

ABSTRACT

Title of Thesis: ILLUMINATING HAPPINESS:
DEVELOPING A THERAPEUTIC COHOUSING
COMMUNITY FOR THOSE AFFECTED BY
SAD

Sara Elizabeth Conover, Master of Architecture,
2019

Thesis Directed By: Professor and Associate Dean of Academic Affairs
& Outreach Madlen Simon, AIA School of
Architecture, Planning, & Preservation

Seasonal Affective Disorder is currently estimated to affect 10 million Americans, meaning that roughly 1 in 30 people struggle with SAD (Yellow Brick Program). This thesis explores the question: how can architectural design improve the mental and physical health of those suffering with SAD? By establishing a cohousing community for those affected, levels of social interaction can increase and in turn provide additional social and psychological benefits. In order to develop a positive and engaging living space, this thesis proposes several architectural design principles for well-being that can then be applied to this type of community. These principles are derived from environmental psychology, indoor environmental qualities, healing architecture, and Nordic winter living cultures in addition to characteristics of cohousing. The final approach will result in a cohousing community implemented in a case study in the Northeastern United States, an area where SAD is most common. These methods can then inform architects on how to develop stimulating and engaging places for those who suffer with depression in order to inspire a positive outlook on the colder seasons.

ILLUMINATING HAPPINESS:
DEVELOPING A THERAPEUTIC COHOUSING COMMUNITY FOR THOSE
AFFECTED BY SAD

by

Sara Elizabeth Conover

Thesis submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Master of Architecture
2019

Advisory Committee:

Professor Madlen Simon, Chair

Professor Emeritus Karl F.G. DuPuy, AIA, Committee Member

Professor Ronit Eisenbach, Committee Member

© Copyright by
Sara Elizabeth Conover
2019

Table of Contents

Table of Contents	iv
List of Figures	vii
List of Abbreviations	xiii
Introduction.....	1
Chapter 1: Seasonal Affective Disorder	3
Criteria, Symptoms, and Causes	3
Factors and Statistics.....	6
Treatment Options.....	9
Chapter 2: Architectural Design Strategies for Improving Well-being	12
Joy, Happiness, and Well-being.....	12
Environmental Psychology	14
Indoor Environmental Quality	19
Healing Architecture Typology.....	27
Nordic Winter Living Culture and Typology.....	36
Summary of Design Aspects for Well-being	45
Chapter 3: Design Aspects and Psychological Benefits of the Cohousing Typology	46
Cohousing as an Ideal Therapeutic Typology.....	46
Cohousing Criteria	46
Cohousing Models and Generations	51

Psychological/Social Implications	53
Applications in the United States	54
Lange Eng Cohousing Community	56
Jystrup Sawmill Housing Cooperative	60
Haptic Designs' Norwegian Elderly Housing Project.....	63
Roam's Ubud Coliving Coworking Space	65
Summary of Cohousing Design Aspects.....	68
 Chapter 4: Design Principles and Programmatic Analysis of a SAD Cohousing Community	
Derived Design Principles for a SAD Cohousing Community.....	69
Design Principles Applying to Programmatic Needs.....	70
Program Considerations and Requirements for a SAD Cohousing Community	72
 Chapter 5: Site Analysis and Critique of Current Development in Burlington, Vermont	
Site Selection.....	75
Analysis of Burlington, Vermont	77
Scope of North Avenue Site.....	82
Progressing Plans for Development on Site.....	89
Critical Analysis of Cambrian Rise Master Plan	93
 Chapter 6: Schematic Design of Site and Massing Exploration	
Overall Design Strategies for Master Plan.....	99

Master Plan Scheme 1: L-Shaped Communities Open to Lakeside.....	101
Master Plan Scheme 2: U-Shaped Communities	102
Master Plan Scheme 3: Linear, Axial Communities.....	103
Organization of Community Exploration.....	105
Community Massing Scheme 1: Centrally-Located Communal Spaces	107
Community Massing Scheme 2: Occupiable Exterior Thresholds	108
Community Massing Scheme 3: Exposed Gable Roof Structures.....	109
Chapter 7: Design Proposal and Application of Design Principles	111
Site Design	111
Community Design	116
Sequence.....	123
Conclusions.....	131
Appendix.....	132
Bibliography	135
Seasonal Affective Disorder.....	135
Architectural Design Strategies for Improving Well-Being	136
Design Aspects and Psychological Benefits of the Cohousing Typology	137
Site Analysis and Critique of Current Development in Burlington, Vermont.....	138

List of Figures

Figure 1: Beneficial effects of sunlight on the mind and the body	6
Figure 2: Ages typically affected by SAD	7
Figure 3: SAD in men versus women	7
Figure 4: United States regions affected by SAD as of 2017	8
Figure 5: Various Light Intensities: a) Exterior light intensity, b) Interior office light intensity, c) Light box therapy intensity	10
Figure 6: Design elements that evoke joy	14
Figure 7: Experiential elements of the biophilia hypothesis	16
Figure 8: Environmental psychology design strategies for the built environment	17
Figure 9: Prospect versus refuge environmental qualities	18
Figure 10: Mathematical transformations to incorporate in landscapes: a) Randomness, b) Translation symmetry, c) Reflectional symmetry, d) Rotational symmetry	19
Figure 11: IEQ design considerations	20
Figure 12: Adjoining side windows bring in additional, balanced daylight	24
Figure 13: South facing clerestory windows increase solar gain during winter months ..	24
Figure 14: Light shelves provide shade and let in indirect, reflected daylight	25
Figure 15: Skylights should be spaced out at half the distance of their height in the space	25
Figure 16: Single roof monitors let in an ample amount of daylight during the winter ...	26
Figure 17: Factors affecting the IEQ of a building	27
Figure 18: Healing architecture design strategies	28
Figure 19: Natural lighting of interior spaces	30

Figure 20: Interior courtyard connections in section	31
Figure 21: Interior courtyard connections in plan.....	31
Figure 22: Interior courtyard interactions in plan	33
Figure 23: Natural lighting of interior spaces.....	34
Figure 24: Interior courtyard interactions in section.....	34
Figure 25: Circulation through greenway	35
Figure 26: Daylighting methods utilized in hospital extension	36
Figure 27: Nordic winter design strategies for achieving hygge	38
Figure 28: Cluster house program and interaction.....	40
Figure 29: Natural lighting of interior spaces	41
Figure 30: Diverging circulation in public realm of house.....	42
Figure 31: Natural lighting of interior spaces	43
Figure 32: 72 hour cabin in Sweden	44
Figure 33: Summary of Critical Architectural Design Strategies for Well-being	45
Figure 34: SCD principles used in cohousing communities.....	47
Figure 35: Cohousing typical programming	48
Figure 36: Lange Eng typical two-bedroom unit.....	50
Figure 37: Lange Eng typical three-bedroom unit.....	50
Figure 38: Generations of cohousing: a) First-generation/linear, b) Second- generation/central, c) Third-generation/hybrid, d) Fourth-generation/dispersed	53
Figure 39: Existing cohousing in the United States as of 2016	55
Figure 40: Moments of social interaction	57
Figure 41: Natural lighting of interior spaces.....	58

Figure 42: Relationship between communal "hub" and private residential units	59
Figure 43: Moments of social interaction	61
Figure 44: Relationship between communal "hub" and private residential units	62
Figure 45: Natural lighting of "interior street"	63
Figure 46: Moments of social interaction	64
Figure 47: Natural lighting of interior spaces	66
Figure 48: Moments of social interaction	67
Figure 49: Relationship between communal "hub" and private residential units	67
Figure 50: Critical Design Aspects of the Cohousing Typology	68
Figure 51: Design principles to apply to a cohousing community for those with SAD ...	70
Figure 52: Architectural elements derived from design principles for a SAD cohousing community	71
Figure 53: Design principles applied to various programming for a SAD cohousing community	72
Figure 54: Proposed program allowances for a SAD cohousing community.....	73
Figure 55: Site selection matrix for a range of cities based on proposed criteria.....	76
Figure 56: Site selection matrix for Burlington, VT and New Haven, CT based on proposed criteria.....	77
Figure 57: Prevalence of SAD in Vermont as of 2017	78
Figure 58: Limited sunshine and daylight hours during the wintertime in Burlington	79
Figure 59: Burlington, Vermont population info with relation to SAD as of 2017.....	79
Figure 60: Prevalence of mental illnesses in the United States as of 2017.....	80

Figure 61: Vermont and United States Suicide Death Rates (per 100,000 people) as of 2016.....	81
Figure 62: Development of cohousing in Vermont as of 2016.....	81
Figure 63: Neighborhoods within Burlington.....	82
Figure 64: Accessibility to UVM Medical Center Seneca Center.....	83
Figure 65: Trials and Recreation in Burlington.....	84
Figure 66: Recreational activities in Burlington.....	84
Figure 67: Accessibility to Burlington Site.....	85
Figure 68: Zoning surrounding immediate site.....	86
Figure 69: Site plan - North Avenue, Burlington.....	87
Figure 70: Sun path diagram – North Avenue, Burlington.....	88
Figure 71: Site section demonstrating change in topography from North Avenue to Lake Champlain.....	88
Figure 72: Island Line Trail during the winter time.....	89
Figure 73: Water flow on site – North Avenue, Burlington.....	89
Figure 74: Cambrian Rise development plan.....	90
Figure 75: Cambrian Rise master plan and programming.....	92
Figure 76: Liberty House loft unit sections demonstrating its spatial design strategies...	93
Figure 77: Cambrian Rise building edges attempting to reinforce main axis.....	94
Figure 78: Cambrian Rise’s limited open park space.....	95
Figure 79: Cambrian Rise's proposed pedestrian and vehicular access.....	96
Figure 80: Building heights along North Avenue.....	97
Figure 81: Open vs. closed conceptual schemes for boundaries of the site.....	100

Figure 82: L-shaped cohousing communities aerial and master plan, NTS	102
Figure 83: U-shaped cohousing communities aerial and master plan, NTS.....	103
Figure 84: Linear cohousing communities aerial and master plan, NTS.....	104
Figure 85: Access and Orientation Scheme 1, NTS	105
Figure 86: Access and Orientation Scheme 2, NTS	106
Figure 87: Access and Orientation Scheme 3, NTS	107
Figure 88: Community Massing Scheme 1 Axon and Section, NTS	108
Figure 89: Community Massing Scheme 2 Axon and Section, NTS	109
Figure 90: Community Massing Scheme 3 Axon and Section, NTS	110
Figure 91: Master Plan, NTS	112
Figure 92: Site Plan, NTS	113
Figure 93: Clear Organization and Central Courtyards	114
Figure 94: Connection to Nature.....	115
Figure 95: Sun Path.....	115
Figure 96: Social Interaction Within Central Courtyard in Summer and Winter	117
Figure 97: Application of Design Principles to Each Cohousing Community	118
Figure 98: Community Ground Floor Plan, NTS	119
Figure 99: Community Social Interactive Spaces.....	119
Figure 100: Connecting Community to Nature	120
Figure 101: Community Unit Types	121
Figure 102: Unit Plans	122
Figure 103: Unit Elevations, NTS	122
Figure 104: Community Approach.....	123

Figure 105: Dining Room	124
Figure 106: Living Room	125
Figure 107: Grilling Area.....	126
Figure 108: Loggia Outside Private Units	126
Figure 109: Dining Nook.....	127
Figure 110: Reading Nook.....	128
Figure 111: Alley Between Communities.....	129
Figure 112: Central Courtyard Experiences During the Summer and Winter.....	130
Figure 113: Presentation Boards.....	131
Figure A 114: Section through Site	132
Figure A 115: Section through Therapy and Education Head House.....	133
Figure A 116: Section through Cohousing Community	133
Figure A 117: Section through Cohousing Community Common House	134
Figure A 118: Section through Central Open Green Space.....	134

List of Abbreviations

ASPECT	A Staff and Patient Environment Calibration Tool
IEQ	Indoor Environmental Quality
SAD	Seasonal Affective Disorder
SCD	Social Contact Design Principles

Introduction

Approximately 10 million people within the United States currently suffer with Seasonal Affective Disorder (SAD), a type of major depression that comes and goes with the changing of seasons and is most common during the fall and winter months of the year.¹ Light deprivation during the darker, colder months causes SAD to appear more frequently in northern climates. Patients experience extreme symptoms that affect their daily quality of life including depression, fatigue, overeating, and irritability.

This thesis aims to employ architectural design and concepts to improve the daily living conditions that can impact a person's well-being during the colder months of the year when SAD is most common. After studying the cause and effects of SAD, a literature review will conclude means of improving well-being through architecture and how those techniques can apply to those suffering with SAD. The building typology of cohousing will also be studied as an environment that creates spaces for daily social interactions and provides additional psychological and social benefits as a result. By combining an analysis of precedents in cohousing and research in improving well-being, this thesis proposes six key design principles that can improve the way in which those with SAD live on a daily: central organization and use of courtyards, connections to nature, public spaces for increased social interaction, daylighting methods, visual/thermal/acoustic comfort and control, and natural materials and textures.

¹ "What Seasonal Affective Disorder (SAD) Is And Is Not." Yellowbrick Program. 2018. Accessed October 22, 2018. <https://www.yellowbrickprogram.com/resources/seasonal-affective-disorder.html>.

The goal of this thesis is to develop a case study for a cohousing community for those affected by SAD through implementing these developed design principles in order to create a successful and engaging living community. This design will then serve as a model for architects to study employ in developing stimulating and engaging places for those who suffer with major depression. As seasons come and go, architectural design will have the ability to improve living experiences in cold climates and promote a positive living experience throughout the year.

Chapter 1: Seasonal Affective Disorder

Criteria, Symptoms, and Causes

The National Institute of Mental Health defines Seasonal Affective Disorder as “a type of depression that comes and goes with the seasons, typically starting in the late fall and early winter and going away during the spring and summer.”² Depression due to changes during the summer months may be possible but is less common than winter episodes of SAD. Dr. Norman E. Rosenthal, a world-renowned psychiatrist studying SAD, has developed a four part criteria to identify patients as sufferers of SAD. In order to be diagnosed with SAD, patients must first have developed a pattern of depression during the winter for at least two consecutive years that alternate with nondepressed periods during the spring and summertime. Second, at least one of those periods should meet the criteria for major depression. Third, no other major psychiatric disorders should be present and finally no any other recurring social or psychological reasons should be apparent that explain the recurring winter depressions.³ Those who experience less frequent mild to moderate symptoms during the fall or winter are considered to have the winter blues, otherwise known as subsyndromal SAD.⁴

Symptoms of SAD can be seen during the darkest times of the winter months when days are very short and nights are very long, approximately between mid-

² “Seasonal Affective Disorder.” National Institute of Mental Health. Accessed October 6, 2018. <https://www.nimh.nih.gov/health/topics/seasonal-affective-disorder/index.shtml>.

³ Rosenthal, Norman E. *Winter Blues: Seasonal Affective Disorder: What It Is and How to Overcome It*. Rev. and updated. New York: Guilford Press. 1998, 32-33.

⁴ “Seasonal Affective Disorder Sufferers Have More Than Just The Winter Blues.” American Psychological Association. February 2, 2013. Accessed October 6, 2018. <http://www.apa.org/news/press/releases/2013/02/seasonal-disorder.aspx>.

September and late March. These symptoms consist of feelings of depression on a daily basis, feelings of hopelessness, having low energy, loss in interests that were once enjoyed, trouble sleeping, changes in appetite and/or weight, feeling sluggish, irritability, difficulty concentrating, and thoughts of death or suicide. Some may experience only a few of these effects, while others may have experiences intense enough to affect their daily quality of life. Symptoms seen during the winter months include low energy, trouble sleeping, overeating, weight gain, carbohydrate cravings, and social withdrawal comparable to the idea of hibernating. All of these common indications are atypical depressive symptoms (with typical depressive symptoms being loss in appetite, sleeping less, and losing weight), causing SAD to be a unique disorder. Those suffering with the winter blues might experience symptoms due to associating winter and fall seasons with a traumatic event or due to having to limit activity based on the weather.

One of the most common symptoms seen in SAD is an increased appetite, or overeating, which involves uncontrollable cravings for sugars and starches. Excessive eating habits combined with a lack of activity tends to lead to weight gain. In the summer months eating habits return to normal and winter weight can be shed. However, as patients get older it becomes increasingly more difficult to lose the weight, leading to a gradual yearly weight gain.

There are three main causes of SAD: inherent vulnerability, stress, and light deprivation. Individuals may be prone to develop SAD if they have a family history of SAD or depression. Those affected might show symptoms early on in their childhood or a trauma-related event during someone's childhood might also cause seasonal depression.

Stress is a common contributor to changes in mood as well, including having a few stressful days at work or trying to care for a large household day after day.

Light deprivation can occur from living within a certain latitude, particularly in regions such as Scandinavia and Iceland where daylight can only last for a few hours during the wintertime. A lack of sunlight or a prolonged exposure to darkness disrupts the body's daily circadian rhythms. The brain's stress hormones then become too low and therefore fail to keep the body energetic and alert.⁵ In addition, SAD may transpire due to an imbalance of neurotransmitters including serotonin and melatonin. These neurotransmitters are produced by the pineal gland located within an area of the brain that is sensitive to natural light. Melatonin is produced in darkness and high levels of this hormone result in depression and fatigue. During the winter months levels of melatonin are increased during these limited hours of sunlight. Serotonin production in turn is decreased during this time and limits the ability to remain calm, limits feelings of well-being, and increases levels of stress and anxiety.⁶ Therefore, it is critical for the body to be exposed to a sufficient amount of sunlight on a daily basis to maintain positive effects on the mind and the body including higher energy, improved mood, and better sleep during the night (Figure 1). However, a simple act of moving from a bright home to a dimmer home can induce negate these effects and increase negative emotions, such as moving from a second-floor apartment into a dark basement. Even a dark workplace can be an issue if it does not receive an ample amount of light. Variations in weather patterns

⁵ Sternberg, Esther M. *Healing Spaces: The Science of Place and Well-Being*. Cambridge, Mass.: Belknap Press of Harvard University Press, 2009, 46.

⁶ Doran, Lisa. "Seasonal Affective Disorder." Barefoot Health Naturopathic Clinic. n.d. Accessed October 6, 2018. <http://www.barefoothealth.ca/seasonal-affective-disorder/>.

can cause also depressive feelings. Sunny days tend to have no effect, whereas a string of dark and cloudy days can spark a change in mood.

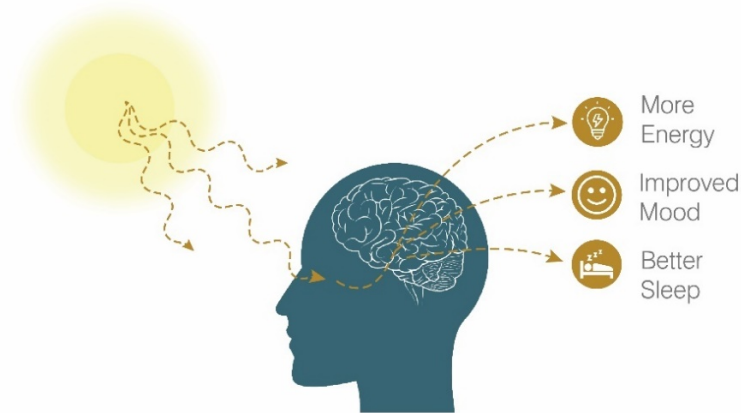


Figure 1: Beneficial effects of sunlight on the mind and the body

Source: Author

Factors and Statistics

An estimated 10 million Americans suffer from Seasonal Affective Disorder, with another 1 to 2 million Americans suffering from a milder form, meaning that SAD affects 1 in every 30 people in the United States.⁷ On average about 6% of Americans, mostly those in northern climates, experience SAD while about 14% of Americans experience the winter blues. SAD is typically seen in young adults and onset between the ages of 18 and 30 (Figure 2). However any age groups could be affected, from children to elderly.

⁷ Yellow Brick Program, “What Seasonal Affective Disorder (SAD) Is And Is Not.”

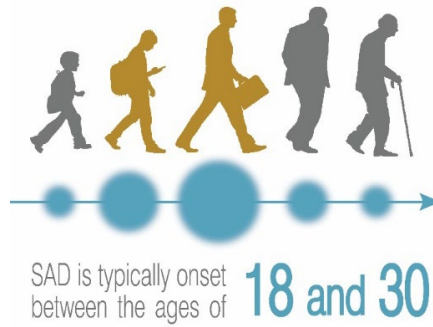


Figure 2: Ages typically affected by SAD

Source: Author, Yellow Brick Program

Several factors can increase the likelihood of developing Seasonal Affective Disorder. Women are four times more likely to have SAD than men (Figure 3). Women tend to be more at risk for depression in general partly due to their hormonal fluctuations. Additional struggles of hormone-related conditions including menstruation, menopause, PMS, and postnatal depression can have a negative effect on a woman’s overall mood. These depressive feelings are then intensified during the darkest months out of the year. Another reason there seems to be a significantly higher rate of SAD in women is because they are easier to diagnose. Their symptoms tend to align with those of general depression, such as sadness, fatigue, and disinterest in once enjoyed activities. Meanwhile, men tend to show significantly different symptoms such as alcohol or drug abuse, which does not necessarily allow for an easy diagnosis of SAD.



Figure 3: SAD in men versus women

Source: Author, Yellow Brick Program

SAD is also more frequent in those who live farther north or south of the equator where there is less sunlight during the wintertime. For example, 1.4% of those living in Florida suffer from SAD compared to 9.7% of those who live in the New England region of the United States (Figure 4).⁸ Location also can affect the timeframe in which people recognize a change in their overall mood. For example, an SAD patient living in Alaska may notice feelings of depression up to a month earlier than someone living in Maryland.

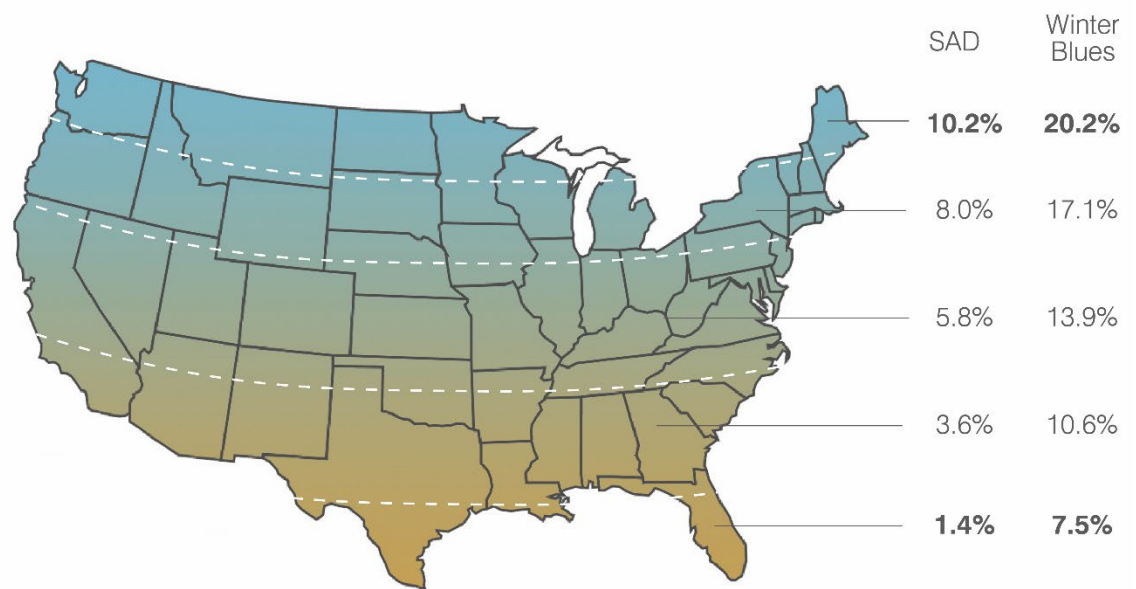


Figure 4: United States regions affected by SAD as of 2017

Source: Author, Psychological Science

SAD is often linked to other psychological disorders and cases. 55% of those with SAD have reported having a close relative with another similar severe depressive disorder and 34% have reported a close relative abusing alcohol.⁹ It has also been shown

⁸ Roecklein, Kathryn A. and Kelly J. Rohan. “Seasonal Affective Disorder: An Overview and Update.” *Psychiatry (Edgmont)*, vol. 2, no. 1, 2005: 22. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3004726/>.

⁹ Yellow Brick Program, “What Seasonal Affective Disorder (SAD) Is And Is Not.”

that SAD typically runs in the family and has a genetic aspect to the disorder.

Treatment Options

While researchers have not discovered a permanent cure for SAD, there are several successful methods to treat SAD including some simple daily routine changes. Getting plenty of sunlight is encouraged which can be gained during outdoor activities such as walking, skating, and skiing. By absorbing sun rays, patients can boost the amount of serotonin produced in order to improve their overall mood. Daily exercise of about 30 minutes a day several times a week also increases serotonin, as well as endorphins, to improve someone's well-being. Other changes in a patient's daily life should be sleeping and waking up at the same time every day, eating three meals a day around the same timeframe, eating balanced meals and less simple carbohydrates or sweet foods, and spending more time with family and loved ones. In addition, there are some more intense treatment options including light therapy, cognitive-behavioral therapy, and medications.

To conduct light therapy, the preferred device is a fluorescent light box producing a light intensity greater than 2,500 lux. Lux is a unit used for illumination intensity to the human eye. For comparison purposes, a brightly lit office is typically less than 500 lux. Outdoor light can be around 4,000 lux on a cloudy day and somewhere between 50,000 and 100,000 lux on a sunny one (Figure 5). Luckily innovative designs have allowed for these light therapy devices to be of reasonable size and portable.

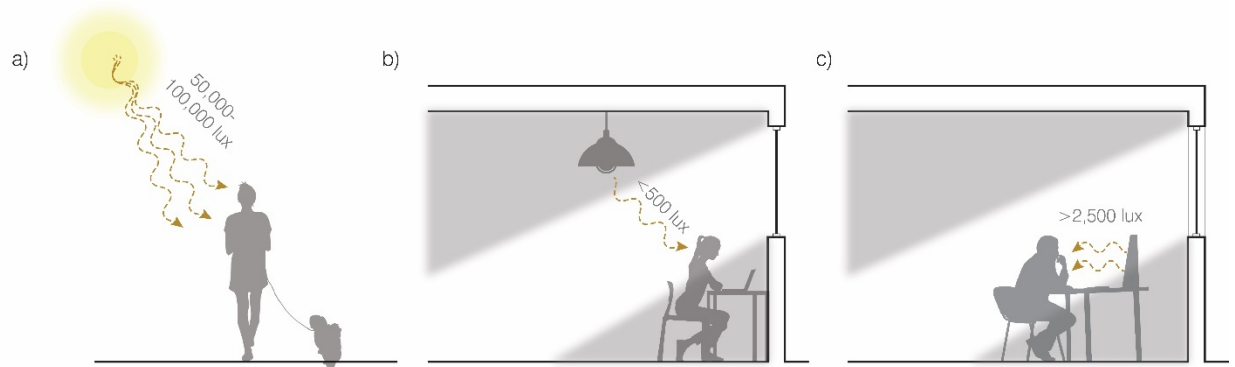


Figure 5: Various Light Intensities: a) Exterior light intensity, b) Interior office light intensity, c) Light box therapy intensity

Source: Author

The proper technique involves a correct distance between the patient and the light source, showing a successful response rate of 65% or higher.¹⁰ After positioning themselves, the patient should be awake but does not need to look directly into the light source. Other activities can be performed during the therapy while sitting such as reading, eating, etc.

The standard “dose” of light that is recommended is 10,000 lux of light for 30 minutes each day. For example, a light box rated at 2,500 lux should be used for two hours a day for the appropriate use. The suggested time of day for use is as early in the morning as possible, typically when the patient awakes or at least by 7 am. Up to 80% of those participating in light therapy can see improvement within two to four days of treatment.¹¹ Relapses are possible, so it is suggested that patients continue with their treatment through the season, but there is a possibility of their daily time exposure

¹⁰ Westrin, Åsa, and Raymond W. Lam. “Seasonal Affective Disorder: A Clinical Update.” *Annals of Clinical Psychiatry*, vol. 19, no. 4, 2007: 242, doi:10.1080/10401230701653476.

<https://pdfs.semanticscholar.org/ec13/73841894a378a8074b5430b3f143ae0ffb83.pdf>.

¹¹ Targum, Steven D. “Seasonal Affective Disorder.” *Psychiatry (Edgmont)*, vol. 5, no. 5, 2008: 33. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2686645/>.

decreasing based on their success. While light therapy has been proven to be successful, some side effects may include headaches, eye strain, nausea, and insomnia.

Antidepressants have also served as successful treatment with equal response rates compared to those participating in light therapy. The only minor difference is that light therapy has an earlier response time, typically within a week or two with less side effects seen. Dawn simulations is another treatment method involving an electronic dawn simulation with a bedside lamp illuminating up to 250 lux over the course of 90 minutes to mimic the rising of the sun at the appropriate time of wake. Cognitive behavior therapy combined with light therapy has proved to be more successful when compared to other methods in terms of symptom severity and relapse rates.

While multiple treatment methods can be tested to improve or possibly cure someone's struggle with SAD, a new approach could be rethinking the way in which these patients are living and how their surrounding environments can decrease the severity of their symptoms. While location and climate greatly affect the possibility of developing this disorder, the design of current living conditions in terms of lighting, views, and engagement with exterior spaces also affect chances of depressive feelings and overall well-being. Architectural design has the opportunity to create positive spaces that improve a person's happiness and well-being in order to prevent SAD from onsetting or becoming worse.

Chapter 2: Architectural Design Strategies for Improving Well-being

Joy, Happiness, and Well-being

SAD negatively affects a patient's overall state of happiness and well-being. In order to understand how a patient's well-being can be improved, these terms psychological terms must be clearly defined to eventually be applied to the built environment. Happiness entails the "experience of joy, contentment, or positive well-being, combined with a sense that one's life is good, meaningful, and worthwhile."¹² This description promotes the idea that fleeting positive emotions combined with a deeper sense of meaning and purpose in life contribute to the overall feeling of happiness.

A person's state of well-being affects their level of happiness, which Merriam-Webster defines as "the state of being happy, healthy, or prosperous."¹³ In other words, well-being is a means in which people can perceive that their lives are going well beyond simple statistics of mortality, economic status, etc. Well-being is often associated with the following: self-perceived health, longevity, mental and physical illnesses, social connections, and productivity. Since the meaning of well-being is somewhat subjective, it can be measured using self-reporting of subjective measures, such as feelings of happiness within the last thirty days, and with objective measures, such as household income.

¹² "What is Happiness?" The Greater Good Science Center at the University of California, Berkeley. n.d. Accessed October 22, 2018.

<https://greatergood.berkeley.edu/topic/happiness/definition#what-is>.

¹³ "Well-being." Merriam-Webster. n.d. Accessed October 22, 2018.

https://www.merriam-webster.com/dictionary/well-being?utm_campaign=sd&utm_medium=serp&utm_source=jsonld.

There are five key ways an individual can increase their well-being: connecting, being active, taking notice, learning, and giving. All of these practices can contribute to improving a SAD patient's levels of happiness and health on an individual level. In order to connect to one another, social relationships should be improved to feel valued and close to others. To be active, one should participate in regular physical activities. Taking notice involves having a broadened awareness for self-understanding, an ability to make positive choices, and having an awareness of thoughts and feelings. Learning should occur at work, during educational activities, and by setting personal goals. Finally, the act of giving involves serving one's community or society as well as helping others.

Another term used to describe well-being is joy, which is described as a “momentary experience of positive emotion” and over time adds up to be a sum of its parts.¹⁴ Joy is slightly different than happiness, in which happiness measures how good someone feels over a period of time. Simple moments of positive experience can increase a patient's overall mood in that particular moment in time. Some examples of items that typically bring immediate joy are cherry blossoms, bubbles, treehouses, ice cream cones, and so on. A further inspection into why certain objects or appearances give joy leads to several common experiences including round items, pops of bright color, symmetrical shapes, a sense of abundance and multiplicity, and feelings of lightness or elevation (Figure 6). An example of abundance applies to confetti, where one confetto is underwhelming but plenty of confetti brings a smile to one's face. Bright color is another

¹⁴ Lee, Ingrid Fetell. “Where joy hides and how to find it.” *TED2018*, TED Conferences, May 21, 2018. Video, 13:37.
https://www.ted.com/talks/ingrid_fetell_lee_where_joy_hides_and_how_to_find_it/up-next?utm_campaign=social&utm_medium=referral&utm_source=facebook.com&utm_content=talk&utm_term=social-science.

example in which color has been shown to be a “sign of life, a sign of energy.”¹⁵ While joy is an experience that people tend to actively seek out, the feeling is held back in restrained in adulthood for fear of judgement and being viewed as too childish, too feminine, or too unserious.

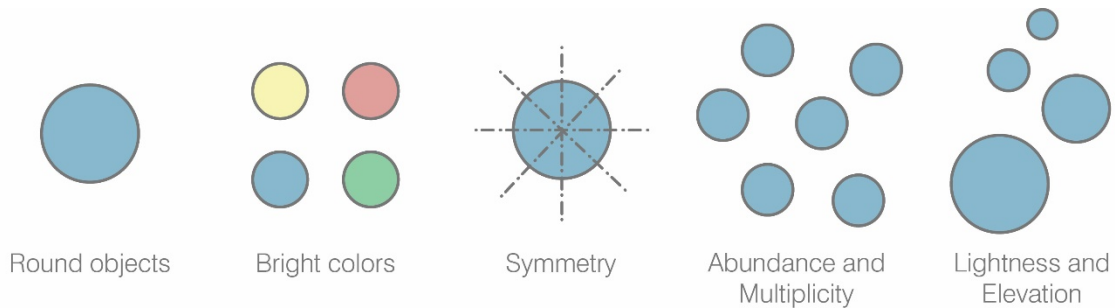


Figure 6: Design elements that evoke joy

Source: Author

To improve a SAD patient’s state of well-being, opportunities for experiences of happiness and joy should be enhanced in order to keep them engaged during the months out of the year that they struggle to feel happy. To do so, architectural design strategies can be implemented to improve the built environment SAD patients experience on a daily basis. Research and precedents can be studied in several areas including environmental psychology, indoor environmental quality, healing architecture, and Nordic winter living culture and typology. Comparing these architectural ideas will show patterns of what is proven to be most successful for improving well-being.

Environmental Psychology

Examining the way in which the environment affects human experiences, behaviors, and well-being as well as vice versa is referred to as environmental

¹⁵ Ingrid Fetell Lee. “Where joy hides and how to find it.”

psychology. This field of study has led to the affirmation of the importance of natural forms as an inspiration for architectural design. The biophilia hypothesis provides evidence for this relationship, which states that humans have a strong attraction towards nature, including plants and other living things. Valuable experiences with nature can include true wilderness, parks, gardens, and natural features on private properties. A connection to nature has proven to be beneficial for human health and well-being with reports of reduced stress, increased attention span, and longevity.¹⁶ There are three notable advantages to connecting with nature that promote these health benefits. The first is that a location near nature typically offers opportunities for physical activity which results in improvements in physical health. Activities within nature also provide occasions for social interaction, such as walking or sitting outdoors with friends and family. A third advantage is a chance to escape from typical daily routines and activities. Nature can provide these benefits due to its fresh air with less pollutants, the fragrances given off by plants, and the visual appreciation of vegetation.

¹⁶ Grinde, Bjørn and Grete Grindal Patil. "Biophilia: Does Visual Contact with Nature Impact on Health and Well-Being?" *International Journal of Environmental Research and Public Health*, vol. 6 no. 9, 2009: 2335.
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2760412/pdf/ijerph-06-02332.pdf>.

