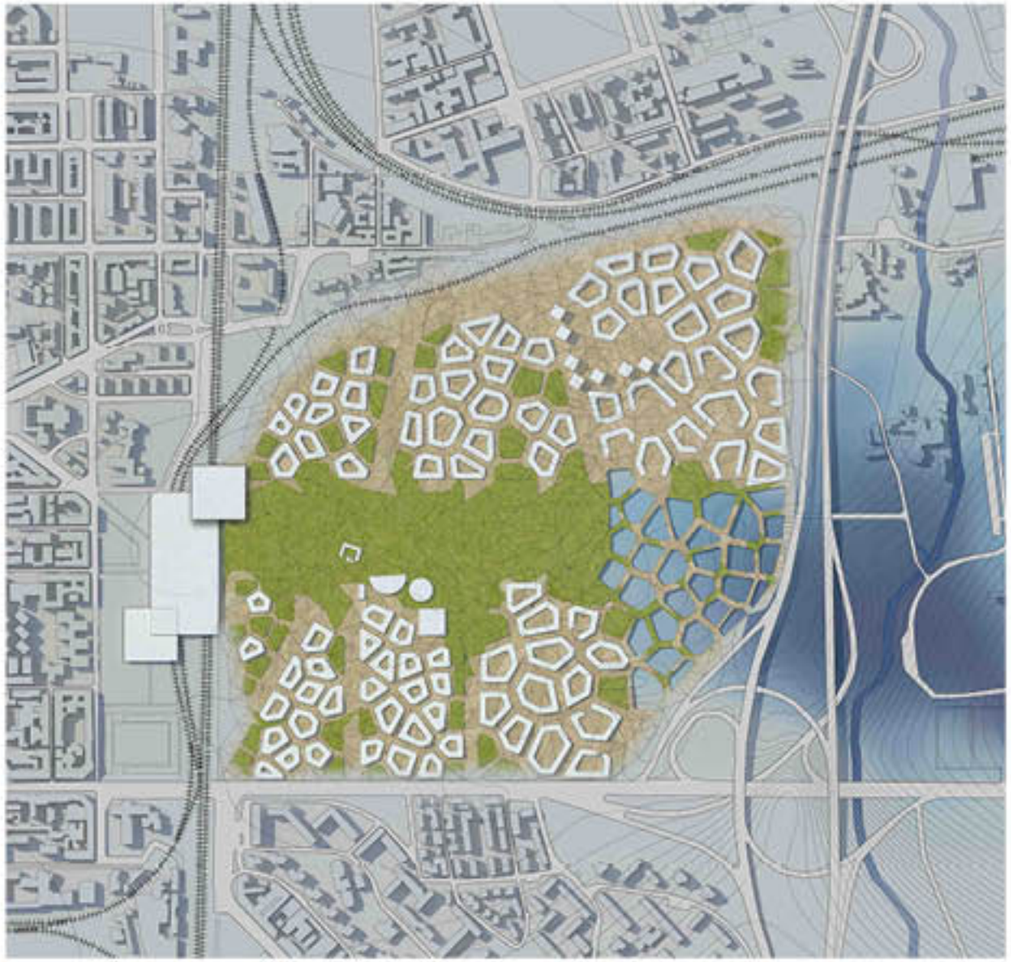
Horizontal subsurface flow (hf)
This method consists of a properly designed water proof basin that contains a filter material, wetland plants (normally reeds) and microorganisms.



Vertical subsurface flow (vf)
In the vertical flow systems (VF) the wastewater is applied through a distribution system on the whole surface area and passes the filter in a more or less vertical path.



Free subsurface flow (ff)
Surface flow wetlands are densely vegetated basins optionally including open water areas. They need some sort of subsurface barrier to prevent seepage and soil or another suitable medium to support the emergent vegetation.



The large-scale waterscape integrating filtering system, residential buildings and flood areas

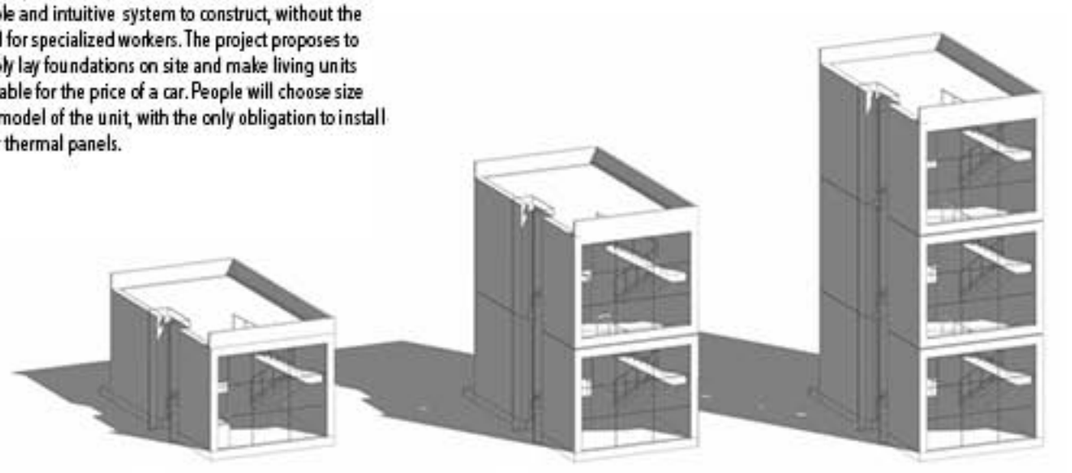
Building on a typical parcel

Architectural plan

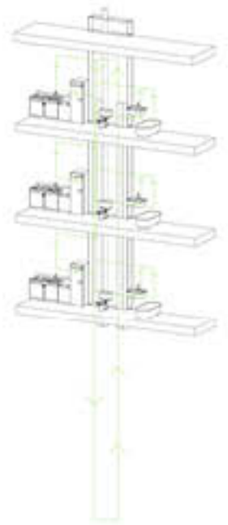
/ WATERWAYS / Prefabrication system

Prefabricated housing unit

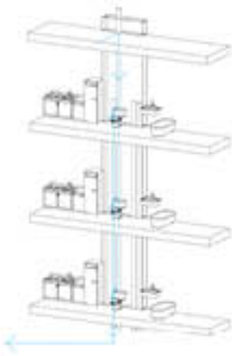
The best solution to decrease cost and increase efficiency is prefabrication. As with computers and mobile phones today, housing units can become a simple and intuitive system to construct, without the need for specialized workers. The project proposes to simply lay foundations on site and make living units available for the price of a car. People will choose size and model of the unit, with the only obligation to install solar thermal panels.



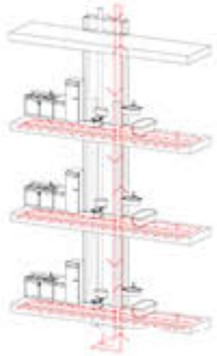
/ WATERWAYS / Water cycle



Grey water cycle

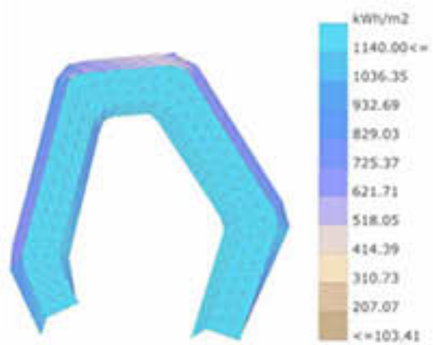


Black water cycle

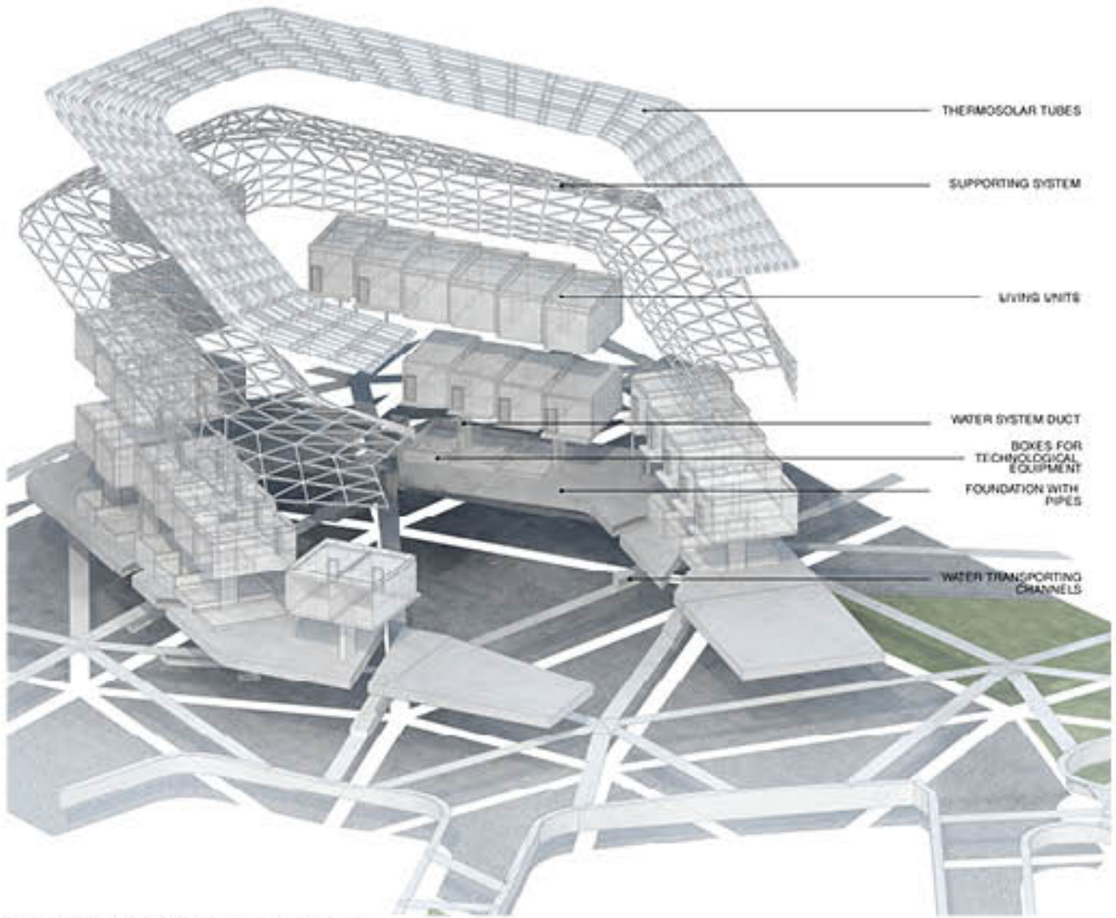


Solar thermal cycle

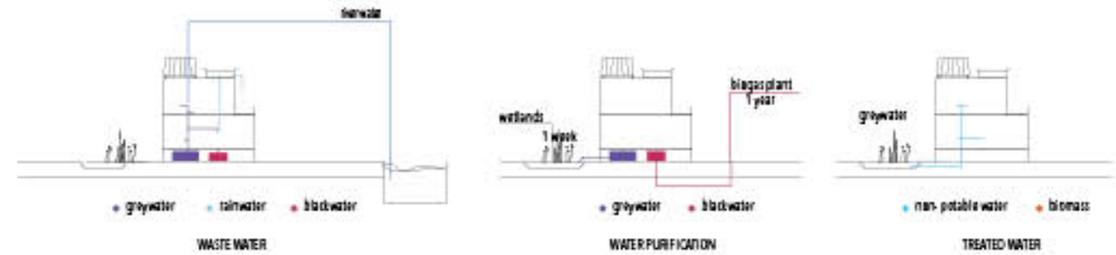
Bird-eye view of the project

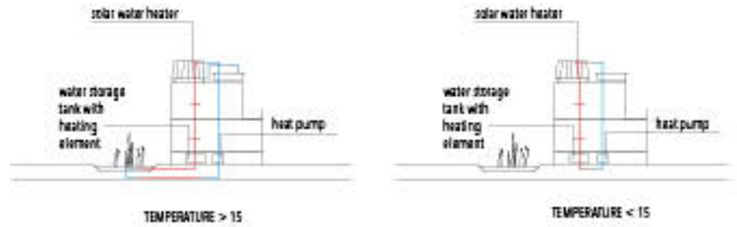


Radiation Analysis



Axonometric view of building's components





View of roof garden

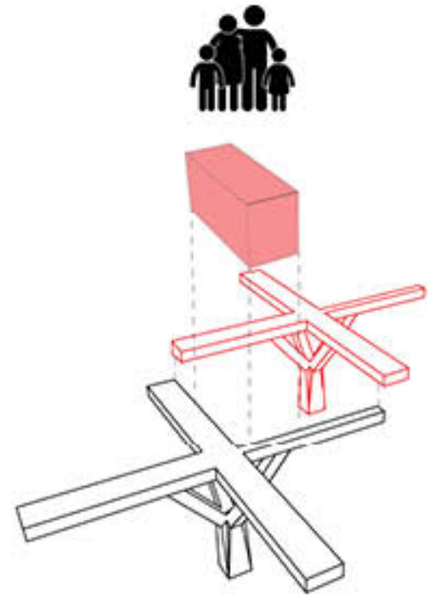
/ WATERWAYS / New Waterscape

A new waterscape in Milan
The building supports farming on its roof, as well as a colony of migratory birds and a large solar thermal installation. Water purification pools feature prominently within the new development, turning into reservoirs to contain water in the event of a flood. Infrastructure elements support leisure activities and greenery is perfectly integrated.

WATER DISTRICT
Milan, Italy

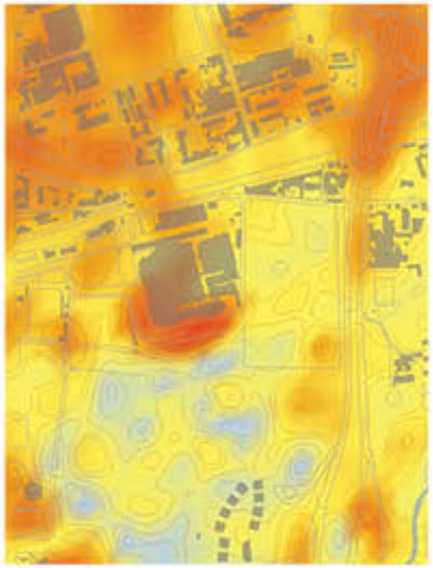
The Water District project combines the FEWS with nature's powers. Located right next to the Lambro River, the area is part of the green network of Milano and presents high flood risk.
The district project is separated in two worlds: the existing vegetation on the ground level is enriched by the addition of local and edible plants which forms the forest garden of the "world below". The human life takes place on the "world above", a floating structure upon which the dwellings and streets are suspended.
Groups of 24 houses are gathered round a greenhouse which produces the FEW's (food, energy by solar panels, geothermal heat), collects wastes (organic wastes and grey water) and serves as human vertical circulation.
Thanks to the shape of the ground and the grid of individual basins, the rain water is collected, stored and streamed progressively to a larger pond which naturally filters the water that is then redistributed by a pipe system to the houses for various domestic uses (undrinkable).
Once all the basins are filled with rain and filtered water (after a few months of rain), the collected water will be enough for the district, and the extra collected and filtered water is sent back to the city system, which makes the district a water producer.
In order to let the sun reach the fauna and flora of the ground level, all the suspended houses need to have a limited cast shadow on the world below. Therefore the proposed house's shape follows this rule, resulting in unusual, yet intriguing silhouettes.
The internal organization on various levels takes advantage of this shape and lays out the living rooms above to benefit from the sunlight, and the night rooms below to benefit from the relaxing views on the forest garden.
The house external structure is a squared wood grid where each 'tile' has a function (window, shelf, or vertical garden) according to its position. The house rooftop hosts a private vegetable garden full of small edible plants, and collects some extra rain water.

Ilaria Calamita



/ WATER DISTRICT / Environmental analysis

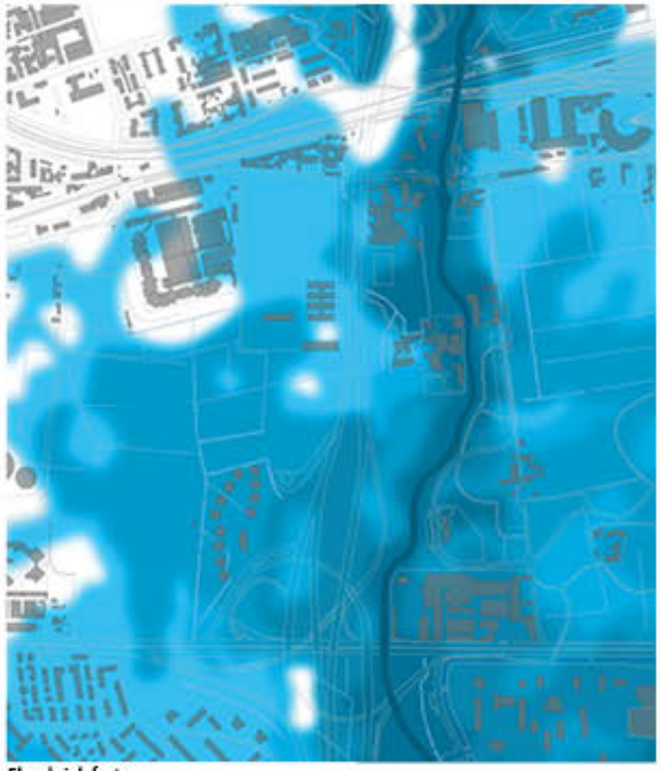
Environmental analysis / The project tries to overcome the natural exposure of the area to floods. The area is considered at high risk and it will probably become more hostile for people to live in the future.
People should not run from it, but find ways to live in these dangerous, yet fragile and potentially rich ecosystems. A deep understanding of the many factors related to naturally occurring floods is the preliminary step toward harnessing nature's power to support a new human colony on site.



Topography

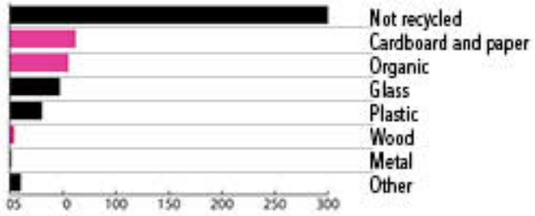
Depth of ground water

Green areas around Milan

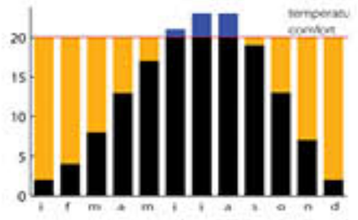


Flood risk factor

/ WATER DISTRICT / FEWs: Biomass and Geothermal



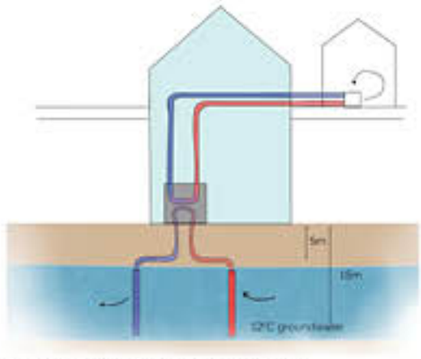
Type of waste



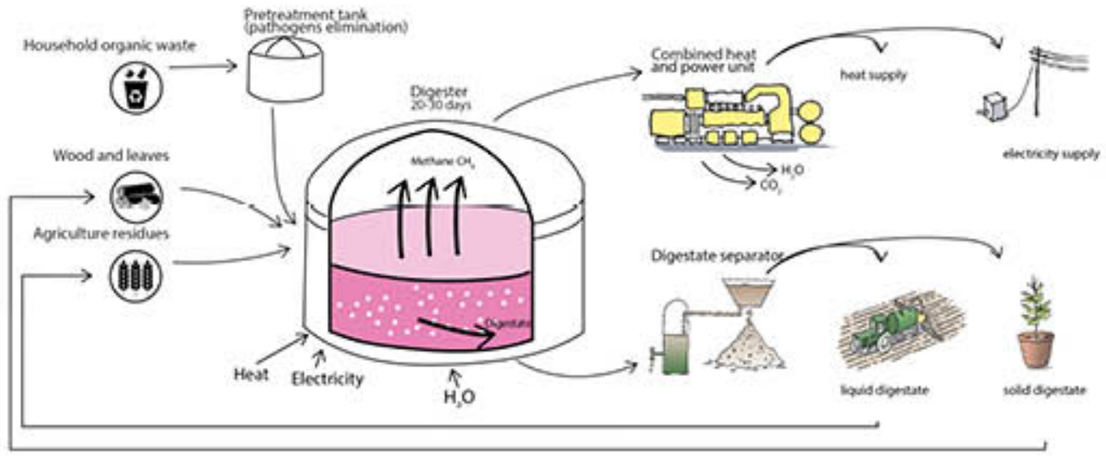
Temperature in Milan

Geothermal energy / The heat pump liquid absorbs the heat from the groundwater, the compressor compresses the liquid to make its temperature raise and reach 80OC°. This heat is then transmitted to the water system of the greenhouse, and then distributed to the houses (heaters, and hot water tank).
In summer, the system works in reverse. The liquid absorbs the extra heat in the house, and then transmits it to the ground water circulating in the pipes.

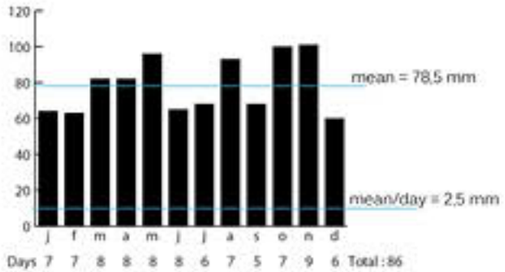
Organic waste and biomass harvesting at local scale



Thermal system from ground to house



Technology: Biomass digester combined heat and power (CHP)



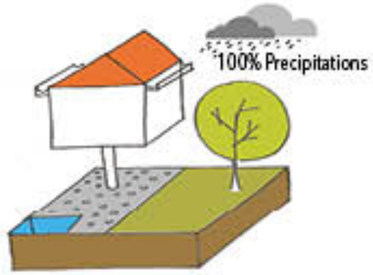
Shaping the ground
The shape of the plot will be "folded" in order to optimize the water drainage and collection.

Rain in Milan / On 1ha of land, it rains approximately 25m3 of water a day. But we can't harvest the rain on the entire site ground. Supposing that we can only harvest on a third of the land, (the other 2/3 are woods, roads, and rivers surfaces), we would harvest a total of 8m3 of water a day. Considering that a person uses in average 0.2 m3 of water a day, a 1ha site could only supply 40 people. But even if 30% of the used water won't go back to the water pipes, due to evaporation and garden watering, the 70% of used water left could be filtered on site and be reused by the same people. In that way we can increase the number of possible inhabitants.

Rainwater harvesting / Turning the impermeable surface in a more permeable one by raising up the building reducing the built surface by more than 80%. Leaving more space for vegetation. Creating water basin for rain water collection and storage. The extra percentages mean that a plot could evaporate and infiltrate more water than what it gets.

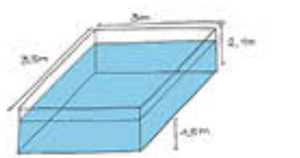
26% evapotranspiration
12% shallow infiltration
19% deep infiltration
18% runoff
25% harvested

26% evapotranspiration
10% shallow infiltration
15% deep infiltration
49% runoff
0% harvested

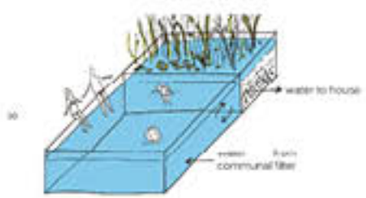


26% evapotranspiration
12% shallow infiltration
18% deep infiltration
19% runoff
25% harvested >44% Total Harvested

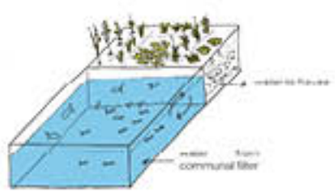
Calculation of rainwater collection
The needs of undrinkable water for a family of 4 amounts to 516 l/day. The individual basin will store water for a month need (16m3). It will also be able to collect up to an extra 6m3 of rain, estimated to be the precipitations during a stormy day on the plot, or the precipitations of a week of rain.



Hydroponic

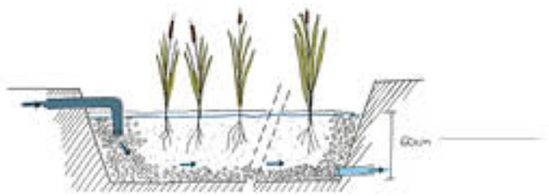


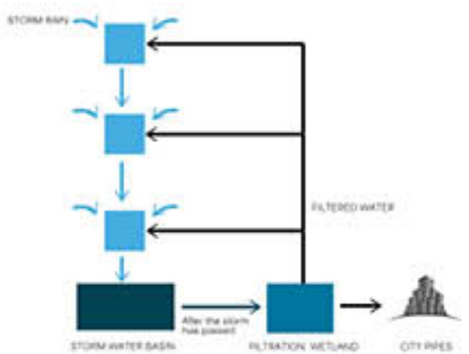
Bio-pool



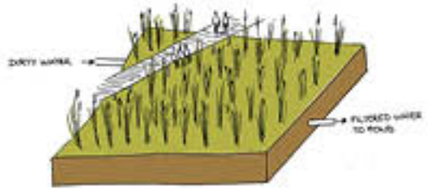
Aquaponic

Water flow on at the district scale / The site grid is aligned in continuation with the existing fields grid. The alignment is north-south and west-east. It also follows the natural slope of the site, going from north-east down to southwest, which will be taken into account for the water management plan.

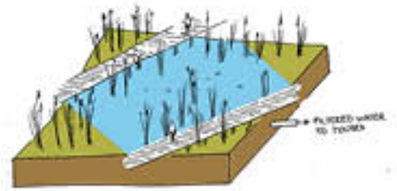




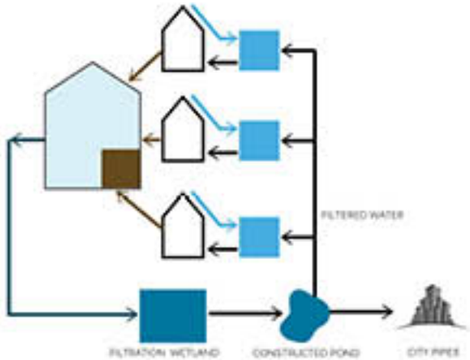
Bad storm and flood periods
In storm and flooding periods, the collective stream is activated. The individual plots collect the rain water to their basins, but the basins will overflow and thus create the diagonal water streams on the entire site.



Wetland and constructed pond
5 m2 of horizontal filter wetland for each inhabitant. Since around 100 people will live on the 1 hectare of land, 500 m2 of wetland are needed. Plus a small pond will be added for increasing the presence of fauna on site.



Wetland layering system
The filter is composed by a single 60cm deep layer of gravel of 2 to 8mm diameter. The water level is maintained 5 cm under the ground surface, so the wetland won't smell and won't attract insects.

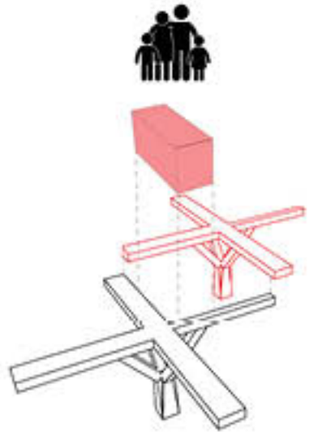


Normal rain periods
In normal rainy days, the plots collect the rain in their basins. The houses use that water for their domestic needs. The grey and black waters produced are drained to the wetland that filters the water. Once filtered, the water goes to a constructed pond.

Masterplan

Ground level

Section A-A' of the district

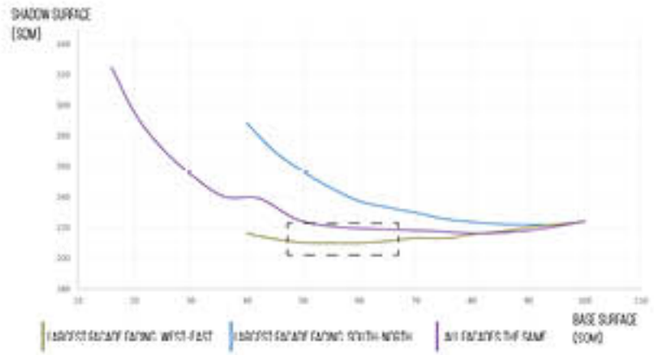


The district structure expansion

The district structure provides the basic infrastructure for the inhabitants The central core, the greenhouse, generates food, electricity, cooling, heating and hot water, it collects the wastes and the gray and black waters, and allows vertical and horizontal circulation. While the aerial concrete structure acts as an horizontal distributer of the resources. The structure is expandable through time, to allow new inhabitants to plug their homes into the system and enlarge the aerial community.

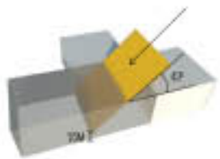
View of the "world below"

/ WATER DISTRICT / Energy form finding

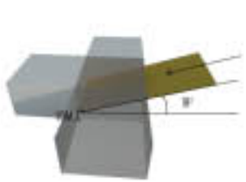


Projected shadow surface according to the shape and its base surface: for a volume of approximately 400 m2, the base surfaces generating the smallest shadows are between 50 and 65 m2, and they also correspond to the shapes whose largest facade is facing west-east.

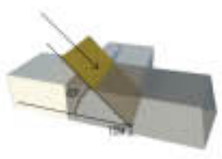
Initial houses shapes



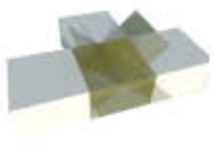
Sun inclination at 10:00



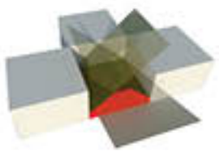
Sun inclination at 12:00



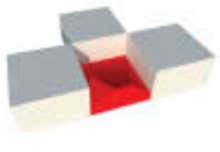
Sun inclination at 13:30



All these cutting planes...

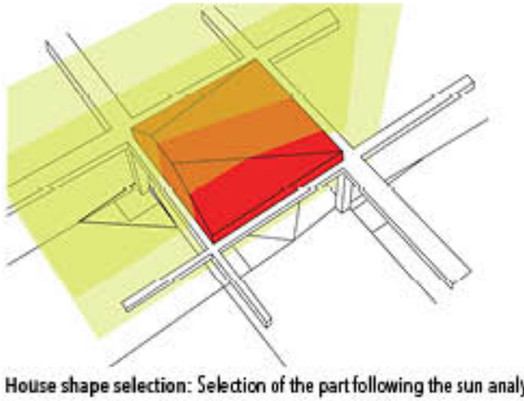


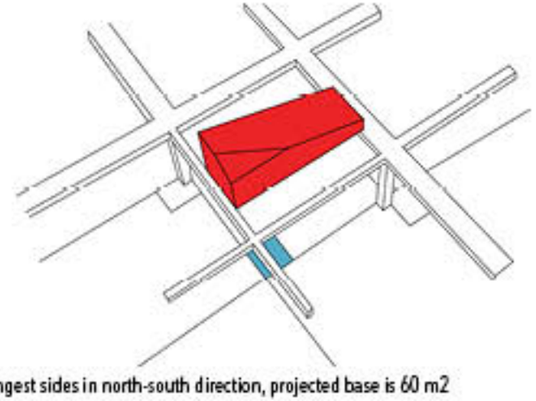
Generate a house shape...



That does not shade its neighbors

From 10:30 to 13:30 on december the all houses will have direct sunlight





House shape selection: Selection of the part following the sun analysis; longest sides in north-south direction, projected base is 60 m2

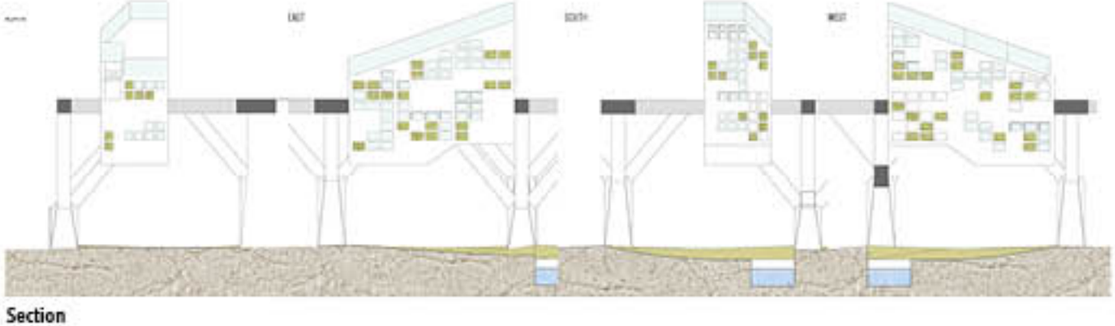
/ WATER DISTRICT / Residential unit

Ground floor plan of the new housing unit

Floor -1 plan of the new housing

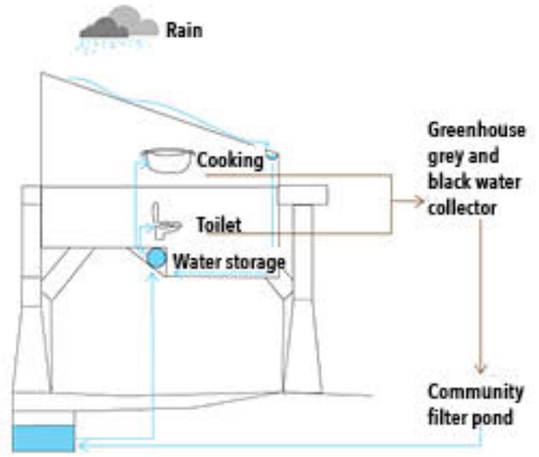
"Ground" floor plan of the new housing

Roof plan of the new housing

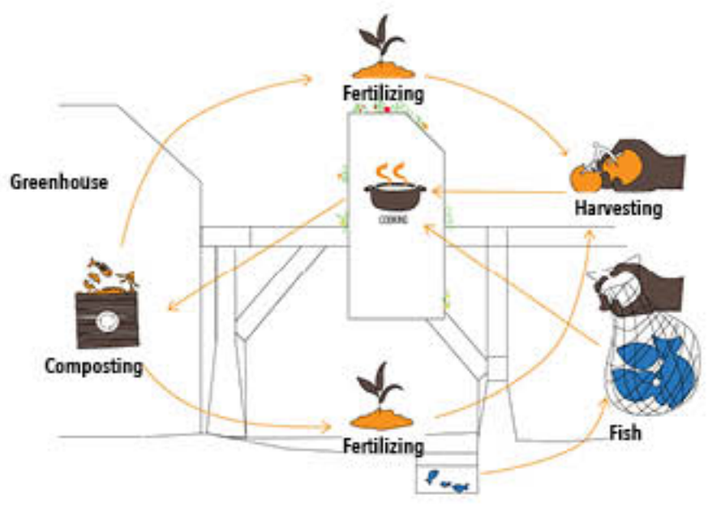


Section

The new housing unit



The water cycle

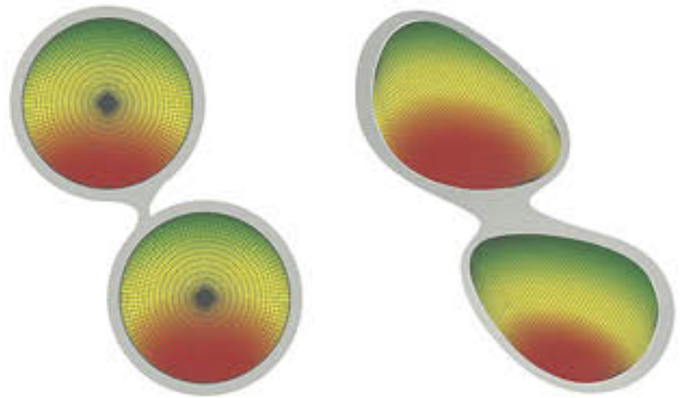


The food cycle

FE(W)² PROJECT
Milan, Italy

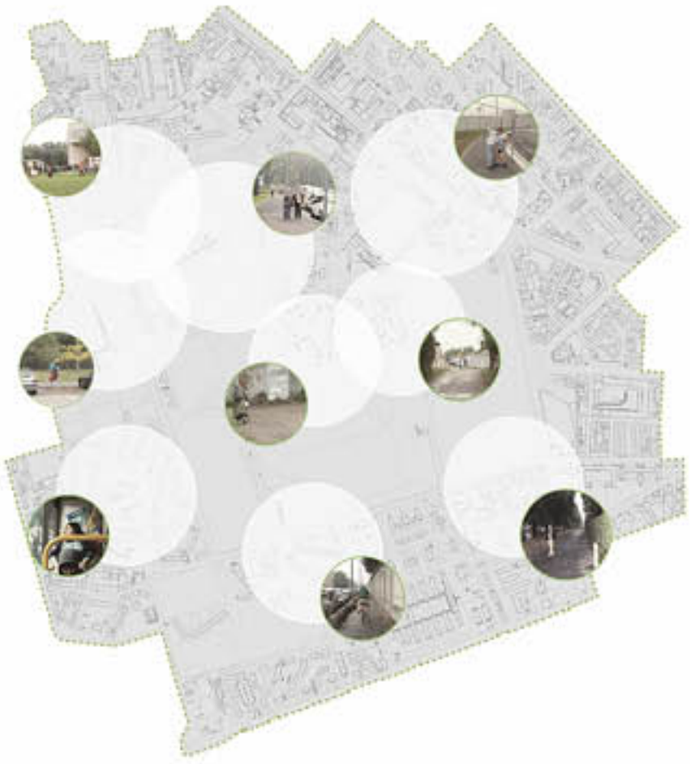
The project proposes a speculative scenario for a laterally distributed urban settlement located at the ex military complex Santa Barbara in the periphery of Milano. It challenges the conventional linear hierarchies and interdependencies between different aspects of our contemporary cities such as food and energy production, waste management, economic systems and labour conditions.
At the urban scale, a generative methodology has been adopted which uses physical forces such as water presence and waste distribution as active agents which inform the design process. Initially a predefined number of functional units (50 residential, 60 biogas plant, 120 farming and 50 service units) are evenly distributed in the project area.
Afterwards, a parametric algorithm is run which follows a specific logic of attraction and repulsion among the different units as well as the influence of the environmental forces appointed by us.
This is an iterative process which results in emergent clusters of units arranged according to environmental forces and their interactions with functional parameters which were set based on our evaluation of the needs of the community, in a way that the farms are shared by different families and the biogas plants are respectively shared by the farms and the residential units.
At the building scale, each cluster is composed of: 1) greenhouse structure which offers crops production all year around;
2) biogas plant which transforms the waste of the system into green energy and bio-fertilizer for the crops; 3) set of residential units which uses the generated resources and provides the waste necessary for the digesters; 4) a different service unit belongs to every cluster as well. This project in particular shows a scenario with a FAB LAB service unit (fabrication laboratories which are spaces of communication, innovation and creativity) which completes the system to a fully self-sustaining community adding work to the equation: Food + Energy + Waste + Work = FE(W)².

Mariela Tsopanova

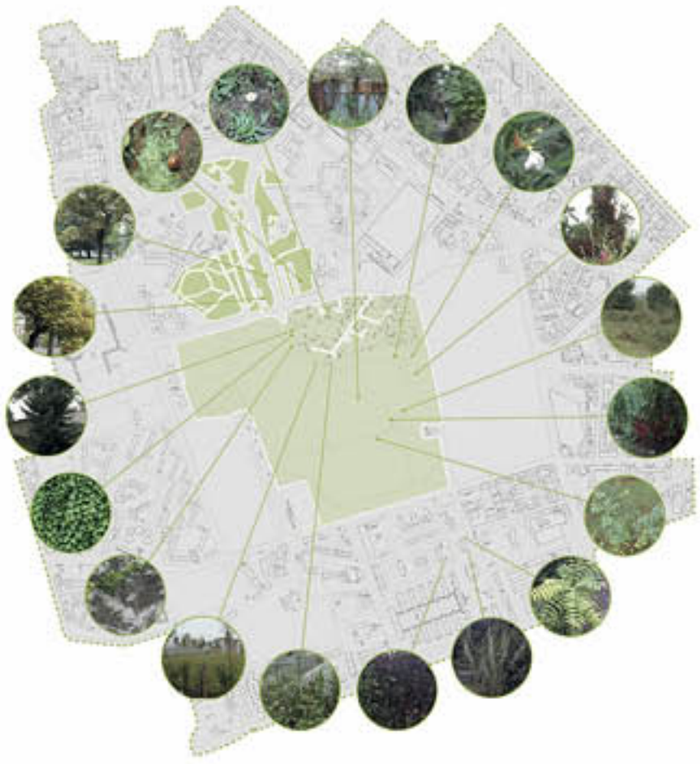


/ FE(W)² PROJECT / People, Vegetation, Ecosystem

Location



People / Diversity of city users: conflict or cohabitation. The area represents a physical border between the different communities settled in the area



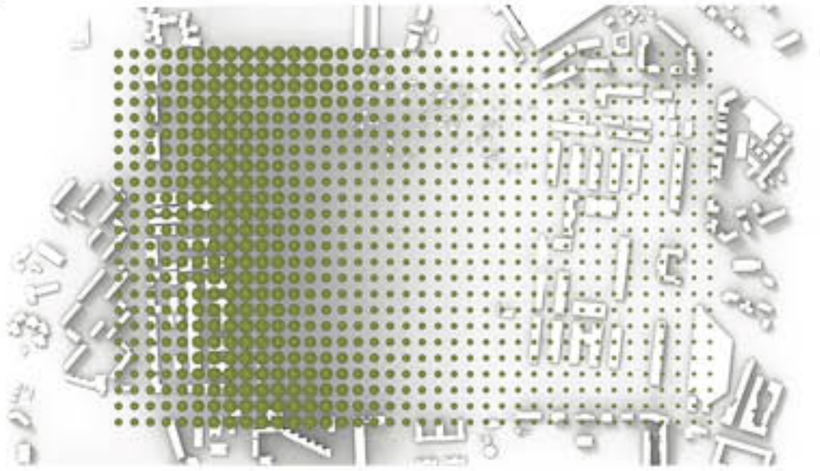
Vegetation / The area is an incredible "collection" of green areas.

Community gardens, wild growing plants and herbs that can be used as pharmaceuticals.

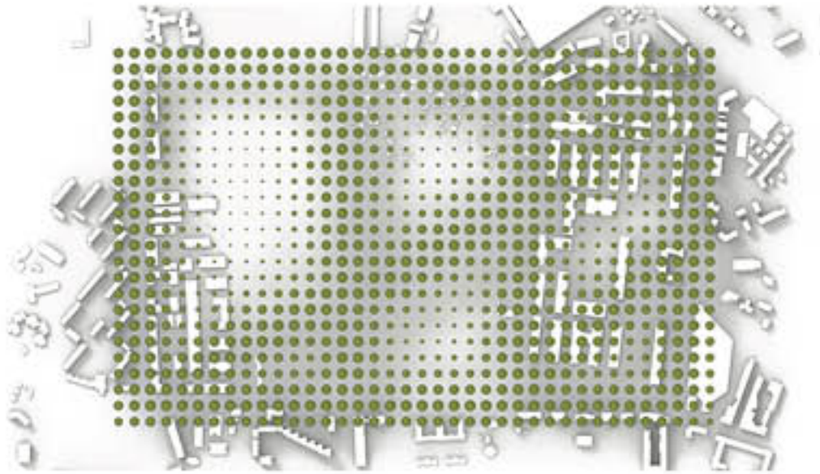
Ecosystem / We have discovered that there exist an unexpected vitality and biodiversity in the otherwise grey looking urban context, raising the prospect of preserving and enriching the existing ecosystem.

Field conditions and invisible forces
A series of visually striking maps convey the varying intensity of key indicators such as water, noise and accessibility on site.

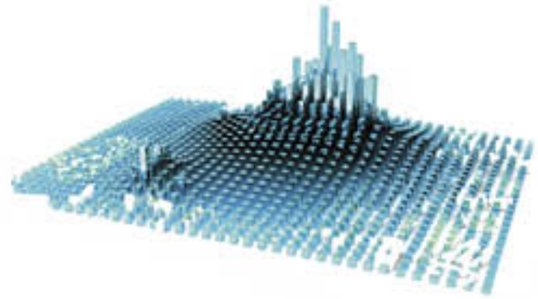
Noise distribution

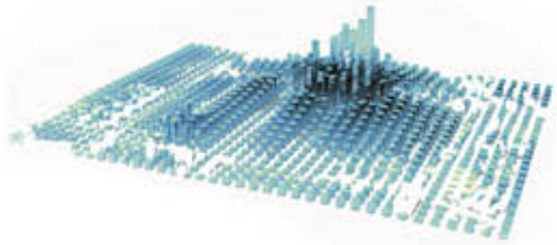


Water forces



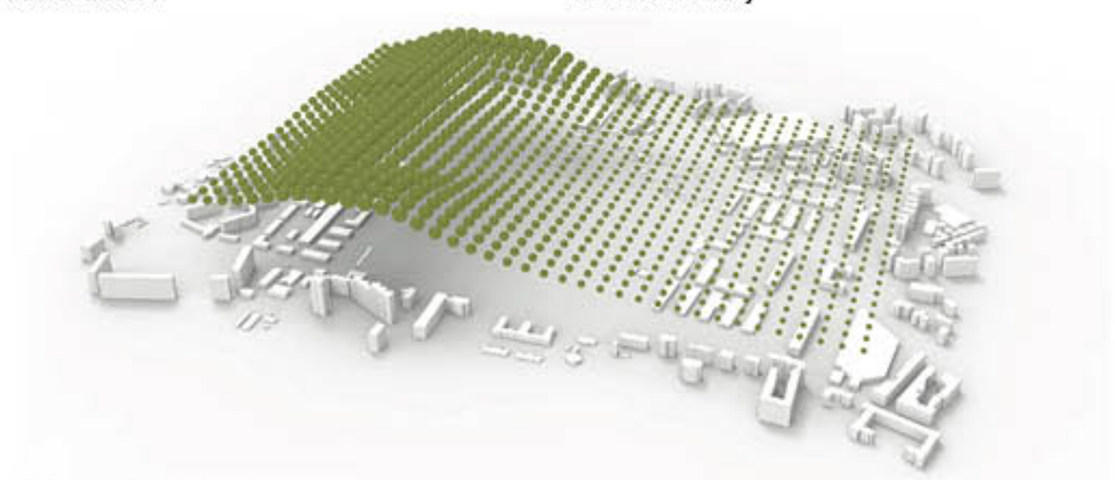
Connection force



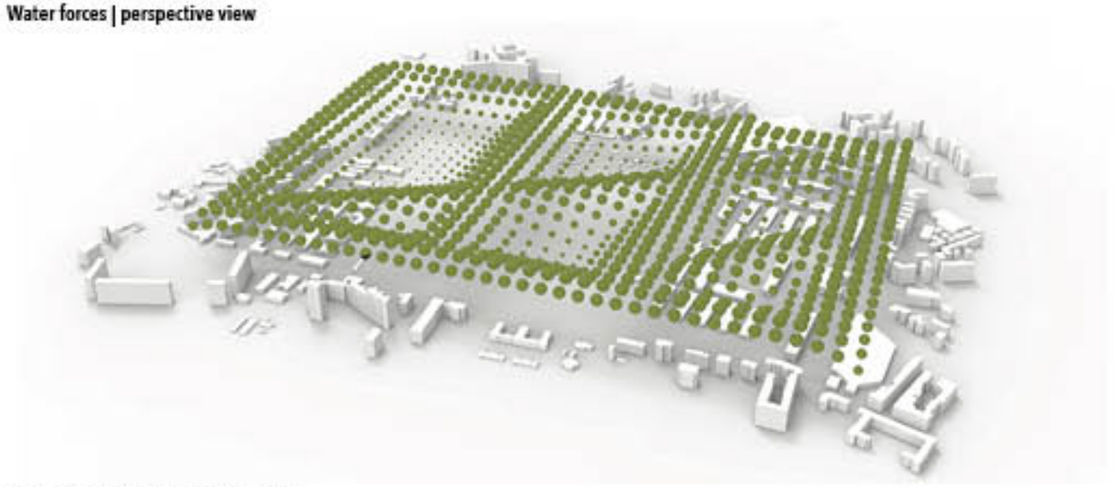


Waste distribution

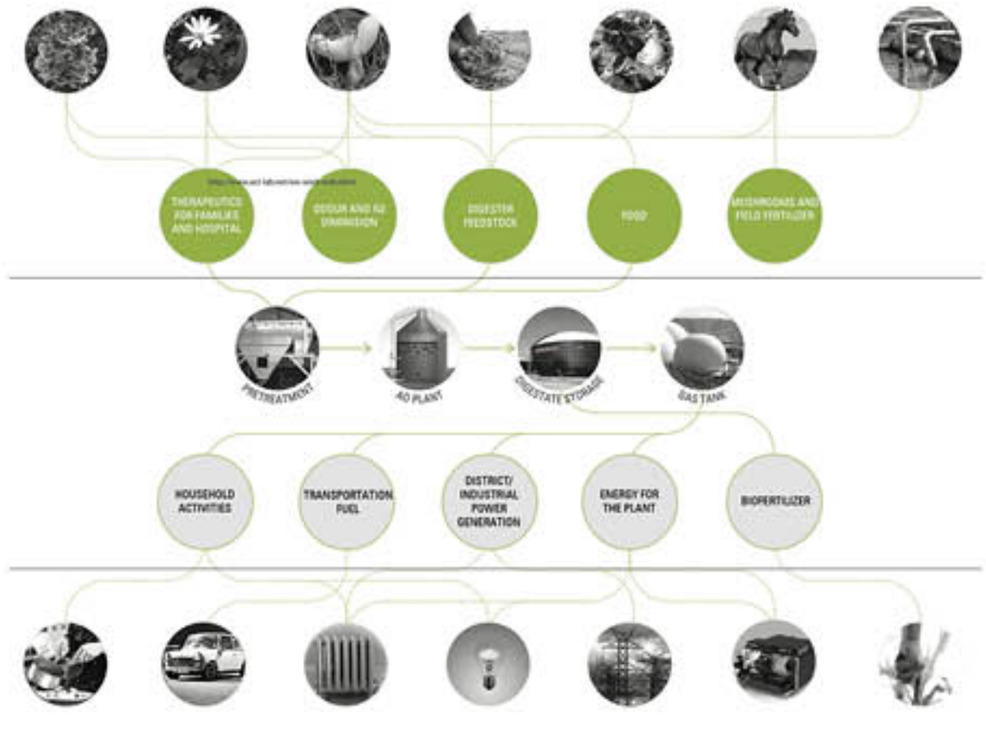
Level of inaccessibility



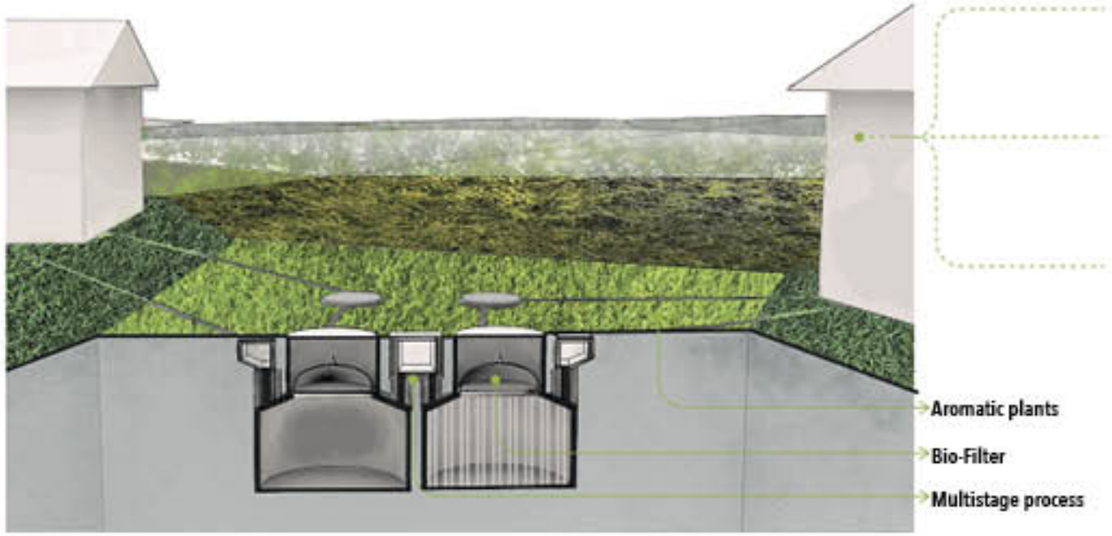
Water forces | perspective view



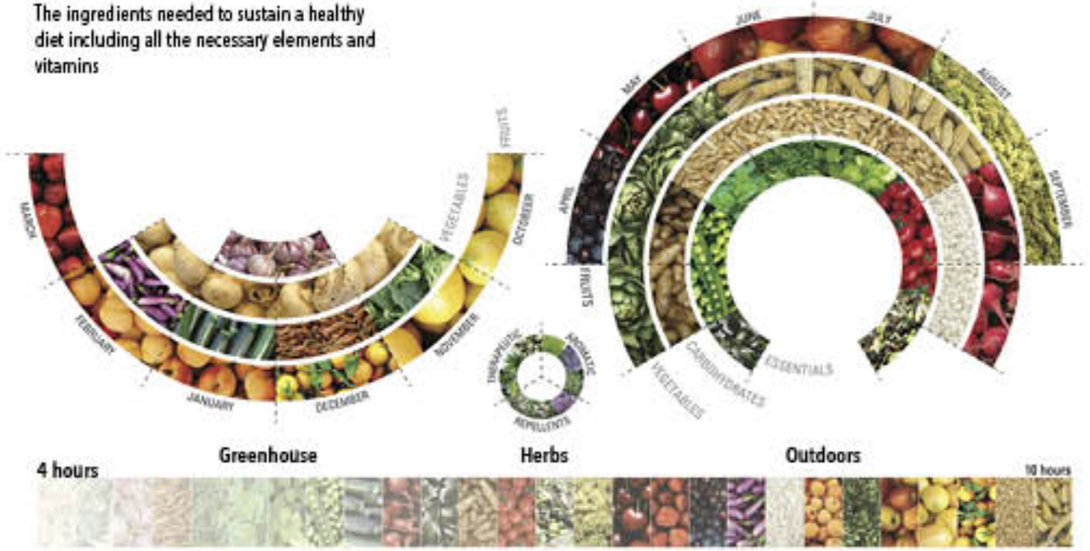
Connection force | perspective view

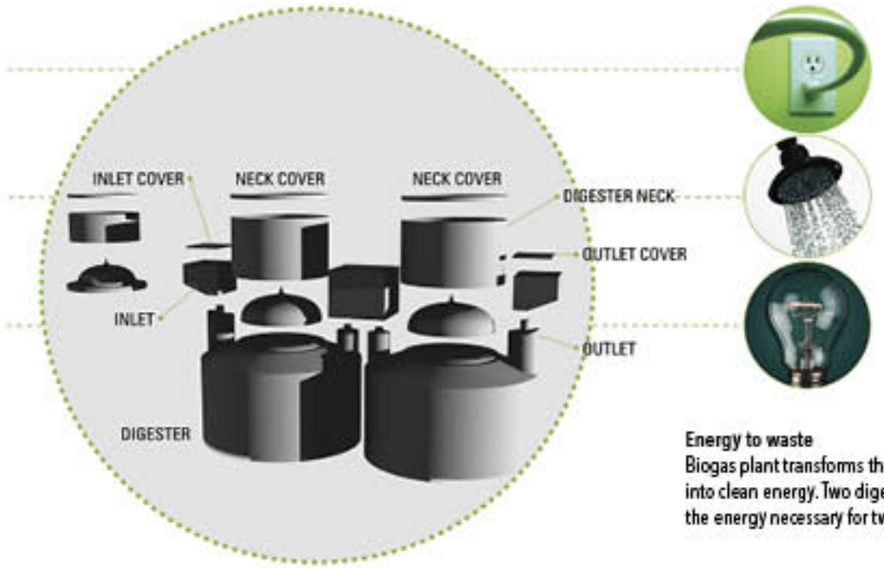


Products of process, processing machines, processed feedstock

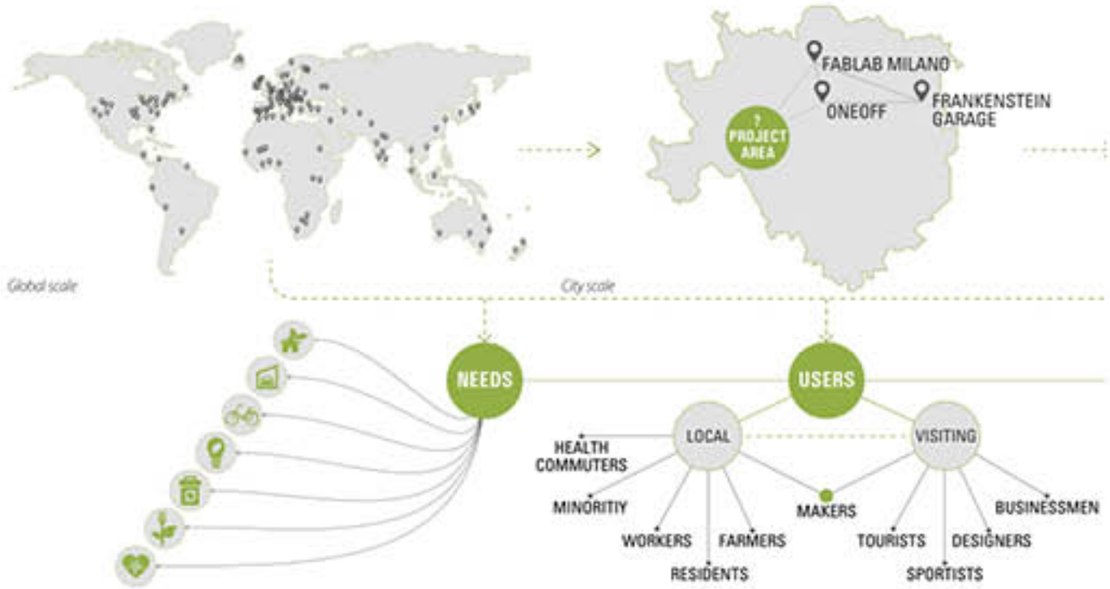


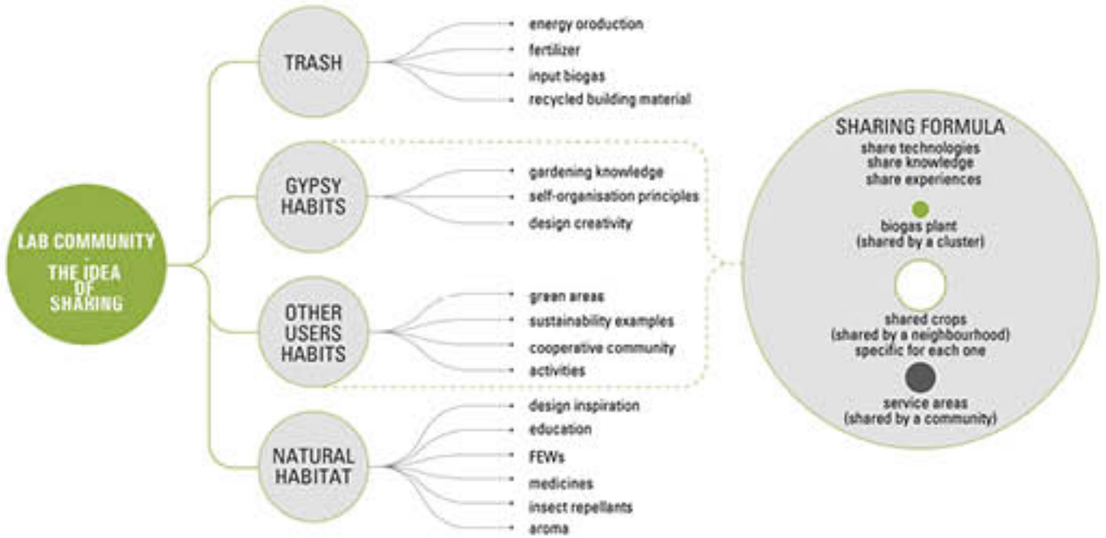
Food
The ingredients needed to sustain a healthy diet including all the necessary elements and vitamins



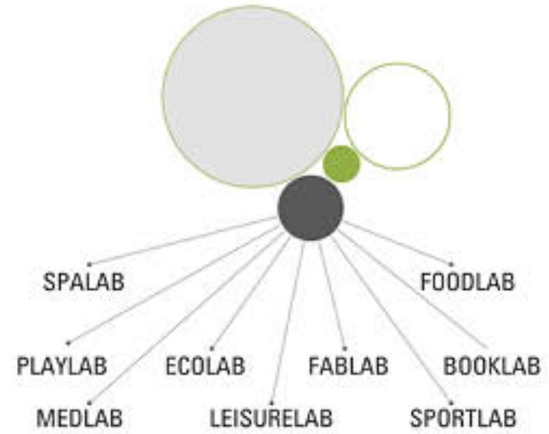


Energy to waste
Biogas plant transforms the waste from the community into clean energy. Two digesters are enough to provide the energy necessary for two families.





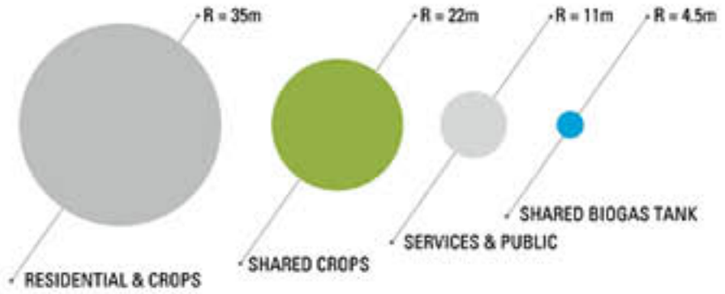
ITEM	TRADITIONAL FIXED DOME	DIY BIOGAS PLANT BY PUXIN
Construction of digestor	4 days	2 days
Air tightening	10 days	no
Air tight test	4 days	no
Total	18 days	2 days

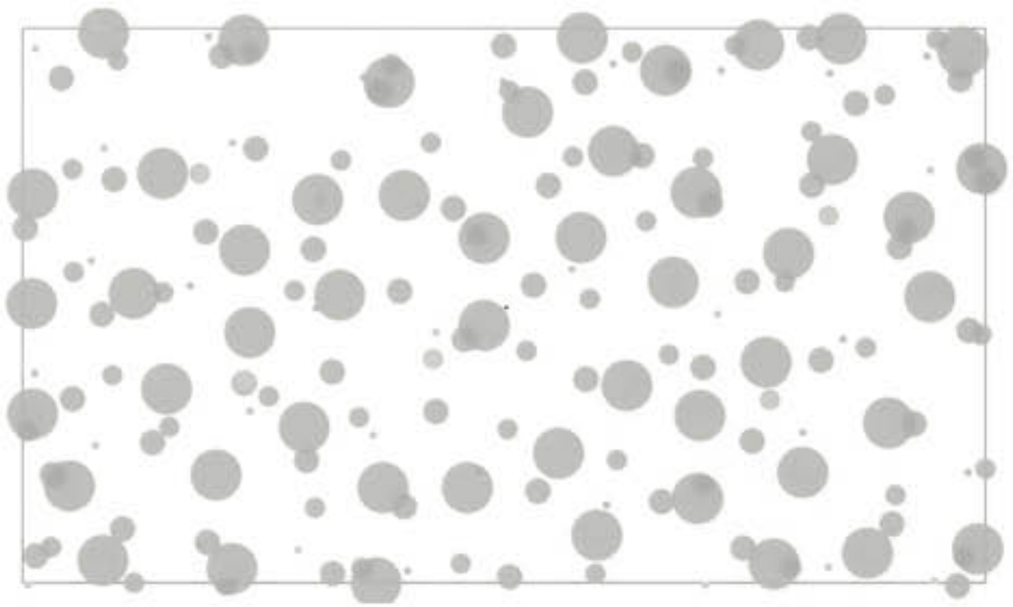


The fab lab idea

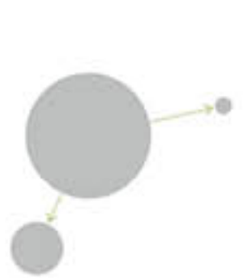
The main goal for a FabLab is to be a space for experimenting at the intersection of bits and atoms, information and matter. It is more than the services it provides, it is a new idea, community organization and urban model spreading all over the world.
A FabLab gives you a space, tools, processes and knowledge for developing physical representations of digital data, and exporting digital data from physical contexts. It is therefore a space that's perfect for experimenting how digital technologies can influence the development of physical objects.
This means, ultimately, that prototypes and final products are developed usually within a FabLab, but with a focus on the digital processes (and their effects) rather than just focusing on manufacturing the object with only traditional processes.

Functional program
4 types of units representing 4 different functions to be distributed in the area





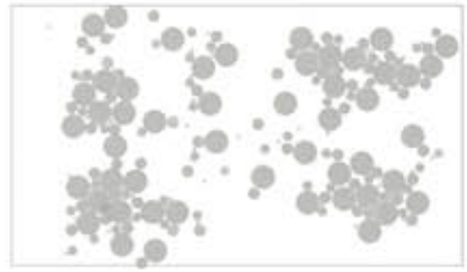
Generative process
Running a scripted algorithm following the logic of the forces we set, the units start clustering together. The initial condition represents an even distribution of the units in the space as they are fed into the algorithm as follows: 50 residential units, 60 biogas energy plants, 120 farming areas and 50 service zones. The calculation was based on our evaluation of the needs of the community, as the farms are shared by different families and the biogas plants are respectively shared by the farms and the residential units.

