

Hydroelectric Imaginaries

From the beginning of the 20th century onwards, Switzerland's resources of water, mountains and money lead (hydro)electrical production to become part of the national myth. Over decades, the hydroelectric power plants with all their connected dams, tunnels, houses, and machines made hydroelectricity something omnipresent in the whole Alpine region. As highly engineered systems they influence large parts of today's landscape. Lake levels fluctuate, rivers carry less water. Like an intricate nervous system, the electrical grid connects the places of hydroelectrical production to the places of consumption. Still, the scattering of productive infrastructures over the Swiss landscape and over national borders leads to a disconnect between producer and consumer. The turbinated water is bound to a capitalist market logic and problems are solved with new technologies, creating an even more complex system of global dependencies.

This hydroelectric imaginary is seeing crisis as a chance for an alternative hydroelectric future. To counter the abstraction of the techno-heroic, mutual influences between humans and bodies of water, electricity and the grid have to be acknowledged. Proximity means responsibility and responsibility is proximity: the characters of electrical production have to receive a bodily presence in the city. 13 towers in Zurich, each connected to an existing substation of the grid, act as storage for electricity. Linked to the grid, they are able to sense instabilities and can counter them by producing and feeding energy into the system. They act like clocks or lighthouses, revealing a rhythm of consumption and production. On the other end of the line sit two reservoirs, whose capacity for storage they are mirroring.

Masterthesis FS 2024

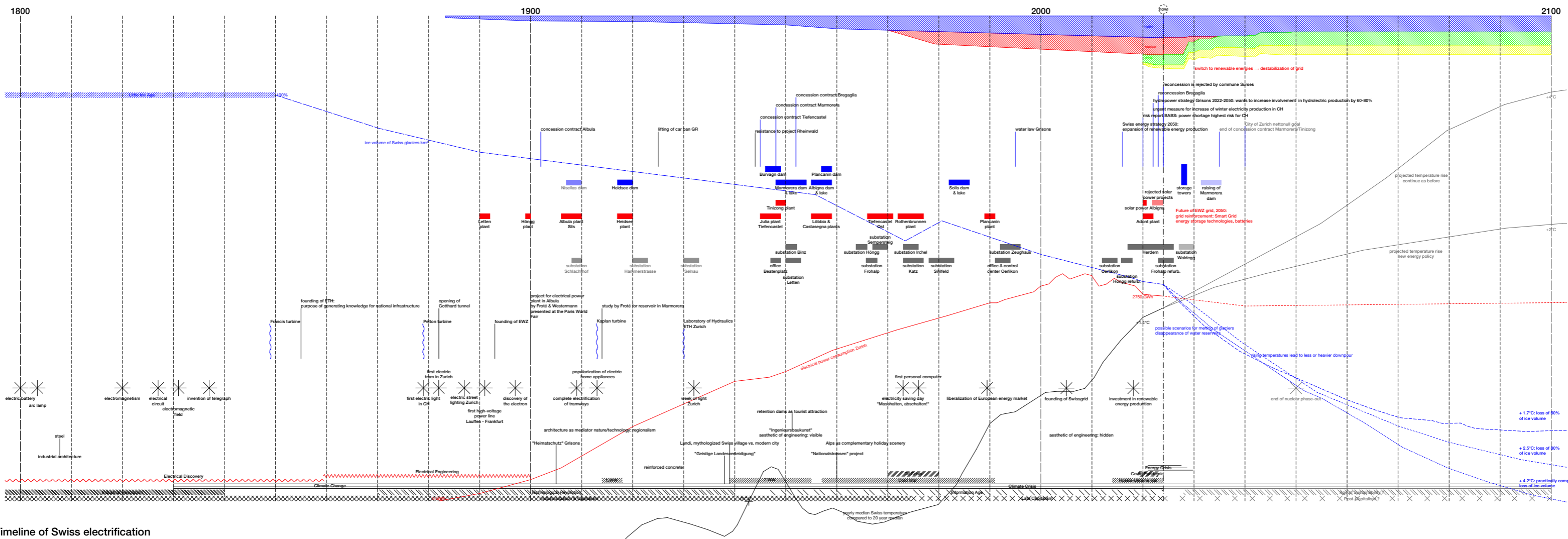
„A Journey Through Our World of Flows“

Chair of Affective Architectures (An Fonteyne)

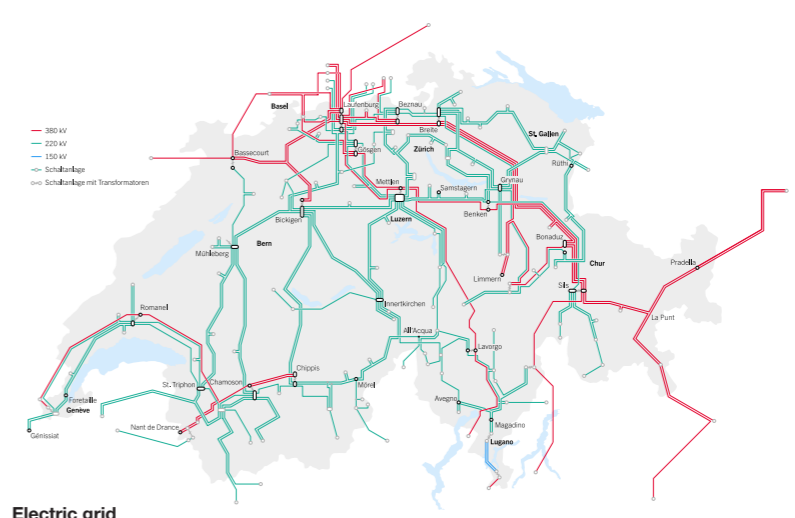
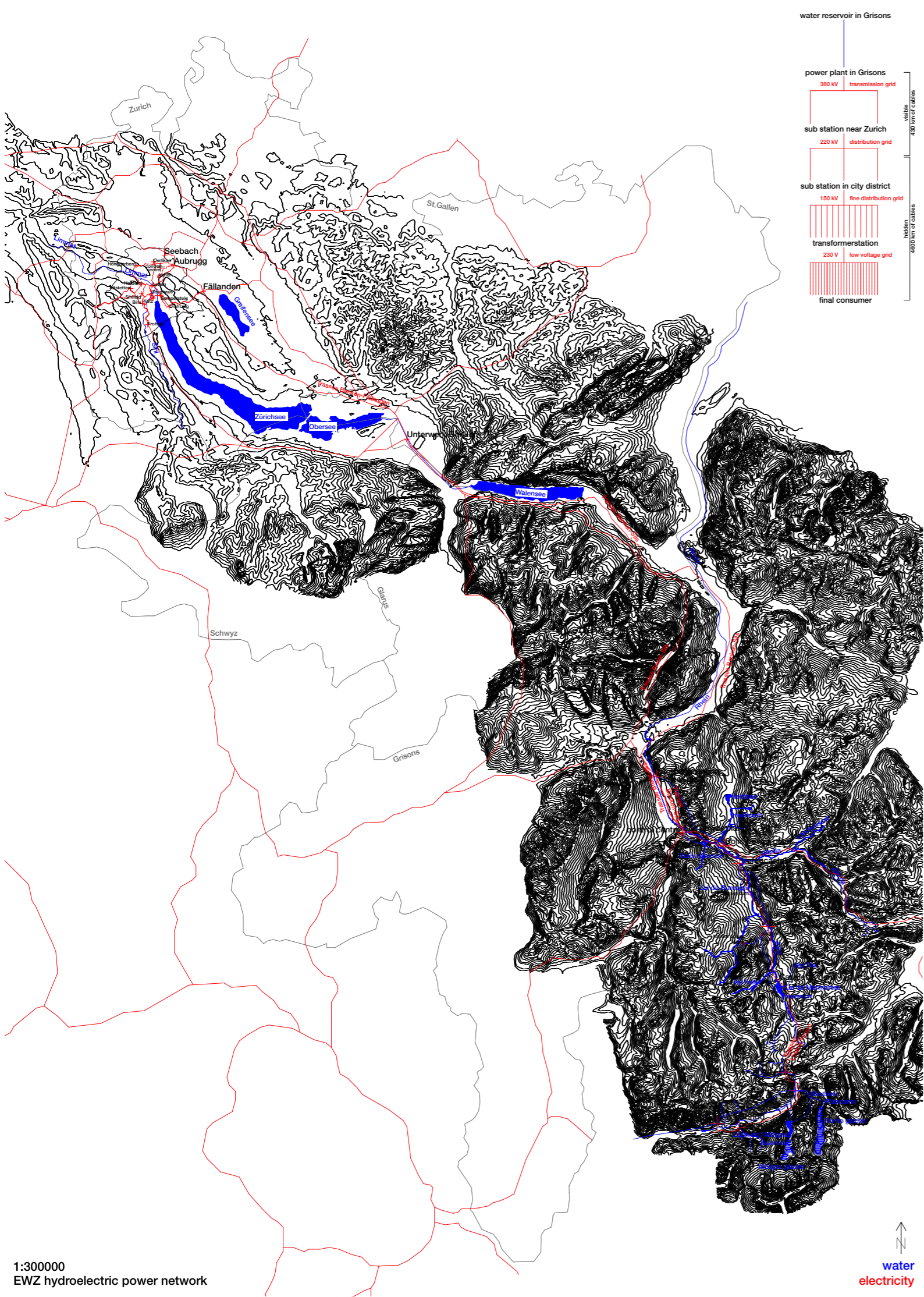
Chair of Art in Time and Space (Rosa Barba)

Lorena Bassi

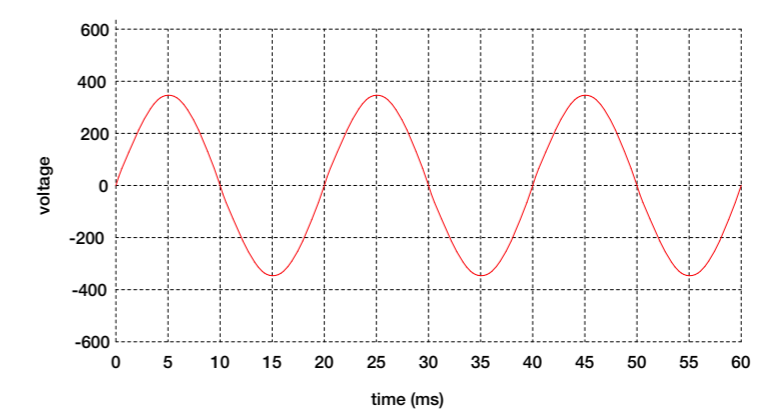
Preparation Phase



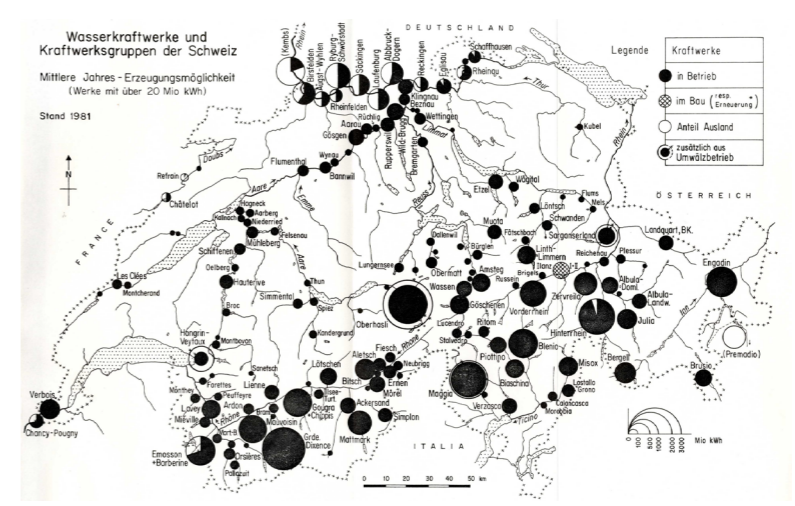
Timeline of Swiss electrification



Electric grid



Sinodial 50 Hertz curve



Swiss hydroelectric power plants and dams

Typologies of physical presence in the landscape

From the beginning of the industrial development in the Alps, the conflict of exploitation of the landscape for tourism versus the exploitation for (hydroelectric) power production and expansion has existed.

The Alps take part in modern development, but at the same time embody its other. Since the end of the 18th century, they take a position of the in-between: economic development and rural fantasy, place of the mundane and place of longing.

Alpine nature and rural folk culture were integrated into national symbolic systems at the same time: Mountains and villages became a political symbol of identification on the inside, a tourist trademark on the outside. While undergoing fundamental changes through the industrialization of the landscape, they were and still are perceived as a romantic counter-world to industrial modernity.¹

The impact on the landscape due to the building of hydropower infrastructure was enormous: Settlements and cultivated land was flooded, millennia-old landscapes were altered. Existing agricultural activities were reduced, while new jobs in the secondary sector started to emerge. Municipalities started to gain revenues through high water taxes and water rates. Landscape protection and ecology were in conflict with economy from the start.

