City Energy Fortress

Master Thesis FS 2021

Katharina Schielke

Process Booklet

ETH Zürich
Departement Architektur
Chair of Architectural Behaviorology
Prof. Momoyo Kaijima

Introduction

The analysis of a given site for me is the most important part of the architectural project development. Whereas contemporary and future architects will be less faced with the situation of building on empty space with little to no surroundings, but more likely have to develop strategies to work with given situations, it is a crucial ability to understand and read the given context.

Starting with the analysis of the city, Zurich has very particular modus of existence. Its development in separated quarters does not make a homogenous fabric but allows many different appearances side by side. One of these quarters is Escher-Wyss, where Herdern site is located.

Coming from the history of being a factory quarter, this part of the city shows itself today as heterogenous pattern of big scale company buildings in private ownership, repurposed former factories and big infrastructural intersections. Since approximately 20 years, the neighbourhood experiences major development; gentrification and re-use fill the left empty spots with financial buildings and big scale office-housing complexes, converting more of the cities ground floor into private space.

In between, bigger and bigger streets are taking away the leftover green spots and traffic is expected to even increase about 30 % until 2030. Infrastructural elements like the Migros spiral ramp or the one belonging to Toni-Areal are abandoned and serve as contemporary witness of times gone by. A rather unlively neighbourhood came to live, where public spaces were pushed on rooftops, not accessible for those who don't know the spaces and where streets and infrastructural needs took over.

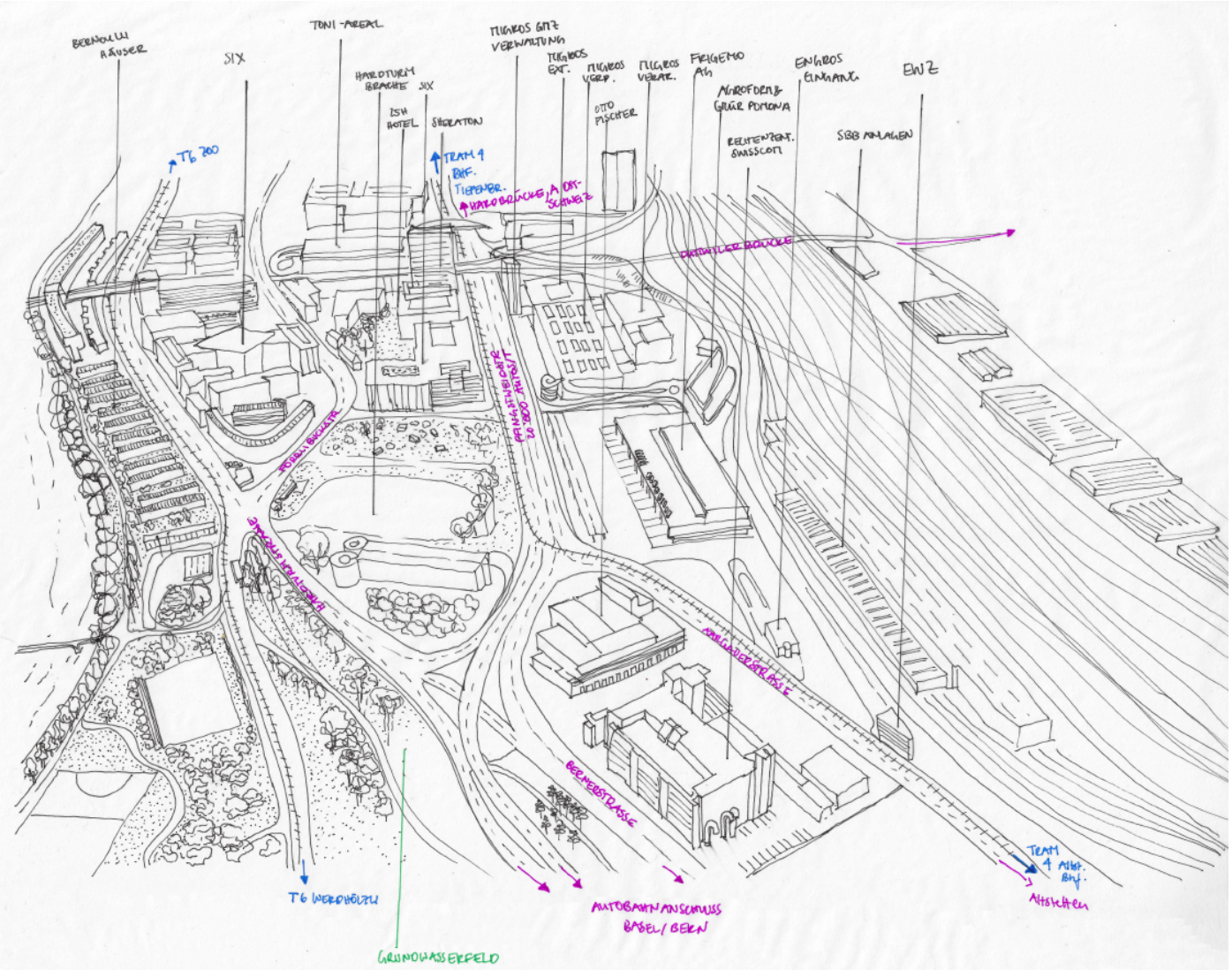
The enormous amount of consumed goods, fueled by capitalist society, lead to this area of the city being Zurich`s central trading hub. The inevitable advantage of trading hubs this close to the city center is that they shorten travel of food, but they also come with huge infrastructural areas that lead – in combination with condensed building practice and massive energy consumption of cooling systems – to urban heat islands. As can be seen on the maps from the Richtplan Zürich, the area already is an urban heat island at night and will become one during the day in the future.

Still this place not only provides problems but also has a huge potential. From the Hönggerberg comes one of the main cold western wind streams, that can cool down the area, the photovoltaic potential is huge due to the fact that the south side will not be built on, whereas the SBB rails are located there and on top of that Migros company has a big energy system, that can be used for the best.

