Home Safe Home:
A Comprehensive Design Guideline to Retrofit Toronto's Post-War Apartment Towers to be Healthier

by

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Master of Architecture

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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.

Abstract

The concept of 'home' goes beyond the simple responsibility of providing shelter. In today's dynamic socio-economic landscape, homes do not only provide physical safety but should also promote mental and social well-being. As defined by the World Health Organization, a healthy house should support and promote complete physical, mental and social well-being. Therefore, it is important to extend the focus beyond personal health and include the health of inhabited buildings as they have a direct impact on well-being.

The COVID-19 pandemic started important discussions about architecture and its profound impact on health. The focus of this research lies at the intersection of emerging health trends and the soaring housing crisis in Canada. As urbanization surges, the challenges of creating livable spaces that are both healthy and affordable become increasingly complex. The Greater Toronto Area (GTA) has a stock of post-war residential towers that once were symbolic of modernist urban planning. Today, this aging housing stock suffers from neglect, disinvestment and isolation, however, it is home to nearly one million people. These towers have become long-term and permanent housing options for many low-income residents and new immigrants, despite the unhealthy living conditions, lack of maintenance and outdated building standards.

The Tower Renewal Partnership is a non-profit initiative that has researched, advocated and developed guidelines to transform these towers and their neighbourhoods to be healthier and connected to their neighbourhood. Delving into the critical elements that define spaces within a home, — lighting, acoustics, thermal comfort, indoor air quality, materials, and spatial design— this thesis develops a guideline for best practices to retrofit this housing stock for a better quality of life. Using the Humberwood Place Tower as a case study for exploring these elements, this thesis aims to build upon the strong foundation of work developed by the Tower Renewal Partnership and improve the health and well-being of residents within the building.

Acknowledgements

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Dedication

To my parents, for encouraging me to pursue my dreams.

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PART 1

Introduction

Context

The COVID-19 pandemic shed light on the adverse health impacts of staying indoors and the limitations in residential design. While the pandemic created issues of physical distancing in homes, it also created loneliness, boredom, isolation, lack of privacy and overcrowding. The city-wide shutdowns during the pandemic forced people to spend more time in their homes than usual. While people in single-family homes had access to private outdoor spaces, allowing them to be active and socialize with ample access to sunlight and fresh air, people in multi-unit residential buildings were isolated, lacked amenities, and were confined to their narrow balconies.

This thesis explores the current situation of the post-war residential towers in Toronto, which were built as a commodity to house the population influx. This residential typology houses over one million people in almost 2000 apartment buildings across the Greater Toronto Area.[1] Initially, these apartments were constructed to house middle-class families during the 1960s – 1980s. These apartments were once considered luxury living and designed to house the nuclear family. Advertised with many amenities - saunas, pools, recreational spaces - these apartments pushed a narrative of modern living. Ironically, these apartment neighbourhoods have now transitioned into low-income neighbourhoods, lacking amenities, proper social spaces, easy access to transportation from the suburbs, and importantly healthy living spaces.

The post-war residential towers present a unique opportunity to be retrofitted, not only to meet the current building code and living standards but also to be transformed into healthy living spaces to reduce illnesses and promote health and well-being in the community. The research study, Vertical Poverty, conducted by the United Way Toronto, outlines the adverse health impacts low-income neighbourhoods have on people's health in addition to mapping the residential buildings with high hazards and risks to occupant health.[2]

The Tower Renewal Partnership focuses on creating healthy neighbourhoods, and their research focuses on various topics and solutions to achieve this. While the Tower Renewal Partnership has a thorough library of research, this thesis aims to build upon their work, fill the gaps, and focus on the issues surrounding health and well-being within the building. Overall, the aim will be to develop a design guideline to help retrofit this large stock of residential buildings, focusing on improving the resident's quality of life.

Overview on Health and Well-being

It is well-known that our environment and surroundings shape our overall health and well-being. However, it was not until the COVID-19 pandemic that architects began to seriously discuss and prioritize residents' comfort. While history has several examples of how domestic architecture evolved, we continue to design homes that do not promote occupant comfort until a pandemic or epidemic forces us to. The history of sanitation is an interesting example which led to a focus on public health and the implementation of waste management systems and extensive sewer networks. Another example is the introduction of open-air verandas, terraces and balconies in homes to improve cross-ventilation and access to daylight as a response to combat Tuberculosis.[3] These examples highlight that the built environment not only affects our daily lives but also contributes to long-term issues. Historically, the built environment has been shaped by these long-term issues.

The World Health Organization (WHO) defines health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."[4] When adding the term 'public,' the scale shifts from one individual to a community. Public health aims to maximize benefits for the greatest number of people. It is impossible to design spaces without considering the long-term effects it will have on a community and its health as public health is inseparable from the built environment. As a result, architects, urban planners, and everyone involved in shaping the city serve a vital role in informing public health.

In the context of housing, health disparities are starkly evident due to the differences in economic and social structures. Post-war towers today are often home to new Canadians and low-income residents.[5] Many of these apartment towers are over 50 years old and are deteriorating in building condition and performance.[6] While these buildings provide affordable housing to low-income demographics, they often compromise on the infrastructure, - inadequate ventilation, poor insulation, and limited access to natural light - all of which contribute to health issues.

Many of these apartment buildings are located in clusters – known as 'apartment neighbourhoods' – and the entirety of these neighbourhoods are poverty-stricken, isolated and lack overall economic opportunities, leading to increased health risks for residents.[7] This thesis explores the potential to transform these structures into healthier living environments for residents.



Fig 0.1 Typical apartment neighbourhood located at 55 - 75 Emmett Ave, York.

Thesis Structure

This thesis is organized into three parts.

Part one introduces the context of the thesis, explores the growing body of research done by Tower Renewal Partnership and situates the thesis's focus. It analyzes the existing condition of the post-war apartment towers in the Greater Toronto Area (GTA) and compares them to the new residential towers being built across the GTA.

Part two combines the literature review, technical analysis, and design synthesis. This part consists of two main chapters – chapters 2 and 3. Chapter 2 focuses on healthy socio-spatial housing outside the individual unit and in connection to the larger neighbourhood. These principles include connections with nature, community interaction and safety, accessibility, and active design. Chapter 3 focuses on the principles of a healthy indoor environment – consisting of the biophysical elements within an individual unit. The biophysical factors studied are lighting, thermal comfort, indoor air quality, acoustics, and materials and finishes.

Part three synthesizes the research from the previous chapters in the form of a design guideline to retrofit post-war residential towers and enhance the quality of life of residents within their units and immediate surroundings. Additionally, part three illustrates the transformation of the post-war residential tower into a healthier environment through design interventions.

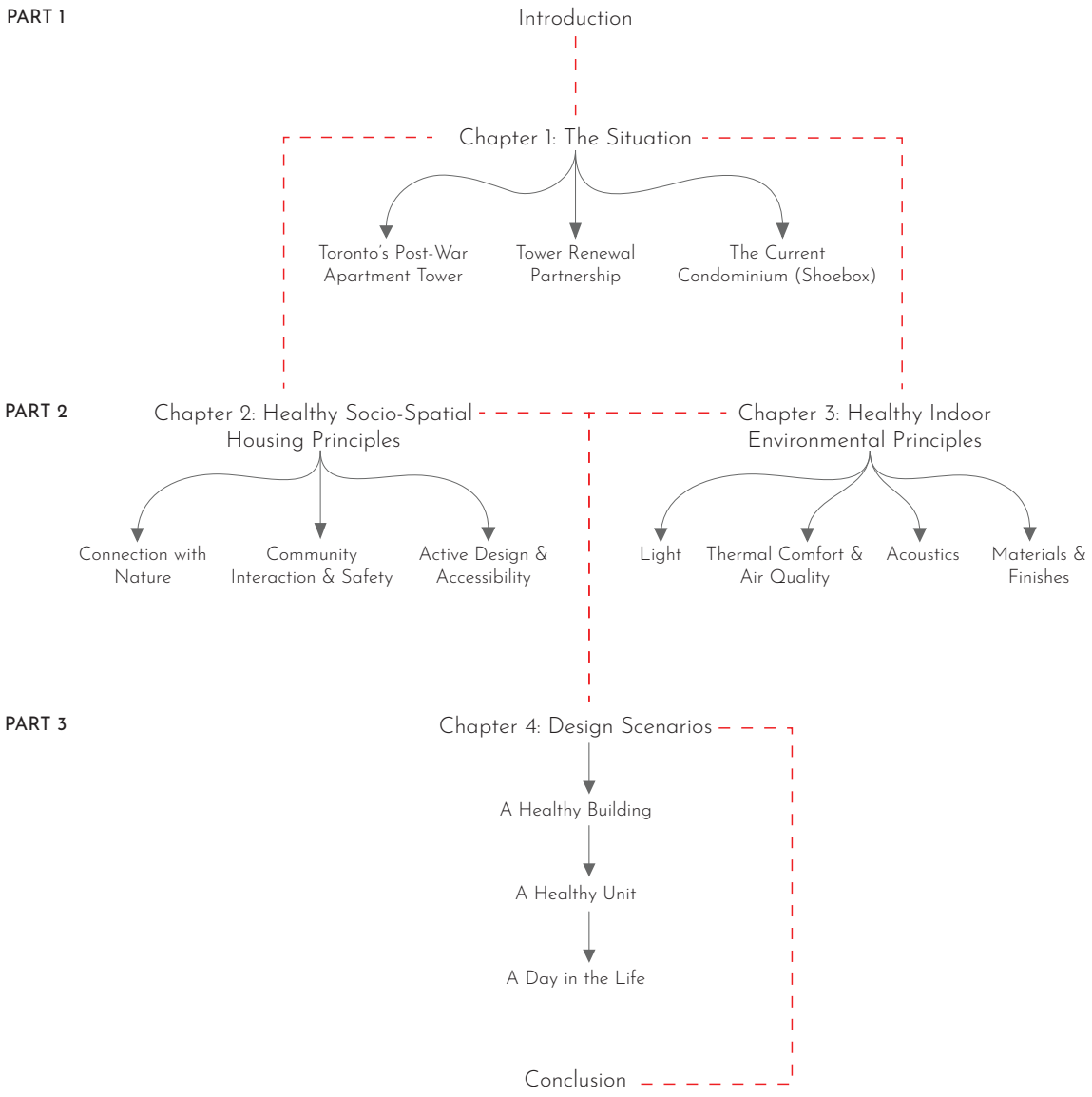


Fig 0.2 Thesis Structure Diagram

Foundational Research by the Tower Renewal Partnership

For decades, homes have been designed in the same way, but the COVID-19 pandemic highlighted the need for change. It demonstrated that the built spaces must promote health and well-being, especially in homes, as people now spend most of their time there. This thesis contributes to a previously established set of standards and research developed by the Tower Renewal Partnership, which focuses on rehabilitating and improving post-war towers. These structures have experienced a gradual decline over the past few decades, and the research aims to address this by enhancing their conditions to support better living environments and create complete communities.

This thesis is greatly influenced by the research conducted by the Tower Renewal Partnership and aims to fill the gaps in the existing research. The research and guidelines developed by the Tower Renewal Partnership can be categorized into three overarching categories. The primary focus is technical issues, driven by environmental quality issues and maintenance and repairs. Retrofits of existing buildings present several challenges, in terms of technicality, by-laws and policies, to ensure the rules are being followed and the upgrade is beneficial. Retrofits vary in scale from minor energy retrofits and maintenance to deep energy retrofits addressing resident comfort and climate resilience; a total of four levels are established.[8] The research does a tremendous job of outlining the technical challenges and defining each level of retrofit for buildings. Additionally, the research outlines the gaps in the existing technical research relating to retrofits. However, one gap in the study that persists is the promotion of human health through building upgrades. While the research acknowledges resident comfort, it is more an inevitable outcome of the improvements rather than the primary intention. The primary intent is to improve the building envelope, eliminate thermal bridges and upgrade mechanical and electrical systems, which will result in substantially reduced heating and cooling loads.[9]

The second focus of the research is on outdoor spaces and amenities, emphasizing the quality of life beyond individual residential units. It aims to create 'complete communities' within apartment neighbourhoods. The report *Toward Healthier Apartment Neighbourhoods* effectively outlines elements in neighbourhoods that affect public health and provides solutions to resolve the issues.[10] This document was effective as it presented realistic solutions while considering the impact and restrictions of the Official Plan and Zoning By-laws. This report highlighted eight themes to achieve healthy and well-served communities in apartment neighbourhoods: natural environment, built environment, transportation, housing, income, employment opportunities, education and learning, and food security.[11] Healthy neighbourhoods are vital to promoting public health, and all the themes outlined in the report play a critical role in supporting this vision. The diverse populations in apartment neighbourhoods are currently underserviced, with a lack of amenities to help them flourish. Apartment neighbourhoods face various challenges with physical disrepair within the building and continue to be restricted by single-use zoning regulations, preventing various community facilities and not meeting diverse community needs.[12] This research will particularly focus on these urgent problems, reinforcing the narrative of the diminished quality of life within these buildings.

Lastly, the Tower Renewal Partnership focuses on zoning policies, by-laws and financial policies to maintain the affordability of this housing stock. Studies such as *Federal Green Housing Measures: Renewal and Affordability, Green Finance and Tower Renewal, and Tower Renewal Enabling Complete Communities*, concentrate on the cost of retrofitting buildings based on the retrofit levels, examining the tax system changes, loans, grants and low-interest financing, and understanding the payback period of retrofitted buildings. The research studies also examine how existing sites can be leveraged to accommodate infill development to meet Canada's growing affordability challenge.[13] These research studies, which effectively highlight the economic process of retrofitting

buildings, also offer solutions to fund the project and encourage property owners to retrofit buildings. While these studies are relevant to the big picture, this thesis will not extensively explore topics of affordability and financing retrofits.

This thesis builds upon the foundational research and standards established by the Tower Renewal Partnership, focusing on the rehabilitation and improvement of post-war towers to foster better living conditions. It intends to contribute notably to the ongoing efforts to improve the quality of life and ultimately encourage a healthier lifestyle for residents in apartment neighbourhoods.

Endnotes

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Chapter 1
The Situation

1.1 Toronto's Post-War Apartment Towers

In the aftermath of World War II, Toronto witnessed a significant transformation in its urban landscape by constructing residential towers. As the city was forced to accommodate its expanding population and address the housing shortage rapidly, these post-war residential towers presented a promising future for middle-class families.[1] Strategically designed to maximize space and provide affordable housing, these structures framed Toronto's skyline, reshaping its architectural identity through the 1960s and 1980s. Over the decades, these towers played a critical role in the city's housing narrative and urban planning ideologies. Apartment neighbourhoods were created alongside single-family homes, schools, community centres, shopping centres, employment zones and recreational areas as key features in the formation of new communities.[2] There are several communities designed this way. The Greater Toronto and Hamilton Area (GTHA) alone contains over 1500 towers, contributing to Canada's significant high-rise housing stock.[3]

Tower in a park

The "tower-in-the-park" concept became a defining feature of 20th-century housing innovation, representing a vision for urban living that coupled high-density residential design with the need for open, shared spaces.[4] The 'tower-in-the-park' style proposed by Le Corbusier, is rooted in modernist principles to combat the chaos of overcrowding by integrating residential towers into landscaped parks. These structures targeted middle-class families, promising a sense of community, privacy and connection to nature amidst urban settings.

Showcasing rectangular silhouettes, these towers built between the 1960s and 1980s across the GTHA reflect modernist architectural principles of simplicity and functionality. These high-rise concrete and masonry-clad structures were built using a cost-effective, flying-form concrete construction featuring clean lines, minimal ornamentation, and exhibiting uniformity in urban design.[5]

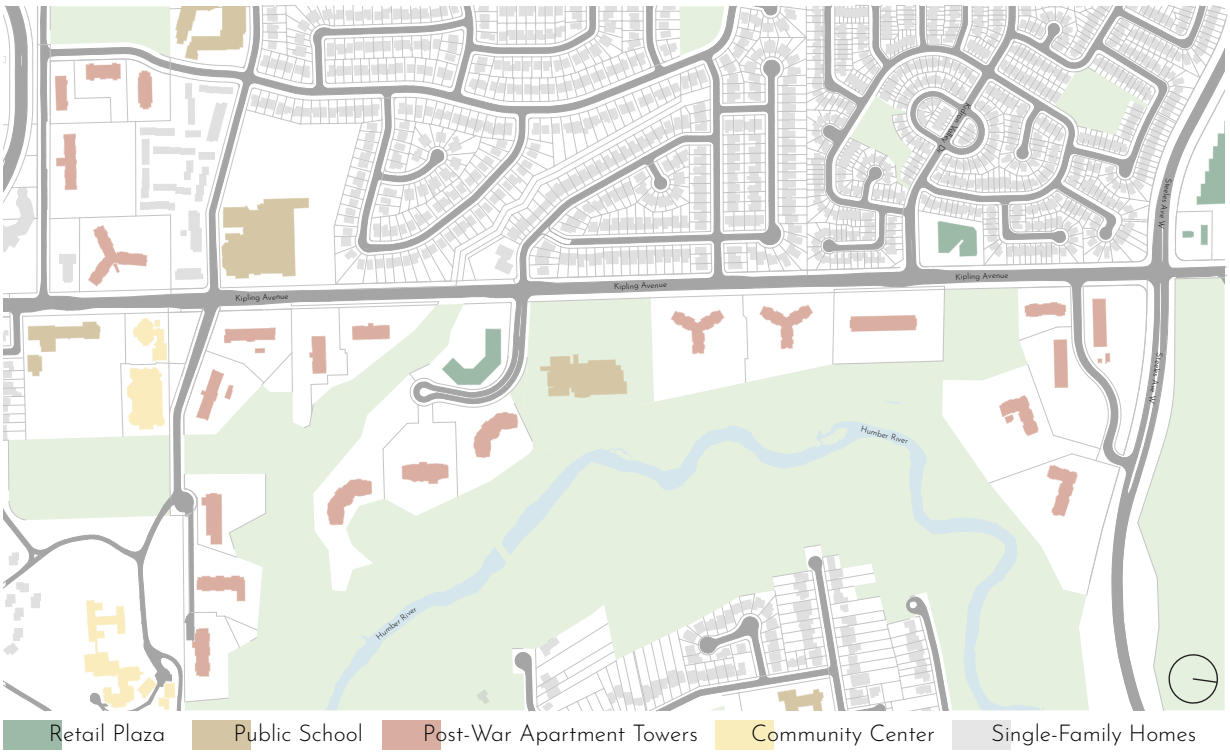


Fig 1.0 Site plan outlining a typical apartment neighbourhood at Kipling Ave and Steeles Ave W, Rexdale.

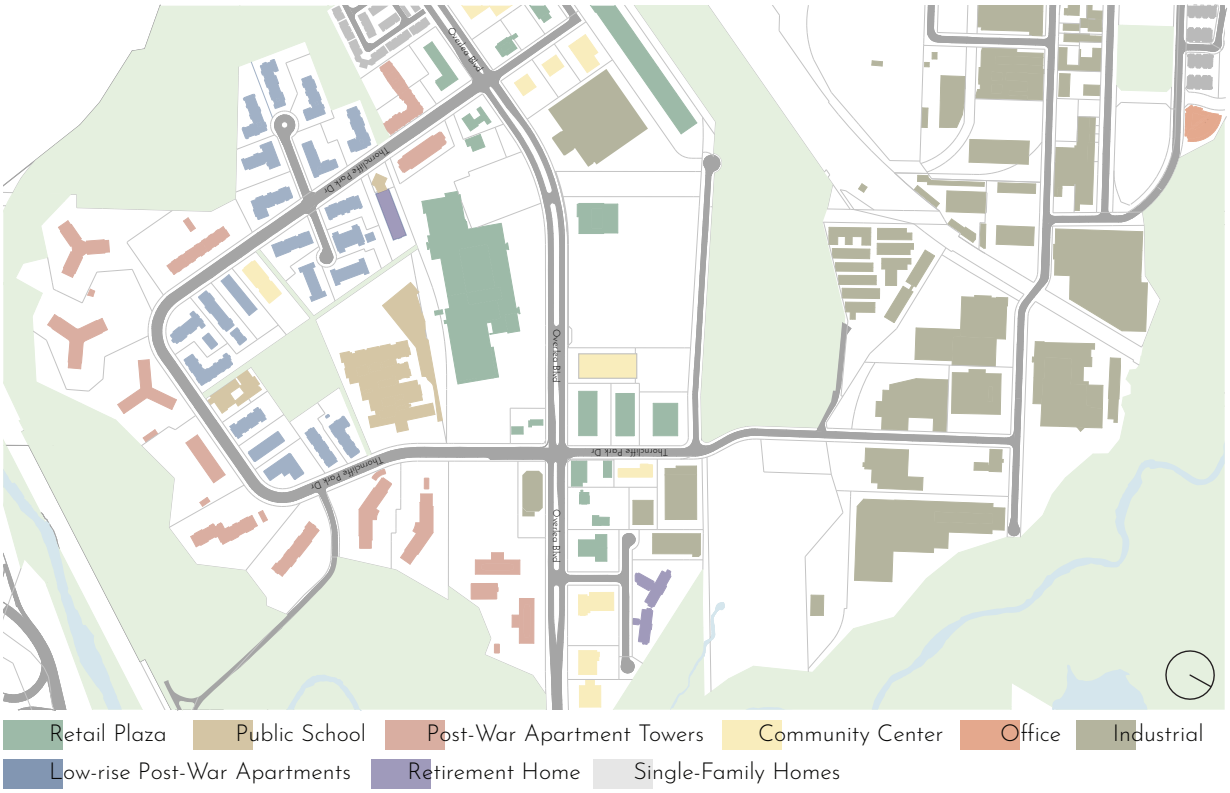
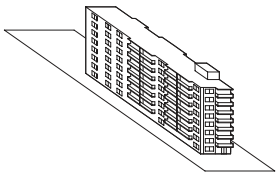


Fig 1.1 Site plan outlining a typical apartment neighbourhood in Thorncliffe Park, East York.



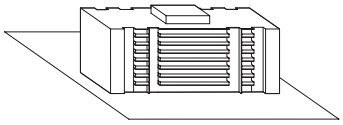
"St. George"

1950 - 1960



56 Thorncliffe Park Drive, East York

Year Building: 1960
Stories: 6



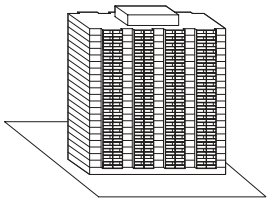
Mid-Rise

1960 - 1979



4 Grandstand Place, East York

Year Building: 1962
Stories: 6



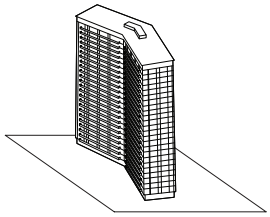
Slab Apartment (Bar)

1960 - 1979



71 Thorncliffe Park Drive, East York

Year Built: 1966
Stories: 21



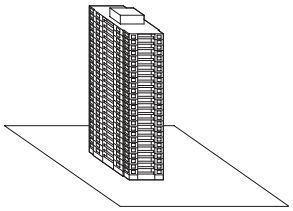
Articulated Bar Tower

1960 - 1979



75 Thorncliffe Park Drive, East York

Year Built: 1966
Stories: 17



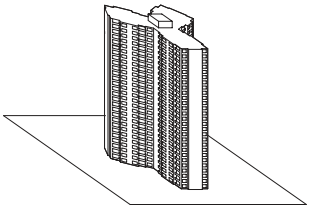
Point Tower

1960 - 1979



5 Dufresne Court, Toronto

Year Built: 1968
Stories: 28



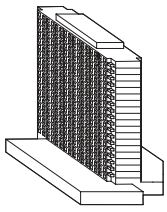
"Mercedes" Tower

1960 - 1979



47 Thorncliffe Park Drive, East York

Year Built: 1966
Stories: 25



"Context" Slab (Podium Building)

1970 -



161-170 Roehampton Ave, Toronto

Year Built: 2020
Stories: 39

Fig 1.2 Chronology of post-war apartment towers in the Greater Toronto Area (GTA) with photograph examples of buildings in the GTA.

Demographics

The initially targeted low-income tenants have replaced the middle-class population in search of affordable housing. The once-considered luxurious living homes, marketed with various amenities - saunas, pools, and recreational rooms - no longer offer the same lifestyle. The current generation of tenants live in deteriorating buildings and face several challenges due to the declining quality of the housing stock.[6] The text *Vertical Legacy* outlines families living in inadequate housing due to unaffordable housing costs, which compels large families to rent smaller apartments or multiple families to share a single unit.[7] Overcrowded units cause stress and conflict as individuals lack privacy. According to research conducted by Vertical Legacy, about one in five apartment units are overcrowded in Toronto. The composition of households in these towers ranges from two-parent families, single-parent families, and multi-family with or without children. In the City of Toronto, approximately 19% of families in high-rise rental apartments are two-parent families, and 14% are female lone-parent families. The remainder is a combination of couples with no children, non-family households, male lone-parent families, and multi-family households.[8]

Residents of these towers can be categorized by various characteristics - income, immigration status, disability, age and education. The text *Vertical Legacy* has attempted to categorize this population. Roughly 49.1% of all immigrant renters live in high-rise rental towers. In search of the Canadian dream, immigrants see these towers as a temporary housing solution. Therefore, the lack of amenities and social spaces does not affect these immigrants. The convenient location and affordable rents are sufficient for the new generation of tenants. The majority of the racialized apartment renters are Black, Filipino, and South Asian. Lastly, approximately one in seven seniors (age 65+), live in high-rise rental towers.[9] However, these buildings provide minimal to no amenities to support seniors, leading to feelings of isolation and loneliness. Overall, high-poverty neighbourhoods attract single-parent, low-income, and immigrant families, while low-poverty neighbourhoods house seniors, singles or couples with no children with higher incomes.[10]

Current Challenges

These promising post-war buildings have aged, and maintenance has dwindled. The post-war residential towers were built in a period where standards, policies, and conservation of energy were not highly enforced or major concerns. Therefore, the housing stock – five decades later – provides environmental sustainability challenges and has been labelled 'Toronto's most wasteful and ecologically irresponsible building type.'[11] In addition to environmental sustainability challenges, the housing stock is home to underserviced communities and has become a neglected resource. The original intent was to create self-sufficient communities; however, the new generation of residents are predominantly new Canadians, new immigrants, and/or low-income families, who do not interact with the apartment towers in the same manner as their predecessors. While the intended residents had access to cars, the newer generation of residents is more reliant on public transportation, rendering the large parking lots useless. Similarly, the originally designed green spaces are now unkempt parklands, and the amenity areas, - such as swimming pools - are abandoned. The intended quality of life envisioned for these buildings is no longer the reality, as they suffer from chronic neglect, disinvestment and growing poverty. The overall upkeep of the building is declining leading to regular elevator breakdowns, water damage, foul smells in the hallway, and lack of thermal comfort in the units due to poor envelope conditions. The post-war towers across Toronto have become estranged and alienated from the urban fabric due to external stigmatization and declining maintenance.[12]

Despite the challenges these concrete structures present, they also provide great opportunities for future housing, amenities and employment, if provided the prospect to be upgraded. The concrete structures are durable and suited for an upgrade, making them a viable housing resource for generations to come.[13] With thoughtful planning, the estranged apartment neighbourhoods can be transformed into dynamic, vibrant and healthy communities.



Fig 1.3 Impersonal corridor with no natural light or place to pause

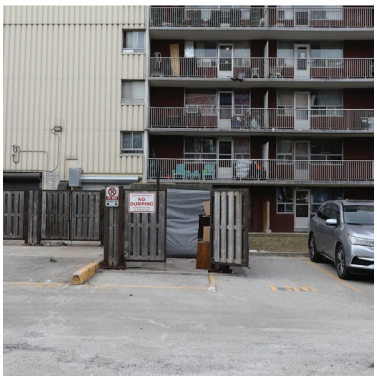


Fig 1.4 Garbage collection near lower level units let foul smells to travel into units



Fig 1.5 Window A/C units indicate lack of thermal comfort in apartments



Fig 1.6 Pigeon nets used to prevent birds into balcony space



Fig 1.7 Ground floor units informally expand balcony space

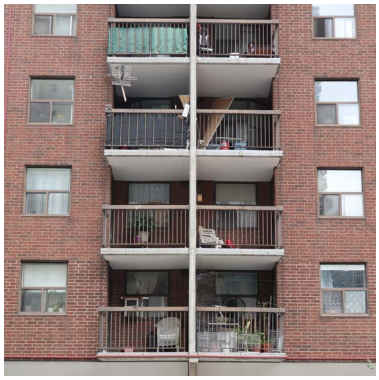


Fig 1.8 Lower units always have curtains drawn and use tarp to create privacy in balcony



Fig 1.9 Unusable balcony space turns into storage space



Fig 1.10 Fenced green space not permitted for use



Fig 1.11 Poorly designed gathering space surrounded by drive aisle infront of building entrance

1.2 Tower Renewal Partnership

The Tower Renewal Partnership represents a collaborative and multidisciplinary initiative, presenting a solution to prevent the decline and eventual demolition of Toronto's aging post-war towers. The initiative aims to revitalize the city's existing post-war tower stock by focusing on six fundamental principles: greenhouse gas reduction, affordability, growth, housing quality, inclusive communities, and culture. Acknowledging the apartment neighbourhoods as a valuable housing asset, it notably shifts the existing negative perspective towards Toronto's modernist high-rise buildings. Furthermore, it suggests that tower renewal should be considered a 'best practice' in future planning and highlights the challenges of embodied energy associated with demolition.[14] The Tower Renewal Partnership has evolved into a city-run program in Toronto to enhance Toronto's stock of post-war apartment towers and surrounding communities.

The established guidelines acknowledge the incredible potential of the city's post-war towers; the solid masonry exteriors are well-suited for minimally invasive over-cladding, providing a new look to the building and upgrading the envelope efficiency. Furthermore, the large, open, unprogrammed green spaces and expansive roof areas can be used for stormwater management systems, solar and rainwater collection, and community engagement activities. Combining sustainable practices with community involvement provides the most success to the Tower Renewal Partnership.

The Tower Renewal Partnership does a promising job of addressing social inequality, environmental sustainability, urban planning and creating complete communities. Although it centers on a macro-level approach to rehabilitating these neighbourhoods, it overlooks the public health of residents within the buildings. Disregarding public health places apartment neighbourhoods at risk of succumbing to a familiar cycle of gradual decline. While the initiative tries to address elements of tenant control, such as

complete communities and culture, the guidelines need to address resident-directed agency and autonomy within the building's design. Including tenant-controlled agencies within these revitalized communities will encourage healthy living for the occupants and foster 'complete communities' and 'culture.'