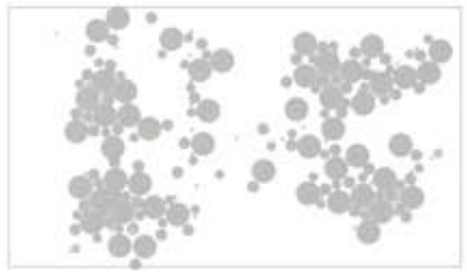


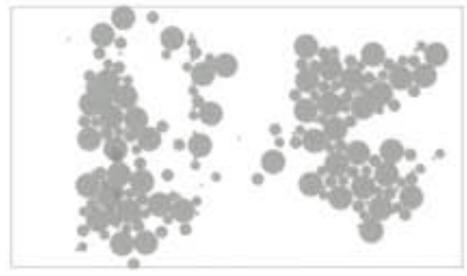
Attraction forces between different units

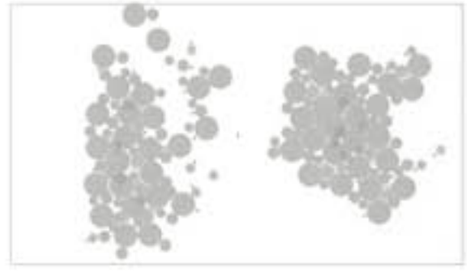
Repulsion forces between similar units

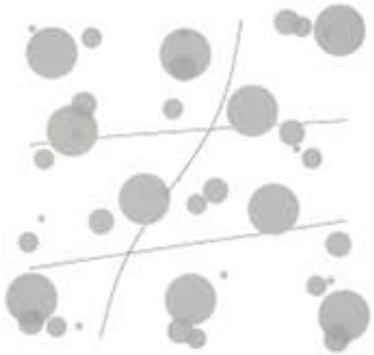
Attraction towards water and connections









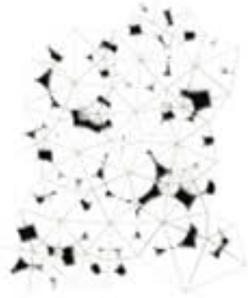


Initial condition

Vector field forces

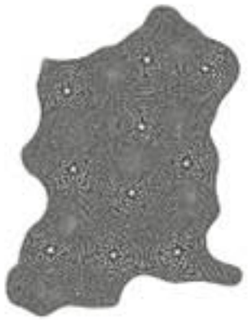
Clustering along attractors

/ FE(W)² PROJECT / Tesselation

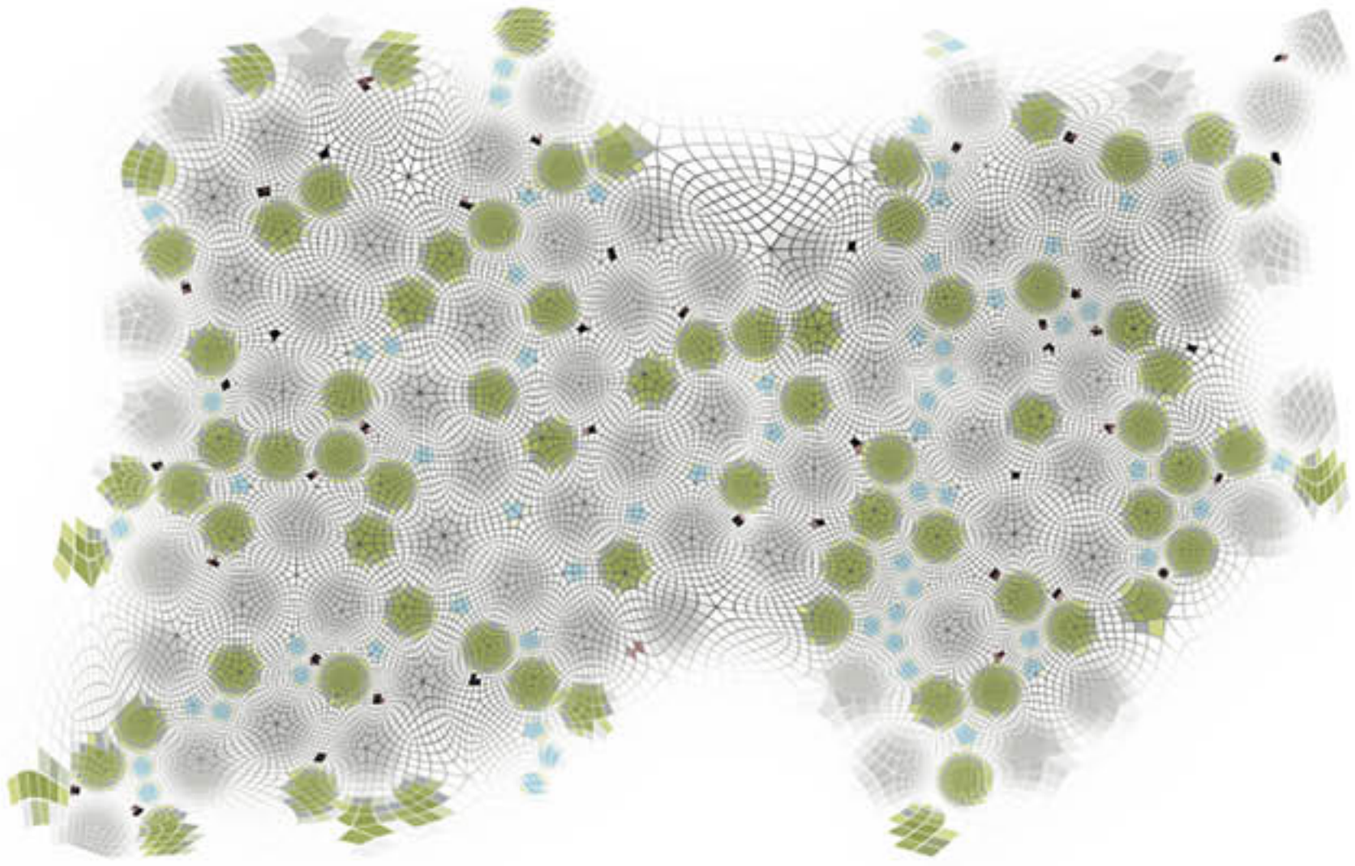


Locating vertices in interstitial spaces

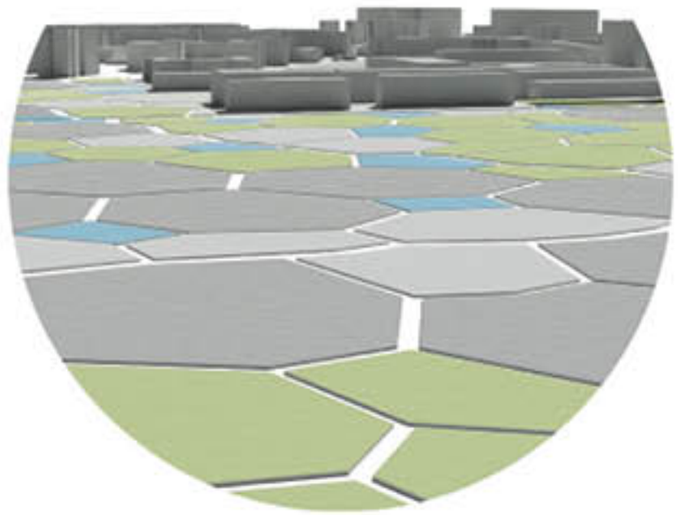
Connecting the vertices into polygons



Catmull-Clark subdivision into a mesh



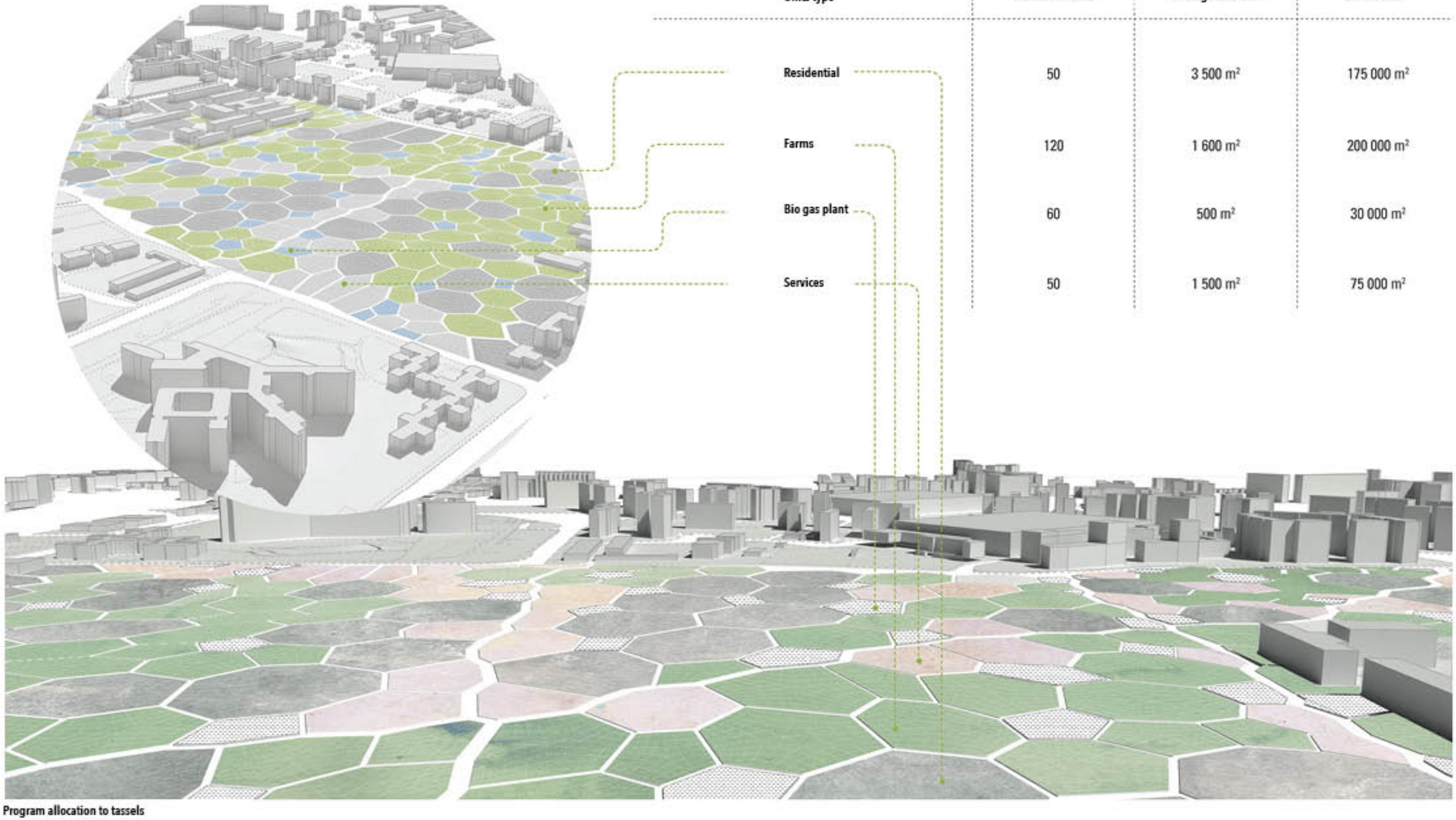
Tessellated field



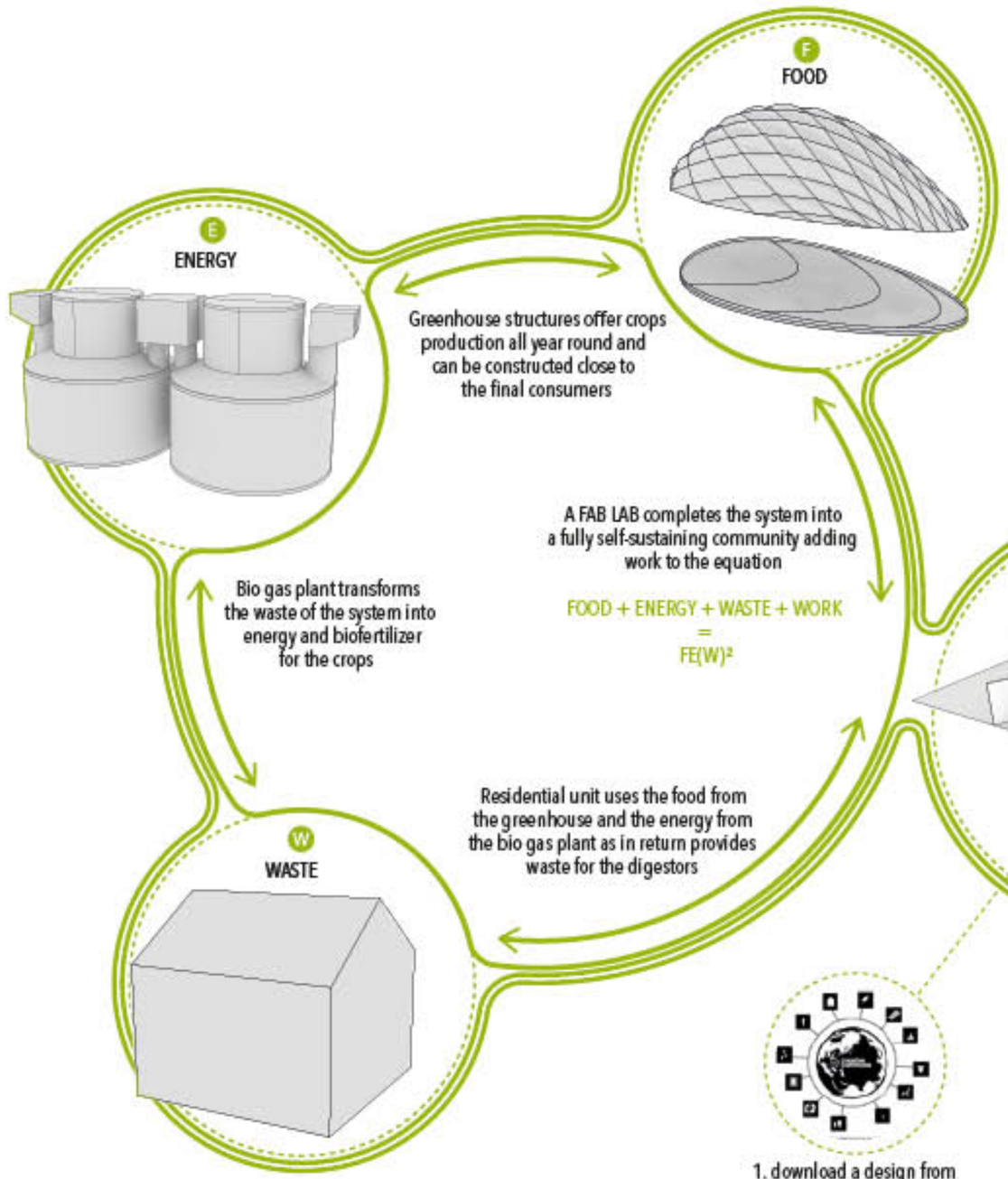
Tesselation on site
The resulting tessellated ground represents an almost perfect balance between field conditions, generative forces and distribution program. The secondary tessellation derived from a Catmull-Clark subdivision gives the opportunity to evaluate smaller portions of land and assign them more specific functions, e.g. strawberry field within the farming unit.

/ FE(W)² PROJECT / Program allocation

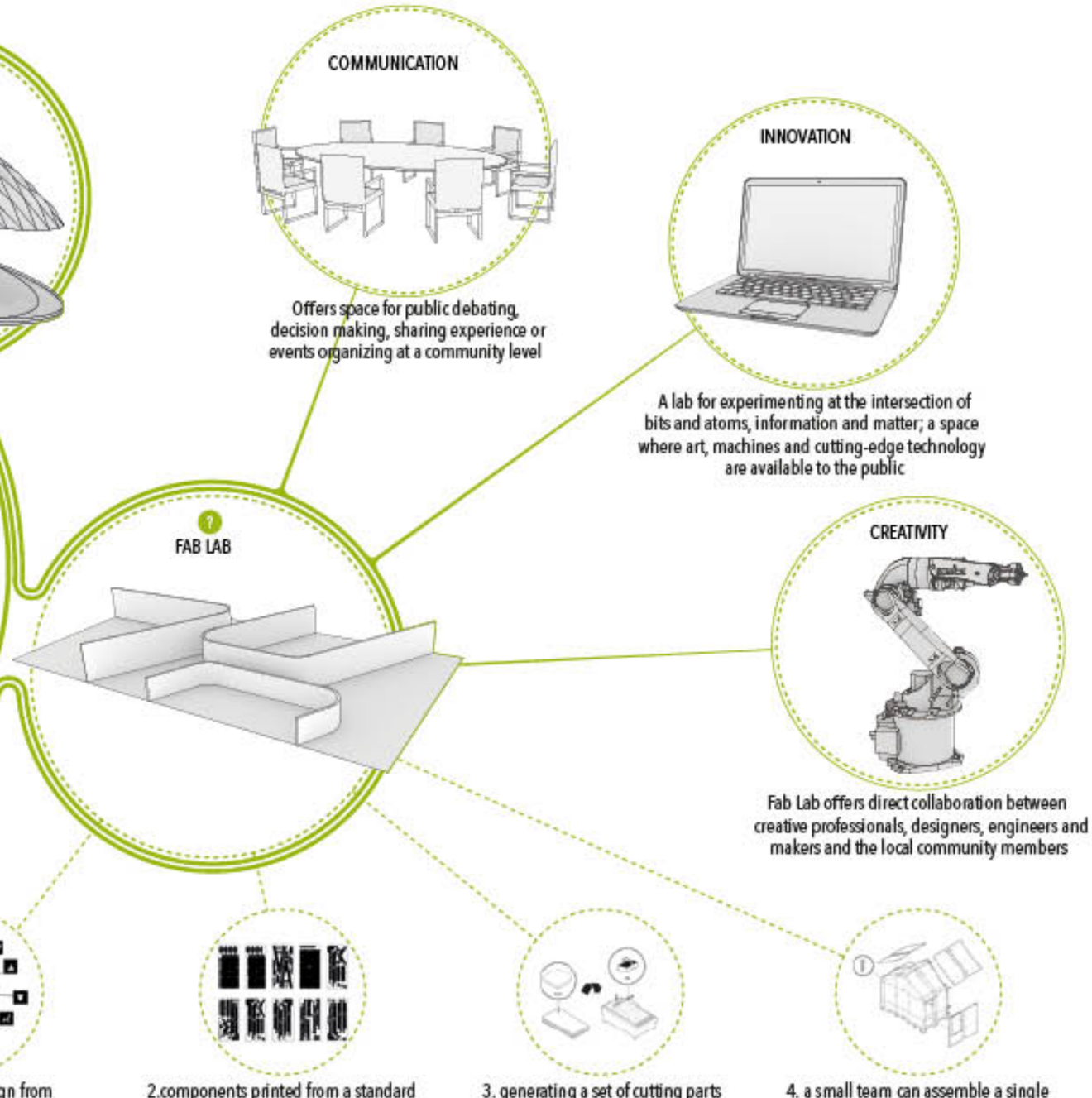
Units type	Number of units	Average area/unit	Overall area
Residential	50	3 500 m²	175 000 m²
Farms	120	1 600 m²	200 000 m²
Bio gas plant	60	500 m²	30 000 m²
Services	50	1 500 m²	75 000 m²



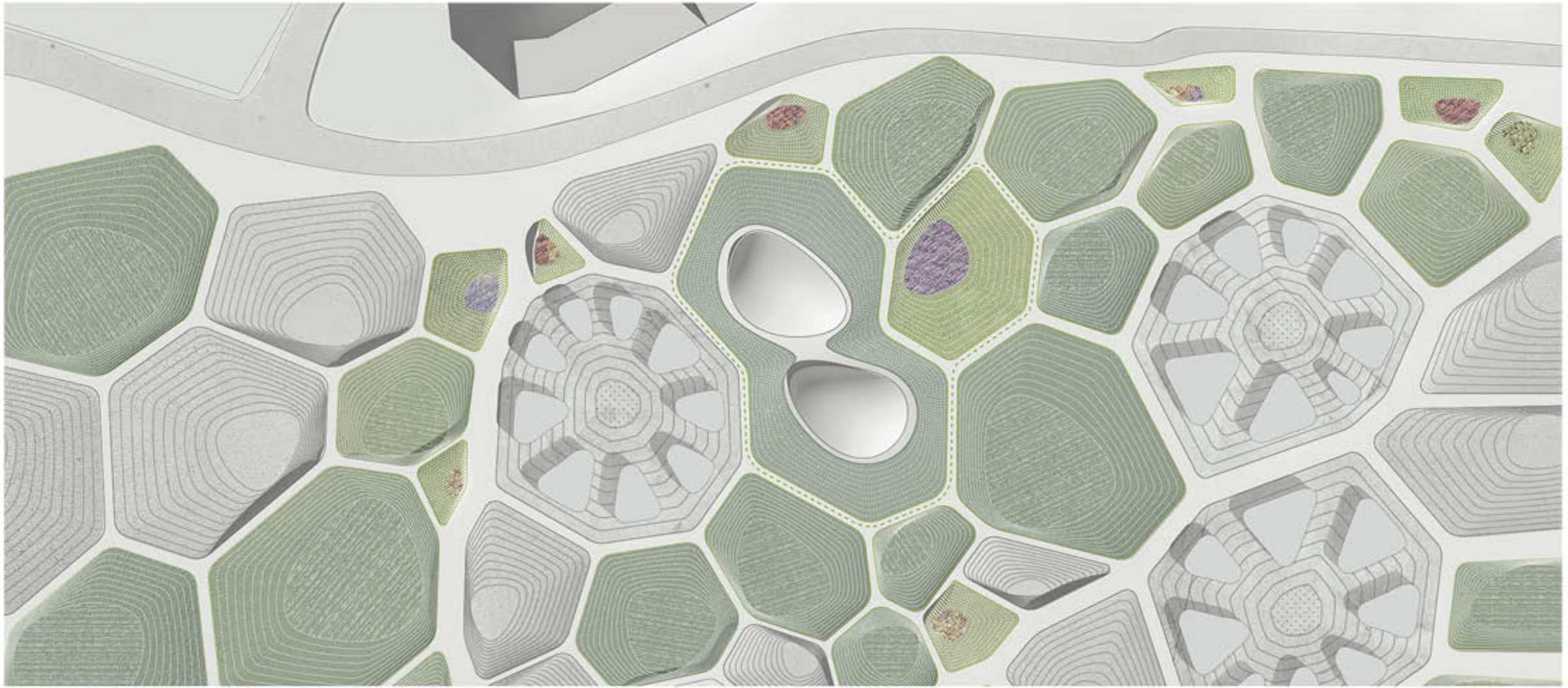
Program allocation to tassels



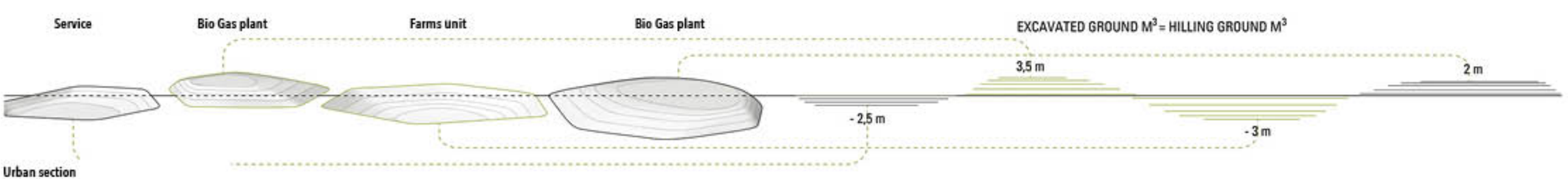
FEW'S strategies



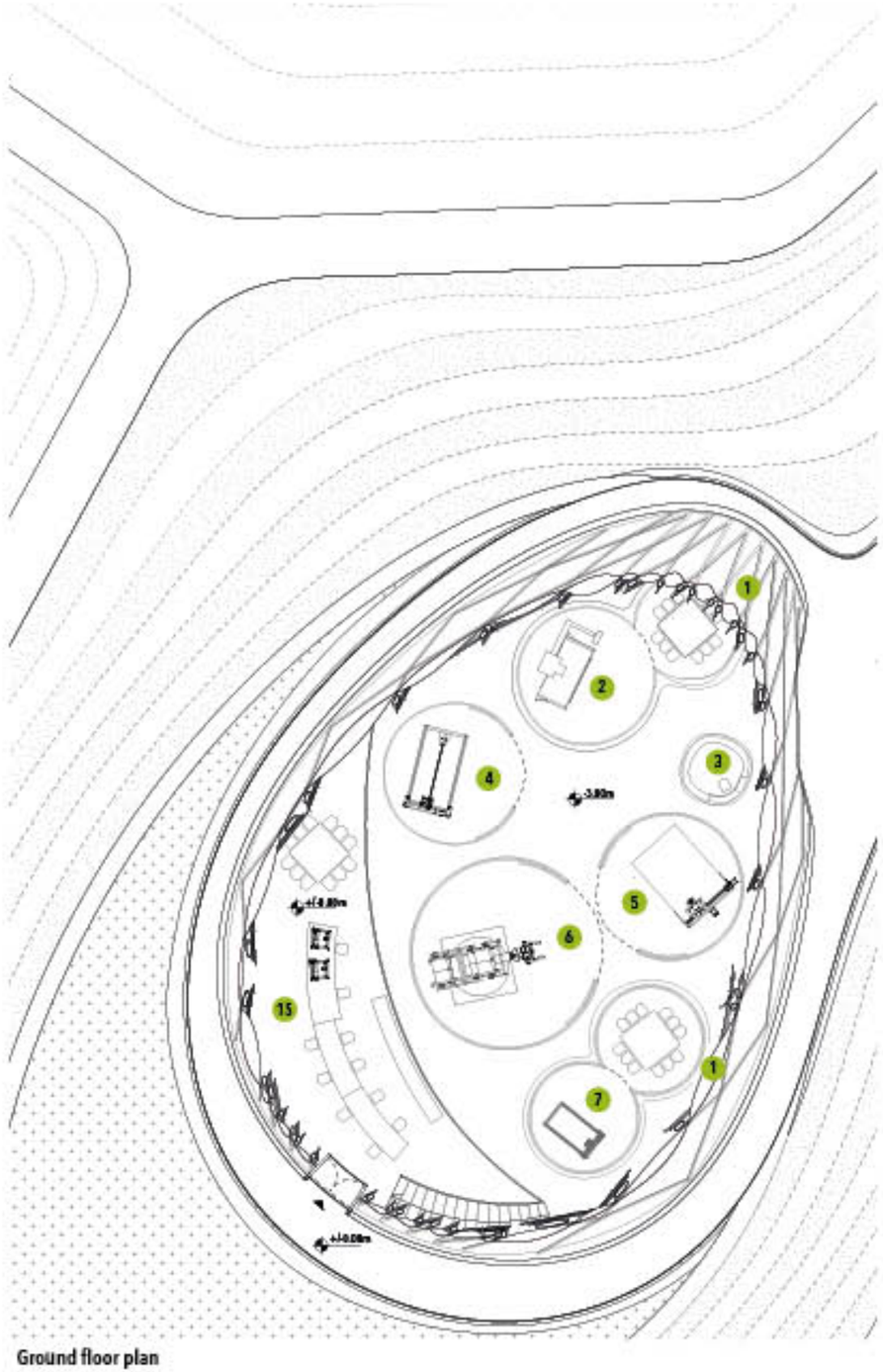
/ FE(W)³ PROJECT / Site development



Masterplan

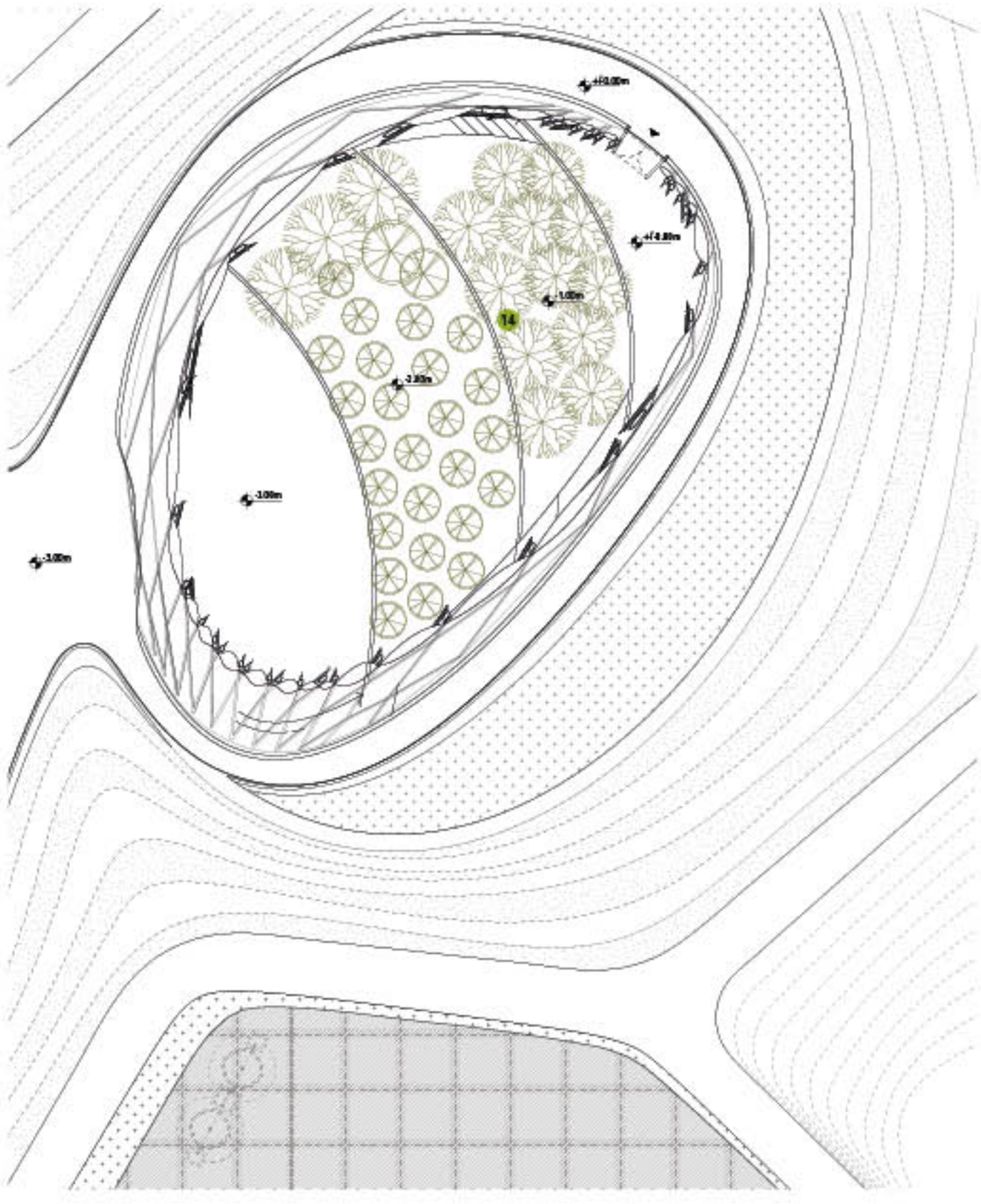


Urban section



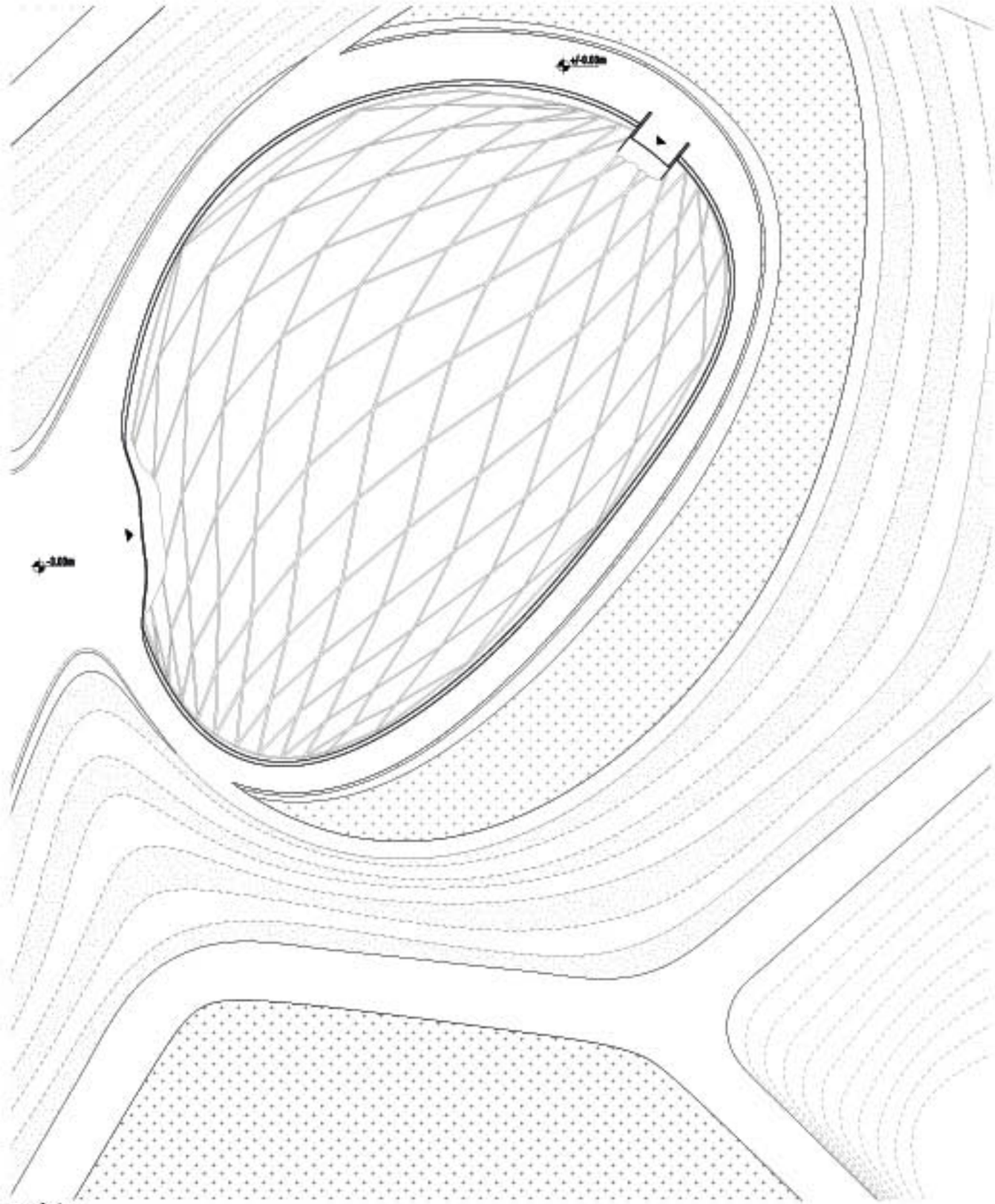
1 COLLABORATION AREA
2 WYNIL CUTTER AREA
3 OPERATIVE AREA
4 LASER CUTTING AREA
5 MILLING MACHINE AREA
6 ROBOTIC ARM AREA
7 MULTI BENDING AREA
14 GREENHOUSE
15 CO-WORKING SPACE

Ground floor plan



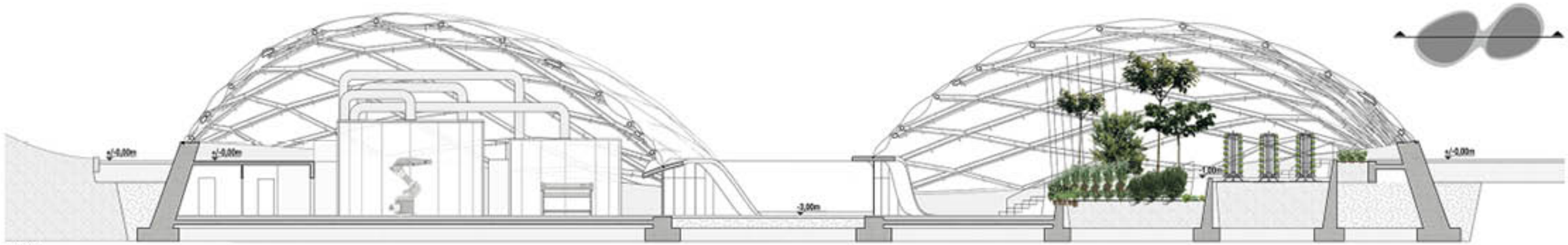
1 COLLABORATION AREA
2 VYNIL CUTTER AREA
3 OPERATIVE AREA
4 LASER CUTTING AREA
5 MILLING MACHINE AREA
6 ROBOTIC ARM AREA
7 MULTI BENDING AREA
8 TECHNICAL ROOM
9 SHOWERS
10 STAFF
11 RESTROOMS
12 MATERIALS STORAGE
13 MARKET
14 GREENHOUSE

Under ground plan



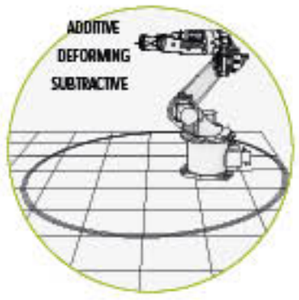
Roof plan

/ FE(W)³ PROJECT / Technology and systems



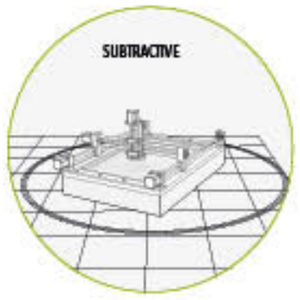
Section

SIX-AXIS ROBOTIC ARM



MULTI BENDING MACHINE

CNC MILLING MACHINE



INTEGRATED MULTI-PERFORMATIVE FACADES

RAPID PROTOTYPING

BUILDINGS

INTERIOR FURNITURE

URBAN FURNITURE

"THE GREENHOUSE AND CABINET OF FUTURE FOSSILS"

VINYL CUTTING MACHINE

LASER CUTTING MACHINE

3D PRINTING MACHINE

STRUCTURES

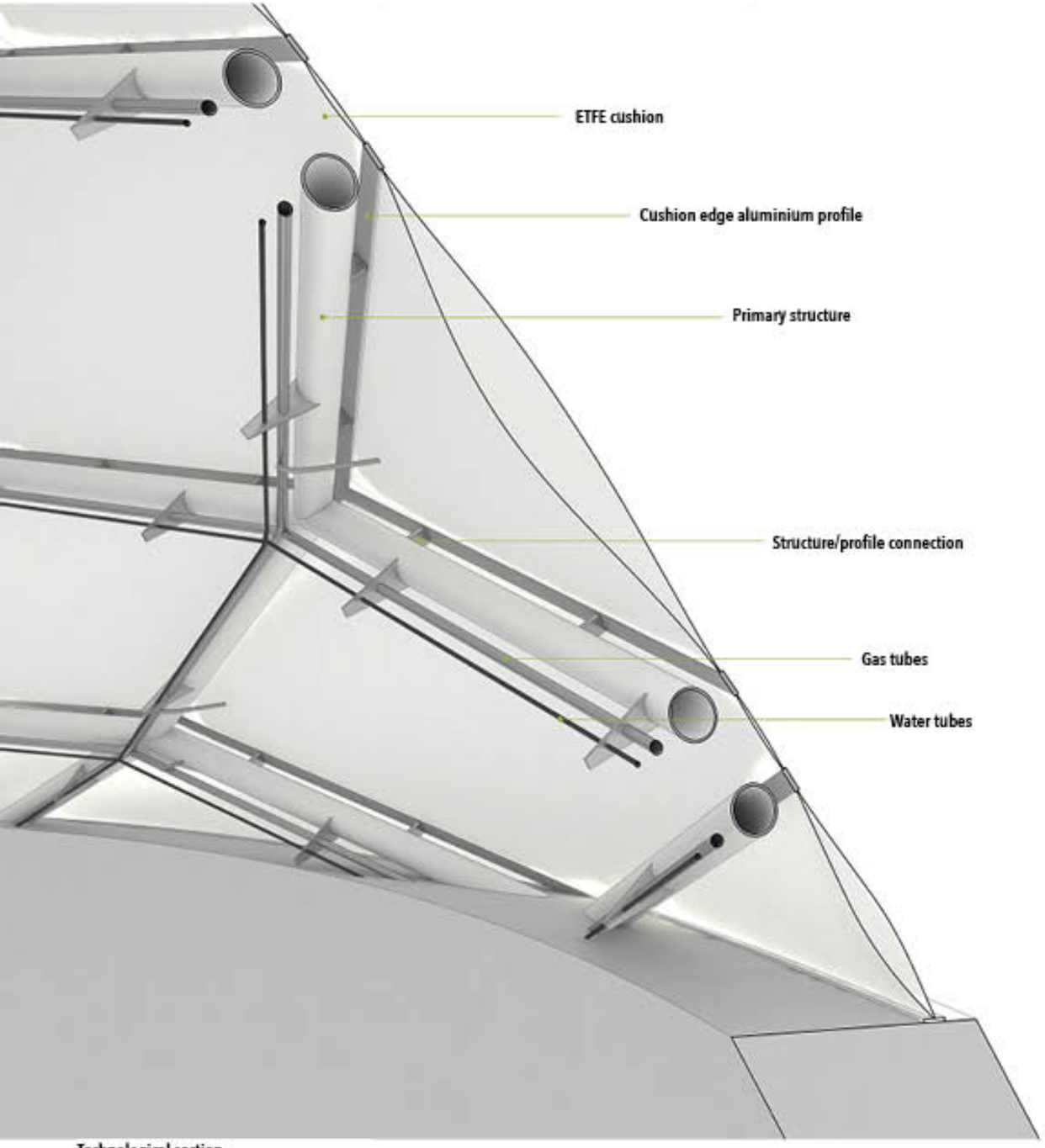
JOINTS

COMPONENTS

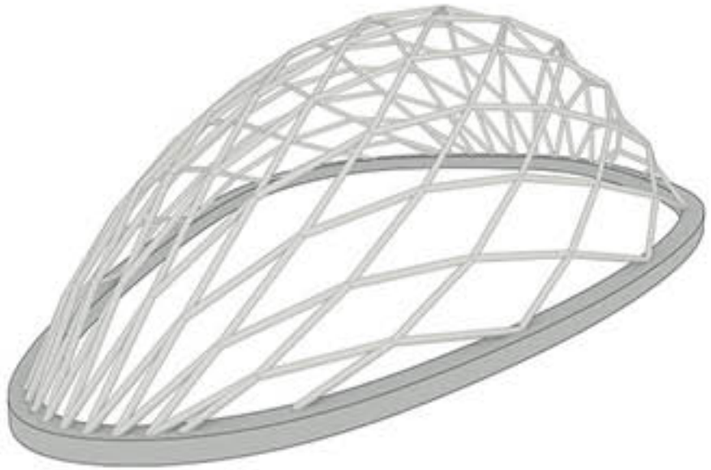
DTU SOLAR DECATHLON 2014

INTERACTIVE WORKSHOP FOR CHILDREN

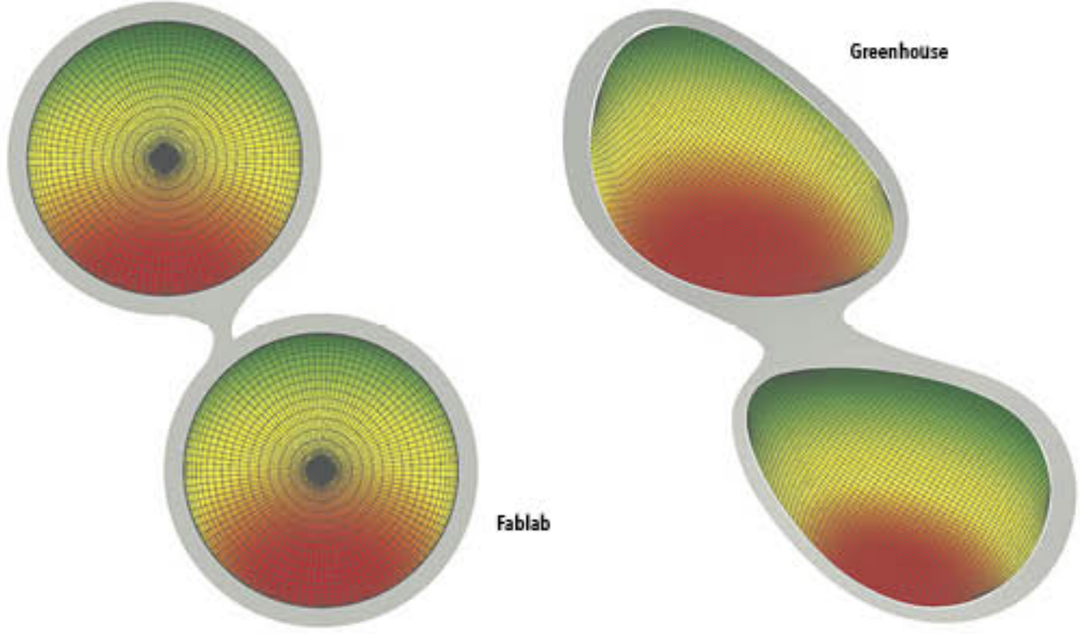
DIY BIOGAS PLANT



Technological section



Sunlight optimization
A shape-optimization process allowed to increase the quantity of sunlight gained by the greenhouse and to decrease it in the Fablab.



/ FE(W)² PROJECT / View of the new structures

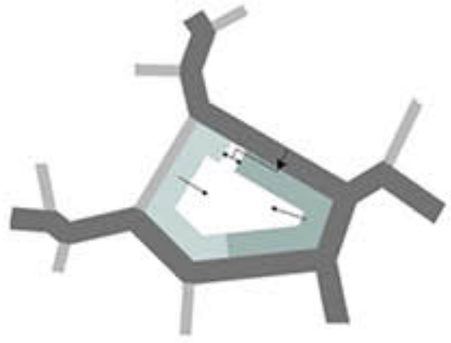
External view

View of roof details

DUG HABITAT
Milan, Italy

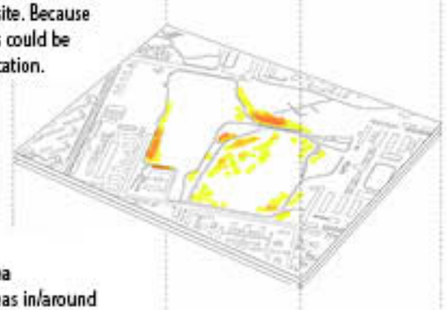
The project starts with considering the opportunities offered by the context–water runoff, topography, presence of trees–as well as limitations, such as high levels of noise and pollution generated by nearby traffic. The most striking feature, however, is the emptiness of the site, reinforced by the urban edge. The project proposal reasserts that feature by pushing all man-made structures below grade.
Building underground provides for a number of well-known advantages, which we investigated by looking at ancient buildings as well as contemporary regional architecture, particularly the Yao Dong in China. The design concept organizing the site is based on circulation patterns simulated by an algorithm using entry points and land features as attractors.
A base tessellation is then differentiated by allocating program to each tassel.
The form of the building reflects consideration of solar radiation and protection from prevailing winds, as well as energy conservation measures. The house forms a ring around a semiprivate outdoor space that opens to the sky but that is protected from public view by its geometry. Program is placed in ways that relate well to open space and form interesting adjacencies with nearby rooms.
Water collection is of primary importance, with the general section of the building being devoted to that, as well as a large kitchen garden and areas for play and relaxation are carefully built in the project.
A set of detail solutions complete the project, indicating construction technologies and solutions to best fulfil the design intent.

Anna Otlik



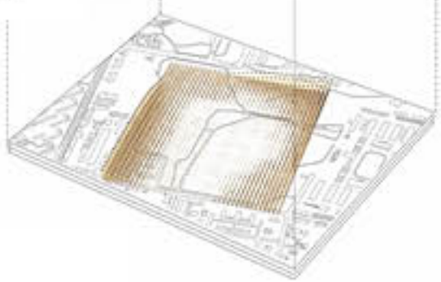
The presence of water
An analysis of the presence of water within the site. Waterways are concentrated in the center of the area, in correspondence with the wild zone.

The presence of hill
An analysis of the hills and their extension. They have a homogeneous height and occupy mostly the center and east/south-east part of the site. Because of good lighting, these hills could be used for solar energy application.



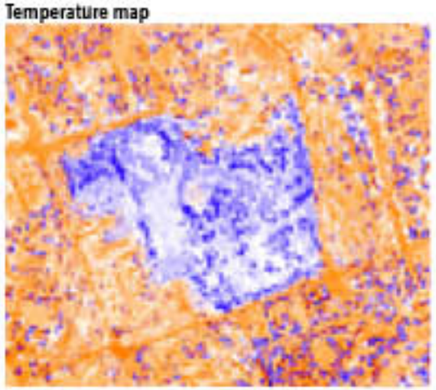
The presence of green area
An analysis of the green areas in/around our site. As we see, the site is a quite large green zone with natural hills and free spaces.

The presence of noise
It shows in 3d the level of noise intensity.



Satellite image of site

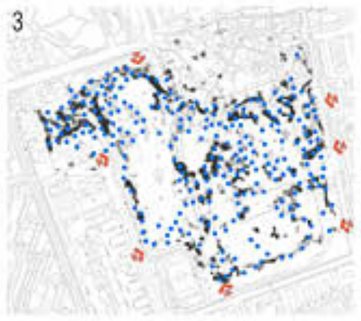
Temperature map



Urban Heat concept

Tessellation
Circulation patterns simulated by an algorithm using entry points and land features as attractors.

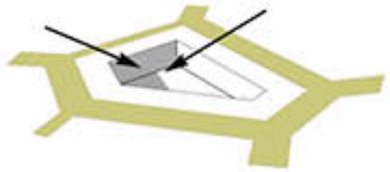
1
Access points



3
Site features as attractors

4
Tesselation pattern

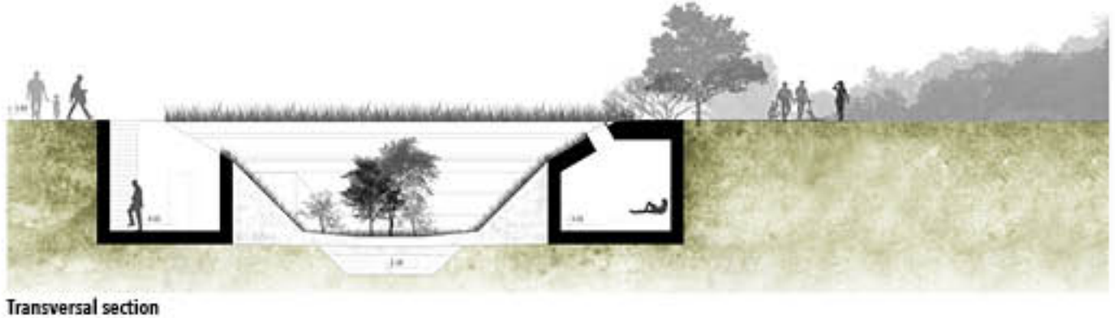
1 - Push down



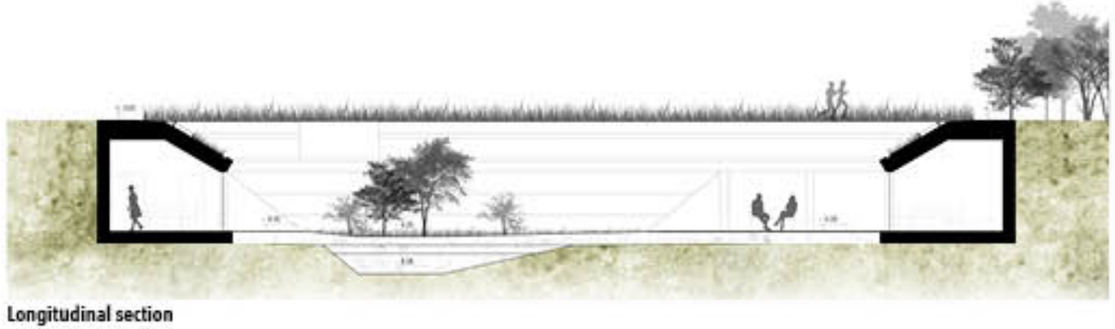
2 - Protect from noise

3 - Slope façades

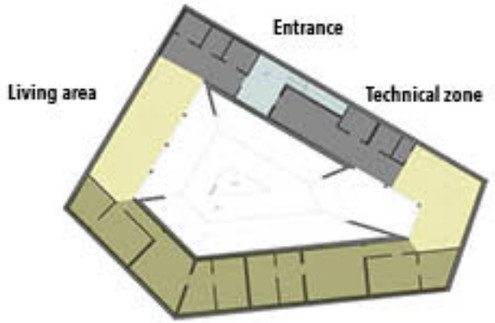
4 - Cut openings



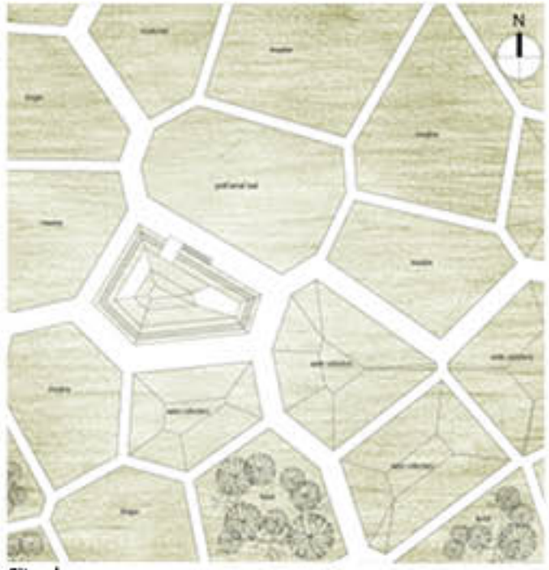
Transversal section



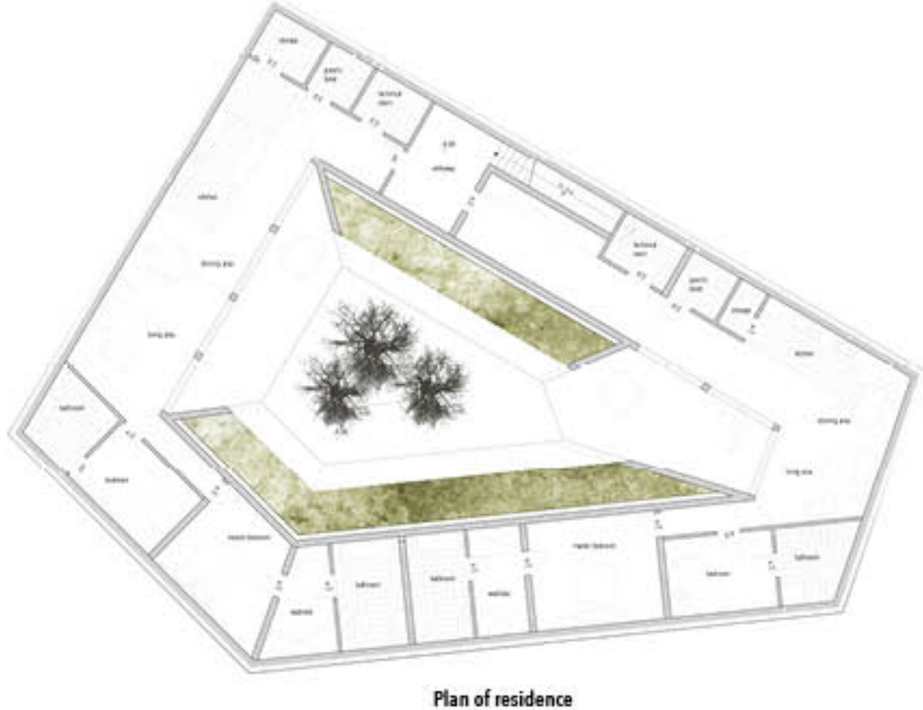
Longitudinal section



Program diagram

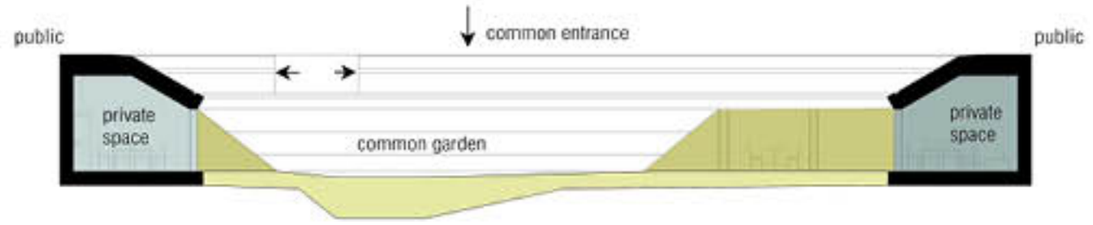


Site plan

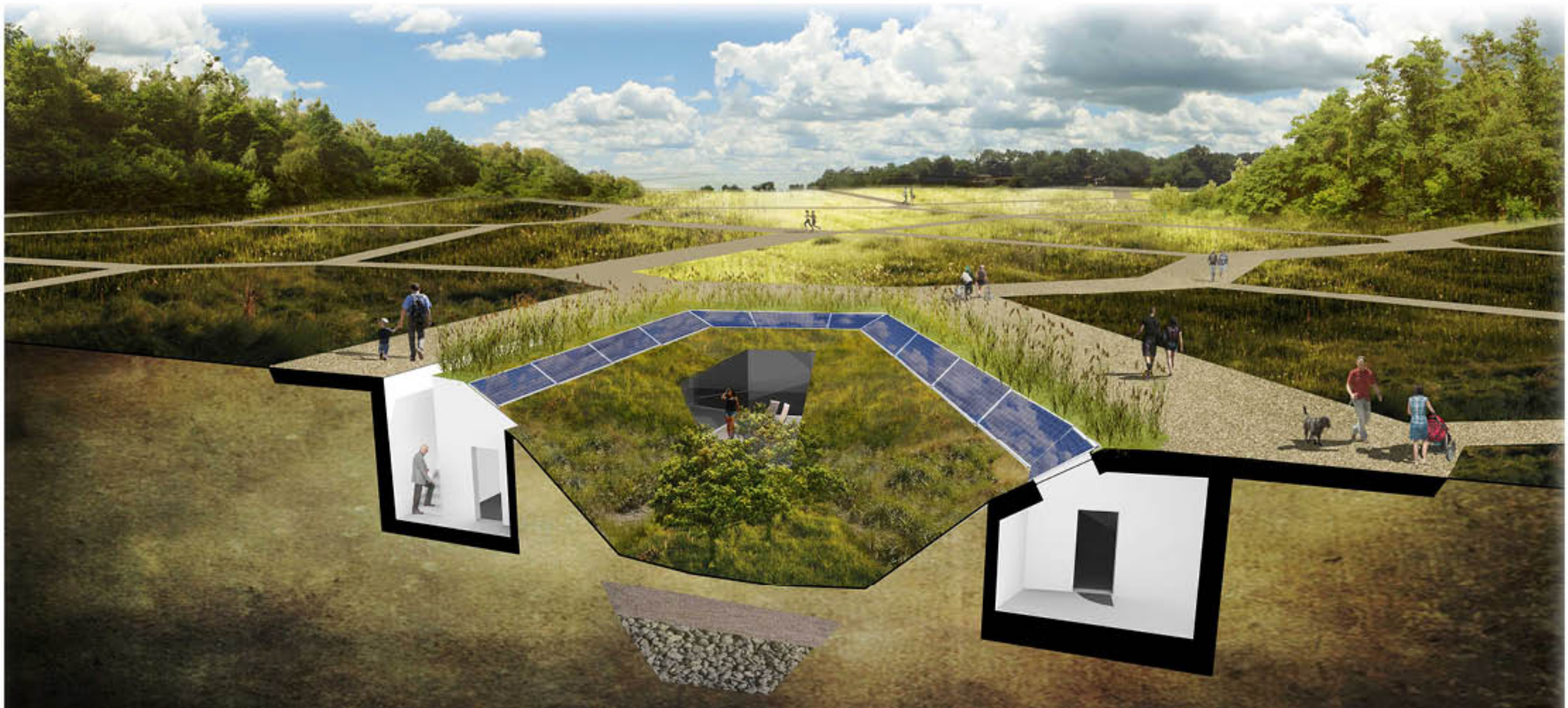


Plan of residence

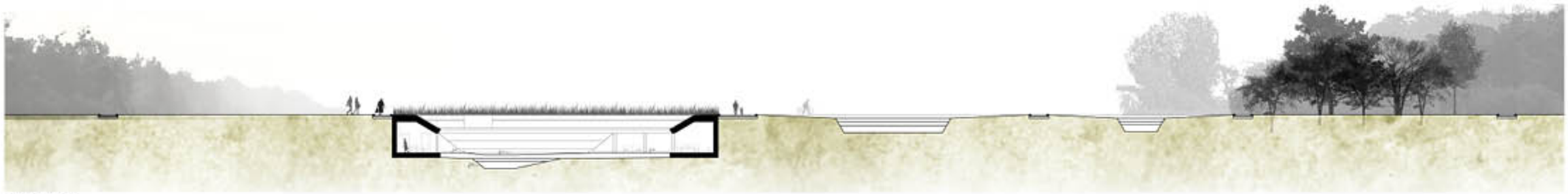
/ DUG HABITAT / Sectional strategies



Program and privacy diagram



/ DUG HABITAT / Relationship to context



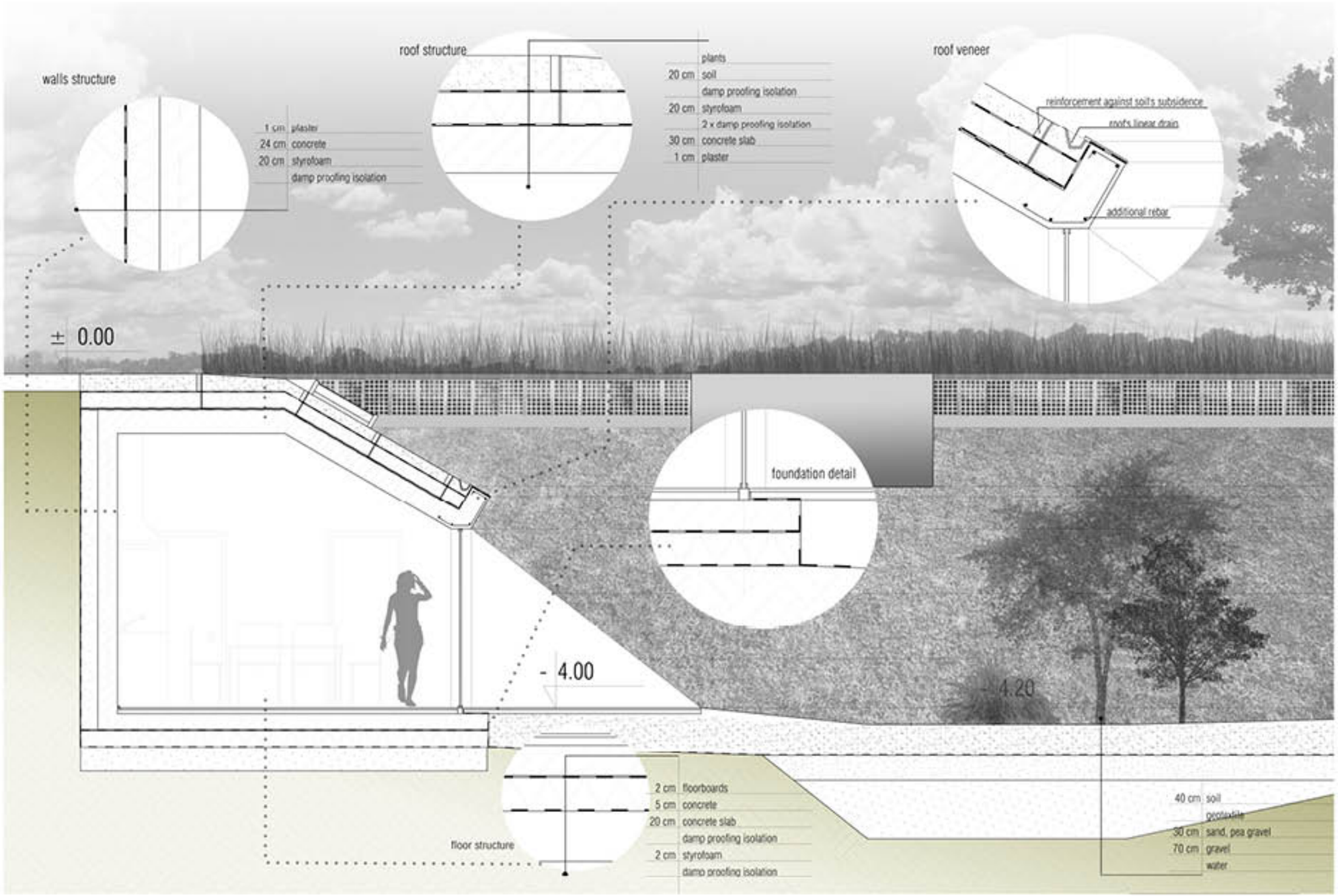
Urban section

External view

Environmental systems

Inside view

/ DUG HABITAT / Technology and systems



Technological section
The project effectively copes with the main challenge of protecting interiors form water infiltration by careful detailing.
Also, it proposes differentiated solutions to each different ground condition: slab on grade, green roof, and cultivated areas.

LIVING THE GROUND
Milan, Italy

The hosing project in the Ortomercato area starts on the edge of the new lowered park, the result of a re-shaping process which aims at establishing a balance between airborne pollutants and groundwater. The project proposal fosters a new ecosystem and provide for a phytodepuration system to deal with the polluted area. The edge presents a sharp slope because of the change of level (about 7 meters) and the main project idea is to work precisely on and within this large wall.
According to the geometry and the soil composition, this edge would easily crumble under the forces of the groundwater. Hence, the project aims at "building the cavity" that prevents the natural erosion and sliding of the ground, and, at the same time, at producing unique living spaces.

The research of the shape is the main part of the work and is a parametric process: individuation, quantification and insertion of the input, virtual algorithm, interpretation of the shape (output) and its peculiar organic lines that can be managed and build with virtual tools only. This project starts from the usual living spaces conceived as quantities (parameters, indeed) and arranged into the ground forming an organic and irregular shell that hosts the living unit, while outside the new natural system is not affected by it.
Both the living unit and the natural environment take advantage from each other: the shell stabilizes the ground allowing the lowered ecosystem, and is supported thanks to the FEW's systems provided by the natural environment within a symbiotic coexistence.

Davy Campana

Noise analysis
The more the streets are crowded, the more fine dust is released in the air. Plants seem the best solution to capture and neutralize this dust.

50-54 dB
55-59 dB
60-64 dB
65-69 dB

Noise's factor:

Railway system

Car traffic

Ortomercato clients

Ortomercato maintanance

Noise map

Pollution reduction conducted by vegetation

polluting	neutralization
carbon monoxide (CO)	2.500 ug/m³ hour
chlorine (Cl)	2.000 ug/m³ hour
fluorine (F)	100 ug/m² hour
nitrogen oxides (NO)	2.000 ug/m³ hour
ozone (O2)	80.000 ug/m³ hour
sulfur dioxide (SO2)	500 ug/m² hour
ammonia (NH3)	400 ug/m² hour

Different type of "green area"

vegetation type (1m²)	leaf surface (m²)
grass (h 3 cm)	6
grass (h 6 cm)	9
grass field (h 60 cm)	up to 225
green roof not cutted	more than 100
screw on facade (th. 10)	3
screw on facade (th. 20)	5
ivy on facade	11.8

Intensity of car traffic

Rain water analysis
Rainwater can be easily collected by roofs.
By using existing building stock we can collect around the 25% of the rain water.