Over the decades, a whole network of supply and pressurised tunnel penetrated the mountains and fed tributary streams. Power stations and their connected infrastructures are highly engineered systems that spatially encompass and influence large parts of today's alpine landscape. Lake levels fluctuate, rivers carry less water.² The hydroelectric power plants with all its connected tunnels, houses, and machines made hydroelectricity to something present in the whole region.³

While the expansion of hydroelectric power-networks can be read as a techno-heroic undertaking from the beginning, different ways of dealing with technology and its integration in the landscape of the Alps as well as the city fabric can be distinguished. Oftentimes, the buildings reflected the prevalent architectural styles being built in the city. Especially the different worker's housing projects brought „modern“ ideas to parts of the country that were normally much later to adopt and integrate new styles.

Due to the development of the Alps through industrialization, Grisons' villages and landscapes can be read today as an extension of Zurich and other metropolitan areas. This development began with the building of hydroelectric infrastructure and trains and continued with the „Nationalstrassen“ project in the 60s, which led to a boom of weekend houses in alpine villages.

dams

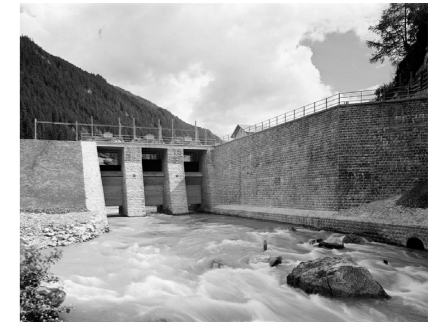
Nisellas dam



Heidsee dam



Burvagn dam



Castiletto dam



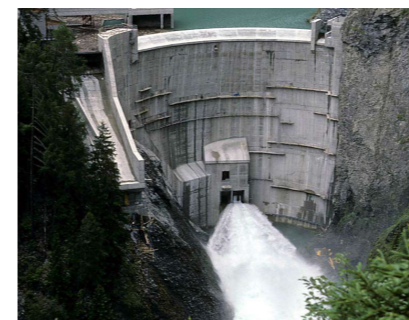
Albigna dam



Plancanin dam



Solils dam



1 Thomass Barfuss: Authentische Kulissen, Graubünden und die Inszenierung der Alpen, p. 19-24

2 ibid. p. 32-35

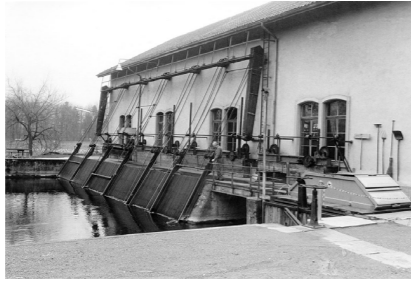
3 Clavuot, Ragetti: Die Kraftwerkbauten im Kanton Graubünden, p. 33

power plants

power plant Letten



power plant Höngg



power plant Sils



power plant Solis



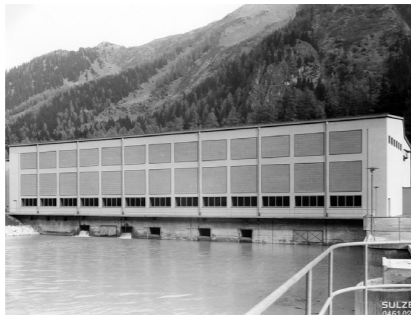
power plant Tiefencastel



power plant Tinizong



power plant Löbbia



power plant Castasegna



power plant Rothenbrunnen



power plant Adont



worker's housing

worker's housing Sils



worker's housing Chur



worker's housing Bad Ragaz



worker's housing Unterterzen



worker's housing Rüti



worker's housing Marmorera



worker's housing Tiefencastel



worker's housing Vicosoprano



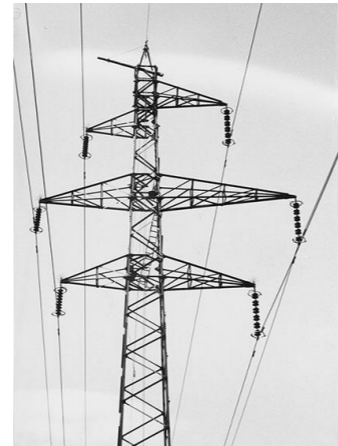
worker's housing Brentan



worker's housing Albigna



pylons



substations

substation Schlachthof



substation Drahtzug



substation Selnau



substation Letten



substation Binz



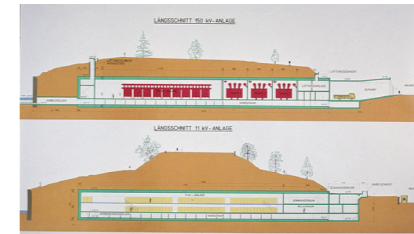
substation Sempersteig



substation Sihlfeld



substation Katz



substation Irchel



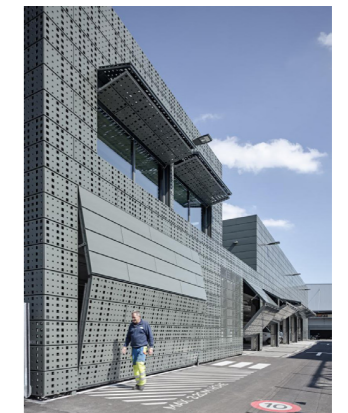
substation Zeughaus



substation Höngg



substation Oerlikon



Assemblage of characters

Julia



Formed by the outflows of several small moraine reservoirs, the Julia takes its first shape in a valley high up in the Alps. On its way down, it is in constant movement, jumping over stones and loudly splashing against their mineral bodies. By its sheer force, the stones are continuously smoothed, the washed off minerals now transported as particles in the water. The first stream is joined by others, and together they grow bigger. Its speed is abruptly halted, when it meets the big, deep body of the Marmorera retention lake. From there, the stream moves forward slowly, growing and shrinking, turning and forming currents inside the lake. Even though now slower in speed, the body of water has gained enormous strength through its size. It pushes hard against the Castiletto earth dam, which is halting its downward passage. Only a small stream is let out on the foot of the wall, allowing the creatures which depend on the water further downstream, to survive. The rest of the water stays in its state of pressure, only being allowed to move downward when the tunnel inside the dam is opened. When it does, the water forcefully pushes through the narrow space and cascades in direction of the power plant. There, it moves through the turbines before joining the stream again. On the way to joining the Albula in Tiefencastel, the stream is retained two more times, slowed down and then released. How would the Julia move, if she hadn't been retained and manipulated for so long?

Albigna glacier



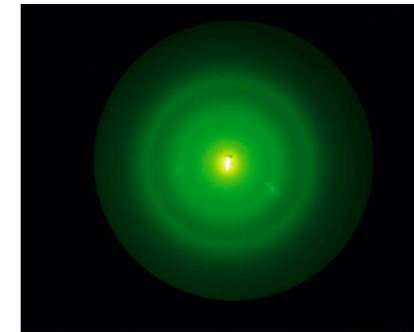
Its mass of ice and firn is the inheritance of the ice streams that formed the mountains and valleys in its surrounding. Succumbing to the force of gravity, its mass is constantly moving ever so slowly down the valley. The flakes of snow, which come to lay on top of the glaciers surface, form a blanket so heavy as to compress the porous firn underneath, until it is transformed into ice. When the moving mass of ice is met with an obstacle on the ground, it tries to pass over it, bending its mass over and around. Trough this, its surface can crack, forming a crevasse. What falls into the crevasse joins the masses of ice for a time, but is not kept there forever. After decades or centuries, it will reappear, its body conserved by the cold. In the summer months, the high temperature of the sun warms the air around the glacier, melting the firn. The meltwater forms many small streams, which leave the glacier's surface at its foot and join the body of water already retained by the Albigna dam. For some time now, the loss of frozen mass in the summer has been greater than the gain in the cold months, making the glacier shrink from cycle to cycle. Without the glacier's capacity of water storage, what will remain is only a lake, fed by rainwater.

turbine and generator



Forged out of steel with highest precision, the turbine's spoon-shaped buckets are arranged in sequence around an inner wheel. When the nozzle at its lower side is opened, water jets into the buckets at incredible speed, making the wheel turn. The force of the water jet is so high, that the sharpness of the steel ridge which it hits, wears off over time. The human workers that maintain the turbine, manually sharpen the edges of the bucket every so often, to bring it back to their standard of efficiency. As the turbine begins to rotate around its axis at full speed, its partner the generator, connected to its axis over a metal shaft, begins to vibrate. The generator's hard and smooth outer shell hides a magnet in its core, which moves synchronously to the turbine. Around the magnet in a dense coil, copper filaments fill the generator's shell. The rotation of the magnet sets off a movement of electrons inside the metal, forming an electric current.

electricity



at the basis of our modern life: an electron, knocked loose out of a copper atom, inside a copper coil, by the turning of a magnet inside the shell of a generator
kinetic energy of the river's water, pushed through a turbine, captured and transformed
together with others of its kind, assembling to create an electric field
not staying still, but always moving along vibrantly, creating a flow of current
changing voltage, from low to high, before being pushed through 430 km of cables
six strands of aluminum and steel rope, held up by the filigree body of pylons standing in a line
moving over mountains and valleys, along rivers and highways, invisible but omnipresent
sometimes reacting with water molecules in the surrounding air, cracking and crackling, discharging
at the city's edge changing voltage again, from high to low, losing force
then going underground, entering hidden spaces filled with inconceivable lengths of entangled cables
transformed again, this time hidden and contained in an isolated tank, surrounded by sulphur hexafluoride, inert and nonreactive, quiet
moving further up, down and along an intricate system of codependency, entering every crease of human existence, affecting every actant on the way
mundane and magical, always dangerous
extracted and then mostly forgotten

Castiletto dam

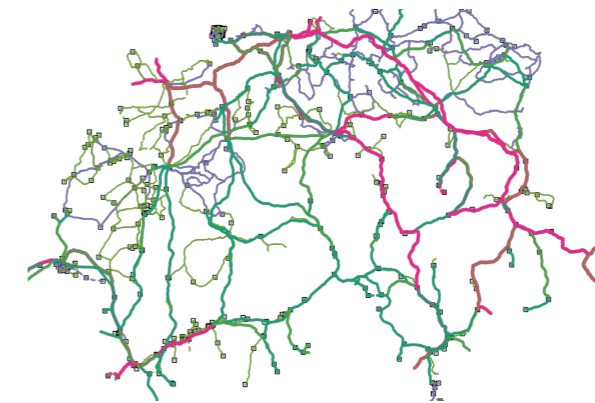


Described as: valley sunken into the penninic Platta ceiling, its primeval mixed forests reduced by grazing. Little fog, sunny and bright, good drainage due to valley winds. Required building materials already available: clay, moraine material, slope debris and stone blocks.

Now, in the middle of the valley, pressing against the deep slopes of Piz Plata and Piz d'Agnel, stands a trapezoidal rammed earth wall with the mass of 2.7 Mio m³. The valley's minerals gathered and piled up in highest precision, perfectly engineered between the two mountain flanks. Castiletto, small castle, is standing on the spot where the old mountain road lead through the valley, passing the village of Marmorera and its surrounding meadows and fields.

Now, its mass of 91 meters is blocking the downward passage of water. In the middle of its vast mineral body sits a concrete wall surrounded by densified clayey material formed in a triangular shape. Inside its dense core, only two revision tunnels cut through the mass. Pressing against the core on both sides are two retaining bodies, containing layers of local debris, a mixture of serpentine rubble of different sizes. Together they build an enormous base of 400m width, slimming and coming together on top to form a 12m wide plateau. The slope facing the valley is terraced and covered with humus, where grass and small trees grow their roots into the artificial mound. The flank to the lake is covered with large stone blocks, appearing and disappearing according to the rhythm of the fluctuating water levels. Algae growing on the stones and drying out again. The wind blows over the mound and across the hill at an enormous speed, almost as if trying to erode the earth wall by its sheer force.

the grid



The components forming the electrical power grid were built for years by different actants, its parts cyclically renewed, enlarged and exchanged. It now forms an incomprehensible system of 6700 kilometers of copper cable lines projected over the landscape. Like an intricate nervous system, it connects all of the characters, communicates with and between them, sends signals from one side of the country, to the other, creating a tangled mess of correspondences.

