Redefining Senior Housing: Architecture as a Catalyst for Health, Autonomy, and Community in Toronto

by

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A thesis
presented to the University Of Waterloo
in fulfilment of the
thesis requirement for the degree of
Master of Architecture

Waterloo, Ontario, Canada, 2025

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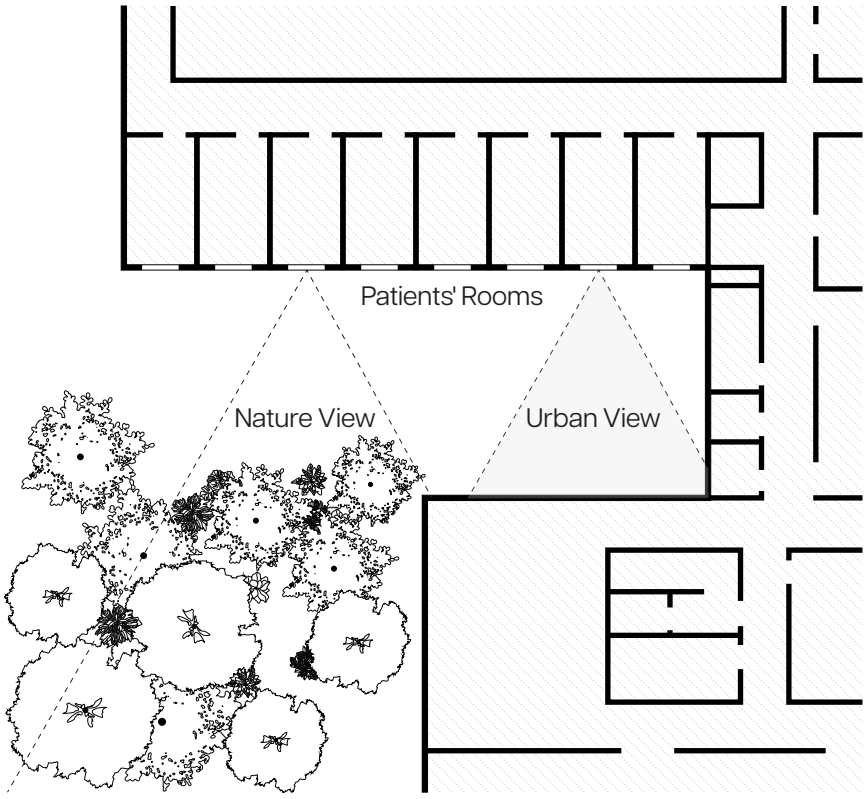
author's declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Figure 1:

Adapted from Roger Ulrich's Diagram. View Through a Window May Influence Recovery from Surgery. 1984.



abstract

research summary.

Keywords:

Age-in-community

Long-term care (LTC)

Retirement home (RH)

The urban environment is not seen as an ideal place to retire as housing is becoming increasingly less attainable in terms of affordability and availability. With an impending demographic shift of seniors estimated to rise in the coming years, a viable housing solution is more pressing. As of 2018, adults over 65 made up 17.4% of the Canadian population, but by projected estimates, this could rise to between 21.4% and 29.5% in 2068.[1] As of 2016, over 60% of adults 65 and over in Toronto had one or more health complications, with numbers projected to rise in the following years.[2] This creates great strain on hospital resources as the population ages and grows. Among seniors, the main priority is finding housing that enables them to age-in-community as the thought of long-term care (LTC) and retirement homes (RHs) are not desirable as they often signal the loss of self-autonomy and often require being displaced from their community. COVID-19 uncovered flaws in the senior housing system through high infection rates, aided by architecture not designed to cope with such circumstances. Following COVID-19, more studies began to draw on previous theories focusing on the psychological effects of architecture on its occupants and, more importantly, how it affects one's health. Significant evidence points to exposure to nature as psychologically improving one's mental and physical state. Notably, Roger S. Ulrich's research in the design of healthcare facilities revealed that patients are discharged faster when exposed to nature within a hospital setting, requiring fewer antibiotics and pain relievers than those without a means of interacting with nature **[see Figure. 1]**.[3] By designing spaces prioritizing health, we can create places of refuge that promote health and well-being outside of a hospital setting. Many of these homes use "beds" as a metric to quantify resources, but this language may indirectly undermine the role that architecture plays as a part in elder care.[4] How can architecture be a driving force in promoting health and fostering independence while supporting the maintenance of physical and cognitive function for seniors in urban Toronto?

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[1] Stephen Verderber, "Reimagining Long-Term Care Architecture in Post-Pandemic Ontario—and Beyond" (University of Toronto, May 16, 2022), https://www.daniels.utoronto.ca/reimagining-long-term-care-architecture-post-pandemic-ontario-and-beyond#Introduction.

[2] "Toronto Housing Market Analysis," January 2019, https://www.toronto.ca/legdocs/mmis/2019/ph/bgrd/backgroundfile-124480.pdf.

[3] Roger S. Ulrich, "View Through a Window May Influence Recovery from Surgery," *Science* 224 (April 27, 1984): 420–21.

[4] Ansar S. Ahmed et al., "Re-Imagining Eldercare in a Post-COVID Ontario," February 19, 2021, https://www.daniels.utoronto.ca/sites/default/files/reimagining_eldercare_roundtable_report_moltc_19feb2021.pdf.

acknowledgments

I would like to recognize and thank my supervisor, David Fortin, for your support throughout my thesis. Thank you for allowing me to work towards goals inside and outside academia and inspiring my work through discussion and your expertise. I am deeply grateful for the guidance, time, and effort you invested in helping me refine my ideas.

Thank you to my committee member, Fiona Lim Tung, for your thoughtful guidance and time and for inspiring a deeper narrative through drawing.

Thank you to Phillip Beasley for sparking my imagination during our early discussions and creating the foundation of this thesis today.

Thank you to Terri Peters for your inspiring studio and for sparking my curiosity, which ultimately led me to this topic.

Thank you to all the friends I have met along the way, and for the unforgettable memories and adventures.

Finally, I would like to thank my family and loved ones for your endless support throughout this process. I am forever grateful for your support, sacrifices, and understanding in my pursuit of higher education. Through school, I've been able to explore the world and have so many amazing life experiences that I had only dreamt of, none of which would have been possible without you.

dedication

For Masaru & Shizue Fujita, Lawrence & Lorraine O'Connor.

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list of abbreviations

ACC	Anterior Cingulate Cortex
ADA	Americans with Disabilities Act
AIA	The American Institute of Architects
APRA	Alexandra Park Residents' Association
ART	Attention Restoration Theory
BIM	Building Information Modeling
CLT	Cross-Laminated Timber
CMHC	Canada Mortgage and Housing Corporation
CNC	Computer Numerical Control
CPP	Canada Pension Plan
DLT	Dowel-Laminated Timber
ETOD	Equitable Transit-Oriented Development
FLTCA	Fixing Long-Term Care Act
GAINS	Guaranteed Annual Income System
GIS	Guaranteed Income Supplement
GLT	Glue-Laminated Timber
IPAC	Infection Prevention and Control
LTC	Long-Term Care
LVL	Laminated-Veneer Lumber
MATCH	Metro Affordable Transit Connected Housing Program
NCD	Noncommunicable Chronic Diseases
NLT	Nail-Laminated Timber
OAA	Ontario Association of Architects
OAS	Old Age Security
PPE	Personal Protective Equipment
RH	Retirement Home
RN	Registered Nurse
SBS	Sick Building Syndrome
SDOH	Social Determinants of Health
TCM	Traditional Chinese Medicine
TOD	Transit-Oriented Development
TSHC	Toronto Seniors Housing Corporation
VOC	Volatile Organic Compounds
WBS	WELL Building Standard

01

introduction

aging-in-community: health-promoting architecture for seniors

Keywords:

Social isolation

Age-in-community

Long-term care (LTC)

Retirement home (RH)

The urban environment is not seen as an ideal place to retire, especially in the case of Toronto. With the impending demographic shift of seniors estimated to rise in the coming years, a viable housing solution is pressing. As of 2018, adults over 65 made up 17.4% of Canada, but by projected estimates, this could rise to between 21.4% and 29.5% in 2068.[5] As of 2016, over 60% of adults 65 and over in Toronto had one or more health complications, with numbers projected to rise in the following years.[6] This creates great strain on hospital resources as the population ages and grows. Among seniors, the main priority is finding housing that suits their needs to age-in-community and thrive. Some of the many factors that influence seniors' decisions are accessibility to healthcare, social isolation, financial capacity, and geographical remoteness.[7] Social isolation is a pressing issue amongst older adults, which can often lead to adverse health effects and decreased well-being.[8] The ability to age-in-community or to remain within an accessible range of the community that one calls home can begin to counteract the problem. For those who call downtown Toronto home, this may not be an option. As the city grows increasingly unaffordable for many, older adults will be forced to decide whether or not to leave their communities in search of their forever home. Long-term care (LTC) and retirement homes (RHs) are not always seen as desirable destinations as they often require being displaced from their community. Many external push factors may influence this decision on their behalf, such as the inability to care for themselves or their own home or being coerced by a loved one.[9] [10] Many of these homes use "beds" as a metric to quantify resources, but this language may indirectly undermine the role that architecture plays as a part in elder care.[11] The terms and ideals of the senior housing model define the architecture that houses these residents. Designating a bed

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5 Verderber, "Reimagining Long-Term Care Architecture in Post-Pandemic Ontario—and Beyond."

6 "Toronto Housing."

7 Ansar S. Ahmed et al., "Re-Imagining Eldercare in a Post-COVID Ontario."

8 Farrow Partners, "Treehouse: A New Paradigm In Senior Living To Enhance Well Being," accessed September 27, 2023, https://farrowpartners.ca/wp-content/uploads/2023/01/Treehouse-Senior-Living-Overview-Element-5-Farrow-Partners-Jan-11-2023-Reduced-PDF.pdf.

9 Deane Simpson, *Young-Old: Urban Utopias of an Aging Society* (Lars Müller Publishers, 2015).

10 Amanda Kolson Hurley, Deane Simpson's "Young-Old," Written, September 23, 2015, https://www.architectmagazine.com/practice/deane-simpsons-young-old_o.

11 Ansar S. Ahmed et al., "Re-Imagining Eldercare in a Post-COVID Ontario."

as a requirement does not consider the quality of the space where the bed is placed; instead, it simply determines the size of the space designated per person, their home. This is more of a burden than a place of care; the aging population is deeply undervalued and forgotten.

Since the 1990s, private equity firms have slowly financialized Canadian LTC and RHs. The financial firms that operate these homes use these places of care as investment opportunities for both real estate as a commodity and operating costs from residents.[12] As of 2021, 57% of LTC homes were privately owned for-profit, 27% not-for-profit, and 16% operated at the level of the public or government.[13] This shift towards privatization will continue to grow as the "grey wave" demographic puts pressure on the increased need for housing, demanding approximately 240,000 new spaces. This directive aims to extract the maximum from the homes, government, workers, and residents by prioritizing profit margins, among other goals. This mindset trickles down to the level of care that directly impacts these residents: paying "customers." For-profit LTC homes led the country in COVID-19-related deaths and lower-quality care outcomes. These can be attributed to insufficient staff and registered nurses (RNs). These low-care outcomes were even worse in franchised for-profit homes that put profit at the forefront of priorities. In 2020, Chartwell, Canada's largest operator, denied PPE to their staff at the peak of the COVID-19 outbreak, additionally voting against living wages for their employees. This treatment of employees directly trickles down to the resident experience, ultimately having profound consequences in terms of well-being. During this time, Chartwell continued to pay out profits to investors with record-high executive bonuses.[14]

These 626 LTC homes at the time housed 78,000 residents, in which 14,960 cases of COVID-19 and 3871 deaths were declared from January 15, 2020, to February 28, 2021. The deaths that occurred within these homes during that time made up 64.5% of all pandemic-related deaths in Ontario.[15] The death rate from COVID-19 among LTC residents was found to be 23.4/1000 at for-profit homes, 18.2/1000 at not-for-profit homes, and 5.8/1000 at municipal-owned homes. This represents a consistent correlation to the level of care provided by each of these homes.[16] The allure of exclusivity that comes with these privately owned care facilities comes at the expense of the resident and their experience. Privatization within the healthcare sector is flawed, shifting focus away from what matters.

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[12] Martine August, "Securitising Seniors Housing: The Financialisation of Real Estate and Social Reproduction in Retirement and Long-Term Care Homes," *Antipode* 54, no. 3 (2022): 653–80, https://doi.org/10.1111/anti.12795. institutions, publicly listed companies, and real estate investment trusts

[13] Noori Akhtar-Danesh et al., "COVID-19 Excess Mortality among Long-Term Care Residents in Ontario, Canada," *PLOS ONE* 17, no. 1 (January 20, 2022): e0262807, https://doi.org/10.1371/journal.pone.0262807.

[14] August, "Securitising Seniors Housing."institutions, publicly listed companies, and real estate investment trusts

[15] Akhtar-Danesh et al., "COVID-19 Excess Mortality among Long-Term Care Residents in Ontario, Canada."

[16] Nathan M. Stall et al., "For-Profit Long-Term Care Homes and the Risk of COVID-19 Outbreaks and Resident Deaths," *CMAJ* 192, no. 33 (August 17, 2020): E946–55, https://doi.org/10.1503/cmaj.201197.

Figure 2:

LTC and RHs within Toronto* (500m x 500m grid spacing).

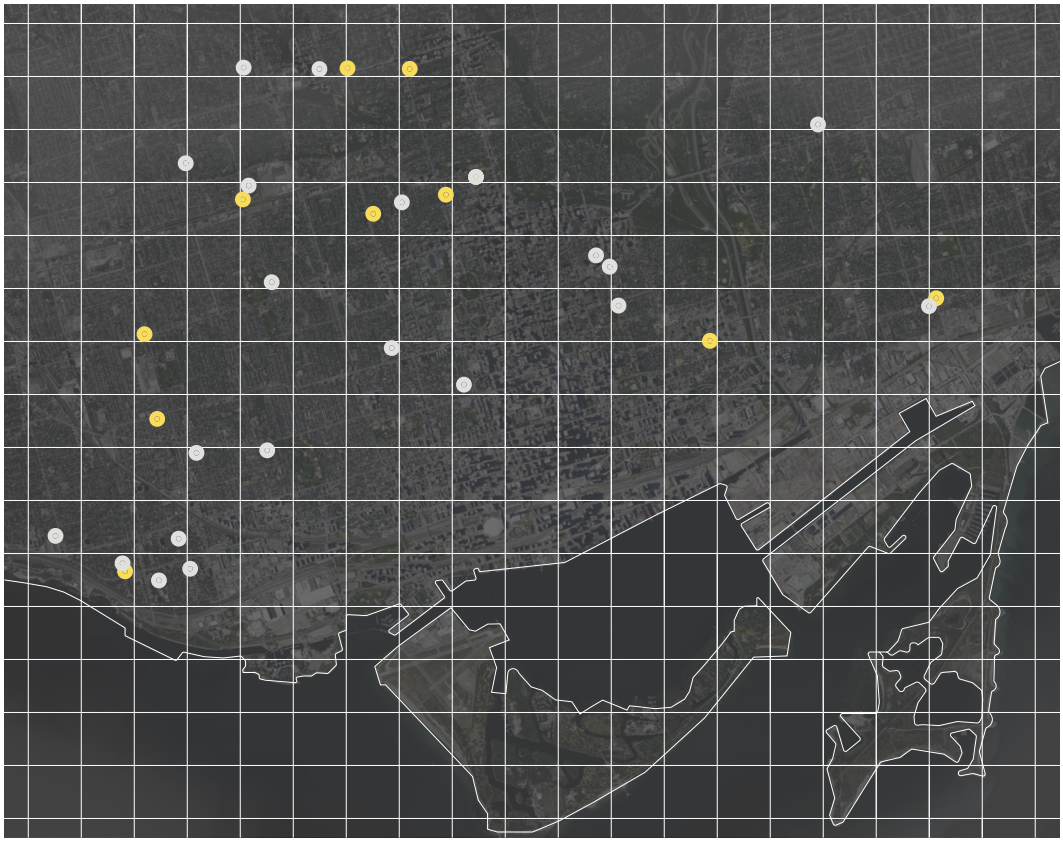
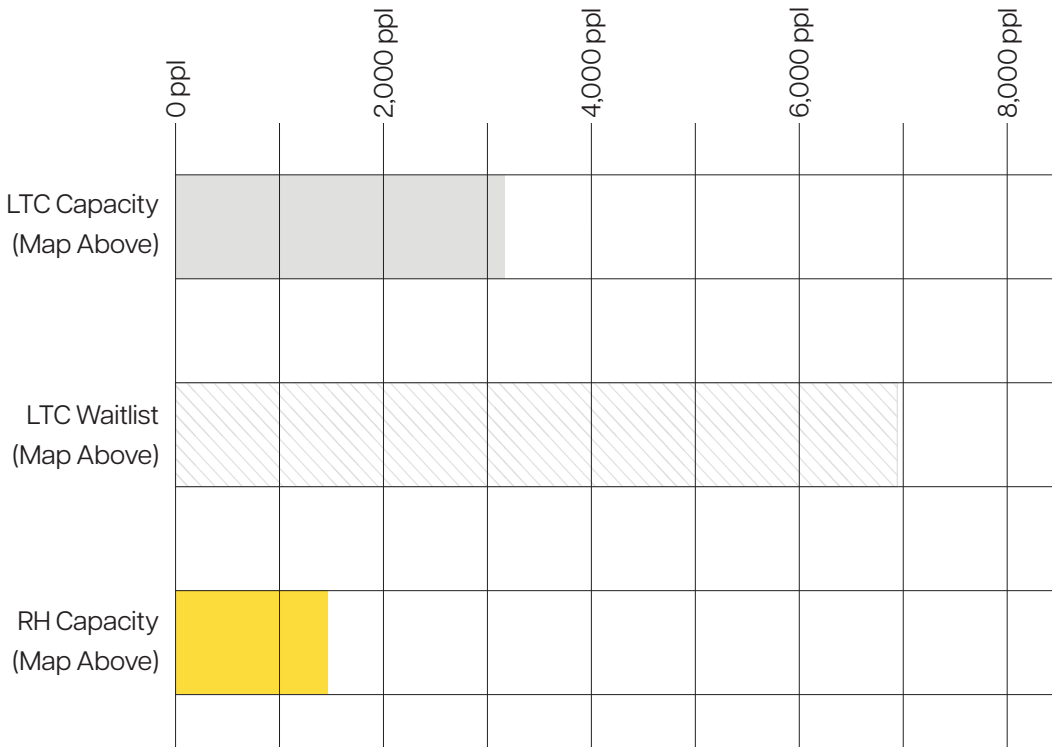


Figure 3:

LTC and RHs capacities from the bounds of the map pictured above.



Keywords:

Evidence-based

Active design

The senior housing model requires a new approach focused on well-being. Architecture has a hand in this, bringing health and independence to the forefront of design. As the most significant concerns when entering a retirement or LTC home are loss of autonomy or social isolation, creating spaces that revolve around community and self-autonomy is essential. Architecture has not commonly been seen as a means of healing. However, as architecture is present in daily life, it is essential to consider how spaces can contribute to healing. Architecture can facilitate itself as a preventative measure, positively promoting the health and well-being of its occupants. Research over the last decades, specifically after the COVID-19 pandemic, has shown that evidence-based design utilizing health-promoting theories has a tangible impact on the human body and mind. Following the COVID-19 pandemic, there has also been anxiety towards indoor environments. Despite this, people spend up to 90% of their day in an enclosed space.[17] [18] Out of necessity, these spaces are where importance should lie; the spaces should be designed to work with the occupant. Thus, as the senior population transitions toward senior housing, this thesis asks:

How can architecture be a driving force in promoting health and fostering independence while supporting the maintenance of physical and cognitive function for seniors in urban Toronto?

Health-promoting Theories

Considerable evidence points to exposure to nature as psychologically improving one's mental and physical state. Notably, Roger S. Ulrich's research in the design of healthcare facilities has revealed that patients are discharged faster when exposed to nature within a hospital setting, requiring fewer antibiotics and pain relievers than those without a means of interacting with nature.[19] Nature is such a vital aspect of our environments in the context of health, and can also be utilized within the designs of our buildings. In designing spaces specifically for the elderly, looking at prolonging active lifestyles can be done through architectural gestures focused on ergonomics and accessibility. By designing spaces prioritizing health through more holistic design philosophies, such as integrating nature and active design, places of refuge that promote health and well-being can exist outside of a hospital setting. Architecture can facilitate itself as a passive preventative measure within the city. A new senior housing model can be developed and integrated into the urban environment, drawing upon many emerging health-promoting theories and fostering the ability to age-in-community through healthy housing **[see Chapter 2 – Health-Promoting Theories].**

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[17] Terri Peters and Kristen D'Penna, "Biophilic Design for Restorative University Learning Environments: A Critical Review of Literature and Design Recommendations," *Sustainability* 12, no. 17 (January 2020): 7064, https://doi.org/10.3390/su12177064.

[18] Ken Yeang and Alan Dilani, *Ecological and Salutogenic Design for a Sustainable Healthy Global Society* (Cambridge Scholars Publishing, 2021), http://ebookcentral.proquest.com/lib/waterloo/detail.action?docID=6896527.

[19] Ulrich, "View Through a Window May Influence Recovery."

There are distinct decisions in the design and execution of a building that affect the everyday lifestyle of its users. The following three areas of focus will be explored in this thesis; these factors are often expedited, standardized, and/or overlooked during design. A renewed perspective is proposed that changes how we approach these topics, putting health at the forefront of design.

Affordability Within the City

As the city is becoming unaffordable for many, it is important to consider affordability, especially for the elderly, who are likely to have reduced income in retirement. Affordability can mean many things to different people. The notion of affordable housing should not only be the ability to afford a house but should foster sustainable affordability beyond the initial cost of housing. These additional expenses should also be able to cover maintenance and operation. The average monthly cost of a standard care Toronto RH unit in 2021 was $4,894, with a heavy care unit being $6,556. Over ten years, this will total $587,280 and $786,720, respectively.[20] In order to contribute to financial and physical well-being, there is a need to identify opportunities where this housing typology can effectively be made more accessible to a larger population. This exploration will encompass considerations of design and constructability, as well as delving into implementations at the policy and governmental level **[see Chapter 3 – Affordability + Construction]**.

Scale + Design

The typical design process starts at the scale of the site and its massing; I propose a new methodology to challenge this, starting by designing at the scale of the aging human body and working outwards. A new catalogue of standardized components and room typologies allows architecture to adapt to any site or suit an individual's needs, allowing for internal flexibility. Components within this catalogue, such as walls, windows, bathrooms, and living spaces, are standardized in their construction, allowing for simple implementation and adaptability over time. A more occupant-focused design methodology is brought to the forefront by designing these spaces at a human scale. Components and rooms will be comprised of ergonomics to aid and assist the processes of aging. Health-promoting theories will guide the placement and orientation of components, allowing for passive health-promotion throughout the building. Even though these components are designed for the scale of the human, specifically a senior, they can create a greater sense of community and well-being when put together to create larger spaces **[see Chapter 4 – Towards a New Architecture for Aging]**.

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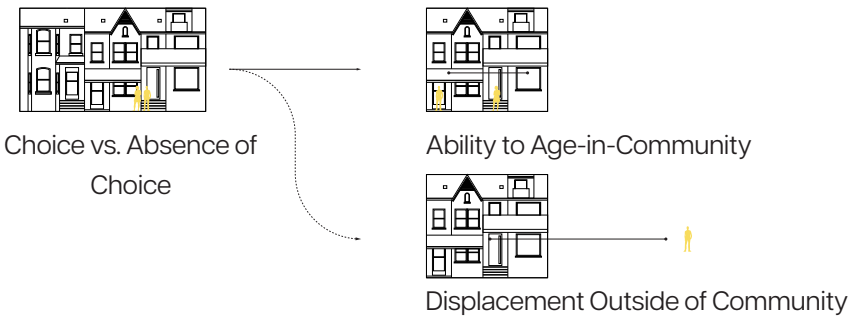
[20] Canada Mortgage and Housing Corporation (CMHC), "Seniors Housing Survey Data," July 6, 2021, https://www.cmhc-schl.gc.ca/professionals/housing-markets-data-and-research/housing-data/data-tables/rental-market/seniors-housing-survey-data-tables.

Social Health of Urban Seniors

In suburbia, some of the primary sources of social interaction are the front porch and walking through the street. With the city's density of high to mid-rise buildings, the porch becomes a balcony, and the street becomes a hallway. Interaction with neighbours is often nonexistent within an apartment building. Within the context of senior housing, long, daunting, and blank corridors often can dictate proxemic relationships of residents, which, in turn, can lead to social isolation.[21] After considering this, how can a residence for seniors create opportunities for social interaction while maintaining density? Architecture within the city has underlying conditions that can hinder socialization. This section will look at what life looks like in the urban environment for a senior, and the impact that architecture can play in this. Finally, a senior's residence will be integrated into the Alexandra Park master plan, utilizing this catalogue to create more thoughtful, healthier housing that Toronto can aspire to build in the future **[see Chapter 5 – Alexandra Park Case Study]**

Figure 4:

Choice of aging-in-community/place vs. displacement.



[21] Stephen Verderber et al., "Residential Environments for Older Persons: A Comprehensive Literature Review (2005–2022)," *HERD: Health Environments Research & Design Journal* 16, no. 3 (July 2023): 291–337, https://doi.org/10.1177/19375867231152611.

Keywords:

Biophilia

Conclusion

In piecing together the aging's physical, emotional, spiritual, social, and financial needs, this demographic can be better accommodated within the built environment, promoting well-being and the ability to age within their community. In an exhibition by The Open Workshop titled "Aging Against the Machine," they state, "Aging is not a problem to be solved. The problem is the range of barriers—physical, social, financial, and cultural—that make it difficult to grow older with dignity and in community."[22] By addressing these barriers and creating environments that promote physical and mental longevity for the aging, we can increase independence and autonomy, allowing for more fulfilling lives. The idea of aging-in-community signifies the importance of social connections and how much impact it has on health. When creating housing within a neighbourhood to support the elderly population, the creation of shared spaces at multiple scales provides options while fostering independence through community. Through health-promoting theories such as the integration of biophilia and active design, buildings can better suit the scale of the aging body. Designing for the aging is not something that can be done universally; it looks different for every individual. Creating neutrality in terms of accessibility is a key consideration for this, allowing for accommodation for a wide range of people and, simultaneously, allowing for the customization of individuals' spaces, matching their needs physically and creating a sense of home. This document strives to serve as a next step for LTC and RHs across Canada, modernizing the model of care.

[22] Neeraj Bhatia et al., "Aging Against the Machine," The Open Workshop, accessed December 28, 2024, https://www.theopenworkshop.ca/projects/aging-against-the-machine/.

02

health-promoting theories

architecture as a passive health-promoter.

New Horizons in Architecture

"Architectural theory is gradually evolving from a traditional reliance on historical precedent to a position informed by critical analysis and, to some extent, scientific method."[23]

As Stephen Verderber has identified, the ever-changing world around us continues to develop, and there is a collective need to solve problems, surpassing the crutch of historical precedent. The field of architecture is reaching an interdisciplinary state, specializing in vast areas of study to respond to a growing body of issues. With rising concerns about the aging population concerning housing and health care, there is an immediate need to intervene at their intersection. In response to COVID-19, the Government of Ontario has pledged $1.75 billion towards modernizing LTC within the province over five years.[24] The desire for better care exists and is being advocated for; now is the time for action. Historical examples have shown that architecture drives the design of healthcare environments; conversely, health rarely drives architecture.

Aging is characterized by temporal deterioration of health with diseases such as cancer, heart disease, and many forms of dementia. The maximum life span estimated is currently 121, but this life expectancy cannot be considered a characteristic. Throughout history, it was not uncommon for humans to not live past 40 years.[25] Therefore, the concept of aging is relatively new to human history and even more contemporary to the architectural practice and the built environment. Aging can be visually observed by greying hair, saggy or wrinkly skin, stiffness of the joints, osteoporosis, loss or reduction in muscle function, memory loss, and eyesight reduction.[26] Aging itself is not a disease but a normal phenomenon that occurs within a lifetime. Sedentary lifestyles paired with chronic diseases are the most prominent burdens for most

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[23] Stephen Verderber, "Architecture for Health - 2050: An International Perspective," *The Journal of Architecture* 8, no. 3 (January 2003): 281–302, https://doi.org/10.1080/1360236032000134808.

[24] Verderber, "Reimagining Long-Term Care Architecture in Post-Pandemic Ontario—and Beyond."

[25] Scott F. Gilbert, "Aging: The Biology of Senescence," in *Developmental Biology. 6th Edition* (Sinauer Associates, 2000), https://www.ncbi.nlm.nih.gov/books/NBK10041/.

[26] Gilbert.

Keywords:

Noncommunicable chronic diseases (NCDs)

Agency

Enabling spaces

Autonomy

Institutionalization

older adults.[27] Noncommunicable chronic diseases (NCDs) that impede healthy aging can be mitigated through physical activity, a well-rounded diet, decreased stress, and higher social connectivity. Human agency gives everyone a unique perspective and provides them with diverse ways of interacting with built space. When designing a house for more than one user, there are very few interventions that can be undertaken to accommodate everyone. This becomes more challenging for older adults, as there is no one-model-fits-all. There are many interpersonal variables that will dictate levels of interaction between people socially, and between the building physically. Enabling spaces undoubtedly allows for individual agency and creates spaces where social interaction can form a sense of community.[28] Through promoting these social and physical interactions, the built environment can prolong one's life through architecture.

Environments within the World Health Organization's report "World Report on Aging and Health" are defined as:

> All the factors in the extrinsic world that form the context of an individual's life; these include home, communities and the broader society; within these environments are a range of factors, including the built environment, people and their relationships, attitudes and values, health and social policies, systems and services.[29]

These aspects of an individual's environment are often lost when moving to retirement and LTC facilities, often being irreplaceable. Considering this, aging-in-place is the best answer, both socially and financially. When aging-in-place is not possible, the presence of design factors that enable an individual to maintain their autonomy while providing options in physical and social spaces defines age-friendly environments and facilitators.[30]

History of Healing Spaces and Architecture for the Aging

For the past five thousand years, healthcare has been approached as the search for a cure rather than maintenance. Only more recently in human history have we begun to look at the roots of disease, concluding that our physical surroundings impact our health.[31] By looking at the history of health related to the physical environment, we can see the pillars of what has previously defined health and how the institutionalization of health came to be.

From the beginning of time, we have established a place to house the ill and elderly. Caves functioned as the earliest forms of hospice, used as spaces of care and healing. Much later, Eastern Asia embraced the home as a place of health which often involved a close relationship with nature, with care provided by younger family members.[32] Traditional Chinese Medicine (TCM) views the body and surrounding environment as synonymous. The body reflects changes

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[27] Hugo Baptista de Oliveira Mederios, Denise Sardinha Mendes Soares de Araújo, and Claudio Gil Soares de Araújo, "Age-Related Mobility Loss Is Joint-Specific: An Analysis from 6,000 Flexitest Results," *American Aging Association* 35, no. 6 (December 2013), https://doi.org/10.1007/s11357-013-9525-z.

[28] Evangelia Chrysikou, Richard Rabnett, and Chariklia Tziraki, "Perspectives on the Role and Synergies of Architecture and Social and Built Environment in Enabling Active Healthy Aging," *Journal of Aging Research* 2016 (2016): 6189349, https://doi.org/10.1155/2016/6189349.

[29] World Health Organization, *World Report on Ageing and Health* (World Health Organization, 2015).

[30] Chrysikou, Rabnett, and Tziraki, "Perspectives on the Role and Synergies of Architecture and Social and Built Environment in Enabling Active Healthy Aging."

[31] Tye Farrow, *Constructing Health: How the Built Environment Enhances Your Mind's Health* (Farrow Architects, 2024).

[32] Stephen Verderber, "Architecture for Health - 2050."

Keywords:

Natural environment

Restorative

in health alongside changes in the environment. TCM embraces the belief that humans can heal, similar to the natural environment. This belief, along with the importance of environmental stewardship, is shared with the local indigenous population. The land that the site of focus inhabits first belonged to the Wendat, Anishinaabe, and Haudenosaunee peoples. The Anishinabek advocate for their model of healthcare, one that "respects and reflects traditional approaches to healing, our medicines, and our cultural values" as the health and wellness of their community is paramount.[33] This involves living and prospering within the natural environment, which can lead to individual and communal well-being.[34] One of the first times healing was considered in the built environment was in ancient Greece, stemming from the Greek pillars of society found in happiness, well-being, and thriving-in-place as theorized by Aristotle. The concept of holistic healing was found in healing temples, encompassed by nature-related environmental factors such as interaction with water, nature, and air as restorative treatment.[35] This attuned relationship between the individual and their environment is not too dissimilar from TCM and Indigenous values. These values in Greek philosophy had a heavy influence on later civilizations and societies. The Roman Empire built on these pillars of society, implementing them into the built environment for the betterment of public health, as seen through baths, sewer systems, and aqueducts. In parallel with the Roman Empire's fall, health advancements faded. The Catholic Church acted to fill this void, with monasteries becoming places of care.[36] They further emphasized faith as a means of healing, gradually leading to the de-emphasis of nature in healthcare from the fifth to the fourteenth century. This lost connection to nature can still be seen in the Western health institutions of care we know today. Although technological advancements in medicine and healthcare have significantly increased life expectancy, the number of health complications in our population continues to rise. With increased health complications per capita, an alternative solution is needed to address hospital resources' burgeoning strain.[37] This approach heavily emphasizes healing only when necessary rather than a more holistic approach, looking at prevention without reason.[38]

Aging-in-Community

Michel Foucault's "Of Other Spaces" delves into human perceptions of space, contemplating the existence of segregated and isolated spaces that arise out of necessity and social constructs. In "Of Other Spaces," Foucault presents the term heterotopia, defining "other" spaces that these societal values and norms have created.[39] The institutionalization of healthcare and healthcare environments are an example of heterotopias, which gave rise to spaces where individuals deemed to be misfits, ill, and insane, and those afflicted with mental or physical disabilities were outcasted from their community in order to heal. These spaces enforce segregation and discrimination of the ill, which can still be seen within architecture today. These heterotopic institutions of deviation were formed on the outskirts of society and often hosted very poor

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[33] Union of Ontario Indians, "Anishinabek Nation Health Transformation," February 25, 2025, https://www.anishinabek.ca/departments/health-secretariat-2/health-transformation/.

[34] Farrow, *Constructing Health*.

[35] Farrow.

[36] Farrow.

[37] Stephen Verderber, "Architecture for Health - 2050."

[38] Farrow, *Constructing Health*.

[39] Michel Foucault, "Of Other Spaces," trans. Jay Miskowiec, *Diacritics* 16 (1986): 22–27, https://doi-org.proxy.lib.uwaterloo.ca/10.2307/464648.

Keywords:

Social network

conditions.[40] [41] The displacement of the aging is a common practice that demands rethinking. Today, the elderly are institutionalized prematurely, although many can still be cared for at home and are displaced merely due to an "absence of choice."[42] While aging-in-place is seen as the new alternative, it is not a universal one-size-fits-all approach. Deane Simpson, author of *Young-old,* speaks to the criticism of age-segregated communities vs. aging-in-place, saying, "We should not simply discount those who are moving into these retirement environments as escapists or isolationists, because they have their own particular reasons for doing so."[43] [44] There are many reasons why displacement occurs, either in the absence of choice or by choice. Regardless of one's reasoning for displacement, we are forced to confront the issues present in both healthcare and housing for the aging. This requires new interventions that promote the maintenance of health, not just treatment. In challenging and deinstitutionalizing the typical environments that one ages in, we can begin to create healthier spaces for both internal and communal well-being.

Often, one of the crucial components in one's life as they age is their social support network beyond family. The presence of a social network for seniors can begin to counteract the social isolation often found within homes outside of the community where someone has lived their entire life. This meaningful connection to one's community often dwindles in later years due to many factors, including proximity. Life without these connections can begin to feel daunting, leading to the perception that one has less purpose and impending social death.[45] This is especially true in the Canadian climate, where winters are unbearable. For some retired Canadians, going south for winter is the answer, with Florida and Arizona as popular temporary destinations, receiving the name snowbirds. The vast majority of snowbirds own their homes, with a small percentage owning mobile homes or renting, which is much more attainable for some.[46] Often living among other snowbirds or in a community of equivalent age fulfills the need to socialize and be within a community. A similar model in Canada can relieve the urge to head south through established community connections. This connection can be seen in Moais, an Okinawan (Japanese) term for five friends bonded for life. In creating strong, established social networks, this group can combat the aging process together, influencing each other along the way.[47] Aging-in-community in an urban environment is not always possible. Our bodies demand different health and ergonomic requirements as we age, thus outgrowing the houses we lived in previously. This sparks a search for housing that allows for maintained independence into the later years of life. Often, this search removes the resident from their original neighbourhood they once called home. By looking at ways architecture can generate spaces of social interaction and the ability to age close to one's community, we can begin to tackle social isolation and some of the non-communicable diseases that face the aging population.

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[40] Stephen Verderber, "Architecture for Health - 2050."

[41] Michel Foucault, "Of Other Spaces."

[42] Ansar S. Ahmed et al., "Re-Imagining Eldercare in a Post-COVID Ontario."

[43] Amanda Kolson Hurley, Deane Simpson's "Young-Old."

[44] Simpson, *Young-Old*.

[45] Janice Blanchard, "Aging in Community: Communitarian Alternative to Aging in Place, Alone," *Generations (San Francisco, Calif.)* 37, no. 4 (2013): 6–13.

[46] Godefroy Desrosiers-Lauzon, "Canadian Snowbirds as Migrants," *Canadian Issues*, spring 2009, 27–32.

[47] Dan Buettner and Sam Skemp, "Blue Zones," *American Journal of Lifestyle Medicine* 10, no. 5 (July 7, 2016): 318–21, https://doi.org/10.1177/1559827616637066.

Keywords:

Social Determinants of Health (SDOH)

What is Health-Promoting Architecture?

Health is largely shaped by the conditions we are born and grow into — our social determinants of health (SDOH). Where we live, work, play, and age has significant implications of up to 80-90% influence on the future of our health and quality of life.[48] There is a growing correlation between architecture and its role in health as a preventative measure. Within healthcare environments, adverse effects of poorly designed spaces have begun to be countered by evidence-based, therapeutic architecture that puts patients first. Outside a hospital setting, minimal evidence-based projects aim to set measurable implementations that a larger body of architects can respond to.[49] As Farrow argues, "Architecture is never neutral. Good architecture has neurological and therapeutic aspects that can help people of all ages do the things they want and need to do."[50] For this thesis, I define health-promoting theories as architectural implementations that encourage healthier living. Architecture can not only enhance the spaces we occupy but can enhance our comfort and mental state, creating the foundations for health to flourish.

Architecture can promote health in two ways: mental and physical well-being (internal) and communal and social well-being (external). These two factors are reciprocal in that external well-being improves internal well-being and vice versa. Within our design choices, architects have the power to dictate the impact of a building on its occupants, with the possibility of having a greater impact on health outcomes than physicians.[51] Health-promoting theories consider what elements positively impact the occupants' mental and physical well-being to support healthy aging. Many of these implementations are qualitative, heavily driven by the quality of the spaces. However, at the same time, health is a science. At the intersection of qualitative and quantitative measures, some spaces overtly contribute to a positive occupant experience. These encompass theories that range from our inner relationship with people and the environments we inhabit, to our relationship to the tectonics, or even the ergonomics of space. To create environments that promote health outside of a hospital setting, it is essential to consider mental and physical health as a uniform concept in the built environment: holistic well-being. Access to nature is a vital catalyst that historical treatment and remedies were centralized around, depicting biophilia as fundamental to health-promotion and well-being. In integrating nature into, and around buildings, paired with active design philosophies that encourage more active lifestyles, architecture takes on a greater holistic view of health. If designed well, program allowing for physical activity can be built around a connection to nature, drawing on the benefits of biophilia and active design. When nature is not possible organically, natural analogues address how this instinctual connection with nature can be restored within the built environment. Aspects such as materials, colours, geometry, and patterns serve as mimicry of nature; although altered, these design elements begin to draw on our traditional reliance on, and relationship with nature that has been lost. [52] In considering the body in space at different scales, and our relationship to our surrounding environment, architecture can move towards health-centric spaces, to promote sustained health and well-being **[see Figure. 5]**.

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48 Jon Lipman et al., "Managing the Built Environment for Health Promotion and Disease Prevention," *Global Advances in Health and Medicine* 11 (December 1, 2022), https://doi.org/10.1177/2164957X221077084.

49 Lipman et al.

50 Farrow, *Constructing Health*.

51 Faris Ali Mustafa and Janan Sabah Ali, "Active Design: Architectural Interventions for Improving Occupational Health Through Reducing Sedentary Behavior," *American Journal of Health Promotion* 37, no. 1 (January 1, 2023): 93–102, https://doi.org/10.1177/08901171221111108.

52 William Browning and Catherine Ryan, "14 Patterns of Biophilic Design," September 12, 2014, https://www.terrapinbrightgreen.com/reports/14-patterns/.

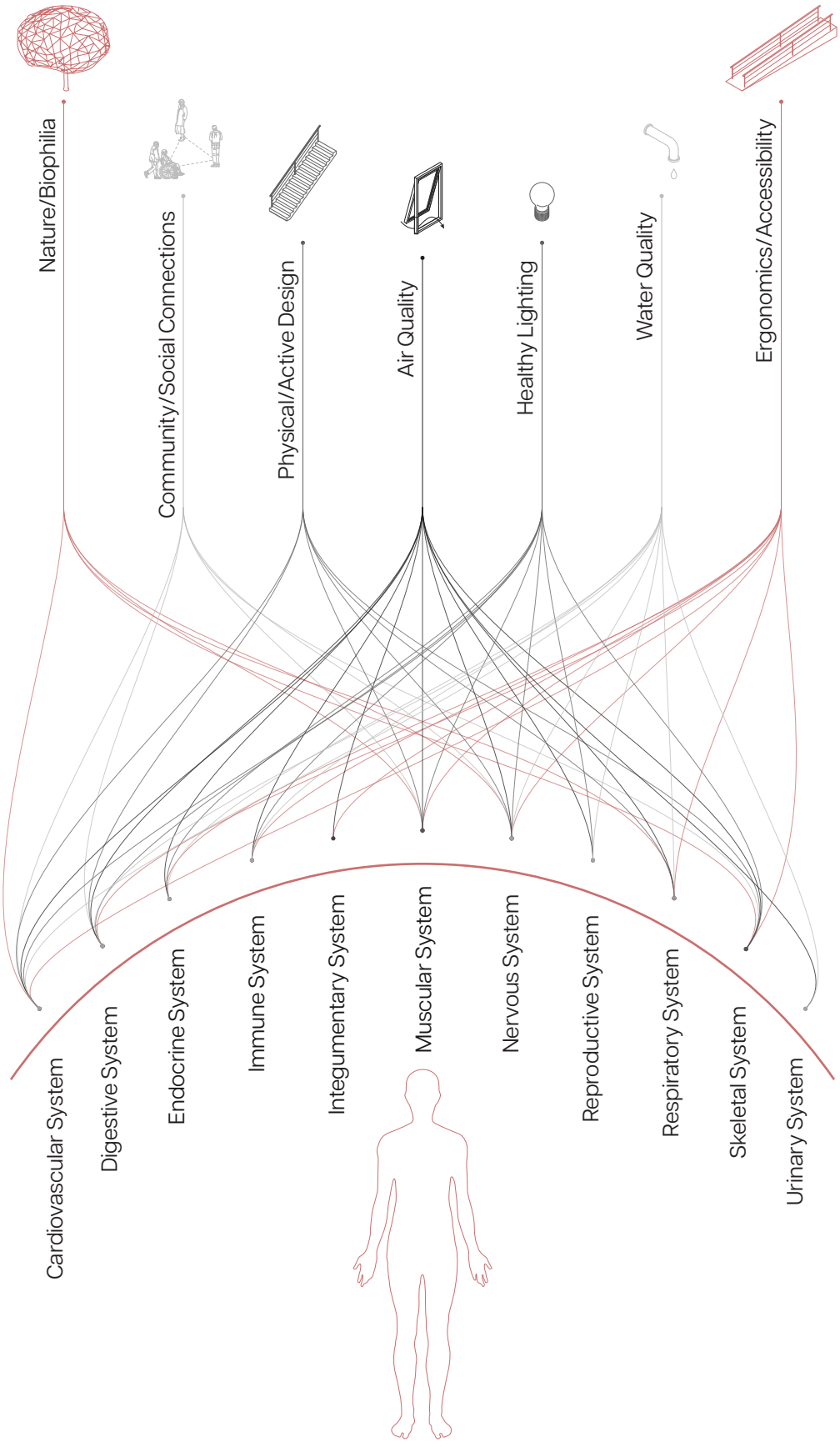

Figure 5:

Impact of the built environment on our social determinants of health (SDOH).

*information and diagram adapted from *WELL Building Standard*

Design Standards and Guidelines for Health and Healthy Aging

Design standards often guide the design professions, leading to more sustainable and well-rounded buildings. Many designers today strive for these accolades in construction, as they are becoming just that - standardized. Although this may be the case, many of these standards consider environmental well-being with some aspects of occupant comfort. This is heavily focused on quantitative data over qualitative, leading to gaps in the reality of our buildings. Following COVID-19, after being homebound for many years, designers and occupants have seen the faults in the buildings we occupy. This has sparked a desire for improvement. Just like any standard, it will change over time, but in the context of health, the health of our friends and families is paramount. The aging population has polarizing needs socially, financially, and physically, often demanding more from their built environment than just the sole purpose of shelter. Standards need to respond to this demand, allowing every home to enable its residents to age-in-place if they choose.[53]

Within Canada, retirement homes (RHs) are still fairly new. In 1983, a study by the Canada Mortgage and Housing Corporation (CMHC) called the *Design Guidelines for Rest Homes/ Retirement Homes in Ontario* outlined proposed design standards for the flourishing typology at the time. In making a case for the use of guidelines, it states, "There is danger of an oversupply of this sort of accommodation, and developers and architects are still unclear on what level of services and accommodation is desired by the market."[54] Despite this study conducted by the CMHC, this 20th-century oversupply is now inadequate for the aging population wave we could see coming decades in advance. This uncertainty in the level of care has led to an undersupplied, inadequate source of housing for the elderly. The standards represented in the CMHC's design guideline are not far from what is in the current *Long-Term Care Home Design Manual 2015* that is used today. This is the only existing government study on RHs and has not enacted any significant changes systematically. This one-off study represents the bare minimum, and without real incentive to do better, this is how it will remain.

The *Long-Term Care Home Design Manual 2015* contains the Ministry of Long-Term Care's current design standards for a model of care. Following the many shortcomings in care seen through COVID-19 in 2021, there was an addition to this design standard, requiring LTC homes to also comply with the *Fixing Long-Term Care Act 2021* (FLTCA).[55] The FLTCA does little to address the architecture but instead adds new provisions surrounding staff, care, protection of residents, and accountability for all parties.[56] Apart from the design standards having little to no renewed outlook of architecture's place in aging since the 1990s, the antiquated architecture in the majority of these homes cannot functionally adapt to their new policies and standards found within the FLTCA, proving ineffective.[57] The 2015 design standard alone is made mostly of quantitative standards and has the beginnings of adding qualitative elements in the "best practices" subsection. The design standards goal is to: "facilitate the provision of quality resident

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53 Janet Reizenstein, "CMHC Nursing Home And Hostels Design Guidelines Study," August 1977, https://publications.gc.ca/collections/collection_2016/schl-cmhc/NH18-25-1-1977-eng.pdf.

54 Keith Becker, "Design Guidelines For Rest Homes / Retirement Homes in Ontario" (Canada Mortgage and Housing Corporation, 1983), https://publications.gc.ca/collections/collection_2017/schl-cmhc/nh15/NH15-631-1983-eng.pdf.

55 Ministry of Long-Term Care, "Long-Term Care Home Design Manual 2015" (Government of Ontario, February 2015), https://www.ontario.ca/files/2023-03/ltc-2015-home-design-manual-2023-02-06-en.pdf.

56 "Fixing Long-Term Care Act, 2021" (Government of Ontario, July 24, 2023), https://www.ontario.ca/laws/view.

57 Verderber, "Reimagining Long-Term Care Architecture in Post-Pandemic Ontario—and Beyond."

Keywords:

Prospect

care in an environment that is comfortable, aesthetically pleasing and as 'home-like' as possible."[58] The standards have limited text speaking to the resident experience, while primarily allotting space for communal and private programs. In creating a more in-depth document focused on the occupant's experience with space, we can see how the qualitative aspects of architecture can support and foster well-being.

The *WELL Building Standard* (WBS) was one of the first of its kind to speak directly to occupant well-being, showing that designers can take action to implement real change on a building's occupants. This standard puts mental and physical health as a top priority, guided heavily by evidence-based design. The information provided by the standard is verifiable and transparent, allowing for widespread implementation. The goal of the WBS is to make spaces that are adaptable, accessible, and equitable. This is what architecture should be. Positive health-promotion significantly reduces the risk of chronic diseases, leading to happier occupants. Although this is a good direction for standards to follow, it is still heavily based on numerical values. For example, *Exterior Active Design* speaks to providing at least one of the following: a bench, drinking fountain, or moveable table/chairs.[59] This standard can be taken further, speaking to the qualities of the space in which they are placed. For example, a bench must be placed along an active walking route looking towards a highly active area of a site, providing prospect. Although not applicable to every site condition, an effort can be made to start to make standards more qualitative to increase positive outcomes.

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[58] Ministry of Long-Term Care, "Long-Term Care Home Design Manual 2015."

[59] "Standard | WELL V2," accessed September 19, 2023, https://v2.wellcertified.com/en/wellv2/overview.

Biophilia: Prevention as a Cure

One of the first uses of the term biophilia was by the psychoanalyst Erich Fromm, describing the human affinity to nature (biophilia) as "... the passionate love of life and of all that is alive; it is the wish to further growth, whether in a person, a plant, an idea, or a social group."[60] [61] This love of life and further growth resonates deeply with this thesis, looking to create a community of further growth through architecture and communal well-being. The recognition of biophilia as an architectural implementation has been adopted by using this affinity to nature to promote the emotional and psychological benefits nature can provide when integrated into, and around a building – biophilic design.[62] Terrapin, a sustainability consulting firm, looks to promote well-being through the integration of nature states, "biophilic design can reduce stress, enhance creativity and clarity of thought, improve our well-being and expedite healing."[63] Biophilia has become mainstream in its deployment in the architectural world with increased interest in the potential benefits for human health and well-being.[64] This checks off many boxes in design standards but is not always utilized to its fullest potential, with interventions being superficial, and having minimal impact on the building or its occupants. Colin Ellard, a prominent writer on topics related to neuroscience and architecture, has done extensive research on these two disciplines, looking to create a linkage across them. Ellard speaks to Ulrich's findings, saying, "most of us feel the truth ... in our bones-that nature can soothe, buoy, and restore."[65] Humans, by nature, need to connect with nature, but in the urban environment, this may not be as accessible or readily available. In Ellard's article "Cognitive and Affective Responses to Natural Scenes," he conducts an experiment comparing pictures of nature and trees to skyscrapers and the urban environment. From this experiment, it was shown that preferred scenes increased cognitive function and triggered opioid reward systems, which can regulate our pain, stress, and emotions.[66] In making nature or nature-related connections within the urban environment more accessible, especially within our buildings, we can begin to deploy these existing theories to improve well-being throughout our entire lifespan.

Due to the unique needs of each aging individual, one's interaction and perspective of buildings can vary. The frequency, duration, and speed in which we encounter architecture affect our experience and perception of space. Terrapin has outlined and compiled *14 Patterns of Biophilic Design* that are implementable, looking to close the gap between research and design. As they write, "Biophilia is the humankind's innate biological connection with nature. It helps explain why crackling fires and crashing waves captivate us; why a garden view can enhance our creativity; why shadows and heights instill fascination and fear; and why animal companionship and

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60 Jason S. Gaekwad et al., "A Meta-Analysis of Emotional Evidence for the Biophilia Hypothesis and Implications for Biophilic Design," *Frontiers in Psychology* 13 (May 27, 2022): 750245, https://doi.org/10.3389/fpsyg.2022.750245.

61 Erich Fromm, *The Anatomy of Human Destructiveness*, 1st ed. (New York: Holt, Rinehart and Winston, 1973).

62 "Standard | WELL V2."

63 Browning and Ryan, "14 Patterns of Biophilic Design."

64 Heather Ohly et al., "Attention Restoration Theory: A Systematic Review of the Attention Restoration Potential of Exposure to Natural Environments," *Journal of Toxicology and Environmental Health, Part B* 19, no. 7 (October 2, 2016): 305–43.

65 Colin Ellard, *Places of the Heart: The Psychogeography of Everyday Life* (Bellevue Literary Press, 2015).

66 Deltcho Valtchanov and Colin Ellard, "Cognitive and Affective Responses to Natural Scenes: Effects of Low Level Visual Properties on Preference, Cognitive Load and Eye-Movements," *Journal of Environmental Psychology* 43 (July 2015): 184–95, http://dx.doi.org/10.1016/j.jenvp.2015.07.001.

Keywords:

Non-rhythmic sensory stimuli

Variability

Volatile organic compounds (VOCs)

strolling through a park have restorative, healing effects."[67] The urban environment and typical LTC/RH settings are not known for their emphasis on nature, limiting access to restorative and healing spaces. There is a deep spiritual connection to nature; this has been extensively studied and shown to yield results for health and well-being.[68] The 14 patterns of biophilic design, as defined by Terrapin, are:

A **visual connection to nature** captivates us. It grabs our attention, providing stimulation and a sense of belonging to the environment.[69] Ulrich's experiment proves that a visual connection with nature has been shown to reduce stress, inflict positive emotion, and increase concentration ability and rates of recovery.[70] Mental and physical health improve as a result - reducing blood pressure, and heart rate, and promoting overtly happier emotions and attitudes. These principles apply to the built environment and demonstrate that the quality and biodiversity of the space are more important than the quantity. A physical, natural scene will always be more effective than digital depictions of nature. However, physical landscapes may be difficult to achieve in the built environment. A thoughtfully coordinated building and landscape that go hand-in-hand can have a greater impact than buildings with views of large landscapes. The primary objective is to create an innate connection between people and nature, which in effect reduces cognitive loads and leads to improved overall well-being.[71]

This poses a challenge within the built environment, especially in urban centres, as it has transformed into a statically defined and predictable place, different from the variabilities and complexity of nature. Irregular and non-measurable interactions with natural elements define **non-rhythmic sensory stimuli**. These interactions can draw attention for brief durations, providing positive distractions such as trees swaying in the wind or bees flying from flower to flower. Terrapin recommends that these non-rhythmic sensory experiences occur every 20 minutes, for 20 seconds, at a distance of 20 feet [6.1 metres] or more. These transient interactions with nature can be designed for all seasons to maximum benefit for nearby occupants.[72] This cannot be explicitly programmed into the design but instead can be encouraged by leveraging the natural world to provide these occurrences. In the case of mid-rise/high-rise residential buildings for the elderly who may not be as mobile, adding biodiversity vertically helps foster interaction throughout the building.

Some non-rhythmic sensory stimuli include the human body's feelings of environmental comfort. Integrating naturally occurring variability in the atmosphere has been shown to have positive effects on comfort and well-being. Current building standards are very strict on thermal comfort and design, limiting variability. **Thermal and airflow variability** such as changes in air temperature, humidity, and airflow mimic that of the natural environment. Natural ventilation can help dissipate indoor air pollutants such as volatile organic compounds (VOCs), which can trigger nausea, headaches, and various respiratory irritations.[73] Other than having a physical,

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67 Browning and Ryan, "14 Patterns of Biophilic Design."

68 For Further Information, See Authors, Roger Ulrich, Jay Appleton, Erich Fromm, Rachel Kaplan, Stephen Verderber, Terri Peters, Kristen D'Penna, William Browning, Catherine Ryan, Colin Ellard, and Tye Farrow.

69 Browning and Ryan, "14 Patterns of Biophilic Design."

70 Ulrich, "View Through a Window May Influence Recovery."

71 Browning and Ryan, "14 Patterns of Biophilic Design."

72 Browning and Ryan.

73 "Standard | WELL V2."

Keywords:

Circadian rhythm

Sick building syndrome (SBS)

functional impact on our health, this same natural variability in our environment such as minor changes in light, sound, and temperature has shown to be a form of soft fascination.[74] Occupant comfort is a critical consideration for the aging population because of varying health-related needs. Enabling the occupants to control this level of variability can be achieved through natural ventilation, operable windows, and access to room-specific controls over lighting and temperature.

Similarly, **dynamic and diffused light** has this same variability. Natural light generates different responses from our bodies, adjusting body temperature, heart rate, and circadian rhythm, which can impact sleep patterns. When the sun rises, the emitted light is yellow, shifting to blue at midday and red in the evening. Blue light is responsible for producing serotonin, and the absence of blue light is responsible for producing melatonin. A balance between the two is linked to better sleep quality, mood, and decreased risk of depression and breast cancer.[75] [76] Lighting for the elderly is important as vision degrades over time; visual awareness and functions such as contrast sensitivity begin to fade with age, requiring up to four times the amount of light compared to a 20-year-old to achieve the same clarity.[77] The elderly are often more susceptible to sick building syndrome (SBS) brought on by unfavourable light, air, and heating conditions within poorly designed spaces. These conditions have been known to lead to headaches, insomnia, and dizziness among other health concerns. With a reduction in visual perception as we age, there is an increased strain on our eyes, leading to irritation.[78] To decrease this strain and risk of SBS, lighting spaces must be designed intentionally to evenly light surfaces and limit glare for maximum visibility. In using natural light wherever possible, we can foster spaces that lead to happier and healthier occupants by encouraging this balance of melatonin and serotonin production.[79]

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74 Browning and Ryan, "14 Patterns of Biophilic Design."

75 Browning and Ryan.

76 Eric R. Kandel, *Principles of Neural Science, Fifth Edition* (McGraw Hill Professional, 2013).

77 Gunnar Horgen and Grethe Eilertsen, "Lighting Old Age – How Lighting Impacts the Ability to Grow Old in Own Housing, Part One.," 2012, https://doi.org/10.3233/WOR-2012-0612-3385.

78 Yaodong Chen et al., "Therapeutic Lighting in the Elderly Living Spaces via a Daylight and Artificial Lighting Integrated Scheme," *Energy and Buildings* 285 (April 15, 2023), https://www-sciencedirect-com.proxy.lib.uwaterloo.ca/science/article/pii/S0378778823001160?via%3Dihub.

79 Browning and Ryan, "14 Patterns of Biophilic Design."

Non-visual connection with nature encompasses the ambient senses we experience without necessarily being physically present in nature. These senses are complex and variable, ranging from sound, smell, and feel **[see Figure. 6+7]**. They create positive references to nature through sensory stimuli. Within Toronto, these senses are often hindered by the built domain. Our senses can be initiated and engaged either artificially, or naturally in architecture and the environment.

The sounds of nature have been shown to improve physical and mental restoration up to 37% faster than the sounds of the urban environment, also reducing blood pressure. Although nature sounds cannot always be generated naturally, urban noises can be suppressed through designing for limited sound transmission, leading to more relaxing interior spaces. Our olfactory system (sense of smell) has also shown the ability to be triggered by the natural environment. Something as simple as the smell of wood has shown a meaningful reduction in blood pressure.[80] Within the design of the landscape, planting vegetation that activates the olfactory system without overpowering it is key for the elderly population. Engaging with nature through touch has been shown to reduce the perception of pain in the elderly population, reducing fatigue and increasing joint mobility through actions such as gardening and environmental stewardship. A similar effect may be replicable on the interior of a building through the use of raw materials, mimicking the exterior environment. It is recommended to allow for 5 to 20 minutes of interaction a day in order to activate the senses.[81]

Figure 6:

Non-visual connection to nature can be activated by smell, such as fragrant vegetation.

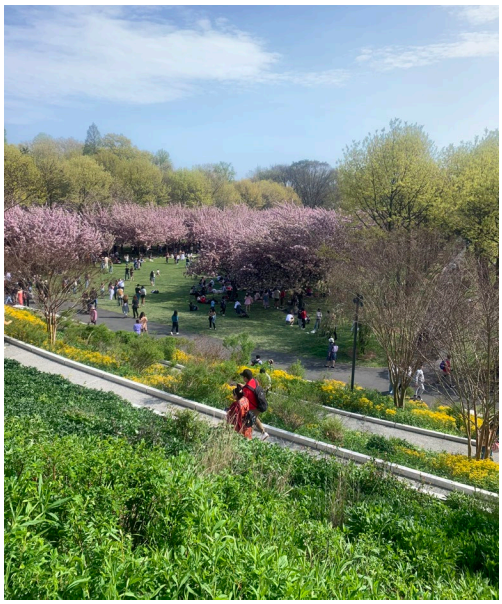

Figure 7:

Auditory connection to nature can be activated by wind blowing through nearby foliage.