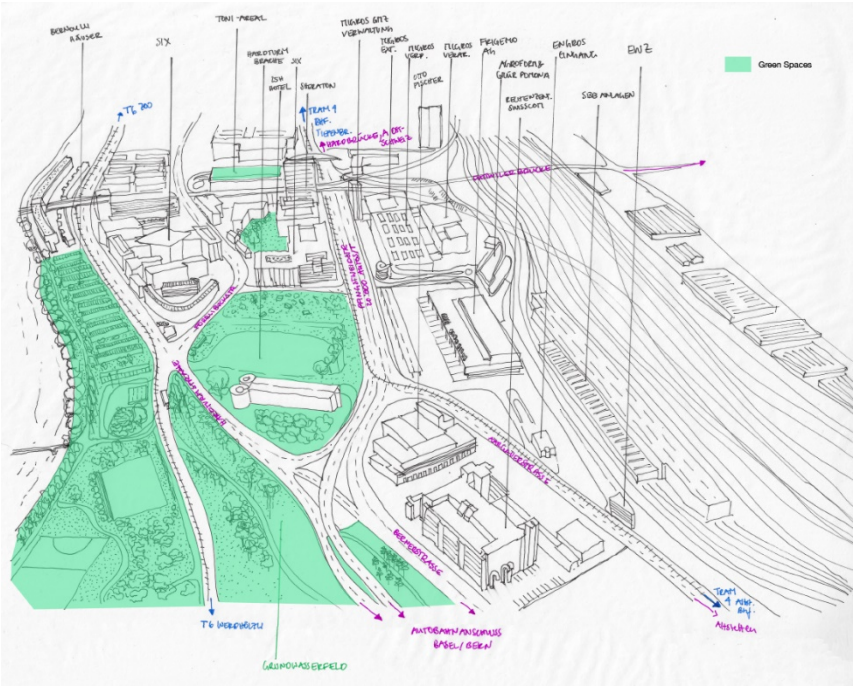
Research

Site Analysis

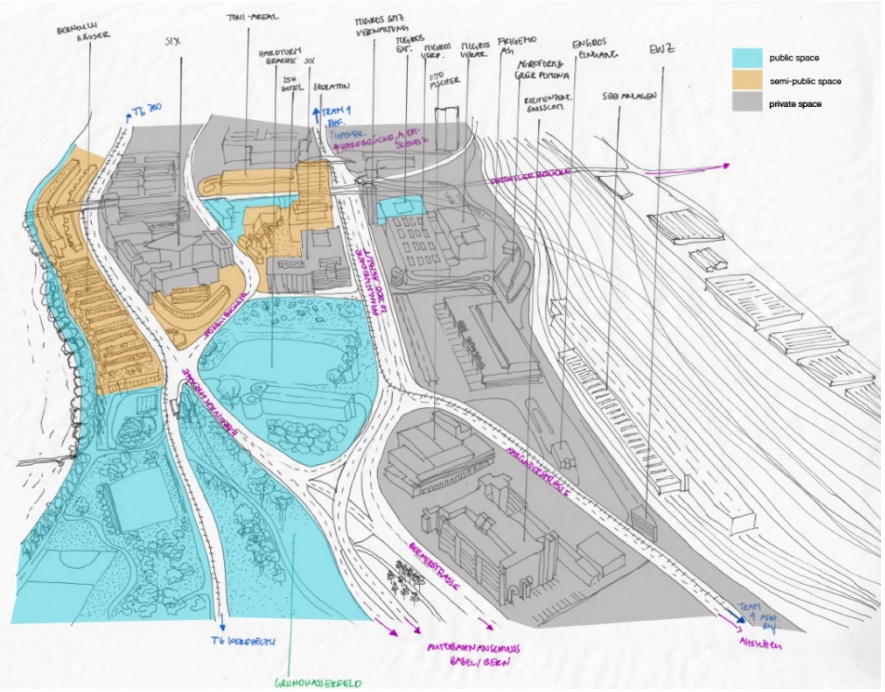
Actor Network Zurich West



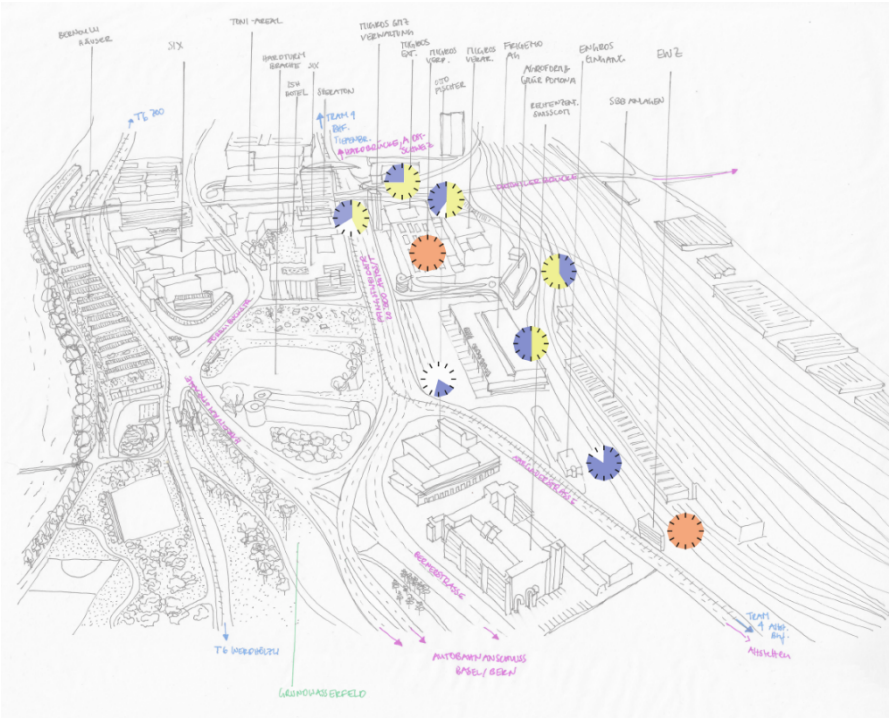
Green Spaces Today



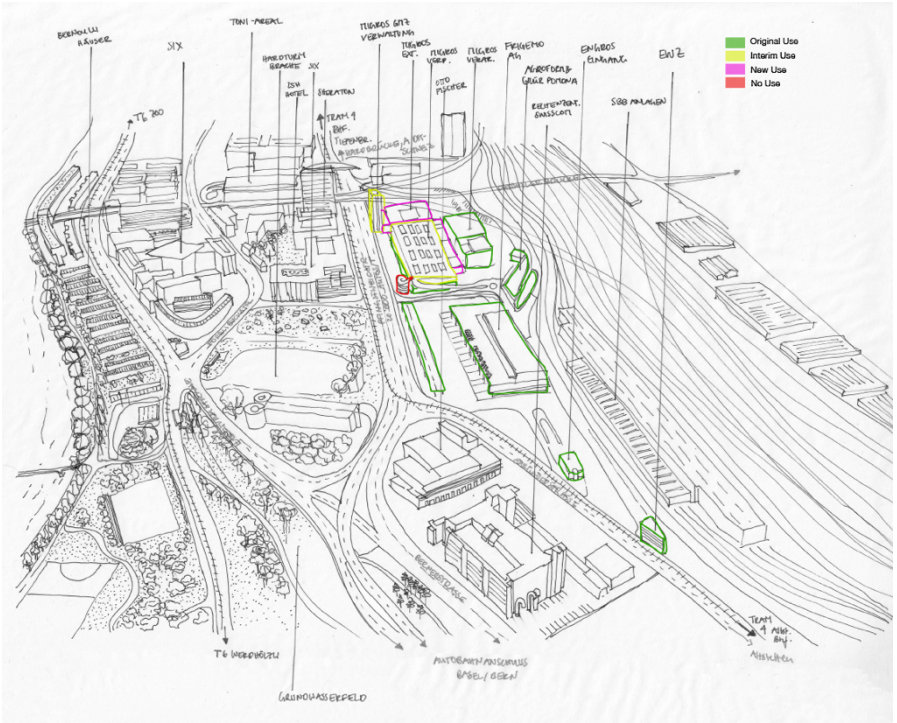
Public Spaces



Time of Use

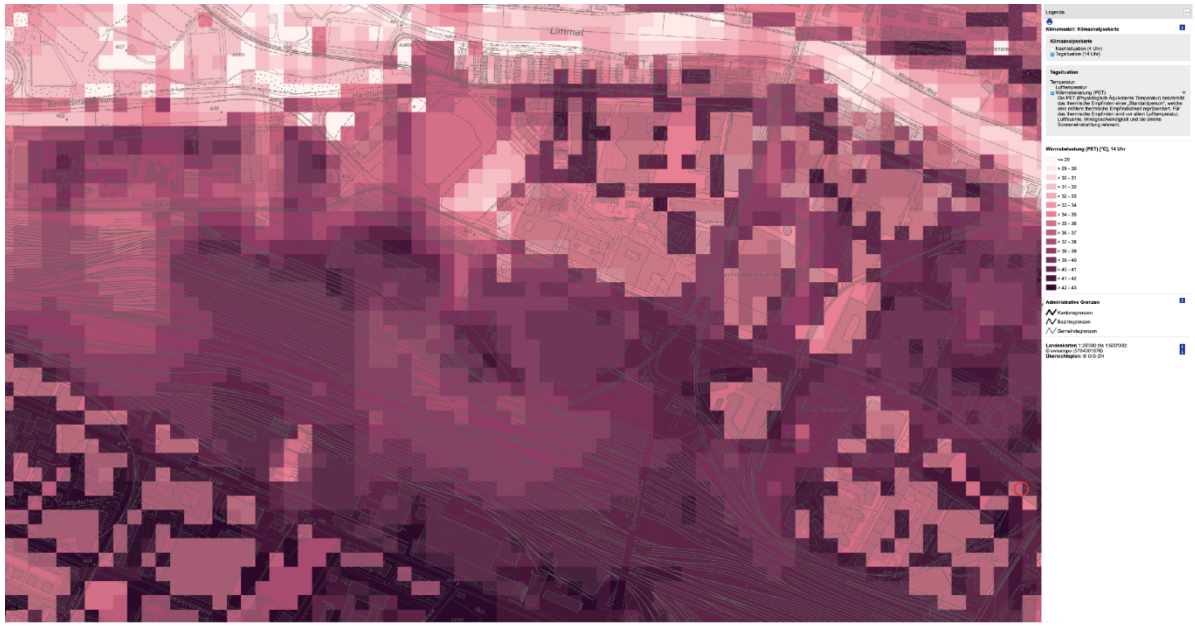


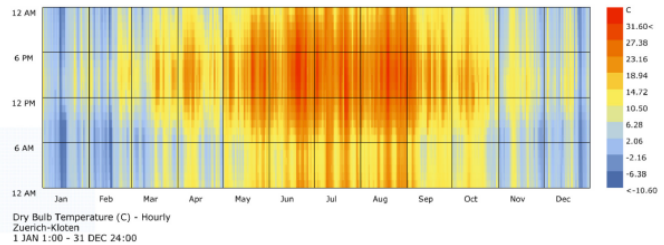
Use

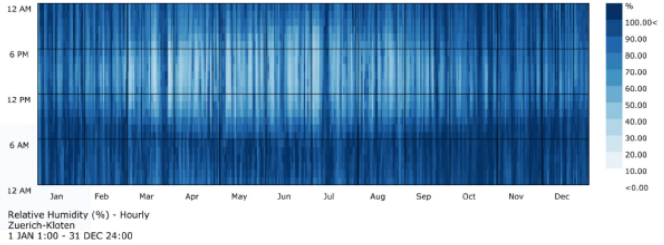


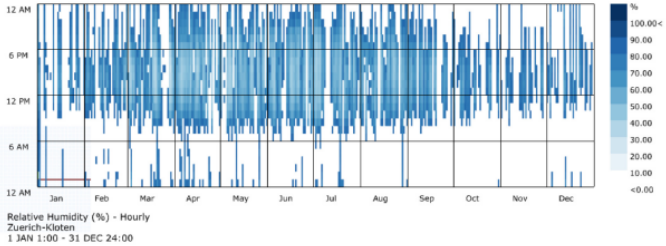
Climate Analysis

Heat Pollution and Humidity

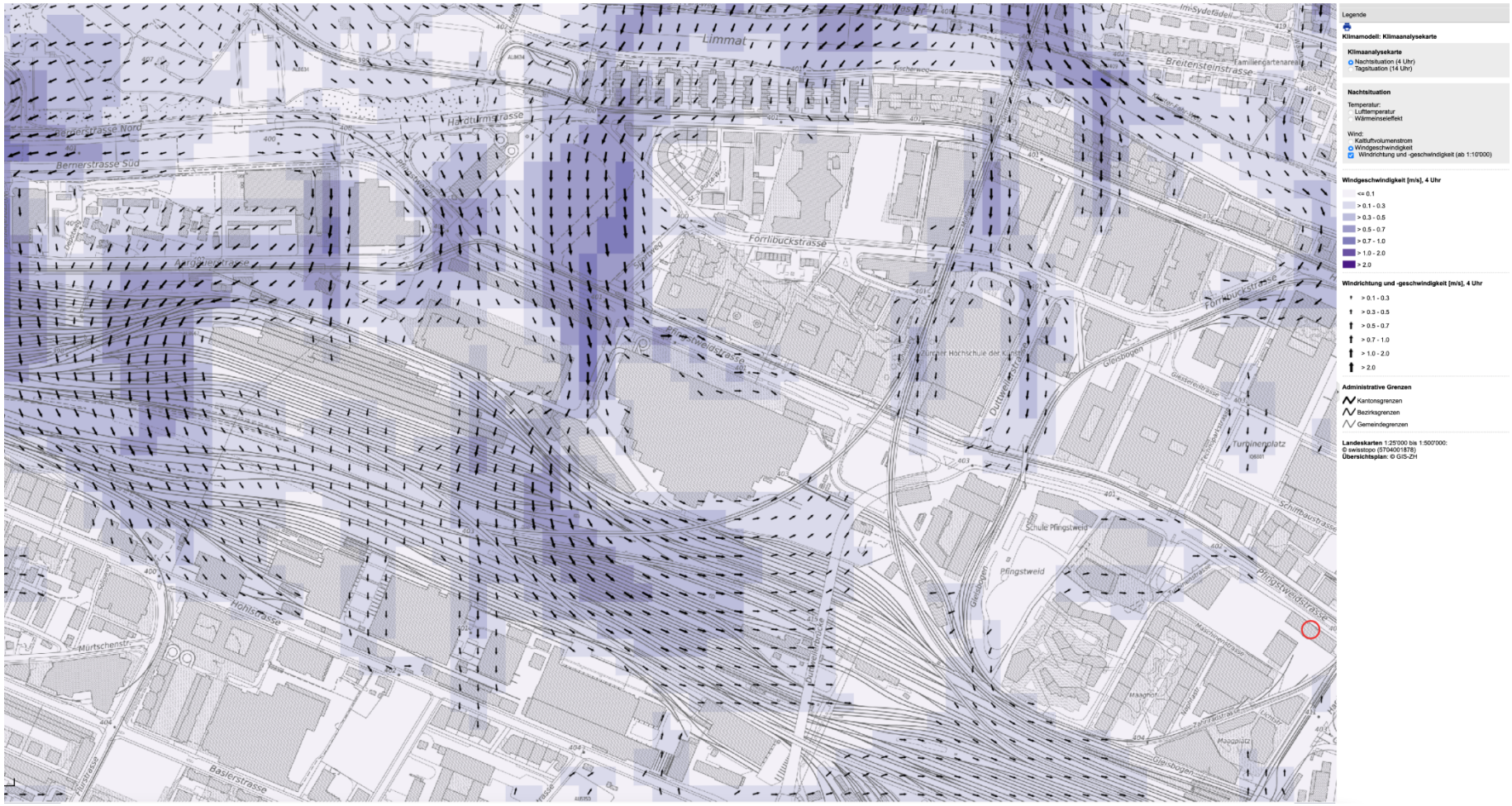


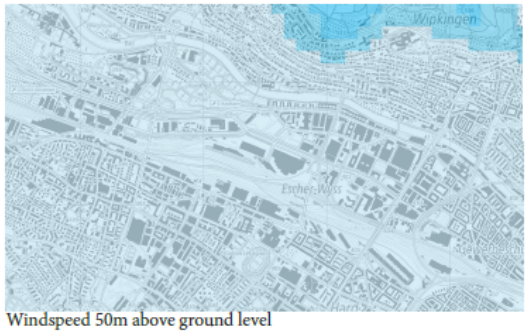




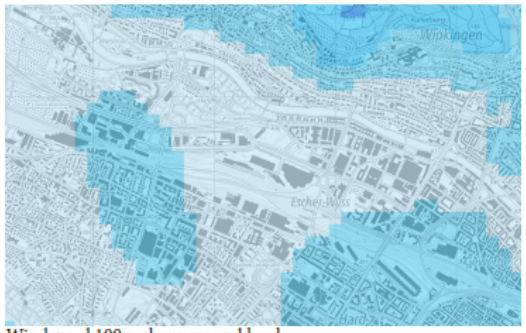


Wind


Legende
Klimamodell: Klimaanalysekarte
Klimaanalysekarte
Nachtsituation (4 Uhr)
Tagsituation (14 Uhr)
Nachtsituation
Temperatur:
Lufttemperatur
Wärmeinseleffekt
Wind:
Kaltluftvolumenstrom
Windgeschwindigkeit
Windrichtung und -geschwindigkeit (ab 1:10'000)
Windgeschwindigkeit [m/s], 4 Uhr
<= 0.1
> 0.1 - 0.3
> 0.3 - 0.5
> 0.5 - 0.7
> 0.7 - 1.0
> 1.0 - 2.0
> 2.0
Windrichtung und -geschwindigkeit [m/s], 4 Uhr
> 0.1 - 0.3
> 0.3 - 0.5
> 0.5 - 0.7
> 0.7 - 1.0
> 1.0 - 2.0
> 2.0
Administrative Grenzen
Kantonsgrenzen
Bezirksgrenzen
Gemeindegrenzen
Landeskarten 1:25'000 bis 1:500'000:
© swisstopo (5704001878)
Übersichtsplan: © GIS-ZH
Limmat
Im Sydefädel
Familiengartenareal
Breitensteinstrasse
Berneristrasse Nord
Berneristrasse Süd
Hardturmstrasse
Förrlibuckstrasse
Pfingstweidstrasse
Duttweilerstrasse
Gleisbogen
Turbinenplatz
Schiffbaustrasse
Schule Pfingstweid
Pfingstweid
Hohlstrasse
Mürtschenstr.
Basierstrasse
Maagplatz



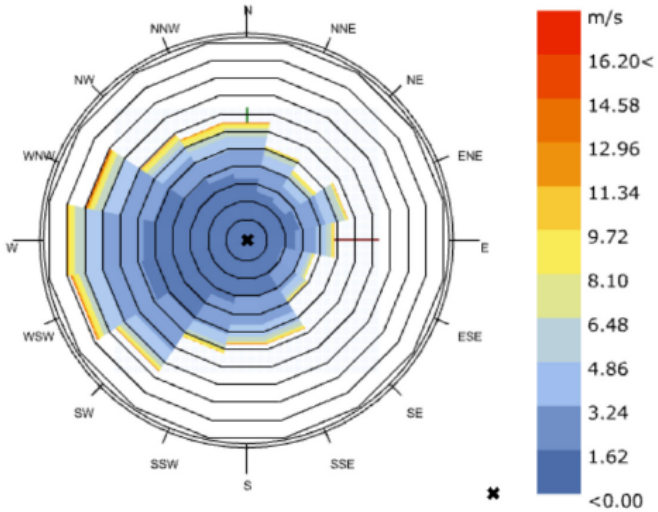
Windspeed 50m above ground level



Windspeed 100m above ground level

Windspeed 125m above ground level

< 4.0 m/s
≥ 4.0 - < 4.5 m/s
≥ 4.5 - < 5.0 m/s
≥ 5.0 - < 5.5 m/s
≥ 5.5 - < 6.0 m/s
≥ 6.0 - < 6.5 m/s

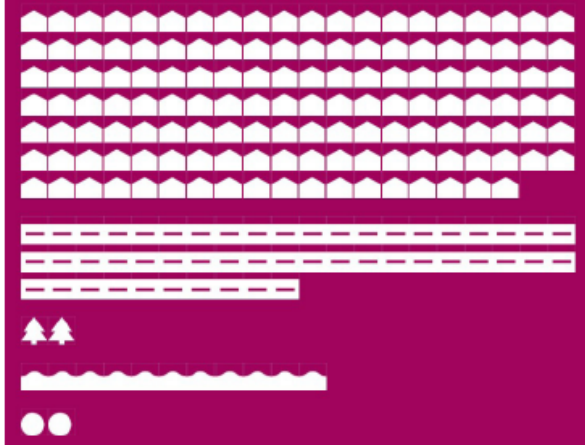


Wind-Rose
Zuerich-Kloten
1 JAN 1:00 - 31 DEC 24:00
Hourly Data: Wind Speed (m/s)
Calm for 2.45% of the time = 215 hours.
Each closed polyline shows frequency of 0.9%. = 83 hours.

Life Quality

Grün oder grau?

Der grösste Teil der Fläche im Quartier Escher Wyss besteht aus Gebäuden und Gebäudeumschwung.