Fig 1.12 Upgraded balcony guardrails and painted exterior wall at 41 Garfella Drive, Etobicoke.

1.3 The Current Shoebox (Condominium)

In contrast to the masonry-clad post-war residential towers, sleek glass-clad condominiums line the Toronto skyline. Although these modern condominiums are appealing to buyers, with seemingly high-end finishes and floor-to-ceiling windows with a view, they do not necessarily offer better health or living conditions than the 1960s residential towers. Despite higher rents and property management fees, condominium residents still face challenges of occupant comfort in their glass-box homes.

Condominium developers prioritize profit and quick sales over occupant health and well-being. These condominiums are built cheaply and fast to maximize profits. For instance, according to the City of Toronto's 'Housing Occupancy Trends 1966-2011' report, between 1996 and 2014, the average size of modern condominium units has shrunk by 20%. In addition to shrinking unit sizes, less than five percent of new condominiums are designed with three bedrooms, reflecting a trend toward smaller, less family-friendly units.[15] This suggests the developers' intentions of aiming to squeeze in more units by sacrificing the size of the units. Reducing the size of units also changes the aspect ratio of the units, which results in deep and narrow units with one large window that provides daylighting to the bedroom, kitchen, and living room at once. It greatly reduces the amount of daylight entering the unit and directly impacts occupant well-being. Beyond the size restraints, condominiums face challenges with adaptability, as shear walls act as demising walls and short, narrow balconies are often rendered useless. Spatially, the design of modern condominiums has regressed compared to the 1960s post-war towers, featuring smaller living areas, bedrooms, and kitchenettes.

While modern condominium buildings offer amenities like gyms, pools, and rooftop BBQ areas, they lack large open fields for children and pets to play in - a common feature in post-war residential towers. Additionally, condominium buildings are so densely situated in urban environments, that the ample sunlight promised by the floor-to-ceiling windows is often shadowed by

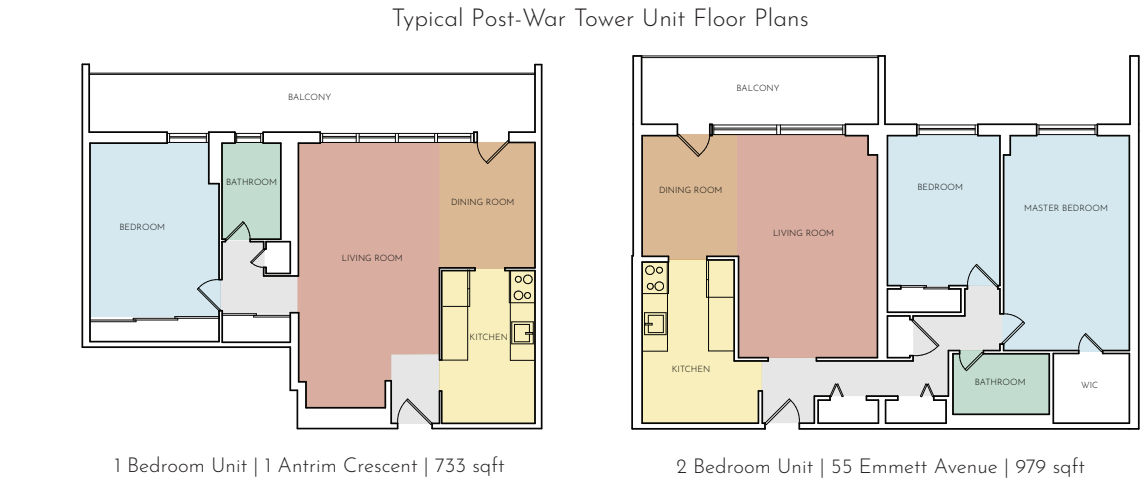


Fig 1.13 Comparison of typical unit floor plans from post-war apartment towers and new construction condominiums. Old post-war residential units were designed with separate rooms for activities, while in new units all spaces flow into each other. Unit sizes are shrinking and some spaces also do not have windows.

a neighbouring building, reducing the natural light available to residents.

The primary feature of modern condominiums – floor-to-ceiling glass walls – poses significant health risks to occupants. It is crucial to acknowledge that while window walls are visually appealing and provide a view, they present issues of thermal inefficiency and are prone to air and water leakage.[16] Some of the most standard glass condominium performance problems are durability, comfort and resilience.[17] Regarding durability, leaky envelopes cause deterioration of interior finishes and eventual mould growth – which can result in adverse health effects. Thermal comfort issues are also widely reported; in winter, units are often too cold, and in the summer, they're too hot. There are additional concerns of overheating in the units facing west. Additionally, the resilience of these buildings is compromised, as the glass envelope performs poorly during extended power outages, rendering the units uninhabitable.[18] Ultimately, despite their modern aesthetic, modern glass-clad condominiums fail to support occupant comfort.

1.4 The Pro forma & the REIT (Affordability challenges)

It is well-known that Canada is facing a housing crisis, with sky-rocketing real estate prices making homeownership and rental housing increasingly out of reach for many. The growing unaffordability and struggle to make ends meet is forcing families into dangerous and unhealthy living conditions. The post-war residential buildings offer lower-than-average market rents due to the deteriorating and outdated conditions, despite them being for-profit.[19] However, regardless of the relatively lower rents, tenants continue to struggle as the gap between rental costs and income widens.

Housing is considered affordable when it is less than or equal to 30 percent of a household's income before tax. But the reality is quite different as many of these towers no longer offer affordable rents. In 2016, approximately 48 percent of tenants in towers paid over 30 percent of their household income in the

City of Toronto.[20] The relatively affordable rents offered by these buildings are resulting in low vacancy rates and declining home ownership. Corporate landlords, such as Real Estate Investment Trusts (REITs) and investment companies such as pension funds invest in these rental towers. By purchasing these deteriorating apartment buildings, investors evict below-market-rate tenants and renovate the units to match new units (known as renovictions).[21] These renovations often consist of upgrading balcony guardrails, replacing existing floor finishes, painting units, replacing kitchen counters and modernizing appliances. Through renovictions, investors can raise the rent, thereby increasing their returns on investments (ROI) and making a profit.

In the past, these rental apartment towers used to be considered temporary or transitional housing for many families - a stepping stone to homeownership. The expectation was families would live in these towers until they could afford to purchase a home. However, over the years, the thought of purchasing and owning a home has become an unattainable dream. These rental apartment towers have become a sinkhole, where the rising costs of living compared to steady wages prevent families from saving enough for a down payment. As a result, the short-term housing condition has turned into a long-term and possible permanent housing option. Investing in the betterment of this housing stock is greatly influenced by three factors:[22]

1. Regulation: compliance with building code or by-law
2. Market demand: attracting more tenants
3. Pricing: generating greater return on investments

Investors often need to see a profit to consider investing in these properties. Developing policies can help to maintain rental affordability and improve the quality of life in these towers. Additionally, tax relief and federal tax incentives can encourage private companies and property owners to invest in improving the housing quality. Three financial scenarios can be considered for this housing typology; 1. REIT government-backed; 2. co-operative housing; 3. Developer owned. The housing stock would look quite different under each financial model (see conclusion).

1.5 Humberwood Place Tower

Humberwood Place, located at 55 Emmett Ave, is situated within the Mount Dennis Neighbourhood, in York. Built in 1968, the building houses 267 units over 23 stories. The development is situated in a typical apartment neighbourhood, clustered with three more post-war towers, alongside single-family homes, a high school, a hospital, and recreational areas. The development towers over the Mount Dennis Neighbourhood and can be seen over the rooftops of single-family homes. While the developments located at 55 Emmett Ave and 65 Emmett Ave are rental properties, the other two towers are condominiums. Humberwood Place is managed by Briarlane Rental Property Management Inc. and has a property manager available on-site. The building offers laundry facilities on site, a daycare center at the ground level – which not all post-war towers are equipped with, and surface and underground parking.

Most of the residents in towers depend on walking, cycling and using public transit to access places.[23] Therefore, ensuring the neighbourhood is well-designed, with accessible paths and convenient access to local stores and amenities is necessary. Humberwood Place has a walk score of 73 out of 100, making most errands accomplishable on foot, a transit score of 75 out of 100 and a bike score of 46 out of 100.[24] Although Humberwood Place has a good walk score, the shopping plazas are situated away from the apartment neighbourhood and along major roads, making it more car-friendly, than pedestrian or public transit friendly.

Demographics

Mount Dennis is a diverse neighbourhood, representing dozens of ethnic groups, with approximately 56.1% of the population being immigrants.[25] The largest ethnic group residing in Mount Dennis is from the Caribbean and West Africa, followed by Western-European and Southeast-Asian communities. Approximately 50% of the population lives in apartments greater than five stories and more than 50% rent their homes. These statistics are quite common in apartment neighbourhoods, as majority of these post-war rental

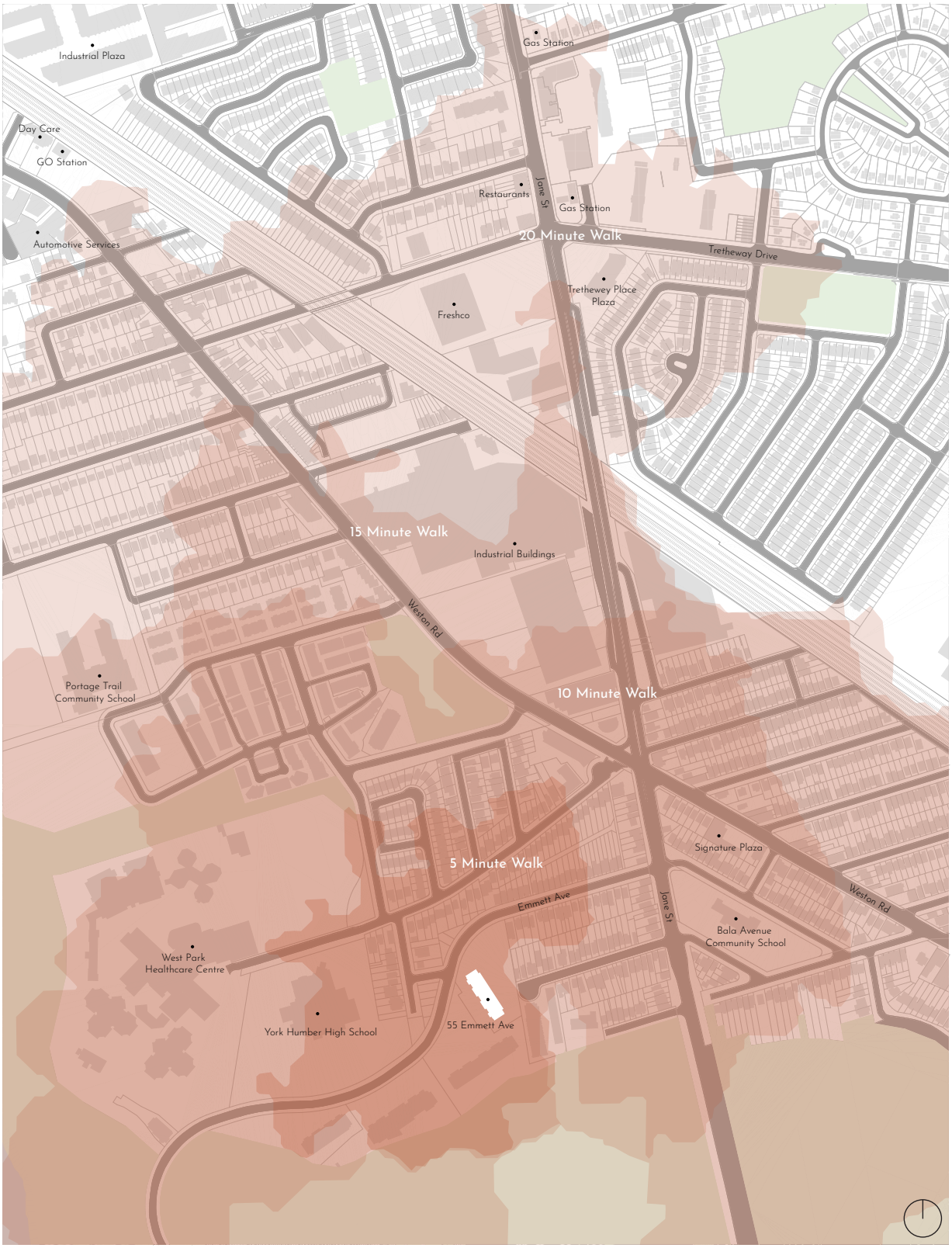


Fig 1.14 Context plan of 55 Emmett Ave, listing the surrounding amenities and the time it takes to walk to each place.



Fig 1.15 Exterior photograph of 55 (left) and 65 Emmett Ave (right).

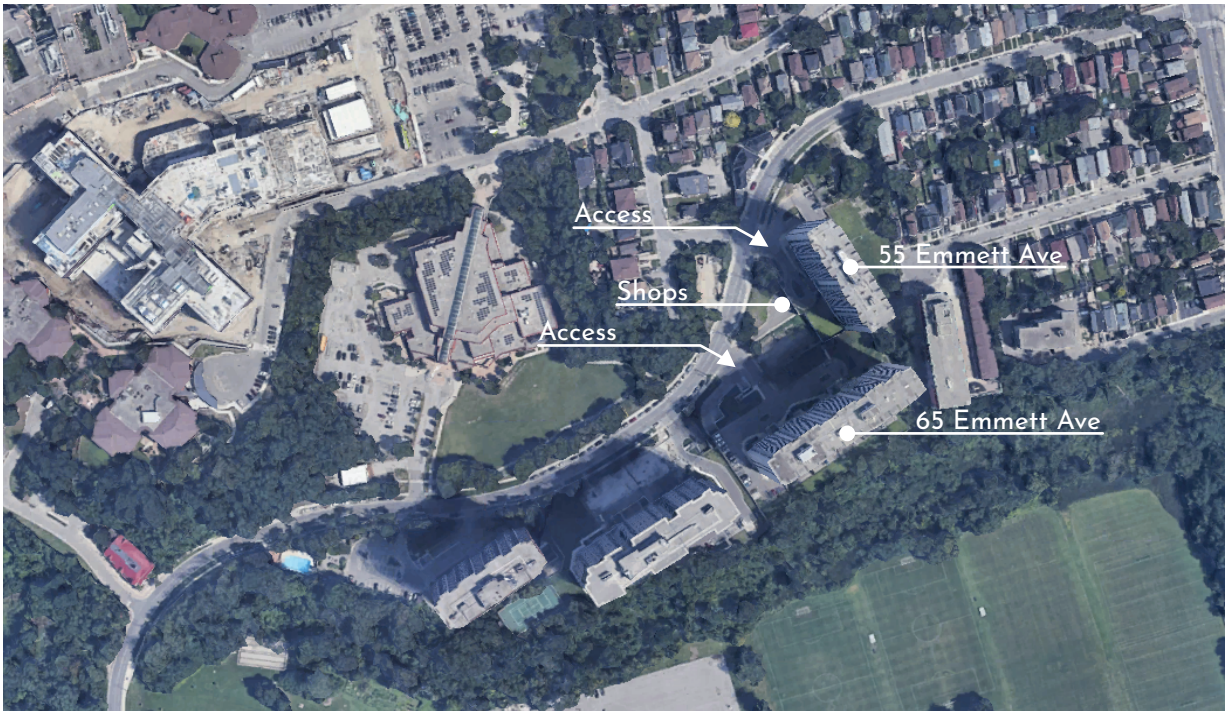


Fig 1.16 Site plan depicting Humberwood Place Tower (55 Emmett Ave) and immediate surrounding context.

properties house new immigrants. Post-war towers provide new immigrants with a more affordable housing option and neighbours with similar ethnocultural backgrounds.[26] Residing in neighbourhoods with people of similar backgrounds allows new immigrants to trust their neighbours, and gain informal support, such as borrowing and lending household items, babysitting children, networking opportunities for jobs, and keeping an eye on their apartment when away.[27]

As of 2016, the average household size in this neighbourhood is 2.56. Living arrangements consist of single adults (age 20 -34) living with their parents, and seniors living alone. Family sizes in this neighbourhood vary from 2 people (44%), 3 people (29%, 4 people (19%), and 5 or more people (9%). While 23% of couples do not have children, 41% of couples do have children, and 36% are single-parent families.[28] Approximately 74% of the population in Mount Dennis receives their income from employment, as wages, salaries and commissions, with the average total income for a household in this area being approximately $30,827.[29] This is below the City of Toronto average, categorizing this neighbourhood as a high-poverty neighbourhood.

Humberwood Place is representative of the many major typological problems present in Toronto's post-war residential towers. The development can be characterized by its dilapidated structure, disconnected outdoor spaces, inefficient balconies, impersonal hallways and lack of accessible community space. In this thesis, Humberwood Place will stand in place for all post-war residential tower developments across the GTHA and address the issues experienced by thousands of residents living in these buildings. Humberwood Place is a typical example of the conditions of post-war towers across the GTHA, and therefore, it will be used as an example in this thesis to develop the guideline.



Fig 1.17 Humberwood Place Tower exterior.



Fig 1.18 Front entrance of Humberwood Place (55 Emmett Ave).



Fig 1.19 Rear surface parking lot and waste collection area of 55 Emmett Ave.

Life in the 1960s

In the 1960s and 1970s, post-war high-rise towers became a significant aspect of suburban development in cities like Toronto, reflecting a modernist vision of urban living. Located in new suburban communities, these towers were often surrounded by green spaces and designed to provide high-density housing for the growing population. The lifestyle in these towers emphasized modern conveniences, with amenities such as swimming pools, saunas, landscaped grounds, underground parking and spacious lobbies. High-rise living was seen as a progressive alternative to the traditional single-family home, offering panoramic views, easy access to services, and transit systems. These developments catered to middle-class nuclear families and were often celebrated for modernity.[30]

High-rise living became deeply ingrained in Toronto's housing landscape. This can be seen in the following newspaper clippings and advertisements, as the buildings were marketed as luxurious living, with electric appliances and amenities.

The case of the disappearing bachelors at 555 Sherbourne.

Luxury downtown apartments where living offers more of life.

It's no mystery to our present tenants that our bachelor apartments are disappearing fast. They discovered that there's just no other place where you can move right in to a brand new, luxury downtown apartment, with balcony, for as little as $239.00. Imagine being only minutes from Yonge and Bloor Streets, Subways, parkways, department stores, theatres, restaurants, hotels and entertainment. A word to the wise though – hurry, they're disappearing fast.

555 Sherbourne is a small city in itself, with a private club having a restaurant and dining room, discotheque, heated indoor pool, 11 squash courts, saunas, gym, running track, along with its own Loblaws and over 20 other fine stores. All this is set in just under an acre of beautifully landscaped grounds with reflecting pool, walkways and an outdoor podium that connects all three towers. Now that's living!

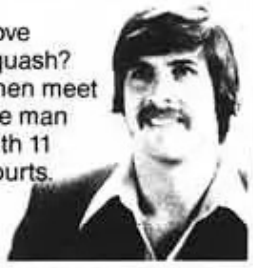
We'd like you to meet just a few of the people who will make 555 Sherbourne a friendly place to call home:



Eli Ronen is our Project Manager. He looks after everything, inside and out. And he's very good at his job, which means he looks after things before they can inconvenience you. With Eli on the job, things should be so smooth that you may never get to meet him. And that's the mark of a good Manager.



555 Sherbourne has its own Loblaws, just steps from your apartment. Not only that but there are over 20 other fine stores too. That can be really nice, when the weather isn't.



Imagine 11 temperature-controlled squash courts with professional coaching, racquet storage and pro shop. They're all yours when you're a member of our Sherbourne Club.



Rebecca is our friendly, full-time Sales Representative at 555 Sherbourne. She will show you one of our brand new, bright, airy bachelor apartments with balcony. You can move right in for as little as $239.00. But hurry Rebecca says there aren't many left.



He's just one of our three Doormen. Besides opening doors, they keep an eye on everything. It's kind of nice to know that you can call on them for assistance... anytime.



He knows how to make everything run smoothly. And if something doesn't, he'll come on the run...anytime. Which is why he's such a super Super.



Actually we have a team of skilled men who will groom the beautifully landscaped grounds around 555 Sherbourne. They tend all the trees and flowers and look after the walkways and reflecting pool. It's like having your own park.



Meet the chef in our dining room and restaurant. When you're a member of our Sherbourne Club, you can relax, have a drink or two, and enjoy an excellent dinner. You can even entertain friends who drop in out of the blue.

IF YOU WOULD LIKE THE COMPLETE STORY ABOUT 555 SHERBOURNE, WE HAVE A NEW BROCHURE THAT'S YOURS FOR THE ASKING. JUST TELEPHONE 967-5555.

Rental office and model suites are open from 10-9 weekdays. Weekends 10-6.

555 Sherbourne

"Where downtown living offers more of life"

Fig 1.20 Newpaper clipping from the 1970s, trageting single's in Toronto to rent bachelor suites.



Fig 1.21 Newspaper clipping in the Toronto Star on Sept. 3, 1947, informing people to not come to Toronto due to a housing shortage.



For Sale

40 SOLD IN 40 DAYS TO TORONTONIANS
85 MORE NOW READY FOR OCCUPANCY

85 Cooperative APARTMENT HOMES

as low as $3750 DOWN

With monthly terms to suit your budget. One- two- and three-bedroom suites . . . ready for you to move in and live

WHEN YOU OWN A CO-OPERATIVE APARTMENT HOME YOU CAN LIVE FOR ABOUT $40 A MONTH—FOREVER! IF YOU WERE RENTING THESE HOMES THEY WOULD COST YOU FROM $150 TO $275 A MONTH! THIS IS SECURITY!

WILFRED SHULMAN, Architect

1. CASA LOMA TOWERS . . .
On Spadina above Bloor within sight of the Castle

2. LAKEVIEW TERRACE . . .
Beach area (East End) . . . on the hill overlooking Lake Ontario

3. CRESCENT MANOR . . . *in Rosedale on exclusive Crescent Road . . . overlooking wooded ravine*

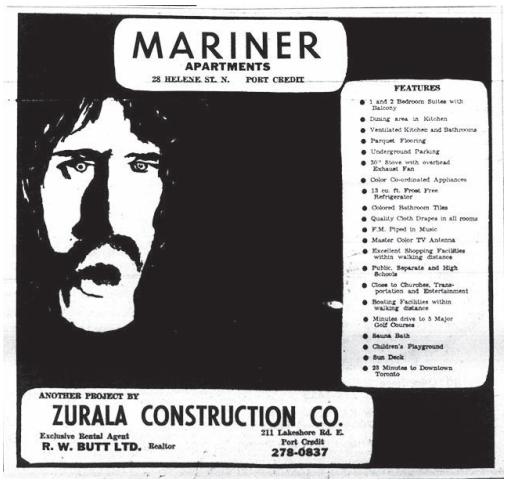
A Proven Success in Toronto When you move into one of these magnificent co-operative apartment homes you leave behind the high costs of a rented apartment. No more worries about painting the house, keeping up lawns and gardens, fretting with plumbers. If you want to go away, you know that your home is safe and cared for. You'll enjoy a new kind of carefree living you've never known before. When you own a Co-operative Apartment outright your maintenance costs are less than half — yes, less than 50% of what you would pay to maintain most homes or apartments.

The low annual maintenance fee ranges from $28 to $48 a month (depending on size of suite and location) and includes taxes, insurance, heat and water, service, maintenance and upkeep. Best of all, you own it.

The four co-operative apartment homes illustrated here have spacious—king-size rooms . . . big walk-in closets . . . more storage space than you'll probably ever need . . . continuously ventilated kitchens completely equipped with Frigidaire electrical appliances . . . your own big private balcony opening off living room and bedrooms in most instances.

Choose the district you want to live in and see these wonderful apartment homes tonight. We urge you to act promptly in order to get the apartment home you want . . . forever.

Fig 1.22 *Advertisement for the Casa Loma Towers in the Globe and Mail, on September 6, 1957.*



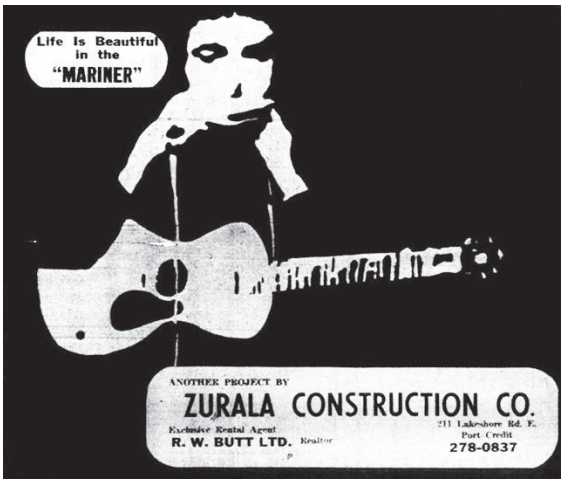




Fig 1.23 Top Left. Adertisement from Mississauga Time in 1969, promoting tower living inspired by an album cover.

Fig 1.24 Top Right. Adertisement from Mississauga Time in 1969, promoting tower living inspired by an album cover.

Fig 1.25 Bottom. Advertizement of the same tower as figure 1.23 and 1.24, offering free rent and featuring amenities.





Fig 1.26 Left. Advertisement from the Toronto Star on April 20, 1970, for 55 Emmett Ave. The building is promoted as "The Place" for childern and working mothers, with a daycare on site and close to schools and amenities.

Fig 1.27 Right. Left. Advertisement from the Toronto Star on July 18, 1970, for 55 Emmett Ave. The building advertises adult suites, and top 9 adult floors, and year round pool & sauna.

Endnotes

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7 Trisha Scantlebury, et al.. Vertical Legacy: The case for revitalizing the GTA's aging rental tower communities. (Toronto, Ontario: United Way Toronto, 2021), 59.

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PART 2

Chapter 2
Healthy Socio-Spatial Housing Principles

The neighbourhood and immediate surroundings around one's house greatly influence their psychological and social health. Research has shown that high-rise living is associated with high rates of mental health issues and social isolation. The disconnection from the ground plane and nature has been shown to negatively affect residents' psychological state and behaviour. [1] Additionally, as residents often rent, rather than own, they see high-rise apartments as temporary living and do not actively engage and try to connect with their neighbours. Communal spaces within the MURBs are often hallways, elevators, the lobby and the mail room. However, these unprogrammed spaces are often used as an efficient means of circulation, with no place to pause or interact with one another.

The common rooms, or amenity spaces these buildings were originally designed with are also no longer present, and where they do still exist, they are not used, in poor condition, and require a high fee.[2] These factors all play into creating a safe and inviting environment for residents which can isolate residents or foster meaningful connections. It is noted that often immigrants from similar backgrounds residing in these buildings attempt to get to know their neighbours, provide support, and socialize.[3]

Lastly, residents in these buildings walk, cycle and depend on public transit to reach their destinations. However, many properties are surrounded by fences as a security, and liability measure, which requires people to take an indirect and much longer route to their destination. Physical barriers discourage people from walking as taking public transit or driving would save time. Transit is greatly relied upon in these communities as most neighbourhoods have at least one bus route.[4]

Overall, these communities need to be better integrated within their neighbourhood to support the diverse population they house. The Tower Renewal Partnership identifies this disconnect between communities and provides strategies with the urban planning framework to provide a positive change to the neighbourhood. It is important to note that while these strategies are effective theoretically and encouraged by the Official Plan,

there are regulations such as the City's zoning by-laws and municipal regulations preventing these changes.[5] This chapter will explore the strategies developed and proposed by the Tower Renewal Partnership to foster healthier, safer and more active neighbourhoods, and suggest strategies to promote interaction and safety within the building.

2.1 Connection with Nature

Connection to nature is essential to leading a healthy life. Access to nature and green spaces is shown to reduce stress, enhance mental health and encourage physical activity. Nature provides clean air, exposure to sunlight, and promotes social integration improving public health and quality of life.[6] Post-war towers across the GTHA are generally surrounded by large green spaces, mature trees and vegetation. However, these green spaces are often underused due to the lack of amenities, playgrounds, benches, programming and maintenance. Some spaces are also inaccessible to residents either through physical barriers, such as fences, or signs restricting use. Poor design and organization of the open spaces also render them unusable, such as a lack of shaded areas, large paved areas, or high vehicle traffic areas.

Improving the connection to nature for residents through improving these elements will encourage residents to utilize the space and engage with each other. The Tower Renewal Partnership aims to improve the micro-climate and outdoor environment, through introducing shaded areas using tree canopies, plantings and hedges.[7] Improving the connection between buildings in clusters by removing fences and improving the sidewalk conditions would also provide neighbourhoods with a sense of community and foster connections through activities such as community gardening and walking clubs. These apartment neighbourhoods have great potential for improvement, especially as they have the space for expansion, though, amendments to the zoning by-laws would be required to achieve this.

Many people convert their balconies into home gardens and introduce biophilic elements in their homes (ex. fake grass, planter boxes, plants) to feel more connected to nature. The downside is that this space is not usable year-round, as balconies are covered in snow in the winter, requiring them to bring the plants inside or let them die outside until next spring or summer. Enclosing the balcony space would help residents who enjoy planting and gardening to utilize their balcony to plant and garden year-round. The solution of enclosing the balcony is a suggestion provided by the Tower Renewal Partnership, to combat thermal bridging through the concrete slab, and reduce indoor temperature fluctuation.[8] Furthermore, providing a communal greenhouse or an indoor garden may also foster connections between residents and provide residents with healthier food options within their communities.



Fig 2.0 Signs near the landscaping at 55-65 Emmett Ave, York, restrict the use of open green space. Lack of bicycle storage in the building results in residents securing bikes to the fence.