Roofs
Total impermeability
25% of the total area
90-100% OF WATER WASTED*

Paved ground
Mostly impermeable
40% of the total area
70-90% OF WATER WASTED*

Green area
highly permeable
30% of the total area
0-20% OF WATER WASTED*

Railway ground
Total permeability
5% of the total area
0-20% OF WATER WASTED*

Rain water management: ground permeability

108-109.5mt
109.5-111 mt
111-112.5 mt
112.5-114 mt

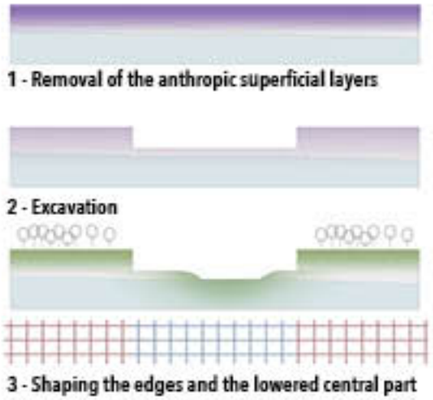
Low hydric system manage to private entities

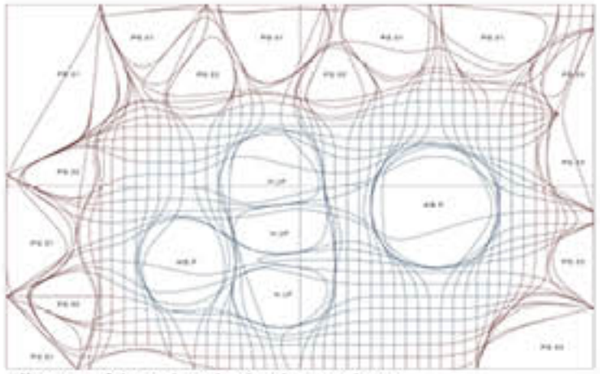
Low hydric system

Isopiezometric line

Water map

/ LIVING THE GROUND / Parametric simulation

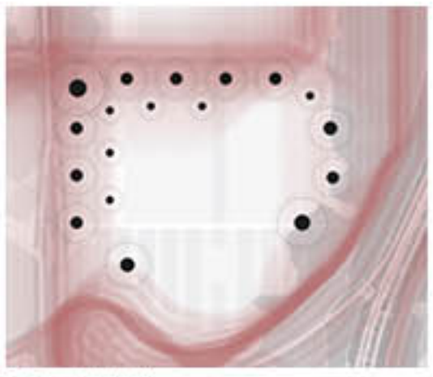




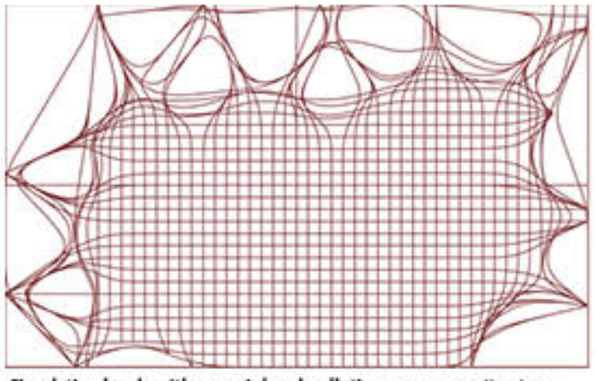
Allocation of dry and wet land within tesselation

Dry land for fields
Traditional farming

Wet land for fields
Phytodepuration/farming

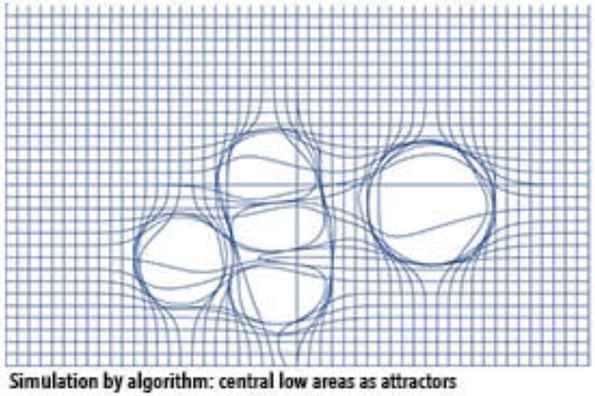


Peripheral pollution sources



Simulation by algorithm: peripheral pollution sources as attractors

Central low areas



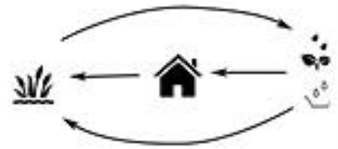
Simulation by algorithm: central low areas as attractors

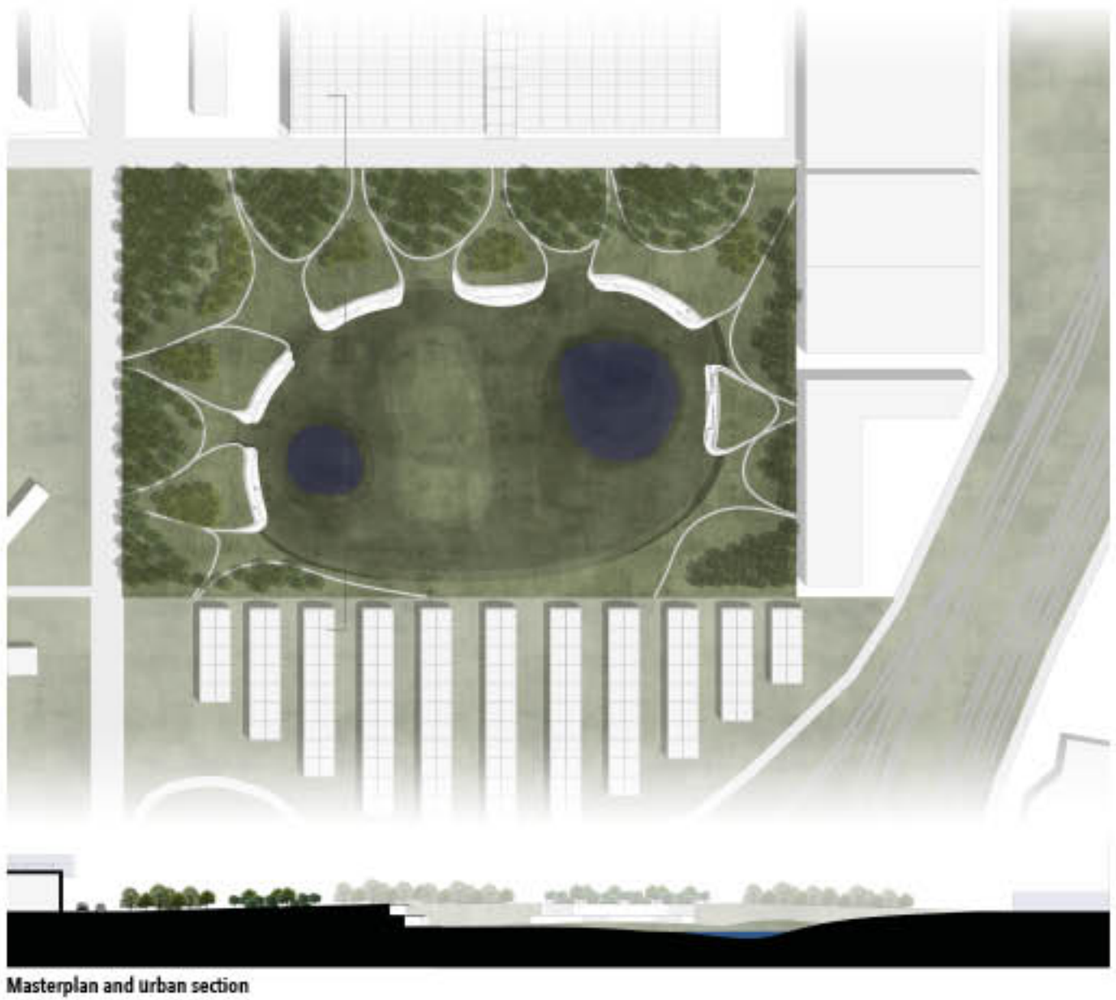
/ LIVING THE GROUND / Site Plan strategy

Urban farming unit (100-150sqm)

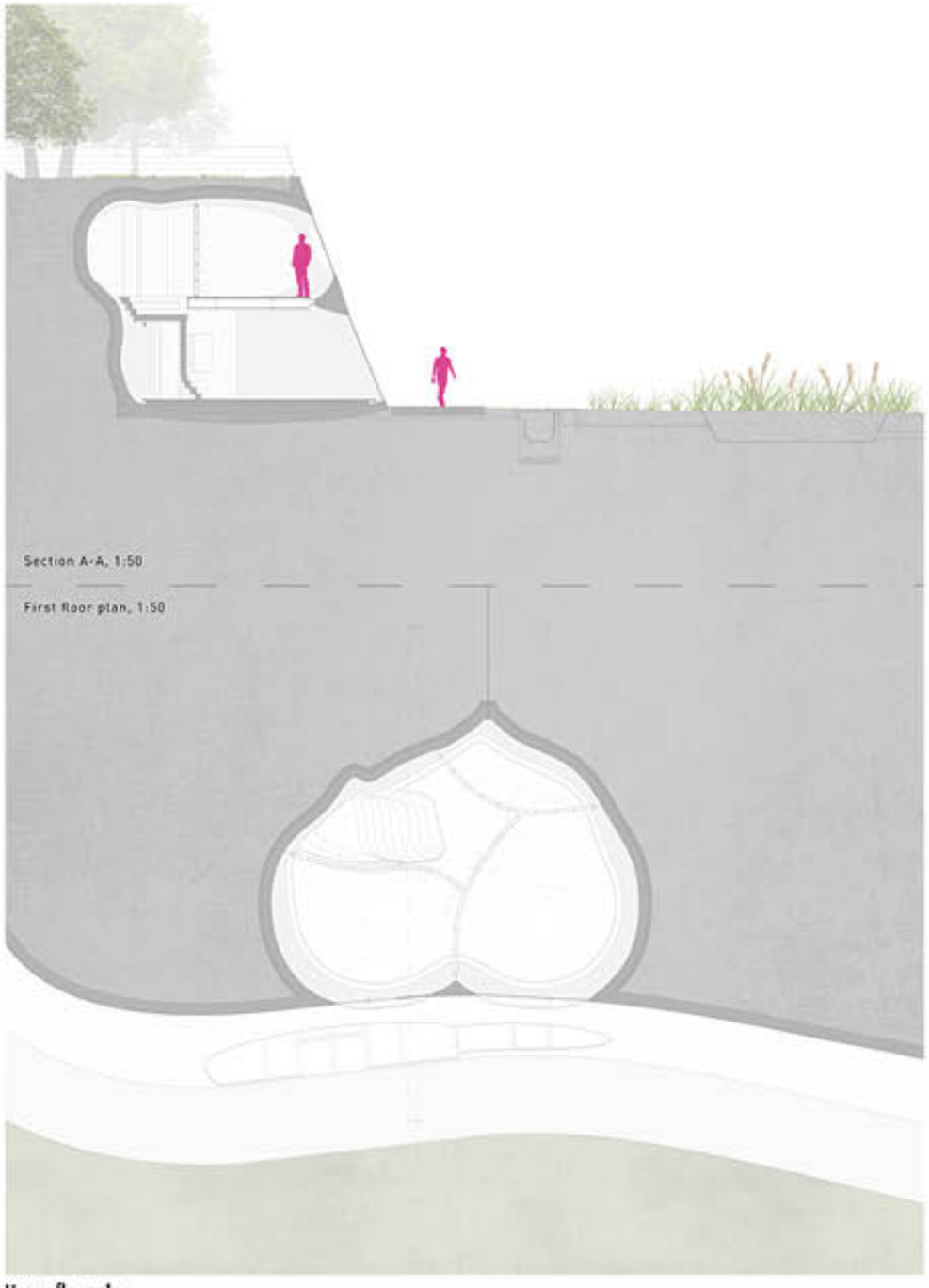
Solar surface

Phytodepuration unit (40sqm)

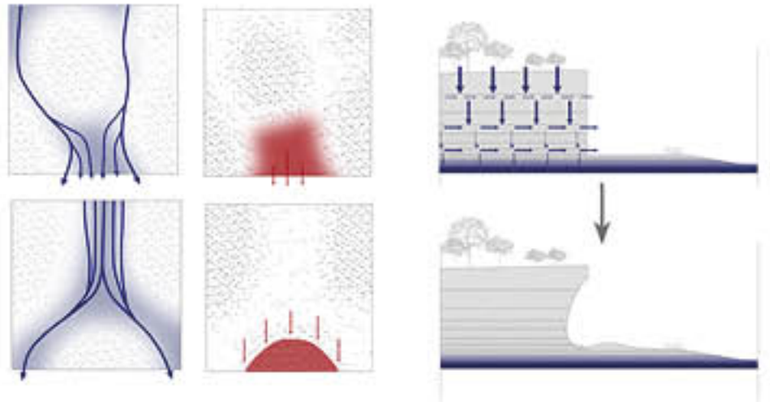


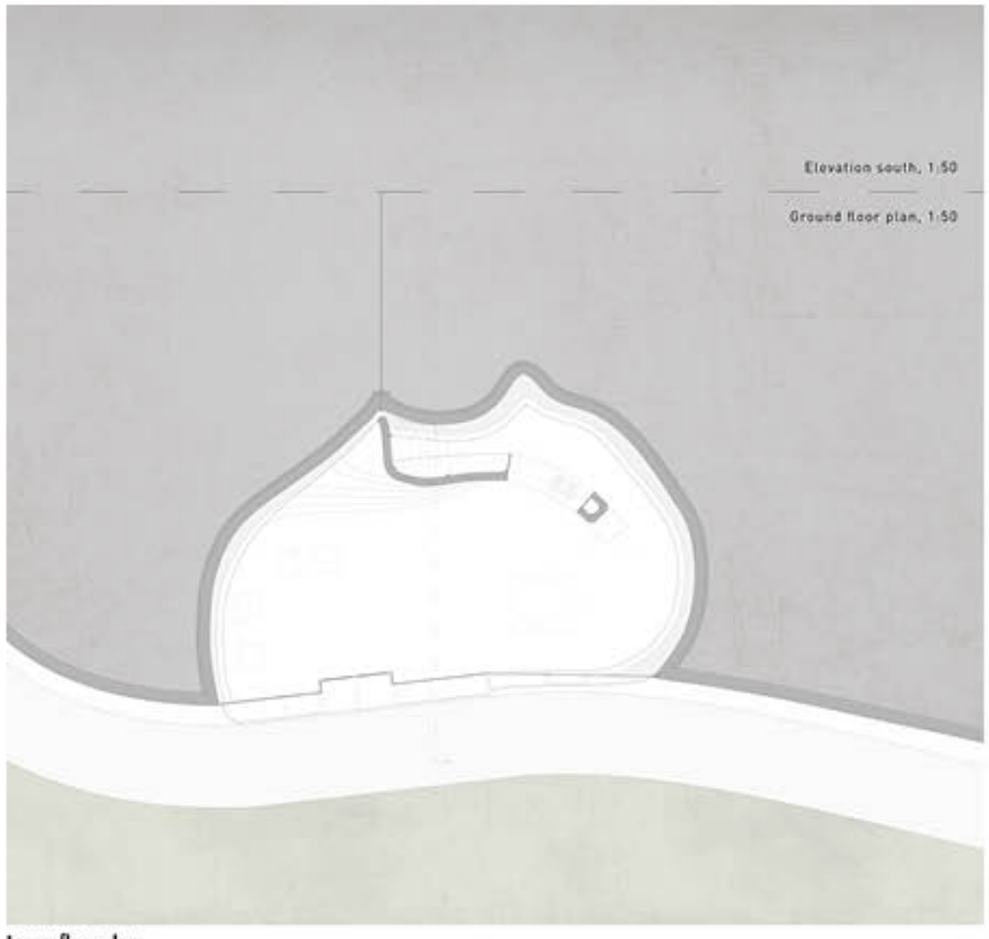


Masterplan and urban section

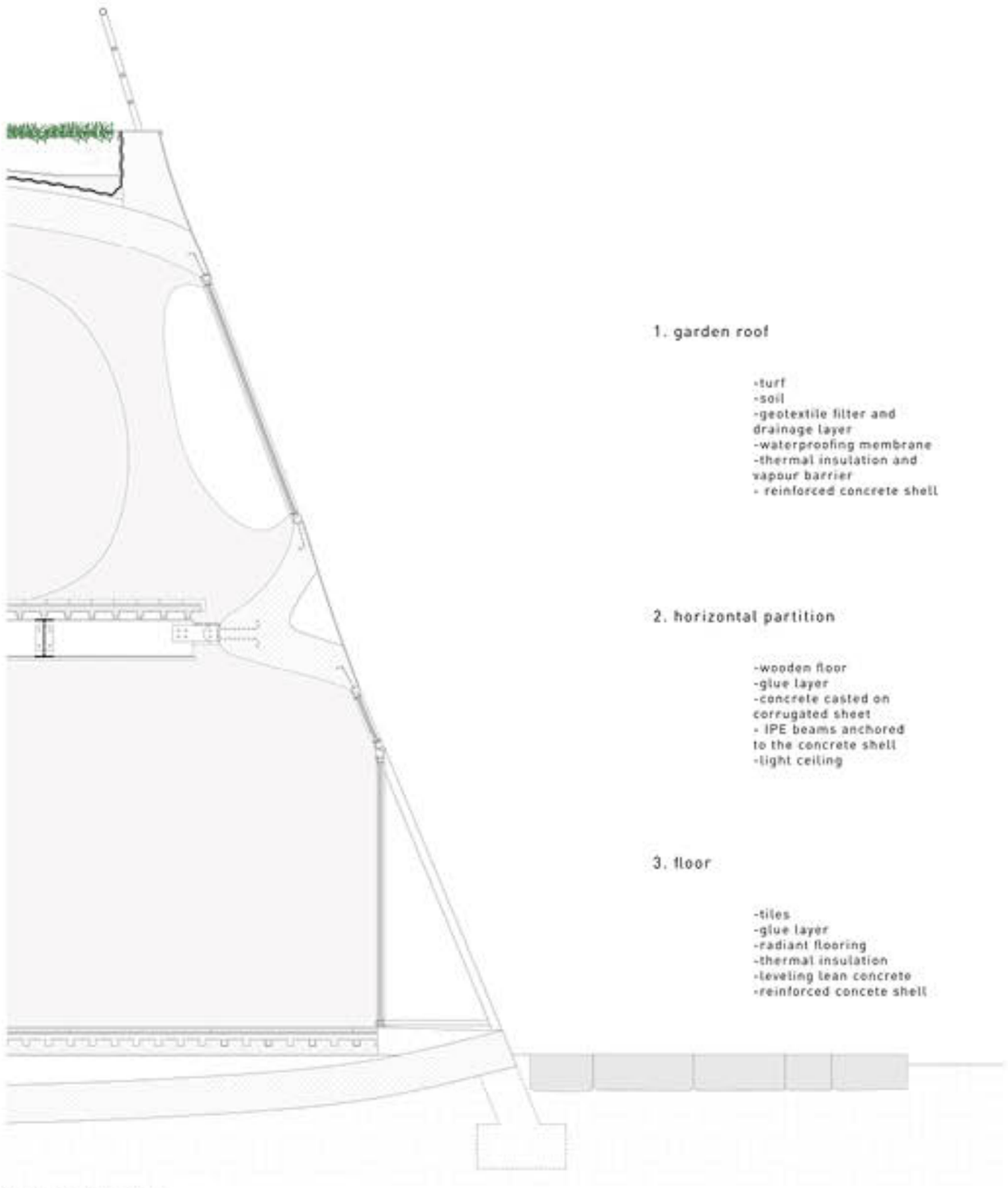


Upper floor plan





Lower floor plan



1. garden roof

-turf
-soil
-geotextile filter and drainage layer
-waterproofing membrane
-thermal insulation and vapour barrier
- reinforced concrete shell

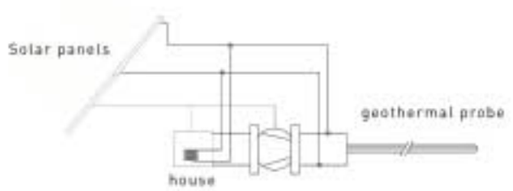
2. horizontal partition

-wooden floor
-glue layer
-concrete casted on corrugated sheet
- IPE beams anchored to the concrete shell
-light ceiling

3. floor

-tiles
-glue layer
-radiant flooring
-thermal insulation
-leveling lean concrete
-reinforced concete shell

Technological section



Geothermal diagram

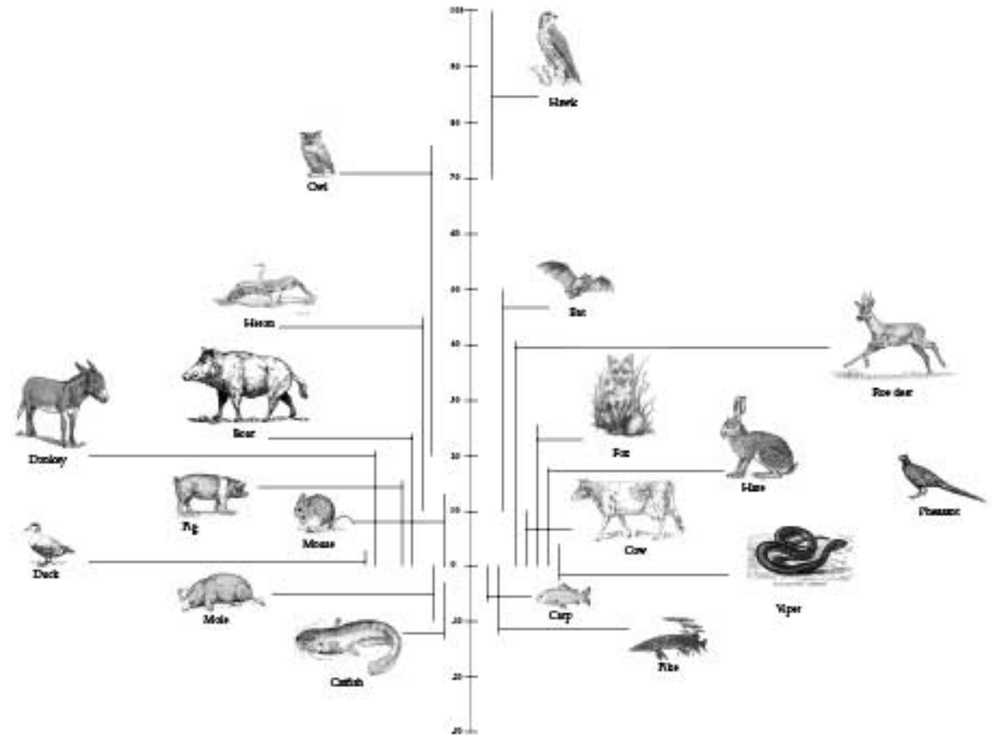
Solar radiation analysis of retaining wall

Interior lower space

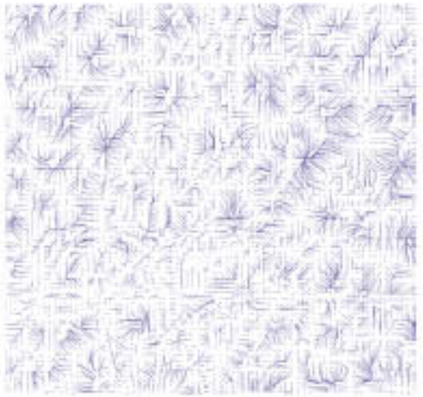
VORTEX
Milan, Italy

The aim of this project is to materialize an environment that is already there as a result of the invisible forces acting on the site. It presents itself as the symbol of a new relation between humans and ecosystem in the south-east suburbs of Milan. 7 billion people, no more cultivable space, global overheating.
This is the "landscape" projects we are going to face in 30 years. Compartmentalization of productive sites, consumption sites (houses) and waste sites is replaced by an holistic model.
The landscape acquires a dynamic dimension and it is shaped adding layers of organic wastes coming from the surroundings, above the remains of demolition. This amazing landfill is covered with biomass forests and phytoremediation plants enabling a long process of re-permeabilization and remediation of the soil from pollutants. Some spaces are kept free from soil addition to create wind tunnels in the landscape.
Three main channels are individuated to multiply the original wind speed by ten, based on the "Venturi effect".
The wind, running inside tunnels swings thousands of vertical turbines, settled along the two sides, producing electricity for the entire neighborhood.
The architecture arises exactly where the wind reaches its highest value. Once it is shaped in 3 dimensions by the wind, it then grows along the section. The structure grabs a fragment of life.
It is sensitive to the quality of the air along its height, to the quality of the aquifer and the river, to animal life. It's the new sensitivity of humans in relation to the ecosystem, which moves beyond the enlightenment model.
This sensitivity is expressed following the layering of soil and air through the alternation of materials, structure, density and rhythm.
Technical functions in the massive basement, Cows and foxes at ground level, insects in the load transfer, human residences in modular blocks, a huge "voliera" for birds. The structure is porous to agents and is covered with triangular expanded metal panels.
A system of small tubes, shaken by wind, comes out from this skin in order to collect CO2 to feed algae and clean the air.

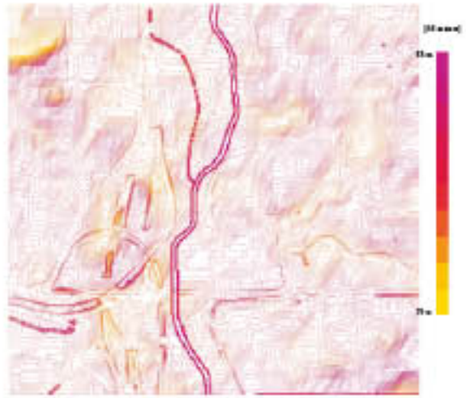
Giovanni Trogu



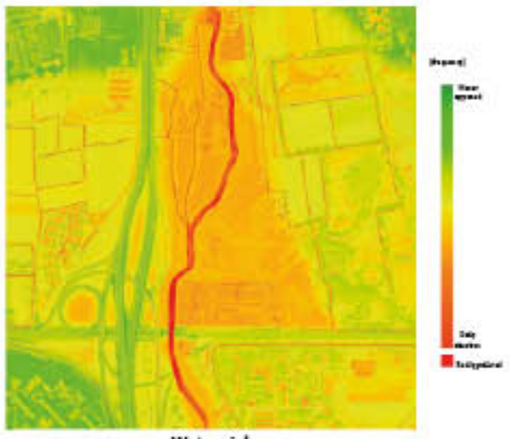
/ VORTEX / Site forces analysis: plan



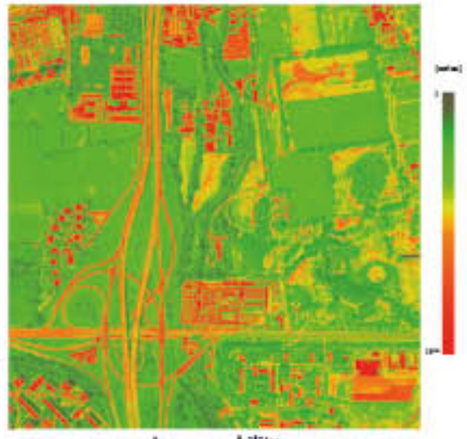
Water flows



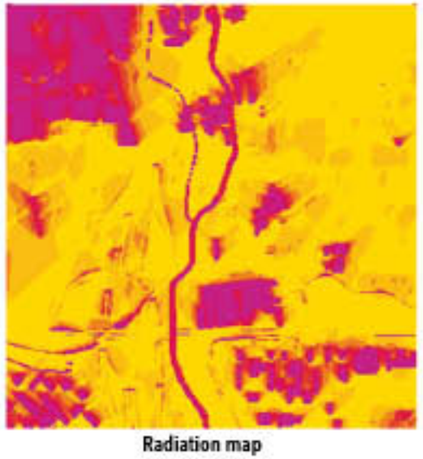
Contours



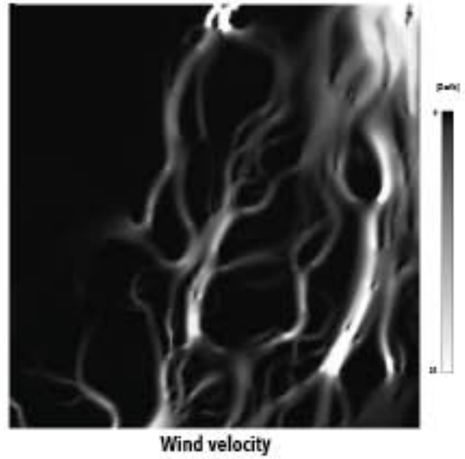
Water risk



Impermeability

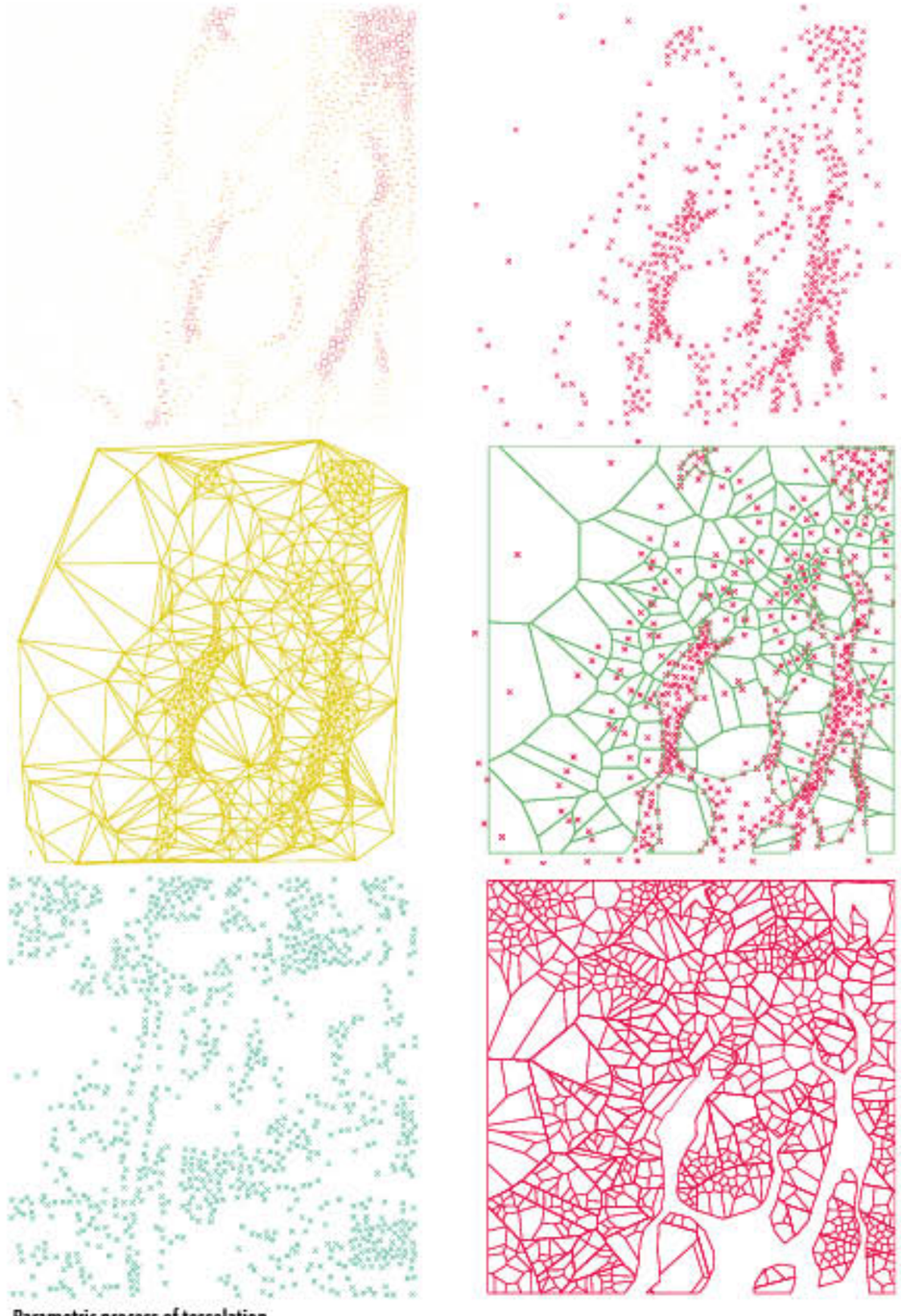


Radiation map

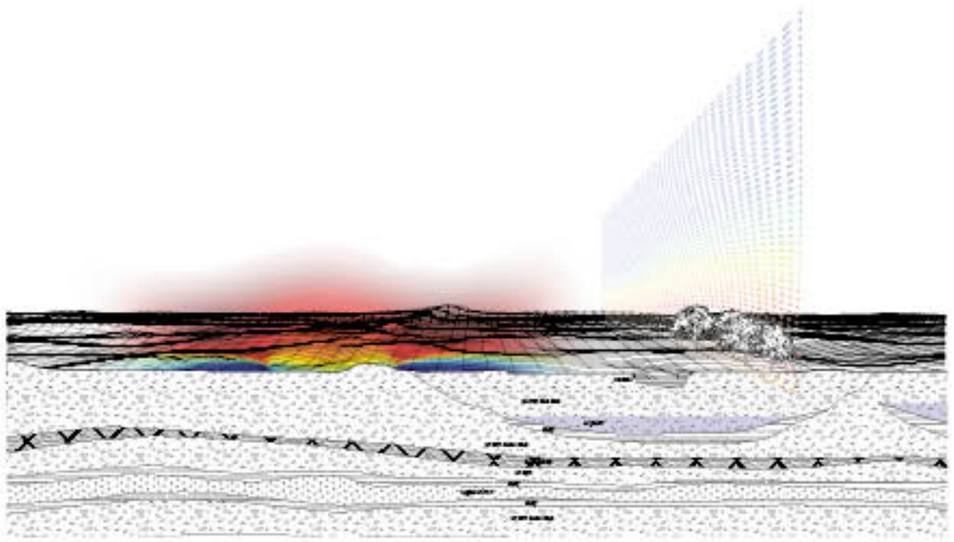


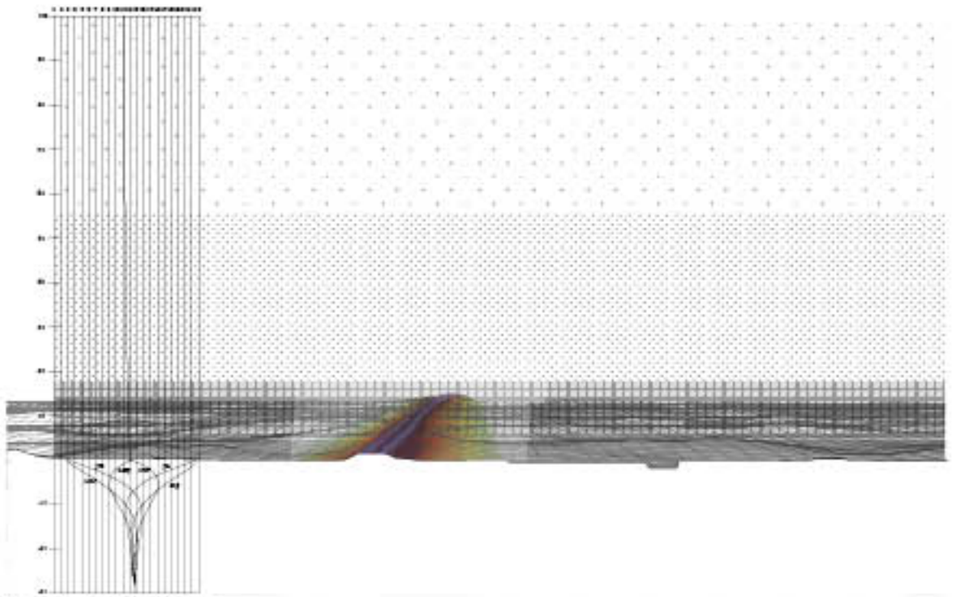
Wind velocity

/ VORTEX / Parametric tesselation: plan

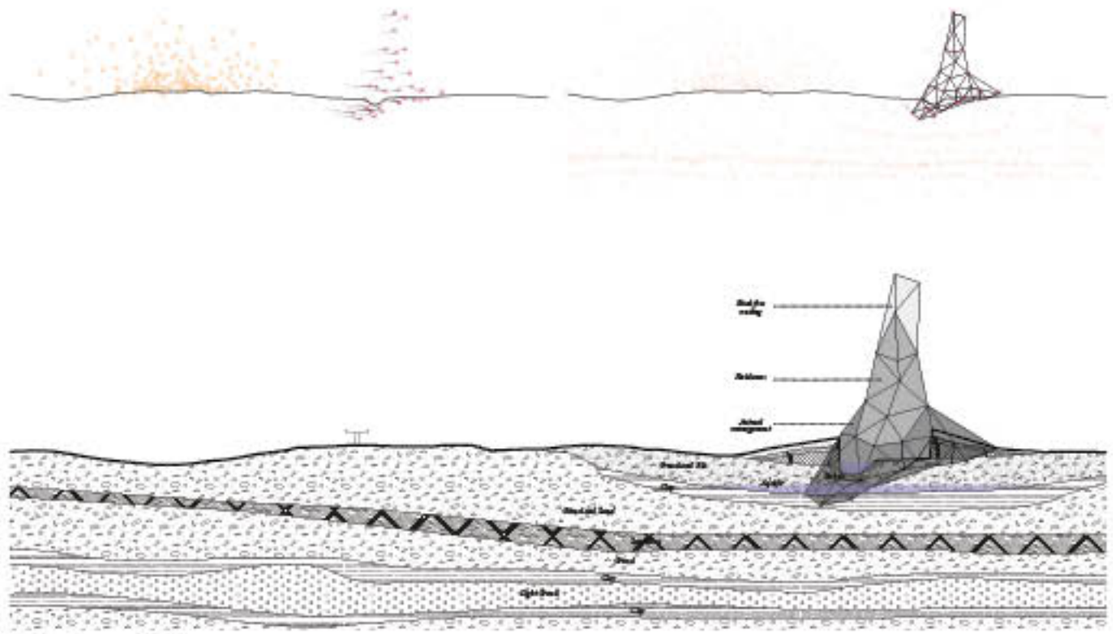


Parametric process of tesselation





Vertical analysis of field forces

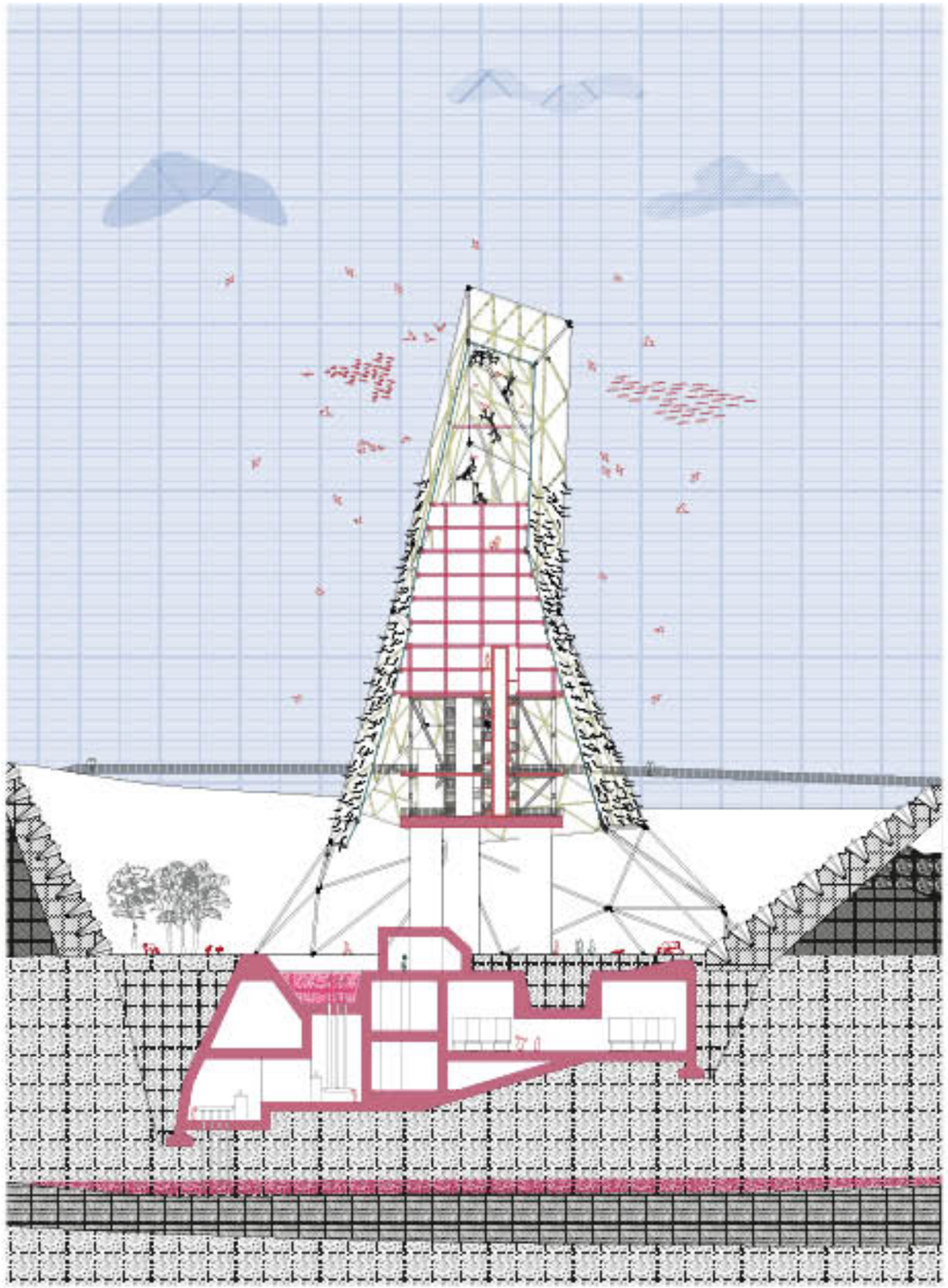


Vertical parametrization

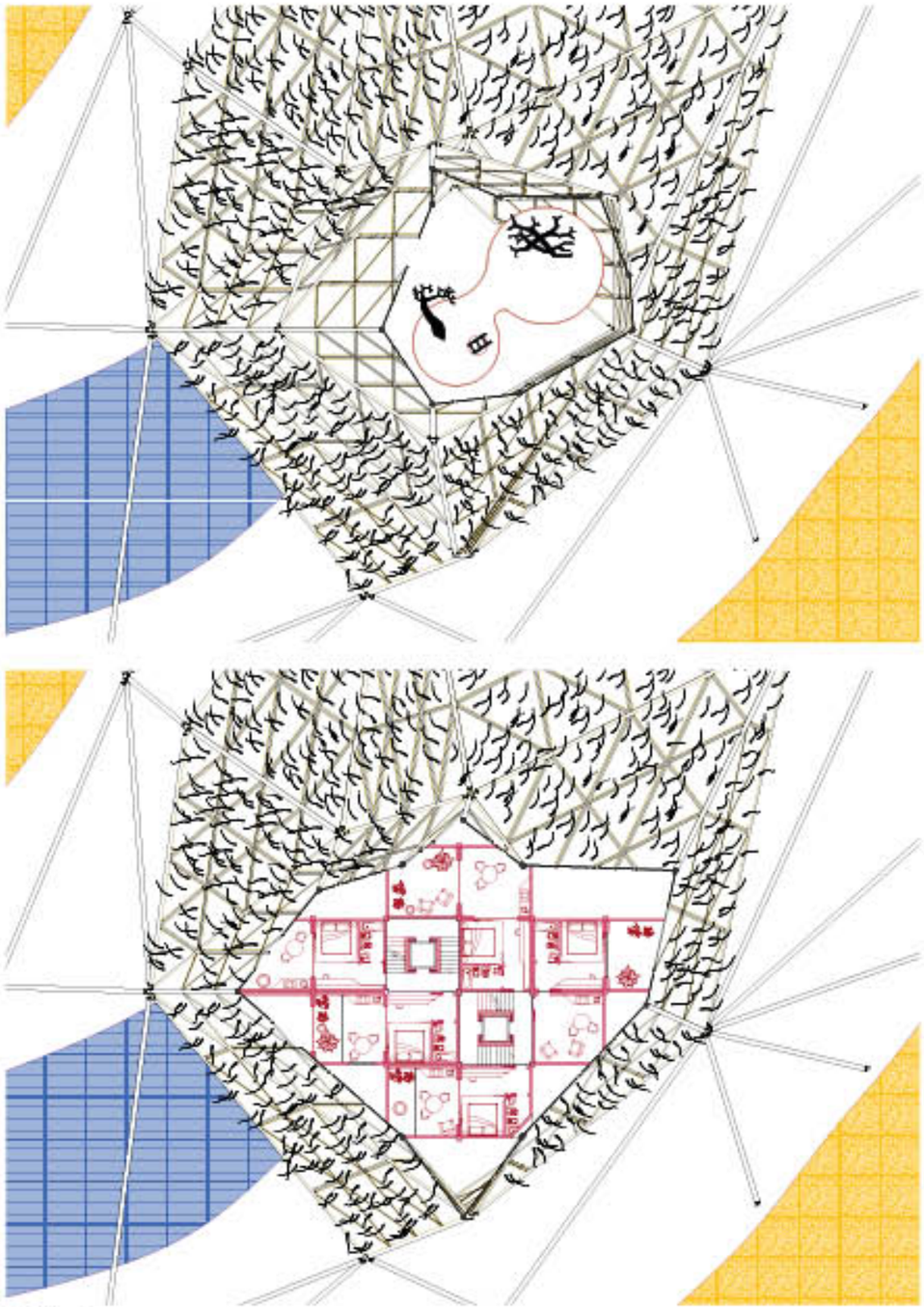
Site strategy

Wind as design tool / Renewable energy is produced by harvesting the increasing wind velocity inside the newly created "canyons". The geometry of the new topography is based on digital wind analysis and analogue simulations using physical models and flags as indicators for speed and velocity.

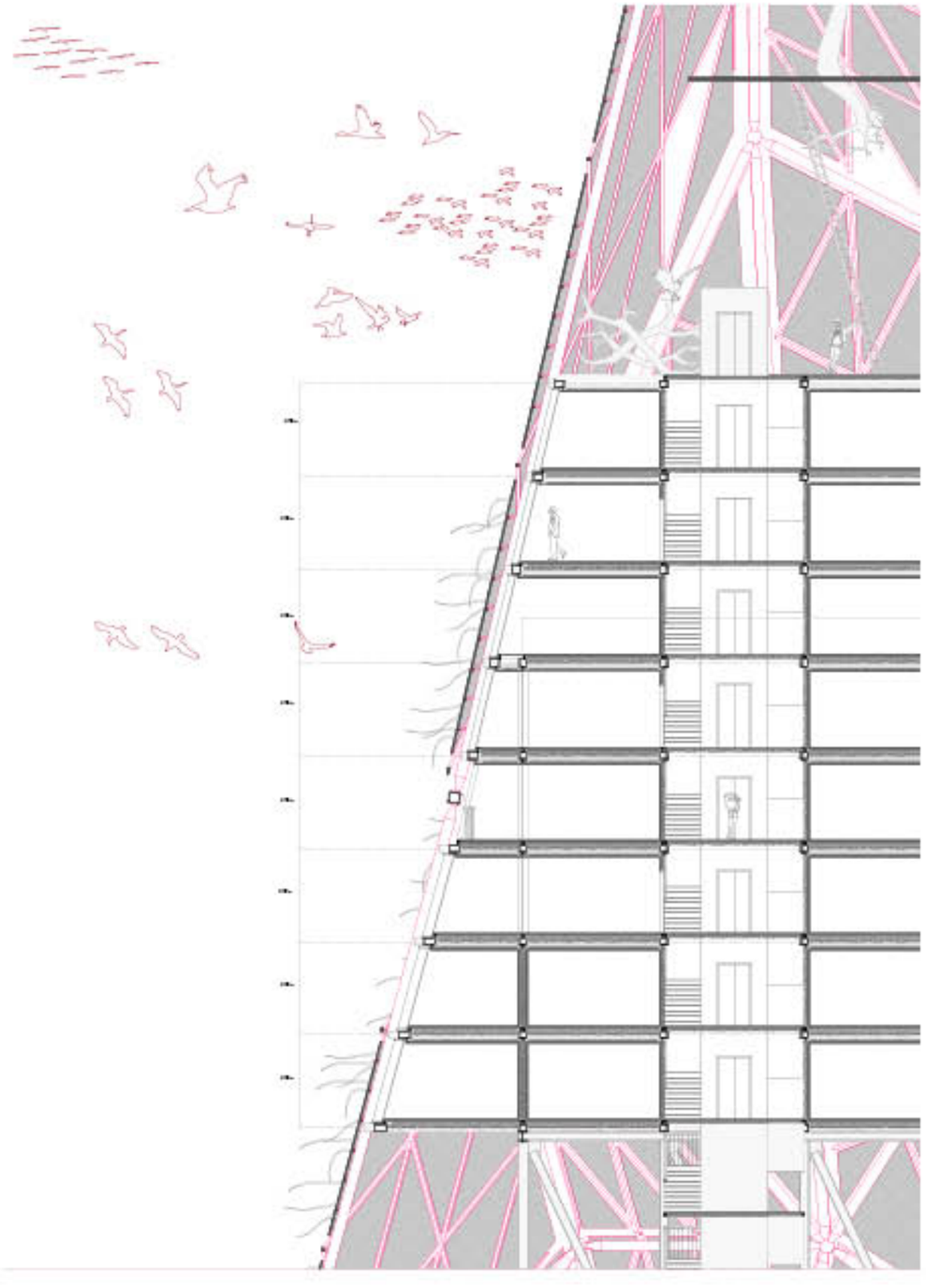
The retaining wall as modular system of cells



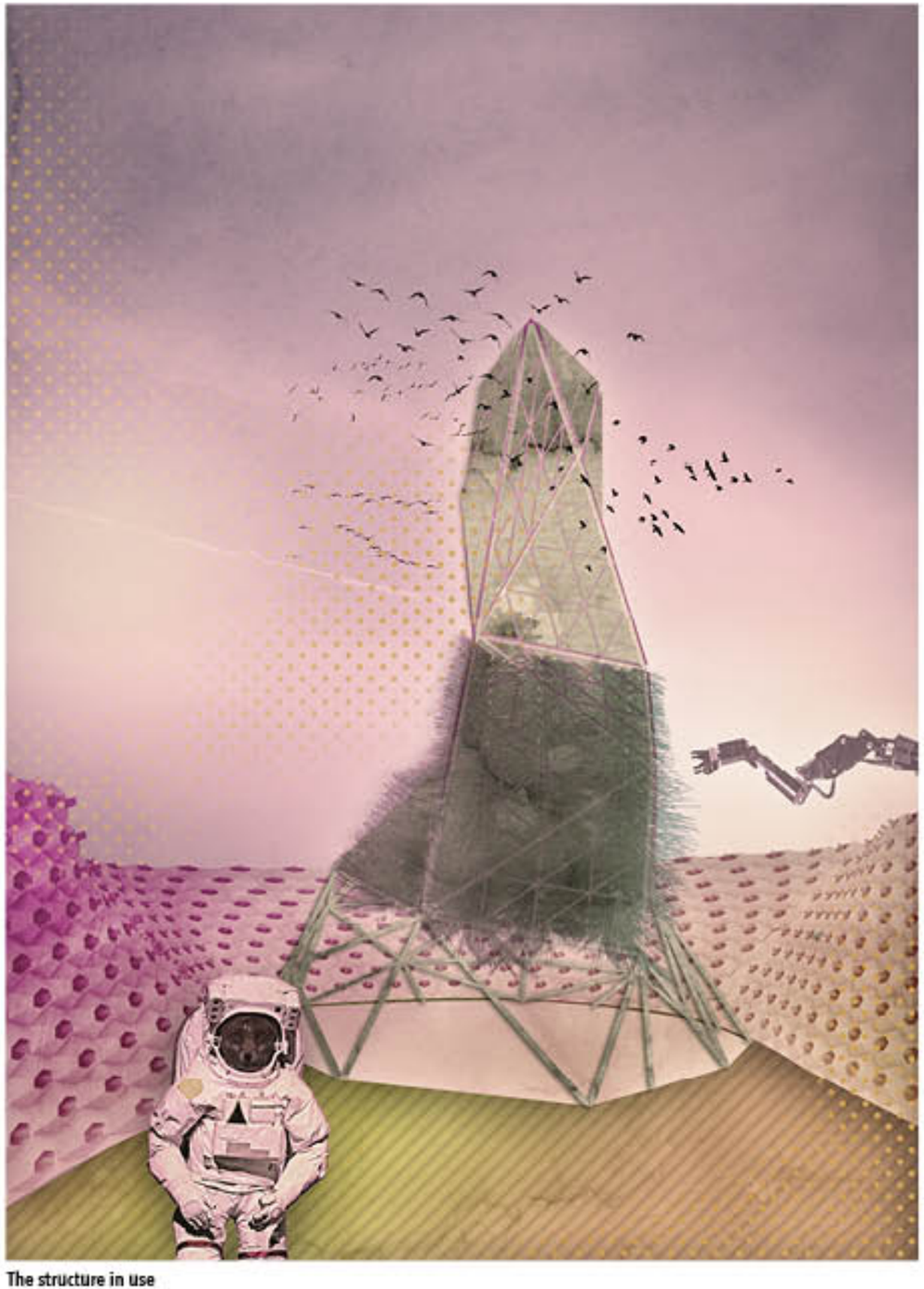
Building section



Building plans



Detail section



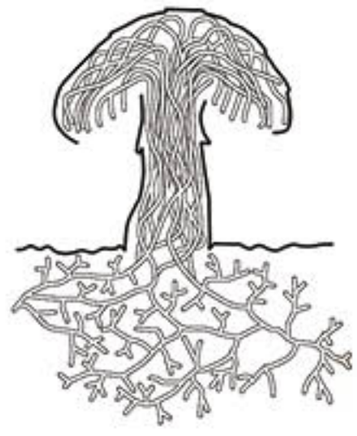
The structure in use

MYCELIUM GREENHOUSE
Milan, Italy

The site is situated in the suburbs of Milan, isolated from the western residential area by the overpass, yet enriched by the Lambro River flowing over its eastern fringe--one of the key factors for the project. The main intent of the project is to turn this area into a rural tourism attraction and a landmark in the landscape.
We focused on evaluating and designing two main components: Farm-land (landscape) and Wet-land (water scape). The site becomes a buffer zone which connects urban and natural space, reflecting the tapering construction density and increasing natural elements.
The existing elements and the design proposal are connected by a space underneath the overpass, which is transformed in community and entertainment space. Based on the study of topography and shadow effects from surrounding construction, the Farmland area is divided into three levels from west to east: Urban - Semi-urban - Nature. These areas are separated by pedestrian pathways and canals which follow the terrain contour line, bringing the water from the Lambro River into the site for irrigation.

Domestic waste water, after the first filtration, will flow back to the Lambro River via the Wetland system. The artificial ecosystem consists of floating green islands, that are designed to direct the flow and increase contact with the water purification system. Due to its hydrological characteristic, this area used to be flooded during the rainy season, thus the housing design must pay attention and adapt to the natural condition.
We propose 2 types of houses in this area: 'in' the water and 'over' the water. "In the water" is a combination of Green-house and living space, a spiral form running from low to high based on the column system to ensure the house is not flooded in the rainy season, while providing the user with a stunning view from above. The main structure of the building is diamond-shaped lattice truss, which is built parametrically based on the solar radiation to regulate the opening and closing of the glaze mesh to minimize energy consumption. Finally, the energy efficiency and economic benefits of the mushroom growth system was the main inspiration for our project.

Huyen Chu Ngoc



Masterplan proposal

Section of the natural ecosystem

Trees used to stabilize river's bank with water absorption

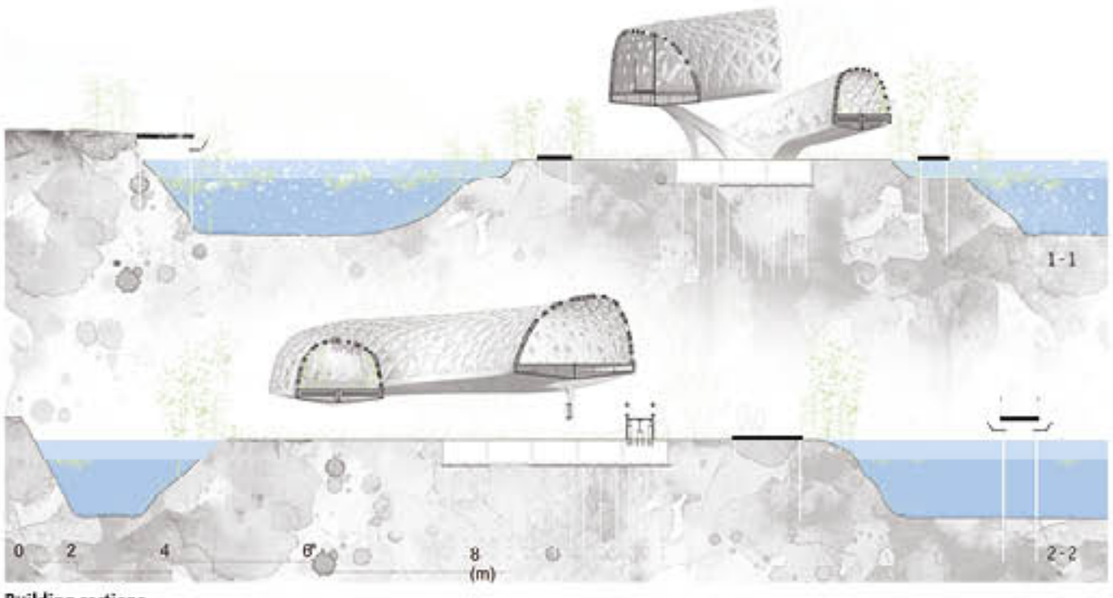
Shrubs partially play a role as filter of different chemical pollutants

Marsh land enhances aerobic and anaerobic nutrient cycle

Aquatic plants help to hold sediments and improve water quality

Site design

Building plan

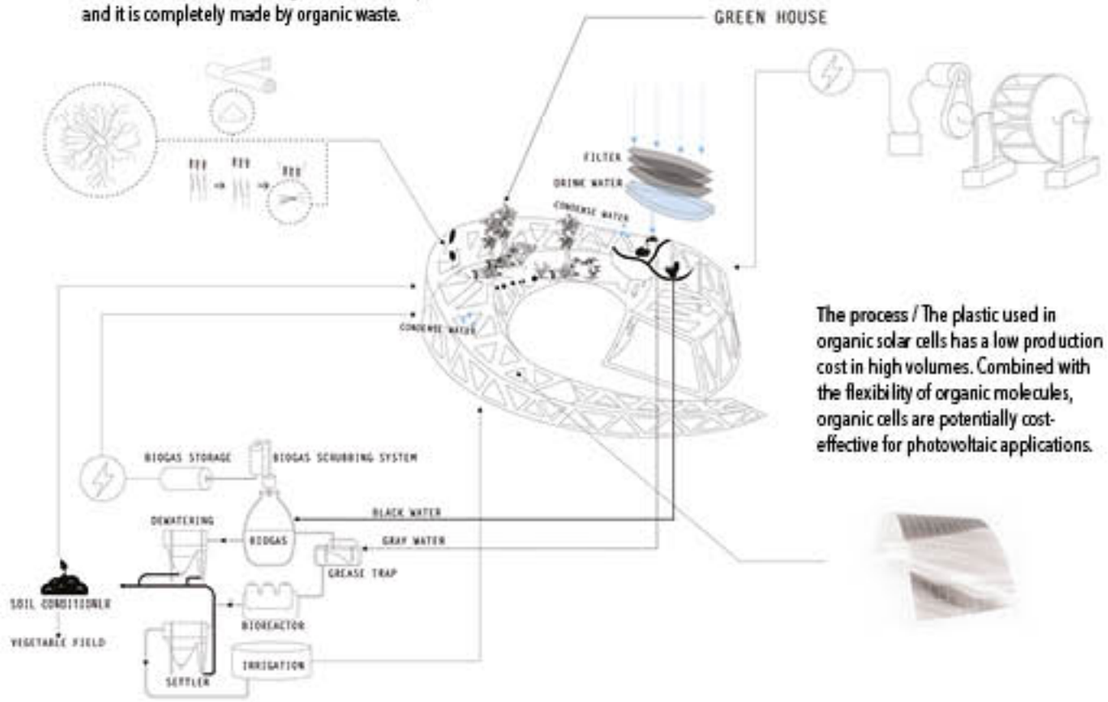


Building sections

/ MYCELIUM GREENHOUSE / Visual experience

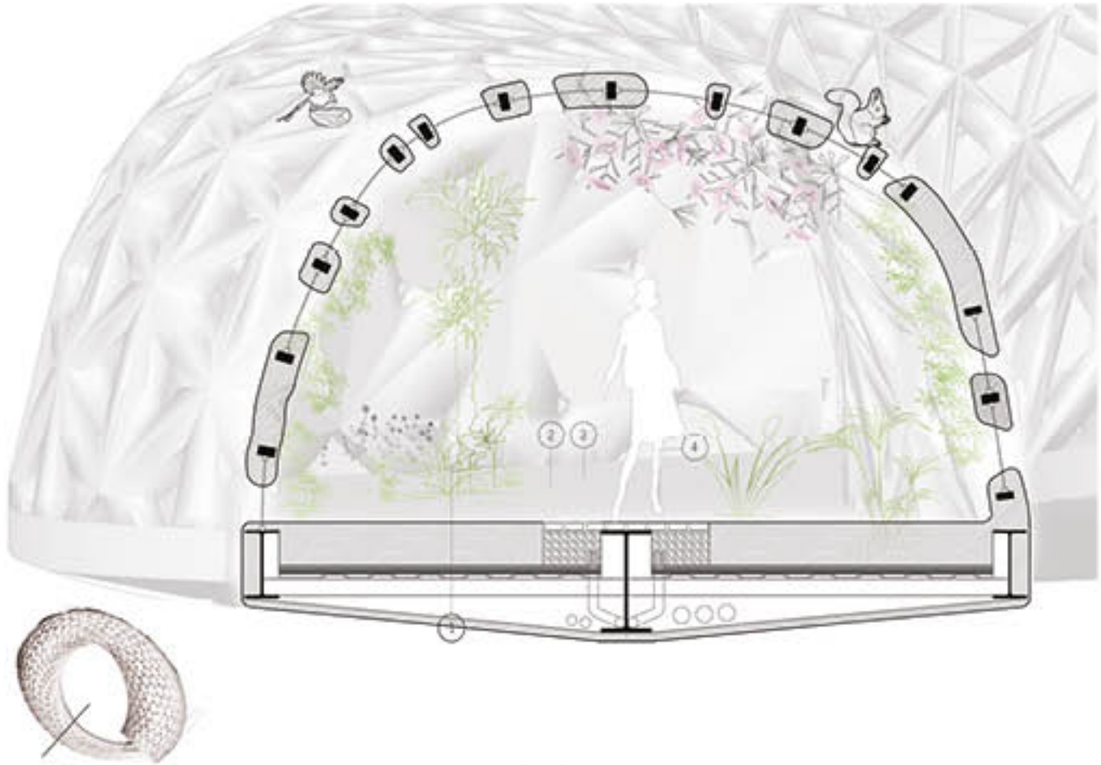
External view

The material / Mycelium is 100% organic.
It is a material which is stronger then concrete,
and it is completely made by organic waste.



System diagram

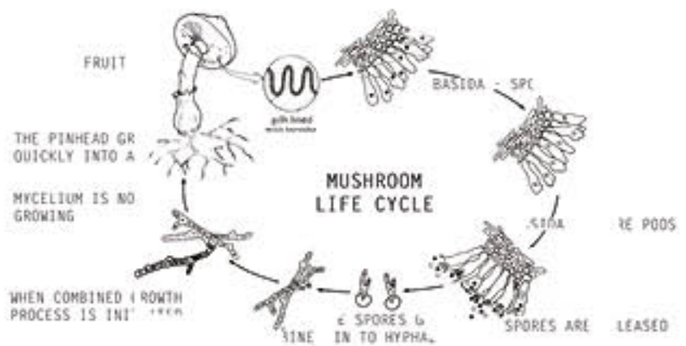
The process / The plastic used in organic solar cells has a low production cost in high volumes. Combined with the flexibility of organic molecules, organic cells are potentially cost-effective for photovoltaic applications.



Detail section

Dynamic views

Fungi's structure / Fungi's chemical composition is a mixture between animal and plant. They have no chlorophyll, instead they do cellular respiration.



Views of living spaces

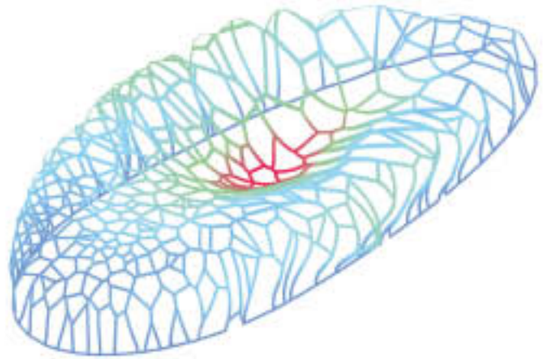
Children bedroom

Roof farming

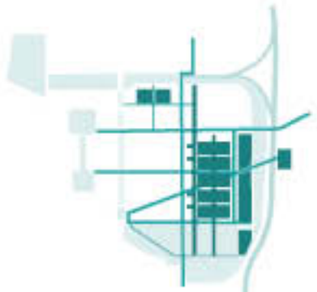
ELYSIUM
Milan, Italy

Elysium is a very innovative low-density residential project. It is in fact characterized by a system of buildings that are closed within a big shall that provides them with a constant temperature during the year, using the greenhouse principles, natural ventilation system and vegetation.
The project area is exactly located over the Underground station of Porta Vittoria. This let us think about how to benefit form the thermal energy generated by the station.
The building has been designed in order to take the air from the station for its heating to reduce energy and emissions. This means that during winter the air taken from the underground level is warmer than the outside air and in summer it is cooler than the very hot air outside.
This process provides a sensible reduction of energy usage for cooling and heating the building during the year.
The air is filtered and pumped into the ETFE shell, where the residential units are placed. These units are designed in order to generate a new way of living: they are fully open to outside air, in order to provide livable spaces strictly connected to the gardens, except for the bathrooms and the bedrooms which are instead closed to guarantee more privacy.
The space under the shell is designed to create a community that tries to be as much as possible self-sufficient.
They can produce their own food trough vegetable gardens and the water is collected and purified trough phytodepuration. The species of trees chosen are Mediterranean plants that remain green for the entire year, and are perfect to live in an internal mild climate.
The vegetation helps also in reducing the noise coming from a congested road that is next to the building and works as a green sound barrier.
The shape of the building comes from an analysis of invisible forces acting on the project site.
The most affecting forces are the Thermal energy and the Noise pollution. They have been analyzed by an algorithm in order to inform a shape that could be located as close as possible to the source of heat and as far as possible from the source of noise.

Matteo Bulgarelli, Chiara Robuschi



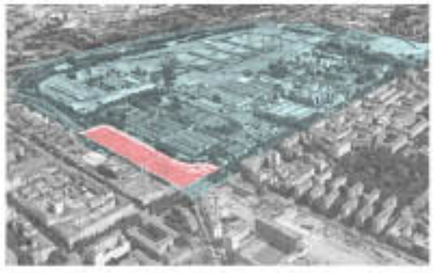
Milano City structure
The project area is located over the Underground station of Porta Vittoria, in the south-east periphery of Milan.



The Masterplan chosen is the that re-qualifies the Ortomercato area without revolutionize the formal equilibrium of the existing area.

