Fostering Social Interactions within Communal Spaces within High-Rise Residential Buildings on UBC Campus

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Executive Summary

High-rise residential buildings are becoming more and more common nowadays, be it in the UBC campus or in many of the cities around the World. Past research suggests that living in high-rise buildings adversely affects people's satisfaction level and social relations. High-rise residences also tend to generate many negative outcomes such as fear, dissatisfaction, behavioural problems, reduced helpfulness, poor social relations and hindered child development. The common spaces in these buildings have the potential to address these issues by creating a feeling of community and bringing people together. These are the spaces which are open to all building residents and can be used by people to sit, study, have a conversation, hold events, and for many other social uses. In this project we examined how the design features and Indoor Environment Quality (IEQ) factors of these spaces affect the social interactions occurring in these spaces.

In this project the social common space in 5 different high rise buildings were analyzed, 3 of which are UBC student residences buildings: Marine Drive, Ponderosa Commons and Walter Gage and the other two are strata owned Academy and Sitka towers. We adopted three approaches to study these buildings: Observations of design features and physical measurements of IEQ features, On-site Observations and Interviews and Survey Questionnaires.

The research team spent approximately 8 hours in each of these spaces and observed and measured its design and Indoor Environmental Quality features such as lighting, thermal comfort, indoor air quality and acoustics. We also observed the use of the space and interviewed people. The survey conducted in received a response rate of around 10% from each building and providing us with some useful insights of occupant's needs and satisfaction levels. We conducted a descriptive analysis on our collected data and have been able to find some interesting conclusions and useful recommendation for the developers of these buildings.

In general, we found that there is not a clear direct correlation between the design features, IEQ factors and the social interactions that occur in these spaces. However, some recommendations can be logically deduced from our findings which are applicable to buildings similar to the buildings studied in this project. These conclusions and recommendations have been described in detail in the report.

There exists a huge scope for further expanding on this study by studying more number of buildings and different common spaces in these buildings such as garbage sorting area and washing rooms. In the last section of the report we have explained the limitations of this study and some suggestions for future work.

Acknowledgements

We would like to thank our course coordinator, Dr. Steven Rogak, for his continuous support and guidance throughout this project. We also sincerely thank Dr. Karen Bartlett and Dr. Murray Hodgson, without their instrumentation support and critical feedback this project couldn't have been completed. We thank Helen Lui, the client, and Hannah Brash, the project coordinator from UBC SEEDS for their support. We are also grateful to the building managers in these 5 buildings, who provided the access, drawings for the buildings and emailed the surveys to building occupants.

1 Introduction

This case study project focuses on the relationship between building design and social interactions in communal spaces in high-rise residential buildings. The design and indoor environment quality (IEQ) features of a space may influence the quantity and quality of social interactions between building residents as well as other users of the space. This research project will focus on assessing the design and indoor environmental quality features in five existing high-rise residential buildings on UBC campus: Walter Gage, Ponderosa Commons, Marine Drive (UBC Student Residences), Academy and Sitka Towers (Strata Owned Condo Towers). The spaces were selected after meetings with the respective building managers and discussions on the design ideology behind these spaces. The selected spaces have similar functions and are common spaces for use by building residents.

1.1 Objectives

The main objectives of this study are:

- To identify and assess the interactions taking place in the communal spaces and determine if and how the design features of the space affect social interactions.
- To understand the impact of the Indoor Environmental Quality (IEQ) factors on the residents use of the space.
- To provide recommendations for future design of common spaces, in high-rise residential buildings, aimed at fostering social interactions in common spaces.

2 Literature Review

The history of high-rises may be traced back to the pyramids of Egypt (48 storey high) and the tower of Babel. However, people did not build any tall structures until the late 1600s. Therefore, living more than a few storeys up is a recent phenomenon. The social science approach to architecture can be dated to middle 1960s. Also the perception of beauty can be traced to 2500 years ago (Gifford 2007).

Gifford in his review in 2007 states that living in high-rises have many negative outcomes such as fear, dissatisfaction, behavioural problems, reduced helpfulness, poor social relations and hindered child development. On the other hand, tall buildings have smaller footprints leaving more room for parks and green spaces. However, these green spaces are under-controlled. High-rises have easier access to transportation, are less noisy on the upper levels, have controlled entrances and have access to cleaner air in the higher levels. He mentions that the outcomes of living in a high-rise depend on various non-building related factors, named "moderating factors". These factors can be either associated with residents or context (environmental and neighbourhood).

So far, five general methodological approaches have been used in research:

1) Case study of one high-rise (satisfaction or helping behaviour)
2) Comparing high-rises with low-rise without considering moderating factors
3) Comparing numerous high-rises with numerous low-rises considering at least some potential moderators
4) Comparing numerous high-rises with numerous low-rises considering many potential moderators
5) Longitudinal design, assessing changes in the same group of residents over time (Gifford 2007)

Gifford believes that no study of high-rises have met all the requirements of a true experiment, therefore no certain conclusions may be drawn. He thinks that to carry out such investigation is very difficult and often researchers are forced to use non-optimal research designs.

Gifford in 2007 concludes that the literature suggests that living in high-rise buildings adversely affects people's satisfaction level and social relations. It is also found that it is not optimal for children, and the crime and fear of crime is higher. It is also probable that living in such buildings account for some of the suicides. He studied the influence of high-rise buildings satisfaction, preferences, social behavior, crime and fear of crime, children, mental health and suicide. In his review, he accounted for moderating factors such as the socioeconomic status of the residents, their ability to choose a housing form, their stage of life, parenting, gender, neighbours and indoor intensity. He also concludes that living in high-rises have different consequences, a few may be caused by the building itself and many are moderated by non-

architectural factors. He also suggests that no solid conclusions can be drawn from the literature as true experiments are impossible in housing research and are determined by multiple factors. He stated that many but not all of the residents are more satisfied by low-rises than high-rise buildings. High-rises are found to be more pleasant for residents when they are more expensive, located in better neighborhoods, and residents chose to live in them. Children's outdoor activities are restricted in high-rises or leaving them unsupervised causing behavioural issues. Residents in high-rises have fewer friendships and help each other less. Crime and fear of crime is higher and a small number of suicides may be associated with living in tall buildings.

In 2008, Amole conducted a study on residential satisfaction in students' housing in Nigeria. He specifically examined the morphological configurations of the halls of residence and how it affects residential satisfaction. He obtained the data from a closed-ended self-administered questionnaire distributed to a sample of 1124 respondents from all the halls of residences in four residential universities in South-western Nigeria. The data included the objective and subjective measures of the physical, social and management attributes of the halls of residences. The objective variables included the configuration of the halls, number of persons in the bedroom, presence or absence of reading room, common room, kitchenette and a balcony. The subjective variables that Amole considered were comfort, bedroom furnishing, privacy in bedroom, the sanitary facilities, kitchenette, design and the location of the hall. Attitudes were measured on a scale from very poor to very good. The demographic variables were also included in the data obtained through the questionnaire. The variables were sex, age, level of study, length of stay, and economic status. The data were analyzed using frequencies, factor analysis and categorical regression. He found more than half (53%) of the respondents dissatisfied with their residences in terms of their social qualities of the residences, especially, the social densities, the kitchenette, bathroom and storage facilities and some demographic characteristics of the students. On the other hand, the length of the hall was found to be a predictor of satisfaction (Amole 2009).

Holahan in 1976 measured and compared the social behaviour in three contrasting sites in a low-income neighborhood. The three sites were: old neighborhood of low-rise tenant houses, a traditional high-rise housing project, and an innovatively designed high-rise housing project. All the three sites were comparable in age, size, socio-economic status and racial background of residents. He found the old neighborhood to have the highest levels of outdoor socializing. He used behavioural mapping to conduct this study, and collected data in each site on three Saturday afternoons during summer. He measured 5 min time-sample of the social behavior of a sample of individuals outdoors, and also did a profile of the range of activities based on a single observation of each individual. The behavioral mapping method that was used in this study consisted of recording the number of individuals engaged in each of the behaviour types

on each site. A list of behavioral categories was selected through initial observations. The youth, below age 20, and adults were studied separately. Interactions were categorized as verbal and nonverbal (Holahan 1976).

A study of informal learning space measured acoustical characteristics and architectural features that may influence people's satisfaction of the space, which was captured from a survey of 850 students (Scannell et al. 2014). It was found that more vegetation, the presence of soft furnishings, and lower seating density increased some components of perceived suitability and well-being. We will investigate these design features in our study.

Another study done in high-rise housing in Taiwan investigated the relation between the courtyard design of high-rise housing complexes and the social interactions (Huang 2006). An on-site observation approach was used in this study on three high-rise residential buildings. The data collected through observations included the number of users, gender, age range, movement flow, location of activity and the type of activity (social or non-social). To identify social activities, the researchers referred to the observable interactions amongst residents including nodding, talking and friendly physical contact. The results indicated that the scenic and activity spaces had the highest percentage of social interactions.

Some of the past studies done to study social interactions in cohousing units provide some useful insights into the communal spaces. In terms of their position in the layout of the community, facilities need to be central (Fromm 1991; McCamant and Durrett 1994)and accessible (Fromm 1991; Hazzeh 1999; McCamant and Durrett 1994). As key activity sites, communal facilities should be placed on shared pathways within residential areas to maximize social interactions (McCamant and Durrett 1994). Visibility of communal facilities is also important to increase opportunities for surveillance, thus increasing use and opportunities for social interaction (Fromm 1991; Hazzeh 1999; McCamant and Durrett 1994).

3 Research Approach

On the basis of the literature review, it was concluded that some of the methods that can be adopted to study the social interactions are on-site observations, survey questionnaires and interviews. The important design features and IEQ factors for study were also developed through the literature review and discussion with Dr. Karen Bartlett who is a professor at the School of Population and Public Health at UBC and with Dr. Murray Hodgson who is a professor in the department of mechanical engineering at UBC. The following design features were selected:

- **Lighting** (natural and artificial)
- **Indoor air quality** (CO2, Ultrafine particulate matter)
- **Background noise level**
- **Thermal comfort** (Wet and dry bulb temperatures, head vs. foot temperature, Relative humidity, Radiant temperature)

3.1 Methodology and Instrumentation

This research project has been divided into three different phases:

1) **Design and IEQ Feature Assessment**: Initially the design features of the space and IEQ factors such as lighting, acoustic, indoor air quality, layout and thermal comfort were measured both quantitatively and qualitatively through real-time measurements. To measure the indoor environmental quality of the spaces, the following devices were used:
    - *Lighting:* Lux meter to measure average lighting level in the space
    - *Indoor air quality:* Q-track to measure CO2 levels and P-track to measure ultrafine particulate matter
    - *Background noise level:* Noise level meter to measure the background noise level when the space is occupied
    - *Thermal comfort:* Questemp to measure wet and dry bulb temperature, globe temperature and relative humidity
2) **On-site observation and interviews:** During this phase each of the spaces was observed over a few hours distributed between weekday/weekend and day/night to identify the quantity and quality of the social interactions taking place in the space. In addition, short interviews with more open-ended questions were asked during observation periods.

3) **Survey Questionnaire**: A survey questionnaire was developed with the objective of capturing occupants' opinions on the Indoor Environment Quality (IEQ) of these common spaces and their user of this space. Most of the questions in the survey were structured asking about the occupants rating on the various IEQ factors based on a Likert scale (1-7) where 1 represents Highly Dissatisfied and 7 represents Highly Satisfied. These questions were taken from the Occupant IEQ Survey developed at the Centre of Built Environment at UC Berkley (Zagreus et al. 2004)In addition to questions on IEQ, the survey had questions related to occupant's use of the space for social interactions and also had some open ended questions asking people's opinions on what they would like to change about the space. The survey was prepared in Google Forms and sent out via email to all the occupants. It was open for one week and a reminder was sent out in the middle of the week.

Once the data collection was complete, the on-site measurements and observations data was compared with the data obtained from the surveys and interviews. A descriptive analysis approach was used to co-relate the data and arrive at logical deductions.

4 Building Analysis

In this section each of the building is analyzed separately based on the design features, on-site observations and survey results. This is followed by a discussion on the various design features and IEQ factors of that building. The summary of the on-site observations of interactions and the weighted average of the satisfaction levels from the survey is presented in Table 4.1 and Table 4.2 respectively. In Table 4.2 the numbers indicated in red represent a satisfaction level that is below the average satisfaction level of all buildings.

Table 4.1 Summary of on-site observations

	Gage Towers	Marine Drive	Ponderosa	Sitka Towers	Academy Towers
Number of Interactions	29	6	5	2	3
Average Duration (min.)	56	14.5	12	2	2
Nature of Interaction	Group Study, Casual, Art, Sport	Casual, Sport	Group Study, Casual	Waiting	Waiting

Table 4.2 Summary of Occupant Satisfaction Levels

	Gage Towers	Marine Drive	Ponderosa	Sitka Towers	Academy Towers	Average
General Layout	5.0	5.7	4.2	4.8	4.4	4.8
Colors and Textures	5.2	5.1	5.3	5.6	5.3	5.3
Thermal Comfort	5.0	5.2	4.3	5.4	4.9	5.0
Air Quality	5.0	5.1	3.8	5.4	4.9	4.8
Lighting	5.2	4.8	4.6	5.7	5.6	5.2
Noise Level	4.0	4.4	4.0	4.8	4.5	4.3
Cleanliness and Maintenance	5.6	5.3	5.9	5.2	5.3	5.4
Access to Space	5.6	5.4	4.9	5.9	5.2	5.4
Seating	3.9	4.2	3.9	5.0	4.6	4.3

4.1 Ponderosa Commons

Ponderosa Commons phase 1 consists of 3 buildings, while not all of them are UBC Residence owned. Phase 2, where the common spaces are supposed to be, is under construction. So there is no specifically designed social space in existing Ponderosa buildings. The space that was studies is the lobby in Arbutus Lounge in Ponderosa Buildings, which includes a casual sitting area and a study area, as showed in Figure 4.1. Figure 4.2 shows the plan of the lobby, where pink arrows indicate natural movement of people in the space. All the measurements and observation data are illustrated in Appendix A.

Figure 4.1. Common spaces in Ponderosa

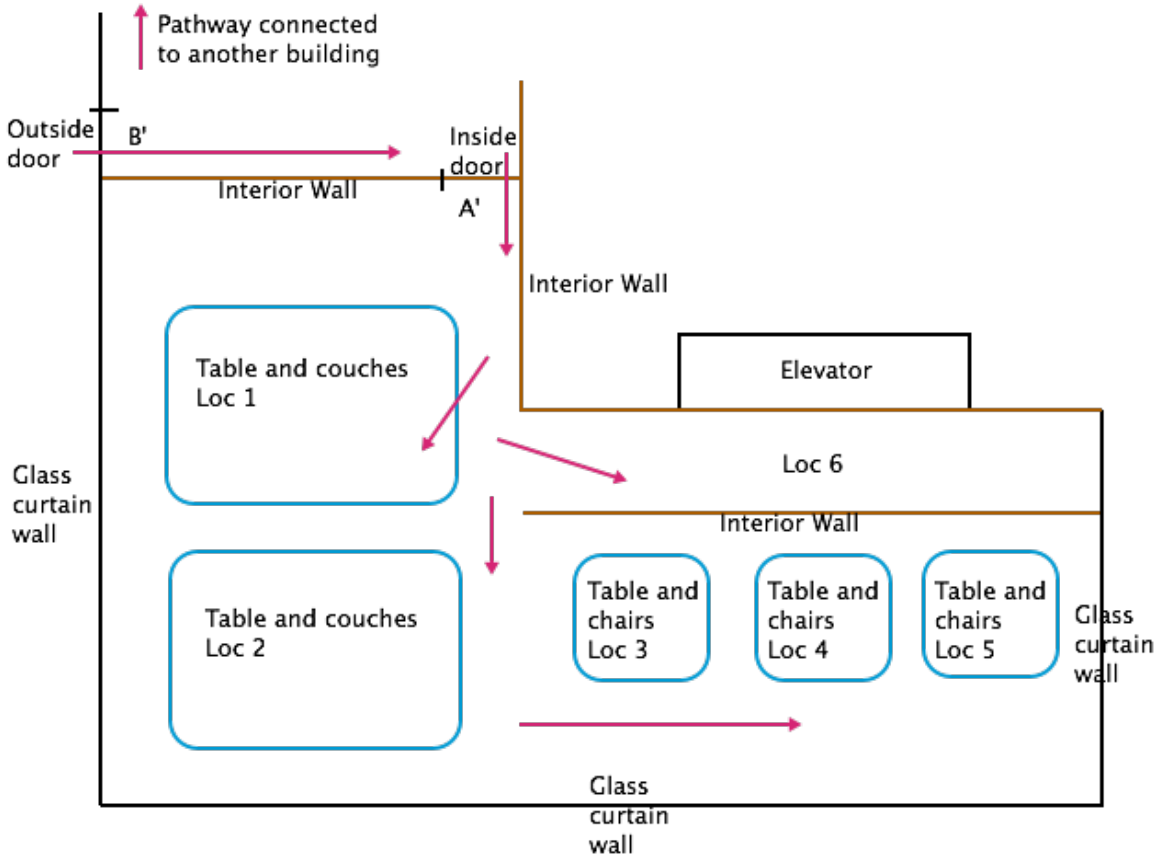

Figure 4.2. Arbutus lobby Plan

In the evening, the lighting is a big issue in Ponderosa. On the first day of measurement, the artificial lighting was below 100 lux on average. Although it was brighter on the second day, but still it was not suitable for study. And some of the lights were not on, making the lobby dim. Figure 4.3 is the picture taken on March 16th.

