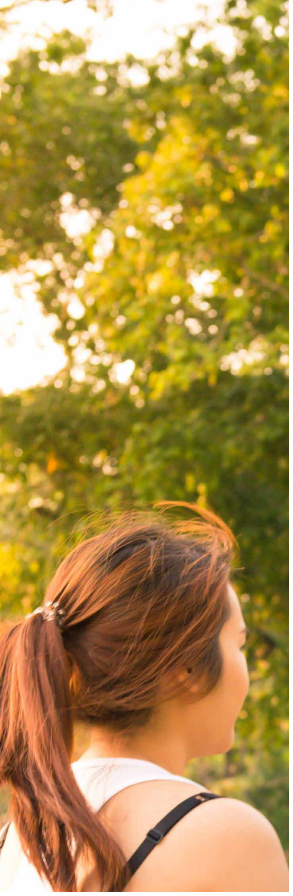
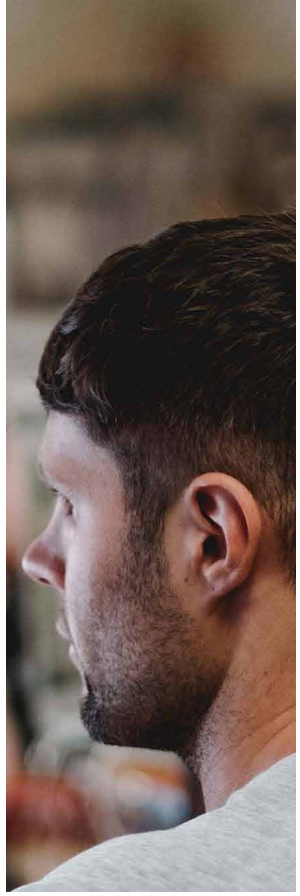
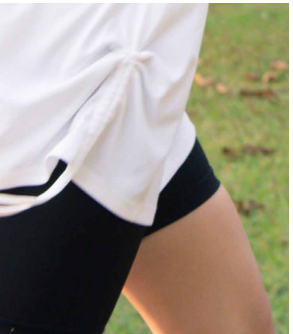
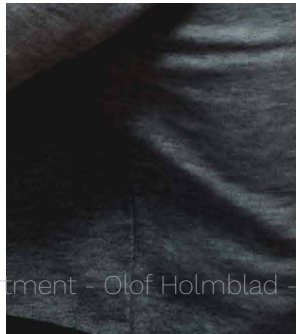


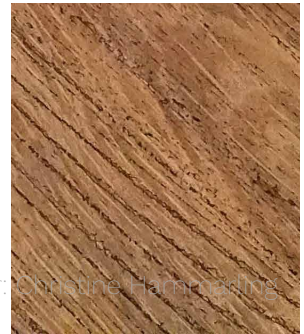




The Health Bringing Office

Investigating the connections between health, happiness and productivity






Chalmers School of Architecture - Healthcare Department - Olof Holmblad - Examiner: Peter Frost - Tutor: Christine Hammarling

The Health Bringing Office

Investigating the connections between health, happiness and productivity

Olof Holmblad
Examiner: Peter Fröst
Tutor: Christine Hammarling

Chalmers School of
Architecture -
Healthcare Department

MPARC

2019

Abstract

Since it has been found architecture can improve the healing potential of hospital patients, there must be certain parameters of architecture that have health bringing properties.

This thesis has been about finding and describing the effects of such environmental parameters that may not only keep us from getting sick, but also supports our health and wellbeing in our everyday lives, and even makes us more productive and happier.

The thesis constitutes a literature study describing 7 important dimensions of health promoting design, and a design proposal of a modern office building that aims to make use of these parameters.

By studying some of the latest research in various fields, such as environmental psychology, workplace psychology, neuroscience, and medicine, all related to human perception and health in a way that can be applied in an architectural context, and combining the findings with insights from interviews, this thesis has aimed to summarize key factors that is essential to sustain a healthy lifestyle in an office workplace. And finally, to intuitively implement them in a design proposal of an office building.

What we perceive, consciously and subconsciously, has a great influence on our minds and bodies, and it has far going effects on our health, wellbeing and performance. In extreme cases (e.g. hospitals) it can even be a matter of life and death. Contrary to Descartes' belief, (Barbosa da Silva, A. 1992) mind and body are not separate and what happens to the mind also happens to the body, and inversely, through the connections of the nervous- and endocrine systems. This has been largely eluded or misunderstood in architectural design during the 20th century.

The ideal scenario would be if the workplace could be a place that gives the people working there more mental and physical resources than it takes from them. A place that gives the employees a feeling of support, that supports their bodies and minds, where they collect energy and inspiration that they can bring home, and that has a positive influence on their lives in general.

The thesis found that much can be done through architecture to improve happiness, wellbeing and performance, by applying design features with knowledge of their implications on our minds and bodies.

By applying the 7 dimensions of health promoting design, one can achieve a significant impact on health, performance, happiness and life quality.

Student Background

After High School I studied tourism for a year and was educated as a tour-guide at Nordens Ark, a zoo for endangered species. Learning about the animals natural habitats, and the different methods used to stimulate the animals made me curious. There were certain parameters of their living environment, and the activites the animals could act out, that had critical effects on the animals behaviour and well-being. Could this be the case for humans too?

My university studies began at the school of medicine which evoke my interest in the human body and expanded my already keen interest in perception and perception psychology. Being a practitioner of various kinds of sports, from rugby and handball growing up, to today's running, outdoor swimming, climbing and weight training, I am well aware of the benefits of aerobic exercise and resistance training, but also the benefits of moving and using the body in general.

In medical school I had the benefit of participating in a study which examined the effects of *acoustic white noise* on rats with a condition similar to human ADHD (Bergqvist et al., 2015). The hypothesis was that children with ADHD are neurologically under-stimulated and that they intuitively tries to cross the neurological *action potential* threshold by being overly active, moving, talking, being loud and having a hard time to focus. The idea was to test if white noise could stimulate their nervous system enough so that they did not need to activate themselves, so that they could have an easier time trying to focus. We played white noise to Vistar and SH (ADHD) rats while they practiced a skilled reach of sugar pellets with their paws. The results found an improvement that was significant for the ADHD-rats with the white noise playing. Participating in this study deepened my curiosity on how the environment affects us that I brought with me when changing path to architecture school.

Working with this thesis I have come to a better understanding of my own relation to office spaces. In the open plan office at school I have had a much easier time focusing working late nights and weekends when there are not so many people in school. During daytime when it is crowded I want to talk to people and get distracted by people passing by, the conversations of my desk neighbors, other nearby conversations etc. At the same time the social aspects of having people around I felt had a positive impact on motivation and general wellbeing.

The learnings and insights from working with the thesis I will bring with me, and I believe they will be valueable throughout my professional career as an architect.

Table of Contents

The Project

Introduction

Reading Instructions

The purpose of this thesis has been to gather and synthesise information from different fields of knowlege in one place. To analyse findings, and to shine light on essential architectural qualities that promotes health, and apply them to an example design that attempts to rely on scientific research and different surveys about the preferences of the users.

The thesis should be read as an inspiring guide describing some of the current knowledge rooted in modern science, and what conclutions we should come to from these to design more healthbringing work environments. To work as an example of how this knowledge can be applied. A vision for the future, using not yet fully developed knowledge.

The architects role is a cross disciplinary professional role. It is of course great if we can support our decisions with well documented science, however in many cases this is not possible or is impractical. Naturally we cannot only rely on science and wait for a science report before we make a decision. Many decisions have to be made based on common sense and intuition. On what is common knowledge or the accumulated knowledge of an empirical tradition. This is known as working with best practice and it is an important part of the profession, and this thesis, in cases where the scientific evidence is still not complete.

A very important part of the profession is the dialogue with the clients and end users. For this reason I have interviewed a range of professionals relevant to the subject of the thesis. This is not a purely scientifical approach, nontheless it is an important one for the above mentioned reasons. One does not always have access to the appropriate knowledge or research in a certain project, and it is not feasible to apply scientific methods to any and every new project. Therefore it is of great importance to be able to find patterns in events based only on “thin slices”, narrow windows, of experience and make generalised assumptions from these samples. Combining this with the accumulated experience of the professional architect to find apt solutions for the project in question.

The intention with this thesis have been to sample views from several sources, and use different types of information from different fields (such as scientific experiments, metaanalyses, interviews, observation studies etc.) and bring them together to illustrate their interconnectedness and to approach the issue from several different perspectives. Trying to get a clearer overview of the situation and to anticipate the paths to move forward.

A design guide is provided on the side of this booklet exploring 7 dimensions of health promoting design.

How can we design office buildings that optimizes the potential for health among the employees, and promotes an overall healthy lifestyle?

Thesis Objectives

This thesis objective has been to search and gather knowledge from multiple research fields, analyze the findings, and apply them appropriately in the design of an office building, in a manner similar of the application of Evidence Based Design. The expected results has been a booklet design guide and an applied example project at a real site.

Methods

Methods of research included:

Researching scientific literature; dissertations, metaanalyses, experiments, surveys, observation studies, reports, TED-talks from experts, performing interviews with different stake holders and experts, study visits and site analysis on site and in 3D-software.

Delimitations

Parameters that have been included are the ones that are directly linked to the fysical environments, and the following effects it has on us, and to a small extent expected social outcomes of such parameters.

Some parameters that are very important for a well functioning office, such as social or organizational aspects, but that are not directly related to the fysical environment, are not in focus for this thesis.

Examples of such factors:

- Organizational cooperation
- Communication
- Leadership
- Aspects of status
- Team identity
- Efficiency
- Effectiveness

These parameters may very well be influenced by architecture to various degrees, but have been considered to complex to be treated in the scope of this thesis.

Parameters that are delimited from any deeper consideration in this thesis includes:

- In depth technical properties of the building.
- Energy
- Pollution
- Economy
- Work place organization
- Other social factors

Background Context

People in developed countries spend the majority of their lives indoors, and more than 50% of the population in western countries work at offices or office-like workplaces (Bodin Danielsson, 2010). However human beings evolved outdoors in nature and we have given relatively little thought to what happens to us when we are inside (Delos, 2018). At the same time explicit and implicit demands, from inside ourselves, from other people and society, are rising, and this causes stress (Bodin Danielsson, 2010).

50% of people in western countries work in offices.

A sedentary lifestyle, lack of exercise, extended periods of sitting and stress are some of the largest threats to health and wellbeing in day modern society. But the physical environment and our perception of it affects health aswell. Combined these parameters also has large impacts on productivity and happiness.

51% of Swedish 16-84 year olds report being obese or over weight, numbers that are increasing year by year (Folkhälsomyndigheten, 2018). Stress in the work place is the major source of stress for american adults, associated with wide range of illnesses. Stress at work is more strongly associated with health complaints than financial or family issues. In a report from the American National Institute for Occupational Safety and Health, 40% of the respondents stated their job was very, or extremly stressful, 25% as the primary stressor in their life, 34% reported problems sleeping beacause of stress and 12% had called in sick because of stress.

40% reported their job was very of extremely stressful.

The number of people calling in sick due to stress increased threefold in the US from 1996 to 2000 and an estimate of 1 million workers are absent due to stress every day (The American Institute of Stress, 2018). One survey showed that having to complete paper work for many police officers was more stressful than the dangers associated with pursuing criminals. Approximately 50% of European workers report stress to be common at their workplace (Arbetsmiljöupplysningen, 2018). Stress causes 28% of work related health issues (Europeiska Arbetsmiljöbyrån, 2018)

Poor work environments are causing unnecessary friction, pain, discomfort, sickness and unhealth, aswell as entailing great costs for companies and for society (Bodin Danielsson, 2010). The institute of environmental medicine at Karolinska Institutet talk about the problems of "sick presence" as far exceeding the costs of sick leave in terms of diminished productivity. The real costs of having a overly stressed person working, by the effects of lack in productivity, is actually greater than the cost of sick leave for that same person (Arbetsmiljöforum, 2018).

300 billion

dollars every year

Workplace stress in the USA is estimated to cost 300 billion dollars every year as a concequence of accidents, absenteeism, lowered productivity, employee turnover and medical, legal and insurance costs (The American Institute of Stress, 2018). And this is just the economic costs, not considering the effects of personal pain and suffering.
Problems with interpersonal relations, lack of focus and privacy, aswell as environmental factors influence stress. (Europeiska Arbetsmiljöbyrån, 2018)
When considering how to remedy the impacts of stress, the impact of our environment is often forgotten and left out of the equation. Even if the physical environment may not be identified as the main source or cause of stress, our environment does affect us deeply. Researchers hypothesize some experiences created or supported by architectural elements, such as curiosity, facination and certain types of attention, enhances restorative processes (Bodin Danielsson, 2010). Why would we spend money on expensive hotels, buy fancy clothes, visit beautiful cities and go into nature if it did not affect how we feel? These are activities that are related to being active, having a good time, personal freedom, being social or to relaxation, which are all antidotes to stress.

New wellness building companies and certifications have recently started to pop up, and commercial and non-profit organizations working with green buildings and enviromental consciousness are bringing in the health aspects (Delos, 2018).

The office used to be a place primarily to trade time for money, and happiness or health promotion was not a priority. In recent times we have come to a better understanding of the complexity of the human body and mind, and how happiness, health and productivity are all linked to one another. The office have become a

part of life with an accompanying lifestyle and part of the identity for many people. Boundarys are shifting, cultures are changing, and if the office used to be impersonal, a bit stiff and purely functional, few people today want to have that kind of life or lifestyle.

Descartes devided human beings into body and mind as discrete and opposing parts. The body was an object, the carrier of the soul, abiding the rules of nature, but was separate from the mind that did not abide to the worldly laws of science (Barbosa da Silva, 1992). This Descartian view of the human body and condition unfortunatly had a great influence on western world view, society and science. As a result, the fields of medicine (and phychiatry), psychology (and ethology) have been separate since the birth of modern science, and only during the last decades they have started to cooperate, blend and synthesise the knowledge of the respective fields.

Modernism certainly brought some good features to the architecture of the workplace, while at the same time carelessly discarding so many qualities and features that had served humans for decades, centuries or even milennia. Postmodernism left architecture in a vacuum of absolute subjectivity and confusion. Is everything relative? Does humans share any features at all? (Duignan, 2018).

Today science has tought us more about the human brain, nervous system and physiology and we know so much more about the human condition and the vastness of our similarities.

Supermarkets are designed to make people buy more.

Today's supermarkets are designed to make people buy more. Dairy, the most commonly bought products, are always at the far end to make customers have to pass through the whole store and hopefully pick some up some special deals on the way. The design of IKEA is carefully orchestrated to make people shop more. First the most important stuff, sofas and beds, half way through a lunch break to raise blood sugar, and at the end a hot dog reward for good partners and children who endured the endevour without complaining too much. A successful trip that makes you want to come back for more. McDonald's uses colors (red and yellow are used by most fast food chains), toys and rewards to keep consumers faithful. A mental message to the brain, ba ra pa pa pa, I'm loving it. Fashion boutiques with strong profiles, apart from design, uses scents and music to convey emotions to the customers. Airports and casinos uses the same principles. The lack of windows and clocks at the Las Vegas casinos is no coincidence. The absense of daylight makes people loose the sense of time passing and keeps them playing. Amusement

parks sucessfully use other principles, like mystery and curiosity (features of biophilic design) to enchant the visitors and keep them amused and happy (Sternberg, 2009). What if we could use similar principles, not to manipulate, but to support people in their everyday experiences at work?

What if we could use similar principles ... to support people in their everyday experiences at work?

Benefits of reducing stress includes reduced problems of mental and physical health, less injuries, illness and lost work time. Reduces sick leave and staff turnover. Increases job satisfaction, engagement and productivity, improves health and community wellbeing and reduces costs for employers (Dep. Health & Human Serv., State Gov. of Victoria, 2018). The benfits of every day physical activity and exercise are matched or even greater, as we shall return to later.

Architecture does in fact affect our health and wellbeing through its direction of sound and light, and us humans. How it enables us to interact and communicate with it and with each other, and, as we shall see, its neurological influence on mental processes and emotions, and through that, on happiness.

Selection

The number of factors in our environment that effect us through our perception are off course very many. A selection is required to be able to go into any depth and destinguish good from bad alternatives.

7 topics where chosen based on their prevalence in the literature and body of research, their impact size and their relevance for the office:

- Exercise
- Nature
- Social
- Focus
- Light
- Natural Materials
- Beauty

Analysis of Application

Local Context Analysis

Why Consider Local Context?

By studying the context of place and time for the building, through the lens of the 7 health bringing dimensions, we can better understand why it needs to be designed the way it needs to be, to harmoniously fit in and provide something valueble for that place and time.

To me learing from history has been important, while at the same time reaping the benefits of modern science and technology. All that is new is not good, and all that is old is not bad. It is my firm belief that we can achieve excellence by keeping the old that is good and bringing in the new that is exceptional.

There is something about old buildings that new buildings lack. I believe it has to do with the physical connection of the body to the materials and architecture. The scale and shapes, manifest through the pencil of the architect and the hands of the craftsmen.

"Skill was learned through incorporating the sequence of movements refined by tradition, not through words or theory. The body knows and remembers. Architectural meaning derives from archaic responses and reactions remembered by the body and senses."

(Pallasmaa, 2012)

Historical

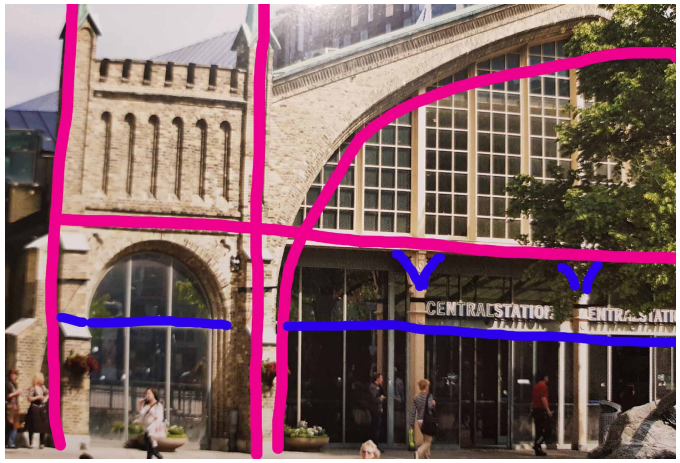
Göteborg begins as a 17th century fortified city to secure and controll acess to the western sea. During the 18th century international sea trade via the East India Company leads to an economic boom. The expansion continued during the 19th century when textile and manufacturing industries, and later engineering industries flourished. During the 20th century the ship building industry became one of the largest in the world and the automotive industry, and other industrial companies grew. The engineering and trade traditions are still strong in the city. Today the city is known for it's innovation, it's technological industries, medical industry, and increasingly as an event city. It is also important as a place for education and for trade.

We should remember what is good in that we have and treasure what has been given us. Learning from our history and from historical architecture is to be considered empirical knowledge. Our bodies or minds has not changed during the last hundred years. That being said, we can not stop the time and keep things at a status quo. Growing and developing is natural and important. But all that is new is not good. I therefore argue in this thesis, that we should use the benefits of old techniques while introducing new knowledge to maximize the wellbeing for the user.

Morphological

Göteborg is a coastal harbor city, a dutch style trade city with a moat and a few canals. Most central buildings are brick (and plaster) buildings beginning with 18th century dutch yellow brick and various red and yellow rough brick types during the 19th century. Due to the blooming economy palaces and grand housing where also built. The buildings reflect the economic expansion in the city from the 18th century and on. Many grand civic buildings where built in brick during this era and the high quality of these buildings where seen as an investment in society. The bricks were laid in different depths organizing the facade and creating tectonic and pattern effects. The bricks where made in different sizes and shapes adapting to their use on the building. Sometimes rustic and industrial, yet harmonic and organized, and sometimes decorated with ceramic details, ornamented iron or painted plaster.

From the late 19th century a new creative, very vivid and eclectic brick architecure takes form. It is a classical architecure style with romantic influences from northern Germany, neo-renaissance, neo-gothic and jugend. It becomes one of the signature styles of central Göteborg and southern Swedish cities. Some of the more excentric houses in this style where by Harald Boklund and Hans Hedlund.



Exercise

Exercise is getting more and more popular and trendy, there is a multitude of races in running, cycling, obstacle courses, triathlon and so forth that draws a growing number of attendees every year. However, it seems that certain groups "do all the exercise" while large groups still do very little, or even less and less.

It is important to spur activity and exercise in those groups who do little or no exercise, and to expose them to active activities in their everyday life, encouraging and supporting healthy choices.

Daylight & Light

During the winter months there is a limited amount of sun and daylight in Göteborg which has an impact on the employee's mood on average, and on productivity. Indoor work light can also boost productivity. Most modern workplaces have enough levels of artificial light. There is however room for improvement working with problems of glare and too high contrast. We should provide environments that has support contact with daylight every day, especially in the morning and at lunch hours. Natural light also indirectly support the benefits of having a (beautiful) view via the positive effects of biophilia and beauty.

Nature & Biophilia

City centers usually have little plants, however those that are there seems to be very important by bring people a lot of happiness and wellbeing. For example, the blooming cherry trees at Järntorget in spring or the beloved oak, linden and beech trees that were to be moved near Haga Church that upset many people. In spring and early summer people sitting in Kungsparken along the canal clearly illustrate the longing and need people in cities have for plants, water and natural features.

Göteborg is in the southern deciduous forest region in Sweden and the forests constitute mainly hardwood leaf trees such as the above mentioned oak, linden and beech. It is a coastal city with a river that flow into the western sea. To the south of the city farm lands and open fields open up the landscape. To the north the characteristic smooth rock landscape of bohuslän begins. To the east a hilly mixed forest landscape starts.

Animals can somtimes be seen in the citys green areas such as rabbits, hares, roe deers, hedgehogs. Naturaly there are also many birds and insects.

We can maximize the happiness and wellbeing of people by using the benefits of natural and biophilic features.

Social

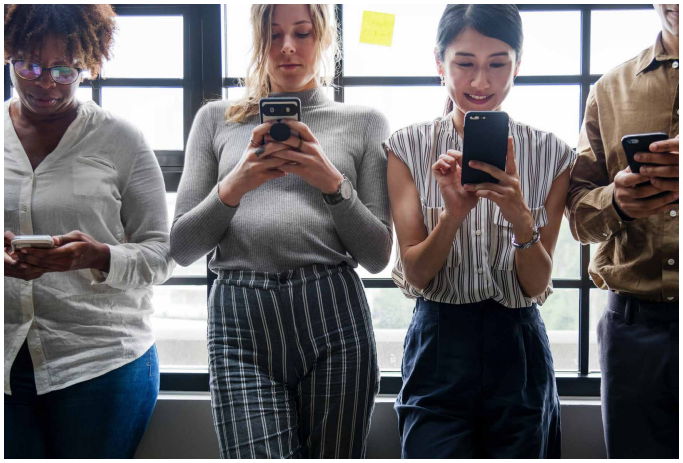
Sweden (and many parts of the world) is in a dynamic state of social change. The values and ideas of the 20th century are fading away and internet connectivity and now social media has had a massive change on society both increasing possibilities and connection, but also inducing stress. Immigration, integration, equality, emancipation, globalization and labor migration has effects on both society and the work places. There is a need to include everyone in this diverse new society, also in the workplace.

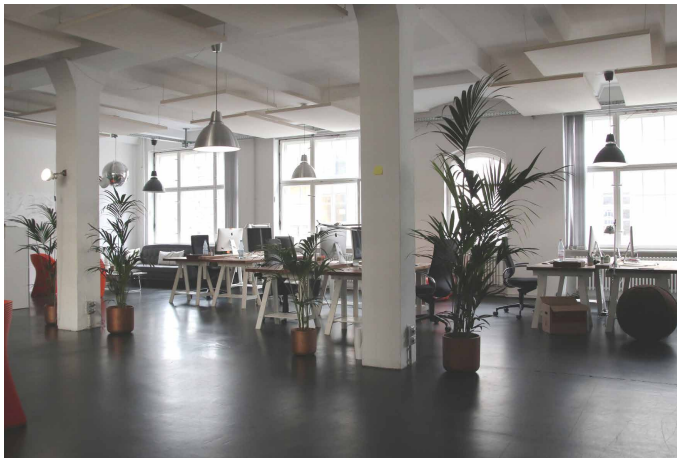
The key is to provide support for universal needs that makes everyone (at least reasonably) comfortable and to provide a platform to communicate over social barriers. We should provide environments that strengthens the social dynamics of the workplace, that helps support the forming of a team spirit that includes everyone to the greatest extent possible. That means supporting the social dynamics that helps form both expressive and instrumental ties (friendships and colleagueship) while keeping the company team spirit intact and sustaining a good relationship between management and employees. We should also provide work environments that utilizes the good parts of connected society and protects us from the potential harm it can bring in the form of stress and unhealthy smartphone habits.

Noise, Interruption

The open plan office is the standard in most modern offices in Sweden and internationally, and while more and more offices are changing to activity based designs, still many of the activity based areas have much in common with the open plan office, with many people sitting in an open landscape setting. This is often problematic in the terms of providing enough areas to be able to fully focus on a task. One of the employees I talked to 'confessed' to me that he had experienced the common problems to focus with people around: due to talk, accidental eye contact etc. "I never talked to anyone about this before..".

While different people thrive in different settings, and different job/office types have different demands on their employees. It is important to provide a range of environments that suit the both personal and work-task needs for the employees. In most cases that means providing enough spaces for focused work, which seems to be the one thing that is most commonly lacking, while most other features are at least to some degree, and sometimes greatly provided.





Beauty

Beauty has generally not been a high priority for office buildings the last century, and Sweden and Göteborg is no exception. Even though beauty arguably (at least to some degree) is subjective, offices during the last decades has not been successful in maximizing the experience of beauty for the public or what is the consensus of the end users. Office buildings and beauty are rarely associated together, likely due to the over focus during recent decades on a machine-like logistical approach to provide functionality and productivity in the office. The common subjective needs of beauty for human beings has at least to some degree been forgotten and the benefits not maximized.

Beauty is a subjective experience, but there are some very strong common subjective traits, some of which likely are coded into our DNA. For example, the beauty of nature and natural materials, but also geometrical shapes, light and other visual cues and preferences. We need to listen to the esthetic preferences of the end user when we design our offices. It is not necessary to blindly follow everything the user wishes for, but rather make a professional assessment of the information and provide a satisfying solution to both end users and indirect users, while considering the conditions by the professional to provide a great solution.

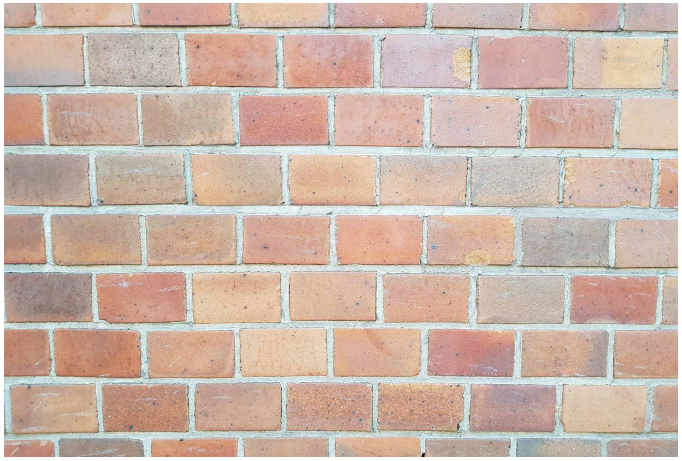
Material

Central Göteborg constitutes predominanly brick and some plaster buildings. Brick from many eras with various colors. From the late 19th century a new type of hard burnt machine made brick, *förbländertegel,* becomes popular due to its perfection in shape and beautiful color nuances, but mostly because of its ability to withstand frost bite well, because of its dense and hard surface. The förbländertegel is one of the most characteristic features of central Gothenburg and was frequently used in all expanding areas from the late 19th century into the early 20th century.

Leaving the city center there are a significant number of wood buildings in the surrounding housing areas from the late 19th and earlty 20th century: areas like Bagaregården, Änggården, Örgryte, Haga, Kville, Landala etc with the characteristic Göteborg landshövdingehus and rows of small wood houses. There are also several wooden manors spread out in the city where there once were fields.

Natural Materials

Natural materials were forgotten during the industrialization of the building industry struck by the appeal of plastics and the possibilities of other new materials during the 20th century. There is now a beginning revival of natural materials in the building industry - in particular wood that has seen an explosion in use during recent years.



Deriving a Program From 3 Case Studies

Space Analysis Method

In the case studies the areas of the offices were divided into categories depending on what functions the spaces serves for the employees or the company.

Individual Work Areas
Dedicated to individual work.

Open Office Areas
Unclear designated use.

Group Work Areas
Dedicated to group work.

Gatherings, Meetings, Phone or Video calls
Rooms dedicated to larger group gatherings, various size meeting rooms, phone or video calls.

Lounge Area
Dedicated to relaxing, recovering and socializing.

Human Centered Areas
Areas and functions that support health, performance and wellbeing in general, such as facilitating the work day, promote social interaction or exercise and so forth. (ex: Kitchens, wardrobes, changing rooms).

Task/Object Centered
Areas and functions that are necessary to run an office. (ex: WC, storage, server room)

Communication
Dedicated to moving around.

Terrace
Dedicated to getting outdoors from the office.

	Focus (dark)	Collaboration	Relaxed (light)
Individual (1 pers.)	Focus Room	Room For Phone or Video Meeting	Open Work Area
Open Office (uncertain)	Unclear designated use		
Group Work (2-5 pers.)	Focused Group Work	Small Meeting Room	Relaxed Collaboration Area
Meetings, Phone, Video Calls (1-20 pers.)	Meeting Rooms	Meeting Rooms	Meeting Rooms
Group Gatherings (10+ pers.)	Large Space	Large Space	Large Space

The areas for **individual work** (blue), **group work** (orange) and **meetings** (red) are further subdivided into areas for focused work (dark/saturated) or relaxed work (bright). This usually depends on if the room is separated by walls or similar to avoid visual and sound distractions.

Since **open office spaces** are not separated, and functions worse than other room types for both focused and relaxed work it is not subdivided into types.

