IMPACT OF WORKPLACE DESIGN AND PLANNING ON SEDENTARY LIFESTYLES

A Thesis

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by

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ABSTRACT

The issue of sedentary behavior in the workplace and its negative effects on health have stirred discussions around implementing a more proactive approach to promote physical movement, particularly in the realms of design and the built environment. The present study looks at the attributes of spatial design that play a role in promoting physical movement in the workplace, specifically in encouraging walking behaviors and stand-up breaks throughout the day. This study utilizes multi-method research framework to compare individual physical activity habits, characteristics of the built environment, physical design attributes, and user behaviors. The outcomes of this study observed a relationship between the design of built environment and users' response and their associated physical movement in the workplace.

BIOGRAPHICAL SKETCH

Born and raised in Indonesia, Cerise was aware of inadequate efforts made to solve daily challenges through design, which in turn has shaped her view towards a holistic, human-centric design philosophy that has the power to enhance quality of lives. Her passion in workplace research stems from the notion of a place where most people spend most their waking lives. Cerise graduated from the Design Environmental Analysis Interior Design program before returning to Cornell to complete her graduate degree in DEA's Facilities Planning and Management concentration. With a formal background in workplace research and design, Cerise leverages the learnings from academic research and applies them to help clients align the design of built environments with business objectives in order to elevate day-to-day work experience. Her other professional research interests also include: corporate campus environment, sensor technologies, and big data insights.

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Thank you to my parents, my number one supporter through the ups and downs of life. Your encouragement has helped be to be who I have become today. This study is a fruit of faith and prayers of those closest to me, thank you my family in Boston who have continued to push me in the last four years.

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Chapter 1: Introduction

Employee productivity and organizational efficiency are imperative for a successful business operation. Many companies believe that by increasing the productivity of their employees, their organization will be more profitable, be ahead in the market, and ultimately raise their bottom lines. Human capital is inevitably one of the most critical attributes to organizational performance. With the raising demands of intellectual huan capital across industries, more and more individuals spend their waking lives in office environments. In developed countries, the number of desk jobs and white-collar workers have grown significantly in the past twenty years, which has resulted in 9 to 5 schedule work hours for the majority of the workforce.

Studies indicated that workers on average spend at least 7 hours of their day sitting in an office setting (Jans et al., 2007). Let's assume individuals spend an average 7 hours of sitting a day with about 40 years of an average work career length; this scenario translates to approximately 29% of time during productive years spent sitting. Ultimately this equates up to a total span of 12 consecutive years of being sedentary at work in the span of human lifetime. These years alone only represents baseline assumption of time spent sitting in the office, not including those hours spent sitting at home watching TV, sitting during work commute, and other idle activities. While sitting does not directly contribute to illness and diseases, prolonged sitting can exacerbate the impact of negative health conditions. Studies found that the amount of time spent being sedentary has been linked with lower energy expenditure and potential higher increase risk of weight gain, obesity, diabetes and heart-related diseases (Owen et al., 2010)

Different environmental fields have looked at opportunities to incorporate fitness activities into our daily lives, from ranging from healthy eating campaigns through urban design planning framework that incorporate walkable paths into urban and suburban

neighborhoods. These strategies and campaigns have proven effective in instilling new habits and behaviors in integrating physical activities, recreational sports, and movement into our daily lives. As researchers continue to study this subject, two key challenges with these types of interventions emerged: 1) impacted groups typically have previously engaged in physical activities and therefore interventions are only effective to physically active groups, 2) if they do affect non-active individuals, these behavior changes are temporary and seldom become a lasting habit. The next question has then evolved into how can physical activity be integrated into the daily activities in a more profound and lasting way. This comes down to making it accessible and easy for individuals to make a better choice in their day-to-day life activities.

The work environment is seen as an opportunity for influencing long term individuals' health. Given the high percentage of our lifetime spent in a workplace, there is an untapped opportunity for a built environment to impact choices for a more active lifestyle and in turn make a lasting impact on health and well-being.

How can a workplace catalyze physical movement and promote health and wellbeing of its occupants? Can workplace design play a proactive role in encouraging individuals to be more physically active, all without sacrificing its fundamental role of supporting individual's productivity? How do physical attributes and user satisfaction correlate with physical movement? These are the types of questions this research study attempts to answer through an empirical case study research.

The present study will evaluate and compare two different office environments to measure attributes of spatial environment that directly contribute to physical movement or sedentary lifestyles. A combination of qualitative and quantitative data collection activities was critical in understanding the context of how the built environment have an impact in individuals' physical activity habit.

Chapter 2: Literature Review

2.1. Definition and Context of Sedentary Behavior

Prolonged sitting behavior, also referred as sedentary behavior, is described as a sitting or lying down activity that expends low metabolic energy between 1.0 to 1.80 metabolic equivalents (MET) (Jans et al., 2007). Sedentary behaviors include any extended time spent on idle activities, which include: continuous sitting and lying, sitting idle with computer at work, sitting during commute, leisure screen/TV viewing, standing still, and other low energy expenditure activities (Jans et al., 2007, Marshall et al., 2004, Hardy et al., 2006, and International Physical Activity Questionnaire, 2005). It is important to distinguish between sedentary behavior and physically inactivity. Being physically inactive suggests one's lack of physical activity or exercise on their day to day life, whereas sedentary behavior is described as engaging in sitting or lying tasks for an extended period (Australian Dept. of Health, accessed in 2017). Specific distinction in understanding the presence of sitting behavior, not merely absence of physical activity (PA) level, is critical in evaluating sedentary behavior. A sedentary individual may have a generally active lifestyle through physical exercises however still spend a majority of their time sitting throughout the day.

While sedentary behavior is not seen as a direct risk for negative health outcomes, few recent studies have pointed out indirect association between prolonged sitting and reduced life expectancy (Bernstein, 2010, Proper et al., 2011). An audit of sedentary behavior research articles between 1989 and after 2005 conducted by Proper el al (2011) have found insufficient evidence for sedentary behavior's association with body weight gain/loss, cardiovascular disease, and endometrial cancer, but found some evidence in its relationship with type 2 diabetes. Other studies have also concluded

strong evidence for independent association between sedentary behavior and mortality from all causes, including cardiovascular disease (Proper et al, 2011, Bernstein, 2010). Previous research studies have concentrated on the relationship between TV viewing and sedentary behavior (Rhodes et al., 2012, Hawley et al., 2010, Marshall et al., 2011) – mainly utilizing TV viewing as a construct for determining sedentary behavior especially among adults. A study examining more than one hundred papers pertaining to sedentary behavior found more than half of the papers evaluated indicated a negative relationship between TV viewing and physical activity (Rhodes et al., 2012). The majority of studies evaluated found some evidence leading to a negative association between screen viewing and physical activity, however no evidence on amount of computer use and sedentary behavior. The study also found that sedentary attitude is positively associated with TV viewing and computer use. Sedentary attitude was defined as having positive preference towards a sitting habit. As a stated previously, only a limited number of studies analyzed sedentary behavior measures of domain-specific sitting, like sitting in the workplace or during commute. Additionally, these behavior measures oftentimes only focus on increasing physical activity and may not directly reduce the frequency or length of sedentary behavior.

As human spend more of their waking time at work, in sit or stand work conditions, it is increasingly more important to look at sedentary behavior among job workers who spend most of their sitting. Graff-Iversen et al. (2007) identified four types of occupational classifications for occupational physical activity: sedentary work (mostly office work), light occupational physical activity (work demanding walking), moderately heavy occupational physical activity (work demanding much walking and lifting), and heavy occupational physical activity (heavy manual labor). This study will focus on the impact of sedentary behavior among mostly office workers, or white-collar workers.

Figure 1. United States Full Time Employment through 2017

In the United States, full time employment has steadily increased in the past twenty years (except for 2009-2010) and is projected to continually rise over the next few years (Bureau of Labor Statistics, 2017). The number of white-collar jobs has doubled between 1940 and 2000 from about 30% of the workforce to 60% (AFL-CIO, 2000). This number is also anticipated to increase as technology advancement and automation shift the workforce demand for more white-collar workers.

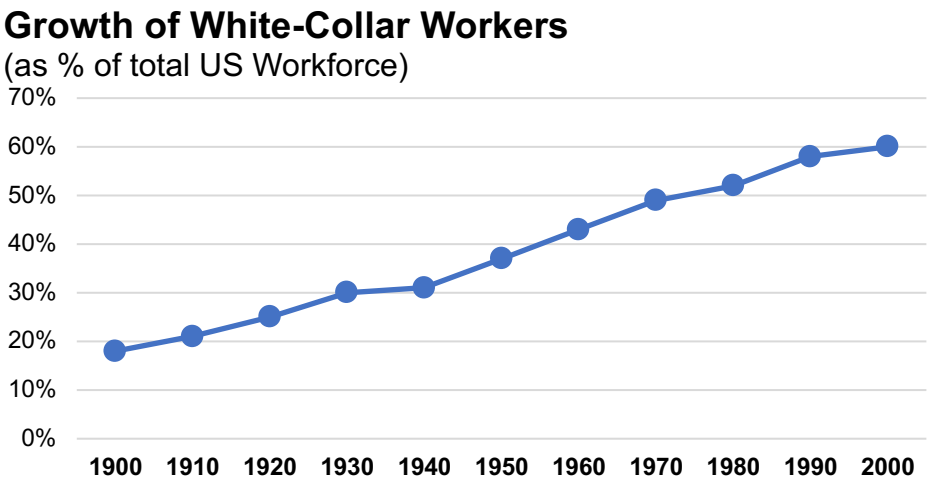


Figure 2. Growth of While Collar Workers (1900 - 2000)

A significant proportion of white-collar workers in the workforce is sedentary during most of their work days. The sedentary behavior among workers seems to be a worldwide issue in developed countries, such as: USA, Sweden, New Zealand, and Australia (Ryan et al., 2011). Kruger et al. (2006) reported that in a sample of 6,360 American workers, over half of the sample population were sedentary during work days, specifically 54.7% among men and 67.8% among women. The range of sedentary time suggests increases over the past few years, with a study on Australian workers that found 77% time spent sitting at work (Thorpe et al., 2008), Dutch workers with average of 7 hours sitting per day (Jans et al., 2007), and 80% American workers average time at work spent sitting (Hua et al., 2012).

It is estimated that effective interventions in the workplace can reduce occupational sitting by as much as 40 minutes over an 8-hour workday, which translated to about 8% reduction in sitting time (Chu et al., 2016). Yates (2011) indicated efforts for promoting stairs and minimizing elevators usage, while proven beneficial in increasing physical activity (PA) level, do not necessarily decrease amount of sedentary behavior.

Even though some people spend their spare time on an exercise routine, which has proven benefits for health outcomes, studies have shown that these concentrated activities are not sufficient to negate the adverse effects of sedentary behaviors (Gilson, 2011). The pattern of having multiple standing breaks or some physical movement distributed throughout the day has been found to be more beneficial than having moderate to vigorous activity for a singular, set amount of time for the day, and be sedentary for the remainder of the day (Australian Department of Health, 2017). Experts have recommended taking frequent standing breaks between sitting periods to break up sitting activity throughout the day. It is recommended that people exercise with moderate intensity activity for about 30 minutes per day and a 5-minute break for every hour spent

sitting (C.G. Ryan et al., 2011). These interruptions in sitting time have been found to cut the adverse risk of prolonged sitting significantly (Australian Department of Health, 2017). Sitting interruptions or standing breaks have also been proven to increase levels of energy, improved mood, and decreased feelings of fatigue, without sacrificing cognitive performance (Bergouignan et al., 2016).

Additionally, studies suggest that amount of physical activity at work positively correlates with individuals' activity outside of work. Those who exercise more physical movement will tend to be more active during their leisure time (Graff-Iversen et al., 2007). While these breaks seemingly are an easy task, many people still do not yet embrace or recognize the immense benefit of practicing this daily.

2.2. Paradigm Shift Towards Health and Well-being

In focusing efforts for a more conscious choice for being less sedentary, it is imperative to understand how the society evolves its perception of health and well-being. Most prevalent in younger generations, the society is now evolving its life philosophy to have more emphasis on the notion of quality of life that spans beyond staying healthy and avoiding sickness. Gallup Well-being Index defines the quality of life as an organization of five key indicators: sense of purpose, social relationships, financial security, relationship to community, and physical health (Gallup-Sharecare Well-Being Index, 2016). This holistic health and well-being view is anchored into a belief where individual well-being is thriving from excelling in these five key indicators. At the center of this paradigm, and to achieve other well-being measures, one should embrace their physical health first and foremost.

Market research studies have confirmed that younger generations have redefined the context of a healthy lifestyle. The generations born after 1981, known as the Millennials

(also referred as Gen Y) and the Plurals (or referred as Generation Z), are the first groups to mature through the evolution of computer, internet, and digital world. This experience impacts the way these groups absorb knowledge, embrace the notion of efficiency, and belief on a wholesome life. Known as the most health-conscious generation with strong opinions on health, these generation groups pay attention to how their food is produced, with an emphasis on sustainable, local, holistic farming and sourcing. Additionally, they also care about what they consume – starting from cutting refined sugars in their diet to shifting from their caffeinated beverages to nutritious kombucha. This health-conscious mindset has infused the world we live in today – with more prominence among urban demographics. The more mature generations have picked up on this belief and slowly have evolved their perspective into this widely-common worldview.

The concept of holistic well-being has led to a more diverse variety of physical activities. Outdoor activities are not only the only way to burn calories. Globally, a huge demand of alternative fitness activities like yoga, barre, pilates, combat, and others have gained popularity. These physical activities are seen as means for fulfilling physical and spiritual aspect of individual well-being. So, what does this shifting lifestyle mean for the prospect of reducing sedentary behavior?

As individuals' awareness towards a holistic well-being lifestyle increases, there is a greater emphasis on understanding how sitting behavior can do harm to the body. A multitude of campaigns, such as 'sitting is the new smoking', have emerged and people have taken notice. The society is at a momentous turning point where sedentary behavior or physical movement interventions will be more widely accepted by the society as means for encouraging a healthier, more productive workforce.

Gone are the days when employers measure productivity by counting the number of people at their seats. The new measures for productivity and innovation have become the quality of peer-to-peer interactions, less 'presenteeism', and happier and engaged employees. With these new productivity goals in mind, employers have started to curate a work experience that would address the five indicators of well-being – how would the workplace give one a sense of purpose, enable social relationships to flourish, address financial security, enhance sense of community, and most importantly, build a physically healthy workforce.

A recent focus group and survey were administered to full-time administrative office workers in Australia (McGuckin et al., 2017), and about 88% believed there is a relationship between sitting time and overall health. Participants also added key health concerns they believed are associated with sitting time, which include: musculoskeletal complaints, general health, and weight-related conditions (obesity, body mass index, etc), being fatigue, and cardiovascular health. Focus group also identified several strategies to encourage behavior change, including: education, supportive colleagues and managers, and environmental 'barriers'. The group elaborated on potential furniture removal or layout change to enforce reduce sitting behaviors. This study confirms that while employers started to pick up on the healthy initiatives, there needs to be more training among managers to accept non-sitting behaviors as an acceptable norm in the workplace.

Additionally, tension exists between the rise of a healthy lifestyle and emerging digital technologies and their associated convenience. As the world becomes more saturated with technologies that simplifies daily life and let people to do more with less, it is easier than ever to sit or lie still throughout the day while getting the work done. The future technology enables computing work, ordering food, running errands, all from a simple

device. The challenge has then become balancing the convenience of tools with individuals' ability to physically engage with the physical space. How can sedentary behavior interventions engage with a health-conscious but technologically-savvy generation?

2.3. Relevancy of Active Design and Planning

Several studies have looked at the efficacy of psychological, social, and environmental interventions in reducing sedentary lifestyles. Psychological interventions are focused on the educational aspect of increasing awareness around sedentary behavior topic and improved general health condition (i.e. nutritional consultation). Social interventions leverage human connections to encourage participation (i.e. health competitions, etc.). Environmental interventions encompass other initiatives that include physical adjustments in the built environment (i.e. furniture layout, artwork installation). Multi-modal approach combining multiple approaches outlined above have been proven effective in aligning health positive messaging with a change in use behavior (Owen, 2010). One key challenge to address is in empowering individuals to make the right yet seemingly 'inconvenient' choice. Trost et al. (2000) still found that self-efficacy is one of the biggest determinants to physical activity. A study of a physical activity campaign in Australia found after a more than ten-year of public campaign and other initiatives that the level of physical activity had been static or declining in some groups (Owen, 2009). Experts suggested that future studies should focus on understanding the impact of environmental interventions as the main indicator for a reduction in sedentary behavior. Environmental interventions can be categorized into two main types: peripheral and planning intervention. Peripheral intervention includes spatial environment improvements that are temporary or reliant of furniture solutions to increase appeal for physical

movement, such as artwork in a staircase, promotional signage, and adjustable sit-stand desks. Planning intervention is a systematic approach in designing built environment based on previously-learned principles that were proven effective in promoting physical activity, which include urban park designed with connectivity and zoned for activities to enable more movement and exploration.

Some environmental interventions have been made to increase physical activity in the workplace sector, specifically in an interior physical environment, however most of these interventions were focused on the peripheral interventions. One of the most common interventions among corporate organizations is the use of adjustable sit to stand workstations to promote posture change and movement. Researchers started to analyze the efficacy of sit-stand desk in shifting user behavior. A cross-sectional study in Sweden (Straker, 2013) focused on the efficacy of adjustable sit-stand workstation in promoting standing breaks among call center workers, who spend most their time at their desk. This multi-modal study offers 90 randomly-selected call-center employees from 15 distinct worksites to utilize sit-stand workstations in addition to receiving an upfront health and wellness consultation.

Straker concluded that three of five participants, regardless of gender, reported using them once a month or less. The primary reasons for not utilizing adjustable desks more regularly was the perception of being disrupted when performing specific work tasks, or a perception of already having sufficient posture shifts while sitting. Additionally, awareness about sitting postures or sedentary behavior was not associated with sitting pattern among those using a sit–stand desk (Straker, 2013). Another study supported this finding, Gilson et al. (2012) reported among workers who received some advice on reducing sitting time for overall health and then given the opportunity to access both

adjustable sit-stand and regular desk, the majority of workers ended up only spending one hour at their adjustable desk.

Straker also pointed out that while access to adjustable sit-stand desks was associated with being less sedentary for some, as of when the study was conducted (2013), there were no studies reported on the long-term effect of adjustable sit-stand desks on sedentary behavior among call center and general office workers. A similar study conducted one year later (Chau et al., 2014) backs the short-term efficacy of sit-stand desks however did not conclude any long-term impact of this intervention.

One thing to note is that increasing number of interventions observed in this literature review reported an increased individuals' awareness towards sedentary behavior. While increasing number of researchers and companies started to promote initiatives around becoming less sedentary, these interventions still rely heavily on individuals making the right choice in their daily activities. It is still unclear whether a combination of education campaigns and opportunities for movement could result in a long-term behavioral change.

To encourage long term change in physical activity, more proactive approaches to enforce physical activity and break prolonged sitting habit are necessary. One study suggested that an approach to promote incidental activity through spatial interventions could help in advocating walking behaviors (Marshall, 2004). More systematic planning interventions seem to show promise in reaching out to more employees than merely motivational approaches.

An urban planning study focused on neighborhood walking pattern conducted by Marcus et al. (2006) suggested that improving access to places for physical activity can result in as much as 25% increase in the number of people being active at least three times per week. In an interior environment, these planning interventions can be interpreted into the

flow of spaces and can vary from as simply as a strategic placement of stairs or corridor spaces in the broader interior environment. Additionally, spatial planning layout can play a pivotal role in reinforcing flow of traffic and people from one space to another. Research by Gilson (2009) stated that spatial layout promoting incidental activity may not directly reduce sitting behavior however it has potential to increase users' movement from their desks to the rest of the work environment. The goal is to create interior environments that are not only suggestive in limiting sedentary behavior but instead proactively direct users to instinctively move more and sit less.

One notable study in rolling-out planning intervention that prompts a call to action was a research conducted by Nicoll and Zimring (2009) that explores the role of stairs in a multi-floor office environment. The study programmed the main 'skip-stop' elevators to only stop at every third floor (excluding ADA elevator and main elevators located at the building core). Building users were expected to take the 'skip-stop' staircase, that was made open and aesthetically pleasing, to reach their destination. An accessible elevator and adjacent enclosed fire exit stairs within the building core were still open to provide options for those in need. Stair utilization was measured using infrared monitors card-reader in addition to an online survey to evaluate users' perception and behaviors toward physical activity.

At the end of the study, this behavior reinforcement strategy has resulted in daily utilization of 'skip-stop' stairs by almost three-quarter of the survey participants and overall was used 3.3 times more than the enclosed stair of the traditional elevator core. By decreasing the scale of multi-floor community within the building, the 'skip-stop' stairs has fostered unplanned interactions among building occupants in addition to an increased in physical activity level. Survey and interview results indicated that the 'push' strategy was a main contributor to the increased use of stairs, in which participants cited,

they “had no other choice” since no elevator nearby was available. (Nicoll and Zimring, 2009).

Other aspects of physical environment that resulted in increased stair use were: perception of safety, visual aesthetics, visibility, and distance. Stairs that are brighter and visually interesting attract more people to utilize them; the placement of stairs near elevator or visible from entrance will also encourage people to choose stairs instead of elevators (Van et al. 2011). This study is consistent with McCormack et al. study in 2004, which concluded that ‘far’ perception of distance correlated with a decline in overall level of physical activity. In addition to promoting stair use, horizontal or floor-level spatial layout plays an important role in determining movement in the space. In the public realm, designers and urban planners have intervened to create environments where physical movements are becoming more accessible and enjoyable. These interventions include creating urban centers in a suburban environment, rejuvenation of public parks in city centers, and creation of walkable paths in urban neighborhoods. Active Design Guidelines in New York City is one of the prime examples of city-wide initiative for promoting physical movement in a built environment. The Guidelines provide strategies and ideas for integrating active design concepts into both outdoor and indoor environment. The intention is to unlock physical activities in ways that are natural, accessible, and easy. These urban strategies have been historically successful in creating new healthy habits among individuals and families, such as: outdoor recreational activities, social physical activities, and leisure walks. When evaluating at active design in an interior environment to date, merely a handful of research studies have focused their efforts on implementing a proactive planning approach that would generate more movement and standing breaks among office workers.

One of the few examples of this study was study at Cornell University office workers to evaluate physical movement and sedentary behavior of individuals located in different work environments (Hua et al., 2013). Hua et al. (2013) investigated the relationship of a range of spatial layouts on sedentary behavior, specifically looking at distance between workstations and community spaces. This voluntary research study utilizes accelerometer to evaluate the number of steps and bouts of movement from multiple work sites. Results from accelerometer were compared against the previously-identified spatial layout metrics, such as: distance, visibility, and enclosure of community (pantry) and support spaces (copy/print, etc.). The study concluded that proximity of community spaces to individual seats is positively correlated with step counts and job satisfaction, which indicated that shorter distance to community spaces results in higher steps count and individual satisfaction.

This present study will focus on diving deeper into workplace planning and design concepts as planning typologies to uncover insights on planning strategies that would contribute to higher physical movement and less sedentary behavior in the workplace. Leveraging research studies from previous years, this study will provide additional insights into the realms of sedentary behavior in the workplace environment. Borrowing concepts from landscape design and urban planning, strategies for increasing walking behaviors in an interior setting could have research implications for developing floor plan layouts that actively reduce sedentary behavior and promote physical activity.

Chapter 3: Tools for Measuring Physical Movement

A combination of objective and subjective measures is necessary to identify relationships between physical environment and sedentary behaviors. Due to unique personal factors that may vary by individual, subjective measures were included to offer additional user insights that may contribute to the physical activity outcomes.

3.1. Objective Measures

3.1.1. Pedometer and Accelerometer

Pedometer is an electronic or electromechanical wearable device that measures steps taken by detecting the tilting movement of hips or legs. Most commonly used as step counters due to its low cost and ease of set-up, the pedometer is relatively effective for broadly estimating physical activity level. However this device does not offer a precise measurement of movement. A study testing multiple pedometer devices identified a wide range of accuracy, ranging between ±.37 through ±.03 of the actual steps taken (Schneider et al, 2013). Due to the relatively lower testing reliability of pedometers, the accelerometer is a superior alternative to traditional pedometer for research purposes.

An accelerometer utilizes a similar approach to the pedometer for tracking physical movement. Accelerometers feature movement sensors that can measure the intensity of physical activity. Typically attached to a person waist with a belt clip, its sensors (including “piezo–electric, micro–mechanical springs, and changes in capacitance”) can distinguish between walking and running activities (Physical Activity Resource Center for Public Health, 2016). An accelerometer becomes highly-utilized in research settings due to its reliability level, with approximately 3-12 days of recommended monitoring to achieve reliable results (Matthews et al, 2003).

3.1.2. Space Syntax

Space syntax is an analytical approach that examines spatial design and layout through an analysis of density, location, linkage, and intersection points of environment that may contribute to changes in human behavior and movement patterns. Space syntax theory historically has been used in architecture and within the field of urban design for identifying an appropriate approach for validating design assumptions and understanding resulting space flow and utilization (Koohsari et al., 2014). An increasing number of design research studies have employed space syntax tools and developed measures for uncovering spatial attributes that lead to higher movement pattern in a built environment. One of the studies conducted by Nicoll looked into the concept of path integration. Path integration highlights areas that are comprised of perceived primary routes of travel that are located close to main spatial landmarks or nodes. Most Integrated Path (MIP) plans were described as visuals that represent the abstraction of functional spaces layout within an overall building floor plan layout. This pathing technique maps out the most streamlined and longest straight lines that "pass through at least one threshold between two adjacent convex spaces" (Nicoll, 2007).

3.1.3. Topological Dimension

Several studies have identified topological factors as a more critical determinant than metric dimensions. Specifically, these factors influence perception and how that person moves around in an urban environment (Hillier and Iida, 2005). Topological dimensions of spatial network, such as: number of turns, visibility, or intelligibility of space, are more important in shaping one's decision than actual metrics of distance or sizing of spaces (Nicoll, 2007; Cohen & Weatherford, 1980).

3.1.4. Ethnographic Research

Ethnographic research is especially helpful when defining an observation that cannot immediately be explained in 'If X, then Y' terms, and where user behavior results could not be predicted by previous literature (Angrosino, 2007). Ethnographic research outcomes incorporated observation of unique demographic attributes that may have impacted user behaviors. To collect enough information for developing insights about specific group, ethnographic researcher typically spends an extended period time immersing him/herself in specific cultural or demographic groups, sometimes referred as 'fieldwork'.

Classical ethnographers typically focused their efforts in local communities and a long-term research, in which they will be totally immersed in the 'field' for 24 hours a day, 7 days per week, and some may stay for months or years (Whitehead, 2005). This prolonged research program will allow researchers to understand local socio-cultural dynamics, rituals, traditions, and other distinguishing factors that may evolve through time. Ethnographic research methods are typically time and labor-intensive, however they capture a comprehensive information and nuances of specific demographics. In addition to fieldwork, ethnographic research also utilizes additional data, such as: secondary data analysis, observations, and other informal or semi-structured ethnographic interviews (Whitehead, 2005). Ethnographic research concept is adapted into workplace design and research field through a more streamlined approach in a shorter timeframe and typically includes fieldwork observations, secondary data analysis, and informal focus groups.

3.1.5. Site Observation

Observational study that encompasses macro-level behavioral mapping of spatial movement provides a high-level understanding on how users utilize the space to identify successes and pain-points in the existing built environments (Whitehead, 2015). Site observation is typically used to substitute more in-depth fieldwork ethnographic research to gain broader insights into how a specific user group behave in their environment. The intent is not merely to understand user habits, but to uncover other internal or external factors that may contribute to a shift in physical movement in the workplace. Understanding of how workplace functions and the associated behaviors that take place within would help reframe the research problems and develop new hypotheses pertaining to the design of the built environment. Additionally, qualitative notes and insights from these observations are critical in validating survey findings and filling the gaps between user-reported insights and the condition of the physical environment.

3.1.6. Building Physical Environment Criteria

Precedent study findings and previously-identified spatial design recommendations were utilized to develop a building environmental criteria in order to rate each research site for its ability to support day to day activities, provide user comfort, and drive satisfaction. Previous research findings were categorized into four main areas of focus, namely:

- **Environmental Quality:** qualitative attributes of building design (core and shell) that contributes to user satisfaction of the built space.
- **Spatial Design:** design qualities of the interiors environment that foster interactions, enable physical movement, and enhance quality of life.

- **User Comfort/Control:** spatial design attributes that ensure an optimal user comfort, ranging from indoor air quality to ergonomic accommodation.
- **Aesthetic Quality:** look and feel of spaces that inspires and encourages desired positive behaviors. These attributes are inclusive of the space design/layout, access to daylight, selection of materials and finishes, and space maintenance.

Several recent literature and theories around these categories were reviewed to outline specific user behaviors that may be affected by these interventions:

Physical Environment Attributes	Literature Precedents
Environmental Quality *(natural daylighting, lighting levels, circulation paths, outside views)*	Aarts & Dijksterhuis, 2000; Marcus et al., 2006; Nicoll, 2007; Active Design Guidelines, 2010, Handy et al., 2002
Spatial Design *(number of turns, distance, visibility, visual barriers)*	Aarts & Dijksterhuis, 2000; Nicoll, 2007 Van Nieuw et al., 2011; Zimring 2005; Nicoll, 2007; McCormack et al., 2004
User Comfort/Control *(user control, ergonomics, partition height)*	Hedge, 2012, Straker, 2013.
Aesthetic Quality *(look and feel, furniture, color, finishes, maintenance)*	Aarts & Dijksterhuis, 2000; Nicoll, 2007; Van Nieuw et al., 2011

Figure 3. Building Environment Criteria

3.2. Subjective Measures

3.2.1. International Physical Activity Questionnaire (IPAQ)

The IPAQ instrument is a self-administered survey that has become the standard questionnaire used to identify individual level of physical activity (PA) as measured by a combination of vigorous, moderate, walking activities over the course of 7 days. An additional indicator variable of “estimated time spent sitting” is included into the IPAQ core questions. The IPAQ instrument has been tested in retest reliability across different demographics and has been proven to be highly-effective among 15 through 69-year old population (IPAQ, 2013) See Appendix A for a detailed questionnaire sample.

3.2.2. Workplace and Physical Activities Survey

A customized paper-based survey was specifically created for this study in addition to the standard IPAQ questions based on study precedents around influencing factors on sedentary behavior. Adopting previous survey framework developed by Hua et al. (2013), the survey is comprised of a series of questions about personal, social, and environmental factors.

Spatial Environment factors

This section consists of specific questions and statements about characteristics of the built environment that may affect one’s physical movement. These questions include user satisfaction with the overall look and feel of physical space, efficiency of space layout, availability of spaces, and visibility of signage and wayfinding elements.

Social factor questions

This section is intended to identify individual's relationship with their work colleagues, connection to company values, and social habits may influence their choice about physical activity at work.

Health and Wellbeing factors

Wellness is a holistic approach that extends beyond just physiological health. These questions evaluate individual's perception of their current health and wellbeing, including their emotional and mental wellness. Questions asked in this section include: work satisfaction, engagement with the work and the organization, and one's perception of physical and mental health.

Demographics

Additional demographic questions were included to identify mediating and moderating variables that may impact physical activity level. Demographic questions included were divided into work and personal level. Work demographic questions include: job in building tenure, workspace tenure, commute pattern, and work arrangement (full time or part time). Personal demographic questions included were: gender, age, weight, BMI, ethnicity, and education level.

3.2.3. User Interviews

User interviews were intended to confirm initial survey findings with building occupants, who represented different job functions in the company. These interviews were used to draw insights and develop an understanding of differences between user types. Specific questions about building environment were included to verify and confirm previously-collected site observation data.

Chapter 4: Research Statement and Hypotheses

4.1. Research Statement

With the development of sophisticated work technology and tools, work activities have become effortless and more seamless than ever. Individuals are enabled to do their work whenever and wherever they are, which has led to an increasing concern around sedentary behaviors and its health implications. As the percentage of white collar workers rapidly growing and will continue to increase, there is an immense opportunity for the workplace to respond and address this sedentary lifestyle.

Given the importance to keep employees healthy and engaged, companies across numerous industries have started to develop a variety of health and wellness offerings to help individuals to be healthier. However, the two main on-going issues with these programs are the limited impact of fitness programs on long-term health and the inability of individuals to maintain lasting healthy behaviors given the opportunity. A recommended healthy habit lies on a constant physical movement throughout the day, which typically is difficult to maintain daily.

This research study intends to bridge the gaps in the existing literatures around physical activity interventions. This study seeks to understand the role of workplace planning and design of the built environment in influencing individual choices and behaviors to instigate a lasting increase in daily physical movement. Many design recommendations highlighted in past studies have been largely dependent on the educational aspect of the built environment, which possessed challenges in implementing a long-term behavioral change in part due to the subsiding self-efficacy behaviors. A seamless, inherent integration of building planning and design can actively push individuals to elevate their physical activity in the work environment.

