NEUROARCHITECTURE

Quantifying Perception to Inform a Design for Improved Mental Well-Being

by

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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.

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“While the brain controls our behaviour and genes control the blueprint for design and structure of the brain, the environment can modulate the function of genes, and ultimately, the structure of our brain… In planning the environments in which we live, architectural design changes our brain and behaviour.”

Fred Gage

ABSTRACT

As complex, biological organisms, neuroarchitecture aims to address notions that natural and built environments can effect changes in our organismic systems at cellular, neurological, emotional, perceptual, and cognitive levels. Knowing this however, there is still little quantifiable data regarding the metrics of interior environments and how they impact human cognition. The question thus arises:

Can we attempt to quantify human perception pertaining to architectural experience through the use of sensing technologies, in order to substantiate the effects of natural elements, and thus inform a design for improved mental well-being?

This thesis aims to explore these ideas first through existing knowledge and theory regarding human perception and sensory stimulation. Furthermore, through self-analysis per the use of modern sensing technologies, both cognitive and environmental data will be gathered in order to gain an understanding of the relationships between spatial qualities and the physiological responses they evoke. Through this method of theory and data collection, a more informed design framework will be proposed to design a student residence that places a greater focus on improved mental well-being.

Keywords

Neuroarchitecture, well-being, perception, sensing technology, EEG

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PREFACE

Humans currently spend approximately 90% of their time indoors, yet there is evidence to suggest that exposure to natural environments can be associated with having various mental health benefits, such as lower levels of stress, and reduced symptoms of anxiety and depression.[1] This disconnect between the built and natural is significant as it suggests that there are correlations between the spaces we inhabit and our overall mental health. Neuroarchitecture, which can be seen as the study of the relationship between health and the management of spaces through the contributions made by the neurosciences, is a field of study that places greater focus on the relationship between mental processes in architectural environments, as well as their impact on the emotional and physical health of people.[2] As complex, biological organisms, this discipline aims to address notions that natural and built environments can effect changes in our organismic systems at cellular, neurological, emotional, perceptual, and cognitive levels. Knowing this however, there is still little quantifiable data regarding the metrics of interior environments and how they impact human cognition. The question thus arises:

Can we attempt to quantify human perception pertaining to architectural experience through the use of sensing technologies, in order to substantiate the effects of natural elements, and thus inform a design for improved mental well-being?

This thesis aims to explore these ideas first through existing knowledge and theory regarding human perception and sensory stimulation. Acting as the foundation for an evidence-based approach towards design, these theories will be investigated architecturally by considering natural strategies that were successful across two building precedents; Paimio Sanatorium, and Simmons Hall at MIT. Furthermore, through self-analysis per the use of modern sensing technologies, both cognitive and environmental data will be gathered across four of the undergraduate residences at the Laurentian University Campus in order to gain an understanding of the relationships between their spatial qualities and the physiological responses they evoke. With post-secondary students currently being the demographic amongst the highest risk for experiencing mental illness, the goal is to use this data as the basis for informing the design of a more responsive student residence. This residence will manifest through the adaptive reuse of the derelict St. Joseph's Hospital in Sudbury, Ontario, as it is a site that has historically been rooted in both health promotion and the community. Additionally, the argument in choosing this site enforces the idea that a new building typology isn't required to address mental wellness, but rather more careful design decisions regarding spatial qualities and the and the emotions they evoke. It is important to note, however, that through the duration of this study the goal is not to provide a solution or prescribed design, but rather substantiate various key elements - natural greenery, light, vistas, materiality, layout, varied levels of social engagement - to inform design choices that place a greater focus on improving mental well-being.

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[1] Pearson, David G., and Tony Craig. "The Great Outdoors? Exploring the Mental Health Benefits of Natural Environments." Frontiers in Psychology (2014).

[2] "What Is Neuroarchitecture." IGI Global. https://www.igi-global.com/dictionary/learning-goes-mobile/52509.

01

NEUROARCHITECTURE

The Brain + Perception
Architecture + Neuroscience

Figure 1.1: Five fundamental modes of sensing for the human brain.

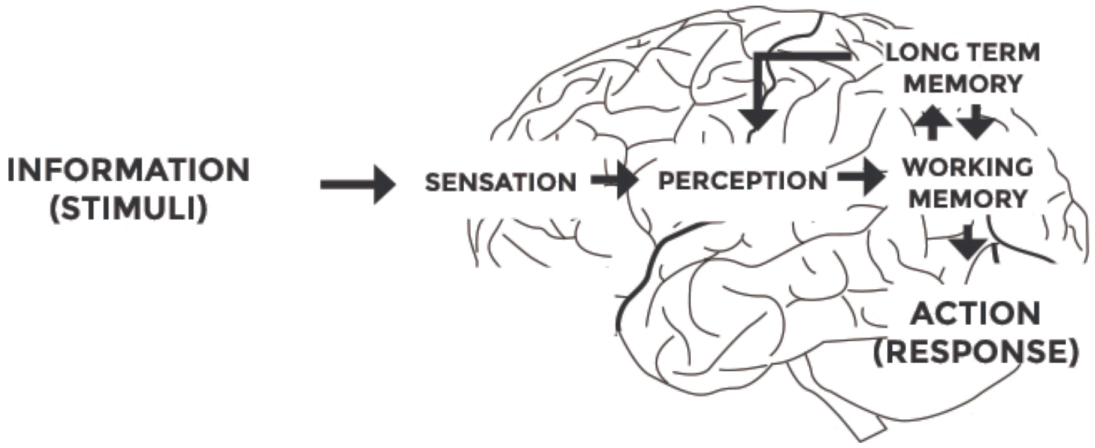

Figure 1.2: The perception process in the human brain.

THE BRAIN + PERCEPTION

The brain is our body's control centre. It allows us to both perceive the world around us and react to internal and external stimuli. The brain allows us to move in a deliberate fashion, learn, store, recall and link information, plan, dream, communicate, and control our vital functions. Fundamentally, the brain holds many of our individual characteristics and traits and thus makes us what we are. Functioning exclusively as the control centre however, the brain must utilize the rest of our body as receptors in order to perceive the external world and prompt the appropriate response. With skin, tongue, nose, ears and eyes, our body is able to receive stimuli and translate them into electric nerve impulses that are transmitted to the brain. These impulses are then processed by specific regions of the brain, and experienced as images, movements, sounds, scents, tastes, temperature and touch. Our body therefore can be observed as a natural sensing organism that is able to address external stimuli as a set of data, or rather inputs, that the brain processes in order to produce a suitable response.

In furthering this analysis of the brain, we begin to investigate human perception and sensory experiences. Philosopher Maurice Merleau-Ponty places the body at the centre of the experiential world. In his work Phenomenology of Perception, he states, "Our own body is in the world as the heart is in the organism: it keeps the visible spectacle constantly alive, it breathes life into it and sustains it inwardly, and with it forms a system."[3] Rather than being a science of the world, or even an act, perception to Merleau-Ponty is a process of continuous interaction involving intentions, expectations and physical actions. Perception therefore plays a major role in determining the mood our brain is in. The sensory impression of external stimuli, followed by the brain's subsequent assessment of that information, combine to shape our behaviour and actions. Similarly, architect Juhani Pallasmaa notes that sensory experiences become integrated through the body and the human mode of being. Our bodies and movements are in constant interaction with the environment; the world and the self are both informing and constantly redefining each other. In essence, "there is no body separate from its domicile in space, and there is no space unrelated to the unconscious image of the perceiving self."[4]

Recognizing this process of perception at a fundamental level is an important starting point for this research as it influences the methodology behind the body of work. Much like the human body acts as a series of sensors that gather data for the brain to be able to perceive the surrounding environment and respond accordingly, this thesis explores the idea of pursuing modern sensing technologies to create a similar mode of work. Both environmental sensors and an electroencephalogram (EEG) will act as a means for collecting data that can be analyzed to influence more responsive design decisions. Additionally, these decisions will place focus on spatial qualities that elicit more positive emotional responses, making the goal of this study to generate a design that has the potential to positively impact mental well-being.

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[3] Merleau-Ponty, Maurice. Phenomenology of Perception. London: Forgotten Books, 2015. P. 235.
[4] Pallasmaa, Juhani. The Eyes of the Skin Architecture and the Senses. John Wiley & Sons Ltd., 2012. P. 40.

ARCHITECTURE + NEUROSCIENCE

Expanding on these ideas of perception, in "The Sixth Sense: The Meaning of Atmosphere and Mood", Pallasmaa posits that humans possess two systems of perceiving; one of precise and focused perception, the conscious, and the other of diffuse and unfocused peripheral scanning, the unconscious.[5] These two systems are independent, yet complement each other in terms of how space is perceived as they address both direct and peripheral vision. Direct, conscious, vision is often of primary concentration as it represents our focused perception and static gaze, however, it is the peripheric, and atmospheric observations of the unconscious that are able to unite all the sensations through the sense of being and self. The experience of atmosphere, or mood is thus viewed as a predominantly emotive mode of sensing.[6]

Pallasmaa states, however, that peripheric perception is often neglected in architecture as architects struggle to acknowledge that emotions have the potential to "evaluate, articulate and structure our relations in the world."[7] Emotions are often regarded as secondary reactions that possess little factual value, when in fact they are affective patterns of the encountered world that arise from primordial levels. Mood has the ability to, "tune us emotively with our environment, and as a consequence we do not need to continuously and consciously monitor its overwhelming medley of details."[8] The potential architects have to more intuitively design space is thus revealed by beginning to analyze human emotions and unconscious perception. With modern sensing technologies, we can begin to quantify these phenomena as more than mere subjective experiences, and rather view them as data that can influence design. This data can provide architects with a foundation of knowledge regarding the multi-sensory experience that is architecture, and therefore begin to inform design decisions that place focus on the well-being building's intended users.

To supplement these thoughts, we turn to the field of neuroscience for a more rigorous exploration of the structure and function of the brain. Beginning to analyze the complex qualities of the human mind is imperative in terms of understanding how the built environment impacts mental wellbeing. As a sensing organ, the brain is responsible for human response to space and thus dictates both how space is perceived, and how it can be shaped. Harry Francis Mallgrave proposes that neuroscience offers architects a sketch of the enormous intricacy of human intellectual and sensory-emotive existence, allowing for a physiological understanding of space. Though he argues that neuroscience may not suggest a theory, it's methodology in understanding the human brain can offer a theoretical route to form basic questions about the people for whom the architect designs. In gaining an increasingly detailed understanding of the human brain, "we are not only achieving major insights into the nature of what has historically been called the 'mind' but also exploring such issues such as memory, consciousness, feelings, thinking,

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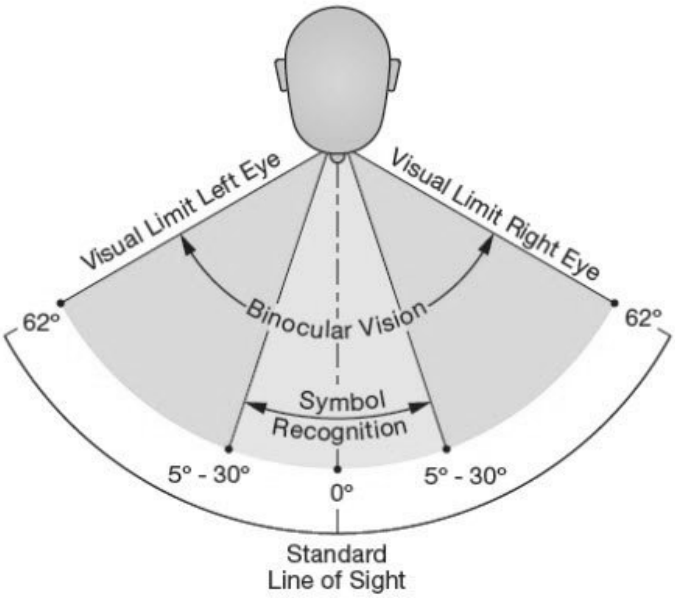
[5] Pallasmaa, Juhani. "The Sixth Sense: The Meaning of Atmosphere and Mood." Architectural Design 86, no. 6 (2016). P. 131.

[6] Ibid. P. 132.

[7] Ibid.

[8] Ibid. P. 133.



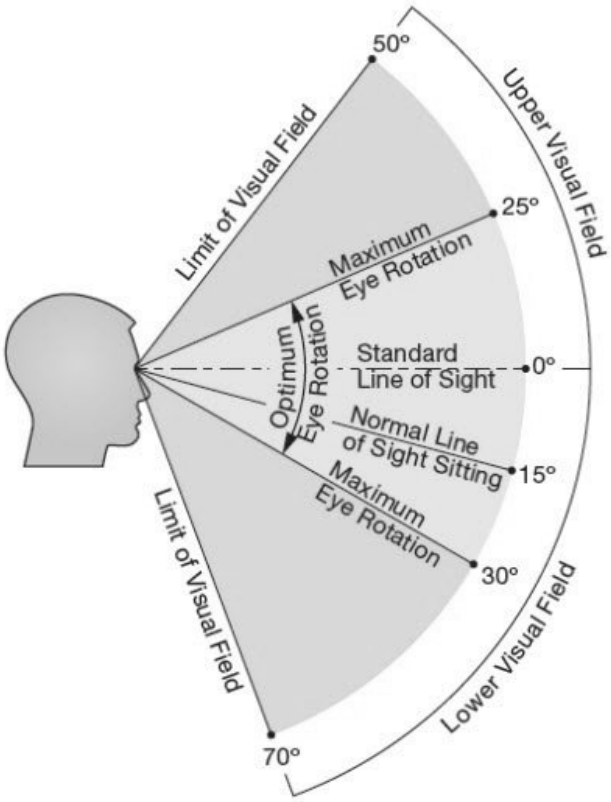


Figure 1.3: Human field of vision, outlining conscious and unconscious modes of perceiving.

and creativity".[9] It is the amalgamation of these two domains, architecture and neuroscience, that yields the term "neuroarchitecture", which can be seen as the study of the relationship between health and the management of spaces through the contributions made by the neurosciences. This field of study places a greater focus on the relationship between mental processes in architectural environments, as well as their impact on the emotional and physical health of people. Both fields deal with amazingly complicated and beautiful structures - buildings and brains - and the purpose of their work should not get lost in the potential to collaborate.[10] Therefore, this thesis is rooted in the thoughts offered by neuroarchitecture as a field of study, and strives to address mental well-being through the use of sensing technologies and an approach to design that mimics that of the brain itself.

[9] Mallgrave, Harry Francis. The Architects Brain: Neuroscience, Creativity, and Architecture. Malden, MA: Wiley-Blackwell, 2012. P. 1.

[10] Pallasmaa, Juhani, Harry Francis Mallgrave, and Michael A. Arbib. Architecture and Neuroscience. Edited by Philip Tidwell. Architecture & Neuroscience. Tapio Wirkkala - Rut Bryk Foundation, 2013. P. 13.

02

BUILDING PRECEDENTS

Paimio Sanatorium
Simmons Hall MIT Residence

Figure 2.1: Paimio Sanatorium, designed by Alvar Aalto.

PAIMIO SANATORIUM

Alvar Aalto
1932
Paimio, Finland

The Paimio Sanitorium, designed by Alvar Aalto in the 1930s in the Southwest portion of Finland, demonstrates both an evidence-based and functional approach to design that focuses on emulating nature while creating a healing environment. The hospital was originally built and designed for patients with tuberculosis, and in response was carefully sited among pine trees in order to meet the required amount of isolation. In aiming to achieve a human centred architecture, Aalto designed the sanatorium with the patients not only in mind, but as the primary inspiration. To address aspects regarding the illness and its treatment, Aalto designed a large roof terrace with extensive views, allowing each patient to be taken in their beds for fresh air. He also incorporated a Southward facing sun balcony at the end of each patient floor in order to provide them with access to as much natural light as possible. Each patient room was planned for two people, and provided each patient with their own wash basin to maintain comfort and a peaceful environment. Additionally, the rooms were painted in soft tones with darker ceilings to create a restfulness effect and aid in the healing process.[11] Every detail of the building was approached in this manner, from the chairs the patients sat on to receive treatment, to the handles of the doors – the focus remaining on the healing process. As tuberculosis is easily transmitted by bacteria, it was also important to ensure that all the surfaces were easy to clean and the spaces could be easily aired. No sharp edges, unnecessary ornaments, or shelves that gather dust were used. The indoor surface materials chosen were also durable against wear and washing; rubber flooring, linoleum,

[11] Anderson, Diana. "Humanizing the Hospital: Design Lessons from a Finnish Sanatorium." Humanities CMAJ, 2010.

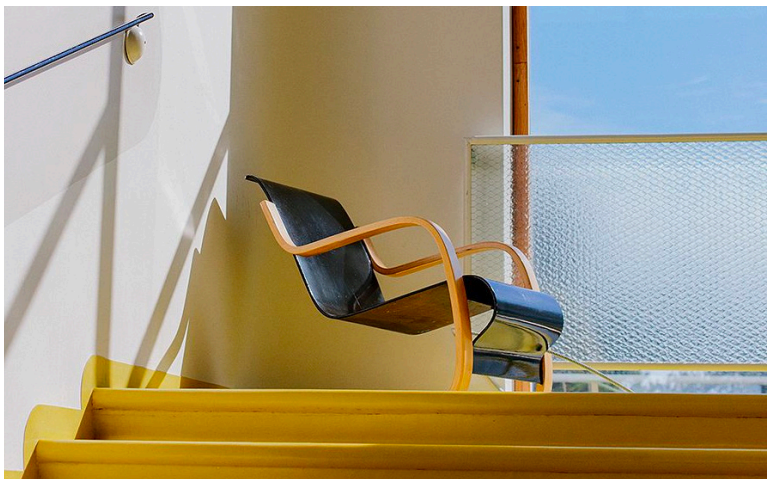


Figure 2.2: Main lobby with curved reception desk with easy to clean surfaces to minimize the accumulation of bacteria (top), and the Pikku Paimio (Little Paimio) armchair designed by Aalto for the sanatorium (bottom).

ceramic slates and shiny painted surfaces.[12] Though this project focused specifically on hospital design, it holds various qualities that can be applied to the design of other buildings in order to begin to humanize architecture. The greatest success of this building is its ability to incorporate the natural environment within its walls. The abundance of natural light and views and access to the surrounding landscape provided tranquil environments with natural healing properties for the patients. To achieve these spaces Aalto considered the building orientation, and designed the program around this to allow natural elements to passively penetrate the building's façade.

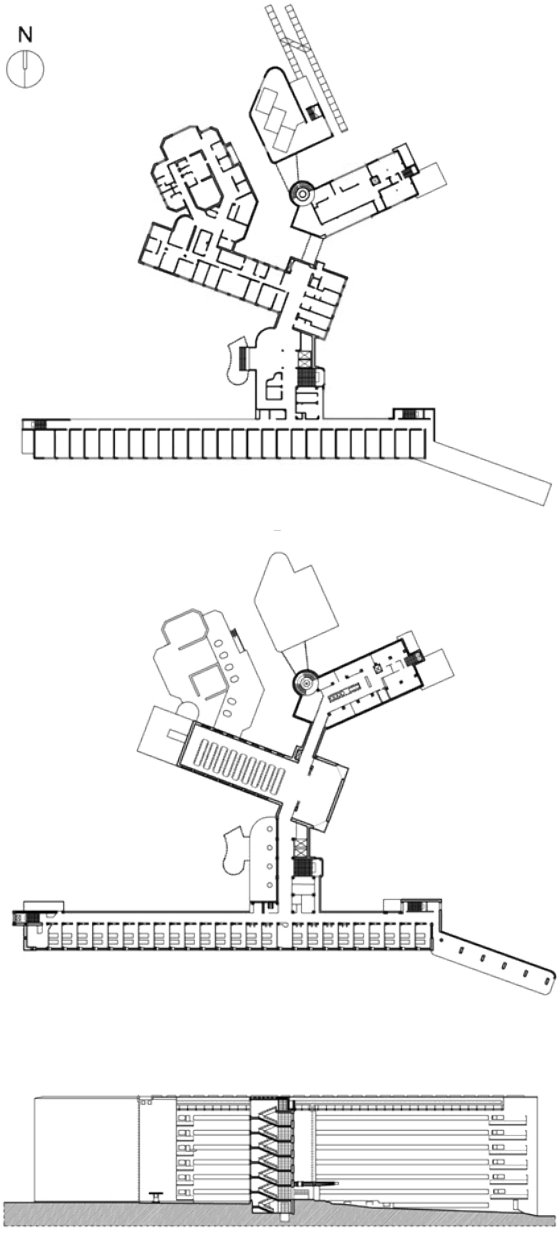


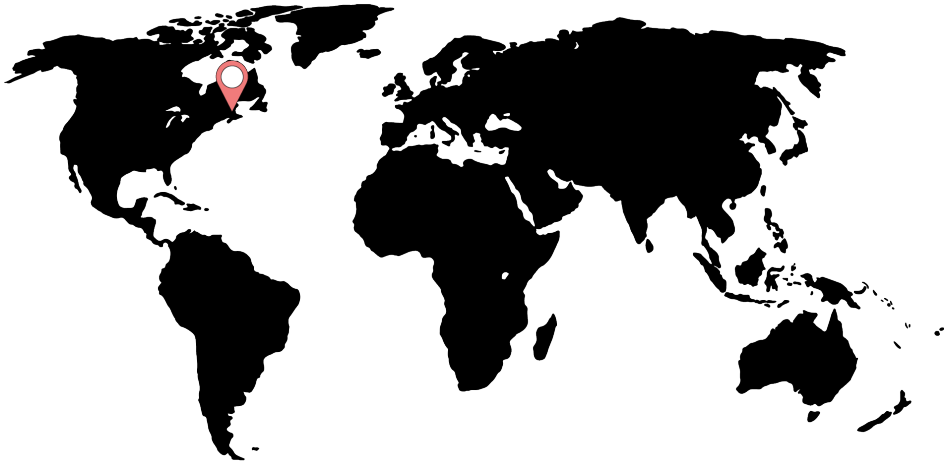
Figure 2.3: Ground floor plan (top), upper level typical plan (middle), and North-South perspective section (bottom).

[12] "Alvar Aalto and the Colors of the Paimio Sanatorium | Design Stories." Finnish Design Shop COM. February 01, 2018.

Figure 2.4: Simmons Hall MIT Residence, designed by Steven Holl.

SIMMONS HALL MIT RESIDENCE

Steven Holl
2002
Cambridge, Massachusetts



Designed by Steven Holl in 2002, Simmons Hall Residence at MIT in Cambridge Massachusetts, demonstrates a student residence whose focus was to create social interaction among students. In addressing this, the 195,00 square foot dormitory is not only home to 350 residences, but has ample social spaces including a 125-seat theatre, night café, street level dining, sporadic lounges, a ball pit, outdoor terraces and spaces of productivity for students.[13] Following this theme, Holl designed 11-foot-wide corridors to enhance the possibilities for urban conditions. The residence also features three types of living accommodations; 62% single rooms, 32% double rooms and 6% triple rooms, allowing for varying levels of privacy while still encouraging social interaction.[14] Holl also ensured that each washroom would not be shared with more than 3 students, to ensure adequate amounts of privacy.

In addition to focusing on social interaction, comfort in the form of natural light and fresh air was of high priority in the design. The monolithic structure is constructed of 3 types of concrete, with 5,538 windows.[15] The abundance of windows creates a constant flicker of changing lights as the different rooms are occupied, resembling a city skyline at night. These windows also welcome plenty of sunlight and natural ventilation for the units, as each residential room has nine operable windows with 18-inch wall depths. This allows the low-angled winter sun to warm up the building, while providing shade in the summer months to keep it cool.[16] Holl also provided students with a variety of

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[13] "Simmons Hall." Maseeh Hall | The Guide to Residences.
[14] Ibid.
[15] Ibid.
[16] Perez, Adelyn. "Simmons Hall at MIT/Steven Holl." ArchDaily. June 21, 2010.

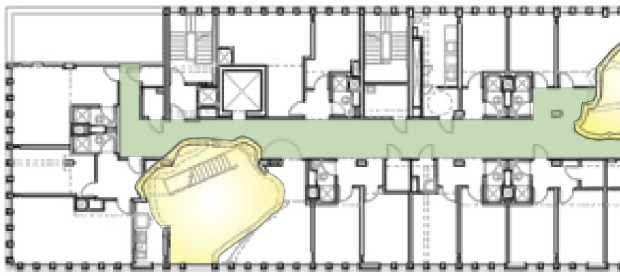
Figure 2.5: First level circulation space (top), and example of a freshman residence room (bottom).

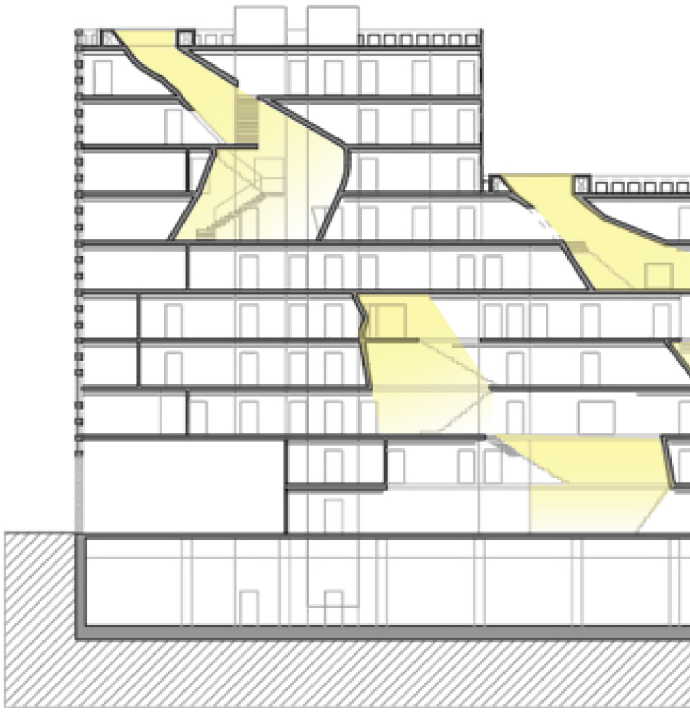
outdoor terraces, creating outdoor spaces with views of the surrounding landscape that are easily accessible.