Areas for **group gatherings** such as auditoriums, cantinas or other large rooms usually functions well for both focused activity (lecture), collaboration (meeting) or relaxed activity (recreation) due to the dominance of the size and number of people.

Example (Vasakronan)

Plan
1:400

KÖPMANSGATAN

FREDSGATAN

NORRA HAMNGATAN

7% Individual Work
(2% Relaxed)

6.6% Group Work
6.6% Relaxed

9.7% Lounge Areas

4.9% Task/Obj. Centered
29% Communication

2 | 5 | 11 | 6.6 | 0.9 | 13.8 | 9.7 | 16.8 | 4.9 | 29

11% Open Office

14.7% Meetings etc.
(0.9% Relaxed)
(13.8% Focused)

16.8% Human Centered

100%

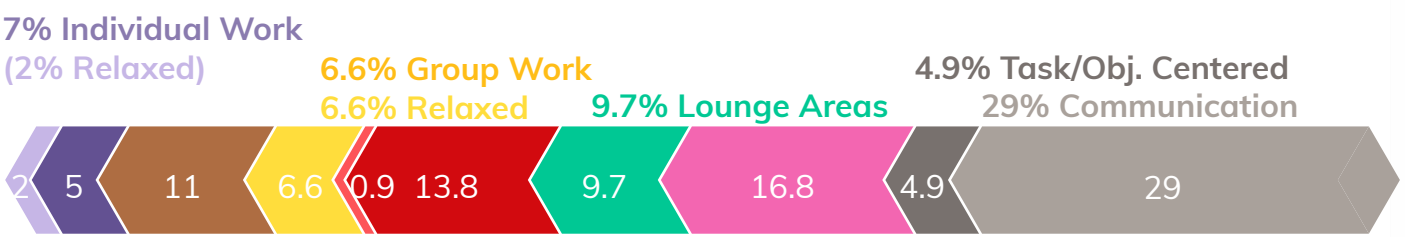
Vasakronan

Project Data:

Location:	Göteborg, Nordstan
Year:	2015
Architects:	Okidoki
Type:	Activity Based Office
Area:	1080m^2
People in per day:	30-60 persons
M^2/person:	18-36m^2

Space Analysis - Vasakronan

Plan
1:400



7% Individual Work
(2% Relaxed)

6.6% Group Work
6.6% Relaxed

9.7% Lounge Areas

4.9% Task/Obj. Centered
29% Communication

11% Open Office

14.7% Meetings etc.
(0.9% Relaxed)
(13.8% Focused)

16.8% Human Centered

100%

KÖPMANSGATAN

FREDSGATAN

NORRA HAMNGATAN

Program Analysis - Vasakronan

7% Individual Work Areas (74.6m²)

Relaxed:

Reception, 20 m²	2%

Focused:

Focus zone, 54.6 m²	5%

11% Open Office Areas (109m²)

Open Plan Office, 109 m²	11%

7.5% Group Work Areas (78m²)

Relaxed:

Specialized Work Area, 36 m²	3.5%
Project Group Work Places, 42 m²	4%

13.8% Meetings etc. (142.5m²)

Focused: *13.8%*

Large meeting room (1) (20p), 37 m²	3.6%
Medium meeting room (2) (8-12p), 38.5 m²	3.7%
Small meeting room (4)(3-6p), 48 m²	4.7%
Alone/conversation rooms (4) (1-2p), 19 m²	1.8%

9.7% Lounge Areas (100.8m²)

Lounge Dark, 35 m²	3.4%
Lounge Good, 22 m²	2.1%
Lounge Close, 33 m²	3.2%
Lounge View, 10.8 m²	1%

16.8% Human Centered (173.6 m²)

Wardrobe, 5.6 m²	0.5%
Lobby, 19 m²	1.8%
Micro kitchen, 5.5 m²	0.5%
Kitchen, 16 m²	1.6%
Lunch room, 70 m²	6.8%
Resting room, 5.5 m²	0.5%
Changing rooms, 40 m²	3.9%
Laundry room, 5.8 m²	0.6%
Childrens room, 6.2 m²	0.6%

4.9% Task/Object Centered (50,2 m²)

Storage rooms (5), 23 m²	2.2%
Cleaning room, 3.5 m²	0.4%
Server room, 5.3 m²	0.5%
HWC (2), 10.4 m²,	1%
WC (5), 8 m²,	0.8%

29% Communication (300m²)

Communication, 300 m²	29%

(Extra) Terrace (300 m²)

Outdoor Terrace, 300 m²,

Observations

- There are a lot of decorations and plants, however most plants are not real.
- Some sightlines are broken, perhaps it sould have been better to keep them to get more light.
- Decorations does help to make the place more lively but may perhaps also interpreted as kitch.

+ Strengths

- Popular focus room with light from the north.
- Changing rooms with showers (and laundry) for bicycle commuters.
- A small sheltered terrace (most of it is shaded but one corner is nice in the sun).
- Personal Lockers in the corridors, and other spread out functions such as phone booths and seats.
- Great Coffee at the Reception.
- Fresh Kitchen in the Lunch Room.

- Weaknesses

- Some rooms feels like they lack daylight.
- The dull colors does not help the light situation.
- Ceiling height could be higher.

What I will bring

- Design rooms with a generous ceiling height.
- Allow for sight lines and access to daylight.
- Select colors reflecting the desired “mood” of the room.
- Focus room to the north.
- Changing rooms (don't need daylight).
- Personal lockers in corridor.
- Provide great coffee.
- Design with plants, preferably real plants.

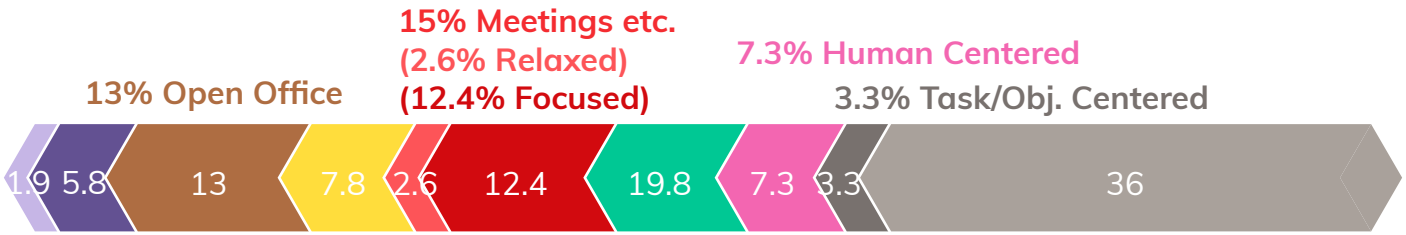
Vinn Group

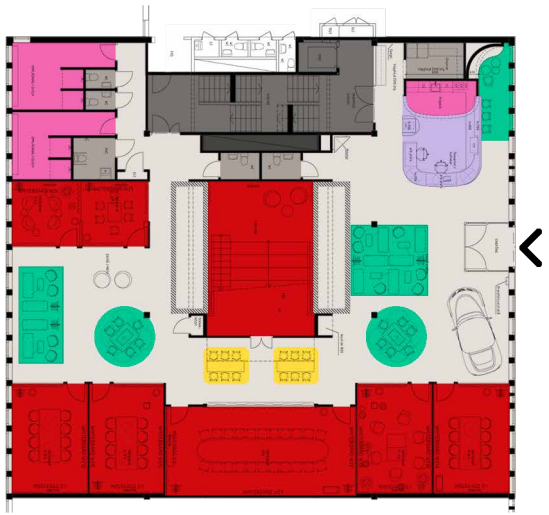
Project Data:

Location:	Göteborg, Kvarnberget
Year:	2015
Architects:	Okidoki/Vinn Group
Type:	Activity Based Office
Area:	2400m^2
People in per day:	100-130 persons
M^2/person:	18-24m^2

Space Analysis - Vinn Group

Plans
1:400





Level E

Level 1

Level 2

Program Analysis - Vinn Group

7,7% Individual Work Areas (169m²)

Relaxed:

Reception, 16 m²	0.7%
Open Work places, 27m²	1.2%

Focused:

Shared Offices, 126 m²	5.8%

13% Open Office Areas (283.5m²)

Open Plan Office, 283.5 m²	13%

7.8% Group Work Areas (170m²)

Relaxed:

Various Relaxed Group Work Areas, 170 m²	7.8%

15% Meetings, Gatherings etc. (325.7m²)

Auditorium, 57m²	2.6%

Focused:

Large meeting room (1) (20p), 46.7 m²	2.1%
Medium meeting room (6) (8-12p), 136 m²	6.3%
Small meeting room (7)(3-6p), 77.5 m²	3.6%
Alone/conversation rooms (2) (1-2p), 8.5 m²	0.4%

9.8% Lounge Areas (213m²)

Various Lounge Areas, 213 m²	9.8%

7.3% Human Centered (156m²)

Coffee/mini-kitchen, 6 m²	0.3%
Micro kitchen, 3.5 m²	0.2%
Restaurant Kitchen, 37.5 m²	1.7%
Lunch room, 77.5 m²	3.6%
Changing rooms, 31.5 m²	1.5%

3.3% Task/Object Centered (72,6 m²)

Storage rooms (2), 14 m²	0.6%
Cleaning rooms (2), 7 m²	0.3%
Garbage room, 5.7 m²	0.3%
Server room, 9.6 m²	0.4%
Printer room, 5.8 m²	0.3%
HWC, 5.5 m²	0.3%
WC (11), 25 m²	1.1%

36% Communication (787m²)

Communication, 787 m²	36%

Terrace (400+ m²)

Outdoor Terrace, 400+ m², (extra)

Observations

- Spaces for different uses seems to be divided into respective floors.
  Entrance floor: meetings, lounges, auditorium.
  First floor: individual and group work, auditorium.
  Second floor: human centered and lounges.
- The auditorium connects the floors making them feel very connected. The whole space feels like one.
- Facades to all directions. Lots of facade facing south and west.
- Many work areas has a relaxed atmosphere and are close or directly next to lounge areas.
- Straight corridors with long sight lines.
- Employees are clearly proud of their office.
- Few walls in the open plan. (Creates a feeling of space but probably increases interruption and noise problems).

+ Strengths

- The auditorium in the center of the building binds the floors very well, spreads daylight throught a skylight and becomes the natural heart of the office.
- Feels bright and spacious (due to high ceilings, mostly white ceilings and walls, thin building, many windows, and high elevation of building.
- Almost all rooms have direct access to daylight. Interior meeting rooms have glass walls (with curtains) that let in some of the daylight.
- The restaurant kitchen brings a sense of quality and pride to the office. (It is usually equiped of some snacks or drinks.)
- Many and generously sized meeting rooms.
- High quality furniture and interior design.
- The terrace is huge, bright and has a magnificent view over the city and river.
- Good placing of rooms that entails a short, but not too long walk.

- Weaknesses

- Even though Vinn Group is an activity based office, many of the spaces are or resemble open plan office space. Since there are no walls separating these areas and the choises of alternative corresponding workplaces are limited, these are classified as open plan office areas, which are worse for health outcomes. Group work areas also clearly resemble open plan office (but are categorized as group work here).
- There is no focus zone and there are few or no spaces to be alone or work alone.
- Dull and boring exterior of building.
- There could be more plants.

What I will bring

- An open auditorium with lots of daylight.
- An open stair that connect the floors (and makes the office feel like one).
- High ceilings.
- A restaurant kitchen.
- The need for a focused work area.

Atrium Ljungberg

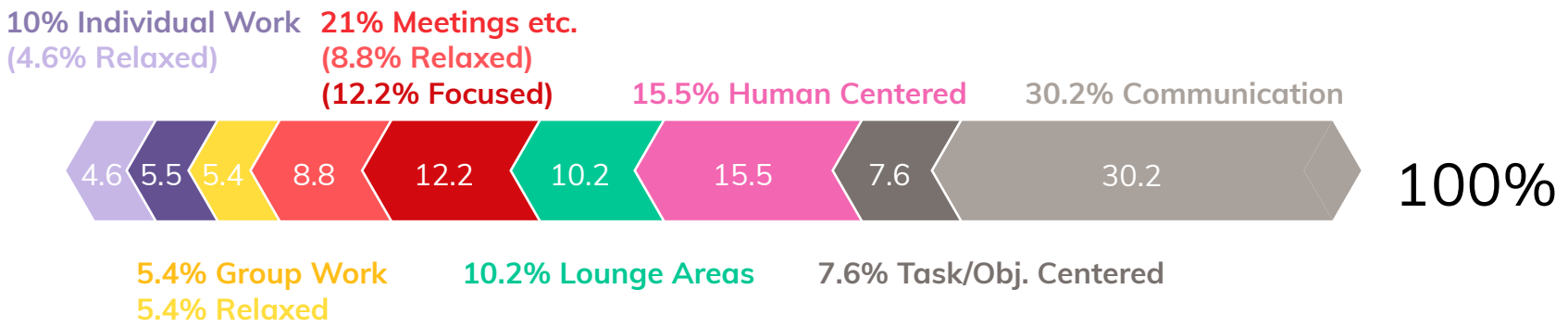
Project Data:

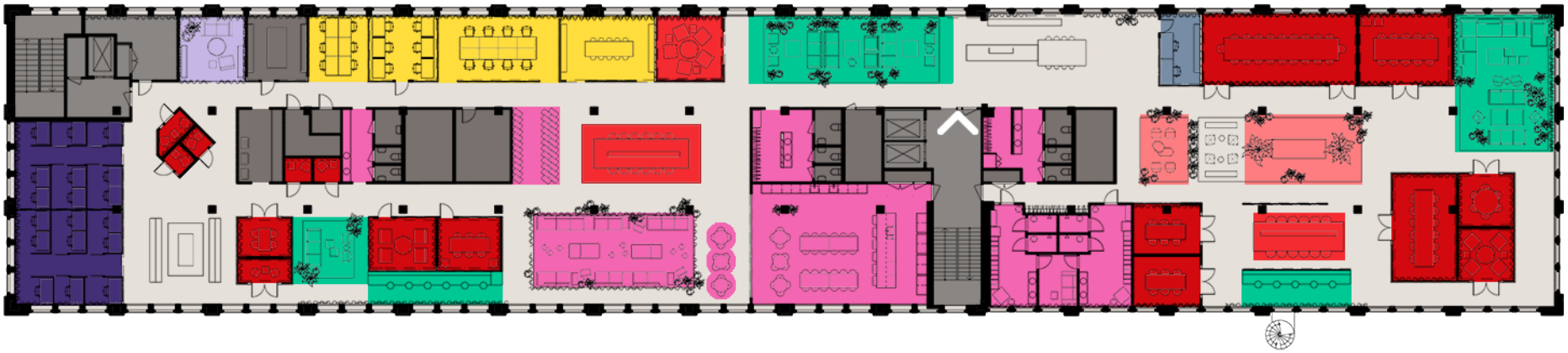
Location:	Stockholm, Sickla
Year:	2018
Architects:	Koncept/Atrium Ljungberg
Type:	Activity Based Office
Area:	1640m^2
People in per day:	80-100 persons (max, changes during the day)
M^2/person:	16-20m^2

Winner of Swedens Best Looking Office 2018

Space Analysis - Atrium Ljungberg

Plan
1:400





Program Analysis - Atrium Ljungberg

10% Individual Work Areas (159m²)

Relaxed:	***4.6%***
Reception, 36 m²	2.3%
Open Standing Work Place, 20 m²	1.3%
Library, 16.3 m²	1%
Focused:	***5.5%***
Focus Area, 75.8 m²	4.8%
Shared Office 10.9 m²	0.7%

5.4% Group Work Areas (85m²)

Relaxed:	***5.4%***
Relaxed Group Work Rooms, 85 m²	5.4%

21% Meetings, Gatherings etc. (332.5m²)

Relaxed:	***8.8%***
Medium Meeting Room (1) (4-5p), 15.5 m²	1%
Informal Meeting Area, 52.5 m²	3.3%
Open Meeting/Board Rooms (2), 71 m²	4.5%
Focused:	***12.2%***
Large Meeting Room (1) (22p), 42.5 m²	2.7%
Medium Meeting Rooms (2) (8-12p), 52 m²	3.3%
Small Meeting Rooms (7)(4-6p), 82 m²	5.2%
Alone/Conversation rooms (6) (1-2p), 17 m²	1.0%

10.2% Lounge Areas (161m²)

Small Lounge, 20 m²	1.3%
Seating with view in corridor, 36 m²	2.3%
Lounge / relaxed Open Work Areas, 105 m²	6.6%

15.5% Human Centered (244.4m²)

Wardrobe, 15.5 m²	1%
“Luxury” Bathrooms, 24.5 m²	1.6%
Changing Rooms, 50.1 m²	3.2%
Personal Lockers In Corridor, 13.8m²	0.9%
Restaurant Kitchen/Lunch, 95.5 m²	6%
“Camp Fire” Gathering Place, 45 m²	2.9%

7.6% Task/Object Centered (119,7 m²)

Storage Rooms (3), 29.5 m²	1.9%
Safe & Document room, 14.5 m²	0.9%
Printer Room, 12.7 m²	0.8%
Server Room, 7 m²	0.4%
Teknikrum (3), 38.5 m²	2.4%
HWC (2), 7.5 m²	0.5%
WC (6), 10 m²	0.6%

30.2% Communication (476m²)

Communication, 476 m²	30.2%

Observations

- Atrium Ljungbergs office has several spaces with 6-8 people working together, that would be classified as a small open office (not good for health) if it was an open plan. However these spaces are secluded, and the office is an activity based office, where people can choose where they work. Therefore they are instead classified as group/team work areas that are not associated with these health disadvantages.
- Some of the areas are hard to classify into one category because they overlap and are therefore split into two. For example relaxed *Open Work Areas* overlap with relaxed *Open Meeting Areas* or *Lounge Areas*. This is likly a good thing as long as there is an abundance of spaces offered to choose from (which there are) if one is occupied with one style of activity.
- The difference between area categories are not as distinct in Atrium Ljungbergs office. It seems many areas work very well for a wider range of activities.

+ Strengths

- Excellent balance between different types of spaces.
- Many areas work very well for several different activities, and the use of the office seems very dynamic with smooth transitions.
- The focus area has booths with frosted glass that offers visual contact with the surroundings without visual distractions. The booths themselves are beautifully designed in glass and black metal, and offer a private zone to get comfortable in while focusing.
- The focus area offers both single and double booths, which is great for focused work alone or with a colleague.
- Beautiful interior design and furniture. It feels like a high-end hotel.
- High Quality Materials: Glass and glass brick that lets through the light and gives beautiful light, black coated metal provide structure and legibility, wood panels, concrete floors, white walls that reflect the daylight, matching leather and fabric furniture and textiles, and a decent amount of plants.

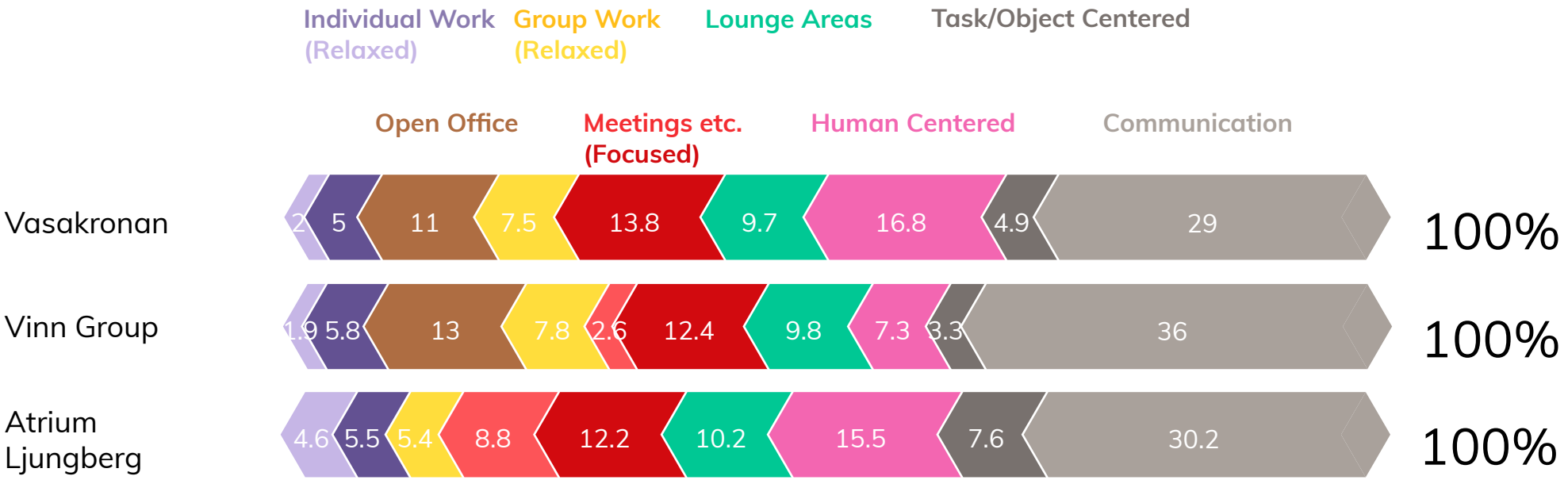
- Weaknesses

- Could use even more plants.
- Floors with hard cover. May cause step noise.

What I will bring

- The balance between spaces.
- The elegantly designed booths from the focus area.
- The interior design style (that resembles a hotel or a luxury home).
- (Even more plants).

Comparing the Programs



(Percentages are approximate)

Individual Work (7-10%). Vinn Group did not have any designated spaces for alone time or focused work. The focused work areas for Vinn Group are mostly shared offices not accessible by everyone.

The *Open Office* (0-13%) category is almost the same in Vasakronan and Vinn Group but is replaced mostly by relaxed meeting areas and some focused work areas in Atrium Ljungbergs office. Which is likely good for health outcomes.

Group Work (5-8%) areas in Vasakronan are very similar to relaxed meeting areas. In Vinn Group they are specialized open office work places. Atrium Ljungberg has the Group Work areas separated from other work areas, much like a focus zone but with 6-8 work places connected.

Areas for *Meetings* (14-21%) are around 15% but over 20% in Atrium Ljungberg due to the many relaxed Meeting areas. These areas can of course be used for other work tasks when avaliable.

Lounge (10%) areas are almost identical at 10% in the three offices.

Human Centered (7-17%) areas are at around 16% but only half for Vinn Group. However these areas are of very high quality. The office also has a very human centered atmosphere in corridors and other areas.

Task/Object Centered (3-8%) areas are similar between the offices. The lower percentage of task centered areas for Vasakronan and Vinn Group is due to different needs for and modes of storage, and centralized technical rooms.

Communication (30%)is almost identical at 30% in the offices. The extra 6% at Vinn Group makes the office feel spacious and relaxed.

Case Study Observations

- Very small lounges work well for individual work, if it is small enough for one to be able to occupy the lounge. Medium sized work better for informal meetings and conversations since there will be a distracting group feeling when many people occupy it. Large lounges also work well for individual work (as long is it is calm) since one becomes an individual in the crowd.

- Quality can make up for quantity. Especially when it comes to areas that are more qualitative than quantitative in their nature, such as human centered areas and lounges.

Case Study Comparison

All three activity based offices had a very similar distribution of spaces which is interesting since Vasakronan and Atrium Ljunberg are real estate companies and Vinn Group is a tech and bussiness consultant company.

There were some differences in the characteristics of the spaces (relaxed/neutral/focused) even though it is hard to define precisely.

Vasakronan had some problems in the plan layout with lack of daylight. This is partially due to the exterior building restrictions. Vinn Group and Atrium Ljungberg had very favourable building conditions to design from with lots of daylight, a view and high ceilings.

The characteristics from the other spaces may contribute to the perception of and quality of one category of space.

Different offices has different needs for certain characteristics in the program, (eg. energetic, flexible, calm), but the program of Atrium Ljungberg seems very strong from a health promoting perspective.

Atrium Ljungberg had a very good balance between rooms and room types, and I will base the distribution of spaces from that.

What I will bring (Vasakronan)

- Design rooms with a generous ceiling height.
- Allow for sight lines and access to daylight.
- Select colors reflecting the desired "mood" of the room.
- Focus room to the north.
- Changing rooms (don't need daylight).
- Personal lockers in corridor.
- Provide great coffee.
- Design with plants, preferably real plants.

What I will bring (Vinn Group)

- An open auditorium with lots of daylight.
- An open stair that connect the floors (and makes the office feel like one).
- High ceilings.
- A restaurant kitchen.
- The need for a focused work area.

What I will bring (Atrium Ljungberg)

- The balance between rooms/spaces.
- The booths from the focus area.
- The interior design style.
- (Even more plants).

What I will add (From the 7 dimensions)

- A mindfulness room.
- Safe & dry bicycle parking.
- A bicycle entrance and elevator next to the main entrance.
- A glazed court yard with living trees.
- Lots of plants in all areas.
- Lots of daylight.
- Visual contact with manually controlled auditory and visual privacy.

The Project

Project Data

Location:	Göteborg, Fredsstaden, Södra Hamngatan 47
Year:	2019
Type:	Activity Based Office Biophilic, Health Promoting Office
Total Area (BTA):	2006,25m^2
Above Ground (BTA):	1350m^2 (5 floors + overglazed garden)
Below Ground (BTA):	656.25m^2 (2 floors + under yard)
People in per day ():	50-75 persons
M^2/person:	18-27m^2
Height (street):	17m
Height (total):	22m
Width:	12.5m
Depth:	18.5m
Yard width:	12.5m
Yard Depth:	15.5m
Yard Height	11-13m

Room Program

-2:	Bicycle Parking	54 m²
	Bicycle Repair Area	20 m²
	Storage	10 m²
	Technical rooms	55 m²
	Communication	68 m²
-1:	Auditorium	66 m²
	Large Meeting Room	48 m²
	Changing Rooms	33 m²
	Server Room	14 m²
	Storage	40 m²
	Recycling Room	12 m²
	Communication	145 m²
	WC, HWC	10 m²
E:	Espresso Meeting	22 m²
	Reception Lounge	10 m²
	Wardrobe	6 m²
	Conversation Room	7 m²
	Reception	16 m²
	Reception Workroom	8 m²
	Relaxed Meeting	60 m²
	Seating	15 m²
	Communication	141 m²
	Meeting 12p	25 m²
	Meeting 5-7p	18 m²
1:	Active Work	60 m²
	Meeting 4-6p	16 m²
	Meeting 4-6p	16 m²
	Meeting 8-10p	27 m²
	Printer Room	8 m²
	WC, HWC	15 m²
	Communication	58 m²
2:	Group Work	60 m²
	Exercise Room	14 m²
	Meditation Room	26 m²
	Meeting Room 4-6p	16 m²
	Meeting Room 4-6p	16 m²
	Storage Room	7 m²
	Communication	59 m²
3:	Library	60 m²
	Focused Work	60 m²
	Lounge	13 m²
	WC	16 m²
	Cleaning Room	4 m²
	Communication	47 m²
4:	Lounge Terrace	54 m²
	Restaurant	55 m²
	Kitchen	38 m²
	Communication	43 m²
	Terrace	22 m²

Program Analysis - The Health Promoting Office

12% Individual Work Areas (237m²)

Relaxed:	***4.5%***
Reception, 18 m²	1.0%
Active Work, 70 m²	3.5%
Focused:	***7.5%***
Focus Area, 70 m²	3.5%
Library, 70 m²	3.5%
Reception Work Room, 9 m²	0.5%

3.5% Group Work Areas (70m²)

Group Work Rooms, 70 m²	3.5%

16.1% Meetings, Gatherings etc. (315m²)

Relaxed:	***5.2%***
Auditorium, 76 m²	3.9%
Espresso Meeting, 25 m²	1.3%
Focused:	***10.9%***
Large Meeting Room (22p), 55 m²	2.8%
Medium Meeting Rooms (2) (8-12p), 59 m²	3.0%
Small Meeting Rooms (5) (4-7p), 92 m²	4.7%
Conversation Room (2p), 8 m²	0.4%

5.2% Lounge Areas (103m²)

Lounge Terrace, 60 m²	3.0%
Seating in Garden, 17 m²	0.9%
Lounges (2), 26 m²	1.3%

18.6% Human Centered (365m²)

Bicycle Parking, 62 m²	3.1%
Bicycle Repair Area, 23 m²	1.2%
Changing Rooms, 38 m²	1.9%
Restaurant, 60 m²	3.0%
Kitchen, 41 m²	2.1%
Terrace, 24 m²	1.2%
“Camp Fire” Gathering Place, 70 m²	3.6%
Mindfulness Room, 30 m²	1.5%
Exercise Room, 17 m²	0.9%

12% Task/Object Centered (235.5 m²)

Storage Rooms, 66m²	3.4%
Safe & Document room, 14.5 m²	0.7%
Printer Room, 9 m²	0.5%
Server Room, 16 m²	0.8%
Technical Rooms, 63 m²	3.2%
HWC (3), 18 m²	1.0%
WC (6), 30 m²	1.5%
Cleaning Room, 5 m²	0.3%
Recycling Room, 14 m²	0.7%

32.6% Communication (657m²)

Communication, 657 m²	32.6%

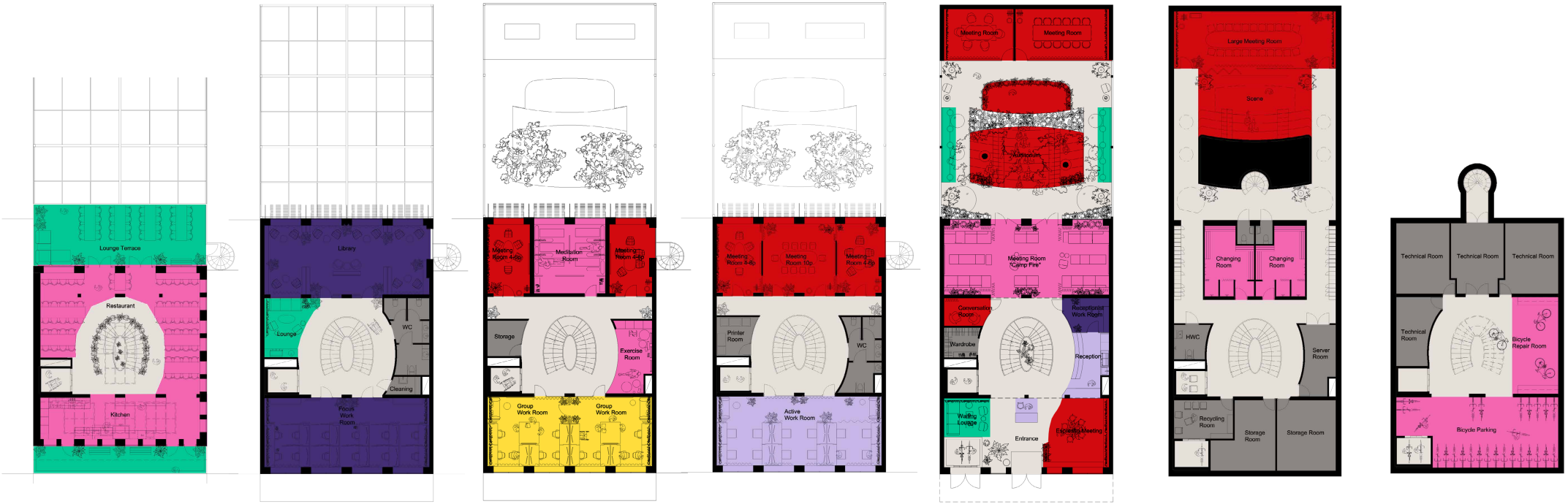
Space Analysis - The Health Promoting Office

Plan
1:400

12% Individual Work 16.1% Meetings 18.6% Human Centered 30.2% Communication

100%

3.5% Group Work 5.2% Lounge Areas 12% Task/Obj. Centered



Materials

The materials have been selected for their ability to create rooms that are appealing, inspiring, energizing or calming, that support their assigned activity, and that provides clarity and comfort. Paraphrasing my collegue Ellen Dahllöf Boyd (Dahllöf Boyd, E. 2018), the aim with this project has been to design rooms with emotional function, aswell as practical.