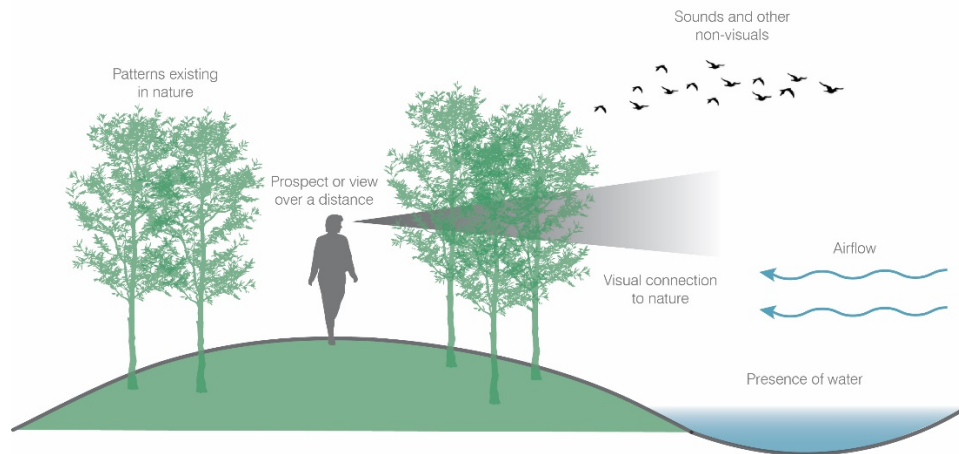


Figure 7: Experiential elements of the biophilia hypothesis

Source: Author

There are several architectural design strategies to incorporate nature back into the built environment. Using natural shapes and forms create interest and richness with curves and organic shapes. Rectilinear shapes are less appealing, even though they are cheaper to fabricate. Using natural materials also create a richness that provide a complexity and show the passage of time unlike synthetic materials. Another strategy is orienting the building on a site to incorporate daylighting and natural ventilation. Ventilation strategies include operable windows and the stack effect, which involves warm, stale air exhausting up high while pulling fresh, cool air down.

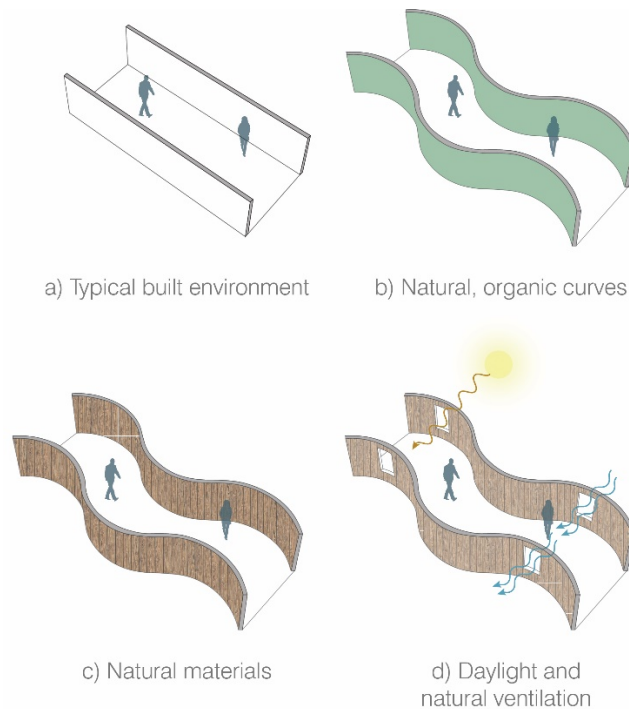


Figure 8: Environmental psychology design strategies for the built environment

Source: Author

To develop appealing natural landscapes within a built environment, building users search for two main environmental qualities: prospect and refuge. Prospective areas are “settings or landscape elements that facilitate obtaining information about the environment.” An example would be a hillscape that allows the visitor to glance around at its existing environment. Refuge points on the other hand refer to “settings that can provide shelter and protection.”¹⁷ Natural elements, such as a cave, protects from weather and other dangerous elements, while a built pavilion within a landscape performs a similar function (Figure 9). The same prospect and refuge methods applies to exterior views from inside. Buildings should design views looking outside that are controlled and

¹⁷ Joye, Yannick. “Architectural Lessons from Environmental Psychology: The Case of Biophilic Architecture.” *Review of General Psychology*, vol. 11, no. 4 (2007): 306. <https://pdfs.semanticscholar.org/08a9/bd25df650197fb58bf8b9c8647ad0abc07a7.pdf>.

avoid excessively using glass material. These types of views within a refuge invite building users to engage with the surrounding natural environment without sacrificing a sense of protection.

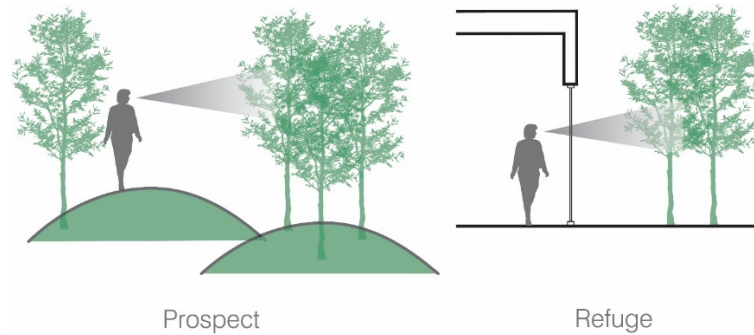


Figure 9: Prospect versus refuge environmental qualities

Source: Author

Other design strategies to incorporate in a landscaped setting are wide and open spaces, variations in topography, clusters of trees, and calm water features. Compositions should be controlled but not overly simple with constant repeating elements. Instead, landscapes should follow simple mathematical transformations including translational symmetries, reflectional symmetries, and rotational symmetries (Figure 10).¹⁸ These combined design strategies can be implemented to a built environment in order to promote natural elements and landscapes that improve mental and physical health.

¹⁸ Quillin, David D. "Biophilia: The benefits and strategies for including nature in the design of buildings." *David D. Quillin Architecture*, July 30, 2017. <http://daviddquillinarchitecture.com/biophilia-the-benefits-and-strategies-for-including-nature-in-the-design-of-buildings/>.

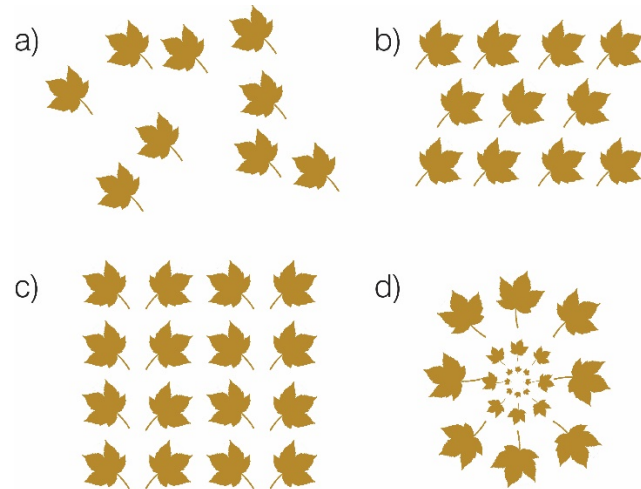


Figure 10: Mathematical transformations to incorporate in landscapes: a) Randomness, b) Translation symmetry, c) Reflectional symmetry, d) Rotational symmetry

Source: Author

Indoor Environmental Quality

The interior built environment is equally, if not more, important than its exterior. ASHRAE guidelines state that a person typically spends about 80-90% of their time indoors, meaning that indoor environments must strive to be comfortable and safe.¹⁹ Four main factors influencing the indoor environmental quality (IEQ) of a building impact the well-being of its users: thermal comfort, indoor air quality, acoustic comfort, and visual comfort (Figure 11).

¹⁹ Al horr, Yousef, Mohammed Arif, Martha Katafygiotou, Ahmed Mazroei, Amit Kaushik, Esam Elsarrag. “Impact of indoor environmental quality on occupant well-being and comfort: A review of the literature.” *International Journal of Sustainable Built Environment*, vol. 5, no. 1, 2016: 1-11. <https://www.sciencedirect.com/science/article/pii/S2212609016300140>.

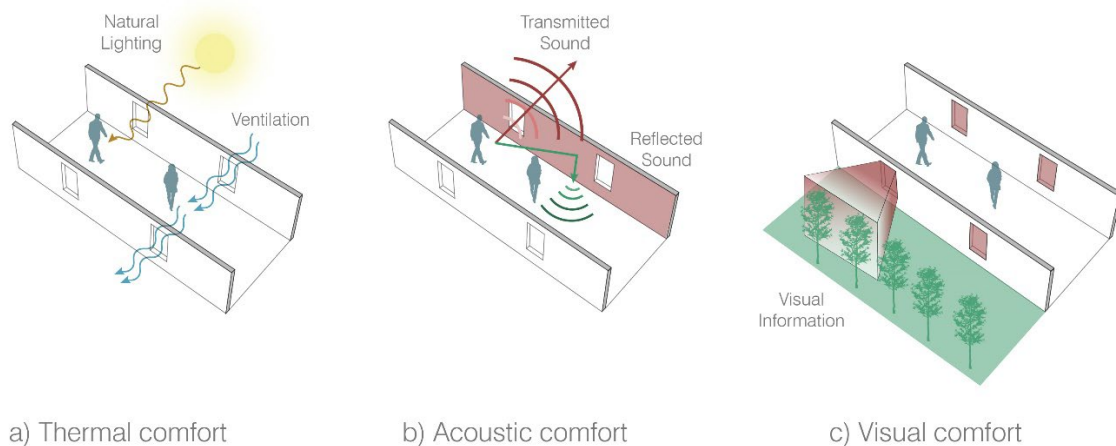


Figure 11: IEQ design considerations

Source: Author

Thermal comfort is expressed as a human's satisfaction with the environment they are in and is influenced mainly by the temperature of the air, air flow, and relative humidity. The air within the indoor environment ideally should contain no contaminants in hazardous concentrations. Any indoor air pollutants can endanger a building user's health and experience. Fresh air and ventilation can improve the flow of air within a space through use of operable windows and easy access to a building's exterior. Additionally, interior environments should strive for low concentrations of levels of carbon dioxide and volatile organic compounds. The level of activity within a space can also affect one's level of thermal comfort.

Acoustic problems can arise when airborne sounds, outdoor noise, and noises from nearby spaces create distractions and lower productivity within a space. However, there are three main strategies to prevent acoustic problems: absorbing sound through acoustic ceiling tiles, blocking of sound in workspaces with panels and reorganization of

spaces, and covering up sounds with masking techniques. These methods provide control over how much transmitted sound is absorbed and reflected based on a space's program.

In terms of visual comfort, humans tend to be visually attracted to contrasts between materials, textures, etc. Contrast, in terms of interior design, typically describes a measured brightness ratio between dark and light surfaces, which depends on the light brought to a space and the reflectance of objects within that space.²⁰ That strong contrast between the two variations in light creates texture and therefore spatial depth that the human eye can perceive. Too little contrast within space can cause it to seem flat and uninteresting.

Colors affect building users' senses and affect their current mood. For example, red causes excitement and can sometimes make a space seem louder. It also has the ability to create a feeling of warmth. Blue fosters a sense of calmness and creates an opposite effect of making spaces seem quieter. Yellow seems friendly and gives off a soft texture. A mixture of these colors creates an interesting dynamic and can engage visitors within a space. However, an overstimulation of too many colors can create too many contrasts and therefore make a space seem overly complex. On the other end of the spectrum, a palette of colors that are too monotone or bland creates a weak environment and gives off very little stimulation.²¹

Window placement is another key consideration in terms of visual comfort. Daylighting and window placement within a space affect the way in which building users feel both physically and mentally. A study by the Center for Building Performance of the

²⁰ Erwine, Barbara. *Creating Sensory Spaces: The Architecture of the Invisible*. (New York: Routledge, Taylor & Francis Group, 2017), 49.

²¹ Erwine, *Creating Sensory Spaces: The Architecture of the Invisible*, 73.

U.S. Department of Energy concluded that major health complaints showed a 20-25% decrease for those who were located near an exterior window for views and daylight as compared to those who were not.²² Exterior windows allow for a sense of openness and spaciousness and cause a room to feel bigger than it truly is.

Those who occupy interior spaces away from exterior windows tend to compensate by decorating those darkened areas with images of landscapes and other nature-related themed decor, demonstrating a need to connect with the outdoor world. 90% of office workers are dissatisfied in windowless environments as it negatively affects their workday.²³ While many countries do not have building codes requiring windows purely for daylighting reasons, researches in the United Kingdom have found that to satisfy at least 85% of building's occupants a window should be at least 11 feet in width.²⁴ This size was not determined solely based on how much daylight was allowed in or if the room had enough artificial light, but was concluded based on the amount of visual information contained within that view. An adequate level of information about the outside world allows for relief to the sense of enclosure.

In addition, windows and daylighting have proven to be an asset for creating a therapeutic environment. Patients residing within windowless rooms have expressed negative feelings and are more likely to suffer from fatigue. However, exterior views available within a room allow patients to recover more quickly and both seasonal and nonseasonal depression can be treated. For example, a study in 2001 involving bipolar

²² Boubekri, Mohamed. *Daylighting, Architecture, and Health: Building Design Strategies*. 1st ed. (Amsterdam: Elsevier Architectural Press, 2008), 97.

²³ Boubekri, *Daylighting, Architecture, and Health: Building Design Strategies*, 99.

²⁴ Boubekri, *Daylighting, Architecture, and Health: Building Design Strategies*, 100.

depressed patients concluded that those placed in rooms with eastern facing windows to receive morning sunlight stayed in the hospital for a shorter period of time than those who were exposed to afternoon sunlight on the western side.²⁵ SAD patients may benefit from residing in spaces that receive an ample amount of morning light, particularly for those who find it difficult to wake during shortened, darker days in the winter.

To achieve adequate amounts of natural light within a built environment, there are two main strategies to incorporating windows: sidelighting systems and toplighting systems. Sidelighting involves light being brought in from the sides of a building—an example of that being a window. Toplighting succeeds in bringing light in from the top of a building to be distributed to the interior space below, typically achieved using a skylight.

The most common sidelighting technique is a side window on the exterior wall of the building. A side window can be incorrectly utilized and cause high discomfort with a glare if not installed in critical areas of a building. Side windows should be used more successfully by bringing daylight in on two adjoining walls in order to bring in more balanced daylight (Figure 12). Clerestories are a type of side window placed up high along a wall with a purpose to provide a deeper penetration of daylight rather than provide exterior views. South facing clerestories are most beneficial, however any angle will avoid a glare due to its height within the building. The correct angling of a building's roofing system and a south facing clerestory window allows light to be admitted during the winter months and block any unnecessary light during the summer (Figure 13). Light shelves are also a commonly used sidelighting method that redirects daylight further back

²⁵ Boubekri, *Daylighting, Architecture, and Health: Building Design Strategies*, 108.

within a room by reflecting it off the ceiling. They distribute light more evenly than side windows and provide shade from direct sunlight (Figure 14). Louvers are similar to light shelves in that they redirect sunlight towards the back of an interior space, however they can be adjusted during seasonal changes to admit the right amount of daylight.

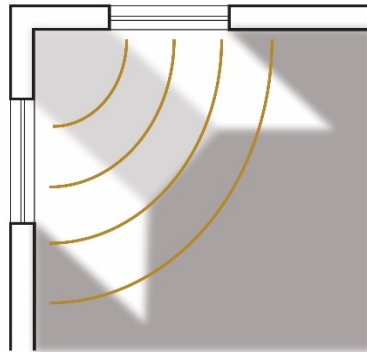


Figure 12: Adjoining side windows bring in additional, balanced daylight

Source: Author

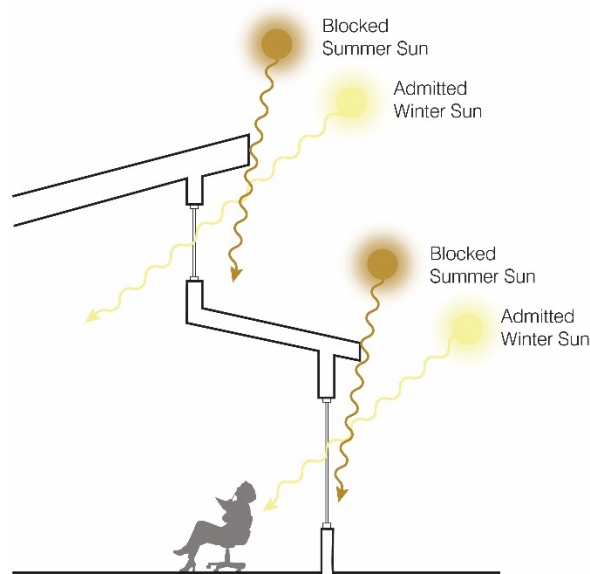


Figure 13: South facing clerestory windows increase solar gain during winter months

Source: Author

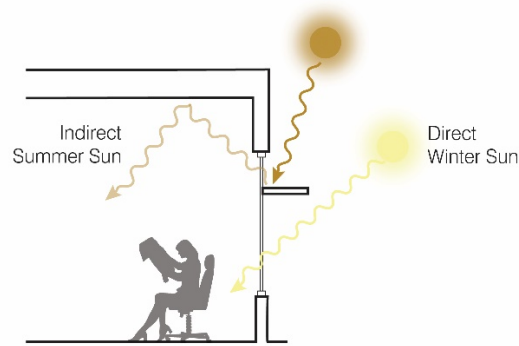


Figure 14: Light shelves provide shade and let in indirect, reflected daylight

Source: Author

Skylighting systems are a typical method of toplighting and if multiple skylights are used within a space, the spacing between them should be equal to their height in the room (Figure 15). Roof monitor and sawtooth systems capture light at certain times of the day and year depending on the program of the building. Roof monitors can be two-sided and therefore provide a distributed amount of daylight as opposed to the directional one-sided method. A single roof monitor system lets light in mainly during the winter and very little during the summer (Figure 16).

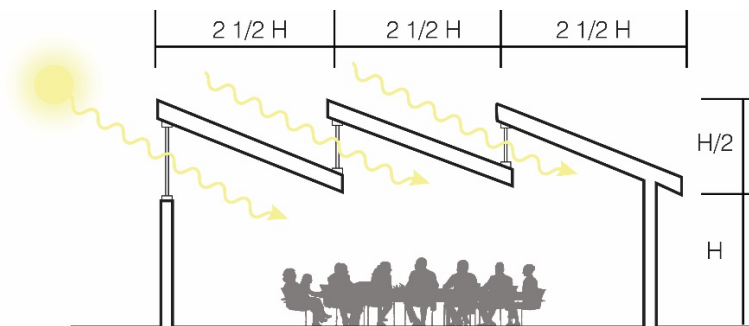


Figure 15: Skylights should be spaced out at half the distance of their height in the space

Source: Author

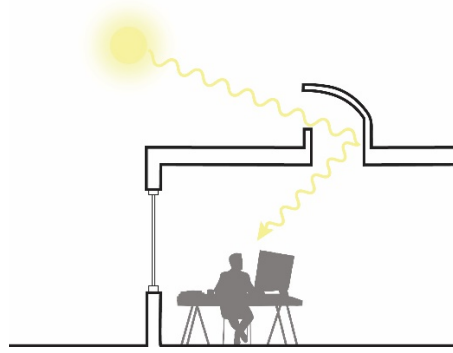


Figure 16: Single roof monitors let in an ample amount of daylight during the winter

Source: Author

IEQ is evaluated through several factors: external conditions, the building, building services, and human activities.²⁶ External conditions include the state of the exterior environment such as temperature, pollution, noise, and lighting. The building's envelope, materials, and interiors along with its HVAC and lighting services serve as indicators of the level of comfort within. Finally, building users and their activities are critical during the building's operations and the level in which they can successfully and comfortably perform these activities serves as an indicator as well. All of these factors affect the IEQ of a building and how satisfied users are with the building's performance (Figure 17). If the interior environment is comfortable and controlled, building users will feel an improvement in well-being both mentally and physically.

²⁶ Delgado, J.M.P.Q., Ricardo Almeida, and Vasco Peixoto de Freitas. "Chapter 2: Indoor Environmental Quality." *School Buildings Rehabilitation: Indoor Environmental Quality and Enclosure Optimization*, (Cham: Springer International Publishing: Imprint: Springer, 2015), 6.

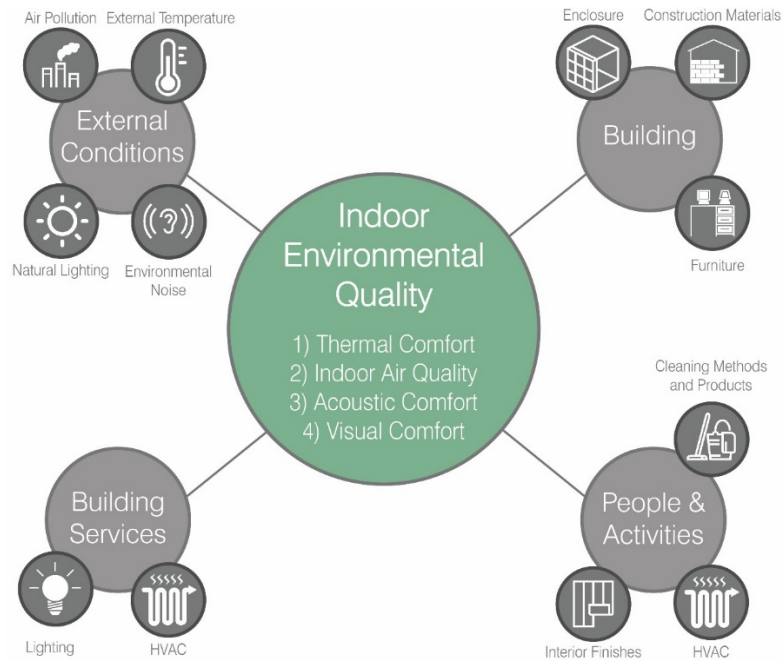


Figure 17: Factors affecting the IEQ of a building

Source: Author

Healing Architecture Typology

Healing architecture is designed for healthcare facilities by creating positive environments to support patients and their families through the stresses resulting from illnesses and healing processes. In order to provide nurturing and therapeutic spaces to improve well-being, building methods should be employed that encourage recovery both mentally and physically. Professors Bryan Lawon and Michael Phiri from the University of Sheffield have developed A Staff and Patient Environment Calibration Tool (ASPECT) by combining research evidence in order to provide guidelines for healthcare buildings in the United Kingdom and Ireland.²⁷ Six main aspects come together to create a list of important features in buildings and how the qualities of these indoor environments can improve daily experiences for its users (Figure 18).

²⁷ Lawson, Bryan. “Healing Architecture.” *Arts & Health*, vol. 2, no. 2, (2010): 102.

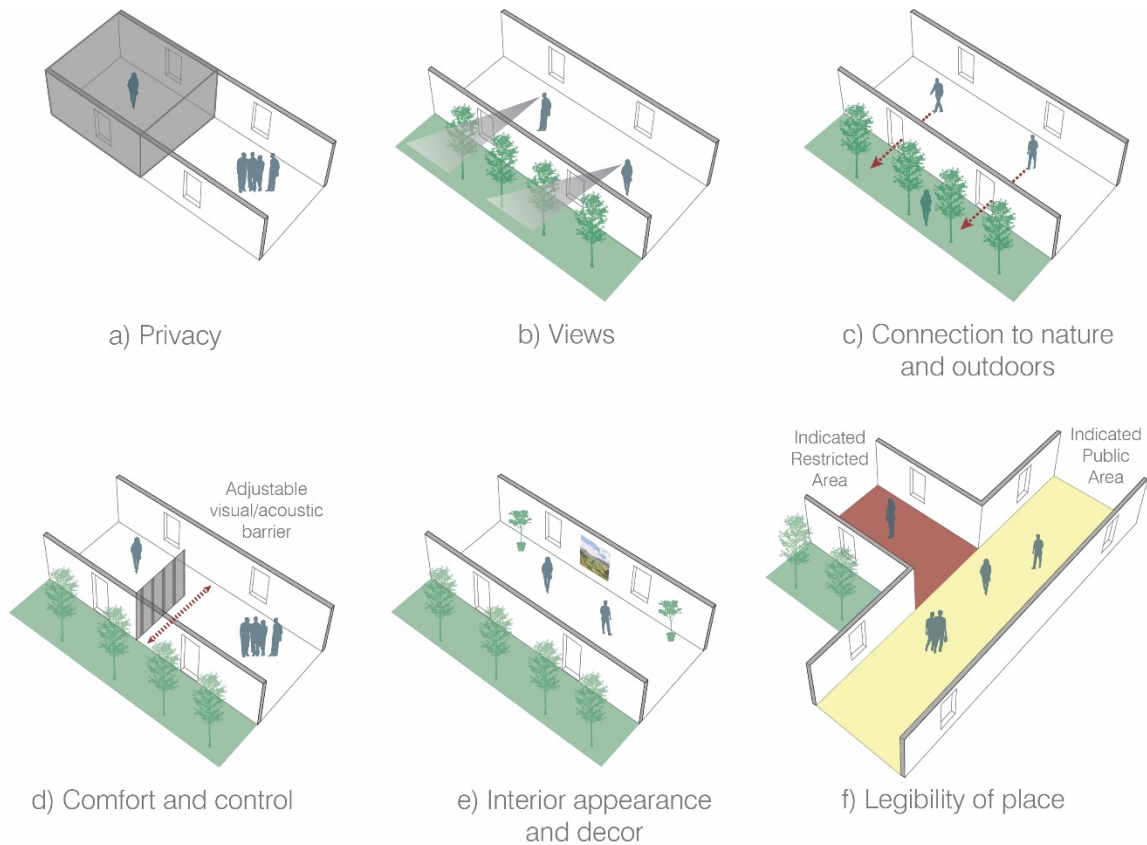


Figure 18: Healing architecture design strategies

Source: Author

The first element is privacy and allowing users to control their level of privacy with their doctors and family, as well as providing a chance to spend time alone. The second is creating views outside of the building to allow for self-healing processes to speed up based on studies referenced in the topic of IEQ. Not only can controlled views create stimulating experiences, but they also allow for visitors to remain calm during stressful or uncomfortable situations. Building users should also have direct, physical connection to nature as a third element. Therapeutic exterior spaces should also be designed for patients and visitors to find relief in after long periods of enclosure. When outdoor accessibility is not possible in extreme weather, interior plants and images of nature can have a similar effect to direct connections to nature. The fourth element allows

patients to feel comfortable within a building by giving occupants control of their experience in terms of creating visual and acoustic barriers. The fifth design element requires areas to be pleasurable to spend time in, so interior appearances should be designed with various colors and textures that are appropriate for the space's use. To maneuver their way through these spaces, the final element requires a hierarchical spatial organization and clear separation of public and private spaces through different materials and markings. This design technique also establishes a legibility of place so building visitors can easily navigate through circulation and acknowledge differential spaces. All of these design techniques allow architecture to create spaces for patients to improve their health and wellbeing through visual stimulation and positive experiences.

A precedent for these healing architectural design methods is the Oasis Cancer Center, located near Naestved's existing hospital in Denmark. The building closes itself off from the high traffic roads surrounding the site, but the facades become more transparent within the two courtyard spaces that bring light to its interior (Figure 19). The internal functions are separated into three areas. The main area within the building is the gathering space is placed between the two courtyards as it serves as the central room for the entire building. The remaining public functions and the administrative programs are organized around the two courtyards (Figure 20).²⁸ By doing so, all of the programmatic elements have visual and physical connections to the green areas throughout the project (Figure 21).

²⁸ Furuto, Alison. "Oasis Cancer Care Center / WE Architecture." ArchDaily. March 13, 2012. Accessed October 17, 2018. <https://www.archdaily.com/215397/oasis-cancer-care-center-we-architecture>.

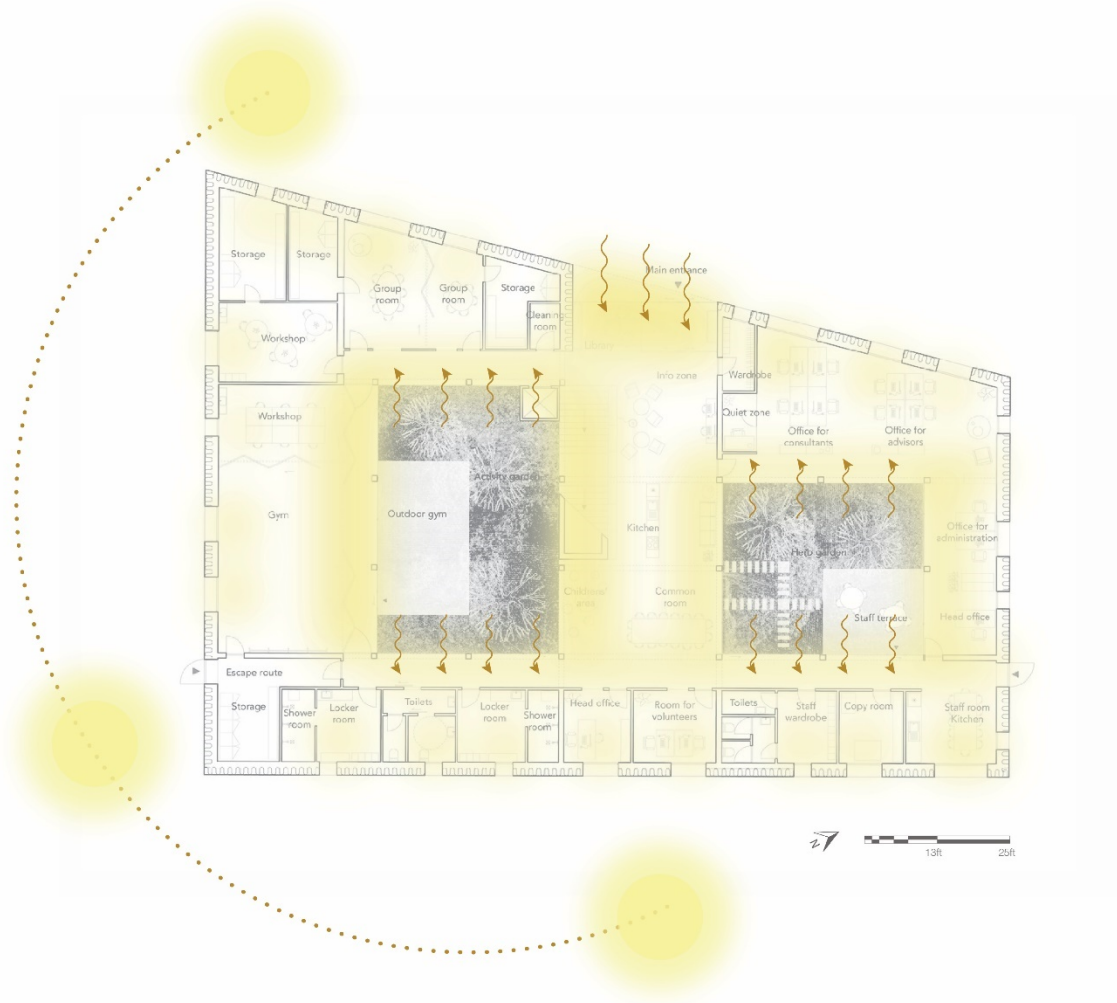


Figure 19: Natural lighting of interior spaces

Source: ArchDaily, Author

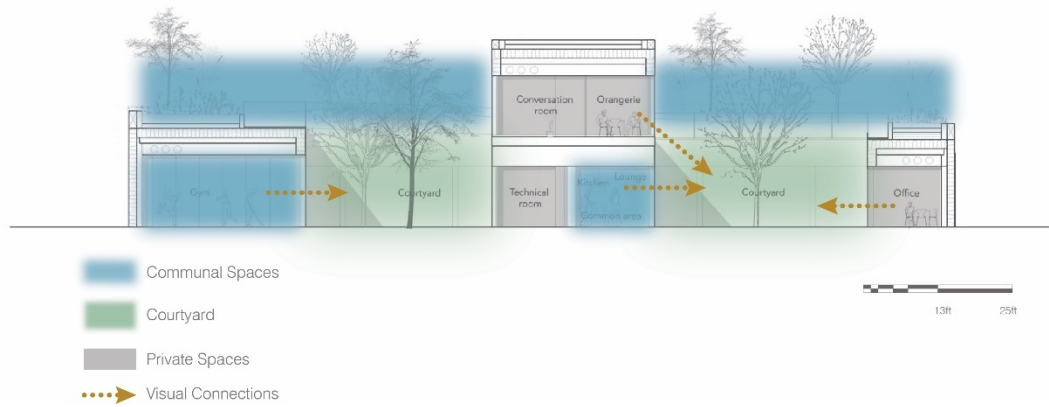


Figure 20: Interior courtyard connections in section
 Source: ArchDaily, Author

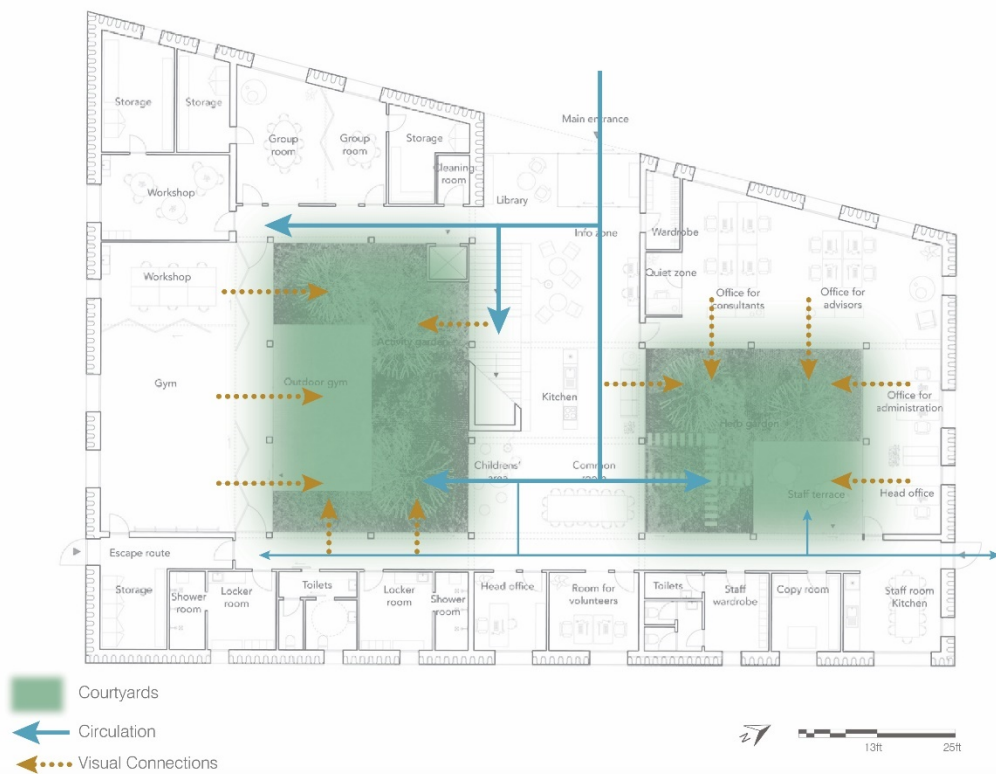


Figure 21: Interior courtyard connections in plan
 Source: ArchDaily, Author

Another cancer treatment center with similar design strategies is the new Livsrum Cancer Counseling Center located in Copenhagen, composed of seven clustered houses surrounding two outdoor green spaces (Figure 22). One courtyard is purposed for meditation and silence, while the other promotes physical activity and social interactions. Each of these individual buildings contain a specific program including a library, kitchen, lounges, retail, and gym facilities. Each building's unique roof height allows it to distinguish itself from the adjacent hospital buildings. In addition, there is a heavy focus on the importance of wellbeing with several rooms open for therapy and conversation. The vision of this treatment center was to create a "homely, open and welcoming environment" and to stray away from the typical institution building type.²⁹ Its modern style designed with familiar, human-scaled materials creates a stark contrast to the customary sterile hospital environment. The smaller cluster of buildings derived from the original concept of one larger building creates a human scale and a variation of spaces.

²⁹ "Livsrum." EFFEKT. 2013. Accessed October 22, 2018. <https://www.effekt.dk/liv/>.