[80] Harumi Ikei, Chorong Song, and Yoshifumi Miyazaki, "Physiological Effects of Wood on Humans: A Review," *Journal of Wood Science* 63 (February 2017): 1–23, https://doi.org/10.1007/s10086-016-1597-9.

[81] Browning and Ryan, "14 Patterns of Biophilic Design."

The **presence of water** has many shared benefits to other non-visual connections to nature. Water is a basic necessity of all life, yet it is often buried within cities for convenience **[see Figure. 8]**. The biophilic potential of water is subsequently lost, hampering the ability to capture attention, intrigue, and the ability to connect life on Earth.[82] The benefits of water in our environment have been shown to reduce stress, lower heart rate/blood pressure, and improve cognitive ability and memory retention. Water can be integrated into a green space or as part of a hardscaped feature. The key to utilizing the presence of water is activating the senses passively through sight, sound, or even touch.[83] The integration of permanent landscape elements, such as a pond, allows for a continuity of connection throughout spring, summer, and fall.

The **connection with natural systems** allows for awareness of natural processes or seasonality. An example of this connection is gardening or a water-capturing system such as a retention pond **[see Figure. 9]**. These examples both provide a non-visual connection to water and a connection to natural systems. Systems like these are linked to environmental stewardship and the innately human act of nurturing something.[84] In a study conducted in Singapore, titled "Nature-based activities improve the well-being of older adults," elderly participants partook in horticulture (gardening) activities, as well as nature-related art projects in urban environments. These activities offered a sense of creativity and achievement with the act of nurturing providing long-term fulfilment and purpose.[85] For seniors looking for less strenuous tasks, merely the act of observation and reflection within nature provides this connection to natural systems not typically found in urban environments. By witnessing and interacting with these temporal shifts in nature, one can experience profound and enlightening thoughts.[86]

Figure 8:

Physical location can impact the natural presence of water, being more abundantly present in some geographical locations.

Figure 9:

A retention basin integrated within the landscape offers both a presence of water and a connection with natural systems that can be witnessed throughout the year.

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[82] Stephen R. Kellert, Judith H. Heerwagen, and Martin L. Mador, eds., *Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life* (John Wiley & Sons, 2008).

[83] Browning and Ryan, "14 Patterns of Biophilic Design."

[84] Browning and Ryan.

[85] Angelia Sia et al., "Nature-Based Activities Improve the Well-Being of Older Adults," *Scientific Reports* 10, no. 1 (October 23, 2020): 18178, https://doi.org/10.1038/s41598-020-74828-w.

[86] Janet Frey Talbot and Rachel Kaplan, "The Benefits of Nearby Nature for Elderly Apartment Residents," *The International Journal of Aging and Human Development* 33, no. 2 (September 1991): 119–30, https://doi-org.proxy.lib.uwaterloo.ca/10.2190/XK9Q-3MDL-XYW9-9QL3.

Keywords:

Biomorphic

Biomorphic forms and patterns reflect geometry, patterns, and tectonics that exist in the natural world and, although not living, similarly capture our attention. Comparable to visual connection to nature, these forms and patterns are shown to reduce stress and allow for a shift of focus, leading to increased levels of concentration.[87] Some of these geometric forms were tested by Oshin Vartanian et al. titled "Impact of contour on aesthetic judgments and approach-avoidance decisions in architecture," where it was found that variations in contours "impact aesthetic judgments and approach-avoidance decisions." Approach-avoidance decisions are theorized by geologist Jay Appleton's "habitat theory," in which the aesthetics one perceives from a natural landscape can be compared to how one views the built environment.[88] If there are signals of favourable conditions to survive, it will be perceived as a more aesthetically beautiful space. Within the article, the study found that participants perceived the curvilinear geometry as more beautiful, activating the brain's anterior cingulate cortex (ACC) **[see Figure. 10+11]**. This region of the brain is responsible for the reward properties and emotional significance of objects.[89] The ACC is fundamental in cognitive processes such as "motivation, decision making, learning, cost-benefit calculation, as well as conflict and error monitoring."[90] This correlation of theory and neurological processes links approach-avoidance decisions, habitat theory, and the decision-making cost-benefit calculations that are all processed when one perceives space. Although these contoured spaces were perceived as more beautiful than their rectilinear counterparts, they had little impact on approach-avoidance decisions.[91] In creating physical environments that draw on natural forms, we can benefit from this connection with nature.

Figure 10:

Does rectilinear geometry serve as an instinctive signal to warn of potential danger?

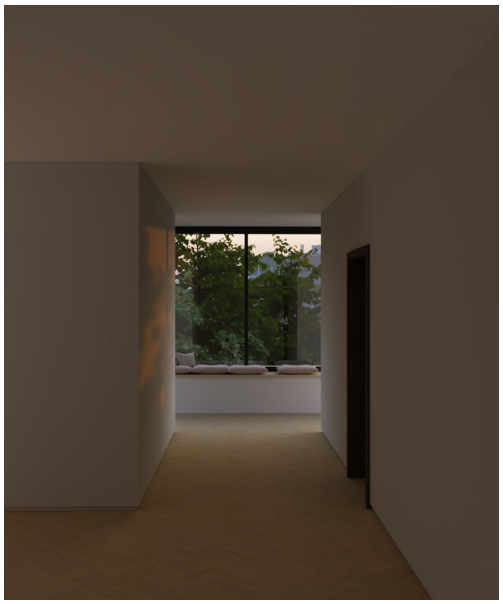
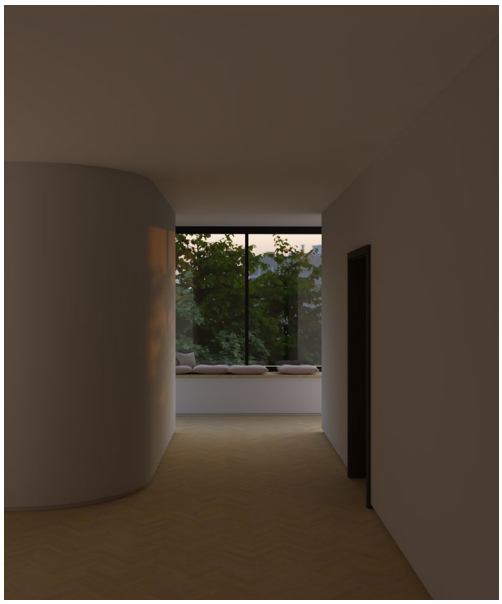


Figure 11:

Does curvilinear geometry evoke more natural scenes, seen as more beautiful and approachable?



87 Browning and Ryan, "14 Patterns of Biophilic Design."

88 Oshin Vartanian et al., "Impact of Contour on Aesthetic Judgments and Approach-Avoidance Decisions in Architecture," *Proceedings of the National Academy of Sciences* 110, no. supplement_2 (June 18, 2013): 10446–53, https://doi.org/10.1073/pnas.1301227110.

89 Vartanian et al.

90 Matthew A.J. Apps, Matthew F.S. Rushworth, and Steve W.C. Chang, "The Anterior Cingulate Gyrus and Social Cognition: Tracking the Motivation of Others," *Neuron* 90, no. 4 (May 18, 2016): 692–707, https://doi.org/10.1016/j.neuron.2016.04.018.

91 Vartanian et al., "Impact of Contour on Aesthetic Judgments and Approach-Avoidance Decisions in Architecture."

Another way to incorporate natural analogues is through **material connection with nature**. By reflecting local ecology that has undergone minimal processing, buildings can have varying effects based on the ratio of natural to processed materials. In a 2007 study published in the *Journal of Wood Science*, a room with a 45% coverage of wood found that people inhabiting the space felt comfortable, also seeing a reduction in blood pressure and an increased heart rate. In contrast, a room made up of 90% coverage of wood found that there was also a significant reduction in blood pressure, but also in brain activity with occupants becoming tired of the large coverage of the material.[92] From this, we can conclude that the ratio of natural materials to artificial or processed materials can have varying impacts based on the setting in which this is used. As such, a higher natural material ratio lends itself towards decreased blood pressure and resting (restore), with lower natural material ratios better suited to higher cognitive ability (stimulation).[93] Such effects have also been seen in Maggie's Centres, built to support those going through various stages of cancer recovery. These non-residential buildings offer care and support to patients, family, and friends, with a particular focus on atmosphere and architecture to counteract the stresses of going through cancer treatment. The experiences of these centres emphasize sensory encounters with material, texture, and the interweaving of physical and immaterial elements in space. The incorporation of wood has been shown to elicit emotional responses through tactile and visual interaction, and strong positive responses from all users of the centres that enable care.[94] Within LTC/RHs, this material connection and interaction is important to contrast from typical healthcare settings. In redefining craft and attention to materiality, a feeling of warmth, safety, and belonging significantly impacts an occupant's connection with a building.

Subtle indicators of natural hierarchy and order are created in using natural materials and forms, creating rhythm, or exposing structure. These factors can evoke more engaging spaces. Like form, **complexity and order** reflect rich sensory information that replicates natural spatial hierarchy. Buildings today are commonly dull, leading to boring, non-stimulating places. This is evident in healthcare institutions, defined by similar material palettes and order of spatial hierarchy. In mimicking fractal patterns found in nature, there is a fine line between overstimulation and restorative environments.[95]

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[92] Yuko Tsunetsugu, Yoshifumi Miyazaki, and Hiroshi Sato, "Physiological Effects in Humans Induced by the Visual Stimulation of Room Interiors with Different Wood Quantities," *Journal of Wood Science* 53, no. 1 (February 2007): 11–16, https://doi.org/10.1007/s10086-006-0812-5.

[93] Browning and Ryan, "14 Patterns of Biophilic Design."

[94] Daryl Martin, Sarah Nettleton, and Christina Buse, "Affecting Care: Maggie's Centres and the Orchestration of Architectural Atmospheres," *Social Science & Medicine* 240 (November 1, 2019): 112563, https://doi.org/10.1016/j.socscimed.2019.112563.

[95] Browning and Ryan, "14 Patterns of Biophilic Design."

Keywords:

Refuge

Prospect-refuge

A restorative environment can also be created through **prospect**, which refers to the unobstructed view of space, evoking feelings of safety and control. Prospect is a spatial response based on cultural anthropology, evolution, and visual preference. The benefits of feeling secure lead to decreased perception of vulnerability and improved comfort levels. By increasing awareness and comfort, a greater viewing range can reduce stress in new environments. With clearly defined thresholds of the space, prospect can be both interior and exterior, primarily focusing on visibility. Within LTC/RHs, visibility is important for safety but also can comfort residents. For interior or small exterior spaces, it is recommended to have a focal length of 6 metres. On exterior or interior spaces with expansive views, it is recommended to have a focal length of 30 metres.[96]

Typically paired with prospect, **refuge** defines a unique space, separate from its surroundings, and sheltered from the environment. These spaces provide coverage, protection, and feelings of contemplation **[see Figure. 12]**. This is an anthropological instinct, engrained in humans to provide this feeling. When combined with prospect, there are enhanced benefits to the lapping of these two spatial qualities in nature. Prospect-refuge, as theorized by Jay Appleton states that this combination is preferred as it affords higher chances of survival from threats as there is a perceived level of increased visibility over a landscape **[see Figure. 13]**.[97] [98] An example of this convergence is standing at the edge of a forest and looking out over a field, with both shelter and visibility beyond.[99] Within the urban environment, covered walkways and balconies are some of the best equivalents to this, providing protected positioning and recess. These architectural elements can be used within LTC/RHs as they can be used in all weather and are accessible for those with decreased mobility.

Figure 12:

The image provides feelings of refuge, sheltered from the surroundings.

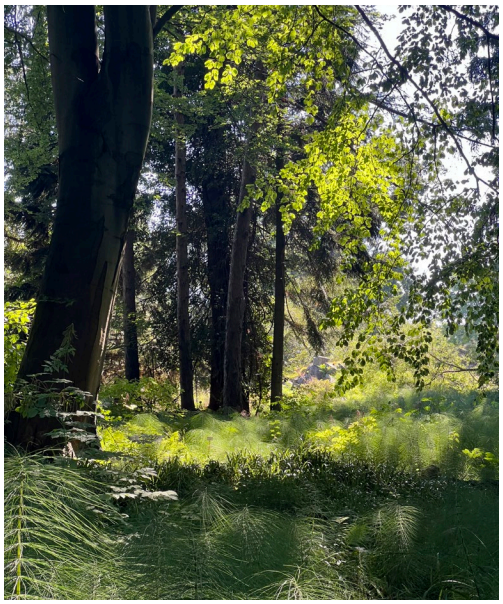
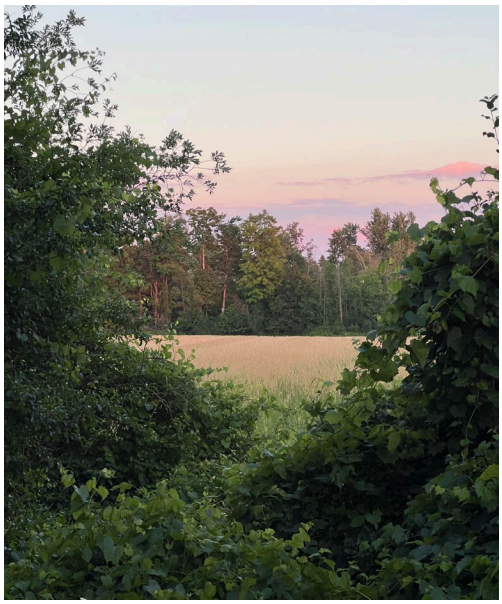


Figure 13:

The image provides feelings of prospect-refuge, providing shelter within tree cover, as well as prospect overlooking the landscape.



96 Browning and Ryan.

97 Birgitta Gatersleben and Matthew Andrews, "When Walking in Nature Is Not Restorative—The Role of Prospect and Refuge," *Health & Place* 20 (March 1, 2013): 91–101, https://doi.org/10.1016/j.healthplace.2013.01.001.2013

98 Jay Appleton, *The Experience of Landscape* (Wiley and Sons, 1996).

99 Browning and Ryan, "14 Patterns of Biophilic Design."

Keywords:

Risk/peril

Mystery

The feelings of safety found in refuge stem from **risk/peril**, an identifiable threat coupled with a safeguard in place. In this scenario, an implied danger evokes intrigue that overrides feelings of caution, creating feelings of exhilaration. For the elderly, this may not be as applicable, but this risk could be as simple as getting your feet wet or exploring something new. The key is to have safeguards in place so there is no inherent risk, but to the person in space, there is the illusion of some **[see Figure. 14]**.[100]

This feeling of risk/peril can also lead to **mystery** or intrigue, created by partial obstruction or sensory stimuli that entices you to move through space **[see Figure. 15]**. This creates the promise of further knowledge in which heightened curiosity offers a reward that engages an individual. This mystery can be achieved in a building through curved geometries, light and shadow, or overgrown gardens and winding, wandering paths.[101]

Figure 14:

An example of risk/peril in nature: walking under a rock wedged between an opening has implied danger but still draws intrigue to pass through.

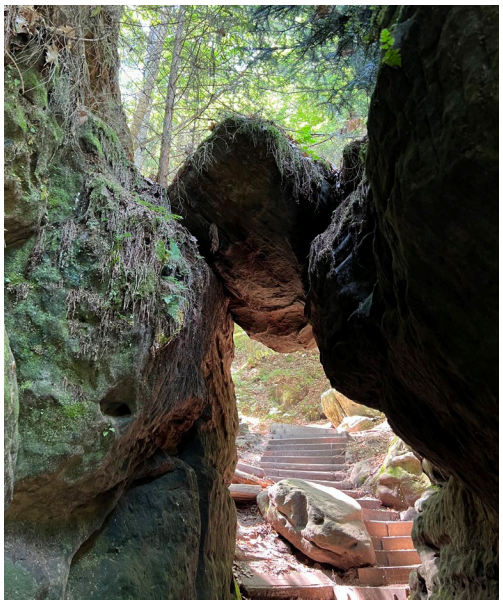


Figure 15:

Partially obstructed pathways create mystery and intrigue, drawing one in through curiosity.

[100] Browning and Ryan.

[101] Browning and Ryan.

Keywords:

Attention restoration theory (ART)

Creating environments within buildings that mimic aspects of the natural world (materials, geometry, rhythm, lighting, etc.) contributes to combatting poorly designed interior spaces. In implementing these aspects into a building, we can start creating enabling spaces where people can age. One of the predominant theories stemming from biophilia is the Attention Restoration Theory (ART), which looks to restore a level of concentration when exposed to nature and natural environments. Attention fatigue can occur from stimulus-specific tasks or ones that lack motivation, heavily linked to decision-making, self-control, and physical aspects of health such as obesity.[102] This is an extremely important consideration for the aging population when looking to preserve cognitive function into the later years of life. Toronto, like all urban environments, has higher demands on our cognitive function. ART states that by shifting cognitive focus from a task to the natural environment, we can recover cognitive capacity, which, in effect, promotes better attention abilities. Positive distraction or the soft fascination of experiencing different spaces draws indirect attention, different from previous tasks.[103] [104] With limited land and vegetation within the city, the design of green spaces becomes critical in creating a place that enables this kind of distraction.

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[102] Avik Basu, Jason Duvall, and Rachel Kaplan, "Attention Restoration Theory: Exploring the Role of Soft Fascination and Mental Bandwidth," *Environment and Behavior* 51, no. 9–10 (November 1, 2019): 1055–81, https://doi.org/10.1177/0013916518774400.\\uc0\\u8220{}Attention Restoration Theory: Exploring the Role of Soft Fascination and Mental Bandwidth,\\uc0\\u8221{} {\\i{}Environment and Behavior} 51, no. 9\\uc0\\u8211{}10 (November 1, 2019

[103] Basu, Duvall, and Kaplan.attending to softly fascinating stimuli not only requires little effort but also leaves mental space for reflection. We propose that soft fascination can be characterized as the interaction of both attentional effort and mental bandwidth and hypothesize that the restorative potential of everyday activities can be categorized based on this interaction. In an online survey, 398 adults rated four activities on Mental Bandwidth (MB

[104] Heather Ohly et al., "Attention Restoration Theory."

Active Design for Health and Community

Architecture can foster care through passive interventions in the way we design. In integrating active design philosophies through circulation, program, and community function, the building creates a space in which brief physical activity becomes commonplace. The goal is to use architecture to passively encourage occupants to exercise regularly without prescribing them to do so directly. The circulation spaces provide the most opportunity for activity as they are already a necessary part of any building's use. In providing stairs in more prominent, accessible areas within the building, occupants will be encouraged to use them for four floors or less. An elevator can be made equally as accessible, but with less prominent visibility from a main entrance, drawing attention to a well-designed stair for those who are physically able. Found within a study on Harvard alums, walking 20 floors a week lowers the risk of having a stroke by up to 20%, while two minutes of climbing stairs per day can amount to up to 1.2 pounds lost per year.[105] [106] [107] Although this may not seem significant, there is more to active design than physical health. The program within the building can heavily influence physical activity. Dispersing programs across multiple floors will draw occupants through the building, creating different opportunities for social interaction that can have significant impacts on motivation and purpose. This distribution of destinations within the building influences horizontal and vertical circulation spaces and creates a diverse range of design opportunities. The quality of design is important for the elderly as bad design may discourage the use of these spaces. Active design, in this case, takes on greater ergonomic importance.[108] Naturally lit, accessible, and generous staircases encourage this social and physical infrastructure throughout the building **[see Chapter 4 –Towards a New Architecture for Aging, the everyday stair]**. In this way, active design and biophilia must be designed in tandem. Interaction with nature, light, and the outdoors significantly improves the quality of interior spaces, which promotes less sedentary lifestyles for residents. Interior programs such as social spaces, amenities, and bike storage with a physical and visual connection to nature can begin to formulate these types of interior qualities that expand outwards, encouraging this activity. Similarly, the exterior environment should provide engaging spaces, increase the frequency of recreational walking, and draw the outside community into the site. These pedestrian-oriented spaces can become centres of interest in animating a diverse public realm of the building at a human scale. A study conducted in the *Journal of Public Health Management and Practice* found that physical activity increased within the largest cities of the United States of America, within cities with higher park density. This positive relationship can be applied globally, but there is a collective need to drive this change within our cities.[109] [110]

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[105] Suyeon Bae, "Influence of Spatial Layout on Physical Activity and Face-to-Face Interactions in the Work Environment" (University of Minnesota, 2015), https://www.proquest.com/docview/1725140482/previewPDF/D6C76A87153D4577PQ/1?accountid=14906&sourcetype=Dissertations%20&%20Theses.

[106] Paffenbarger Ralph S. et al., "Physical Activity, All-Cause Mortality, and Longevity of College Alumni," *New England Journal of Medicine* 314, no. 10 (March 6, 1986): 605–13, https://doi.org/10.1056/NEJM198603063141003.

[107] Mustafa and Ali, "Active Design: Architectural Interventions for Improving Occupational Health Through Reducing Sedentary Behavior."

[108] City of New York, "The Active Design Guidelines," 2010, https://www.nyc.gov/assets/planning/download/pdf/plans-studies/active-design-guidelines/adguidelines.pdf.

[109] Viniece L. Jennings, Claire K. Larson, and Lincoln R. Larson, "Ecosystem Services and Preventive Medicine: A Natural Connection," *American Journal of Preventive Medicine* 50, no. 5 (May 1, 2016): 642–45, https://doi.org/10.1016/j.amepre.2015.11.001.

[110] Stephanie T. West, Kindal A. Shores, and Lanay M. Mudd, "Association of Available Parkland, Physical Activity, and Overweight in America's Largest Cities," *Journal of Public Health Management and Practice* 18, no. 5 (October 2012): 423, https://doi.org/10.1097/PHH.0b013e318238ea27.

Conclusion

The history of aging in its relationship to architecture has not yet been clearly defined. What has been well-defined is a growing population of older adults who will need housing to adapt to suit the needs of aging. This is ever important as records show people are living longer and spending a longer portion of their lives as seniors. The United Nations projects Canada's life expectancy to reach 83.67 by the year 2030, which is an increase of 5.6% since 2000.[111] The continuity of independence and autonomy as we age is important to sustaining active lifestyles into later years. Further, having attainable housing options within one's community is key to supporting lasting social connections that are integral to support networks. In enhancing the spaces we occupy we can promote healthy lifestyles and aging through human connection with nature, people, and community. Today, design standards do not suggest buildings have much impact on our health, especially in standards for the aging. Only recently have studies begun to speak to this correlation between health and the built environment. Still, these recent studies neglect the aging population, not utilizing the knowledge of how much of an impact our environments have on us. Biophilia has been shown to affect cognitive function, as well as psychological and physiological well-being. [112] However, why is this approach less evident in buildings designed today? Biophilic design is by no means a one-size-fits-all approach. Many of these patterns are difficult to apply in dense urban areas such as Toronto. Different areas of the world, and even different sites within the same city, will create different opportunities for implementation. The current design of mid-rise/high-rise buildings often does not utilize biophilia and active design philosophies. Exit stairs often go unutilized, hallways are often uninhabited, and neighbours are often strangers. In the creation and documentation of this thesis, health-promoting theories will be explored in hopes that they will one day become standard in their recognition and deployment, enabling happier, healthier, more socially connected lives. This goes well beyond the aging population but begins to position the universal acceptance of architecture as a form of care.

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[111] United Nations Population Division, "Life Expectancy at Birth," Population Division Data Portal, accessed February 11, 2025, https://population.un.org/dataportal/data/indicators/61/locations/124/start/1950/end/2030/empirical?df=16336f3e-f17f-4b7f-8345-a8f1e5f75f4a.

[112] Browning and Ryan, "14 Patterns of Biophilic Design."

03

affordability + construction

making seniors housing attainable.

Keywords:

Affordability

Inadequate

Defining Affordability

Affordability can mean many things to different people. The notion of affordable housing should not only be the ability to afford a house but should foster sustainable affordability beyond the initial investment. These additional expenses should also be able to cover maintenance and operation.[113] Creating a renewed senior housing model that goes beyond the bare minimum in terms of building code and occupant comfort does not lend itself to being cheaper. Good architecture costs money; if treated as a long-term commitment, good architecture can reduce strain on our healthcare system, thereby reducing the cost needed to support healthcare facilities. At a policy level, if healthy housing is supported financially through incentives in construction, this tackles a handful of issues currently pressing within society. These include affordability, attainability, the strain on our healthcare system, and the inadequate availability of senior housing. Government funding plays a crucial role in influencing the supply and influx of affordable housing. With the rising costs of construction materials and labour, additional incentives are critical in allowing designers, developers, governments, and co-operatives to take on these projects.

[113] "Making Affordable Housing a Reality in Cities" (World Economic Forum, June 2019), https://www3.weforum.org/docs/WEF_Making_Affordable_Housing_A_Reality_In_Cities_report.pdf.

Keywords:

Land pooling

Brownfield

Greenfield

Transit-oriented developments (TODs)

Review of Policies to Foster Affordable Housing

There are many strategies for making housing affordable, ranging from land acquisition and land use to financing and developments in construction. In order to make this system work, long-term strategies need to be implemented to foster affordability into the future, including holding investors and developers to more strict policies.[114]

Land pooling/readjustment is one strategy in land acquisition that can make housing more affordable. This involves the buying agency returning a small portion of the newly developed land to the original owner, giving them the equivalent land value before the completed work. A second strategy in land acquisition is formal acquisition, which occurs when local authority deems the land imperative to the intended purpose/access to the land, compelling owners to sell or remove them through involuntary eviction. Finally, negotiated settlement occurs when land is exchanged for financial compensation with no return stake in the developed land.[115] Compared to a negotiated settlement, land pooling can help reduce high upfront costs, in turn leading to more affordable development, also being less abrasive than formal acquisition.

Land use and zoning will also determine the cost of housing and can lead to urban sprawl and decreased accessibility. When negotiating costs, housing developments on brownfield versus greenfield sites are a large consideration. Brownfield sites reduce sprawl, providing greater accessibility to jobs, enriching infrastructure, and encouraging redevelopment of vacant or underutilized land. These sites are often highly desirable as they are located within cities and towns. Greenfield sites are typically cheaper and easier to acquire as they may not be situated in dense city cores.[116] As these sites are often located outside the city, they increase urban sprawl, which encourages sedentary lifestyles and NCDs that frequently impair the health of older adults. The cost advantage for these sites is often offset by the need to build new infrastructure (roads, hydro, water supply).[117] These sites provide more flexibility in developments as they may not be prescribed to their previous use. In changing the land zoning, integrated inclusionary policies can also play a key role in affordability. Implemented in 2022, Toronto's inclusionary zoning requires a percentage of new developments to include affordable housing, having higher demands in the downtown core and guaranteeing maintained affordability for 99 years.[118] Inclusionary policies such as this ensure the construction of affordable housing, which in turn reduces potential displacement due to unaffordability.

Transit-oriented developments (TODs) often have development rights for affordable housing, such as these inclusionary policies when located near major transit nodes. In Los Angeles County, a similar policy was enacted called the Metro Affordable Transit Connected Housing Program (MATCH), established for households that are earning 80% or less of the area's median income.[119] Specific policies centred around TODs help to reduce reliance on personal vehicles,

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[114] Gertjan Wijburg, "Tax-Incentivized Housing Production and the Affordability Crisis: International Lessons from the Low-Income Housing Tax Credit Program in the United States," *Housing Studies* 39, no. 7 (2024): 1632–57, https://doi.org/10.1080/02673037.2022.2135172.

[115] "Making Affordable Housing a Reality in Cities."

[116] "Making Affordable Housing a Reality in Cities."

[117] "Making Affordable Housing a Reality in Cities."

[118] City of Toronto, "Toronto City Council Adopts New Inclusionary Zoning Policy to Get More Affordable Housing Built," City of Toronto (City of Toronto, November 9, 2021), Toronto, Ontario, Canada, https://www.toronto.ca/news/toronto-city-council-adopts-new-inclusionary-zoning-policy-to-get-more-affordable-housing-built/.

[119] "Metro Affordable Transit Connected Housing - Program Overview" (Los Angeles County), accessed January 21, 2025, https://www.matchfundla.com/wp-content/uploads/2021/10/MATCH-OVERVIEW-AND-TERM-SHEET.pdf.

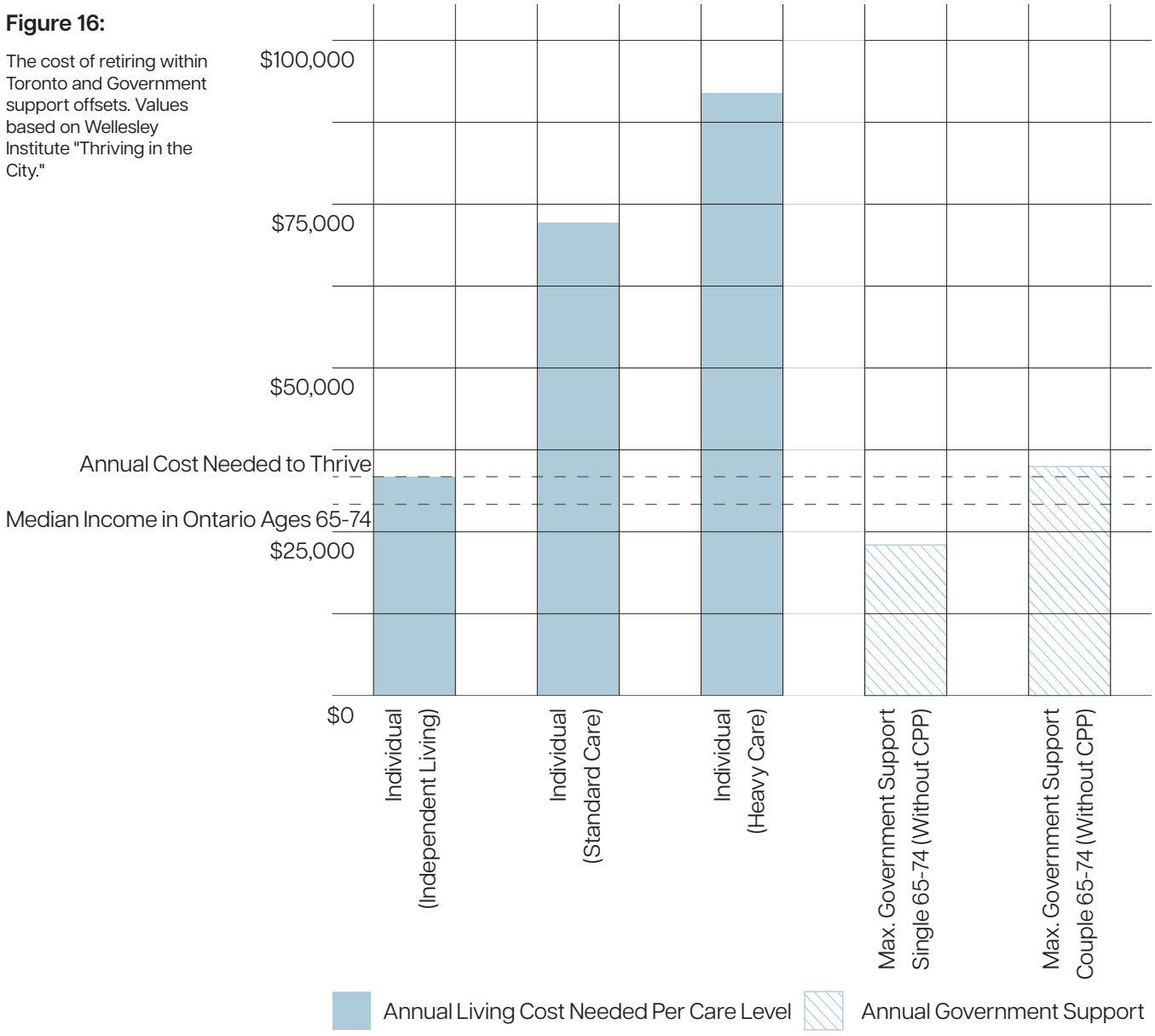
Keywords:

Equitable transit-oriented developments (ETODs)

promoting more active lifestyles but also reducing the cost of ownership. As TODs are often desirable, low-income renters are often displaced to be rented at an above-market price. Equitable transit-oriented developments (ETODs) are similar to TODs but heavily emphasize affordability, social justice, and the community's needs. For the elderly, TODs and ETODs provide a unique opportunity to maintain physical connections, but ETODs provide better financial security through equitable and structured methodologies and resources.[120] The aging population often sees a reduction in mobility caused by physical ability; adjacency to an ETOD/TOD can allow for maintained independence through continuity in everyday errands.[121]

Figure 16:

The cost of retiring within Toronto and Government support offsets. Values based on Wellesley Institute "Thriving in the City."



[120] Hamilton Transit-Oriented Affordable Housing Lab, "Equitable Transit-Oriented Development: A New Approach" (Hamilton, Ontario, December 2024), https://drive.google.com/file/d/1N321UO3hviXqCF085stOEfxOYotdzX_c/view?usp=sharing&usp=embed_facebook.

[121] Brittany S. Wood et al., "Aging Populations and Transit-Oriented Development: Socioeconomic, Demographic, and Neighborhood Trends from 2000 and 2010," *Transportation Research Record* 2598, no. 1 (2016): 75–83, https://doi.org/10.3141/2598-09.

Keywords:

Old age security (OAS)

Guaranteed income supplement (GIS)

Spouse's allowance

Canadian pension plan (CPP)

Guaranteed annual income system (GAINS)

Financing and Cost Reduction

Affordable housing relies on a combination of factors and strategies that reduce costs to make housing attainable. These strategies include tax incentives, grants, and property tax exemptions, such as the 25-35-year exemption for developers used in New York to incentivize affordable housing.[122] [123] Although this strategy assists in future affordability, the initial cost of housing projects is one of the largest barriers to success. One way to reduce the cost of development is by providing low interest rates or discounts for developers, encouraging them to take on lower profit margins. The government can additionally act as a guarantor for debt, giving organizations or developers with less financial capital the ability to build affordable housing.[124] It is important to critique developers, looking for socially conscious developers to take on a project for the right reasons.[125] As seen in the redevelopment of Regent Park in Toronto, local developer The Daniels Corporation introduced increased market housing alongside their rent-gear-to-income housing, significantly differing from the original proposal.[126] In holding the government and developers accountable, developments can become genuine and socially mindful, having more realistic expectations. Alternatives to developers' funding are private equity funds and pension funds issued by insurance companies and banks, who view affordable housing as an opportunity to diversify an investment portfolio, while not looking for large financial returns.[127] [128] The Canadian and Ontario Government can assist in reducing development costs by prioritizing the review of documentation and registering properties by waiving fees on affordable housing developments. Fast-tracking these projects will help reduce overall building costs, which is another key to affordability. [129] In alleviating some of the financial burden, good housing can be made more accessible for older adults as many begin to transition into retirement.

Government Support for the Elderly

Canada offers several government-funded programs for the elderly that assist with the cost of living. Many of these benefits are available in Ontario starting as early as age 60, with most commonly starting at age 65. These programs are Old Age Security (OAS), Guaranteed Income Supplement (GIS), Spouse's Allowance, and the Canada Pension Plan (CPP).[130] Within Ontario, the Guaranteed Annual Income System (GAINS) is additionally available to those over the age of 65.

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122 "Making Affordable Housing a Reality in Cities."

123 Natalie Sachmechi, "Here's What the Governor's Revamped Tax-Incentive Plan for Affordable Housing Developers Could Look Like," *Crain's New York Business*, January 24, 2022.

124 "Making Affordable Housing a Reality in Cities."

125 Christopher Alexander et al., *The Production of Houses* (New York: New York: Oxford University Press, 1985).

126 Zachary Hyde, "Giving Back to Get Ahead: Altruism as a Developer Strategy of Accumulation through Affordable Housing Policy in Toronto and Vancouver," *Geoforum* 134 (August 1, 2022): 187–96, https://doi.org/10.1016/j.geoforum.2018.07.005.

127 "Making Affordable Housing a Reality in Cities."

128 August, "Securitising Seniors Housing."institutions, publicly listed companies, and real estate investment trusts

129 "Making Affordable Housing a Reality in Cities."

130 Federal/Provincial/Territorial Ministers Responsible for Seniors Forum, "What Every Canadian Should Know About Income and Benefits From Government Programs," 2010, https://www.canada.ca/content/dam/esdc-edsc/documents/corporate/seniors/forum/brochure-02-eng.pdf.

As of 2024, the maximum monthly amount one can receive from CPP at the age of 65 is $1364.60, with an average amount of $831.92 received across the country.[131] The monthly amount one can receive for OAS depends on age, with people 65 to 74 receiving a maximum of $713.34 and 75 and older receiving $784.67.[132] GIS is different from other government programs as the amount you receive is dependent on your spouse or common-law partner with the maximum being $1,065.47 and the minimum being $641.35.[133] Within Ontario, GAINS supplements the Federal Government's benefits contributing an additional $87 per month for individuals and $174 for couples.[134] Even when receiving maximum government support, an individual does not have the financial capacity to "thrive" **[see Figure. 16]** leaving those without external financial support vulnerable to a lesser quality of life in retirement.

How Does the Cost-of-Living Support Health?

The idea of thriving in retirement starts to consider the income needed to not only support living but also healthy living. A study conducted by the Wellesley Institute in Toronto showed that the required cost for an individual to comfortably remain within Toronto between the ages of 65 and 74 is between $32,947 and $33,509 annually. For a couple, this number is between $47,716 and $48,505.[135] The numbers used by the Wellesley Institute assume that the model retiree is able-bodied, lives independently without support, and does not consider the aforementioned price of supported living in Toronto. Still, there is a large discrepancy between individuals and couples, with the cost of retirement more heavily burdening those unable to split the cost of living and savings. These individuals are more likely to experience insufficient income. Government support from the Federal and Provincial Governments only goes so far. In Ontario, there is a guaranteed $22,389.72 for individuals and $17,300.28 (per person) for couples (not including CPP), proving to be a large gap between thriving in retirement and the realities of retirement.[136] The median income after tax for residents of Ontario aged 65-74 is $29,034, which still falls short of the amount needed to thrive. This discrepancy in the cost of retirement suggests that many older adults within Ontario are not in a sufficient financial position for their health to thrive, especially considering the swelling costs of living.[137] A response to rising life expectancy and duration spent in retirement is accessible and affordable housing that supports external support services. An Alternate model is seniors' co-ops which offer a stake within a property without outright ownership, creating the benefit of affordability while still maintaining equity at resale **[see Figure. 17]**. Shared maintenance costs allow for more extensive spaces compared to a single home and are managed by a collective community.[138] This reinforces the feeling

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131 Government of Canada, "Canada Pension Plan: How Much Could You Receive," service initiation, October 8, 2015, https://www.canada.ca/en/services/benefits/publicpensions/cpp/cpp-benefit/amount.html.

132 Employment and Social Development Canada, "Old Age Security: How Much You Could Receive," October 30, 2015, https://www.canada.ca/en/services/benefits/publicpensions/cpp/old-age-security/benefit-amount.html.

133 Government of Canada, "Guaranteed Income Supplement: How Much You Could Receive," October 28, 2015, https://www.canada.ca/en/services/benefits/publicpensions/cpp/old-age-security/guaranteed-income-supplement/benefit-amount.html.

134 "Ontario Guaranteed Annual Income System Payments for Seniors | Ontario.Ca," accessed May 30, 2024, http://www.ontario.ca/page/guaranteed-annual-income-system-payments-seniors.

135 Nazeefah Laher and Seong-gee Um, "Thriving in the City: What Does It Cost to Have a Healthy Retirement?," *Wellesley Institue*, 2018, https://books-scholarsportal-info.proxy.lib.uwaterloo.ca/en/read?id=/ebooks/ebooks5/cpdc5/2019-10-07/1/10101066#page=12.

136 "Ontario Guaranteed Annual Income System Payments for Seniors | Ontario.Ca."

137 Nazeefah Laher and Seong-gee Um, "Thriving in the City: What Does It Cost to Have a Healthy Retirement?"

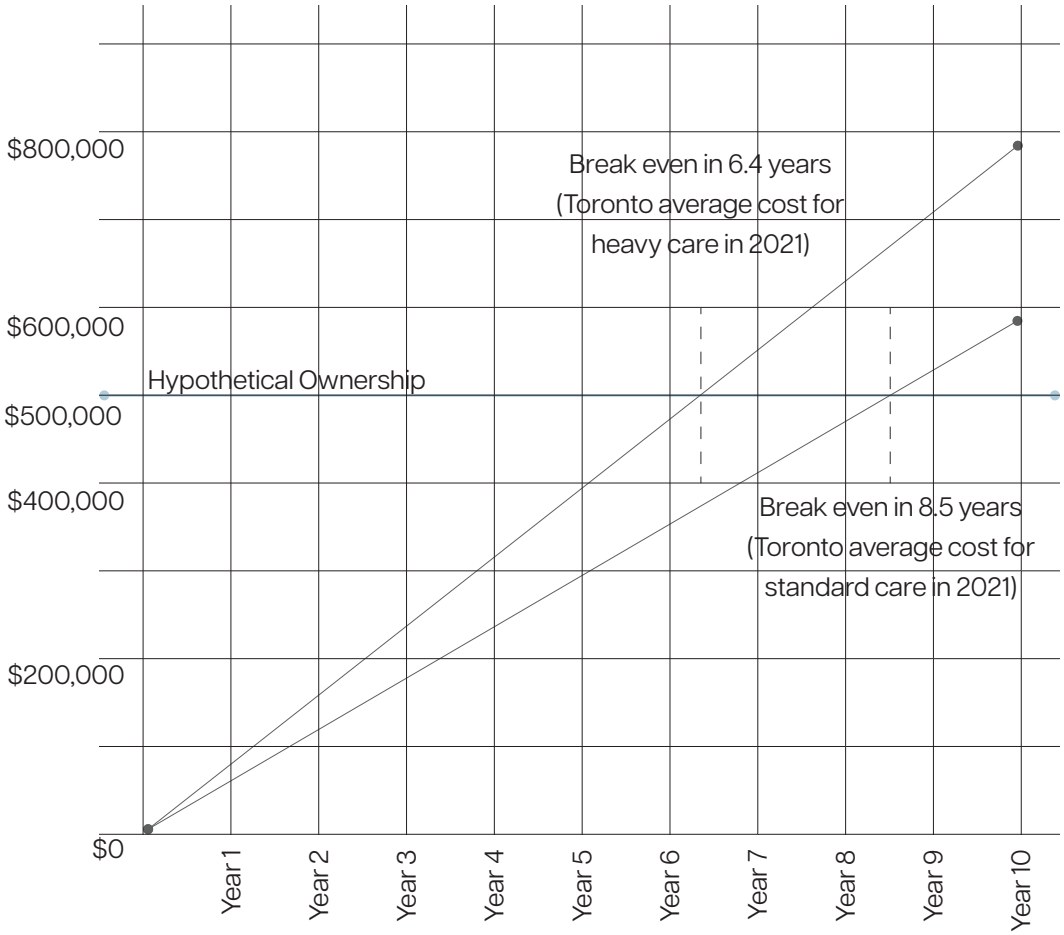
138 United States Department of Agriculture, "Developing and Sustaining Rural Senior Cooperative Housing - Research Report," 2001, http://seniorcoops.org/wp-content/uploads/2015/06/Research-Report.pdf.

of autonomy and ownership of one's space without the adoption of full ownership and its associated responsibilities. All members of the co-op benefit from their stake and are woven into a socially connected network.

From a socio-cultural perspective, race and gender can also significantly impact the quality of retirement and health. Women require substantially more income in retirement compared to men in large part due to a lower working salary throughout their lives. This disadvantage leads to women being twice as likely to experience poverty in retirement compared to men.[139] Similarly, race, immigration, and barriers with language can lead to similar inequality. These groups may find jobs more difficult to acquire, leading to financial uncertainty, and ultimately affecting their ability to thrive later in life. Additionally, the level of care one needs also impacts affordability. Heavy care, defined as more than 1.5 hours of care per day, has a higher cost than standard care, defined as less than 1.5 hours of care per day.[140] In not being able to afford the level of care needed to maintain daily function, well-being is compromised. This ability to have financial stability in retirement allows for social necessities, living expenses, and family to be accounted for, not compromising in terms of health, and health outcomes because of financial capacity.[141]

Figure 17:

Ownership vs. Renting. A hypothetical $500,000 unit could be purchased in less than ten years at the current cost of senior housing in Toronto reported in the CMHC's Seniors' Housing Report Ontario, 2021.



[139] Nazeefah Laher and Seong-gee Um, "Thriving in the City: What Does It Cost to Have a Healthy Retirement?"

[140] Canada Mortgage and Housing Corporation (CMHC), "Seniors' Housing Survey Methodology," June 27, 2022, https://www.cmhc-schl.gc.ca/professionals/housing-markets-data-and-research/housing-research/surveys/methods/methodology-seniors-housing-survey.

[141] Nazeefah Laher and Seong-gee Um, "Thriving in the City: What Does It Cost to Have a Healthy Retirement?"

Keywords:

Prefabrication

Balloon framing

Architecture's Response to the World's Needs

One of the most prominent movements in recent architectural history is that of prefabricated architecture and the industrialization of buildings. Following the Industrial Revolution, designers of all disciplines faced new possibilities in how they produced and assembled. This marked a turning point in how we design. That being said, industrialization in construction has been around since the first conception of the building itself, gradually growing in scale throughout time.[142] Prefabricated movements throughout history were driven by the rapid need for growth and a construction method with the financial ability to facilitate this growth. Today, the waitlist for LTC in Ontario is approximately 48,000 people and is growing rapidly.[143] There is an immediate need to create or retrofit homes to house this demographic.[144] As the world searches for production and financial efficiencies to meet the needs of demographics such as the aging population, prefabrication has come back to the forefront in re-imagining old methods of construction. In using prefabrication, architectural intent is not compromised and can be refocused on providing environments that support the daily well-being of its occupants.

Brief History of Prefabricated Architecture

It is understood that the first known application of prefabrication methods in construction was the "Manning Houses" created by a London-based Carpenter named John Manning.[145] Initially made out of wood in 1830, these structures were targeted towards Australian settlers. This form of construction was linked to colonial expansion and enslavement due to its quick assembly, allowing settlers to establish themselves quickly and cost-efficiently.[146]

One of the first major uses of modularity in construction began in Chicago. The city's rapid growth from 1833 onwards coincided with new construction materials of dimensional lumber and mass-produced nails becoming more readily available, giving way to post-and-beam construction.[147] A new method emerged, more efficient and less laborious than its predecessor. Balloon framing as a construction method had widespread usage throughout North America, Northern Europe, Australia, and Japan. This involved standardized timber studs of 2 inches by 4 inches spaced 16 inches apart. The standardization of construction elements such as balloon framing revolutionized the construction industry, leading to efficiencies in constructability, reduced labour and material costs, and the potential for industrialization.

Around this same time, many designers globally began to design prefabricated shelters that could be easily assembled. Following the adoption of balloon framing as standard, companies such as Sears would offer houses within catalogues, sending house kits that included materials alongside construction plans and claiming a cost reduction of 40% on labour.[148] Shortly after

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142 Anna Tofiluk, "Problems and Challenges of the Built Environment and the Potential of Prefabricated Architecture," *Archives of Civil Engineering; 2023; Vol. 69; No 3; 405 –424*, 2023, https://journals.pan.pl/dlibra/publication/146088/edition/128484.

143 "The Data," OLTCA, accessed February 2, 2025, https://www.oltca.com/about-long-term-care/the-data/.

144 SHS Consulting et al., "Seniors' Residential/Housing Options Capacity Assessment and Projections," accessed February 2, 2025, https://books.scholarsportal.info/en/read?id=/ebooks/ebooks2/ogdc/2011-11-07/1/291035#page=13.

145 João Mascarenhas-Mateus and Ana Paula Pires, eds., vol. 1 (London: CRC Press, 2021), https://doi.org/10.1201/9781003173359.

146 Mascarenhas-Mateus and Pires.

147 Colin Davies, *The Prefabricated Home* (Reaktion Books, 2005).

148 Colin Davies.

the Great Depression, Sears closed its housing department with General Homes taking over the manufacturing. General Homes, like General Motors, looked to build homes in the same manner that cars were being built - along a production line in order to capitalize on this growing market.[149] [150] The technological developments in cheaper materials such as plasterboard, fibreboard, and plywood allowed companies to take their hand at reproducing a prefabricated home for America. Prefabricated housing was prevalent in the United States around the 19th and 20th centuries, looking to solve the economic hardships that the country faced at the time. Just before the end of WWII, the focus shifted towards rapid production of these houses, with only a small fraction of them being built. These housing projects were often hampered by backlogs in production, too many individual parts, and logistical issues.[151] In Britain, following WWI, its government encouraged non-traditional housing methods in order to calm civil unrest over material and labour shortages. One of the most successful examples, the "Dorlonco," made of steel, boasted its differences from the predominantly wood structures coming out from the United States. Even through the success observed by Americans and Germans, the prefabricated movement was always a temporary fix until the resumption of material and labour supplies was once again heightened.[152] [153] Similar conditions in WWII led to a similar response from the British government, this time putting forward a mass-produced product titled the AIROH. Leaning on the spare capacity of other industries in the shortages of the war, the government enlisted the aircraft industry. Factories were repurposed to begin outputting full sections of houses instead of planes. Many of the same methods for planes were used in the construction of the AIROH, prominently made of aluminum and steel. This movement was once again temporary until life returned to normal, and the push of prefabrication was once again halted.[154] Today, we experience a similar need for housing driven by economic hardship, displaying similarities to historical precedent. The need for increased senior housing supply becomes ever more pressing as the quantity and age of people on the waiting list for LTC and RHs continue to grow.

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149 Colin Davies.

150 Barry Bergdoll and Peter Christensen, *Home Delivery: Fabricating the Modern Dwelling* (The Museum of Modern Art, 2008).

151 Colin Davies, *The Prefabricated Home*.

152 Colin Davies.

153 Cheryl Buckley, "Modernity, Tradition and the Design of the 'Industrial Village' of Dormanstown 1917–1923," *Journal of Design History* 23, no. 1 (2010): 21–41.

154 Colin Davies, *The Prefabricated Home*.

Keywords:

Computer numerical control (CNC)

Material and Technological Innovation

The prefabricated housing movement gave way to many new methods of construction, some of which are still used today. The image of prefabrication was previously clouded by failure or viewed as a temporary solution to larger problems. Not until the production of prefabricated concrete slabs had widespread success did prefabricated construction prove inexpensive and effective in the ease of constructability. Precast-concrete panels gave way to larger and taller buildings, being produced faster than ever before at higher densities.[155] Timber has had similar success and has returned to the forefront of architecture, supported by modern manufacturing techniques allowing taller buildings than previously conceived. Advancement is achieved through the rapid development of mass timber structural elements such as Glue-Laminated Timber (GLT), Laminated-Veneer Lumber (LVL), Nail-Laminated Timber (NLT), Dowel-Laminated Timber (DLT), and the most prevalent Cross-Laminated Timber (CLT).[156] The movement of mass timber buildings brought about new methods of construction and new possibilities for the industrialization of buildings. With the nature of construction for mass timber mostly being assembled off-site, this construction method lends itself to prefabrication, often precisely cut using CNC (Computer Numerical Control) machines.[157]

Over the years, architects have continued to challenge the ideas of why buildings are so defiant to factory production. The introduction of digital tools and parametric architecture invited a renewed outlook on building production and established a new relationship between machine and design.[158] Over the past decade, this close relationship between machine and design has allowed for new advancements in building technology accelerating modularity, and the ability to more rapidly than ever, produce standardized parts as construction costs rise.[159]

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155 Colin Davies.

156 Ali Sayigh, ed., *The Importance of Wood and Timber in Sustainable Buildings*, Innovative Renewable Energy (Cham: Springer International Publishing, 2022), https://doi.org/10.1007/978-3-030-71700-1.

157 Sayigh.

158 Bergdoll and Christensen, *Home Delivery*.

159 Bergdoll and Christensen.

How can Healthy Living be more Affordable Through Architecture?

Healthy architecture is influenced by more than the physical entity of the building, but also the context, having significant social and physical implications on how an occupant interacts with space. Not only does the physical space affect occupants, but the self-rated health of older adults is also shown to be negatively affected by housing affordability.[160] Thus, the concept of aging-in-community is important to the success of this typology. However, as Toronto's real estate prices continue to climb, the goal of affordable, healthy architecture becomes much harder to achieve. The focus site within this thesis is a brownfield site located at 571 Dundas Street West, Toronto. Although, in theory, more expensive, sites like these within the city help fulfill the goal of aging-in-community and promoting the social well-being of those who live there. This can be achieved in many ways, and when combined, affordable, adequate housing can become more attainable than it is today. To make sites like this within Toronto more affordable, policies can be implemented to encourage developers, designers, and organizations to take lower profit margins. It must be considered that high-quality constructors may be at a disadvantage in competing for bids, which lowers the pool of skilled labourers. Thus, local governments and licensing boards must encourage and incentivize the contract of affordable housing bids amongst building developers. A successful example of this at a large-scale is BUILD NOW Waterloo Region. Teaming with private and public sectors as well as not-for-profit partners, BUILD NOW receives donated land or land at a marginal cost in which developers work at cost, eradicating mark-ups.[161] This creates tangible, realistic affordability into the future, which governments can begin to adopt, partnering with like-minded allies in pursuit of affordability. This can also be encouraged at the government level or even by governing bodies of licensing boards such as the OAA or AIA, encouraging members to contribute.[162] In combination with governments or housing co-operatives creating subsidized housing, limiting profits will ensure access to good housing. This has been practiced in Vienna, Austria since the 1920s, where today, 62% of housing is subsidized, with the city itself owning 25% of it.[163] For seniors, a subsidized housing model provides stability in housing prices and can ensure wider access to more people. In ensuring a high level of construction with a focus on occupant health, the government would be incentivized to use this housing as assistive to health infrastructure and housing attainability.

Prefabrication Supporting Affordability

Affordability is important for this typology as it is one of the main factors that elicits choices. The costs of construction weigh heavily on the final cost of the building. Looking at ways construction can be fast-tracked assists in lowering the overall cost of the building. Considering how cost reduction can be achieved while maintaining architectural goals without compromise is important. One of the goals for this typology was for it to be replicable and applicable to any site for greater affordability in the future. This led to prefabrication, which was more prevalent for mass timber structures than conventional construction methods; it is just a matter of cost. Prefabrication has gained traction in countries such as China, utilized for its benefits in quality control, and waste reduction, reducing a building's carbon emissions by up to 15% compared to

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[160] Min Wang et al., "Examining the Impacts of House Prices on Self-Rated Health of Older Adults: The Mediating Role of Subjective Well-Being," *Buildings* 15, no. 1 (January 2025): 53, https://doi.org/10.3390/buildings15010053.\\uc0\\u8221{} {\\i{}Buildings} 15, no. 1 (January 2025

[161] "BUILDNOW: Waterloo Region," *BUILD NOW: Waterloo Region* (blog), accessed February 11, 2025, https://buildnowwr.ca/about-us/.

[162] Alex Bozikovic et al., *House Divided : How the Missing Middle Will Solve Toronto's Housing Crisis*, First (Toronto: Coach House Books, 2019), https://web-p-ebscohost-com.proxy.lib.uwaterloo.ca/ehost/ebookviewer/ebook/bmxlYmtfXzIwODc4NzNfX0FO0?sid=5c8f38ec-5102-4050-a868-65e58e2da198@redis&vid=0&format=EB&rid=1.

[163] Alex Bozikovic et al.

cast-in-situ construction. Considering that the construction industry accounts for 36% of global energy consumption, prefabrication offers an immediate solution to reduce carbon emissions created by the built environment.[164] In "Forest Products Journal," it is claimed that even though there is a higher upfront cost to mass timber than concrete, the total life cycle cost for 60 years shows mass timber to have a lower net cost. The bulk of these upfront costs stem from the cost of construction, meaning that as construction methods become more efficient for this material, costs can be reduced.[165] A pilot study conducted for the CreateTO additionally found mass timber more cost-effective than concrete. When the study was conducted, there were inflated costs concerning concrete, formwork, and rebar. Even though this was the case, the study projects that mass timber will be competitive with conventional construction methods within Toronto.[166] Looking at the cost and weighing the architectural intent, timber offers the premanufactured nature that this typology is looking for, additionally having the benefits of carbon offset. Regarding health-promotion, timber construction has been shown to affect occupants positively when not encapsulated. As the code around timber advances rapidly, it is hard to say if timber can be used for its health-promoting properties if it cannot be left exposed. Through the process of replicable design and components, this construction can be made more affordable with prefabricated parts built off-site. The benefit of standardized parts provides an opportunity for a building to be recycled over time, reusing parts in new buildings given they are in good condition.

One of the best examples within Toronto of exposing timber is Limberlost Place by Moriyama Teshima and Acton Ostry Architects. Their construction method also has the potential to be standardized and prefabricated for replicable construction. Limberlost Place utilizes a hybrid of timber and steel structure, built to 10-storeys of exposed timber.[167] Although a hybrid of steel and timber, the project creates a precedent of exposed timber for a different typology that can begin to shift into the residential realm. A prefabricated structure of this nature within its locality can serve as a starting point in housing typologies.

When looking to create a senior housing model that goes above the minimum, the cost of development is important in underlining that this new housing typology is to remain an affordable option. In creating a new typology of housing that can be applied to any site, standardized components can be easily replicated and proven efficient from a cost and constructability perspective. The proposed structural system will be prefabricated, allowing for precise reproduction of parts **[see Figure. 18]**. Generous spans allow for flexible interior spaces that cater to site-specific requirements, such as how the ground plane of the building interacts with its context. Rooms and ergonomic devices are standard in their designs but not prescriptive in accessibility, offering universal flexibility for occupants. A catalogue of these rooms and ergonomic devices will be designed, using health-promoting theories to guide design decisions with the overarching goal of creating a space that feels like home **[see Chapter 4 – Towards a New Architecture for Aging].**

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164 Jian Li Hao et al., "Carbon Emission Reduction in Prefabrication Construction during Materialization Stage: A BIM-Based Life-Cycle Assessment Approach," *Science of The Total Environment* 723 (June 25, 2020), https://doi.org/10.1016/j.scitotenv.2020.137870.

165 Hongmei Gu, Shaobo Liang, and Richard Bergman, "Comparison of Building Construction and Life-Cycle Cost for a High-Rise Mass Timber Building with Its Concrete Alternative," *Forest Products Journal* 70, no. 4 (February 4, 2021): 482–92, https://doi.org/10.13073/FPJ-D-20-00052.

166 CreateTO, "Mass Timber Pilot Study - Key Findings and Next Steps" (Toronto, March 27, 2023), https://www.toronto.ca/legdocs/mmis/2023/ra/bgrd/backgroundfile-235430.pdf.

167 "Limberlost Place," Moriyama Teshima Architects, accessed December 31, 2024, https://mtarch.com/projects/limberlost-place-george-brown-college/.

assembly

exploded assembly of structural module.

