MEETING THE SKY



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00
meeting the sky
design of cities
edmund bacon, 1967

MEETING THE SKY `Throughout history, architects have lavished much of their tenderest care on the part of the building which meets the sky. From the akroterion of the Greek temples, which delicately fused the harsh pedimental triangle with the upper atmosphere, through the spires and turrets of the Gothic churches, from the tortuous writhing figures, volutes, and urns on Baroque parapets to the cupolas and iron filigree of the Victorian period, this area has been a characteristic expression of the spirit of the times.

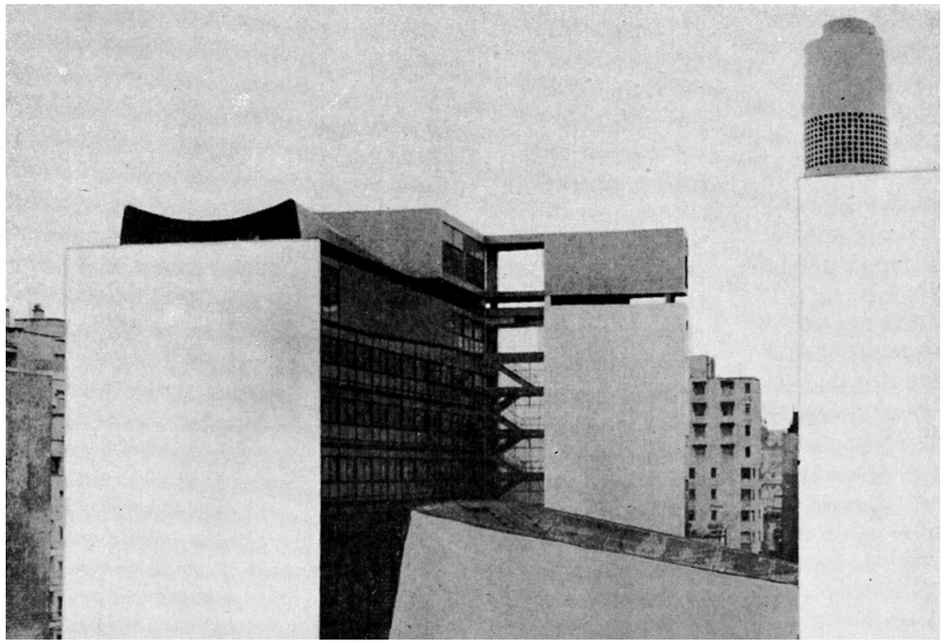
Now, all too often, we establish a typical floor and repeat it mindlessly upward - all thought ceasing before the sky is reached. We sweep our rubbish into the upper air and use it as the crowning feature of our designs, with pipes, air-conditioners, and TV aerials as symbols of our relationship with the infinity of space.
The skyline of the city has long been a dominant element in urban design and should be reconstituted as a major determinant in citybuilding.´

- Edmund Bacon, 1967



00
zurich observations
changing perspective





00
teatro san martín, buenos aires
mario roberto alvarez

visiting the teatro san martin as
a starting point for the project

Meeting the sky is an instinctive human desire and has for centuries shaped how we built our cities.
The shape of the roof, initially reflecting climate, technology and available materials defines the transition between the buildings and the sky.

Observing today‘s cities we find ourselves below inaccessible landscapes of technical installations.

The typology of the infrastructural roof, a phenomenon of the 1990s, has taken over large surface areas and completely cut our connection to the sky.

Giving up the top of our buildings for purely infrastructural uses and technological devices symbolises its current value for society and at the same time prevents all other types of uses, despite the urgent need for densification.

Throughout the research, I investigated a highly complex territory shaped by economic, technical, ecological, political, and legislative factors.

To understand the parameters currently defining our roof spaces, I started reconstructing how the phenomenon of the infrastructural roof emerged and analysed the existing territory. This becomes the pre-requisite for intervention.

The research is conducted on five scales: the Sky, the Territory, the System, the Platform and the Body.

I. SKY

RELATING TO THE SKY

Relating to the sky is important, it orients us within rhythms of nature and connects us to the external environment. In contemporary construction we have often lost the connection to the sky. The strive for horizontality and efficiency manifests itself in the prevalence of flat roofs. Appearing as a cover that completely seals the top of a building, it prevents any vertical dialogue and relation to the environment above.

II. TERRITORY

HISTORICAL DEVELOPMENT

The relation of buildings to the sky has changed fundamentally throughout the last 150 years. Until the mid 19th century, Zurich‘s cityscape was characterised by pitched roofs with steep slopes of 38-45°, climate and local materials being the shaping parameters.

In the second half of the 19th century, the city of Zurich grew immensely. Whilst atypical for its climatic zone, these „Gründerzeitbauten“ were thriving for sun and air in the industrial city and their trimmed hipped roofs offered “Dachzinnen”, a new typology of roof terraces. Usable spaces for photography studios, drying laundry, overlooking the city and as far as the alps, spaces for dancing, for representation through advertisement, sunbathing or watching the first Zeppelins and hot air balloons rise above the city. The **use of the roof is strongly embedded in Zurich‘s culture and has always been a common space, almost perceived as part of the public sphere.**

Advancing material properties and technologies resulted in the construction of Zurich’s first flat roofs of industrial buildings around 1900. In the 1930s, with the „New Objectivity“ movement, first representational buildings and housing developments in the city‘s surroundings were constructed, applying flat roofs as usable outdoor space for terraces and gardens.

5.4KM^2 OF ZURICH

The widespread adoption of flat roofs across all building types in Zurich began in the 1950s, since then, flat roofs have accounted for more than 80% of all newly constructed buildings each year. This shift was largely driven by economic considerations: flat roofs were practical, requiring less surface area of building envelope and thus reducing the overall building volume for the same usable space. The result was lower material and energy consumption, translating directly into cost savings.

Today, around **48% of Zurich‘s buildings are covered by flat roofs, adding up to a surface area of 5.4km2.** These surfaces create new patterns and densities within the city, especially accumulating in industrial and public building zones, where they account for more than 75% of the built surface.

III. PLATFORM

NORMS AND REGULATIONS

Norms and regulations act as „design drivers”, shaping the whole roof territory. Although roof typologies have changed completely over the past 100 years, building regulations still follow the historical 45° pitch of the steep roof. This angle aims to preserve the incidence of light in the street space, but as flat roofs have become more common and economic pressures have increased, these regulations have led to the development of attic floors and fragmented roofscapes, often further cluttered by additional layers of infrastructural installations.
In terms of building regulations, the infrastructural roofs were initially justified by Zurich‘s existing roofscape. „Dachzinnen“ and chimneys have always characterised the cityscape and the new technology and machines are seen as a „progressive“ variation. **Since „chimneys, solar energy systems and technically conditioned roof structures“ are considered an exception from the building law in 1995 (§292 PBG)**, the roof territory changed completely. This carte blanche eliminated the need for technical rooms on the attic floor, a switch so significant that infrastructural roofs can easily be classified as built before or after 1995.

SURFACE

The effort to build a flat roof is extremely high. Besides the technical challenges and the danger of leakage, frequency and intensity of maintenance make the flat roof very time-consuming and costly, especially if calculated for the entire life-span of a building. Since the 1991 building zone regulations, it is mandatory to build green roofs in Zurich. While intended for ecological compensation, in reality most roofs of existing buildings remain gravelled - existing structures and economic factors limit the options for ecological upgrades. This is especially the case with the large volume of flat-roofed buildings from the 1970s and 80s, which will soon reach their next renovation cycle.

IV. SYSTEM

INFRASTRUCTURE SPACE

Our societal understanding of comfort—driven by expectations for climate control, convenience, and technical services—has led infrastructure spaces to occupy an increasingly significant share of our buildings and cities. At the same time, due to safety regulations, these areas are typically strictly separated from human encounters. The increasing professionalisation and specialisation of building systems has led to a disconnect between infrastructure and architecture.

TECHNICAL DEVICES

Through advancing technologies and consequently established norms and regulations the phenomenon of the infrastructural roof emerged in the 1990s. The inventions of modern technologies like the lift in the 1890s, the radio broadcasting in the 1920s, new ventilation systems after the oil crisis 1973 and the advancing technology of solar energy in the 1980s changed the way we design completely. The consequences and residues of our expectations for „hyper-comfort“ become clearly visible on our roofs and become apparent in the form of machine rooms, antennas, ventilation ducts, solar panels and maintenance devices. **Analysing roofs through aerial views reveals that on average, 30% of the roof surface area of administrative, industrial and commercial buildings is occupied by technical devices**, in the case of residential buildings, even less. Due to their configuration, inefficient distribution, economic viability and safety regulations, the entire roof slab is rendered inaccessible.

Technical roofs can be described as fluid spaces. **The life span of buildings far exceeds the life span of technical devices. Ranging from 5-25 years**, antennas, solar panels, lifts and ventilation systems have to be exchanged, often they are replaced even before the end of their service life due to changes in usage or adapted regulations.
To project the future development of the technical landscape means to dissect it into individual devices and analyse their functions. While the roof structures above lifts will disappear due to the invention of machine room-less elevators, all other categories of systems are expected to increase in quantity and scope. The number of mobile-antennas are rapidly increasing and expected to double every 18 months, demands for climate and ventilation systems are predicted to expand to be able to compensate for rising temperatures and increasing air pollution. Here, also the efficiency paradox comes into play: While the machines themselves get more efficient and become smaller, the demands set by the user will grow, this leads, for example, to larger air ducts in order to reduce the air speed and thus reduce the noise emissions of the machine. Potential alternatives could be provided by centralised district cooling. Solar systems are subject to a new energy law, which requires the installation of solar panels on all non-usable roofs with more than 300m2 built surface until 2040. Accordingly, with all of these devices increasing, also new SUVA norms will be established and the maintenance systems will continue to grow.

TO CONCEAL OR TO EXPOSE

Architectural approaches to infrastructure space can vary widely, ranging from concealing technical elements, exposing them as intentional design features, to integrating them into the overall architectural concept. Instead of a clear attitude, we‘re currently faced with an ambiguity of concepts. Whilst hidden within our buildings, the installations suddenly appear on our roofs, indicating the missing synergy between buildings and their infrastructure. The status quo often neglects these systems; there are no archival materials or coherent plans, as each specialist planner typically only concerns their part. Given the short operational lifespan of technical systems, thorough coordination is often deemed unnecessary.

V. BODY

MAINTENANCE

The inaccessibility of the roof mostly relates to economic viability, access and safety. Currently, the only human presence in these spaces is for the pragmatic purpose of maintenance and is only possible with authorised facility staff or a special permission to access.
Besides the inspections of the roof surface itself, all technical devices need to be maintained regularly as well, making it a much more frequented space than expected. Depending on the devices present, **up to 35 people per year will enter a roof space in interdependent rhythms.**

Investigating roof projections, traces of humans like small tiled paths, railings and rope systems predefine every step of movement within the space. All maintenance elements on the roof are defined by the human body - in extreme situations. 2m is the length of a human falling horizontally, 30cm is the most minimal width of a path someone could walk and the 1.2t capacity is defined by 2x the weight of a human person falling the max. 6.5m when attached to a rope safety system. In general these areas function as spaces of care - dedicated to maintaining buildings and their systems. Importantly, the work carried out always serves other spaces and functions, reducing the roof to a pure service zone.

SENSORIAL PERCEPTION

Experiencing the roof spaces is very special. Its qualities lay in its location as a high place, its relation to the sky and the external environment, but also in the characteristics of the infrastructure space itself.
As a purely functional space, not intended for humans, it is a space we don‘t often encounter. Noise, sounds, vibrations, electrical fields, air flows and smells of the surfacing technical installations allow us to read what is hidden inside.

RESEARCH QUESTION

Our societal understanding of comfort, driven by expectations for climate control, convenience, and technical services, has led **infrastructure spaces to occupy an increasingly significant percentage of our buildings and cities.** At the same time, due to safety regulations, these areas are strictly separated from human encounters.

Zurich‘s roofscape reflects this development, approximately half of the city‘s built-up area exists again above our heads as mostly inaccessible, infrastructural space.

The city of Zurich has 5.4 km² of flat roof surface.

Their current state is a product of modern technologies and consequently established norms and regulations from the 1990s. As an appendix of the building, technical systems are permitted to exceed the highest point of the structure and are only restrained in dimension by what is functionally necessary. Since 1995 **„Chimneys, solar energy systems and technically conditioned roof structures“ are considered an exception from the building law. §292 PBG**

Surfacing from the black boxes that we design around them, the technical devices become a matter of public interest. Infrastructural roofs appear as no-mans land, a space negotiating between private and public and only ever accessed for the purpose of maintenance, offering potential for new projections.

Aerial view analyses show, that on average **only 30% of the roof surface area of administrative, industrial and commercial buildings is occupied by technical devices,** in the case of residential buildings, even less. Still, machine rooms, antennas, ventilation ducts, solar panels and maintenance devices render the entire spaces inaccessible, due to inefficient distribution, economic viability and safety regulations.

The project aims to reclaim the yet un-programmed space from a social and environmental perspective.
How can infrastructural roofs transform from purely technically conditioned to experiencable spaces?

Which parameters and regulations would need to change to enable human presence?
What incentives are needed to open roofs to public use?
How does the space have to be re-configured to allow hybridity and co-existance?
Could the project be temporary, adapting to the short-lived rythms of infrastructure?

OBJECTIVE

The project will focus on the transformation of the existing roof territory in Zurich. As roofs have always been productive and very complex spaces, instead of simplifying, **it proposes an alternative to the exclusive use for technical devices and enhances their complexity through projecting the additional layer of usage.**

To physically re-claim the roof space also means re-claiming agency.

Infrastructural roofs today can also be described as „(...) an entire factory of equipment that enables us to exist, a space (...) that begins to compete with the architecture. It is a domain over which architects have lost all control, a zone surrendered to other professions.“ -Rem Koolhaas, 2014

Technical systems defining the spaces today are expected to increase in scope and quantity and many of our commercial and institutional buildings constructed over the past few decades rely so strongly on these systems that they would be uninhabitable without them. Therefore, **the project will not aim to liberate the platform from technical devices, but rather dissect their functions and necessities to understand how they can be adapted, dressed and re-configured.**
The aim is to create **hybrid spaces, spaces of co-existance** that negotiate between human usage, the environment and systems by making spatial use of infrastructure. Instead of producing `storage rooms´, the §292 PBG exception of technical structures from the building law should provoke productive freedom to design through re-configuration.

AREAS OF INVESTIGATION

While, in the current discourse of densification, roofs of residential buildings will in future presumably be used as private outdoor spaces or extended upwards for further housing development, it is the roofs of **administrative, commercial, public and industrial buildings** that we can program more freely. These buildings have an average of 806m² of surface per building, 3.5x more than a residential building and make up 51.9% of the flat roof territory.
These buildings often have extremely high climatic requirements, making them particularly relevant to this discourse.

PROGRAM

The project will explore the appropriation / reclaiming of the roof spaces as part of the public sphere. Looking at them from a social perspective, their character and type will range in use, typology and scale but their interrelation is their **collective quality**. Projecting social activities, places for gathering and shared encounters relates back to the historical use of roof spaces in Zurich.
It will explore the relation between humans and infrastructure, notions of temporality and accessibility.

The research methodology so far was characterized by the investigation on five scales. These included theoretical, historical, legislative, technical and spatial inquiries.

In order to specify the assignment and start with the design project, the next semester will be divided into three main chapters, each overlapping in time.

APPROPRIATION OF SPACE

Appropriation of Space is seen as a first intervention. The projected film scenes become reality, inaccessible spaces are unlocked and the experience of space will be shared.
Through collective visits of infrastructural roof spaces and performative activations, potential uses can be tested. This will be important to understand the character of the considered spaces and should contribute to decisions on future programming of the new grounds.

REGULATORY SCENARIOS

As the infrastructural roofs are a global phenomenon taking different shapes in different legal frameworks, the norms and regulations currently shaping the territory will serve as the first design tool for change.
Flat roofs can be characterised as fluid spaces; due to the short life spans of technical devices, they are very reactive to regulatory changes, so small changes in regulations can be implemented in short times. Different scenarios of adaptations to relevant law tests will be tested, enabling new uses and transformation of infrastructural roof spaces on the scale of the city.

As visible in the diversity of the existing roofscape, norms and regulations are never objective and leave space for interpretation.

PROJECT PROPOSAL

The architectural project will consist of a series of interventions, set within the framework of the adapted regulation, testing this „subjectivity of law“.
The case studies could vary in scale, typology and location but should all propose an alternative approach to today‘s infrastructural roofspaces, to benefit people, buildings as well as the environment. These newly established spaces should therefore be programmed through their collective quality.

KW 35 -36
INTRO, SKY

KW 37-38
PLATFORM, SYSTEM
17.09. review 01

KW 39-40
TERRITORY, BODY
03.10. hand-in vorprogramm

KW 41-42
PLATFORM, TERRITORY
14.10. review 02

KW 43-44
BODY, SYSTEM

KW 45-46
TERRITORY, BODY
12.11. review 03
03.10. hand-in programmvorschlag

KW 47-48
SKY, CONCLUSION
26.11. presentation masterthemensitzung

KW 49-52
RESEARCH CONCLUSION

KW 02-06
APPROPRIATION OF SPACE

KW 07-10
TESTING SCENARIOS
review 01

KW 11-14
PROJECT DEVELOPMENT
review 02

KW 15-20
PROJECT DEVELOPMENT
review 03

KW 21-22
22.05. hand in master-thesis
25.05. final presentation

I

SKY

`The image of the sky is the basic
reference in human perception of the space of the external environment.´

- Zdzisław Pelczarski
The Criterion of access to the sky view, 2022

`Encompassing 360 degrees, this realm of overview gives a unique perspective on the world below: „the instinct to climb up to some high place from which you can look down and survey your world, seems to be a fundamental human instinct. (...)´

- Christopher Alexander, A Pattern Language, 1977

The following reader consists of two types of text.
The texts that I have written to synthesize.

And the texts, quotes and lawtexts I have found, that are relevant to the topic.

The chapter on the SKY approaches the topic from a theoretical and phenomenological perspective.

I.I Associations

I.II Human Relation to the Sky

The question of how, and where, we relate to the sky gestures toward an essential dimension of our spatial experience. The contact between human body and sky is formative, orienting us within the cycles of time, rhythms of weather, and the wider material context of nature and world. The sky serves simultaneously as orientation and as inspiration, mediating our exposure to light and shifting atmospheres. Our relation to the sky can be differentiated into looking up and being up, immersed within its openness.

Relating to the sky is often associated with emotions, fascination and desire.
When trying to explain the relevance and character of these spaces, I find myself recalling many memories and stories.
Everyone can relate to specific moments, as these places have very special qualities and evoke strong emotional responses.

I immediately have to think of a series of moments, often related to transgression or appropriation.

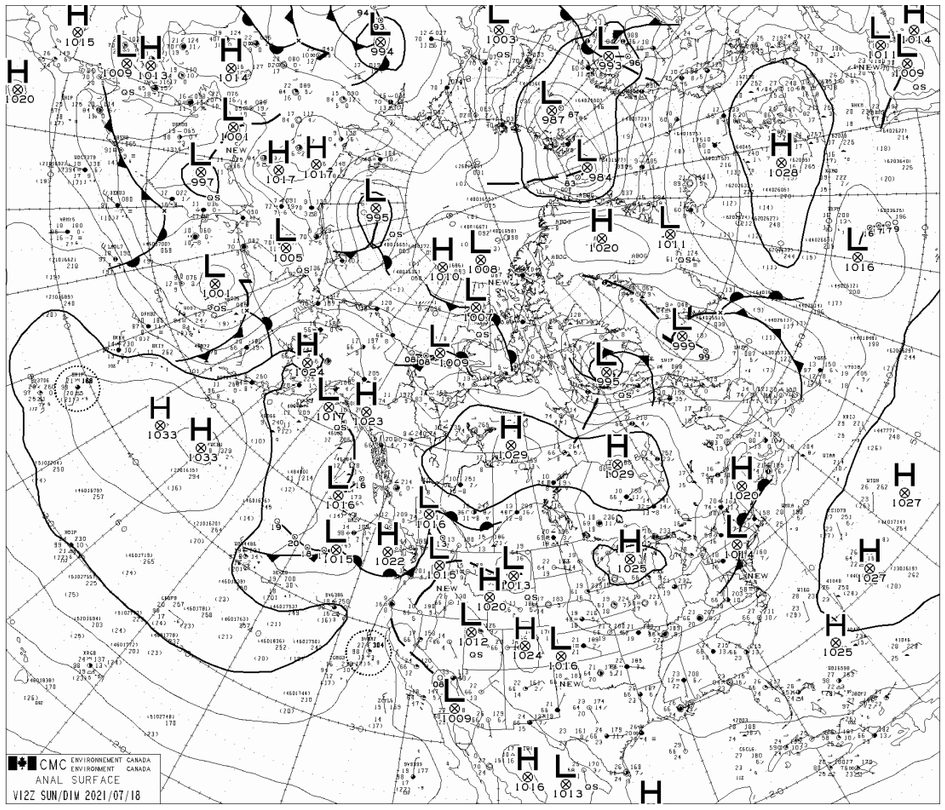
As children, every Easter we would have breakfast on the low-pitched tiled roof of our friend‘s vacation house, overlooking the alps.
When it was forbidden to leave the house in the evening during the pandemic, we were living in an attic apartment and every chance we got we would climb through the roof window for a breath of fresh air. My first studio was surrounded by a roof terrace, so we were watching the sunrise on one side and set on the other, an entire day marked by the changing sky.
A little roof terrace in Sydney, a locked roof hatch in Geneva, sleeping on a terrace outside in Ticino or overlooking the roofs in Buenos Aires, with which this investigation started, are just a few that come to mind.

This collection of memories is not an exception, everyone holds an archive of experience shaped by moments of proximity to the sky. The sky, becomes at once personal and collective.

I.III Where Buildings Meet the Sky

The roof zone is where buildings meet the sky. It is a realm of contradiction, between shelter and openness. Many artists, writers and architects have explored this relation in the past. The concepts for how to meet the sky are countless, between sculptural and functional approaches.

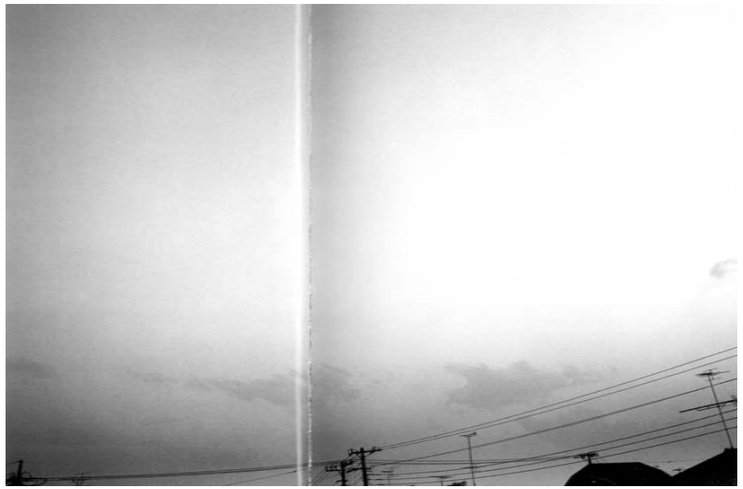
In the context of contemporary construction we have often lost the connection to the sky. The strive for horizontality and efficiency manifests itself in the prevalence of flat roofs. Appearing as a cover that completely seals the top of a building, it prevents any vertical dialogue and relation to the environment above.



I.01
weather map

`(...) the ‘room’ of Lebensraum is not an enclosure but an opening, one that affords scope for growth and movement. It has no walls, only the horizons progressively disclosed to the traveller as he passes along a trail; no floor, only the ground beneath his feet; no ceiling, only the sky arching overhead.´

- Tim Ingold, Being Alive: Essays on Movement, Knowledge and Description. 2011



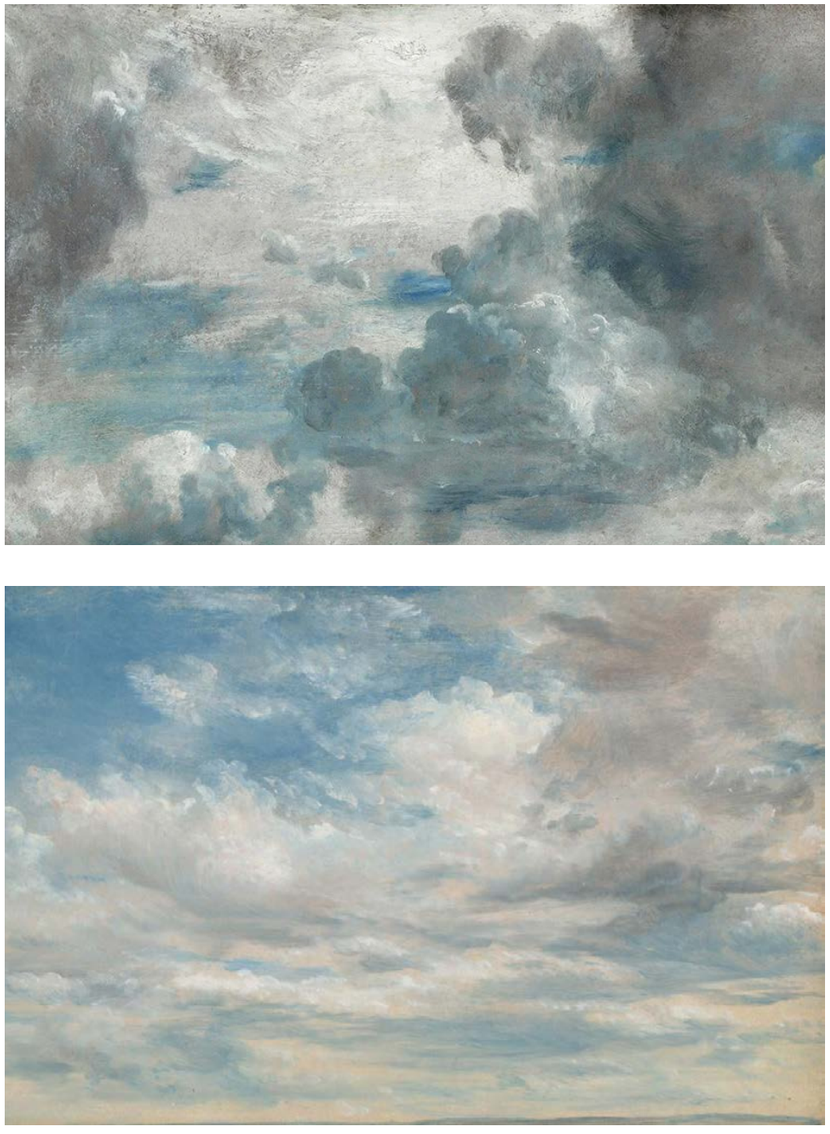




I.02
skyscapes
akihito yasumi, 1999

`Aimlessly yet tirelessly the photographer goes on releasing the shutter. For the forms of nature apparent in the sky „change by the second, and the sky doesn‘t stay the same even for one second“ (ibid.). In the selflessness of the ecstasy that ensues, gazing up into the heavens above is no different to gazing deep into one‘s own inner self, the external world and the internal world of the artist‘s feelings miraculously merge.´

- Akihito Yasumi, Skyscapes, 1999



I.03
cloud studies
john constable, 1821-22

I.04
foreign policy
tacita dean, 2016



`(...) perhaps we attribute to all perceived (raised) objects empathetically what we observe about the behavior of things not bound to earth, such as birds, airplanes and clouds and the proud independence of the sun and moon.´

- Rudolph Arnheim, The Dynamics of Architectural Form, 1977

THE CRITERION OF ACCESS TO THE SKY VIEW IN RESIDENTIAL ENVIRONMENT ARCHITECTURAL DESIGNING

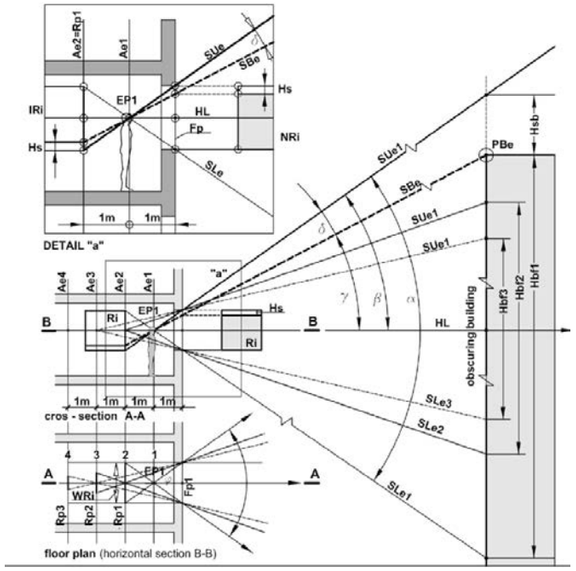
Abstract

Standards specifying the requirements for daylight in shaping the interiors of residential buildings do not cover issues related to visual perception and the role of light as a carrier of images of the outside world. The general recommendations in this regard, given in the 2018 European Lighting Standard can hardly be considered an unambiguous, precise normative regulation. According to the author, the in alienable element of the view through the window is the image of the sky, which is the basic reference in human perception of the space of the external environment.
The aim of the research is to identify the main determinants for ensuring access to the sky view from apartments in housing estates with high intensity of development.The analyzes are based on the author‘s simple graphical research methods capable of simulating the visual perception of images of the external environment space through a window. The key parameter in the analyzes is the vertical viewing angle, called the sky view entry angle. Its minimum value set at 7.5°C is of fundamental importance in shaping the geometric relations between neighbouring buildings. The research results oblige, in the context of the paradigm of sustainable housing development, to recognize the criterion of access to the sky view from residential interiors as a mandatory design guideline.

- Zdzisław Pelczarski, 2022

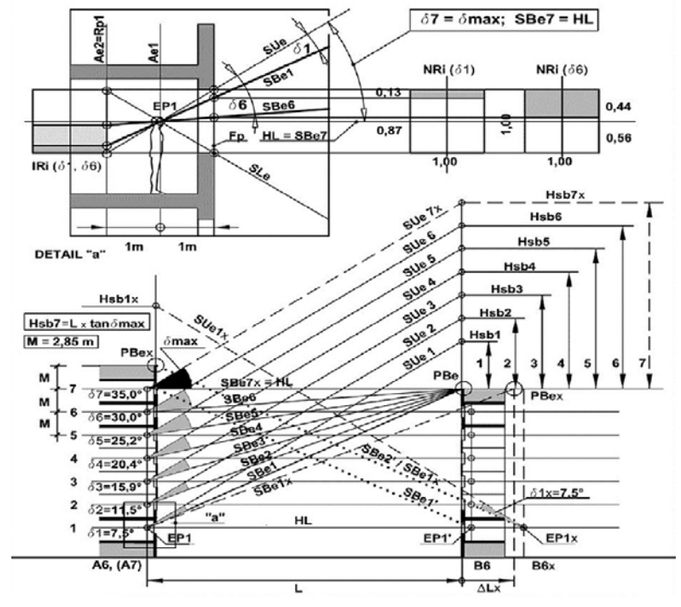
I.05
the criterion of access to the sky view, zdzisław pelczarski

fig. 5



I.06
the criterion of access to the sky view, zdzisław pelczarski

fig. 9





I.07
super summer, 1976
coop himmelblau

I.08
watching the solar eclipse







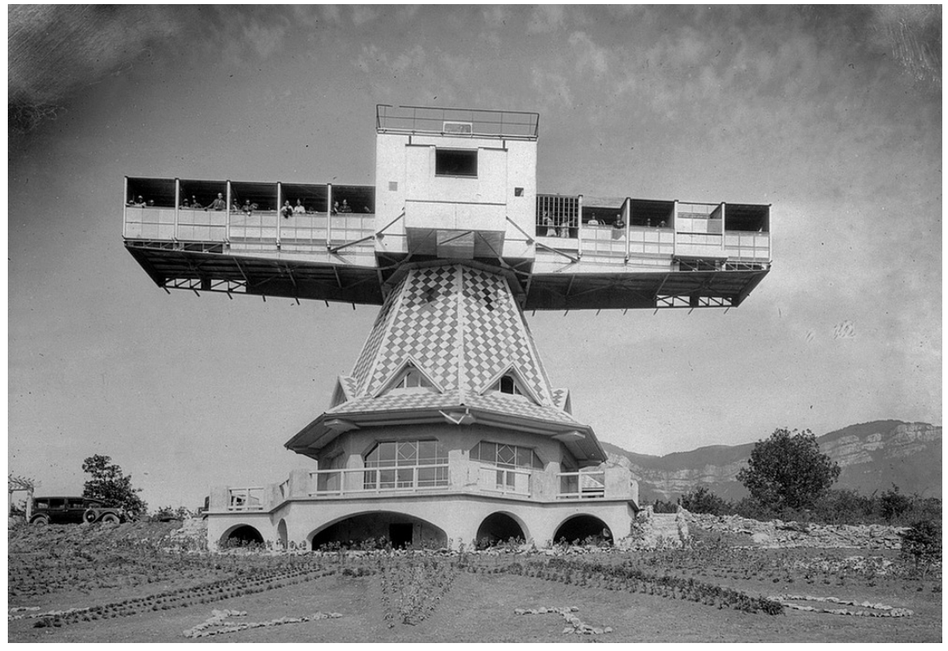






I.09
la terraza
leopoldo torre nilsson, 1963

I.10
rotating sanatorium
jean saidman, 1920s and 30s











I.11
roman signer
performance in geneva

HIGH PLACES „The instinct to climb up to some high place, from which you can look down and survey your world, seems to be a fundamental human instinct.“

(...) These high places have two seperate and complementary functions. They gave people a place to climb up to, from which they can look down upon their world. And they give people a place which they can see from far away and orient themselves toward, when they are on the ground.

High places are equally important, too, as places from which to look down: places that give a spectacular, comprehensive view of the town. Visitors can go to them to get a sense of the entire area they have come to; and the people who live there can do so too - to reassess the shape and scope of their surroundings. But these visits to high places will have no freshness or exhilaration if there is a ride to the top in a car or elevator. To get a full sense of the magnificence of the view, it seems necessary to work for it, to leave the car or elevator, and to climb. The act of climbing, even if only for a few steps, clears the mind and prepares the body.
As for distribution, we suggest about one of these high places for each community of 7000, high enough to be seen throughout the community. If high places are less frequent, they tend to be too special, and they have less power as landmarks.

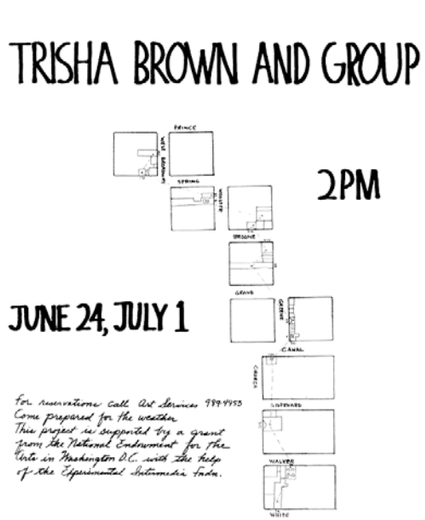
Therefore:

Build occasional high places as landmarks throughout the city. They can be a natural part of the topography, or towers, or part of the roofs of the highest local building - but in any case, they should include a physical climb.“

- Alexander, Christopher.
A Pattern Language.1977



I.12
trisha brown
roof performance, new york



I.13
trisha brown
performance map



I.14
beatles concert
london rooftops, 1969



I.15
ghost dog
jim jarmusch, 1999



I.16
la grande vadrouille 1966

PRESENCE IN CINEMA For its many inherent qualities, the inaccessible roof has a disproportionate presence in cinema. The following list just features a few.

1955 To Catch a Thief. Alfred Hitchcock
emotional narrative, roof to symbolize being literally and metaphorically above the law

1958 Vertigo. Alfred Hitchcock
rooftop chase, policeman falls

1963 La Terraza. Leopoldo Nilsson
living on the roof and threatening to jump when parents urge them to leave, leisure space

1963 Le Mépris. Jean-Luc Godard
casa malaparte, sunbathing

1964 Mary Poppins. Robert Stevens
onthe rooftops of london, smoking chimneys, walking and singing, chimneysweepers

1966 La Grande Vadrouille
landing on the rooftops of Paris with a parachute

1969 The Italian Job. F. Gary Gray
cars on the lignotto factory, driving across roofscape

1974 Karlsson vom Dach. Olle Hellbom
flying and living above the cities rooftops

1980 Permanent Vacation. Jim Jarmusch
wandering the streets of manhatten, sleeping and waking up on the roof

1985 Tokyo-Ga. Wim Wenders
golf on rooftops in tokyo

1987 The Untouchables. Brian De Palma
fight and chasing scene

1987 Himmel über Berlin. Wim Wenders
angles watching the city from above

1994 Léon: The Professional. Luc Besso
teaching how to shoot from a rooftop, (over)view and control

1995 Le Haine. Mathieu Kassovitz
rooftop as a hang-out spot

1996 Matilda. Danny DeVito
climbing on roof, hidden pathway

1998 Following. Christopher Nolan
escape on roof from burglary, roof as a private space for intimate discussions

1999 The Matrix. Lana Wachowski, Lilly Wachowski
fight scenes, making use of the „emptiness“ of the roof, no trespassing

1999 Ghost Dog. Jim Jarmusch
the pigeon keepers living on the roof

2001 Yamakasi. Luc Besson
parcour scenes, climbing up to the „peak“

2002 Infernal Affairs. Andrew Lau and Alan Mak
Hongkong rooftops, being alone, suspenseful, emotionally charged moments, cemetery

2002 Spider-Man. Sam Raimi
roof scene where spider-man powers are discovered, jump between roofs in new york

2003 Oldboy. Park Chan-wook
roof scene between technical installations, sitting and almost falling from the edge

2006 The Departed. Martin Scorsese
shooting scene on rooftop, space for secret meetings or discussions

2009 The Hangover. Todd Phillips
rooptop drinks, no trespassing, rooftop heat, burning sun, being locked out

2012 Skyfall. Sam Mendes
rooftop chase motorcycle, istanbul

2015 Spectre. Sam Mendes
James Bond, jumping across roof installations

2016 Highrise. Ben Wheatley
social segretation, roof garden, emissions from technical devices visible

2017 Moriyama-San. Beka Lemoine
living on the roofs, several scenes, film screening at night

> appropriation of a forbidden/inaccessible space
signs: no trespassing visible
> heroic qualities, freedom, relation to the sky
> away from the masses
secret/private conversations and confrontations
> leisure space, social space, sunbathing
> roofs as alternative/hidden path



I.17
the house with flying roof, 1973
coop himmelblau

`Wir haben deutlich gesehen, welch großes Gewicht dem Element Dach in der ganzen Baugeschichte und in der heutigen Architektur zukommt. Die Bedeutung und Wirkung des Daches wird auch durch die vielen täglichen Redewendungen illustriert, die den Begriff Dach verwenden: «Etwas unters Dach bringen», «Ein Dach über dem Kopf haben», «Einem aufs Dach steigen», «Unter Dach und Fach». Das zeigt uns, wie sehr der Mensch mit diesem Teilstück seines Hauses verbunden ist, es zeigt uns aber auch, welche Bedeutung er ihm beimißt.

Wir stellen fest, daß praktisch alle menschlichen Wohnstätten in irgendeiner Form bedacht waren. Und ist es nicht so, daß wir uns eher ein Dach ohne Haus, als ein Haus ohne Dach vorstellen können?´

- in: Wohnen, Das Dach:
Form, Funktion, Tradition, 1967

`A roof is the most essential part of the building.
People have lived without walls, but never without roofs.´

- Paul Grillo
in „Form, function, and design“, 1960

„(...) of those elements in the home which most bear the mark of man, the most typical is certainly the roof, the cover, the shelter; the home is a roof above al else; the walls surround but do not cover; if you have a roof, you have a home....“

- Pierre Deffontaines

WHERE BUILDING MEETS SKY
- The Dialogue between Horizontal and Vertical

Introduction

`Buildings provide man with shelter - shelter that fufills both functional and emotional needs for security. The
roof is man‘s
basic shelter, it is cover from snow, rain, wind and sun.
As a primary element in a structure, it affects the way a building works and looks. Because of its importance to
man‘s survival, it has become the focus of much energy and attention.´ (p.11)

`The shape of each roof is a resolution of manifold forces. Functionally, the roof is a response to the constraints imposed
by climate, technology and avalable materials. Beyond this social, cultural and personal values, as well as style affect which forms will be used and how they will be built. The roof
becomes a highly specific expression of these forces
and their
resolution at a particular time and place.´ (p.12)

`Because a building is generally anchored in the ground with a free end toward the sky it might suggest upward movement. But there are also downward forces, especially the visual weight directed down toward the center of gravity. The reading of a building in either direction is highly subjective - it depends upon the overall proportions and the treatment of end connections to the ground and sky.´ (p.16)

`The roof zone is where building meets sky - it is the transition zone between the two. Moving up from the ground, it aspires to some relationship with the space that envelopes it. Like the capital of a column, the roof mediates the connection of the vertical building with the vault of the sky. In order to provide cover, the roof must have some horizontal component. It can range from flat to a very steep slope. The mixture of horizontal and vertical elements and their interplay within the roof zone determines the character of the transition.

A transition is a matter of degree - it can be gradual and smooth or sudden, abrupt. The zone can be as thin as a line or as deep as a building. The most minimal transition is the flat horizontal plane, which provides for little connection or exchange with the sky. As some vertical component begins to appear, in either sloped or upright pieces, the roof becomes less of a barrier. These vertical elements give the roof zone some depth and provide for a more open and gradual transition. A thick transition allows for some exchange - some building gets up into the sky and some sky gets down into the building. It creates a knitting together that strengthens and enriches the connection.´ (p.17-18)

Forms and Spaces

`The simple and straight termination of a building with a flat roof is closed above; it provides for no formal or spatial exchange in the vertical direction. When horizontal pieces within the roof zone are moved up and down, creating terraces for example, openness out can be achieved. As the roof acquires some vertical component it becomes sloped or curved. Formally these elements start to make a connection up; spatially they are capable of total enclosure. The pitch influences the volume of space defined and the degree of connection to the sky. ´ (p.30-31)

`The large form of a roof establishes its formal and spatial orientation. This form can also be tempered by smaller pieces that qualify and support that orientation. Their functions are often space-making, climate control and ornament. Beyond this they function to either accentuate, mediate or close the transition to the sky. There is a whole range of pieces that occur in the roof zone which define habitable spaces. In making a formal connection either up or down, these spaces exist on the edge, as a combination of inside and outside spaces. When the inside pushes out through the roof, „little houses“ or rooms are stuck out into space. These include dormers, cupolas, turrets and clerestories as well as other similar but nameless varieties. The outside can also push into the roof to create partially defined spaces. Some have sides and no cover, such as a roof terrace surrounded by parapet walls, a porch set in amidst the roof forms and a widows walk bordered by railing or balustrade - their openness above orients them up. Others have cover and no sides, including the overhanging eave, which provides cover outside of the walls and the portico, porch or veranda where the roof extends out over a room-size space. These spaces open out, not up - when raised high in the roof zone they connect out to the horizon. (...)

Rooves contain even smaller formal pieces (...) Many pieces are vertical: the weathervane, chimney, antenae, balustrades, pinnacles and mechanical systems, whether picturesque or unsightly, serve to break the line of the roof and penetrate the sky.´ (p.42-45)

Associations and Experiences

`The roof is essential to man in a fundamental, pragmatic way. As a result, roof forms reflect the climate, and the technology and materials available when they were built. The slope of the roof is often considered one of the surest indications of climate. Because of its importance to survival, the roof is
the focus of much time, energy and care. Roof forms, however, go beyond mere function to encompass fundamental psychological, philosophical and poetic meanings that embrace dreams, memories, imagination and ideals of beauty, as well as the need for shelter. These meanings are shaped by social, cultural, stylistic and personal values. As such,
they are highly subjective and individual, specific to both place and time, and strongly bound up in perception.´ (p.53)

`Thus differentiated by gravity, the directions of up and down have specific perceived qualities and take on particular meanings. (...) Man has long accorded being up with superiority. These meanings pervade our language: we speak of being „on top“ of things, dealing with those „higher up“, walking „tall“ and thinking „lofty“ thoughts. Movement upwards becomes liberating as one conquers gravity -it is a metaphor for growth, longing and reaching.´ (p.55)

`The differences between up and down and the connotations of movement up lead to a vertical differentiation of space in the built environment. Different levels take on particular qualities; they become more private as they become more removed from the ground. The upper regions of the building are intimate, they can become the domain of dreams and fantasy: „haven‘t dreams always liked to perch on high?“ The uppermost stories, ranging from the dusty attic to the penthouse suite, have ambiguous qualities. The romantic aspect endowed by their elevation and remoteness gives them an aloof superiority, a certain prestige. In the past, this was mitigated by the everyday inconveniences of living above, the extra work involved in getting there and in transporting the essentials of life up and down. The introduction of technical means to do this - plumbing, central heat, electricity and elevators - has changed the situation. Being up has lost the heroic, ascetic quality but retains the values of privacy, overview and connection to the sky. ´(p.61-63)

`The roof zone, as the top zone, becomes very special, endowed with the importance of the head (dreams), the flowering qualities of branches and the openness, light and spirituality associated with the sky. As the high point or summit, the roof is an area in architecture that allows and even provides for very sculptural and active forms. Because of its importance and many meanings to man, it has often been highly ornamented and detailed. It has been the crowning of the building, „architecture‘s glorified end“.´ (p.66)

`There are several ways to see the roof from the outside: from the ground either up close or far away and from above at a distance.´(p.72)

`From afar, shape and silhouette dominate and roofs blend together, either with the natural landscape or with other roofs, to form a roofscape. Skylines and roofscapes can have sculptural qualities and active forms - they can become a new landscape.´ (p.74)

`To be on a roof requires a flat roof - a roof garden or terrace. Experience of the roof from on top, is limited - it involves mostly sky and very little building. There are pieces of building that do get up on to roof terraces, including parapet walls that provide their only enclosure and other sculptural and landscaping forms. This „raised ground“ involves no cover, it is totally open to the sky: „using the top of the roof does not give one a feeling of shelter, in fact it turns the womb inside-out and a person perched up on a roof can feel a sweep of freedom, a giddy sense of liberation from earthbound problems.“
Being up on a roof can be exhilerating because it is up. Up is removed and safe from both the activities and the threats on the ground. With its connotations of the spiritual, this position is above, higher, detached and priveleged. ´(p.80)

`We often attribute to our gods this state of being above, looking down over us all. There are parallel experiences in being on top of mountains, towers and aloft in ships; „one can feel oneself cut off from the world and yet owner of the world.“´(p.81)

`Experience on the roof can define a world in itself. Viewed from here surrounding roofs combine to form - between earth and sky - a roofscape that becomes a new landscape. The height of the roof above the ground affects the perception of and relation to things below. ´(p.82)

`Experience within the roof zone (...) is only possible when the roof zone has some thickness, coming from a combination of horizontal and vertical elements. Thus the roof becomes permeable not only formally but spatially - it allows one to take part in the transition from building to sky.´ (p.83)

`The habitable roof zone is a realm of contradiction. As part building and part sky it embodies the tension between the opposites of shelter and openness. (...) habitable outdoor terraces can open directly off of indoor spaces and also form the roof to spaces below - here there is little distinction between roof and ground. In both cases qualities of the elements melt together; the resulting complexity and ambiguity allows for richness of experience.´ (p.89)

- Sandra Leigh Olson Snow, MIT, 1968



I.18
skyline of new york
1931 beaux arts ball, ny
architects dressed as their own buildings, crowns

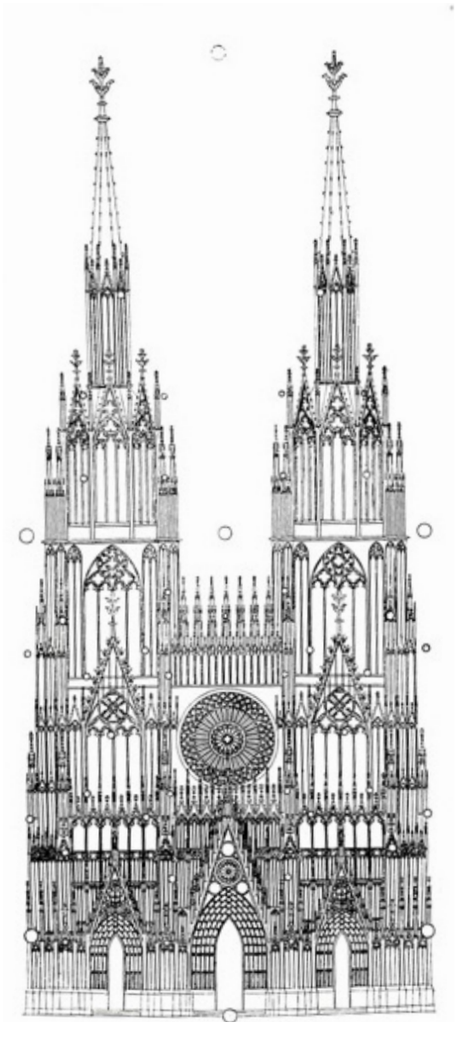
(center: wiliam van alen, chrysler building)

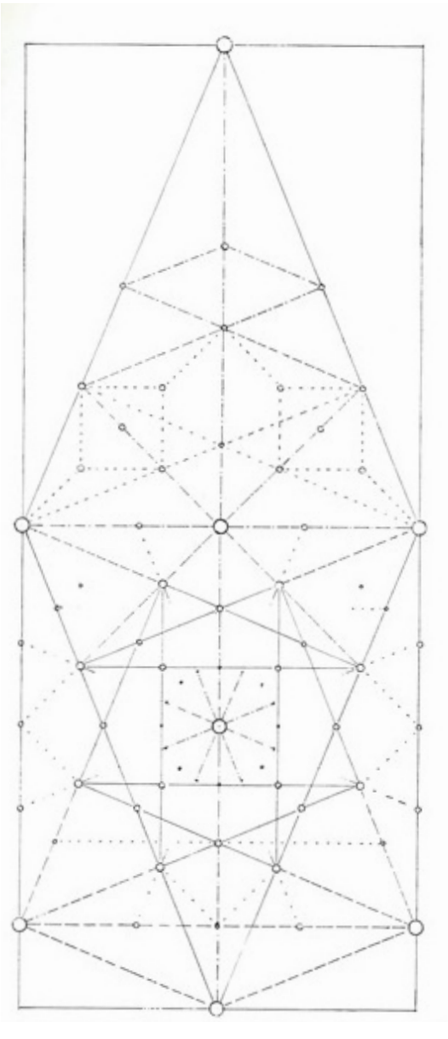
I.19
1439 strassburger münster

the verticality of the roof is a fundamental element of sacred architecture, symbolizing a connection between the earth and the heavens

„Every line was designed, (...) to carry the eye upward - to give a feeling of verticality and lightness.“

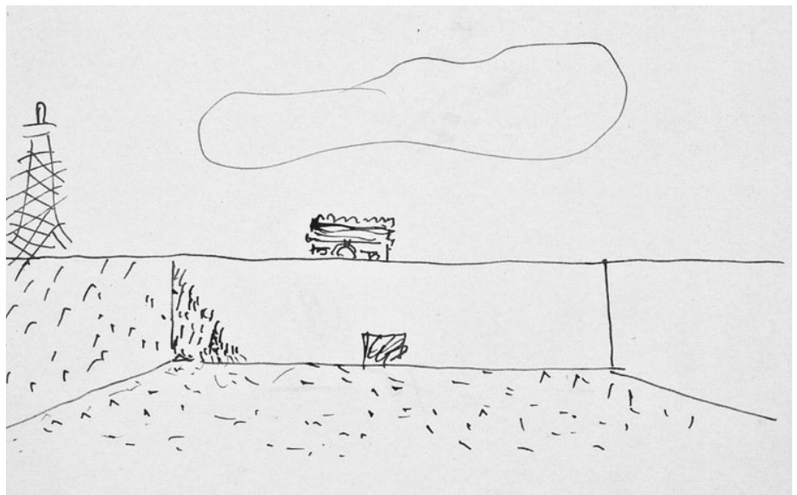
- Mies van der Rohe on gothic architecture







I.20
appartement de charles de beistegui, le corbusier, 1931



I.21
appartement de charles de beistegui, le corbusier, 1931

THE ROOF GARDENS. The flat roof demands in the first place systematic utilization for domestic purposes: roof terrace, roof garden. On the other hand, the reinforced concrete demands protection against changing temperatures. Overactivity on the part of the reinforced concrete is prevented by the maintenance of a constant humidity on the roof concrete. The roof terrace satisfies both demands (a rain-dampened layer of sand covered with concrete slabs with lawns in the interstices ; the earth of the flowerbeds in direct contact with the layer of sand). In this way the rain water will flow off extremely slowly. Waste pipes in the interior of the building. Thus a latent humidity will remain continually on the roof skin. The roof gardens will display highly luxuriant vegetation. Shrubs and even small trees up to 3 or 4 metres tall can be planted. In this way the roof garden will become the most favoured place in the building. In general, roof gardens mean to a city the recovery of all the built-up area.