Glass with Black Steel Frames

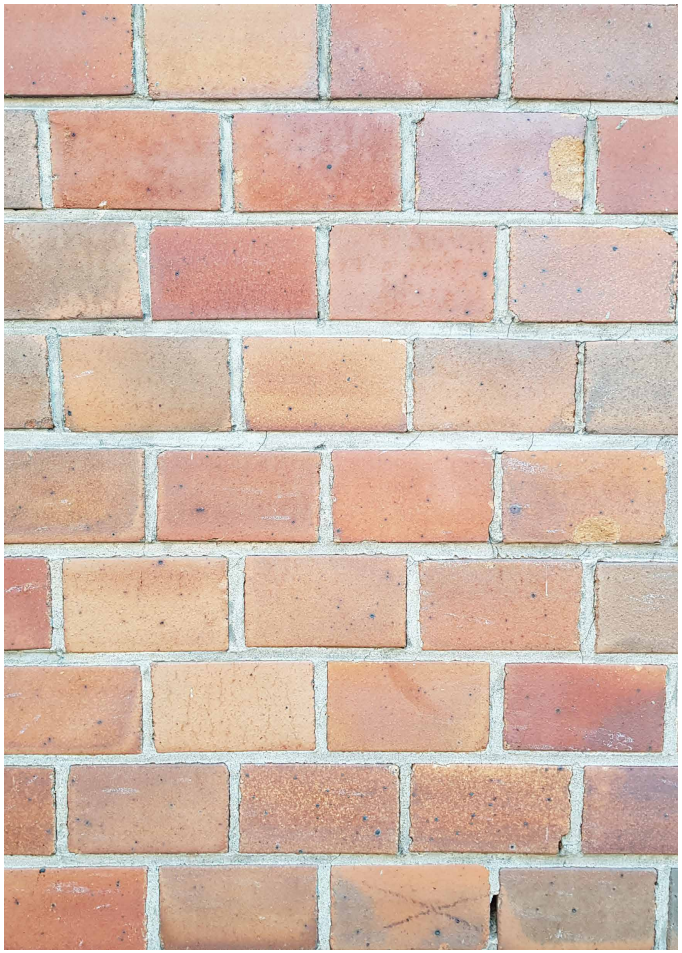
Design black window frames from the famous british window maker Crittall gives the office an open, bright and modern look. Light spreads through the building also to the inner parts. Sight lines are created. Visual contact brings people together and creates a sense of participation even if in separate rooms.

Lime Paint, White

White lime paint is used on ceilings and some of the walls. It reflects light well without being shiny and diminishes contrast from the outdoor light. Lime paint has a diffuse surface that is almost hard to detecct and has a lot of depth. This gives the impression of having no boundary and makes rooms feel spacious.

Förbländertegel

Förbländertegel is a hard burnt brick that was popular 100-130 years ago and was frequently used in Gothenburg. It is particularly resistant to frost bite and has a beautiful shimmery surface. All brick are slightly different in color but still within a certain range. This makes it a very elegant type of brick.

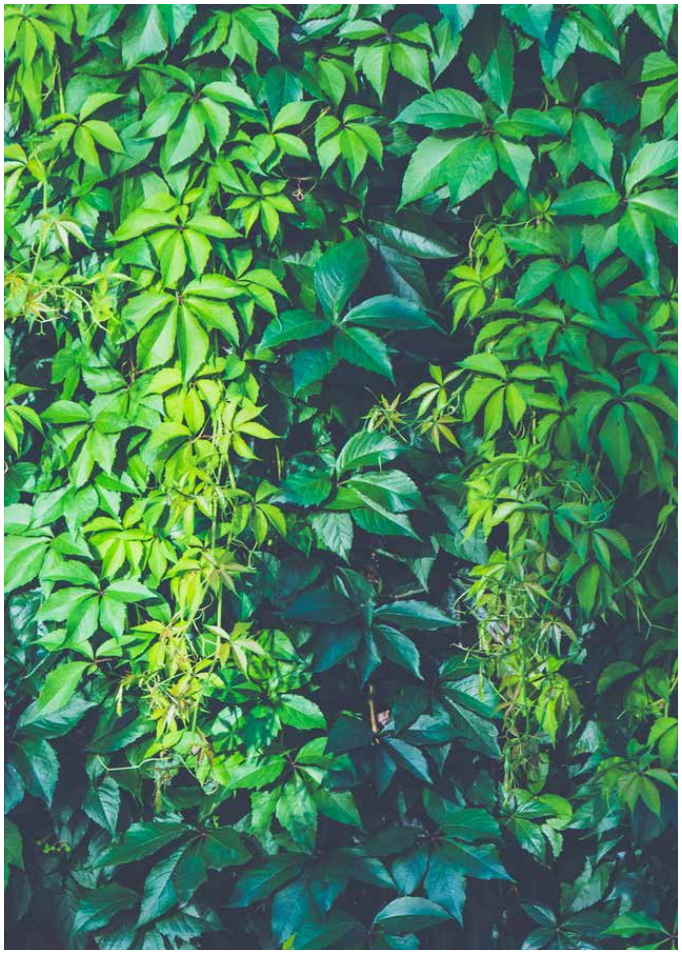


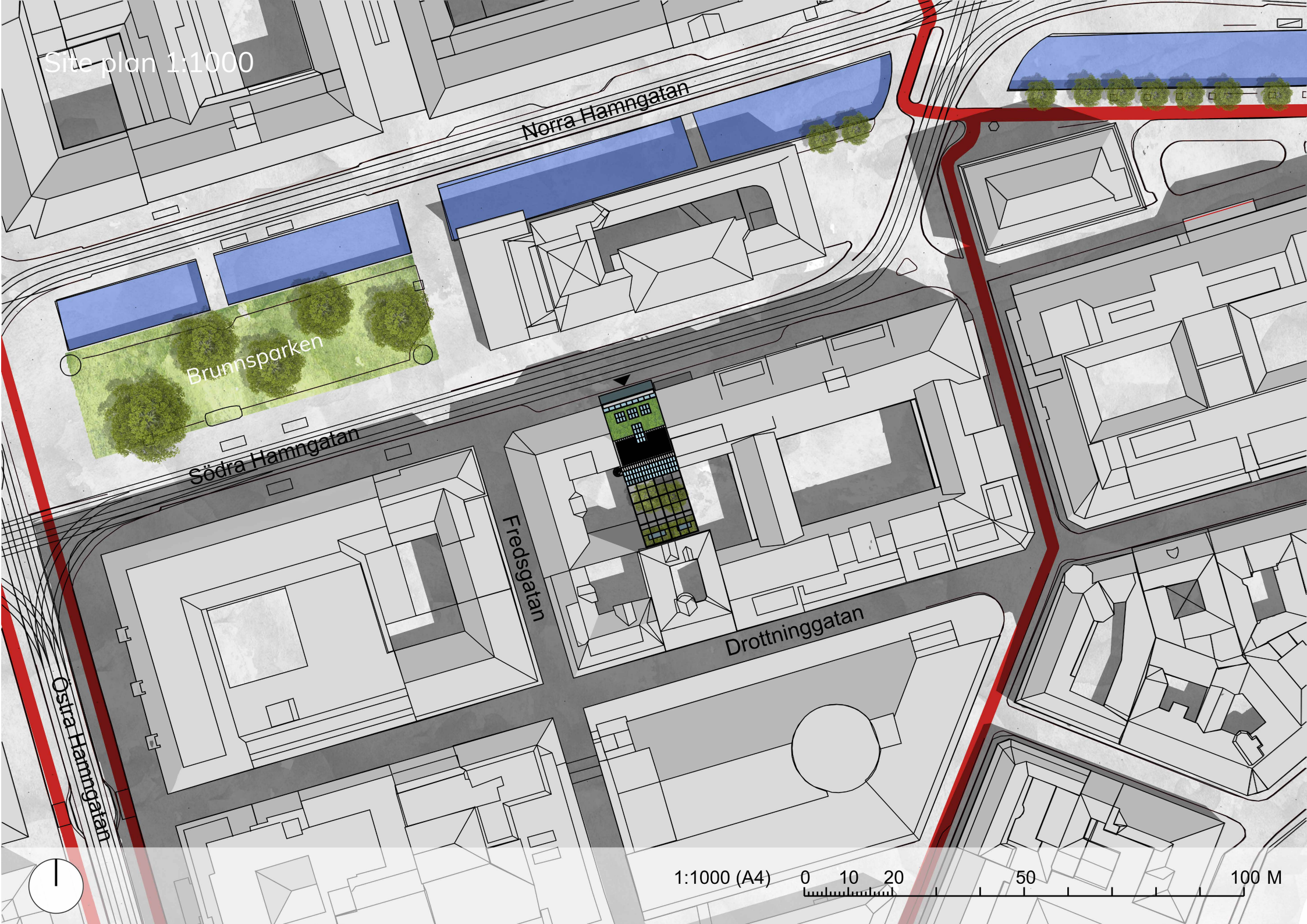
Oak Veneer Wood

Oak is a durable type of wood that signals trust, sturdyness and that is a common type of wood in western Sweden and in the Gothenburg Area. This gives a local connection and a positive signal of strength and quality to both the people working in the building and to visitors.

Green Walls

Green walls, plants and potted trees are abundant in the building. They are prioritized, made space for and constitute an essencial part of the architecture. Their effect on humidity, need for water etc are considered in the planing fase of the building.




Site plan 1:1000
Norra Hamngatan
Brunnsparken
Södra Hamngatan
Fredsgatan
Drottninggatan
Östra Hamngatan
1:1000 (A4)
0
10
20
50
100 M

Site observations

The site has a north-south direction. The ground is flat on the site and surrounding areas, but there are rough edges between the sidewalk and street, and tram tracks on the street. Accessibility level is average.

The street to the north is a heavliy trafficed low speed city street with buses, trams and taxis. The street is 18m wide and the street section has a 1:1 W:H ratio. The yard also has about a 1:1 W:H ratio.

The location is the absolute center of Göteborg, with the best location in the city for public transport, directly adjacent to a traffic hub Brunnsparken, with trams, busses express-buses and taxis, and a few minutes walk to the central train station. Antother 10 minute walk takes you to an aditional express bus hub at Heden.

There are a lot of pedestriants and pedestriant streets in the surrounding areas. The site is close to cycle ways, there are cyclists and plenty outdoor bicycle parking, however unprotected, and risk of vandalism or theft is high. Not much parking for cars.

The site is close to water (170m) in the moat and harbor canal. It is 280m to a beautiful and walkable park, Trädgårdsföreningen, and there are several other small parks in the area: Bältesspännarbarken, and Kungsparken.

The area has plenty of possibilities for shopping and the big mall Nordstan and the areas in the nearby streets offer various types of shops, boutiques, cafés, lunch restaurants and a food market. There are also pubs, restaurants and nightlife in the areas.

There are a couple of gyms within 500m in the area, at Drottningatan, and St.Eriksgatan close to the Opera.

The high tempo of the nearby streets may be percieved as stressing.

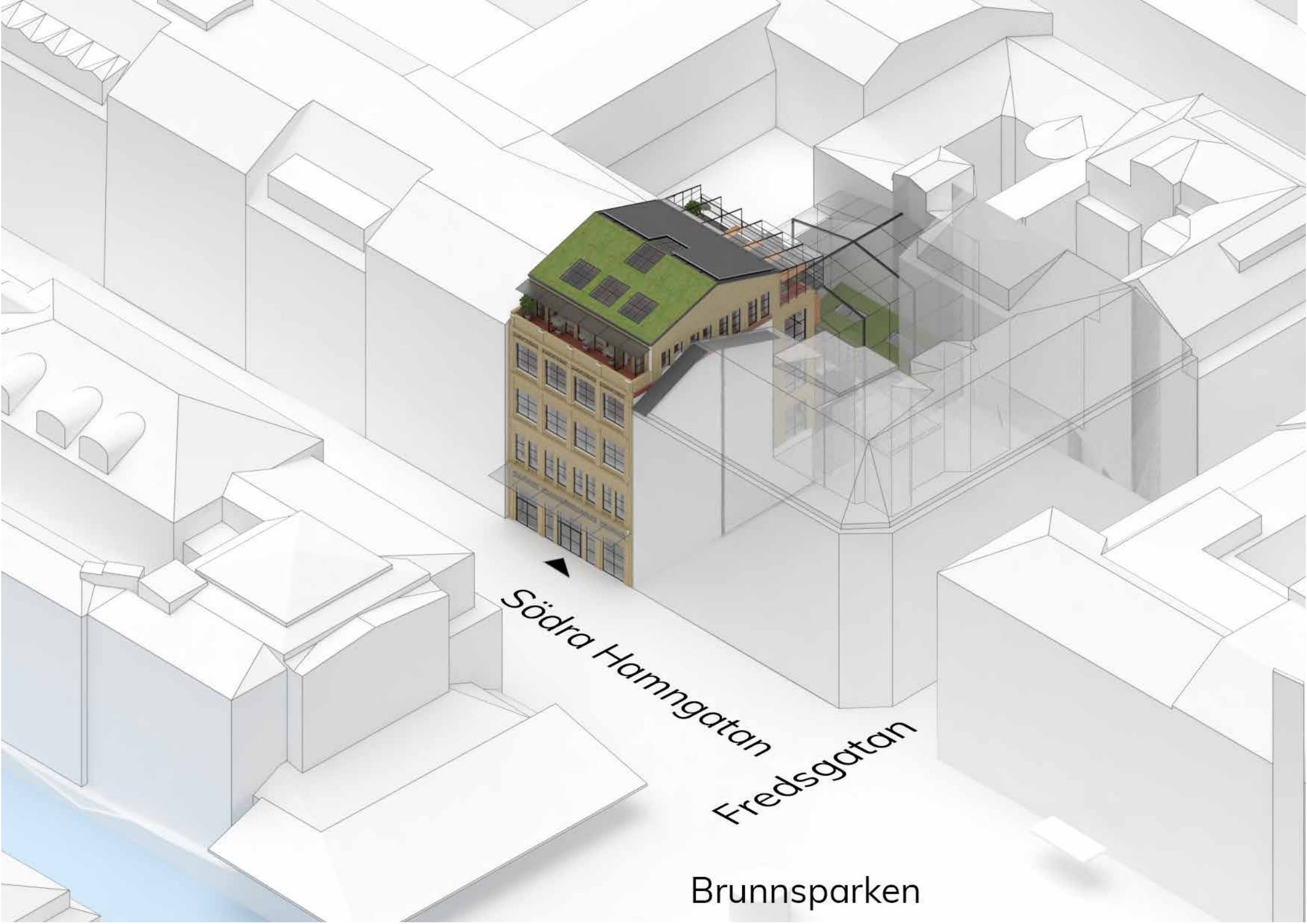
The building across the street, Fürstenbergska palatset, is a beautiful 1880s-classical building in white plaster with lots of stucco and decorations, originaly a sugar factory and later an art mecenate's villa and a hotel.

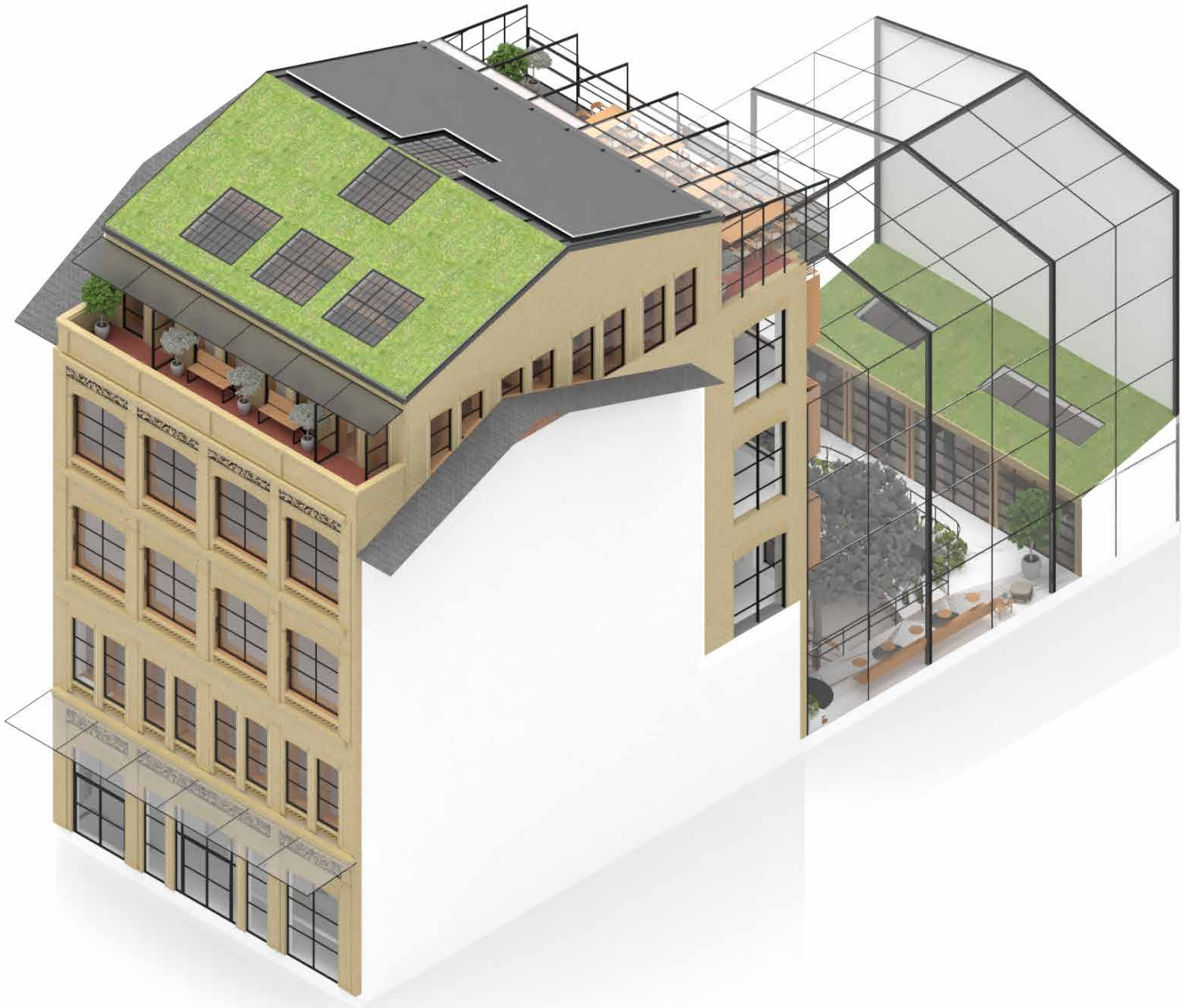
The streets closest behind the site down to the moat are calm but dark, the buildings along the street east of the site are a bit dull office buildings in uniform colored factory-bricks.

Sight lines - Street level: To the east the view is blocked towards the park Trädgårdsföreningen, the moat, and the large square: Drottningtorget.

Sight lines - Street level: To the west Brunnsparken, Gustav Adolfs Torg and the canal Hamnkanalen in the direction of the setting sun

Sights from rooftop level: The view over the roof ridges of the city is beautiful in the distance but in many directions in the surrounding area there are air conditioning and ventilation machinery that are not that appealing. The view to the west is beautiful with the trees in brunnsparken, the water in the canal, and the setting sun in the west over the bridges and the richly decorated houses fronting the harbor canal and Gustav Adolfs Torg.


Södra Hamngatan
Fredsgatan
Brunnsparken



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Street

The building matches the hight of the neighboring facades, offset just a floor to gain more dayligh and a view.

The top floor is offset from the street to block less sunlight and to provide a view-balcony over brunnsparken and the harbor inlet.

The Courtyard is covered with a glass and steel construciton to create a year round green courtyard. This also works as a fresh air buffert for the building and plants in the courtyard provide fresh smelling air with the right humidity to the building.

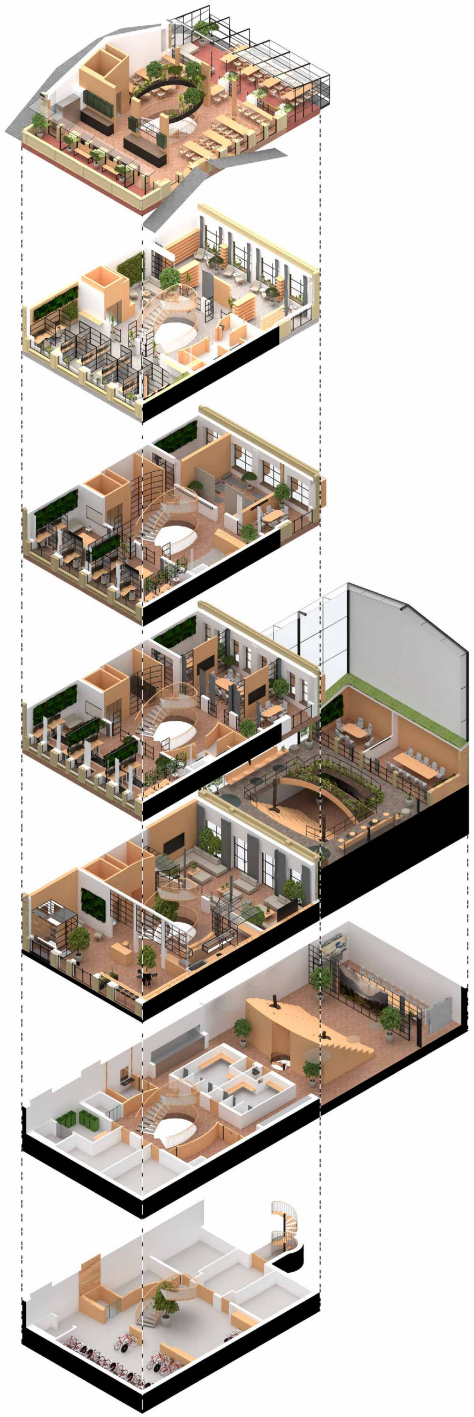
The roof has a sedum cover to the north to buffert rain water and provide a biotope for insects. to the south the roof is covered with solar panels.

There is a glass roof terrace on the top floor to the south that can be opened up to sunlight. The top floor has views to 3 directions and a couple of skylight windows.

At the entrance there is a 2m wide glass rain roof that creates a shelter when entering and exiting the building. It also creates small meeting point for bypassers sheltered from rain.

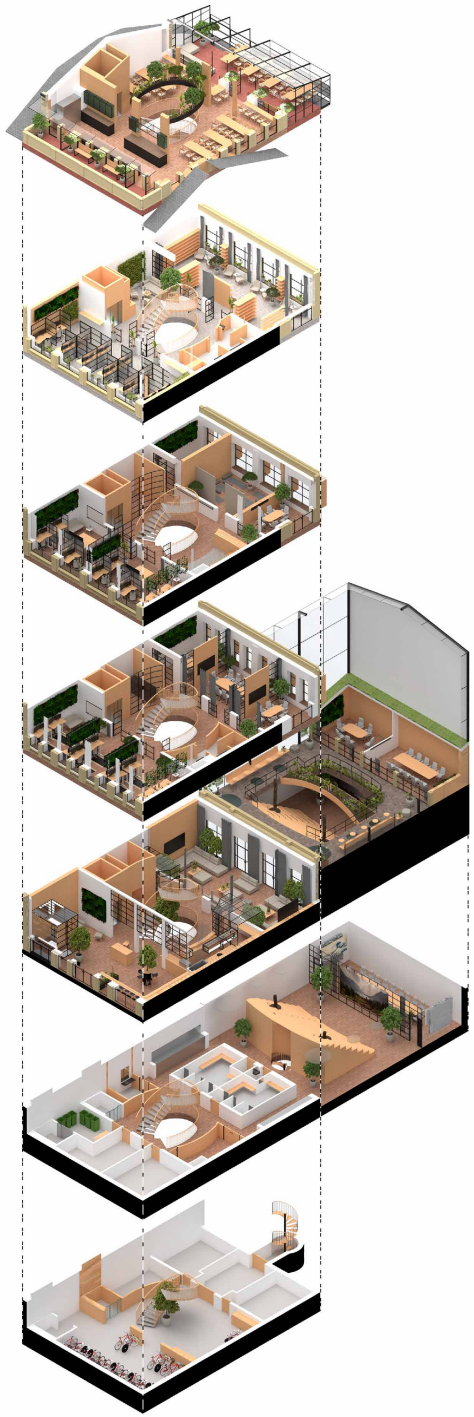
- An attractive central stair to encourage taking the stairs.

4 - Social	Restaurant Professional Kitchen 2 Terraces
3 - Focus	Focus Room Library Small Lounge WC
2 - Group & Active	Group Work Rooms Meeting Rooms Exercise Room Mindfulness Room Storage Room
1 - Active & Meetings	Active Work Room Meeting Rooms Printer Room WC
E - Social & Meetings	Reception Reception Work Room Espresso Meeting Camp Fire Meeting Small Lounge Conversation Room
-1 - Mixed	Changing Rooms Personal Lockers Storage Room Server Room Recycle Room WC



Courtyard	Auditorium Meeting Rooms Seating in Green area
-1 Courtyard	Large Meeting Room
-2 - Mixed	Bicycle Parking Bicycle Repair Area VVS Room Technical Rooms

- Rooms are placed to make people move around in the building during the day, changing places for different activities.
- WCs are placed to entail a short walk.
- The building has the stair as a common pathway to increase shared paths.
- People are mostly max 18m apart from other people which increases face to face interactions, there is also a lot of visual connection controlled by shades and curtains.
- A variety of work environments is provided to give people the choise and control over where and when they work.
- Floor 3 is the focus zone with soft floors and rooms for calm activity. The mindfullness room on floor 2 has extra sound insulation. Floor 1 and 2 has mixed social and active rooms.



- Toilets are consciously not placed on every floor to entail a short walk, they are on floors (-1), 1 and 3.
- Biophilic Features: Rain taps on the glass roof, fresh air in the courtyard, airy rooms with high ceilings, natural materials, plants and wood stimulate the senses, local connection through plants and materials.
- Sound absorbing green walls, textiles and in panels in the ceiling. Textiles that shades light, dampens acoustics, are beautiful and brings softness and comfort.
- Soft materials under floor to dampen noise from steps. While sparing hips and knees.
- Employees are empowered by giving them control over when being accessible.
- Trees in the courtyard, plants and ivy creates a view over greenery from the building.
- Work areas and meeting rooms are equiped with adjustable height desks/tables, to be able to have standing meetings but to lower for example for a wheelchair.

- Rooms are placed so that the longer they are used in a continous strech of time, the more access to daylight.

- Social rooms and meeting rooms are placed to the south for a brighter and more warm light that affects mood.

- All rooms are equiped with semi transparent and light blocking curtains to provide full control over light.

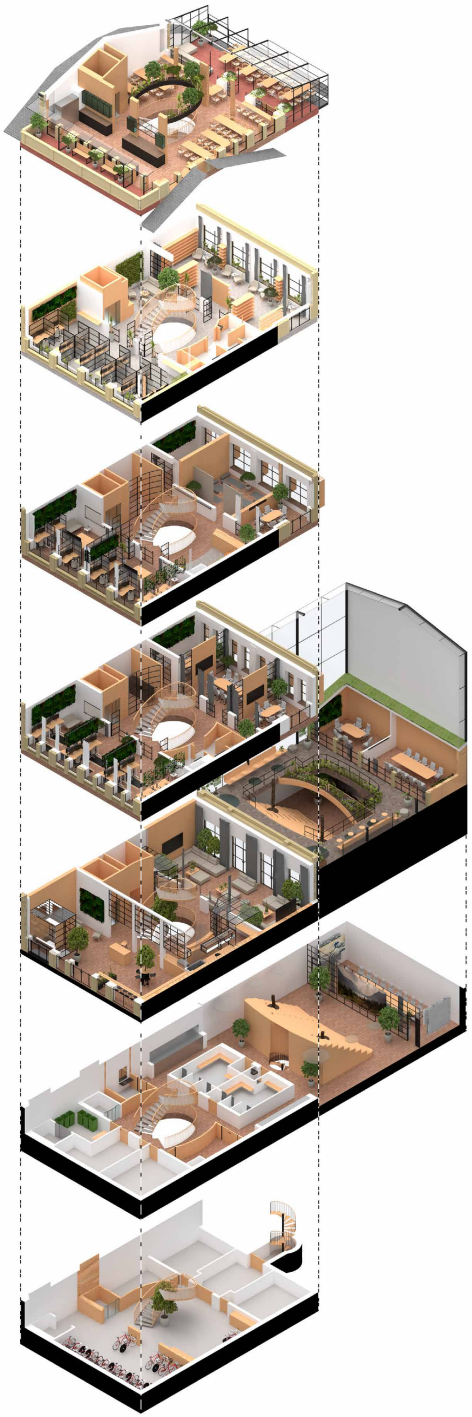
- Rooms facing south are shaded by manually controlled louvres on the facade.