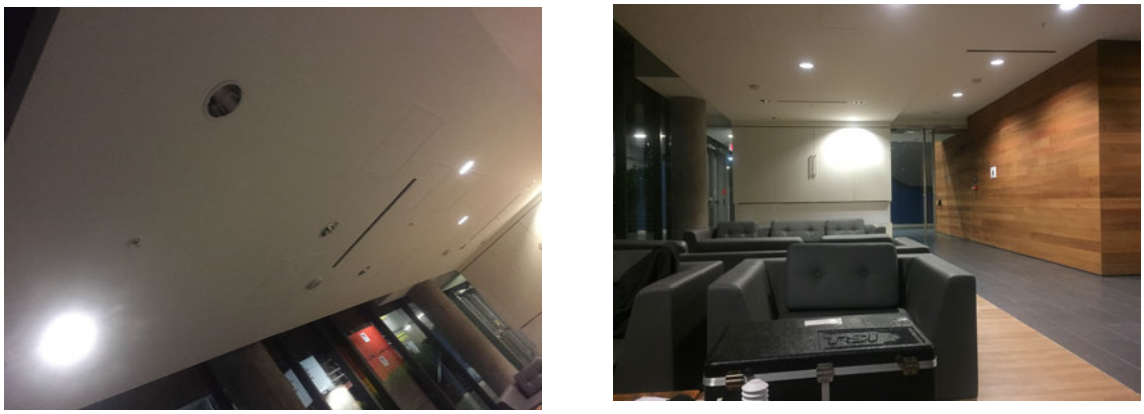

Figure 4.3. Lightings in Arbutus lobby

In the day, the curtain walls allow much sunlight in. The illuminance level is not even distributed throughout the space. The good thing is that the blinds on the south façade are controllable to avoid straight sunshine. Other observations of the internal and external factors are attached in Appendix A.

During our on-site observations, very little interactions and group studying were observed in this space as can be concluded from Table 4.1. During the observation period, two people were studying and four groups of people had short (under 10 minutes) conversations. The interactions were mostly casual talking. As can be observed from Table 4.1, a total of 5 interactions were observed during approximately 6 hours of observation. The average time for each conversation was around 12 minutes. The on-site social interactions observation data has been attached in Appendix A.

According to interviews with people, it was found that people like the windows and openness of the space as well as its quietness. However, they were dissatisfied with the small number of tables and outlets, poor lighting, dark colors, size of the space being too small, no close access to food or drinks, and access to the space (two key cards are needed which makes it hard to enter if you have your hand full). Interviews show that people use this space for studying during exams; also some social gatherings are organized in this space.

The total number of responses for this survey was 29. The results indicated residents use this space mostly for general discussion and rarely for academic discussions. The average time spent by occupant in this space per day is around 10.46 minutes. As per the survey most of the occupants have their conversations at the couches, chairs, near the elevator and the table area. The occupants in this building were not very satisfied with the air quality and seating in this

space. In comparison to other buildings, the occupants were least satisfied with the various design features and IEQ factors of this space as can be seen from Table 4.2. The other findings from the survey are summarized in Appendix A.

Some of the insightful comments in the survey from residents are mentioned below:

"I would like the study space to be separate from the couches and the couch/ tv area to be more interesting and comfortable. It would be nice for that space to make me want to spend time there. The study space is the only time I am downstairs."

"Open the stairs so that people can walk upstairs. Have floor lounges on every floor like in first year residences or else we don't even see anyone."

"Add more chairs! Also increase lighting level, as at the evening you literally can't stay there because your eyes hurt from the dim light. Also way too often there is some vent turned on, it makes too much of nice [sic] *and the space is too cold (windy??) because of it, makes it unpleasant to stay there :("*

"It is unfortunate that I have to walk to Marine Drive Commons to study, socialize, recharge my laundry card, pick up mail, etc. etc. Also, there is a lingering garbage room scent more than 50% of the time due to bad ventilation and close proximity to the garbage room"

"Having a lounge beside a study space is not a good idea. I don't feel comfortable having conversations when people are trying to study!"

"There have been weeks at a time where it smells for days, not just one hour out of one day. When it's like this, I barely want to be in that space, let alone socialize in it. Also, the acoustics are a bit loud, so if I want to have a private conversation, I obviously wouldn't do it there. If there's lots of people studying, it can also get a bit noisy."

"During the winter when I was seating in the desk area behind the elevators, it was too cold to study even with all the windows closed."

4.1.1 Discussion

a) Space Conflict

There is a conflict in this space between the lounge and the study space, both of which are combined into one. As suggested by the survey the satisfaction of the residents of the residents with the general layout is 4.17 and the comments state that people are generally do not feel comfortable in having a conversation here when people are studying. As a result even though the lounge is beautifully designed with comfortable couches and a TV, it is rarely used by the residents for social interactions. This is supported by our observation data where the space was mostly being used as a study space.

b) Air Quality

The ventilation system in this space was not very effective as during our observations we noticed a bad smell in the space. As indicated by the feedback of the residents, the poor air quality of this space is one the most interfering factor with their use of the space and it has a rating of 3.79, which is the lowest amongst the other factors. The residents have also complained about this "garbage" smell in their comments about this space.

c) Seating Area

As per our observation this area had comfortable couches and seating, but the total number of seating was 18 which is low considering the number of residents who live in this building (605) The seating area in this space got a rating of 3.9 and this is mainly because the residents need more seating in this space especially for study purposes. Overall, the seating area in this space is one of the most enhancing design features of this space which encourages use of this space for social interactions.

d) Thermal Comfort

The observations indicate a temperature of 20.5 degrees in late summer evenings, which is inside the thermal comfort zone of people. However in winter it is anticipates that the place gets cold due to its low wall/window ratio. This can also be ascertained from the survey results, as thermal comfort is one of the important factors that interfere with residents' use of this space, which has also been mentioned by the residents in their comments.

e) Lighting

This space has poor lighting especially during the night, and the dark wall colors further reduces the light in this space. The satisfaction rating of the lighting is 4.62 and the comments of the residents suggest that the low lighting in this space interferes with their use of this space for academic purposes.

f) Acoustics

The acoustics of this space has also been voted as an interfering factor for the use of this space, the satisfaction level for noise is 4.03. However, the observed noise level of 56.3 dBA is low because during our observations there were not many people using the space. The low ratings for the noise level are probably due to lack of sound absorbing surfaces in this area and also there are some construction sites very near to this space. The low wall/window ratio also results in less sound absorption.

g) Natural Daylighting

The abundance of natural daylighting and the large windows in this space were some of the good design features in this space. As per the survey results natural daylighting was one of the important encouraging factors for the use of this space.

4.2 Marine Drive Residence

There are 6 buildings in Marine Drive in total. Building 3 in the middle is the Commonsblock building (See Figure 4.4). Figure 4.5 shows the target common spaces within Commonsblock. Two night measurements and two day measurements have been done in Marine Drive Commonsblock. The measured IEQ factors and the observation data for other internal and external factors are in Appendix B.

Figure 4.4. Layout of Marine Drive Residence

Figure 4.5. Common spaces in Marine Drive Commonsblock

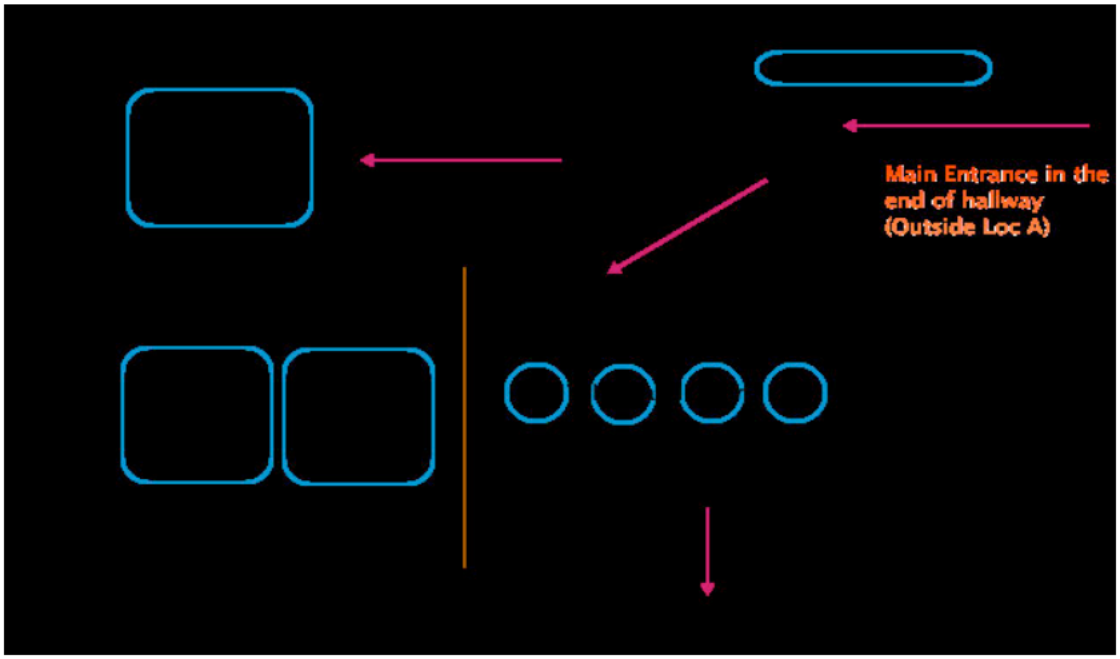

Figure 4.6. Plan of the Marine Drive common spaces

This space was found to be mostly used as an individual casual study area and not as a social space, and was used mostly during the late night hours. The first few people in the space studying quietly were giving the others the impression that this space is a quiet study area. However, some interactions were observed mostly in the hallway and at the vending machine. The duration of the interactions was quite long (about 30 minutes) and the interactions were mostly casual talking. As can be observed from Table 4.1 the total interactions were 6 during 8 hours of observation period and the average duration of the interactions were around 14.5 minutes. The on-site social interactions observation data has been attached in Appendix B.

The total number of responses for this survey was 177. The residents use this space mostly for general discussion and academic discussions. The average time spent by occupant in this space per day is around 37.8 minutes. As per the survey most of the occupants have their conversations at the couches, study rooms, near the fireplace, and the table area. The occupants of this building were mostly satisfied with the various design features and IEQ factors of this space. In comparison to the spaces in other buildings they were less satisfied with the lighting, seating, colors and cleanliness in this space as can be seen from Table 4.2. The other findings from the survey are summarized in Appendix B.

Some of the insightful comments from residents are mentioned below:

"Vary the furniture- add larger tables but keep the couches next to the fire place. Make it more like a living room."

"I think there needs to be more outlets around if possible. Also the small rooms smell bad sometimes."

"Nothing much. I love that they have comfy sofas for me to just sit down next to my friends and talk about intimate conversations. The worst place to talk are the tall seats across the ballroom."

"If it had a restaurant connected to it - ie: if the Point Grill was attached to it instead of in another building. I use it most frequently for the services and amenities provided there - fitness room, study room - which tend to be solo activities."

"The meeting rooms don't have good acoustics (noises bounce off walls a lot) and makes it hard to study when people are socializing in these areas. The atmosphere of the meeting rooms aren't that conducive to studying/hanging out in (possibly because of the acoustics and also maybe because of the SUPER squeaky chairs)."

"I would make the comfortable seating area closer to the door because having to walk all the way to the back of the building makes me not want to sit there"

"WATER FOUNTAINS! It's hard to fit a waterbottle under the tap in the bathroom, and you can't control the temperature of the water. This is irritating if I'm studying late at night and don't want to lose time running back to my room."

"Two problems: 1)It is a far too open, dark, uninteresting room with the atmosphere of a school cafeteria after everyone has left. 2) it is in no proximity whatsoever to anything of interest. There's is [sic] *two vending machines and these cold, un-welcoming study rooms, and that's it. Social interactions are not a planned event for the purpose of interacting. People meet for something. For a coffee, for a stretch out in the sun, for a beer, to be away from something. The only comparative advantage the commonsblock could have is I offer a cozy, nice space where people feel welcome and well. But instead of using it's proximity to nature, the feeling of space in the room is that of being separated of said nature. The room is a big, long, tunnel connecting the seating area with an empty hallway instead of opening space into nature."*

"Although I do not personally use this space often, I feel that it is absolutely perfect for social interactions, and would not change anything "

"It needs a more inviting, warm environment. A more modern, welcoming vicinity with more comfortable chairs and an area to purchase food/drinks. A lot of people will meet over a coffee or lunch; however, since neither of these things are available there, they will more more likely to go to the Point or the Sub."

"In winter, the big study room and the red couch area can be a bit cold since air from the outside goes in frequently."

"It might be nicer if there was some sort of separation between a quiet and non-quiet area, so that I don't feel bad talking around people that seem to be studying."

"1. Need a water fountain or water cooler. 2. Better table layout. 3. Semi-organized events. 4. Usually hard to find a spot"

4.2.1 Discussion

a) Location

This space is not connected to any of the buildings and is located at the far end of Commonsblock. This inconvenient location has been a major factor that interferes with the use of this space.

b) Café

This space just has 2 vending machines and doesn't have any water fountains. As suggested by the comments of the residents, the space should have water fountains and a café.

c) User Control

As per the observations, the furniture in the space was adjustable and space users had a control on the temperature of this space. The survey results also show the same opinion; the residents are generally satisfied with the thermal comfort (5.17/7) and the general layout (5.75/7) of this space. These two factors have also been rated as the space enhancing factors for social interactions.

d) Natural daylighting

The space was observed to have good natural daylighting and furnishings. This observation is supported by the survey results as well since the natural daylighting and furnishings have been voted as one of the space enhancing design features.

e) Use of space

It was observed that the space was mostly being used as a study space and was generally very quiet. As a result the residents perceived this space as a study space and felt uncomfortable to have conversations in this space.

f) Seating Area

As per our observation this area had comfortable couches and seating, but the total number of seating was 30 which is low considering the number of residents who live in this building (1634). The seating area in this space got a rating of 4.19 and this is mainly because the residents need more seating in this space especially for study purposes. Overall, the seating area has been rated as both an enhancing design feature because it's comfortable and most interfering design feature due to its low number.

g) Acoustics

The acoustics in this space has been rated as an interfering factor for social interactions and has received a satisfaction rating of 4.42. These results conflict with the measured value of acoustics (48 dBA) which is really low and should not interfere with people's interactions.

4.3 Walter Gage Residence

There are 3 towers in Walter Gage residence, connected with each other by a common space in the middle. The researched space is the connection area (Figure 4.7). Two night measurements and a day lighting measurement were conducted. The measured IEQ factors and the observation data for other internal and external factors are in Appendix C.

Figure 4.7. Common space in Walter Gage

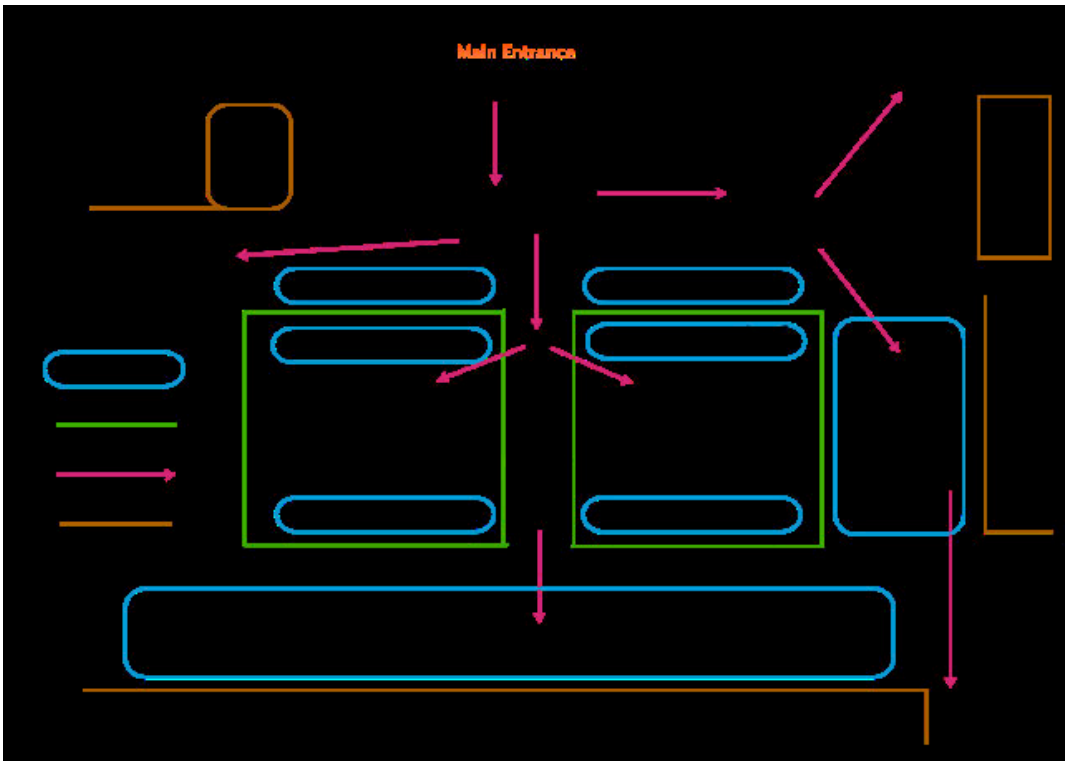

Figure 4.8. Gage lobby Plan

The light mainly comes from artificial lighting, even in the day. The only source of natural lighting is the skylights (Figure 4.9). There is a TV, which is usually on in the evening. A small shop is just a few steps away from the seating area (Figure 4.11).