4.2. Research Purpose

This study aims to uncover key physical design and planning insights that are critical in shaping physical activity in the work environment. The findings and outcomes from this study will be unique and largely beneficial for future studies due to the following aspects:

- In-depth analysis of spatial layout and metric strategies that have direct linkage to space utilization and reduced sedentary behavior
- Integration of quantitative research methods and a more qualitative ethnographic approach to understand the context of each work environment

4.3. Research Questions

The questions that this study attempts to answer:

- How does the work environment influence physical movement in a professional setting? What are the most important space attributes that encourage/discourage walking behaviors?
- .How might the effect of spatial design attributes have an impact on individuals who are already active compared to those who are more sedentary?
- What other external factors may influence physical activity in the workplace? How might we instill these existing behaviors to encourage others?

4.4. Hypotheses

This study examines the relationship between specific spatial/design attributes, observed space utilization, and self-reported physical activity and perception of workplace design. The hypotheses tested in this study are:

4.4.1. Hypothesis #1: Building occupants who are seated further away from shared community spaces will have higher sedentary behaviors than those seated closer to community spaces due to distance perception.

4.4.2. Hypothesis #2: Building occupants will have higher sedentary behaviors if the location of their seats has a higher number of directional turns (which indicated lower visibility) to shared community spaces.

4.4.3. Hypothesis #3: Perception of sitting too much and individual awareness towards sedentary behavior topic have an impact on individuals' physical movement in the workplace.

4.4.4. Hypothesis #4: Satisfaction with the work environment and positive outlook of the organization are positively associated with physical movement in the workplace.

Chapter 5: Methodology

The study utilizes a multi-method data gathering process to collect information from two distinct workplace sites with different design planning concepts. Data collection and analyses of each site were conducted independently to compare and contrast results from both sites.

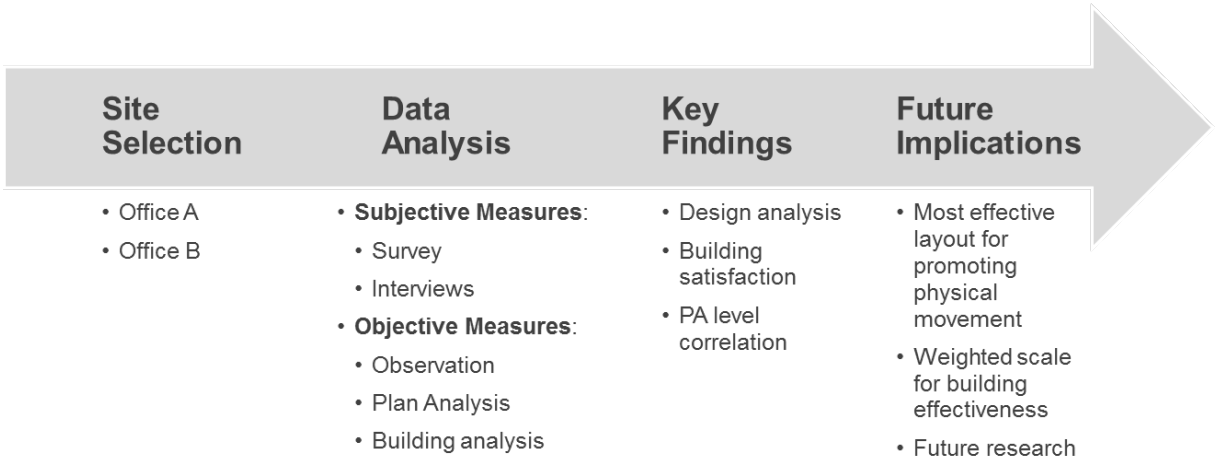


Figure 4. Methodology and Results

5.1. Research sites selection

Two work environments were selected for this study based on the following key requirements: 1) occupation in at least five-story tall building, 2) representation of the same industry sector with consistent anticipated individual workstyles, 3) location within the same geographic area and urban environment to control for locational bias.

The study had initially included criteria of an inter-connecting staircase as a spatial feature, however this requirement has since been dropped given the constraint of site selection process. This study is now focused on lateral spatial relationship and planning attributes within one floor work environment. Both research sites represent an architecture professional services firm industry with focus on corporate workplace sector as the main client industry served. Similar to the majority of corporate offices across other industries, both offices feature an open workplace area, collaborative spaces, and

shared community spaces. Both selected sites satisfied the criteria previously outlined and were deemed representational of typical corporate settings and the broader workplaces in the nation. Both research sites selected were situated in New York City that offers a well-connected underground transportation system. The city is among the most walkable cities in the United States, which may contribute to a habitual bias towards physical activity.

CAD floor plans of both sites were acquired through the participating building contact. The floor plans were analyzed prior to data-collection activities to identify overall plan layout typology based on the distribution of meeting spaces and other community spaces as they relate to the workspace areas. Anticipated high-traffic areas, underutilized work areas, and other spatial attributes were noted in preparation of data collection activities.

Figure 5. Site A Building Exterior

5.2. Site A

Site A resides on a relatively large floor plate 38-story high-rise building adjacent to Bryant Park, New York and is located within a short walking distance to Bryant Park and an underground public transit. The multi-tenant building features a recently-renovated lobby space for visitor check-in and has a security turnstile access. An emergency staircase is accessible through the workplace floors for lobby access only. All vertical traffic to floors is handled through multiple tiered elevator banks. Site A occupies the 6th

floor (full floor) with an approximate gross area of 32,000 square feet and a net occupiable area of about 22,500 usable square feet.

Figure 6. Site B Exterior Building

5.3. Site B

Site B resides on a smaller floor plate 18-story historic building within a short walking distance to the Union Square Public Park and an underground public transit. Similarly, Site B is also a multi-tenant property who recently underwent building common area renovation. The building features a compact and functional reception lobby area with no security turnstile access. Emergency staircase to and from workplace floors is accessible from lobby level and vice versa. Site B occupies a full floor on the 4th floor with an approximate gross area of 17,250 square feet with a net occupiable area of approximately 14,000 square feet.

5.4. Participants Recruitment

Prior to the data collection activities, an email was sent to notify employees from each site about a 3-day design research study and to ask for their participation in a survey about building satisfaction and physical activity level (see Appendix B for recruitment materials). Participants for user interviews were randomly selected by each building contact to represent samples of varying job functions and workstyles. Work functions

included in the sample are architects, designers, project managers, and various administrative functions.

During the first day of study, all employees were asked voluntarily to participate in a paper-based survey. Participants were given a quick verbal overview of the study and were asked to sign the International Review Board (IRB) consent form that describes the intent of research study in greater detail.

5.5. Compensation

No financial or physical compensation was given for completing this study.

5.6. Instruments

This research study operationalized a multi-method data gathering approach to cultivate both quantitative and qualitative insights. Below is the description of each data-collection tool and its intended data outcomes:

5.6.1. Objective Measures

Building Physical Environment Criteria

The Building Physical Environment Criteria is developed and built upon previous research studies around physical environmental attributes that may have an impact on user behaviors in the built environment. Additional literature reviews and recent studies on sedentary behaviors are utilized to guide and distill the environmental criteria included in the analysis, such as: user comfort, environmental quality, and spatial design factors for physical movement2. The criteria are divided into three main evaluation categories: Work Environment, Individual Workspace, and Shared Community Spaces. Rating of 0 represents the least desired quality of environment and 3 represents the most desirable attribute of environment.

Building Physical Environment Ratings: **Work Environment**

Overall View to the Outside
3: View of scenic landscapes and greenery
2: View of streetscape including exterior buildings and vehicular traffic
1: View of parking lot, exterior wall of adjacent building
0: No view to the outside
Daylight Penetration
3: >80% of overall office environment receives natural daylight
2: 51-80% of overall office environment receives natural daylight
1: 20-50% of overall office environment receives natural daylight
0: <20% of overall office environment receives natural daylight
Ambient environment (Temperature)
3: Comfortable temperature level, not too cold or warm allowing
2: Mostly comfortable with occasional below and above average room temperature
1: Slightly below or above room temperature
0: Extremely below or above room temperature that is uncomfortable to users.
Lighting Level
3: Well-lit with sufficient access to artificial lighting
2: Sufficiently lit for either computer or paper-based work
1: Inconsistently lit depending the time of day or seat location
0: Too bright causing glare or too dark for any work tasks
Office Circulation
3: Easy to navigate and signage is available
2: Relatively easy to navigate with no/limited signage
1: Confusing with a number of turns with no signs of signage
0: Impossible to navigate for people who have no experience being in the space
Circulation Path
3: Has adequate width and pockets for conversations to happen
2: Wide enough to support some conversations along the path
1: Narrow and is inadequate for interactions to occur
0: Does not comply to baseline circulation width requirements of 30”

Table 1. Building Physical Environment Ratings: Work Environment

Building Physical Environment Ratings: **Individual Workspace**

Access to Views
3: Distance to window < 10 feet
2: Distance to window between 11-20 feet
1: Distance to window between 21-30 feet
0: Distance to window is more than 30 feet
Daylight Penetration
3: Sufficient access to daylight with access to shades
2: Sufficient access to daylight without shades causing occasional glares
1: Limited access to daylight
0: No access to daylight
Workstation
3: Multiple work surfaces with ample storage and separate small meeting area
2: Multiple work surfaces with ample storage and/or a guest chair
1: Single work surface with ample layout space and adequate storage
0: Compact, single work surface with very limited amount of storage
Office
3: Multiple work surfaces with ample storage and separate small meeting area
2: Multiple work surfaces with ample storage and/or a guest chair
1: Single work surface with ample layout space and adequate storage
0: Compact, single work surface with very limited amount of storage
Individual Control
3: User has direct control over temperature and lighting
2: User has direct control over lighting or temperature
1: Temperature/lighting is centrally controlled but can be adjusted universally
0: Temperature/lighting is centrally-controlled and is not adjustable
Partition Height
3: Partition height provides seated-height visual enclosure or less
2: Partition height is approximately 6-12 inches higher than seated height
1: Partition height is more than 12 inches higher than seated height
0: Partition is higher than 72 inches or with no partition available
Furniture Ergonomics
3: Height-adjustable desk and ergonomic chair (height, armrest, lumbar)
2: Height-adjustable desk or ergonomic chair with some adjustability
1: Desk and chair have some manual adjustability
0: Desk and chair are fixed and not adjustable

Table 2. Building Physical Environment Ratings: Individual Workspace

Building Physical Environment Ratings: **Shared Spaces**

Visibility of Community Spaces
3: Highly-visible and immediately adjacent to work areas
2: Visible and are located less than 2 turns away from work areas
1: Not visible and located between 3-4 turns away from work areas
0: Not visible and located more than 4 turns away from work areas
Proximity of Community Spaces
3: Furthest distance from work areas to the community spaces is <50 feet away
2: Furthest distance from work areas to the community spaces is 50-100 feet away
1: Furthest distance from work areas to the community spaces is 101-150 feet away
0: Furthest distance from work areas to the community spaces is >150 feet away
Visibility of Stairs
3: Staircase is highly-visible and immediately adjacent to work areas
2: Staircase is visible and are located less than 2 turns away from work areas
1: Staircase is not visible and located between 3-4 turns away from work areas
0: Staircase is not visible and located more than 4 turns away from work areas
Accessibility of Stairs
3: Staircase is highly-accessible; transparent, unlocked, with no door/open doors
2: Staircase is accessible; unlocked and has open doors
1: Staircase is somewhat accessible; unlocked or with badge access
0: Staircase is not accessible
Visibility of Elevators
3: Elevators are not visible and located more than 4 turns away from work areas
2: Elevators are not visible and located between 3-4 turns away from work areas
1: Elevators are not visible and located between 2 turns away from work areas
0: Elevators are highly-visible and immediately adjacent to work areas
Proximity Between Staircase and Elevators
3: Staircase and elevators are directly adjacent to each other
2: Staircase is located nearby the elevators with visible signage
1: Staircase is located away from elevators with visible directional signage
0: Staircase is located further away from elevators with no visible signage
Visibility between staircase and elevators
3: Staircase is highly visible from the elevator lobby
2: Staircase is somewhat visible from elevator lobby, located 2 turns away or less
1: Staircase is not visible from elevator lobby, located 3-4 turns away or less
0: Staircase is not visible from elevator lobby, located more than 4 turns away

Table 3. Building Physical Environment Ratings: Shared Spaces

Floor Plan Analysis

Floor plan from each site was analyzed based on attributes of spatial environment are hypothesized to affect physical movement and sedentary behavior in the workplace. The identified spatial attributes were then benchmarked against each other and compared to other sedentary behavior findings collected from other data collection activities.

Attributes	Supporting Literature
Building Analysis **Building core/shell layout** includes connectivity, scale, use function, as attributes that may have an impact on walking behaviors	Nicoll (2007) reported the following building layout attributes have impact on stair usage: travel distances from stair to nearest entrance and the elevator, accessibility of each stair, number of turns required for travel from the stair to closest entrance, and the most integrated path (MIP).
Overall Office Layout **Efficiency of floor plan** (centralized vs. distributed) **Active and Underutilized Areas** **Space Deficiencies and Workarounds**	Hua & Ying (2013) found proximity to amenity spaces is positively associated with sedentary behavior. McCormack et al. study in 2004, concluded perception of distance and destination is negatively correlated with overall level of physical activity.
Collaborative + Support Spaces **Location of Shared Spaces** **Meeting Spaces Ratio** *(number of spaces in proportion to number of seats)* **Proximity of Shared Spaces** *(distance to workspace areas)* **Visibility of Shared Spaces** *(number of turns from workspace areas)*	Social Cognitive Theory supports the hypothesis about positive relationship between gathering spaces and increase in physical movement. Handy et al., (2002) identified connectivity, availability of alternative routes as measured by number of street intersections as important attributes to utilization.
Individual Workspace Areas **Layout and Sizing of Individual Desk** (workstation, benching, office) **Layout of Work Neighborhoods** (adjacent gathering areas) **Visibility of Overall Workspace from Individual Desk**	Handy et al., (2002) identified density/intensity of workspace areas as dimensions of built environment.

Figure 7. Floor Plan Analysis Attributes

The Bronfenbrenner ecological theory (Bronfenbrenner, 1977) explains that there are multitudes of internal and external factors affecting how one

perceives built environment and makes day-to-day short-term decisions. The human brain is wired by responses to stimuli that will determine their corresponding habits, such as: choosing elevators or stairs, getting up and down from their desk. The building design analysis takes into consideration both quantitative and qualitative metrics to understand the distribution, sizing, layout, and quantity of spaces across the workplace. Four key metrics analyzed in the study include: building and workplace metrics, individual workspaces, collaboration spaces, and community spaces.

Building and Workplace Metrics:

Several key building and workplace strategy metrics were included to understand the distribution of spaces and how these spaces efficiently support the workplace population:

- **Building design:** insights on the location, sizing, and design of the building. If applicable, the notes include recent renovation work and age of the building.
- **Floor:** location of floor in the building stack and size of floor plate that determines building scale and walkability
- **Number of seats:** total workplace population including those who were not assigned to conventional workspace 'desk', i.e. reception
- **Approximate allocation of square footage (sf) per person:** A calculated number based on the total usable square foot available divided by the number of seats. This number is used to understand the density of workspace in comparison to industry average density.
- **Workstation size:** total footprint of standard workstation calculated by multiplying the depth and width of main work area footprint.

- **Collaboration Seat Ratio:** ratio of total meeting room seats in comparison to number of individual seats. For example, a collaboration seat ratio of 1:2 workplace seats indicates that there is one collaboration seat located in conference room for every two workplace seats. This ratio indicates the availability and accessibility of meeting spaces, which resulted in individuals occupying their workstation seats longer for meetings.
- **Layout/configuration:** General layout of the workplace design that dictates the spatial quality and user flow.

5.6.2. Subjective Measures

International Physical Activity Questionnaire (IPAQ)

The IPAQ instrument was administered in a paper-based format. It is a standard questionnaire used to categorize individual level of physical activity (PA) as measured by a combination of vigorous, moderate, walking activities over the course of 7 days. IPAQ instrument has been tested in retest reliability across different demographics and has been proven to be highly-effective among 15 to 69-year old population. See Appendix A for detailed questionnaire sample.

Workplace Physical Activities Survey

This custom paper-based survey is a combination specific space-related questions in addition to the Workplace Environmental Satisfaction Survey from Hua et al. study (2014). The survey is comprised of several 5-point Likert scale questions and is comprised of the International Physical Activity Questionnaire with additional series of questions developed based on previous literature references on sedentary behavior topic.

Demographic questions were included to identify mediating and moderating variables that may impact physical activity level. Overall building satisfaction was asked through two main Likert-scale questions that identified “overall satisfaction of the spatial environment” and “perception of the spatial environment’s ability to support work”. The Likert 5-point satisfaction scale ranges from “Very much” to “Not at all”.

User Interviews

User interviews were conducted with group of individuals from each site who represented various job functions. The focus group intends to gain better understanding of how users utilize the workplace, identify attributes of workplace that contribute to an increase or decrease in physical activity or sedentary behavior, and other additional insights about the design of the work environment. Each interview was approximately 1-hour in length with up to five people representing different positions in the company.

Interviews were conducted with four users from Site A and five users from Site B. Interviews insights were documented and reported independently to allow for clearer comparison around the two-building design and layout. Due to scheduling constraints, Site A participants were interviewed together in a one-hour focus group session, whilst Site B participants were interviewed individually.

Interview questions were developed for each interview based on interviewer’s understanding of building flow and usage. Additionally, probes were utilized to guide the discussions, particularly around: space satisfaction, work functions and associated physical activity required, and other workplace-related insights. Interview insights were transcribed in a word document and were

used to compare against initial hypothesis and assumptions for each floor plan.

5.6.3. Synthesis of Data

Variety of data points collected through activities was triangulated to evaluate the impact of individual perception of well-being, response to stimuli (design attributes, physical environmental quality), and day-to-day habits. The results of this study will be used to evaluate alignment between these attributes and the resulting physical movement in the workplace.

5.7. Data Collection

The data collection activities for Site A and B were conducted in a consecutive two-week period between May 7-9th, 2013 and May 14-16th, 2013 respectively. 3-day period for each site was chosen during mid work week (Tuesday through Thursday) to control for atypical mobility and attendance patterns during the beginning and the end of a work week. Researcher physically distributed the survey on day 1 and verbally introduce the study overview and intent before handing users an IRB consent form for their signature. Approximately thirty (30) randomly-selected participants from each building completed the survey, which was collected during the last day of observation. Site B had a slightly higher survey participation rate. A poster was sent ahead through email prior to the study to the main contacts for each office. Those who have expressed interest in participating in the study were asked to contribute in a focus group. Participants that were notified were told that there would be no action required on their part and were instructed to perform their work as usual.

5.7.1. Day 1: Discovery

The Physical Activity Survey was administered to participants through a paper format. The survey is comprised of multiple choice and open-ended questions inquiring about general exercise habit, workplace and job satisfaction. The researcher performed a behavioral mapping exercise to understand how users navigate themselves around the workspace. This activity offers insights on the space utilization and the gaps between space design and behaviors.

5.7.2. Day 2: Deep Dive

The researcher continued to record utilization of space throughout the day to understand impact of space attributes on utilization. Observations were recorded through site journal, space evaluation scoring sheet, and photographs.

5.7.3. Day 3: Evaluation

The researcher also interviewed 3-4 individuals from different job functions from each site through a group or individual interview format. Topics discussed include: office culture, health and wellness activities, and feedback on office design. The researcher continued to review physical environment attributes and documented through photos.

5.8. Survey Data Analysis

Data from IPAQ and Workplace Physical Activities Survey were transcribed into an Excel spreadsheet for further data analyses. High-level results from each site were presented in bar or pie charts in addition to average Likert scale insights from each site. Most data were presented as a comparison of the two sites to reflect a true comparison of two distinct sites.

Chapter 6: Results

The results of this study were divided into five main categories: 1) workplace design attributes, 2) demographic overview, 3) user satisfaction, 4) behavioral habits, and 5) physical attributes of individual seats. Analyses of findings from each category represented an aggregated outcome of employee survey, floor plan analysis, behavioral mapping, and user interviews.

6.1. Workplace Design Attributes

Floor plan analyses were used to provide high-level insights around the flow and circulation of each workspace. Main and secondary circulation paths were identified in red to diagram anticipated user flow given the workplace planning intent. Collaborative spaces highlighted in green illustrate the distribution and location of these space types in relation to the workspace area. Community spaces, such as café and gathering space, were shaded in yellow to represent shared community spaces.

Figure 8. Site A Floor Plan Layout

6.1.1. Site A Overview

Building floor plate is an L-shaped building with shared spaces and visitor space located in the middle of L-layout dividing the two 'wings' (highlighted in yellow above). Visitor reception area is located right across from the elevator lobby, with adjacent central café featuring a pantry area with access to food appliances, including refrigerator, microwave, and an industrial-sized coffee machine. The pantry also features a seating area that accommodates up to 12 seats. The floor plate is organized by three circulation paths converging into the reception/community areas. The main circulation paths parallel to the reception area are relatively wide and serve as the main connector to the largest meeting room with a view to the park. Building perimeter is strategically populated with open workspace areas in addition to several meeting spaces. Support spaces, like copy and print area, are situated within the building core, giving an equitable access for all employees. Workspace areas are divided into small neighborhoods of 8-12 seat groupings with a small central gathering area in each workstation neighborhood. Enclosed rooms are located either along the building core or the end of workspace areas, which maximized visual connectivity within the open workspace area. Natural daylight is evident along the workspace areas along the building perimeter, however feel sparse in the building core.

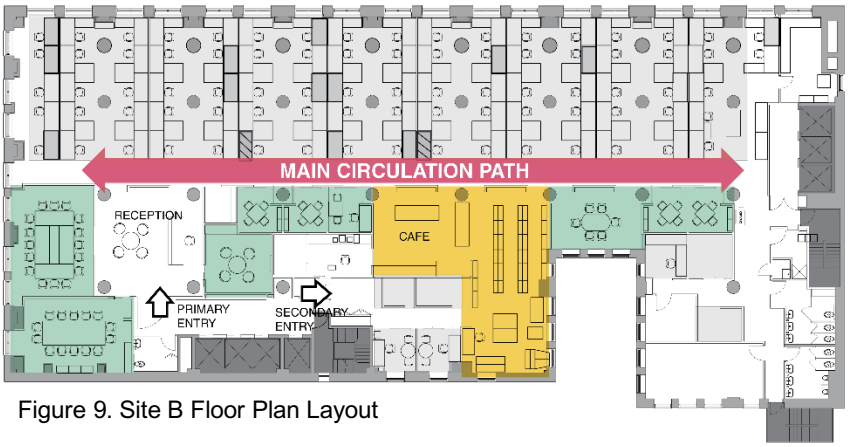


Figure 9. Site B Floor Plan Layout

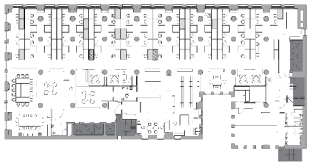
6.1.2. Site B Overview

The building floor plate is an elongated rectangular shape with a fairly narrow and long corridor adjacent to a large open workspace area. A visitor reception area is located nearby main elevator lobby and is surrounded by large client-facing meeting spaces. A full-height partition is utilized to block direct sightline and separate the main workspace area from the visitor reception area. Beyond the partition are rows of workstation neighborhoods that are organized by workplace clusters of approximately 10 seats each. Additional workspace area for a subset of employees is located along the secondary back corridor next to the café and library area highlighted in yellow.

A central café is situated off the main circulation path adjacent to the workspace area and features a kitchenette area with seating for up to 8 seats. Narrow circulation width results in this main avenue's use as a functional hallway and discourages prolonged social interactions along this path. An exposed ceiling structure and shallow floor plate depths allow for a greater sense of openness and visual connectivity in the workspace area. The elongated floor plan layout allows for a centralized access of community space and an equal distribution of shared spaces.

6.2. Comparison of Floor Plan Layouts and Workplace Metrics

In addition to qualitative analysis of floor plan layout, a square footage take-off and space counts were evaluated using common industry metrics to understand the provisioning of individual, collaborative, and community spaces, all to evaluate how these built spaces may have an influence on walking and sedentary behavior. Factors included in the floor plan analyses include: area measurement, location, footprint per seat, collaborative ratio, community spaces ratio, and other qualitative attributes of floor plate. AutoCad software was used to calculate square footage area, space counts, and distance between workspace areas to the community spaces.



		Site A	Site B
Building Design Attributes	**Building**	Large modern office space (n=200) in a recently renovated class-A building with a view to adjacent public park	Medium-sized office (n=80) in a minimally updated class-B building
	Floor Location	6th floor (in a 38-story high-rise historic building)	4th floor (in a 20-story mid-rise historic building)
	Floor Plate Size	Approximately 22,640 USF	Approximately 17,255 SF
	Layout/ Configuration	L-shaped floor plate with main entry and café space serve as the 'connector' of workspace 'wings'.	Narrow rectangular floor plate with shared spaces band running through lower half portion of floor.
	Access to Stairs	Limited accessibility, emergency stairs only available for descending the stairs.	Accessible to employees, close proximity and high-visibility from elevator lobby.
Workplace Metrics	**Number of Seats**	174 workplace seats	94 workplace seats
	Density (USF/seat)	130 USF/seat	184 USF/seat
	Workstation Size	36 SF (6' x 6' footprint)	42 SF (6' x 7' footprint)
	Collab. Seats	72 collaborative seats	52 collaborative seats
	Collab. Seats Ratio	1 : 2.4 workplace seats (one collaboration seat for every 2.4 workplace seats)	1 : 1.8 workplace seats (one collaboration seat for every 1.8 workplace seats)
	Community Space Allocation (Size, Number of Seats, % of seats)	440 SF / 12 seats 7% of total seats	410 SF 8 seats / 8.5% of total seats
	Proportion of Community Space	2.5 SF/seat Approximately 1.94% of total floor plate	4.4 SF/seat Approximately 2.4% of total floor plate
Community Distance	**Shortest Distance** (From Workspace to Community)	20 feet	10 feet
	Furthest Distance (From Workspace to Community)	210 feet	124 feet

Figure 10. Overview of Site Design Attributes

6.2.1. Building Design Attributes Comparison

Site A and Site B have fundamental differences in the types of building and access to staircases. Site B have a significant smaller floor plate, at a 25% lesser footprint than Site A, with a simpler floor-plate organization. Site B also features a direct accessibility to the emergency staircase, in comparison to limited staircase access in Site A. These building attributes may have an impact on the way occupants perceive their workspace and the average number of stairs climbed among the two site occupants.

6.2.2. Workplace Metrics Comparison

Allocation of square feet per seat was calculated by dividing the total usable square feet of floor area by the total number of workplace seats. This USF/seat essentially is a measure of space to accommodate individual, collaborative, and community spaces' share per seat. The density of floor plate in Site A is relatively high at 130 usable square feet per seat in comparison to Site B at 184 usable square feet per seat. GSA workplace benchmarking recommended an optimal workplace density of approximately 190 square feet per person (GSA, 2012).

Consistent with the overall floor density, Site A also has smaller individual workspace footprint at 36 square feet per seat in comparison to Site B's 42 square feet allocated to each individual workstation. Site B also features a higher ratio of collaborative seats per workplace seat. Collaborative seat ratio is calculated by dividing the total number of workplace seats from the total number of seats in all meeting rooms. Industry benchmarking for professional services firms recommends a best practice ratio of 1 collaborative seats for every 2 workplace seats (HOK benchmarking, 2012). Site A has a lower collaboration seat ratio of 1 collaboration seat for every 2.4 workplace seats. Site B has a collaboration ratio of 1 collaboration seat for every 1.85 workplace seats. The

greater availability of collaboration seats allows for increased access of alternative work spaces in addition to the availability of individual desks, which may encourage physical movement from one space to another.

Community spaces are defined as café space or gathering point that is shared among workplace occupants. Sizing and availability of central community spaces were measured by two key areas: 1) size as measured by the square footage of space, 2) total number of community space seats and percentage of seats compared to the total number of workplace seats, 3) proportionate share of community space (in square foot) for each workplace seat. Site A has a central café with approximately 12 seats or equivalent to 7% of the total workplace population. Site B features a central café area that accommodate about 8 seats or equivalent to 8.5% of the total population.

A proportionate share of community space was calculated by dividing the total size of community spaces (in sf) with number of workplace seats. The central café at Site A was measured at approximately 440 square feet in area, which translates to about 2.5 sf of café space allocation per workplace seat. The central café at Site B was at approximately 410 square feet in size, which translates to approximately 4.4 sf of café space allocation per workplace seat. Benchmarking for community spaces in an urban environment recommends a baseline of approximately 5 sf/workplace seat (Gensler, 2014). Comparing overall access to other work spaces and community spaces, Site B has more access to larger individual workspace, more meeting spaces, and larger proportion of café and seats, all within smaller floor plate, which may have an impact in how users utilize their workspace. Site A features a larger floor population, with more proximate and smaller individual workspace, fewer meeting spaces and a smaller café.

6.2.3. Distances to Community Spaces Comparison

Location of shared community spaces is hypothesized to have direct contribution to the number of steps and number of times users stand up from their individual seats (Hua et al., 2013). Distances to and from community space were measured by the distance of community spaces to the closest and furthest workplace seats to indicate the range of distance. The central community space at Site A is located about 20 feet away from the closest workspace area and about 210 feet away from the furthest work neighborhoods. The central community space at Site B is located about 10 feet away from the closest workspace area and about 124 feet away from the furthest work neighborhoods. Site B's smaller floor plate and layout have an average half of Site A's distance to any work neighborhoods.

6.3. Comparison of User Flow and Physical Environment Attributes

Behavioral mapping exercise was performed on the first day of observation to understand how building occupants move through the workplace and identify 'hot spots' where activities and movements occur. The behavior mapping and physical environment attributes are comprised of three main components, 1) floor plan analysis of circulation flow to represent anticipated utilization by design (i.e. community spaces, workplace, and support spaces), 2) activities mapping throughout one full day of observation represents the 'actual utilization', and 3) ratings of the physical environment.

6.3.1. Site A Analysis

Site A: Circulation and Anticipated User Flow

Floor plan analysis of Site A highlights a cluster of hot-spot areas where higher traffic is expected based on the location, visibility, and proximity of the shared community spaces. Highlighted areas below in pink marked as 'Library' and 'Meeting' act as the

‘landmarks’ or destination points in the space. The cluster of orange zones represents areas where more social group activities are expected to occur based on the location and intended design of these spaces.

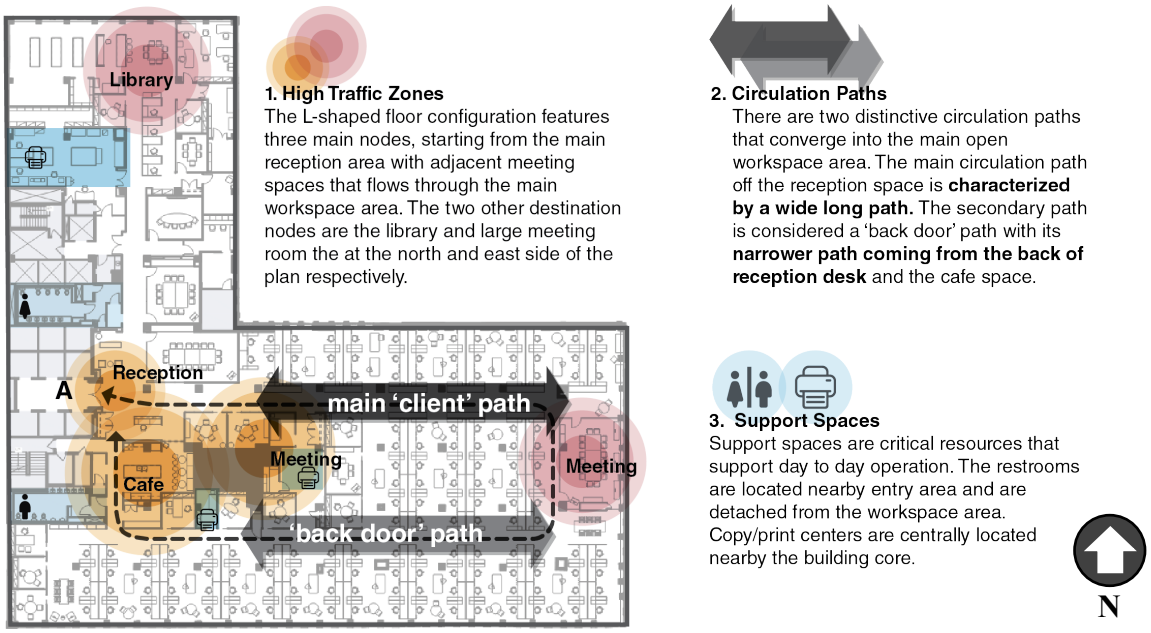


Figure 11. Office A Floor Plan Analysis (Anticipated)

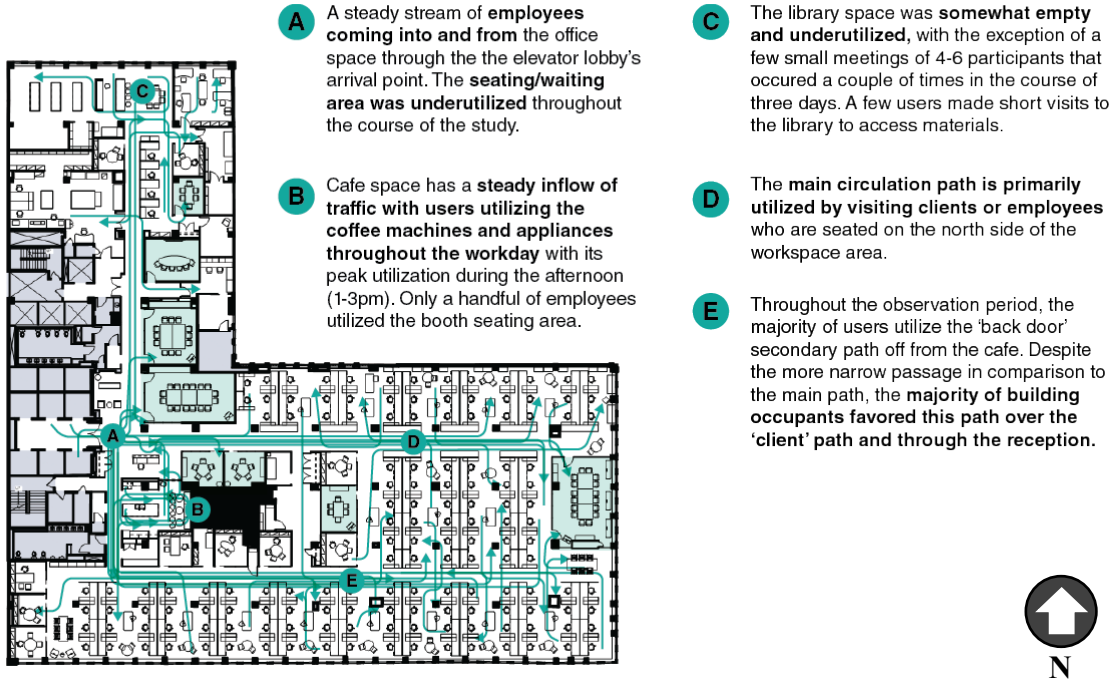


Figure 12. Site A Behavioral Mapping Analysis (Actual)

Site A: Physical Environment Ratings

Behavioral mapping exercise is critical to confirm and compare the floor plan analysis with how users utilize the space. These observations add additional layers of information about how the space is configured or how it affects user behaviors. Contrary to the previous plan analysis, a few of the previously-identified heavy traffic areas in Site B were underutilized, specifically the library area highlighted in the letter C was empty throughout the observation even though it was previously marked as potential 'hot spot' due to its location in the floor. As anticipated, there were significant traffic occurring within the community space area (Including the reception area). This may have been due to the perception of distance and non-visibility of this space from the general workspace area. The secondary circulation path towards the bottom of the floor plan was utilized more often by users than the main circulation path.