Figure 18:

Structure informed by Limberlost Place by Moriyama Teshima and Acton Ostry Architects

Components

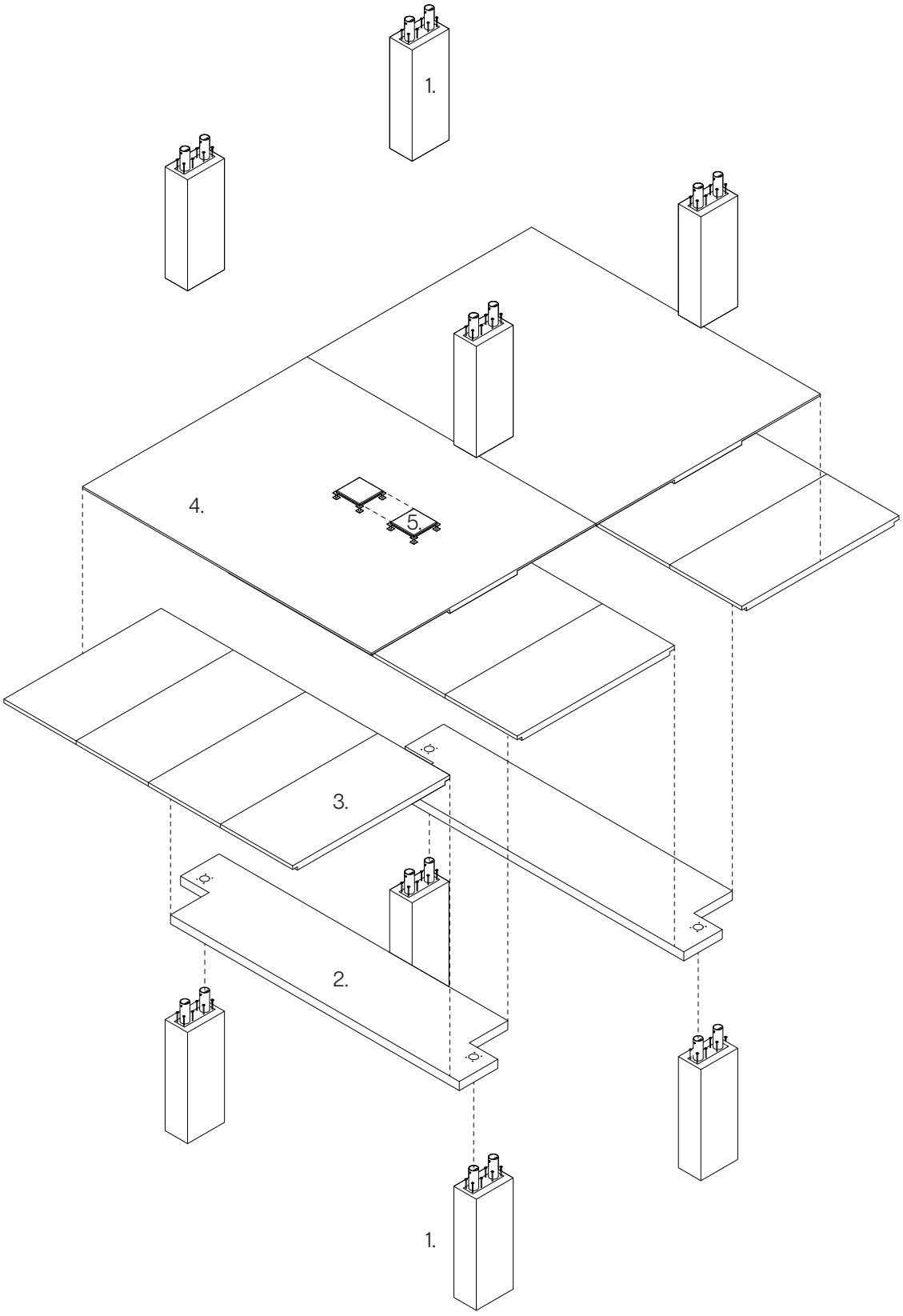
1. Glulam column with stacking hardware

2. CLT Slab

3. CLT infill slab

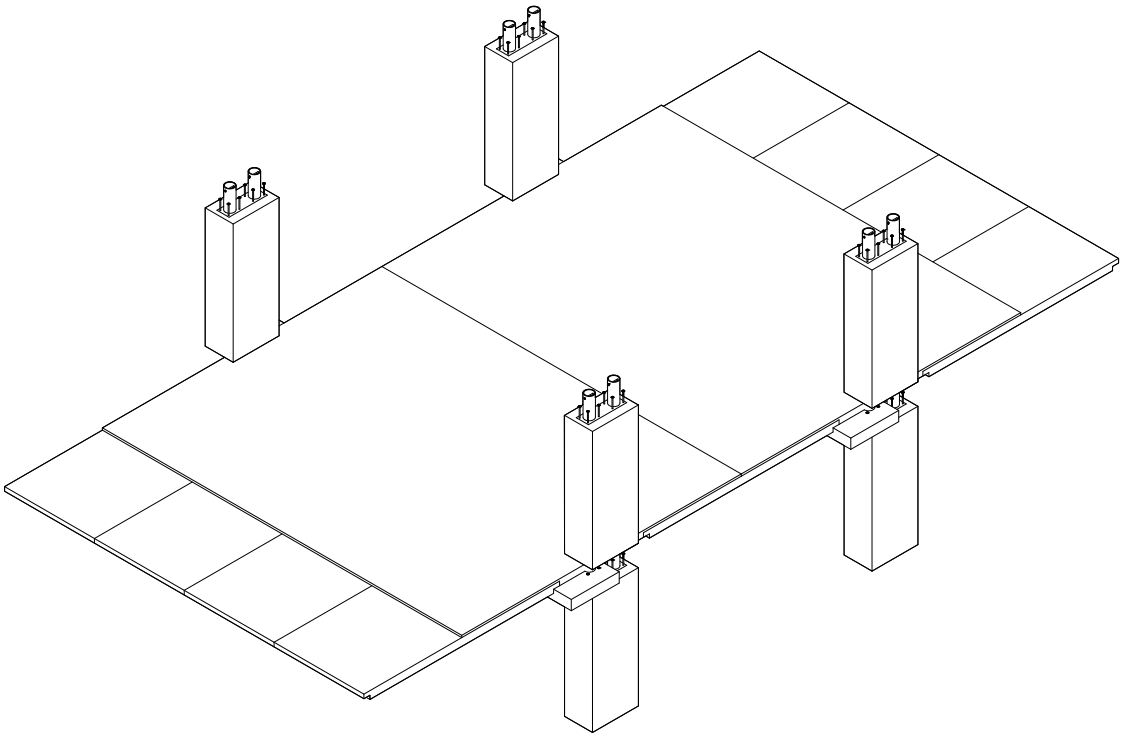
4. Concrete topping

5. Raised utility access floor



modular structure

replicable = affordable.



04

towards a new architecture for aging

developing a design vocabulary of spaces and their details.

Ergonomics for Healthy Aging

This chapter is focused on the aging human body, and how aging affects our interactions with the built environment. The typical hospital/LTC/RH setting is designed to cater to accessibility and the safety of patients, yet these spaces are overtly institutional and do not foster a sense of home. The heavy focus on accessibility inhibits those still able-bodied, as the architecture is catered to a specific occupant. This can increase the prevalence of sedentary lifestyles in older adults because the architecture does not passively encourage more active lifestyles. Architecture can promote physical activity, but the overarching experience of using a space needs to provide a feeling of comfort that encourages continued use. The human body's interaction with space is not solely based on visual perception but on various points of contact within a space. The built environment has a diverse range of elements that affect human emotion and behaviour. Examples of these elements are natural ventilation, air quality, chemical contaminants of materials, excessive temperatures or noise, and lighting levels.[168] Accessibility is often viewed as a checklist and fails to consider the ergonomics of space relative to different ranges of ability. Not as often are the ergonomics of space considered in making it more accessible and safer to a wider range of people. Equally important is architecture at a detailed scale because, cumulatively, details discreetly define our experience of the built environment. For some who have a disability, their interaction with a space looks very different from another. The consideration of the ergonomics of space is becoming ever more important as the number of people with at least one disability is on the rise. Statistics Canada found that 27% of Canadians aged 15 and up have at least one disability that impacts their day-to-day activities. Of those aged 65+, mobility, agility, and pain-related issues were among the most common.[169] Implementing strategies that make day-to-day tasks less strenuous on the aging body allows for prolonged independence and is critical to fostering a meaningful outlook on life.

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[168] Mustafa and Ali, "Active Design: Architectural Interventions for Improving Occupational Health Through Reducing Sedentary Behavior."

[169] Statistics Canada Government of Canada, "The Disability Rate in Canada Increased in 2022," April 3, 2024, https://www.statcan.gc.ca/o1/en/plus/5980-disability-rate-canada-increased-2022.

Keywords:

The Modulor

Vitruvian Man

The Human Archetype and The New Modulor

Over five hundred years ago, Leonardo da Vinci created one of human history's most recognizable drawings, depicting a man's ideal proportions.[170] Just over four hundred and fifty years later, Le Corbusier created The Modulor, a proportion system built around a human figure based on mathematics and human form.[171] Leonardo da Vinci's Vitruvian Man and Le Corbusier's Modulor both depict tall, muscular, able-bodied men as the human archetype around which the built world should be established. At the time of the creation of both figures, accessibility was of far less concern in the built environment compared to today, where many guidelines and standards advocate for a new standard. As graphic standards play such a significant role in architecture, it is important to consider a human figure that is more inclusive in age, race, gender, and physical ability.[172] Moving away from a single scalar figure, a diverse range of body types, abilities, races, and genders will make up the new Modulor.

The following pages offer a catalogue of design considerations responding to the changing ergonomics of the aging body. This will explore the adaptability of architectural elements addressing a range of mobility capacities beyond the able-bodied occupant. A specific focus on tectonics and details of space can foster feelings of acceptance, comfort, and accessibility currently lacking in the antiquated architecture of LTC/RHs today.

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[170] Diana M. Thomas et al., "Revisiting Leonardo Da Vinci's *Vitruvian Man* Using Contemporary Measurements," *JAMA* 323, no. 22 (June 9, 2020): 2342, https://doi.org/10.1001/jama.2020.3501.

[171] Marie-Pascale Corcuff, "Modularity and Proportions in Architecture and Their Relevance to a Generative Approach to Architectural Design," *Nexus Network Journal* 14, no. 1 (April 1, 2012): 53–73, https://doi.org/10.1007/s00004-011-0097-x.

[172] Lance Hosey, "Hidden Lines: Gender, Race, and the Body in 'Graphic Standards,'" *Journal of Architectural Education (1984-)* 55, no. 2 (2001): 101–12.

Figure 19:

Adapted from Leonardo da Vinci. Vitruvian Man. 1490. Ink, 35cm x 26cm.

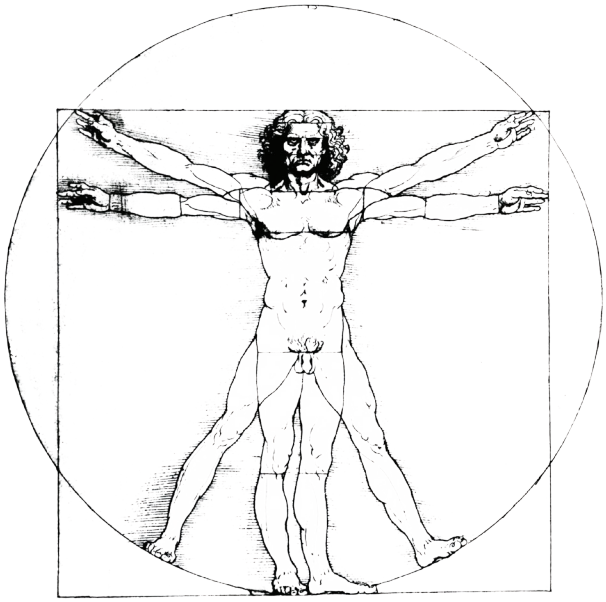


Figure 20:

Adapted from Le Corbusier. The Modulor. 1955.

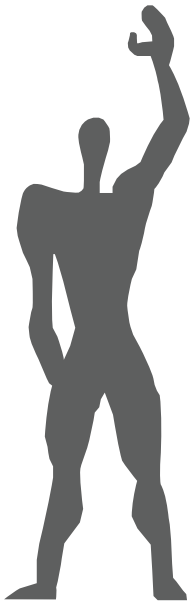
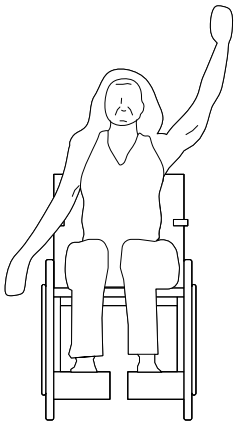


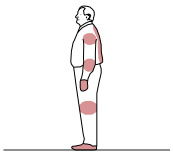
Figure 21:

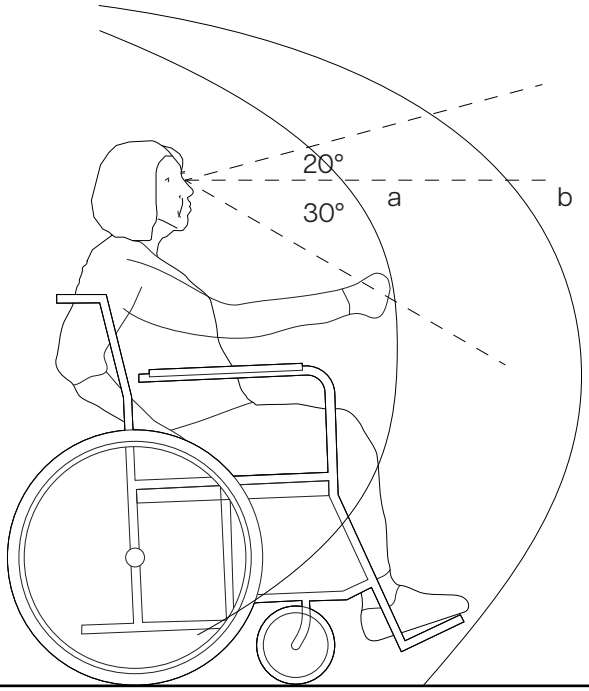
The undiscussed modulor.

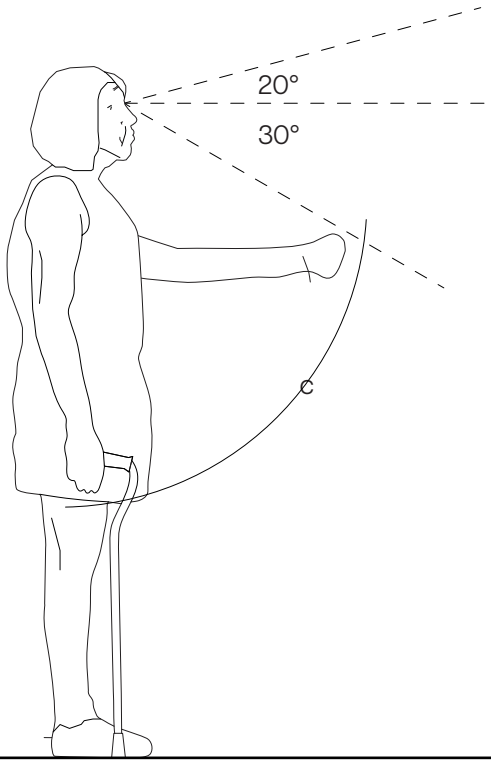


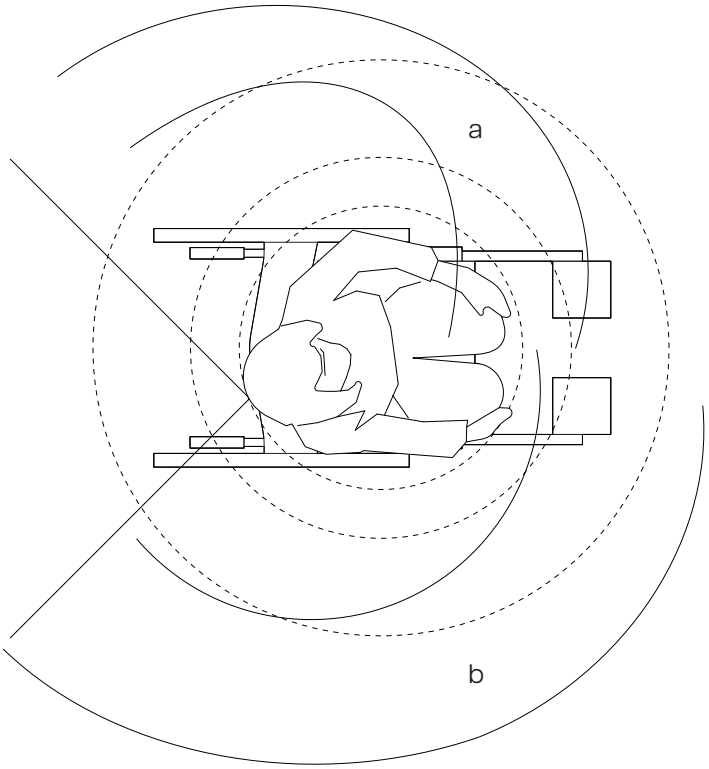
range of motion

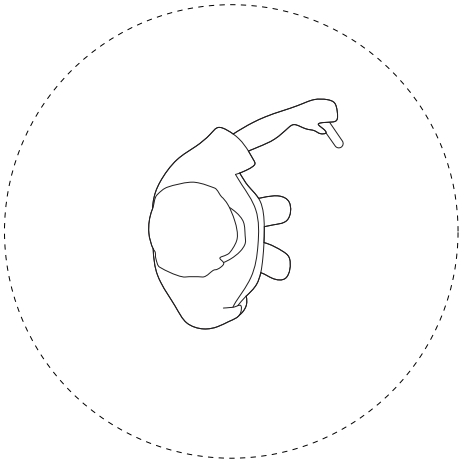
accessibility of the aging body in space.











5’-0” [1.50m] min. turn radius

a - comfortable reach from seat

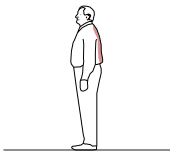
b - extended reach from seat

4’-0” [1.20m] min. turn radius

c - comfortable reach from standing position

*all information and diagrams adapted from *Neufert Architects’ Data Fourth Edition*.

posture and balance



changes in the aging body's form.

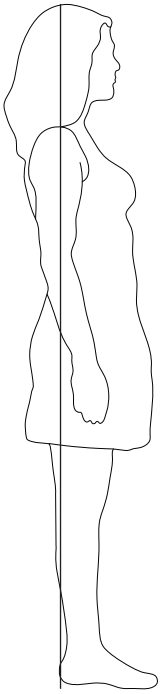
Stages of Posture

1. Centred joints and centre of gravity

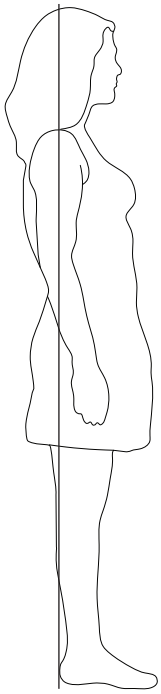
2. Youthful posture with mild kyphosis (rounding of back)

3. Kyphosis with no forward lean

4. Kyphosis and forward-leaning



1.



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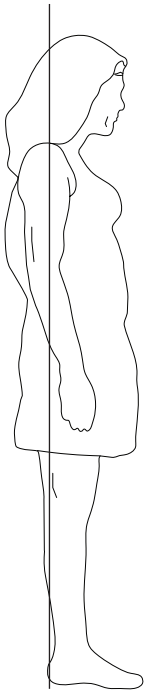

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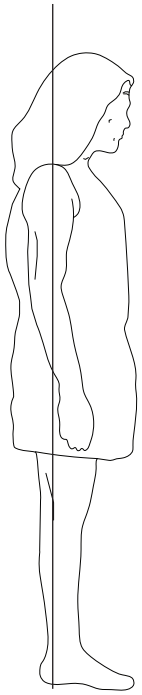


4.

Age Range

65-79

Change in Height

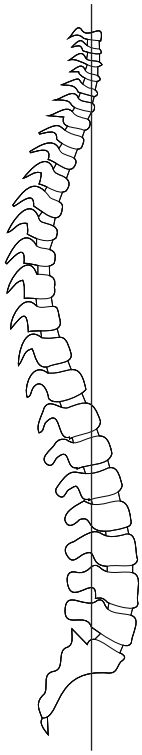
-48mm

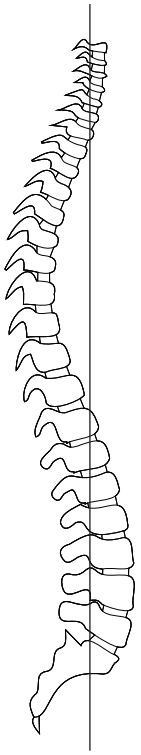
Age Range

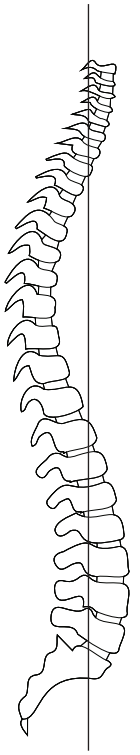
80+

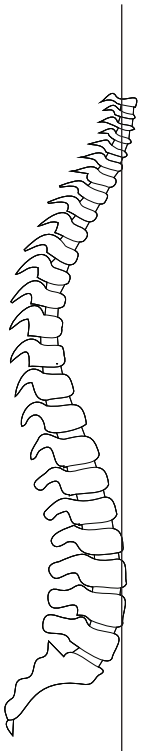
Change in Height

-54mm







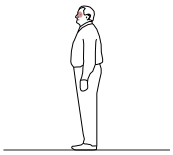


*information and diagrams adapted from "Changes in posture and balance with age".

*spine diagrams adapted from "The Spine: Anatomy and Function"

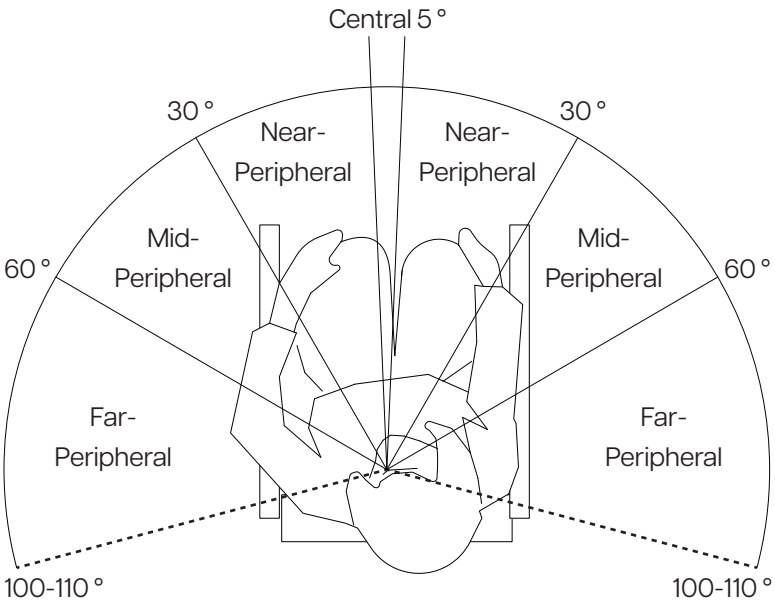
ergonomics of the eye

aging range of vision and legibility.



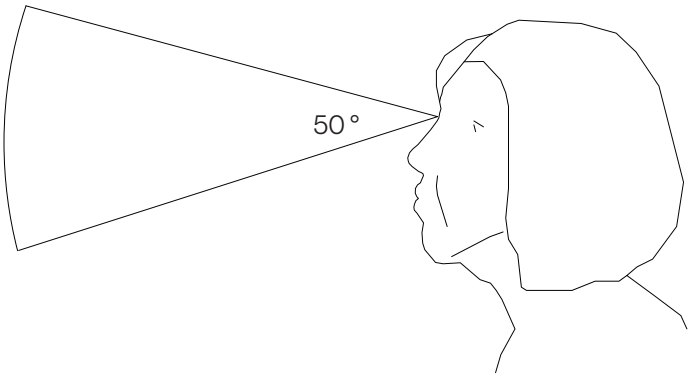
Field of Vision

As one ages, their field of vision gradually diminishes, losing both range in peripheral and central vision.



Aperture of Vision

The approximate aperture of healthy near-peripheral vision.



Reading Font Size (Near Sight)

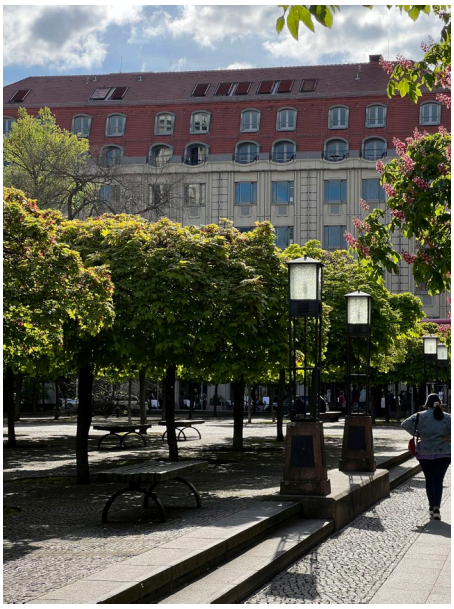
As our eyes begin to decline, it is important to consider readability in the design of a building in relation to font size. Relevant information, such as wayfinding, is a key consideration in accessibility and safety.

Age 10	Example Text	2.5mm
Age 20	Example Text	2.8mm
Age 30	Example Text	3.2mm
Age 40	Example Text	3.5mm
Age 50	Example Text	4.2mm
Age 60	Example Text	4.9mm
Age 70	Example Text	5.6mm
Age 80+	Example Text	6.7mm

*all information and diagrams adapted from "Gaze-Aware Streaming Solutions for the Next Generation of Mobile VR Experiences, Perception Research of Artificial Intelligence in Environmental Public Health Physiotherapy Nursing for the Elderly".

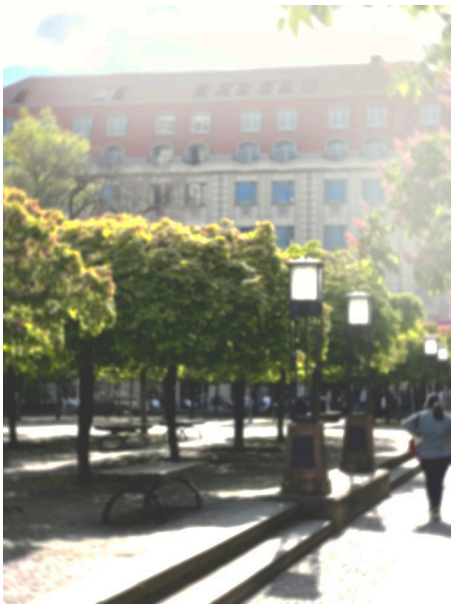
vision impairment

changing the perception of space.



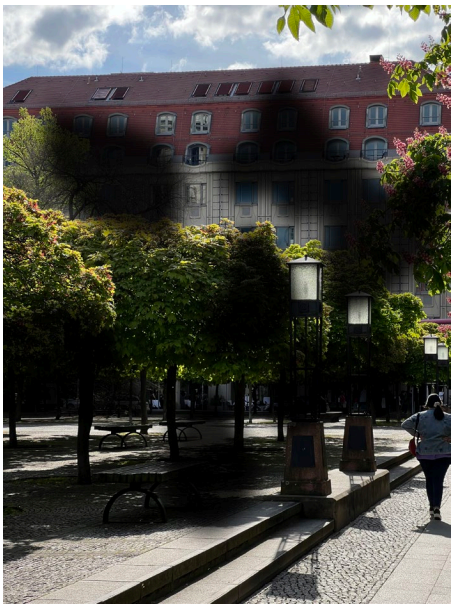
Healthy Vision

Limited impairments.



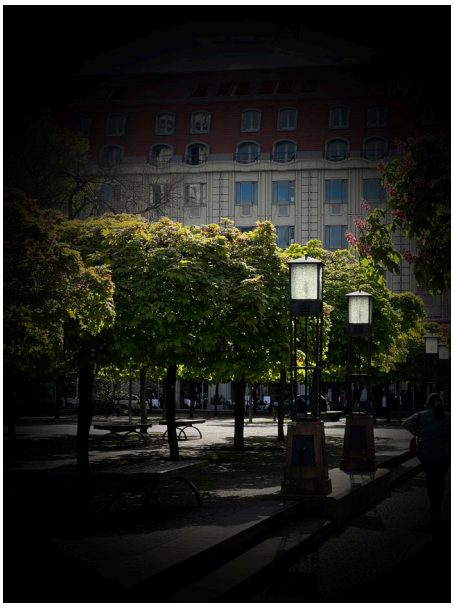
Cataracts

Bright colours can become faded.



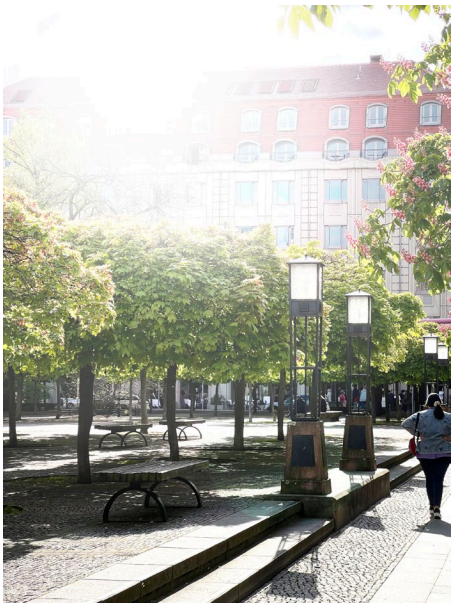
Diabetic Retinopathy

Can cause blotchy vision, especially in daylight.



Glaucoma

Loss of peripheral vision.



Glare

Intensified glare from light sources.

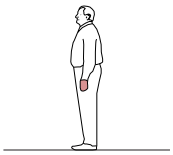
Presbyopia

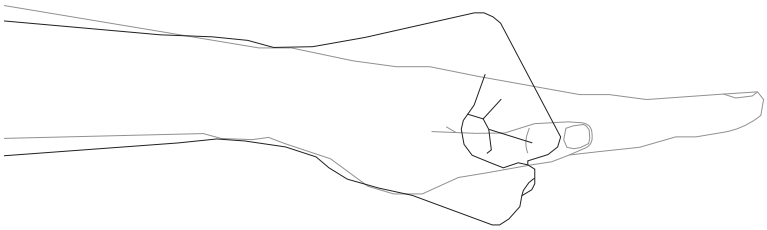
Farsightedness with age.

*all information and diagrams adapted from Versant Health's Vision Loss Simulator.

ergonomics of the hand

aging range of motion, dexterity, strength, and skin coefficient.





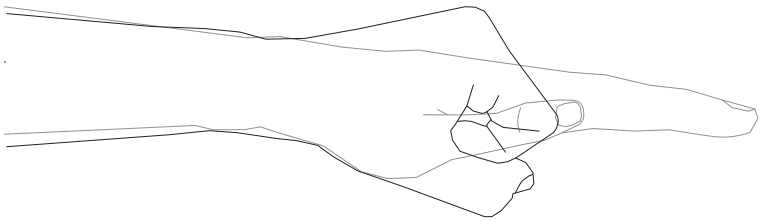
Range of Motion
95-100%

Strength
95-100%

Friction Coefficient
75-100%

Ages 20-40

This age group has the highest range of motion, strength, and friction coefficient of skin.



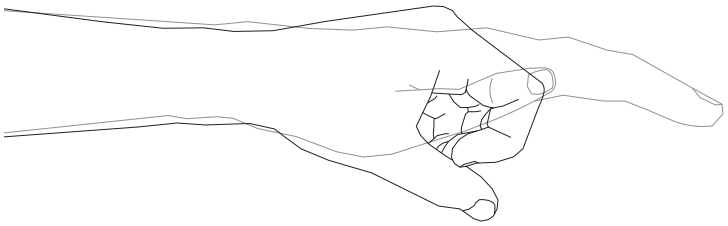
Range of Motion
85-95%

Strength
70-95%

Friction Coefficient
30-75%

Ages 40-80

This age group is where range of motion, strength, and friction coefficient of skin begin to decline.



Range of Motion
80-85%

Strength
55-70%

Friction Coefficient
30%

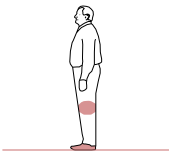
Ages 80+

This age group has a significantly lower range of motion, strength, and friction coefficient of skin.

*all information taken from "Grasp Synthesis for the Hands of Elderly People with Reduced Muscular Force, Slippery Skin, and Limitation in Range of Motion".

interior thresholds

designing accessible transitions.

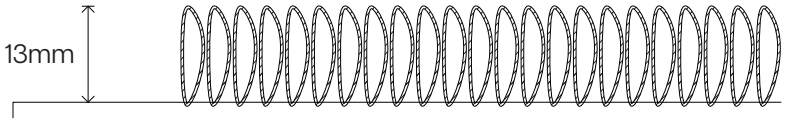


Hard Surface Threshold

Changes in level can be up to 1/4" [6mm], and 1/2" [13mm]given that there is a 1:2 slope after 1/4" off the ground. Changes in level are not permitted in clear floor space.

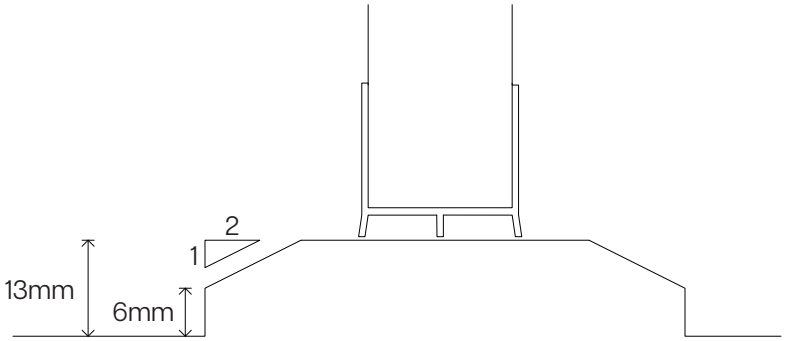
Carpet Threshold

The carpet pile is to have a maximum height of 1/2" [13mm] given that the surface is firm with limited to no cushion below.



Door Threshold

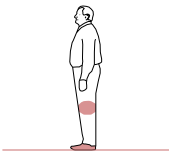
Thresholds at a doorway can have a maximum height of 1/2" [13mm], given that there is a 1:2 slope after 1/4" [6mm] off the ground.



*all information and diagrams adapted from *ADA in Details: Interpreting the 2010 Americans with Disabilities Act Standards for Accessible Design*.

exterior thresholds

designing accessible transitions.

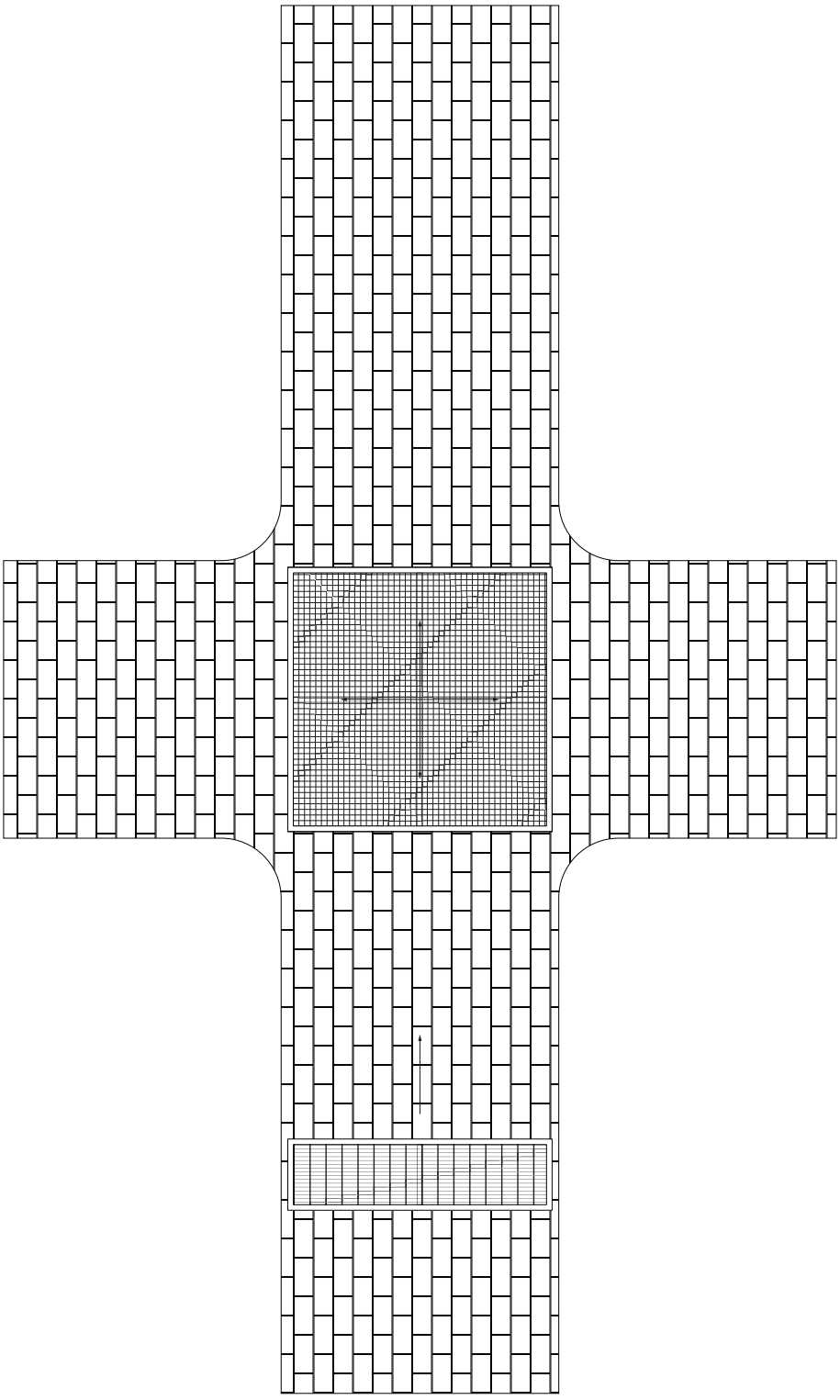


Non-directional Openings

Openings in walkways can be a maximum of 1/2" [13mm] between grates, pavers, or control joints.

Linear Openings

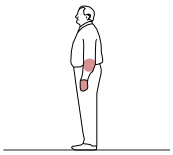
Elongated linear openings in walkways can be a maximum of 1/2" [13mm] in the direction perpendicular to pedestrian flow.

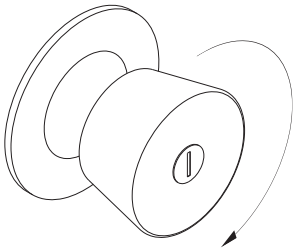


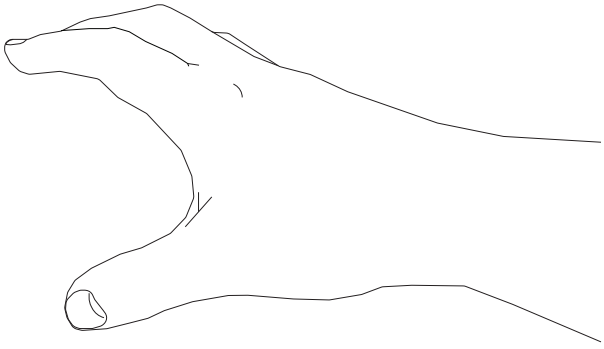
*all information taken from *ADA in Details: Interpreting the 2010 Americans with Disabilities Act Standards for Accessible Design*.

the door handle

aging made accessible.

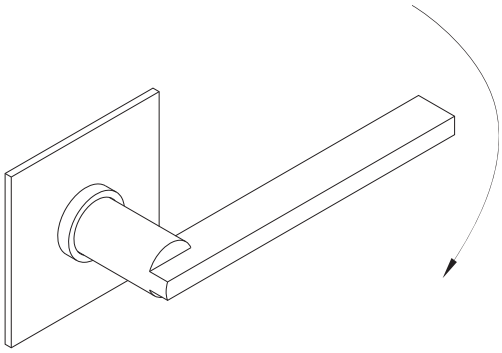


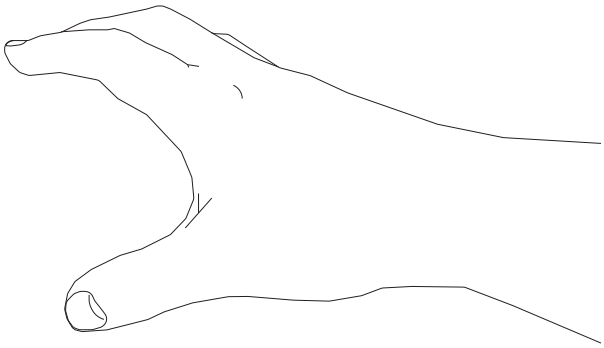




Standard Knob Handle

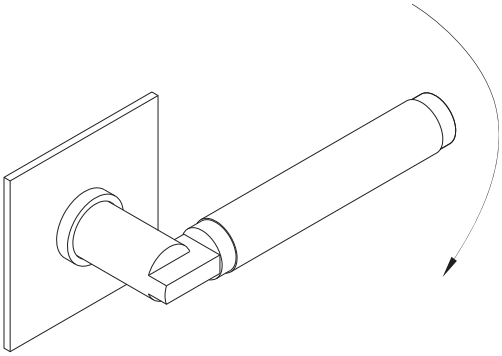
Knob handles require dexterity, strength, and range of motion in the hand and wrist. This handle is best suited for younger occupants.

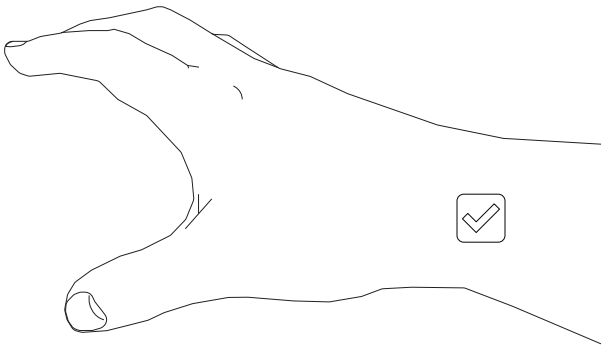




Lever Handle

Lever handles require less dexterity, strength, and range of motion ,as grip strength is not as necessary. This handle is best as range of motion (ROM) starts to decline.



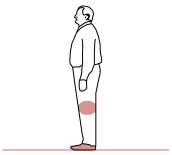


Lever Handle for the Aging

As dexterity, strength, and range of motion significantly reduce, adding grip to an enlarged handle makes doors more accessible.

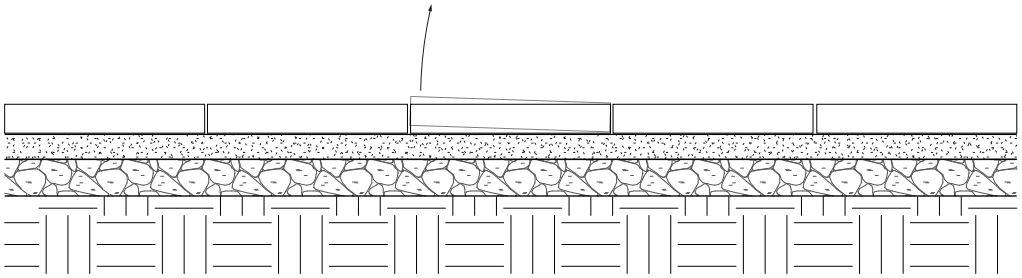
exterior materiality

encouraging safe use of the outdoors and predicting potential hazards.



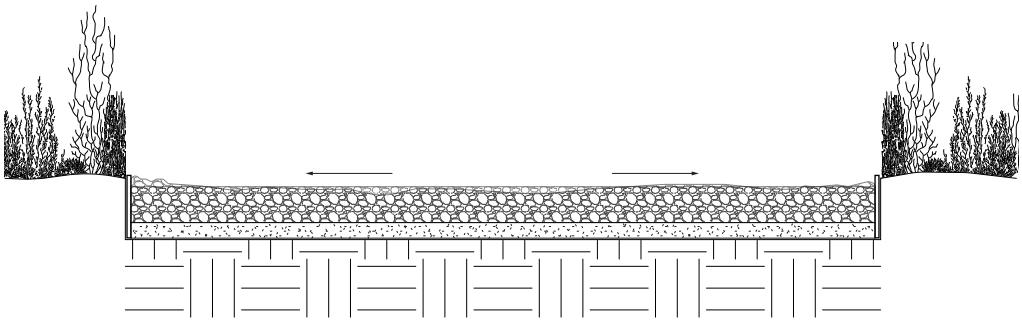
Paver Pathway

Permeable surfaces require a high frequency of maintenance in order to be considered accessible.



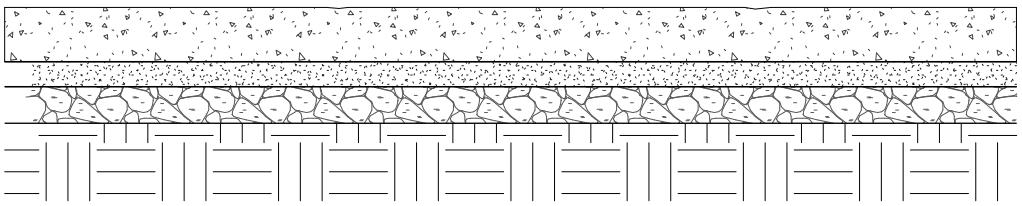
Gravel Pathway

Gravel can become loose when exposed to the elements. When not firmly packed, it can be considered inaccessible, even causing adjacent surfaces to be unsafe if loose aggregate is present.



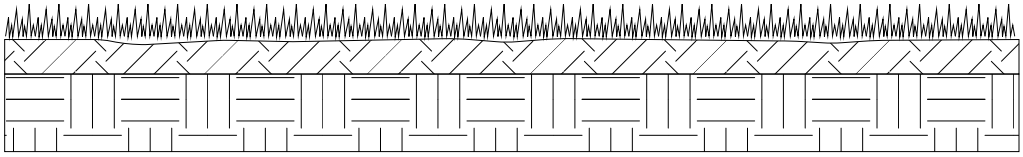
Concrete Pathway

Concrete is a permeable surface that can develop imperfections when exposed to the elements. Oil and gas can change this permeability, leading to standing water, changing traction, and potential dangers in colder climates.



Grass

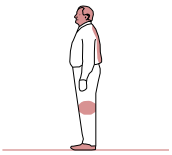
Grass and other natural surfaces are unpredictable and should not be considered accessible unless frequently maintained.



*all information taken from *ADA in Details: Interpreting the 2010 Americans with Disabilities Act Standards for Accessible Design*.

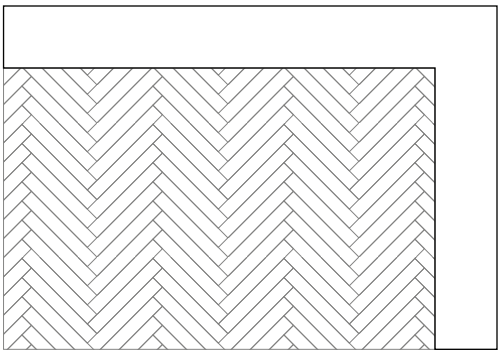
interior materiality

encouraging safe use of indoors through surfaces.



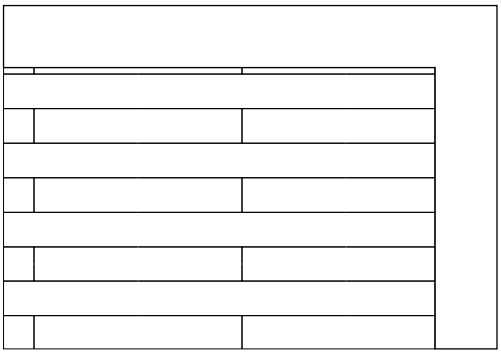
Wood Flooring

Wood provides a connection to nature through its texture and colouring. Its warm properties provide comfort to occupants, but as it is porous, it can lead to difficulties in cleaning.



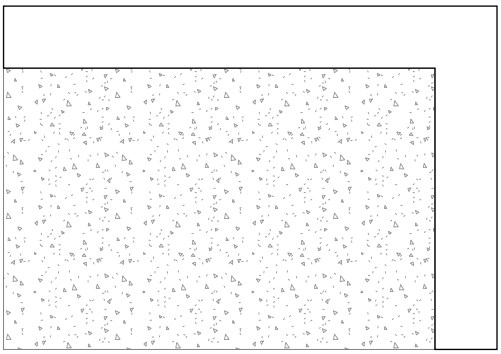
Vinyl Flooring

Similar to wood flooring, vinyl is a mimicry of nature and can have many of the same effects. Different from wood, vinyl is smooth and waterproof, allowing for easier maintenance.



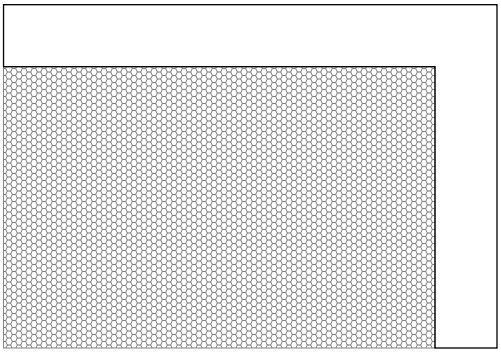
Concrete Flooring

Concrete is cold and hard, leading to discomfort. Concrete can be used in spaces that favour durability over comfort.



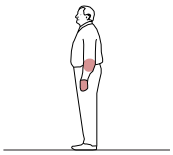
Rubber Flooring

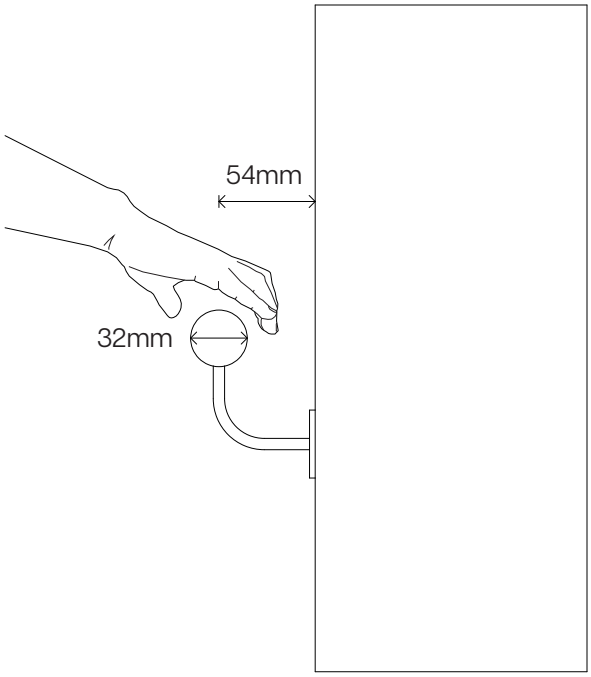
Rubber is an anti-slip surface that is waterproof, durable, and easily cleaned. If cushioned, rubber can reduce fall impacts, a common danger in LTC and RHs.



the handrail

corridor and stair accessibility.



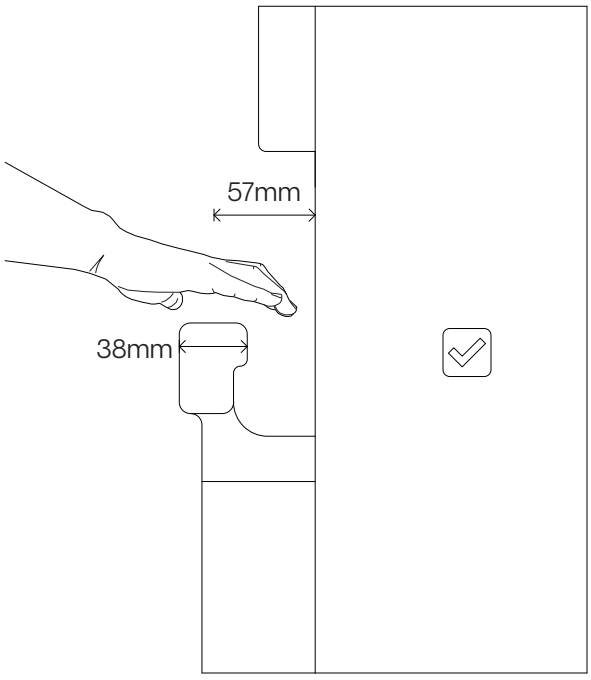


Standard Grab Bar Handrail

In order to use this handrail, users need to make a cup shape to wrap around the railing. With decreased dexterity and ROM, these railings become more difficult to use with age. With a decreased skin coefficient, this railing shape can be slippery due to its purely curved surface.

Distance From Wall
54mm

Support Width
32mm



Leaning Handrail

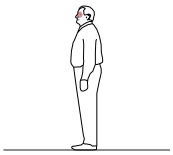
A leaning handrail allows users to lean or wrap their hands around the railing. The flat surface supports leaning for those with limited ROM. As the railing is better integrated into the wall, it deviates from an institutional setting.

Increased Distance From Wall (+)
57mm

Increased Support Width (+)
38mm

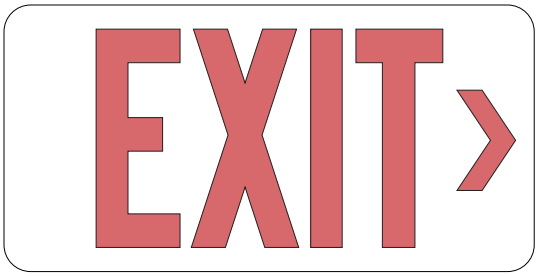
wayfinding

navigating the built environment.



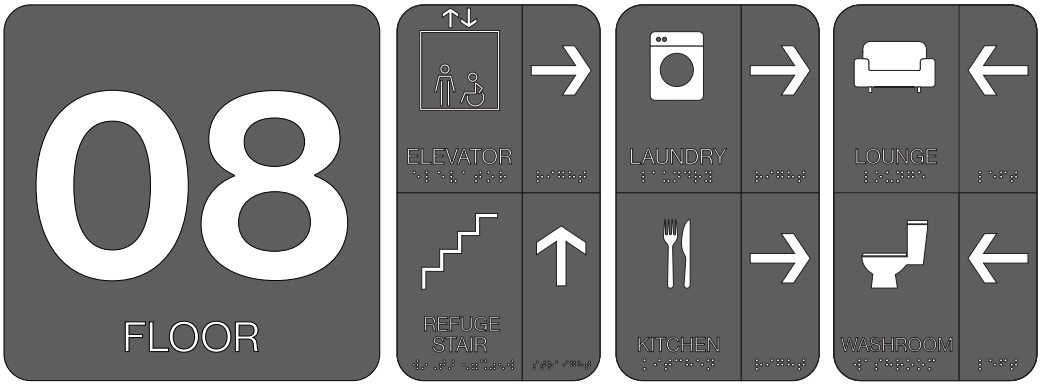
Safety Signage

Although not home-like, standardized signing that is easily recognizable is key to the safety of all building occupants.



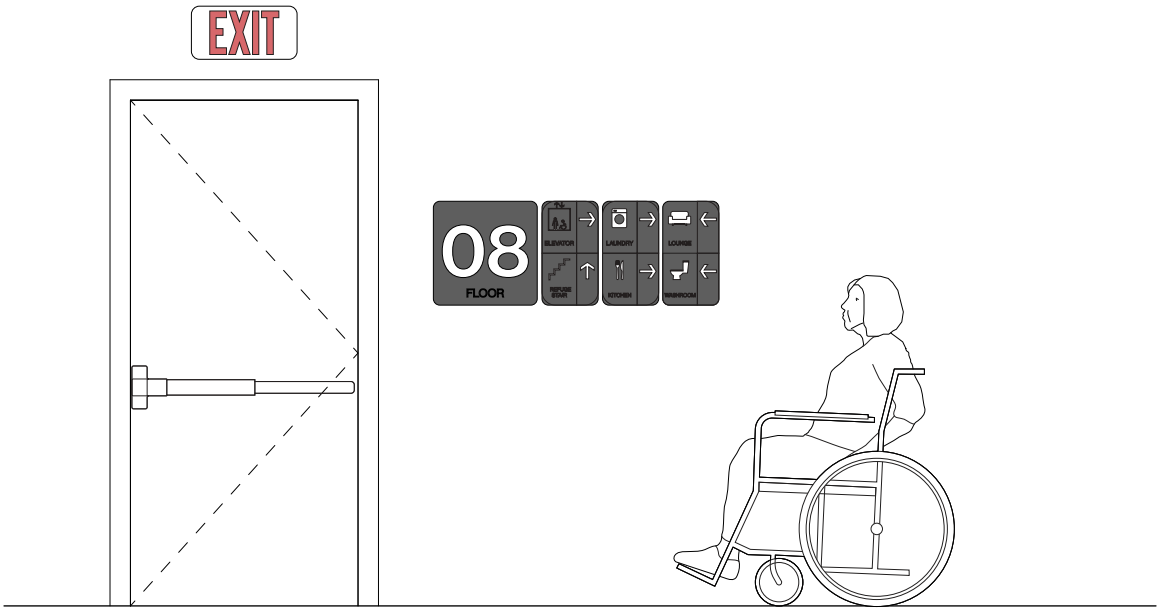
Wayfinding Signage

High-contrast floor directory signage allows for readability for those with reduced visibility or impairments that affect legibility.



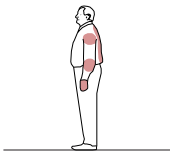
Signage Placement

Signage located at corridor intersections and outside vertical circulation allows for ease in navigating unfamiliar areas.



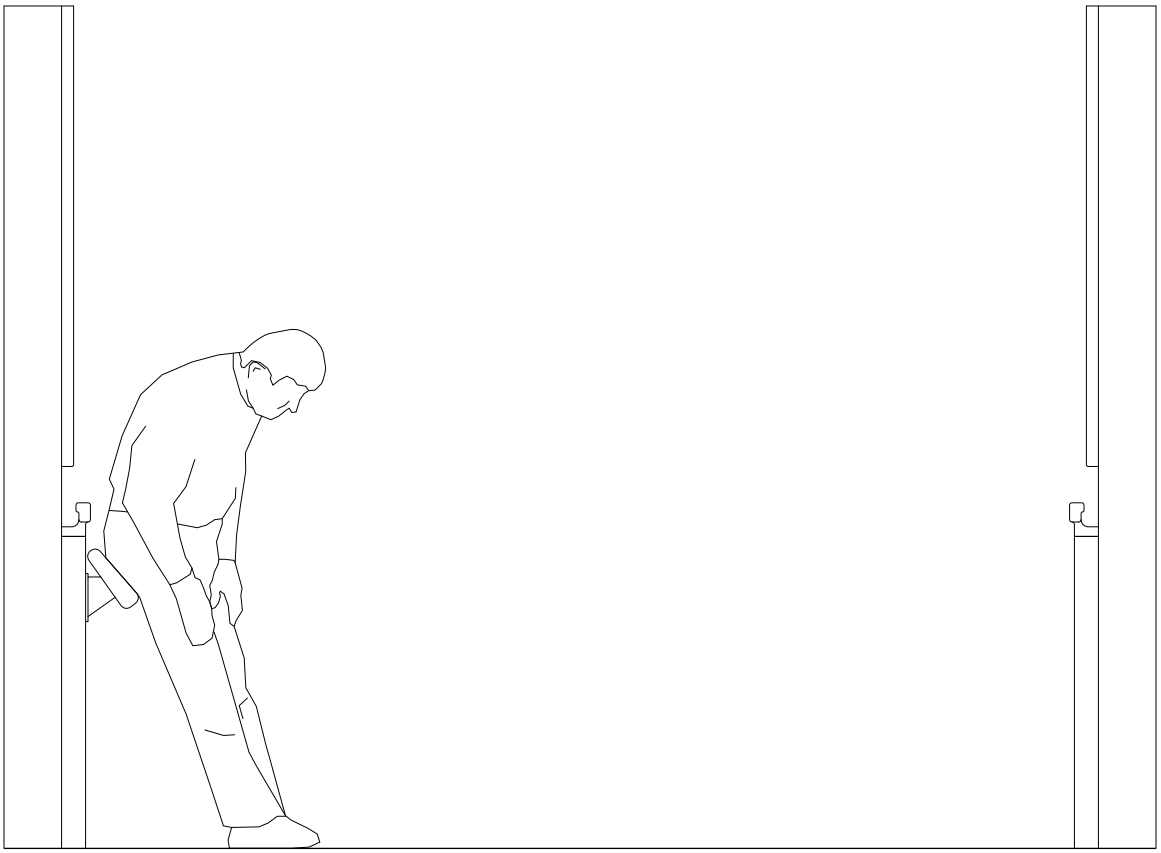
the leaning bench

corridor rest spots.



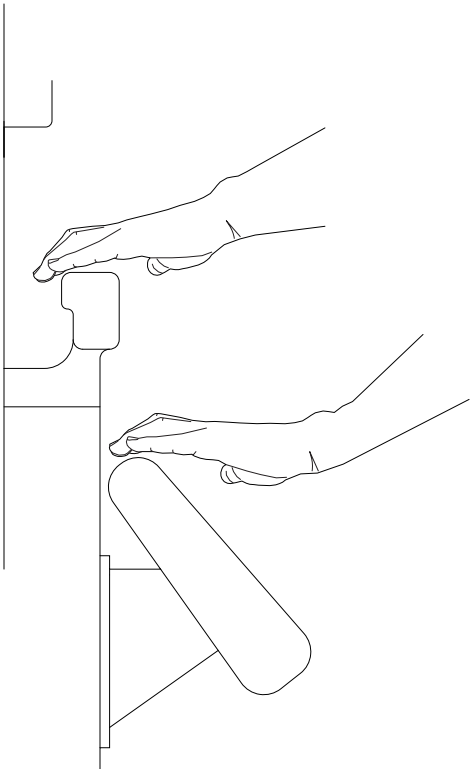
Leaning Bench

This is not meant to replace the bench or seated position but to allow for brief rests from physical activity. This position also reduces the strain of getting up from a seated position.



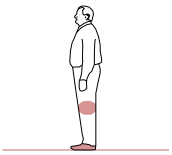
Balance Aid

When paired with the corridor's handrail, the bench works as a secondary support device that can be used to maintain balance.



the stair

encouraging active aging..