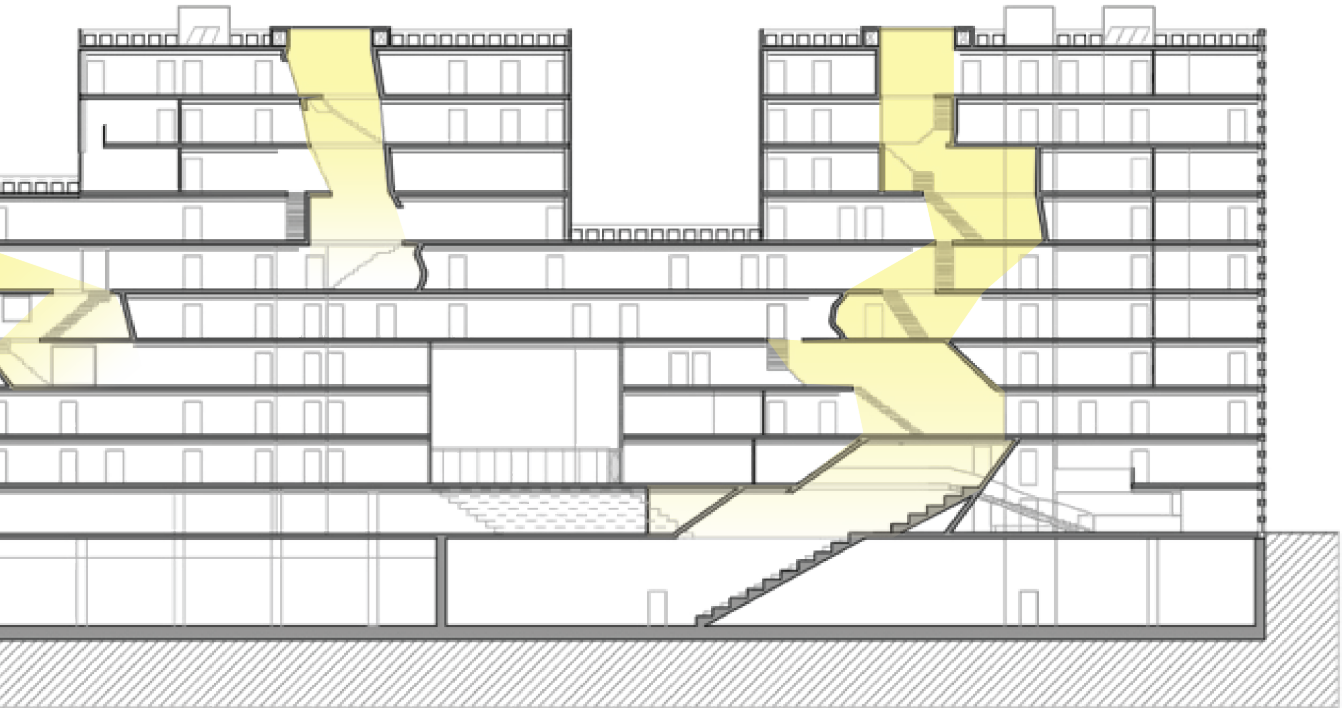
Referred to as the "sponge" Simmons Hall is a porous structure that soaks up light through a series of large openings that filter through the building in section. While these cuts allow natural light in, they also allow for interactive spaces for students, providing views of different levels and curved walls to interact with. In the original design these sections were known as the building's "lungs", as Holl intended for them to bring natural light down while circulating air up.[17] Though these breaks were not implemented to the large scale that he desired, they were still successful in bringing natural light to spaces that would have otherwise lacked in natural light. The design choices made regarding of program, public and private spaces, natural light and ventilation are all crucial design decisions in this project as Simmons Hall was able to reduce reports of mental illness on the MIT campus by approximately 20% since its construction. Similar to the elements that were successful in Aalto's Paimio Sanatorium, Holl was able to passively allow natural elements to flood interior spaces. Again, the design decisions in this project were focused around the building's inhabitants and their well-being.

[17] Perez, Adelyn. "Simmons Hall at MIT/Steven Holl." ArchDaily. June 21, 2010.

Figure 2.6: Floor plan (7th floor) and building section outlining circulation space (green) and building “lungs” that allow natural light and air to circulate through interior spaces (yellow).







03

STUDENT MENTAL HEALTH

The Current State + The Buildings that House Them

THE CURRENT STATE + THE BUILDINGS THAT HOUSE THEM

Mental illness is observed as a disease that causes disturbances in thought or behaviour, resulting in an inability to cope with life's demands and routines. Though anyone is susceptible to mental illness, it is exceedingly prevalent in the student population. Not only is mental health a common issue, but the cases of struggles with the disease are rising. The Spring 2016 National College Health Assessment (NCHA), a national online survey that collects information on students' health behaviours, attitudes, and perceptions, indicated that depression, anxiety and suicide attempts are increasing among Ontario's post-secondary students:

+ **46%** of students reported feeling so depressed in the previous year it was difficult to function (increased from 40% in 2013);
+ **65%** of students reported experiencing overwhelming anxiety in the previous year (up from 58% in 2013);
+ **14%** had seriously considered suicide in the previous year (up from 11% in 2013);
+ **2.2%** of students reported a suicide attempt within the previous year (up from 1.5% in 2013)[18]

Throughout Ontario, colleges and universities have begun to make mental wellness a priority in terms of services offered for students, however this does not address the buildings that house them. Maslow's *Hierarchy of Needs* acts as a useful model for understanding how housing circumstances have a key role in addressing this issue. Level one and two of his hierarchy are considered fundamental, or "deficiency," needs as they speak to the buildings we reside in and human safety.[19] Levels three and four are considered psychological needs as they deal with human relationships and interaction. The last level is self-fulfillment, which can only be met if the other needs have been addressed. It is important to note that the foundation of the pyramid speaks to the built environment, making housing our most fundamental need. In addition to housing our fragile bodies and actions, buildings house our minds, memories, desires, and dreams. Pallasmaa explains that:

"*Our buildings are crucial extensions of ourselves, both individually and collectively. Buildings mediate between the world and our consciousness through internalizing the world and externalizing the mind. Architecture is a materialized expression of mental space, and our mental space itself is structured by architecture.***"**[20]

For this reason, it is important to consider student residences when aiming to address the mental well-being of this demographic. Though having access to support services is an important step, addressing the buildings that students reside in is crucial in terms of forming a strong support system. Bearing in mind these ideas, this study will continue through the examination of four existing undergraduate student residences at Laurentian University.

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[18] Council of Ontario Universities. "In It Together: Taking Action on Student Mental Health," 2017, 1–10.

[19] Cooper, Rachel, Elizabeth Burton, and Cary L. Cooper. Wellbeing and the Environment. Wellbeing: A Complete Reference Guide. Vol. 2. Wiley-Blackwell, 2014.

[20] Pallasmaa, Juhani, Harry Francis Mallgrave, and Michael A. Arbib. Architecture and Neuroscience. 2013. P. 8.

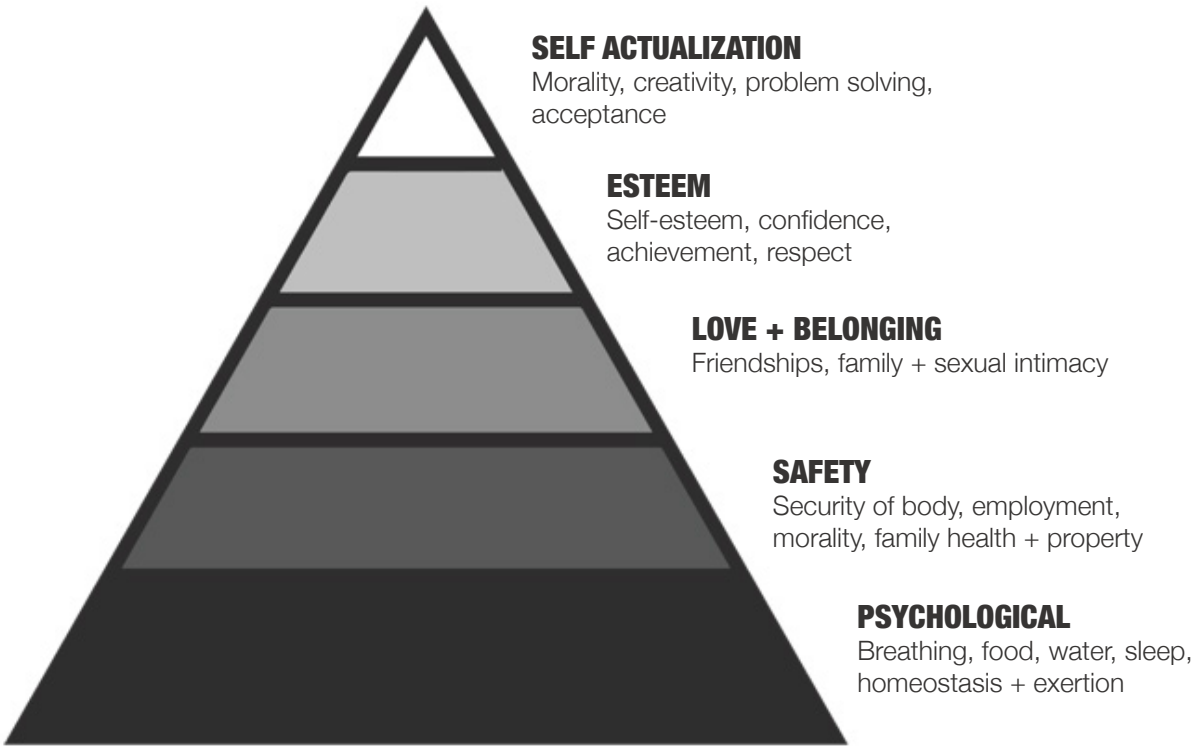


Figure 3.1: Maslow's *Hierarchy of Needs* showing how mental well-being cannot be achieved until basic physical needs are met.

The methodological approach to this research begins at the macro-scale by dissecting the existing residence buildings in order to understand potential external stimuli. This first stage in the analysis involves cataloguing the building typologies, unit configurations and layouts, followed by mapping their proximity to services that can promote positive well-being for students if they are easily accessible. Furthering this investigation, both the private and public spaces of the residences will be assessed on a micro-scale through sensing technologies. These sensors will begin to provide insight regarding the environmental characteristics of various spaces and their corresponding emotional responses. The preceding sections will further explain these sensing technologies, their utilization as design tools, and the data that was gathered.

04

SENSING TECHNOLOGIES

Emotive Sensing
Environment Sensing

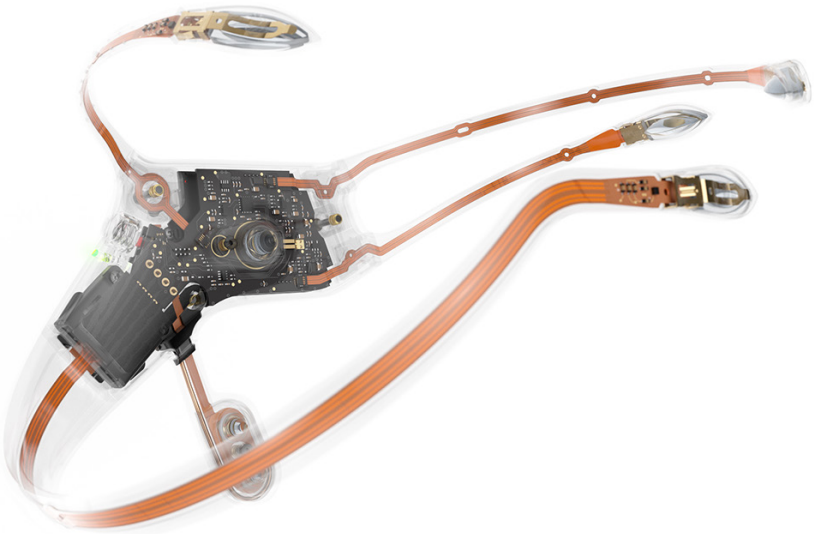


Figure 4.1: Emotiv Insight EEG (top), and model outlining hardware, wiring and sensors (bottom). This EEG has five sensors and two reference points used to monitor both brain waves and six performance metrics.

EMOTIVE SENSING

The first form of sensing technology utilized during this study regards the human brain and perception. Through self-analysis per the use of the Emotiv Insight EEG, cognitive data was gathered across four of the undergraduate residences at the Laurentian University Campus in order to begin to understand the different subconscious emotions of the circulation spaces, social spaces, and apartments. In aiming to map a typical student day on campus, data was gathered both in the morning when students were preparing to leave for class, and evening when they returned from class. The EEG used to gather this data measured six performance metrics including; engagement, interest, focus, stress, relaxation and interest, which is achieved through five electrode sensors analyze three major areas of the brain:

+ **Frontal Lobe:** Executive functions, thinking, planning, organizing and problem solving, emotions and behavioural control.
  [Electrodes AF3 + AF4]
+ **Parietal Lobe:** Responsible for perception, making sense of the world, arithmetic, spelling.
  [Electrode Pz]
+ **Temporal Lobe:** Memory, understanding and language.
  [Electrodes T7 + T8] [21]

It is important to stress that though this analysis provides insight to human emotional responses to space, the data was collected on a personal basis. Knowing this, the data does not speak to all people, but rather offers insight to a student perspective of residence existing residence buildings. Collecting data in this manner is therefore being used solely as a method for understanding space on a subconscious level. It is not seeking to prescribe a clear-cut design, but rather inform design decisions.

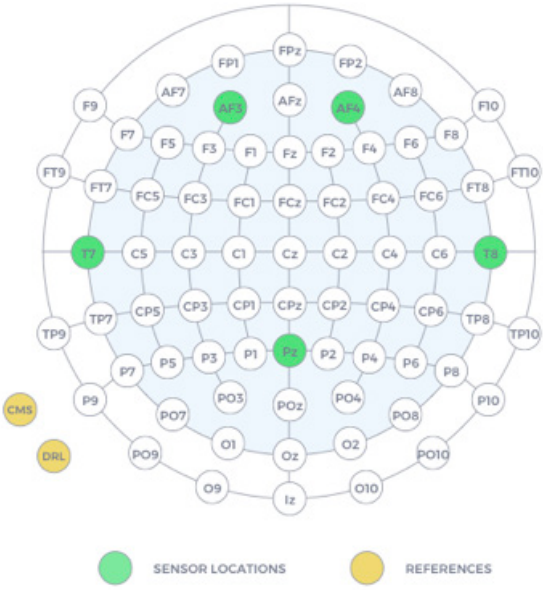


Figure 4.2: Diagram outlining EEG sensor locations.

[21] "Cortical Functions Reference." Trans Cranial Technologies. Wanchai, 2012.

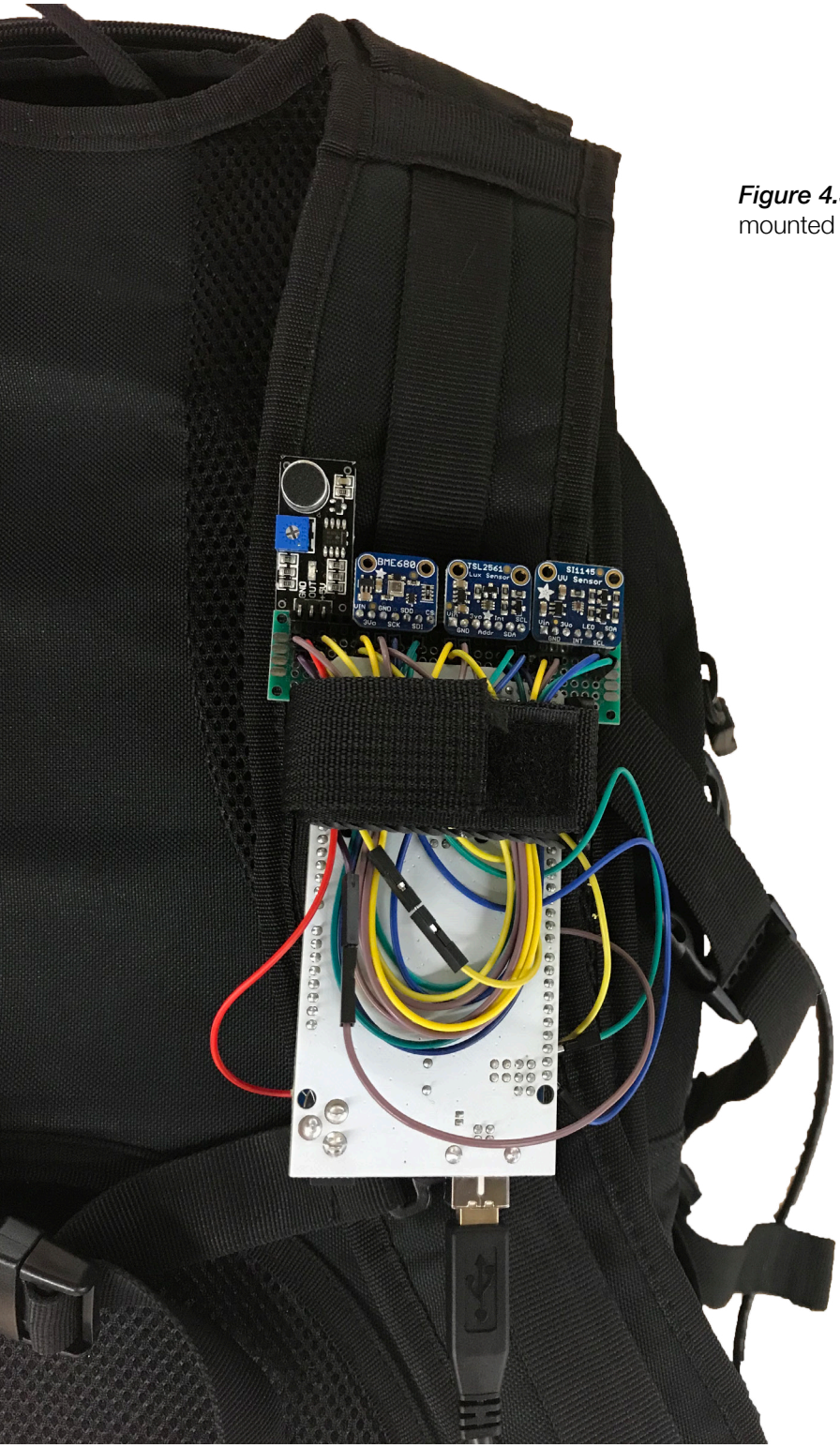


Figure 4.3: Environmental sensor cluster mounted to backpack for data collection.

ENVIRONMENT SENSING

Simultaneously, a cluster of environmental sensors were used to monitor the surrounding conditions within the residences including; temperature, air pressure, humidity, air quality, UV and artificial light. Much like the EEG monitored subconscious human responses, the environmental sensors were used to visualize spatial conditions that are not always discernible. The choices made regarding the conditions that were investigated were based on qualities observed across the two building precedents that proved to be exemplary of having a positive impact on well-being. Aspects of those projects, including having an abundance of natural light, natural air and green space, all contributed to creating spaces that improved the wellness of their inhabitants, and were thus considered in this investigation.

Collecting this second data set is crucial as it provides the opportunity to attempt to quantify human perception as more than subjective instances. By cross-referencing the two data sets, we are able to identify patterns, and therefore recognize the environmental conditions that elicit the respective emotional responses. In order to compare these data sets however, they must first be normalized. This process involved remapping the values between a domain of one and zero, allowing the different metrics to be compared on the same scale. This was achieved through a *Grasshopper* definition in *Rhino,* that would read the data from an Excel spreadsheet, and then re-write it to the same sheet. From there it was possible to graph the data sets and observe the patterns between them. It is through this process that the sensing technologies were used as a design tool. The patterns identified across these data sets will be used to influence design decisions that place focus on fostering improved mental well-being.

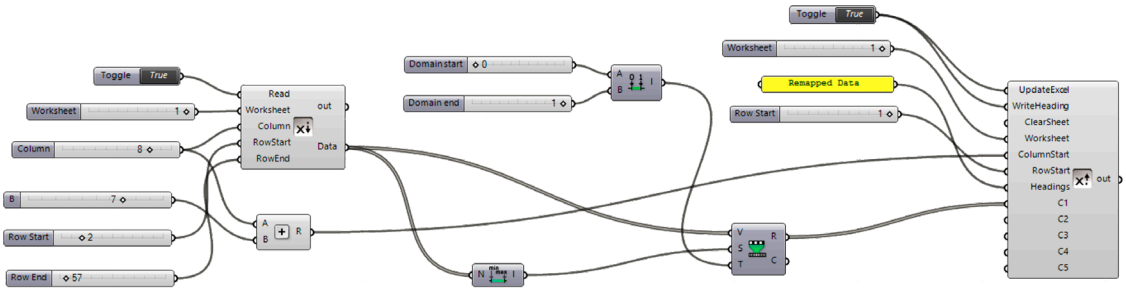


Figure 4.4: Grasshopper definition used to re-map and normalize data sets for comparison.

05

LAURENTIAN UNIVERSITY CAMPUS

Macro-Scale: Mapping + Cataloguing
Micro-Scale: Residence Sensing + Analyses

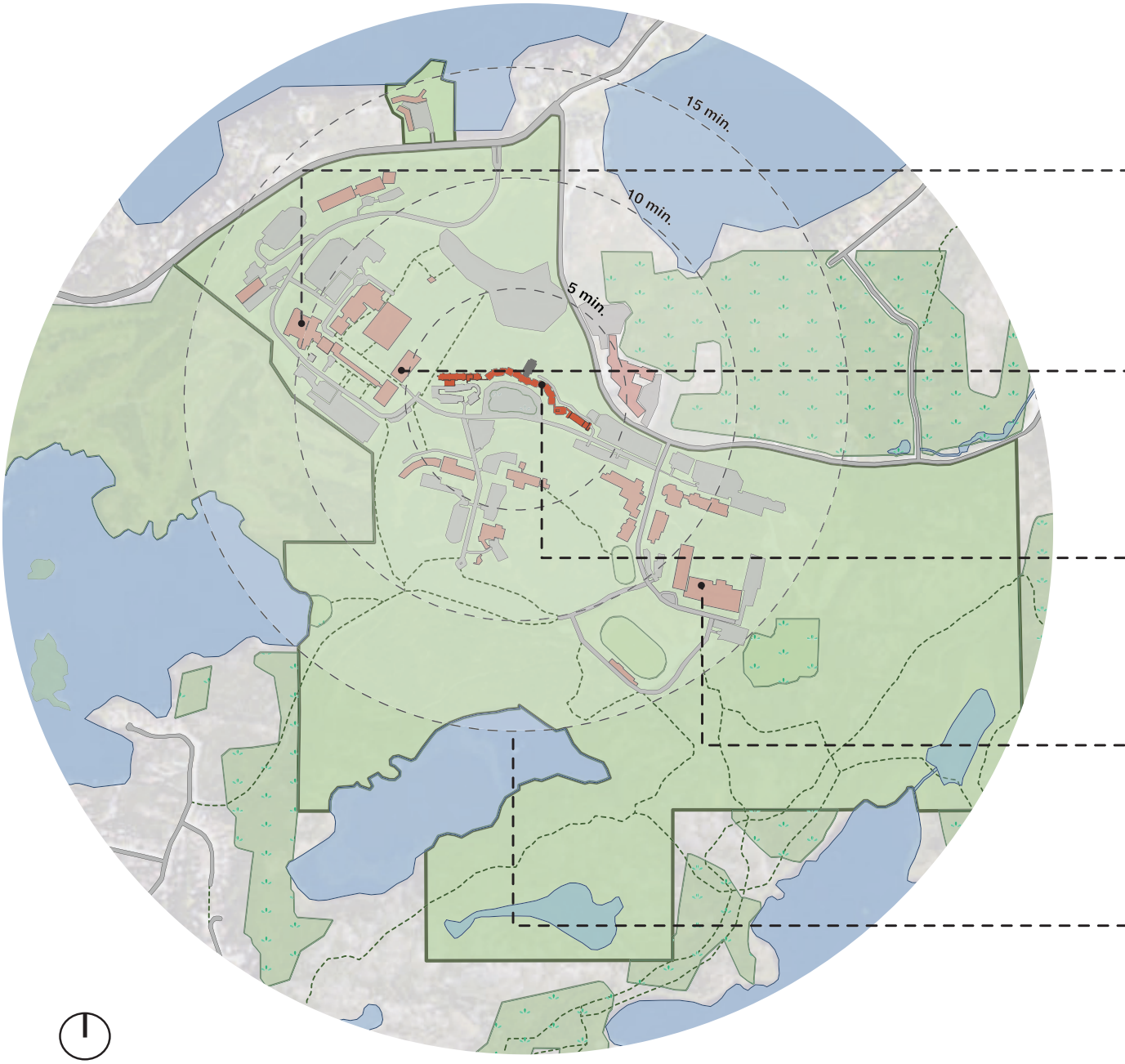
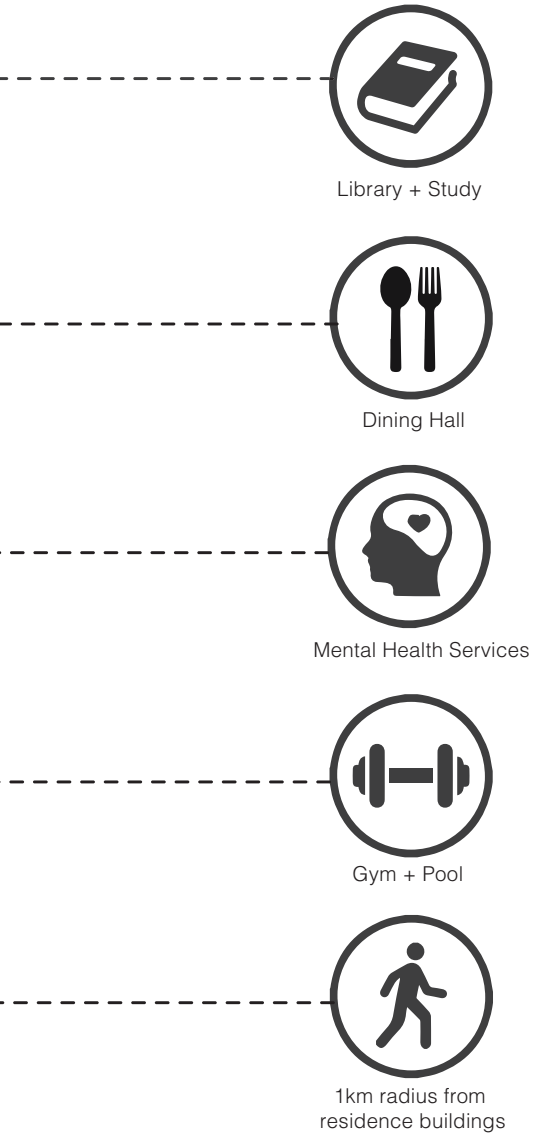


Figure 5.1: Laurentian University campus map outlining amenities within a 15 minute walking radius of student residences. Having easy access to these services can aid in improving mental and physical well-being.

MACRO SCALE: MAPPING + CATALOGUING



There are four main undergraduate residences located on the Laurentian University campus that were the focus of observation throughout this study:

+ University College Residence [UC]
+ Single Student Residence [SSR]
+ West Residence
+ East Residence

The initial analysis of these residences involved forming an understanding of both the building typologies, and their proximity to amenities with the potential to improve mental well-being. The distance each amenity is from a student's dorm can determine whether or not they choose to make use of the service, and thus affect their overall mental state. On the Laurentian campus, the mental health services office is located directly within SSR, providing a huge benefit to anyone seeking guidance and assistance. The main dining hall is also relatively close, approximately a 5-minute walk from the residences. However, both the gym and library are almost a 15-minute walk from the residences in opposite directions. With studies being of high demand, and a majority of students already lacking in physical activity, having these two amenities at such polar distances makes it difficult to make use of both. Students are therefore forced to decide between maintaining their physical health, or focusing on their academics. This is a choice that should not have to be made, as balancing both can contribute to impacting mental well-being positively. In aiming to address issues such as this in a new design, programmatic decisions will place emphasis on providing easier access to these services for students.