Physical Environment Ratings

Building physical environment ratings are used to analyze additional variables that may affect one's decision in utilizing the spaces, which in turn could have an influence in walking and sedentary behaviors. The physical environment ratings measure overall environment quality, interior look and feel, and the physical quality of the building amenities as shown on Table 1. Each building was rated using a measurement criteria list to measure the building's effectiveness in supporting physical movement. Higher score in this rating represents greater user satisfaction that may impact space utilization and physical movement in the work environment.

Site A work environment scored 36 out of 60 possible total score and performed consistently across the Work Environment and Individual Workspace section, except for the Shared Spaces section. Site B work environment outperformed Site A and scored 44 out of 60 possible total score, with a significantly higher score for Shared Spaces

category. Both sites performed similarly under overall work environment measures; Site A performed better under ‘views to the outside’ and ‘circulation path’. Shared spaces section measures visibility, accessibility, and proximity of shared community spaces to the workspace areas. Site A fell short under the visibility and proximity of community spaces, elevators, and stairs. Individual workspace section measures user satisfaction of the work environment that may have an impact on the increased physical movement in the workplace. Site A and Site B performed equally under Individual Workspace category.

Summary of Building Physical Environment Ratings

	Max Score	Site A	Site B
Work Environment	**18**	**13**	**12**
Overall View to the Outside	3	2	1
Daylight Penetration	3	2	3
Ambient environment (Temperature)	3	2	2
Lighting Level	3	3	3
Office Circulation	3	2	2
Circulation Path	3	2	1
Shared Spaces	**21**	**8**	**16**
Visibility of Community Spaces	3	2	3
Proximity of Community Spaces	3	0	2
Visibility of Stairs	3	1	1
Accessibility of Stairs	3	1	3
Visibility of Elevators	3	1	1
Proximity Between Staircase and Elevators	3	2	3
Visibility Between Staircase and Elevators	3	1	3
Individual Workspace	**21**	**15**	**15**
Access to Views	3	2	3
Daylight Penetration	3	3	2
Workstation	3	3	3
Office	3	2	2
Individual Control	3	0	0
Partition Height	3	3	3
Furniture Ergonomics	3	2	2
Total Score	**60**	**36**	**43**

Table 4. Summary of Building Physical Environment Rating

Proximity of Site A to a public park allows for most workspace areas to enjoy the outdoor views. Daylight penetrates through much of workspace areas, except for a portion of employees seated by the wall building perimeter and in the interior spaces. Overall ambient environment was consistent throughout the observation days. Artificial lighting was adequate and comfortable across all workspace areas. The L-shaped floor plate was organized by function of spaces and was efficiently planned to allow for equitable access to shared spaces from any given work area. Circulation path was wide and clearly delineated from individual workspace areas using filing cabinets that divide the two areas. Wide circulation paths enabled users to utilize these paths as breakout areas.

Site A: Work Environment	**13**/18
Overall View to the Outside	**2**/3
2: View of streetscape including exterior buildings and vehicular traffic The majority of workspace areas in Site A benefitted from views to adjacent public park (Bryant Park) and adjacent building's landscapes.	
Daylight Penetration	**2**/3
2: 51-80% of overall office environment receives natural daylight Most of workspace areas have access to natural daylight and operable shades, with the exception to those seated in the windowless areas and interior offices.	
Ambient environment (Temperature)	**2**/3
2: Mostly comfortable with occasional below/above average room temperature Centrally-controlled temperature in the building responds to the outside climate. Throughout the course of observations, the temperature was fairly comfortable with occassional flux of high/low temperature.	
Lighting Level	**3**/3
3: Well lit with sufficient access to artificial lighting The workspace areas were sufficiently lit through overhead ceiling lights and felt comfortable for computer or paper-based task.	
Office Circulation	**2**/3
2: Relatively easy to navigate with no/limited signage The office features limited signage but has clearly-defined and intuitive main circulation paths.	
Circulation Path	**2**/3
2: Wide enough to support some conversations along the path The main circulation path was generous and allows conversations to occur along the open corridor.	

Table 5. Site A: Work Environment Ratings

Shared spaces in Site A are comprised of central café, reception area, client-facing meeting spaces, and the material library. A cluster of shared spaces was located less than two turns away from the workspace. The staircase at Site A was located nearby the elevator lobby, however it was neither accessible nor visible from the elevator lobby area. The elevators serve as the primary means for going up and down the floors and were visible from the reception area.

Site A: Shared Spaces	**8**/21
Visibility of Community Spaces	**2**/3
2: Visible and are located less than 2 turns away from work areas Cafe and conference rooms are centrally located and directly adjacent to the work areas.	
Proximity of Community Spaces	**0**/3
0: Furthest distance from any work areas to the community spaces is more than 150 feet away Distance from the furthest workspace to the cafe is more than 150 feet away.	
Visibility of Stairs	**1**/3
1: Staircase is not visible and located between 3-4 turns away from work areas Staircase is not visible from the work areas and is located about 3 turns away from the workspace.	
Accessibility of Stairs	**1**/3
1: Staircase is somewhat accessible; unlocked or with badge access Staircase is highly accessible and transparent with open doors from the elevator lobby area.	
Visibility of Elevators	**1**/3
1: Elevators are somewhat visible and located between 2 turns away from work areas Elevators are located adjacent to the reception area but not visible from workspace.	
Proximity Between Staircase and Elevators	**2**/3
2: Staircase is located nearby the elevators with visible signage Staircase is in close proximity to the elevator lobby with visible emergency exit signage.	
Visibility Between Staircase and Elevators	**1**/3
1: Staircase is not visible from elevator lobby, located between 3-4 turns away or less Even though in close proximity, the staircase is somewhat secluded and not visible from the elevator lobby.	

Table 6. Site A: Shared Spaces

Given individual workspace's location along the building perimeters, users have access to ample daylight penetration. Individual workstations had ample work surfaces with ability to host a guest in the workstation. The offices are equipped with a work wall and a large work surface that multi-functioned as a guest meeting table, with an ability to host up to two guests. User adjustability over the ambient environment was not available; lighting and temperature were centrally-controlled. Partition height was at seated-height privacy, offering balance between individual privacy and openness of the workplace.

Site A: Individual Workspace	**15**/21
Access to Views	**2**/3
2: Distance to window between 11-20 feet Average distance from any workspace areas to windows were between 11-20 feet. The distance across all workspace ranged from 0 - 50 feet.	
Daylight Penetration	**3**/3
3: Sufficient access to daylight with access to shades The majority of individual workspace areas have access to adequate daylight and could utilize operable shades to control daylight penetration.	
Workstation	**3**/3
3: Multiple work surfaces with ample storage and separate small meeting area The workstation features a secondary workspace return that could also function as a storage unit or guest seating. On every workspace cluster, a central team meeting area was available.	
Office	**2**/3
2: Multiple work surfaces with ample storage and/or a guest chair The office space features a main work surface that functions as a meeting table in addition to an elongated work surface for layout space.	
Individual Control	**0**/3
0: Temperature/lighting is centrally-controlled and is not adjustable Temperature and lighting are centrally controlled and cannot be adjusted by users.	
Partition Height	**3**/3
3: Partition height provides seated-height visual enclosure or less The workstations have a seated height privacy, which allows for a physical and peripheral visual barrier between a workstation to another workstation across.	
Furniture Ergonomics	**2**/3
2: Height-adjustable desk or ergonomic chair with some adjustability The individual workspace areas consisted of a fixed desk and secondary work surface in addition to an adjustable ergonomic chair.	
Site A Total	**36**/60

Table 7. Site A: Individual Workspace

Site A Interview Insights

Participants reported that emergency stairs were restricted from the lobby level, which confirmed the low stair utilization. Emergency staircase is only available for exit to the ground level/lobby. Perception of access limitation and discouragement from building management have prompted an 'elevator culture' in the office. Some noted that many of their colleagues were not even aware of the location of emergency stairs.

Participants also reported high satisfaction towards the ambient work environment, particularly the natural daylight, building sustainability components, and adjustability of windows. Location of community spaces at a central location is desirable, café space was mostly utilized for informal conversations and short coffee breaks. A couple individuals mentioned that it was challenging to have an alienated destination workspace (the library) at one end of the L-shaped floor, which has resulted in minimal library use. One reported that employees rarely used this space unless required to given the perception of distance and being disconnected with the rest of the workplace.

Overall, interview participants were satisfied with the workspace layout and availability of spaces. Informal meeting spaces located in each work neighborhood were utilized frequently by groups. Individuals reported that stand-up meetings at bar-height counter were highly desired and highly utilized. Four individuals from Site A were interviewed to represent diverse functions within the organization: administrative functions (librarian and administrative assistant), architecture, and design. At the time of interview, most individuals had been with the company at least two years except for one with a three-month tenure. Most individuals reported that their job functions require them to be physically active throughout the day for a

variety of reasons, such as: traveling for on-site or off-site meetings or performing administrative tasks (copy or printing). Group concurred that day-to-day physical movement in the workplace was largely depended on job functions and specific project needs. Individuals from interior design and architecture background have more similar workstyles and spent most of their time working on computer at their desk with occasional meetings throughout the day. The administrative assistant tends to have a more internally-mobile workstyle and move around the office throughout the day. The librarian has a split workstyle between focus and mobile workstyle both in and outside the office and spent most of the workday on either on-site meetings or working at the library.

Site A: Fieldwork Images

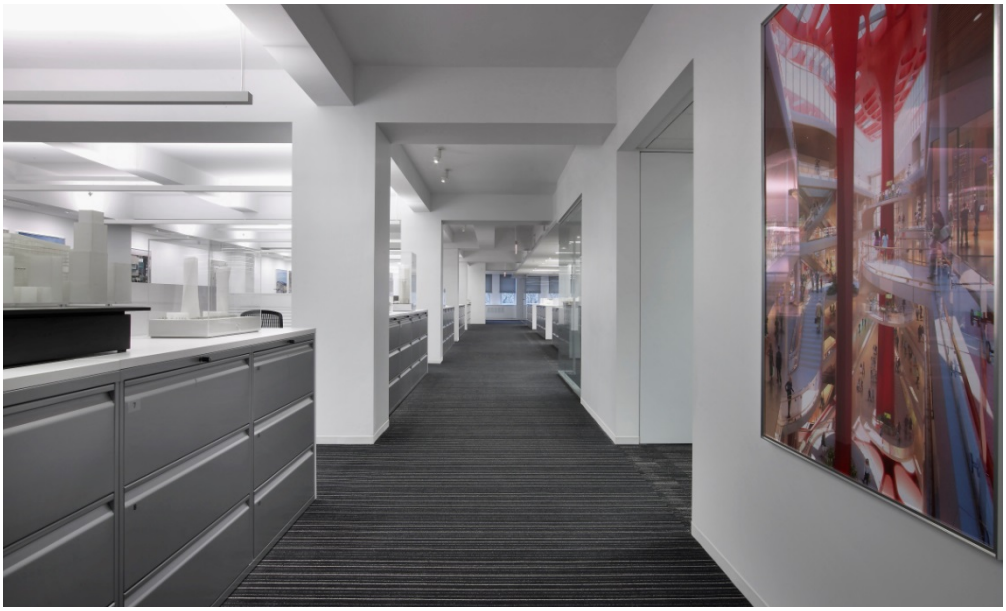


Image 1. Site A: Underutilized wide circulation paths

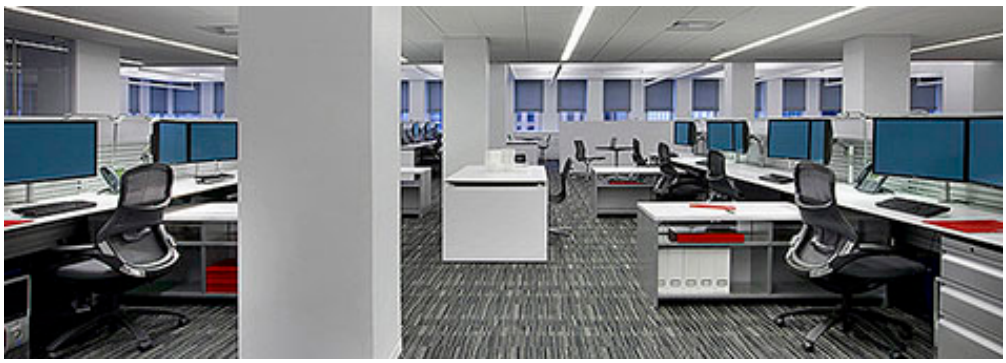


Image 2. Site A: Open workspace areas with adjacent meeting spaces

Image 3. Workstation neighborhood with a central team meeting area

Image 4. Inaccessible Emergency Staircase Adjacent to the Reception Area

6.3.2. Site B Analysis

Site B: Circulation and Anticipated User Flow

Floor plan analysis of Site B highlights more dispersed hot-spots or areas throughout the floor where higher traffic is anticipated. The pink areas highlighted potential highly-utilized spaces based on the size and design intent of the meeting spaces. The orange areas represent stops in-between the main and secondary circulation paths.

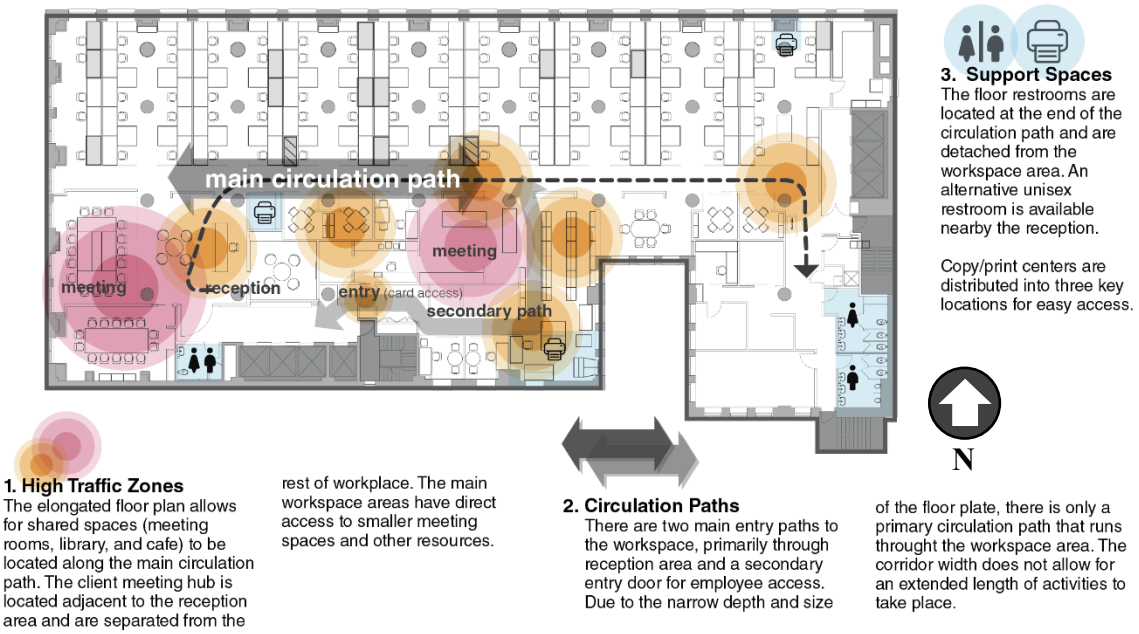


Figure 13. Office B Floor Plan Analysis

Site B: Activities Mapping

Site B main circulation path was highly-utilized during the observation period. This aligns with the initial floor plan analysis that highlighted hot spots in the middle section of floor plan nearby café and meeting spaces. The secondary paths and orange zones by the library area were utilized more sparingly throughout the day. Overall the space utilization aligns consistently with the design intent and flow of the floor.

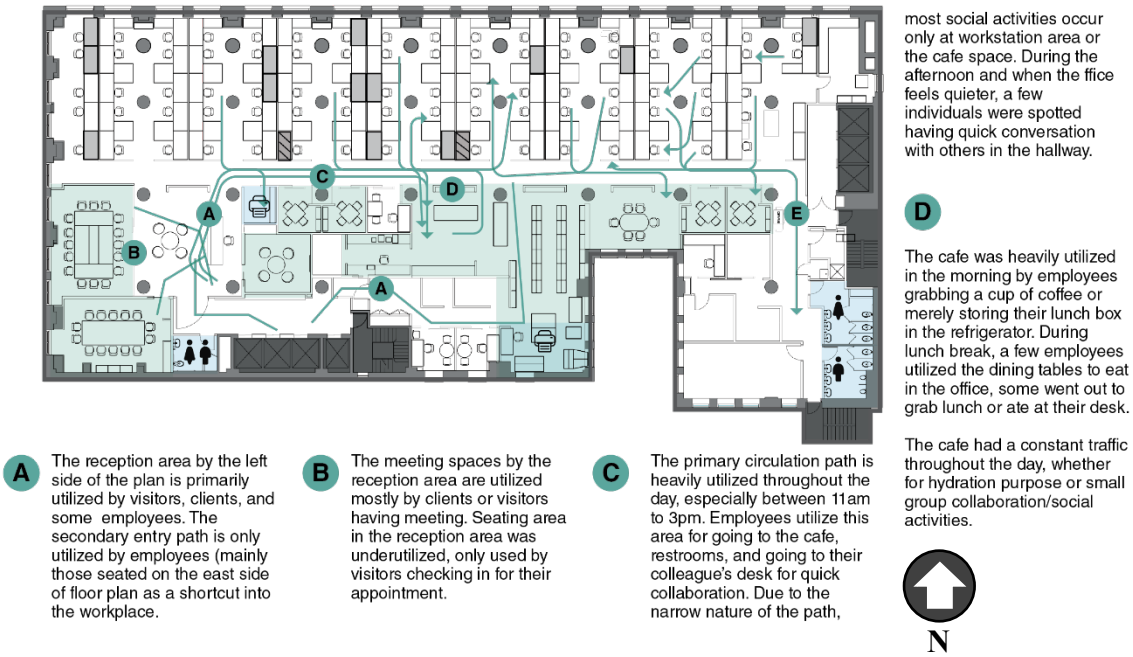


Figure 14. Office B Behavior Mapping Analysis

Site B: Physical Environment Ratings

Site B was located approximately five minutes away from a nearby public park. The site does not have an immediate adjacency to an open outdoor space. The main workspace area has a view to an adjacent building that was positioned directly behind, which limited the quality of daylight coming into the space. The elongated, shallow workspace areas provided an opportunity for more than 80% of office occupants to have access to natural daylight. The ambient environment was reasonably comfortable with an occasional flux of temperature due to the building HVAC system. Artificial ambient lighting was adequate throughout the workspace area. The office circulation was simple and intuitive to navigate even with no significant signage or wayfinding tools. Main circulation path was clearly defined however was narrow in width, therefore discouraging users from congregating around this area.

Site B: Work Environment	12/18
Overall View to the Outside	**1**/3
1: View of parking lot, exterior wall of adjacent building All workspace areas have views to an adjacent building. Due to the narrow street blocks, the view to the outside was fairly static.	
Daylight Penetration	**3**/3
3: >80% of overall office environment receives natural daylight All workspace areas has access to natural daylight and operable windows.	
Ambient environment (Temperature)	**2**/3
2: Mostly comfortable with occasional below/above average room temperature Centrally-controlled temperature in the building responds to the outside climate. Throughout the course of observations, the temperature was fairly comfortable with occassional flux of high/low temperature.	
Lighting Level	**3**/3
3: Well lit with sufficient access to artificial lighting The workspace areas were sufficiently lit through overhead ceiling lights and felt comfortable for computer or paper-based task.	
Office Circulation	**2**/3
2: Relatively easy to navigate with no/limited signage The office features limited signage but has clearly-defined and intuitive main circulation paths.	
Circulation Path	**1**/3
1: Narrow and is inadequate for interactions to occur The corridor features a functional path however was fairly narrow and discouraged conversations to occur.	

Table 8. Site B: Work Environment

Shared spaces in Site B is consisted of main client meeting spaces, reception area, and the central café that was connected to the material library. Central café and material library areas were situated at the center of workplace environment, allowing equal access for all users. Due to the smaller floor footprint, community spaces were conveniently located no more than 100 feet away from any given desk. A highly visible emergency staircase was located directly adjacent to the elevator waiting area and served as a primary staircase. The elevator lobby was in direct proximity to and was visible from the reception area; this made it a ‘default’ option for both visitors and staff.

Site B: Shared Spaces	16/21
Visibility of Community Spaces	**3**/3
3: Highly-visible and immediately adjacent to work areas Cafe and conference rooms are centrally located and directly adjacent to the work areas.	
Proximity of Community Spaces	**2**/3
2: Furthest distance from work areas to the community spaces is 50-100 feet away Distance from the furthest workspace area to the cafe is at 100 feet.	
Visibility of Stairs	**1**/3
1: Staircase is not visible and located between 3-4 turns away from work areas Staircase is not visible from the work areas and is located about 3 turns away from the workspace.	
Accessibility of Stairs	**3**/3
3: Staircase is highly-accessible; transparent, unlocked, has no door/open doors Staircase is highly accessible and visible from the elevator waiting area.	
Visibility of Elevators	**1**/3
1: Elevators are somewhat visible and located between 2 turns away from work areas Elevators are located adjacent to the reception area but not visible from workspace.	
Proximity Between Staircase and Elevators	**3**/3
3: Staircase and elevators are directly adjacent to each other Staircase is directly adjacent to the elevator lobby, encouraging users to take stairs whilst waiting for elevators.	
Visibility Between Staircase and Elevators	**3**/3
3: Staircase is highly visible from the elevator lobby Staircase opens up to the elevator lobby and is highly visible.	

Table 9. Site B: Shared Spaces

The majority of Site B respondents have access to outside views and daylight through perimeter windows. Workstations featured multiple work surfaces and had a seated-height privacy panel. Offices were compact, smaller in footprint in comparison to Site A offices, but featured similar office components: work desk, storage unit, and a meeting table. Furniture ergonomic adjustability was consistent with Site A, featuring a fixed desk spine and a secondary work surface.

Site B: Individual Workspace	15/21
Access to Views	**3**/3
3: Distance to window < 10 feet Average distance from any workspace areas to windows were less than 10 feet. The distance across all workspace ranged from 0 - 30 feet.	
Daylight Penetration	**2**/3
2: Sufficient access to daylight without shades causing occasional glares The majority of individual workspace areas have access to adequate daylight however have occasional glares from the daylight.	
Workstation	**3**/3
3: Multiple work surfaces with ample storage and separate small meeting area The workstation features a shared secondary workspace return. On every workspace cluster, a central team meeting area was available.	
Office	**2**/3
2: Multiple work surfaces with ample storage and/or a guest chair The office space is very compact however features an adequate single work surface in addition to small table for one additional person.	
Individual Control	**0**/3
0: Temperature/lighting is centrally-controlled and is not adjustable Temperature and lighting are centrally controlled and cannot be adjusted by users.	
Partition Height	**3**/3
3: Partition height provides seated-height visual enclosure or less The workstations have a seated height privacy, which allows for a physical and peripheral visual barrier between a workstation to another workstation across.	
Furniture Ergonomics	**2**/3
2: Height-adjustable desk or ergonomic chair with some adjustability The individual workspace areas consisted of a fixed desk and secondary work surface in addition to an adjustable ergonomic chair.	

Site B Total **43**/60

Table 10. Site B: Individual Workspace

Site B Interview Insights

Participants across different work functions reported consistent workstyles of a mix of focus work and meetings throughout the day, with the exception of the architects and designers who were more tethered to their desk. While the group reported that their job does not require them to walk frequently, participants were aware of the

issue of sedentary behavior in the workplace. They indicated that some individuals make conscious efforts to walk and move more throughout their work day. Average people in this office choose stairs as the first option for descending given its prominent location next to elevators as well as elevator speed and waiting time. However, participants mentioned that narrow stair treads and perception of physical safety have led some users opting for elevators as their first option for vertical transportation. Other factors that encouraged users to move around the workplace include: unregulated office temperature (too cold or to hot) and the proximity of bathrooms or community spaces. Participants suggested a few ideas to encourage physical movement, such as: providing more variety of work spaces, larger community spaces as 'anchors' for activities, and the ability to adjust the height of workstations.

Interview participants indicated that café and corridor are typically highly utilized for having informal conversations. However, some reported that given the limited corridor width, informal conversations could feel disruptive to the surrounding work areas. It was also observed that information conversations rarely occurred in these circulation space. Individual workspace areas with a central table were used for team meetings or focus work that requires a larger work surface. Social events and activities were typically held at the central café and adjacent material library area. Central café was seen as a convenient location and provided desired functionality for group activities. Meeting spaces and phone rooms were also heavily utilized for phone calls and in-person meetings at least 3-4 times a day by each team. Some reported that teams frequently utilized these spaces as a 'war' room for project team members to use for an extended period of time.

Site B interview participants were comprised of five different job roles, namely: architect, marketing director, project manager, strategy consultant, and design director. For streamlining interview insights, these job functions were categorized into the following: architecture, professional services (strategy consultant), management (project manager, design director, marketing director). Participants represent a range of work tenure, ranging from two weeks through 7 years with the company. Average tenure was 5 years. On average, interview participants are mobile, some reported flexible workstyle of being in the office for 4 days a week and when they are in the office, spent about 50-70% of their time at my desk and the rest of their time at meetings and on the go.

Site B: Fieldwork Images

Image 5. Site B: Entrance and Lobby Area

Image 7. Main Circulation Paths along the workpace areas

Image 6. Site B: Open Workspace Areas directly adjacent to the Community Spaces

6.4. Survey Demographics Overview

Due to the nature of paper-based survey, participants could skip questions they did not feel comfortable answering. Demographic questions some respondents chose not to answer, such as: gender, BMI, and weight. Results reported below in this section are only comprised of answered responses unless noted otherwise.

6.4.1. Gender

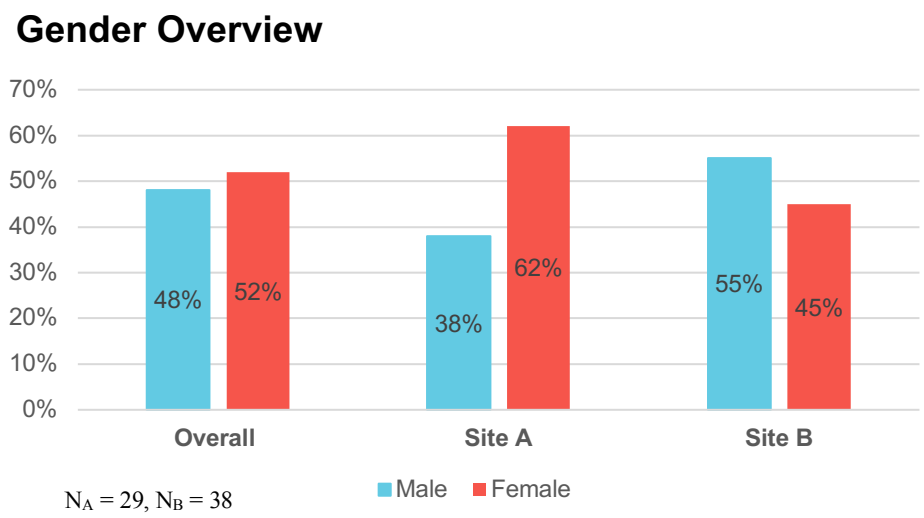


Figure 15. Gender Groups

About 71 respondents participated in this study and came from two distinct site locations, Site A (n=29) and Site B (n=38). About 95% of participants responded to the gender question (n=67). Among those who responded, there is an even distribution of male and female respondents at 48% males and 52% females. Inverse composition of males and females was observed among the two research sites. Site A has a higher female population at 62% (n=19) in comparison to site B at 45% (n=17). The difference in sample sizes, Site B with significantly larger sample size, may have led to the disproportioned genders. Overall the sampling represents an even proportion of both genders and is deemed sufficient for generalization to a broader population.

6.4.2. Age

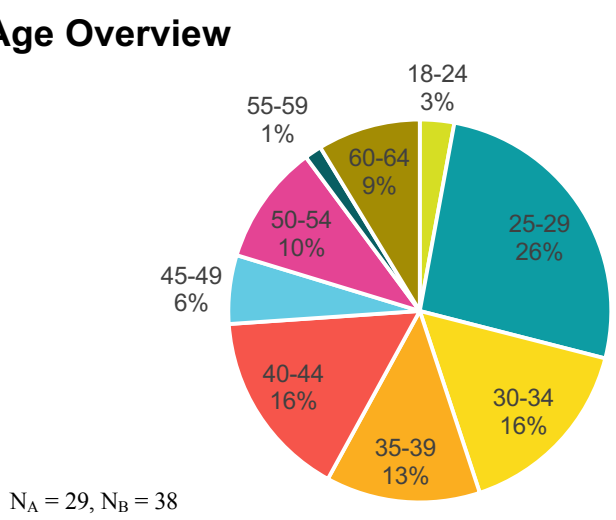


Figure 16. Age Groups

Variety of age groups were represented with an even distribution of age groups. 3% of respondents aged between 18-24 years old (n=2), 26% between 25-29 years (n=18), 16% between 30-34 years (n=11), 13% between 35-39 years (n=9), 16% between 40-44 years (n=11), 10% between 50-54 years (n=7), 1% between 55-59 (n=1), 9% between 60-64 (n=6), and 0% respondents above 65 years (n=0). Percentage of 25 - 29-year-old group at 26% is almost doubled the average of other age groups. The high number of younger population may be due to selection bias of those who may be more interested and have a higher awareness of the sedentary behavior topic. The age groups data was filtered by building to narrow down potential generational differences across both sites.

