

I CARE HOME



A light filled space
with greenery
supporting elderly people
suffering from dementia

Reminiscent of ordinary encounters...

*A walk in the forest,
Flowers sprouting from the ground.
Basking in the morning sun,
Barefoot in the sand.
The scent of Magnolias roaming through the park,
At the seaside eyes will shut.
The gust of wind,
Sudden summer rain,
Abundance.*



Figure 1 (Cover page): A view towards nature
Figure 2: Sunset in Copenhagen

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ABSTRACT

The focus of this thesis paper revolves around the healing, positive effects of nature and lighting in improving life quality in the context of care homes, for elderly people suffering from dementia. Under these premises the development of the design solution has been drawn cross-disciplinary, amongst scientific, technical and creative approaches to light.

The goal of this paper is to highlight specific methodologies and design tools that are applicable according to the cognitive and mobility limitations that dementia causes in patients. Through a vast literature survey, a design scheme and criteria are highlighted, tackling amongst others, the topics of nature, light and the build environment, suggesting a synergy between them. The goal is to reinforce the human-nature connection in care homes, under the key constrain of the indoor space. Here, a research gap appears whereas majority of light-filled spaces with greenery for dementia patients have only had applicability outdoor.

A lighting design solution is being proposed in the contextual case of Nældebjerg care home, located in Denmark, with an approach shaped according to daylight cycles and seasonal rhythms. Nature remains the core inspiration for the design conceptualisation, aiming to create a room for well being for elderly suffering from dementia.

The applicability of the design, its limitations and further works are being discussed on the basis of dementia relevant assessment tools.

TABLE OF CONTENTS

ABSTRACT

INTRODUCTION

1. MOTIVATION

- 1.1 Dementia - Contextual case Denmark
- 1.2 Living with dementia - a bridge to well being through light and nature
- 1.3 Sensory stimulation

2. VISION

3. METHODOLOGY

- 3.1 Person centred care
- 3.2 NBTS - Nature based therapeutic service
- 3.3 Literature survey
- 3.4 Design experiment model
- 3.4 EAT - Environmental Audit Tool

4. A HOME IN THE CARE HOME

- 4.1 Controlled flow of circadian rhythm
- 4.2 Sensory rooms

5. PROBLEM FORMULATION

- ~Research question

6. NORDIC DAYLIGHT CYCLES

7. LITERATURE REVIEW

- 7.1. NATURE
 - ~ Healing landscapes + criteria
- 7.2 LIGHT
- 7.3 THE BUILD ENVIRONMENT
 - ~Biophilia and sensory stimulation in architecture + criteria

8. DESIGN CRITERIA CHAIN

- 8.1 The receiver ~The brain of perception and memories

9. APPLICATION - SPATIAL DEFINITION AND DAYLIGHT

- 9.1 Space
- 9.2 Geographical orientation
- 9.3 Spatial definition - EAT (Environmental Audit Tool)
- 9.4 Light apertures
 - ~ Shading and Ventilation
 - ~ Daylight factor (DF)
 - ~ Light layers

TABLE OF CONTENTS

10. DESIGN CONCEPT - OVERALL ZONES

A. THE BALCONY

B. THE NOOK

C. THE SEASONAL WALL

~ Danish flora and fauna

~ Exploratory phase

~ Composition balance

~ Seasonal transformations

~ Wall set-up

11. DESIGN DISCUSSION

12. EVALUATION AND FUTURE WORKS

13. CONCLUSION

14. REFERENCE LIST

INTRODUCTION

Research in lighting design in joined application with greenery, appears to have limited extent in the case of indoor examples. Spaces such as atrium, therapeutic outdoor gardens, greenhouses or verandas do however serve as references, yet there is no widespread knowledge in how to replicate them within the perimeter of four walls. Beside of transferring some design methods from these applications, the over returning criteria that has lead the development of this paper, remains 'Nature'. The design approach is rooted in natural elements that are known to form and strengthen the innate connection between humans and the natural world, outlining biophilia and sensory stimulation as medium of communicating. Nature exposure as known and felt by each human alive, which seems as nearly everywhere accessible with every step one takes outside ones home, it almost disappear in the context of care homes. Due to the illness and ageing, dementia patients spend most of their lives indoor.

Dementia as a a syndrome is associated with a range of diseases which are characterised by the progressive impairment of brain functions, including language, memory, perception, personality and cognitive skills (Fay et. al 2010); this case opens vast considerations in the context of improving patients quality of life in care homes. It is certain that a broad spectrum of professional backgrounds (doctors, physiologists, nutritionists, designers) can have a very different, yet complimentary input in aligning dementia limitations with a suitable lighting design concept. Though, this paper focuses on the effect of lighting, and particularly - daylight exposure, according to visual or non visual qualities of light.

Since various studies shown that dementia patients are generally exposed to lower levels of light than recommended (Chaundhury, 2016), the goal is to re-imagine the build environment in care homes and open up apertures for daylight intake, where possible. Given that exposure to higher lighting levels is associated with improved circadian rhythm quality and mood, increased daytime wakefulness, alertness and disruptive behaviour (Chaundhury, 2016) the design solution aims to give better access to daylight, complemented by electric light throughout diurnal and seasonal shifts. Moreover, the stimulative potential coming from greenery, tactile elements and access to view is meant to decrease agitation, allowing patients to wander and connect with community of family in an environment that appears less hospitalized.

The design development follows a criteria chain and methodology formed on the basis of the literature survey. The concept proposes the potential of light to communicate stories of outdoor natural elements in the indoor space of the care home, as well as signal soft transitions of time through seasonal changes.

Due to the limitations of Covid19, there has not been a possibility for accessing the Nældebjerg care home in order to pursue observations or testing. These limitations are part of the final discussion of this paper and possible future works.



Figure 3: Nature exploration

1. MOTIVATION

1.1 Dementia - a contextual case Denmark

Dementia is a terminal illness, generally affecting the elderly. The affects of dementia include loss of short-term memory, other cognitive impairments, depression and impacts on the quality of life. According to various health institutes, dementia describes a syndrome associated with a range of diseases which are characterised by the progressive impairment of brain functions, including language, memory, perception, personality and cognitive skills. (Fay et al, 2010).

In Denmark more than 40,000 older people over the age of 65 years are living in a care center, out of which +92% suffer of dementia (Figure 4). The vast majority of residents, between 60-80% suffer from advanced dementia (Alzheimer media-notat-om aeldre-og-demens, 2020). Under these conditions, Denmark is facing a demographic challenge due to the fast growing ageing population.

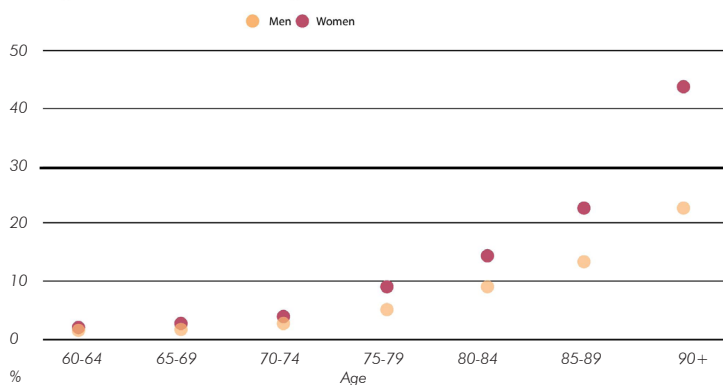


Figure 4: Estimated dementia percentage incidence in relation to age; Retrieved from: World Alzheimer Report 2015

People with dementia, depending on the stage and severity of the illness, do not perceive their surroundings in the same way as people without cognitive and physical impairments. Evidence is growing of the potential for the built and natural environment to improve their quality of life and general well being. Well-designed environments will also provide a better work setting for nursing and caring staff as well as for families and friends visiting the care homes (Fay et al, 2010).

1.2 Living with dementia

~ a bridge to well being through light and nature

Due to the conditions of the illness, living with dementia makes patients spend most of their time in the indoor space, therefore, the importance of the physical environment in care homes is increasingly recognized as a key component in the care of residents with dementia. Initial work in this area focused on the role of the physical environment on behavioural outcomes (e.g., wandering, agitation, and aggression); more recently, the focus has expanded to include individuals' physical functioning, emotional well-being and social interaction, which are significant contributors to residents' quality of life. (Fay et al, 2010).

Opposite to the limitation of living predominantly in indoor spaces, stands the positive impact of outdoor natural space for dementia residents. Activities that are physical or social in nature, such as going for walks, gardening, and group activities, can benefit residents with dementia. Nature exposure surely includes the benefit of daylight exposure, under the visual and non visual qualities of light. The impact stands to be supporting mental health, mood, as well as reduced agitation, aggression and reduced use of behavioural medications (Chaudhury 2017).

Both the challenges and the documented work that has been already done in relation to living with dementia, serve as a base upon which this paper is developed; and stands as a motivation to continue this bridge to well being through light and nature.



Figure 5: Nældebjerg care home

1.3 Sensory stimulation

Aiming to base the development of this paper within the contextual case of Denmark, I came across a position statement of the Danish national dementia strategy, the National Action Plan on Dementia 2025, where a number of initiatives are launched to strengthen Denmark as a dementia friendly society. The ambition is to maintain dignity, safety and quality of life for people with dementia and their families. One of the suggested methods to fulfil this goal is by providing person centred care, for example, through sensory stimulation. (Henriksen, 2018)



By using sensory stimulation, it is possible to activate the senses and thereby evoke positive feelings and memories, which can promote social interaction and well-being for people with dementia. (Henriksen, 2018, p3)

Figure 6: Person centred care symbol

2. VISION

Imagine if...

The existing limits of the build environment in care homes can be expanded in order to nurture an integrative space that considers light and nature to the extend of providing a relative outdoor landscape in the indoor space.

The vision is to analyse and imagine what forms the base of human's fascination with nature and nature's characteristics under various day-light conditions. Further the motivation is to transfer these elements into the indoor space in order to stimulate well being, trigger past memories and establish a connection to the environment, for dementia patients.

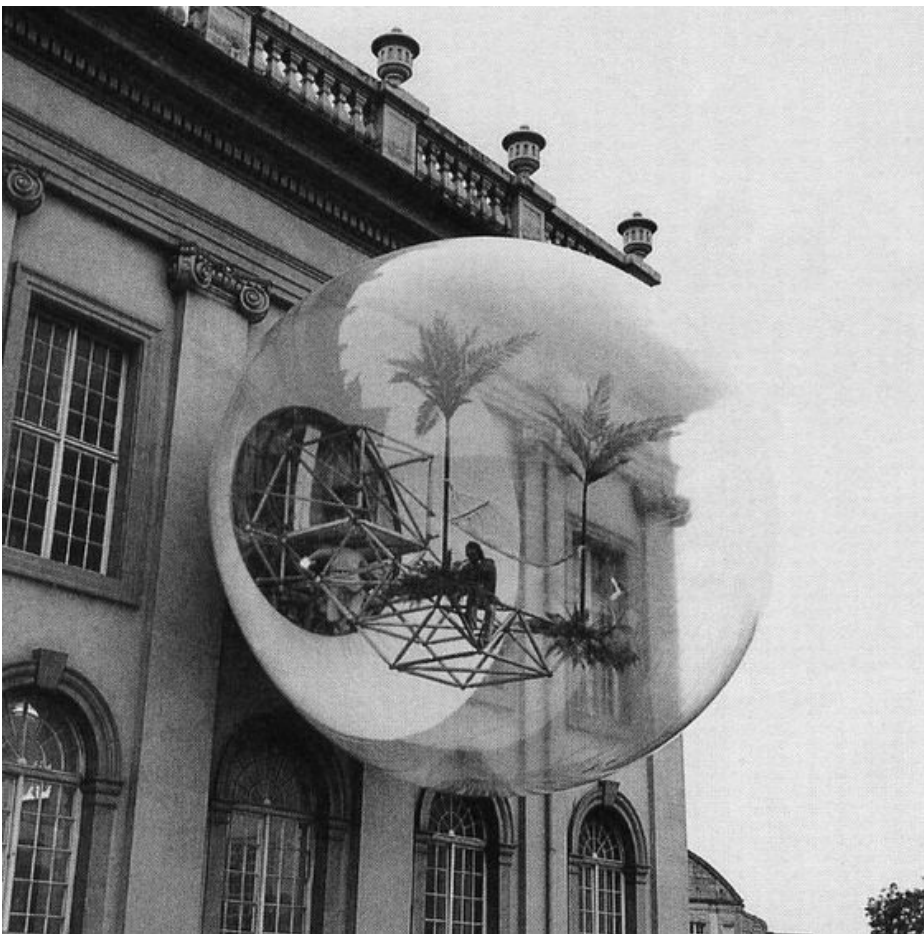


Figure 7: Oase no.7 by Haus-Ruker

3.METHODOLOGY

3.1 Person centred care

Inspired by the vision of the Danish National Action Plan for dementia, I am using the following methodology pillars in order to set an intention when designing for dementia patients. The extend to which this topic affects life quality includes patients, their families, care giver and society at large. Aiming to design for person centred care, the following notions are suggested by the Danish health care in pursuing this goal; the design should be:

- ~ Valuing people with dementia and those who care for them*
 - ~ Treating people as individuals*
 - ~ Looking at the world from the perspective of a person with dementia*
 - ~ Offering a positive social environment in which a person with dementia can experience relative well being*
- (Henriksen,2018)*

3.2 Nature based therapeutic service

Attempting to find guidelines for the design of light filled spaces with greenery supporting elderly suffering from dementia, I came across a knowledge gap which showed that most of the research has been primarily focused on outdoor spaces. As later seen in the literature review section, most research has been showing healing gardens, parks or recreational spaces, all located outdoors.