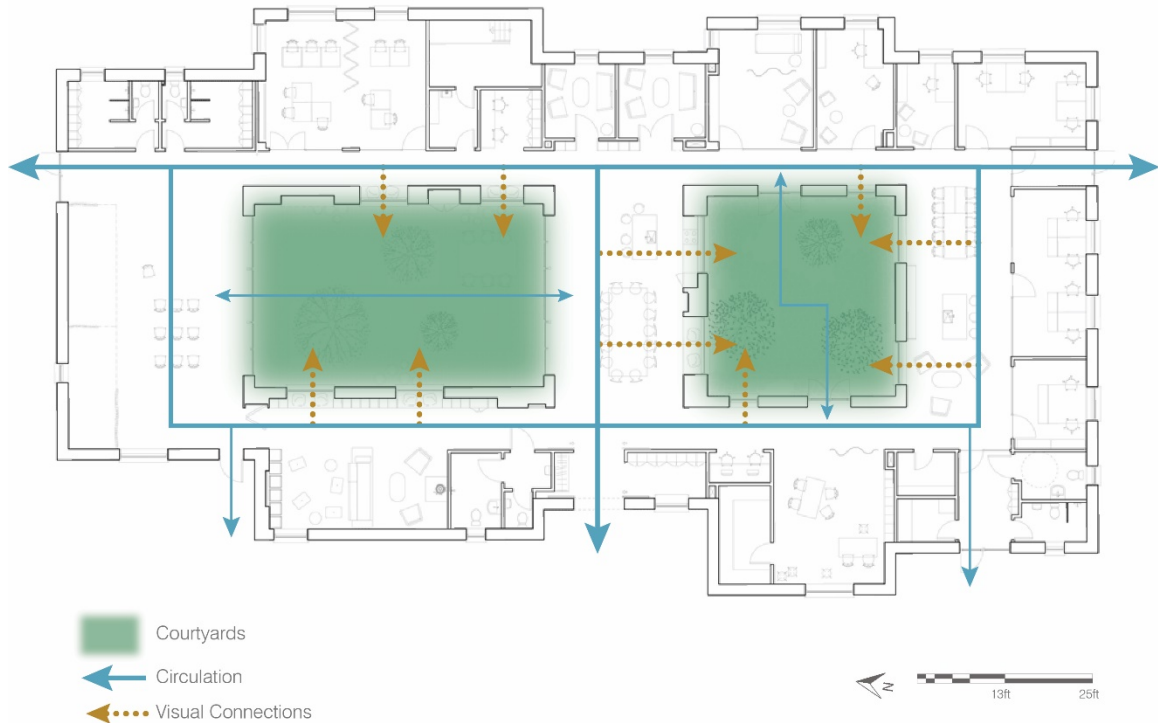


Figure 22: Interior courtyard interactions in plan

Source: ArchDaily, Author

The overall design has similarities to the Oasis Cancer Center. The site is comparable in that it is surrounded by main roads on three sides, so the courtyards were placed in the center of the building to protect them from noise and chaos. The courtyards provide a therapeutic relief and natural light similar to the ones at the Oasis Cancer Center (Figure 23). All of the programmatic spaces face onto these courtyards (Figure 24). Its larger communal space, named “Livsrums” meaning “Life Space,” is in the heart of the complex, in comparable size and shape to the main gathering area at the Oasis Center, to create a center that promotes a clear, natural circulation throughout the rest of the development.³⁰

³⁰ Zilliacus, Ariana. “Livsrums Cancer Counselling Center.” ArcSpace. December 6, 2017. Accessed October 22, 2018. <https://arcspace.com/feature/livsrums-cancer-counselling-center/>.

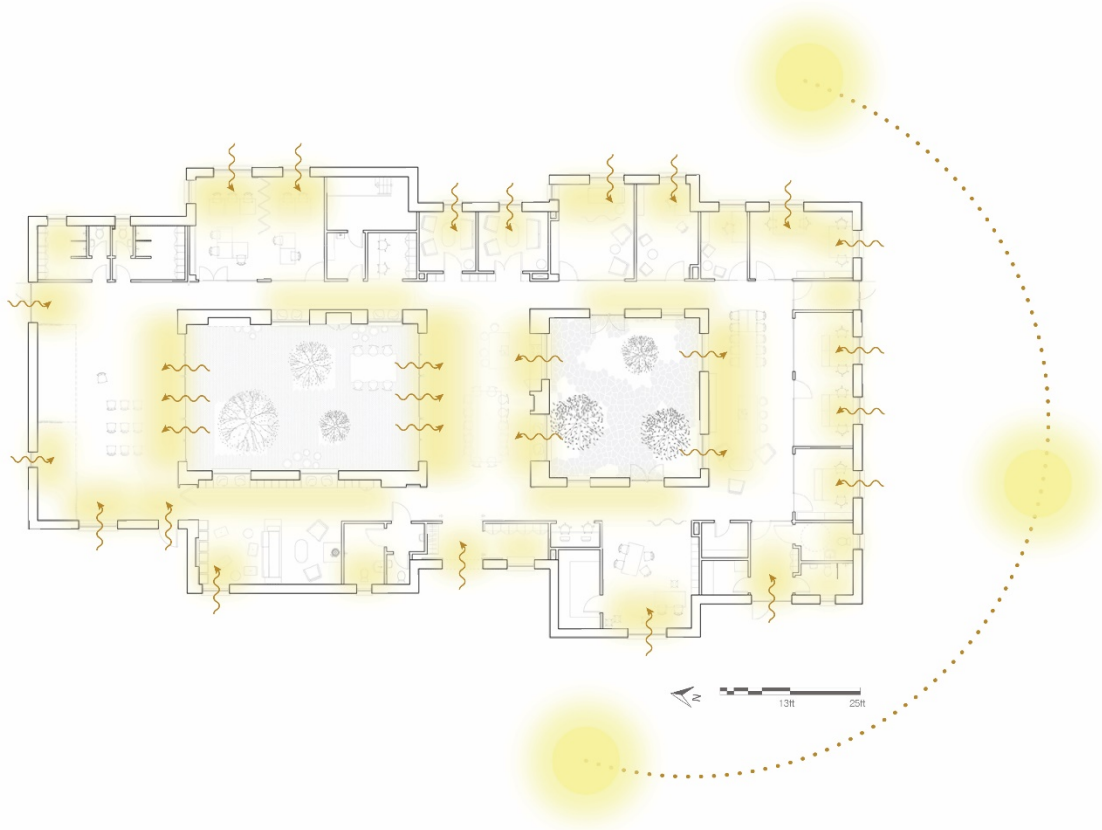


Figure 23: Natural lighting of interior spaces

Source: ArchDaily, Author

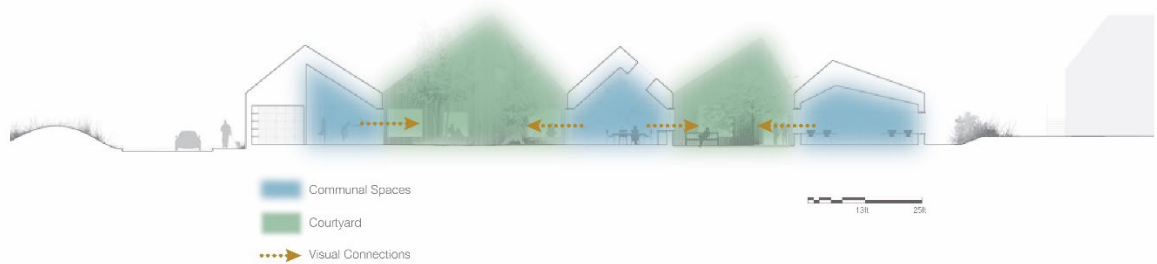


Figure 24: Interior courtyard interactions in section

Source: ArchDaily, Author

The winning design for the University Hospital RWTH Aachen in Germany serves as a final example that uniquely addresses the beneficial landscaping possibilities

of the healing architecture typology. The project creates a partially-underground extension embedded into the existing landscape in order to minimize visual impacts and develop a green parkway for patients, students, staff, and the surrounding community.³¹ The greenway serves as a way finder for all patients and visitors navigating through the project (Figure 25). By implementing the principles of healing architecture, the new facilities will provide plenty of natural light and easy access to green spaces. Daylighting within the building is controlled through horizontal louvers for private programming uses, while skylights are utilized to bring in sunlight to illuminate larger public spaces. (Figure 26). The building sweeps off the ground and extends over the landscape to form an inviting main public entrance. In order to produce an open and efficient layout, all remote meeting spaces are carefully designed to be flexible and encourage employee interactions.

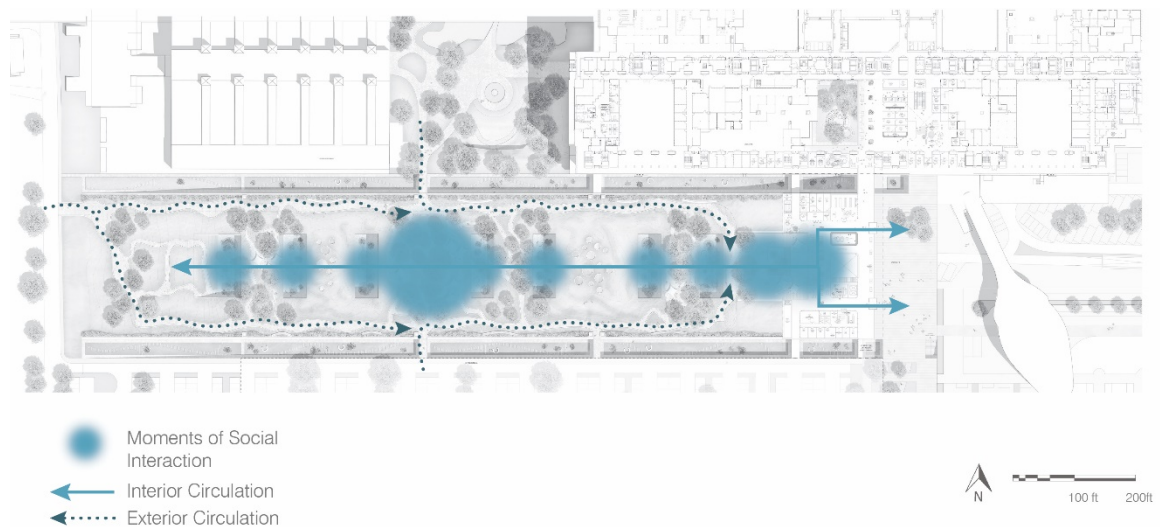


Figure 25: Circulation through greenway

Source: CF Møller, Author

³¹ “CF Møller And Henn Win International Hospital Competition in Germany.” CF Møller. April 4, 2017. Accessed October 17, 2018. <https://www.cfmoller.com/r/-da/c-f-moeller-og-henn-vinder-international-hospitalskonkurrence-i-tyskland-i16694.html>.

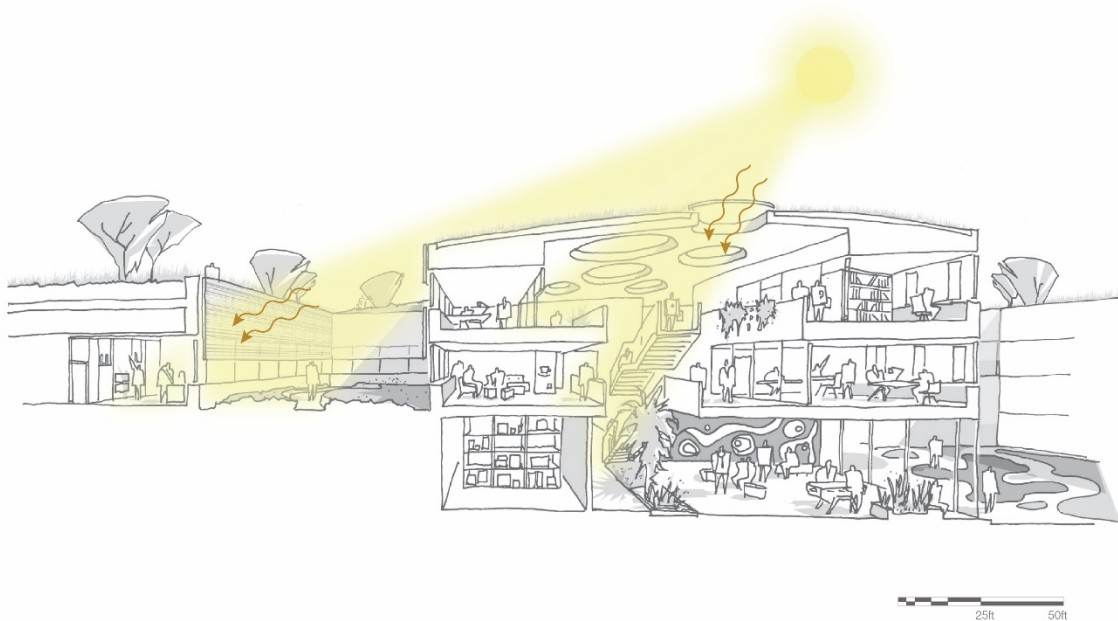


Figure 26: Daylighting methods utilized in hospital extension

Source: CF Møller, Author

Nordic Winter Living Culture and Typology

Scandinavian countries seem to have a greater understanding of well-being and how to improve upon it based on their reputation for being the happiest region in the world. Denmark, for example, has been ranked as the happiest country in 2016, 2013, and 2012 according to the World Happiness Report.³² The countries of Denmark, Norway, Sweden, and Finland all experience short, dark, and freezing winter days for half of the year and yet their population still manages to embrace the harsh seasonal change rather than simply endure it. The culture is significantly different in these regions as they embody a winter culture they call “hygge” (pronounced hue-guh). This Danish term is defined as a “quality of coziness and comfortable conviviality that engenders a feeling of

³² Wiking, Meik. *The Little Book of Hygge: Danish Secrets to Happy Living*. (United Kingdom: HarperCollins, 2017), 209.

contentment or well-being.”³³ The word stems from the Norwegian term “hugga,” meaning “to comfort” or “to console.” While there is no direct English translation, the closest meaning is a sense of coziness. Hygge is also seen as a state of mindfulness in which one can make mundane tasks more enjoyable.

Several architectural elements should be combined to create an ideal setting for hygge (Figure 27). A common space that every Scandinavian home has is a hygge-krog, otherwise known as a comfy nook where one can cozy up with a blanket, a good book, or some warm baked goods. Another key feature within a hygge household is a fireplace and other methods of creating warmth, particularly during those cold winters. The hearth of a home represents an intensity in the feeling of togetherness, as family and friends gather around for warmth and conversation. This experience of harmony is another important element in creating hygge. While it may be achieved alone, approximately 67% of Danes suggest that the best number of people for hygge is three or more.³⁴ Natural textures, typically wood, are seen throughout these homes as well in order to provoke a connection to nature. A connection to the exterior should also be incorporated into the architecture through small openings to set up views to the immediate landscape.

³³ Altman, Anna. “The Year of Hygge, The Danish Obsession With Getting Cozy.” *The New Yorker*. December 18, 2016. Accessed October 6, 2018.

<https://www.newyorker.com/culture/culture-desk/the-year-of-hygge-the-danish-obsession-with-getting-cozy>.

³⁴ Wiking, *The Little Book of Hygge: Danish Secrets to Happy Living*, 46.

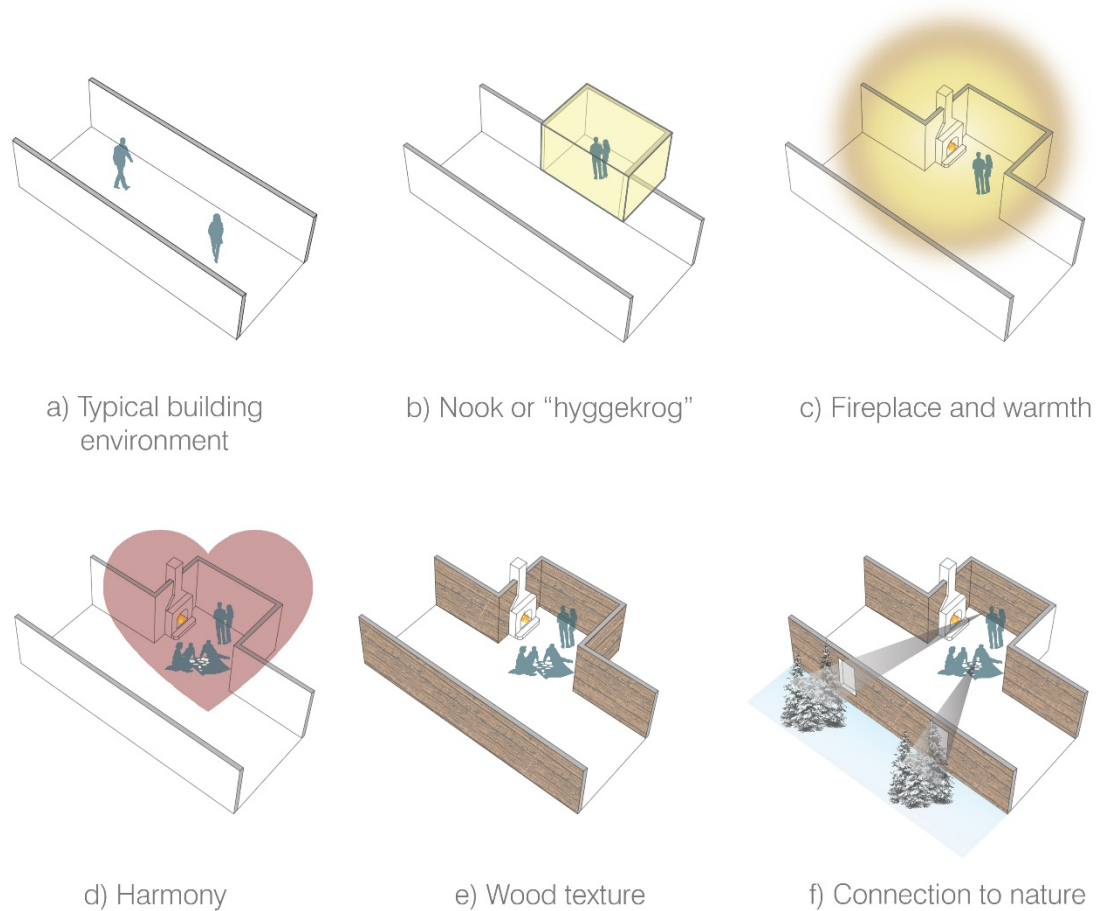


Figure 27: Nordic winter design strategies for achieving hygge

Source: Author

In addition to these design elements, a certain atmosphere needs to be created by turning down the lights and possibly lighting candles. Strategic lighting is important to create soothing paths of light within the space. Typically, the lower the temperature of the light, the more hygge it creates. 1,800K is the ideal temperature for hygge to produce a glow similar to a burning candle or a sunset. For comparison purposes, fluorescent lamps are around 5,000K and incandescent lamps are about 3,000K.³⁵

³⁵ Wiking, *The Little Book of Hygge: Danish Secrets to Happy Living*, 6.

Architecture in the Nordic region embodies these this cultural traditions and visions in order to create warm, bright, and engaging spaces. The four core principles of Scandinavian architecture and design include light, comfort, energy efficiency, and connection to nature.³⁶ Since Scandinavians spend most of their time indoors during the wintertime, lighting techniques such as skylights and glass roofs are critical to provide as much daylight as possible. A neutral palette of materials within a building allows for light to reflect and illuminate. Natural textures can also enhance the level of comfort within a space. To keep a space warm and cozy, efficient insulation and radiant heating and cooling systems, typically powered by clean energy, are employed within buildings. Using the best energy methods can decrease consumption levels and also the building's carbon footprint.

The Gjøvik House, located an hour outside Oslo upon a hillside facing the woods, serves as a typical precedent for a Scandinavian winter home that embraces these design characteristics. This modern, minimal cluster house consists of six overlapping cubes of program of varying sizes to create loosely defined areas and create a sensation of being together as a family without necessarily being together in the same room.³⁷ The layout serves as an example of moving away from the popular open-floor plan and hone in on a broken-plan type (Figure 28). The thresholds between these spaces are marked by changes in floor level and materiality. Materials continue from the floor to the wall and

³⁶ Lucia. "5 Principles of Scandinavian Architecture." Modlar, 2017. Accessed November 14, 2018. <https://www.modlar.com/news/241/5-principles-of-scandinavian-architecture/>.

³⁷ Mairs, Jessica. "Cosy corners and muted colours make house by Norm Architects the 'epitome of hygge'." Dezeen. January 11, 2018. Accessed October 17, 2018. <https://www.dezeen.com/2018/01/11/cosy-corners-muted-colours-make-norm-architects-norwegian-home-epitome-hygge-architecture-oslo/>.

transition between concrete and wood to give off warm tones, a key characteristic of the Scandinavian concept of hygge. The cluster house typology also promotes a design with the harsh winters in mind in order to create a cozy and inviting feeling while taking shelter.

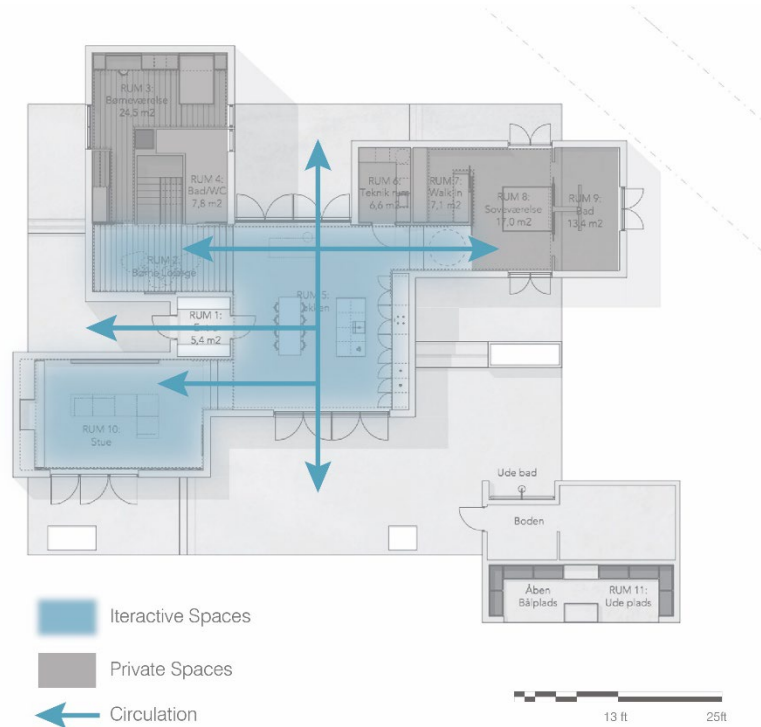


Figure 28: Cluster house program and interaction

Source: Dezeen, Author

Throughout the roughly 1,670 square foot home there are plenty of nooks, or hyggekrogen, to cozy up in with selected views carefully framed in smaller windows. The kitchen, however, serves as the home’s central space and therefore has the greatest outlook over the site with light pouring in through the floor-to-ceiling windows and bouncing off into adjacent rooms (Figure 29). Each flat roofed cube is constructed with uniform, thin vertical planks of wood designed to silver as time passes to match the

bright, snowy mountain it sits upon. The facade cladding was specifically chosen to eventually fade into the hillside and blend in with its surrounding peaceful landscape.

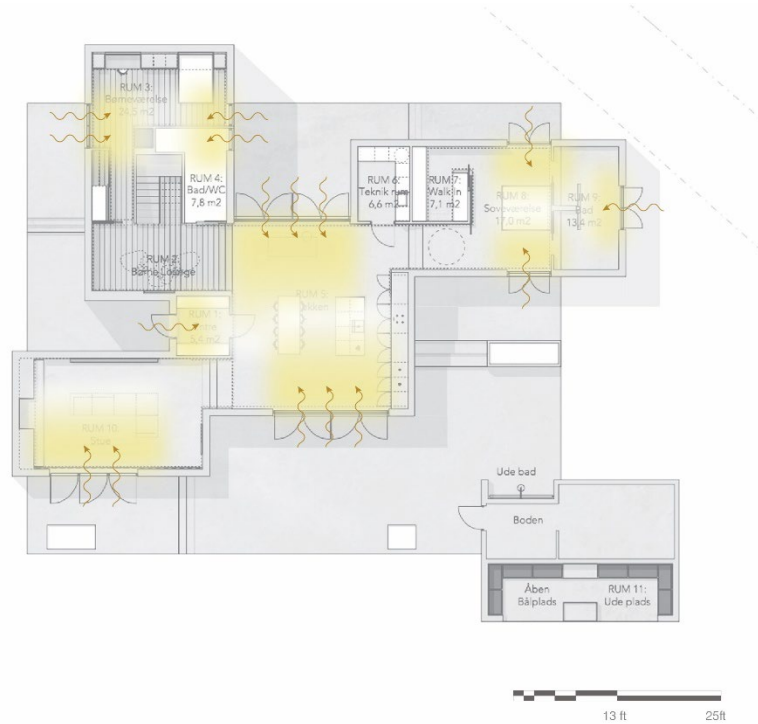


Figure 29: Natural lighting of interior spaces

Source: Dezeen, Author

Another example of a typical Scandinavian winter home is the Split View Mountain Lodge in Havsdalen, Norway serving as a private holiday home adjacent a popular ski resort with hiking and other recreational opportunities nearby.³⁸ The design incorporates four bedrooms, a guest suite, living and dining areas, a youth lounge, and an area for the younger children to play. The massing consists of a main volume to house the bedrooms which then splits off into the two main living areas. Right before the split is the kitchen area with the main volume ending with the guest suite to complete the three main

³⁸ “Split View Mountain Lodge / Reiulf Ramstad Arkitekter.” ArchDaily. February 5, 2014. Accessed October 17, 2018. <https://www.archdaily.com/473775/split-view-mountain-lodge-reiulf-ramstad-arkitekter>.

split views all capped with floor-to-ceiling glazed walls (Figure 30). The shift in program is also emphasized by the change in floor level to accommodate for the sloping terrain on the site.

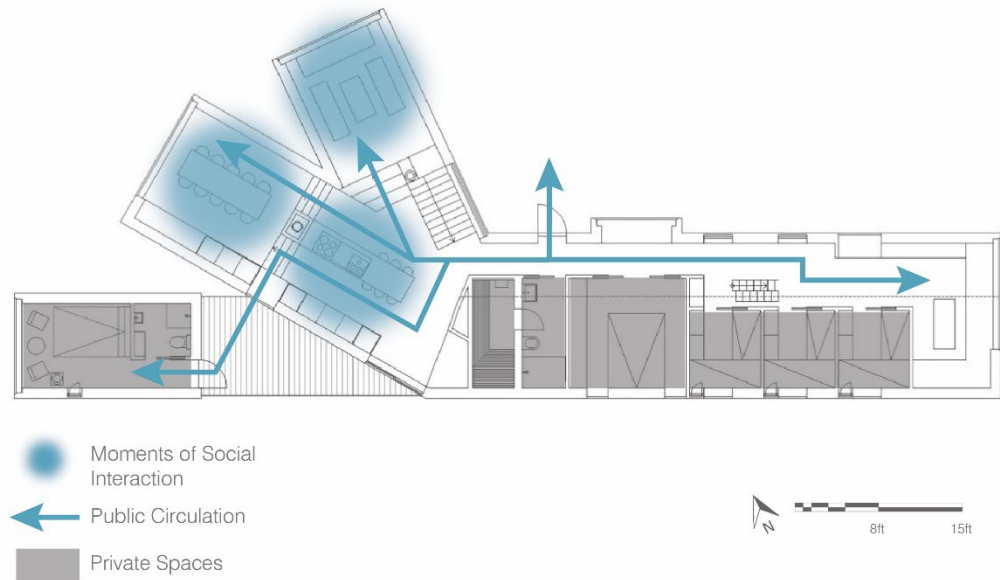


Figure 30: Diverging circulation in public realm of house

Source: ArchDaily, Author

The timber cladding on the outside of the cabin will fade to grey over time to blend in with the landscape, similar to the Gjøvik House in Oslo. The timber material continues into the interior of the house along the floors, walls, and ceiling with the exception of the concrete floor within the main entrance. In addition to the tall glazing placed at the gabled ends of the home that provide plenty of daylight to stream in, smaller windows are placed strategically throughout to provide several glimpses to the surrounding environment when appropriate and additional lighting in private rooms (Figure 31).

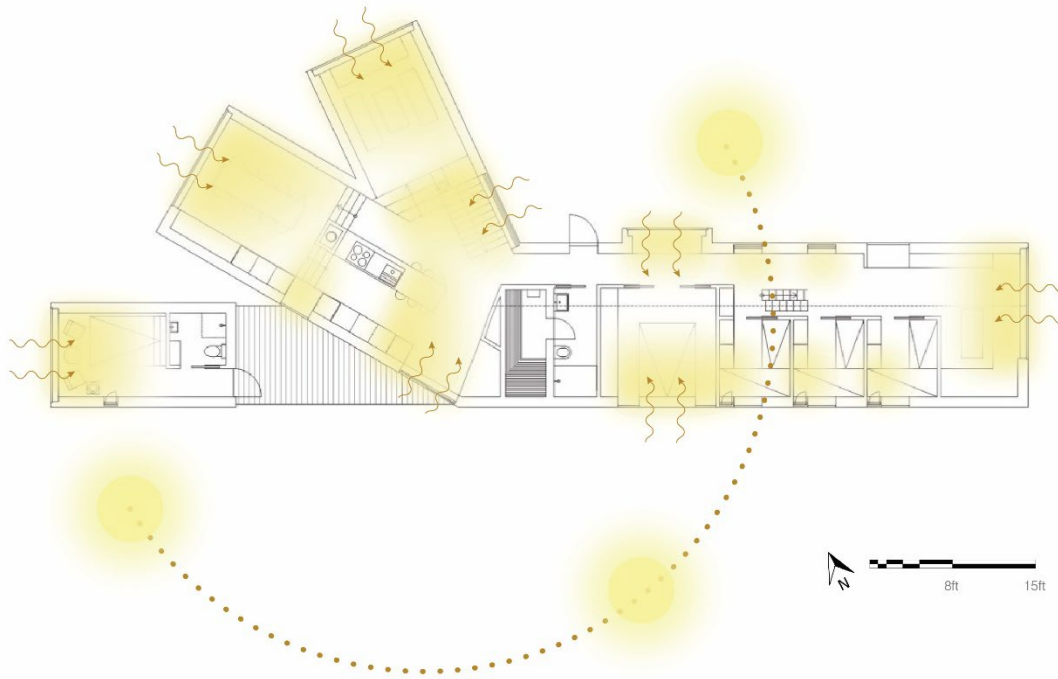


Figure 31: Natural lighting of interior spaces

Source: ArchDaily, Author

A unique example of Nordic architecture focuses on improving mental health within nature. In the fall of 2017, the Karolinska Institutet developed a research project to deduce if it was possible to reduce stress during 72 full hours in Swedish nature. A group of students developed custom-made glass cabins on Henriksholm Island in western Sweden and invited five people with stressful jobs to go off the grid for three straight days. The group found that the participants' stress levels were reduced by 70% and as a result these cabins are now open to the public as a retreat.³⁹

³⁹ Wang, Lucy. "Stressed Out? Sweden's 72 Hour Cabins Are Designed to Soothe." Dwell. November 27, 2017. Accessed October 17, 2018. <https://www.dwell.com/article/stressed-out-swedens-72-hour-cabins-are-designed-to-soothe-5f767bda>.



Figure 32: 72 hour cabin in Sweden

Source: West Sweden Tourist Board

The cabins were designed as simple gable forms inspired by barns spread out through the Dalsland countryside and were built out of locally-sourced materials. The boards made from untreated planks of Norway Spruce were placed several millimeters apart to create natural ventilation. Three of the four walls are composed of large glass panes with no curtains separating the visitors from their environment. The intention was to sync their sleep schedules with the rising and setting of the sun. The interior of the cabin has space for a bed and a small amount of storage, encouraging visitors to enjoy a majority of their time outside and sleeping underneath the glass roof showcasing the stars at night. Each cabin stands on pillars as not to leave a permanent footprint on the site and were positioned in order to obtain optimal lakeside views. The overall intent of this experience is to allow guests to be one with nature.

All of these precedents serve as examples for how Scandinavians design architecture during the harsh winters. Overall, their daily living experiences are improved

based on the built environments that they create and therefore those populations have achieved a greater sense of well-being.

Summary of Design Aspects for Well-being

These various architectural design strategies provide opportunities to improve one’s well-being. Three key elements of design can have positive effects on a person’s level of happiness and joy: spatial organization, social aspects, and engagement of the senses. Within these areas of design, many methods are commonly used amongst all building typologies and cultures — including connections to nature, programmatic spaces for social interaction, daylighting, and comfort controls (Figure 33). By employing a combination of these design methods, architects can create built environments for those suffering with SAD in order to improve their daily lives as well as improve their overall well-being and happiness.

	Spatial Organization			Social Aspects		Engagement of the Senses			
	Central Organization & Use of Courtyards	Blurring Interior and Exterior Spaces	Connection to Nature	Spaces for Increased Social Interaction	Access to Physical Activities	Daylighting	Visual/Acoustic/Thermal Control	Variation in Colors and Textures	Natural Materials and Textures
Environmental Psychology			●	●	●				●
Indoor Environmental Quality			●			●	●	●	
Healing Architecture	●	●	●	●	●	●	●	●	
Nordic Winter Living Culture and Typology	●		●	●		●	●		●

Figure 33: Summary of Critical Architectural Design Strategies for Well-being

Source: Author

Chapter 3: Design Aspects and Psychological Benefits of the Cohousing Typology

Cohousing as an Ideal Therapeutic Typology

Cohousing serves as an ideal living environment for those suffering with SAD as it creates opportunities for socialization and interaction within an engaging living environment. This typology is constructed through design methods that successfully improve residents' state of well-being.

Cohousing emerged in 1964 in Denmark when a group of friends were unsatisfied with the limited housing options available to them. The state of single-family housing and apartment complexes in this region were undesirable and encouraged isolated lives. During this time, the baby boomers generation supported the idea of changing how young adults lived with a new housing typology where groups were able to create livable communities that shared common facilities. The term “cohousing,” used to describe this building typology, was eventually created by California architects Kathryn McCamant and Charles Durrett, which they ended up introducing in North America in the 1990s.

Cohousing Criteria

Cohousing is designed with the intention of creating inclusive living, rather than simply communal living, with a balance between daily social interactions and privacy. As a result, this typology is categorized as a form of collective housing with four main characteristics. The first involves aspects of social contact design, meaning that the building and landscape encourages a strong sense of community. Cohousing developments tend to employ social contact design (SCD) principles in order to encourage an increase in casual social interactions and increase opportunities for informal

socialization.⁴⁰ SCD principles include: provision of indoor and outdoor communal facilities, visibility into all communal spaces, car-free communities if possible, smooth transitions between public and private spaces, semi-private outdoor spaces directly outside of private units to encourage socialization, positioning important facilities and points of access along public walkways (Figure 34).