Gebäude (69%)
Verkehrsfläche (25%)
Wald (1%)
Gewässer (5%)
Übrige (1%)

22

Lebensqualität im Quartier

99 Prozent der Bevölkerung des Quartiers Escher Wyss leben gerne in der Stadt Zürich, und 55 Prozent beurteilen die Lebensqualität als sehr gut.*

Alter

Im Quartier gibt es weder Alterszentren noch Alterswohnungen. Über die ganze Stadt verteilen sich 35 Standorte mit Alterswohnungen und 20 Alterszentren.

Sportanlagen

Die einzige Sportanlage im Quartier ist eine Sporthalle. In der Stadt gibt es 108 Sportanlagen. Darunter fallen neben Sporthallen auch Beachvolleyballfelder oder Fussballplätze.

Spielplätze

Ein Spielplatz erfreut die Kinder im Quartier. Die Abdeckung ist mit einem Spielplatz pro 610 Kindern tiefer als im städtischen Durchschnitt, wo auf einen Spielplatz 290 Kinder kommen.

Stadtleben

Im Quartier gibt es 2 Quartiertreffs. Sie sind wichtige Treffpunkte für die Quartierbevölkerung.

Park und Picknick

In diesem Quartier dienen 2 Parks der Erholung im Grünen. Über die Stadt verteilt gibt es 117 Parks, 99 Picknickplätze und 16 Waldhütten.

* Stichprobenunsicherheit: 2–10 Prozentpunkte.

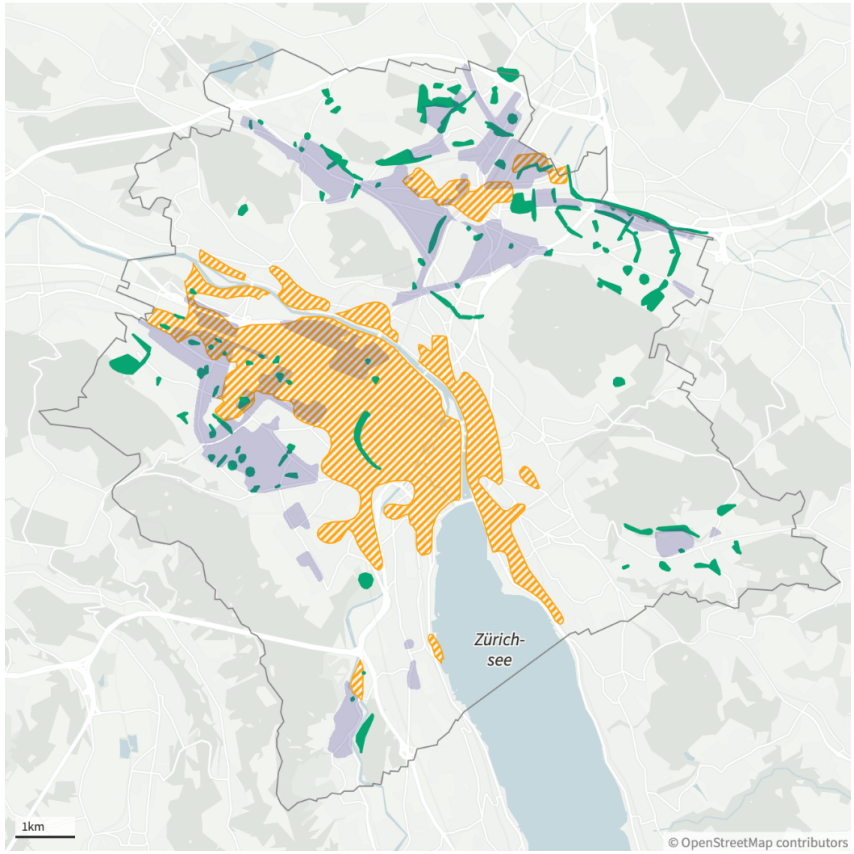
12

Heat and Parks

Dichte, Hitze und neue Parks in Zürich

Entwicklung gemäss kommunalem Richtplan

- Gebiete, in denen dichter gebaut werden soll, als es die Bau- und Zonenordnung (BZO) heute erlaubt
- Geplante neue Freiräume (Parks und Plätze) gemäss Planung 2018
- Verbesserung der bioklimatischen Situation bei Tag und Nacht notwendig



Hotspots

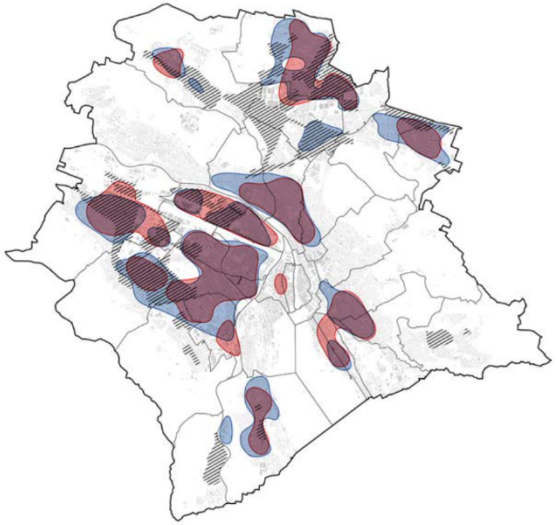
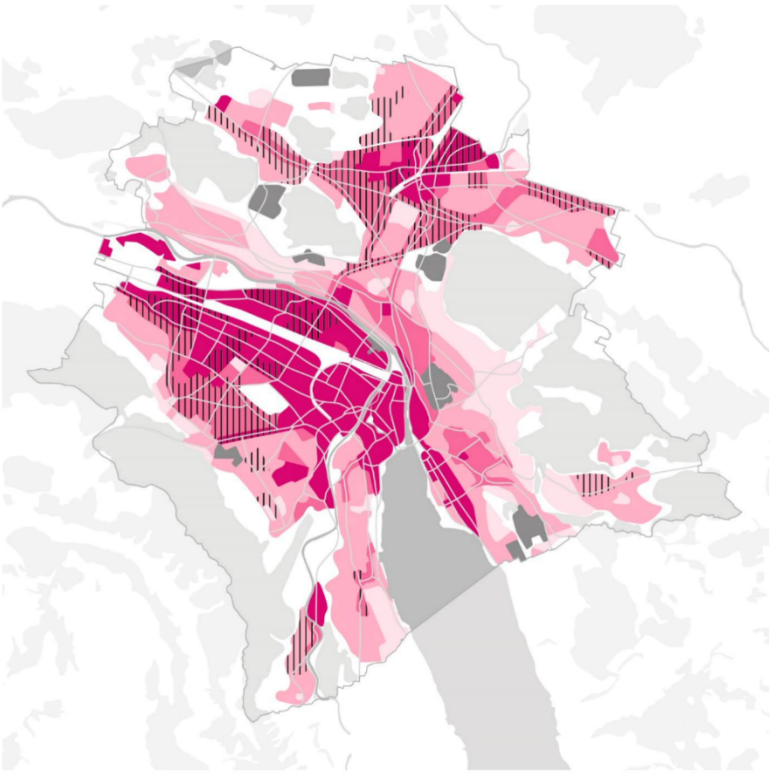


Abb. 25: Vulnerabilität und Überlagerung der Hotspots am Tag und in der Nacht, Prognose 2030

Hotspots Tag und Nacht, Gegenwart, mit den Verdichtungsgebieten

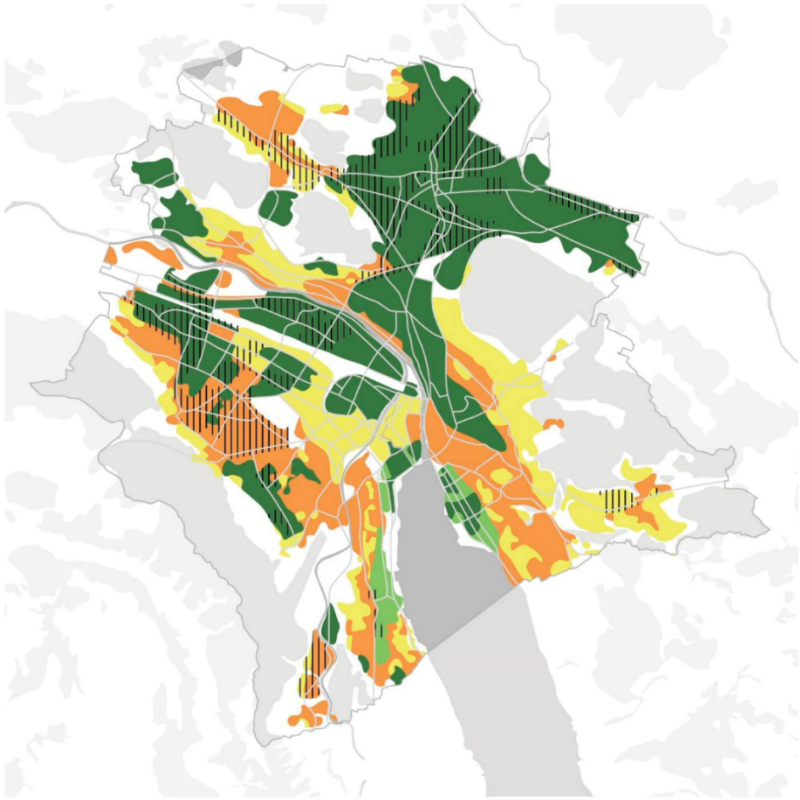
- Hotspots Tag
- Hotspots Nacht
- Hotspots Tag und Nacht
- Siedlungsraum
- Stadtquartiere Zürich
- Gebiete mit baulicher Verdichtung über BZO 2016 hinaus (kommunaler Richtplan SLöBA)

Efficiency



Ausnützungsziffer >250 %, Wohnen und Arbeiten
Ausnützungsziffer 150–270 %, Wohnen und Arbeiten
Ausnützungsziffer 100–170 %,Wohnen
Ausnützungsziffer 50–135 %, Wohnen
Hochschule, Spitalanlage
Gebiet mit baulicher Verdichtung > BZO 2016

Availability of Renewable Energy



Angebot an lokal verfügbaren erneuerbaren Energien oder Abwärme sehr gut
Angebot an lokal verfügbaren erneuerbaren Energien oder Abwärme gut
Angebot an lokal verfügbaren erneuerbaren Energien oder Abwärme kritisch
Angebot an lokal verfügbaren erneuerbaren Energien oder Abwärme ungenügend
Gebiet mit baulicher Verdichtung > BZO 2016

Energy Analysis

Migros Energy Consumption 2017

Bereiche	Stromverbrauch		Wärmeverbrauch		Wasserverbrauch		CO_2-Emissionen	
	MWh	Ver. (in %)	MWh	Ver. (in %)	m^3	Ver. (in %)	Tonnen	Ver. (in %)
Filialen	73805	−1,4	4401	−7,5	151144	−9,1	993	−21,3
Betriebszentrale	11890	−17,0	2606	−5,8	25500	−8,3	386	6,0
Transport	–	–	–	–	–	–	3337	−1,3
Fitness	7804	0,3	5921	16,5	140998	4,7	924	8,3
Total	**93499**	**−3.5**	**12928**	**−2,6**	**317642**	**−3,4**	**5640**	**−3,7**

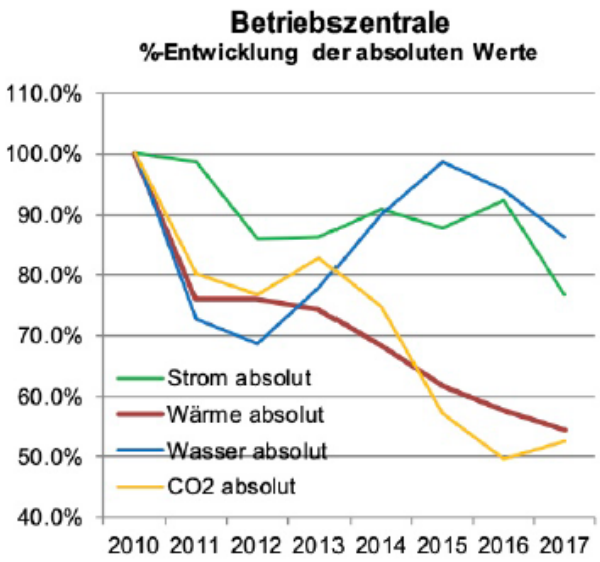
Die absoluten Mengen der Bereiche im Jahr mit der prozentualen Zu- oder Abnahme zum Vorjahr.

Alle Bereiche ausser den Fitnessparks konnten ihren Verbrauch reduzieren. Bei den Fitnessparks sind die technischen Reduktionsmöglichkeiten schon weitgehend ausgereizt. Die Bedürfnisse der Fitness- und Wellness-Kunden stehen dort im Vordergrund.

Enthaltene Bereiche:
Filialen: Gesamtverbrauch Supermärkte, M-Restaurants und Fachmärkte der Genossenschaft Migros Zürich
Logistik: Betriebszentrale Herdern (exkl. Fremdvermietete Flächen)
Transport: Sämtliche Filialbelieferungen durch die Genossenschaft Migros Zürich
Fitness: 6 Fitnessparks der Migros Zürich (inkl. Glattpark aber ohne Sihlcity)

Nicht enthalten:
Klubschulen
Allgemeinverbrauch in Zentren
Golf- und Freizeitanlagen
Fremdvermietete Liegenschaften

Energy Consumption Headquarter Migros



Verbrauch Energie und Wasser, Entwicklung der absoluten Zahlen seit 2010 (2010 = 100%). Gesamte Betriebszentrale Herdern, aber nur die selber genutzten Bereiche, ohne Partnermieter. Die Wärme umfasst die Wärmeerzeugung aus Gas und Öl, sowie die Fernwärme ab dem öffentlichen Netz, aber keine Abwärmenutzung.