MICRO SCALE: RESIDENCE SENSING + ANALYSES

In furthering the analyses of the residences, the focus transitions from a macro-scale to a micro-scale by means of sensing technologies. These sensors were used to gather cognitive and environmental data throughout the circulation spaces, shared communal rooms and apartments in both the morning and evening. The purpose of this investigation was to simulate a typical student day, and in doing so begin to understand the environmental conditions in each building, and how they affect human emotional responses. Provided the restrictions of this method being a self-analysis, in addition to the duration of the data collection period, the aim was not to produce definitive data, but rather begin to offer insight regarding human perception by quantifying it through spatial evaluations. Additionally, the collection of this data intends to substantiate the design decisions made by Aalto and Holl in the buildings studied prior, by presenting figures to support the notions that a building layout centred around natural elements, and social engagement is beneficial in improving well-being. The preceding diagrams are therefore a summation of this process and the research that compliments it. Through both plan and section, the various unit configurations and public spaces were explored in terms of size, materiality and level of social stimulation. In each instance, the fluctuations in emotional responses, as well as environmental conditions, are also identified in their subsequent locations.

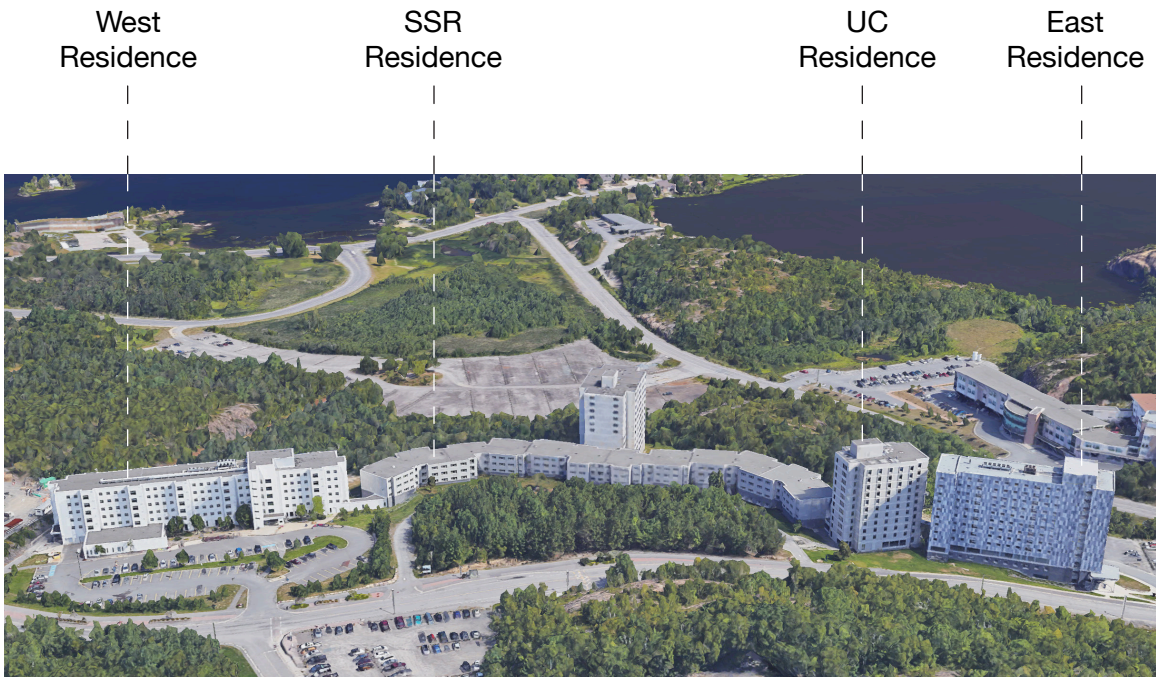


Figure 5.2: Aerial view of the four undergraduate residences at Laurentian University in Sudbury, ON.

West Residence

BUILDING TYPE
6 storey mid-rise building.
Residential, administration, classrooms.
Main level consisting of auxiliary spaces and amenities, remaining upper levels used as residential space and study rooms.
Air-conditioned with two elevators.

YEAR OF CONSTRUCTION
2006

NUMBER OF STUDENTS
223 students

NUMBER OF UNITS
55 self-contained apartments

TYPE OF UNITS
TYPE A: 5 single apartments with one bedroom, bathroom, kitchen and living area.
TYPE B: 50 self-contained apartments with 4 bedrooms, 2 bathrooms, kitchen and living area.

SIZE OF UNITS
TYPE A: 38.86 m^2 (1 student)
TYPE B: 91.33 m^2 (4 students)

LAYOUT
Five floors of double loaded corridors with self-contained apartments on each side. Communal study/lounge in the centre of each floor. Main level acts as circulation space with offices, small classrooms, an events room, laundry and public washrooms.

PUBLIC AMENITIES
Study/classrooms
Public washrooms
Laundry
Residence offices
Mailboxes

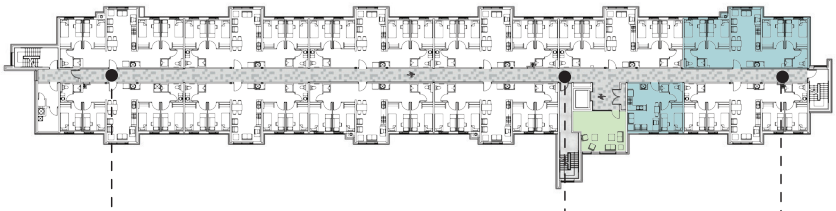
RESIDENCE LEVEL PUBLIC SPACES
Study room/lounge on each residential level

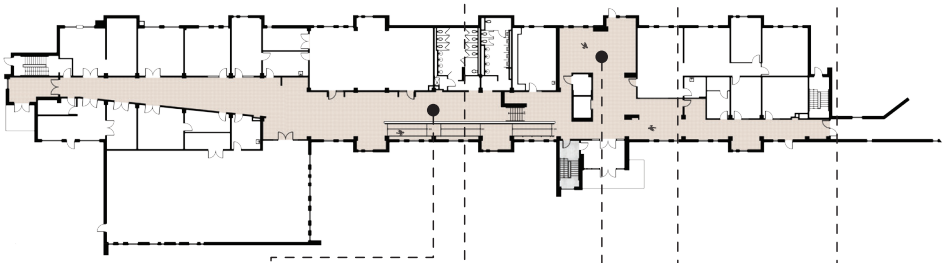
MATERIALS
Concrete block
Drywall
Vinyl Tile
Acoustic Tile Ceiling

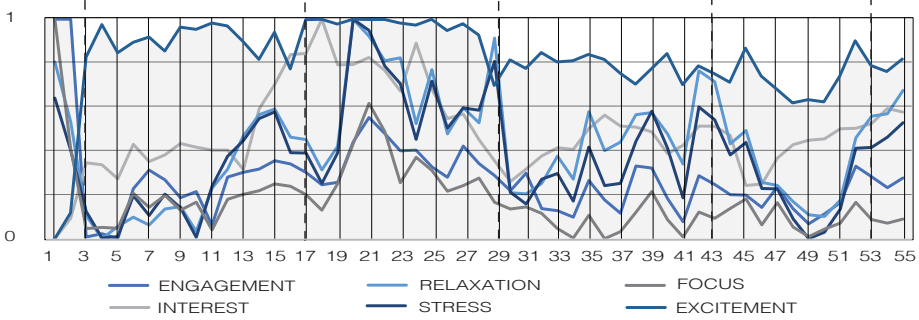
9:00 AM

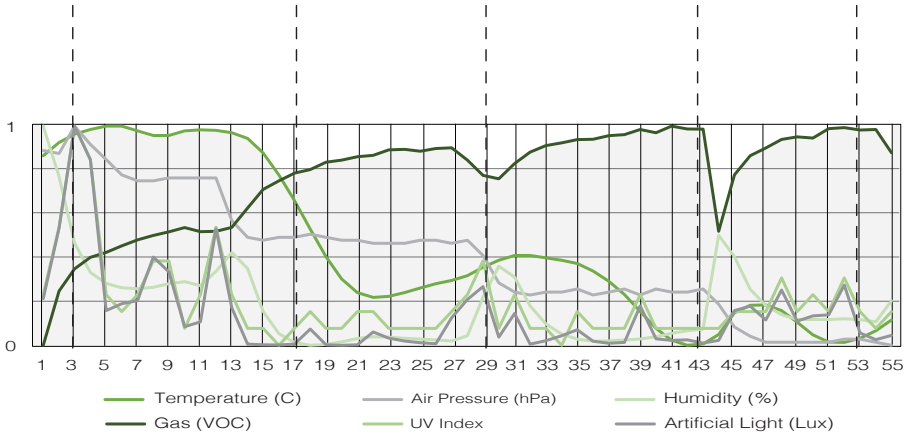
YEAR OF CONSTRUCTION
2006

BUILDING TYPE
6 storey mid-rise building.
Residential, administration, classrooms.
Main level consisting of auxiliary spaces and amenities, remaining upper levels used as residential space and study rooms.
Air-conditioned with two elevators.

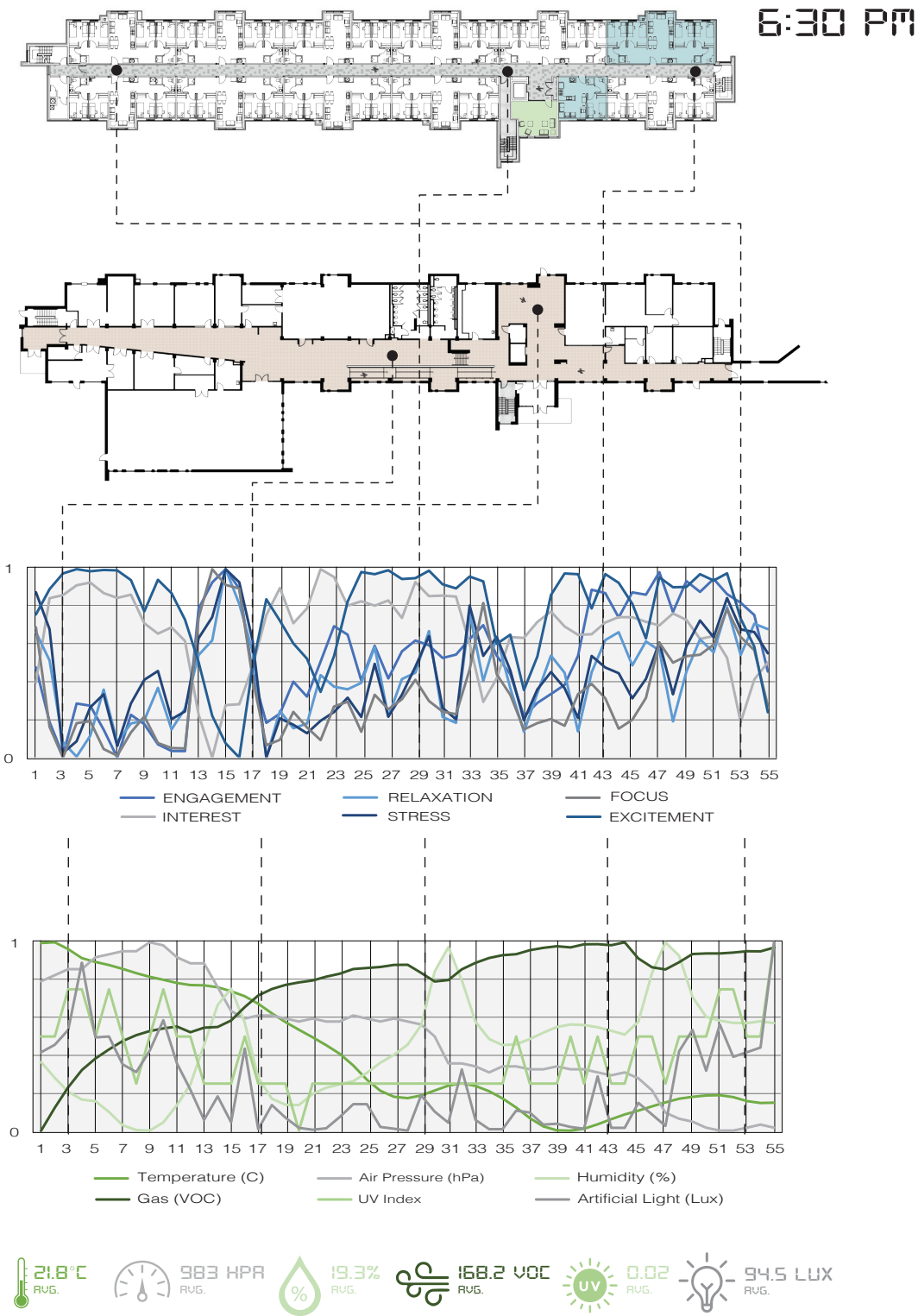








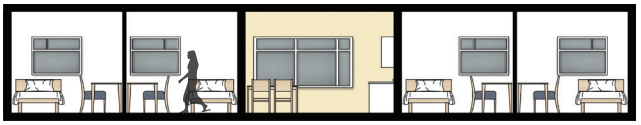
20.9°C AVG. | 986 HPA AVG. | 13.8% AVG. | 174.5 VOC AVG. | 0.03 AVG. | 223.9 LUX AVG.

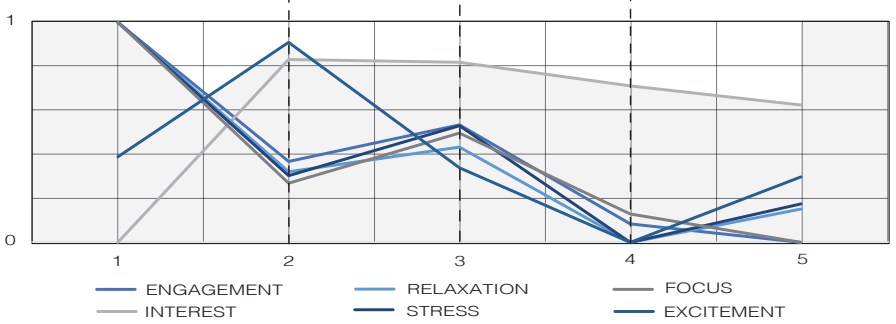

6:30 PM
1
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55
ENGAGEMENT
RELAXATION
FOCUS
INTEREST
STRESS
EXCITEMENT
1
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55
Temperature (C)
Air Pressure (hPa)
Humidity (%)
Gas (VOC)
UV Index
Artificial Light (Lux)
21.8°C AVG.
983 HPA AVG.
19.3% AVG.
168.2 VOC AVG.
0.02 AVG.
94.5 LUX AVG.

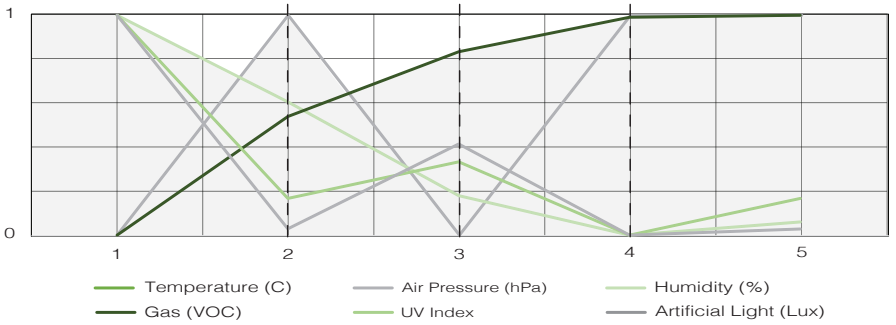
9:15 AM

TYPE A
50 self-contained apartments with 4 bedrooms, 2 bathrooms, kitchen and living area.

SIZE
TYPE B: 91.33 m2
(4 students)







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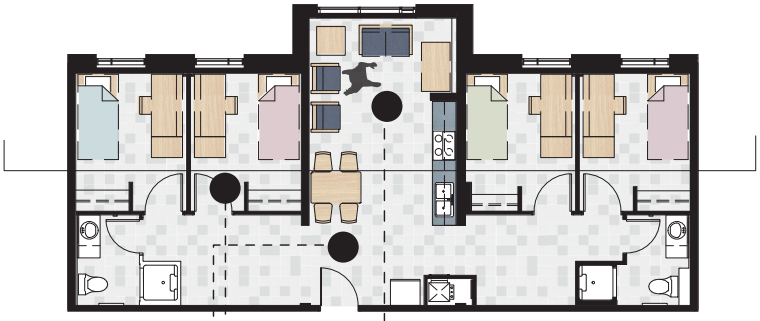
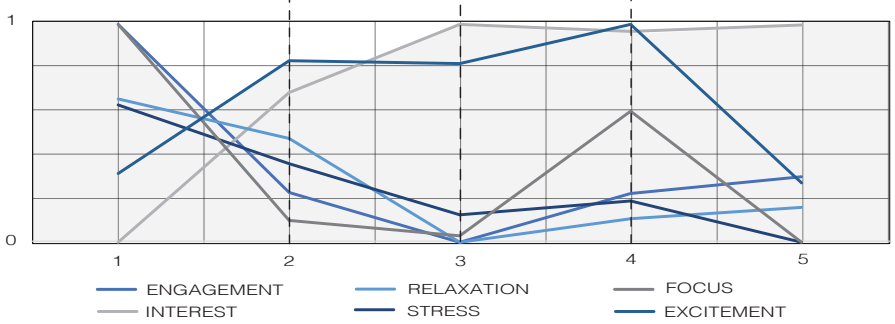
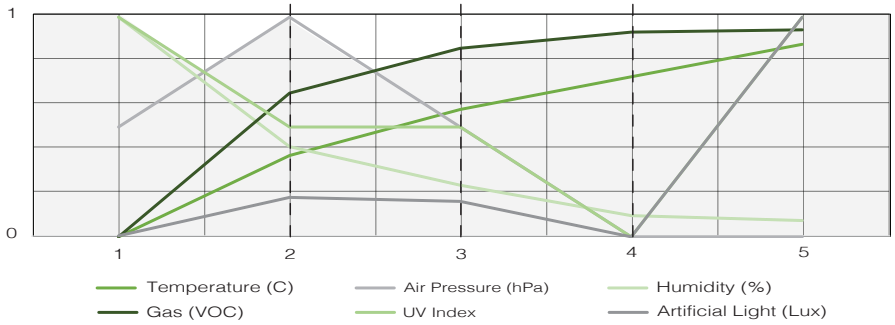




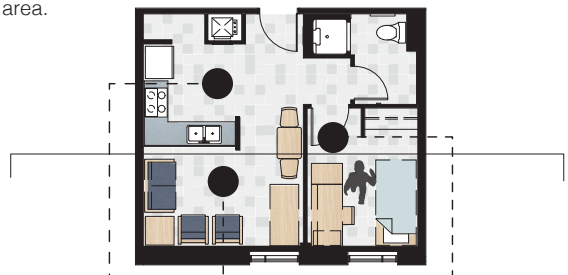


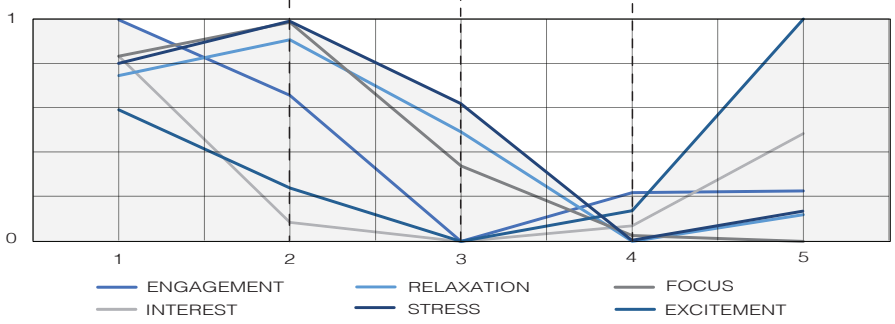
21.5°C AVG. 982 HPA AVG. 23.9% AVG. 147.8 VOC AVG. 0.02 AVG. 70.8 LUX AVG.

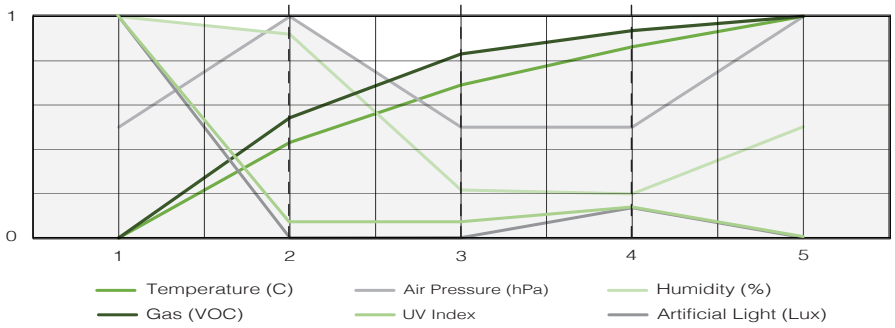
9:30 AM

TYPE B
5 single apartments with one bedroom, bathroom, kitchen and living area.

SIZE
38.86 m2
(1 student)

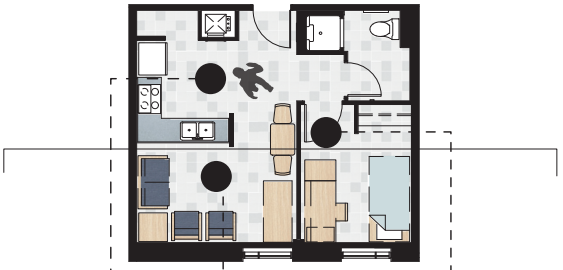


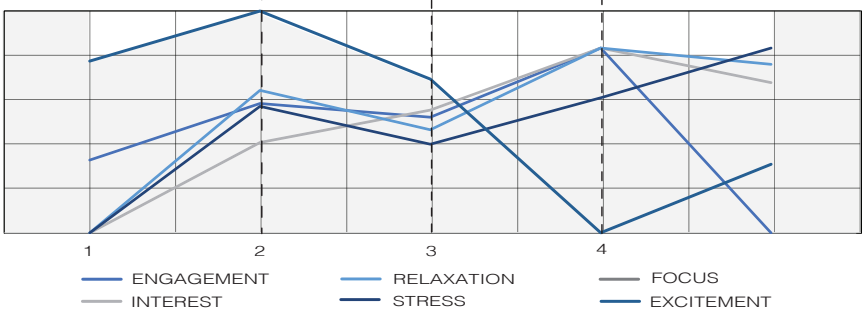


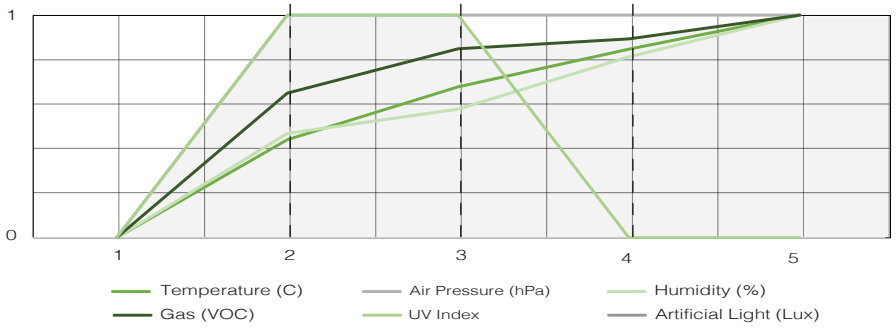


21.5°C AVG. | 986 HPA AVG. | 29.7% AVG. | 96.9 VOC AVG. | 0.04 AVG. | 395.6 LUX AVG.

6:50 PM



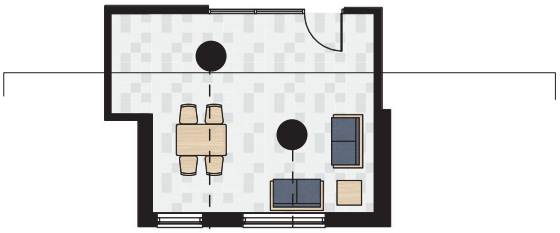


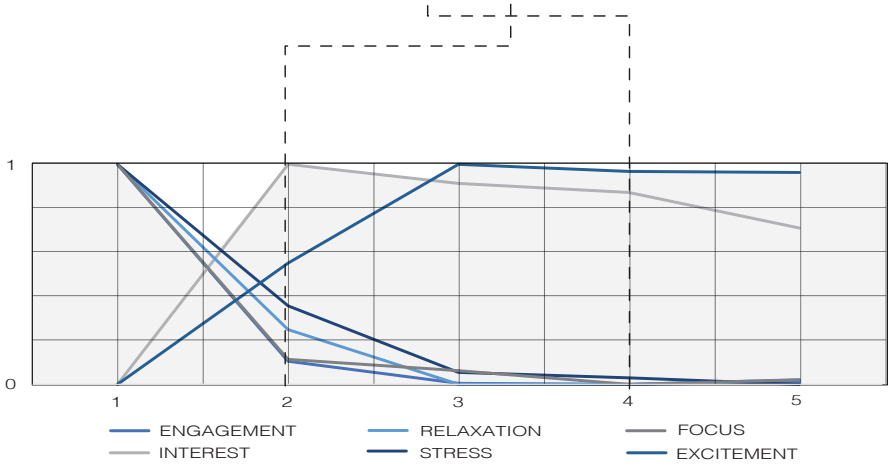


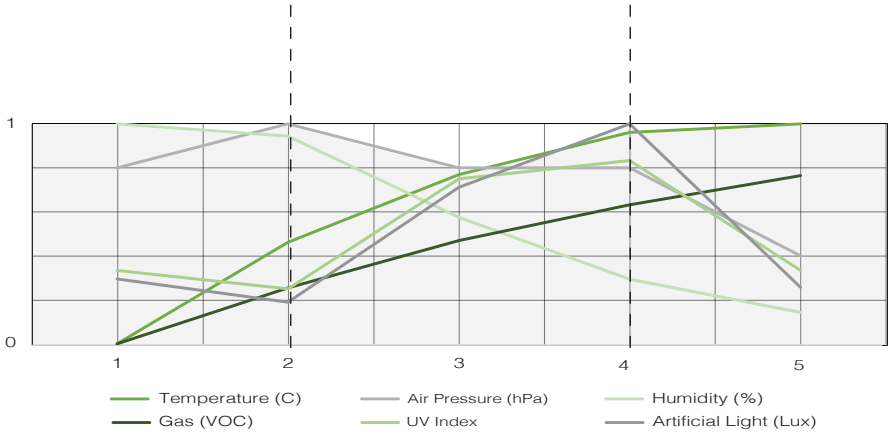
21.8°C AVG. 982 HPA AVG. 24.5% AVG. 122.7 VOC AVG. UV 0.02 AVG. 88 LUX AVG.