Calling on the control center, transformer, substation, generator, turbine, dam and reservoir. Through its cables runs a three-phase alternating current, highest pressure for maximum efficiency and minimal energy loss on the way. At the basis of it, lies an oscillating sine curve of 50 Hertz, the swinging of voltage in fifty cycles per minute. For a seamless extraction of electricity to work, it has to be kept in continuous, almost perfect balance. Every Volt of electricity consumed or produced, has a consequence on the grid and its stability, making the curve oscillate higher or lower, invisible peaks and valleys. Consumption and production are in a state of constant play.

Demands are always met and changes in frequency smoothed out. The grid goes over national borders, taking and giving from its European neighbors for the sake of stability.

In the future, new actants will join this highly sensitive assemblage. Their power production not constant, but highly influenced by weather, climate and seasons. Their unpredictability leading to an instability of the grid.

substation Katz



In the center of the City, lies an artificial hill, a piece of manipulated and utilized earth. Inside of it, forgotten caverns and newly built cavities. Created as a show of power in the baroque, a bulwark of piled and terraced earth was constructed as a link in a defensive structure around the former city core. Its sides reinforced by vaulted fortification walls, on its highest point a platform for cannons.

A city beautification wave repurposed the hill, planting a botanical garden. Its highest point, formerly used as a lookout for enemies, was now transformed to gaze over the city and take in the view.

In 1940, motivated by the fear of invasion, it shortly returned to its initial purpose as a link in the Limmat defense line. The vaults inside the fortification walls quickly converted into shelters, complete with emergency toilets, septic tanks and exit ladders.

Continuing in the tradition of digging, this time as a show of power of engineering, two rectangular tunnels of 9m height, were driven 88m into the hill in the 1970s. Under the botanical garden and all its trees, plants, insects, mice and birds; behind the mineral baroque fortification wall, two parallel caverns were mined into the artificial hill, connected to each other in front and back. Their leg-like cavities forming a three-story underground building with massive reinforced concrete walls, only its head poking out at one side.

Inside of it, compactly packed into the dark space, are rows of 150 kV and 22kV switchgears, encapsulated systems for transforming electricity, controlled with sulphur hexafluoride.

Further underground, the substation is connected to four others of its kind: Sihlfeld, Drahtzug, Letten, Zeughaus, forming again only a link in an intricate system.

Marmorera reservoir



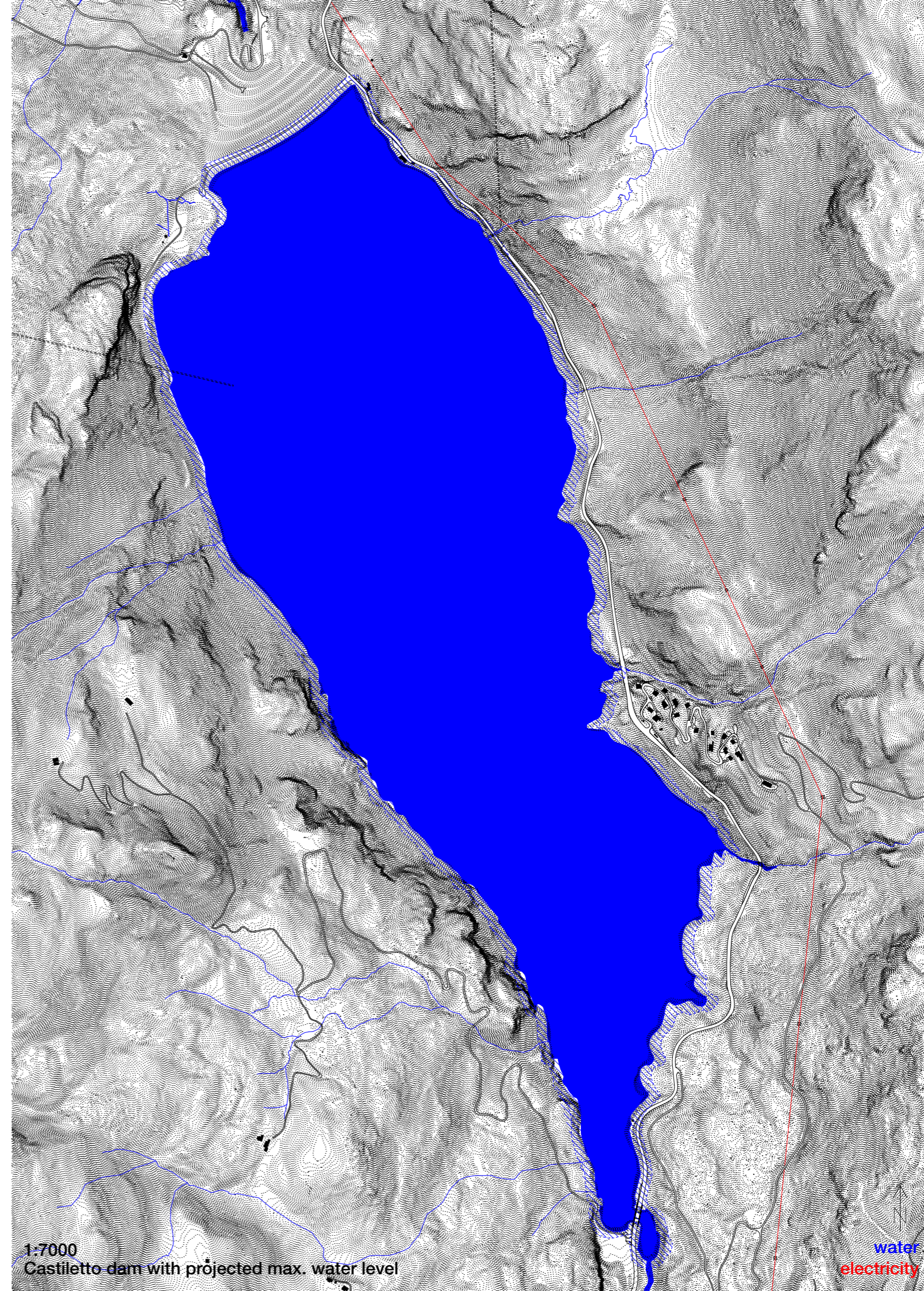
Water from the Julia, water collected in the Val Faller and water streams from the Alp Flix catchment area channeled together and mixed to form a big body of water. Rainwater, spring water and glacial water pressing against the earth dam standing in their way. The water's mass serves an ulterior purpose, acting as a storage of kinetic energy not just for EWZ and Switzerland, but for the whole of Europe. Its mass and water levels are determined by consumption and request, leading it to fluctuate from high to low in the course of a year.

Before there was a lake and a dam, there was a village. Its existence carefully recorded before being destroyed: 29 houses, one church, one school, 52 barns and granaries, 140 ha of meadows and woodlands. 24 male landowners voted yes for the sale and destruction of their village, 2 male landowners voted no. 2 families had to be expropriated by the federal court. Land acquisition costs: 5 million, suddenly making the deeply indebted community a wealthy one. The dead were not left in the seabed but exhumed from the earth and brought to New-Marmorera, a village built on the windy flank of the lake, in an imitation of regional architecture, an imitation of a given up home.

The abandoned valley was carefully mapped for its earth, debris, and rock and then scraped to gather material for the dam. Where did the debris of the destroyed village go? Is it still under the water's surface, joined by the new topography of mineral sediments brought in by the Julia? Are they part of the new ecosystem joined by the trout now living in the water?

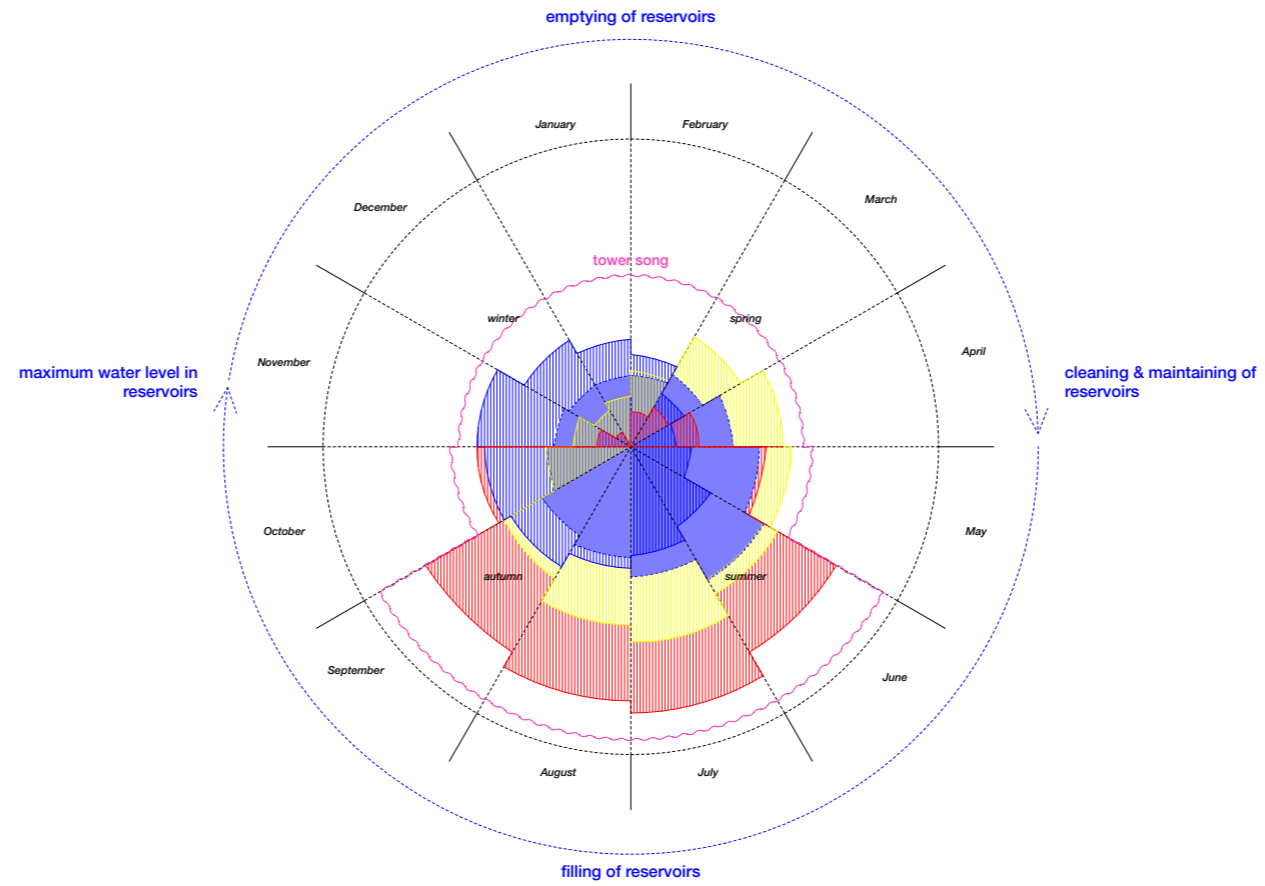
Elaboration Phase

To meet the future demands on the grid and to manage the change to renewable energy production, EWZ is planning on different expansions of their network. One such expansion is planned for the Castiletto dam in Grisons. EWZ announced that they were planning a project with a 14 meter higher dam at the beginning of 2024. This would lead to a higher maximum water level and subsequently flood parts of the street, a bridge and some buildings along the shore. Furthermore, this project would once again place most of the impact of hydroelectrical production on the Alpine region, disconnected from the City of Zurich where the majority of electrical consumption is actually happening.