-Le Corbusier and Pierre Jeanneret,
Les 5 Points d'une Architecture Nouvelle, 1926

DAS FLACHE DACH Replying to Gropius's questionnaire about the flat roof, Le Corbusier said that he had come to realize the beauty of its pure form when as a young man he had climbed up on his houses while they were in construction and still unroofed (he was referring to his very early houses, which had pitched roofs)
„all spread out before me; the heavens vaulted infinitely far above. The air was calm and, far from the street, one had a feeling of security and well-being - but on the next day, when the roof was put up, all was destroyed, all was lost."

Le Corbusier
in: Gropius, „Das flache Dach,"

I.22
periscope





III.23
villas on shopping mall roof
zhuzhou, china



III.24
adamo faiden
once building, 2011

SKY `Cities are our greatest-ever invention in terms of democratising access to education, health and mobility. Their infrastructures make up a network so dense that, when considered along with the buildings themselves, they end up forming a new stratum of the Earth‘s crust. Viewed in section, cities look like an artificial mantle of varying thickness. Their surface, therefore, is where they are most exposed to any atmospheric variables.

Seen in this way, buildings‘ encounter with the sky forces them to constantly update their ambitions and design protocols. The tops of our constructions can reach beyond their technical nature: they can become spaces for new events. As a result, water tanks, air conditioning units, ventilation pipes and machine rooms migrate elsewhere in the section: new ground is cleared, to be truly acknowledged as a special place. An open platform, as-yet-unprogrammed and in direct contact with the sky.
If we could imagine our cities as fragments of an artificial crust, we would stop worrying about the skyline and instead focus on a new groundline that will no longer coincide with the natural soil level. We would no longer be moved by the formal repertoire that we find at the top of buildings. So, to draw up a new contract with the sky, we will have to inhabit the entire thickness of the cities. Both its valleys and its peaks. In this sense, living in the air could be much more than a strategy to compact and densify our habitat: it could become the expression of a collective desire. Describing the city in these terms would allow us to discover a vacant territory, permeable to new projections and fantasies.

The sky covers all geographical features. The city is one of them, the one that we design for ourselves.´

- Adamo Faiden, 2G, 2024

THE SKY FRONT `The flat roof was an architectural statement for the avant garde of Modern Architecture in the nineteen twenties, even an ideological expression of architecture itself. Can a flat roof give architecture a special quality or significance then?

It can, but not in the way that you so often see it being used. In today‘s architectural world, the flat roof is mainly a design cliche, without any kind of statement or ideology, a kind of mannerism. For the construction world it is just an economic way of covering up the upper surface of a building. In the shape itself I can see no special qualities; where I am concerned the quality would need to appear from the conceptual integration with the building itself, or from the use of the building.´

- Interview with Xavier De Geyter
in: The sky front. flat roof architecture, 1998

THE SKY FRONT `Over the coming decades there will undoubtedly be a fundamental change in the use of our customary roof forms in connection with urban architecture ocations (city centres, vilage centres, redevelopments, etc.) Following the unbridled increase: in land consumption over the last fifty years, open space is quietly becoming scarce. (...)

(...) the roof will take its rightful place as a fully-fledged fifth wall, adopting significance both in the uses it offers and the visual experience it generates. It will then no longer be possible too degrade the flat roof into a collective space for chimneys, air conditioning vents, emergency domes, flagpoles, machine rooms, etc., it will be taken up into the concept of the building itself and judged accordingly.´

-Eddie Vanzieleghem
in: The sky front : flat roof architecture, 1998



I.25
moscow open air cinema
spartak kndeghtsyan and
telman gevorgyan, 1964

I.26
auditoire en plein air, université
de fribourg, denis honegger







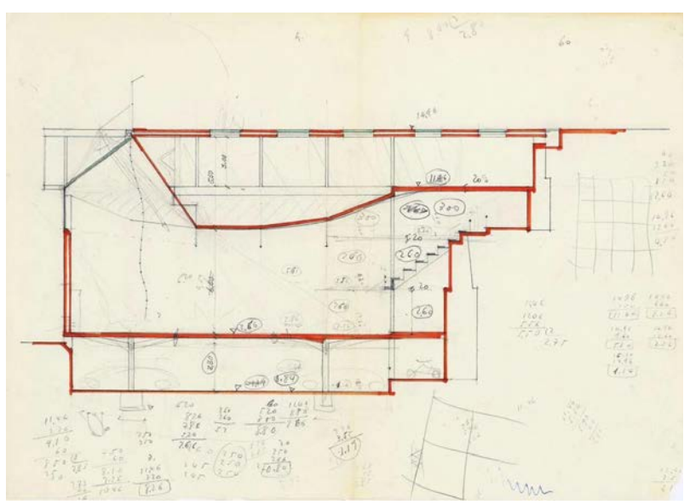
I.27
tokyo ga, wim wenders
golf on the roof

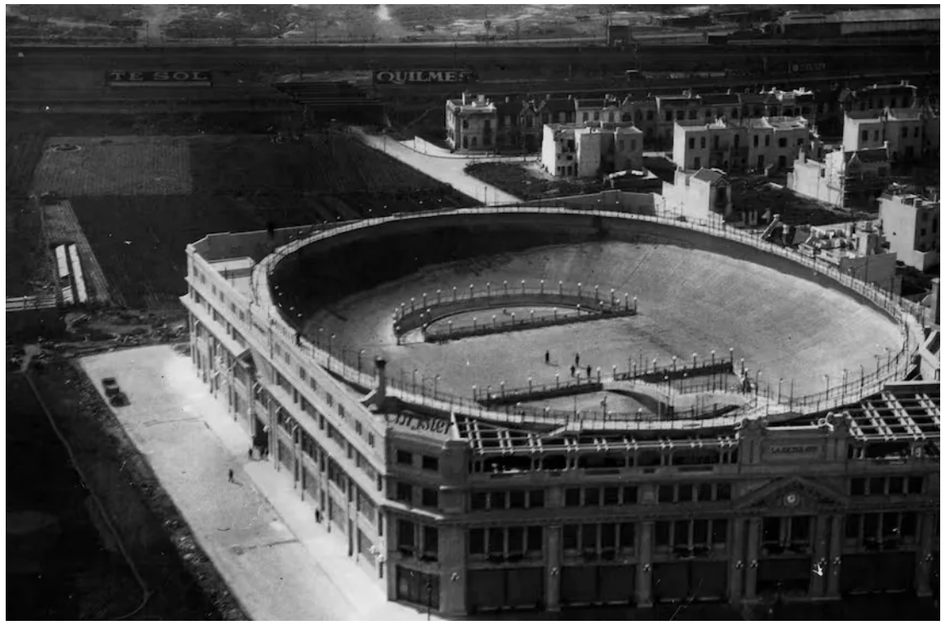


I.28
mini golf on roof, tokyo



I.29
alejandro de la sota
maravillas, 1960





I.30
palacio acorta,
buenos aires, 1928

„We must invent and rebuild ex novo our modern city like an immense and tumultuous shipyard, active, mobile and everywhere dynamic, and the modern building like a gigantic machine, Lifts must no longer hide away like solitary worms in the stairwells, but the stairs - now useless - must be abolished (...)
(...) everything must be revolutionalised; that we must exploit our roofs and put our basements to work; depreciate the importance of the facades (...)“

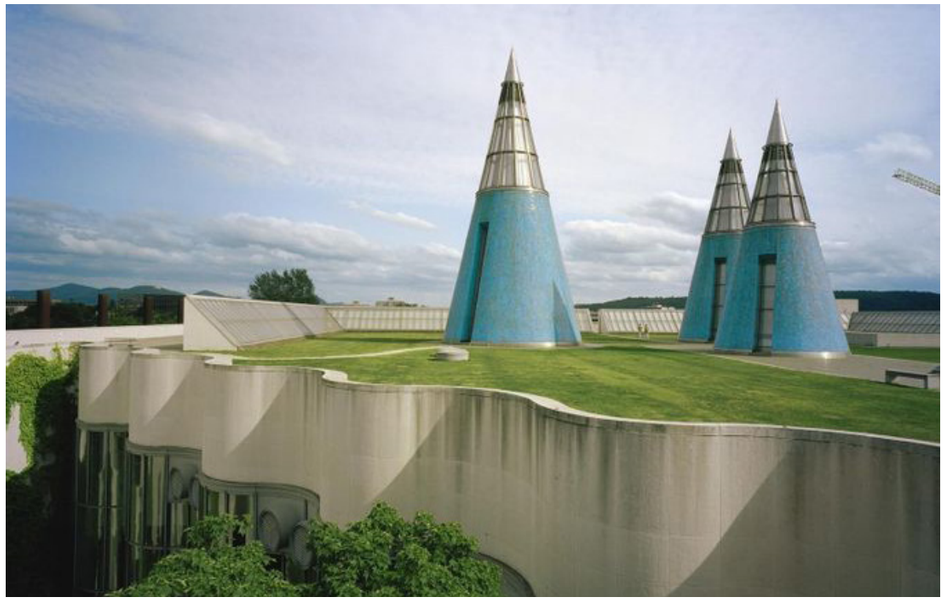
-Antonio Sant´Elia
Foundation Manifesto of Futurism, 1909

„The concept facade is already passing from architecture. No place remains in buildings for which is not adapted to some function: to the development of the front (balconies, advertisement) is added the exploitation of the roofs (garden terraces, landing grounds)“

-László Moholy-Nagy

I.31
lignotto factory, fiat
torino, 1923



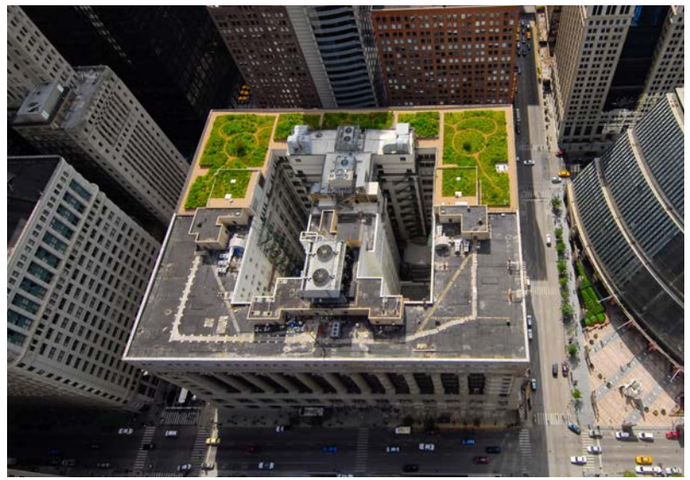


I.32
bundeskunsthalle bonn
gustav peichl, 1992



I.33
chicago city hall
rooftop garden, co-existance
with technical devices





TAKING ADVANTAGE OF THE ROOF This is one of the few well documented cases where a roof garden has been included as no extra capital cost. Considered in isolation, a grass roof is more expensive than a conventional flat roof. At Willis Faber DUmas, however, other factors outweighed the greater initial construction cost. For instance, the greatly increased insulation afforded by the soil layer meant significant reductions in heating and cooling costs. Early calculations showed that insulation would be so good as to eliminate totally the need for an expansion joint across the building, removing at a stroke an entire line of columns and associated foundations.
Another, more potent, argument for the roof garden was its amenity value. The architects took a creative view and argued that the garden would reduce staff turn-over and thus prove cost efficient in the long run. (...) The client was impressed but nervous about the idea of maintaining a full scale garden. When the architects suggested a straightforward expanse of grass, agreement was reached. (...)
Planting in the one acre garden remains limited to grass and the Euonymus Japonica perimeter hedge which conseals the roof parapet, thus creating the splendid illusion of a ground level garden. A continuous walkway or jogging track runs between the planted hedge and the roof edge. The small terrace area outside the restaurant and the track are the only hard surfaces. (...)

-Bramante, Gabriele. Willis Faber & Dumas Building: Ipswich 1975, Architect: Foster Associates. London:Phaidon Press, 1993.



I.34
willis, faber & dumas building, ipswich, norman foster, 1975

I.35
willis, faber & dumas building, ipswich, norman foster, 1975



II

TERRITORY

„On July 1, 1908, a zeppelin flew over the city of Zurich for the first time. At Zurich City Hall, everyone from the janitor to the mayor climbed up to the roof terrace.“

- Nebelspalter : das Humor- und Satire-Magazin, 1990

The chapter on TERRITORY investigates the historical development and the quantification of space.

II.I Historical Development

The relation of buildings to the sky has changed fundamentally throughout the last 150 years. Until the mid 19th century, Zurich‘s cityscape was characterised by pitched roofs with steep slopes of 38-45°. Since climate and local materials were the most important parameters shaping the roof, frequent rainfalls and wooden constructions with thatched - and later shingled roofs defined the high-pitched typology.

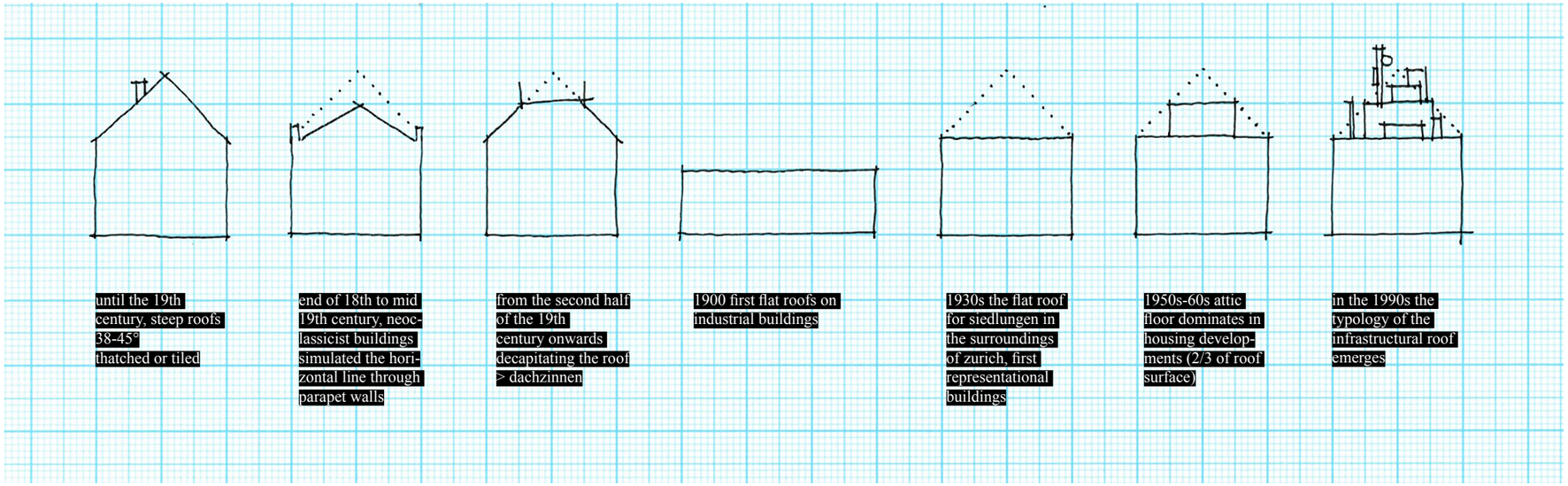
In the second half of the 19th century, the city of Zurich grew immensely. Through industrialisation and the first integration of neighbouring municipalities in 1893, the city almost doubled in size within 10 years. Whilst atypical for its climatic zone, these „Gründerzeitbauten“ were thriving for sun and air in the industrial city and their trimmed hipped roofs offered “Dachzinnen”, a new typology of roof terraces. Usable spaces for photography studios, drying laundry, overlooking the city and as far as the alps, spaces for dancing, for representation through advertisement, sunbathing or watching the first Zeppelins and hot air balloons rise above the city. The use of the roof is strongly embedded in Zurich‘s culture and has always been a common space, almost perceived as part of the public sphere.

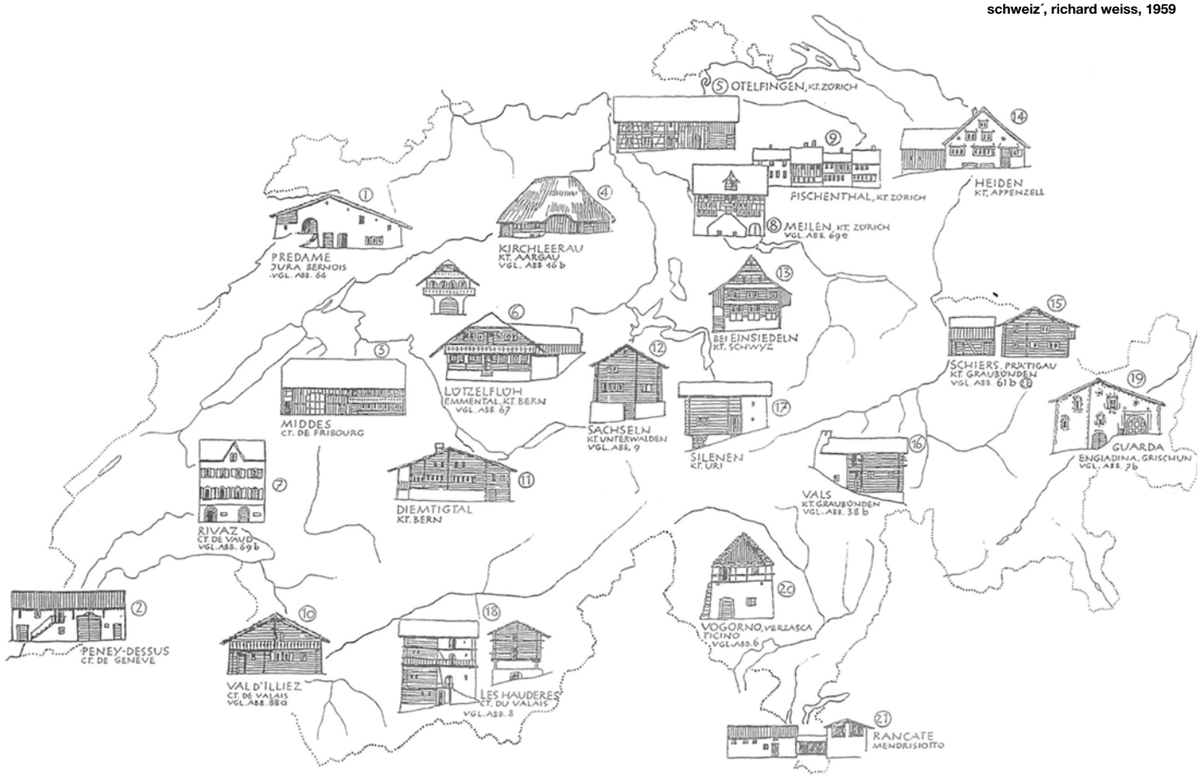
Advancing material properties and technologies like Holzzement, roofing felt, asphalt, as well as reinforced concrete and steel resulted in the construction of Zurich’s first flat roofs of industrial buildings around 1900. In the 1930s, with the „New Objectivity“ movement, first representational buildings and housing developments in the city‘s surroundings were constructed, applying flat roofs as usable outdoor space for terraces and gardens.

II.II 5.4km2 of Zurich

While the Heimatschutz-Bewegung opposed this development in the 1920s, their widespread adoption across all building types in Zurich began in the 1950s. Since then, flat roofs have accounted for more than 80% of all newly constructed buildings each year.
This shift was largely driven by economic considerations: flat roofs were practical, requiring less surface area of the building envelope and thus reducing the overall building volume for the same usable space. The result was lower material and energy consumption, translating directly into cost savings.

Consequently, the fundamental idea of new ground seems to have been forgotten. Technical equipment, safety regulations and economic considerations, rendered most of the roof spaces inaccessible. Today, around 48% of Zurich‘s buildings are covered by flat roofs, adding up to a surface area of 5.4km2. These surfaces create new patterns and densities within the city, especially accumulating in industrial and public building zones, where they account for more than 75% of the built surface.


until the 19th century, steep roofs 38-45° thatched or tiled
end of 18th to mid 19th century, neoclassicist buildings simulated the horizontal line through parapet walls
from the second half of the 19th century onwards decapitating the roof > dachzinnen
1900 first flat roofs on industrial buildings
1930s the flat roof for siedlungen in the surroundings of zurich, first representational buildings
1950s-60s attic floor dominates in housing developments (2/3 of roof surface)
in the 1990s the typology of the infrastructural roof emerges



II.01
`häuser und landschaften der schweiz´, richard weiss, 1959

CLIMATE AND LOCALITY

Until the mid 19th century, Zurichs cityscape was characterized by pitched roofs with steep slopes of 38-45°. Since climate and local materials were the most important parameters for the their shape, frequent rainfall defined the steep roofs of the city.

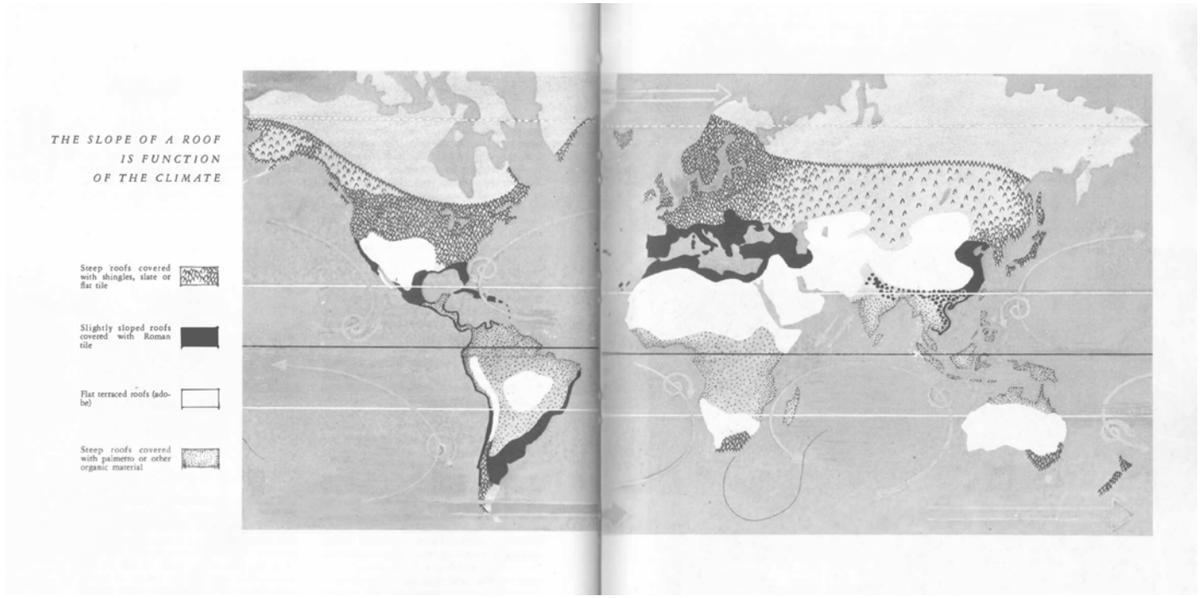
Earlier roof coverings were thatched roofs, while during the 16th century, due to fire risks in the denser urban environment, the roof coverings slowly transformed to heavier tiled roofs. The last thatched roofs disappeared around 1900, after an official prohibition by the canton of Zurich.

In this predominent typology, the attic mediates between the building and the roof. Its porosity was one of its most important features, as the air flow through the roof covering enabled smoke to escape and ensured the conservation of wooden constructions. As an unheated, but dry space, that was often only accessible via steep staircases or ladders, it was not intended for human habitation.
Instead, it offered space for other important uses: It provided a cold space for the storage of food and firewood, but also tools or furniture. It was used for drying laundry or herbs and other foods. Sometimes it also provided additional servants‘ quarters or in case of public buildings was used as archival space.

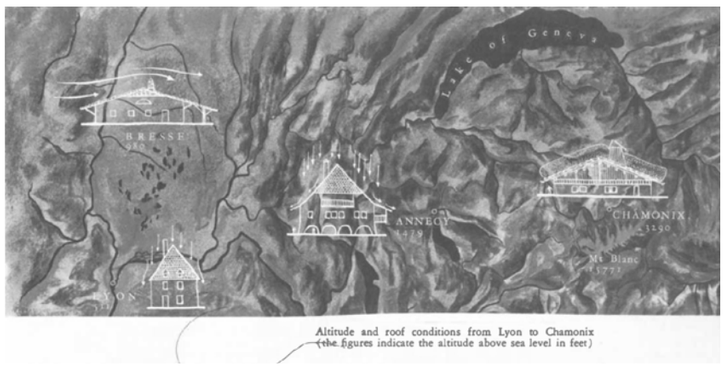
From the 60s and 70s onwards, still existing attic spaces have often been transformed into additional housing space.

Roofs Roofs exist to shelter mankind from three principal vicissitudes of weather—wind, and extremes of temperature. As a shield against water in the form of rain, snow, or ice, all roofs must be waterproof or as nearly so as the available building materials permit. As a protection against excessive heat or undue cold, all roofs must possess heat-insulating value; they must prevent the transmission of heat from the inside of the building to the outside, as well as the penetration of heat into the interior. The most obvious requirement is waterproofness, for damage resulting from leaks in roofs or their appurtenances is one of the most troublesome calamities that can occur in a building. Undesired water in an interior is not only distressing and unhealthy for the occupants but also destructive of many types of building material and finish; a small leak can cause hundreds of dollars‘ worth of damage. The utmost care must therefore be taken by the architect to avoid any possibility of leakage, and it is significant to note how great an amount of ingenuity has been displayed by architects, engineers, chemists, physicists, and building-materials manufacturers to obviate any such difficulties. (p. 565)

- Talbot Hamlin, Forms and Functions of Twentieth-Century Architecture, 1952



II.02
`form, function, and design´
paul grillo, 1960



Altitude and roof conditions from Lyon to Chamonix
(the figures indicate the altitude above sea level in feet)

II.03
altitude and roof conditions
from lyon to chamonix

THE SLOPE OF A ROOF IS FUNCTION OF THE CLIMATE

A roof is characterized not only by the material it is made of, but also by its slope. Climate is the reason for every particular roof angle in the design of an archetype. The slope of roofs offers all possible angles with the horizontal. Some vertical wall treatments may even be explained as roof design. For instance, some walls exposed to driving rains are covered with shingles, exactly like a roof. This design is found for the same reason in New England as well as in Norway. Flat roof design is widespread nowadays, although it is not everywhere as sensible as in the architecture of Tibet, Morocco, or in the pueblo villages of the South West. If we lay out on a climate map of the world, the regions that use the same kind of roof design, we find that within similar climatic conditions, the peasant covers his farm the same way anywhere on earth.

1. Only the desertic zones use flat roofing, as in the pueblo architecture of Arizona, the Sahara border regions, Arabia, Iran, Tibet, etc. This is not done by choice, but because wood, the main material for a sloped roof, is scarce. Wood is reserved for religious and government buildings, that all have sloped roofs, which have thus become a symbol of dignity and power.

2. The slope increases gradually on either side of the tropics, in proportion to the increase of humidity. The slope is slight in the warm temperate zone, where Roman tile rules the design. It increases in the colder temperate zone, where flat tile and slate are the materials used, and it finally attains such steepness that it becomes impossible to climb atop the roof without a ladder, in the northern regions and the equatorial zones, where thatch or shingle is the material used, and rainfall is abundant.

LOCAL ALTITUDE AND WIND CONDITIONS ALSO INFLUENCE ROOF DESIGN

Since climate is the reason for roof slope, we can expect to witness a difference in design according to differences in altitude, as climate is also affected by altitude.

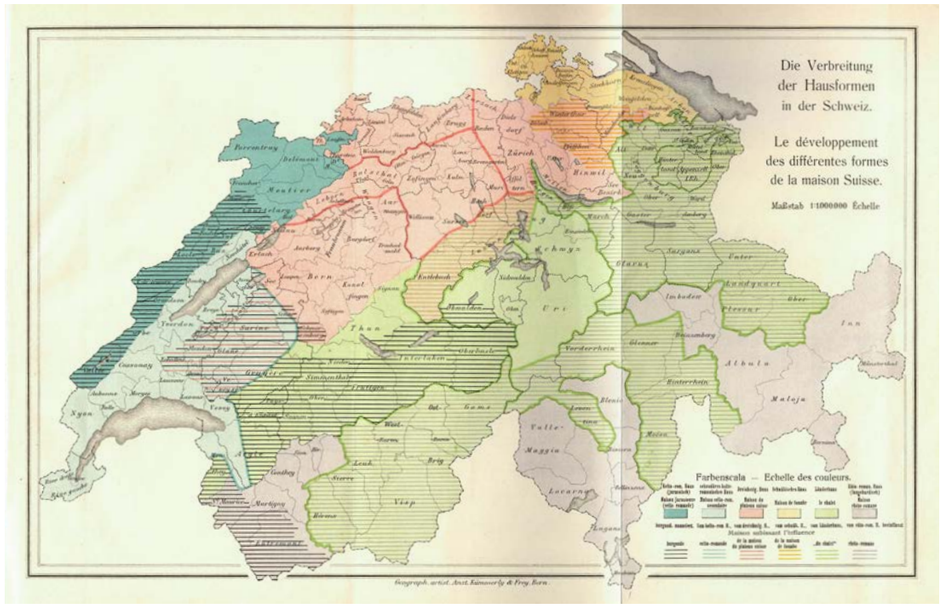
This proves to be true. Let‘s choose as an example a very small region in France where, within 100 miles, the climate changes from polar-like conditions to Mediterranean mellowness. It is an intriguing experience for the designer to take the train from Chamonix to Lyon, and just look outside the window. Without moving from his seat, he will have witnessed a parade of every kind of slope of roof possible, and this is why:

(...) In Chamonix, where snows are heavy, the roofs are slightly sloped, with a wide overhang and covered with wood shakes. The reason: snow accumulates on the roof, clings to the wood, whereas a stronger pitch would make it slide. It soon builds up a cosy blanket offering a powerful insulation against the cold. The wide overhang also permits the farmer to reach the stable at the rear without shoveling snow. In Annecy, where precipitation has become rain, the roofs are high-pitched and covered with small flat tiles shaped like the scales of a fish, on which the water glides as on the back of a duck. In the Dombes plains, where heavy rain storms and winds are frequent, such high hats would be carried away by the first squall. Here, roofs are low-pitched, but covered with a very heavy Roman tile, as light wood shakes like those used in Chamonix would be blown off. Each tile is designed so as to be a little gutter to evacuate the water faster, but heavy enough to withstand a high wind. Finally, in Lyon, where there are heavy rains but little wind, the roofs are higher pitched and covered with slate, on which the rain flows harmlessly. (...)

NEW TECHNIQUES OPEN FRESH POSSIBILITIES IN ROOF DESIGN

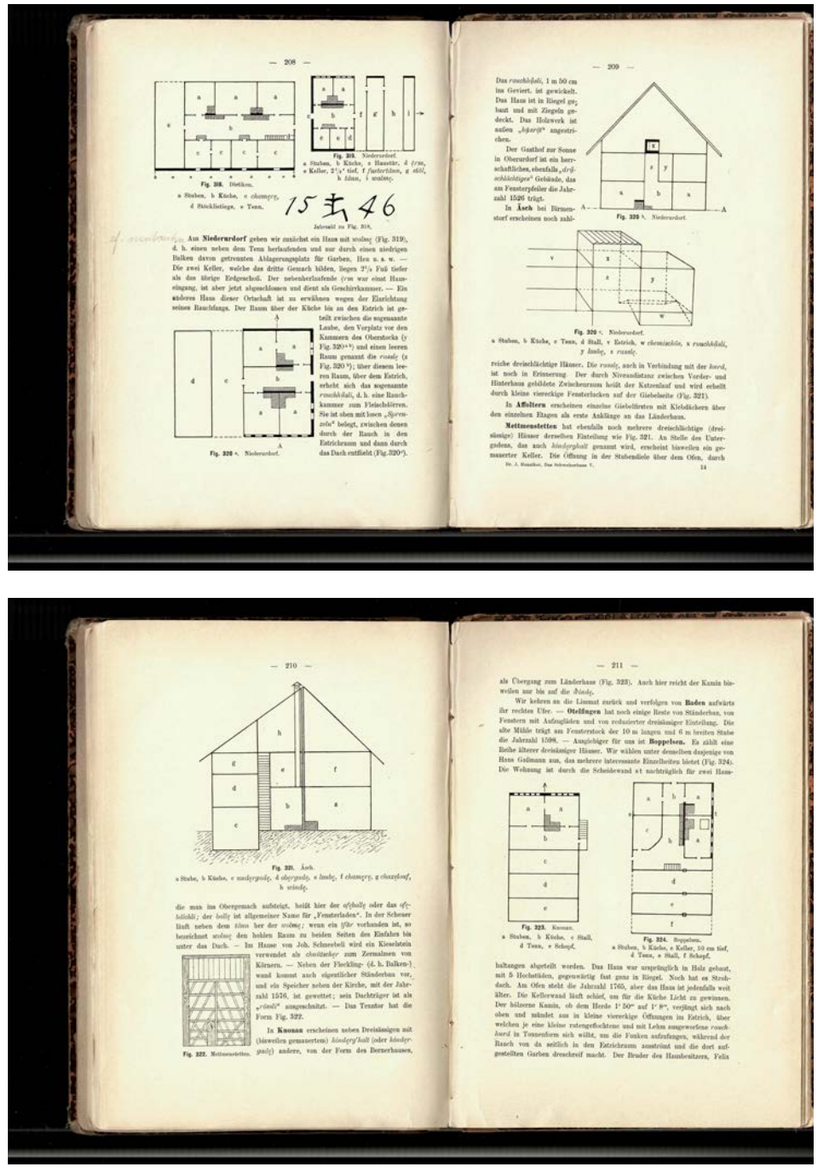
Until not too long ago, it was impossible to make a roof that would not leak, unless water was shed from its slope immediately. Today, we can use our „built-up” roofs as swimming pools, as the new flexible sprayed-on plastic sheetings can cover surfaces of any curvature with a permanent waterproof skin. There is no longer any reason for the designer to follow obsolete roof patterns which have evolved from other techniques. (...)

-Paul Grillo in „Form, function, and design“, 1960



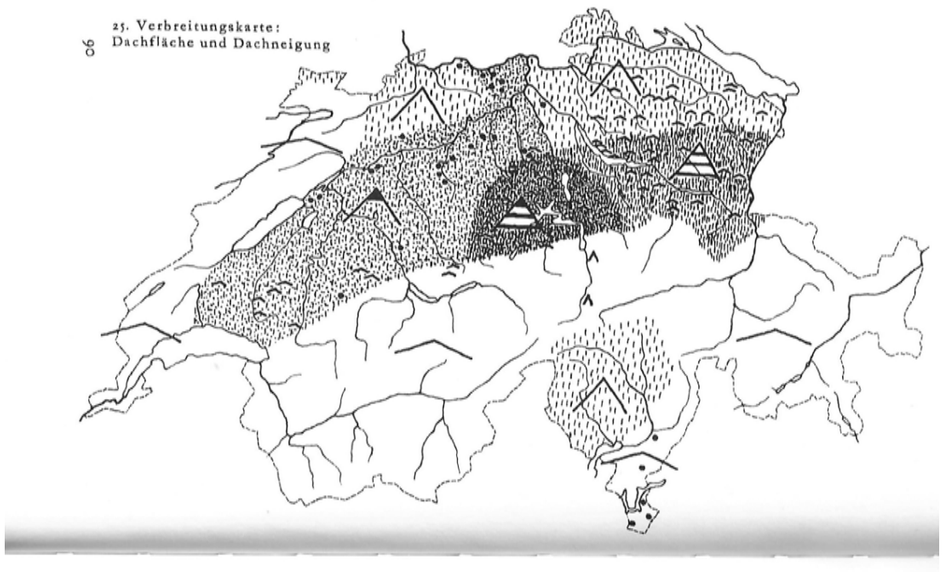
II.04
`das schweizer haus - nach seinen landschaftlichen formen und seiner geschichtlichen entwicklung´, dr. c. jecklin, dr. j. hunziker 1914

II.05
`das schweizer haus - das dreisässige haus´, dr. c. jecklin, dr. j. hunziker 1908



II.06
`häuser und landschaften der schweiz´, richard weiss, 1959

roof slopes and shapes



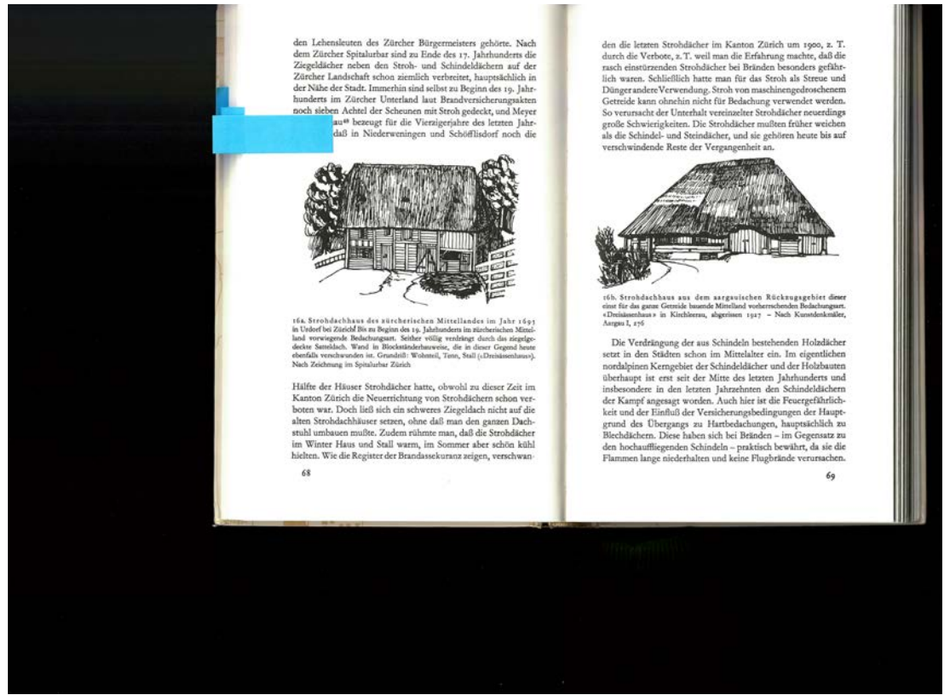
SIGNATUR		BEZEICHNUNG	SCHEMA	VERBREITUNGSGEBIET UND -TENDENZ
FLÄCHEN	EINZELANGABEN (NACH HUNZIKER)			
1	^	SATTELDACH SCHWACHGENEIGT		ALPEN UND JURA (→ SCHINDELN) SÜD- UND WESTSCHWEIZ (→ HOHLZIEGEL) RELIKTE (NACH HUNZIKER) IM OSTSCHWEIZERISCHEN VORALPENGEBIET UND IN DER ZENTRALSCHWEIZ.
2	Λ	SATTELDACH STEIL		MITTELLAND UND ALPINER TESSIN VOM MITTELLAND AUSBREITUNGSTENDENZ GEGEN ALPENGEBIET
3	•	VOLLWALM		RELIKTE (NACH HUNZIKER). HEUTE FAST VÖLLIG VERSCHWUNDEN. FLACHES VIERSEITDACH IM TESSIN, VON ITALIEN HER SICH AUSBREITEND.
4		HALBWALM (a) KRÜPPELWALM (b) (»GERSCHILD«)	a b	HALBWALM ZURÜCKWEICHEND WIE WALM, KRÜPPELWALM ABER ZEIGT NEUE AUSBREITUNGSTENDENZ VOM BERNBIET NACH W UND O.
5		KLEBDÄCHER		NORD- UND VORALPINES GEBIET DER ZENTRAL- UND OSTSCHWEIZ. (NIEDERSCHLAGSREICHE ZONE)
6		KRÜPPELWALM UND KLEBDÄCHER		ÜBERSCHNEIDUNG KRÜPPELWALM – KLEBDÄCHER (BEIDE ALS »RESTE« DES VOLLWALMS) IN DER ZENTRALSCHWEIZ.

DACHNEIGUNG: STARK GENEIGTE DÄCHER, »STEILDÄCHER« ÜBER 45° △ (STROHDÄCHER 50-65°)
SCHWACH GENEIGTE DÄCHER, »FLACHDÄCHER« UNTER 45° △ (STEINPLATTENDÄCHER 20-50°, UNGENAGELTE SCHINDELDÄCHER ETWAS STEILER)

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II.07
`häuser und landschaften der schweiz´, richard weiss, 1959

traditional thatched roofs in the canton of zurich



den Lehensleuten des Zürcher Bürgermeisters gehörte. Nach dem Zürcher Spitalurbar sind zu Ende des 17. Jahrhunderts die Ziegeldächer neben den Stroh- und Schindeldächern auf der Zürcher Landschaft schon ziemlich verbreitet, hauptsächlich in der Nähe der Stadt. Immerhin sind selbst zu Beginn des 19. Jahrhunderts im Zürcher Unterland laut Brandversicherungsakten noch sieben Achtel der Scheunen mit Stroh gedeckt, und Meyer [illegible]au[48] bezeugt für die Vierzigerjahre des letzten Jahrhunderts, daß in Niederweningen und Schöfflisdorf noch die

164. Strohdachhaus des zürcherischen Mittellandes im Jahr 1693 in Urdorf bei Zürich. Bis zu Beginn des 19. Jahrhunderts im zürcherischen Mittelland vorwiegende Bedachungsart. Seither völlig verdrängt durch das ziegelgedeckte Satteldach. Wand in Blockständerbauweise, die in dieser Gegend heute ebenfalls verschwunden ist. Grundriß: Wohnteil, Tenn, Stall («Dreisässenhaus»). Nach Zeichnung im Spitalurbar Zürich

Hälfte der Häuser Strohdächer hatte, obwohl zu dieser Zeit im Kanton Zürich die Neuerrichtung von Strohdächern schon verboten war. Doch ließ sich ein schweres Ziegeldach nicht auf die alten Strohdachhäuser setzen, ohne daß man den ganzen Dachstuhl umbauen mußte. Zudem rühmte man, daß die Strohdächer im Winter Haus und Stall warm, im Sommer aber schön kühl hielten. Wie die Register der Brandassekuranz zeigen, verschwan-

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den die letzten Strohdächer im Kanton Zürich um 1900, z. T. durch die Verbote, z. T. weil man die Erfahrung machte, daß die rasch einstürzenden Strohdächer bei Bränden besonders gefährlich waren. Schließlich hatte man für das Stroh als Streue und Dünger andere Verwendung. Stroh von maschinengedroschenem Getreide kann ohnehin nicht für Bedachung verwendet werden. So verursacht der Unterhalt vereinzelter Strohdächer neuerdings große Schwierigkeiten. Die Strohdächer mußten früher weichen als die Schindel- und Steindächer, und sie gehören heute bis auf verschwindende Reste der Vergangenheit an.

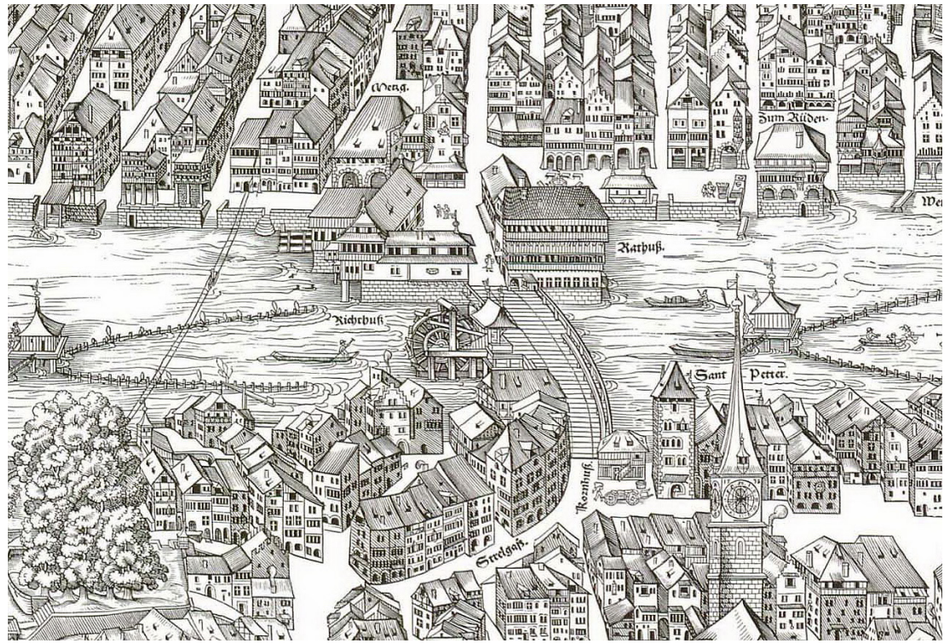
16b. Strohdachhaus aus dem aargauischen Rückzugsgebiet dieser einst für das ganze Getreide bauende Mittelland vorherrschenden Bedachungsart. «Dreisässenhaus» in Kirchleerau, abgerissen 1947 – Nach Kunstdenkmäler, Aargau I, 276

Die Verdrängung der aus Schindeln bestehenden Holzdächer setzet in den Städten schon im Mittelalter ein. Im eigentlichen nordalpinen Kerngebiet der Schindeldächer und der Holzbauten überhaupt ist erst seit der Mitte des letzten Jahrhunderts und insbesondere in den letzten Jahrzehnten den Schindeldächern der Kampf angesagt worden. Auch hier ist die Feuergefährlichkeit und der Einfluß der Versicherungsbedingungen der Hauptgrund des Übergangs zu Hartbedachungen, hauptsächlich zu Blechdächern. Diese haben sich bei Bränden – im Gegensatz zu den hochaufliegenden Schindeln – praktisch bewährt, da sie die Flammen lange niederhalten und keine Flugbrände verursachen.