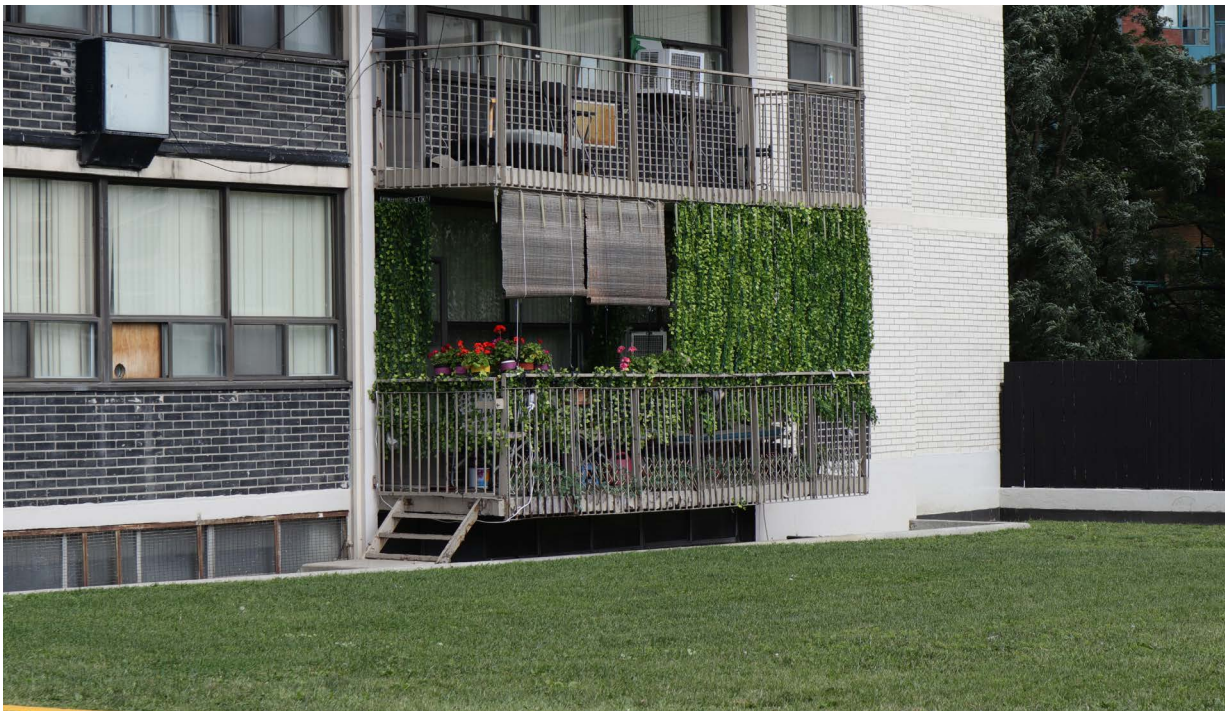


Fig 2.1 Residents create private garden by growing plants on the balcony and introducing fake ivy and greenery. 55 Emmett Ave, York.

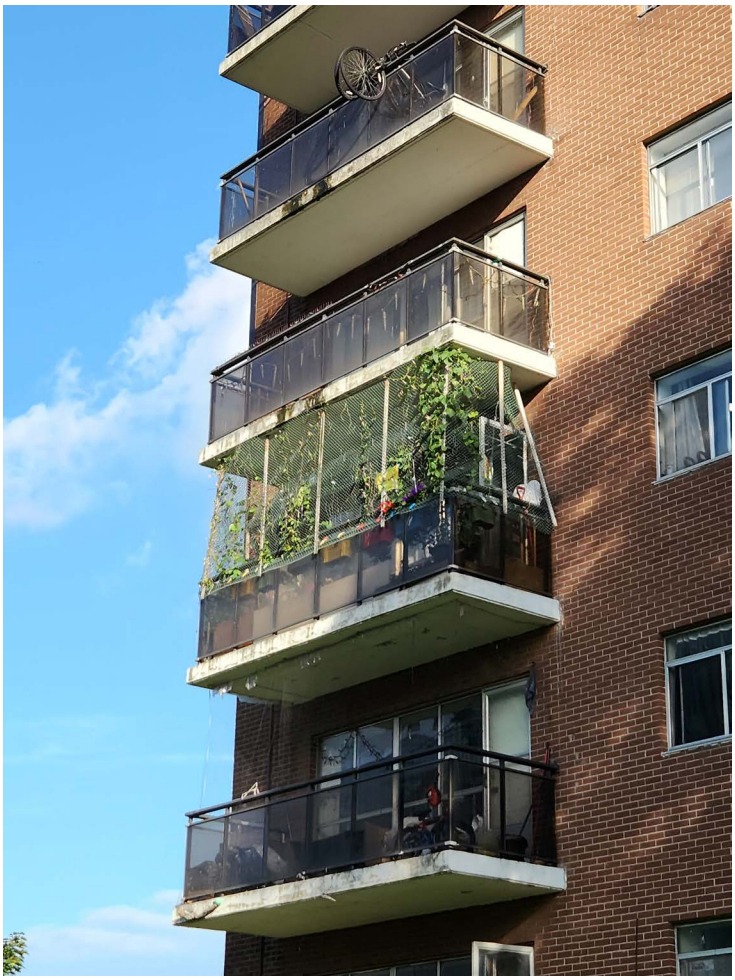
2.1.1 Lack of Dedicated Spaces for Residents to Connect with Nature Year-round

Context

Although post-war towers are surrounded by large open fields, - some even close to ravines and walking trails, - residents residing at higher levels are disconnected from the ground plane and attempt to create their own green space in their homes. While the balcony would be an ideal space for this activity, plants on the balcony die out in the winter, or residents must bring them inside. Unprogrammed green spaces often go underused and do not live up to their full potential.

Fig 2.2 Left. Residents create private garden by enclosing their balcony with chicken wire and growing plants in the summer. 1901 Martin Grove Road, Etobicoke.

Fig 2.3 Right. A large, unprogrammed open field in front of 10 Garfella Drive, Etobicoke - typically used by kids to play catch.





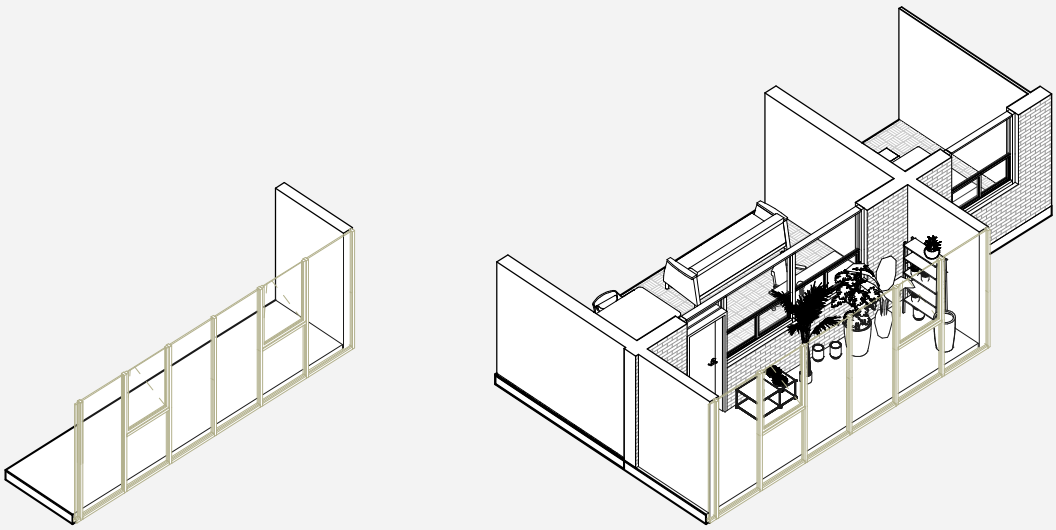
Solutions

Providing residents with dedicated indoor spaces to grow plants can help to maintain the connection to nature year-round. Whether it is a private space within the home, such as an enclosed winter garden or a communal indoor garden, these spaces can foster connections among residents, and promote healthier lifestyles through activities such as gardening, and exercise. Communal gardens can also provide these communities with healthier food options.

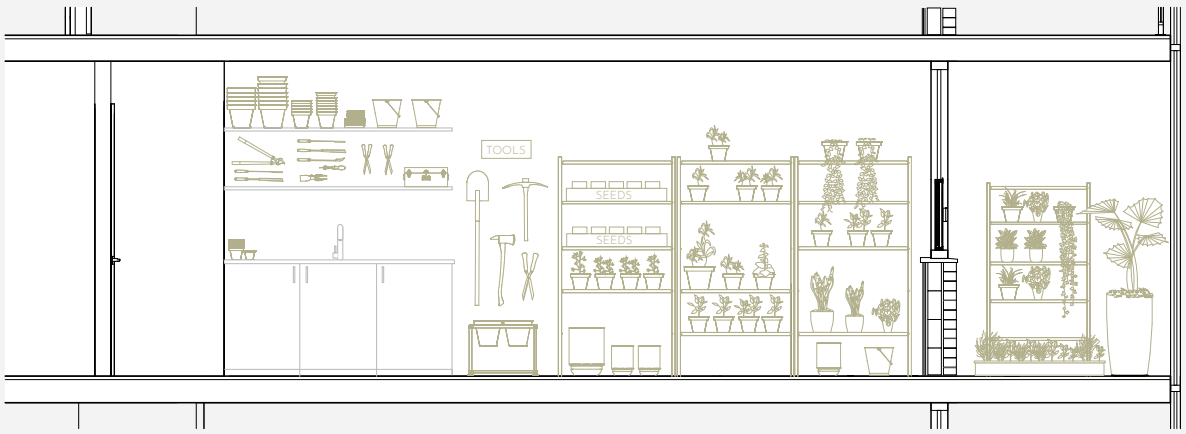
Fig 2.4 Top. Enclosed balcony transformed into a private garden.

Fig 2.5 Bottom. Unit transformed into a communal indoor garden.

Enclose balcony to transform it into a private winter garden



Create a communal indoor garden, or greenhouse



2.2 Community Interaction, Safety and Privacy

Post-war towers experience social limitations, however, due to being located in low-income neighbourhoods, these buildings often also experience higher crime rates, drug dealing, vandalism, and property damage.[9] These actions cause distrust among neighbours, raising alertness and stress when leaving their apartment or fear of leaving their units. Residents have reported that due to the fear of gun violence in their neighbourhood, they no not allow their children to go out and play.[10] This fear causes stress, isolation and various mental health issues.[11]

Issues of security are addressed by the Tower Renewal Partnership by enhancing the space around the towers to be more inviting. Interventions include improving lighting conditions, adding or increasing surveillance, whether it is through installing cameras or adding programmed spaces at ground level to increase eyes on the street.[12] Adding retail stores, cafes, housing, or gathering spaces for residents can improve the sense of safety as it would create a livelier street scape. Additionally, improving the lighting conditions by illuminating the walkways, building entrance and dead pockets surrounding the tower can help improve the night time environment.[13]

Enhancing the indoor space to feel more secure is also essential to feeling secure. While many condominiums and high-rise towers have a concierge, this is not common among the older post-war towers. A concierge service would help residents to feel safer. Residents have reported that they are afraid of even walking to the garbage chute on their floor and having strangers knocking their door looking for drugs. Allowing natural light in hallways, can make the space feel welcoming, and improve visibility. Creating places to pause in the hallway can encourage residents to pause and converse, allowing residents to get to know one another and build trust.

Lastly, units located on the lower level often have their curtains drawn and utilize storage and furniture to protect privacy. Lack of privacy in lower units also prevents residents from using their balcony space. Ill-defined boundaries between private balcony space and public realm permits residents to informally encroach public space. Ensuring residents feel safe in their homes and neighbourhood is crucial to creating vibrant communities where people feel like they belong.



Fig 2.6 Residents utilize common items (ex. tarps, furniture, plastic) to create privacy in balconies, diminishing the look of the building exterior at 7 Glamorgan Ave, Scarborough.

2.2.1 Concerns of Visual Privacy in Lower Level Units

Context

Units located on the lower level often have their curtains drawn and utilize storage and furniture to protect privacy. This can create issues of lack of daylight entering the unit and obstruct views of the outdoors. Lack of privacy in lower units also prevents residents from using their balcony space, as they do not feel comfortable being observed by pedestrians, and instead use it as storage space. Ill-defined boundaries between private balcony space and the public realm results in residents informally encroaching on public space.

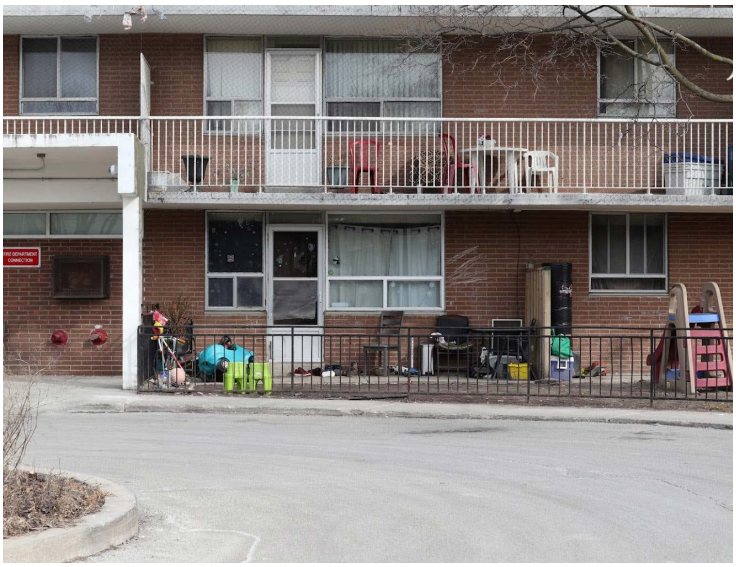
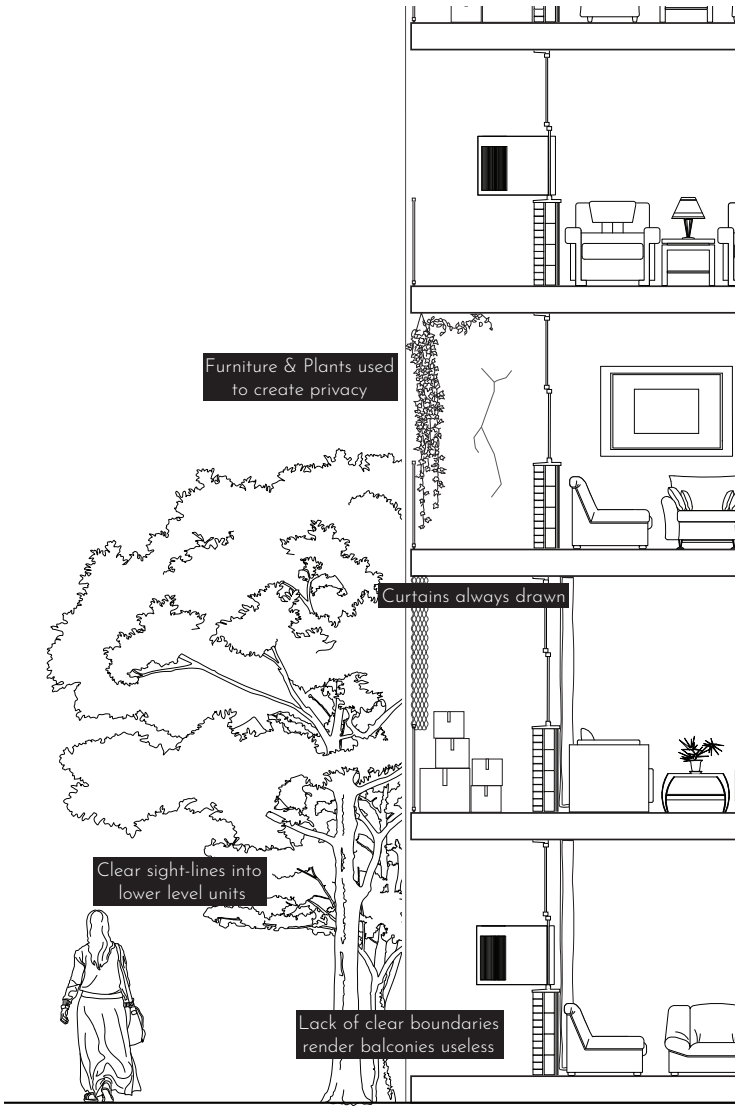




Fig 2.7 Top left. Ground-level residents informally encroach beyond private balcony space.

Fig 2.8 Bottom left. Ground-level residents do not use balcony space due to the lack of boundary between private and public space.

Fig 2.9 Right. Visual privacy concerns in lower-level units mapped on a building section.

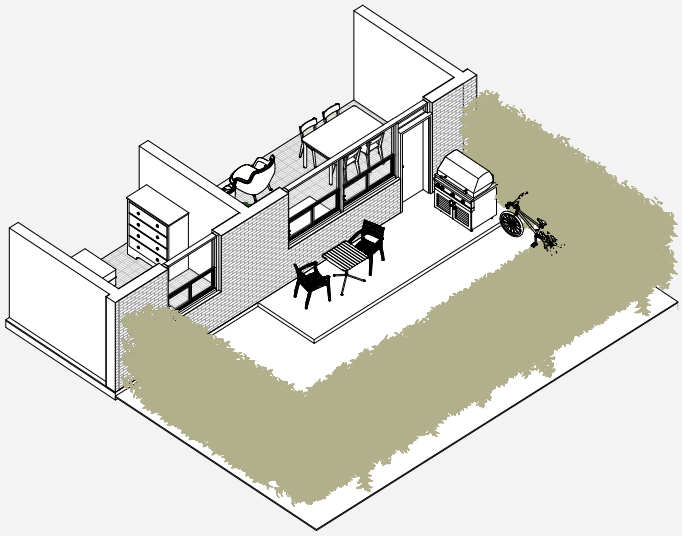


For residents to feel comfortable within their unit, a level of privacy needs to be maintained between their private space and outdoor public space. Providing visual privacy for lower-level units while maintaining access to daylight can be achieved through various measures such as fencing, vegetation, planter boxes, privacy screens, and shading devices. Clearly defining the public and private boundary for ground-level units will ensure residents can utilize their outdoor space without worry. These strategies will limit views into the lower units and their private outdoor spaces.

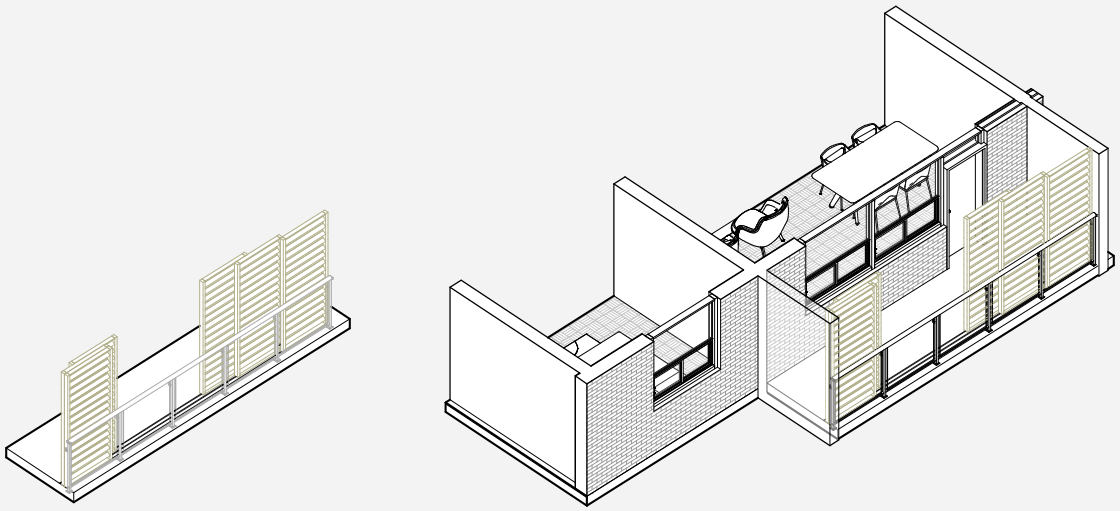
Fig 2.10 Top. Typical approach to maintaining privacy for ground-level units through the addition of hedges at the perimeter of the unit balcony.

Fig 2.11 Bottom. Typical approach to maintaining privacy for lower-level units (excluding ground-level units) through the addition of sliding perforated privacy screens on the balcony.

Add vegetation at the ground level balconies to give them privacy



Install perforated slider privacy screens to allow in sunlight



2.2.2 Lack of Places to Pause Within the Building to Interact

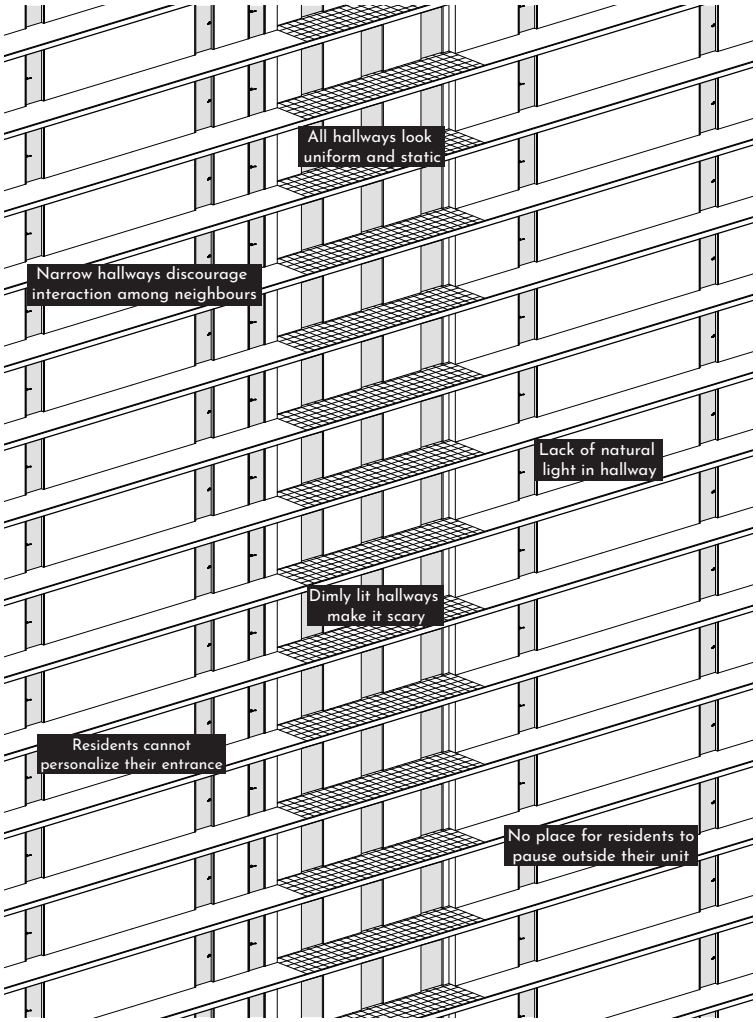
Context

The corridor in MURBs is often a narrow and dimly lit place, simply used as circulation, with no place to pause or connect with your neighbours like on a residential street. Poor lighting quality in common residential hallways not only compromises safety and creates a sense of fear in residents, but also discourages residents from conversing and engaging with one another.

Fig 2.12 Left. Typical corridor at 55 Emmett Ave, York.

Fig 2.13 Right. Issues of typical post-war tower corridors mapped on building section.





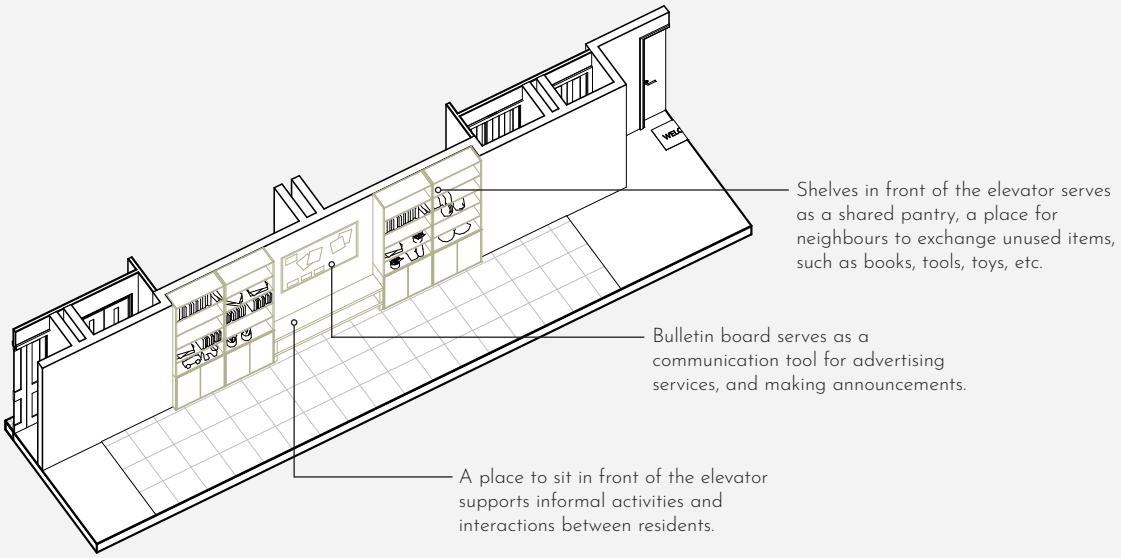
Transforming the corridor to have places for residents to pause intentionally can make the space livelier and act as a residential street. Creating a space in front of the elevator for residents to exchange conversations and items can also foster connections. Likewise, by recessing the front door of units, residents can set down their belonging before entering, helping to reduce outdoor pollutants. It will also enable residents to decorate and personalize their front entrance, bringing life to the otherwise dull corridor.

Fig 2.14 Top. Transformation of the transition space in front of the elevator to serve as a versatile communication system.

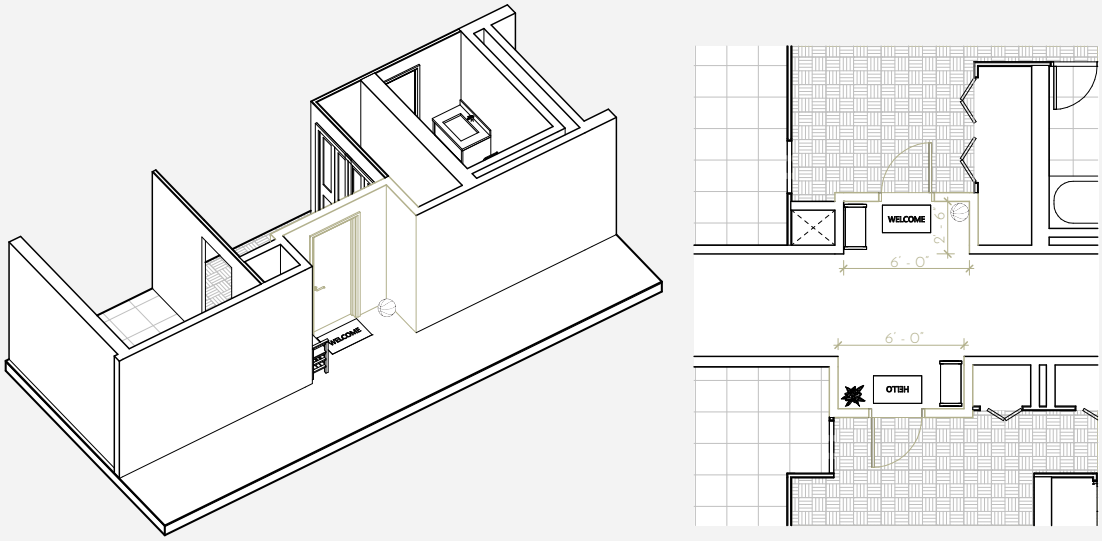
Fig 2.15 Bottom left. Typical approach to recessed unit front door (axonometric).

Fig 2.16 Bottom right. Typical approach to recessed unit front door (plan).

Introduce places to pause (in front of elevator)



Recess unit entrance to allow residents to personalize it



2.3 Active Design and Accessibility

Active design is one which promotes occupants to be physically active. Several studies have shown that physical activity lessens symptoms of mental and physical health conditions.[14] Physical activity has proven to reduce diseases, disabilities and premature death.[15] Physical activity comes in various forms, whether it is walking, exercising, or biking. To increase physical activity among occupants in MURBs, it is essential to pick a site that is close to work, school, parks, public transit, and local shops; this encourages residents to walk more and rely less on cars. Additionally, designing circulation spaces (corridors, and stairs) to be more attractive, can also promote indoor physical activity.

Equally, housing design must accommodate accessible spaces for physically disabled individuals or wheelchair users. Numerous guidelines exist to design accessible spaces, in addition to, the Ontario Building Code, but some key concerns include, accessible circulation spaces, accessible balcony spaces, lowered window-sill heights for views, and glass balcony railings for views. Incorporating these design considerations can help physically disabled individuals and wheelchair users to remain active. The Tower Renewal Partnership has retrofitted 20 percent of the unit in the Ken Soble Tower to be barrier free for senior residents.[16] Although this may not be possible for all buildings, retrofitting some percentage of units to be accessible, would better serve the elderly residents.

While the Tower Renewal Partnership promotes active design through improving walkability within the neighbourhoods and animating spaces to encourage physical activity[17], various MURBs are not design to active and accessible spaces to all. Enhancing these spaces to be inclusive, safe, and attractive, can help promote an active, engaging and healthy lifestyle among residents.



