



# RESTORATIVE ENVIRONMENT DESIGN

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# FOREWORD

MARJUT NOUSIAINEN

- Many natural environments are restorative.  
Picture: Meeri Heikkilä



Restorative environment supports the wellbeing of human beings. It reduces mental fatigue, improves productivity and helps to relieve stress (1). Additional terms can be used to describe a restorative environment, such as a healing, therapeutic, integrative and revitalizing environment. Restoration, for human beings, is very much the same as stress relief (2). It helps the human capacity for physical, psychological and social regeneration and reversion (3).

Many natural environments are restorative, but also interior environments can be experienced as such, if they are designed delicately. However, one can often sense that a constructed environment has ceased caring. Usually other objections than those aiming at wellbeing are guiding the design of environments. It is a challenge to find a fit between all the demands and systems of a constructed environment, and also reach an end product that appeals to everyone. The restorative qualities of an environment are often left unprioritized, the result of which is that our environments can even be detrimental to our health. The need for restorative design is born out of this phenomenon, and also from the gap that has been formed between nature and the human being.

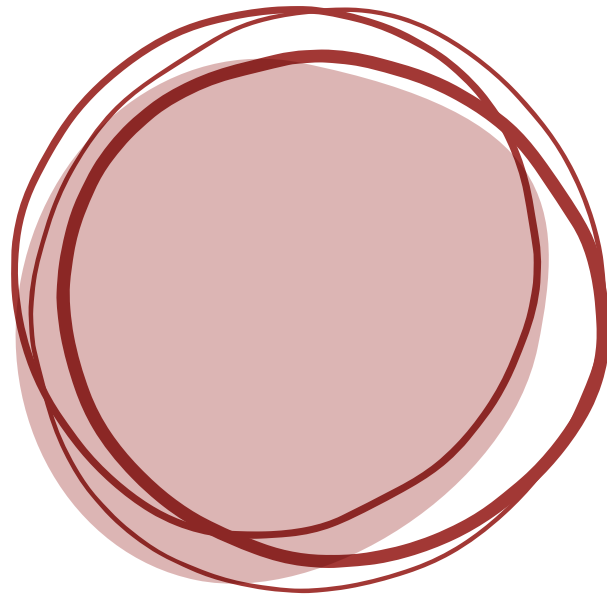
The human being has distanced itself from nature, for instance, because of the evolution in technology, and also because of information and population growth (4). The majority of our day is spent indoors in spaces, which very seldom give support to our wellbeing. Many children spend less time outdoors than their parents did in their childhood (5). Experiencing nature in childhood helps in children's development, and establishes a healthy connection towards nature for the rest of their lives. Without this connection we do not experience ourselves as being a part of nature. We should recreate the harmonic relationship towards nature, in order to understand, respect and enshrine it more deeply. This is possible through restorative thinking and design. We can restore this connection to nature by creating healthy and comfortable spaces where nature is present in its many forms, as scenery, as plants, shapes, lights, sounds, materials and scents. Restorative thinking also improves sustainable thinking, and the need to treasure and conserve the environment, which is vital to us.

This book seeks to awaken the reader and remind about the importance of our environment, perhaps in a novel way, and provide guidelines and tools for designing restorative environments.

■ The eye rests in nature.  
Repovesi national park  
Picture: Meeri Heikkilä







# OUTLINING THE TOPIC

JUKKA HÄKKINEN  
HEIKKI LINDROOS

# THE EYE RESTS IN NATURE

JUKKA HÄKKINEN

We made a family trip to the woods for the weekend. It was wonderful to walk and eat in the crispy autumn weather, amidst the incipient of the autumn foliage. When the evening came we all felt renewed and relaxed. I work in a research group that studies the visual perception of sceneries and because of this I immediately began to ponder over my experience from the perspective of perception psychology: why is the experience of nature relaxing? Does science have anything to say about this?

One known theoretical approach is based on evolutionary biology thinking. According to it a relaxing environment is such where the human race has evolved. By thinking this way, relaxing would result from the fact that our visual system does not generate any cognitive struggle when operating in nature, because these mechanisms have evolved to function exactly in this type of an environment. It is even better for us, if we can observe others in an undisturbed fashion and experience ourselves being in safety, because then there is no threat of a surprising attack by a predator in the bushes. Evolutionary biology would then explain the high ground spot on top of a rock as a choice to have a break and enjoy a snack.

How then does natural scenery differ from a constructed landscape? For one thing the basic properties, like colors and shapes, are different. Thinking from this perspective, the visual system would have evolved in order to observe the sets of shapes and colors that exist in nature. Research on cognitive neuroscience supports this view. It has been found that the visual properties of natural scenery can be perceived in an exceptionally quick fashion.

The findings related to the visual perception of natural sceneries are part of a long research tradition where it has been shown that the visual system resolves the data in a picture in a particular order. Firstly, the visual system perceives the simple things, like the outlines, the larger colored areas and moving things. What follows is the perception of surfaces and objects, and finally, somewhat later, the meaning of objects is processed. For example, if I am watching a football on a turf, first I perceive that curved outlines, then the roundness, after a while I will recognize the ball-like shape and finally the meaning for the object being my old familiar football. It takes just a short moment for all this to happen, only some fractions of a second.

Research has shown though that the perception of some of the features of a picture does not proceed in the assumed order. One of these features is the naturalness of a picture. If the test subjects were given a random picture and instructions to distinguish if the scenery was a natural or constructed, they were able to tell the difference in a matter of two milliseconds. This is an extremely short time and the sorting out of data happens much faster than the distinguishing the meaning of the picture. In other words, the test subjects can distinguish a natural scenery much sooner from a constructed scenery than they can tell if it is a forest or a field.

Researchers have been astonished in finding out that natural sceneries take this shortcut in the processing of the visual system. This theory supports the view that the visual system has evolved to make efficient assessments on the features of natural scenery. The fast distinguishing of natural scenery is based on the outlining of statistical properties. The structures and colors of forest scenery, on average, are much different from typical urban scenery, and the visual system exploits this by operating the information through fast data processing routes.

Out of this a natural question arises, are all the patterns of the nature equally easily distinguished? Are the grains of wood or the patterns on the surface of granite something that our visual system can perceive effortlessly? At the moment we have no conclusion on the matter, but the topic should be certainly studied more closely. That would offer an explanation for the results that imply relaxing effects of wood materials.

As a researcher on perception I am excited about the fact that the relaxing family trip to nature also includes some basic phenomena of perception. A forest scenery can be observed with new eyes, because among the patterns and colors of nature might hide in it some new research ideas for the study of perception psychology. What is also exciting is the idea of the possibility to transfer at least some of the relaxing effects of nature into the design of interiors that support human wellbeing.

# THE STATE OF THE MODERN WORLD

HEIKKI LINDROOS

Our constructed surroundings create the field for our everyday activity. Our surroundings are becoming more and more restless, as the forces that shape them are continuously focused into fewer hands. This is a global development. We should take the control over our lives, and our surroundings, more into our own hands. The decisions about what shapes and colors we have around us come from a fewer sources. The media is powerfully guiding our thinking and doing into a predetermined and limited direction, by different means of information technology. Maybe we have already surpassed the boundary of the envisaged totalitarian society by James Orwell (1903-1950), where all of our thinking and doing is pre-designed.

A national and international design education is humbly unknowingly implementing this concept, and without understanding its dangers. The opportunity to influence our surroundings is created by the fast and effortless transfer of information. This is exploited by many authors to the benefit their own interests. However, the digital transfer of information is a two-edged sword. The opportunities created by it can be efficiently utilized to our advantage by constructing better environments and increasing awareness of the benefits of such surroundings.

**If we want to improve our living environment, everything begins with realization though, as well as a multidisciplinary awareness of the situation.  
Awareness of where we are.**

If we want to improve our living environment, everything begins with realization though, as well as a multidisciplinary awareness of the situation. Awareness of where we are. By utilizing the findings of scientific research on our environments we can guide our awareness into the right direction. Our own generation might already be late in the process, but our resources should be concentrated to the upcoming generations of designers, that in the future, take the responsibility for our living environments. The purpose of this book is not to give ready-made answers and concepts but through research findings and examples to guide our awareness towards a better result in terms of the design of our living environments.

The quantity of things around us is sufficient, but quality and environmental friendliness are hopefully going to improve significantly in the future. An environment that supports mental wellbeing includes opposites, is functional, esthetic and safe. A good environment is consistent of situations that are of different lengths, interlaced and consecutive. It should not be formed only from fashionable factors that are trendy at the time, which often tends to be happening. True interior architecture and design create an environment where we feel that we ourselves are in control of our own lives. That creates safety in our environment. All of this can be influenced by restorative design, and that way being aware of our situation in respective environments.

■ The amount of things around us is sufficient.  
Picture: Andreas Gursky



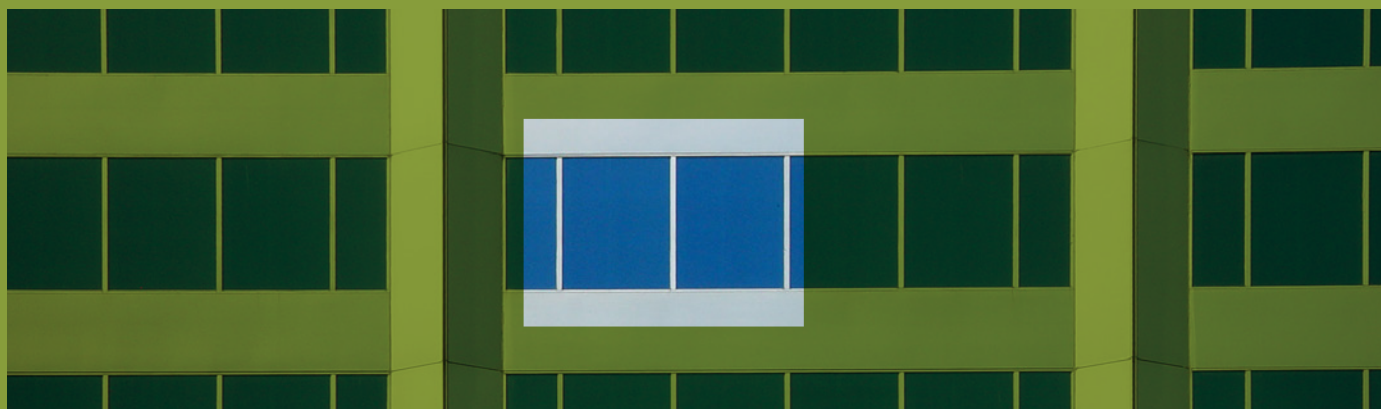


# INTRODUCTION

MARJUT NOUSIAINEN

Our living environment has a huge impact on our wellbeing. According to research we actually spend about 90 % of the day indoors. Instead of restorativeness, the design of these spaces is guided by other factors, such as practicality, efficiency and economy. Design should also consider use of the space and the end user and his or her needs. What often is ignored is how much our living environment influences our mood, health and behavior. A constructed environment can impact us positively by supporting our wellbeing, but what is important is how it can also impact us negatively, for example, by increasing depressiveness, use of pain medication and recovery time. Designers, as the creators of our living environments, have a huge responsibility. All the choices we make, such as materials, lighting, forms and colors, affect us, without us noticing, and they shape our spatial experience. There are many essential factors of an indoor environment affecting human wellbeing that are presented in this book. At first however, we process some of the theories that have resulted to restorative thinking, as well as health-, development-, and learning environments, where restorativeness is particularly important.

According to research we spend up to about **90%** of the day indoors.



■ The relevance of an indoor environment is significant to our wellbeing.  
Picture: Morguefile.com



**Restorative environmental design =  
responsibility of nature +  
responsibility of wellbeing**

There lies an incredible power in nature. We humans need nature around ourselves for us to feel good. Watching and experiencing nature has proven positive effects for humans. For example, viewing natural scenery can relax the mind and a walk in the woods can make everyday worries become forgotten. The nature revitalizes and assists in stress recovery. Humans also feel better in a constructed environment where nature is present. The design of a constructed environment should therefore happen on the conditions of nature and in conformity with it. This type of responsive architecture supports health and wellbeing mentally and physically.

One explanation for the restorative effects of nature is the need that human beings have for connecting with nature. This phenomenon is also called by the term biophilia hypothesis. Throughout the history of human evolution we have developed in nature and in direct connection with nature. Large scale constructed environment is still something new to us. We need some form of a connection to nature for us to function and develop well. When we humans distance ourselves from nature, we feel ill and become mentally fatigued. Often we seek a natural environment to recover from these effects. Biophilic design aims at strengthening this connection between humans and nature. (6.)

The design of restorative environments also includes a responsibility for sustainable development. Ecology and economical, social and cultural factors are also linked to sustainable development (7: 10). Restorative design should avoid and minimize the effects that construction has on the planet as well as on humans. Environments that support



wellbeing cannot be created in opposition of nature, but with respect to nature and on the conditions of nature. Everyone should take responsibility for our environment and for our future. The principles of sustainable development are nowadays on the surface. Humans and our worldview is changing towards more environmentally conscious and construction is becoming more responsible. However, sustainable development should not be only focused on minimizing environmental damage, but also on supporting human wellbeing. Professor of social ecology, Stephen R. Kellert, has united sustainable development and biophilic design under a term Restorative Environmental Design, which includes the notion of responsibility for our environment together with the responsibility for human wellbeing [5]. Restorative design simultaneously supports wellbeing, nourishes the soul, connects us with nature and time, and respects nature.

Restorativeness of nature has been studied already since the 1980's. There are two theories that have inspired the majority of research on restorative environments thereafter. One of them is Attention Restoration Theory (ART), which is one way of understanding restorative environments and the revitalizing effects of nature. The other one is based on the research of Roger S. Ulrich and his colleagues, according to which the viewing of nature influences humans positively, particularly in a stressful situation, such as when we are located in a hospital. The research of Ulrich is mainly focused on hospital environments, which has largely given birth to Evidence Based Design (EBD). EBD is a design movement for healthcare environments that support wellbeing.



■ There lies an incredible force in nature  
Picture: Meeri Heikkilä

**Nature captivates our attention delicately. Viewing nature does not demand any struggles and direct concentration, but it is at its best as carefree, relaxing and fascinating.**

Many other later studies have supported the idea that natural environments have restorative properties in comparison with urban environments. (3: 8.)

## **ATTENTION RESTORATION THEORY**

Rachel and Stephen Kaplan and their colleagues have shown in their research that spending time in nature can quickly cure mental fatigue. They make a clear distinction between constructed environments and nature and their respective demands for perception and concentration. According to their theory, an urban city environment wears us down mentally, because it demands us continuing direct concentration and perception. Before long our capacity to focus our attention is worn down. This fatigue can be a result of exposure to traffic, advertisement, information overload, watching television and overly burdensome work or study. Mental fatigue manifests itself as difficulties to concentrate, stress, negative emotions, irritability, indecisiveness, impatience, mental inertia and damage. (1; 4; 9; 10.)

Attention Restoration Theory suggests that nature and restorative environments can help us to revive from this fatigue, and to offer rest, because nature captures our attention more delicately. Viewing nature does not demand any struggles and direct concentration, but it is at its best carefree, relaxing and fascinating. As we watch the movements of nature, such as the swish of leaves in the wind or the movement of the surface of water, our mind rests. In addition to the fascinating character of nature, for example, a momentary leave to nature can be reviving. (4; 9; 10.) The support of nature is particularly important in healthcare-, developmental- and educational environments, such as hospitals and schools, where humans are often most receiving, or responsive.

## **DESIGNING HEALTHCARE ENVIRONMENTS**

Healthcare environments such as hospitals, rehabilitation centers and nursing homes are buildings that are intended to treat and cure the sick, and support wellbeing. Initially also healthcare environments per se were considered as having an impact on the recovery and wellbeing of

patients. Since then, after the evolution of technology, hospitals have developed into large, unnatural and often inhuman facilities that can be stressful and unsuitable for the mental needs of hospital patients, visitors and the staff. (11.) A hospital environment is often characterized by the sight of endless corridors, shiny surfaces, colorlessness and the smell of disinfectants. For a long time the design of health-care environments has focused on efficiency, hygiene and practicality, instead of restorativeness. The needs of the patients have not really been considered. (12.) During the past couple of years a new awareness about the significance of nature has begun to rise. The trend in healthcare buildings has been towards a healthier, more caring and patient centered direction (13). Already in the 1800's, Florence Nightingale, a pioneer in healthcare, realized the significance of comfort in healthcare environments. She wrote notes about her observations on how the qualities of environments, such as colors, shapes and light, affect the mental and physical wellbeing of her patients. (14:74.)

Evidence Based Design was born in USA in the 1980's for the design of healthcare environments that are maximizing the wellbeing and functions of patients, relatives and the staff. The purpose is to create pragmatic design solutions that are based on the findings of research. Research in this case is often comparative and is based on the experiences of patients about different elements of their environment. In 2004, already over 600 different type of studies had been done on the effects of healthcare environments on patient outcomes (15).



■ Akershus University Hospital, Norway  
C.F.Møller Architects  
Picture: Torben Ekesrodt

## Stress can slow down the patients' recovery.

A majority of studies is based on stress factors that are often central for the wellbeing of patients. Stress is a psychological and physiological reaction to a situation that is a threat to wellbeing. There is a lot of evidence on how badly designed spaces negatively affect the wellbeing of patients; they create stress and complicate the recovery process. This is manifested as anxiety, helplessness, passivity, insomnia, depression, high blood pressure, weakened immune system functionality and increased use of pain medication. (11.) Hospitals are often very stressful places for patients, relatives and the staff. Things that cause stress in healthcare environments are often noise, dazzle, lack of windows, a confusing environment and the lack of privacy (13.) A stressful healthcare environment can make the stress that is induced by the illness or the injury even worse. Stress slows down the recovery of patients. Also the stress experienced by the staff can have a negative impact on the treatment and thus on the overall wellbeing of patients. (11.)

Healthcare environments should psychologically increase the wellbeing of patients. Many studies show that well designed spaces reduce anxiety and pain, and also decrease blood pressure (12). Evidence based design aims to reduce the stress of patients and help them recover from stress, and thus contributing to their overall recovery. Stress can be reduced, for example, by increasing social support, the of control, connection to nature, and positive stimulus, as well as by striving to avoid any negative stress factors in a physical environment. Evidence based design also aims at returning the patient back to the center of the hospital environment and attention. It also highlights the individuality and privacy of patients and suggests the use of private rooms for patients. A well-designed healthcare environment is not neutral or too dominant, but harmonic. In such an environment the nature is present, all the senses are nursed, one can regulate his or her own environment and it is free of stress-factors (11). Restorative reforms can be justified also from an economic perspective. Faster patient recovery times, increased satisfaction and lower amounts of hospital infections and accidents lead to economic savings. (13.)

### DESIGN OF DEVELOPMENT- AND LEARNING ENVIRONMENTS

Our surroundings shape us without us even noticing it. This has a particularly significant impact on a young evolving human being. Children learn things about life and values from their environ-

ment that have a huge impact on their development and values later in their lives. That intuitively highlights the importance of restorative qualities in development- and learning environments such as daycares and schools. These types of environments are among the first relevant development environments after home and the living environment. A child receives instruction, makes friends and spends the majority of his or her time in a school. The school shapes the child's understanding of the world, of him- or herself and others. (16: 81.) A well-planned development- and learning environment supports the progress, wellbeing, coping, learning, self-expression and social relationships.

The purpose of a school building is to enhance learning. Its design is often guided by the pedagogical requirements. The schools of the past were very austere places where one acted as the teacher told. There was not much room allowed for creativity, individualism and imagination. (17: 10 – 11). Also, many school buildings, and particularly the large ones, often separate the students from the nature. Studying is often occurring indoors with books and computers. Studying is seldom experiential and inclusive of nature. Many learning environments have thus evolved like hospitals, into empty shell type spaces where daily activities are being carried out. (5.) A learning process is nonetheless dependent on a physical environment. Children behave differently in different environments. A school building therefore should support learning through its shapes, colors, lights, materials, acoustics and its connection to nature (16: 81). Schools must create a safe and healthy development- and learning environment for the children. As awareness of these things increases the development- and learning environments are in many ways shaping into more restorative and nature-friendly places.

The connection to nature in childhood promotes emotional and cognitive growth and creates a sustainable, harmonic and respectable relationship with nature. The connection to nature can also contribute the espousal of sustainable thinking. A human being, who is brought up as experiencing of being a part of nature, feels nature's restorativeness, understands his or her responsibility in sustaining nature and develops with respect for nature. However, children encounter fewer and fewer opportunities for contact with nature. Just a few decades ago children spent more time playing in nature than nowadays. Development- and learning environments should, on their part, connect children with nature and offer them opportunities to experience nature. Nature can positively



■ Daycare Omenapuisto (Apple Park), Helsinki. Häkli Ky.  
Picture: Jussi Tiainen

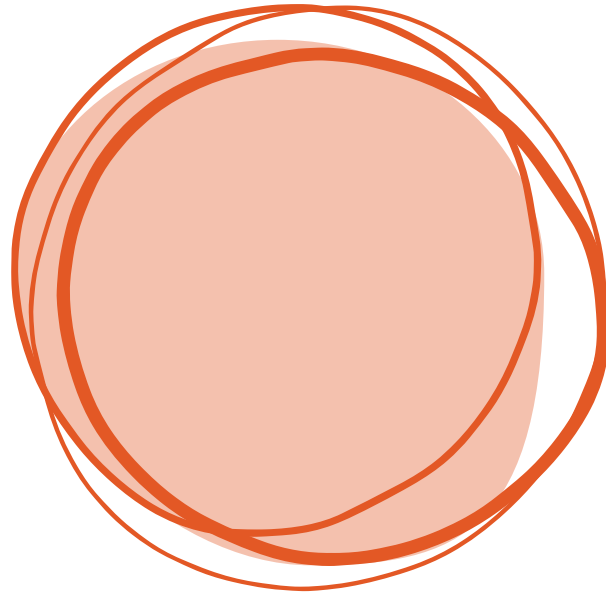
Tehtaanmäki School, Inkeroinen. Alvar Aalto  
Picture: Meeri Heikkilä



influence the social relationships that are formed in development- and learning environments. (5.)