What we consider very interesting in this masterplan is the attempt of creating a green ring that hugs the entire area.

The project site has been chosen exactly within this green ring, in order to participate in creating an ecological belt.



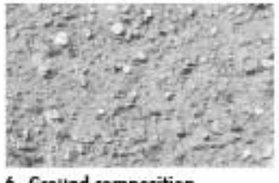
1 - Train entrance

2 - Station entrance

3 - Existing slow mobility path

4 - Accumulation of sand /pebbles

5 - Condition of the area

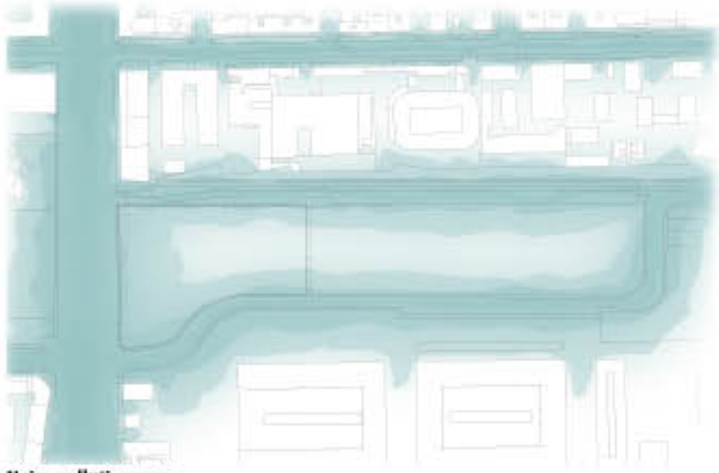


6 - Ground composition

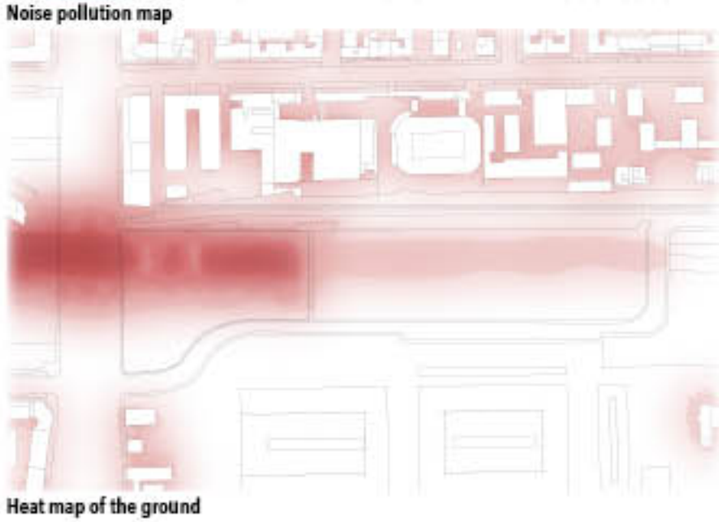
Strengths:
- Exposure
- Wide open space
- Accessibility
- Transformation area

Weaknesses:
- Presence of a noisy railway
- Presence of a big congested road
- Low aesthetic value of surroundings
- Absence of urban density

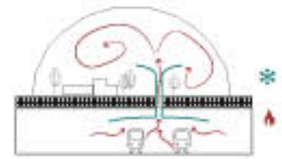
Opportunities:
- Underground station
- Site belonging to a green belt
- Wide area usable for water harvesting
- Presence of reusable materials



Noise pollution map



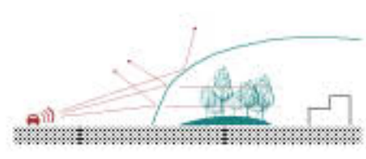
Heat map of the ground



Use of station exhausted air - Winter

Use of station exhausted air - Summer

Fragmented cover to bounce noise



Green noise barrier

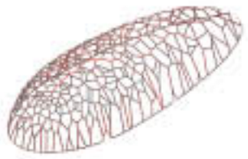
Noise Voronoi

Voronoi mapping on the cover surface

Translated Voronoi on the roof cover

Cells' intensification

Reinforced structure

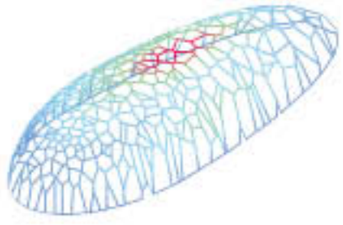


Axial force diagram

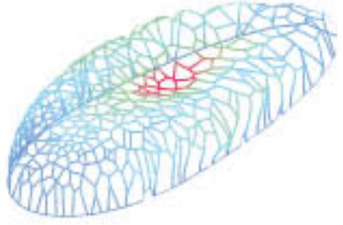
Bending moment diagram

Torsion diagram

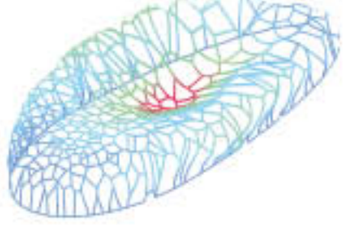
Shear force diagram



Deflection without pillars: max 1.8 cm



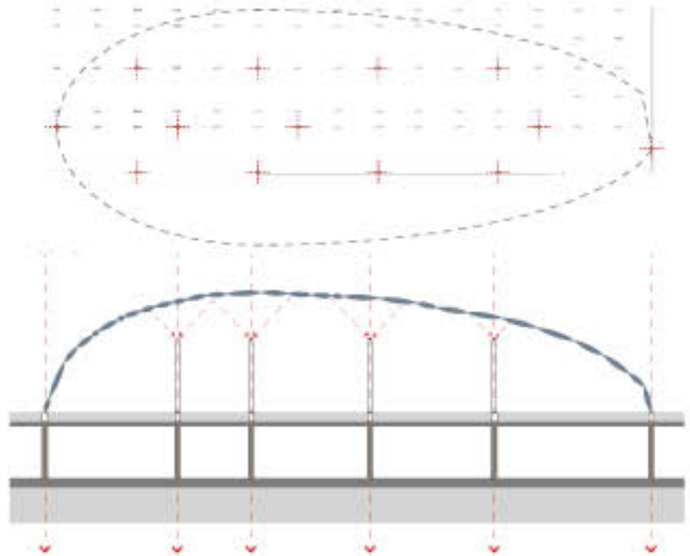
Deflection without pillars: step 1



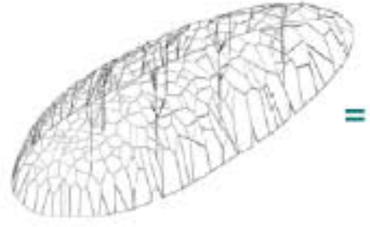
Deflection without pillars: step 2

Shell structure
The unique geometry of the mullions reveals the load forces intensifying towards the top of the dome, providing greater transparency at the ground level.

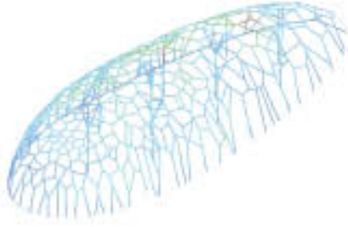
Structural continuity
The placement of columns supporting the shell reflects the structural grid of the existing underground building station.



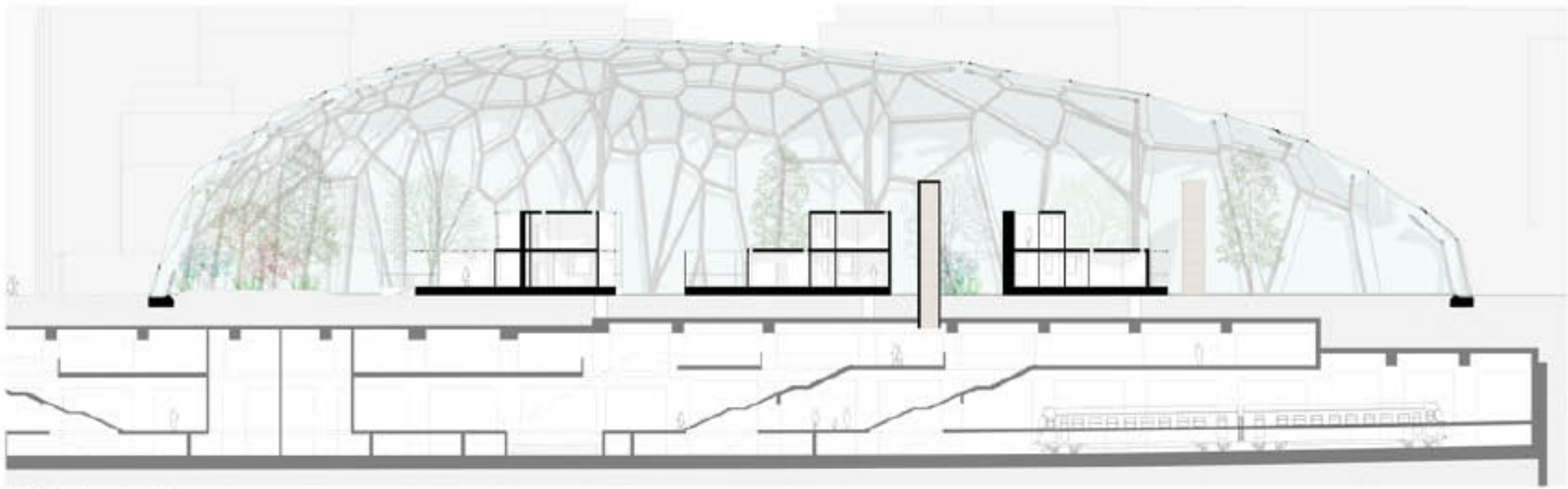
Additional pillars



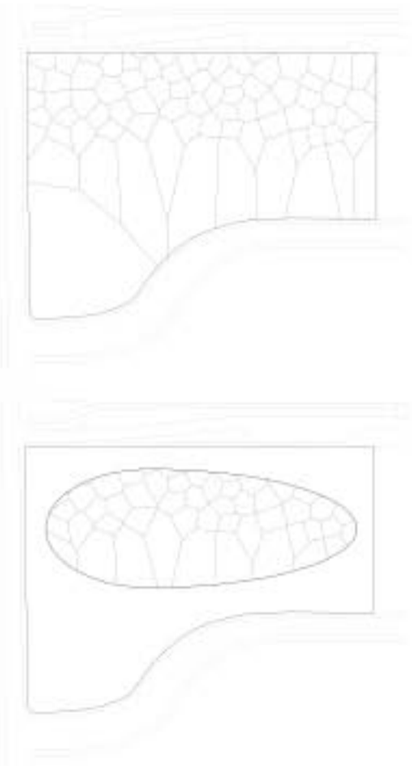
Complete structure

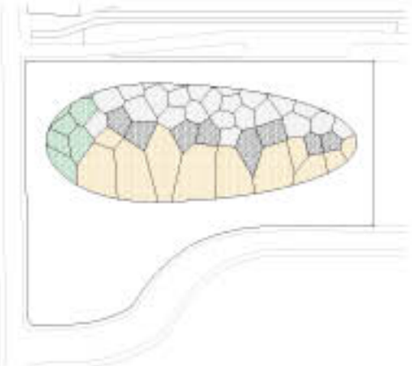


Complete structure behavior



Building plan and section





Tesselation and program allocation

Axonometric view of the system

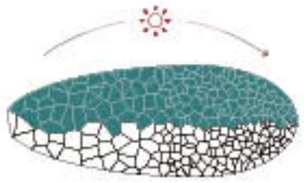
Green house effect - Winter

Green house effect - Summer

Water harvesting and Phytoremediation

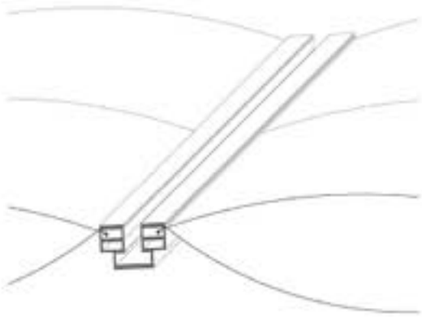
Agriculture

Composting

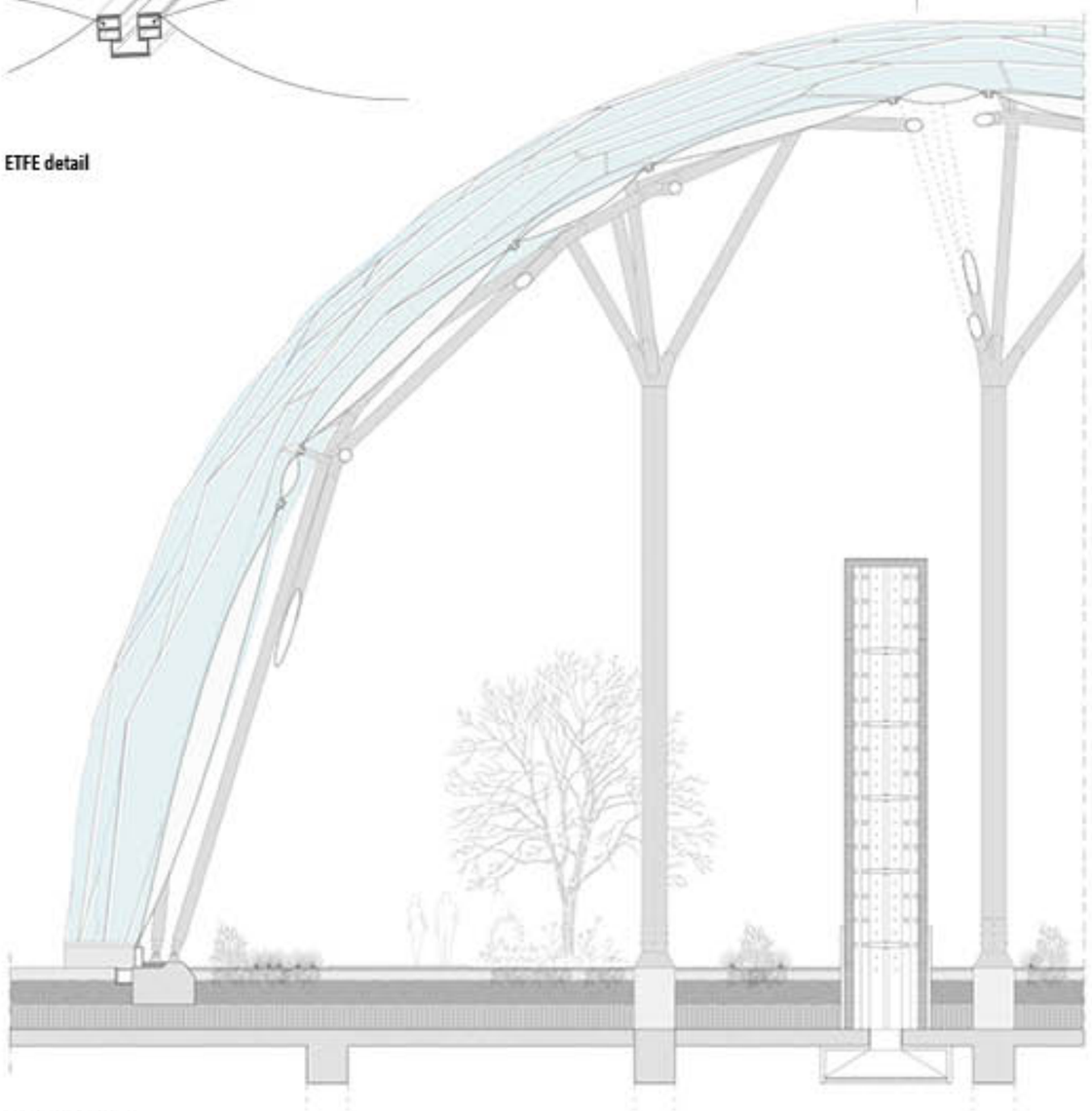


Solar energy

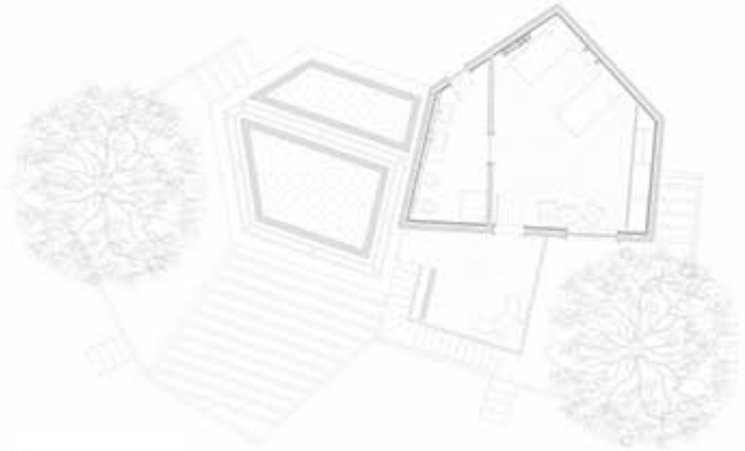
Inside views



ETFE detail



Detailed section



First floor plan

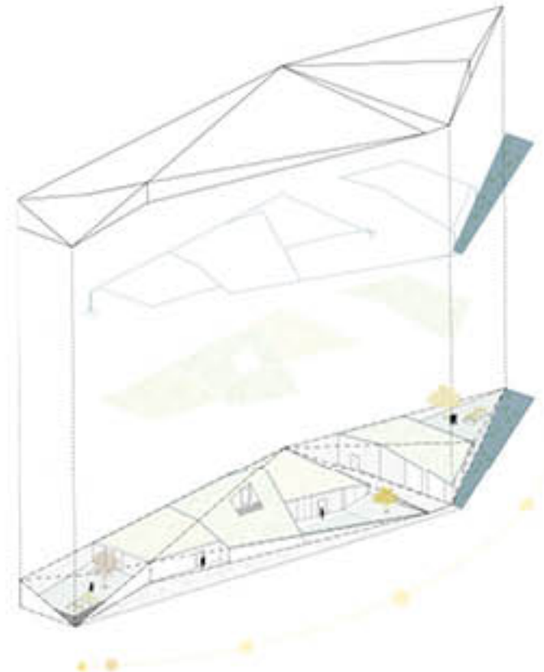
Ground floor plan

Building section

SOLAR PATIO HOUSE
Milan, Italy

Solar Patio House is proposing an innovative urban system that integrates productive, educational, residential and social functions together. The sun is the primary energy source for food production, a powerful renewable energy, as well as a catalyst for social relationships. In this project it is the most important element taken into consideration.
Starting from the solar analysis of the tectonic structure of the area, the complex is organized following the sun path: the slopes oriented to gain the maximum solar radiation are used for food or energy production as well as for social purposes, while those facing north are dedicated to water treatment.
The entire system is designed to build a new urban model able to integrate different typologies of spaces, in a gradual transition from the most public, the promenade, to the most private one, the inner patio, connected through a common courtyard. Shared among the housing units, the courtyard is important not just from an energetic point of view but also to enhance the social relationships among neighborhoods. Every edge is manipulated and modified by the shadows generated in different moments of the year together with the inner rhomboidal excavations of each single unit.
The Inner functional program of the houses is distributed according to the sun path, meaning that the most irradiated parts become the living spaces and the shaded ones the bedrooms, but everything faces the most important element of the complex, from which the light comes: the patio.

Susanna Vissani

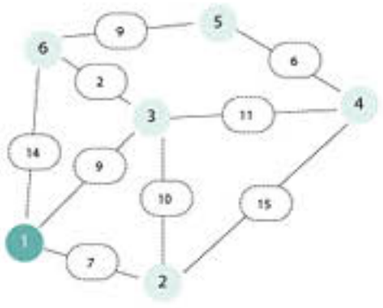


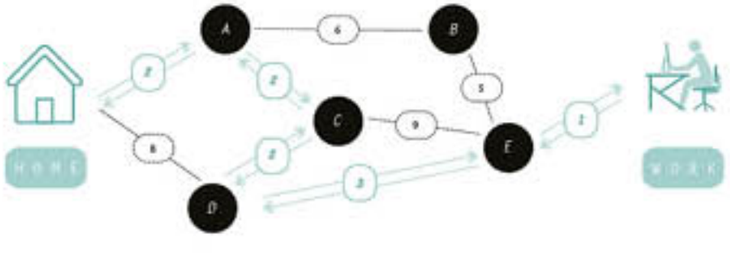
How can human movement shape the space?

Edsger Dijkstra

Dijkstra ALGORITHM

The aim is to FIND THE SHORTEST PATH BETWEEN TWO POINTS, one departure and one a r r i v a l with the method we can get not only the shortest path between a starting point and a destination but the *shortest-path tree*, that is, all the shortest paths between a starting point and all other points of the network.



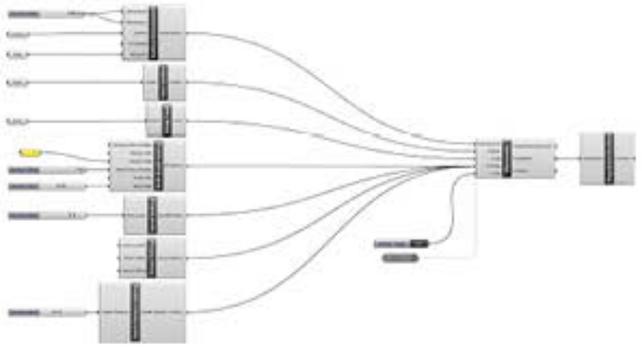


Physarum polycephalum

Heather Barnett
artist | TED contributor

So where does that intelligence lie?

/ SOLAR PATIO HOUSE / Computational strategy

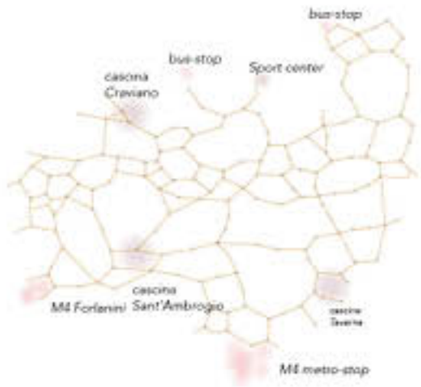


1 - Growing from point-emitters

2 - Discovering through sensors

3 - Reaching point attractors

4 - Spreading in the city

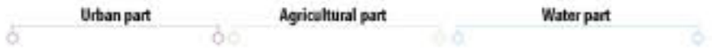


/ SOLAR PATIO HOUSE / Invisible forces

Noise map

Topography map

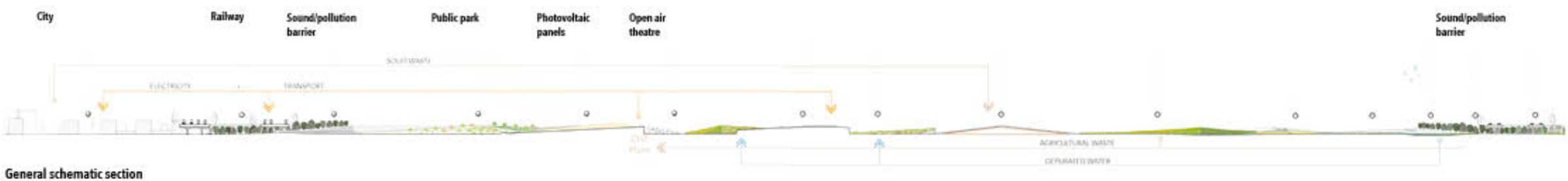
Flooding map



Legend:

- Forest
- Phytoremediation
- Wetland
- Biomass
- Food production
- Urban green rooms

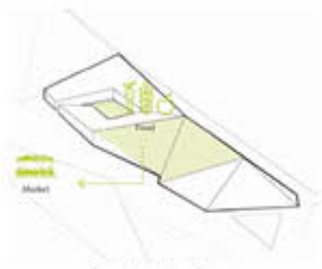
Functional diagram



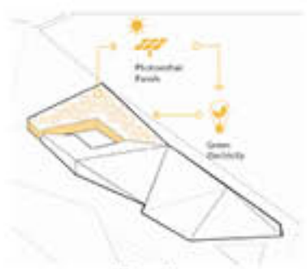
General schematic section

/ SOLAR PATIO HOUSE / Building development

Masterplan

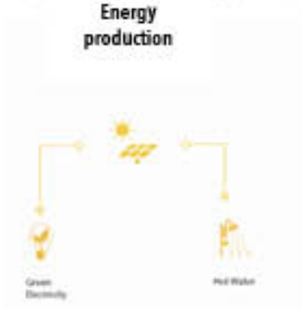


Food production



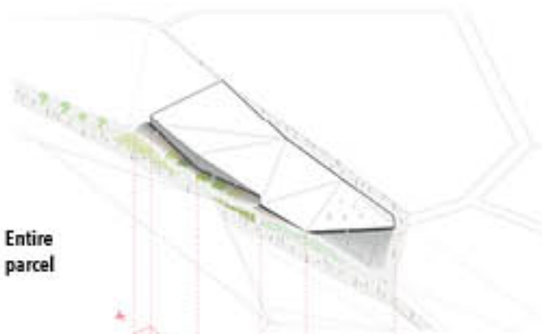
Energy production

Water / compost production



/ SOLAR PATIO HOUSE / Program development

Entire parcel

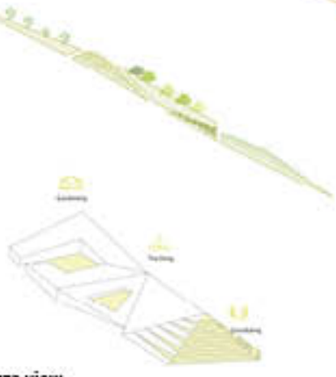


Cutting public spaces

Main paths

Urban green rooms

Green system



Public piazza view

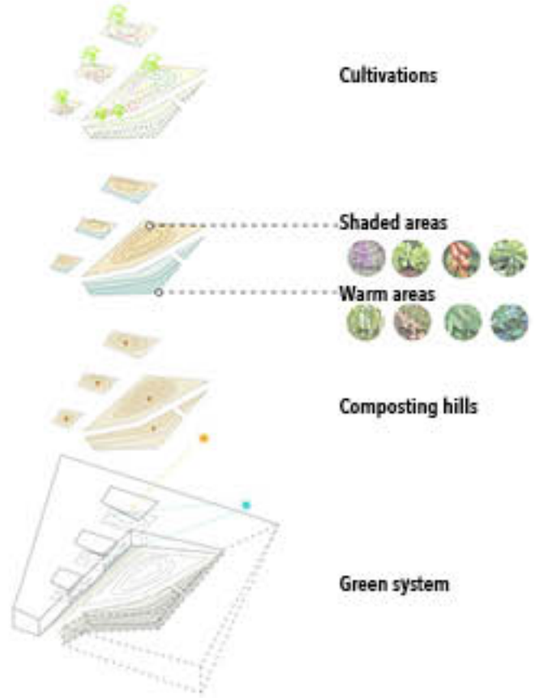
Gradient of spaces: from public to private

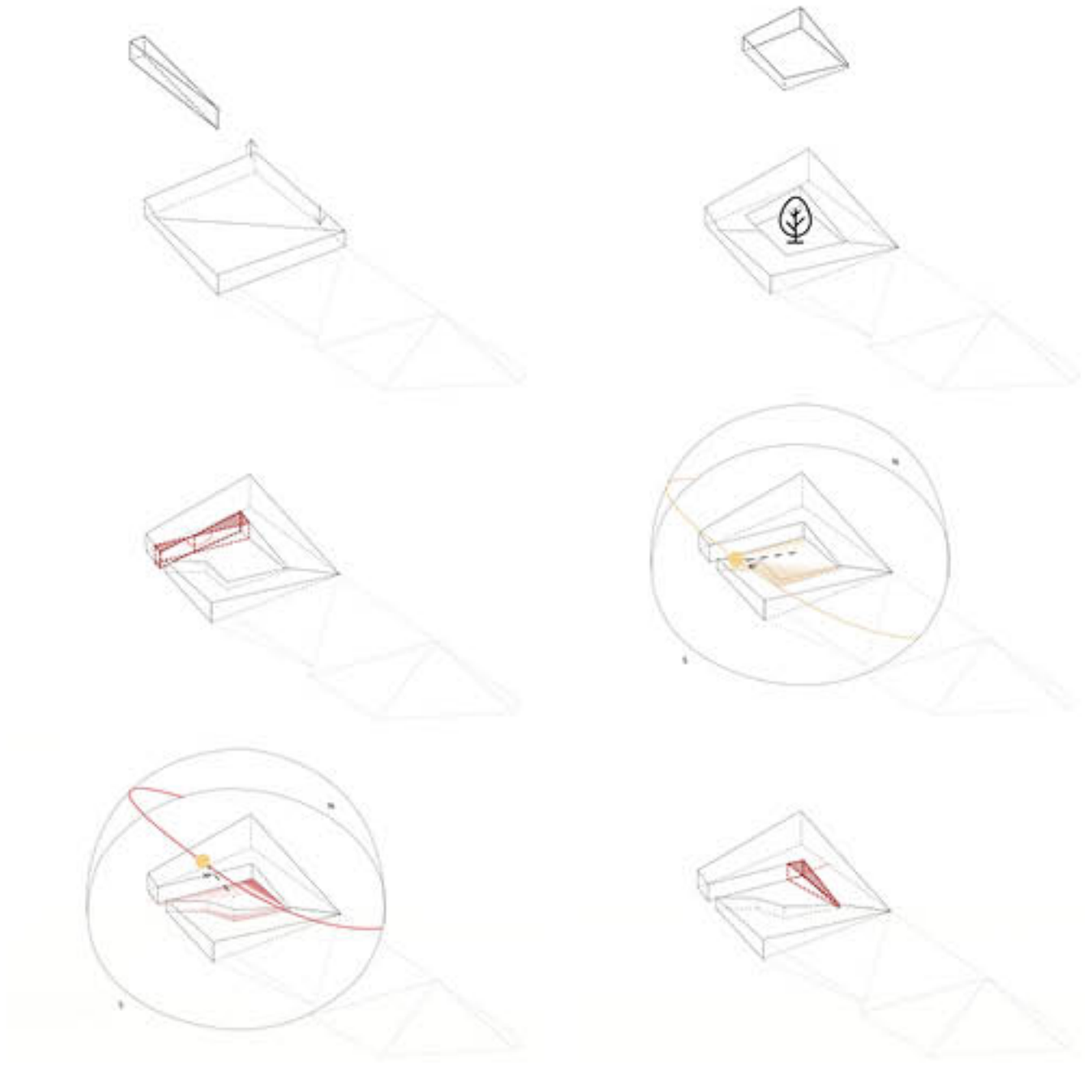
Public piazza view

Green system view


A
A
B

Parcel unit


Cultivations
Shaded areas
Warm areas
Composting hills
Green system

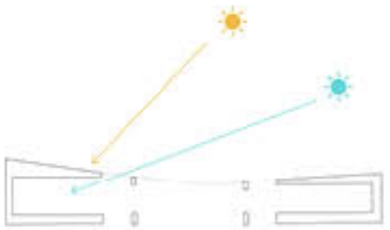


Building section

Electricity production

Water recycle

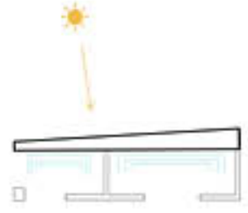
Natural ventilation



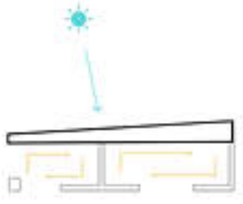
Sunlight radiation

Visibility

Interior climate



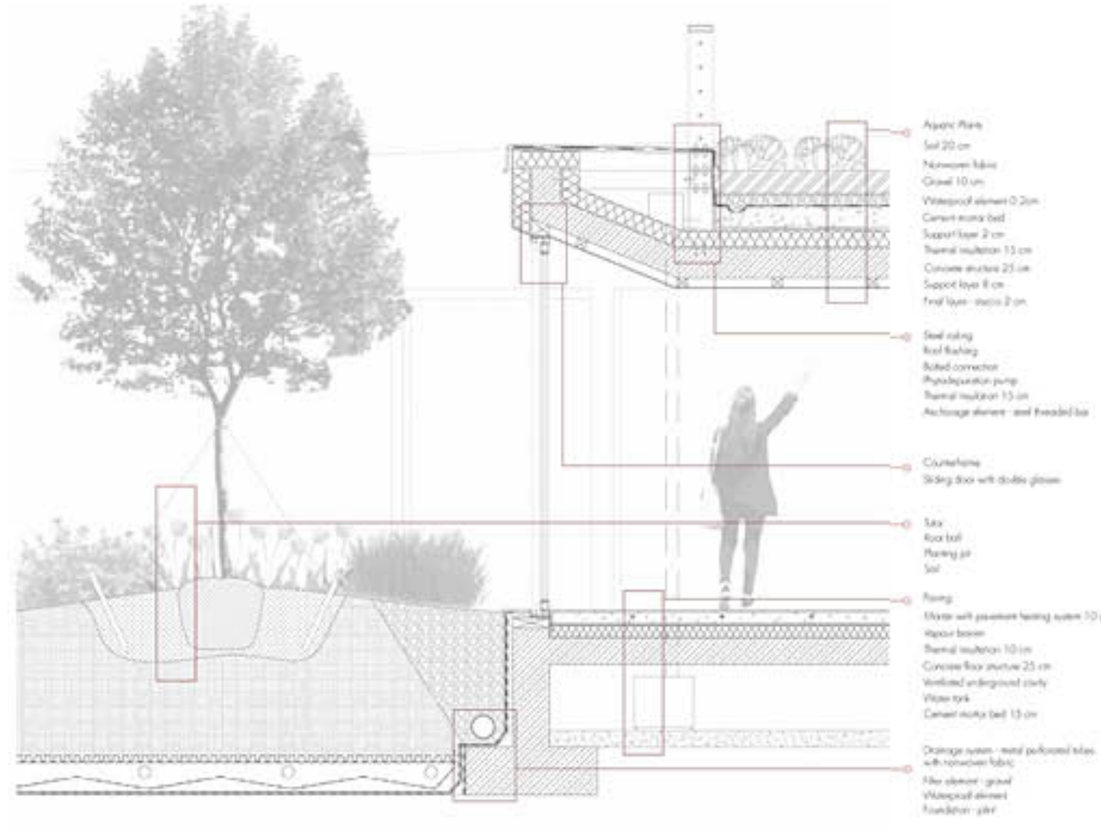
Thermal mass storage

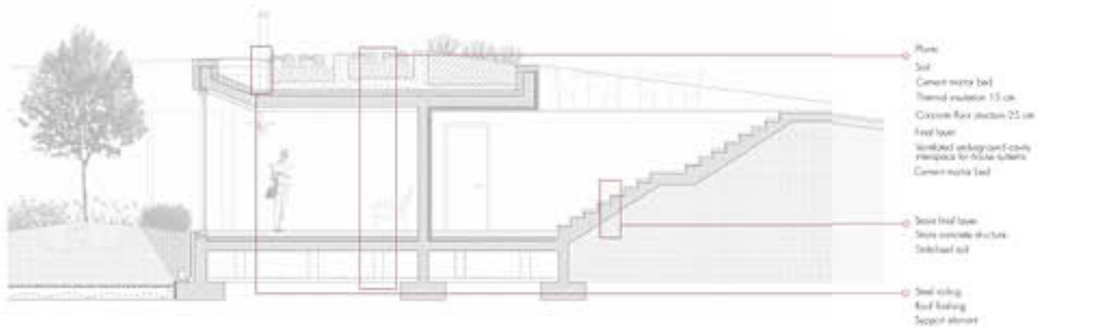


Insulation thermal mass

Building section

/ SOLAR PATIO HOUSE / Construction details





Detailed section

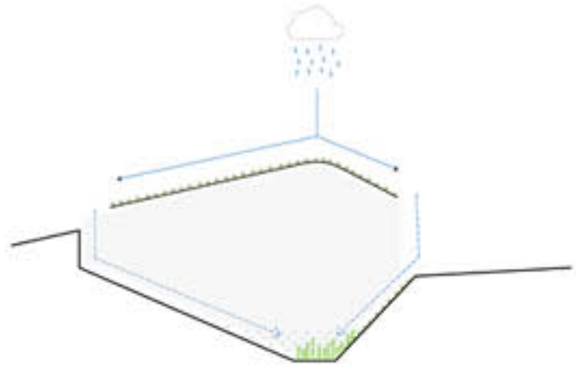
/ SOLAR PATIO HOUSE / Interior space

Inside views

RAINY HOUSE
Milan, Italy

The Rainy House project focuses on co-generation design strategies for a sustainable urban metabolism.
Might we think to reuse rain water within a water recycling system with seepage irrigation to feed all the vegetable for each individual residential unit? How much water does a square meter of vegetable garden need per day? How much rain water does Milan offer per year and how many liters of water does a person use per day for its domestic uses?
Once we understand all these components, we can focus on the genius loci of the landscape.
The wetland area holds aquatic plants which they might be used to purify rain water, to irrigate and to raise food locally, but in order to create that metabolism, can we image to transform buildings in water channels? The answer might appears unrealistic, but the Rainy House tries to propose a real answer.
The house is shaped with different slopes and it stands from the ground with a steel light structure. A green roof starts the process of purification and an aquaponic system purifies rain water naturally with no pesticides.
An harvesting system control the flows and split the purified water for the domestic uses and for irrigation.
The inner shape is derived from a geometrical relationship between the triangular shape of the project area and fixed point control curves. The soil is dug up till the heart of the house, the place to live.
The limit that defines the covered space from the outside is a green sheet deformed from the angle of the solar rays in order to allow maximum solar irradiations inside the interior spaces.
The shape derives from a process called geometric stitching method curves which relates again to the geometrical triangular shape of the project area. Geometry and environment together shape the Rainy House.

Alberto Lunardi



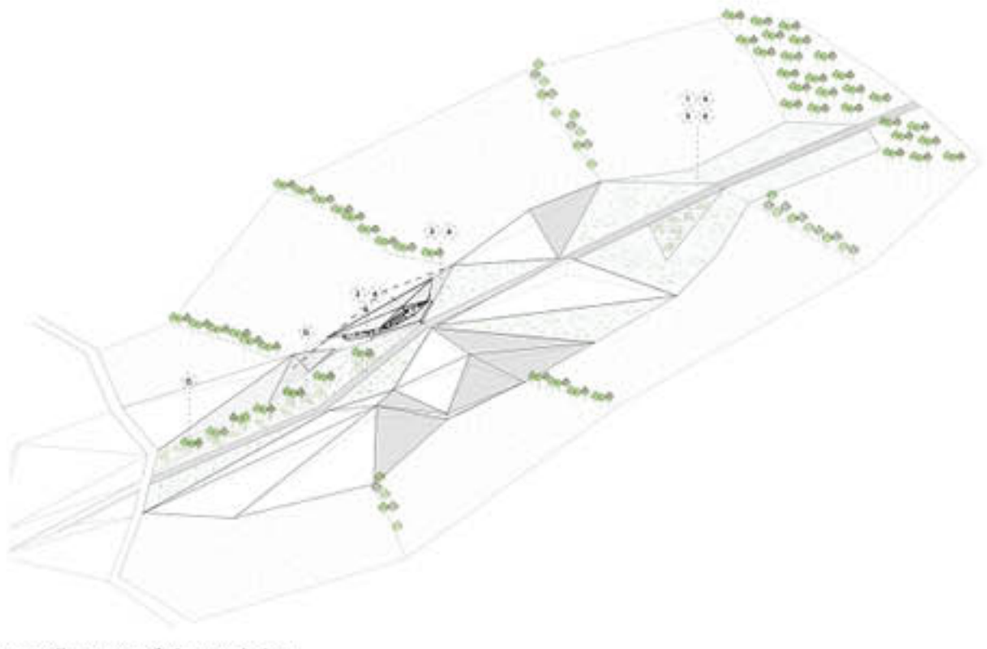
Transforming the building into a water channel

1. Water lily
2. Water soldier
3. Reed
4. Bur-reed
5. Sedges
6. Sweet flag

Purifying water using aquatic plants

Constructed wetland in the sustainable landscape

Raising local food using water for irrigation



Axonometric illustration of the metabolism

Trees absorb CO2, removing and storing the carbon while releasing the oxygen back into the air. By reducing the energy demand for cooling the house, we reduce carbon dioxide and other pollution emissions from power plants.

Windows (glazing) on the southern facing side of the building in order to absorb the sun's heat energy to warm a building during the winter. Trees placed strategically around a single-family home can cut summer air conditioning needs by up to 50%.

With green roofs, water is stored by the substrate and then taken up by the plants from where it is returned to the atmosphere through transpiration and evaporation.

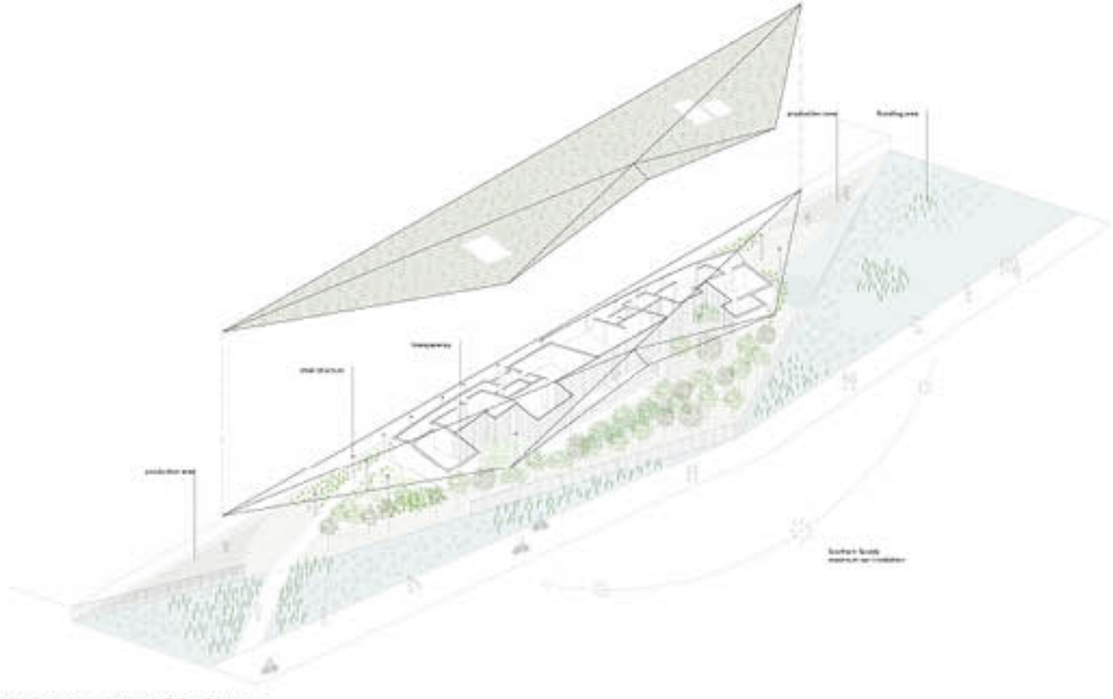
Saving energy with low technologies

Steel structure | Light house that can be recycled.

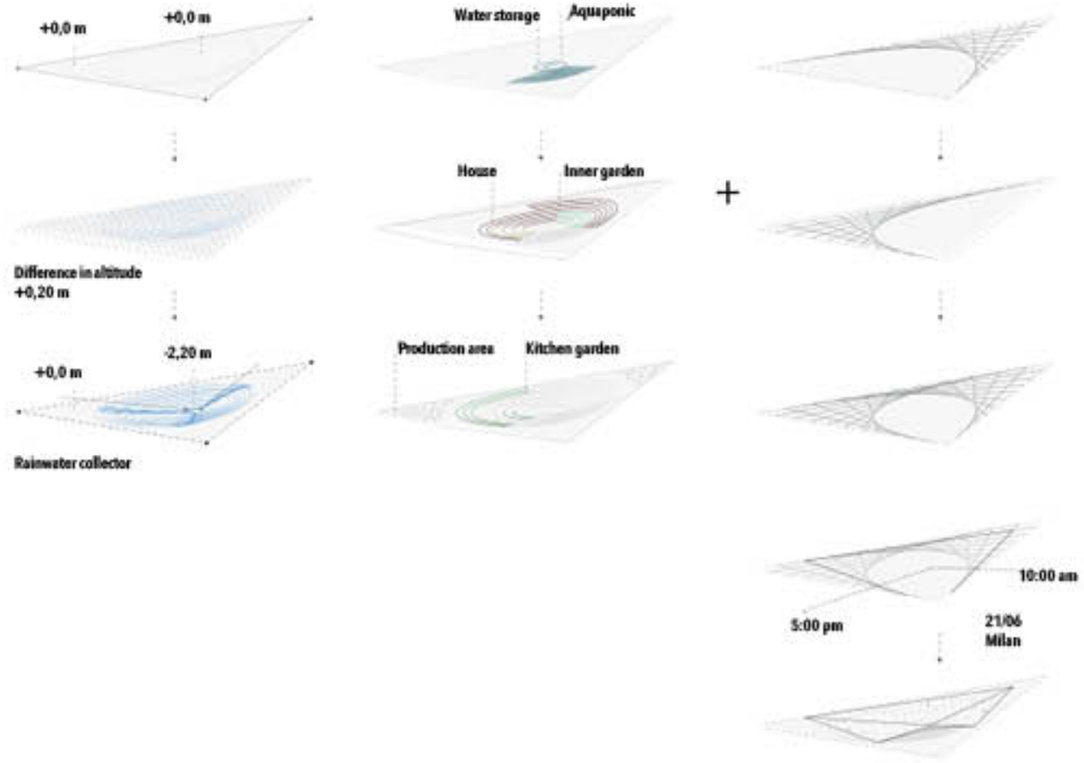
Aquaponic system. Naturally organic. No pesticides, chemical or mined fertilizers are used as these would kill the fish.
Produces 4 to 10 times more vegetables than conventional agriculture.

150 sqm production area | vegetable garden.

Producing food with fishes and soil

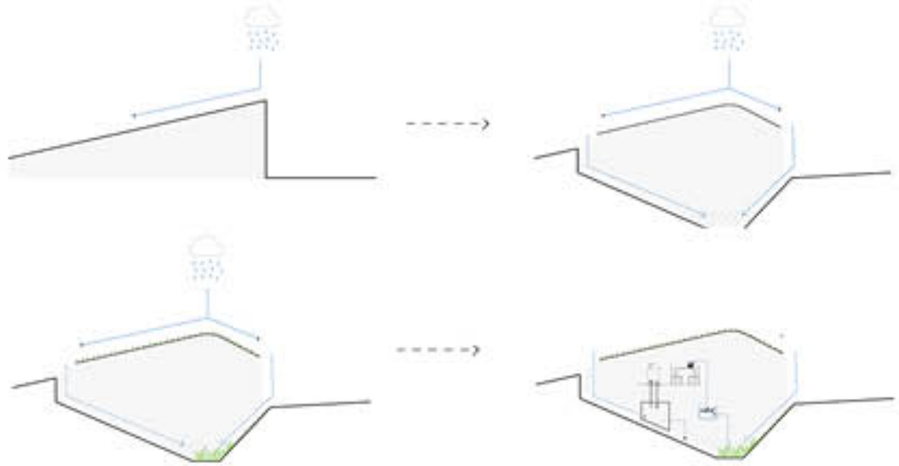


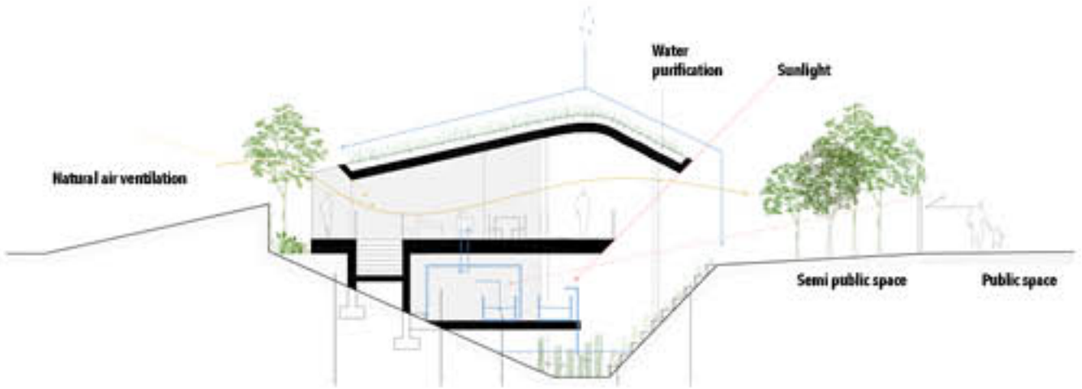
Axonometric view of the house


+0,0 m
+0,0 m
Difference in altitude
+0,20 m
-2,20 m
+0,0 m
Rainwater collector
Water storage
Aquaponic
House
Inner garden
Production area
Kitchen garden
10:00 am
5:00 pm
21/06
Milan


Production area
Entrance
Kitchen gardens
Fruit trees
Water plants
Inner garden
Production area
Wetland
Flooding area
Public area

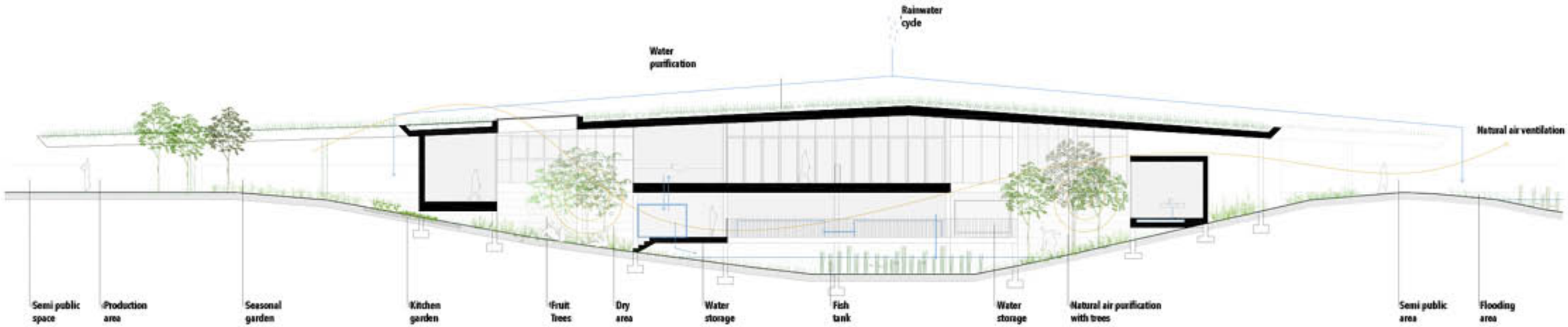
Plan

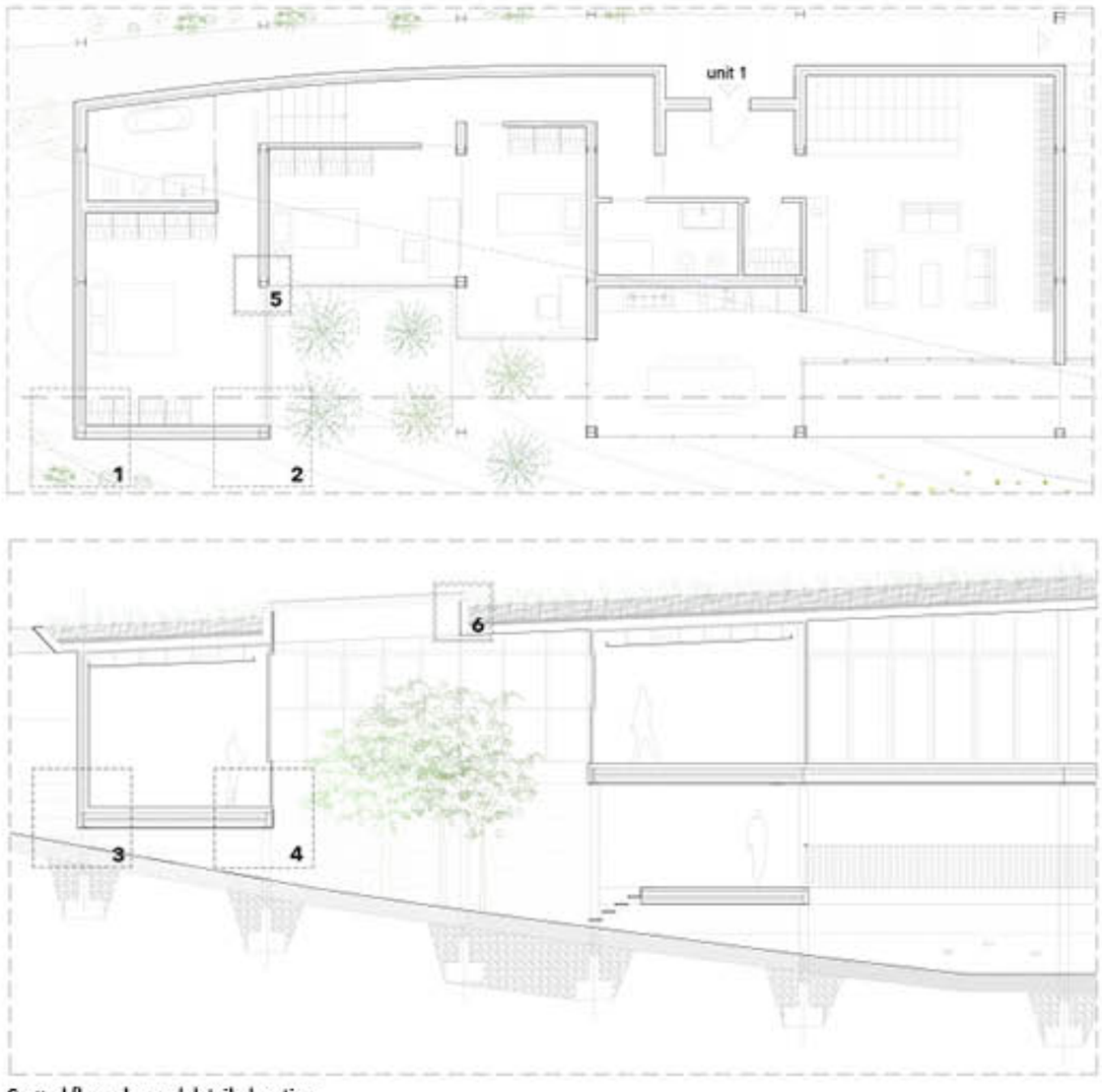



Water
purification
Sunlight
Natural air ventilation
Semi public space
Public space


Flooding area


Raising water level

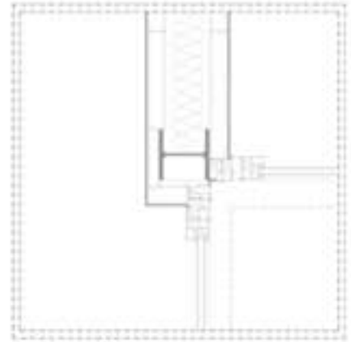

Rainwater
cycle
Water
purification
Natural air ventilation
Semi public
space
Production
area
Seasonal
garden
Kitchen
garden
Fruit
Trees
Dry
area
Water
storage
Fish
tank
Water
storage
Natural air purification
with trees
Semi public
area
Flooding
area



Ground floor plan and detailed section

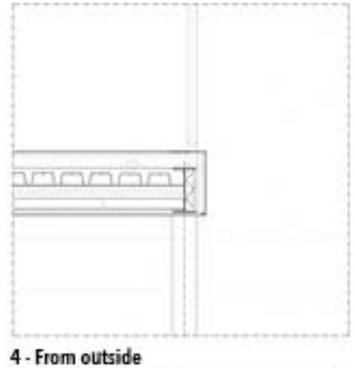
1 - The hidden structure

2 - From outside
Cor-ten steel cladding, vertical batten xed back to steel stud, void for air ventilation, rigid foam insulation board, steel stud, cladding panel, plaster board.



5 - From outside
Cor-ten steel cladding, vertical batten xed back to steel stud, void for air ventilation, rigid foam insulation board, steel stud, cladding panel, plaster board.

3 - Suspended floors



4 - From outside
Cor-ten steel cladding, horizontal batten xed back to steel stud, void for air ventilation, rigid foam insulation board, deck plate, screed, floor heating, flooring.

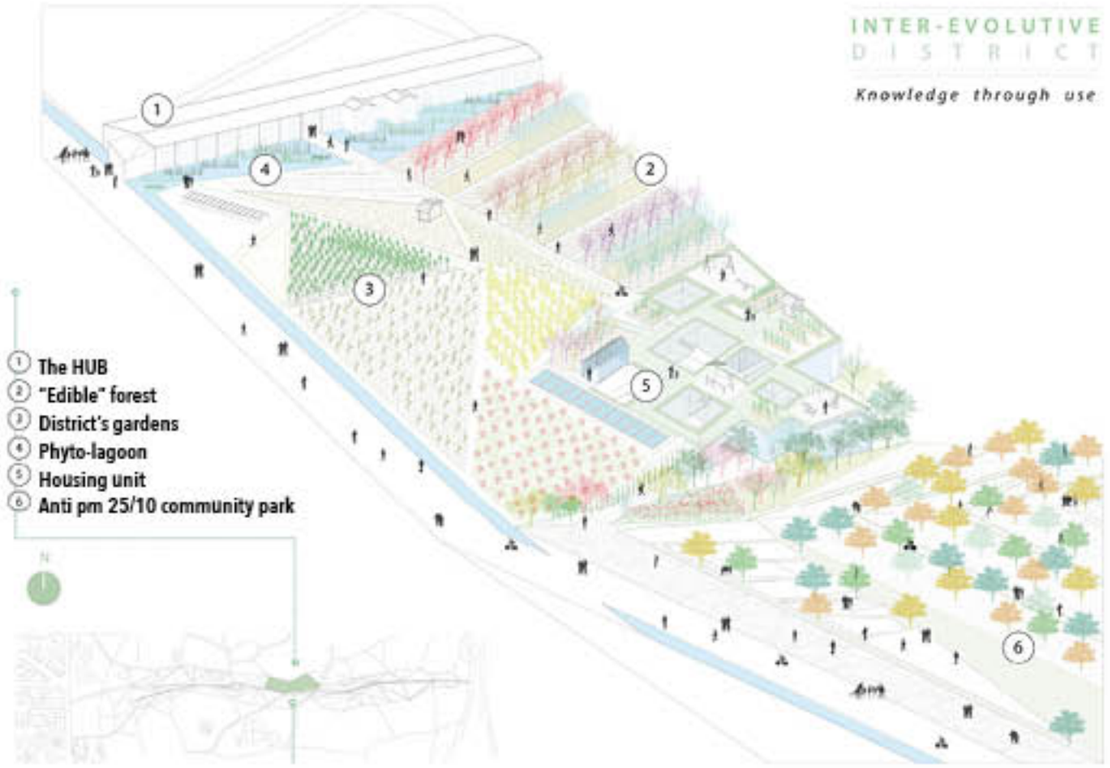
6 - Skylight + Green roof
Aluminum window frames, metal flashing. Vegetation, soil, gravel, drainage board, roof membrane, concrete slab.

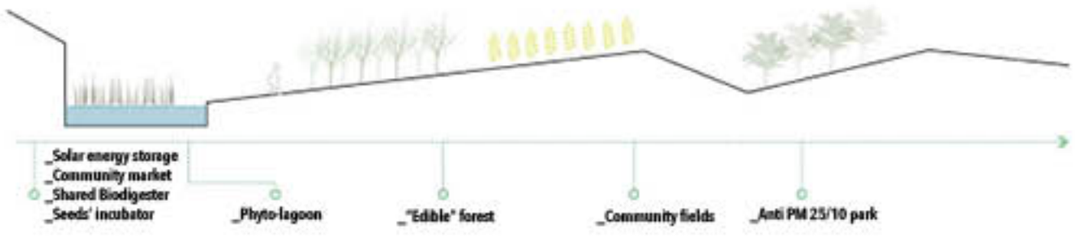
INTER-EVOLUTIVE DISTRICT
Milan, Italy

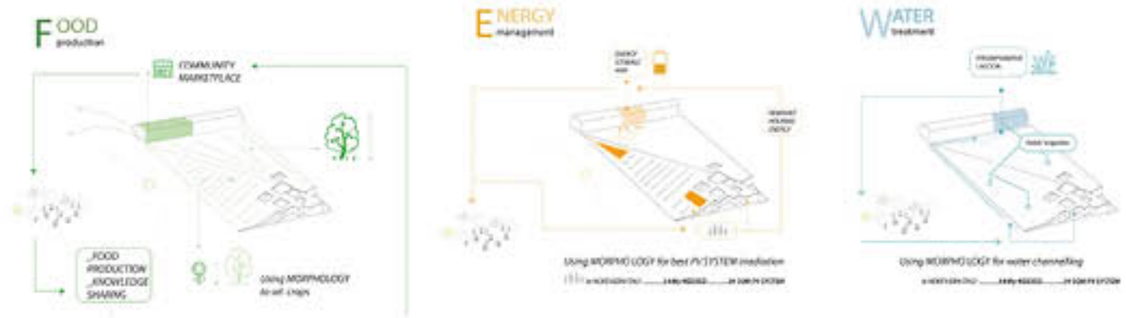
The project is part of a masterplan built on movement and re-configuration of space. Accordingly, the inter-evolutive district and its house, translate the concept of landscape as an instrument for knowledge, into an underground and intimate experience. The district is intended as a virtuous closed system, made out of different FEWs collaborating and interacting between each other.
Different public and gathering functions are also added, in order to make this space a place in which people can spend time, not only pass by. The program is made by six different elements: a Hub, an edible forest, community gardens, a phyto-lagoon, a house unit, all facing an anti PM 10/25 community park. The house unit is developed partially under the ground level and partially above it, but it embodies a tight connection between -1 floor, and a liveable roof.

The continuity of the landscape is one of the driving forces of the whole project, with the aim of camouflaging the anthropic environment and merging it with the green system of the marterplan.
With a re-configurable zoning and a flexible space design, the house is developed into a relationship between room and open space, as a matrix to define the program.
To every room corresponds a certain courtyard, with a different landscape program for everyone. Using the slope of the parcel as a roof, the house is developed in platforms, connected by stairs, in which we are able to perceive the entire fabric from ever changing points of view.
These two elements of the program are intended to be a matrix for all the masterplan, trying to merge in themselves a closed-cycle system which can be replicated in other parcels.