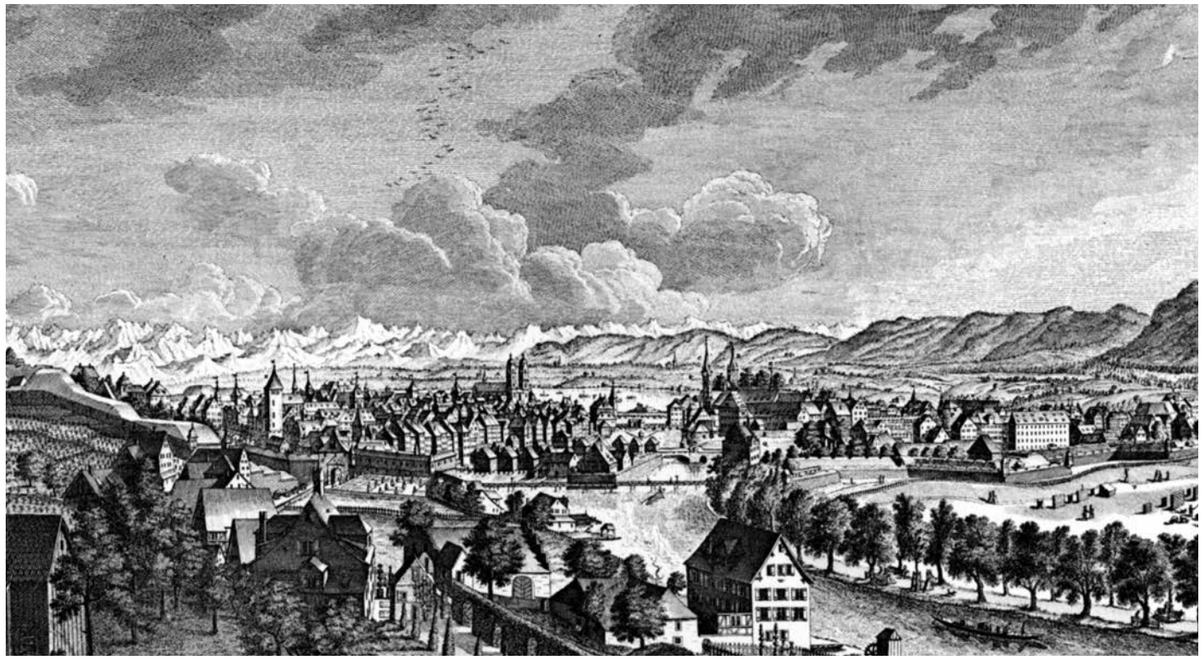
69



II.08
around 1500
altar panels from the twelve apostles chapel of the gross-münster by hans leu der ältere

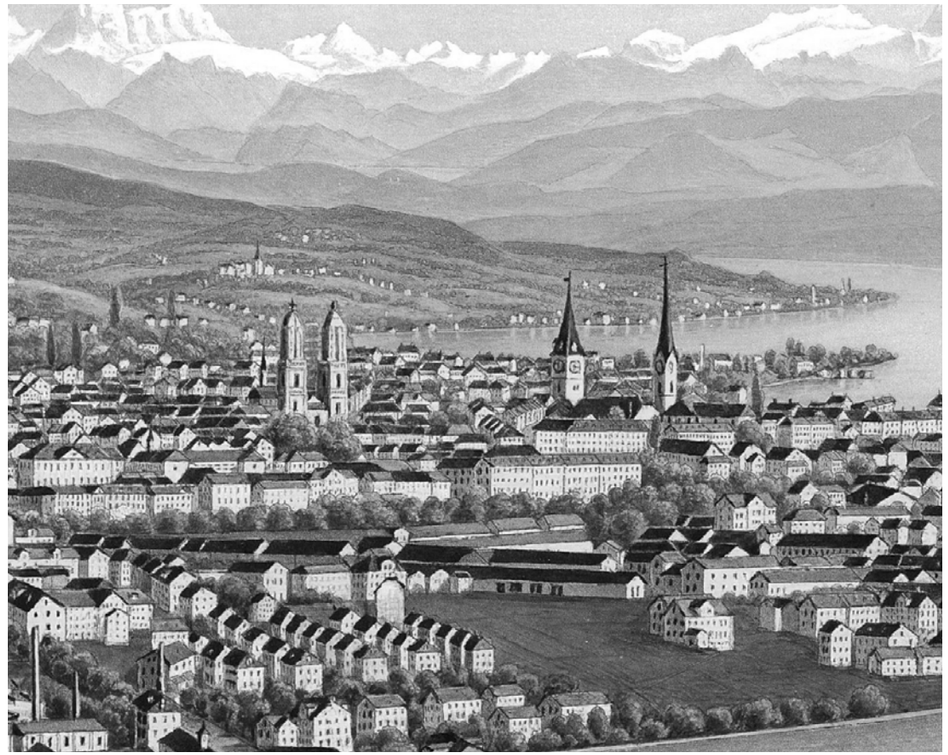


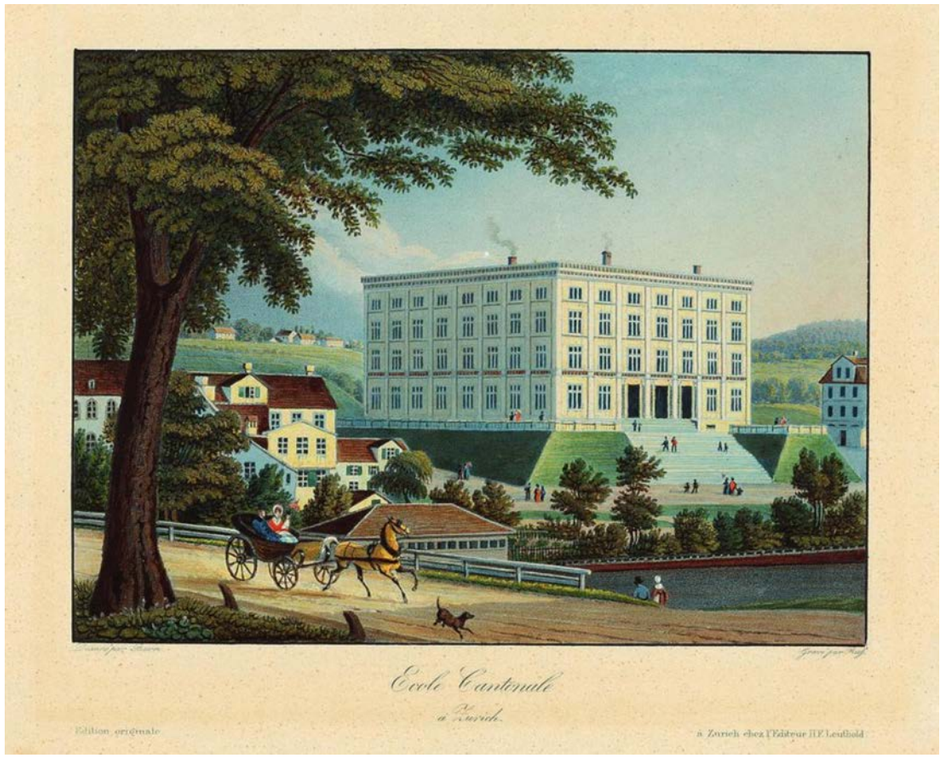
II.09
1576 murerplan
the medieval city since the 13th century



II.10
1781 zurich stampfenbach
rudolf holzhalb

II.11
1848 view over zurich
johann caspar uster, rudolf dickenmann





II.12
1839-42 zürich rämistrasse 59, ehem. kantonsschule
gustav albert wegmann

following the neoclassicist tradition of schinkels bauakademie in berlin



II.13
1896-1900 palais henneberg, emil schmid-kerez

pitched roof hidden behind a parapet wall, simulating the horizontal line







II.14
1990-99 wohnheim zürichberg

DECAPITATING THE ROOF
from the mid 19th century

During the second half of the 19th century, the city of Zurich grew immensly. Through industrialization and the first integration of neighbouring municipalities in 1893, the city almost doubled in size within 10 years. Between 1888-98, an additional 40% of the city were constructed and with it a new roof typology emerged.

The so called „Gründerzeitbauten“ were thriving for sun and air in the industrial city and soon the trimmed-hipped roofs dominated the cityscape. The new usable outdoor space of the „Dachzinnen“ was first thought as an extension of the living spaces but was soon also applied to public buildings.

Even though it is not how we predominately build today, this typology still strongly characterizes the cityscape and opened up completely new possibilities for the city life.

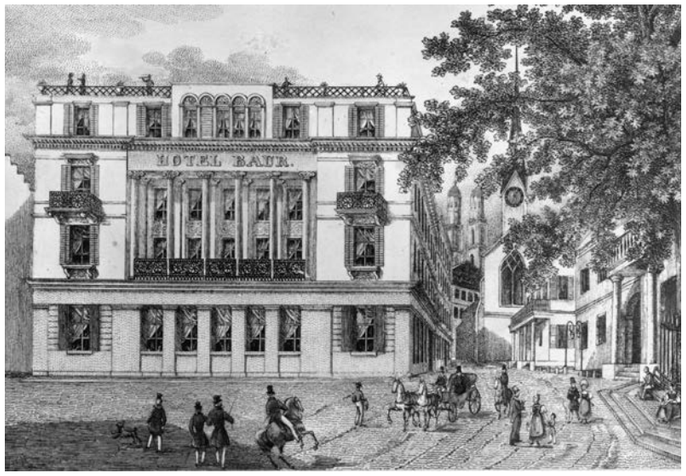
These terraces served a whole range of uses, such as photography studios, drying laundry, overview and orientation, spaces for dancing, used for representation through advertisement, sunbathing or watching the first Zeppelins and hot air balloons rise above the city.

The typology opened the path for the flat roof, which would completely change the cityscape just shortly after.



II.15
1835 hotel baur en ville, zürich

in neoclassicistic tradition, the pitched roof is hidden behind a parapet wall/balustrade, simulating a horizontal line



II.16
1835 hotel baur en ville, zürich



II.17
1883 poststrasse zürich

as one of the first in zurich, the building offers a roof terrace with a view over the surrounding city



II.18
1896-98 friedhof aussersihl, blick von dachzinne luther-strasse 20

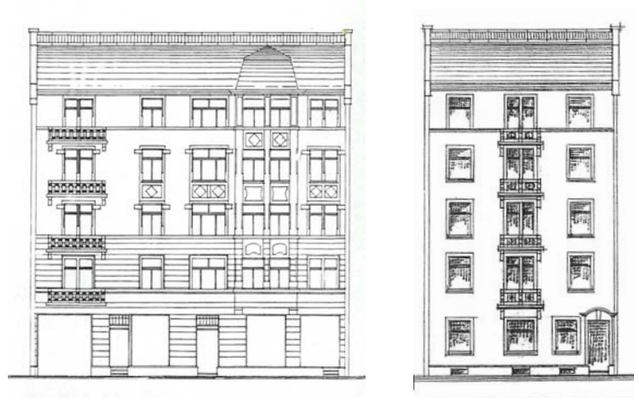


II.19
um 1900, gründerzeithäuser am stauffacher

during the construction boom of 1888-1898 most new buildings featured the typical zurich roof terraces, called `dachzinnen´

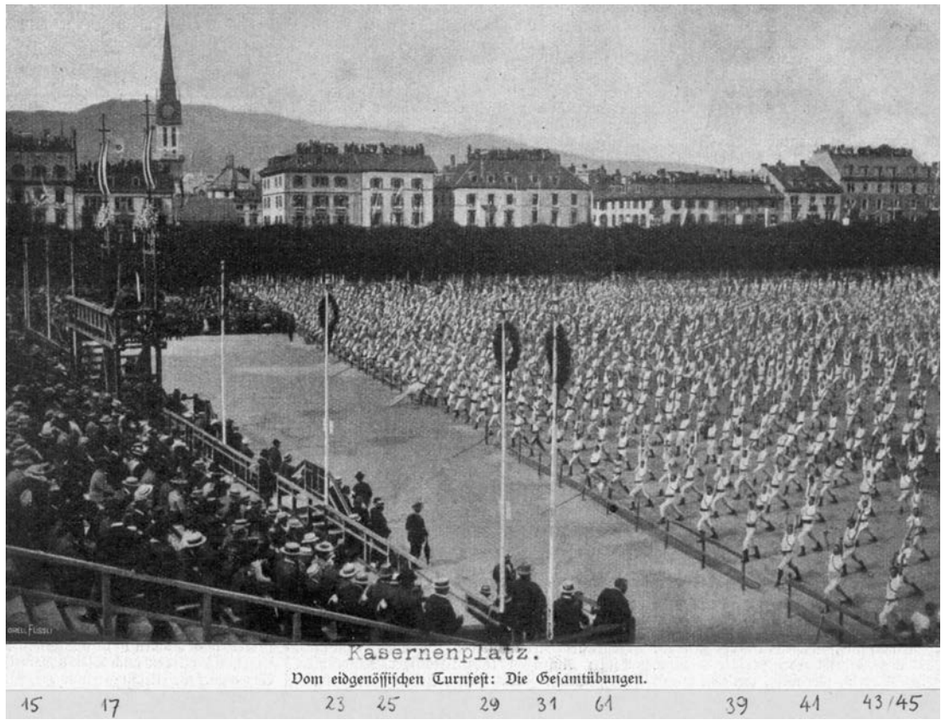


II.20
1900 hochstrasse werbung sternwarte



II.21
1898 fabrikstrasse 21-23
1910 heinrichstrasse 133-137





II.22
1903 eidgenössisches turnfest

the roof terraces as a tribune from which to watch the festivities



II.23
1886-1900 altstadt mit blick auf die eidgenössische technische hochschule

`Frage 4989: Geht es an, dass eine Mietspartei auf dem gemeinsamen Dachboden Kleider ausklopft und bürstet, während die andere eine nasse Wäsche dort hängen hat, auch gestärkte Herrenhemden und Vorhänge? Im Vertrage ist nur von der gemeinsamen Benützung des Bodenraumes gesagt. Es ist zwar noch eine kleine Dachzinne da, wo bei trockenem Wetter Wäsche gehängt werden und Kleider geklopft werden können. Bei Regenwetter ist aber kein separates Eckchen vorhanden. Wie richten sich erfahrene Hausfrauen in solchem Falle ein?´

- 1899 Schweizer Hausfrauenzeitung



II.24
1909 photoatelier
johannes meiner

between 1855 and 1915, there were more than 100 such studios in the city of zurich

`Mit wahrem Vergnügen stieg eine Tante nach der anderen die steile Treppe hinauf auf die Dachzinne, wo der neue Apparat aufgestellt war. Ihre Liebenswürdigkeit wurde so gross, dass sie bei 30° Celsius auf dem Blechboden stillsassen ohne den Sonnenstich oder die Migräne zu bekommen. (...)´

- 1875, Ein glücklicher Erbe, Reblausgesichte in brei bis vier Kapiteln



II.25
1911 photoatelier
bruno eduard schucht



II.26
1909 photoatelier
johannes meiner



Als ich ein kleiner Bub war, kannte man noch keine Flugzeuge. Wohl sprach man davon, aber die Leute, ja sogar viele Professoren sagten: Das ist verrückt, das ist unmöglich. Das Flugzeug ist ja schwerer als die Luft. Dann kam der Zeppelin nach Zürich. Ich erinnere mich sehr gut. Wir saßen gerade in der Schule. Es war ein schöner Sommertag und sehr heiß. Da schaute man lieber zum Fenster hinaus als an die Wandtafel. Plötzlich ein Geschrei: «de Zeppelin, de Zeppelin!» Ohne den Lehrer zu fragen, rannten wir alle ans Fenster. Richtig! Dort über dem Zürichberg stand eine kleine, weiße, silberglänzende Wolke, der Zeppelin. Ganz tief fuhr er über die Stadt, kreiste mehrmals um das Großmünster.
Alle Straßen, Plätze und Dachzinnen waren voll Menschen. Das war ein Jubel. Zum erstenmal war da ein lenkbares Flugschiff. Aber es war eben kein Flugzeug, sondern auch nur ein langer Ballon. Es hatte wohl Motoren und Propeller, aber es war wegen dem «Gas», womit es gefüllt war, immer noch leichter als Luft.

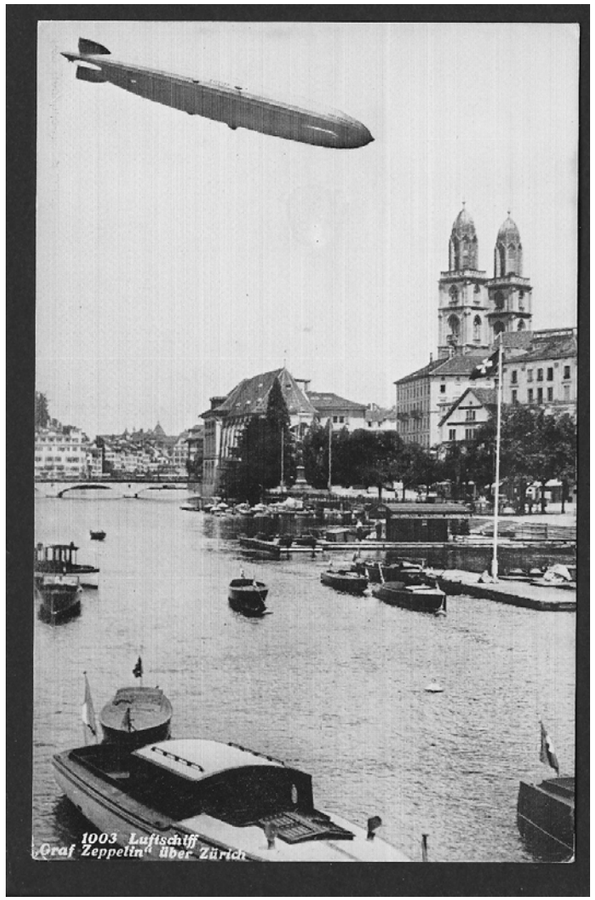
- Schweizerische Gehörlosen-Zeitung, Fliegen, 1946

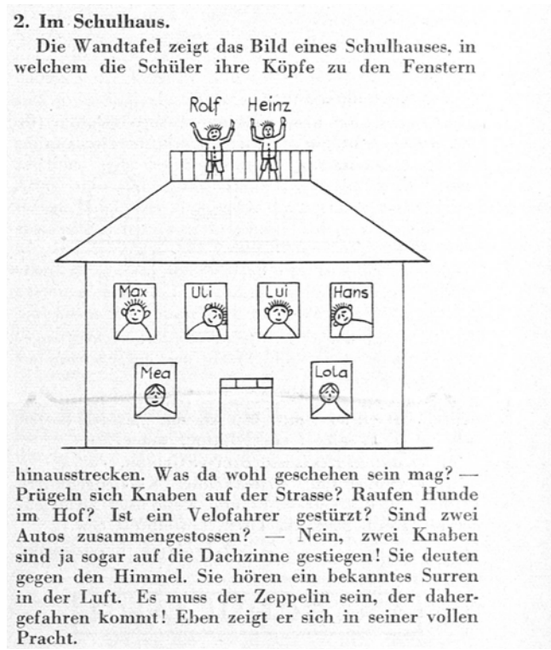
`Am 1. Juli 1908 uberflog erstmals ein Luftschiff die Stadt Zurich. Zur Erinnerung an dieses Ereignis wurde noch im gleichen Jahr eine Strasse nach dem Zeppelin benannt. Im Zürcher Stadthaus lief jedermann, vom Hauswart bis zum Stadtprasidenten, auf die Dachzinne. Nachdem männiglich den kühnen Zeppelinern mit Händen und Taschentüchern zugewinkt hatte (...)´

- Nebelspalter : das Humor- und Satire-Magazin, Was wollte der Grossfürst in der Parfümerie? 1990

II.27
1936 auszug schulbuch watching the zeppelin from the schools roof terrace

II.28
1908 graf zeppelin über zürich





2. Im Schulhaus.

Die Wandtafel zeigt das Bild eines Schulhauses, in welchem die Schüler ihre Köpfe zu den Fenstern

hinausstrecken. Was da wohl geschehen sein mag? — Prügeln sich Knaben auf der Strasse? Raufen Hunde im Hof? Ist ein Velofahrer gestürzt? Sind zwei Autos zusammengestossen? — Nein, zwei Knaben sind ja sogar auf die Dachzinne gestiegen! Sie deuten gegen den Himmel. Sie hören ein bekanntes Surren in der Luft. Es muss der Zeppelin sein, der dahergefahren kommt! Eben zeigt er sich in seiner vollen Pracht.



II.29
1933 altstadt zürich
krebsgasse 6



II.30
1947 altstadt zürich

II.31
1976 kaminfeger altstadt zürich



ALTSTADTSANIERUNG 1948

(...) die in den Sanierungskampagnen zerstörten Bauten und die damit aus dem Stadtbild getilgten Architekturformen verraten ebenso viel über die zeitgenössische Architekturauffassung, weil sie umgekehrt offenbar nicht zu deren Idealvorstellungen passten. Abstockungen bestehender Bauten und die Respektierung einheitlicher Traufhöhen für die Neubauten hatten zudem eine weitere Vereinheitlichung in der bis dahin sehr viel bewegteren Dachlandschaft zur Folge; dieselbe Tendenz wurde etwa mit dem Ersatz von Dachzinnen durch Schrägdächer gefördert. (p.152)

Als Resultat der Sanierungskampagnen verschwanden damit spätklassizistische und historistische Architektur-formen- wie Gesimsprofile, Fensterverdachungen, Putzquaderungen oder die axial bezogene Einzelbefensterung in klassizistischer Tradition- tendenziell aus dem Stadtbild; dasselbe gilt für flache oder flach geneigte Dächer und Dachzinnen, wie sie im 19.Jahrhundert vielfach erstellt worden waren. Gerade diese baulichen Eingriffe waren sicherlich vorrangig ästhetisch motiviert, dürften die im 19.Jahrhundert entstandenen Häuser doch noch in vergleichsweise gutem baulichem Zustand gewesen sein. (p.153)



Abb. 73: Viktor Nussbaumer, Theodor E. Laubi, Sanierungsprojekt für die Altstadt, Block 19 (1948). Fassaden an der Schifflände, Bestand (oben) und Projekt (unten).

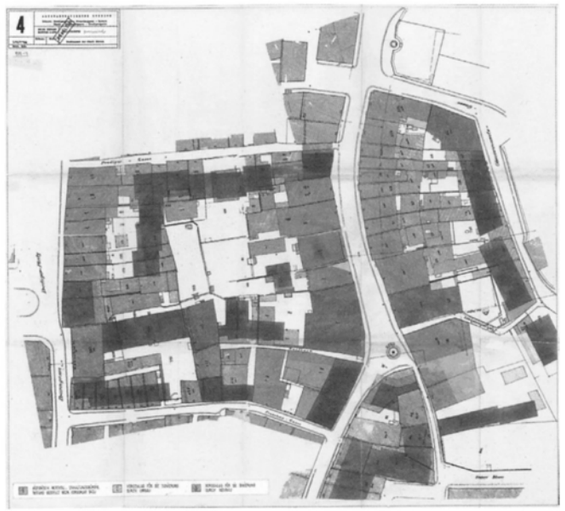


Abb. 74: Conrad D. Furrer, Alfred Gradmann, Georges-Pierre Dubois und Jakob Eschenmoser, Sanierungsprojekt für die Altstadt, Block 4 (1945). Übersichtsplan Bestand und vorgeschlagene Neubebauung.

II.32
project „altstadtsanierung“,
albert heinrich steiner, 1946

proposal to remove roof
`dachzinnen´



Abb. 86: Viktor Nussbaumer, Theodor E. Laubi, Sanierungsprojekt für die Altstadt, Block 19 (1948). Fassaden Geigergasse, Bestand (oben) und Projekt (unten).

II.33
project „altstadtsanierung“,
albert heinrich steiner, 1946

proposal to remove chimneys

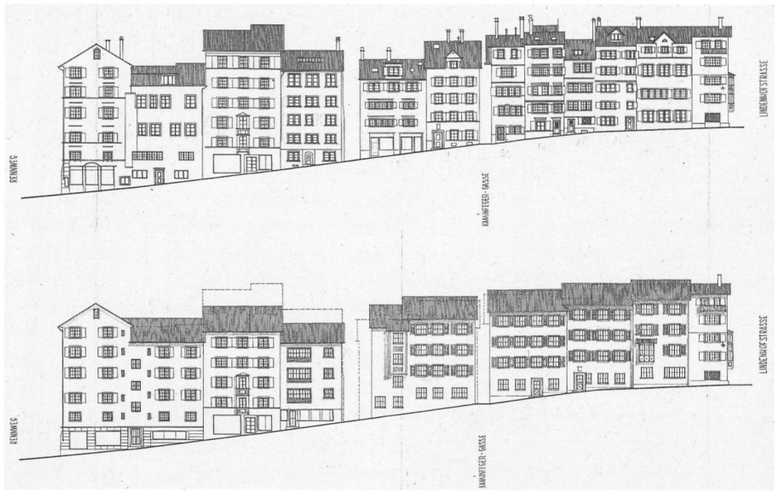


Abb. 87: Viktor Nussbaumer, Hans Hubacher, Sanierungsprojekt für die Altstadt, Block 22 (1951). Fassaden an der Fortunagasse, Bestand (oben) und Projekt (unten).



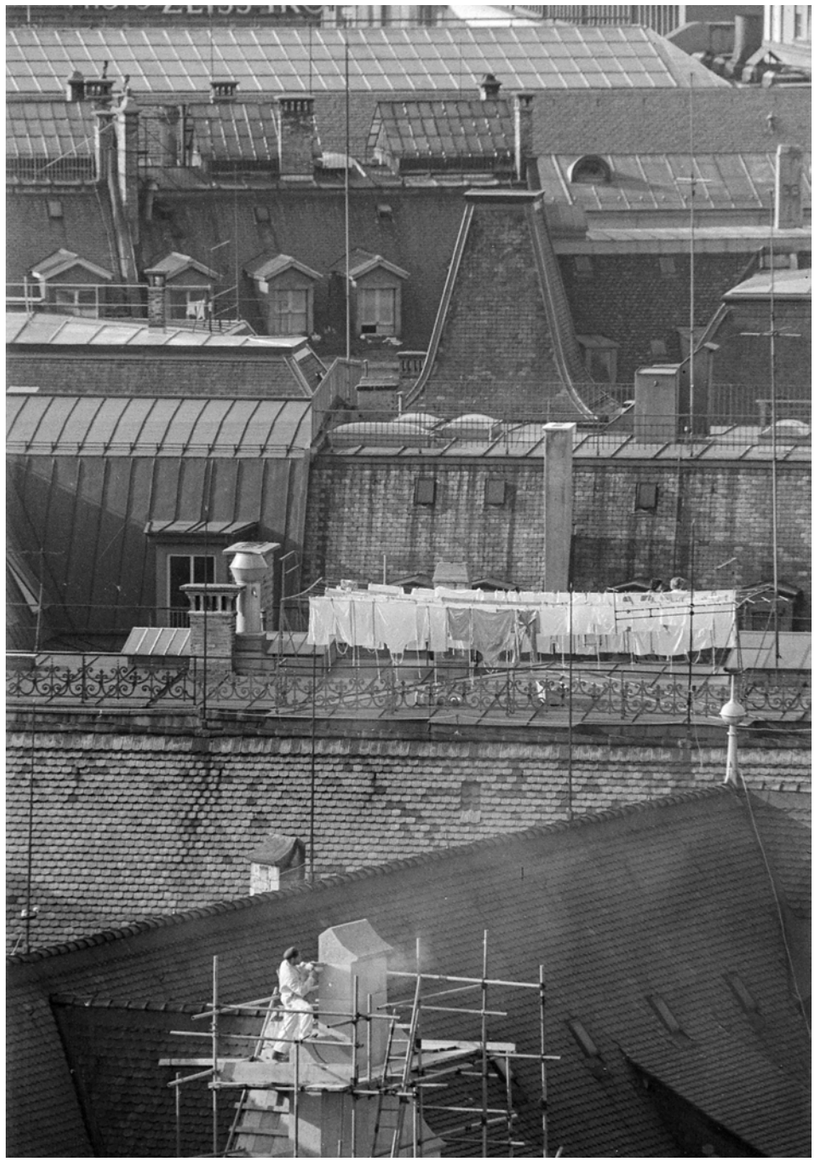
II.34
1960 ankengasse

II.35
1960 freigutstrasse



II.36
1960 bahnhofstrasse





II.37
1960 stadthausquai

HISTORICAL USES Since the late 19th century, the use of roof spaces is strongly embedded in Zurich´s culture. By studying historical magazines and images a lot of different uses could be identified

1875 Photographie
(bei 30°C auf dem Blech der Dachzinne)

1888 Schweizer Frauenzeitung: bei Kopfweh frische Luft auf der Dachzinne, Gesundheitsaspekt

1891 Ballonaufstieg 1891 in Zürich,
viele Menschen auf den Dachzinnen

1899 Hausfrauen Zeitung - Wäsche ausklopfen und aufhängen bei schönem Wetter

1899 Aublick über Zürich und die Alpen

1908 am 01.Juli 1908 überflog erstmals ein Luftschiff Zürich (Artikel von 1990), vom Hauswart bis Stadtpräsidenten waren alle auf der Dachzinne

1910 Fensterbeobachtungen, Brotkrummen werden auf einer Dachzinne für die Spatzen verteilt

1917 29 Dachzinnen für Vermessungspunkte

1931 Werbung Siedlung Neubühl, Gassen der Altstadt lassen keinen Sonnenblick zu, die Kinder klettern auf der Dachzinne um sich zu wärmen

1932 Waldmannsburg bei Zürich, Dachzinne mit Tanzfläche aus Beton

1933 Repräsentation, skulpturengeschmückte Dachzinnen des Physikgebäudes der ETH

1936 Schulbuch zeigt zwei Knaben auf der Dachzinne beim Zeppelin beobachten

1937 „Auf der hohen, heißen Dachzinne saßen wir oft in völliger Zufriedenheit.“

1946 Fliegen - Zeppelin in Zürich. Alle Strassen und Dachzinnen waren voller Menschen

1947 Dachzinne als gemeinschaftlicher Ort! man holt bei Regen die Wäsche der Nachbarn rein

1949 unbenutzte Dachzinne zum Sonnenbaden

1950 Tagebuch Max Frisch, mit einer Zigarre auf der Dachzinne, unter Wäschestangen durchbücken, Ausblick

1951 Artikel von 2012 über die Altstandtsanierung, Rückbau der Dachzinnen und Kamine, „Dachzinnen wurden im 19.Jh. viel erstellt“

1957 Horizont und Panorama, 360° Rundsicht von einer Dachzinne, Schulklasse analysiert Horizont

1970 Stromschlag nach Installation einer Dachantenne durch einen Maler

1976 Bild von Kaminfeger auf dem Dach

1984 Gasmotorwärmepumpe (ADA) auf horizontaler Fläche der Dachzinne

1997 Hochparterre, Werbung für Sonnenliegen zum Sonnen auf den Dachzinnen

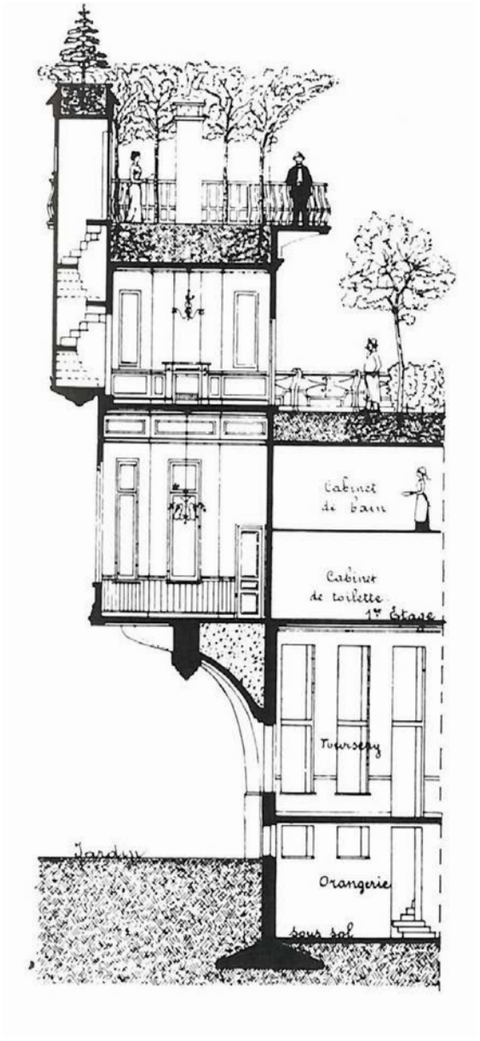
2008 neues Dachzinnenprojekt der PWG

2019 neue Maisonettewohnungen mit privaten Dachzinnen = Tendenz Privatisierung des Daches

2019 Dachzinne als Werbeträger für Photographie

2054 Artikel von 1953
„(...) mit Nylonit gepanzerte Landeplatte für die Taxihelikopter, und die Postsäcke werden hier durch einen neben dem Kehricht- und Wäscheschacht liegenden Postkanal direkt vom Postflieger eingeworfen, gelangen automatisch zum Concierge, ^welcher die Post per Hauslift verteilt.“

> the roof as a common space,
from which the public can be observed
> exposed to the sun/warmth
> space where everyone has access equally
> mostly domestic space used/managed by women
and children
> roof for represenational purposes, advertisement



II.38
1904 francois hennebique, his own house in bourg-la-reine

THE FLAT ROOF
beginning of the 20th century

In the beginning of the 20th century, advancing material properties and technologies like holzcement, dachpappe, asphalt, reinforced concrete and steel resulted in Zurichs early experiments with flat roofs on a larger scale.
First, industrial buildings were constructed. The Rote Fabrik and the Escher Wyss Areal profit from newly available large building spans.

In the 1920s and 30s, the Neue Bauen movement from Germany began influencing the swiss building culture. The first applications with housing were newly constructed „Siedlungen“ in the outskirts of the city. Neubühl as the most prominent example promotes the idea of „befreites wohnen“ with air, light and sun as central ideas.
With this new orientation, the roof becomes an outdoor space, its terraces are seen as an extension of the living area.

Importantly, the adoption of the flat roof also meant a new unprecedent freedom to design. Architects were no longer constrained by the inherited forms of pitched roofs; the focus shifted towards efficiency in volume and flexibility in floor plan, shaping buildings according to the needs and aspirations of contemporary society.

By the 1930s, also many representational buildings commit to the expression of the flat roof. The Kispi, the Neue Börse and the Museum für Gestaltung are examples of this.

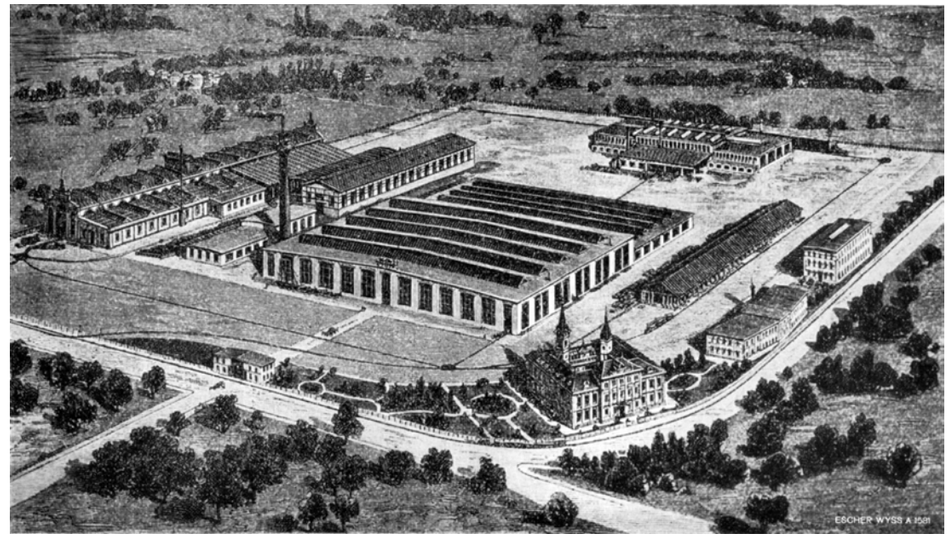


II.39
1892-96 rote fabrik
zürich wollishofen

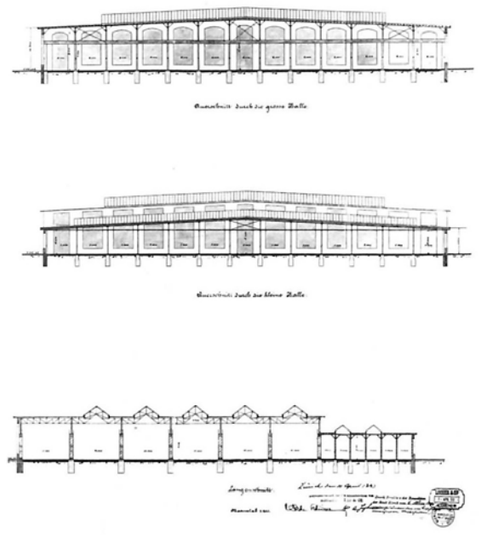
architect carl arnold séquin for
the silk company henneberg



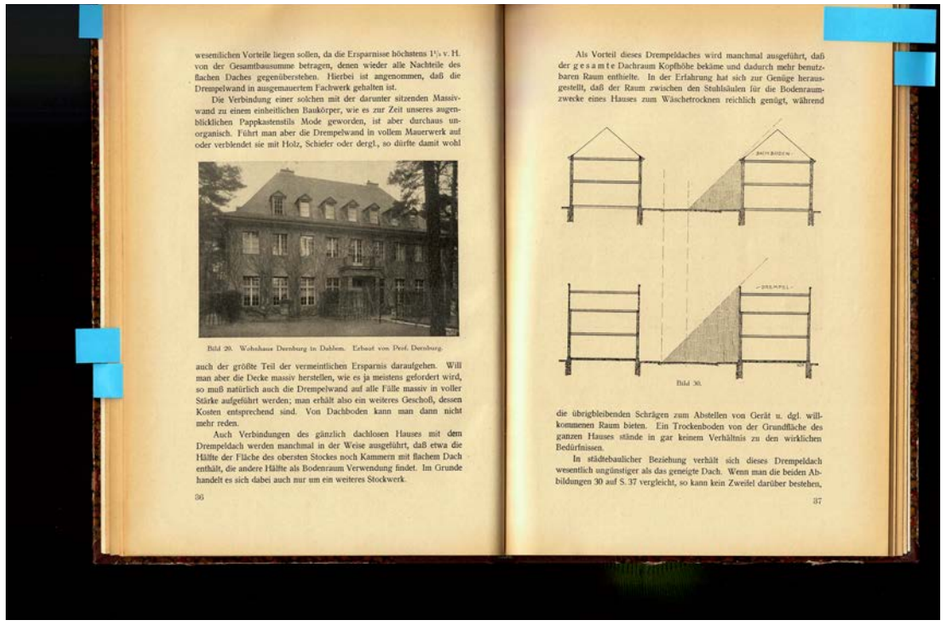
II.40
1892 rote fabrik
seidenwebereien, horgen



II.41
1903 escher wyss areal, ausser-
sihl hard



II.42
1892-94 escher wyss
maschinenfabrik ag
baufirma locher & cie


wesentlichen Vorteile liegen sollen, da die Ersparnisse höchstens 1½ v. H. von der Gesamtbausumme betragen, denen wieder alle Nachteile des flachen Daches gegenüberstehen. Hierbei ist angenommen, daß die Drempelwand in ausgemauertem Fachwerk gehalten ist.

Die Verbindung einer solchen mit der darunter sitzenden Massivwand zu einem einheitlichen Baukörper, wie es zur Zeit unseres augenblicklichen Pappkastenstils Mode geworden, ist aber durchaus unorganisch. Führt man aber die Drempelwand in vollem Mauerwerk auf oder verblendet sie mit Holz, Schiefer oder dergl., so dürfte damit wohl

Bild 29. Wohnhaus Dernburg in Dahlem. Erbaut von Prof. Dernburg.

auch der größte Teil der vermeintlichen Ersparnis daraufgehen. Will man aber die Decke massiv herstellen, wie es ja meistens gefordert wird, so muß natürlich auch die Drempelwand auf alle Fälle massiv in voller Stärke aufgeführt werden; man erhält also ein weiteres Geschoß, dessen Kosten entsprechend sind. Von Dachboden kann man dann nicht mehr reden.

Auch Verbindungen des gänzlich dachlosen Hauses mit dem Drempeldach werden manchmal in der Weise ausgeführt, daß etwa die Hälfte der Fläche des obersten Stockes noch Kammern mit flachem Dach enthält, die andere Hälfte als Bodenraum Verwendung findet. Im Grunde handelt es sich dabei auch nur um ein weiteres Stockwerk.

86

Als Vorteil dieses Drempeldaches wird manchmal ausgeführt, daß der gesamte Dachraum Kopfhöhe bekäme und dadurch mehr benutzbaren Raum enthielte. In der Erfahrung hat sich zur Genüge herausgestellt, daß der Raum zwischen den Stahlsäulen für die Bodenraumzwecke eines Hauses zum Wäschetrocknen reichlich genügt, während

Bild 30.

die übrigbleibenden Schrägen zum Abstellen von Gerät u. dgl. willkommenen Raum bieten. Ein Trockenboden von der Grundfläche des ganzen Hauses stände in gar keinem Verhältnis zu den wirklichen Bedürfnissen.

In städtebaulicher Beziehung verhält sich dieses Drempeldach wesentlich ungünstiger als das geneigte Dach. Wenn man die beiden Abbildungen 30 auf S. 37 vergleicht, so kann kein Zweifel darüber bestehen,

87

II.43
1927 paul schultze-naumburg
flaches oder geneigtes dach

publication and survey as a reply to walter gropius survey „das flache dach“



II.44
1926-28 berlin
zehlendorfer dächerstreit

„Next comes a justification of flat roofs on functional grounds, supported by a lengthy piece of autobiography about the disastrous behaviour of the pitched roof on his carly cinema at Chaux-de-Fonds, where the snow melted from internal heating on the high parts of the roof, and the water ran down until it encountered the unthawed snow at the eaves plate, where-upon it ran back down the inside of the walls. This he claims, is avoided on a flat roof laid to fall toward the warmed centre, as in the villa at Chaux, and
„If this is the only solution to extreme cases, we can be sure it is the solution- type for all cases.“
—a most remarkable declaration from one who had earlier refused to argue from le cas d‘espèce.“

In any case, the main argument in favour of flat roofs is aesthetic, and is developed in the latter part of the essay, which is largely a transcript of his lecture at the Sorbonne.

What I wish to show, is that there is an established hierarchy of different states of minds, and that certain of them are, perhaps, superior to others. This, at all events, I allow myself to aflirm since it is for me a certainty: mind manifests itself through geometry. From this I deduce that when geometry is all-powerful, mind has made progress over preceding periods of barbarism... arrived at a period of intellectual clarity such as the Renaissance, it arrives also at the all-powerful horizontal, the horizontal that closes the composition at its crown.

or, put more bluntly, a parapet concealed the pitched roof behind.

Now, we dispose today of the means to pursue this magnificent ascent towards geometry, thanks to the invention of reinforced concrete, which offers us the most pure mechanism for orthogonal composition.

and the employment of such pure mechanisms carries within it, he asserts, perfection.

-Reyner Banham on Le Corbusier
in: Theory and Design in the first machine age,
1960

`(...) he set out the reasons for creating, in place of old-style roofs, garden terraces which „in cities are often the only (gardens), since land is expensive, and plots are small and often completely covered with buildings. A few terraces have already been developed, in France in particular, in which plants grow no less readily than on the ground, where one has the benefit of fresher air, where one may take lunch or dinner, sleep, sunbathe and engage in openair physical exercise, beyond the view of neighbours; where one may also, if the house is large and the budget is generous, have a swimming pool or tennis court.
It is a secret garden, a different, unexpected type of garden, rich with all the flavour of its novelty (....)“, which offered „the ability intimately to combine the life of the building with that of the garden, and through it with the natural environment.“´

- Lurçat, André. Terrasses et jardins. Paris: Ed. d’art Charles Moreau, 1929.

But beyond this relationship with nature and landscape, Lurçat was proposing a new order for roofs: „at the very moment when the aeroplane is enabling us to view our cities from a fresh perspective.“

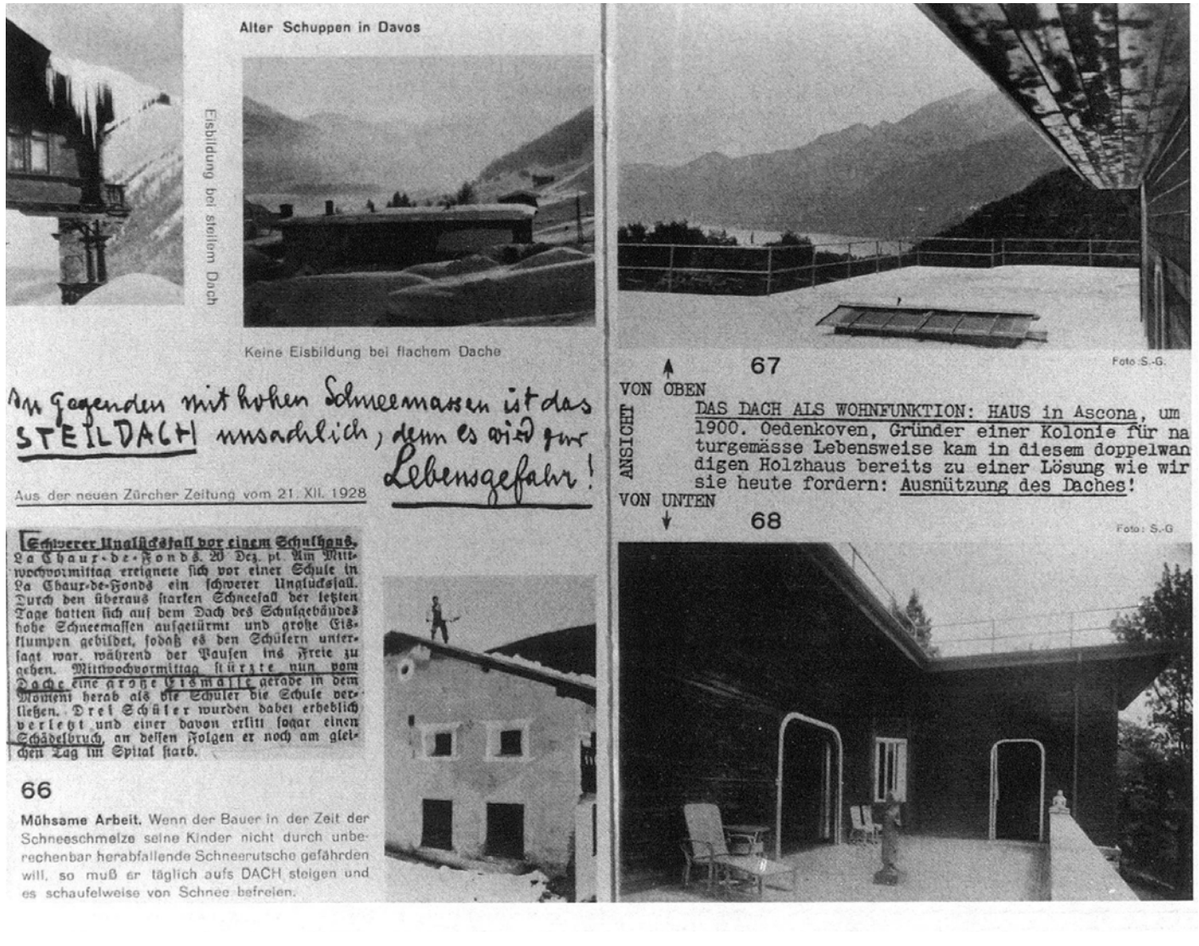
-Roland Matthu in: The Sky Front, 1998 (p.279)







II.45
1939 schweizerische landesausstellung



II.46
1929 befreites wohnen, siegfried giedion



II.47
1931 zürcher illustrierte

aus der festung in die siedlung

`kein sonnenstrahl fällt in die dunkle gasse der altstadt. da stehen drei kinder sich selbst überlassen und frösteln. vater und mutter sind dem verdienst nachgegangen. ueber dem estrich auf der dachzinne scheint einzig die sonne. da steigen die kinder durch die dunklen gänge die steilen treppen hinauf auf die dachzinne, um sich zu wärmen - aber mit schlechtem gewissen, denn die mutter hat ihnen verboten, allein auf die zinne zu gehen.´

II.48
1930-32 werkbundsiedlung neubühl

paul artaria, max ernst haefeli, carl hubacher, werner max moser, emil roth, hans schmidt, rudolf steiger

`licht, luft und sonne´





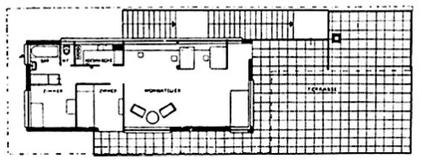


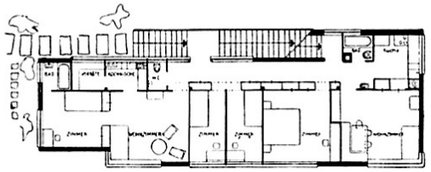
II.49
1931 albisstrasse 153-161

flachdach siedlung, charlotte enggist









II.50
1933 villa schlehstud, meilen
hans fischli



peter fischli: ` (...) für das haus in meilen musste man die technologie erst erfinden und verwendete dachpappe. was man nicht wusste: ein flachdach braucht eine leichte neigung und einen abfluss, sodass das wasser nicht steht. eine kindheitserinnerung ist, dass sich einmal im jahr aufgrund der feuchtigkeit ein gelber ring an der decke abzeichnete. darüber durfte man nicht sprechen. das war tabu. der elefant im raum. der maler überstrich die decke, man hat das problem wegretuschiert. meilen hatte mein vater gewählt, weil das bauland so billig war. das war noch nicht die wohlhabende goldküste, unsere nachbarn waren alle bauern. da war so ein haus eine provokation. bauen konnte er es, weil es damals noch keinen zonenplan gab. das kam erst in den 50ern, und in vielen gemeinden galt ein flachdachhaus als störung des dorfbildes.´

- https://www.hochparterre.ch/nachrichten/buchrezensionen/das-flachdach-und-die-zuercher-konkreten#



II.51
1935 kinderspital zürich



II.52
1930 neue börse
am bleicherweg

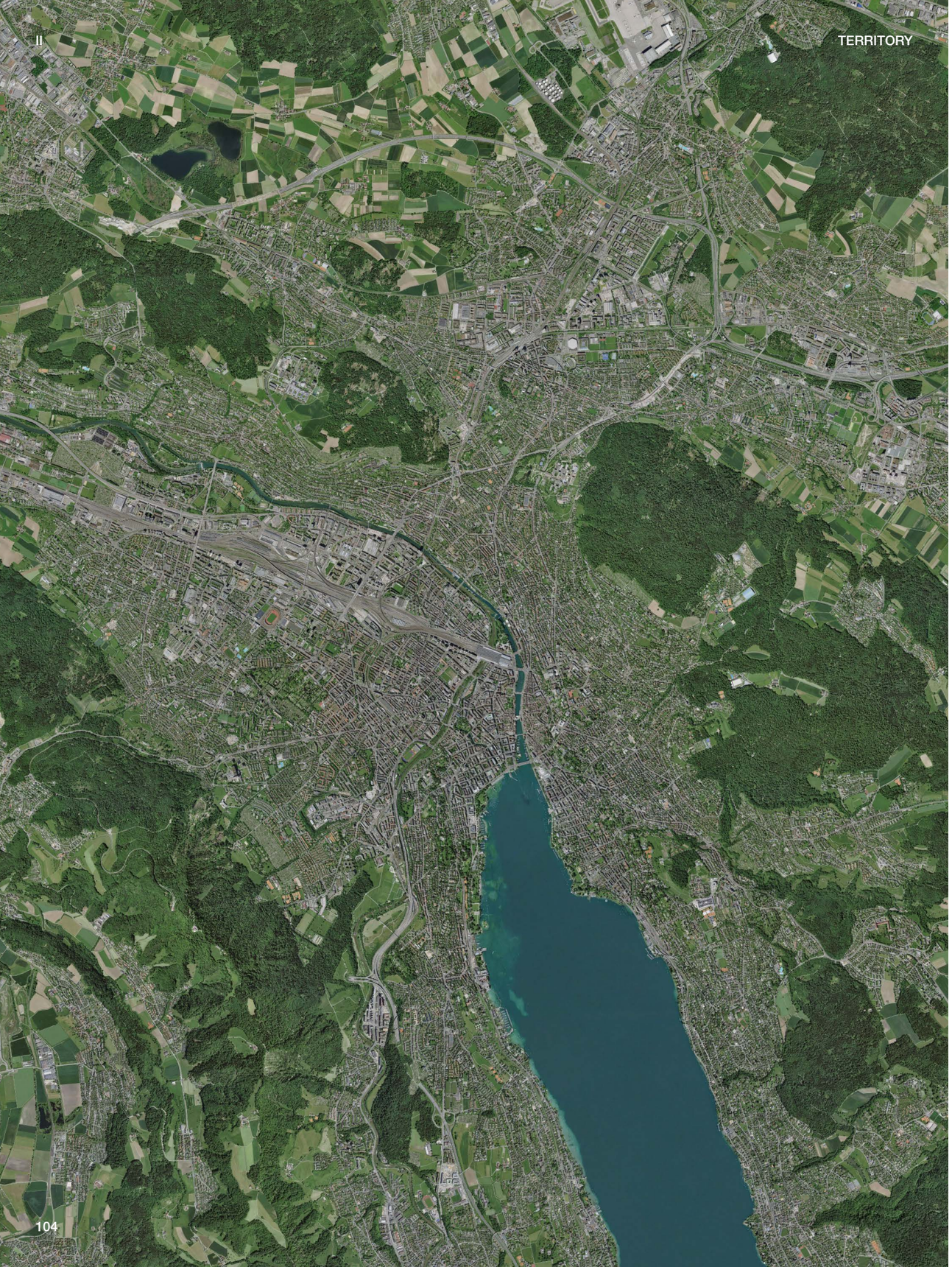
`neues bauen´ in zürich



II.53
1933 museum für gestaltung
zürich, ausstellungsstrasse

adolf steger und karl egender





II.54
zurich
aerial view

THE FLAT ROOF
since the 1950s

While the Heimatschutzbewegung and others opposed this development in the 1920s, the flat roofs still became well established in Switzerland from the 1950s onwards and were used across all types of building uses.