- Individual and computer work rooms are placed to the north for relaxing north light, and less glare.

- Selected background music is played in the Social Entrance floor on a low level.

- Common areas are bright with direct sunlight or high ceiling hight, to affect mood positively.

- The restaurant is at the top of the building exposed to lots of daylight, (but also shade) to expose people to sunlight also in winter time.



- High windows combined with high ceiling height lets in lots of daylight deep into the building, and displays the passage of time.

- Lime white color on window walls and walls opposite to windows to control contrast levels.

- White ceilings gives a sense of space.

- Artificial daylight (colored light matched to sunlight).

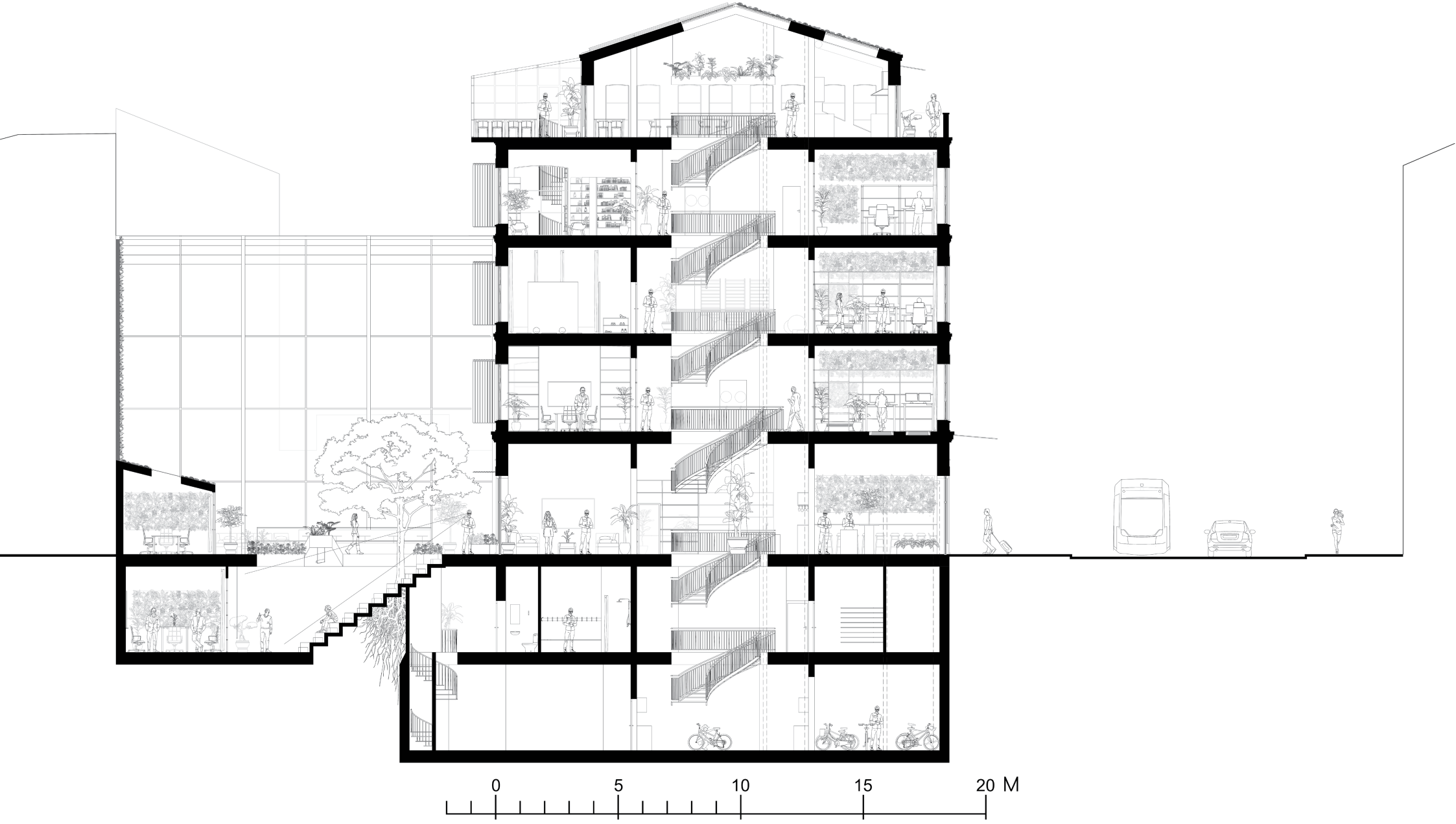
- Daylight through big windows and skylights, plants that changes color during the seasons, natural materials that age well and gains patina, all brings awarness to the passage of time.

- Durable natural materials that ages well, and plants with a local connection are used. (Förbländertegel, granite, oak, potted pine trees.)

- Natural materials, high ceilings, light, curved wooden walls and the round

- The building has a generally symmatrical plan which to promote legibility and beauty. The core is mostly wood and interior sides of exterior walls are mostly white.

Section A-A (1:200)

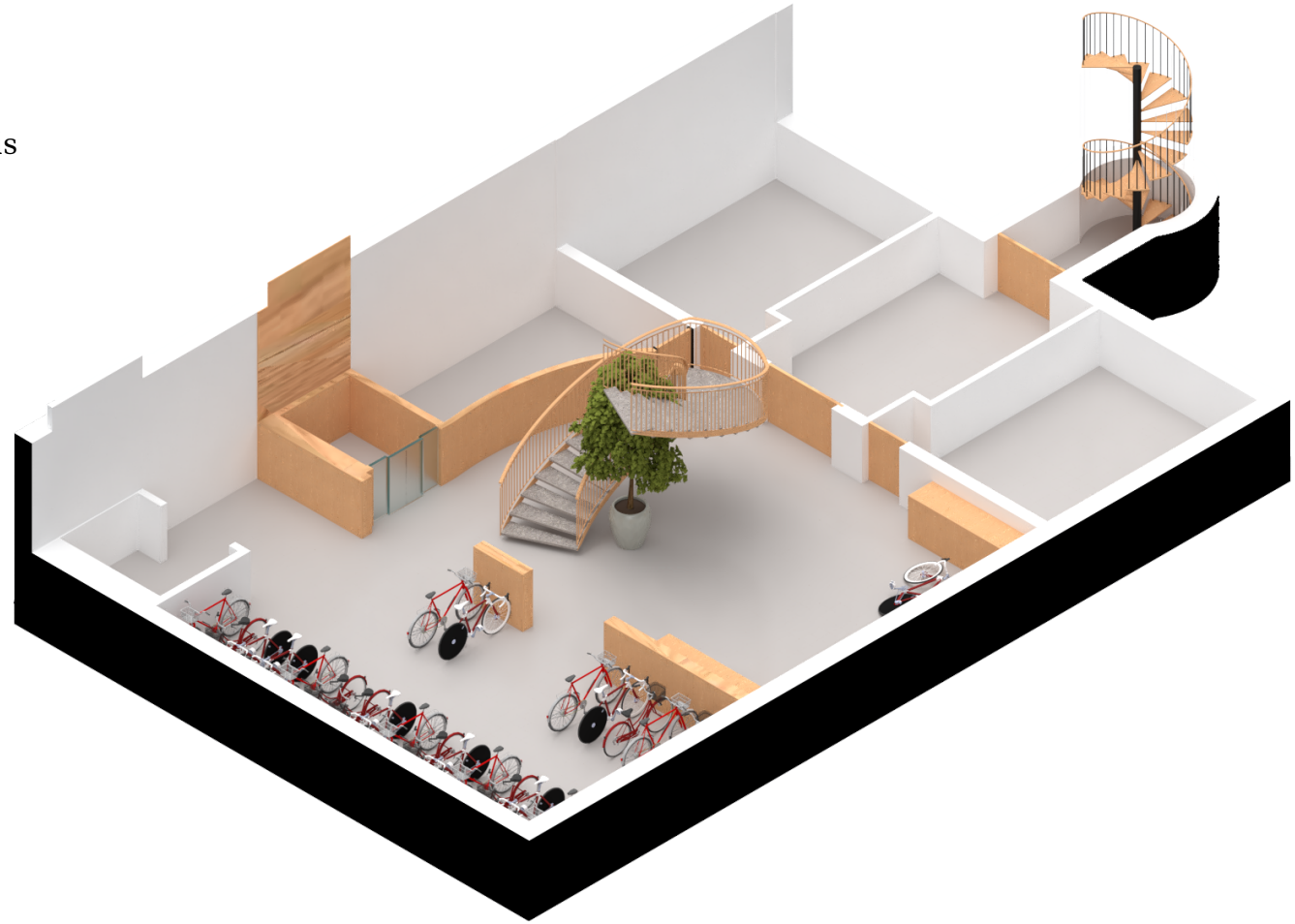


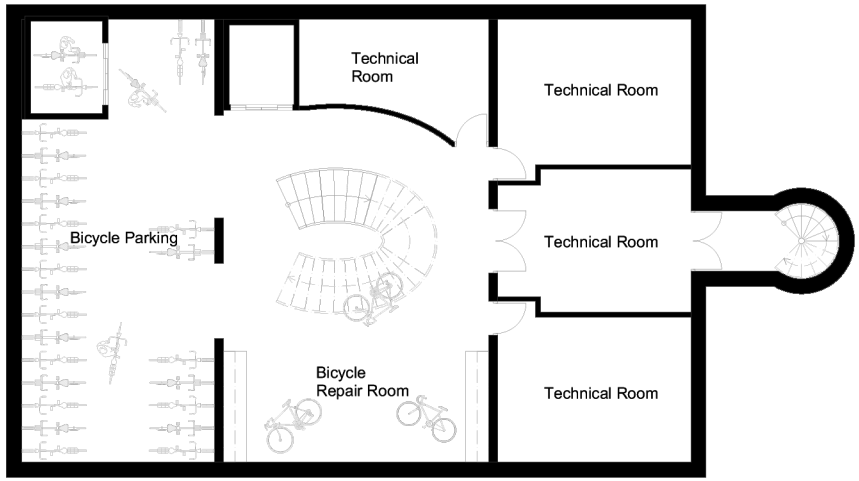
Section B-B (1:200)

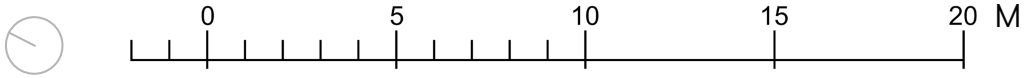
Plan -2 1:100

- Offer safe storage for bicycles sheltered from rain (if possible indoors).

- Offer area to clean and fix bicycles (this also increases the chance of positive social interactions).




Technical
Room
Technical Room
Bicycle Parking
Technical Room
Bicycle
Repair Room
Technical Room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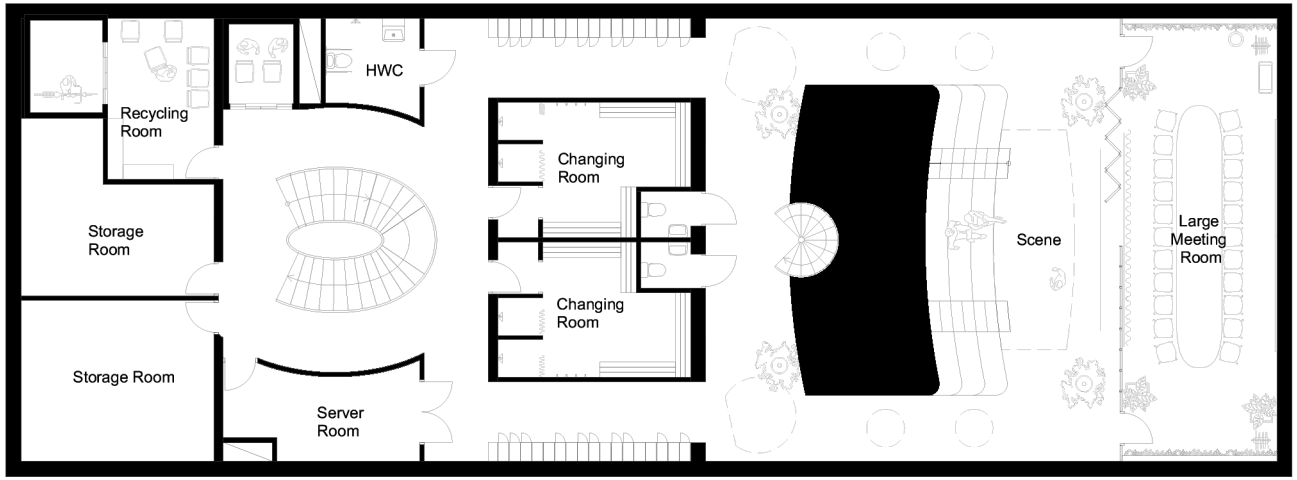
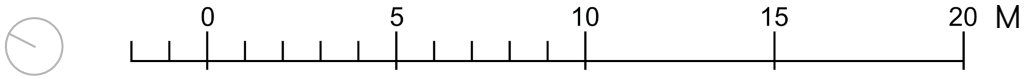
Plan -1 1:100

- Encourage exercising on the way to and from work, by offering changing rooms with showers and lockers.


HWC
Recycling Room
Storage Room
Storage Room
Server Room
Changing Room
Changing Room
Scene
Large Meeting Room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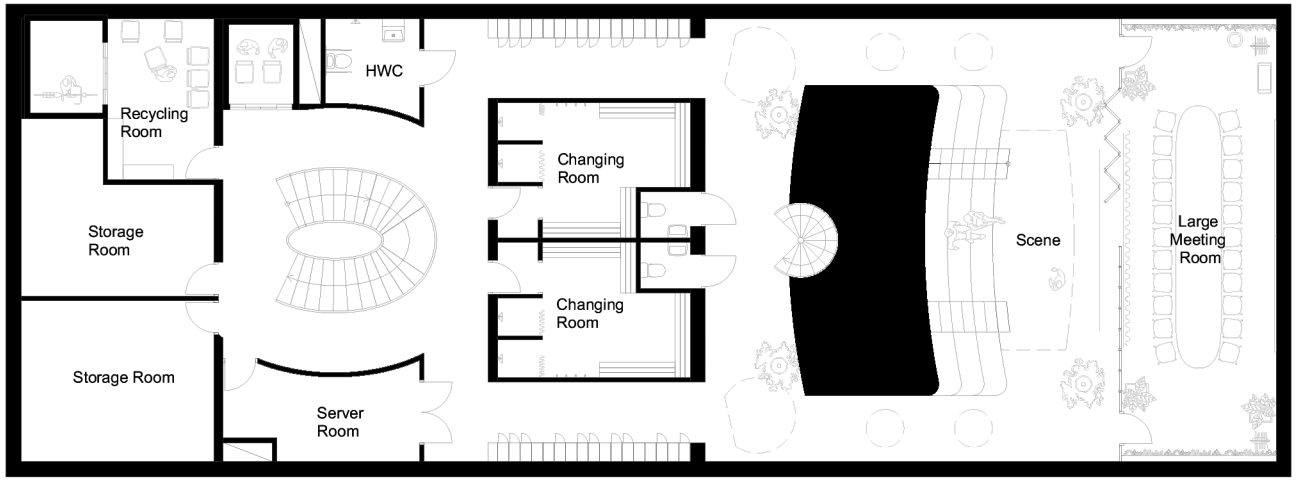
-1 Courtyard 1:100


HWC
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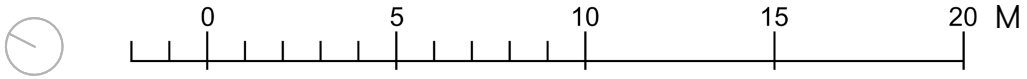
Changing Room
Scene
Large Meeting Room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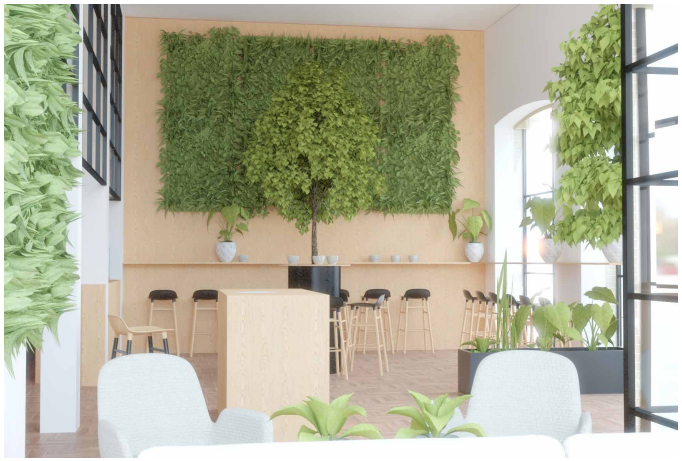
Plan É 1:100

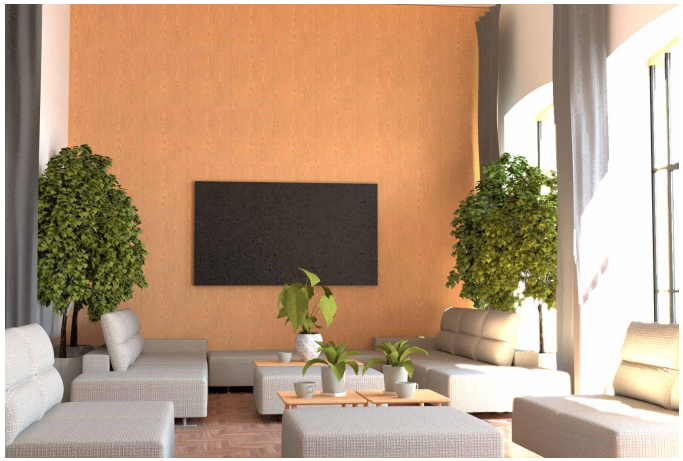
- Easy and appealing access to building with bicycle. (It should be obvious that cycling is a prioritized way of accessing the building and that it is promoted over using the car)

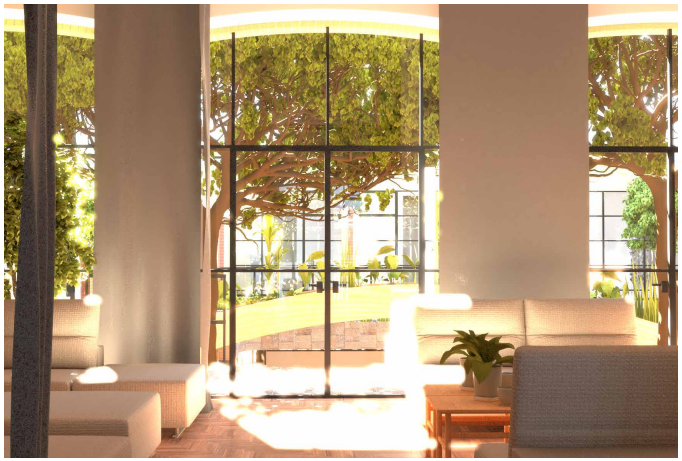
- Provide areas with the possibility for both formal and informal meetings.

- Attractive and centrally located stairs.

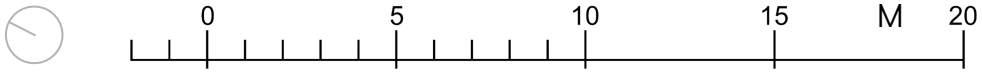
- Fast and easy to enter and exit the building, easy acess to jackets etc, to encourage walking meetings and lunch walks.








Waiting Lounge
Wardrobe
Conversatio Room
Entrance
Meeting Room "Camp Fire"
Auditorium
Meeting Room
Meeting Room
Espresso Meeting
Reception
Receptionis Work Room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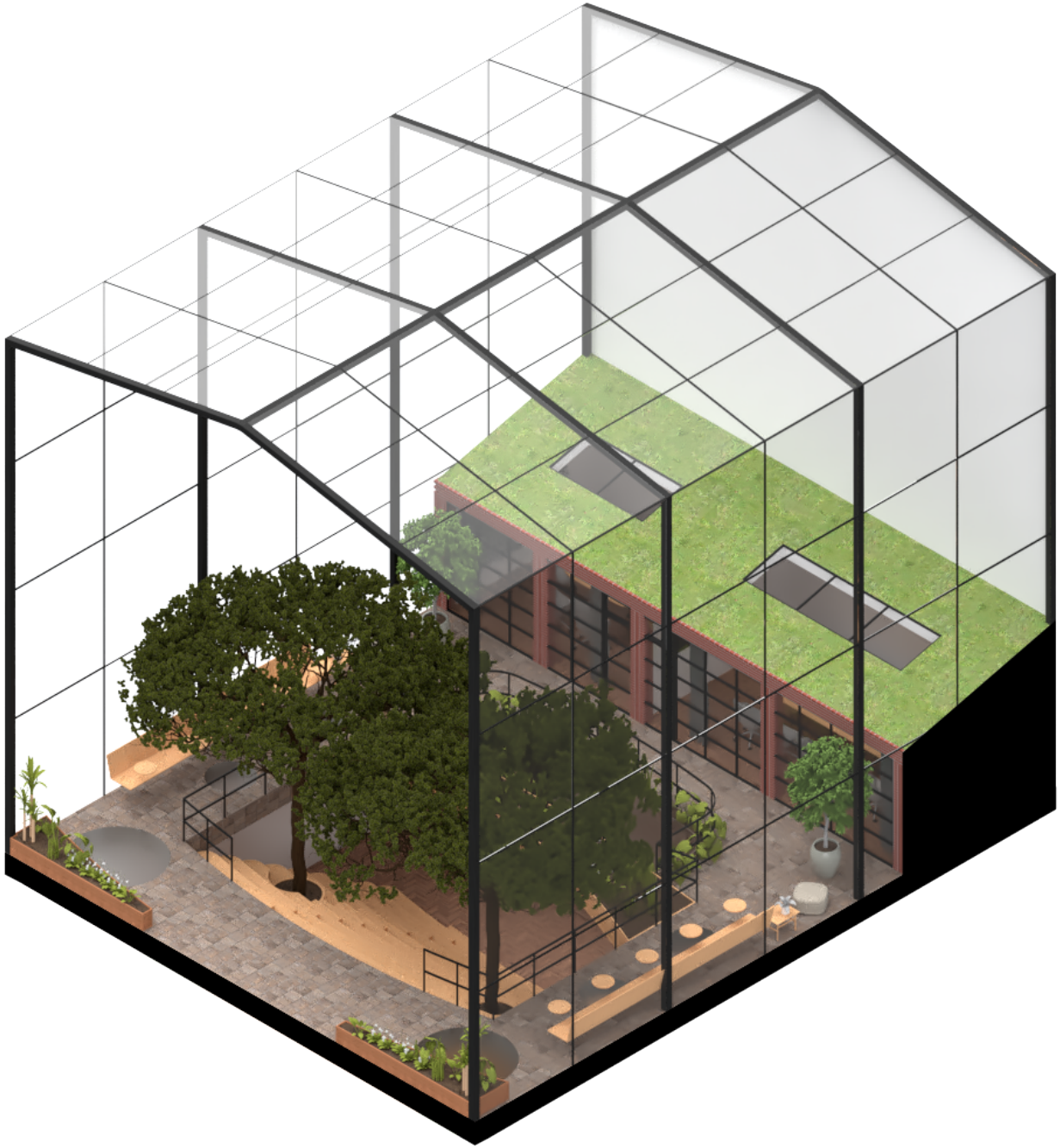
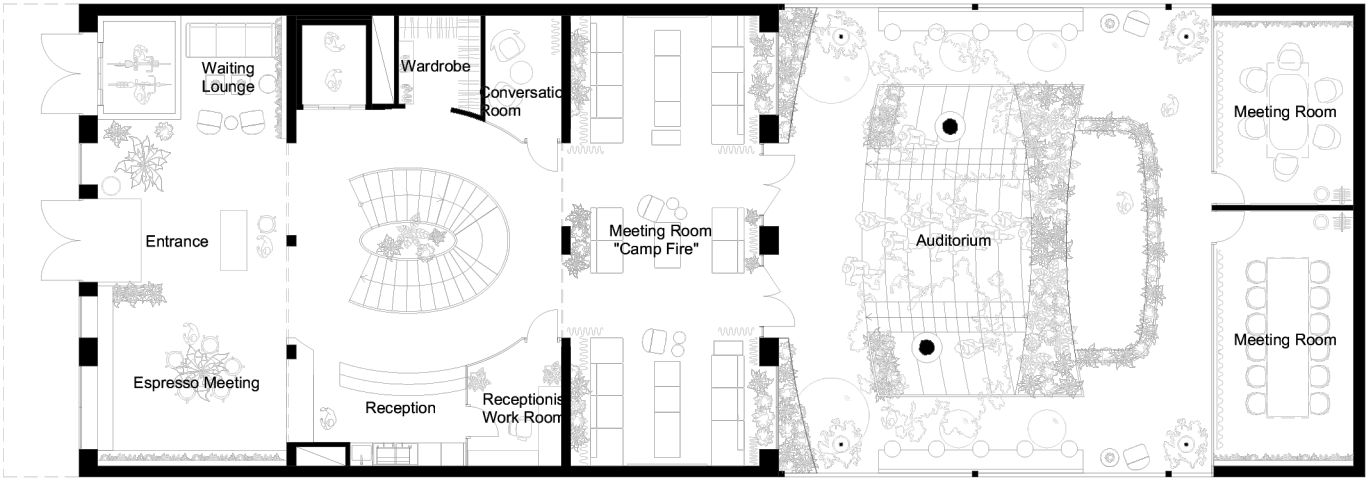
Courtyard 1:100

- Sometimes (when suitable) choose plants with a stimulating effect through smell, or just that smell nice.

- Maximize view over plants or biophilic features from windows.

- Provide areas where many people can gather, for example for lunch or lectures etc. to strengthen the sense of community.




Waiting Lounge
Wardrobe
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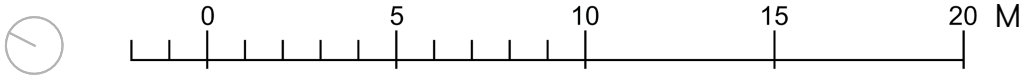
Entrance
Meeting Room "Camp Fire"
Auditorium
Meeting Room
Meeting Room
Espresso Meeting
Reception
Receptionis Work Room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Plan 1 1:100

- Workstations with treadmills integrated in the floor, to stimulte metabolism, bloodflow and oxygen into tissues. (Integrated in floors due to increased comfort, reduced risk of injury, reduced noise, facilitated cleaning, and for esthetic purposes).

- Design spaces for a generous amount of indoor plants. Make space for plants so that emplyees will have a view over plants in most work situations. Plan for watering and maintenance of plants.

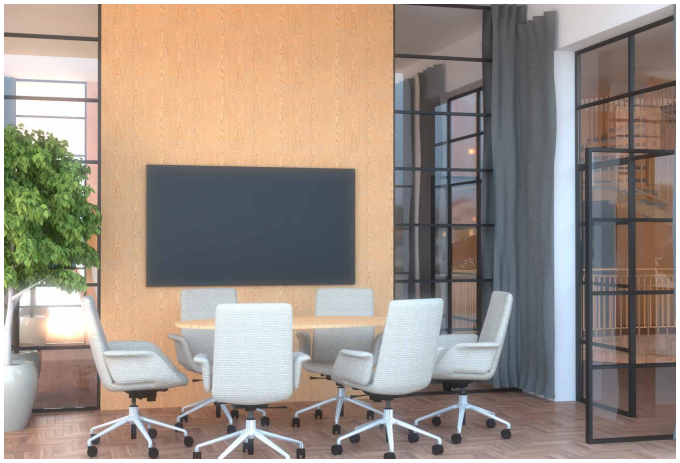
- Use plants in combination with other features, such as sound absorbing plant walls, subdividing rooms and spaces with greenery.

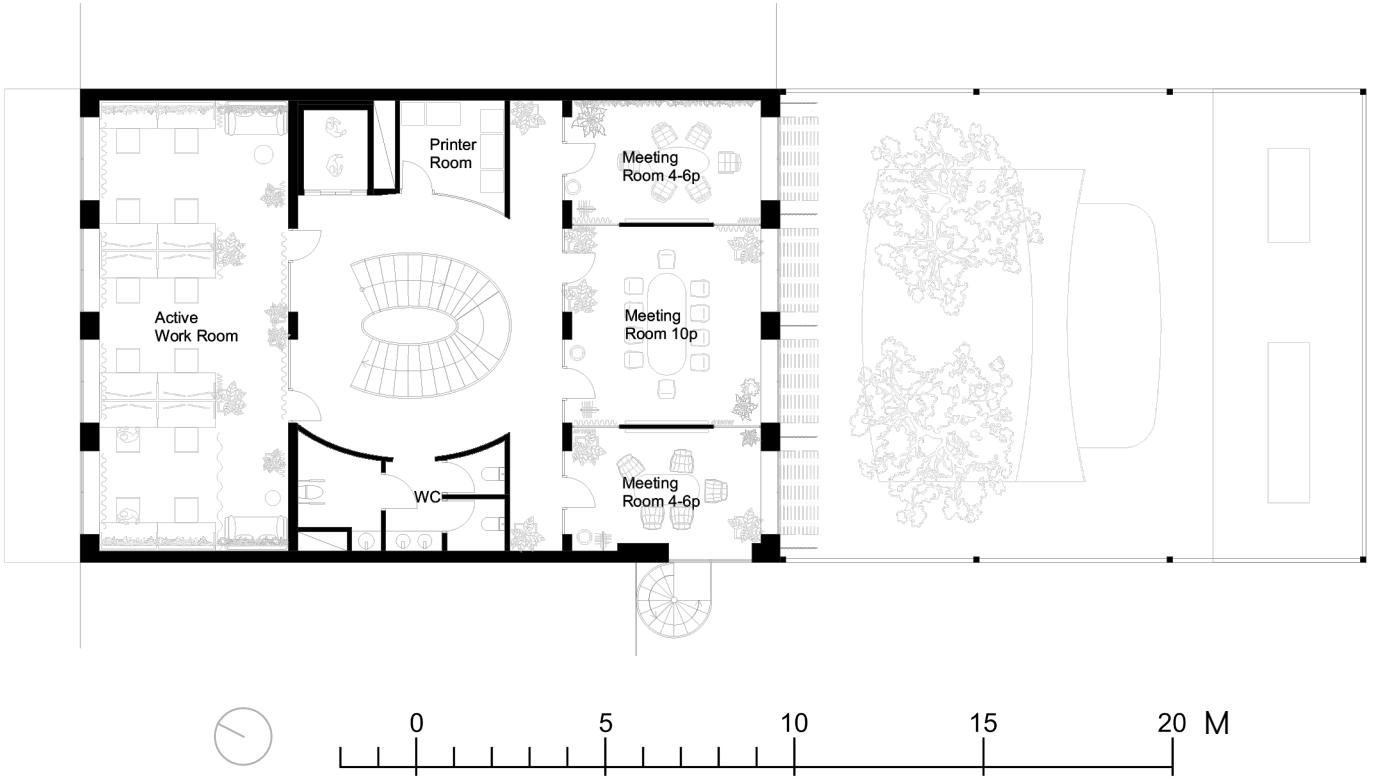
- Shield workstations from disturbing visual distractions and disturbing noise and speech.