In order to transfer this type of setting into the parameters of the build environment, I am using the outdoor concept of Nacadia garden, for constructing a base methodology for designing an indoor alternative. Nacadia is a local example which can be characterized as a behavioural setting - a place where the physical environment and human behaviour are indissolubly connected (Sidenius et al, 2017). Nacadia outdoor gardens are supporting at the moment: depression, eating disorders, veterans, people with mobility impairments and stress related conditions. The concept, layout and overall setting of Nacadia project has the objective to provide treatment for patients with stress-related illness to obtain evidence based knowledge about the effect of healing garden design and nature-based therapy for this patient group. The design of Nacadia and the NBT(Nature based therapy) concept was developed from 2007-2009 by an interdisciplinary group at the University of Copenhagen.

In the development of this paper, I am selecting few criteria from the Nacadia model, which can be further applied in context of four walls. This model called Nature Based Therapeutic Service (NBTS) stands for combining mental health treatment with nature and service for a therapy that is systemically beneficial for the individual, the community, and the nature together. However, my approach will not attempt to therapeutic goals, which is by far, outside of my area of knowledge.

The extend to which I would like to use the Nacadia case study is relate to the part of the model that stands for involvement and reciprocity of the human-nature connection. This model can empower the user to develop relationships, build skills, connect to the community, and gain a sense of purpose and fulfilment. The assumption is that a mutually beneficial approach can reconnect humans with nature for individual and community sustainability, through the power of relationship, compassion, empowerment, and love. (Sidenius et al, 2017)

The core components of NBTS which I would like to carry further in the development of this paper, are:



Figure 8: Nature elements

~ **Deep ecology**

Deep ecology aims to identify the complex factors of the human-nature relationship and move toward a more holistic sustainability movement. An ecological self-concept is one in which a person understands their direct interdependence with the planet (Devall & Sessions, 1985). NBTS can offer this deeper connection to people who may not have had a reason for one, due to modern day and urban lifestyles, or illness.

~ **Biophilia**

This hypothesis suggests that human beings experience an inherent connection with nature rooted in our evolutionary history. This theory further depicts natural elements, or constellations of elements that trigger a connection in humans, as well as the human perception of environments, both bodily and mentally. (Wilson, 1993)

~ **Human-animal bond**

The study of the human-animal bond is an emerging body of research mostly concerning the emotional relationship between humans and animals. There is mounting scientific proof suggesting physiological changes in humans and in animals when experiencing physical contact and positive relationship with each other. These changes include an increase in oxytocin and dopamine, a decrease in blood pressure and heart rate, improved levels of fitness, fewer symptoms of depression and anxiety, and disease reduction (Beck & Katcher, 1996).

These physiological changes are similar to what is seen in people with positive relationships with other people. Love and relationships are beneficial, regardless of with whom such love is shared, and NBTS gives and avenue for these connections (Sidenius et al, 2017).

3.3 Literature survey

In order to develop this paper's vision, I have researched a wide spectrum of literature, which undergoes few triangulations while aiming to narrow down and formulate the design direction. Hence, the following keywords and other related variations were utilized to search for relevant articles: care home environment, daylight benefits, indoor greenery, biophilia, sensory stimulation, healing architecture, dementia. Six databases were included: Google scholar, AAU library, Journal of Sustainability Education, Research gate, Science direct.

References were also selected by searching the reference lists of relevant articles and by reviewing key pieces recommended by experts in the field.

3.4 Design experiment model

Part of the curriculum of the MA in Lighting Design, AAU, the Design Experiment Model has served as a scheme and general mindset, when aiming to develop a cross disciplinary lighting design solutions with knowledge of light (Hansen&Mullins, 2014/ p 316). According to this model, light as a multi-dimensional design element has fundamental importance for a sustainable environment. This approach discusses the need for an integration of scientific, technical and creative approaches to light supported by theory, methods and applications toward fulfilling this need. (Hansen& Mullins, 2014).

Along the lines of this model, I have redrawn a scheme, which is aligned to the specific steps of this paper's particular design process, as seen in Figure 9. Besides, for outlining a solution that combines research and creative design processes, the methodology tackles problem based learning (PBL) steps, such as:

Idea generation, Problem analysis, Problem solving, Design, Implementation.

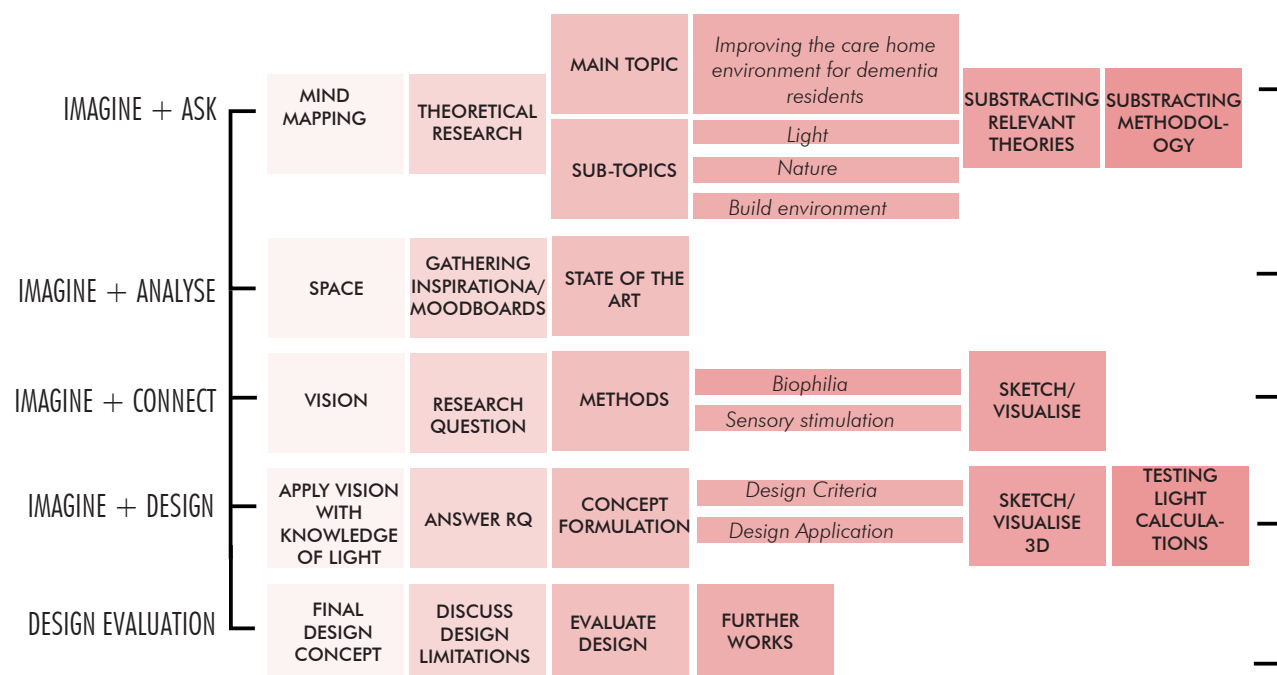


Figure 9: Redrawn of the The Design Experiment Model

3.5 The Environmental Audit Tool (EAT)

In the implementation phase of the design, I found valuable to use The Environmental Audit Tool (EAT) which works as a design aid when developing new care home environments. The tool also work in assessing whether a design proposals meets these criteria, hence it will be used for this purpose also in the evaluation phase of this paper's design.

The principles of EAT are based on a literature survey conducted by Fleming et al (2008). According to Felming (2008) these principles are enabling care aimed design of environments that support the abilities of people with dementia. Thus, such spaces should:

1. Be safe and secure
2. Be small
3. Be simple and have good 'visual access'
4. Reduce unwanted stimulation
5. Highlight important stimuli
6. Provide for planned wandering
7. Be familiar
8. Provide opportunities for privacy and community
9. Provide links to the community
10. Be domestic

Figure 10: Criteria of the Environmental audit tool

Following this overall methodology, I am attempting to establish a framework and set of criteria that will allow the solution to be rooted in dementia-specific tools and approaches.

3.6 Computer generated images

For the lighting design phase of this paper, I have used the following software: Sketchup, Rhino for 3D simulation, Enscape for rendering, Dialux, Velux Daylight Visualiser for light calculations.

4. A HOME IN THE CARE HOME

At the moment there are applications of light technologies and sensory stimulations in care homes around Denmark which are giving this research a view over the state of the art.

Controlled flow of circadian lighting was implemented in a new nursing home in 2014, in Aarhus. The controlled lighting concept aims to support the daily care of residents with dementia. The concept aims to imitate the beneficial effects of the natural light and thus supports the body's natural circadian rhythm. (Henriksen, 2018).



Figure 11: Circadian lighting Aarhus care home

According to the Position Statement of the Society of Light and Lighting (2019), the term 'circadian lighting' or 'human centric lighting' is still being discussed in terms of its applicability and limitations, which should not be considered a replacement for daylight. In this sense, human centric or circadian lighting implies a transition from tradition approaches to lighting design and application, referring to the creation of a lighting system, dynamic in both intensity and spectrum, which can be controlled to stimulate the human circadian system.

However, it is recognised that, for stimulation of the circadian well-being there are a myriad other factors to consider. (Position Statement, Society of Light&Lighting, 2019). As highlighted by Deborah Burne, '... with the link between light and health, there are no honoured rules, an established body of rules or proven best practices that can be used to redefine this paradigm of lighting design with health benefits.' There have been various attempts to quantify circadian light and its impacts, however, the Society recognises the need to further define and monitor in this field. (Position Statement, Society of Light&Lighting, 2019)

Reflecting on this perspective around circadian lighting, my intention in the development of this paper is keep nature at the core of the design stimulation. As studies have shown, exposure to all-day bright light has been proven to increase total sleep duration, decrease restlessness and provide modest benefits in mood, cognition and functional decline (Chaudhury 2017).

4.1 Sensory rooms (snoezel rooms) have been implemented in few nursing homes around Denmark. These are designed environments that combines stimulation by light, movement, music and tactile objects, and can be used to calm and stimulate people with dementia. (Henriksen, 2018).



Figure 12: Sensory room in care homes Denmark

While creating sensory environments for dementia patients, design guides seem to call for appropriate levels of sensory stimulation, striking a careful balance between environmental over-stimulation and deprivation. Research showed that residents face difficulties with sensory over-stimulation, which may increase the distraction, agitation, and confusion associated with dementia. At the same time, sensory deprivation has been identified as a potential problem in many dementia care environments. Recommendations include removing unnecessary clutter, providing tactile stimulation in surfaces and wall hangings, and eliminating over-stimulation from televisions, alarms, and so forth. (Dayet al, 2000).

As seen in the example above (Figure 12) there appear to be various stimuli in relation to the room size, use of screens and picture elements of nature instead of actual natural elements, which can create an unharmonious and unfamiliar context for the patients. Various design guidelines argue that certain levels of sensory stimulation may be required to promote engagement in activities and interaction and to minimize withdrawal among people with dementia, even if overall the positive impact of sensory stimulation has received limited research. (Day et al 2000).

While grasping the state of the art around this paper's topic in relation to light and sensory stimulation, particularly in the local context, I am forming the intentions that the design will later follow. Confirmed by the EAT (Environmental Audit Tool) referred to in this paper's Methodology, removing unwanted stimulation while highlighting important stimuli are two of the main design criteria, when designing for well being in care homes.

Furthermore, keeping nature and natural light as an anchor in the design development, despite of possible use of lighting technologies it is a conscious choice in the triangulation process of this paper. The problem formulation will further synthesize on the already mentioned founding and gaps, while keeping the vision of nature integration in the indoor environment.



Figure 13: Nature exploration Stevens Klint, Denmark

5. PROBLEM FORMULATION

RESEARCH QUESTION

How can architectural boundaries be reshaped in care homes, in order to provide sensory stimulation through nature, and a controlled aperture for light, thus facilitating psycho-social positive outcome for residents suffering from dementia?

1.How to establish seasonal stimulation through daylight and greenery to support well being for patients suffering from dementia?

2.What type of electric light solution can complement the daylight intake to ensure visual and non visual light quality all year around?

6. NORDIC DAYLIGHT CYCLES

In Denmark the sun shines on average 1,496 hours a year. Both in relation to the daily weather changes and seasonal changes, the Danish weather is quite diverse. The sun light intensities vary from up to 100,000 lux during the summer to 30,000 lux during the winter. The weather condition is cloudy approximately 66% during the year, distributed in 57,7% in the summer period (April - September and 72,6% in the winter period. (Mathiasen, 2015)

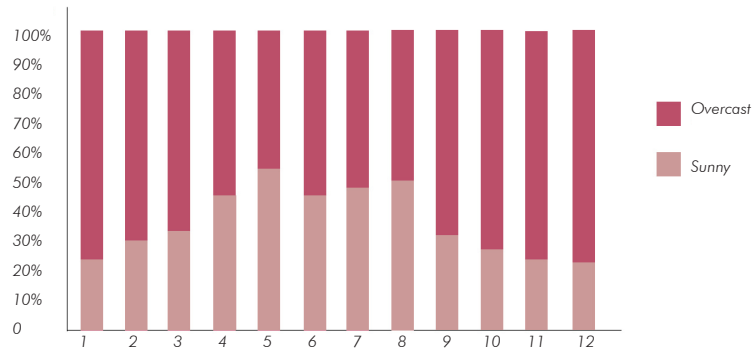


Figure 14: Source: Nordic daylight cycles

The specific winter darkness in Denmark is not only caused by the lower intensity of the sun, caused by the lower solar height, but it is also increased by the cloudy winter sky. These dynamic changes manifest in terms of intensity and color temperature. (Mathiasen, 2015)

7. LITERATURE REVIEW

In the early stages of this paper - “Imagine + Ask”, “Imagine + Connect” according to the Design Experiment Model I have been looking into various literature reviews related to creating a Light filled space with light and greenery in care homes for elderly suffering from dementia.