This shift was driven by clear economic logic. The flat roof proved to be a practical solution: less total surface area meant reduced building volume for the same usable space, translating directly into material and energy savings and therefore lower costs.

Consequently, the fundamental idea of offering a Technical equipment and safety regulations, along with economic considerations, rendered most of the roof spaces inaccessible

Today, flat roofs are a defining feature of Zurich's cityscape and around 48% of Zurich's buildings have flat roofs (5.4 km2).

Flat roofs The development of modern technology has now removed most of the earlier objections to the use of flat roofs, whatever the climate may be. The movement toward an increasing use of this type arose at the very beginning of the nineteenth century, when many post-Colonial and Classic Revival houses had flat roofs of metal. That movement was accelerated by the growing economic pressure for the greatest possible cubic content of building per dollar spent; obviously with a flat roof there were no waste attic spaces. By the middle of the century the flat roof had become practically universal in all urban construction, whether for domestic or for industrial and commercial purposes. Moreover, because flat roofs were not exposed to the view of the passer-by, it was possible to use cheap and extremely unsightly materials, provided they were waterproof. The result was a flood of inventions and developments of all kinds of roofing material based on paper, felt, pitch, rubber, or tar. (p.580)

- Talbot Hamlin, Forms and Functions of Twentieth-Century Architecture, 1952



II.55
zurich roofs
aerial view

11km²

surface area

49 002

buildings in total



II.56
zurich flat roofs
aerial view

48,8% flat roofs

12 697 buildings in total

5.4km² surface area

425m² area per roof

51,2% pitched roofs

36 305 buildings in total

5.6km² surface area

156m2 area per roof



II.57
zurich flat roofs
(excl. housing)
aerial view

48,1% housing

9 221 buildings in total

2.6km² surface area

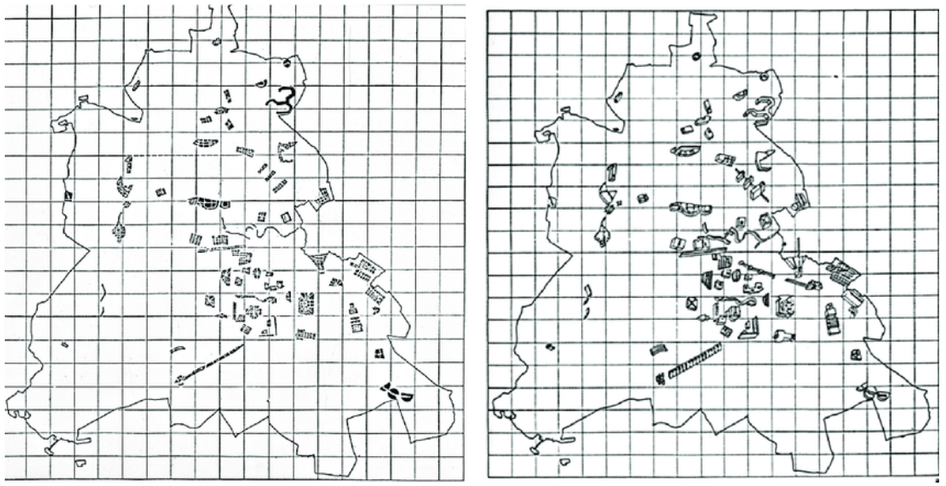
282m² area per roof

51,9% other uses (administration, industry, commerce, ...)

3 476 buildings in total

2.8km² surface area

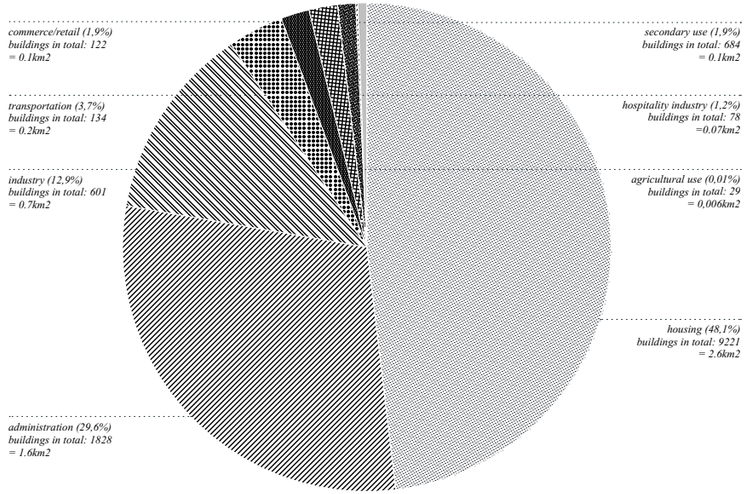
806m² area per roof



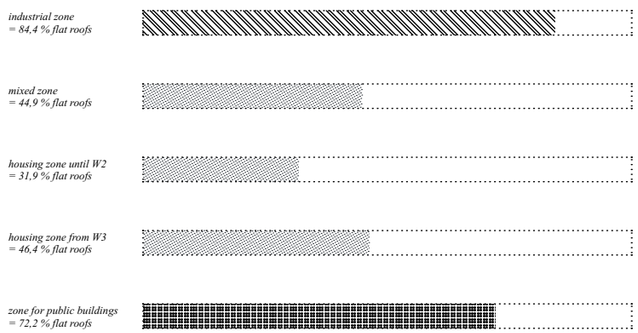
II.58
berlin as a green archipelago
o.m. ungers

fragmented city

flat roofs
by building use



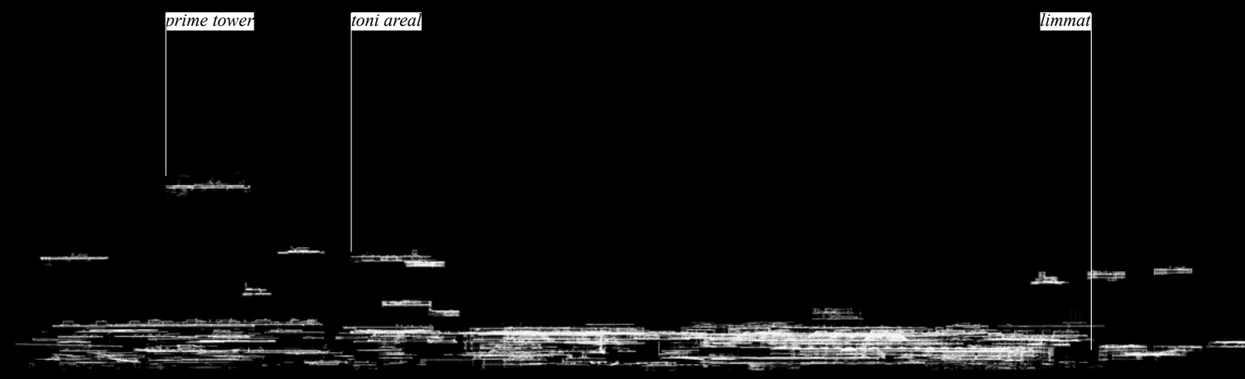
flat roofs
by building zone



II.59
point cloud section of all flat roofs in zurich, industriequartier

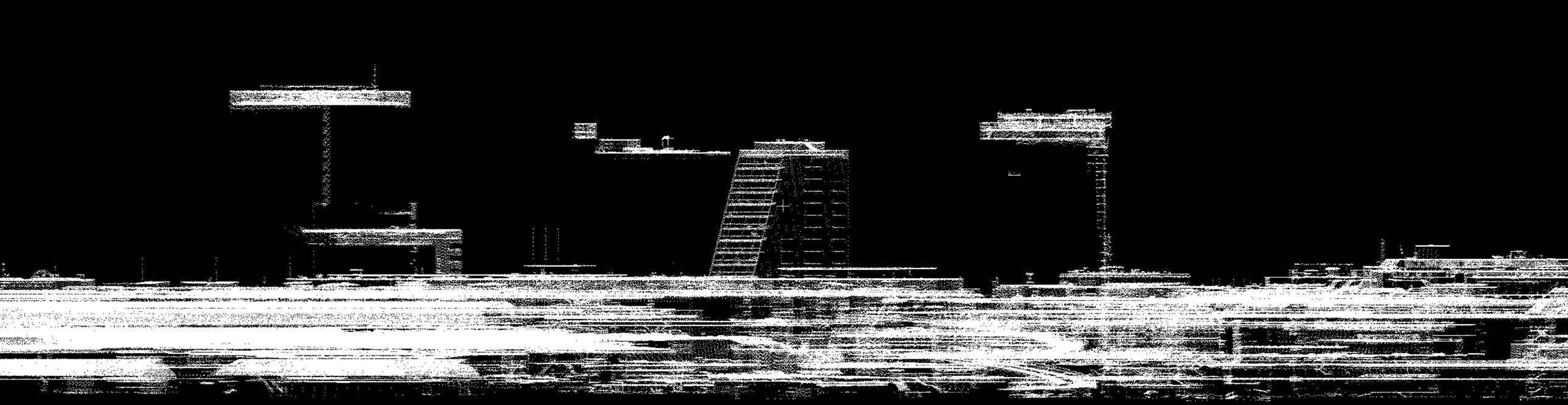
the new densities are also visible in section





II.60
point cloud section of all flat roofs in zurich, industriequartier

the new densities are also visible in section



III

PLATFORM

`Zurich building regulations are largely based on what has already been built historically. The chimneys and roof cornices of the old town are nowadays used to legitimize the infrastructural roofs with their ventilation systems, antennas, and other technical structures disrupting the roof. ´

- Hannes Reichel, Chair of Architecture and Building Process ETHZ

On the scale of the PLATFORM, the focus lays on the regulatory conditions.

III.I Norms and Regulations

Norms and regulations act as „design drivers", shaping the whole roof territory by defining rules for the individual platforms.

Although roof typologies have changed completely over the past 100 years, building regulations still follow the historical 45° pitch of the steep roof. This angle aims to preserve the incidence of light in the street space, but as flat roofs have become more common and economic pressures have increased, these regulations have led to the development of attic floors and fragmented roofscapes, often further cluttered by additional layers of infrastructural installations.

In terms of building regulations, the infrastructural roofs were initially justified by Zurich's existing roofscape. „Dachzinnen" and chimneys have always characterised the cityscape and the new technology and machines are seen as a „progressive" variation. Since „chimneys, solar energy systems and technically conditioned roof structures" are considered an exception from the building law in 1995 (§292 PBG), the roof territory changed completely. This carte blanche eliminated the need for technical rooms on the attic floor, a switch so significant that infrastructural roofs can easily be classified as built before or after 1995.

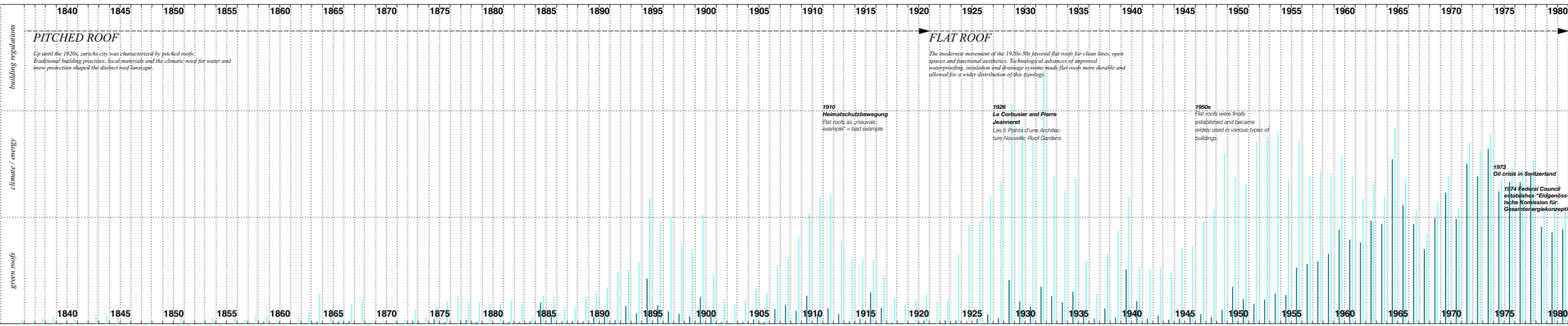
As an appendix of the building, technical systems on top of our roofs are permitted to exceed the highest point of the structure and are only restrained in dimension by `what is functionally necessary´. §292 PBG is described as an aesthetic norm, aiming to ensure that the roof and roof structures appear as a harmonious whole, keeping the city's roofscape „calm", paradoxically the exception through the half-sentence is doing the exact opposite.

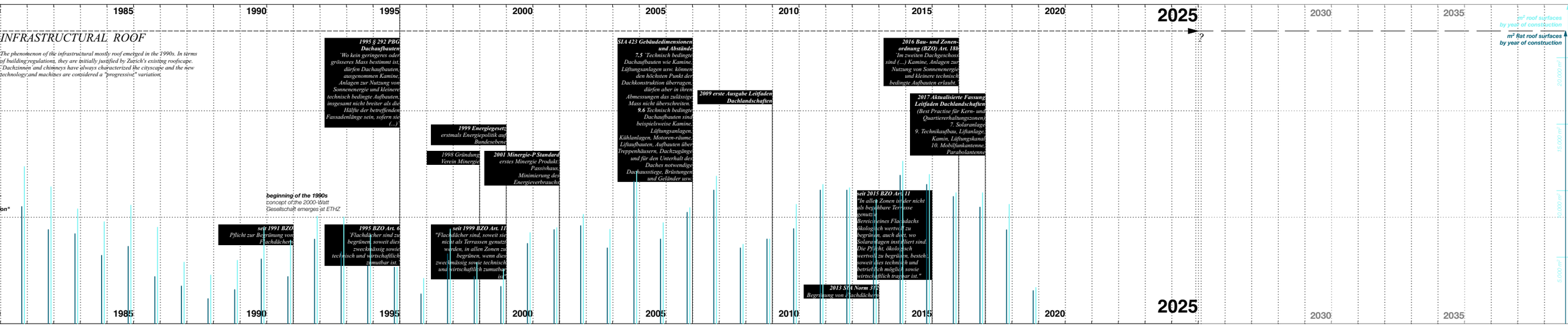
Having technical systems as the „crowning features" of our designs, represents their current value for society.

III.II Surface

The effort to build a flat roof is extremely high. Besides the technical challenges and the danger of leakage, frequency and intensity of maintenance make the flat roof very time-consuming and costly, especially if calculated for the entire life-span of a building.

Since the 1991 building zone regulations, it is mandatory to build green roofs in Zurich. While intended for ecological compensation, in reality most roofs of existing buildings remain gravelled - existing structures and economic factors limit the options for ecological upgrades. This is especially the case with the large volume of flat-roofed buildings from the 1970s and 80s, which will soon reach their next renovation cycle. When flat roofs are being renovated or newly constructed, green roofs are distinguished between intensive and extensive systems. Intensive systems are rare but provide functional ecosystems, benefitting biodiversity and climate, while extensive green roofs often primarily serve the technological purpose of absorbing rainfall and offering thermal insulation.


1840 1845 1850 1855 1860 1865 1870 1875 1880 1885 1890 1895 1900 1905 1910 1915 1920 1925 1930 1935 1940 1945 1950 1955 1960 1965 1970 1975 1980
building regulations
climate / energy
green roofs
PITCHED ROOF
Up until the 1920s, zurichs city was characterized by pitched roofs. Traditional building practises, local materials and the climatic need for water and snow protection shaped the distinct roof landscape.
FLAT ROOF
The modernist movement of the 1920s-50s favored flat roofs for clean lines, open spaces and functional aesthetics. Technological advances of improved waterproofing, insulation and drainage systems made flat roofs more durable and allowed for a wider distribution of this typology.
1910
Heimatschutzbewegung
Flat roofs as „mauvais; example" = bad example
1926
Le Corbusier and Pierre Jeanneret
Les 5 Points d'une Architacture: Nouvelle; Roof Gardens
1950s
Flat roofs were finally established and became widely used in various types of buildings.
1973
Oil crisis in Switzerland
1974 Federal Council establishes "Eidgenössische Kommission für Gesamtenergiekonzepti

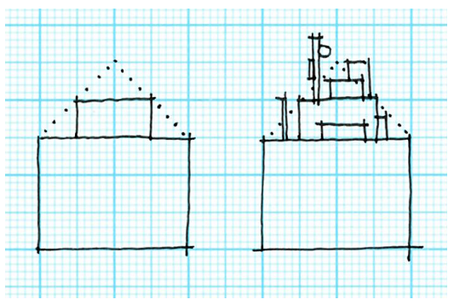


1995 Planungs- und Baugesetz, PBG
Kanton Zürich

§292 Dachaufbauten

Wo kein geringeres oder grösseres Mass bestimmt ist, dürfen Dachaufbauten, ausgenommen Kamine, Anlagen zur Nutzung von Sonnenenergie und kleinere technisch bedingte Aufbauten, insgesamt nicht breiter als die Hälfte der betreffenden Fassadenlänge sein, sofern sie

a. bei Schrägdächern über die tatsächliche Dachebene hinausragen
b. bei Flachdächern das vorgeschriebene Mass der Rückversetzungen unterschreiten



Entscheid Zürich Verwaltungsgericht 2000

`Eine gewöhnliche Mobilfunk-Basisstation ist in einer Wohnzone zonenkonform. Sie ist nicht an die Vorschriften betreffend Gebäude- und Firsthöhe gebunden, sondern kann als Dachaufbaute gemäss §292 PBG bewilligt werden.´

Entscheid Zürich Verwaltungsgericht 2004

`Nachträgliche Bauverweigerung für einen Dachausstieg; Befehl zur Beseitigung. Die umstrittene Dachaufbaute - ein eingehauster Ausstieg auf eine Dachterrasse - ist nicht als kleinere technisch bedingte Aufbaute im Sinn von Art. 24 d Abs. 3 BZO der Stadt Zürich zu qualifizieren, weshalb deren Errichtung nach Art. 24d Abs. 2 BZO im zweiten Dachgeschoss unzulässig ist.“

Entscheid Zürich Verwaltungsgericht 2015

`Der Begriff „Gesamthöhe“ ist kantonal definiert. Kantonalrechtlich auszulegen ist daher auch eine kommunale Bestimmung, wonach „die massgebenden Gebäudeteile für die Gesamthöhe“ eine bestimmte Höhenkote nicht überschreiten dürfen. (...) Eine Fotovoltaikanlage ist eine „technisch bedingte Dachaufbaute“ und zählt nicht zur Gesamthöhe´

Entscheid Zürich Verwaltungsgericht 2020

`Bei § 292 PBG handelt es sich um eine Asthetiknorm, welche bezweckt, dass Dach und Dachaufbauten in einem abgerundeten harmonischen Bild als ein aufeinander abgestimmtes Ganzes erscheinen. Insbesondere sollen überdimensionierte, dem Dachbereich ein Übergewicht verleihende Aufbauten verhindert werden. Ein Ziel von § 292 PBG ist es, die Dachgestaltung ruhig zu halten.´

[2] In allen Bauzonen können Vollgeschosse durch Dach-, Attika- oder Untergeschosse ersetzt werden; zusammengerechnet dürfen sie jedoch die erlaubte Zahl der Vollgeschosse nicht überschreiten.

§ 277.[25]

2. Fassadenhöhe[55]

A. Begriff und Messweise

§ 278.[55, 59] [1] Die Fassadenhöhe ist der grösste Höhenunterschied zwischen der Schnittlinie der Fassadenflucht mit der Oberkante der Dachkonstruktion und der dazugehörigen Fassadenlinie.

[2] Bei Flachdachbauten wird die Fassadenhöhe bis zur Oberkante der Brüstung bzw. des Geländers gemessen, es sei denn, die Brüstung oder das Geländer ist um mindestens 1 m gegenüber der Fassadenflucht zurückversetzt.

B. Mass und Berechnung

I. Grundsatz

§ 279.[55, 59] [1] Die höchstzulässige Fassadenhöhe beträgt unter Vorbehalt der Bestimmungen über die Hochhäuser 25 m.

[2] Im Übrigen bestimmen die Gemeinden die zulässige Fassadenhöhe. Sie können vorsehen, dass die zulässige Fassadenhöhe auch durch Verkehrsbaulinien bestimmt wird. Entscheidend ist das geringere Mass.

II. Abweichungen

§ 280.[55, 59] [1] Giebelseitig erhöht sich das zulässige Mass um die sich aus der Dachneigung von 45° ergebende Höhe, höchstens aber um 7 m, sofern die Bau- und Zonenordnung nichts anderes bestimmt.

[2] Bei Attikageschossen erhöht sich die Fassadenhöhe auf den fassadenbündigen Seiten um 3,3 m, sofern die Bau- und Zonenordnung nichts anderes bestimmt.

[3] Die Fassadenhöhe aufgrund der Verkehrsbaulinien ergibt sich aus deren um einen Neuntel vergrösserten Abstand und kann um das Mass einer allfälligen Gebäuderückversetzung erhöht werden. Sie gilt bis auf eine Tiefe von 15 m. Im Bereich unterschiedlicher Baulinienabstände ist bis auf eine Tiefe von 15 m der grössere Abstand massgebend.

[4] Wird die Konstruktionsstärke der Wärmedämmung grösser als 20 cm, so darf die zulässige Fassadenhöhe im entsprechenden Umfang, jedoch höchstens um 25 cm, überschritten werden.

3. Gesamthöhe[54]

Begriff

§ 281.[55, 59] Die Gesamthöhe ist der grösste Höhenunterschied zwischen dem höchsten Punkt der Dachkonstruktion und den lotrecht darunter liegenden Punkten auf dem massgebenden Terrain.

c. dass beim rückwärtigen Grenzbau für den Nachbarn nach Lage, Beschaffenheit und Zonenzugehörigkeit seines Grundstücks der Anbau eines Hauptgebäudes möglich ist.

§ 288.[25]

II. Öffnungen in Grenzfassaden[27]

§ 289. [1] Öffnungen in Grenzfassaden bedürfen der baurechtlichen Bewilligung der Baubehörde und der Zustimmung des Nachbarn.

[2] Der Nachbar kann mangels abweichender privatrechtlicher Regelung solche Öffnungen seinerseits verbauen, es sei denn, das bisherige Recht habe einen Anspruch auf deren Fortbestand gegeben.

C. Brandmauern

1. Baupflicht

§ 290. [1] Werden Gebäude aneinandergebaut oder wird ein Gebäude an die Grenze gestellt, so ist eine Brandmauer zu errichten.

[2] Wo ein wirksamer Brandschutz es erfordert, sind Zwischenbrandmauern zu erstellen.

[3] Öffnungen in Brandmauern oder deren Weglassung in einzelnen Geschossen sind zulässig, wenn die Nutzungsart oder andere Verhältnisse es rechtfertigen und ein genügender Brandschutz gewährleistet bleibt.

2. Nachbarliche Verträge

§ 291. [1] Kommt zwischen Nachbarn kein privatrechtlicher Vertrag über die Erstellung einer gemeinsamen Brandmauer zustande, hat jeder auf eigenem Grund eine hinreichende Brandmauer zu errichten.

[2] Über eine gemeinsame Brandmauer darf mangels entgegenstehender privatrechtlicher Regelung jeder Beteiligte nach den anerkannten Regeln der Baukunde verfügen, insbesondere sie unterfangen, erhöhen, vertiefen oder verlängern, wenn dadurch die Zweckbestimmung der Mauer, Gebäude zu scheiden und zu sichern, nicht beeinträchtigt wird. Für das Verfahren gelten die Bestimmungen über die Inanspruchnahme von Nachbargrundstücken.

VI. Weitere Bestimmungen über die Erscheinung von Gebäuden

Dachaufbauten

§ 292.[55, 59] Wo kein geringeres oder grösseres Mass bestimmt ist, dürfen Dachaufbauten, ausgenommen Kamine, Anlagen zur Nutzung von Sonnenenergie und kleinere technisch bedingte Aufbauten, insgesamt nicht breiter als die Hälfte der betreffenden Fassadenlänge sein, sofern sie

a. bei Schrägdächern über die tatsächliche Dachebene hinausragen,

b. bei Flachdächern das vorgeschriebene Mass der Rückversetzungen unterschreiten.

7 HÖHENBEGRIFFE, HÖHENMASSE

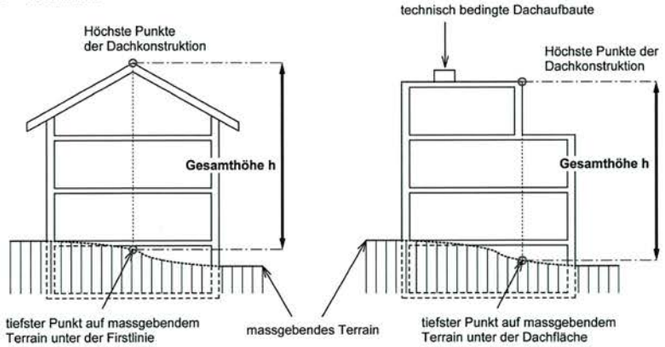
7.1 Die Begriffe betreffend der Höhe von Punkten, Linien und Bauten dienen der Dimensionierung der Bauten in ihrer dritten Dimension bzw. als Hilfsgrösse zur Festlegung von Niveaus bestimmter Gebäudepunkte und Geschosse.

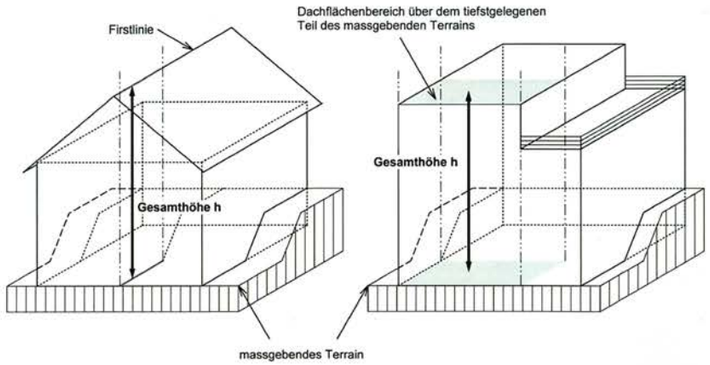
7.2 Die Niveaulinie bestimmt die Höhenlage von Anlagen und bezieht sich auf Strassenachsen, Strassenlinien oder Baulinien.

7.3 Die Gesamthöhe ist der grösste Höhenunterschied zwischen den höchsten Punkten der Dachkonstruktion und den lotrecht darunter liegenden Punkten auf dem massgebenden Terrain.

7.4 Bei den höchsten Punkten der Dachkonstruktion handelt es sich bei Giebeldächern um die Firstlinie, bei Flachdächern um die Dachfläche, beziehungsweise um den Dachflächenbereich über dem tiefstgelegenen Teil des massgebenden Terrains.

Figur 9 Gesamthöhe





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9 DACHGESTALTUNG

9.1 Flachdächer sind Dachabschlüsse von Bauten mit einer Neigung bis 5%.

9.2 Schrägdächer sind Dachabschlüsse von Bauten mit einer Neigung von mehr als 5%.

9.3 Dachdurchbruch ist der Sammelbegriff für Dachaufbaute, Dacheinschnitt und Dachflächenfenster.

9.4 Die Dimensionen der Dachdurchbrüche werden durch Breitenmasse oder Flächenmasse geregelt. Sie können auch mittels Verhältniszahlen begrenzt werden.

9.5 Es wird zwischen technisch bedingten Dachaufbauten und nutzbaren Dachaufbauten unterschieden.

9.6 Technisch bedingte Dachaufbauten sind beispielsweise Kamine, Lüftungsanlagen, Kühlanlagen, Motorenräume, Liftaufbauten, Aufbauten über Treppenhäusern, Dachzugänge und für den Unterhalt des Daches notwendige Dachausstiege, Brüstungen und Geländer usw.

9.7 Nutzbare Dachaufbauten sind beispielsweise Lukarnen, Dachgauben, gedeckte Sitzplätze auf Flachdächern usw.

9.8 Nutzbar sind Dachaufbauten, wenn
- der Raum der unter dem Dachaufbau liegenden Fläche eine festgelegte minimale lichte Höhe erreicht und
- eine genügende Belichtung gewährleistet ist.

9.9 Über das Attikageschoss hinausragende Bauteile werden wie Dachaufbauten behandelt.

9.10 Wird die Dachfläche gegen innen durchbrochen, handelt es sich um Dacheinschnitte.

9.11 Dacheinschnitte sind beispielsweise Dachterrassen oder zurückversetzte Fenster in Schrägdächern.

9.12 Dachflächenfenster sind Verglasungen in der Ebene der Dachfläche, die der Belichtung dienen.

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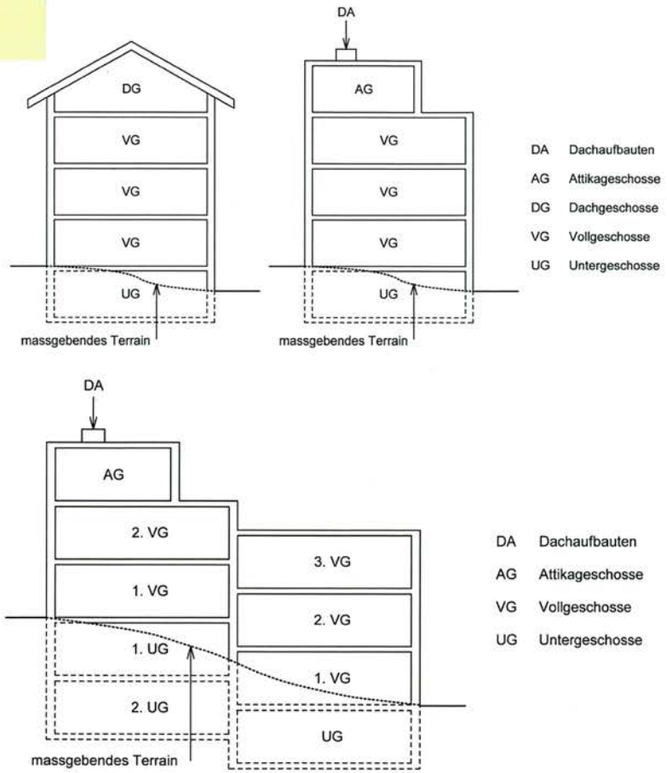
8 GESCHOSSE

8.1 Begriffe und Festlegungen betreffend Geschosse dienen der Differenzierung verschiedener Bauzonen und der Regelungen in Sondernutzungsplänen.

8.2 Vollgeschosse sind alle Geschosse von Gebäuden ausser Unter-, Dach- und Attikageschosse.

8.3 Bei zusammengebauten Gebäuden und bei Gebäuden, die in der Höhe oder in der Situation gestaffelt sind, wird die Vollgeschosszahl für jeden Gebäudeteil bzw. für jedes Gebäude separat ermittelt.

Figur 15 Geschosse und Geschosszahl



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9 DACHGESTALTUNG

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9.3 Dachdurchbruch ist der Sammelbegriff für Dachaufbaute, Dacheinschnitt und Dachflächenfenster.

9.4 Die Dimensionen der Dachdurchbrüche werden durch Breitenmasse oder Flächenmasse geregelt. Sie können auch mittels Verhältniszahlen begrenzt werden.

9.5 Es wird zwischen technisch bedingten Dachaufbauten und nutzbaren Dachaufbauten unterschieden.

9.6 Technisch bedingte Dachaufbauten sind beispielsweise Kamine, Lüftungsanlagen, Kühlanlagen, Motorenräume, Liftaufbauten, Aufbauten über Treppenhäusern, Dachzugänge und für den Unterhalt des Daches notwendige Dachausstiege, Brüstungen und Geländer usw.

9.7 Nutzbare Dachaufbauten sind beispielsweise Lukarnen, Dachgauben, gedeckte Sitzplätze auf Flachdächern usw.

9.8 Nutzbar sind Dachaufbauten, wenn
- der Raum der unter dem Dachaufbau liegenden Fläche eine festgelegte minimale lichte Höhe erreicht und
- eine genügende Belichtung gewährleistet ist.

9.9 Über das Attikageschoss hinausragende Bauteile werden wie Dachaufbauten behandelt.

9.10 Wird die Dachfläche gegen innen durchbrochen, handelt es sich um Dacheinschnitte.

9.11 Dacheinschnitte sind beispielsweise Dachterrassen oder zurückversetzte Fenster in Schrägdächern.

9.12 Dachflächenfenster sind Verglasungen in der Ebene der Dachfläche, die der Belichtung dienen.

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Dachgestaltung bei Attikageschossen

Art. 7a[28] [1] Dachgeschosse über Flachdächern (Attikageschosse) müssen, mit Ausnahme der nach § 292 des Planungs- und Baugesetzes[29] zulässigen Dachaufbauten, ein Profil einhalten, das auf den fiktiven Traufseiten unter Einhaltung der zulässigen Gebäudehöhe maximal 1 m über der Schnittlinie zwischen der Aussenkante der Fassade und der Oberkante des fertigen Fussbodens des Attikageschosses unter 45 ° angelegt wird.

[2] In den 2-, 3-, und 4-geschossigen Wohnzonen darf das Attikageschoss hangseitig fassadenbündig angeordnet werden, wenn auf dieser Seite unter Einbezug des Attikageschosses die zulässige Gebäudehöhe eingehalten wird und seine Fläche nicht grösser wird als die eines Attikageschosses gemäss Abs. 1.

[3] Brüstungen von Dachterrassen sind von den Breitenbeschränkungen für Dachaufbauten ausgenommen, sofern sie die zulässige Gebäudehöhe nicht überschreiten.

[4] Der First für die Bestimmung des Dachprofils von Gebäuden mit Flachdach ist in der Richtung der Gebäudelängsseite zu wählen. Bei zusammengebauten Gebäuden ist in der Regel die Längsseite des Gebäudekomplexes massgebend. Bis zu einem Verhältnis der Gebäudelängs- zur Gebäudeschmalseite von 4 : 3 kann die Firstrichtung frei gewählt werden.

Arealüberbauung

Art. 8[30] [1] Arealüberbauungen sind in allen Wohnzonen, ausgenommen W2b, sowie in allen Zentrumszonen und Zonen für öffentliche Bauten zulässig.

[2] Die Arealfläche muss mindestens 6000 m² betragen.

[3] Für die Arealüberbauung müssen ausreichend Gemeinschaftsräume geschaffen werden. Von den für leichte Zweiräder zu erstellenden Abstellplätzen ist ein angemessener Anteil zu überdecken.

[4] Innerhalb der Arealüberbauung gelten für die Grenz- und Gebäudeabstände die kantonalen Abstandsvorschriften. Gegenüber Grundstücken und Gebäuden ausserhalb der Arealüberbauung sind die zonengemässen Abstände einzuhalten.

[5] Die zonengemässe Vollgeschosszahl darf in der Wohnzone W2 auf drei, in der Wohnzone W3 auf vier, in der Wohnzone W4b auf fünf Vollgeschosse und in den übrigen Zonen auf sieben Vollgeschosse erhöht werden. Die maximale Gebäudehöhe beträgt in den Wohnzonen W2 und W3 12,5 m, in der Wohnzone W4b 15,5 m und in den übrigen Zonen 25 m.

28 Fassung gem. GRB vom 30. November 2016; Inkraftsetzung 1. November 2018 (STRB Nr. 686/2018).
29 Planungs- und Baugesetz vom 7. September 1975, PBG, LS 700.1.
30 Fassung gem. GRB vom 30. November 2016; Inkraftsetzung 1. November 2018 (STRB Nr. 686/2018).

[2] Dacheinschnitte und Dachaufbauten sind nur im ersten Dachgeschoss zulässig.

[3] Im zweiten Dachgeschoss sind nur Dachflächenfenster sowie Kamine, Anlagen zur Nutzung von Sonnenenergie und kleinere technisch bedingte Aufbauten erlaubt. Die Gesamtfläche der Dachfenster darf im zweiten Dachgeschoss höchstens einen Achtel der Bodenfläche des zugehörigen Raums betragen.

[4] Wo Mansardendächer, Zinnendächer und ähnliche steile Dachformen vorherrschen und die Mehrzahl der Gebäude mit ihrer Traufe die erlaubte Gebäudehöhe erreicht, ist eine Durchstossung der für das Schrägdach zulässigen Dachebene gestattet.

[5] Zur Wahrung gebietstypischer Dachformen und im Interesse eines besseren Erscheinungsbilds können in den Kernzonen City, Enge, Hirschengraben, Mythenquai, Parkring, Rämistrasse, Seefeld, Selnau, Utoquai und Zähringerstrasse Abweichungen von der Längenbeschränkung von Dachaufbauten bewilligt oder angeordnet werden.

Wohnanteil

Art. 40[87] [1] Von der anrechenbaren Fläche der Vollgeschosse und der solche ersetzenden Dach- und Untergeschosse eines Grundstückes ist mindestens der im Zonenplan festgelegte Anteil als Wohnfläche zu realisieren.

[2] Ist ein Wohnanteil vorgeschrieben, müssen anrechenbare Flächen im Dachgeschoss dem Wohnen dienen. Vorbehalten bleibt eine Verlegung gemäss Abs. 3.

[3] Die Wohnfläche kann innerhalb des Gebäudes und innerhalb eines Umkreises mit einem Radius von 150 m in der Kernzone Altstadt und von 300 m in den übrigen Zonen verlegt werden. Eine Weiterverlegung aus diesem Umkreis hinaus ist nicht zulässig. Diese Beschränkung ist vor Baubeginn im Grundbuch anzumerken.

[4] In Gebieten mit einem vorgeschriebenen Wohnanteil von 90 % darf der Wohnanteil zugunsten von Betrieben und Einrichtungen, welche vorwiegend die in einem näheren Umkreis wohnende Bevölkerung mit Dingen oder Dienstleistungen des alltäglichen Bedarfs versorgen, auf höchstens folgende Werte herabgesetzt werden:

50 %	in zweigeschossigen Zonen
66 %	in dreigeschossigen Zonen
75 %	in viergeschossigen Zonen
80 %	in fünfgeschossigen Zonen

87 Änderung vorgesehen, noch nicht in Kraft (GRB vom 22. September 2021).

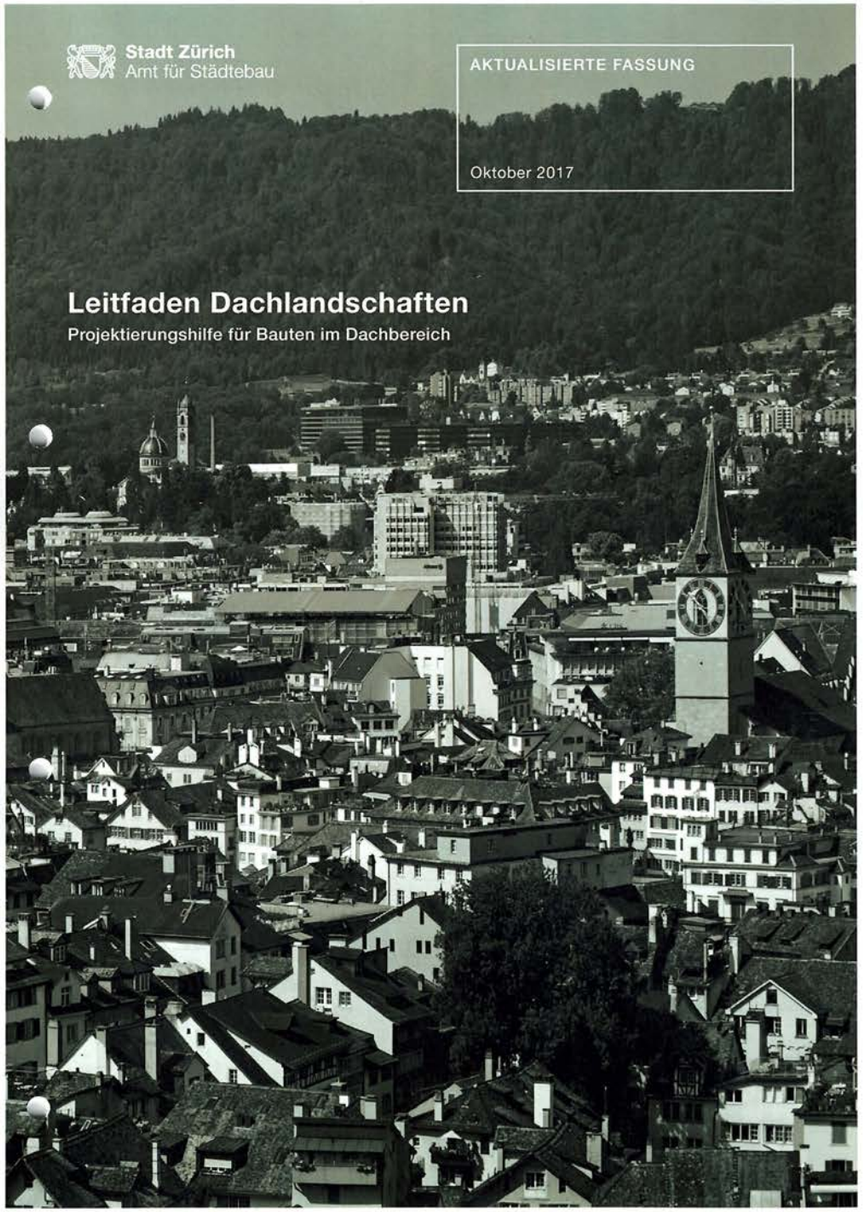
Stadt Zürich
Amt für Städtebau

AKTUALISIERTE FASSUNG

Oktober 2017

Leitfaden Dachlandschaften

Projektierungshilfe für Bauten im Dachbereich



1 EINLEITUNG

Ein Dach ist mehr als der blosse Abschluss eines Gebäudes. Dach und Dachgeschoss werden auf vielfältige Weise genutzt, wobei diese Nutzungen unterschiedlich in Erscheinung treten.

Im Sinne des raumplanerischen Grundsatzes der Siedlungsentwicklung nach innen erlaubt die Bau- und Zonenordnung (BZO) der Stadt Zürich den Ausbau von mindestens einem Dachgeschoss in allen Zonen. Das Planungs- und Baugesetz (PBG) des Kantons Zürich fördert das Wohnen im Dach, indem es die dort realisierte Ausnützung bis zu einem gewissen Mass von der Anrechenbarkeit befreit.

Unabhängig von den neuen Wohnnutzungen steigen die Ansprüche und die Anforderungen an die technische Ausrüstung der Gebäude: Liftüberfahrten, Anlagen zur Wärmerückgewinnung, Kamine, Abluftrohre und Mobilfunkantennen werden zusätzlich auf den Dächern angeordnet.



Luftsicht auf den Paradeplatz

Bund, Kanton und Stadt Zürich streben die Energiewende an. Die Stadtzürcher Bevölkerung bekennt sich zudem zur 2000-Watt-Gesellschaft. Das verpflichtet die Stadt, den Energieverbrauch zu senken, den CO_2-Ausstoss zu reduzieren und die erneuerbaren Energien zu fördern. Solaranlagen leisten dabei einen wichtigen Beitrag zu diesen Zielen. Mit der Revision des Raumplanungsgesetzes des Bundes (RPG) gelten seit dem 1. Mai 2014 neue Bestimmungen für Solaranlagen, wonach für die Mehrzahl der Solaranlagen keine Baubewilligung, sondern nur noch eine Meldepflicht besteht.

Die verschiedenen Nutzungen von Dächern und Dachgeschossen beeinflussen und konkurrieren sich teilweise. Die Kombination und Anzahl der verschiedenen Interventionen auf demselben Dach müssen entsprechend koordiniert werden, um zu gestalterisch befriedigenden, guten, respektive besonders guten Lösungen zu gelangen.

Die heutigen Wohnansprüche und die technischen Anlagen im und auf dem Dach können zu neuen Gestaltungsformen führen. Häuser mit Flachdächern können viele Ansprüche mit einem Attikageschoss relativ einfach lösen. Bei Schrägdächern kommt eine Konvention und wichtige Symbolik hinzu: Das Dach bildet den Abschluss. Es wirkt als «Hut», der mit seiner Krempe (Dachvorsprung) das Haus schützt. Dieser soll – um im optischen Ausdruck glaubwürdig zu bleiben – nicht verändert werden. Das verlangt einen äusserst sorgfältigen Umgang mit Dachöffnungen und Dachaufbauten. Anzahl, Grösse, Form und Detailausbildung sind entscheidend. Wichtig dabei ist zum Beispiel die durchgehende Traufe als klare Begrenzung zur Fassade.

Das Prinzip für das Bauen am Dach lässt sich in vier Punkten zusammenfassen:

1. Die Dachflächen sind sorgfältig zu gestalten.
2. Die Anzahl unterschiedlicher Elemente und die Summe der Interventionen sind so knapp wie möglich zu halten.
3. Der Kontext muss beachtet werden: Dach, Quartier, Strassen- und Hofseite.
4. Es gilt gestalterisch gute Lösungen zu finden, welche die baurechtlichen Anforderungen erfüllen.

9 TECHNIKAUFBAU, LIFTANLAGE, KAMIN, LÜFTUNGSKANAL



Limmatstrasse

Aufgrund erhöhter raumklimatischer Anforderungen treten technische Aufbauten häufiger und dominanter in Erscheinung und verändern die Dachlandschaft und die Silhouette der Gebäude. Sie ergeben sich direkt aus der Nutzung oder Nutzungsänderung. Zu diesen Aufbauten gehören Lüftungs- und Klimageräte, Wärmerückgewinnungseinrichtungen und Kondensatoren.

Die technischen Aufbauten und ihre Dimensionen werden leider oft nach Fertigstellung des Gebäudes geplant, aufgebaut oder nachgerüstet. Eine Integration ist in solchen Fällen nur noch bedingt möglich. Als Prinzip gilt aber: Die technischen Anlagen sind von Beginn an in die Projektierung einzubinden und in das Gebäudevolumen zu integrieren.

Grundsätze Technikaufbau

- Technische Aufbauten sind Teil der Architektur, sie gehören zur Projektierung des Gebäudes.
- Technische Aufbauten sind in die Volumetrie zu integrieren beziehungsweise auf wenige, klare Volumen zu konzentrieren und in Gruppen zusammenzufassen.
- Nachträglich erstellte Technikaufbauten müssen Bezug nehmen auf den gebauten Kontext: Proportionen, Gliederung, Materialisierung, Farbgebung. Konkret bedeutet dies, dass sich die technischen Aufbauten entsprechend der Dachform, Dachgeometrie, Lage und Material einzuordnen haben.

Grundsätze Liftanlage

- Die Integration in die Gebäudestruktur ist gestalterisch die beste Lösung.
- Liftanbauten und -aufbauten müssen Bezug nehmen auf den gebauten Kontext: Proportionen, Gliederung, Materialisierung, Farbgebung.
- Eine klare Ordnung der Elemente muss erkennbar sein. Eine Kumulation oder eine Konkurrenz mit weiteren Elementen ist zu vermeiden.
- Die Traufe ist ein wichtiges Gestaltungselement und soll in der Regel nicht unterbrochen werden.



Strassburgstrasse



Nordstrasse

Beispiele Technikaufbau auf Inventarobjekten



Morgartenstrasse, kommunales Inventar

Technikanlagen auf Inventarobjekten unterliegen erhöhten Anforderungen an Gestaltung, Farb- und Materialwahl. Oft sind die Anforderungen des Umwelt- und Gesundheitsschutzes Zürich (UGZ) und die Anliegen der Denkmalpflege widersprüchlich. Es ist von Vorteil, die Abklärungen frühzeitig und gemeinsam mit beiden Ämtern zu führen, damit eine für alle Beteiligten zufrieden stellende Lösung angestrebt werden kann.

Beispiele Technikaufbau auf Hochhäusern



Pfingstweidstrasse

Technikaufbauten auf Hochhäusern erfordern eine besonders sorgfältige Gestaltung (§ 284 PBG). Die Aufbauten sind innerhalb der maximalen Gebäudehöhe zu erstellen. Sie gehören, wie auch die Fassadenreinigungsanlagen, zur Architektur. Sie sind gemeinsam mit Dach und Fassade zu projektieren und als Teil des Gebäudes in das Volumen zu integrieren. Nachträgliche Aufbauten werden als Abschluss wahrgenommen und sind in geordneter Form zusammenzufassen.

10 MOBILFUNKANTENNE, PARABOLANTENNE



Hammerstrasse

Die Mobilfunk- und Parabolantennen bilden eigenständige Elemente oder Gruppen und können in der Regel so angebracht werden, dass sie die Gesamtwirkung des Gebäudes nicht beeinträchtigen.

Um eine flächendeckende Versorgung zu erreichen, bilden Mobilfunkantennen unter sich ein Netz und sind damit bedingt standortunabhängig. Parabolantennen dienen hingegen der Versorgung des Gebäudes mit Radio- und Fernsehsignalen und sind standortgebunden.



Am Wasser

Sogenannte Pipe-Anlagen stellen eine neuere Möglichkeit dar, Mobilfunkantennen optisch zurückhaltend zu gestalten. Die abgebildete Antenne ergibt eine befriedigende Gesamtwirkung. Tarnungen und Verkleidungen werden im Gegensatz zu Pipe-Anlagen in der Stadt Zürich in der Regel nicht mehr bewilligt.



Idaplatz

Parabolantennen mit einem Durchmesser von weniger als 80 cm benötigen keine Baubewilligung. Meist bilden sie Gruppen und werden Teil der sekundären Schicht der Dachlandschaft. Sie werden als zusätzliche, eigenständige Anlagen wahrgenommen und stehen nicht in Konkurrenz zur Architektur. Die Einordnung dieser Kleinanlagen ist meist befriedigend.

1 VERSTÄNDIGUNG

In der vorliegenden Norm werden die nachstehend aufgeführten Begriffe verwendet. Diese Begriffe sind im Anhang B in alphabetischer Reihenfolge aufgelistet.

1.1 **Allgemeine Begriffe**

1.1.1 **Dachbegrünung** *Végétalisation de toiture*
Bewusst angelegte oder sich spontan entwickelte Begrünung eines Bauwerkes durch die Einrichtung einer Vegetationstragschicht. Die Differenzierung von Dachbegrünungen in Extensiv- und Intensivbegrünung erfolgt nach der Art der Vegetation, dem Ausmass der erforderlichen Pflege und den Nutzungsanforderungen.