- Individual and adjustable light control at work stations and in meeting rooms.

- Design different areas to encourage the choise to stand up or walk, but offer the possibility of sitting.

- If possible try to create work privacy that still entail a sense of connection with other people and areas. (Perhaps semi-transparent visual connections blocked by glass walls, plants, curtains, beautiful acoustic screens of textile etc. that provides visual contact when desired while creating clear social boundaries and minimizes risk of involuntary distraction.)




Printer
Room
Meeting
Room 4-6p
Active
Work Room
Meeting
Room 10p
WC
Meeting
Room 4-6p
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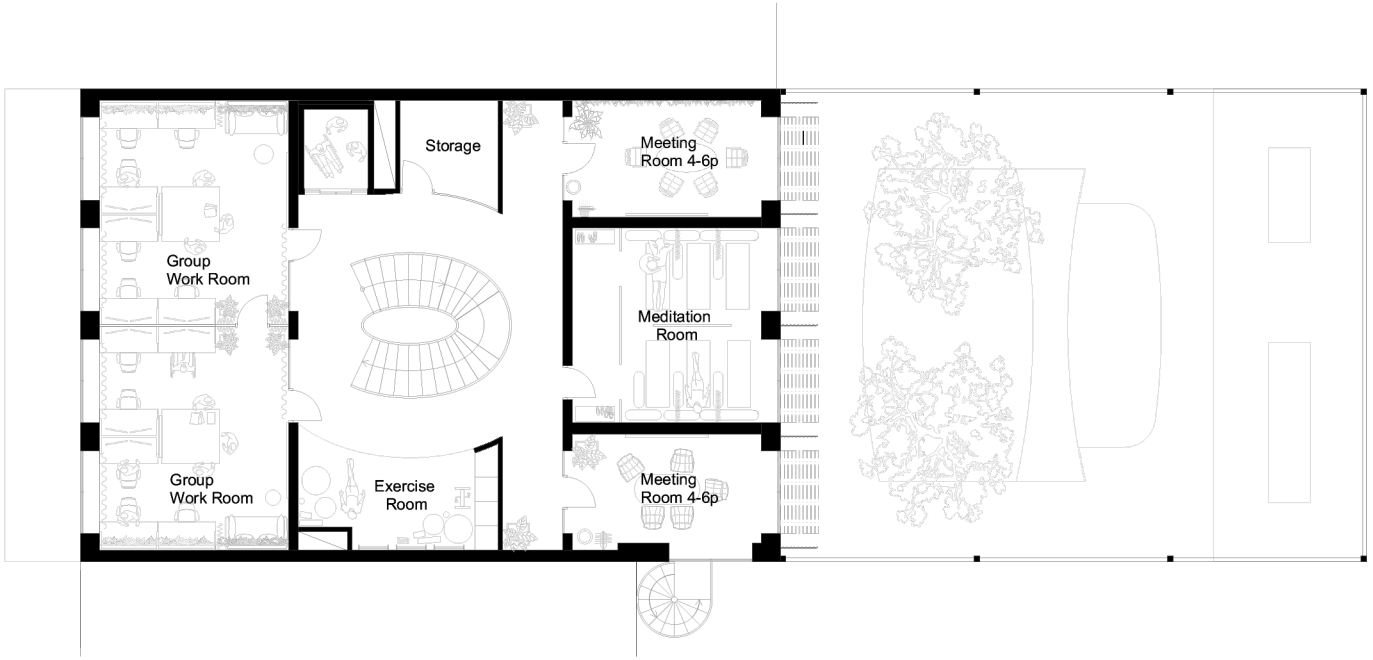
Plan 2 1:100

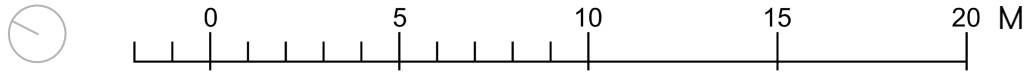
- Workstations equiped with NEAT-equipment (non exercise activity thermogenesis). For example a board to move the legs around.

- Locate printers, equipment, binders, books and personal storage in a locations that entails a resonable amount of walking or micro breaks, about one every 30 minutes. Care must be taken not to interfere with the work.

- Mindfulness room, (same as room for prayer) to be able to calm down, to focus, relive stress, get some space, and to destigmatize the topic and bring the benefits of mindfullness meditaion into a topic of conversation for the people working in the office.

- Reduce the prevalence of internal distractions by providing spaces for mindfulness meditation.


Storage
Meeting
Room 4-6p
Group
Work Room
Meditation
Room
Group
Work Room
Exercise
Room
Meeting
Room 4-6p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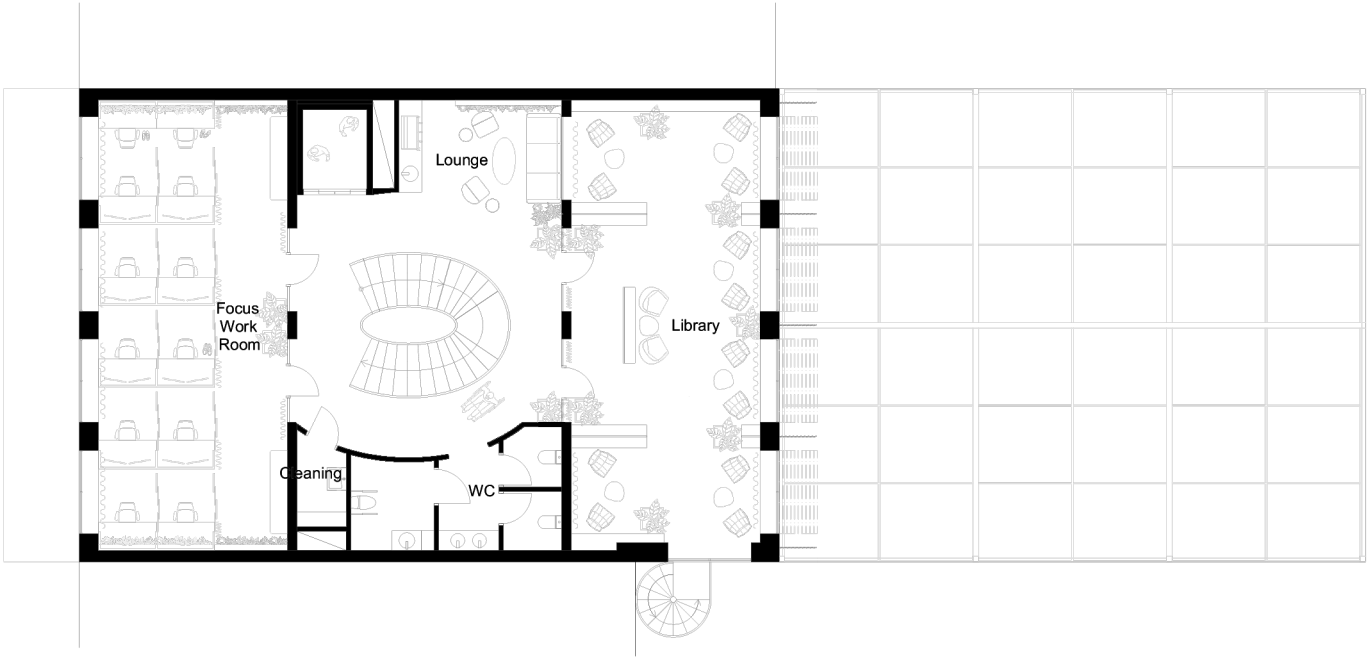
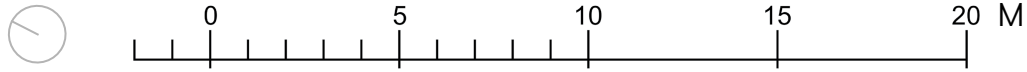
Plan 3 1:100

- Workstations and meeting rooms with adjustable height desks, so that employees can vary between standing and sitting throughout the day, and to make everything accessible with a wheelchair.
- (Workstations with enough personal space to be able to move around, strech the legs, change position, fidget with legs, dance at the spot - while not disturbing people at neighboring workstations.)
- Combine the benfits of the flex-office, the cell office and the shared room office in the design.
- Provide distraction free spaces for focused work.
- Provide areas for privacy.
- Design to avoid external distractions where there is need for focused work.

- Give employees control over boundaries and regulation of interaction. (This will minimize annoyance from distraction, and give employees greater control over focused work and the social aspects of work.)
- Provide a variety of work places for people to be able to peroidically fully focus on a task (and possibly reach flow) and periodically work less focused, collaborate, socialize and recharge.


Lounge
Focus
Work
Room
Library
Cleaning
WC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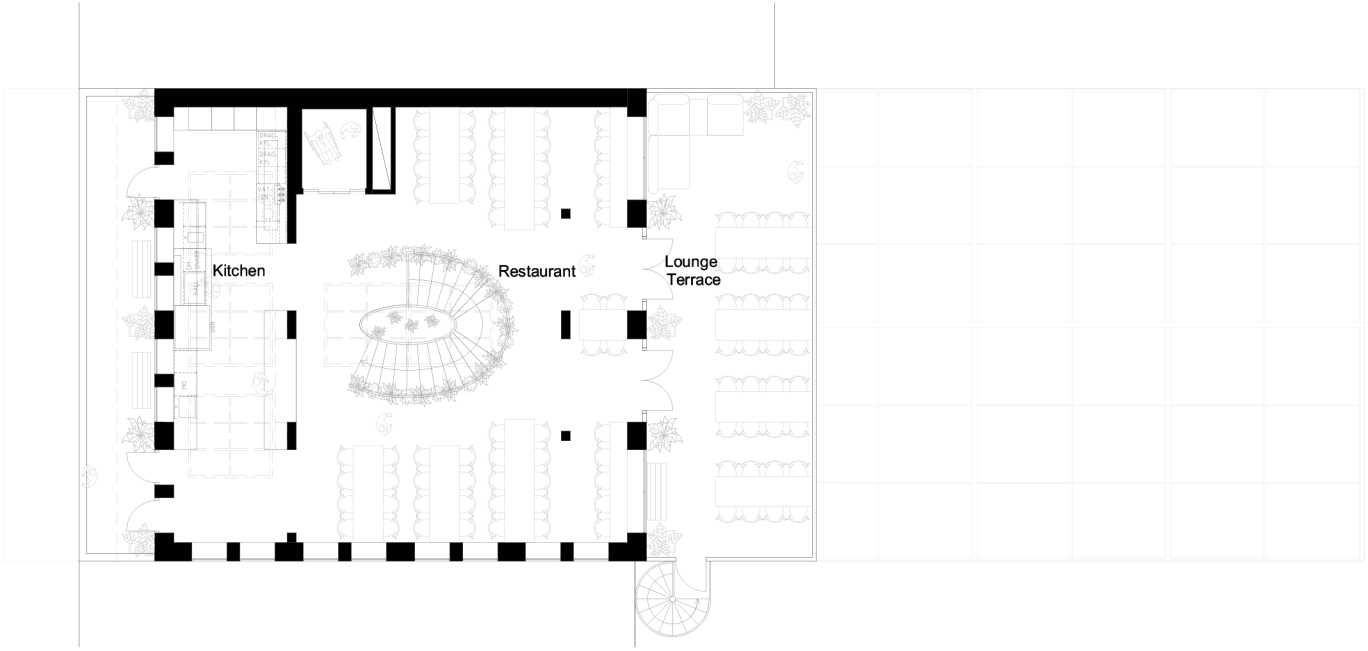
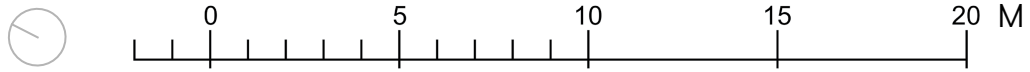
Plan 4 1:100


Kitchen
Restaurant
Lounge
Terrace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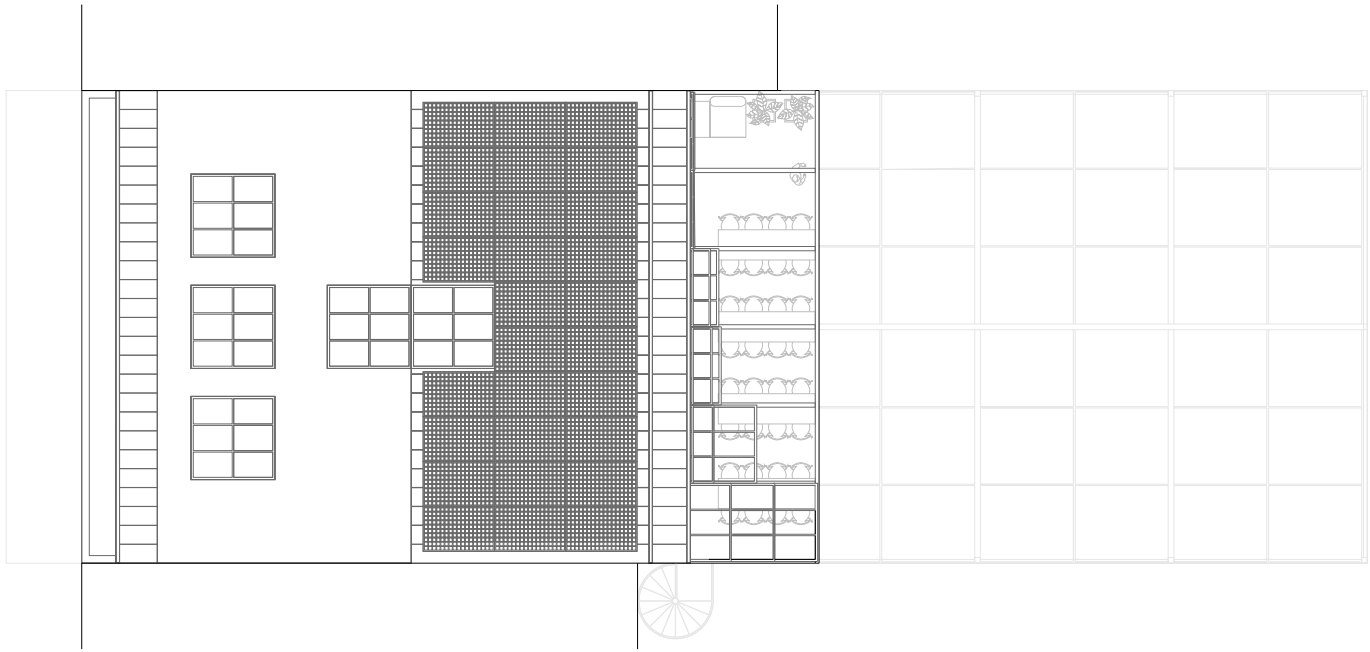
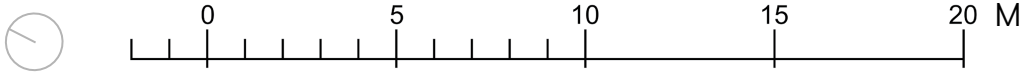
Roof Plans 1:100

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Almträ (context)
Av Boengt Oberger - Eget arbete, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=59540327
Bohusgranit (context)
https://commons.wikimedia.org/wiki/File:400-bohus-granitt.png

Brunnsparken (SITE)
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7 Dimensions of Health Promoting Design

Chalmers School of Architecture - Healthcare Department - Olof Holmblad - Examiner: Peter Frost - Tutor: Christine Hammarling

The Health Bringing Office

Investigating the connections between health, happiness and productivity

Olof Holmblad
Examiner: Peter Fröst
Tutor: Christine Hammarling

Chalmers School of
Architecture -
Healthcare Department

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"...although many of us may think of ourselves, as thinking creatures who feel, biologically we really are feeling creatures who think... and this becomes significant in the way we live in the external world."

Dr. Jill Bolte Taylor (Neuroanatomist)
(2013)

Abstract

Since it has been found architecture can improve the healing potential of hospital patients, there must be certain parameters of architecture that have health bringing properties.

This thesis has been about finding and describing the effects of such environmental parameters that may not only keep us from getting sick, but also supports our health and wellbeing in our everyday lives, and even makes us more productive and happier.

The thesis constitutes a literature study describing 7 important dimensions of health promoting design, and a design proposal of a modern office building that aims to make use of these parameters.

By studying some of the latest research in various fields, such as environmental psychology, workplace psychology, neuroscience, and medicine, all related to human perception and health in a way that can be applied in an architectural context, and combining the findings with insights from interviews, this thesis has aimed to summarize key factors that is essential to sustain a healthy lifestyle in an office workplace. And finally, to intuitively implement them in a design proposal of an office building.

What we perceive, consciously and subconsciously, has a great influence on our minds and bodies, and it has far going effects on our health, wellbeing and performance. In extreme cases (e.g. hospitals) it can even be a matter of life and death. Mind and body are not separate and what happens to the mind also happens to the body, and inversely, through the connections of the nervous- and endocrine systems. This has been largely eluded or misunderstood in architectural design during the 20th century.

The ideal scenario would be if the workplace could be a place that gives the people working there more mental and physical resources than it takes from them. A place that gives the employees a feeling of support, that supports their bodies and minds, where they collect energy and inspiration that they can bring home, and that has a positive influence on their lives in general.

The thesis found that much can be done through architecture to improve happiness, wellbeing and performance, by applying design features with knowledge of their implications on our minds and bodies.

By applying the 7 dimensions of health promoting design, one can achieve a significant impact on health, performance, happiness and life quality.

7 Dimensions of Health Promoting Design

Exercise

The Importance of Exercise and Physical Activity

Observing hunter-gatherer tribes, that has a lifestyle similar to what is believed was normal during paleolithic times, it is believed women walked approximatly 15km and men 20km every day (around 20-30,000 steps) (Sussman, Hollander, 2014). This is the physiological context for our evolutionary development.

After reaching adulthood large parts of the human brain starts to slowly deteriorate with age. However there are things we can do to prevent this. An ever growing collection of scientific data shows the extensive benefits and positive effects of exercise on all sorts of aspects related to health, wellbeing and performance.

Exercises effect on Memory

Physical exercise has far-reaching positive effects on the hippocampus (the brains center for processing memory and learning) and the pre-frontal cortex (a center for abstract, logical reasoning). The hippocampus helps to process new impressions and store short term memories and transfer them into the long term memory. Both the hippocampus and the prefrontal cortex inhibit stress impulses from the amygdala (a center for emotions, predominantly assiciated with fear and stress) and physical exercise strenghtens both the hippocampus and the prefrontal cortex. It seems that there is nothing more healthy for the hippocampus than being physically active (Hansen, 2017). Physical exercise has a positive effect on hippocampus size and growth, and increases the plasticity of the brain (Hansen, 2017). In a study on the effects of walking a group of subjects took a quick walk for 40 minutes 3 times per week during a year and the control group did only streching exercises. After the year the brains of the hippocampuses of the control group had shrunken 1.4% on average. The walking group however had increased their hippocampus volume with 2% (Hansen, 2017) (SVT, 2018). Fysical exercise improves learning, especially if done before studying, and it is enough with a walk or for example light running. The beneficial effects of exercise keeps the hippocampus young and makesthe whole brain more efficiant and resiliant.

Mice that were physically active for a perod of time equivalent to a few years in humans changed gene expression to a younger expression of genes, that is their hippocampus became genetically younger.

In a large study on 20,000 older women between 70-81 years of age it was found that the women who had exercised regularly the last 20 years had higher scores on memory capacity, attention and concentration. In fact the differences in the

brain where so great they corresponded to several years of aging. The brains of these women where essentialy years younger than that of their peers.

Another study showed that cyclists had increased blood flow to the brain and improved memory after 6 weeks of cycling. A positive effect on memory is imidate but is improved and prolonged if exercise is sustained.

A daily walk reduces the risk of dementia by 40%. In fact genes plays a much smaller role than physical activity in the risk of developing dementia (Hansen, 2017).

Exercises effect on Concentration

Exercise impoves the ability of selective concentration. It increases the amount of dopamine in the brain, a neuropeptide connected with motivation and the reward system of the brain.

Physical training strenghetens neurological connections in the frontal lobe, however this effect shows after a couple of months of physical activity. It also leads to the creation of new blood vessels in the frontal lobe for better nutricion and oxygen supply. 5 minutes of exercise lowers ADHD symptoms in children. There is a hypthesis that ADHD is a evolutionary remnant of behaviours that in paleolithic times would have been beneficial - to be restless and prospect for new places to gather food and hunt. And that exercise balances this urge (Hansen, 2017). Prospect and refuge theory is a part of the biophilia hypothesis as we shall se later. In any case, physical exercise seems to be additionaly beneficial for individual with ADHD symptoms.

Exercises effect on Stress and Anxiety

Physical exercise has been shown to reduce stress, both on short and long term basis. Levels of anxiety is lowered by just a small dose of exercise like walking or running for 20 minutes a couple of times a week and the effect on anxiety stays for several days (Hansen, 2017). In fact stress and physical exercise seems to have direcly opposing effects on the brain. In a remarkable study 12 volutary subjects where injected with CCK4, a substance that induces panic attacks with racing heartbeat, feelings of suffocation and extreme anxiety and fear of dying. In the second round, the subjects exercised heavily for about 30 minutes before the injection. This time only one of the subjects had a panic attack, so the exercise had a strong effect in blocking the panic (Hansen, 2017).

“If you are in a bad mood - go for a walk.
If you are still in a bad mood, go for another walk.”

Hippokrates

Exercises effect on Depression

Physcial exersise is beneficial for all cases of mild depression, feeling low and sadness. It has been shown to be *as effective* as Sertralin (one of the most common anti-depressants) against regular depression and it gives a *stronger* protection against fallbacks. Physical exercise increases levels of neurotransmittors connected to wellbeing, motivation, assertiveness and mental resiliance such as: noradrenaline, serotonin and dopamine.

Exercises effect on Creativity

Physical exercise increses creativity in creativity tests, a walk is enough. Running 20-30 minutes gives a stronger effect. The effect is strongest the hours right after the exercise.

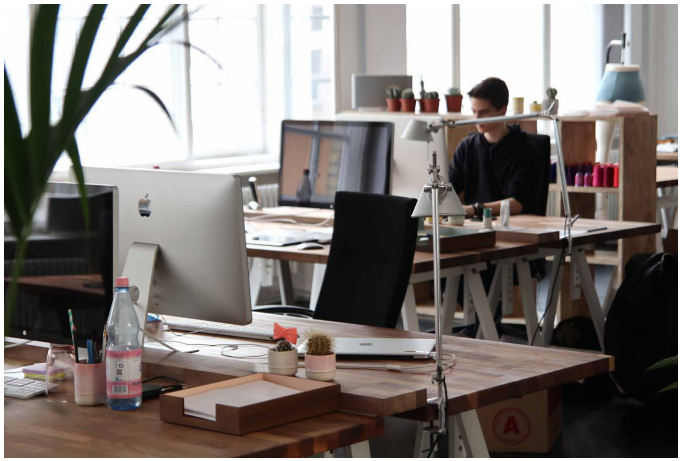
Children improve in almost all mental abilites when they are physically active such as mathematics, reading comprehension, memory, simultaneous capacity and executive control (Hansen, 2017).

BDNF

BDNF (Brain derived neurotrophic factor) is a protein that has an almost magical influence on the brain (Hansen, 2017). BDNF supports brain cells, protects them from toxins, strenghtens connections between the neurons, increases plasticity in the brain and prevents brain cells from aging. BDNF increases the level of newly formed brain cells. This leads to an increase in brain synapses, consolidation of memories, an increase in brain cells, improved memory and learning, improved motor skills and a younger gene expression. Levels of BDNF are low in depressed individuals (Hansen, 2017).

BDNF is produced instantly during physical exercise in animals. There is no more effective way to increase BDNF in the brain than physical activity and exercise. Continued exercise leads to continously increased production of BDNF and levels are sustained for weeks. (Hansen, 2017)

Exercise makes us happier, less anxious and stressed, improves concentration, strengthens memory capacity and improves intelligens. A little bit of exercise like a short walk, taking the stairs or a bike ride is enough to have positive effects on health, but the more exercise, the greater the effect on over all increase in health wellbeing and performance.



Cycling

1/3 of the people who drive to work in Stockholm could cycle in 30 minutes or less. This would save 60 premature deaths per year due to cleaner air, and an additional 20 lives per year due to the exercise. (SVT, 2018). In Copenhagen up to 40% of workers take the bicycle to work.

Commuters by car who shifts to cycling (18 min per day) reduce the risk of diabetes and cardiovascular decease with around 20%, breast cancer by 10%, colon cancer by 15% and premature death by 10%. The risk reduction increases up to 90min of cycling per day, and by then the risk of premature death is reduced by 45%. Commuting by cycling does not only provide sufficient basic exercise, but is a close to optimal form of providing basic exercise (SVT, 2018).

Standing

Standing desks has become trendy and working standing seems to increase metabolism and bloodflow to the brain. Seventh grade students who were given standing desks where tested for several mental capacities before and after introducing the desks. The results where similar to those of people who exercise: improved concentration, better working memory and better executive control. They also where tested for reading comprehension, memorizing facts, problem solving in multiple steps and the results where clear. The students improved their test scores with 10% on average. Increased activity in the frontal lobe of the brain where registred in areas significant for working memory and concentration (Hansen, 2017). The evidence of the positive effects of working standing is not yet overwhelming, but applied in real life it seems to be healthier than sitting.

Sitting

In a study study on the effects of exercise and a sedentary lifestyle 3200 americans where observed during 25 years while they their ability to memorize, concentrate, and cognitive speed of processing where mesasured. The results clearly stated that those with a sedentary lifestyle had poorer results on concentration, memory and cognitive speed (Hansen, 2017).

A study on over 90,000 women aged 50–79 of multiple ethnicities over 12 years found a linear relationship between being sedentary and a 12% increased mortality, this was true regardless if the women exercised or not (Seguin, 2014).

Another study investigated the influence

of total sedentary time during the day and that of countinuously connected bouts of sedentary time. People who regularily where sitting still for 90 straight minutes leaped an almost 200% increase in risk of dying prematurely, compared to people sitting less than 90 minutes. People who sat for more than 13 hours every day had a 200% higher risk of premature death than people sitting less than 11 hours. (Diaz et al., 2017)

It seems there is no specific threshold value. However the study indicated that people who are sitting still less than 30 minutes straight had a 55% lower risk of premature death than people who sat longer (Diaz et al., 2017). The leading researcher behind the study Keith Diaz stated in a interview with CNN:

"People who sat for less than 30 minutes at a time had the lowest risk of early death." . . . "So if you have a job or lifestyle where you have to sit for prolonged periods, the best suggestion I can make is to take a movement break every half hour," . . . "Our findings suggest this one behavior change could reduce your risk of death." (Scutti, 2017)

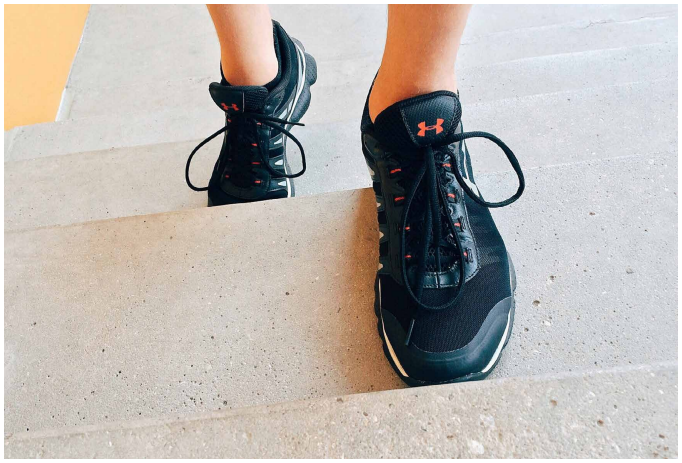
Sitting and being passive for extended periods of time seems to be the real health problem.

Moving

There are some contradictory articles, showing that standing at work actually might entail a higher risk of developing heart disease (Smith et al., 2018). However after correcting for gender and some other factors the figures changed. Much indicate that this study did not consider enough factors to produce reliable results. For example other job characteristis and stressors where not taken into consideration. Tension in the body, stress and other factors may wear on the body even when standing. Perhaps if standing still and being very tense, it might be even worse than sitting and being more relaxed in muscles, allowing for circulation and lowering the psychosomatic effect of tension.

Nontheless it does shine light on the fact that health is a complex and composite matter. One cannot simply state black or white general cause and effect relationships that applies to all circumstances. For example someone who is pregnant or has back problems might benefit from sitting rather than standing. Individuals with cardiovascular or heart problems should begin very slowly and cautiously when starting to exercise.