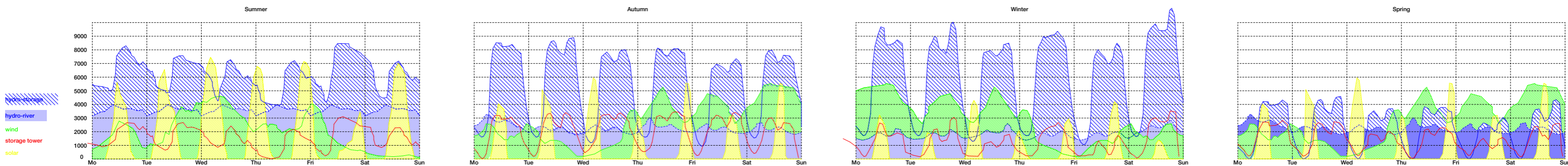


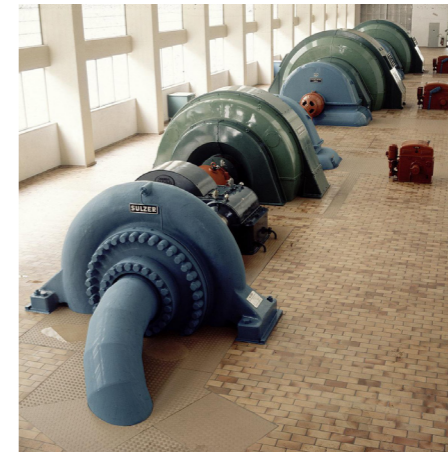
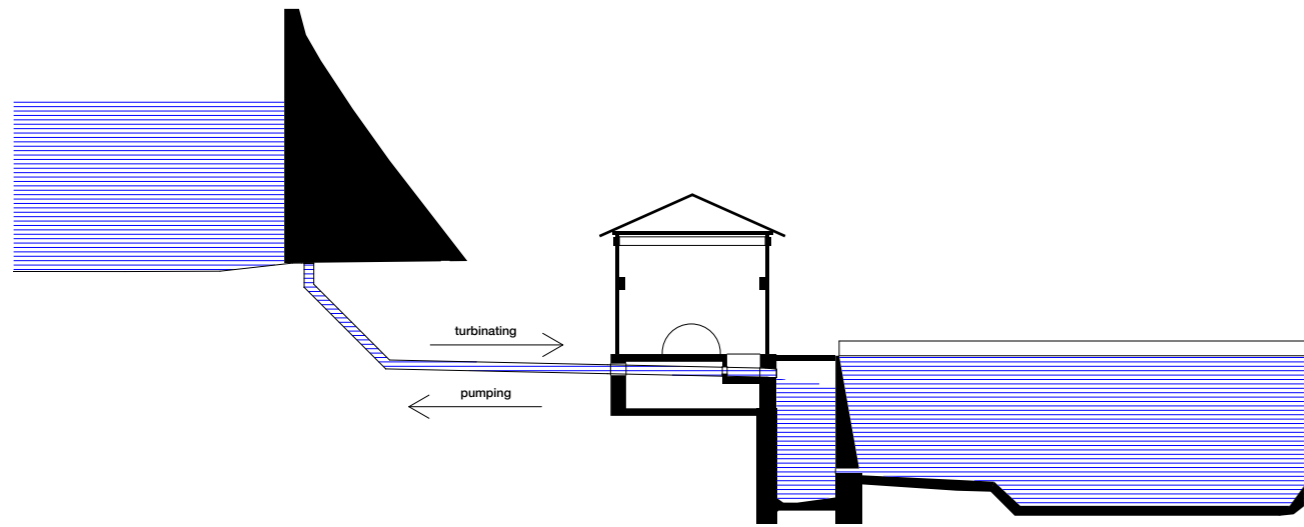
1:7000
Castiletto dam with projected max. water level

water
electricity



- water in reservoir
- water in rivers
- outside temperature
- hours of sunshine





Turbines and generators in the Löbbia power plant

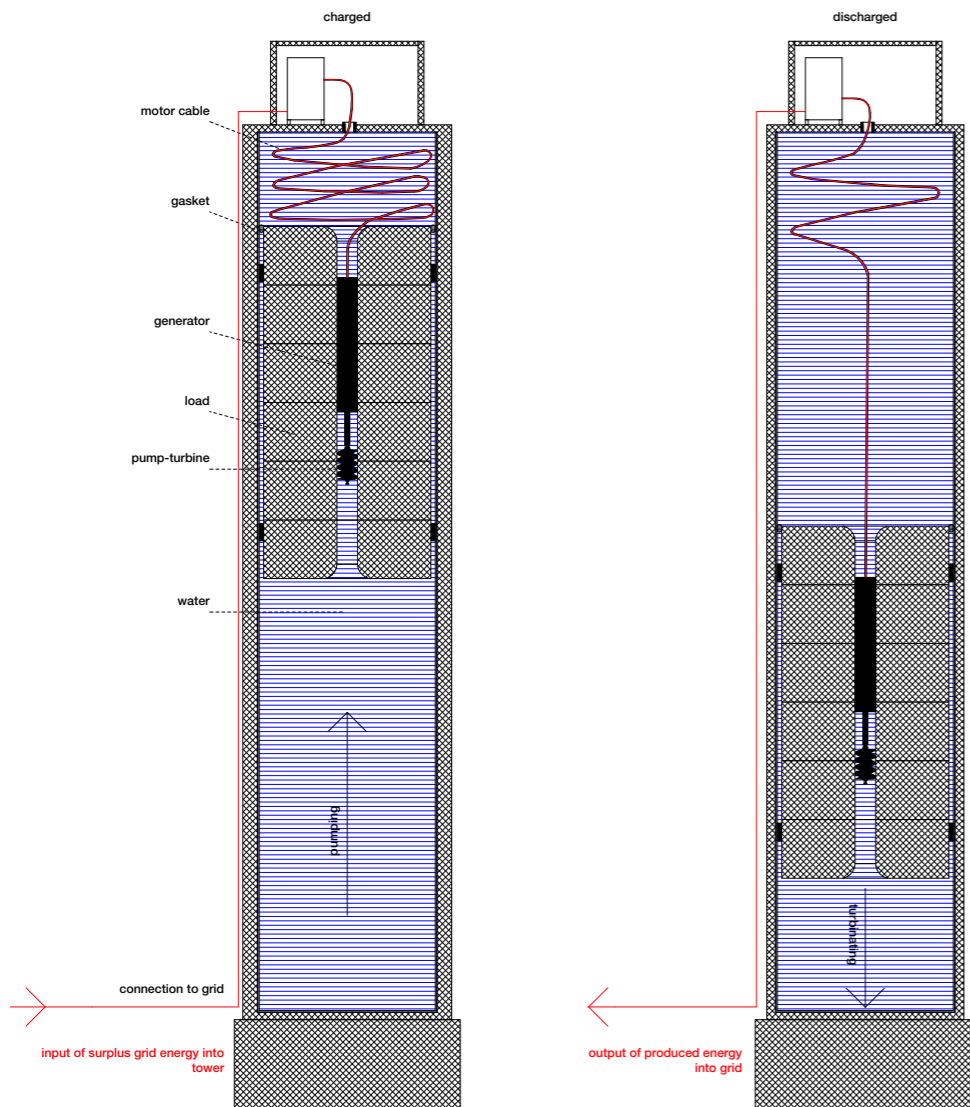


Diagram of storage tower



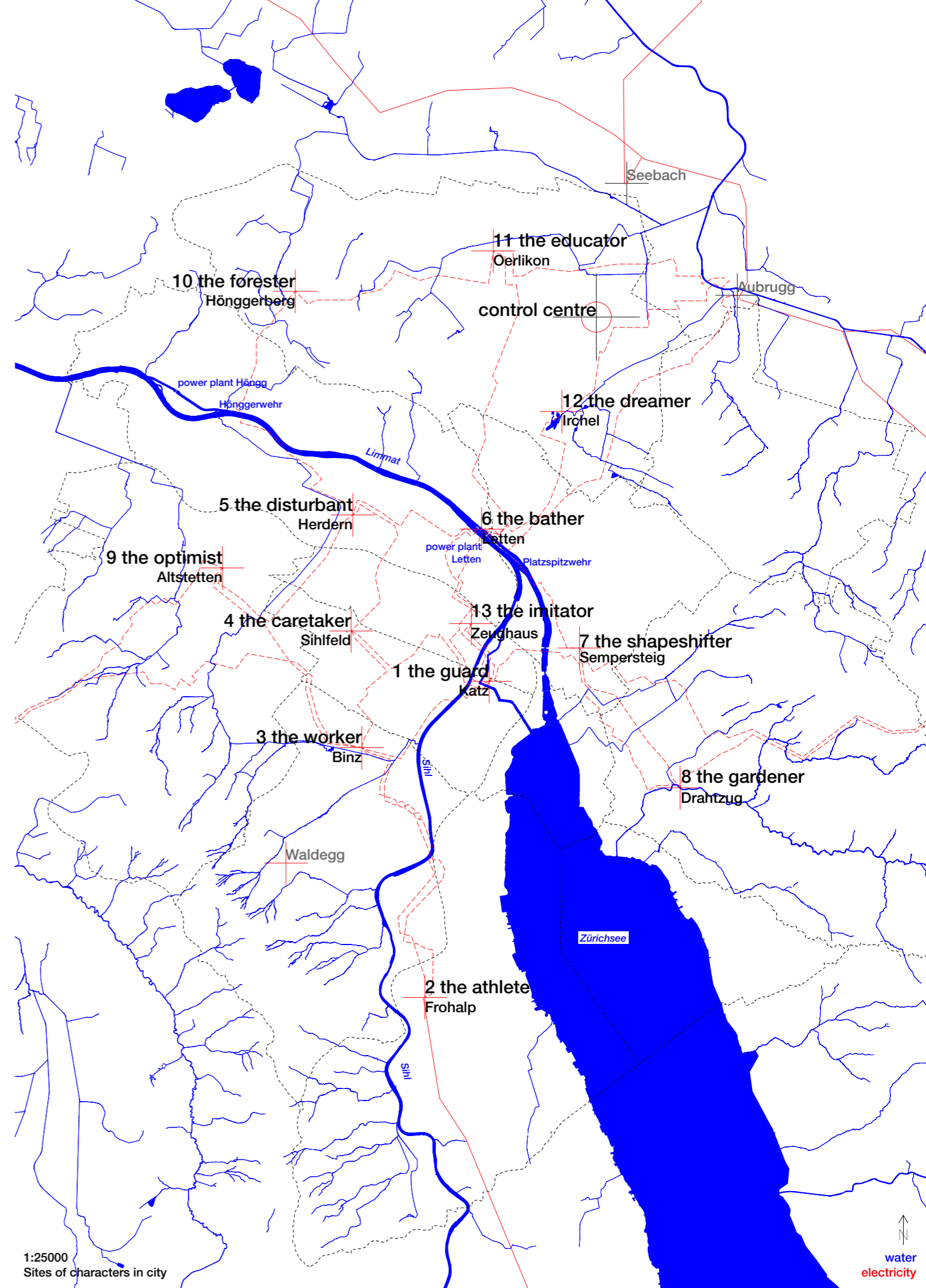
Albigna dam



Castiletto earth dam

Storage characters

To counter the abstraction of the techno-heroic, mutual influences between humans and bodies of water, electricity and the grid have to be acknowledged. Proximity means responsibility and responsibility is proximity: the characters of electrical production have to receive a bodily presence in the city. 13 towers in Zurich, each connected to an existing substation of the grid, act as storage for electricity. Linked to the grid, they are able to sense an instability of the 50 Hertz curve and can counter it by producing and feeding energy into the system. On the other end of the line, sit two reservoirs, whose capacity for storage they are mirroring. Their built form is claiming a visible and loud presence in the city fabric. They act like clocks or lighthouses, revealing a rhythm of consumption and production.





71 Guard 1970

In the center of the City, lies an artificial hill, a piece of manipulated and utilized earth. Inside of it, forgotten caverns and recently built cavities.

Slender and tall the Guard grows out of the cavernous substation Katz's head. The tower's concrete surface is perfectly smooth, its faceted body playing with light and shadow. Its mineral form and presence beautiful and troubling at the same time.