A school environment must be an environment that supports wellbeing, learning and coping. In order to be that kind of an environment it must have, for example, natural light, natural scenery, plants and wooden surfaces. A school building must support children of different age, culture and sex, and teachers doing their work. Interior solutions can be supportive of communality and sociality. The space in a learning environment must also leave room for creativity and imagination. Overly monotonous environments weaken the child's world of experience rather than enrich it. On the other hand, an overly neutral environment can bore the mind, as an overly multiform environment can interfere with attention.

There is a need in schools for different type of spaces, such as classrooms that support direct instruction, participatory workshop spaces, spaces reserved for quieting down and spaces for social gatherings. All these spaces also function as spaces for instruction. In comparison with old familiar classrooms, the new classrooms should have more workshop type spaces that support active learning, by doing and interaction, instead of passive learning, by listening and reading. Schools should have combinable multipurpose learning spaces. A restorative school environment supports all its users and is flexible in terms of different needs and situations. Flexibility and versatility are essential things in the schools of the future. In addition to educational activities, many schools also function as community centers and diverse cultural and recreational spaces. (17: 12 – 17.) A well-designed development- and learning environment enhances social interaction, is safe, create opportunities for self-expression and supports wellbeing and sustainable development.



# TAKING ALL THE SENSES INTO ACCOUNT

MARJUT NOUSIAINEN



We sense our environment with all of our body: by watching, listening, smelling and touching, and in the case of small children often also by tasting. Taste however, from the position of experiencing nature, is not the most relevant sense, but maybe indirectly. Instead, vision-, hearing-, smelling- and touching senses should be considered in the design of a healthy environment. All these senses have their role in achieving a nature experience and thus a constructed environment should feed all of them. All our senses function simultaneously and in connection to each other. In a natural environment, such as a forest or a park, all the senses are stimulated, whereas in a constructed environment the experienced can remain one-sided. (18: 44 - 45.) Forgetting one sensory experience in interior design can ruin the whole space, because even a beautiful space can feel uncomfortable if there is a bad smell or bad acoustics. (19: 68.)

Our senses have evolved over time. In a present-day constructed environment different senses are more dominant than in the past, in a natural environment. (20: 14.) The visibility of the world has been pronounced and nowadays eyesight is the primary sense in terms of access to information. Sight is active and by seeing one obtains an accurate picture of the environment. On the other hand, hearing and olfaction are passive but more emotional senses and they usually also draw more attention. Emotional senses evoke different type of feelings, more sensitively than visual experiences, in good and bad. (21: 33) In addition to seeing, hearing and olfaction we also sense the space around us by touching it. Touch is the most intimate of our senses, but in comparison to other senses, it produces less information of our surroundings. As visibility increases the importance of other senses has decreased, which unfortunately can be seen in the design of constructed environments. In order to produce a holistic spatial experience we should consider all the senses more equally. (20: 15.) At its best a spatial experience is multisensory. Our senses must be both cherished and, in a good way, challenged by providing positive sensory stimulus. What is most essential is that we strive to remove negative sensory stimulus and, in right amounts, increase positive sensory stimulus. A space which feeds all of the senses can be called sensory ergonomic and healthy.

**A restorative environment nourishes all the senses.**





# VISION

## THE SIGNIFICANCE OF VISION TODAY

Sight is our dominating way of sensing. A large part of our body's sense receptors is focused on our eyes and we understand and estimate the world mainly by seeing it. (21: 33; 22: 266.) The world today is, above all, visual and the dominating position of vision has been further improved by advancements in literacy and electric light. In former days, there were fewer tasks that demanded a sharp vision. Other senses were often more important than vision when operating in murky conditions. (20: 22 – 23.)

Vision is a cognitive sense, which makes the environment a distant perceptible object. By seeing we can investigate and reveal facts about our environment, but we only receive a superficial experience of the space around us. Many visual elements, such as patterns or colors, we can touch and sense only with our eyes. By offering pleasing views only for our eyes, we often leave our other senses cold. This happens unfortunately often in constructed environments. Although architecture should feed all the senses, it is often understood only through visual perception. Sight can be considered as the overpowering sense, but it does not provide an emotional connection as strong as the other senses. Our memories, imagination and dreams are left unmoved in a purely visual environment. When we have strong feelings, for example as we kiss, we often close our eyes. We do this because otherwise there would be too many distractive sensual stimuli, and seeing could actually disrupt our feeling. (18: 22, 50.)

**A restorative visual environment  
is clear, relaxing, harmonic  
and interesting.**



■ Art that depicts nature can be calming in the way of a real natural scenery.  
Picture: [medium.com/@dustin](https://medium.com/@dustin)

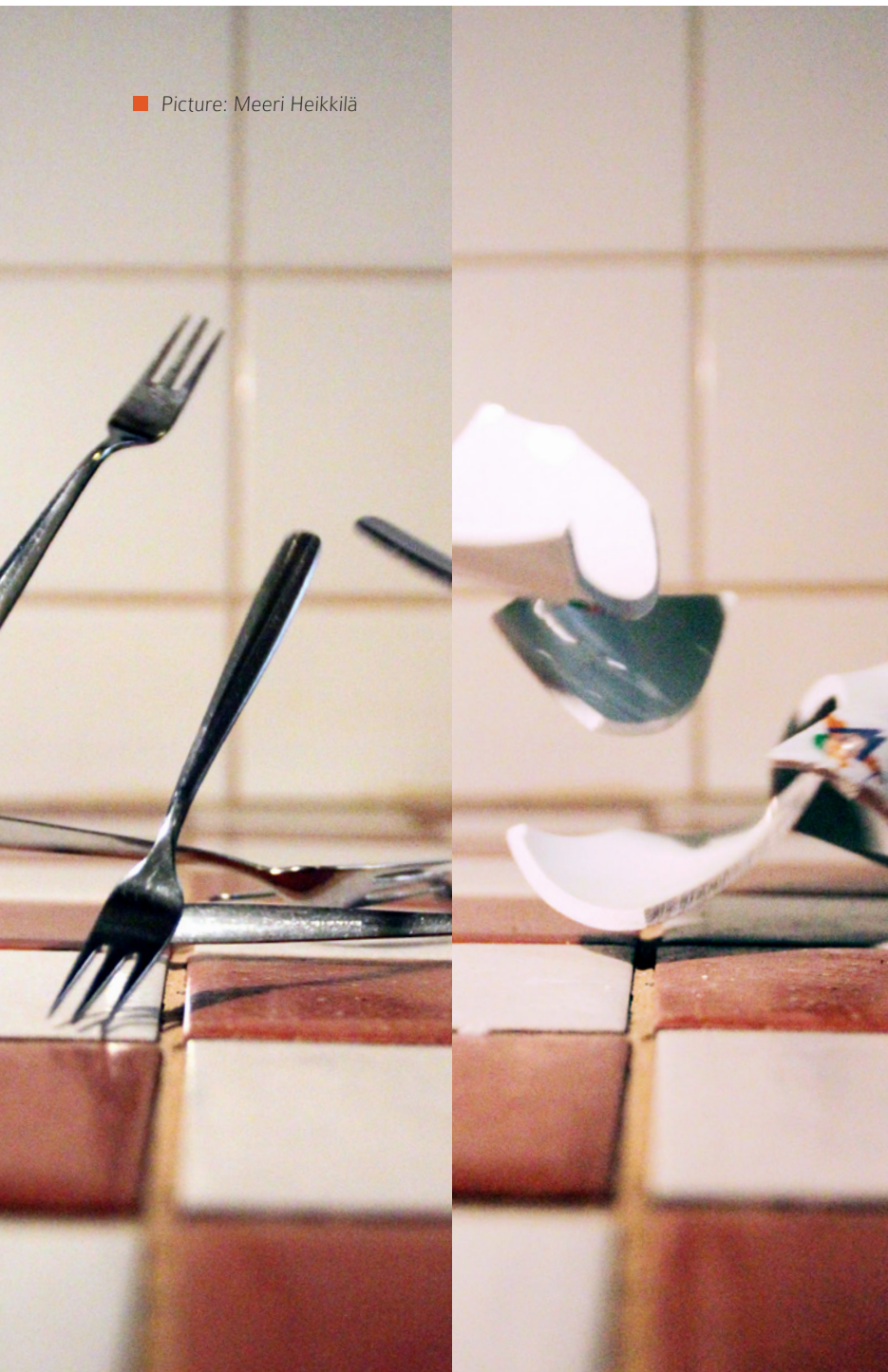
## A VISUALLY PLEASING ENVIRONMENT

We all need beauty around us. A healthy environment is not only beautiful but also visually interesting and peaceful. There is no room for stress inducing visual elements, such as devices, wires, mess, dazzle and indistinctiveness. On the other hand, a healthy environment must be harmonic by its colors, patterns and massing, and also provide positive stimuli, such as art, nature, music or activities. Art is a wonderful positive distraction, which can take our attention away from unfortunate things, relieve stress and lift our mood. Collecting art is a subjective effort, but for example in hospital environments, use of natural sceneries and performance art are, in general, experienced as more calming than the use of abstract art. At worst, abstract art can be disturbing and even increase stress. On the other hand, art that expresses nature can function as positively as authentic natural scenery does. (12:23.)

In designing a room one should consider the application of it. Do the tasks that are performed in the room require concentration, or should there be an objective to take the thoughts away from the procedures? In schools, concentration as well as alertness is required from students. In hospital environments positive stimuli can, for a moment, take the patient's thoughts away from the health problem, whereas the hospital staff can yearn for a more concentration-supportive environment. A healthy visual environment is therefore at its best appeasing as well as intriguing in a positive way. Attention should also be given for the fact that where in the room the subject's gaze is mostly directed at. For example, in hospitals where patients spend the majority of their time lying on their backs, there should be a focus on what the patients see on the ceiling.

A healthy visual environment is most of all harmonic and peaceful. In a healthy vital environment there is a lot to look at. Many natural environments, for example, are environments that fit the criteria. A healthy visual constructed environment is unambiguous but simultaneously smooth from its outlines and pleasing for the eye.

■ Picture: Meeri Heikkilä



# HEARING

A restorative acoustic environment is soft and pleasant.

## THE SIGNIFICANCE OF HEARING IN TODAY'S WORLD

A space can also be experienced by listening to it, although a hearing experience is not necessarily as direct as a visual experience would be. All spaces have different types of acoustic environments and all the materials that the space is consisted of can be heard from the tone of it. Hearing assists in imagining and defining the atmosphere of a space. A space can be measured, to some extent, only by listening to it. For example, an echo gives an idea of the size and features of a space because large spaces are often resonant and small spaces often even too quiet. (18: 54 ; 19: 68.)

With motorization and industrialization the role of the sense of hearing has changed. Nowadays there are more sounds, from multiple sources simultaneously, and they intermingle into obscure background noise. (20: 19.) Our constructed environments are full of unwanted noise, which covers required audio information and causes stress to us (24: 122). Noise has multiple negative effects and it can cause, among other things, attention disorders, digestive disorders, increase blood pressure and make falling asleep more difficult. (25: 102). At worst, loud noise also causes hearing damages or voice disorders, for example, to teachers who have to raise their voice and speak amidst the loud noise levels (25: 98; 26: 10). The noises coming from traffic and machines cover the significant noises of nature that are so full of life.

## A PLEASANT ACUSTIC ENVIRONMENT

One of the most important features of a space is its acoustic environment. A restorative acoustic environment is soft and pleasant. There is not too much noise or echo and its acoustic conditions boost the activities that the space is designed for. (26: 9.) Soft noises are generally experienced as healthier than echoing noises. Noises from traffic, industry and other human sourced noises are experienced as unpleasant (21: 157). Therefore, for example, it is good to not locate hospitals close to noisy traffic routes. As noises from traffic can cause stress, sounds from nature can also help to relieve it (24: 112). Research has shown the amenity of the sounds of nature. For example the singing of birds, the ripple of waves, the whoosh of the wind and the rustling of leaves are

experienced as pleasant sounds. (21: 157.) In a healthy constructed environment one could therefore make use of the sounds of nature as audio recordings played in the background. Also silence can have significant healing effects. Silence contains in it a feeling of eternity, something that is pursued by human beings. However, silence is not unambiguously pleasing, but it can also be associated with the feeling of emptiness. Silence is often relaxing, but on the other hand sounds can denote life, and by the same token silence can denote death. (19: 126; 21: 159.)

The experience of an acoustic environment is always personal. Situational factors and personal preferences influence the evaluation of the acoustic environment and the tolerance for noise. During nighttime we need a quieter acoustic environment than during daytime. Also, the individual feeling of control influences the tolerance for noise. Research has shown that people tolerate noise better if they themselves can control the source of it. (26: 10 – 12.)

Noises often bring to mind memories of places. Spaces constructed for different purposes sound completely different. A home, a hospital and a school all have their own specific acoustic environments. A home environment is hardly ever loud and echoing. Hospitals and schools on the other hand can be very noisy places. Environments that are full of life in general have no room for background noise, such as radio and television. However, in some environments, such as open offices, it is required to have some steady background noise to cover any distractive sounds, such as a speaking voice coming from the neighboring workstation (25: 98; 26: 158 – 159).

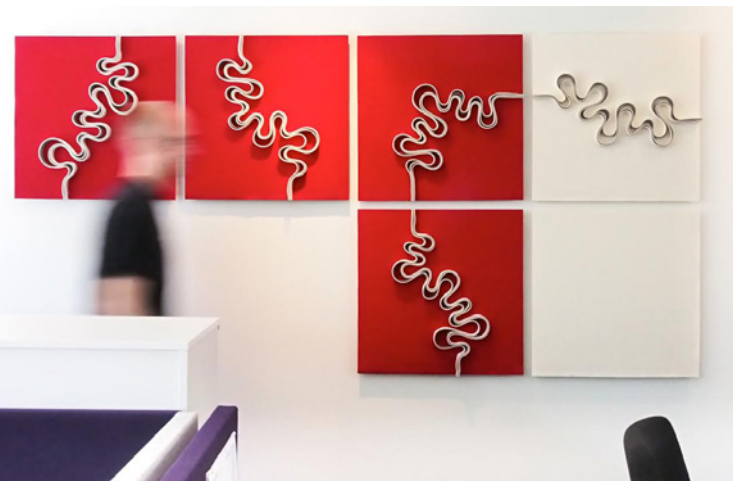
## ACOUSTIC DESIGN

A healthy acoustic environment is created with acoustic design by influencing the insulation and materials of the building. Acoustic design often covers four sections, which largely overlap with each other; room acoustics, construction acoustics, noise prevention and vibration insulation. Room acoustics influence how the sound behaves inside a room. Construction acoustics influence the soundproofing between different spaces. Noise prevention prevents the emergence and spreading of noise. Vibration insulation aims at insulating the vibration resulting from different devices in a building. (26: 25 – 25.)

Soundproofing is characteristic to tight structures, which prevents noise from transferring



■ Innofusor: Acoustic wall panels  
Pictures: Innofusor



from one space to another and from outside to inside. With soundproofing wall-, floor-, and roof constructions and windows one can create a tranquil environment that is protected from internal and external noise. In addition to the formerly mentioned, the choice of surface materials also defines the acoustics of a room. With room acoustics the aim is to control the transfer of sound, its reflection and attenuation, inside a space. Materials that soak up sound attenuate any sounds created inside a room. Taking this into consideration, one should use sound absorbing surface materials, particularly in large or noisy spaces. Especially good room acoustics are needed in spaces where speech- and musical presentations are being held. In performance rooms, such as classrooms, one should be able to speak so that the listeners can clearly hear what is being spoken, without burdening the voice of the speaker. These types of spaces should have reflective surfaces that direct the voice of the speaker towards the listeners, as well as absorbing surfaces, that decrease the echoing inside the space so that one can understand the speech. In designing room acoustics one should take into consideration the need of reflective surfaces, the shape of the space and the necessary absorbing surfaces [26: 46, 158 – 159]. When designing challenging projects the design of an acoustic environment and noise control demand cooperation between the architect and professional acoustics specialists.

## THE ACOUSTIC ENVIRONMENT OF A HOSPITAL

Hospitals are often very loud places, because of the operations performed there and the devices used there. Hospitals also often have an echo, because of the many hard and sound reflecting surfaces. Loud noise in healthcare environments causes stress to patients as well as the staff and thus impairs patient outcomes. Other symptoms may include headache, irritation, sleeping problems and communication disorders. (12; 27: 44.) Use of shared rooms in hospitals intensifies the problems associated with sound. Offering single rooms for patients can reduce that problem. The acoustic properties of hospital rooms can be further enhanced by installing sound absorbing materials into the ceiling and by trying to eliminate the sources of noise. (28: 285.) There should be an effort to reduce everyday noise and instead fill the hospital with pleasant and relaxing sounds from the patient's home environment and from nature. Many studies have shown that pleasant music that the patients themselves can control reduces anxiety, pain and stress (12). Sairaalahuoneiden akustisia ominaisuuksia voidaan entistään parantaa asentamalla kattoon ääntä absorvoivia materiaaleja sekä yrittämällä eliminoida melun lähteitä. (28: 285.) Jokapäiväistä melua pitäisi pyrkiä vähentämään ja täyttää sairaalaympäristö sen sijaan miellyttävillä, potilasta rauhoittavilla äänillä kotiympäristöstä ja luonnosta. Useat tutkimukset ovat osoittaneet, että miellyttävä musiikki, jota potilas voi itse kontrolloida, vähentää ahdistusta, kipua ja stressiä (12).

# OLFACTION

A restorative  
scent environment  
is mild, pleasant  
and clean.



■ Herbs can be used in interior spaces as sources of pleasant scents.  
Picture: Meeri Heikkilä

## THE SIGNIFICANCE OF OLFACTION IN TODAY'S WORLD

Olfaction is functioning all the time, with every breath we take, also when we sleep (22: 24). We cannot regulate its activities and we can not exactly focus our attention to it. Nowadays olfaction has become our least needful sense, although originally it was essential for our survival. (22: 58; 29: 11.) We can, for example, take the smell of our home for granted and focus our attention to the smells only if they distract or please us. Nonetheless, olfaction is still a very important sense, because we can quickly notice any changes in a smell. On the other hand, we also become quickly tired and easily get used to strong scents, and therefore after a while, we fail to recognize the scents so easily. (29: 13, 15.)

We continually live amid an endless amount of smells. The smell of a thing, an object or a person smells largely influences its appraisal (22: 60). It is easy to reason if a thing is good or bad based on its scent. Also, every space has its own unique scent, which consists of all that a space is consisted of. Positive scents also create a positive image of a space, whereas negative scents quickly create a negative image of a space (21: 161). It does not matter how beautiful a space is; if it smells bad, we experience it as unpleasant, because a scent is closely related to the air that we breathe (19: 68).

A strong scent can be very memorable and raise memories to mind. In our minds, it can take us back to a specific place or time. (18: 58.) Scents as well as memories are linked to our emotions and a strong emotion linked to a scent leaves a permanent engram. A scent often is a stronger way to bring



back a memory from childhood to mind, than a photograph. (29: 14 – 16.) Scents have a psychological impact on us and therefore scents can also be used as a way to manipulate an atmosphere, or cover behind it any other unpleasant smells (24: 42). Studies have shown that we react to a good scent unconsciously. For example, based on one study a pleasant smell attached to a casino gambling machine significantly increased the money that was spent on it in comparison to other games. (29: 13.)

## DESIGNING A HEALTHY SCENT ENVIRONMENT

Scents impact a person's behavior and feeling of wellbeing. Many of these types of scents are linked to the natural environment. Nature's scents are often mild, pleasant and clean. (29: 15.) In western culture, natural scents, such as smells of flowers and fruits, are perceived as pleasant. On the other hand, scents in a constructed environment, produced by traffic and industry, may be considered as unpleasant emissions. (21: 161.) By choosing the right type of scents, a pleasant scent environment can be created, even in a constructed environment.

The experience of scents is always subjective. Scent preferences are not inborn but learned (21: 161). Based on surveys, some scents, such as the smell of coffee or freshly cut grass, can be considered even universally pleasant. According to one Japanese study, the green scents of plants also have stress reducing effects on healthy humans. (29: 24 – 25.) Herbs and plants are often used in interior spaces as the sources of pleasant scents, for example juniper and thyme can be used as room air fresheners (7: 51). Research has shown that lemon has the strongest positive, energizing and mood lifting effect (29: 15). On the other hand, lavender is capable of calming and relaxing a person. According to studies, the smell of vanilla in hospital environments cools the emotions in a positive way, soothes the patient and lowers stress. It is said that Rosemary increases alertness and attention in a school environment. (29: 26.)

In a healthy environment one should not have strong distractive scents, such as the pungent smell of chemicals or disinfectants. On the other hand, a healthy environment should be filled with pleasant and moderate scents, such as the smells of herbs, plants or food. In a hospital environment patients could be offered positive sensory stimuli in the form of scents, which evoke restful mental images, for example, of a home or natural environment. Pleasant scents can be used in this way to decrease anxiety and lift a person's mood in a stressful environment.

# TOUCH

**A restorative touch environment is grainy, warm and natural.**

## THE SIGNIFICANCE OF TOUCH IN TODAY'S WORLD

The relevance of the feel of material has diminished in a constructed environment as the significance of visuality increases (18: 34). However, the oldest and most important of our senses is touch (22: 103). That what we touch and feel is very individual, emotional and intimate. Our skin connects as well as separates us from the outside world and through that we feel, for example, the flow of air, the warmth of things, humidity and texture. The feel of material influences our spatial experience, eases orientation and assists us in outlining the world three-dimensionally.

## DESIGNING AN ENVIRONMENT THAT FEELS PLEASANT

How a space feels is an essential criterion in evaluating the amenity of an environment. Touch makes things real to us. (21: 35.) Choices of materials are key in regards to the sense of touch, in the design of healthy environments. Some materials are downright inviting a person to touch, whereas others are even off-putting. Natural materials generally affect us in a positive way. Structural materials, such as stone and wood, feel real to us and cause a stronger sensation than artificial materials. Some materials, such as wood, always feel pleasant, natural and warm.