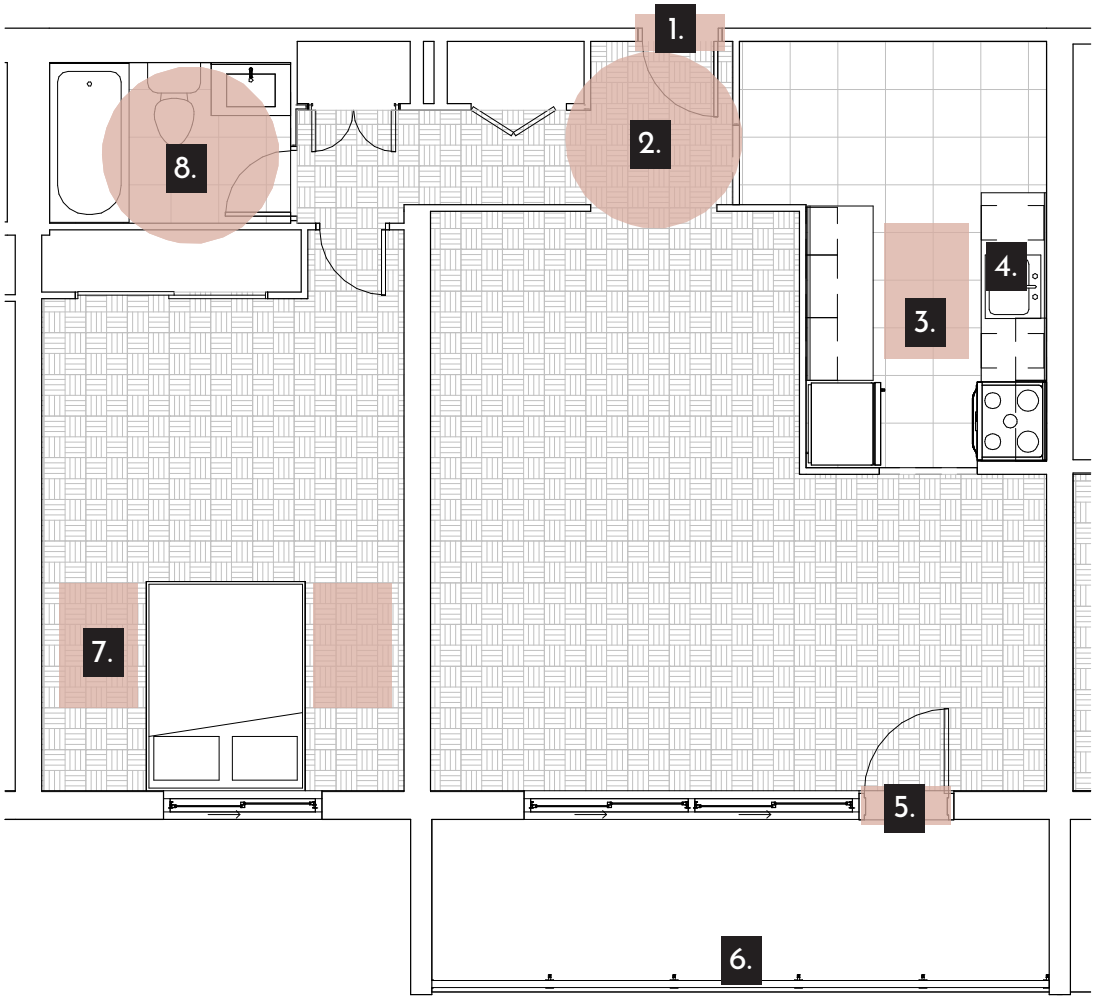
Fig 2.17 Accessible building entrance of 1440 Lawrence Ave W, North York.

2.3.1 Lack of Accessible Units in the Building

Context

Several communal and circulation spaces are designed with accessibility in mind in post-war residential towers yet, many buildings still lack accessible units with the appropriate barrier-free dimensions. Taking into consideration the elderly population that resides in these buildings, retrofitting a percentage of units to be barrier-free, can better serve the elderly population in these buildings.

Fig 2.18 Typical one-bedroom unit floor plan at 55 Emmett Ave highlighting lack of accessibility.



1. Inaccessible main entrance door - minimum 860mm clearance required (CSA 5.2.1 & 7.3.2)

2. Inadequate turnaround diameter in front of main entrance

3. Adequate clear floor area of 800mm x 1350mm (CSA 7.4.4)

4. Inaccessible counter/sink height (CSA 7.4.4.2)

5. Threshold step at balcony makes it inaccessible (CSA 7.3.2)

6. Metal railing blocks exterior view

7. Adequate clear floor area next to bed of 800mm x 1350mm (CSA 7.4.5.1)

8. Inaccessible bathroom clearance areas and no barrier-free fixture (CSA 7.4.3)

Many residents in post-war towers are elderly and require barrier-free access to navigate spaces. By incorporating barrier-free units into these buildings, elderly residents feel included and can remain active. Additionally, accessible units enable residents to maintain their independence and remain active within the community, enhancing their quality of life.

Fig 2.19 Typical accessible one-bedroom unit floor plan at 55 Emmett Ave.

Upgrade unit to meet the Canadian Standards Association (CSA) for accessible design



1. Minimum door clearance of 860mm (CSA 5.2.1 & 7.3.2)

2. Adequate turnaround diameter (1500mm) in front of main entrance

3. Open up kitchen for adequate clear floor area of 800mm x 1350mm (CSA 7.4.4) + turnaround diameter of 1500mm

4. Accessible counter/sink height of 860mm (CSA 7.4.4.2) + knee clearance under counter

5. No threshold step above 13mm at balcony makes it inaccessible (CSA 5.2.6) + 860mm door clearance

6. Glass railing to allow exterior views

7. Adequate clear floor area next to bed of 800mm x 1350mm (CSA 7.4.5.1)

8. Bathroom enlarged to accommodate clearance areas + appropriate barrier-free fixtures (CSA 7.4.3)

2.4 Summary

The principles discussed in this chapter highlight the importance of integrating healthy socio-spatial considerations into tower neighbourhoods. Connection to nature, nurturing community interactions, ensuring safety, and promoting active design and accessibility are crucial elements in creating environments that support both the physical and mental well-being of residents.

Current high-rise living often leads to social isolation, poor mental health, and a lack of community engagement. By rethinking the design of these spaces—improving access to nature, enhancing safety, and encouraging physical activity through thoughtful design—there is a significant opportunity to transform these living environments into vibrant, inclusive, and supportive communities. Creating spaces for interaction within the building can help foster a sense of belonging and community, overall leaving a positive impact on residents' social well-being.

These improvements require not only strategic urban planning but also overcoming existing regulatory barriers. As demonstrated by the Tower Renewal Partnership, there is a pathway to revitalizing these communities, but it will require rigorous efforts from policymakers, urban planners, and residents. The goal should be to create spaces where all residents can be supported and thrive, allowing them to feel safe and part of a community.

Endnotes

1 Ade Kearns et al., "'Living the High Life'? Residential, Social and Psychosocial Outcomes for High-Rise Occupants in a Deprived Context," Housing Studies 27, no. 1 (2012): 101 https://doi.org/10.1080/02673037.2012.632080.

2 MacDonnell et al., Vertical Poverty, vii.

3 MacDonnell et al., Vertical Poverty, x.

4 Stewart, et al. Toward Healthier Apartment, 37-38.

5 Stewart, et al. Toward Healthier Apartment.

6 Jo Barton and Mike Rogerson, "The Importance of Greenspace for Mental Health," BJPsych International 14, no. 4 (November 1, 2017): 79–81.

7 Stewart, et al. Toward Healthier Apartment, 20-24.

8 Tower Renewal Partnership. Thermal Comfort & Cooling in Apartment Towers. (Toronto, 2017), 10 – 11.

9 MacDonnell et al., Vertical Poverty, 86-87.

10 MacDonnell et al., Vertical Poverty, 96 – 97.

11 Statistics Canada Government of Canada, "The Neighbourhood Ties of Long-Term Residents in Lower-Income Neighbourhoods," June 7, 2023, https://www150.statcan.gc.ca/n1/pub/11f0019m/11f0019m2023004-eng.htm.

12 Stewart, et al. Toward Healthier Apartment, 30.

13 Stewart, et al. Toward Healthier Apartment, 30.

14 Jesper Krogh et al., "The Effect of Exercise in Clinically Depressed Adults: Systematic Review and Meta-Analysis of Randomized Controlled Trials," The Journal of Clinical Psychiatry 72, no. 4 (April 2011): 529–38, https://doi.org/10.4088/JCP.08r04913blu.

15 Baker and Steemers. Healthy Homes, 31-33.

16 Tower Renewal Partnership. Ken Soble Tower Transformation | A Case Study in Deep Retrofit and Housing Renewal. Toronto, 2020.

17 Stewart, et al. Toward Healthier Apartment, 36-34.

Chapter 3

Healthy Indoor Environment Principles

3.1 Natural Light

Natural day and night cycles have guided the evolution of most life on Earth. The human circadian rhythm is connected to cycles of exposure to natural light and darkness as any other mammal. The built environment does not always allow people to experience these natural cycles consistently. While many conditions are not in the realm of control of architects, the design of homes is and should be shaped to support the human circadian rhythms as much as possible. Light not only contributes to physical health but also provides people with a sense of safety and comfort.[1]

Daylighting research and studies have mainly focused on workplaces and their effect on employee productivity. However, daylighting also plays a critical role in residential spaces, significantly impacting residents' physical and psychological health. With the shift in home use post-pandemic and people using their homes as their workplaces, exposure to the natural rhythms of daylight is decreased. Adequate natural and artificial lighting is essential to creating a pleasant living environment that can enhance the quality of life.

In Multi-Unit Residential Buildings (MURBs), the challenge lies in balancing natural and artificial light to create optimal lighting conditions. This chapter explores the importance of both daylighting and artificial lighting in post-war residential towers built in the 1960s – 1980s, discussing their impacts on health and wellness, design strategies, and implementation challenges. As previously mentioned, the post-war towers built in the 1960s were designed for daylighting, but how effective are the methods used today? This chapter is structured to provide a comprehensive overview, beginning with the benefits of natural light, followed by artificial lighting solutions, and concluding with practical applications in residential buildings.

The Role of Daylighting in Health and Wellness

The biological environment affects people psychologically and physiologically, whether we are consciously aware of the exposure to light or not. One of the most significant benefits of natural light is its role in vitamin D synthesis. When the skin is exposed to sunlight, it stimulates the production of vitamin D and helps regulate the body's absorption and use of calcium and phosphorus, - crucial for normal development of bones and teeth.[2] Adequate levels of Vitamin D help prevent a range of illnesses, such as cancer, osteoporosis, diabetes, multiple sclerosis, and other immune system diseases.

Although there is no specific measure of how much vitamin D is required for healthy adults, the need for vitamin D photosynthesis can range from fifteen minutes to three hours a day, three to four times a week. The length of exposure is dependent on skin type, season, and geographic location. For reference, while even fifteen minutes of sun exposure for some people may be enough to produce vitamin D for days, dark-skinned may require longer than three hours of sun exposure to produce enough vitamin D.[3]

UV-A, UV-B, and UV-C

Before delving further into the effects of daylight, it is important to understand ultraviolet light. Ultraviolet refers to electromagnetic radiation within the UV spectrum, and can be divided into wavelengths.[4] There are three wavelength spectra, UV-A, UV-B, and UV-C. UV-C is the most dangerous and can burn the skin; however, it is entirely absorbed by the ozone layer. UV-B is responsible for stimulating vitamin D production, causing sunburns, and aging skin. Lastly, UV-A plays a role in darkening the skin and pigmentation.[5] This is important information as glass filters out about 95% of the UV-B radiation. Consequently, when people spend time indoors, the UV-B radiation does not even reach the skin. Therefore, the length of sun exposure stated previously, does not account for exposure through a window or glass.

In addition to vitamin D production, exposure to natural light during the day and darkness at night helps to maintain a healthy circadian rhythm. The circadian rhythm influences sleep patterns, brain activity, metabolism, hormone production, and behaviour.[6] Exposure to daylight results in the secretion of serotonin, which is responsible for our state of alertness, and in darkness or low light levels melatonin secretion increases causing drowsiness.[7] Disruptions to this cycle, caused by shift work, jet lag, and excessive screen time can lead to sleep disorders and other health problems.

Insufficient daylight exposure and a disturbance of the serotonin/melatonin cycle have consequences, such as seasonal affective disorder (SAD). Symptoms of SAD are characterized by drastic mood swings, low energy levels and depression.[8] This is more common during the winter season when the sun sets early and the days are shorter. Moreover, most people are indoors - at work or school - when the sun is out during the day. People living and working in windowless environments are at great risk of having a disturbed circadian rhythm, as they are not producing enough serotonin during the day and are suppressing melatonin production. Understanding the impact of natural light on physical health is crucial to ensure that effective daylighting strategies are incorporated into residential building design.

Artificial Lighting

Artificial lighting plays an indispensable role in our world today, from bedside lamps to city skylines. Artificial lighting reaches places where daylight cannot and sometimes even replaces daylight. This is commonly seen in the kitchens in MURBs, where artificial light is used even during the day due to the spatial organization. Artificial lighting allows us to extend our activities beyond daylight hours and transforms spaces to be cozy, inviting, and safe.

Artificial lighting used in workplaces has significantly changed how they are designed, permitting deeper floor plates

and using artificial lighting to illuminate the core of the building.[9] Fortunately, shallow floor plates in MURBs ensure that most of the living spaces receive daylight. However, as many individuals are active within their homes in the evening, it becomes unavoidable to rely on artificial lighting. Prolonged and intense exposure to artificial light is equivalent to saying that people are continuously exposed to blue light.

Blue light exists in both natural (the sun) and artificial lighting. Continuous and excessive exposure to blue light has a significant impact on health, including biological impacts on the circadian rhythm.[10] Additionally, exposure to blue light through artificial lighting (LEDs, TV, phones) can decrease melatonin production at night, resulting in lack of drowsiness and poor sleep quality.[11] Research has shown that dynamic light, mimicking daylight, has positive effects on mood and productivity compared to static lighting fixed at the same luminance.[12] Exposure to cool white light (3500K – 4100K) is recommended during the daytime as they are richer in blue light. During the evening and nighttime, exposure to soft white and warm white light (2700K – 3000K) is recommended, to reduce exposure to blue light emissions.[13]

The intensity and temperature of artificial light significantly influences productivity, alertness, and overall performance. The spatial distribution of light and colours of the ceiling, walls, and floor are also important contributing factors.[14] Using lighter coloured finishes and reflective colours allows the space to appear brighter. Although no study proves that greater illuminance equals better mood, there is a connection between lighting conditions and positive influence on cognitive task performance.[15] This thesis will not focus on improving artificial lighting in post-war towers, but it is still crucial to understand its health impacts. Nighttime exposure to artificial light is unavoidable, but individuals can control the types of lighting used in their homes.

Solar Control and Shading Devices in MURBs

Appropriate levels of natural and artificial light are necessary for good physical health, comfort and safety. Although floor-to-ceiling windows may look appealing in condominium buildings, they do not respond appropriately to the lack of daylighting in MURBs. Cladding residential buildings in all glass with no daylighting controls can cause issues for residents, such as overheating, excessive solar gain, and glare.[16] Curtain walls in MURBs also make it difficult for residents to furnish spaces.

One advantage of post-war towers is that they were typically designed with daylighting in mind. As a result, they are often surrounded by large open spaces and not overshadowed by other MURBs. Newly designed MURBs do not have this advantage. Usually, they are situated close to one another, casting large shadows on one another and the streets. In addition, all units lack privacy regardless of their level, forcing many residents to have their curtains drawn constantly.

Designing for daylighting is more challenging in MURBs as all windows are located on one plane, facing one direction, unlike single-family homes where the windows can be oriented in all directions. Therefore, controlling the amount of daylight entering a space is crucial. Windows should allow residents a view of the outside, let in sunlight while minimizing glare and solar heat gain, and providing residents privacy.[17] Shading devices can help combat these issues. Units which receive direct sunlight cause more discomfort to occupants compared to units which receive ambient natural light.[18] Shading devices can be fixed or operable, offering occupants flexibility to adjust it to their preference.

Summary

In conclusion, the research outlines the profound impact of natural light on the physical and psychological health of residents, highlighting benefits such as increased vitamin D synthesis, regulated circadian rhythms, and improved mood and

productivity. While artificial light can replace natural light, excessive exposure to blue light can disrupt the circadian rhythm. Therefore, it is crucial to balance natural light and artificial light in MURBs. New condominium buildings can account for appropriate daylighting exposure through passive strategies such as building orientation, window sizes and including lightwells. But existing MURBs need to be retrofitted to provide healthy exposure to natural light. Addressing concerns such as visual privacy, overheating, inadequate sunlight, and poor corridor lighting are fundamental to designing healthier living environments where occupants can control the natural light entering in their space.

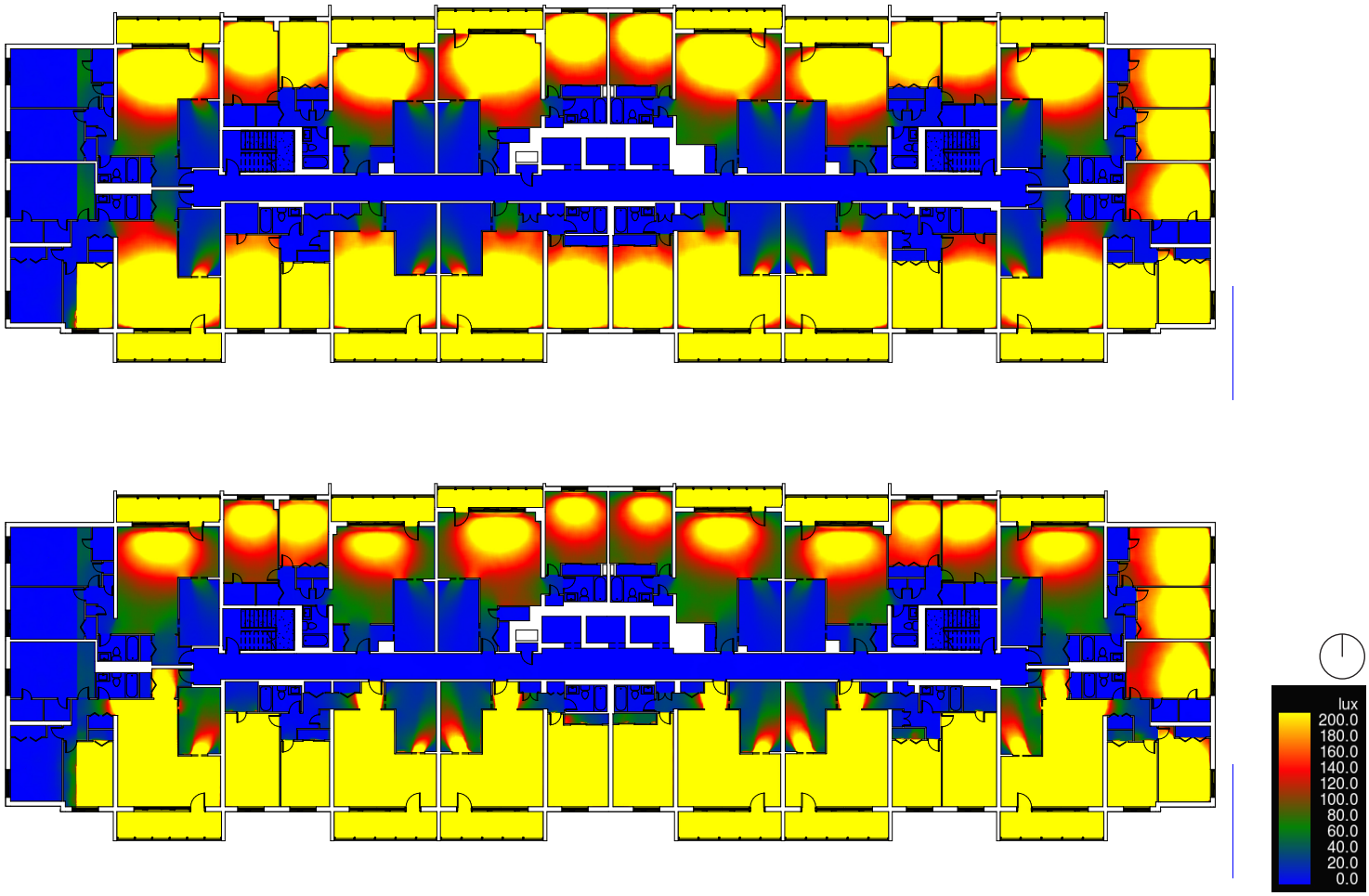
3.1.1 Issues of Overheating in South and West Facing Units

Context

Units located on the south and west sides of the building often experience overheating due to direct exposure to sunlight throughout the day. This can create uncomfortable indoor temperatures and encourage residents to keep their curtains drawn at all times or use furniture as a buffer and block sunlight from entering the unit. As a result, residents rely more on artificial lighting, as they can better control indoor lighting conditions. The current building envelope consists of single-glazed windows and minimal insulation, which also contribute to heat gain. Additionally, not all spaces require plenty of natural light, therefore varying levels of light is necessary to create a balanced environment.

Fig 3.0 Top. Daylight analysis of a typical post-war tower floor plan at 12pm on June 21 (Summer Solstice).

Fig 3.1 Bottom. Daylight analysis of a typical post-war tower floor plan at 12pm on December 21 (Winter Solstice).

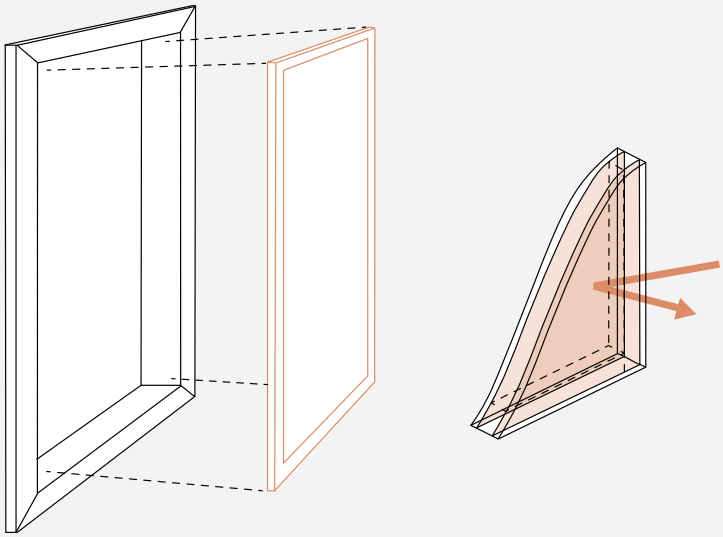


Upgrading the building envelope be the primary step to ensuring a more comfortable indoor environment. The Tower Renewal Partnership already proposes upgrading the entire building envelope, however, a targeted upgrade of the windows to double pane windows with low-emissivity (Low-E) coating will help to minimize solar heat gain. Furthermore, installing adjustable shades and louvres permits residents to control their indoor environment, maintain a comfortable temperature and tailor their living space to their preferences.

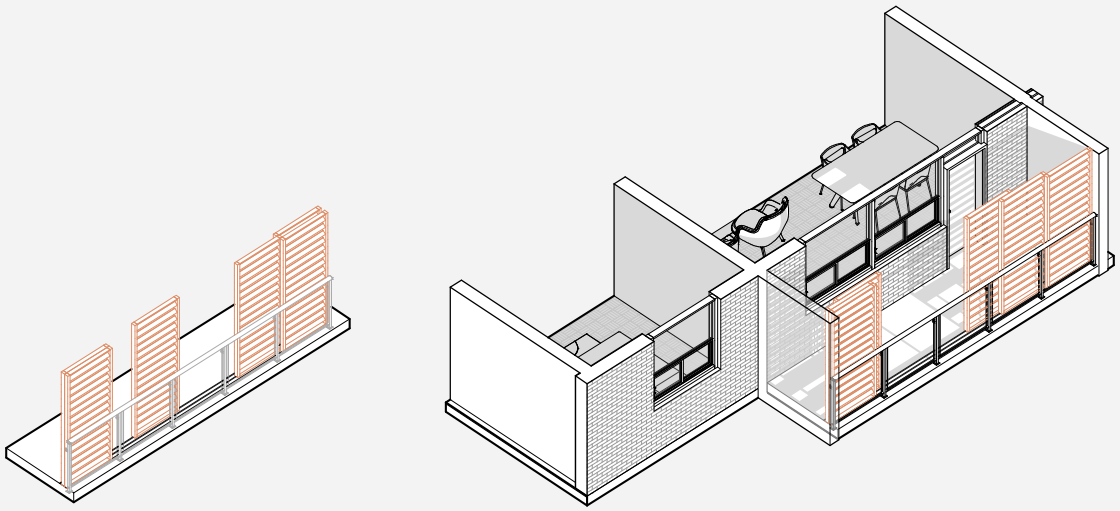
Fig 3.2 Top. Replace the windows in the existing openings with low-E coated double-glazed windows.

Fig 3.3 Bottom. Typical approach to shading south and west-facing units through the installation of sliding screens.

Upgrade single-glazed windows to double-glazed windows with low-e coating



Install adjustable shades/louvres to reduce solar heat gain



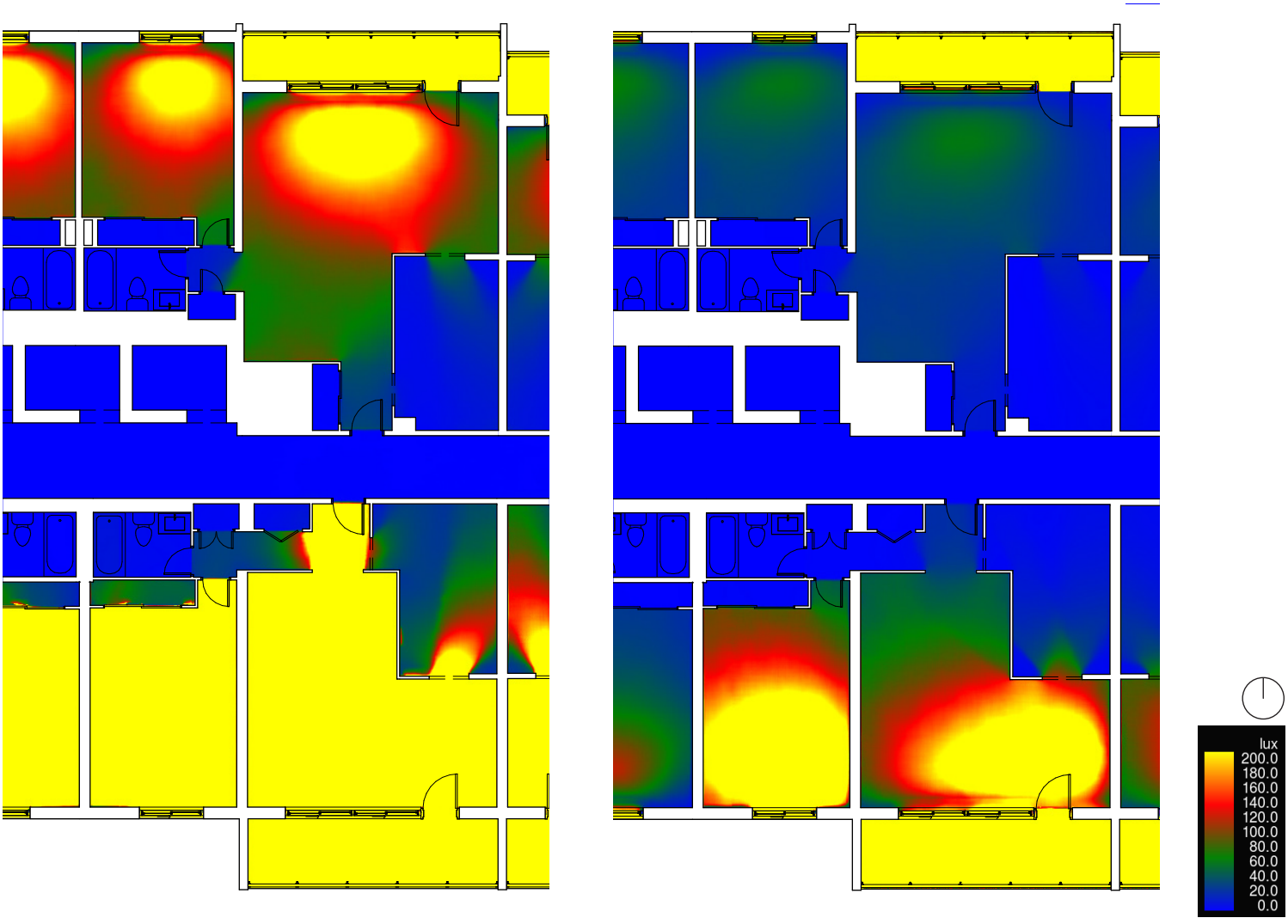
3.1.2 Increased Dependence on Artificial Lighting in Units Facing North

Context

The same strategies cannot be used on north-facing units as south-facing units, as both have different requirements. While south-facing units suffer from solar heat gain, north facing units lack direct sunlight exposure, resulting in dark interiors, with increased dependence on artificial lighting. Therefore, the north façade would not benefit from shading devices, rather it would benefit from an increased window-to-wall ratio.

Fig 3.4 Left. Daylight analysis of a typical north and south-facing unit plan at 12pm on December 21 (Winter Solstice).

Fig 3.5 Right. Daylight analysis of a typical north and south-facing unit plan at 5pm on December 21 (Winter Solstice).



Solution

Building orientation should be considered during the initial stage of the building design and units should not solely face north, as daylighting quality would be poor.[19] Some steps can be taken to increase ambient light entering the unit, such as increasing the window-to-wall ratio of units facing north. Additionally, reconfiguring the balcony space to be 'interior space' would prevent balconies from shading the unit below and allow residents to utilize the balcony space as a sunroom.

Fig 3.6 Top left. Reconfiguration of the balcony as interior space, and increase of window-to-wall ratio on the north facade.

Fig 3.7 Top right. Reconfiguration of the balcony as interior space, with dimensions.

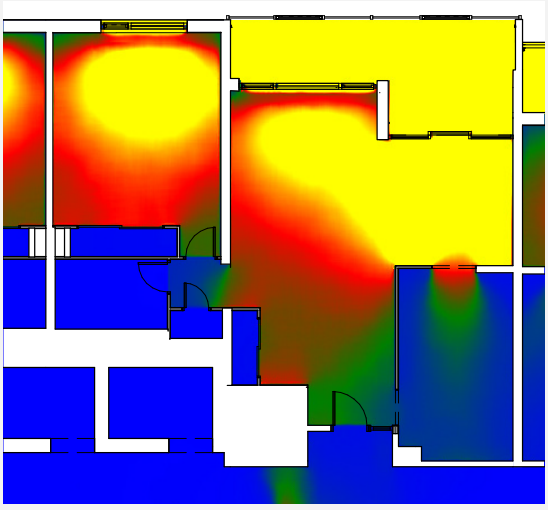
Fig 3.8 Bottom. Daylight analysis of north-facing units post-modifications at 12pm (left), and 5pm (right) on December 21 (Winter Solstice).