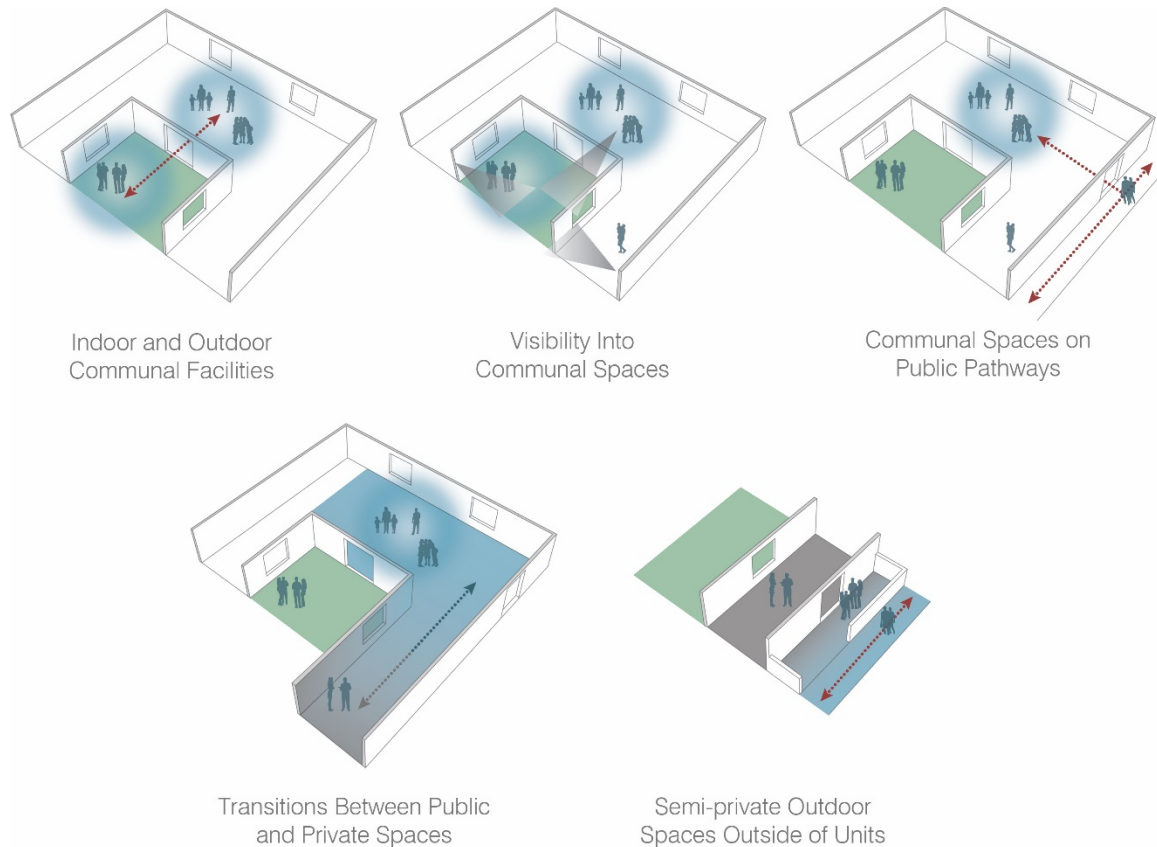


Figure 34: SCD principles used in cohousing communities

Source: Author

The second characteristic includes extensive common facilities that provide common spaces designed for daily use to supplement the connected private living areas. Units within these buildings may be small, but that loss of square footage is reinstated

⁴⁰ McCamant, Kathryn, and Charles Durrett. *Cohousing: A Contemporary Approach to Housing Ourselves*. 1st ed. Berkeley, Calif.: Habitat Press, 1988.

into the communal spaces and facilities provided to every resident (Figure 35). These communal spaces provide areas for less frequent household activities while the private units provide space for typical daily activities.

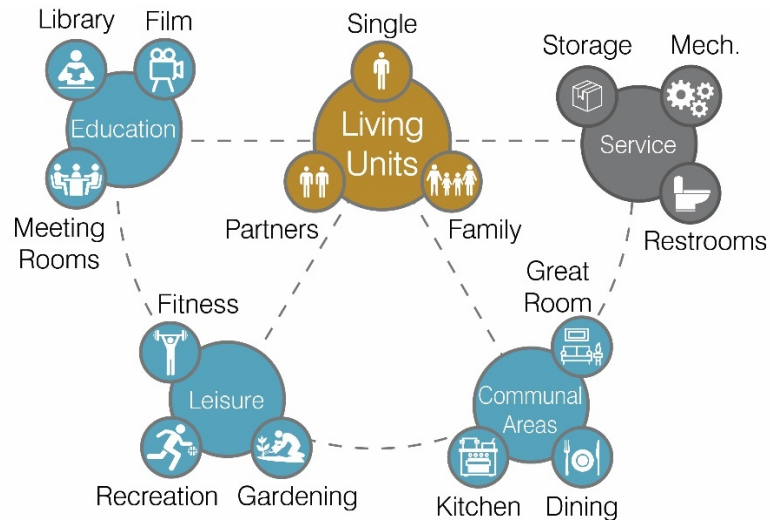


Figure 35: Cohousing typical programming

Source: Author

Common facilities are a key component to the design and should include a common kitchen and dining room at a minimum in a central location within the site. Within the dining hall, residents can share evening meals with one another whether it be once, twice, or several times a week. Residents also participate in preparing these meals, which serves as an opportunity for families to spend more time with one another and for those who are living alone to socialize. Additional common spaces may include laundry, playrooms, meeting rooms, guest rooms, bike storage, gardens, play courts, a playground, and offices. Exterior amenities are equally as critical, such as a central public path that goes through the development as a way finder. The design of these exterior spaces is successful in cohousing communities in comparison to typical apartment dwellings because designs are considered within the early stages of development. Outdoor spaces

are important to these residents because these are where inhabitants will spend most of their time socializing outside of their own private units.

In order to provide a high level of quality of these outdoor areas, cohousing developments encourage a separation between residents and their cars to reduce the amount of parking lots and garages on site. This allows those exterior spaces to become more intimate and less fragmented in order to create a true sense of place. Without their cars, walkability is encouraged as a way for residents to participate in their daily physical activity and connect with the immediate community surrounding them. Intentional community connections within these cohousing developments are critical as well to create a safe and welcome living community. For example, living and dining spaces are designed to face common pathways so neighbors have eyes on any activity within. Private dwellings should be private, self-sufficient, and contain the typical kitchen, living, dining, bedrooms, and bathrooms. These units differ from traditional apartments in that the square footage is significantly smaller.

An example of these unit types can be seen in Denmark's Lange Eng cohousing community with units ranging from 700 to 1,500 square feet (Figure 36, Figure 37). Another typical feature seen in these types of units are two separate entries — one entry from the building's exterior and another entry from a communal courtyard shared by the entire cohousing community. This is due to offsetting the cost of building and upkeep of common spaces and facilities used by all residents and therefore making the units more affordable. The cost of living is also decreased in these cohousing developments because of shared resources and self-management. While cohousing projects tend to vary in size, 27 units appears to be the ideal number. 12 households or fewer tend to have infrequent

social interactions and 40 households or more may feel too overwhelming to accommodate. Too few units also mean less shared resources and finances for upkeep.

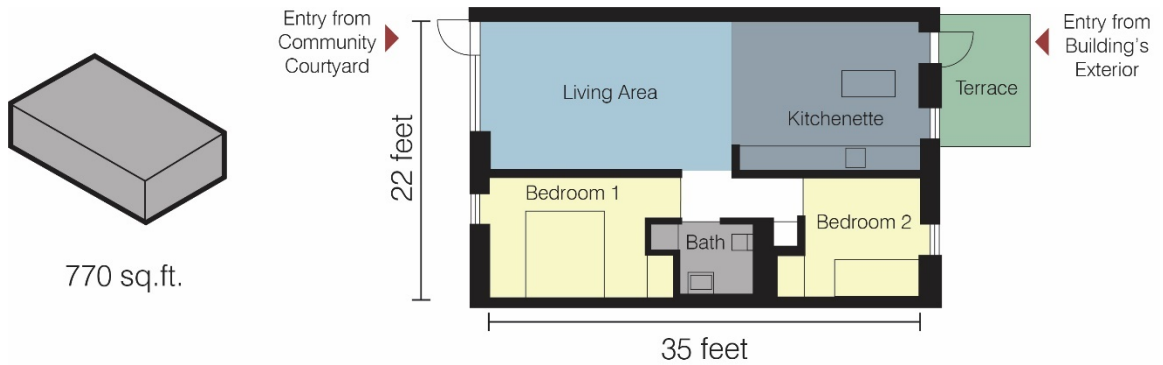


Figure 36: Lange Eng typical two-bedroom unit

Source: Author



Figure 37: Lange Eng typical three-bedroom unit

Source: Author

A third characteristic of cohousing is that resident involvement is critical during recruitment and building operations. Cohousing communities may include future residents in design and strategy meetings for development. Once residents are moved in,

the final characteristic involves developing collaborative lifestyles that offer support networks, sociability, and security within the community.

Cohousing Models and Generations

Several models for cohousing are available, each with their own challenges and opportunities. A resident-led model has every resident involved in the design and development process and has them responsible for all financial costs associated with the project. Therefore, this model tends to be the least preferable option due to its time and financial commitment as well as any possible financial risks. A partnership model allows developers and residents of the community to work together throughout all processes and operations. Developers can provide potential sites to build upon, their own expertise, and additional finances. This option removes any risks and lack of resources that residents can experience in the resident-led model. A speculative approach allows the developer to manage all the designs and development. The community is then shaped by the residents once they move in.

During the housing development's operation, residents are typically involved in managing the indoor and outdoor spaces, preparing communal meals between one and three times a week, and organizing social events. These events can range from social hours, educational classes, exercise sessions, etc. Residents are also encouraged to become involved in activities outside their immediate housing community.

There are four distinct generations of cohousing that serve as models for organization and design (Figure 38). First-generation cohousing stems from a conservative approach during its early design history with the common house only occupying 1,500 square feet and the private units averaging 1,500 square feet per unit

arranged linearly with the common house at their end. The second-generation increased in size due to the typology's success with a centrally located common house totaling 5,000 square feet with the private units averaging 1,000 square feet per unit. The organization formed a central courtyard to provide a safe, social area to be used by the whole community. Pedestrian paths increased in importance and were directly related to the private units. Third-generation cohousing involves a common house occupying 10,000 square feet in a central location with private units occupying 750 square feet per unit. At this point the facilities belonging to the common house and the private dwelling units all occupy the same building, forming a tighter hybrid of the previous two generations. The final fourth-generation cohousing consists of larger clusters of communities consisting of two- and three- generation cohousing buildings dispersed among a larger site.⁴¹

⁴¹ ScottHanson, Chris and Kelly ScottHanson. *Cohousing Handbook: building a place for community*. Gabriola Island: New Society Publishers, 2005: 128-129.

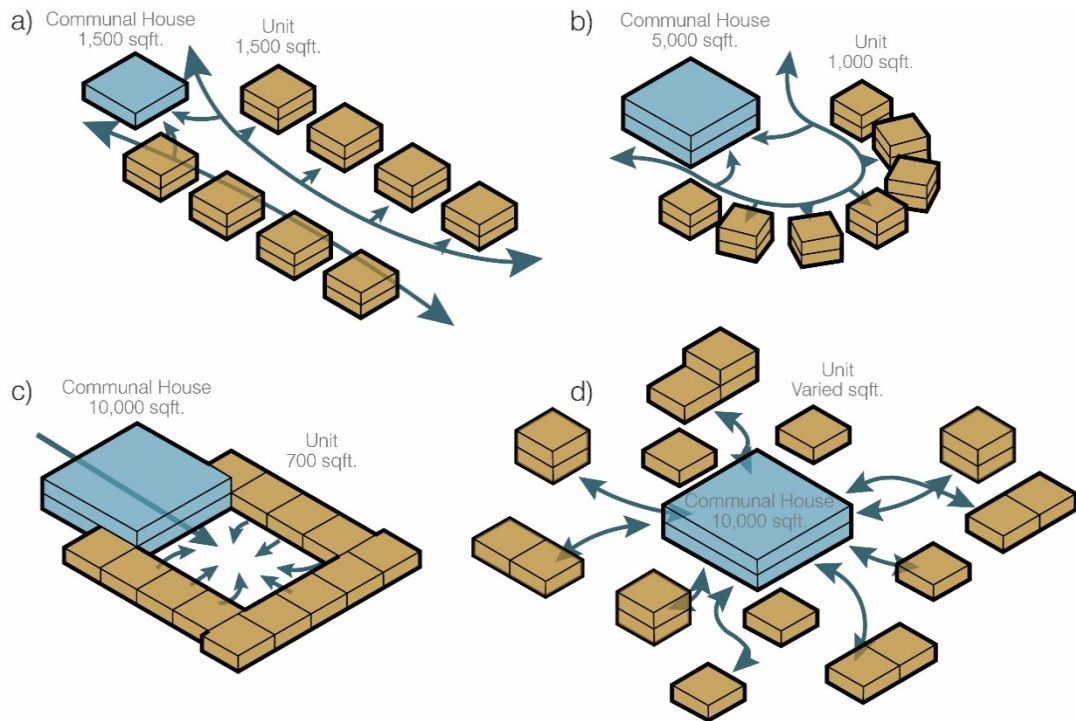


Figure 38: Generations of cohousing: a) First-generation/linear, b) Second-generation/central, c) Third-generation/hybrid, d) Fourth-generation/dispersed

Source: Author

Psychological/Social Implications

Arguably the most successful benefits of living in cohousing communities are a better quality of life, an increased sense of well-being, and a more affordable lifestyle. According to Maslow’s hierarchy of needs, well-being can increase as each of Maslow’s five levels are achieved. These levels include: physiological, safety, feeling of belonging, self-esteem, and self-actualization.⁴² Well-being can be increased within cohousing developments through increased opportunities for socialization, support networks, security and safety, sharing responsibilities and resources, and living with people with

⁴² Williams, Jo. “Sun, Surf and Sustainable Housing-Cohousing, the Californian Experience.” *International Planning Studies*, vol. 10 no. 2, 2005: 161. doi: 10.1080/13563470500258824. <https://rsa-tandfonline-com.proxy-um.researchport.umd.edu/doi/full/10.1080/13563470500258824?scroll=top&needAccess=true#.W86UGmhKhPY>.

similar interests. The level of safety is increased with supervision for children as they roam freely outside and for anyone walking back to their private dwelling alone at night.

Cohousing has also proven to have a positive effect on environmental behaviors. Increased peer pressure encourages residents to adopt pro-environmental behaviors and instead of focusing on an individual's environmental responsibility, the community adopts a collective responsibility. Residents develop a high sense of environmental awareness and sustainable practices, which then become the norm within the community. Several environmental benefits stem from these sustainable practices. On average, cohousing developments in the United States were found to earn 31% space savings, 57% electricity savings, and 8% goods savings. By clustering dwellings together or by having private units all within one building, a significant amount of energy is conserved more land is conserved as well. Resources are reduced when it comes to ownerships of cars, washing machines, freezers, and lawn mowers. Since cohousing communities tend to include communal laundry facilities, resident ownership of washing machines was reduced by 25%.⁴³

Applications in the United States

Cohousing was first introduced in the United States by architects McCamant and Durrett in 1986. In 2006, just under 3,500 people were living in cohousing communities within 37 states as California leads with cohousing accommodating 42% of its current living communities (Figure 39). As of March 2017, more than 160 cohousing communities have been established in the United States with over 130 communities in the

⁴³ Williams, Jo. "Predicting an American future for cohousing." *Futures*, vol. 40, no. 3, 2008: 273. <https://doi.org/10.1016/j.futures.2007.08.022>.
<https://www.sciencedirect.com/science/article/pii/S0016328707001103?via%3Dihub>.

process of being developed. Most of these cohousing communities are intergenerational with both young children and elders, but senior cohousing has become popular as well. Adoption of cohousing is predicted to continue to increase in the United States at a slow pace. Currently, the building type is bordering between being a niche market type and being a mainstream choice of housing. According to a survey from 2012 given by The Cohousing Research Network, 96% of cohousing residents in the United States have reported an improved quality of life.⁴⁴

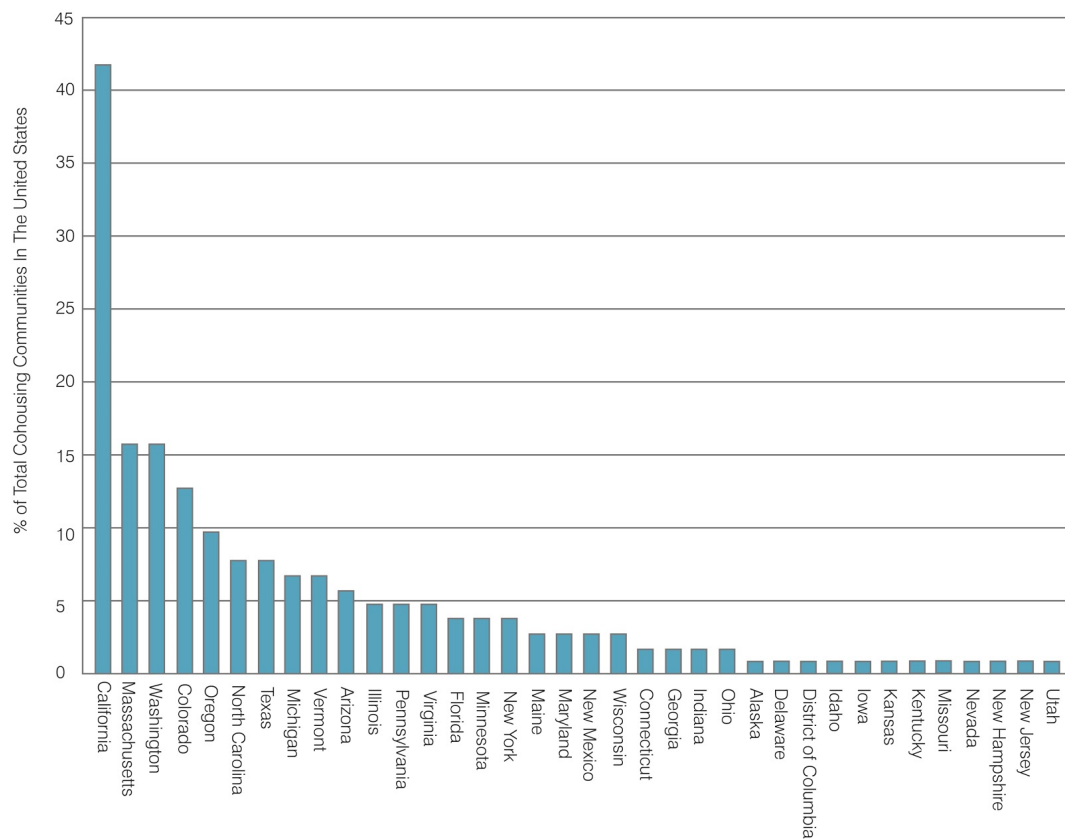


Figure 39: Existing cohousing in the United States as of 2016

Source: Author, Cohousing Network

⁴⁴ “Cohousing in the United States: An Innovative Model of Sustainable Neighborhoods.” The Cohousing Association of the United States. March 6, 2017. Accessed October 24, 2018.

<https://www.cohousing.org/sites/default/files/attachments/StateofCohousingintheU.S.%203-6-17.pdf>.

Lange Eng Cohousing Community

Lange Eng means “long meadow” in Danish, which describes the site for the Lange Eng cohousing community in Albertslund, Denmark.⁴⁵ Completed in 2009, the building itself is the size of a typical Danish block and is composed of approximately 54 apartments of various sizes to house more than 200 residents within the community.⁴⁶ All of the shared amenities surround a communal garden space in the center of the site. Every unit has direct access to this garden space with terraces coming off of the living spaces in order to allow the interior spaces to bleed outside (Figure 40). The outer perimeter of the building faces the forested area surrounding it and its facade is relatively closed off. However, the light and open facade faces inward towards the garden space, bringing light and air to each unit’s living area and terrace (Figure 41).

⁴⁵ “Lange Eng Cohousing Community.” Dorte Mandrup. n.d. Accessed March 26, 2018. <http://www.dortemandrup.dk/work/lange-eng-cohousing-community>.

⁴⁶ “Lange Eng Collective Living.” Architizer. 2017. Accessed March 26, 2018. <https://architizer.com/projects/lange-eng-collective-living/>.



Figure 40: Moments of social interaction

Source: ArchDaily, Author

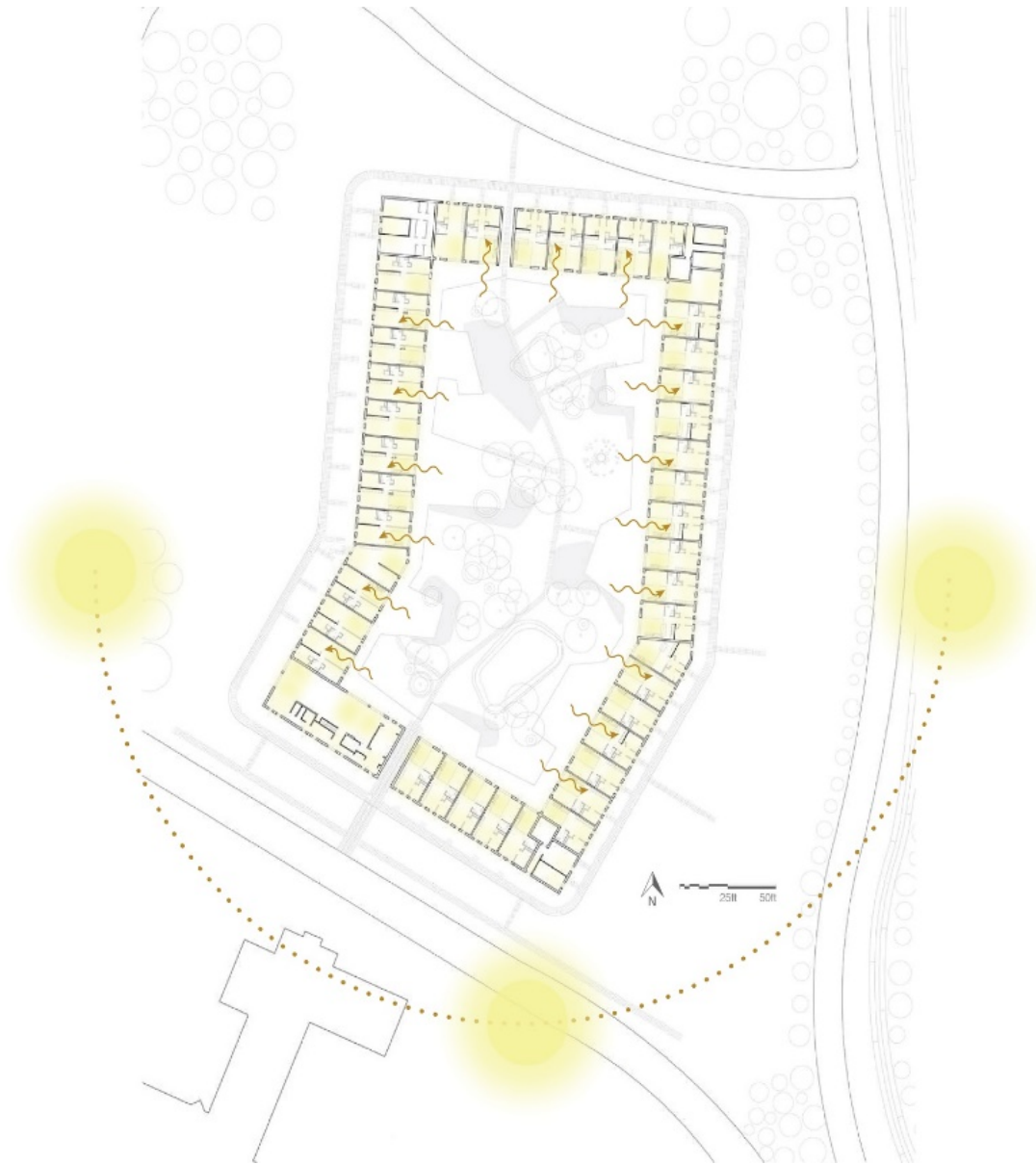


Figure 41: Natural lighting of interior spaces

Source: ArchDaily, Author

A sense of community is created through social interactions within its play areas, theater room, and the shared dining room all located at one end of the building (Figure 42). While residents have the opportunity to eat together every day, there is also the option to take food away back to their units in order to bond with their immediate families. An important aspect of this unique community is its shared social responsibility.

For example, every six weeks residents are expected to aid in cooking the daily meals, as well as tend in the community garden. In addition to being involved in these monthly services, community members are also welcome to attend group meetings in order to voice their opinions on any decision making and to communicate any concerns they feel necessary.



Figure 42: Relationship between communal "hub" and private residential units

Source: ArchDaily, Author

In most of cohousing developments, children tend to make up at least half the residential population. Within the Lange Eng community, the children are given free reign within the large communal garden space and are encouraged to play outside daily.

Additional interior spaces such as play rooms, lounges, and entertainment setups provide an outlet when weather serves as an inconvenience.

Communal transportation is provided for any residents interested in going into the city, including the younger generations to allow them to explore and venture out on their own. In some situations, a car share program is arranged so the adults can share ownership of cars located at the outermost perimeter of the property. However, since biking is a popular mode of transportation in Denmark, bike storage is currently being implemented and increased. In addition to saving energy with these transportation methods, Lange Eng also saves on bringing shipments of food and goods into the community. While most food is grown in the communal garden, any additional vegetables needed are delivered by local farmers within the surrounding area to cut down on cost and carbon emissions. Overall, the Lange Eng cohousing community is most successful in its relationship to its site, the general massing, and its high levels of interaction.

Jystrup Sawmill Housing Cooperative

The Jystrup Sawmill housing co-operative is a small village-within-a-village built in 1984 located in Ringstead, Norway. Previously a sawmill, this development contains 21 units with a total of five different apartment types and communal space occupying about 40% of the entire building.⁴⁷ The entire co-op building was built using wood construction with wood facades painted an off-black. The building's facade and overall

⁴⁷ "Communal Living Under One Big Roof." Vandkunsten Architects. n.d. Accessed March 26, 2018. <http://vandkunsten.com/en/projects/bofaellesskab-i-det-gamle-savvaerk-2>.

form does not directly respond to its existing site as successfully as Lange Eng. The original design involved several individual homes surrounding a communal space using a central courtyard organizational method, but the final constructed scheme is an L-shaped building with a covered street filled with growing plants and an area for play (Figure 43). A glass roof covers this “interior street,” which serves as one of several communal spaces and adds to the social functions of the community. The glass roofing includes an operable skylight to adjust for temperature changes, which is primarily useful during the colder winter months. The community's Common House serves as the main communal space located at the joint end of the L shape (Figure 44). Adjacent to this program is a communal garden divided into several outdoors rooms, including a rose garden, a soccer field, and a large lawn.

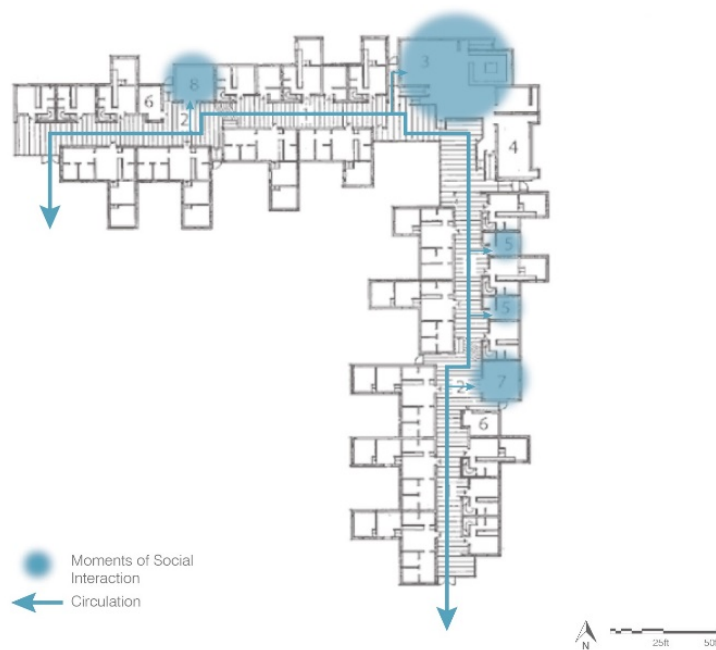


Figure 43: Moments of social interaction

Source: *Creating Cohousing: Building Sustainable Communities*, Author

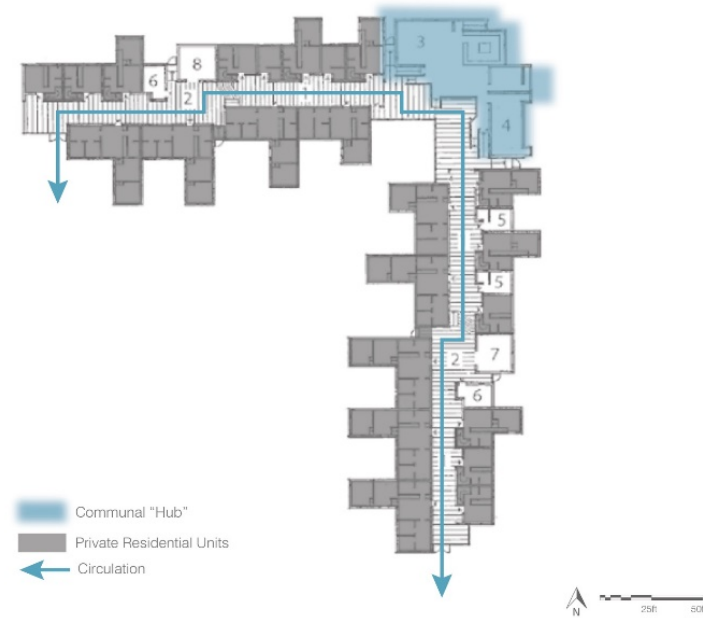


Figure 44: Relationship between communal "hub" and private residential units
 Source: *Creating Cohousing: Building Sustainable Communities*, Author

All the south and west facing one story units face look into the garden area and have terraces leading out their back doors. While the north and east facing two story units do not have direct access to the communal exterior spaces, they do have private roof decks that allow outdoor views and direct sunlight. The alternating heights of the housing units allow for each living area to get as much daylight as possible. The “interior street” gets light in through its glass roof, which then allows light into the units facing into it (Figure 45). The Common House has the highest level of sun exposure within the community with two open levels for dining. A majority of the meals enjoyed in the dining room are cooked by the residents, including the younger generations. Any children ages ten years or older are encouraged to participate in cooking daily meals and therefore succeeds in including all age groups in terms of socialization. Perks are also given to several teenagers and young adults, including access to several private units within the

Common House that become temporarily available for them to reside in with easy access to dining and common areas.

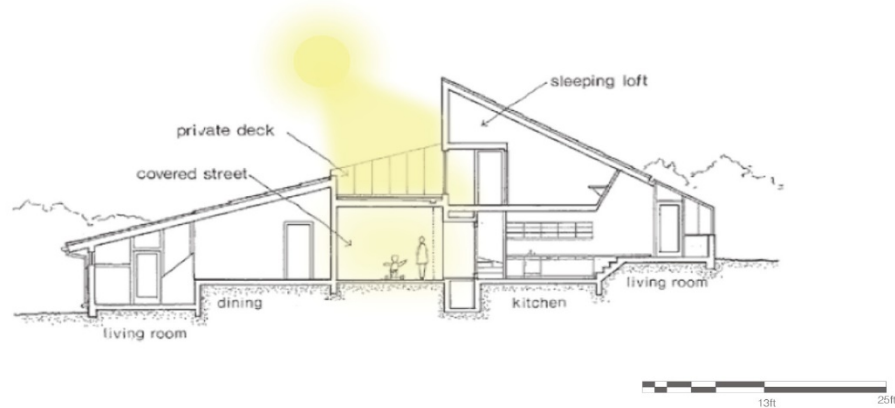


Figure 45: Natural lighting of "interior street"

Source: *Creating Cohousing: Building Sustainable Communities*, Author

Haptic Designs' Norwegian Elderly Housing Project

In 2016, Haptic Architects won a competition for an Elderly Housing project in Norway. Located between the capital of Oslo and many of the country's popular suburbs, the building serves to assist the area's growing elderly population.⁴⁸ Not only does the housing development take advantage of its stunning location and views of Oslofjord, but it also creates shifts between public and private spaces through adjustments in its landscaping and how the architecture interacts with it. In order to adhere to the existing surroundings, all of the design decisions draw inspiration from materials and colors used throughout the town. Drøbak is known for its traditional timber framed houses and

⁴⁸ Frearson, Amy. "Haptic Designs Elderly Housing for Norway to Encourage Residents to Socialise." *Dezeen*. November 17, 2016. Accessed March 26, 2018. <https://www.dezeen.com/2016/11/17/haptic-designs-elderly-housing-clt-drobak-norway>.

narrow streets. Cross-laminated timber was chosen to reflect these existing structures as opposed to steel or concrete.

The project's program focuses on social interaction in a way that promotes positive mental and physical health. Various common spaces—including gardens, shops, restaurants, and a public square—are designed to encourage interaction between the elders and their surrounding community, both within external and internal spaces. The communal garden provides a social area for residents and neighbors to come together (Figure 46). Each ground level unit also has direct access to this space and views out to the natural surroundings. These organizational methods allow residents to have positive social experiences that can improve their health and well-being.



Figure 46: Moments of social interaction

Source: Dezeen, Author

Roam's Ubud Coliving Coworking Space

German architect Alexis Dornier took on the co-living typology by renovating a group of apartment blocks in Bali for Roam, a client who gives visitors the opportunity to travel back and forth among several co-living complexes around the world.⁴⁹ The three existing rundown apartment buildings were given rooftop gathering spaces all connected by bridges. The programming model used serves as a combination of student housing and a hotel. Visitors can rent a room and have access to any communal spaces and resources available for work and pleasure.

The ground and first floor units consist of a bedroom along with a private bath and patio space. The entry and patio spaces provide large floor-to-ceiling windows to let light into the units that streams in from the courtyard (Figure 47). Some of its main amenities include rooftop lounge areas, a swimming pool, a communal kitchen, a yoga studio, and a barbeque garden (Figure 48). Most of these common spaces are located on top of the open-air roof sheltered by a canopy, ranging in materials from bamboo to polycarbonate (Figure 49). Additional materials used include sculpted wood, concrete, and stone paving. Instead of adhering to traditional building styles and materials, this U-shaped building utilizes low ceilings, V-shaped columns, and large canopies.⁵⁰ The ever-changing atmosphere and architecture of the community allows for adapting to accommodate for future meeting rooms, offices, and lecture spaces.

⁴⁹ "ROAM Co-living." Alexis Dornier. 2015. Accessed October 21, 2018. <https://www.alexisdornier.com/#/roam-ubud/>.

⁵⁰ Frearson, Amy. "Alexis Dornier completes co-living complex in Bali with communal areas on its roof." Dezeen. June 9, 2016. Accessed October 21, 2018. <https://www.dezeen.com/2016/06/09/alexis-dornier-architecture-roam-co-living-housing-residential-complex-bali-indonesia-communal-roof/>.