Even if the initial research started in a broad manner, it soon made sense to divide the topic into subcategories, in order to be able to structure and grasp its complexity. Keeping the core goal, the three focus areas that I found relevant are: Nature, Light and The Build environment, as seen in Figure 15. This separation helped the research process gain depth into each separate topic and further focus on how to merge the findings, and design homogeneously. The literature review enables the collection of relevant methods and tools to design for the particular needs of dementia patients. At the end of each section part there will be highlighted key criteria to further design according to this paper’s motivation.

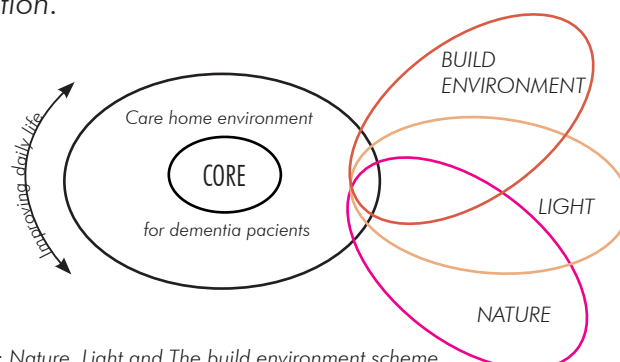


Figure 15: Nature, Light and The build environment scheme

7.1 NATURE

At this moment in time there is a great body of empirical and theoretical research stating the positive impact that nature has on humans. Yet, there is not only one way to replicate such scape. Along the research I came across various questions that were also touched upon by Kaplan S. and Kaplan P. in their quest to describe nature connections, back in 1989, in their book : 'The experience of nature- a psychological perspective'. I would like to mention some of these questions in order to highlight the richness and wonder of this topic, despite all studies, models and terminologies, it seems rather humbling to embark on analysing and implementing nature's greatness and its potential to connect. It appears that the element of chemistry that lays between living forms such as humans and nature, it is of an unexplainable matter- which both sustains its existence, yet it is uncertain to recreate.

In their effort to integrate a substantial research into a framework and perspective on the role nature plays, Kaplan starts by asking:

"- Is it real? Is the effect of nature on people as powerful as it intuitively seems to be?

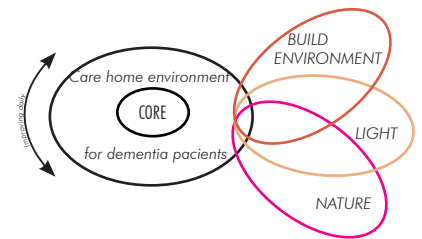
- What lies behind the power of environments that not only attract and are appreciated by people but are apparently able to restore hassled individuals to healthy and effective functioning?

- Are some natural patterns better than others? Is there a way to design, to manage, to interpret natural environments so as to enhance these beneficial influences?" (Kaplan&Kaplan,1989)

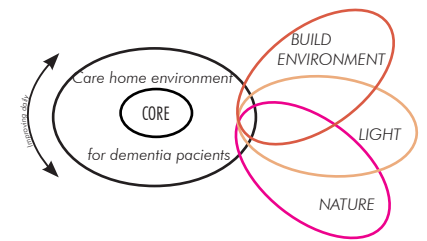
In order to answer these questions, the research unfolds a gradual description of nature and human's relation to nature, particularly referring to elderly suffering from dementia. The scope of this part of the research is to link nature to light and the build environment into a new multidisciplinary approach. Ultimately the goal is to subtract elements, patterns and models that can form the base for the design conceptualisation.

Nature connotes many settings. It can refer to near by settings or far-away ones - rather vast and pristine where there has been little human intervention. The use of the word 'nature' is intended to be broad and inclusive, whereas it is implicit that much of humans connection with nature is impacted by the common evolutionary origins, which I am not going to touch upon in this paper. Nature as we perceive it both in the urban and non-urban settings include fields, street trees and backyard gardens, places that are managed or oppositely unkempt, where plants grow by human design or despite of it. (Kaplan&Kaplan,1989, p195)

Most places for health care, such a the therapeutic garden Nacadia (Sidenius et al, 2017) are build upon the premises that natural settings give restorative experiences for different health issues. In these cases, the experience of a far-away nature connection is being brought to near-by natural settings; being easily accessible from the heart of cities.



For the goal of this paper, the scale is being taken from the near-by setting, down to the indoor context. nature inspired well being into the perimeter of the brick walls. Even if indoor applicability has been less explored, Kaplan stated that “enough is known both to indicate the value of creating and enhancing such settings and to provide some focus for the intuitions that many people have about the cultivation and management of the nature nearby” (Kaplan&Kaplan, 1989, p 196)



Various studies found that with more time spent in outdoor gardens residents with dementia exhibited less agitation and aggressive behaviour. This outcome persisted through the winter months despite no physical access to the space. Studies have also shown stress-reducing, restorative effects associated with time spent outdoors. (Chaudhury, 2017). The urgency that the literature review shows it to take this potential for nature inspired well being into the perimeter of the brick walls.

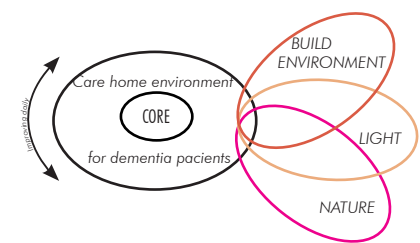
~Healing landscapes

Healing, for the purposes of this discussion, embodies the three ideas articulated by landscape architect Clare Cooper Marcus (1999): relative relief from the condition of illness, stress reduction, and improvement in the sense of overall well-being. Looking at the setting of healing landscapes, there are various ‘sky forms’, light spaces and nature’s stimulative values that are carried into psychological and physical well being goals (Guenther, Vittori, 2013, p 74). As stated by Guenther&Vittori, (2013), ‘gardens designed to heal should themselves be in an aligned relationship with their biophysical and cultural contexts. Positive outcomes in such gardens tend to transport people away from the intensity of the healthcare protocols, and hospitalised environment through contrasts and conscious distractions. ‘



Figure 16: Legacy Salmon Creek forecourt garden

The example of the Legacy Salmon Creek forecourt garden (Figure 16) juxtaposes geometric and organic forms as it terraces from the entrance road beyond to the hospital entrance. Paving blocks and porous paving recharge groundwater; the water feature provides the sound of water in the court. (Guenther&Vittori, 2013, p 75). This case it is a proof of merging the existing with nature elements, through activation of various senses: sight, smell, sound, etc, and an overall spatial redefinition, with zones and paths according to specific activities.