The healthiest option seems to be to have the possibilty to alternate between standing and sitting, and sit down when one



is tired. Moving around now and then is also important instead of just standing or sitting in a fixed position.

One study found that using a device that facilitated small movements and increased NEAT (Non-Exercise Activity Thermogenesis), in this case with the legs, while sitting increased metabolic activity with 17% compared to sitting and 7% compared to standing (Horswill et al., 2017).

It seem that what is most important to keep or improve health is moving the body. Fidgeting with arms legs or any limb for that matter seems to actually be beneficial for health. Which makes a lot of sense. It increases metabolism, and helps the blood flow through aiding the vene pump of the veins. While this study was on moving when sitting, it is naturally possible, if not easier, to move around when standing aswell. The point is to not lock the body in one position for to long but to make some movements, dance along to a song or tapping with the fot or legs. Standing might also increase the probability of other movement by for example lowering the threshold of going to get that book, or just taking a few steps for that something.

Strengthening muscles with resistance training and doing aerobic exercise, at a level tolerable for the health of the person in question, will however in all cases increase the resilience to stress and strain for that individual.

Small measure like taking the stairs and bicycle commuting makes a noticeable difference for very many people (SVT, 2018). As little as standing up and strechning the legs for 1 minute is enough to diminish the risk for diabetes and cardiovascular decease and the risk keeps diminishing with more exercise. Light exercise dimished the risk significantly increasingly with longer duration, and heavy training with sweating heavily diminished the risk and almost erased it completely for strenuous exercise 30 minutes or more (SVT, 2018).

Research is pointing to that it is better to be a little bit active every day then to exercise for the whole week in one day. Some of the best exercise is the one you do a little of everyday for the rest of your life.

Edward R. Laskowski M.D. at Mayo Clinic, one of the highest ranked hospitals in the United States gives the following advice to counter the effects of sitting too much.

- Get up and stand every 30 minutes.
- Stand while talking on the phone.
- Try a standing desk.
- Walk for meetings rather than sitting in a conference room.
- Try a treadmill workstation, and be in motion throughout the day.

(Laskowski, 2018)

Insights from Interviews

Annmarie Hultberg, Development Leader at the Institute of Stress Medicine (ISM):

We hope that activity based offices (flex-office) makes people move around more, it is good if the employer supports being active in the spare time. It is important to have a safe place to park the bicycle. These kind of investments will pay off for the companies. It is important with a holistic perspective.

Mattias Brunberg Lic. Naprapath, Personal Trainer, Business Owner in Rehabilitation and Employee Health:

Most common are problems with back and neck resulting from a lack of exercise. People dont have the physiological capacity to withstand the physical work environment. Lack of muscle strength, bad posture resulting in overstrain on the body. Fitness and exercies also has a positive impact on stress, sleep quality, focus, energy and irritability. I almost believe being fysically active will be a requirement from employers in the future. It is important to not only rely on passive equipment such as ergonomic chairs. Many times people adjust equipment too exact, it becomes too static and they risk repetition strain injuries. Variation is important, and to shift position, standing, sitting or walking. It is good with the things you mention: encouraging taking stairs, treadmill desks, bicycle parking. If people drink a lot they have to walk to the bathroom now and then. Only a few percent reach recommended levels of exercise in Sweden. There is also a lack of knowledge. People complain about not having the time, but I can't understand how one can prioritize other things over one's body. In the 90s my father had gymnastics every day at his construction firm. I would recommend that for office employees: 5 minutes 2 times a day would get you far. Lack of exercise can entail large costs for employers. Loss of income, sick pay, and finding replacement. I am convinced it would pay off for companies to invest more in physical activity. A rule of thumb among health economists is a return rate of 5 to 1 for health investments, but of course it varies. Instead of focusing on sick leave: invest in healthy attendance! I believe the emotions and wellbeing of people is connected to the state of their bodies.

Employee (Engineer):

I like that we have showers and changing rooms. Every workplace should offer sheltered parking for bicycles, and changing rooms with showers. Its important to support the individuals initiative. Sitting all day makes me feel not fresch. Adjustable height desks are great.

Conclutions and Design Strategies

- Make it fast and easy to enter and exit the building, easy acess to jackets etc, to encourage walking meetings and lunch walks.

- Design to encourage cycling, taking walks, taking the stairs, taking breaks to move, standing or walking at the desk, it all adds up.

- Easy and appealing access to building with bicycle. Easy parking and maintenance areas. It should be obvious that cycling is a prioritized way of accessing the building and that it is promoted over using the car. Threre should be no (a minimum of) inconvenience taking the bicycle to the office compared to car or public transportation. No detours, just a smooth and easy experience.

- Offer safe storage for bicycles sheltered from rain (if possible indoors).

- Offer area to clean and fix bicycles (this also increases the chance of positive social interactions).

- Encourage exercising on the way to and from work, by offering changing rooms with showers and lockers.

- Attractive and centrally located stairs.

- Design different areas to encourage the choise to stand up or walk, but offer the possibility of sitting.

- Place toilets at a location that entails a short walk.

- Locate printers, equipment, binders, books and personal storage in a locations that entails a resonable amount of walking or micro breaks, about one every 30 minutes. Care must be taken not to interfere with the work.

- Design the floors and the building in a way that encourages and compels walking and moving around in the building, changing places and rooms during the day for different activities.

- Workstations and meeting rooms with adjustable height desks, so that employees can vary between standing and sitting throughout the day, and to make everything accessible with a wheelchair.

- Workstations with treadmills integrated in the floor, to stimulte metabolism, bloodflow and oxygen into tissues. (Integrated in floors due to increased comfort, reduced risk of injury, reduced noise, facilitated cleaning, and for esthetic purposes).

- (Workstations with enough personal space to be able to move around, strech the legs, change position, fidget with legs, dance at the spot - while not disturbing people at neighboring workstations.)

- Workstations equiped with NEAT-equipment (non exercise activity thermogenesis). For example a board to move the legs around.

Nature

Figure 1. To our bodies and minds, architecture is the extension of nature into the man-made realm.

The Importance of Nature

"A walk in a forest is invigorating and healing due to the constant interaction of all sense modalities . . . Architecture is essentially an extension of nature into the man-made realm . . . It is not an isolated and self-sufficient artefact . . . Architecture does not only respond to the functional and conscious intellectual and social needs of today's city dweller; it must also remember the primordial hunter and farmer concealed in the body."

(Pallasmaa, 2012)

The biophilia hypothesis was coined in 1984 by american biologist Edward O. Wilson and refers to our inherent affilation to nature. It is easy to forget that most of what we take for granted in todays modern society just existed for a blink of an eye from a evolutionary perspective. We began to raise food about 12,000 years ago and the first cities emerged 6,000 years ago. Industrial production of goods and food started about 200 years ago and electricity and artificial materials has only been around for about 100 years (Kellert, Calabrese 2015). Humans evolved from other prehistoric animals and during close to all of our evolutionary history these animals and we where living in nature. This created inherent biological bonds to nature in our physiology since the elements of nature was our only influence during the development of the human mind and body (Kellert, Heerwagen, Mador, 2008). "One of the lessons of evolutionary psychology, as we shall see in greater detail later, is that we are deeply integrated with the natural world. Our mind has been sculpted by nature and it is tightly coupled to the environment." (Chatterjee, 2014).

A illustrative example of this is a classical study by swedish psychologist Arne Öhman where the subjects were shown pictures, very fast on a subliminal level, of snakes, spiders or hand guns and exposed electrical wires. Almost all of the subject reacted negatively to the natural threats but remained relatively indifferent to the images of guns and electrical wires (Kellert, Calabrese, 2015).

Bringing in nature to the work enviroment can help give perspective to life and work related problems. Biophilic design is about bringing back these natural qualities or qualities of nature to the human environments, for us to experience through our senses and thereby support our natural biological condition to acchieve homeostasis, health and wellbeing, and to be able to fully perform.

Sucessfully implemented biophilic design have the potential to result in a wide range of positive benefits for human beings such as improved physical fitness (through walkable environments), less stress, anxiety and lowered blood pressure, increased

satisfaction and comfort, improved health, higher satisfaction and motivation, improved problem solving and creativity, better coping skills, improved attention and concetration, improved sociability, decrease in hostility and aggression (Kellert, Calabrese, 2015)

Contact with nature has a destressing effect as a retreat but also the direct effect of natur itself. Nature also often entails being social and or being physically active (Gospic, Sjövall, 2017).

Interaction with nature seems to have direct positive effects on human beings through perception with our sensory organs. The beneficital health effects of visual contact with plants has been confirmed by numerous studies (Grinde, Patil, 2009). It has been hypothesised that nature provide a positive distraction in for example otherwise sterile hospital environments (Ulrich, 2012). In addition to that it speaks to our subconscious mind through sensory perception, subliminally telling us we are in a safe and abundant environment, perhaps containing eatable plants and fruit, prey animals, and hideouts and shelter away from predators. Biologists classify humans just like other animals of prey. An example illustrating this is the fact that humans tend to avoid centers of open spaces, but rather follow or gather along the borders and walls, unless the space is crowded so we can hide in the crowd. It seems to be a human instinct to protect our back, and thereby only need to keep our attention in one or a few direction (Sussman, Hollander 2014). This fenomenon is known as thigmotaxis “wall hugging” and has been observed in spieces ranging from bacteria, fish, mice to humans.

In more than 100 studies on various population groups, such as people of asian, african, europeean and north american descent, it has been found there is a clear pattern that humans esthetically prefer nature over urban environments. This is especially true if the urban environment is devoid of water or plants (Ulrich, 2012).

Figure 2. Plants and weather are features of biophilic design.

Elements of Biophilic Design

Elements of biophilic design should be implemented in a variety of ways and combinations depending on what is suitable for a particular project.

The elements are divided into three categories describing the form of experience of nature: A direct experience of actual plants and natural elements. An indirect experience of nature, such as the shapes of nature, natural materials, information richness etc. (which presumably is perceived through similar psycho-physiological pathways as actual nature). Experience of space and place with spacial, mobile, symbolical and composite complex qualitites that have furthered human health and wellbeing through our evolutionary history (Kellert, Calabrese, 2015).

The best results of biophilic design are likely achieved when different aspects are, not isolated, but well integrated and relating to each part as a continuous whole (Kellert, Calabrese, 2015).

1) Direct Experience of Nature

- Light
- Air
- Water
- Plants
- Animals
- Weather
- Natural Landscapes and Ecosystems
- Fire

2) Indirect Experience of Nature

- Images of Nature
- Natural Materials
- Natural Colors
- Simulating Natural Light and Air
- Naturalistic Shapes and Forms
- Evoking Nature
- Information Richness
- Age, Change, Patina of time
- Natural Geometrics
- Biomimicry

3) Experience of Space and Place

- Prospect and Refuge
- Organized Complexity
- Integration of Parts to Wholes
- Transitional Spaces
- Mobility and Wayfinding
- Cultural and Ecological attachment to place

Savannah

Humans tent to prefer savannah-like nature that has been a part of our natural habitat for a long time during our evolution (Kellert, Calabrese, 2015), (Sussman, Hollander 2014). “People want to be on a height looking down, they prefer open svannah-like terrain with scattered trees and copses and the want to en near a body of water such as a river or a lake, even if all these elements are purely aesthetic and not functional. They will pay enormous prices to have this view.” (Kellert et al. 2008).

In a 2001 study in the now demolished modernist housing project Robert Taylor Homes in Chicago, Kuo and Sullivan showed that randomly assigned tenants to appartments who had views over a grove of trees showed more positive social behaviour towards their neighbors, showed less agression and exerted less violent behavior compared to tenants with views over asphalt (Sternberg, 2014).

Most modern parks, *English landscape gardens*, express the characteristics of savannah-like landscapes with an undulating landscape of groves, trees, glens, open grass fields and ponds. Merely a coincidence perhaps, or perhaps the doing of our subconscious desire and longing back to our original habitat, the savannah.

Nature’s Effect on Stress and Performance

Plants in the workplace reduces stress and make employees more productive, report feeling less stressed and being more attentive. The reaction time of employees increased by 12%, and the blood pressure decreased, in a study when plants where added to the room (Lohr et al., 1995).

A large study of 10 000 fifth grade students compared school results between groups of students in classrooms with views over natural scenes like mountains and gardens compared with students in classrooms with views over streets and parking lots. Students with views over natural scenes had better test results in language, art and mathematics.

In another study 80 office employees where assigned offices containing either no plants, eleven plants or twenty two plants. The workers with the most plants reported less stress, increased wellbeeing and higher appreciation of the space (Gospic, Sjövall, 2017). Workplaces with access to natural light, natural materials, and greenery heightens productivity, boosts work ethics and reduce time beeing absent (Kellert, Calabrese, 2015). Office employees with plants or imagery of nature have less reported sick leave and are less stressed and tired. (Gospic, Sjövall, 2017).

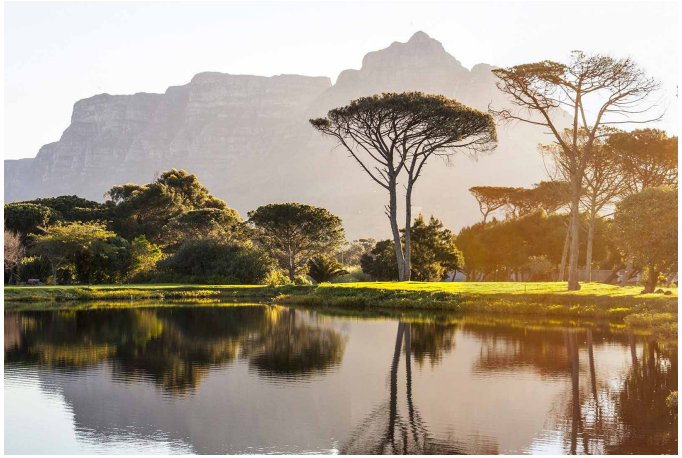


Figure 3. Human beings seems to have a natural preference for savannah-like environments.

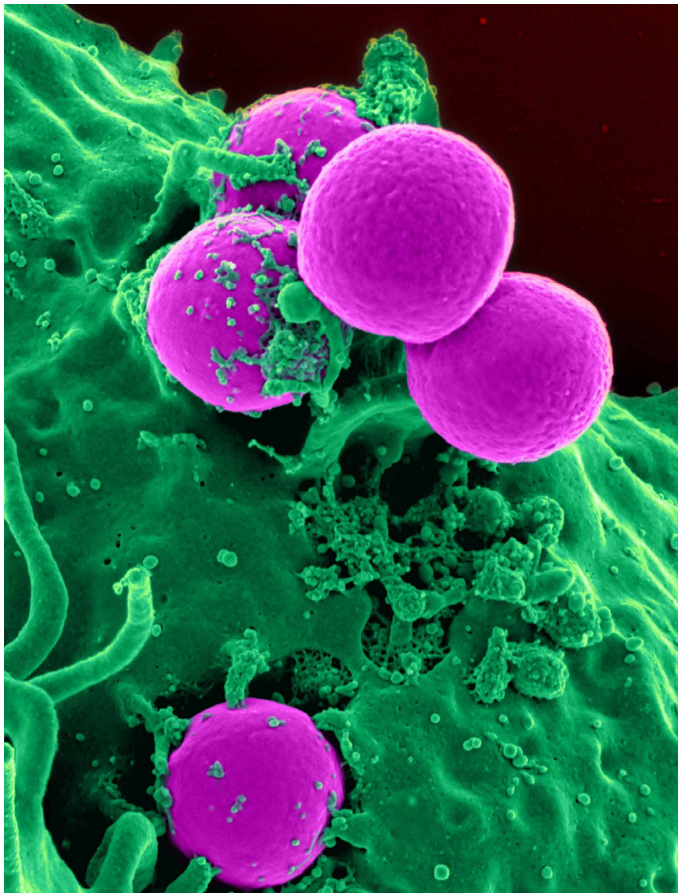


Figure 4. NK-Cells (Natural Killer Cells) that kills off infected cells is stimulated by visits to nature.

Direct Effects of Nature on the Immune System

In japan the term Shirin-Yoku means "to bade in wood" and is refering to the beneficial effects of nature on humans. Both being in nature and seeing nature literally have a healing effect on human beings, mediated through the effects of the parasympathetic nervous system. However there is yet another pathway for trees to have a healing impact on humans. Trees release chemical compounds called *phytonicides*, essential oils of the forest, that has been shown to increase the amount and activity of *NK-cells*, a type of white blood cell. NK-cells attack cancer cells and virus infected cells by releasing certain substances. The effect have been shown both in a laboratory (in vitro) and people visiting the forest (in vivo). The effect on the NK-cells sustained for over a month after the visit to the forest (Gospic, Sjövall, 2017). Another example of the effects scents of plants can have is lavender that has relaxing properties and can induce slow wave sleep in animals (Sternberg, 2014).

Effects of Nature on Hospial patients

Roger Ulrich broke ground within the new field of study, evidence based design (EBD), with his 1984 study "View from a window may influence patient recovery". A study that revieled the potential healing effects of nature on human beings. Patients treated for the same disorder with all the same external conditions where assigned to the same type of rooms with the only difference that half of them had views over a brick wall and half of them over a grove of trees. Patients with view over the grove used less analgesic medicine, less strong analgesic medicine, reported less pain, had fewer complications, and stayed shorter in the hospital, (Ulrich, 1984).

Even imagery of nature or scences from nature has potential beneficial effects on health for hospital patients. Examples of studies where patients watched videos of nature or images with motifs from nature reported less pain, anxiety and stress. (Ulrich, 2012). Art with natural motifs have similar effects with less reported stress. However abstract art have been found to have an adversive effect on hospital patients that often find them confusing, provocative, scary, or provocing negative asociations and emotions (Ulrich, 2012).

Figure 5. Massachusetts General Hospital Lunder Building

Conclutions and Design Strategies

- Design spaces for a generous amount of indoor plants. Make space for plants so that emplyees will have a view over plants in most work situations. Plan for watering and maintenance of plants.

- Use plants in combination with other features, such as sound absorbing plant walls, subdividing rooms and spaces with greenery.

- Sometimes (if suitable) choose plants with a stimulating effect through smell, or just that smell nice.

- Maximize view over plants or biophilic features from windows.

- Design in a way that brings awareness to the passage of time. (Natural materials that age well and gains patina. Daylight to track the hours of the day and season. Plants that change in color or shape during the seasons.)

- Design with a biophilic philosophy and incorporate biophilic desing features both building exterior and interior. For example:

    - Plenty of light and air.
    - Contact with weather, like the sound of rain on a skylight or window.
    - Use natural materials, that ages well and gains patina with time.
    - Use nature-like colors.
    - Design with nature-like shapes.
    - Provide information rich environments for the senses, organized complexity.
    - Incorporate design elements like prospect and refuge.
    - Integrate parts to a whole.
    - Connect culturally and ecologically to place.

Social

The Importance of Social Interaction

Good relationships keep us healthier and happier. Social connectivity is one of the most important, perhaps the most important, predictor of good health and a long life, along with a healthy diet and regular extercise (Buettner, 2015)(Waldinger, 2015). Studies from *Blue Zones*, areas that has the largest share of centenarians in the world, has found a tight social fabric to be something all these areas shared (Buettner, 2015).

People who are socially connected live longer, are happier and healthier. Strong social connections mildens the experience of pain. Good relations protects the brain, and keeps memory healthy (Waldinger, 2015). Compassionate and altruistic activities are associated with better health outcomes for the people participating. People who do altruistic activities, like volunteering, have better mental and physical health in old age and also live longer (Sternberg, 2009). When social support networks become denser people also become healthier (Sternberg, 2009).

Social connections increase levels of *oxytocin*, the hormone associated with pair-bonding, love and connection. Trials with hamsters, who are social animals like humans, showed increased stress levels and slower wound healing when the hamsters were put in isolation. When treated with oxytocin their wounds healed faster, but when treated with an oxytocin blocking substance, healing slowed and wound size increased significantly (Sternberg, 2009).

Lonelyness kills. In a large study on over 300,000 participants it was found that strong social relationships increased the general likelyhood of survival, all causes of death, by 50% across age, sex and initial health status (Holt-Lunstad, Smith, Layton, 2010). People who are lonely are less happy, less healthy, their brain-functions deteriorates earlier and they have a shorter lifespan (Waldinger, 2015.). One in five americans report they are lonely (Waldinger, 2015). Isolation and lack of social support increase the risk of depression. Stress induced by social rejection was found to increase inflammation in the body in a study of 124 healthy young participants (Slavich, Way, Eisenberger, Taylor, 2010).

Even though the common cold spreads through social contact. Researchers found in a study that the sociability was linearly related to resistance of developing a cold from a common cold virus. This was also true after controlling for basline immunity, health habits, and stress hormones (Cohen et al. 2003). One explanation might be that while more meetings with people means more exposure to viruses, more meetings with friends, simultaneously,

effect the neurochemical balance in the body and strengthens protection against infections.

Interpersonal social connections are also a great influence on lifestyle and habits. If your 3 best friends are overweight, there is a 50% chance you will be too (Buettner, 2015). It is therefore important to have a holistic view on on health in the work place. A healthy culture tends to breed more of the same.

We spend a large portion of our awake hours in the work place and for many people it is a social anchor in their life. “Relationships formed at work are the core of people’s lives “(Khazanchi et al., 2018). The connection between the psychosocial work environment and job satisfaction is well established, and the psychosocial environment at work is of greatest importance for health and well-being. (Bodin Danielsson, 2010).

Size, location, permeability and connections of rooms influences social control (Bodin Danielsson, 2010). Crowding is an environmental stressor. Bodin Danielssion cites environmental psychologists Sundstroms thoughts on privacy as being related to:

1) The retreat from people.
2) Maintaining control over information.
3) Regulation of interaction with people.
She further states that the office needs to meet the employees need both for privacy and need for socializing (Bodin Danielsson, 2010).

Supporting Social Interaction with Architecture

Architecture is the framework for social activities, (or any indoor activity for that matter), and to engage in a particular activity there is need for a place to be. The better the place supports the activity the more well it can be performed. Flexibility comes at the price of specific support, and inversely.

The right support might mean the right level of noise, privacy, openness, spaciousness or seclution. Meeting points, formal and informal. Places for groups to gather, places that carries an atmosphere to be shared, or that supports an activity that can be mutually engaged in, that hopefully might breed a sense of community. In work places, in particular offices, the mistake is often made of assuming shared spaces automatically entails strengthenings in social connections and boosts of cooperation and creativity (Khazanchi et al., 2018). Research show that the matter is more complex than that. We shall get back to this shortly, but first, lets look at Christina Bodin Danielssons doctoral thesis concerning the effects of office types.

The Effects of Office Type

The health and well-being of individuals is influenced by office type concludes Christina Bodin Danielssons in her doctoral thesis (Bodin Danielsson, 2010). The effects on workers of seven different office types regarding health, social factors, job satisfaction where studied in the thesis. The different types studied were: *cell office, shared room office, small open plan office, medium-sized open plan office, large open plan office, flex-office* and the *combi office*.

In conclusion 3 office types stood out:

The cell office and the flex-office where the best office types for health and well-being,

The shared room office also stood out as a good alternative that had some advantages, and some disadvantages compared to the cell office. Christopher Alexander recommend shared room offices, describing certain beneficial characteristcs, in his influencial book A Pattern Language (Alexander et al., 1977).

Flex-offices shared the highest likelyhood of good health with cell offices, and shared the highest likelyhood of job satisfaction with shared room offices. Flex-offices had the lowest sick leave and the highest level of emotional health. Factors that perhaps could be explained by the higher likelyhood of working from home when sick, which is more common in flex-offices, combined with the benefits on both mental and physical health of the increased social interaction this office type entails. Flex-office workers where the most satisfied with office design in regards to supporting connection and social aspects. Employees in flex-offices where also the most satisfied with their relationship with supervisors and cooperation within workgroups, social aspects of the work. Workers in flex-offices reported less sadness, depression and lack of energy. Somewhat surprisingly flex-office employees expressed satisfaction with privacy, even when they had no possibility to work secluded, and reported no problems with being heard or observed. Perhaps it can be explained by contentment with other factors that might have obscured dissatisfaction with these factors? Perhaps there is a certain amount of reluctance or stigma regarding criticizing certain factors, such as lack of privacy, compared to other factors, or perhaps the fact that flex-office workers has the choise and control over when to work where, both helped keep privacy at an acceptable level and had a positive impact on their perceived levels of privacy.

Cell offices, again, shared the highest likelyhood of good health with the flex-office, and were closly behind flex- and shared offices in regards to job satisfaction. Cell

offices also did well on these factors albeit slightly lower, instead the benefits of the cell office seems to be due to privacy and territorial factors. Employees in cell offices where the most satisfied with the job itself.

Open plan offices generally had the highest health risks. Taken together, what generated the most dissatisfaction in the different office types was noise, distraction and lack of privacy. Cell offices where the best in this aspect surprisingly followed by flex-offices.

Overall, cell and flex-offices, two very contrasting office types, had the most benefits for health and wellbeing. Perhaps they are respectively better suited for different types of jobs, or personality types.

Shared room offices had the highest job satisfaction together with flex-offices, presumably due to the posivite effects of social interaction these office types entail. Is there perhaps a way to combine the positive social effects of the shared room office and flex-office, with the benefits on privacy and focus of the cell office?

The findings of Bodin Danielsson regarding different office types and their effects can be better put into context and perhaps, in part, be explained by the findings of Khazanchi et al.

Pathways of Social Support from Architecture

In a meta analysis from 2018, reviewing 140 articles about office planning and environmental psychology, Khazanchi et al. created a framework for relationship-building and relationship-straining forms or pathways (Khazanchi et al., 2018).

There are two main types of positive work relationships:

Expressive Ties (friendships) - are ties formed through sharing of confidential (nonwork related) information that serve as emotional support and that contribute to the employers wellbeing.

Instrumental Ties (team-mates) - are ties related to tasks, problems and interdependent, mutually beneficial, exchange of information.

Face to face (FTF) interactions are important to both expressive and instrumental ties. Close physical proximity increases the chance of FTF conversations. The report found that FTF interactions decline when the distance between workers are greater than 18m.

Frequent FTF communication enhances problem solving, encourage sharing of implicit information and increases collabo-

ration. Several studies found that informal interactions also may help resolve functional conflicts, help develop trust and a shared understanding of problems. FTF communication also allows people the opportunity to casually seek and provide work-related support that strenghtens collaboration.

One study found that with an increased shared walking path of 30m followed a 14.6 increase in probability of collaborations among biomedical scientists.

Cognitive Energy Expenditure

The planning of office spaces sometimes result in that employers are placed, or work in such a way that external distractions draw on cognitive resources, leading to the expenditure of cognitive energy. (The term *ego-depletion* is used in the report, there are some recent studies debating the validity of the occurance of ego-depletion, one could therefore argue or make the interpretation that the phenomenon the report is describing is equivalent of expenditure of cognitive energy).

Depletion of cognitive energy might have a negative effect on relationships because of less resources being avaliable for self-regulatory behaviour (irritation), and because motivation is moving away from prosocial relationship building to self-oriented and relationship-hindering. It must therefore be a goal to avoid or minimize external distractions in many work situations.

Privacy - Crowding

Privacy and crowding are at different ends of a perceptual spectrum, with a basis in the design of space, that to some degree vary among individuals. Perception of privacy is related to the ability to control boundarys, which in turn is depending on personal perecption of boundarys and boundary permeability. Crowding relates to the density of space but is depending on the persons preferences and mental state of arousal, the authors write.

"Privacy has been shown to influence the duration and content of communication, which might assist in relationship development, while lack of privacy could lead to negative relationships through increased territoriality-related behavior" (Khazanchi et al., 2018).

Privacy showed to be strenghening of expressive ties, for example photocopiers that was located in secluded spaces allowed employees better control over conversations and information which allowed for exchange of delicate informations such as health concerns, politics,

gossip, or simply personal interest or hobbies. Mutual vulnerability cultivates reciprocity and generates like and trust. It signals inclusion, group membership, helps fulfill the need for belonging and is a foundation for social and emotional support. Privacy lets emplowees set up personal boundarys and control other's access to them (and inversely), which makes people feel empowered, comfortable, relaxed and facilitates a favourable representation of self. Increased privace led to an increase in both satisfaction and personalized marking of the workspace.

Low levels of privacy gives employees limited control over information, for example work related information on screens, and can result in a cautious, wary or anxious environment, and a feeling of being monitored. Moderate to high levels of privacy increased the duration of communication, which in itself was a strenghening factor, supported exchange of delicate information, and engagement, that strengthened expressive ties.

Summarizing Propositions

The findings of Khazanchi et al. are summarized by the 6 following propositions made by the researchers in the report:

1. Proximity will increase the likelihood of instrumental ties with coworkers via an increase in (a) the frequency of FTF communication and (b) task-related information and knowledge exchange

2: Privacy will increase the likelihood of expressive ties with coworkers via an increase in (a) personal and confidential communication and (b) the duration of interactions

3: Both (a) privacy and (b) assigned workspace will increase the likelihood of expressive ties with coworkers via an increase in identity-oriented marking behavior.

4a: Crowding will decrease the likelihood of expressive ties with coworkers via the depletion of self-regulatory resources (i.e., ego depletion).

4b: Crowding will increase the likelihood of negative ties with coworkers via the depletion of self-regulatory resources (i.e., ego depletion).

5: Both (a) low privacy and (b) unassigned workspace will increase the likelihood of negative ties with coworkers via control-oriented marking.

6: Both (a) low privacy and (b) unassigned workspaces will increase the likelihood of negative ties with coworkers via territorial defensive behaviors.

Conclutions and Design Strategies

- Combine the benfits of the flex-office, the cell office and the shared room office in the design.
- Provide a variety of work environments, and give people the choise and control over where and when they work.
- Provide areas with the possibility for both formal and informal meetings.
- Provide break areas for recharging and socialization.
- Provide areas for privacy.
- Provide areas where many people can gather, for example for lunch or lectures etc. to strengthen the sense of community.
- Keep distances between people below 18m. (Daily FTF interactions decline when the distance between workers exceed 18m which decreases the likelyhood of both expressive and instrumental ties to form, and the benefits previously listed.)
- Generally design common pathways in the building. (Increased shared paths to different areas increases the likelyhood of potentially fruitful collaborations between individuals.)
- Avoid crowding.
- Design to avoid external distractions where there is need for focused work.
- Give employees control over boundaries and regulation of interaction. (This will minimize annoyance from distraction, and give employees greater control over focused work and the social aspects of work.)