When the day gets dark, light is emitted from the tower's head, calmly shining on its surroundings, watching over them.

caverns & cavities, fortification

show of power

Fortification

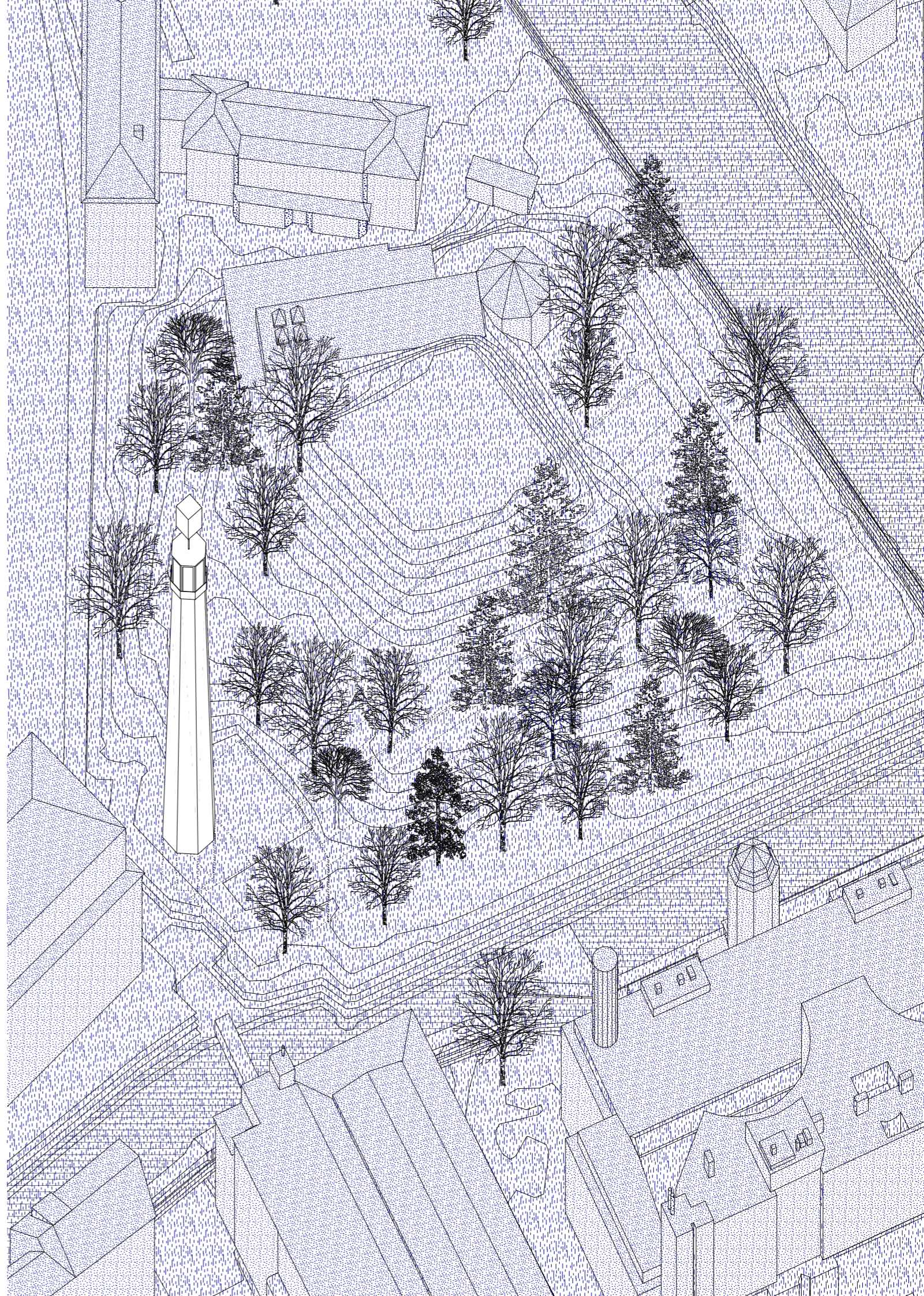
botanical garden

engineering of tunnels, mixing parallel tunnels, head looking out

powerful

dominant

fortified



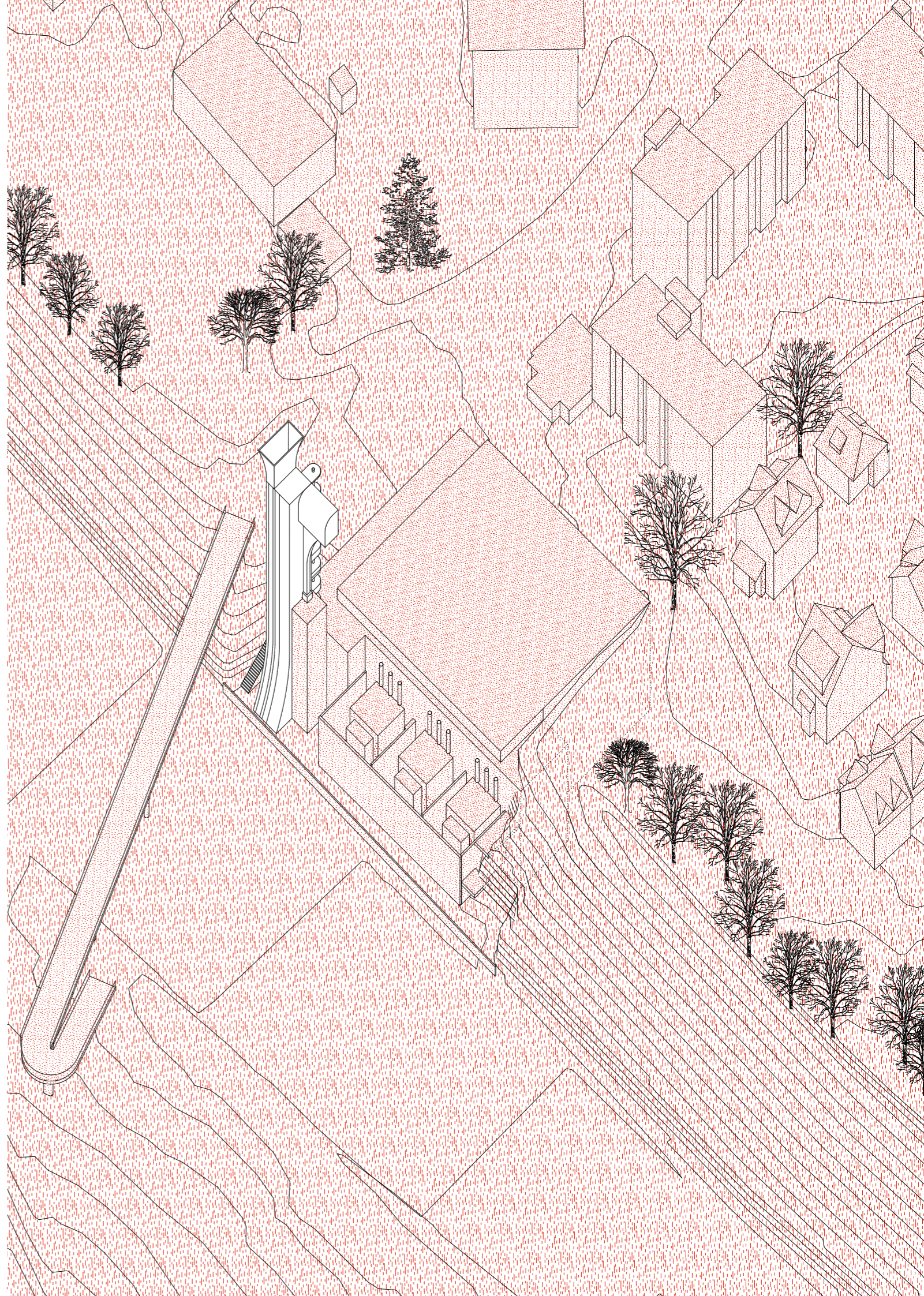
2 . Frohlp 1960
2 athlete

The existing substation's front faces the A3 highway, its back is dug into the cool earth. On its roof, orange sand and two nets: a tennis court. Humans playing, cars speeding by. The tower, too heavy, damned to stand still. Still, its body is strong and robust, a perfectly curved shiny surface. It wants to be seen, heard and appreciated, from the speeding car as well as up close.

is heavy, strong, along
highway
carrying tennis court on roof
concrete, no floor



Strong sturdy robust forced
athletic mighty

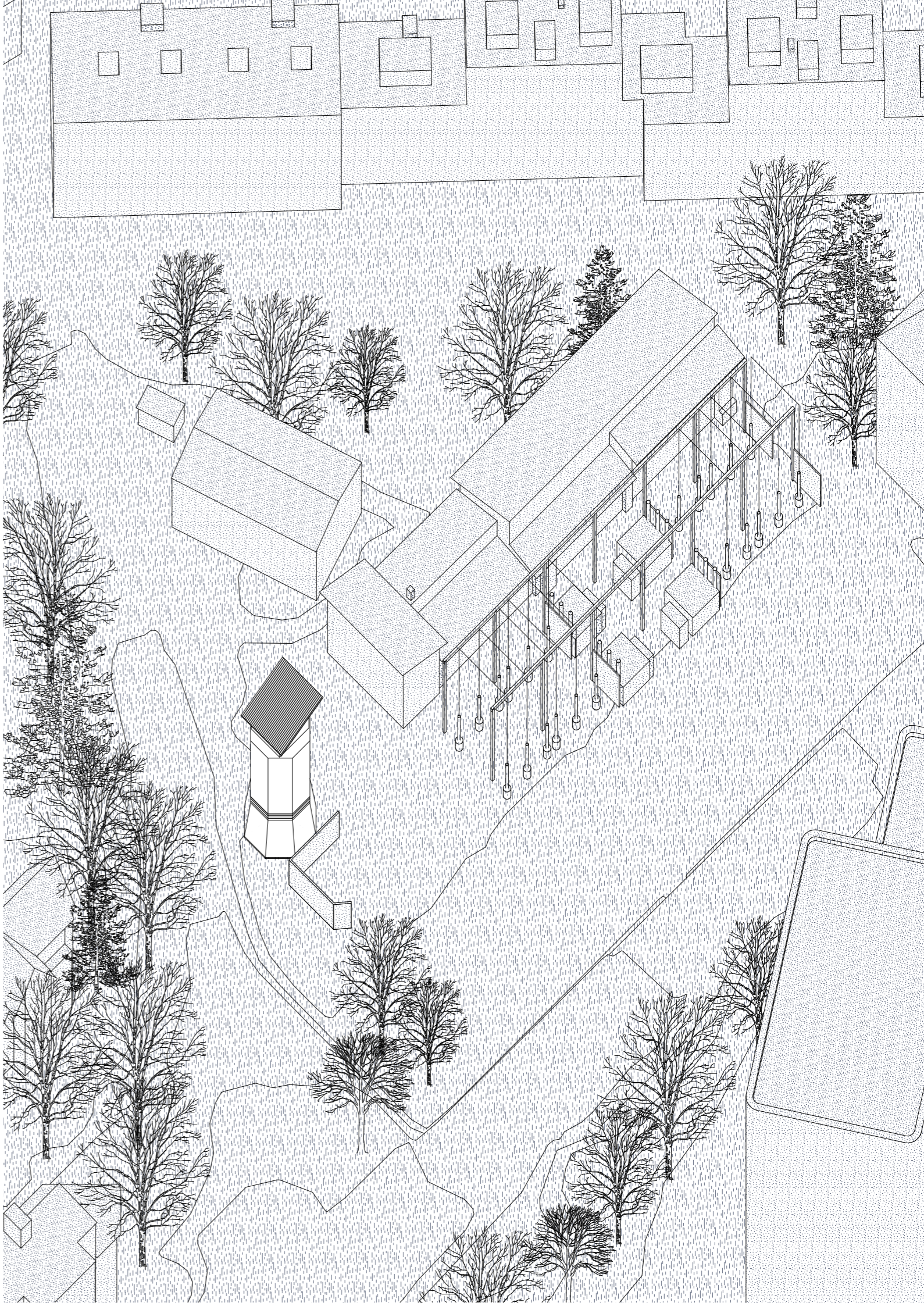


3 worker
Binz 1950s
broad and sturdy
unobtrusive and practical
concrete outer layer
no fuss
here do to a good job



completely overground, visible
industrial aesthetic
+ technology visible
+ brick facade
functional
head & tail
natural light