Continuing the scope of finding guidelines to design light filled spaces with greenery for well being in care homes, the next criteria are marked by nature's realm:

- ~~~~~
- ~Celebrate the rhythm and cycles of nature through design by acknowledging seasonal change, natural patterns, and the movement of sun or natural materials.
 - ~Present seasonal experiences with views of infinity aligned with contextual celestial movements of the sun, moon, and stars, etc
 - ~Engage all various senses with plants, wind, water, earth, movement, and music
 - ~Utilize horizontal and vertical dynamics that draw the user into the space and provide visual focus beyond it
 - ~Evoke memory and familiarity
 - ~Contrast with the context of the hospitalised experience through changing scale, materials (nature over man-made), microclimate (e.g., fresh air, dew, breeze, and sunlight), sound levels (in contrast with the public address system) and views (e.g., infinity at the micro and macro scale, reflections, from windows).
 - ~Employ ergonomic and spatially comfortable details or patients, visitors, and staff. (Guenther, Vittori, 2013, p 78)

7.2 LIGHT

In describing the catalyst between the element of nature and the one of light, Louis.I.Kahn writes: " When sight came, the first moment of sight was the realization of beauty. I don't mean beautiful, or very beautiful, or extremely beautiful. Just simply beauty itself, which is stronger than any adjectives that you might find to add to it. It is total harmony without knowing, without reservation, without criticism, without choice. It is a feeling of total harmony as though you were meeting your maker, the maker being that of nature, because nature is the maker of all that is made. You cannot design anything without nature helping you. " (Lobell, (1979); Stephen et al, 2008, p 229).

In designing lighting solutions the visual and physical qualities of light are equally important. According to Liljefors (1999) "when we see, we are always experiencing space and light, inseparably connected, yet separately characterised by specific entities regarding the space on the one hand, the light on the other. Light and shadow describe the space

while the space describes the light.” Lighting design is therefore meant to create rooms according to senses and needs. A large number of elements must be connected and arranged in order to fulfil a various requirements such as function, climate, acoustics, statics, architecture etc. Liljefors(1999) argues that light gives a decisive condition to the design of the visual space, however it is no neutral conveyor of the environment. Other basic questions like spatial character, atmosphere, orientation in the space, visibility etc. are requirements known in the formation of a positive visual experience. Accordingly, Liljefors (1999) suggests a series of visual and non visual criterias for a “good lighting design” in two levels:

Level 1:

Directly visual: safety, security, orientation, visibility

Indirectly visual: stimulate, well-being

Non-visual: hormonal balance (tiredness, depression)

Level 2:

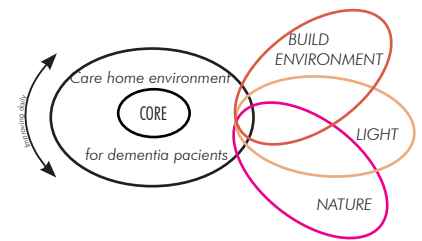
Directly visual: level of light, light distribution, shadows, reflections, colour of light, glarefree

Physical: illuminance, luminance, glare index/ UGR ,colour rendering index /CRI, colour temperature, no flicker

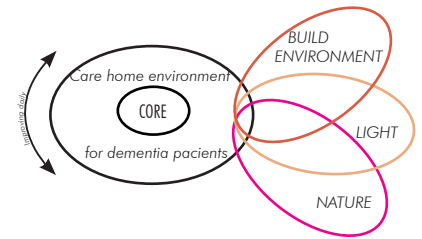
Given these consideration, exposure to light, in the case of residents with dementia in care homes, as stated by Chaundhury, (2016) is considerably lower than recommended (i.e., <2,000 lux) lighting levels and thus spend the majority of their days in dim room light, negatively impacting both affect and well-being. Exposure to higher lighting levels (e.g., through the use of a bright light box ranging from 2,500–10,000 lux), is associated with improved circadian rhythm quality and mood, increased consolidation of night-time sleep, increased daytime wakefulness, alertness and decreased agitation and disruptive behavior. (Chaundhury, 2016).

Particularly in northern habitats, for example, reduced daylight in the winter is associated with increased levels of Seasonal Affective Disorder (SAD), characterized by “light hunger.” Strategies to relieve symptoms include bright light therapy, better access to indoor daylight, and increased time outdoors. (Stephen et al, 2008)

Daylight exposure, seen from the perimeter of the build environment, is it related to the geographical position of the building in cause. Orientation is described by Florence Nightingale (Volf, 2013) as a factor that determine the benefit from the sunlight. Nightingale has, based on her research of light in hospitalised settings, came across wards without sunlight often having a higher mortality rate than wards with sunlight. Moreover, the seasonal variations play a particular role in the healing, which is why she recommended healing spaces are oriented to the South in order to embrace the most of the sunlight, and throughout the year provides most light during the dark winter. (Volf, 2013)



Re-imagining nature and light into the context of the build environment aspire to negotiation between the walls and the outer surrounding by opening a dialogue between the human and the elements. It can take place through:



- ~Design windows that can become lenses to better focus on nature, while providing a controlled air exchange and thermal conditioning
- ~Regard lighting in relation to geographical orientation
- ~Deliver a conscious access to daylight, and view of vegetation and fauna
- ~Considering simultaneously the visual and non visual effect of light
- ~Regard seasonal variations

7.3 THE BUILD ENVIRONMENT

For this paper, the reshaping of the build environment plays an essential role that appears to have been denied, as a form of overlooking the human-nature connection in the modern architecture. (Stephen et al, 2008). As architectural historian Vincent Scully (1991) described "The relationship of man-made structures to the natural world . . . has been neglected by architecture. . . . There are many reasons for this. Foremost among them . . . is the blindness of the contemporary urban world to everything that is not itself, to nature most of all." The absence of scientific data demonstrating the illogical and self-defeating implications of creating in opposition to the natural environment has been a key cause of this blindness. (Stephen et al, 2008)

Highlighting the importance of the build environment in relation to the world, Merleau-Ponty made the following observation, referring to the paintings of Cezanne (Figure 17):

"In my view the task of architecture is to make visible how the world touches us"
(Stephen et al, 2008)

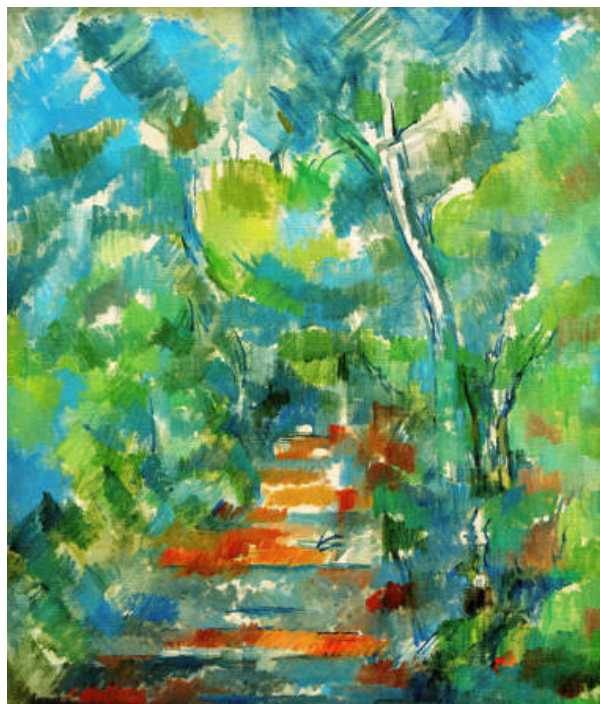
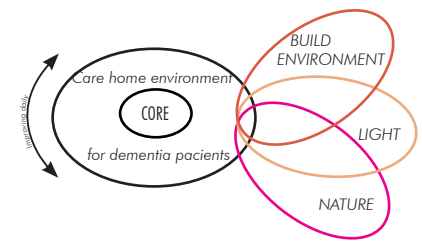


Figure 17: "Sousbois provençal"
(Undergrowth in Provence)
Cézanne, Paul 1839-1906.

~Biophilia and sensory stimulation in architecture

As a result of the overall theoretical research, the role of architecture can be seen for this particular case, at the intersection between biophilia and sensory stimulation. Biophilia is rooted in the early methodology of this design as a key component for NBTs (Nature based therapeutic service), along its various implications of the natural world. Besides, sensory stimulation has relevant ramifications as a design tool which argues that "certain levels of sensory stimulation may be required to promote engagement in activities and interaction and to minimize withdrawal among people with dementia". (Day, Carreon & Stump, 2000).

According to Stephen et al (2008), "biophilic design recognizes that the line between indoors and outdoors must be rethought; that indoor rooms must communicate with outdoor rooms; that windows must become doors."



BIOPHILIA



SENSORY STIMULATION

Looking at how architecture can evoke the qualities of nature through the use of light, air, materials, color, spatial definition, movement patterns, openings and enclosures, and connections to the outdoors, there are certain attributes of nature that are presented as an approach according to restorative environmental design. These attributes are known to trigger sensory stimulation:

Sensory richness, Motion, Serendipity, Prospect and refuge, Freeness

Sensory richness

Regards abundance of natural setting, such as odors, sounds, tastes, smells, haptic sensations, and visual patterns that fluctuate with time (daily and seasonal) and weather. The environment overall sensory richness changes with the habitat and location, and highlights the momentum of one person being part of a bigger flow of changes, rooted in the evolutionary relation between humans and nature, down to the present moment. Applied within the build environment can be a setting that triggers various senses.

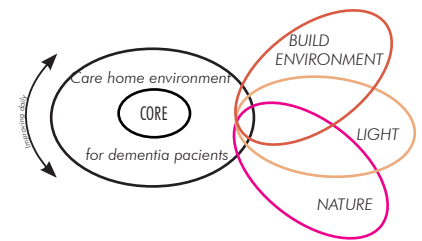
Motion

Known as 'Heraclitean movement', natural motion signals comfort and safety. A fish tank, for example, readily captures attention and ongoing fascination. Studies by Katcher show that not only do people enjoy watching the fish, they also experience reduced stress and improved relaxation in clinical settings (Katcher & Wilkins, 1993). Similarly, such events are caused by birds and small animals, stirring, leaves rustling in the breeze, water gurgling in a stream, light and shade shifting as the tree canopy opens and closes to sunlight, early morning mist lifting, and clouds responding to air currents. (Stephen et al, 2008, p 229)

Serendipity

Refers to ephemeral and unexpected encounters with animals, vegetation, and spatial features which are common in natural environments. The sudden appearance and disappearance of natural elements, a deer in the woods, a wild flower, or the scale from which this is being seen, can cause people to stop and watch closer. Serendipity is therefore a scene where a switch in focus from the larger, ambient environment to a specific element often leads to closer inspection of immediate surroundings and discovery of other details that are missed when attention is diffuse. (Stephen et al, 2008, p 231).

Transferring serendipity in buildings is seen through building ornamentation or in the rays of light that enter a space at a certain time of day, at a certain angle, illuminating surfaces and creating ephemeral patterns.



Prospect and refuge

According to Stephen et al, (2008), most appealing places should provide prospect and refuge simultaneously, however, there are times when either just high refuge or high prospect may be very desirable. The intersection between a prospect (visual access) and refuge (enclosure) as “the ability to see without being seen.” He describes this attribute as a fundamental response to the environment associated with protection and hazard surveillance. According to biophilic theories in architecture, accomplishing prospect and refuge covers a wide palette of materials, light, openings, screenings, gaps, peepholes, changes in height, overhangs, implied horizons, and borrowed elements from external prospects, such as views of a tower or hilltop. (Stephen et al, 2008, p 235).

Freeness

In natural environments there are commonly many choices and opportunities to support behavioral and emotional needs, thus nature rarely funnel behavior in a particular direction. Having this lack of boundaries widens sensory awareness and creates a psychological and physical sense of freedom. Along the build environment, Stephen et al, (2018), states that freeness can be evoked even with modest interior openings, multiple view corridors, and the opening up of interior and exterior vistas as one moves through space. In this manner the perceived barriers and blockade that architecture usually entails, are being reduced. (Stephen et al, (2018), p234)

8. DESIGN CRITERIA CHAIN

After the literature survey has been done around the topics of Nature, Light and The build environment, various criteria were formulated in order to carry a lighting design development that can be rooted in these three core topics, yet accommodate the context of dementia. Given that these criteria are intreconected, they can be applied in various combinations according to certain steps in the design development. The ‘chain of criteria’ will be symbolically carried throughout the desgn development of this paper, aiming to be applied in most of its extent.

NATURE

~ Celebrate the rhythm and cycles of nature through design by acknowledging seasonal change, natural patterns, and the movement of sun or natural materials.

~ Present seasonal experiences with views of infinity aligned with contextual celestial movements of the sun, moon, and stars, etc

~ Utilize horizontal and vertical dynamics that draw the user into the space and provide visual focus beyond it

~ Evoke memory and familiarity

~ Contrast with the context of the hospitalised experience through changing scale, materials (nature over man-made), microclimate (e.g., fresh air, dew, breeze, and sunlight), sound levels (in contrast with the public address system) and views (e.g., infinity at the micro and macro scale, reflections, from windows)

~ Employ ergonomic and spatially comfortable details or patients, visitors, and staff.

LIGHT

~ Design windows that can become lenses to better focus on nature, while providing a controlled air exchange and thermal conditioning

~ Regards lighting in relation to geographical orientation

~ Deliver a conscious access to daylight, and view of vegetation and fauna

~ Considering the visual and non visual effect of light

BUILD ENVIRONMENT

~ Sensory richness regards abundance of natural setting, such as odors, sounds, tastes, smells, haptic sensations

~ Motion elements of natural motion signal comfort and safety; leafs falling, animals movement, wathching the rain

~ Serendipity and epheerality stands for unexpected encounters with natural elements that shifts the perspective focus

~ Prospect and refuge offer "the ability to see without being seen."

~ Freeness can be evoked even with modest interior openings, multiple view corridors, and the opening up of interior and exterior vistas as one moves through space.

seasonal
transitions

natural
patterns +
materials

landscape +
contextual
views

vertical +
horizontal
dynamics

familiar
local

non-hospitalised

ergonomic

conscious
daylight access

diurnal

climate
regulated

light quality-
visual + non
visual

sensory
richness

motion
elements

serendipity,
ephemerality

prospect +
refuge

freeness

8.1 The receiver

~The brain of perception and memories

The scope of creating a well being place for patients with dementia is to enable the possibility of triggering certain cognitive capabilities that can benefit the person's brain capacity on daily basis and life expectancy.

'People, like trees and snowflakes, differ from each other', Kaplan frames it, while highlighting the varied preference of natural environments which can be related to each individual's background. Given this amazing variation, it is rather complex to delimit some significant consistency in people's perceptions of the environment and preferences, especially when the targeted user carries conditions of cognitive impairments and memory degradation. Of all the cognitive capabilities as seen in the map below, the ones that are recognised to deteriorate first due to dementia are: Memory, Language, Orientation and Processing speed.

PERCEPTION

~ codes and coordinates sensations to provide them with meaning

ATTENTION

~ capability of generation, selecting, directing and maintaining adequate activation levels to process relevant

LEARNING

~ stable transformations of behaviour due to the acquisition of new knowledge or abilities

PROCESSING SPEED

~ the relationship between cognitive execution and time; processing of information fast and automatic

MEMEORY

~ registers, stores and elicits different experiences; eg. ideas, images, events, etc



MEMORY

~ registers, stores and elicits different experiences; eg. ideas, images, events, etc

COMPREHENSION

~ capacity of understanding, analyzing and thinking about the received information

LANGUAGE

~ system of linguistic signs that enable verbal and written communication

PRAXIS

~ capacity of executing voluntary movements, intended and organised to accomplish a plan and objective

REASONING

~ enables problem solving, extraction of conclusions, in a manner that logical relationships can be established

GNOSIA

~ capability of recognising previously learned information from our senses

ORIENTATION

~ capability of being aware of oneself and of the surroundings

Figure 18: Brain functions - perception and memory

According to Kaplan (1989) nature exposure scales of satisfaction that they have been testing on larger communities, it appears that the view of gardens, near-by natural areas and the possibility to walk around nature, were the preferred elements in the perception of positive natural environments. It highlights that proximity and engagement, be it alone or socially are key components in stimulating positive brain responses. (Kaplan, (1989), p 158)

Moreover, variety in landscapes or green settings were noted by Kaplan, as a source of memory triggers, reminiscing past experiences even back to childhood. (Kaplan, (1989), p 163). Departing from various studies of environmental psephology that testify the benefits of nature interaction, seasonal events or scenes, along nature's yearly transitions are also potential activators of memory, reasoning or gnosis.



Figure 19: View from the Botanical Garden Copenhagen

9. APPLICATION

SPATIAL DEFINITION and DAYLIGHT

~~~~~  
How can architectural boundaries be reshaped in care homes, in order to provide sensory stimulation through nature, and a controlled aperture for light, thus facilitating psycho-social positive outcome for residents suffering from dementia?

landscape +  
contextual  
views

conscious  
daylight access

diurnal

climate  
regulated



## 9.1 SPACE

This project has been developed around the dementia care home Plejecentret Nældebjerg, located in Greve, Denmark. This facility is home for 75 residents, who are living in private apartments and sharing communal spaces for recreation, activities, treatments and daily routines. As the theoretical research unraveled, most of the patients spend their days around the perimeter of this indoor space, due to the limitations that the illness brought upon them.

The Nældebjerg care is composed of two block building of four floor levels each (Figure 20, Figure 21).

In the initial assessment of this paper, I have been analysing the layout of these buildings in order to establish where a light filled space with greenery is most suitable to be created for the patients. As people with dementia have heightened sensitivity to environmental triggers and cues, it is important that the physical environment is appropriate and responsive to their cognitive abilities and functioning.

Relaying the choice of space on theoretical findings, I have decided to base this paper's work on the area located in building B of the assembly (figure x), which stands at the meeting point between 6 individual apartments, located on each side (Figure 21). Research shows that 5-15 residents group settings have been proven to positively impact resident's well being, behaviour, functioning, and activity engagement. (Chaudhury, 2016). Moreover, this choice facilitates easy access, in the proximity of the patients' private rooms, since higher gradation of space (a range of private, semi-private and public spaces) displayed greater active behaviour and well-being for dementia patients. (Chaudhury, 2016).



Figure 20: Nældebjerg care home, Greve

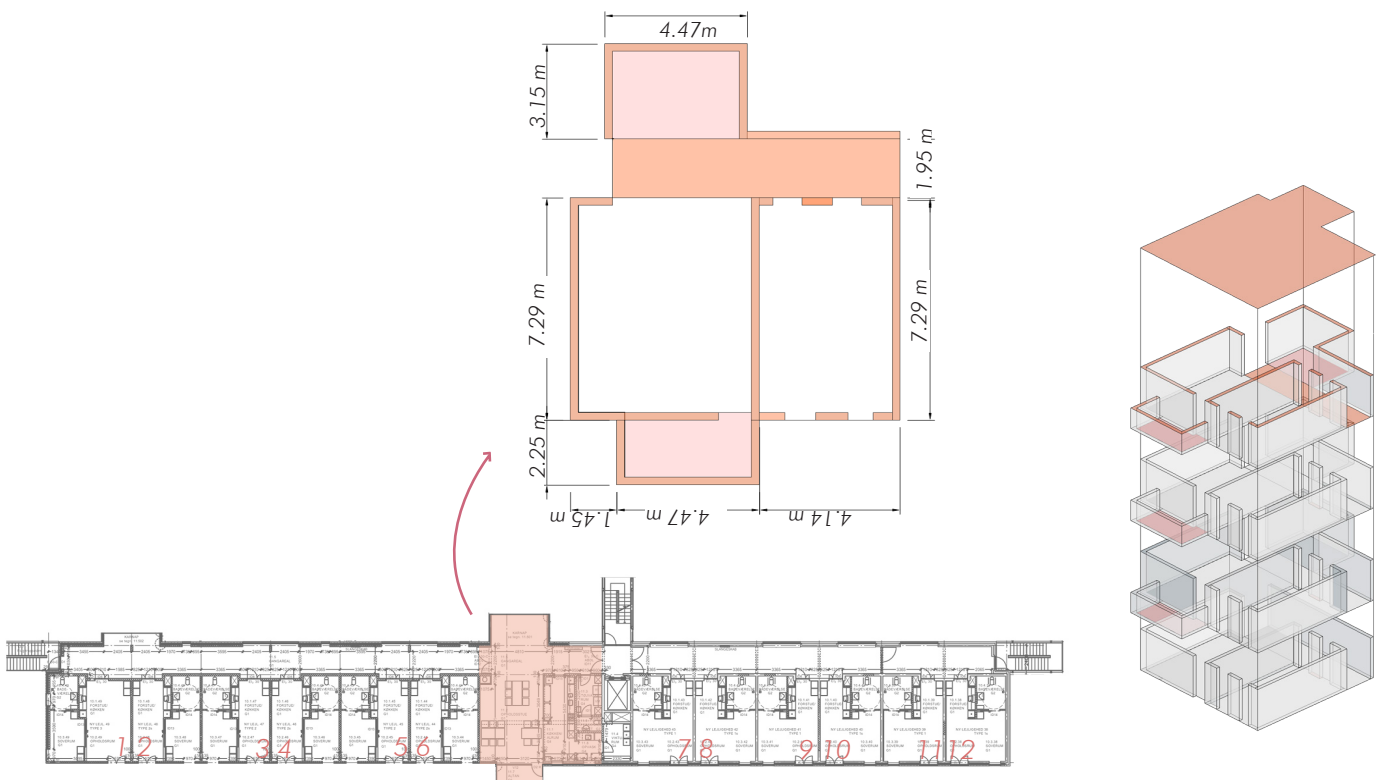


Figure 21: Nældebjerg care home: top plan- flow and activity room; Building's floors view