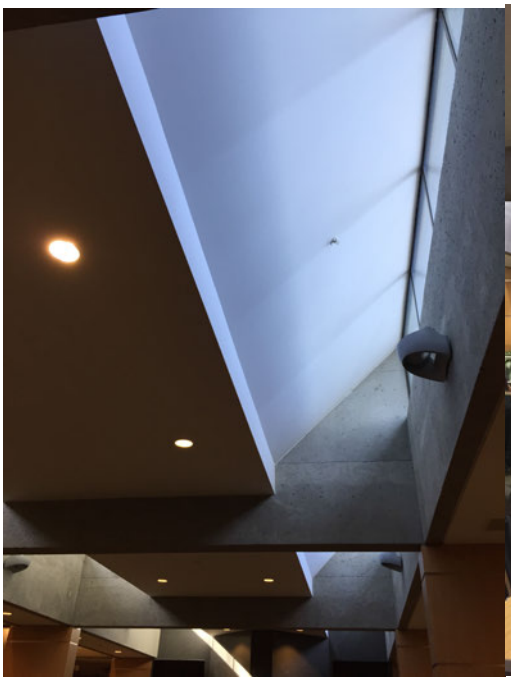

Figure 4.9. Natural lighting in Gage

Figure 4.10. TV in the area

Figure 4.11. Shop

Other issues are noted down in **Error! Reference source not found.**.

The Walter Gage residence was found to have the most number of interactions among the three student residences. This common space is connecting the three Walter Gage towers with over 1300 student residents. This area has plenty of space for group meetings and is mostly used for group and individual studying.

According to the interviews, residents like the different kinds of seating available, noisiness (they are more comfortable studying in noise), soft couches, ventilation and close distance to the exterior door. They are willing to have more outlets for laptops and more tables. They usually use the space for casual talks, watching movies group and individual studying. The total number of interactions observed in this space during approximately 8 hour of observation was 29 and the average duration of the interactions were 56 minutes. This space had the most number and type of interactions in comparison to other spaces. The on-site social interactions observation data has been attached in Appendix C.

The total number of responses for this survey was 151. The residents use this space mostly for general discussion and academic discussions. The average time spent by occupant in this space per day is around 42.8 minutes. As per survey most of the occupants have their conversations at the couches, lounge, near the fireside and the table area. The occupants of this building were mostly satisfied with the various design features and IEQ factors of this space. In comparison to

the spaces in other buildings they were less satisfied with the seating and noise level in this space as can be seen from Table 4.2. The other findings from the survey are summarized in Appendix C. Some of the insightful comments from residents are mentioned below:

"I very much like and enjoy the common area. It is an excellent place to socialize, but not exactly an ideal location to study. This is due to the abundance of distractions (noise, people to talk to, etc.), however the quiet areas nearby fulfill this need."

"I would prefer to not have study tables in Fireside Lounge as to increase its use for conversations or general hangout space as I feel uncomfortable socializing in a space where I am surrounded by people studying."

"Some of the seats don't have backs which is awkward for studying or just sitting for long periods of time. Sometimes the smell of smoke drifts in from outside. Not always free seats or tables"

"Most people use it for studying so there is hardly any social interaction happening. This applies to me as well. If it was less deemed as a studying area and more of a hangout area, playing some soft music would be nice for a change."

"The lounge has limited space to study. There's rooms to seat but not enough tables"

"More seating space, tables for studying, noise reduction"

"Firstly, it looks too hotel. Like boring cheap hotel. Can't they get different colored couches or something? Secondly, there's never enough space/seating. Often I just wont go down because I don't think I'll be able to get seats"

4.3.1 Discussion

a) Acoustics

Again, the acoustics issue here is tricky. All the students that we interviewed like the noise in the space, which they think is necessary for their study. However, as per the result of survey, acoustics turns to be the second worst feature in this space. This is because the tolerance of noise level differs from person to person. The people we interviewed were using that space at that time, which is a result of loving the space, while the students who filled out the survey may not use the space at all. That's why we received conflicting feedbacks in interviews and surveys.

b) Seating

i) General Liking

The interesting thing is that seating became the feature that people like most, as well as the one people dislike most. For example, one student mentioned in the interview that she likes the variety of types of seats in the space while one student in survey complained about the seats without backs, as they are not comfortable for

study. The perceived reason for this contradicting finding may be two-fold. First, the flavour of seating really depends on people. Second, different interpretation of the function of the space somehow determines people's favour of seating. To those who use the space for study, some of the seats are not suitable, but to those who regard this space as a hangout space, the seats are well-designed in terms of flexibility and sense of variety.

ii) Available Space

Most of students think there should be more seating. Given the fact that no Wi-Fi exists in students' rooms except the common space on the ground floor, 68 seats with over 1300 residents are not enough at all.

c) Layout and furnishings

Despite some feedbacks on "boring cheap hotel" type of furnishing, most of the people find the space attractive because of the layout and furnishing. The space creates a sense of openness and inviting.

d) Not clear function of space

The designed function of this common space is not clear. There are study rooms around this central area however people don't go to the quiet study rooms often. There is also a lounge nearby, however the table and chairs in the lounge tend to make it a study space. The researched space should serve as a hangout area for social interactions, but most of students regard it as another study area (according to observations and survey). The ambiguity of the function of the space does create conflicts. The students who have talks in this space feel uncomfortable socializing when surrounded by people studying. Meanwhile, the studying students feel distracted by the noise and people walking by.

e) Food service

More than one person mentioned the good to have the shop besides the common space. According to our interviews and observations, students tend to buy some snacks as a break of study. Proximity to shop and vending machine increases the time that people spend in this space (42.8 minutes, which is the highest among all the five buildings).

f) Access to the space

Last but not least, the most influential factor that contributes to the highly used common space in Walter Gage is that the common space is the connection of the three towers. Everyone must walk though this space to get into and out of their homes. The easy access, or let's say, the required access to this space increases the usage of the common space.

4.4 Academy Tower

Academy Tower is a Polygon high-rise residential development which is owned by Strata. This building has 132 residents. Due to some security and privacy issues, the research team had limited access to the building. Therefore, only two day measurements were done in Academy. The measured IEQ factors and the observation data for other internal and external factors are in Appendix D.

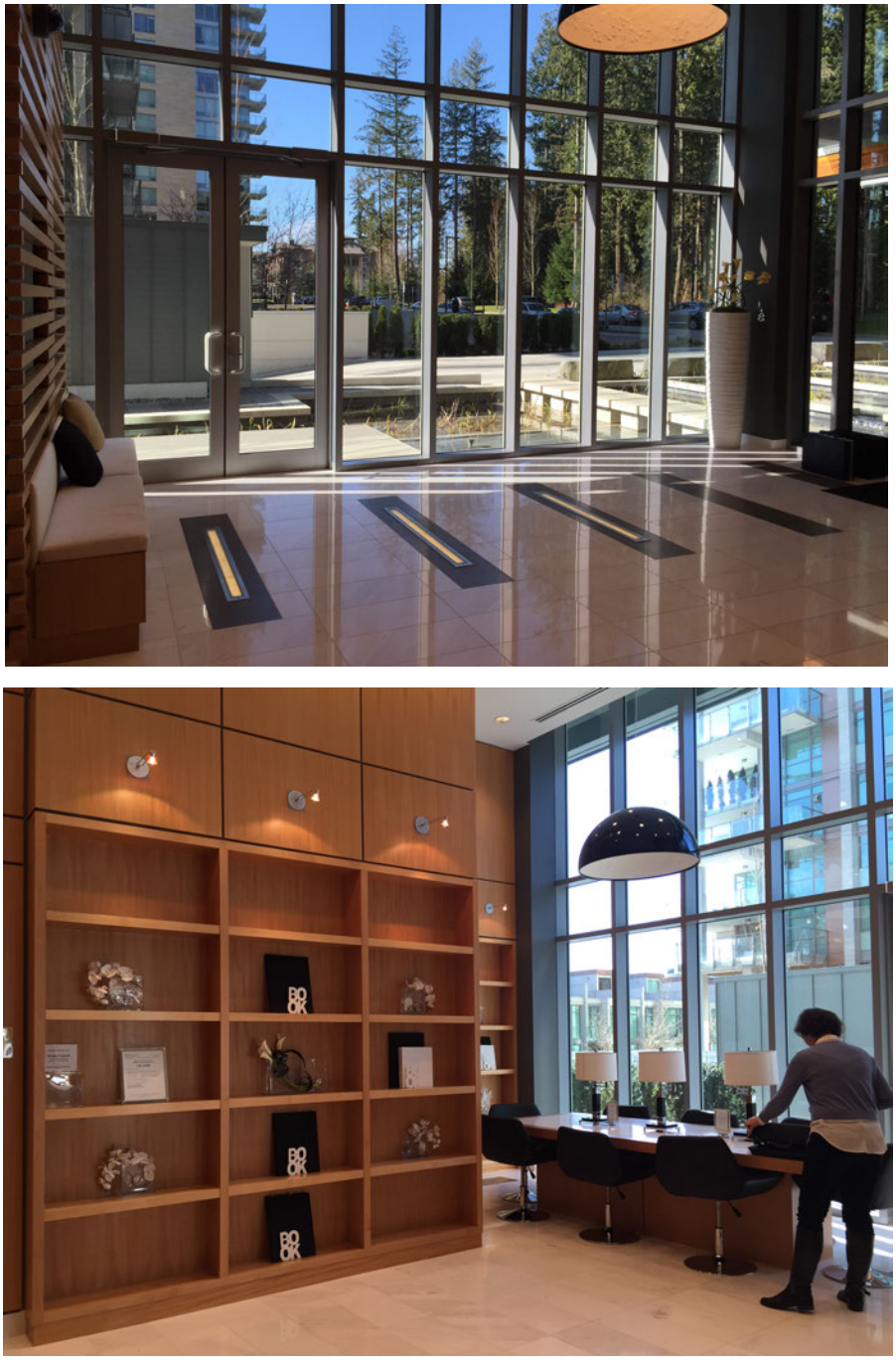

Figure 4.12. Academy Lobby

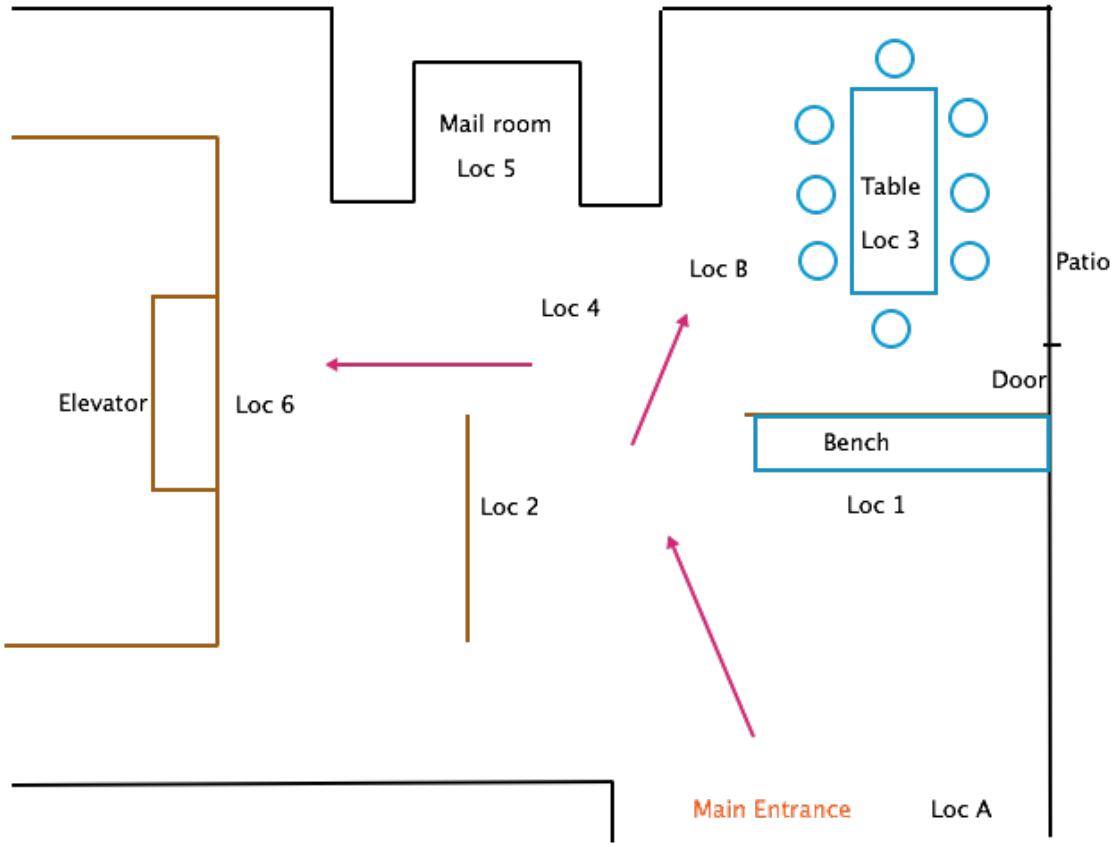

Figure 4.13. Academy lobby plan

On the second measurement day, the team noticed new signs in the space which limited the use of the space by the residents. The signs state the space is “for meeting only” and “It is not to be used as a personal study/work/play area” on the table. (Figure 4.14)

Figure 4.14. Signs on the Table

Another interesting finding is that there is no mailbox or unit number with “4” which is a bad number in the Chinese culture due to its same pronunciation of the character “death”. (Figure 4.15). Also, all the signs and notices were written in English and Chinese. This implies that the majority of the residents are Chinese.

Figure 4.15. Mail boxes without number “4”

Very little social interactions were observed in the lobby area of Academy tower. People were mostly passing by to reach the elevator. When people were together, they had short talks while waiting for the elevator. The space was full of signs that discourage social interactions. The signs require people not to make noise in the lobby to avoid disturbance for ground floor residents, also the table was said to be used only for building meetings and not for study purposes. The bench in the lobby seats at most 4 people and is very uncomfortable. The amount of natural lighting and views are very pleasant, but people do not use the space for any purposes other than waiting for a few minutes. As can be seen from Table 4.1, the total number of interactions observed in this space during approximately 8 hour of observation were only 4 and the average duration of the interactions were 4 minutes.

The total numbers of responses for Academy survey were 16. The residents normally used this space sometimes for general discussions and never for academic discussions. The average time spent by occupant in this space per day is around 13.3 minutes. As per the survey most of the occupants have their conversations at the conference table and on the bench. The occupants of this building were mostly satisfied with the various design features and IEQ factors of this space. In comparison to the spaces in other buildings they were less satisfied with the layout,

thermal comfort, access and cleanliness. Other findings from the survey are summarized in Appendix D. Some of the insightful comments from residents are as follows:

"Try not to impose unreasonable rules on using communal space, such as forbidding individual private study by tenants".

"Try to have similar layout as in the neighboring Sage and Wesbrook which appear to make much better use of communal space".

"Providing some magazines or newspapers to make better use of the decorating bookself, and hence to motivate tenants to take a relaxing brief stay there."

"For more social interaction, add something fun. A foosball table or pool table. Maybe a watercooler. The one large table can be intimidating to sit at if there are already 2+ people sitting there. Especially how it's tucked in the corner like that. People will first sit at the outermost, closest seats. As a stranger, it's awkward to slip in behind them and sit on the other side of the table."

"More separation from the adjacent living spaces - the noise travels quite easily and disturbs residents - the space that was supposed to be a gathering place had been restricted and and basically decoration - it would be nice if the doors to the pond opened for air"

4.4.1 Discussion

a) **Layout**

Although the table in the lobby is a nice place to sit, the first people usually sit on the outermost chairs, limiting the use of the other chairs at the corner by the other occupants. The table is confined at the corner and there is not enough space around it.

b) **Seating**

The seating in this space consists of a bench and a table with eight chairs. The bench is very uncomfortable, however the table is a nice place to sit and study or read. According to survey, the residents would like to have magazines and newspapers in the bookshelf to be able to sit at the table and read. However, the signs on the table limit the use of it to meetings only.

c) **Acoustic**

To make the best use of the space, the lobby area is very close to the ground floor units. There is no acoustic separation and the noise travels in the lobby, which is found very disturbing by the residents. The signs in the lobby that limit the use of the space are aimed to minimize the noise travelling to the units. It is recommended to allow for adequate distance between the common areas and the residential units as well as separating these areas acoustically, so the residents can use the common areas freely at any time.