Reconfigure balcony to be interior space and increase window-to-wall ratio on the north facade





Daylight analysis





3.1.3 Lack of Natural Light in the Kitchen Due to Plan Organization

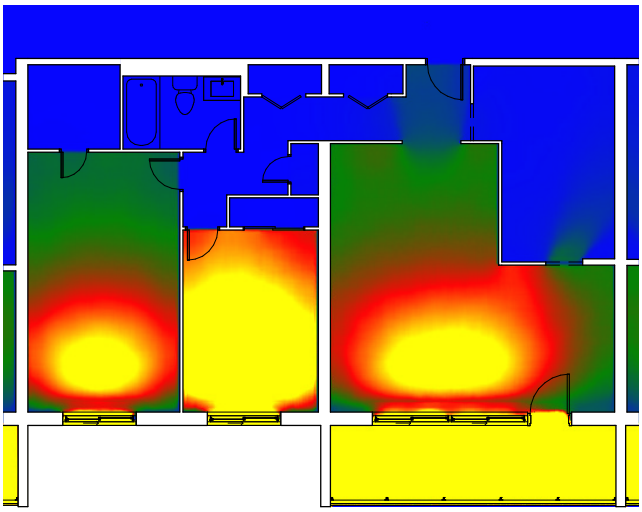
Context

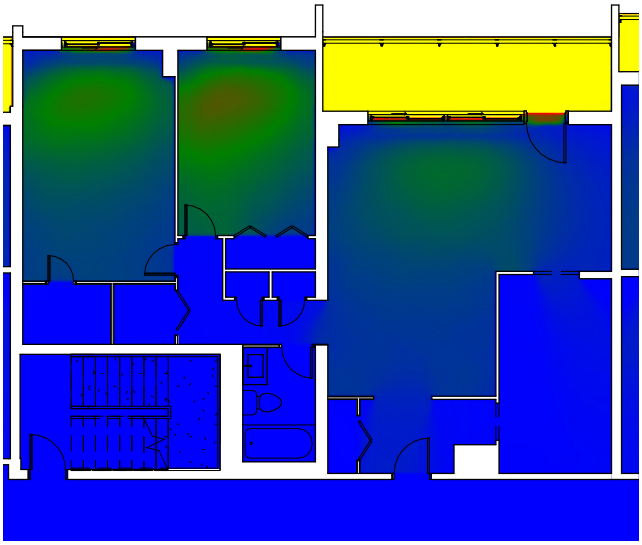
The spatial organization of the kitchen in many post-war residential towers limits the flow of natural light. The kitchen in most post-war towers is enclosed and separated from the living and dining space with a partition. While this separation is preferred in some cases, such as when hiding a messy kitchen from guests, it often results in a dimly lit space, with no natural light and dependence on artificial lighting.

Fig 3.9 Left top. Daylight analysis of typical south-facing unit at 6pm on June 21 (Summer Solstice).

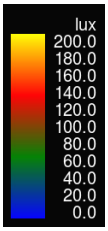
Fig 3.10 Left bottom. Daylight analysis of typical south-facing unit at 5pm on December 21 (Winter Solstice).

Fig 3.11 Right. Typical post-war tower kitchen at 1901 Martin Grove Road, Etobicoke.







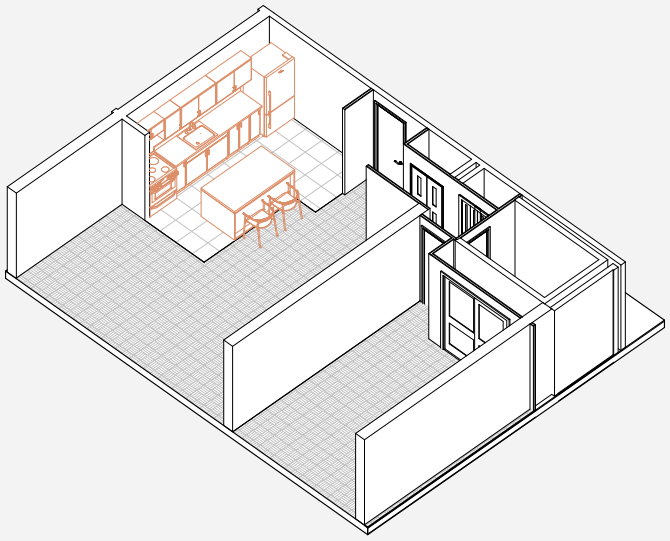


Renovating the kitchen area and replacing the partition walls with an island or peninsula would help to open the kitchen to more natural light. However, this would not maintain the current privacy the walls provide. To maintain the privacy and separation of the kitchen from other living spaces, sliding frosted glass walls can be installed to allow residents to modify their space as needed. The units in the post-war towers are quite spacious compared to newer condominiums, therefore these changes can be spatially afforded.

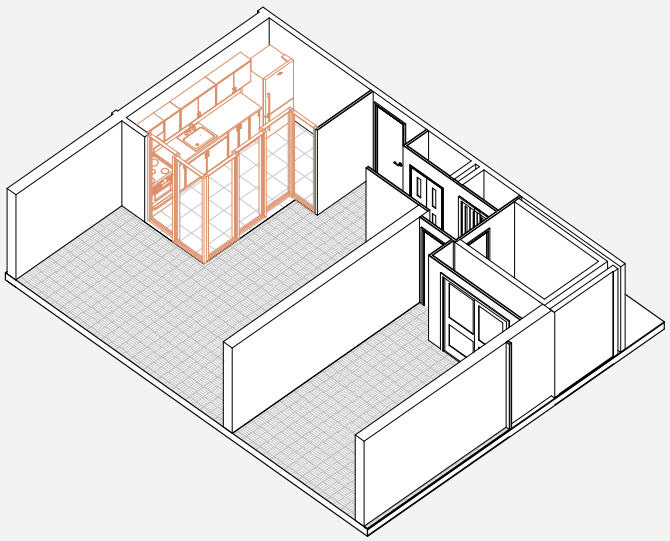
Fig 3.12 Top. Typical approach to open up the kitchen for improved daylight in the kitchen.

Fig 3.13 Bottom. Typical approach to open up the kitchen for improved daylight in the kitchen and introduce frosted sliding glass partitions for privacy.

Replace partition walls with island



Replace partition walls with frosted glass sliding partitions



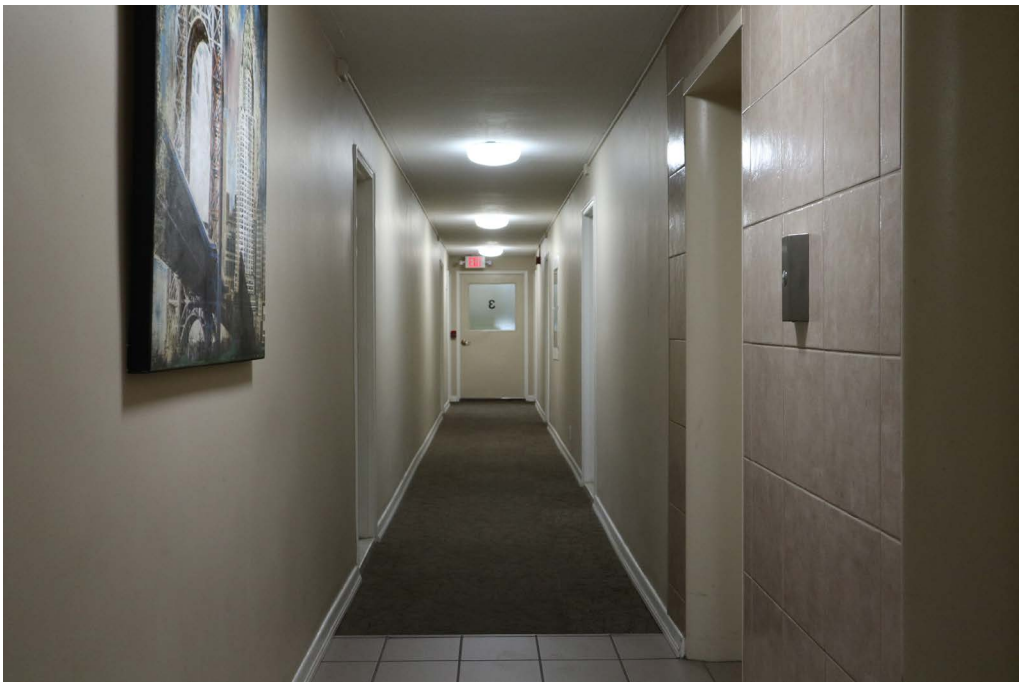
3.1.4 Lack of Natural Light in Common Corridors

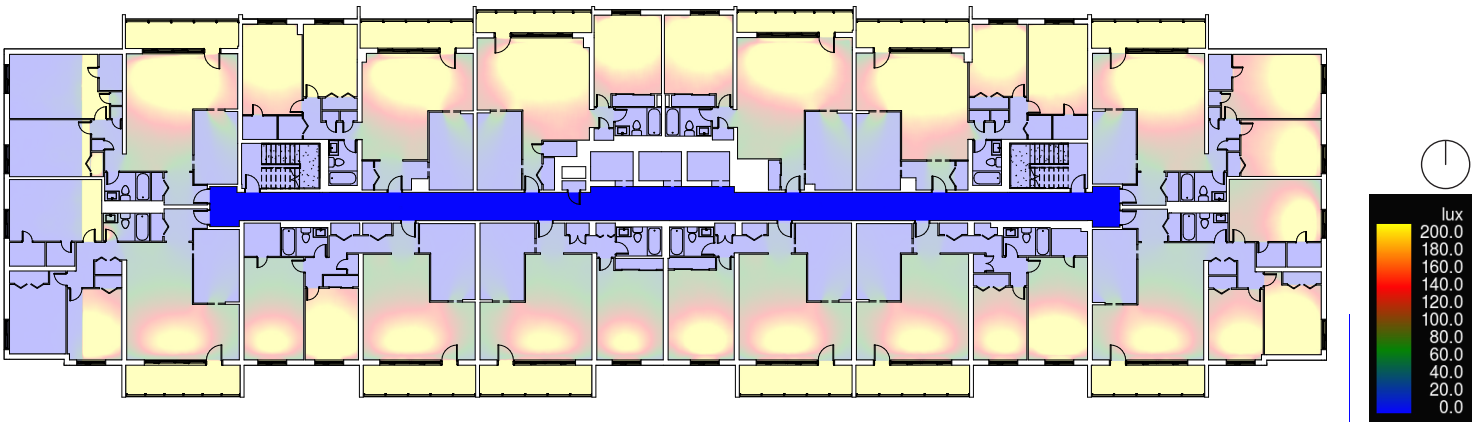
Context

Poor lighting quality in common residential hallways not only compromises safety and creates a sense of fear in residents, but also discourages residents from conversing and engaging with one another. Hallways in residential buildings are narrow, dimly lit and unprogrammed spaces, simply used as an efficient means of circulation. Introducing natural light within common hallways could create a more lively environment with movement as natural light alters the space. It can also create a sense of community by acting as a residential street.

Fig 3.14 Top. Typical impersonal hallway at 199 Roehampton Ave, Toronto.

Fig 3.15 Bottom. Daylight analysis of typical common corridor with no daylight access.





Solution

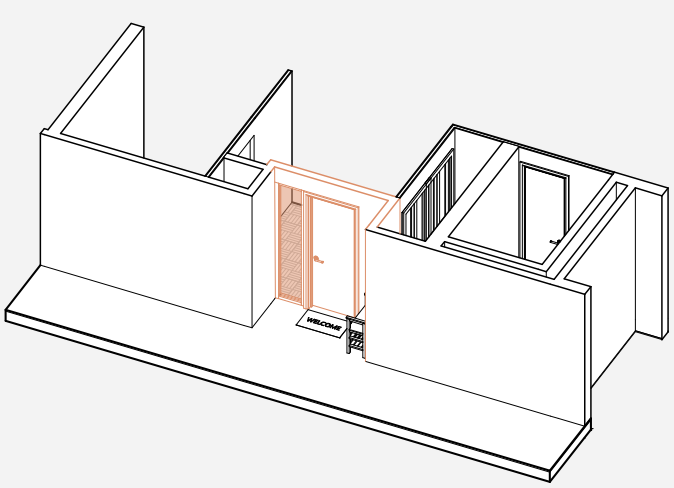
The corridor can be transformed into a place to be and pause, rather than a means of circulation, by flooding it with natural light. Adding a sidelite next to the front door of units would allow light into the hallway from the units. The sidelite can be frosted or clear with blinds allowing residents to maintain privacy. Furthermore, recessing the front door area will widen the corridor and provide residents with a place to drop their groceries, wet umbrellas and shoes before entering. This transitional space can be personalized, encouraging residents to engage with neighbours.

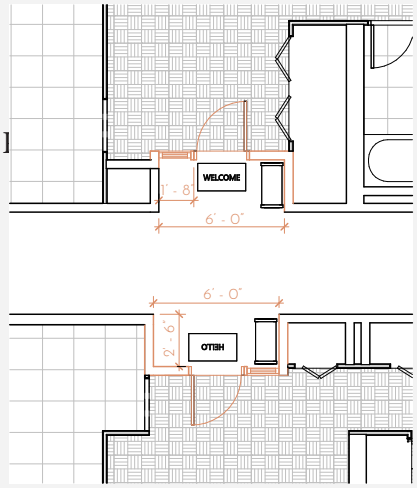
Fig 3.16 Top left. Typical approach to recessed unit front door with sidelite (axonometric).

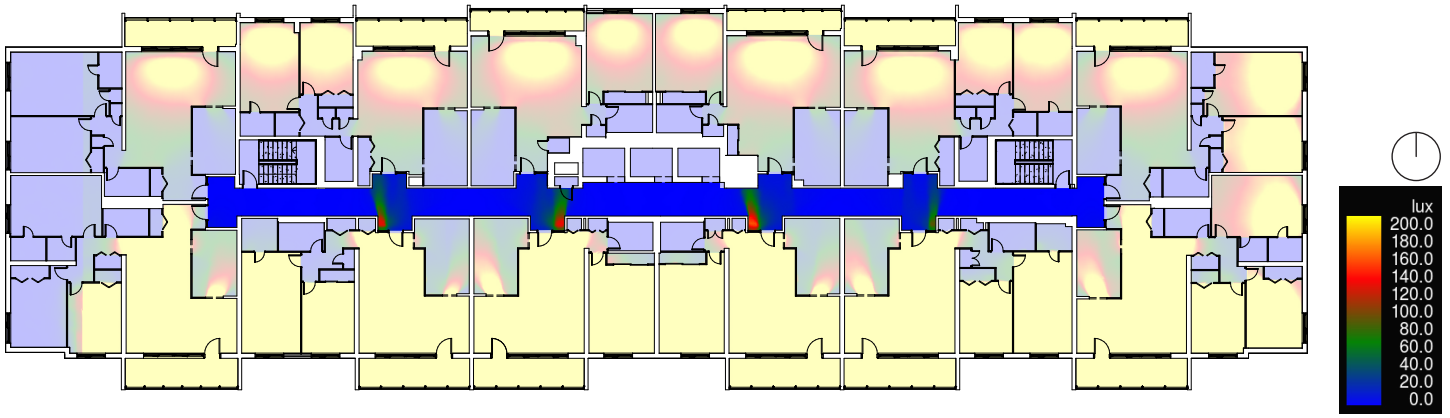
Fig 3.17 Top right. Typical approach to recessed unit front door with sidelite (plan).

Fig 3.18 Bottom. Daylight analysis of corridor post-modifications on December 21 at 12pm.

Recess and add a sidelite next to unit entrance







3.2 Thermal Comfort & Air Quality

The thermal environment is a crucial aspect of health and should be considered to create a comfortable and stimulating environment for occupants. During the design phase, passive design strategies can be implemented to leverage the climatic conditions and ensure a comfortable indoor environment. The thermal environment consists of more than just the air temperature, - it also includes indoor air quality, passive heating through sunlight (see section 3.1) and natural ventilation.[20] The cause of many problems in high-rise buildings stems from the interaction between air, moisture and heat.[21]

Being able to control and adjust one's environment to increase comfort is referred to as adaptive action – this includes the ability to increase or decrease the temperature and open a window for better airflow. This also includes making personal adjustments – through putting on or removing layers of clothing or changing your activity.[22] Both levels of adjustments are linked. If individuals are not able to control one or the other, such as not being able to open a window, it can create uncomfortable and possibly fatal environments. In workplace environments, individuals often do not have the autonomy to adjust their environments, and they can be hesitant to make personal adjustments.[23] However, within their personal space – such as their home – one has more autonomy to make these changes.

Toronto's post-war apartment towers are in desperate need of an upgrade to meet today's standards of thermal comfort. Minimal insulation, thermal bridging through the concrete balconies, and poor airtightness all contribute to inconsistent indoor environments and increased dependency on heating systems. The Tower Renewal Partnership has successfully acknowledged the issues of thermal comfort within these structures and has provided various solutions to resolve these issues to provide a more comfortable living environment.[24] Upgrading the envelope of the building is a significant step to resolving the issue of poor insulation. Another major suggestion made by the Tower Renewal Partnership is to

enclose and insulate the balcony, mitigating condensation and the risk of mould.[25] This section will explore the health impact poor thermal comfort and air quality have and strategies that can be used to mitigate these conditions.

3.2.1 Temperature

Ideal thermal comfort conditions vary for different people - while some might enjoy the warmth, others may not. Extreme temperatures have the most severe effects on vulnerable people – the elderly, the sick and the young. Severely high and low temperatures are linked to various health issues, ranging from minor discomfort to mortality. High temperatures during the summer can cause the body temperature to rise above 40 degrees Celsius, causing individuals to become dehydrated or get a heat stroke, which can lead to confusion/unconsciousness.[26] Low temperatures contribute to health issues such as poor respiratory and cardiovascular health, and social isolation resulting in mental illness.

Urban areas are more susceptible to issues with high temperatures due to the phenomenon of urban heat-island effect. The heat-island effect is the process of the sun heating buildings and paved surfaces throughout the day and gradually releasing this heat at night, which results in urban areas experiencing warmer temperatures than rural areas. Therefore, it is important to have green spaces and trees shading the paved areas to limit and minimize the heat-island effect.

Moreover, high-poverty areas are more vulnerable to these conditions as many residents do not have the liberty to control the temperature in their units.[27] A survey by the United Way Toronto revealed that approximately 50 percent of tenants in post-war apartment towers stated that their units are sometimes or always too hot, and with concerns of global warming these problems are expected to get worse if no action is taken.[28] To combat excess heat in units and control their immediate environment, some tenants have broken window locks to allow in more airflow, while others have taken it upon themselves to install window A/C units.[29]

It is essential to understand that the same thermal environment may not be comfortable for everyone. Various factors determine thermal comfort, including metabolic rate, clothing insulation, air temperature, radiant temperature, air velocity and relative humidity.[30] Additionally, different activities require different temperatures, such as a person exercising would feel more comfortable in lower temperatures than someone working at their desk or resting. Therefore, central temperature control is not always effective in satisfying all occupants.

3.2.2 Indoor Air Quality

Indoor air quality (IAQ) refers to the quality of air within and around building structures, relating to the health and comfort of occupants. Air also carries pollutants which can have health effects from single or repeated exposure.[31] Sources of indoor air pollutants include building materials and finishes (see section 3.3), household cleaning products, excess moisture, and outdoor sources such as outdoor air pollution and pesticides. In residential buildings, most indoor air quality problems arise when ventilation and airflow are reduced.[32] As a result there are, three general approaches to maintaining good indoor air quality can be applied; source control, dilatation, and mechanical filtration and extraction. By addressing the source of the issues, such as utilizing low-VOC materials (see section 3.3), indoor pollutants can be reduced. Using mechanical systems, such as air conditioning helps to recirculate air and extract pollutants.[33] Natural ventilation also plays a critical role in bringing in outdoor air and diluting pollutant concentrations.

Furthermore, airtightness is essential to maintaining a controlled and comfortable indoor environment. While an airtight building envelope will control air leakage and prevent cold drafts from windows or doors, it can also result in the accumulation of indoor air pollutants.[34] Therefore, it is vital to balance an airtight building and ensure adequate indoor air quality.

Impact on Health and Well-Being

Various indoor activities produce harmful pollutants. Activities such as smoking, cooking, and even cleaning all produce indoor air pollutants. Inadequate ventilation can intensify the pollutants created by these activities and cause the build up of harmful substances in homes.[35] Constant exposure to these pollutants presents various health risks to residents. Immediate side effects of exposure to pollutants include eye, nose, and throat irritation, in addition to symptoms of headaches, dizziness and fatigue. These effects are often short-term and treatable through eliminating the source of the pollution. However, these common symptoms are often difficult to categorize as a result of indoor air pollution.[36] Long-term effects of exposure to indoor air pollution include respiratory diseases, heart disease, and cancer, but it may take years to be noticed and can be fatal.[37] Hence, it is important to ensure good air quality in homes despite no obvious signs of poor IAQ. Emissions from traffic, landfills, and industrial areas, are considered outdoor air pollutants, which also contribute to poor air quality in homes due to proximity.

Humidity and Mould

Water is a deleterious substance – it can cause deterioration in buildings if it enters the building envelope and cause structural damage. Similarly, excess exposure to moisture and humidity can cause surface condensation and mould growth. A study revealed that approximately 20% of buildings show signs of dampness or moisture damage.[38] This damage is evident through water leakage, bubbles or discoloration of floor coverings and ceilings, and visible mould growth on surfaces. Issues of dampness are more prevalent in overcrowded homes without appropriate heating, ventilation or insulation[39] – all existent in the current post-war apartment towers. Damp indoor spaces are associated with indoor pollutants such as allergens (dust mites, and fungi), and bacteria growth (microbial

VOCs and viruses).[40] These pollutants all have negative health impacts on tenants, such as asthma development, respiratory illnesses, and coughing and wheezing.[41]

In MURBs, ventilation is often provided by a pressurized corridor, where air passes under the front door of the units. Unfortunately, this system is not effective, and occupants often complain of poor indoor air quality and discomfort.[42] Natural ventilation is driven by two forces: thermal buoyancy and wind pressure.[43] Natural ventilation often goes hand in hand with mechanical ventilation, creating a hybrid ventilation system. There are various rules of thumb when designing buildings to effectively use natural ventilation and reduce the use of mechanical ventilation, for instance providing openings (operable windows, or doors) on opposite sides of a home to ensure cross ventilation or using stack ventilation in tall spaces.[44] However, in MURBs units often only face one side and use single-sided ventilation, - except corner units facing two directions.

In post-war towers, tenants have reported issues with air quality, stating there are problems of stuffiness, airlessness in their buildings and foul odours coming from the corridor and garbage room. Residents often leave their front doors open while cooking in the winter to exhaust any smoke or smells due to the lack of an exhaust fan in the kitchen.[45] Additionally, tenants living on the lower levels near the outdoor garbage areas have reported that this area is often not kept tidy, and smell bad. This results in residents being hesitant to open windows for fresh air or use their balcony space, as the smell would enter their apartment. These situations create uncomfortable living environments for tenants, and basic maintenance can resolve these issues.

Summary

Addressing thermal comfort and indoor air quality is crucial for enhancing the living conditions in MURBs, especially in aging post-war apartment towers, where the mechanical system is outdated and requires an upgrade. In new construction buildings,

utilizing passive design strategies to ensure a good indoor environment, providing residents with the freedom to control their environment, and ensuring good mechanical systems ultimately lead to a safer and comfortable living environment. The Tower Renewal Partnership has extensively researched the topics of thermal comfort and air quality and has successfully identified the key issues that need to be addressed. They have also presented solutions to address these issues and implemented them in buildings. The Ken Soble Tower renewal project created a healthier living space for residents after retrofitting the building to exceed current standards.[46] Therefore, this section will simply implement the solutions provided by the Tower Renewal Partnership in the site selected for this thesis.

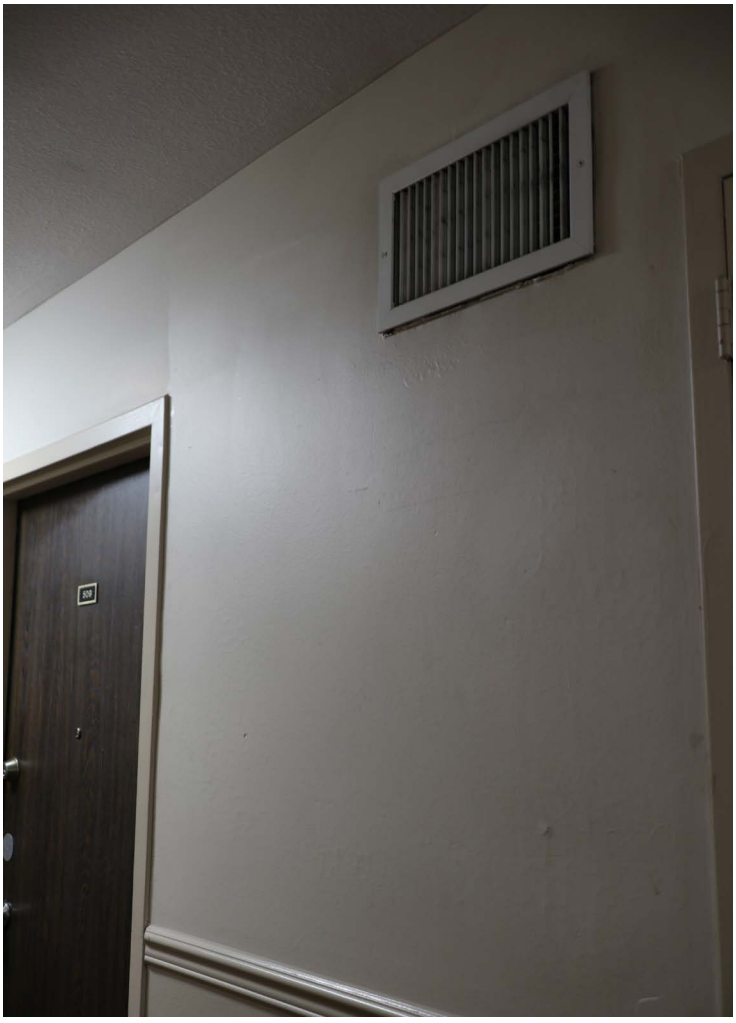
3.2.3 Lack of Fresh Air Directly Entering Units

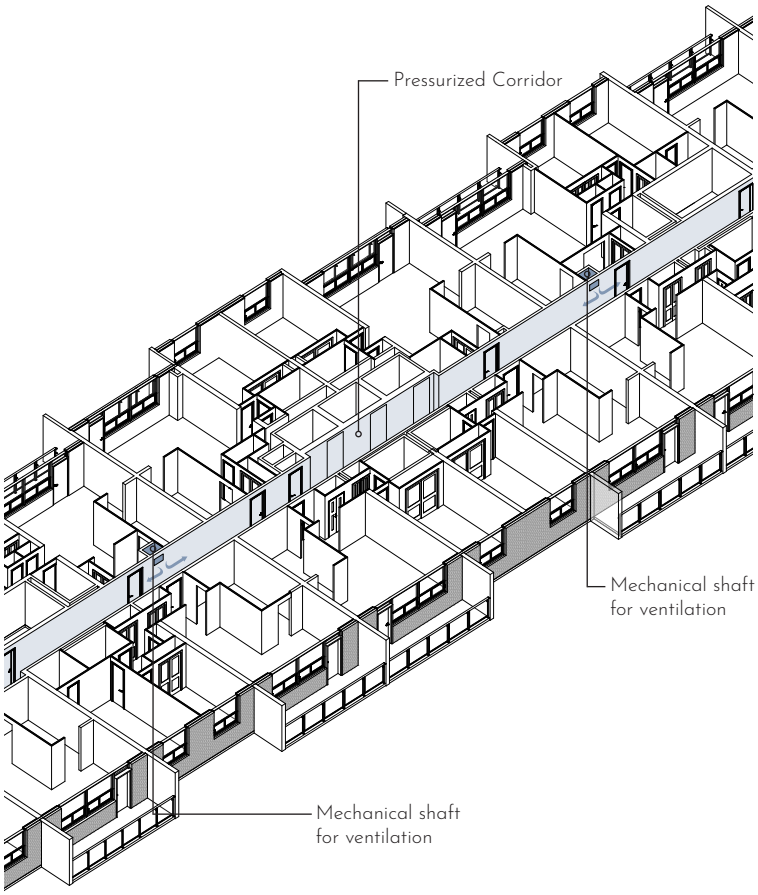
Context

Fresh air is often supplied through undercuts in the unit's front doors. Positively pressurizing the corridor drives fresh air into the unit. However, research has shown this is not an adequate or effective solution to delivering fresh air and units have poor indoor air quality. Additionally, this also drives foul odours from the corridor into the unit. Residents often resort to opening windows for fresh, which is acceptable but not always feasible based on weather conditions.

Fig 3.19 Left. Image of fresh air duct in corridor at 55 Emmett Ave, York.

Fig 3.20 Right. Airflow diagram in typical post-war pressurized corridor tower.