1.1.2 **Extensivbegrünung** *Végétalisation extensive*
Dachbegrünungen auf dünnen Vegetationstragschichten (Schichtdicke 80 bis 200 mm), die sich aus angesäter, angepflanzter sowie sich spontan angesiedelter Vegetation entwickeln. Der Bewuchs besteht aus Moosen, Sukkulenten, Kräutern und Gräsern, die sich an die extremen Standortbedingungen anpassen und eine hohe Regenerationsfähigkeit haben.

1.1.3 **Intensivbegrünung** *Végétalisation intensive*
Einfache Intensivbegrünung: Nach gestalterischen Zielvorstellungen angelegte, flächige Dachbegrünung auf mittlerer Vegetationstragschicht (120 bis 300 mm) mit niedrigen und mittelhohen Pflanzen.

Aufwendige Intensivbegrünung (Dachgärten): Zier-, Gebrauchs- oder Spielrasen sowie Stauden-, Strauch- und Baumpflanzungen. In der Regel auf Vegetationstragschicht von 200 bis über 500 mm.

1.1.4 **Biogeographische Regionen** *Région biogéographique*
Naturräumliche Gliederung eines Gebiets auf der Basis von floristischen und faunistischen Verbreitungsmustern der darin vorkommenden Arten. Die Schweiz wird in sechs Haupt- und elf Unterregionen eingeteilt.

Die Einteilung widerspiegelt die unterschiedlichen geologischen, geomorphologischen und klimatischen Standortbedingungen, die nacheiszeitliche Ausbreitungsdynamik und die zunehmende Beeinflussung durch die demographische und technische Entwicklung der menschlichen Gesellschaft.

1.1.5 **Ökotyp** *Écotype*
Eine bestimmte Form eines Lebewesens, das im Vergleich zu anderen Populationen der gleichen Art eigene genetisch fixierte ökologische Ansprüche an seine Umwelt stellt.

1.1.6 **Ökologischer Ausgleich** *Compensation écologique*
Der ökologische Ausgleich dient der Kompensation der intensiven Bodennutzung. Auch ausserhalb geschützter Lebensräume sollen sowohl im Landwirtschafts- wie auch innerhalb des Siedlungsgebiets natürliche Lebensbedingungen für Pflanzen und Tiere erhalten bleiben oder geschaffen werden.

Gemäss Bundesgesetz über den Natur- und Heimatschutz (Art. 18b Abs. 2) [4] bzw. Verordnung über den Natur- und Heimatschutz (Art. 15) [5] werden folgende Ziele angestrebt:
- Vernetzung isolierter Biotope (auch durch Aufwertung, Wiederherstellung oder Neuschaffung von Biotopen),
- Förderung der Artenvielfalt,
- möglichst naturnahe und schonende Bodennutzung,
- Einbringen von Natur in den Siedlungsraum,
- Belebung des Landschaftsbildes.

1.1.7 **Solaranlage** *Installation solaire*
Anlage, mit der Sonnenenergie genutzt werden kann. Es werden thermische Solaranlagen und Photovoltaikanlagen oder Kombinationen davon unterschieden.

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2.3 Filterschicht

2.3.1 Zur Trennung der Drainage- und der Vegetationstragschicht ist eine Filterschicht zu projektieren, welche den dauerhaften Schutz der Drainageschicht vor dem Eintrag von Feinstoffen aus der Vegetationstragschicht schützt.

2.3.2 Die Überlappung von Geotextilien ist material- und situationsabhängig zu projektieren.

2.4 Vegetationstragschicht

2.4.1 Allgemein

2.4.1.1 Die klimatischen Verhältnisse sind zu beachten – im Speziellen die Anforderungen, welche sich aufgrund der Niederschlagsverhältnisse ergeben.

2.4.1.2 Bei der Wahl des Materials und der Schichtdicken sind Exposition und Beschattung zu berücksichtigen.

2.4.1.3 Schichtdicke und Typ der Vegetationstragschicht sind entsprechend dem projektierten Bewuchs und Deckungsgrad zu planen.

2.4.1.4 Bei der Planung der Schichtdicken sind die materialspezifischen Setzungen einzukalkulieren.

2.4.1.5 Variable Schichtdicken der Vegetationstragschicht zur Förderung der ökologischen Vielfalt (Biodiversität) sind bei der Projektierung festzulegen.

2.4.2 **Bei extensiver Dachbegrünung**

Tabelle 1 Erzielbare Wuchsformen in Abhängigkeit von der Dicke der Vegetationstragschicht bei extensiver Dachbegrünung

	Wuchsformen bei extensiven Dachbegrünungen			
				
Erscheinungsbild	Felsensteppe (nicht geschlossener Bewuchs)	Blumenwiese (nicht geschlossener Bewuchs)	Blumenwiesenartig mit steigendem Anteil an Gräsern	Blumenwiese mit Gräsern, Rasenflächen, Staudenpflanzungen
Schichtdicke (nach erfolgter Setzung)	ab 80 mm	ab 100 mm	ab 120 mm	ab 150 mm
Pflanzenformen	Sedum-Arten, Moose, geringer Anteil Kräuter	Sedum-Arten, Kräuter, geringer Anteil Gräser	Gräser, Kräuter	Gräser, geringer Anteil Kräuter

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Tabelle 2 Grundanforderungen an verschiedene Klimaregionen

Jahresniederschlag *	Dicke der Vegetationstragschicht (nach erfolgter Setzung)	Minimale relevante Wasserkapazität (Luftkapazität LK und nutzbare Feldkapazität nFK)	Nutzbare Feldkapazität (nFK)
< 800 mm	110 mm	55 l/m²	27,5 l/m²
800–1000 mm	100 mm	50 l/m²	25,0 l/m²
1000–1200 mm	90 mm	45 l/m²	22,5 l/m²
> 1200 mm	80 mm	40 l/m²	20,0 l/m²

* Jahresniederschlagswerte können bei MeteoSchweiz bezogen werden.

2.4.3 Bei intensiver Dachbegrünung

Tabelle 3 Erzielbare Wuchsformen in Abhängigkeit von der Dicke der Vegetationstragschicht bei intensiver Dachbegrünung

	Wuchsformen bei intensiven Dachbegrünungen		
			
Erscheinungsbild	Rasen, Wiesen, Stauden und niedere Gehölze	Stauden und mittelhohe Gehölze	Hohe Gehölze
Schichtdicke	120–300 mm	300–500 mm	> 500 mm
Pflanzenformen	Gräser, Stauden, Kleingehölze	Stauden, Kleingehölze	Klein- und Grossgehölze

2.4.3.1 Bei intensiver Begrünung ist zu beachten:
- Oberhalb der Sickerschicht gilt SIA 318.
- Für Boden, der befahren, ausgehoben, transportiert und geschüttet wird, sind Schutzmassnahmen zu projektieren, um die ursprüngliche Bodenqualität zu gewährleisten.
- Für die Erfassung des Ausgangszustandes des Bodens, die Projektierung der Erdarbeiten und von Schutzmassnahmen sind SN 640582 und der Leitfaden *Bodenschutz* des BAFU [10] zu berücksichtigen.
- Bei Verdacht auf belastetes Bodenmaterial (z.B. aus Nutzgärten, aus ehemaligem Rebland, aus der Nähe von stark befahrenen Strassen und Eisenbahnlinien) sind Schadstoffuntersuchungen durchzuführen und entsprechende Massnahmen zu projektieren.
- Die Qualität des vorhandenen Bodens ist zu prüfen und die notwendigen Bodenverbesserungen sind festzulegen.
- Ab einem Bodenaufbau von 300 mm ist ein bodennaher Aufbau mit Unterboden und Oberboden nach SIA 318 möglich. Die minimalen Schichtdicken für Oberboden gemäss SIA 318 sind einzuhalten.

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2.10 Regenwassernutzung

Regenwasser, welches eine begrünte Dachfläche durchfliesst, kann wie Grauwasser verwendet werden. Insbesondere bei Vegetationstragschichten mit organischem Anteil kann es zu einer Trübung des Regenwassers durch ausgewaschene Huminsäuren kommen. Die Trübung ist in der Regel hygienisch unbedenklich.

2.11 Bewässerung

2.11.1 Bei der Projektierung von Extensivbegrünungen ist je nach Jahreszeit, Witterung und Vegetationstyp eine Bewässerung für die Anwachszeit einzuplanen.

2.11.2 Bei Intensivbegrünungen ist in Abhängigkeit des Begrünungsziels, dem Aufbau der Boden- und Entwässerungsschichten sowie der geplanten Pflegeaufwendungen eine Bewässerungsanlage zu projektieren.

2.12 Kombination von Dachbegrünung und Solarenergienutzung

2.12.1 Die mögliche Beschattungswirkung auf Solaranlagen durch die Vegetation einer Dachbegrünung ist bei der Planung zu berücksichtigen. Die Vegetationstragschicht vor dem Solarmodulbereich kann auf einem 30 cm bis 50 cm breiten Streifen in der Schichtdicke reduziert werden oder es kann eine Erhöhung der Aufständerung geplant werden.

2.12.2 Bei Begrünungen mit Solarenergienutzung sind die Funktionen der Dachbegrünung gleichwertig wie die Funktionen der Energiegewinnung zu berücksichtigen.

2.12.3 Die Vegetationstragschicht für die Dachbegrünung ist auch unter den Solarmodulflächen einzurichten, um die Wasserspeicherfähigkeit und den Standort als Ersatzhabitat für Flora und Fauna zu gewährleisten.

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Art. 9[33] [1] Hochhäuser sind in den im entsprechenden Ergänzungsplan bezeichneten Gebieten zulässig. Hochhäuser

[2] Die zulässige Gesamthöhe beträgt in den Gebieten I und II 80 m und im Gebiet III 40 m (vorbehältlich Abs. 3).

[3] Im Hochschulgebiet Zürich-Zentrum gilt eine maximale Höhenkote von 512 m ü. M.

Art. 10[34] [1] Abgrabungen für Haus- und Kellerzugänge, Gartenausgänge sowie Ein- und Ausfahrten zu Einzel-, Doppel- und Sammelgaragen sind zulässig. Abgrabungen, Aufschüttungen

[2] Im Übrigen sind nur geringfügige Abgrabungen und Aufschüttungen zulässig. Zwecks Einordnung in die bauliche und landschaftliche Umgebung und insbesondere zur Sicherstellung eines harmonischen Geländeverlaufs können weitergehende Terrainveränderungen bewilligt werden. Die Gebäudehöhe muss auch vom gestalteten Terrain aus eingehalten werden.

Art. 11[35] [1] In allen Zonen ist der nicht als begehbare Terrasse genutzte Bereich eines Flachdachs ökologisch wertvoll zu begrünen, auch dort, wo Solaranlagen installiert sind. Die Pflicht, ökologisch wertvoll zu begrünen, besteht, soweit dies technisch und betrieblich möglich sowie wirtschaftlich tragbar ist. Begrünung, Spiel- und Ruheflächen, Gärten

[2] Bei der Erstellung von Hauptgebäuden sind in Wohnzonen mindestens zwei Drittel, in den Quartiererhaltungszonen mindestens die Hälfte und in Zentrumszonen mindestens ein Drittel der nicht mit Gebäuden überstellten Parzellenfläche zu begrünen. Ein Teil dieser Fläche ist der Art der Überbauung entsprechend als Spiel- oder Ruhefläche oder als Freizeit- oder Pflanzgarten herzurichten.

[3] Die Herrichtung solcher Freizeit- oder Pflanzgärten, Spiel- oder Ruheflächen kann bei bestehenden Mehrfamilienhäusern verlangt werden, wenn dafür ein Bedürfnis vorhanden und die Verpflichtung technisch und wirtschaftlich zumutbar ist.

Art. 11a[36] [1] In den Baumschutzgebieten ist das Fällen von Bäumen mit einem Stammumfang von mehr als 80 cm bewilligungspflichtig. Ebenso benötigen Eingriffe im Kronenbereich oder am Wurzelwerk solcher Bäume, die sich wie eine Beseitigung auswirken oder eine solche notwendig machen, eine Bewilligung. Baumschutz

33 Fassung gem. GRB vom 5. Juni 2019; Inkraftsetzung 17. Februar 2020 (STRB Nr. 1039/2019).
34 Fassung gem. GRB vom 30. November 2016; Inkraftsetzung 1. November 2018 (STRB Nr. 686/2018).
35 Fassung gem. GRB vom 30. November 2016; Inkraftsetzung 1. November 2018 (STRB Nr. 686/2018).
36 Eingefügt durch GRB vom 30. November 2016; Inkraftsetzung 1. November 2018 (STRB Nr. 686/2018).

Stadt Zürich
Grün Stadt Zürich

Gründachpflege		April	Mai	Juni	Juli	Aug	Sep	Okt	Nov	Dez-März
Im Ausführungsjahr	Kurzkontrolle, Entfernung von Problempflanzen, v.a. invasive Neophyten **ab Zeitpunkt Substratschüttung** - alle 4-5 Wochen.									
Erstellungspflege 1.-3. Jahr.	Keine Düngung. Bewässerung nur in Extremsommer.									
	Jäten der invasiven Neophyten Einsatz alle 4-5 Wochen									
	Einjähriges Berufkraut (*Erigeron annuus*) ganzjährig Blüte/Wachstum möglich									
	Schmalblättriges Greiskraut (*Senecio inaequidens*)									
	2x jährlich Kontrolle und Jäten von Problempflanzen, artspezifische Entsorgung.									
	Rundkiesbereiche und Dachabläufe vegetationsfrei halten. Schnittstelle zu Wartungsvertrag klären.									
	Ersatz gepflanzter Arten bei Abgang.									
	Nachsaat bei ungenügendem Deckungsgrad oder unerwünschten Kahlstellen.									
	Ausgleichen oder ergänzen von Substrat									
Regelpflege	Kurzkontrolle und jäten der invasiven Neophyten alle 4-5 Wochen									
	Einjähriges Berufkraut									
	Schmalblättriges Greiskraut									
	2x jährlich Kontrolle und Jäten von Problempflanzen, artgerechte Entsorgung.									
	Mahd und Entfernung Mähgut, gestaffelt jedes Jahr 50% der Fläche. Oder nach Pflegeplan.									
	PV: Beschattung verhindern. Jäten oder Mähen von hochwüchsigen Pflanzen.									
	Rundkiesbereiche und Dachabläufe vegetationsfrei halten. Schnittstelle zu Wartungsvertrag klären.									
	Pflege und Ergänzung von Kleinstrukturen (Asthaufen, etc.). Periodisch freijäten, Holzstapel bei Zerfall ergänzen. Pflegeplan.									
Qualitätskontrolle	Qualitätskontrolle Vegetation / Vegetationsdeckung alle 5 Jahre									
Wartungsarbeiten	Gemäss Vorschriften SIA / SUVA und individuellem Wartungsvertrag. Details in SFG - Schweizerische Fachvereinigung Gebäudebegrünung: Empfehlung zur Pflege und Wartung von extensiven Dachbegrünungen (Ausgabe 2023).									

Legende

Zeitfenster für den Einsatz / die Einsätze
Einsatz nach Bedarf



III.01
technopark

green roof, during summer a duck family lived on the roof

III.02
stampfenbachstrasse 114

gravel roof, plants started growing between pipes and ducts





III.03
HPM hönggerberg

green roof since transformation
partly used as herb garden



III.04
technopark

green roof, during summer a
duck family lived on the roof



III.05
CLA

green roof, tall grasses

III.06
HPM hönggerberg

gravel roof, hazel tree started growing on the roof



IV

SYSTEM

`Because of this failure of the architectural profession to - almost literally - keep its house in order, it fell to another body of men to assume responsibility for the maintenance of decent environmental conditions: everybody from plumbers to consulting engineers. They represented `another culture´, so alien that most architects held it beneath contempt, and still do.´

- Reyner Banham, The Architecture of the well-tempered Environment. 1969

`The ceiling used to be decorative, a symbolic plane, a place invested with intense iconography. Now, it has become an entire factory of equipment that enables us to exist, a space so deep that it begins to compete with the architecture. It is a domain over which architects have lost all control, a zone surrendered to other professions.´

- Rem Koolhaas, Elements of Architecture, 14th Venice Biennale of Architecture, 2014

The chapter on the SYSTEM explores the technical and performative aspect defining the spaces.

IV.I Infrastructure Space

Our societal understanding of comfort—driven by expectations for climate control, convenience, and technical services—has led infrastructure spaces to occupy an increasingly significant share of our buildings and cities. At the same time, due to safety regulations, these areas are typically strictly separated from human encounters. The increasing professionalisation and specialisation of building systems has led to a disconnect between infrastructure and architecture. Architects now frequently design flat roofs as vacant surfaces, prioritising the most efficient and cost-effective arrangement of technical equipment.

Given the pressure for densification, especially in urban contexts where every square meter is optimised, it is crucial to question this attitude and investigate the opportunities for creating hybrid spaces that integrate infrastructure with human use.

IV.II Technical Devices

Through advancing technologies and consequently established norms and regulations the phenomenon of the infrastructural roof emerged in the 1990s. The inventions of modern technologies like the lift in the 1890s, the radio broadcasting in the 1920s, new ventilation systems after the oil crisis 1973 and the advancing technology of solar energy in the 1980s changed the way we design completely. The consequences and residues of our expectations for „hyper-comfort“ become clearly visible on our roofs and become apparent in the form of machine rooms, antennas, ventilation ducts, solar panels and maintenance devices.

Analysing roofs through aerial views reveals that these technical devices occupy on average ~ 30% roof surface area per platform of administrative, industrial and commercial buildings, but due to their configuration, the entire roof slab is rendered inaccessible. These technical roofs can be described as fluid spaces. The life span of buildings far exceeds the life span of technical devices. Ranging from 5-25 years, antennas, solar panels, lifts and ventilation systems have to be exchanged, often they are replaced even before the end of their service life due to changes in usage or adapted regulations. Constantly advancing technologies and consequently established norms result in very reactive spaces. Small changes in regulations can be implemented in short times, verifiable in overlays of established regulations with dated aerial views.

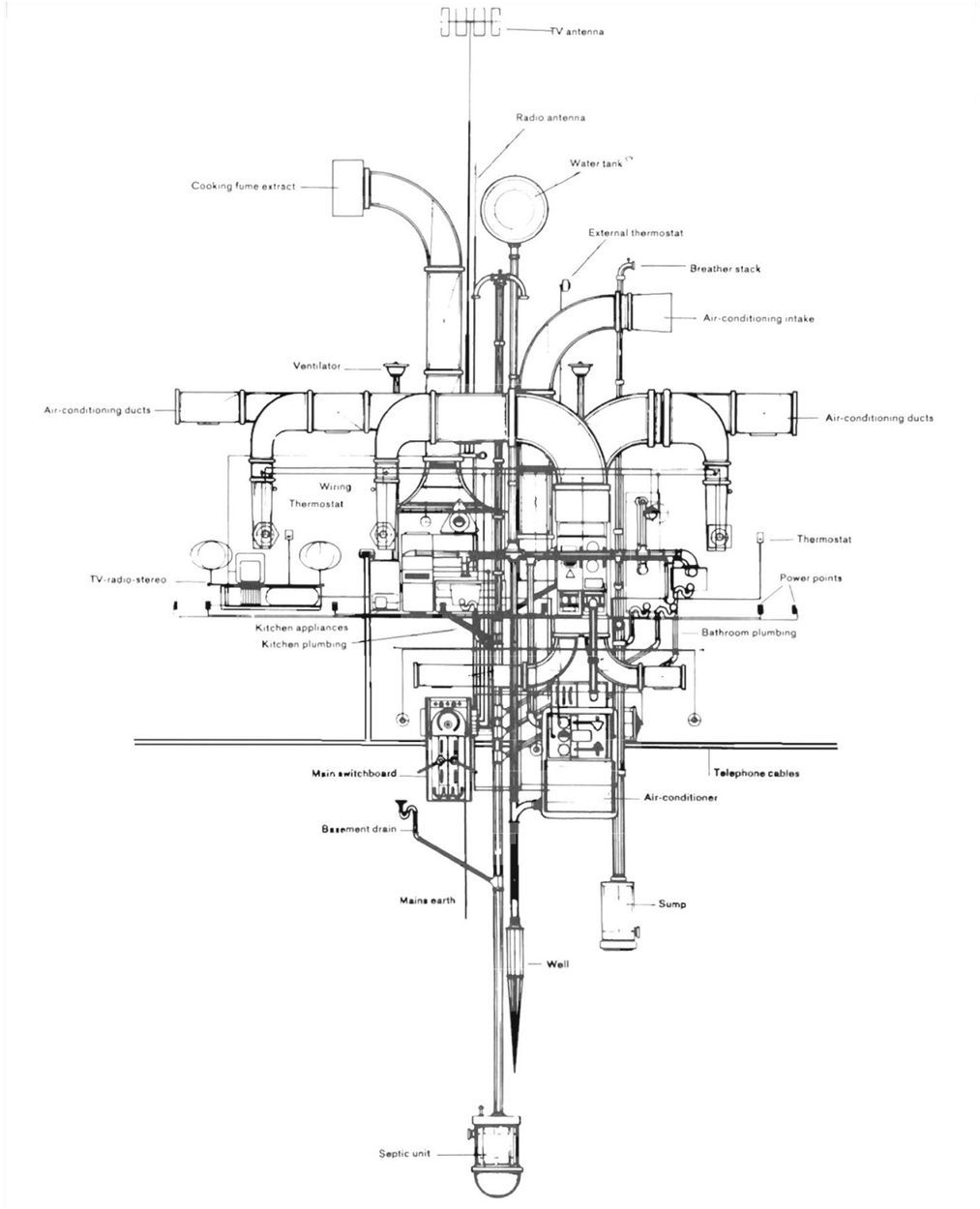
To project the future development of the technical landscape means to dissect it into individual devices and analyse their functions. While the roof structures above lifts will disappear due to the invention of machine room-less elevators, all other categories of systems are expected to increase in quantity and scope. The number of mobile-antennas are rapidly increasing and expected to double every 18 months, demands for HVAC systems are predicted to expand to be able to compensate for increasing air pollution and global warming. Here, also the efficiency paradox comes into play: While the machines themselves get more efficient and become smaller, the demands set by the user will grow, this leads, for example, to larger air ducts in order to reduce the air speed and thus reduce the noise emissions of the machine. Potential alternatives could be provided by centralised district cooling. Solar systems are subject to a new energy law, which requires the installation of solar panels on all non-usable roofs with more than 300m2 built surface until 2040. Accordingly, with all of these devices increasing, also new SUVA norms will be established and the maintenance systems will continue to grow.

These prognoses are speculative but result from a series of conversations during the research, conducted with people working in the sector.

IV.III To Expose or To Conceal

Architectural approaches to infrastructure space can vary widely, ranging from concealing technical elements, exposing them as intentional design features, to integrating them into the overall architectural concept.

The status quo often neglects these systems; there are no archival materials or coherent plans, as each specialist typically only plans their part. Given the short operational lifespan of technical systems, thorough coordination is often deemed unnecessary. Infrastructures are mostly concealed, remaining hidden and invisible. Instead of a clear attitude, we‘re currently faced with an ambiguity of concepts. Already within the entity of one building we find an inconsistency between concealing and exposure. Whilst hidden within our structures, the installations suddenly appear on our roofs, indicating the missing synergy between buildings and their infrastructure. Surfacing from the black boxes that we „design“ around them, they suddenly become a matter of public interest.

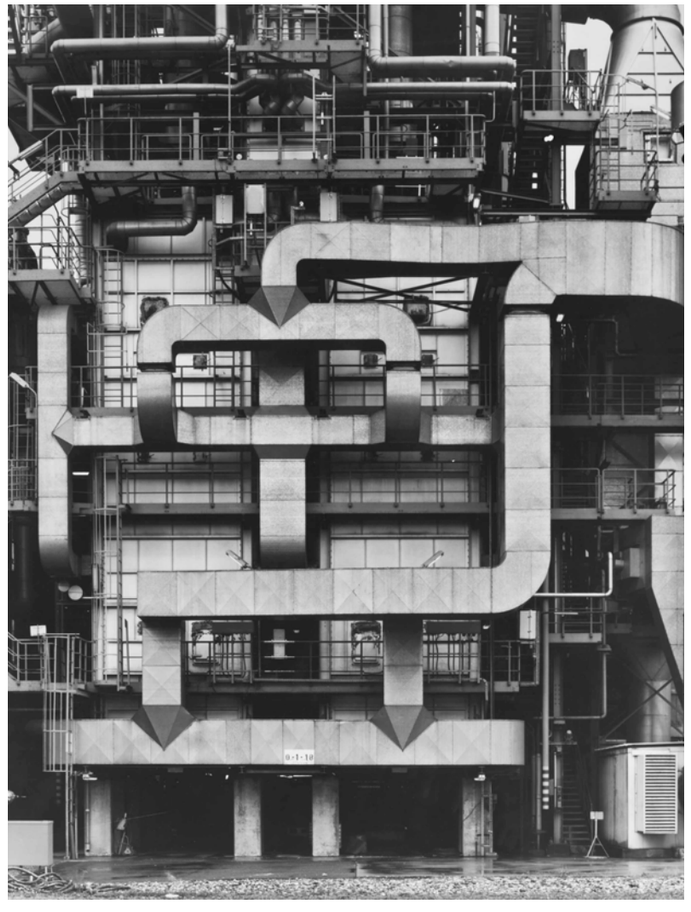


IV.07
a home is not a house, 1965
reyner banham and
françois dallegret

`Infrastructure (…) must be regarded as more as a mere servant to utility; it must become responsive to cultural and contextual distinctions, and be reclaimed as a truly public resource. To make these broad objectives achievable in the first place, infrastructural systems (…) must be viewed as more than a technical issue, and treated equally as a social issue in scope and design and a common good in an ecology of interrelationships vital to furthering life.´

- Introduction in: Infrastructure Space, 2017

IV. 08
bernd and hilla becher



MECHANICAL EQUIPMENT

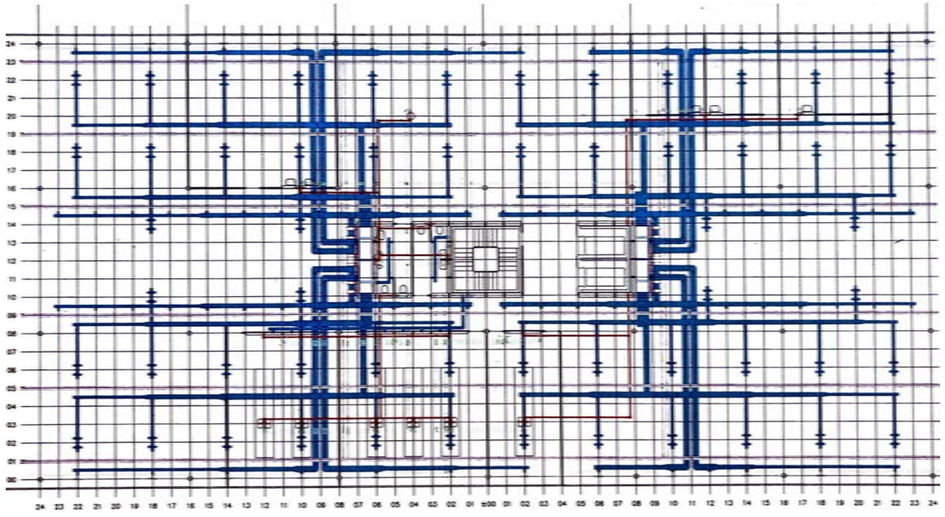
Mechanical Equipment contributes immeasurably to the services and amenities provided in twentieth-century buildings. This equipment has made it both possible and economically feasible to increase the physical dimensions of buildings and to create within them an environment satisfying to man‘s biological needs. As a result, mechanical equipment has become an important and characteristic element of modern building. With the extensive use made of and the dependence placed on this equipment the size of the mechanical plant itself has increased. Consequently, in the planning and development of many projects the space requirements for such elements become a matter of first importance. Successful buildings which provide a satisfying environment for man‘s various activities are those in which adequate consideration has been given to mechanical services providing for the production, distribution, and precise control of heating, cooling, lighting, and the like. (p.192)

SPACE CONSIDERATIONS

In the interest of efficiency and low maintenance costs, ample space allotment with easy access becomes a major consideration in the design of every installation. The importance of this factor is attested by the fact that mechanical equipment may constitute from 20 to 40 per cent of the total building cost; indeed, in industrial plants it may account for considerably more than half the entire building investment.

(...) Not infrequently, refrigerating-machine and fan rooms, duct distributions, and the like can be located in penthouses or in a top-floor ceiling space.

- Talbot Hamlin, Forms and Functions of Twentieth-Century Architecture, 1952



IV.09
fritz haller, plan showing water, heating, ventilation, and electrical lines

AFTER COMFORT - A USER’S GUIDE

The fossil fuel era is ending rapidly. The International Energy Agency has indicated that global use of fossil fuels will peak by the end of the 2020s. However, the projected data looks more like a cliff than a pinnacle, whose long, flat plateau will stretch decades into the future. This is in part because of the ways that fossil fuel use is locked into buildings and has become integral to so many aspects of our lifestyles. As a result, we cannot just “build more efficiently” to stem the extraction of fossil fuels. Rather, the duration of fossil fuel dependency is in large part determined by how rapidly and radically existing buildings can be decarbonized. Over-carbonized economies have shaped their lifeworlds around artificially abundant and cheap energy resources. Architects, engineers, historians, technologists, and others need to consider the shape, pace, and aspirations of the decarbonization process. We need to determine how best to design and create buildings appropriate to a new lifeworld: after carbon, after comfort.

Comfort is difficult to let go of, on both the individual and social scales. Thermal comfort encourages well-being and health; it provides consistency and predictability. Over-carbonized economies have come to rely on it. With the slow decline of mechanically-induced interior thermal consistency comes a shift in expectations and aspirations. Life after comfort does not have to be uncomfortable. However, it will involve adjusted desires, compromises, and difficult decisions. The HVAC-centered form of comfort that has proliferated since the postwar era was only ever attainable by a privileged few. Today, climate change is making everyone uncomfortable, and the promise of comfort is only sold by those who are exacerbating the conditions making us uncomfortable in the first place. We are all after comfort: both getting over it and yearning for it.

Comfort is a construct. Many new commercial and institutional buildings built over the past few decades rely so heavily on fossil-fueled mechanical HVAC systems that they would be uninhabitable without them. Many of the stylistic and programmatic debates in architecture in these same decades similarly relied on HVAC for their explorations and innovations. In other cases, often at the residential scale, buildings have been produced with an expectation of cheap energy, which has meant that adequate insulation, cross ventilation, and other design-based passive thermal measures have not been considered. Our determinedly slow, casual move away from fossil fuels, with limited political or socio-economic support, is already resulting in “green inequity” and novel forms of thermal violence. Over the decades to come, enclaves where upper-class neighborhoods engage with expensive “green tech” such as electric vehicles and heat pumps will coexist alongside poorer areas that cannot afford to make any transition from the carbon-fueled lifestyles they need to get by.

What tomorrow’s comfort might look like can be glimpsed by looking both back into the past and forward to the cutting edge of contemporary practice. Design strategies and social practices that we already know of and can implement now have the potential to address the costs of this fossil-fueled conditioning and adjust our relationship to comfort accordingly. At the same time, they can promote steps towards green equity, offering global citizens everywhere ways of living sustainably in buildings and landscapes that achieve comfort through emissions mitigation and adaptation. As a cultural and technological realm of experimentation and speculation, and through its entanglement with the building industry, economic systems, and energy transitions, architecture’s value is evolving. This User’s Guide offers tools for nurturing novel relationships to the thermal interior in an era after comfort.

- a project by e-flux Architecture in collaboration with the University of Technology Sydney, the Technical University of Munich, the University of Liverpool, and Transsolar

EIGHT POINTS ON INFRASTRUCTURE AND ARCHITECTURE

Hardly any other area of the built environment has had such a paradoxical existence as the field of infrastructure. While few other means have inscribed themselves so deeply into architecture, becoming part of our daily lives and vocabulary, infrastructure remains, in effect, an invisible presence. It‘s only when the system breaks down, or the connection is lost, that we become aware of it, and then usually in a negative sense. This lack of awareness seems all the more surprising given that over the last 200 years infrastructure has widely undermined the traditional conception of architecture as an enclosed space.

Indeed, the far-reaching transformation of architecture in the recent past is less the result of formal innovations such as the international style or postmodernism than a new set of fields of expertise (for instance, in hygiene), processes (for instance, in electrification or access to water), and agents (such as building, machine, or sanitation engineers) that allow the regulation of the environment, or the surroundings of buildings, through a series of new apparatuses, devices, or appliances. This expertise would bring with it a comprehensive reorganization of architecture and urban planning, and large-scale reallocations among the various practitioners. These changes, which are in the broadest sense political, have generally been linked to the development of infrastructure.

But how have these new practices changed our relationship to space? In what ways have they altered our understanding of architecture? Lastly, and most fundamentally, what does infrastructure mean in relation to architecture?

1 Infrastructure is a modern neologism. It originated with the French railways in the late nineteenth century to describe the earthworks necessary for the laying of rail tracks. Only in the postwar years did its definition expand to take in airports, oil pipelines, fuel storage tanks, and various communications and air defense systems, before it finally acquired its current social and economic meaning.
With this final expansion of meaning, the term belatedly - only very recently - entered architecture, implying at the same time a division between a superstructure and an infrastructure.

2 In architecture, infrastructure does not refer to the substructure that carries a superstructure - that would be a foundation - but rather to those technical systems that are designed to optimize the use of the space and make it permeable to people, goods, media, and energy. Infrastructure does therefore not support a building, but rather its use and ever-changing conditions in time.

3 Infrastructure refers to requirements that are linked to the performance of architecture. In the first instance, this means only the individual pieces of equipment that provide for the smooth running of a building, such as the heating or ventilation systems that enhance comfort, the telephone lines that improve communication, or the water supply that ensures sanitation. These requirements
have led not only to a precise regulation of the various flows (of water, electricity, people) into and out of the house, but also, increasingly, to a programming of the space itself-the bathroom, kitchen, laundry room, etc. Infrastructure is thus not only a physical component or a system, but both at once.

4 What characterizes the technical object is the close monitoring of its efficiency - its many infrastructural operations (heating, cooling, ventilation, communications) all being subject to constant evaluation and optimization. Therefore, what characterizes infrastructure is the fact that the various functions of architecture - isolating, load bearing, moving, circulating, etc. - are laid out in such a manner as to render the different dimensions of existence explicit. Correspondingly, it is possible to conceive these functions individually, but also to give them form, or alter, improve on, or reject them.

5 This transformation far more comprehensively reflects the modernist attempt to objectivize the means and instruments of architecture by differentiations: between served and servant spaces, between load-bearing and supported elements, between ornament and structure, or indeed between infrastructure and architecture. This division finds its expression, bureaucratically, in the proliferation of safety, energy, and fire regulations and norms,
but also in the increasing specialization of architectural education.

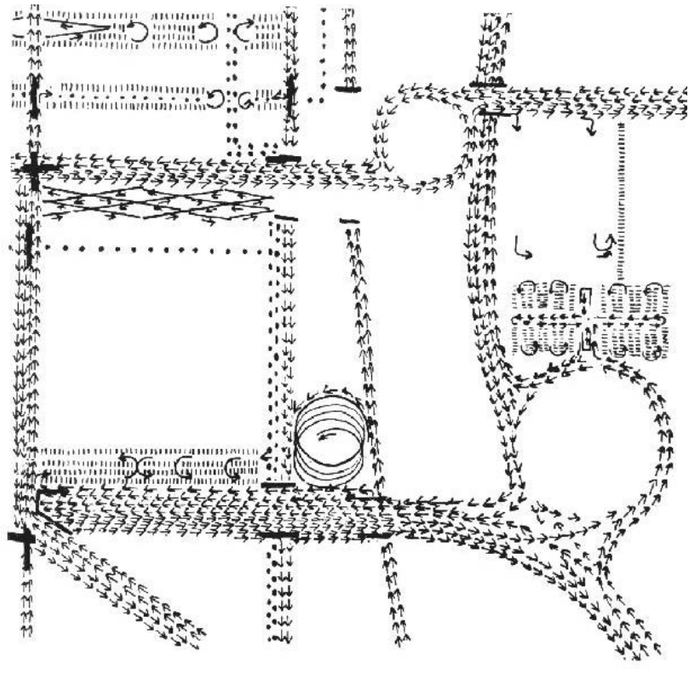
6 To speak about infrastructure therefore implies making a fundamental distinction between different types of elements within a building. In this process, the design of infrastructure, with its sophisticated technologies, is often separated from the realm of architectural design, since it is thought to concern only isolated, specific functions of architecture, for which responsibility can only be delegated to a specialist in that field.

7 But in reality the opposite is true. Technology does not only concern specific, isolated aspects of architecture to which particular functions can be assigned, in the manner of household appliances or kitchen and bathroom fittings. Technology, in its broadest sense, is - and always has been - also the precondition of architecture. From this perspective, infrastructure is no longer to be
seen as a product of modernity‘s civilizing march, but rather must be understood in a much broader cultural and historical context, as a technology or tool used to provide for human needs or alleviate scarcities

8 In its etymological sense, technology means artistry. It denotes the capacity, using the means of a given time and place, to not only find a concrete solution for a problem, but also to give it a meaning. In this way it helps to reassert, as shared experience, the aesthetic dimension of life. For what technology is doing is not only representing a new reality, but helping us to decipher that reality.

- Laurent Stalder and Carlotta Darò: Eight Points on Infrastructure and Architecture. Infrastructure Space, 2018.

IV.10
louis kahn, traffic study project philadelphia



The infrastructure space on our roofs is composed by a series of technical devices. To propose a stretegy, the individual components must be analyzed, dissected into their actual functions and their future development anticipated.

p.162 **Lift**

p.168 **Ventilation**

p.174 **Antenna**

p.182 **Solar**

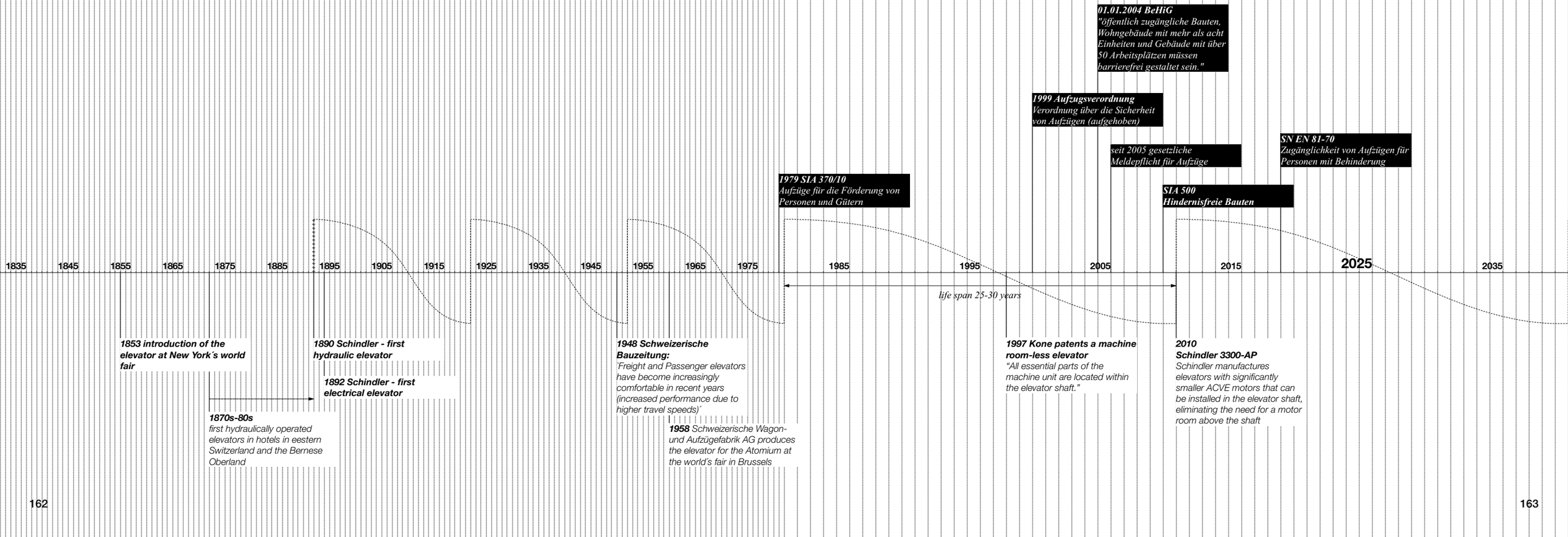
p.188 **Maintenance**

Measurement Points

Weather Stations, Wind Vanes

Lightning Protection

Advertisement


01.01.2004 BeHiG
"öffentlich zugängliche Bauten, Wohngebäude mit mehr als acht Einheiten und Gebäude mit über 50 Arbeitsplätzen müssen barrierefrei gestaltet sein."
1999 Aufzugsverordnung
Verordnung über die Sicherheit von Aufzügen (aufgehoben)
seit 2005 gesetzliche Meldepflicht für Aufzüge
SN EN 81-70
Zugänglichkeit von Aufzügen für Personen mit Behinderung
1979 SIA 370/10
Aufzüge für die Förderung von Personen und Gütern
SIA 500
Hindernisfreie Bauten
1835 1845 1855 1865 1875 1885 1895 1905 1915 1925 1935 1945 1955 1965 1975 1985 1995 2005 2015 2025 2035
life span 25-30 years
1853 introduction of the elevator at New York´s world fair
1890 Schindler - first hydraulic elevator
1892 Schindler - first electrical elevator
1870s-80s
first hydraulically operated elevators in hotels in eestern Switzerland and the Bernese Oberland
1948 Schweizerische Bauzeitung:
'Freight and Passenger elevators have become increasingly comfortable in recent years (increased performance due to higher travel speeds)'
1958 Schweizerische Wagon- und Aufzügefabrik AG produces the elevator for the Atomium at the world's fair in Brussels
1997 Kone patents a machine room-less elevator
"All essential parts of the machine unit are located within the elevator shaft."
2010
Schindler 3300-AP
Schindler manufactures elevators with significantly smaller ACVE motors that can be installed in the elevator shaft, eliminating the need for a motor room above the shaft

LIFT

The development of elevators began in the 1870s and 1880s with the first installations in hotels in eastern Switzerland and the Bernese Oberland. Schindler soon followed, producing their first hydraulic and electrical elevators in 1890 and 1892.

Elevators revolutionized building accessibility and vertical transport, enabling taller buildings and urban densification.

The invention of the elevator also shifted the internal hierarchy of buildings: attics, once dusty storage spaces, have been transformed into penthouse apartments. The top floor, once seen as heroic or remote, has become associated with prestige and desirable living.

Today, through technological advances, specifically since the introduction of machine room-less elevators in the 2000, lift machine rooms are no longer projected onto the roof. As they have a typical lifespan of 25-30 years, they are the first of categories of technical components to soon dissappear from our roop spaces.

From the street to the roof, the rooms pile up one on top of the other, while the tent of a horizonless sky encloses the entire city. But the height of city buildings is a purely exterior one. Elevators do away with the heroism of stair climbing so that there is no longer any virtue in living up near the sky. Home has become mere horizontality. The different rooms that compose living quarters jammed into one floor all lack one of the fundamental principles for distinguishing and classifying the values of intimacy.
But in addition to the intimate value of verticality, a house in a big city lacks cosmicity. For here, where houses are no longer set in natural surroundings, the relationship between house and space becomes an artificial one.

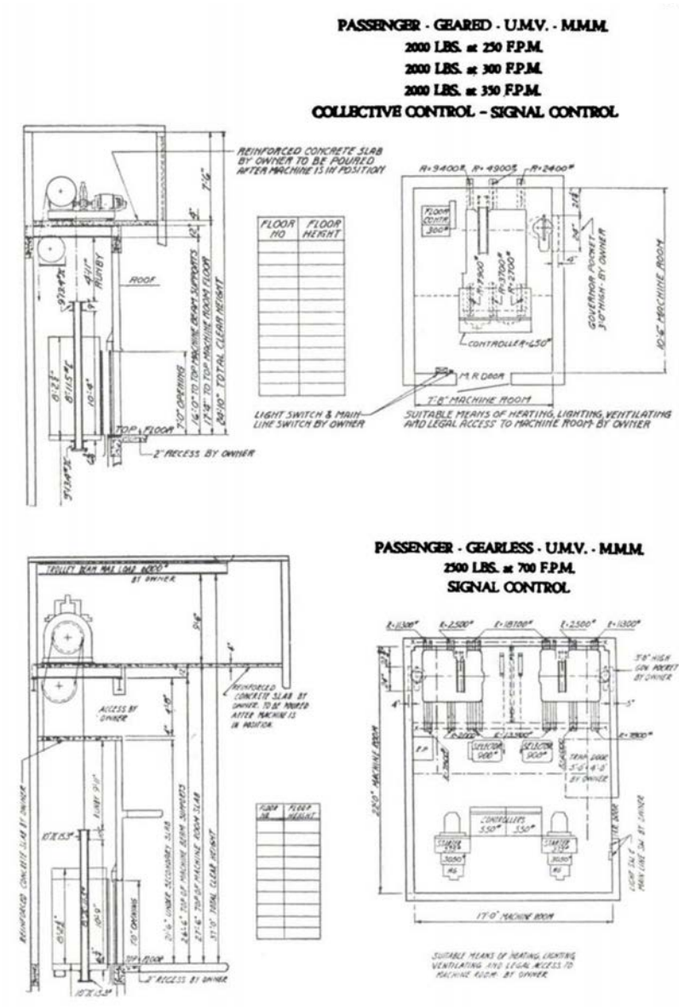
- Gaston Bachelard, Poetics of Space, 1957
on horizontality and the lack of cosmicity



IV.11
schweizerische bauzeitung
25.februar 1933

IV.12
1905 hammenschwand lift
bürgenstock, stans - 152,8m

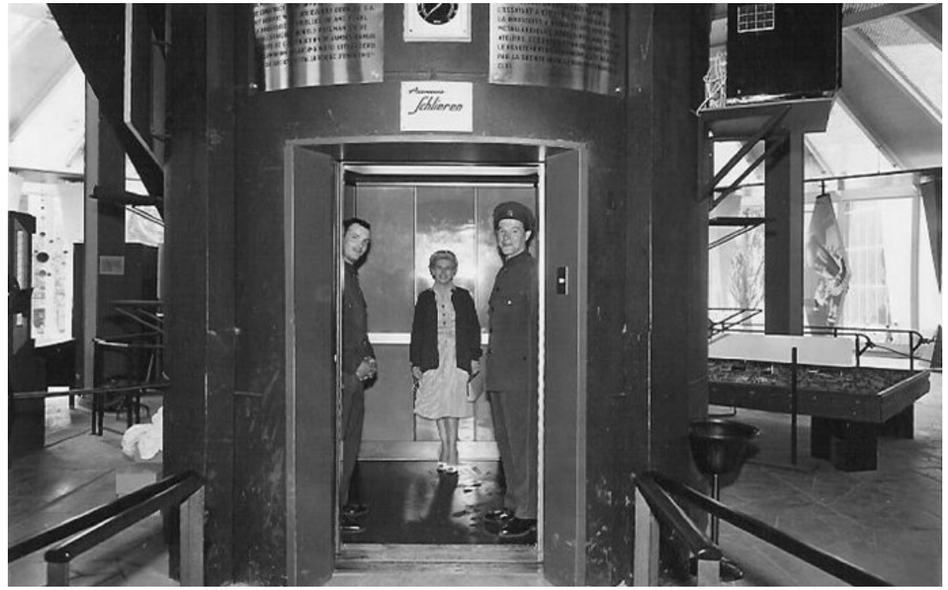




IV.13
1952 talbot hamlin, forms and functions of twentieth-century architecture

IV.14
1958 elevator for the atomium at brussels expo ‘58 - 90,7m

schweizerische wagon- und aufzügefabrik ag



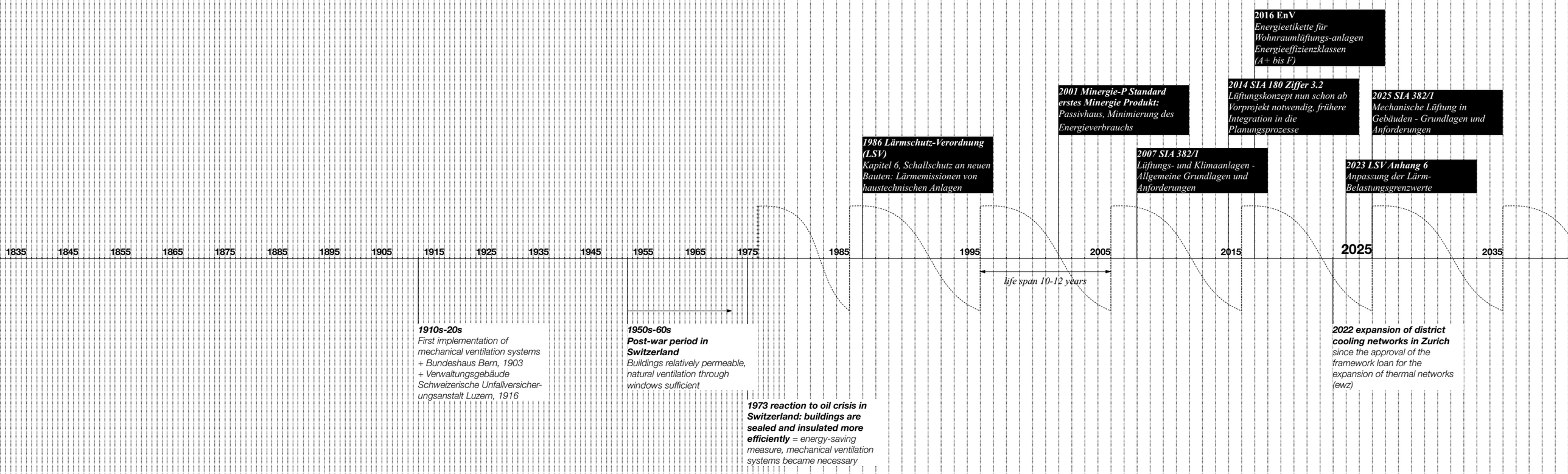
ELEVATOR
Elevator service is the lifeline of the tall building. The elevator shafts form the one fixed element of the service core, around which are grouped the stairs, toilets, and corridors. The cost of elevators (especially the cost of high-speed units) is a chief factor in determining how high a given structure can economically be built. In many low buildings where goods are handled elevators are also required, and their placing is an important element of planning; in high buildings they are absolutely vital.

(...) The machines may be either overhead or in the basement; usually the former is the case in the latest installations. The top-driven elevator, with its machinery above, is the type favored almost universally for large installations; the bottom-driven elevator is used chiefly in low buildings and in alterations of older structures.