openness
earnest
spread out



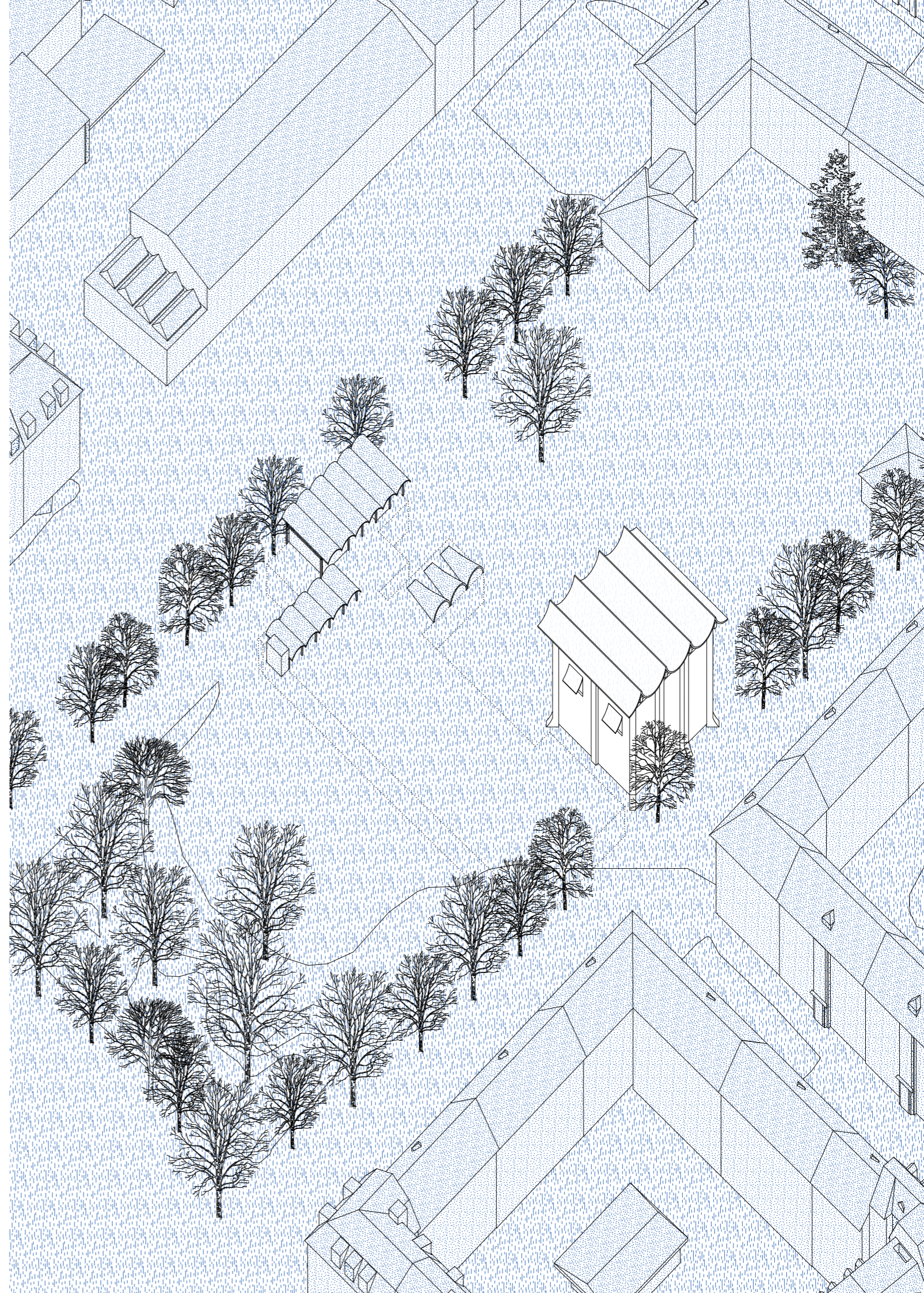
4 caretaker

Sihlfeld 1980

Facing the entrance pavilion to the substation Sihlfeld, the Caretaker positions itself on the opposite side of the green field. It marks the entrance to the park as well as the end of the substation's underground extension. From there, it greets passersby and park dwellers with its calm and friendly presence. In the dark, its eyes shine like a guiding light.



*dug into park
entrances with pavilion
structure + roof
lightness
sunless looking outwards,
giving clue of underground building
alluding,
hissing
glimpse out
insinuating
giving
cover
interactivity*



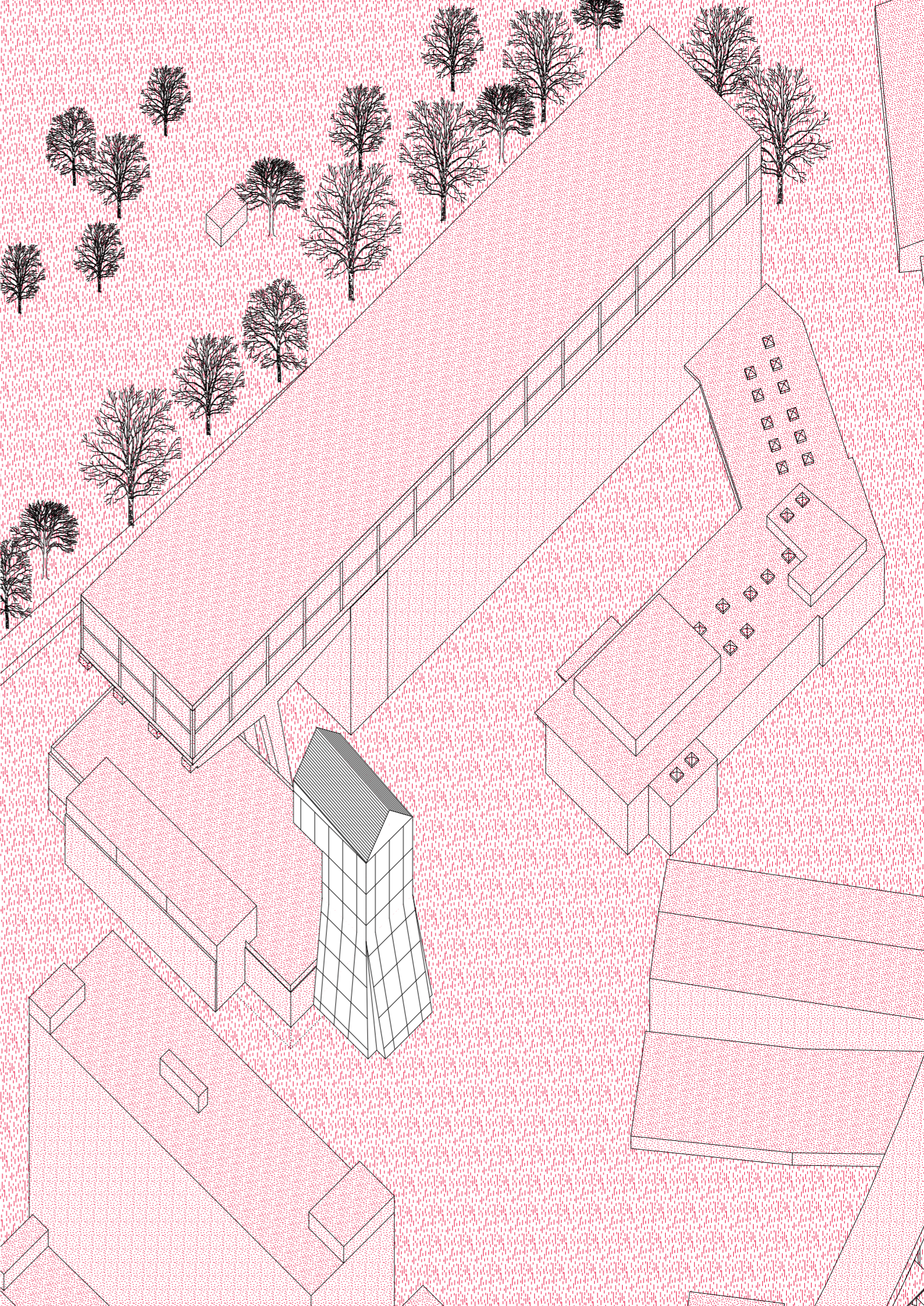
Herdern *rujoing*
5 **disturbant**

Loud and confident the tower leans over the Herdern substation. Its head protruding forward and extending out, provocatively confronting the new EWZ operational building. On its two sides, cars and trains drive by, seeing its unmovable figure from afar.



like Napfhaus, over which office extension towers industrial character big building towers over very closed, unobtrusive building

from confident defiant steadfast



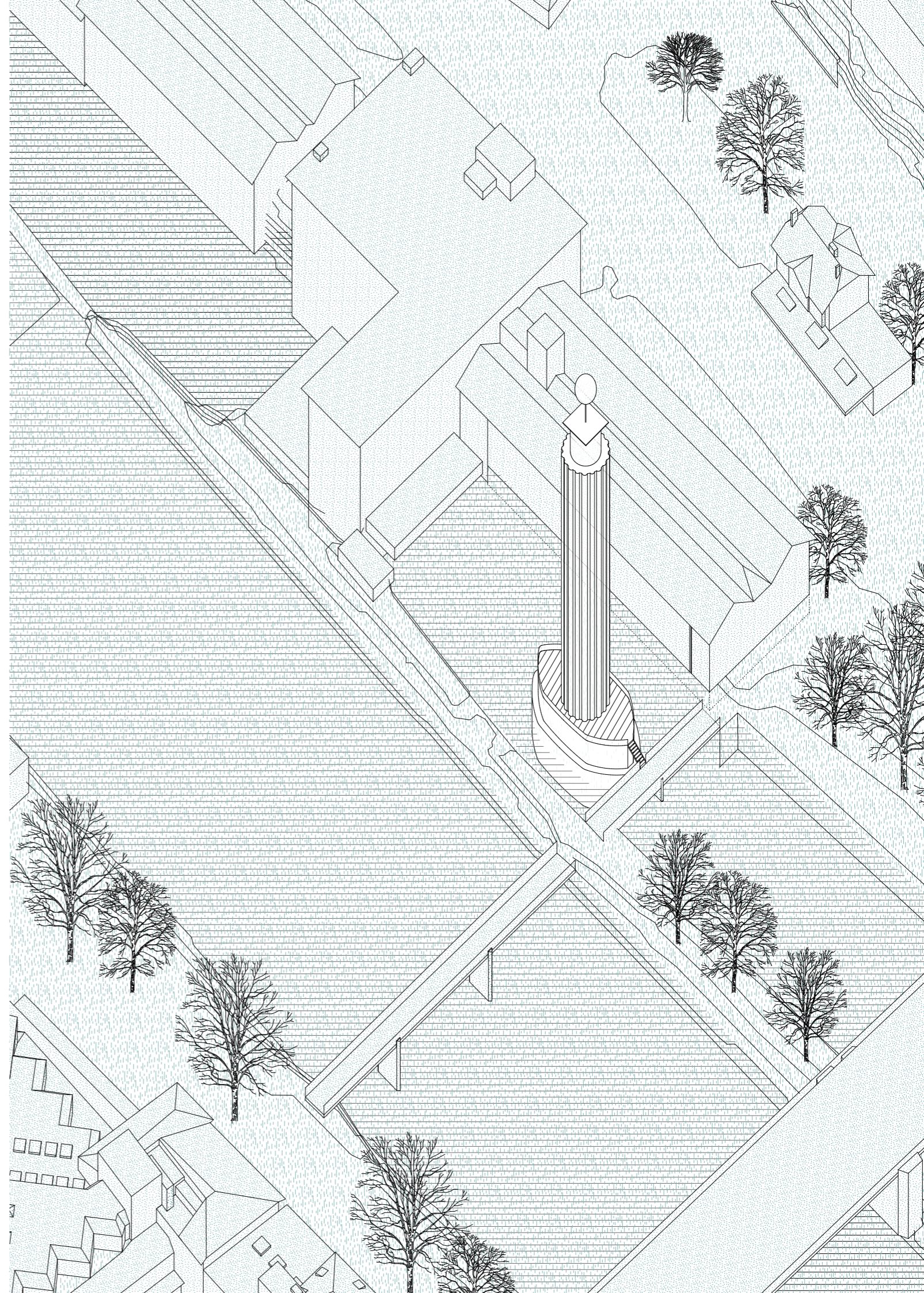
6 bather

Standing in the water filled courtyard of the Limmat power plant and the substation inside the shell of the old Wasserwerk, the Bather is at the center of attention. Its massive longitudinally shaped foot emerges from the water, offering a platform reminiscent of a bath towel.

From its firm base, its rounded body reaches high into the sky, shimmering and reflecting the sun and the water. Its head is formed like a big yellow globe of light, glowing over the surrounding riverside, prolonging the feeling of daylight for a short time.

*built inside existing building
(former Wasserwerk)
completely hollowed out &
filled with new use
façade as masque*