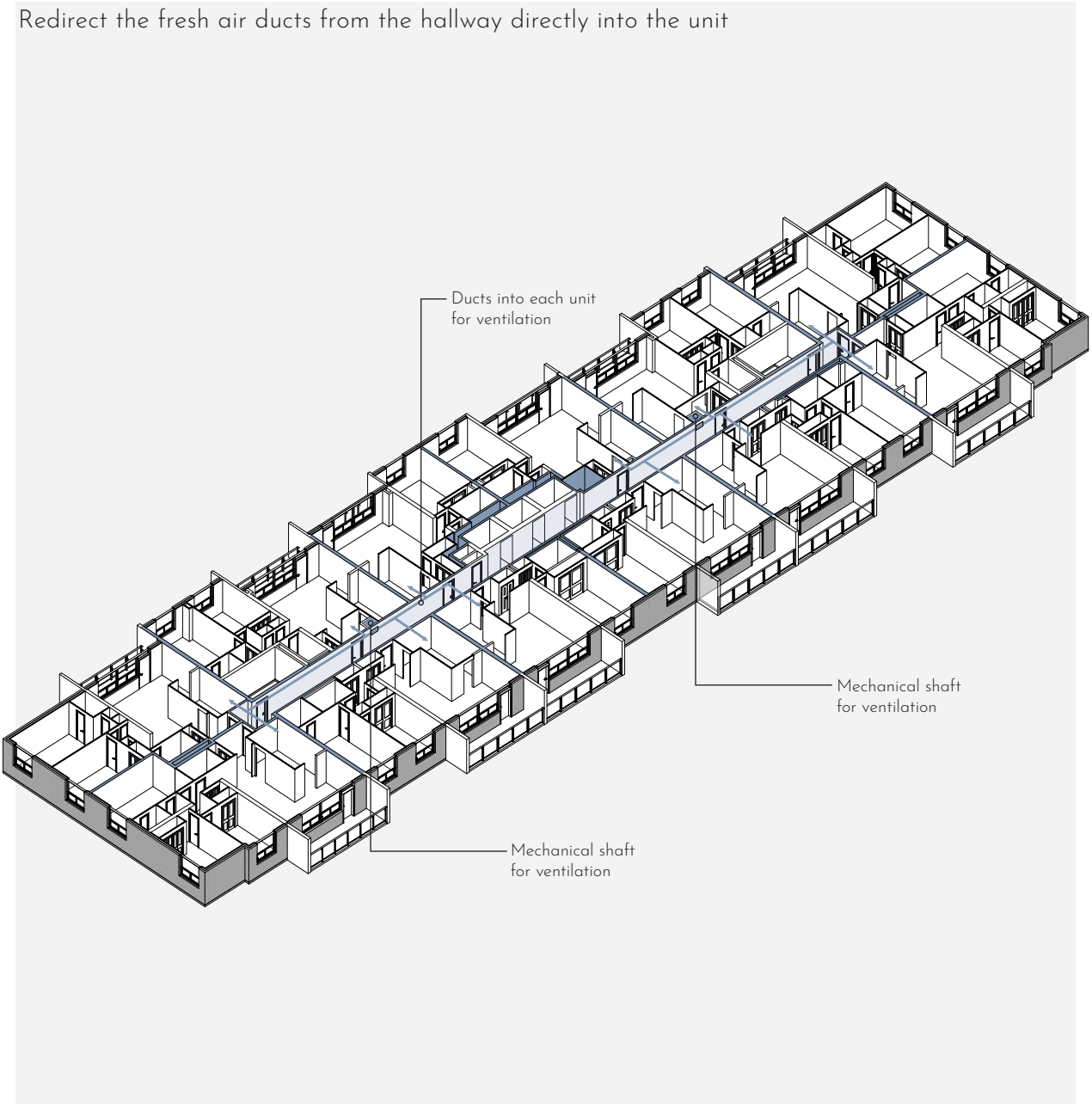




Solution

The Tower Renewal Partnership has provided a solution to this problem by directly supplying units with fresh air by redirecting the ducts from the corridor into each unit. This solves the issue of poor air quality within units and allows each unit to receive fresh without pollutants. It is important to note that why this is an effective solution, it reduces the floor-to-ceiling height in corridors.

Fig 3.21 Typical approach to redirecting fresh air through ducts into each unit.



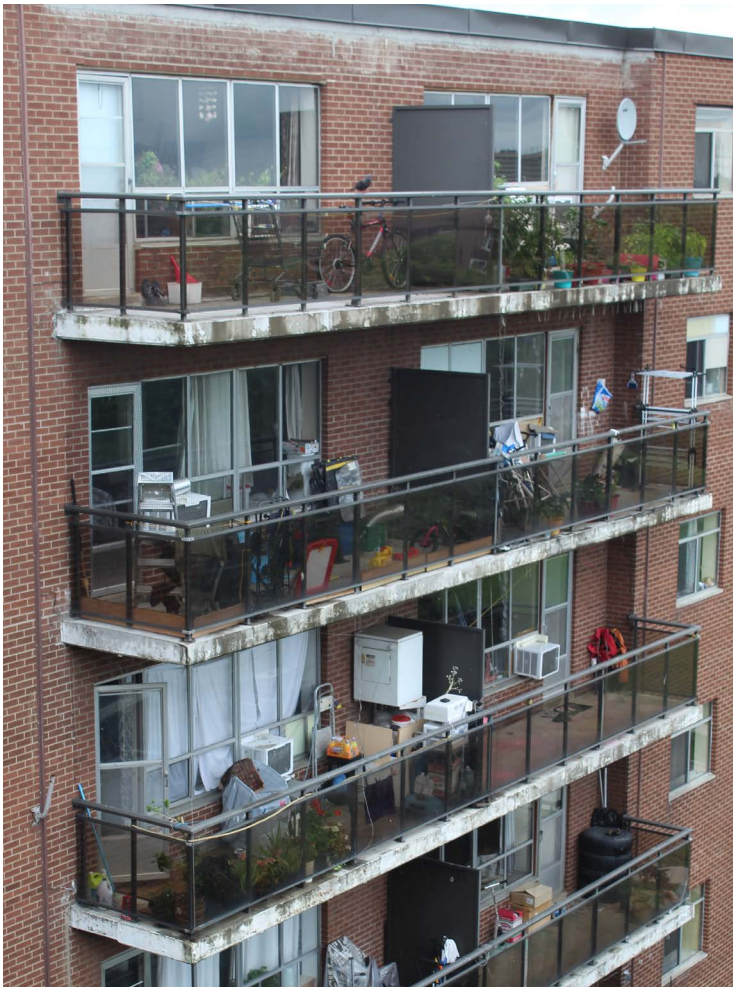
3.2.4 Thermal Bridging Through Concrete Balcony Slab

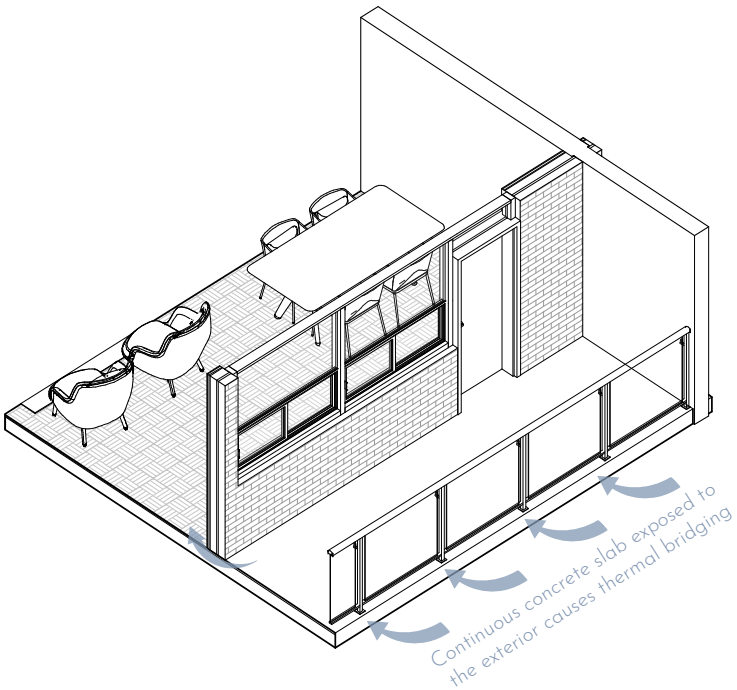
Context

Thermal Bridging is a major issue in post-war residential towers, as the concrete floor slab is exposed to the exterior conditions with no insulation. This causes fluctuations in the interior temperature, resulting in discomfort. Additionally, the temperature fluctuation often causes the adhesive below the parquet flooring to weaken resulting in the flooring popping up due to excessive moisture and humidity in the unit.

Fig 3.22 Left. Exposed concrete balcony slabs at 1901 Martin Grove Road, Etobicoke.

Fig 3.23 Right. Diagram demonstrating typical thermal bridging in post-war tower units.





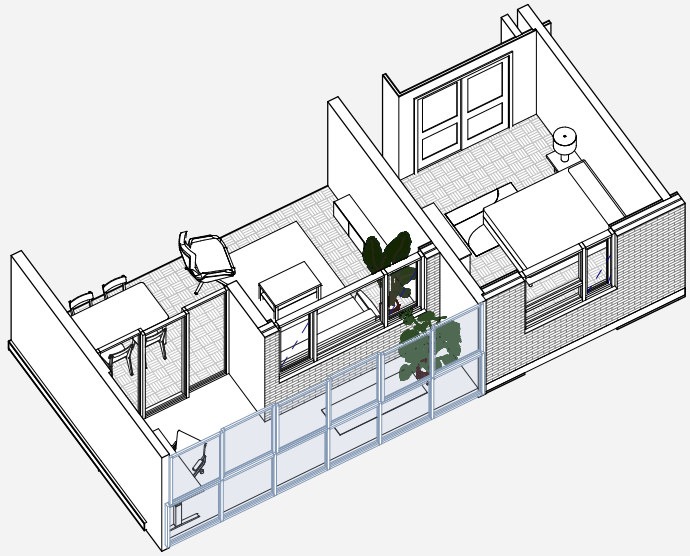
Solution

The Tower Renewal Partnership conducted thermal simulations and energy analysis to resolve the issue of thermal bridging, and condensation within units by adding insulation to the envelope and creating an airtight barrier. They have further proposed to enclose the balcony with an insulated glass curtain wall. This will ensure the concrete balcony slab is no longer acting as a thermal bridge. This solution not only resolves the issue of temperature fluctuation within the unit but also allows the balcony to serve as an extension of the living space.

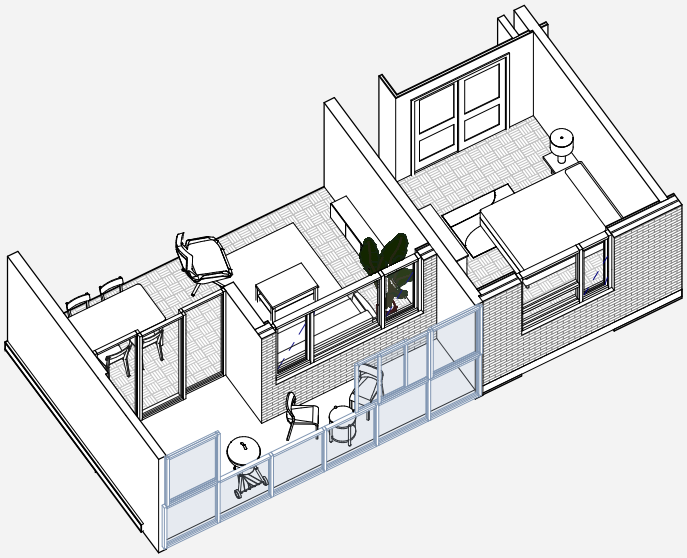
Fig 3.24 Top. Typical approach to resolving thermal bridging at the balcony concrete slab (winter use).

Fig 3.25 Bottom. Typical approach to resolving thermal bridging at the balcony concrete slab (summer use).

Enclose the balcony with an insulated wall - winter condition



Enclose the balcony with insulated wall - summer condition



3.3 Acoustics

Acoustics are critical in creating healthy multi-unit residential buildings, as they help foster healthy and harmonious living environments. Acoustics in multi-unit residential buildings study the sound transmission across shared walls, floors, and ceilings, directly influencing occupant comfort. In the context of healthy housing, effectively managing acoustics in densely populated settings is not merely about reducing noise levels; it's about creating living spaces that promote relaxation, ensure privacy, and support mental health. Research has shown that noise exposure significantly shapes human comfort and health. The term 'noise' is defined as an unwanted or unpleasant sound.[47] This implies that the listener would be annoyed or irritated by this type of sound. Such sounds in an urban setting would include traffic noise, construction, aircraft, or industrial noise. In MURBs noise from neighbouring occupants include speech, loud music, and general domestic activity. Moreover, natural sounds, such as birds chirping and ocean waves, are perceived as positive by most people.[48]

While random and uncontrollable events cause sounds and noise, managing the noise entering the dwelling can prevent occupants' discomfort. Research evidence has shown that unwanted sounds cause discomfort and annoyance in people, and nighttime noise, is linked to the risk of disease due to sleep disturbance.[49] Research shows that noise coming from occupants in the same suite and direct neighbouring units presents the biggest issue among residents. Furthermore, as the size of dwelling units shrinks in new development MURBs, noise and unwanted sounds cause more disturbances as occupants have to share smaller spaces (e.g., setting up workstations in living rooms).[50] By delving into the fundamentals of residential acoustics, this section highlights the necessity of sound management strategies in the pursuit of creating healthier, supportive, and nurturing living spaces.

Fundamentals of Sound in Homes

Noise travels between spaces in various ways. It is critical to distinguish between air-borne, structure-borne, and impact sounds to identify their sources and devise an effective mitigation strategy. Impact noise travels between rooms through structure (ex. walls, floors, columns), where the energy is delivered directly to the structure. For example, footfall on the floor above, a door slamming, or vibrations from machinery (ex. vacuuming in the unit above).[51] Air-borne sounds transfer energy to the air, such as speech, musical instruments, and domestic appliances (ex. blender). Another type of sound transmission is flanking sound. Flanking sound is when the sound takes an alternate route to pass around the primary partition.[52] Typical pathways of flanking sound would include through space above the ceiling, joints in a wall, floor, or ceiling, through windows, and under doors. When sounds travel through these methods, it can create poor acoustic conditions and acoustic dissatisfaction; especially in high-density developments where neighbouring unit windows are in close proximity, and units share demising walls, floors and ceilings.[53]

Sound absorption and sound insulation are also important key concepts. Sound absorption is most effective when placed in the same space as the sound source and the listener, such as curtains in the living room. Regardless, it is important to note that even good sound-absorbing material will only absorb approximately half of the sound energy. When a room does not have sound-absorbing surfaces, the sound reflects many times from the hard surfaces of the wall – known as reverberation. While reverberation can be beneficial in certain cases (ex. listening to music), it is not helpful in homes. Sound insulation separates a sound source from the receiver and reduces the sound energy as it passes through the structure.[54] Therefore, for an element to be acoustically well-insulated, it needs to be heavy, dense, and rigid; if the material is light, porous and fluffy, it will not be an effective sound insulation. These fundamentals will help to devise solutions to control and mitigate unwanted noise in MURBs.

Acoustic Challenges in Existing Homes

Acoustic challenges are inherent in existing MURBs; familiar noise sources in residential areas are categorized into two groups: outdoor and indoor sources. Outdoor sources include sounds outside the building (neighbourhood park, street, etc.). Indoor sources can be divided into systems and services, neighbours, and other occupants. Systems and services would include noises generated by the built environment, such as water installations, service installations, and HVAC. Noise from neighbours would come from adjacent units (through the floor, ceiling, and demising walls) and shared spaces (e.g. hallways and stairways). Lastly, noise from other occupants would include other household members talking and doing different activities.[55]

The selection of building materials and construction techniques significantly influences sound transmission in MURBs, affecting the privacy and comfort of residents. Problems often occur in the common circulation spaces, where the unit shares a wall with the corridor or staircase, and there are openings in that wall, such as doors, windows, and ventilation openings.[56] Post-war towers generally have parquet flooring (hardwood) adhered directly to the concrete slab, which has slightly better sound attenuation than bare concrete floors, or floors with ceramic tiles. Despite this, placing a resilient layer between the flooring and the concrete would significantly improve the impact noise transfer between units. In addition to the flooring, suspending the ceiling finish independently from the concrete slab can also offer more noise control between units.[57] Currently, typical ceilings have a putty coat directly applied to the underside of the concrete, offering no acoustic barrier. Furthermore, unlike new condominium buildings, the demising walls in post-war towers are not completely poured concrete. Portions of the wall between units are partition walls to allow for services and plumbing, through which noise travels easily.[58]

Evidence shows that the glazed surfaces are the most transmissive to sound. Therefore, positioning the glazed façade away from busy streets and noise sources is a good solution to prevent noise infiltration into units. Consequently, when windows face noise sources, occupants are less likely to use the windows for ventilation, resulting in issues of overheating and poor air quality (see section 3.2.2).[59] While it is not possible to ensure all windows can face away from noise, it is essential to provide occupants with alternative windows to ensure they are operable for ventilation. In summary, building construction greatly influences noise levels and allows environmental noise to enter the building.

Health Implications of Poor Acoustics

Poor acoustical environments contribute to deteriorating health. While only a small percentage of people experience severe health effects from noise exposure, a larger percentage experience feelings of discomfort or stress. Environmental noise causes both acute and chronic health consequences.[60] Recent studies have shown that exposure to transportation noise (e.g. traffic) hinders health in several ways and is linked to sleep disturbance and hypertension. Studies have also demonstrated that constant impact noise can create uncomfortable environments for occupants in adjacent spaces. Noise can also cause feelings of insecurity when privacy is not maintained, and conversations can be heard in adjoining rooms.[61] A survey outlines the effect of noise issues in multi-unit residential buildings during the lockdown. While traffic noise decreased during the lockdown, indoor noise sources increased and caused more annoyance among occupants during the lockdown; impact noise was reported as the most annoying, followed by airborne noise through floors/ceilings and walls.[62] While these noises affected work and study, it also affected resident's sleep and mood.[63]

While these results were taken during the pandemic, when most people were forced to stay home, many still work from home and face similar issues daily. Noise interferes with cognitive processing and can be damaging to both mental and physical

health. Noise influences the central nervous system, leading to emotional stress, anxiety, and cognitive and memory defects.[64]

Noise monitoring in Toronto revealed that noise levels in Toronto are above the World Health Organization's limit for both daytime and nighttime exposure.[65] Furthermore, lower-income populations are more likely to be exposed to elevated noise levels than people with higher incomes. Resolving the issue of noise can help with creating less disturbances and better relations among neighbours in MURBs, in addition to improving occupant comfort through critical listening, memory retention, speech projection and privacy.[66]

Summary

There are several practical design solutions to enhance the acoustic environment in MURBs. Beginning with thoughtful planning in the design stage, and creating acoustical zones, organizing spaces becomes easier. The acoustical zones can be categorized based on their intended use - quiet zones for focused work, and rest, loud zones for social and recreational spaces, and flexible zones for collaborative spaces.[67] Considering acoustics early in the design process can help to strategically orient the building, consider land use and mitigate environmental noise infiltration. Consequently, this will help select appropriate construction materials to minimize sound transmission during the design development and construction phase. Although this process is beneficial for new construction buildings, existing MURBs would require retrofits to achieve acoustic separation.

To conclude, maintaining quality acoustics in Multi-Unit Residential Buildings (MURBs) is critical to creating healthy, and comfortable living environments. Understanding the challenges occupants face, how sound works in MURBs, and the impact of building materials is the first step to addressing the issues of acoustics in these environments. Improving acoustics within the

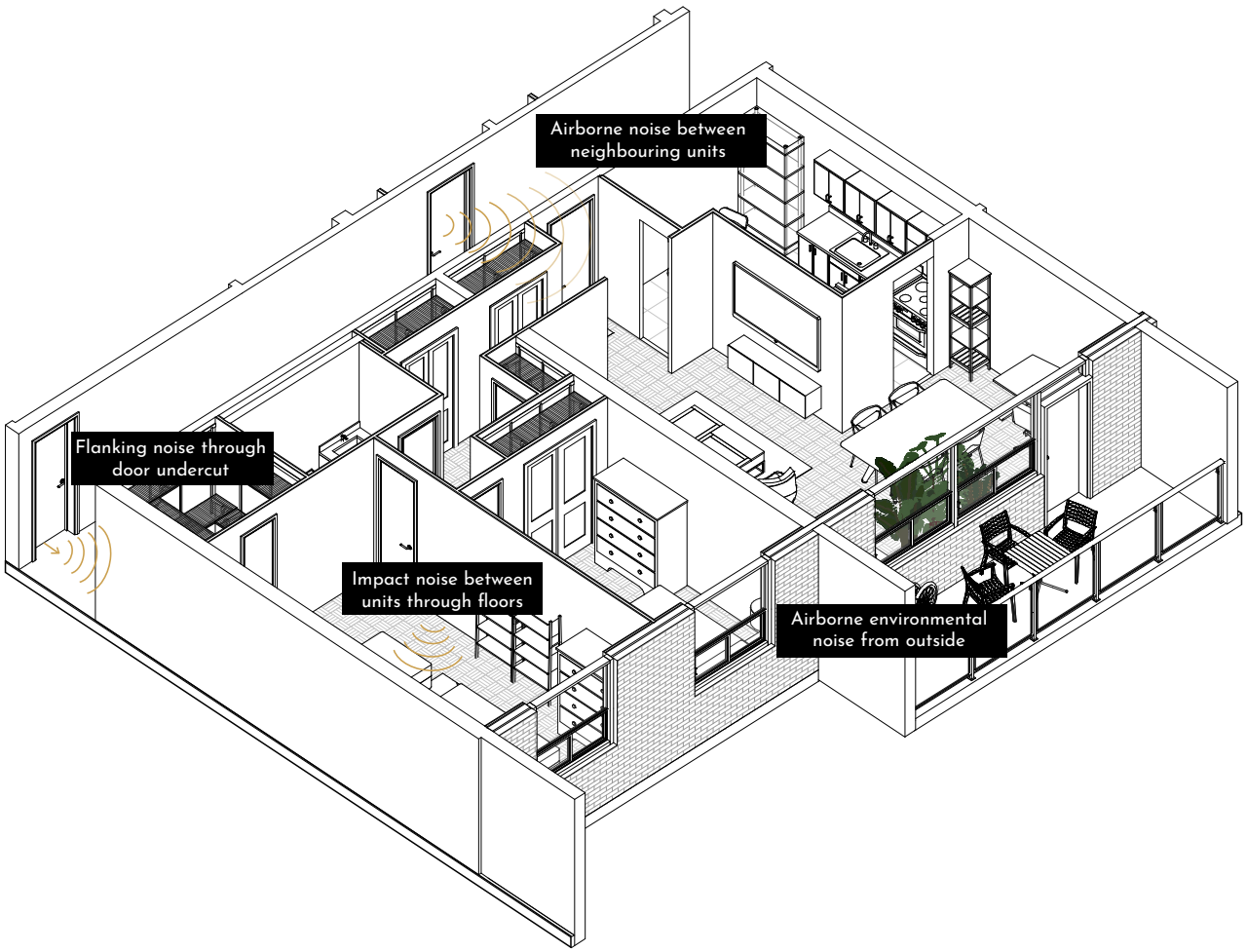
building would reduce annoyance, and foster quality connections among neighbours. Improving outdoor noise environments will also reflect on the overall community by promoting an active lifestyle and reducing overall transportation noise levels.[68] Ultimately, planning for good acoustics in the initial design stages of a residential building reduces frustration, stress and the need for occupants to use DIY solutions.

3.3.1 Lack of Noise Separation Between Units and Communal Spaces

Context

While concrete is a good soundproofing barrier, it still transfers impact noise between units, causing disturbance among neighbours. The demising walls in post-war residential towers are not continuous solid concrete walls, therefore residents can normally hear their neighbours in their units. Moreover, the undercut in the unit's front doors meant for fresh air often allows sounds to travel from the unit to the corridor and vice versa. This sound transmission between units is a concern for many residents as it risks privacy in their own homes.

Fig 3.26 Existing sound transfer routes between units and common spaces.

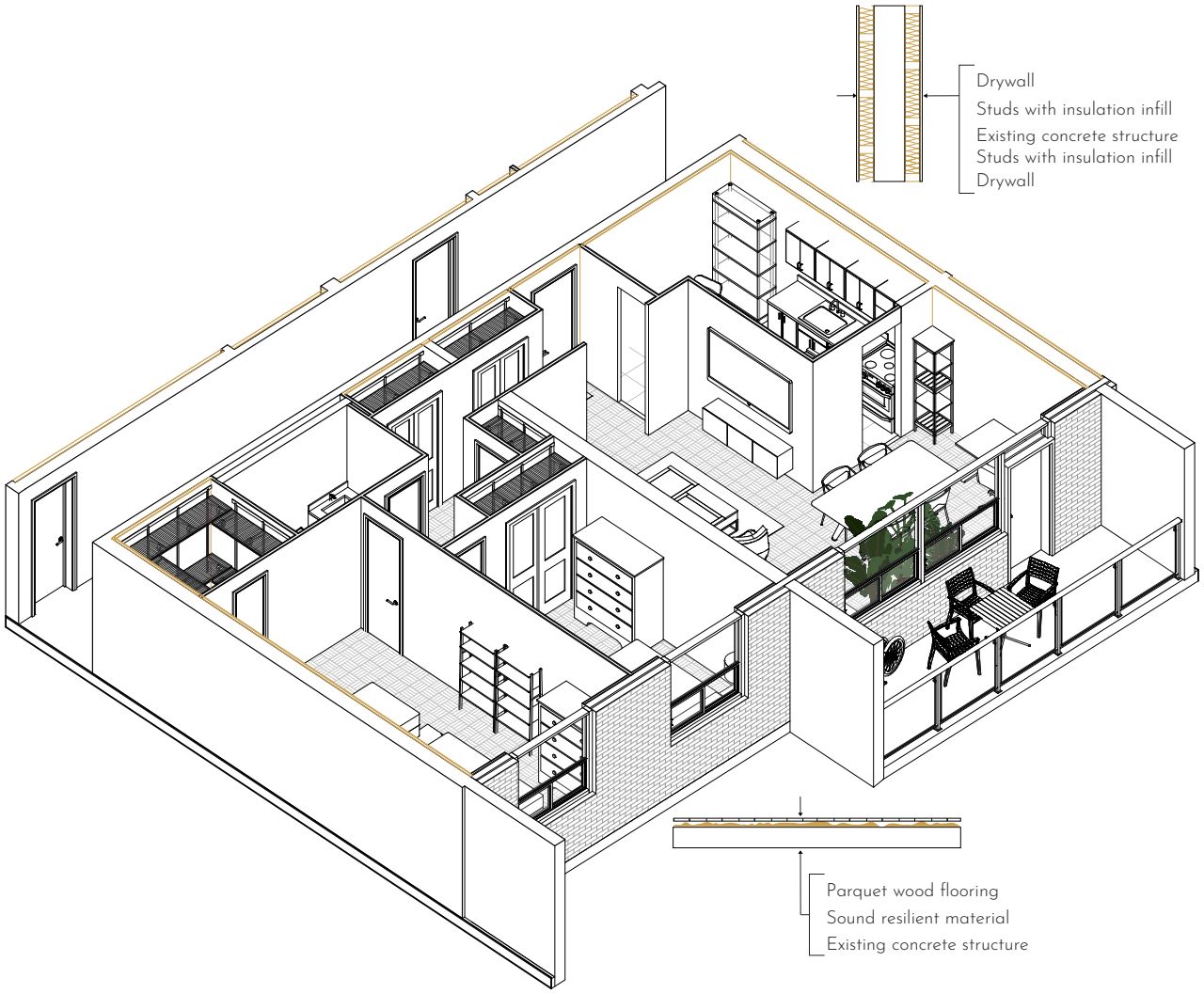


Solution

To address the issue of sound transmission in post-war residential towers, the demising walls and floor assemblies need to be improved. Adding a layer of sound-insulating material on the demising walls can significantly reduce noise transfer between units. Additionally, the impact noise on floors can be mitigated by installing a resilient sound attenuating layer between the floor finish and concrete slab. Implementing these measures can significantly improve the acoustic environment within units and maintain occupant privacy.

Fig 3.27 Improving existing wall and floor construction assemblies to limit sound transfer between units and common spaces.

Improve the acoustic environment by adding sound resilient material in the floor and demising walls.



3.4 Materials and Finishes

The choice of building materials can impact the environment, and simultaneously influence human perception of a space. As people spend approximately 90% of their time in their homes, they are three times more likely to be exposed to chemicals in their homes than in other places.[69] In addition to building materials, there are various toxic chemicals present in our finishes, from paints to sealants to stains that release harmful chemicals. Some of the most common elements found in housing materials include volatile organic compounds (VOCs), mould, asbestos, lead, combustion gas, and particulates.[70] Although most of these are less common in new construction, it's essential to know how to address them when retrofitting existing residential structures.

While materials containing lead and asbestos are no longer extensively used in building materials, it is important to note that post-war residential buildings are not up to code and were built in a period where lead, asbestos and phthalates were still used in building materials. Constant exposure to these contaminants may have a significant impact on health. Especially as these buildings age and materials deteriorate - residents are exposed to these contaminants.

In addition to the physical effects of material deterioration on health, the appearance of materials as they age also have an impact on occupant well-being. The lack of maintenance provides the impression of a neglected building, causing residents to feel embarrassed, afraid and possibly sick. Material choices are very closely linked to indoor air quality as particles present within the home can make individuals sick and can be difficult to diagnose (see section 3.2.2). Adequate ventilation can remove these particles from our environment and reduce indoor pollution. This sub-chapter will focus on the impact of the aging building on resident health, low-emitting and non-toxic materials, and maintenance.

Common Materials and Finishes in Post-War Buildings

Despite having a combination of floor plates, post-war buildings share similar materials and construction strategies. These structures primarily use poured concrete and shear wall construction for durability and fire resistance, with some gaps in demising walls to install services and plumbing.[71] Brick is commonly used to clad these buildings, with 4-inch concrete blocks running from slab to slab. This provides a low-maintenance material that can last decades with proper care and upkeep. The windows are single-glazed with metal frames, and the balconies are protected with metal railings.

The interiors of the buildings utilize similar materials, with painted plaster walls throughout the common areas and hallways. The hallways are carpeted, except for tiled sections in front of the elevators. Within the units, parquet flooring is directly adhered to the concrete slab in the living space and bedroom, while tiles are installed in the kitchen and washroom to protect against moisture. While the concrete structure and shear walls are still durable and in solid condition[72], the finishes within the buildings are deteriorating and pose a risk to occupants. Reports of mould, mildew, foul odors, and stuffiness have presented concerns related to living conditions within these buildings.[73]

Volatile Organic Compounds

Volatile organic compounds (VOCs) are organic compounds present in indoor and outdoor environments that are harmful to humans through inhalation. The impact of VOCs on human health is more pronounced indoors than outdoors.[74] The United States Environmental Protection Agency (USEPA) outlines various household sources that emit VOCs, which include paints, wood preservatives, aerosol sprays, pesticides, adhesives, furniture and furnishings, composite wood products and flooring materials.[75] Long-term exposure to VOCs can cause eye, nose and throat irritation, headaches, nausea and loss of coordination. It can also be detrimental to the liver, kidneys and central nervous system.

Signs of exposure to VOCs present themselves in various ways including allergic skin reaction, fatigue, dizziness, dyspnea and others.[76] Preventative measures to reduce high levels of VOCs in the home include removing the products that emit VOCs. If that is not possible, properly ventilating and increasing fresh air flow in the space can help reduce the concentration of VOCs indoors.[77]

There are healthier alternatives to materials containing VOCs, which include low-emitting adhesives, sealants and cleaners.[78] Various specifications can be found to help choose appropriate and healthier alternatives to toxic materials in construction. LEED for Building Design and Construction: New Construction encourages the use of environmentally friendly, economical, and socially preferable materials and provides a material ingredient list that complies.[79] In addition, the WELL Building Standard provides guidance on how to limit toxic material use in construction,[80] and the International Living Future Institute provides a 'Red List' of chemicals prevalent in construction that pose serious risks to human health and the environment.[81] Utilizing these resources can assist in selecting healthier material options and inform individuals on how they need to be maintained.