ARCHITECTURAL REQUIREMENTS
In addition to shaft and lobby space on the main and typical floor plans, the architect must keep in mind the extra space required for the elevator machines and he must allow for access to them and provide means for handling heavy parts in case of replacement. The horizontal and vertical clearances required at the machine level are frequently a determining factor in the exterior form of the building, and the study of the elevator plan is not complete until the necessary dimensions have been applied to the building envelope; indeed, the original conception of the envelope as expressed in the preliminary sketches may have to be changed considerably. Where the building envelope is regulated by zoning ordinances the space requirements of the machine rooms may make necessary the replanning or even the loss of a rentable floor.

- Talbot Hamlin, Forms and Functions of Twentieth-Century Architecture, 1952

Ventilation



VENTILATION + CLIMATE

Switzerland's first mechanical ventilation systems appeared in the 1910s and 1920s, primarily in representational buildings as the Bundeshaus in Bern in 1903 or the SUVA building in Lucern in 1916.

Their use expanded significantly after the oil crisis of 1973, as increased awareness of energy efficiency made ventilation a tool for saving energy.

Today, ventilation and climate systems are highly regulated by norms and regulations, covering factors such as noise, temperature, and air flow rates. Buildings must comply with specific criteria, the introduction of the "Minergie-P" standard in 2001for example completely changed how many buildings are constructed today.

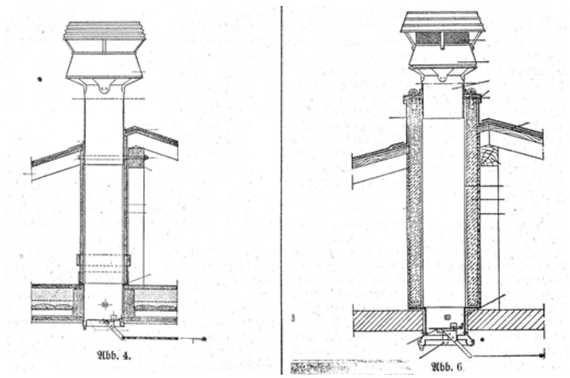
Modern ventilation and climate control are largely driven by the pursuit of indoor comfort, replacing traditional natural ventilation through operable windows. With rising expectations for interior climate quality, the demand for such systems continues to grow—a trend further reinforced by global warming and increasing air pollution. This follows the principle of the Jevons Paradox: as systems become more efficient and accessible, overall demand rises.

As these systems have a lifespan of 10-12 years, they adapt quickly to changing regulations. However, predictions for the future development of ventilation systems are varied.

Dominik Grepper (Zehnder Group) expects the use of ventilation systems to increase, especially as issues like global warming, air pollution and noise intensify. Additionally, standards such as the Minergie P certification require mechanical ventilation systems.

Henning Schulz (Schulz Ingenieure) believes that cooling will play an increasingly important role in the future, with demand continuing to rise. District cooling systems are currently being established in many cities, which would eliminate the need for rooftop or external air conditioning units. Additionally, the waste heat generated from cooling can be repurposed for other energy systems.

Prof. Arno Schlüter (ETHZ) states that the evolution of ventilation systems should not be driven by ever more complex technology, but rather by a better understanding and use of passive, simple, and robust solutions wherever possible. He sees significant potential in optimizing control strategies and rethinking the cultural paradigm of comfort, which could reduce energy demands and the extent of technical installations in the future.

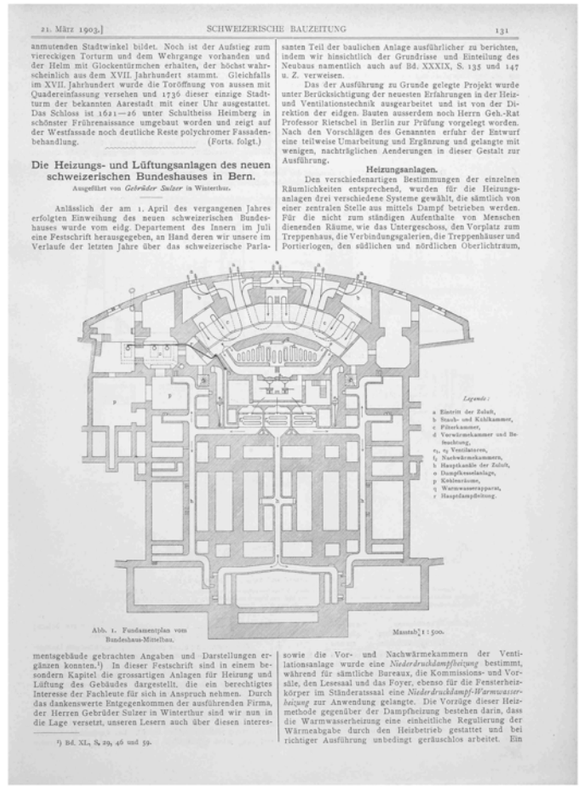


IV.15
illustrierte schweizerische handwerker-zeitung automatische lüftung, 1916

IV.16
schweizerische bauzeitung, advertisement 1910



IV.17
lüftungsanlage bundeshaus bern, 1903


21. März 1903.] SCHWEIZERISCHE BAUZEITUNG 131

anmutenden Stadtwinkel bildet. Noch ist der Aufstieg zum viereckigen Torturm und dem Wehrgange vorhanden und der Helm mit Glockentürmchen erhalten, der höchst wahrscheinlich aus dem XVII. Jahrhundert stammt. Gleichfalls im XVII. Jahrhundert wurde die Toröffnung von aussen mit Quadereinfassung versehen und 1736 dieser einzige Stadtturm der bekannten Aarestadt mit einer Uhr ausgestattet. Das Schloss ist 1631—46 unter Schultheiss Heimberg in schönster Frührenaissance umgebaut worden und zeigt auf der Westfassade noch deutliche Reste polychromer Fassadenbehandlung. (Forts. folgt.)

Die Heizungs- und Lüftungsanlagen des neuen schweizerischen Bundeshauses in Bern.

Ausgeführt von *Gebrüder Sulzer* in Winterthur.

Anlässlich der am 1. April des vergangenen Jahres erfolgten Einweihung des neuen schweizerischen Bundeshauses wurde vom eidg. Departement des Innern im Juli eine Festschrift herausgegeben, an Hand deren wir unsere im Verlaufe der letzten Jahre über das schweizerische Parlamentsgebäude gebrachten Angaben und Darstellungen ergänzen konnten.[1]) In dieser Festschrift sind in einem besondern Kapitel die grossartigen Anlagen für Heizung und Lüftung des Gebäudes dargestellt, die ein berechtigtes Interesse der Fachleute für sich in Anspruch nehmen. Durch das dankenswerte Entgegenkommen der ausführenden Firma, der Herren Gebrüder Sulzer in Winterthur sind wir nun in die Lage versetzt, unseren Lesern auch über diesen interessanten Teil der baulichen Anlage ausführlicher zu berichten, indem wir hinsichtlich der Grundrisse und Einteilung des Neubaus namentlich auch auf Bd. XXXIX, S. 135 und 147 u. Z. verweisen.

Das der Ausführung zu Grunde gelegte Projekt wurde unter Berücksichtigung der neuesten Erfahrungen in der Heiz- und Ventilationstechnik ausgearbeitet und ist von der Direktion der eidgen. Bauten ausserdem noch Herrn Geh.-Rat Professor Rietschel in Berlin zur Prüfung vorgelegt worden. Nach den Vorschlägen des Genannten erfuhr der Entwurf eine teilweise Umarbeitung und Ergänzung und gelangte mit wenigen, nachträglichen Aenderungen in dieser Gestalt zur Ausführung.

Heizungsanlagen.

Den verschiedenartigen Bestimmungen der einzelnen Räumlichkeiten entsprechend, wurden für die Heizungsanlagen drei verschiedene Systeme gewählt, die sämtlich von einer zentralen Stelle aus mittels Dampf betrieben werden. Für die nicht zum ständigen Aufenthalte von Menschen dienenden Räume, wie das Untergeschoss, den Vorplatz zum Treppenhaus, die Verbindungsgalerien, die Treppenhäuser und Portierlogen, den südlichen und nördlichen Oberlichtraum, sowie die Vor- und Nachwärmekammern der Ventilationsanlage wurde eine *Niederdruckdampfheizung* bestimmt, während für sämtliche Bureaux, die Kommissions- und Vorsäle, den Lesesaal und das Foyer, ebenso für die Fensterheizkörper im Ständeratssaal eine *Niederdruckdampf-Warmwasserheizung* zur Anwendung gelangte. Die Vorzüge dieser Heizmethode gegenüber der Dampfheizung bestehen darin, dass die Warmwasserheizung eine einheitliche Regulierung der Wärmeabgabe durch den Heizbetrieb gestattet und bei richtiger Ausführung unbedingt geräuschlos arbeitet. Ein

Abb. 1. Fundamentplan vom Bundeshaus-Mittelbau. Maßstab 1 : 500.

Legende:
a Eintritt der Zuluft,
b Staub- und Kühlkammer,
c Filterkammer,
d Vorwärmekammer und Befeuchtung,
e, e1 Ventilatoren,
f, f1 Nachwärmekammern,
h Hauptkanäle der Zuluft,
o Dampfmaschinenanlage,
p Kesselräume,
q Warmwasserapparat,
r Hauptdampfleitung.

[1]) Bd. XL, S. 29, 46 und 59.

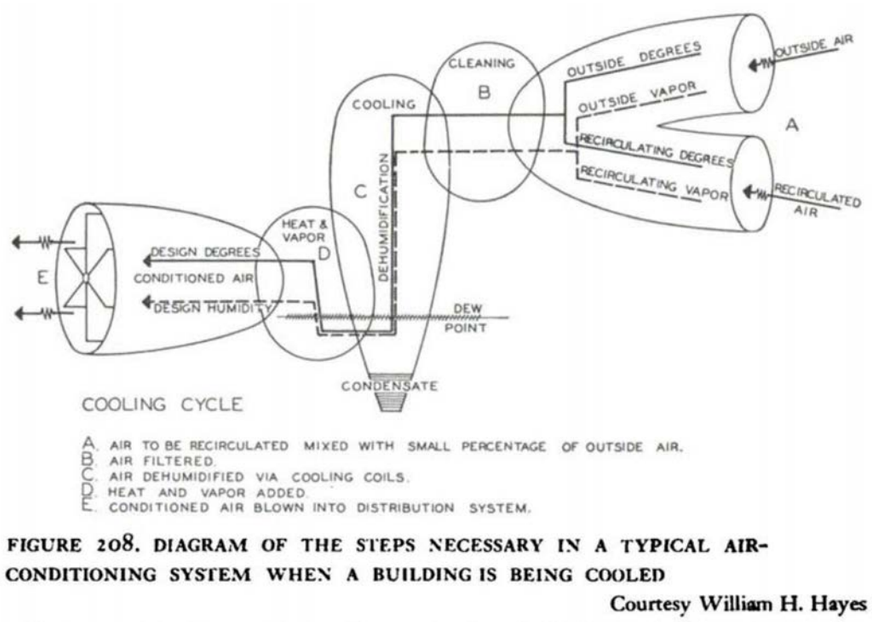


FIGURE 208. DIAGRAM OF THE STEPS NECESSARY IN A TYPICAL AIR-CONDITIONING SYSTEM WHEN A BUILDING IS BEING COOLED

Courtesy William H. Hayes

IV.18
talbot hamlin, forms and functions of twentieth-century architecture, 1952

AIR CONDITIONING

The basic purposes of air-conditioning systems are:

1. To maintain temperatures and humidities that are comfortable for occupants or suitable for industrial processes
2. To create air motion, where this will contribute comfort
3. To remove odors, humidity, and heat locally generated, as in locker rooms, washrooms, kitchens, laundries, and machine rooms
4. To avoid the accumulation of vapors that might constitute a health, fire, or explosion hazard

Basically a good air-conditioning system must do all the following:
1. Maintain the correct temperatures for comfort, changing them automatically with the weather and with other requirements
2. Maintain the relative humidity within acceptable limits at all temperatures
3. Circulate enough air to maintain reasonable inlet temperatures and humidities and to assure proper distribution and diffusion without objectionable „drafts“
4. Introduce a sufficient proportion of outdoor air to secure comfort and health, avert odors, and prevent the fouling of coils and ducts
5. Remove used air in such a manner as to preclude smoke or other objectionable constituents
6. Remove objectionable dust from the air being supplied
The use of a high proportion of outdoor air may be a simple way of giving good results, but it is a costly way since in summer it takes more refrigeration —and in winter more fuel—to „condition“ outdoor air than to use recirculated return air.

VENTILATION
Mechanical ventilation has two basic objectives: (1) to introduce sufficient outdoor air for the comfort and health of the occupants; and (2) to carry away heat, humidity, odors, and harmful gases

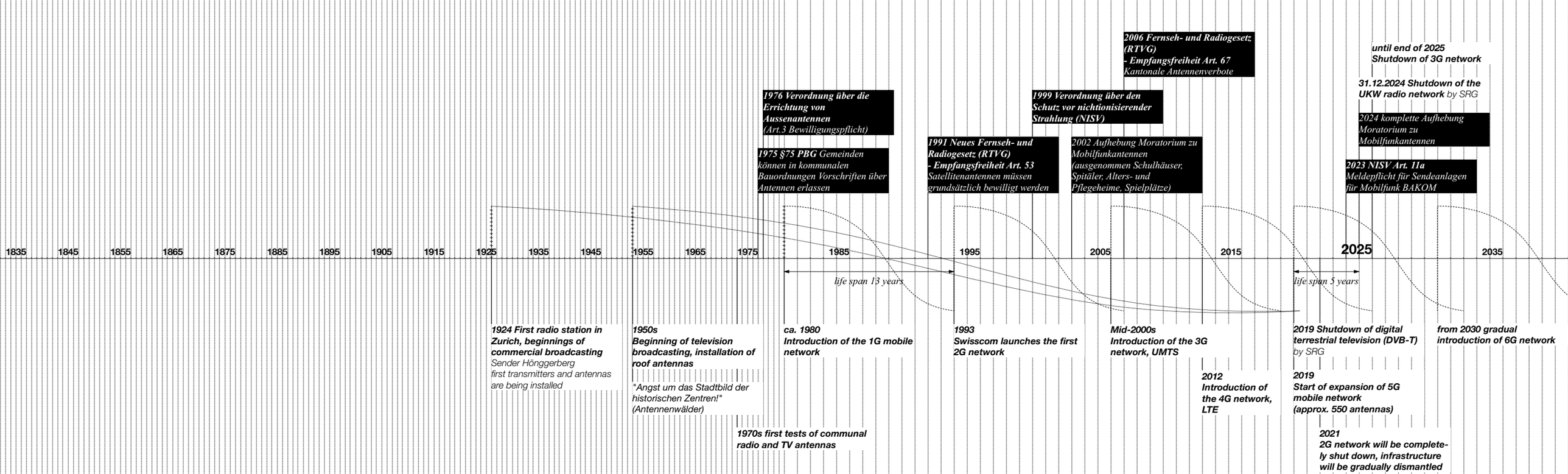
- Talbot Hamlin, Forms and Functions of Twentieth-Century Architecture, 1952

DISTRICT COOLING

Similar to district heating, district cooling is provided by one or more central plants, such as groundwater cooling plants or compression cooling plants, and distributed to customers via a pipe network. District cooling is transported to consumers in the form of cold water (~8°C) through a pipe network that is independent of district heating. The water heated in the customers‘ cooling systems (~16°C) flows back to the district cooling center via a second pipe network, where it is cooled down again. District cooling can provide an environmentally friendly and user-friendly alternative to conventional air conditioning systems. In conventional air conditioning systems, compression refrigeration systems are powered by electrical energy. This results in high electricity consumption in summer. In addition, in most cases, large recoolers are required on the roofs of buildings. The use of district cooling frees up space on roofs for photovoltaic systems or greenery. Instead of electrical energy, district cooling can use a combination of groundwater and electrical energy or a combination of heat and electrical energy to provide cooling. The decisive factor for the environmental friendliness of district cooling is therefore the source of electrical energy and heat.

-Regionalwerke Baden

Antenna


2006 Fernseh- und Radiogesetz (RTVG)
- Empfangsfreiheit Art. 67
Kantonale Antennenverbote
until end of 2025
Shutdown of 3G network
31.12.2024 Shutdown of the UKW radio network by SRG
1999 Verordnung über den Schutz vor nichtionisierender Strahlung (NISV)
2024 komplette Aufhebung Moratorium zu Mobilfunkantennen
1976 Verordnung über die Errichtung von Aussenantennen (Art.3 Bewilligungspflicht)
1991 Neues Fernseh- und Radiogesetz (RTVG)
- Empfangsfreiheit Art. 53
Satellitenantennen müssen grundsätzlich bewilligt werden
2002 Aufhebung Moratorium zu Mobilfunkantennen (ausgenommen Schulhäuser, Spitäler, Alters- und Pflegeheime, Spielplätze)
2023 NISV Art. 11a
Meldepflicht für Sendeanlagen für Mobilfunk BAKOM
1975 §75 PBG Gemeinden können in kommunalen Bauordnungen Vorschriften über Antennen erlassen
1835 1845 1855 1865 1875 1885 1895 1905 1915 1925 1935 1945 1955 1965 1975 1985 1995 2005 2015 2025 2035
life span 13 years
life span 5 years
1924 First radio station in Zurich, beginnings of commercial broadcasting
Sender Hönggerberg
first transmitters and antennas are being installed
1950s
Beginning of television broadcasting, installation of roof antennas
"Angst um das Stadtbild der historischen Zentren!"
(Antennenwälder)
1970s first tests of communal radio and TV antennas
ca. 1980
Introduction of the 1G mobile network
1993
Swisscom launches the first 2G network
Mid-2000s
Introduction of the 3G network, UMTS
2012
Introduction of the 4G network, LTE
2019 Shutdown of digital terrestrial television (DVB-T)
by SRG
2019
Start of expansion of 5G mobile network
(approx. 550 antennas)
2021
2G network will be completely shut down, infrastructure will be gradually dismantled
from 2030 gradual introduction of 6G network

ANTENNA

Antennas first emerged with the rise of radio broadcasting in the 1920s and television in the 1950s. Even at that time, critical voices objected to them, primarily out of concern for the impact on the city's roofscape.

"Weg mit den Antennenwäldern auf den Dächern" (Schweizer Heimatschutz 1961)

The starting point of mobile communications in the 1980s, with the introduction of 1G technology, marked another milestone. Since then, each new generation of mobile networks has arrived in increasingly rapid succession: while the initial cycle lasted thirteen years, today a new system is introduced roughly every five years, further determining the transformation of our city's rooftops.

For many years, the installation of antennas on public buildings such as schools, nursing homes, and hospitals was prohibited under the "antenna moratorium." However, this restriction was lifted in 2024. Now, both the city and canton earn significant revenue by leasing rooftop space for antennas.

Antennas are essential elements of the urban infrastructure, supporting the communication networks our society depends on. Their primary purpose is to ensure connectivity for mobile and data services, with their importance only increasing as new generations of networks - 5G and 6G - are developed. Official projections already anticipate a significant expansion of antenna installations across Zurich in the coming years.

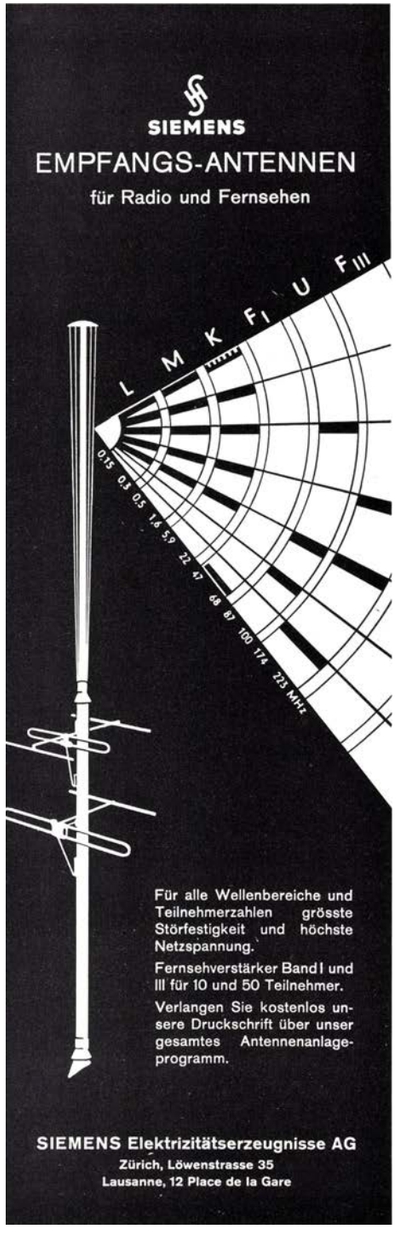
Despite their critical role, antennas have relatively short lifespans, typically five years or even less, as technology cycles accelerate. This rapid renewal often leaves behind obsolete structures, as currently visible in the old radio and TV antennas, which are no longer receiving any signals.

Antennas have long been at the centre of public debate over the cityscape. While a variety of technical devices occupy rooftops, antennas are the most visible and frequently discussed. Concerns about electromagnetic fields surround mobile antennas, raising questions about proximity and health risks.

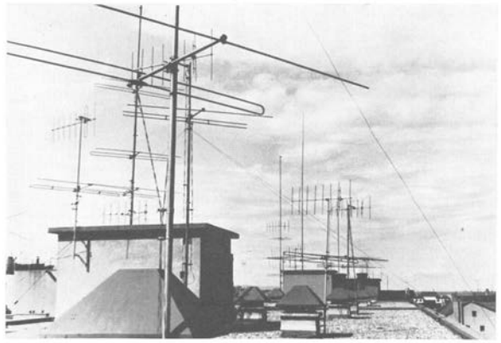
In Switzerland, three major network operators dominate the landscape: Swisscom, Salt, and Sunrise. They typically sign contracts lasting five to ten years for antenna placements, which not only secure their economic interests but also restrict the transformation and alternative use of rooftop spaces. Safety guidelines often block access to areas around antennas, reducing the available space for other potential uses.

IV.19
sendemast, fake chimney
2009





IV.20
bauen und wohnen, 1956



Weg mit den «Antennenwäldern» auf den Dächern!

Schon vor etlichen Jahrzehnten, d. h. in der Geburtszeit des Radios, ertönte dieser Kampfruf. Der Ästhetik wegen wurde gegen die doppelt und vierfach gespannten Drähte auf den Dächern protestiert. In der Tat, Dorf- und Stadtbilder wurden ‚verschandelt'. Allerdings trugen damals auch die noch in der Luft herumhängenden elektrischen Drähte und die Telephonleitungen wesentlich dazu bei, den Anblick ganzer Stadt-, Dorf- und Landschaftsteile zu verunstalten. Das sei der ‚Fluch der Technik', so argumentierten viele heimat- und naturliebende Leute. In Wirklichkeit handelte es sich um eine technische Kinderkrankheit. Innert verhältnismäßig kurzer Zeit wurde es möglich, das unansehnliche Drahtgewirr zum Verschwinden zu bringen; denn die neuen Radioapparate arbeiteten auf Mittel- und Langwellen auch ohne Außenantenne völlig befriedigend. Der technische Fortschritt hatte aus sich selbst die anfänglichen Unzulänglichkeiten überwunden.

Mit dem UKW-Rundspruch und dem Fernsehen kehrte jedoch das Problem der Antennen auf unseren Dächern zurück, und diesmal war und ist es schwerer zu lösen; denn die Ausbreitungsbedingungen für UKW und Fernsehen sind von denjenigen der Radiowellen für Mittel- und Langwellenempfang grundsätzlich verschieden. In den UKW-Bereichen gelten für die Ausbreitung praktisch bereits optische Gesetze, d. h., daß zwischen Sende- und Empfangsanlage in der Regel *direkte* Sicht vorhanden sein sollte. Es ist freilich möglich, daß durch Reflexionen an harten Gegenständen – Bergen, Hängen, Felsen, Wäldern, Häusern usw. – ein Empfang trotzdem möglich ist. Diese reflektierten Wellen können aber beim Fernsehen sogenannte ‚Geisterbilder' und beim UKW-Rundspruch Verzerrungen des Tones verursachen. Die Forderung nach möglichst direkter Sicht ruft also meistens einem möglichst hohen Standort der Empfangsantenne. Ein weiterer Nachteil der UKW-Empfangstechnik ist, daß für den UKW-Rundspruch und für jeden zu empfangenden Fernsehsender in der Regel je eine separate, d. h. verschieden lange Antenne nötig ist. Die Größe,

IV.21
schweizer heimatschutz, 1961

IV.22
financial income through mobile antennas, city and canton of zurich

So viel verdient die Stadt mit Mobilfunkantennen

Standort	Jahresmiete in Fr.	Anzahl Antennen
Elektrizitätswerk der Stadt Zürich (EWZ)	1'863'000	207
Verkehrsbetriebe Zürich (VBZ)	144'000	16
Verwaltungsgebäude der Stadt Zürich	80'000	9
Gewerbe- und Wohnliegenschaften	60'273	6
Grün Stadt Zürich	30'000	10
Total Stadt Zürich	**2'177'273**	**248**

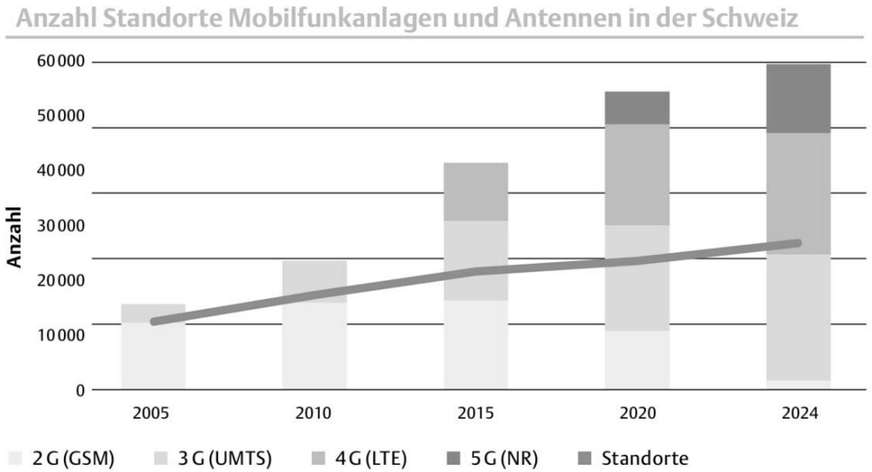
Tabelle: mre • Quelle: mrs, Behördenangaben • Daten herunterladen

So viel verdient der Kanton mit Mobilfunkantennen

Standort	Jahresmiete in Fr.	Anzahl Antennen
Kantonale Gebäude und Grundstücke	388'000	40
Universitätsspital (Schätzung)	150'000	10
Universität Zürich	40'000	4
Total Kanton Zürich	578'000	54

* *Schätzung*

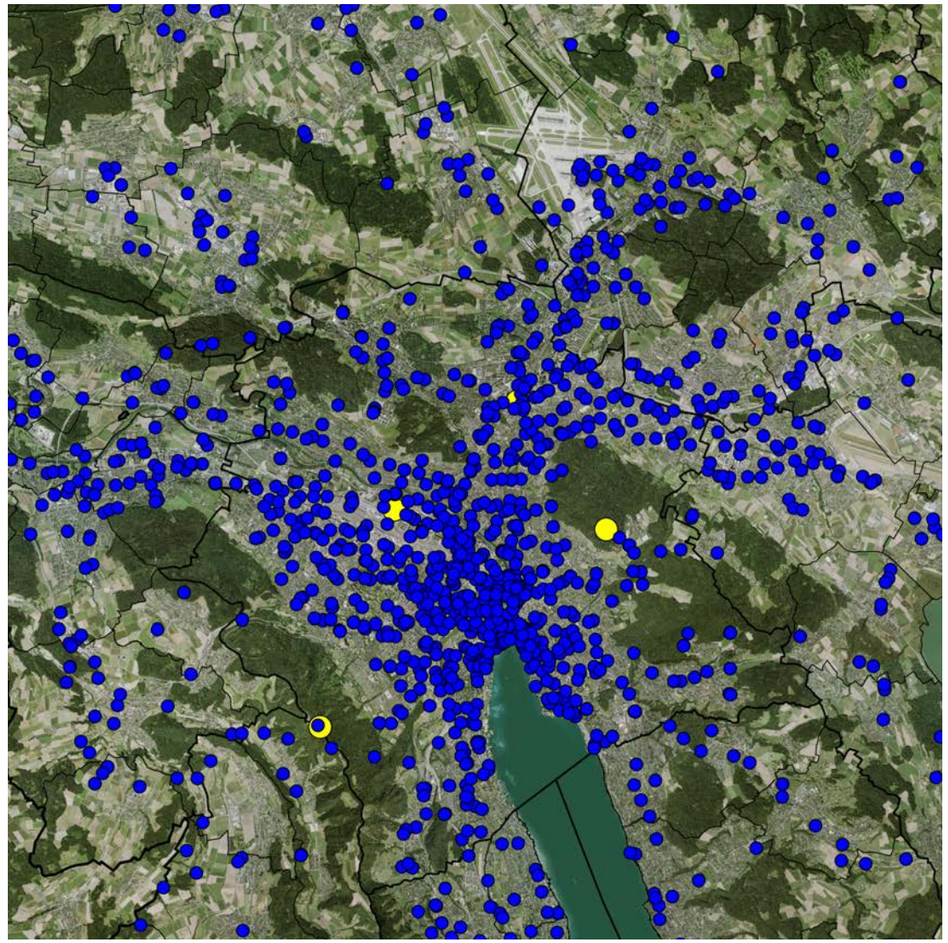
Tabelle: mre • Quelle: mrs/Behördenangaben • Daten herunterladen



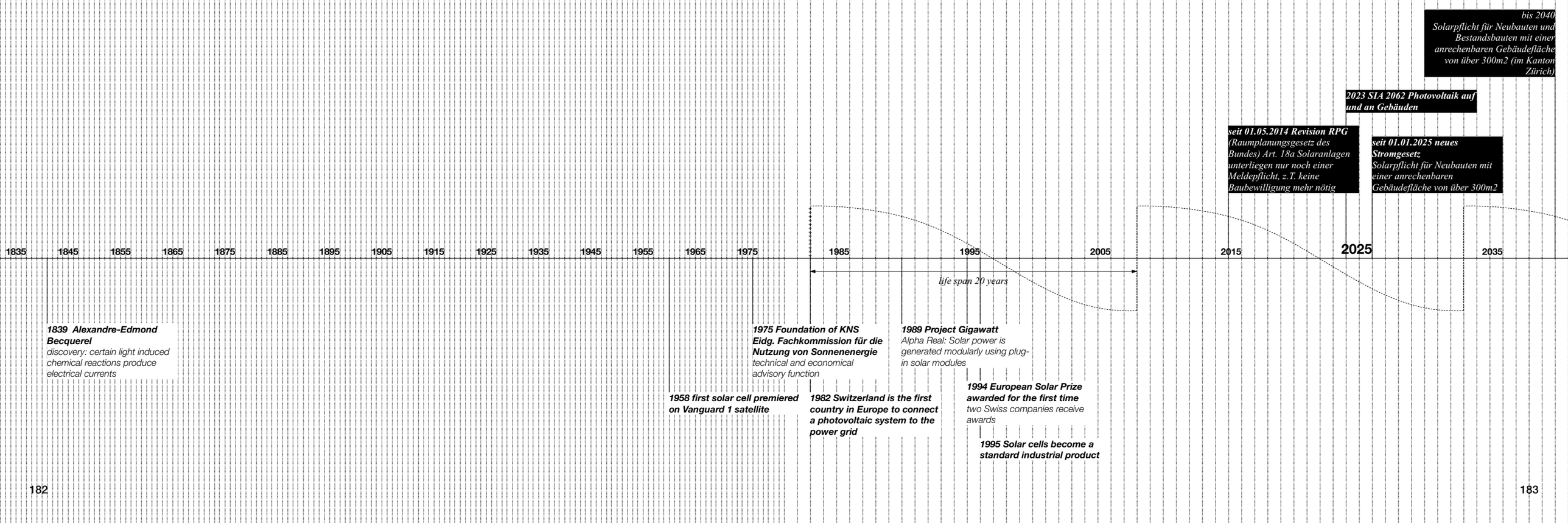
IV.23
anzahl standorte mobilfunk-antennen und antennen in der schweiz

Seit 2005 hat sich die Anzahl Standorte von Mobilfunkanlangen in der Schweiz mehr als verdoppelt. Mit dem Ausbau des 5G-Netzes ist ebenfalls die Anzahl installierter Antennen je Standort stetig gestiegen. Geschuldet ist diese Entwicklung dem steigenden Datenkonsum von Nutzerinnen und Nutzern. Gemäss der Erhebung von Ericsson verdoppelte sich in den letzten Jahren das mobile Datenvolumen weltweit alle 18 Monate hauptsächlich aufgrund vermehrter Videonutzung. Die Videoübertragung macht heute rund drei Viertel des gesamten mobilen Datenverkehrs aus.

IV.24
standorte von mobilfunkanlagen stadt zürich



Solar


bis 2040
Solarpflicht für Neubauten und Bestandsbauten mit einer anrechenbaren Gebäudefläche von über 300m2 (im Kanton Zürich)
2023 SIA 2062 Photovoltaik auf und an Gebäuden
seit 01.05.2014 Revision RPG (Raumplanungsgesetz des Bundes) Art. 18a Solaranlagen unterliegen nur noch einer Meldepflicht, z.T. keine Baubewilligung mehr nötig
seit 01.01.2025 neues Stromgesetz
Solarpflicht für Neubauten mit einer anrechenbaren Gebäudefläche von über 300m2
1835 1845 1855 1865 1875 1885 1895 1905 1915 1925 1935 1945 1955 1965 1975 1985 1995 2005 2015 2025 2035
life span 20 years
1839 Alexandre-Edmond Becquerel
discovery: certain light induced chemical reactions produce electrical currents
1958 first solar cell premiered on Vanguard 1 satellite
1975 Foundation of KNS Eidg. Fachkommission für die Nutzung von Sonnenenergie
technical and economical advisory function
1982 Switzerland is the first country in Europe to connect a photovoltaic system to the power grid
1989 Project Gigawatt
Alpha Real: Solar power is generated modularly using plug-in solar modules
1994 European Solar Prize awarded for the first time
two Swiss companies receive awards
1995 Solar cells become a standard industrial product

SOLAR

The first solar panels were installed in Switzerland in the 1980s and, since 1995, they have become a standardized industrial product.

Their typical lifespan is around 20 years, though some of the older systems, such as the one at Technopark, have proven to last longer.

Solar panels are installed for renewable energy production. The city of Zurich aims to meet 4–6% of its energy needs with solar power by 2050.

Through a new law, requiring new and existing buildings of more than 300m2 footprint to install solar systems by 2040. Subsequently, the use of solar panels is expected to increase significantly.

Solar systems today also exists as rental models, similar to antennas. Surface are of roof space can be rented to firms for a fixed amount of years, generating additional income without the effort of maintenance.

Peter Küng (solar installer at Solarsys) I would say that the overall trend in the industry over the past 10 years, since I started working in this field, has remained largely unchanged.
In fact, we sometimes hear that large companies are struggling to get enough projects. The most interesting development at the moment, in my opinion, is the combination of solar panels and green roofs. Solar panels significantly accelerate plant growth, meaning we have to mow up to five times a year to prevent efficiency losses due to shading. Recently, we started mounting the panels at a height of 80–100 cm, but this can hinder the green roof and also creates challenges with wind loads.

Prof. Arno Schlüter (ETHZ) presumes that the use of solar panels will continue to grow, driven by regulations and the need for renewable energy, but integrating them with other rooftop functions—such as green roofs and public spaces—will become increasingly important.
He sees potential in designing roofs as multi-functional platforms where vegetation, energy production, and human activities coexist in synergy.

Retrofitting a solar installation is often more complicated than expected. Solar panels frequently compete for space with all other technical equipment already present on the roof. The condition and age of the roof are also important factors—it's generally not advisable to install a solar system on a roof that is approaching the end of its lifespan before the roof covering has been renovated.

IV.25
1995 vermessung, photogrammetrie, kulturtechnik
project gigawatt, system solkit

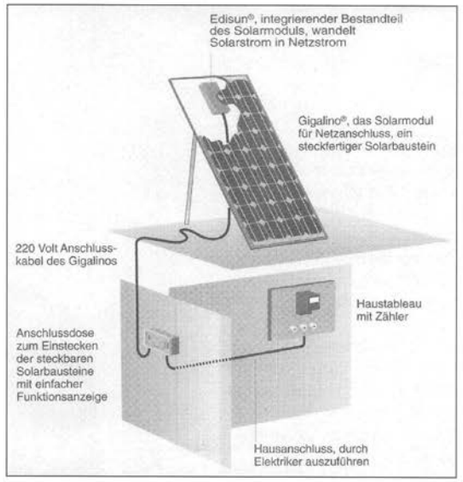


Abb. 12: Projekt Gigawatt: steckerfertige Solarmodule Gigalino.

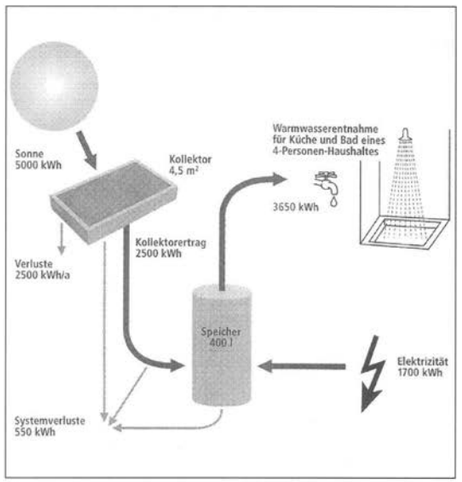
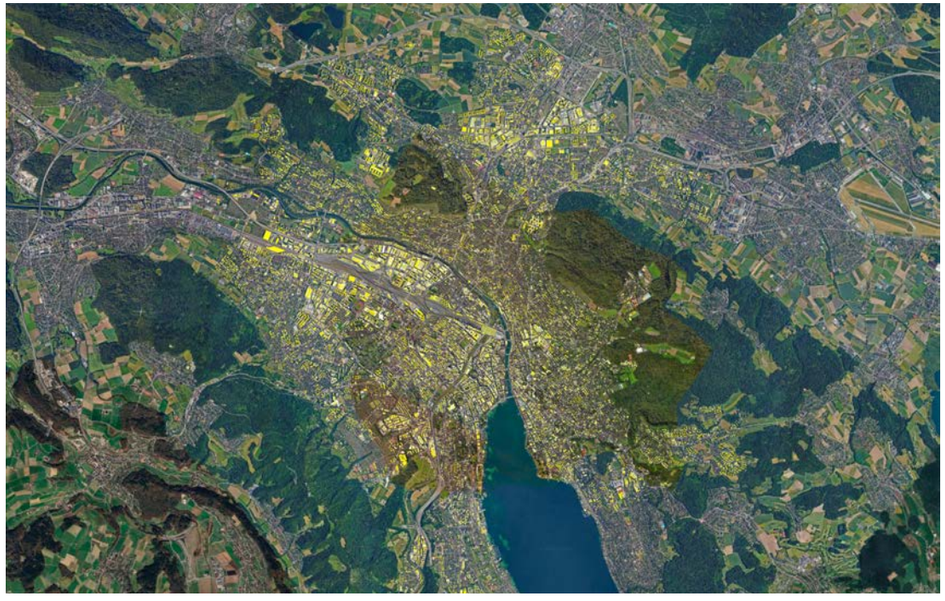


Abb. 13: Kleinsystem Solkit für solare Warmwasseraufbereitung.



IV.26
swisssolar, solarpotential dächer zürich

IV.28
1995 vermessung, photogrammetrie, kulturtechnik
sonnenenergie in der schweiz



IV.27
swisssolar, 4% anteil solarstrom schweiz

Partie rédactionnelle

Regionale und kommunale Energieplanungen:

Sonnenenergie in der Schweiz

Th. Glatthard

Regionale und kommunale Energieplanungen fördern den Einsatz einheimischer und regenerierbarer Energien, die Nutzung bestehender lokaler Energiequellen sowie den rationellen Einsatz von Energie. Der folgende Beitrag stellt die Möglichkeiten und Grenzen der Sonnenenergienutzung in der Schweiz vor.

Les planifications énergétiques régionales et communales permettent de promouvoir l'emploi d'énergies indigènes et renouvelables, l'utilisation de sources d'énergies locales existantes ainsi que l'emploi rationnel d'énergie. Le présent exposé décrit les possibilités et les limites de l'énergie solaire en Suisse.

Le pianificazioni energetiche a livello regionale e comunale incentivano l'uso di energie nazionali e rigenerabili, lo sfruttamento di fonti energetiche locali già esistenti e l'impiego razionale dell'energia. Nell'articolo seguente si presentano le possibilità e i limiti dello sfruttamento dell'energia solare.

Sonnenenergie kann genutzt werden, um Wärme, Strom und Brennstoff zu gewinnen. In der Schweiz sind bisher gegen 10 000 Anlagen zur Wärmeerzeugung und rund 700 Anlagen zur Stromproduktion in Betrieb. Die Brennstofferzeugung steht erst am Anfang.
Bei Solaranlagen zur Wärmeerzeugung wird zwischen aktiven und passiven Systemen unterschieden. Aktive Systeme (Sonnenkollektoren) benötigen für den Wärmetransport mittels Pumpen oder Ventilatoren Strom; passive Systeme (sogenannte Solar-Architektur) benötigen keine Zusatzenergie.
Photovoltaik (abgekürzt PV) bezeichnet die Stromerzeugung aus Solaranlagen. Mit einem Quadratmeter Solarzellen werden je nach Standort rund 100 Kilowattstunden pro Jahr produziert, was dem Verbrauch eines Fernsehgerätes entspricht. Bei Netzverbundanlagen können Überschüsse aus der Photovoltaikanlage an das EW-Netz abgegeben werden, ein Mehrverbrauch wird aus dem EW-Netz bezogen. Die Verrechnung des eingespiesenen bzw. bezogenen Stroms erfolgt über einen Stromzähler. Die Elektrizitätswerke betreiben selbst rund 100 Anlagen bzw. sind daran beteiligt.
Dem breiten Einsatz der Sonnenenergie stehen die geringe Energiedichte der einfallenden Sonnenstrahlen und die starken zeitlichen Schwankungen der Strahlungsintensität sowie zurzeit noch die hohen Kosten entgegen. Die Forschung und Entwicklung in der Solartechnik machen aber grosse Fortschritte, so dass diese umweltfreundliche Energie an Bedeutung zunehmen wird.

Zentrale Solarkraftwerke

Das grösste Photovoltaik-Kraftwerk der Schweiz befindet sich auf dem Mont Soleil im Berner Jura (Abb. 1). 1986/87 erarbeitete die Elektrowatt AG, Zürich, in Zusammenarbeit mit der ETH Zürich eine standortunabhängige Konzeptstudie für den Bau eines Solarkraftwerks mit einer Leistung von 5000 Kilowatt. Die Realisierung erfolgte durch die Bernischen Kraftwerke AG und weitere Elektrizitätsgesellschaften und Industrieunternehmen auf dem Mont Soleil oberhalb St-Imier. Finanzielle Unterstützung leisteten der Nationale Energieforschungsfonds (NEFF), der Bund und

Förderung der Sonnenenergienutzung

Die Sonnenenergieverbände zusammen mit dem Schweizerischen Gemeindeverband haben die «Energie-Umwelt-Charta» lanciert. Die sparsame und sinnvolle Energienutzung soll mit einem Punktesystem und dem Titel «Energiestadt» belohnt werden. Und auch die Beschleunigungsaktion Solare Vorwärmung im Rahmen von «Energie 2000» gibt der Verbreitung der Sonnenenergienutzung neue Impulse.
In der gleichen Richtung wirkt auch der Zusammenschluss der Sonnenenergieverbände und der Berufs- und Fachverbände zur Swissolar, an deren Spitze der CVP-Ständerat Bruno Frick als Präsident steht.
Aber auch die kantonalen und kommunalen Bau- und Energievorschriften können die Sonnenenergienutzung unterstützen. Im Kanton Bern können aufgrund des revidierten Baugesetzes seit Januar 1995 die meisten Sonnenenergieanlagen ohne Baubewilligung montiert werden. Der Kanton Bern hat im September 1994 eine Broschüre «Der vereinfachte Weg zur Solaranlage» herausgegeben, in der Empfehlungen zur Auswahl und Anordnung von Energiekollektoren zusammengefasst sind. (Bezug: Wasser- und Energiewirtschaftsamt des Kantons Bern, Reiterstrasse 11, 3011 Bern.)



Abb. 1: Grösstes Photovoltaik-Kraftwerk der Schweiz: Mont Soleil im Berner Jura.



Abb. 2: Grösstes Photovoltaik-Kraftwerk in den Schweizer Alpen: Caischavedra ob Disentis.

Maintenance

1983 VUV Art.17
´Dächer, die aus betrieblichen Gründen oft betreten werden müssen, sind so zu gestalten, dass sie von den Arbeitnehmern sicher begangen werden können.´

1996 EN 795 Norm für persönliche Absturzsicherungsausrüstung

1997 SN EN 795 Norm für persönliche Absturzsicherungsausrüstung
Einführung in der Schweiz

2011 BauAV Art.81e
´Zugänge zu Anlagen (...) auf Dächern dürfen begangen werden, wenn die zur Sicherung notwendigen festen Vorrichtungen wie Laufstege oder feste Leitern zwischen den Aussteigöffnungen im Dach und den betreffenden Anlagen vorhanden sind.´

2021 SIA 271
´Sicherheitsvorrichtungen wie Höhensicherungssysteme, Anschlagpunkte, Geländer, Dachaufstiege usw. sind unter Berücksichtigung der örtlichen BauAV und der lokalen Vorschriften so zu projektieren, dass ein gefahrloser Unterhalt (...) möglich ist.´

1835 1845 1855 1865 1875 1885 1895 1905 1915 1925 1935 1945 1955 1965 1975 1985 1995 2005 2015 **2025** 2035

2014 company registration
Lux-Top Schweiz
Lux-Top Deutschland was founded in 1993

2014 company registration
ABS Absturzsicherungen CH
ABS Safety GmbH (Germany) was founded in 2003

MAINTENANCE

The industry for rooftop safety systems and devices is relatively young, having only emerged over the past 20–25 years. This development reflects society's evolving relationship with safety. The systems primary purpose is to protect workers during maintenance cycles for all other technical equipment.

While the metal components themselves can last indefinitely, they are often replaced when building usage changes. According to Richard Weiss, these systems cannot be re-used, as this would lead to issues around certification and proving their functionality.

Looking ahead, the demand for rooftop safety systems is expected to rise further. As more technical equipment is installed and maintenance needs grow, additional safety provisions will inevitably follow.

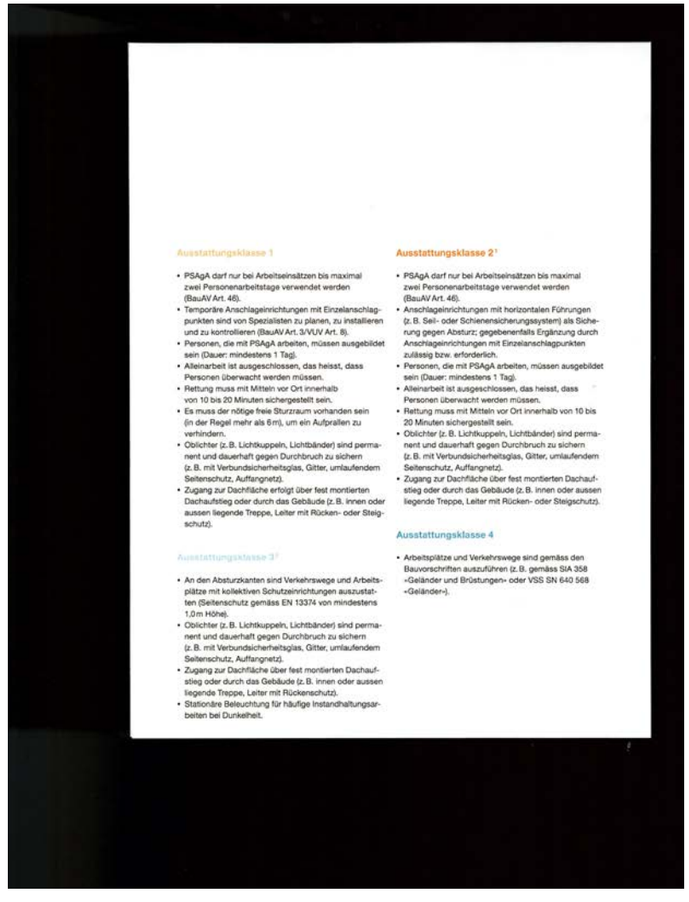
Richard Weiss (technical sales consultant at ABS)
`The company's market volume is and will also in the coming years be growing steadily, driven by increasing regulations and greater societal awareness for safety. In the future, system development might focus more on railings, which offer simple application, work well in combination with solar installations, and don't require special safety training like a PSAgA course. In central Switzerland, many railings are already being installed, just in Zurich, they are still largely avoided for aesthetic reasons. ´

IV.29
petzl logo, advertisement for rope systems

PETZL®

Access
the
inaccessible

IV.30
suva ausstattungsklassen 1-4 defining necessary systems



Ausstattungsklasse 1

- PSAgA darf nur bei Arbeitseinsätzen bis maximal zwei Personenarbeitstage verwendet werden (BauAV Art. 46).
- Temporäre Anschlageinrichtungen mit Einzelanschlagpunkten sind von Spezialisten zu planen, zu installieren und zu kontrollieren (BauAV Art. 3/VUV Art. 8).
- Personen, die mit PSAgA arbeiten, müssen ausgebildet sein (Dauer: mindestens 1 Tag).
- Alleinarbeit ist ausgeschlossen, das heisst, dass Personen überwacht werden müssen.
- Rettung muss mit Mitteln vor Ort innerhalb von 10 bis 20 Minuten sichergestellt sein.
- Es muss der nötige freie Sturzraum vorhanden sein (in der Regel mehr als 6 m), um ein Aufprallen zu verhindern.
- Oblichter (z. B. Lichtkuppeln, Lichtbänder) sind permanent und dauerhaft gegen Durchbruch zu sichern (z. B. mit Verbundsicherheitsglas, Gitter, umlaufendem Seitenschutz, Auffangnetz).
- Zugang zur Dachfläche erfolgt über fest montierten Dachaufstieg oder durch das Gebäude (z. B. innen oder aussen liegende Treppe, Leiter mit Rücken- oder Steigschutz).