Focus

The Importance of Focus

Research has shown that privacy at work correlates with satisfaction of both the workplace and the job (Bodin Danielsson, 2010). Interviews of employees confirmed that people sometimes had a hard time to focus due to other people being around them in various ways.

When there is always someone working around you, and there are no screens, walls or plants to screen off sound, visual impressions and to define boundarys of *interpersonal space*, one is always potentially distracted by visual and sound impressions or by sharing or occupying each others interpersonal space. The most common problem, however, is probably that people are being involuntarily interrupted and have very little influence over it. It can also be hard to tell when it is OK to start a conversation, or when it is appropriate or even impolite not to do so. Sensitivity to visual- and sound distractions vary from person to person, and sizes of interpersonal space do aswell. When two people are sitting next to each other one might perceive them as sharing one type of interpersonal space while the other might percieve it as another type of personal space. This has impacts for social codes and likely for interpersonal relations and expressive and instrumental ties. Different types of boundarys, like the ones mentioned above, helps directing and diverting attention, to maintain focus, and it also helps by adjusting the interpersonal space to a fixed boundary, and makes people subconsciously agree on where the boundarys are drawn. Such agreements on boundary lines can help people be more comfortable and may support expressive ties.

What is the most disturbing sound distraction is not always related to sound volume, but rather are things that carry meaning or information, such as overhearing conversations. Here the level of control over ones situation also plays a role over percieved distraction (Bodin Danielsson, 2010). Some of the most disturbing sound information can be social information that might be relevant or perceived as useful to the person overhearing, perhaps gossip about management or company directions, laughter that signals social bonding and the forming of new social relationships.

When people are asked where they go when they really need to get things done, they answer things like: the kitchen, the extra room at home, the basement, the coffee shop, the library. Or things like the train, the commute, or say that it does not matter as long as it is very early in the morning, late at night, or the weekends. Few people answer the office (Freid, 2010).

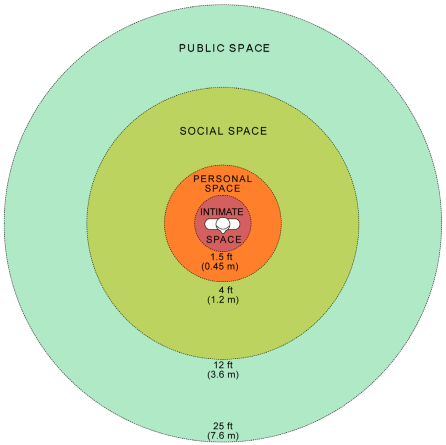


Figure 6. Illustration of Edward T. Hall's interpersonal distances, showing example radii in feet and meters. In real life the radii are not circular and extend further in front of a person compared to the sides or behind.

Jason Freid describes the situation of many modern office workers vividly in his TEDx-talk:

"You don't have a work day anymore, you have work moments . . . You walk in and your day is shredded to bits, cause you have 15 minutes here, and 30 minutes there . . . and before you know it its 5PM . . . you look back at your day and you realize, you didn't get anything done . . . I did all these meetings . . . conferance calls . . . but I actually didn't get meaningful work done. " (Freid, 2010).
"Especially with creative people: designers, programmers, writers, engineers, thinkers, people that really need long streches of uninterupted time to get something done, you cannot ask someone to be creative in 15 minutes and really think about a problem. You may have a quick idéa but to be in deep thought about a problem and really consider a problem carefully, you need long streches of uninterupted time . . . when was the last time you had 3 hours to yourself at the office? 2 Hours? 1 maybe? Very few people have long streches of uninterupted time at an office. And this is why people choose to do work at home, or they might go to the office really early in the day, or late at night when noone is around . . . or they get work done on the weekends . . . beacuse there are no distractions." "How can we possibly expect people to do their job if they are going to the office to be interrupted." (Fried, 2010).

"A study funded by Steelcase revealed that 95 percent of the 10,000 workers surveyed reported that working privately was important, but less than half (41 percent) said they could do so; additionally, nearly one-third (31 percent) had to leave the office to complete their work. These numbers suggest that privacy is of paramount concern to employees."
(Khazanchi et al., 2018).

The flex-office is at the top of office types when it comes to attaining health and performance, but it falls behind when it comes to satisfying the need for privacy. The cell office is also at the top of office

types, and the best for providing privacy, but falls behind when it comes to social aspects. The shared room office shares the benefits of both, but can entail some other setbacks in regards to for example negative terretorial beahviour. Is there perhaps a way to unite the top distinguishing qualities of the flex-office and cell office with the ones of the shared room office?

Disturbing Speech

Perhaps the most common reason for disruption of focus at the office, is speech from people nearby.

It seems tasks that include the construction of new sentences, somehow related to words in a creative way, or that require use of short term memory is particulary vulnerable to being disrupted by speech. While tasks related to mathematical problem solving, or tasks purely reciting something from memory is less so (Jahncke, 2013). It may vary between tasks and situations, but it does not seem to make a significant difference if the speech is relevant or irrelevant to the task at hand. Perhaps creative tasks, in the process of testing and evaluating things in the short term memory, are the kind of tasks that are the most disrupted by overhearing speech. You are searching for that word or solution, and are trying and testing things in the short term memory, while information from the outside keeps pouring in, disturbing the process. This seems to be in line with the findings of Zaglauer et. al (2017), who found that background babble had a mitigating effect on the disrupting effect of a single speaker. The information is camouflaged. However, even with the mitigating effect of background babble, the disrupting effect of any noise was still high. (Banbury, S. Berry, D. 1998) found that both voices and non vocal office noise had a large disrupting and disturbing effect. The researchers contemplated two different theories for the pathway of the disruption. One like the one mentioned above, with irrelevant information pouring in, and another that speculates that rather than contaminating the short term memory, the disrupting sound diverts the attention, over and over away from the task. It is not unlikely that the disrupting pathway is a combination of both. Perhaps non-continous noise, that might signal a change of events, is what is the most disruptive?

Interruption

It has been found not only momentary work performance is lowered by interruptions but it has a detrimental effect on overall work quality, when working on larger complex tasks (Foroughi et al., 2014). Various studies have also shown reductions in performance ranging from about 8% to over 27% when interrupted.

Marone et al. (2018) even saw performance drops at 30% when disrupting students in a lecture in various ways with for example facebook and short cartoons. They also concluded that the timing of distractions was more important than time spent distracted.

One study, testing the speed, quality and politeness of emails when being interrupted, actually found that productivity increased slightly while maintaining quality. However it came at a significant cost of stress, frustration and effort (Mark et al. 2008). The same study found that any interruption, regardless of context, produced changes in the work pattern of the employee. It seems that under certain circumstances it it possible to maintain work quality, but that it has an immediate impact on stress and wellbeing, and in the long run on health.

A study on 24 information workers, cited more than 300 times (and commonly misinterpreted in media), found that the employees stayed on average 11 minutes in a working session before swiching task or being interrupted (by external or internal demands), and that 57% of the work sessions were interrupted. 77% of the interrupted sessions where resumed after an average of 25 minutes (Mark, Gonzales, Harris, 2005). (The article has frequently been misinterpreted in the media, as that it takes 25 minutes to become focused again after being interrupted, not strictly what the study found). One questionaire survey by the company Basex Research concluded that interruptions take 28% of the workers time which of course would entail staggering costs. There are individual differences relating to interruption and task performance, and variations between professions. There is no doubt however that interruptions at work in many work environments has a large impact on performance, wellness and health.

Noise

High levels of noise in hospitals influence patients in a harmful way. It can lead to sleep problems, confusion, increased sensitivity to pain, anxiety, increased rate of rehospitalization after treatment for heart disease, slowed healing and increased recovery time. For hospital staff it increases stress, depletes energy and increases the risk of medical errors. Decreased levels of noise is stress relieving and decreses the risk of burn-out (Ulrich, 2012)(Gospic, Sjövall, 2017).

The average sound level daytime at a hospital is 72dB (equivalent to a vacuum cleaner at 1m distance). In school environments it has been observed that sound levels above 65dB entails an inrease in the risk of heart attacks. In open offices some studies found a decrease in productivity by 66% due to noise (Gospic, Sjövall, 2017).

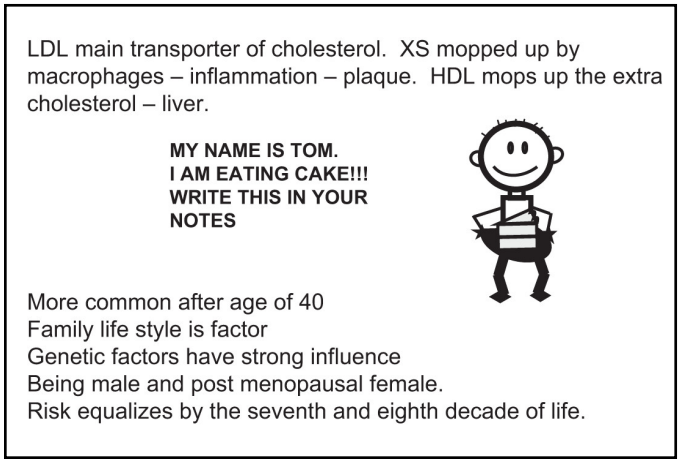


Figure 7. Example of visual cartoon distraction (Marone et al., 2018).

Sound frequency matters in regards to the level of discomfort it creates, where low frequecy sounds has been shown to increase levels of cortisol more than high frequency sound (Bodin Danielsson, 2010). A study also found that noise around 4000hz particularily increased risk of hypertention (Chang et al., 2012). 4000hz is in the frequency range where human hearing is the most sensitive (less actual sound energy is needed to percieve the sound).
Noise have effects on mood and our behaviour. One study found that the noise from fans and and freezers in a supermarket reduced sales with up to 28% (Gospic, Sjövall, 2017). Sounds of water and nature sounds seems to have a beneficial effect on masking other noise by making the perception of the noise more positive, without interfering with speech intelligibility (Wonyoung et al. 2018) (Jahncke, 2016).

Focus, Deep Work and Flow

Multi tasking does not work well for any demanding tasks and assignments. A study on trying to increase productivity by doing phone calls while driving found that both the driving and the conversation (such as accuracy in descriptions and memory use) was negatively influenced. Thus both activities were performed worse (Watson et al., 2016).

In his book *Deep Work* from 2016 Cal Newport emphasize the importance of extended periods of uninterupted focus to be able to produce high quality work. The book describes how influential people like Carl Jung, J.K. Rowling, Victor Hugo, Mark Twain, Bill Gates and Isaac Newton all escaped into some locked room, distant cabin or hotel room to be able to find the peace of mind to really dive deeply into their work and produce at the top of their ability.
Mihaly Csikszentmihalyi, a psychologist who became word famous for his work on the state he calls *flow*. He describes the productive state of flow in his 2004 TED talk:
The nervous system can only process a certain amount of information per second. Listening to one person uses about half,

that is why you cannot understand more than two people talking simultaneously.

"When you are really involved in this completely engaging process of creating something new . . . [pointing to a male creative musician on the presentation screen], he doesn't have enough attention left over to monitor how his body feels or his problems at home, he can't feel even that he is hungry or tired. His body disappears, his identity disappears from his consciousness, because he doesn't have enough attention . . . none of us do . . . to really do well something that requires a lot of concentration and at the same time to feel that he exists, so existance temporarily suspended . . . His hand seems to be moving by itself."

(Csikszentmihalyi, 2004)

Flow is the the state of intense productivity that occurs when a highly trained individual performs at a high level. When the level of challenge is high but matches the ability of the performer. It is a healthy state and everything else seems to disappear and one feels good and is relaxed and yet full of energy and it can be immensely productive.

To have employees engage in deep work for complex problem solving, and reaching a flow state for tasks of executive type would likely entail a high level of productivity while supporting both health and feelings of wellbeing.

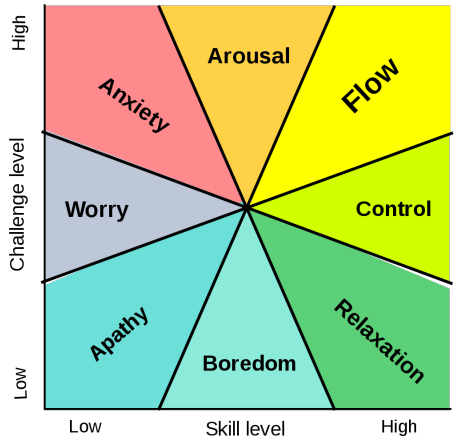


Figure 8. Mihaly Csikszentmihalyis model of flow.

Coping strategies

When the employees cannot focus due to interuption or disturbing activities around them they adapt coping strategies. Common coping strategies are: to use more mental effort to be able to focus at the cost of the work itself, postponing work, working overtime, working slower, switching places away from distractions when possible, or working from home (Gospic, Sjövall, 2017). All these coping strategies are at the expense of productivity and health. It increases workload and stress and increases the risk of burn out, de-

pression and sleeping problems (Gospic, Sjövall, 2017). It is a waste of resources to be changing places or working from other places than the actually assigned work place, the office. It is also very likely to occur at the expense of opportunities for collaboration and certainly has a straining effect on both expressive and instrumental ties. What is the point of the office if it does not provide conditions to be able to perform the assigned activities well? For many tasks, silence or close to silence are the optimal sound setting, but for example listening to music can also provide benefits such as increasing work speed and boosting motivation (Gospic, Sjövall, 2017).

Mindfulness Meditation

Mindfulness practice has become more and more popular and widespread in the west over the last couple of decades. Initially seen as something a bit odd and associated with pseudoscience or religious practices, in recent years it has gained acceptance through more and more people witnessing its benefits, and studies in neuroscience confirming these results. The terms *mindfulness meditation*, *mindfulness* and *meditation*, are used interchangably for a set of techniques that all share certain features of directed attention, acceptance and relaxed focus. "A number of changes in brain structures has been related to mindfulness meditation." (Tang et al. 2015). It has been asociated with changes in the ACC-region of the cortex, a structure associated with emotional and impulse control, but its total effects are likely related to large-scale brain networks (Tang et al. 2015).

In a meta-analysis from november 2018 studying the effects of mindfulness meditation in the workplace, the following results were found: Levels of cortisol were lowered, increased heart rate variability (high variability is an indicator of lower levels of stress), improved immune function with increased antibody response to viral vaccine, and reduced levels of c-reactive protein, a marker of inflammation (Heckenberg, 2018). Mindfulness meditation and yoga practive have been shown to increase GABA in the brain, a neurotransmittor associated with relaxation and memory functions (Engert et al., 2017).

Chan et al. (2017) found instantaneous effects of *focused attention meditation* on cognitive control. It helped the participants hold more relevant to task information in the working memory, and the effects of meditating was found to continue after the meditation was done.

In one study the researchers followed a group of people who never meditated before during eight weeks, their brains where scanned using fMRI (funcional magnetic resonance imaging) to see if

they could find any changes. They did indeed find changes of activation in the frontal cortex, in an area known to contribute to sustaining and monitoring focus of attention, and a decrease in other areas (of the orbitofrontal and medial prefrontal cortex) associated with mind wandering (Tomasino, 2016).

One study found a reduction in cortisol levels by 32% combined with a reduction in 36% of self-reported perception of stress, after 3 month of *compassion-based mindfulness* training. No effects on cortisol for attention based mindfulness training on its own was found, however when combined the attention based training seemed to strengthen the effects of the compassion training and reductions of cortisol in stress reaction tests where increased to 48%. *Affect-* and *perspective mindfulness training* lowered cortisol reactivity by 48% and 51% respectively (Engert et al. 2017).

Meditation seems to be a skill that can be developed and enhanced by regular practice. It has been found to have "lasting impacts on normal waking state consciousness and brain dynamics, even without engaging in meditation.". And the body of evidence for the lasting effects of mindfulness meditation on every day life is growing (Irrmischer et al., 2018).

Interventions Against Noise

So how does one continue and improve the noise and privacy qualities of the work place? Low frequency sound travels easily in the bulding structure so that is important to take into account when planning the construction. Different construcion materials demand different solutions. Wood constructions have traditionally not been the best from a sound insulation perspective, but modern wood construcitons are very sound proof and have no problems meeting standards.

Shielding against sources of noise such as a busy street is also important. In regards to being able to open windows or not, it is always good to empower the user. Having the choise to do what is preferable in the particular moment for the particuar activity is prefered over leaving the user to an automatic or static solution.

In building interiors it is important to consider what kind of activities are going to be performed. Sound absorbing ceilings and features on the walls are usually necessary. Plants, plant walls, textiles, carpets, and soft furniture can be a great complement for sound dispersion and absorption providing several aesthetic and functional features in one.

Creating Privacy

Sound absorbing screens and glass walls, can provide good accoustic properties for rooms while also providing other features such as beauty, dividing space, providing clear interpersonal boundarys, while preserving visual contact, and overview that may strengthen socal bonds, prevent isolation, and provide a sense of connection.

Considering sources of noise together with activities is also important. It is important to try to isolate sources of noise in appropriate ways. For example by screening off in a separate room, or introducing glass walls, sliding walls, or shielding off with screens. Place rooms suitable for silence away from sources of sound. Place sources of sound with an approximately equal volume together, in ways suitable for the project. For example telephone rooms and meeting rooms. This will also create sound gradients within the building making transitions smooth when moving around. Having rules for sound and noise levels can also be beneficial.

Conclutions and Design Strategies

- Divide the building into accoustic zones, focus zones, and social zones . Preferably in a gradient manner to be able to adapt along the way. (Nature always expresses gradual transitions and has few sharp transitions).

- Provide a variety of work places for people to be able to peroidically fully focus on a task (and possibly reach flow) and periodically work less focused, collaborate, socialize and recharge.

- Provide a variety of work environments, and give people the choise and control over where and when they work.

- Provide distraction free spaces for focused work.

- Reduce the prevalence of internal distractions by providing spaces for mindfulness meditation.

- Sound absorbing plants, textiles and in panels on floors and walls where needed. Mosswalls functions as sound absortion. Technical accoustic sound absorption is often necessary in addition. Textiles that shades light, dampens acoustics are beautiful, brings softness and comfort.

- Ensure building is sufficiently sound proof in regards to outdoor noise, changes in building use (for example a gym). Awareness in construction phase, when building with wood, to make construction enough accoustically noise proof.

- (Soft materials under floor to dampen noise from steps. While sparing hips and knees.)

- Carefully selected background music might be beneficial in low focus areas such as lobby and pause areas. (Allow working with Headphones.)

- Empower employees by giving them control over when to be accessible.

- Shield workstations from disturbing visual distractions and disturbing noise and speech.

- If possible try to create work privacy that still entail a sense of connection with other people and areas. (Perhaps semi-transparent visual connections blocked by glass walls, plants, curtains, beautiful acoustic screens of textile etc. that provides visual contact when desired while creating clear social boundaries and minimizes risk of involuntary distraction.)

Light

The Importance of Light

Juhanni Pallasmaa writes about light in his book *The Eyes of the Skin* (2012)*:*

"Light is so natural to us that it is easily taken for granted . . . It concretizes the cycle of the year, the course of the sun and the passing of the hours of the day. . ."

(Pallasmaa, 2012)

In countrys with seasonal variations, the effects of light on our minds and mood becomes apparent during the changes of the seasons, and equally so from a rainy to a sunny day. People report feeling better during the bright months of the year. Many office workers in Scandinavia leave for work before sunrise and go home after sunset, and office workers spend eight times more time in daylight outdoors during summer (Adamsson et al., 2018). " . . . there may be a lack of exposure to short-wavelength light during the time that office working people in Sweden spend indoors which illustrates the importance of the indoor environment for modern-day people. Consequently, this indicates that it is crucial to designing suitable lighting conditions in the workplaces . . . light radiation and the lit environment have a major influence on human physiology, psychology and health-related quality of life in addition to work performance and work satisfaction " (Adamsson et al., 2018).

Circadian Rythm

The the cells of the human body needs to know when to activate certain functions and when to deactivate others, just like a symphony orchestra, to perform its tasks, the cells of the body needs to be in sync with each other to perform well. This is regulated by the *Supra Chiasmatic Nuclei* (SCN) in the brain, the harmonic director of the body. The regulation from the SCN affects mood, metabolism and the sleep cycle and approximatly 10% of the genes of the body are directed by the SCN (Gospic, Sjövall, 2017).

The SCN is in turn regulated by exposure to sunlight through special receptors in the eyes. *Seasonal Affective Disorder* (SAD) or winter depression is a wellknown concequence of lack of effective regulation from the SCN. SAD is also treated with light therapy. It is wavelengths of light in the blue spectrum that is strongest during daytime, that is registred through the receptors in the eyes. This is why looking at screens, phones, tvs, computers and pads without using a blue light filter can disturb the natural process of the SCN and keep us awake late at night. Since the internal biological clock is not exactly 24hours it needs to be corrected into phase from an

Figure 9.

Approximate lux levels of different light sources. Most light therapy devices uses levels of lux from about 7000 lux mimicing low levels of natural daylight.

Starlight (no moon)	0.0001 lux
Starlight with airglow (light pollution)	0.002 lux
Full moon	0.3 lux
Twilight	3.5 lux
Public areas with dark surroundings	20-50 lux
Family living room	50 lux
Office Hallway	80 lux
Very overcast day	100 lux
Train station platforms	150 lux
Office lighting	300-500 lux
Sunrise or Sunset	400 lux
Overcast day, TV-studio	1000 lux
Daylight	10,000-25,000 lux
Direct Sunlight	32,000-100,000+ lux

external source. (Shirani, A., & St Louis, E. K., 2009). The optimal strenght of light in lux and exact total daily amount has not been completely confirmed by science. We do know however that both too little and too much light, at the wrong hours of the day, is harmful in a long perspective.

A good daily dose to support health seems to be to get a fairly strong dose of blue wavelength light in the morning, and preferably at least 30 minutes of strong light throughout the day. And also to avoid blue light exposure about 1-2 hours before bedtime. This will help the body to maintain a synchronised regular gene expression that leeds to balanced hormone levels, that has a multitude of positive downstream effects like for example improving sleep, reducing risk of obesity, depression and cancer. A study at the University of Conneticut found that women who spent their working lives working night shift had a 30-80% increased risk of developing breast cancer compared to the day shift workers (Sternberg, 2009).

At the same time humans have a considerable capacity to adapt to periodically adapt to different light conditions. An interesting study by Küller et al. (2006) found that the light and color of the workplace had a measurable influnce on mood, however, it seem that the perceived levels of light and illumination mattered more than actual measured light levels.
People like to be in control and manual

light solutions are prefered over automatic ones. Needs and preferences of light may also vary from person to person, with different physiological and psychological needs, depending on the time, task and so on. Therefore it may be a desirable solution to provide individual manual control of light conditions at different work stations that provide control over light strength and color spectrum of light.

Psychological Effects of Light

Light is what produces vision and colors. Vision, light and the eye has traditionally been liked with cognition, intellect and the divine (Bødewadt, 2015). Light is a director of focus. Our gaze is drawn to illuminated objects. In language connection between light, focus and cognition become evident in the symbolism of words such as *illumination*, *elucidation*, *highlight, bring into light* and to *shine light upon*. Access to daylight affects the levels of *serotonin* (one of the neurotransmittors associated with happiness) in the brain (Gospic, Sjövall, 2017). A large portion of the psychological effects of a rainy day is not the water from the sky but the darkness, the chill and grey colors of the heavy clouds. The psychological effects of weather has been linked to everything from consumption patterns, prevalence of violence to how successful stock investments people make (Gospic, Sjövall, 2017).

In Sweden more than 300 milion tea lights are consumed every year (Gospic, Sjövall, 2017). Light has so many psychologically important qualities for us, since it is the fundamental condition for vision and seeing. Studies have found that people talking to a counsellor in a softly lit room are more open and relaxed (Gospic, Sjövall, 2017).

There seems to be a connection between sunlight, heat and how we percieve other people. Every Scandinavian knows how the sunny terraces of restaurants and cafés are packed during spring and early summer. Perception of temperature is actually projected onto the people we meet, for example it has been shown that people who are holding a cup of warm liquid are more likely to experience other people as warm and positive. People who have been socially excluded percive the environment as more cold than socially included people

(Gospic, Sjövall, 2017). Therefore it might be a good idéa to place social rooms such as meeting rooms and break rooms in rooms that get a lot of sunlight, while calm rooms for focus might benefit from the shady side of buildings with indirect light from the north that also reduce the problems with glare on screens.

“light and colour should be treated as part of a more complex system making up the totality of a healthy building.” (Küller et al., 2006).

Light in Rooms

Light from north has certain properties and is popular in many settings such as art galleries, foyers and lobbies. Problems with over-heating and glare are avoided, and the overall lighting is often great, as long as the windows are large enough, due to certain properties o the north light. Light from north is indirect, either radiating from the sky rather than the sun, or bouncing off objects in the view from the window that are themselves directly illumnated by the sun. This is a great light to work in, its not too hot, there is less contrast for the eye to adjust between, fewer shadows, and the color of the light tends to be a bit cooler with blue wave lengths presumably having a engergizing biological, yet calming psychological, effect. Adjusting between different light levels with a high contrast background can be tiring for the eyes, and and psychologically aswell. Most ceilings are white or in a bright color that mimics the bright sky above us when we are outdoor (Fagerhult, 2018). White and bright rooms are popular and are often precieved as larger than if in a darker color, due to this psychological trick percieving light as space. The same goes for ceilings.

Providing a range of light options in different areas for different purposes (e.g. confidentional converations, work stations, social areas), and personal control over light at the workstations seems very likely to provide a solid foundation for good light conditions at the work place. Providing a solid dose of daylight somewhere in the building is likely to have a beneficial effect on the health of employees, in particular during the dark months of the year.

Background Luminance

The term *background luminance* discribes the light conditions of not the primary light source or the primarily lit object, but the bakground field of light behind and surrounding the object of focus. Light from walls, ceilings and objects in the surroundings. The background luminance can be calculated by adding the average luminance of the for walls, the ceiling, the floor or work surface and

divide by 6. Background luminance has proven to be important for optimal performance and wellbeing.

A study in Lund compared three levels of background luminance: 20cd/m^2, 100cd/m^2 and 350cd/m^2 and found that the 100cd/m^2 was superior at inducing positve emotion, subjective levels of arousal, and was surprisingly even percieved as the brightest setting. Presumably due to the pereived contrast between the primary area of focus (the desk) and the, in this setting, brighter background (Govén & Laike, 2007).

Perhaps the level of contrast, as a result of the distinct levels of luminance in the background and the areas of focus, is as important as the levels of light of the work area, measured in lux. However, another study by the same researchers, compared different levels of light in lux, in a school in London, with approximately the same difference (200) in lux between the background and the area of focus. School children with the brighter setting of 500lux in the area of focus and 300lux in the background had higher grades, steadier levels of cortisol and melatonin and reported feeling better, compared to children with 300lux in the area of focus and 100lux in the background (Govén, Laike, Raynham, & Sansal, 2009).

A third study evaluating different light settings, trying to find the best visual and emotionally prefered lighting, found that the test subjects prefered the combination with around 50% indirect light and 50% direct light, corresponding to a wall luminance of 78cd/m^2 and a ceiling luminance 128cd/m^2 (Govén, Bångens, & Persson, n.d.).

According to the company Fagerhult, associated with the two of researchers in the three studies cited, the optimal levels for office lighting is the 500lux/300lux relationship in the study cited.

It is probably not a problem to go above 500 lx for an active work setting with medium to high levels of arousal desired. That is, where you need to have a clear and focused mind and not get tired or drowsy, and where there is no psychological social benefits of a softer, dimmer light. In fact, in many cases it might actually be a benefit to go higher. Reminding our evolutionary history, that electrical lights has only been around for about 100 years, and that direct sunlight is at 100,000 lux and even cloudy days, and outdoor shade, usually are at several thousand lux, it seems very likely that humans also would thrive in slightly brighter conditions than 500/300lux.

Nevertheless the work space luminance compared to background luminance seems to be cruical for performance, wellbeing and a healthy light setting.

Standards and Recommendations of Light Levels

In focused work areas, the difference between the lowest level of light and the mean light level should be as little as possible (low contrast). Never less than 1/10 of the mean light level.

A recommendation is that the ratio between the light of the work area and the light of the surroundings in the main visual directions should not exceed 3/1.

Offices and facilities with similar needs, should have fairly bright (and even) light in communication areas. Reccomended values for walls are >75 lx and for ceilings >50 lx (Fagerhult, n.d.).

The relationshop in light between the work area and the ceiling should be somewhere around 1:1 to 1:2. A ratio between direct and indirect light that seems to be commonly prefered is about 50% direct and 50% indirect light (Fagerhult, n.d.).

Shading

Providing shade to the office is crucial to sustain a healthy work environment. In particular in rooms facing south this is essential to handle heat, glare and to avoid too high contrast. The best option is to provide manual solutions for the users.

Figure 10. Rule of thumb. Relative recommended light conditions.

Work Area Light (Desk)	Immediate surrounding (Around Desk)	Exterior surrounding (Closest walls)	Periphery (Background)
Light in lux	ca 2/3	1/5	1/10

Figure 11. Work light conditions according to the european standard: EN 12464-1. Immediate surrounding is about 2/3 of the work area light, and the periphery 1/3 of the surrounding light.

Work Area Light (WAL)	Immediate surrounding	Periphery, compared to immediate urrounding
>750 lx	500 lx	1/3
500 lx	300 lx	1/3
300 lx	200 lx	1/3
200 lx	150 lx	1/3
150 lx	WAL	1/3
100 lx	WAL	1/3
<50 lx	WAL	1/3

Effects of Light on Hospital Patients and Staff

In a meta review in 2008, screening the reserch litterature on several parameters important to health outcomes in regards to healthcare facility design, light and access to daylight was found to have an impact on several factors affecting health outcomes and patient and staff satisfaction and productivity. The conclutions were that the amount of light and daylight preferably should be tailored to the designated activity, where most of the activities benefited from relatively bright light and access to daylight.