## 9.2 GEOGRAPHICAL ORIENTATION

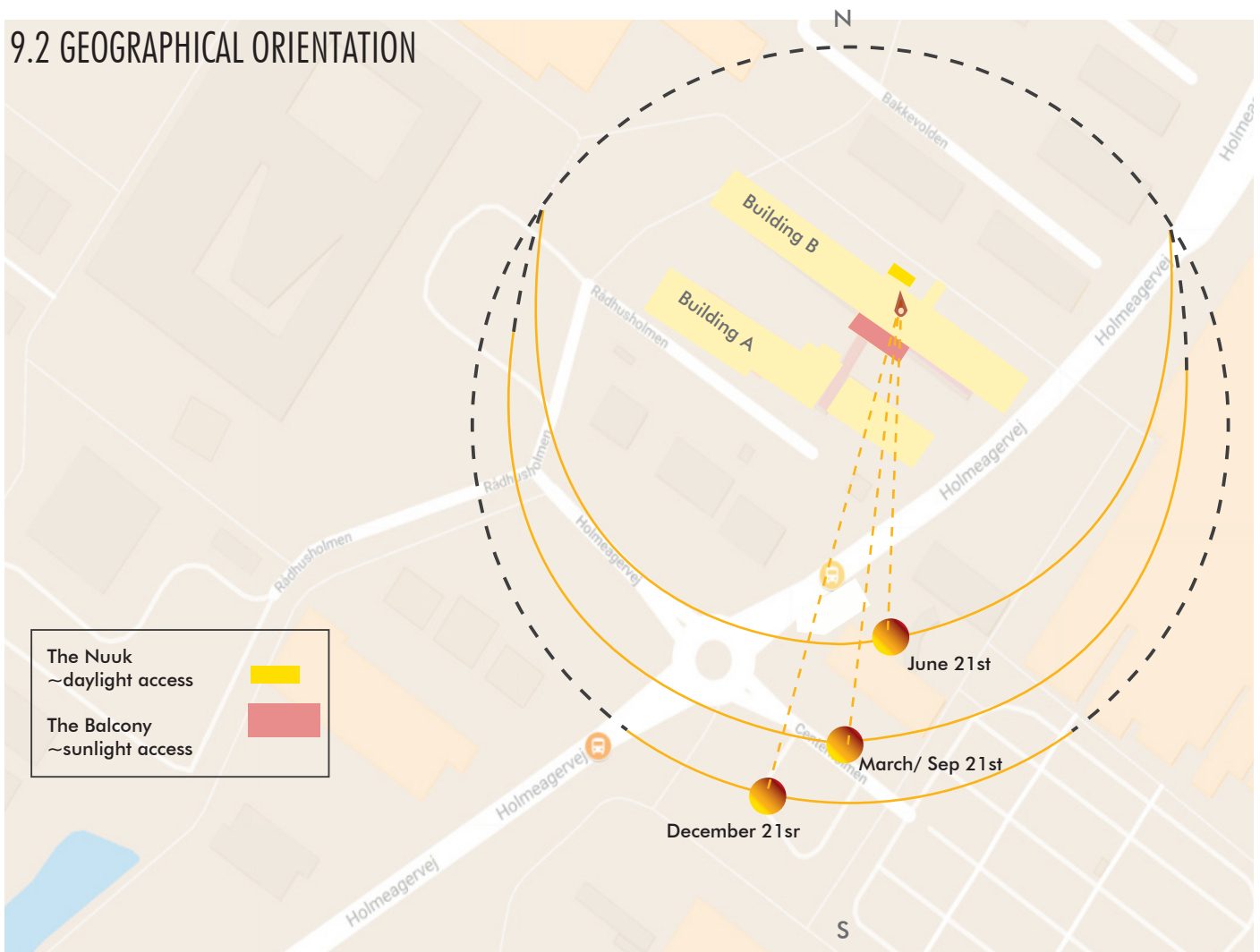


Figure 22: Geographical Orientation & Sun Rotation Nældebjerg care home

Amongs others, this section will touch upon the highlighted points in the criteria chain: landscape and contextual view, conscious daylight access, diurnal rhythms and climate regulations.

The room where the design will unfold is meant to function as an activity space, hence to be used in daytime. This room is located at the forth level of the building reaching an elevation of 10 meters, at floor plane. Since the room is situated centrally within the building plan, the only two possible openings towards light are oriented towards north and south. (Figure22)

Considering that **geographical orientation is an essential part of the criteria chain** that the design development is aiming to attain, **opening apertures in the existing architecture can reveal different stories in relation to light penetration and view.**

The already existing **sunlight opening** that the room has is the balcony facing south. However, as seen in figure 22, there is a spatial extension facing north, in the form of a nook, that can function as a **daylight opening** into the room. This possibility is further explored in the next sections.

## 9.3 SPATIAL DEFINITION ~ THE ENVIRONMENTAL AUDIT TOOL (EAT)

Across the key literature review areas: Nature, Light and The build environment, the lastest stands as a pillar for this part of the design, in order to re-imagine the existing architectural boundaries. Accordingly, the Environment audit tool (EAT), as introduced in the Methodology it is applied here in the formation of spaces for dementia care. (figure)

|                                                    |
|----------------------------------------------------|
| 1. Be safe and secure                              |
| 2. Be small                                        |
| 3. Be simple and have good 'visual access'         |
| 4. Reduce unwanted stimulation                     |
| 5. Highlight important stimuli                     |
| 6. Provide for planned wandering                   |
| 7. Be familiar                                     |
| 8. Provide opportunities for privacy and community |
| 9. Provide links to the community                  |
| 10. Be domestic                                    |

Figure 10: Criteria of the Environmental

The activity room chosen for this design, has intially been devided into two separate rooms (figure x). In order to provide enough space for **visual access** (EAT3) and **planned wandering** (EAT6), I have extended the space by removing the separation wall (figurex). In line with EAT6, in order to **provide opportunities both for privacy and community**, the suggested new room contains a central area and an adjacent nook, right accross the hallway path, yet connected visually to the main area (Figure 23).

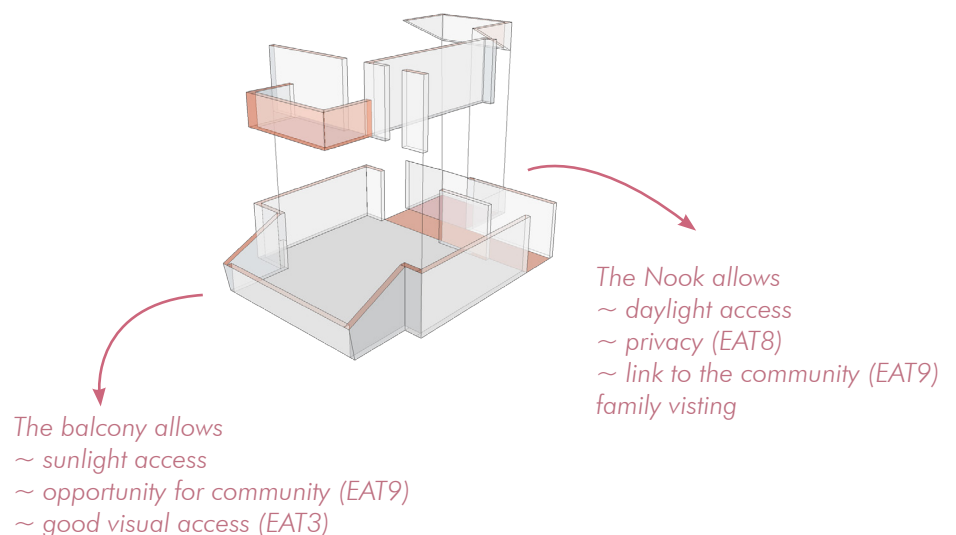


Figure 23: Spatial definition - activity room

The EAT points that have not been touched upon in this section, will serve as a construct framework throughout the whole design development.

## 9.4 LIGHT APERTURES

Referring to the elements of a room, Louis.I.Kahn named 'the window as being the most marvellous one'; asking, "What slice of the sun does your building have?" To paraphrase:

"What slice of sun enters your room? What range of mood does the light offer from morning to night, from day to day, from season to season and all through the years?" (Louis I. Kahn; Guenther, Vittori, 2013). Touching upon the possibility of opening up the architectural space throughout the window, the design considerations have been made in relation to the sun orientation.

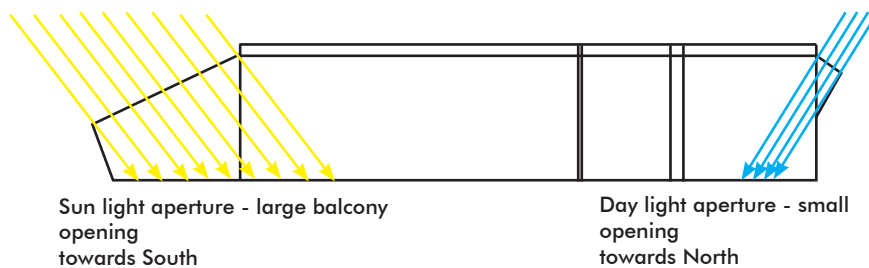


Figure 24: Light aperture, section view

Secondly, the reasoning came across few of the criteria chain, to provide **conscious daylight access to view, vegetation and fauna.**

Towards the south there is the balcony opening, with the possibility for a large indoor greenery ground, under the most of sunlight potential in this room, while opening up a large view for the observer.

Towards the north, the nook is an opportunity for a rather tailored observation of nature, throughout a slim opening pointed at the sky, while allowing only daylight into the space.

The two light zones that the apertures can create are of significant different meaning, offering the possibility to experience the **diurnal and seasonal shifts of nature and light.**

## Shading and ventilation

Opening up architectural boundaries and creating larger windows surely includes considerations towards air exchange and thermal conditioning. Following a natural design path, rather than a technological one, the climate control I am suggesting is the possibility for window openings and use of outdoor Venetian blinds. This solution allows the care takers in the care home to **adjust and control the light and air intake**, according to their needs, time of the day or season. (figure)

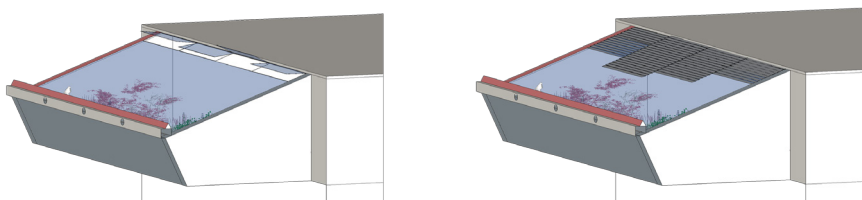


Figure 25: Shading&Ventilation, perspective view



## Daylight factor (DF)

The Daylight Factor (DF) it is a measure used to in design and architecture to assess the internal natural lighting levels comparing to the level of light outside a building. This calculation estimates how much light will actually reach occupants throughout a building.

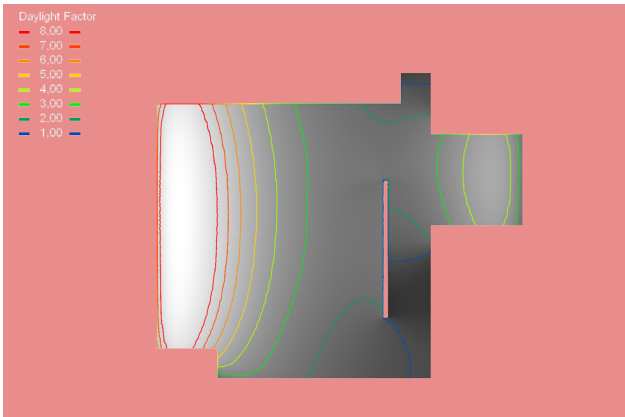


Figure 26: Daylight Factor

## Light layers

In the analysis of daylight runned through an annual review, using Velux Daylight Visualiser, the direction and shape of light penetrating the room can be seen (Figure 27). Further considerations towards the creation of atmosphere, zones in the room, furnitnure placement and overall dynamic are also being based on this light evaluation.