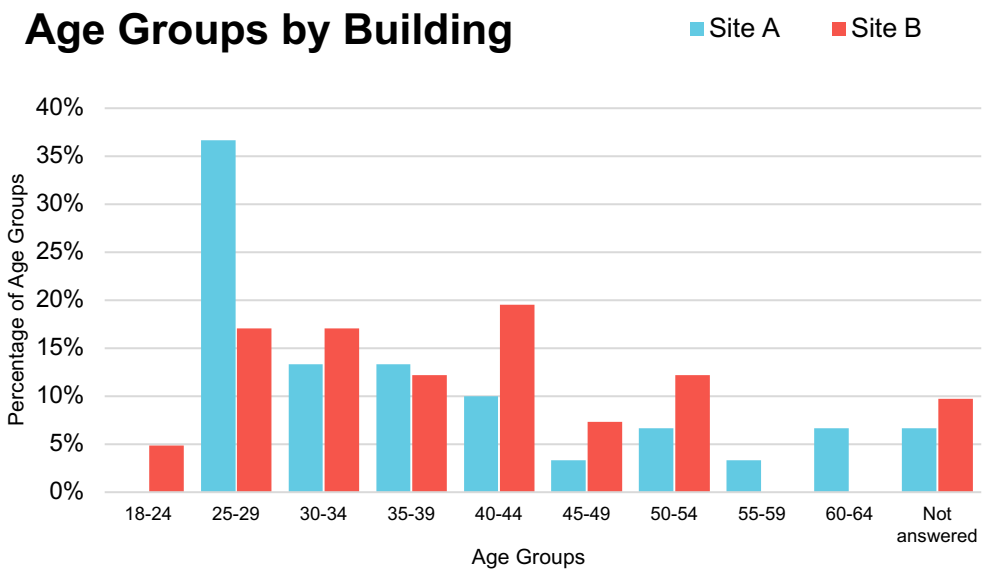


Figure 17. Age Groups by Building

Site A has a significantly higher percentage of 25-29 age group at 37% (n=11) compared to those in Site B at 17% (n=7). Site B has a more equal distribution of age groups from 18 through 54 years. Site A has higher percentage of 35-39 group (13%, n=4), 55-59 group (3%, n =1), and the 60-64 group (7%, n=2). Only Site B has a group from age 18-24 (5%, n=2). Site B has higher percentages of 30-34 group (17%, n=7), 40-44 group (20%, n=8),45-49 (7%, n=3), and 50-54 group (12%, n=5). About 7% Site A respondents (n=2) and 10% Site B respondents chose to not answer the question.

6.4.3. Generation

One approach to understand generational expectations is to filter age groups based on their corresponding generational segments, namely: Millennials, Gen X, Baby Boomers, and Traditionalist. Millennials were defined as individuals who were born in or after 1984 or were at the age of 29 years old or younger in 2013. Gen X was defined as those who were born between 1969 and 1983 or aged between 30 and

44 years old in 2013. Baby Boomers were defined as individuals who were born between 1949 and 1968 or aged between 45 and 64 years old in 2013. Traditionalists were defined as those who were born on or before 1948 or aged older than 65 years old in 2013.

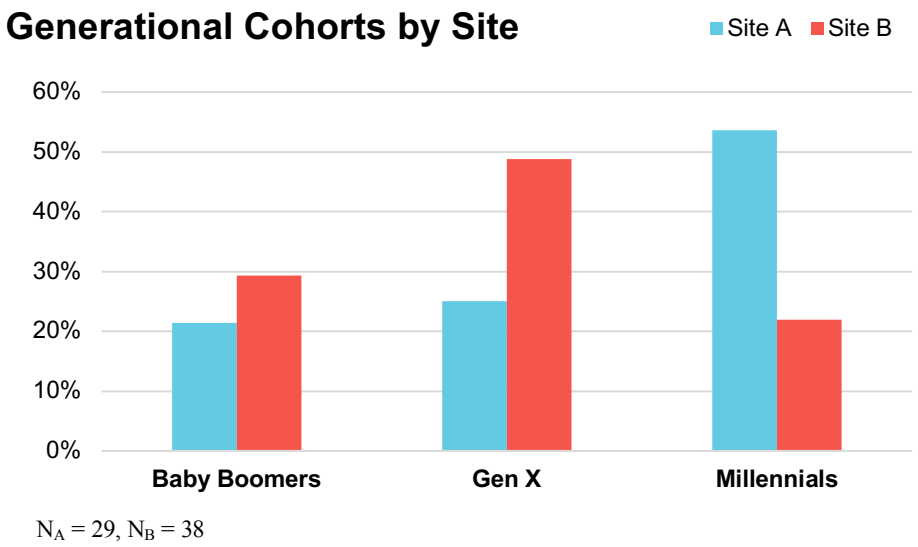


Figure 18. Generational Cohorts by Site Chart

Key Demographic Variables	Site A		Site B		Chi Square
	n	%	n	%	
Generation	**27**	**100.00%**	**41**	**100.00%**	
Baby Boomers	6	21.43%	12	29.27%	0.0226
Gen X	7	25.00%	20	48.78%	
Millennials	14	53.57%	9	21.95%	

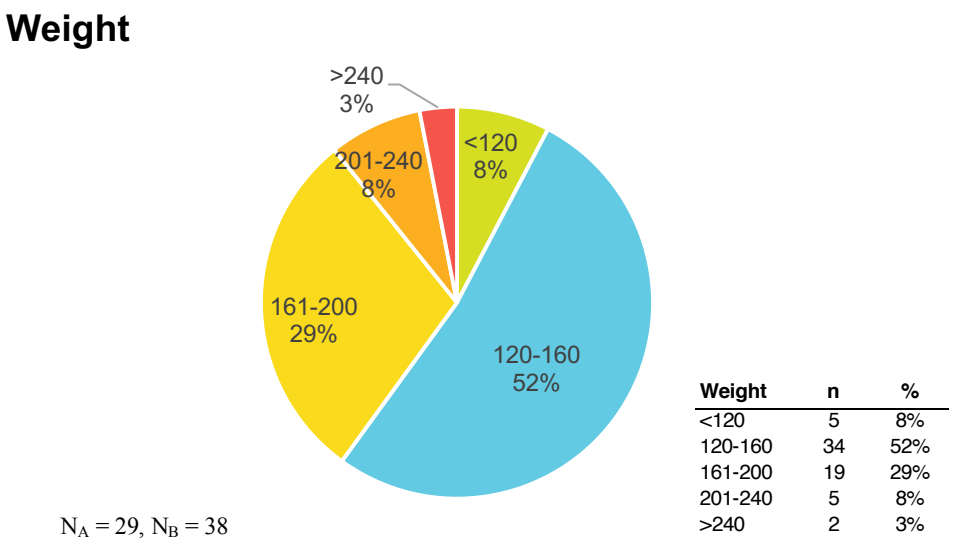
Figure 19. Generational Segments by Site Table

Site A respondents consisted of a large proportion of Millennials at 54% (n=14), followed by Gen X group at 25% (n=7), Baby Boomers at 21% (n=6), and not answered at 7% (n=2). Site B respondents were comprised of predominantly Gen X group at 49% (n=20), followed by Baby Boomers at 29% (n=12), and Millennials at 22% (n=9). None of the respondents from both sites were categorized as

Traditionalist. The breakdown of generational groups may be representational of the architecture industry demographics.

6.4.4. Weight and BMI

Most respondents, at sixty percent, weighed below 160 pounds (n=39). Eight percent of individuals weighed less than 120 pounds (n=5). Thirty-four percent of sample weighed between 120-160 pounds (n=34), twenty-nine percent weighed between 161-200 pounds (n=19), eight percent weighed between 201-240 pounds (n=5), and three percent weighed more than 240 pounds (n=2).



Weight	n	%
<120	5	8%
120-160	34	52%
161-200	19	29%
201-240	5	8%
>240	2	3%

Figure 20. Weight Groups

Only 86% of participants indicated their Body Mass Index (BMI) score in the survey (n=61). The average BMI score among those who answered is 24.35, which is significantly below national average at 26.6.

The min, median, and max BMI score are 17.9, 23.8, 36.7, respectively among all participants across both sites. A standard World Health Organization guidelines of obesity level based on of BMI score <18.5 as underweight, 18.5-24.99 normal, ≥25

overweight, and ≥30 obese were applied. Most samples, at 62%, are within the healthy weight category (n=38), 28% was categorized as 'overweight' (n=17), and 10% was 'Obese' (n= 6). The percentage of 'Obese' individuals participating in the study is well-below national obesity average of 34.9%.

Overall BMI and weight level of participants are significantly 'healthier' than national and state average. There are a few factors that may contribute to the relatively healthy sample size: socio and environmental factors, such as: high-educated respondents, geographically located in a highly-walkable urban location, and other cultural factors. Alternatively, this could be a representation of the Architecture/Design industry population profile.

	Site A		**Site B**	
	N	%	N	%
<120	3	4.23%	2	2.82%
120-140	8	11.27%	7	9.86%
141-160	7	9.86%	12	16.90%
161-180	6	8.45%	8	11.27%
181-200	1	1.41%	4	5.63%
201-220	1	1.41%	2	2.82%
221-240	0	0.00%	2	2.82%
>240	1	1.41%	1	1.41%
Not answered	2	2.82%	3	4.23%

Table 11. Weight Comparison by Site

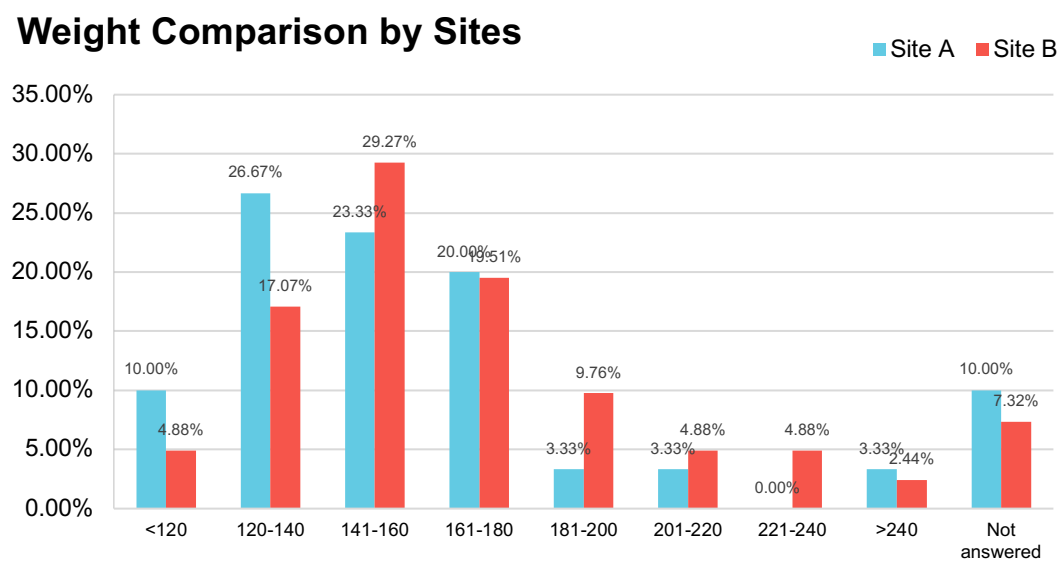


Figure 21. Weight Comparison by Site

Distribution of weight illustrates marginal differences across two sites. Site A has 70% of its of population weighed between 120 and 180lbs, in comparison to 66% of Site B. About 22% of Site B population weighed more than 180lbs, compared to only 10% of Site A population weighed higher than 180lbs. More individuals in Site A weighed less than 120lbs at 10% compared to those of Site B at 5%.

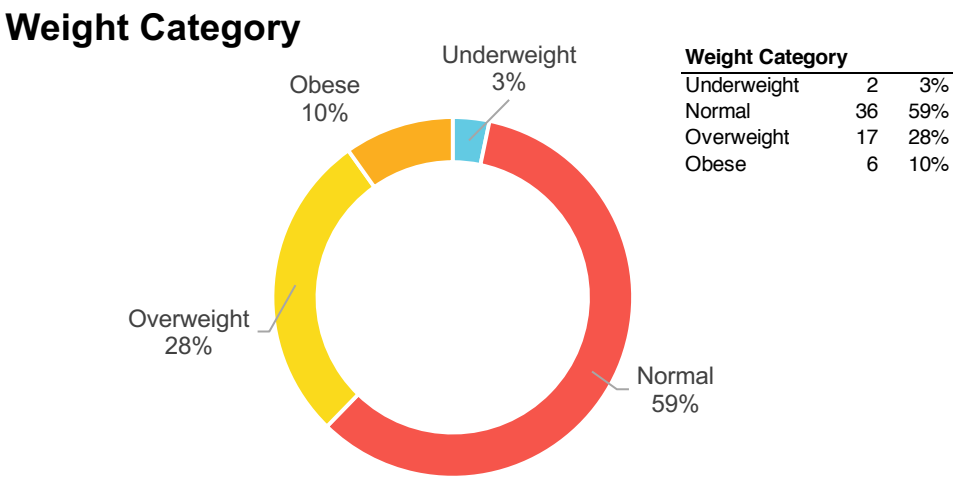


Figure 22. Weight Category

Comparison of weight category across two sites reveal a similar proportion of weight categories. More than 56% (n=17) of Site A respondents are categorized into Normal BMI, compared to 46% those of Site B (n=19). Close to one third of Site A respondents were 'Overweight' (23%) or 'Obese' (7%), compared to 24% of Site B. Site B has higher percentage of 'Overweight' and 'Obese' respondents at 24% and 10% respectively. Overall Site B has a higher number of respondents who were categorized as 'Overweight' and 'Obese' based on the standard World Health Organization guidelines for determining obesity levels.

	Site A		Site B	
	N	%	N	%
Underweight		0.00%	2	4.88%
Normal	17	56.67%	19	46.34%
Overweight	7	23.33%	10	24.39%
Obese	2	6.67%	4	9.76%
Not Answered	4	13.33%	6	14.63%
	30	**100.00%**	**41**	**100.00%**

Table 12. Weight Category Comparison by Site

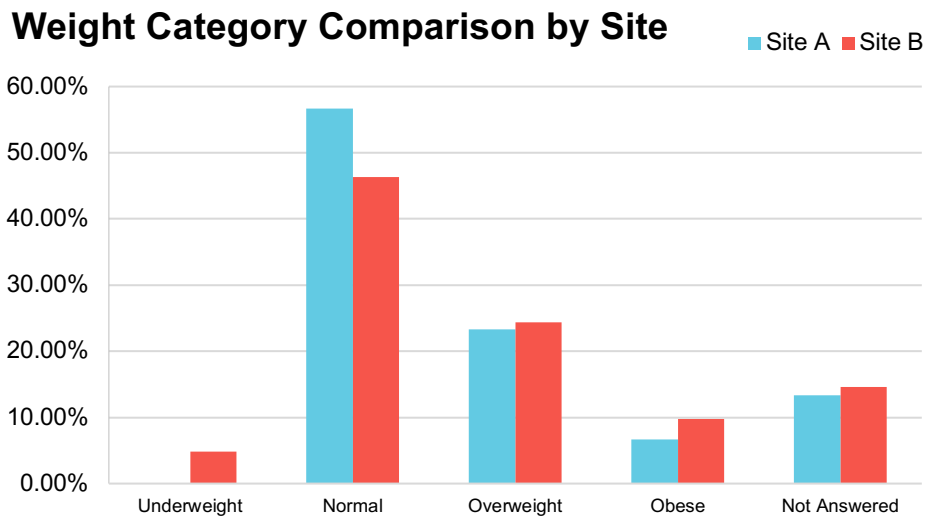


Figure 23. Weight Comparison by Site

A marginal weight disparity was observed between male and female study participants, with a total of 23% of male participants were categorized as ‘Overweight’ and ‘Obese’ in comparison to 15% of their female counterparts. Male participants in the ‘Obese’ weight category was also four times higher than female participants.

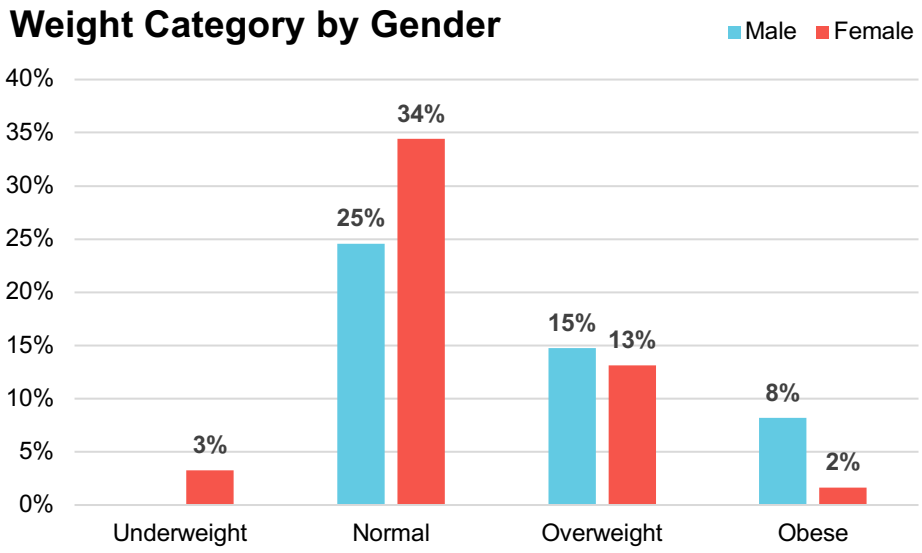


Figure 24. Weight Category by Gender

There were no significant BMI differences among various reported ethnicity/race. Education is observed to have a relationship with weight category. Those who attended less than college degrees (n=5) were all classified under ‘Overweight’ or ‘Obese’ category.

High School/Associate	**3**	**5%**
Overweight	2	3%
Obese	1	2%
College-level	**36**	**59%**
Underweight	1	2%
Normal	22	36%
Overweight	9	15%
Obese	4	7%
Post-Graduate	**22**	**36%**
Underweight	1	2%
Normal	14	23%
Overweight	6	10%
Obese	1	2%

Figure 25. Weight Categories by Education Level

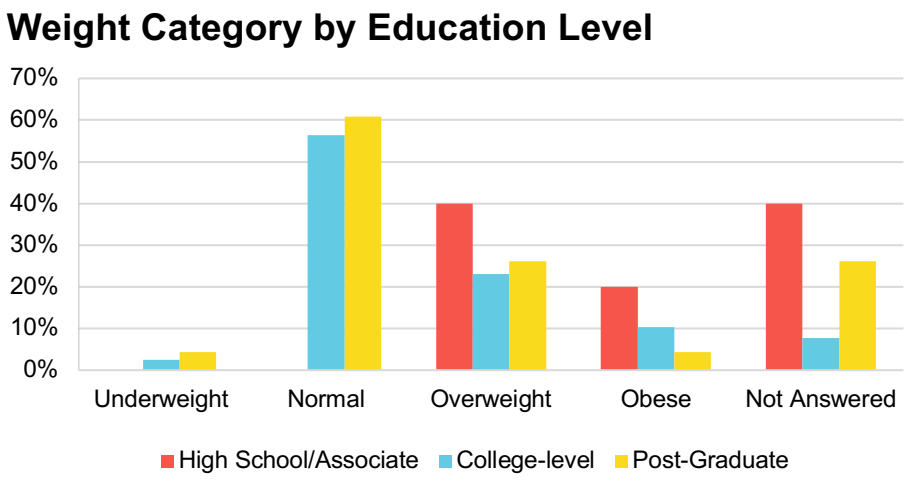


Figure 26. Weight Category by Education Level

Key Demographic Variables	Site A		Site B		Chi Square
	n	%	n	%	
Education	**29**	**100.00%**	**38**	**100.00%**	
High School/Associate	4	13.79%	1	2.63%	0.1804
College-level	14	48.28%	25	65.79%	
Post-Graduate	11	37.93%	12	31.58%	

Figure 27. Education Comparison by Site

6.4.5. Education

Four respondents did not respond to the education question, leaving a total of 67 respondents included in this analysis. The majority of respondents, at 85%, indicated Bachelor and Post-Graduate as their highest level of education (n=57), with Post-Graduates and Bachelors at 34% (n=23) and 51% (n= 34), respectively. Seven percent of participants attended some college (n=5) in addition to four percent received an Associate degree (n=3). One percent of participants reported high school as their highest level of education (n=1) and another percent attended some high school education (n=1) before entering the workforce.

Education		
Some high school or less	1	1%
High School	1	1%
Associate	3	4%
Some College	5	7%
Bachelor	34	51%
Post-Graduate	23	34%

Table 13. Education

Race/Ethnicity		
White	49	75%
Asian	8	12%
Black/African American	2	3%
Hispanic	2	3%
Other	4	6%

Table 14. Race/Ethnicity

6.4.6. Race/Ethnicity

Participants represent diverse ethnicities, with 75% White (n=49), followed by 12% Asian (n=8), 3% Black/African American (n=2), 3% 'Hispanic' (n=2), 6% other ethnicities (n=4).

6.4.7. Building and Workspace Tenure

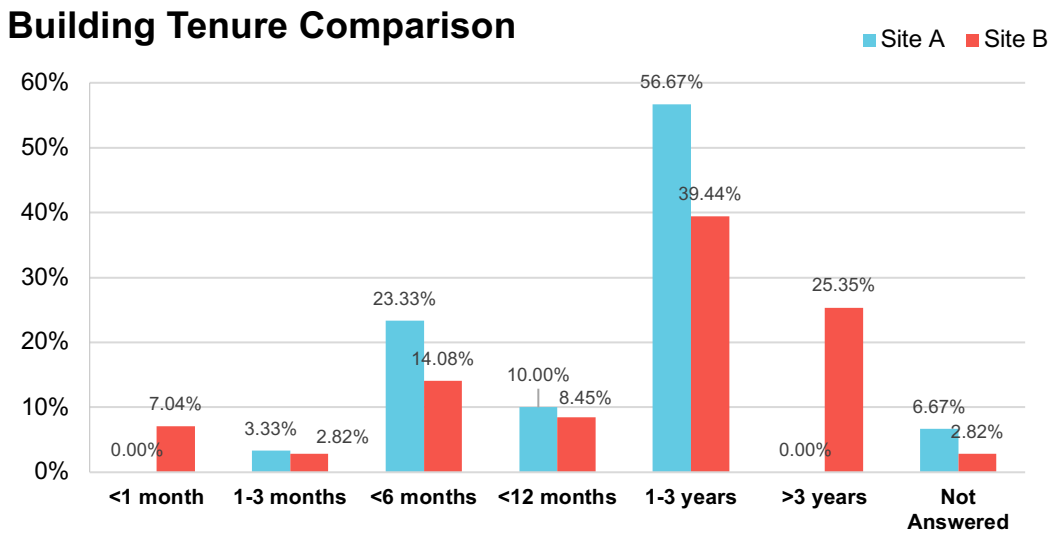


Figure 28. Length of Time Working in the Building

	Site A	Site B
<1 month	0.00%	7.04%
1-3 months	3.33%	2.82%
<6 months	23.33%	14.08%
<12 months	10.00%	8.45%
1-3 years	56.67%	39.44%
>3 years	0.00%	25.35%
Not Answered	6.67%	2.82%

Table 15. Length of Time Working in the Building

More than half of Site A respondents have spent one to three years working in the building and about a a third have spent less than one year in the building. Most Site B respondents, at 65%, had spent more than one year in the building, the remaining third of respondents have spent less than one year working in the building. A small proportion of Site B respondents, at 10%, had only been in the building for less than 3 months. Given Site A's recent relocation, the majority of occupants may have still

been adjusting to the new workplace.

Length of Time in the Workspace

	Site A		Site B	
< 2 weeks	0	0.0%	3	7.3%
<1 month	1	3.3%	3	7.3%
1-3 months	5	16.7%	6	14.6%
<6 months	1	3.3%	9	22.0%
<12 months	0	0.0%	7	17.1%
1-3 years	7	23.3%	6	14.6%
>3 years	14	46.7%	7	17.1%
Not answered	2	6.7%	0	0.0%

Table 16. Length of Time Working in the Workspace

Length of time spent in individual workspace or desk was utilized to confirm individual workplace habits to ensure that reported physical movement in the space was a true reflection of how users would naturally respond to the built environment. About 47% of respondents from Site A had spent more than 3 years in the workspace, 23% spent about 1-3 years, 17% spent 1-3 months, and 3% spent less than 6 months and less than one month each. Site B has a more distributed range of workspace occupancy tenures, with the largest proportion of groups occupying their workspace for less than six months (22%).

There is a misalignment between time spent in the building and time spent in the workspace among Site A respondents. Most respondents from Site A spent more than three years in their workspace (at 47%) in addition to some spent between one to three years in the building at 23%. These averages are much higher than average of time spent in the building among six-month tenure group. This misalignment in averages may be attributed to measurement error, in which users may have understood the question differently. These respondents may have interpreted the question about the length of time spent in the workspace more broadly as a question about their length of employment.

6.5. User Satisfaction

6.5.1. Building Performance and Satisfaction

As mentioned in the previous section, participants could skip survey questions they did not feel comfortable answering. Results reported below in this section are only inclusive of those who answered to the questions unless noted otherwise.

More than half of the participants across two buildings reported satisfaction with the overall building and the interior environment with 30% (n=21) reported they were 'very much' satisfied and 29% (n=20) were 'somewhat satisfied'. About 24% (n=17) feel 'neutral' or indifferent about their spatial environment. Only about 17% respondents indicated dissatisfaction: 13% (n=9) felt 'somewhat not' satisfied and 4% (n=3) indicated they were 'not at all' satisfied.

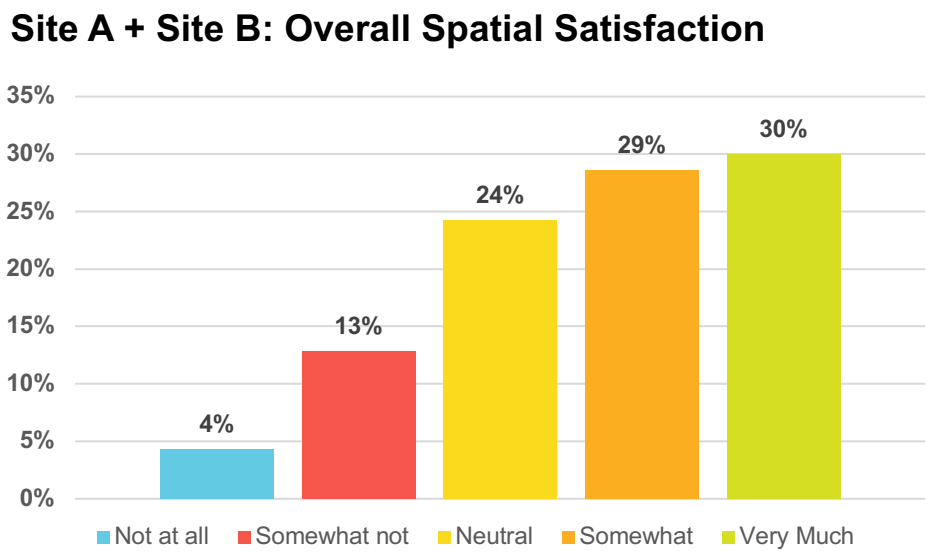


Figure 29. Overall Spatial Satisfaction

About 57% (n=17) of Site A respondents were 'very much' satisfied, 20% (n=6) 'somewhat' satisfied and 'neutral' respectively, and 4% (n=1) 'somewhat not' satisfied with the spatial environment. Respondents from Site B at 10% (n=4) were

'very much' satisfied, 35% (n=14) felt 'somewhat' satisfied, 28% (n=11) were 'neutral', and 8% (n=3) 'not at all' satisfied with the spatial environment.

When comparing spatial satisfaction between the two buildings, Site A has a significantly higher satisfaction rate compared to those of Site B. Most Site A respondents, at more than three out of four reported positive satisfaction with the spatial environment. High spatial satisfaction in Site A may be attributed to the 'newness' nature of the workplace after recent relocation.

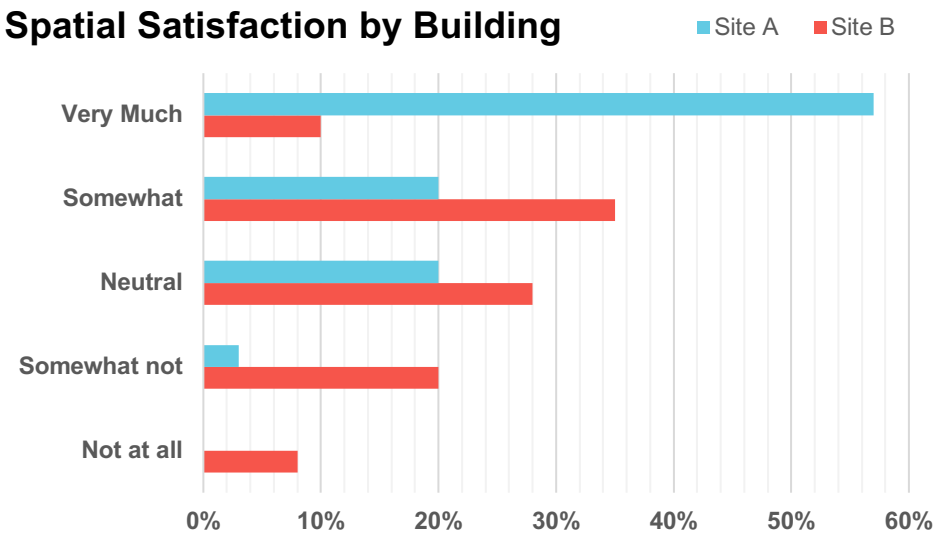


Figure 30.Spatial Satisfaction Between Buildings

Spatial Satisfaction	Avg	Site A	Site B
Not at all	4%	0%	8%
Somewhat not	13%	3%	20%
Neutral	24%	20%	28%
Somewhat	29%	20%	35%
Very Much	30%	57%	10%

Table 17. Spatial Satisfaction Comparison

The average overall satisfaction between the two buildings is 3.67 (n=70) with SD=1.16. The min, median, max was 1.00, 4.00, and 5.00, respectively.

The average spatial environment satisfaction for Site A is significantly higher (mean of 4.30) in comparison to that of Site B (mean of 3.20). This aligns with the median,

min, max comparison of the two sites. Site A has a min of 2.00 ('not satisfied') and a median of 5.00 ('very satisfied'), which indicates many users were highly satisfied with their building. Site B has a min of 1.00 ('very dissatisfied') and a median of 3.00 ('neutral').

The average score of the "spatial environment's ability to support work" between the two buildings is 3.84 (n=70) with SD=1.02. The min, median, max was 1.00, 4.00, and 5.00, respectively. The average score of "spatial environment's ability to support work" was marginally higher than that of the environmental satisfaction, however the distribution of min, median, and max were comparable. The average rating for Site A is higher (mean of 4.33) in comparison to site B (mean of 3.48).

Site A has a min of 3.00 ('neutral') and a median of 5.00 ('very satisfied'), indicating a significantly higher rating than Site B. Site B has a min of 1.00 ('very dissatisfied') and a median of 4.00 ('somewhat satisfied').

	Average	Min	Median	Max
Overall Spatial Satisfaction				
Both sites	3.67	1.00	4.00	5.00
Site A	4.30	2.00	5.00	5.00
Site B	3.20	1.00	3.00	5.00
Spatial Environment's Ability to Support Work				
Both sites	3.84	1.00	4.00	5.00
Site A	4.33	3.00	5.00	5.00
Site B	3.48	1.00	4.00	5.00

Figure 31. Overall Building Satisfaction (average and by site)

To dive deeper on specific attributes of the work environment, the survey utilizes multiple Likert-scale sections to assess user perception of their job and work environment. Likert-scale questions, measuring agreement level, were focused on statements pertaining about work environment components that may have impact on sedentary behaviors in the workplace. Ratings were reported on a 5-point Likert scale, with score of 1 being "Strongly Disagree", 2 being "Disagree", 3 being

"Neutral", 4 being "Agree", and 5 being "Strongly Agree". Full sample statistical analysis was provided for this section.

The questions about work environment component included were focused around: Overall Work Environment, Individual Workspace, Ambient Environment, Ergonomics, Personal Habits, Job Satisfaction, Pantry, Copy/Printer station, Conference Rooms, and Informal Meeting Spaces.

6.5.2. Overall Work Environment Ratings

Overall work environment section was comprised of ten main statements that describe and measure the effectiveness, efficiency, usage, and availability of spaces. In general, Site A user satisfaction was higher than those of Site B across all aspects of the overall work environment.

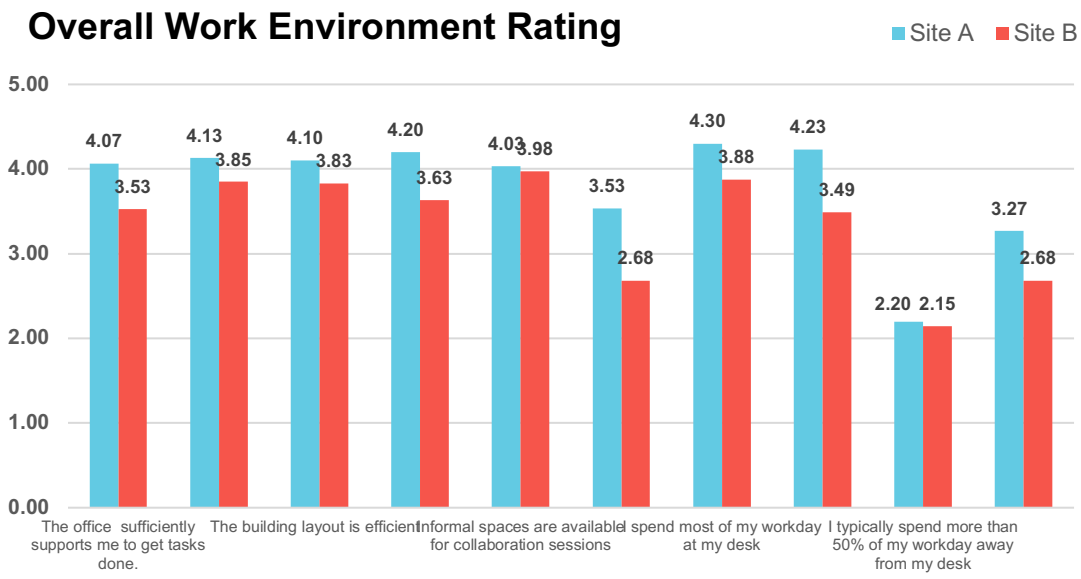


Figure 32. Overall Work Environment Ratings

Among all overall work environment ratings, the highest disparity of user satisfaction rating lies on the environment's ability to 'motivate users to spend more time in the

office' and its ability to 'support collaborative work'. Ratings across 'availability of informal spaces' and 'typically spend 50% of my workday away from my desk' were almost equivalent among the two sites.