Wood can in many ways be thought of as the best of materials. Instead of choosing smooth surface materials, a selection of more structural alternatives could be considered, which also offers an experience of the surface texture. For example, roughness or texture in textiles, tiles or structured wall surfaces creates multi-sensuality in a space, which is further highlighted by a judicious choice of lighting. However, one should not forget contrast. Combinations of different types of surfaces, structured and smooth, create an interesting and multidimensional environment, which is as pleasant to the hand as to the eye.

The sterility of a modern environment with its large glass surfaces does not provide people with trustworthy sensory experiences (18: 34). Many public spaces, such as hospitals, are often experienced as very clinical. The choice of materials is often guided by cleanability and antibacteriability. An environment of this kind consists of shiny, hard and artificial surfaces. In this type of an environment there is not enough feel of the material, and therefore it feels unnatural and completely separate from nature. Because of this, people can have a feeling of rootlessness towards the time and place (20: 31). We should more daring and use enjoyable natural materials in surfaces, such as wood, which has a sense of age and history in it. Pleasant warmth on skin feels like home, and its yearning is relieved by warm natural materials (18: 62 – 63). Nature, sun and natural materials touch us, and together they are a spectacular healing force.



■ Some materials, such as wood, always feel pleasant, natural and warm.  
Picture: Meeri Heikkilä

# MULTI- SENSORITY

**Nature is naturally  
a multisensory environment.**

## THE RELATIONS BETWEEN THE SENSES

Although we sense a space with all of our senses, one sensation often dominates an experience of an environment (21: 167). However, studies that have focused on mutual effects of senses have shown that a sensory experience can be further strengthened with other senses. It has been found, for example, that due to the combined effect of vision and olfaction, the reaction time shortens if both stimuli are experienced to be coming from the same source. (20: 15, 26.) Thus, in general it can be said that an experience is stronger, if a sensory stimulus affects many senses simultaneously. Senses together are often capable of providing more accurate information than any of them alone. The more sensory stimuli are provided about the same thing, the easier it is to react to the stimuli. The significance of multisensority is especially highlighted in situations where a user lacks some sense, or if one of the user's senses has become weakened.

Paying attention to multisensority is especially practical from the position of safety and warnings. It has been utilized in traffic and in devices. In traffic lights, both the visual light stimuli as well as the beep sound signal the switching of the light to the user (20: 26). Likewise, the grooves in the white side- and centerlines of a road communicate to the driver, in addition to their visual function, that their car has drifted too close to the edge or the center. In a home environment, the red color in ceramic stoves communicates the vision that they are hot, without the need to bring the hand close to a hot plate to feel its state of hotness. Therefore, a plate

is certainly forgotten on much less often in this way than without a visual stimulus. Taking many senses into account in design consequently increases the informativeness and safety of objects and space.

Multisensority is also often a disadvantage when sensing negative things, because, for example, noise can be experienced as louder in an ugly environment, or a scent can obtain a negative label if it is materially connected to a tedious sound (21: 167). Senses therefore highlight each other in good and bad.

## THE MULTISENSORITY OF NATURE AND CONSTRUCTED ENVIRONMENTS

Nature is naturally a multisensory environment. As we ramble in nature, all of our senses are being fed. Nature occupies our eyes, our ears, our nose, and invites us to touch. A constructed environment should be built by reproducing these same properties. Choice of materials can have a very tangible effect on the multisensority of a space. Use of natural materials easily brings the good multisensory properties of nature also to an interior space. Natural materials not only pamper our sense of touch, but they are also visual, they have a natural smell and with their qualities they affect the room acoustics of a space. A space can and should be experienced holistically multisensorily, rather than only visually, as is usual. For the interior designer, this both provides opportunities and creates challenges (20: 23). A multisensory experience is created with materials, colors, shapes, lights, sounds and smells. A multisensory space can have both refreshing positive sensory stimuli as well as relaxing and restful elements, depending on the purpose. It is ideal that the atmosphere can be changed in accordance to the user or the use of the space, especially in public spaces, where there are many users.

Conflicting and misleading sensory stimuli that is potentially dangerous should be avoided in constructed environments. The easiest sense to bluff is vision, especially if it is weak. For example, shiny surfaces together with glass walls and an insufficient lighting is a combination that, to a visually impaired person, is hard to be perceived. Shiny, transparent and reflective surfaces may lead even a person with a good vision to a dangerous



■ A view from a sauna. Karhusaari (Bear Island),  
Kotka archipelago. Heikki Lindroos  
Picture: Wanha Fiskari Matkat Oy

situation. An environment should have some visual contrast as well, for example, between colors or materials, to make the conceptualization of different areas easier. For example, the steps of a stairway should have contrast markings on them so they can be more easily detected. This is especially important in public spaces where the user is not always familiar. On the other hand, use of powerful cross striping on the floor can help the visually impaired with locating the places where there are no stairs. An environment that is designed with multisensority in mind serves all of its users best, also those who have some of their senses impaired. (20: 27 – 29.)

**An environment that is designed with multisensority in mind serves all of its users in the best possible way, also those who have some of their senses impaired.**

# CASE 1 / SENSORY ERGONOMICS

HEIKKI LINDROOS

In 2007, the Kymenlaakso University of Applied Sciences organized the second national MODO-design competition. Sensory ergonomics was the selected subject of the competition. Formerly, ergonomics was principally understood as the numeric measurement of working postures, and tasks related to them, which had the aim of reaching optimal outcomes from the individual's point of view and in terms of the desired working postures. The MODO 2007 –competition, with its topic, sought to pay attention to all the factors that influence a space, factors that regulate our operations through various senses.

## **LAAJASALO CHURCH, HELSINKI**

Year of completion: 2003

Architecture by Kari Järvinen and Merja Nieminen

A church building has experienced some interesting changes during its 2000 –year existence. Despite its modest beginnings, a church space has over the centuries formed into a tool of the rulers to control their communities. Often in the design of church spaces, all the senses that guide us have been utilized. Formerly, the height of the spaces, ornamentation with strong colors, the heavenly light that reaches the altar through the stained glass windows and the mystical scent of candles, created a space that strongly affects the senses. This effect intensified the message, which wanted to be conveyed to the public. In today's world, church is part of our society. It has approached a normal human being as an integrative space, where the same elements that affect the senses are still used, but for different reasons. A church has formed into a spiritual space, the purpose of which is to integrate, give belief and calm down a human being in a busy and complicated society.

The exterior architecture of the Laajasalo church, with its distinctive vertical- and horizontal surfaces, which have been coated with patinated sheets of copper, has a peaceful expression and adapts to its environment in a balanced way. Office spaces and children's play spaces are also associated with a church. Their exterior surfaces have been painted with a red color, which beautifully integrates with a patinated copper surface. Finnish wood has been used in the church's interior in different ways. The front doors of the church, as well as parts of the paneling, consist of horizontal lines that bring tranquility to the spaces and decrease the scale to a level of a person.

## CASE 1 / SENSORY ERGONOMICS

The altar relief is a kind of a wall size piece of art, the main material of which is wood, which has been processed in many ways, though in a way that it forms a totality with the church hall. The altar relief has been produced and designed by sculptor Pauno Pohjolainen. The crude hewn form of the altar relief, together with the red wooden part and glass elements, is not a work of art that expresses the power of the church, but with its fine shapes, it supports the individual human being. A work of art, with its various surfaces, makes the senses of a person to move on a spiritual level, individualistically. The lighting on the gable wall, which mainly comes from the side of the altar, nicely brings up the three-dimensionality of the altar relief.

The wooden roof truss of the space with its hanging lamps forms an interesting section of the church hall. The church hall has a necessary amount of elements that make the space unique. However, the space does not highlight the smallness of a human being, but it creates a spiritual space where it is possible to escape the everyday life. The common spaces of the church, such as a small café, are sympathetic in their scale and make the interaction between various people easy. Horizontal splinting and large window surfaces that open to the church's ward have been cleverly used in these spaces. The wooden surfaces in the spaces are tangible, and so finely bring up the restorative properties of wood. The floors of the church space are made of stone-like tiles or solid boards that are processed into a matte color that together with other wooden surfaces form a beautiful whole. Only the church's organ is deviant from the rest of the space, as well as the gallery that is built in front of the organ. They are likely not part of the original plan. Professor Jouko Järvisalo has designed the church's altar and loose furniture. Among the furniture, especially the baptism stand is beautifully simple.

The Laajasalo church produces a positively holistic experience of architectural space. The space is easily approachable and nourishes all the senses of a visitor. Visually it is skillfully made and harmonic. The contrasts function well. There is a lot to look at and the eyes have been steered towards the altar relief in a right way, however not too much. The touch environment is pleasant due to its wooden surfaces. The haptic properties of wood should be brought up a lot. Even the powerful texture of the wooden altar board is noticeable, although it is outside the reach of touch. The acoustic environment is peaceful and pleasant. There is no distractive echo being created and it is natural to speak. There are no unpleasant scents. The world of scents

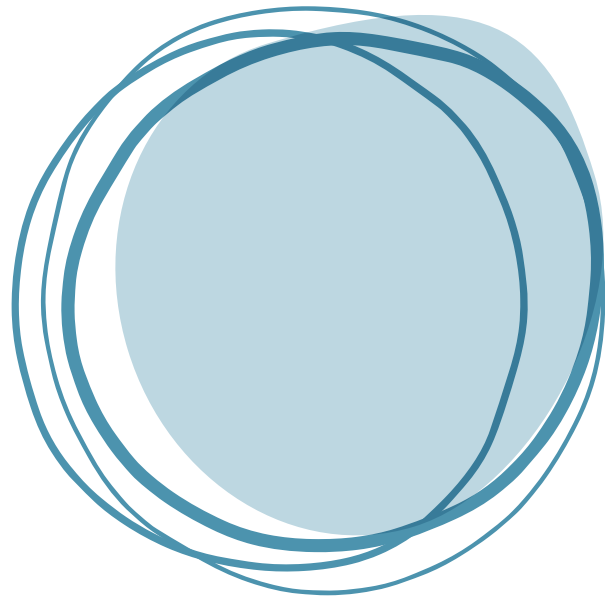


## CASE 1 / SENSORY ERGONOMICS

is more like neutral and natural. Although in 2003 the word sensory ergonomics was not in the vocabulary, and even Tekes adopted its use only later, the Laajasalo church with its skillful designers has reached a whole, which supports our senses in a challenging space and highlights the spirituality of a space for a human being in the modern world. It is necessary to evoke the awareness of designers about all of this in a more general way, so that not only fashionability would become the most important factor when making exterior and interior spaces. A fashionable thing is already tomorrow outdated and only holistic, good design can last. Alvar Aalto called it architectural synthesis.



■ Laajasalo church, Helsinki. Kari Järvinen ja Merja Nieminen  
Photographs: Meeri Heikkilä



# HEALTHY LIGHTING

MARJUT NOUSIAINEN



■ The natural light in a forest is beautifully filtered through the trees.  
Photograph: Meeri Heikkilä

The light exposes to us that what we see but it also influences our mood, our body and our emotions. Light also brings life into a constructed space, and the right type of lighting is in a key role in a healthy environment. Above all, we need natural light to feel good. A constructed environment should have natural light in all spaces where people spend their time. Staying in a space without any natural light can lead to depression, whereas natural light has a great invigorating strength. Unfortunately however, the lighting of a building cannot be in any circumstances taken care of with daylight alone. A healthy environment should therefore have natural light as well as carefully chosen artificial light. Also artificial light influences the wellbeing of people. It has an especially great significance in the north particularly, because little natural light is available during the winter. There where natural light cannot be exploited one should use as healthy artificial light as possible that fits each situation and time. There should be enough light according to the need, also during evenings and nightly. Thus, a designer has a great responsibility, because lighting design can have a significant impact on the living conditions of people for years (39: 6).

**For us to feel good, we need natural light.**

# NATURAL LIGHT



## THE PLAY OF LIGHT AND SHADOW

Natural light is a lively and naturally changing light, which creates different atmospheres, colors and moods, outdoors as well as indoors. Natural light consists of direct sunlight, the diffuse radiation of the sky together with the radiation that is reflected from the environment. Outside the light changes according to the time of the day and year, and based on weather and other climatic factors. (31: 286.) Inside a space the light that comes from the windows plays, creates shadows and makes our environment more three-dimensional. Light and shadow take turns revealing and covering the environment. (30: 16.) Both the quantity and quality of light has relevance for our wellbeing. Excess sunlight can also feel unpleasant and unsafe, as well as dazzle and warm up. Therefore it is essential to offer alternatives for choosing and regulating light. In a healthy environment there is space for both light and shadow. The space is simultaneously safe and open. (28: 119.)

Windows connect a constructed environment with the external world. They let in the scenery and natural light. It is also relevant that what kind of a window the light comes in from. Light that comes in from multiple windows and directions is healthier than light coming from one individual window, because it is livelier and puts light and shadow into a state of play. From the standpoint of the quality of light,



■ Light and shadow in a space  
Picture: Meeri Heikkilä



■ Viikki church, Helsinki  
JKMM Architects  
Picture: Meeri Heikkilä

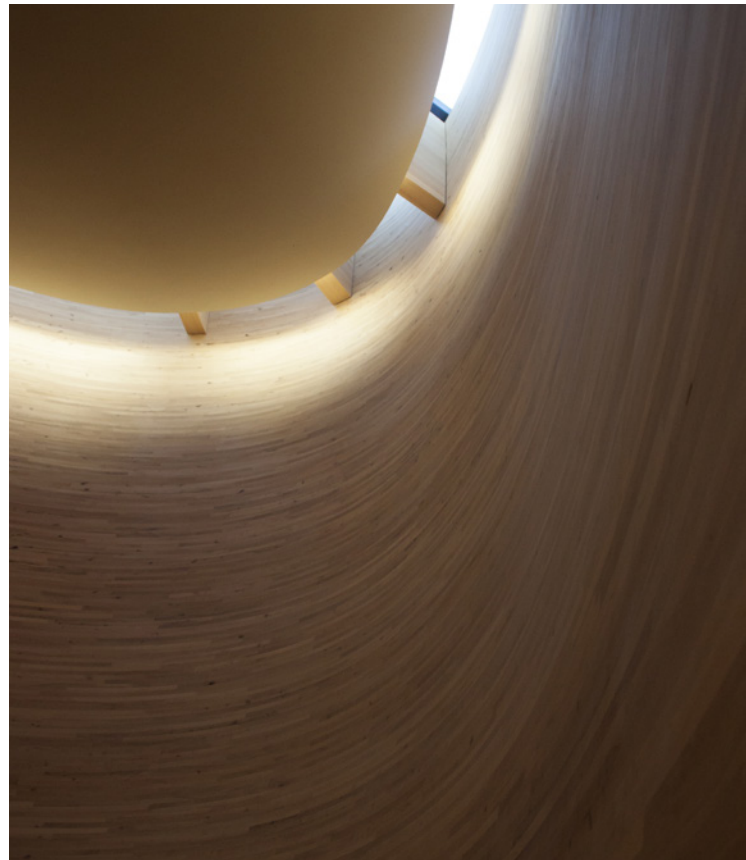
many small windows can therefore be better than one big window, although the amount of light would be the same. Many windows also mean many different types of sceneries, which increase the experientiality of a space. (19 : 72 – 74.) By changing the size and location of the windows the amount of natural light that comes in can be influenced. It is recommended to raise windows upwards, because windows that are placed high or windows that are tall give more light than windows that are placed low or that are low (32: 55). Although only a fragment of sunlight enters indoors through the windows, it is also often necessary to regulate it. Light filtered through vegetation, blinds, gratings or curtains is softer, livelier and feels safer than direct sunlight does. Blinds and curtains are necessary to prevent and regulate the dazzling and heating of the room created by light. (28: 119.) Naturally, also other buildings, trees and terrain shapes shade the windows and impact the amount of light that comes inside (31: 286). Deciduous trees are good regulators of light and during summertime they protect the house from overheating and beautifully filter the moving light through their leaves. However during wintertime they let in almost all of the scarce light through their leafless branches and on to the window surfaces of the house (7: 20).

## NATURAL LIGHT AS PART OF THE BUILDING'S LIGHTING

Until the 1940's natural light was the most important source of light for buildings. As artificial lighting generalized the

significance of natural light decreased. Recently the relevance of natural light has again become highlighted as environmentally friendly and energy saving source of light. (33: 2.) Natural light and that how it moves throughout the day should therefore be utilized in constructed environments to minimize the need for artificial light. The less artificial light sources are needed, the smaller the energy consumption of the building is too (32: 54). In the utilization of natural light the first relevant thing to consider is to locate the building as usefully as possible in regards to the movement of the sun. A building should be located so that the sides that need the most light are directed towards the south.

The floor plan of the building and division of rooms also impact the maximal utilization of natural light. The spaces that are in active use during daytime, such as living- and dining spaces, should be located to the sunniest side of the building. Spaces that are reserved for only sleeping do not require as much light and they can also be located to the shadiest side of the building. A larger connected space is better at spreading natural light to the environment than tiny divided spaces. Therefore elements that delimit the splitting of light indoors, such as walls, should be kept as light, transparent and minimalistic as possible, so that natural light could also be had in spaces without sunlight. Glass walls are often a good solution for dividing spaces instead of covering walls. This works well, for example, in office environments that are consisting of many compartment-like workspaces. Then, natural light can shine into a corridor or inside the building. In addition, inner windows, skylights



■ Kamppi Chapel of Silence, Helsinki. K2S Architects  
Picture: Meeri Heikkilä

**Healthy lighting = natural light +  
quality artificial light**

or floor windows between different storeys are effective in increasing the brightness of spaces and the splitting of light. Also the choice of surface materials impacts the quality and quantity of light. White and reflective surfaces naturally strengthen brightness, whereas dark surfaces absorb light into themselves. (32: 54 – 55.)

### **QUALITY OF NATURAL LIGHT**

Natural light is the best kind of light for a human eye (33: 5). The spectrum of sunlight continues throughout the range of visible light and therefore it is also called as a full spectrum light. Sunlight is almost never completely white, as it is often imagined. Many things, such as the height of the sun, layers of clouds, humidity, ozone concentration levels and impurities impact the color and the shape of the spectrum of light. The color of the light can be observed with Kelvin values (K), which tell the color temperature of light. The larger the Kelvin value is, the cooler alias bluer the color of the light is, and the smaller the Kelvin value is the warmer alias redder the color of the light is. When the sun is higher up than 30 degrees the color temperature of direct sunlight is around 5500 K, which is also considered as the shade of natural light in artificial lighting, for example in daylight lamps. As the sun is at its lowest point during morning and sunset glow times the color temperature is correspondingly lower and light can be even very reddish. The color temperature of a bright blue sky can be even over 10 000 K alias very blue. It can be noticed for example as scattered light coming down from a blue sky and hitting shadowy spots, a light which is very bluish. (7: 20 - 21; 30: 8; 31: 282.)

### **THE EFFECTS OF NATURAL LIGHT**

Natural light is the best lighting solution in many ways; it is just the right type of quality for seeing and its utilization in a constructed environment decreases a building's energy costs. However, the impact of natural light on human beings is much larger than only the above-mentioned, because it affects a human being physiologically as well as psychologically. Natural light heals



overall wellbeing and health. It positively affects the body, among other things, by decreasing fatigue and eyestrain, together with increasing safety. Natural light also contributes to our merge with nature and the living environment, and it contains the same positive effects as nature.

(33: 2 – 4.)

Light impacts us through our eyes and skin (30: 8). Light affects the human skin, among other things, by producing D-vitamin, which is needed for the absorption of calcium. On the other hand, light traveling into the eyes gives us visual perception and it controls our circadian rhythm and synchronizes our internal clock to follow the 24-hour rhythm. Research has also shown that natural light controls the production and regulation of the melatonin hormone, which affects for example our falling asleep and mood. (33: 5 -8.) Seasonal affective disorder is a mood disorder caused by lack of sunlight, which occurs especially during winter-time, when there is less sunlight available. Its symptoms are, among other things, depression, irritation, fatigue and increased need for sleep. Seasonal affective disorder can be treated with light therapy, for which there are nowadays full-spectrum light lamps available, even to homes. The strain on eyes is however the most usual inconvenience caused by lack of light. Eyestrain can lead to headaches and fatigue, and that way to stress (34.) Sufficient lighting should therefore, in addition to natural light, be supplemented with healthy artificial lighting.



■ “A human being needs different types of light throughout the different times of the day. Too much of bright light can be detrimental to our health. Sunset Camera creates a sunset kind of orange light, which increases the production of melatonin hormone, appeases and prepares us for sleeping. The winning concept of the 2012 Habitare Design Competition by Leo Lindroos. Picture: Miika Ullakko.”