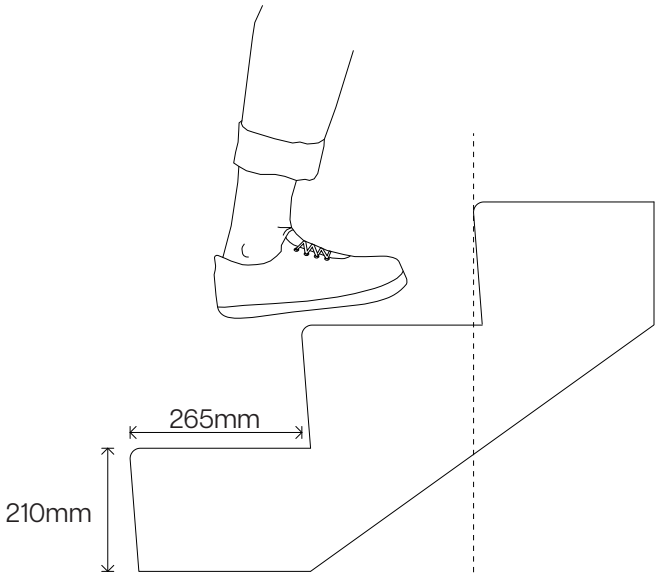
Standard Stair Design

With falls being more common among older adults, stairs are not as much of a consideration in LTC/RHs. The standard stair design is not specific to LTC/RHs, therefore stairs themselves are not age-friendly, leading to increased falls/accidents and promoting inactive lifestyles through lack of accessibility. Large nosings and small tread lengths lead to increase falling-tripping potential.

Tread
Min. 220mm, Max. 265mm

Riser
Max. 210mm

Nosing
Max. 15mm



Aging-Oriented Stairs

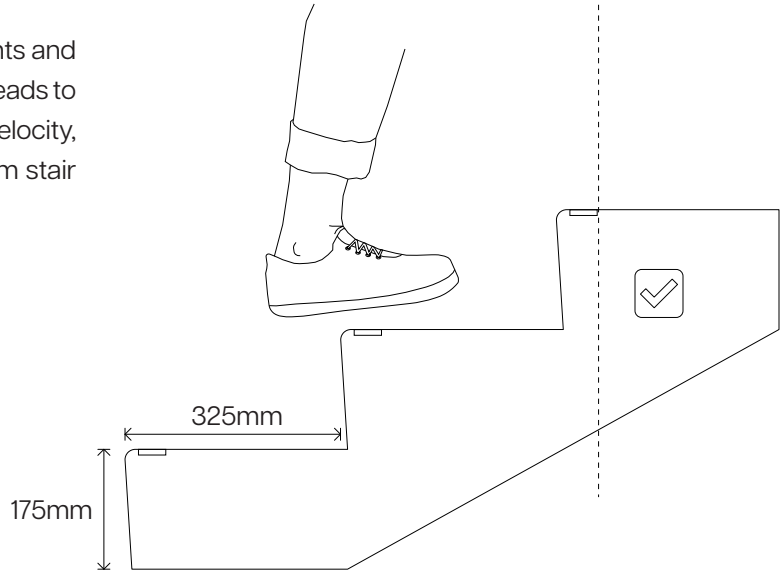
By making stairs safer, we can decrease potential accidents and increase/prolong active lifestyles. Increased tread length leads to decreased reliance on handrails, increases balance and velocity, and increases both vertical and horizontal clearance from stair to stair.

Increased Tread Length (+)
325mm

Decreased Riser Height (-)
175mm

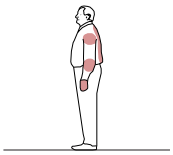
Reduced Nosing (-)
0-10mm

Tactile/Colour Contrast Strip Added



*all information taken from *Ontario Building Code*, *Design Guidelines for Rest Homes / Retirement Homes in Ontario*, "Stair Gait in Older Adults Worsens With Smaller Step Treads and When Transitioning Between Level and Stair Walking".

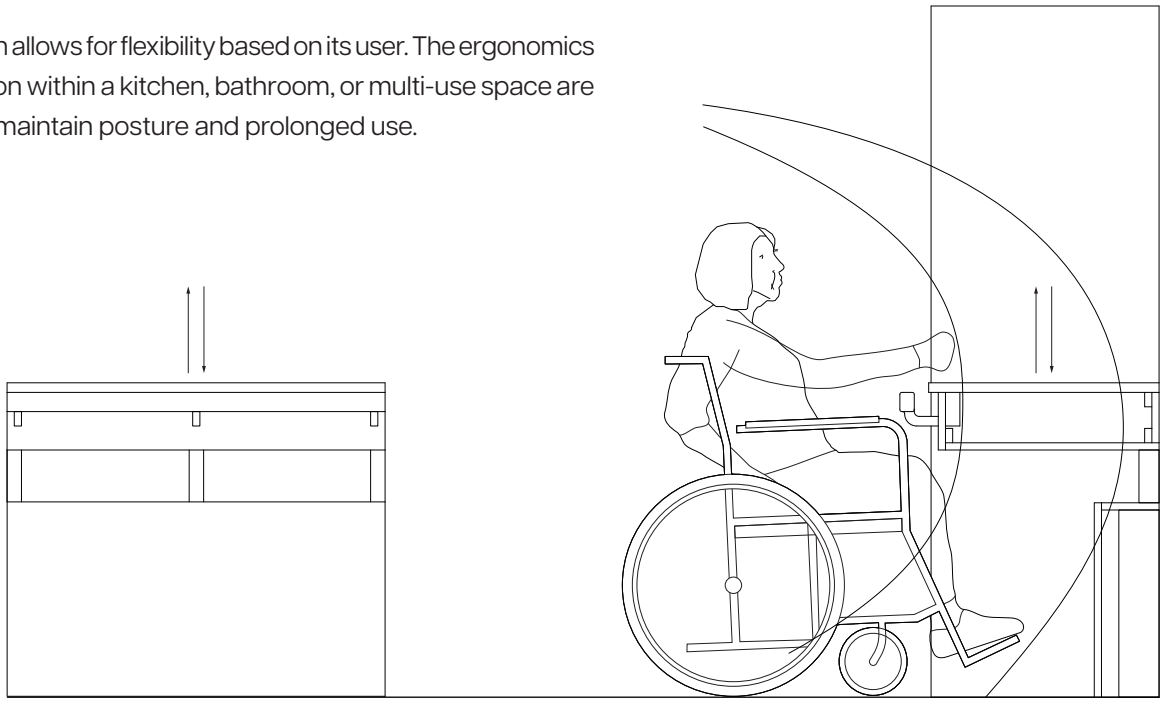
reach and wingspan



comfortable navigation at varied heights.

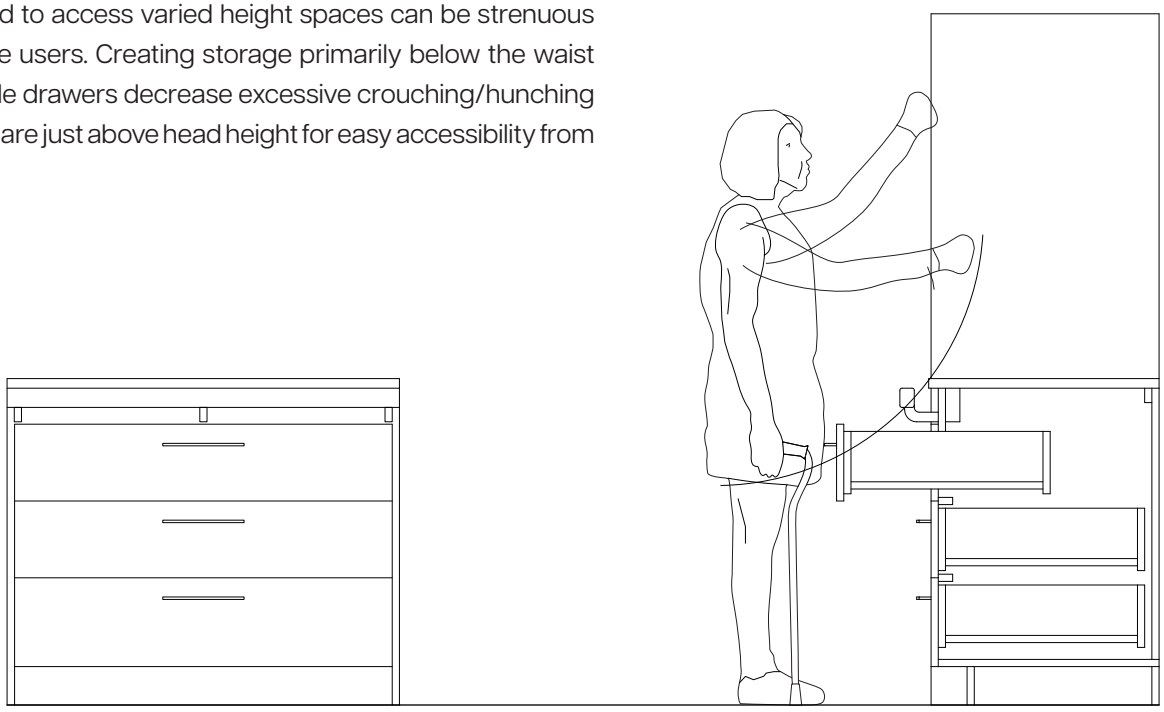
Workstation

An adjustable workstation allows for flexibility based on its user. The ergonomics of the primary workstation within a kitchen, bathroom, or multi-use space are important and can help maintain posture and prolonged use.

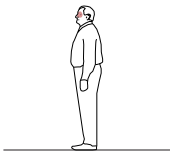


Storage

The movements required to access varied height spaces can be strenuous and dangerous for some users. Creating storage primarily below the waist helps to reduce this, while drawers decrease excessive crouching/hunching over. Large storage units are just above head height for easy accessibility from an upright position.



window types

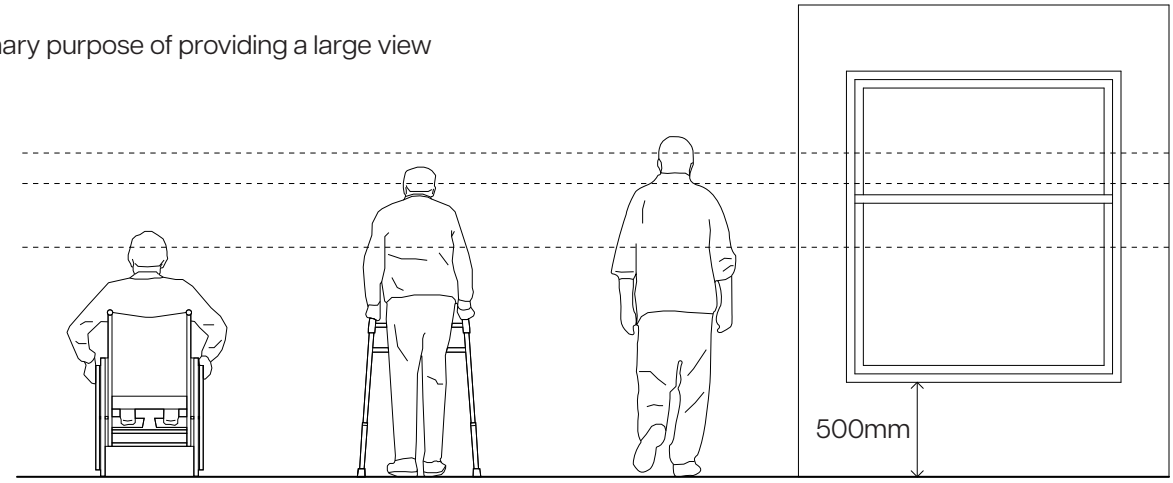


a visual connection to the outdoors.

Viewing Window

A window with the primary purpose of providing a large view of the outdoors.

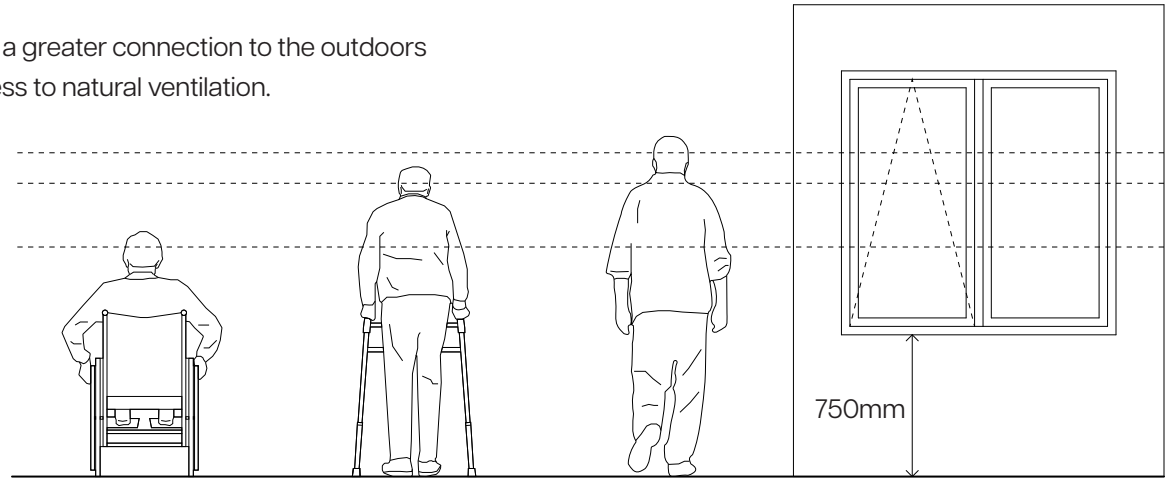
Distance Off Floor
500mm



Operable Window

A window that provides a greater connection to the outdoors via ample light and access to natural ventilation.

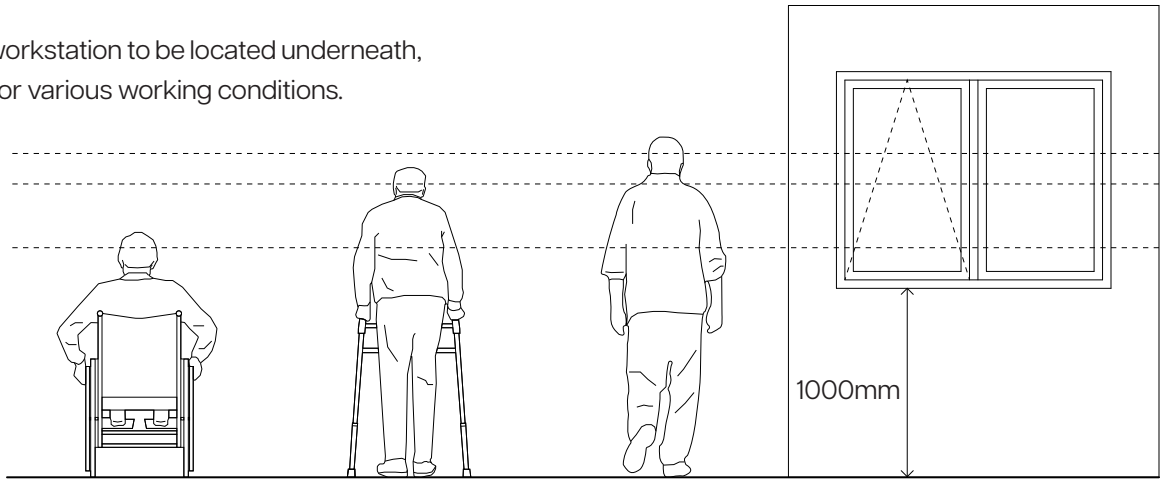
Distance Off Floor
750mm



Workstation Window

A window that allows a workstation to be located underneath, provides sufficient light for various working conditions.

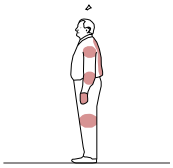
Distance Off Floor
1000mm



*all information and diagrams adapted from *Neufert Architects' Data Fourth Edition*.

the exterior bench

rest spots with views.



Exterior Bench

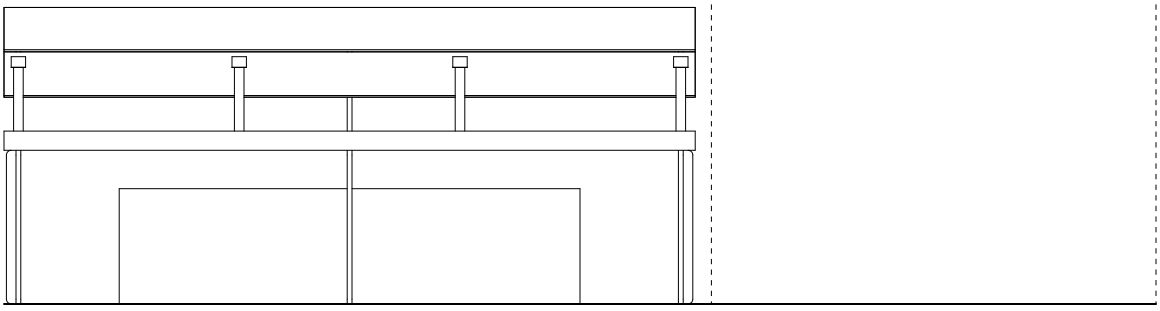
A bench under a tree provides shade, and allowing for more comfortable conditions to sit for longer periods of time.

Handrail

An elevated handrail assists in vertical mobility and support to and from a seated position.

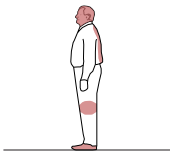
Clear Space

A space beside a bench allows for wheelchairs to be in-line with other users.



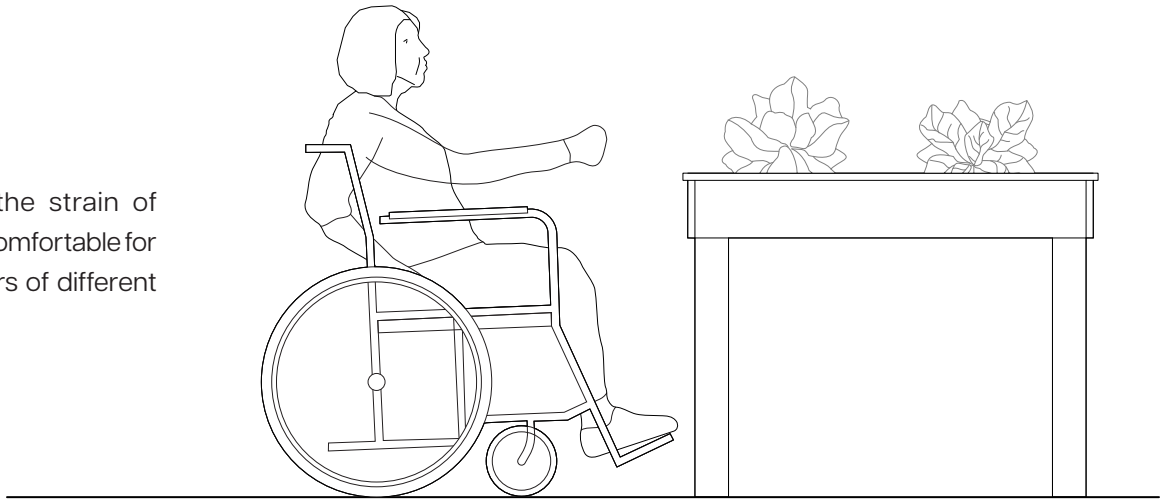
the garden

comfortable connection to nature,



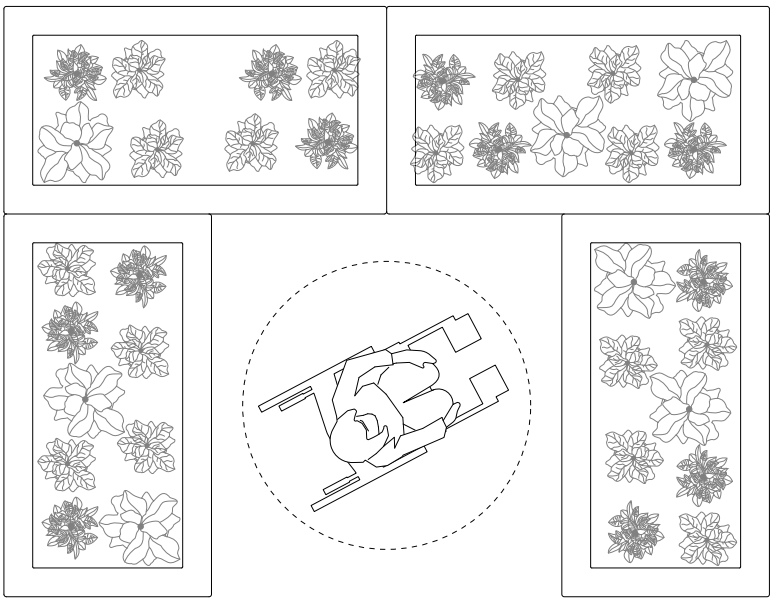
Raised Beds

Raised beds reduce the strain of crouching, being more comfortable for a broader range of users of different physical abilities.



Turning Radius

Gardens should be arranged so that they are wheelchair accessible, allowing all users to experience the benefits of gardening.



Towards Universal Design

The following section will outline the thesis to this point, drawing on health-promoting theories and ergonomics for healthy aging while being structured around prefabricated elements. Other theories and researchers' work also support health-promoting theories, predominately from Terrapin's *14 Patterns of Biophilic Design*. Building off a renewed "Modulor," spaces are more universally accessible and can prolong self-autonomy into later years. In designing a realigned architectural approach, holistic design can significantly improve the quality of life for a range of occupants through their physical environment.

Project Housing Types:

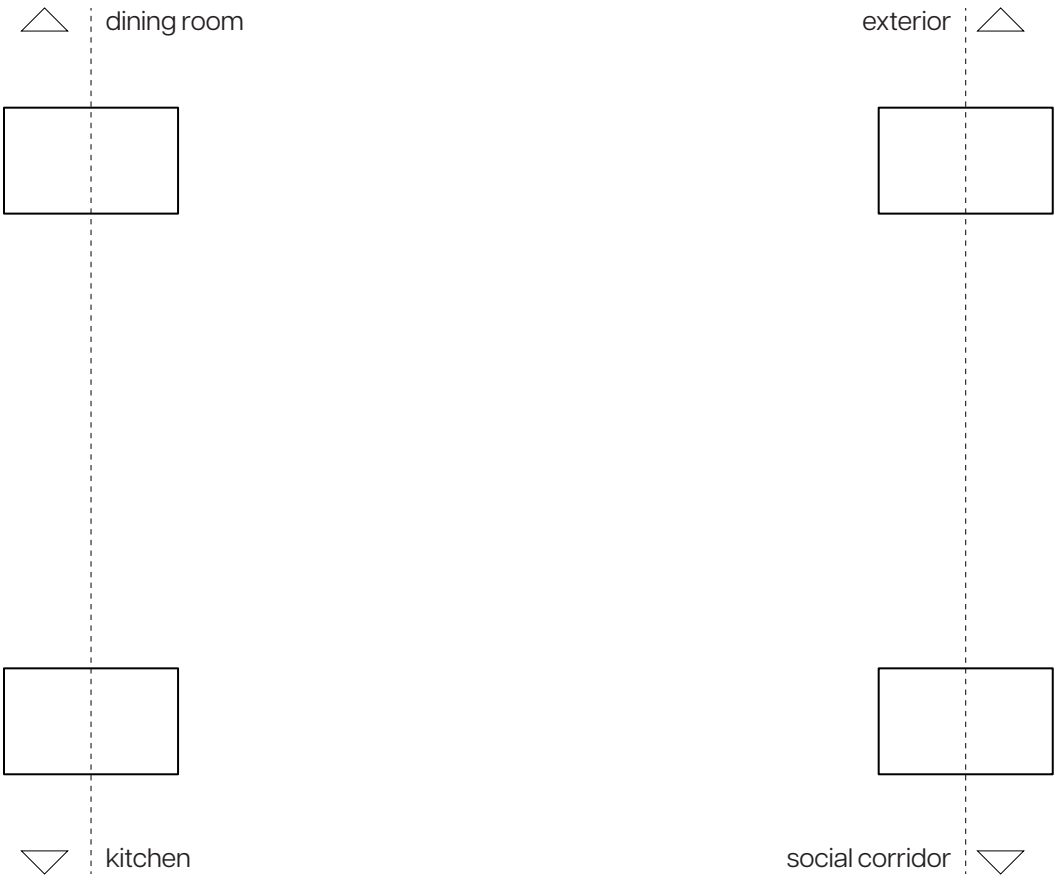
The featured rooms are designed for specific use to either RH or LTC, with some being universal to both. The housing category in which a room applies to will be indicated by the following:

RH only

Both RH and LTC

Proximity Relationships:

To best optimize prefabricated design, rooms have been designed to be closely related to other room types while still offering flexibility in placement and orientation. The following notation is the recommended proximity relationship to encourage active, social, and enriching environments:



Category Types:

The following categories are colour-coordinated to the previously presented chapters, presenting evidence-based research to back up design decisions, leading to a more holistic design approach. This will be accompanied by a page number where a textual reference can be found or an image of a designed ergonomic device. The following categories will be represented:

health-promoting theories
including aging-in-community, biophilia, active deisgn.

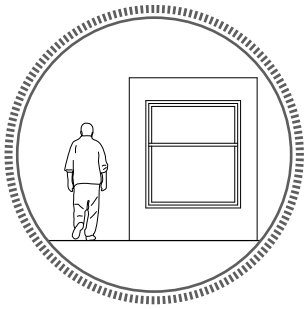
affordability + construction
prefabrication

towards a new architecture for aging
ergonomic devices

Examples:

visual connection to nature
[page 18]

prefabrication assembly
[page 42]



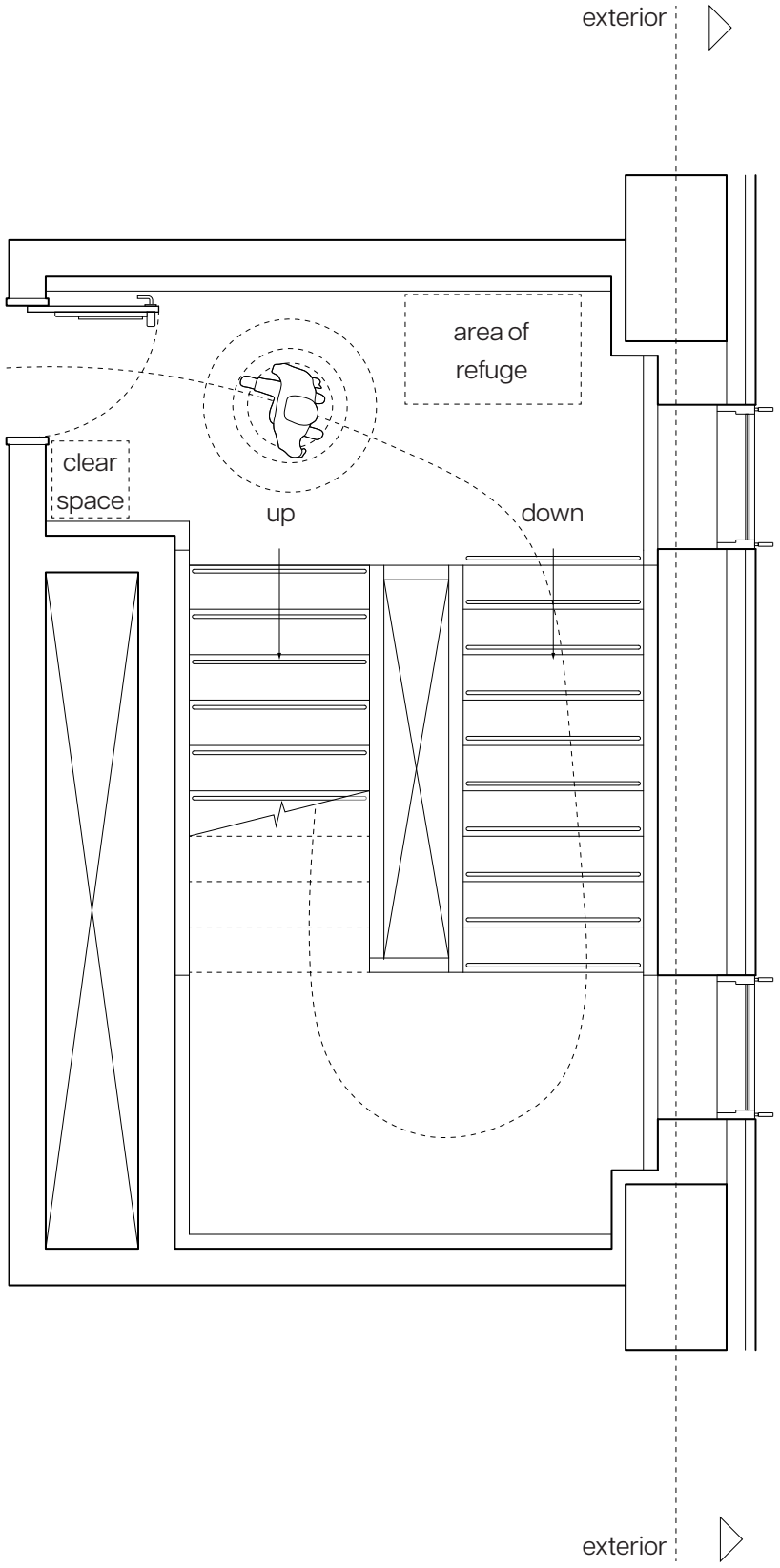
the everyday stair

1:50

0.5m 2m
0m 1m

encouraging active lifestyles.

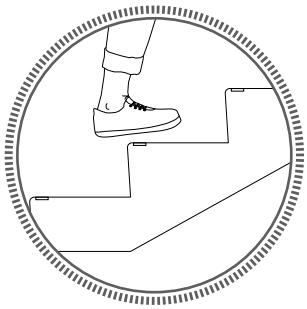
RH LTC



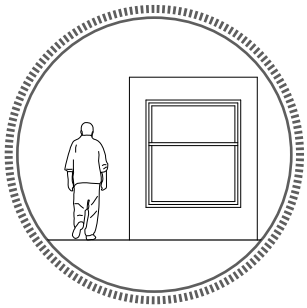
The everyday stair is designed to encourage daily and repeated use as the primary means of circulation throughout the building. In making stairs more age-friendly, this short action becomes a major source of activity within a day.[173] To encourage prolonged use, the everyday stair is designed to be generous, comfortable, and well-lit with natural daylight. Locating the everyday stairs on the exterior of the building contrasts typical exit stairs, often landlocked within buildings. This component is the artery of the building, connecting all functions of the building mechanically and socially, while fostering a vertical community within dense urban areas.

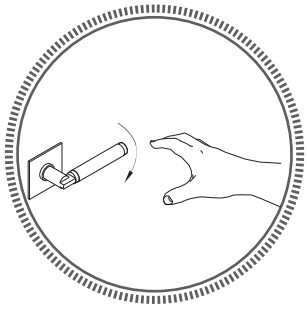
visual connection to nature
[page 18]

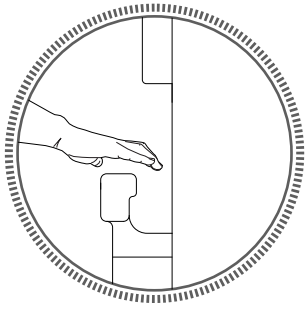
active design
[page 27]



prefabrication assembly
[page 42]







173 City of New York, "The Active Design Guidelines."

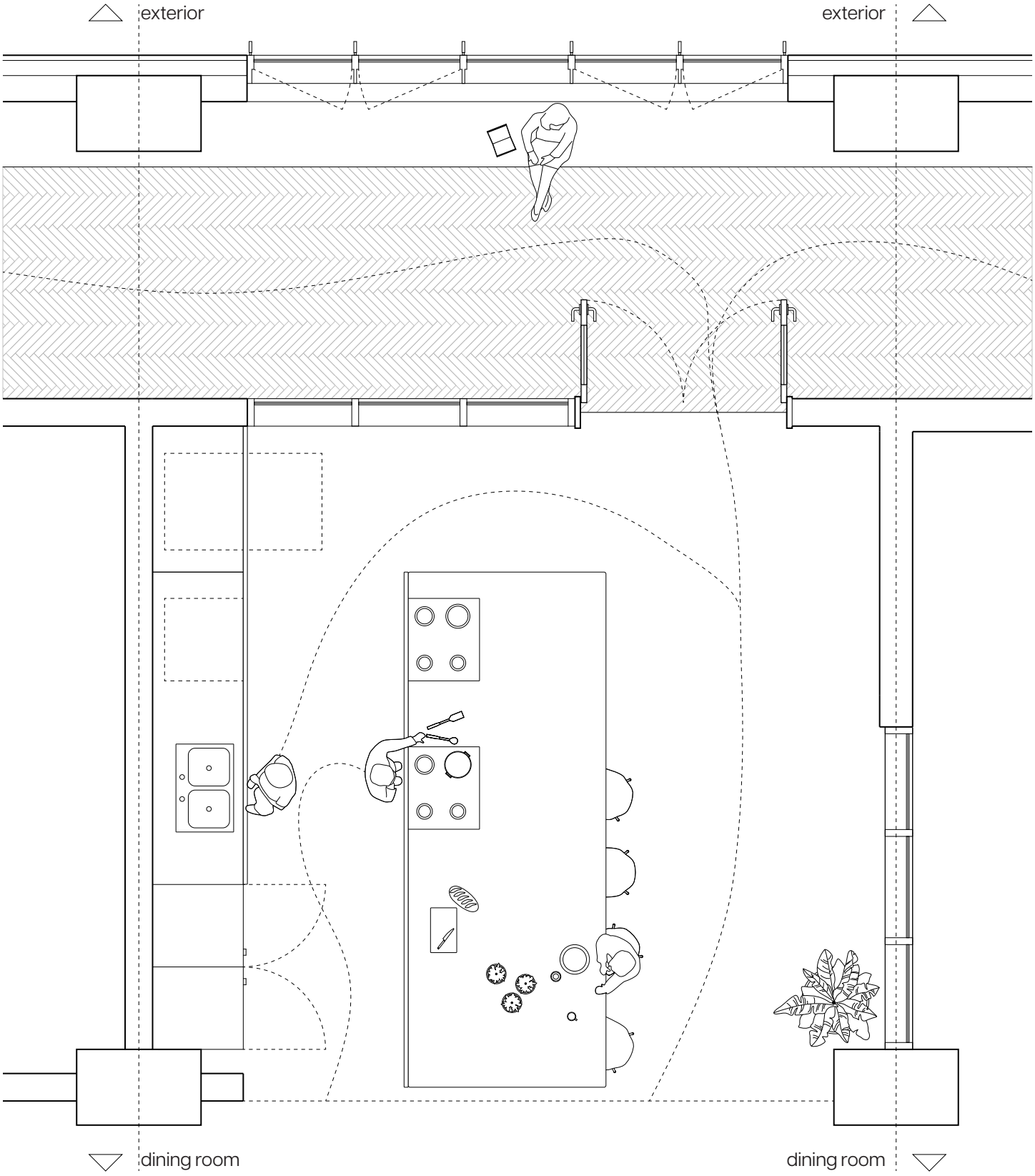
the common kitchen

1:50

0.5m 2m
0m 1m

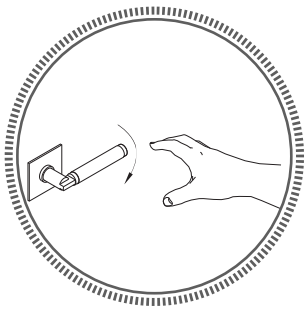
heart of the home.

RH LTC

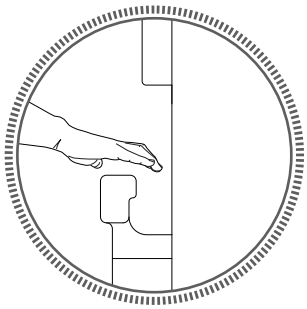


The kitchen encompasses a significant portion of our lives at home; the space is often viewed as the heart of the home and is key to personal autonomy and independence.[174] The kitchen also supports a range of hobbies that can allow residents to continue to do the things they love. Through everyday tasks such as cooking and eating, residents can connect through their common interests and overlapping schedules. The common kitchen takes on the role of the heart of the building. It is a primary hub of activity that creates spaces of interaction and fosters relationships among residents. Maintaining adjacencies to corridors, the dining room, and the exterior increases foot traffic, while natural light creates enjoyable spaces that can be inhabited comfortably for longer periods of time. The number of kitchens per floor will vary depending on the size of the building, with one kitchen serving approximately 10 residents.

aging-in-community
[page 11]

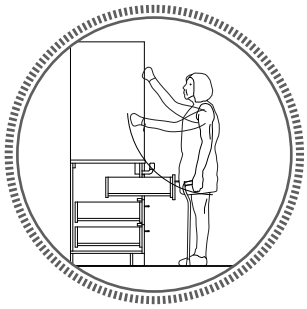


visual connection to nature
[page 18]

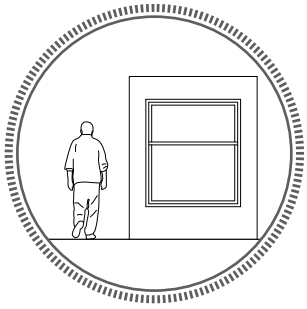


thermal and airflow variability
[page 18]

dynamic and diffused lighting
[page 19]



prefabrication assembly
[page 42]



[174] Widya Ramadhani and Lynne Dearborn, "Older Indonesian Women's Experience to Maintain Independence in Food-Related Activities," *Innovation in Aging* 6, no. Suppl 1 (December 20, 2022): 307, https://doi.org/10.1093/geroni/igac059.1217.

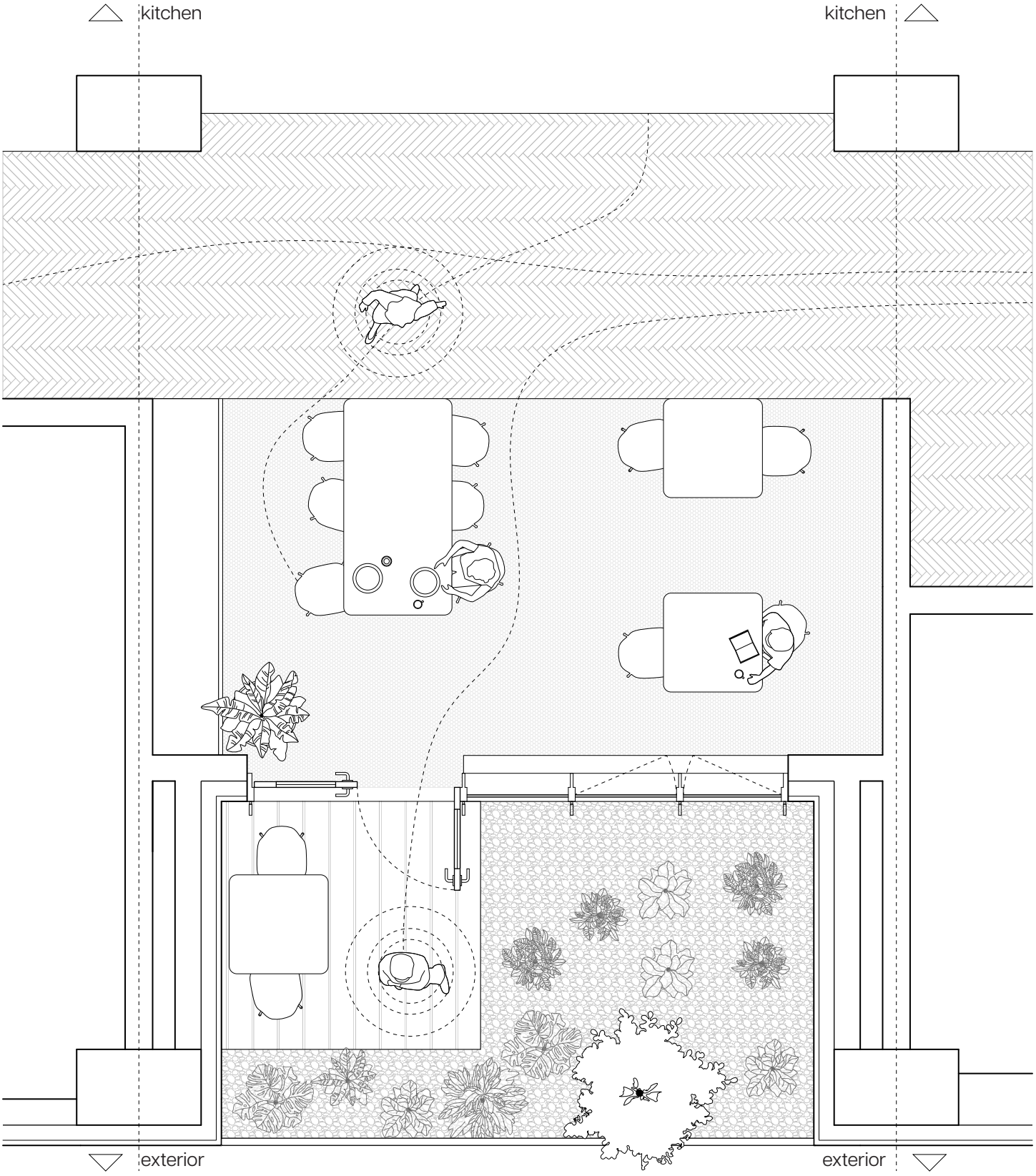
the common dining room

1:50

0.5m 2m
0m 1m

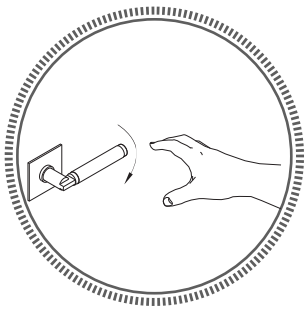
social gathering space.

RH LTC

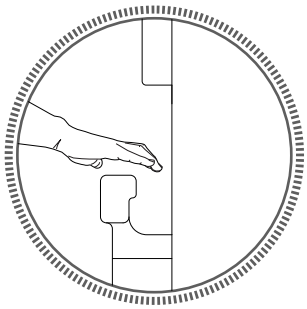


The common dining room is similar in function and is set adjacent to the kitchen; together, these two components function as one. A designed connection to the exterior allows natural light to penetrate the floorplate on either side of the building. A small garden located within the dining room allows for a natural connection vertically through the building, which can be occupied during warmer months. Outside of more active times when residents typically have meals, this room can be used as a secondary living space.

aging-in-community
[page 11]

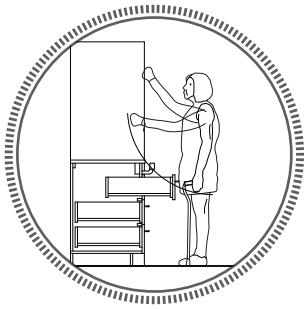


visual connection to nature
[page 18]

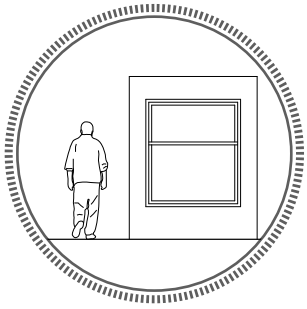


dynamic and diffused lighting
[page 19]

prospect-refuge
[page 24]



prefabrication assembly
[page 42]



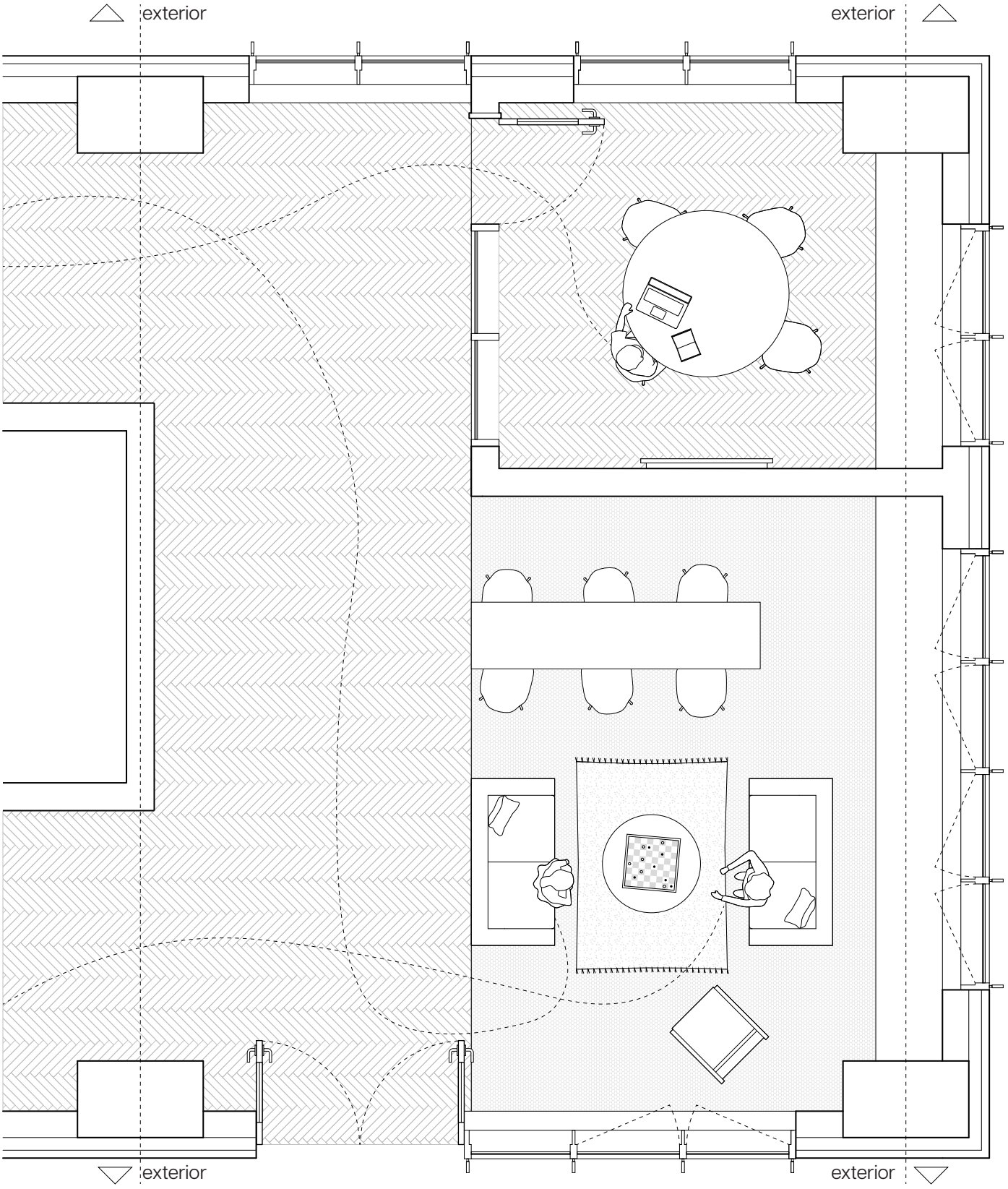
the common living room

1:50

0.5m 2m
0m 1m

intermediate social spaces.

RH LTC

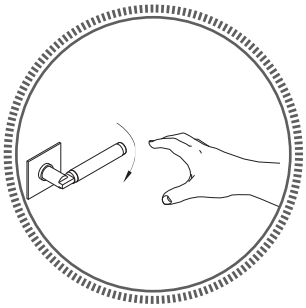


Outside of the private living space, a communal living space will be located on each floor. These spaces are geared towards community, social well-being, and active aging, hosting small group activities.[175] There are additional quiet spaces within the communal living room, giving a space outside the home to focus or disconnect when desired. These spaces are surrounded by natural lighting and ventilation, with external views allowing for a connection to nature.

aging-in-community
[page 11]

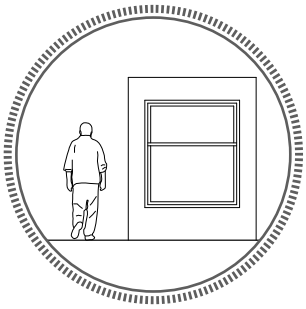
prefabrication assembly
[page 42]

visual connection to nature
[page 18]



thermal and airflow variability
[page 18]

dynamic and diffused lighting
[page 19]



active design
[page 27]

[175] Esther H. K. Yung, Sheila Conejos, and Edwin H. W. Chan, "Social Needs of the Elderly and Active Aging in Public Open Spaces in Urban Renewal," *Cities* 52 (March 1, 2016): 114–22, https://doi.org/10.1016/j.cities.2015.11.022.

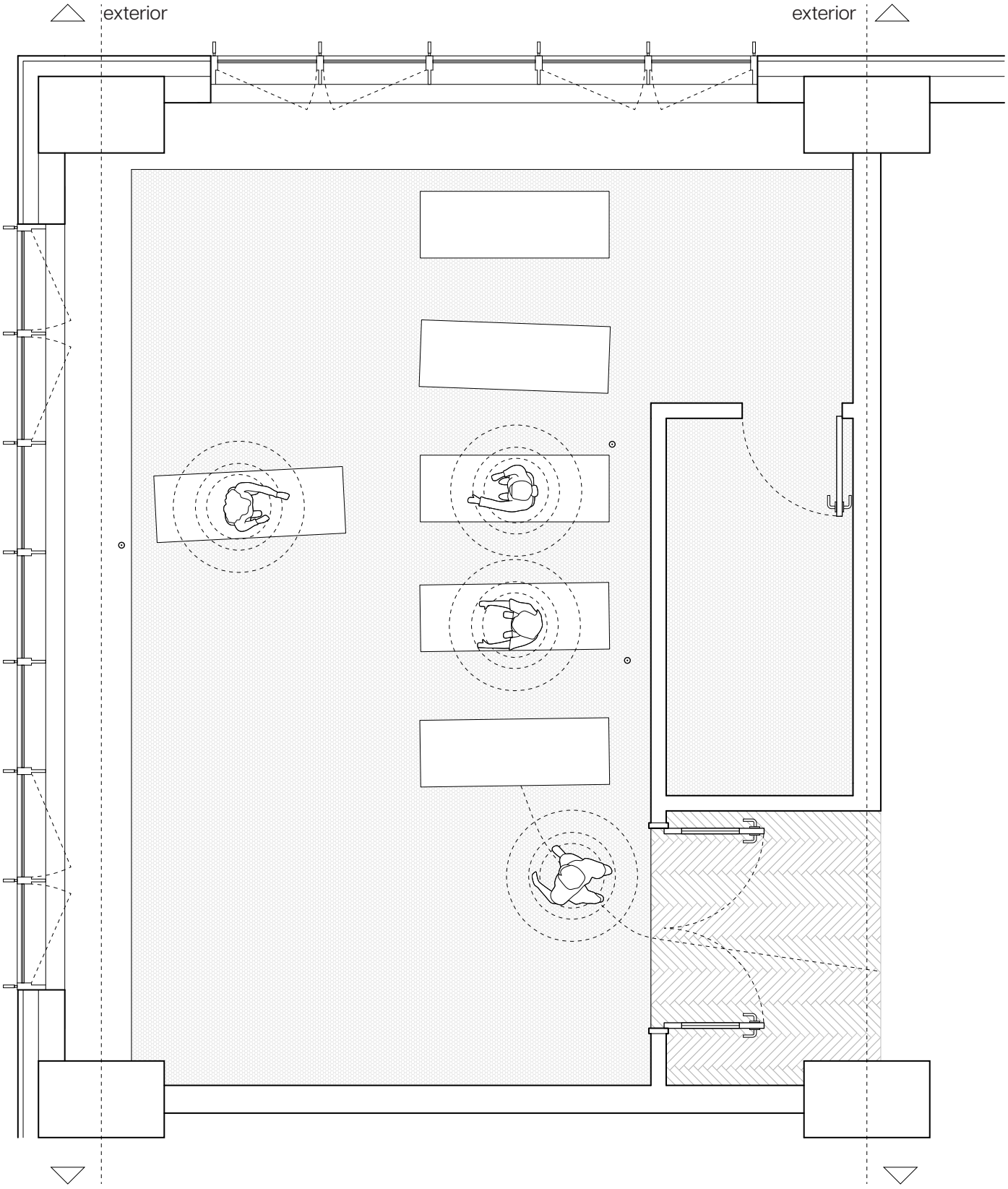
the multipurpose space

1:50

0.5m 2m
0m 1m

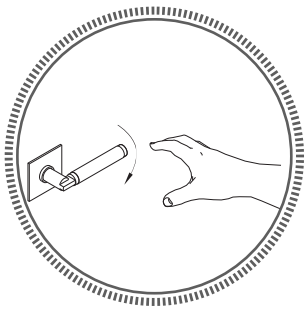
vertically aggregated social space.

RH LTC



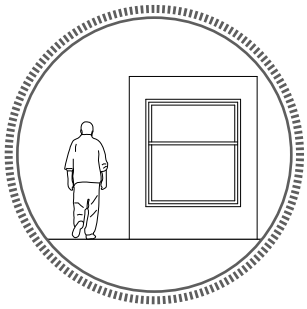
The multipurpose space is another component focused on communal well-being. These rooms are to be staggered vertically throughout the building. This requires residents to travel to floors outside of their common domain, thus allowing interaction with people outside of their circle.[176] Designed to be ambiguous, these rooms can be programmed in different configurations, comfortably adding diversity to the range of activities with a primary focus on occupant comfort.

visual connection to nature
[page 18]



thermal and airflow variability
[page 18]

dynamic and diffused lighting
[page 19]



active design
[page 27]

prefabrication assembly
[page 42]

176 Yung, Conejos, and Chan.

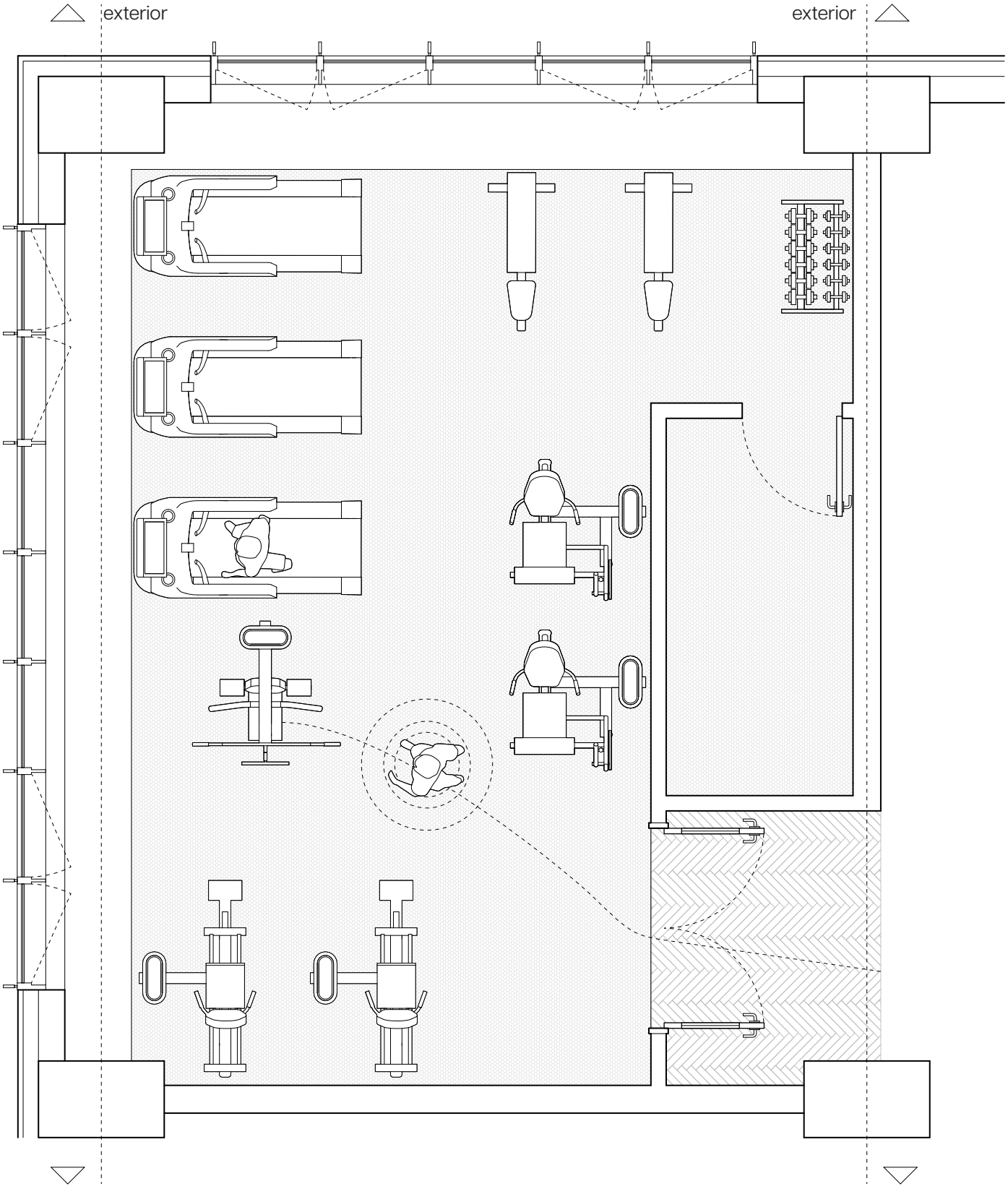
the multipurpose space

1:50

0m 0.5m 1m 2m

vertically aggregated social space.

RH LTC

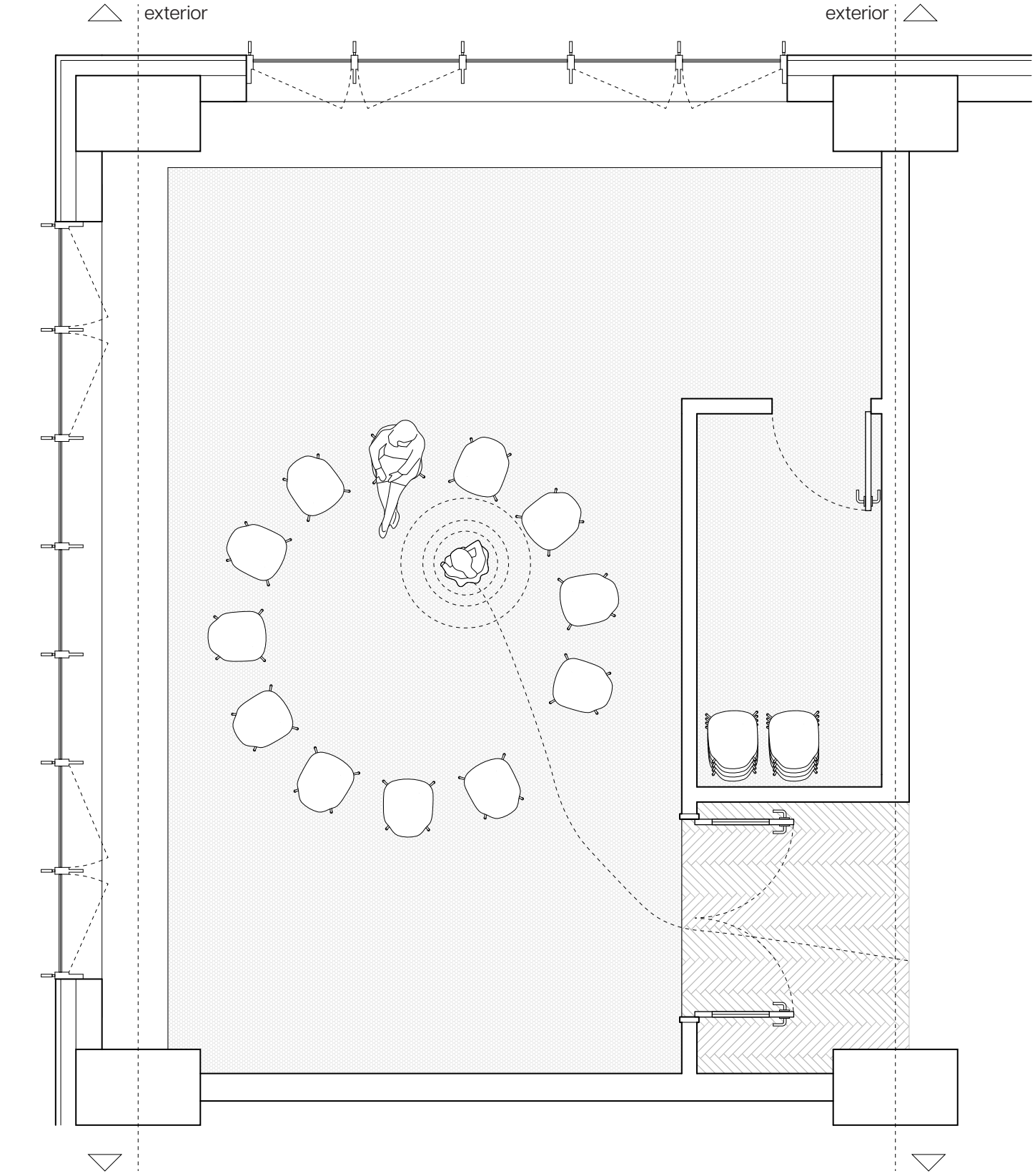


the multipurpose space

1:50

0m 0.5m 1m 2m

vertically aggregated social space.