More than 4 out of 5 respondents from both sites reported that they spent most of their workday at their desk, about 90% and 82% of respondents from Site A and B respectively. 60% of respondents from site A indicated that the office design motivates them to spend more time in the office, about five times higher than those of Site B (12%).

Line of communications between teams were rated more effectively among Site A respondents. Ninety-percent of Site A respondents reported the design support effective communications, compared to 67% among Site B population. Collaborative work was better facilitated at Site A (at 90% satisfaction rate), while only 69% of Site B respondents were satisfied with their team collaboration. Aligned with the previous statement, respondents from Site B also indicated lower satisfaction in the office's ability to support concentration work at 26%, compared to those of Site A reporting 50% satisfaction.

Overall Work Environment		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The office environment sufficiently supports me to get tasks done.	Combined Avg	1.43%	10.00%	14.29%	60.00%	14.29%
	Site A	0.00%	6.67%	13.33%	46.67%	33.33%
	Site B	2.50%	12.50%	15.00%	70.00%	0.00%
The floor layout is efficient enough for me to get to most spaces.	Combined Avg	0.00%	5.63%	11.27%	63.38%	19.72%
	Site A		3.33%	16.67%	43.33%	36.67%
	Site B		7.32%	7.32%	78.05%	7.32%
The building layout is efficient enough for me to get to most spaces.	Combined Avg	0.00%	0.00%	18.31%	69.01%	12.68%
	Site A			16.67%	56.67%	26.67%
	Site B			19.51%	78.05%	2.44%
The office environment allows me to communicate effectively with my colleagues.	Combined Avg	0.00%	9.86%	12.68%	57.75%	19.72%
	Site A		6.67%	3.33%	53.33%	36.67%
	Site B		12.20%	19.51%	60.98%	7.32%
Informal spaces are available to use for collaboration sessions.	Combined Avg	1.43%	1.43%	11.43%	61.43%	24.29%
	Site A	3.45%	0.00%	10.34%	48.28%	37.93%
	Site B	0.00%	2.44%	12.20%	70.73%	14.63%
The office design motivates me to spend more time in the office.	Combined Avg	7.14%	21.43%	38.57%	21.43%	11.43%
	Site A	6.90%	10.34%	20.69%	34.48%	27.59%
	Site B	7.32%	29.27%	51.22%	12.20%	0.00%
I typically spent most of my workday at my desk.	Combined Avg	0.00%	7.04%	7.04%	59.15%	26.76%
	Site A		3.33%	6.67%	46.67%	43.33%
	Site B		9.76%	7.32%	68.29%	14.63%
The office environment supports collaborative work.	Combined Avg	0.00%	9.86%	16.90%	56.34%	16.90%
	Site A		0.00%	10.00%	56.67%	33.33%
	Site B		17.07%	21.95%	56.10%	4.88%
I typically spend more than 50% of my workday away from my desk.	Combined Avg	25.35%	50.70%	8.45%	12.68%	2.82%
	Site A	26.67%	50.00%	6.67%	10.00%	6.67%
	Site B	24.39%	51.22%	9.76%	14.63%	0.00%
The office environment supports work that requires concentration.	Combined Avg	9.86%	26.76%	26.76%	33.80%	2.82%
	Site A	0.00%	30.00%	20.00%	43.33%	6.67%
	Site B	17.07%	24.39%	31.71%	26.83%	0.00%

Table 18.Overall Work Environment Ratings

6.5.3. Individual Work Environment Ratings

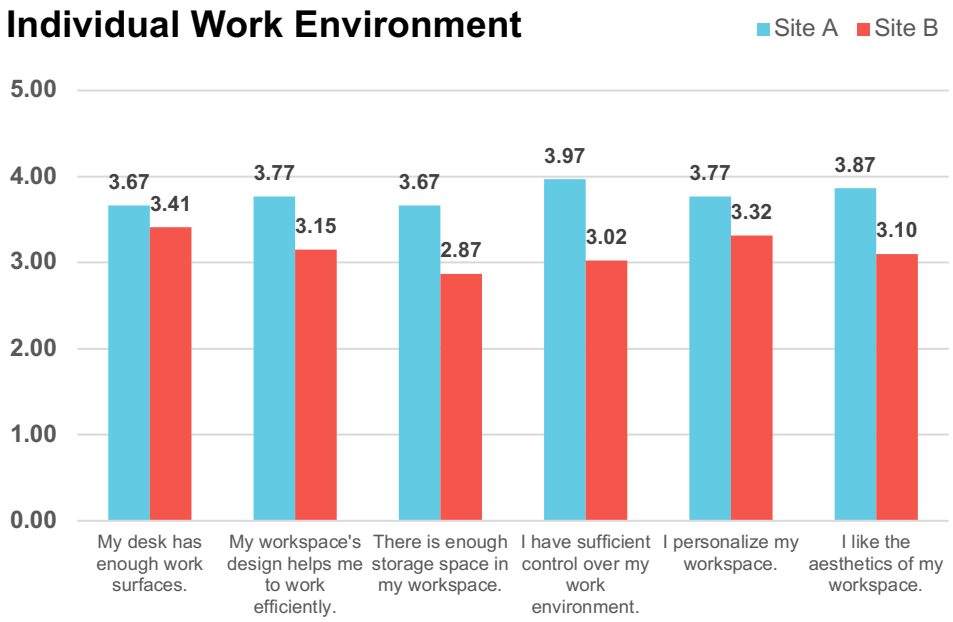


Figure 33. Individual Work Environment Ratings Comparison

Individual Work Environment		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
My desk has enough work surfaces to support my work.	Combined	7.04%	18.31%	8.45%	47.89%	18.31%
	Site A	3.33%	23.33%	3.33%	43.33%	26.67%
	Site B	9.76%	14.63%	12.20%	51.22%	12.20%
The design of my office/workspace helps me to work efficiently.	Combined	1.43%	24.29%	18.57%	42.86%	12.86%
	Site A	0.00%	20.00%	10.00%	43.33%	26.67%
	Site B	2.50%	27.50%	25.00%	42.50%	2.50%
There is enough storage space in my office/work space.	Combined	8.70%	26.09%	15.94%	33.33%	15.94%
	Site A	6.67%	16.67%	10.00%	36.67%	30.00%
	Site B	10.26%	33.33%	20.51%	30.77%	5.13%
I have sufficient control over my work environment.	Combined	4.23%	18.31%	23.94%	38.03%	15.49%
	Site A	0.00%	10.00%	16.67%	40.00%	33.33%
	Site B	7.32%	24.39%	29.27%	36.59%	2.44%
I personalize my office/workspace.	Combined	0.00%	14.08%	30.99%	45.07%	9.86%
	Site A		10.00%	26.67%	40.00%	23.33%
	Site B		17.07%	34.15%	48.78%	0.00%
I like the aesthetics of my office/workspace.	Combined	7.04%	12.68%	23.94%	43.66%	12.68%
	Site A	3.33%	10.00%	13.33%	43.33%	30.00%
	Site B	9.76%	14.63%	31.71%	43.90%	0.00%

Table 19. Individual Work Environment Ratings

Individual work environment satisfaction was measured through questions around the effectiveness, layout, amount of storage and work surface, perceived control, individual personalization, and the look and feel of individual workspace. Site A has an overall higher satisfaction with mostly ‘above average’ ratings than those of Site

B with mostly 'neutral' ratings. Seventy percent of Site A participants were satisfied with the workspace design and its ability to efficiently support work, compared to those from Site B at 45% satisfaction. Storage satisfaction at workstations were averaged at 66% for Site A and 36% for Site B.

Perception of control over the work environment in Site A (73%) is almost doubled those of Site B (39%). Personalization of workspace marginally differs between the two buildings with 63% Site A and 49% of Site B respondents indicated that they personalize their workspace. Almost three-quarter of Site A respondents were pleased with the look and feel of their workspace (both workstation and offices), compared to 44% of those of Site B.

6.5.4. Ambient Work Environment Ratings

Ambient environment was measured through the user perception of indoor air quality, temperature, sick building syndrome, glare, acoustic, outside views, access to daylight, and artificial lighting. Both sites performed similarly under four ambient environment rating variables: sick building syndrome, outside views, daylight access, and temperature control. These variables have increasingly become baseline standard for office buildings and thus explained the consistent ratings. See figure below for detailed reporting of full sample statistics.

Site A reported mixed response on the ventilation and temperature of the office environment at 53% and 50% respectively. Site B respondents reported 41% satisfaction on the ventilation, however a much lower 19% satisfaction for temperature in the workspace was reported. Acoustics were also rated higher among Site A respondents at 23% concerns about office acoustics, compared to much higher 43% complaints among Site B respondents. Lighting control at an

individual level was not available for Site B respondents, with only 27% reported that they have control over lighting at their workspace. Almost 80% of Site A respondents reported control over their lighting. Majority of respondents from both sites reported sufficient artificial lighting in the workplace, at 86% and 76% for Site A and B respectively.

Perception of glares were asked based on the two main sources of glares, daylight and light fixtures. Site A performs better on glares from daylight, with only 13% reported cases, compared to 20% daylight glares from Site B. Site B outperforms Site A in the reported case of lighting fixtures glares, with only 5% respondents reported glare issues, compared to 13% fixture glare issues at Site A.

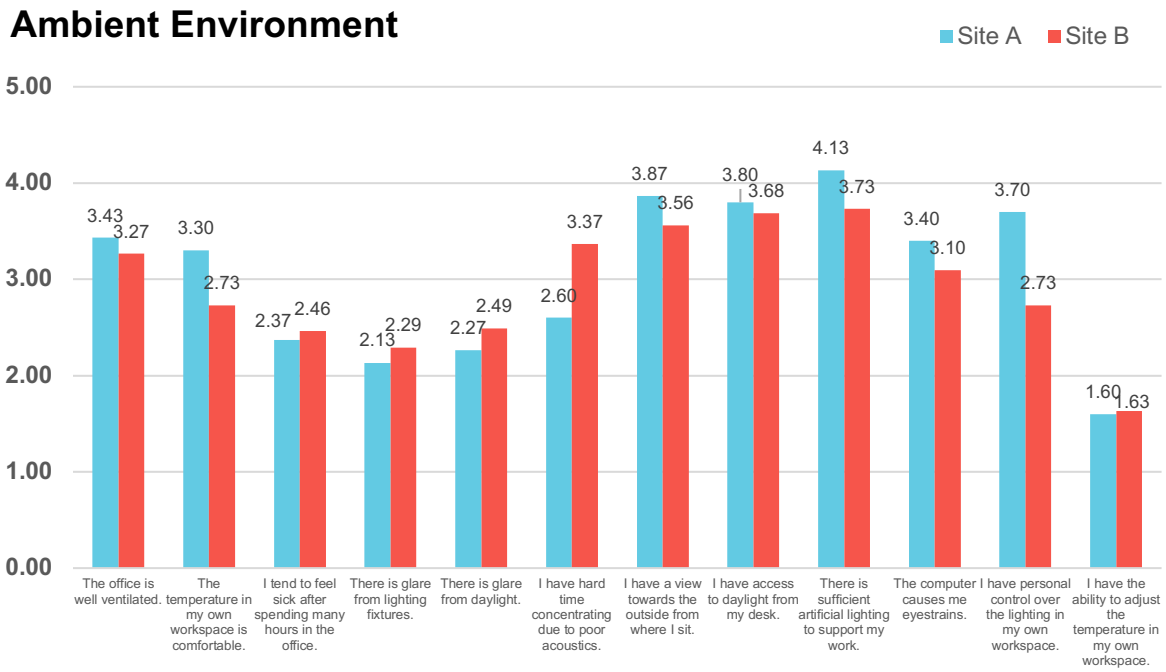


Figure 34. Ambient Environment Ratings Comparison

Ambient Environment		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The office is well ventilated.	Combined Avg	2.82%	19.72%	26.76%	42.25%	8.45%
	Site A	6.67%	23.33%	6.67%	46.67%	16.67%
	Site B	0.00%	17.07%	41.46%	39.02%	2.44%
The temperature in my own office/work space is comfortable.	Combined Avg	2.82%	36.62%	28.17%	25.35%	7.04%
	Site A	6.67%	20.00%	23.33%	36.67%	13.33%
	Site B	0.00%	48.78%	31.71%	17.07%	2.44%
I tend to feel sick after spending many hours in the office.	Combined Avg	14.08%	43.66%	29.58%	11.27%	1.41%
	Site A	23.33%	33.33%	30.00%	10.00%	3.33%
	Site B	7.32%	51.22%	29.27%	12.20%	0.00%
There is glare from lighting fixtures.	Combined Avg	14.08%	59.15%	18.31%	7.04%	1.41%
	Site A	26.67%	50.00%	10.00%	10.00%	3.33%
	Site B	4.88%	65.85%	24.39%	4.88%	0.00%
There is glare from daylight.	Combined Avg	15.49%	47.89%	19.72%	15.49%	1.41%
	Site A	23.33%	43.33%	20.00%	10.00%	3.33%
	Site B	9.76%	51.22%	19.51%	19.51%	0.00%
I have hard time concentrating due to poor acoustics.	Combined Avg	7.04%	28.17%	29.58%	23.94%	11.27%
	Site A	13.33%	40.00%	23.33%	20.00%	3.33%
	Site B	2.44%	19.51%	34.15%	26.83%	17.07%
I have a view towards the outside from where I sit.	Combined Avg	9.86%	9.86%	5.63%	50.70%	23.94%
	Site A	10.00%	6.67%	6.67%	40.00%	36.67%
	Site B	9.76%	12.20%	4.88%	58.54%	14.63%
I have access to daylight from my desk.	Combined Avg	7.14%	8.57%	11.43%	44.29%	28.57%
	Site A	10.34%	6.90%	10.34%	24.14%	48.28%
	Site B	4.88%	9.76%	12.20%	58.54%	14.63%
There is sufficient artificial lighting to support my work.	Combined Avg	4.23%	4.23%	9.86%	60.56%	21.13%
	Site A	6.67%	3.33%	3.33%	43.33%	43.33%
	Site B	2.44%	4.88%	14.63%	73.17%	4.88%
The computer causes me eyestrains.	Combined Avg	5.63%	22.54%	25.35%	36.62%	9.86%
	Site A	10.00%	13.33%	20.00%	40.00%	16.67%
	Site B	2.44%	29.27%	29.27%	34.15%	4.88%
I have personal control over the lighting on own my office/work space.	Combined Avg	9.86%	23.94%	21.13%	32.39%	12.68%
	Site A	6.67%	13.33%	10.00%	43.33%	26.67%
	Site B	12.20%	31.71%	29.27%	24.39%	2.44%
I have the ability to adjust the temperature in my own office/work space.	Combined Avg	50.70%	40.85%	5.63%	1.41%	1.41%
	Site A	53.33%	36.67%	6.67%	3.33%	0.00%
	Site B	48.78%	43.90%	4.88%	0.00%	2.44%

Table 20. Ambient Environment Ratings

6.5.5. Ergonomic Ratings

Ergonomic ratings were measured by the following aspects of workspace: desk and chair functionality, comfort, adjustability, in addition to the availability of personal task lighting. Both sites received comparable ratings for chair adjustability (at 93%) and perception of back and lower back pain (at 37%). Both sites received an above average rating for task chair comfort, functionality, adjustability. Site A ratings outperformed Site B across large proportion of ergonomics variables: 1) chair comfort at 70% compared to those of Site B at 63%, 2) chair's back support at 83%

compared to 73% at Site B, 3) chair's lower back rest support at 70% compared to 54% at Site B, 4) chair's lumbar support at 80% compared to 68% at Site B, 5) desk height at 87% compared to 68% at Site B, 6) availability of personal task light at 93% compared to 58% at site B, 7) ability to swap out chair at 40% compared to 37% at Site B.

Site A respondents also reported higher proportion of users who frequently performed their work standing up at 33% compared to 28% of those from Site B. It was unclear whether a sit-stand option was available to a subset of population in Site A or B as an alternative to the standard fixed desk.

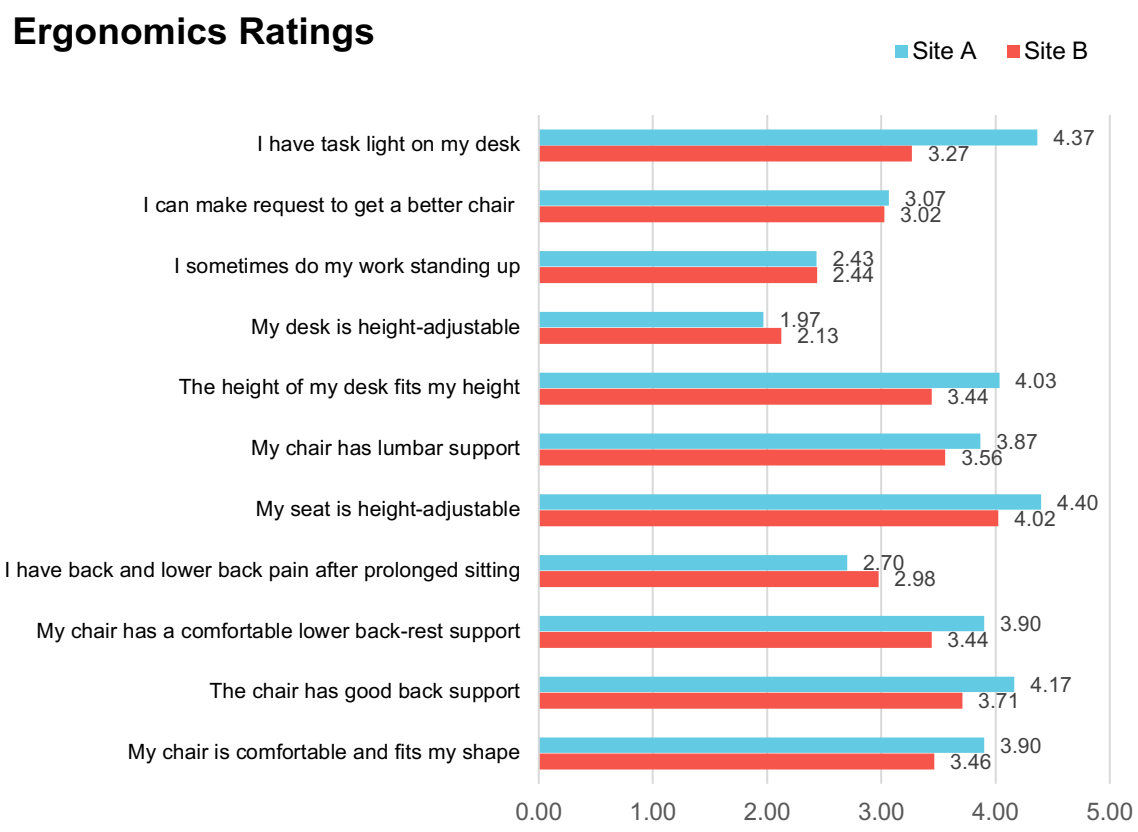


Figure 35. Ergonomics Ratings

Ergonomics		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
My chair is comfortable and fits my shape.	Combined Avg	1.41%	14.08%	18.31%	50.70%	15.49%
	Site A	3.33%	6.67%	20.00%	36.67%	33.33%
	Site B	0.00%	19.51%	17.07%	60.98%	2.44%
The chair back-rest is large enough to provide good back support.	Combined Avg	0.00%	2.82%	19.72%	61.97%	15.49%
	Site A	0.00%	0.00%	16.67%	50.00%	33.33%
	Site B	0.00%	4.88%	21.95%	70.73%	2.44%
My chair has a comfortable lower back-rest support.	Combined Avg	1.41%	9.86%	28.17%	45.07%	15.49%
	Site A	3.33%	6.67%	20.00%	36.67%	33.33%
	Site B	0.00%	12.20%	34.15%	51.22%	2.44%
I experience back and lower back pain after prolonged sitting.	Combined Avg	14.08%	28.17%	21.13%	30.99%	5.63%
	Site A	26.67%	23.33%	13.33%	26.67%	10.00%
	Site B	4.88%	31.71%	26.83%	34.15%	2.44%
My seat is height-adjustable.	Combined Avg	0.00%	1.41%	5.63%	66.20%	26.76%
	Site A	0.00%	0.00%	6.67%	46.67%	46.67%
	Site B	0.00%	2.44%	4.88%	80.49%	12.20%
My chair has lumbar support.	Combined Avg	1.41%	12.68%	12.68%	61.97%	11.27%
	Site A	3.33%	10.00%	6.67%	56.67%	23.33%
	Site B	0.00%	14.63%	17.07%	65.85%	2.44%
The height of my desk fits my height.	Combined Avg	2.82%	12.68%	8.45%	64.79%	11.27%
	Site A	0.00%	10.00%	3.33%	60.00%	26.67%
	Site B	4.88%	14.63%	12.20%	68.29%	0.00%
My desk is height-adjustable.	Combined Avg	37.14%	41.43%	4.29%	12.86%	4.29%
	Site A	43.33%	36.67%	6.67%	6.67%	6.67%
	Site B	32.50%	45.00%	2.50%	17.50%	2.50%
I sometimes do my work standing up.	Combined Avg	23.19%	42.03%	4.35%	28.99%	1.45%
	Site A	30.00%	33.33%	3.33%	30.00%	3.33%
	Site B	17.95%	48.72%	5.13%	28.21%	0.00%
I can make request to have my chair replaced with one that suits me best.	Combined Avg	7.04%	23.94%	30.99%	33.80%	4.23%
	Site A	10.00%	20.00%	30.00%	33.33%	6.67%
	Site B	4.88%	26.83%	31.71%	34.15%	2.44%
I have a task light at my desk.	Combined Avg	4.23%	14.08%	8.45%	50.70%	22.54%
	Site A	0.00%	3.33%	3.33%	46.67%	46.67%
	Site B	7.32%	21.95%	12.20%	53.66%	4.88%

Table 21. Ergonomics Ratings

6.5.6. Satisfaction on Specific Space Attributes

In addition to general ratings on perception of job and physical activities, respondents were also asked about a series of questions pertaining to specific spaces:

Pantry

For each workplace components, respondents were asked to rate its utilization, look/feel, maintenance, and location to understand any factors that may affect how users utilize the space. Respondents from Site B reported higher perceived utilization of pantry space at 88% (n=36) respondents

reported “Strongly Agree” or “Agree” on frequently-utilized pantry, compared to 80% (n=24) agreement in Site A. In contrast, respondents from Site B reported less satisfaction on the availability of sufficient appliances and supplies at 81% (n=33) compared to those from Site A at 90% (n=27). Site B pantry maintenance and cleanliness fell short at 54% satisfaction rate (n=22) compared to 90% satisfaction among Site A respondents (n=27). Almost a quarter of Site A respondents only utilize the pantry during lunch time (n=7); this may be due to the location and proportionate sizing of pantry in Site A. Only about 7% of Site B respondents use pantry exclusively during lunch time (n=4). A few individuals in Site A, about 10%, own their own coffee/tea/fridge in their work area (n=3).

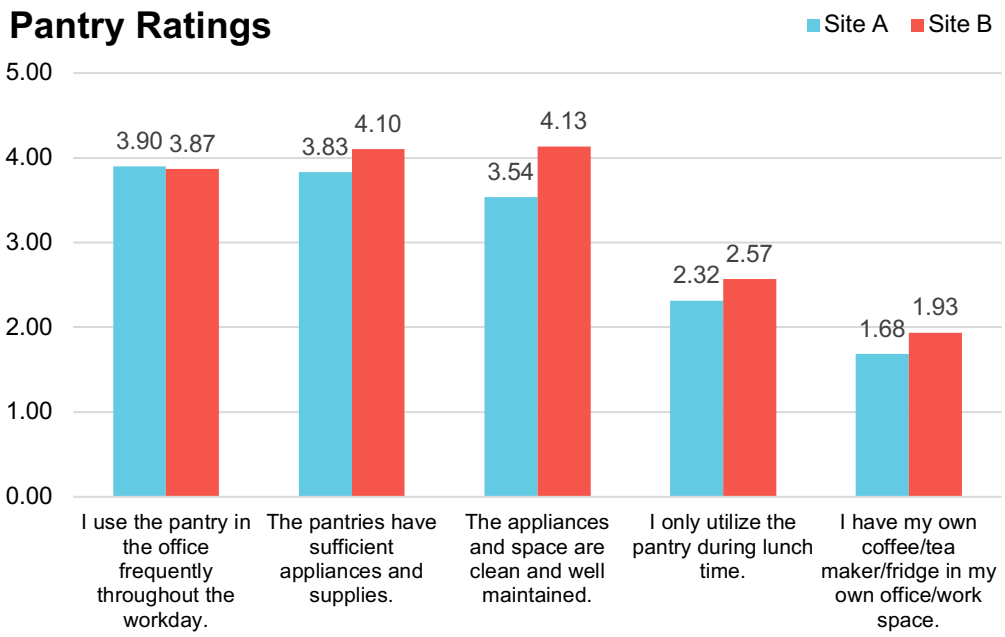


Figure 36. Average Pantry Ratings Comparison

Pantry		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I use the pantry in the office frequently throughout the workday.	Combined Avg	1.41%	4.23%	9.86%	73.24%	11.27%
	Site A	3.33%	3.33%	13.33%	63.33%	16.67%
	Site B	0.00%	4.88%	7.32%	80.49%	7.32%
The pantries have sufficient appliances and supplies.	Combined Avg	0.00%	2.82%	12.68%	71.83%	12.68%
	Site A	0.00%	3.33%	6.67%	66.67%	23.33%
	Site B	0.00%	2.44%	17.07%	75.61%	4.88%
The appliances and space are clean and well maintained.	Combined Avg	1.41%	5.63%	23.94%	50.70%	18.31%
	Site A	3.33%	0.00%	6.67%	60.00%	30.00%
	Site B	0.00%	9.76%	36.59%	43.90%	9.76%
I only utilize the pantry during lunch time.	Combined Avg	7.04%	60.56%	18.31%	11.27%	2.82%
	Site A	10.00%	53.33%	13.33%	16.67%	6.67%
	Site B	4.88%	65.85%	21.95%	7.32%	0.00%
I have my own coffee/tea maker/fridge in my own office/work space.	Combined Avg	38.03%	52.11%	5.63%	1.41%	2.82%
	Site A	36.67%	50.00%	3.33%	3.33%	6.67%
	Site B	39.02%	53.66%	7.32%	0.00%	0.00%

Table 22. Pantry Ratings

Copy/Print Station

About roughly a quarter of respondents from both Site A and Site B reported owning printer in their own office/workspace at 27% and 22% respectively. One out of five Site A respondents felt that the “printer is located too far away” from their seats. In contrary, only one individual from Site B respondents felt that the printer is out of reach. Utilization of printer/copy station is almost equivalent among both locations at 70% and 73% agreement for both Site A and Site B respectively. Perception of job requirements for printing and copying was also similar among Site A at 57% and Site B at 51%.

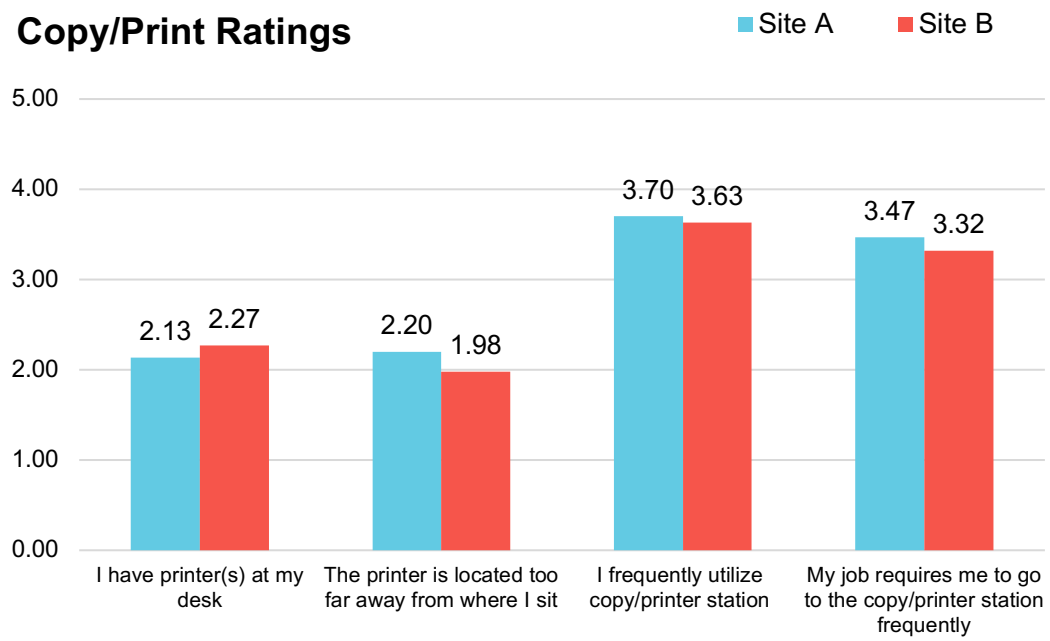


Figure 37. Average Copy/Print Ratings Comparison

Copy/Print Station		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I have printer(s) in my own office/work space.	Combined Avg	32.39%	42.25%	1.41%	19.72%	4.23%
	Site A	43.33%	30.00%	0.00%	23.33%	3.33%
	Site B	24.39%	51.22%	2.44%	17.07%	4.88%
The printer is located too far away from where I sit.	Combined Avg	23.94%	54.93%	11.27%	9.86%	0.00%
	Site A	33.33%	33.33%	13.33%	20.00%	0.00%
	Site B	17.07%	70.73%	9.76%	2.44%	0.00%
I frequently utilize copy/printer station throughout the day.	Combined Avg	2.82%	12.68%	12.68%	59.15%	12.68%
	Site A	3.33%	16.67%	10.00%	46.67%	23.33%
	Site B	2.44%	9.76%	14.63%	68.29%	4.88%
My job requires me to go to the copy/printer station frequently.	Combined Avg	4.23%	18.31%	23.94%	42.25%	11.27%
	Site A	6.67%	13.33%	23.33%	40.00%	16.67%
	Site B	2.44%	21.95%	24.39%	43.90%	7.32%

Table 23. Copy/Print Station Ratings

Conference Rooms

86% of respondents from Site A (n=25) reported that the conference rooms are located within the central area of the office, in comparison to 68% (n=28) of Site B respondents who agreed with the statement. Distribution of conference room spaces was asked whether they think the workspace areas "have equal distance to the conference rooms." Four out of five respondents (at 86%) from Site A agreed with the statement, while much lower percentage of Site B respondents at 46% agreed.

Amount of time spent in conference rooms in a work week varied by individuals with about 28% and 15% respondents from Site A and Site B spent a "great amount of time in conference rooms in a typical work week." Small percentage individuals reported using conference rooms as secondary workspace, at 17% and 22% in Site A and B respectively. View to the outside or the rest of workplace from conference room spaces were highly rated in Site A at 66%, while Site B performed about half as much as Site A at 32%. Both sites also confirmed availability of meeting room reservation system to book meeting spaces.