# ARTIFICIAL LIGHT

## QUALITY OF ARTIFICIAL LIGHT

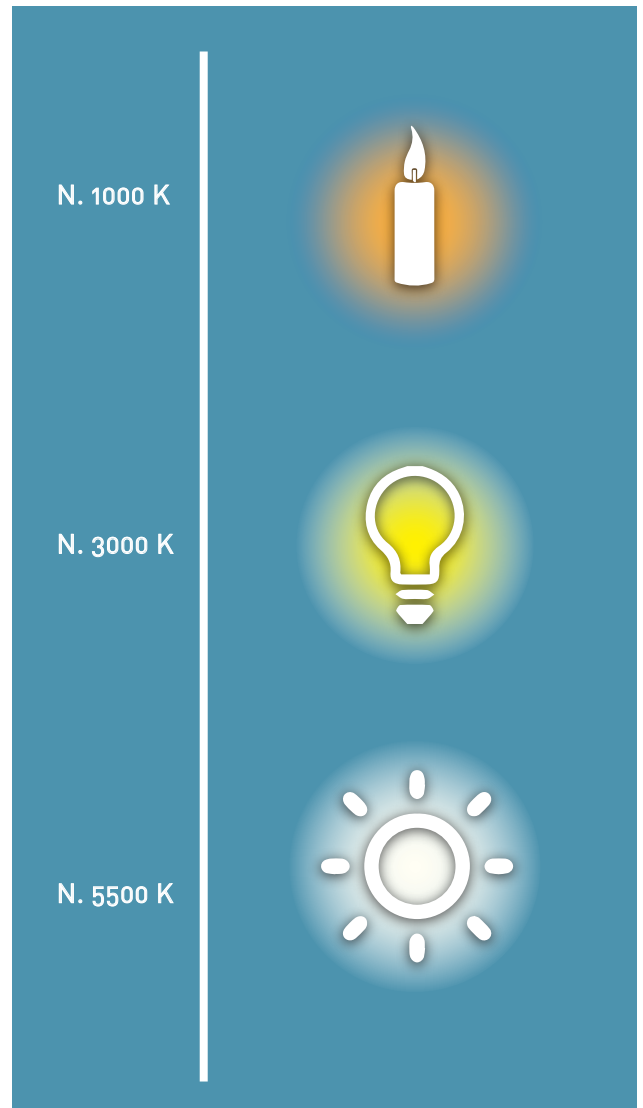
Healthy artificial light is as close to natural light as possible. As it is with natural light, artificial light either should not be estimated based on its quantity only, but also by its quality. The atmosphere created by lighting is born out of multiple different components, such as the color light, its quantity and direction, and the lamp's shape, size and location (35: 6). For artificial light to be healthy it should not distort colors, strain the eyes or cause distracting dazzling. The most important feature of artificial light that affects humans is the light's spectral distribution. Different spectrums of light affect people in different psychological and physiological ways. (33: 3.) Natural light has the healthiest spectral distribution, as well as artificial light imitating it (30: 15). Full spectrum daylight lamps come very near to the distribution of natural light, for that they also produce light from the blue part of the distribution (33: 3). The light of daylight lamps is of high quality and they replicate the right kind of colors. They also have many positive effects of the natural light, for that they can, for example, refresh the mind and improve productivity.

The color of a daylight lamp is colder than the light of a customary yellow light bulb. However, the according to recommendations artificial light should have a color temperature that is analogous to daylight when it is used during daytime to supplement natural light (31: 287). This

type of daylight color temperature is often 5500 K, in which case the light is white-like (30: 9). Anyways, the use of a daylight lamp is recommended, because it does not distort colors and, for example, it eases reading. (30: 15.) However, warmer hue light sources that are more suitable with twilight can be used during evening hours, because a warmer hue light feels more cozy and relaxing than a cold shade. The experience of hues is subjective though. In general, a light may be considered warm when its color temperature is below 3300 K. For example, the traditional yellow light bulb is of this kind. The color temperature of a candle is approximately 1000 K, which is already of a rather warm orange type. Correspondingly a light may be considered cold when its color temperature is above 5300 K. In addition to natural light, a daylight lamp emits this type of light. (25: 274; 30: 9.)

Kelvin values give the best idea about the color of the light-source, but they do not tell more about the quality of light. When buying artificial light sources and lamps the quality of light can be examined most efficiently by getting familiar with the spectral distribution curves of light sources. That reveals the hues embodied in the daylight spectrum and what interrelation the light source contains.

Color rendering index (CRI) tells the color reproduction capabilities of a light source. In working spaces one should use light sources that have a color reproduction capability of at least 80 Ra, so that the surfaces and people would look to be of right type of colors. Provided that one is working with



colors, the color reproduction capability should be at least 90 Ra. The best possible CRI is 100 Ra. (25: 274.) Full spectrum daylight lamps that are also sold in Finland often have a color temperature of 5500 K and a color reproduction capability of around 96 Ra. There are also different types of lamps, fluorescents and LEDs available. Light bulbs and halogen lights should not be used anymore at all, because of their energy consumption and heat production. Therefore, for artificial light, one should use energy efficient light sources that have as small as possible heat release.

## **GUIDANCE FOR INTERIOR LIGHTING**

A good interior lighting can be obtained with sufficient, high quality and non-dazzling light. A good lighting is versatile and modifiable and it offers sufficient general lighting as well as ambience lighting. The source of the light should never be seen directly but instead the light should be soft, filtered and indirect. Light transforms into a visible form only when it hits something. Thus it is essential to also design where the light hits. The colors and reflections of surfaces help with the perception of space. Light surfaces bring more light to a space, whereas dark surfaces absorb light in them. When light hits a shiny surface it is reflected back, which creates dazzle. It is therefore important to place and direct light sources to where they are really needed, such as work surfaces. (35: 5.)

General lighting that is healthy and soft is always somehow filtered such as the scattered light that coming to the room on a cloudy day. This type of light can be accomplished by filtering light to a space, for example, through an opal glass surface or a canvas. A soft scattered light can also be obtained by hiding the lamp behind a cover strip or directing the light indirectly to a space for example through the ceiling or the walls. The reflecting surfaces of indirect light should always be light but not dazzling-inducing. For the creation of indirect light one can use ready-made or tailor-made light strips and –shelves, where the light source is hidden in the shelf or behind a cover strip and the light scatters evenly to a space through the ceiling. The lower the light source is from the ceiling the softer and more fragmented light can be made happen.

In order to create an indirect light, light sources can also be directly integrated to the architecture or even on top of fixtures, under or inside the cover strips.

In order to create an even and soft light one can also build large and even light-surfaces by installing light sources to an appropriate distance, for example, behind an opal glass- or an acrylic sheet.

Lighting should always be sufficiently modifiable and versatile so that it served as many users and situations as possible. We need different type of light in different situations, for example, when we clean, read, work, or relax. Different people also need different types of light, which should be considered if spaces have various users. For example, a 60 year old needs approximately two to three times more light than a 20 year old (31: 109). On the other hand, someone might shun a warm yellow light when another one would react the same towards a cold blue light, because of the things they associate to the respective color temperatures. The lighting of a public space is particularly challenging since light should please everyone. If a space has a changing user, for example in an office or a ward, each user of the room should be able to adjust the lighting for their own needs. Lamps should be placed around so that they sufficiently support the different functions of a space. In addition to the ceiling, lamps can be also located on floors, walls and tables. However, an abundance of lamps does not mean that all of them need to be used simultaneously, but rather that



■ Daycare Omenapuisto (“Apple Park”), Helsinki. Häkli Ky  
Picture: Jussi Tiainen

**Indirect light is a soft general lighting,  
which does not induce dazzle.**



■ Daycare Omenapuisto  
("Apple Park")  
Helsinki. Häkli Ky  
Picture: Jussi Tiainen

for every situation there is something to choose from.

If all the lamps of a space are put on from the same switch, then the lighting does not have any adjustability. It would be good to divide the lamps to groups, when control of each group easily creates different lighting conditions. Also, many lamps should be equipped with a dimmer. In the same way as natural light changes throughout the day, artificial light should also be modifiable. The color temperature of light sources should be chosen according to when each lamp is used. For example, a cooler light for general lighting used during daytime and a warmer light for interior lighting used during evening-time. Inside an individual lamp or behind an indirect light-strip one can also have more different colored light sources, in which case the color temperature of a lamp can be changed according to the situation or time of the day.

## LIGHTING OF WORKPLACES

Sufficient lighting is particularly important, especially in working environments. Insufficient or bad lighting has numerous negative impacts on human beings. In addition to hampering seeing

it can also cause dazzling and flickering, change the mood, decrease concentration and disturb a daily natural rhythm. Insufficient or bad quality light can also induce eye fatigue, stress, headache, mistakes and accidents. In a working space, high quality light should exist evenly around the whole working space. Natural light and windows is extremely important in working spaces too, but uniform lighting also requires artificial light for evening out natural light and creating equivalent light also deeper into the building. Light sources should be located so that they do not dazzle, reflect from a display or from elsewhere from the environment, and shadow the working space. (25: 268 – 271.) Functional workspace lighting is born out of the use of lamps that illuminate directly downwards, indirect lighting and the combinations of these. Often the best solution is to use indirect light, which does not dazzle. Lighting can also be created by getting part of the light as smooth general lighting and part of the light as local workstation lighting. (25: 275 – 276.)

Direct sunlight also often disturbs work, for example in office spaces, when windows frequently need to be covered. However, one should strive to let in as much as possible natural light in right spots, for that it decreases stress and absences, together with increases in productivity and job satisfaction, and thereby it also benefits the employer economically. Full spectrum daylight lamps can also replace missing natural light. Research has shown that increases in wellbeing in offices lit with natural light and daylight lamps. (33: 9 – 11.)

## **LIGHTING OF LEARNING ENVIRONMENTS**

School environments are also working environments that require good lighting for teachers and students. Studies have shown that especially natural light in classrooms has positive impacts on the school performance and behavior of students (36). Natural light is the best possible light for reading and therefore also for learning (33: 18). Students who have studied in spaces with natural light have, for example, received better test results than the control groups with windowless or poorly lit spaces (33: 38). Students in windowless rooms have been found to have, for example, restlessness, hostility, insecurity, maladjustment and concentration difficulties. Natural light has also numerous other positive physiological and psychological effects in schools attributable to D-vitamin, such as decreases in tooth decay together with better vision, growth and immune



■ Daycare Omenapuisto ("Apple Park"), Helsinki. Häkli Ky  
Picture: Jussi Tiainen

system [33: 17-19]. Natural light is also particularly needed in schools for the regulation of the circadian rhythm, for that the body needs sunlight to know when to release hormones, of which some for example improve memory, and others concentration. Also the seasonal affective disorder is caused by the lack of natural light, and its symptoms, such as restlessness and irritability, have been found in children who study in windowless classrooms. It is good to bring natural light into the classroom from many different spots and directions. In an ideal case the windows could be skylight windows or high windows on the sides of the classrooms. (36.)

A larger quantity of natural light could therefore lead to a better health, school performance and overall experience. In the same way full spectrum light can also be positive compared with traditional fluorescents. Studies have shown that, for example, the amount of absences have decreased in schools with full spectrum lighting. In old schools, where natural light cannot necessarily be increased, it would be good to replace the old fluorescents with full spectrum fluorescents though. Classrooms should be selected to have lamps that do not induce dazzle, but instead distribute light evenly to the whole space. An even lighting assures the student with equal learning conditions. Dazzling light hampers learning, strains the eyes and induces nausea and headache. Indirect non-dazzling light is fits well for use in classrooms. Also surface materials should be chosen so that they do not create any distracting reflections. The reflecting power or



albedo of a surface of a ceiling can be even 90-100%, of walls and furniture around 40-55%, but of the floor only 20-30%, which is also the reflecting power of the surface natural wood material. Educational wall surfaces can have a lower reflecting power than other walls, alias they can, for example, be darker effect walls, which have a color that attracts looks. [36.]

## LIGHTING OF HEALTHCARE ENVIRONMENTS

Natural light is a very essential part of revitalizing and restorative healthcare environment. Contact with nature and nature scenery are also often associated with natural light and together they are a significant revitalizing power. One should utilize as much as possible natural light in a hospital environment and all in all of its spaces. There is clear evidence that natural light has various positive physiological and psychological effects in hospitals, for the patients as well as the staff. Among other things, natural light decreases the psychological and physical strain of patients and the staff. Studies have shown that natural light also improves patients' recovery times, sleep and safety, as well as it decreases their length of stays in the hospital, decreases depression and eases pain. [33: 32, 38; 37: 3.] In other words, natural light speeds up the healing of patients. Therefore it is essential to offer natural light to all the hospital's patient rooms, preferably to bathrooms and hallways too. When considering the floor plans of the hospital, all the patient rooms should be located next to the windows, and for example spaces that are intended for short operations, such as scans, should be located to the middle of the building if necessary [37: 3]. Natural light traveling through the windows is very positive for the patients, if the light does not dazzle and if it can be controlled [13]. As important as it is to have natural light is that it can be regulated, for example, with blinds and different type of curtain solutions. [37:3.]

The diversity of the spaces and the various needs of patients and the staff create their own challenges for the lighting of healthcare environments. The hospital staff always needs sufficient working light when they execute challenging operations that require perceptiveness, whereas a patient can need a more relaxing and softer light. Insufficient lighting during operations can lead to malpractice, whereas excess light can lead to stress for the patient. Ideal lighting conditions

Natural light speeds up the recovery of patients in a hospital.

vary a lot between different spaces and people. The color rendering properties of light is also essential, because the doctor needs to see the colors of the skin and the wound as actual, whereas the patient needs to see them as healthy as possible. In this situation as well, natural light works best. (37: 1 – 2).

In order to create a home-like environment to patient rooms, it would be good to use light in a versatile way, which includes working- and general lighting, as well as ambience lighting. Many lighting alternatives and the adaptability of light help in creating different moods to a space. It would be good to equip lamps with dimmers and divide them in different series. If the patients themselves can regulate the lighting of their rooms, it can decrease their stress and increase their sense of control. However, the controls should be logical and simple enough, because too many alternatives and adjustments can confuse the patient and again lead to stress. In hospitals one should also consider how the lamps look like when the patients are lying in beds or sitting on wheelchairs. It is not desirable to see a dazzling ceiling lamp above a bed or an eye-level light source dazzling directly to the eyes. In general, wards should aim to use as much soft and indirect light as possible. Studies have shown that a premeditated natural light and artificial light and their controllability speed up the recovery of a patient. (37: 2.)

The elderly need especially much light. Thus, good lighting is extremely important in nursing homes as well. The adaptability of an eye weakens with age and vision becomes worse (25: 90.) A 60 year old needs already almost three times as much light compared with a 20 year old, and an 80 year old even more. Adaptation to new things also takes more time for the elderly. For this reason, brightness differences between rooms should not be too big, because moving from a bright room to a dark room can cause a momentary blindness. (34: 7.) Sufficient lighting can decrease falling of the elderly, whereas the D-vitamin received from natural light speeds up the recovery from falling. Right kind of lighting can also assist the elderly to function more independently by improving their appetite, mood and self-confidence. (33:33.)

## CASE 2 / DYNAMIC LIGHTING

MERI VALTA

Dynamic lighting is a modifiable way to illuminate interior spaces that mimics natural light. It regulates our internal clock and positively affects our wellbeing. With dynamic lighting one can seamlessly adjust the intensity as well as color temperature of light and create different types of atmospheres to different situations. Each user of a space can adjust fitting lighting conditions for themselves, and the lighting can be programmed in a desirable way, for example, in accordance with the daylight rhythm. The adjustability of the color temperature of light can be achieved by using two different light sources of which one is of more warm tone and the other more cool tone. By adjusting the intensity levels of light sources the color temperature can be seamlessly mixed and modified from warm to cool. (38.)

### **AM KIRSCHBAUMER HOF -ASSISTED LIVING BUILDING, GERMANY**

Year of completion: 2013

Lighting design and realization, Philips

When a human being ages, there happens changes in physical performance, which can for its part lead to psychological changes too. With appropriately designed and functional lighting one can support the autonomy of the elderly and create safety in their environment. In 2013 in Germany an assisted living building for the elderly was completed. Its lighting was carried out according to the principles of dynamic lighting. Lighting manufacturer Philips was responsible for the design and execution of the lighting, and once it was completed it was a forerunner in its field. With dynamic lighting it was possible to create natural light -type lighting conditions indoors and adjust the conditions flexibly, according to the users, application and situation. With lighting one aims at imitating the spectral distribution of natural light, which has been found to be the best for human wellbeing in terms of artificial lighting. (39.)

Above all, when designing the lighting of the project the goal was to support the natural circadian rhythm of the elderly. As people age their hormonal activity slows down and the production of melatonin hormone weakens. The combination of low access to daylight with deficiency of this “hormone of darkness”, as melatonin is sometimes also called, causes unfavorable disturbances in the circadian rhythm. Brighter than normal lamps that mimicked daylight

## CASE 2 / DYNAMIC LIGHTING

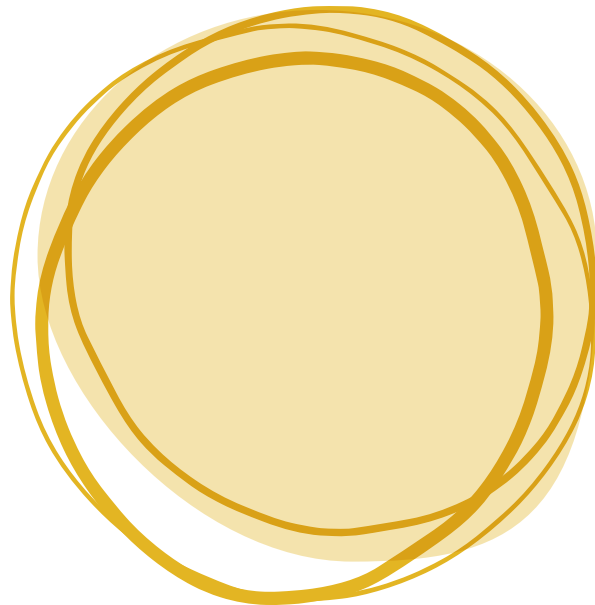
conditions were installed in spaces that are most actively used by the residents and the staff, such as common rooms, patient rooms and hallways. Lighting that produce non-dazzling light were installed in groups of four lights and they were adjusted so that they generate brighter than normal light. Already an increase in the amount of light has been found to reduce aggression in Alzheimer patients. In addition to this the spaces were supplemented with lighting-control systems that enabled an intelligent control of the color temperature and quantity of light. In this way the lighting of the spaces is possible to be regulated flexibly. With the help of the control system, the color shade of light is regulated automatically during the day by adapting to the natural light production of sunlight. During the light of dawn the shade of light can be almost reddish. The shade changes through the different shades of blue and white back to a reddish shade towards the evening. Lighting that is too strong during evening time does not allow our system to relax and calm down. The color temperature of general lighting in spaces was chosen to be 4000 K, which is a very neutral white. It fits well with hospital environments due to its good light production capabilities. {39.}

The resident's quality of everyday life was experienced to have improved with the implementation of dynamic lighting. The lighting boosted social interaction and it created a safe operating environment. It was also experienced to generate a pleasant and refreshing atmosphere, in addition to which it produced a sense of wellbeing. Safe lighting also contributed to the elderly's active and independent movement in the spaces. The support that dynamic lighting had for the patients' circadian rhythm was experienced to be significant, in addition to which the positive effects of the lighting were directed towards the staff as well. As dynamic lighting becomes more common, we have an opportunity to influence and support our wellbeing also through lighting. The measures are not necessarily large, but the results can be significant. {39.}

## CASE 2 / DYNAMIC LIGHTING



■ Am Kirschaumer Hof – assisted living building, Germany  
Pictures: Philips



# THE FORM AND CLARITY OF AN ENVIRONMENT

MARJUT NOUSIAINEN

Environment and architecture shape us in many ways without us noticing it. The shapes and measures of the environment affect our mood and spatial experience. A space can get us to feel or change our behavior in a certain way; it can be attractive or aversive. The effects of the environment can be personal to us, but also cultural or even universal. For example, the geometry and proportions have universal effects on human beings, for that they have been derived from the human body and nature. (19: 9 – 13.) The organic shapes of nature generally feel more natural than the plain shapes of a constructed environment.

### THE LINES OF NATURE

Our spatial experience is dependent upon what type of a design language is supporting a human being (19: 43). A straight line refers to clarity and an organic line to life and mobility. Nothing is completely straight or square but everything meanders and undulates. Nature creates unbelievably rich and complex forms, for example in tree branches. In the same way the shapes created by moving water are never straight (19:47). Paths in a forest created by humans or animals are also meandering by nature. Therefore, curved, soft shapes also feel familiar to us and please our eye. Curved shapes have movement, life and energy. The freer the shape is, the livelier it is too. Our eyes travel in the contours of nature and the moving shapes also encourage us to move (19: 54). On the other hand even surfaces, square edges and overly straight lines can feel unnatural, strange and distant

# DESIGN LANGUAGE

Organic forms have movement and life.



■ Aihki – tree in Lapland  
Picture: Tapani Touru



■ The Parliament additional building,  
Helsinki. Helin&Co Architects  
Picture: Meeri Heikkilä

(19: 12). They are shapes invented by humans that are born only by thinking, not naturally (19: 50). A tree naturally grows straight upwards, but still it is never completely straight from its outlines. Thus, there is a lot different even between a straight and a nearly straight line.

Combining straight lines and surfaces creates corners and angles that break fluid motion and looks. Corners can be straight, sharp, open or round. The magnitudes of corners influence our experience of them. They can be welcoming, or vice versa. Straight corners can feel unbalanced but lifeless. Narrow inner corners can feel distressing, whereas large open or rounded inner corners can feel welcoming, as outspread hands. Sharp outer corners, and all the shapes that protrude towards us, can feel threatening and one should avoid them too. (19: 40.) On the other hand, cutting or rounding of the tips, sharp corners can be flattened out. A healthy space should never be threatening, but easy to look at.

Spaces should be designed so that its atmosphere and design language match with its function. Straight corners and lines however depict a human constructed environment. It is hard to avoid them in modern architecture, which is consisted of almost completely straight, pragmatic, efficient and clear rectangular shape rooms, doors and windows (19: 34).



They are easy to comprise, draw, produce, build, deliver, style and furnish, but as such they lack a lot of life. Small things can have a significant meaning though. Even straight lines are possible to be made more vivid and so that they slightly remind of movement. By connecting straight lines one can also build curvy-like forms. (19: 50 – 52) Additionally, rounded angles ease with the movement of the eye and hand from one line to another (19: 103). Also, the way we enter a space and how the space opens to us influences the quality of our spatial experience. There is a large difference in if the space opens or closes in front of us. (19: 38 – 39.)

Curvy shapes are more natural and livelier, but more challenging in a constructed environment. It is easy to get tired in an environment, which is too soft and pleasant, because a person also needs clarity and stimuli to remind about the task at hand. Even an organic environment however can be given clarity by adding straight lines there. In general, furniture and items have more round shapes than the spaces around them. Thus, curvy shapes fit better and more naturally together with soft materials than hard materials. For example, pleated curtains, cushioned sofas and pillows are always curvy shapes and they soften a square space. Use of curves where they do not fit can however beset even more than a straight line. (19: 52 – 53.)