9:45 AM

COMMON ROOM
29.9 m2
1 on each floor, available to all students

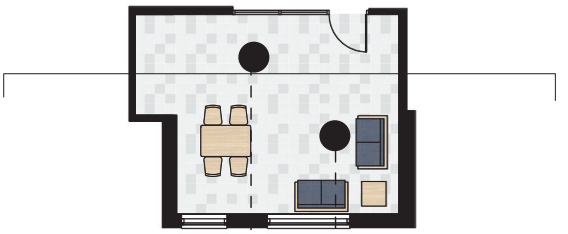


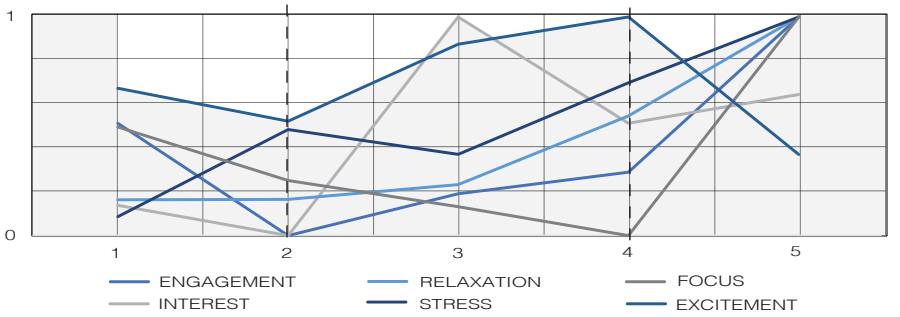


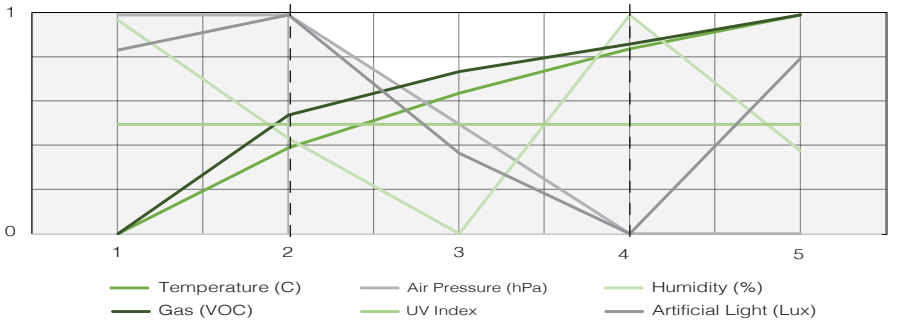


24.6°C AVG. | 985 HPA AVG. | 14.3% AVG. | 61.4 VOC AVG. | 0.11 AVG. | 1103.8 LUX AVG.

7:00 PM







22.4°C AVG. 981 HPA AVG. 20.1% AVG. 128 VOC AVG. 0.04 AVG. 275.8 LUX AVG.

Single Student Residence

BUILDING TYPE
3 storey low-rise building.
Residential, food services, study, administration.
Main level consisting of auxiliary spaces and amenities, known as “student street”.
Upper three levels used as three blocks of residential space denoted as “J-Block”, “B-Block”, “M-Block”.
Not air conditioned, no elevator.

YEAR OF CONSTRUCTION
1973
2014 (building renovation)

NUMBER OF STUDENTS
387 students

NUMBER OF UNITS
72 mixed units consisting of single and double rooms, 4 or 6 students per room.
8 units per block across three floors.

TYPE OF UNITS
TYPE A: 54, six-person apartments with 2 double bedrooms, 2 single bedrooms, 2 bathrooms, kitchen and living area.
TYPE B: 18, four-person apartments with 2 double bedrooms, 2 bathrooms, kitchen and living area.

SIZE OF UNITS
TYPE A: 94.5 m^2 (6 students)
TYPE B: 68.9 m^2 (4 students)

LAYOUT
Three floors consisting of disconnected blocks of residential space with meandering double loaded corridors. Main level acts as circulation space, making up the majority of what is called “Student Street”. This public level consists of building services and amenities accessible to all students, as well as acts as circulation space that connects all the residences together.

PUBLIC AMENITIES
Convenience Store
Food
Games Rooms
Laundry
Public Washrooms
Study rooms
Mental Health Services
Mailboxes

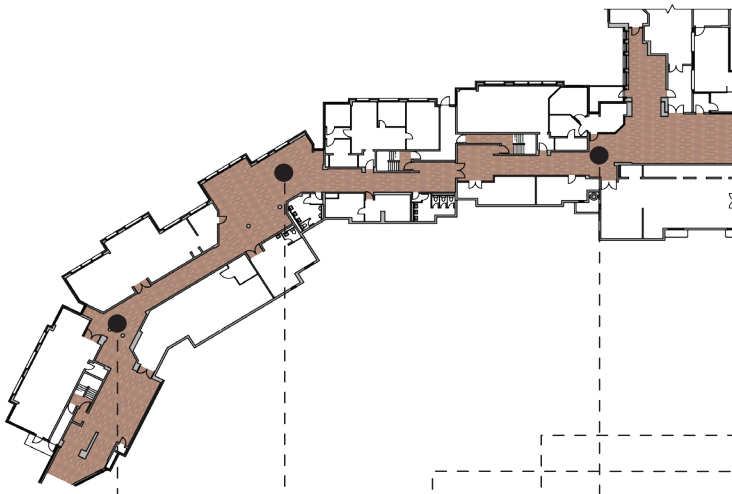
RESIDENT LEVEL PUBLIC SPACES
No public space on residential levels

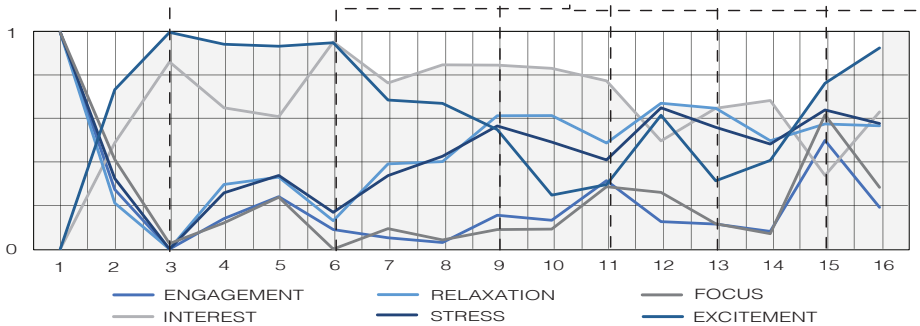
MATERIALS
Brick
Vinyl Tile
Drywall
Acoustic Tile Ceiling
Fabric Pillars

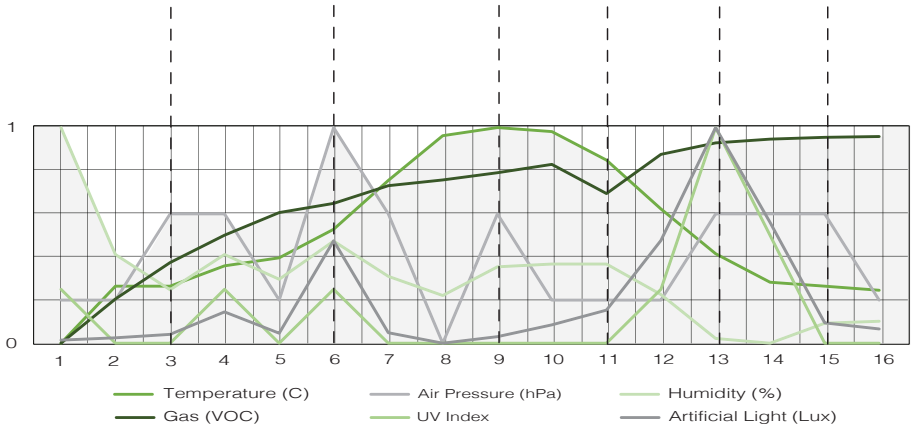
10:00 AM

YEAR OF CONSTRUCTION
1973
2014 (building renovation)

BUILDING TYPE
3 storey low-rise building.
Residential, food services, study, administration.
Main level consisting of auxiliary spaces and amenities, known as “student street”. Upper three levels used as three blocks of residential space denoted as “J-Block”, “B-Block”, “M-Block”.
Not air conditioned, no elevator.

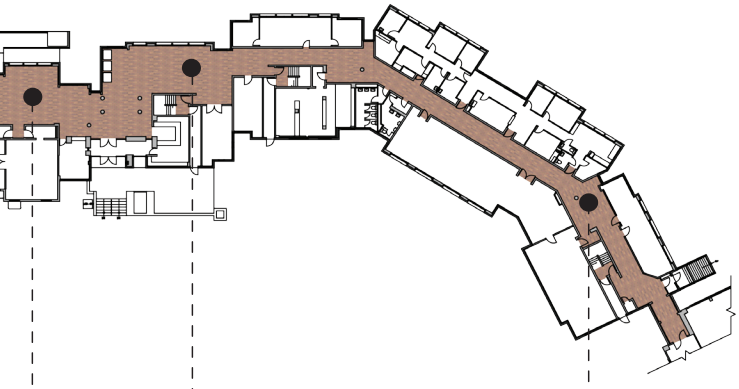


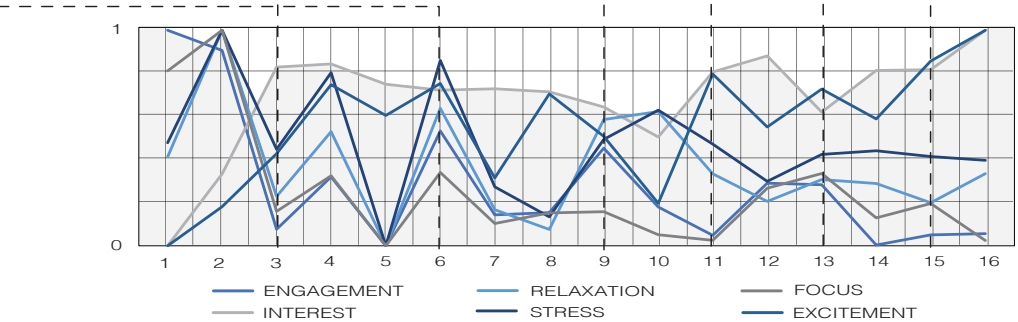


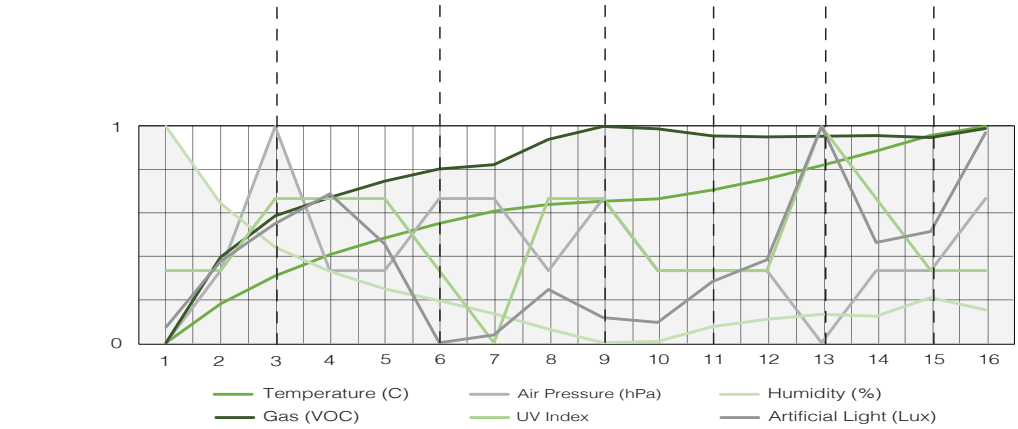


24.7°C AVG. | 987 HPA AVG. | 16.2% AVG. | 111.1 VOC AVG. | 0.03 AVG. | 162.1 LUX AVG.

6:00 PM



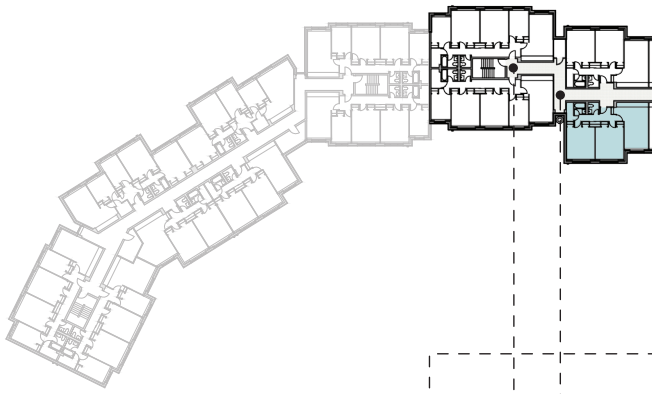


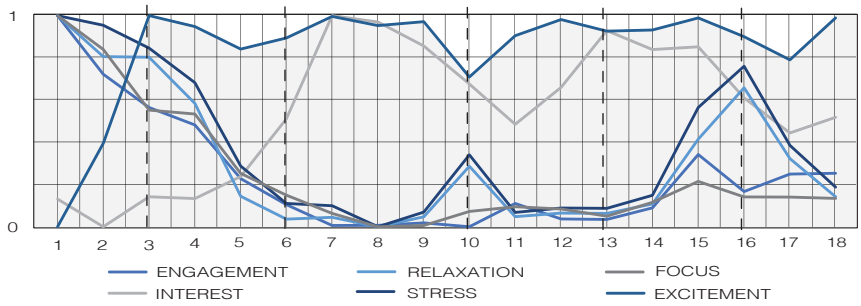


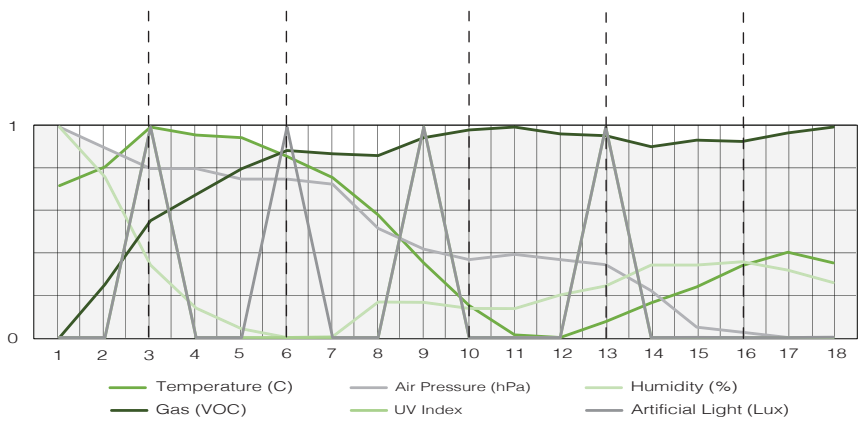
23.3°C AVG. 983 HPA AVG. 21.1% AVG. 135.4 VOC AVG. 0.02 AVG. 81.9 LUX AVG.

10:15 AM

"B-BLOCK" CIRCULATION
Double loaded corridors
across three levels.

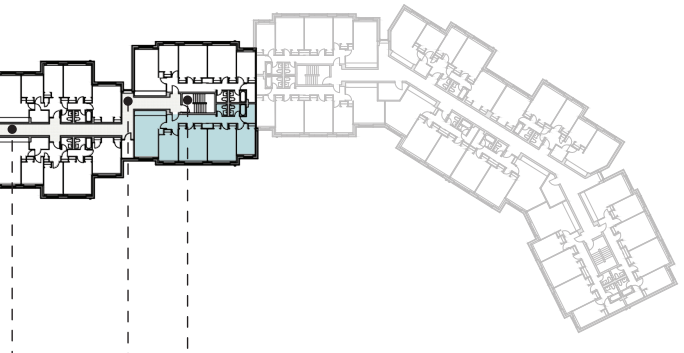


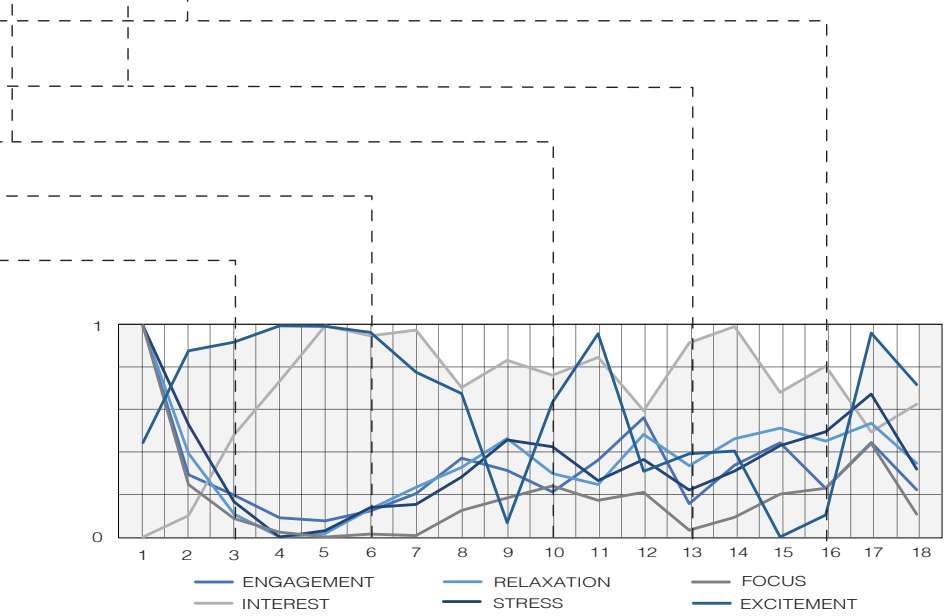


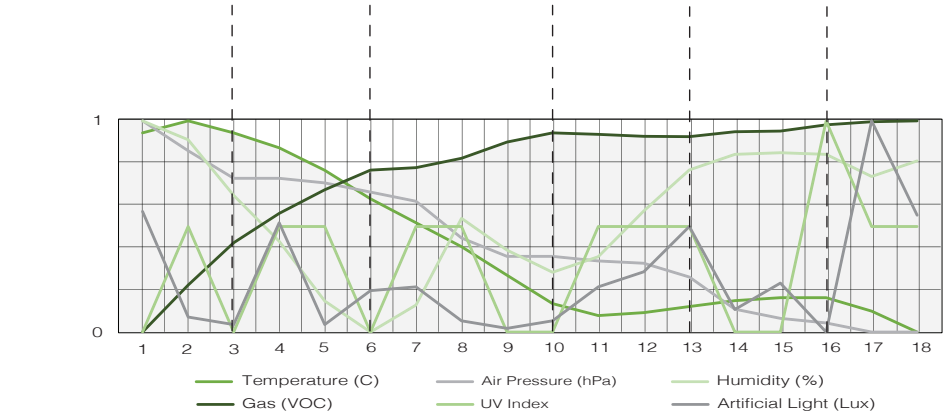


24.5°C AVG. 986 HPA AVG. 16.4% AVG. 134.9 VOC AVG. 98.3 AVG. 13126 LUX AVG.

6:15 PM

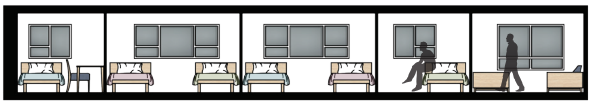






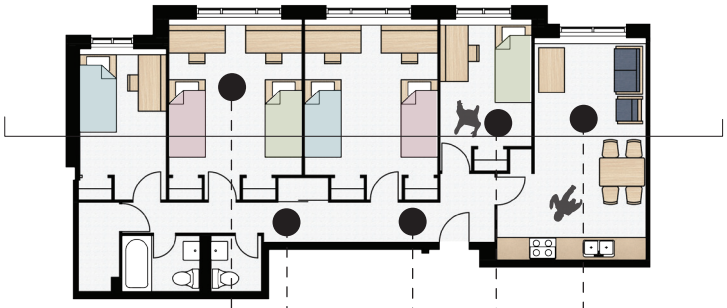
24.6°C AVG. 983 HPA AVG. 19.4% AVG. 124.1 VOC AVG. 0.02 AVG. 17.5 LUX AVG.

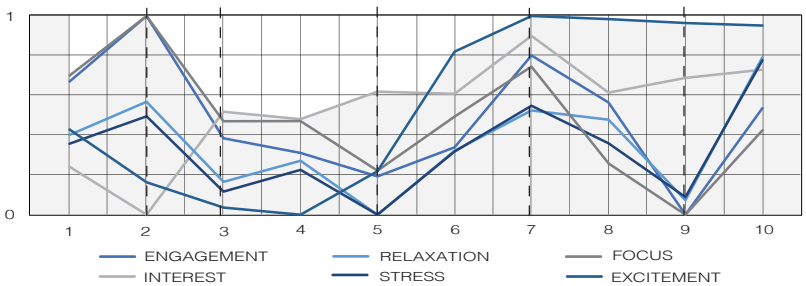
10:20 AM

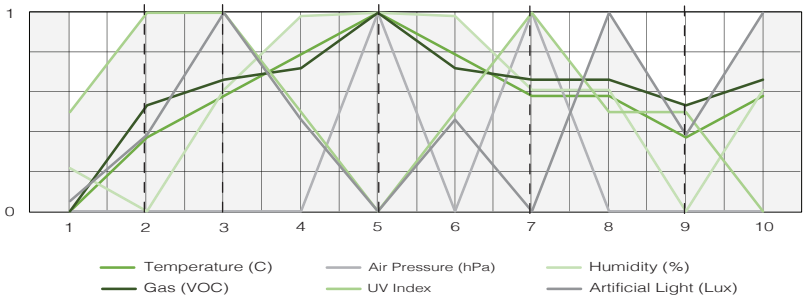


UNIT TYPE A
54, six-person apartments with 2 double bedrooms, 2 single bedrooms, 2 bathrooms, kitchen and living area.

SIZE
94.5 m2 (6 students)

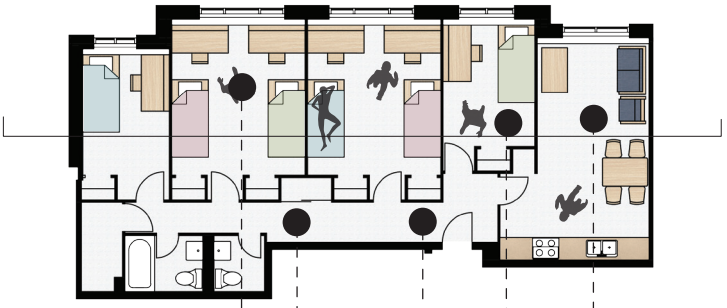


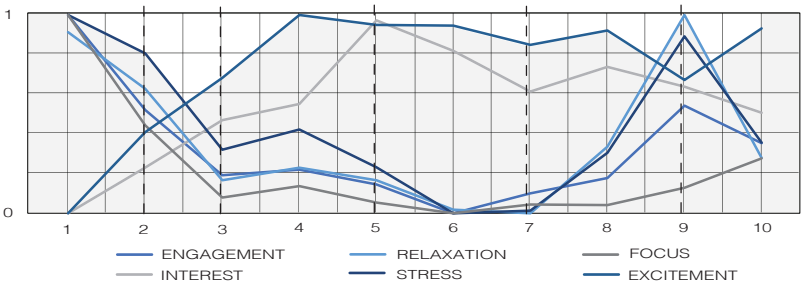


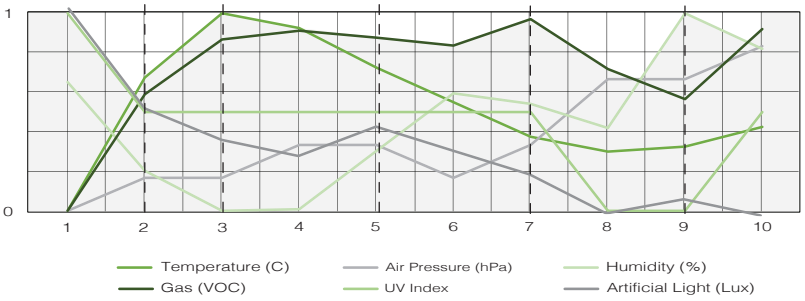


12.6°C AVG. 986 HPA AVG. 30.7% AVG. 68.9 VOC AVG. UV 0.02 AVG. 27.8 LUX AVG.

6:20 PM





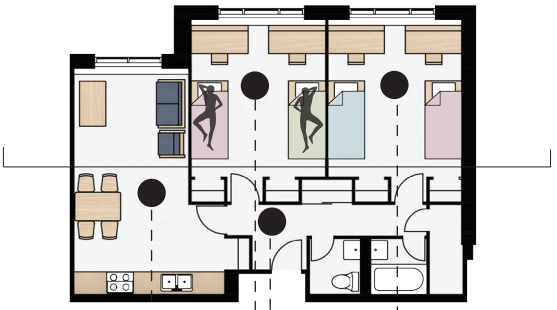


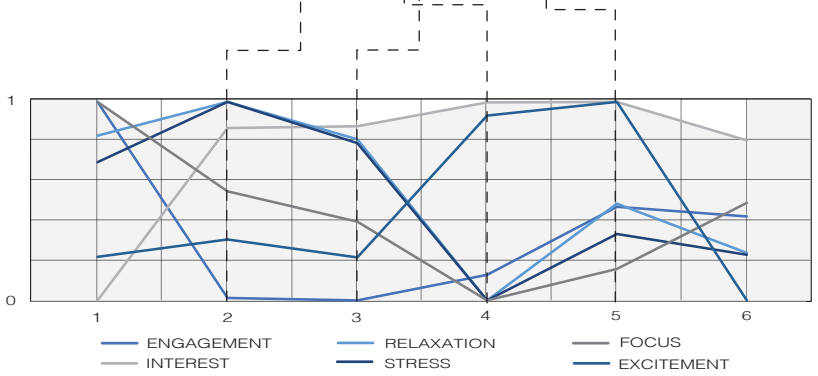
23.9°C AVG. 983 HPA AVG. 26.1% AVG. 118.7 VOC AVG. 0.02 AVG. 8.8 LUX AVG.

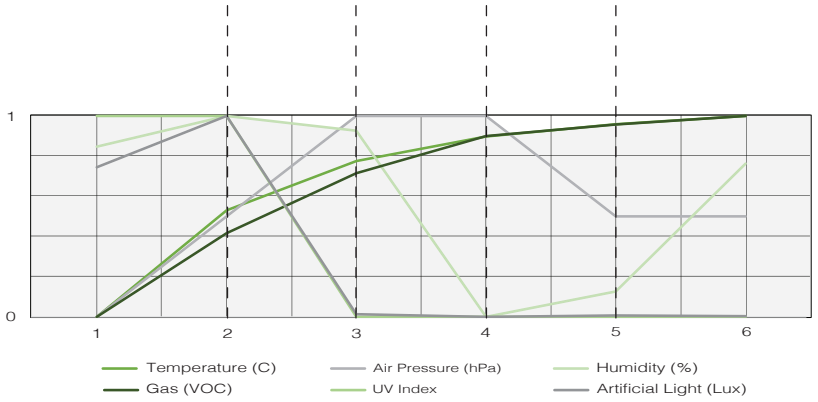
10:25 AM

UNIT TYPE B
18, four-person apartments with 2 double bedrooms, 2 bathrooms, kitchen and living area.

SIZE
68.9 m2 (4 students)

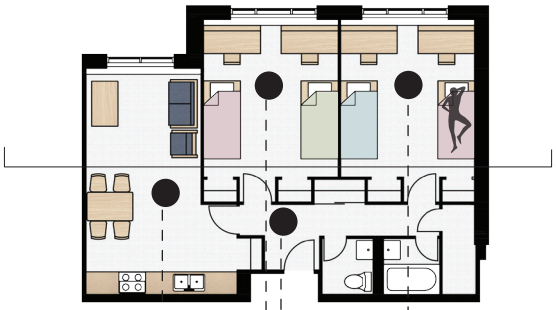


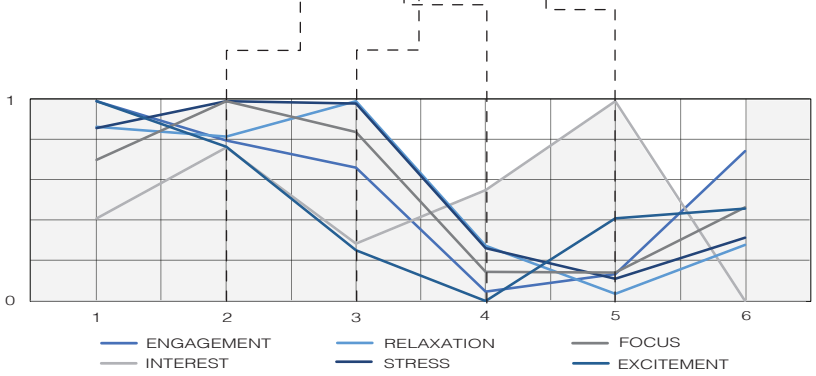


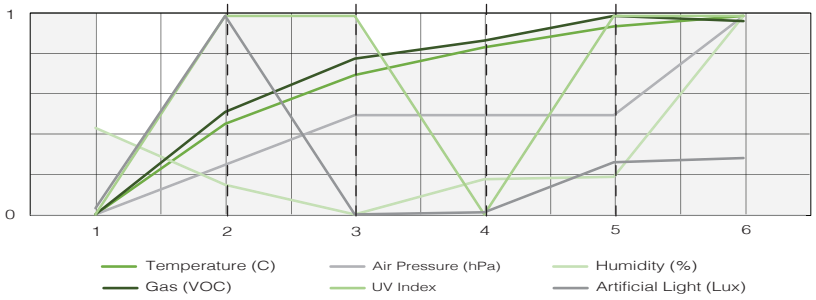


24.6°C AVG. 986 HPA AVG. 24.5% AVG. 84.7 VOC AVG. 0.04 AVG. 264 LUX AVG.