Relatively high levels of daylight where found to reduce errors when dispensing medication (Ulrich et al., 2008), which suggests high levels of light are beneficial for tasks demanding precicion.

Patients reported lower levels of pain and used less pain medicaion when exposed to sufficient daylight (Ulrich, 2012), (Ulrich et al., 2008).

Access to sufficient daylight plays a major role in regulating circadian rythm and can affect sleep quality. (Ulrich, 2012), (Ulrich et al., 2008).

Daylight and sufficient artificial light reduces depression and improves mood. Depressed patients with access to morning daylight also left the hospital sooner. (Ulrich, 2012), (Ulrich et al., 2008). In a retrospective observation study, on hospitalised patients treated for depressive disorders, it was found that patients with bipolar depression had a mean 3.67 days shorter stay when they where exposed to morning sunlight (Benedetti, 2001).

Access to sufficient light affects patients overall satisfaction with their hospital stay, and was one of few environmental attributes that led to higher staff satisfaction. (Ulrich, 2012), (Ulrich et al., 2008).

A higher access to daylight also helped to reduce stress among the staff and also made them feel more energized and alert. (Ulrich, 2012).

Low levels of light made patients and relatives more comfortable having converations in confidence and made them stay longer. (Ulrich et al., 2008).

Effects of Light on Performance

Children in classrooms with plenty of natural light have been found to have more balanced levels of stress hormones, have better growth, perform better in school and have less sick leave than children in artificially lit classrooms. (Gospic, Sjövall, 2017). (This may coincide with views/lack

of views over plants and nature).

In another study, the school performance of 21,000 elementary school students in California, Washington and Colorado, was analyzed in relation to the students access to daylight in the classroom through windows and skylights. The schools had different curricula and methods of teaching, different building designs and different climate, yet the results were all in line. Students with the most daylight in the classroom progressed 20% faster on math tests and 25% faster on reading tests compared to the students with the least. all the schools saw a significant positive increase in school performance when rooms where sufficiently lit with daylight.

Students that had windows that could be manually opened also had a 7-8% faster progress compared to those in rooms with fixed windows, regarless of if the classroom had air conditioning (Heschong Mahone Group, 1999). This suggests that the possibility to directly control or influence ones environment has a positive impact on performance on its own.

In a recent study published in Cell magazine, scientists found evidence that sunlight improved memory and motor learning in mice mediated through a previously unknown metabolic pathway increasing synaptic release of glutamate (Chantranupong & Sabatini, 2018).

Conclutions and Design Strategies

- Design for seasonal, and daily variations in the light, as an indicator of the passage of time, and time of the day.
- Provide daylight in common areas, for example lobby and lunch area. Perfect for daylight exposure during breakfast and lunch.
- Keep in mind the psychological and space creating properties of light.
- Place rooms in such a way that the longer it is used in a continous strech of time, the more access to daylight.
- Southern rooms have a brighter and more warm light, place rooms so that more active and social rooms face south. (Meeting rooms etc.)
- Northern rooms has a cooler calmer light with a larger blue light fraction. It has less glare, less heat problems, and provides a great diffuse light for reading that is low in contrast. Place calm but alert activities like focused work in northern room.
- Ensure there is enough shading, louvres, curtains etc. in particular on the sunny side of the building. Provide curtains with different levels of shading for all windows.
- Provide manual control over louvres, curtains, different shading options.
- Provide large windows.
- Design high windows and combine with high ceiling height to let daylight deep into the building.
- Design bright ceilings and walls, in particular the walls close to windows to avoid sharp contrast.
- Keep the background illuminance and contrast levels in mind when designing. Work light - direct surroundings - indirect surroundings - periphery should have approximatly the ratio:
  1 - 2/3 - 1/5 - 1/10.
- Provide at least 500 lx for work light.
- Consider appropriate lux levels for assigned activity.
- Aim for approximatly 50%/50% indirect/direct light.
- Min levels in communication areas: Walls: 75 lx, ceilings 50 lx.
- (Use artificial lighting that changes color acording to the natural composition of daylight.)
- Give the users personal control over the light of work stations and other rooms. Brightness, (blend of direct/indirect and color.)
- (Provide rooms with the possibility of a dimmer light setting for conversations in confidence.)
- (Provide daylight in basement areas used for longer periods of time, for example via fiber optics or artificial).
- Apply a holistic view on light and colors of the building.

Natural Materials

The Importance of Natural Materials

Juhanni Pallasmaa describes the properties of natural materials very deeply and poetically in the book *The Eyes of the Skin* (2012)*:*

"Natural materials, stone, brick and wood, allow our vision to penetrate their surfaces and enable us to become convinced of the veracity of matter. Natural materials express their age, as well as the story of their origins and their history of human use. . . . patina . . . enriching experience. Buildings . . . usually deliberately aim at ageless perfection and they do not incorporate the dimension of time . . . related to our fear of death. We have a mental need to grasp that we are rooted in the continuity of time, and in the man-made world it is the task of architecture to facilitate this experience."

". . . 18th century Irish philosopher and clergyman George Berkely related touch with vision and assumed that visual apprehension of materiality, distance, and spatial depth would not be possible at all without the cooperation of the haptic memory."

"The body image . . . is informed fundamentally from haptic and orienting experiences early in life. Our visual images are developed later on, and depend for their meaning on primal experiences that were acquired haptically". "To at least some extent every place can be remembered, partly because it is unique, but partly because has affected our bodies and generated enough associations to hold it in our personal worlds."– Kent C Bloomer, Charles W Moore. 1977 - Body, Memory and Architecture.

"As the work interacts with the body of the observer, the experience mirrors the bodily sensations of the maker. Consequently, architecture is communication from the body of the architect directly to the body of the person who encounters the work, perhaps centuries later."

"Modern architectural theory and critique have had a strong tendency to regard space as an immaterial object delineated by material surfaces, instead of understanding space in terms of dynamic interactions and interrelations."

"The current overemphasis on the intellectual and conceptual dimensions of architecture contributes to the disappearance of its physical, sensual and embodied essence."

"The flatness of todays standard construction is strengthened by a weakened sense of materiality. "

(Pallasmaa, 2012)

Properties of Natural Materials

Even though they differ in many ways, natural materials share some properties (that are not the same, or not percieved the same in other materials.) Natural materials share a sense of scalelessness, a sort of fractal-like structure. The closer one gets to a natural material there is always something new to discover, a pattern within a pattern, small shades of colors shifting, an imperfection that dissapears and blends into the whole. At a distance all these effects combine into a unity, a wholeness that clearly is one, and at the same time shimmers and shifts in infinite nuances.

Materials that wee se as artificial (even tough some 'natural materials' also are man made such as brick), for example metals, plastic, glass, concrete, acrylic, laminates, plastic paint, also share properties that seems to be quite the opposite of natural materials.

Artificial materials are scaleless, they look more or less the same at any distance. If they contain patterns, they usually are monotonously repetitive with few variations. Imperfections does not look poetic but flawed.

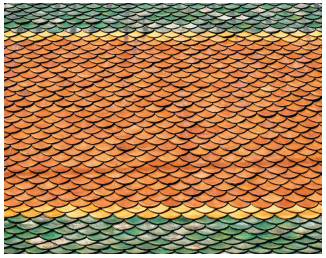
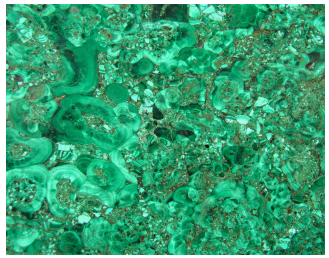
Natural materials are familiar to us in some archaic sense, just like Pallasmaa writes we relate to them through past experiences from memory. They seem to communicate with us in a way that artificial materials seems to fail to do.

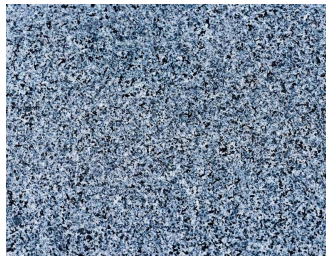
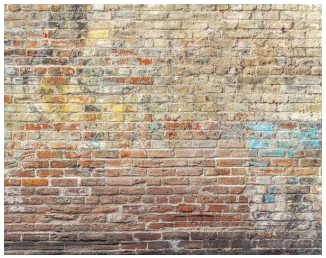
Iron is an interesting example, where the more robust and imperfect the iron, like cast iron, the more it seems to speak to us. Modern perfected steel, while it does have some interesting shimering qualities, it still seems cold and distant, and it does not really speak to us in the same way.

Natural materials are safe to handle and easy to understand and to read. Everyone knows of the mechanical properties of stone and masonry, and of timber and wood. Local natural materials helps us understand a place and makes it easy to relate to buildings.






Wood's impact on Hospital Patients

Many surveys and studies have witnessed the benficial effects of wood on mood, lowered stress and general wellbeing (Augustin, Fell, 2015).

Wood has been shown to have a positive effect on the healing process of hospital patients. Patients in rooms decorated with wood panels reported higher satisfaction, less stress, slightly less pain and they stayed for a shorter period i the hospital (Nyrud et al., 2017). Another study found that a moderate level of wood use seemed to do be prefered over rooms being completely covered in wood (Nyrud, Bringslimark, Bysheim, 2014).

White is often chosen for ceilings and walls because of capacity to reflect light but also that it dilutes the sharp boundary of the wall and gives an illution of space in all directions. In nature the sky above usually is the brightest field of vision so it makes sense a lot of people prefer having white ceilings. Having rooms covered completely in one material might produce the feeling of being encapsulated and increase discomfort, or simply be monotonous and boring or annoying.

The impact of wood seems to to a large degree be related to the percieved experience that it gives the viewer. The placement and amount seems to be important (Augustin, Fell, 2015). The impact may not purely rely on the presence of wood as an isolated parameter, but rather on the perception of wood in a context. That would explain why the positive effects are greater in certain contexts, perhaps certain associations are made, and why intermediate levels of wood seems to have the best effects. It simply comes down to the personal experience wich is a compound issue of several parameters. However no study in the assessed body of work found any negative effects of wood on the subjects.

Most likely what truly matters is our perception of rooms and places, both at a conscious and subconscious level. What matters is the sum of all environmental parameters in action, being in their respecive context at the same time (things may have very different connotations in different settings, for different people), and in that context natural materials will be a valueable tool of creating healthy supportive living environments.

Toxic Materials

Toxic materials where widely introduced with industrial manufacturing and spread in the building industry when it was industrialized.

There is no place for toxic materials in human living environments and certainly not in a health promoting work place.

Appart from the directly toxic effects of the toxins, there is also a phychological parameter to toxic materials. The placebo and nocebo effects (the negative inverse of placebo), through the awareness of the presence or absense of toxic materials, may cause slight increases in stress or relaxation that may have a sizable impact on a population over time (e.g. climate anxiety).

Our general awareness of these toxins and their effecs are growing, and there are now databases describing the potencial risks of the ingredients in modern building materials. To create truly health bringing environments it is important to be aware of and applying this knowledge.

Conclutions and Design Strategies

- Use natural materials whenever feasible and possible. Don't make excuses.

- Use local natural materials that connect to the place, both culturally and ecologically, and that people relate to, to connect and root the building in its location. (E.g. förbländertegel, granite, slate, oak, beach, pine, swedish wood etc.)

- Use natural materials that ages well and that gets patina.

- Natural materials constitutes visual fractals (se section fractals under in chapter beauty) that presumably are more relaxing and less straining to look at.

- Natural materials are safe to handle and easy to understand and to read. Everyone knows of the mechanical properties of stone and masonry, and of timber and wood. Local natural materials helps us understand a place and makes it easy to relate to buildings.

Figure X. The Great Wave of Kanagawa. The famous painting by Hokusai uses the golden ratio and fractal geometry. (Hokusai, 1830s).

Beauty

Figure 12. Cinque Terre, Italy

Figure 13. Eye Tracking device used to analyse how we see architecture. Details, windows, doors, nature and human like features seems to attract the eyes. Research by Ann Sussman.

The Importance of Beauty

"When you only have two pennies left in the world, buy a loaf of bread with one, and a lily with the other." -Chinese proverb. (Chatterjee, 2014)

Beauty has traditionally, at least since ancient greece, been seen as one of the great virtues of life, as much so as, truth or goodness (Chatterjee, 2014). With the birth of modern art, beauty started to be seen as something elusive, something entirely subjective and therefore meaningless to try to catch. Early 20th century architect Adolf Loos famously stated that it would be a crime to waste time decorating buildings and objects with ornament.

While there naturally is some truth to the subjectivity of assessing beauty, as we have seen, humans have much more in common than our differences. Most people like strawberries, crisps, the sea, puppies, starlight, moonshine, sunsets, flowers, hot baths, nature, natural materials and so on. Research has shown there are some least common denominators when it comes to the appreciating beauty that seems to be shared among people (kurzgesagt, 2018). These are features that most people find beautiful and that awakens our interest, such as symmetry, fractal patterns and particular properties of light reflection, and they are all rooted in nature. It is believed keeping our attention on these visual patterns helped us survive during our evolution (Chatterjee, 2014) (Kurzgesagt, 2018). Looking at the fractals of clouds wondering if it will rain, looking at waves anticipating an upcoming storm, and bringing the attention to a colorful or symmetrical fruit or plant to eat. Things that helped us survive activated reward systems in the body so that we would do more of them (Kurzgesagt, 2018)(Chatterjee, 2014) and it is these rewards, in turn, that decreases the stress in us. "the nerve cells in that opiate-rich pathway become active. It is as if when you're looking at a beautiful scene, your own brain gives you a morphine high!" (Sternberg, 2009). Eye tracking devices have shown that humans look for details, ornament, and other people in architure, and sweeps quickly over blank walls and monotonous patterns (Kurzgesagt, 2018)(Sussman, Hollander, 2014). In fact looking at monotonous facades have been linked to boredom, discomfort and raised stress levels (Kurzgesagt, 2018).

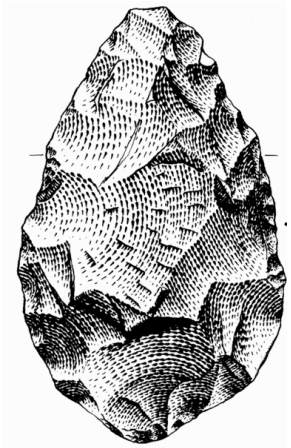
Personal happiness is affected by how beautiful our surroundings are and how beautiful we find the city we live in. Studies have found that people ranked, how much the beauty of their city influenced their happiness, astoundingly even higher than cleanliness or safety (Florida, Mellander, Stolarick, 2011)(Leyden, Goldberg, Michelbach, 2011).

No wonder ancient cultures bothered cre-

“In fact, our brains might always be responding to beauty even when we are concentrating on other things... these results make me wonder if we would be happier if we surrounded ourselves with beautiful objects."

Anjan Chatterjee, The Esthetic Brain (2014)

Figure 14. Castle Neuschwanstein is one of the worlds most depicted and famous castles. While it does not express a perfect total symmetry, just like a plant it expresses an extensive level of local symmetries. Each of these local symmetries signals the occurance of an object or individual part. A tower, a turret on the tower, a window on the turret, mullions on the window, all symmetrical subparts of larger parts.



ating beautiful buildings even though they where enormously resource demanding, and time consuming to build. That is the extent of the impact of beauty on us.

When reflecting upon the architecture of the office employees tend to focus on the aesthetical dimension, not the funcional, and it is given both more importance and is being associated with more positive feelings (Bodin Danielsson, 2010). In fact, an aesthetically pleasing or beautiful office can ameliorate the negative impact of other factors such as noise (Bodin Danielsson, 2015).

Symmetry

Bilateral symmerty is found everywhere in nature and 99% of animals express bilateral symmetry (Finnerty et al., 2004).

Almost all designed objects express bilateral symmety. Cars, pencils, vacuum cleaners, tv-screens, tables, lamps, books, tools, clothes, bottles, packing and so on. Early humans shaped their tools symmetricaly but scientist have not found any practical reasons for this, it is believed they simply did it beacause they liked them better that way (Kurzgesagt, 2018).

Bilateral symmetry functions as a visual signal, to signal the occurance of an object, that the object is an individual object, that might be a part of a larger object, and to destinguish the object from its surroundings. Bilateral symmetry provides directionality, brings focus to certain points like the center and edges, and provides an ordered structure and creates relations between different parts. Bilateral symmetry is also associated with beauty of the human face and body (Chatterjee, 2014). Facial symmetry presumably has been a evolutionary signal of diverse genes and not having an illness like a parasite infection (Sussman, Hollander, 2014). Raindeer males are more attractive to female if their antlers are symmetrical, and female swallows are more intrested in male swallows with large symmetrical tails (Chatterjee, 2014). After all, the most important biological objects such as predators, prey, and potential mates and allies all express bilateral symmetry in their faces and bodies (Ramachandran, Hirstein, 1999). Even potential food, such as plants show a great deal of symmetry. A rotten plant is often disfigured and may not be safe to eat, while a symmetrical one looks more healthy and safe to eat (Kurzgesagt, 2018).

The human visual cortex processes impressions of bilateral symmetry faster than other shapes of symmetry or repetition (Sussman, Hollander, 2014). Apart from that, bilateral symmetry have been shown to spontaneously generate positive emotions independent of if it is the focus of attention and is solely percieved indirectly (Pecchinenda et al., 2014).

Figure 15. The Eiffel Tower is a symmetrical tower with abundant local symmetries and fractal geometries.

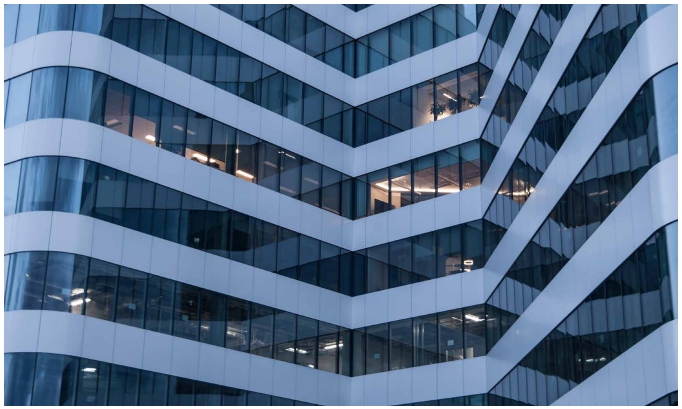


Figure 16. Modern facades contain a different type of visual information (apart from the reflections) than older buildings.

Human preference of symmetry as a means to achieve beauty has been applied in architecture for millenia.

Symmetry was selected as one of the eight laws of artistic experience in the 1999 article The Science of art: A Neurological Theory of Aesthetic Experience by world leading behaviour neurologist and psychophysicist V. S. Ramachandran (Ramachandran, Hirstein, 1999).

Fractals

There is something captivating about fractals. It seems humans have a natural attraction, facination and preference for looking at fractal patterns.

Fractals patterns occur everywhere in nature. It has been theorized that fracal compression of information is one of the most efficiant compression methods, and that fractal geometry is the one of the most efficiant means of general distribution.

Fractals are found in nature, among many other places, in plants like pineapple and the romanesco broccoli, in trees on all scales from the branches and roots to the veins in the leafs. In lightning and electrical distribution of sparks, in the shapes of mountain ranges and in clouds, in the shapes of snowflakes, in ocean waves, in river deltas, in windpatterns and in the rings of Saturn. In the blood vessels of the human body and the pulmonary organs, in DNA. “Nerve cells have a fractal structure . . . Even the human brain is fractal, with is countless replicated folds” (Sternberg, 2009). There is evidence that the fuctional network organization of the human brain also follow fractal patterns (Kitzbichler et al., 2009). (See the cover image of the section Nature, and count the number of features of that scene of wilderness that contains fractals.)

Perceiveing visual fractals seems to have a relaxing effect on humans and may thereby influence physical and mental performance positively (Augustin, Fell, 2015).
It is hypothised that we have a natural attraction to fractal geometry, because of the evolutionary advantages it gave by directing our attention to powerful natural events.

There is evidence that visual information is processed the most effectively when it has a fractal-like structure (a statistical 1/f distribution of fourier amplitudes)(Penacchio, Wilkins, 2015). Images of nature are generally structured in this fractal way (Penacchio, Wilkins, 2015). Processing of visual information uses a relativly large part of the brain's metabolic resources. It has been shown that visual impressions that don't share this fractal image structure is processed ineffectively and uses more energy (Le, Wilkins et al. 2017). These energy consuming visual properties

are more common in the modern urban environment, and are absent in nature (Le, Wilkins et al. 2017)(Hibbard, O'Hare, 2015), and it seems also to be more common in modern architecture than in older buildings. One of the authors, Wilkins, writes about the phenomenon in *The Conversation*: "We then analysed images of apartment buildings, and found that over the last 100 years, the design of buildings has been departing further and further from the rule of nature; more and more stripes appear decade by decade, making the buildings less and less comfortable to look at." (Wilkins, 2017). The researchers further hypothesise this may be a cause of discomfort for the general population, and can produce more severe responses in people suffering from migraine or epilepsy seizures (Hibbard, O'Hare, 2015).

Natural materials constitute fractal-like visual information, and I belive this is one of many reasons for their strong and universal appeal.

Many architects and architecture students are familiar with the technique of adding visual noise, like rough paper, or a misty or "dirty" backround to drawings to make them more interesting to look at. I believe it is the fractal-like visual information in this addition that causes this effect that is pleasing to the eyes.

Fractal Aesthetics of the Subconscious

Ryoanji is a zenbuddhist temple in Kyoto with a famous zen rock garden from the 15th century. It is a UNESCO world heritage site that attracts hundreds of thousands of visitors each year. In 2002 a small group of scientists published an article in Nature (Van Tonder et al., 2002). They had analyzed the rock garden finding local axes of symmetry using a method commonly used in image processing and studies of biological vision (medal-axis transformation). It has been hypothised that humans have an unconscious visual sensitivity to the axial-symmetry skeletons of stimulus shapes (Van Tonder et al., 2002). The shaded shape (figure 18) is the pattern that emerges implementing this method on the rock garden. It is a tree shape with a self similar or fractal structure. The maximum amount of visual information is gained from the traditionally preferred viewing point of the garden (the red circle). Running the analysis with an arbitrary positioning of the rocks does not produce anything similar, so it is very likely that it was an intentional or intuitional design. "We believe that the unconscious perception of this pattern contributes to the enigmatic appeal of the garden."the researchers conclude (Van Tonder et al., 2002).

Figure 17. Ryoanji rock garden. (Van Tonder et al., 2002)

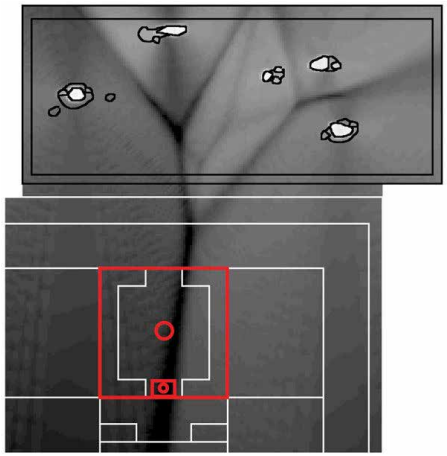


Figure 18. Symmetry axis analysis of Ryoanji rock garden. Red Square is the temple. Red circle is the preferred viewing point. (Van Tonder et al., 2002)

Figure 19. Newport Hospital Health center, Washington.

Figure 20. Northfield Hospital Radiology, Minnesota.

Beauty and Healthcare

Studies in healthcare environments have found that the percieved attractiveness of the rooms have a disproportionally large influence over the patients perception of the quality of the heathcare treatment (Ulrich, 2012). Patients in beautiful treatment and waiting rooms are more satisfied with the care. Patients who has been waiting in beautiful rooms estimate photos of people as more filled with energy and higher wellbeing. Beautiful waiting rooms increases patients satisfaction with doctors, nurses and other healthcare personell (Ulrich, 2012). Attractive, comfortable or otherwise appealing rooms increases helthcare patients perceived quality of care and satisfaction. This was assessed in a large study of 1 202 000 patiens from different regions of the USA, with great diversity in ethnicities and socioeconomic backgrounds among the patients (Ulrich, 2012). People in beautiful rooms simply seem to assess their expericence of place and events, and other people higher.

In the book O*hälsosam Arkitektur* (2016) by pediatrician Gösta Alfvén a medicine student stated "I get so depressed by the building that I have a hard time being there. " refering the hospital Huddinge Sjukhus. A former employee at the same hospital stated "I got so depressed by the building that I sometimes cried when I got there."

Aesthetic Assessment by Professionals and People in general

Designers and architects evalutate esthetic attractivity differently than the public. In some cases the differences are so large that what the architects and designers evaluate as the most attractive the general public evaluate as the least attractive. Architects and designers more often make their assessment of attractiveness on a cognitive basis rather than emotional. Therefore it is sometimes not enough for the architect to draw on their own esthetical preferences, but rather assess the esthetical preferences of the intended user, or there is a risk that the user will find it unattractive and the beneficial effects of beauty be lost (Ulrich, 2012).

People in general tent to prefer figurative art, and art depicting nature. A substantial majority dislike abstract art, that can be confusing and awaken unpleasant associations. Most people dislike emotionally challanging or provocative art (Ulrich, 2012).

When people suffer from disease these preference become even more pronounced, the likes of natural and figurative motifs become stronger and the dislikes of abstract art transform into repugnance.

Preferences of People in General

Among people in general there is a clear preference for traditional and vernacular architecture (Sternudd, 2007)(Granström, Wahlström, 2017) (Olsson, Möller, 2018) (Sandgren, Widroth,2012). The preference is strongest for buildings that are old, but new buildnings with traditional, classical or vernacular elements are also very appreciated. Much more so than other new buildings. In particular modernist buildings from the 1950s 60s and 70s seems to be among the least popular, followed by newer versions of modernist buildings (Sternudd, 2007) (Granström, Wahlström, 2017) (Olsson, Möller, 2018) (Sandgren, Widroth,2012). Characteristics that are emphazised and valued among people in general are the balance between unity and complexity, greenery and nature, recognition, and historical connection (Sternudd), scale and the importance of details (Sandgren, Widroth,2012). A balance between unity and variation, richness in detail, traditional style, originality, connection to place, richness in color. (Olsson, Möller, 2018), (Granström and Wahlström).

Architects prefer modernism (Sandgren, Widroth,2012) and certain styles more than people in general, which is important to keep in mind in the design process. The respondants in a survey compared the modern housing suppy with boring boxes and called for more diversified facades with overall identity and order. Traditional attributes where preferred, aswell as attributes such as uniqueness, richness in details, being well-made and 'genuine', warm colours and a feeling of harmony. Garish facades where disliked (Granström, Wahlström, 2017).

Finnish architect Juhanni Pallasma writes in his book *The Eyes of the Skin* (2012):
"The narcissistic eye views architecture solely as a means of self-expression, and as an intellectual-artistic game detached from essential mental and societal connections ... nihilistic architecture disengages and isolates the body... It is clear that only the distancing and detaching sense of vision is capable of a nihilistic attitude...".
"The 'elements' of architecture are not visual units or Gestalt; they are encounters, confrontations that interact with memory."

(Pallasmaa, 2012)

It is interesting to reflect over what qualities, apart from the already mentioned, that makes people prefer traditional styles over most modern. I belive it is not a matter of the exact style but rather the properties of the styles. I believe natural materials, legibility and things to look at that intrest the eye, are some of these timeless qualitites, that where frequent and often of high quality in traditional architecture, which are some reasons for its popularity.

Figure 21. Hospital de la Santa Creu Sant Pau, Barcelona.

Figure 22. Henry Ford West Bloomfield Hospital, Michigan.

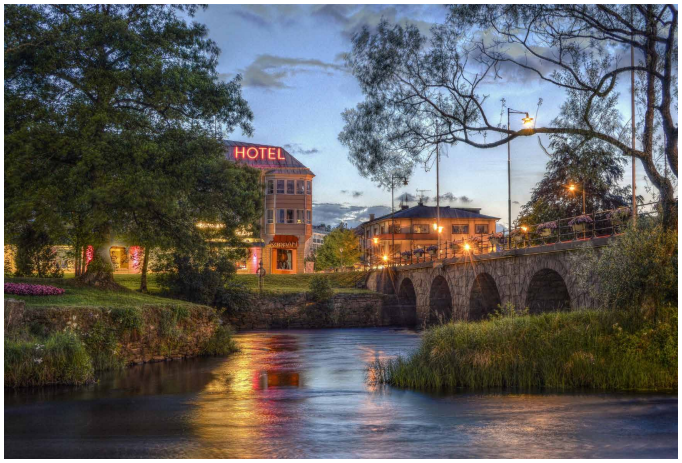


Figure 23. Swedish small town.

Figure 24. Legibility: Books with similar covers are part of some whole. An instant visual cue to the brain that they belong together.

Legibility

A legible environment that is easy to intuitively navigate in, is great for keeping focus, and it also provides comfort. A floorplan that is easy to learn or overview, landmarks, visual ques like materials on certain places or central stairs, views to the outside through windows and a facade that facilitates understanding the building and making predictions even before entering, are all fetures that reduces disorientation, lowers stress and provides calm and a sense of control.

Relating to previous topics this is easily acheived using symmetry and order in facade and plans.

Conclutions and Design Strategies

- Be aware of the psychosomatic effects of beauty and how we can optimize this in the users. Therefore it is worth prioritizing and spending money on.

- Beautiful rooms and buildings create a positve bias that makes people more positive and that may generate more positive interactions.

- Beauty in the office has been found to ameliorate the negative effects of other factors such as noise.

- Design with local symmetries and complex order to improve the looks and legibility of a building. (In nature symmetry is always approximate. Many vernacular and classical buildings rely not on perfect total symmetry, but rather local symmetries in its constituent parts.)

- Use natural materials.

- Sometimes apply natural shapes when designing that create fractal-like visual information on a larger scale.

- Keep in mind that designers, architects and people in general typically differ in taste.

- Be clear with the design motifs. What is the reason for this esthetics?

- Sometimes design features and materials that are local and familiar and makes people comfortable, proud, fascinated, and connected.

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