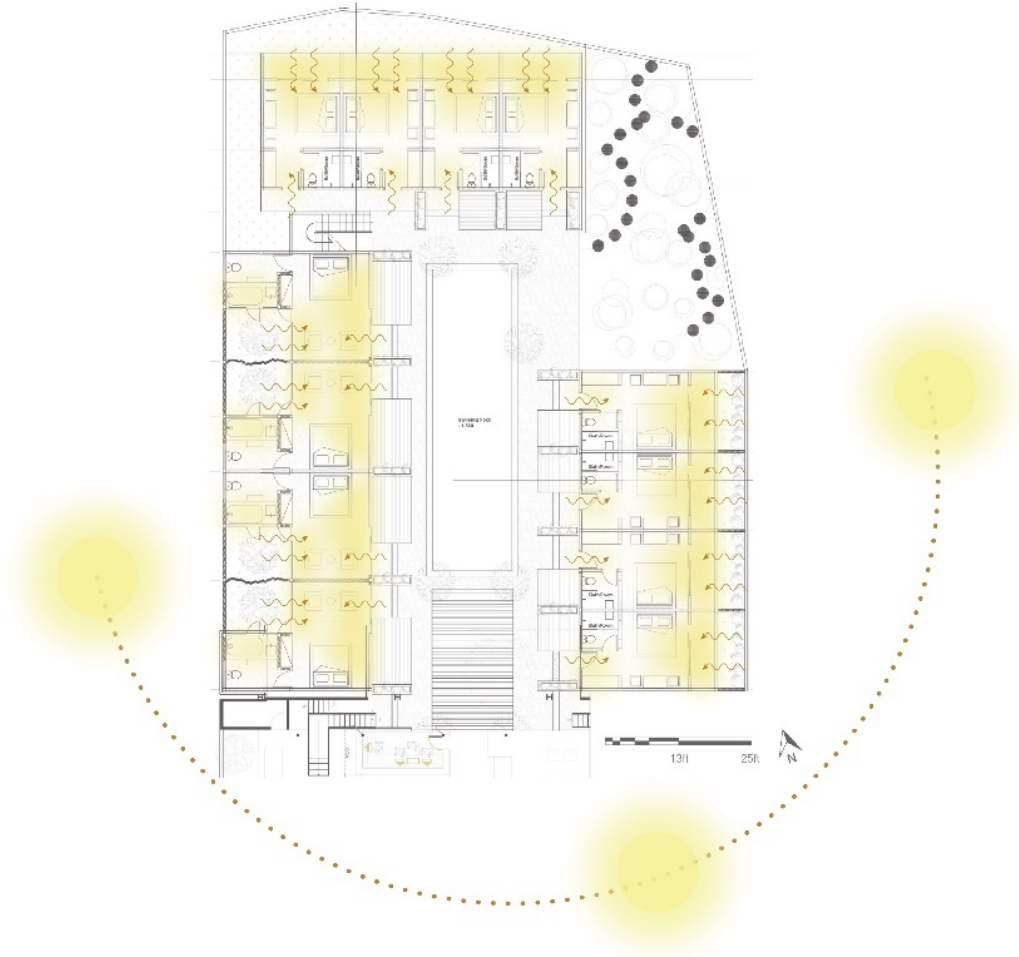


Figure 47: Natural lighting of interior spaces
Source: Dezeen, Author

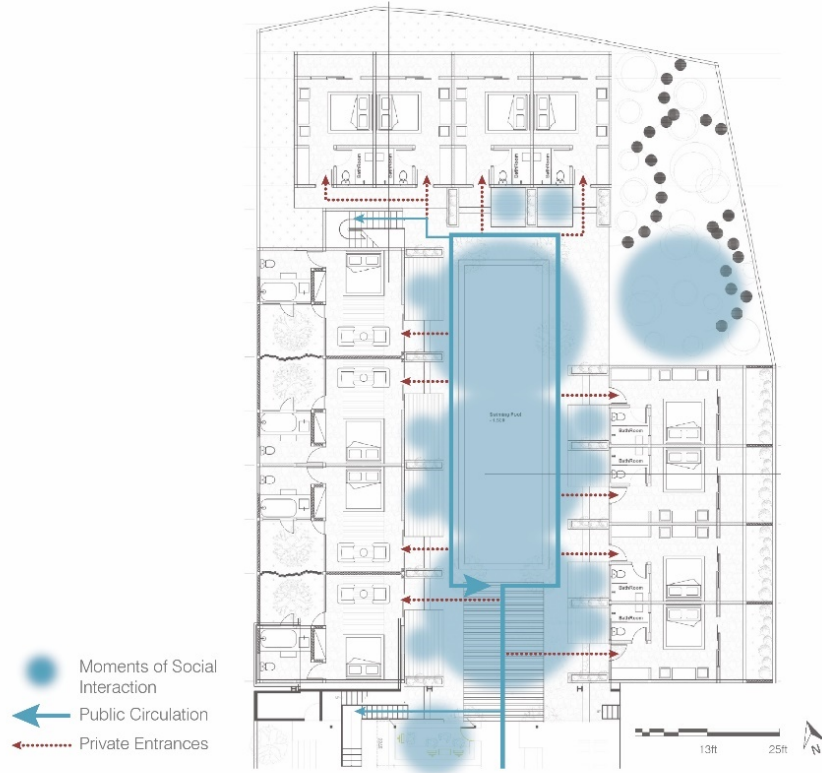


Figure 48: Moments of social interaction
 Source: Dezeen, Author

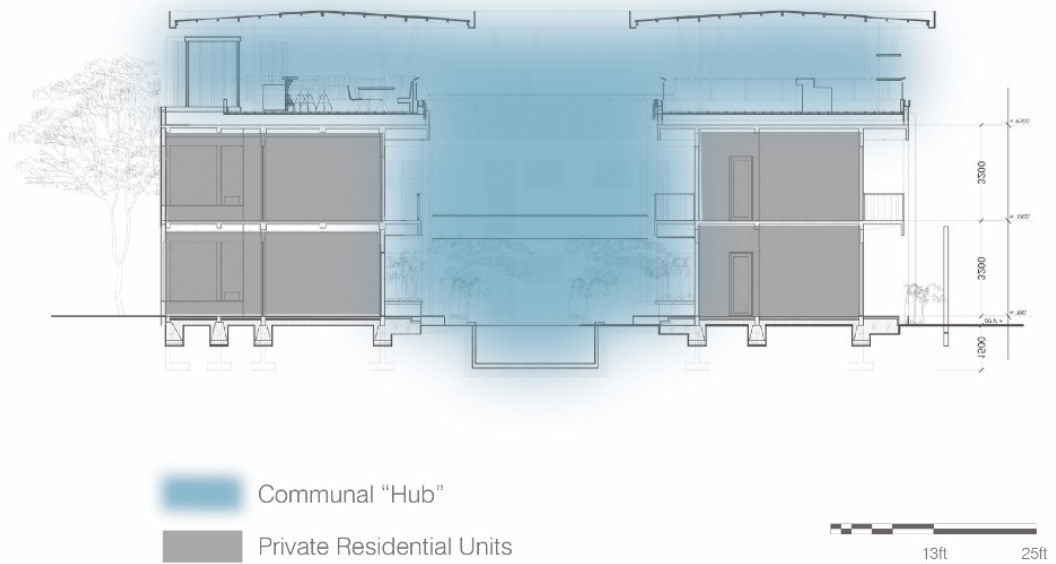


Figure 49: Relationship between communal "hub" and private residential units
 Source: Dezeen, Author

Summary of Cohousing Design Aspects

In summary, all of these precedents serve as primary examples of typical design strategies for cohousing (Figure 50). Spatial organization is critically important in order to create direct access to communal spaces for residents to interact with each other on a daily basis. Every single example of this housing typology employed central courtyards and provided connections to natural surroundings. Daylighting methods were also utilized to create spaces that residents feel comfortable living in and performing daily activities in. All of these design strategies demonstrate how cohousing can increase opportunities for social interaction and create a sense of community, while also accommodating spaces for private use. Cohousing proves to be an ideal building typology for those with SAD in order to provide psychological and social benefits for their overall well-being. Applying appropriate design principles to this housing type will create a model to improve the quality of life for those suffering with SAD.

	Spatial Organization			Social Aspects			Engagement of the Senses		
	Central Organization & Use of Courtyards	Blurring Interior and Exterior Spaces	Connection to Nature	Spaces for Increased Social Interaction	Access to Physical Activities	Shared Resources	Daylighting	Variation in Colors and Textures	Natural Materials and Textures
Lange Eng Cohousing Community	●	●	●	●		●	●		
Jystrup Sawmill Housing Cooperative	●	●	●	●	●	●	●		●
Haptic Designs' Norwegian Elderly Housing	●		●	●				●	●
Roam's Ubud Coliving Co-working Space	●	●		●	●	●	●	●	●

Figure 50: Critical Design Aspects of the Cohousing Typology

Source: Author

Chapter 4: Design Principles and Programmatic Analysis of a SAD Cohousing Community

Derived Design Principles for a SAD Cohousing Community

Through conclusive research on architectural design strategies for well-being and design aspects of cohousing, methods can be extracted from these findings in order to develop key simplified design principles to apply to a cohousing community for those with SAD. As mentioned in Chapter 2, design strategies for well-being from various typologies overlap in many aspects. The most common design element found was a connection to nature, which was seen in all four fields of research of environmental psychology, IEQ, healing architecture, and Nordic winter architecture. A strong connection to nature is critical for all these design areas, as well as cohousing communities as discussed in Chapter 3. Other common aspects for improving well-being are numerous spaces for increased social interaction, daylighting methods, and visual/acoustic/thermal comfort and control. Additionally, design strategies for cohousing communities include central organization of program and implementation of courtyards, multiple spaces for daily social interaction, shared resources, daylighting methods, and natural materials and textures.

By combining these design strategies to suit the needs of those with SAD, six key design principles can be determined: central organization and use of courtyards, connection to nature, public spaces for increased social interaction, daylighting methods, visual/thermal/acoustic comfort and control, and natural materials and textures (Figure 51). A clear central organization will help residents locate communal amenities and central courtyards will provide additional spaces for daily social interactions. Courtyards

will also provide opportunities for connections to nature and prompt residents to participate in recreational activities, even in colder weather. Daylighting within the community will improve residents' overall mood and provide focus for any social activities they will be participating in. Providing residents with controls for visual connections and thermal comfort allows them to feel in control of their living experience and indoor environment. Finally, spaces finished with nature materials will provide residents with a connection to nature and provoke a warm, calming atmosphere.

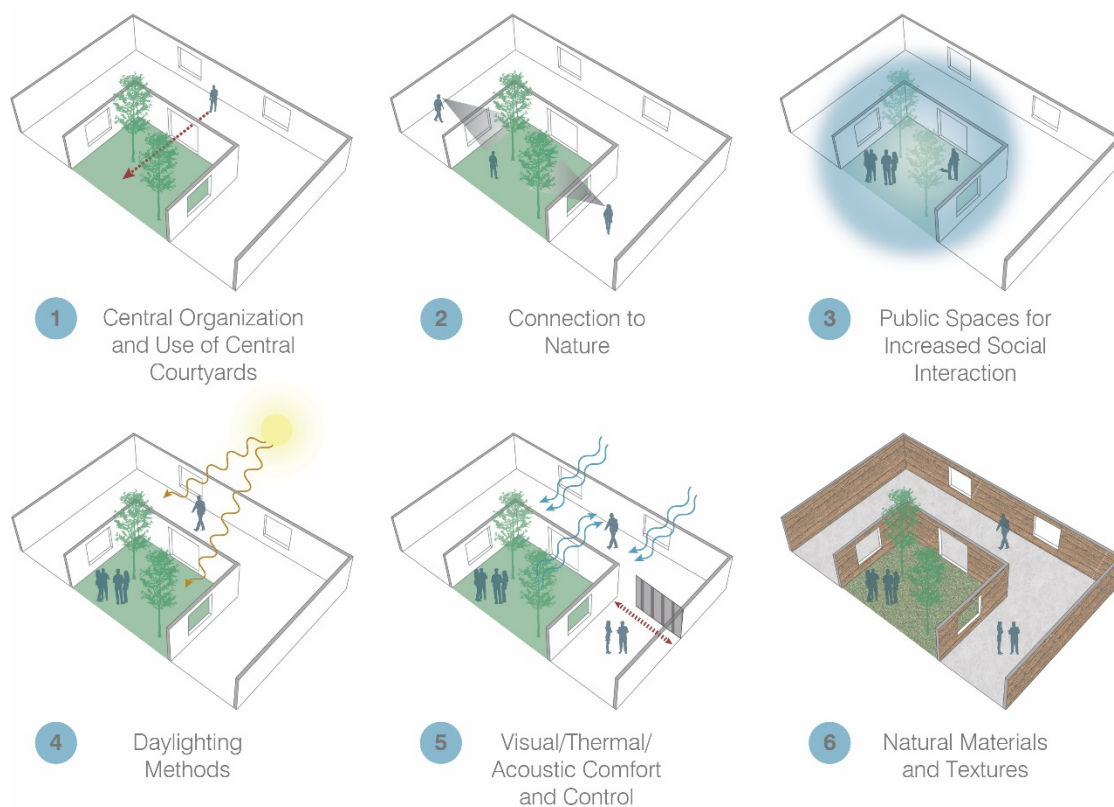


Figure 51: Design principles to apply to a cohousing community for those with SAD
Source: Author

Design Principles Applying to Programmatic Needs

These design principles can then be applied to a case study in order to improve the daily living experience of someone suffering with SAD. Each of these design

principles promote several architectural elements that can be successfully employed to this building type (Figure 52).

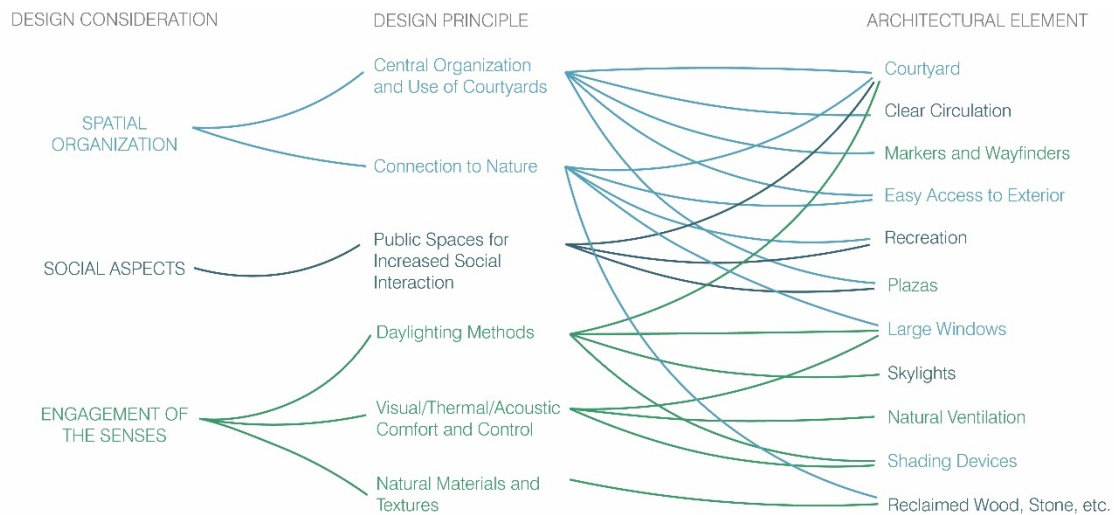


Figure 52: Architectural elements derived from design principles for a SAD cohousing community

Source: Author

The design principles also apply to the programmatic needs of this model of a cohousing community. In reference to the typical cohousing programming discussed in Chapter 3, within a community for those with SAD there are five main programmatic uses: social living, private living, leisure activities, therapy methods, and education. Under these main programmatic uses, the six main design principles can be employed to promote wellness for specific programmatic activities ranging from cooking and dining to fitness and recreation to research and group meetings (). These researched design strategies create therapeutic and social environments for those with SAD to improve their private and social living experiences and improve their overall well-being year-round.

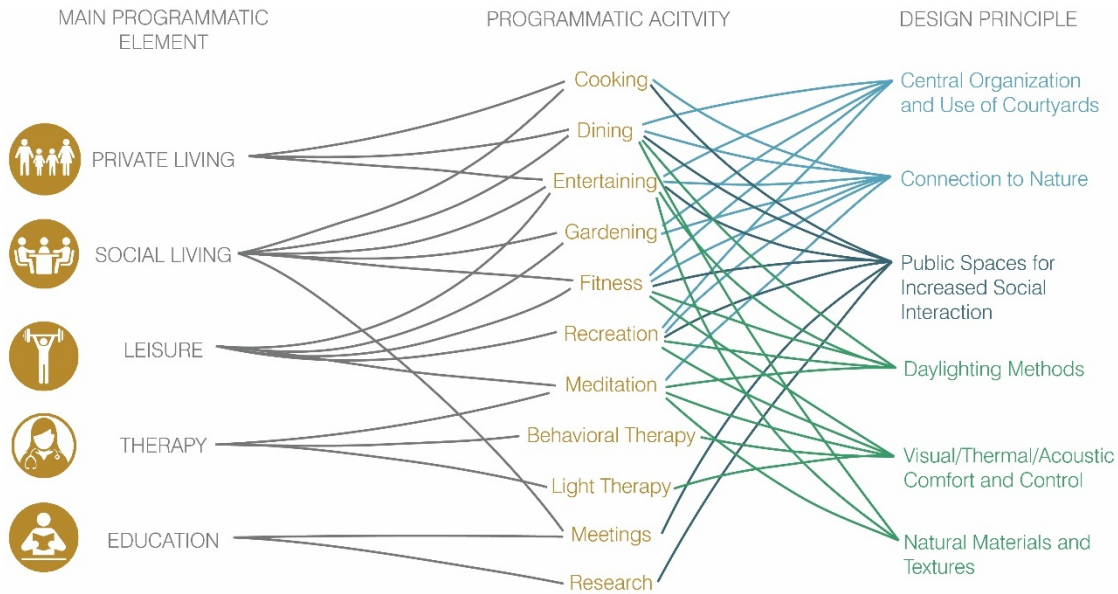


Figure 53: Design principles applied to various programming for a SAD cohousing community

Source: Author

Program Considerations and Requirements for a SAD Cohousing Community

The program for this cohousing development should be catered towards those with SAD to encourage socialization, stimulate engaging activities, and provide opportunities for treatment and therapy. Public, communal spaces are critical for these social interactions to take place, but private units and areas will create a balance for those affected. Communal spaces will consist of those typical to a cohousing community such as gardens, dining halls, kitchens, laundry facilities, etc. Semi-private spaces might also be considered, for example outside of private units to encourage quick interactions and provide a gradual transition between the public and private realms. A range of 20-30 people compose a traditional cohousing community, so 12 residences will be accommodated in this housing development composed of several unit types including one bedroom, two bedroom, and three bedroom units.

Proposed Program

	Use/Notes	Quantity	Area (s.f.)	Total Area (s.f.)	
Residential Units	Studio Unit	Single story	2	375	750
	One-Bedroom Unit	Single story	4	390	1,560
	Loft Unit	Two stories	6	710	4,260
	Total		12		6,570
Total Gross Area				6,570 Square Feet	
Communal Spaces	Kitchen	Accommodating 5-10 people	1	220	350
	Dining Room	For meals, community mtgs.	1	700	700
	Living Room		1	500	500
	Porch	Outdoor living	1	350	350
	Loft Spaces		2	600	1,200
	Total				3,100
Service	Mail Room		1	225	225
	Pantry		1	150	150
	Bathrooms	1 ADA	2	55	110
	Laundry Facility		1	100	100
	Storage	For residents	1	200	200
	Trash/Recycling Room		1	100	100
	Coat Closet		1	20	20
	Mechanical			200	200
	Total				
	Circulation		About 20% of building area		221
Common House Total Gross Area				1,326 Square Feet	
Common House Total Gross Area x 1.45 = Building Total Net Area				1,923 Square Feet	
Exterior Spaces	Communal Garden/Courtyard		1	4,000	4,000
	Outdoor Dining Space	Fire pit, grilling	1	500	500
	Picnic Pavilion		1	500	500
	Parking*	Burlington parking regulations	12 spaces	162	1,944
	Total				
Exterior Spaces Total Area				6,944 Square Feet	

Figure 54: Proposed program allowances for a SAD cohousing community

Source: Author

A key component of the development is therapy and treatment. Several of these treatment options may be done in the comfort of the residents' units, including light therapy. Light therapy could also be accommodated for in smaller social spaces to prevent isolation. Additional space for treatment should be housed in a therapy/research center to include opportunities for group therapy sessions, mediation, and other forms of treatment. A larger, adaptable social space could be transformed from an informal gathering space to a presentation room where to bring in researchers from the local University of Vermont and other can institutions to promote new research and treatments related to SAD. While the focus is on creating a social atmosphere within the cohousing development, creating spaces for residents to seek out treatment is essential.

A final consideration when considering the full extent of the building site is how public this housing development should be. A simple design method is keeping the property private and only allowing residents to have full reign of the site. Another option would be to keep part of the property private for residents of this development to utilize but then allow the community to take advantage of the waterfront views and gardens that the residents would also have access to. Another consideration is how the site will interact with the newly renovated neighboring living community to create social interactions on a larger scale through recreation, social gatherings, and the like. Regardless, the site should have a formal street frontage to welcome residents and visitors. However, towards the back of the development it would be beneficial to have the site transition into green space to provide gardens to walk through and recreation space nearby, along with easy access to the waterfront and the walking trail that runs through the back of the property. There is opportunity to make some of these amenities public based on what is best for the residents living within the community.

Chapter 5: Site Analysis and Critique of Current Development in Burlington, Vermont

Site Selection

The proposed site for this thesis should pertain to those with SAD in terms of its demographics, location and proximity, transportation services, and summer and wintertime activities. The site should be located in the northeast United States, where SAD is most common. To focus on those who may be affected by SAD, the majority age group within that area should be those between the ages of 18 and 30.

The location of the site should be located within or surrounding a major city that includes a research and/or treatment center with a focus on SAD, winter blues, depression, etc. Proximity to this research/treatment center is extremely important and should be accessible by car or other means of public transportation. Public transportation options should be considered to allow residents of the site to have access to nearby activities and social opportunities. Bus stops, subway stops, and biking paths should be located within a reasonable walking distance from the site for convenience and safety. Proximity to park systems should also be a priority in order to provide a connection to nature and opportunities for daily physical activities such as walking, hiking, biking, etc. A waterfront location would be beneficial to the users of the site in order to provide tranquil views and additional daily waterfront activities such as boating, swimming, fishing, etc.

Several northeastern U.S. regions comply in some way with the proposed site selection criteria: Burlington, Vermont; New Haven, Connecticut; Mystic Lakes, Massachusetts; Lake George, New York; and Charlotte, New York (Figure 55). These

cities were primarily selected based on popular tourism during summer/winter seasons and their severe winter climates. To break down their eligibility for this thesis project, a majority of their population must be between the ages of 18 and 30 and must have a high prevalence of mental illnesses. Their location is greatly important in terms of proximity to a major city, SAD research, depression treatment centers, park systems and transportation. Finally, each region should have a wide range of winter and summertime activities available for the community to engage in.

City Focused Site Selection

		Burlington, VT	New Haven, CT	Mystic Lakes, MA	Lake George, NY	Charlotte, NY
User Profile	Majority Age Group 18-30	10 / 10	10 / 10	5 / 10	5 / 10	5 / 10
		Majority 18-24 and 25-34	Majority 18-24 and 25-34	Majority 25-34 and 45-54	Majority 25-24 and 45-54	Majority 25-34 and 45-54
Location Qualities	Proximity to Major City	10 / 10 Burlington	10 / 10 New Haven	6 / 10 15 minutes outside Boston	3 / 10 1 hour outside Albany	6 / 10 15 minutes outside Rochester
	Proximity to Research	10 / 10 University of Vermont Winter Blues Lab	10 / 10 Yale University Winter Depression Clinic	5 / 10 Massachusetts General Hospital	0 / 10 None	5 / 10 University of Rochester Medical Center
	Prevalence of Mental Illnesses	4 / 5	2 / 5	3 / 5	1 / 5	1 / 5
	Proximity to Depression Treatment Center	5 / 5	5 / 5	3 / 5	1 / 5	1 / 5
	Proximity to Park System	10 / 10 Oakledge Park, North Beach	10 / 10 East Shore Park, Morgan Point, East Rock Park	6 / 10 Mystic Lakes State Park	3 / 10 Lake George Recreation Park	6 / 10 Durand Eastman Park, Turning Point Park
	Public Transportation	4 / 5	4 / 5	4 / 5	1 / 5	3 / 5
	Wintertime Activities	9 / 10 Skiing, snowmobiling, ice skating, hockey	9 / 10 Ice climbing, snow shoeing, ice skating	3 / 10 Hockey, ice skating (in Boston)	10 / 10 Skiing, snowmobiling, skating	3 / 10 Hockey
Seasonal Activities	Summertime Activities	9 / 10 Hiking, swimming, sailing	9 / 10 Paddling, hiking, rock climbing, golf	6 / 10 Swimming, sailing	10 / 10 Swimming, hiking	3 / 10 Golf
	Totals	71 / 75	69 / 75	41 / 75	34 / 75	33 / 75

Figure 55: Site selection matrix for a range of cities based on proposed criteria
Source: Author

The cities of Burlington, VT and New Haven, CT demonstrate the greatest potential for valuable resources and opportunities for those with SAD. In order to choose a specific site, the criteria for a potential site was broken down based on location

proximities (Figure 56). The most important factor is the site’s close proximity to a research center to provide treatments and additional guidance on the disorder while considering all travel methods of car, bus, and bike. Additionally, its location to a depression treatment center, park system, and waterfront are all equally significant. In conclusion, a site located on North Avenue in Burlington is the best suited for this case study based on its notable qualities.

Address Specific Site Selection

	Burlington, VT			New Haven, CT		
	Starr Farm Beach	North Avenue	Oakledge Park	Lighthouse Rd	Farnam Drive	Edgerton Park
Proximity to Research Center	2 / 10 6.6 miles	8 / 10 2.5 miles	4 / 10 4.8 miles	2 / 10 6.1 miles	4 / 10 4.8 miles	4 / 10 4.5 miles
Proximity to Research Center: By Car	1 / 5 16 minutes	3 / 5 12 minutes	4 / 5 10 minutes	1 / 5 16 minutes	4 / 5 10 minutes	4 / 5 10 minutes
Proximity to Research Center: By Bus	1 / 5 50 minutes	3 / 5 28 minutes	1 / 5 60 minutes	1 / 5 50 minutes	2 / 5 44 minutes	4 / 5 20 minutes
Proximity to Research Center: By Bike	2 / 5 25 minutes	4 / 5 14 minutes	2 / 5 25 minutes	1 / 5 40 minutes	2 / 5 25 minutes	3 / 5 20 minutes
Proximity to Public Transportation	9 / 10	9 / 10	3 / 10	10 / 10	3 / 10	3 / 10
	Oakledge Park, North Beach	East Shore Park, Morgan Point, East Rock Park	Mystic Lakes State Park	Lake George Recreation Park	Durand Eastman Park, Turning Point Park	Durand Eastman Park, Turning Point Park
Proximity to Depression Treatment Center	10 / 10	10 / 10	5 / 10	0 / 10	5 / 10	5 / 10
	University of Vermont Winter Blues Lab	Yale University Winter Depression Clinic	Massachusetts General Hospital	None	University of Rochester Medical Center	University of Rochester Medical Center
Proximity to Park System	10 / 10	10 / 10	6 / 10	3 / 10	6 / 10	6 / 10
	Oakledge Park, North Beach	East Shore Park, Morgan Point, East Rock Park	Mystic Lakes State Park	Lake George Recreation Park	Durand Eastman Park, Turning Point Park	Durand Eastman Park, Turning Point Park
Proximity to Waterfront	5 / 10	8 / 10	5 / 10	8 / 10	3 / 10	3 / 10
Totals	40 / 65	55 / 65	30 / 65	26 / 65	29 / 65	32 / 65

Figure 56: Site selection matrix for Burlington, VT and New Haven, CT based on proposed criteria

Source: Author

Analysis of Burlington, Vermont

The state of Vermont represents one of the northeastern states with a large percentage struggling with SAD, within the range of 8% to 10.2% of the population. Roughly 17.1% to 20.2% of the northeastern region population suffers with the winter

blues as well (Figure 57). This trend may be due to the state’s climate in which the summers are mild and the winters are long, dark, and cold. However, every season is represented with distinct changes in temperature and precipitation which is why Vermont is referred to as the “four season state.” The average temperature for the winter season is 22°F and summers range between 70 and 80°F, rarely reaching 90°F. The region of Burlington itself receives an average of 81 inches of snow each year.⁵¹ The shortest days of the year fall within December and January with an average of 9 hours of daylight and an average of 3 hours of pure sunshine. The longest days of the year fall within May, June, and July with an average of 15 daylight hours and an average of 9.5 sunshine hours.⁵²

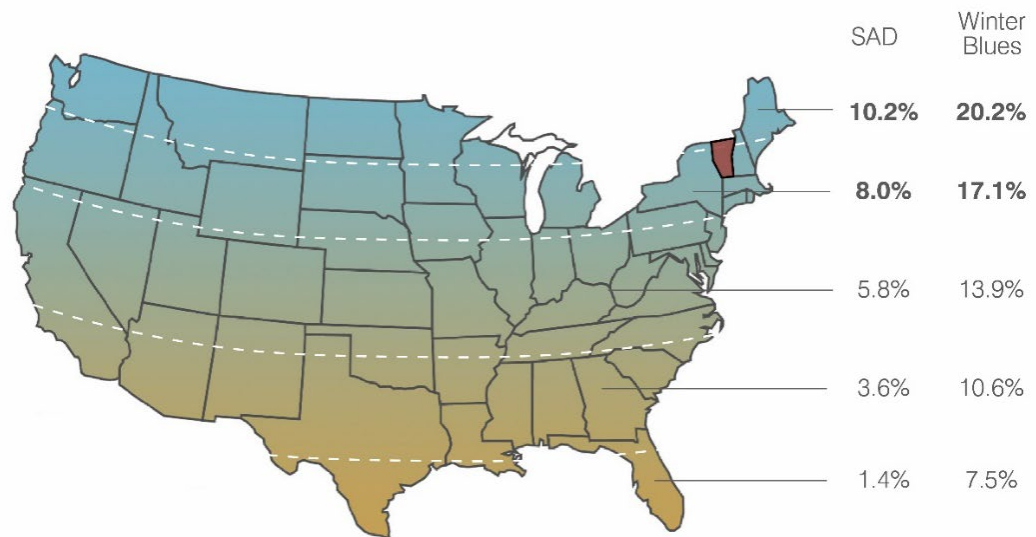


Figure 57: Prevalence of SAD in Vermont as of 2017

Source: Author, Psychological Science

⁵¹ “Climate Burlington – Vermont.” US Climate Data, last modified 2018, last accessed November 24, 2018. <https://www.usclimatedata.com/climate/burlington/vermont/united-states/usvt0033>.

⁵² “Monthly weather forecast and Climate: Burlington, VT.” Weather Atlas, last modified 2018, last accessed November 24, 2018. <https://www.weather-us.com/en/vermont-usa/burlington-climate>.

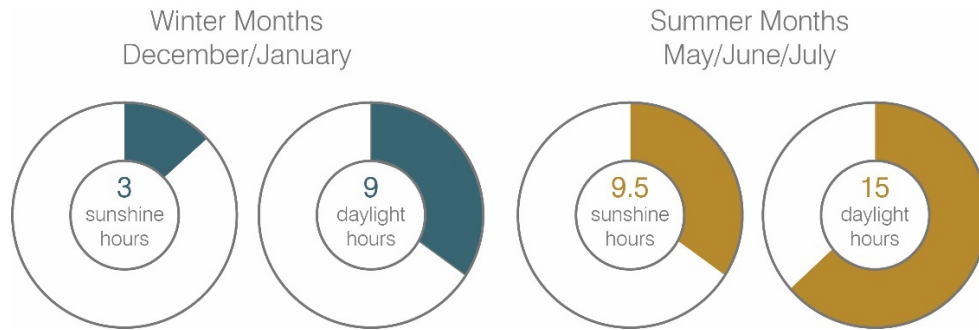


Figure 58: Limited sunshine and daylight hours during the wintertime in Burlington
 Source: Author

The city of Burlington’s majority age group is between the ages of 18 and 30, which are the primary ages for those with SAD. The population is also slightly more female at around 50.5%, which is the prominent gender affected by SAD (Figure 59).⁵³

Burlington, Vermont

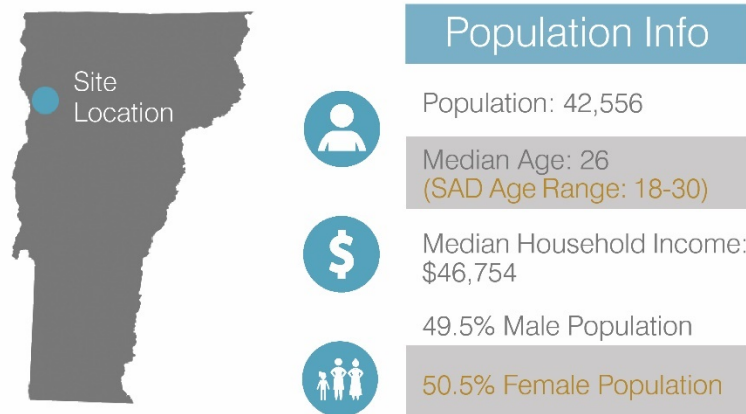


Figure 59: Burlington, Vermont population info with relation to SAD as of 2017
 Source: Author, Data USA

In terms of the status of mental health in Vermont, the state is ranked as the 6th state with the highest prevalence of mental illnesses (Figure 60).⁵⁴ Even with this high

⁵³ “Health and Safety: Burlington, VT.” Data USA, last modified 2017, last accessed November 24, 2018. <https://datausa.io/profile/geo/burlington-vt/#health>.

⁵⁴ “2017 State of Mental Health in America - Ranking the States.” Mental Health America, last modified 2018, last accessed November 24, 2018.

prevalence, only 57.7% of adults with mental illnesses receive professional treatment. There is roughly 535 mental health professionals for every 100,000 people in Burlington, VT.⁵⁵ This struggle with mental health has led to some dramatic statistics in terms of risky and harmful behaviors. Deaths caused by drug overdose in the state of Vermont is 22.2 per 100,000 people, in contrast to the national average which is only 19.8 deaths per 100,000 people. In addition, 22.7% of adults in the city of Burlington reported excessive drinking in 2017.⁵⁶ Similarly, the suicide rate in Vermont has been consistently higher than the national average. As of 2016, death by suicide is 35% higher in Vermont than the US national average (Figure 61).⁵⁷

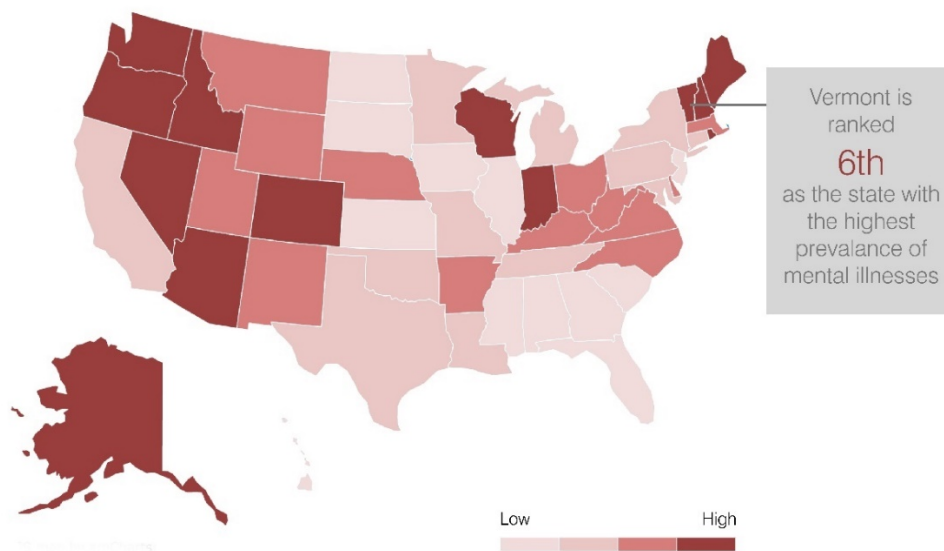


Figure 60: Prevalence of mental illnesses in the United States as of 2017

Source: Author, Mental Health America

<http://www.mentalhealthamerica.net/issues/2017-state-mental-health-america-ranking-states>.

⁵⁵ “Health and Safety: Burlington, VT.” Data USA.

⁵⁶ “Health and Safety: Burlington, VT.” Data USA.

⁵⁷ Stone DM, Simon TR, Fowler KA, et al. “Vital Signs: Trends in State Suicide Rates — United States, 1999–2016 and Circumstances Contributing to Suicide — 27 States, 2015.” *MMWR Morb Mortal Wkly Rep*, vol. 67, no. 22 (2015): 617-624. DOI: <http://dx.doi.org/10.15585/mmwr.mm6722a1>.