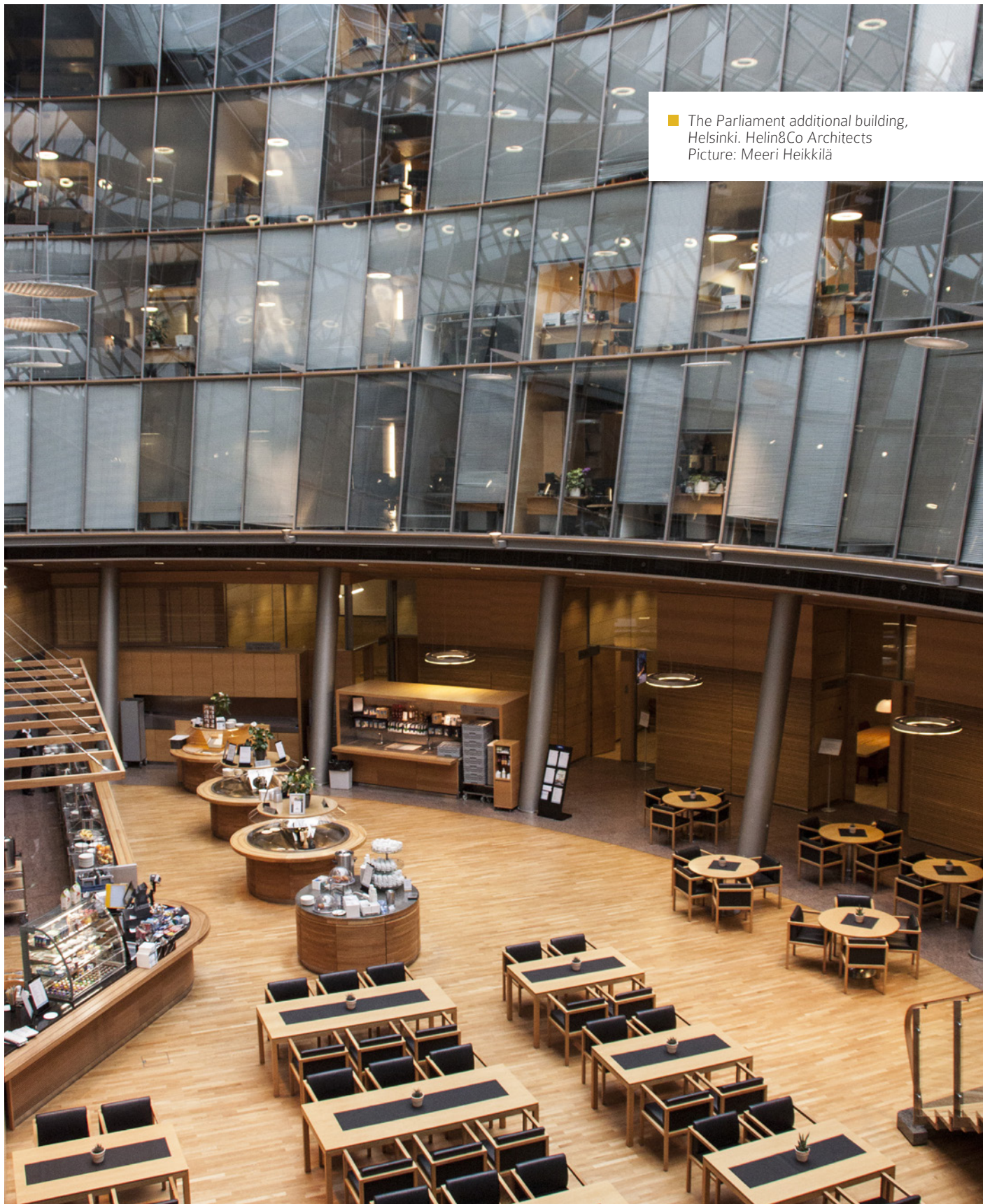
**A round table  
brings people  
together.**

## **A CIRCLE**

Shapes also have practical effects in a social sense. For example, diverse types of table groups evoke different type of conversation. A round table gathers people around it as equal and it supports communication, whereas a rectangular table more easily leads to separate conversations. A circle has a center and between the center and the ring there is a tension. When we sit by the ring of a circle we are all equal and our attention is focused towards the center. Therefore circle-shaped settings are more social and a circle is a good shape for a community. A circle shaped space can be too rigid though, and it requires deviations to be livelier. An ellipse is a circle-like shape. However, it is not as equal as a circle, because it has two different directions. An ellipse-shaped table or space fits well with a situation where, for example, the speaker is at the end of the table or the room. (19: 31 – 32.)

## **A SQUARE**

A square is very clear and rigid but balanced and practical shape. A square-shaped space has two directions and it is easy to navigate. However, a square space has corners where movement stops, and square furniture has angles where one can walk into. Different materials and colors on different surfaces form clear boundaries and lines for a visual environment. If, for example, a roof and walls are the same color, the borderlines slightly disappear, and then distinctive distressing corners are not formed. Square shapes and corners do not advance movement, but they support balance and harmony with their dimensions that are easily distinguishable. That can also feel uncompromising though. A completely square environment has no life, unlike a non-square one, and it has to be brought to life with light and softer shapes. Arches in doors and windows, houseplants, furniture and decorations can soften a room. Square rooms need a lot of stuff however, for them to come to life, thereby feeding a materialistic culture. (19: 34.)



■ The Parliament additional building,  
Helsinki. Helin&Co Architects  
Picture: Meeri Heikkilä

# A CLEAR AND PLEASANT ENVIRON- MENTS

**A restorative environment has both straight clear shapes and lively soft arcs.**

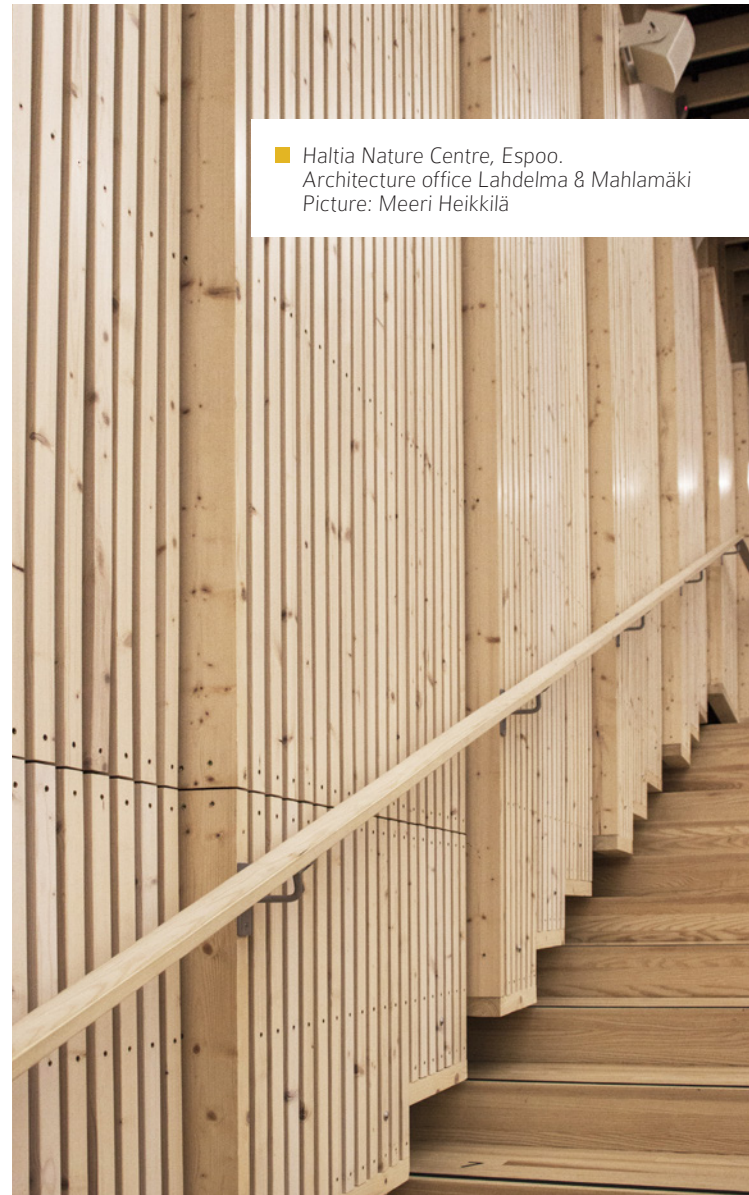
## A PLEASANT ENVIRONMENT

Lively environments support wellbeing, but in order to be healthy though, an environment must also be clear and easily intelligible. At times we need more mobility, sometimes clarity to think. Rarely we need just the other however, but the answer is in a combination of these two. (19: 55.) A restorative space could therefore have easily intelligible round shapes that have been softened and brought to life with tender arcs and roundenings?. Also the diversity of the environment increases the feeling of comfort. In a pleasant environment there is a lot to be looked at, but not too much so it would become oppressive. A lively space must also be conceived three dimensionally, not only on the level of the floor plan. When we move in nature, no ground we walk on is completely flat. A constructed environment can therefore have level separations in suitable places, for example in the floor or the ceiling. One must remember that the level separations without pertinent ramps do not belong to an unobstructed environment though. However, level separations in the ceiling are effective solutions. (19: 34.)

For a space to not induce stress, it must neither be too narrow or cramped, but one should be able to move there freely. For a room to be spacious though, it does not need to be large but only correctly organized. The requirement of space is subjective. A space that is too large or too high feels unsafe to many, whereas a small space agonizing. Often people also search support and comfort from small rooms where they feel themselves safe (18: 58). Many public buildings

can seem oppressive, already because of their large size alone. Long continuous corridors make large buildings even more institutional. They do not support wellbeing, but they often feel distressing. With small changes, such as indirectness, varying widths or recesses, even a corridor can be transformed into more interesting. (19: 117.)

A pleasant environment should not have too much reiteration either. For example, high-rise buildings or hospitals can appear like large institutions that have been assembled out of identical boxes, which are used as human preservation units. Box-likeness, large size, lack of individuality and repetitiveness of a shape can be experienced as oppressing and unnatural. These boxes need a lot for them to become lively. Everything is slightly different in nature. No leaf of a tree is similar to each other. Repetition of a particular shape brings out a rhythm. A rhythm may appear dead and oppressive if it continues identically for too long, as in an endlessly long hospital corridor, which is full of coincident doors. The merger of spaces and their dialogue would be a healthier solution. The repetition of shapes without a reason does not consider the true need and individualism of forms. For example, every window of a building could in principle be different, for that every one of them is located in different places and in different relation to sun and the surrounding nature. Every view from inside out would be different. Repetition however is also a basis for rhythm and it creates structure to an environment. A rhythm that is becoming distressing can be eased by breaking lines and by creating vividness and deviations into the regularity. (19: 25 – 27.)



■ Haltia Nature Centre, Espoo.  
Architecture office Lahdelma & Mahlamäki  
Picture: Meeri Heikkilä



■ Onni Centre for Wellbeing, Pukkila, Finland.  
Architecture firm L&M Sievänen Oy  
Picture: Architecture firm L&M Sievänen Oy

## WAYFINDING

Wayfinding is navigation in a constructed environment. A well-designed environment assists its user to experience the space in a positive way and to reach the user's objective without problems. In order to support wellbeing, the environment and the routes should be unambiguous and logical. From a window view it is easy to perceive where in the building you are and where you are heading. A lack of windows in the middle of a large building hampers navigation in a space. An environment can also guide a person by offering clues and signposts about location and direction. Signposts are an important part of the environment in public spaces. Signposts must be clear and unambiguous and they must be designed carefully to correspond with their purpose. Also, it is possible to have too many signposts, which confuses the user even more. (45.) Colors, materials and graphics can also be used to guide the user from a room to another. Passageways should therefore be comprehensively designed as part of the building. An unambiguous environment can generate a sense of control over a situation. An ambiguous environment can instead lead the wayfarer astray and induce anxiety and stress.

**Windows ease the navigation in a space.**

## A FLEXIBLE SPACE

The transformability and flexibility of an environment increase its versatility. Public spaces, such as hospitals, schools and working environments should be suited for many different users and uses. This also makes the design of spaces more challenging. Spaces must be flexible and transformable to different needs so that they can support all of its various users. Many spaces have to simultaneously support the customer service provider as well as the customer, both of which may have very diverging needs. For example, schools are development- and learning environments for students but working environments for teachers. (25: 126.) Flexible and transformable school spaces enable the best possible learning conditions, for groups of various sizes, for various subjects and various learning methods. Transformable classrooms convert based on the occasion, and they can be pieced together or divided to smaller spaces if necessary. This allows for taking care of the possibility of changing needs in the future and in that way supporting the longevity and durability of the building. (17: 16 – 17.) The transformability of products and furniture also increases their versatility. Products that comply with various solutions, assemblies and situations are more long lasting, and thus more ecological, than products that cannot be modified.

# TRANSFORM- ABILITY OF A SPACE

An environment can support  
social interaction.

## A sense of control relieves stress.

### REGULATION OF PROPRIETARY SPACE IN A HEALTHCARE ENVIRONMENT

All of us have our own boundaries and we need personal space in different ways (19: 10). The need for private space is highlighted when it is in danger, such as in a hospital. Spaces that respect our privacy and us as individuals are healthy. If someone crosses your limit and threatens your privacy it can induce stress and push you into a corner. Studies show that people who feel that they have a sense of control over their situation cope better with stress, and they are healthier, than people who lack the possibility to influence their situations and environment. The feeling of lack of control in a hospital induces stress to the patients. Patients cannot control their own space while they are in the hospital, however it can improve their state of mind if they can influence many things, such as the amount of privacy, lighting, music and temperature. (12.)

Some patients need more privacy and others need more social support. The wishes of an individual patient can also change day to day. Single or double rooms are better than larger wards. A private room guarantees privacy and improves the quality and quantity of sleep, but on the other hand in double rooms the roommate can be a source of social support. Incompatible personalities, noise pollution, lack of privacy and sleep disorders however often disclose the need for private patients rooms. Private patient rooms are better than shared rooms, because they better allow for family visits and overnight stays. Private rooms further the recovery of patients by decreasing the risk of infection and improving the quality of treatment and communication. Private patient rooms should also have space for family members to spend their time conveniently. (12; 13.) Private rooms and good social spaces are a good solution that can guarantee privacy as well as social support for patients. Transformability in interior solutions assists in pleasing everyone's desires and in relieving stress. (28: 285). One solution is to offer an open floor plan, which has movable interior walls, so that the environment can be changed according to the needs. In that case however, for example, the between-spaces acoustics is more challenging to be solved. For example, if desired, one wall of the hospital rooms could be opened to public spaces for daytime and closed again for evening time. In this way, the patient could





personally decide how much he or she wants to share with others, which would significantly increase his or her sense of control.

Humans need social support from each other. People who receive more social support are healthier and less stressed. With the organization of furniture a healthy environment could encourage, but not force, social interaction with other patients and family members. Various comfortable and movable seating formations in wards summon the patients out of their rooms with visitors and other patients. Uncomfortable benches and wall-mounted seats on hallways can do the opposite though. Round tables gather together everyone that is sitting around it. Smaller dining tables can evoke more conversation. Social spaces should have natural light and seats, which can be placed next to each other. For example, gardens are wonderful environments for social interaction. A healthy environment also assists family visits of patients, among other things, by increasing comfortable waiting areas and offering possibilities for overnight stays in patient rooms. According to research, patients that receive more social support from their family members recover better from surgeries. (12.)

■ A modifiable hospital room concept  
Picture: Marjut Nousiainen

# CASE 3 / TRANSFORMING SCHOOL BUILDING

MERI VALTA & HEIKKI LINDROOS

## **MANSIKKAMÄKI SCHOOL, KOUVOLA**

Year of completion: 2014

Architecture by Linja Architects, Oulu; Timo Koljonen and Roope Rissanen

The largest school made out of tree in Finland has around 600 students, of which 100 belongs to special aid district. Autistic children have their own educational spaces in the school. The starting points for the design of Mansikkamäki school have been to create a safe and healthy, appropriate learning environment in terms of learning and instruction, which advances the psychological and physical wellbeing of the people using the space. The ecology, transformability and life cycle expenses have received special focus in the design of the school.

The school building has been designed around an atrium yard. In this way every classroom or working space has a view either towards the inner court (atrium) or directly towards the nature. The building beautifully basks in natural light with playfully located, various size, windows supporting this effect. A diverse window solution guarantees the supply of continuous and alternating natural light. The view that opens from the window eases and supports the navigation of a person moving inside, positioning of self as well as location of objects relative to the environment. This has been additionally supported with different color hallways that have been further enhanced with adequate color rack solutions. These rack solutions also were one of the most memorable elements on Mansikkamäki.

A magnificent architectonic detail can also be found from the hallway structures upstairs. The institutional structure has been successfully broken in a simple way, which works great in practice. A stair railing with oak laths creates an interesting surface, beautifully sieves light, and when installed indirectly, it makes the space comfortable and the shape of the building more easily perceivable.

## **ADAPTABILITY AND TRANSFORMABILITY**

At first glance, the classrooms of the school are not much different from ones already previously realized. With a closer look on the subject, one can perceive implemented visions, and even

## CASE 3 / TRANSFORMING SCHOOL BUILDING

dreams, which are waiting for their turn. According to the school principal the design sought to strengthen a culture of “doing together”, and it shows in many ways too. Instead of a traditional school desk –model, Mansikkamäki primary school children study around a polygonal desk, which are easily made into different size small groups. This kind of a simple custom can have a significant effect in a psychological sense: no one is left outside the group, which easily happens with the traditional school desk –model. Another distinction compared to the traditional model is the lack of storage compartment. Personal items are stored in a common locker inside the classroom. In this way one avoids the formation of private spaces, which has been found to increase social interaction.

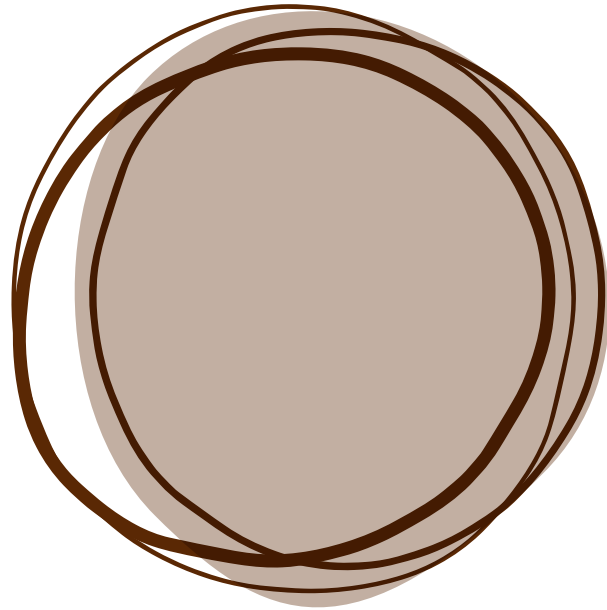
The classrooms are spatially large and there is a direct view to the nature from all of them. They can be split into two, at best even to three different size sections. Oak veneered folding doors function as room dividers. Some classrooms also have double doors. In terms of the transformability of the space, the function of double doors is a bit airy. Folding doors allow a greater transformability of the space, and in addition to that the thought could be developed further. Movable dividing walls could bring more opportunities of variation of how to implement the division of space in classrooms. Also, the mood of the space could change. The other side of the space could be more activating and encourage, for example, mathematical and thinking demanding efforts. The other side of the classroom could be dominated by a calmer mood, which would subtly guide towards attentive and, for example, creative activity. This type of divisions of space could also be used case by case between different personalities, how they are located in the classroom when the space is open. In addition, some of the classrooms have an aquarium -type space, which in accordance to its name is a small, windowed room. The aquarium -type space enables a so-called differentiation. In which case the student, who for example has advanced further than others, or is behind, can have a distraction-free peace of work and still remain under the supervision of the teacher. Downstairs one can find an auditorium –type space, which transforms into an educational space for a larger crowd, a theater stage or a meeting place with friends, when necessary. During a normal school day the space has low bookshelves, but thanks to wheels that are placed under the shelves they can be effortlessly moved to the side on request.

## CASE 3 / TRANSFORMING SCHOOL BUILDING

According to the school principle the culture of doing together is largely born out of attitudes. For example, alternative instructional methods and versatile uses of spaces are eventually on the responsibility of the staff, their time, resources and creativity. The versatile spaces of Mansikkamäki, such as for example the bright corner in the lobby with its relaxed beanbags, conveniently break the plainness and orderliness of the school, in every sense of the word. Taking a class there could offer an invigorating and equal alternative to what is customary.



■ Mansikkamäki School, Kouvola. Linja Architects  
Pictures: Meeri Heikkilä



# MATERIALS

MARJUT NOUSIAINEN  
PETRI HEINO

- Nature's materials are genuine and emotive.  
Picture: [medium.com/@dustin](https://medium.com/@dustin)



## Nature's materials invite touch.

Materials make the world tangible and real to us. That what we feel on our skin in a constructed environment is based on the choice of surface materials we make. All materials have their own properties; they create a certain kind of an atmosphere to a space and influence our spatial experience. Wood always feels warm, stone hard, plastic unnatural and concrete cold. Therefore, for example, a space decorated with wood often has a warm atmosphere, and a space decorated with concrete often has a cold atmosphere. (19: 92 – 93.) With the emphasis on artificial materials and visuality in constructed environments, materiality, experientiality and honesty have become weakened (18: 34). For example, a wood reproduction produces only a positive visual experience at its best. It can look good, but not feel, sound or feel right. Compared to an authentic material, an artificial one is always false and negatively impacts our spatial experience. (19: 69.)