Neben vielen Reduktionsmassnahmen haben grosse Automatisierungsprojekte in den letzten Jahren den Strombedarf auch wieder ansteigen lassen. Umso bemerkenswerter ist die deutliche Reduktion seit 2010.

Der Wasserbedarf hängt über die Rückkühlung der Kälteanlagen auch stark vom Klima ab.

Der Wärmebedarf aus fossilen Quellen (und damit die CO_2-Emmissionen) konnte durch den konsequenten Ausbau der Abwärmenutzung in den letzten Jahren reduziert werden.

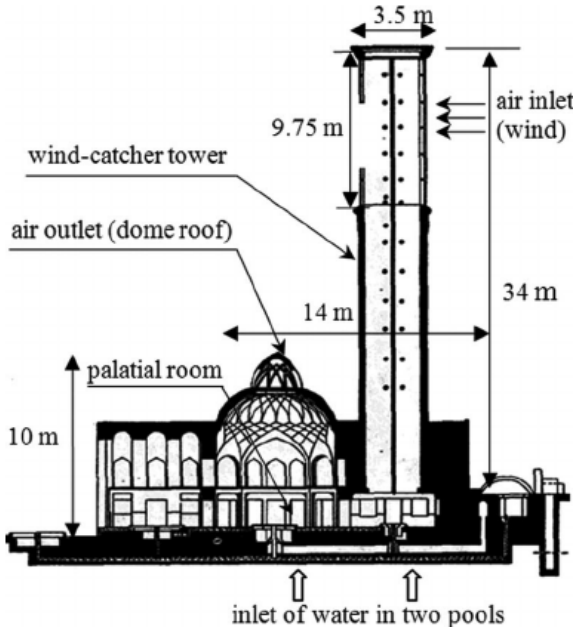
Analyzing the historical development of Herdern Areal in the context with the whole quarter of Escher-Wyss made clear that this trading hub space has still its purpose today, because the placement is ideal. Because the highway connections are close by, the distance to the city center and its users is short and there is enough space to navigate and maneuver huge 40-ton-trucks. Also future development predicts, that this area will always be a trading space, maybe a central hub for cargo souterrain, as well as Migros does not want to leave this precios place of todays city, although needs will change.

Phenomenological perceptions brought me to the understanding that this part of the city is big scale. As human you feel sucked into the street, cut off by fences, are usually surrounded from not only the sides but also the top from built structure. Big traffic gives the soundtrack to this feeling and the surfaces of glass, concrete, asphalt, metal and brick complete the feeling of being in an industrial quarter where the human scale is not the authoritative.

The ecological aspect, analyzed in the before shown maps, is a direct consequence of the built urban environment and is getting worse by the project of Hardturm stadium. The urban heat island effect is widely known and since this year also specifically addressed from the government of the city of Zurich. Still solutions are missing.

References

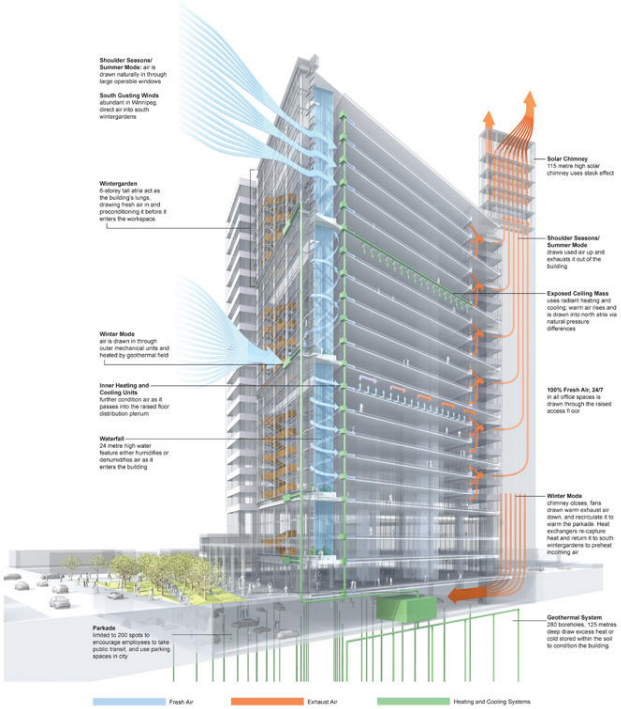
Bagdir (Windcatcher), Yazd, Iran



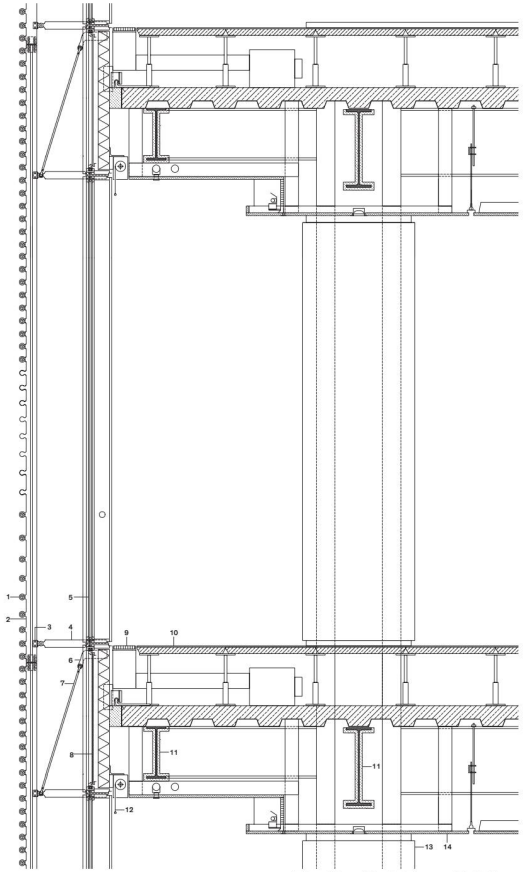
Kaust Windtower,Jeddah, Saudi Arabia, 2009

SESC Pompeia, São Paolo, Brasil, 1986

Manitoba Hydro Place, office building, Winnipeg, Canada 2009



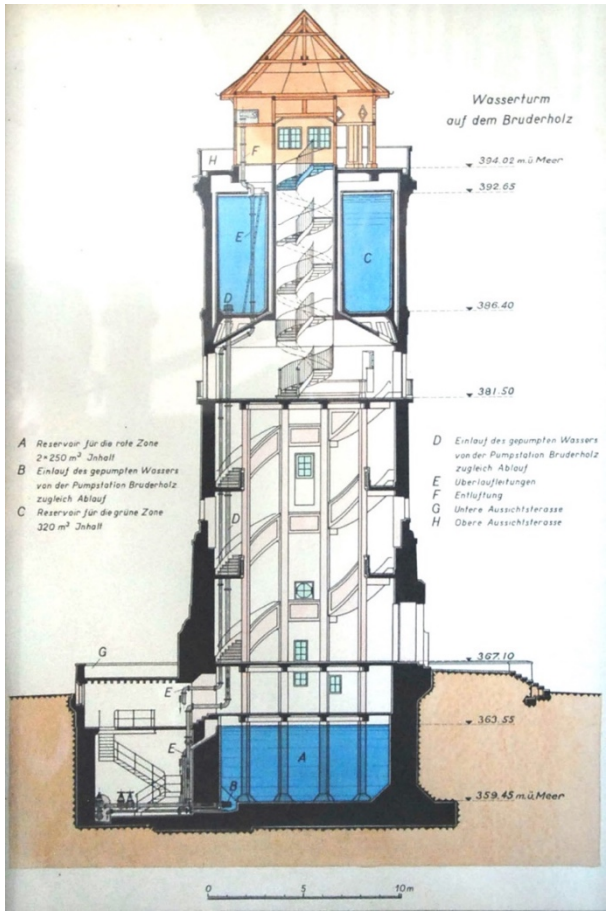
New York Times Building, Renzo Piano Building Workshop, 2007 – Façade Reference