4.5 Sitka Tower

Sitka tower with 68 residents was also studied. Same as Academy building limited access allowed for only two day measurements in this building. Same as Academy building limited access allowed for only two day measurements in Sitka. The common space that was studied is the lobby area (Figure 4.16). Figure 4.17 shows a layout and location numbers in this space. The measured IEQ factors and the observation data for other internal and external factors are in Appendix E.

Figure 4.16. Sitka lobby

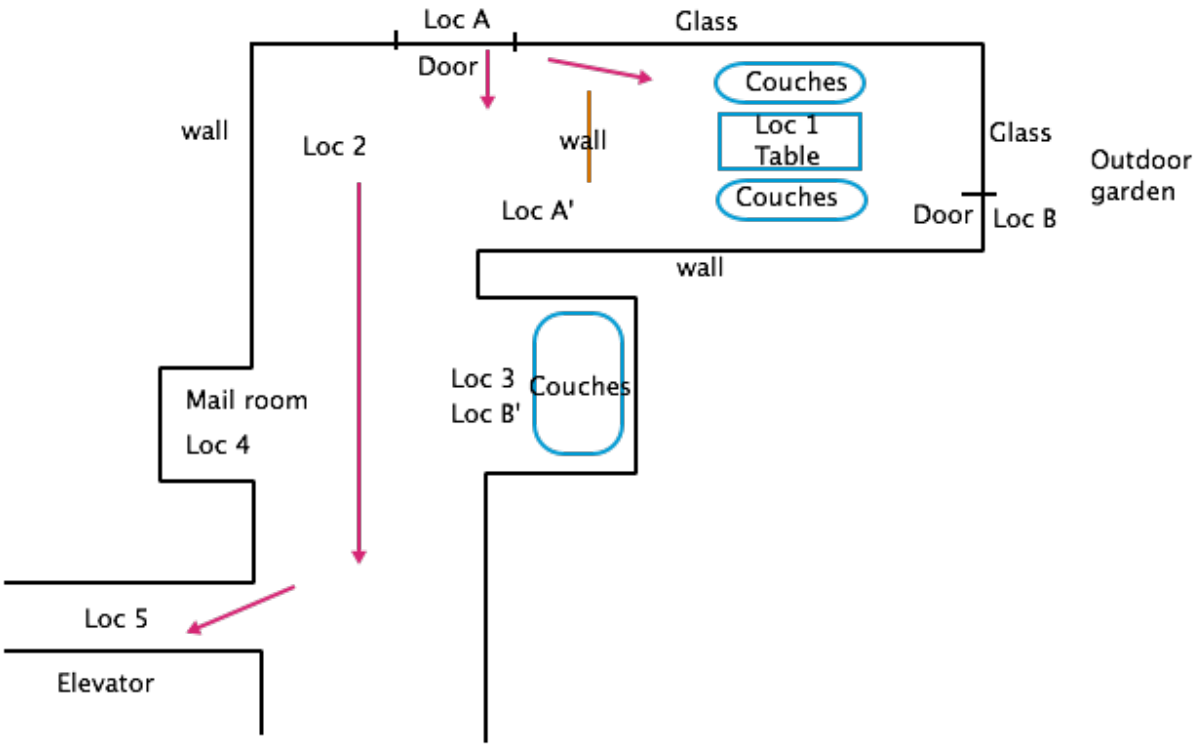

Figure 4.17. Layout of Sitka lobby

This space was found to be mostly used as a waiting area. A few interactions were observed during the observation periods. They were mostly short talks while people were waiting for a cab or a friend. According to interviews with people, they use the space to catch up with a friend or wait for a cab. The space is not very often used, but the sofas are found to be comfortable. The openness of the space was found to make a seated person uncomfortable when others pass by. As can be seen from Table 4.1, the total number of interactions observed in this space during approximately 8 hour of observation were only 4 and the average duration of the interactions were 4 minutes.

The total number of responses for this survey was only 9. The weighted average of the satisfaction levels (1-7 as Highly dissatisfied to Highly Satisfied) for different design features is shown in Figure 13.1. The space is rarely used by the residents. The average time spent by occupant in this space per day is around 7.35 minutes. As per the survey, most of the occupants have their conversations at the lobby couches and some even use the outdoor space for their conversations. The occupants of this building were mostly satisfied with the various design features and IEQ factors of this space. In comparison to the spaces in other buildings they were less satisfied with the cleanliness and maintenance as can be seen from Table 4.2. The other findings from the survey are summarized in Appendix E.

Some of the insightful comments from residents are as follows:

"I don't use this space, and don't have the need or desire to. However, I do like the garden space outside"

"The color in the lobby area is cool. I cannot imagine to seat there just to enjoy my time! Also there is a small lobby for this big building. The second lobby (In front of post boxes) is just waste of space. Nobody can feel comfortable to seat because of layout."

"I would make one part more private, they are too open to everyone walking by for an actual conversation. A workout space would be amazing."

"I think it's really beneficial in terms of having a physical space in the building that is prioritized for socializing because does it not only make things convenient but also is comforting knowing that there is a space available if I ever needed one for whatever reason."

4.5.1 Discussion

a) Layout and size

The lobby area at Sitka consists of two sections. The first section is by the entrance and another section is located in front of mailroom. The first section is thought to be too open for people to feel comfortable to sit down and talk. The second space is not a desirable space for residents to use as it is located in front of mail boxes and elevators where people do not feel comfortable seating there. Also, the lobby area is thought to be very small

compare to the building. However, the garden, which has benches and is accessible from the lobby, is sometimes used for socializing. Surveys show that people like the garden more than the lobby itself.

b) Furnishings

Although the couches in the lobby are comfortable, the colors used in the space are not inviting, as they are mostly cool colors.

c) Benefits of having a space for social interactions

People in this building are interested in having a space dedicate for social interactions. They also think that a workout space might serve both functions: exercising and socializing.

5 Conclusions

The conclusions section has been divided into six sub-sections where each of the design features is analyzed and then the external factors affecting the social interactions occurring in these spaces are discussed.

5.1 Indoor Air Quality

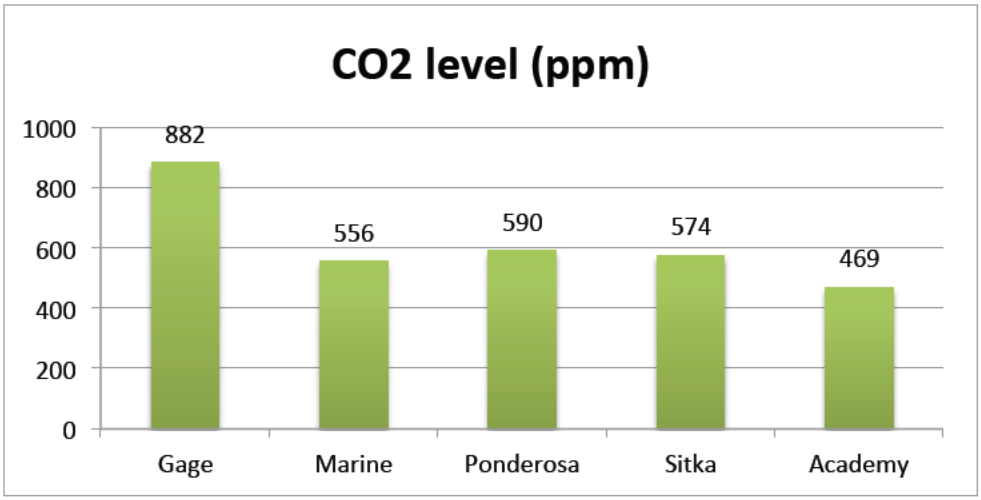

Figure 5.1. Average of measurements of average CO_2 level in five buildings

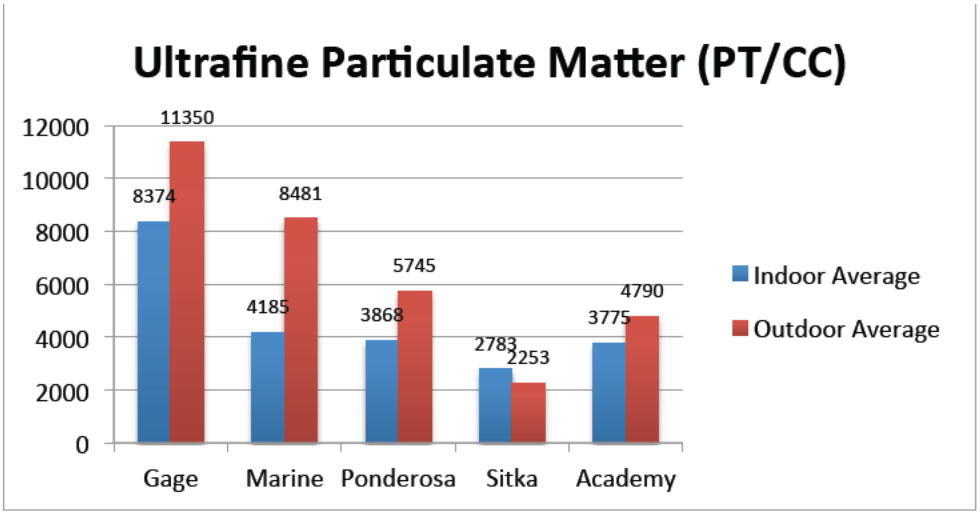

Figure 5.2. Average of measurements of UPM in five buildings

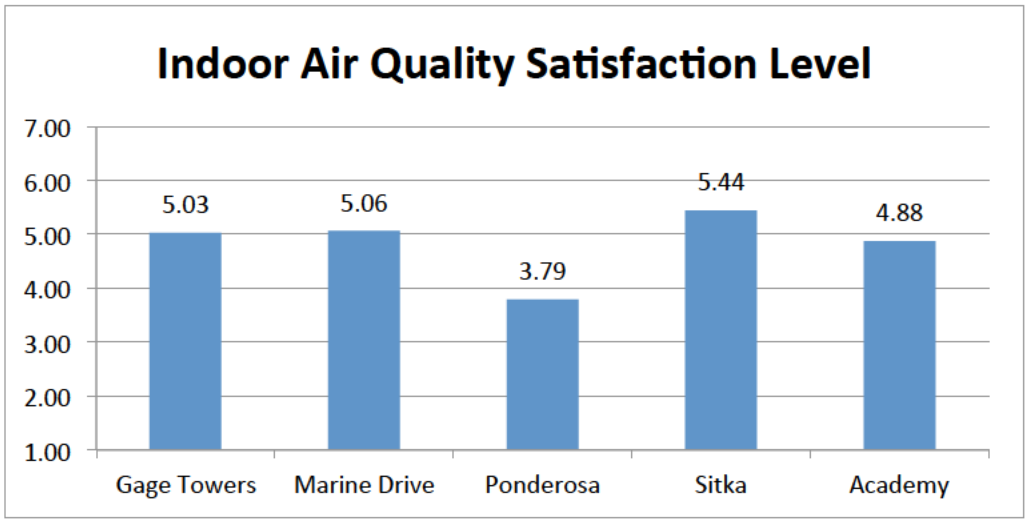

Figure 5.3 Satisfaction level of IAQ in five buildings

According to ASHRAE 62.1- 2013 "Ventilation for Acceptable Indoor Air Quality", an average of 1000ppm (or 650ppm over the ambient CO_2 level as described in WorkSafeBC IAQ guideline), is the threshold based on the mass balance of produced CO_2 by the occupants and acceptable fresh air ventilation rate to dilute the CO_2. The CO_2 is used as a surrogate for other unmeasured biochemical, bacteria and etc., which contribute to the indoor air quality and need to be controlled by ventilation.

All the five studied buildings had acceptable CO_2 levels. Walter Gage had the highest level due to the highest number of people in it. High level of CO_2 does not introduce any health risks to the occupants, but will affect the performance of the occupants. This criteria is a good indicator of indoor air quality, however is not a comprehensive one.

Ultrafine Particulate Matter (UPM) is a qualitative measure to determine the ability of the building envelope and ventilation system to remove outdoor air pollution particulate matter when there is no indoor source of UPM. In case there are indoor UPM sources, the indoor to outdoor ratio would be more than 1. There is no established standard for the UPM level in indoor air; however, research suggests that high indoor UPM level correlates with dissatisfaction and/or sick building syndrome complaints.

In this study, UPM measurements were taken both outdoor and indoor (close to the entrance door). It was found that in all the five studied buildings, the indoor UPM levels were less than outdoor UPM except in Sitka where the indoor UPM was higher than outdoor UPM level. The possible reason is that there are indoor sources of UPM, however, the Point Grey UBC campus is a very clean environment and the UPM levels are very low in general.

Our assumption was that people will report dissatisfaction where indoor UPM level is high. However, in Gage, where UPM level is the highest, people reported satisfaction (5.03). It is

suggested that people cannot sense the difference of UPM when the overall level is low (Point Grey campus is a generally clean environment). UPM level influences people's feeling only when it's high, for example people feel stuffy in downtown area. Moreover, the lowest IAQ satisfaction level was for Ponderosa although the UPM level there was pretty low. As per the survey, the low satisfaction level was because of the reported bad smell in Ponderosa, not the UPM level. One finding is in accordance with our anticipation. Sitka, where the UPM level was the lowest, had the highest IAQ satisfaction level. In conclusion, UPM levels in these five buildings were all acceptable and thus not sensible to occupants.

All the buildings except Ponderosa have good indoor air quality. The human feeling of indoor air quality is influenced by many factors besides CO_2 and UPM.

5.2 Thermal Comfort

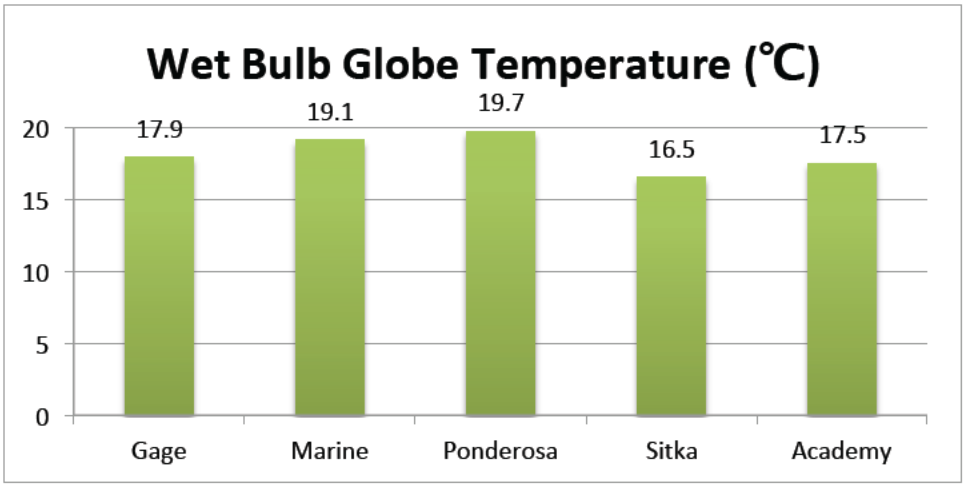

Figure 5.4 Average of WBGT in five buildings

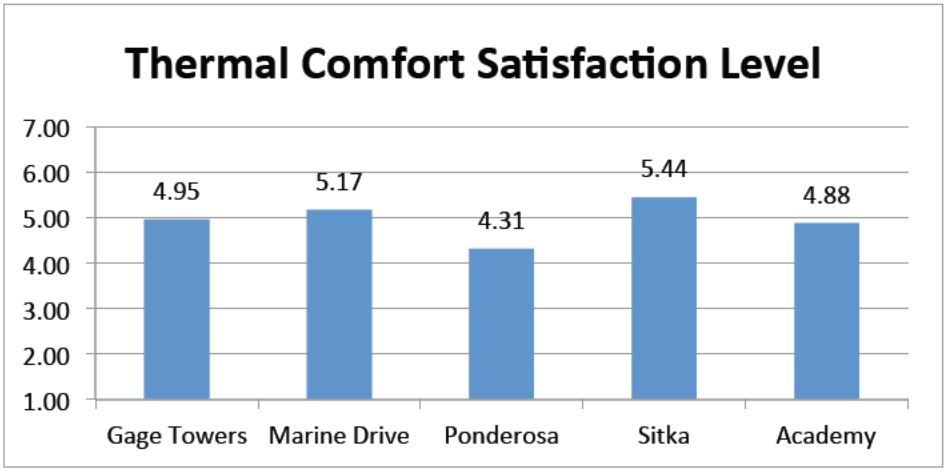

Figure 5.5 Thermal Comfort satisfaction level in five buildings

According to ASHRAE 55- 2010, the human comfort is affected by a combination of dry bulb temperature, relative humidity, and globe temperature or radiant energy. WBGT (wet-bulb globe temperature) is an indicator of temperature, humidity, wind speed, and visible and infrared temperature. WBGT is used to determine possible heat or cold stress conditions and is derived from the following equation:

WBGT= 0.7 Tw +0.2 Tg+ 0.1 Td

In all the five studied buildings, the temperature and relative humidity were in normal range (see Table 5.1 for comfortable temperature and relative humidity ranges). Also, there was no major temperature difference between head and foot level, so no local discomfort due to vertical air temperature difference was observed. However, in all the spaces except for Gage, due to high glazing area, local discomfort might happen for a person seating beside the window.