Ausstattungsklasse 2[1]

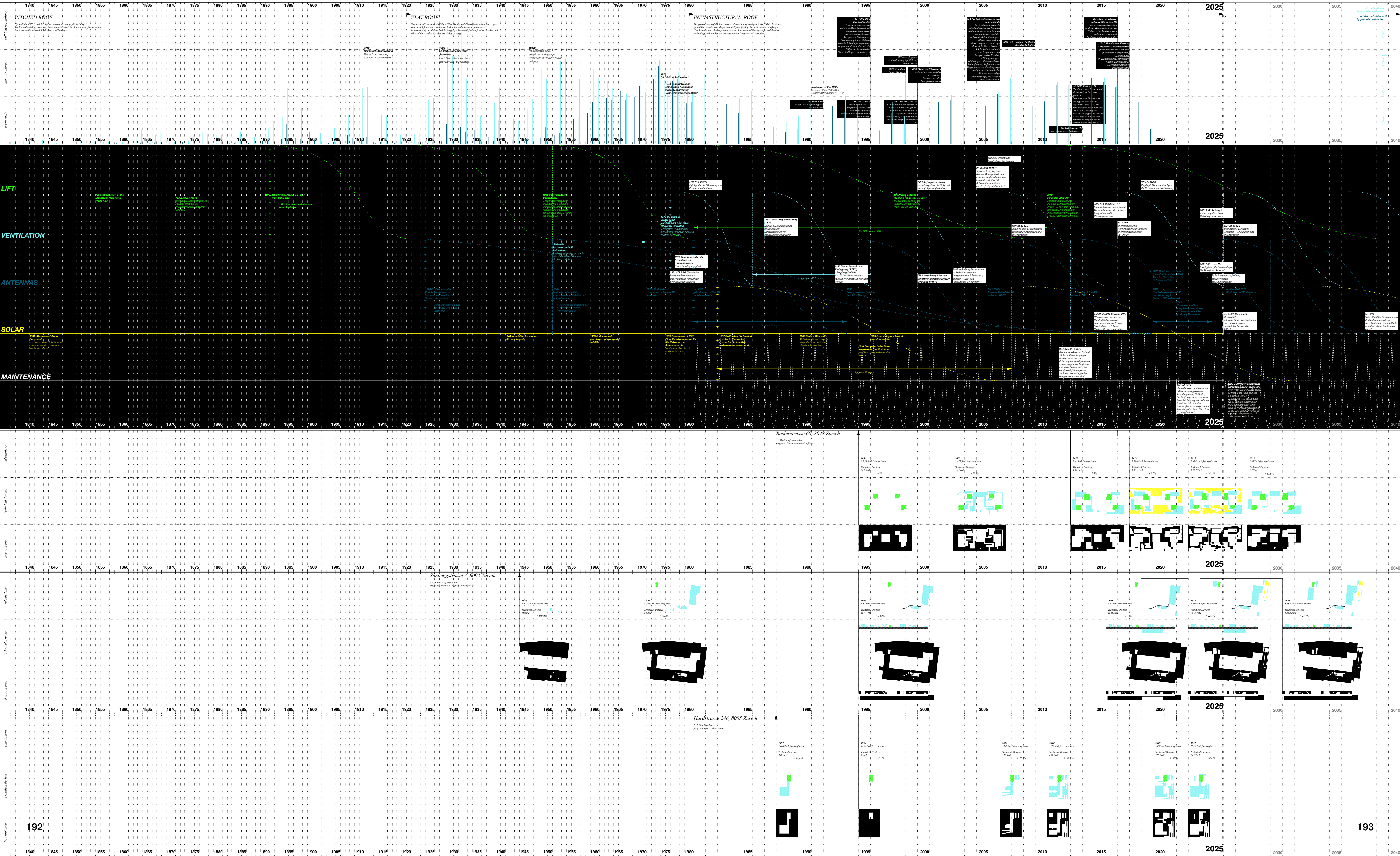
- PSAgA darf nur bei Arbeitseinsätzen bis maximal zwei Personenarbeitstage verwendet werden (BauAV Art. 46).
- Anschlageinrichtungen mit horizontalen Führungen (z. B. Seil- oder Schienensicherungssystem) als Sicherung gegen Absturz; gegebenenfalls Ergänzung durch Anschlageinrichtungen mit Einzelanschlagpunkten zulässig bzw. erforderlich.
- Personen, die mit PSAgA arbeiten, müssen ausgebildet sein (Dauer: mindestens 1 Tag).
- Alleinarbeit ist ausgeschlossen, das heisst, dass Personen überwacht werden müssen.
- Rettung muss mit Mitteln vor Ort innerhalb von 10 bis 20 Minuten sichergestellt sein.
- Oblichter (z. B. Lichtkuppeln, Lichtbänder) sind permanent und dauerhaft gegen Durchbruch zu sichern (z. B. mit Verbundsicherheitsglas, Gitter, umlaufendem Seitenschutz, Auffangnetz).
- Zugang zur Dachfläche über fest montierten Dachaufstieg oder durch das Gebäude (z. B. innen oder aussen liegende Treppe, Leiter mit Rücken- oder Steigschutz).

Ausstattungsklasse 3[1]

- An den Absturzkanten sind Verkehrswege und Arbeitsplätze mit kollektiven Schutzeinrichtungen auszustatten (Seitenschutz gemäss EN 13374 von mindestens 1,0 m Höhe).
- Oblichter (z. B. Lichtkuppeln, Lichtbänder) sind permanent und dauerhaft gegen Durchbruch zu sichern (z. B. mit Verbundsicherheitsglas, Gitter, umlaufendem Seitenschutz, Auffangnetz).
- Zugang zur Dachfläche über fest montierten Dachaufstieg oder durch das Gebäude (z. B. innen oder aussen liegende Treppe, Leiter mit Rückenschutz).
- Stationäre Beleuchtung für häufige Instandhaltungsarbeiten bei Dunkelheit.

Ausstattungsklasse 4

- Arbeitsplätze und Verkehrswege sind gemäss den Bauvorschriften auszuführen (z. B. gemäss SIA 358 «Geländer und Brüstungen» oder VSS SN 640 568 «Geländer»).


building regulations
climate / energy
green roofs
PITCHED ROOF
Up until the 1920s, zurichs city was characterized by pitched roofs. Traditional building practises, local materials and the climatic need for water and snow protection shaped the distinct roof lanscape.
FLAT ROOF
The modernist movement of the 1920s-50s favored flat roofs for clean lines, open spaces and functional aesthetics. Technological advances of improved waterproofing, insulation and drainage systems made flat-roofs more durable and allowed for a wider distribution of this typology.
INFRASTRUCTURAL ROOF
The phenomenon of the infrastructural mostly roof emerged in the 1990s. In terms of building regulations, they are initially justified by Zurich's existing roofscape. 'Dachzinnen' and chimneys have always characterized the cityscape and the new technology and machines are considered a "progressive" variation.
1910 Heimatschutzbewegung
Flat roofs as ,mauvais exemple' = bad example
1926 Le Corbusier and Pierre Jeanneret
Les 5 Points d'une Architecture Nouvelle: Roof Gardens
1950s
Flat roofs were finally established and became widely used in various types of buildings.
1973 Oil crisis in Switzerland
1974 Federal Council establishes "Eidgenössische Komission für Gesamtenergiekonzeption"
beginning of the 1990s
concept of the 2000-Watt Gesellschaft emerges at ETHZ
seit 1991 BZO
Pflicht zur Begrünung von Flachdächern
1995 § 292 PBG Dachaufbauten
'Wo kein geringeres oder grösseres Mass bestimmt ist, dürfen Dachaufbauten, ausgenommen Kamine, Anlagen zur Nutzung von Sonnenenergie und kleinere technisch bedingte Aufbauten, insgesamt nicht breiter als die Hälfte der betreffenden Fassadenlänge sein, sofern sie (...)
1995 BZO Art. 6
'Flachdächer sind zu begrünen, soweit dies zweckmässig sowie technisch und wirtschaftlich zumutbar ist.'
1998 Gründung Verein Minergie
1999 Energiegesetz
erstmals Energiepolitik auf Bundesebene
seit 1999 BZO Art. 11
"Flachdächer sind, soweit sie nicht als Terrassen genutzt werden, in allen Zonen zu begrünen, wenn dies zweckmässig sowie technisch und wirtschaftlich zumutbar ist."
2001 Minergie-P Standard
erstes Minergie Produkt: Passivhaus, Minimierung des Energieverbrauchs
SIA 423 Gebäudedimensionen und Abstände
7.5 'Technisch bedingte Dachaufbauten wie Kamine, Lüftungsanlagen usw. können den höchsten Punkt der Dachkonstruktion überragen, dürfen aber in ihren Abmessungen das zulässige Mass nicht überschreiten.'
9.6 Technisch bedingte Dachaufbauten sind beispielsweise Kamine, Lüftungsanlagen, Kühlanlagen, Motoren-räume, Liftaufbauten, Aufbauten über Treppenhäusern, Dachzugänge und für den Unterhalt des Daches notwendige Dachausstiege, Brüstungen und Geländer usw.
2009 erste Ausgabe Leitfaden Dachlandschaften
2013 SIA Norm 312
Begrünung von Flachdächern
seit 2015 BZO Art. 11
"In allen Zonen ist der nicht als begehbare Terrasse genutzte Bereich eines Flachdachs ökologisch wertvoll zu begrünen, auch dort, wo Solaranlagen installiert sind. Die Pflicht, ökologisch wertvoll zu begrünen, besteht, soweit dies technisch und betrieblich möglich sowie wirtschaftlich tragbar ist."
2016 Bau- und Zonenordnung (BZO) Art. 18b
'Im zweiten Dachgeschoss sind (...) Kamine, Anlagen zur Nutzung von Sonnenenergie und kleinere technisch bedingte Aufbauten erlaubt.'
2017 Aktualisierte Fassung Leitfaden Dachlandschaften
(Best Practise für Kern- und Quartiererhaltungszonen)
7. Solaranlage
9. Technikaufbau, Liftanlage, Kamin, Lüftungskanal
10. Mobilfunkantenne, Parabolantenne
m² roof surfaces by year of construction
m² flat roof surfaces by year of construction
LIFT
1853 Introduction of the Elevator at New Yorks World Fair
1870er/80er Jahre
erste hydraulisch betriebenen Aufzüge in Hotels der Westschweiz und im Berner Oberland
1890 first hydraulic elevator from Schindler
1892 first electrical elevator from Schindler
1948 Schweizerische Bauzeitung:
Freight and Passenger elevators have become increasingly comfortable in recent years increased performance due to higher travel speeds
1979 SIA 370/10
Aufzüge für die Förderung von Personen und Gütern
1997 Kone patents a machine room-less elevator
"All essential parts of the machine unit are located within the elevator shaft"
1999 Aufzugsverordnung
Verordnung über die Sicherheit von Aufzügen (aufgehoben)
01.01.2004 BeHiG
"öffentlich zugängliche Bauten, Wohngebäude mit mehr als acht Einheiten und Gebäude mit über 50 Arbeitsplätzen müssen barrierefrei gestaltet sein."
seit 2005 gesetzliche Meldepflicht für Aufzüge
2010 Schindler 3300-AP
Schindler manufactures elevators with significantly smaller ACVE motors that can be installed in the elevator shaft, eliminating the need for a motor room above the shaft
SN EN 81-70
Zugänglichkeit von Aufzügen für Personen mit Behinderung
life span 25-30 years
VENTILATION
1950s-60s Post-war period in Switzerland:
Buildings relatively permeable, natural ventilation through windows sufficient
1973 Oil crisis in Switzerland:
Buildings are now more efficiently insulated = energy-saving measure, mechanical ventilation systems became necessary
1986 Lärmschutz-Verordnung (LSV)
Kapitel 6, Schallschutz an neuen Bauten: Lärmemissionen von haustechnischen Anlagen
2007 SIA 382/1
Lüftungs- und Klimaanlagen - Allgemeine Grundlagen und Anforderungen
2014 SIA 180 Ziffer 3.2
Lüftungskonzept nun schon ab Vorprojekt notwendig, frühere Integration in die Planungsprozesse
2016 EnV
Energieetikette für Wohnraumlüftungs-anlagen Energieeffizienzklassen (A+ bis F)
2023 LSV Anhang 6
Anpassung der Lärm-Belastungsgrenzwerte
2025 SIA 382/1
Mechanische Lüftung in Gebäuden - Grundlagen und Anforderungen
1976 Verordnung über die Errichtung von Aussenantennen
(Art.3 Bewilligungspflicht)
1975 §75 PBG Gemeinden können in kommunalen Bauordnungen Vorschriften über Antennen erlassen
1992 Neues Fernseh- und Radiogesetz (RTVG) - Empfangsfreiheit
Art. 53 Satellitenantennen müssen grundsätzlich bewilligt werden
life span 10-12 years
1999 Verordnung über den Schutz vor nichtionisierender Strahlung (NISV)
2002 Aufhebung Moratorium zu Mobilfunkantennen
(ausgenommen Schulhäuser, Spitäler, Alters- und Pflegeheime, Spielplätze)
2019 Shutdown of digital terrestrial television (DVB-T) by the Swiss Broadcasting Corporation (SRG)
2023 NISV Art. 11a
Meldepflicht für Sendeanlagen für Mobilfunk BAKOM
2024 komplette Aufhebung Moratorium zu Mobilfunkantennen
ANTENNAS
1924 First radiostation in Zurich, beginnings of commercial broadcasting
First transmitters and antennas are being installed.
1950s Beginning of television broadcasting, installation of roof antennas
1970s first tests of communal radio and TV antennas
ca. 1980 introduction of the 1G mobile network
1993 Swisscom launches the first 2G network
Mid-2000s introduction of the 3G network, UMTS
2012 introduction of the 4G network, LTE
2019 Start of expansion of 5G mobile network (approx. 550 antennas)
2021 2G network will be completely shut down, infrastructure will be gradually dismantled
until end of 2025 Shutdown of 3G network
life span 13 years
life span 5 years
SOLAR
1839 Alexandre-Edmond Becquerel
discovery: certain light induced chemical reactions produce electrical currents
1940 foundation for modern silicon solar cells
1958 first solar cell premiered on Vanguard 1 satellite
1975 Foundation of KNS Eidg. Fachkommission für die Nutzung von Sonnenenergie
technical and economic advisory function
1982 Switzerland is the first country in Europe to connect a photovoltaic system to the power grid
1989 Project Gigawatt
Alpha Real: Solar power is generated modularly using plug-in solar modules
1994 European Solar Prize awarded for the first time
two Swiss companies receive awards
1995 Solar cells as a typical industrial product
life span 20 years
seit 01.05.2014 Revision RPG
(Raumplanungsgesetz des Bundes) Solaranlagen unterliegen nur noch einer Meldepflicht, z.T. keine Baubewilligung mehr nötig
seit 01.01.2025 neues Stromgesetz
Solarpflicht für Neubauten mit einer anrechenbaren Gebäudefläche von über 300m2
bis 2024
Solarpflicht für Neubauten und Bestandsbauten mit einer anrechenbaren Gebäudefläche von über 300m2 (im Kanton Zürich?)
MAINTENANCE
2011 BauAV Art.81e
'Zugänge zu Anlagen (...) auf Dächern dürfen begangen werden, wenn die zur Sicherung notwendigen festen Vorrichtungen wie Laufstege oder feste Leitern zwischen den Ausstiegöffnungen im Dach und den betreffenden Anlagen vorhanden sind.'
2021 SIA 271
'Sicherheitsvorrichtungen wie Höhensicherungssysteme, Anschlagpunkte, Geländer, Dachaufstiege usw. sind unter Berücksichtigung der örtlichen BauAV und der lokalen Vorschriften so zu projektieren, dass ein gefahrloser Unterhalt (...) möglich ist.'
2025 SUVA (Schweizerische Unfallversicherungsanstalt)
'Every year, around 220 people fall from roofs while carrying out roofing work in Switzerland. The consequences of falls are usually much more serious than in other types of workplace accidents. Of the 220 people involved in accidents, three die and 15 suffer permanent injuries'
calculations
technical devices
free roof area
Baslerstrasse 60, 8048 Zurich
3.532m2 roof area today
program: 'business center', offices
1994
3.250,6m2 free roof area
Technical Devices
281,4m2
> 8%
2002
2.477,8m2 free roof area
Technical Devices
1.054m2
> 29,8%
2012
2.419m2 free roof area
Technical Devices
1.113m2
> 31,5%
2016
1.280,8m2 free roof area
Technical Devices
2.251,2m2
> 63,7%
2022
1.474,3m2 free roof area
Technical Devices
2.057,7m2
> 58,3%
2023
2.417m2 free roof area
Technical Devices
1.115m2
> 31,6%
Sonneggstrasse 3, 8092 Zurich
6.959,9m2 roof area today
program: university, offices, laboratories
1944
3.171,5m2 free roof area
Technical Devices
16,4m2
> 0,005%
1970
4.503,9m2 free roof area
Technical Devices
540m2
> 10,7%
1994
5.810m2 free roof area
Technical Devices
1149,9m2
> 16,5%
2015
5.576m2 free roof area
Technical Devices
1383,9m2
> 19,8%
2018
5.416,4m2 free roof area
Technical Devices
1543,5m2
> 22,1%
2023
5.467,7m2 free roof area
Technical Devices
1.492,2m2
> 21,4%
Hardstrasse 246, 8005 Zurich
1.767,6m2 roof area
program: offices, data center
1987
1418,2m2 free roof area
Technical Devices
349,4m2
> 19,8%
1994
1694,6m2 free roof area
Technical Devices
73m2
> 4,1%
2006
1440,7m2 free roof area
Technical Devices
326,9m2
> 18,5%
2010
1110,4m2 free roof area
Technical Devices
657,2m2
> 37,2%
2019
1057,4m2 free roof area
Technical Devices
710,2m2
> 40%
2021
1049,7m2 free roof area
Technical Devices
717,9m2
> 40,6%
2025

CONVERSATION WITH PROF. ARNO SCHLÜTER
Architecture and Building Systems Group, ITA, ETHZ

SW I am currently working on the topic of infrastructural roofs, questioning their current functions and trying to understand their spatial potential. These spaces are of course closely entangled with technical systems that supply the building and have to be taken in account when planning a transformational project.

Can buildings be adapted retrospectively or are they dependent on technical solutions for their entire lifetime?

AS I've been in Singapore for 15 years now, and there, roof landscapes have a completely different importance. In the tropics, these so-called "void decks" and the opportunity to access the rooftop as a recreational space are quite dominant. Therefore, the conflicts over how these spaces are used are much stronger.
Here in Zurich, especially in office and commercial buildings—roofs are rarely used. As a result, technical equipment is simply placed on top, as these spaces were never imagines for other functions.

Ventilation systems for example don't have to occupy the roof by default. Often, it's a combination of economics, practicality, and sometimes a lack of imagination by planners and engineers. With centralised ventilation systems, equipment is typically placed on the roof, since the space is otherwise unused. However, there are alternative concepts, such as decentralised or naturally ventilated systems, that don't require the use of the roof. These systems, though, require the building to be designed accordingly - with features like suspended ceilings or vertical shafts, which need significant space.

Switching to a different ventilation system can make it difficult to serve large or deep floor plans. In buildings requiring constant conditioning - take the Prime Tower, for example, with its sealed façade and high internal loads - mechanical systems on the roof are essentially unavoidable without major structural changes. While ambitious redesigns are possible - like large roof openings - they are rarely realised in practice.

SW How will ventilation and climate systems evolve in the future? Many firms that I have talked to predict a substantial increase of such systems in the coming years.

AS This is what the firms want. If nothing changes, this is what could happen. The problem we currently face is that our summers are getting hotter and heatwaves are lasting longer, but most of our buildings are not equipped to handle these conditions. If we as architects don't take action, the likely outcome will be the quick installation of air conditioning systems.

These units typically require cooling equipment, which is usually placed on the roof. But that's just one option. Our research shows that much of this additional cooling demand could be met with passive solutions - such as better operable windows, nighttime cooling, and combined heating and cooling systems, which many office buildings already have. Cooling with air conditioning is actually the least efficient method.

We also have very high air quality here in Zurich, so in nearly all cases, it's possible to ventilate with open windows; only in rare cases is this not feasible. Issues are more often thermal rather than related to air quality.

In most cases, buildings can be improved with simple measures: shading, natural ventilation, or cross-ventilation. We've created absurd situations, like building glass towers without any external shading—no matter how good the glass is, you still have to remove vast amounts of heat. Despite advances in glass technology, with higher insulation values and greater proportions of glass in façades, the challenge of cooling remains - and must be addressed. Future buildings will need to be designed differently to handle increased heat.

What we already know is that the solution does not have to involve ever more technology. However, if we fail to act, buildings will end up relying more and more on technical systems.

SW Do you believe that the jevons paradox/effect applies to the development of technical systems? Meaning that with increasing efficiency also the demand for such systems increases.

AS Generally speaking, technical building systems and their energy demand have significantly decreased over the past 25 years—by about 30–40% less energy and emissions per square meter.

However, we are building more and more square meters overall. Switzerland is growing, and instead of the previous 27 square meters of living space per person, we now have 43. This is the key point: as comfort levels rise, so does demand—this is the rebound effect.
It's not necessarily that people are using technical systems more intensively, but that other parameters shift: larger homes, for example. And of course, when people believe their systems are efficient, they tend to use them more freely and may not turn them off as often.
A good example: we once studied a small village with 309 buildings. In some older houses, only a single room was heated with a classic stove, so people used very little energy for heating—because they knew it was costly and inconvenient. In contrast, new buildings from the 2000s were heated throughout without a second thought.

SW Is it possible to quantify/estimate how many m2 of built space is used for technical systems today?

AS This really depends on the building. There are certainly buildings today with a high degree of technical installations. In general, the amount of building services required has increased, as buildings are becoming more and more technically equipped.
This is well-known in research on embodied emissions, where various studies - often based on case studies - examine individual buildings. These studies often find that building services can account for around 30% of a building's total CO_2 emissions.

Since the past ten years, Architects, planners, and building services engineers are increasingly aware that you can't just keep adding more and more technology as before - there's a shift in mindset. So I don't think it will continue to rise linearly.

However, the issue of cooling will be interesting. If we don't manage to design new buildings - or retrofit existing ones - to handle hotter days and heatwaves, we will definitely see many more technical installations in the coming years. But those installations may not be located on the roof; instead, they'll be mounted on facades. Then we'll start to see these unsightly protrusions all over building exteriors.

SW Could centralised cooling systems provide an alternative?

AS This is a global trend. It is called district cooling or low-temperature systems. Especially in very hot countries where constant cooling is needed, that's definitely the direction things are headed. In Singapore, for example, we've done a lot of research in the last five or six years on how to use district cooling systems. But over there, cooling is required 24/7, so the investment is worthwhile.

In Switzerland, even though it's getting warmer, we only really need cooling for 20 to 25 days a year. Large-scale adoption of cooling systems here only makes sense in buildings with constant cooling needs—like the laboratories, for example. We once calculated this for the university quarter and did a study on district cooling for the whole campus. It would drastically reduce CO_2 emissions, but the effort involved would be enormous.

What is more likely to happen here is the use of combined heating and cooling systems. A common method is using geothermal probes, which provide a steady temperature of about 13 to 15°C. That can be used as a base for heating—pumped up to 35°C in winter for an efficient heating system. In summer, the same system provides "free cooling": excess heat can be transferred into the ground, and the building can circulate cooler fluid instead. Some buildings around the lake use lake water for this purpose.
I believe using geothermal or groundwater cooling will become increasingly common. The good news is that these systems don't add more cooling units to rooftops, since the cooling source comes from elsewhere.

SW Researching these technical systems, I learned a lot about maintenance processes and the immense effort involved. Is this factor included in calculations for a building from the start?

AS The industry isn't interested in simplifying or improving, as that would go against their business model. Planners also earn a percentage based on the amount of technology they install, which of course makes it less likely for buildings to be designed with fewer or simpler systems. That's a core issue.

Developers, on the other hand, don't want to take any risks. If they're developing a building and a major tenant moves in, they want to guarantee it's always exactly 21°C, to avoid any complaints about it being too hot or too cold.

So, it's really a systemic problem. The concept and design of the building must come from architects and planners, and there needs to be an informed conversation with all parties. Planners need explicit approval and clear direction to design with less technology.

Responsibility must be shared. It's not just about avoiding blame if a system fails; everyone in the process, including the developer, must be informed and involved. Ultimately, as in many traditional processes, this requires cooperation along the whole chain. Many planners or engineers have little incentive to do things differently or better - they stick to established methods that also ensure their income. Maintenance is just another part of that system.

SW How does solar energy come to play here and is it possible to compensate for the energy consumption of other systems?

AS One aspect is the energy needed for operation; the other is the effort required to install all of this technology - ventilation systems with all their pumps, distribution units, pipes, and so on. That's extremely labor-intensive. But focusing on building operations, the main goal is to cover as much of the building's energy demand as possible with renewables, which often means solar energy.
For certain periods, this works very well. For example, there's a temporal overlap between cooling needs and solar power production. If you have a cooling system primarily powered by solar energy, everything aligns well, when it's hot and the sun is shining, you also need the most cooling. This match is ideal.

Whether solar is worthwhile depends on how much of the produced energy can actually be used within the building - what's known as "self-sufficiency." That is, the goal is to consume as much of your own generated energy on-site as possible. This makes the system both economically and ecologically strongest. So, solar is a good fit for the cooling demand. If you have a rooftop solar installation and use the electricity it produces to power cooling during peak loads, you can provide cooling with relatively low additional CO2 emissions. Heating is trickier, though, because when you need most heating - on grey, foggy, snowy days - the sun isn't shining as much.

But this overlap between solar energy production and cooling demand does exist and is interesting, although it only covers a smaller part of total building needs. Solar requirements may also become mandatory. There are model regulations at the cantonal level, for example, specifying that a certain percentage of a new building's energy must come from solar. Not all cantons follow these standards, but some do, such as requiring solar panels for new buildings. This makes a lot of sense - it's the most economical and ecological way to generate electricity. So, in a way, it's a no-brainer. But for the roof, it means yet another layer is added, which needs to be considered in planning.

What really interests us are the synergies between vegetation and solar panels. There are interesting connections: for example, a roof gets extremely hot under direct sunlight, but if you provide shading with solar panels, you increase biodiversity and can actually produce more on the roof. Conversely, the evaporation from plants can improve the efficiency of the solar panels.

This creates a kind of symbiosis, which I personally find very appealing. In my vision for future rooftops, solar panels, vegetation, and people can coexist side by side.

SW Historically, roof spaces were often used in Zurich. The typology of „Dachzinnen" exists since the 19th century and a lot of sources mention it as public or common space quite interesting. The solar installer would now argue from the exact opposite perspective. Solar systems accelerate the growth of plants on a green roof significantly and therefore increase the need for maintenance cycles from twice a year to five times a year. An often applied solution is to install the solar panels at around 1m height, therefore again compromising the growth of the green roof through shading.

Generally this is possible as technical installations are considered an exception from the building law.

AS wreat space, but here there seems to be no awareness or intention to make use of the roof for any purpose.

SW Historically, roof spaces were often used in Zurich. The typology of „Dachzinnen" exists since the 19th century and a lot of sources mention it as public or common space.

AS Today, due to increasing pressure on space, unused roof spaces are generally disappearing. The traditional attic for hanging laundry, for example, has vanished from the city of Zurich completely.

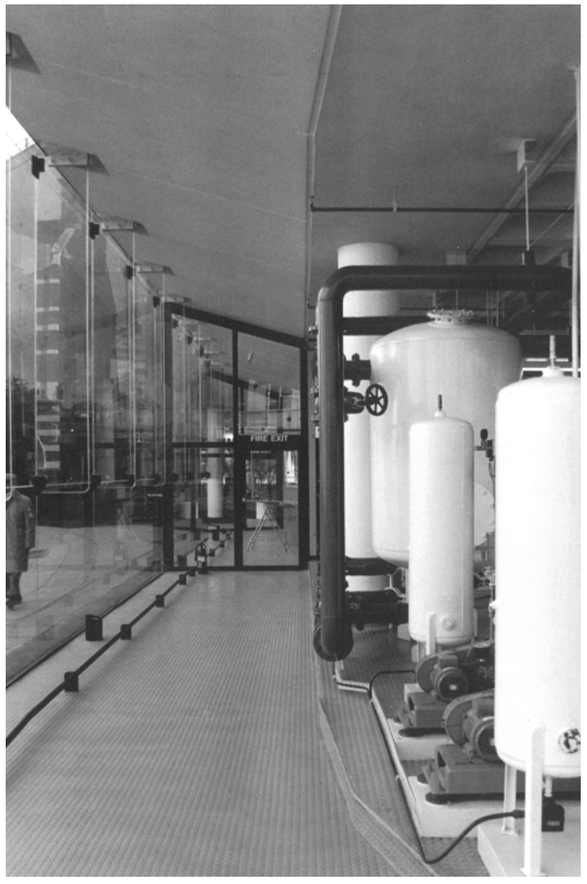
*SW Mapping flat roofed spaces adds up to 5.4km2 of vacant territory in Zurich. Only 30% of this surface is actually occupied by technical devices, still in most cases, the whole surface is rendered inaccessible.
What is your position on the integration of building systems? Does it make sense to integrate technical devices even if they have such short lifespans and the systems change rapidly?*

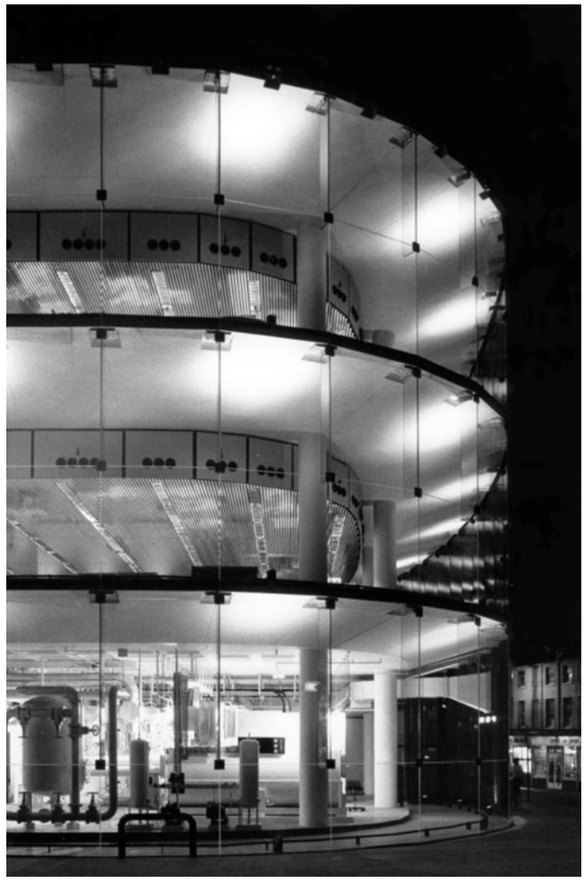
AS It's true that sometimes these systems are quite prone to failure, but as an engineer I can say that their physical and thermodynamic principles haven't changed in 100 years. There are heating systems from a century ago that still work today. I think it's more a case of planned obsolescence - these devices are often designed not to last as long. Technically, these systems are quite simple: ventilators, heat exchangers, and water pumps are not high-tech.
In many cases, efficiency could be improved much more by simply optimising how these systems are controlled and operated. Much of our research questions whether things need to run 24/7, or if spaces should only be ventilated or cooled when they're actually in use. By improving system controls, we see a 20–30% reduction in energy use and running hours, which likely also extends the system's lifespan.

It's an unfortunate cycle - the manufacturers profit from frequent replacements and repairs. If a building is designed with a central ventilation system, it's difficult to move away from that later. For new buildings and renovations, we should look for opportunities to replace these systems with passive or simpler, more robust solutions. That's something our profession has largely forgotten how to do; it's just easier to rely on technology.

Typically, we design the visible surfaces—what's hidden behind dropped ceilings and inside walls often isn't considered, yet it accommodates all this infrastructure to create a clean interior. Most people aren't aware of this; we focus on the room itself and maybe notice a light fitting, without thinking about the implications. Rem Koolhaas's "fake ceiling" exhibition from the Venice Biennale illustrates this perfectly.

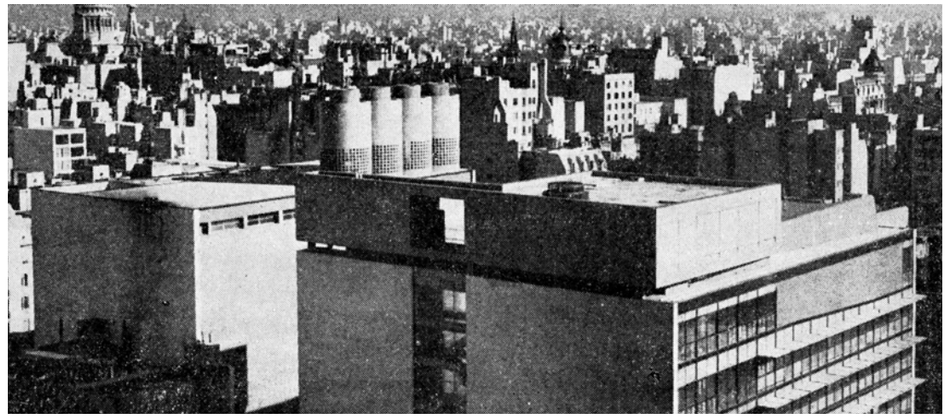
„(...) a domain over which architects have lost all control, a zone surrendered to other professions."
- Rem Koolhaas, Venice Biennale, 2014

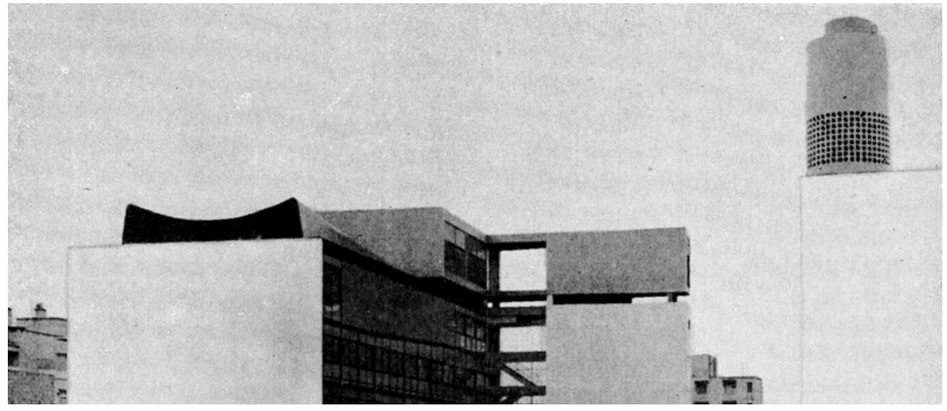


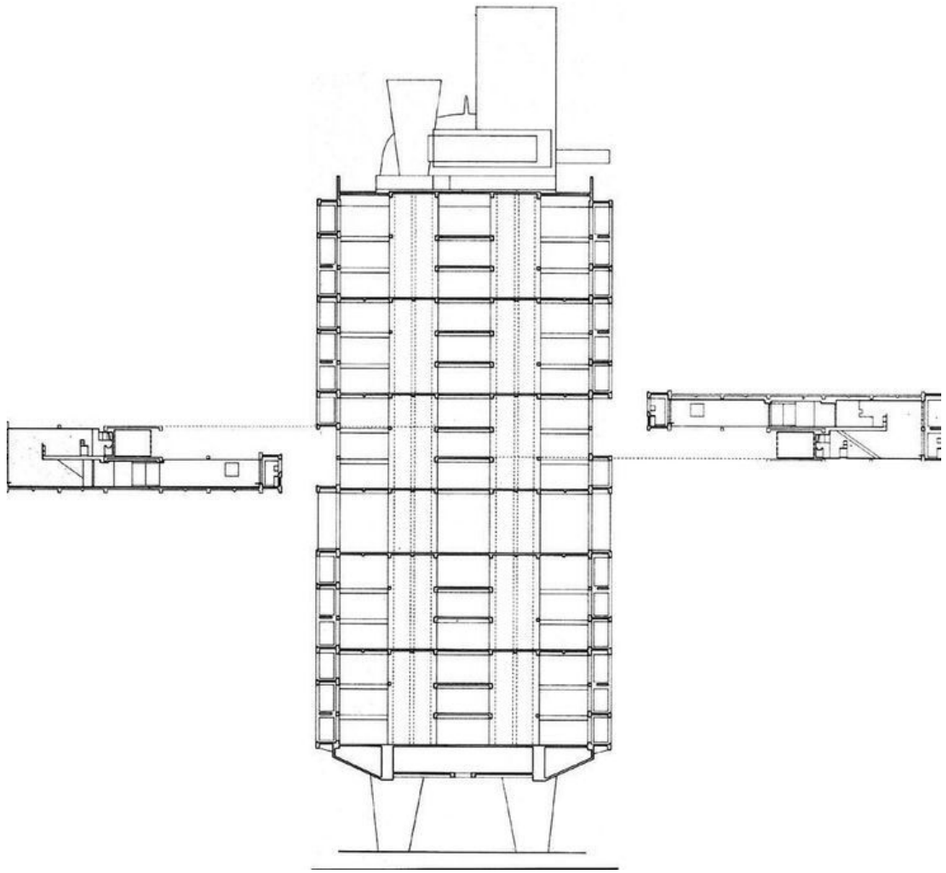


IV.31
willis, faber & dumas building
ipswich, norman foster, 1975

IV.32
teatro san martín, buenos aires
mario roberto alvarez







IV.33
unité d'habitation
le corbusier, 1945

IV.34
centre pompidou, renzo piano
and richard rogers, 1977



IV.35
mauersegler
peter thomann, 2010-15



V

BODY

`In front of it are high barbed-wire fences, locked gates, signs saying No TRESPASSING, and beyond, through sooty air, you see ugly strange shapes of metal and brick whose purpose is unknown, and whose masters you will never see.
What it‘s for you don‘t know, and why it‘s there, there‘s no one to tell, and so all you can feel is alienated, estranged, as though you didn‘t belong there. (...)
All this technology has somehow made you a stranger in your own land.´

- Robert M. Pirsig, Zen and the Art of Motorcycle Maintenance, 1974

On the scale of the BODY, the focus lays on the spatial and sensorial qualities of the space.

V.I Access and Maintenance

The inaccessibility of the roof mostly relates to economic viability, access and safety. Currently, the only human presence in these spaces is for the pragmatic purpose of maintenance and is only possible with authorised facility staff or a special permission to access.

Besides the inspections of the roof surface itself, all technical devices need to be maintained regularly as well, making it a much more frequented space than expected. Depending on the devices present, up to 35x people per year will enter a roof space in interdependent rhythms, some of the work can only be conducted seasonally and depending on climatic conditions. This number only calculates the regular inspections, not yet considering necessary repairs in case of malfunctions.

Investigating roof projections, traces of humans like small tiled paths, railings and rope systems seem out of scale and alien to their surroundings. They predefine every step of movement within the space. A choreography of movements, based on avoiding danger zones, which are all spaces 2m from a roof edge or skylight.
All maintenance elements on the roof are defined by the human body - in extreme situations. 2m is the length of a human falling horizontally, 30cm is the most minimal width of a path someone could walk and the 1.2t capacity is defined by 2x the weight of a human person falling the max. 6.5m when attached to a rope safety system.

In general these areas function as spaces of care—dedicated to maintaining buildings and their systems. Importantly, the work carried out always serves other spaces and functions, reducing the roof to a pure service zone.

To understand their processes and spatial qualities, gaining physical access to these spaces was important.
Throughout the research I visited many infrastructural roofs in Zurich, accompanied by people working in the facility management sector, but also assisted repairs and maintenance work with firms in the industry.

V.II Sensorial Experience

Experiencing the roof spaces is very special. Its qualities lay in its location as a high place, its relation to the sky and the external environment, but also in the characteristics of the infrastructure space itself.
As a purely functional space, not intended for humans, it is a space we don‘t often encounter. Noise, sounds, vibrations, electrical fields, air flows and smells of the surfacing technical installations allow us to read what is hidden inside. As humans are normally strictly separated from these machines, a transformation of the roof spaces is a chance to overcome the disconnection and improve human relation to infrastructure.

Surfacing through the roof plane, often via steep staircases or ladders, opens up a completely new perspective on the city. The perception turns outwards and the space appears almost as part of the public sphere.

V.III Projections

The projections represent an initial strategy. As reclaiming space through appropriation is disproportionately represented in cinema, the collages open up the imagination for future uses and thus serves as a starting point for the project.

1930 ML

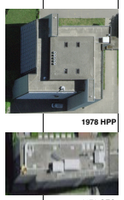

1962 FBS


1965 SBB


1963 UST


1968 STF


1980 HPM


1978 HPP

1978 SFG


1975 HTS


1993 TECHNO


2004 HCI


1995 CLA

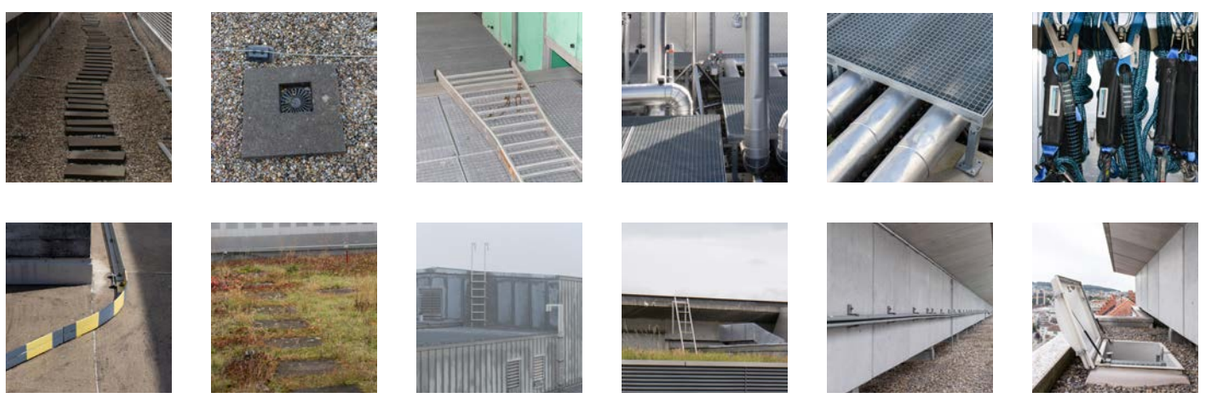

2012 HPL

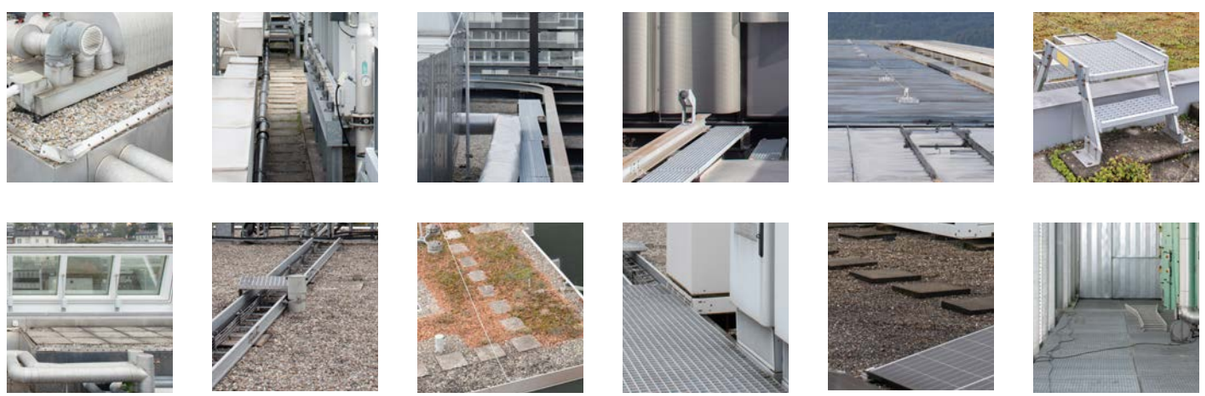

2014 TONI

1925 1930 1935 1940 1945 1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025

	ML	FBS	UST	SBB	*STF*	*HTS*	*HPP*	*SFG*	*HPM*	*TECHNO*	*CLA*	*HCI*	*HPL*	*TONI*
ADDRESS	Sonnegggstrasse 3	Förrlibuckstrasse 110'	Walherallee 11a, Uster	Langstrasse 175	Stampfenbachstrasse 114	Hardturmstrasse 161 / Förrlibuckstrasse 150	HPP, Höngggerbergring 64	Ausstellungsstrasse 104	HPM, Otto-Stern-Weg 3	Technoparkstrasse 1	Tannenstrasse 3	HCI, Wolfgang-Pauli-Strasse 10	HPL, Otto-Stern-Weg 7	Pfingstweidstrasse 96
CONTACT	Andi Schmid	Andreas Spack	Alberto Perales	Marino Weber	Saad Daudi	Raffaele Vattimo	Martin Wirth	Georges Kaufmann	Marco Eichenberger	Jens Knoche	Andi Schmid	Lukas Wild	Stefan Hauri	Michael Grimm
DATE OF VISIT	01.09.2025 08:00	04.11.2025 10:00	10.11.2025 08:00	16.10.2025 17:30	09.10.2025 10:00	08.10.2025 14:00	05.09.2025 13:00	17.10.2025 13:30	09.09.2025 10:00	04.11.2025 08:00	01.09.2025 08:00	02.09.2025 09:00	04.09.2025 11:00	08.10.2025 14:30
YEAR	**1933**	**1962**	**1963**	**1965**	**1968**	**1975**	**1978**	**1978**	**1980**	**1993**	**1995**	**2004**	**2012**	**2014**
TRANSFORMATION	1935, 1942, 1951, 1980, 1972, 2022	2006, 2024	2002, 2020, 2021	1998, 2016, 2026	2010	1999, 2016, 2019, 2022	1987, 2010	2013	2016, 2019	2013, 2016	2015, 2023	2022	2022	-
USES	auditorium, office, laboratory	office, housing	office	office	office	office, commercial use, restaurant	office, laboratory	school	office, laboratory	office	office, laboratory, data center	auditorium, office, laboratory, canteen	office, laboratory	housing, office, canteen
BUILDING ZONE	Oe7 - zone for public buildings (municipal development plan)	Z6 - six story center zone (res. quota = 0)	-	Z5 - five story center zone	W5 - five story residential zone (res. quota = 0)	Z6 - six story center zone (res. quota = 0)	Oe - zone for public buildings	Oe7 - zone for public buildings	Oe - zone for public buildings	Z6 - six story center zone (res. quota = 0)	Oe06 - zone for public buildings (municipal development plan)	Oe - zone for public buildings	Oe - zone for public buildings	Z6 - six story center zone (res. quota = 16, municipal development plan)
ROOF AREA (m²)	**6 341 m2**	**1 840 m2**	**1 376 m2**	**580 m2**	**599 m2**	**6 253 m2**	**1 030 m2**	**923 m2**	**2 087 m2**	**1 862 m2**	**2 430 m2**	**16 786 m2**	**1 901 m2**	**3 148 m2**
% TECHNICAL DEVICES	**18,0 %**	**30,6 %**		**19,5 %**	**26,6 %**	**10,3 %**	**4,2 %**	**42,8 %**	**12,3 %**	**24,6 %**	**30,5 %**	**44,6 %**	**63,2 %**	**76,7 %**
TYPES OF DEVICES	lift machine room, heat exchanger, ventilation, weather station	ventilation	lift machine room, ventilation, chiller, solar panel	heat exchanger, maintenance crane, antenna	heat exchanger, ventilation	heat exchanger, ventilation, antenna, maintenance crane	antenna, weather station, maintenance crane	ventilation, maintenance crane, solar panel, weather station	ventilation, weather station, maintenance crane	ventilation, lift machine rooms	ventilation, maintenance crane	lift machine rooms, ventilation, maintenance crane, solar panels	ventilation, solar panels, weather station, maintenance crane	heat exchanger, ventilation, maintenance crane, antenna
SURFACE	gravel	gravel, green roof	gravel	gravel, bitumen membrane	gravel	gravel, green roof	concrete slabs, gravel	gravel	green roof	green roof, metal sheet	green roof, gravel	metal sheet, green roof	green roof	gravel
MAINTENANCE CYCLE	1x per year, external firm	1x per year, external firm	1x per year	-	2x per year, external firm	2x per year, external firm 1x per week internal inspection	1x per year, external firm	1x per year, external firm	1x per year, external firm	1x per year, external firms	1x per year, external firm	1x per year, external firm	1x per year, external firm	2x per year, external firm every 2 months internal inspection
ACCESS	staircase through storage room, overhead structure	staircase through ventilation control center	staircase next to lift machine room	ceiling hatch to ventilation control center with door, ladder antenna	staircase, roof hatch	access through ventilation control center, ladder to second level	access through ventilation control center	access through fire escape, sculptural staircase	access through ventilation control center, ladder to second level	access through staircase next to lift machine room	ladder through ventilation control center	staircase next to lift machine room	foldable ladder in garbage room, roof hatch	staircase next to lift machine room
NOISE (DB)	-	-	74 db	-	65 db	66 db	-	-	80 db (ventilation control center)	-	-	-	-	-
INFO	+ during summer, there was a beehive in the weather station, Andi Schmid was on the roof weekly + the roof of the 1972 extension hosts a research project with a parabolic reflector + the roof infrastructures on the 1942 extension are not used since 10 years and completely obsolete, but it would be too expensive to remove them (chimneys, ventilation, machine room, ...)	+ transformation project 2024, expansion of the „attic floor" previously used for technical rooms into 6 apartments, making use of the 1995 §292 PBG regulation	+ repair of a chiller on the roof, I joined for 1 of the 3,5 days process + chiller normally has to be inspected 1x per year, this year the firm was already on this roof 5 times for various defects and repairs (warranty of machine 10 years but normally lasts up to 25 years) + 36kg of refrigerant was spilled from circuit B, very polluting greenhouse gas	+ currently in renovation, ventilation systems are planned to be added onto the roof + large antenna swisscom and sunrise restricts the planning process	+ roof extension 2010 added all the technical equipment on the roof (did not happen at Hochbauamt Zürich next doors)	+ the buildings technical devices have been renovated throughout the last 10 years, still the building is planned to be demolished in 2035. the lifetime of the building is calculated from the lifespan of technical devices as it wouldn't be economically efficient to replace them again. + important location for antennas, the roof has a steel structure just for the attachment of antennas. the 3G antennas were removed in 2024 but the poles and cables partly remain	+ Martin Wirth visits the roof for sunrise almost every day, as he is one of the few persons with a key. He knows the view to all directions and can explain how far and what you can see (e.g. until Germany on a clear day) + sometimes there are problems with the waterproofing of the roof (concrete and tiles as roof surface are not ideal + the technical devices inside the control center are incredibly loud	+ the internal facility team is not permitted to enter the outer part of the roof, as a SUVA course would be needed (not profitable, as it would have to be repeated yearly) + crane is used often, for cleaning and maintenance purposes, has its own garage on the roof	+ floor with technical rooms is still in use, therefore roof almost free + ventilation control center of extension incredibly loud and a lot of vibration	+ all technical systems (ventilation, solar etc.) still from year of construction, only motors of ventilation systems have been changed + building has been extended by 2 floors in 2013, since then green roof + transformation was complicated as everything had to be brought in by helicopter) + new maintenance systems will be installed on the 05.11.2025 (installation very expensive but necessary due to SUVA norms) + green roof as „biotop", during summer a duck family lived there, the former technical manager had beehives on the roof + users constantly ask for a roof terrace, but the fire risk is too high due to cigarettes on dry greenery during summer	+ one of the most complicated technical buildings of ETH (due to frequent user changes the technical devices have to be adapted regularly) + the maintenance crane is not efficient anymore and will have to be replaced soon	+ solar panels are added by ETH Immobilien in sections (due to issues in financing), with the solar panels new maintenance bridges are added that guide people across the roof + constant adaption of technical systems due to size of the building, most of it is still from the construction of the building 25 years ago + conditions on roof: very bright, blinding, very hot in summer, almost no green surface areas + unused terraces one level below as they only connect to the ventilation control rooms and are not regularly accessible + facade crane is only used for maintenance (cleaning with external crane) as it is very slow and not so efficient anymore	+ roof with a lot of topography, movement across levels with ladders + specific regulations by Grünstadt Zürich, green roof concept with sand piles and dead wood	+ high-rise regulations: technical devices have to be within the highest point of the building + technical devices on the roof are for housing (100 apartments), offices and canteen + steel cage around infrastructural roofs, Michael Grimm: we from the facility services would prefer a railing so we could enjoy the view + lightning protection nets spanned across machines for insurance reasons

V.01
maintenance systems







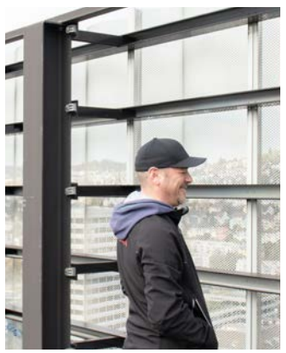
alberto perales



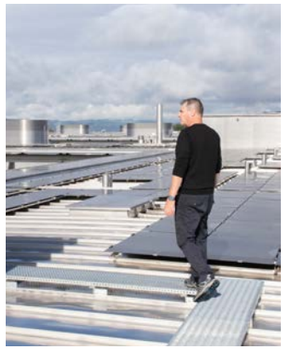
sead dauti



andi schmid



michael grimm



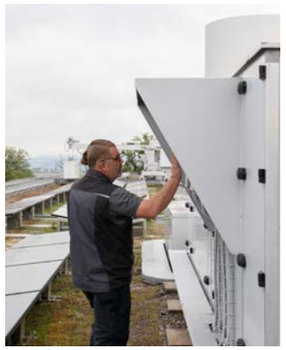
lukas wild



andi schmid



marco eichenberger



stefan hauri

During the 13 weeks of the semester, I visited 14 roofs in Zurich, ca. one roof per week.