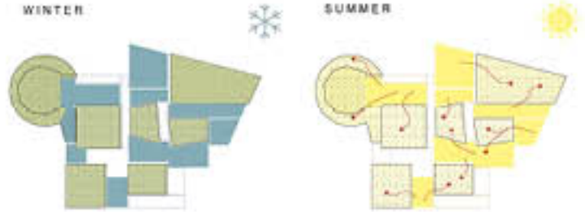
Giovanni Nardi







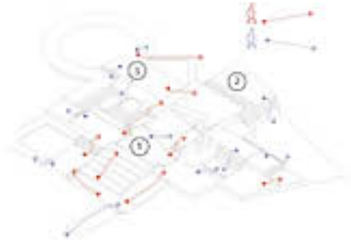
"Green Rooms" / Every space conceived as a unit made of thematic courtyard+room



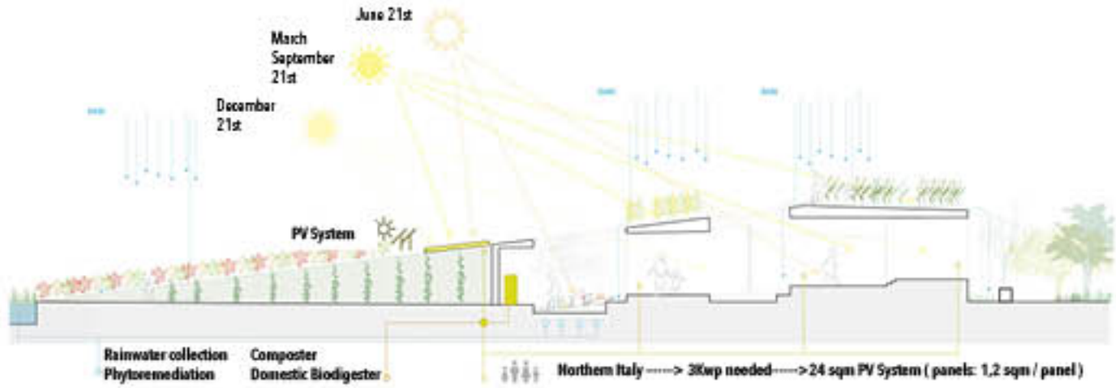
Morphology as an instrument
Different levels for different activities

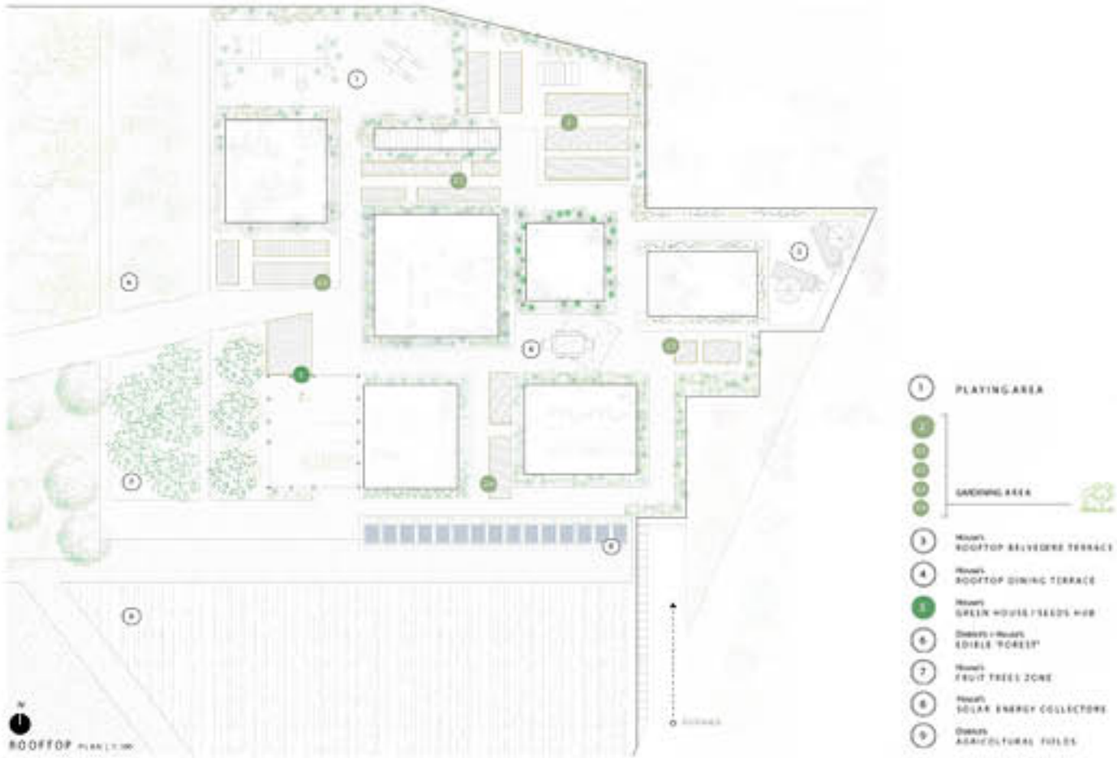
Points of view

From public to private



Circulation / Interactions

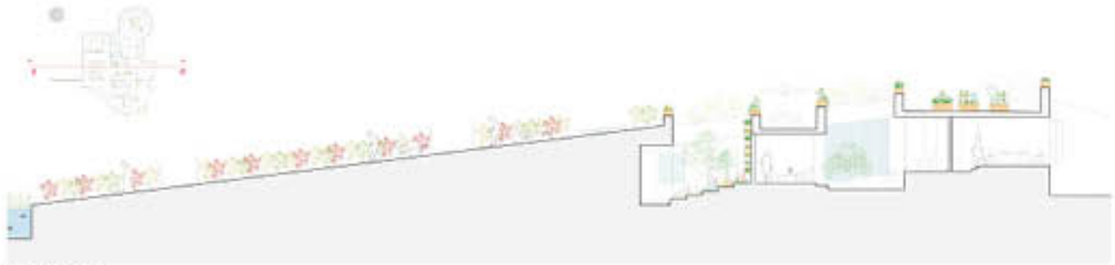




External view

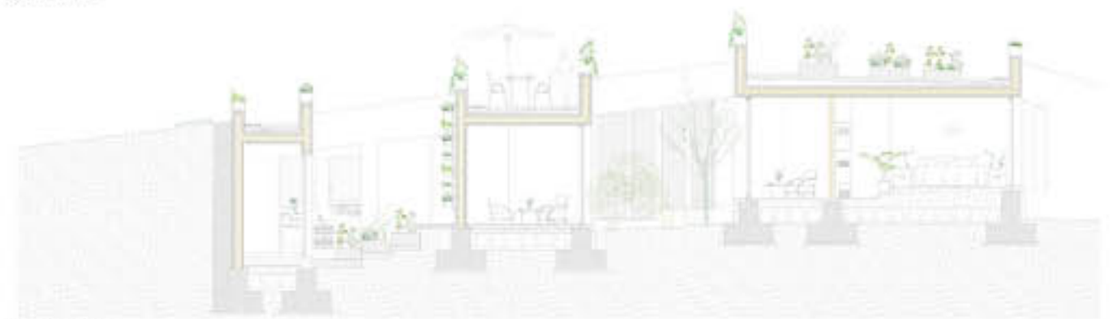
External view

Section A-A'



Section B-B'

Section C-C'



Detail section

Towards the living room

From the kitchen

From the kids' running corridor

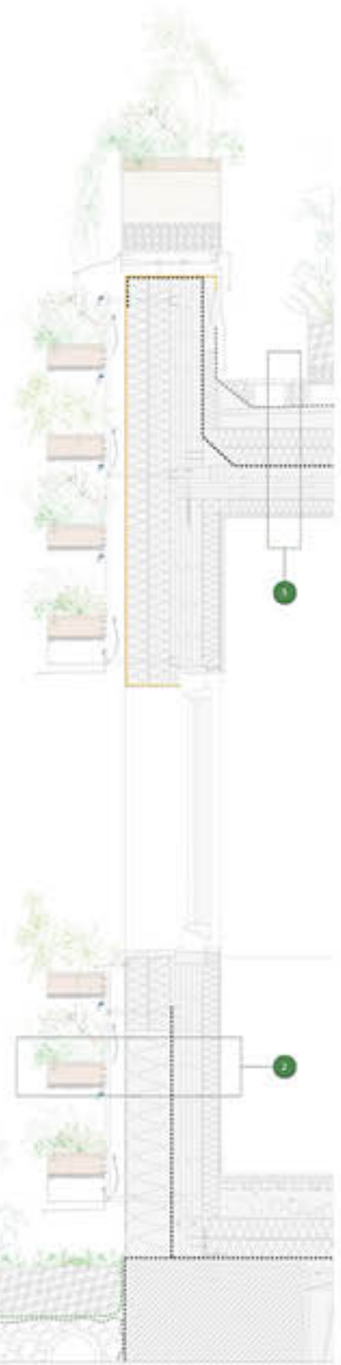
Throughout the master bathroom

1_ From inside to outside:

- Wood paving 2 cm
- Clad plaster layer 1,25 cm + 1,25 cm
- Dry sand
- Under floor heating system
- Lightweight system's screed
- Polystyrene foam insulation
- Bituminous layer
- Ventilated igloo for concrete slab
- Reinforced concrete pillar

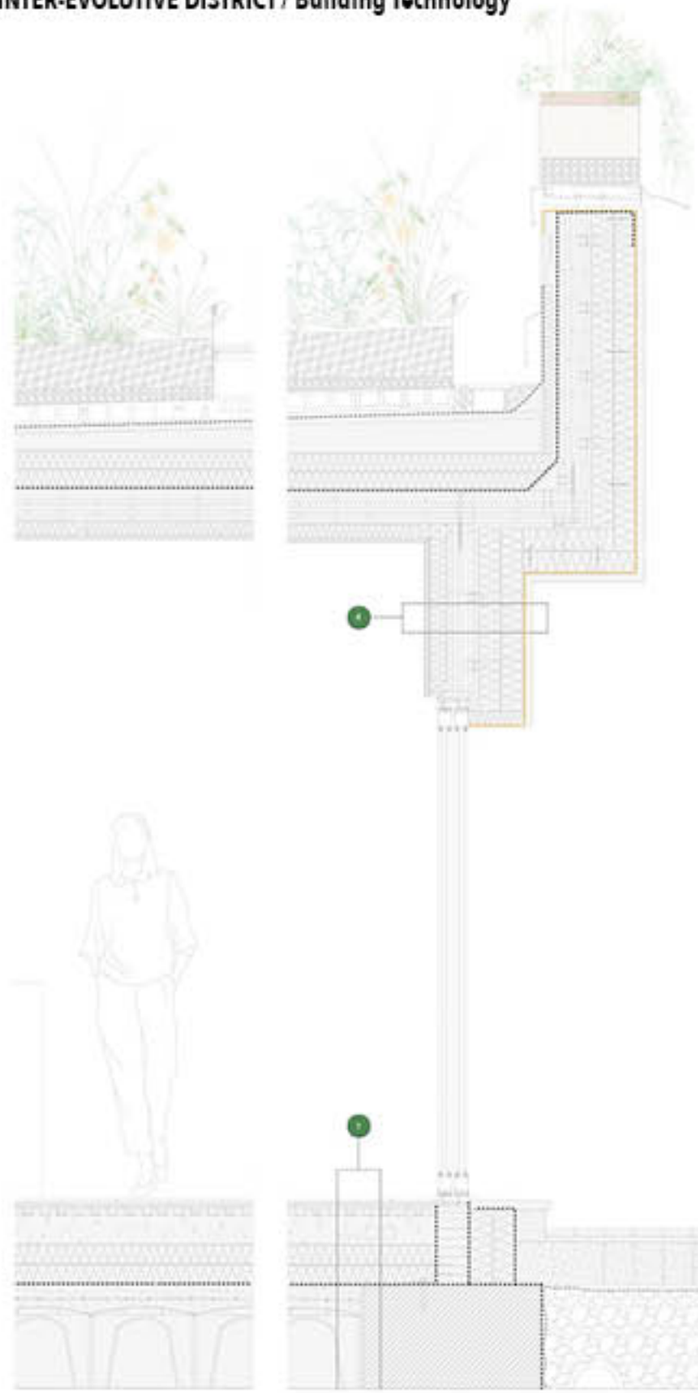
2_ From inside to outside:

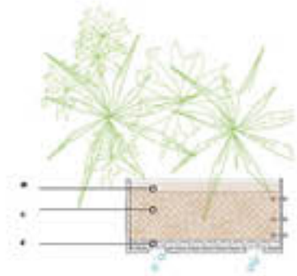
- Interior finishing
- Insulation (systems' cavity)
- X-LAM 12 cm
- Waterproof membrane
- Waterproof insulation
- Waterproof plaster
- Steel structure for vase
- Irrigation system joint to the steel str.



Detailed section

/ INTER-EVOLUTIVE DISTRICT / Building Technology





3_ From inside to outside:

- Interior finishing
- Clad plaster layer 0,95 cm
- Wood fiber insulation 6 cm
- X-LAM 14 cm
- Vapor barrier
- Polystyrene foam insulation
- Wooden planks
- OSB panal 1,8 cm
- Water collection / drainage rigid element
- Filter layer
- Drainage channel

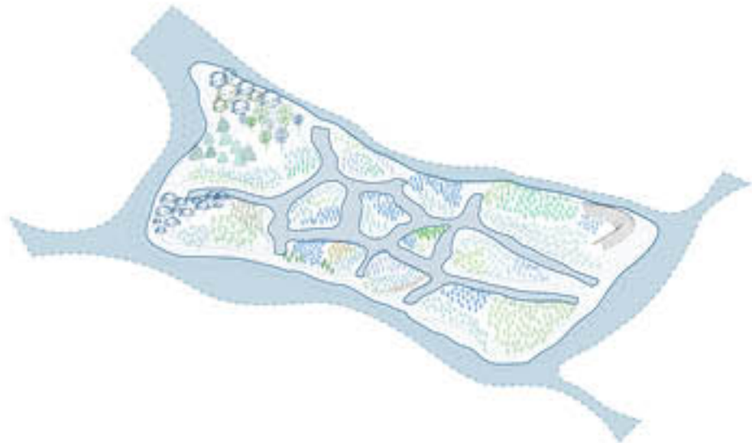
4_ From inside to outside:

- Interior finishing
- Clad plaster layer 0,95 cm
- Wood fiber insulation 6 cm
- X-LAM 12 cm
- Wood fiber insulation 8 cm + 8cm
- Wind + water sealing
- Wood planks for outer covering

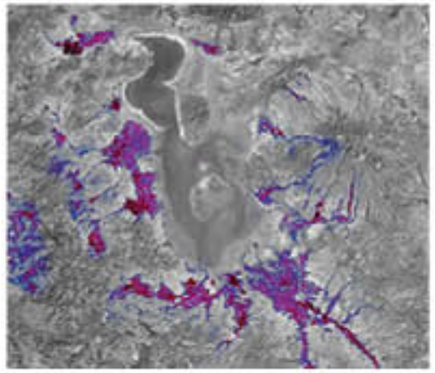
SALT SPRAWL
Lake Urmia, Iran

Salt Sprawl shows alternative ways of thinking, designing and manufacturing architecture. It sees the building and the landscape as living organisms which are the result of energies they are surrounded by and that work with them.
The project is located in the biggest saline lake of the world, Lake Urmia (Iran), which is characterized by arid climate and a wide difference between day-time and night-time temperature.
Surface flow and direct rainfall are the main water sources of the lake, but as a result of increasing temperatures and human activities, the surface of the lake has been decreasing by 80% in the last 15 years. Environmental resources (sun, water and salt) are the foundations of the project. Starting from the consequences of water scarcity, natural evaporation and salt deposit, the aim is to re-establish a balance between architecture and environment. The ecosystem approach tends to reduce the amount of water used for agriculture by shaping the soil and by ensuring natural drainage. Furthermore, the FEW strategy connects architecture and environment: each parcel provides a system of salt/desalinated water canals which restores the water cycle and different agriculture typologies which follow soil salinity. In this process, the building acts as a filter which uses the leftover of the evaporation process - salt - both as renewable energy source and as a construction material.
The building prototype is inspired by two basic concepts: form follows energy and a passive climate structure. The envelope follows the solar radiation analysis and results in a paraboloidal shape in section and in elevation, which is designed to maximize/minimize sun energy collection. Considering sun path, the wall thickness changes along the section in order to absorb solar radiation along the day and release it during the night.
The house is made of a timber structure and prefabricated salt panels which improve the conditions of inhabitation; salt porosity and reflectance, in fact, work with the differences of temperature outside and with the solar shape of the building improving internal comfort conditions.

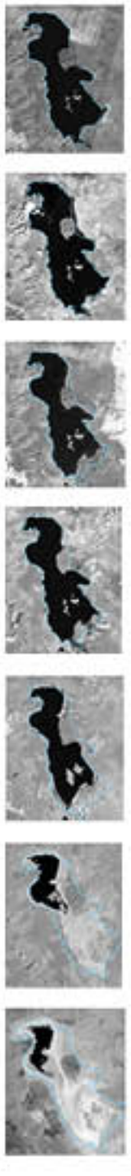
Mara Fraticelli



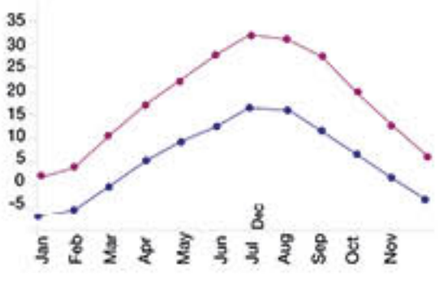
Lake Urmia is the largest permanent hypersaline lake in the world and was designed a UNESCO Biosphere Reserve in 1976. The lake is an important habitat for many species of reptiles, amphibians, mammals and migrant birds. The surface area has been estimated around 6100 km2, but since 1995 it has generally been declining and was estimated from satellite data to be only 2366 km2 in August of 2011.



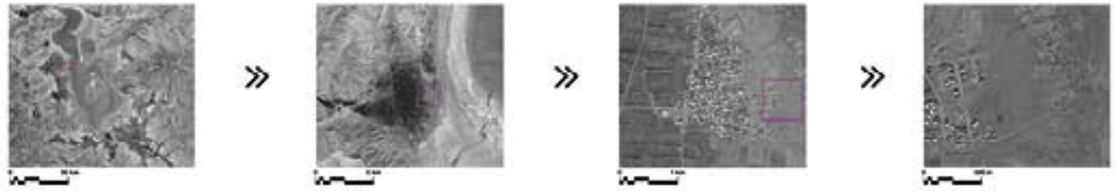
Water management
The watershed of the lake is an important agricultural region with a population of around 6.4 million people; an estimated 76 million people live within a radius of 500 km. As a result, the lake's water level has dropped by as much as 9 meters over the last two decades.

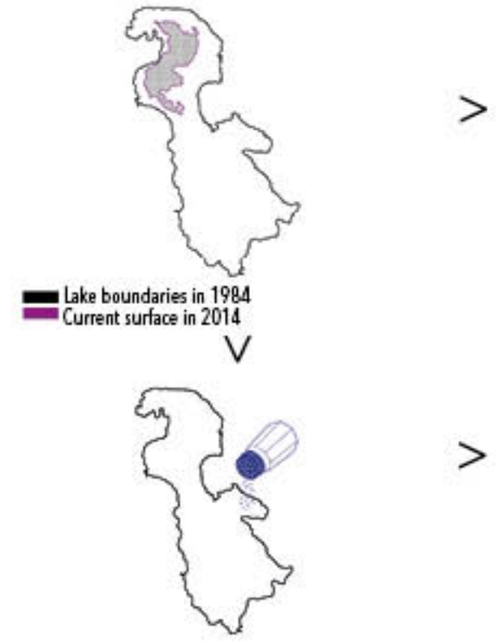


Damn construction
The the dyke-type "Kalantari" highway connects the two major cities across the lake and bisects the lake into northern and southern part. As a consequence, natural water circulation, sedimentation pattern and evaporation rates have been significantly altered and high levels of heavy metal contaminants have been introduced to the lake environment



Increased temperature
The average annual temperature increased of 7° from 2000 to 2011. The annual rainfall within the basin from 1967 to 2006 was 235 mm, with variation between about 440 mm in 1968 to less than 150 mm in 2000. The arid to semi-arid climate of the basin means that agriculture is largely dependent on irrigation.

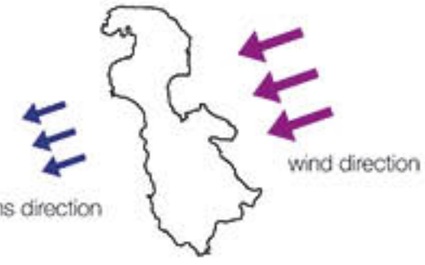




As lake levels decline, the exposed lake bed is left with a covering of salts, primarily sodium chloride, making a great salty desert on much of the 400 Km2 of lost surface area.

The concentration of salt in the lake passed from 200 g/L to 300 g/L with a red negative impact on growth rate, reproduction and mortality of phytoplancton and algae colonies.

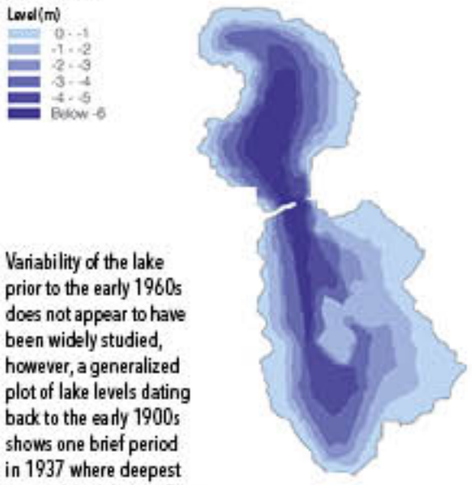
The high salinity has caused a severe decline in biodiversity (both species richness and biomass).The endemic Artemia Uromiyehna populations that live in a salinity level of 240 g/L have stopped hatching, except at the mouths of incoming streams where salinities are lower.



Exposed to wind erosion, the salt desert generates 'salt storms' with serious impacts on local agriculture as well as regional health causing respiratory illness, eye problems and throat cancer in the worst cases

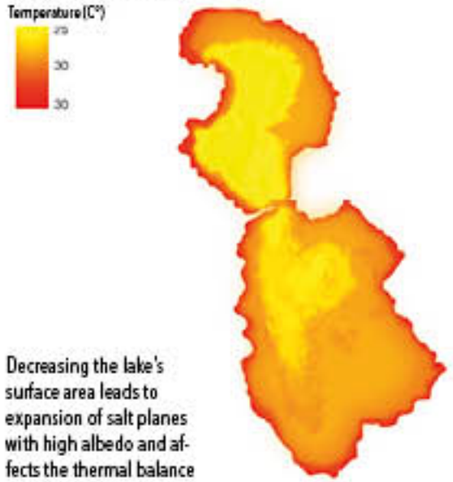
As a result, species that feed on brine shrimp have declined dramatically and migratory waterbirds have abandoned the area.

Water level

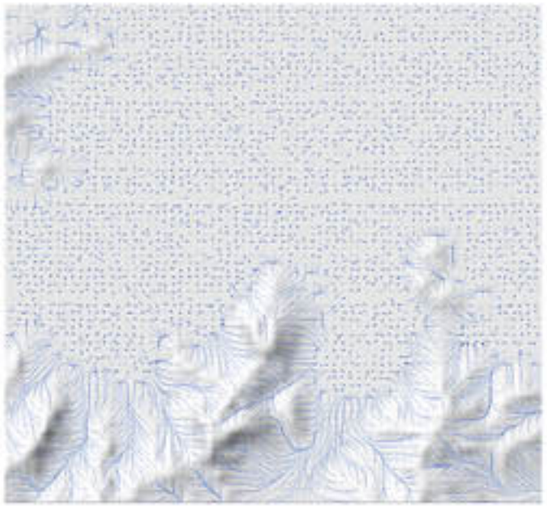


Variability of the lake prior to the early 1960s does not appear to have been widely studied, however, a generalized plot of lake levels dating back to the early 1900s shows one brief period in 1937 where deepest point of the lake was 7 mt under the surface level.

Summer average temperature



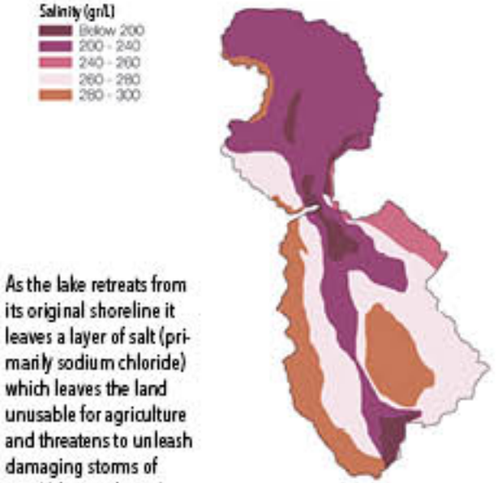
Decreasing the lake's surface area leads to expansion of salt planes with high albedo and affects the thermal balance of the atmosphere above the lake.



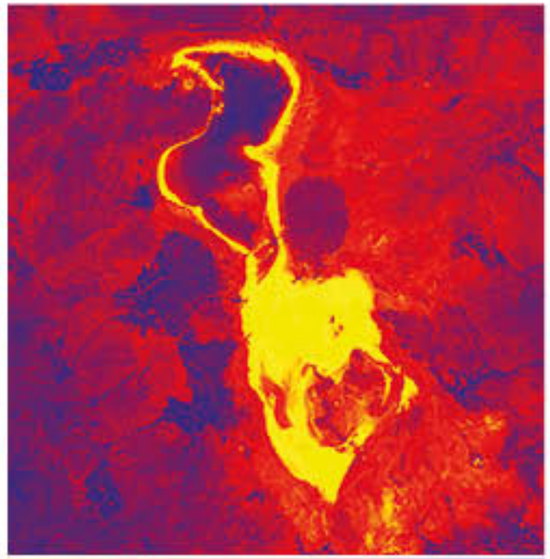
Water flow simulation

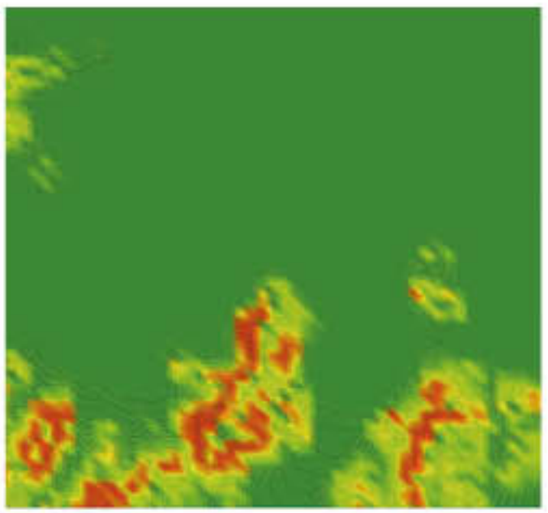
Contour lines

Salinity

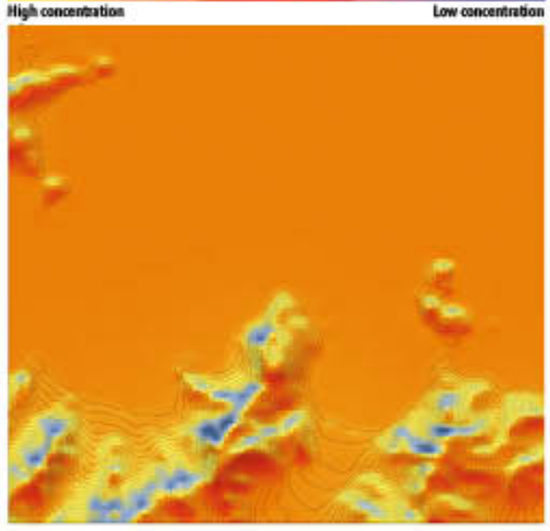


As the lake retreats from its original shoreline it leaves a layer of salt (primarily sodium chloride) which leaves the land unusable for agriculture and threatens to unleash damaging storms of wind-blown salt on the surrounding area.

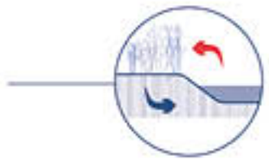




Slope gradient

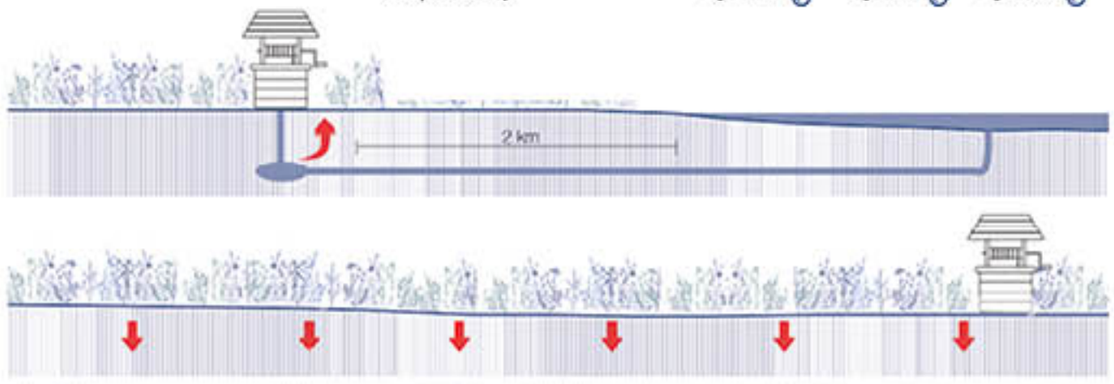


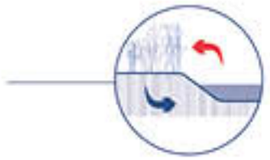
Annual solar radiation



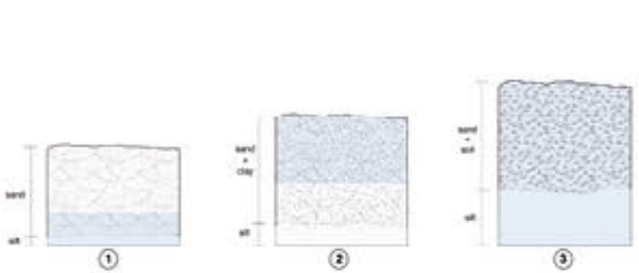
"Ecosystem approach"
The 'ecosystem approach' is a strategy for the integrated management of land and living resources that promotes conservation and sustainable use in an equitable way.

Agricolture-based economy / Cultivation of:





Different soil stratifications for different agriculture typologies / One of the main problem of the agricultural fields around the Urmia Lake is their soil composition - mainly sandy soil - that absorbs water very quickly and leaves the surface semi-dry. Furthermore, the typologies of plants cultivated should consider both the soil stratification (that means the way of draining water) and the salinity concentration of the soil itself. Because the provinces that surround the lake have an economy based on agriculture, it is important to find the right dimension of each lot in order to produce enough food and sell it.

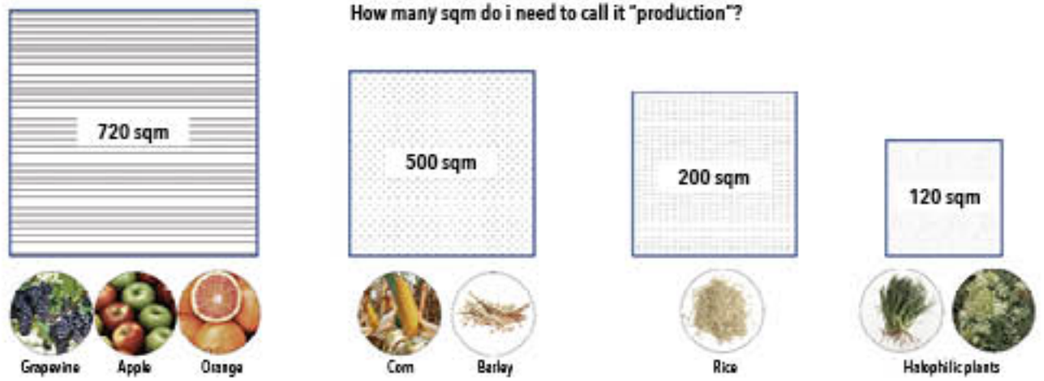


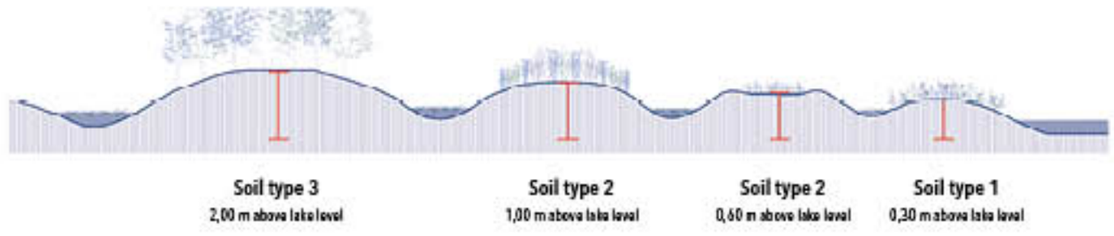
Type 1
low salinity

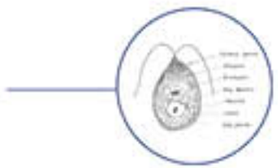
Type 2
medium salinity

Type 3
high salinity

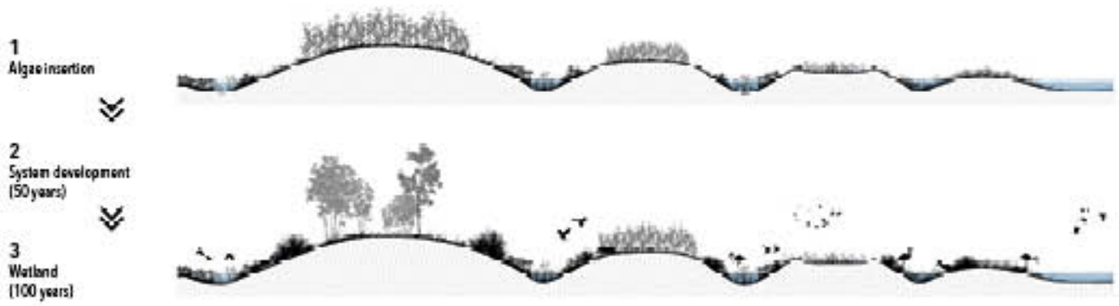
How many sqm do i need to call it "production"?

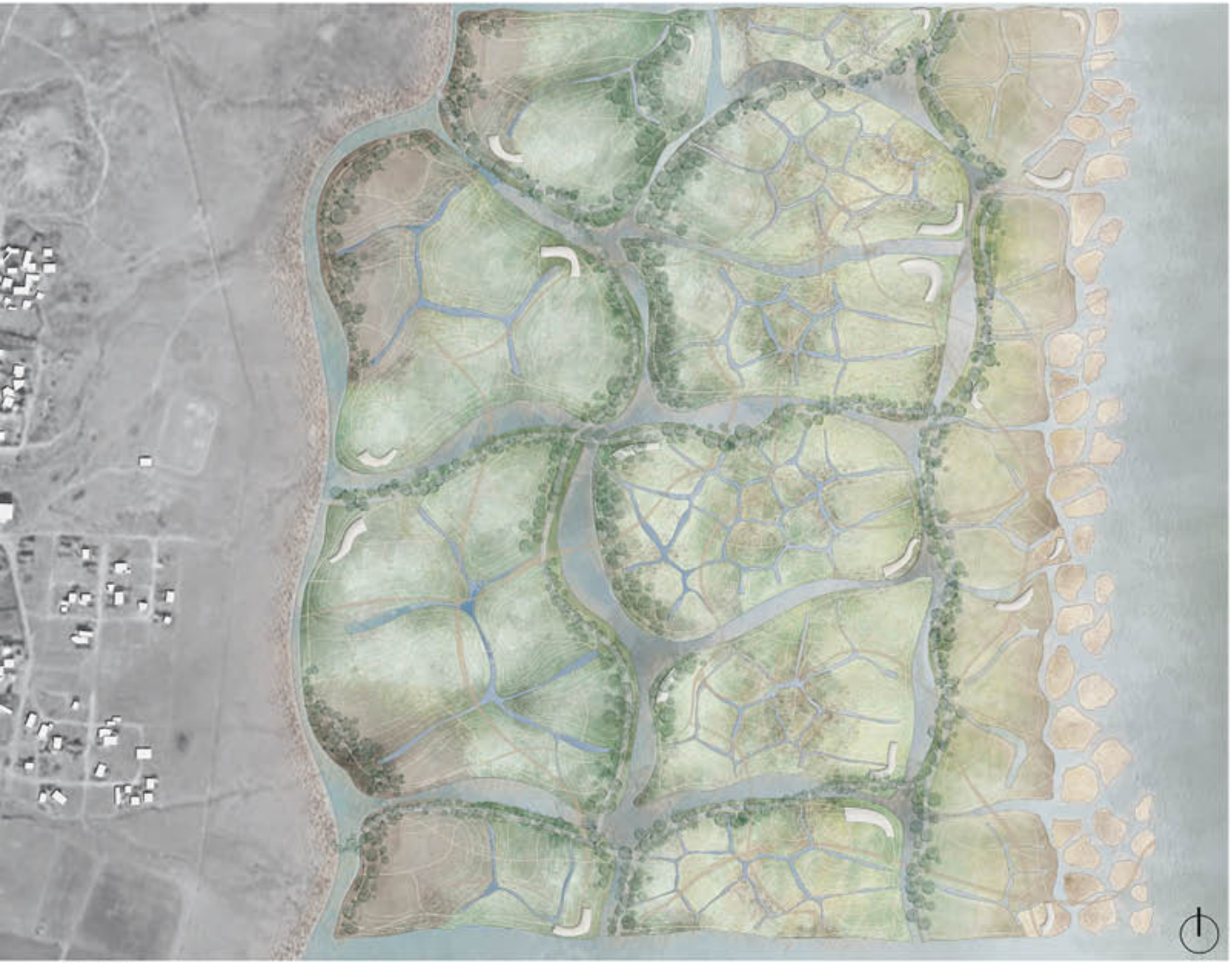






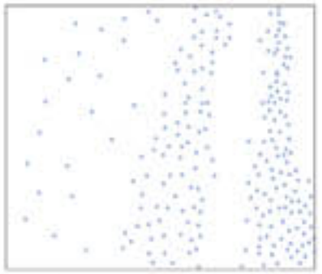
Dunaliella algae / Dunaliella is a genus of the algae family of Dunaliellaceae. It is the only natural species that grows in the Dead Sea because of its capability to resist high level of water salinity.



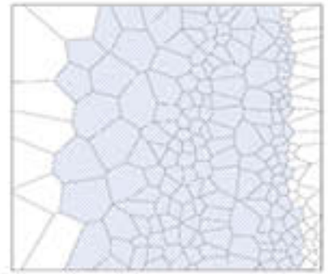


Masterplan

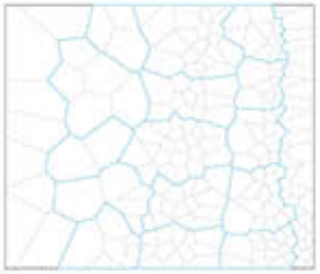
Salt typology



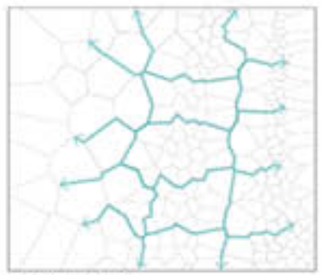
Point derivation



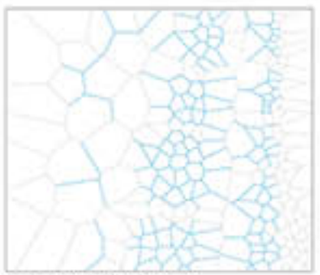
Voronoi tessellation



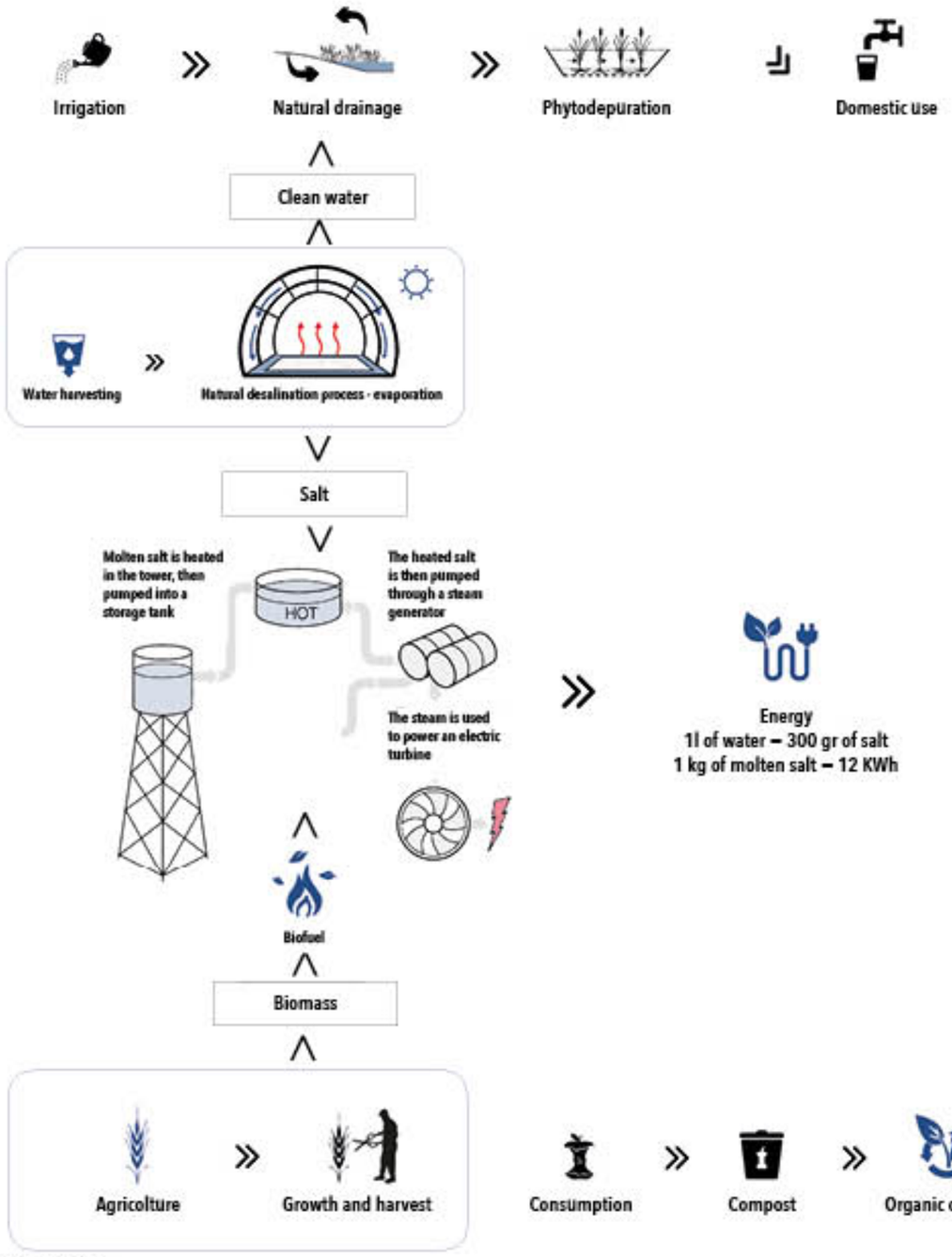
Parcel subdivision



Salt water canals

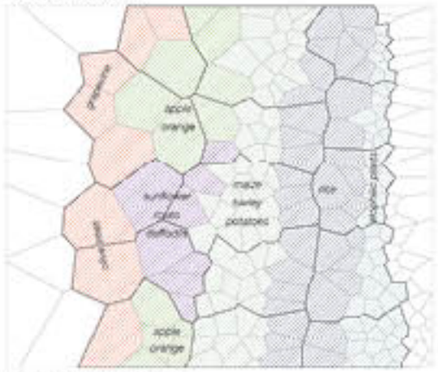


Desalinated water canals



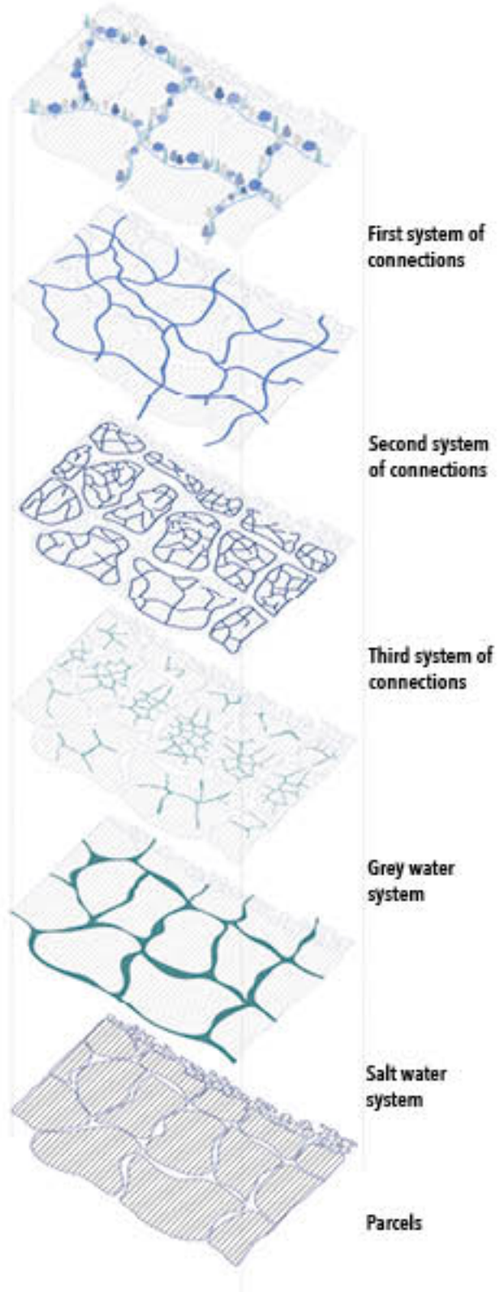
FEW'S strategies

FEW's interaction



Agriculture typologies

- Food production self-sufficiency
- Energy production
- Reuse of waste
- Water recycle
- Micro-economy based on agriculture



Hierarchy of the system

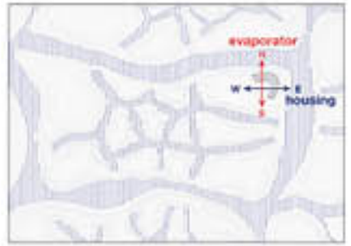
Parcel strategy
Each parcel is designed according to the FEW's program, providing a continuous interaction between the building and the environment.
The presence of a big portion of agriculture and the water canals provide the right amount of food, energy and waste for a singular family. The network of paths crosses the parcel and, at the same time, subdivides it into small parts - each of them with different function such as food cultivation, landfill, biomass, ecc...

The building is displayed at the edge of the parcel, directly connected to the water canals in order to guarantee the water cycle and salt extraction.
The portion of the building dedicated to the evaporator faces a north-south orientation so that it guarantees the maximum amount of surface covered by solar radiation and it guarantees a continuous evaporation. On the contrary, the portion dedicated to housing follows a east-west orientation so that it avoids direct solar radiation during the day.

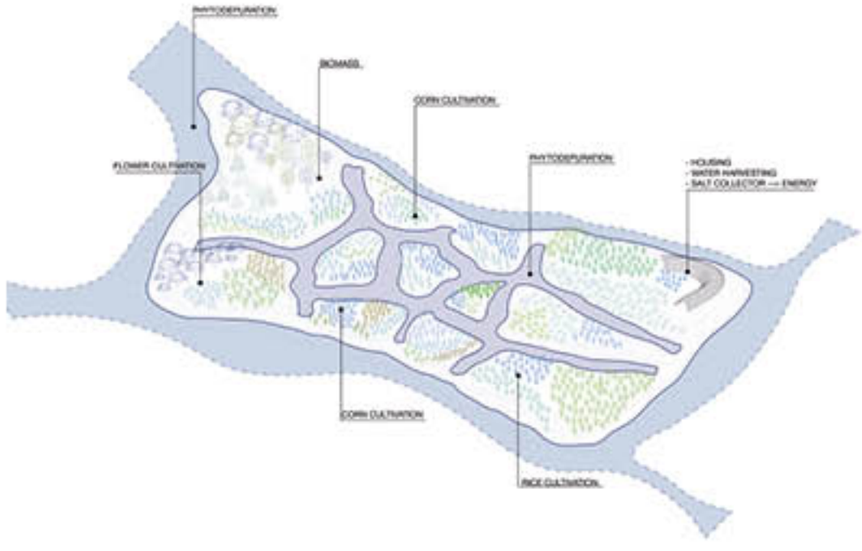
Parcel design

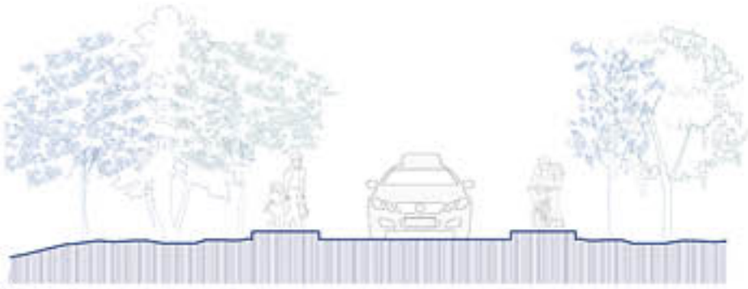
Function: direct connection to water canals

Landscape: integration with path network



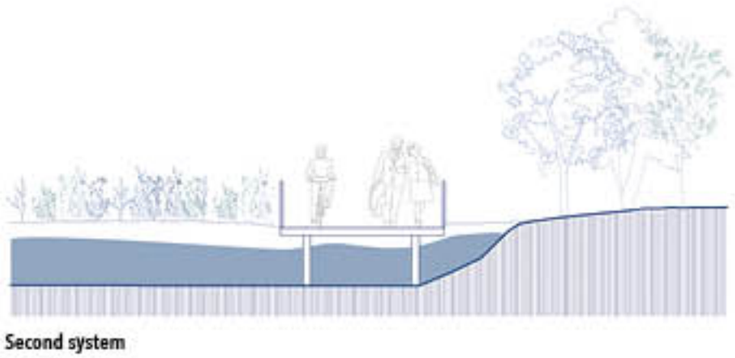
Program: N-S and E-W orientation





First system

The first system of connection consists of 4 mt wide roads, lied with pedestrian paths and trees. This system is the continuation of the existing urban street network and crosses the site according to the idea of 'cardo' and 'decumano', dividing it into eight sectors strictly connected.

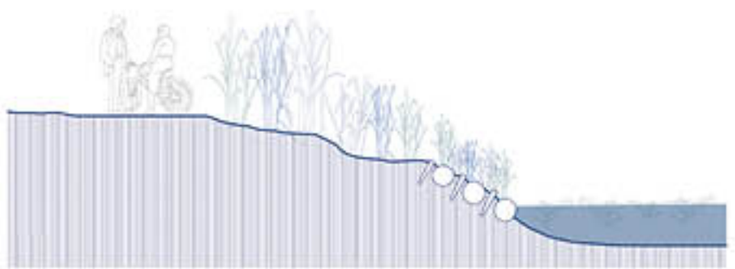


Second system

The second system is for pedestrians only and it is more linked to the experience of the place rather than the function of connection itself. It's an organic and fluid network elevated above the ground that connects all the buildings. Sometimes it becomes a pier on the water canals, sometimes a runway through trees or through agricultural fields.

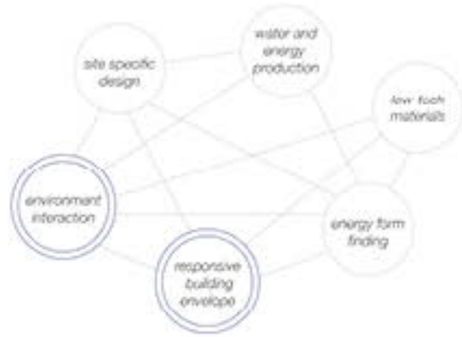
Third system

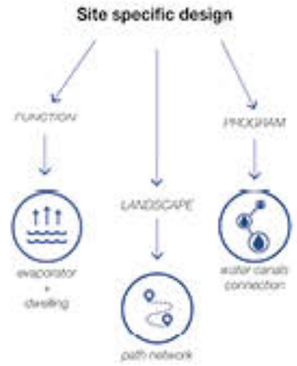
Since most of the land is dedicated to agriculture, it is important to provide a network of streets reserved for the passage of tractors and other means. The third system crosses and cuts the parcel, dividing it into smaller parts, each of them dedicated to a different typology of agriculture.



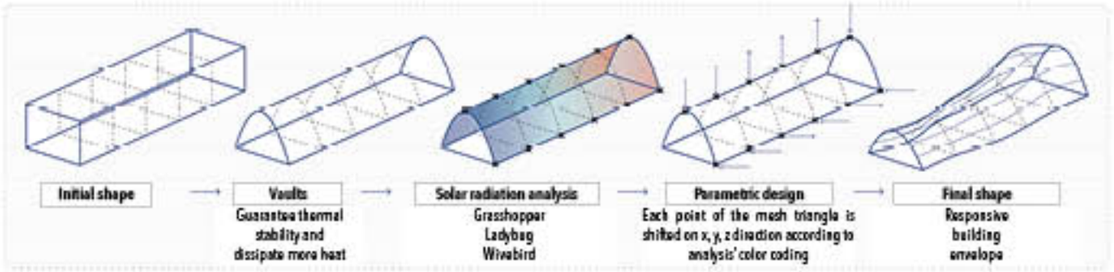
Water canals - Phytodepuration system

According to the strategies of the project, water management and reuse is important for the success of the project. Thanks to the the natural slope, water is drained from agricultural fields to the water canals; then, it is depurated thanks to the alge from chemical agents usually used in agriculture and purified water is pumped and stored into tanks in order to re-start the process.



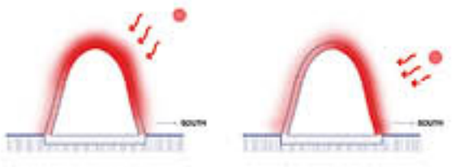


External view

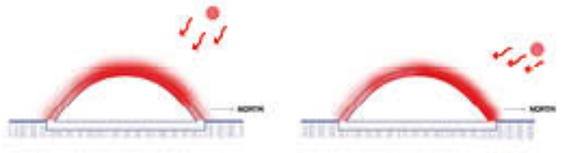


Conceptual diagram of form finding

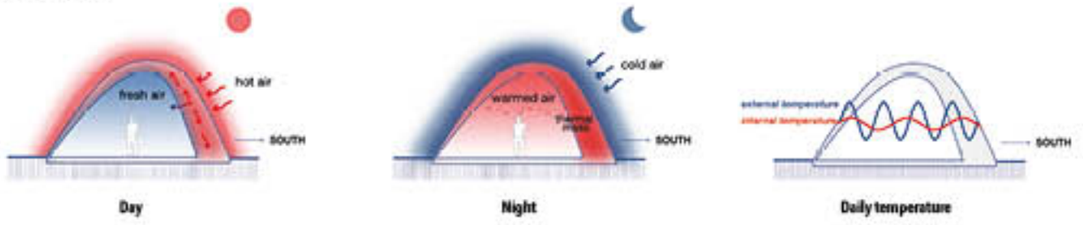
Height

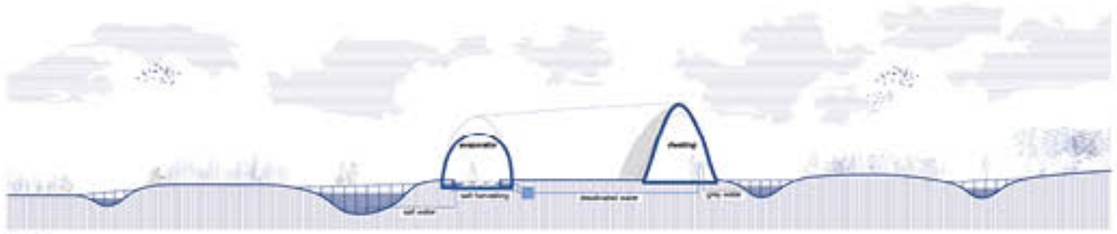


Width

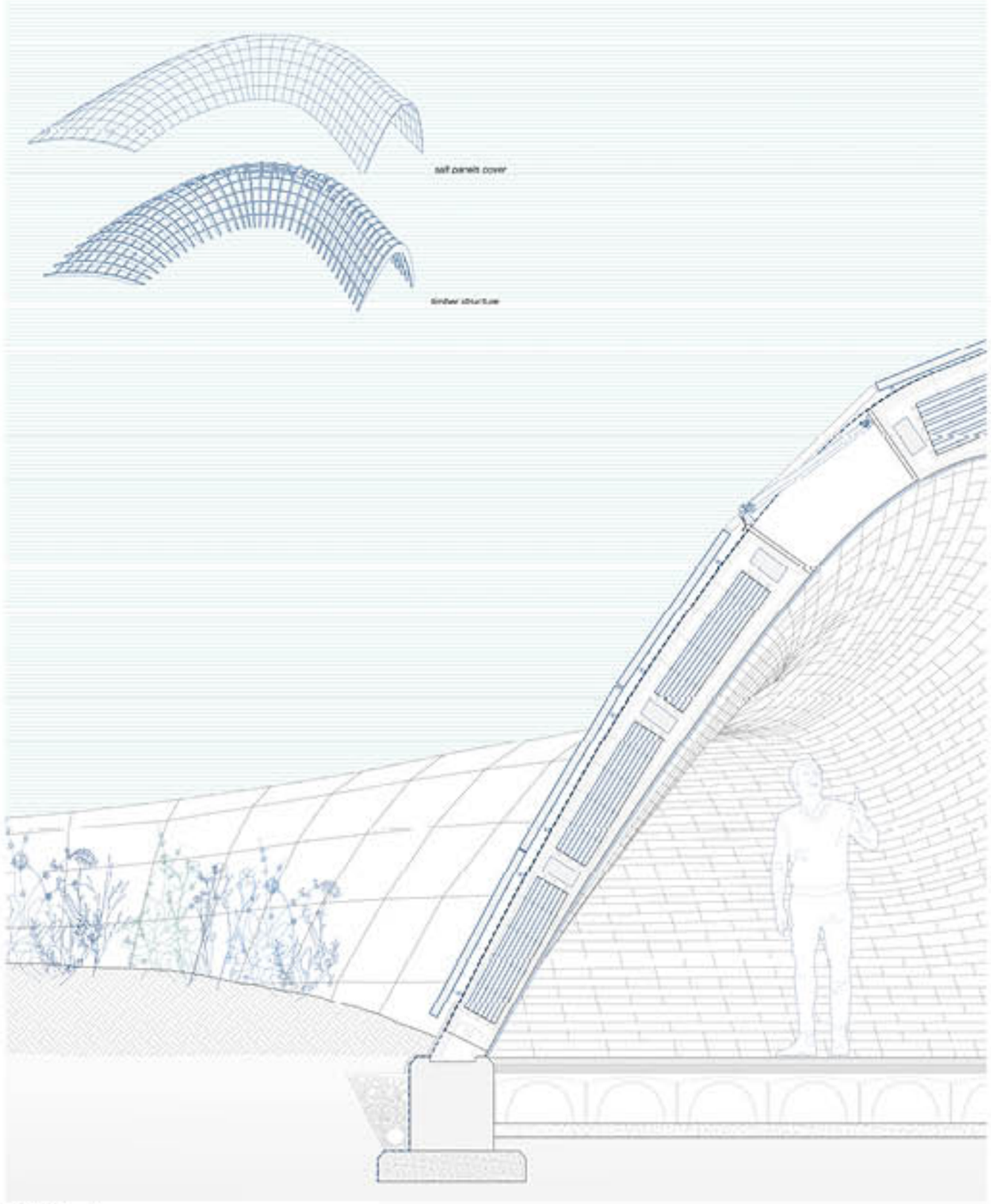


Wall thickness



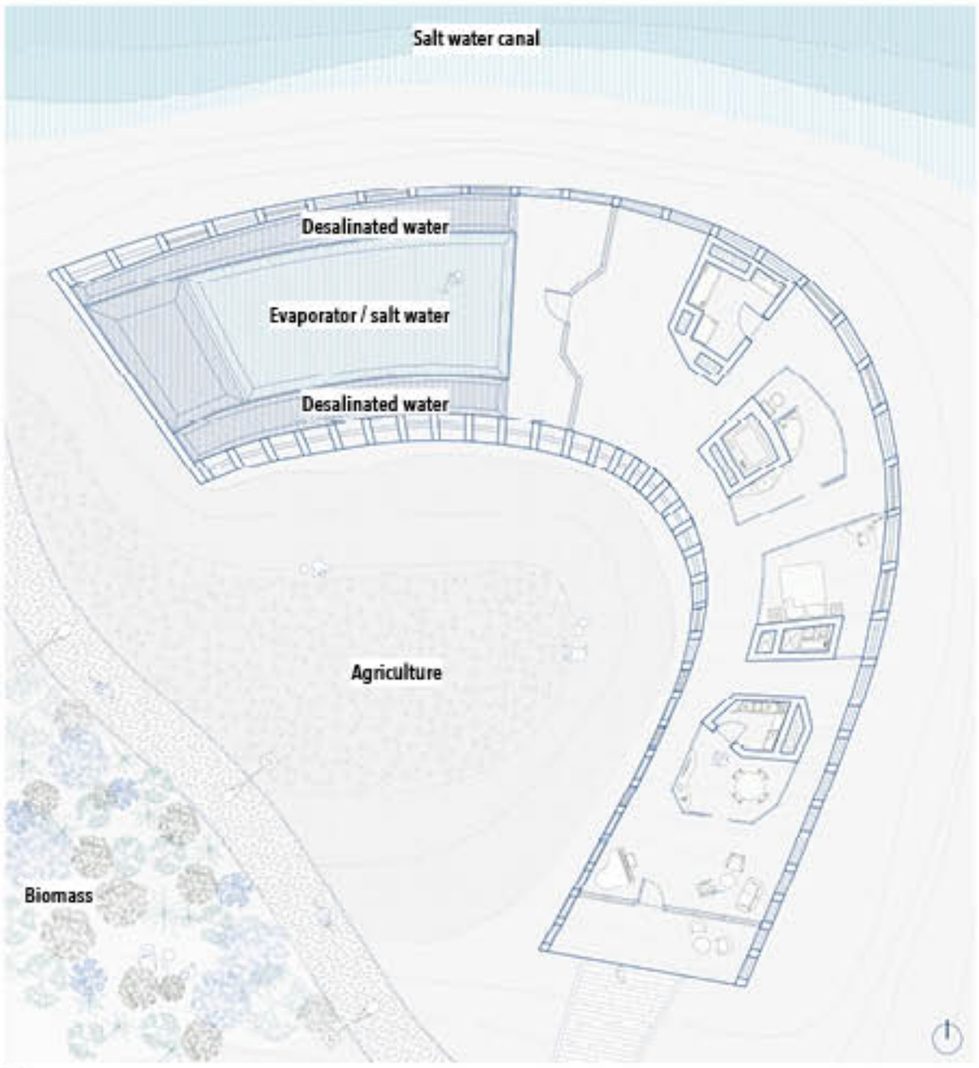


Section



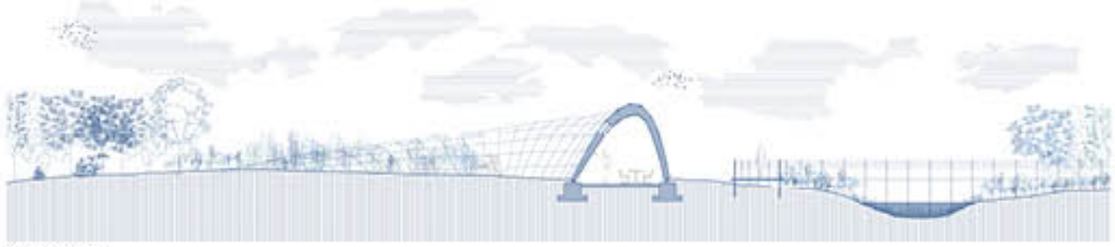
Detailed section

Interior design strategy
The different thicknesses of the walls provide a stabilization f the temperature inside the building, avoiding the concentration if heat/ cold in some areas. With this system, the building works as a whole structure, a unique room. The optimal solution consists of fixed walls containing services and sliding panels, in order to create a space that is both flexible and livable.



Plan

Section A-A'

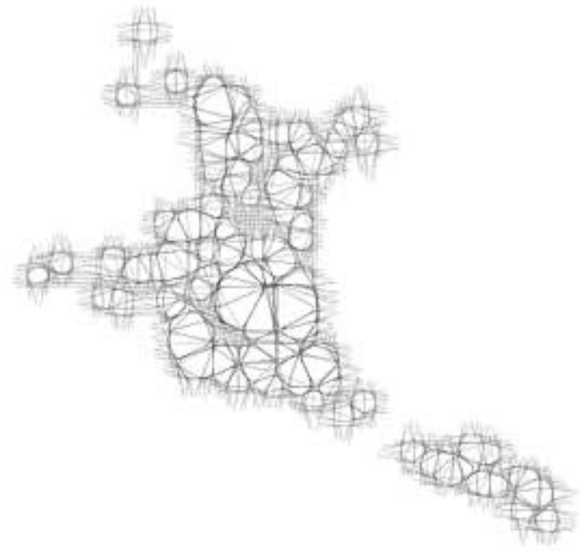


Section B-B'

SAVE KIRIBATI
Kiribati, Pacific Ocean

Kiribati is an island nation in the central Pacific Ocean, surrounded for miles only by water. In the last few years Kiribati is being known due to the climate change and the rising of sea level that is slowly flooding the islands. Because of that Kiribati's people are the first in the word to become refugees for climate change.
Kiribati islands are really flat and low, especially the Fanning Island, that has the highest point at 9 feet on the sea level, and with more than a thousand inhabitants it is one of the most in danger island.
The predictions for the next fifty years are that the level of the sea will slowly increase, reaching whit the tides the 9 feet high.
It means that Fanning Island people will be forced to leave their territory. The people of the island are really attached to their roots and they have developed a way of living that is in perfect balance between the land and the sea.
The Save Kiribati project has the purpose to give to these people the chance to stay in their place, maintaining their living habits avoiding to be refugees in a foreign country. But to achieve that the only way is to evolve a rural population into a technological one, that could adapt and live in a new sophisticated system.
The project is based on the complete absence of land, a biology-inspired floating system composed of parts that works together in order to make the entire system work in balance.
The masterplan propose a series of floating cells each with a specific and unique purpose like water collection, water desalination, energy production, animal farming, plants cultivations, dwelling units and so on.
Each unit has only one purpose, ensuring the exchange and the collaboration between different parts.
The entire system is endosed in a floating ribbon that, following the tides movement, generate and collect energy for the whole system, guaranteeing a visual limit to the population, avoiding an alienating sense of living in nothingness. Only few spots of land are protected by huge walls in order to become a sanctuary and a memory of the past.

Alessio Palmieri



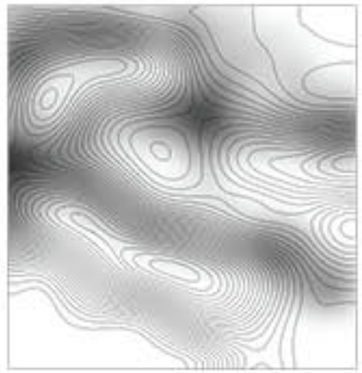


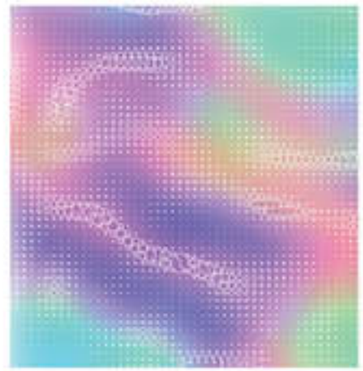


Flood analysis: +0m (2017)

Flood analysis: +1m (predicted in 2050)

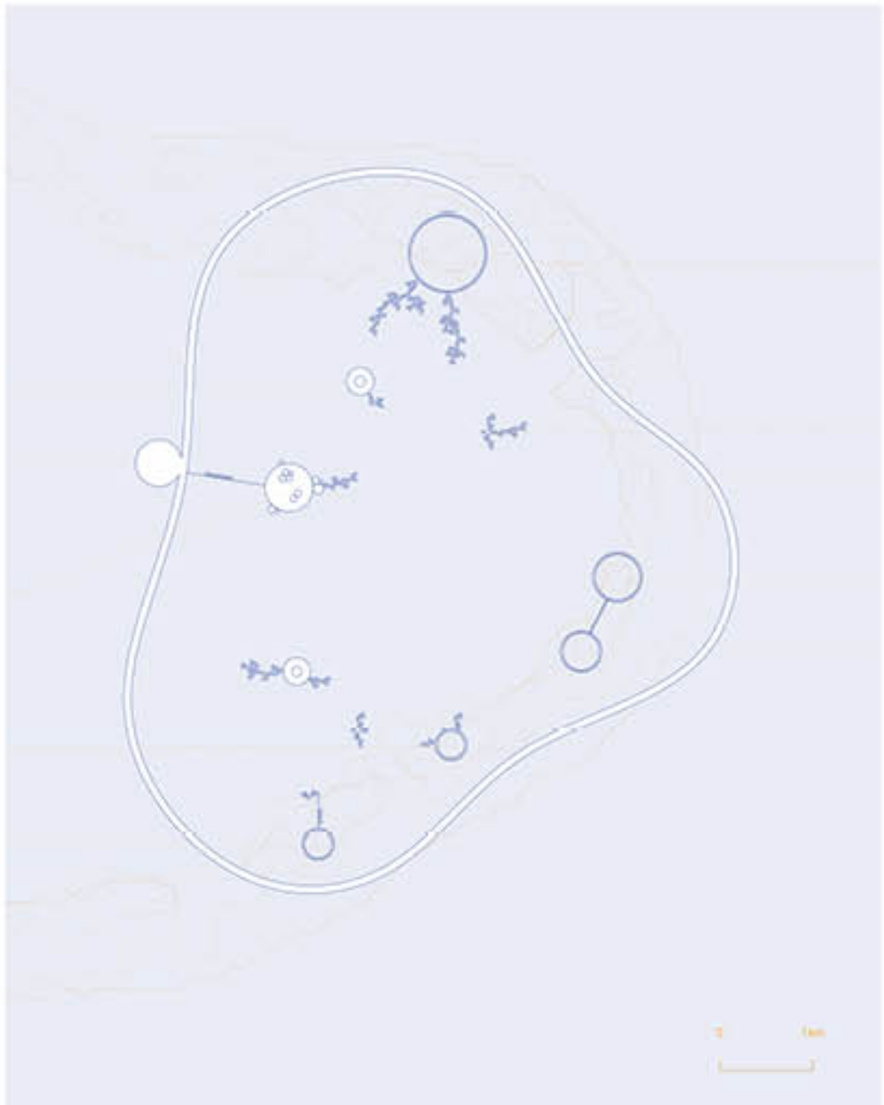
Flood analysis: +2m (predicted in 2100)

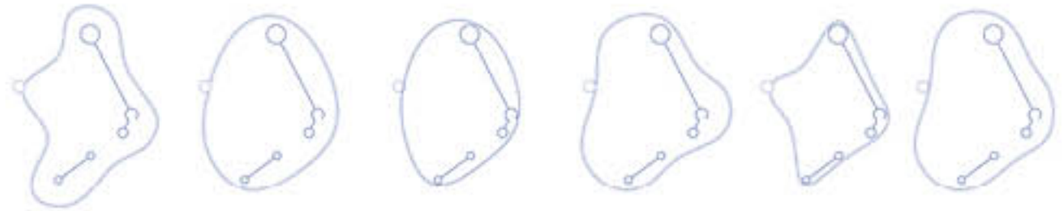




Flood analysis

Water flow simulations



Site strategy



The ribbon
A continuos ribbon made of floating deck units provides for a flexible, yet secure system of containment for all the units to withstand currents and tides.