Vermont and United States Suicide Death Rates (per 100,000 people)

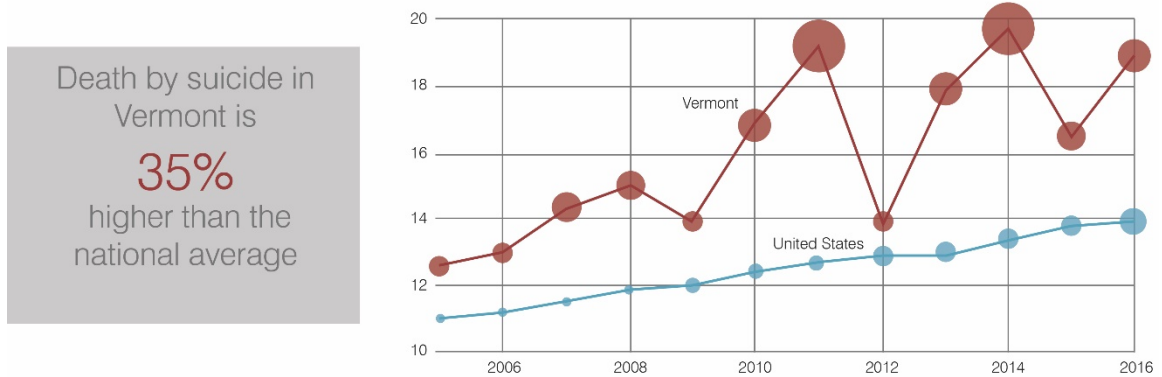


Figure 61: Vermont and United States Suicide Death Rates (per 100,000 people) as of 2016

Source: Author, U.S. Centers for Disease Control and Prevention

The state of Vermont is among the few in the U.S. where cohousing has started to be introduced. As of 2017, there are eight functioning cohousing communities with one under construction (Figure 62). With that in mind, the typology of cohousing would be ideal to continue to implement in this area as the idea becomes more and more popular.

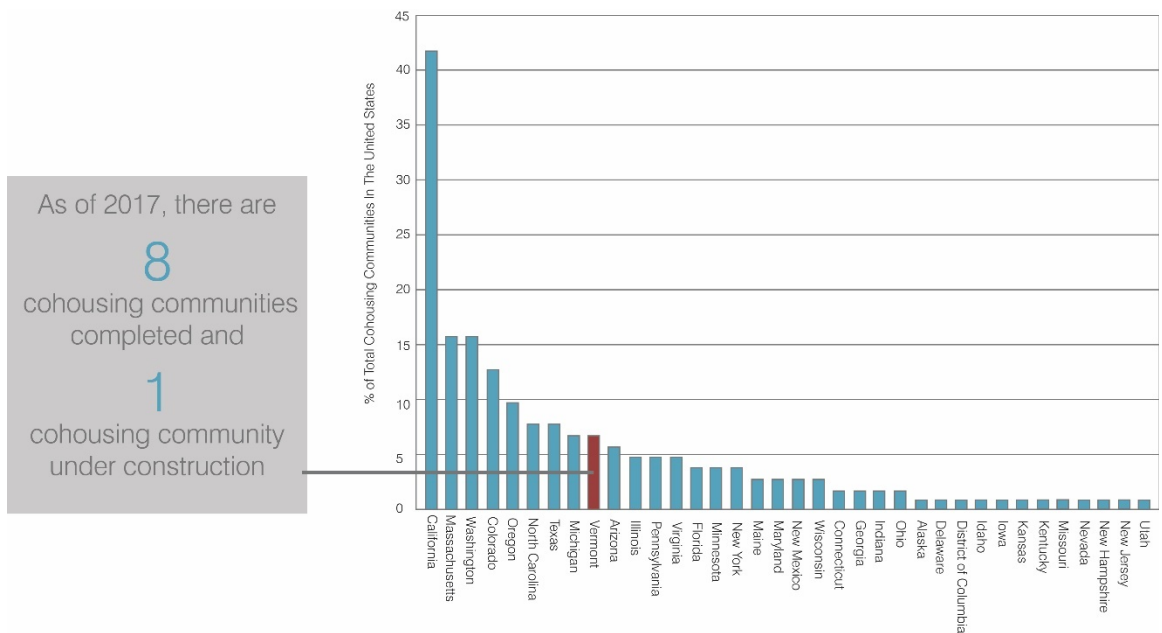


Figure 62: Development of cohousing in Vermont as of 2016

Source: Author, Cohousing Network

Scope of North Avenue Site

The city of Burlington is composed of several smaller neighborhoods, including North End and South End (Figure 63). The New North End neighborhood includes the location of the site for this thesis within a more suburban environment. Downtown Burlington is located in the heart of the city where restaurants, shops, and industries are located and larger public events are held. To the east side of downtown is the University of Vermont, which is where the UVM Medical Center Seneca Center is located. This medical center will provide treatment services and research opportunities for SAD and is accessible from the site on North Avenue by car, bus, and bike in under 30 minutes (Figure 64).

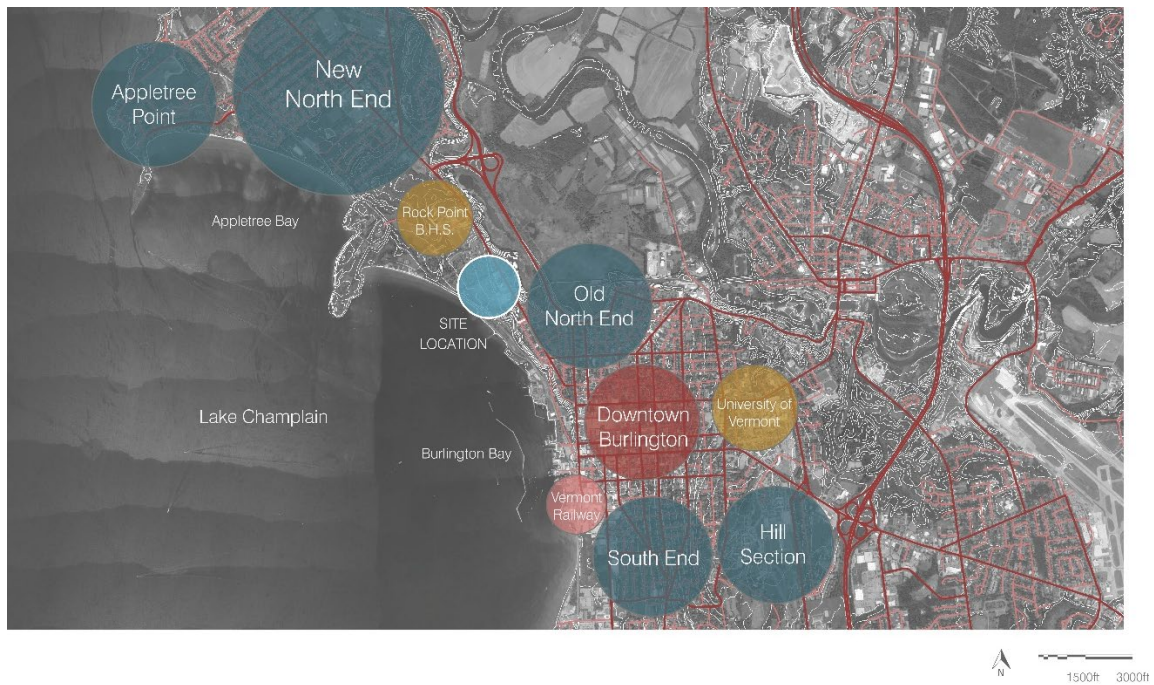


Figure 63: Neighborhoods within Burlington

Source: Google Earth, Author

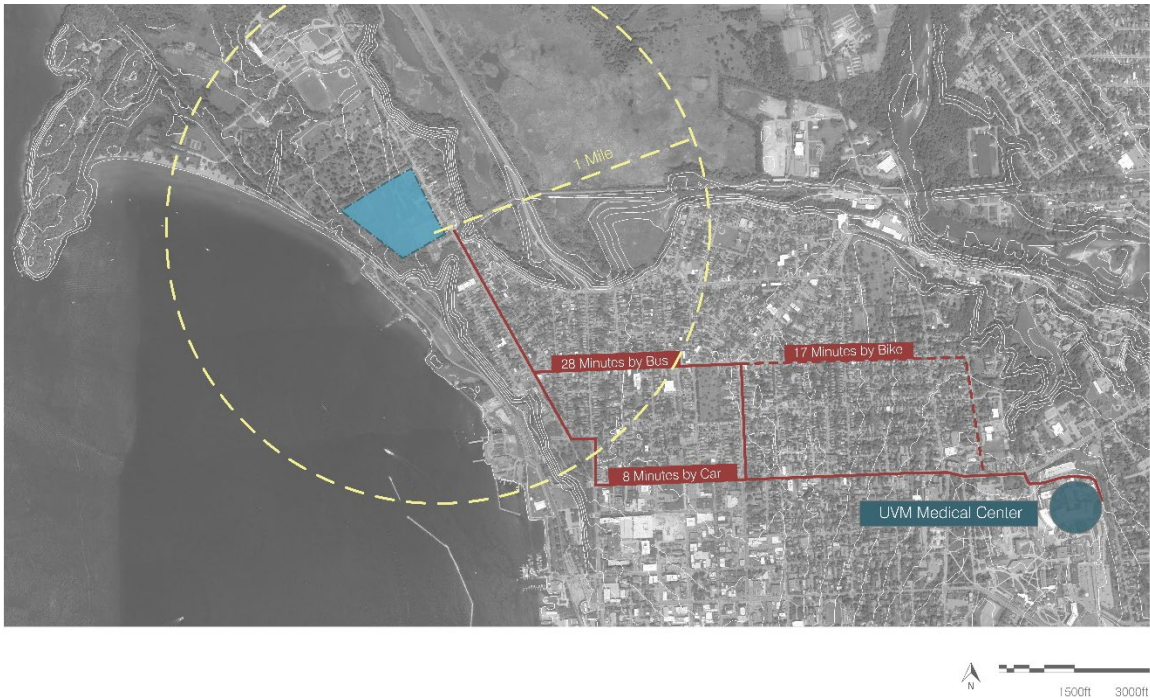


Figure 64: Accessibility to UVM Medical Center Seneca Center

Source: Google Earth, Author

The site on North Avenue is surrounded by plenty of recreational spaces including several parks and reserves to keep those with SAD engaged in physical and social activities. Two main trails provide pedestrian and bicycle access to these areas, with one following Route 127 on the northern side of Burlington and one following the waterfront along Lake Chaplain called the Island Line Trail (Figure 65). Recreational activities within the city consist of biking, ice skating, ice hockey, gardening, skate boarding, basketball, baseball, and many more that residents can be participate in during both the summer and winter seasons. Waterfront recreation consists of sailing, fishing, swimming, and canoeing that all typically occur during the warmer months (Figure 66).

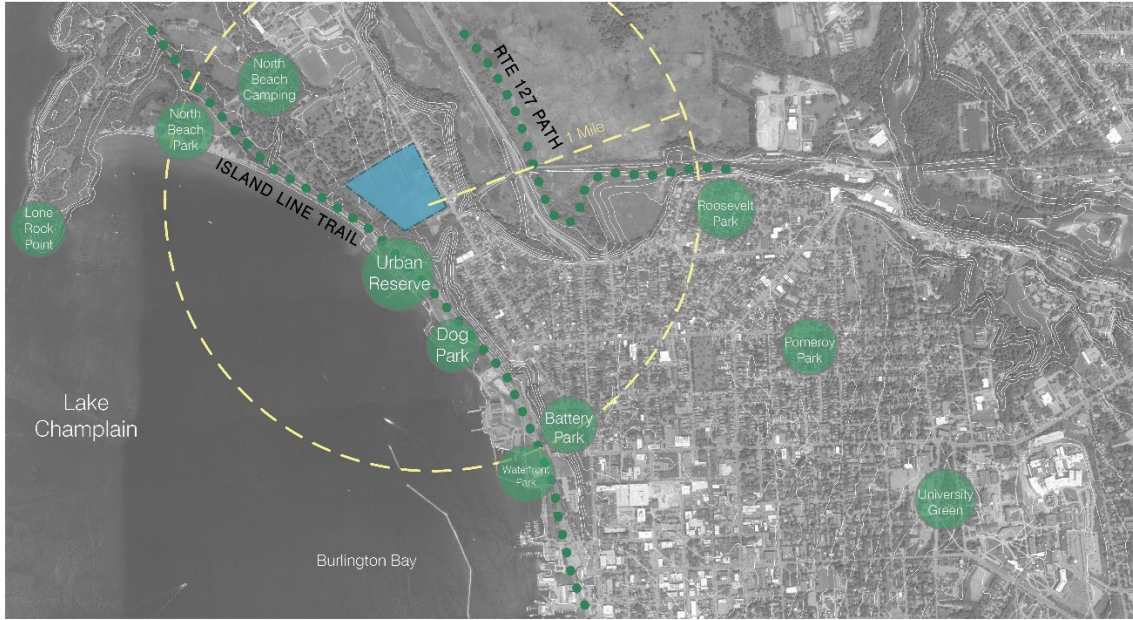


Figure 65: Trails and Recreation in Burlington

Source: Google Earth, Author



Figure 66: Recreational activities in Burlington

Source: Google Earth, Author

Traffic flow is heavy along North Avenue as it connects northern suburban neighborhoods to the downtown area of Burlington (Figure 67). The public bus system runs along this avenue with a stop located right in front of the property. The Vermont Railway also passes through this area of the city and continues down to the southern waterfront area downtown. The site is zoned as waterfront residential with medium density, meaning that the property has the potential to house multiple residential units needed for a cohousing community. The area is surrounded by multiple recreational zones with lower density residential areas to the southeast (Figure 68).

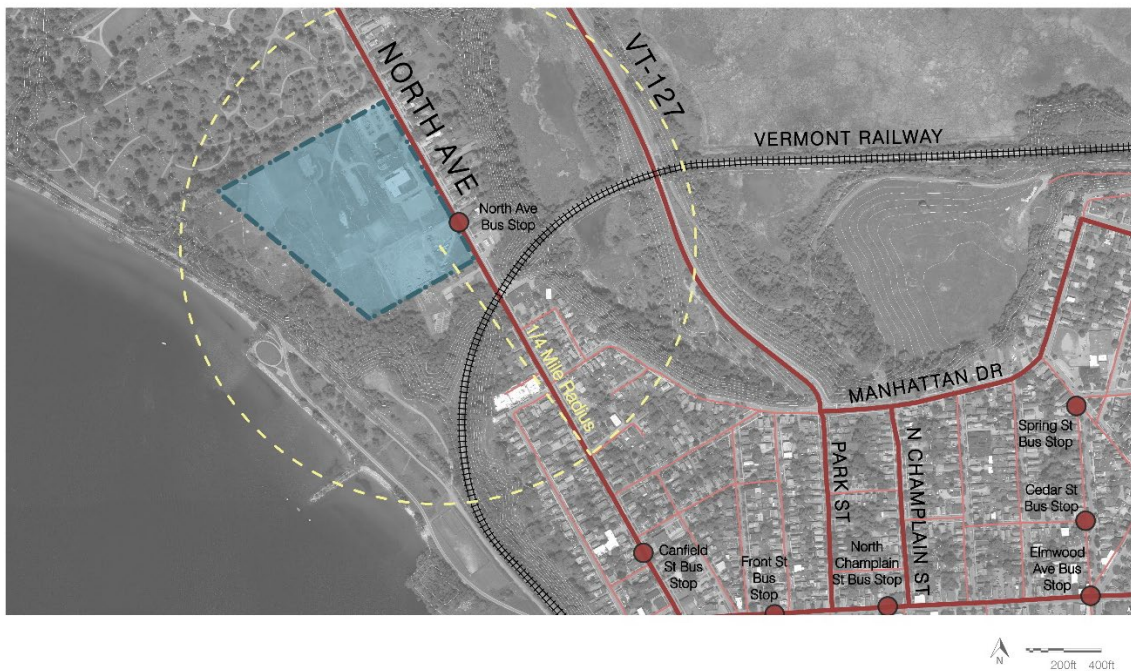


Figure 67: Accessibility to Burlington Site
Source: Google Earth, Author



Figure 68: Zoning surrounding immediate site

Source: Google Earth, Author

The property on North Avenue is composed of two parcels owned by the University of Vermont. The 6-acre area houses an existing building, now named the Liberty House, which serves public rented apartments. The building’s program has transitioned from many uses, including St. Joseph’s Child Center serving orphaned children from 1884 to 1983. Burlington College eventually purchased the property in 2010 and remained as the land owner even after the college’s closing in 2016.⁵⁸ The remainder of the site is mainly open space or forested with a cemetery to the northwest, single family detached homes to the north and southeast, and a waterfront green space and trail to the southwest (Figure 69). The site’s topography shows a steep rise in height directly along the waterfront and transitions to a gradual rise to a large hill towards North

⁵⁸ Lilly, Amy. “On the Rise: Liberty House Opens in Burlington.” Seven Days VT, Da Capo Publishing, September 17, 2017, last accessed November 26, 2018. <https://www.sevendaysvt.com/vermont/on-the-rise-liberty-house-opens-in-burlington/Content?oid=8180446>.

Avenue (Figure 71). The site's dramatic topography highlights where water flow occurs towards Lake Champlain, which serves as an environmental consideration that will influence design decisions (Figure 73).

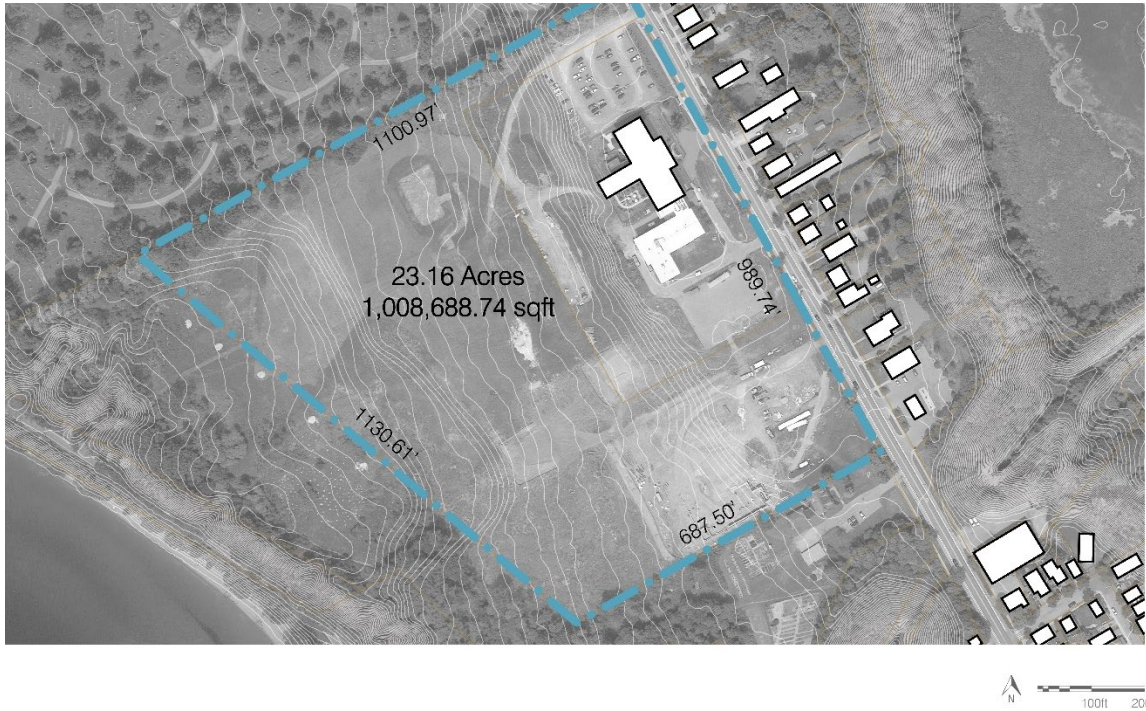


Figure 69: Site plan - North Avenue, Burlington
Source: Google Earth, Author

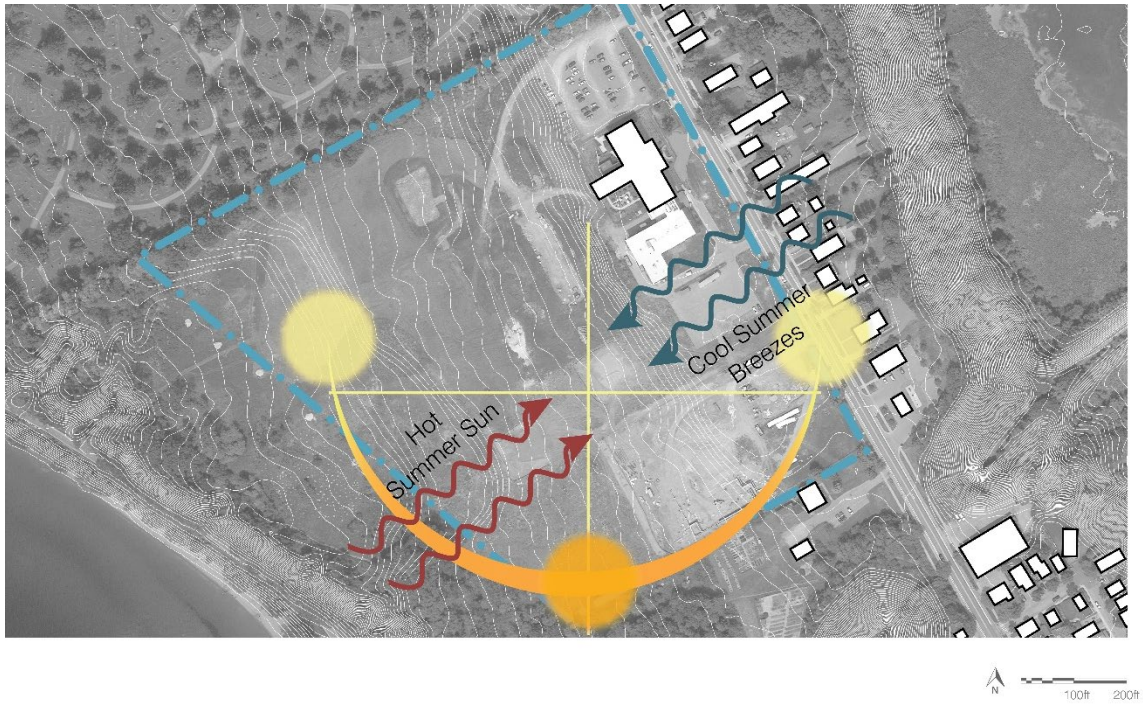


Figure 70: Sun path diagram – North Avenue, Burlington

Source: Google Earth, Author

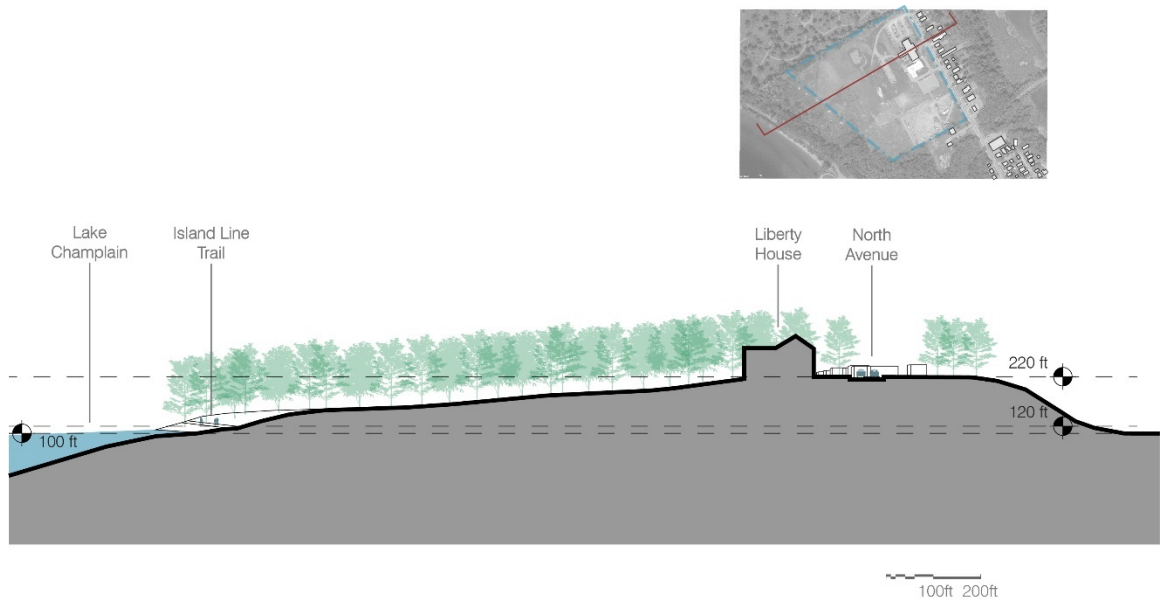


Figure 71: Site section demonstrating change in topography from North Avenue to Lake Champlain

Source: Google Earth, Author



Figure 72: Island Line Trail during the winter time

Source: Author



Figure 73: Water flow on site – North Avenue, Burlington

Source: Google Earth, Author

Progressing Plans for Development on Site

Currently the 21.6-acre lakefront property on North Avenue is undergoing plans for development headed by Eric Farrell, who recently purchased the land from Burlington College. Cambrian Rise, the city’s soon-to-be largest planned housing development, will be composed of 14 buildings and eventually house 739 units — 240 condos, 353 rentals,

and 146 affordable units with an additional hotel housing 42 rooms.⁵⁹ The total construction process of the currently proposed plan is intended to take at least six to eight years with the possibility of more development in the future if the density increases as predicted. In order to do so, the project aims to provide housing with easy access to downtown Burlington through local transportation and bike trails with several amenities available to entice residents to stay long-term. Small businesses will also be established throughout the site to increase job availability (Figure 74).



Figure 74: Cambrian Rise development plan

Source: Delta Marketing Group

⁵⁹ Jickling, Katie, “Cambrian Rising: A Massive Project Advances Quietly in the Queen City.” Seven Days VT, Da Capo Publishing, July 19, 2018. <https://www.sevendaysvt.com/vermont/cambrian-rising-a-massive-project-advances-quietly-in-the-queen-city/Content?oid=6848773>.

Farrell's plans were not initially well received by the city of Burlington. In 2015, the backlash slowed down the permitting process with concerns of traffic, an inappropriately proposed 14-story building scale, stormwater runoff, and other environmental concerns. Save Open Space-Burlington was one of the opposing groups that protested the development with worries of destruction to the land and negative environmental effects to Lake Champlain. Mayor Miro Weinberger reached out to Farrell and encouraged a six-month hiatus to address community concerns through public hearings and negotiations with community organizations. Eventually, the feuding parties compromised to construct a deal in which the Vermont Land Trust along with the city of Burlington purchased the 12 acres along the waterfront to establish a public park. Senior housing developer Cathedral Square will construct one of the development's buildings in order to provide affordable housing unit options and senior housing by fall of 2019 (Figure 75). The project is currently going through Vermont's Act 250 process which considers the project's effects on air quality, streams and shorelines, soil erosion, waste disposal, transportation, and many other land use and development considerations.

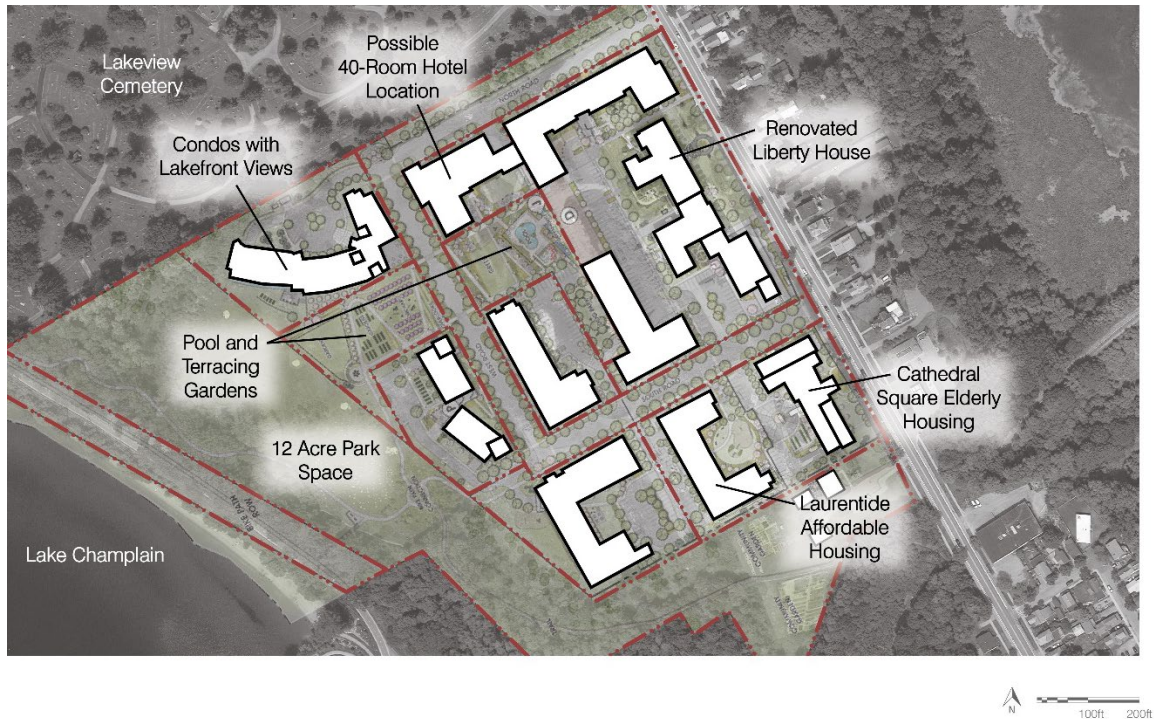


Figure 75: Cambrian Rise master plan and programming

Source: Google Earth, T.J. Boyle Associates, Author

As of July 1, 2018, the first preservation phase of the project has been completed with the restoration of the former children’s orphanage building. Now named Liberty House, Duncan Wisniewski Architecture created 64 units over the five floors with one-bedroom, loft, and studio units. Through the construction process a majority of the building was preserved with massive wood trusses now being exposed, tall brick walls becoming focal points within circulation spaces, and wood ceilings being restored to retain the initial character of the building. Liberty House advertises its waterfront views, bike storage, several amenities, a car sharing program, and a rooftop veranda available for all residents to use.⁶⁰

⁶⁰ Lilly, Amy, “On the Rise: Liberty House Opens in Burlington.

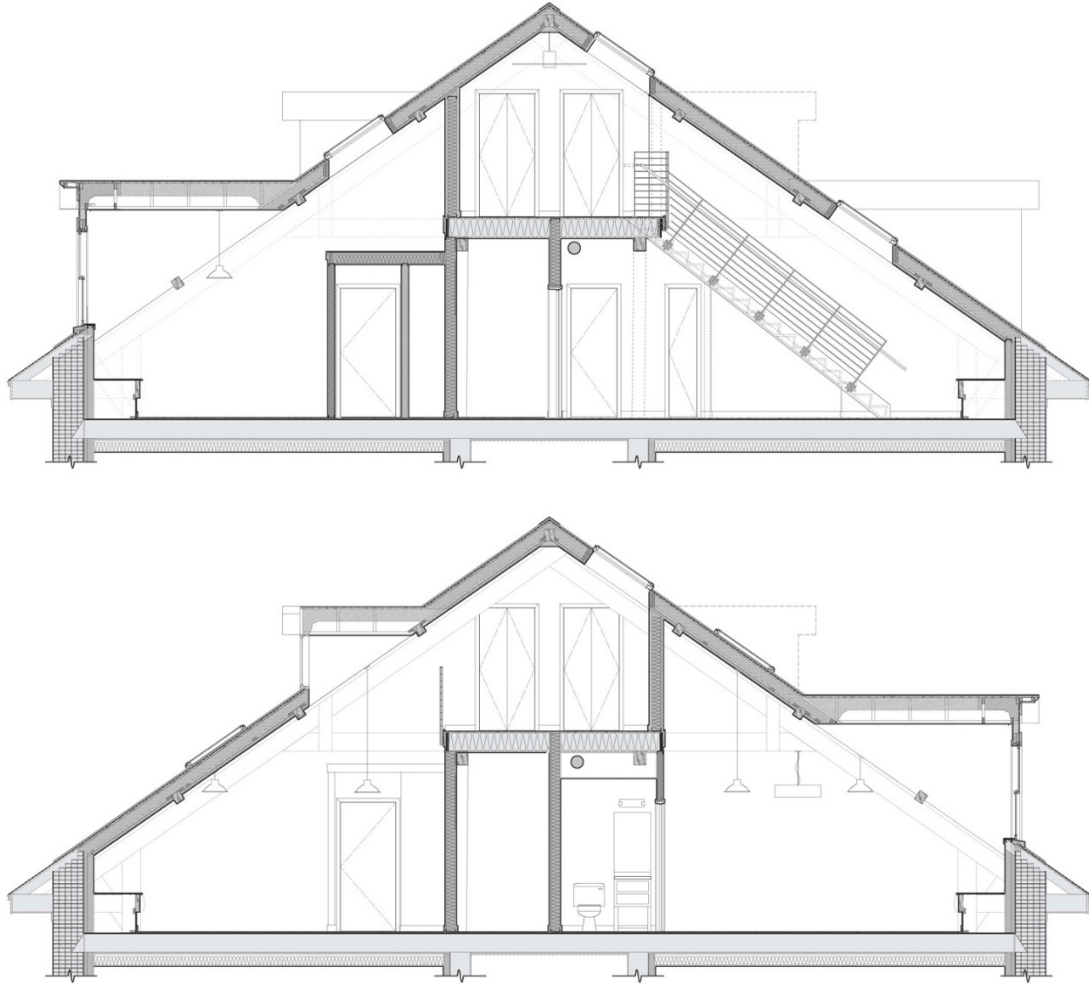


Figure 76: Liberty House loft unit sections demonstrating its spatial design strategies

Source: Duncan Wisniewski Architecture

Critical Analysis of Cambrian Rise Master Plan

Currently, the Cambrian Rise master plan proposes some design opportunities as well as some problematic choices to be implemented onto the site. By restoring the character of the Liberty House, the existing five-story building has the opportunity to become the site's jewel with its symmetrical form stretching towards the waterfront. This implies a strong axial approach sloping down towards the lake that could be reinforced with building edges and specific programming. While the suggested plan does imply an

axis through the only open area between North Avenue and the water, the axis is not strongly enforced by the built environment (Figure 77). If the buildings' longer edges were facing the open area, particularly on the east side, the axis would be further emphasized. The axis is also mainly implied through the lack of buildings and does not provide a direct walking route or pathway to guide residents directly down towards the water. If the design preferred to create a more formal sequence through the site, a more direct pathway could establish that connection.