Table 5.1, Comfortable temperature (°C) and relative humidity for a sedentary person according to WorkSafeBC

	30% RH	50% RH	60% RH
Summer	23-27	23-26	23-26
Winter	20-24	20-24	20-23

5.3 Acoustics Comparison

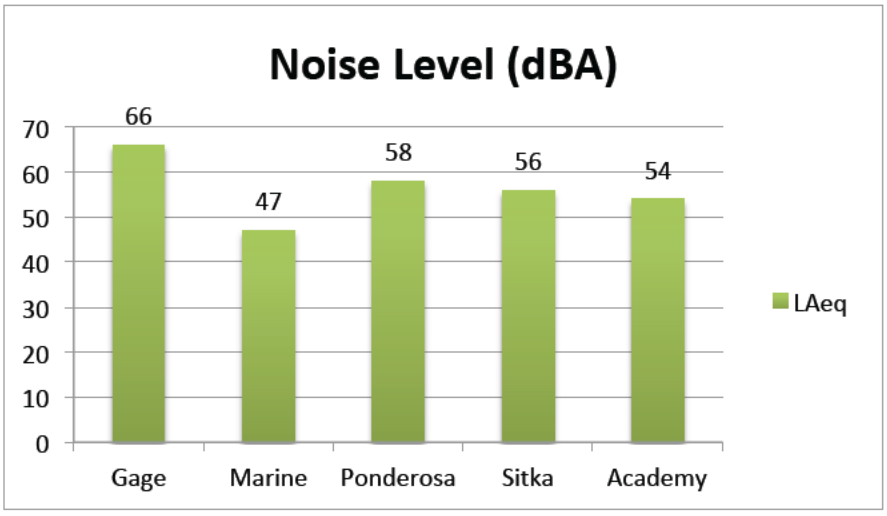

Figure 5.6. Noise level in five buildings

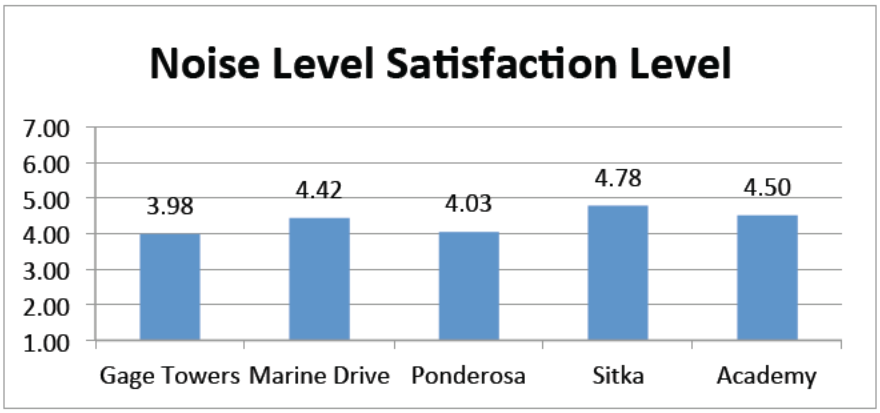

Figure 5.7 . Satisfaction level of Noise in five buildings

As **Error! Reference source not found.** shows, acoustics satisfaction was pretty low for all the studied buildings. In order to comment on the cause of dissatisfaction, other acoustics criteria should be measured and analyzed. The research team was unable to do other acoustic tests because the measurement of other acoustics criteria requires generating noise in the space. The research team was limited in terms of what they could do in the spaces as they were all occupied.

An interesting finding is that although the noise level in Gage is the highest, the biggest number of interactions was observed in Gage. Although people complain about noise in Gage according to the survey, there were still lots of people using the common space and they seemed not influenced by the noise. A possible explanation is that, based on observation in that space, the voice goes down quickly in the space, due to large volume of the space and furnishing materials. Therefore, people tend not to be influenced by the talking happening beside them. However in other four buildings, where the common spaces are smaller than the one in Gage, echoes are frequently observed. A whisper three meters away can be easily heard.

5.4 Lighting

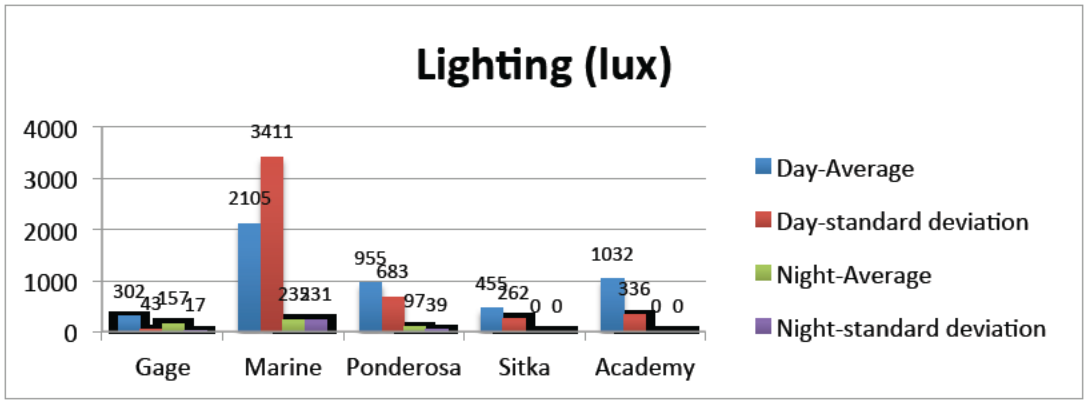

Figure 5.8. Lighting measurements in five buildings

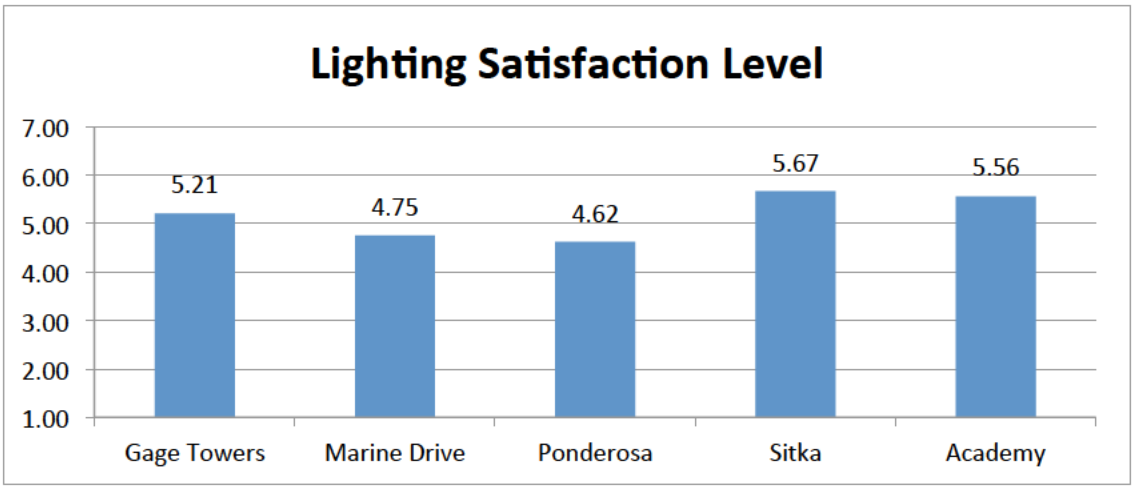

Figure 5.9 Satisfaction level of lighting in five buildings

According to the Lighting Handbook by WorkSafeBC, the amount of light needed is determined by the task (see Table 5.2). The intent is that people can see without strain. In general, older people need more light for the same task than young people. Over 2000 lux can be too much light and may cause problem with glare.

Table 5.2, Minimum lighting level required for different tasks according to WorkSafeBC

Task	Minimum lighting level (lux)
Simple orientation	50
Occasional visual tasks	100
High contrast/large print	200
Medium contrast/small print	500
Low contrast/very small print	1000

According to Table 5.2, the required lighting level for reading and study purposes (small print) is about 500 Lux. In the daytime, the lighting in Gage (302 lux) didn't meet the requirement, but there were still lots of students studying in the space. Other buildings all have adequate daylighting. In the evening, none of the buildings have adequate artificial lighting for study. This is understandable if the spaces are not designed for study. But since people tend to use the space to read and work, residents complain about the lighting especially in Marine Drive (satisfaction level of 4.75), which had the highest non-uniform lighting distribution (231 standard deviation), and in Ponderosa (satisfaction level of 4.62), which had the lowest average lighting level (97 lux). In general, the lighting satisfaction level was lower in UBC student residences compared to condo towers. This is probably because residents use the space more often for study purposes in UBC residences.

5.5 Layout, Colors and Texture, Cleanliness, Seating and Access

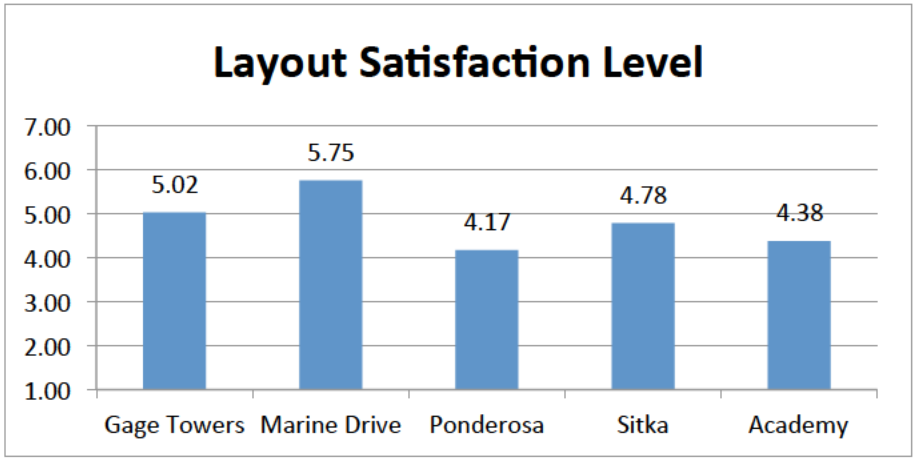

Figure 5.10 Satisfaction level of layout of the space in five buildings

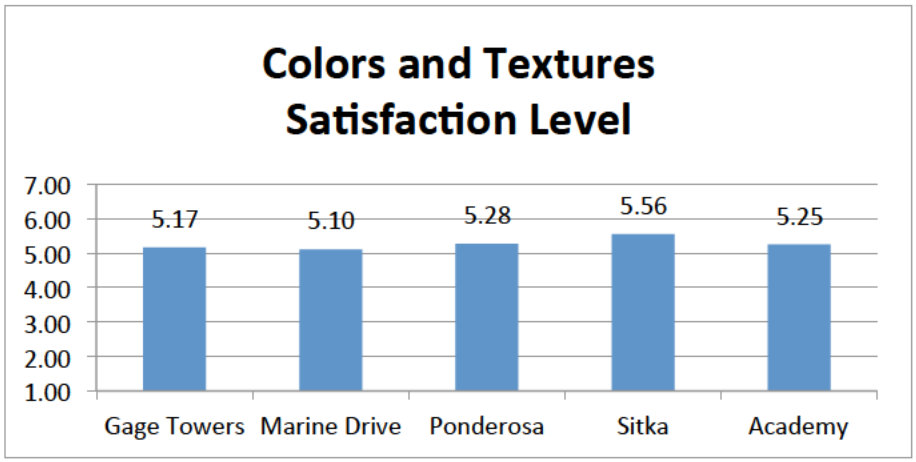

Figure 5.11. Satisfaction level of color and texture in five buildings

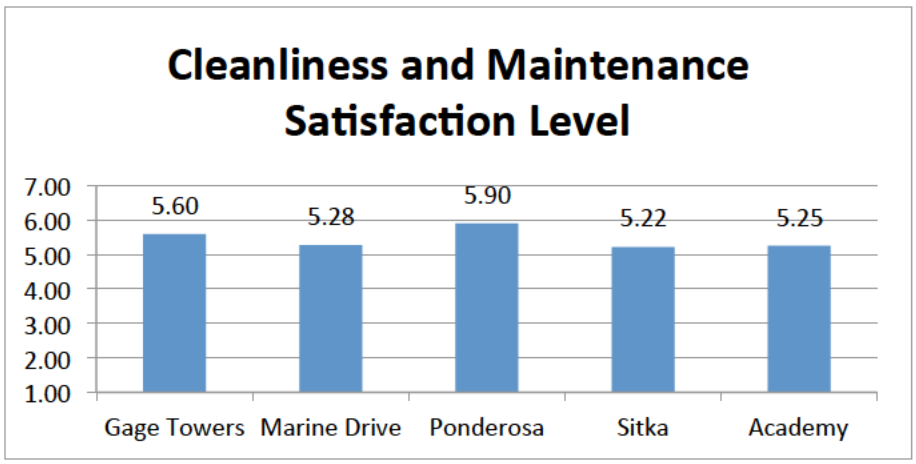

Figure 5.12. Satisfaction level of Cleanliness and Maintenance in five buildings

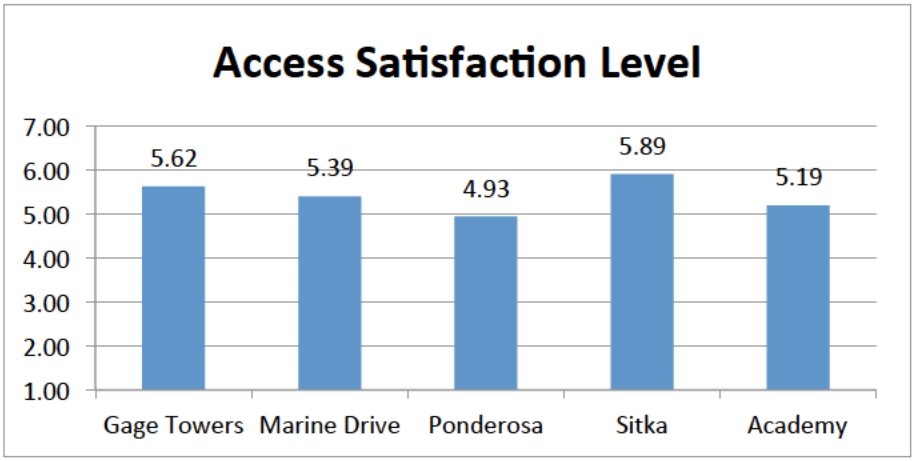

Figure 5.13. Satisfaction level of access to the common space in five buildings

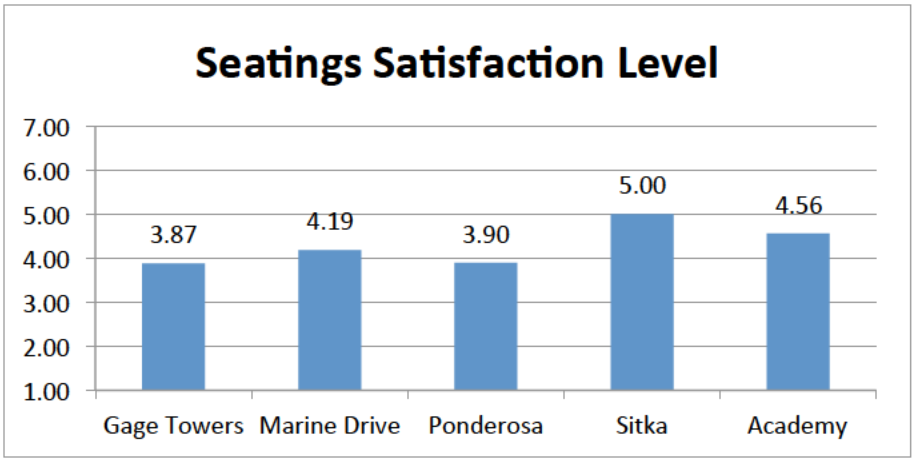

Figure 5.14. Satisfaction level of seating in five buildings

In general, people showed lower satisfaction levels (below 5.0) for the layout of the spaces and the seating. The residents were generally satisfied with the colors and textures used in the space as well as the cleanliness and maintenance of them.

5.6 External Factors

In this study we found that there are multiple non-building related factors that affect the use of the space for social interactions. The summary of the other factors where were observed is shown in Table 5.3.

The following are some of the factors that we observed in this study:

- The presence of places in the neighbourhood where people can socialize in, such as restaurants, cafe, pubs, community centers, etc. For instance, there is a café near Marine Drive Commonsblock, so people tend to go there instead of socializing in the common space in the Commonsblock.
- The presence of food or drinks in the space, as people like to eat/drink while socializing.