116 The New York Times Building

Watertowers

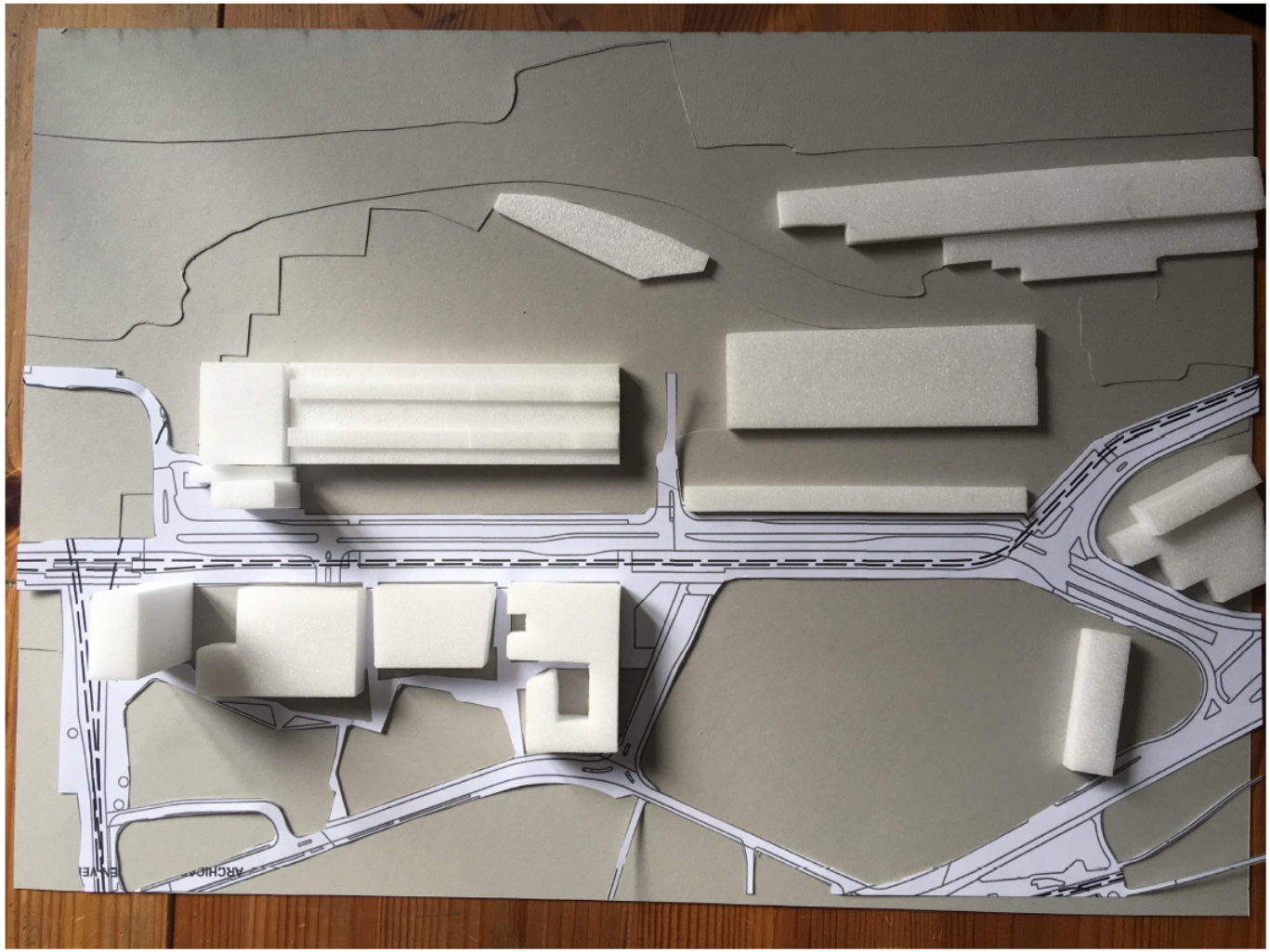
Bruderholz, Basel



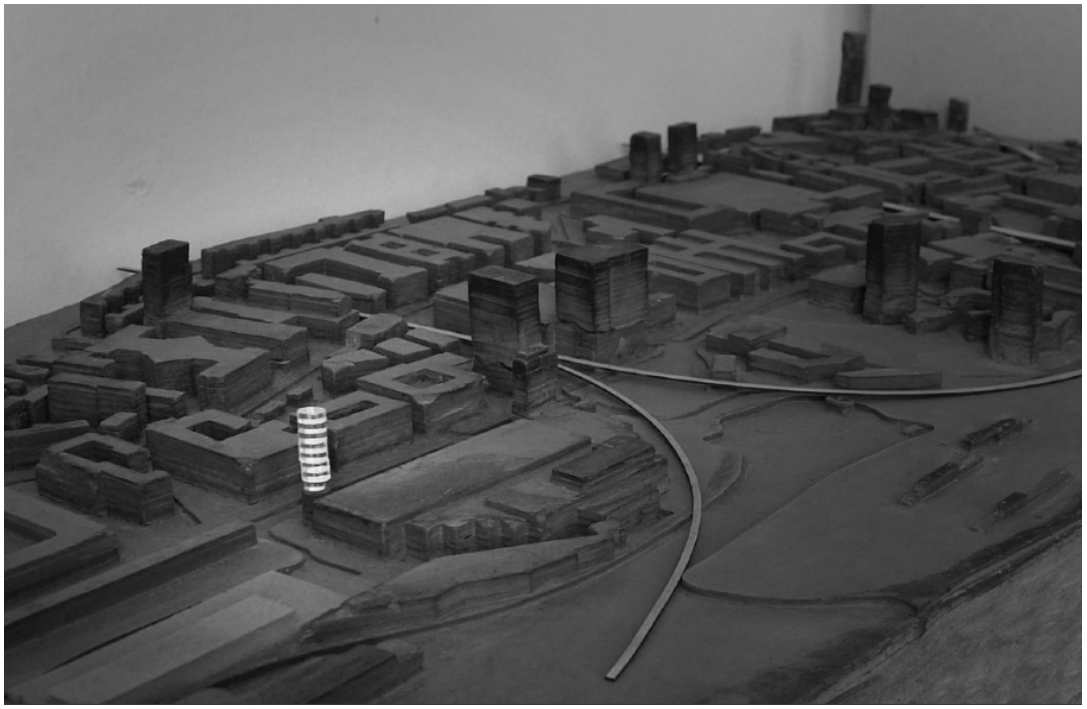
Water Tower Ghlin, V+ Architects, 2014

Model

Working Model



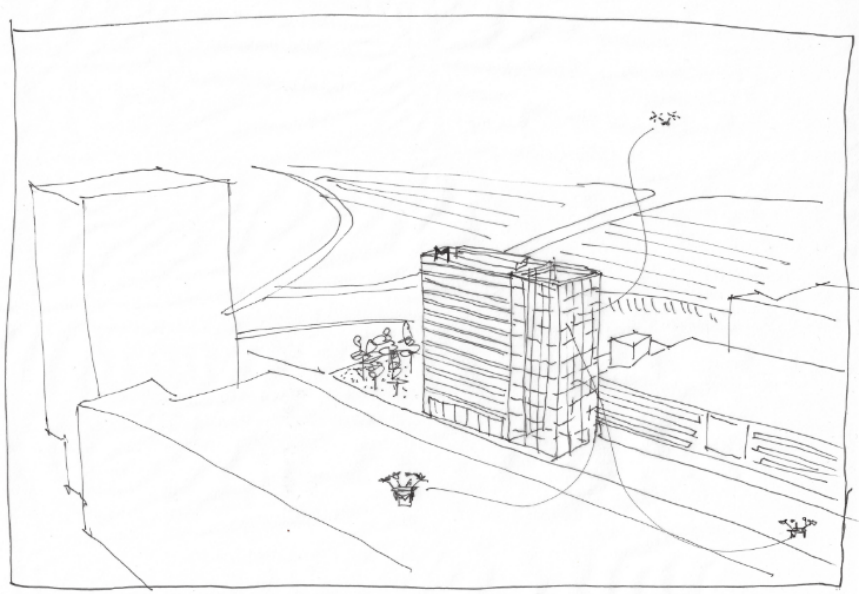
Site Model



Sketches

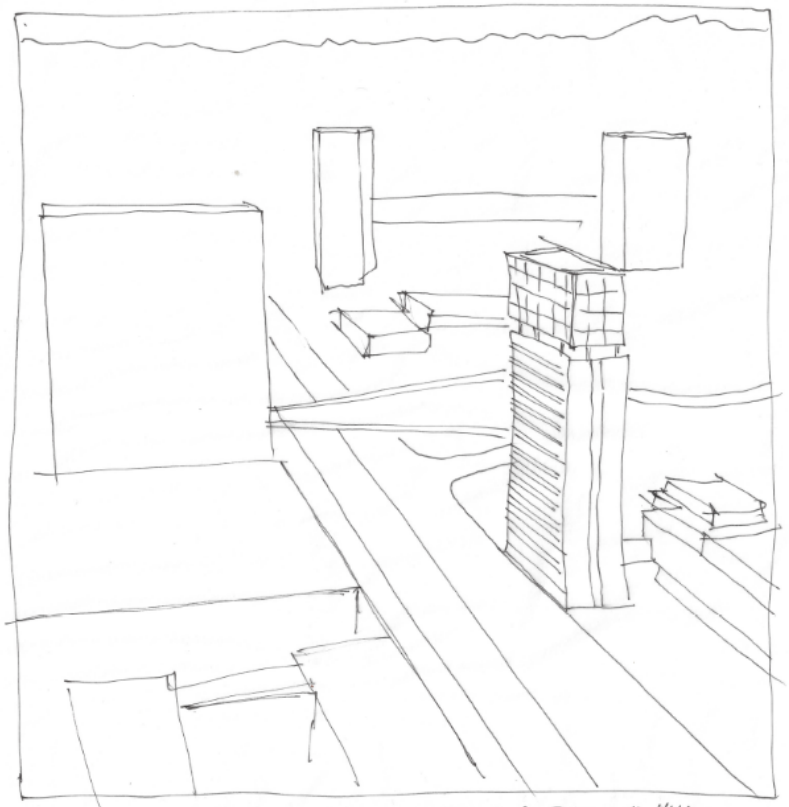
First Idea Sketches

Drone Delivery System



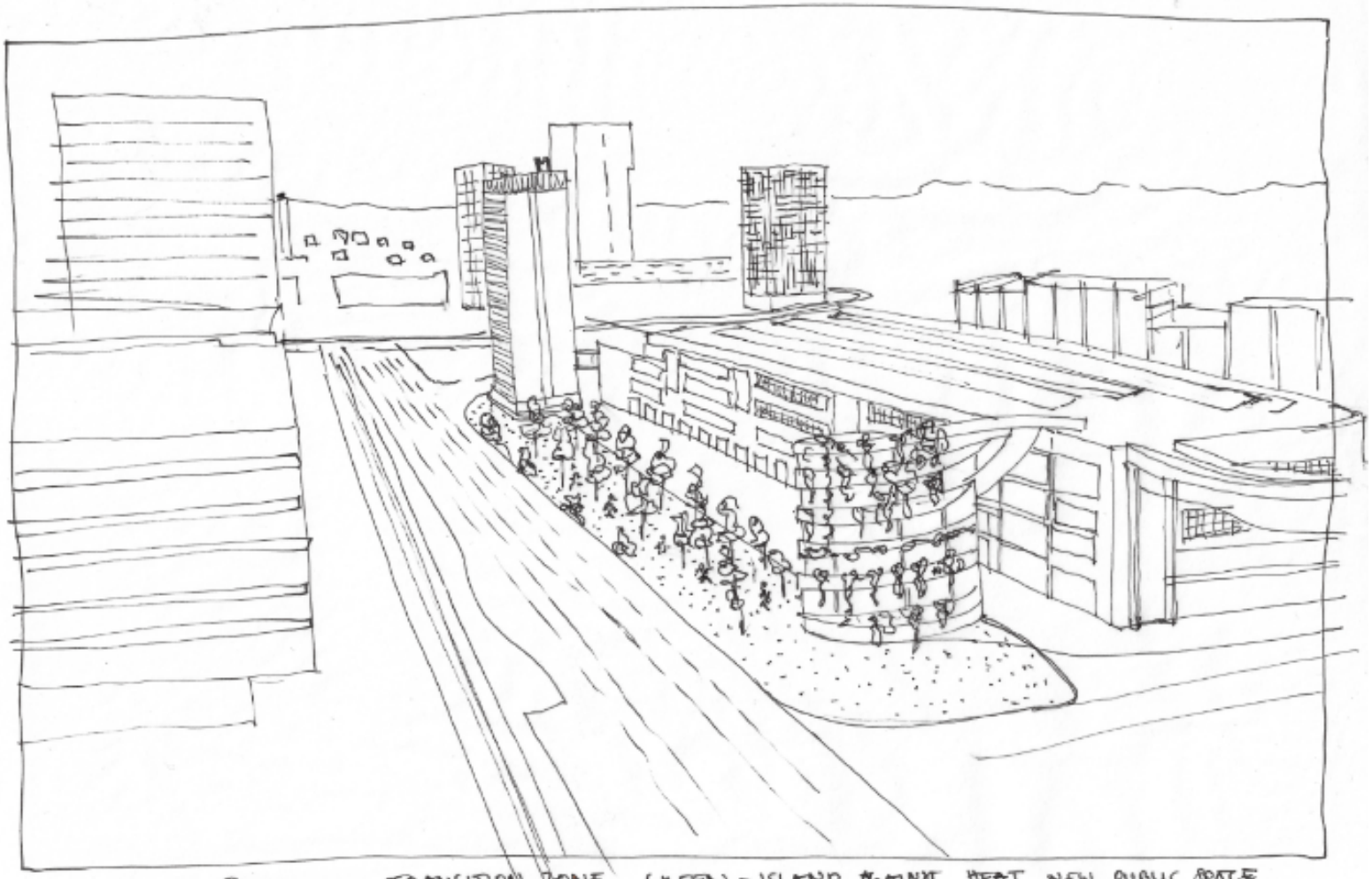
EXTENSION OF TIGGROS ADMINISTRATION TOWER FOR DRONE-DELIVERY, NEW PUBLIC SPACE IN FRONT