## NATURAL VS ARTIFICIAL

Warm and richly textured surface materials create a strong sensory experience and we are deeply touched by them, whereas surfaces that are too flat or cool can leave us cold. Structural materials also make for a more interesting visual experience, because they offer a surface structure for light to play with. A material that feels, looks and sounds pleasant produces a positive multisensory experience and is therefore healthy. Many natural materials are like this. Their texture is lively and warm, they invite to touch and offer a perfect reflective surface for light, as well as they smell and sound pleasant. On the other hand, an environment that consists of artificial surfaces often offers one-sided sensory experiences. (18: 34.)

Nature's materials in general feel natural and healthy for humans. On the contrary, many artificial materials feel unnatural, cold and even unhealthy. Artificial materials have no history and one cannot sense time in an artificial environment. Nature's materials on the other hand are authentic and emotive. One can sense an age and a history of them. Natural materials, such as wood and stone, connect us to nature and history. Unlike artificial materials, nature's materials also often become only more beautiful as they age. Patina of age further increases the piquancy, honesty and experientiality of an authentic material. (18: 34.) A beautifully worn hand-made wood surface downright invites to touch, whereas less an artificial material that has worn with less dignity can do the opposite. In the best case, a material's

# SURFACE MATERIALS

MARJUT NOUSIAINEN



■ Viikki church, Helsinki. JKMM Architects  
Picture: Meeri Heikkilä

## A restorative and sustainable environment goes hand in hand.

story can connect us with life and its continuity. Artificial materials, such as metal, concrete and plastic are not suitable materials to a healthy habitat. On the other hand, natural materials such as wood are. (19: 93.) The restorative effects of wood are significant to a human being.

### ECOLOGICAL MATERIALS

A restorative and sustainable environment goes hand in hand. A healthy environment is born out of respect for nature; it stands the test of time and conserves the environment as well as deepens the connection between nature and the human being. Employed materials should be natural, sustainable and ecological always when it is possible. Properties of ecological materials, in addition to being natural, are, among other things, renewability, recyclability, longevity, abundance, as small as possible need for refinement, production and maintenance, as well as close availability. The less the material is needed to be refined, the more ecological it is. (7: 57 – 59.) Environmental certifications, lifecycle analyses and eco-labels help with the selection of ecological materials (7: 13 – 14). Wood is superior in this aspect as well; it is a renewable natural resource, which can be re-used and recycled. Moreover, it is abundantly available in Finland. Management of the wood's source information is part of socially sustainable raw material procurement. Then, one can reliably state that the wood is from lawfully cut forests whose ownership rights are in order. In addition, forests are managed sustainably. Other building materials do not have corresponding systems.

### MAIN SURFACES

The floor, the ceiling and walls make up the largest surfaces of a space. Thus, they are also the main surfaces in terms of material choices. The floor is the most important light reflecting surface of a space, as well as the surface that our looks are most directed towards, and therefore it should be selected with care. In selecting the material, one should focus, among other things, to its the ecological-, heat-, acoustic-, durability- and reflective properties. Wood, in its many forms, is a good floor material. Other natural and ecological floor materials are, for example,



bamboo, cork and linoleum. Also natural stone and ceramic tiles are suitable for floor and wall surfaces, especially in wet and heavy wear and tear rooms. There are many types of tiles but, in general, more structural and pleasantly feeling surfaces can be thought of as multisensory, and therefore healthier, in relation to shiny and smooth tiles. In an ecological sense, tiles bind a lot of energy because of their production and transportation, but on the other hand they can be very durable. (32: 78 – 83.) Vinyls, laminates and plastic carpets cannot be thought of as restorative surface materials.

Wood is a multiform material and it is suitable to be used for the upholstery of walls and interior ceilings, as such or processed. It can be used in the form of boards, laths, panels, plywood and different type of claddings. Wood as supporting frame material can be often left exposed and it thus also functions as surface material. The processing opportunities for wood are endless. One can do various types of patterns on the surface of the wood, in which case the surface can be made even richer. If necessary, surface treatment agents in a healthy environment should be made of traditional nature's raw materials, such as whitewashes, plasters and natural wax's or other M1 –emission rating produced surface treatment agents. Natural paints are durable, environmentally harmless substances and they do not release any noxious substances into the air inside, as for example solvent-borne paints do. (7: 101 – 103.) In addition, for example, clay-mortar plastered hand-finished structural wall-surfaces are vivid and create multisensory experiences and extra-dimensionality to the space, compared to plane wall surfaces alone. Alternative to plastering or a wood surface, there are also, for example, textural plant-fiber wallpapers available (32: 91). When selecting surfaces, one should also consider their cleanability and the hygiene requirements of the space.

## **MATERIALS IN A HEALTHCARE ENVIRONMENT**

According to a survey conducted in Canada, none of the answerers had experienced wood in hospital environments, not significantly at least. Instead, they experienced hospitals to be consisting mainly out of metal, glass, plastic and textiles. (46.) Healthcare environments largely consist out of artificial, plain and hard surface materials. The main reasons for that are hygiene,

cleanability and heavy wear and tear that often create constraints in terms of the use of natural materials, such as wood, in public spaces. Often also prejudice is a reason for this as well. Surfaces in healthcare environments have to be dust non-collecting, easily cleanable and resistant to strong detergents. Operation rooms have the most strict hygiene requirements, but generally the whole hospital should be clean and sterile so that infections could not spread. Wards also have high hygiene requirements. (28: 190.) In addition to hygiene, when making material choices for healthcare environments it would be important however that one would also pay attention to, among other things, the acoustics properties, and that the materials are non-dazzling, non-slippery and natural.

Floors especially are required to be easily cleanable and durable. A few studies have compared the significance of floor materials in hospitals. They have found out, for example, that the feared fitted carpeted, when it is properly cleaned, is not necessarily so unhealthy as is often thought. A carpet is a good floor material from the perspective of a patient, because, for example, the elderly have easier to walk on it, and therefore less falling accidents happen. A carpet is thought of as a better material than vinyl, also because of its non-slippery, non-dazzling properties, acoustics and convenience. In addition it has been considered to increase comfort and homeliness, and that way enhancing the healing of patients by, among other things, increasing the length of visitors' stay and the amount of social support that is received from them. However, the hospital staff prefers the vinyl more for two reasons. It is easier to clean and push carts on. Softer and more homely than traditional vinyl floor materials can at least be, if possible, used in wards though, if their cleanup is correctly taken care of. Operation rooms, labs, intensive care units and moist spaces should however avoid fitted carpets at least. (12; 47.) According to a survey that was conducted in Norsk Treteknisk Institut in Norway, also the hospital staff is most pleased by patient wards that had used wood on floors and on the walls opposite to the patient's bed (48). According to a research conducted in Canada, Fell and Lavoie determined three strategies for how to increase the use of wood in the interior design of public spaces: 1. Wood could be used high up, where it is not as exposed to wear and tear, 2. Wood could be refined to be more durable and washable, 3. Wood could be used together with other materials that are considered pleasing, such as glass, plants and stone. (46.) In order to make a healthcare environment softer



and more natural, many surfaces that are not touched could be made more natural at least. For example, ceiling surfaces and the upper parts of the walls are not exposed to touch, but they are integral viewing-surfaces in wards and operation rooms, where patients are lying in beds. Installation of natural surfaces on high places enables all other benefits except for the sense of touch. In addition to viewing-surfaces, it would be important to strive to bring the warmth and texture of the materials also onto contact surfaces, such as furniture, so as to accomplish a positive sensation of touch as well.

■ Onni Centre of Wellbeing, Pukkila.  
Architecture firm L&M Sievänen Oy  
Picture: Architecture firm L&M  
Sievänen Oy



# THE OVER-POWERING WOOD

PETRI HEINO

## IN PRAISE OF WOOD

A wood surface is beautiful and warm. It appeals to the emotions. Wood is a material that is ecological, flexible in many ways, ancient and at the same time forward-looking. It is the oldest building materials used by humans. As many building materials evolved, it remained characteristic only in some areas, because of its availability, workability and insulation properties. Finland of the northern taiga is a land of wood construction. Two thirds of Finland is covered in forest. The view has always been wooden, in scenery as well as in buildings. The tradition of the use of wood was threatened to end with the tsunami of urbanization, but along the new composition and processing opportunities, and the progression of bio-economy, wood has made its comeback in cities, high-risers and interior design.

Wood is a product of nature, an organic material, which grows in forests empowered by sunlight, creating oxygen into the atmosphere, binding carbon dioxide into its biomass, producing building material and other goods, and it is exploitable as biofuel in every phases of its lifecycle. From an ecological perspective wood is superior compared to other materials when its chain of origin is known and certified. European forests are certified and quantitatively sustainably managed. Criticism for forestry is directed towards poor treatment of the biotopes of endangered plants and animals. By purchasing European or certified wood one can be sure that the forestry is controlled by third parties and continuously improved.

In addition to the ecological rationality for the use of wood, it is important to consider its psychological dimensions. Wood is physically close to a human being, from the cradle to the grave. Its essence is familiar to us. Skin enjoys a wood surface, would it be on a summer terrace or in a sauna. The genuine wood connects the human being to nature, amid the surge of artificial materials, and as it changes and ages it is a lasting material, and therefore safe.

Use of wood is easy, even children can make a spear and build huts. A doghouse, a woodshed, a fence, a terrace and earlier, a small house, were born with fundamental citizen skills. A more demanding wood building requires the designer to understand its behavior, and identification and acceptance of its special features. If you take up a building project you should have an idea of wood construction from the beginning, especially if it is a case of a wooden frame building. In an indoor environment it is possible to include wood into the design also later in the project.

There have been many praise writings written about wood in the world. Roy Mänttari brought up one of the most interesting ideas in the introduction of a book written for the Museum of Architecture's Wood Architecture Exhibition: "The biggest benefit of wood architecture is its commitment to time. It reaches out into the history of construction, and like in all construction, it targets into the future, at the same time as it displays the manifestations of aging on its face. The erosion caused by humans and forces of nature is displayed in a wooden building in a similar way as the internal decay of an organic substance. Wood architecture is not eternal. It requires maintenance, which consequently makes it so humane." (49.)



■ Daycare Omenapuisto,  
Helsinki. Häkli Ky.  
Pictures: Jussi Tiainen

■ Wooden stool  
Marjut Nousiainen  
Pictures: Meeri Heikkilä



## PROPERTIES OF WOOD

Wood as a material has numerous good properties that advocate its use. Wood is a renewable natural material and the forests of Finland grow faster than they are consumed. Use of wood can significantly reduce carbon dioxide emissions. Wood is a local material and when compared with other materials, its transportation and refinement requires significantly less energy. In addition, wood is a recyclable material. After using it, it can be made into new products and finally utilized as thermal energy.

Wood is light, and in the directions of its grain it is very strong. When properly designed, wood can be used in building light and strong structures into indoor- and outdoor spaces. Also, it is easy to make extensions, additional layers, lofts or removals into a wooden frame even later. The cell structure of wood insulates heat naturally. Wood as a hygroscopic substance evens out moisture and retains a pleasant room air, during winter as well as summer. The smell of wood is familiar to everyone and it is generally considered as enjoyable. The smell is formed from ingredients typical to individual species of wood, such as terpene, tannic acid and essential oils. Over time the scent becomes diluted and surface finishes can weaken its effect too.

Wood also has acoustic properties. An impermeable wood surface does not mute a sound. For example, when connected against the surface of a wood veneer about 90% of sound energy is reflected back. By grooving and perforating the surface in different ways, and changing the background material one can influence the noise suppression features. Noise suppression usually requires the use of varved structures. One can use acoustical wood panel surfaces and lowered ceilings in indoor ceiling constructions as part of the building's acoustic design. The acoustic properties of wood are utilized a lot, for example, in auditoriums and concert halls.

Wood is also an antibacterial material. The attributes of different species of wood vary, but as a general trait the extractives of wood and the fast drying out of its surface prevent the growth of harmful microbes.



■ The overpowering wood.  
Picture: pexels.com

# RESTORATIVENESS OF WOOD

MARJUT NOUSIAINEN

## Wood revitalizes!



■ Nature Centre Haltia, Espoo.  
Architect firm Lahdelma & Mahlamäki  
Picture: Meeri Heikkilä

It is only in a sauna or at the summer cottage that a Finn encounters wood surfaces in abundance. These kinds of environments with wooden interiors are experienced as relaxing and stress reducing. Research during the recent years has shown that wood as a material has numerous restorative effects on humans and that it should be utilized more extensively too. The use of wood in interior spaces positively influences our wellbeing physically as well as psychologically. For example, a study that was conducted in Canada found wood to have similar stress reducing properties as nature, the revitalizing effects of which have been studied a lot in the field of environmental psychology. [53.]

The impact of wood on a human being has been studied in many different research institutes, with physiological as well as psychological experiments. The physiological experiments have included, for example, control of the pulse and blood pressure when a human is exposed to wood. In addition, after exposure to wood, the personal opinion, changes in psychological impression and the amenity of wood have been assessed with subjective evaluations. Also, the connection between the physiological and psychological reaction has been studied. The test subjects have been exposed to wood, for example, by showing them pictures of indoor spaces that have been decorated with wood, with the goal of finding out what quantity of wood feels pleasant to them and what type of activities they would want to perform in each of the spaces. The test subjects have also been requested to spend short amounts of time in spaces that have been dec-



orated in different ways, to see how the space affects them physiologically and psychologically. More physical experiments have also been conducted, where the test subjects have performed different tasks in spaces that have been decorated in various ways, or then they have just been requested to look or touch different materials for a moment. (48; 53; – 60.)

The research has shown, among other things, that spaces that have been decorated in different ways cause different type of physiological reactions. Results indicate that looking at wood and staying in spaces that have been decorated with wood reduce stress. One Japanese study also suggests that the human body would have been designed to reach positively to natural materials, because even touching cooled wood does not cause physical stress although it would feel unpleasant. An Austrian study found that the test subjects also slept better in a wooden bed compared to a wood imitation. Sleeping in a wooden bed was found to save up to 3500 heartbeats a day. However, studies show that even the use of wood has its limits, because generally people perceived a moderately wooden interior decoration as more pleasant than a completely white or wooden decor. According to these results, wood could be used in interior spaces, such as healthcare- and development environments, as a stress reducing element part of restorative design. (48; 53; - 60.)

## MOST PLEASANT WOOD SURFACES



The Haptic Research Island experiment, conducted by Kymenlaakso University of Applied Sciences, studied what kind of wood materials people like the most and what type of components of experience are connected to their preferences. Finely sawn spruce, old oak, oak log, grey oak, BirchUp –special glulam, lacquered oak parquet, OSB –panel, glued laminated birch and laminate. Results show that the most pleasant materials among test subjects were glued laminated birch, old oak, oak log and grey oak. They were found to be beautiful and causing the least negative emotions. Finely sawn spruce, laminate, OBS –panel and lacquered oak parquet were least liked. They were considered to be least esthetic and causing most negative emotions. (61.)

## CASE 4 / PLACE FOR EMOTIONS

PETRI HEINO

### **FRIROM, ST. OLAV HOSPITAL, NORWAY**

Year of completion: 2013

Architecture by Suunniva Huus Norbø and Maren Storihle Ødegård

Our environment most affects people who are stressed. FRIrom is a nine square meter wooden pavilion, which is located on the roof the clinic for women and children of St. Olav hospital in Trondheim. FRIrom is created to be a place with a good atmosphere and where family members and patients can find a feeling of peace and safety in their difficult circumstances. It is a place where everyone can enjoy quietness and being without any restrictions resulting from the environment – no obligations, no expectations, no interruptions.

Throughout the design process the architects studied factors that affect human beings, such as light, the sky and natural materials. Their aim was to create an environment and space for contemplation, as well as give something back to the user. They looked for the same type of feeling, which happens when one sits around a campfire – there one can be quiet, just sit and look at the flames that live their own lives, feel warmth and the smell of burning wood. (62.)

Most humans are conscious of their own private space around themselves. Evaluation and control of the own space are necessities for relaxation and a sense of security. The shape of the pavilion is an inwardly rotating spiral, which has a round space inside it. The shape closes the human inside it, but also always has an open and clear way out. A big glass door provides the user with control of the environment, during both entry and exit. Footsteps that are machined into the floor, hooks on the walls and a seat that organically grows out of a solid wood wall, guide the users to take their coat and shoes off. Doing just that the user communicates that the space is occupied. Shoes are taken off often only at home, so it helps the users to relax. A wool-surfaced cushion covers the floor of the round space. It is a transformable piece of furniture that together with a large pillow gives the user a freedom in using the space. The room has no ordinary furniture or windows, just a large round skylight and covering solid wood walls. (62; 63.)

## CASE 4 / PLACE FOR EMOTIONS

The pavilion is built out of Norwegian wood, which reminds of forest and nature, unlike many other rooms in the hospital. The implemented solutions are unique and designed especially for this project. The wood parts are made of 50 mm thick laminated pine panels by using a digital model. The annual rings of the gable-wood create an alternating expression on the wall where no spot is similar. New patterns can be found on every visit. Many users of the space have mentioned nature as an important source of peace and recovery. Research has also shown a significant connection between the elements of nature and stress level declines. In a hospital, it is difficult to get a daily connection with nature. Use of natural materials such as wood can bring elements of nature to places where it is normally not so easy. (62; 63.)

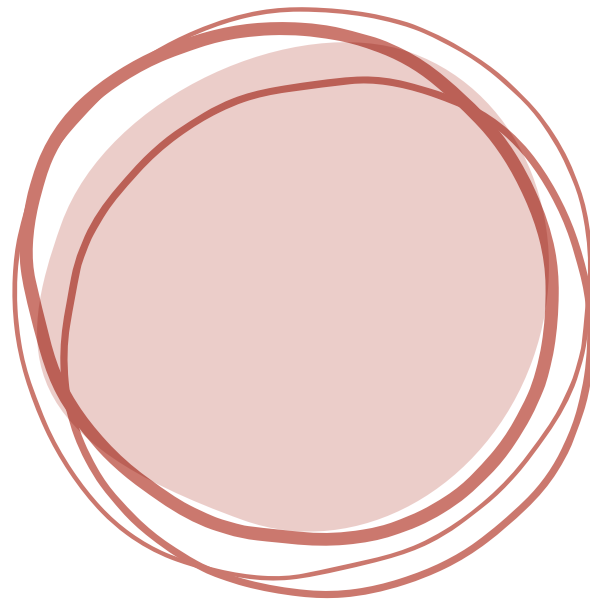
The acoustic environment of a room, which can be heard when a person has settled down to the space, is dominated by the sounds of birds and water. Sound is calming. It is also possible to play your own records or to enjoy complete silence. The experience of the space is different based on the time of the day or the year. During daytime the skylight guides one's attention towards the sky and natural light, which is constantly changing. When darkness arrives, small origami cranes, which have a light source in them, come out and create a feeling of a lower ceiling, therefore completely changing the atmosphere of the space. An origami is an old Japanese art form, which is connected with happiness and hope. Children, family members and partners have made origami cranes as symbols for hope and as memories of something important. (62; 63.)

One of the most important topics in FRIrom is that you can be alone and completely certain that you cannot be seen. Therefore nature could not have been presented by scenic windows or terrace plants alone. A pavilion built entirely out of wood brings nature out in a different way. The architects thought it was important to use wood innovatively by bringing the user a new and unexpected experience. The surface needed to be soft when leaned onto, and to smell natural. The surface is therefore sanded very smooth and processed with a mix of beeswax and linseed oil, which has been added with white pigment. The aim was to retain a tone of blonde wood as time passes. (62.)

## CASE 4 / PLACE FOR EMOTIONS



■ Friom, St. Olav Hospital, Norway  
Sunniva Huus Nordbø and Maren Strohile Ødegård  
Pictures: Pasi Aalto



# HEALTHY INDOOR AIR

MARJUT NOUSIAINEN



■ Picture: picjumbo.com

## Clean air is essential for our wellbeing.

Clean air is essential for our wellbeing. However, it is nowadays very hard to find. The air outdoors is polluted by the industry and traffic, and the indoor air is often even more impure. The majority of the air we breathe during the day is however indoor air, so that its quality largely impacts to our health and the restorativity of the space. Indoor air consists of different type of gases, particles and microbes. Indoor climate on the other hand consists of indoor air and physical factors that impact its quality, such as thermal conditions, airflow, humidity, radiation, lighting and noise. (64: 23; 65; 15.)

Indoor air quality should be of such kind that it does not cause health hazards but that rather it supports the wellbeing of humans. However, in terms of indoor air, the industrialized construction has changed towards the negative and it has become a public health issue (64: 24). Bad indoor air can cause, for example, allergic-, respiratory- and skin-symptoms, irritative symptoms in the eyes, nose, throat and the pharynx, fatigue, headache, nausea, as well as dizziness. Buildings that cause these types of symptoms are often called sick buildings. Buildings that suffer from the sick building –syndrome are often put to use after 1976 and mechanical ventilation is typical to them, which nowadays is required practically in all of new construction. (65: 17 – 20.) The sick building –syndrome dates back to the 1970's energy crisis, when together with the rise of the price of oil, building technique was quickly changed. The changes that were made were mainly based on the conservation of energy, and the quality of indoor climate was largely left without a notice. (64: 75.)

## THE IMPURITIES OF INDOORS AIR

The quality of indoor air is diminished, for example, by construction- and indoor decoration materials as well as furniture and objects effluents, inadequate cleanliness, moisture damage of the building and wrong kind of thermal conditions. Also the human itself and its activities impact the quality of indoor air. (65: 16.) For example, burning candles, use of chemicals and cooking increase indoor air impurities. The location of the building also has a large impact on the quality of indoor air, because the outdoor air pollution make up for part of the indoor air impurities (64: 28). Indoor air can also have harmful radon-radiation, which in the worst case causes lung cancer. Radon can enter the indoor air from the soil under- and around the building, from stony building materials and with household water. (65: 97 – 99.)

The chemical impurities appearing in indoor air are one major cause of indoor air problems. They are, for example, organic compounds i.e. VOC's (volatile organic compounds), evaporating from building- and interior decoration materials, formaldehyde evaporating from many coatings, carbon dioxide caused by human metabolism, and house dust. (65: 31.)