- The weather conditions: For example when its sunny people tend to spend time outside other than inside.
- The demographics and culture of the building: For example, undergraduate students tend to socialize more than graduate students due to the nature of their studies. People in a condo tower are less likely to socialize with other residents compared to residents in a student residence.
- The first few users and the way they use the space affect how and how much other will use that space. For example, people don't want to interrupt others so if the first person is reading, then the followers won't talk in that space.

Table 5.3 Summary of Internal and External Factors

	Gage Towers	Marine Drive	Ponderosa	Sitka Towers	Academy Towers
Access	Open, Centrally connected	Open, Not connected	Restricted, Connected	Restricted, Connected	Restricted, Connected
Other areas in space	Café, Gym, Study Rooms, Games Room	Vending Machines, Gym, Study Rooms, Games Room	None	None	None
Outdoor Common Space	Benches	Green Outdoor Space	Benches	Green Outdoor Space	Green Outdoor Space
Material (%soft/hard)	50/50	80/20	40/60	10/90	40/60
Wall/Window Ratio	No Windows	3:5	3:5	6:3	1:1

6 Recommendations for Developers

From this study, we concluded that there is not a clear direct correlation between the design features, IEQ factors and the social interactions that occur in these spaces. However, some recommendations can be logically deduced from our findings which are applicable to buildings similar to the buildings studied in this project. One of the most important recommendations is that the function of the space should be clearly defined so people perceive it as a social space. To foster the interactions, there should be a medium in the space which encourages people to interact and use the space; this can talk the form of a small café, gym or children's playroom etc. The space should be centrally located, have adequate lighting and ventilation. In addition to this, the residents should be able to control the space by adjusting their thermal comfort or rearranging the layout of the furniture. It would be better if the designer could have an idea of the target residents' needs before designing the common spaces in residential buildings.

The detailed recommendations are explained below:

- **Clearly define the function of the common space**
  The function of a common space should be clearly defined whether it's for study or social interactions. In case a common space has multiple purposes the different spaces should be separated from each other to provide acoustical privacy and to provide appropriate type of furnishings (fewer seats for a social space, more seats for study area). Holding more social events in these spaces or having some board games attached to the table can make the function of these social spaces more clear.
- **The size of the common space**
  Design larger communal spaces so people feel comfortable to sit down and use the space while others are using it.
- **Provide a medium for social interaction in the space**
  People are encouraged to meet and interact over something be it for a coffee, for a snack, going to a gym, studying together or taking their child out. Having an add-on to a common space like a café, games room, gym or children's playroom may increase the social interactions in that space.
- **Resident control over the space**
  The users of the space are more satisfied with their space when they have some degree of control over it. Some examples are as follows:
    - Different types of furniture which residents can move according to their needs
    - Control over the temperature and their thermal comfort such as being able to open the windows or open/close shades
    - The power to control the lighting according to their activity in the space. Having local lighting as well as adequate background lighting
    - Control over ventilation such as having operable windows in the common spaces

- **Location of the common space**
  The space should be centrally located so that it is easily visible and accessible to all the residents, and they do not have to make an “effort” to go there.
- **Provide acoustical privacy in the space**
  Separate the communal spaces acoustically from the residential units so that residents can freely use the space.
- **Outdoor common spaces**
  Having outdoor spaces is appreciated by residents, however will interfere with the use of the indoor common space.
- **Ventilation**
  People do care about ventilation according to comments from the survey. Good ventilation will increase the usage of a common space.
- **Sufficient Lighting**
  The lighting in the space should be appropriate and as per the requirements for the space, they may exceed the requirements but should not be below it. Lighting should be given special consideration especially if a study space is being designed in the common space. However, the presence of natural daylighting seems to have no correlation with the use of the space.
- **Design for target residents**
  Target residents should be defined and analyzed before design the common space in residential buildings, since the culture among residents influence the usage of a common space. In general, students require more space for study, while families and professional workers don’t need study spaces. The buildings for undergraduate students should have more social space compared to those for graduate students.

7 Limitations and Future Work

The study on environmental psychology has many limitations. In this study, limitations were as follows:

1) Limited access to the spaces in Condo towers
2) Time distribution of measurements
3) Limited measurement period
4) Non-building related factors affecting the results
5) Limited number of studied buildings, especially for condo towers.

In addition to the design and IEQ features, there are many other factors that may also influence social interactions, including personal and cultural factors, social factors, and time period the community has been in existence (Clitheroe et al. 1998). These factors have not been taken into account in our study due to time limitation.

In order to ensure the well-being of communities, the designers need more certain answer to the question 'what enhances social interactions in a space' to be able to design spaces that foster social interactions and consequently the mental well-being of the human being. More in-depth study in environmental psychology will help answer this question. A more detailed analysis of the culture of these buildings can be included as a part of future research. It is suggested that future research be done in this area with a larger number of high-rises and for a longer period of time. Some other common areas such as garbage sorting areas and washing areas should also be explored. It will be beneficial to have a large sample of buildings and observations so that the results with statistical power can be obtained. In this study, it was also found that interviewing residents as well as the survey questionnaire could be very helpful in giving the researchers some insight about the needs of the residents.

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9 Appendix A- Ponderosa Commons

1. On-site Measurement of Design Features

The location numbers in Table 9.1 are referred to Figure 4.2.

Table 9.1. Measurement results in Ponderosa

Date and Time of Observation	**Building**		**Weather Condition**		**Observers**	
March 15th, 9:50pm	Ponderosa		Rainy		A, R	
LIGHTING	Loc 1	Loc 2	Loc 3	Loc 4	Loc 5	Loc 6
Lighting in the evening (lux)	60	50	93	79	110	67
ACOUSTICS	Location 4					
Occupied building noise level (dBA) LAeq	60.0					
IAQ	Outdoor	Indoor				
Ultrafine particulate matter (PT/CC)	6080	Location A'			Location B'	
		3470			2730	
CO2 (ppm)	Location	Indoor				
		Min		Max	Average	
	4	624		653	632	
THERMAL COMFORT						
Globe Temperature- WBGTi (℃)	18.9					
DB Temperature (℃)	19					
WB Temperature (℃)	15.2					
RH (%)	47					
Head temp vs. foot temp	State the difference if any: 0.1 difference in WB and DB					
Date and Time of Observation	**Building**		**Weather Condition**		**Observers**	
March 16th, 10:00pm	Ponderosa		Clear		A, R	
LIGHTING	Loc 1	Loc 2	Loc 3	Loc 4	Loc 5	Loc 6
Lighting in the evening (lux)	100	45	163	174	124	100
ACOUSTICS	Location 4					
Occupied building noise level (dBA) LAeq	56.3					
IAQ	Outdoor	Indoor				
Ultrafine particulate matter (PT/CC)	5410	Location A'			Location B'	
		4320			4950	
CO2 (ppm)	Location	Indoor				
		Min		Max	Average	
	4	522		1221	549	
THERMAL COMFORT						

Globe Temperature- WBGTi (℃)	20.5					
DB Temperature (℃)	20.7					
WB Temperature (℃)	15.4					
RH (%)	34					
Head temp vs. foot temp)	State the difference if any: 0.1 difference in WB and DB					
Date and Time of Observation	**Building**		**Weather Condition**		**Observers**	
March 17th, 2.25pm	Ponderosa		Sunny		A	
LIGHTING	Loc 1	Loc 2	Loc 3	Loc 4	Loc 5	Loc 6
Lighting in the day (lux)	780	1602	650	500	Under Sun: 13200 In the shadow: 2100	97

2. Other internal and external factors observed

Table 9.2 Observed issues in Ponderosa Arbutus lobby

SEATING	Number	Type	Space area (m2)
	18	10 couches, 8 chairs	183
VEGETATION	Yes/No	Notes: no inside	
	No		
MATERIAL	soft/hard	Notes:	
	40%/60%		
ACCESS TO SPACE	Notes: People have to walk by this space to go to the elevators. 2 key cards required doors.		
CLEANLINESS AND MAINTENANCE	Notes: very clean. There was an unusual disgusting smell one day.		
WINDOW/WALL RATIO	5:3		
OTHER	Notes: Constructions are going on outside the space. Only 4 outlets near the study tables.		

3. On-site observations of social interactions

Table 9.3. Social Interaction Observations in Ponderosa Arbutus

Weather	No. of people involved	Purpose/nature	Duration	Comments
Rain	2	Study	45 min	
Clear	2	Wait/casual talk	3-5 min	
Clear	2	Casual talk	3-5 min	

Weather	No. of people involved	Purpose/nature	Duration	Comments
Sunny	2	Casual talk	5-10 min	
Clear	3	Casual talk	3 min	
Night	3	Academic	45 min	3 people were studying individually

4. Survey Results

Some useful findings from the survey are presented below

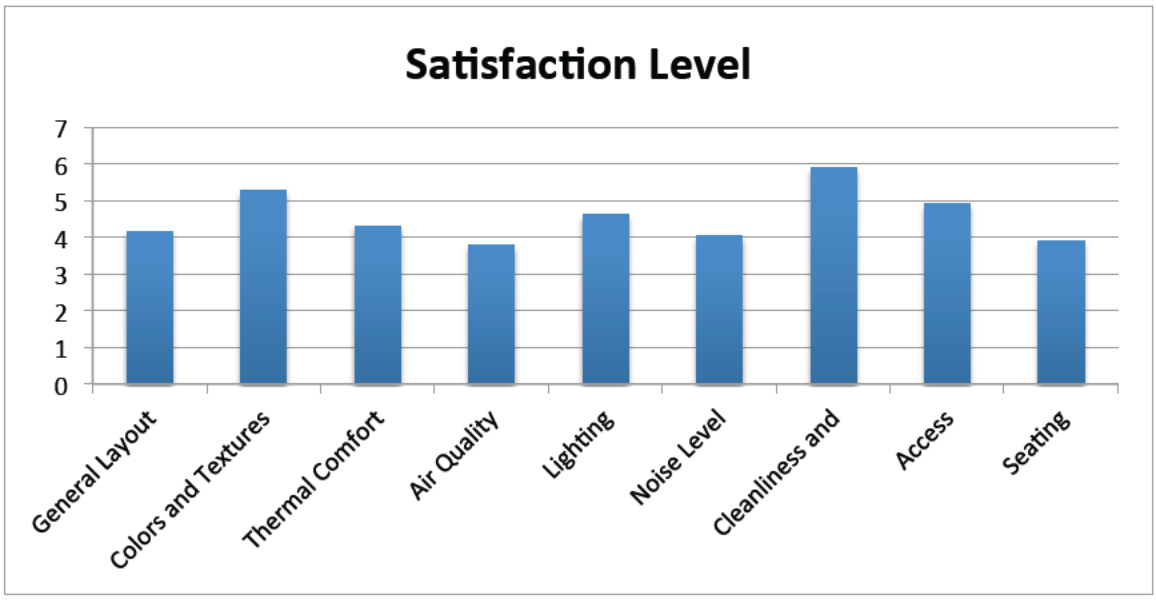

Figure 9.1. Satisfaction level of different design features in Ponderosa

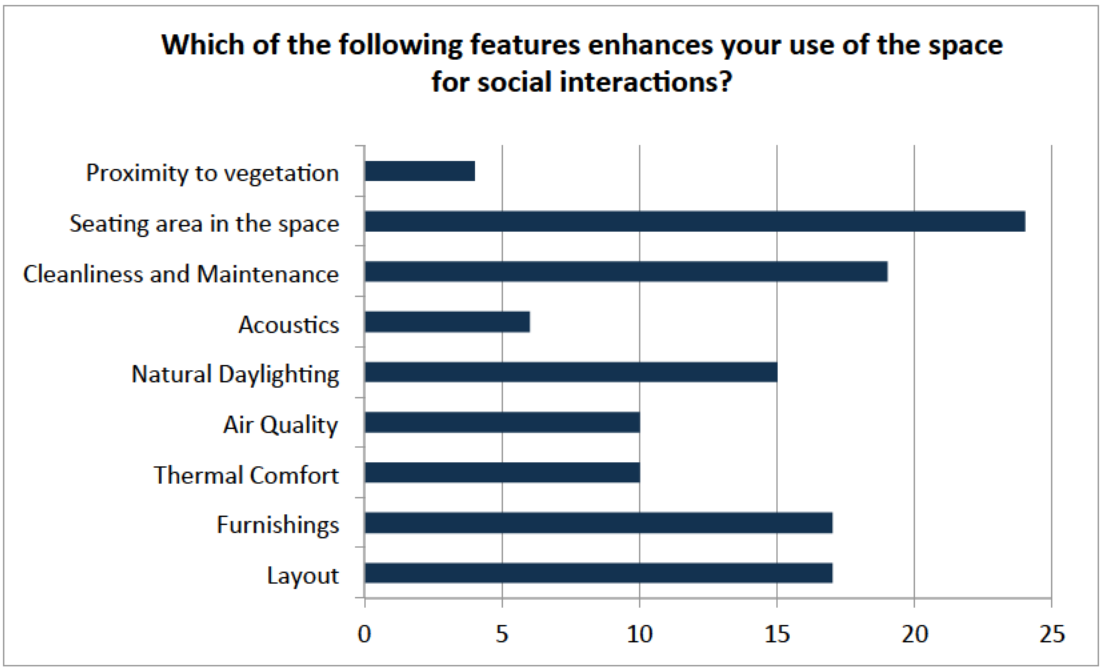

Figure 9.2. Which of the following features enhances your use of the space for social interactions?

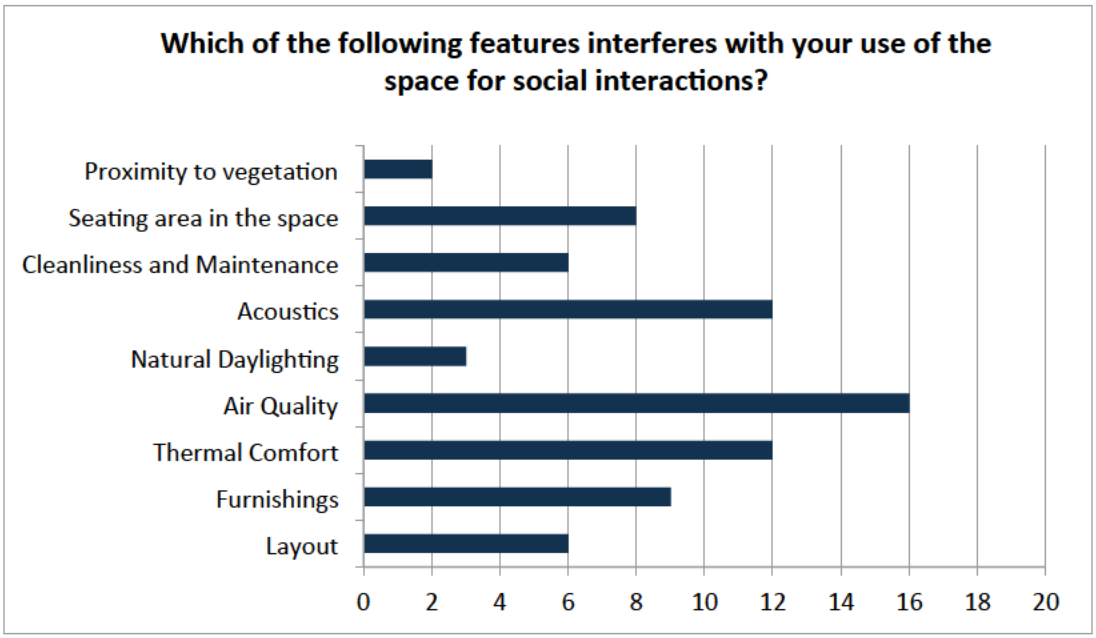

Figure 9.3. Which of the following features interferes with your use of the space for social interactions?

10 Appendix B-Marine Drive

1. On-site Measurement of Design Features

The location numbers in Table 10.1are referred to Figure 4.6.