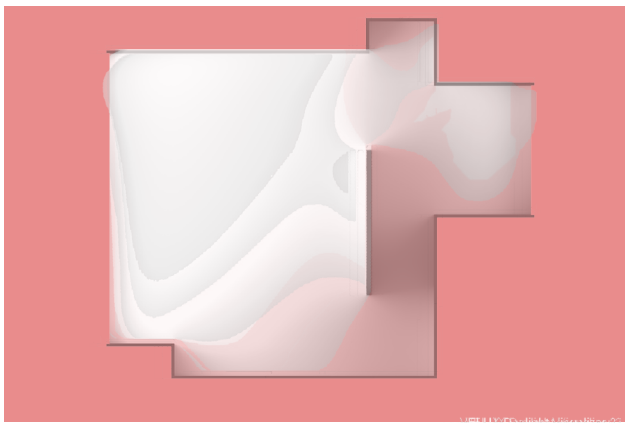


Figure 27: Light levels from Annual review calculation

# APPLICATION

## 10. DESIGN CONCEPT

~~~~~  
1.How to establish seasonal stimulation through daylight and greenery to support well being for patients suffering from dementia?

2.What type of electric light solution can complement the daylight income to ensure visual and non visual light quality of the daylight all year around?

natural
patterns +
materials

landscape +
contextual
views

vertical +
horizontal
dynamics

non-hospitalised

ergonomic

light quality-
visual + non
visual

sensory
richness

freeness

DESIGN CONCEPT- OVERALL ZONES

The concept formulation of the design has undergone various iterations, initially starting with handsketches, mind maps, and various floor plans in the creations of zones, functions, light distribution. Following the EAT tool and various of the criteria chain points stated above, the spatial definition regarded:

Flow~ easy accessibility and transfer

Non-hospitalised layout~ varied seating spaces, natural materials

Ergonomics~ furniture with rounded edges in order to create a spatial softens and comfort for the elderly people

Varied spatial experiences: possibility to be closer or further from daylight and greenery; spaces for individual time or community

Sensory richness + freeness: an open space layout, with abundance of greenery

Electric light in accordance with daylight levels, placed towards the North side of the room

In the next sections, the three concept design zones that formulate the final solution will be described in detail, with regard to specific criteria, theme and anchor to nature.

The three zone are:

THE BALCONY

THE NOOK

THE WALL OF SEASONS

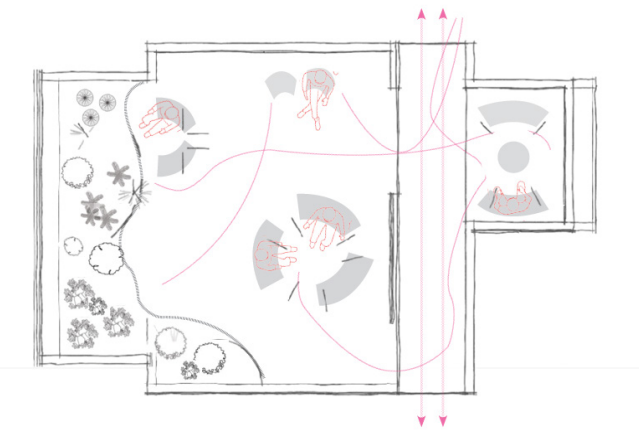


Figure 28: Top plan, zone, furniture placement and flow

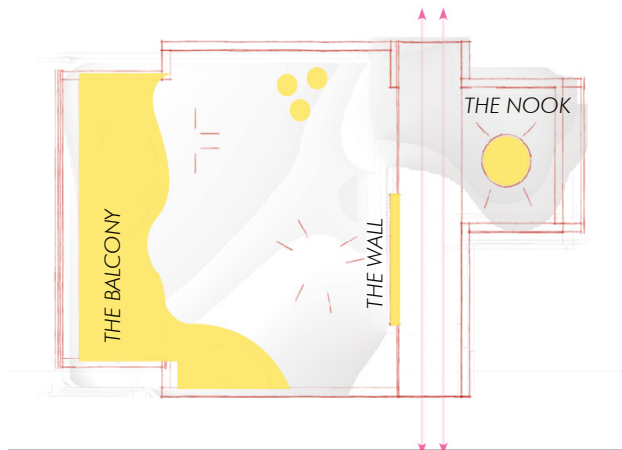


Figure 29: Electric light placement in compensation of daylight levels

DESIGN CONCEPT - OVERALL ZONES

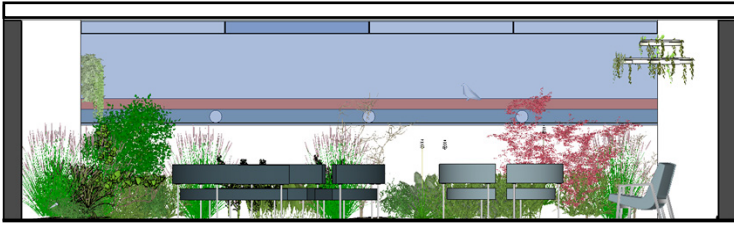


Figure 30: The balcony
~ facing South

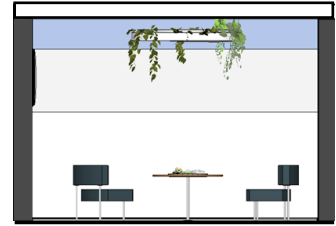


Figure 31: The nook
~ facing North-West



Figure 32:
Section view
~ facing West

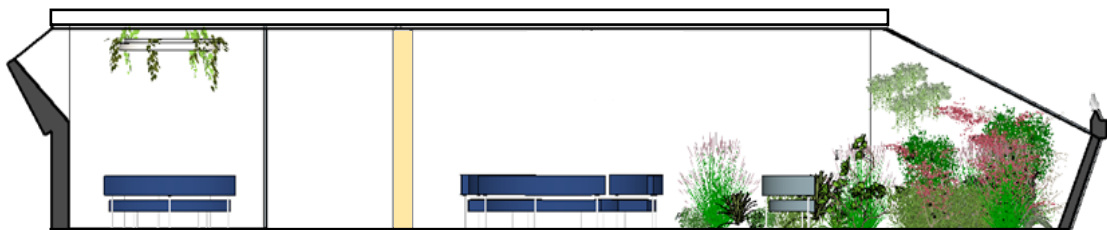


Figure 33:
Section view
~ facing North-East

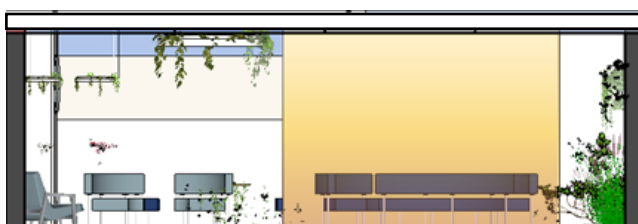


Figure 34:
The seasonal wall
~ facing North-West

seasonal
transitions

natural
patterns +
materials

familiar
local

non-hospitalised

conscious
daylight access

light quality-
visual + non
visual

sensory
richness

motion
elements

serendipity,
ephemerality

freeness

APPLICATION

A. DESIGN CONCEPT - THE BALCONY

~~~~~  
1.How to establish seasonal stimulation through daylight and greenery to support well being for patients suffering from dementia?

2.What type of electric light solution can complement the daylight income to ensure visual and non visual light quality of the daylight all year around?

## A. Design concept - THE BALCONY

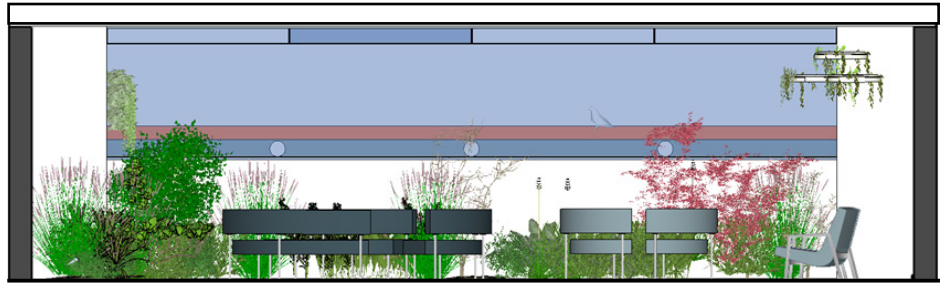


Figure 30: The Balcony facing South

The balcony is the foundation part of the design concept, aiming to merge light and nature into a **sensory richness** scene while further bridging the indoor to the outdoor environment. In the development of this part various points from the criteria chain have been used.

Such as a large **landscape aperture** the balcony provides a view of seasonal transitions both through sunlight and the bed of greenery under the window, which will follow its natural growth course. The aim is for the user to be able to come as close as possible to an outdoor nature experience. Incorporating biophilic criteria of **serendipity and ephemerality**, the scene is opening for the possibility of natural **motion elements** such as birds flying by, fresh air and wind, and the dynamic of daylight interacting with the room's architecture and furniture.

~ The sun does not realize how beautiful it is until after a room is made.

(Louis Kahn)



Figure 35: Final concept Balcony close up





Underlining the methodological tool of NBTS, the criteria of **human-animal bond** is applied here, outside of the balcony with a bird house solution across the whole length of the window. This element in the design is meant to strengthen the reciprocity theory of **nature based relationships**. Accordingly, the chosen greenery floor was meant to give a **familiar feeling** by using **local plants** that the patients could recognise from past experiences.

The layout of the overall space was primary influenced by the balcony. A conscious choice was made to expand the greenery towards the room, such as nature is gradually taking over the build environment.

The user can experience the space from various levels in the room, both by simply **being the space** or by **seeing the space**, either from a distance seating space or by passing by. The seating areas are providing this opportunity to be closer or further from the balcony (Figure 36) as well as to support **individual time** or support a **community feeling**.



Figure 36: Final concept Balcony perspective

As seen in figure x, the seating zone further from the balcony space is meant to allow for a comfortable, **private zone**. An electric lighting solution is being introduced here in order to compensate for the differences in daylight intake. The luminaire solution is further described in the next section.

For the purpose of this zone, 3 ceiling lamps aim to create a sense of separation from the rest of the room, with the possibility to adjust light levels, according to personal preferences, diurnal and seasonal shifts.

As studies have shown the care home environment can negatively affect the patients due to the lack of a 'home-like' feeling. According to Bille&Flohr, (2007), the relationship between light, culture material and day-to-day activities can orchestrate and shape a sense of comfort, hospitality and inclusion in indoor spaces. Since his study has been formulated around the Danish culture, the current design solution is aiming to make use of materials, furniture choice and lighting to **release from a hospitalised look**.

The goal is for patients, care takers and families to be given an environment that they can naturally relate to.



Figure 37: Observation corner daylight



Figure 38: Observation corner daylight + electric light

# APPLICATION

## B. DESIGN CONCEPT - THE NOOK

~~~~~  
1.How to establish seasonal stimulation through daylight and greenery to support well being for patients suffering from dementia?

2.What type of electric light solution can complement the daylight income to ensure visual and non visual light quality of the daylight all year around?

natural
patterns +
materials

landscape +
contextual
views

vertical +
horizontal
dynamics

conscious
daylight access

diurnal

light quality-
visual + non
visual

motion
elements

prospect +
refuge

B. Design concept - THE NOOK

This part of the design concept aims to touch upon various points from the criteria chain, as part of a method to construct spaces with greenery and light for the well being of elderly suffering from dementia.

*Due to its semi-separate placement and size, the nook opens a possibility for **prospect and refuge**, it gives visual access to the rest of the room, yet remaining private. This space is meant to be used alone or with a companion, across the **care home community or family**.*

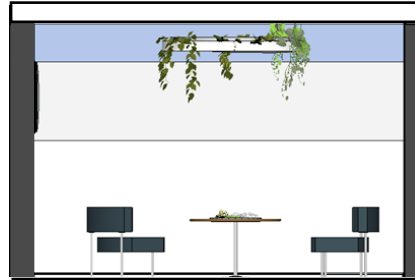


Figure 31: The Nook facing North West

*The concept of the nook gravitates around the light aperture which gives a **contextual view of the open sky**. According to the literature review, **motion elements** such as clouds, rain, snow, birds, can create a prospect for wonder and relax the viewer. The **horizontal skylight** functions as a screen with **visual and non visual light qualities** to the user seating under it, in terms light exposure and visual context.*

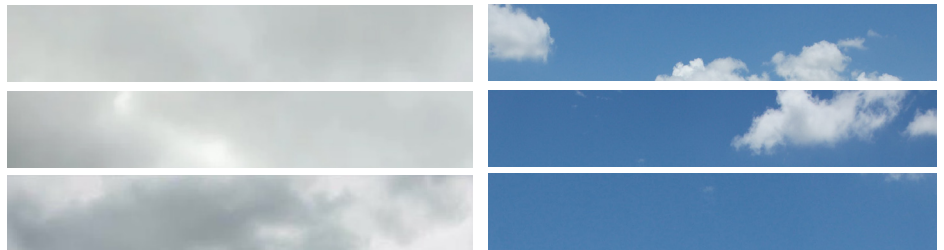


Figure 39: Sky views

Considering the orientation of the nook towards north, there are low levels of daylight entering the aperture, especially in the winter season. I am proposaing an electrical lighting solution for this scope. The suggested luminaire is also inspired by nature, having an integrated section where plants can grow. The lamp has a circular shape and it is composed of circular elements: top metallic plate, lighting LED plate and a circular diffuser (Figure 40).

The hanging lamp has a downwards distribution and it is dimmable, in order for the care takers to be able to adjust the levels according to needs and time of the day. This solution is meant to create a warm light zone compensating for insufficient daylight entering the room, and particularly in the winter season.

A smaller sample of the same lamp idea, has been shown in The balcony zone.

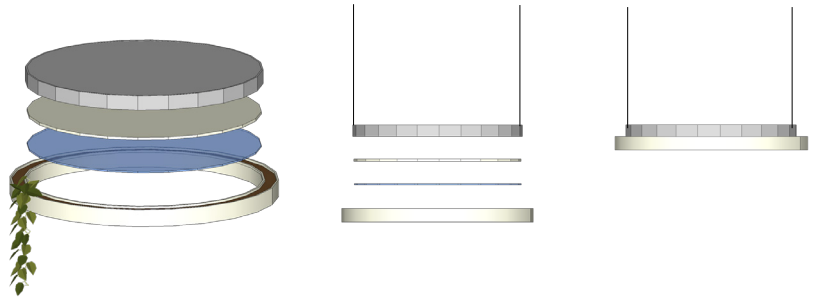


Figure 40: Cylindrical luminaire set up

~ Clouds in the sky very much resembles the thoughts in our minds!
Both changes perpetually, from one second to another!

(Mehmed Murat Ildan)



Figure 41: Final concept Nook daylight



Figure 42: Final concept Nook daylight + electric light



Figure 43: Nature exploration Denmark



Figure 44: The tactile table

Sensory stimulation has endless extends while interacting with nature outdoor; it is nearly impossible to take a walk, even in the urban context and not encounter natural materiality, such as leafs, flora, wood, stones, soil, sand, etc. **Natural patterns** and materials are rich in texture, colour and form, triggering senses and curiosity. These elements are part of the vast experience that is 'nature'.

Within the design concept of the nook I am aiming to bring this personal tactile experiences closer to the user. The proposal is a simple plate of stones and green plants integrated in the table of the nook. These elements can be touched, even picked up in order to open a discussion or support wander.

There are various limitations of this idea in relation to the type of plants and stones that can be safely used by dementia patients. Another suggested possibility is for this activity to be carried under supervision, weather from care takers or family members. The purpose is to place triggering **natural elements** in the room, at various levels in order to give elderly patients what is regarded as the most accessible interaction s outside a care home.

seasonal
transitions

natural
patterns +
materials

vertical +
horizontal
dynamics

APPLICATION

C. Design concept - THE WALL OF SEASONS

~~~~~  
1.How to establish seasonal stimulation through daylight and greenery to support well being for patients suffering from dementia?