The most essential thing to consider when designing a healthy indoor environment is the chemical impurities originating from building- and indoor decoration materials and furniture, which diminish the quality of indoor air (66). Many soft materials, such as carpets and curtains, soak up impurities and it can be quite a long time that they function as their reservoir, even though the original source of the impurities would have already been removed (65: 38).

# FACTORS THAT INFLUENCE THE QUALITY OF INDOOR CLIMATE

Majority of the humans experiences air temperatures of 21-22 °C as most enjoyable.

## PHYSICAL FACTORS

Also physical factors, such as temperature conditions, radiation, lighting and noise, can influence the person's satisfaction and experience with indoor air quality. Temperature conditions, in addition to air and surface temperatures, including air movement and humidity, can be seen as the most important physical factor influencing indoor air. Air temperature directly influences our spatial experience and satisfaction, together with the excretion of impurities in materials. Also surface material temperatures impact how we experience the air temperature. Majority of the humans experiences air temperatures of 21-22 °C as most enjoyable. Air temperatures higher than that often feel dry and stale, as well as causing fatigue and diminishing the ability to concentrate. On the other hand, cooler air increases draftiness, influences mobility and increases susceptibility to colds and aches. (65: 113 – 114; 67: 10.)

Draftiness induces unpleasantness. The movement of air, low room and surface temperatures, temperatures of airflows, speed fluctuations, direction and hit point, together with the metabolism capacity of the human being, and clothing, can influence the sense of draftiness in a space. In order to avoid draftiness, the speed of air movement should be in right relation to the air temperature. (65: 115.)

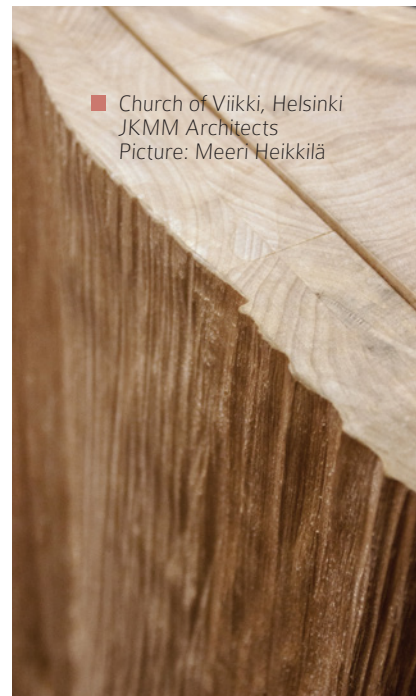
Relative indoor air humidity that is best for the health can be hard to attain during winter-time. The air is often too dry. Buildings that have a completely mechanical ventilation system also generally have dryer air than elsewhere. Air that is too dry increases respiratory-, mucous- and skin irritation symptoms. (7:49.) During summertime in turn, the air is often too moist. Air that is too moist can cause mildewing of constructions and increase of microbes, and thus hinder the building as well as the health of the people. (65: 115). The higher the building's relative air humidity is, the lower its temperature should be (64: 32). Wooden surfaces and plants balance the humidity of indoor air (19: 60, 163).



## WOODEN SURFACES

A space that is decorated with wood has a pleasant indoor climate. Wood surfaces have good thermodynamic properties. Because of its porosity, wood conducts heat poorly, i.e. a wooden surface feels warm. Wood also has a good heat storage capacity, alias heat capacity. For a coniferous is the same level as a brick has. Constructions that have a good heat capacity can store the thermal radiation of the sun, or other excessive heat in the room, to itself, and correspondingly relinquish that stored energy when the room temperature goes down. The layer of wooden surfaces that influence indoor temperatures is approximately 40 mm thick, so a wood veneer alone cannot reach that same result. (52.)

Solid wood surfaces can also even the humidity levels in a space. For its part, this also positively impacts the comfort of humans. Solid wood surface absorbs the humidity caused by humans, which can otherwise feel as cooler air. Correspondingly, a wooden surface also releases moisture to the air when it is needed. Warm wooden surfaces in a space therefore increase the sense of warmth in a space, although the temperature would remain the same. This allows for the decrease of indoor temperatures without lowering the comfort, and thus resulting to energy saving. (68.)



■ Church of Viikki, Helsinki  
JKMM Architects  
Picture: Meeri Heikkilä

## FINNISH INDOOR CLIMATE CLASSIFICATIONS



The indoor air classification standardization is ongoing in Europe. In Finland the quality of indoor climate is divided into three classes, S1, S2 and S3. The indoor climate classifications can be used in setting indoor climate objectives when designing the space.

- **S1:** The building's indoor air is of excellent quality and the space has no noticeable smells. The space has no damages or impurities that diminish the quality of air. The temperature conditions are enjoyable and they can be controlled. The space has no draft or overheating. The space has very good sound- and lighting conditions in accordance with the intended use.
- **S2:** The building's indoor air quality is of good quality and the space has no disruptive smells. The space has no damages or impurities that diminish the quality of air. The temperature conditions are good and usually there is no draft, but overheating is possible during summertime. The space also has good sound- and lighting conditions in accordance with its intended use.
- **S3:** The building's indoor air quality, temperature conditions as well as sound- and lighting conditions are satisfactory and meet the minimum building requirements. (66.)

# IMPROVING THE QUALITY OF INDOOR AIR

## EMISSION-FREE MATERIALS – FINNISH CLASSIFICATION

One can improve the quality of indoor air, among other things, by decreasing the amount of emissions or increasing the efficiency of ventilation. Emission standards have been developed in order to reduce the emissions of materials. Based on their emissions, tested construction materials are divided into emission stages M1, M2 and M3, of which M1 is the best or lowest emission stage. The materials' emission stages define, for example, the total concentration levels (TVOC) of the dissolving organic compounds, as well as the upper limits of formaldehyde and ammonia emissions in all stages. In a restorative environment one should mainly aim to use M1 –stage low emission materials. (66.) All the listed M1 –marked low emission materials have been listed on the Finnish Construction Foundation's website ([www.rts.fi](http://www.rts.fi)). Also, some of the fixtures, such as kitchen furniture, have received a M1 –standard.

Often the largest emissions come from artificial materials, such as plastics, glues and paints, whereas natural materials are less toxic and healthier for human beings. The older the buildings are, the less emissions come from their materials. New furniture and paints however always bring new emissions to the air and it would be good to replace them with non-poisonous natural alternatives. (19: 162 – 164.) In addition to surface materials, one should also pay attention to the emissions of furniture and objects. Everything that a space consists of impacts the quality of its air. In many households the children's room can be thought of as the home's most impure space, because of the plastic toys that are situated there.



■ A green wall.  
Picture: GreenHouseEffect Oy

## PLANTS AS INDOOR AIR CLEANERS

Plants are the only things that can produce clean air and therefore a polluted city cannot have too many trees and plants to improve the quality of its air. Plants improve the quality of air effectively also indoors, because they purify and renew the air as well as remove impurities and harmful substances from indoor air. Research have showed that plants remove toxic chemical substances from indoor air, such as formaldehyde, benzene, acetone and ammonia, that are used, for example, in construction materials and furniture. Some plants also can further develop their abilities of removing particular toxins after being exposed to them. Plants also have positive effects on the regulation of humidity and temperature of the space as well as accumulation of dust. (7: 50 – 51; 19: 60.) However, some plants can also decrease the quality of indoor air by emitting impurities into the air.



■ Ventilation can be intensified with window ventilation.  
Picture: pixgood.com

## VENTILATION

Ventilation is needed in buildings to maintain good indoor air. The building's ventilation is used, for example, to reduce impurities from the indoor air caused by materials and in bringing fresher outdoor air as replacement air. Generally the ventilation is organized so that the air flows from clean spaces of the building towards the dirty ones and exits therefrom. Because of the accruing impurities to the air, ventilation that is too small is harmful to health. On the other hand, ventilation that is too large wastes energy and creates disturbing draftiness. The ventilation can be managed gravitationally or mechanically. (65: 119, 139.)

Gravitational ventilation is natural, self-sufficient, economical, silent, healthy and long-lasting alternative to the ventilation of a building (7: 78). Gravitational ventilation is based on the temperature and pressure differences of outdoor- and indoor air. The effect of gravitational ventilation varies with weather conditions. It works best when there are large differences between indoor- and outdoor air temperatures and pressures. Thus, gravitational ventilation works best during wintertime and is at its worst during summertime. If no temperature differences or wind occur, then ventilation can remain nonexistent and it should be intensified with window ventilation. (65: 123.) "Sick building"-syndrome symptoms do not occur in buildings that have gravitational ventilation, compared with mechanically ventilated buildings where they often occur (7: 78).

Mechanical ventilation can be arranged with output air ventilation only, or both input- and output air ventilation. In mechanical output air ventilation the flow of air from inside to outside is intensified through exhaust fans, alias powered roof ventilation. In this way the flow of air can be held constant regardless of weather conditions. In mechanical input- and out air ventilation the incoming air is also conducted into the building mechanically. In this way incoming air can also be filtered and warmed up prior to it being imported. (65: 123 – 124.) The cleaning of the ventilation systems should receive extra attention so that they do not turn into sources of air impurities themselves. (64: 93).

## **FILTERED INDOOR AIR IN HEALTHCARE ENVIRONMENTS**

A healthcare environment creates many challenges in terms of healthy indoor air. Infections can spread from patient to patient through air and the immunity of many patients is also lower than normal. Good indoor air is therefore a prerequisite for every healthcare environment. With efficient ventilation and air filtering one can maintain a good quality of indoor air and reduce the manifestation and spread of infections. In terms of the spread of infections, the most sensitive areas of healthcare environments are, for example, surgical wards, intensive burn care units, where patients have an immune deficiency. Efficient HEPA –air filters (high-efficiency particulate air filters) are recommended for use at least in these areas, but also other spaces must have efficient ventilation. Many studies have shown that HEPA –filters are very efficient in filtering harmful pathogens off the air. Sufficient ventilation and regular cleaning and maintenance of ventilation systems are essential in controlling the pathogens of air. (13.) In terms of the quality of air in healthcare environments one must also consider low emission materials and the cleanability of surfaces. In healthcare environments, as in other buildings too, efficient ventilation and low construction- and interior decoration emissions are most fundamental tools in the creation of healthy indoor air.

**Good indoor air is a prerequisite for every healthcare environment.**

# CASE 5 / A BUILDING THAT IS CONTROLLED WITH REGARD TO ITS INDOOR AIR

PETRI HEINO

## **LUUKKU HOUSE, MÄNTYHARJU**

Year of completion: 2010

Architecture by Aalto University

Because of its high quality of indoor air control and visual appearance, the Luukku House was selected as a case-subject that portrays healthy indoor air. With the Luukku House, the Aalto University architecture team participated in the Solar Decathlon Europe 2010 Competition. The goal of the team was to realize a wooden dwelling house, which would be as competitive as possible for the Madrid contest, but would at the same time function as an experimental house for Finnish zero-energy-building. The project's sub-goals were associated with the advancement of Finnish energy efficient building and discovery of new innovative solutions. Wood was chosen as the building- and interior decoration material, because of its ecological properties, and also for its visual and functional idiosyncrasies, that assist in the different events of the decathlon. (69; 70.)

The building's indoor air control is tightly connected to its energy efficiency. In designing an energy efficient building, powered by solar energy, one should pay particular attention to prevailing temperatures, the relative humidity, rotation of the sun, and the amount of solar radiation. A compact building sheathing is a precondition to good indoor air and energy efficiency. It was realized with meticulous construction, use of right structures and airtightness measurement. The temperature control of the house was carried out with structural solutions and ventilation. PCM (phase changing material) was also utilized in the house, which, in particular temperatures, changes its state and binds or releases thermal energy with changes in temperature. (69; 70.)

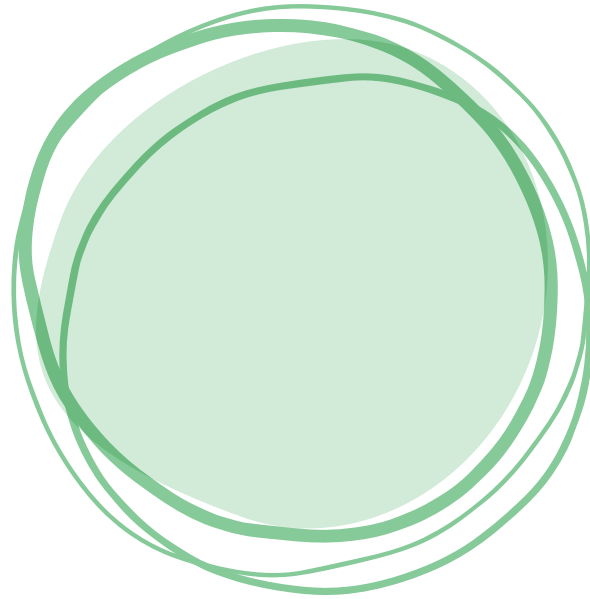
The aim was to control indoor air humidity levels with ventilation and the hygroscopic properties of wooden surfaces. This was realized partially by maximizing the use of wooden surfaces. Many of the visible surfaces were wooden but, in addition to that, the wall panels were castelated and the air flows behind the panels, which increases the scope of the wooden surface. Wood was also used in the furniture in a surface maximizing way. The house functioned superbly

## CASE 5 / A BUILDING THAT IS CONTROLLED WITH REGARD TO ITS INDOOR AIR

as an energy-plus-house in Madrid. Later measurements showed that the house was a zero-energy-building in Helsinki. Management of indoor air conditions was achieved with excellently chosen active and passive operations. The house received top scores for its architecture; the insightful and elegant use of wood had a significant role in it. (69; 70.)



■ Luukku House, Mäntylharju. Aalto University  
Pictures: Sarianna Salminen



# NATURE CONNECTEDNESS

MARJUT NOUSIAINEN





The favorite places of humans are often natural environments where people retreat when they want to be alone, clarify their thoughts, gather strength or recover something. Research has shown that people enjoy a walk in a natural environment more than in an urban environment, particularly if they need to recover from stress. We experience many natural environments as appeasing, revitalizing and pleasant surroundings that maintain our inner balance. Our experience is partially depended to that we experience some places, such as natural environments, as less demanding than other places, such as urban environments. Some places are naturally more restorative than others, but our own preferences influence how we experience our environment as well. Also, other than natural environments can be experienced as restorative. Generally, restorative environments please the eye and they are fascinating and interesting. They do not only enable stress recovery but also enhance it. (3; 16: 94 – 97.)

Nature connectedness is essential for our wellbeing (4). The viewing as well as experiencing of nature has revitalizing and stress reducing influences on a human being. However, we still spend the majority of our time in constructed, and often very unnatural environments. Luckily, we can experience the connectedness with nature in many ways in a constructed environment as well. With restorative design one can create a deeper connection between a human being and the nature. The most relevant thing is the location and window-view of the building. What we see through a window influences our mood and health. The more there are windows in various

■ Hospice Djursland, Denmark.  
C.F.Møller Architects  
Picture: Adam Moerk

**Nature connectedness is essential for our wellbeing**

# NATURE VIEW

■ *Windows allow the scenery to be part of the decoration*  
Picture: Morguefile.com



directions, the more scenery we get inside.

Although our scenery would not be a verdant forest or a blue ocean, through the window we often get natural light, which connects us with nature. Natural light changes as the day progresses and creates a natural circadian rhythm to us. Lacking natural scenery can also be compensated, if necessary, with pictures of nature or by concretely bringing nature inside in the form of plants or natural materials. All these connections with nature have proven positive effects on our wellbeing. Previously in this book we have dealt with natural light and natural materials. Now we will focus on nature view and plants.

## WINDOW VIEW

The location of the building has a significant impact also on how we experience the interior space. Windows connect the interior and exterior and allow the scenery to be part of the decoration. They give natural light, information about the weather and create a connection with the surrounding time and place. There is a lot of difference whether one can see buildings, a forest or a park through the window. Many of us need the peace of nature and enjoy natural sceneries. Several studies have also shown that viewing natural scenery can ease stress significantly more efficiently than viewing a constructed environment (23). In order for a view to be healthy, it should therefore always have something natural, not only constructed environment. Especially water, vegetation and sceneries, that are not overly complicated or too simple and that have depth and a point of reference, are experienced as pleasing (16: 103 – 104). For example, looking at a horizon is very pacifying. Nature captures our attention and interest delicately but efficiently and therefore offers positive stimulus. The positive effects of viewing nature can

## Nature view alleviates stress.

occur already in as much as 3-5 minutes. (23.) Looking at a nature view enhances our mood and concentration, as well as reduces stress and negative emotions, such as fear, anxiety, anger and grief (71). Physical effects can be seen as positive changes, for example, in blood pressure, heart rate and muscle tension (23). Nature view in a working environment can concretely influence, for example, efficiency, job satisfaction and productivity. In studying the role of nature in workplaces, we have found out that workers do not want to work in spaces without windows. (10.)

### THE SIGNIFICANCE OF A NATURE VIEW IN HEALTHCARE ENVIRONMENTS

The location and scenery of a building are particularly important in healthcare environments. For the patients to be able to look out through a window, regardless of the landscape, helps them to stay in touch with the world. Every patient room should always have a window. The significance of a nature view is highlighted especially in a hospital, where patients experience stress, because the healing implications of nature are even larger to a human being who has a true need for recovery (3). Nature offers a tranquil positive stimulation that can bring the patient's thoughts away from his or her own state or sickness (11). Looking at nature can quickly, already in a few minutes, alleviate stress, but looking at it for even a longer time can also speed up and facilitate the patients' recovery (23). It has been shown that a view outside to nature influences the patients recovering from a surgery more than a view to a neighboring house. In the tests, the patients recovering from a surgery that were placed in rooms that provided a view to nature recovered faster than patients in similar rooms that had a view to a brick wall. They also needed less pain medication and were mentally better off than the comparison group. The significance of a window view is highlighted in the case of patients recovering from a surgery, because it can be their only connection with nature. The results showed that in designing and locating hospitals one should also take window views into account. (71.) The direction of the windows also has relevance in terms of sunniness. Depression patients have been observed to return home faster, and the mortality rate of myocardial infarction patients has been lower on the building's sunny side compared with the shady side. A healthcare environment should always have a view to a nature view through the window, pictures of nature or a possibility to access the garden. (12.)



## AN ARTIFICIAL NATURE VIEW

In order to have a restorative experience of nature one does not necessarily need a real nature view. In places where real nature is not possible, a virtual nature view or pictures of nature can also influence positively. For example, a study done in Sweden investigated if pictures of nature have an effect on the recovery of heart surgery patients. The results showed that the patients who looked at pictures of nature experienced less anxiety and needed less of the strong pain medication than the comparison group that had no pictures. (12.) Many tests have also used video material of nature instead of a real nature view. Studies have shown that even a short session of watching at a film of nature can help in alleviating stress. Studies, where humans have been first exposed to stressful video material and then either to a nature- or city view, have shown that recovery from stress is faster and more complete when looking at a nature view rather than an urban environment. This was seen in the results of physiological tests already after 3 minutes of watching, as well as in positive evaluations from the test subjects. (2.) Very realistic virtual nature environments, made possible by the modern technology, can too make a revitalizing experience of nature. This is essential, particularly to those who are not themselves able to get out, such as many of the elderly or patients recovering from a surgery, or to people spending long times in solitary confinement, such as astronauts or submarine crews. (72.)

# PLANTS

## HOUSEPLANTS

Plants in indoor spaces connect us with nature and bring life to an indoor environment. Positive effects of plants in indoor spaces are significant and multi-disciplinary. Plants, for example, substantially increase the quality of indoor air, influence the regulation of the humidity and dust buildup of the space, as well as soften the environment visually and acoustically. Scents of plants, especially of herbs, can also freshen the air with their smell and create positive fragrance experiences. (7: 49-51;

19: 60; 24: 43.) Positive effects of plants can also be psychological, because the act of just looking at plants has found to impact us in a positive way (23). According to research, plants in windowless spaces can; increase efficiency, attention and productivity, increase pain tolerance, lower blood pressure and alleviate stress. Houseplants therefore have similar positive effects as watching nature has. (73; 74.)

## GARDENS

The opportunity to visit a garden, for example in a working environment or healthcare environment, functions restoratively even in a more multi-disciplinary way, because like a forest, the garden can occupy all of our senses. Studies have shown that having a garden at work positively impacts, among other things, stress and comfort (8). Nature can also be brought into a healthcare environment in the form of an appealing garden, which, to many patients, makes a concrete touch with nature possible and also offers a nature view from many windows (12). Several studies have shown that having gardens in hospital environments has many positive restorative effects. A garden is a very therapeutic environment. It can reduce stress and lift the mood of patients as well as the staff. It can also increase the amount of social support and offer a hiding place out from the clinical healthcare environment to the patients, the family as well as the staff. (23.) All of them have a good opportunity to visit the garden or elsewhere in the courtyard, where there would be walkways, seats, beautiful nature and fresh air to offer. Verdant rooftop gardens and indoor gardens are also good alternatives.

■ Plants have a positive impact on the quality of the indoor environment.  
Picture: deathtothestockphoto.com



■ Rooftop garden  
St. Olav Hospital, Norway  
Picture: Pasi Aalto

## CASE 6 / NATURE IN A CONSTRUCTED ENVIRONMENT

PETRI HEINO

### **WOODEN TOWN OF MYLLYPURO, HELSINKI**

Land-use planning by Architecture firm Artto Palo Rossi Tikka Oy

A land-use plan for around 1500 residents of a tight wooden structured town house area was carried out in the Myllypuro water tower surroundings in Helsinki. The plan is based on an international architecture competition, which was won by Architecture firm Artto Palo Rossi Tikka Oy. The City Planning Department's land-use plan was order in 2004 and now, 10 years later, the area is under construction. The reason for slow progress is in land-use plan appeals. The logging of nearby forests is a concern for many citizens.