6:25 PM







24.5 °C AVG. 983 HPA AVG. 23.3% AVG. 103.6 VOC AVG. 0.02 AVG. 26.2 LUX AVG.

University College Residence

BUILDING TYPE
11 storey high-rise building.
Residential, study.
Main level consisting of public entrance and connection to “Student Street”. Remaining upper levels used as residential space with communal kitchen, lounge, and public washrooms on each floor.
Not air-conditioned with two elevators

YEAR OF CONSTRUCTION
1969

NUMBER OF STUDENTS
240 students

NUMBER OF UNITS
150 units consisting of 100 “dorm style” double bedrooms and 50 single bedrooms.
15 units per floor

TYPE OF UNITS
TYPE A: 100, “dorm style” double bedrooms consisting of two beds and two desks
TYPE B: 50, single bedrooms consisting of one bed and one desk

SIZE OF UNITS
TYPE A: 16.4 m^2 (2 students)
TYPE B: 10 m^2 (1 student)

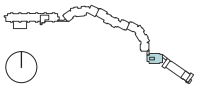
LAYOUT
11 floors consisting of a main level of circulation space, and 10 levels of residential space. Each residential level is a rectangular loop of double and single bedrooms with a communal kitchen and lounge, public washrooms of alternating gender per floor, and laundry on even floors.

PUBLIC AMENITIES
Mailboxes
Laundry

RESIDENT LEVEL PUBLIC SPACES
Communal kitchen
Lounge room

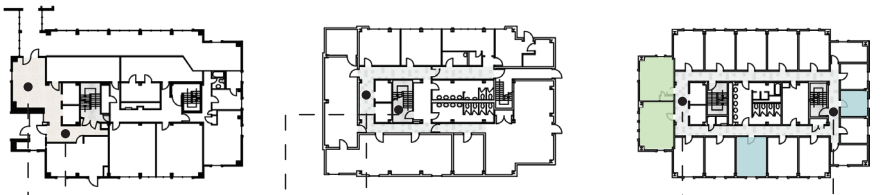
MATERIALS
Concrete block
Drywall
Vinyl Tile
Acoustic Tile Ceiling

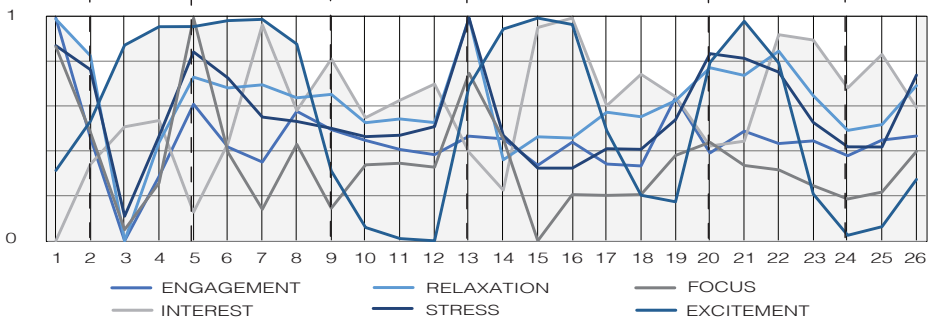
10:30 AM

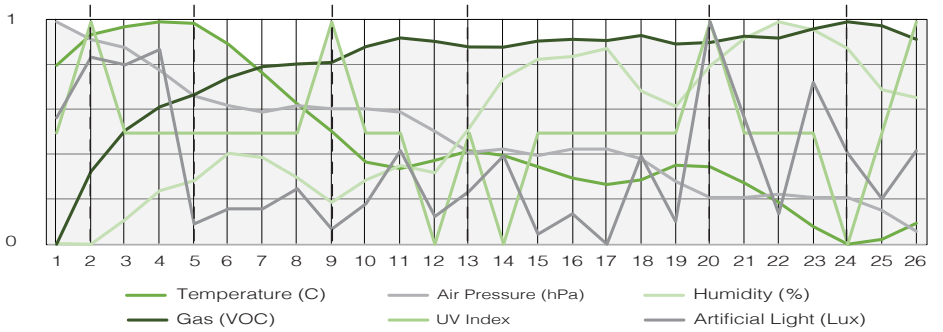


YEAR OF CONSTRUCTION
1969

BUILDING TYPE
11 storey high-rise building. Residential, study. Main level consisting of public entrance and connection to “Student Street”. Remaining upper levels used as residential space with communal kitchen, lounge, and public washrooms on each floor. Not air-conditioned with two elevators

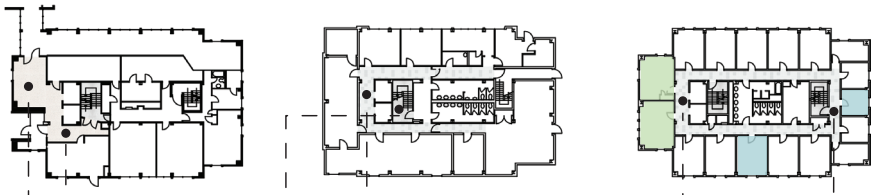


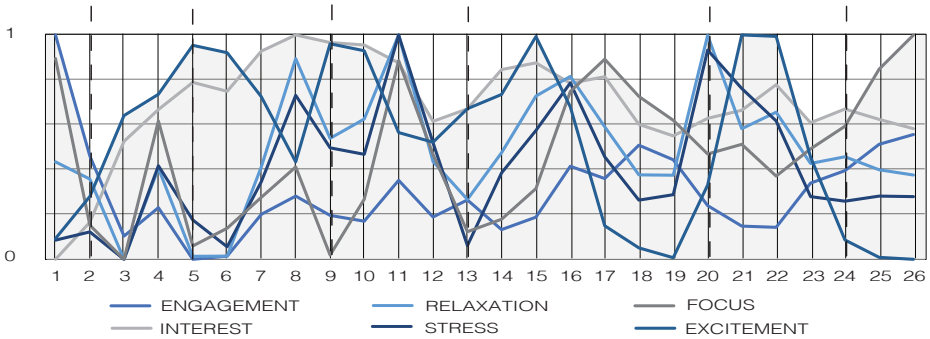


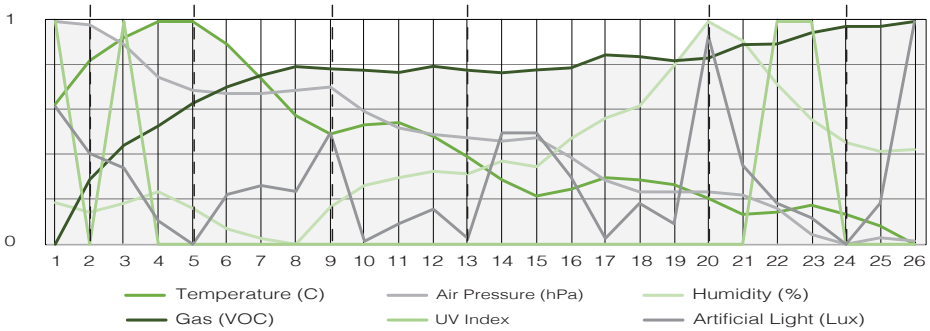


22.6°C AVG. | 986 HPA AVG. | 19.1% AVG. | 141.8 VOC AVG. | 0.02 AVG. | 35.3 LUX AVG.

5:30 PM



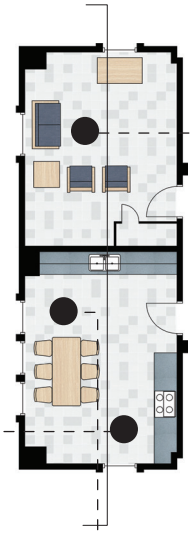


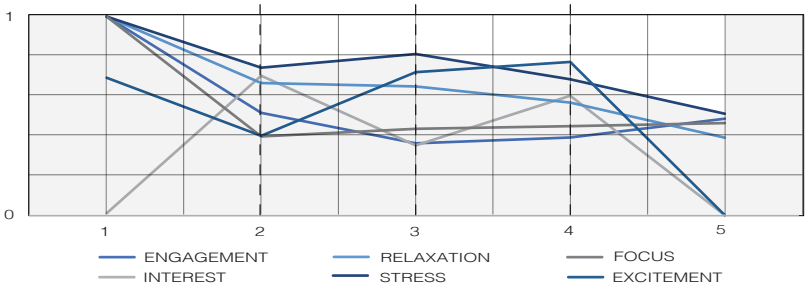


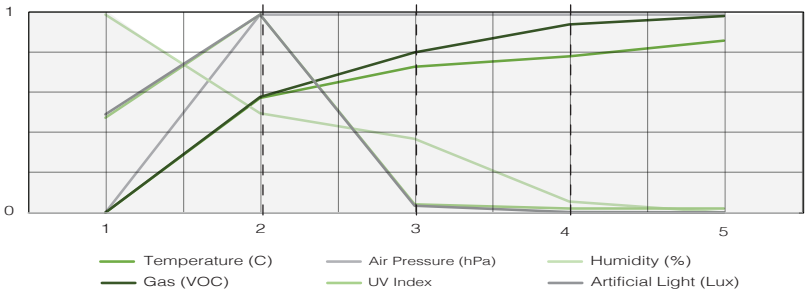
22.2°C AVG. | 982 HPA AVG. | 23% AVG. | 137.6 VOC AVG. | 0.02 AVG. | 258.4 LUX AVG.

10:40 AM

COMMON AREAS
Shared kitchen and lounge on each floor.

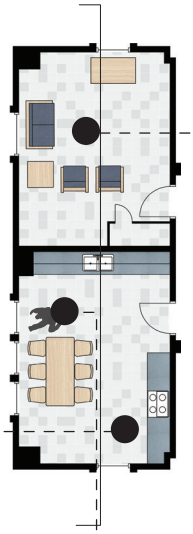


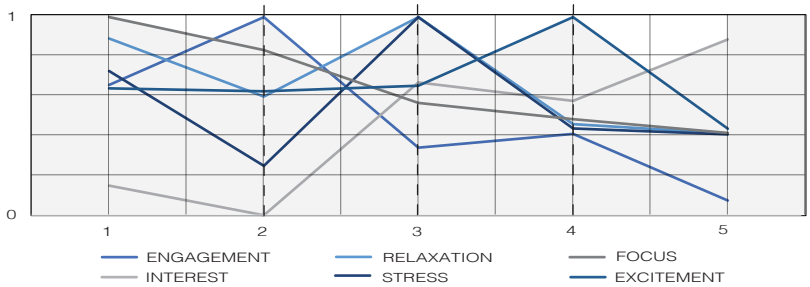


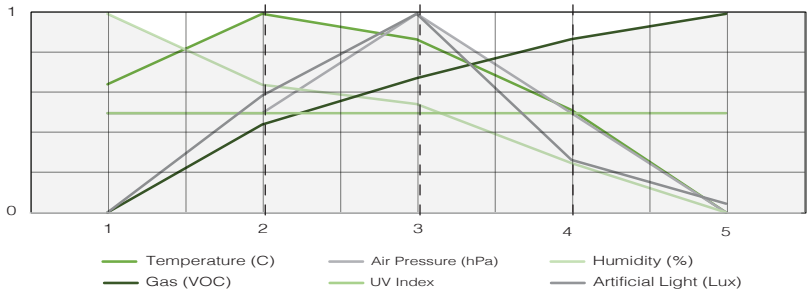


21.6°C AVG. | 985 HPA AVG. | 23.5% AVG. | 113.9 VOC AVG. | 0.09 AVG. | 1086.2 LUX AVG.

5:40 PM





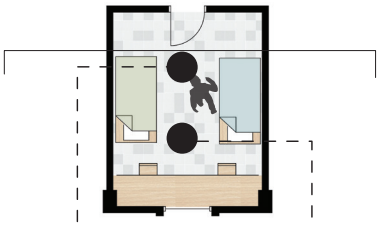


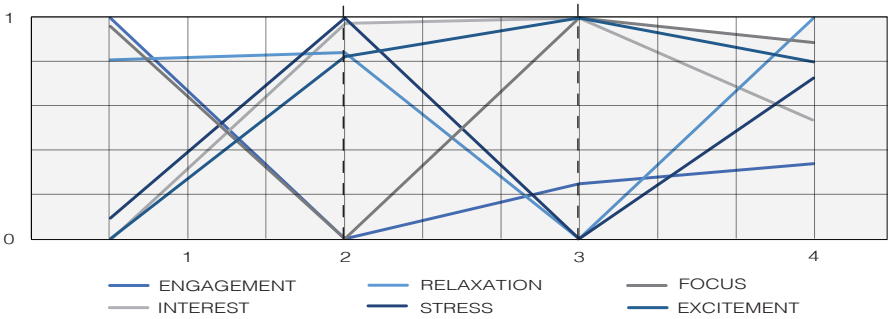
22.2°C AVG. 982 HPA AVG. 29.1% AVG. 96.8 VOC AVG. 0.02 AVG. 36.8 LUX AVG.

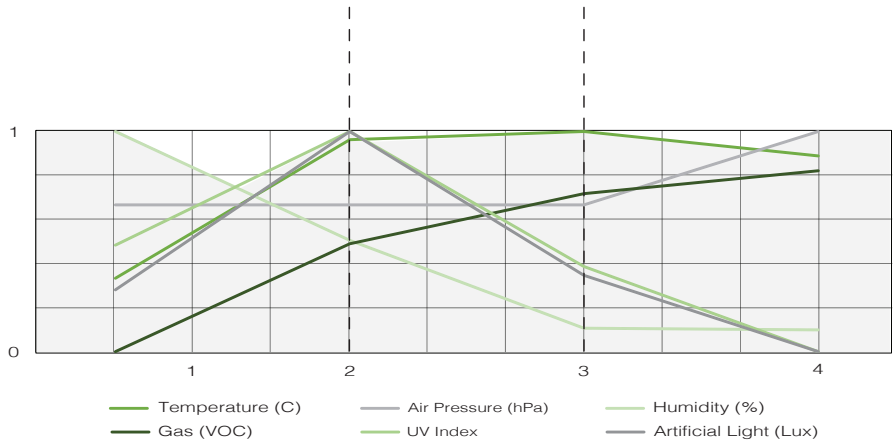
10:45 AM

TYPE A
"Dorm Style" double bedrooms with two beds and two desks

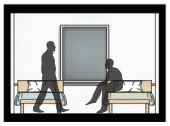
SIZE
16.4m2 (2 students)







22.8°C AVG. 986 HPA AVG. 23.6% AVG. 57.5 VOC AVG. 0.03 AVG. 290 LUX AVG.



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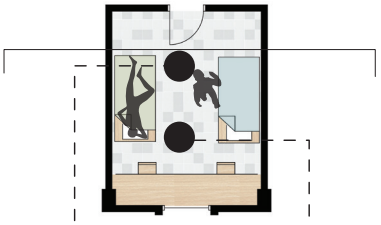
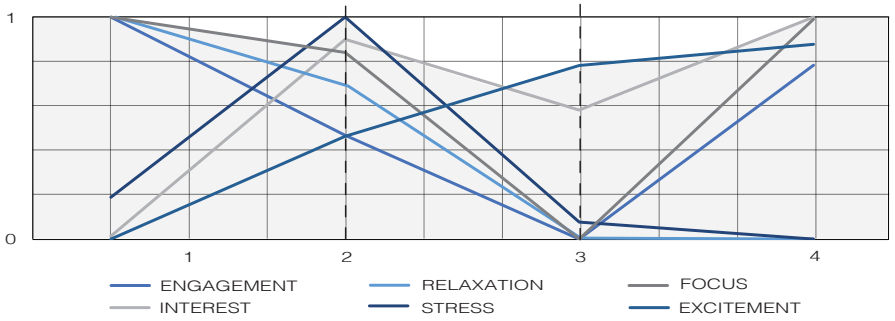
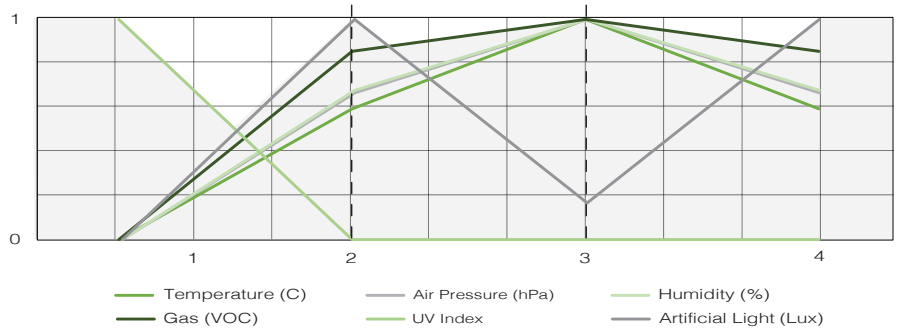




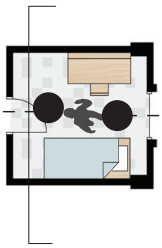


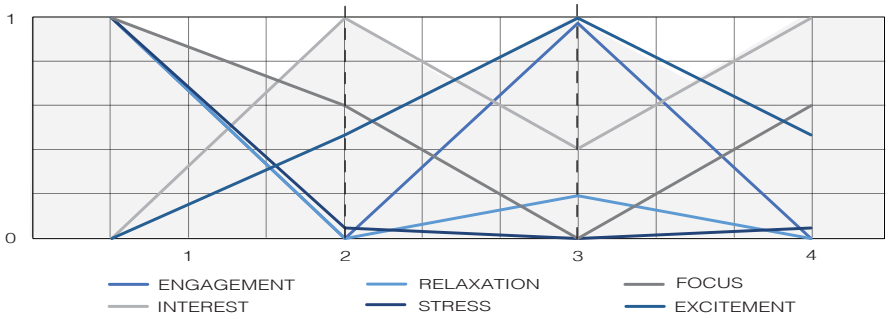
22.1 C AVG. 982 HPA AVG. 32.9% AVG. 88.2 VOC AVG. 0.01 AVG. 4.8 LUX AVG.

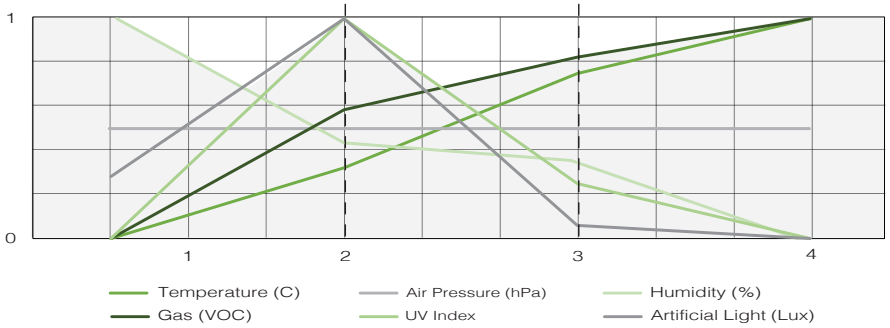
10:50 AM

TYPE B
Single bedroom with one bed and one desks

SIZE
10 m2 (1 student)

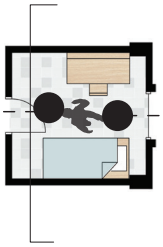


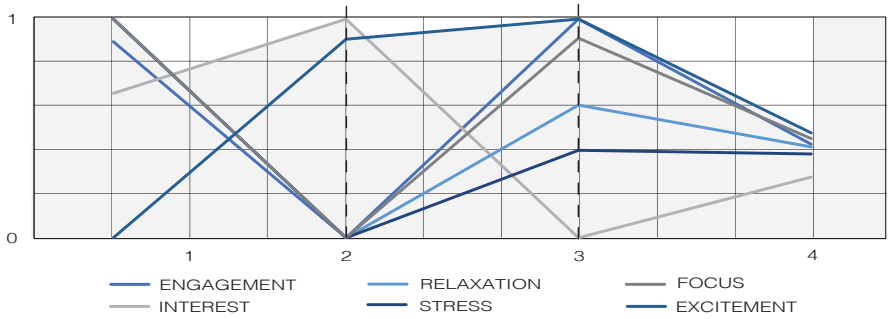


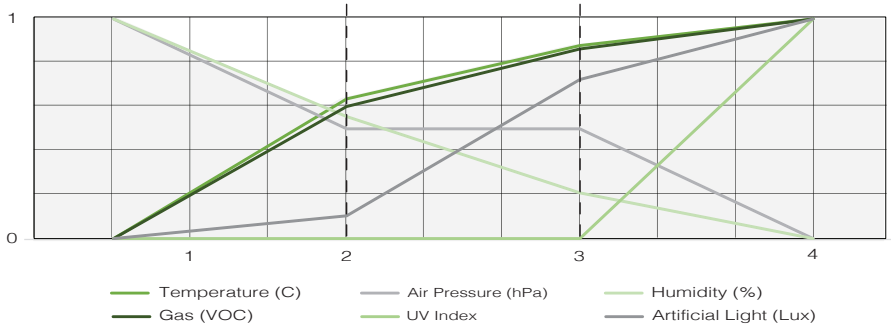


22.3°C AVG. 986 HPA AVG. 21.5% AVG. 111.3 VOC AVG. 0.09 AVG. 894.7 LUX AVG.

5:50 PM







22.7°C AVG. 982 HPA AVG. 26.5% AVG. 93.1 VOC AVG. 0.02 AVG. 27.3 LUX AVG.

East Residence

BUILDING TYPE
11 storey high-rise apartment building.
Residential, food services, study, administration.
Main level consisting of circulation space, bistro and lounge, second level acting as a connection to “Student Street” with some residential space, and remaining floors as residential space.
Air-conditioned with two elevators

YEAR OF CONSTRUCTION
2012

NUMBER OF STUDENTS
236 students

NUMBER OF UNITS
56 self-contained apartments

TYPE OF UNITS
TYPE A: 10 self-contained apartments with 3 bedrooms, 2 bathrooms, kitchen and living area.
TYPE B: 46 self-contained apartments with 4 bedrooms, 2 bathrooms, kitchen and living area.

SIZE OF UNITS
TYPE A: 93.3 m^2 (3 students)
TYPE B: 92.6 m^2 (4 students)

LAYOUT
11 floors consisting of a main level with circulation space, bistro and lounge area. The second level is mixed use, acting as a link to “Student Street” with study rooms, laundry, lounge area and two apartments. The remaining floors are double loaded corridors with self-contained apartments.

PUBLIC AMENITIES
Bistro
Lounge
Study rooms
Laundry
Mailboxes

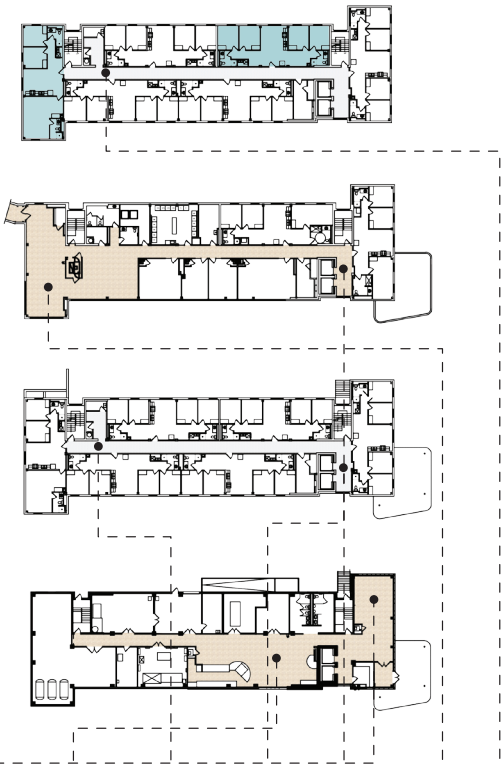
RESIDENT LEVEL PUBLIC SPACES
2nd Floor: Study rooms and lounge area
Remaining residential levels do not have any public space.