Re-Densification



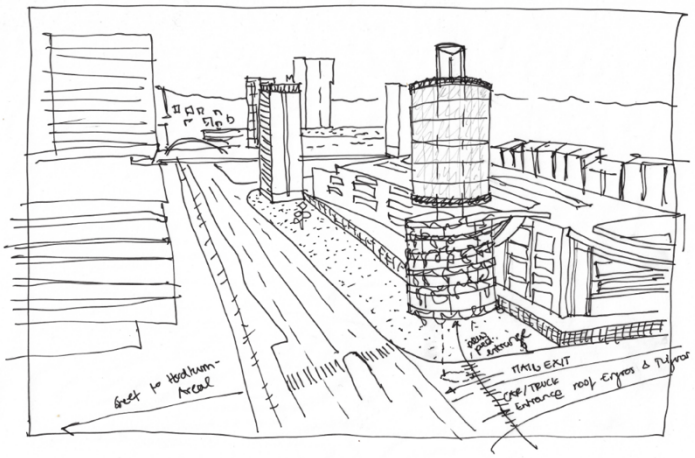
RE-DENSIFICATION ON TOP OF TIGGROS HIGH-RISE, IN CONTEXT WITH PUBLIC HIGH-RISES

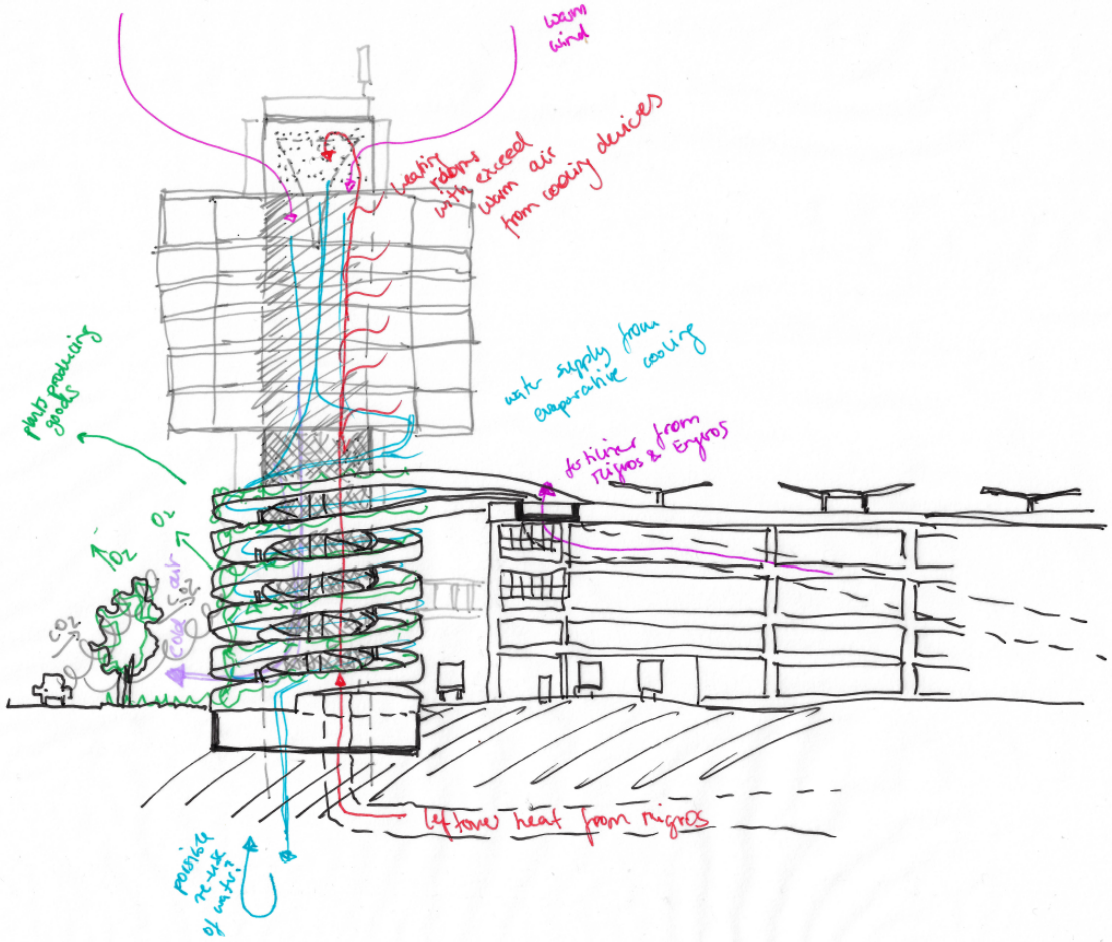
Ramp Re-Use



RE-USE OF RAMP, NEW TRANSITION ZONE, GREEN-ISLAND AGAINST HEAT, NEW PUBLIC SPACE

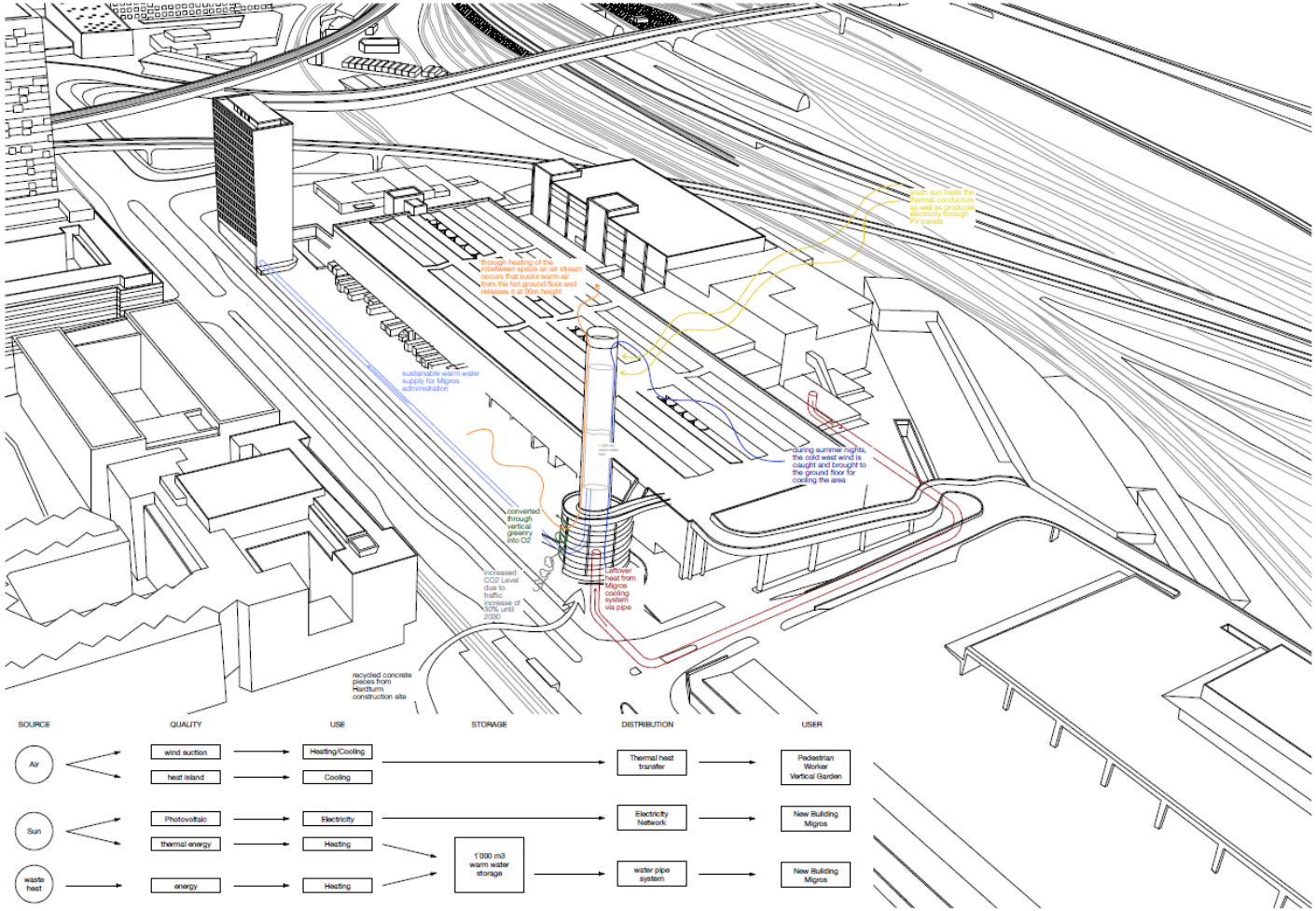
First Sketch City Energy Fortress



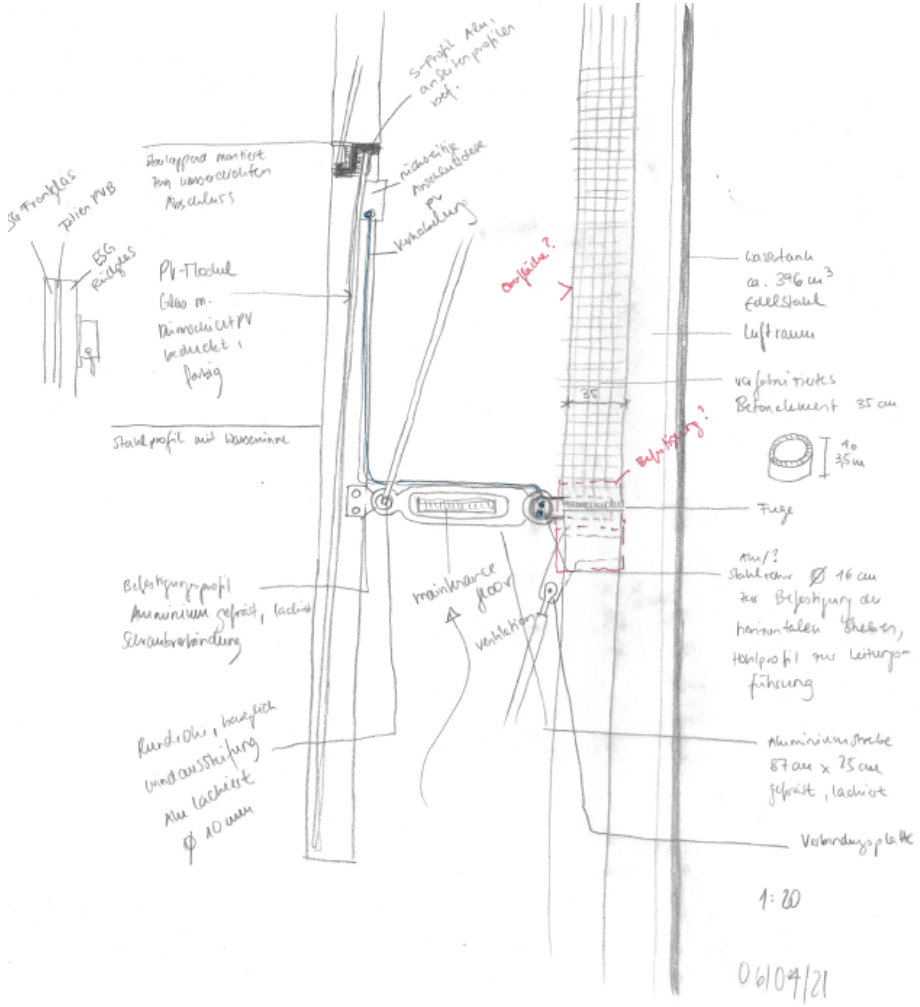


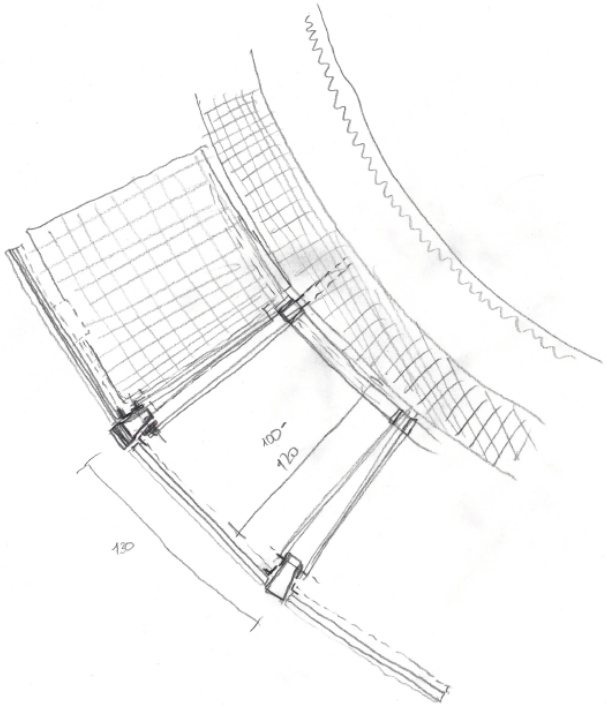
First Visualizations

First Actor Networking Drawing and System Chain



Detail Development

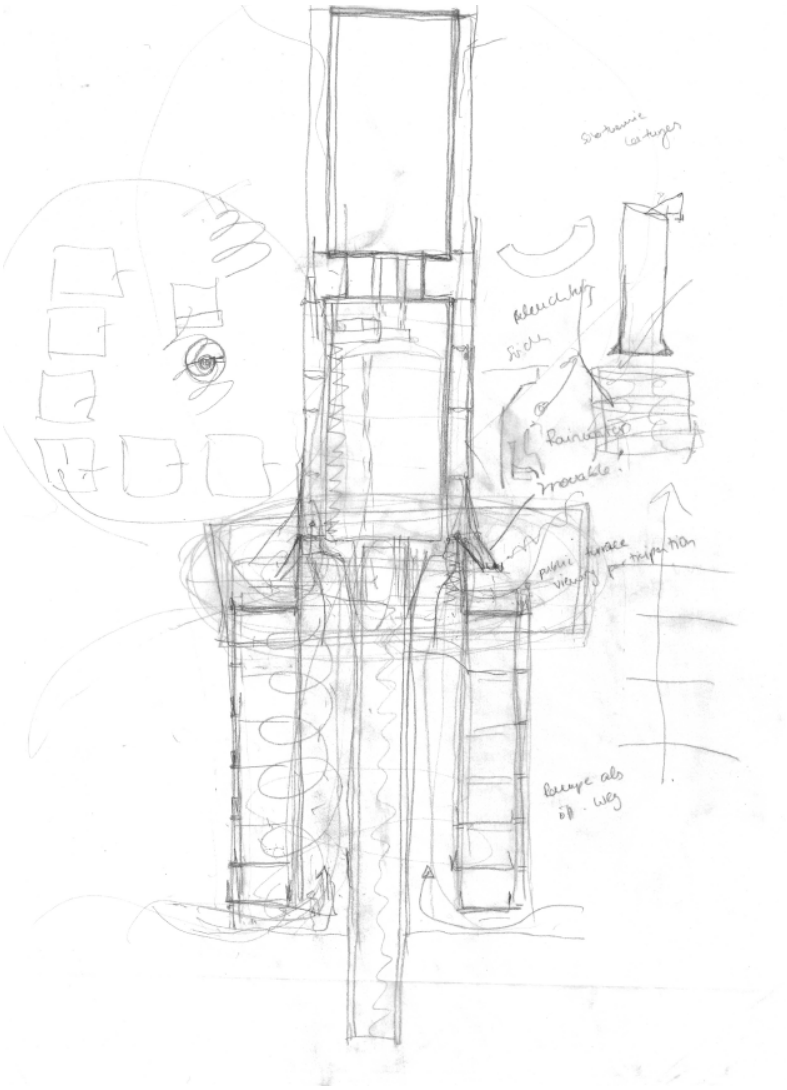


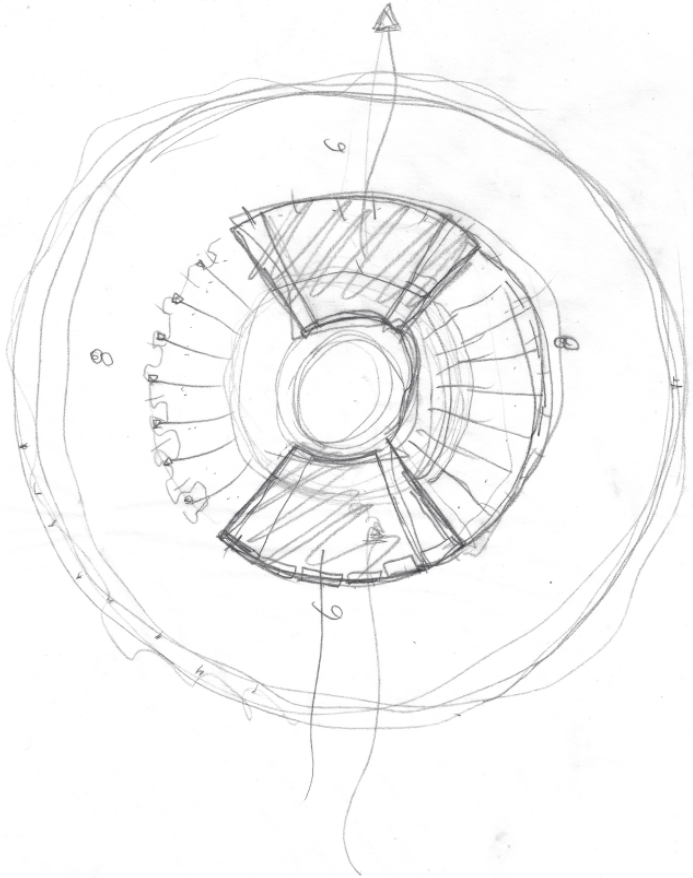


1:20

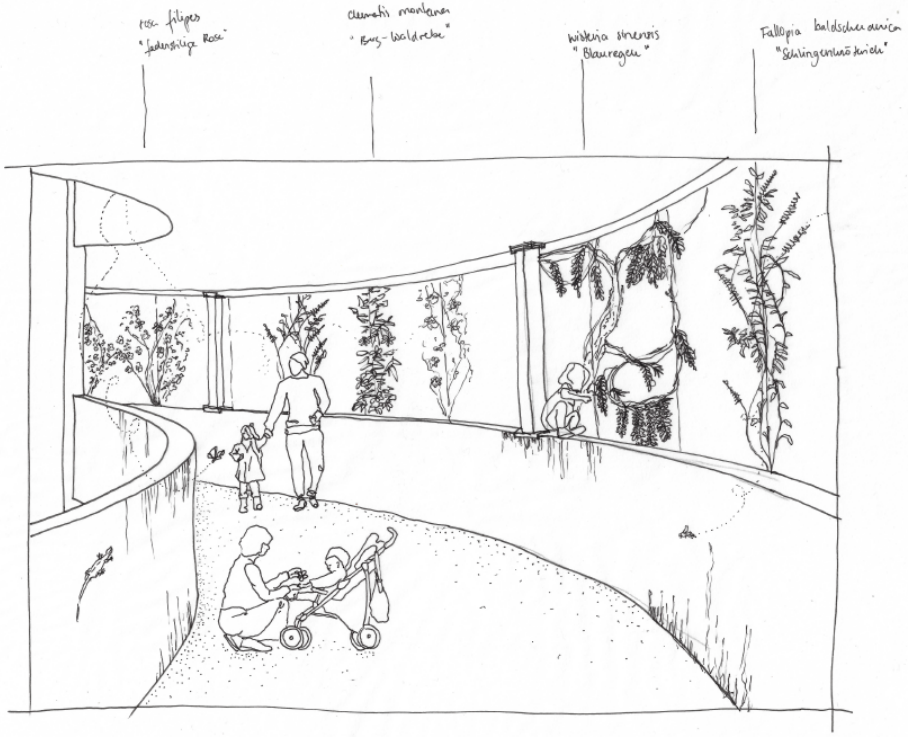
07/01/21

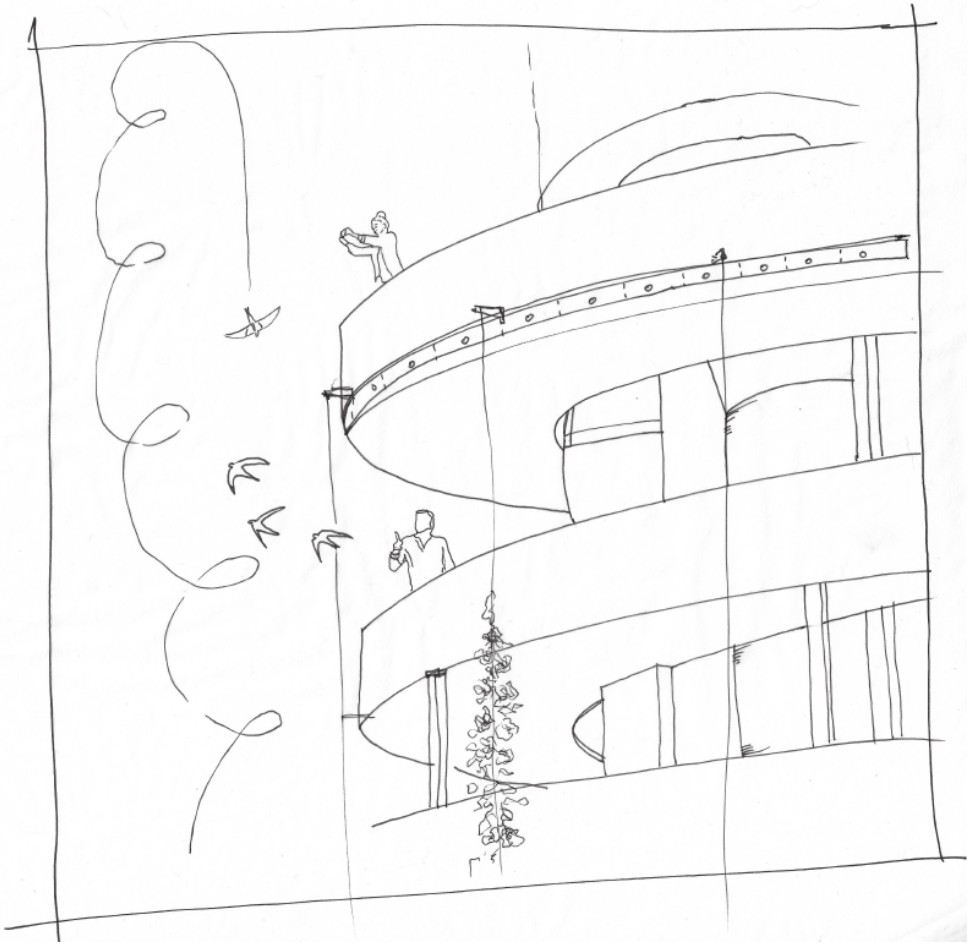
Project Development

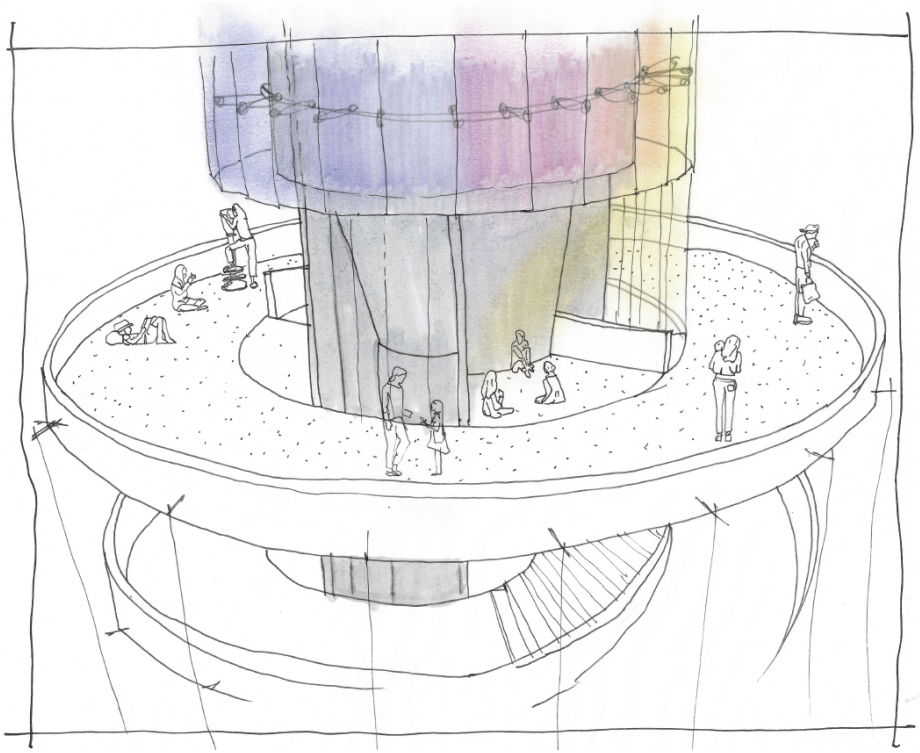


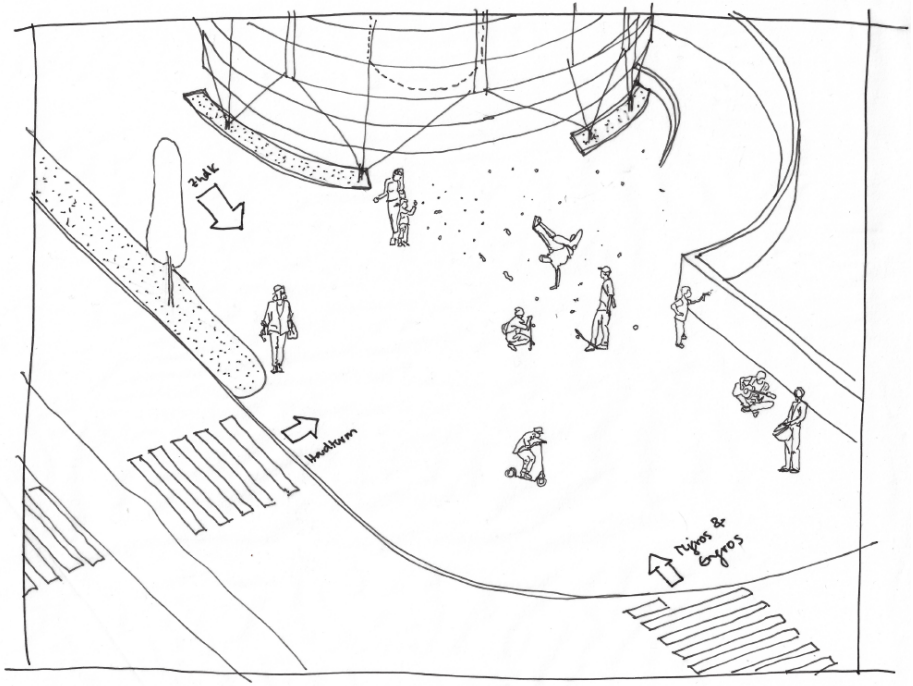


First Mood Sketches

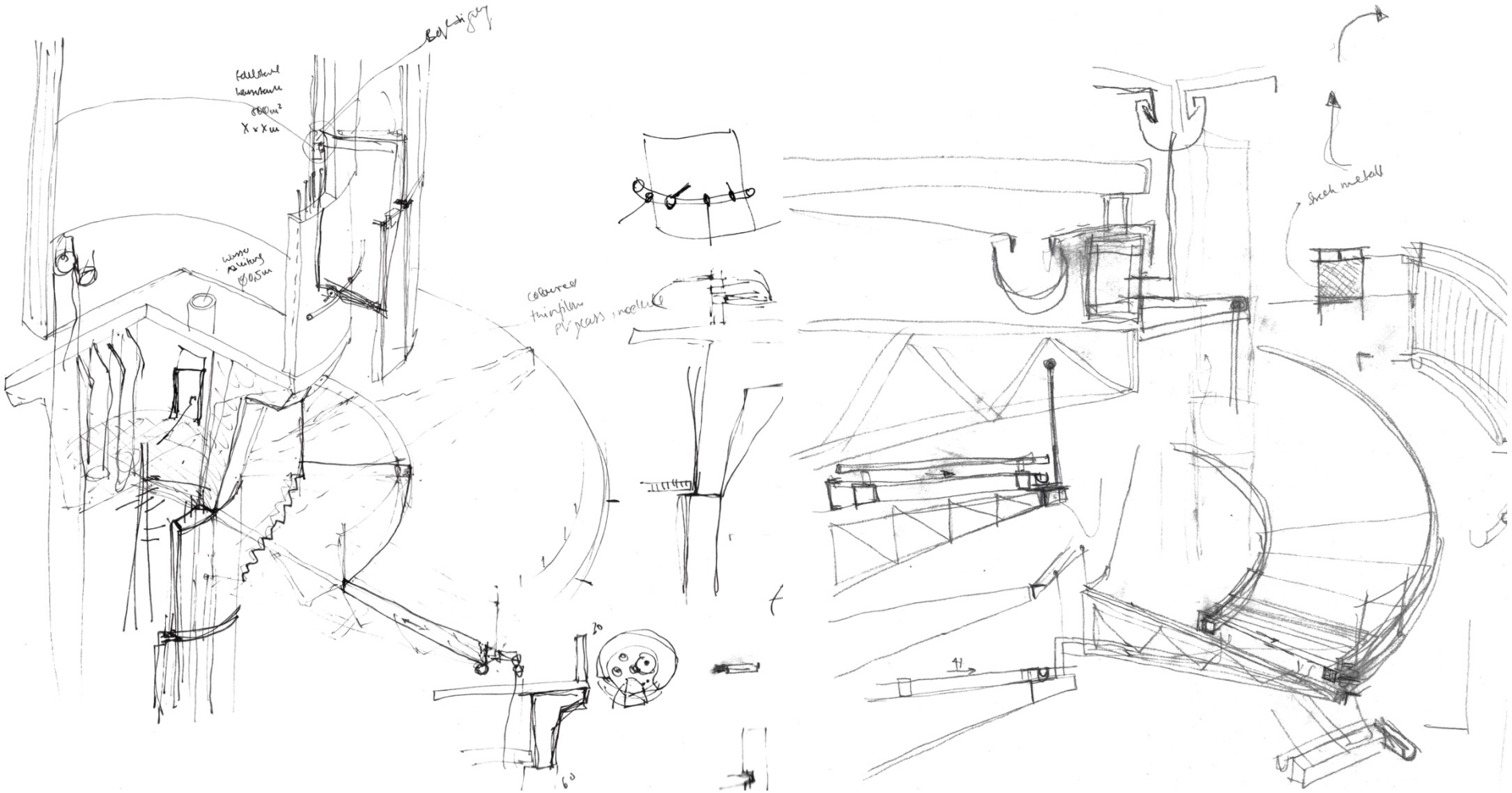




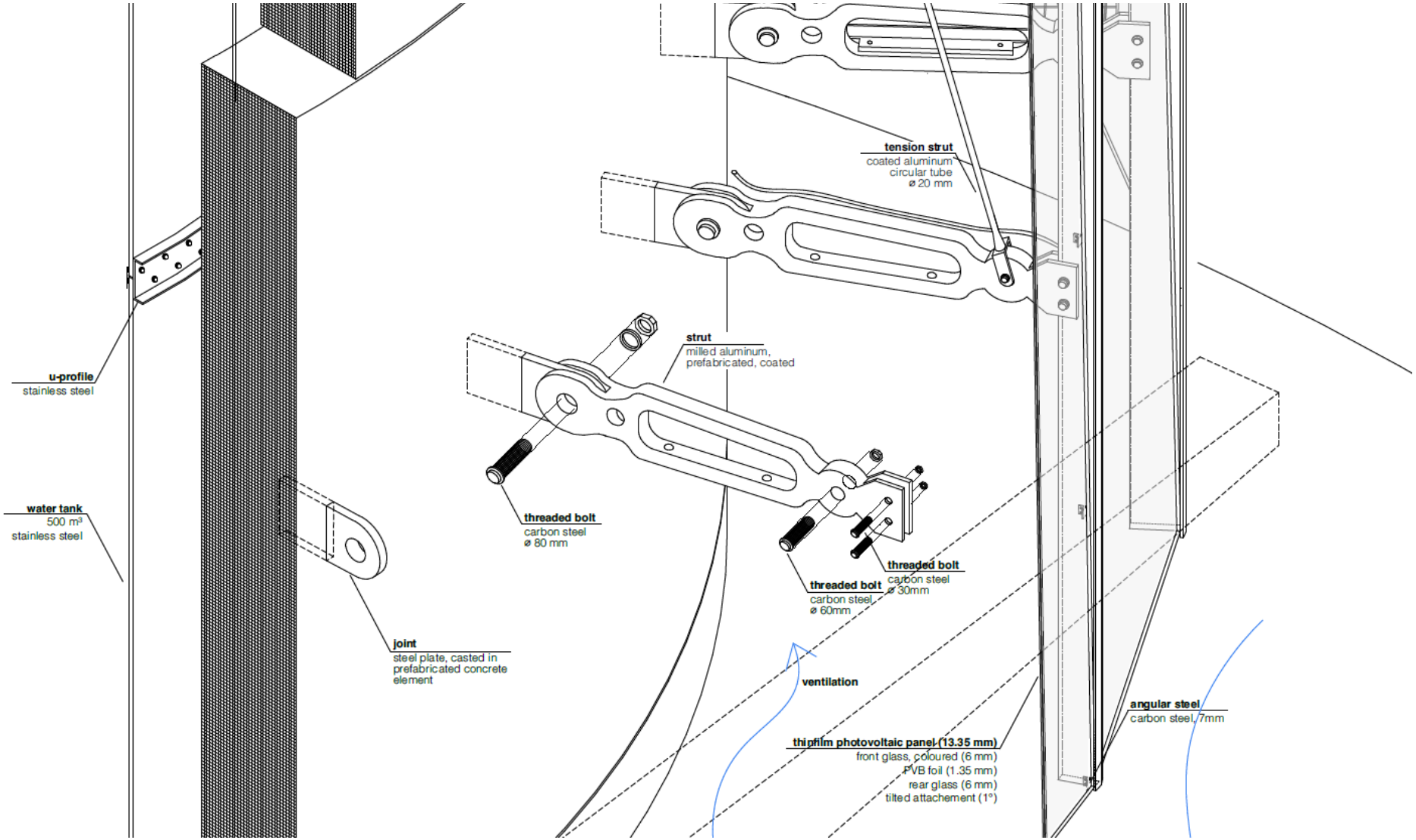



Zuk
Headturm
Tipros &
Gyros

Development Construction Detail



First Detail Drawing



My design project is trying to embrace the given situation, not changing this highly functioning trading hub into a general open space but reconnecting elements that are currently out of use. The spiral