2.What type of electric light solution can complement the daylight income to ensure visual and non visual light quality of the daylight all year around?

sensory  
richness

motion  
elements

serendipity,  
ephemerality

freeness

## C. THE WALL OF SEASONS - danish flora and fauna

The concept of the wall came across in order to provide sensory stimulation inspired by nature, throughout the whole year. Given that weather condition in Denmark is cloudy approximately 72,6% in the winter period(Mathiasen, 2015), the overall design concept can benefit from an indoor stimulative lighting element to compensate for the lower input from the outdoor.

In the development of this concept nature remains the main inspiration, particularly referring to the context of Denmark, I have gathered different landscapes and symbols specific to the Danish seasonal changes. Floral species such as Anemone are known to be the messenger of spring in Denmark. The Sørt Sol phenomenon seen mostly in the southern part of Jylland, Denmark, announces Spring or Autumn, having flocks of birds covering the sky.

Despite of the rich natural stories and pallets, the design must remain within the construct of the criteria chain and methodology in order to design according to the specific of dementia care.

The first step in the drawing of the seasonal wall, I have highlighted a colour scheme and a gradient transition specific to each season. These colours can be further used to signal seasonal change and mood.

### Nature stories and symbols ~ Colours



Figure 45: Anemone



Figure 46: Sort sol spring



Figure 47: Summer



Figure 48: Summer Sun

#### SPRING

#### SUMMER

SØRT SOL phenomenon

- flocks of birds retuning to Denmark

ANEMONE

- beds of white anemone covering the soil after winter

FILEDS OF GREEN AND FLORA ABUNDANCE

SUMMER SUN LIGHT

WATER WAVES

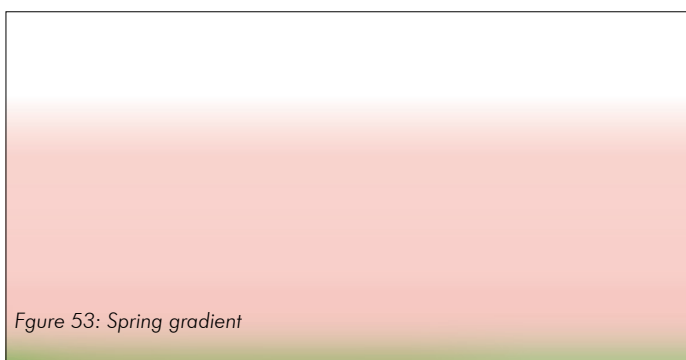
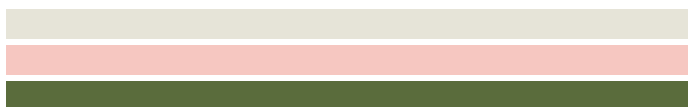


Figure 53: Spring gradient

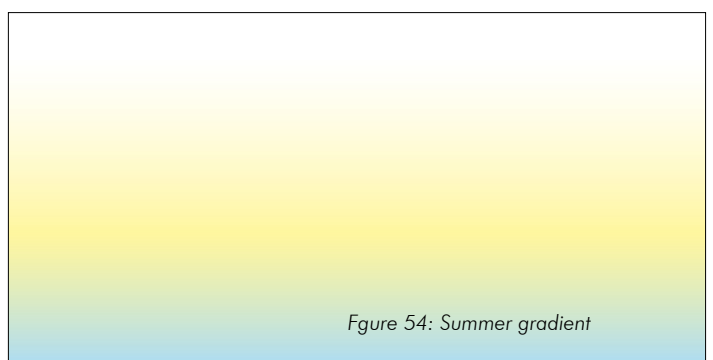


Figure 54: Summer gradient



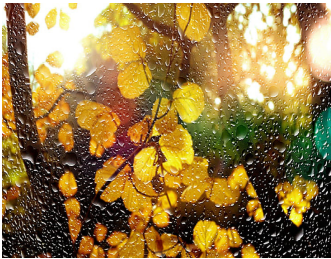


Figure 49: Rain



Figure 50: Sort sol autumn



Figure 51: Winter



Figure 52: Snow fall

### AUTUMN

SØRT SOL phenomenon  
- flocks of birds leaving Denmark for the south  
LEAFS FALLING  
RAINY SEASON

### WINTER

TREE TRUNKS LEAFLESS  
SNOW FALLING

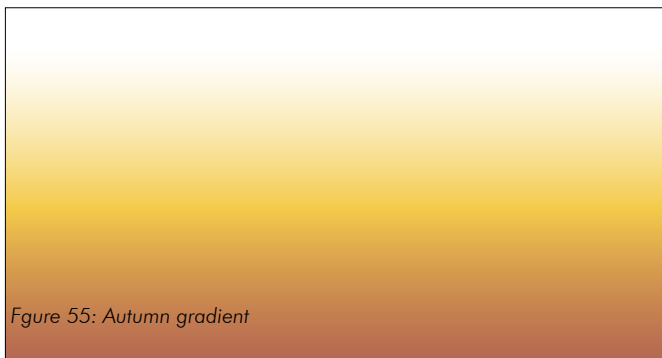


Figure 55: Autumn gradient

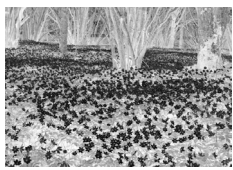


Figure 56: Winter gradient

## Seasonal wall ~ Exploratory phase

After being able to extract colours for each season, in the further development of the idea, I have looked at forming a composition on the wall inspired by the natural landscapes. The principles of visual compositions that I considered are: shape, proportion, orientation, balance, harmony among elements, field of view, focus, and motion, direction, path if aiming for a dynamic composition.

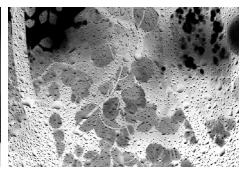
In order to highlight these principles, I have processed the images, inverting the colours. This process showed pattern variation and a dynamic of motion that can be further used in the storytelling of the wall. The purpose of highlighting these patterns is to be able to replicate them through lighting.



FLOWERS GROWTH  
slow motion  
ground level



BIRDS FLIGHT  
dynamic motion  
sky level



RAIN DROPS  
fluid motion  
eye level



SNOW FALLING  
playful motion- varied rhythm  
sky level



REPETITION



FOCUS POINT



ALIGNMENT

## Composition balance

In the first sketch below I have extracted the tree as a central element, surrounded by a variety of motion elements such as birds flying, rain drops, and flowers sprouting. However, for the purpose of this design proposal the intention is to avoid over-stimulation, therefore having the concept composition furthermore simplified.

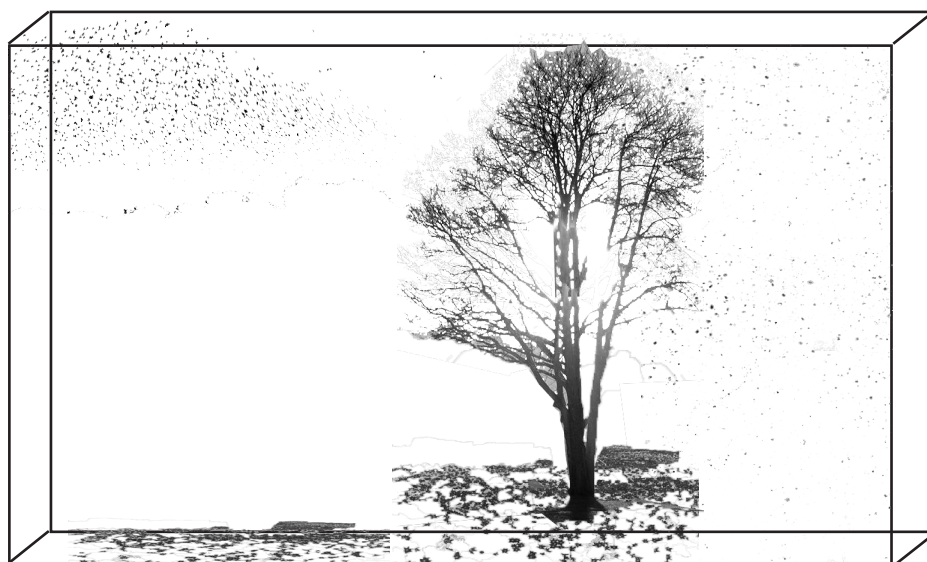


Figure 57: Composition balance

## Seasonal transformation ~ final concept

In the quest of simplifying the design concept of the wall, I am suggesting a transition and grouping of one element that can take four shapes throughout the seasons. The element is a dot, or a pixel which can formulate as seen bellow:

a flock of birds, transforming into a sun disk, transforming into rain, and finally transforming into snow. The formation of images through light pixels/ dots can replicate the natural movement when programmed accordingly to give direction, speed, duration, flow, etc.

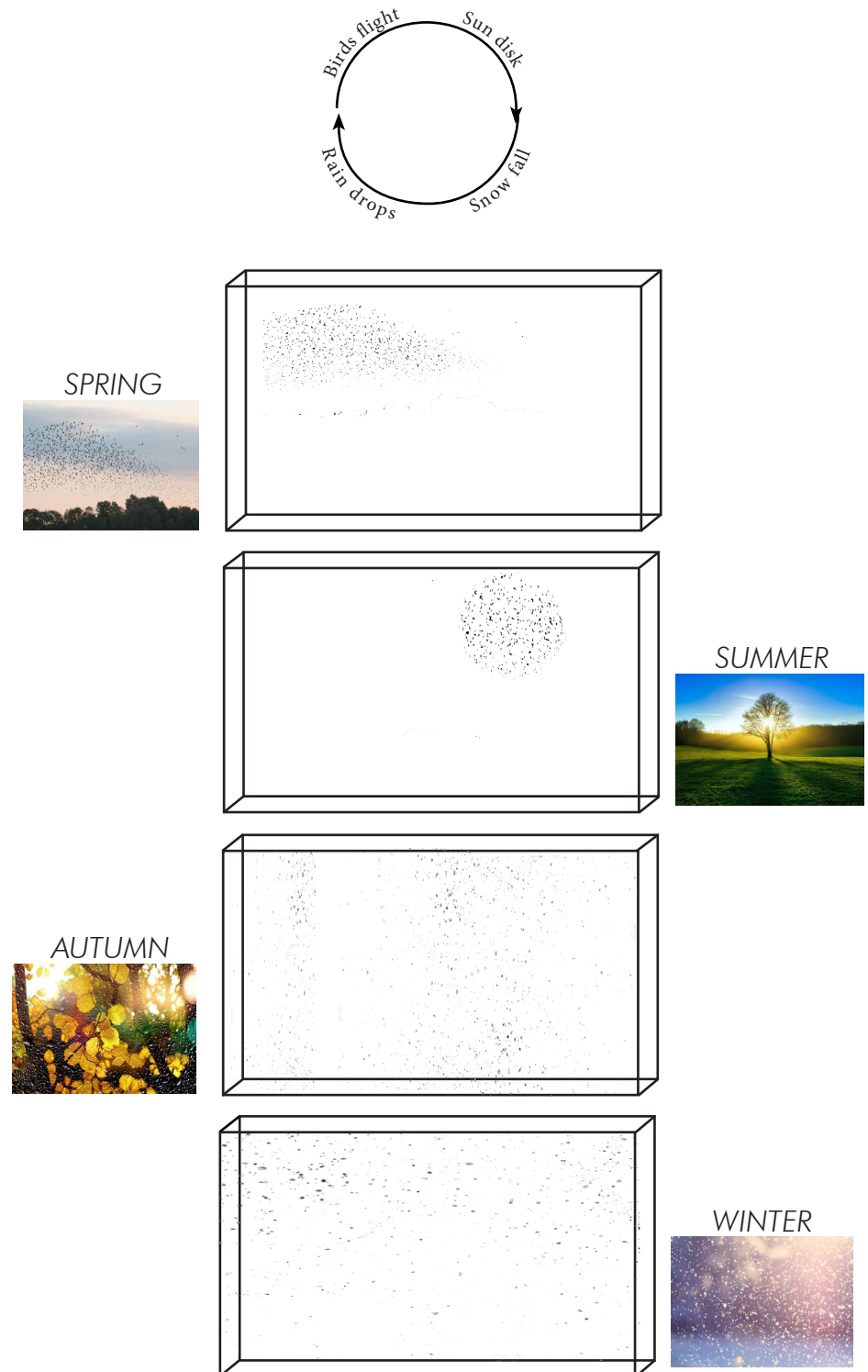


Figure 58: Seasonal transformation 4 seasons walls

## Seasonal wall ~ set up

Given that the concept of the seasonal wall is still in incipient phase, various aspects must be considered and tested.

The technical sketch bellow represents a vision on how the actual lighting system can be created in the wall.