In addition to language and the people, forests had a strong role in building the Finnish national identity. Romantic nationalist artists portrayed the beauty, spirituality and sanctity of the Finnish forest nature. On the other hand it led to the reverence of the forests, but then also into their total exploitation. We have the forests to thank for our current standard of living. At the same time the seeds of contradictive attitudes about our forests were being planted. People still think of wood as an ecological and positive thing, but the logging of wood evokes some protesting. Foresters have failed in the preservation of the Finnish primeval forests. The paintings of the old growth forests by Gallen-Kallela and Halonen have been installed into the consciousness of the nation and are the cornerstones of every Finns' mind. The artistic communion with intensive forestry has not come to exist. The communion is just economic, and on the other hand social; the Finnish families do own the forests.

The arrangement of street- and house networks in Myllypuro's sensitive and challenging terrain of solid rocks, and old- and dead pine trees, was a difficult task. In order to achieve an efficient structure, the chains of houses have been gathered so that they form a tight urban structure that follows the contour of the terrain. The construction is firmly in line with the streets, which creates a strong contrast between the surrounding nature and the street space. The yard -side of the houses remains, if possible, natural by conserving the trees and repairing the damages that have occurred to the undergrowth during construction. The urban space between the chains of houses reminds of the milieu and construction principles of the wooden towns of the past. The common street in the area forms a quite narrow street network, of which

## CASE 6 / NATURE IN A CONSTRUCTED ENVIRONMENT

the living streets branch out to the plots. The modular dimension of the folding of the living streets is 50 meters, and as the construction zone is 9 meters deep, there is at least 21 meters of yard space that is left between the houses. [75.]

At present, about a half of the area has been finished. The liaison between the constructed and natural environment is very successful in the blocks that have been actualized so far. The pristine taiga forest, erratic blocks, surfaces of solid rocks and the diverse deadwoods in the yards have often been managed to remain completely untouched. All the houses have a view and access to a natural forest. However, the forest strip is narrow, and thus the next bloc of houses can be seen through the trees. The contrast between the urbanity of the streets and the naturalness of the yards is large. This project is a great example of efficient city development that respects nature as well as considers the humans' longing for nature.



■ Wooden town of Myllypuro, Helsinki  
Pictures: Meeri Heikkilä

# CLOSING WORDS

MARJUT NOUSIAINEN  
HEIKKI LINDROOS  
PETRI HEINO

Our path to finding the restorative environment has begun already in 2005. At the time, the Kymenlaakso University of Applied Sciences interior design teacher Heikki Lindroos started the Modo –design competitions for design students. It had the goal of finding new type of approaches to design problems and to make the designers to think about their task from a broader perspective. The assignments deviated from what was customary and they approached the design subject differently. There was an open atmosphere of doing together; doing the work together developed solutions to the challenges of the. There are confluences between the themes of the competitions and the subject matter of the book. The theme of one year was Sensory Ergonomics, in which case the aim was to get the students to think about the experience of space and products in a multisensory way. The concept of multisensory was created for this purpose. The theme of the last Modo –competition was Healing Environment, whereof our thought about restorativeness was also beginning to develop concretely. The international participants of the competition were trying to think that what a wooden space or product, that supported human wellbeing, would be like.

Since then, Kymenlaakso University of Applied Sciences established the Wood Academy, which brought restorative thinking and wood together. Wood Academy sought to increase the use and knowledge of wood. As other materials have evolved, the role of wood in society has diminished. There has been a fantasy that materials have no relevance on humans. However, with restorative think-

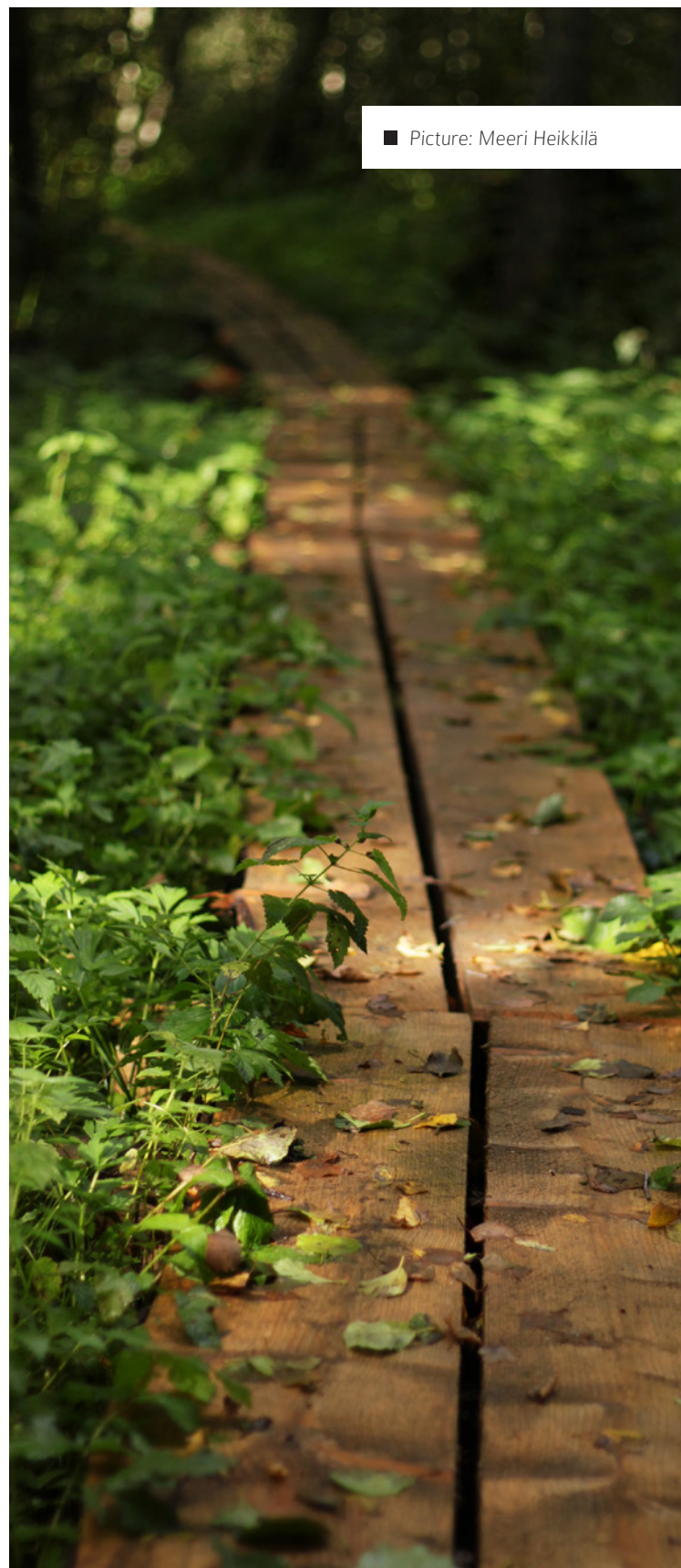


ing we have come to learn that everything that a space is consisted of has importance for humans. Studies that have been conducted clearly show the restorative properties of wood. Wood is more than a sustainable ecological material; it touches the human being. But how does it work?

Through the multidisciplinary team of experts that was gathered around Wood Academy and the interdisciplinary discourse we have learned more about wood as a material, about a restorative environment and the connection between the two. However, we are only in the beginning of the path of understanding. More research is needed on the positive effects of wood.

In this book we become more familiar with the complexity of restorative design, multidisciplinary and interdisciplinary in the designer- and customer sectors. It is important to be aware of one's place, opportunities and responsibilities as an individual in a rapidly changing world. Our possibilities of designing better environments are good, as long as we are aware of them. The restorative approach in design will be even more important in the future. It is one way to cope with the challenges of the future. Wood is an outstanding material in restorative design. It can be utilized with many different techniques and its psychological possibilities of influence are yet largely unexamined. The connection between the human and nature lies within us. The roots of humans and wood are also deep in the same soil.

We invite everyone to this collective path  
[www.facebook.com/restorative](http://www.facebook.com/restorative).



# SOURCES

1. Korpela, Kalevi 1999: Are favorite places restorative environments? *EDRA 22/1999 Healthy Environments*.
2. Ulrich, Roger S.; Simons, Robert F.; Losito, Barbara D.; Fiorito, Evelyn; Miles, Mark A. & Zelson, Michael 1991: Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology* (1991) 11. 201 – 230.
3. Hartig, Terry & Staats, Henk 2006: Linking preference for environments with their restorative quality. *Teoksessa From landscape research to landscape planning. Aspects of integration, education and application, toim. Bärbel Tress, Gunther Tress, Gary Fry & Paul Opdam. The Netherlands: Springer. 279 – 292.*
4. Kaplan, Stephen 1992: *The Restorative Environment, Nature and Human Experience. The role of Horticulture in Human Well-Being and Social Development.* Portland, OR: Timber Press.
5. Kellert, Stephen R. 2005: *Designing Healthy Schools. Independent School* (2005) 65. 58 – 61.
6. Kellert, Stephen R. & Wilson Edward O. 1993: *The Biophilia Hypothesis.* Washington: Island Press.
7. Aminoff, Jalo & Kontinen, Leena 2004: *Terve koti ja asuinympäristö.* Helsinki: Rakennustieto.
8. Stigsdotter, Ulrika A. 2004: *A Garden at your Workplace may Reduce Stress.* Stockholm: International Academy for Design and Health. 147 – 157.
9. Hartig, Terry; Korpela, Kalevi; Evans, Gary W. & Gärling, Tommy 1997: *A measure of Restorative Quality in Environments.* *Scandinavian Housing & Planning Research* 14. 175 – 194.
10. Kaplan, Rachel 1993: *The role of nature in the context of the workplace.* *Landscape and Urban Planning*, 26 (1993). Amsterdam: Elsevier Science Publishers B.V. 193 – 201.
11. Ulrich, Roger S. 1991: *Effects of interior design on wellness: Theory and recent scientific research.* *Journal of Healthcare Interior Design* (1991) vol. 3. 97 – 109.
12. Ulrich, Roger S. 2000: *Evidence based environmental design for improving medical outcomes. Healing by design: Building for Healthcare in the 21st Century,* Montreal. Accessible at [https://www.researchgate.net/publication/254623064\\_Evidence\\_Based\\_Environmental\\_Design\\_for\\_Improving\\_Medical\\_Outcomes](https://www.researchgate.net/publication/254623064_Evidence_Based_Environmental_Design_for_Improving_Medical_Outcomes) [cited: 12.9.2014].
13. Joseph, Anjali 2010: *Hospital that heal - Hospital design for the 21st century.* Secunderabad: Asian Hospital and Healthcare mangement. Accessible at <http://www.asian-hhm.com/healthcare-management/hospitals-heal> [cited: 3.9.2014].
14. Nightingale, Florence 1964: *Sairaanhoidosta.* 3.p. Helsinki: WSOY.
15. Ulrich, Roger S.; Quan Xiaboo; Zimring, Craig; Joseph, Anjali & Choudhary, Ruchi 2004: *The Role of the Physical Environment in the Hospital of the 21<sup>st</sup> Century: A Once-in-a-Lifetime Opportunity.* Concord: The Center for Health Design.

16. Aura, Seppo; Horelli, Liisa & Korpela, Kalevi 1997: Ympäristöpsykologian perusteet. Helsinki: WSOY.
17. Nuikkinen, Kaisa 2011: Learning Spaces: How They Meet Evolving Educational Needs. Teoksessa *The Best School in the world, Seven Finnish Examples from the 21st Century*, toim. Maija Kasvio. Helsinki: Museum of Finnish Architecture. 10 – 19.
18. Pallasmaa, Juhani 2012 : *The eyes of the skin: Architecture and the senses*. 3.p. West Sussex: John Wiley & Sons Ltd.
19. Day, Christopher 2014: *Places of the soul, Architecture and Environmental Design as a Healing Art*. 3.p. New York: Routledge.
20. Jokiniemi, Jukka 2007: *Kaupunki kaikille aisteille – Moniaistisuus ja saavutettavuus rakennetussa ympäristössä*. Väitöskirja. Helsinki: Teknillinen korkeakoulu, Arkkitehtiosasto, Kaupunkisuunnittelu.
21. Virtanen, Anne 2000: *Tilasta paikkaan, estetiikasta ekologiaan: Maantieteellisiä tulkintoja eletystä kaupungista*. Väitöskirja. Turun yliopiston julkaisuja C155. Turku: Painosalama.
22. Ackermann, Diane 1990: *Aistien historiaa (A natural history of the senses)*. Helsinki: WSOY.
23. Ulrich, Roger S. 2002: *Health Benefits of Gardens in Hospitals. Plants for people*. International Exhibition Floriade 2002.
24. Day, Christopher 2002: *Spirit & Place*. United Kingdom: Butterworth-Heinemann.
25. Launis, Martti & Lehtelä, Jouni 2011: *Ergonomia*. Helsinki: Työterveyslaitos.
26. RIL 243-1-2007: *Rakennusten akustinen suunnittelu, akustiikan perusteet*. Helsinki: Suomen Rakennusinsinöörien Liitto RIL ry.
27. Berglund, Birgitta; Lindvall, Thomas & Schwela, Dietrich H. 1999: *Guidelines for community noise*. Geneva: World Health Organization WHO. Accessible at [http://www.bape.gouv.qc.ca/sections/mandats/du\\_vallon/documents/DB19.pdf](http://www.bape.gouv.qc.ca/sections/mandats/du_vallon/documents/DB19.pdf) [cited 3.9.2014].
28. Wagenaar, Cor 2006: *The architecture of hospitals*. Amsterdam: Nai Publishers.
29. Tuominen, Jari 2012: *Tuoksujen ihmeellinen maailma*. Helsinki: Kustannusosakeyhtiö Kureeri.
30. Rihlana, Seppo 1999: *Valaistus ja värit sisustus-suunnittelussa*. Helsinki: Rakennustieto Oy.
31. Halonen, Liisa & Lehtovaara, Jorma 1992: *Valaistustekniikka*. Espoo: Otatieto Oy.
32. Conran, Terence 2009: *Eco House book*. London: Conran Octopus Ltd.
33. Edwards, L. & Torcellini P. 2002: *A Literature Review of the Effects of Natural Light on Building Occupants*. Technical report. Colorado: National Renewable Energy

Laboratory. Accessible at [www.nrel.gov/docs/fy02osti/30769.pdf](http://www.nrel.gov/docs/fy02osti/30769.pdf) [cited 3.9.2014].

34. Zilber Steven A. 1993: Review of health effects of indoor lighting. Kent: Architronic. Accessible at <http://www.pembaserv.com/lighting%20health%20effects.htm> [cited: 3.9.2014].

35. Motiva 2010: Joka kodin valaistusopas. Helsinki: Motiva Oy. Accessible at [www.lamputtieto.fi](http://www.lamputtieto.fi) [cited: 13.8.2014].

36. Sojoudi, Sahar 2012: Indoor lighting of the classes and its effects. Department of Architecture, Faculty of Design and Architecture, Universiti Putra Malaysia. Accessible at [http://6thsastech.khi.ac.ir/data1/urb%20&%20arc/1%20\(10\).pdf](http://6thsastech.khi.ac.ir/data1/urb%20&%20arc/1%20(10).pdf) [cited: 4.9.2014].

37. Nayar, Jean 2008: Healing light. Artikkel: Contract Oct2008, Vol. 49 Issue 10. 3.p. Database: MasterFILE Elite. 42 – 46.

38. Philips 2014: Mitä on dynaaminen valaistus? Accessible at <http://www.lighting.philips.fi/ratkaisut/teemat/dynaaminen-valaistus.html> [cited: 21.10.2014].

39. Philips 2014: Am Kirschbaumer Hof -palvelutalo. Accessible at <http://www.lighting.philips.fi/projects/am-kirschbaumer-hof.wpd> [cited: 21.10.2014].

40. Soddu, Celestino 1992: Generative Art & Science. Rome: Celestino Soddu and Enrica Colabella architects. Accessible at [www.soddu.it](http://www.soddu.it) [cited: 10.10.2014].

41. Generative Design Lab. Accessible at [http://www.generative-design.com/index\\_lab.htm](http://www.generative-design.com/index_lab.htm) [cited 10.10.2014].

42. Soddu, Celestino 2006: Generative Design, A swimmer in a Natural Sea Frame. Rome: Celestino Soddu and Enrica Colabella architects. Saatavilla: [www.argenia.it](http://www.argenia.it) [cited: 10.10.2014].

43. Colabella, Enrica 2008: Generative Design. Unpublished paper presented at 11th Generative Art Conference, Milano, Italy.

44. Soddu, Celestino 1994: Generative Art. Rome: Celestino Soddu and Enrica Colabella architects. Accessible at [www.argenia.it](http://www.argenia.it) [cited: 10.10.2014].

45. Aust, Steve 2006: In search of...Wayfinding. Cincinnati: Signweb. Accessible at <http://www.signweb.com/content/in-search-ofwayfinding#.VCQE1hac0pU> [cited 25.9.2014].

46. Fell, David & Lavoie, Patrick 2009: Opportunities for increased use of wood as a visual material in built environments. Quebec: FPInnovations – Forintek Division.

47. Joseph, Anjali 2006: Impact of the environment on infections in healthcare facilities. Concord: The Center for Health Design. Accessible at <https://www.healthdesign.org/chd/research/impact-environment-infectionshealth-care-facilities> [cited: 15.9.2014].

48. Bringslimark, Tina & Nyrud, Anders 2009: Patient rooms with different degrees of wood: A preference study conducted among hospital staff. Norway: Treteknisk.

49. Arkkitehtuuria puusta – from wood to architecture

2005. Helsinki: Suomen Rakennustaiteen museo.
50. RT RakMK-21502: Rakennusten paloturvallisuus, määräykset ja ohjeet 2011. Suomen rakentamismääräyskokoelma. Helsinki: Rakennustietosäätiö.
51. RT 08-11098: Sisusteiden paloturvallisuus, julkiset tilat. Helsinki: Rakennustietosäätiö.
52. Siikanen, Unto 2008: Puurakentaminen. Helsinki: Rakennustieto.
53. Fell, David 2010: Wood in the human environment: Restorative properties of wood in the built indoor environment. Vancouver: The University of British Columbia.
54. Human Research (1): Stonepine – Positive health effects of stone pine furniture. Weiz: Human Research, Institute of Health Technology and Prevention Research.
55. Human Research (2): Solid fir furniture reduces strain, during and after concentration periods. Weiz: Human Research, Institute of Health Technology and Prevention Research.
56. Sakuragawa, Satoshi; Miyazaki, Yoshifumi; Kaneko, Tomoyuki & Makita, Teruo 2005: Influence of wood wall panels on physiological and psychological responses. Japan: Journal of Wood Science (2005)51. 136 – 140.
57. Sakuragawa, Satoshi 2006: Change in the impression of rooms with interior wood finishes arranged differently: questionnaire survey with the use of photographs for the analysis of impressions of rooms concerning living activities. Japan: Journal of Wood Science (2006) 52. 290 – 294.
58. Sakuragawa, Satoshi; Kaneko, Tomoyuki & Miyazaki, Yoshifumi 2007: Effects of contact with wood on blood pressure and subjective evaluation. Japan: Journal of Wood Science (2008) 54. 107 – 113.
59. Tsunetsugu, Yuko; Miyazaki, Yoshifumi & Sato, Hiroshi 2005: Visual effects of interior design in actual-size living rooms on physiological responses. Japan: Building and Environment 40 (2005). 1341 – 1346.
60. Tsunetsugu, Yuko; Miyazaki, Yoshifumi & Sato, Hiroshi 2007: Physiological effects in humans induced by the visual stimulation of room interiors with different wood quantities. Japan: Journal of Wood Science (2007) 53(1). 11 – 16.
61. Wallenius, Marjut 2014: Haptic Research Island. Kouvola: Kymenlaakson ammattikorkeakoulu.
62. Nordbø, Sunniva Huus 2014: Sähköpostihaastattelu 29.10.2014.
63. Frirom 2012. Saatavilla: <http://frirom.no/> [viitattu 29.10.2014].
64. Korhonen, Heikki & Lintunen, Martti 2003: Hyvä sisäilma. Helsinki: Oy Like Kustannus Ltd.
65. Sisäilmätietokeskus 1996: Terveellinen sisäilma. Helsinki: Suomen Sisäilmaston Mittauspalvelu Oy.
66. RT 07-10946: Sisäilmastoluokitus 2008. Helsinki: Rakennustietosäätiö.

67. Haatela, Tari; Nordman, Henrik & Talikka, Mirja 1993: Sisäilma ja terveys. Helsinki: Allergialiitto.
68. Kairi, Matti 2007: Puutuoteala tulevaisuuden tuotantotalana. Päättäjien 22. Metsäakatemia, Jämsänjokilaakso 9. - 11.5.2007.
69. Aalto-yliopisto 2012: Luukku-talo, puinen nollaenergiatalo 2020. Loppuraportti 2012. Helsinki: Aalto-yliopisto, taiteiden ja suunnittelun korkeakoulu.
70. Teknillinen korkeakoulu 2010: Studies done by wood technology students to the Solar Decathlon 2010 project. Julkaisematon raportti. Helsinki: Teknillinen korkeakoulu, Puunjalostustekniikan laitos, Puutuotetekniikka.
71. Ulrich, Roger S. 1984: View through a Window May Influence Recovery from Surgery. *Science* vol. 224 (4647). 420 – 421.
72. Depledge, M. H.; Stone, R. J. & Bird, W. J. 2011: Can Natural and Virtual Environments Be Used To Promote Improved Human Health and Wellbeing? *Environmental Science & Technology*. Washington: ACS Publications.
73. Lohr, Virginia I.; Pearson-Mims, Caroline H. & Goodwin, Georgia K. 1996: Interior Plants May Improve Worker Productivity and Reduce Stress in a Windowless Environment. *Journal of Environmental Horticulture* 14(2). Washington: The Horticultural Research Institute. 97 – 100.
74. Lohr, Virginia I. & Pearson-Mims, Caroline H. 2000: Physical Discomfort May Be Reduced in the Presence of Interior Plants. *HortTechnology* 10. Alexandria: American Society for Horticultural Science. 53 - 58.
75. Arkkitehtityöhuone Artto Palo Rossi Tikka Oy 2004: Myllypuron puukaupunkialue. Arkkitehtityöhuoneen esitys.