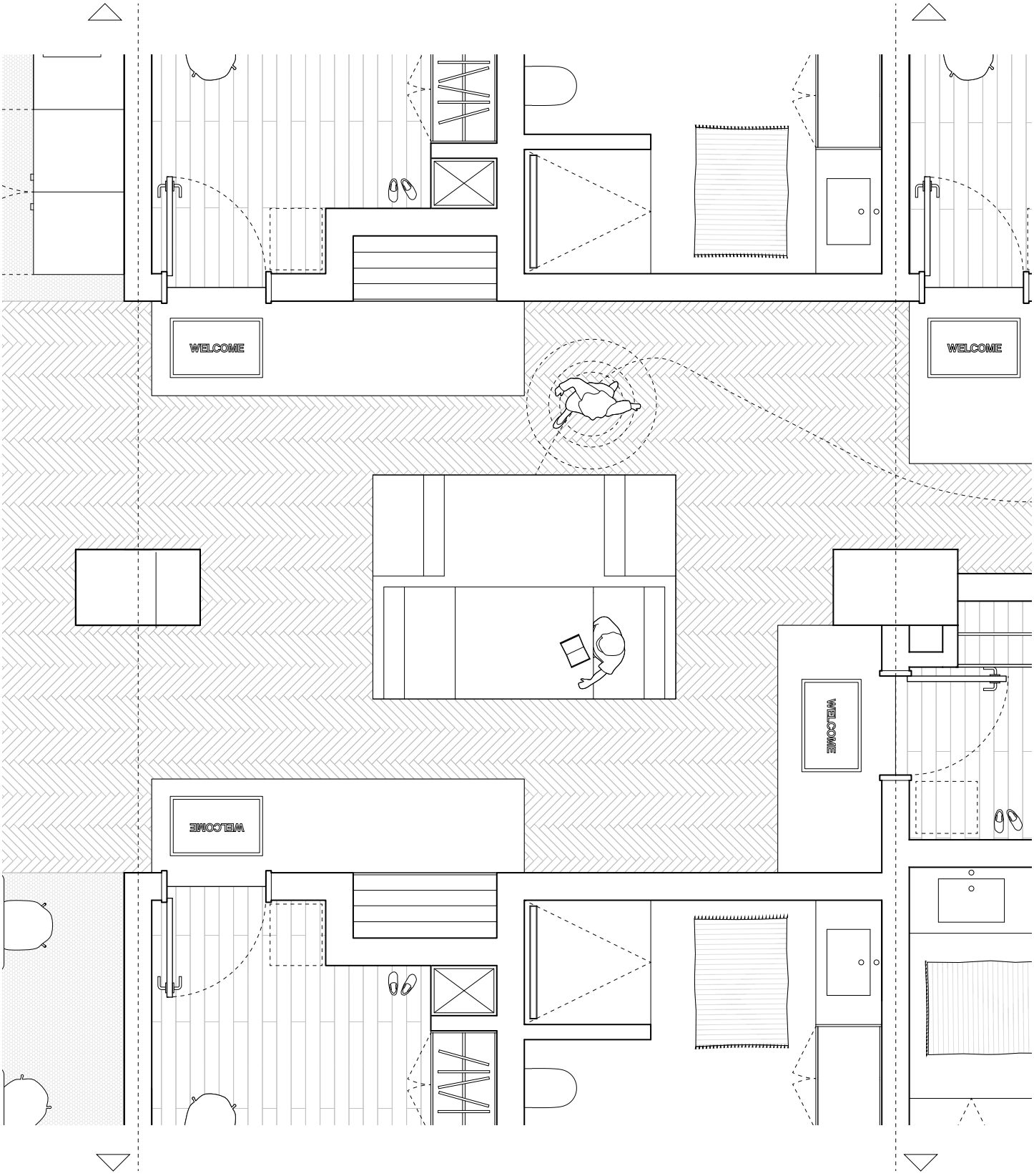
the social corridor

1:50

0.5m 2m
0m 1m

horizontally aggregated social space.

RH LTC

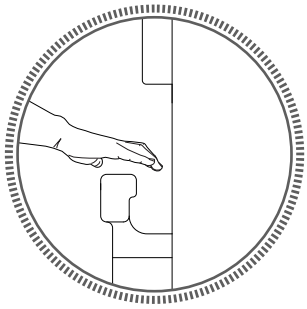


The social corridor is an integral part of sustainable social living. Within mid/high-rise developments, the corridor is rarely occupied, used for the sole purpose of circulation throughout a building.[177] The social corridor looks to change this, making the corridor an inhabitable space where spontaneous socialization is encouraged to occur. This follows the successful model of a suburban front porch, which offers the chance to people-watch and socialize with passersby. In addition, central amenity spaces allow for common areas such as lending libraries, reading nooks, intermediate gathering spaces, and places to rest.

aging-in-community
[page 11]

active design
[page 27]

prefabrication assembly
[page 42]



[177] Yuli Kalson Sagala, Rully Damayanti, and Rony Gunawan Sunaryo, "Corridor as a Sustainable Social Space in High-Rise Residential Building," *Advances in Civil Engineering and Sustainable Architecture* 4 (2022), https://doi.org/10.9744/acesa.v4i1.11273.

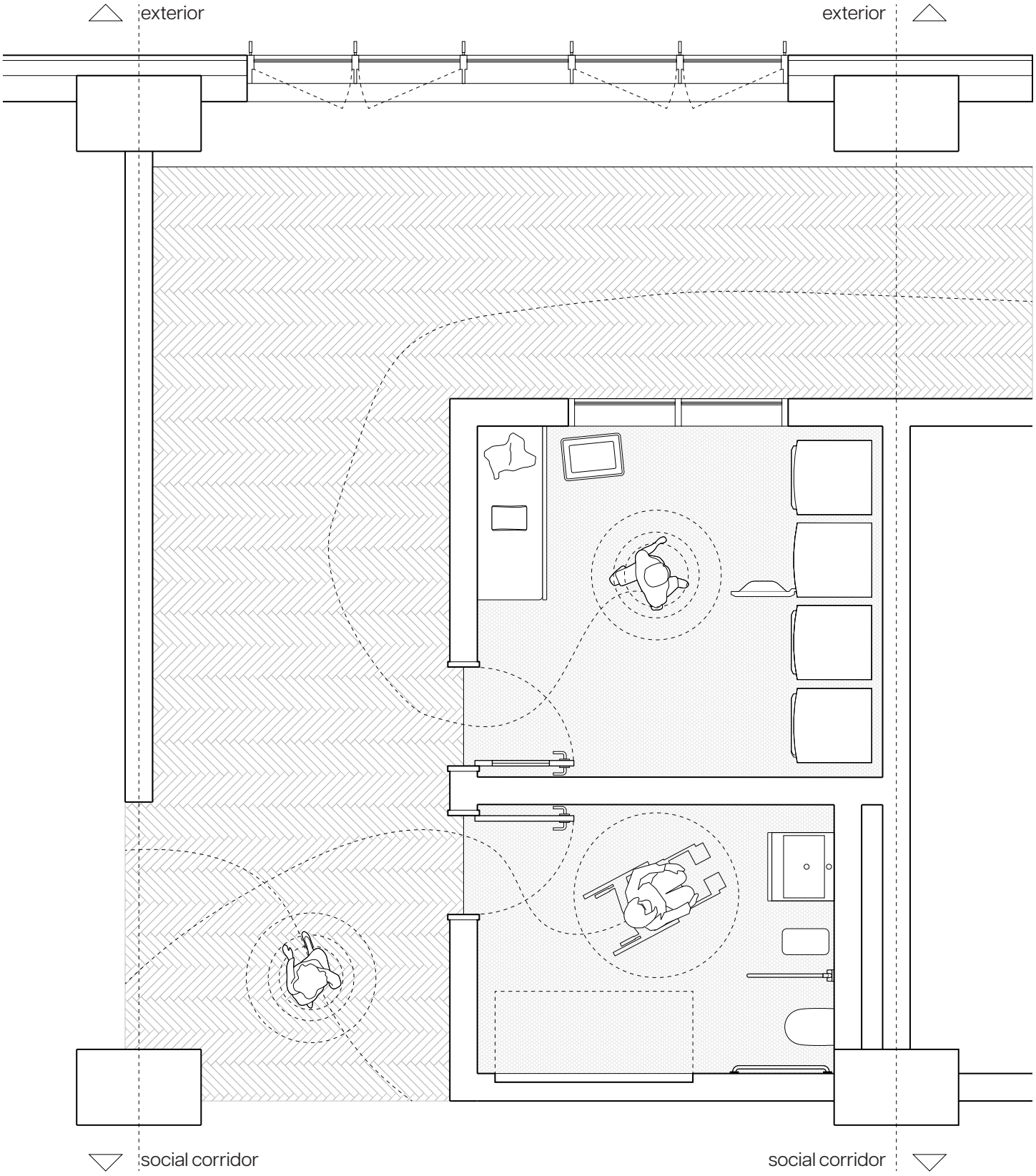
the common wet rooms

1:50

0m 0.5m 1m 2m

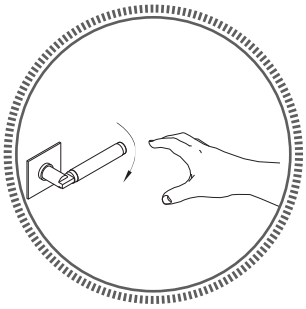
servicing common spaces.

RH LTC

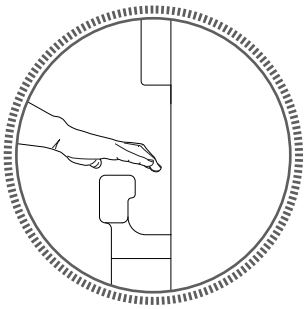


The common wet rooms service common spaces, making them comfortably occupiable for longer periods of time. Amenities such as a laundry room allow for maintained independence while reducing maintenance responsibilities within the household. Having internal household functions brought to the exterior of the house also allows for physical exercise and opportunities to interact with neighbours. The wet rooms are located adjacent to high-activity areas and off of the social corridors, making them easily accessible.[178] Connection to natural light and views of nature is maintained throughout this portion of the building. Locating these rooms within the interior allows light to penetrate deeper into the floorplate while seating along exterior walls provides intermediate resting and gathering places.

aging-in-community
[page 11]

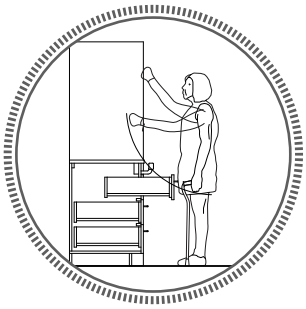


visual connection to nature
[page 18]

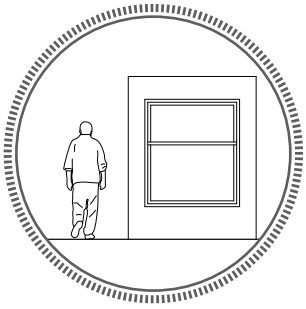


thermal and airflow variability
[page 18]

dynamic and diffused lighting
[page 19]



prefabrication assembly
[page 42]



178 City of New York, "The Active Design Guidelines."

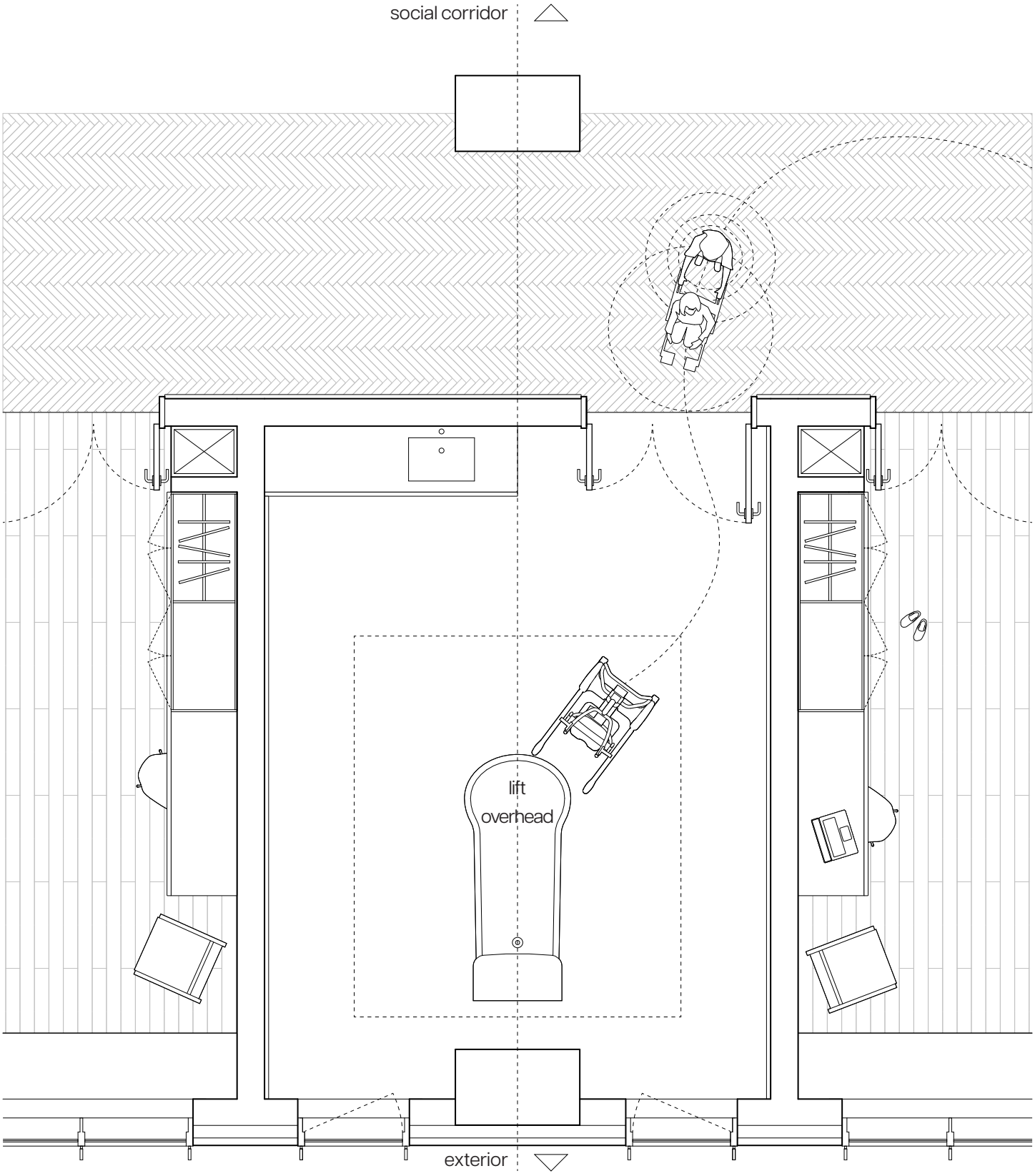
the tub room

1:50

0.5m 2m
0m 1m

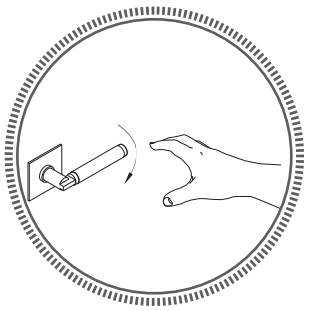
assisted bathing.

RH LTC

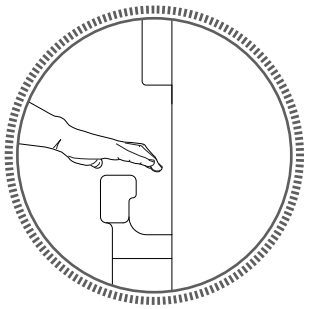


The tub room, part of the long-term care modules, assists both residents and caregivers in the process of bathing. Located on every floor, these rooms allow for accessible bathing for those who are unable to care for themselves. Proximity to the exterior for natural light and ventilation is still a consideration in this room while maintaining privacy through changing transparencies in glass and exterior screens.

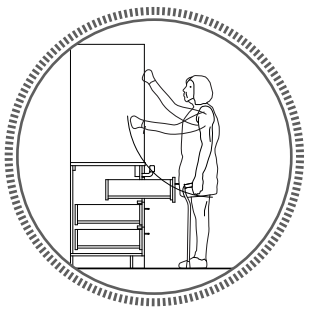
aging-in-community
[page 11]



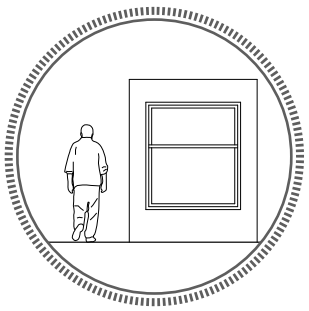
visual connection to nature
[page 18]



thermal and airflow variability
[page 18]



dynamic and diffused lighting
[page 19]



prefabrication assembly
[page 42]

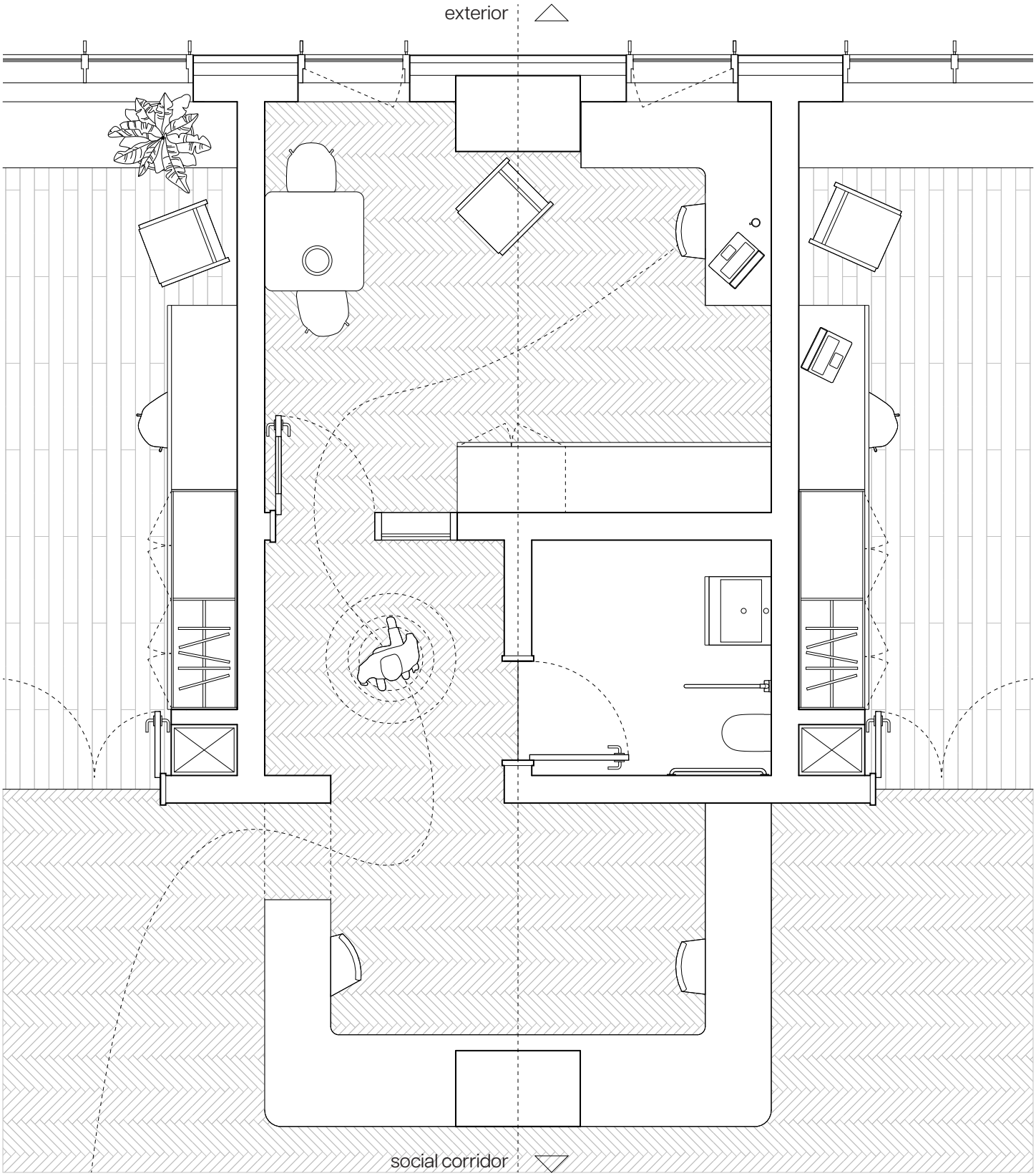
the nurse station

1:50

0.5m 2m

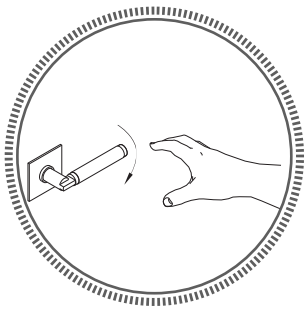
servicing common spaces.

RH LTC

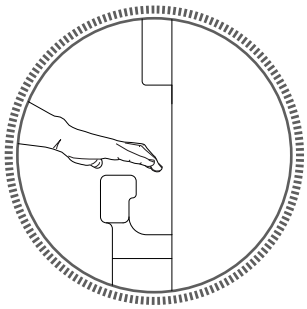


The nursing station is located centrally in plan, offering unobstructed views of residents for attending nurses. The nursing station has a bathroom for staff use, storage for residents' medical needs, a small, quiet resting area, and an office space. Back-of-house spaces are often neglected in current LTC/RH models but should be equally prioritized. The health of the staff is equally as important as the residents'; the two often positively affect each other. Therefore, despite its central location, the nursing station is still connected to the exterior for abundant natural light and ventilation. The windows are also enlarged to provide a pleasant and non-isolating workplace.

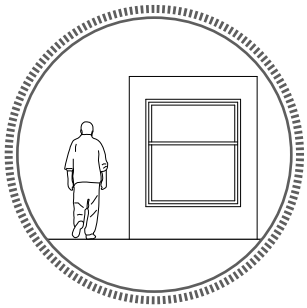
aging-in-community
[page 11]



visual connection to nature
[page 18]



thermal and airflow variability
[page 18]



dynamic and diffused lighting
[page 19]

prefabrication assembly
[page 42]

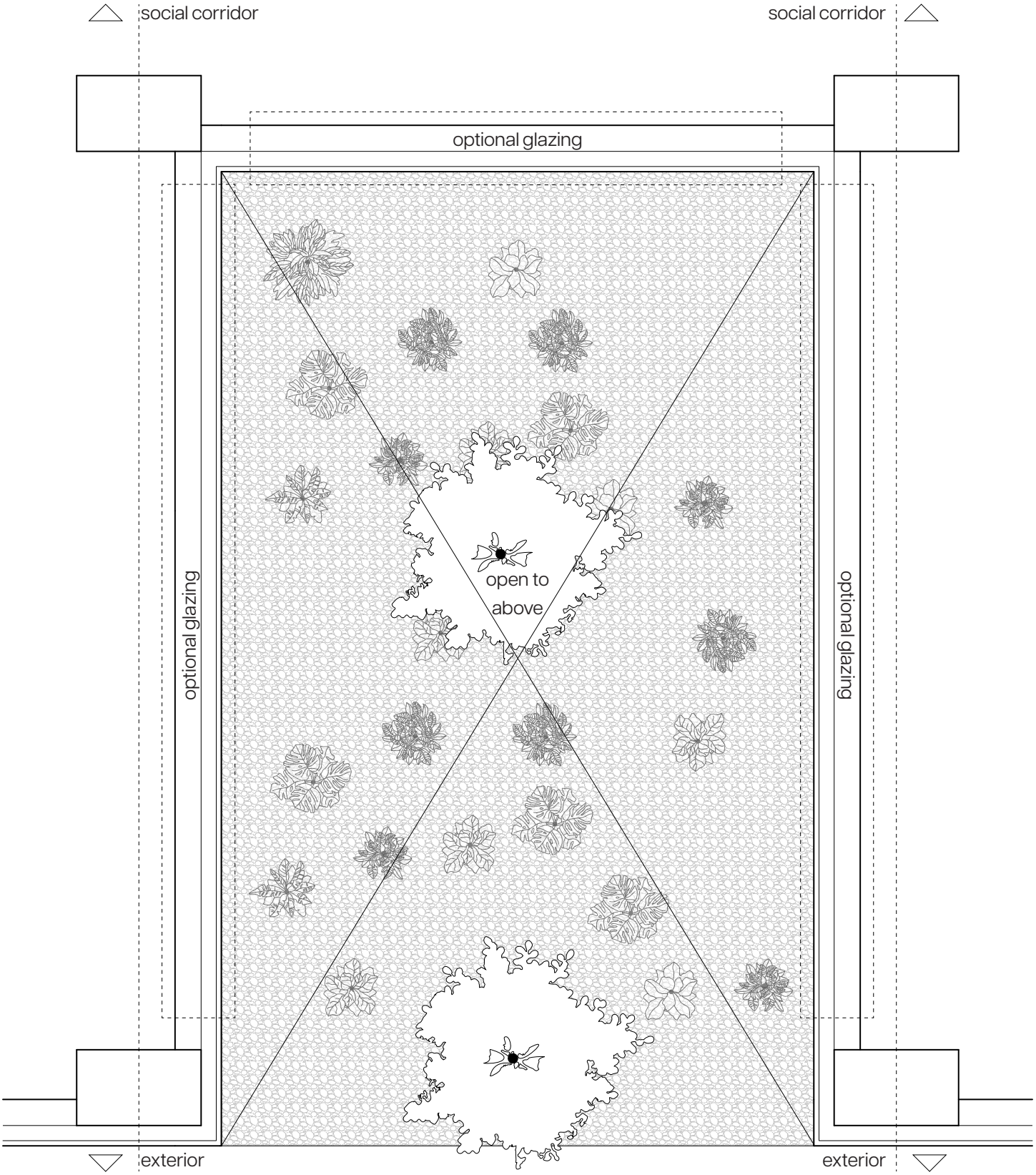
the garden courtyard

1:50

0m 0.5m 1m 2m

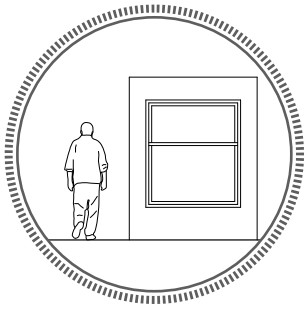
getting closer to nature.

RH LTC



Garden Courtyards are void spaces within the floor plate, offering a more intimate connection to nature from within the building. With an adjacency to the corridor, these spaces provide brief daily glimpses of natural systems that can be seen changing throughout the seasons.[179] This module is open to above, allowing natural light to penetrate the building and creating opportunities for more enjoyable interior spaces.

visual connection to nature
[page 18]



thermal and airflow variability
[page 18]

dynamic and diffused lighting
[page 19]

connection to natural systems
[page 21]

prefabrication assembly
[page 42]

[179] Browning and Ryan, "14 Patterns of Biophilic Design."

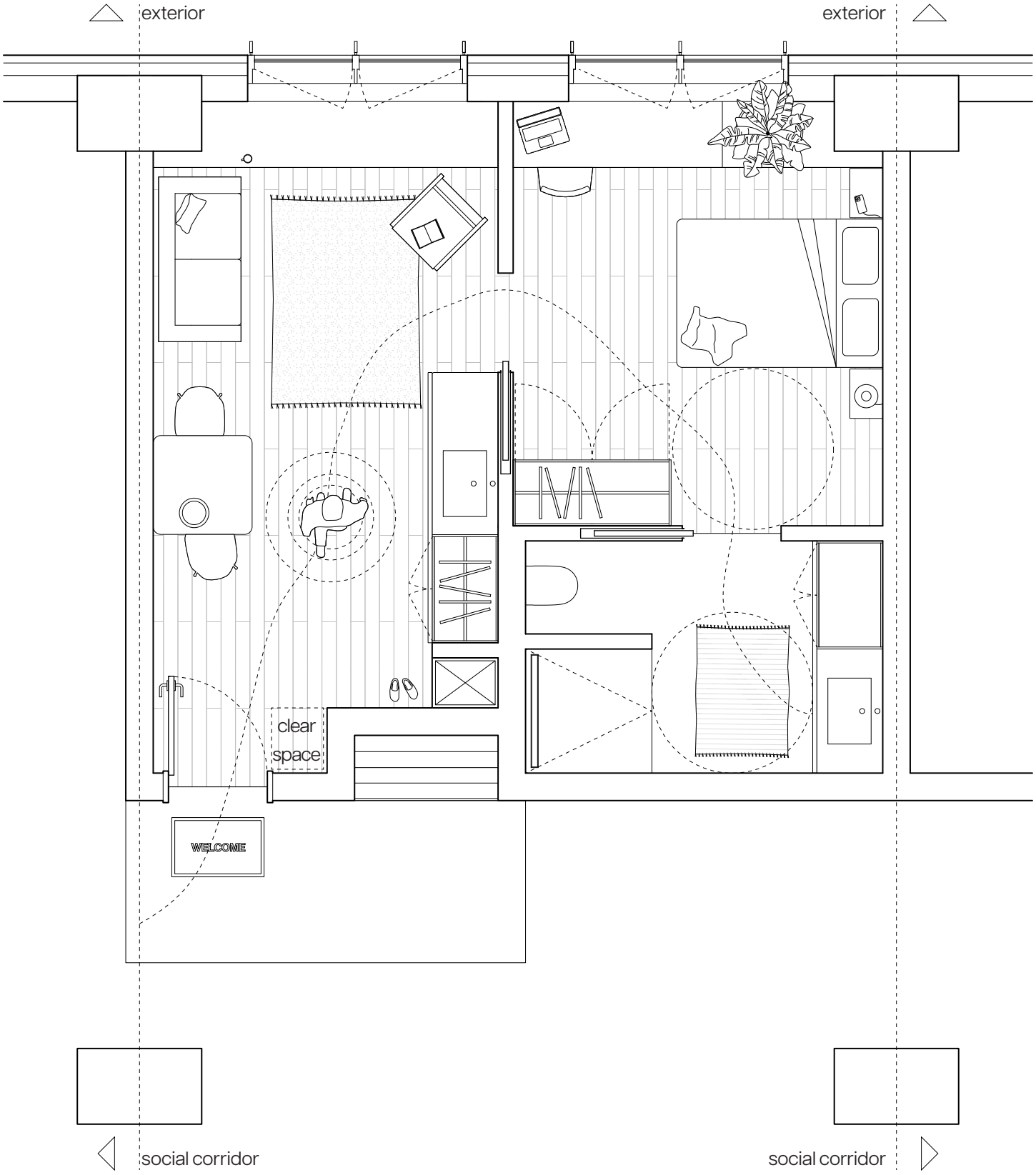
the home

1:50

0.5m 2m
0m 1m

independent living.

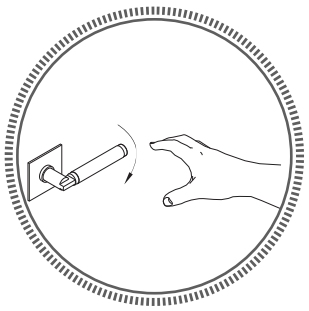
RH LTC



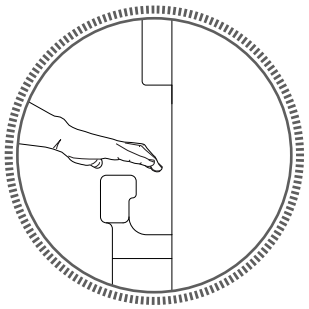
The home is the most important space of the building; it is the space one can truly call their own. Creating space that directly opposes typical institutional spaces is paramount to all residents' continued comfort and independence.[180] [181] This is where one can decompress and find comfort in things that are familiar. Aging-in-community speaks to more than the community itself, but also the physical environment in which one inhabits. Being able to create a space that is uniquely your own allows for continuity in one's environment.

The home is designed to maintain prolonged independence through the previously shown ergonomic devices, both supporting and fostering mental and physical health. The biophilic principles of natural light and ventilation are key in these spaces as they are occupied for longer durations. Prospect and people-watching are encouraged through bench seating and curated thresholds with views overlooking social spaces, both interior and exterior.[182] Adjacent to the front door of the home, a change in materiality defines the transition from semi-public to private space, accompanied by a bench to define the "front porch."

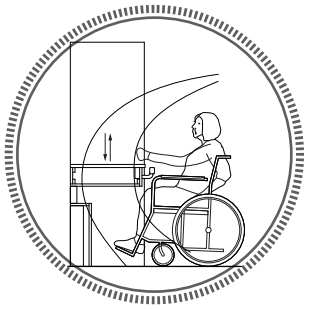
aging-in-community
[page 11]



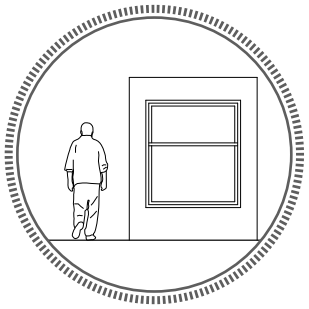
visual connection to nature
[page 18]



thermal and airflow variability
[page 18]



dynamic and diffused lighting
[page 19]



prefabrication assembly
[page 42]

[180] Ansar S. Ahmed et al., "Re-Imagining Eldercare in a Post-COVID Ontario."

[181] Christopher Alexander et al., *The Production of Houses*.

[182] Browning and Ryan, "14 Patterns of Biophilic Design."

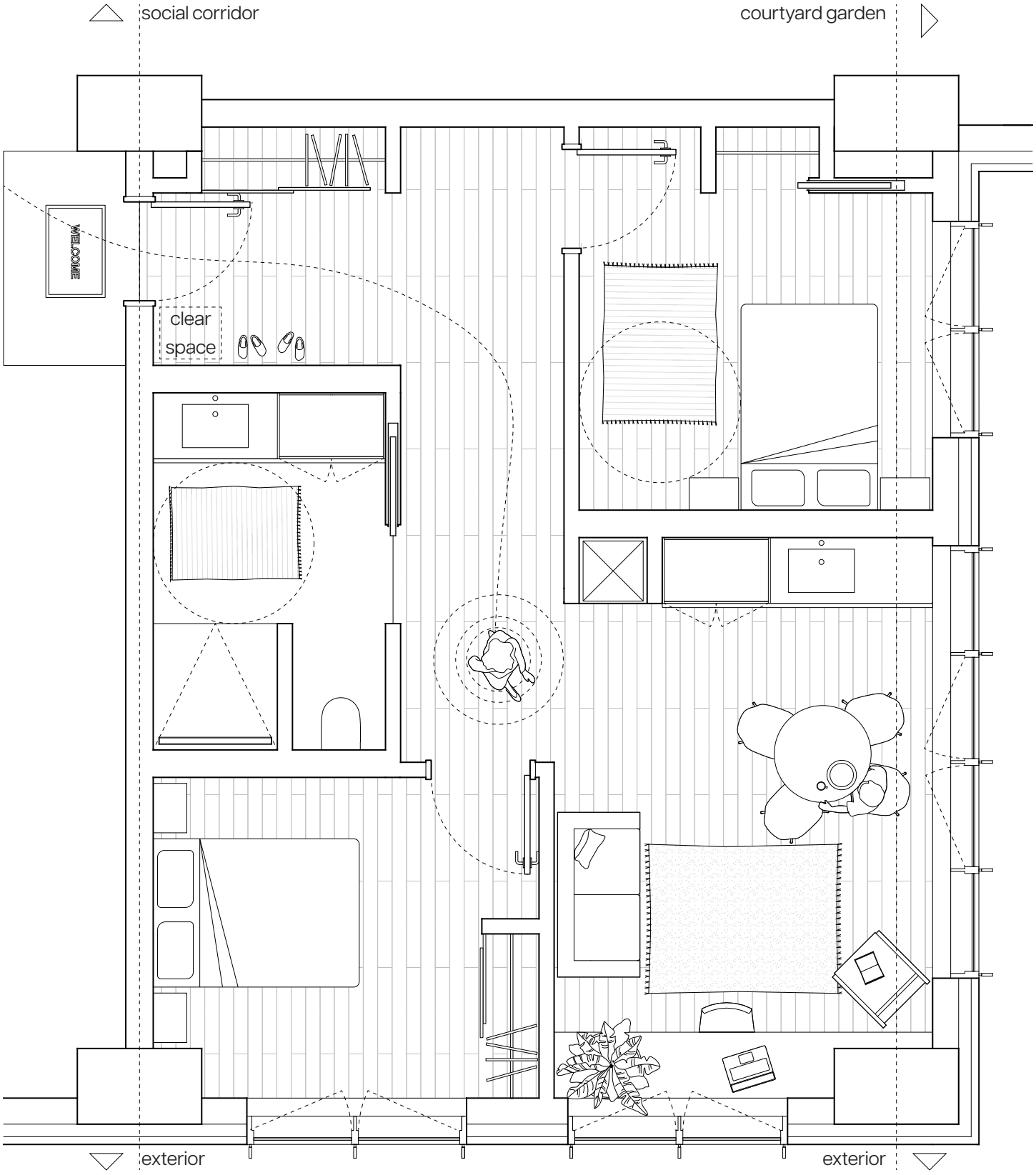
the home+

1:50

0.5m 2m
0m 1m

independent living.

RH LTC



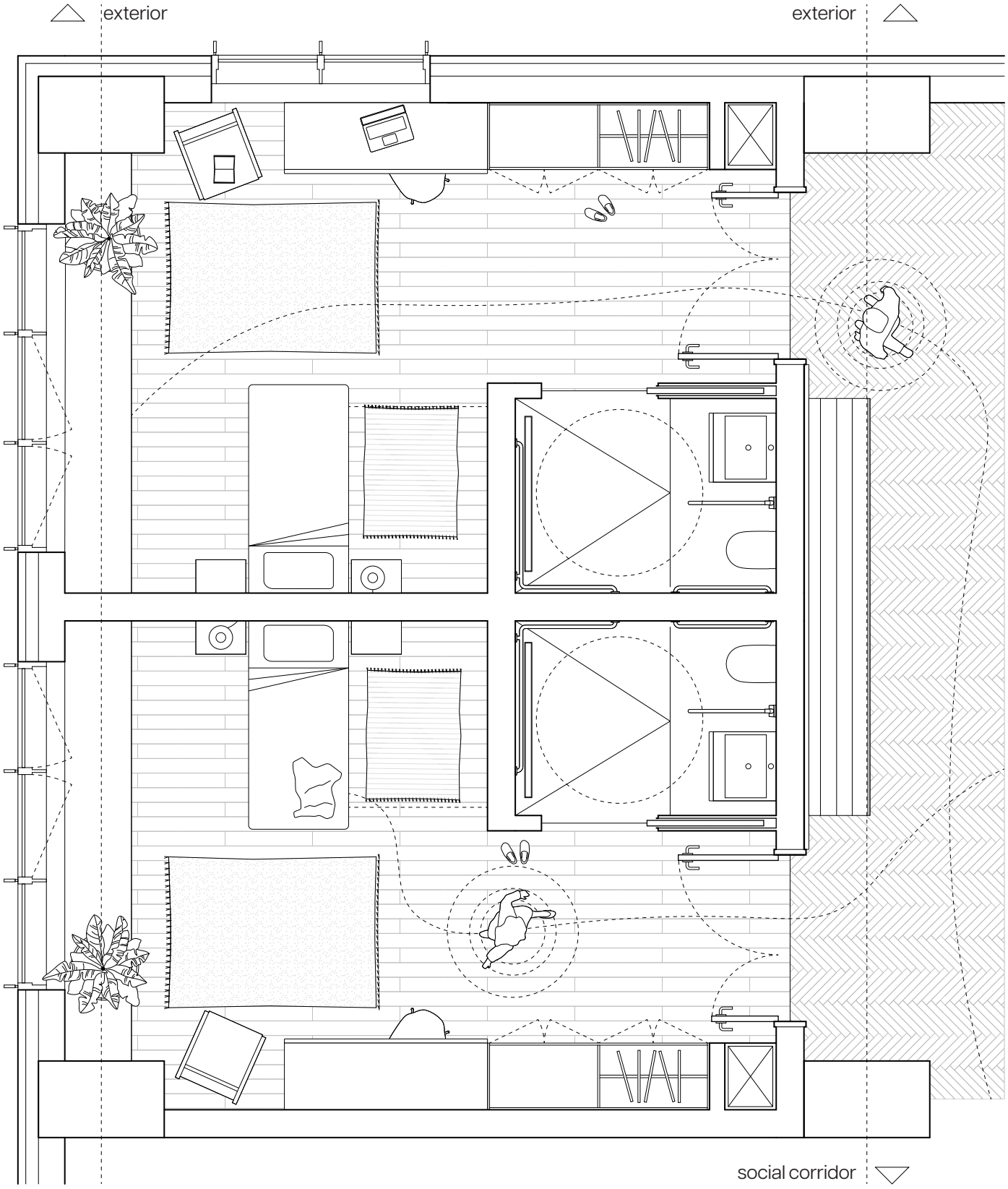
the care home

1:50

0.5m 2m
0m 1m

assisted living.

RH LTC



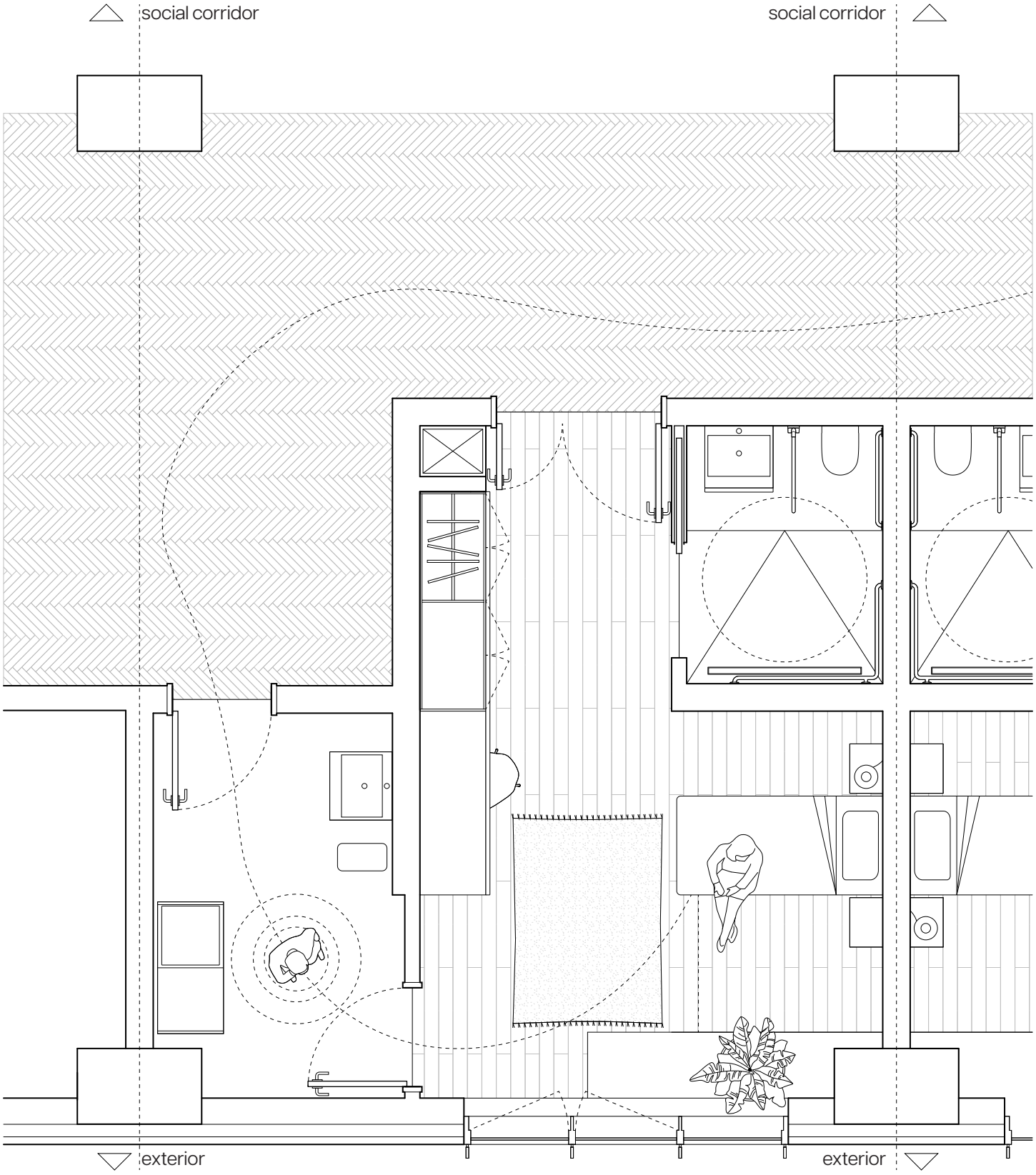
the IPAC room

1:50

0m 0.5m 1m 2m

Infection Prevention and Control.

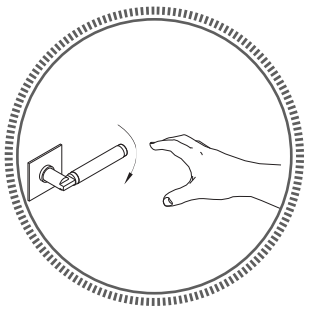
RH LTC



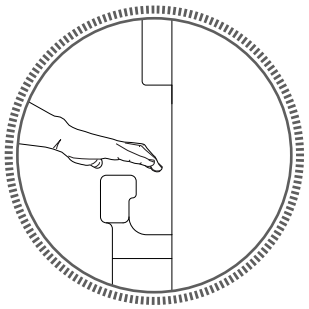
The IPAC (Infection Prevention and Control) room is specific to the long-term care space programming. As part of outbreak management, this room will safely maintain outbreaks and effectively care for those who need it most in a dedicated space.

Designed based on hospital scrub rooms and isolation rooms found in healthcare settings, the IPAC room is designed with an adjacent room for sterilization. Once an infected individual is in the room, all access will be through the adjacent sterilization room with dedicated space for both clean and dirty PPE. The room is ventilated adequately to prevent airborne pathogens from being transmitted and causing further outbreaks.[183] The room itself is a replica of the home layout, not to make one feel outcasted and to maintain a familiar environment more conducive to healing. These rooms will be allocated across a building as necessary based on the number of residents within the building.

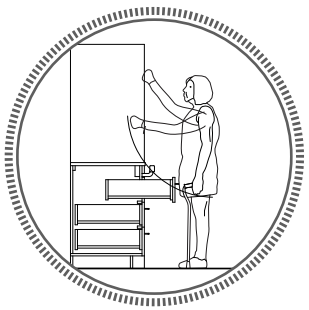
aging-in-community
[page 11]



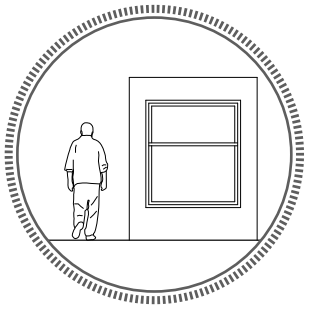
visual connection to nature
[page 18]



thermal and airflow variability
[page 18]

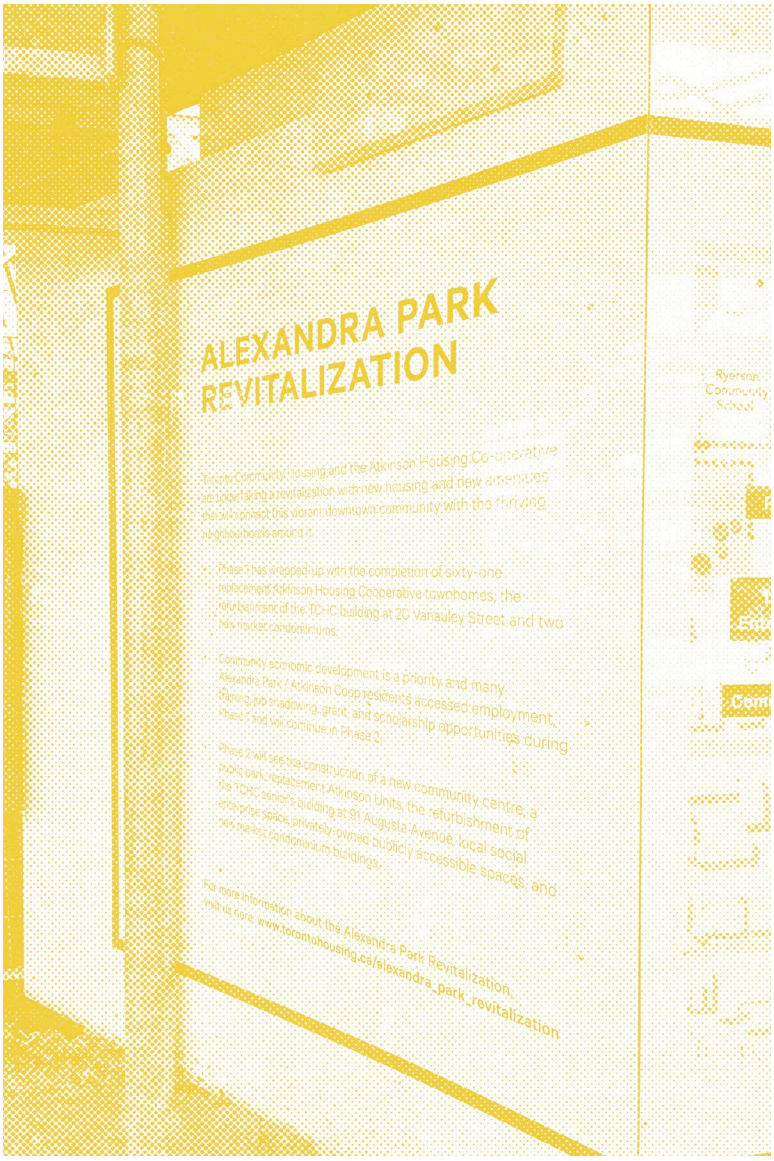


dynamic and diffused lighting
[page 19]



prefabrication assembly
[page 42]

[183] Public Health Ontario, "Infection Prevention and Control for Long-Term Care Homes: Summary of Key Principles and Best Practices," 2020, https://www.publichealthontario.ca/-/media/documents/l/2021/ipac-ltch-principles-best-practices.


ALEXANDRA PARK
REVITALIZATION
Ryerson
Community
School

05

Alexandra Park case study

re-imaging the urban environment for the elderly.

Alexandra Park Neighbourhood

Alexandra Park is adjacent to some of Toronto's most well-known neighbourhoods: Chinatown, Kensington, and Queen Street West **[see Figure. 22]**. This neighbourhood is defined by its boundaries of Dundas Street West, Bathurst Street, Queen Street West, and Spadina Avenue **[see Figure. 23]**. Alexandra Park is characterized by its rent-geared-to-income housing, which houses a large portion of this neighbourhood's population of 2,500 people.[184] Three significant housing developments make up the majority of the 806 rental units within the area, two of which are owned by Toronto Community Housing.[185] After the Alexandra Park housing development opened in 1968, the community was a large part of what made this neighbourhood special. In 1969, the Alexandra Park Residents' Association (APRA) was formed, providing social and recreational benefits for the community while strengthening ties with surrounding communities.[186] The opening of the Alexandra Park community centre in 1978 took on many of the programs once hosted within the neighbourhood, becoming a hub for social events, and standing as a pillar of community activism. In the mid-1980s, drug and social problems became a prominent concern in the neighbourhood.[187] Although many residents felt powerless, the APRA tried to increase community-based programs in an attempt to create outlets as alternatives to crime. These programs diminished as the APRA's attention shifted to converting into a co-operative in the early 1990s. [188] As residents expressed the need for change, a housing co-operative was their next logical step, giving the community greater autonomy. After years of government negligence, the community was incorporated in 1997 as the Atkinson Housing Co-operative. The organization seeks to revitalize the community today through large-scale physical interventions that address existing social

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[184] City of Toronto, "Alexandra Park Urban Design Guidelines," August 2013, https://www.toronto.ca/legdocs/mmis/2013/te/bgrd/backgroundfile-61227.pdf.

[185] City of Toronto.

[186] Jorge Sousa, *Building a Co-Operative Community in Public Housing: The Case of the Atkinson Housing Co-Operative* (University of Toronto Press, 2013), https://books.scholarsportal.info/en/read?id=/ebooks/ebooks3/utpress/2013-10-15/1/9781442666375#page=230.

[187] Jorge Sousa.

[188] Jorge Sousa.

Figure 22:

Alexandra Park masterplan focus area.

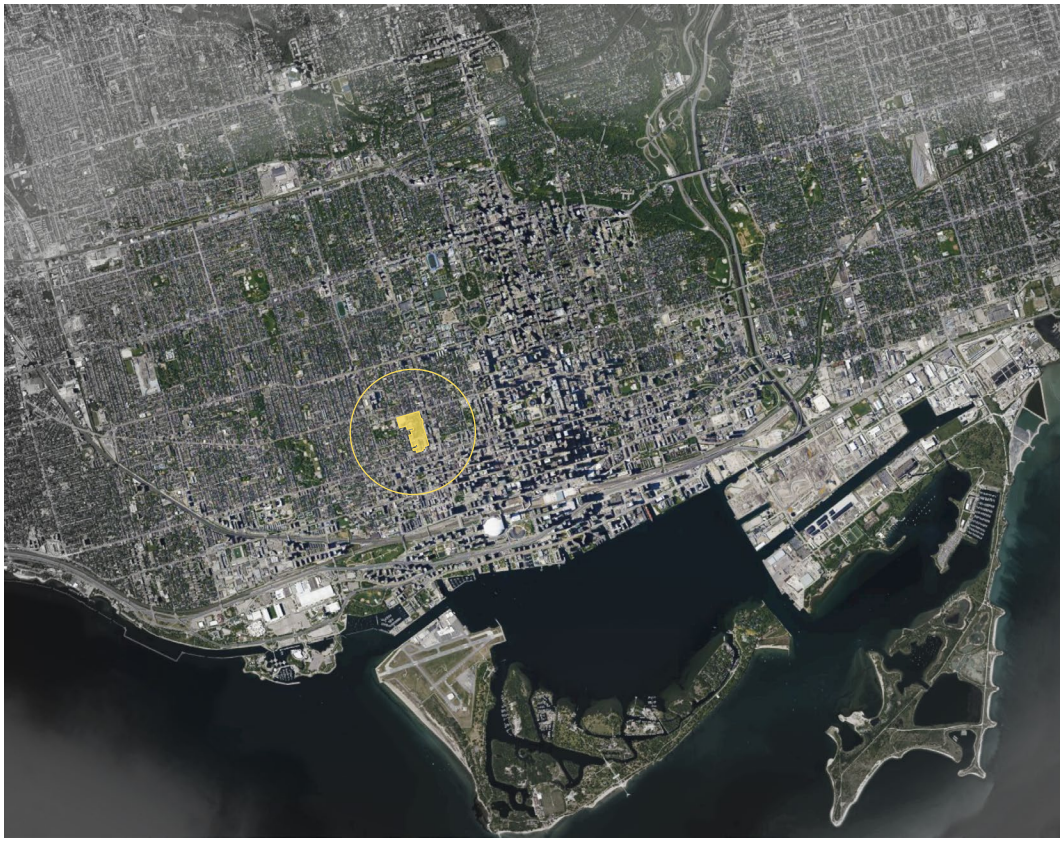


Figure 23:

Chinatown neighbourhood borders.

Figure 24:

Proximity to local amenities.

1. FreshCo.
600m (9 min walk)
6m elevation +/-

2. Toronto Western Hospital
450m (6 min walk)
5m elevation +/-

3. Kiever Synagogue
250m (4 min walk)
3m elevation +/-

4. Sanderson Library
400m (4 min walk)
3m elevation +/-

5. Carr Street Gospel Church
350m (5 min walk)
3m elevation+/-

6. Alexandra Park Community Centre
250m (4 min walk)
1m elevation +/-

7. TD Bank + Scotiabank
300m (4 min walk)
1m elevation +/-

8. Rexall
350m (5 min walk)
1m elevation +/-

issues in Alexandra Park.[189] With a focus on the development of mixed-income housing, this initiative looks to strengthen the community once again in this neighbourhood.

As described in the urban planning study of the neighbourhood, "One of the challenges the community has been struggling with is that Alexandra Park is currently insular, structured by inefficient green spaces and a meandering pedestrian network."[190] This significantly limits pedestrian mobility through the site and has raised many concerns for personal safety for those who frequent the neighbourhood. Massively intensifying the neighbourhood through the proposed masterplan will promote permeability and a more developed public realm, creating a greater sense of community. A key consideration for seniors is accessibility to resources and amenities near them. These work as an incentive to stay active, as well as playing a role in convenience, prompting the ability to age-in-community. Within walking distance of the proposed site are grocery stores, banks, pharmacies, places of worship, a hospital, and places of cultural/recreational activities. The surrounding area is relatively flat, allowing for easier walkability without too much strain on the body **[see Figure. 24]**.

189 Jorge Sousa.

190 City of Toronto, "Alexandra Park Urban Design Guidelines."

Figure 25:

15-minute travel radius by transportation type (500m x 500m grid spacing).

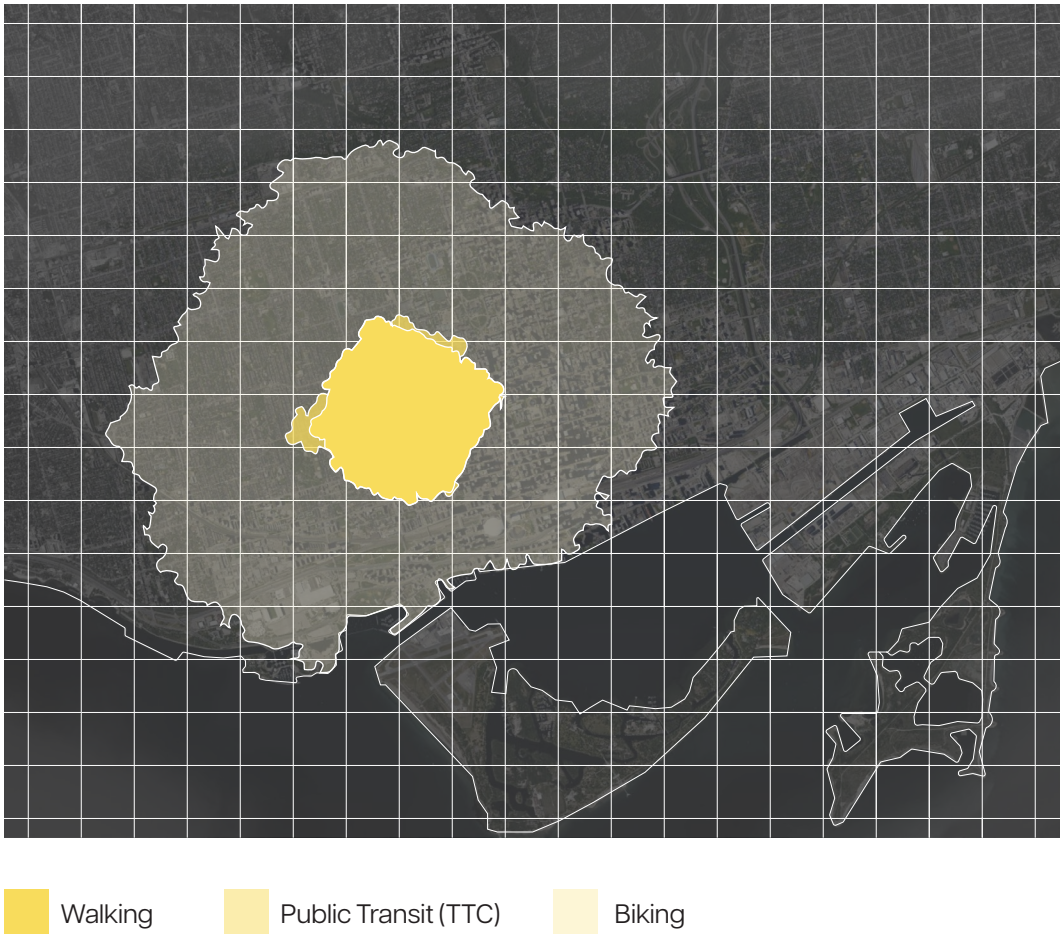
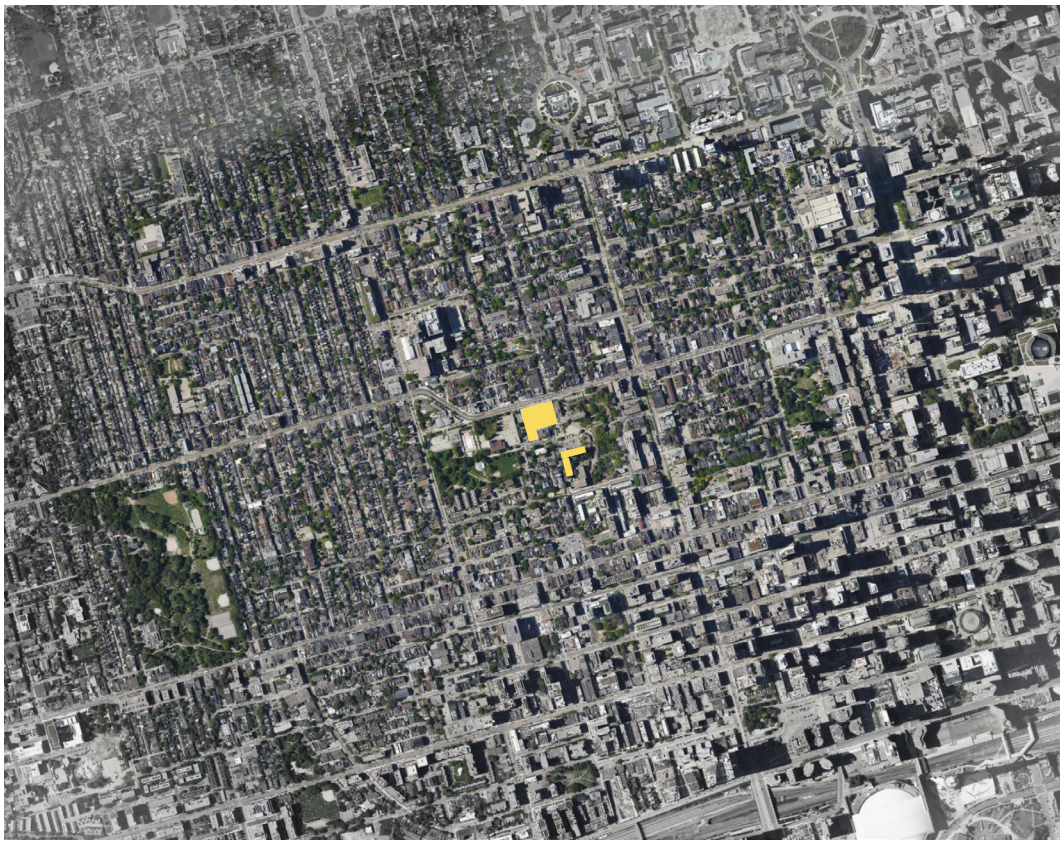


Figure 26:

Nearby 91 Augusta Avenue.