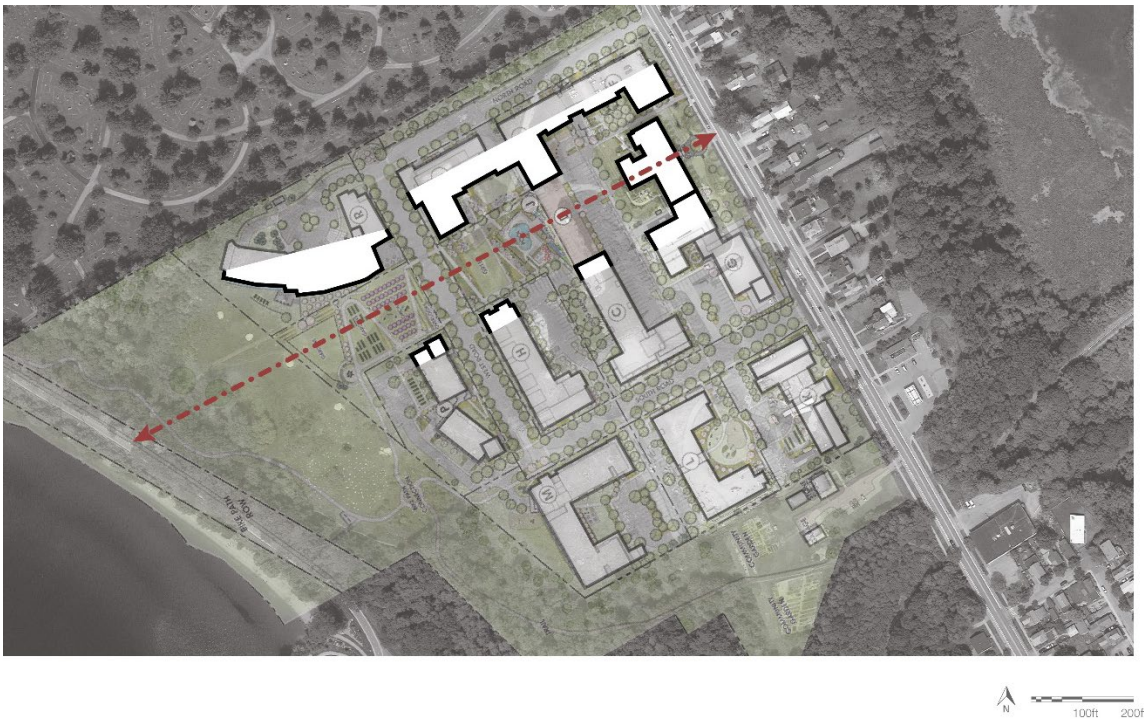


Figure 77: Cambrian Rise building edges attempting to reinforce main axis

Source: Google Earth, T.J. Boyle Associates, Author

The terracing gardens within that open area does provide some green space amidst an otherwise heavily built environment. In addition, the 12-acre park on the south side of the site fosters the remaining amount of green space that the city of Burlington strongly favored. Unfortunately, with this proposed park only 36% of the site is open space

(Figure 78). With a lack of recreational areas on site and open areas with limited programming for activities, the city of Burlington does not greatly benefit from this design. The proposed master plan does include a friendly pedestrian connection between the existing biking and walking path along the water's edge and North Avenue (Figure 79). However, the pathway might not be heavily used if the site does not provide enough recreational activities and programming that invites the surrounding community into the developed area.



Figure 78: Cambrian Rise's limited open park space
Source: Google Earth, T.J. Boyle Associates, Author



Figure 79: Cambrian Rise's proposed pedestrian and vehicular access

Source: Google Earth, T.J. Boyle Associates, Author

In addition to having access to Lake Champlain, lakefront views provide an opportunity for building properties within sight of the enticing scene before them. However, the proposed Cambrian Rise master plan has few buildings with unobstructed views out towards the water. A majority of the best views are given to those who can afford to live in the condos to the west side of the site, while those who may only be able to live in affordable housing are located in a wooded corner to the northeast. While real estate developers see this as an opportunity to earn more profit based on the value of those condo units, the residents of Burlington will not benefit from the full potential of the site's worthy location. The residential units located in the center of the site might also lack waterfront views based on the tall building heights in front of them. Although the site does drop off dramatically towards the shore, the massive sizes of these buildings compete with one another. The vast difference in building heights is also noticeable in

comparison to the one-, two-, and three-story homes on the north side of North Avenue. The four and five story buildings on the proposed site create a densely developed environment in juxtaposition with the low-rise, single family homes across the street (Figure 80). Other opportunities to address this could have been developing a taller edge along the street and lowering the scale towards the water or building a lower edge along North Avenue and rising in scale to accommodate for the dramatic change in topography.



Figure 80: Building heights along North Avenue
Source: Google Earth, T.J. Boyle Associates, Author

Overall, the master plan of the Cambrian Rise development takes advantage of some opportunities of the site on North Avenue. With a close proximity to downtown, it provides public transportation options and connects to the existing biking and walking path going along the shoreline. The renovated Liberty House is located along an open axis going towards the lake, however no direct access is provided. The proposed park

provides open space but does not take advantage of additional programmatic uses that could be provided to encourage the larger surrounding community to take advantage of the development. The density upon the site might also serve as a challenge in response to the existing conditions along North Avenue and the lack of views towards the waterfront. By redesigning a more cohesive master plan better serving both those with SAD and the greater city of Burlington, this particular site could be of great value with improved design strategies and amenities.

Chapter 6: Schematic Design of Site and Massing Exploration

Overall Design Strategies for Master Plan

Several master schemes were explored with slight variations in how both sides of the site were treated. All concepts share a similar attitude towards the north half of the site with the Liberty House remaining in its purest form allowing for a green space to occupy the central axis before terminating to the woods. On either side of this space, multi-family residential buildings align along this axis. Each scheme experiments with how that central space is utilized.

The site to the south is where explorations into how the SAD cohousing communities are organized. Each share similarities in program with a research/therapy building at the head of the site with a recreation center at the end of the main street that connects the two. Along that main street are the individual cohousing communities with their own central courtyards. All schemes share the strategy of dividing the two halves of the site with trees to create a natural barrier between the two to reinforce the idea that these are communities of two different densities.

The site located before the existing Liberty House will remain in order to allow for denser development as hoped for by the local community with the southern half of the site remaining open for the SAD cohousing community. Several explorations were conducted in order to conclude the treatment of the overall natural boundaries of the site and where permeability would occur (Figure 81).



Figure 81: Open vs. closed conceptual schemes for boundaries of the site

Source: Author

Master Plan Scheme 1: L-Shaped Communities Open to Lakeside

The first design scheme organized each cohousing community as an L-shape with the common house occupying the corner closest to the lake and leaving the other corner open for entry into the courtyard (Figure 82). By organizing the private living units along the edges closest to North Avenue and the wooded areas the courtyard then opens itself up to the lakeside with half of the units having strong views in that direction. All the private units in this scheme are also treated equally with similar building heights. This general organization around an implied courtyard takes precedent after the Jystrup Sawmill Housing Cooperative. The therapy/research house implements two central courtyards with a common interior space connecting the two, similar to the Oasis Cancer Care Center and the Livsrum Cancer Counseling Center.



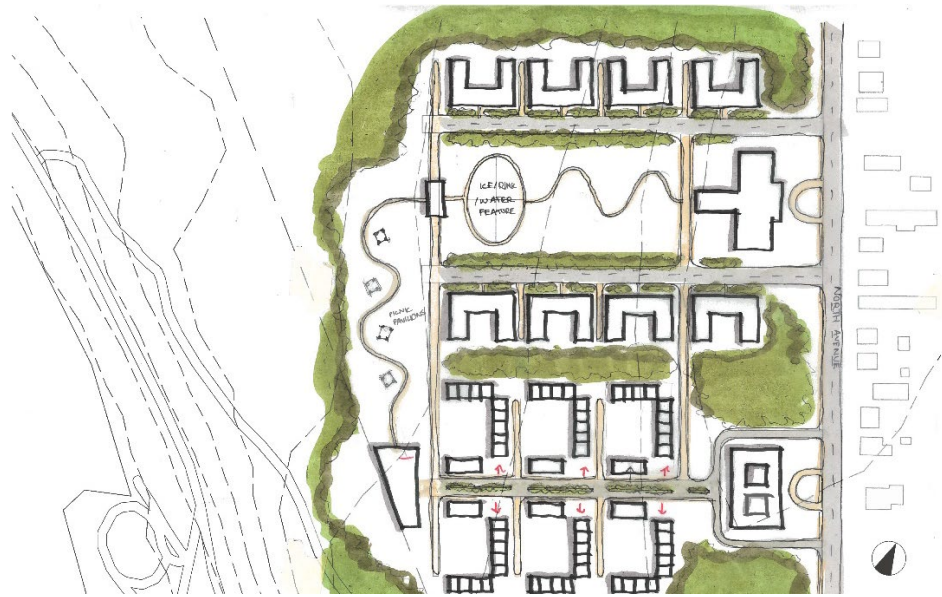


Figure 82: L-shaped cohousing communities aerial and master plan, NTS

Source: Author

Master Plan Scheme 2: U-Shaped Communities

The second scheme explores the option of a central cohousing model slightly shifted to have the common house occupying the same corner as the previous scheme but with a variation in height to allow for rooftop terraces that take advantage of the views out towards the lake (Figure 83). The general organization slightly resembles the program organization of the Lange Eng Cohousing Community. The private living units surround the central courtyard on all three sides to enclose the space with two-story units to the northeastern side and one story units to the southwest side to allow the taller units to have views over the lower ones. The research/therapy house has a single central courtyard with the option for a roof terrace on the southern side to take advantage of the views and sunlight throughout the day.

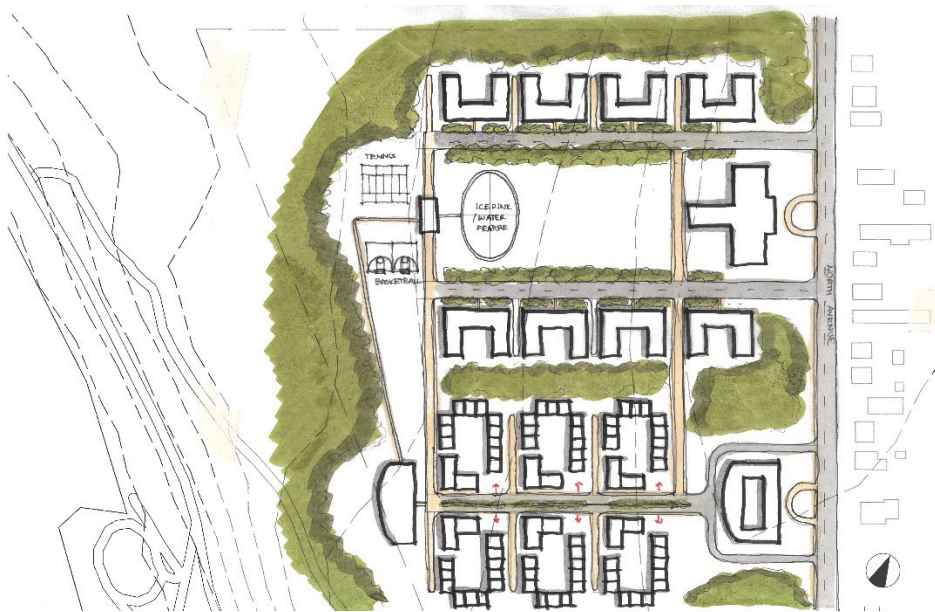
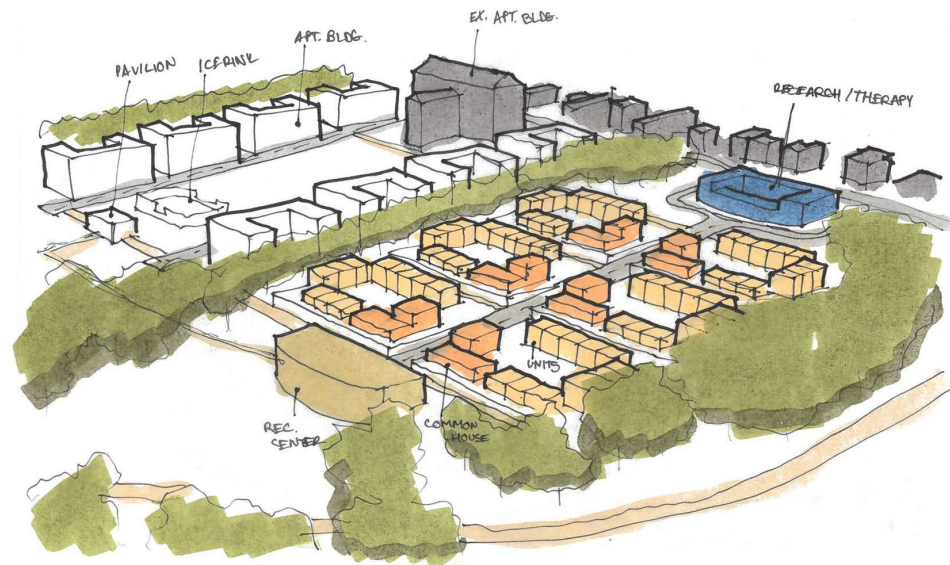


Figure 83: U-shaped cohousing communities aerial and master plan, NTS

Source: Author

Master Plan Scheme 3: Linear, Axial Communities

The third scheme organizes the communities along a linear cross axis with the common house centrally located at the head with units on either side of the central courtyard (Figure 84). The courtyards are then open at the ends to the wooded areas on

either side of the site. The therapy/research building has implied courtyards on either side of the main entry points with the major programs of education and therapy located on opposing wings. This scheme was developed further based on its clear organization and its central courtyards connecting its residents to nature at the open ends, relating back to the design principles established for a SAD cohousing community.



Figure 84: Linear cohousing communities aerial and master plan, NTS

Source: Author

Organization of Community Exploration

Through the process of designing these communities, there were several schemes involving the organization of the site in terms of access and orientation. The first scheme orients each community east-west with common houses facing pedestrian-friendly streets to offer more casual social interactions between them. There are also several main roads, with two terminating to picnic pavilions that then lead towards the recreational trails within the natural environment. The challenges associated with this scheme involve a lack of hierarchy and an unnecessary number of access roads circulating around and within the community.

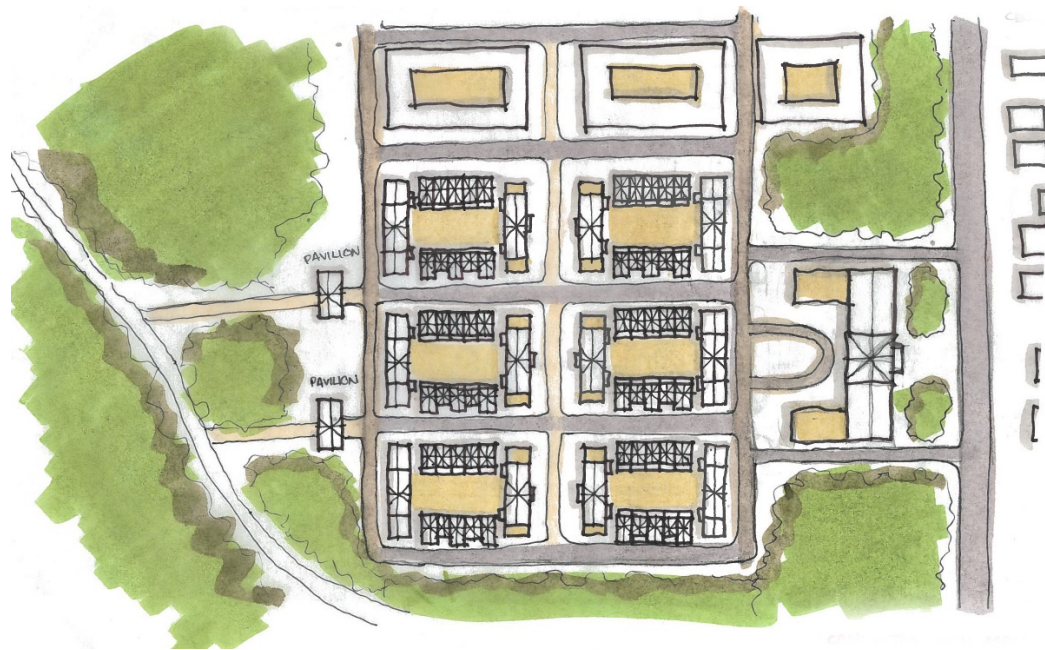


Figure 85: Access and Orientation Scheme 1, NTS

Source: Author

The second scheme involves a linear axis from the head therapy and research building down through a pedestrian-friendly alleyway with smaller recreational pavilions facing onto it. Each pavilion has the opportunity to serve as a unique program such as a

pool, sauna, fitness studio, weight room, etc. to allow for recreational opportunities throughout the year. However, while this passageway does provide opportunities for intermingling among communities, it becomes unclear as to what this circulation space is used for.

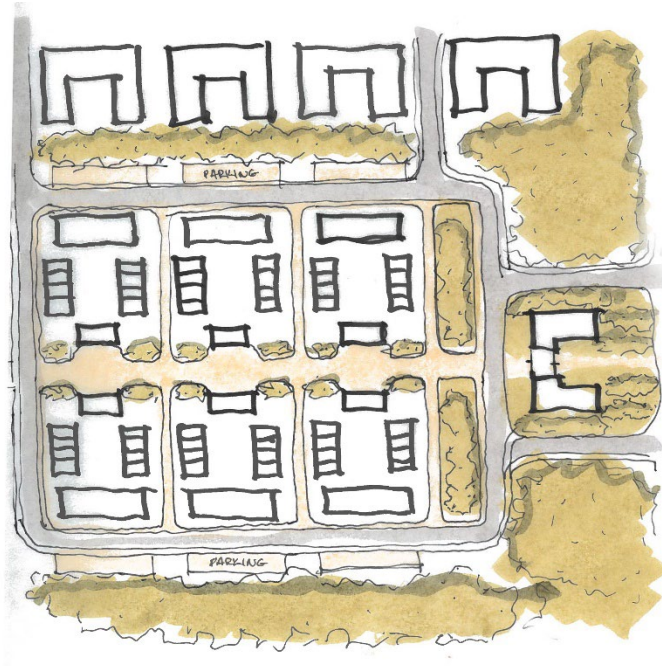


Figure 86: Access and Orientation Scheme 2, NTS

Source: Author

The final scheme orients the communities north-south to allow the common houses to orient themselves along the street to create that edge all the way down the main axis of the site. This scheme was further developed as seen in Chapter 7.

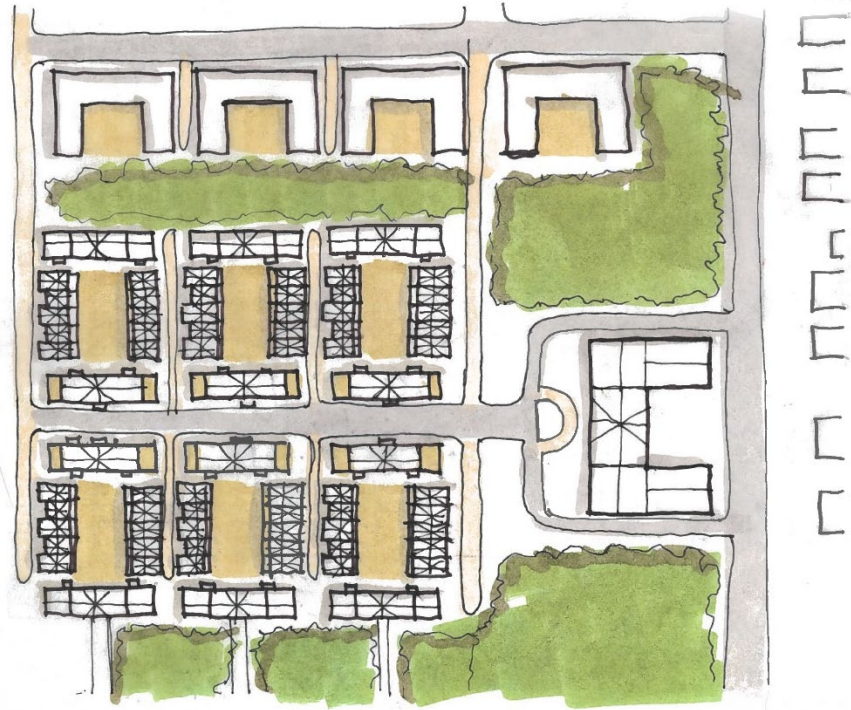


Figure 87: Access and Orientation Scheme 3, NTS

Source: Author

Community Massing Scheme 1: Centrally-Located Communal Spaces

Upon selecting a linear organization for each cohousing community, several schemes explored the massing of the common house and a potential counterpart that terminated the community's main axis at the other end of the courtyard as well as the massing and programmatic organization of the private units. The following schemes employ a mixture of studio, one-bedroom, and two-bedroom units. A unique module is then created for each to have various unit types expanding horizontally or vertically.

The first scheme angles the roofs of each building away from the central courtyard to allow for snow to collect on the outside of the community rather than within the central space (Figure 88). The angled roofs also allowed for clerestory windows to let light down into spaces below. The common house located towards the street houses the

lounge on center with views into the courtyard with counterpart on the opposite end of the community that houses a double-height dining room with a kitchen adjacent to it. In this case, both main communal spaces occupy the central space with views and access to the shared courtyard.

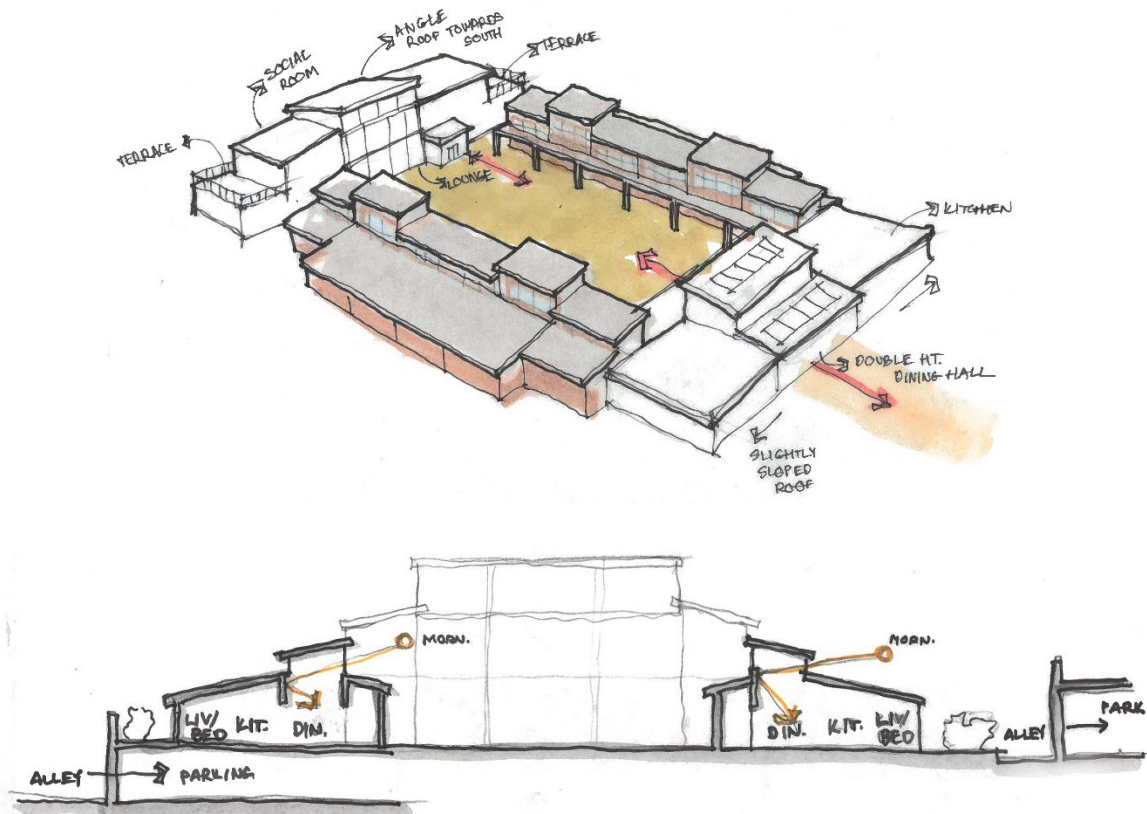


Figure 88: Community Massing Scheme 1 Axon and Section, NTS

Source: Author

Community Massing Scheme 2: Occupiable Exterior Thresholds

The second massing scheme uses gable roofs with light wells to bounce light down into the private units. Both common houses at each end have a void occupying the central space at the ground level to act as thresholds into the community or out to nature (Figure 89). The dining room is located above the main entrance off the street to have residents look down into the courtyard with service program, such as the kitchen and

storage area, on either side. An outdoor porch area is located at the other end with social spaces on either wing.

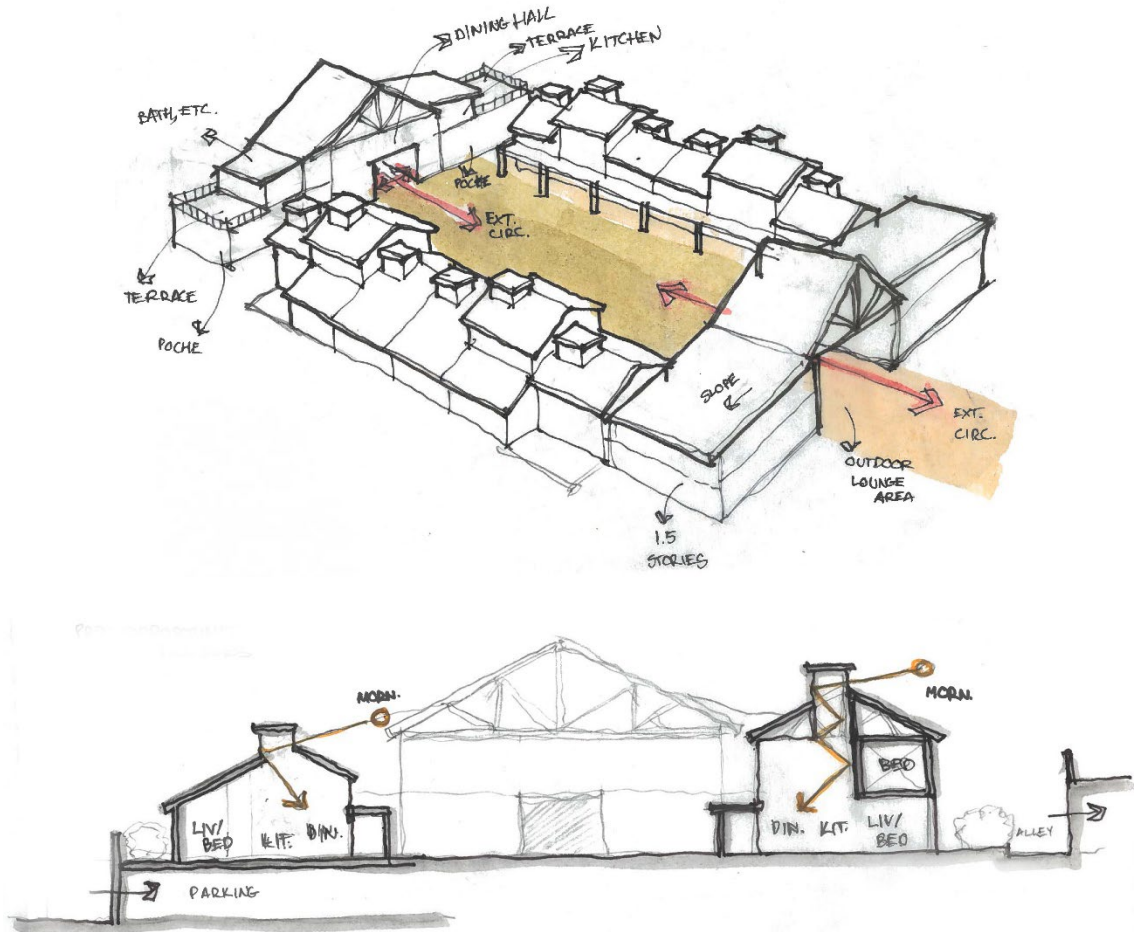


Figure 89: Community Massing Scheme 2 Axon and Section, NTS

Source: Author

Community Massing Scheme 3: Exposed Gable Roof Structures

The final scheme also employs gable roof structures; however, these roofs are rotated to emphasize the individuality of each unit (Figure 90). This structure also allows the face of each unit to increase to allow for larger windows to bring light in. These units use light wells similarly to the first scheme to let light bounce into the lower spaces. The common houses also rotate orientation of the roofs to form long barn-like structures to

house the communal program. The common house on the street houses the dining room and kitchen, while the lounge space in a similar manner. These gable roof structures also allow the opportunity for exposed roof trusses to highlight the natural wood material, relating back to the SAD cohousing design principles, as well as the ability to make the spaces feel much larger. This scheme was pushed for further development as seen in Chapter 7.

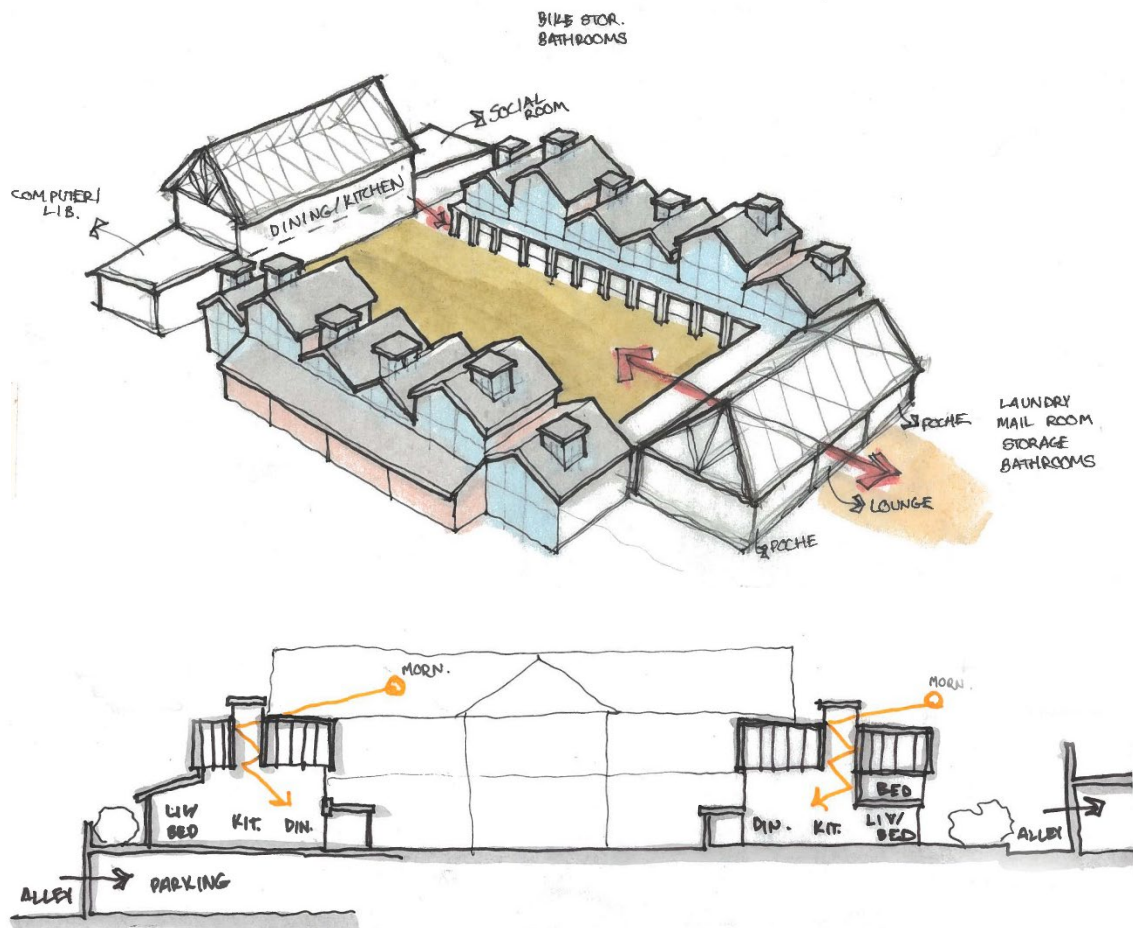


Figure 90: Community Massing Scheme 3 Axon and Section, NTS

Source: Author

Chapter 7: Design Proposal and Application of Design Principles

Site Design

The overall design for the site on North Avenue considered the existing conditions and the density requested by the local developer. With that in mind, the existing building at the northern tip of the site remains in its purest form to create a strong axis out towards the lake. Multi-family residential buildings were then located on either side of the communal green space that occupies the center of that axis (Figure 91). The remaining site was then designed to incorporate the SAD cohousing communities incorporating the established design principles (Figure 92). Any previously wooded areas that were removed over the past few years by the city of Burlington were then reintroduced throughout the overall site in order to promote connections to nature to improve the living conditions of those who reside here. The natural topography was adjusted as little as possible to allow a continuous slope down towards the lake, with most of the topographic change occurring towards where the recreational trails begin at the end of the community.



Figure 91: Master Plan, NTS
Source: Author

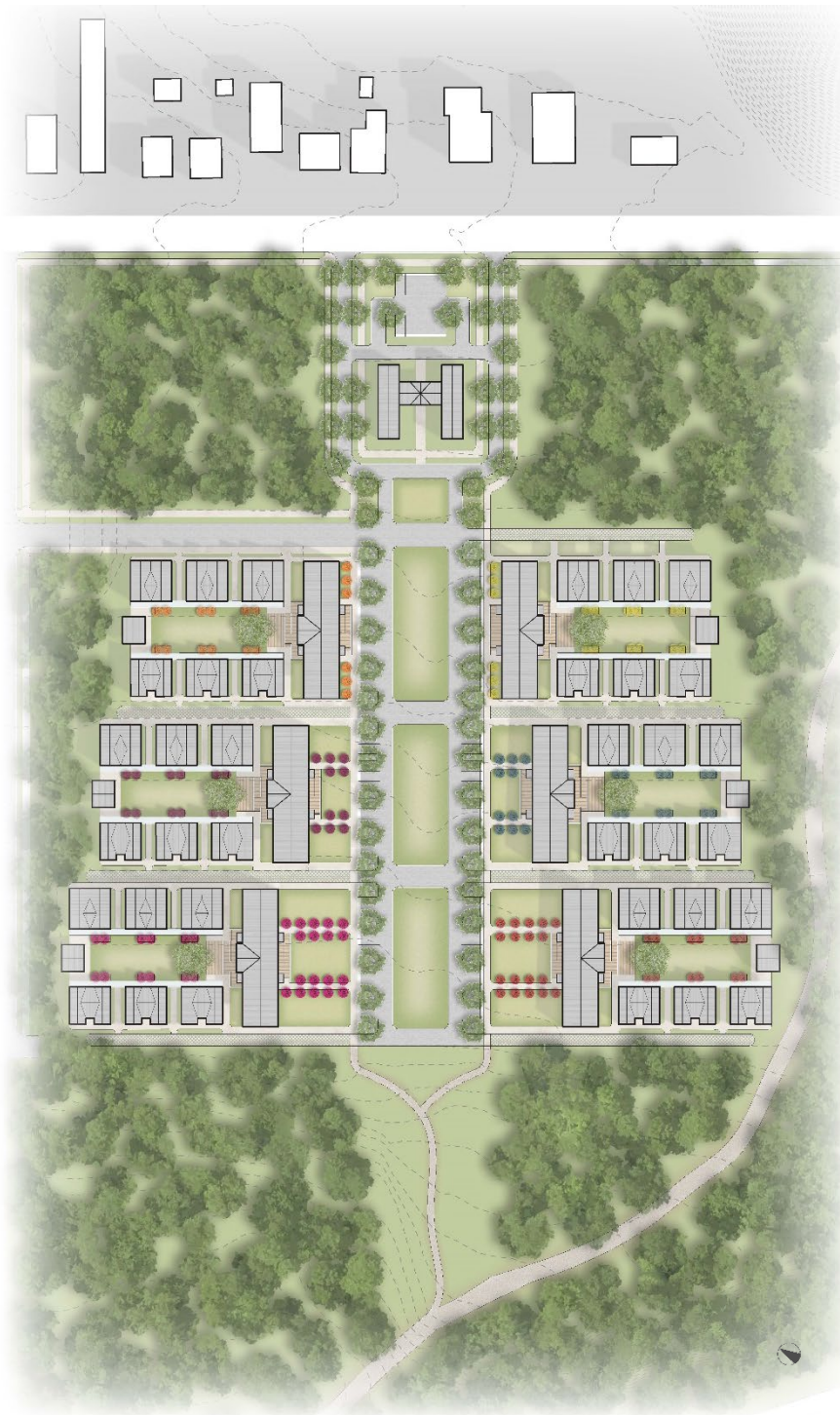


Figure 92: Site Plan, NTS

Source: Author

The overall community is organized along a central axis that extends from North Avenue through the therapy and educationan house at the end of the site all the way down

to the recreational trails connecting down to Lake Champlain. This organization mirrors the strong axial design to the north side of the site. Each cohousing community is then oriented on a cross axis, each with a central courtyard on that axis, for a total of six living communities (Figure 93). The top two communities in close proximity to the therapy and education house will provide short-term living for those with SAD who seek out treatment for a year or two before moving on. The remaining four cohousing communities provide long-term living for those residents who wish to invest in a unit and an even stronger community network. Not only are these six communities connected to a green space along the main axis, but they are connected to the natural environment surrounding them as well (Figure 94). Finally, it was important to consider the position of the sun in order to ensure each courtyard received an ample amount of daylight throughout the year (Figure 95).