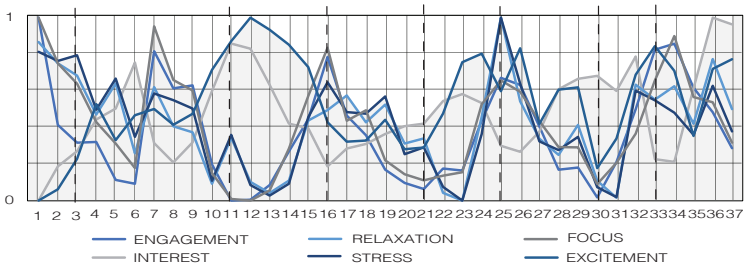
MATERIALS
Concrete
Drywall
Vinyl Tile

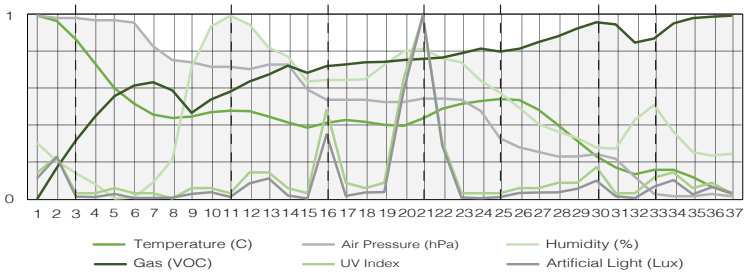
11:00 AM

YEAR OF CONSTRUCTION
2012

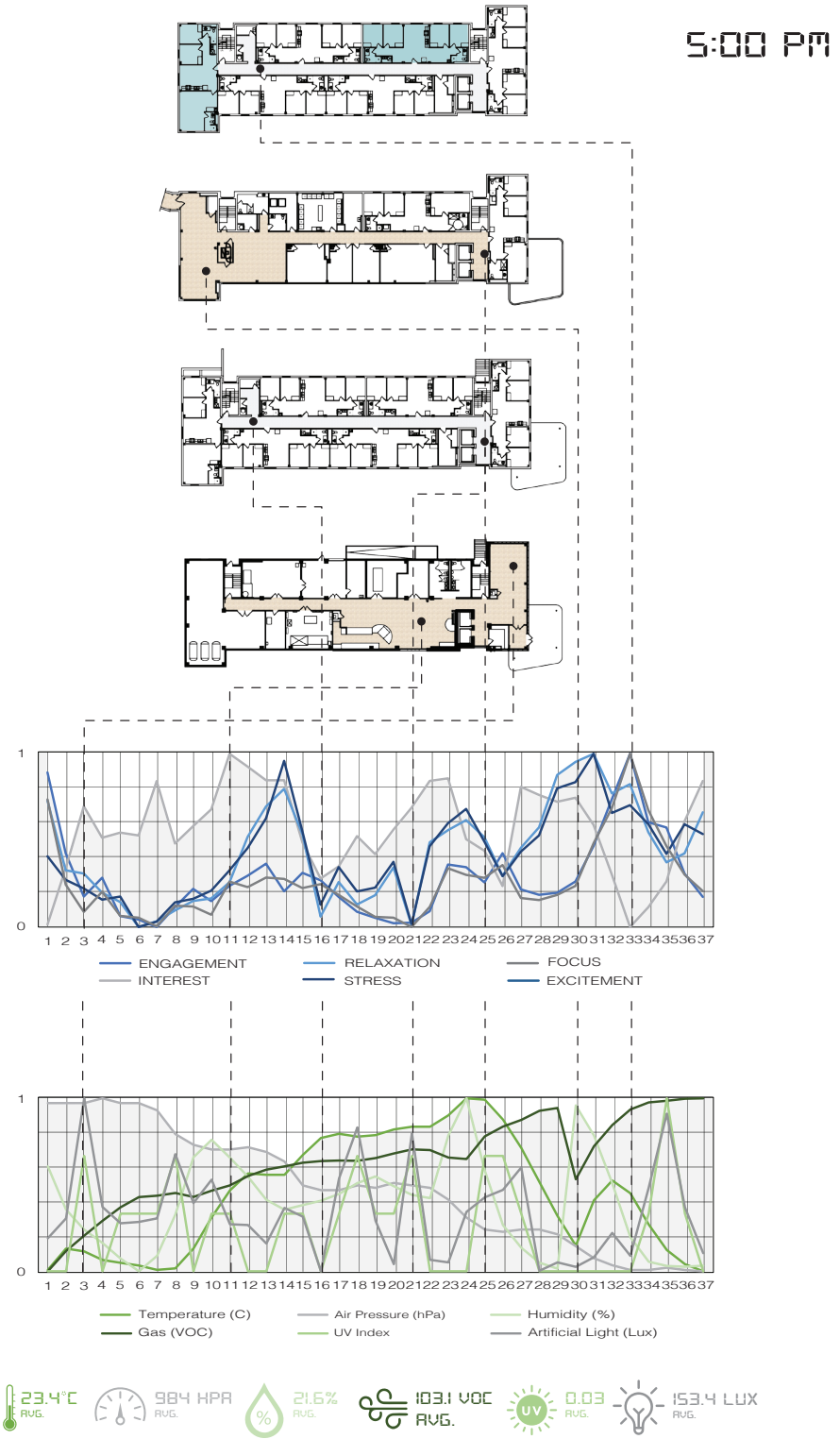
BUILDING TYPE
11 storey high-rise apartment building.
Residential, food services, study, administration.
Main level consisting of circulation space, bistro and lounge, second level acting as a connection to “Student Street” with some residential space, and remaining floors as residential space.
Air-conditioned with two elevators



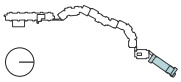




24.7°C AVG. | 987 HPA AVG. | 15.0% AVG. | 144.4 VOC AVG. | 0.05 AVG. | 607.8 LUX AVG.

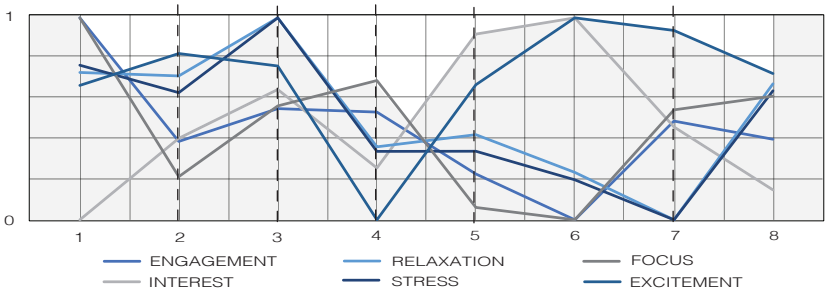

5:00 PM
1
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37
ENGAGEMENT
INTEREST
RELAXATION
STRESS
FOCUS
EXCITEMENT
1
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37
Temperature (C)
Gas (VOC)
Air Pressure (hPa)
UV Index
Humidity (%)
Artificial Light (Lux)
23.4°C AVG.
984 HPA AVG.
21.6% AVG.
103.1 VOC AVG.
UV
0.03 AVG.
153.4 LUX AVG.

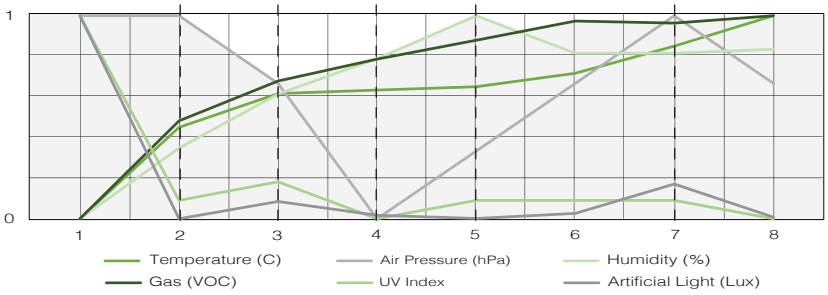
11:15 AM



TYPE A
10 self-contained apartments with 3 bedrooms, 2 bathrooms, kitchen and living area.

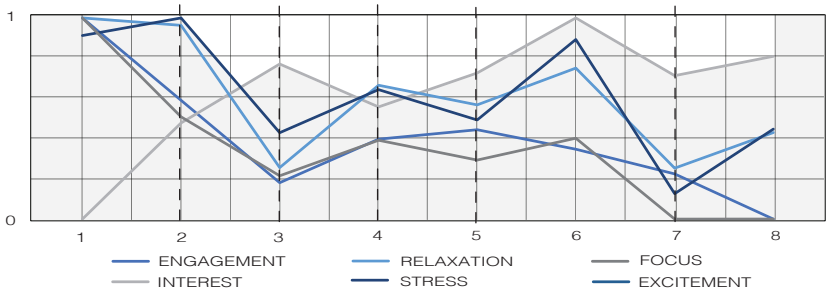
SIZE
93.3 m2 (3 students)

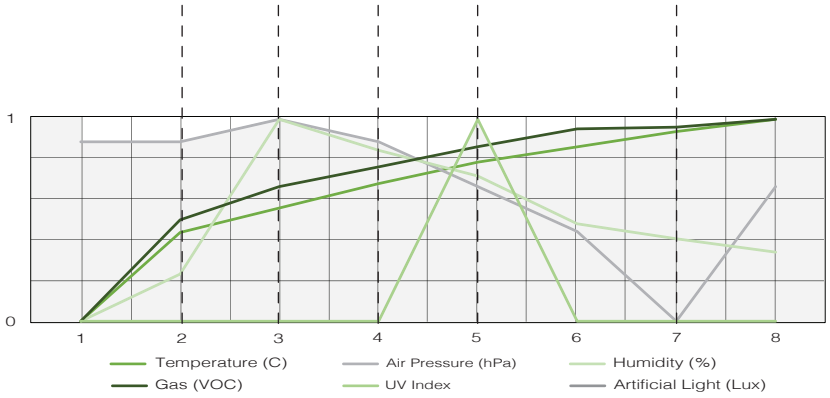




23.8°C AVG. 986 HPA AVG. 25.3% AVG. 98.6 VOC AVG. 0.04 AVG. 296.4 LUX AVG.

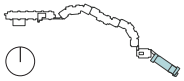
5:15 PM





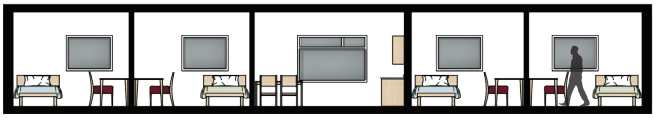
23.9°C AVG. 982 HPA AVG. 29.1% AVG. 88.6 VOC AVG. 0.03 AVG. 239.3 LUX AVG.

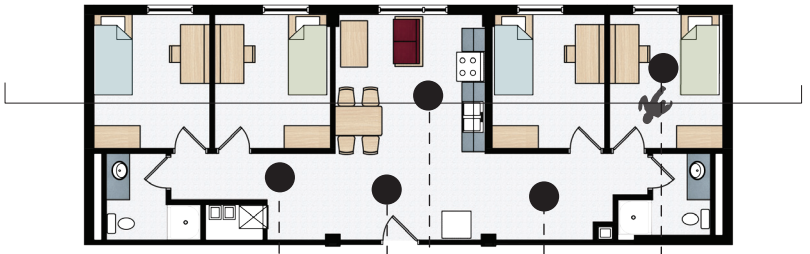
11:20 AM

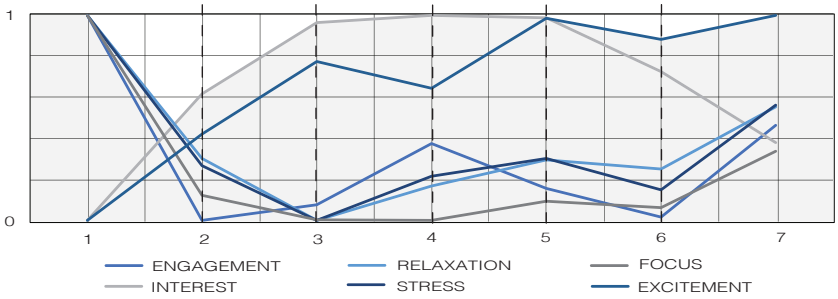


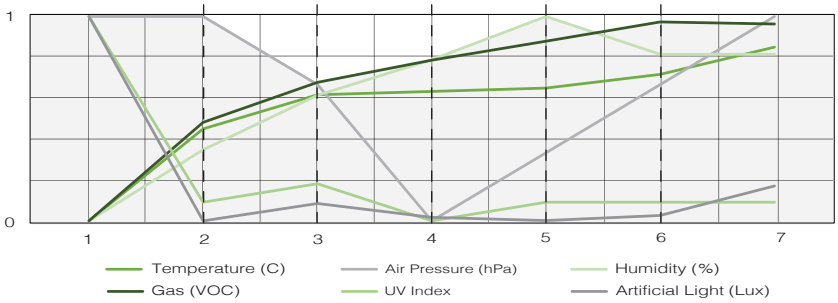
TYPE B
46 self-contained apartments with 4 bedrooms, 2 bathrooms, kitchen and living area.

SIZE
92.6 m2 (4 students)



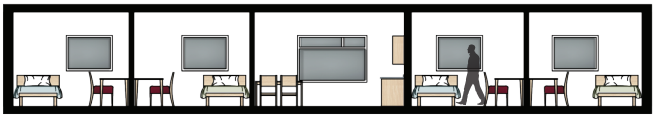


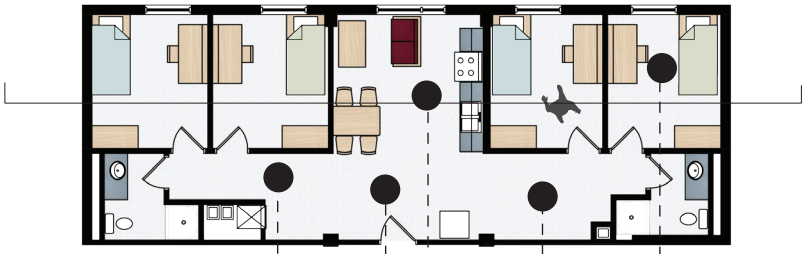


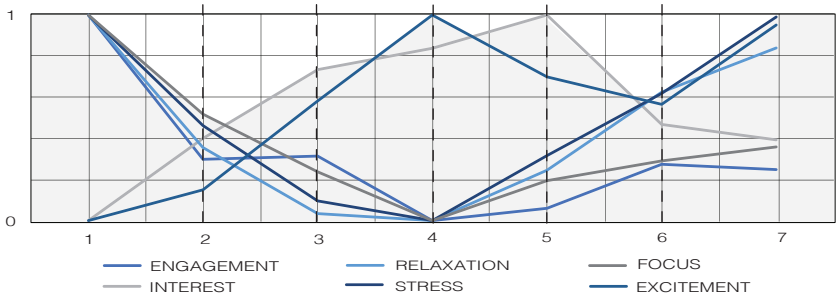


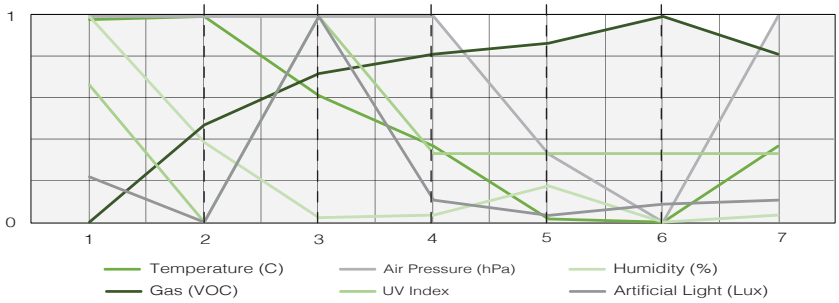
23.8°C AVG. 986 HPA AVG. 23.4% AVG. 98.6 VOC AVG. 0.04 AVG. 296.3 LUX AVG.

5:20 PM









22.4°C AVG. 875 HPA AVG. 25.6% AVG. 89.8 VOC AVG. 0.02 AVG. 95.3 LUX AVG.

Throughout this process what became the most apparent is the significance of both natural elements, more specifically light and greenery, and the importance of layout in promoting social interaction. Across the four residences, there were more positive emotional responses – increased interest, engagement, relaxation and reduced stress – in all instances where there were greater views to the outdoors, with large amounts of natural light entering the space. These findings support the approaches taken by Aalto and Holl, as they focused on allowing both natural light and air to flood interior spaces. What differs with their projects and the Laurentian University Residences however, is location and climate. Both Aalto and Holl were able to provide inhabitants with access to the outdoors year-round as the temperatures present were much more moderate. With Sudbury being a cold Northern climate, strategies such as incorporating greenspace indoors could address this issue. Additionally, creating more dynamic layouts that allow for both larger social spaces and adequate amounts of privacy can evoke more engagement, interest, and less stress overall. This was evident in the circulation spaces of UC where the social room was easily accessible to all residents on the floor, versus the long double-loaded corridors found in West, SSR and East. Though offering more privacy, these residences had the opposite effect, discouraging residents from socializing outside of their units. However, UC did not offer enough privacy, as most students shared double rooms and relied on public washrooms for hygiene. Lacking privacy to both sleep and maintain sufficient hygiene are two factors that can evoke high levels of stress and anxiety for students. Therefore, in seeking to address mental well-being in a new student residence the key characteristics of the design framework are as follows;

The implementation of indoor green spaces and natural light have the ability to reduce stressors that may cause anxiety. Additionally, organizing apartments in a dynamic manner that promote social interaction while maintaining levels of privacy can reduce stressors that cause depression by minimizing feelings of isolation and promoting independence. This notion of creating a gradient from public to private will be further implemented throughout the extents of the building as it will offer ample public program for both residents and the larger community to ensure that the building is full of life.

06

THE PROPOSED SITE

History + Adaptive Reuse Strategies
Site Analysis

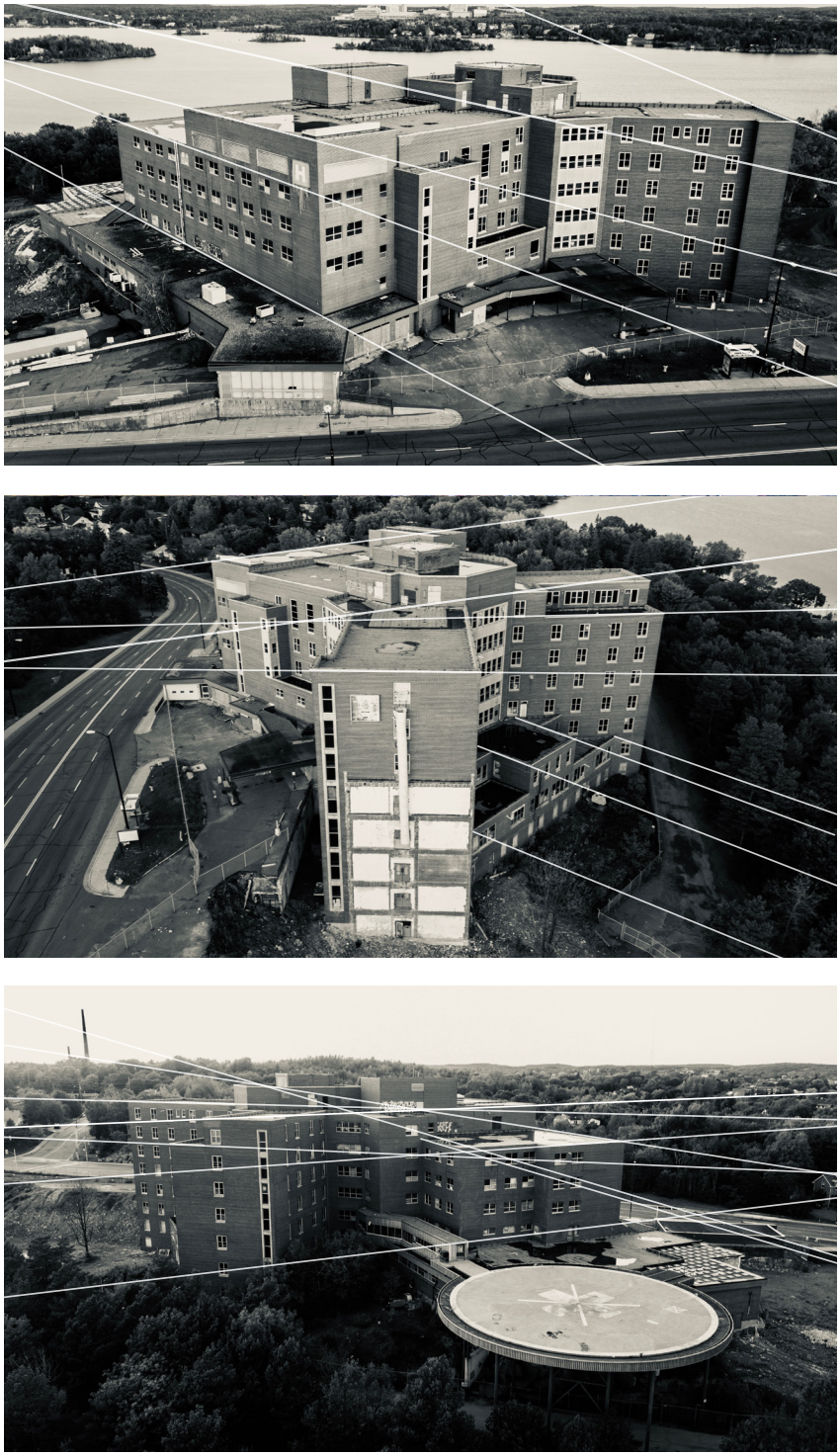


Figure 6.1: Images of the abandoned St. Joseph's Hospital in Sudbury, Ontario depicting the current state and various site lines.

HISTORY + ADAPTIVE REUSE STRATEGIES

St. Joseph's Hospital
1950
Sudbury, Ontario

With its long-standing history as a site rooted in health, the now abandoned St. Joseph's Hospital in Sudbury, Ontario is ideal in seeking a location for a new student residence that focuses on improving mental wellbeing. Public health became of increasing interest to the city of Sudbury in June of 1896 when Sisters St. Raphael, St. Cyprien and Aimée-de-Marie of the Order of the Grey Nuns of the Cross of Ottawa arrived to lay the foundations for what was to become the St. Joseph's Hospital.[22] The Sister's first arrived in Sudbury to aid in a typhoid fever outbreak, but would remain to form the foundation for both the St. Joseph's Hospital and a nursing school. Over the years the hospital would grow to accommodate the needs of the city, yet still functioned as the only source of hospital care until 1950 when it expanded to include the Sudbury General Hospital of Immaculate Heart of Mary [1950], the Sudbury Algoma Sanatorium [1952] and the Sudbury Memorial Hospital [1954].[23] The hospital continued to grow, becoming the largest hospital in Northern Ontario in terms of number of beds provided. By the end of this decade, in addition to services provided by a general-type hospital, the institution offered specialized clinics including Orthopedic, Rehabilitation, and Cerebral Palsy. The present-day site now sits discarded however, as the building could no longer expand to hold the growing program of the hospital.

Situated along Paris Street, the St. Joseph's site rests between the Laurentian University Main Campus and the McEwen School of Architecture Downtown Campus,

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[22] Bouchard, Jeannette L. Seven Decades of Caring: To Those Who Care Past, Present, Future. Sudbury, Ont.: Laurentian University Press, 1984.
[23] Ibid.

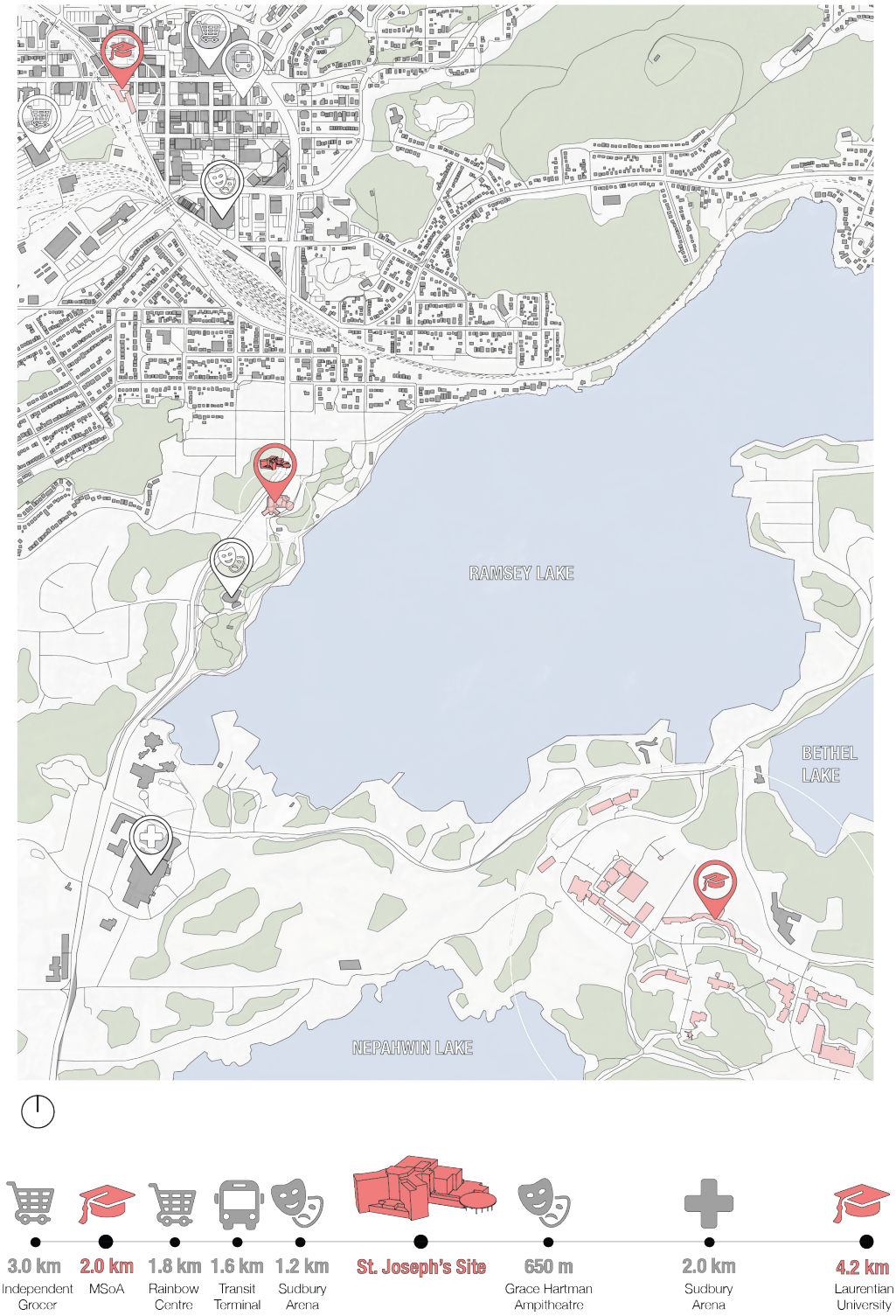
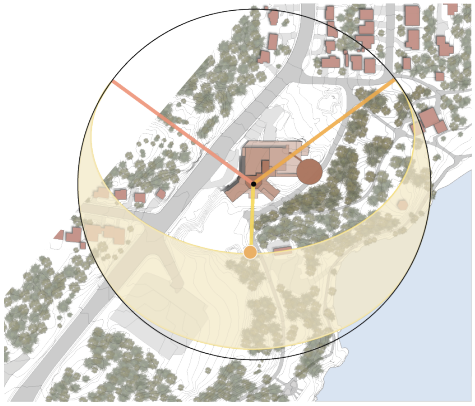


Figure 6.2: Map outlining the proximation of the St. Joseph's site to both campuses and key amenities.

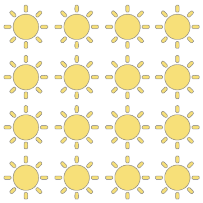
thus making it easily accessible to students with classes at either location. Additionally, the site is situated along public transit routes, making it easily accessible to both students and the general public. Within 2km of the site students will also have access to essential amenities including groceries, entertainment via the Grace Hartman Amphitheater and Sudbury Arena, and the Hospital, all of which again lie along the available transit routes.

With the surplus of infrastructure currently in Sudbury, it makes sense to seek to repurpose this site as both a sustainable approach to the program and a form of giving back to the community. As the original structure once stood to promote public wellness, this adaptive reuse project will continue to do so through a different lens. Rather than proposing a private, executive residence as many past developers, this student residence will offer ample public program for both students, and the surrounding community. Through the extension of existing trail networks, people will be able to access the building from both Paris street, as well as Bell Park. Additionally, through regreening, the surrounding site will be proposed as an extension of Bell Park, offering open green space and a small soccer field. A more in depth site analysis was completed to further inform this idea.

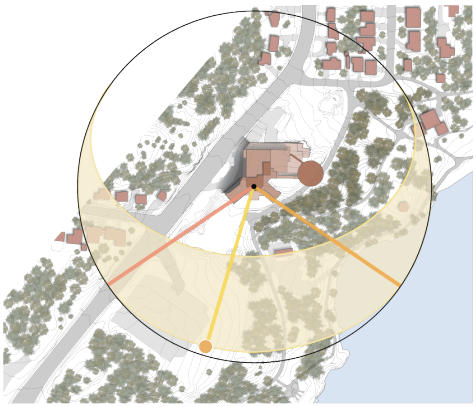


Summer Sun Path

Sunrise: 5:30 a.m.
Sunset: 9:30 p.m.
Shadow Length: 7.6 m (Approx.)