To understand their processes and spatial qualities, gaining physical access to these spaces was important to me.

Accompanied by people working in the facility management sector, I got to know a completely different perspective on buildings and their functioning. I assisted repairs, followed maintenance cycles and learned how to install safety systems.

I was always warmly welcomed for my visits, and there was a clear sense of curiosity and appreciation from those I met that someone from the field of architecture was taking interest in their world. Sometimes the visits went on for 2-3 hours and took detours into ventilation rooms, consequent air channels, huge technical spaces in the basement and more, to explain how the interrelated systems work.

„Taking care of a building“ and keeping the system running means knowing what a space needs quite well. From a functional and practical perspective, I got a lot of unrelated complaints to architects in general.

„Architects should also consider to plan spaces for the once that clean and maintain the building. A break room without a window does not count. Could you pass that on?“
or
„Just so you know... if you plan a window in a courtyard you cannot put it so high up that we cannot reach it with our ladder. It is impossible to clean.“

Opposing to the domestic roof spaces of mostly women and children that I researched historically, the technical roof territory today is dominated by men.

At the same time I understood that it is a very social one. The technical managers of neighbouring buildings know each other and often wave to each other from „their“ roofs. As a result, I was put in touch with a growing network: I received phone numbers, was already announced before I could call, and knew who to contact next.

24x
roof inspection
early detection of leaks, by internal facility management or external firm

2x (+3x)
gardener
mowing and removing invasive plants + plants whose roots could puncture the roof membrane.

1x
lift
lift maintenance, access to the lift machine room

1x
ventilation
check and maintenance of ventilation system, waterproofing ducts before winter starts

1x
climate systems
maintenance of cooling machines and heat exchangers, often more than 1x per year

1x
maintenance systems
yearly inspection, protocol neccessary

1x (+1x)
solar systems
cleaning of panels if needed, close interdependency with greenery on roof

30cm
instandhaltungsgang
minimal width of a path used for maintenance (new regulation since 2025)

50cm
wartungsgang
regular width of a path used for maintenance, minimum if used between solar panels

2m
gefahrenzone
danger zone along roof edges and skylights, minimum distance to be kept, only access with PSAgA
2m = max. person laying horizontally

2.5m
rope system to edge
distance of steel rope systems to all edges, since 2025 there is a tolerance of 2.25-2.75m

1.2t
load capacity
of all maintenance systems
1.2t = 2x the fall of a human (600kg)
devices may deform in case of a fall and must be replaced after





V.02
repair with alberto perales
service technician, meier tobler

object: Hesta Immobilien Klima, Weiherallee 11a, 8610 Uster
date: monday, 10.11.2025
time: 08:00
with: Alberto Perales Tel. 078 794 61 49
task: repair on the roof (only with dry weat her conditions)

REPAIR OF A CHILLER (CARRIER 30XA)

08:30 - Arrival in Uster

meeting point - freight lift with janitor
inspection of roof space, clarification of all access points

08:45 - Transport of tools and materials

from car to roof, the freight lift only reaches the 6th floor, the rest must be carried by hand

09:15 - Set-up in service room on the roof

prior protocols and data sheets are avaiable

09:30 - System check for malfunctions

the electrical control panel shows two system errors in the chiller during the past months

10:00 - pumping of refrigerant circuit A

of 36.5 kg R134a, there is no refrigerant left (important to locate leak within the system, as refrigerant is very harmful to the environment)

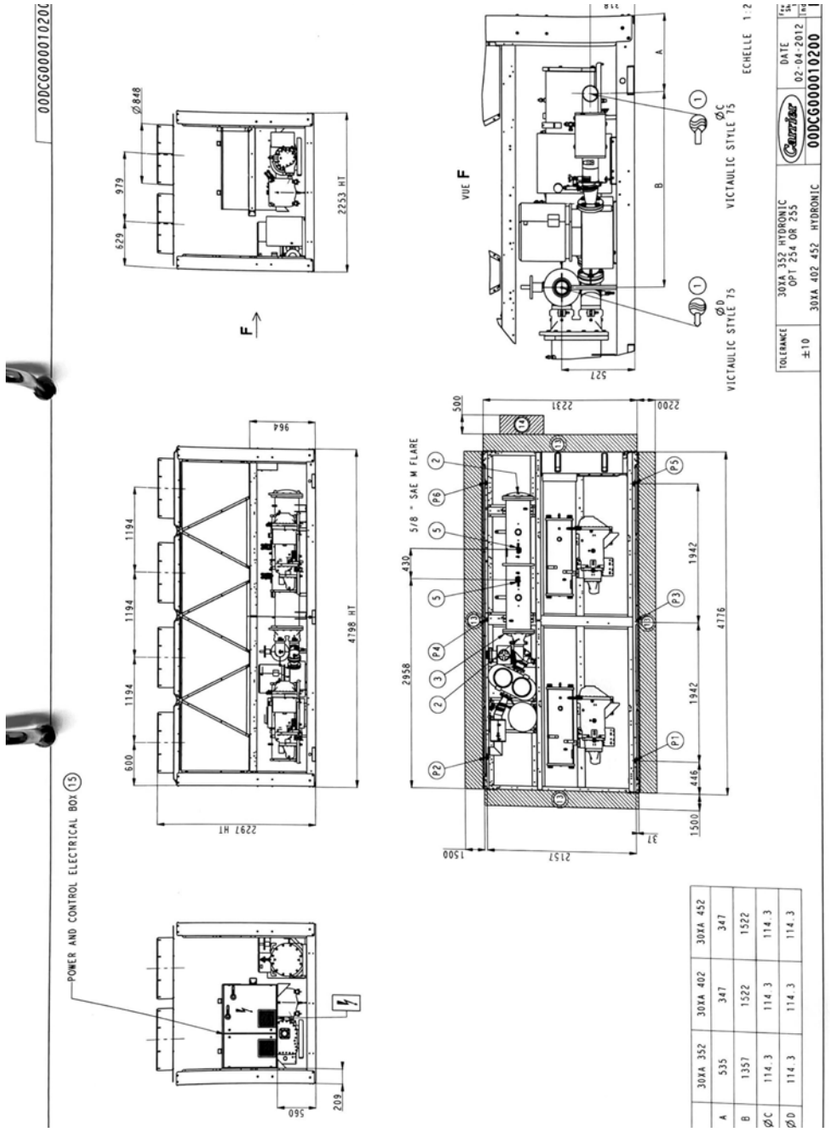
replacing the two safety valves (07/2019)
and the filter piston (2023), both still appear intact

10:30 - pumping of refrigerant circuit B

there should be 50 kg of refrigerant (by 13:00, 30 kg had already been pumped out), safety valves and filters can only be replaced after the coolant has been pumped out.

`As the next stage in the development of climate control systems, I think the machines themselves will become smaller and more efficient. They also don't necessarily have to be placed on the roof—the main unit can be located in a technical room, with only the fan and heat exchanger positioned outside.
However, the issue of refrigerants is becoming increasingly important, as many refrigerants (such as the R134a in this machine) are highly damaging to the environment.
I would say in future the systems will probably evolve towards propane as refrigerant, but they are much more demanding to maintain. Maintenance must always be performed in pairs, with gas masks, and you have to carry a gas detector due to safety regulations.´

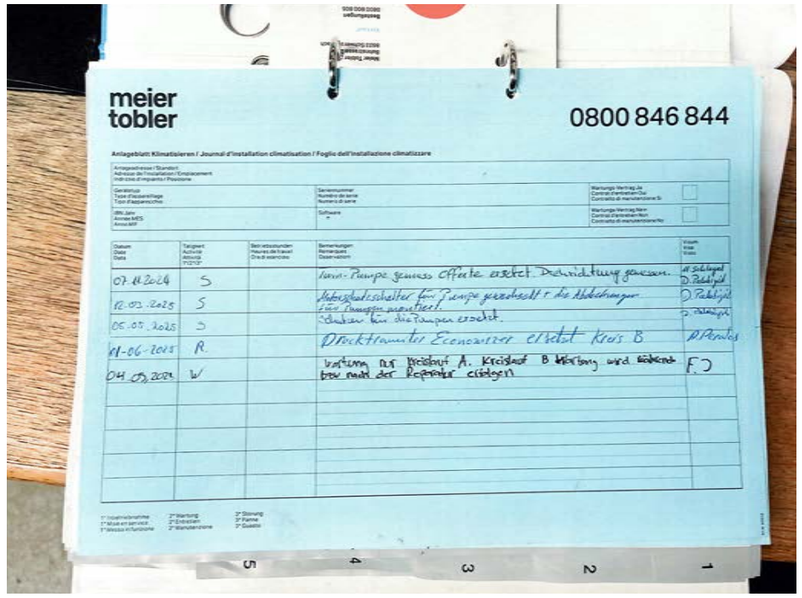
-Alberto Perales (service technician at Meier Tobler) on how he imagines climate systems to evolve in the coming years

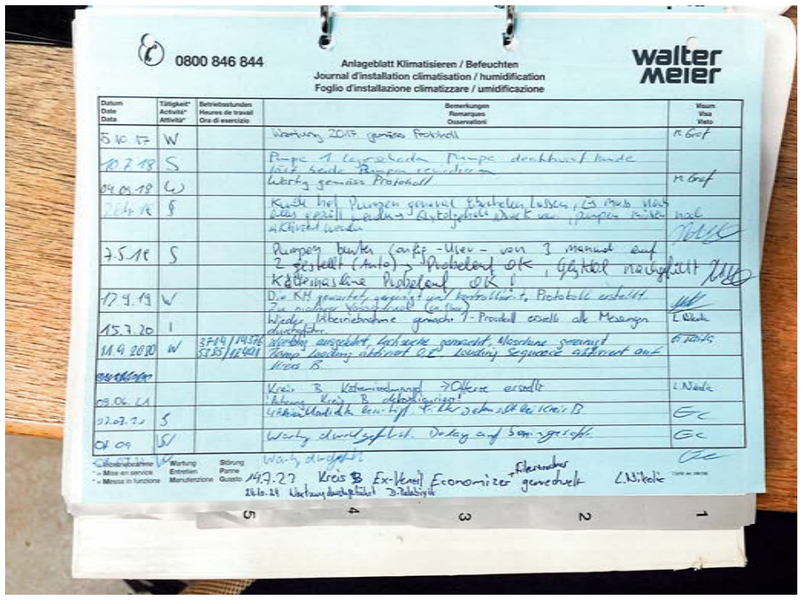


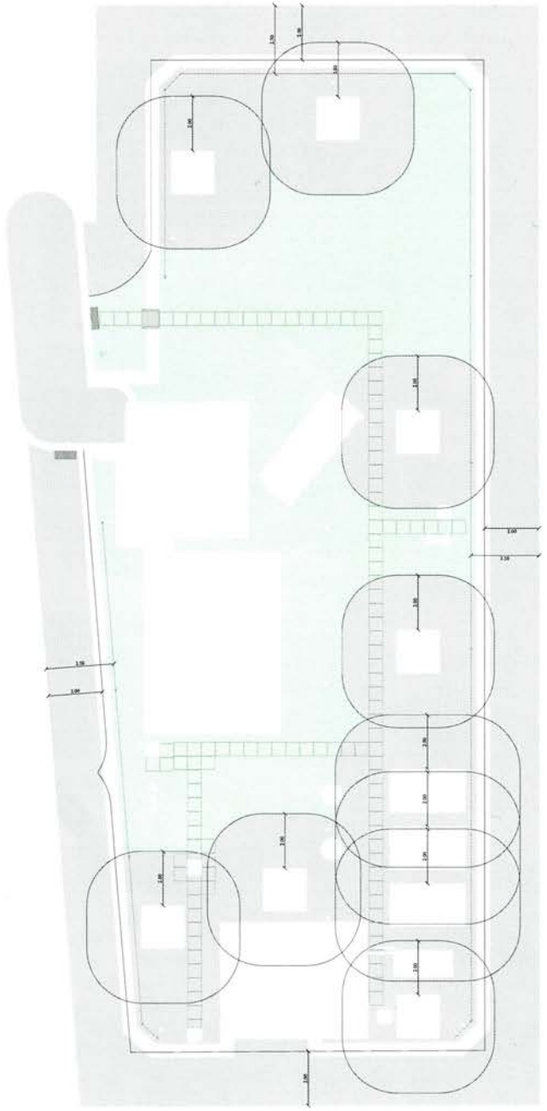
V.03
datasheet chiller
carrier 30xa hydronic

V.04
maintenance protocols

in 2025, this was already the fifth time that meier tobler was on site for repairs and maintenance of the machine







V.05
danger zones and normed distances
exemplary plan SFG

date: thursday, 23.10.2025
time: 08:30
address: Im Grund 15, 5405 Baden-Dättwil
contact: Richard Weiss
task: montage and main tenance of safety rope systems for roofs

INSTALLATION AND MAINTENANCE COURSE ABS ABSTURZSICHERUNGEN

participants
solar installers, roofing specialists, industrial climbers (all working on roofs and are dependent on safety measures)

09:00 - introductions on legal framework, SUVA regulations, important dimensions

09:45 - presentation of products ranging across various roof covering types

11:15 - simulation of roof installation on a magnetic board, understanding key distances und SUVA ausstellungsklassen
simulating single attachment points vs. rope systems

12:15 - lunch, talk with Peter Küng (Solarsys) and Tomas (Preisig)

13:00 - montage of a rope system, rope attachment points on different roof coverings

16:00 - protocols and instruction on how to check safety systems, required by SUVA regulations, once a year

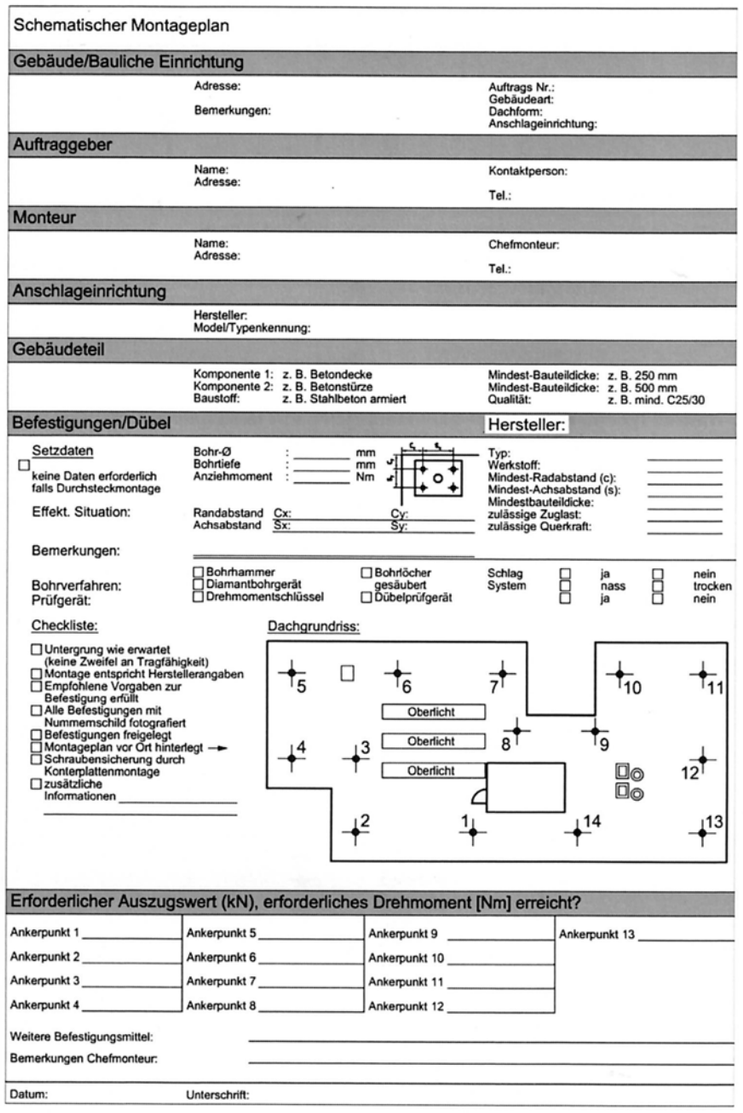
16:30 - talk with Richard Weiss, additional questions

`The company's market volume is and will also in the coming years be growing steadily, driven by increasing regulations and greater societal awareness for safety.
In the future, system development might focus more on railings, which offer simple application, work well in combination with solar installations, and don't require special safety training like a PSAgA course. In central Switzerland, many railings are already being installed, just in Zurich, they are still largely avoided for aesthetic reasons. ´

-Richard Weiss (technical sales consultant at ABS Absturzsicherungen) on how he imagines the safety systems to evolve in the coming years

I would say that the overall trend in the industry over the past 10 years, since I started working in this field, has remained largely unchanged.
In fact, we sometimes hear that large companies are struggling to get enough projects. The most interesting development at the moment, in my opinion, is the combination of solar panels and green roofs. Solar panels significantly accelerate plant growth, meaning we have to mow up to five times a year to prevent efficiency losses due to shading. Recently, we started mounting the panels at a height of 80–100 cm, but this can hinder the green roof and also creates challenges with wind loads.

-Peter Küng (solar installer at Solarsys) on how he imagines solar systems to evolve in the coming years



Schematischer Montageplan

Gebäude/Bauliche Einrichtung

Adresse:
Bemerkungen:
Auftrags Nr.:
Gebäudeart:
Dachform:
Anschlageinrichtung:

Auftraggeber

Name:
Adresse:
Kontaktperson:
Tel.:

Monteur

Name:
Adresse:
Chefmonteur:
Tel.:

Anschlageinrichtung

Hersteller:
Model/Typenkennung:

Gebäudeteil

Komponente 1: z. B. Betondecke
Komponente 2: z. B. Betonstürze
Baustoff: z. B. Stahlbeton armiert
Mindest-Bauteildicke: z. B. 250 mm
Mindest-Bauteildicke: z. B. 500 mm
Qualität: z. B. mind. C25/30

Befestigungen/Dübel — Hersteller:

Setzdaten
☐ keine Daten erforderlich falls Durchsteckmontage
Bohr-Ø : mm
Bohrtiefe : mm
Anziehmoment : Nm
Typ:
Werkstoff:
Mindest-Radabstand (c):
Mindest-Achsabstand (s):
Mindestbauteildicke:
zulässige Zuglast:
zulässige Querkraft:

Effekt. Situation:
Randabstand Cx: Cy:
Achsabstand Sx: Sy:

Bemerkungen:

Bohrverfahren: ☐ Bohrhammer ☐ Diamantbohrgerät ☐ Drehmomentschlüssel
Prüfgerät: ☐ Bohrlöcher gesäubert ☐ Dübelprüfgerät
Schlag System ☐ ja ☐ nasss ☐ ja ☐ nein ☐ trocken ☐ nein

Checkliste:
- ☐ Untergrung wie erwartet (keine Zweifel an Tragfähigkeit)
- ☐ Montage entspricht Herstellerangaben
- ☐ Empfohlene Vorgaben zur Befestigung erfüllt
- ☐ Alle Befestigungen mit Nummernschild fotografiert
- ☐ Befestigungen freigelegt
- ☐ Montageplan vor Ort hinterlegt →
- ☐ Schraubensicherung durch Konterplattenmontage
- ☐ zusätzliche Informationen

Dachgrundriss:

Erforderlicher Auszugswert (kN), erforderliches Drehmoment [Nm] erreicht?

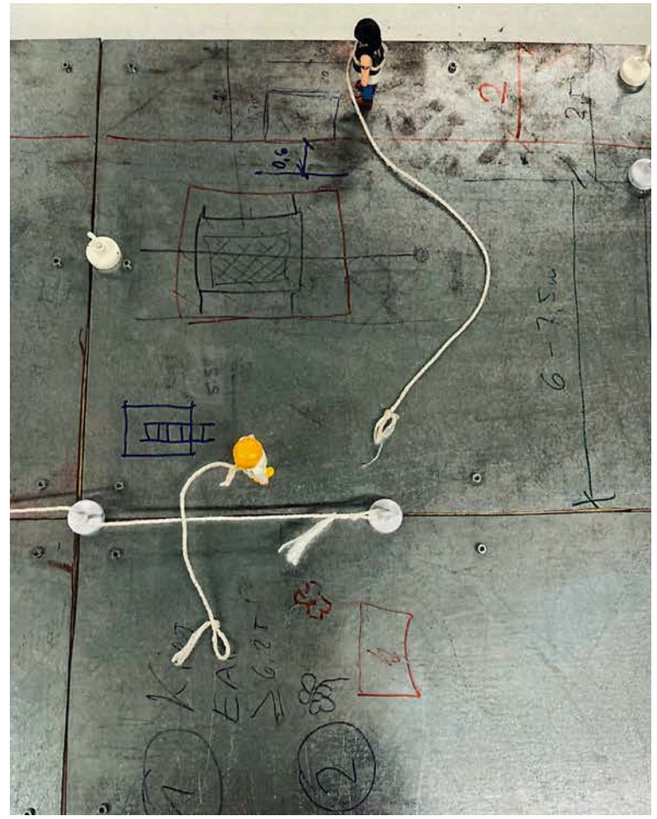
Ankerpunkt 1	Ankerpunkt 5	Ankerpunkt 9	Ankerpunkt 13
Ankerpunkt 2	Ankerpunkt 6	Ankerpunkt 10	
Ankerpunkt 3	Ankerpunkt 7	Ankerpunkt 11	
Ankerpunkt 4	Ankerpunkt 8	Ankerpunkt 12	

Weitere Befestigungsmittel:
Bemerkungen Chefmonteur:

Datum: Unterschrift:

V.06
simulation of roof installation on a magnetic board

distances and SUVA norms difference between EAP and roof systems



V.07
simulation of roof installation on a magnetic board

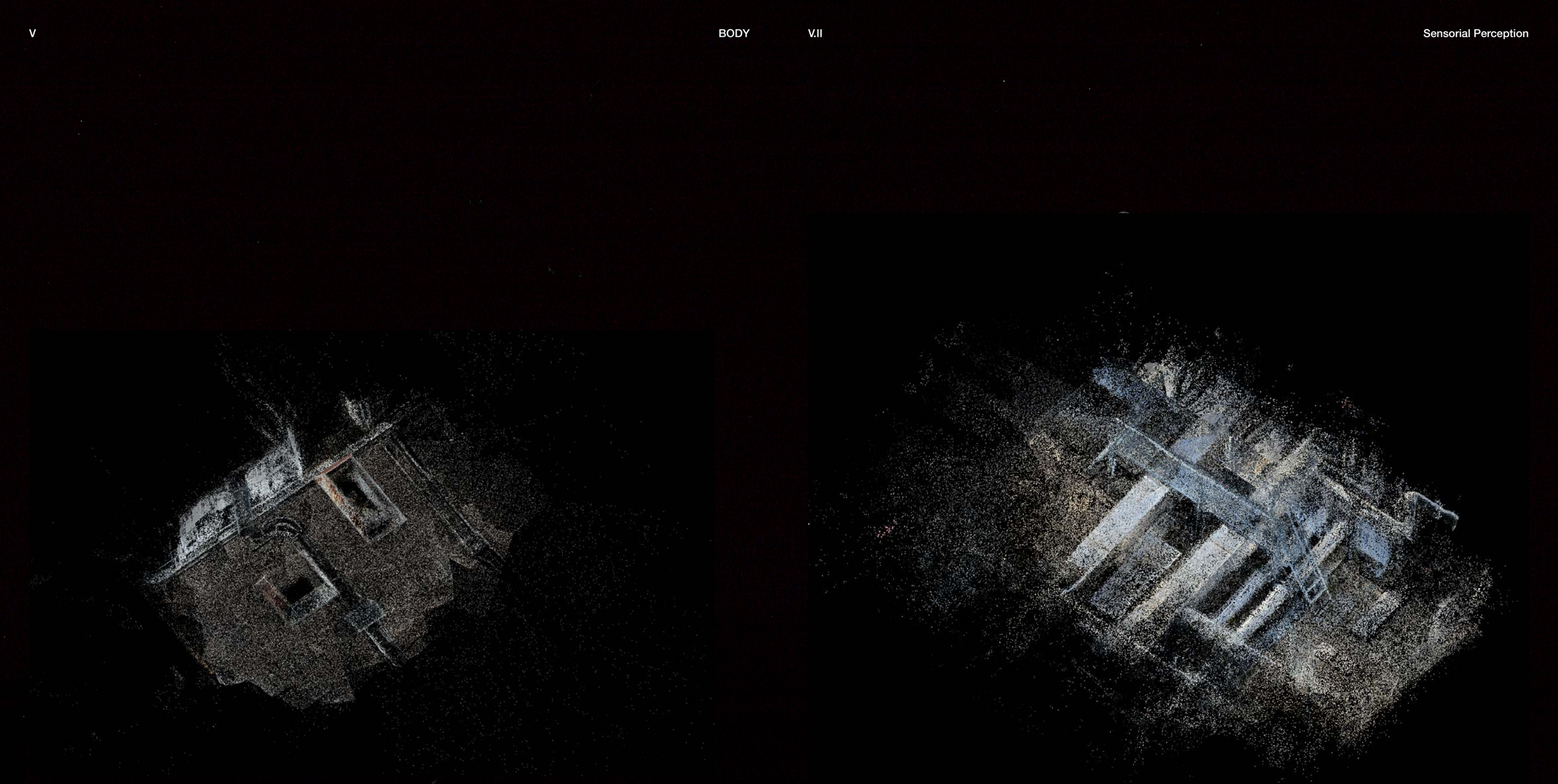
distances and SUVA norms difference between EAP and roof systems

V.08
abs absturzsicherung montage and maintenance course

installation of a rope system

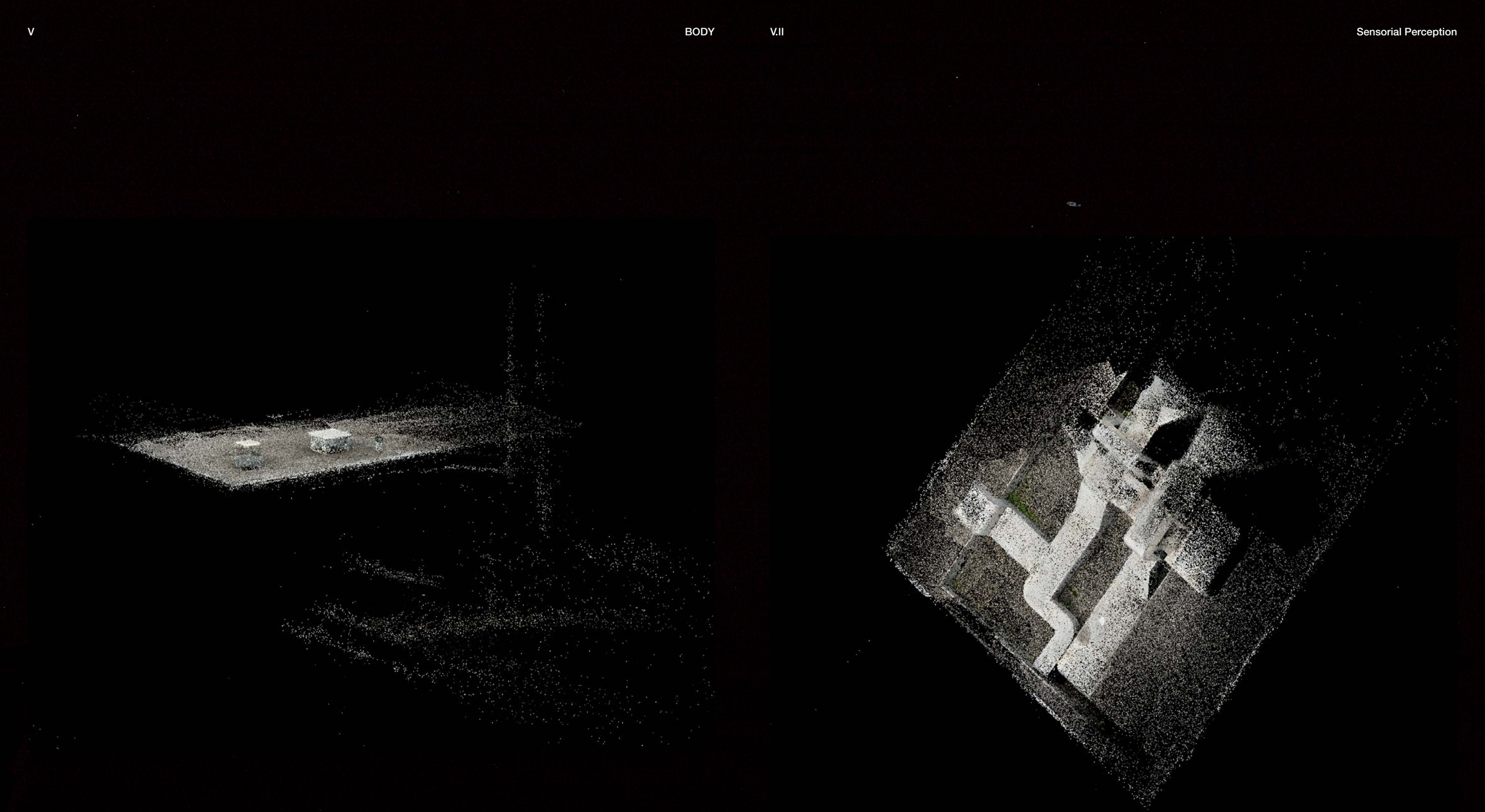






V.09
point cloud fragments

left HTS
right TONI



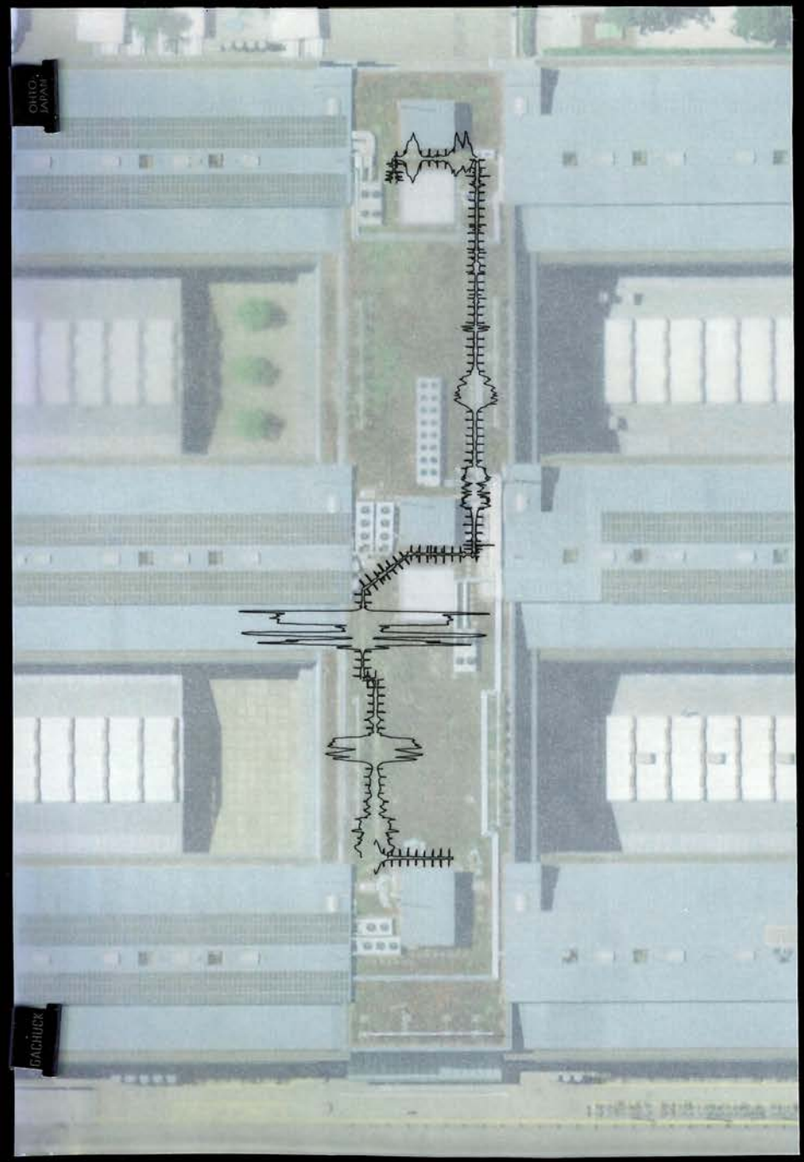
V.10
point cloud fragments

left SBB
right STF

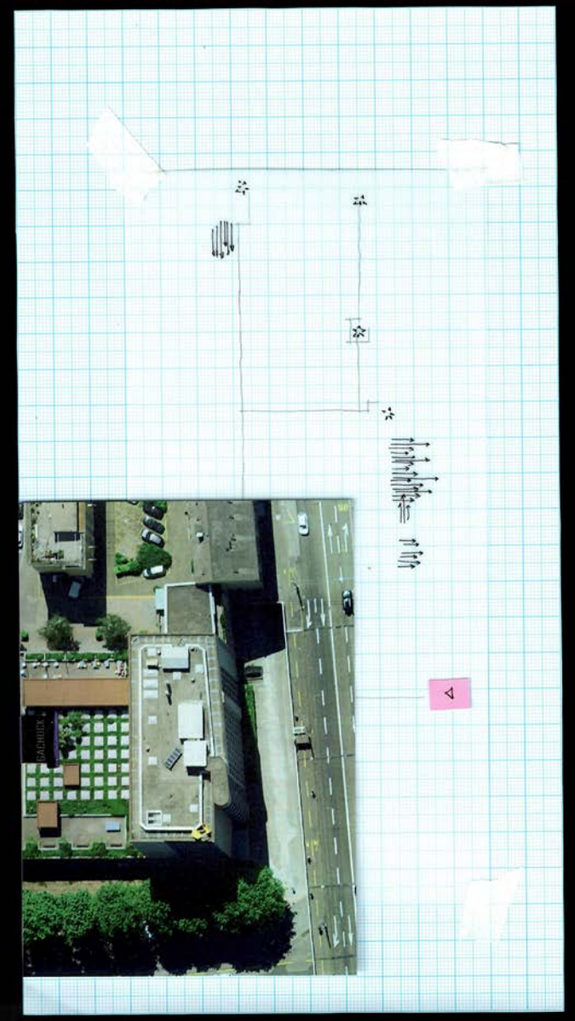
V. 11
ventilation scheme CLA

the roof serves purely as a valve
for supply and exhaust air

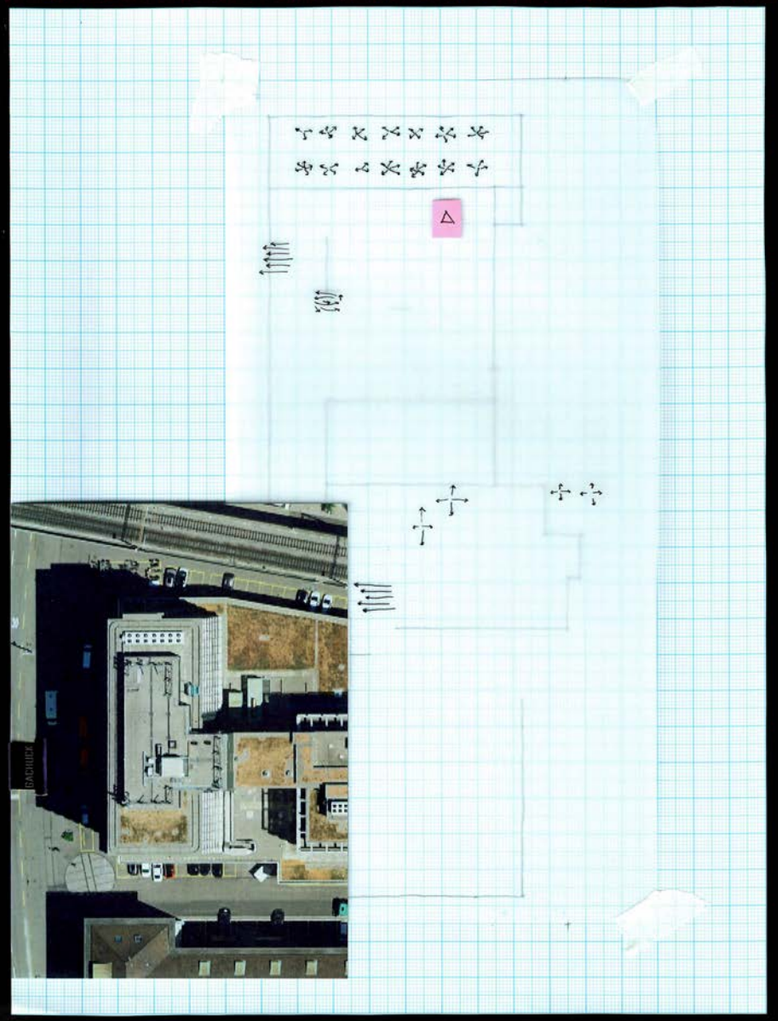




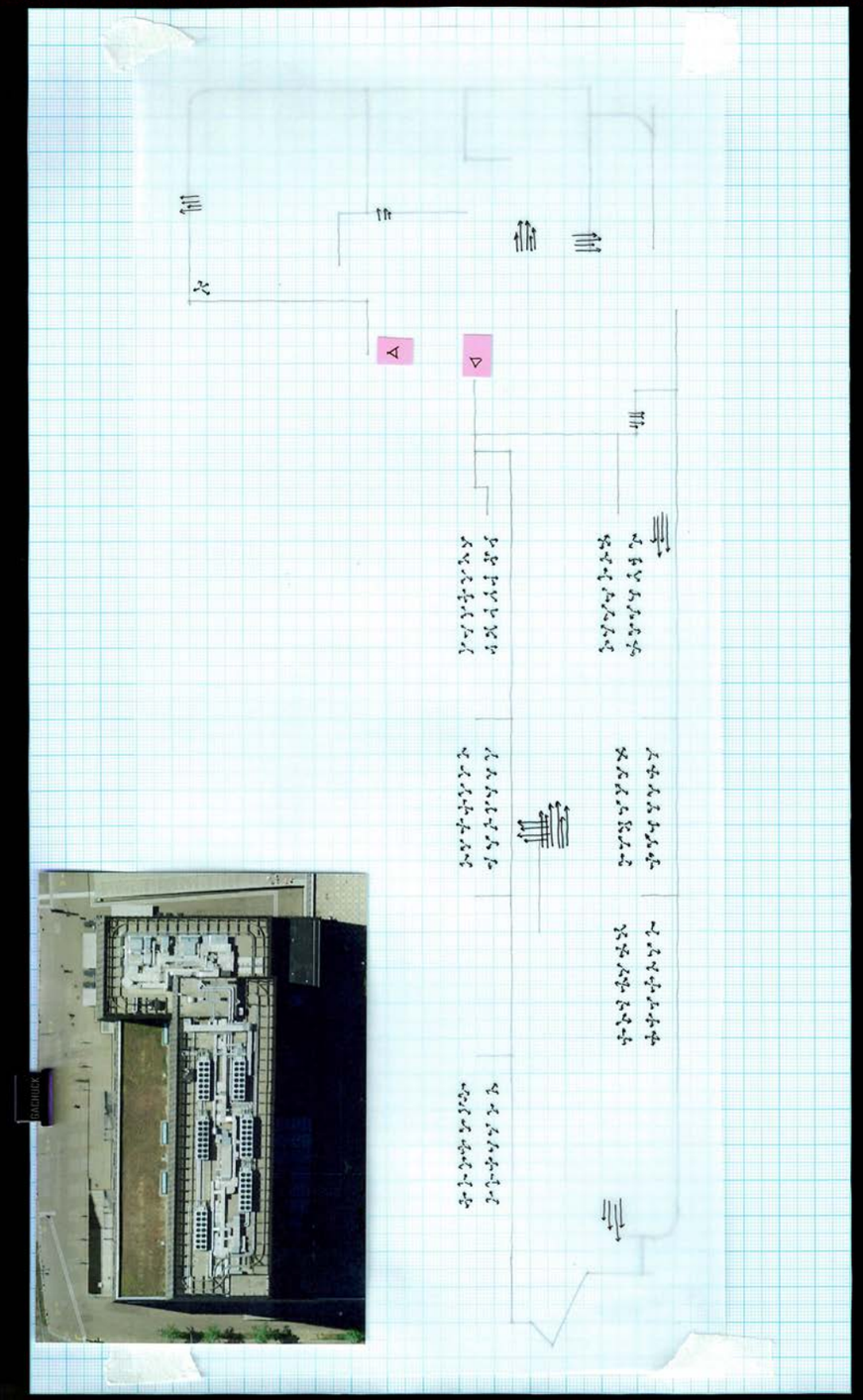
IV.12
transforming electromagnetic
fields into soundwaves



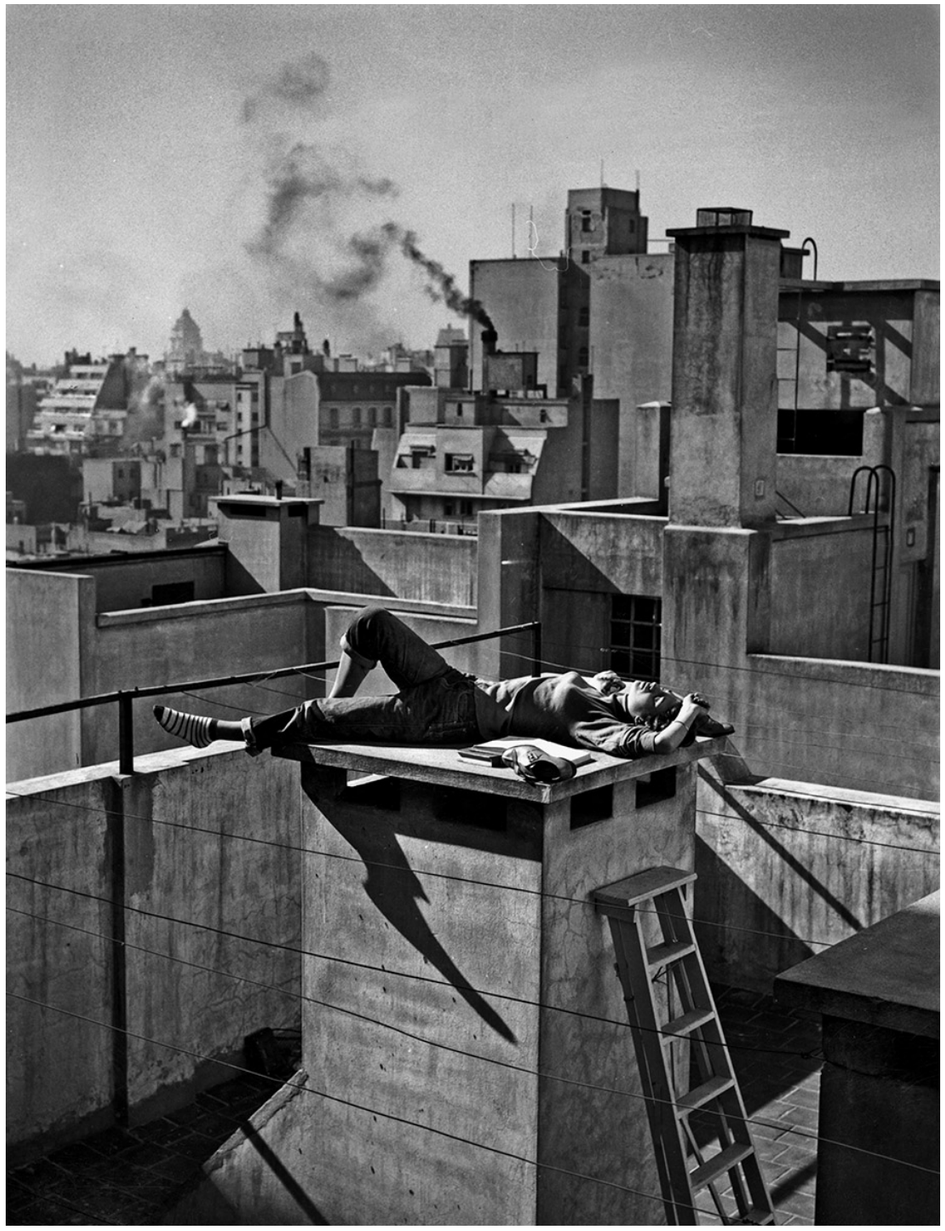
IV.13
air flows
SFG



IV.14
air flows
HTS



IV.15
air flows
TONI



IV.16
annemarie heinrich,
veraneando en la ciudad, 1959

AWARENESS OF SPACE AS EXPERIENCE

The basic ingredient of architectural design consists of two elements, mass and space. The essence of design is the interrelation between these two. ments of the universe. In our culture the preponderant preoccupation is with mass, and to such an extent that many designers are „space blind.“

Awareness of space goes far beyond cerebral activity. It engages the full range of senses and feelings, requiring involvement of the whole self to make a full response to it possible.

The human organism progresses in its capacity to perceive space from the spaceless embryonic state, through the limited space exploration of the infant, to the primarily two-dimensional exploration of the crawling child, and finally to the bodily leap into space essential to the athlete‘s skill and the dancer‘s art. There is an intellectual parallel of deepening perception which is based on becoming connected with larger and larger systems. In architectural terms it means progressing from the earth and earth materials into the less tangible elements of the universe. Through this sense of connection with a system greater than himself man achieves aesthetic satisfaction, and the more nearly universal the system, the deeper the satisfaction.This is why a conscious expression of space is essential to the highest expression of architecture.

O to realize space!
The plenteousness of all,
that there are no bounds,
To emerge and be of the sky,
of the sun and moon and flying clouds,
as one with them.

In these words Walt Whitman has given a great assignment to architecture. But it can never be fulfilled unless the designers themselves develop an awareness of space through the involvement of their whole being.

SPACE AND MOVEMENT

(...) The changing visual picture is only the beginning of the sensory experience; the changes from light to shade, from hot to cold, from noise to silence, the flow of smells associated with spaces, and the tactile quality of the surface under-foot, all are important in the cumulative effect. Underlying it all is the modular rhythm of footsteps, the unchanging measure of space since earliest civilization. There is the muscular effort to cross a court, for instance, or the exhilaration induced by the prospect of ascending or descending a stairway.

- Edmund Bacon, 1967



V.17
permanent vacation, 1980



V.18
la terraza, 1963



V.19
infernal affairs, 2002



V.20
mary poppins, 1964



V.21
infernal affairs, 2002



V.22
matrix, 1999



V.23
ghost dog, 1999

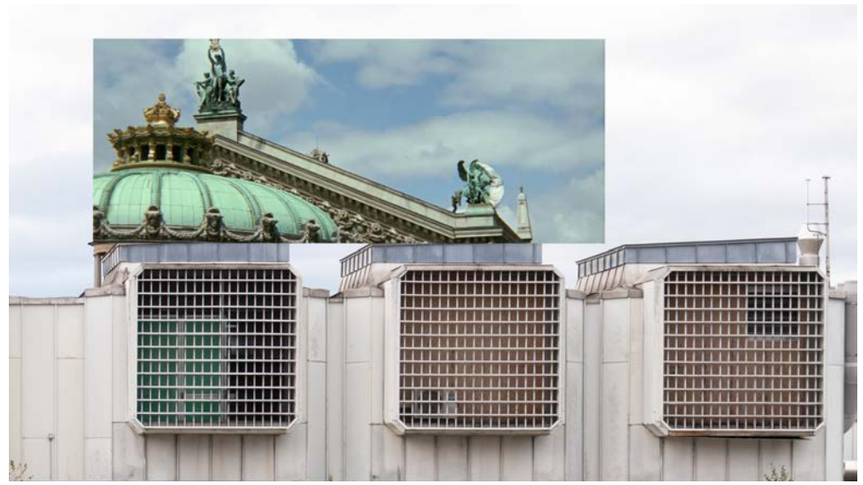


V.24
following, 1998



V.25
wings of desire, 1987

V.26
la grande vadrouille, 1966



V.27
karlsson vom dach, 1974



V.28
oldboy, 2003



THANKS

Project Supervision

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Alberto Perales	Meier Tobler AG

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