*masquerading inhabiting
mimicking hiding*



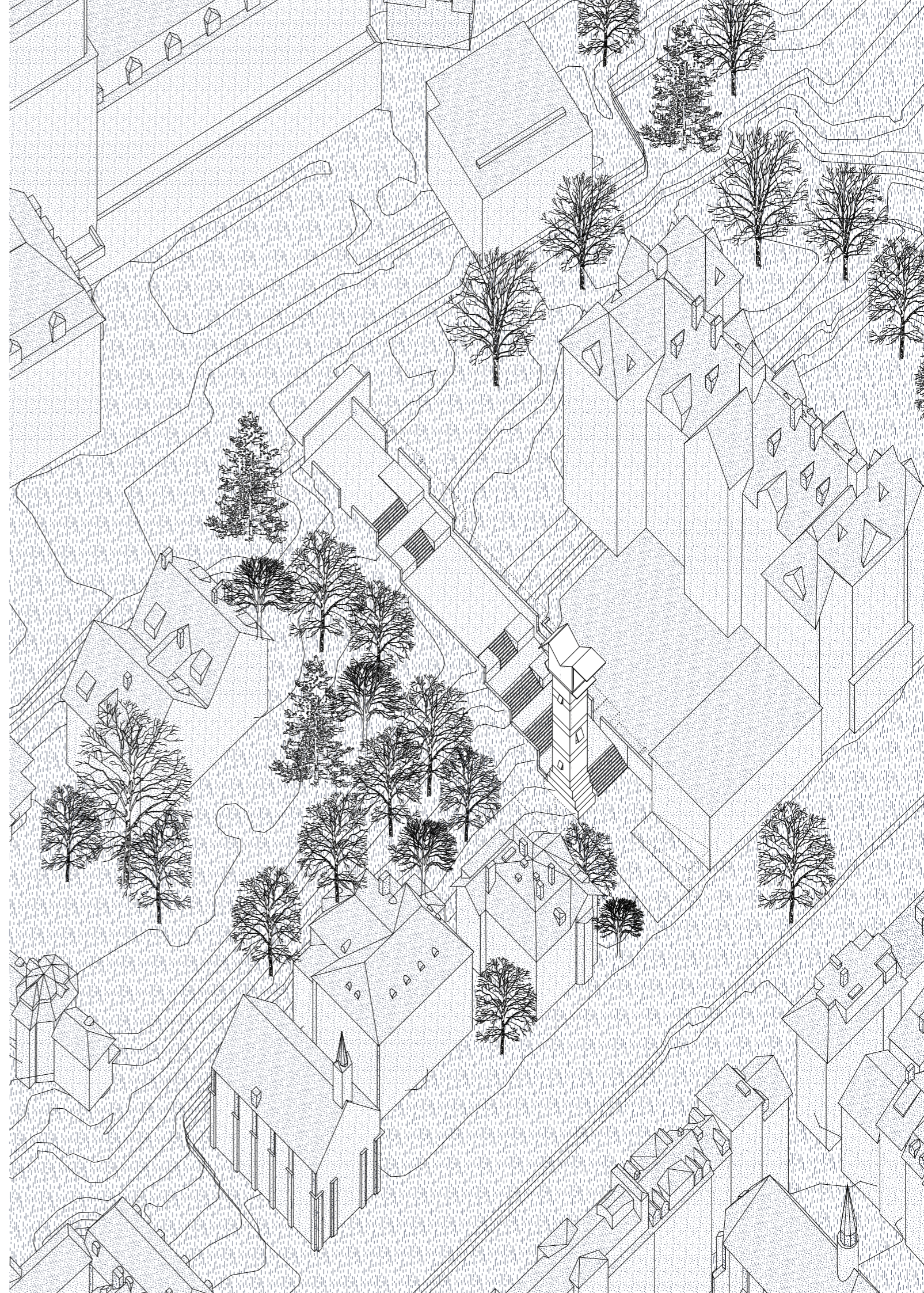
7 ~~7~~ shapeshifter 1970s

A substation as hidden cavern, its roof a terraced stair-landscape, its entrance a camouflaged hydraulic gate. To the Hirschengraben, trying to merge into the stairs, the tower stands in a spot marking the entrance of the terraced passage. If one is unattentive, it might be missed. Its mantle helps it to stay low-key, making its movements, opening and closing, even more unexpected and startling.

Dug into the ground, roof covered with stair-landscape hidden, building takes form of stairs - hydraulic gate



*shifting
shapeshifting
'mper'ohating* ~~mischievous~~

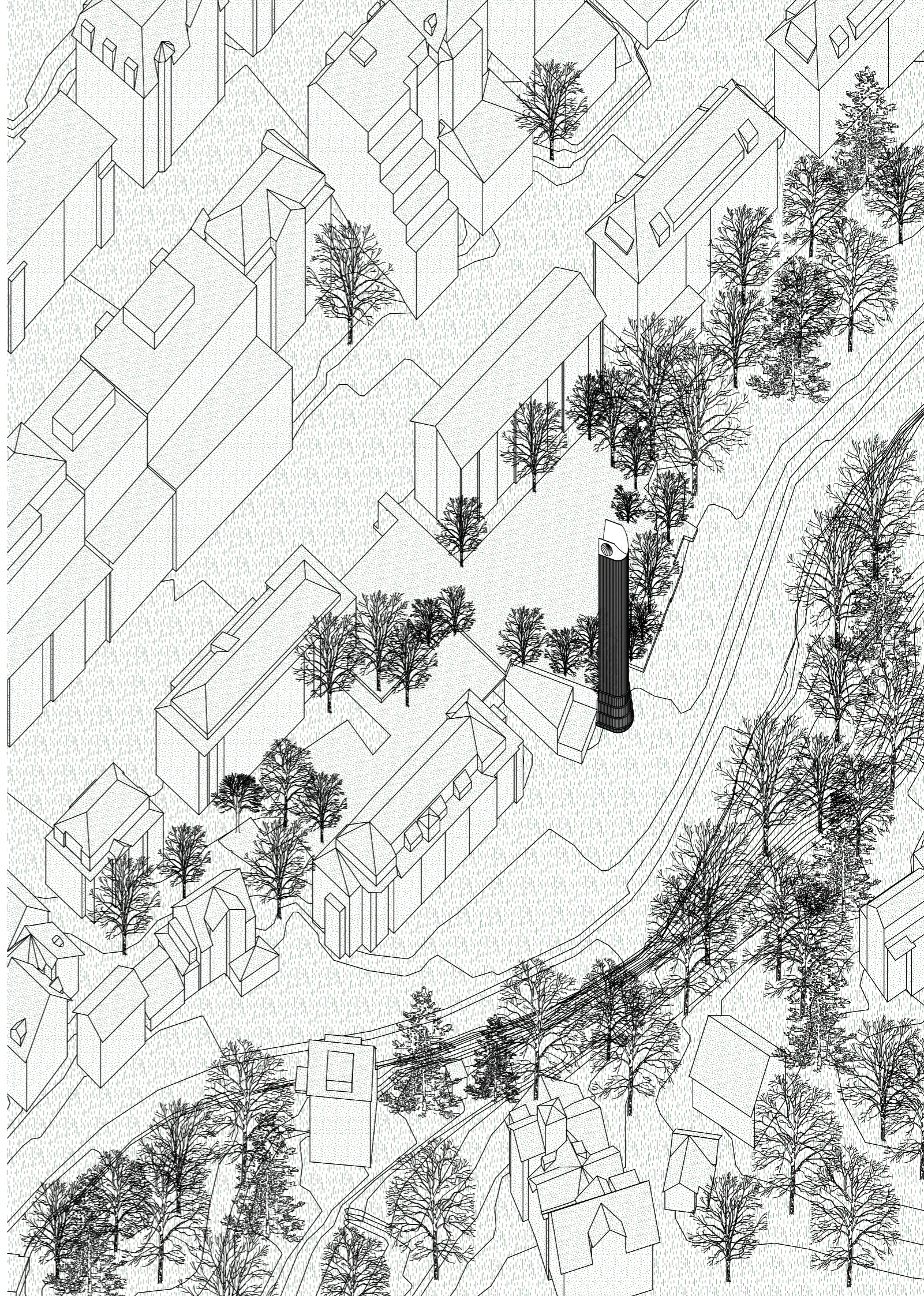


8 gardener

Standing in front of a substation which acts like a wall, embeds itself into the landscape, disappears behind vegetation. The gardener stands in front of the moving wall, not feeling a particular need to make itself seen. Its outer body is rough and ridged, inviting plants, mosses and lichen to grow on it. Over time, it will grow to match its surroundings.



*mostly underground
covered in vegetation
next to botanical gardens &
fields
embedded in residential
neighborhood
low profile building
roof for playground
disappearing embedding
conforming
matching*



9 optimist

Altstetten

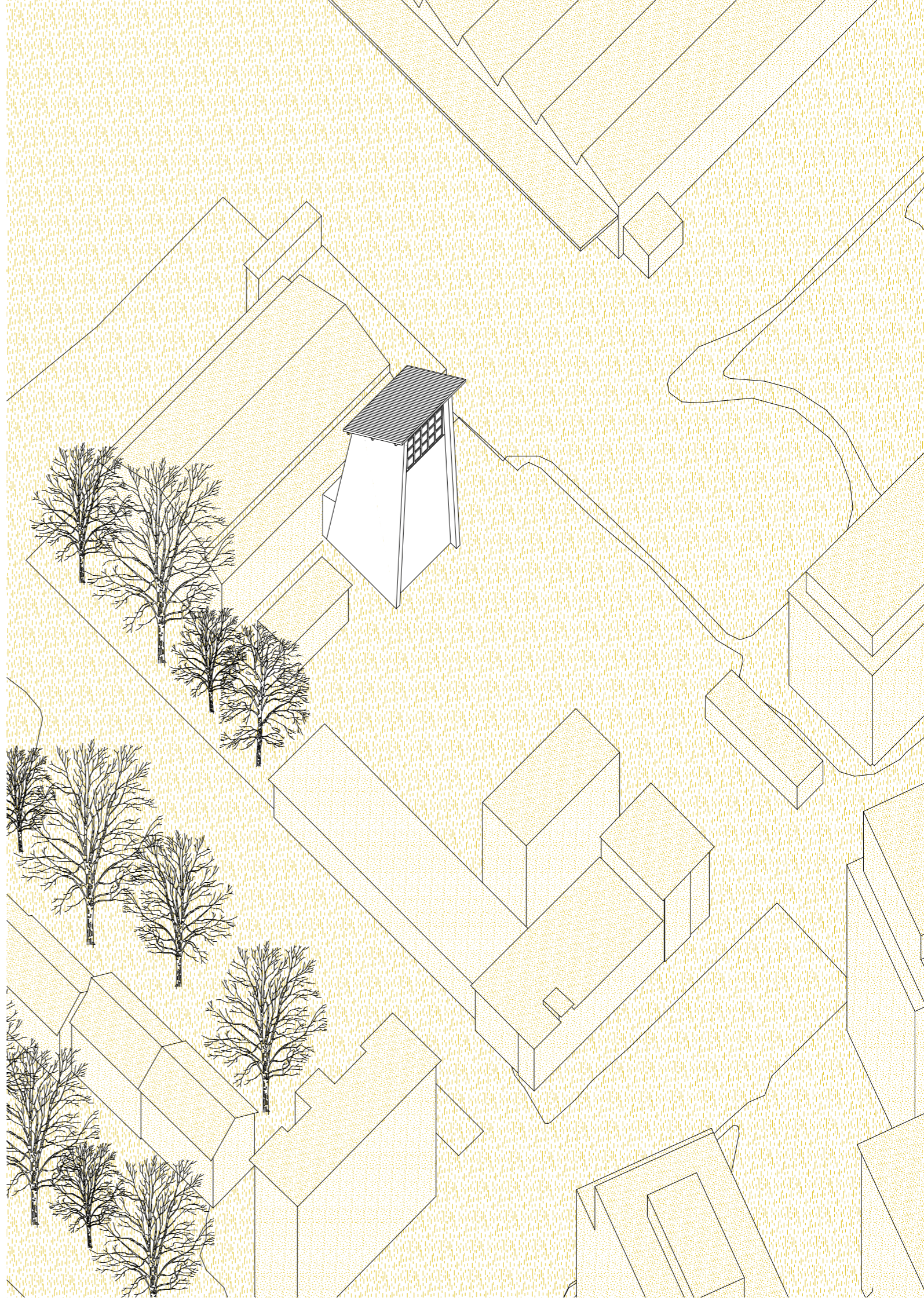
1960

The Optimist is stuck on a drab industrial plot in Altstetten, attached to a closed off substation building. Still, this does not bring down its good faith in the future. Waiting excitedly, it looks out into its surroundings.