Table 10.1. Results of measurements in Marine Drive

Date and Time of Observation	**Building**		**Weather Condition**		**Observers**
Feb 10th, 11:00am	Marine Drive		Cloudy		A, R
LIGHTING	Location 1	Location 2	Location 3	Location 4	Time
Lighting in the day (lux)	323	793	400	500(by Window), 350(Table)	11:00 am
ACOUSTICS	Location 1	Location 2	Location 3	Location 4	
Occupied building noise level (dBA) LAeq	44 at 11:10	43.5 at 11:30	42.1 at 11:55	47.7 at 12:07	11-12 am
IAQ	Outdoor		Indoor		
Ultrafine particulate matter (PT/CC)	Location A	Location B	Location A'	Location B'	
	12,500	15,200	6,600	6,140	11:25am
CO2 (ppm)	Location	Indoor			
		Min	Max	Average	
	1	505	586	516	
	2	505	820	520	
	3	503	590	520	
	4	501	586	518	
THERMAL COMFORT					11:40am
Globe Temperature- WBGTi (℃)	21				
DB Temperature (℃)	20.6				
WB Temperature (℃)	21				
RH (%)	50%				
Local discomfort (head temp vs. foot temp)	State the difference if any: 0.1 difference in WB and DB				
Date and Time of Observation	**Building**		**Weather Condition**		**Observers**
10th Feb, 6:20pm	Marine Drive		Clear		A, R, S
LIGHTING	Location 1	Location 2	Location 3	Location 4	Time
Lighting in the evening (lux)	276	67	17 (light off)	400	
ACOUSTICS	Location 1				
Occupied building noise level (dBA) LAeq	47.1				7:05pm
IAQ	Outdoor		Indoor		

Ultrafine particulate matter (PT/CC)	Location A	Location B	Location A'	Location B'	
	13,600	12,100	5,790	5,500	11:25am
CO2 (ppm)	Location	Min	Max	Average	
	1	501	736	609	7:00pm
THERMAL COMFORT	Foot		Head		6:39pm
Globe Temperature- WBGTi (°C)	18.9		18.9		
DB Temperature (°C)	21.7		21.9		
WB Temperature (°C)	17.7		17.5		
RH (%)	48		44		
Head temp vs. foot temp	State the difference if any: 0.2 difference in DB and WB				
Date and Time of Observation	**Building**		**Weather Condition**		**Observers**
Feb 15th, 12:45pm	Marine Drive		Sunny, 10°C outside		A, R, S
LIGHTING	Location 1	Location 2	Location 3	Location 4	Time
Lighting in the day (lux)	760	1260	1750	11052	
ACOUSTICS	Location 1				
Occupied building noise level (dBA) LAeq	51				
IAQ	Outdoor		Indoor		
Ultrafine particulate matter (PT/CC)	Location A	Location B	Location A'	Location B'	
	1410	1430	1990	1800	
CO2 (ppm)	Location	Indoor			
		Min	Max	Average	
	1	488	699	507	
THERMAL COMFORT	Foot		Head		
Globe Temperature- WBGTi (°C)	19.1		18.9		
DB Temperature (°C)	22.3		22.6		
WB Temperature (°C)	17.4		16.9		
RH (%)	40		39		
Date and Time of Observation	**Building**		**Weather Condition**		**Observers**
Feb 15th, 10:15pm	Marine Drive		Clear		A, R, S
LIGHTING	Location 1	Location 2	Location 3	Location 4	Time
Lighting in the evening (lux)	300	67	20	730	
ACOUSTICS	Location 1		Location 2		
Occupied building noise level (dBA) LAeq	48.7		57.5		
IAQ	Outdoor		Indoor		
Ultrafine particulate matter (PT/CC)	Location A	Location B	Location A'	Location B'	

	5880	5730	3000	2660	
CO2 (ppm)	Location	Min	Max	Average	
	1	575	781	600	
	4	645	838	662	
THERMAL COMFORT	Foot		Head		
Globe Temperature- WBGTi (°C)	17.3		17.5		
DB Temperature (°C)	21.1		21.2		
WB Temperature (°C)	15.7		15.8		
RH (%)	42		41		

2. Other internal and external factors observed

Table 10.2. Observed issues in Marine Drive Commonsblock

SEATING	Number	Type	Space area (m2)
	30	18 couches, 12 chairs	142
VEGETATION	Yes/No	Notes: beautiful green view outside	
	No		
MATERIAL	soft/hard	Notes: soft carpet and fabric couches	
	80%/20%		
ACCESS TO SPACE	Notes: inconvenient. The building is separate in the middle and the common space is in the end of the hallway.		
CLEANLINESS AND MAINTENANCE	Notes: cleaning everyday but dirty carpet and dirt on floor		
WALL/WINDOW RATIO	3:5		
OTHER	Notes: Temperature control for occupants. Stuffy feeling inside. In sunny days, everyone is out.		

3. On-site observations of social interactions

Table 10.3. Social Interaction Observations in Marine Drive Commonsblock

Weather	# People involved	Purpose/nature	Duration	Comments
Clear	2	Casual talk	26 min	Talk about sports
Clear	2	-	30 min	Work individually
Clear	2	-	30 min	Lying down and read
Clear	2	Casual talk	3 min	Take pictures

Weather	# People involved	Purpose/nature	Duration	Comments
Clear	6	-	-	Working individually
Clear	3	Casual talk	42 min	Sitting around a table
Sunny	2	Wait for a friend/talk	2 min	
Clear	4	Casual talk	5 min	At the vending machine
Clear	6	Casual talk	10 min	
	13	-	45- 60 min	Working individually

4. Survey Results

Some useful findings from the survey are presented below

Figure 10.1. Satisfaction levels of design features in Marine Drive

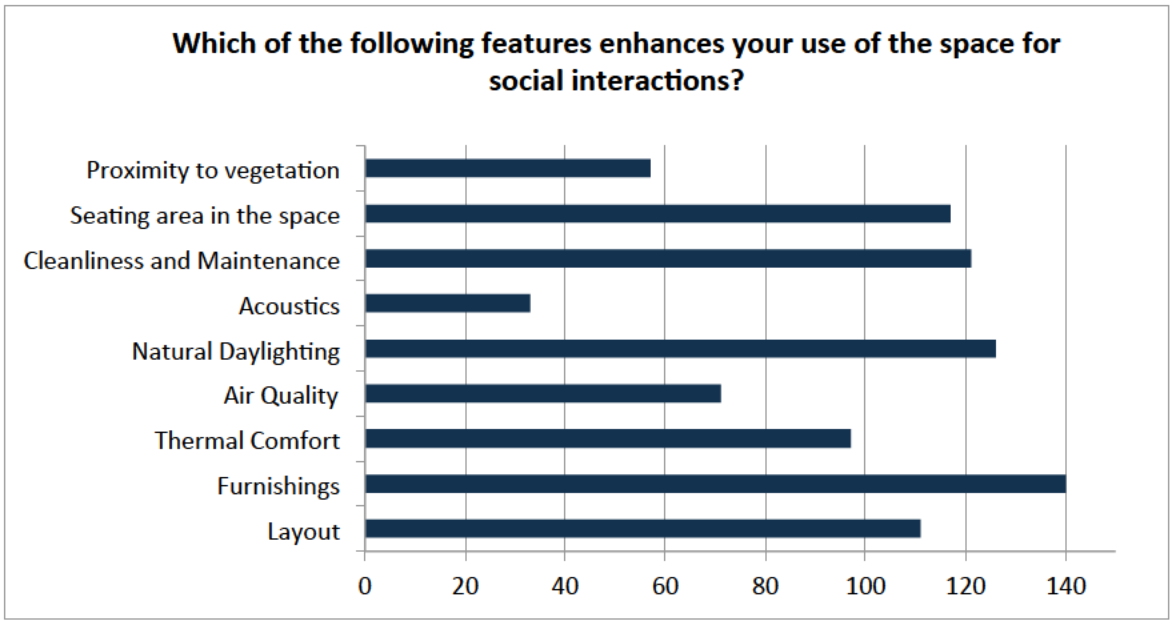

Figure 10.2. Which of the following features enhances your use of the space for social interactions?

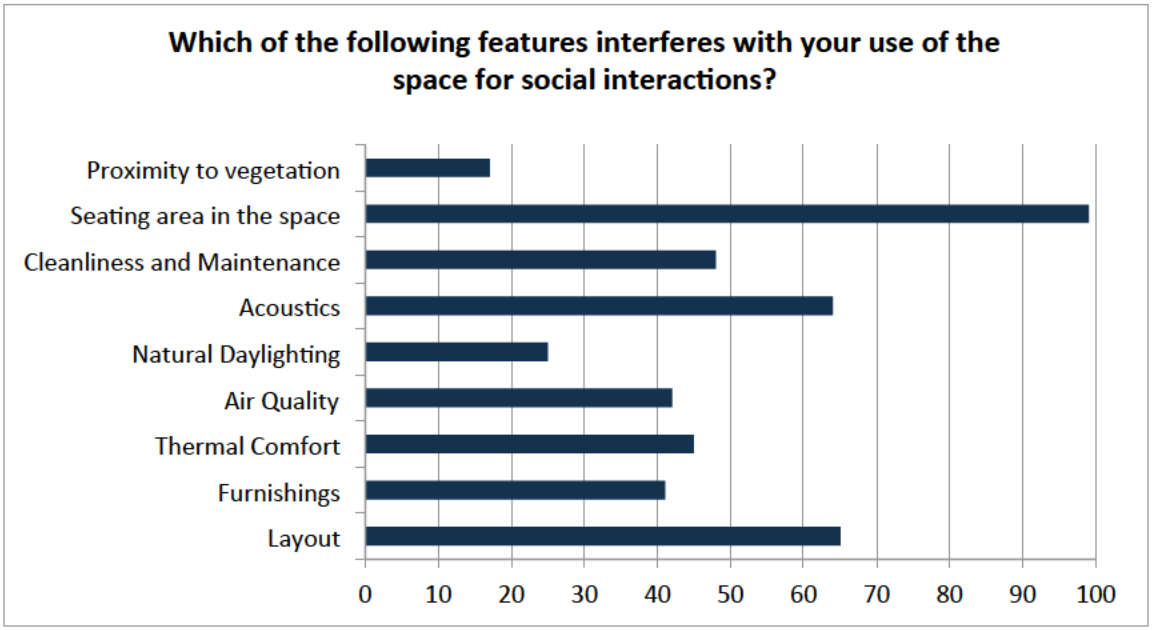

Figure 10.3. Which of the following features interferes with your use of the space for social interactions?

11 Appendix C-Gage Towers

1. On-site Measurement of Design Features

The location numbers in Table 11.1 are referred to Figure 4.8.

Table 11.1. Measurement Results in Gage

Date and Time of Observation	**Building**		**Weather Condition**		**Observers**	
March 1st, 10:15pm	Gage		Rainy and cloudy		A, R, S	
LIGHTING	Loc 1	Loc 2	Loc 3	Loc 4	Loc 5	Loc 6
Lighting in the evening (lux)	150	135	142	160	198	180
ACOUSTICS	Location 4					
Occupied building noise level (dBA) LAeq	70.0					
IAQ	Outdoor	Indoor				
Ultrafine particulate matter (PT/CC)	2900	Location A	Location B	Location C		
		2460	2410	-		
CO2 (ppm)	Location	Indoor				
		Min	Max	Average		
	1	634	712	652		
	4	600	965	723		
THERMAL COMFORT	Desk level					
Globe Temperature- WBGTi (℃)	17.9					
DB Temperature (℃)	22.7					
WB Temperature (℃)	13.8					
RH (%)	32					
Date and Time of Observation	**Building**		**Weather Condition**		**Observers**	
Feb. 23rd, 10:30pm	Gage		Clear		S, R	
LIGHTING	Loc 1	Loc 2	Loc 3	Loc 4	Loc 5	Loc 6
Lighting in the evening (lux)	165	145	143	148	-	-
ACOUSTICS	Location 4					
Occupied building noise level (dBA) LAeq	62.6					
IAQ	Outdoor	Indoor				
Ultrafine particulate matter (PT/CC)	19800	Location A	Location B	Location C		
		12100	12500	12400		
CO2 (ppm)	Location	Indoor				
		Min	Max	Average		
	6	1300	1568	1448		

	C	647	745	704		
THERMAL COMFORT	Desk level					
Globe Temperature- WBGTi (°C)	17.9					
DB Temperature (°C)	21.0					
WB Temperature (°C)	16.0					
RH (%)	37					
Date and Time of Observation	**Building**		**Weather Condition**		**Observers**	
Feb. 23rd, 12:45pm	Gage		Sunny		A	
LIGHTING	Loc 1	Loc 2	Loc 3	Loc 4	Loc 5	Loc 6
Lighting in the day (lux)	300	350	335	300	-	225

2. Other internal and external factors observed

Table 11.2 Observed issues in Walter Gage lobby

SEATING	Number	Type	Space area (m2)
	68	Couches and chairs	340
VEGETATION	Yes/No	Notes: Planted plots	
	Yes		
MATERIAL	soft/hard	Notes: carpet, leather couch, wood chairs and tables, wood columns and concrete ceiling.	
	50%/50%		
ACCESS TO SPACE	Notes: Easy access without restriction.		
CLEANLINESS AND MAINTENANCE	Notes: Clean		
WINDOW/WALL RATIO	0. Notes: Windows are only on top of the central area.		
OTHER	Notes: 41 people were sitting with snacks from the shop. Mostly undergrads. Shop closes at 11pm. Most of students left around 11pm. Pretty noisy – people with headphones. Glass railings create a feeling of openness. There are 7 individual studies and 18 group interactions at 11:12pm (previously 7:22). A big TV but it's not open every day.		

3. On-site observations of social interactions

Table 11.3. Social Interaction Observations in Walter Gage

Weather	# People involved	Purpose/nature	Duration	Comments
Sunny	2	Casual talk/wait	2 min	
Clear	3-5	Study/group	50 min	

Weather	# People involved	Purpose/nature	Duration	Comments
		discussion		
Clear	3-5	Study/group discussion	60 min	
Clear	1	-	50 min	Watch movie on laptop
Clear	2	Group discussion/casual talk	60 min	
Sunny	2	Study/group discussion	N/A	
Sunny	1	-	-	Working individually
Clear	3	Casual talk	40 min	Drinking coffee together while talking
Clear	3	Casual talk	60 min	
Clear	1	-	80 min	Working individually
Clear	2-4	Group discussion/casual talk	25 min	
Clear	2	Group discussion/casual talk	65 min	
Rainy	3	Study/group discussion	>105 min	
Rainy	2	Casual talk/wait	2 min	
Rainy	3	Group discussion/casual talk	85 min	
Rainy	3	Study/group discussion	80 min	
Rainy	2	Study/group discussion	80 min	
Rainy	2-3	Group discussion/casual talk	65 min	
Rainy	3	Group discussion/casual talk	>105 min	
Rainy	2	Study/group discussion	90 min	

Weather	# People involved	Purpose/nature	Duration	Comments
Clear	2	Drawing/casual talk	60 min	
Clear	3	-	80 min	Watch movie alone
Clear	3	Casual talk	10 min	
Clear	3	Study/group discussion	85 min	
Clear	2	Study/group discussion	30 min	
Rainy	5-10	Casual talk	35 min	
Rainy	3-4	Study	35 min	
Rainy	4-5	Study/group discussion	60 min	
Rainy	2	Study silently	100 min	
Rainy	2	Study/casual talk	>105 min	
Rainy	2	Study silently	>105 min	No talking
Rainy	2-3	Talk and relax on the couch	>105 min	

4. Survey Results

Some useful findings from the survey are presented below

Figure 11.1. Satisfaction levels of design features in Walter Gage

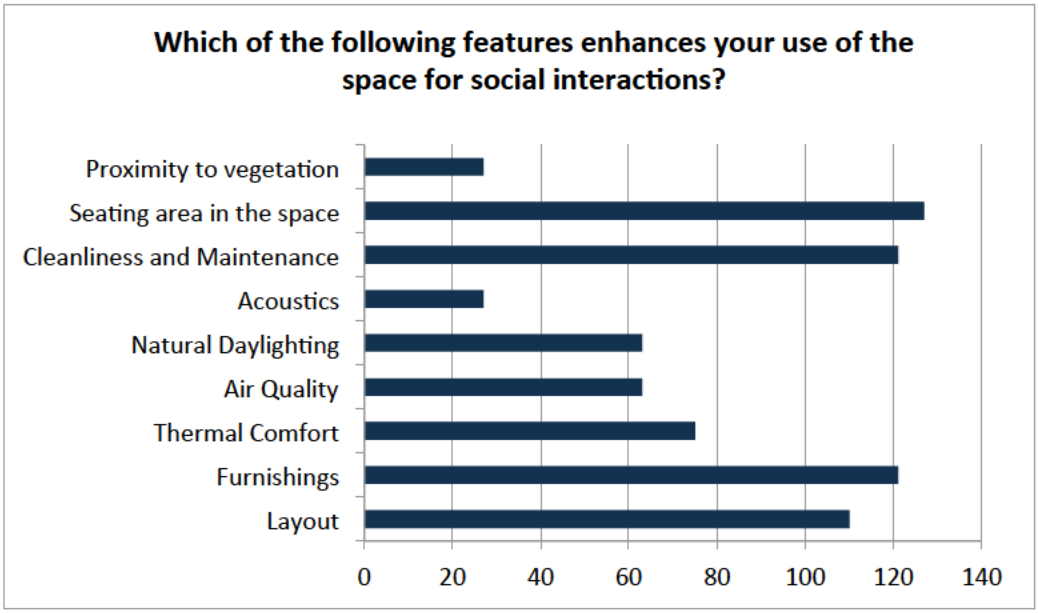

Figure 11.2. Which of the following features enhances your use of the space for social interactions?