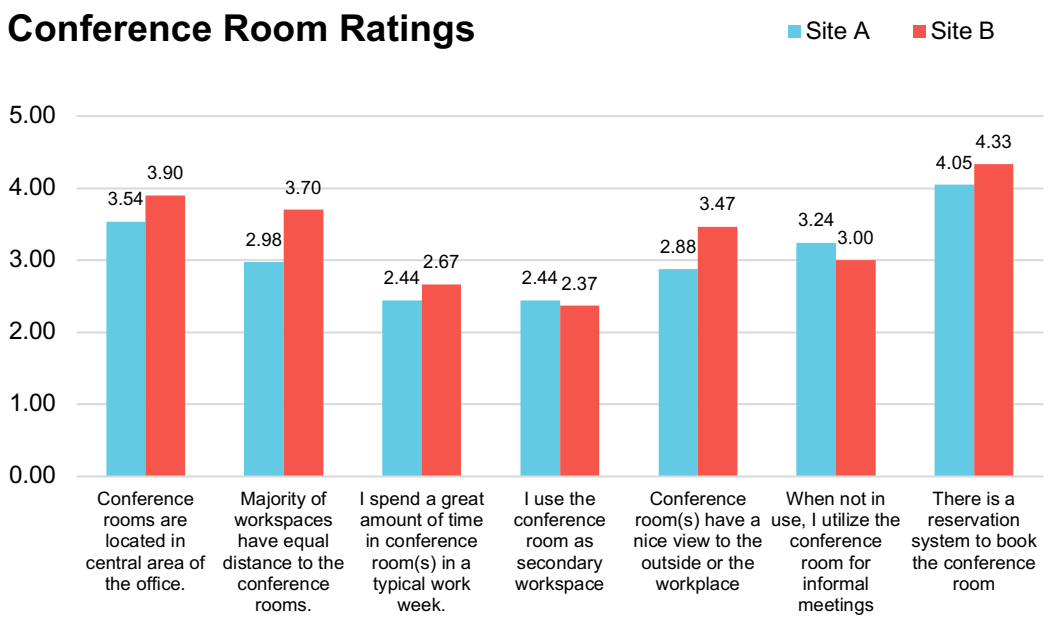


Figure 38. Average Conference Room Ratings Comparison

Conference Rooms		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Conference rooms are located in central area of the office.	Combined Avg	0.00%	10.00%	14.29%	67.14%	8.57%
	Site A	0.00%	3.45%	10.34%	65.52%	20.69%
	Site B	0.00%	14.63%	17.07%	68.29%	0.00%
Most individual offices and work spaces have equal distance to the conference rooms.	Combined Avg	2.86%	30.00%	7.14%	51.43%	8.57%
	Site A	0.00%	17.24%	3.45%	58.62%	20.69%
	Site B	4.88%	39.02%	9.76%	46.34%	0.00%
I spend a great amount of time in conference room(s) in a typical work week.	Combined Avg	10.00%	42.86%	27.14%	20.00%	0.00%
	Site A	10.34%	31.03%	31.03%	27.59%	0.00%
	Site B	9.76%	51.22%	24.39%	14.63%	0.00%
I use the conference room as secondary workspace.	Combined Avg	11.43%	54.29%	14.29%	18.57%	1.43%
	Site A	13.79%	48.28%	20.69%	13.79%	3.45%
	Site B	9.76%	58.54%	9.76%	21.95%	0.00%
The conference room(s) have a nice view to the outside or to the overall work areas.	Combined Avg	4.29%	27.14%	22.86%	38.57%	7.14%
	Site A	0.00%	20.69%	13.79%	51.72%	13.79%
	Site B	7.32%	31.71%	29.27%	29.27%	2.44%
When not in use, I tend to utilize the conference room for informal collaborations.	Combined Avg	8.57%	22.86%	15.71%	47.14%	5.71%
	Site A	10.34%	27.59%	10.34%	44.83%	6.90%
	Site B	7.32%	19.51%	19.51%	48.78%	4.88%
There is a reservation system to book the conference room.	Combined Avg	0.00%	1.43%	2.86%	67.14%	28.57%
	Site A	0.00%	0.00%	0.00%	51.72%	48.28%
	Site B	0.00%	2.44%	4.88%	78.05%	14.63%

Table 24. Conference Room Ratings

Informal Meeting Spaces

More than half Site A respondents (55%) utilize informal meeting spaces for socialization, in comparison to those 48% in Site B. Majority of Site A respondents, at 69%, agreed that “informal meeting areas are centrally

located in the office", while fewer Site B respondents at 46% felt similarly. Several Site A respondents at 35% also utilized the space as secondary work space, compared to only 19% in Site B. Distribution of informal meeting spaces received similar ratings from Site A and B respondents, at 68% and 54% respectively, who believed these spaces are well-distributed. Respondents also agreed that the utilization of these informal meeting space was not consistent across the office and that certain groups utilize these at a higher frequency.

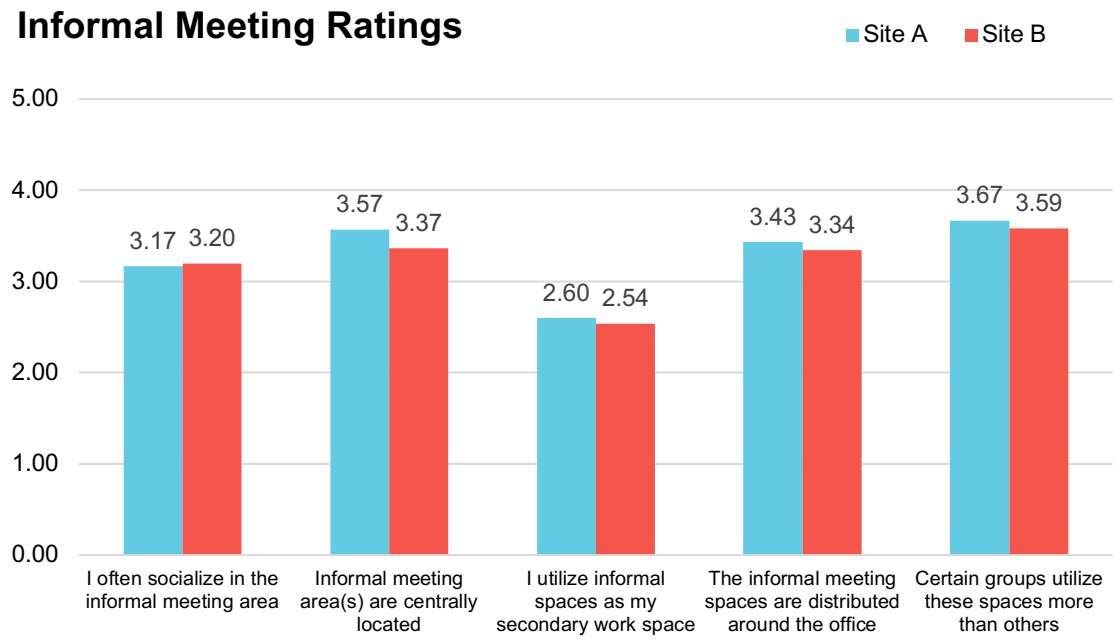


Figure 39. Average Informal Meeting Spaces Ratings Comparison

Informal Meeting Spaces		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I often socialize with my colleagues in the informal meeting area.	Combined Avg	4.29%	28.57%	15.71%	42.86%	8.57%
	Site A	6.90%	27.59%	10.34%	41.38%	13.79%
	Site B	2.44%	29.27%	19.51%	43.90%	4.88%
Informal meeting area(s) are centrally located within the office.	Combined Avg	1.43%	10.00%	32.86%	48.57%	7.14%
	Site A	0.00%	13.79%	17.24%	55.17%	13.79%
	Site B	2.44%	7.32%	43.90%	43.90%	2.44%
I utilize informal spaces as my secondary work space.	Combined Avg	12.86%	44.29%	17.14%	21.43%	4.29%
	Site A	17.24%	37.93%	10.34%	27.59%	6.90%
	Site B	9.76%	48.78%	21.95%	17.07%	2.44%
The informal meeting spaces are distributed around the office.	Combined Avg	2.90%	15.94%	21.74%	49.28%	10.14%
	Site A	3.57%	10.71%	17.86%	50.00%	17.86%
	Site B	2.44%	19.51%	24.39%	48.78%	4.88%
Certain groups utilize these spaces more than others.	Combined Avg	1.43%	5.71%	28.57%	52.86%	11.43%
	Site A	0.00%	3.45%	24.14%	62.07%	10.34%
	Site B	2.44%	7.32%	31.71%	46.34%	12.20%

Table 25. Informal Meeting Spaces Ratings

Visibility of Encouraging Signage and Wayfinding

In support of previous literature about the efficacy of encouraging signage on physical movement in the workplace, respondents were asked about signage visibility and their view on its impact on personal choices. Signage and wayfinding elements are defined as suggestive instructions for taking breaks during the work day along with the associated benefits of physical activity in the workplace.

More than three-quarter of Site A respondents indicated that there is no visible signage in their workplace, with the remainder quarter not aware if one is available. Site B respondents have varying opinions about the visibility and availability of signage, with more than half (56%) indicated that there is no visible signage, 37% indicated signage is available, and the rest indicated not knowing or did not answered the question. Varying responses from Site B may be attributed to seasonal company initiatives occurring for a short period of time throughout the year, i.e. campaigns during wellness week.

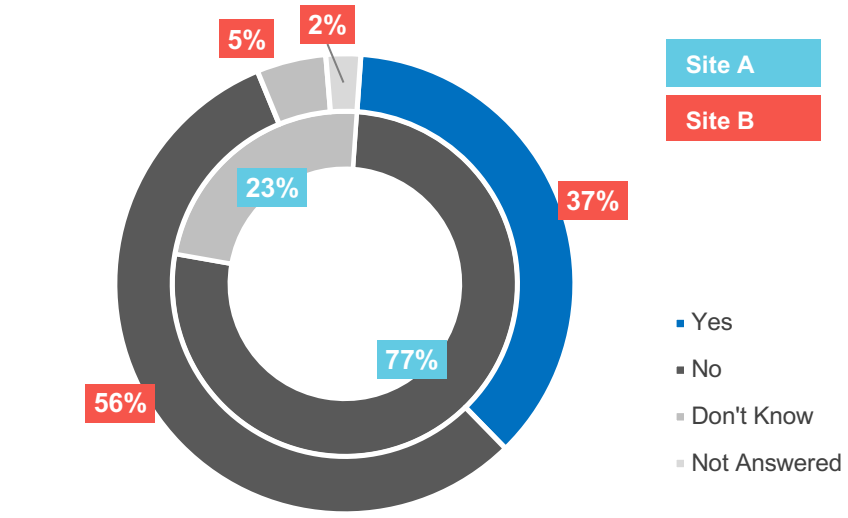


Figure 40. Perception of Signage Availability by Site

Availability of Signage		
Site A	n	%
Don't know	7	23.3%
No	23	76.7%
Site B	n	%
Don't know	2	4.9%
No	23	56.1%
Yes	15	36.6%
Not answered	1	2.4%

Table 26. Availability of Encouraging Signage

Individuals were asked about whether they believe encouraging signage has positive impact on their daily choices. Site A and B have opposing views about the statement with 67% of Site A respondents indicated that they either felt 'strongly disagree' or 'disagree' that signage influences their daily decision in taking stairs. The other 30% of individuals from Site A believe that signage has a positive impact on daily behaviors.

Most Site B respondents, at about 54%, agreed with the statement with the other 37% of respondents did not answer the question. Only about 5% of Site B respondents disagreed with the statement.

The high number of disagreement from Site A may be related to 1) their previous experience; all Site A respondents never had an exposure to this means for behavior change and thus did not believe in the impact on behavior, 2) Site A's access constraints to the emergency stairs does not accommodate for more physical movement, in which signage will not directly affect their daily habit. On the other hand, Site B respondents have access to their stairs and may have been positively empowered by these signage in the past.

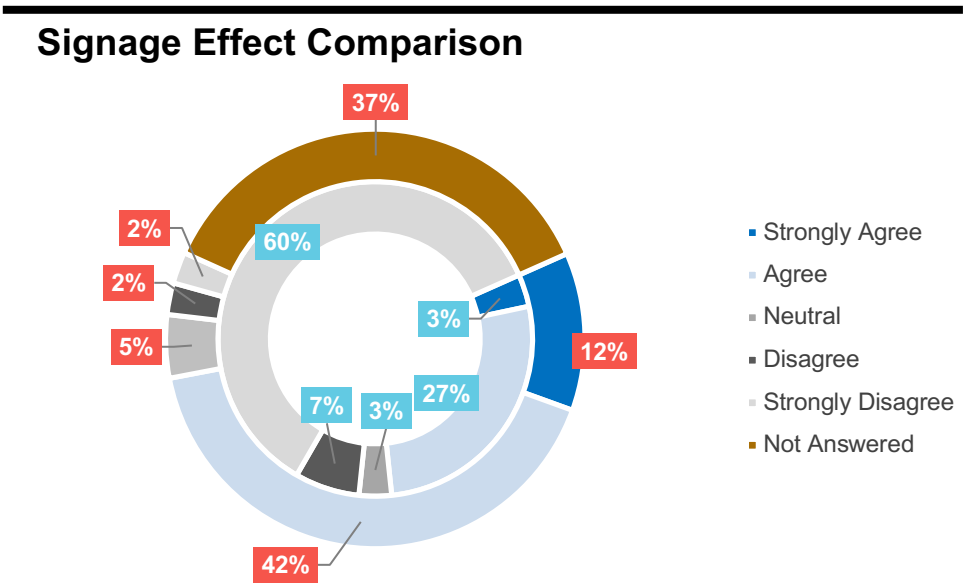


Figure 41. Signage Effect on Decision Comparison

Signage Effect on Decision

Site A	n	%
Strongly Disagree	8	60.00%
Disagree	2	6.67%
Neutral	1	3.33%
Agree	1	26.67%
Strongly Agree	18	3.33%

Site B	n	%
Strongly Disagree	17	2.44%
Disagree	1	2.44%
Neutral	2	4.88%
Agree	5	41.46%
Strongly Agree	1	12.20%
Not Answered	15	36.59%

Figure 42. Perception of Signage's Effect on Decision

Respondents were also asked whether they think encouraging signage elements can promote a lasting impact for more than one month. Respondents from Site A indicated mixed feedback; 47% of respondents

believe that the signage impact can last for more than a month, while the other 43% of respondents do not think it will result in a lasting behavioral change. High majority of Site B respondents at about 60% believed that the effect of signage can last for more than a month, while the other 29% did not answer to the question.

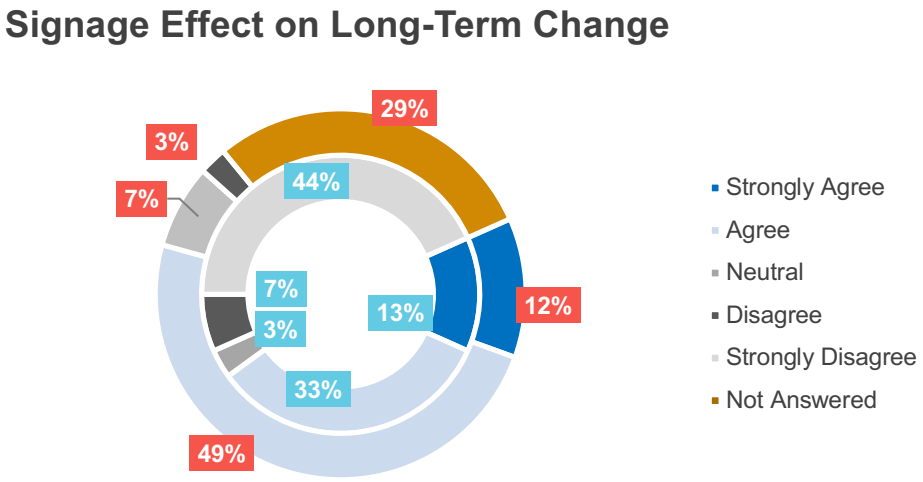


Figure 43. Perceived Signage Effect on Long Term Change Comparison

Signage Effect on Long-term Change

Site A	n	%
Strongly Disagree	13	43.33%
Disagree	2	6.67%
Neutral	1	3.33%
Agree	10	33.33%
Strongly Agree	4	13.33%

Site B	n	%
Strongly Disagree	0	0.00%
Disagree	1	2.44%
Neutral	3	7.32%
Agree	20	48.78%
Strongly Agree	5	12.20%
Not Answered	12	29.27%

Table 27. Signage Impact and Long-Term Change (more than a month)

6.5.7. Job Satisfaction

Job satisfaction was measured through perception of social, physical, and emotional aspects of work towards one's view of satisfaction with the organization. Site A excels in 9 out of 10 job satisfaction aspects in comparison to Site B, except for employees' participation in group physical activity initiative. Perception of job

satisfaction in Site A is significantly more positive in comparison to Site B over six job satisfaction dimensions, such as: attention to employees' well-being, offering of physical activity initiatives, expectation of workloads, availability of resources, good friendship at work, sense of appreciation at work. Perception of job satisfaction among Site A respondents is marginally higher than those in Site B for the following categories: work compensation, feeling motivated at work, and sense of office culture. One category that Site B excels above Site A was self-perceived participation in group physical activity initiatives.

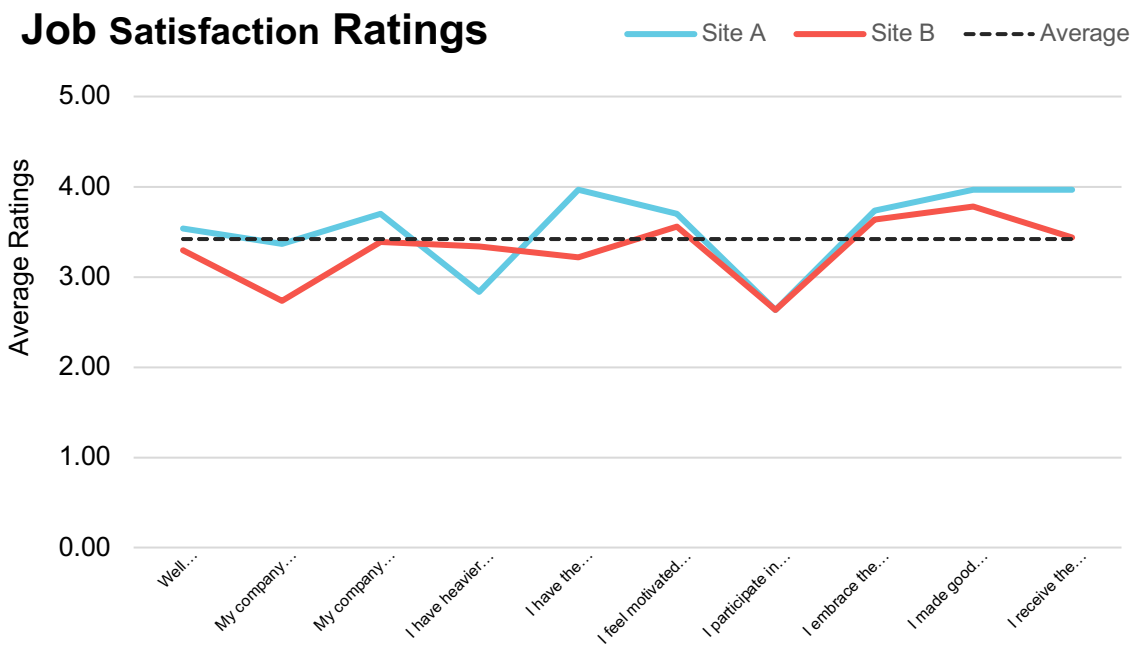


Figure 44. Job Satisfaction Ratings Comparison

Job Satisfaction		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am well compensated for my work.	Combined Avg	2.82%	16.90%	23.94%	50.70%	5.63%
	Site A	3.33%	13.33%	23.33%	46.67%	13.33%
	Site B	2.44%	19.51%	24.39%	53.66%	0.00%
The company has physical activity initiative, such as: gym, biking, etc.	Combined Avg	11.27%	25.35%	19.72%	39.44%	4.23%
	Site A	10.00%	13.33%	16.67%	50.00%	10.00%
	Site B	12.20%	34.15%	21.95%	31.71%	0.00%
The company pays attention to my well-being.	Combined Avg	4.23%	8.45%	28.17%	49.30%	9.86%
	Site A	3.33%	10.00%	16.67%	53.33%	16.67%
	Site B	4.88%	7.32%	36.59%	46.34%	4.88%
I have heavier workload than I expect.	Combined Avg	1.41%	23.94%	39.44%	30.99%	4.23%
	Site A	3.33%	33.33%	43.33%	16.67%	3.33%
	Site B	0.00%	17.07%	36.59%	41.46%	4.88%
I have the resources I need to do my job well.	Combined Avg	0.00%	16.90%	22.54%	50.70%	9.86%
	Site A	0.00%	10.00%	6.67%	60.00%	23.33%
	Site B	0.00%	21.95%	34.15%	43.90%	0.00%
I feel motivated at work.	Combined Avg	0.00%	12.68%	22.54%	54.93%	9.86%
	Site A	0.00%	13.33%	16.67%	56.67%	13.33%
	Site B	0.00%	12.20%	26.83%	53.66%	7.32%
I participate in-group physical activity initiative.	Combined Avg	8.45%	45.07%	21.13%	25.35%	0.00%
	Site A	6.67%	46.67%	23.33%	23.33%	0.00%
	Site B	9.76%	43.90%	19.51%	26.83%	0.00%
I embrace the culture of the office.	Combined Avg	0.00%	7.04%	29.58%	52.11%	11.27%
	Site A	0.00%	10.00%	20.00%	56.67%	13.33%
	Site B	0.00%	4.88%	36.59%	48.78%	9.76%
I made good friendships with people in the office.	Combined Avg	0.00%	5.63%	19.72%	57.75%	16.90%
	Site A	0.00%	6.67%	13.33%	56.67%	23.33%
	Site B	0.00%	4.88%	24.39%	58.54%	12.20%
I receive the appreciation I deserve at work.	Combined Avg	0.00%	11.27%	23.94%	52.11%	12.68%
	Site A	0.00%	10.00%	6.67%	60.00%	23.33%
	Site B	0.00%	12.20%	36.59%	46.34%	4.88%

Table 28. Job Satisfaction Ratings

6.6. Behavioral Habits

6.6.1. Level of Physical Activity

Level of physical activity was measured by the intensity of vigorous, moderate, and walking activities as determined by amount of time spent under each activity, which were defined as the following:

1. **Vigorous Physical Activity:** activities that involves individuals breathing significantly harder than normal, which may include carrying heavy loads, performing heavy cardio workout, digging, performing heavy construction work, or climbing up stairs.

2. **Moderate Physical Activity:** activities that involves individuals breathing somewhat harder than normal, which may include carrying light loads, jogging, bicycling, swimming, dancing This excludes walking activities.
3. **Walking Physical Activity:** walking activities that may include brisk walking, walking for leisure, and climbing down stairs.

As part of the short form of the IPAQ questionnaire, participants were asked to estimate their time spent on Vigorous, Moderate, Walking, and Sitting activities of at least 10 minutes at any given time during the past 7-day period.

Seventy-four percent of respondents from both sites spent 10 minutes or more on vigorous physical activities for at least one day a week (n=52), and more than two thirds of these individuals also performed more than one hour of vigorous activities a one-week period. The average time spent on of vigorous activities was 150 minutes (2.5 hours) with a median of 75 minutes (SD=225.6).

Seventy-six percent of respondents from both sites spent 10 minutes or more on moderate physical activities for at least one day a week (n=54). Among those 54 individuals, forty of them performed more than one hour of moderate activities in one week period. The average time expended on moderate activities was 201 minutes (3.35 hours) with a median of 90 minutes (SD=267.1).

Ninety-three percent of respondents from both sites spent at least 60 minutes of walking activities (n=66). More than half of respondents (n=38), walked on average 60 minutes every day during the one-week period, totaling up to about 420 minutes per week. The average time individuals spent walking was 457 minutes (7.6 hours) with a median of 420 minutes (SD=350.67).

The International Physical Activity Questionnaire prescribes the minimum and maximum values of activity duration to exclude any outliers in the data. Participants

were required to only capture physical activities with minimum duration of 10 minutes to result in any health benefits. Questions included in the survey required respondents to estimate and capture any physical activity based on aforementioned physical activity categories. Maximum values of duration were intended to exclude any data that is unreasonably high. Data values totaling more than 16 hours (across Walking, Moderate, and Vigorous) were excluded from the analysis, as suggested by the International Physical Activity Questionnaire (IPAQ) scoring protocols. This data exclusion assumes that average individuals spend approximately 8 hours per day conducting other activities, i.e. resting, sleeping.

Additionally, the duration of reported time spent in each physical activity cannot physically exceed 180 minutes per day. As a result, any values that were above the limit mentioned were capped at 180 minutes as suggested by the IPAQ scoring protocols. The scoring protocols also cap for a maximum of 21 hours of activity in a week to be reported under each category, which equates to 3 hours multiplies by 7 days a week.

Once data was cleaned and prepped, time spent under each category were converted to metabolic rate (MET) minutes per week. An average MET value was assigned to each activity mode (Walking, Moderate, Vigorous) based on its intensity of exercise. Here are the MET values derived from the IPAQ Reliability Study (Ainsworth et al, 2001): 1) Walking MET-minutes/week = 3.3 multiplied by walking minutes and walking days, 2) Moderate MET-minutes/week = 4.0 multiplied by moderate-intensity activity minutes and moderate days, 3) Vigorous MET-minutes/week = 8.0 multiplied by vigorous-intensity activity minutes and vigorous days. Total physical activity MET score was calculated through a sum of Walking, Moderate, and Vigorous MET-minutes/week scores.

Utilizing the guidelines from IPAQ, the results from various physical activities were coded into total amount of metabolic rate (MET) based on the intensity of each activity. The total MET accumulated per week was used to determine the physical activity (PA) level of each person. The PA level was categorized into 'Low', 'Medium', 'High'. Below were the guidelines utilized to categorize PA level:

- **High PA level:** Individuals who performed a consistent amount of high-intensity physical activities. The IPAQ study recommended a measure that is equivalent to approximately one hour more than the lower PA level. The established criteria for data coding were: 1) vigorous activities of more than 3 days a week that result in a minimum of 1,500 MET-minutes/week, or 2) a combination of walking, moderate, and vigorous physical activities totaling up to at least 3,000 MET-minutes/week.
- **Moderate PA level:** Individuals who performed some physical activity above than allotted for low category. The IPAQ study described the moderate PA as individual activities that equate to about 30 minutes of moderate-intensity throughout the majority of a week. This translates to the following activity patterns: 1) 20 minutes of vigorous-intensity activities for at least 3 days a week, 2) at least 30 minutes of moderate-intensity activities for 5 or more days, 3) 5 or more days of walking, moderate, and vigorous physical activities totaling up to at least 600 MET-minutes/week.
- **Low PA level:** Individuals who do not satisfy the Moderate physical activity requirements.

Self-Reported Time Spent on Physical Activities

	Min/Max	Average *(SD)*	Median
Vigorous Activities			
Number of days/week	0/7	2.04 *(1.7)*	2
Number of minutes/day	0/180*	*50.46 (58.619)*	30
Number of hours/week	0/21*	2.49 *(3.76)*	1.25
Moderate Activities			
Number of days/week	0/7	2.87 *(2.35)*	3
Number of minutes/day	0/60	54.26 *(59.25)*	30
Number of hours/week	0/21*	3.35 *(4.45)*	1.5
Walking			
Number of days/week	0/7	5.97 *(1.838)*	7
Number of minutes/day	0/180*	71.18 *(50.84)*	60
Number of hours/week	0/21*	7.65 *(5.9)*	7

**truncated data based on IPAQ scoring protocol*

Table 29. Comparison of Time Spent on Physical Activities

Calculated Physical Activity (PA) levels (Low, Medium, High) of occupants from each site were fairly aligned with the overall combined PA level average. A large majority of population from both sites at 92% (n=65) were classified to have a Moderate or High physical activity level. About 46% of respondents (n=33) had a 'high' PA level, followed by 45% (n=32) classified as 'moderate'. Only a small proportion of overall respondents had a 'low' level of PA (8%, n=6). The high percentage of PA level across the two sites may be attributed to two main drivers: 1) location of sites in a walkable urban neighborhood with convenient access to public transit, 2) selection bias of those who participated in the study due to pre-existing awareness and interest in the personal health and well-being topics.

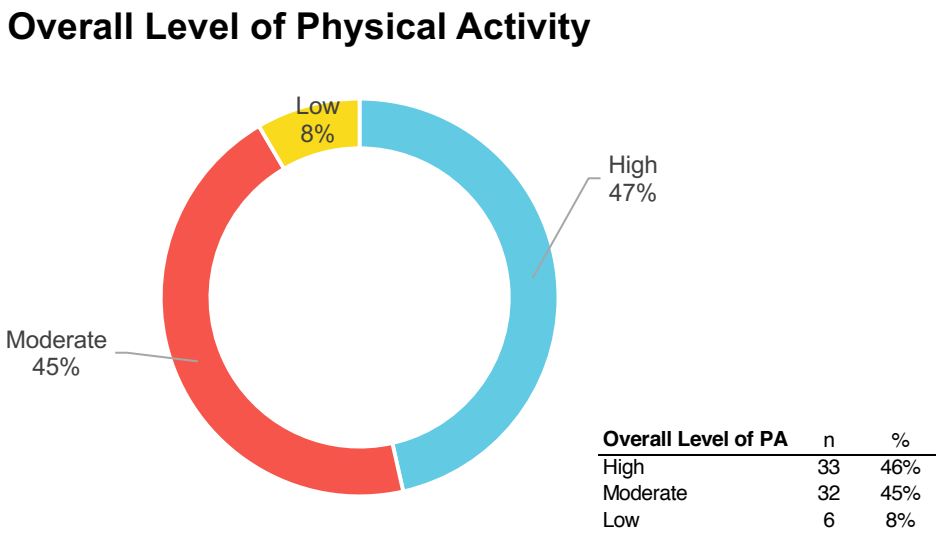


Figure 45. Overall Level of Physical Activity

Level of PA		n	%
Overall	Low	6	8%
	Moderate	32	45%
	High	33	46%
Site A	Low	3	10%
	Moderate	13	43%
	High	14	47%
Site B	Low	3	7%
	Moderate	19	46%
	High	19	46%

Table 30. Level of PA Comparison

Forty-seven percent of respondents from Site A conducted 'high' level of physical activity (n=14), forty-three performed in a 'moderate' PA (n=13), and ten percent engaged in 'low' level of PA (n=3). Comparatively, forty-six percent of respondents from Site B was engaged in 'high' and 'moderate' level of physical activity (n=14) respectively with the remaining seven percent engaged in 'low' level of PA (n=3). Site A respondents have a marginally higher proportion of those with 'High' level of PA by one-percent. A closer look at occupants' PA level from each building reveals a higher proportion of 'Moderate' PA level and lower 'Low' PA level among Site B occupants by three percent each. Site A has a higher proportion of 'Low' and

'Moderate' PA level building occupants. This may be attributed to better staircase accessibility in Site B.

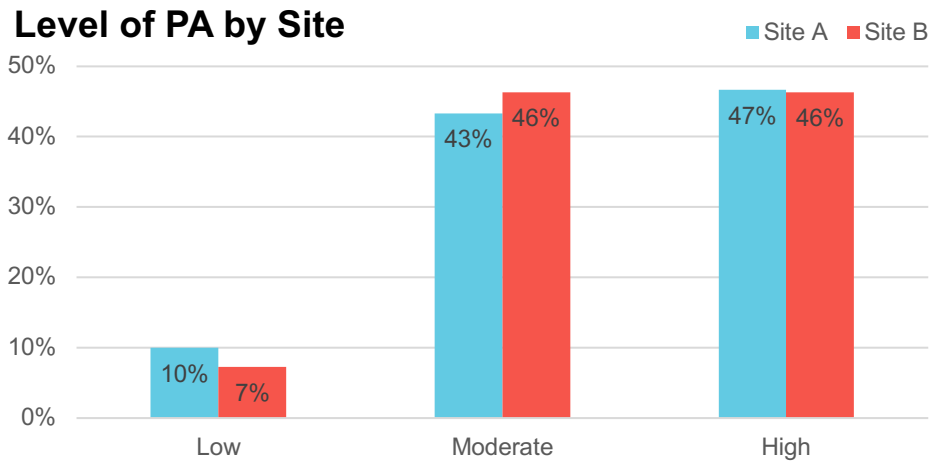


Figure 46. Level of PA by Building

6.6.2. Building and Workspace Tenure

Average number of hours spent across the two sites is 8.8 hours per day (SD=1.5), totaling up to 44 hours per week (SD=7.5). The median number of hours spent across the two sites is 9 hours per day or 45 hours per week.

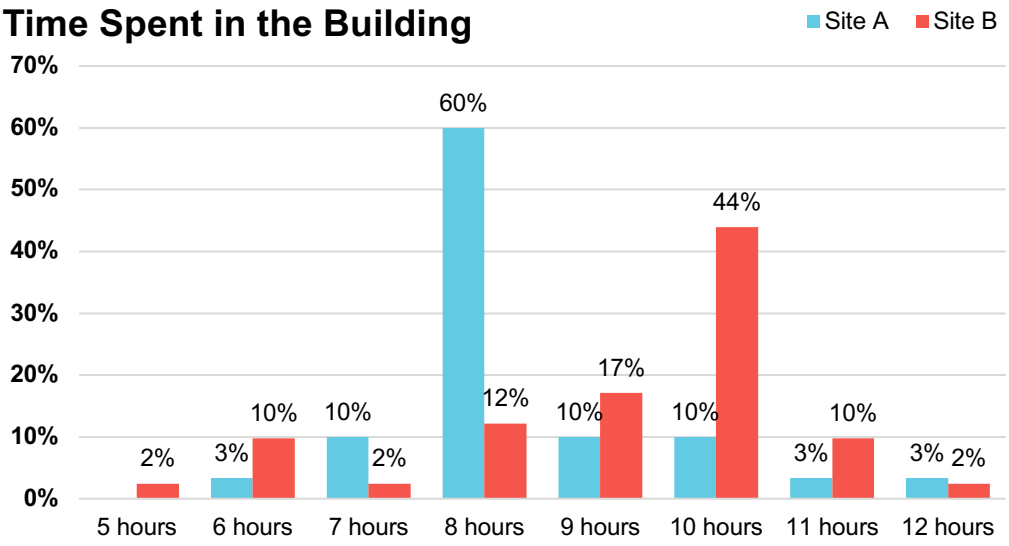


Figure 47. Comparison of Time Spent in the Building across Both Sites

Average reported time sitting is 62 hours per week for both sites. Site A participants spent an average of 60 hours per week (SD=23.12). Site B respondents spent an average of 63 hours per week (SD=17.84). This number is higher than those average hours reported spent in the building across sites, this may be due misreported sitting time that may have included hours spent sitting elsewhere other than those spent in the building.