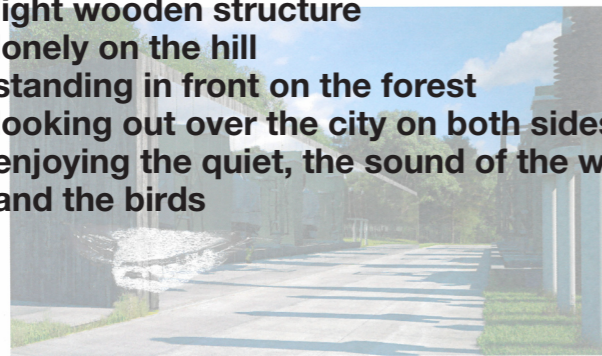
Very big, purely industrial
overground
low + long building
industrial aesthetic, functional

pragmatic
functional
straight forward



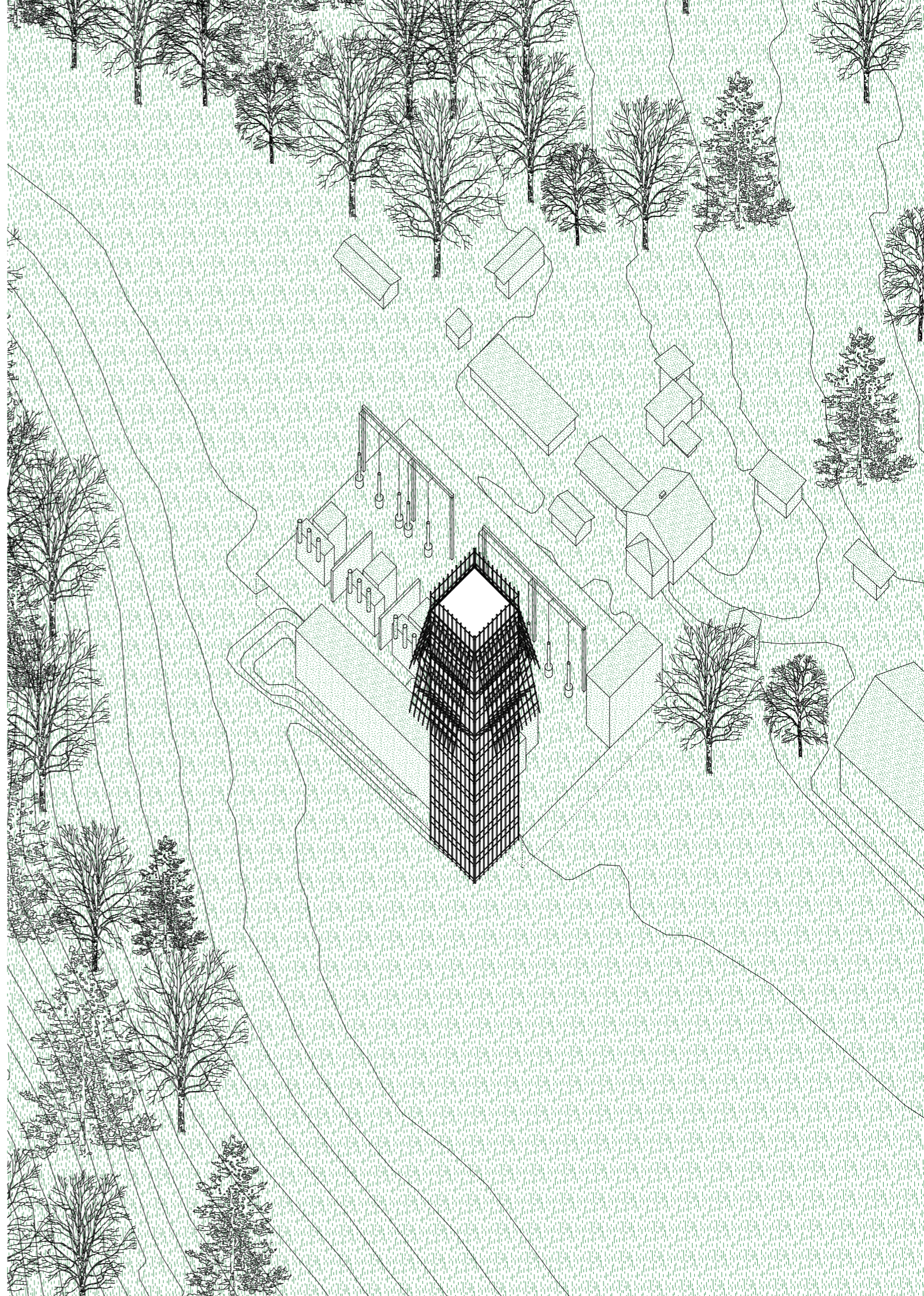
10 10 forester
Höngg 10.6 / 2020

light wooden structure
lonely on the hill
standing in front on the forest
looking out over the city on both sides
enjoying the quiet, the sound of the wind
and the birds



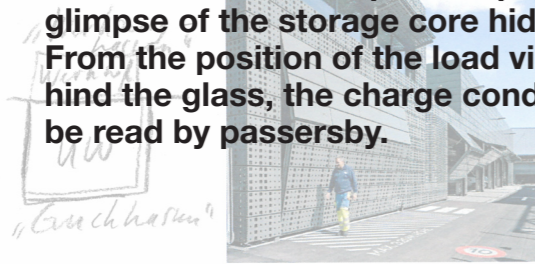
open, Frischluftunterwerk
visible, audible (in part)
at edge of forest
lightness
mirroring

direct
thrustful
genus



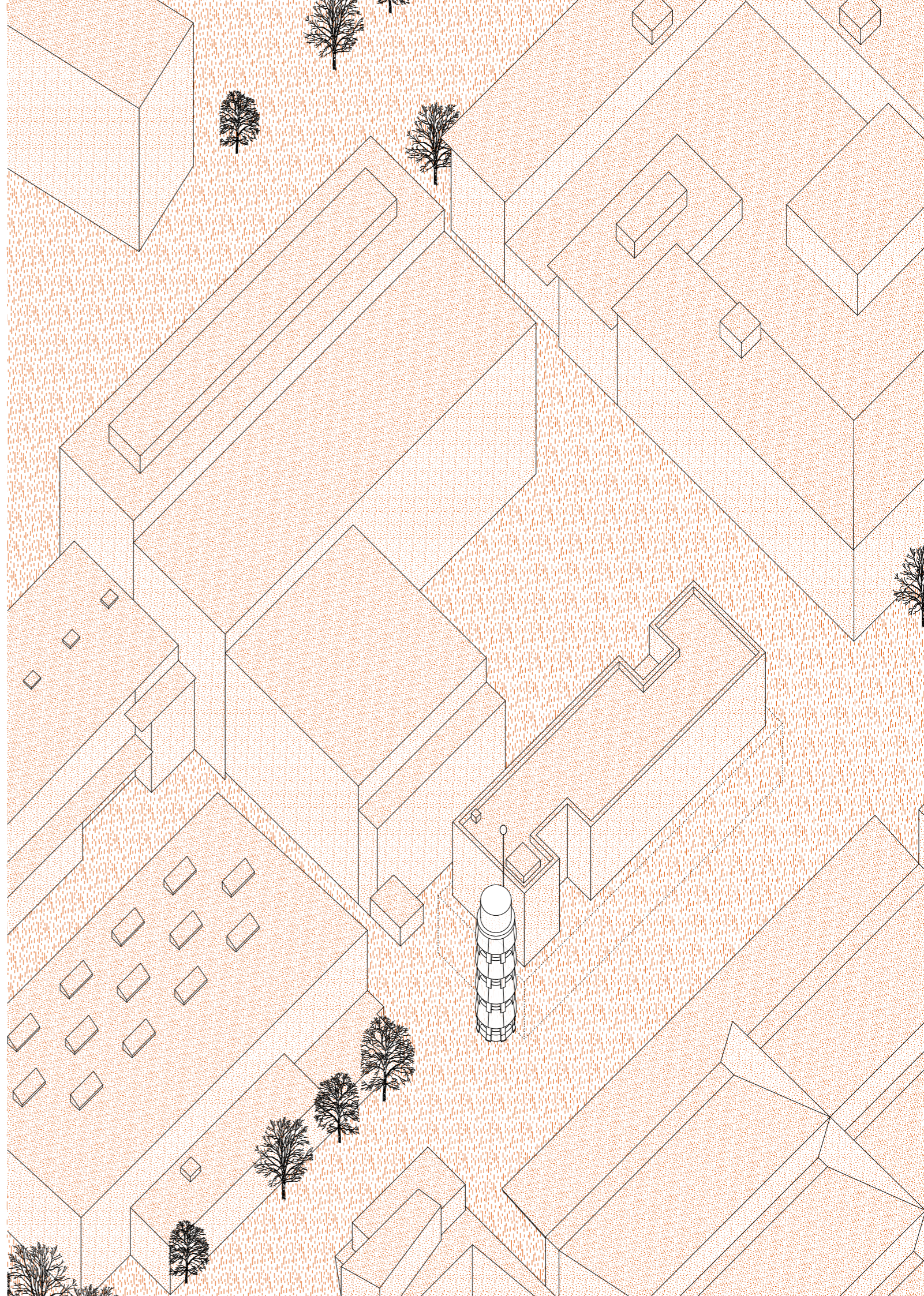
11 11 **educator** 2015

Positioned next to the newest substation, which proudly shows the transformers inside to the surrounding neighborhood. The tower's skin is opened up to give a glimpse of the storage core hidden inside. From the position of the load visible behind the glass, the charge condition can be read by passersby.



"Couch house"

also network support point
idea of peep box - underground bus
still tangible
almost pedagogical role
educative
compact / dense
educative
instructional
communicatory



12 dreamer

¹⁹⁸⁰
The tower's base is dug into the flank of the Irchel park, weighed down. Behind it, even further into the hill, the submerged substation.

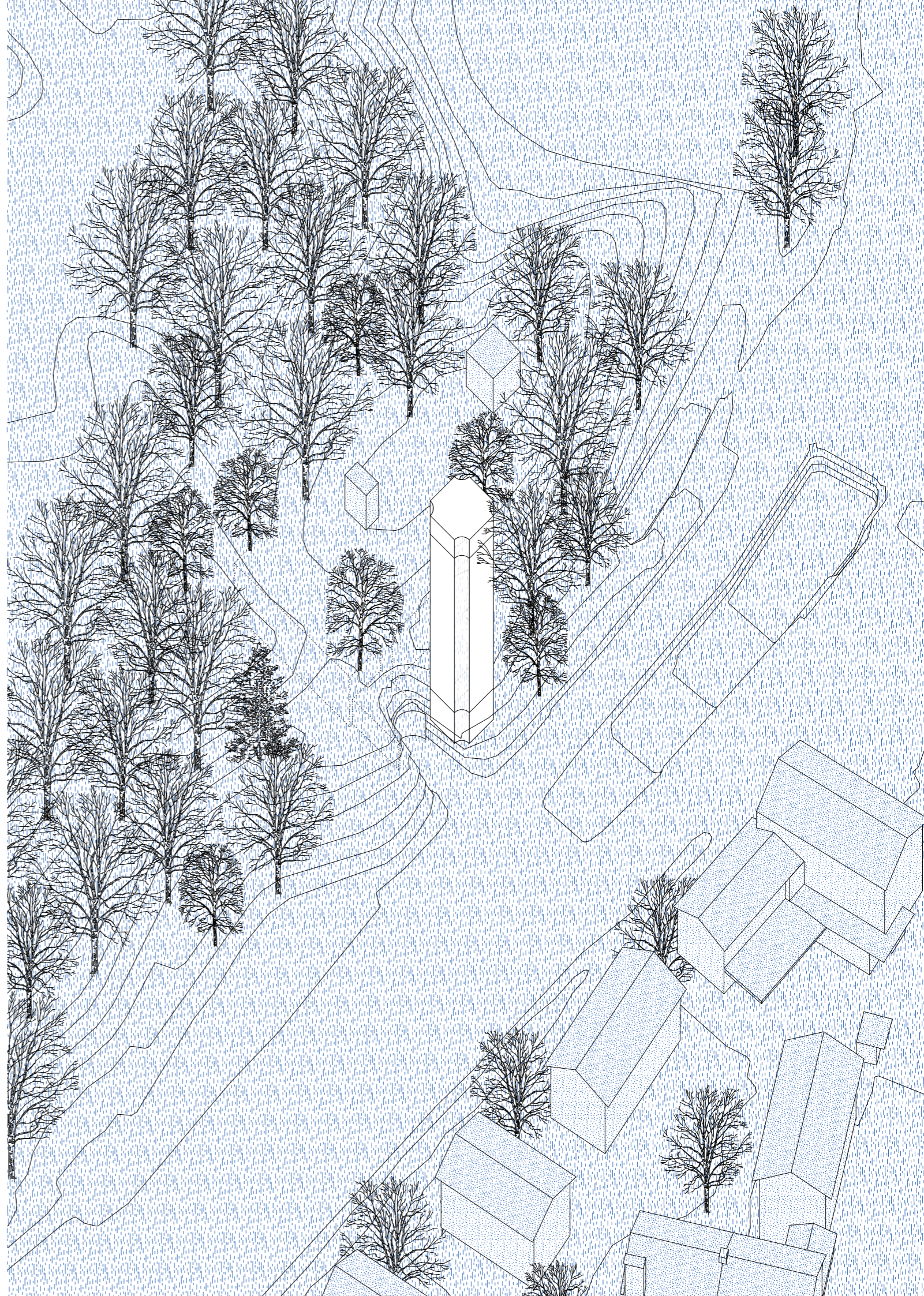
Its head grows high into the sky, almost touching the clouds.

It seems distant and far away, dreaming of the dam, the power plant, the river, the glacier.



embedded in landscape of park
entrance towards Westhangen
accumulation of infrastructure
+ car (Westhangen)
+ tram (Tunnel, Wanderschleife)
+ substation

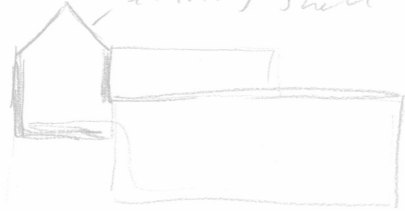
purely infrastructure
honest
reserved
modest
Frankfurt



13 **13 imitator**
 Zeughaus 1990
Backed into the corner of the enormous Zeughaus courtyard, the Imitator would rather disappear. To camouflage, it is clothed in bricks and plaster and covered with familiar shapes and forms.



partly in existing building, partly underground
hidden existing shell



hidden pretending camouflage