Walkaway and living unit

Farming core unit

Form finding and construction process
The shape of the units is derived from a form-finding process using a digital simulation to inflate a flexible envelope. Different base shapes are tested for structural integrity and evaluated for their potentials to house human activities.

Case 1

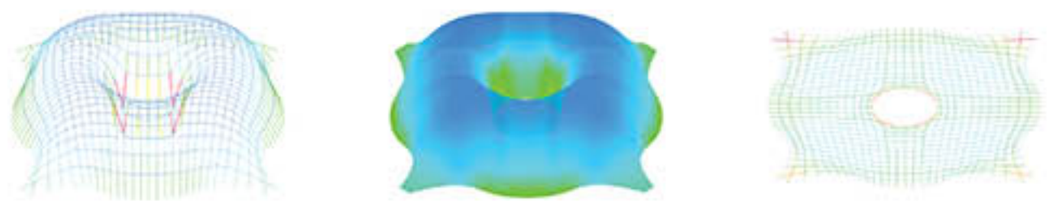
Case 2

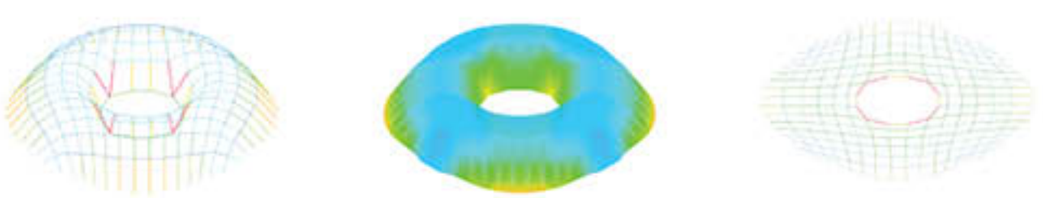
Case 3

Inflatable skin

Section

Final results

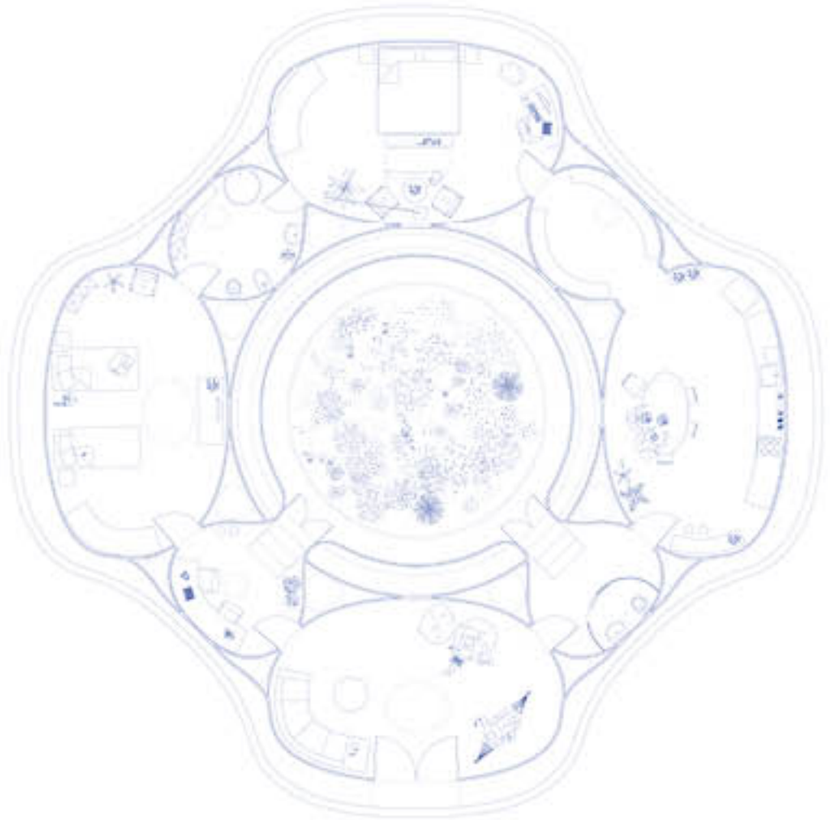


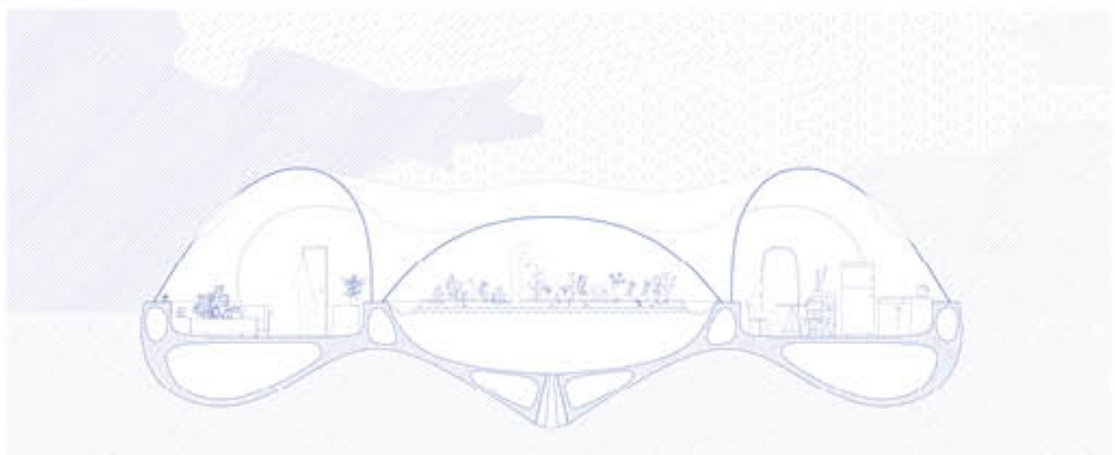


Stress diagram

Compression-resistant shape

Form diagram





Plan and section

Dwelling unit

Cultivation unit

Water desalination unit

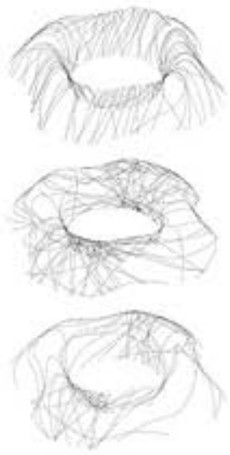
Farming unit

Fabrication process

The design concept is based on the study of biological construction processes for fiber-reinforced structures. These processes are relevant for applications in architecture, as they don't require complex formwork and are capable of adapting to the varying demands of individual constructions.

Diving bell water spider reinforcing and air-bubbling from the inside.

Rigidifying resin system



Reinforcement layers

Stable fibrus nest construction of the Diving bell water spider.

Woven glass fabric

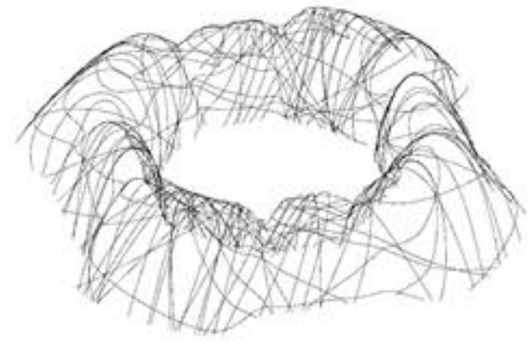
Microscopic image of the Diving bell water spider's nest.

Air cells structure

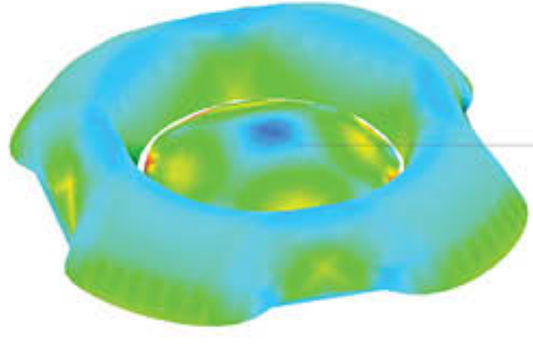
The biological processes form customized fiber-reinforced structures in a highly material-effective and functionally integrated way. In this respect, the web building process of the diving bell water spider (Agyroneda Aquatica) is of particular interest. The underlying behavioral patterns and design rules were analyzed, abstracted and transferred into a technological fabrication process.

Air cell structure

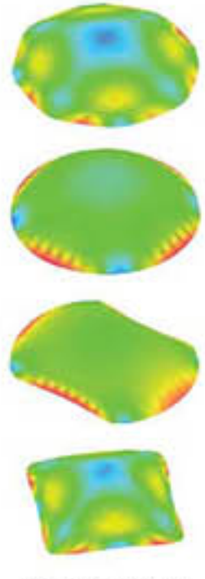
Reinforcement layers



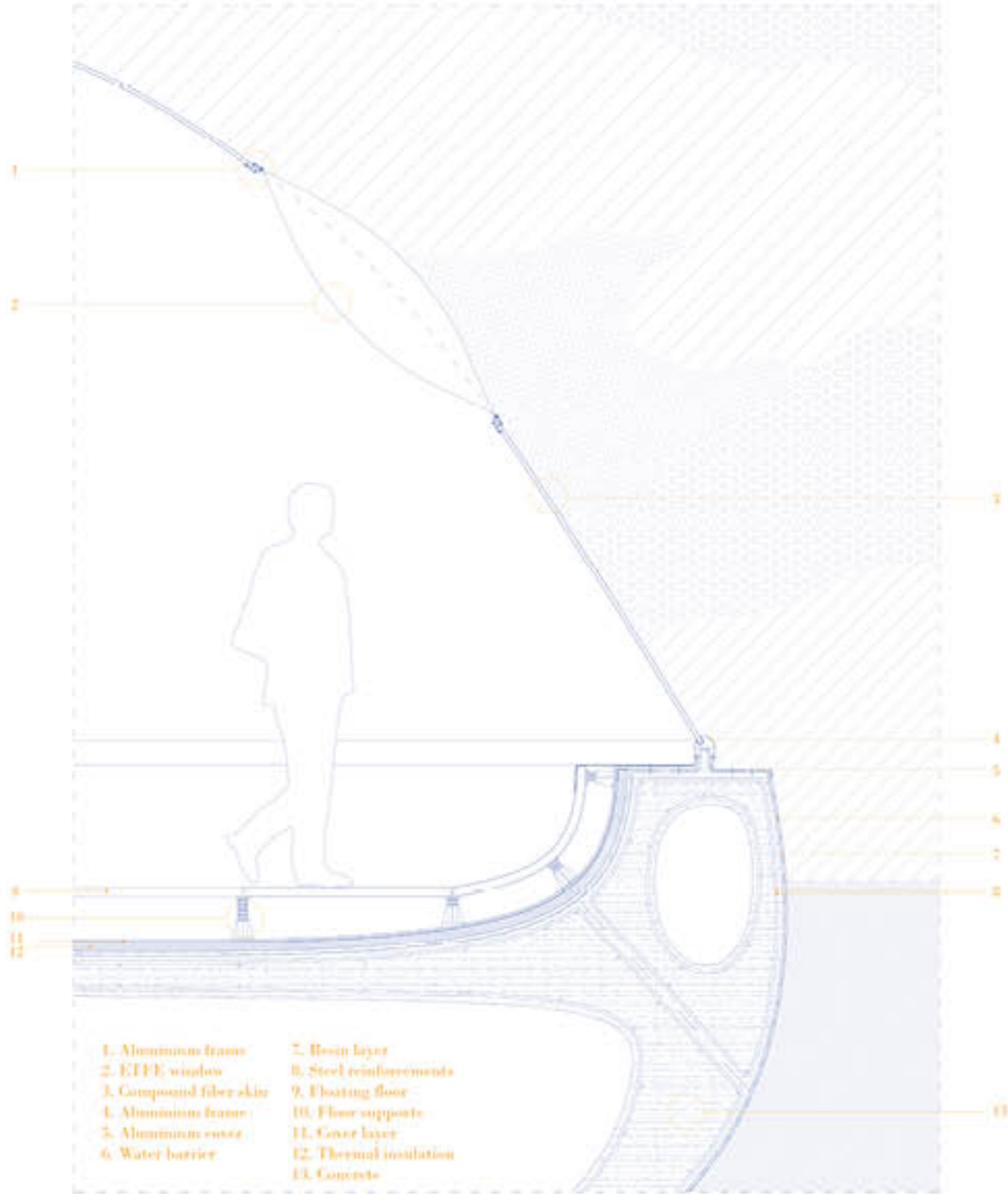
Rigidifying resin system



Central core



Compression tests



Detailed section

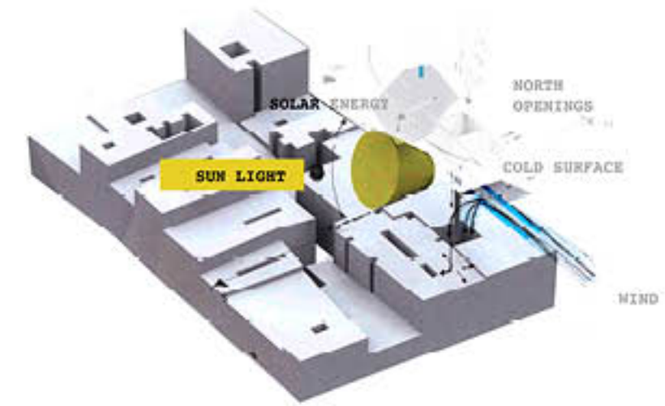
Interior view of the bedroom

Interior view of the kitchen

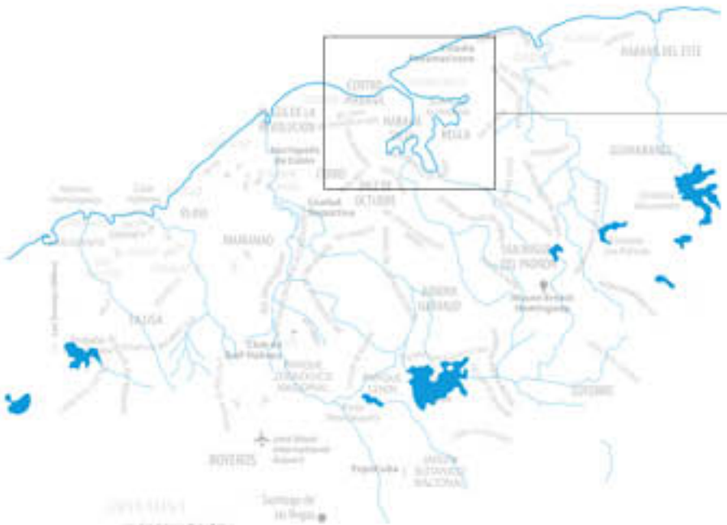
HAVANA PROJECT
Havana, Cuba

The aim of the project it to understand the energy generation/distribution as a process which can then be developed as a parasitic apparatus of specific prototypes, in this case in the urban context.
The idea of the micro-intervention, with small modules which interiorize the climatic factors of the context and act as apparatuses creators of autonomy.
The place where this theory was applied is La Habana, Cuba, more specifically the Old Havana.
The water infrastructure in this area is in very precarious conditions, this together with the drought that has been affecting the area for a few years now reinforces the urgent need for capital interventions focused on the generation / distribution / correct use of water.
The second factor to take into account is the energy generation as a key point in achieving the autonomy of the city, the correct functioning of which is affected by the evident economic limitations.
Both of the goals, energy and water generation are achieved by using the immediate resources that the context offers. Energy is collected from the direct solar radiation, very important in the
Caribbean context, with more that 300 sunny days average per year, and water is generated by the use of condensation techniques.
The humidity in Havana is very high, around 70% average, this with full of moisture will get in contact with surfaces of lower temperature (5-6 Degrees), in order for it to condense, re-directing it to storage point as well as to the elevated storage tanks in each block.
The project started with the creation of a mega-structure over the city, idea that was developed after, converting this mega-building into many small prototypes, exteriorly absorbing the city spirit, and interiorly creating energy 'from thin air'.
Each prototype is different, depending on its location, its formal composition is given by the subtraction of 'shapes' that respond to specific functions.

Adrian Labaut



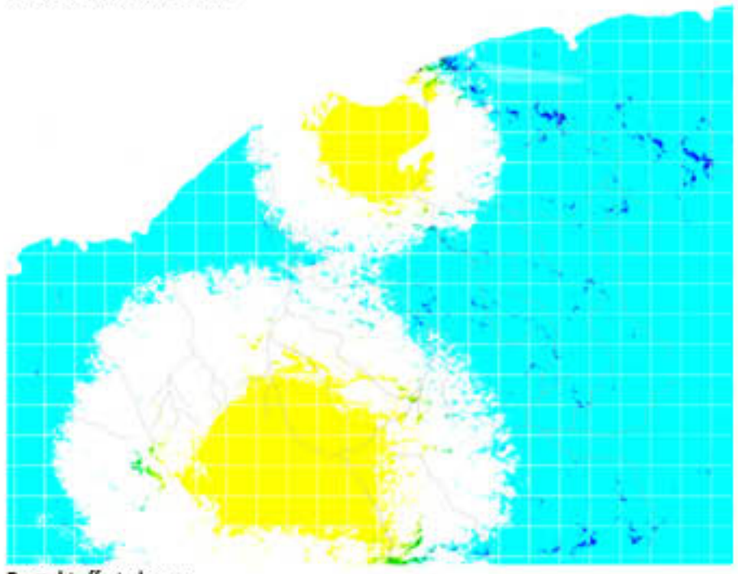
Water scarcity in Cuba / The hydrologic drought affects 139 towns out of 168 (82% of the country), 53 of them declared to be in "extreme drought". In 2016 the amount of rain in Cuba was just the 65% of the historic average.



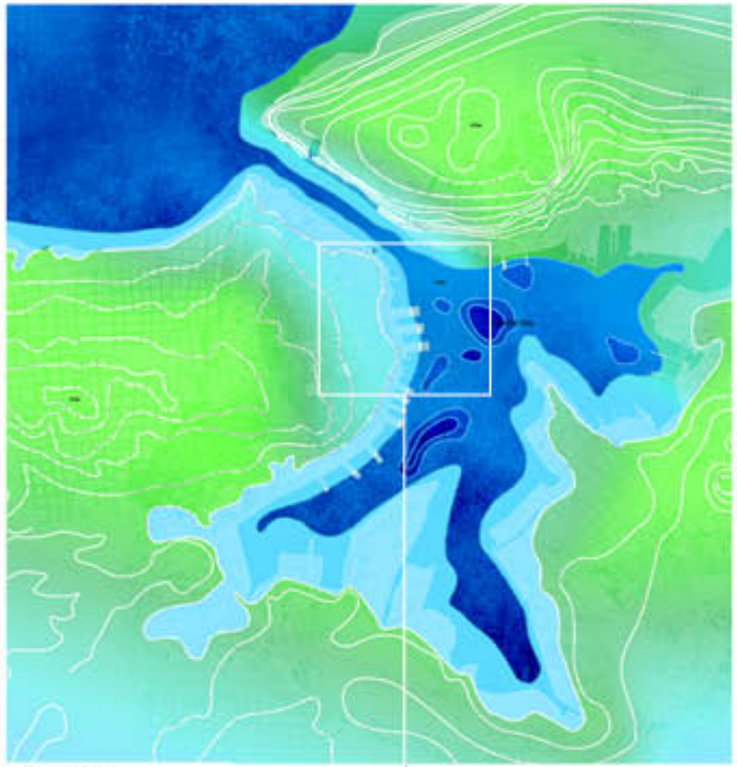
Water waste

Water reservoirs in Habana

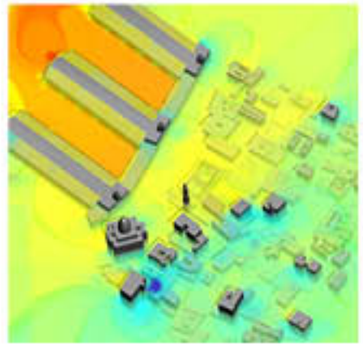
Drought

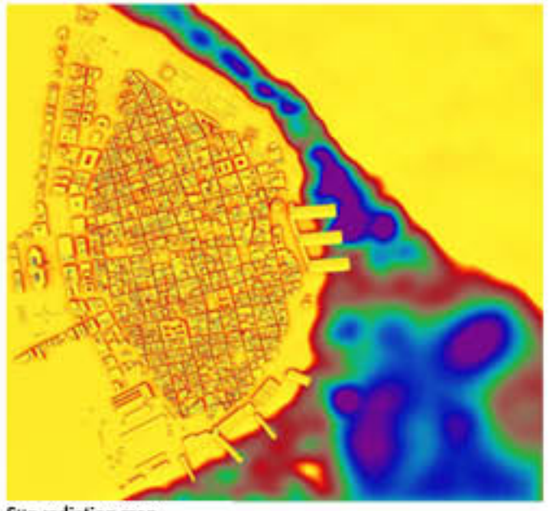


Drought affected zones

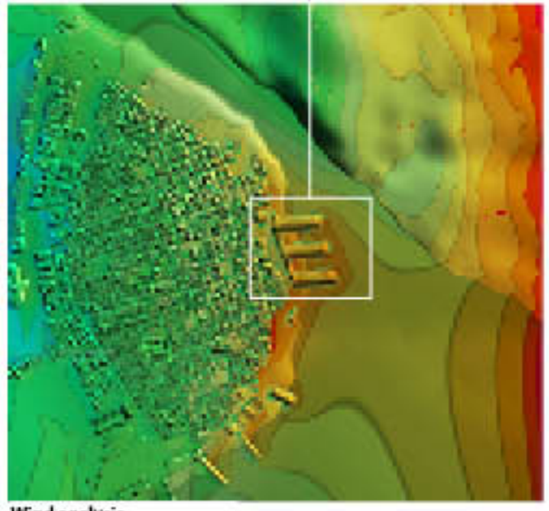


Topography

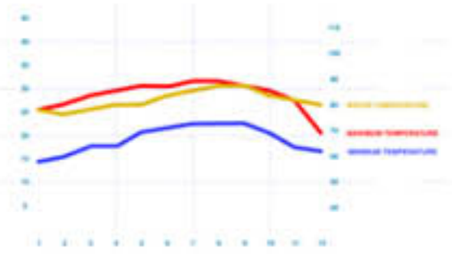




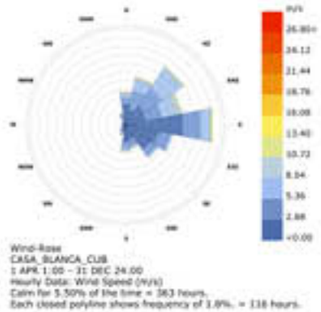
Sun radiation map



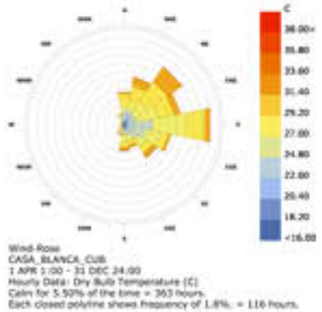
Wind analysis



Temperature

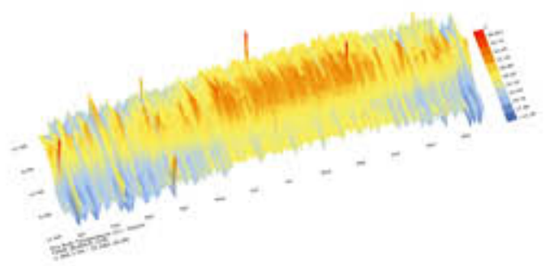


Wind speed

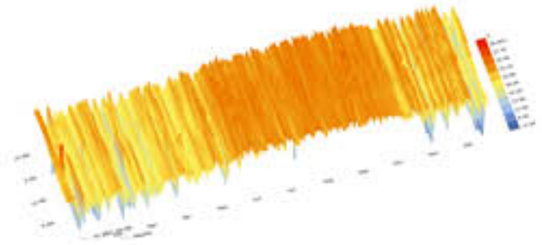


Dry bulb temperatures

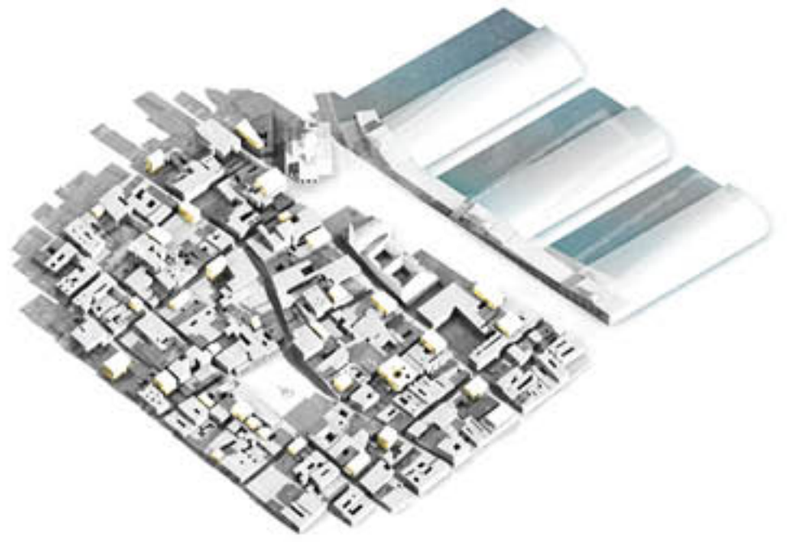
Masterplan



Dry bulb temperatures



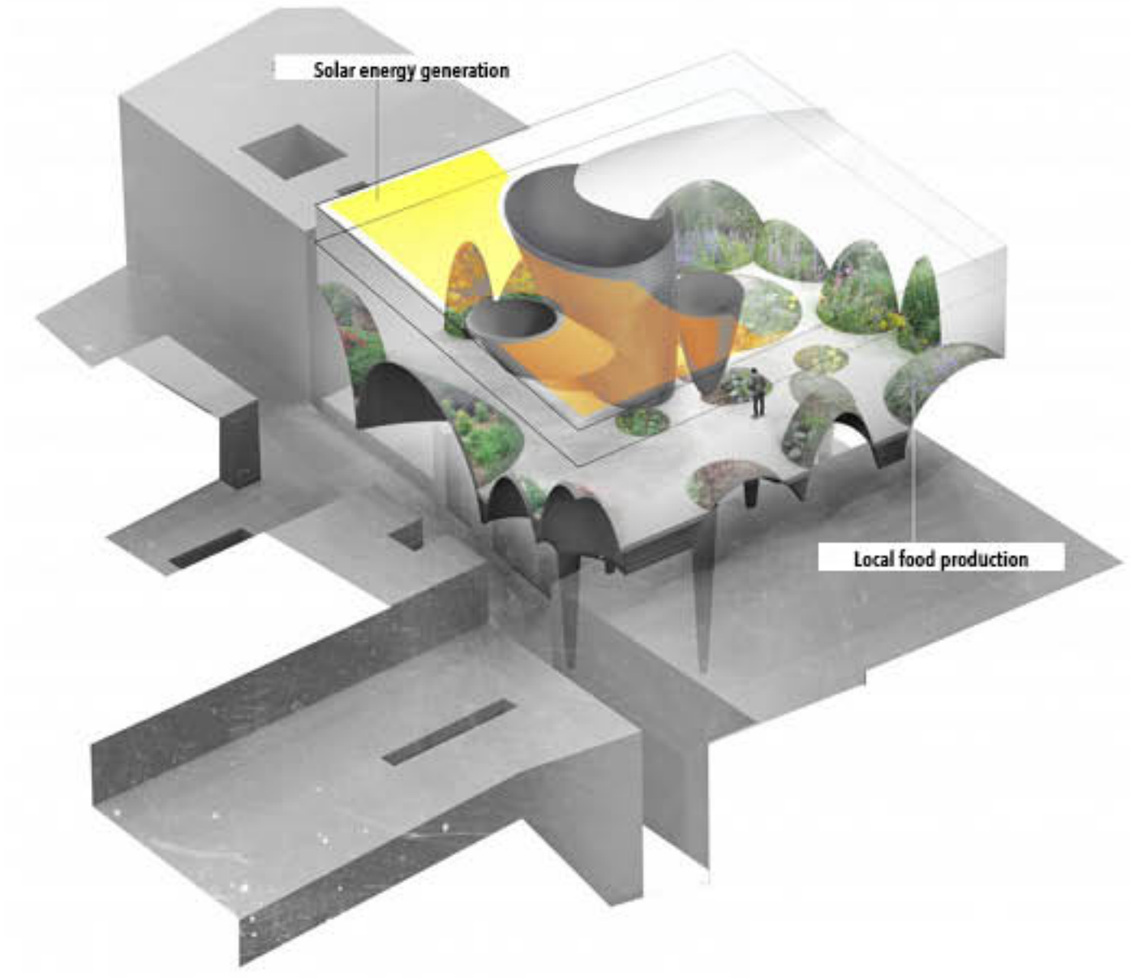
Dew point temperatures



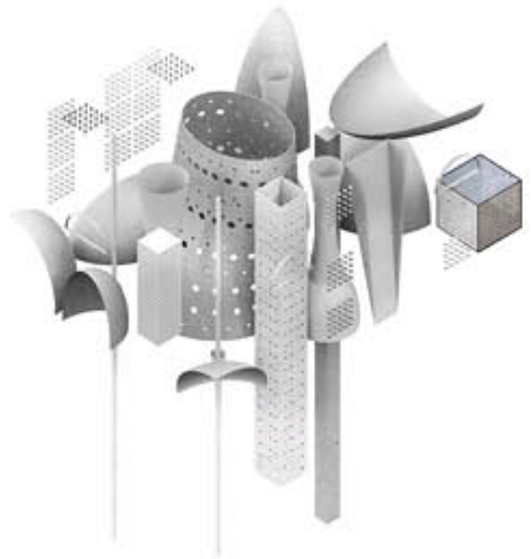
Location of new elements

Built area

Internal yards



Single structure components

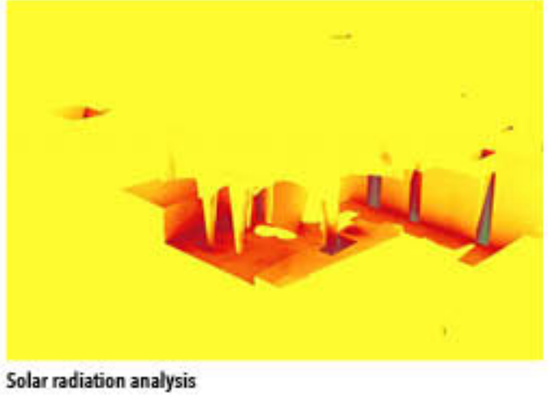


Model components

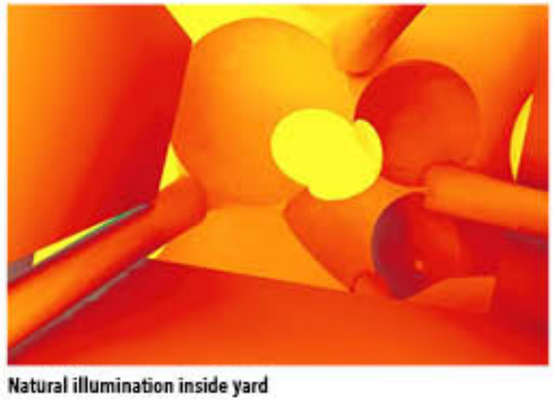
Solar collectors area : 46 sqm
Energy generation :
Input average : 1000 W / sqm
2 sqm x 1000 (W/sqm) = 2000
2000 x 0.20 (20% efficiency panel) = 400
400 x 7 (hours of sun radiation) = 2800 W/h per day

The Mechanism

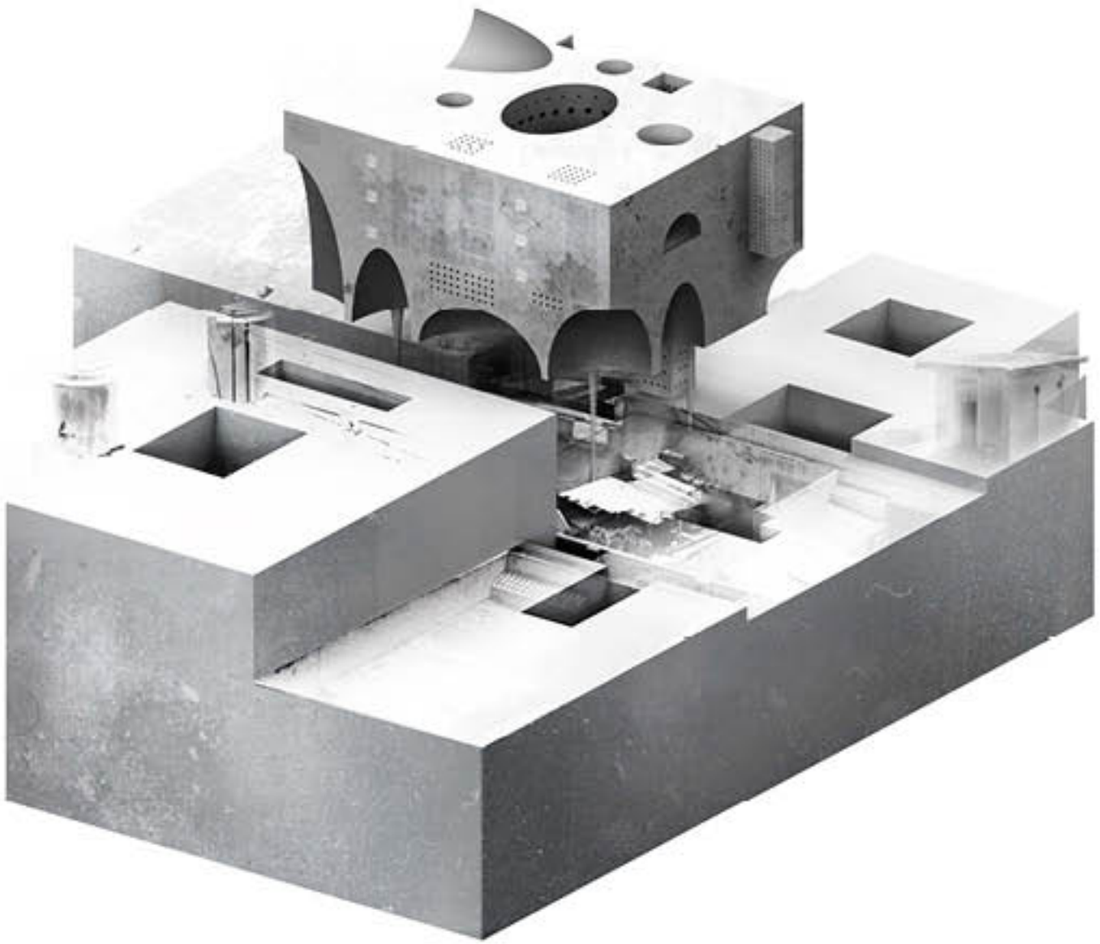
Water condensation area : 475 sqm
Average water generation / sqm : 25 l / day
Water generation average : 11 875 l / day



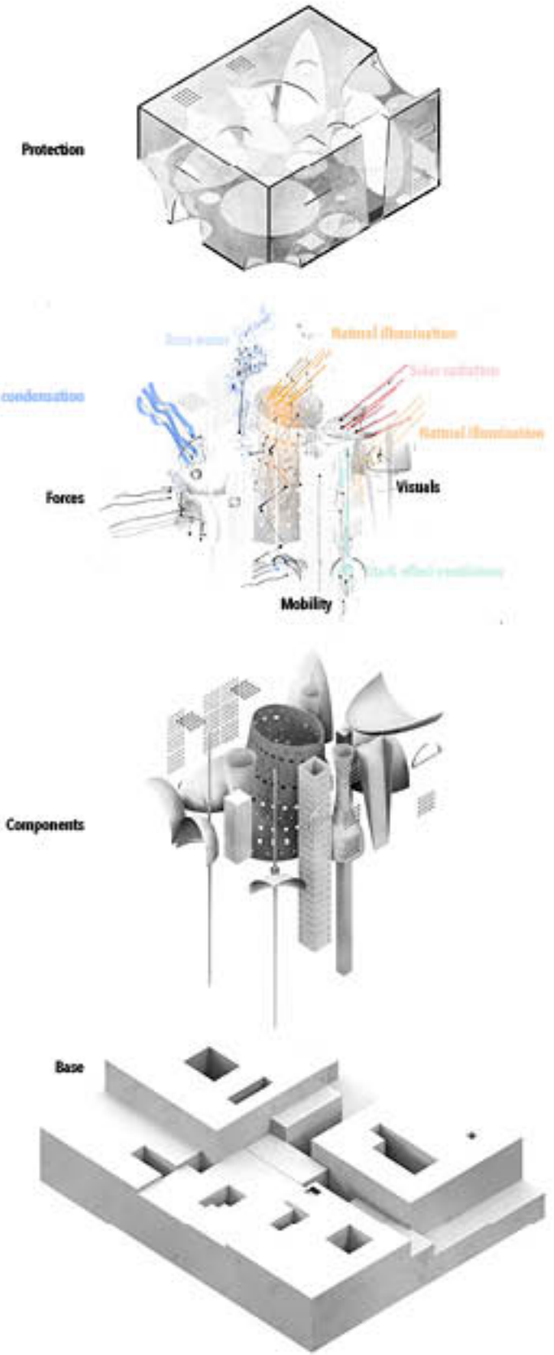
Solar radiation analysis



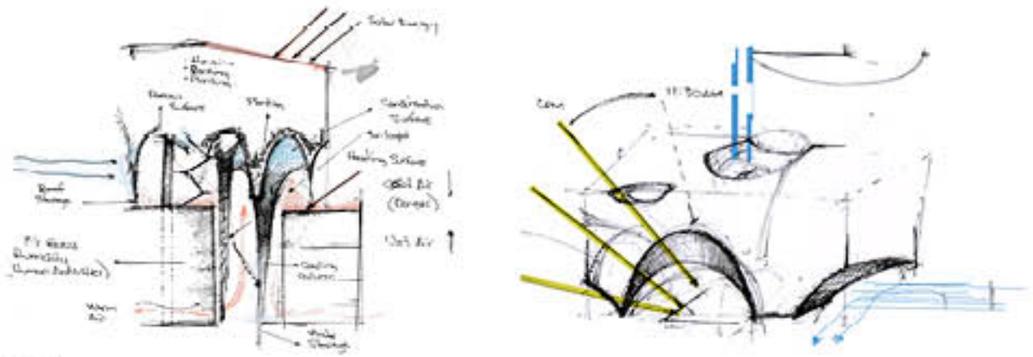
Natural illumination inside yard



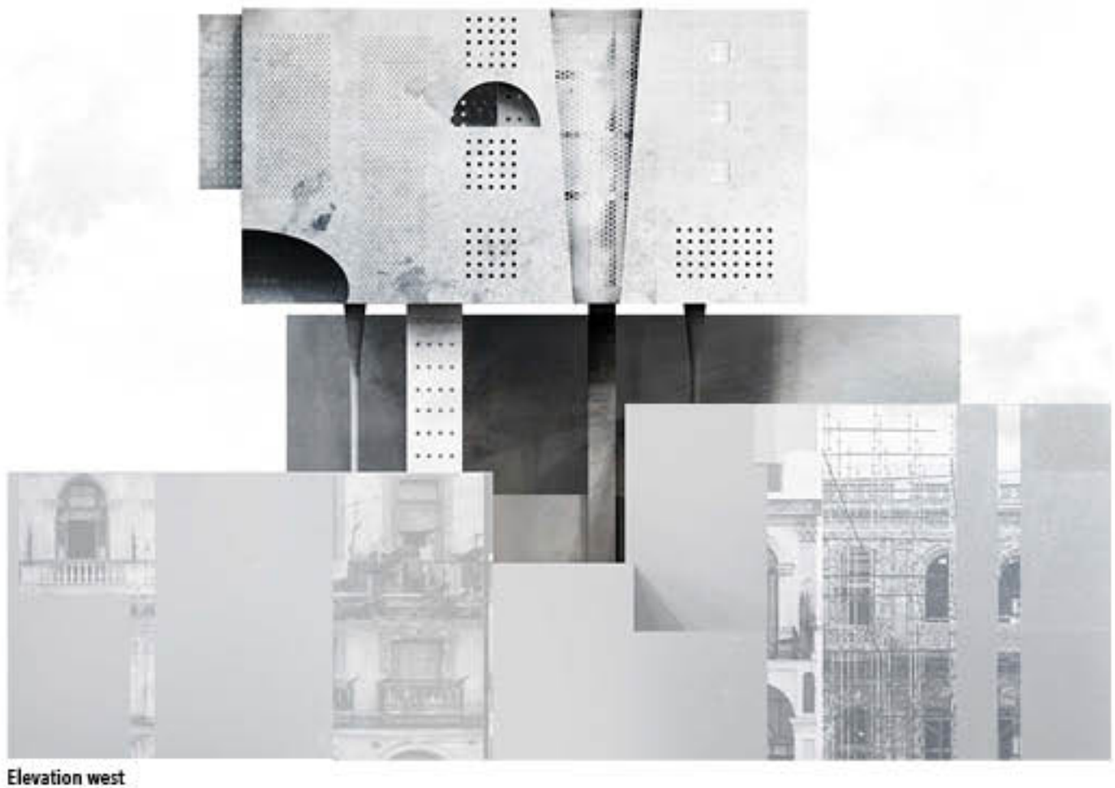
External view



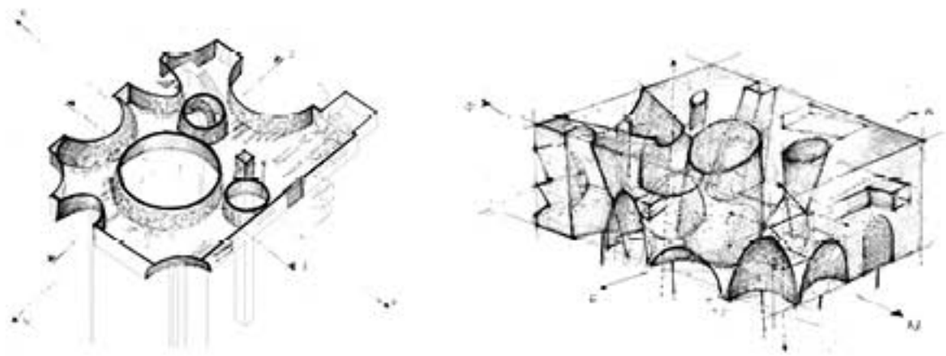
Exploded axonometric view



Sketch diagrams

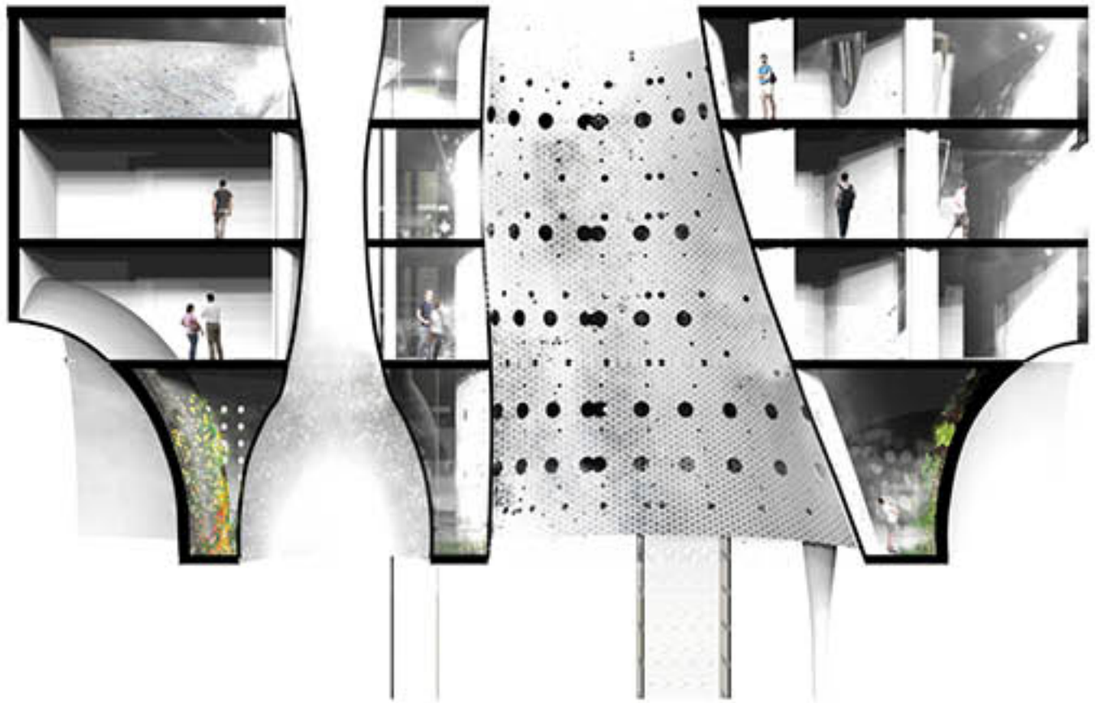


Elevation west



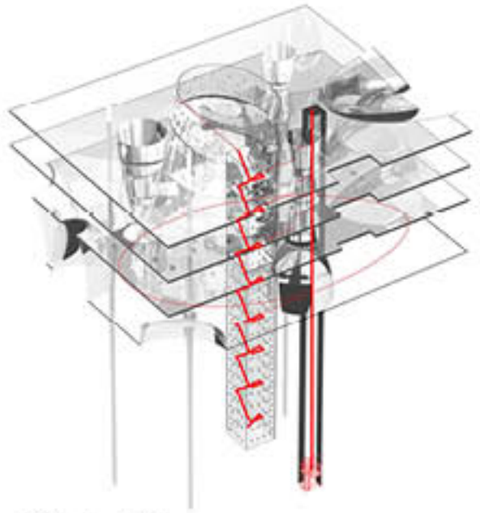
Sketch diagrams

Elevation est

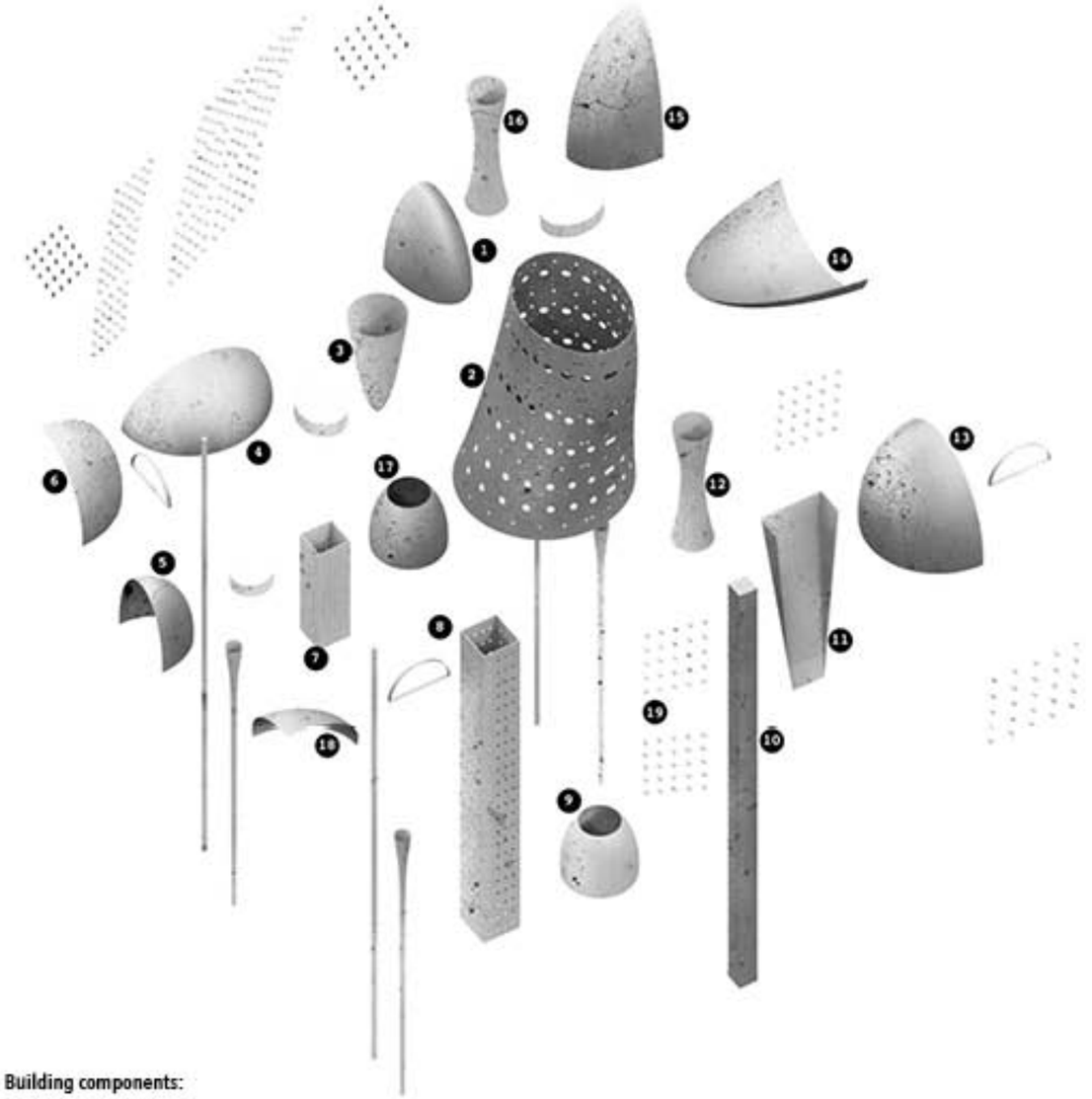


Section

Internal divisions

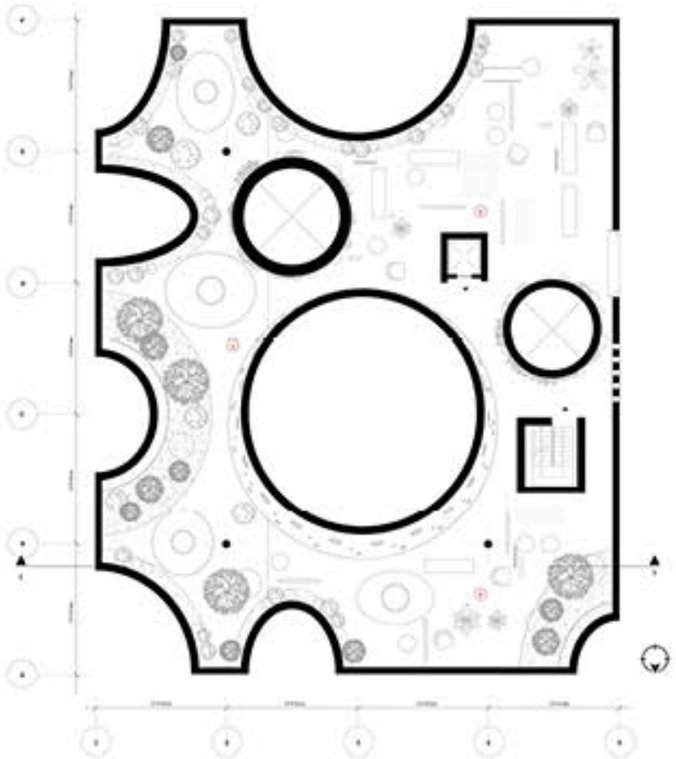


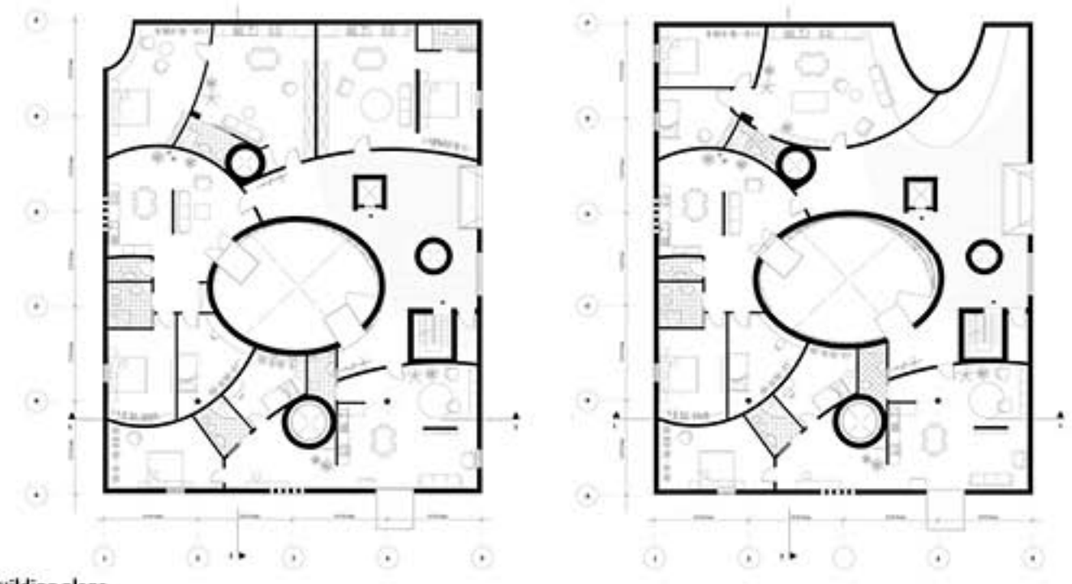
Vertical mobility



Building components:

1. Moisture condenser
2. Internal patio
3. Rain collector
4. Moisture condenser
5. Gardening
6. Moisture condenser
7. Balcony
8. Staircase
9. Stark ventilation system
10. Lift
11. Common area illumination
12. Stack ventilation system
13. Illumination housing below
14. Solar panels
15. Moisture condenser
16. Stark ventilation system
17. Stark ventilation system
18. Gardening
19. Perforations





Legend

Floor 1 plan:

1. Public hall	
2. Studio apartment 1	30.0 m²
Apartment 2:	52.3 m²
3. Living room/kitchen	28.0 m²
4. Bedroom 1	20.0 m²
5. Bathroom	4.3 m²
Apartment 3:	88.6 m²
6. Living room/kitchen	30.0 m²
7. Bathroom 1	2.8 m²
8. Bathroom 2	5.3 m²
9. Bedroom 1	18.7 m²
10. Bedroom 2	13.4 m²
Apartment 4:	65.8 m²
11. Common space	14.5 m²
12. Bedroom 1	18.9 m²
13. Bathroom 1	4.8 m²
14. Bedroom 2	8.6 m²
15. Bathroom 2	2.3 m²
16. Living room/kitchen	46.8 m²

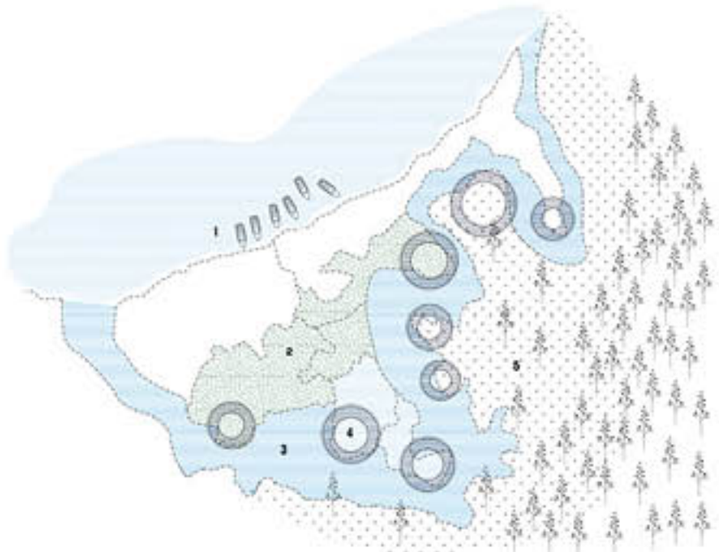
Building plans

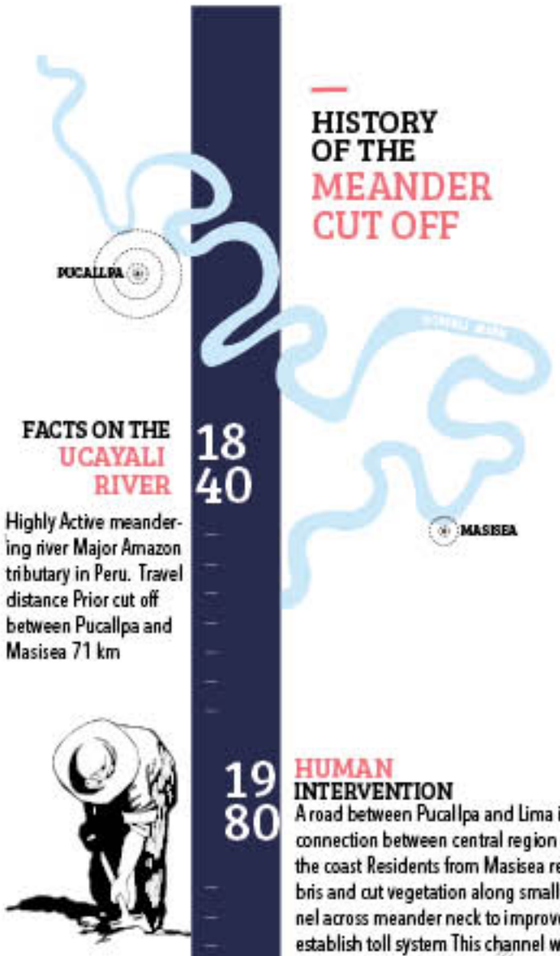
POTENTIALS OF THE OX -BOW LAKE

Pucallpa, Peru

Flooding in Pucallpa is one of the major concerns in the currently developing urban city of the Ucayali Region in Peru.
Pucallpa is found along the Ucayali River, a major tributary of the Amazon River. It is a highly active meandering river of today that has gone through several transformations over the past decades.
An anthropogenic meander cut off in 1996 was one of the critical human activities that contributed to the shortening of the river upstream which further resulted in rapid water flows downstream. The flooding brings destruction to the urban environment and livelihood of the inhabitants in Pucallpa. The anthropogenic meander cut off initiated by the people living in Maisea is an example of how human interference can pose an effect on the natural environment.
Life in Pucallpa is threatened by three problems; the lack of clean water, excess solid waste and flooding. The solution to these problems has used two main strategies, the introduction of a wetland and anaerobic digester. Firstly, the flooding pattern along the bend of the ox-bow lake was observed. The shoreline changed and differed up to 50 meters.
With the empty porous land along the shore being so prone to flood, a new ecosystem was proposed to take on its full potential. A wetland system is introduced to eliminate further erosion and serves as flood protection to soak up the excessive water. This water is then stored to be used during dry seasons and for irrigation of agriculture to increase food production. A new natural habitat will also be created to enhance wildlife biodiversity.
Secondly, to deal with the excessive organic waste, an anaerobic digester is introduced where organic waste is decomposed without the presence of oxygen. By placing it within the shared spaces of the community, it allows for social interaction and creates a sense of ownership.
The proposed circular housing further enhances this concept, creating a shared gathering space along the inner ring of the cirde.
Each cirde serves a public function and is all connected by a bridging system. The circular housing can therefore be seen as a typology that enhances the lifestyle of the local community but also is a result of the continuation of the landscape surrounding them.

Alice Tzu -Ting Huang





HISTORY OF THE MEANDER CUT OFF

FACTS ON THE UCAYALI RIVER

Highly Active meandering river Major Amazon tributary in Peru. Travel distance Prior cut off between Pucallpa and Masisea 71 km

18 40

19 80

HUMAN INTERVENTION

A road between Pucallpa and Lima is the only connection between central region of Ucayali & the coast Residents from Masisea removed debris and cut vegetation along small flood channel across meander neck to improve transit and establish toll system This channel was physically widened more and more throughout the years

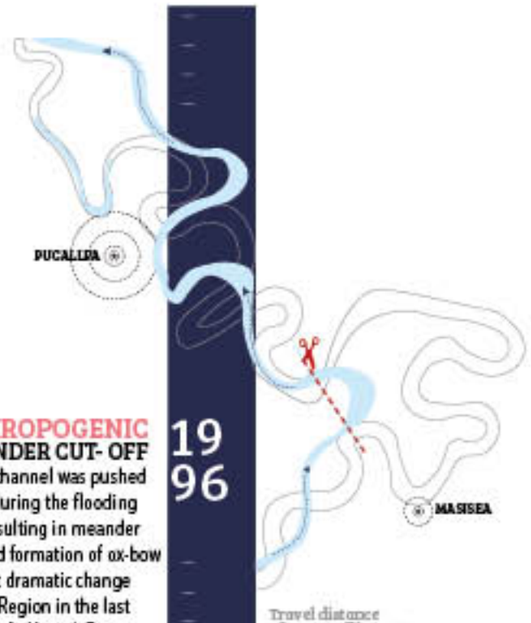
Project location

Pucallpa is found along the Ucayali River, a major tributary of the Amazon River. Flooding in Pucallpa is one of the major concerns in the currently developing urban city of the Ucayali Region in Peru.

Topography

Vegetation

Precipitation



ANTHROPOGENIC MEANDER CUT- OFF

The river channel was pushed through during the flooding season resulting in meander cut-off and formation of ox-bow lake. Most dramatic change in UcayaliRegion in the last 300 years. As Ucayali River continued to change its course throughout the years, the river moved further and further away from Masisea each time.

19 96

Travel distance after cut off between Pucallpa and Masisea 7.5 km

SHIBIBO-CONIBO community is a group of indigenous people who moved away from Masisea to live in urban areas such as Pucallpa. Many people also fled from Guerrilla fighting in countryside to Pucallpa

PUERTO CALLAO PUCALLPA TODAY

The Shibibo- Conibo ommunity, 8 % of the registered indigenous population now reside in district of Pucalla, called Puerto Callao found along the shores of Yarinacocha Ox-bow lake that was formed due to the anthropogenic meander cut off in 1996.