91 Augusta Avenue **[see Figure. 26]**, located within the masterplan area, is a popular choice of housing for seniors within the neighbourhood.[191] The building is currently run by Toronto Seniors Housing Corporation (TSHC), who use an integrated service model to allow seniors to age-in-place.[192] This building is not slated to be revitalized within the masterplan, but serves its purpose of keeping seniors within their neighbourhood. Despite this, the building itself does not appear to have been built to house the elderly. The building in its current state is in disrepair. Its concrete block corridors and confined spaces do not appear conducive to healthy aging through architecture. However, the strength of the community among residents seems to prevail above all. The existing masterplan does not consider the vulnerable populations within and surrounding the neighbourhood; no housing is considered for the elderly.

This typology not only positions itself as a catalyst for change within this community but also as an example of human-centric architecture in the urban environment. Building off existing models of care, we can position everyday architecture to shift towards health-promoting environments. This neighbourhood has the beginnings of enabling residents to age-in-community, but the architecture that houses them does not reflect the level of care one would expect for the senior population. If we can reflect this level of care in our architecture with an already strong foundation of community, we can create a catalyst for change that extends far beyond the boundaries of Alexandra Park.

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[191] Lena, Aging Alone in Chinatown, October 17, 2017, https://thelocal.to/portrait-how-lena-lives-481d5ac8f0ea/.

[192] "About Us," Toronto Seniors Housing Corporation, accessed December 26, 2024, https://www.torontoseniorshousing.ca/about/about-us/.

life in built environments

advocating for healthier aging.

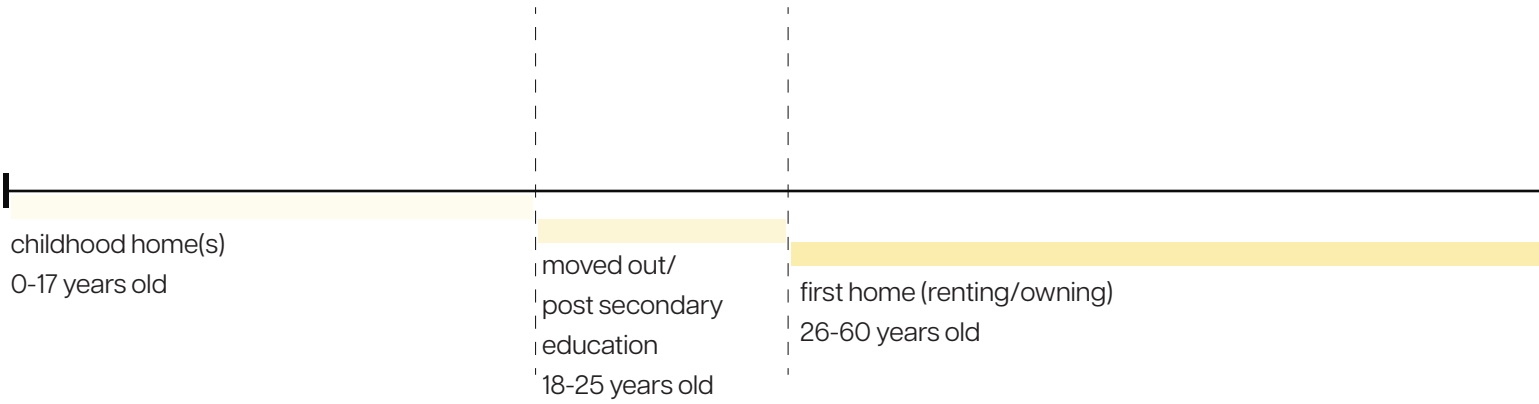
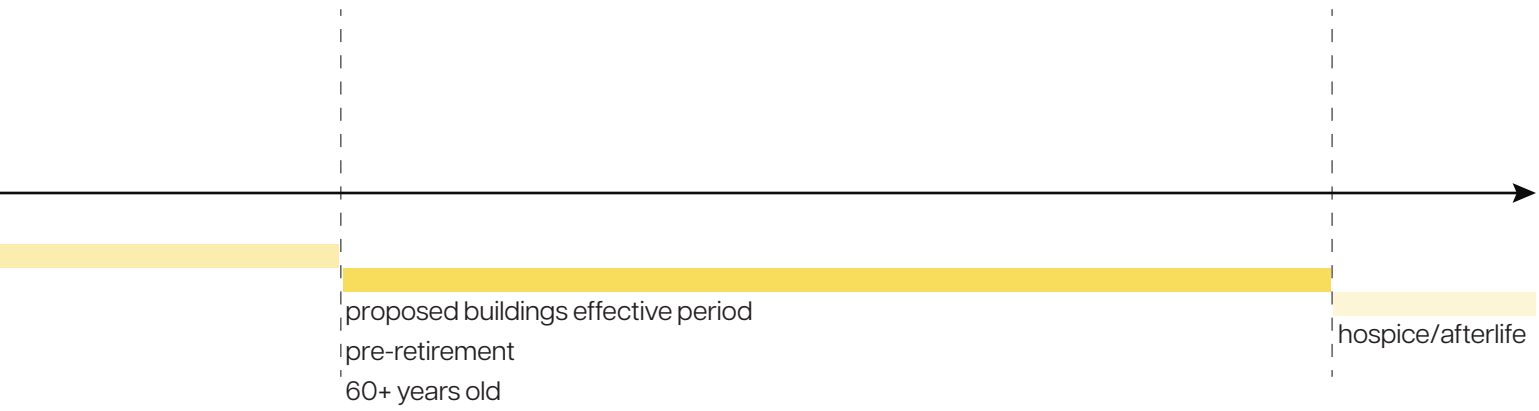


Figure 27:

The proposed typology's effective period of being occupied.

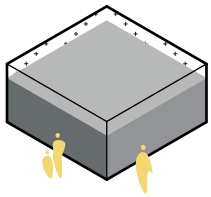
In advocating for healthier aging, there needs to be alternative options available that provide an accessible, affordable solution to a wider range of people. This involves the production of more homes with a specific focus on the aging body. The presented housing typology will fill a gap between home ownership and retirement, providing alternative options that allow one to age independently. This autonomy creates a foundation for aging-in-community within a health-promoting environment, which can positively influence the aging body.


proposed buildings effective period
pre-retirement
60+ years old
hospice/afterlife

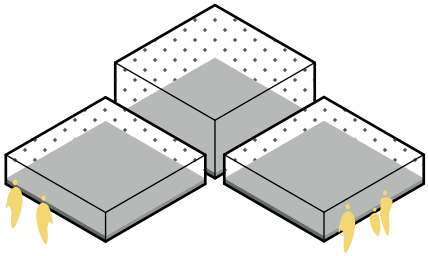
Kensington-Chinatown

demographics at a glance.

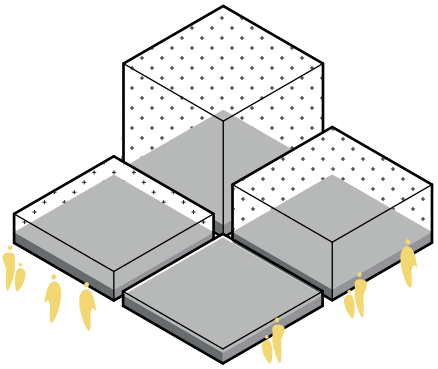
density per sq. km



Ontario | 15.9 ppl

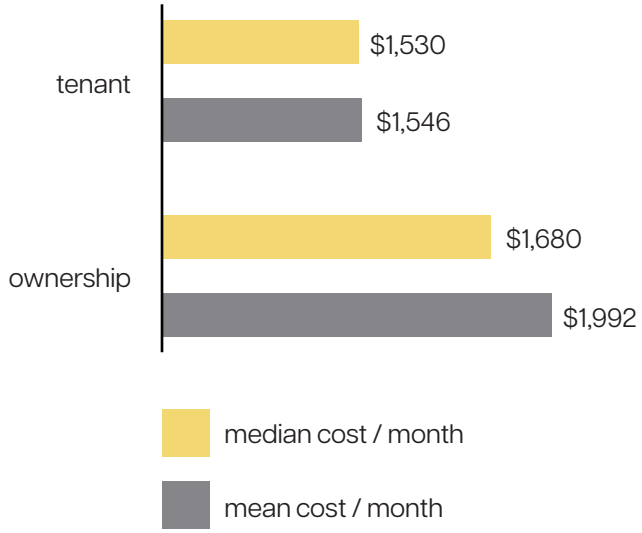


Toronto | 4,428 ppl

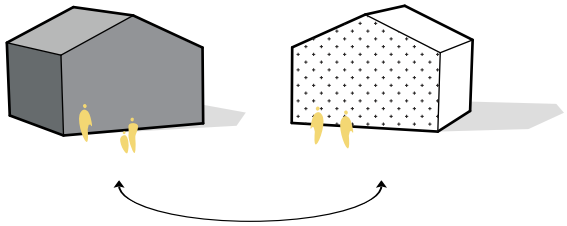


Chinatown-Kensington | 12,235 ppl

cost of housing

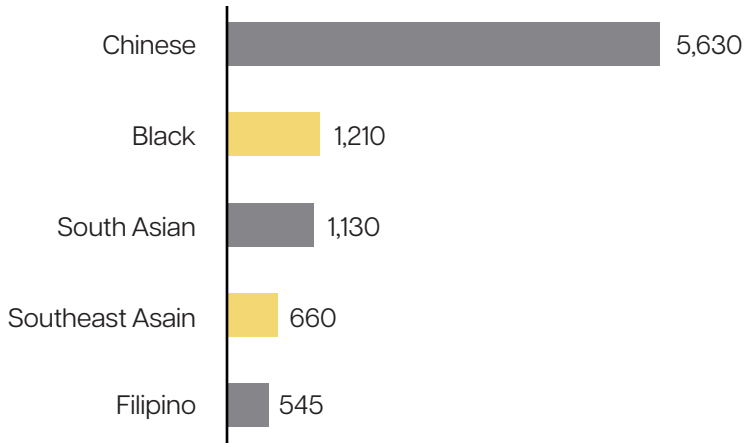


type of ownership

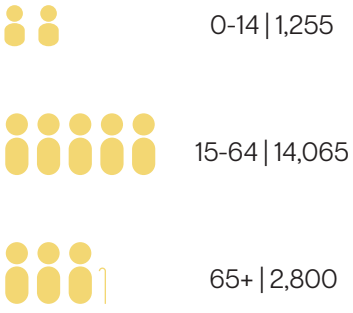


tenants | owners
6,515 3,005

visible ethnicities



age of population

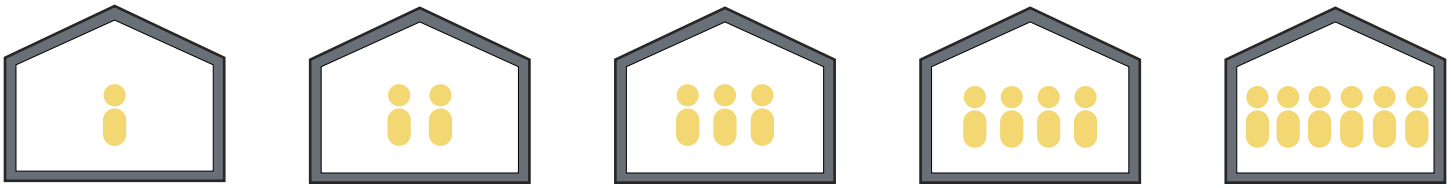


0-14 | 1,255

15-64 | 14,065

65+ | 2,800

avg. household by size



1 person | 4,670 ppl

2 person | 2,285 ppl

3 person |1,015 ppl

4 person | 555 ppl

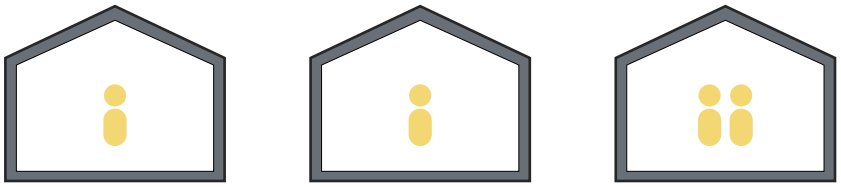
5+ person | 415 ppl

avg. household

2016 | 2.00 ppu

2021 | 1.90 ppu

senior living arrangements



865 or 36.4% of seniors 65-84 live alone

city avg. 24.7%

280 or 44.8% of seniors 85+ live alone

city avg. 31.6%

1,655 or 59.1% of seniors 65+ do not live alone

The Kensington-Chinatown area is dense both in people and diversity. The main takeaways from the demographics of this neighbourhood are the unaffordability of housing and the number of seniors living alone.[193] [194] The number of seniors living alone is well above the city average, leading to questions about whether homes enable them to age-in-place safely or if there is an absence of choice. Within the neighbourhood, the existing housing stock has been classified as unaffordable (41.8%), unsuitable (9.8%), and inadequate (8%).[195] With such a high percentage of unaffordable housing, seniors have an absence of choice. Consequently, this drives them to inhabit unsuitable, inadequate housing or leave their neighbourhood in search of more accommodating alternatives that suit their financial and physical demands.

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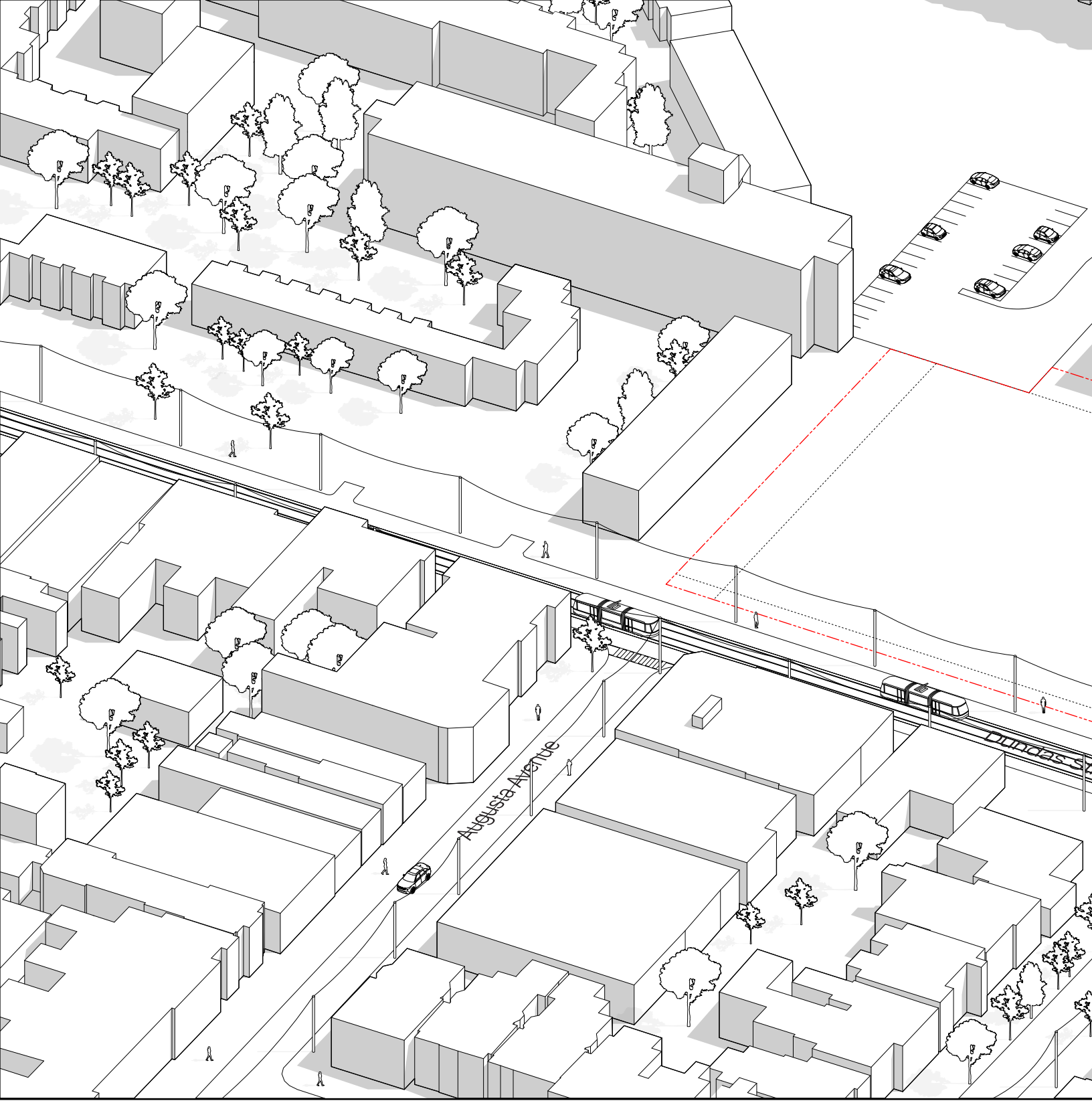
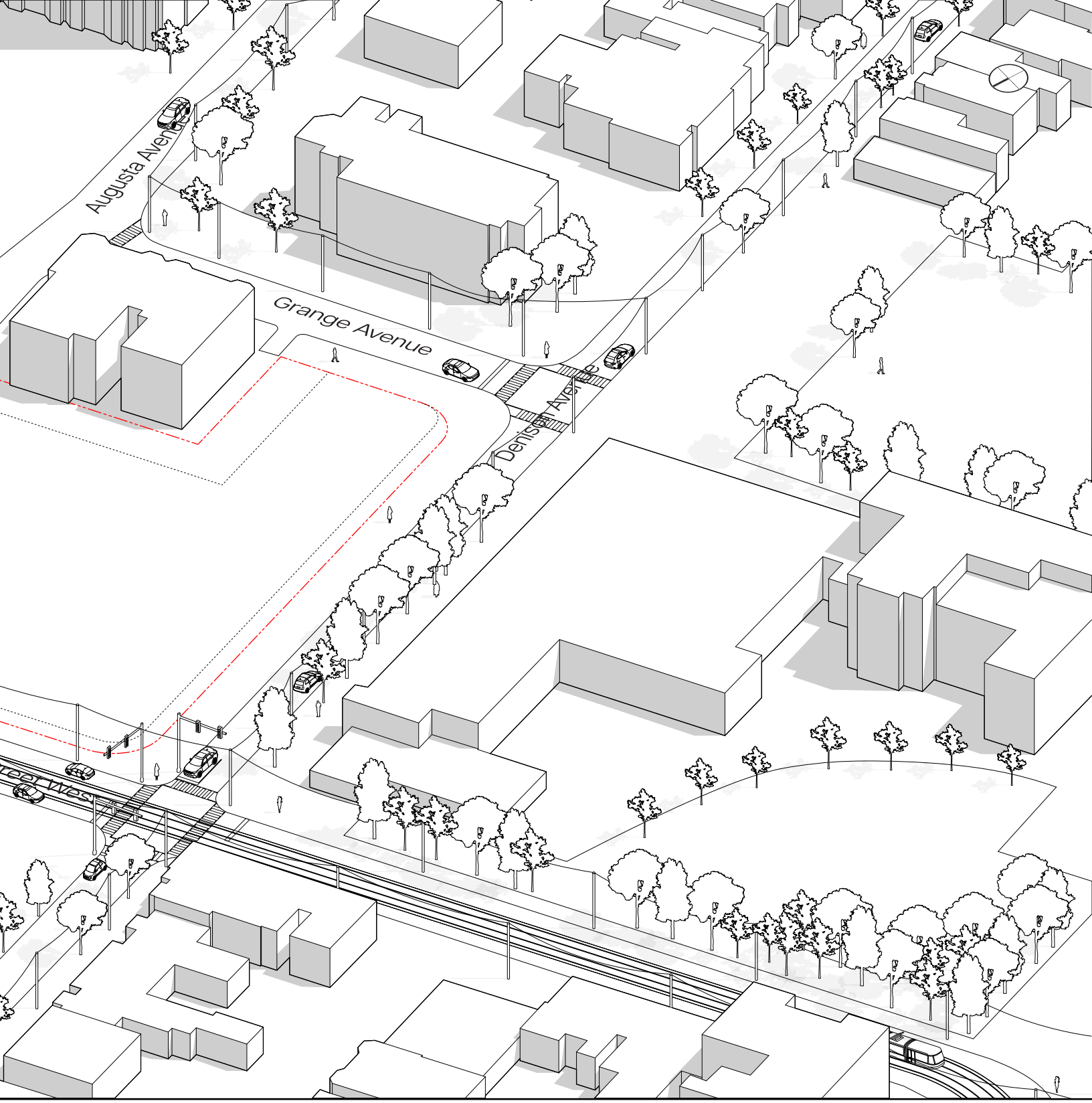
[193] City of Toronto, "Neighbourhood Profile - Kensington-Chinatown" (City of Toronto, 2018), https://www.toronto.ca/ext/sdfa/Neighbourhood%20Profiles/pdf/2016/pdf1/cpa78.pdf.

[194] City of Toronto, "Neighbourhood Profile Detail," City of Toronto (City of Toronto, April 12, 2022), Toronto, Ontario, Canada, https://www.toronto.ca/city-government/data-research-maps/neighbourhoods-communities/neighbourhood-profiles/find-your-neighbourhood/neighbourhood-profile-detail/.

[195] Toronto.

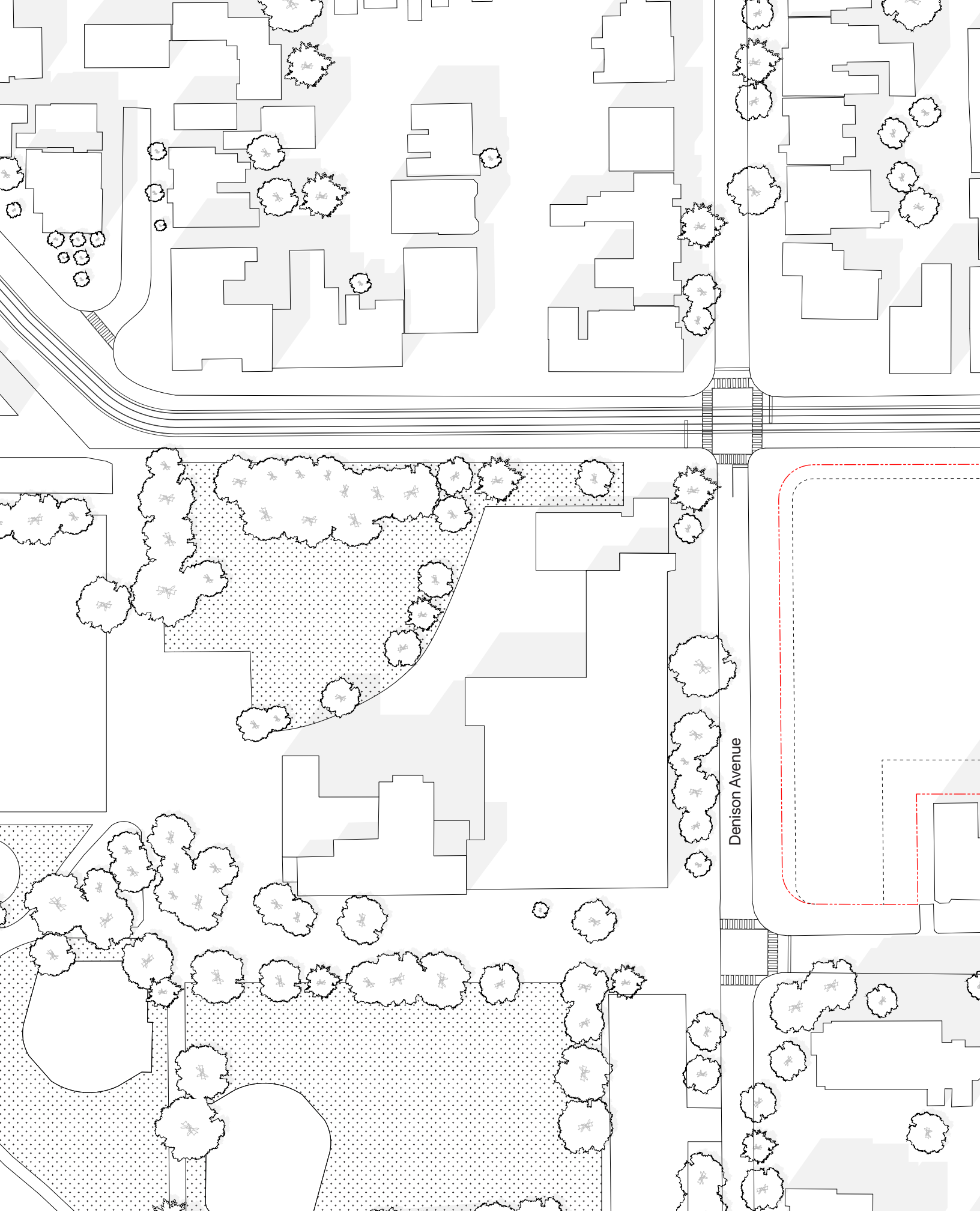


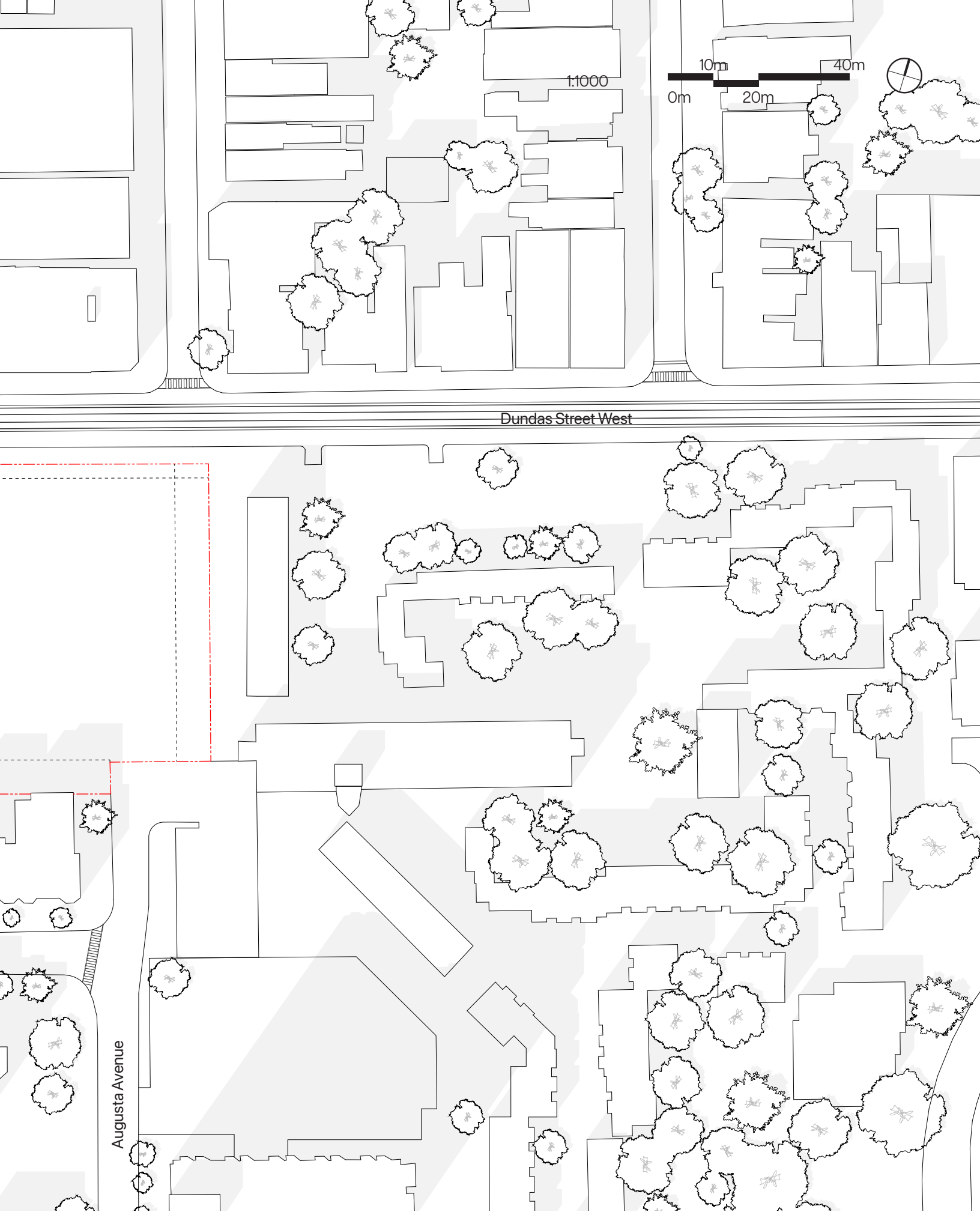
existing site

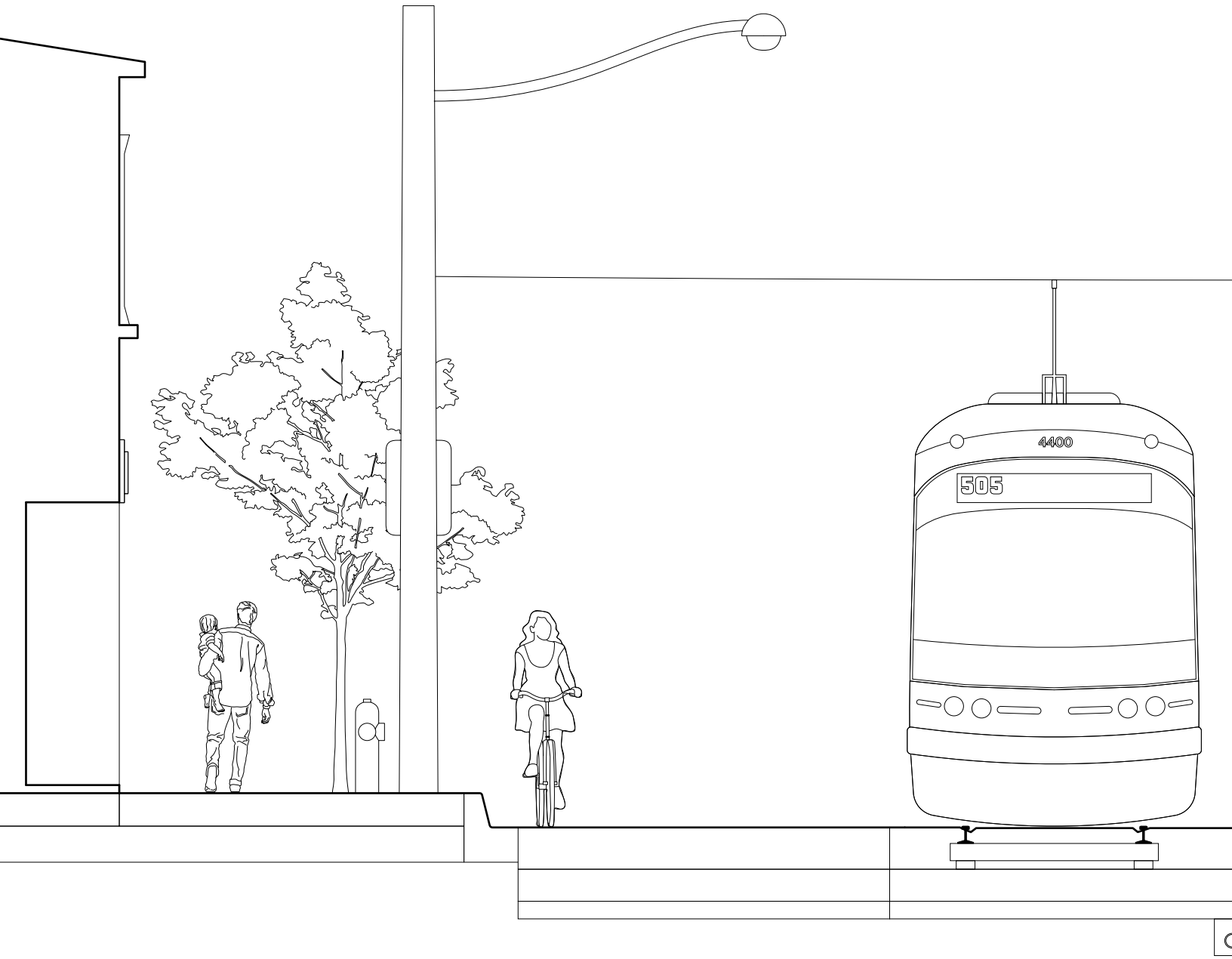


The existing site is currently in development to become two towers of 14 and 15-storeys, hosting 103 and 188 residential units, respectively.[196] As part of the Alexandra Park masterplan, this site had the greatest accessibility and potential to be home to the elderly, also catering to the needs of the Kensington-Chinatown Community.

[196] Urban Toronto, "Alexandra Park Revitalization," Urban Toronto, accessed December 18, 2024, https://urbantoronto.ca/database/projects/alexandra-park-revitalization.1646.


Denison Avenue

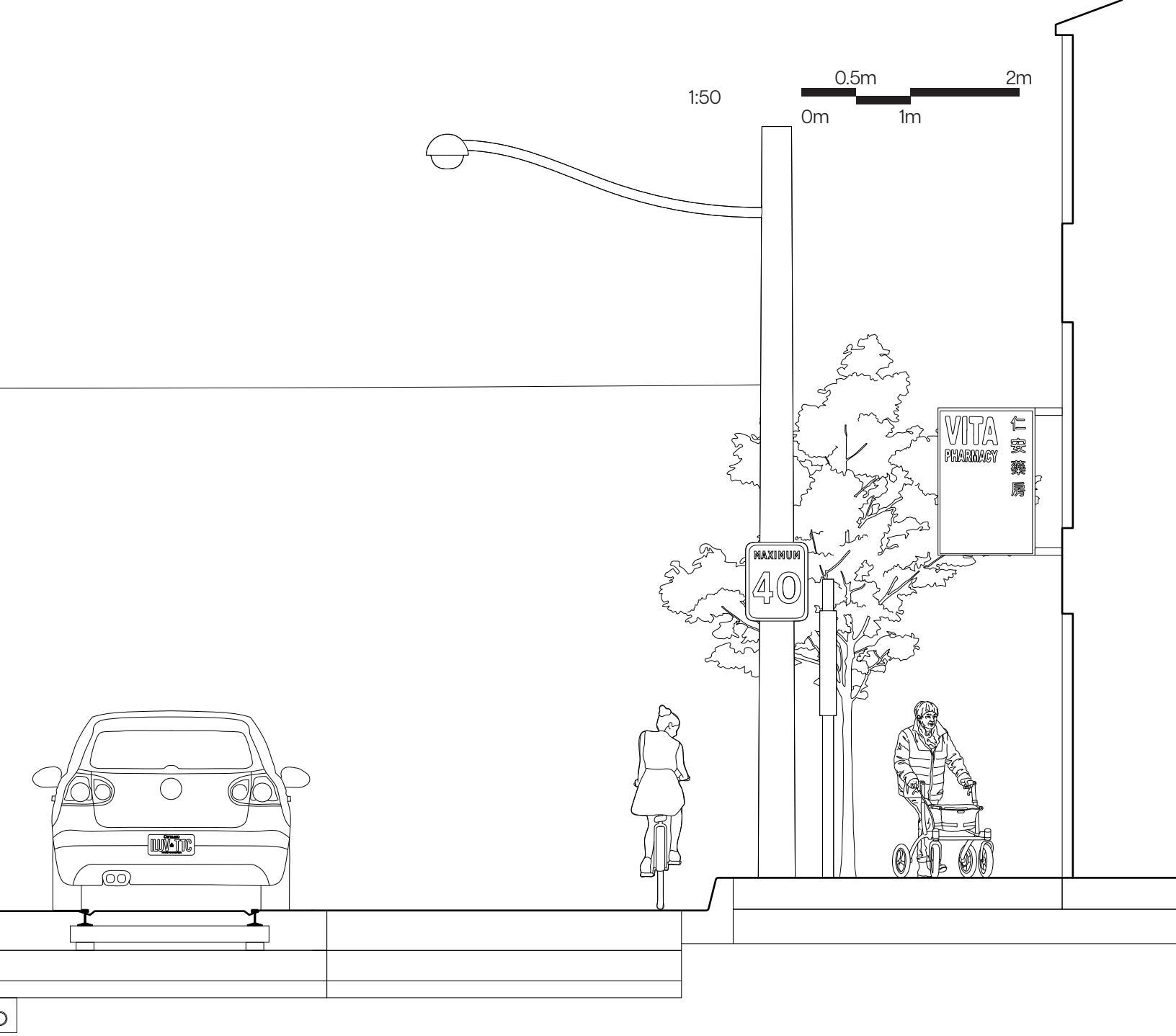

1:1000
0m
10m
20m
40m
Dundas Street West
Augusta Avenue



sidewalk
3.50m [11' - 6"]

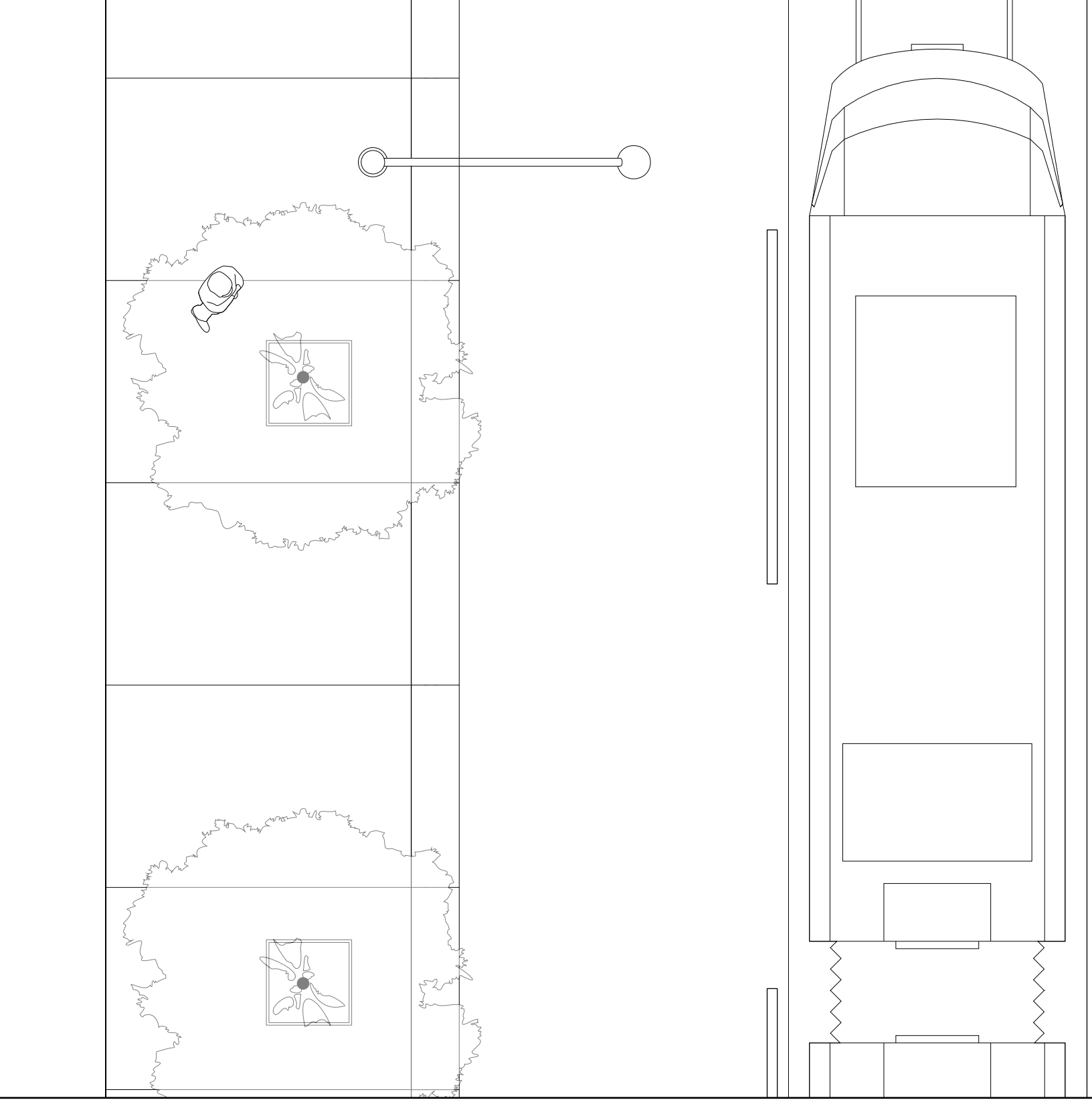
westbound traffic
6.25m [20' - 6"]

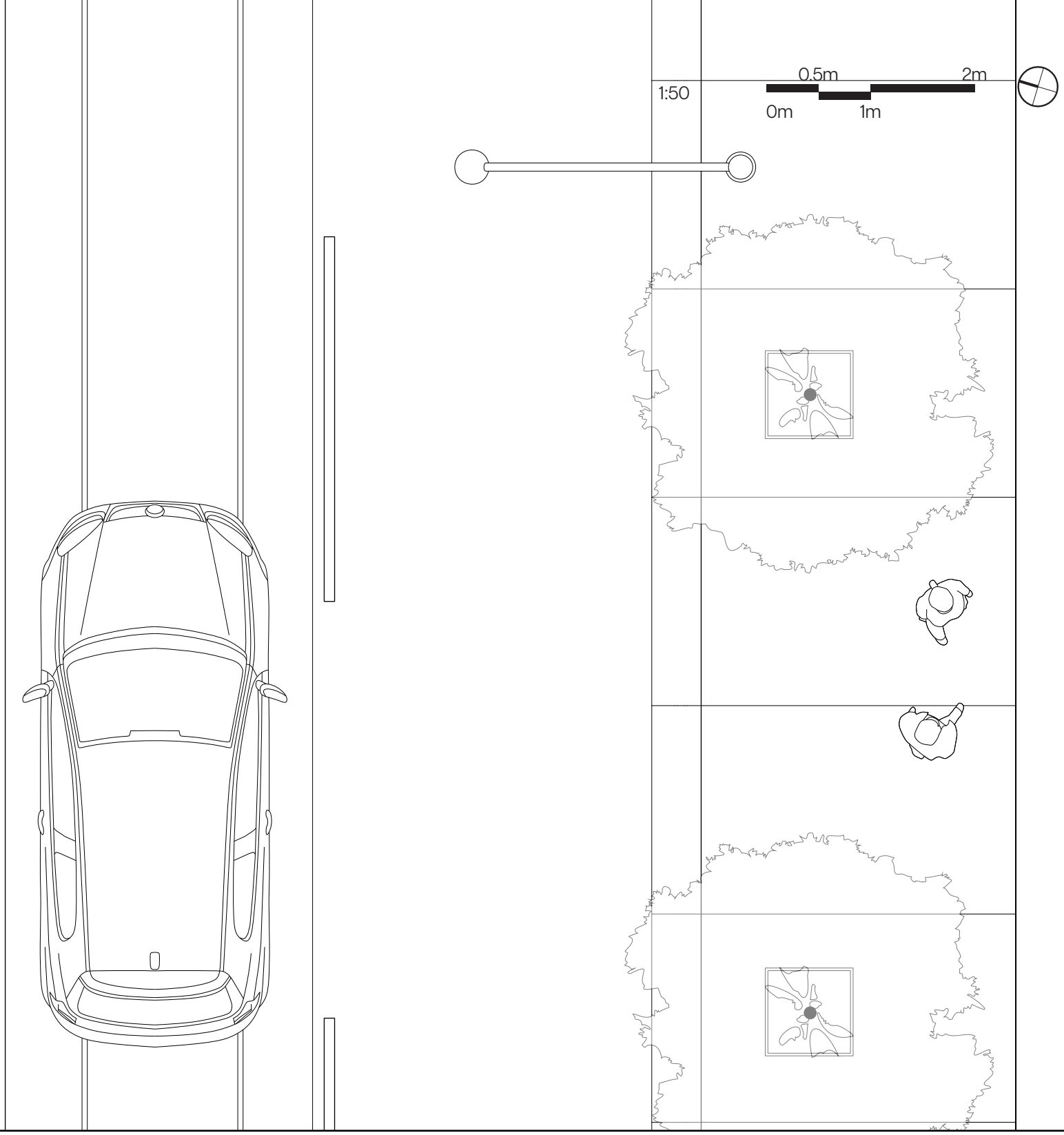
Dundas Street West



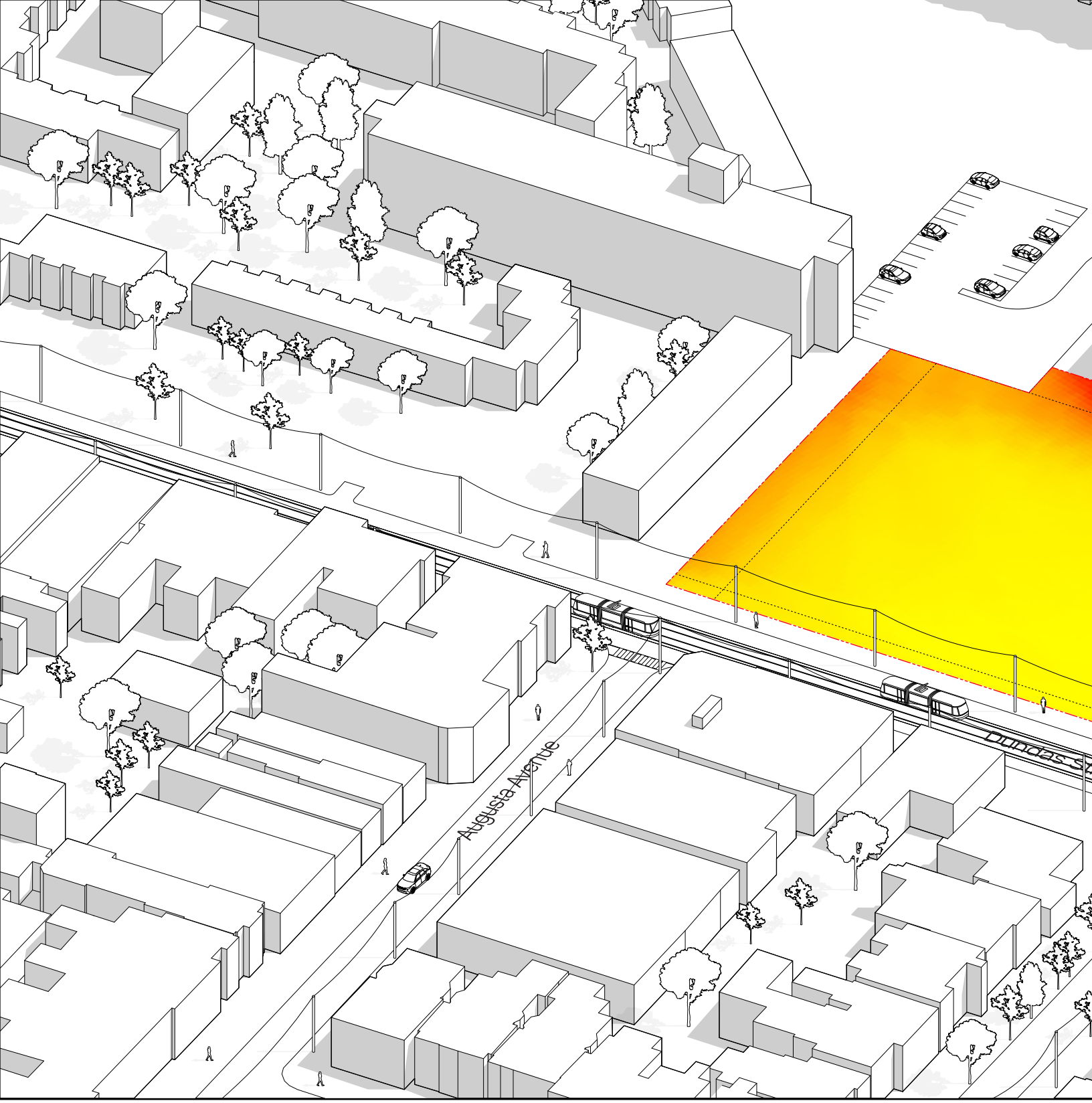
eastbound traffic
6.25m [20' - 6"]

sidewalk
3.50m [11' - 6"]



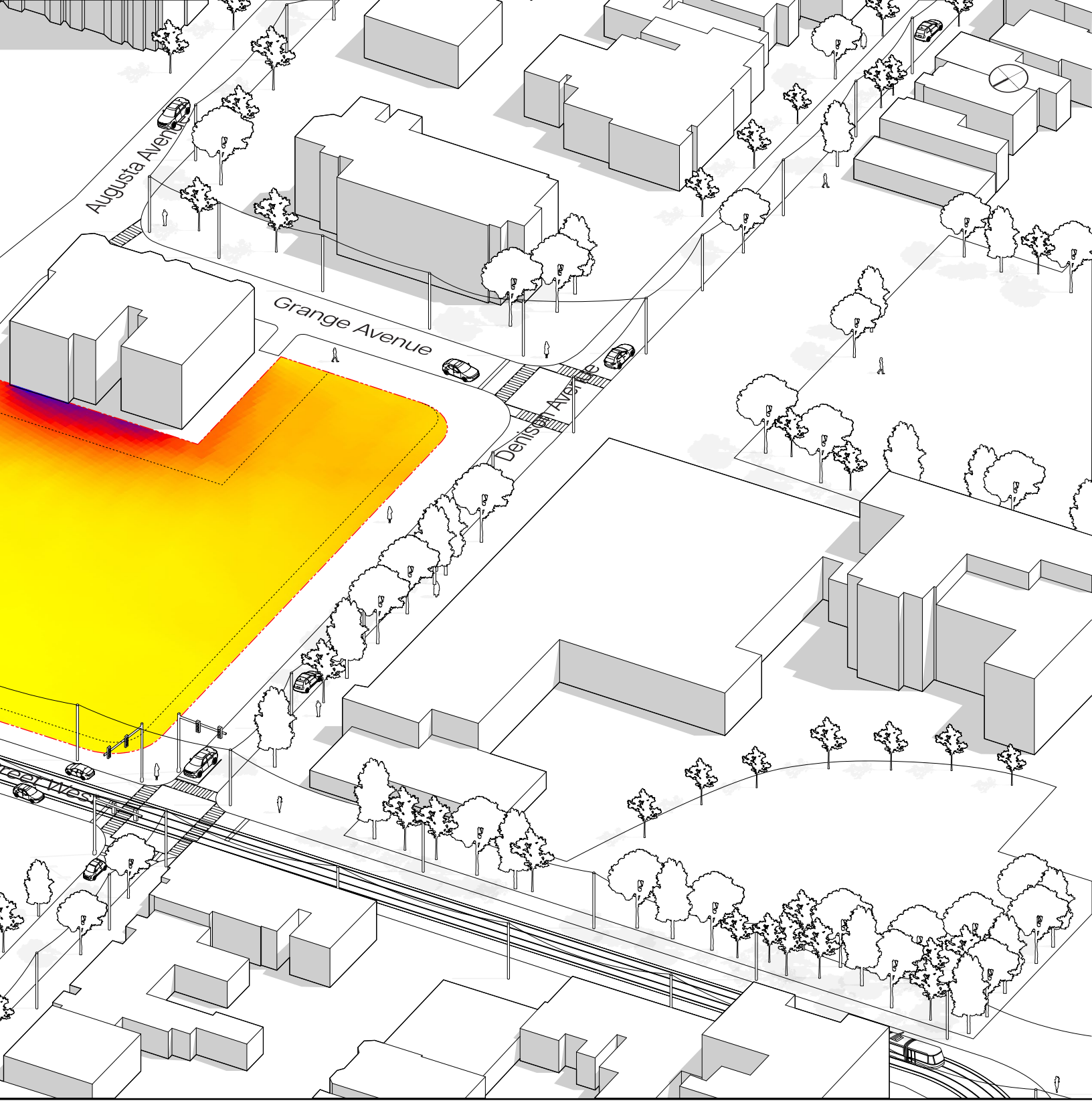


Dundas Street West has expansive sidewalks, allowing for comfortable walking, especially for those with mobility aids and assistive devices. Due to the width of the road and lack of intersections, there are limited crosswalks, particularly hampering those with accessibility needs. The site's northwest corner has a crosswalk, and streetcar stops in either direction, making it a significant access point to the surrounding neighbourhood and Toronto.

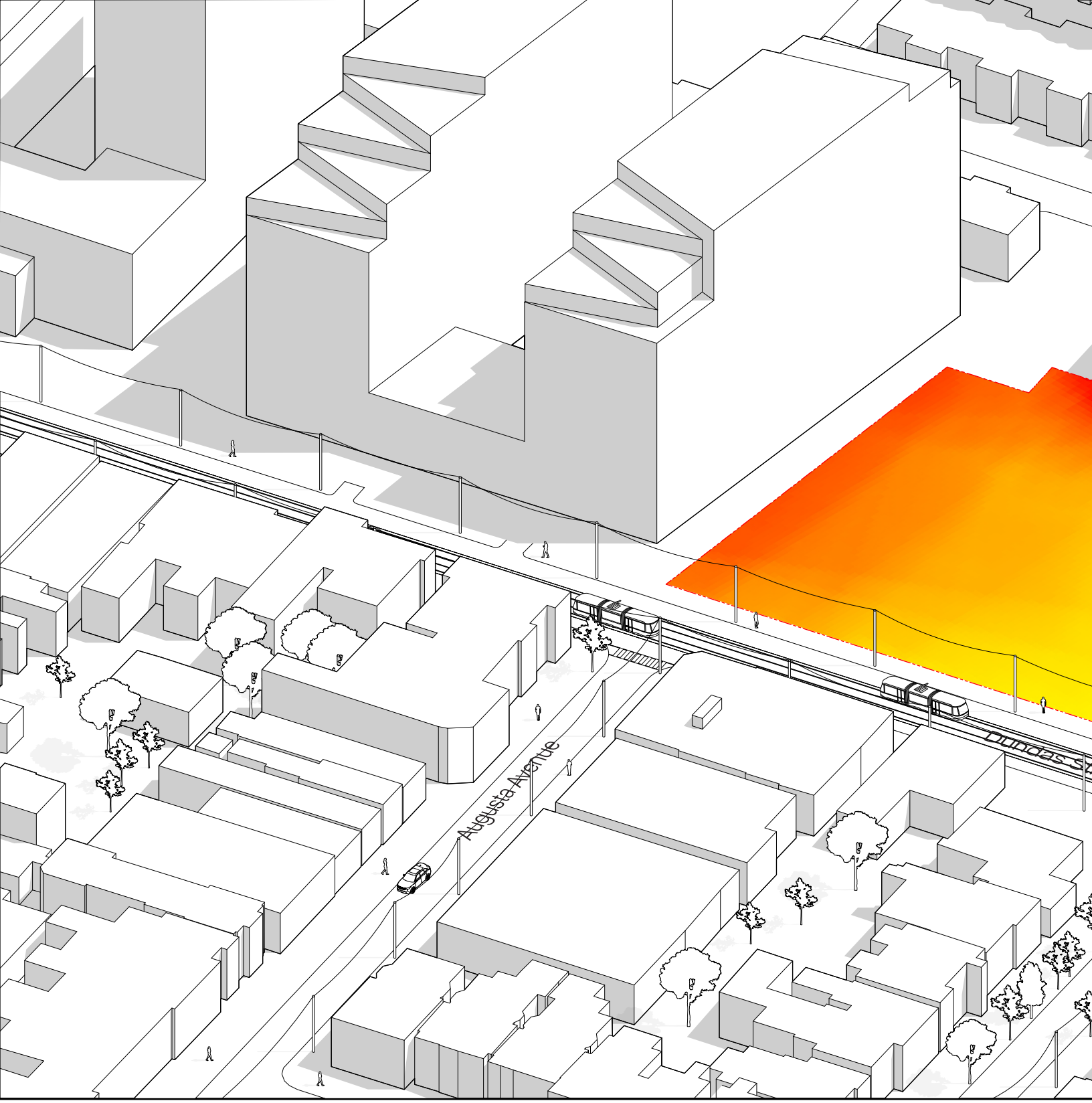


0 395 790 1185 1580 1975 2370 2765 3160 3555 3950 hrs

annual daylight hours



The existing site has little daylight obstruction from adjacent buildings, creating an opportunity for a public park at the south of the site. Locating building masses to the North allows for maximum daylight for the site throughout the year.



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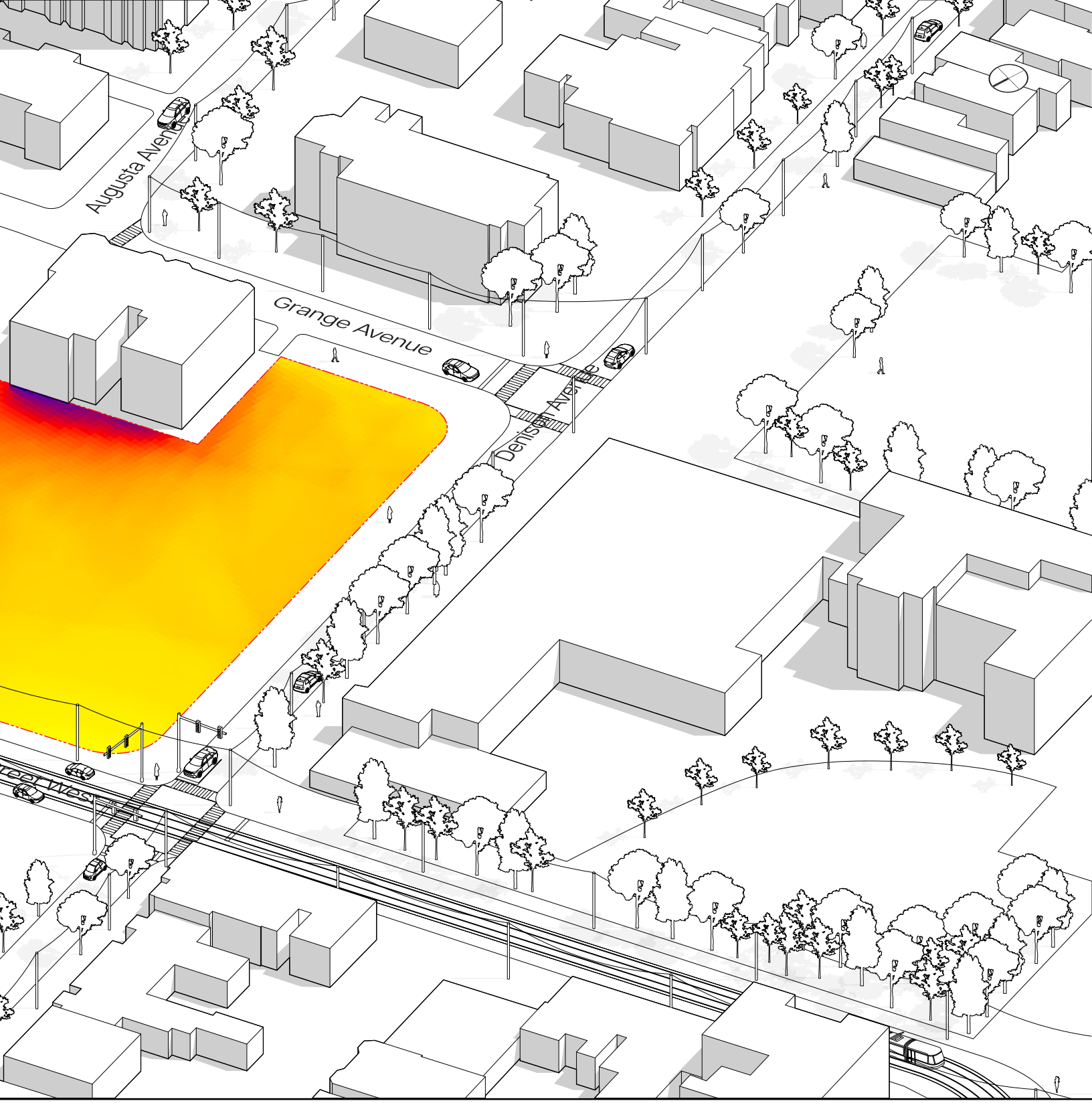
annual daylight hours



After bringing the proposed masterplan buildings into this scenario, the site is slightly more obstructed, but overall, this has minimal effect on any design considerations.