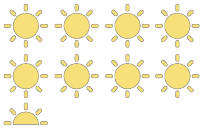


16h total daylight

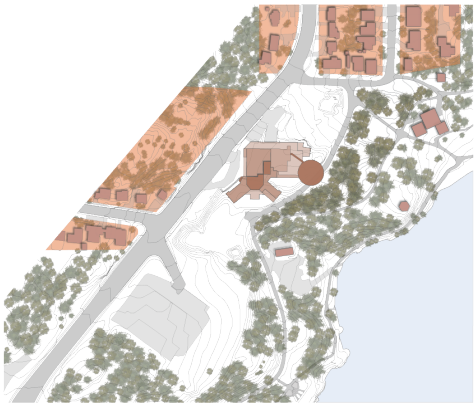


Winter Sun Path

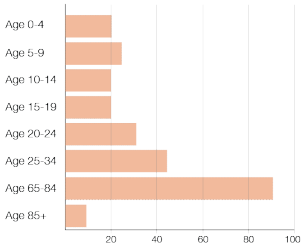
Sunrise: 8:00 a.m.
Sunset: 4:30 p.m.
Shadow Length: 53.9 m (Approx.)



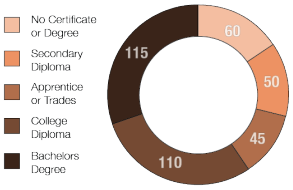
8.5h total daylight



Population by Demographic



Education Level



433 total people in Kingsmount-Downtown-Bell Park Neighbourhood

145 Single Detached
10 Semi Detached
20 Duplex
20 Apartment < 5 Storeys

2.3 avg. people per household

Figure 6.3: Site analyses including sun travel and demographics of the surrounding neighbourhood.

SITE ANALYSIS

Prior to applying the strategies that resulted from the data collection process, a more in-depth site analysis was completed to understand the existing conditions of the site and surrounding area. This analysis included a dissection of both natural and built elements.

Solar Exposure

With one of the goals of the design framework being to maximise solar gain and exposure, a solar study of the existing building was completed. During the summer season the South façade of the building sees approximately 16 hours of sun, and 8.5 hours in the winter comparatively. Knowing both the amount of daylight and path of travel are important in terms of the interior building layout. To maximise solar exposure across each of the units, they must be arranged along the South façade of the building.

Neighbourhood

Focusing on a closer proximity to the site I analyzed the surrounding neighbourhood, traffic flow and Bell Park. The Kingsmount-Downtown-Bell Park Neighbourhood is comprised mostly of middle class with the largest demographic being between 65-84. Of this population most people hold college diploma or bachelor's degree. The neighbourhood also averages 2 people per household, with the housing typologies being mostly single detached homes with a handful of semi-detached, duplexes and apartments less than five storeys.

Traffic

Located on Paris Street, the St. Joseph's site sits along a major artery of the city and therefore sees a lot of traffic. In 2017 for an 8-hour duration during peak hours, approximately 19,745 vehicles passed through the Boland and Paris intersection, in addition to 51 pedestrians. This heavy traffic can account for a large amount of sound vibration, thus influencing programmatic decisions and layouts, such as the location of residence rooms and public spaces. The pedestrian flow also shows that the site is accessible without a vehicle, allowing students the opportunity to walk or take public transit easily.

Bell Park

Within 200m of the site lies Bell Park, which would provide students with a bike route, walking/running trails, two beaches, a concession stand, and in the winter the Ramsey Lake Skate path, all of which promote activity and healthy living in every season. The park measures 157,000 sq meters and constantly has events that students would be able to participate in addition to an abundance of green space consisting mostly of white pine, jack pine, birch and poplar trees. Additionally, it lies along Ramsey lake, providing 7.9 sq kilometres of water for students to enjoy and de-stress. Various studies have proven that people respond better to both trees and water as they hold biophilic principles that can improve mental well-being. Examples of this are increased focus, less mental fatigue, reduced anxiety, reduced depression, better sleep and improved air quality. Making this natural landscape easily accessible to students can therefore promote improved mental wellness.

Activities and Amenities

- Bell Park Bike Trail
- Rainbow Routes [Trans Canada Trail]
- Bell Park Beach
- Ramsey Lake Skate Path
- Bell Park Concession

Accessiblie within 200-250m radius of building.

Bell Park Area
157,377 Sq Meters

Ramsey Lake Area
7.9 Sq Kilometers

Tree Types

White Pine | Jack Pine | Birch | Poplar

Transportation and Traffic

St. Joseph South [Buses 500, 181, 189]
St. Joesph North [Buses 500, 501, 502, 181, 182]

19,745 Total Vehicles

443 Trucks

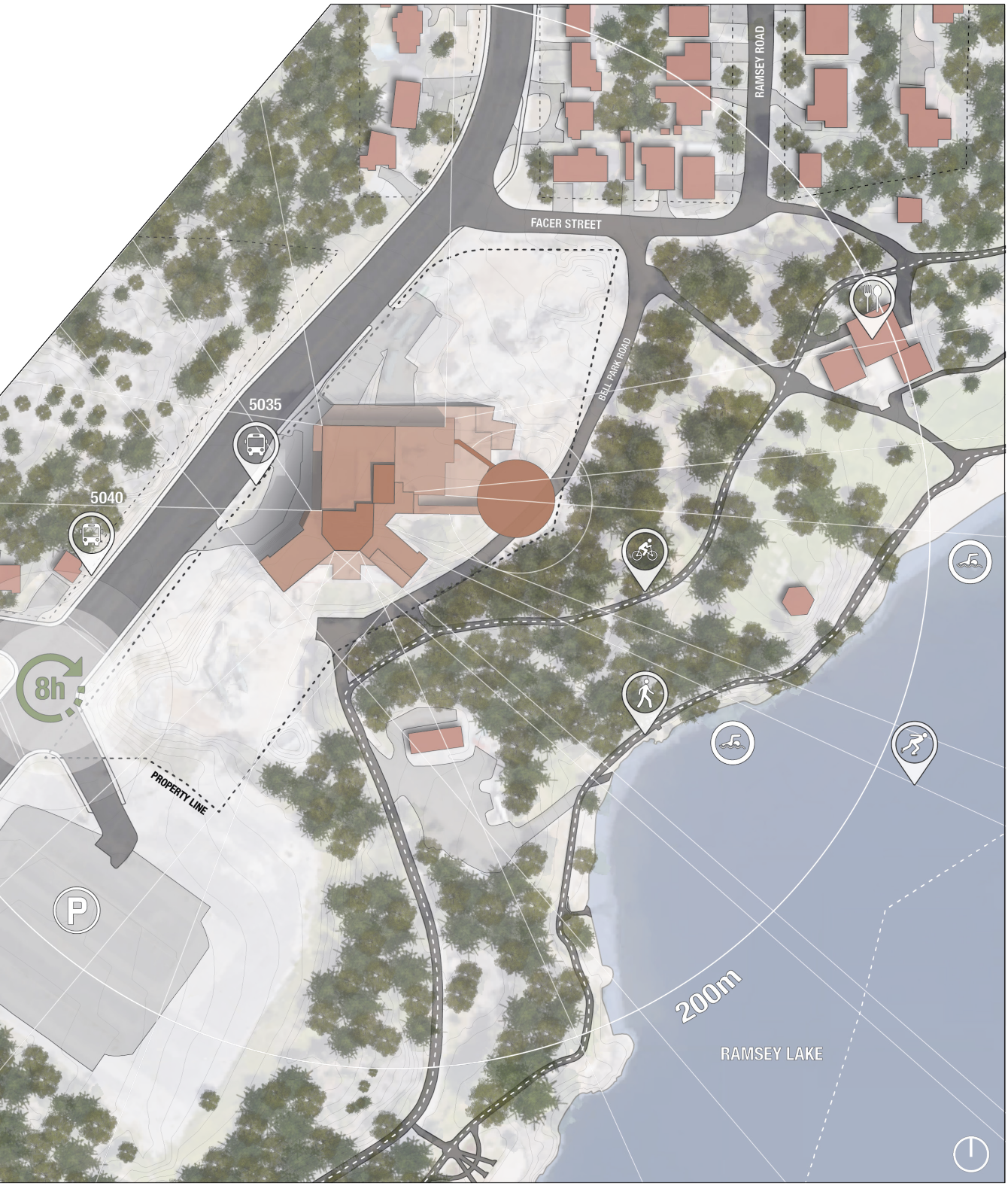
51 Pedestrians

2017 Reports for 8hr duration during peak hours.

Mental Health Benefits

Increased Focus
Less Mental Fatigue
Reduced Anxiety
Reduced Depression
Better Sleep
Improved Air Quality

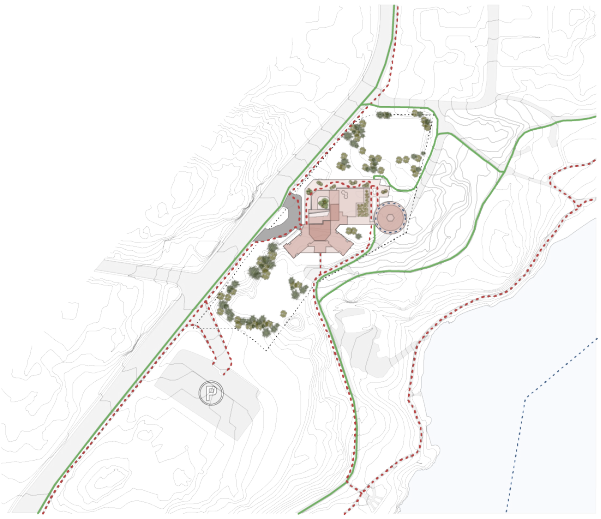
Figure 6.4: Analysis of existing site conditions in regards to traffic, pedestrian flow, trail networks, activities and amenities via Bell Park, and the mental health benefits of the surrounding natural landscape.


RAMSEY ROAD
FACER STREET
BELL PARK ROAD
5035
5040
8h
PROPERTY LINE
P
200m
RAMSEY LAKE

07

STUDENT RESIDENCE DESIGN

An Informed Design Framework
“Micro-Homes”



CYCLING FLOW
Bell Park Bike Trail

PEDESTRIAN FOOT TRAFFIC FLOW
Rainbow Routes [Trans Canada Trail]

SKATING PATH
Ramsey Lake Skate Path

PUBLIC TRANSIT ROUTE
St. Joseph South [Buses 500, 181, 189]
St. Joseph North [Buses 500, 501, 502, 181, 182]

MAJOR TRAFFIC ARTERY
via Paris Street

BELL PARK
157,377 m² of green space

RAMSEY LAKE
7.9 km², public access to Bell Park Beach

PUBLIC PARK + SOCCER FIELD
New additions via adaptive reuse

Figure 7.1: Proposed site outlining surrounding activities, the natural landscape, and pedestrian paths of travel.

AN INFORMED DESIGN FRAMEWORK

Succeeding the site analysis, the initial urban move was addressing building access. Rather than separate the natural landscape from the streetscape, the building functions as a hub, bridging the gap between the two via the extension of existing trails through and on the building. As outlined in the site diagrams, the existing pedestrian paths from Bell park extend and ramp up the roof of the building to bring people to street level. From there they can either enter the building or continue along Paris Street. Similarly, cyclists are able to travel through the building and either stop to make use of the provided dressing facilities and urban park or continue along the Bell Park Bike Path. Upon addressing building access, the arrangement of spaces, amenities and attributes would be addressed based on the conclusions made from the biometric data. This data, in conjunction with a rigorous site analysis, were used to propose a more informed design framework centred around improving mental well-being. The key elements of this framework are outlined in the preceding pages.

Gradient from Public to Private

In addressing both the surrounding urban fabric and mental wellness, one strategy in the design of the residence was creating a gradient from public to private spaces. Isolation is often a concern when regarding mental well-being, so providing public access to the amenities of the lowers levels encourages opportunity for social interaction. As observed in the biometric data, having privacy for personal care is of equal importance, and in response the building becomes more private as it progresses upwards.

Physical Activity + Study

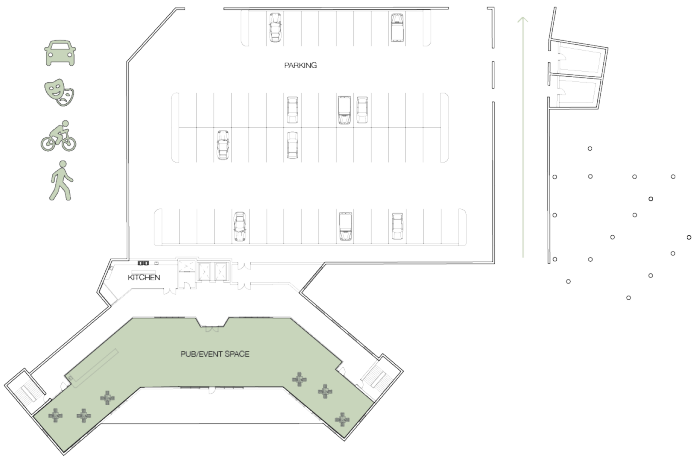
Ease of access to both physical activity and study are crucial as they go hand in hand when seeking to improve well-being. As recognized in the initial proximity study of the Laurentian campus, the gym and library were at opposite ends, posing a debate of which to use. For this reason, both the public gym and central 360 study café are accessed via the same level. The gym faces North, as this portion of the building has less natural light, is cooler, and offers more visual stimulation from traffic and outdoor park. The indoor track is also located in this area and cantilevers out of the building to simulate the idea that you are running outside. Contrastively, 360-study café has views to the water and direct Southern sun as it is a space intended to reduce stress and increase focus through the natural elements that surround it. This space is also encompassed by a walking loop in the summer months, and skate loop in the winter to further promote physical activity year-round.

High Ceilings + Open Concept

Additionally, the EEG data exhibited that higher ceilings and an open concept can evoke more positive feelings of freedom and provoke dynamic activities. For this reason, there are both public and private spaces throughout the building that address this. The first example of this is in the cantilevered track on the North-West side of the building. Having higher ceilings in this space creates the feeling that you are in an open, outdoor setting and therefore promotes increased focus and motivation to be active. Additionally, this notion is explored through terraced floors where students are able to gather, study, and socialize.

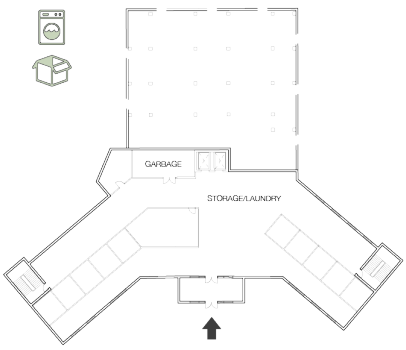
LEVEL 1

Level 1: Main entrance from Paris street, roof terrace with green courtyard, residence and mental health office, dining hall, living wall, convenience store, gym, access to 360 study café + walking/skate loop.



LEVEL P

Level P: Extension of Bell Park bike path through building, indoor parking for residents and staff, ramp to roof terrace,
Event space and pub.



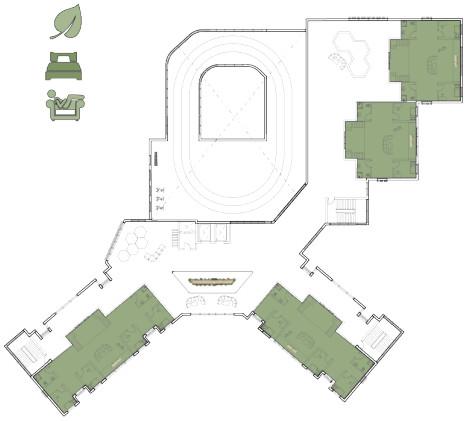
LEVEL 0

Level 0: Least amount of light, South entrance, storage units and laundry for residents.

Figure 7.2: Diagrammatic floor plans, levels 0-1.

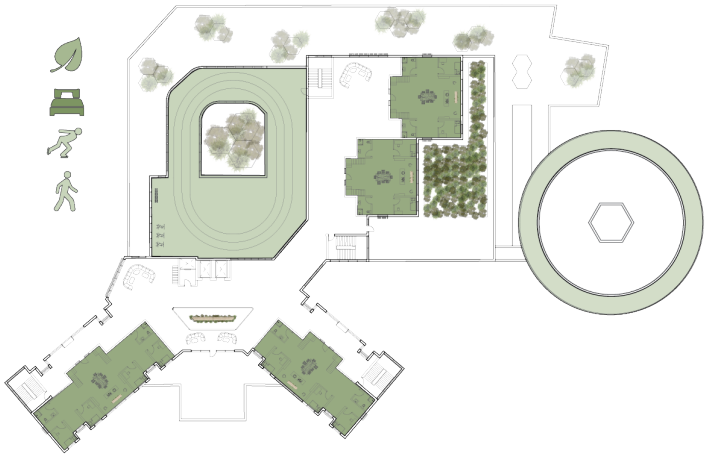
LEVEL 4

Level 4: Micro-homes, living wall, terraced flooring lounge/study spaces.



LEVEL 3

Level 3: Micro-homes, living wall, terraced flooring lounge/study spaces.



LEVEL 2

Level 2: Indoor cantilever track, living wall micro-homes, terraced floor

Figure 7.3: Diagrammatic floor plans, levels 2-4.

LEVEL 7

Level 7: Micro-homes, grad student homes, living wall, terraced flooring lounge/ study spaces.

LEVEL 6

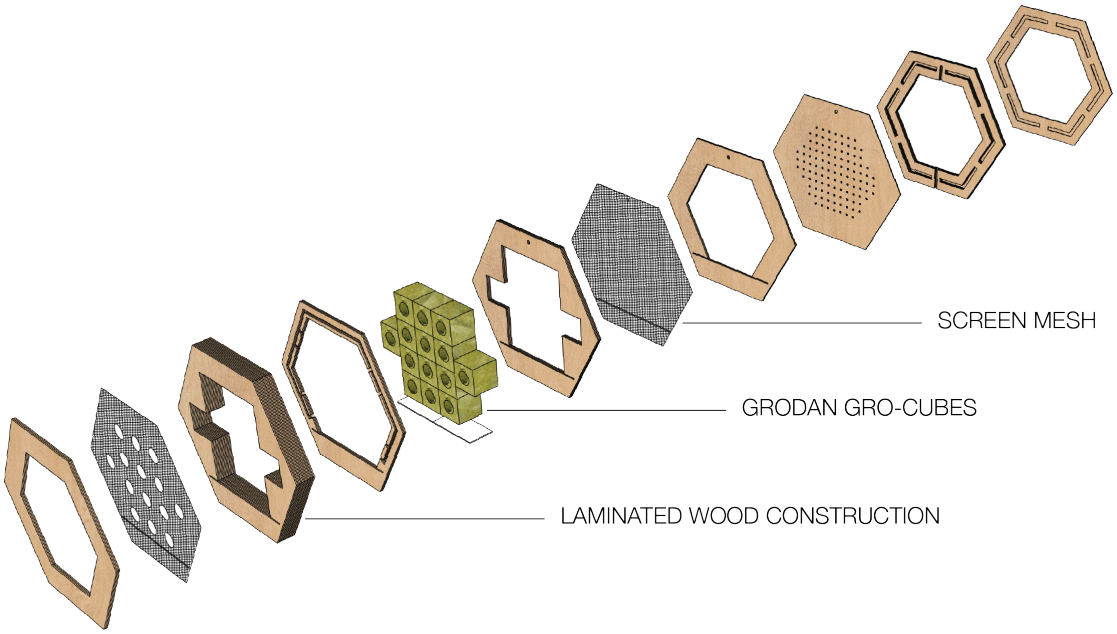
Level 6: Mico-homes, grad student homes, living wall, terraced flooring lounge/ study spaces.

LEVEL 5

Level 5: Micro-homes, living wall, terraced flooring lounge/study spaces.

Figure 7.4: Diagrammatic floor plans, levels 5-7.

Figure 7.5: Exploded axonometric drawing of one living wall module.

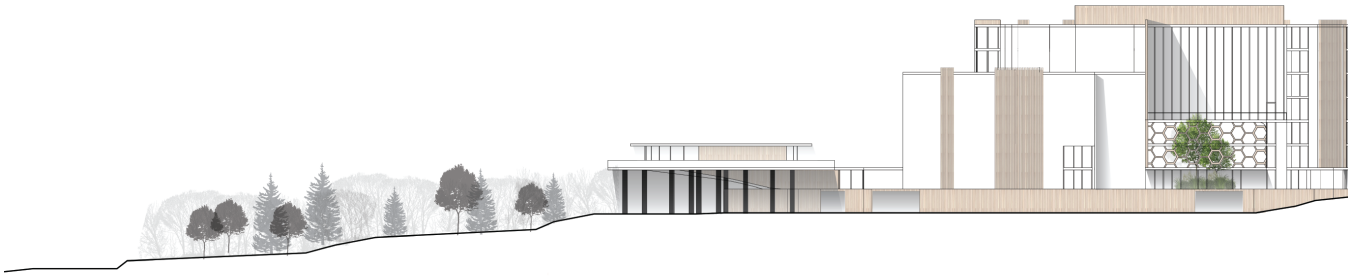


Indoor Core of Greenery
Though the surrounding site and park offer an ample amount of greenery, a large issue in the North is the stark winter landscape. In combatting this a core of greenery, referenced to as "The Hive" has been designed to puncture each floor, and create a space for students to lounge, socialize and study around. Its name comes from the hexagonal shape of each module to form was resembles a beehive, instilling the idea that the health of the individual is based on the health of the greater collective. In addition to the one central core, each unit also features a smaller living wall to further promote these ideals and provide greenery year-round.

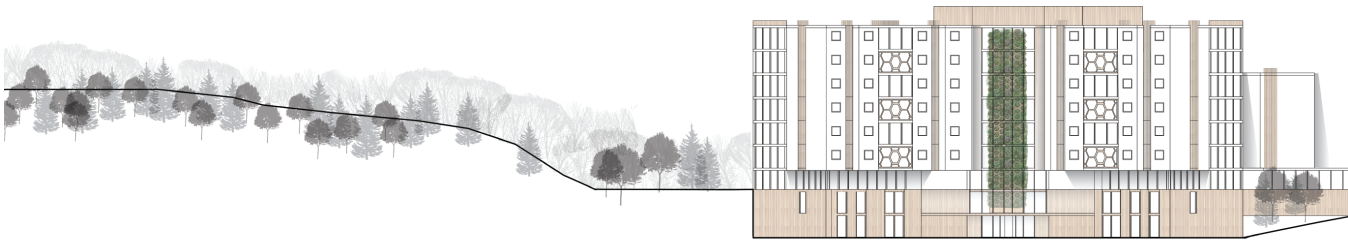
Natural Light + Views
Maximizing both views to the surrounding landscape and Southern sun exposure played a large role in informing the program and layout of the micro-homes in the residence. Through the EEG data that was gathered, supplemented by academic studies, it has been proven that having ample natural light and greenery can improve your overall mood, and emotions including excitement, engagement, interest, relaxation and focus. For this reason, all of the units in the building are facing the water and have Southern exposure. They are also located further from Paris street, reducing noise from the traffic of Paris street.

Each of these characteristics were considered in both the design of the public spaces and private spaces and the implications are further outlined in the following elevations and sections.

Figure 7.6: Elevation of "The Hive" living wall, which functions as the central core of greenery throughout the residence.