20 17

Population of Pucallpa
200 people in 1900
400, 000 people today

Temperature

Economic activity

Case study site

FACTS ON THE YARINACOCHA OX-BOW LAKE

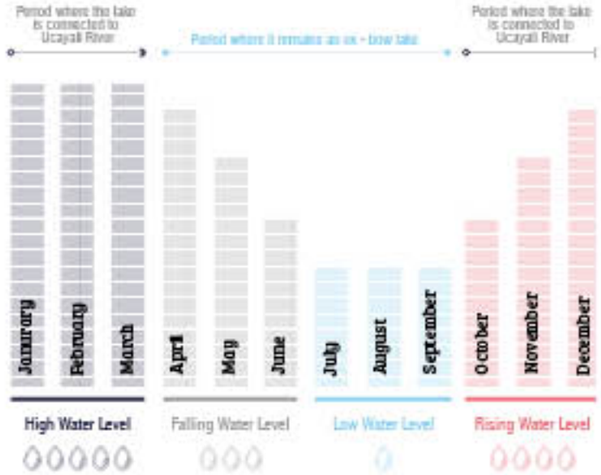
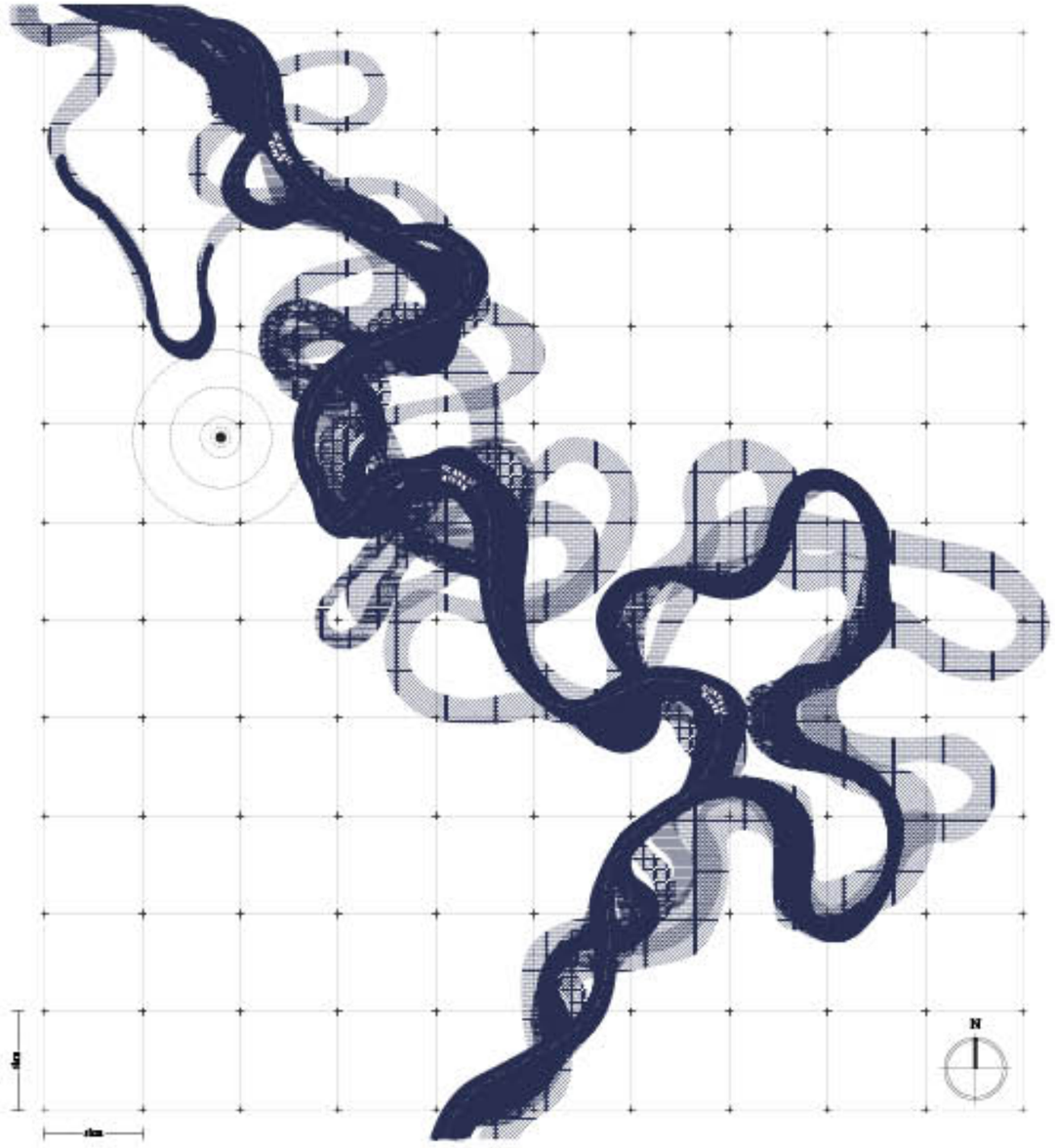
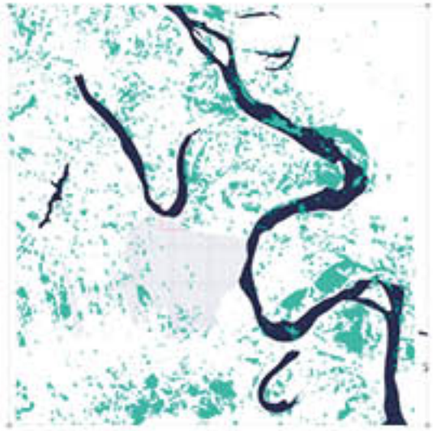


Table showing the water level of Lake Yarinacocha during the year

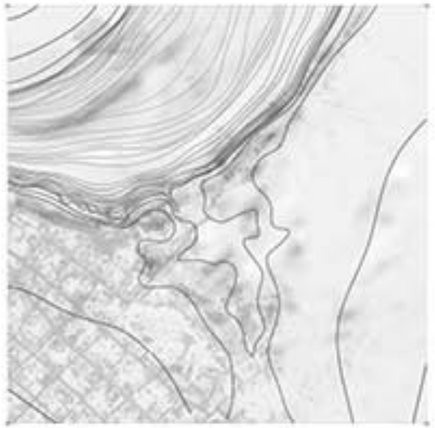
Schematic presentation of the area that is now occupied by many of the Shipibo- Conibo people who left Masisea after the meander cut off in 1996



Flood map

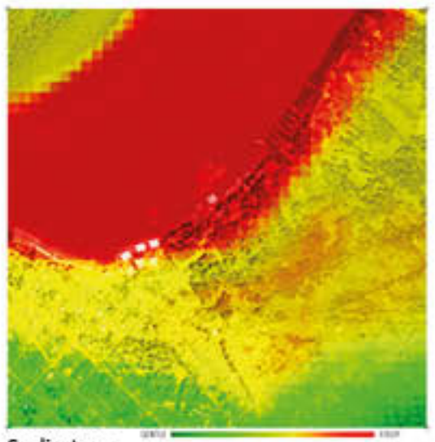


Deforestation

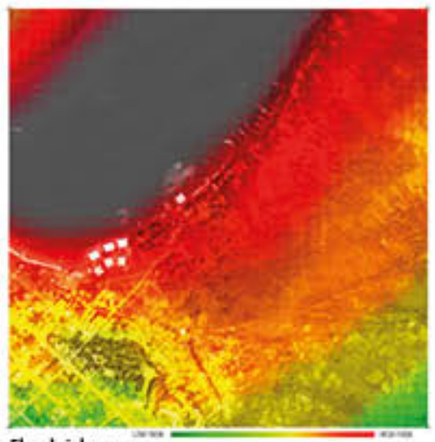


Topography map

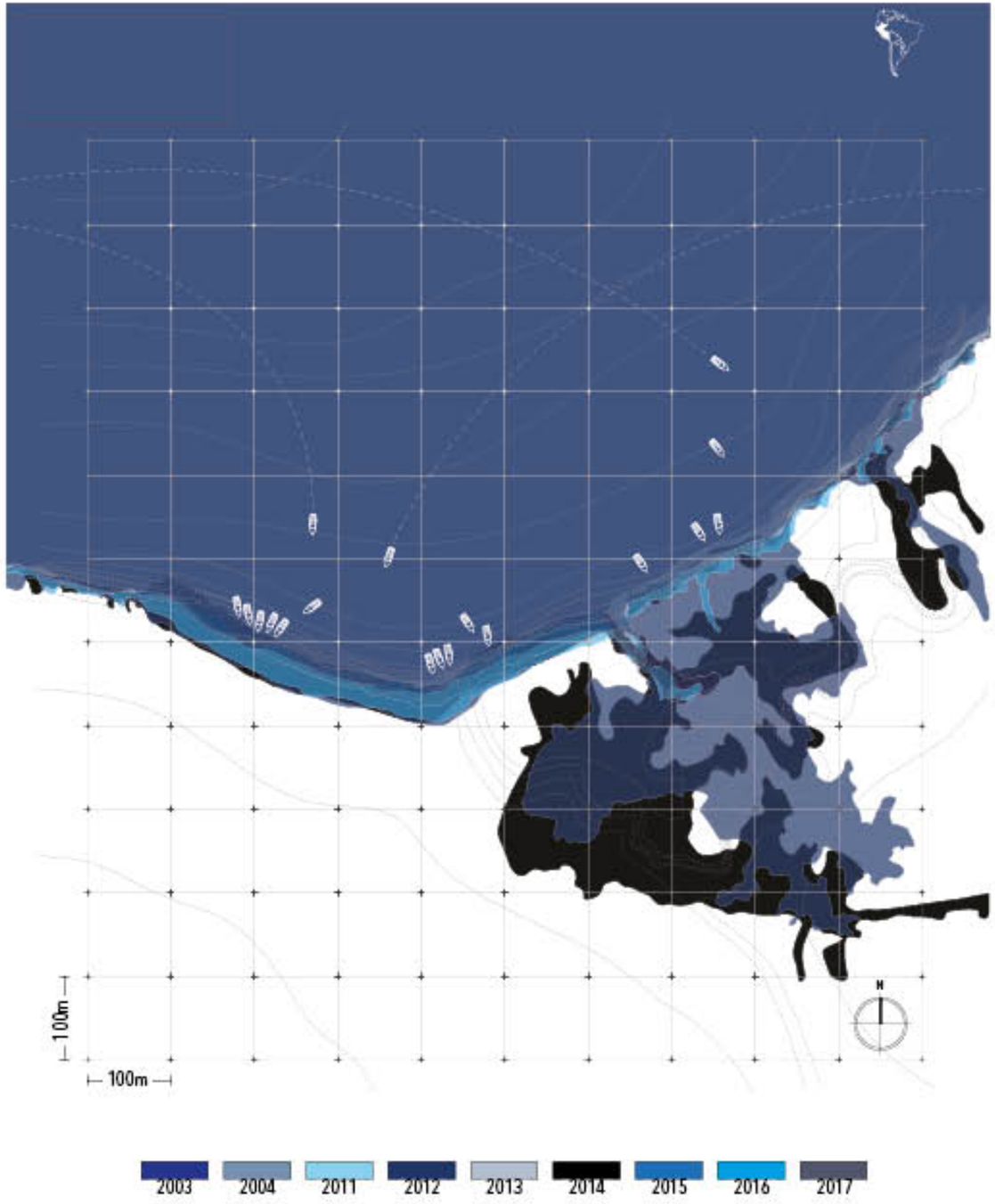
Water flow map



Gradient map



Flood risk map



1 LACK OF CLEAN WATER

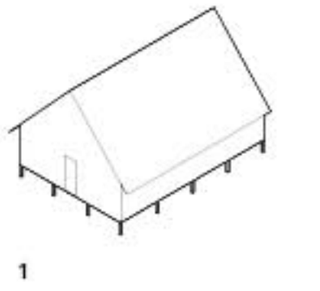
only 6 out of 10 homes have access to drinking water only 6 out of 10 homes have access to drinking water

2 EXCESSIVE SOLID WASTE

Source : characterization study developed by "Ciudad Saludable"

Physical composition of solid waste in the city of Pucallpa

COMPONENTS	PERCENTAGE %
Paper	1.52
Cardboard	1.10
Plastics PET	1.76
Hard plastics and plastic bags	8.64
Ferrous Metals	1.74
Glass	0.79
Pampers & feminine pads/ tampons	2.62
Batteries	0.58
Rubber	0.10
Wood	0.29
Leather	0.28
Bones	0.05
Textiles	1.62
Inert material (dirt, stones, etc)	4.64
Organic waste	75.28
TOTAL	100.00



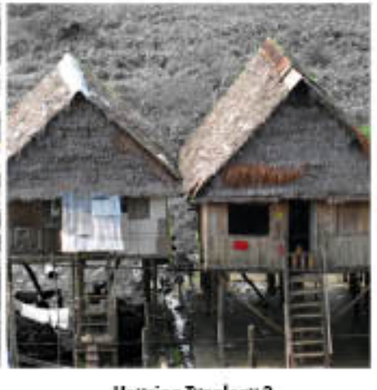
1

2

3

Housing Typology 1

Housing Typology 2



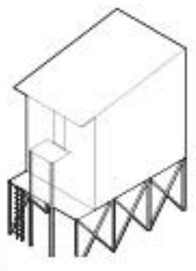
Housing Typology 3

3 FLOODING

EXISTING situation during LOW flood season

EXISTING situation during HIGH flood season

4



5

Housing Typology 4

Typical roofs houses made from palm leaves

Housing Typology 5

KEY FEATURES OF OFFLINE WETLAND SYSTEM

Introducing wetlands in the flood plain can play a number of roles i environment, principally water purification, flood control and shorel

OFFLINE SYSTEM

Offline wetlands are constructed adjacent to the main body of water. Water enters the large surface area of the wetland allowing it to spread out and helps stop heavy flows.

What are the processes of wetland?

PHYSICAL FILTRATION
Solid particles are filtered from the water

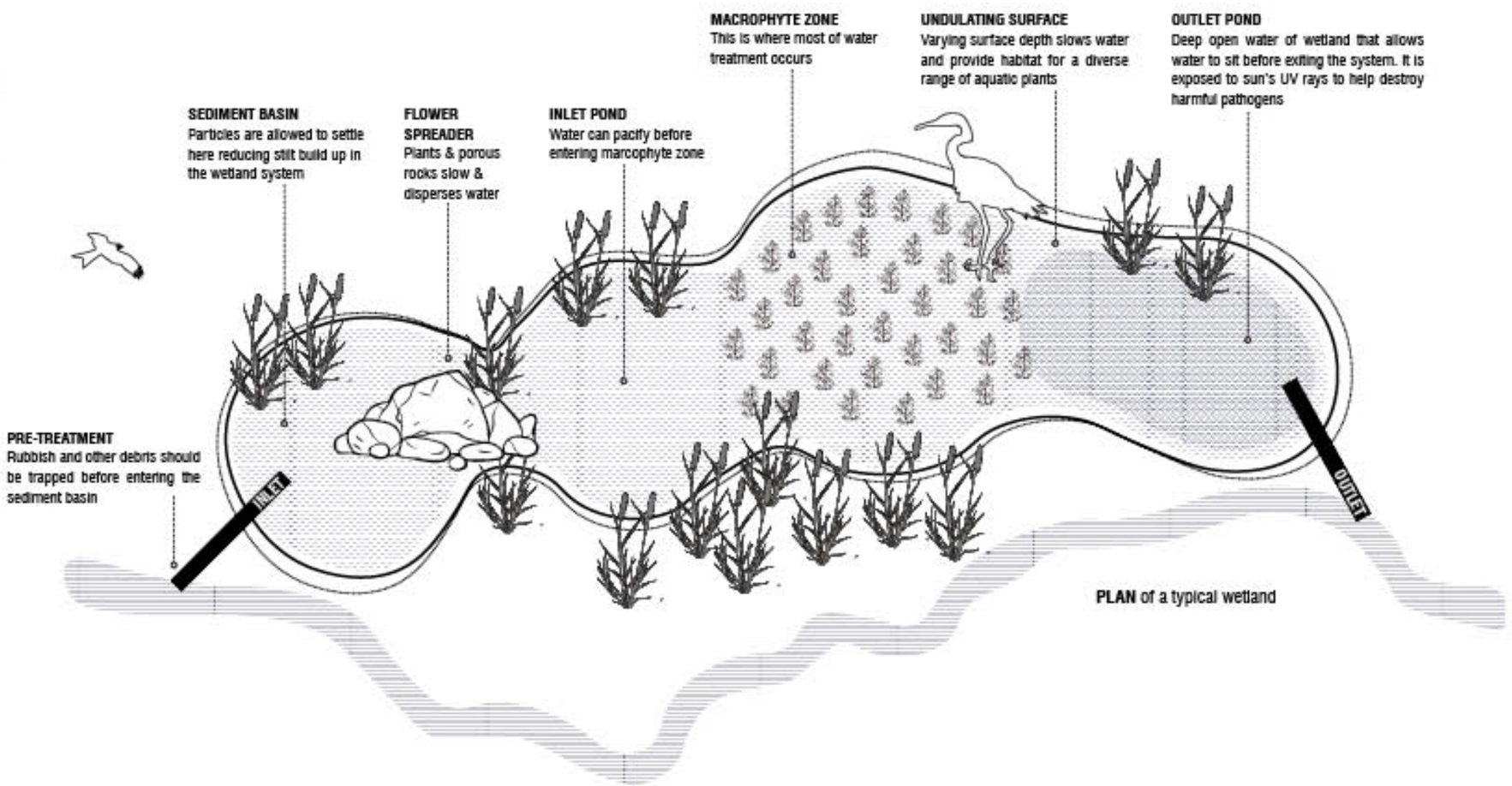
BIOLOGICAL & CHEMICAL FILTRATION
Dissolved chemicals and excess nutrients are trapped and absorbed by plants and microorganisms

POLLUTANT TRANSFORMATION
Microbes act as a biofilter to convert nitrogenous pollutants. Slowly moving water allows waterborne pathogens greater exposure to the sun UV's

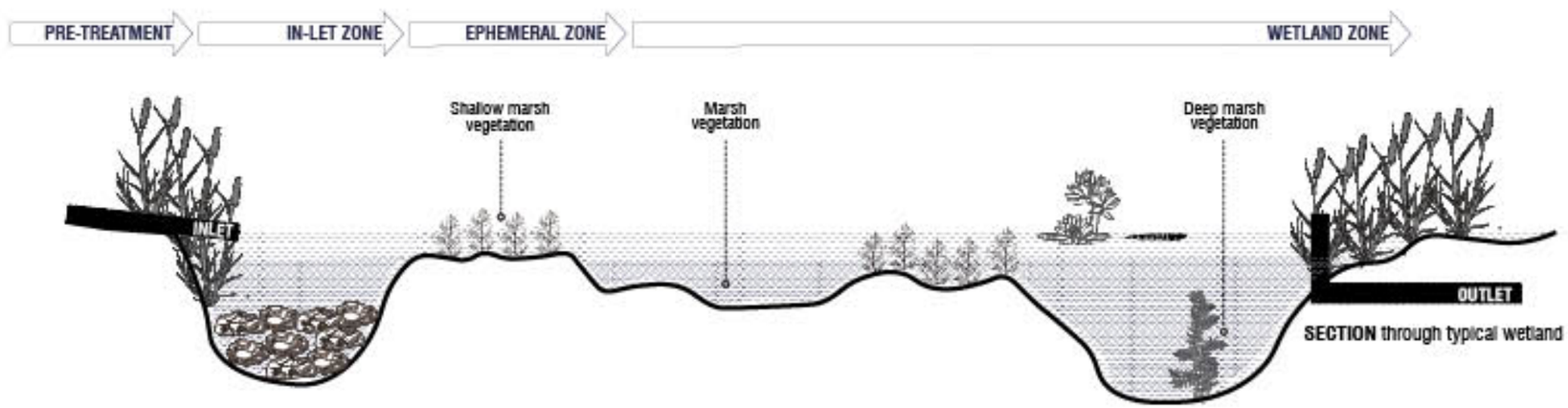
FLOOD, EROSION & FLOW REDUCTION
Wetlands hold large quantities of water and redice the amount entering stormwater system. The shape and vegetation also pacifies the water flow reducing the risk of flash flooding and erosion.

WILDLIFE HABITAT
Preserve natural ecosystems and create shelter and habitat for important animals, birds, fish and plants.

/ POTENTIALS OF THE OX -BOW LAKE / Environmental strategy



PLAN of a typical wetland



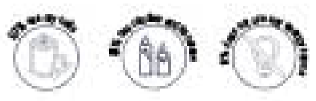
SECTION through typical wetland

KEY FEATURES OF ANAEROBIC DIGESTION

Energy usage for cooking in Pucallpa

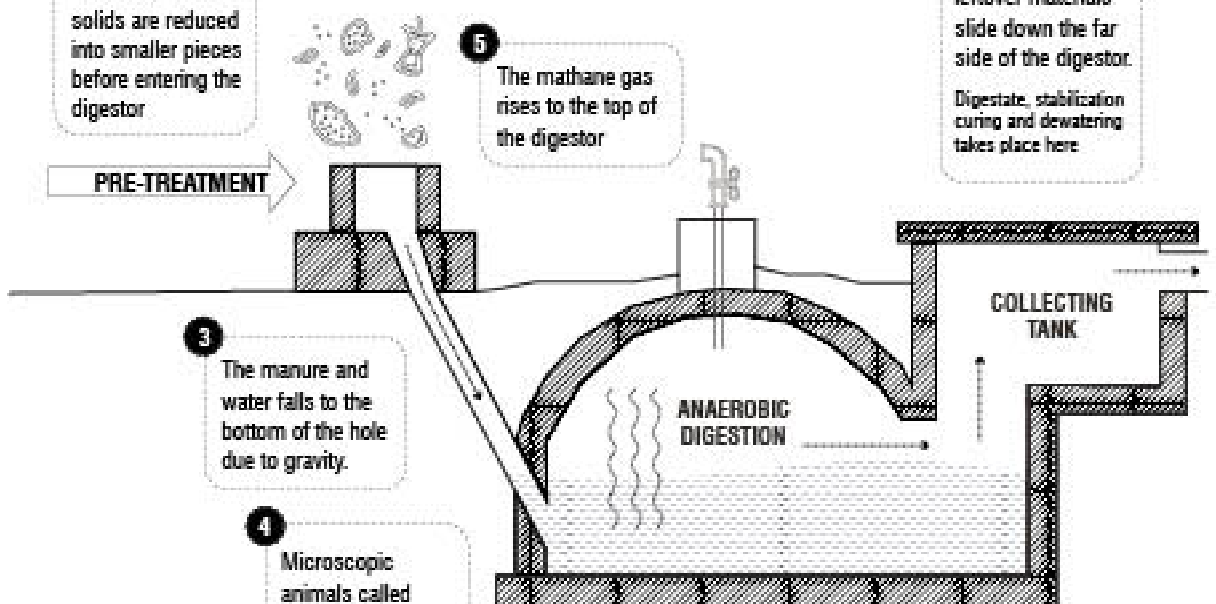
45 % of the community is not connected to the electricity grid

Energy usage for small appliances and lighting in Pucallpa



How much energy can be produced from waste?

Digesting 1 tonne/ 1000kg of food waste can generate about 500 kWh of energy; slurry is lower yielding and purpose grown crops higher.



1. **ORGANIC WASTE** is drained into macerator where solids are reduced into smaller pieces before entering the digestor

2. The organic waste is shoveled in and water is added into the digestor

   The main part of the digestor is an under ground hole with a bottom that slopes away from the inlet.

3. The manure and water falls to the bottom of the hole due to gravity.

4. Microscopic animals called microbes digest the organic wastes without presence of oxygen.

   As a by product, they emit a gass called methane.

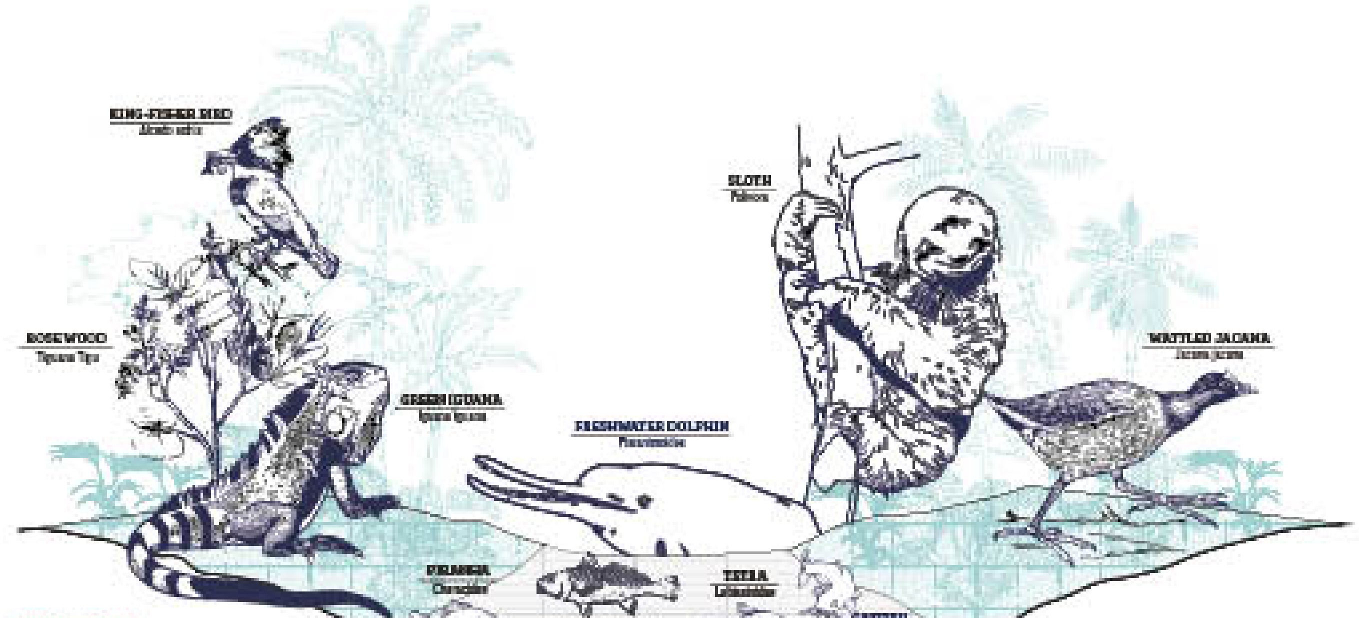
5. The mathane gas rises to the top of the digestor

6. A tube carries the gas from the top of the digestor into the kitchen.

   The tube is connected to a burner that can be used for cooking and can be turned on and off as needed.

6. After the methan gas is released, the leftover materials slide down the far side of the digestor.

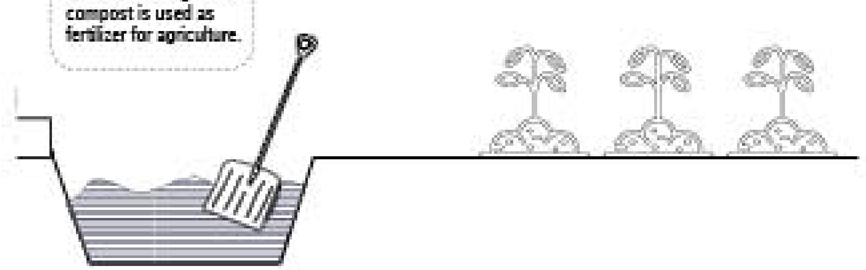
   Digestate, stabilization curing and dewatering takes place here



BIODIVERSITY OF LAKE YARINACOCHA

7. There is an openable cover on the outlet of the digestor where the leftover materials can be retrieved.

   The left over organic compost is used as fertilizer for agriculture.

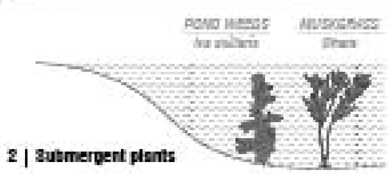


VEGETATION

Diversity in vegetation is an important aspect of wetland design. The marcophyte zone should have a minimum 80% coverage. There are 3 main groups of plants.

1 | Emergent plants

Plants that root in the substrate and grow above the water surface such as reeds and rushes.



2 | Submergent plants

Plants that root in the substrate and grow underwater.

3 | Floating plants

Plants that float on the surface and hang roots in the water to uptake nutrients.

Masterplan

Low flood season
Water flooding over swamps

Mid flood season
Water flooding over agricultural fields

High flood season
Water flooding over perennial crops

Functions

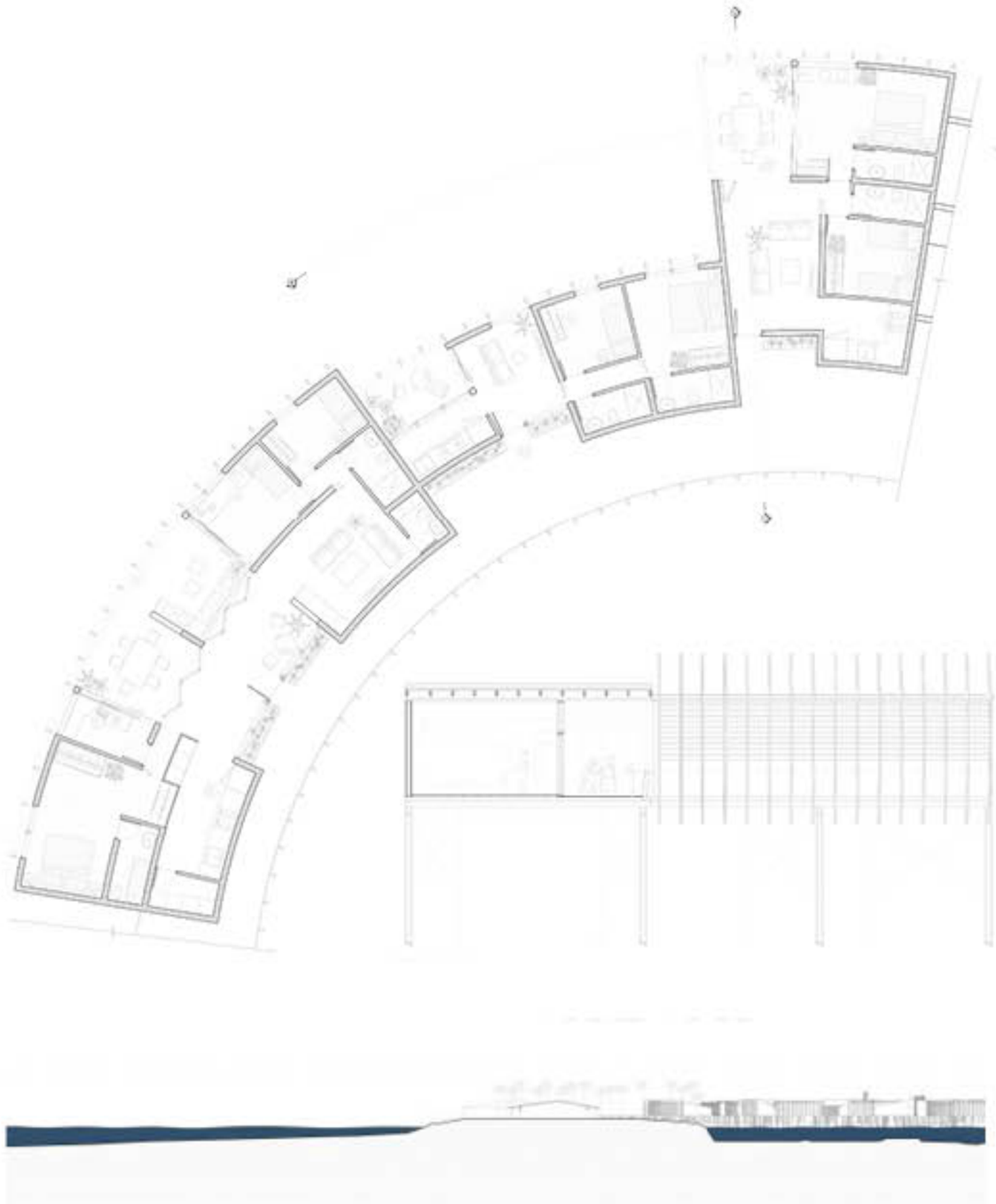
Private / Public

Access

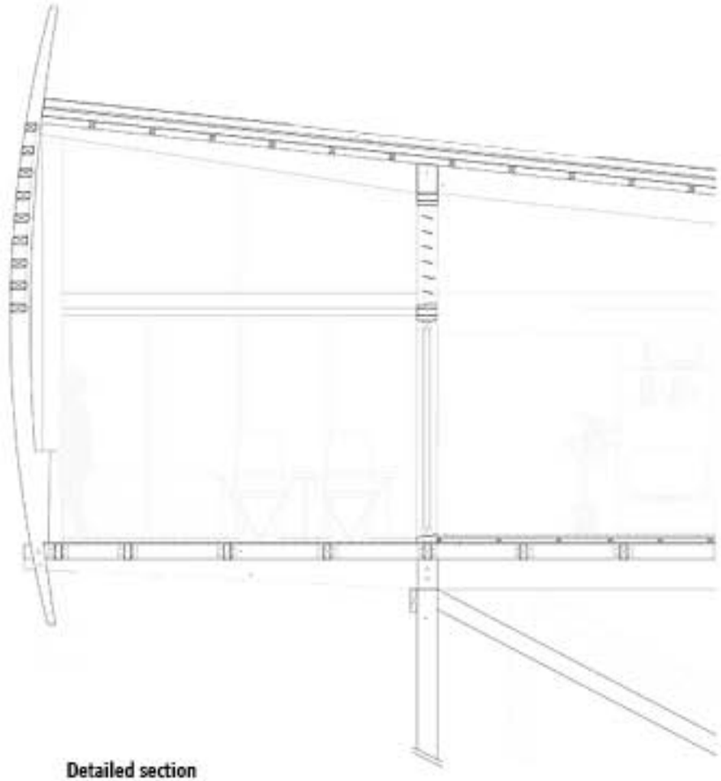
Wetland/Swamp/Agricultural fields

Proposal
1 Harbour: Introduce a formal port where locals and tourists can benefit from enhances security: overfishing and illegal transportation of timber can be monitored. 2 Agricultural fields. 3 Wetland. 4 Housing. Specific crops benefit from flood, help reduce impacts from flooding acts as water storage. 5 Woodland Integrate as part of the wetland ecosystem.

Section and plan



Housing units



Palm thatch
Fire-retarding membrane
Waterproof sprayed over palm thatch
75x50 purlins (600mm apart)
Cement beam filling
Timber rafter (1000 mm apart)

Timber framed pixel glass louvers
Treated timber header plate
Timber framed folding doors

100x22mm chamfered toungue and grooved floor finish
25mm sagex insulation
38x38 studs (600mm apart)
22mm shutter board

Galvanised steel plate
150x75 bearers (1000)
Timber cross beams
Timber joints
Customized timber shaders bolted to the chamfered timber joist
Twin 150x50mm timber column with 50mm gap and 150x150 spaces blocks

Detailed section

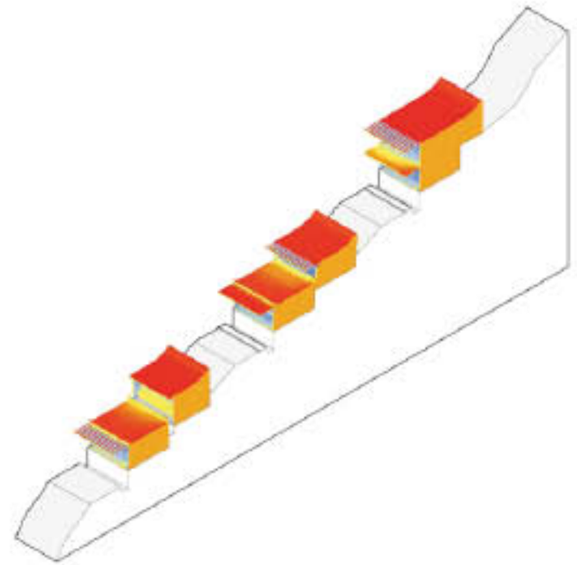
External view

DESERT INCUBATOR
La Rabita, Spain

The project, located in the direst region of Europe, seeks to integrate living and farming environments to create a hybrid building typology, where resources are shared, inputs & outputs exchanged and where a mutually beneficial coexistence with the delicate surrounding environment can be achieved.
The guided expansion of ultra-profitable hydroponic farming in the context of La Rabita, is key to stimulating the local economy and preserving natural ecosystems. The diminishing fresh water supply is one of the main concerns facing new development in the region. The proposed scheme aims to generate its own water resources and in so doing replenish the already desert-like environment.
The project looks at three possible options to expand growable areas in the different geographical regions found at the site: terraced development - on the steep mountain slopes, vertical development - on the flat plains, floating development - on the sea.

These opportunities highlight the variability of terrain and give an appropriate, unique identity to each area.
The terraced developments focused on in the proposal, considers existing models of living and farming, while integrating advanced building techniques, cooling systems and Food, Energy, Waste strategies. The moulded form of the terraced structures, follows an optimisation of air circulation, to maximise fresh water production and cool temperatures in growing and living spaces. Living spaces inside and outside are almost equal in dimension, following local climatic conditions and traditional living in the south of Spain.
Streets and access routes run between structures, connecting the development along its contours. The salt water canals are integrated into the street landscape, allowing evaporative cooling to humidify the shaded, lush zone. This micro-climate will increase biodiversity and make the arid landscape more liveable.

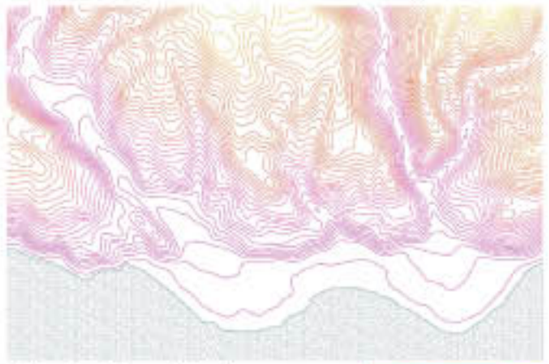
Jacob Holman



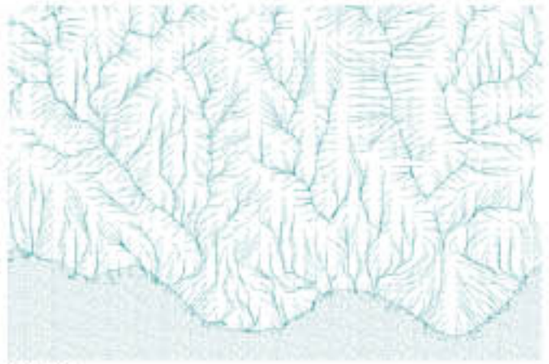
Campo de Dallas Area & Surrounding Coastline

La Rabita, Spain / Agriculture is a significant user of water resources in Europe, particularly in Spain, where the land cultivated by irrigation in 1999 covered 3.7 million ha, that is, 14.5% of usable agricultural land and 55% of total agricultural production. Irrigation today represents 80% of the total water demand in Spain and nearly 90% of actual water consumption. The Almeria and Granada coastline of the Tabernas Desert, is the epicentre of southern Spain's two billion-Euro a-year agricultural industry. Located in Europe's driest desert, this region has the greatest concentration of greenhouses in the world: 'el mar de plastico' extends over 22.000 ha in the Campo de Dalias area, producing millions of tons of produce for European markets every year. Because of the system's rapid growth and success its development has led to a number of environmental, social and political problems induding; contamination of water and aquatic ecosystems, salinization and decrease of groundwater sources, pollution of ground surface area, erosion, desertification and racial segregation.

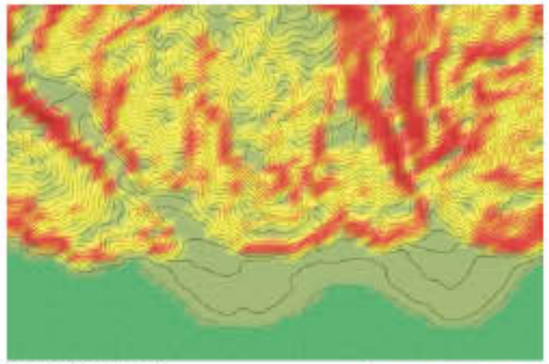
Current situation



Contour height map [10m]

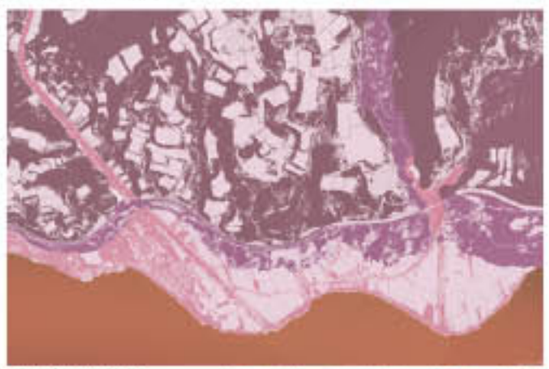


Water flows map

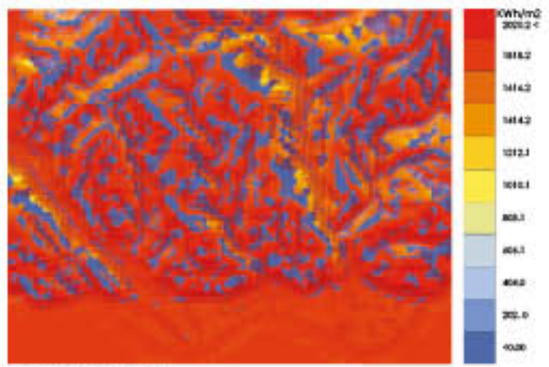


Slope Gradient map

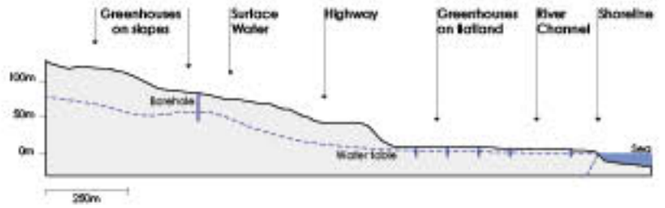
Temperature Gradient map

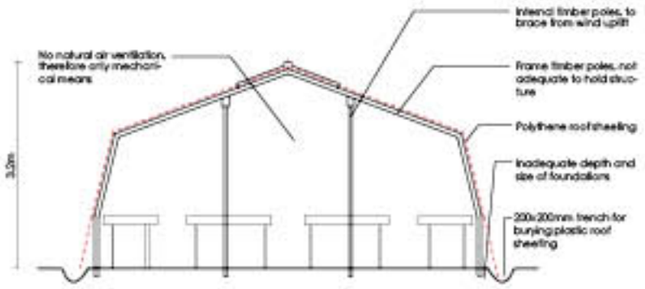


Soil salinity map

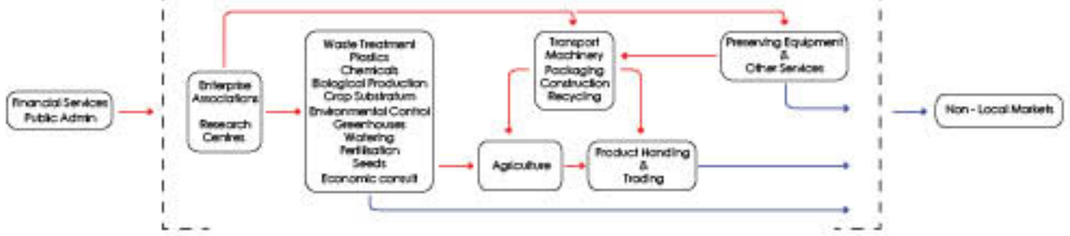


Soil radiation map





Steep Gradient Hillside settlements
-Follows the contours where available
- Cut into the earth to create flat land for construction
- Creates an organic pattern of development
- Greenhouses separated by steep slopes and scattered
- Landslides and Rockfalls are frequent
- Dimensions: (20m x 160m) Long & thin



Wild Olive

Saltwart

Esparto grass

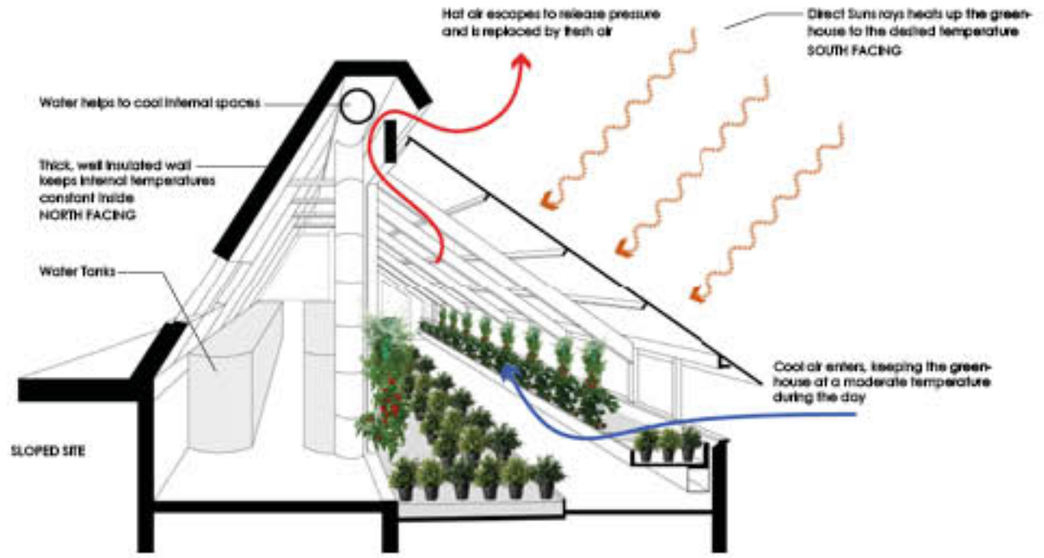
Marsh Rosemary

Jujube Tree

Sea Lavender

Prickly Pear

Agave



Ideal greenhouse conditions in la Rabita Hydroponics are favorable because they require less water, nutrients and water recydable, less maintenance of soil, easier to prune and pick, produce higher yields, no need for pesticides, less space required, environment and pest control.

Controlled Temperatures: Day 24 - 29C, Night 16 - 24C. For optimal growth and minimized plant disease

Spacing: Distance between plants depends on species. This effects air circulation, lighting and accessibility for pruning.

Lighting: Artificial light is needed during winter months. A balance must be found between heat and light infiltration.

Relative Humidity: Day 60 - 80%, Night 80 - 95%. This is important for water intake and decrease of plant disease

Tomato

Zucchini

Cucumber

Strawberries

Peppers

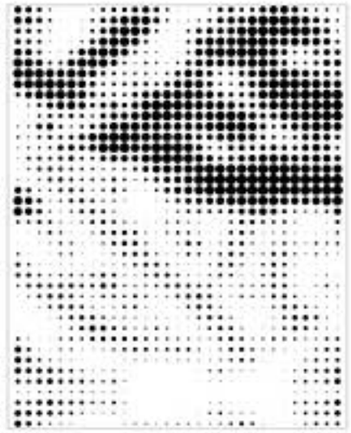
Watermelons

Greens beans

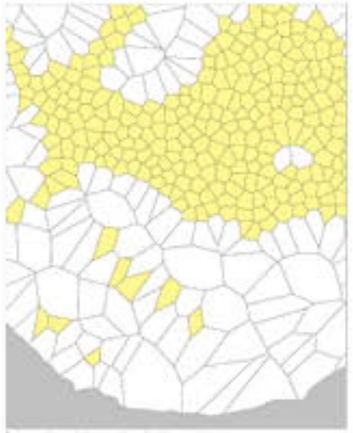
Melon

Eggplant

La Rabita and surroundings

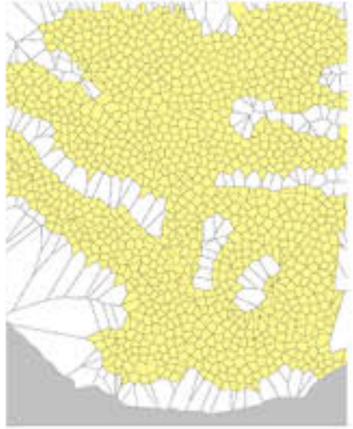


Intensity of Solar Radiation - Point display



Intensity of Solar Radiation - Pattern

Water Proximity - Point display



Water Proximity - Pattern

Development Areas

The Site was analysed with all its existing conditions; roads, waterways, buildings, productive, open space, solar radiation, slope inclination, prominent geographical features. On the layers of slope indination and solar radiation, the optimal places to build within these conditions were highlighted and overlayed over one another.
Where these areas overlapped formed the basis of the waterway system route. The route combines these areas as well as the quickest route from the highest point on the site to the lowest at a gradient of 1% (1m down for every 100m across). An area around the water channels was determined and a new buildable land area was produced.

Water system

Greenhouses

Natural areas

Accessibility

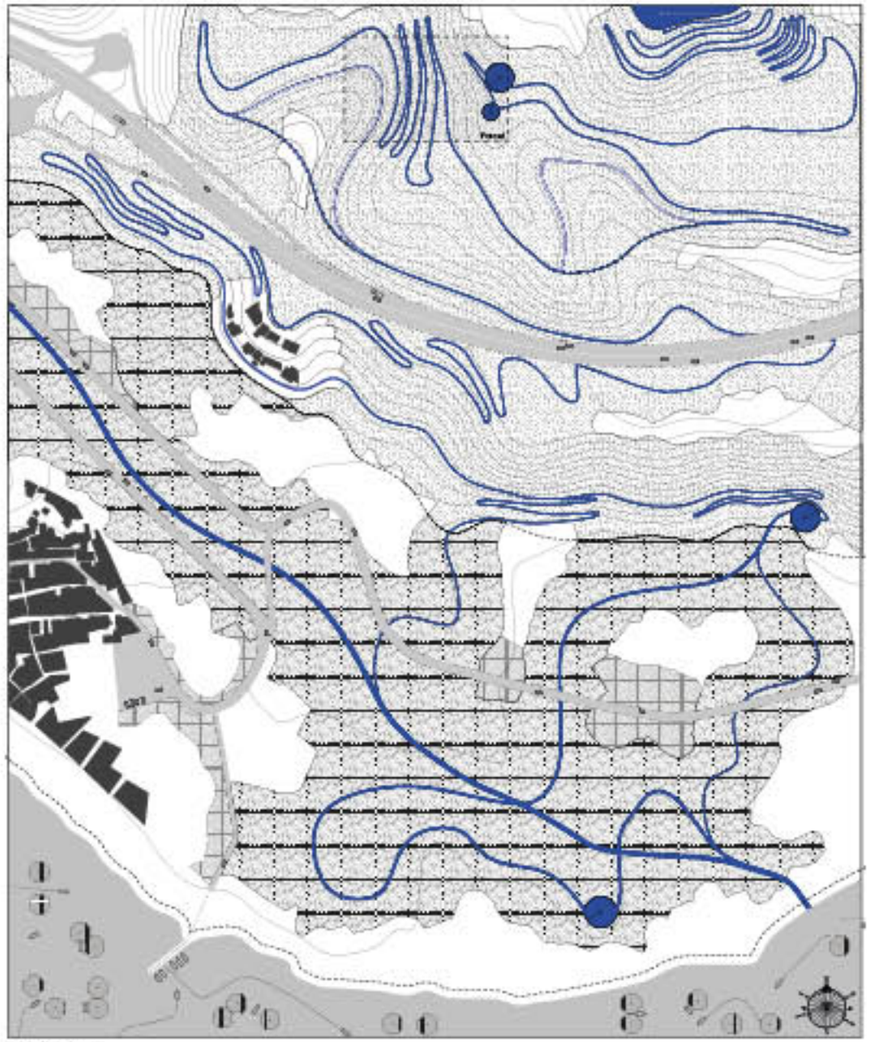
Creating A Water Channel - Salt Water Greenhouses will attach to this system

01
terraced development - mountainside

02
vertical development - flat land

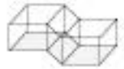
01
floating development - sea

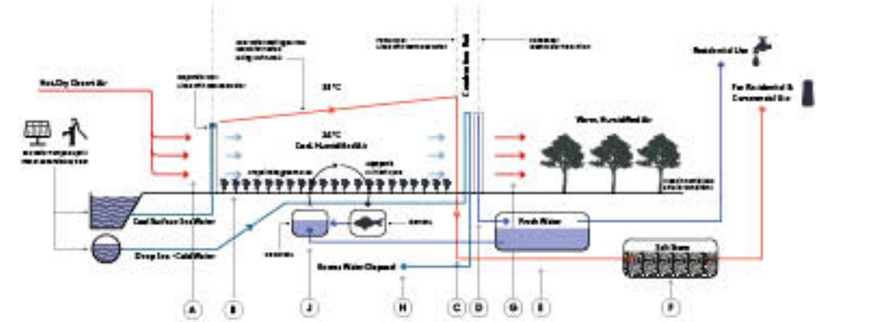
Site section



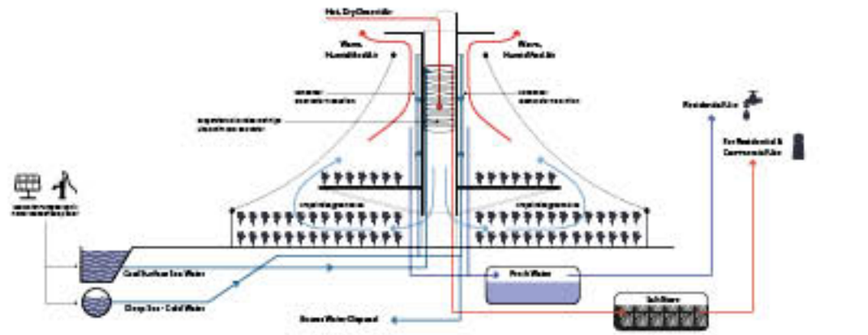
Masterplan

01 Terraces

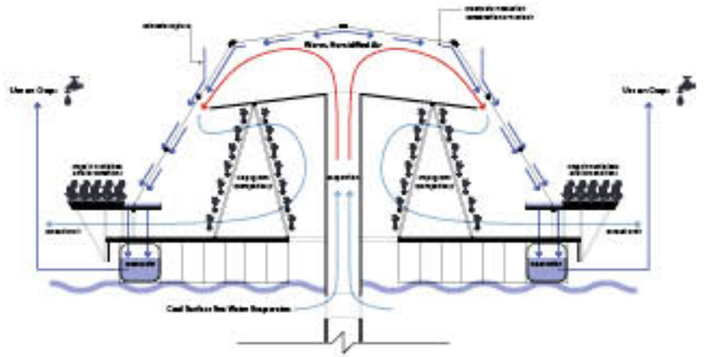




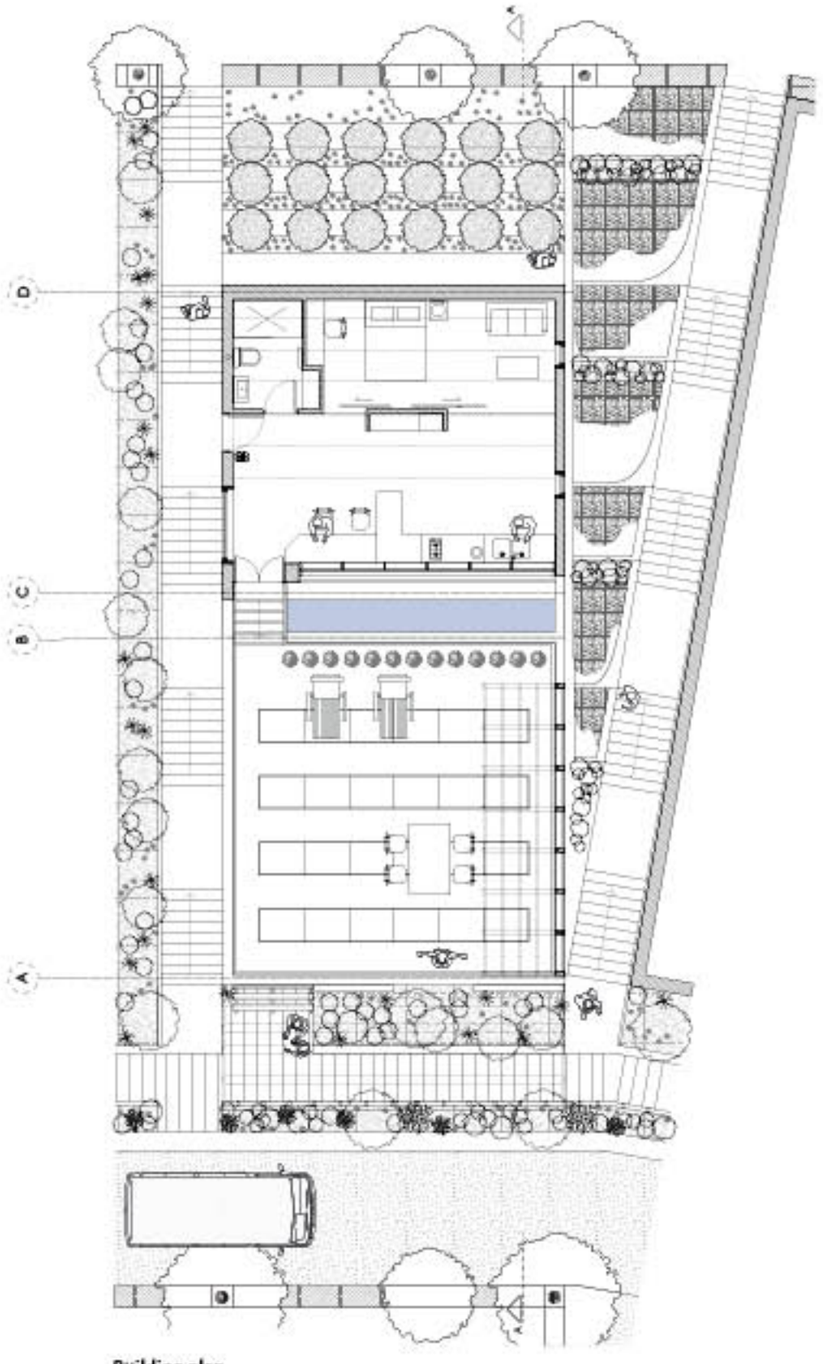
02 Vertical



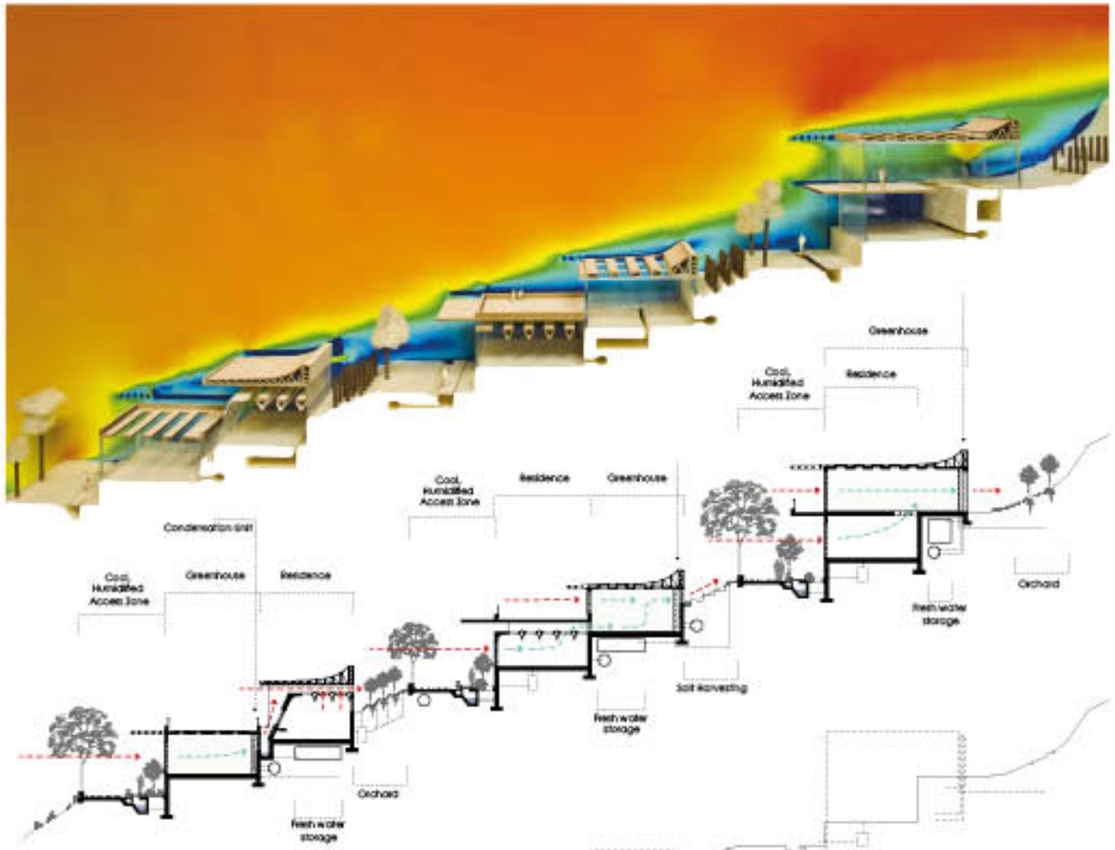
03 Floating



Parcel development



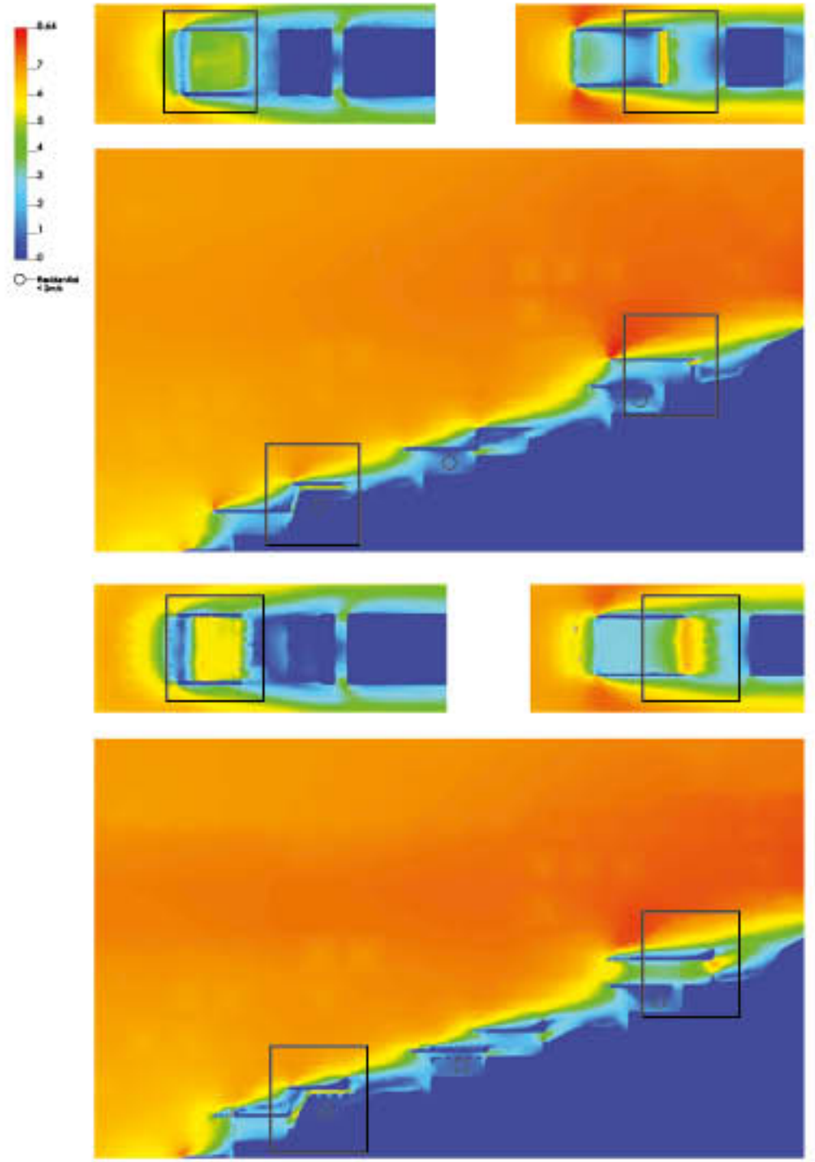
Building plan



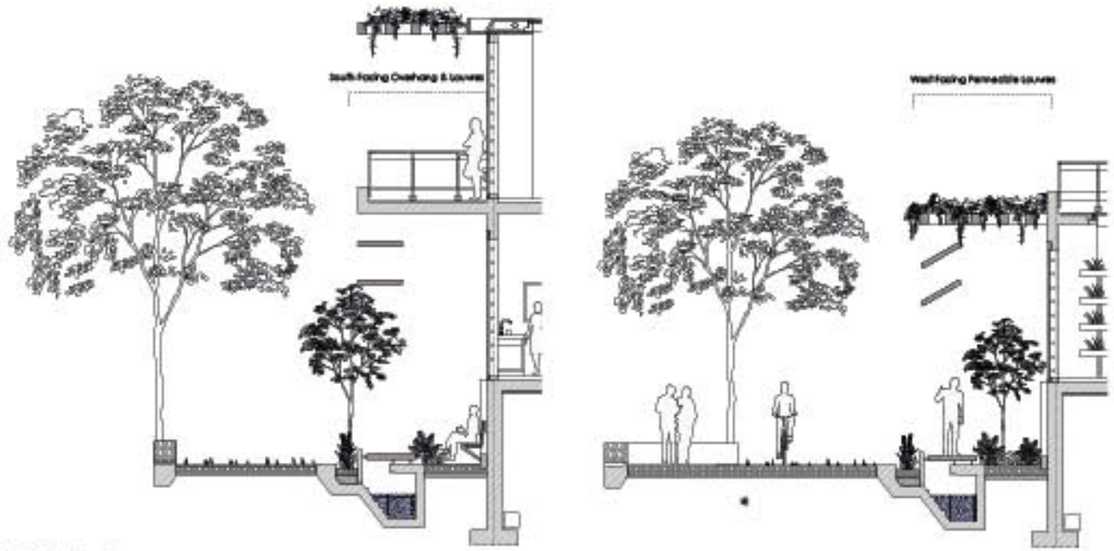
All elements overlaid

WATER cooling & humidification system

AIR temperature & flow, generating fresh water



Wind flow & solar gain analysis - CFD :
The site parcel subjected to a wind speed of 6m/s showing different results when changing the shape of the roof structure



Detailed section

/ DESERT INCUBATOR / Building performance

Section

MYCELIUM NEST

Phu Do, Vietnam

Phu Do is a village in Hanoi, Vietnam, which is famous for its tradition of noodle making. However, the village is facing the problem of pollution from noodle production activity.

This bio-pollutant with nitrogen and phosphorus as its components has caused the eutrophication of water body, which is invisible inside the village but evident in the outside canal receiving waste water from the drainage.

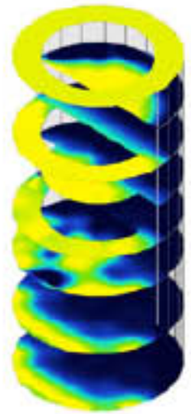
The aim of the project is to deal with the issue by using an environmental and sustainable approach. Mycelium, the subterranean part of mushrooms, is brought in with its symbolism on the invisible pollution and, at the same time, as a organic solution to the pollution. Aquaponic system, with its vertical mechanism of circulating waste water, is also introduced due to its high efficiency on pollutant transformation and food production. In this project, mycelia and aquaponic system are working together based on the mutualistic symbiosis of mycelium itself and the root of plants.

At the architectural level, an adaptable solution is carried out regarding the site as a whole. A system of mini towers, the "Mycelium Nest", are plugged in the village. In order to solve different level of pollution, the tower requires vertical flexibility based on the parameters which determine how many layers are enough for the acquaponic system to purify a certain volume of waste water.

The project concerns not only the problem of pollution, but also the life style and living condition of the inhabitants in this area.

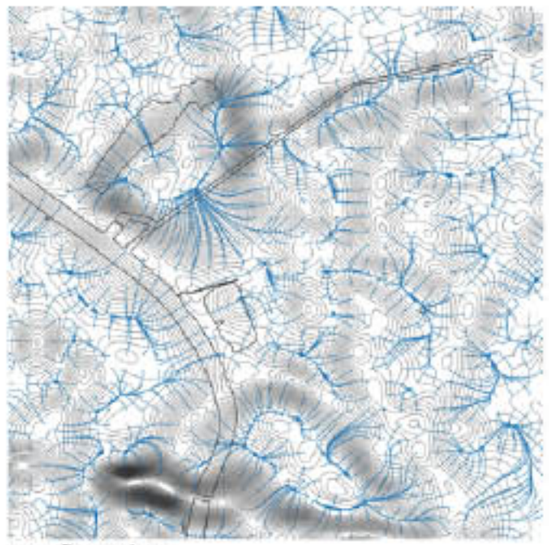
The program in the tower is distributed based on its location, amount of direct sunlight, and the living habits of the villagers. To allow for flexibility in height, the tower is constructed with a prefabricated, fast assembled and randomly looking wooden skeleton. The structure also simulates the growth of mycelium, working as armature for the mycelia to grow, naturally generating a gradient differentiation on the facade correlated to the variation of direct sunlight.

Wenjun Zeng



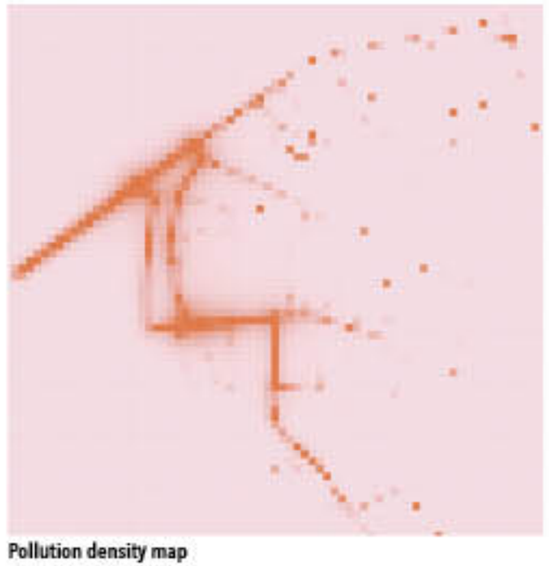
Acupuncture approach / The village of Phu Do in Hanoi, Vietnam, famous for its tradition of noodle making, is facing the problem of pollution from noodle production activity. The project attempts to resolve the issue by identifying critical points in the village based on in-depth analysis of pollution sources.