Alexandra Park masterplan

Toronto's renewed urban site.

Keywords:

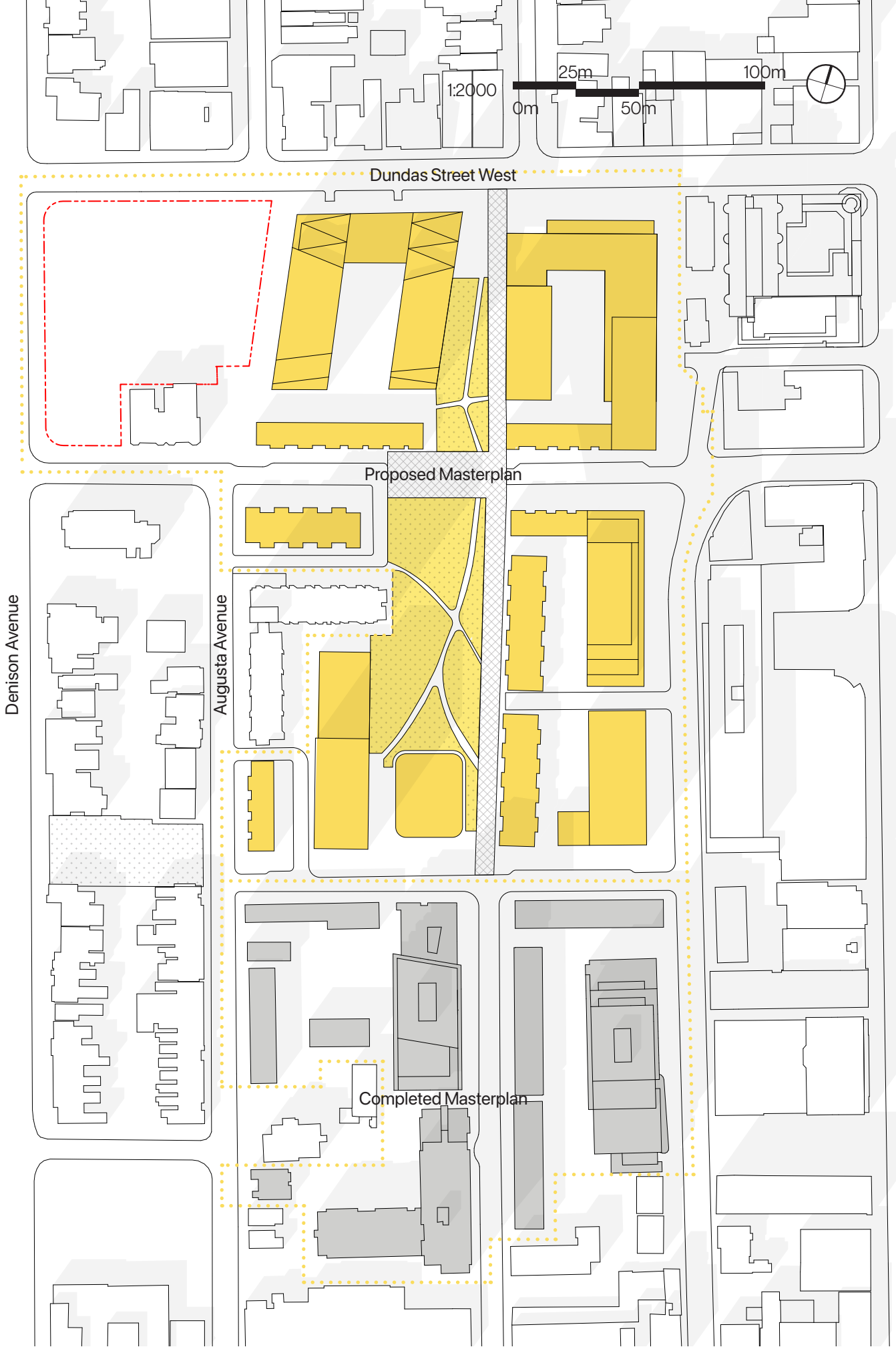
Displacement

The Alexandra Park masterplan has already started to work its way through the neighbourhood, highlighted in grey, with future developments highlighted in yellow. This masterplan has strong ties to the community and looks to create a revitalized neighbourhood for the benefit of all. The guiding principles are as follows:

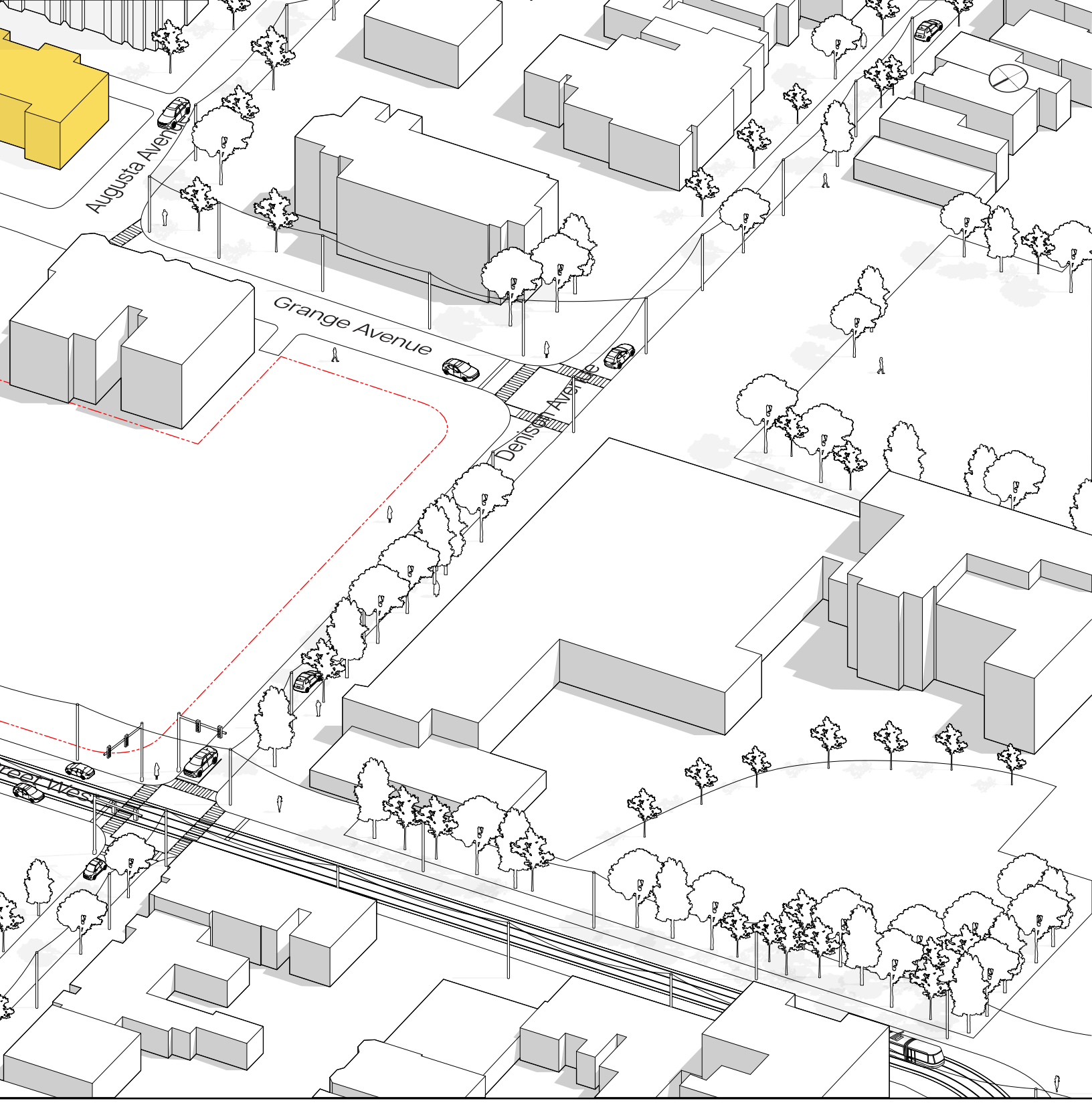
1. Zero displacement
2. Good housing
3. Provide more than housing
4. Planning together first
5. Minimizing disruption
6. Protecting tenants' rights
7. Developing connections
8. Ensuring participation
9. Nurturing a green, clean and beautiful community
10. Enhancing social, recreational, learning and economic opportunities[197]

These principles successfully incorporate the existing community, ensuring a stable and predictable future. However, these principles fail to address vulnerable populations such as the prominent aging population.

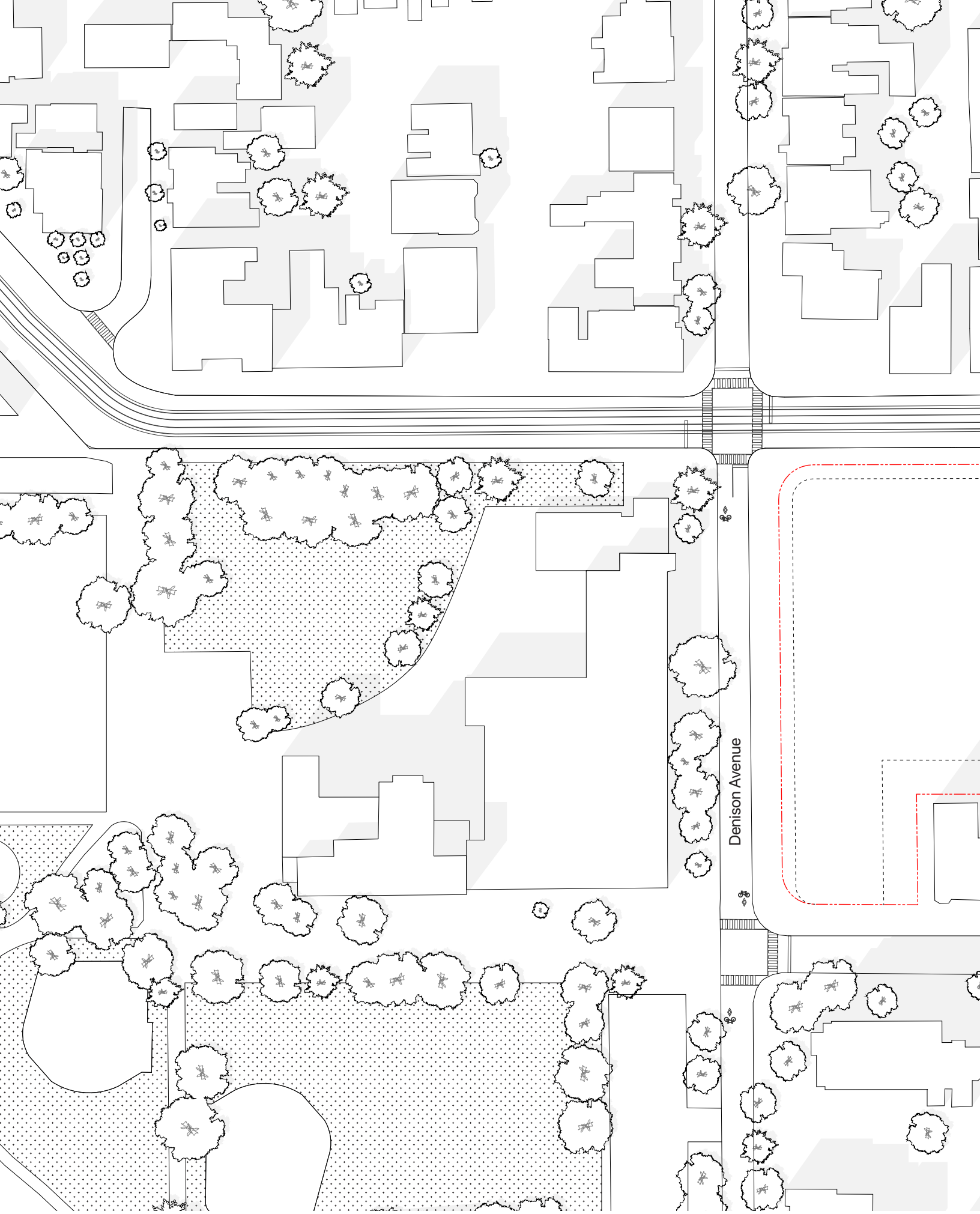
[197] "Alexandra Park | Toronto Community Housing," accessed October 29, 2023, https://www.torontohousing.ca/building-construction-and-revitalization/revitalization/alexandra-park.

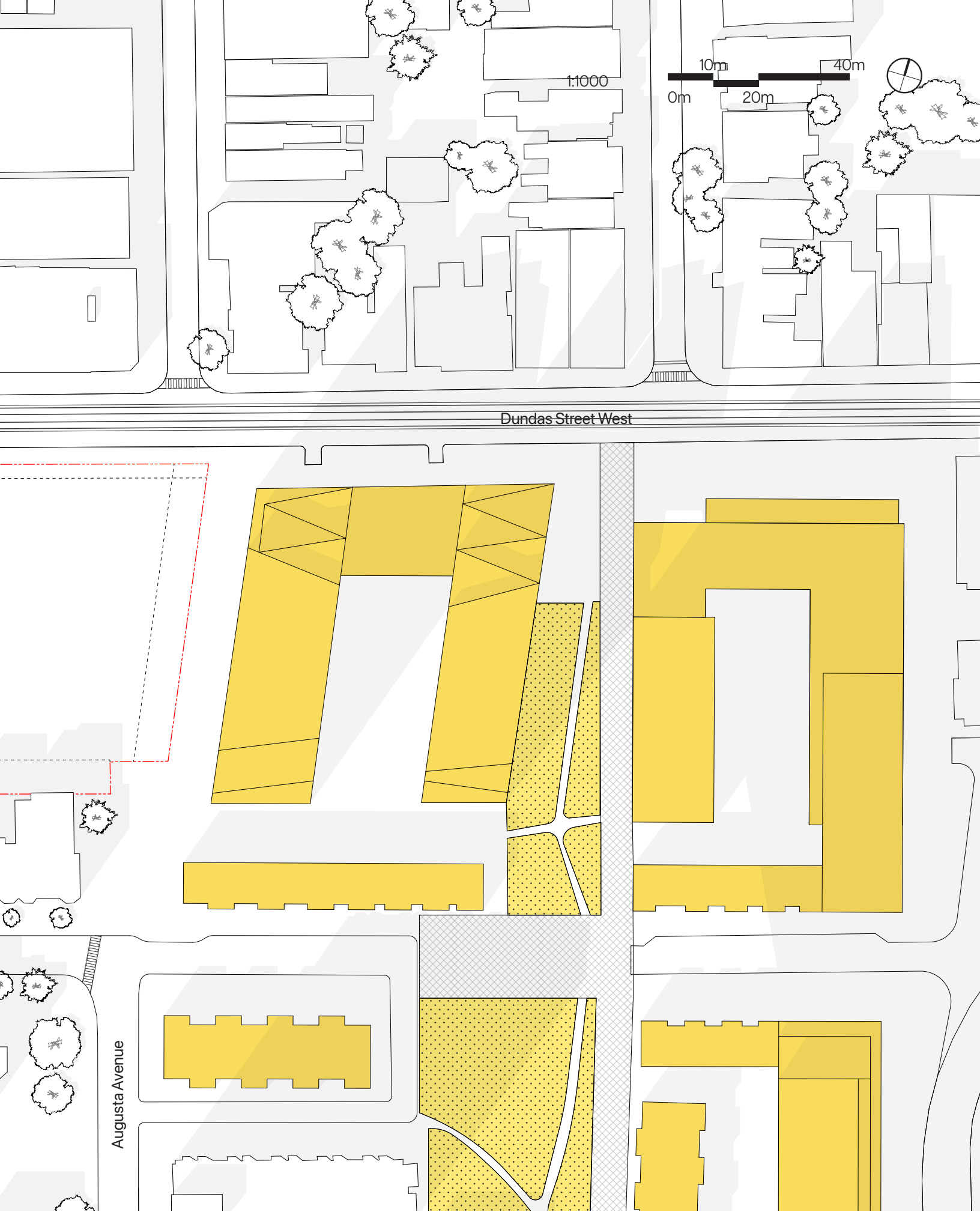

1:2000
0m
25m
50m
100m
Dundas Street West
Proposed Masterplan
Denison Avenue
Augusta Avenue
Completed Masterplan

proposed masterplan site



The proposed masterplan significantly densifies the Alexandra Park area by adding condominium developments. Neighbouring the site to the East is a 15-storey tower, with more developments ongoing to the South and East of the site.


Denison Avenue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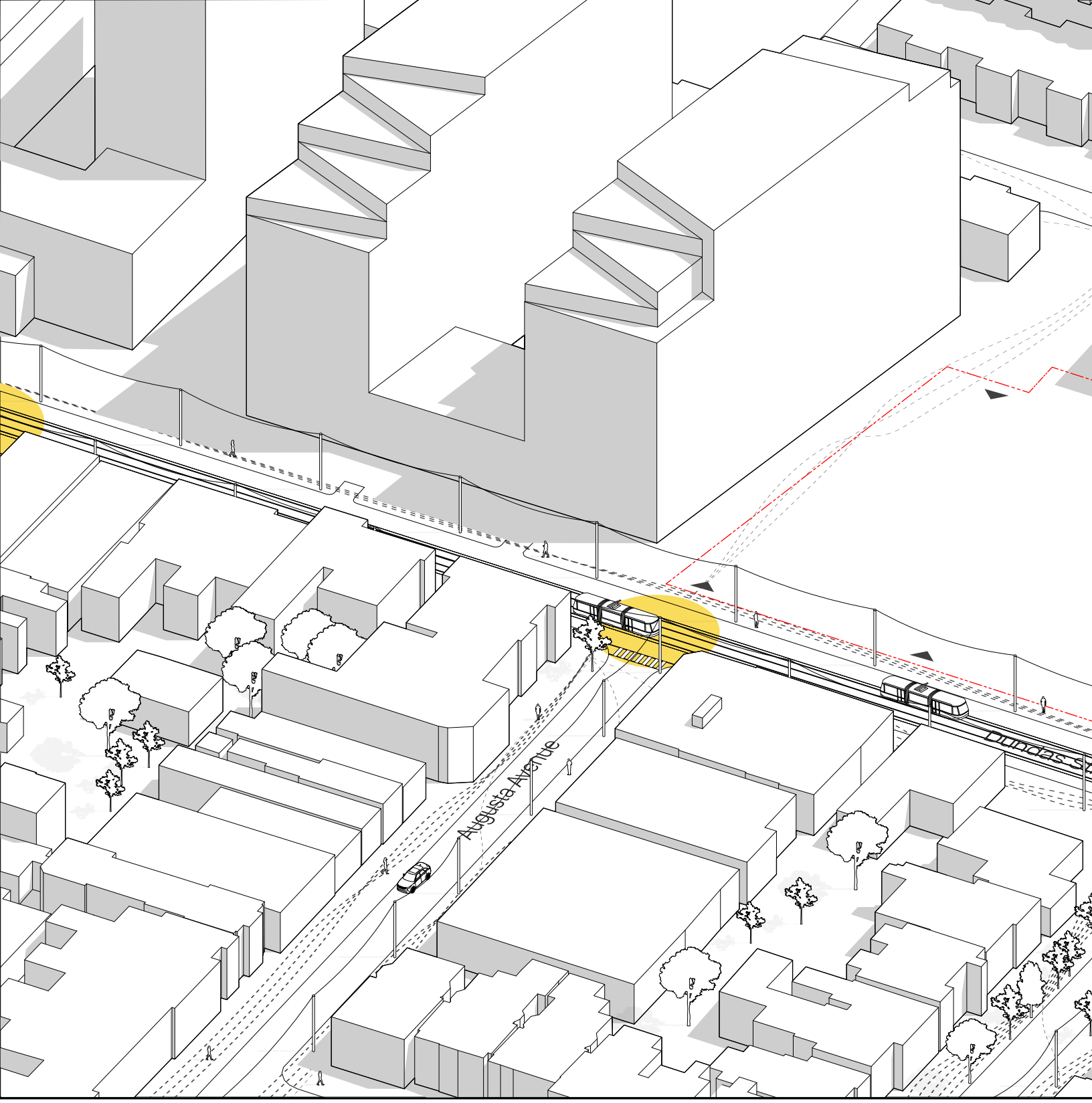
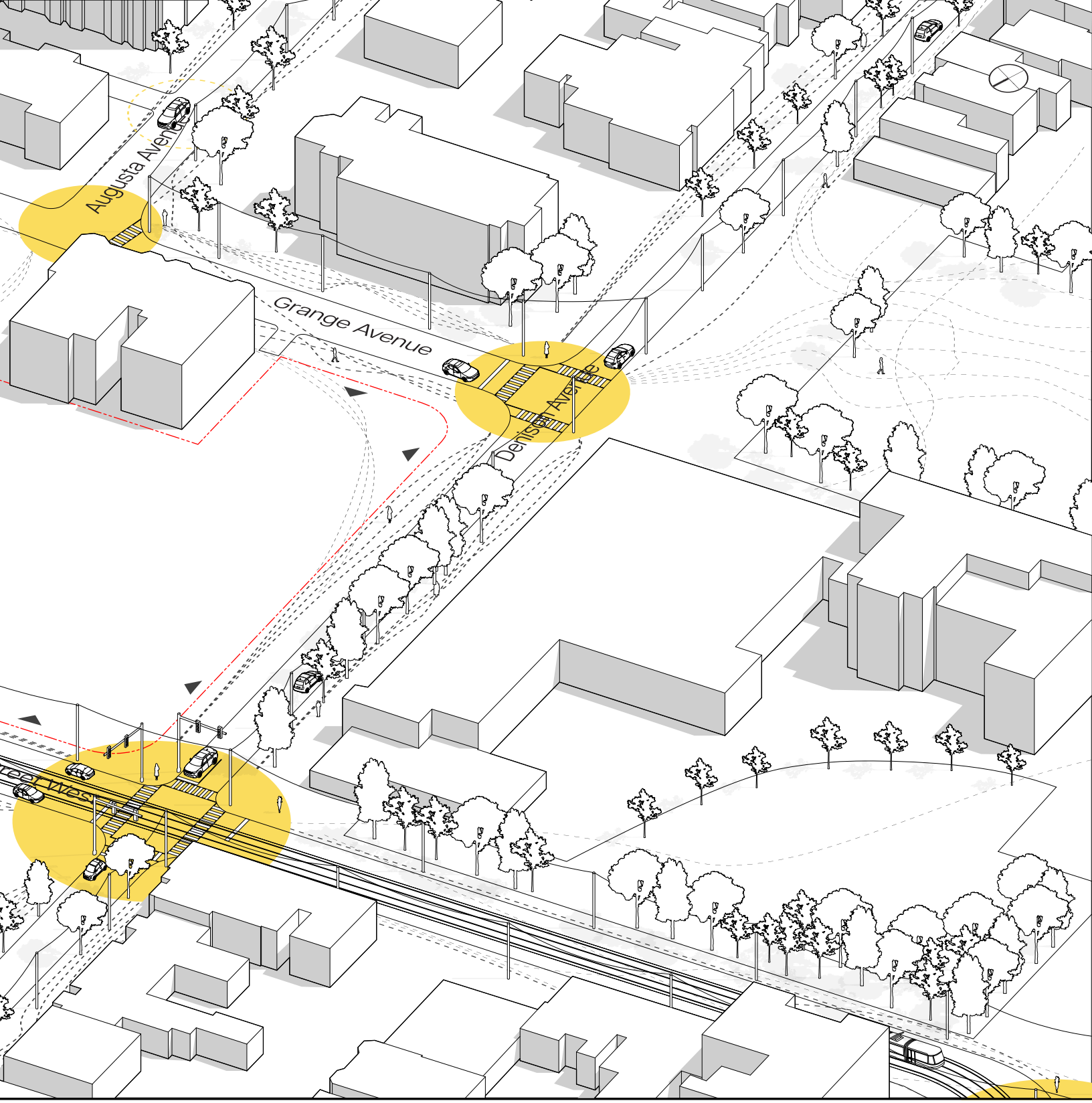
40m
Dundas Street West
Augusta Avenue



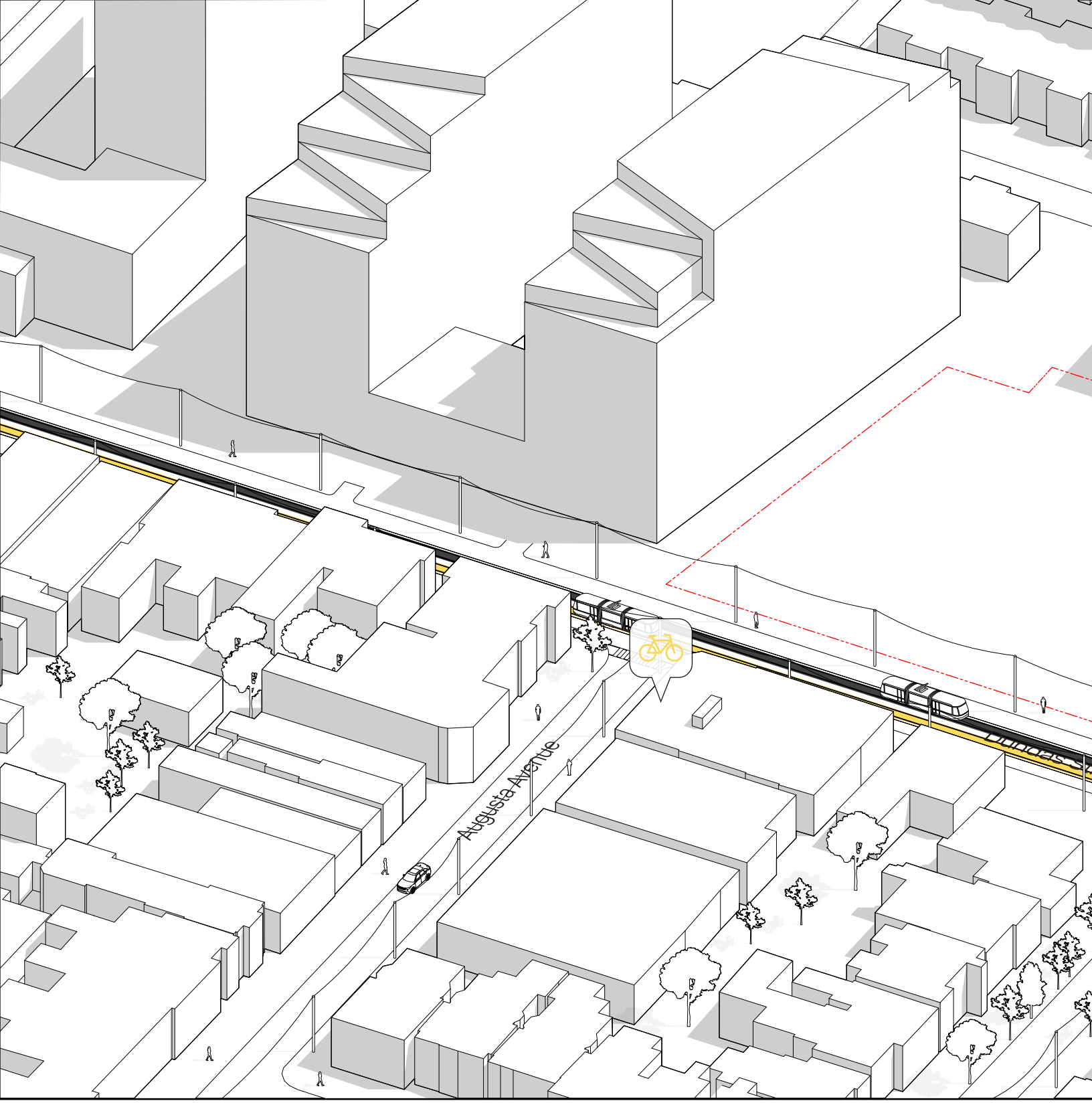
desired path

established path

pedestrian pathing



The existing site has heavy pedestrian traffic with the potential for desired pathways shown cutting through the site. To accommodate this, a pedestrian laneway will be located to the East, and garden space will allow for circulation around the site. Public space located adjacent to the site is one of many ways to engage the community and maintain existing social connections.



transit score

98

505 streetcar

bike score

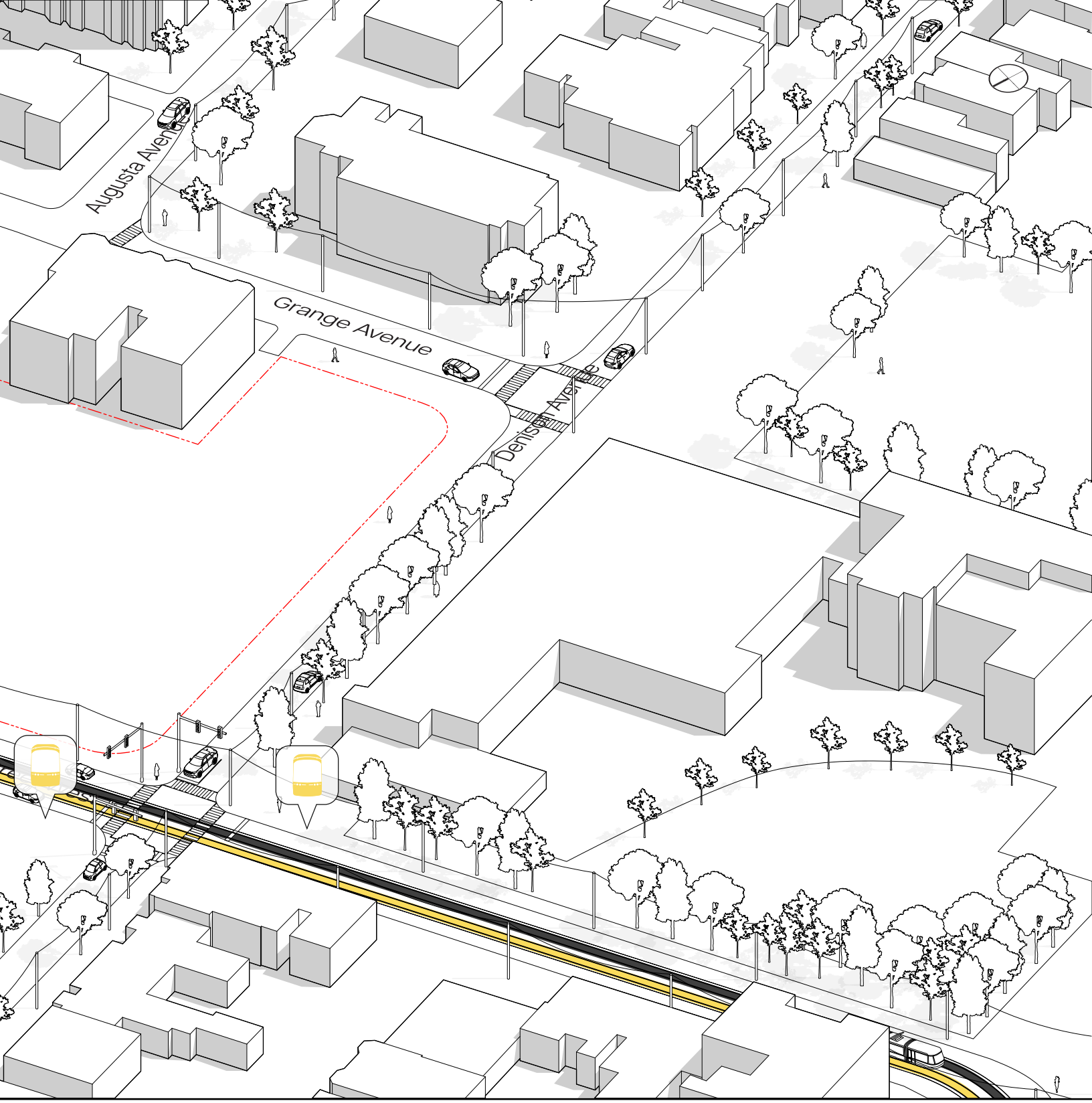
100

bike share

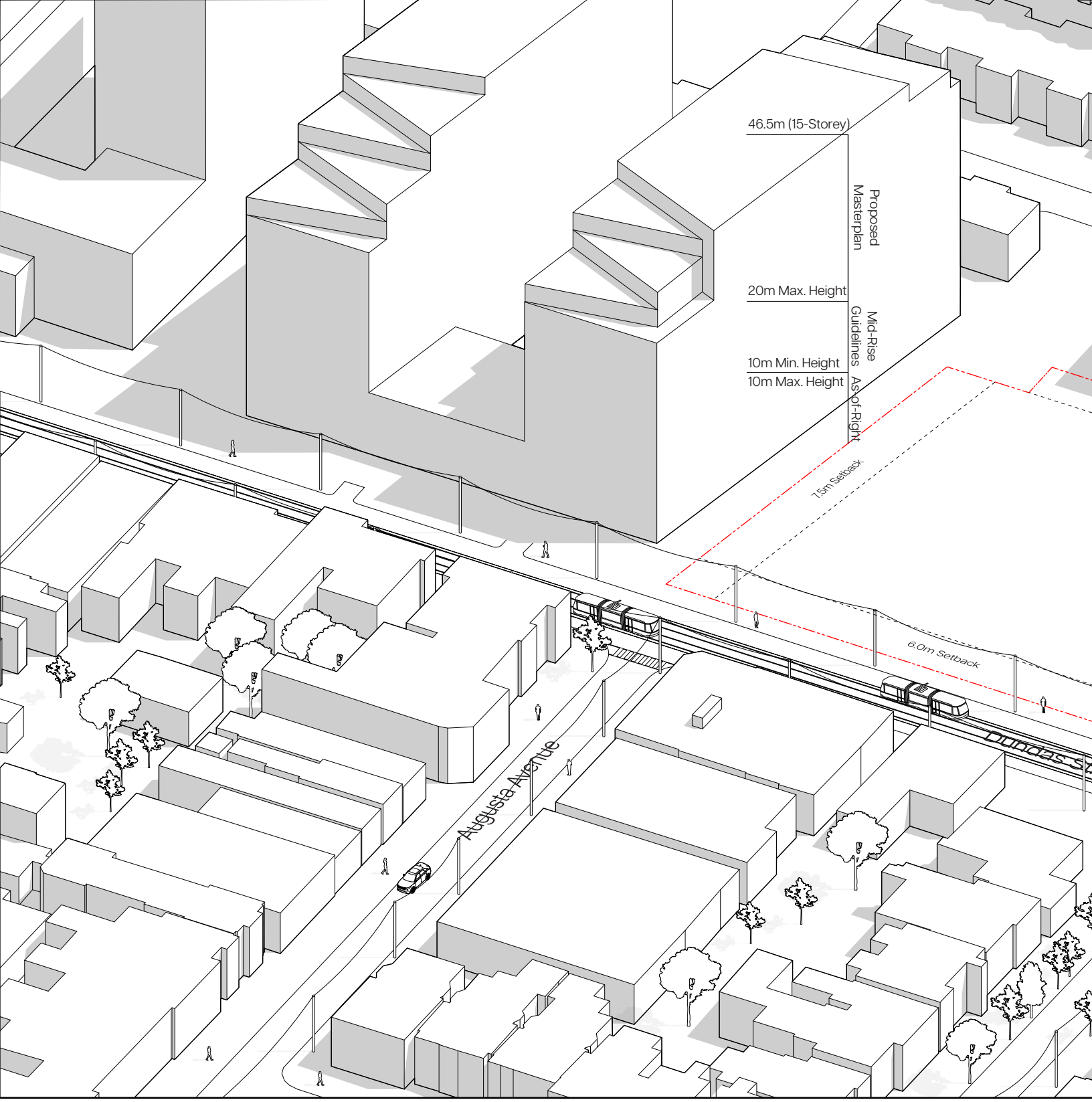
walk score

86

transit access



Accessibility to transit and amenities is essential as we age, as it promotes activity and physical health and allows the elderly to age-in-community. Transit around the site is highly accessible, with the 505 Streetcar running down Dundas Street West. The surrounding area is highly walkable and has a city bike share station located near the site for those who are able.



zoning as-of-right

max. building height | 10m

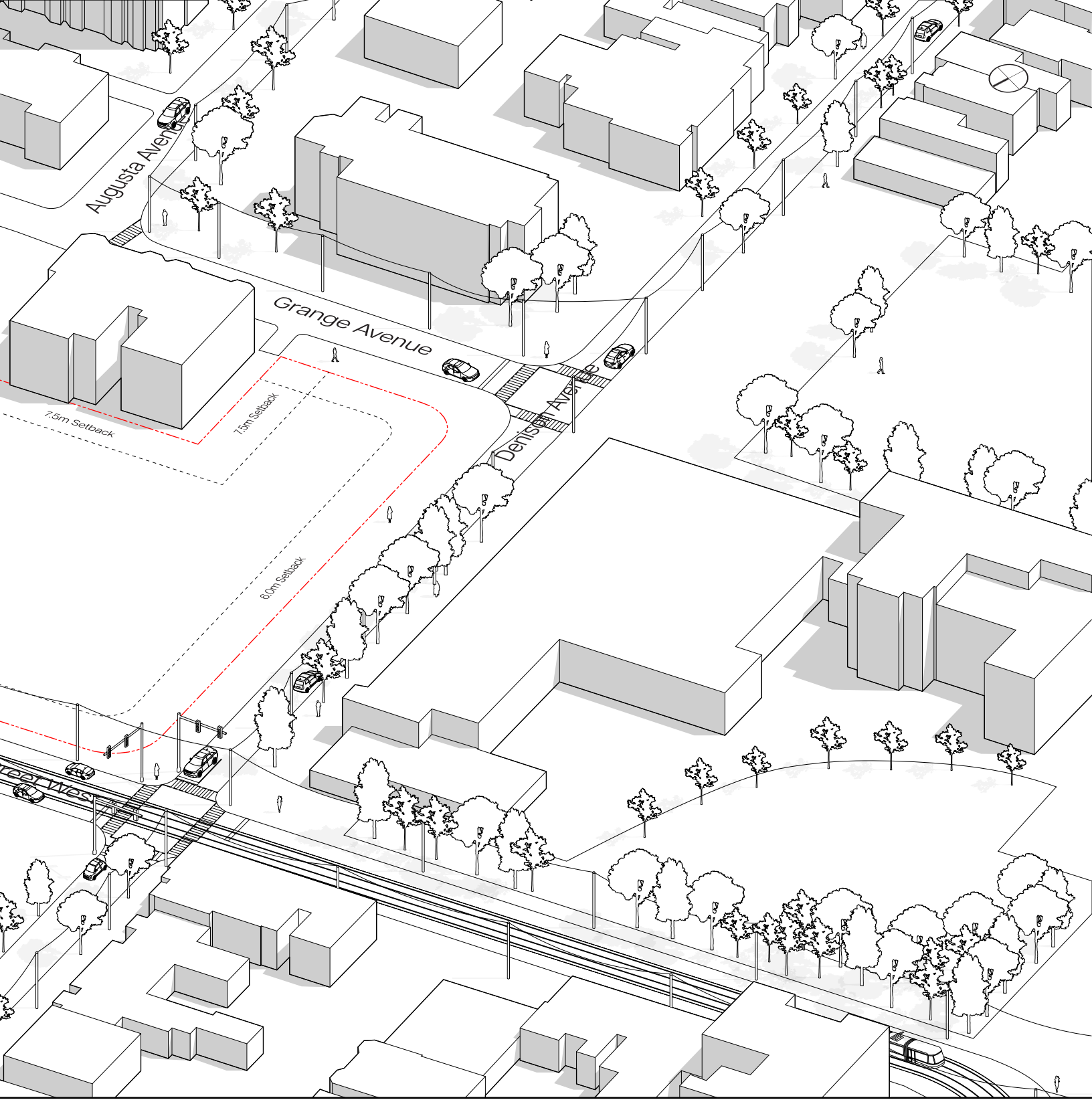
mid-rise guidelines

max. building height | 20m / 6-storeys
80% of Dundas Street | 16m
front angular plane @ 16m

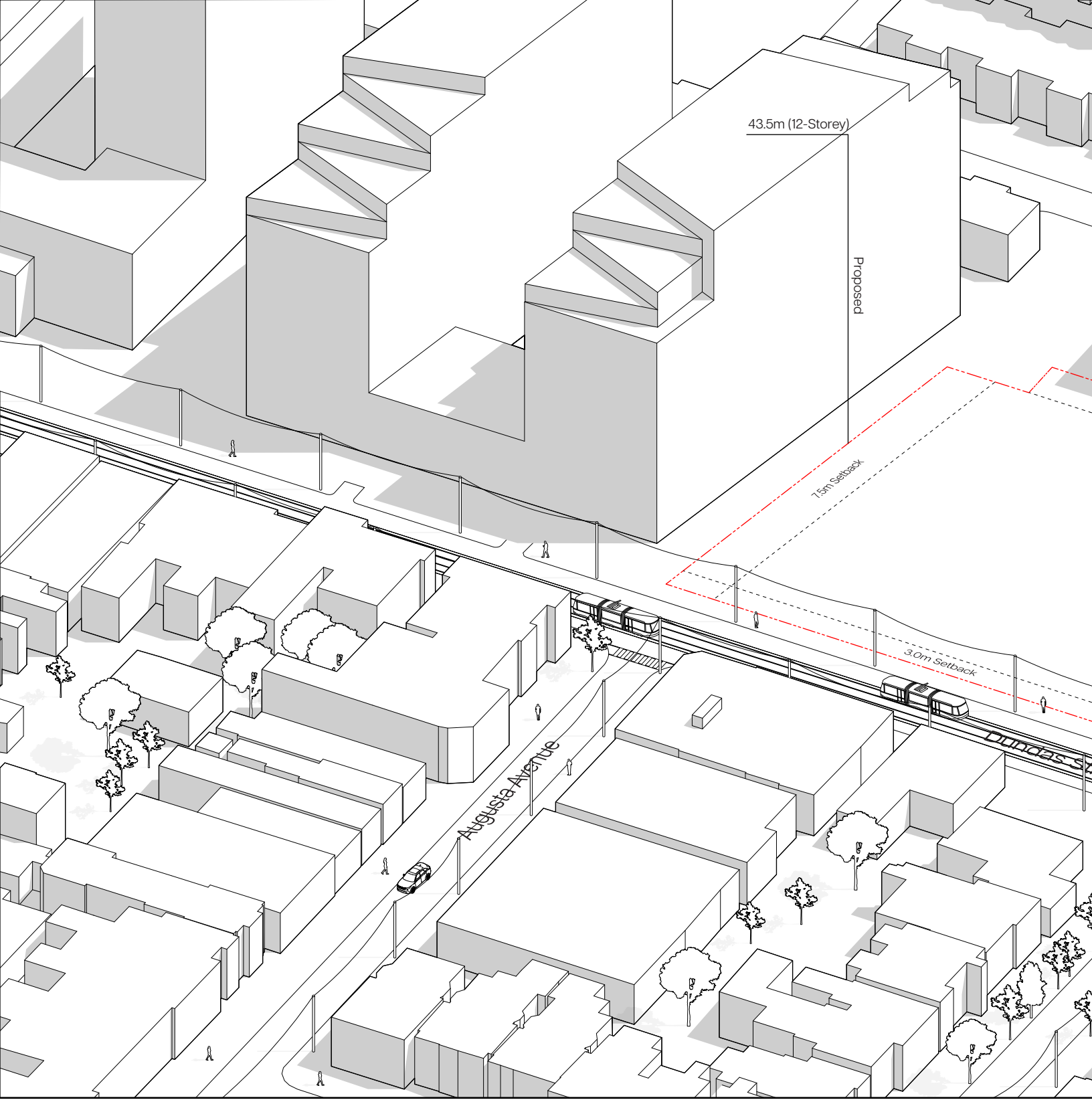
proposed masterplan

46.5m / 15-storey*
*assumes 4.5m ground floor and 3m floor height

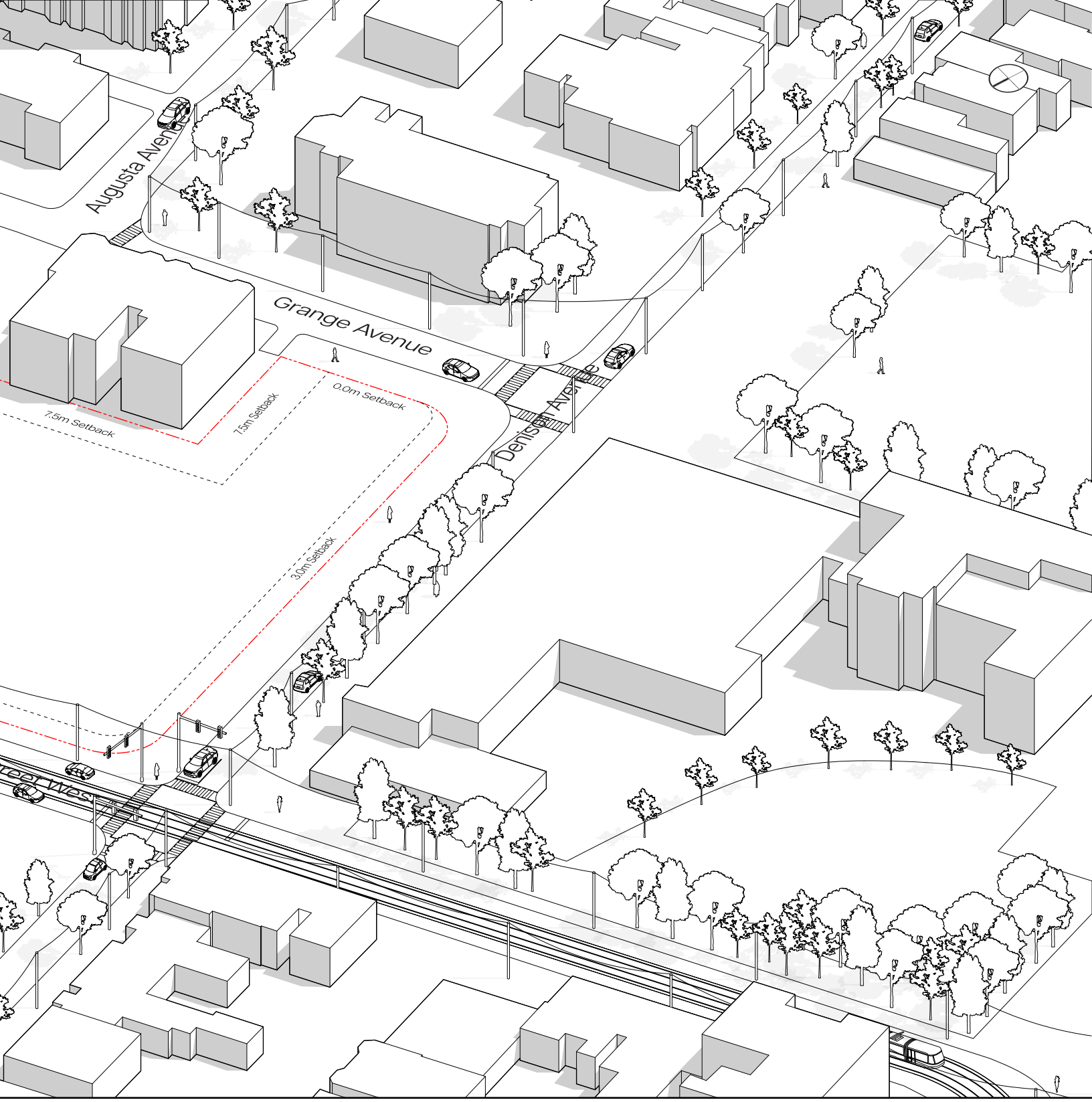
zoning diagram



In analyzing the site's zoning, the proposed building currently under construction exceeds the as-of-right and the mid-rise guideline by-laws.



proposed zoning diagram



I want to propose working in the spirit of the by-law and zoning as I am applying a mass timber structure to this typology. As the zoning for mass timber buildings in Ontario continues to evolve rapidly, I would like to push the boundaries of zoning for this occupancy. Based on the Council on Tall Buildings and Urban Habitat's research paper on exposed timber, I am proposing exposing timber in low-rise applications that are fire-separated from taller structures. In mid-high-rise applications that are sprinklered, I am proposing minimally exposed areas of timber.[198]

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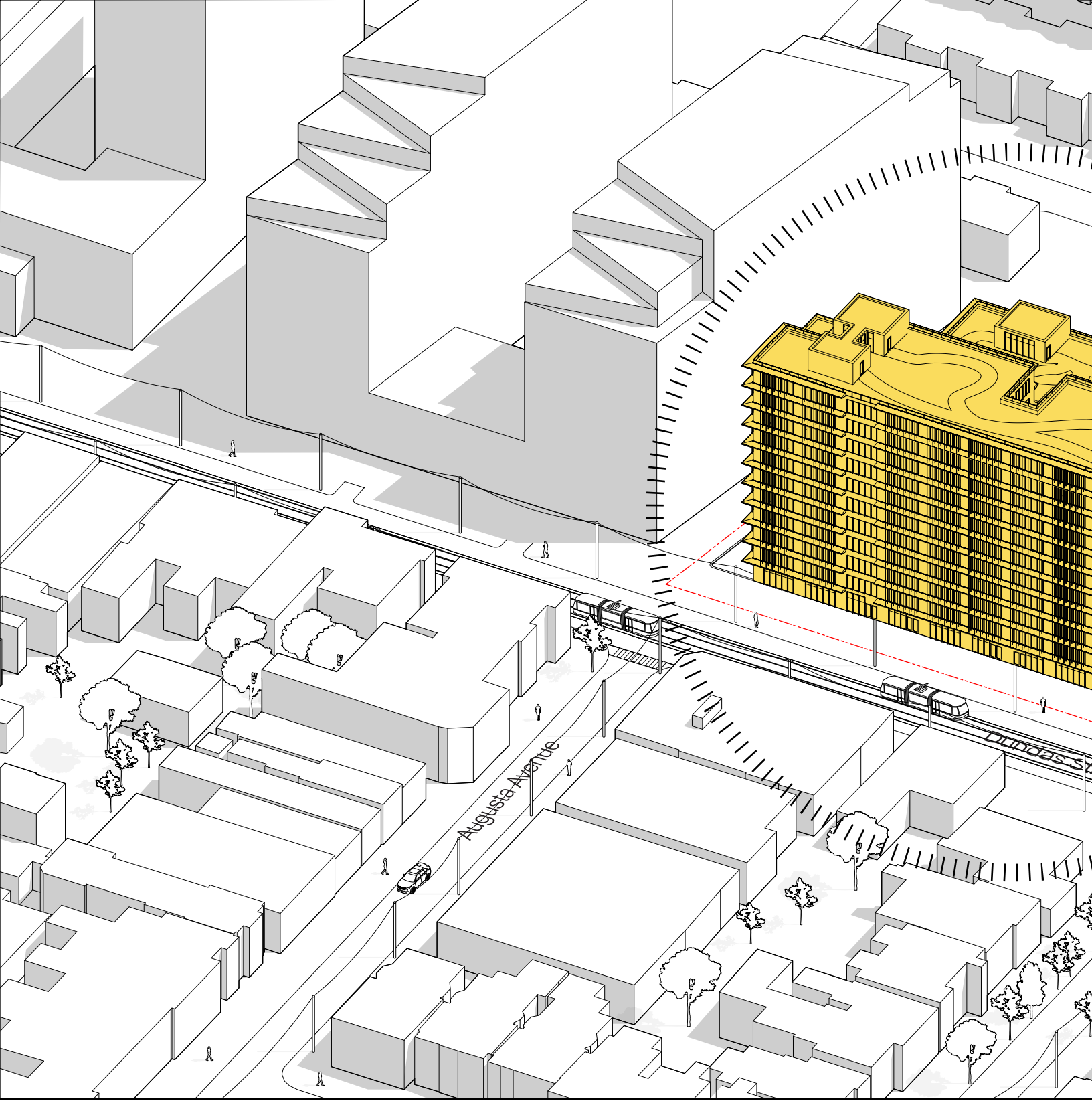
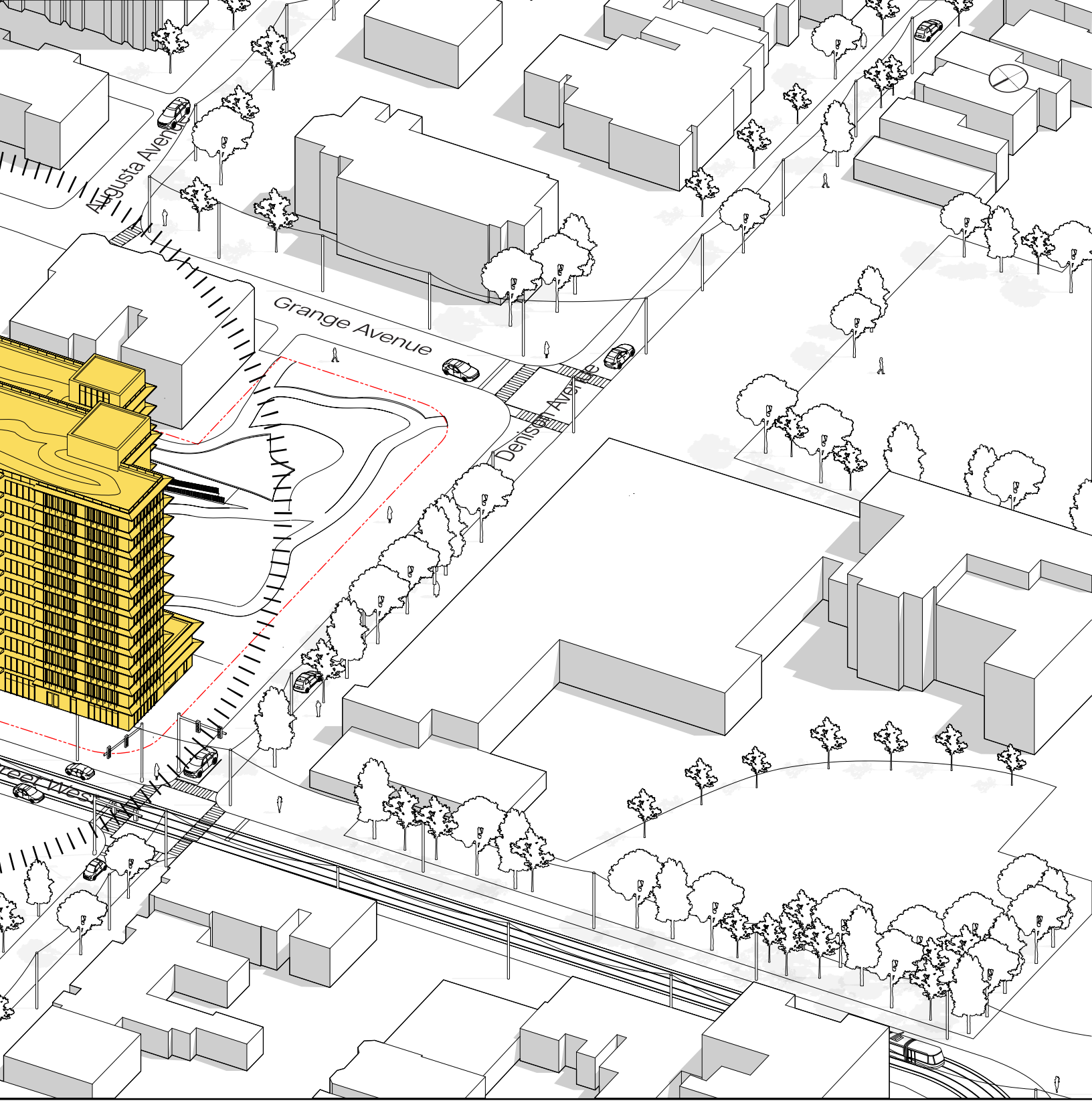
198 David Baker et al., "Exposed Mass Timber in High-Rise Structures: A Practical Discussion of a Complex Fire Problem," *Council on Tall Buildings and Urban Habitat*, 2022, https://global.ctbuh.org/resources/papers/download/4527-exposed-mass-timber-in-high-rise-structures-a-practical-discussion-of-a-complex-fire-problem.pdf.



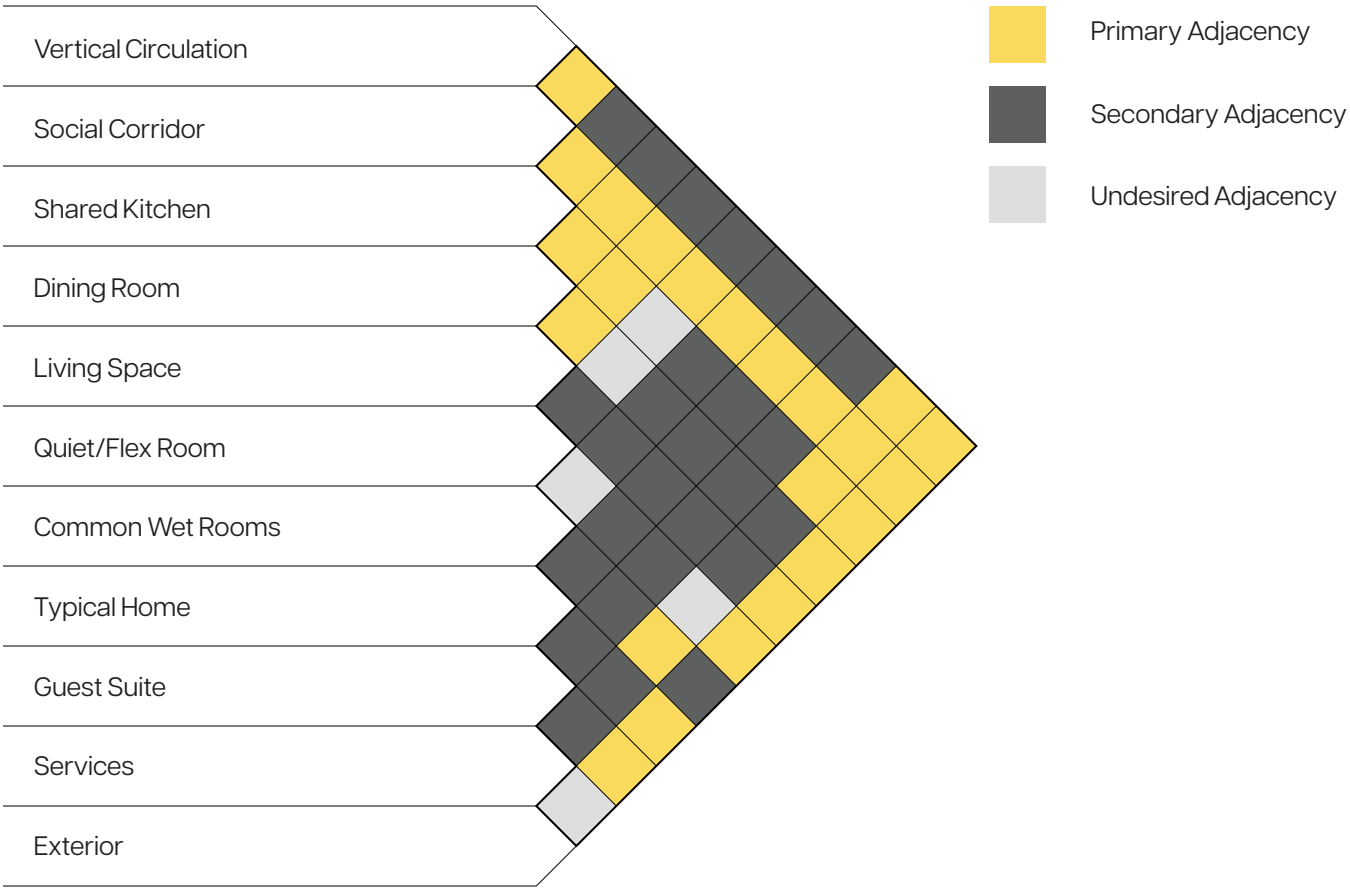
massing



This is a unique opportunity to contribute to a large-scale revitalization directly in the downtown core. The goal of the building is to create a physical and social network throughout the building. Destinations help achieve social connections throughout the building, which is imperative to the aging population. This also encourages physical activity that can begin to counter NCDs that plague the elderly population. Integrating health-promoting theories, especially the principles and patterns of biophilia, will create more cognitively stimulating, restful environments that aim to promote well-being in the Alexandra Park neighbourhood.