ramp leading up to Migros roof is an abandoned witness of times gone by, a fenced-off space without use. In implementing my “energy pillar” into it, I manage to reincorporate this infrastructural element into the city scape and give it a new purpose.

It transforms into a new public space, surrounded by new, vertical greenery, that will stop the emissions from Pfingstweidstrasse. I do not perceive this tower to stand in a row with the profit maximizing high rises that are built and planned for Zurich. It is a conscious decision to build a landmark where form follows its function and not the episteme of typology.

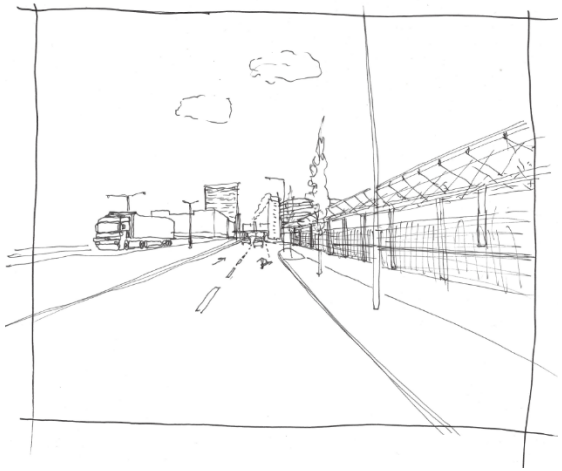
The tower is producing and saving energy generated by this place. The void in between the Façade will serve as wind channel, by day as solar chimney, by night as windcatcher. This will allow a relatively stable temperature inside the concrete core where 1.000 m3 of water is stored to be heated sustainably by waste heat from Migros.

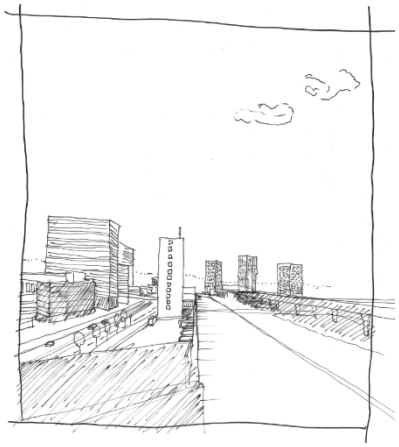
Photovoltaics produce electricity that will move the façade panels and light the space; overproduced power can be saved in the warm water tanks as well. I implement a kind of industrial