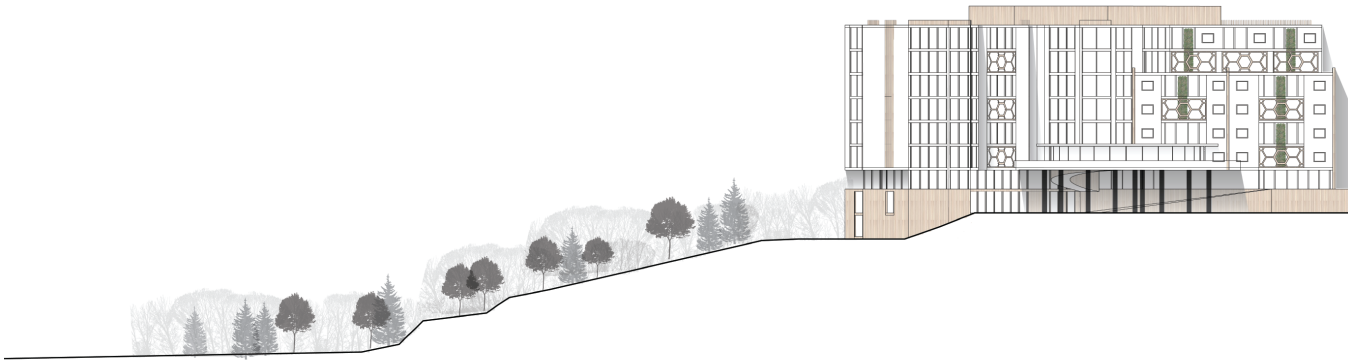


NORTH ELEVATION



SOUTH ELEVATION

WEST ELEVATION



EAST ELEVATION

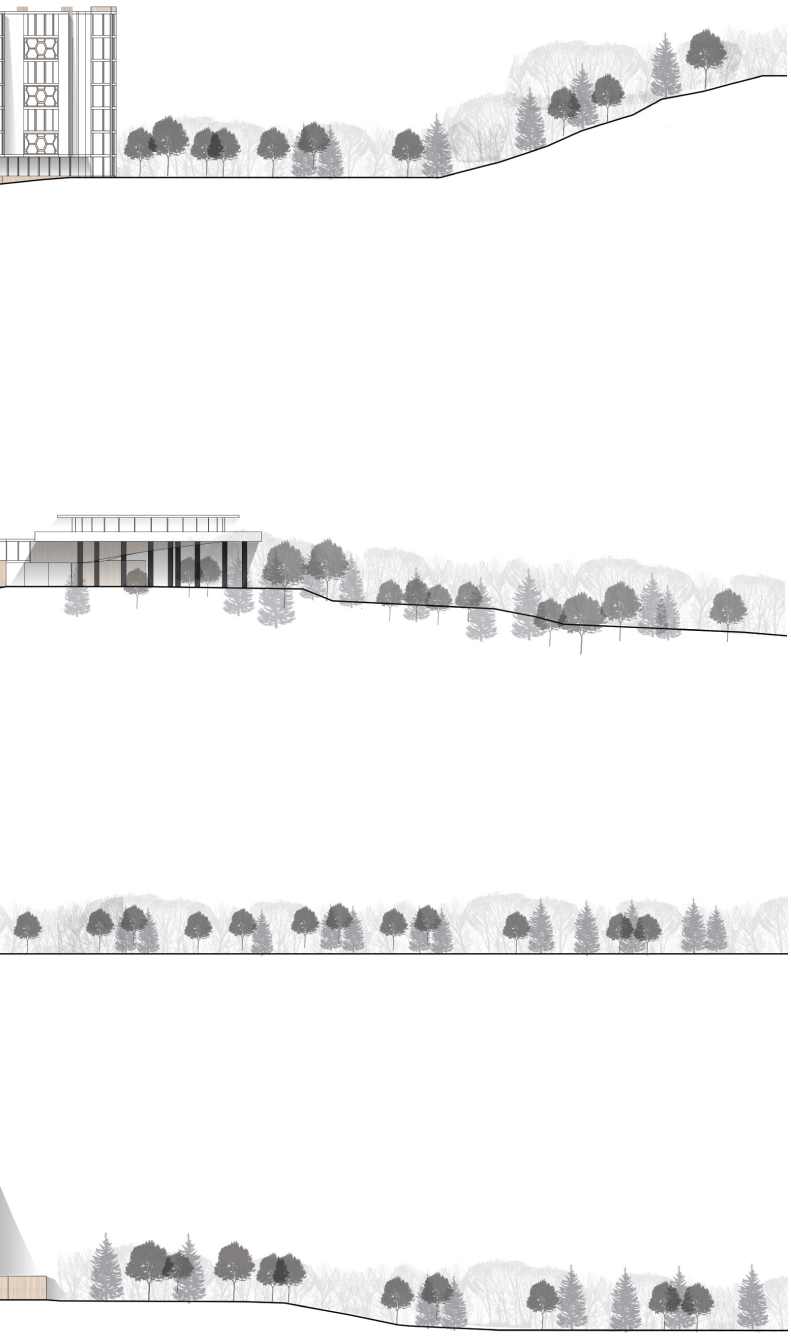
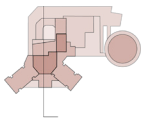
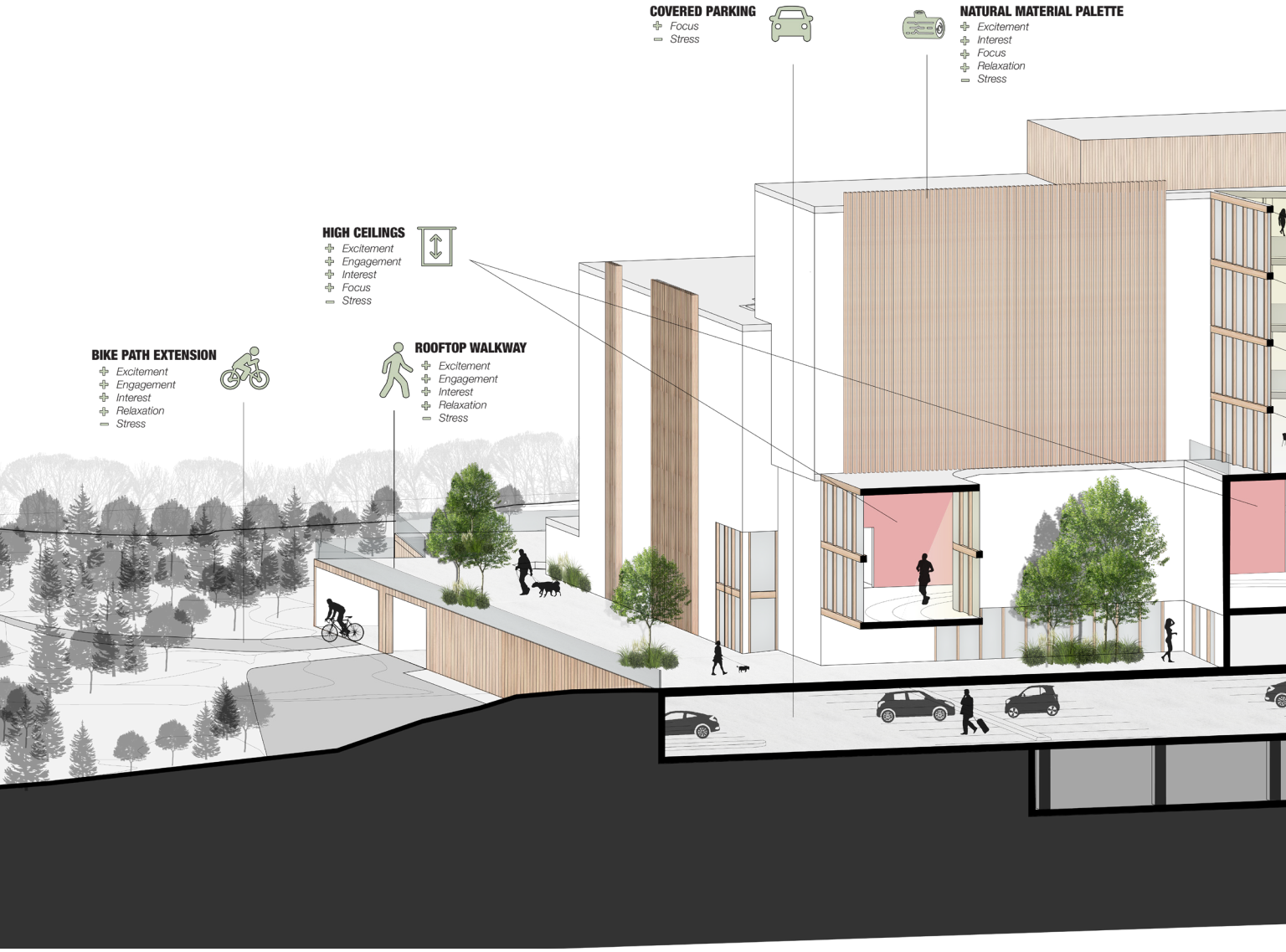


Figure 7.7: Building elevations showing changes in topography, natural materials, and various living wall locations.



NORTH-SOUTH SECTION



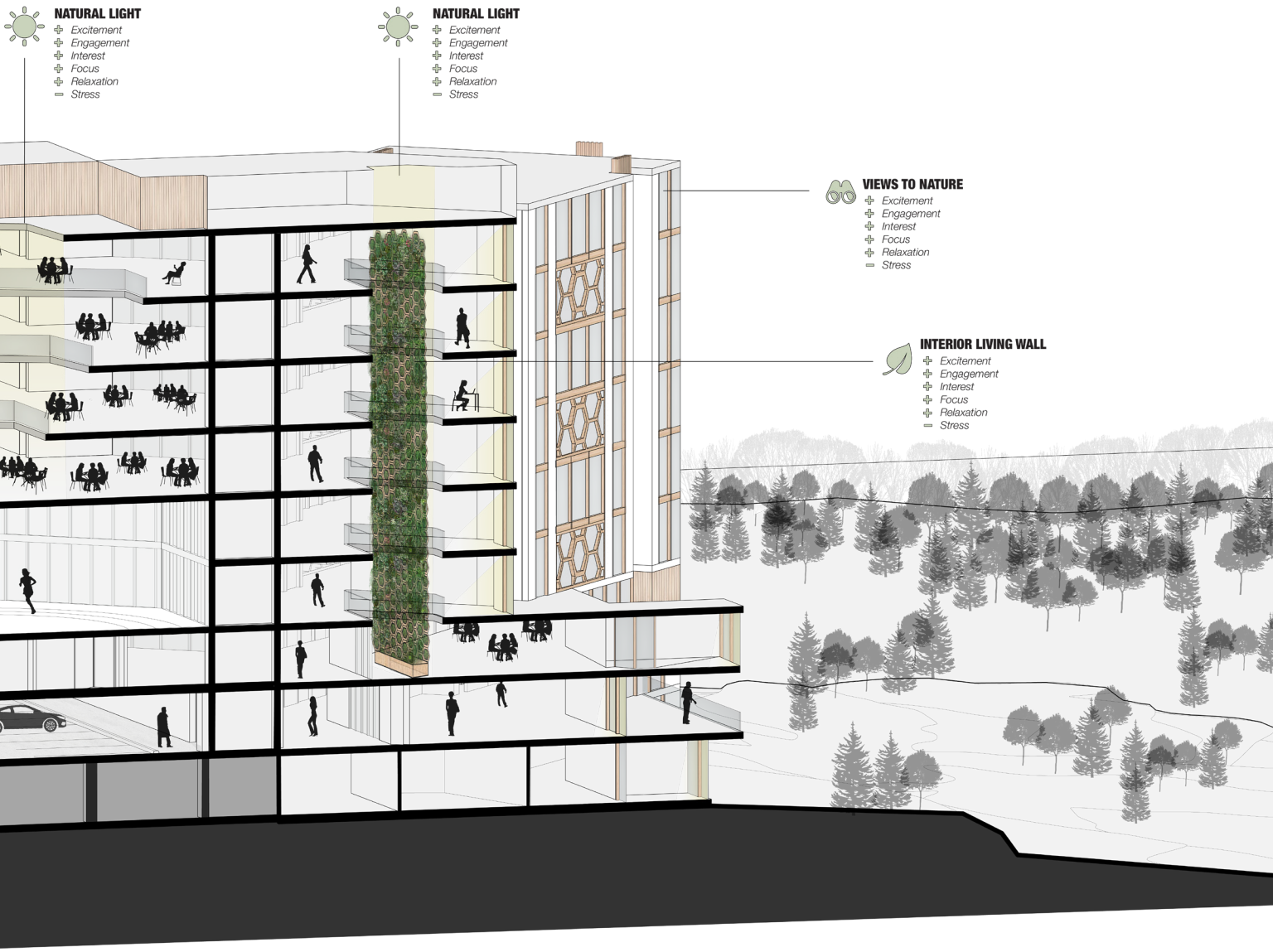


Figure 7.8: Diagrammatic section showing habitation and key building elements that place a focus on improving well-being.

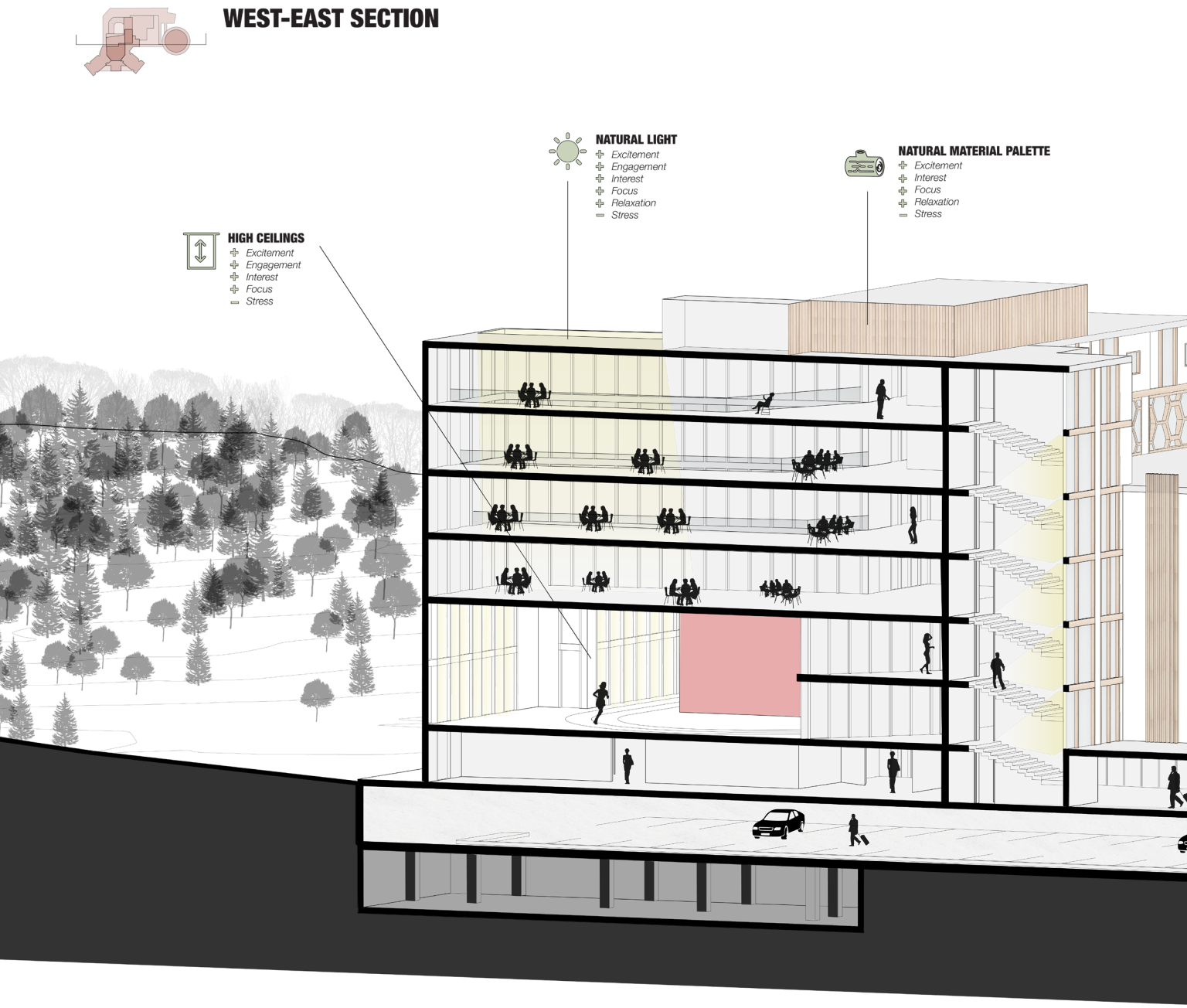
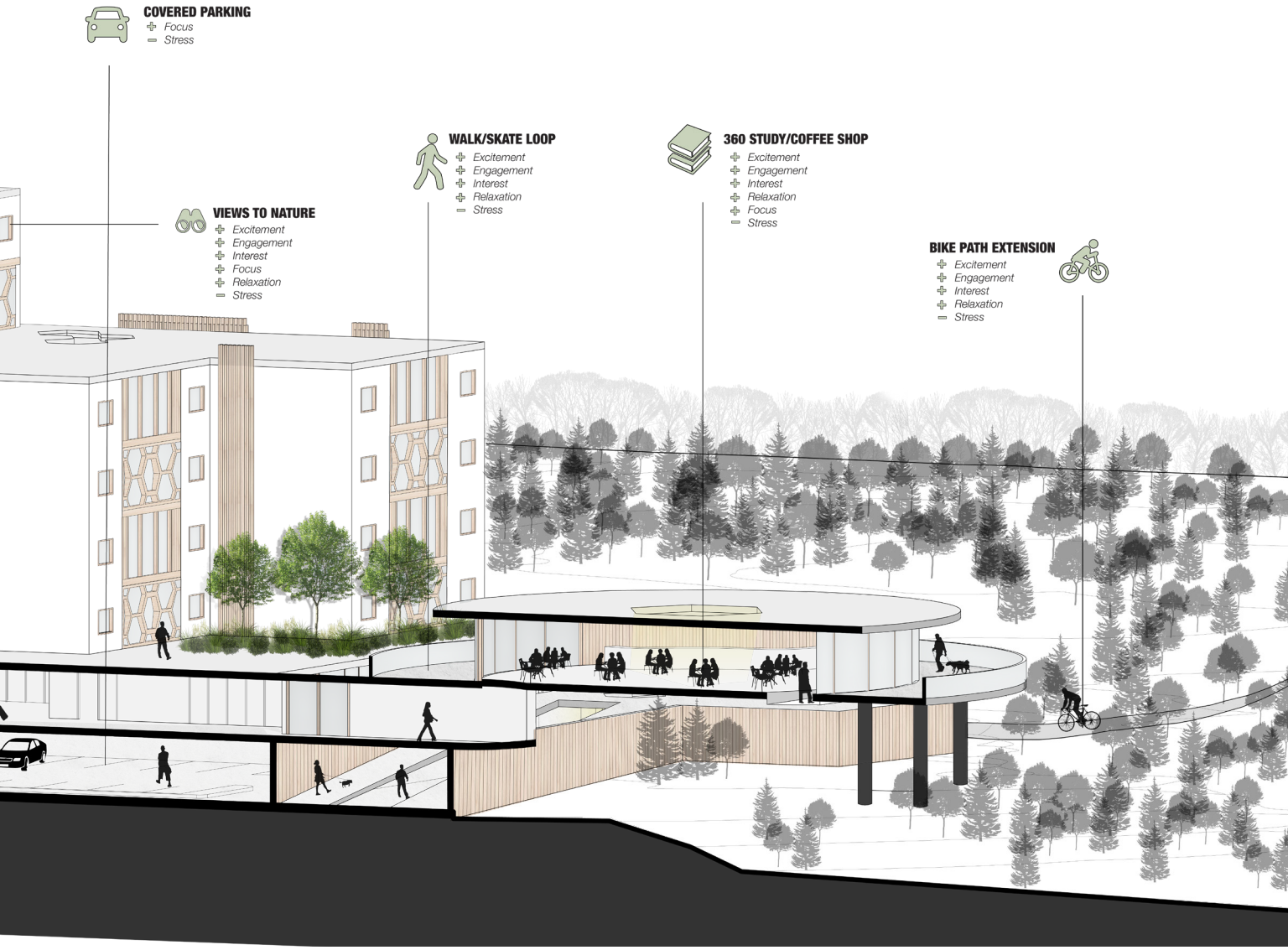


Figure 7.9: Diagrammatic section showing habitation and key building elements that place a focus on improving well-being.


COVERED PARKING
+ Focus
− Stress
VIEWS TO NATURE
+ Excitement
+ Engagement
+ Interest
+ Focus
+ Relaxation
− Stress
WALK/SKATE LOOP
+ Excitement
+ Engagement
+ Interest
+ Relaxation
− Stress
360 STUDY/COFFEE SHOP
+ Excitement
+ Engagement
+ Interest
+ Relaxation
+ Focus
− Stress
BIKE PATH EXTENSION
+ Excitement
+ Engagement
+ Interest
+ Relaxation
− Stress

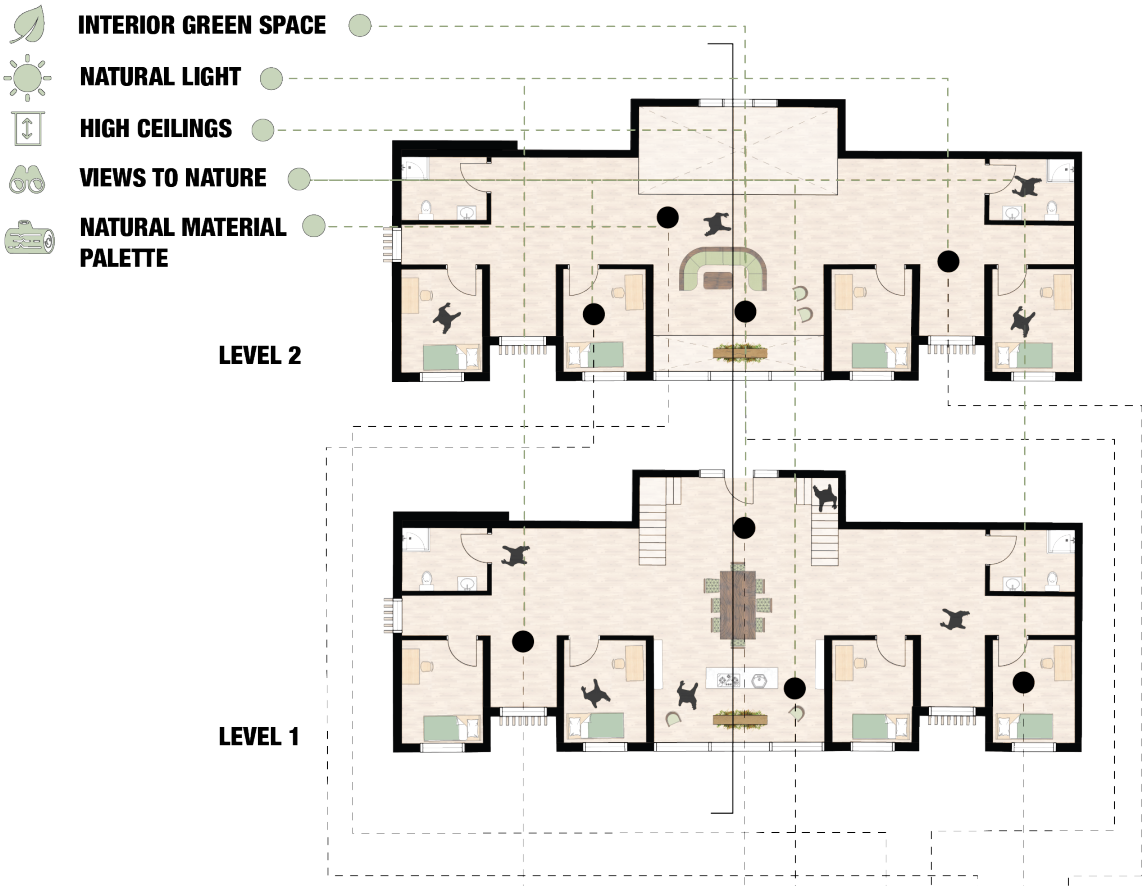
“MICRO-HOMES”

In aiming to design apartments that are able to promote social interaction while maintaining adequate levels of privacy, the notion of “micro-homes” came to fruition. The idea is that each apartment would function as a small home within the larger program. Each micro-home spans across two floors, with kitchen and dining on the main level, and a living/lounge space on the upper level. In each home, every student has their own private bedroom, and each bathroom is shared with no more than two students. Additionally, each home features its own living wall that spans both levels. This living wall not only brings greenery year-round to each home but references the same ideals as the larger living wall by creating a central core that students can gather around. The micro-homes all face South-South-West, offering views to the landscape and water, in addition to an abundance of natural light to flood each space. Similar in design, the building features three “grad student homes”. These homes offer greater privacy for students continuing education in a PhD program. These homes still span two floors and each one has its own living wall as well.

In total, there are 10 micro-homes throughout the building, housing between four and eight students. On average each micro-home offers 37 m^2 of private space per resident. With the grad student homes being larger, they offer 61 m^2 per resident. In total the residence houses 72 students and breaks from the idea of trying to maximize number of students per square foot, but rather creates a home away from home. The characteristics implemented to improve well-being, hypothetical EEG data for a typical micro-home, and the spatial qualities attributed to that data are outlined through the preceding drawings. In both instances, the EEG data is overall more stable, due to the use of more natural materials throughout, the living wall that spans both levels, varied ceiling heights, natural light in both private and public spaces, and views to nature from every angle. The abundance of natural light offered by the Southern exposure, in conjunction with vistas, the living wall and private bedrooms are also fundamental in keeping stress at a minimum. Lastly, with each micro-home and grad home being two levels, opportunity for more dynamic social activity is possible and therefore increased engagement, excitement and interest is encouraged throughout.

STUDENT "MICRO-HOME"

10 Micro-Homes accommodating between 4 and 8 students. Each home features private bedrooms, washrooms, shared kitchen, living and a living wall across two-storeys. This allows for more natural light, openess and dynamic activity.



Through the above proposed methods, dotted areas are expected to elicit increased levels of engagement, relaxation, interest, excitement and focus while reducing stress.

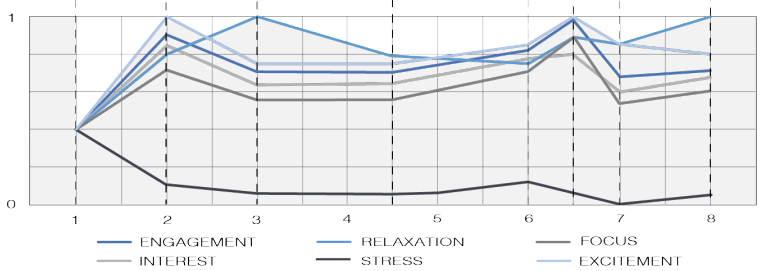
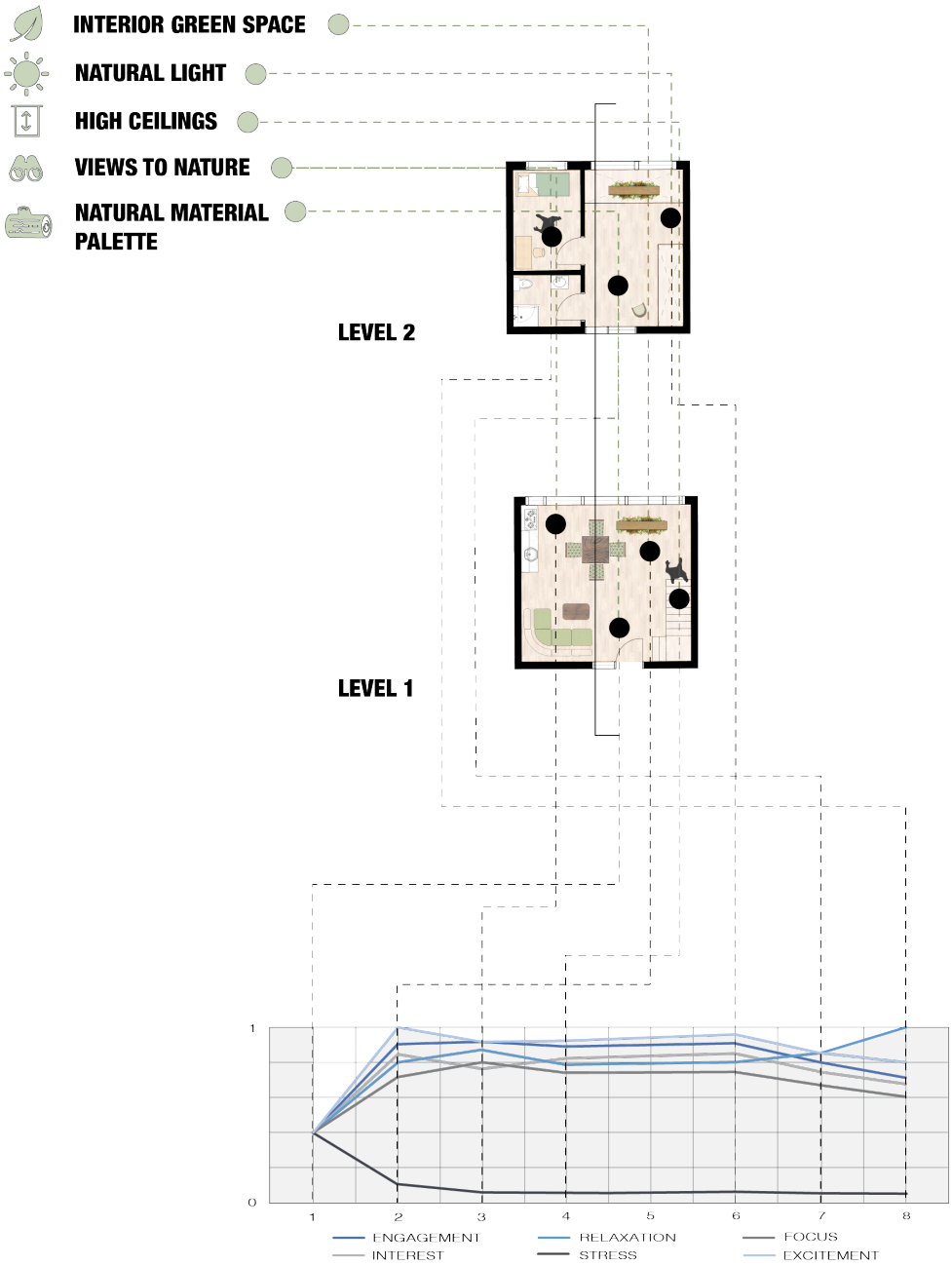


Figure 7.10

GRAD STUDENT HOME

3 Grad Student Homes accommodating 1 student each. Each home is two-storeys with a private bedroom, washroom, kitchen, living and a living wall. This allows for more natural light, openess and dynamic activity while provide each student with increased privacy for focused study.



Through the above proposed methods, dotted areas are expected to elicit increased levels of engagement, relaxation, interest, excitement and focus while reducing stress.

Figure 7.11

Figure 7.12: Sectional perspective of a typical “Micro-Home” speaking to quality of space, scale, vistas and nature.

APPENDIX

The following appendix is a documentation of the models built to compliment this body of work. The models constructed include a 1:500 site model of the existing St. Joseph's site, exhibiting the surrounding neighourhood topography and natural elements. Additionally, a single living wall module was constructed at 1:1 to explore form, materiality, and the hydroponic system. All models were constructed and photographed by the author.

St. Joseph's site model at 1:500

Living Wall Module at 1:1

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