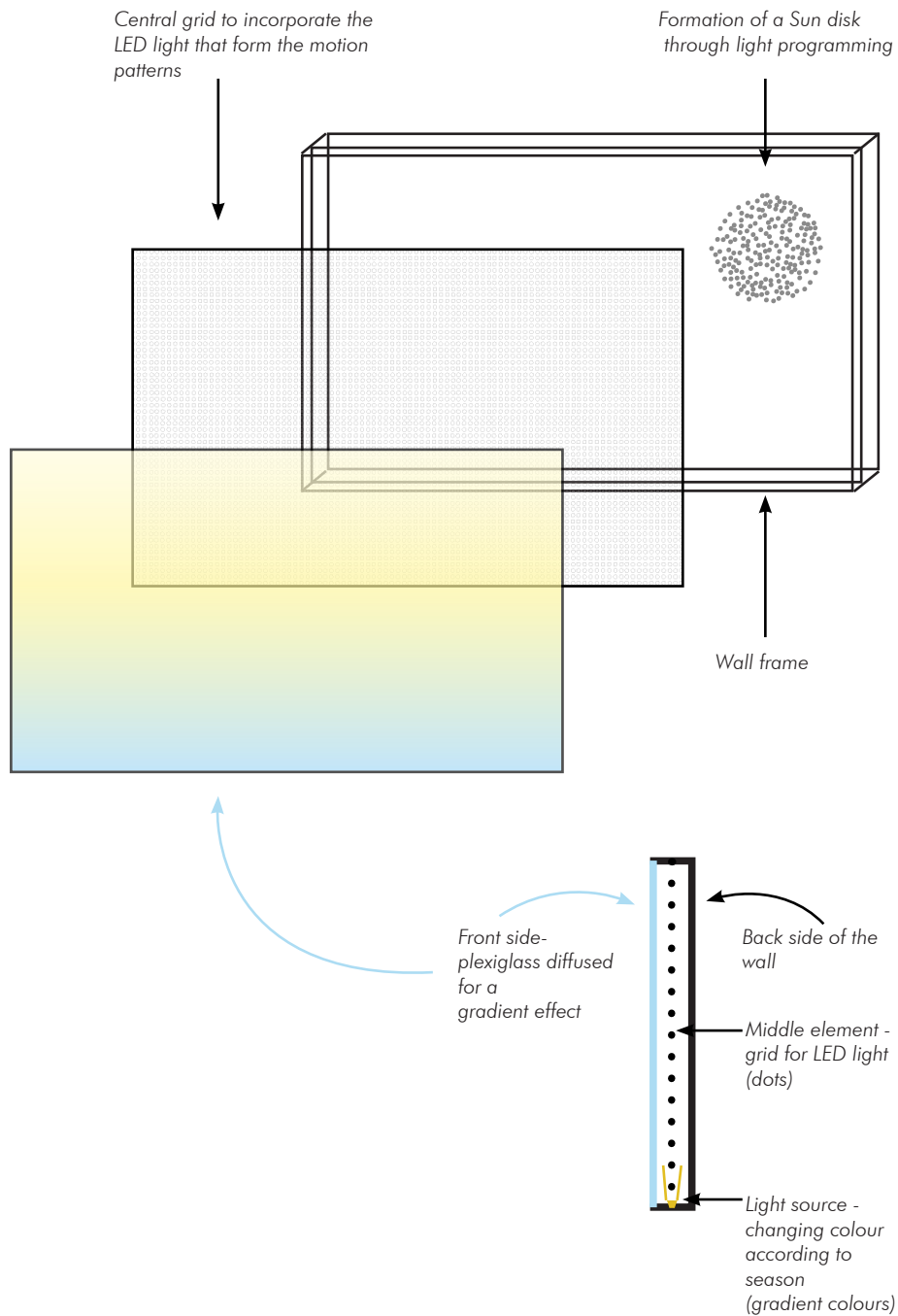


Figure 59: Seasonal wall set up

Figure 60: Section cut Seasonal wall set up





## 11. DESIGN DISCUSSION

Now that the design concept has been introduced, it is possible to open a discussion whether the Research Question has been answered through this solution. The research question, introduced in Section 5 is:

**How can architectural boundaries be reshaped in care homes, in order to provide sensory stimulation through nature, and a controlled aperture for light, thus facilitating psycho-social positive outcome for residents suffering from dementia?**

According to the theoretical research and the initial state of the art survey amongst light-filled spaces with greenery in care homes, for elderly suffering from dementia, the topic appeared to miss clear guidelines of applicability. However, by combining separate fields together such as architecture, light, biophilia and sensory stimulation, various design criteria could be extracted in order to answer the research question. The design criteria that have been formulated in the shape of a 'Criteria chain', given that the research revealed various aspects the design should consider. This chain aimed to link and transform the literature survey into a design solution with concrete applicability.

Tapping into the particular case of dementia as a condition of living and limitation, in the context of the Danish care home and health system, different design tools such as: person centred care through sensory stimulation, NBTS(Nature based therapeutic service), EAT(Environmental audit tool), formed the base for what should be an improvement in designing lighting and spaces for dementia.

Towards this goal, the design concept aimed to reshape the existing architectural boundaries, where possible, and provide conscious daylight exposure within the indoor space. In creating a controlled aperture for light both visual and non-visual qualities of light have been considered such as light distribution, seasonal variations of light and sky conditions and climate control; an electric lighting solution has been introduced in order to complement and support the daylight environment diurnal and seasonal.

The design concept at its core inspiration and motivation aimed to reinforce the human-nature connection, aiming to make it possible even within the build environment. Natural elements, symbols and stories motivated the design concept. By integrating an oasis of greenery under a large window view the design solution aims to tap into reducing stress and open a non-hospitalized ambient for elderly with dementia and those who care for them. The lighting design solution took various shapes within the Nook, the Balcony and the Seasonal wall, supporting the natural rhythms of the nature, with an indoor environment meant to 'appear under an open sky, yet keeping its roof. '

Within the next section, limitations of the design concept will be dis-

seasonal  
transitions

natural  
patterns +  
materials

landscape +  
contextual  
views

vertical +  
horizontal  
dynamics

familiar  
local

non-hospitalised

ergonomic

conscious  
daylight access

diurnal

climate  
regulated

light quality-  
visual + non  
visual

sensory  
richness

motion  
elements

serendipity,  
ephemerality

prospect +  
refuge

freeness

## 12. EVALUATION AND FUTURE WORKS

As framed in the Methodology of this paper, the EAT (Environmental audit tool) works both as a design guideline and evaluation scheme. I would like to reintroduce this tool, formed of 10 simplified criteria of designing for dementia.

|                                                    |
|----------------------------------------------------|
| 1. Be safe and secure                              |
| 2. Be small                                        |
| 3. Be simple and have good 'visual access'         |
| 4. Reduce unwanted stimulation                     |
| 5. Highlight important stimuli                     |
| 6. Provide for planned wandering                   |
| 7. Be familiar                                     |
| 8. Provide opportunities for privacy and community |
| 9. Provide links to the community                  |
| 10. Be domestic                                    |

Figure 10: Criteria of the Environmental

According to these points the proposed lighting design solution aimed to remain within this framework, by simplifying and opening up the initial architectural boundaries. By consciously dividing the space into the three zones proposed as: The balcony, the Nook and the Seasonal wall, the design concept aimed to be homogeneously stimulative, while providing opportunities for both privacy and community. The design aimed to also be domestic, giving a sense of familiarity and perhaps trigger past memories for the user.

The lighting solution aimed to provide safety, visibility and orientation in the space, considering spatial layout and flow, as well as light levels.

It is however doubtful that in order to evaluate such a design solution for patients in care homes, and particularly under the condition of dementia, various testing and surveys could give a clear answer whether the design meets the EAT criteria. Moreover, I would like to mention the incipient phases of the electric lighting solutions: the cylindrical lamp and particularly the wall, which requires further development of light programming and testing.

In terms of the overall distribution of the light, there are visual criteria that could be further calculated such as glare levels, colour of light, reflections; and physical criteria such luminance, colour rendering and flicker.

In regard to the proposed area of greenery in the balcony, a future work could be towards integrating growth lights in between the plants, to particularity stimulate the plant growth in the dark seasons.







## 13. CONCLUSION

*There seems to be a need for multi disciplinary approaches in the health care environment, where nature and light it is no longer an element of exclusivity , but one of choice, perhaps joy, or therapeutic purpose. This paper's research showed vast potential in the beneficial qualities of daylight and greenery for elderly people suffering from dementia. Within the construct of architecture, lighting design can allow spaces for openness and view, fresh air and the sight of birds flying. Along these lines, Wilson (1984) argues that "people are not capable of living a complete and healthy life detached from nature".*

*It is of great importance that lighting design can intervene as a tool in an already build environment to shape atmosphere, to the extend of visual and biological benefits. It seems appropriate to mention that this paper has been inspired by an initiative that will be constructed in the actual care home of Nældebjerg, located in Greve. The BUILD group project that professor Nanet Mathiansen is conducting has initially been the reason why this paper took shape. The project is still developing in the aim of creating such as this paper, a light filled space with greenery in care homes, for elderly suffering from dementia.*

*Due to the constrains of the pandemic, this paper had to be written separately from the group project; however, it is a reality that biologists, landscape architects, care givers and lighting designer are opening new possibilities for a societal change in the way we relate to people affected by illness.*

*The conceptual framework and design proposal that this paper unfolded can hopefully be used to contribute to this body of work, by creating narratives with light and nurture a positive change.*

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## IMAGE SOURCES

Figure 1 (Cover page): A view towards nature (Self produced)

Figure 2: Sunset in Copenhagen (Self produced)

Figure 3: Nature exploration (Self produced)

Figure 4: Estimated dementia percentage incidence in relation to age;  
Retrieved from: World Alzheimer Report 2015

Figure 5: Nældebjerg care home, Retrieved from Healthcare Denmark,  
White paper - Denmark a dementia friendly society, 2018

Figure 6: Person centred care symbol (Google images)

Figure 7: Oase no.7 by Haus-Rucker (Deutsche museum)

Figure 8: Nature elements (Self produced)

Figure 9: Redrawn of the The Design Experiemnt Model (Self produced)

Figure 10: Criteria of the Environmental audit tool (Self produced)

Figure 11: Circadian lighting Aarhus care home, Retrieved from Healthcare Denmark, White paper - Denmark a dementia friendly society, 2018

Figure 12: Sensory room in care homes Denmark, Retrieved from Healthcare Denmark, White paper - Denmark a dementia friendly society, 2018

Figure 13: Nature exploration Stevens Klint, Denamrk, (Self produced)

Figure 14: Source: Nordic daylight cycles, Theilgaard J. Det danske vejr. Gyldendal, 2006; Volf, 2013

Figure 15: Nature, Light and The build environment scheme (Self produced)

Figure 16: Legacy Salmon Creek forecourt garden, Guenter vittori, 2013

Figure 17: "Sousbois provençal" (Undergrowth in Provence) Cézanne, Paul 1839-1906. Source: <https://www.kunst-fuer-alle.de/english/fine-art/artist/image/paul-cezanne/39/1/129961/sousbois-provencal/index.htm>

Figure 18: Brain functions - perception and memory Source: <https://www.bitbrain.com/blog/dementia-cognitive-stimulation-therapy>

Figure 19: View from the Botanical Garden Copenhagen (Self produced)

Figure 20: Nældebjerg care home, Greve, Retrieved from Healthcare Denmark, White paper - Denmark a dementia friendly society, 2018

Figure 21: Nældebjerg care home: top plan- floow and activity room; Building's floors view (Self produced)

Figure 22: Geographical Orientation & Sun Rotation Nældebjerg care home (Self produced)

Figure 23: Spatial definition - activity room (Self produced)

Figure 24: Light aperture (Self produced)

Figure 25: Shading&Ventilation, perspective view (Self produced)

Figure 26: Daylight Factor (Self produced)

Figure 27: Light levels from Anual review calculation (Self produced)

Figure 28: Top plan, furniture placement and flow (Self produced)

Figure 29: Electric light placement in compensation of daylight levels

Figure 30: The balcony ~ facing South (Self produced)

Figure 31: The nook facing north west (Self produced)



Figure 32: Section view facing West (Self produced)  
Figure 33: Section view facing North East (Self produced)  
Figure 34: Seasonal Wall facing N-W (Self produced)  
Figure 35: Final concept Balcony close up (Self produced)  
Figure 36: Final concept Balcony perspective (Self produced)  
Figure 37: Observation corner daylight (Self produced)  
Figure 38: Observation corner daylight + electric light (Self produced)  
Figure 39: Sky views (Self produced)  
Figure 40: Cylindrical luminaire set up (Self produced)  
Figure 41: Final concept Nook daylight (Self produced)  
Figure 42: Final concept Nook daylight + electric light (Self produced)  
Figure 43: Nature exploration Denmark (Self produced)  
Figure 44: The tactile table (Self produced)  
Figure 45: Anemone (Google images)  
Figure 46: Sort sol spring (Google images)  
Figure 47: Summer (Google images)  
Figure 48: Summer Sun (Google images)  
Figure 49: Rain (Google images)  
Figure 50: Sort sol autumn (Google images)  
Figure 51: Winter (Google images)  
Figure 52: Snow fall (Google images)  
Figure 53: Spring gradient (Self produced)  
Figure 54: Summer gradient (Self produced)  
Figure 55: Autumn gradient (Self produced)  
Figure 56: Winter gradient (Self produced)  
Figure 57: Composition balance (Self produced)  
Figure 58: Seasonal transformation 4 seasons walls (Self produced)  
Figure 59: Seasonal wall set up (Self produced)  
Figure 60: Section cut Seasonal wall set up (Self produced)  
Figure 61: Concept wall spring (Self produced)  
Figure 62: Concept wall summer (Self produced)  
Figure 63: Concept wall autumn (Self produced)  
Figure 64: Concept wall winter (Self produced)