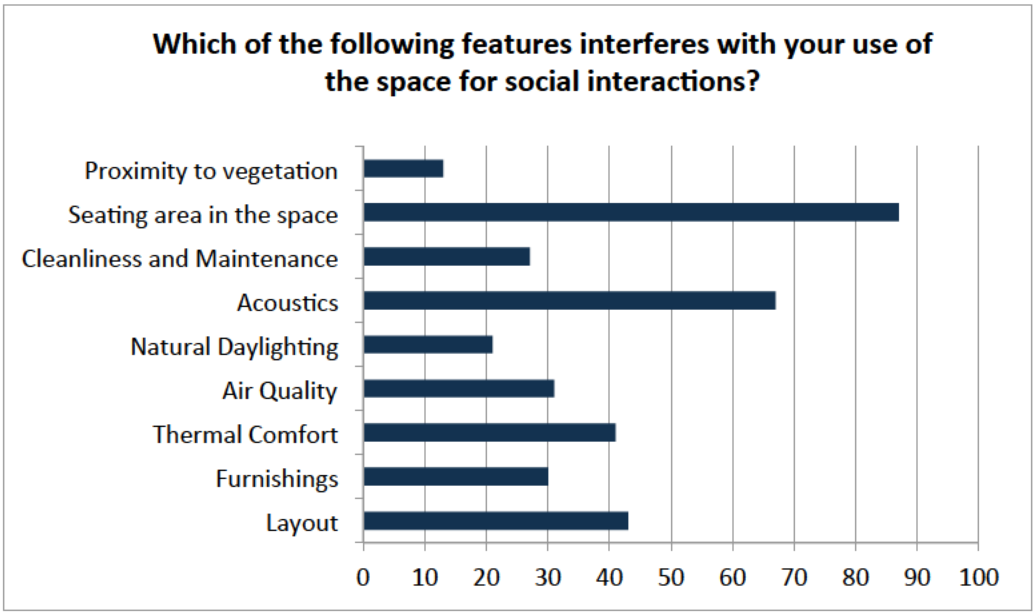

Figure 11.3. Which of the following features interferes with your use of the space for social interactions?

12 Appendix D-Academy Towers

1. On-site Measurement of Design Features

The location numbers in Table 12.1 are referred to Figure 4.13.

Table 12.1. Results of measurements in Academy

Date and Time of Observation	**Building**		**Weather Condition**		**Observers**	
March 2nd, 11am	Academy		Sunny		S, R	
LIGHTING	Loc 1	Loc 2	Loc 3	Loc 4	Loc 5	Loc 6
Lighting in the day (lux)	1305	1033	1365	1331	824	450
ACOUSTICS	Location 3					
Occupied building noise level (dBA) LAeq	54.3					
IAQ	Outdoor	Indoor				
Ultrafine particulate matter (PT/CC)	5430	Location A		Location B		
		3400		3940		
CO2 (ppm)	Location	Indoor				
		Min	Max	Average		
	3	444	481	462		
THERMAL COMFORT						
Globe Temperature- WBGTi (℃)	16.5					
DB Temperature (℃)	20.4					
WB Temperature (℃)	14.3					
RH (%)	37					
Date and Time of Observation	**Building**		**Weather Condition**		**Observers**	
March 7th, 12:00pm	Academy		Sunny		A, S	
LIGHTING	Loc 1	Loc 2	Loc 3	Loc 4	Loc 5	Loc 6
Lighting in the day (lux)	1600	930	1200	1050	800	500
ACOUSTICS	Location 3					
Occupied building noise level (dBA) LAeq	54.7					
IAQ	Outdoor	Indoor				
Ultrafine particulate matter (PT/CC)	4150	Location A		Location B		
		3820		3940		
CO2 (ppm)	Location	Indoor				
		Min	Max	Average		
	3	460	597	476		
THERMAL COMFORT						

Globe Temperature- WBGTi (℃)	18.4
DB Temperature (℃)	22.0
WB Temperature (℃)	16.5
RH (%)	36

2. Other internal and external factors observed

Table 12.2. Observed issues in Academy lobby

SEATING	Number	Type	Space area (m2)
	12	1 bench (allow 4 people sitting on) and 8 chairs	-
VEGETATION	Yes/No	Notes: limited plants outside	
	No		
MATERIAL	soft/hard	Notes: soft – bench	
	10%/90%	hard - others	
ACCESS TO SPACE	Notes: access requires keys.		
CLEANLINESS AND MAINTENANCE	Notes: Clean. A notice to prohibit kids from playing in the lobby to protect the ground floor.		
WINDOW/WALL RATIO	3:6		
OTHER	Notes: some potential buyers were looking the house with a building seller.		

4. Survey Results

Some useful findings from the survey are presented below

Figure 12.1. Satisfaction level of design features in Academy Tower

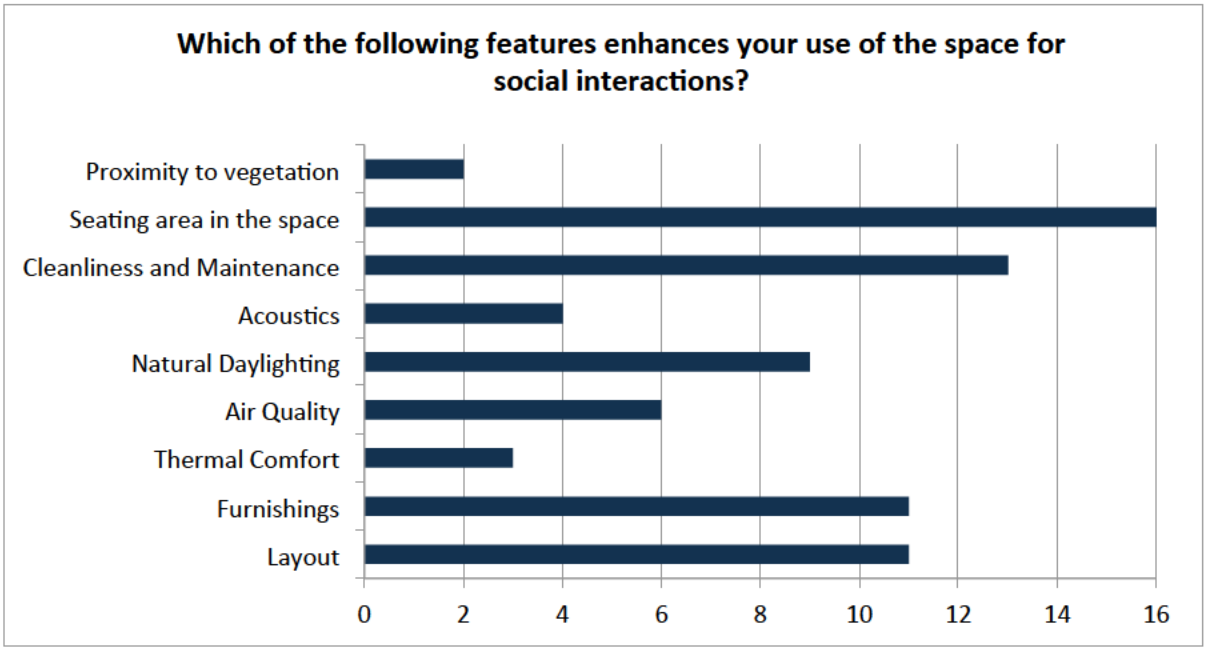

Figure 12.2. Which of the following features enhances your use of the space for social interactions?

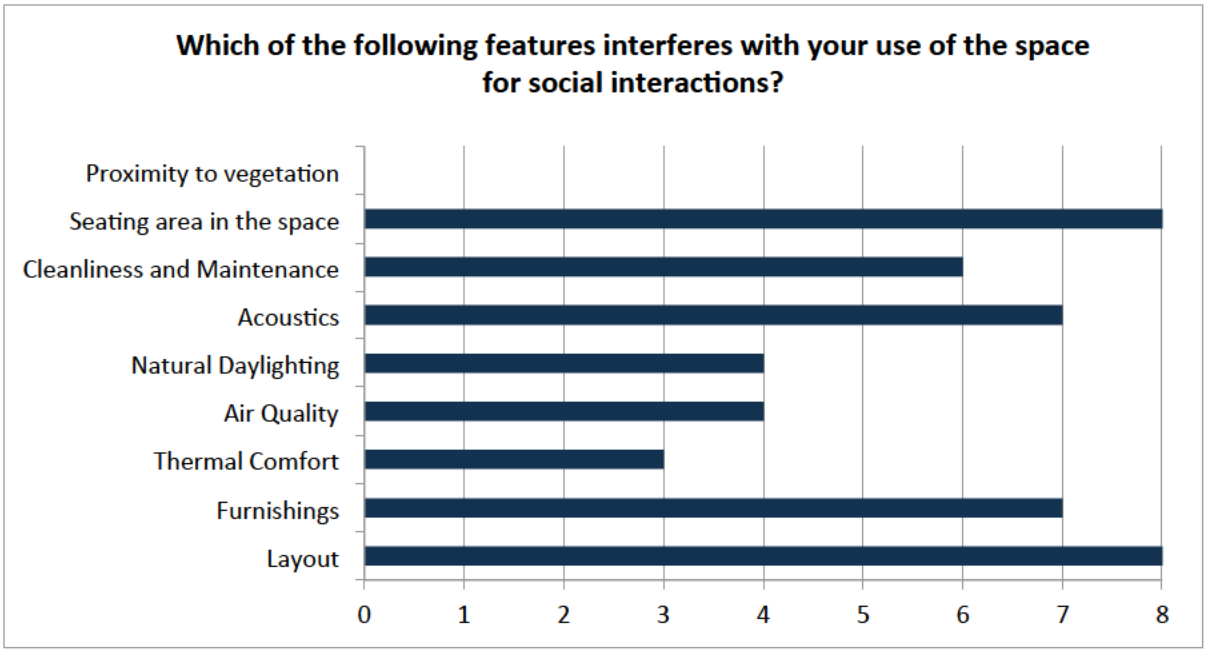

Figure 12.3. Which of the following features interferes with your use of the space for social interactions?

13 Appendix E-Sitka Towers

1. On-site Measurement of Design Features

The location numbers in Table 13.1 are referred to Figure 4.17.

Table 13.1. Results of measurements in Sitka

Date and Time of Observation	**Building**		**Weather Condition**		**Observers**	
March 2nd, 1:13pm	Sitka		Windy		S, R	
LIGHTING	Loc 1	Loc 2	Loc 3	Loc 4	Loc 5	-
Lighting in the day (lux)	704	873	363	324	113	-
ACOUSTICS	Location 1					
Occupied building noise level (dBA) LAeq	53.9					
IAQ	Outdoor			Indoor		
Ultrafine particulate matter (PT/CC)	Location A	Location B		Location A'	Location B'	
	1430	1830		1330	1360	
CO2 (ppm)	Location	Indoor				
		Min	Max	Average		
	1	444	676	546		
THERMAL COMFORT						
Globe Temperature- WBGTi (℃)	16.0					
DB Temperature (℃)	19.3					
WB Temperature (℃)	14.2					
RH (%)	38					
Date and Time of Observation	**Building**		**Weather Condition**		**Observers**	
March 7th, 12:30pm	Sitka		Sunny		A, S	
LIGHTING	Loc 1	Loc 2	Loc 3	Loc 4	Loc 5	-
Lighting in the day (lux)	520	850	370	325	107	-
ACOUSTICS	Location 1					
Occupied building noise level (dBA) LAeq	78.1(talking), 58.9(quiet)					
IAQ	Outdoor			Indoor		
Ultrafine particulate matter (PT/CC)	Location A	Location B		Location A'	Location B'	
	3500	-		4360	4080	
CO2 (ppm)	Location	Indoor				
		Min	Max	Average		
	1	460	791	602		
THERMAL COMFORT						

Globe Temperature- WBGTi (℃)	17.0
DB Temperature (℃)	20.9
WB Temperature (℃)	15.3
RH (%)	37

2. Other internal and external factors observed

Table 13.2. Observed issues in Sitka

SEATING	Number	Type	Space area (m2)
	6	Couch	
VEGETATION	Yes/No	Notes: artificial flowers	
	Yes		
MATERIAL	soft/hard	Notes: comfortable leather & carpet	
	40%/60%		
ACCESS TO SPACE	Notes: access requires keys		
CLEANLINESS AND MAINTENANCE	Notes: Clean		
WINDOW/WALL RATIO	1:1		
OTHER	Notes: low ceiling above the common space		

4. Survey Results

Some useful findings from the survey are presented below

Figure 13.1. Satisfaction level of design features in Sitka Tower

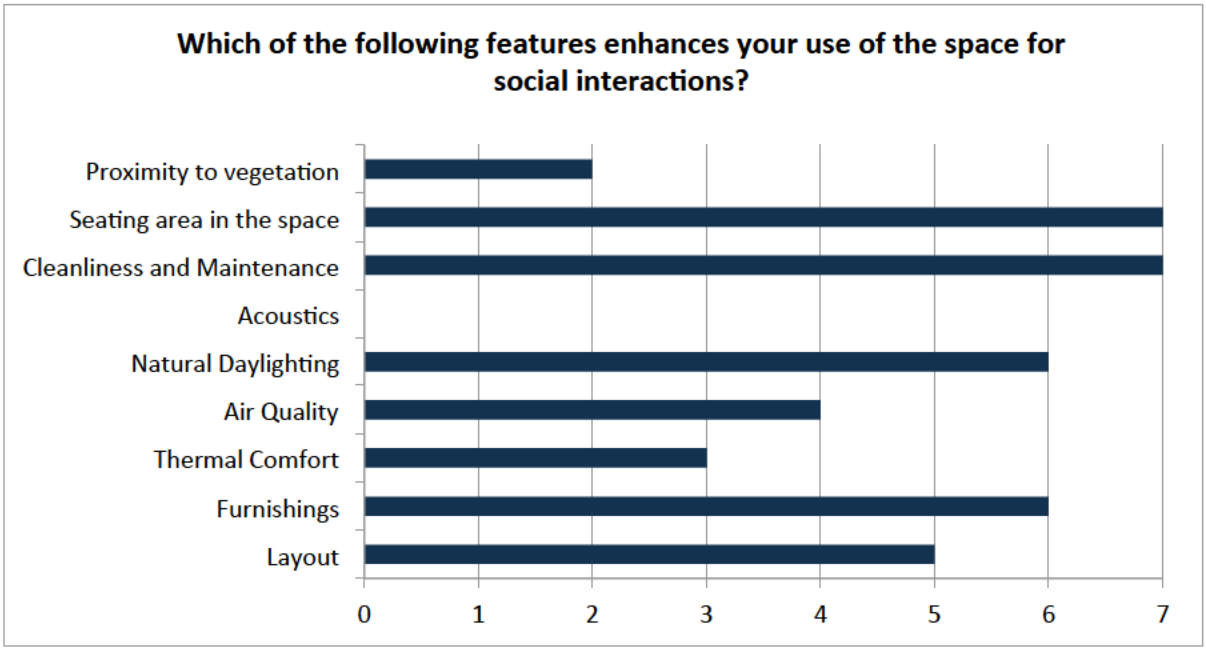

Figure 13.2. Which of the following features enhances your use of the space for social interactions?

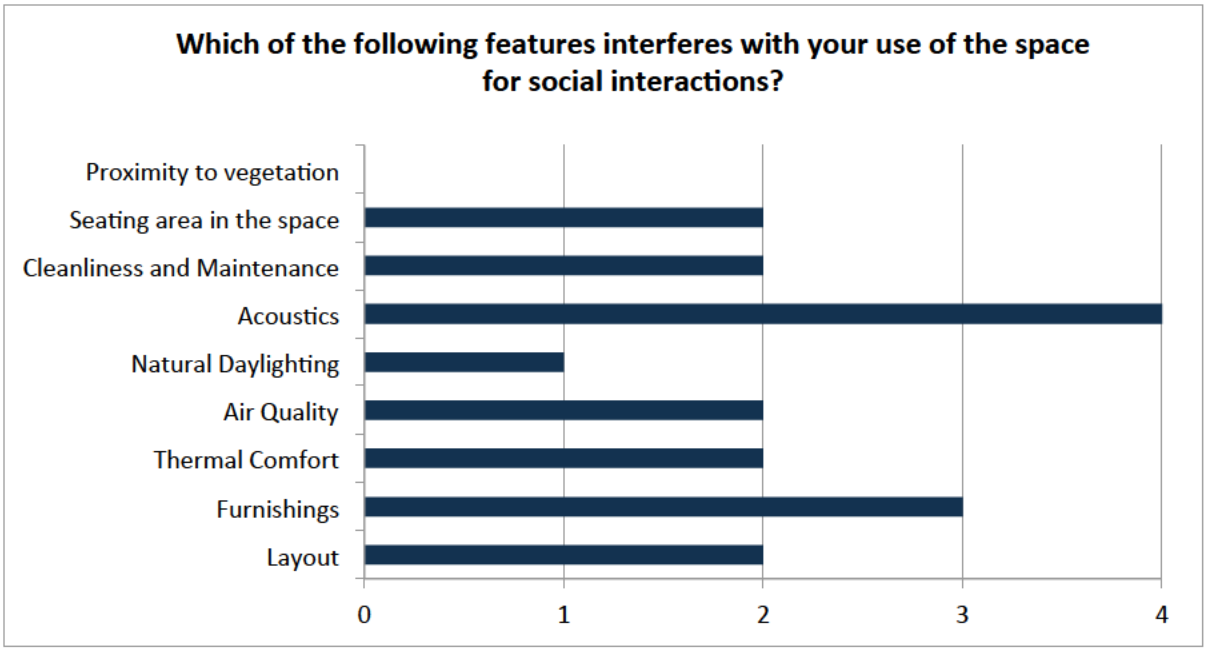

Figure 13.3. Which of the following features interferes with your use of the space for social interactions?