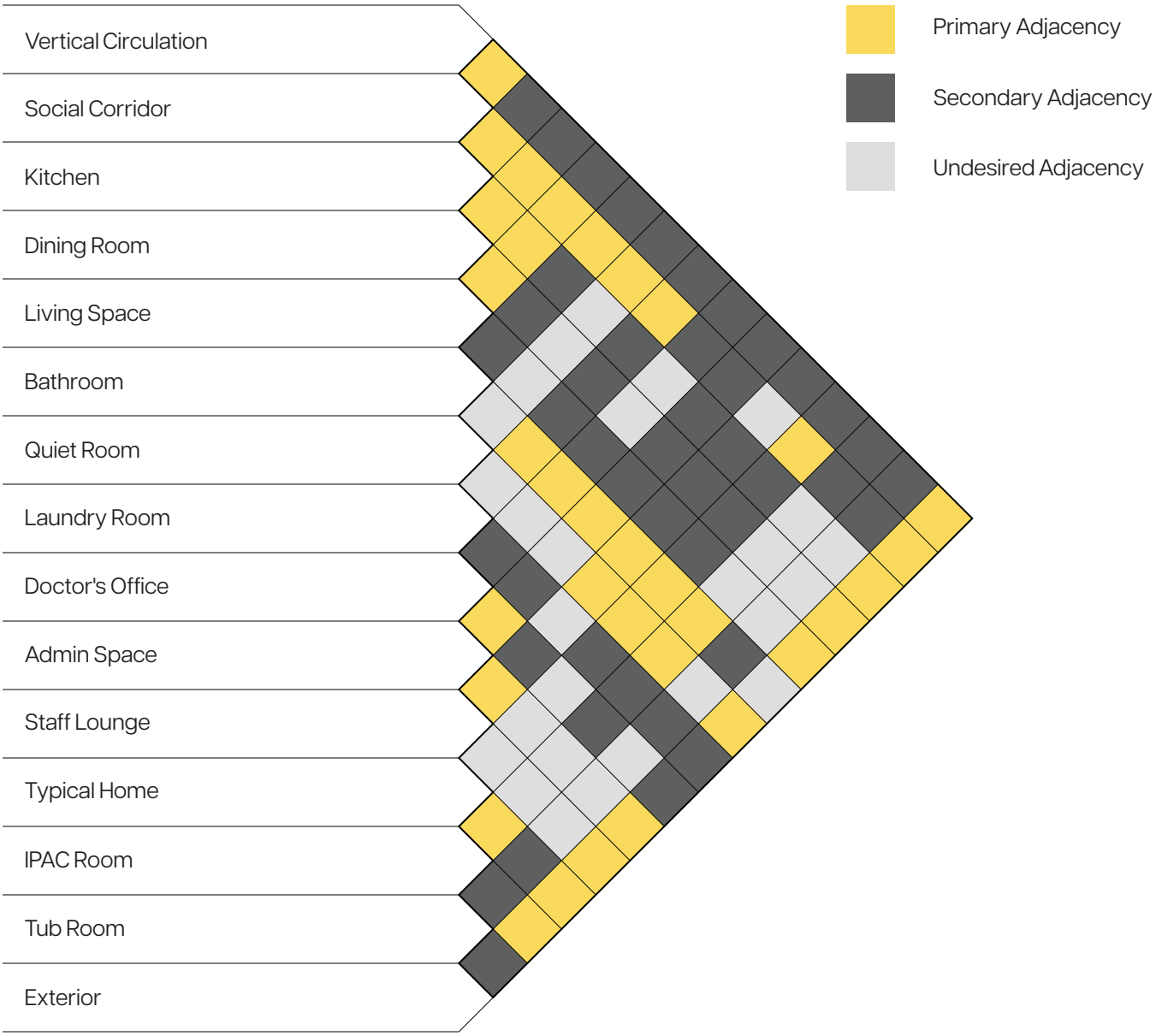
independent living

proximity matrix.



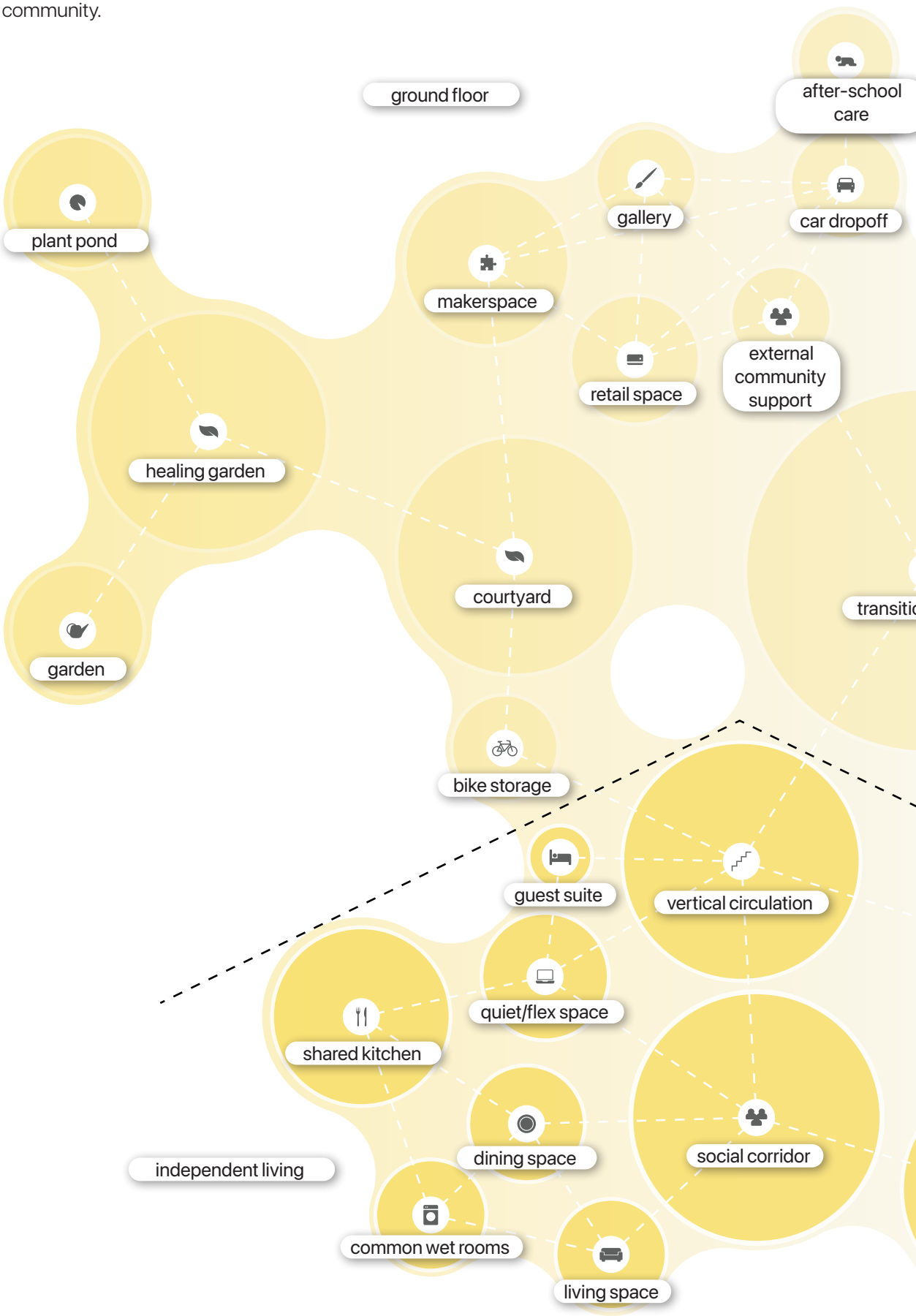
assisted living

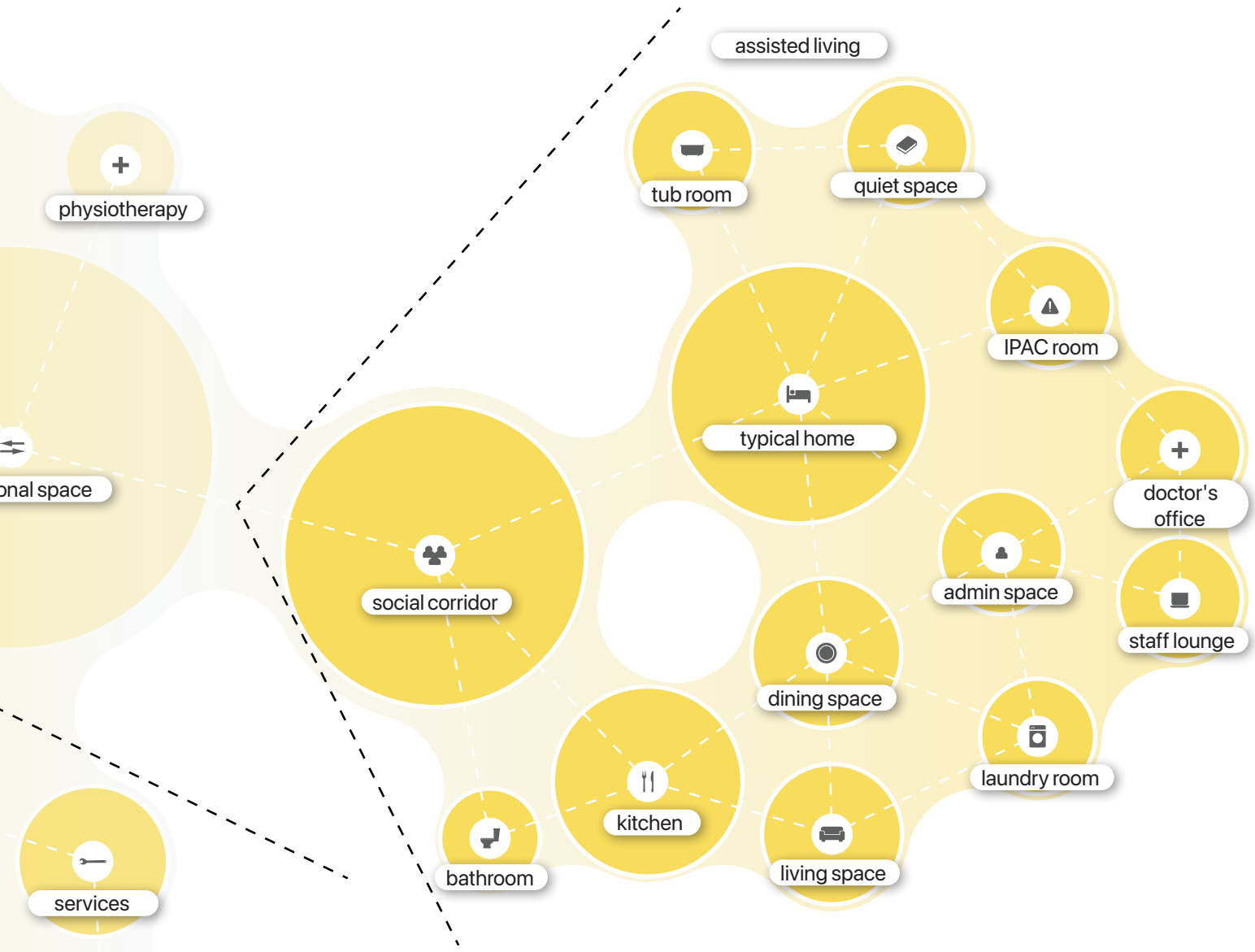
proximity matrix.



program diagram

fostering health through community.





The program of the building is centred around seniors, creating interstitial spaces that promote social interaction and the ability to maintain physical and cognitive ability through health-promoting theories.

The public realm will look to draw people into the site with programs to also support the community. This site will act as a public amenity, connecting the community and the greater City of Toronto. Within the interior, architecture is defined by moving away from terms such as units or beds and focusing on living spaces as homes. Within the home, providing residents with options and the ability to maintain personal autonomy is central to the methodology of the program.

corridor comparison

design of circulation spaces' impact on use.

Figure 28:

Typical double-loaded corridors are often limited in social spaces, providing limited or no natural light.

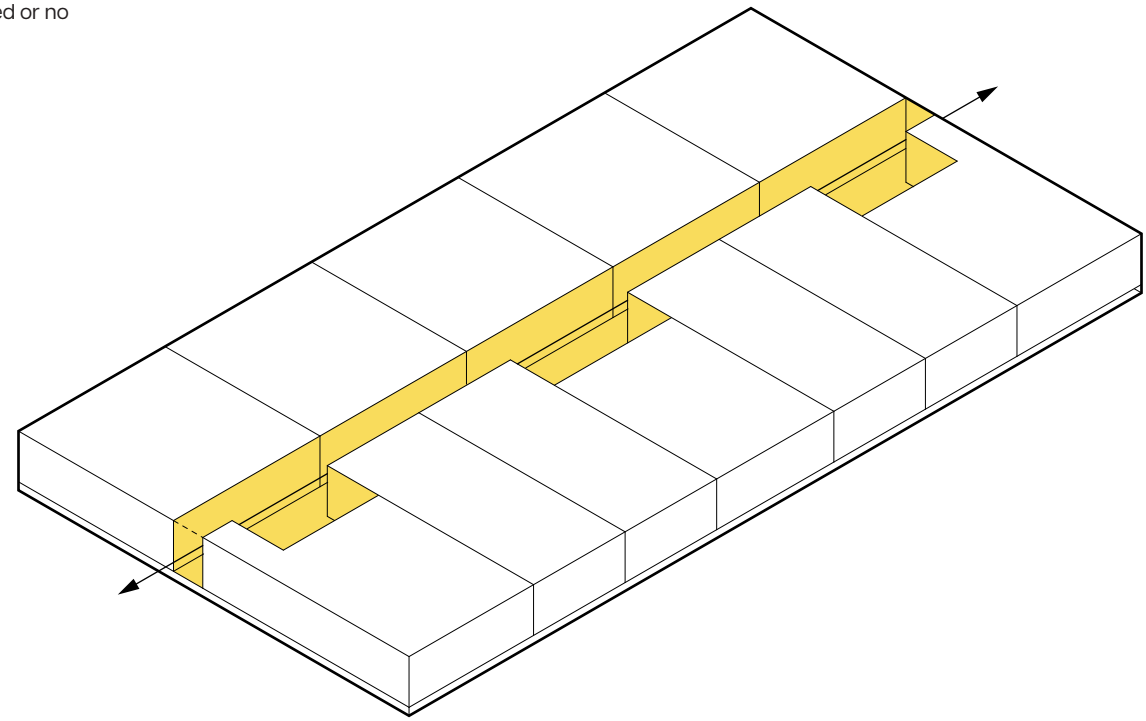
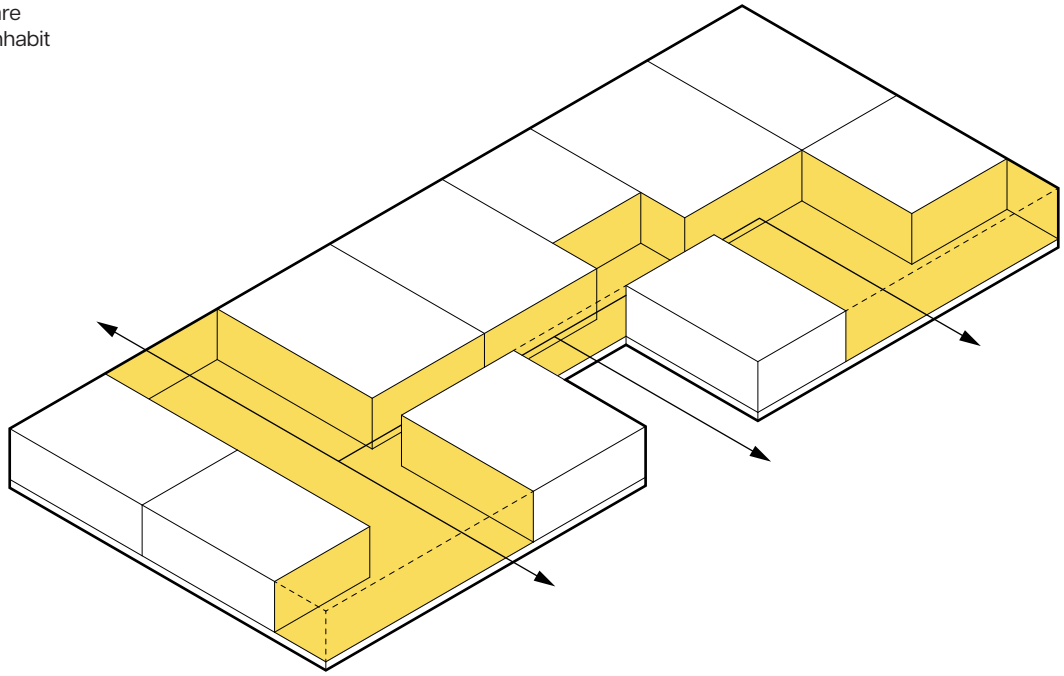
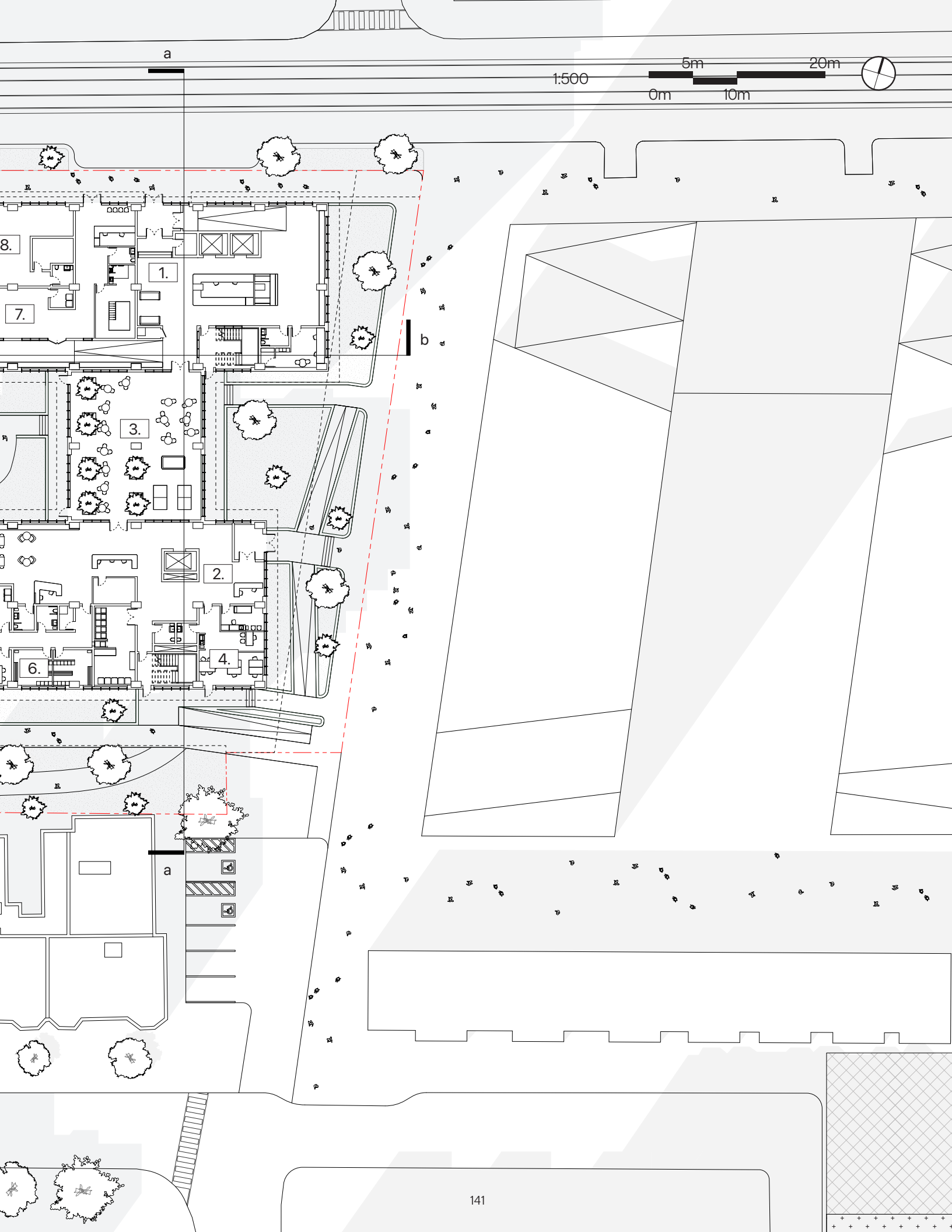


Figure 29:

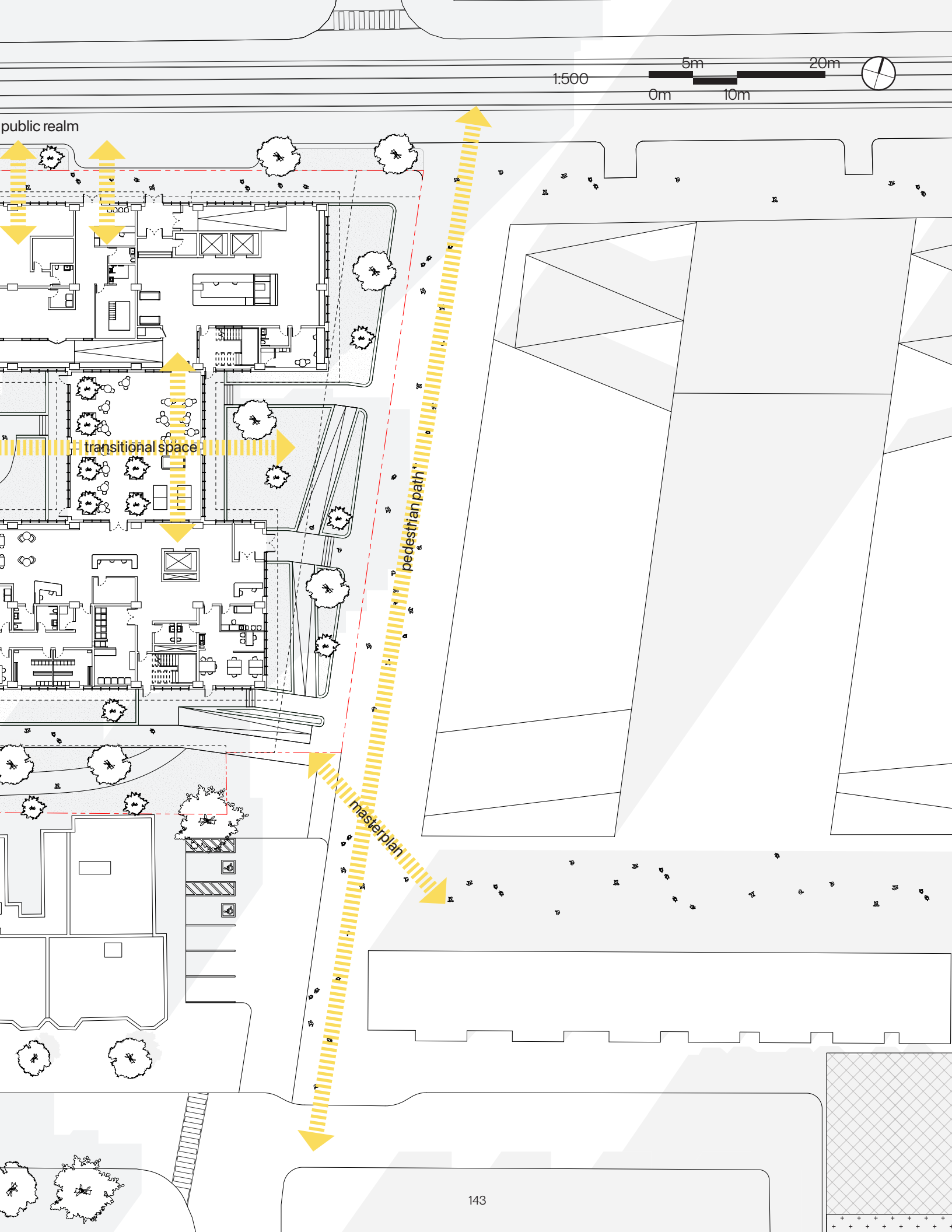
Hybrid single/double-loaded corridors offer spaces for socialization and create naturally lit environments that are more enjoyable to inhabit for longer periods.



Dundas Street West
Denison Avenue
b
1. independent /RH entrance
2. LTC entrance
3. transitional space/external community support
4. admin spaces
5. LTC assisted dining/lounge
6. LTC staff back of house
7. physiotherapy
8. retail spaces
9. makerspace
10. after-school care
11. bike storage
12. loading area
13. healing garden
14. plant pond
15. community garden

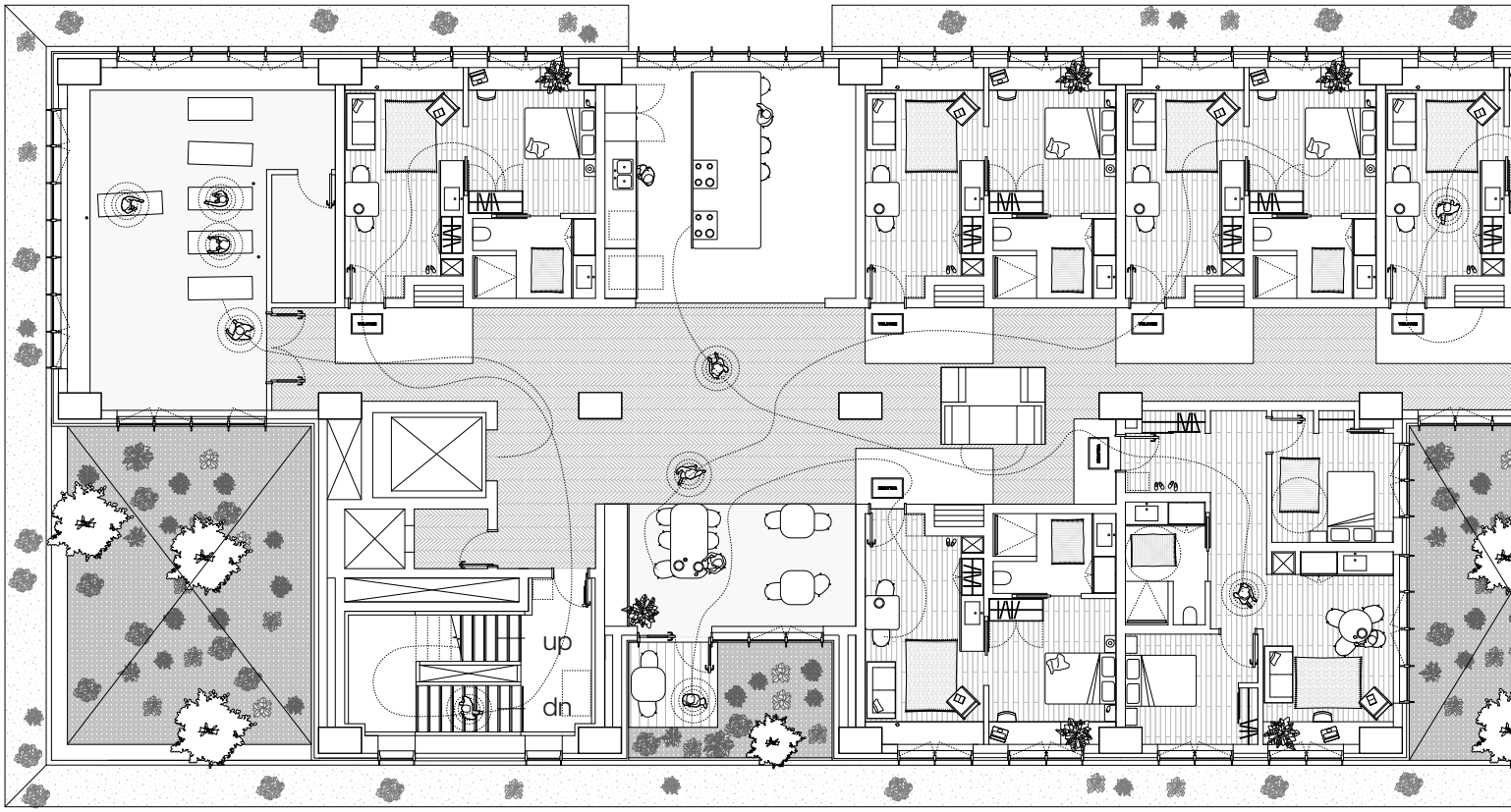

a
1:500
5m
20m
0m
10m
8.
1.
7.
b
3.
2.
6.
4.
a

Dundas Street West
retail /
Ryerson Community School
Denison Avenue
Alexandra Park


1:500
0m
10m
5m
20m
public realm
transitional space
pedestrian path
masterplan

typical floor plan

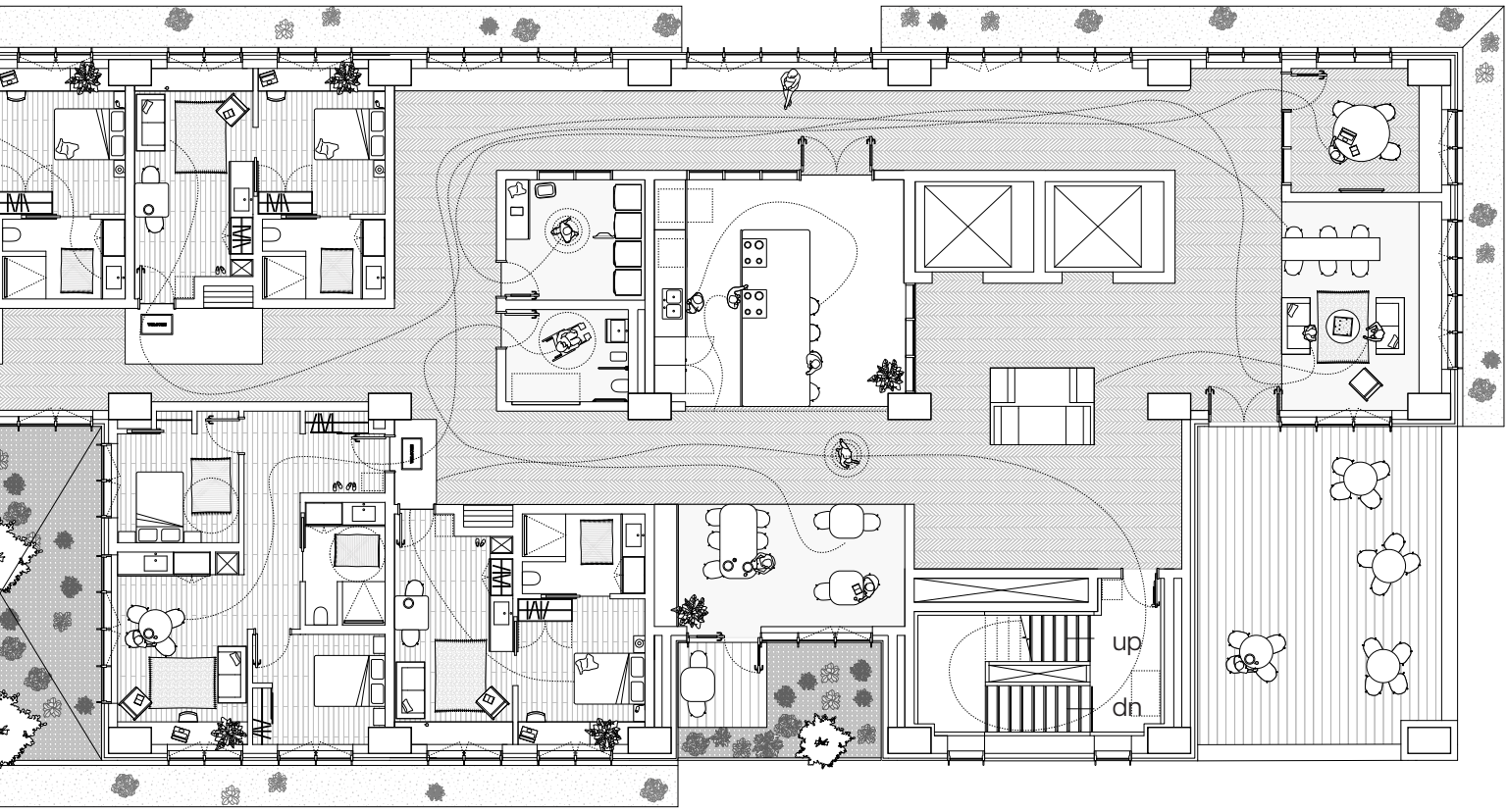
independent living.



1:200

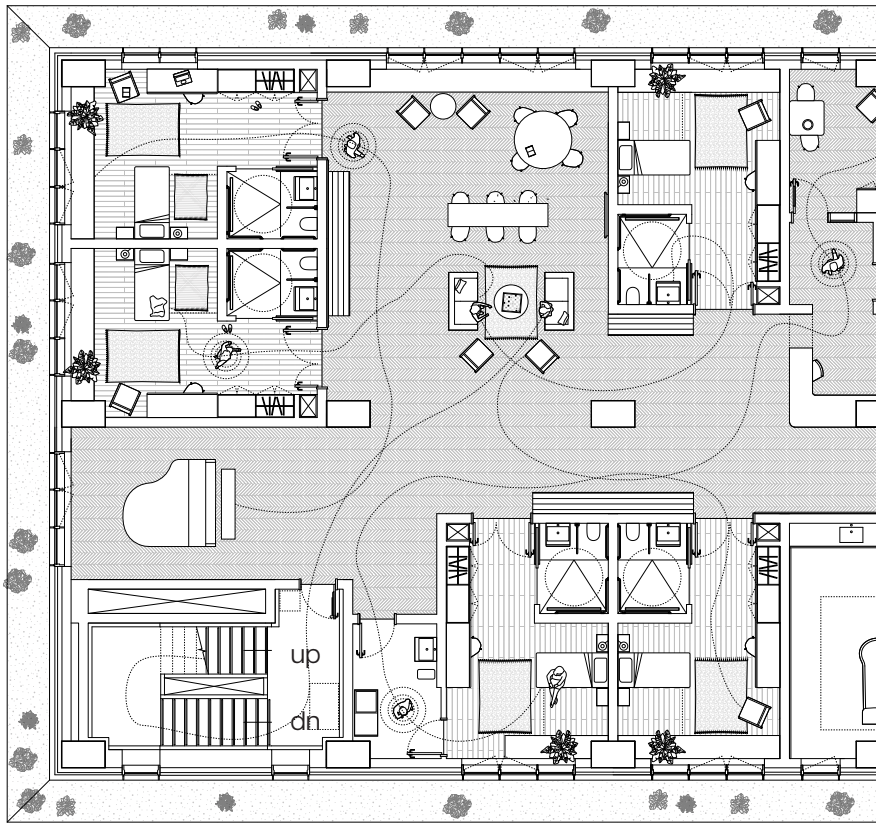
2m 8m

0m 4m



typical floor plan

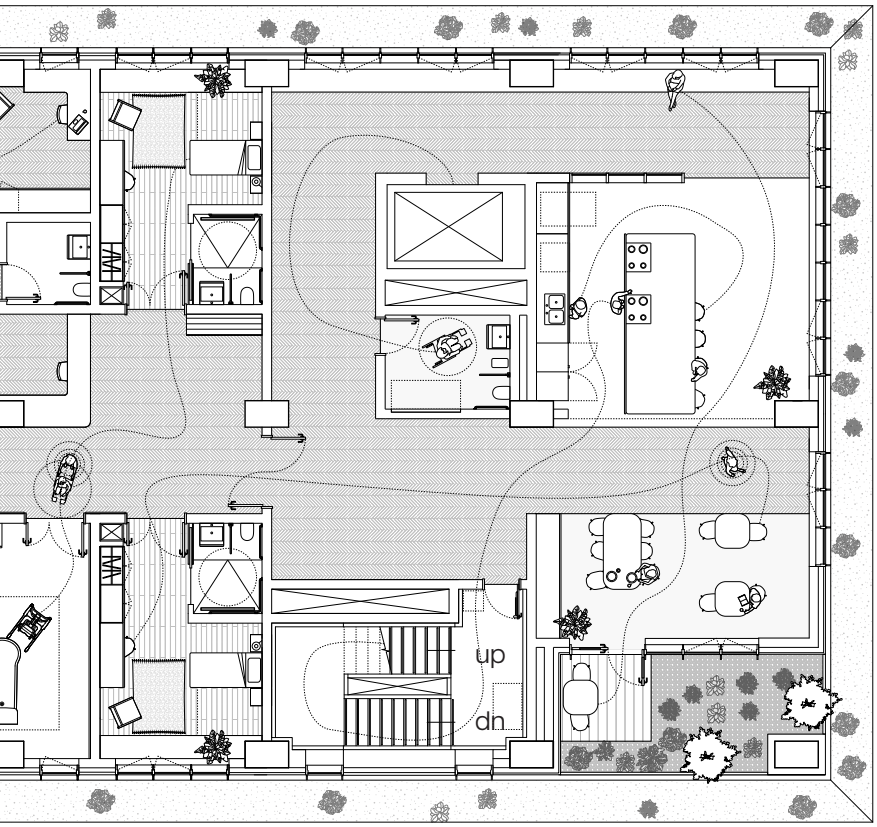
assisted living.



1:200

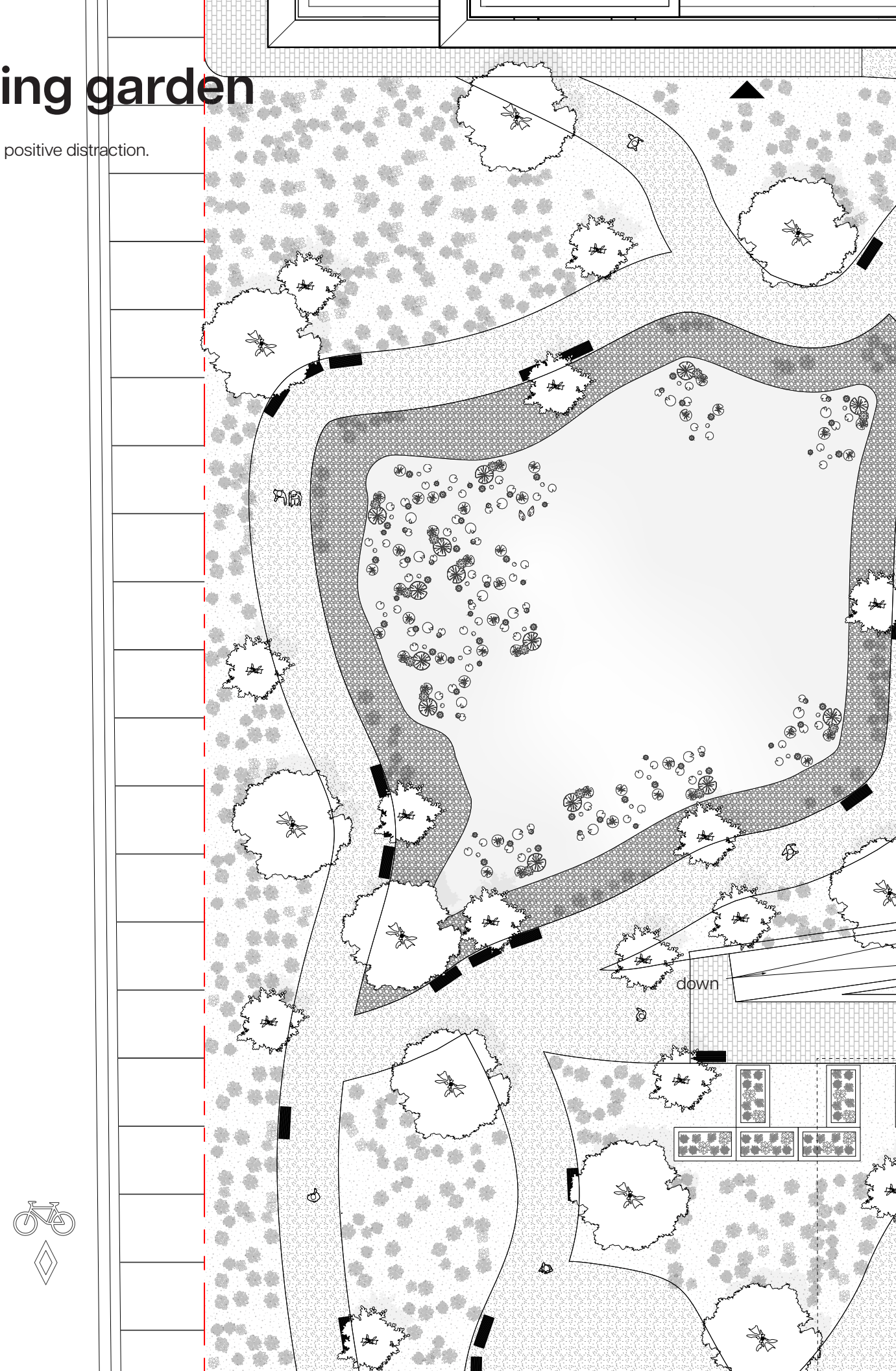
2m 8m

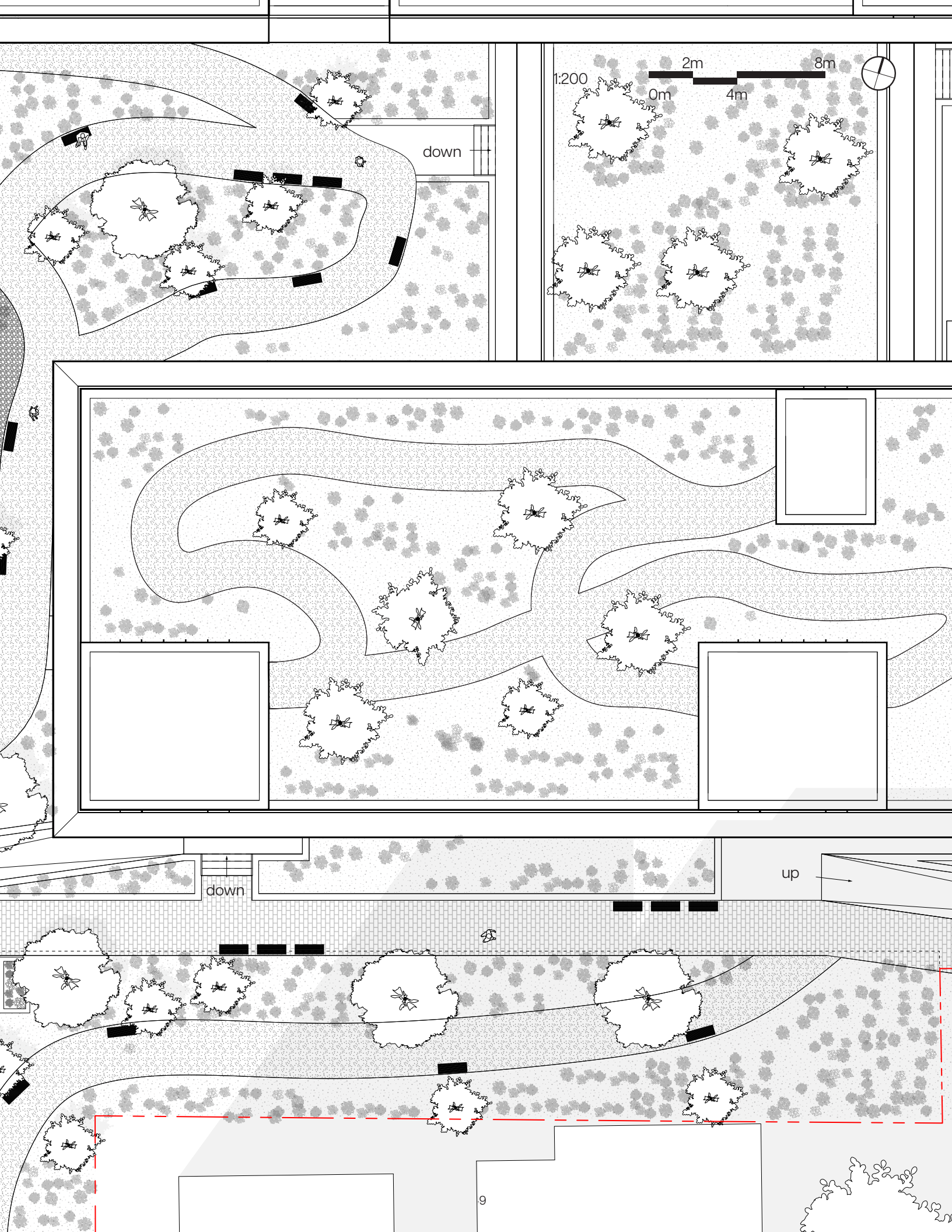
0m 4m



healing garden

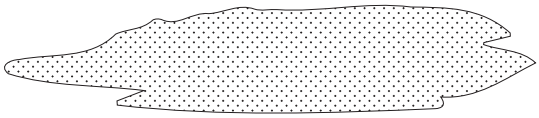
daily biophilic positive distraction.




down
1:200
2m
8m
0m
4m
down
up
9

section a-a

continuity and change in home environment.



1:200

2m 8m

0m 4m

section b-b

arterial circulation spaces.

1:200
0m
2m
4m
8m

a day in the life

study of daily activities.

Figure 30:

View from within the healing garden looking towards the transitional space.

Nora has just moved into her new home at 571 Dundas Street West after living in the nearby Alexandra Park neighbourhood for her whole life. She was scared she would have to move away from the neighbourhood she had called home because of a lack of accessible options. Nora and her husband Pascal are both in good health but are looking for a home to grow into. Many of their friends have also found a home in the same building, making it an easy decision.

Nora begins her morning by grabbing a coffee at a nearby cafe, hoping to stay active. She usually walks early while the city is quiet and sits in the healing garden to enjoy the peaceful day.

Figure 31:

Typical common dining room and kitchen.

Nora's daughter is coming to visit today with her granddaughter. She is grateful she can be a part of their lives as they also live close by on Queen Street West. Nora heads back upstairs to the fourth floor, taking the stairs as it is not too strenuous. She meets her daughter in the dining room talking to one of Nora's old friends who lives on the same floor.

Figure 32:

View looking down corridor, sloping below grade.

After Nora's daughter leaves, she goes back down the stairs to wait for Pascal, who is doing physiotherapy for his sore shoulder. As she waits, she notices the activity going on in the makerspace; curious about the programs offered, she believes this is a great way to connect with the building community and stay busy during the day.

Figure 33:

Transitional space allows for all residents to interact, creating a larger sense of community.

After Pascal finishes physiotherapy, they walk through the transitional space to visit one of the couple's old friends who is staying in LTC. They notice the range of ages within the building, finding it refreshing not to feel isolated exclusively to people of similar age as it makes them feel young.

Figure 34:
Typical LTC home.

Once they reach her floor they have a look at her room, noticing it is not too different from their own. After a quick stop at her room, they enjoy each other's company back in the transitional space, appreciating the view of the garden.

Figure 35:

Typical RH/independent living home.

At the end of the day, Nora and Pascal head back to their home, looking to wind down. They feel fulfilled having so many friends and family close by and find comfort in knowing they can grow together in this home for years to come.

Conclusion

Senior housing has been neglected in Canada for decades, often disregarded as its own typology with its own codes and standards. Only through COVID-19 were the flaws in the typology brought to light, sparking a renewed discourse that explores the direct physical and psychological impacts of architecture on its occupants. This thesis advocates for a non-universal approach to design for the aging, as the idea of an ideal occupant is obsolete, and we must consider users of all needs and abilities. With aspirations to promote health through architecture, many concepts are explored, such as aging-in-community, biophilia, and active design, to advance senior housing as a typology and realize a future model for care. These concepts are underpinned by key health-promoting theories from researchers such as Terrapin's *14 Patterns of Biophilic Design*, Ulrich's View Through a Window, and Farrow's book *Constructing Health*. This thesis equally prioritizes the large and the small-scale implications of design as they relate to health-promotion. In senior housing, space design, lighting, and prospect is just as important as ergonomic devices such as handrails, door handles, and slip guards. The thesis also considers factors in seniors' housing that are non-physical yet are equally important to the conception of "well-being." Well-being as a theme in architecture consists of many parts; apart from the mental and physical, this thesis also explores financial well-being and the ability to age-in-community. These concepts are progressed through the encouragement of policy changes that relate to ownership and funding pre- and post-construction. All the elements explored coincide to form a holistic vision of the renewed typology, as seen in the final design proposed in the thesis. In looking to provide rapid, affordable, health-conscious architecture, this thesis lays out a guide of how these spaces should be designed for the future, not being prescriptive or limited to the Toronto area but widely applicable to any context. Senior housing needs to be developed rapidly to support the upward trend in the aging population wave. The guide resultingly creates a new lens in the typology, contributing both to the betterment of senior housing as well as architecture as health infrastructure.

Personal Reflection

The discussion of aging is one that I often have with my parents - context, affordability, health, and proximity to loved ones are all factors that are central to their lives and ability to thrive. This topic is one that is very close to me, having seen my grandparents grow out of their homes, either moving in with family or into a retirement community. While reading this thesis, I hope that designers and architects consider the current state of architecture in relation to well-being. In prospect of retirement for my parents and further generations, I hope we can build on the wealth of knowledge surrounding healthy aging to nurture a deeper and more thoughtful approach to housing.

06

appendix

additional resources.

The following are some projects, both local and abroad, that have inspired this project through program, philosophy, financial structure, and community outreach. Many of these projects draw on various health-promoting theories, all positively contributing to the well-being of their occupants.

The Rekai Centre

elderly housing case study.

Architect:
Montgomery Sisam

Year:
Not Complete

Bibliography:

Montgomery Sisam. “The Rekai Centre Cherry Place – Montgomery Sisam.” Accessed September 27, 2023. https://www.montgomerysisam.com/project/the-rekai-centre-cherry-place/.

The Rekai Centre is a not-for-profit that provides LTC services in downtown Toronto, consisting of 348 LTC residents, a dialysis clinic, and a student co-op school program for personal support workers. Residential and required support spaces are included in this 12-storey building, with outdoor spaces providing views of rooftop gardens, downtown, and the lake in the distance. The Rekai Centre has additionally accommodated infection control by equipping rooms with negative pressure and oxygen supply, reducing the risk of spreading the disease throughout the home.

The not-for-profit model is significant, especially in the City of Toronto. Looking at external programs that can support the interior program but also financially support the construction and operation of the building makes seniors’ housing affordable. Their infection control design is also an attractive model that will be important as COVID-19 and potential new viruses spread.

Figure 36:

Exterior rendering of The Rekai Centre by Montgomery Sisam.

Tree House

elderly housing case study.

Architect:
Farrow Partners

Year:
Not Complete

Bibliography:

Farrow Partners. “Treehouse: A New Paradigm In Senior Living To Enhance Well Being.” Accessed September 27, 2023. https://farrowpartners.ca/wp-content/uploads/2023/01/Treehouse-Senior-Living-Overview-Element-5-Farrow-Partners-Jan-11-2023-Reduced-PDF.pdf.

“Multiple polls show that 93% of those over 55 will do anything to stay in their own homes rather than move to a typical retirement facility. Two of the most common fears are loneliness and decision-making autonomy, which cause many people to lose their sense of purpose in life.”

The Treehouse model comprises multigenerational housing looking to remove the term “senior” through community support. This housing project aims for seniors to maintain independence through social interaction and a place that feels like home.

Independent living with a multigenerational component yields benefits for all residents. The feeling of home creates a place that fosters a sense of belonging; combined with social interaction, this model heavily emphasizes the benefits of collective living for seniors. The residents’ independence can lead to restored purpose and control.

Figure 37:

Exterior rendering of Treehouse by Farrow Partners.

Home for Senior Citizens

elderly housing case study.

Architect:
Peter Zumthor

Year:
1993

Bibliography:

Orthos Logos. “Atelier Peter Zumthor & Partner AG: Homes for Senior Citizens.” Orthos Logos, September 2019. https://orthoslogos.fr/architecture/homes-for-senior-citizens/.

This home by Peter Zumthor was designed to foster independent living, allowing those who are still able to live with full autonomy to continue to do so. Connected at the rear of the building is an existing nursing facility that can be used by residents when the time comes. The building draws on the ideas of refuge, feeling like a “big rock,” but also draws on prospect having expansive views over a valley. Although a suburban site, the goal was to create a rural feel, drawing on materials such as wood, and exposed concrete to create these ‘farmstead’ environments.

Figure 38:

Interior room looking out over the valley beyond.

Paimio Sanatorium

healing environment case study.

Architect:
Alvar and Aino Aalto

Year:
1933

Bibliography:

Paimio Sanatorium. “Paimio Sanatorium History.” Accessed February 20, 2025. https://paimiosanatorium.com/sanatorium/history/.

As one of the Aalto’s greatest architectural achievements, the Paimio Sanatorium was conceived as a “medical instrument,” providing a space that aided the healing process of tuberculosis. Using the known health-promoting theories at the time of construction, cross-ventilation and exposure to natural light were key considerations in the design and the recovery of patients. The Aaltos designed almost everything within the building that a patient would interact with, remaining one of the best examples of health-conscious architecture to date.

Figure 39:

Patient basking in the sun on a veranda at the Paimio Sanatorium.

Nightingale 1

community case study.

Architect:
Breathe

Year:
2017

Bibliography:

Paula Pintos. “Nightingale 1 / Breathe Architecture.” ArchDaily, February 26, 2019. https://www.archdaily.com/912227/nightingale-1-breathe-architecture.

This project prioritizes sustainability and social living, incorporating biophilic design principles fostering the connection of people through nature. Focusing on social interactions, The Nightingale 1 project encourages community living through shared spaces and communal gardens. This is meant to foster a strong community within the building and surrounding area. The building brings together a group of like-minded individuals with similar values. The ground floor was designed around community engagement of the residents and for outreach to the greater Brunswick Community. The public realm was developed alongside the building with seating, and a semi-private laneway that activates the ground floor, creating opportunities for social interaction.

The Nightingale 1 project public realm shows the ability to activate a community through a building. Integrating public programs can create spaces for social interaction and foster communal well-being.

Figure 40:

Exterior Photograph of Nightingale 1 by Peter Clarke for Breathe.

60 Richmond Street

community case study.

Architect:
Teeple Architects Inc.

Year:
2011

Bibliography:

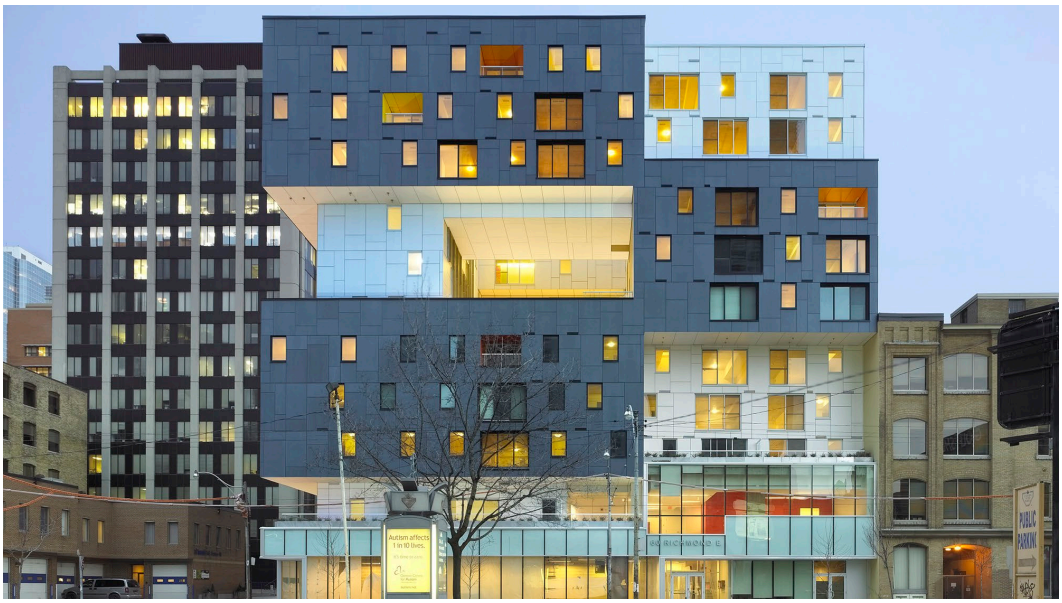
Teeple Architects. “60 Richmond Street East Housing Co-Op.” Teeple Architects, May 19, 2015. http://www.teeplearch.com/portfolio/60-richmond-east-housing-development/.

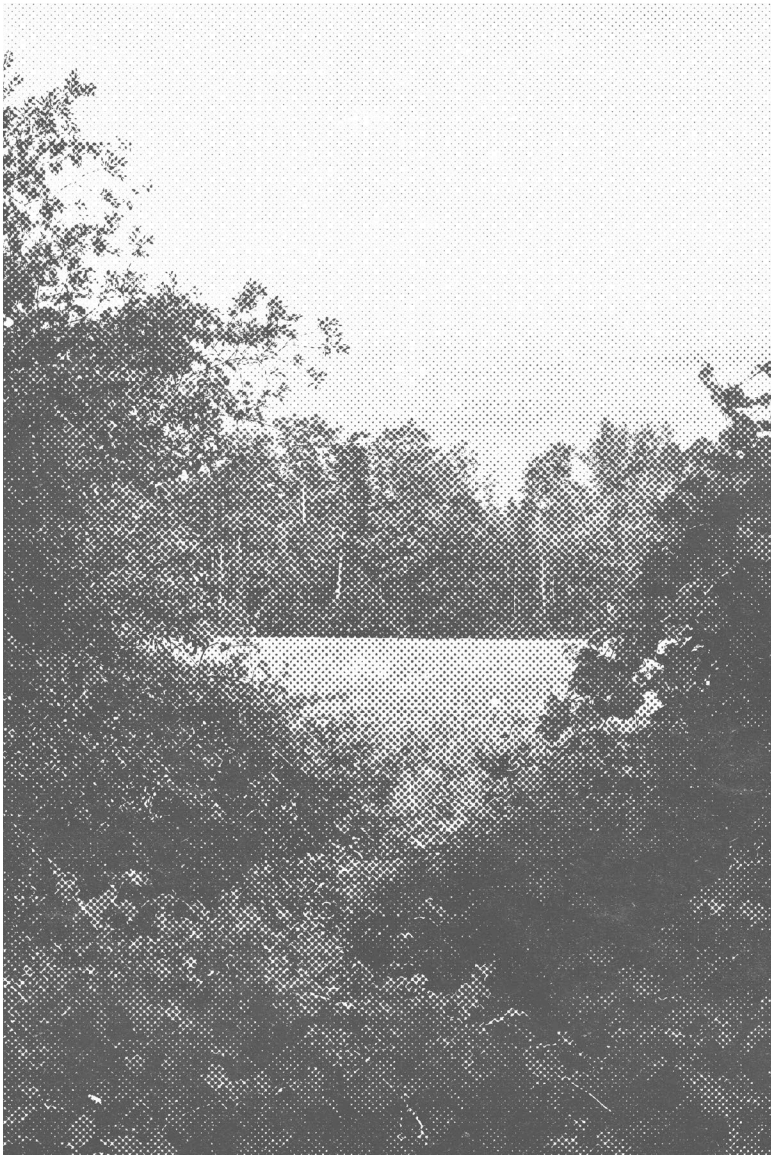
60 Richmond was initially intended for residents displaced from the Regent Park revitalization project. However, with fewer residents than expected, some units were replaced with affordable rental units. The social structure of the co-op allows occupants to live independently, creating a community through shared spaces and infrastructure to provide opportunities to learn and internal openings to supplement income. The 6th floor hosts a garden terrace, providing the community training kitchen with the opportunity to use produce and a green space for residents.

As one of Toronto’s first Co-op housing initiatives since the mid-90s, 60 Richmond aims to provide for its community. Designing amenities that better a community through communal learning is a significant way to improve well-being.

Figure 41:

Exterior photograph of 60 Richmond Street by Shai Gil for Teeple Architects Inc.





07

bibliography

citations.

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