Health Impact of Aging and Degradation

The aging and degradation of materials in post-war residential buildings present significant structural integrity, aesthetics, and occupant health challenges. The post-war buildings are well over five decades old, or are reaching this milestone, and regular upkeep has decreased. Although the concrete skeletons of the buildings are still sturdy and in the early stages of their life cycle, the exterior masonry walls and infrastructure have reached their durability threshold.[82] Common complaints from tenants include disrepair in common areas, frequent elevator breakdowns, and pest infestations in units.[83] While elevator breakdowns are unpredictable and do not affect residents in their units, it can cause inconveniences and be stressful. Residents may find themselves stuck when running late, or forced to take the stairs with heavy groceries, or even render themselves immobile and trapped if they

have physical disabilities preventing them from taking the stairs. A survey conducted by United Way Toronto revealed that in high-poverty neighbourhoods elevators broke down more frequently than in other areas, where it only occurred a couple times a year.[84] Understanding the lifecycle of elevators, many of these buildings should have had their elevators and equipment replaced by now. However, elevator maintenance and replacement is expensive, which explains why many property managers and landlords have not replaced them yet.[85]

In addition to elevator breakdown issues, tenants also reported poor condition in common areas throughout the buildings, such as broken laundry machines, disrepair of walls, floors, and ceilings, broken locks on building entrances, and smelly corridors.[86] These issues leave residents feelings unsafe as there is nothing preventing trespassers from entering the building. Moreover, the carpet in the corridor is not cleaned regularly, resulting in accumulated dirt and dust, leading to foul smells.[87]

Residents have also reported issues of decay and disrepair within their units, where a majority of their time is spent. The survey conducted by United Way Toronto showed that residents faced various issues, including plumbing issues in the washroom, and kitchen, damaged kitchen counters and cupboards, malfunctioning kitchen appliances, poor heating and cooling, electrical problems, cold drafts from windows and doors and more.[88] Many of these issues are a result of the building components reaching the end of their lifecycle and needing replacement. Approximately 35 percent of residents noted that they required three or more major repairs in their apartments throughout the year. Comments from the residents stated that repairs within units were promised, but landlords did not follow through despite them being a health and safety hazard. Water ingress in the units is another common problem, whether it's from leaky windows or rotting pipes in the walls. This leads to mould growth within the units making tenants sick and resulting in them having to take time off from work. Additionally, broken tiles and pests within the units present a danger for young children to move freely in the home.[89]

These problems affect residents psychologically through mental stress and frustration. Moreover, issues of mould, mildew, cold drafts through windows, and foul smells from the corridor can cause serious physical health problems. Majority of these issues can be eradicated through regular maintenance of the building. A complete retrofit of the building would ensure further enhancement of the residents' quality of life in these buildings and extend the life of these buildings for future generations.

Summary

Regular maintenance is crucial in providing healthy and safe spaces for residents in the building, whether it is major repairs, or regular cleaning of common areas. As these buildings age, the deterioration of materials exposes residents to toxic chemicals such as lead, asbestos, and VOC-emitting finishes. Upgrading materials at the end of their life cycle ensures functionality, occupant welfare, and safety. While regular maintenance, inspection, and cleaning are responsibilities of the landlord, property manager, and residents, designers and architects can select healthy and easy-to-clean materials to ensure maintenance is not difficult and materials are durable. Selecting low-VOC materials will ensure good health for residents, and easy-to-clean, durable materials will prolong the life of the building to foster safer and healthier lifestyles. The choice of materials is closely linked to indoor air quality and ventilation, as adequate airflow and ventilation can help move indoor pollutants outside (see section 3.2.2). Overall, the lack of upkeep and end-of-life materials in post-war towers create unhealthy living conditions for residents.

3.4.1 Unhealthy Materials and Finishes

Context

It has already been established that the materials in post-war towers are degrading and require an upgrade. However, it is crucial to ensure that the chosen materials are not simply replaced but prioritize occupant health. Replacing the existing materials with healthy, low-VOC and durable materials will minimize indoor pollutants improving indoor air quality. The following diagram represents the worst case scenario of common materials found in post-war towers.

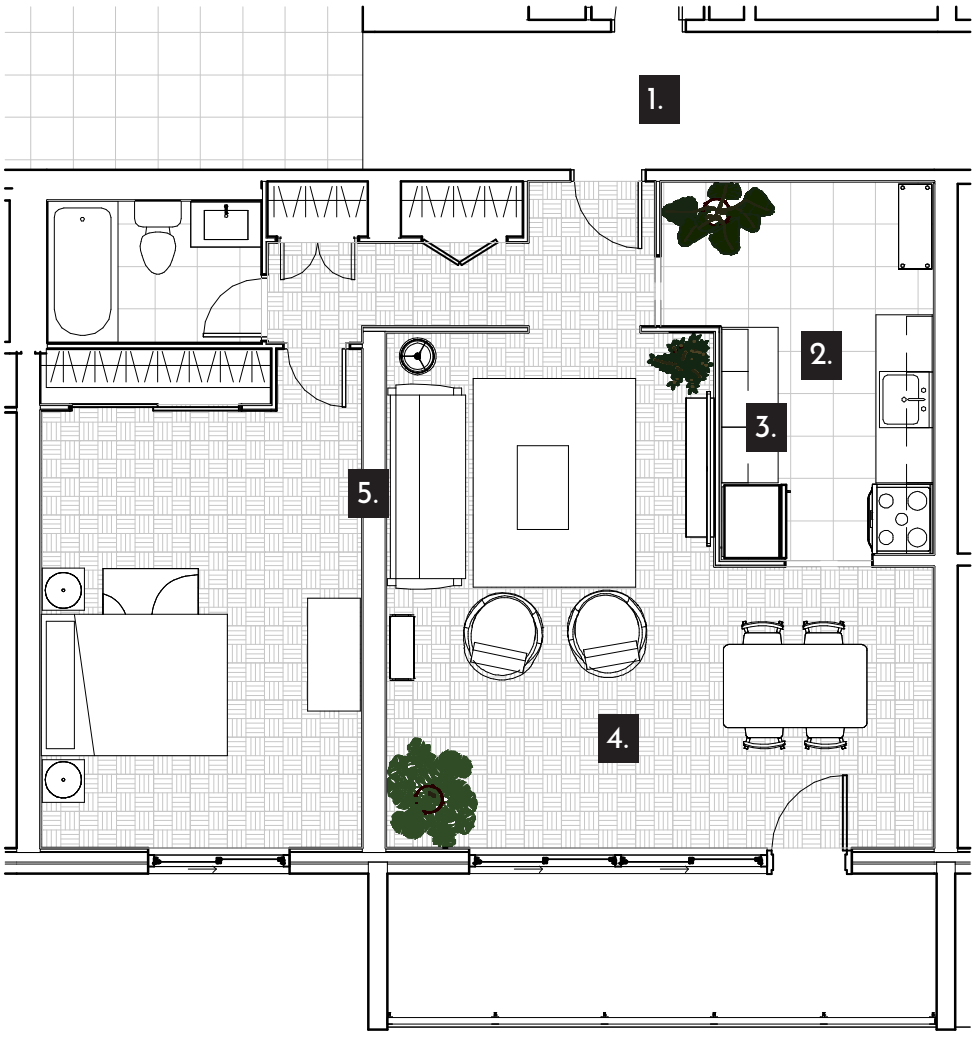


Fig 3.28 Existing materials and finishes in a typical post-war tower unit.

1. Carpet in Corridor: Carpet is a material that accumulates dust very easily, but in addition to that, carpet can contain fly ash, vinyl or polyurethane backing, which can be highly toxic.[90]

2. Kitchen Tiles: Ceramic tiles in the kitchen and washroom with a glaze can contain lead.[91]

3. Kitchen Counter & Millwork: Sealed stone countertops, and laminate countertops contain toxic chemicals, and the sealers wear off overtime and are released into the indoor environment. Kitchen cupboards made of particleboard or MDF contain carcinogenic binders.[92]

4. Parquet Flooring: the polyurethane adhesive used to adhere parquet flooring to concrete contains toxic catalysts and asthmagens.[93]

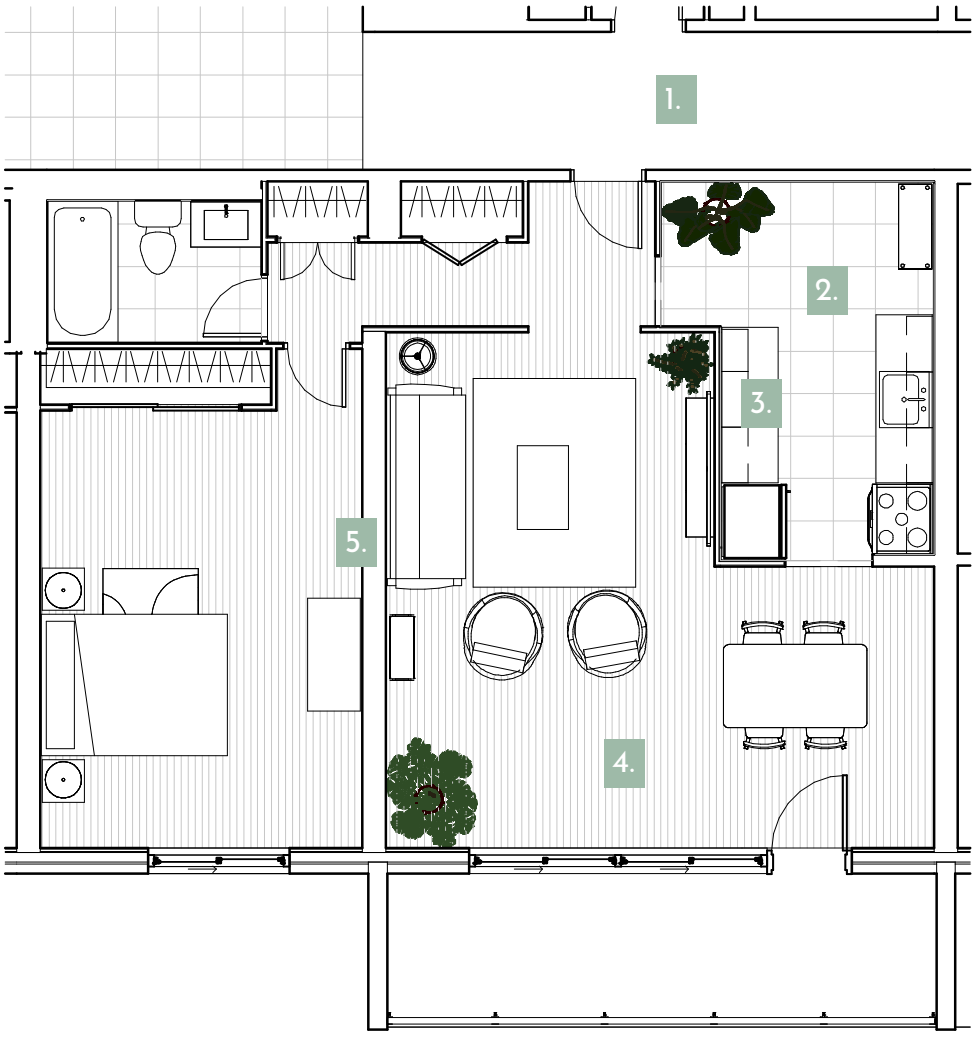
5. Drywall & Paint: Drywall if made with synthetic material can contain mercury and hazardous anti-microbials. Latex paint is the most common indoor paint option.[94]

Solution

To address the aging and outdated materials, the material guidelines mentioned above (Red list, LEED and WELL) will be used to select appropriate materials. These guidelines will ensure the materials chosen are non-toxic, low-VOC, easy to clean and durable. Replacing the unit floors, paint, kitchen counters, casework, and the carpet in the corridor is the main priority.

Fig 3.29 Replacing existing materials to healthy, low-VOC materials and finishes.

Upgrade materials and finishes to low-VOC materials, and durable materials that require minimal maintenance



1. The carpet in the corridor can be replaced with pre-finished cork flooring, which is a low-hazard flooring option but durable in high-traffic areas.95

2. The existing ceramic tiles in the kitchen and washroom can be replaced with new ceramic or porcelain tiles as long as the tiles do not contain lead. Also, avoid using epoxy grouts.96

3. The existing countertop can be replaced with unsealed natural stone, or porcelain slabs with no lead.

4. The existing parquet flooring can be replaced with pre-finished solid hardwood flooring. Additionally, adding sleepers and nailing the finish floor would reduce the need for adhesives.

5. Using drywall with natural gypsum is of low hazard. Lime paint is also mold and mildew-resistant, and zero VOC. The next best option is mineral silicate paint, containing a small amount of synthetic polymer binder.

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PART 3

Chapter 4

Design Scenarios

4.1 Guideline Summary

This chapter summarizes the socio-spatial and indoor environmental principles outlined in this thesis and practically applies the concepts. Figure 4.1, outlines the concerns, consequences and solutions comprehensively discussed in this thesis. Following this, sections 4.2 and 4.3 exhibit two typical family dynamics residing in post-war towers and showcase the impact of retrofitting post-war towers on these families.

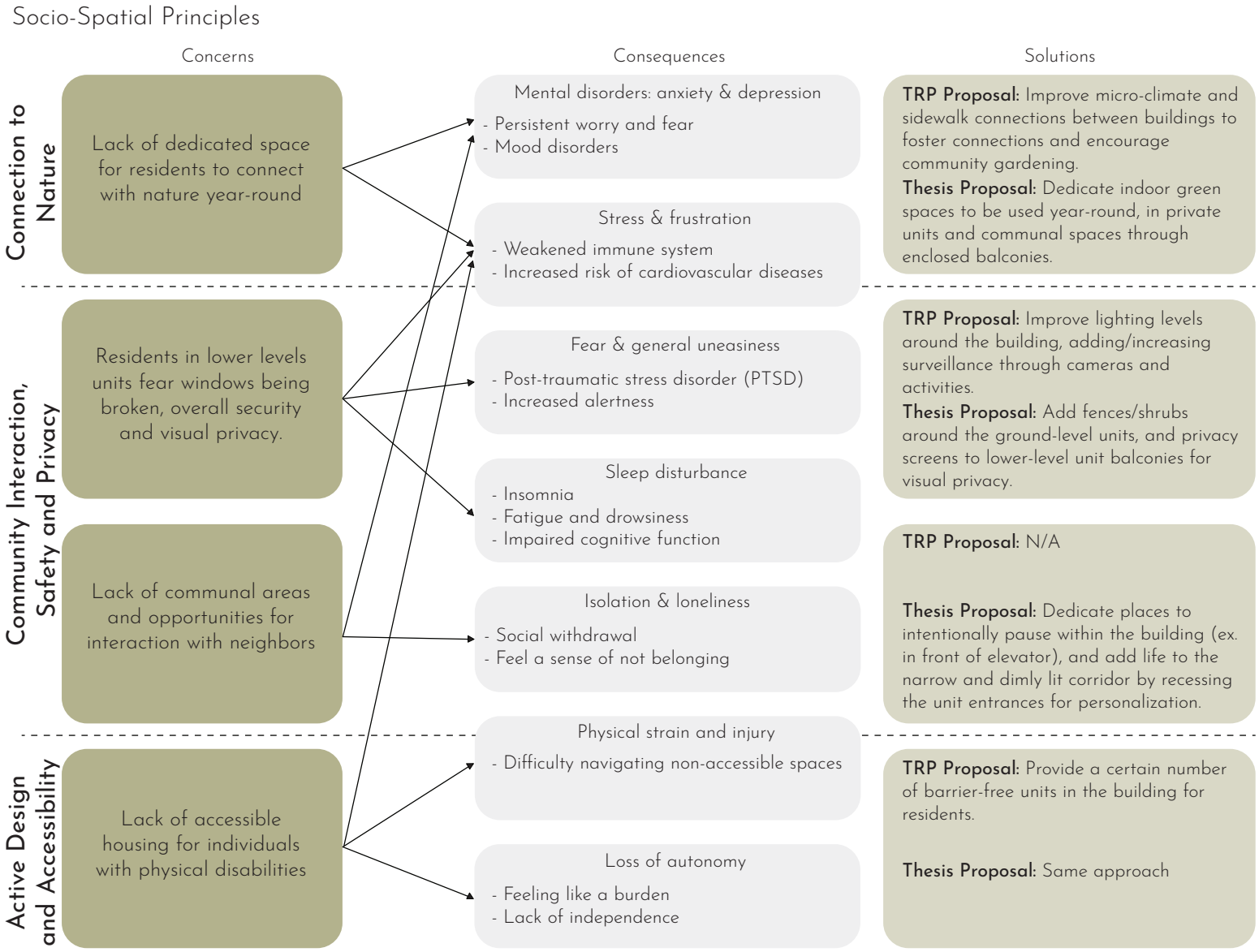
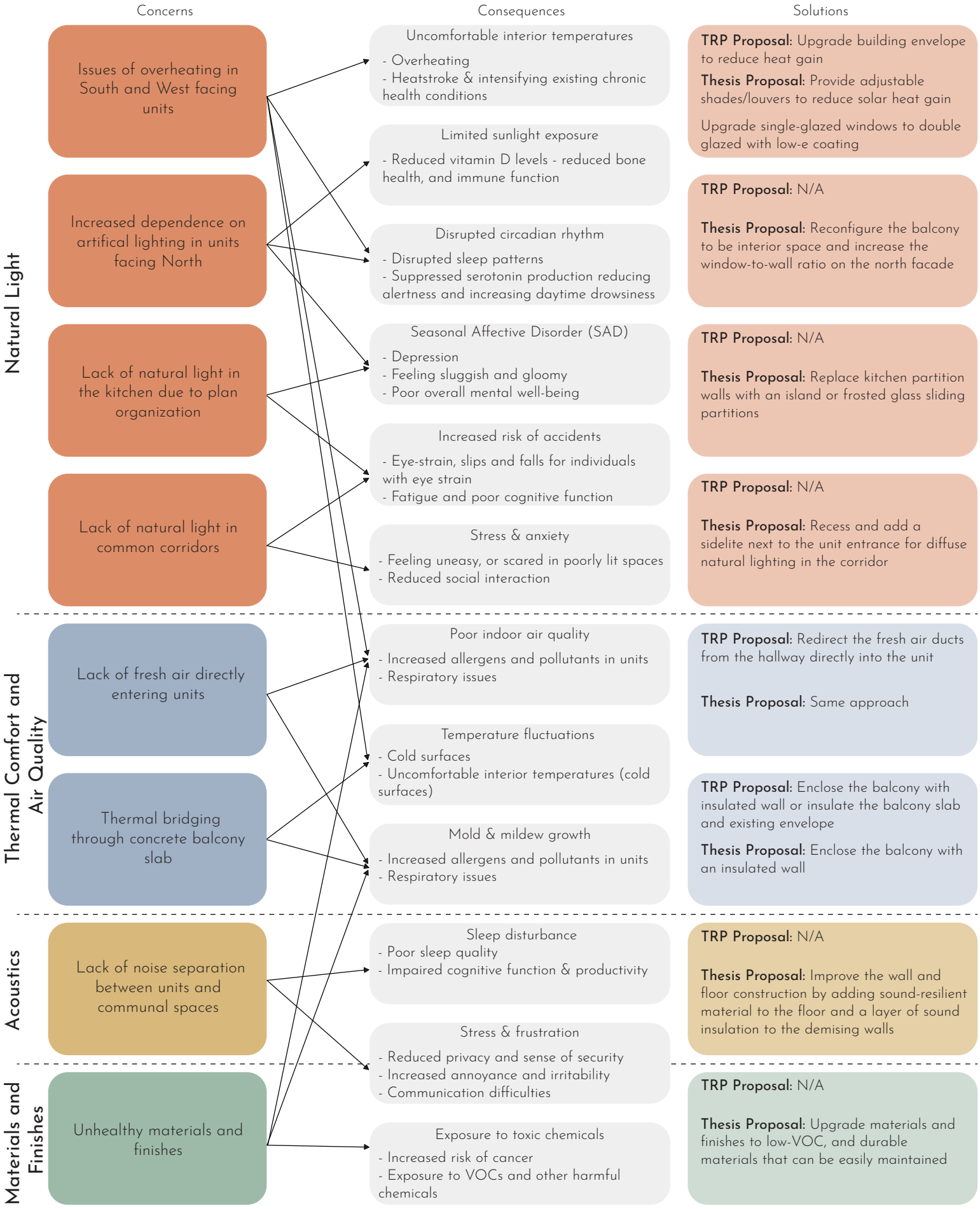


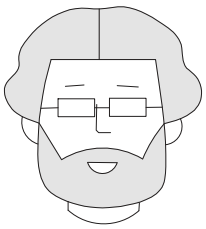
Fig 4.1 Design Guideline Summary (pages 94 & 95).

Indoor Environment Principles



4.2 Family of Five

This family of five has recently moved to this two-bedroom unit at 55 Emmett Ave and is trying to settle into this new space without getting in each other's way. The loud and crowded apartment is becoming an issue for all family members to enjoy their personal space.

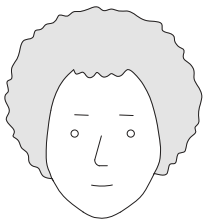


Dad, 39

Hobbies: Watching TV, barbequing & reading

Concerns: No space to bbq and enjoy quiet space

Schedule:
7am - 9am: Read & get ready for work
9am - 6pm: Goes to work
6pm - 7pm: Do chores: & help with dinner
7pm - 9pm: Eat dinner & unwind by watching TV
9pm - 10pm: Go for a stroll outside in the summer & in the corridor in the winter.
11pm: Go to bed

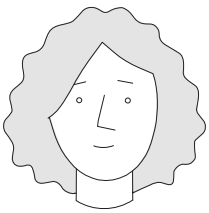


Mom, 37

Hobbies: Gardening, Watching TV, bike riding, and baking

Concerns: Lack of dedicated workspace, noisy in the living room, no pantry

Schedule:
7am - 8:30am: Prepare meals & get ready for work
8:30am - 4pm: Work from home
4pm - 7pm: Prepare after school snack, relax & make dinner
7pm - 9pm: Eat dinner & unwind by watching TV
9pm - 10pm: Go for a stroll/bike ride in the summer & in the corridor in the winter.
11pm: Go to bed

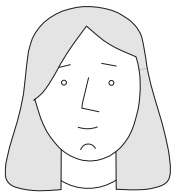


Older Sister, 14

Hobbies: Volleyball, bike riding, basketball and playing the cello

Concerns: Doesn't like sharing bedroom with two other people & no quiet place to do homework

Schedule:
8am - 8:30am: Get ready for school
8:30am - 4pm: At School
4pm - 7pm: Do homework and relax
7pm - 9pm: Eat dinner & clean up after dinner
9pm - 10pm: Watch TV and get ready for bed
10pm: Go to bed

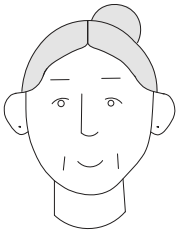


Younger Sister, 12

Hobbies: Painting, singing, babysit neighbours' kids.

Concerns: Doesn't like sharing bedroom with two other people & no quiet place to do homework

Schedule:
8am - 8:30am: Get ready for school
8:30am - 3pm: At School
3pm - 7pm: Do homework and babysit the neighbours' kids
7pm - 9pm: Eat dinner & clean up after dinner
9pm - 10pm: watch and get ready for bed
10pm: Go to bed



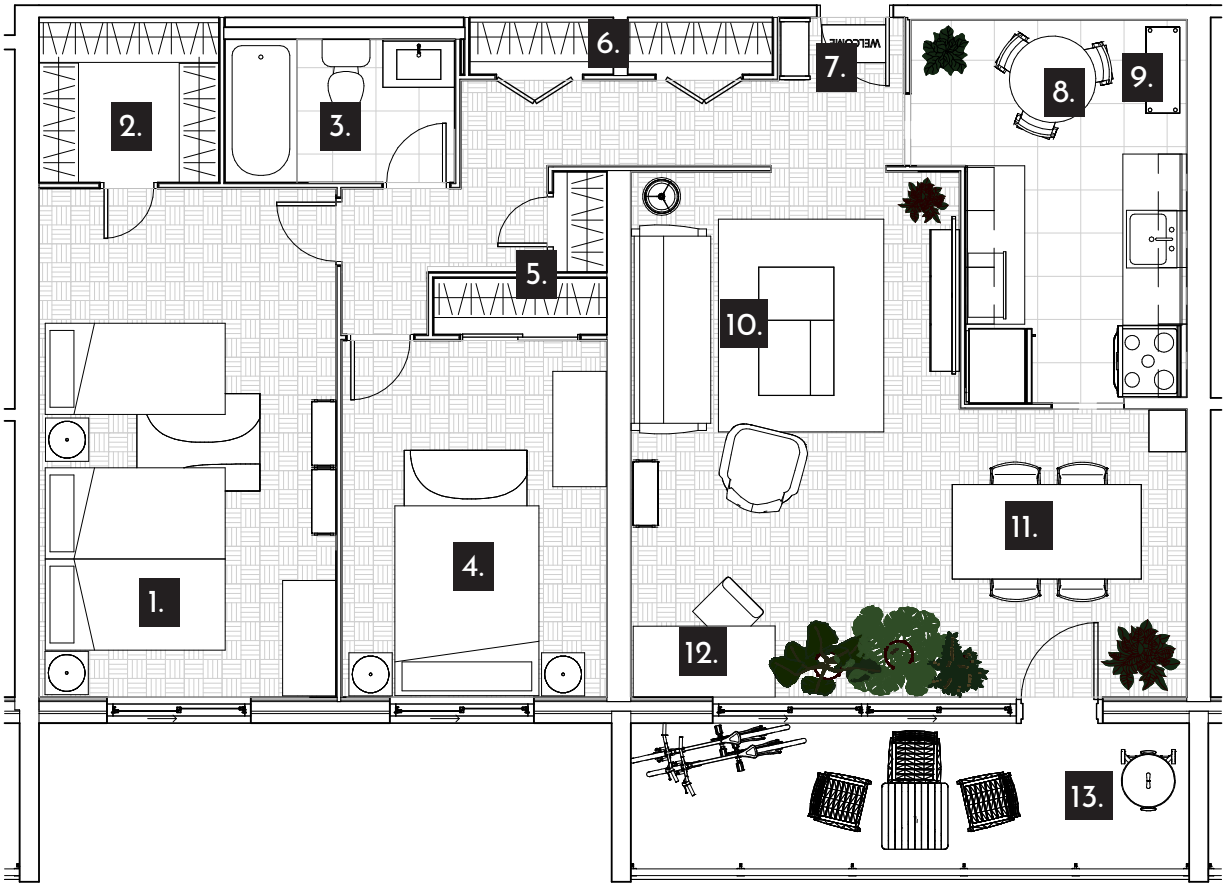
Grandma, 67

Hobbies: Gardening, knitting, read the newspaper, go for a stroll, babysit neighbours' kids

Concerns: Find it difficult to enjoy gardening, feels isolated

Schedule:
6am - 8:30am: Read the paper, have breakfast
8:30am - 2pm: Babysit neighbours' kids
3pm - 4pm: Take a nap
4pm - 5pm: Garden, go for a stroll and sit in the lobby
5pm - 7pm: Help make dinner & eat dinner
7pm - 8pm: go for a stroll or knit indoors
9pm: Go to bed

Fig 4.2 Existing unit layout of the family of five and outlining concerns.



1. The children and the grandmother share the master bedroom for sleeping arrangements

2. The Walk-in-closet is filled with the kids' clothes, with little space for the grandma's clothes

3. In the morning using the bathroom is often an issue as almost everyone needs to leave at the same time, requiring the parents to wake up earlier

4. The second bedroom is for the parents.

5. The closet in the bedroom is quite small to hold all their clothes so they utilize the linen closet in the hallway to store all their items, along with Grandma's belongings

6. While one coat closet is used to store all the miscellaneous items from everyone's hobbies, the other one is used to store winter jackets, and other outdoor equipment that is not used often.

7. A large rack by the entrance holds everyone's shoes.

8. A small table in the kitchen is used to store snacks and some pantry items

9. Due to running out of storage space in the kitchen, the shelf holds most of the larger appliances (ex. blender, rice cooker, air fryer. bags of rice and flour).

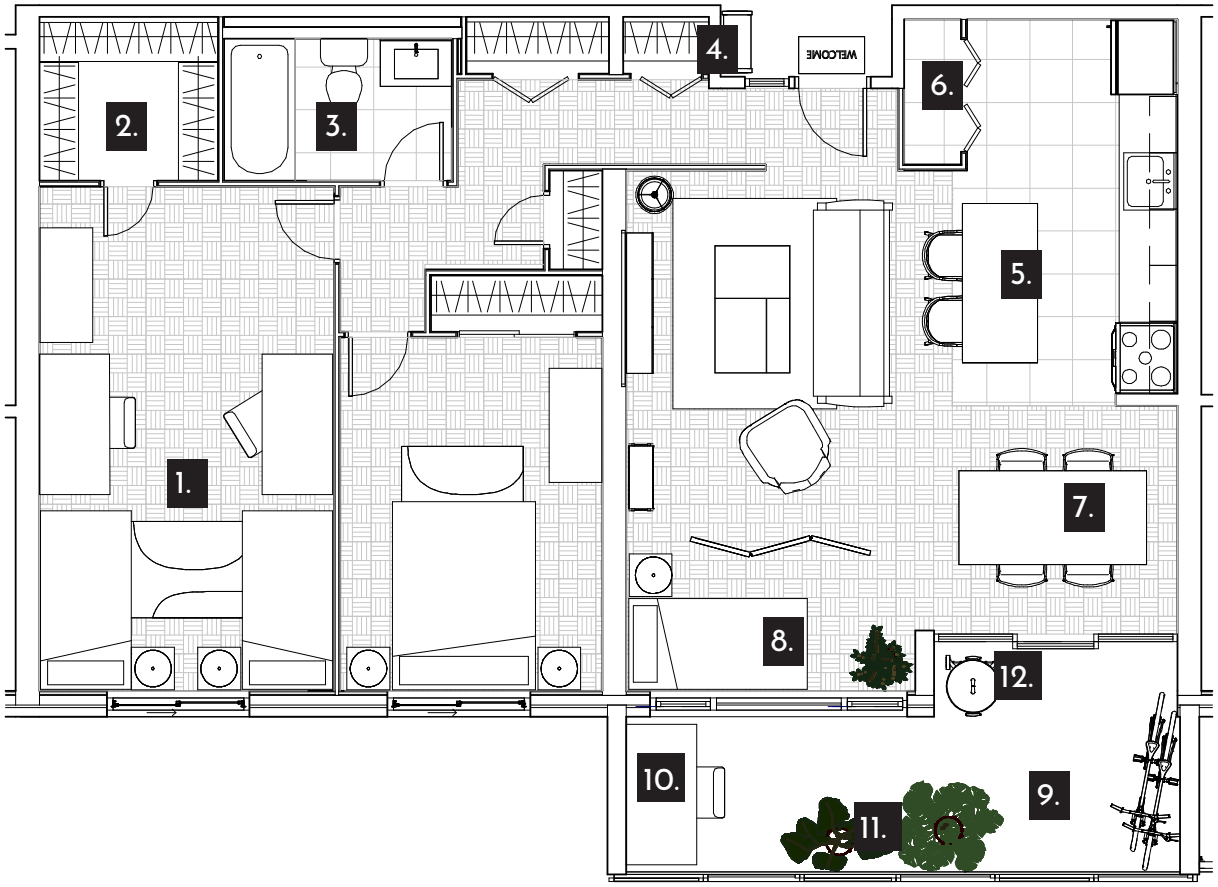
10. The living room is used by everyone to relax in the evening and during the day the grandma naps on the couch.