Building occupants from site A spent an average of 8.35 hours sitting per day, ranging from 6.4 hours per day (min=6.4) to 12 hours per day (max=12). Building occupants from site B spent an average of 9.1 hours sitting per day, ranging from 4.8 hours per day (min=6.4) to 12 hours per day (max=12).

6.6.3. Perception of Health + Physical Activity

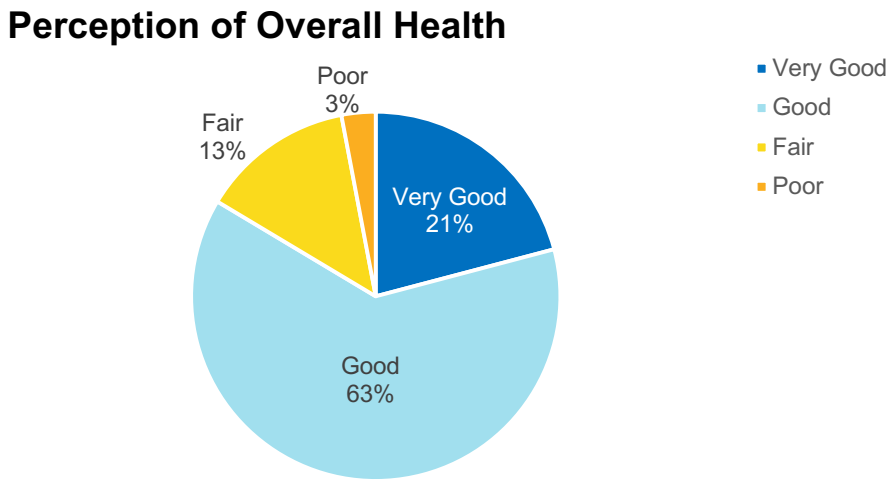


Figure 48. Perception of Overall Health

Perception of overall health was measured by a 5-point Likert scale question ('very good', 'good', 'fair', 'poor', 'very poor') in addition to an 'I don't know' option. Eighty-four percent of respondents felt they are in overall good health, 21% in 'very good' health (n=14) and 63% in 'good' health (n=42).

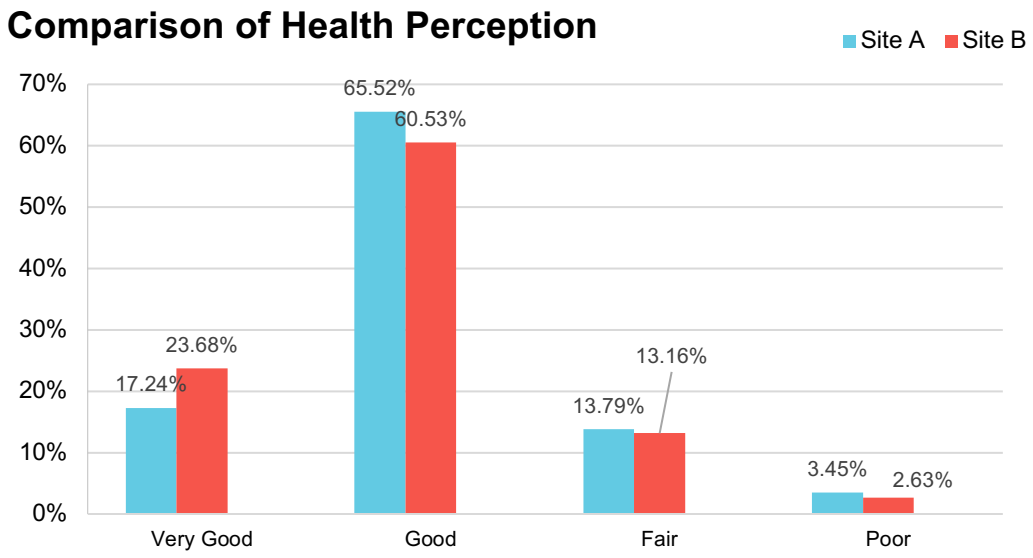


Figure 49. Comparison of Health Perception

Aggregate average of individuals' perception of overall health are consistent across two sites at approximately 82-84% of respondents from both sites reported they are in 'good' or 'very good' overall health condition. About 13-14% Site A and B respondents reported 'fair' health, and about 2-3.5% reported 'poor' health.

Almost half of respondents (49%, n=35) felt that they exercise less than they need and 34% (n=24) believed that they don't know enough to answer. Only 13% (n=9) respondents felt that they exercise as much as they need. About 4% of respondents chose to skip this question.

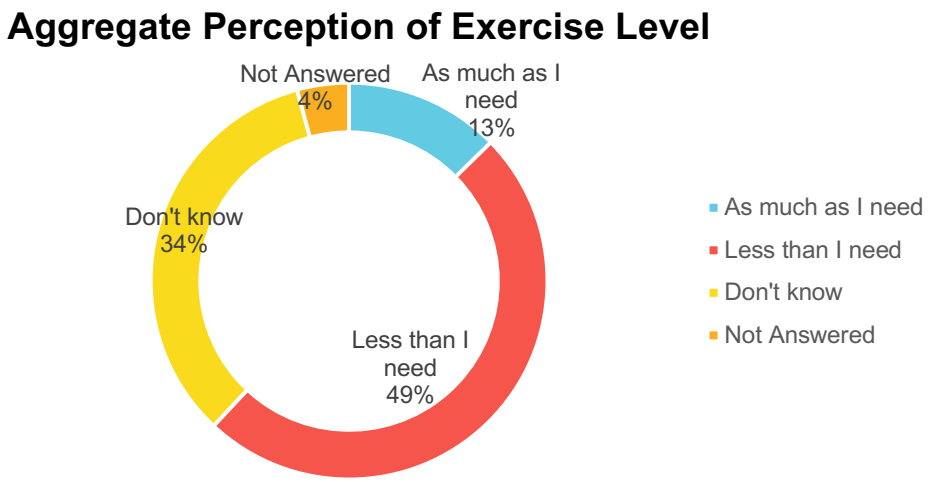


Figure 50. Aggregate Perception of Exercise Level

An inverse trend was observed between Site A and Site B respondents' perception of exercise level. More than three-quarter of Site A respondents don't know about their exercise level. About 20% of Site A respondents felt they exercise less than they need and only 3% felt they exercise as much as they need. On the other hand, about 70% of Site B respondents felt that they were aware they exercise less than they need, with a mere 3% felt they don't know their exercise level. About one out of five Site B respondents indicated exercising as much as they need. Overall Site B

respondents were generally more informed about their exercise level than those of Site A.

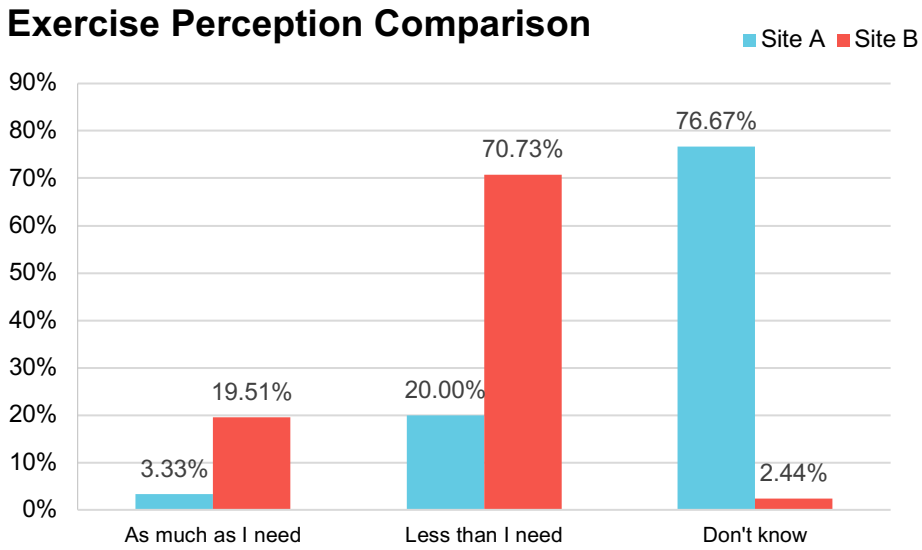


Figure 51. Exercise Perception Comparison

There was a positive association between exercise level and individual health perception. All individuals who reported engaging in exercise as much as they need also rated their health as ‘good’ or ‘very good’. Majority of those answered they exercise less than they need indicated ‘good’ and ‘very good’ health, with about 15% respondents reported ‘fair’ health condition. A quarter of individuals reported ‘don’t know’ their exercise level indicated their health as ‘fair’ or ‘poor’. Among those respondents who reported a ‘poor’ health condition, at 8%, they also indicated they don’t know about their exercise level. Only individuals in the ‘don’t know’ exercise level group reported a ‘poor’ health condition.

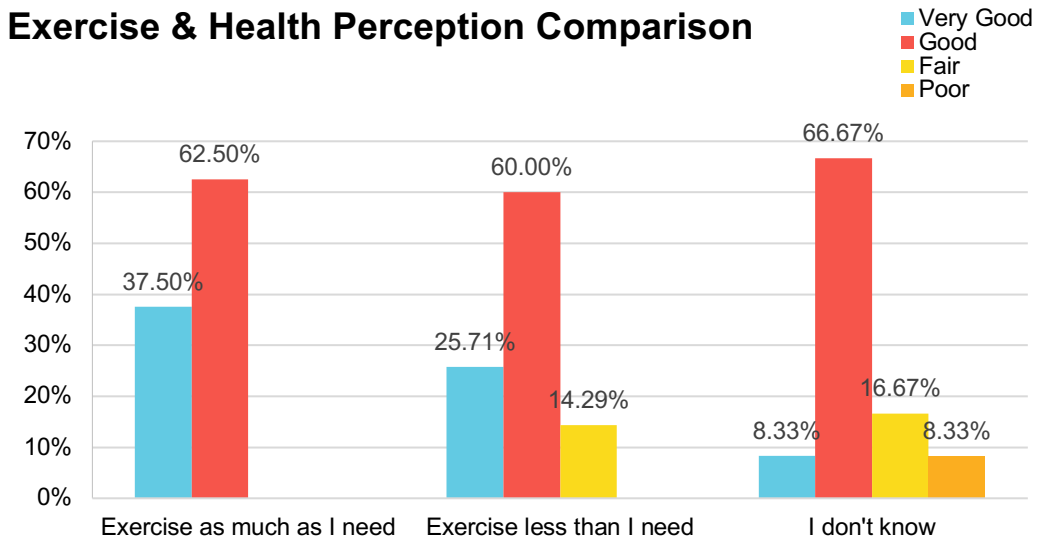


Figure 52. Health Perception Sorted by Exercise Perception

Interestingly, almost all Site A respondents indicated that they either exercise less than they need or not sure about their exercise level. One individual in Site A responded they exercise as much as they need, however declined to answer their health condition.

	Site A				Site B				
	As much as I need	Less than I need	Don't know	Overall	As much as I need	Less than I need	Don't know	Overall	Combined
Very Good	0%	50%	9%	17%	38%	21%	0%	24%	21%
Good	0%	50%	70%	66%	63%	62%	0%	61%	63%
Fair	0%	0%	17%	14%	0%	17%	0%	13%	13%
Poor	0%	0%	4%	3%	0%	0%	100%	3%	3%
Overall	3%	20%	77%		20%	71%	2%		

Figure 53. Health and Exercise Perception by Site

Almost half of study participants reported that they engage in moderate physical activities (PA) at more than 30 minutes of each occurrence for 3-5 days a week (43%, n=30). 23% of participants were active in moderate PA 6-7 days, another 23% engaged in 0-2 days per week, with the remaining 10% (n=7) were not aware of their PA level.

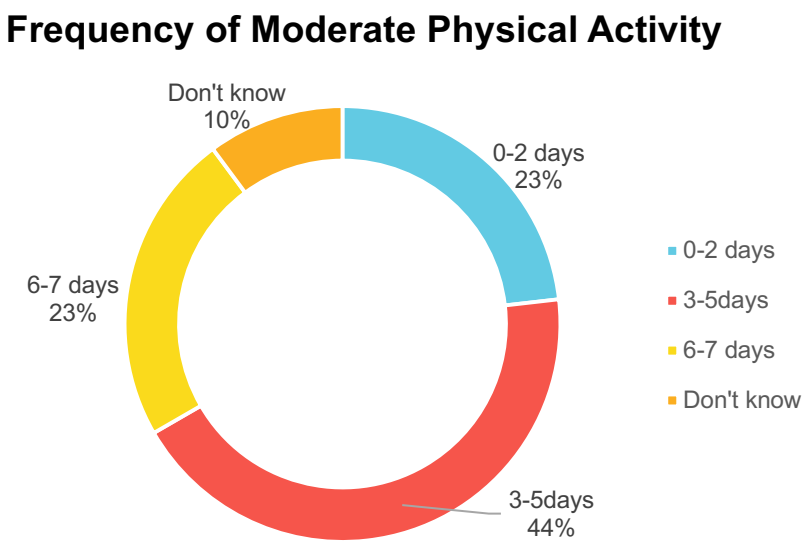


Figure 54. Frequency of Moderate Physical Activity

6.6.4. Frequency of Stair-Climbing in the Building

Participants were asked to estimate the number of times and number of stories they climb during a typical weekday. Site A participants reported an average of 0.39 times per week with a maximum of 6.7 stories for each occurrence (SD=1.3). Overall, Site A respondents climbed an average of 0.39 story per week with an average of 0.33 story for each occurrence (SD=0.8). On average, Site A participants climbed about 1.23 stories per week and has a maximum number of 20 stories climbed per week (SD=4.03).

Site B respondents climbed about seven times more in frequency, at an average of 2.96 times per week, with an average of 3.29 stories for each occurrence (SD=1.47). On average, Site B participants climbed about 11.61 stories per week and has a maximum number of 72 stories climbed per week (SD=14.58).

	Frequency				Stories				Stories/week			
	Avg	Min	Max	SD	Avg	Min	Max	SD	Avg	Min	Max	SD
Site A	0.39	0.00	6.70	1.33	0.33	0.00	3.00	0.80	1.23	0.00	20.00	4.03
Site B	2.96	0.00	18.00	3.62	3.29	0.00	4.00	1.47	11.61	0.00	72.00	14.58

Table 31. Comparison of Stair Climbing Occurrences and Frequency

6.6.5. Stairs and Elevators Usage

When asked about the first choice of going up and down the floors, 61% of respondents from Site A opted for elevators, with 24% indicated that number of floors is the primary deciding factor. Preference among Site B respondents is split into both elevators and stairs at 39% and 25% respectively. Site B respondents also stated additional reasons for choosing their first choice of going up and down as the 'number of floors' or the 'direction of travel'. Site A respondents have a significantly lower percentage of individuals selecting for stairs for their primary path of travel; this may be due to the accessibility of stairs/elevators provided by the building.

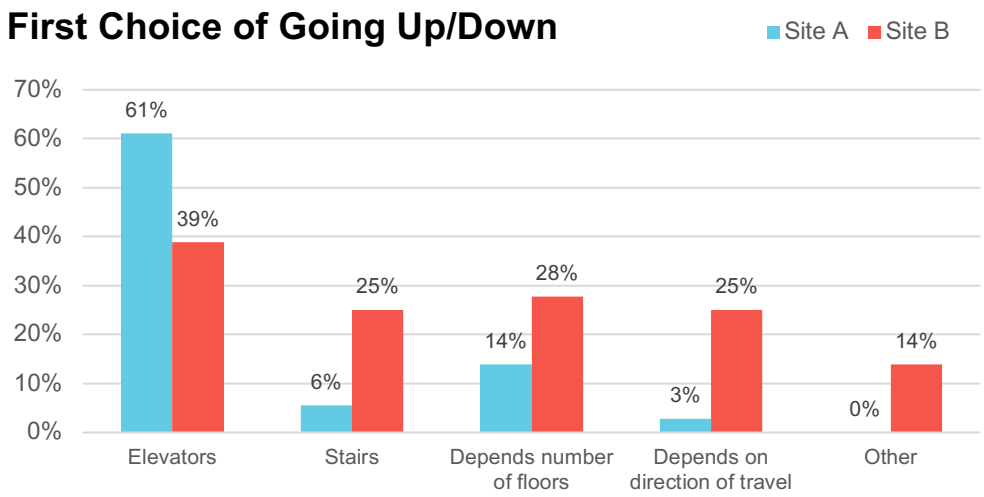


Figure 55. First Choice of Going Up/Down

Among the two sites, main influence on elevator usage is attributed to the perception of convenience, at 61% among Site A participants and 53% among Site B participants. Other reasons listed as main influence on elevator usage among Site B respondents, include: 25% feeling lazy, 17% avoiding sweat, 14% habit, 19%

carrying heavy loads, 3% health problems, and other reasons not listed. Site A listed the following reasons for the influence on elevator usage: 11% habit, 8% avoiding sweat, 6% feeling lazy, 6% carrying heavy loads, 3% not feeling fit enough, and another 3% perception of destination being too far.

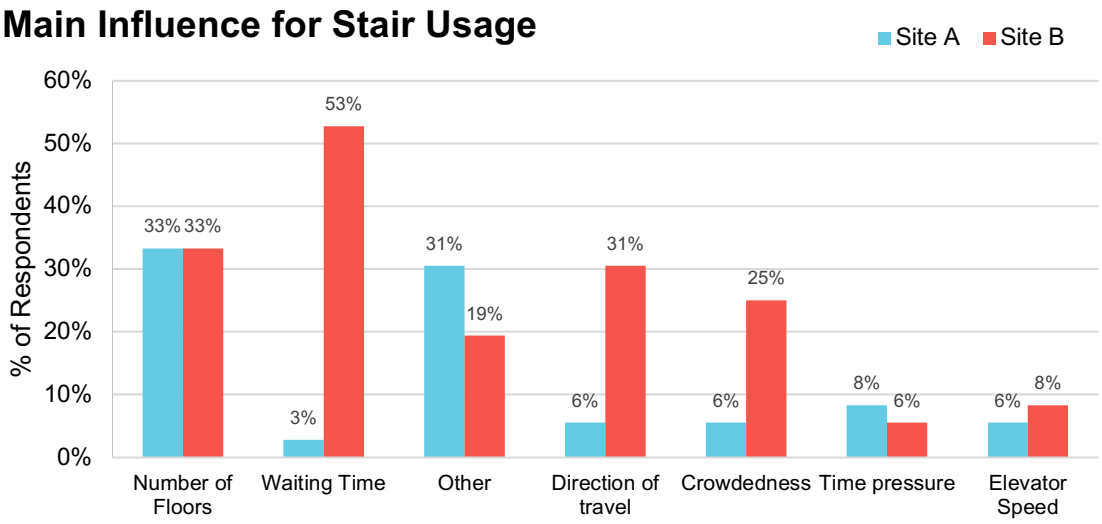


Figure 56. Main Influence for Stair Usage

6.7. Factors that Encourage Stair Utilization

Participants from both sites were asked to check applicable factors that they feel may affect their decisions in taking the stairs. Approximately half of respondents from both sites indicated the perceived need to get some exercise as their main reason for taking stairs. Respondents from Site A also indicated 'Proximity to building entrance.

	Site A		Site B	
	n	%	n	%
Look and feel of stairs	6	19%	6	12%
Proximity to bldg entrance	9	28%	7	14%
Daylight in stairs	7	22%	6	12%
Motivating signage	1	3%	1	2%
Colleage motivation	1	3%	5	10%
To get exercise	14	44%	26	51%
Other	4	13%	26	51%

Table 32. Factors that Encourage Users to Take Stairs

6.8. Personal Habits

Personal habits section evaluates daily work habits and individuals' awareness on sedentary behavior in the workplace. Majority of respondents from both sites, 67% and 64% for Site A and B respectively, felt that they sit more than they should. Four out of five site respondents took a walking break for every 60-120 minutes of sitting. This represents was a higher proportion of perceived walking behavior at Site A than those of Site B at 66%. A large percentage of Site B respondents at 83% indicated that they frequently spend more than 8 hours of their day in the office than their counterparts from Site A with only 59% of overall respondents spent more time in the office. Twenty-seven percent of Site B respondents reported taking breaks outside the office, while only 17% of Site A participants responded likewise. In contrast, 27% respondents from Site A indicated that they exercise every day, almost doubled those indicated performing daily exercise in Site B (15%). The majority of individuals from both sites indicated they spend more than 30 minutes walking on a typical day at 80% and 73% for Site A and B respectively. Snacking habits at individual desk is consistent between the two sites, 48% in Site A and 46% in Site B.

In addition to self-perception of health, individuals were also asked whether their colleagues or friends perceived them as a physically active person. Almost half of Site B respondents felt that their peers valued them as physically active, compared to only a quarter in Site A. Majority of individuals from both sites 1) were self-conscious about their weight, at 77% and 61% among Site A and B, 2) used public transit on a daily basis, at 90% and 83% in Site A and B, 3) preferred walking to driving for a shorter distance trip at 79% and 85% among Site A and B respondents, 4) enjoyed taking a walk both outdoors and indoors at 90% and 83% among site A and B respondents, 5) felt that

their occupation is stationary and does not require them to walk regularly at 17% and 22% for both Site A and B.

Personal Habits		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I sit way more than I should during workday.	Combined Avg	0.00%	14.08%	21.13%	43.66%	21.13%
	Site A	0.00%	13.33%	20.00%	36.67%	30.00%
	Site B	0.00%	14.63%	21.95%	48.78%	14.63%
I take a walk break every 60-120 minutes of sitting.	Combined Avg	1.41%	18.31%	8.45%	57.75%	14.08%
	Site A	3.33%	6.67%	10.00%	56.67%	23.33%
	Site B	0.00%	26.83%	7.32%	58.54%	7.32%
I take coffee or smoking breaks outside the office.	Combined Avg	19.72%	46.48%	11.27%	18.31%	4.23%
	Site A	33.33%	43.33%	6.67%	10.00%	6.67%
	Site B	9.76%	48.78%	14.63%	24.39%	2.44%
I exercise every day.	Combined Avg	7.04%	57.75%	15.49%	16.90%	2.82%
	Site A	10.00%	60.00%	3.33%	20.00%	6.67%
	Site B	4.88%	56.10%	24.39%	14.63%	0.00%
I spend more than 30 minutes walking on a typical day.	Combined Avg	1.41%	18.31%	4.23%	63.38%	12.68%
	Site A	0.00%	16.67%	3.33%	60.00%	20.00%
	Site B	2.44%	19.51%	4.88%	65.85%	7.32%
I have snacking habit while sitting and/or working at my desk.	Combined Avg	14.29%	21.43%	17.14%	42.86%	4.29%
	Site A	20.69%	17.24%	13.79%	44.83%	3.45%
	Site B	9.76%	24.39%	19.51%	41.46%	4.88%
My colleagues or friends told me that I am physically active.	Combined Avg	8.57%	17.14%	40.00%	25.71%	8.57%
	Site A	13.33%	20.00%	43.33%	16.67%	6.67%
	Site B	5.00%	15.00%	37.50%	32.50%	10.00%
I am conscious about my weight.	Combined Avg	1.41%	11.27%	19.72%	53.52%	14.08%
	Site A	0.00%	10.00%	13.33%	63.33%	13.33%
	Site B	2.44%	12.20%	24.39%	46.34%	14.63%
I use public transit on a daily basis.	Combined Avg	2.86%	10.00%	1.43%	40.00%	45.71%
	Site A	6.90%	3.45%	0.00%	20.69%	68.97%
	Site B	0.00%	14.63%	2.44%	53.66%	29.27%
I frequently stay in office for more than 8 hours a day.	Combined Avg	4.29%	10.00%	12.86%	54.29%	18.57%
	Site A	10.34%	6.90%	24.14%	37.93%	20.69%
	Site B	0.00%	12.20%	4.88%	65.85%	17.07%
I prefer walking to driving for shorter distance trip.	Combined Avg	1.43%	8.57%	7.14%	48.57%	34.29%
	Site A	3.45%	10.34%	6.90%	31.03%	48.28%
	Site B	0.00%	7.32%	7.32%	60.98%	24.39%
I enjoy taking a walk both outdoors and indoors.	Combined Avg	1.43%	1.43%	11.43%	54.29%	31.43%
	Site A	3.45%	3.45%	3.45%	44.83%	44.83%
	Site B	0.00%	0.00%	17.07%	60.98%	21.95%
My occupation requires me to walk frequently throughout workday.	Combined Avg	17.14%	37.14%	25.71%	20.00%	0.00%
	Site A	24.14%	34.48%	24.14%	17.24%	0.00%
	Site B	12.20%	39.02%	26.83%	21.95%	0.00%

Table 33. Personal Habits Ratings

6.8.1. Commute and Transportation

Time spent on commuting on foot or public transportation is regarded as the main sources of daily physical activity. Survey respondents were asked about their daily commuting habits throughout the week to understand physical activity habits outside work. Respondents from both sites spent on average 37 minutes commuting to work and 38 minutes commuting back from work, which corresponds to an average distance travelled of 8.8 miles.

	Average of Miles travelled to work *(miles)*	Average Commute to Work *(minutes)*	Average Commute from Work *(minutes)*
Site A	11.06	40.62	42.52
Site B	7.14	34.17	34.78
Combined	8.79	36.84	37.99

Figure 57. Average Commute Time and Miles Travelled

The average distance traveled to and from work was 11.06 miles among Site A respondents and 7.14 miles among Site B respondents. Average time spent commuting to and from work were 41 minutes and 43 minutes respectively. The average commute time among Site A respondents is significantly higher than those of Site B. Respondents from Site B reported an average of 34 minutes time spent commuting to work and 35 minutes going back from work. Means of transportation and commute pattern throughout the week provide an overview of work and physical activity patterns.

Commute Pattern to and from Site A

The high majority of respondents from Site A utilized public transit daily (at 80% average, n= 24), with a particularly higher public transit utilization rate between Monday through Wednesday. The second most common means of getting to work was walking (average of 8%), with a significant increase in utilization from Wednesday through Friday. A combination of bike/walk and public transit was utilized more frequently mid-week towards the weekend. Bicycle usage was not apparent during earlier days in the week, with some

usage during a Friday. With the exception of getting to work on the weekend, none of the respondents drives to work.

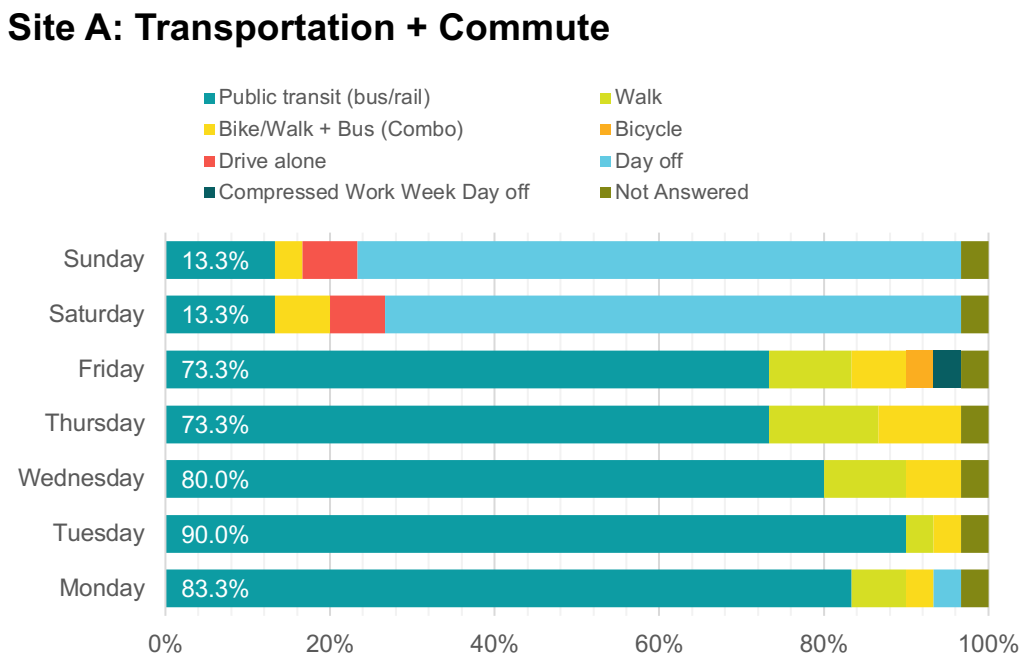


Figure 58. Site A Transportation and Commute

Commute Pattern to and from Site B

Respondents from Site B utilized a variety of transportation modes getting to and from work. About 70% of respondents utilized public transit as their primary means of getting to and from work; this is about 10% lower than those of Site A. Site B has a higher proportion of respondents walking to work at an average of 17% (n=7). Other means of transportation utilized include biking, driving alone, and motorcycle. A few respondents who did not come to the office also reported working from home, traveling for business, other day off.

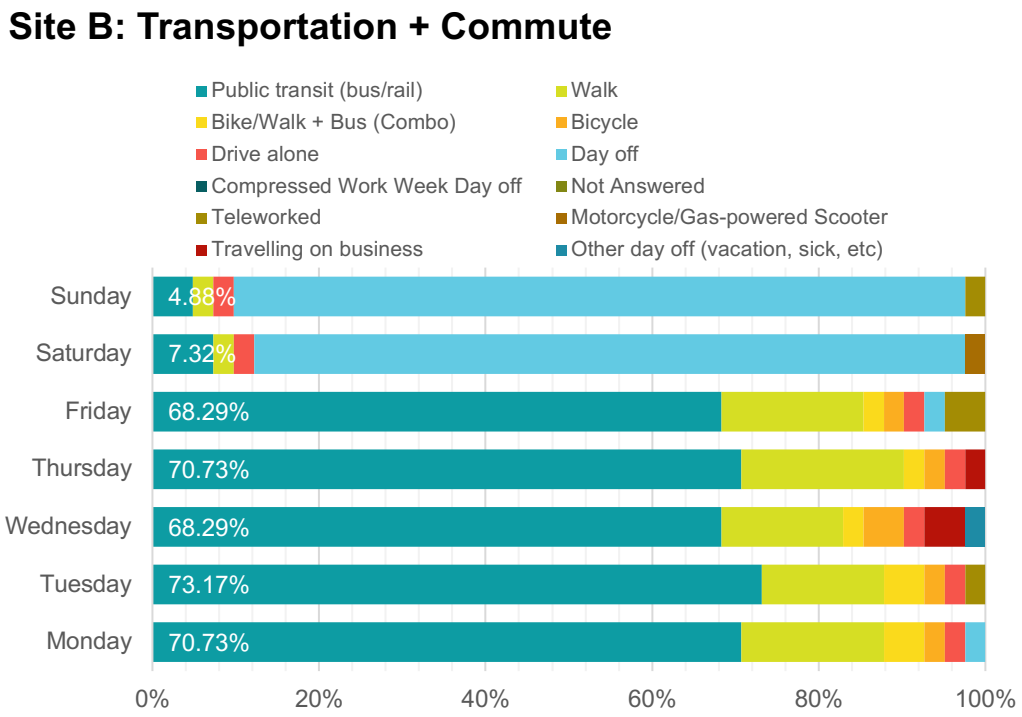


Figure 59. Site B Transportation and Commute

6.9. Physical Attributes of Individual Seats

In addition to self-reported responses gathered though the workplace survey, each collected survey was identified with their seat type and location in the floor plan. This allows for triangulation of data between user perception and the workplace attributes. The identification of seat location and positioning in relation to the rest of work environment was measured through three main measurements: seat types, distance from support, and the visibility of community spaces.

6.9.1. Seat Types

Seat types were identified through assessing the location if individual seats in the work neighborhoods, whether they are in a windowless room, middle row, nearby corridor aisle, or nearby windows. Most respondents in Site A were seated near corridor aisle at 39.29%, 25% of respondents seated in middle row and nearby

windows respectively, and the remaining 11% seated in windowless area. Site B respondents were mostly seated in nearby windows at 41.03%, 20.77% at nearby aisle, 20.51% at middle row, and the remainder 7.69% in windowless area. Windowless areas were identified as seats that were located more than 30 feet away from windows or areas with no access to windows. Site A has a higher proportion of windowless seats at nearly 11% comparted to 8% those of Site B. Site B has the highest proportion of seats located nearby windows area.