Figure 93: Clear Organization and Central Courtyards

Source: Author



Figure 94: Connection to Nature

Source: Author

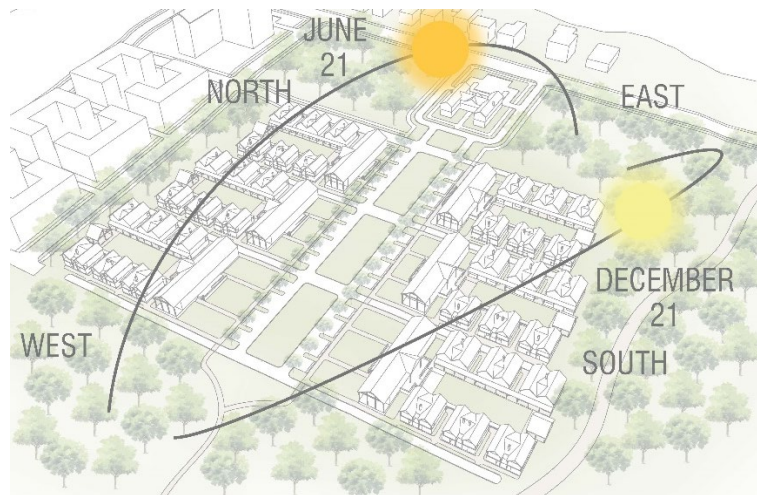


Figure 95: Sun Path

Source: Author

The therapy and education head house at the top of the site serves as an opportunity for any residents within the community as well as those who live in Burlington to receive professional therapy and treatment for SAD. Mental health professionals also have the ability to inform patients about daily activities they can engage in to encourage those struggling with SAD to stay active and involved rather than isolating themselves from the community. This building also provides a connection to

University of Vermont's medical center to allow educators to come in and provide group behavioral therapy as part of their research and clinical trials.

For more detailed information as well as an overall depiction of the length of the designed site, please see the Appendix.

Community Design

Each of the six key design principles established for a SAD cohousing community were implemented into the design of each individual community. The first being a connection a nature and the surrounding environment, in which residents were connected to a central green space as well as the surrounding woods on either side and towards the lake. Then, the central courtyards were designed with the common house at the head with the private units surrounding it on either side. This space allows for larger outdoor social interactions throughout the year, a common design element seen in several cohousing precedents (Figure 96).



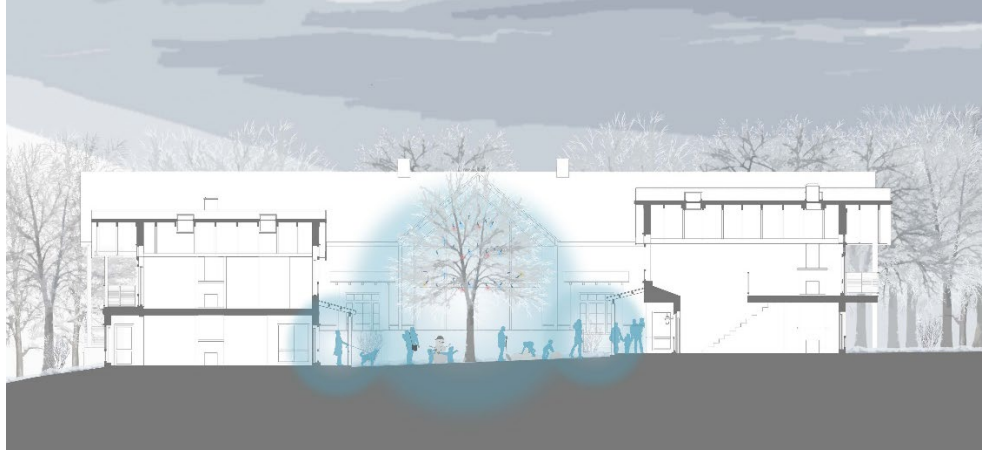


Figure 96: Social Interaction Within Central Courtyard in Summer and Winter

Source: Author

Another design principle includes maximizing the amount of daylight, which is achieved with light streaming into the units throughout the day. During the summertime, skylights allow for light to come in from above and during the wintertime individual fireplaces provide extra light, particularly in the evenings. Residents also have the ability to control how much light comes in with operable sliding wooden louver screens on the windows on either end of their units. To ensure residents are comfortable within their unit, operable windows in the summertime allow for air to circulate through and eliminates the need for central air conditioning. During the wintertime, radiant heating within the floor warms the interior of the unit along with the use of the fireplaces. Finally, natural materials are implemented into the buildings including wood and masonry (Figure 97).



Figure 97: Application of Design Principles to Each Cohousing Community

Source: Author

As stated before, each cohousing community is organized with the common house at the head along the main street. Beyond that is the central courtyard with private units on either side and the wooded area beyond (Figure 98). The units are arranged as duplexes in order to increase efficiency in terms of heating and cooling, but also to still allow for subtle permeability as well as additional light and air between the units. The common house contains many of the communal spaces seen in cohousing including a kitchen, dining room, living room, laundry, storage, and open lofts above for flexible

spaces such as a children’s play area. Within these spaces there are plenty of opportunities for social interaction that continue throughout the whole community out into the central courtyard and ending with a picnic pavilion before the woods (Figure 99).

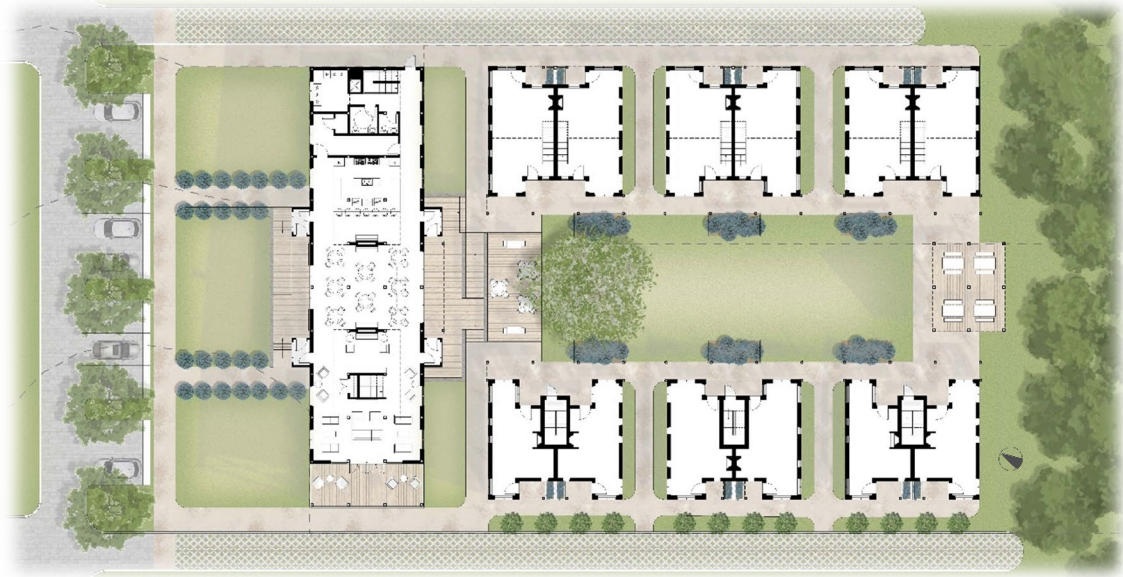


Figure 98: Community Ground Floor Plan, NTS

Source: Author

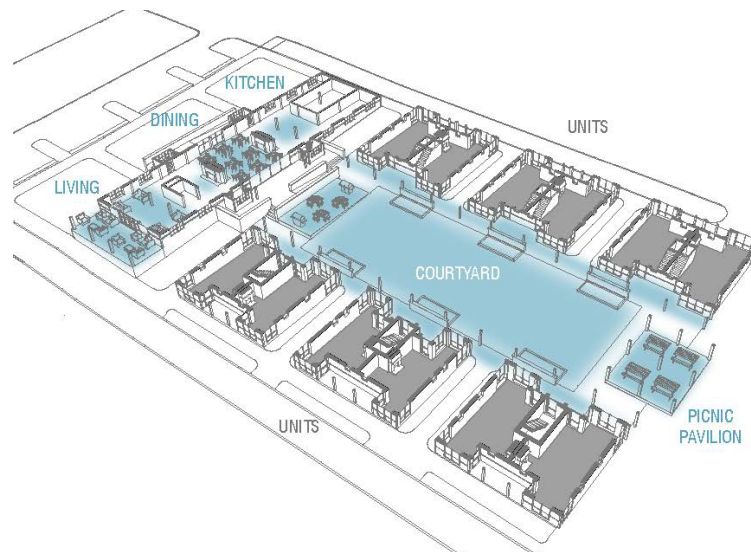


Figure 99: Community Social Interactive Spaces

Source: Author



Figure 100: Connecting Community to Nature

Source: Author

There are three different unit types included within each community (Figure 101). Six loft units occupy the east side of the community with each unit consisting of a two-story space. Four one-bedroom units and two studio units occupy the west side of the community, each either occupying the ground level or second level to stack on top of one another. In total, there are twelve units in each cohousing community with various types of units to allow for a diverse group of people from families to couples to those who live alone.



Figure 101: Community Unit Types

Source: Author

Each of these units have similar characteristics, including efficiency and flexibility to allow for the kitchen, dining, and living spaces to be smaller in order to accommodate for the larger communal spaces shared inside the common house (Figure 102). Plenty of storage space is provided within these units in addition to the optional storage available inside the common house for any personal gear and belongings not necessarily used year-round. The units, as well as the common house, employ the use of wooded textures throughout as well as a masonry base (Figure 103). Board and batten siding is used on the exterior while white painted is used on the interior with natural wood used for the floors, ceilings, and structural members. White painted brick grounds the base of the units, while the common house is grounded with stone.



Figure 102: Unit Plans
Source: Author



Figure 103: Unit Elevations, NTS
Source: Author

Sequence

Residents access their community by having the ability to park outside their common house off the main street in order to encourage them to enter through the common house before continuing to their private unit (Figure 104). This procession will increase the likelihood of social interactions with neighbors in passing. A resident can then enter through the common house from one of two sides: to enter directly into the kitchen area to drop off any groceries or check what's cooking for dinner or to enter into a more intimate entryway to pick up their mail or greet a friend that has been awaiting their arrival.



Figure 104: Community Approach

Source: Author

In the center of the house is the dining room located on center with the courtyard to provide views out towards nature and to allow for plenty of daylight to come through the large windows, which can be adjusted with operable louvers (Figure 105). There are

also fireplaces on either side of the room in order to provide extra light and warmth, particularly during the wintertime. There is a living area off of the dining room to provide additional social space to be used by the residents with an outdoor porch as well with views out towards the lake (Figure 106).



Figure 105: Dining Room

Source: Author



Figure 106: Living Room

Source: Author

Located just outside the common house in the central courtyard is a grilling area to allow for the social atmosphere of the dining space to bleed outside while still having direct access to the kitchen (Figure 107). The courtyard's central axis is terminated with a picnic pavilion with the wooded area beyond. Residents walk through the central courtyard to then reach their private unit on either side underneath an open loggia to stay covered during inclement weather, such as rain or snow (Figure 108). However, the roof of the loggia is constructed out of a translucent material that still allows for daylight to come through and continue into the adjacent units. Entries into these units are located within smaller porch-like areas to provide additional social interactions in passing between neighbors.



Figure 107: Grilling Area

Source: Author



Figure 108: Loggia Outside Private Units

Source: Author

Within the private units the design principles are applied to create an enjoyable living experience for those experiencing SAD. Just inside the main entryway is the

kitchen and dining nook area to create a warm and bright atmosphere for those who live there to wake up to (Figure 109) Since those with SAD struggle to rise out of bed in the mornings, particularly during the wintertime, the residents are encouraged to rise with the sun as light streams in from all three sides of the dining nook. They can then enjoy their morning cup of coffee and breakfast with views out into the central courtyard space. A similar experience is created in the evening on the back side of the units for the residents to end their day. As the sun sets, each resident has a reading nook area with their own personal fireplace within the unit to provide light and warmth during the night, which is particularly beneficial during Vermont’s winter months (Figure 110).



Figure 109: Dining Nook

Source: Author



Figure 110: Reading Nook

Source: Author

While each unit has direct access to a natural environment within the central courtyard out their front door, each one has a secondary access through the alleyway between neighboring communities (Figure 111). This pedestrian friendly alley also provides additional access for cars for special circumstances such as move in or guest parking. The lower level units have doors leading directly out to this area with additional vegetation located just outside. The upper level units instead have balconies for additional light and air looking onto to this space.



Figure 111: Alley Between Communities

Source: Author

With plenty of opportunities for social interaction throughout a resident's experience through the common house and into their private unit, the most important social space is the central courtyard within each community. This not only serves as an area for neighbors to greet one another, but also provide a space for social and recreational activities throughout the year to encourage those with SAD to step outside and connect with others (Figure 112). Enjoying their time outdoors and interacting with other residents within this place will improve every resident's overall well-being.



Figure 112: Central Courtyard Experiences During the Summer and Winter
Source: Author

Conclusions

Architecture has been proven to have a strong influence on the overall well-being of those who experience it but utilizing key design ideas and methods. However, design also has the ability to improve the mental and physical health of those suffering with Seasonal Affective Disorder by employing critical design principles to connect people to nature, increase the opportunity for social interactions, implement central courtyards, maximize daylight, improve levels of comfort, and apply the use of natural materials and textures.

This design for a cohousing community for those with SAD not only serves as an example of how architecture can treat this mental disorder, but also serves as an example of how architects can employ this model as a standard for living for everyone in order to improve well-being and evoke happiness year-round.

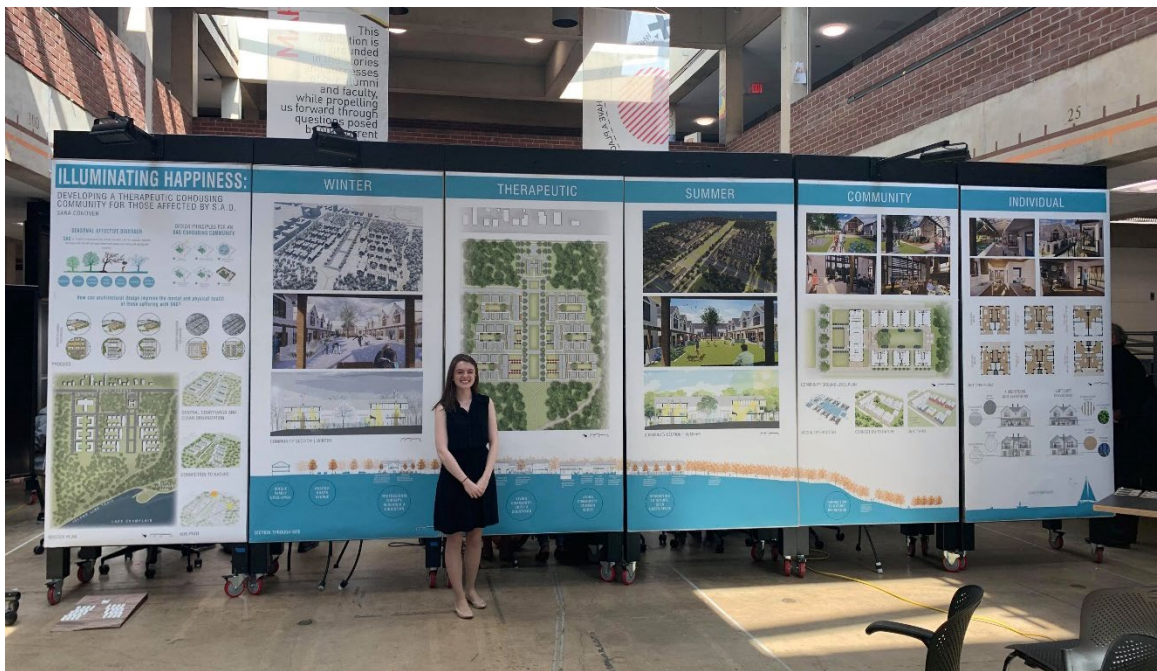


Figure 113: Presentation Boards

Source: Author

Appendix

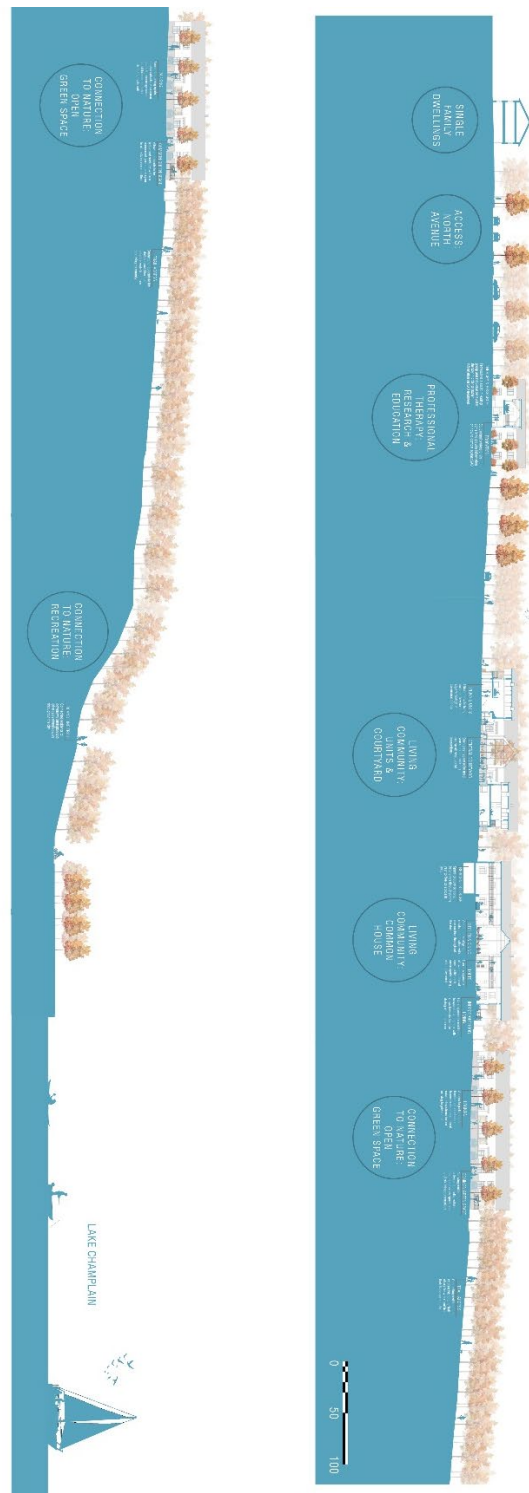


Figure A 114: Section through Site
Source: Author



Figure A 115: Section through Therapy and Education Head House
Source: Author

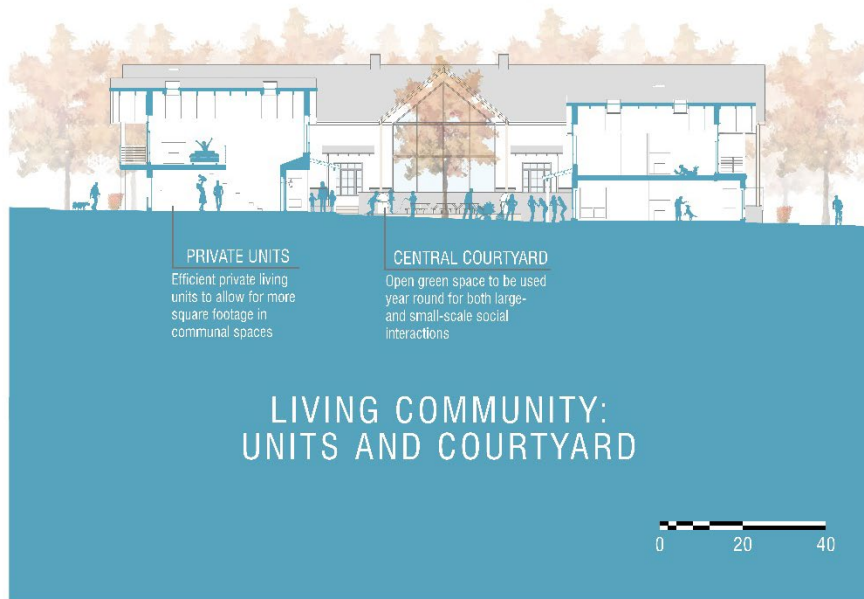


Figure A 116: Section through Cohousing Community
Source: Author

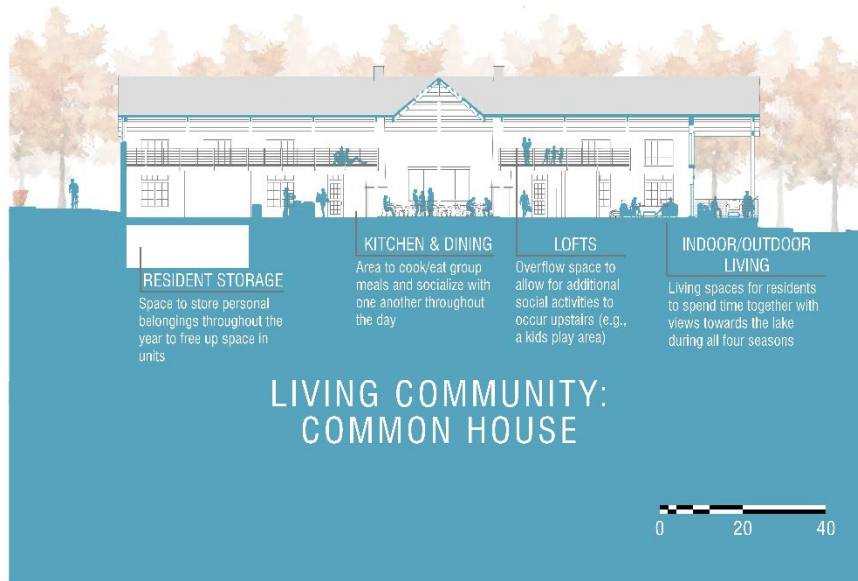


Figure A 117: Section through Cohousing Community Common House

Source: Author

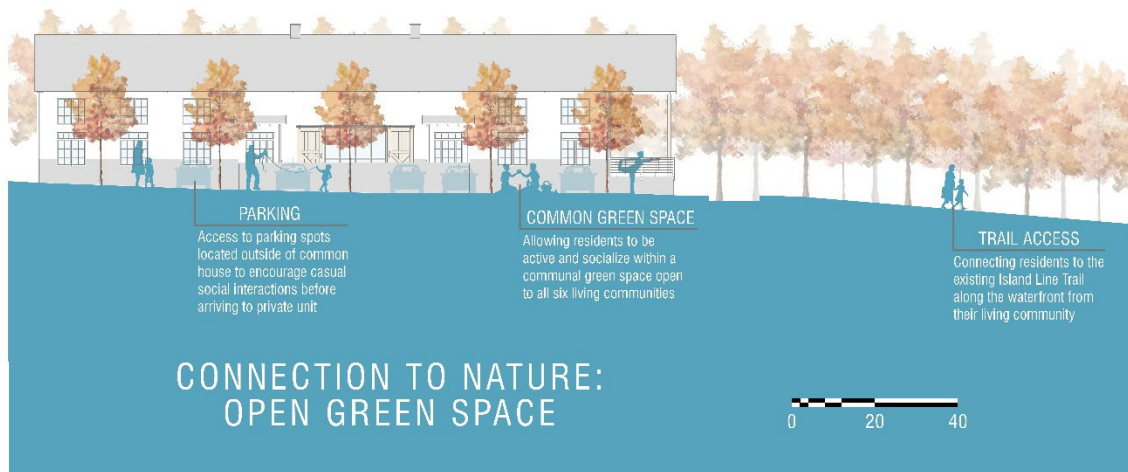


Figure A 118: Section through Central Open Green Space

Source: Author

Bibliography

Seasonal Affective Disorder

Doran, Lisa. "Seasonal Affective Disorder." Barefoot Health Naturopathic Clinic. n.d. Accessed October 6, 2018. <http://www.barefoothealth.ca/seasonal-affective-disorder/>.

Lee, Ingrid Fetell. "Where joy hides and how to find it." *TED2018*, TED Conferences, May 21, 2018. Video, 13:37.
https://www.ted.com/talks/ingrid_fetell_lee_where_joy_hides_and_how_to_find_it/up-next?utm_campaign=social&utm_medium=referral&utm_source=facebook.com&utm_content=talk&utm_term=social-science.

Roecklein, Kathryn A. and Kelly J. Rohan. "Seasonal Affective Disorder: An Overview and Update." *Psychiatry (Edgmont)*, vol. 2, no. 1, 2005: 20-26.
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3004726/>.

Rosenthal, Norman E. *Winter Blues: Seasonal Affective Disorder: What It Is and How to Overcome It*. Rev. and updated. New York: Guilford Press. 1998.

"Seasonal Affective Disorder." National Institute of Mental Health. Accessed October 6, 2018. <https://www.nimh.nih.gov/health/topics/seasonal-affective-disorder/index.shtml>.

"Seasonal Affective Disorder Sufferers Have More Than Just The Winter Blues." American Psychological Association. February 2, 2013. Accessed October 6, 2018.
<http://www.apa.org/news/press/releases/2013/02/seasonal-disorder.aspx>.

Sternberg, Esther M. *Healing Spaces: The Science of Place and Well-Being*. Cambridge, Mass.: Belknap Press of Harvard University Press, 2009.

Targum, Steven D. "Seasonal Affective Disorder." *Psychiatry (Edgmont)*, vol. 5, no. 5, 2008: 31-33. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2686645/>.

Westrin, Åsa, and Raymond W. Lam. "Seasonal Affective Disorder: A Clinical Update." *Annals of Clinical Psychiatry*, vol. 19, no. 4, 2007: 239–246., doi:10.1080/10401230701653476.
<https://pdfs.semanticscholar.org/ec13/73841894a378a8074b5430b3f143ae0ffb83.pdf>.

"What is Happiness?" The Greater Good Science Center at the University of California, Berkeley. n.d. Accessed October 22, 2018.
<https://greatergood.berkeley.edu/topic/happiness/definition#what-is>.

"What Seasonal Affective Disorder (SAD) Is And Is Not." Yellowbrick Program. 2018. Accessed October 22, 2018. <https://www.yellowbrickprogram.com/resources/seasonal-affective-disorder.html>.

“Well-being.” Merriam-Webster. n.d. Accessed October 22, 2018. https://www.merriam-webster.com/dictionary/well-being?utm_campaign=sd&utm_medium=serp&utm_source=jsonld.

Architectural Design Strategies for Improving Well-Being

Al horr, Yousef, Mohammed Arif, Martha Katafygiotou, Ahmed Mazroei, Amit Kaushik, Esam Elsarrag. “Impact of indoor environmental quality on occupant well-being and comfort: A review of the literature.” *International Journal of Sustainable Built Environment*, vol. 5, no. 1, 2016: 1-11.

<https://www.sciencedirect.com/science/article/pii/S2212609016300140>.

Altman, Anna. “The Year of Hygge, The Danish Obsession With Getting Cozy.” *The New Yorker*. December 18, 2016. Accessed October 6, 2018.

<https://www.newyorker.com/culture/culture-desk/the-year-of-hygge-the-danish-obsession-with-getting-cozy>.

Boubekri, Mohamed. *Daylighting, Architecture, and Health: Building Design Strategies*. 1st ed. Amsterdam: Elsevier Architectural Press, 2008.

“CF Møller And Henn Win International Hospital Competition in Germany.” CF Møller. April 4, 2017. Accessed October 17, 2018. <https://www.cfmoller.com/r/-da/c-f-moeller-og-henn-vinder-international-hospitalskonkurrence-i-tyskland-i16694.html>.

Delgado, J.M.P.Q., Ricardo Almeida, and Vasco Peixoto de Freitas. “Chapter 2: Indoor Environmental Quality.” *School Buildings Rehabilitation: Indoor Environmental Quality and Enclosure Optimization*, 5-17. Cham: Springer International Publishing: Imprint: Springer, 2015.

Erwine, Barbara. *Creating Sensory Spaces: The Architecture of the Invisible*. New York: Routledge, Taylor & Francis Group, 2017.

Furuto, Alison. “Oasis Cancer Care Center / WE Architecture.” *ArchDaily*. March 13, 2012. Accessed October 17, 2018. <https://www.archdaily.com/215397/oasis-cancer-care-center-we-architecture>.

Grinde, Bjørn and Grete Grindal Patil. “Biophilia: Does Visual Contact with Nature Impact on Health and Well-Being?” *International Journal of Environmental Research and Public Health*, vol. 6 no. 9, 2009: 2332-2343.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2760412/pdf/ijerph-06-02332.pdf>.

Joye, Yannick. “Architectural Lessons from Environmental Psychology: The Case of Biophilic Architecture.” *Review of General Psychology*, vol. 11, no. 4 (2007): 305-328. <https://pdfs.semanticscholar.org/08a9/bd25df650197fb58bf8b9c8647ad0abc07a7.pdf>.

Lawson, Bryan. "Healing Architecture." *Arts & Health*, vol. 2, no. 2, (2010): 95-108.

"Livsrum." EFFEKT. 2013. Accessed October 22, 2018. <https://www.effekt.dk/liv/>.

Lucia. "5 Principles of Scandinavian Architecture." Modlar, 2017. Accessed November 14, 2018. <https://www.modlar.com/news/241/5-principles-of-scandinavian-architecture/>.

Mairs, Jessica. "Cosy corners and muted colours make house by Norm Architects the 'epitome of hygge'." Dezeen. January 11, 2018. Accessed October 17, 2018. <https://www.dezeen.com/2018/01/11/cosy-corners-muted-colours-make-norm-architects-norwegian-home-epitome-hygge-architecture-oslo/>.

Quillin, David D. "Biophilia: The benefits and strategies for including nature in the design of buildings." David D. Quillin Architecture, July 30, 2017. <http://daviddquillinarchitecture.com/biophilia-the-benefits-and-strategies-for-including-nature-in-the-design-of-buildings/>.

"Split View Mountain Lodge / Reiulf Ramstad Arkitekter." ArchDaily. February 5, 2014. Accessed October 17, 2018. <https://www.archdaily.com/473775/split-view-mountain-lodge-reiulf-ramstad-arkitekter>.

Wang, Lucy. "Stressed Out? Sweden's 72 Hour Cabins Are Designed to Soothe." Dwell. November 27, 2017. Accessed October 17, 2018. <https://www.dwell.com/article/stressed-out-swedens-72-hour-cabins-are-designed-to-soothe-5f767bda>.

Wiking, Meik. *The Little Book of Hygge: Danish Secrets to Happy Living*. United Kingdom: HarperCollins, 2017.

Zilliaccus, Ariana. "Livsrum Cancer Counselling Center." ArcSpace. December 6, 2017. Accessed October 22, 2018. <https://arcspace.com/feature/livsrum-cancer-counselling-center/>.

Design Aspects and Psychological Benefits of the Cohousing Typology

"Cohousing in the United States: An Innovative Model of Sustainable Neighborhoods." The Cohousing Association of the United States. March 6, 2017. Accessed October 24, 2018. <https://www.cohousing.org/sites/default/files/attachments/StateofCohousingintheU.S.%203-6-17.pdf>.

"Communal Living Under One Big Roof." Vandkunsten Architects. n.d. Accessed March 26, 2018. <http://vandkunsten.com/en/projects/bofaellesskab-i-det-gamle-savvaerk-2>.

Dorais, Joanne Magdalena, "Lower Mount Royal Cohousing: In Search Of A Community" Master's Degree Project, University of Calgary, Alberta, 2008, University

of Calgary Institutional Repository.
<https://dspace.ucalgary.ca/bitstream/1880/40617/1/dorais.pdf>.

Frearson, Amy. "Alexis Dornier completes co-living complex in Bali with communal areas on its roof." *Dezeen*. June 9, 2016. Accessed October 21, 2018.
<https://www.dezeen.com/2016/06/09/alexis-dornier-architecture-roam-co-living-housing-residential-complex-bali-indonesia-communal-roof/>.

Frearson, Amy. "Haptic Designs Elderly Housing for Norway to Encourage Residents to Socialise." *Dezeen*. November 17, 2016. Accessed March 26, 2018.
<https://www.dezeen.com/2016/11/17/haptic-designs-elderly-housing-clt-drobak-norway>.

"Lange Eng Cohousing Community." Dorte Mandrup. n.d. Accessed March 26, 2018.
<http://www.dortemandrup.dk/work/lange-eng-cohousing-community>.

"Lange Eng Collective Living." Architizer. 2017. Accessed March 26, 2018.
<https://architizer.com/projects/lange-eng-collective-living/>.

McCamant, Kathryn, and Charles Durrett. *Cohousing: A Contemporary Approach to Housing Ourselves*. 1st ed. Berkeley, Calif.: Habitat Press, 1988.

"ROAM Co-living." Alexis Dornier. 2015. Accessed October 21, 2018.
<https://www.alexisdornier.com/#/roam-ubud/>.

ScottHanson, Chris and Kelly ScottHanson. *Cohousing Handbook: building a place for community*. Gabriola Island: New Society Publishers, 2005.

Williams, Jo. "Predicting an American future for cohousing." *Futures*, vol. 40, no. 3, 2008: 268-286. <https://doi.org/10.1016/j.futures.2007.08.022>.
<https://www.sciencedirect.com/science/article/pii/S0016328707001103?via%3Dihub>.

Williams, Jo. "Sun, Surf and Sustainable Housing-Cohousing, the Californian Experience." *International Planning Studies*, vol. 10 no. 2, 2005: 145–177. doi: 10.1080/13563470500258824. <https://rsa-tandfonline-com.proxy-um.researchport.umd.edu/doi/full/10.1080/13563470500258824?scroll=top&needAccess=true#.W86UGmhKhPY>.

Site Analysis and Critique of Current Development in Burlington, Vermont

"Climate Burlington – Vermont." US Climate Data, last modified 2018, last accessed November 24, 2018. <https://www.usclimatedata.com/climate/burlington/vermont/united-states/usvt0033>.

"Liberty House." Duncan Wisniewski Architecture, last modified 2017, last accessed November 26, 2018. <https://www.duncanwisniewski.com/liberty-house/>.

“Health and Safety: Burlington, VT.” Data USA, last modified 2017, last accessed November 24, 2018. <https://datausa.io/profile/geo/burlington-vt/#health>.

Jickling, Katie, “Cambrian Rising: A Massive Project Advances Quietly in the Queen City.” Seven Days VT, Da Capo Publishing, July 19, 2018. <https://www.sevendaysvt.com/vermont/cambrian-rising-a-massive-project-advances-quietly-in-the-queen-city/Content?oid=6848773>.

Lilly, Amy. “On the Rise: Liberty House Opens in Burlington.” Seven Days VT, Da Capo Publishing, September 17, 2017, last accessed November 26, 2018. <https://www.sevendaysvt.com/vermont/on-the-rise-liberty-house-opens-in-burlington/Content?oid=8180446>.

“Monthly weather forecast and Climate: Burlington, VT.” Weather Atlas, last modified 2018, last accessed November 24, 2018. <https://www.weather-us.com/en/vermont-usa/burlington-climate>.

“2017 State of Mental Health in America - Ranking the States.” Mental Health America, last modified 2018, last accessed November 24, 2018. <http://www.mentalhealthamerica.net/issues/2017-state-mental-health-america-ranking-states>.

Stone DM, Simon TR, Fowler KA, et al. “Vital Signs: Trends in State Suicide Rates — United States, 1999–2016 and Circumstances Contributing to Suicide — 27 States, 2015.” *MMWR Morb Mortal Wkly Rep*, vol. 67, no. 22 (2015): 617-624. DOI: <http://dx.doi.org/10.15585/mmwr.mm6722a1>.