Satellite image of village



Water flow analysis

Existing drainage system



Pollution density map

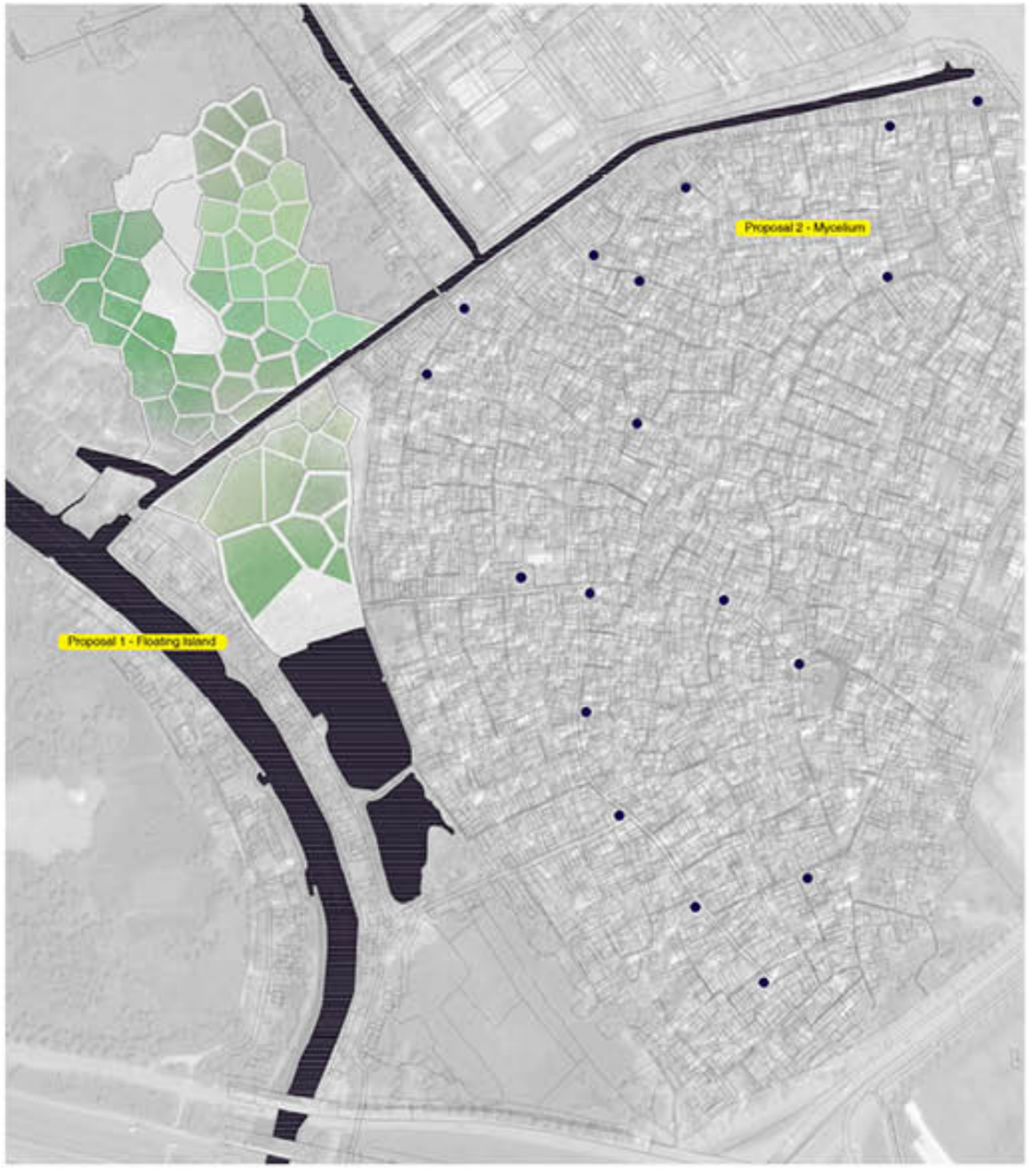
Noodle making process

Building density analysis map

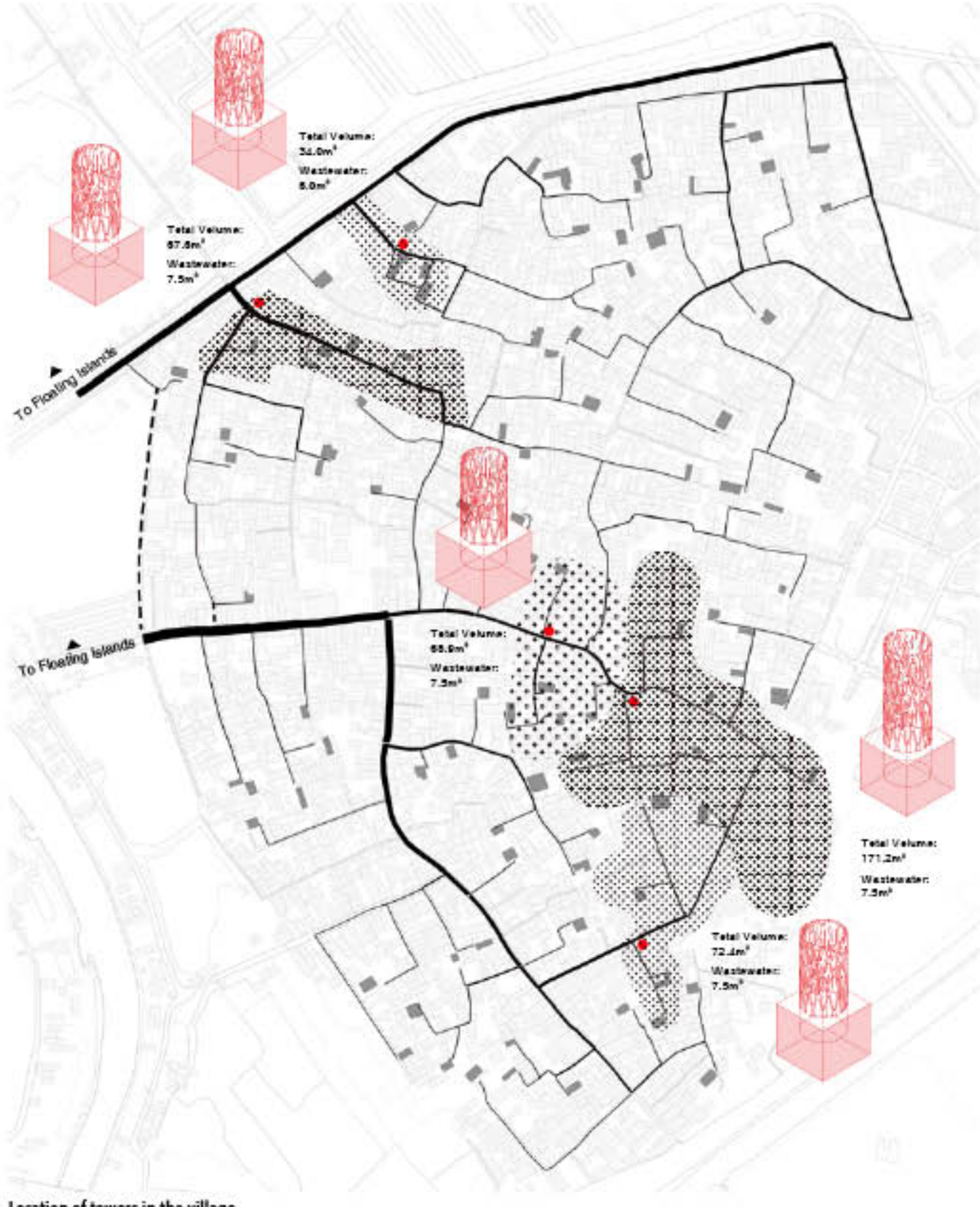
Drainage system analysis map

Volume of polluted water BEFORE purification

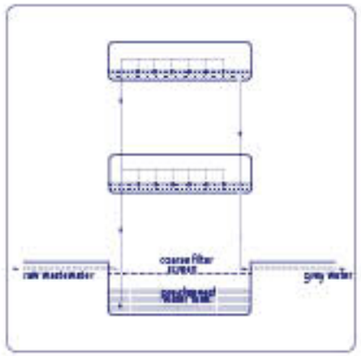
Volume of polluted water AFTER purification



Masterplan proposal: intensive acupuncture in the village and extensive purification in outside area



Location of towers in the village

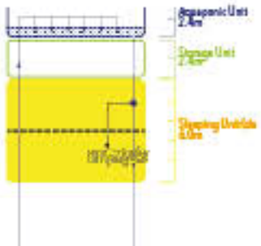


System evolvement

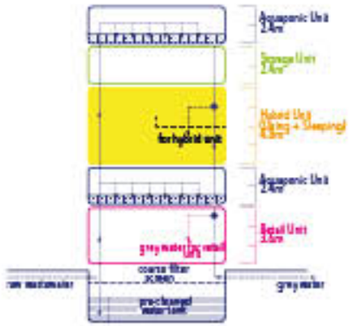
For flow rate, 2 gallon per minute, which equals to 30m³ per hour, could be a proper value in non-commercial aquaponic system.
If a 30cm grow bed is adopted, the time for filtrating water is 1 ~4 hours regardless of the area of the grow bed. Basically, there are at least 2 layers to complete the process of purification.
The volume of water tank should be at least the water consumption of the area per day which is calculated by the equation below:

Daily water consumption = population in the area x 0.18m
(Average water consumption/day/person)

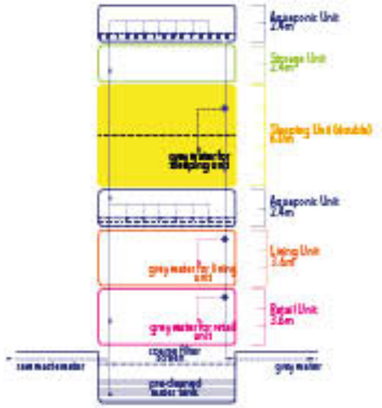
For ? persons
Total height: ? m



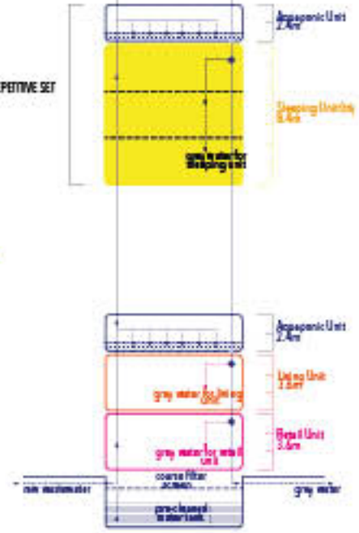
FOR 1~2 PERSONS
For 1-2 persons
Total height: 15.6m



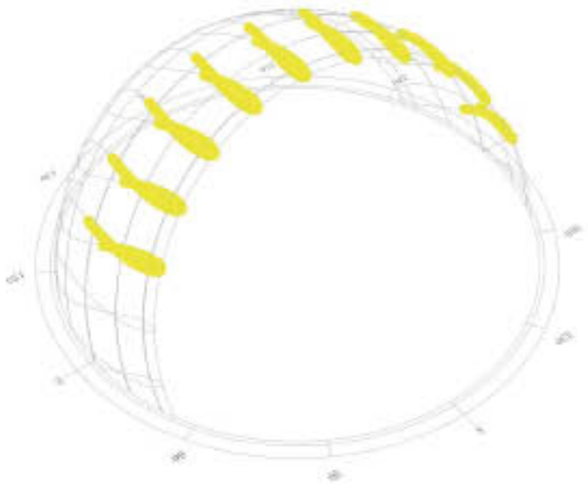
FOR 2~4 PERSONS
For 2-4 persons
Total height: 20.4m



REPETITIVE SET

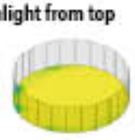


Building section

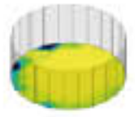


Sun path analysis

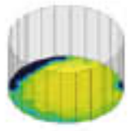
Sunlight from top



Floor height: 2.4 m



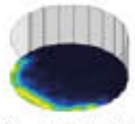
Floor height: 3.6 m



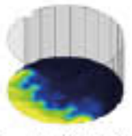
Floor height: 4.8 m

Sunlight form souther side

Floor height: 2.4 m



Floor height: 3.6 m



Floor height: 4.8 m

Direct sunlight testing
Testing 1 - single floor
Period summer (Apr. 1 - Sept. 30)
Minimum direct sunlight: 6 hours

Direct sunlight testing: SINGLE floors

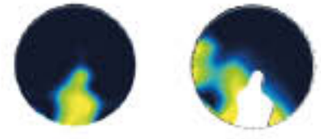
Direct sunlight testing: MULTIPLE floors

Roof

Roof-1F

Roof-2F

Roof-3F



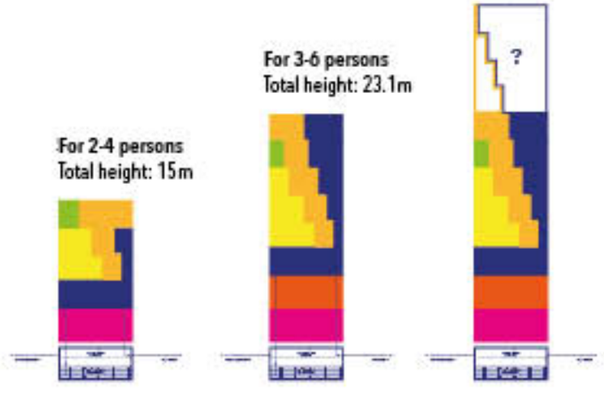
Roof-4F

Roof-5F

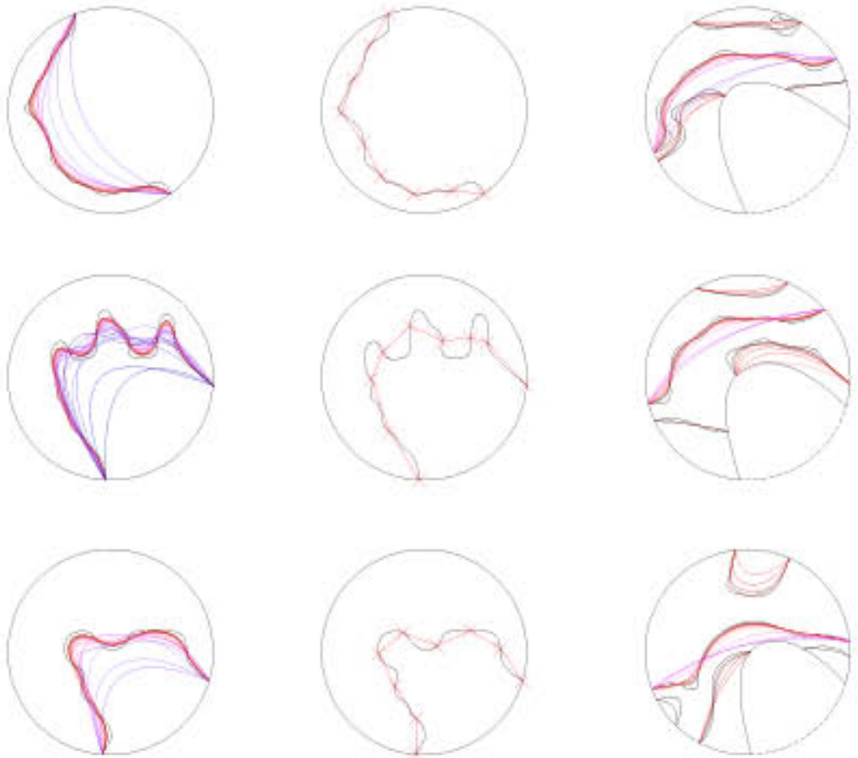
For ? persons
Is it possible?

For 3-6 persons
Total height: 23.1m

For 2-4 persons
Total height: 15m



Direct sunlight



Sunlight

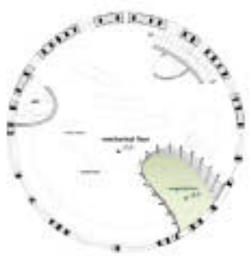
Structure

Plan

3rd floor plan

Roof plan

Ground floor plan



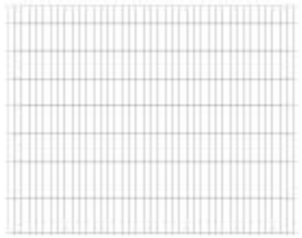
2nd floor plan

6th floor plan

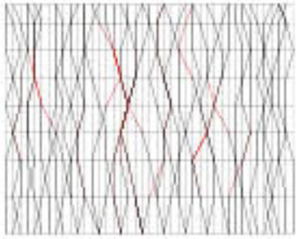
Basement floor plan

1st floor plan

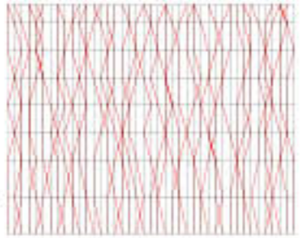
5th floor plan



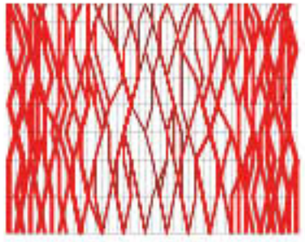
01 Unfold the cylinder
Divide the surface into
2.4m x 0.7m grids



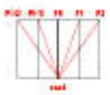
05 Add connection: Where there is no enough substrate for mycelium to grow

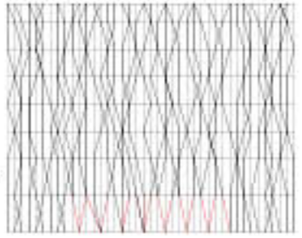


02 Create a path from bottom to top: Each intersection points at the bottom is regarded as a seed, when moving upwards,it only reach the point [-1,1] as illustrated.



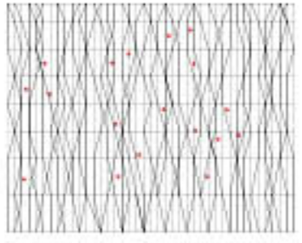
06 Create continuous differentiation according to the growth of mycelium



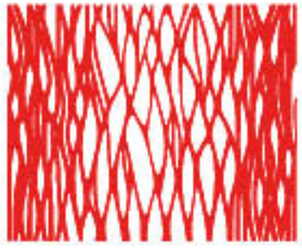


03 Create openings for the ground floor: In this case the seed can reach point [-2,2] of grid line 1.

07 Smoothen the joint to simulate the form of mycelium when is growing together.



04 Create openings on the facade: In this case the seed can reach point [-2,2] of the nearest grid line.



08 Adjust the shape on the ground floor: for better bearing load

External view and digital model

/ MYCELIUM NEST / Visualization

The sentinels
The presence of the purification towers emerging from the roofscape of a traditional village is quite striking. They announce the silent work of plants filtering polluted water and a reminder of the invisible forces on which our survival depends.

REVERSE DESERTIFICATION

Cyprus

The island of Cyprus is suffering with desertification. During the summer times the temperatures reach 45 degrees and during the whole span of a year the rainwater accumulation is far from sufficient for the island. It can be resolved if new theories are proposed, visualized and applied. It is the accumulation of rain and its distribution that can define and revitalise the island.

At the early stages of the project we were focusing on the existing agriculture's need for water and later a community emerged. Housing, courtyards, gardens and new agriculture was introduced with a functional roof that distributes water.

The project started with the visualization of GIS-data into an informative and communicative way to bring awareness to non-experts on desertification effective layers. The main aim was to introduce guidance and proposals on the matter of rainwater collection, saving and distribution. The geoportal website of the Cypriot Government provides a great amount of GIS data and all are open-source.

It is from there that we take initiative and on the way to developing a software that brings awareness on environmental issues concerning Cyprus.

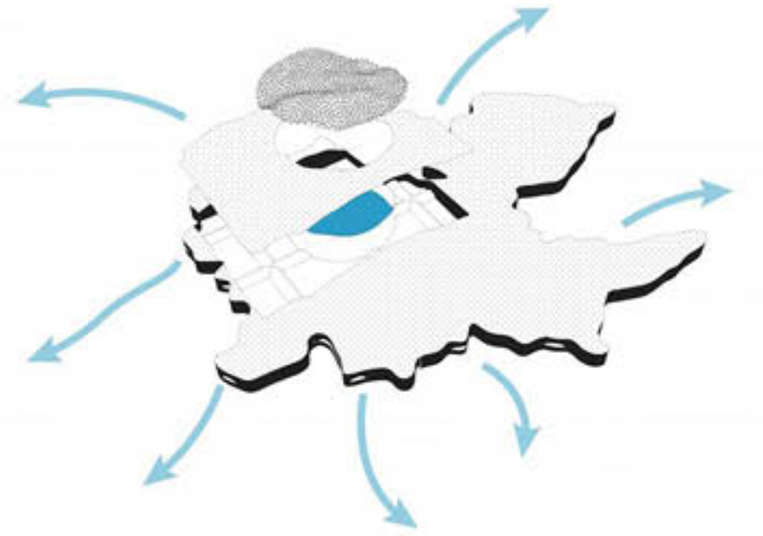
The housing units derive from an algorithmic exploration on traditional houses in Cyprus.

Morphologies were created based on the attributes that a house offers. Depending on the needs of each room (light, ventilation, privacy, greenery) the algorithm unfolded a massive amount of housing typologies.

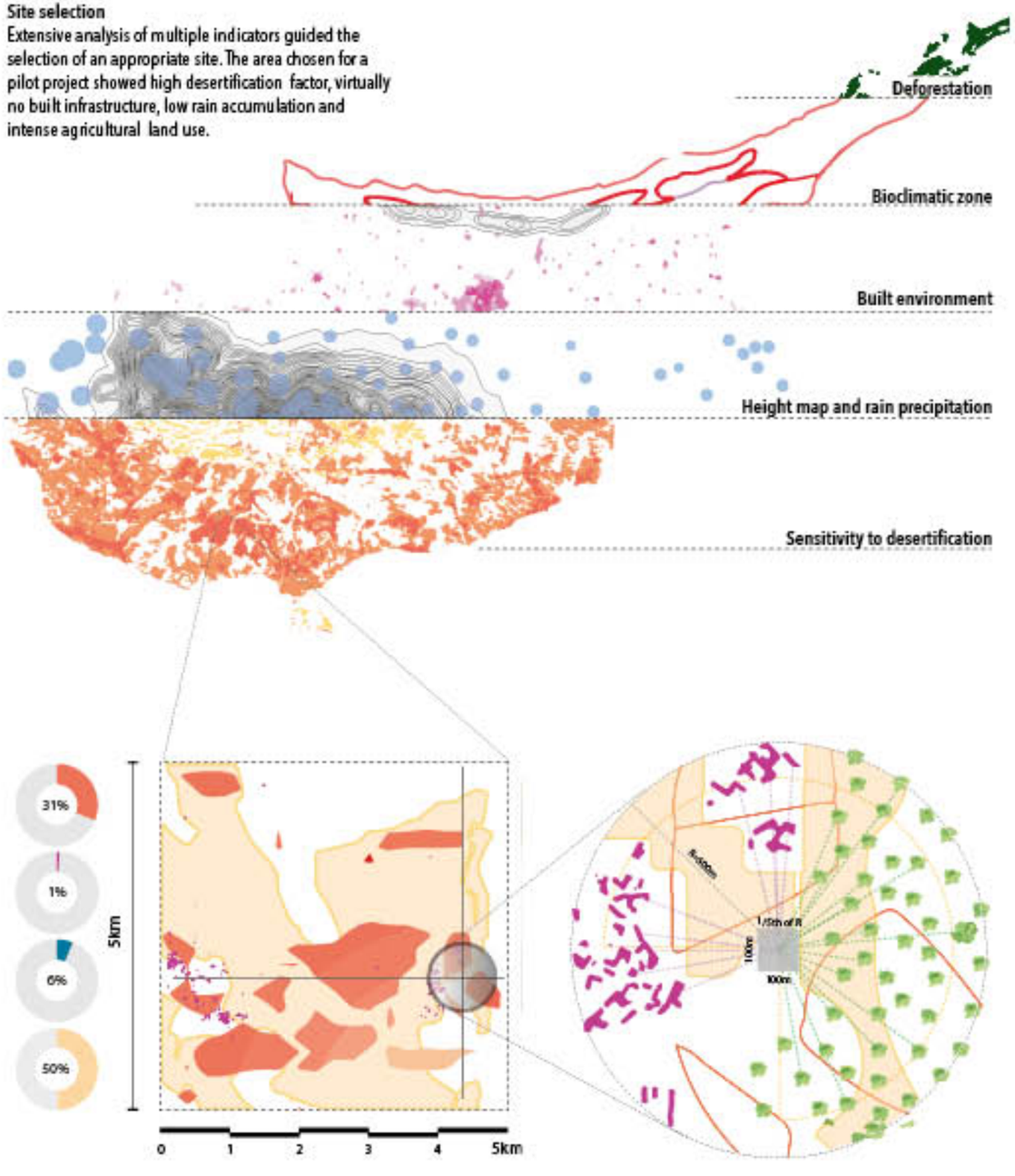
By adding yet another layer of parameters (ratio of housing and courtyards, ratio of rainwater collection and greenery etc.) the algorithm produced the appropriate design.

It is the combination of working manually and parametrically that brings together the best functional, spatial and aesthetic proposal. From the result of the masterplan algorithm we apply our knowledge on architectural composition for the final touches (accessibility from all sides, eliminating dead corners etc.). The structure is altered and calculated as it goes along up to the final stage. It is then tessellated into prefabricated elements. The dimensions are based on the production and transportation guidelines communicated with the manufacturer.

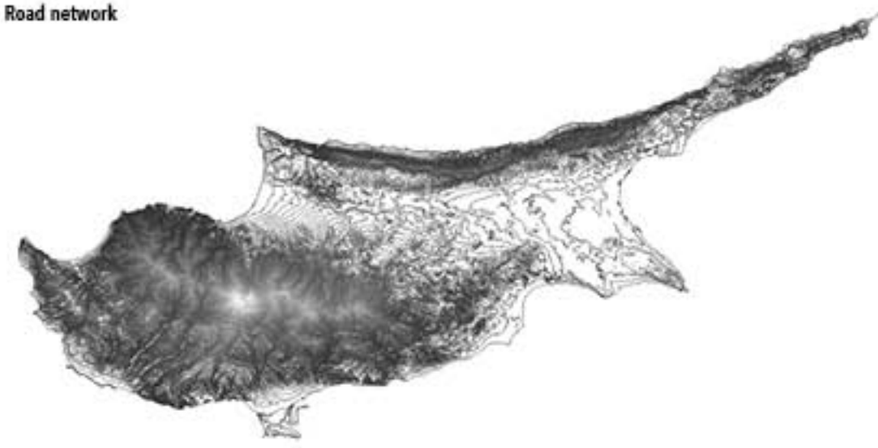
Marios Messios



Site selection
Extensive analysis of multiple indicators guided the selection of an appropriate site. The area chosen for a pilot project showed high desertification factor, virtually no built infrastructure, low rain accumulation and intense agricultural land use.



Road network

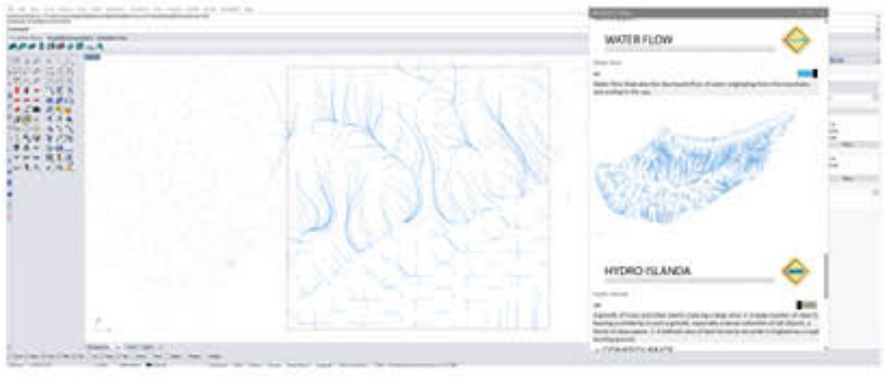


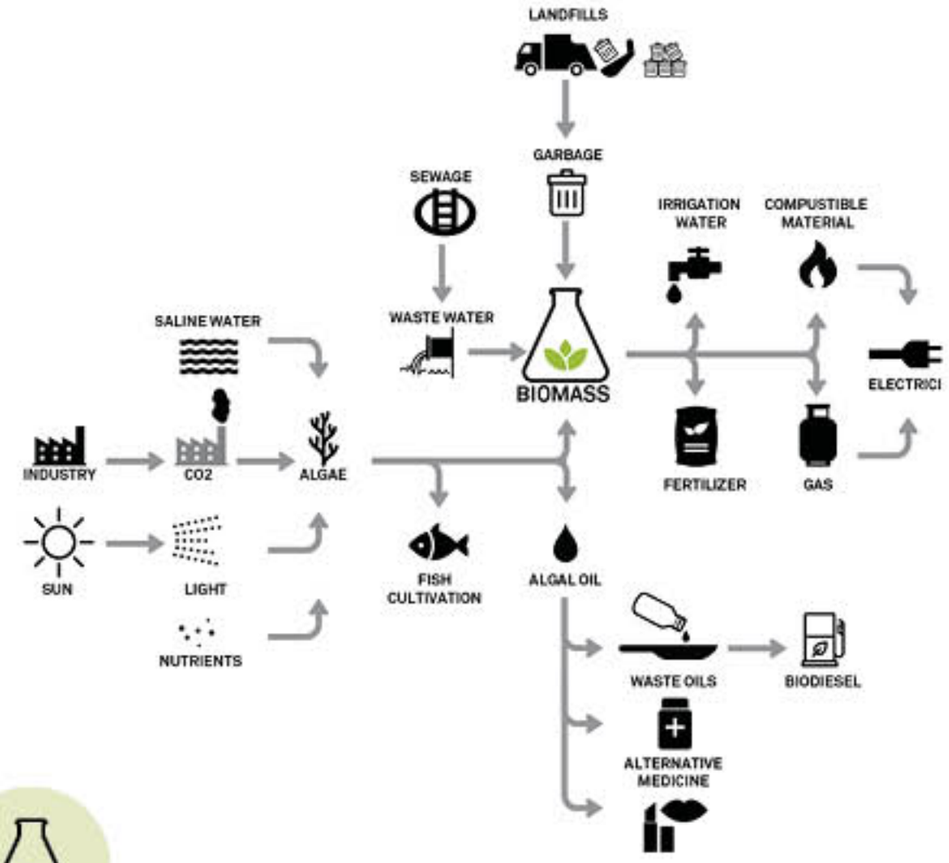
Elevation height-map

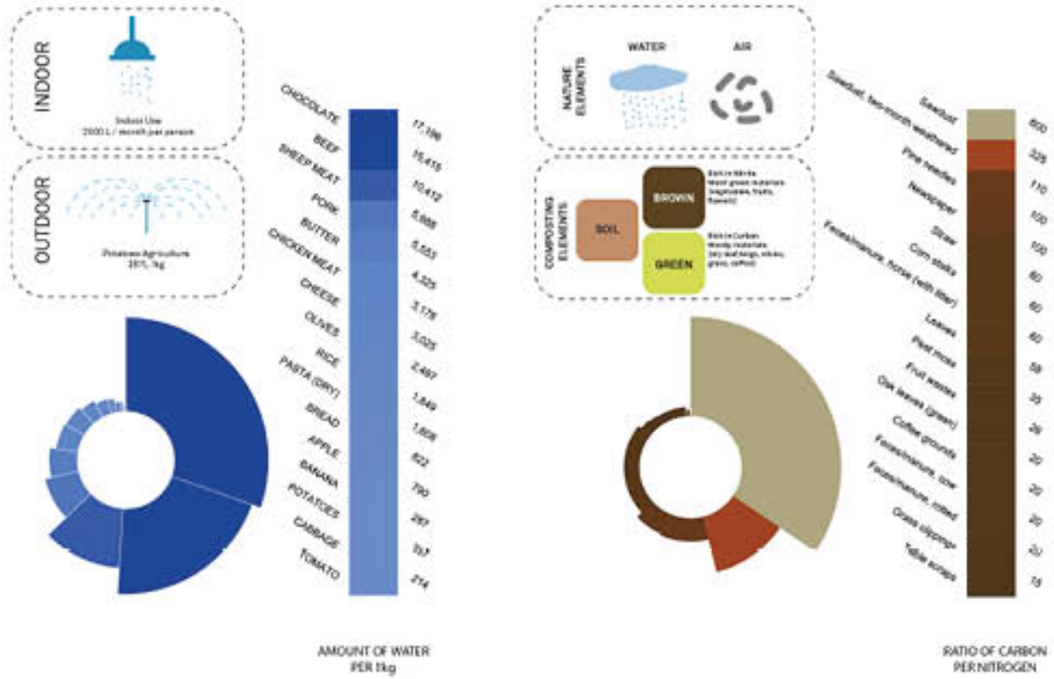
Built environment

GIS Data visualization interface
The project started with the visualization of GIS-data in an intuitive web interface, so as to bring awareness to non-experts on desertification's multiple factors.
The website of the Cypriot Government provided access to a great amount of GIS data in open-source format.

/ REVERSE DESERTIFICATION / Mapping and visualizing indicators



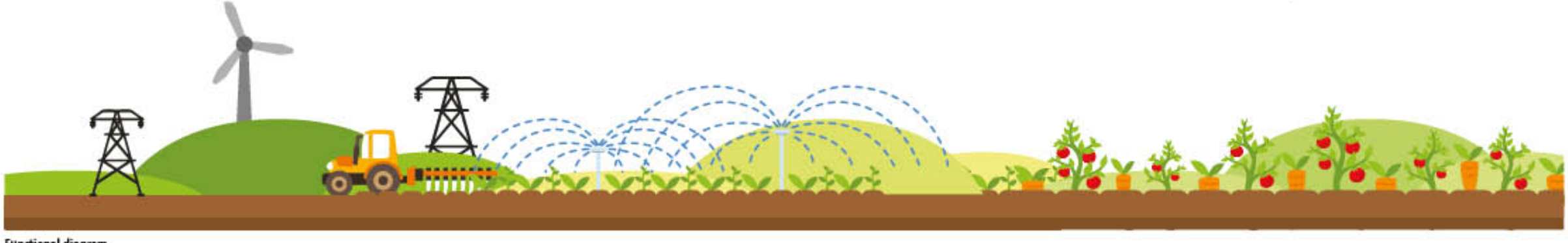




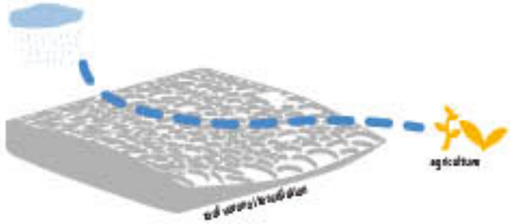
Biomass

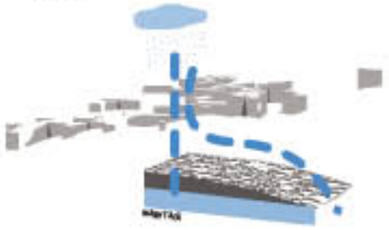
Water

Compost

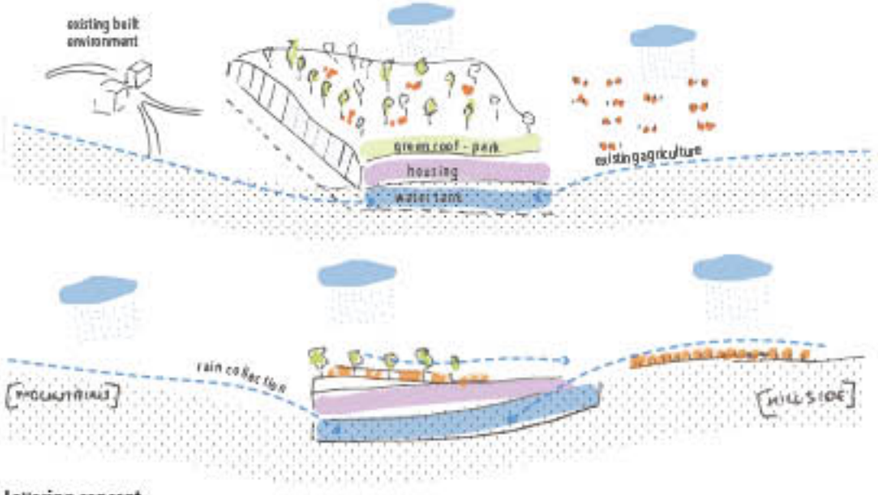


Functional diagram



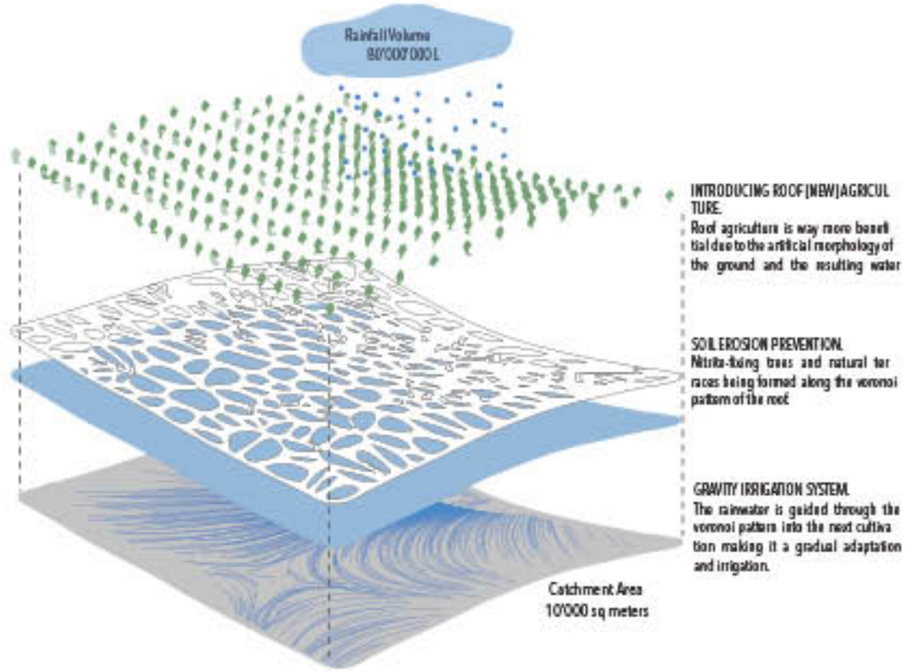


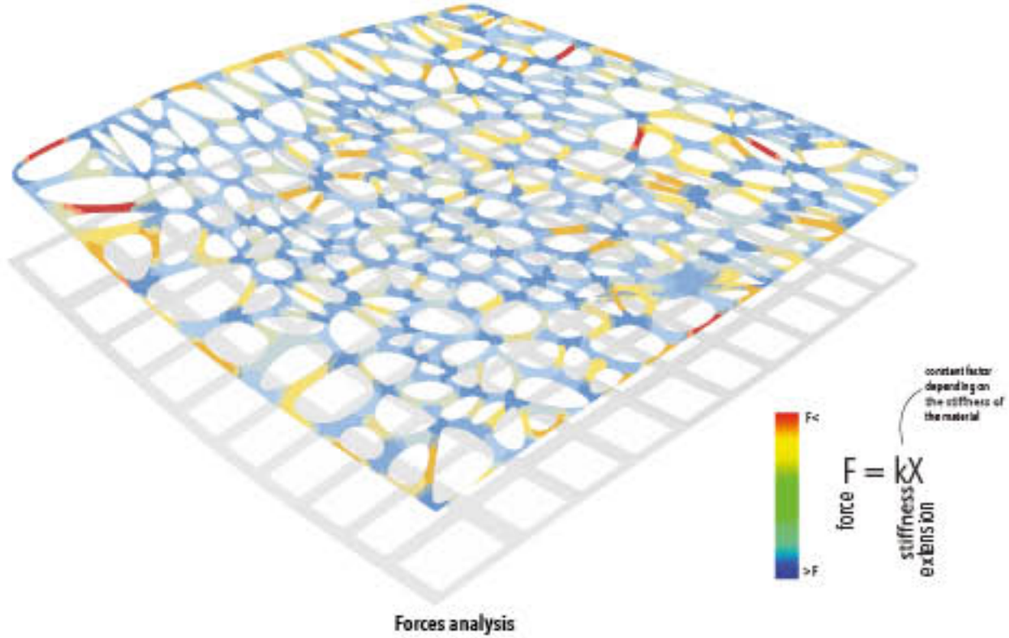
Water use diagram



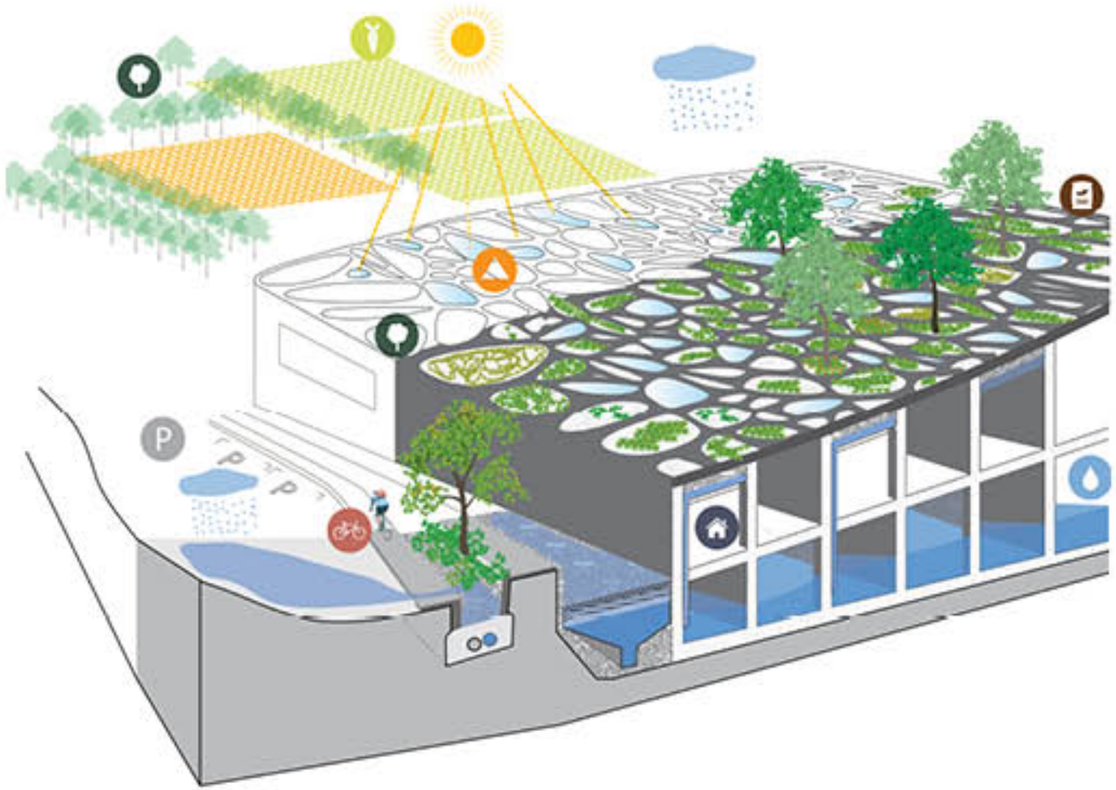
Layering concept

Water management
The project is entirely organized around water. The ground is shaped in ways that increase water collection; similarly, the section of the building allows for water collection through the roof and storage in the basement.

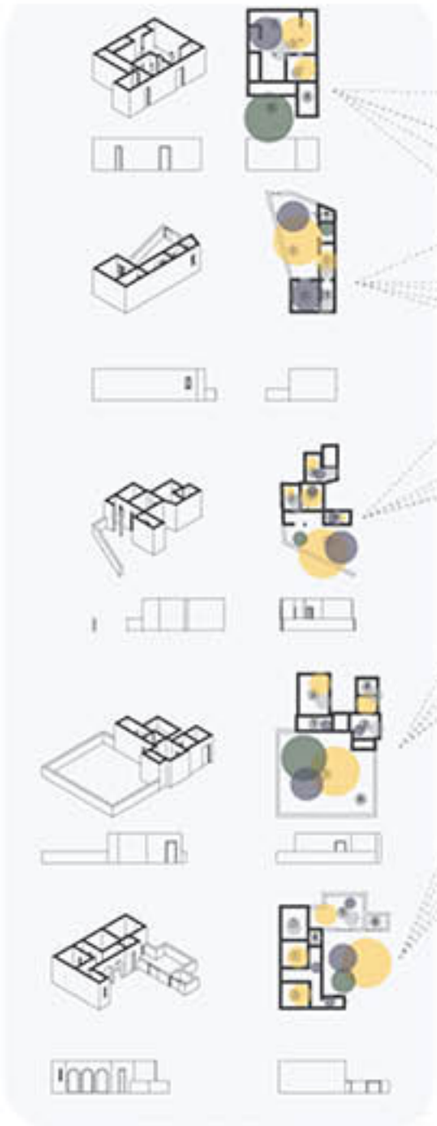




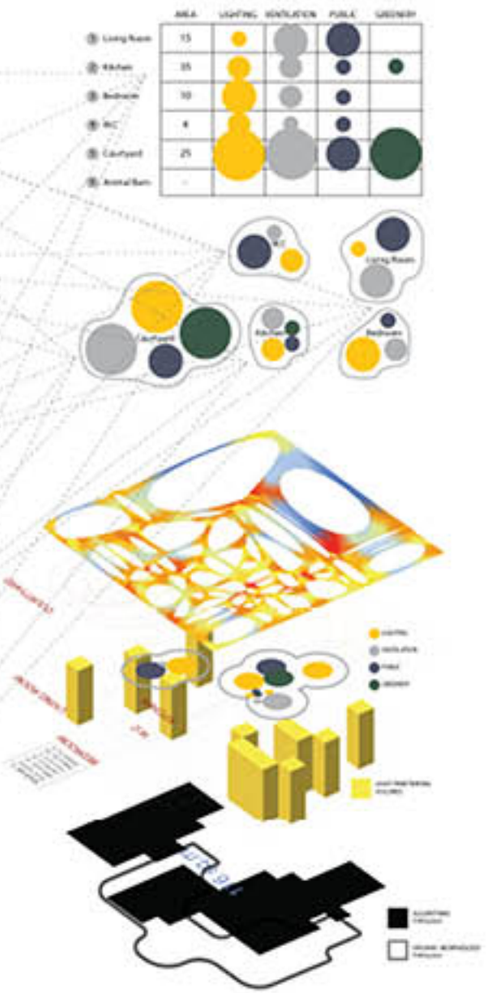
Forces analysis



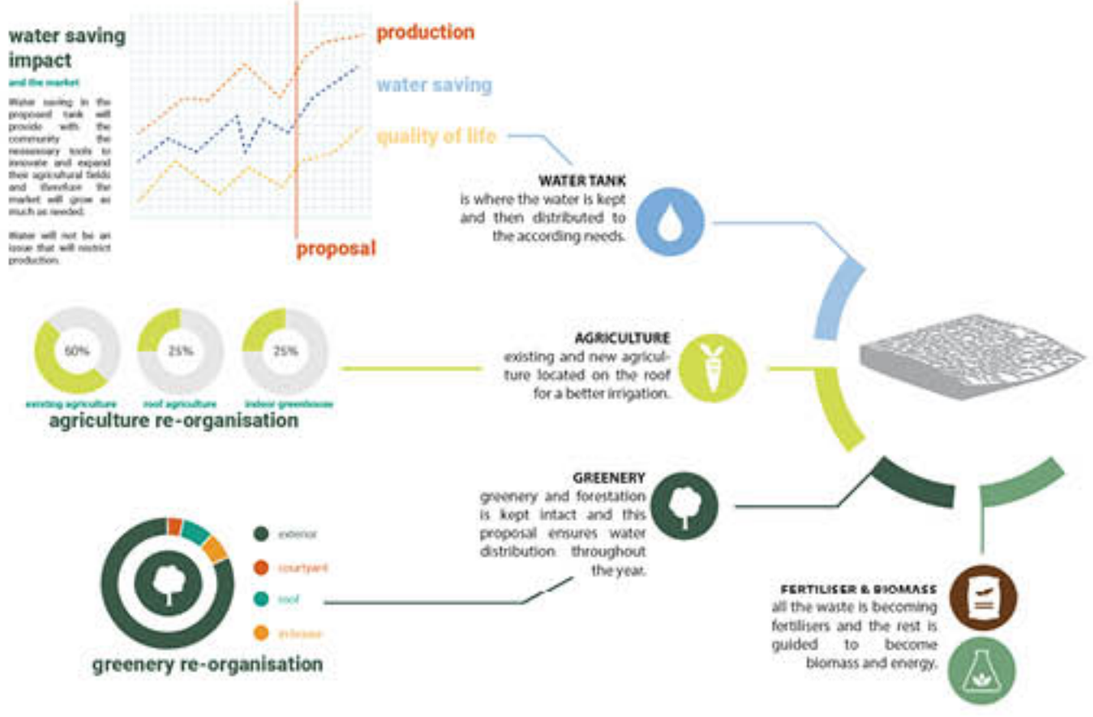
Building diagram
The building is fully integrated with environmental systems and the ground.
A trench along its foundations allows for water retention and storage, as well as landscape amenities for visual enjoyment.
The roof combines skylights with planting and opening for vegetation to grow on the lower level.



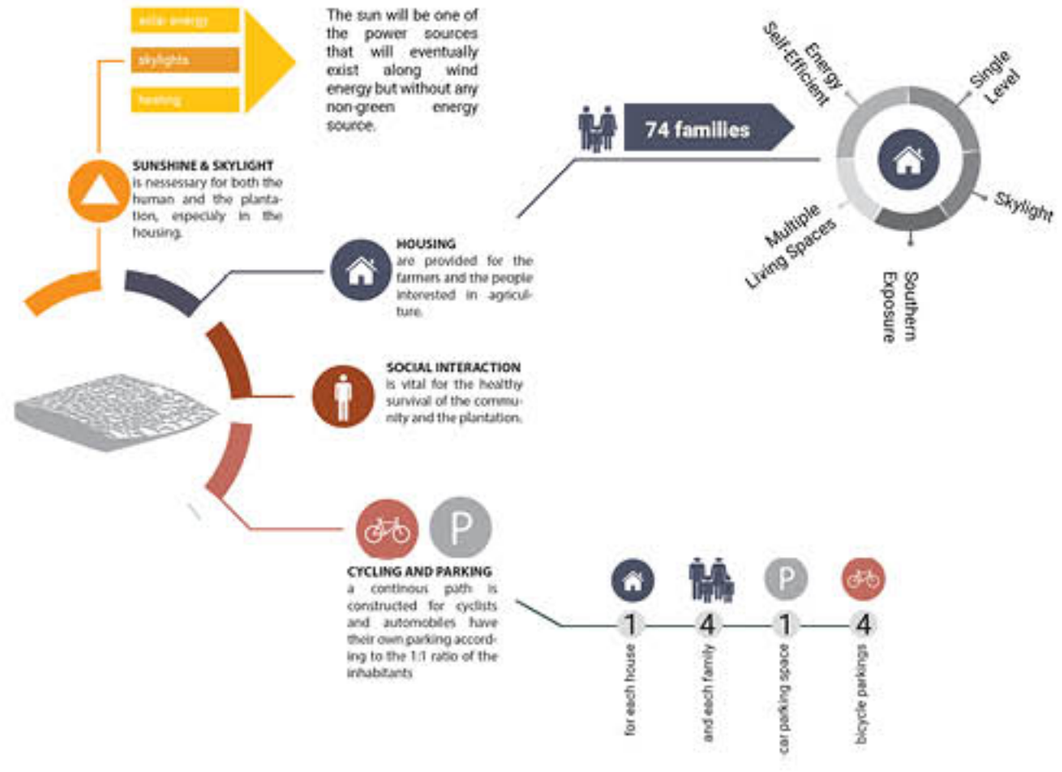
Traditional housing



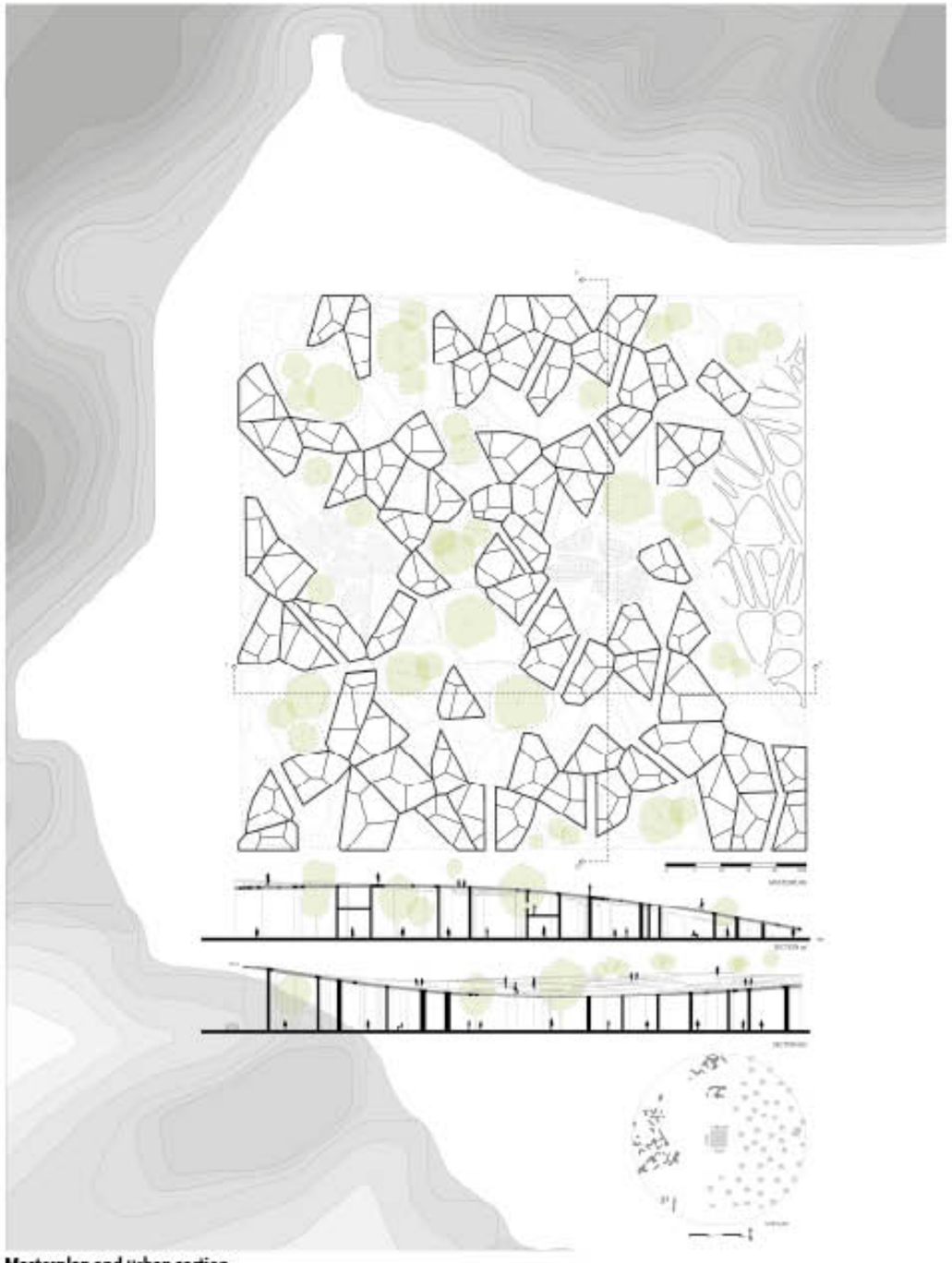
Algorithmic morphologies



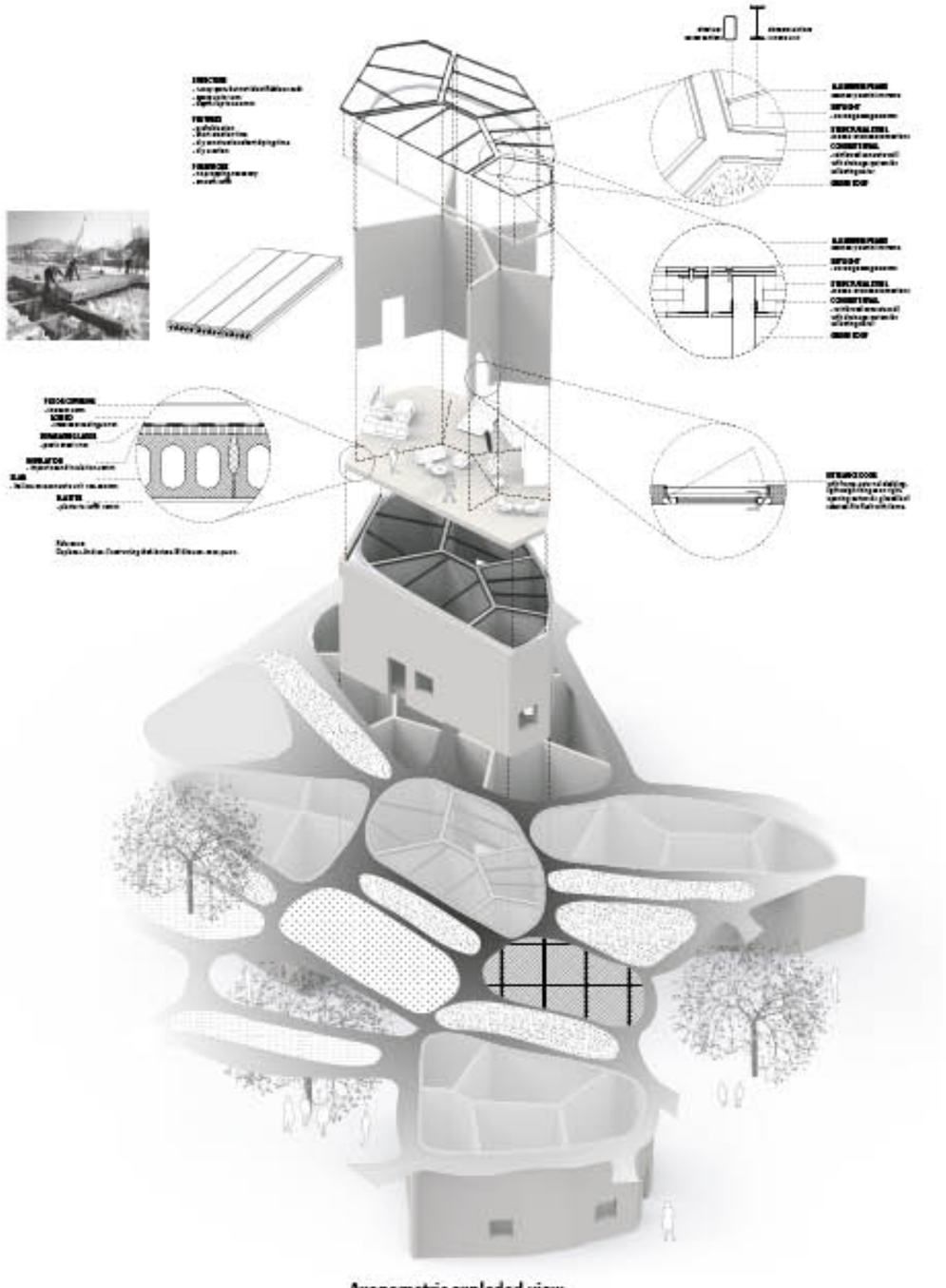
Bird-eye view



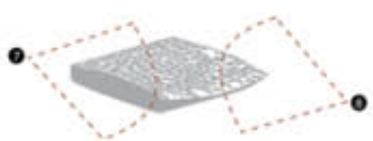
Bird-eye view

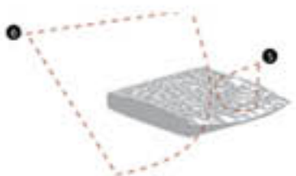


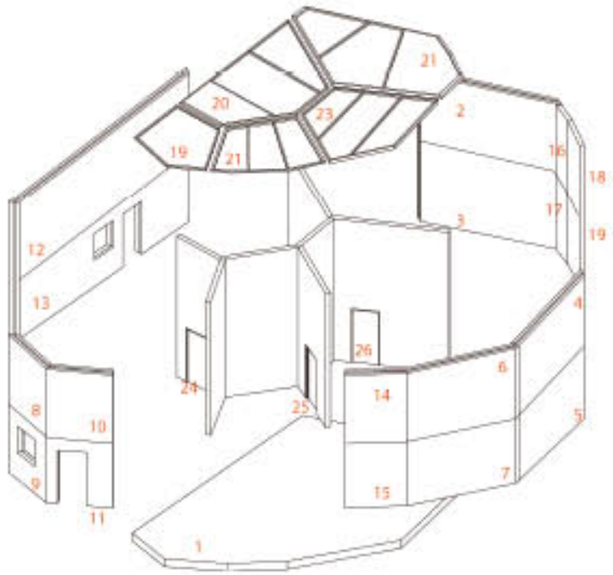
Masterplan and urban section



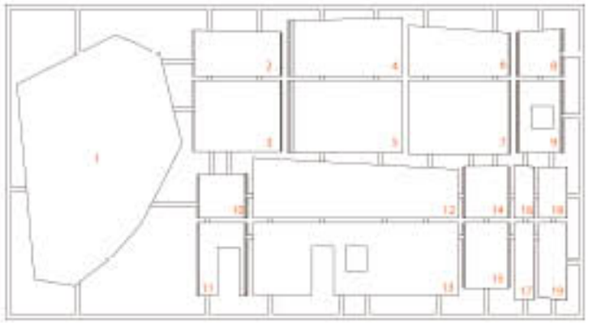
Axonometric exploded view

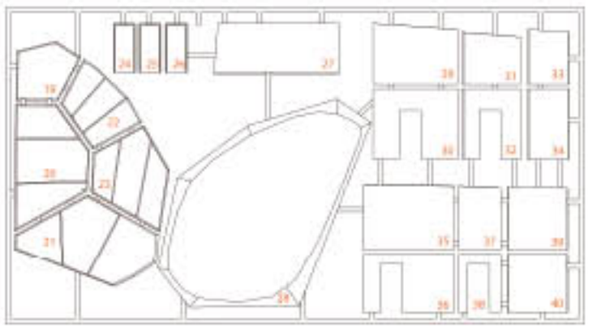






Exploded construction kit



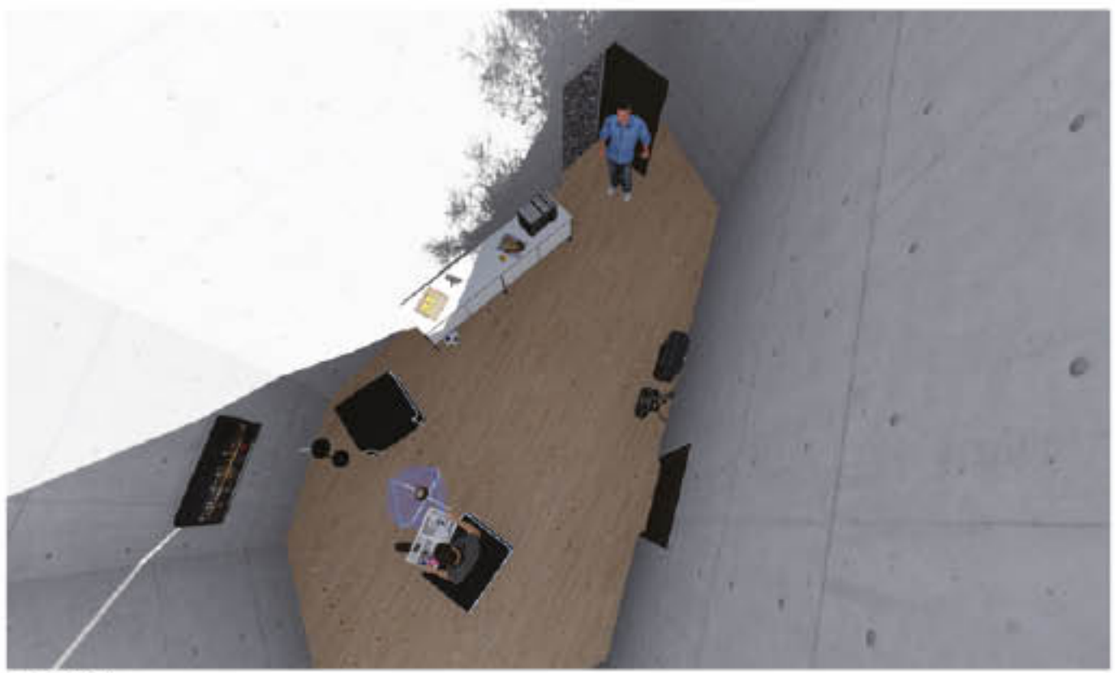


Building assemblage:

01 Excavate for foundations and install slab
- The spread footings foundations are laid before any installation of slab
- The slab is transferred on the field as a one or two prefabricated elements that sit on a prepared soil

02 Assemble wall parts
- The prefabricated wall elements come together and sits inside a construction steel frame that it has on the sides
- The interior walls are thinner and they have triangular edges that are joined with bolts

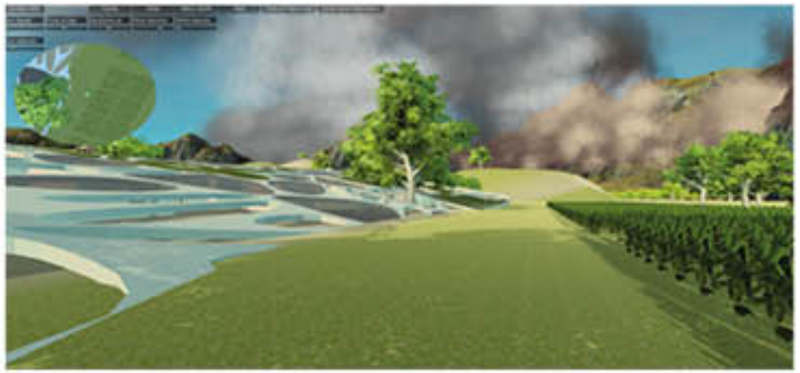
03 Install rooftop cover, windows and doors
- Weld the window parts on the skylights. Construction steel must come together with welding and aluminium frames with bolted connections.



Interior views

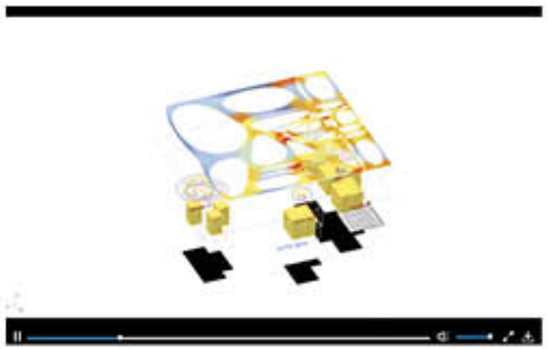
/ REVERSE DESERTIFICATION / Online game

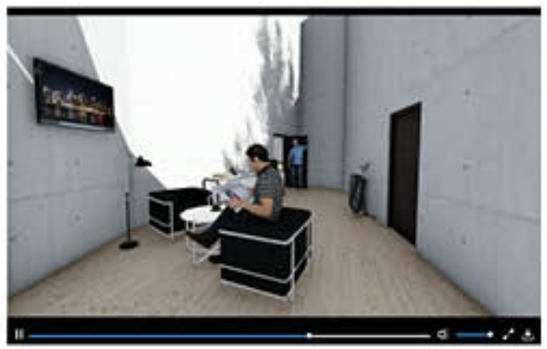
Multiple platforms
The project also exist as massively multiplayer online game (MMO) that brings players to experience the site and the building. It also provide for the opportunity to engage with multiple activities related to water preservation and sustainable farming.
Additionally, a short animation shows the design concept and development in a dynamic way, together with a walkthrough of the project.



Screenshots from video game

/ REVERSE DESERTIFICATION / Animation





Screenshots from animation

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Hope Strode is a practicing landscape architect and architect. In 2014 she co-founded Atelier de Molfetta Strode, a landscape architecture firm with offices in Milan and Lugano. Prior to establishing her firm, she practiced professionally in the United States, Canada and Europe. She is currently an Adjunct Professor at the Graduate School of Architecture at the Politecnico in Milan.

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Giovanni Nardi was born in Venice in 1988 and moved to Milan in 2007 to join Environmental Architecture at Politecnico. After graduation, he studied photography at the Italian Institute of Milan, specializing in architecture photography. During his Master course in Architecture, he studied with Professor Giostra and served as co-editor for the 2016/17 yearbook.

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