element in this changing industrial quarter with the intention to mark this place, raise awareness for transforming spaces, local potentials and giving a solution that does not require demolishing or interfering with existing processes.

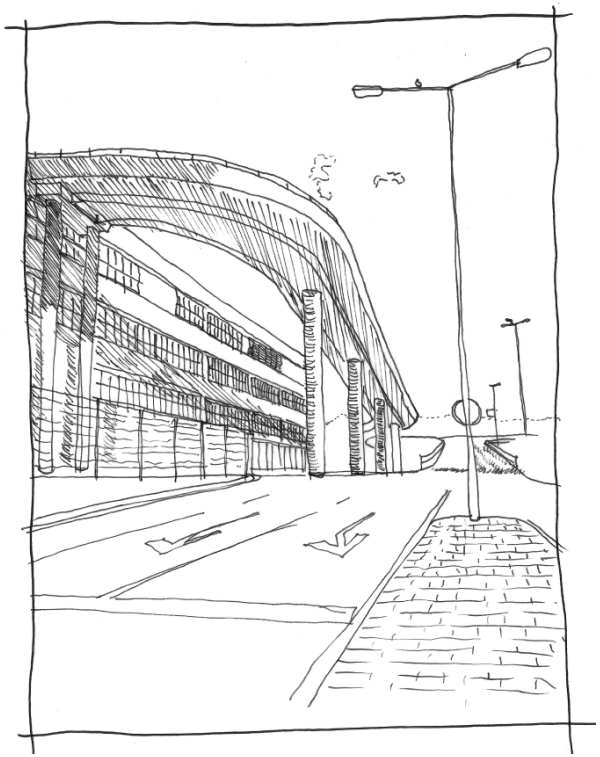
The construction is mostly made up out of prefabricated elements. Waste Concrete from Herdern Areal can be used in the production of the tube-like bottom elements inside the ramp and will keep in colour and looks a resemblance of this place. On top are f concrete tubular elements, made of two pieces that will be attached on site. The build the inner shell, steel anchors for the milled aluminum elements are already in-casted.

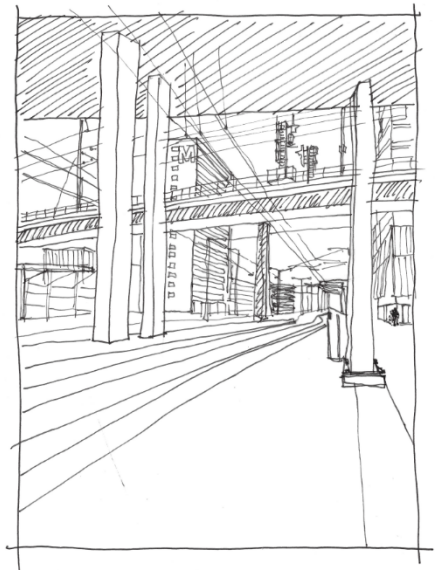
The outer shell is designed to be prefabricated and attached step by step as the tower grows. Finally from the top with a built on crane, the fragile and filigrane PV panels will be attached precisely into their places.

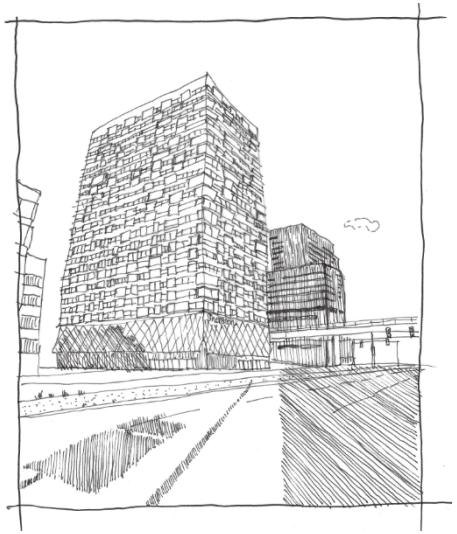
Serial Sketches Pfingstweidstrasse



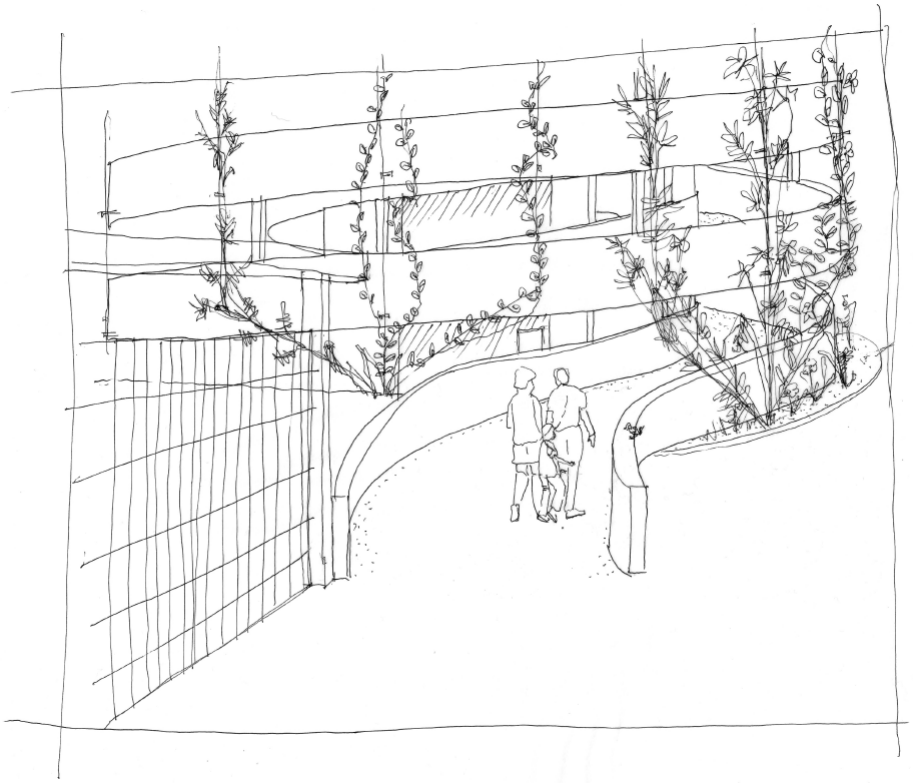


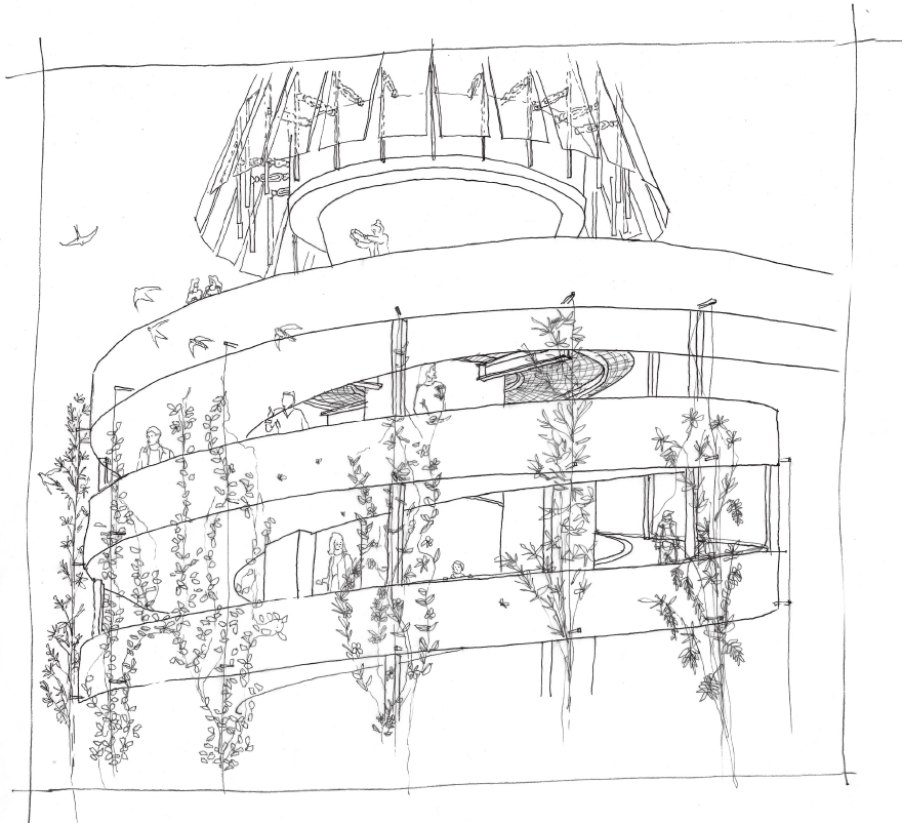






Final Beahviourology Sketches of the ramp





Visualisation Day, Evening and Night