11. The dining area doubles as a workspace for the mother and a place to dine in the evening.

12. After school, the children complete their homework on the table in the living room, which can be quite noisy while the parents are trying to cook in the kitchen.

13. The balcony is used as storage normally, while there are chairs and a table outside, it is rarely used by the family.

Fig 4.3 Modified unit layout for family of five after the retrofits.



1. The children now have their own bedroom (sharing) with desks for a quiet place to study.

2. The use of the walk-in closet remains the same.

3. The bathroom remains a problem for the family in the morning.

4. One of the two coat closets has shrunk to provide more space at the entrance. A shoe rack outside the unit now holds everyone's shoes. The recessed front door allows the family to personalize it and the sidelite creates a livelier common corridor for all residents.

5. Retrofitting the kitchen and adding an island with seats has opened up the living space.

6. Opening up the kitchen created room for a pantry to house appliances and food out of sight.

7. The dining room is now only used as a space to eat and for family gatherings.

8. Reorganizing the balcony has created a small nook and enough space to provide Grandma with a private sleeping area.

9. Enclosing the balcony has allowed it to be used as an indoor space.

10. A designated working area for the mom allows her to work productively, away from the household noise.

11. The balcony can also be used as a winter garden, allowing the grandma to enjoy her hobbies.

12. In the summer, the enclosed balcony can be opened up, allowing the dad to BBQ and host gatherings.

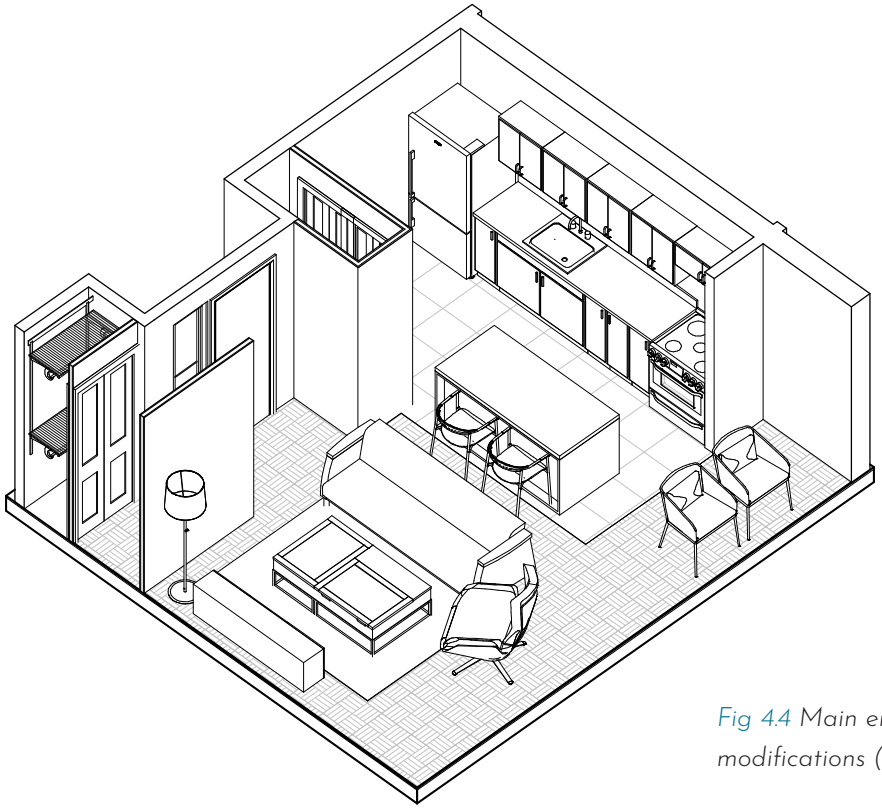


Fig 4.4 Main entrance and kitchen modifications (axonometric).

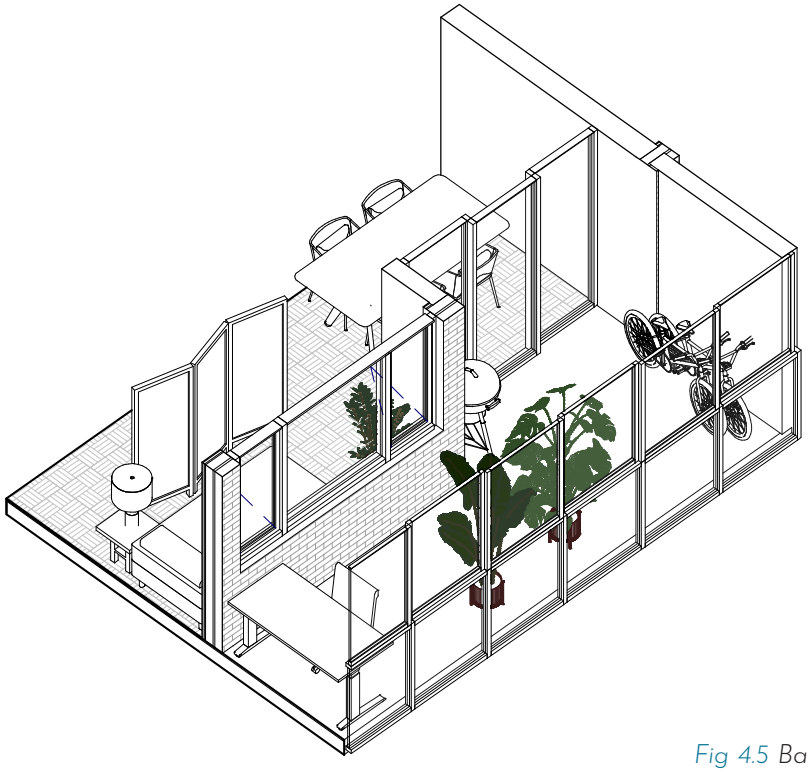
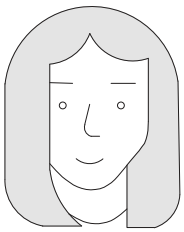


Fig 4.5 Balcony enclosure modifications (axonometric).

4.3 Family of Three

This family of three living in a one-bedroom unit at 55 Emmett Ave., is struggling to find a place within their community, as they do not feel safe. The mother is finding it difficult to keep her kids safe, as the degrading wood floor and finishes are proving to be a safety hazard to the younger child. Additionally, as the unit quickly fills up with belongings, the mother is finding it challenging to create personal space for herself and host gatherings.

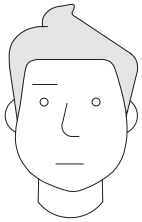


Mom, 31

Hobbies: Outdoor activities (running, skiing, bike riding), photography, & does event planning on the side, hosting friends & family over

Concerns: No private space to sleep, home feels crowded with no space to host gatherings, & feels unsafe in ground floor unit

Schedule:
7am - 9am: Get ready for the day, drop off kids to school & daycare & walk the dog
9am - 12pm: Go to work
12pm - 3pm: Pick up baby sister from daycare and work from home
3pm - 4pm: Pick up older brother from school & prepare after school snacks
4pm - 6pm: Prepare dinner
6pm - 7pm: Take kids to the park
7pm - 8:30pm: Have dinner & put baby sister to bed.
8:30pm - 10pm: Clean up
10pm - 11:00pm: Watch TV, take the dog out
12am: Go to bed

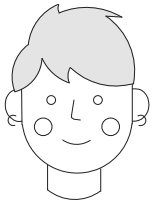


Older Brother, 8

Hobbies: Playing with friends, watching TV, outdoor activities (bike riding, skiing)

Concerns: Has to play in the corridor, cannot go outside

Schedule:
8am - 9am: Get ready for school
9am - 3pm: At school
3pm - 4pm: Go home and watch TV
4pm - 6pm: Play in the corridor with neighbouring kids
6pm - 7pm: Go to the park
7pm - 8:30pm: Eat dinner & watch TV
8:30pm: Go to bed

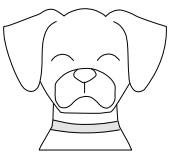


Baby Sister, 4

Hobbies: Napping, watching Paw Patrol, going to the park

Concerns: None

Schedule:
8:30am: Get ready for daycare
8:30am - 12pm: At daycare
12pm - 2pm: At home, napping
2pm - 6pm: Eat snacks, play with dog & watch TV
6pm - 7pm: Go to the park
7pm - 7:30pm: Eat Dinner
8pm: Go to bed



Dog, 3

Hobbies: Barking at neighbours, running in the hallway, going for walks

Concerns: Not enough space to run around

Schedule:
7am - 8:30am: Wake up & go for a walk with mom
8:30am - 6pm: Eat, nap, play, repeat
6pm - 7pm: Go to the park
7pm - 9pm: Eat, nap, play
9pm - 10pm: Go for a walk before bedtime
10pm: Bedtime

Fig 4.6 Existing unit layout of the family of three & dog.



1. The two children share the only bedroom for sleeping. The closet in the bedroom in addition to a dresser holds both their clothes along with some of mom's clothes.

2. The single bathroom is currently working well for the family with no issues so far

3. The linen closet in the hallway is currently used to store all the family's outdoor equipment, such as skiing equipment, other sports equipment and accessories for the dog

4. The coat closet holds everyone's seasonal clothes and accessories, such as winter clothes, jackets and boots

5. The couch in the living room doubles as a place to relax and a place to sleep for the mom

6. A corner of the kitchen is dedicated to the Dog's items, with a bed, food and water bowl, this causes problems of bringing germs into the kitchen.

7. The kitchen is a hazard for the younger sister as she opens and closes all the cupboards. A baby gate is installed on both kitchen entrances.

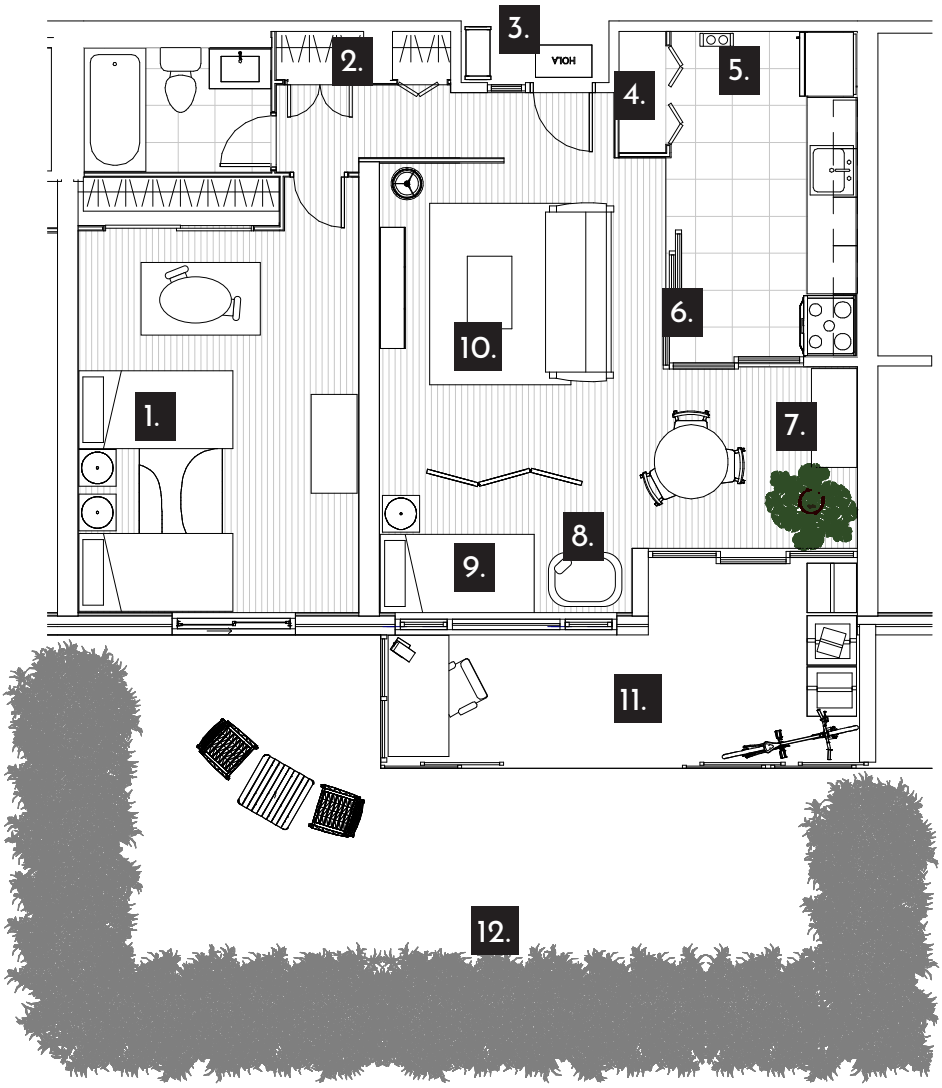
8. The dining table is only used during dinner time and is not a prominent gathering space for the family

9. Living on the ground floor is concerning for the mother as she fears people breaking in. Therefore, boxes from her event planning business are stacked along the balcony door and wall, along with her bicycle.

10. A table in the living room serves as a place for the mom to do her work

11. The balcony is completely useless to the family as there is no specific boundary separating the public and private space on the ground floor, giving pedestrians clear sightlines into the unit.

Fig 4.7 Modified unit layout for family of three after the retrofits.



1. The children's sleeping arrangements have not changed.

2. The use of the linen closet in the hallway for outdoor equipment has not changed.

3. The larger entry area allows the family to drop some of their wet boots, and clothes outside the unit and prevent bringing germs into the house.

4. Retrofitting the kitchen has made space for a designated pantry in the kitchen.

5. The dog's food and water bowl is still in the kitchen.

6. Installing sliding glass doors in the kitchen allows the mom to keep the baby out of the kitchen and still keep an eye on her while cooking.

7. A smaller dining table allows the dining room to also be used for storing the mom's clothes.

8. The dog bed has been relocated near the window and out of the kitchen.

9. Reorganizing the balcony configuration has created a space for a bed for the mom, a movable partition can be used for some privacy.

10. The living room is now used solely for entertainment purposes and relaxing for the family.

11. Reconfiguration of the balcony space, and enclosing it has created additional storage space, along with space for a private office.

12. Placing hedges around the perimeter of the ground floor unit, gives the family more privacy from pedestrians. A boundary between private and public spaces allows the family to utilize their private outdoor space and let the dog out to run around.

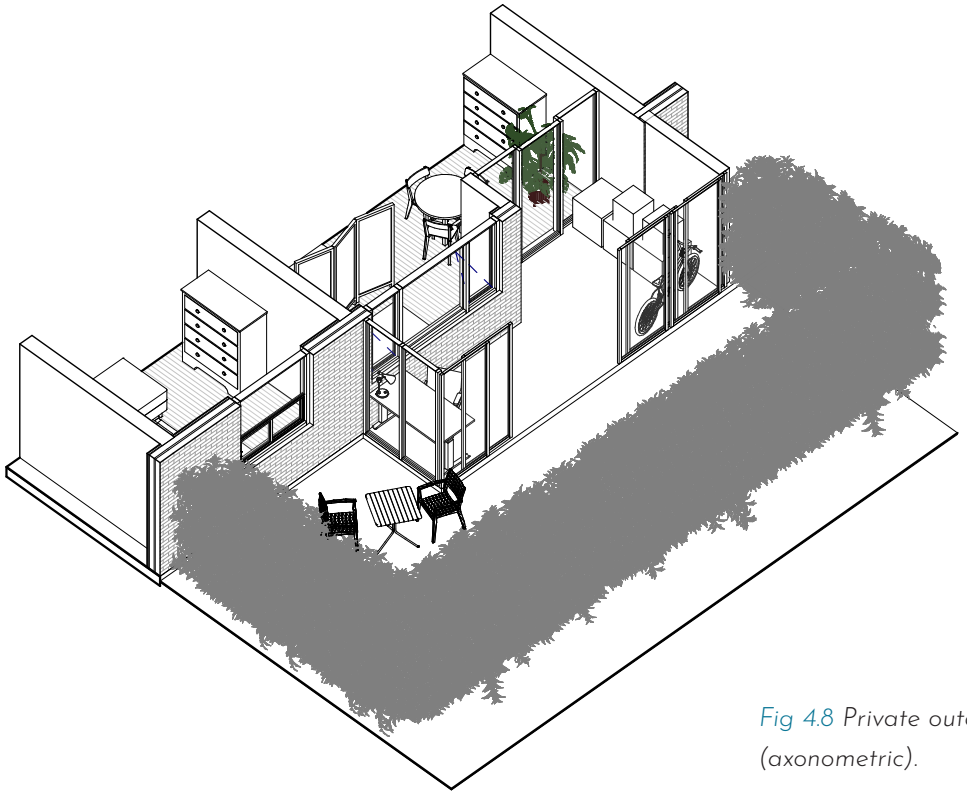


Fig 4.8 Private outdoor space modifications (axonometric).

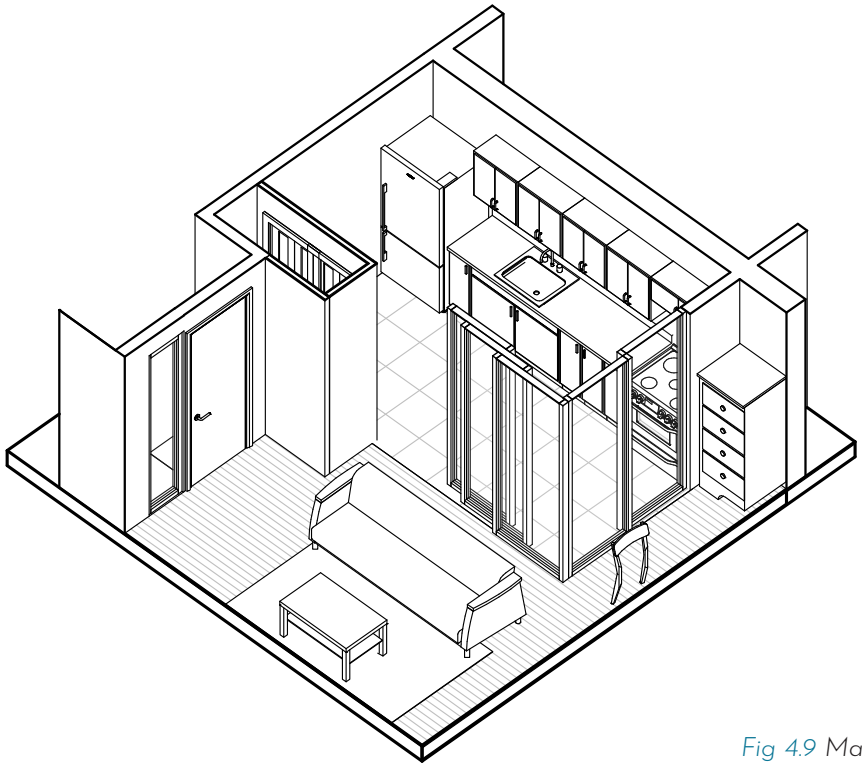


Fig 4.9 Main entrance and kitchen modifications (axonometric).

Conclusion

The connection between housing, health, and well-being is becoming increasingly critical as people face challenges of urbanization, aging infrastructure and health disparities. Additionally, as the role of 'home' changes in many people's lives, it is more important to address the limitations in residential design. This thesis addressed these challenges by exploring the conditions of post-war residential towers in the GTHA and building upon the foundational research conducted by the Tower Renewal Partnership. While the Tower Renewal Partnership focuses primarily on retrofitting this housing stock to be energy efficient, better integrated into the suburban communities and amendments required to zoning by-laws and policies, this thesis focuses on the health and comfort of the occupants to ensure they feel a sense of belonging within their communities and lead a healthy lifestyle.

These towers are aging and the quality of life in these towers is deteriorating, but it is still home to thousands of people, from all walks of life. These buildings were constructed as commodity housing and temporary housing options until families could afford their own homes. However, as the real estate market conditions worsen, families have turned these towers into permanent homes. Through careful consideration of socio-spatial principles, indoor environmental quality, and design interventions, these concrete structures can be transformed into vibrant, healthy and active communities. With approximately 2000 post-war residential towers across the GTHA, this housing stock presents unique challenges but great opportunities for transformation and improvement for future generations. By focusing on enhancing natural light, improving thermal comfort and air quality, ensuring acoustic comfort, and utilizing non-toxic materials, this thesis creates a thorough guideline for creating a healthy living environment. With these issues in mind, this thesis studies the demographics of the population living in these buildings and understands the common issues people deal with daily. The common issues are explored further in the second part of this thesis, in addition to the detrimental effects of poor building conditions on occupants' health. Solutions to these common issues are seen through the transformation of the Humberwood Place Tower, a typical post-war residential tower.

The solutions proposed in this thesis are made under the assumption that all post-war residential towers will be stripped to the structure by the Tower Renewal Partnership prior to retrofits to ensure all systems are working appropriately. Additionally, all the suggestions proposed are assumed under a typical floor plan and may differ slightly due to the variations in building conditions. The Tower Renewal Partnership looks to enhance the energy efficiency of the buildings, and this additional step will help promote a healthier lifestyle and encourage interaction among residents. Overall, this thesis contributes to a broader movement toward healthier post-war tower life.

Understanding the future financial models of post-war towers

The future financial models of post-war residential towers is a critical question in the ongoing development of urban housing. As these aging high-rise buildings now face significant challenges related to maintenance, energy efficiency, and affordability, the question of who will fund and finance these projects arises. As the City of Toronto explores new ways to preserve and modernize this housing stock, different financial scenarios offer unique paths forward. Each scenario - government-backed REITs, cooperative housing models, and developer ownership, - brings diverse implications for the financial sustainability, affordability, and social dynamic of these towers. Understanding the outcomes of each model is key to shaping the future of this housing stock.

In a cooperative housing model, the post-war residential towers would shift to a tenant-managed financial structure, where residents collectively own and operate the building. This scenario would emphasize community involvement and affordability, allowing residents to make decisions about maintenance, upgrades and management. Additionally, unlike regular rental properties, where landlords are able to increase rent prices for their profit, cooperative housing is a non-profit organization. This would allow for more transparency in the finances required to operate the building. The community-driven nature of cooperative housing would allow residents to build

roots in the community, foster social cohesion and have the agency to make decisions that improve the quality of living for all.[1]

In contrast, in a developer-owned scenario, the post-war residential towers would be driven primarily by profit. Developers would focus on maximizing the return on investment by renovating or redeveloping these aging buildings to attract higher-income tenants (see section 1.4). This could lead to gentrification, as rent prices increase significantly with upgraded amenities and luxury finishes. While the existing towers are redeveloped into condominiums or high-end rental units, lower-income residents would likely be displaced. The long-term success of these towers under developer ownership would depend on the demand for housing. This approach could neglect the community's needs or make the housing less affordable, disregarding the original purpose of providing affordable, community-focused housing.

Lastly, post-war residential towers owned and operated by government-backed Real Estate Investment Trusts (REITs), are another option in which the financial model would focus on long-term sustainability and affordability. The government's involvement would ensure consistent funding for maintenance and retrofitting. The government backing would also provide economic stability, allowing for investments in public amenities such as green spaces, community centers, and wellness programs. Over time, these towers would evolve into stable, long-term housing options for middle- and low-income residents, preserving the original affordable housing intent while improving facilities.

Next Steps: Future Research

For future research, it would be beneficial to explore how these buildings can be transformed to better accommodate multi-generational families. As families become increasingly diverse and are required to live together due to financial conditions, the demand for larger and more flexible units is growing. These buildings, designed with flexibility and adaptability in mind, offer opportunities to meet this demand. These buildings use

non-continuous concrete demising walls, which permit reconfiguration, and expansion of units. Units can be easily modified around these demising walls, to support various family structures and co-living arrangements. In addition to the horizontal expansion of units, these units can also be extended vertically, to span two floors. These adaptations can be supported with universal design principles, smart home technologies and co-housing ideologies, to enhance the livability of these units.

In contrast, new condominium buildings unfortunately do not offer this level of flexibility, as units are not designed within equal bays and are divided with continuous concrete shear walls. The rigid structure of new buildings limits the ability to modify, reconfigure, and expand units, making it difficult to adapt the units in the future and meet the evolving needs of diverse families. As a result, in approximately 20 to 30 years, when growing families require larger spaces to live, condominiums will fail to accommodate the dynamic living arrangements. Furthermore, when these new buildings reach their end of life, the efficiency of the glass-clad envelope, the shrinking unit sizes, the lack of adaptability and living spaces without windows will need to be addressed. This future study will be critical to ensuring the housing needs of future generations are met.

In conclusion, this housing stock presents a unique opportunity to be retrofitted and transformed into healthy living conditions. Including the design guideline, - developed through this research - in the framework developed by the Tower Renewal Partnership, will ensure the development of healthy, inclusive and sustainable housing options. This research contributes to the broader conversation of public health and demonstrates the need for healthy housing. Furthermore, this study advocates for a more holistic approach to residential design and emphasizes the need for communication between architects, urban planners, building scientists and occupants. Opening communication among these people will help to create homes that support physical, mental and social well-being. To conclude, the transformation of these towers represents a crucial step to addressing the housing crisis in the GTHA, while improving public health.

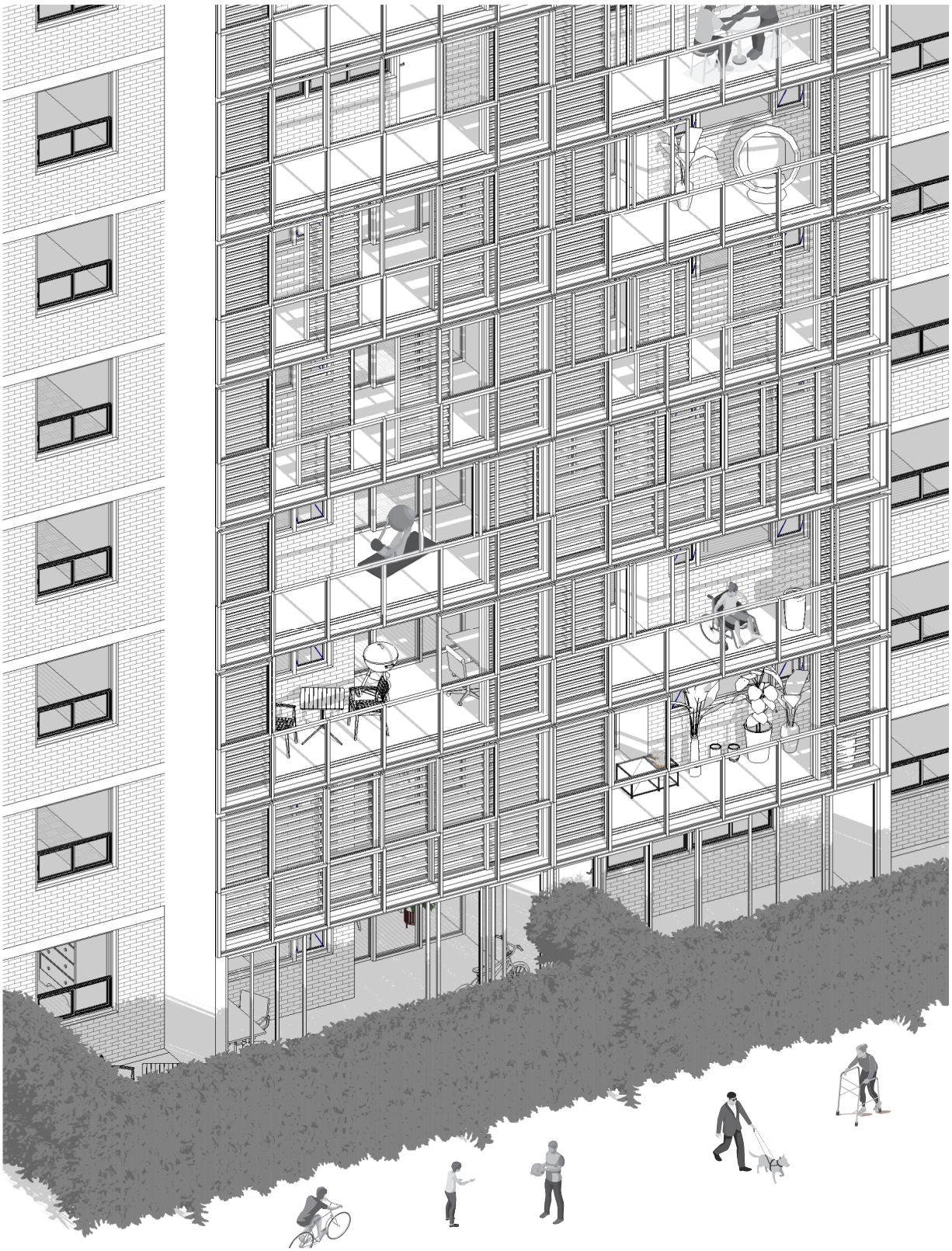


Fig 5.0 South facade of a typical post-retrofit post-war tower.

Endnotes

1 "What Is a Co-Op?," Co-Operative Housing Federation of Toronto (blog), accessed October 2, 2024, https://co-ophousingtoronto.coop/our-sector/what-is-a-coop/.

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