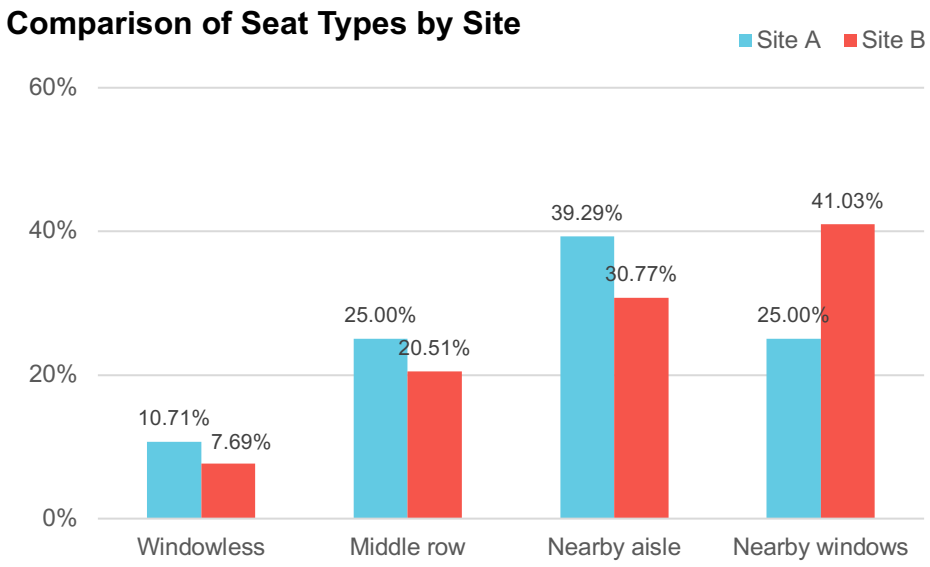


Figure 60. Comparison of Seat Types by Site

6.9.2. Distance from Community Spaces

Distance from/to Community Spaces was measured by the distance (in feet) between individual seats to shared community spaces, which were defined in categorical variables as: 0 to 30 feet, 31 to 60 feet, 61 to 120 feet, or more than 120 feet away from individual seat.

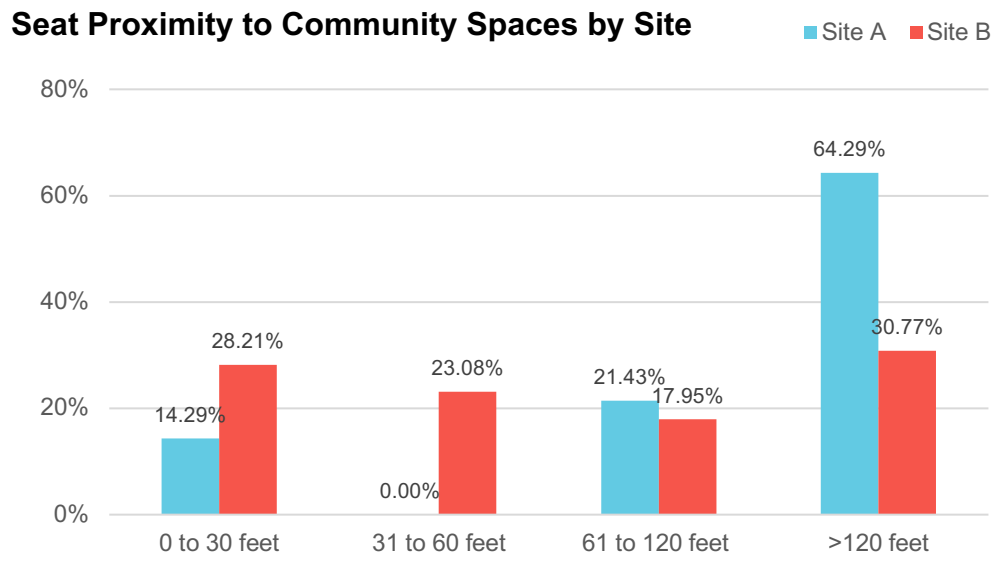


Figure 61. Seat Proximity to Community Spaces by Site

The majority of Site A respondent seats, at 64.29%, were located more than 120 feet away, 21.43% were between 61-120 feet, and 14.29% were 0 to 30 feet from shared community spaces. Site B has a more even distribution of seat proximity to community spaces, with 28.21% located within 0 to 30 feet, 23.08% between 31 to 60 feet, 17.95% within 61-120 feet, and the remainder 20.77% located more than 120 feet away from the shared community spaces.

6.9.3. Visibility of Community Spaces and Number of Turns

Visibility of community spaces are defined by the number of turns from individual seats, in which the number of turns indicated the level of community spaces' visibility from individual seats. The higher number of turns results in a lower visual visibility from the shared community spaces. The number of turns was categorized into: 'zero turn', 'one to two turns', 'three to four turns', and 'more than four turns'. Site A respondent seats were located between one to more than four turns away from community spaces. None of the workplace seats was located within direct line of sight to the community spaces. Almost a third

(32.14%) of Site A respondents were seated one to two turns away, more than half (53.57%) were seated three to four turns away, and the remaining (14.29%) located more than four turns away from community spaces. About 12.5% of Site B respondents were seated within direct sightline to the community space, almost half (47.5%) seated within one to two turns away, 35% seated three to four turns away, and only 5% of respondents were seated more than four turns away. Overall, community spaces at Site B have greater visibility from the workspace areas, as indicated by the majority of workplace seats (60%) located within zero to two turns away. None of the respondents from Site A has direct sightlines to the community spaces.

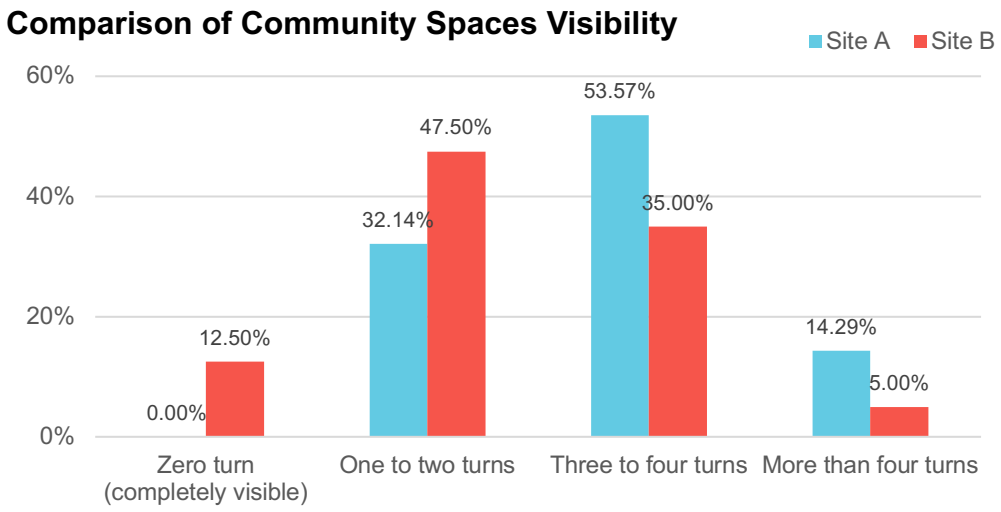


Figure 62. Comparison of Community Spaces Visibility

6.10. Statistical Analysis

6.10.1. ANOVA: Design, Behavioral, and Physical Activity Attributes

A univariate analysis of variance (ANOVA) test measures statistically significant differences between Site A and Site B. The study assumes significance at p-value of 0.1 or less. The ANOVA test was utilized to compare the difference between the

means of key design, behavioral, and physical activity (PA) attributes among the two sites. The mean numbers were taken from quantitative input from the workplace survey tool, which include: average hours spent in building, average hours spent sitting, etc. In cases where questions were asked in 5-scale Likert format, the categorical variables were converted into continuous through simple conversion of 1 to 5 points (score of 5 as 'strongly agree' and 1 as 'strongly disagree).

Design attributes included in the analysis were related to user perception of the accessibility of stairs, efficiency of floor plan, satisfaction with the spatial environment, effectiveness of work environment, and the workplace's ability to support communications. There are significant differences in means between the 'perceived stair access' and the 'satisfaction with the spatial environment' among the two sites. Site A has a significantly higher satisfaction with the spatial environment while it has a significantly lower perceived stair access (both at p=<.0001). Mean ratings of 'perceived workplace effectiveness' significantly differs between Site A and B at p=0.0094.

	Site A		Site B		
Design Attributes	**Mean**	**Std Error**	**Mean**	**Std Error**	**P-value**
Perceived stair access	2.76	0.19	3.93	0.16	<.0001
Perceived floor efficiency	4.14	0.14	3.85	0.11	0.1148
Satisfaction with spatial environment	4.3	0.19	3.2	0.16	<.0001
Perceived workplace effectiveness	4.07	0.15	3.5	0.14	0.0094
Design support communications	4.2	0.15	3.63	0.13	0.0045

Table 34. Design Attributes ANOVA Analysis

Behavioral attributes included in this analysis were individuals' personal perception about their job, social network, and personal habits at work. Behavioral attributes questions specifically addressed: perception of sitting too much, motivation at work, adoption of office culture, and relationship with colleagues. Behavioral attributes were rated consistently across two research sites with Site A ratings being

marginally higher compared to those of Site B. There is not any significant difference of results across the two sites for any of the behavioral attributes.

	Site A		Site B		
Behavioral Attributes	**Mean**	**Std Error**	**Mean**	**Std Error**	**P-value**
Perception of sitting too much	3.69	0.16	3.56	0.13	0.5313
Feeling motivated at work	3.69	0.16	3.55	0.14	0.5015
Embrace culture of the office	3.73	0.14	3.63	0.12	0.5957
Great relationship with colleagues	3.97	0.14	3.78	0.12	0.3123

Table 35. Behavioral Attributes ANOVA Analysis

Physical activity attributes include the average time spent in the building, average hours sitting, stories climbed per week, and the number of times individuals stand up from their desk per day. There is a significant difference in the average 'hours spent in the building' among the two sites (at p=0.0401); Site B spent, on average, higher number of hours in the building. A significant difference was also found in the means of 'stories climbed per week', at p=0.0003, highlighting Site B's mean of stories climbed approximately 9 times higher than that of Site A. There are no significant differences reported between 'hours spent sitting per day' or the 'number of stand-ups per day'.

	Site A		Site B		
Physical Activity Attributes	**Mean**	**Std Error**	**Mean**	**Std Error**	**P-value**
Hours spent sitting per day	8.63	0.56	8.71	0.48	0.9078
Hours spent in the building per day	8.37	0.18	9.10	0.23	0.0401
Stories climbed per week	1.23	2.08	11.61	1.78	0.0003
Number of stand-ups per day	12.53	1.53	12.84	1.30	0.8784

Table 36. Physical Activity Attributes ANOVA Analysis

6.10.2. Chi Square: Key Sedentary Behavior Metrics

The study prioritizes four metrics that were highly contributed to the level of sedentary behavior in workplace, namely: 1) individual physical activity (PA) level, 2) number of physical turns from individual seats to shared community spaces, 3) seat types, and 4) distance from support spaces. A non-parametric data analysis Chi

Square test was utilized to understand distinct differences between Site A and Site B metrics.

Physical Activity levels were compared across two sites to identify individual habits and outline any outliers across the two sites. The distribution of PA level across both sites was equally distributed and had no significant value difference as indicated by a chi square p-value of 0.9396.

Key Variables	Site A		Site B		Chi Square
	n	%	n	%	
Physical Activity Level	**30**	**100.00%**	**41**	**100.00%**	
Low	3	10.00%	3	7.32%	0.9396
Moderate	13	43.33%	19	46.34%	
High	14	46.67%	19	46.34%	

Table 37. Physical Activity Level Chi Square

There was significant difference between the number of turns in Site A and Site B seats with a Chi square p-value of 0.0585. Distribution of respondent seats in Site B were more varied than the expected distribution. This indicates that Site B has more visible community spaces than those of Site A.

Key Variables	Site A		Site B		Chi Square
	n	%	n	%	
Number of turns	**28**	**100.00%**	**40**	**100.00%**	
Zero turn (completely visible)	0	0.00%	5	12.50%	0.0585
One to two turns	9	32.14%	19	47.50%	
Three to four turns	15	53.57%	14	35.00%	
More than four turns	4	14.29%	2	5.00%	

Figure 63. Number of Turns Chi Square

The types of seats occupied by respondents in Site A and Site B were fairly distributed across all categories and were aligned with the expected outcomes. There was not any significant difference between Site A and Site B seat types (Chi square p-value of 0.6347).

Key Variables	Site A		Site B		Chi Square
	n	%	n	%	
Seat Types	**28**	**100.00%**	**39**	**100.00%**	
Windowless	3	10.71%	3	7.69%	0.6347
Middle row	7	25.00%	8	20.51%	
Nearby aisle	11	39.29%	12	30.77%	
Nearby windows	7	25.00%	16	41.03%	

Figure 64. Seat Types Chi Square

An understanding of the range of distances to community spaces helps determine specific relationships between distance and other key sedentary behavior metrics. The distance of seats to community spaces was measured by a CAD tool to identify distance between each respondent's seats to key community space, such as: employee café. Distance types were highly varied among the two sites. There was a significant difference between the distance types among Site A and B with 0.0072 Chi Square p-value.

Key Variables	Site A		Site B		Chi Square
	n	%	n	%	
Distance from Support	**28**	**100.01%**	**39**	**100.01%**	
0 to 30 feet	4	14.29%	11	28.21%	0.0072
31 to 60 feet	0	0.00%	9	23.08%	
61 to 120 feet	6	21.43%	7	17.95%	
>120 feet	18	64.29%	12	30.77%	

Figure 65. Distance to Support Spaces Chi Square

6.11. Hypotheses Correlational and ANOVA Analysis

A Pearson Correlation analysis was used to identify any correlations between key variables highlighted in the initial hypotheses and the confidence level of such relationships. Statistical results were reported by site to compare distinctive responses to each site's work environment and to identify any additional unique attributes of each site's physical environment attributes that contributed to the amount of sedentary behavior.

6.11.1. Hypothesis 1: Distance from Community Spaces

H.1: Building occupants who are seated further away from shared community spaces will have higher sedentary behaviors than those seated closer to community spaces due to distance perception.

Site A: Hypothesis 1

	Hours Sitting	Nmbr of Standups	Distance from Support
Hours Sitting	1.0000		
Nmbr of Standups	-0.0370	1.0000	
Distance from Support	0.0292	0.1178	1.0000

Table 38. Site A: Correlations between distance from support and physical activity

A Pearson correlation test indicated no significant correlation between the distance of community spaces and number of standups among Site A respondents. Number of standups are weakly correlated with desk's distance from community spaces (r=.1178, p=.2338). This weak correlation is not significant.

Site B: Hypothesis 1

	Hours Sitting	Nmbr of Standups	Distance from Support
Hours Sitting	1.0000		
Nmbr of Standups	0.1104	1.0000	
Distance from Support	0.2451	0.2976* p=0.007	1.0000

Table 39. Site B: Correlations between distance from support and physical activity

There are some positive correlations between distance from support and physical movement in Site B. Number of standups have a positive correlation with distance from support (r=.2976, significant at p= 0.007). This relationship indicates that individuals who are seated further from community spaces will likely stand-up more often than those individuals seated closer to these spaces. Number of hours sitting is positively correlated with desk's distance

from community spaces, however not statistically significant (r=.2451, p=.8179).

Correlation between Distance and Number of Stand-Ups

The variation of number of standups between different distance groups among the two sites reveal an interesting trend. Group #1 participants who were seated between 0 to 30 feet away from support spaces universally had the least number of average standups (mean of 10.75 and 10 stand-ups a day for both Site A and B respectively). Site A respondents' average standups dropped among those seated 61-120 feet away and increased for those seated more than 120 feet away from community spaces. In contrast, the average number of standups seem to increase with distance among Site B respondents. Site B's Group #2 and #3 who were seated 31-60 feet and 60-120 feet away from support spaces, overall had higher average of stand-ups with an average of 11.44 and 15.86 stand-ups per day. This statistically significant finding suggests that the Distance to Support has some influence on the frequency of individuals getting up from their desk throughout the day; this was especially demonstrated in Site B results. Site A respondents seated in between 0 to 30 feet and 31-60 feet group opted to not answer to the standup questions and therefore were not represented in the chart below.

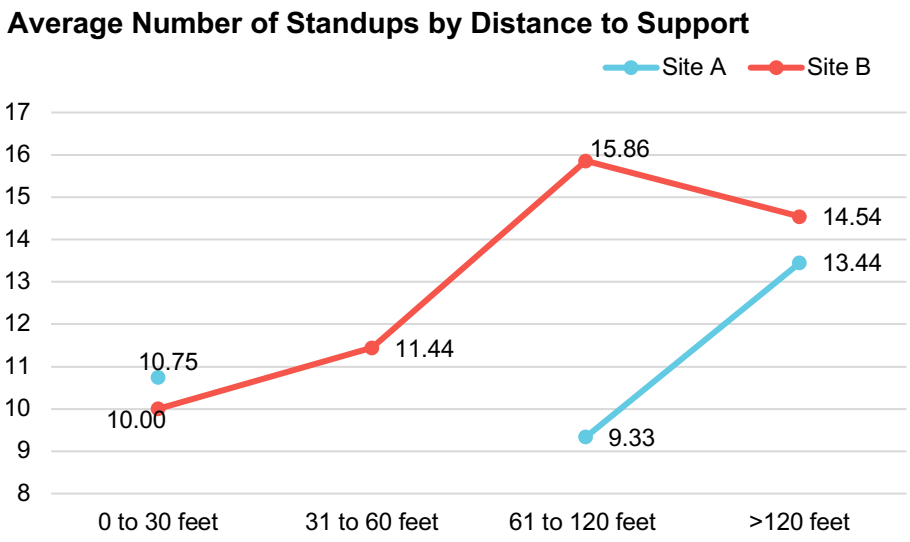


Figure 66. Comparison of Average Standups by Distance to Support by Building

Comparison of Distance to Support and Average Standups

Distance		Site A	Site B
0 to 30 feet	Avg Standups	10.75	10.00
	N	4	11
31 to 60 feet	Avg Standups	-	11.44
	N	-	9
61 to 120 feet	Avg Standups	9.33	15.86
	N	6	7
>120 feet	Avg Standups	13.44	14.54
	N	18	12
Not Answered	N	2	2

Figure 67. Comparison of Distance to Support and Average Standups

ANOVA analysis of distance and level of PA

Relationship between level of PA and distance from support was analyzed through one-way ANOVA analysis to compare Site A and Site B results.

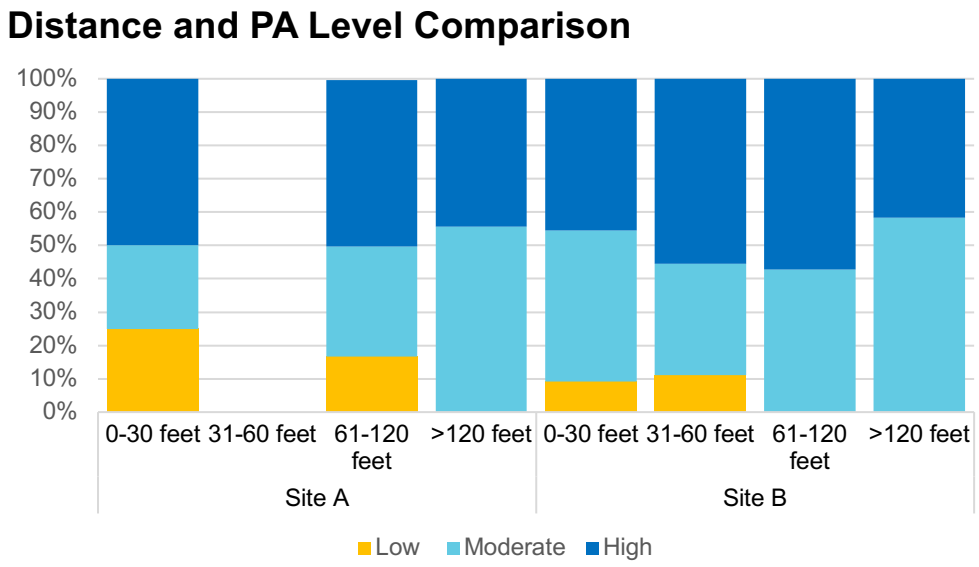


Figure 68. Comparison of Distance and PA Level

The distribution of 'high' physical activity level is constant across all seats from varied distances, at more than 40% of each group. 'Moderate' physical activity level was consistent among those seated more than 120 feet away from support spaces. None of the 'low' level of physical activity respondents was in the >120 feet away category of seat distance. Fisher exact test of chi square of both sites' results indicated p-values of .2688 and .8798 for Site A and Site B respectively. At significance level of 0.1, the null hypothesis of independence is not rejected, there is no correlation between distance and individuals' PA level.

6.11.2. Hypothesis 2: Visibility of Community Spaces

H.2: Building occupants will have higher sedentary behaviors if the location of their seats has a higher number of directional turns (which indicated lower visibility) to shared community spaces.

Comparison of Community Spaces Visibility

As mentioned in the previous chi square analyses, a significant difference between the number of turns in Site A and Site B was observed, with a Chi square p-value of 0.0585. Distribution of respondent seats in Site B is more varied than the expected distribution. This indicates that Site B has more visible community spaces than those of Site A.

Correlation between number of turns and PA variables

Site A: Hypothesis 2

	Hours Sitting	Number of Standups	Number of Turns
Hours Sitting	1.0000		
Nmbr of Standups	-0.0370	1.0000	
Number of Turns	0.3769* p=0.0577	0.2032	1.0000

Table 40. Site A: Correlation between number of turns and PA variables

There is a significant positive correlation between the number of turns to community spaces and the reported number of hours sitting at r=.3769, p=.0577 among Site A respondents. This strong correlation suggests that individuals seated in an area with lower visibility to community spaces, as indicated by the higher number of turns from individual desk, tend to be more sedentary than their colleagues with a more direct visibility to the community

spaces. Number of turns area is somewhat correlated with the reported number of standups, however this number is not statistically significant.

Site B: Hypothesis 2

	Hours Sitting	Number of Standups	Number of Turns
Hours Sitting	1.0000		
Nmbr of Standups	0.1104	1.0000	
Number of Turns	-0.0177	-0.0241	1.0000

Table 41. Site B: Correlation between number of turns and PA variables

There is no significant correlation observed between the number of turns and PA variables (hours sitting and number of standups) across Site B respondents. This may be due to the lack variety between the seat types among Site B respondents.

Analysis of Number of Turns and Individual PA Level

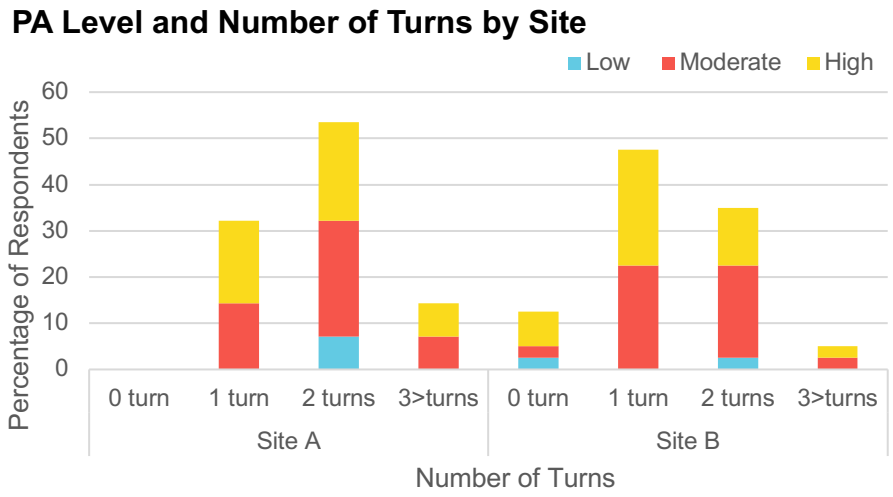


Figure 69. Comparison of Number of Turns and Respondents' PA Level

ANOVA Number of Turns and PA Level

		0 turn	1 turn	2 turns	3>turns
Site A	Low	0	0	7.14	0
p=.9505	Moderate	0	14.29	25	7.14
	High	0	17.86	21.43	7.14
Site B	Low	2.5	0	2.5	0
p=.449	Moderate	2.5	22.5	20	2.5
	High	7.5	25	12.5	2.5

Table 42. Comparison of Number of Turns and PA Level

Results from both sites indicated there is no correlation between number of turns from desk to support spaces and individuals PA level at p=0.9505 and p=.449 for Site A and B respectively. This means visibility of shared community spaces has no direct impact on individuals' PA level.

6.11.3. Hypothesis 3: Awareness towards Sedentary Behavior

H.3: Perception of sitting too much and individual awareness towards sedentary behavior topic have an impact on individuals' physical movement in the workplace.

Correlation between sitting perception and PA variables

Site A: Hypothesis 3

	Hours Sitting	Number of Standups	Too Much Sitting
Hours Sitting	1.0000		
Nmbr of Standups	-0.0370	1.0000	
Too Much Sitting	0.0427	0.1618	1.0000
Stories per Week	-0.0134	-0.2429	-0.2367

Table 43. Site A: Correlation between perception of sitting and PA variables

Perception of sitting among Site A respondents is somewhat positively correlated with the number of standups (r=0.1618), however this finding is not statistically significant. Number of stories climbed per week is negatively correlated with number of standups and perception of sitting too much, however these findings are not significant.

Site B: Hypothesis 3

	Hours Sitting	Number of Standups	Too Much Sitting
Hours Sitting	1.0000		
Nmbr of Standups	0.1104	1.0000	
Too Much Sitting	-0.0013	0.1460	1.0000
Stories per Week	0.0164	0.0379	0.4339* p=0.0082

Table 44. Site B: Correlation between perception of sitting and PA variables

Site B results show similar non-significant results among variables mentioned in Site A. However, a significant correlation is evident between stories climbed per week and the perception of sitting too much variables at r=.4339 (p=.0082). This correlation suggests that building respondents who felt that they sit too much also climbed more flights of stairs per week.

Correlation between Sitting Perception and Stories Climbed per Week

A closer analysis of the perception of sitting among individuals as agreed in statement “I sit more than I should during work week” reveals significant differences in responses from Site B. Respondents from both sites who do not feel they sit too much also did not climb any stairs during the week. Site A respondents who felt neutral, disagreed, or strongly disagreed about the substantial amount of sitting they do during weekdays did not report any stairs climbed during the week of survey. A correlation test did not reveal any significant pattern among respondents from Site A, individuals across all perception levels had somewhat consistent stair climbing activity. These results may have also been due to limited accessibility of staircase in Site A. Results from Site B, however, have interesting stair climbing behavior pattern in relation to their sitting perception. Site B respondents who do not think they sit more than they should also logged zero flight of stairs. The number of stairs climbed increase for those respondents who were more aware about their sitting behavior, shifting from 0 flights to 12 flights. Interestingly, those who felt that they sit more than they should climbed a similar number of flights per week to those who felt otherwise. Individuals who feel neutral about their sitting behavior logged the highest number of stories climbed in a week at an average of 15 stories per week. Individuals who strongly felt that they sit more

than they should also rank second lowest in the average stories climbed per week.

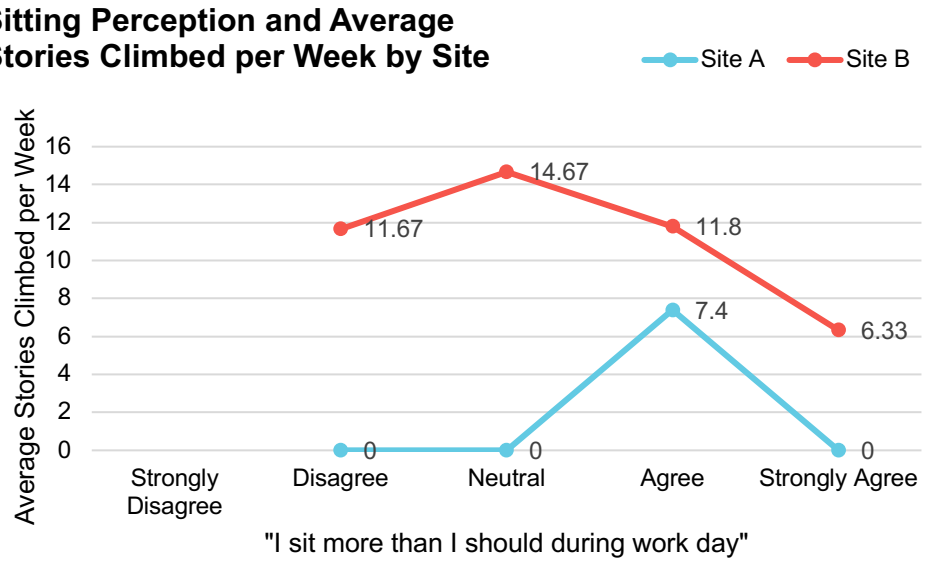


Figure 70. Sitting Perception and Average Stories Climbed per Week by Site

Correlation between Sitting Perception, PA Level, and Decisions for Climbing Stairs

A significant portion of Site A respondents, at 40% indicated they sit too much during their workdays. Approximately one-third of individuals who have 'high' and 'moderate' PA level also indicated 'too much sitting' as their main reason for climbing stairs – this finding is consistent between Site A and B. A third of Moderate and High PA level individuals from Site A indicated perception of 'sitting too much' as main reason for taking the stairs. A slightly lower percentage of individuals from Site B, at 29% of Moderate and High PA level individuals shared the same sentiment for taking the stairs.

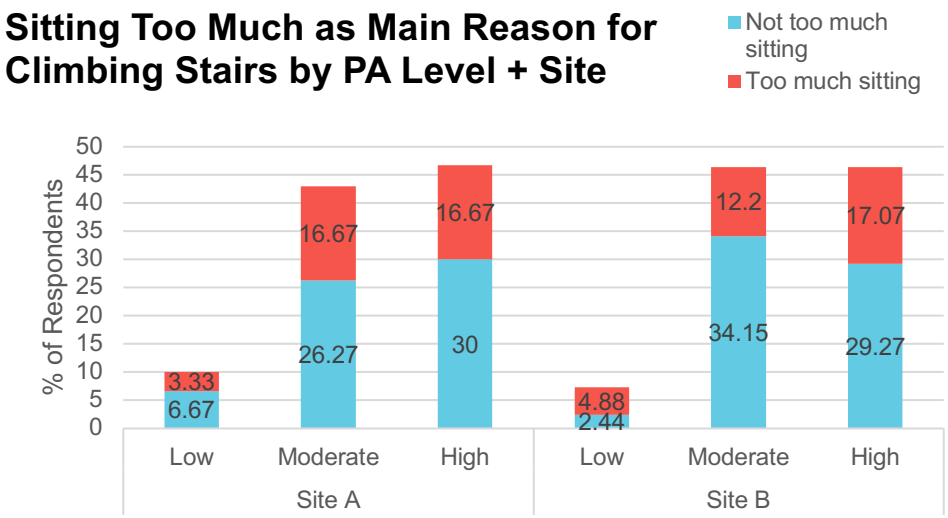


Figure 71. Perception of Sitting Too Much as Main Reason for Climbing Stairs

6.11.4. Hypothesis 4: Work Environment and Job Satisfaction

H.4: Satisfaction with the work environment and positive outlook of the organization are positively associated with physical movement in the workplace.

Correlation between Satisfaction Levels and PA variables

Site A: Hypothesis 4

	Hours Sitting	Number of Standups	Motivated at Work
Hours Sitting	1.0000		
Nmbr of Standups	-0.0370	1.0000	
Motivated at Work	-0.3139	-0.1532	1.0000
Spatial Satisfaction	-0.0849	0.0456 p=.0631	0.5026* p=0.0089

Table 45. Site A: Correlation between User Satisfaction and PA Variables

A Pearson correlation test did not reveal any significant relationship between job satisfaction, spatial satisfaction, and the PA variables among Site A respondents. A strong correlation found between spatial satisfaction and users feeling motivated at work at r=.5026 and p=.0089. This finding suggests that individuals who are highly satisfied with their work environment are also

motivated at work. There is no distinct correlation found between spatial satisfaction and number of standups at r=.0457, this result is significant at p=-.0631. A trend towards inverse correlations between feeling motivated at work and the number of hours spent sitting and number of standups was observed at r=-.3139 and r=-.1532, however this result is not statistically significant. If this was true, this would mean individuals who are more motivated at work will sit less and stand up more often than those felt less motivated at work.

Site B: Hypothesis 4

	Hours Sitting	Number of Standups	Motivated at Work
Hours Sitting	1.0000		
Nmbr of Standups	0.1104	1.0000	
Motivated at Work	0.1927	-0.4035* p=0.0147	1.0000
Spatial Satisfaction	0.0092	-0.4162* p=0.0116	0.2711

Table 46. Site B: Correlation between User Satisfaction and PA Variables

In contrast to Site A's results, Pearson Correlation test on Site B results indicated inverse correlations between job and spatial environment satisfactions with the average number of standups. Feeling motivated at work is negatively correlated with the average number of standups at r=-.4035 and p=.0147. Similarly, spatial satisfaction is also negatively correlated with the average number of standups at r=-.4162 and p=.0116. These negative correlations suggest that individuals who are more satisfied with their job and satisfied with their spatial work environment would stand up less during their workday. There was no correlation reported between satisfaction levels and number of hours spent sitting.

Correlation between Job Satisfaction and Average Standups

None of the respondents felt strongly unmotivated at work. Number of standups is comparatively higher among respondents who do not feel motivated at work at an average of 15 and 16 standups per day respectively for Site A and Site B. For Site A respondents, individuals who felt most unmotivated had the highest number of standups. The average number of standups consistently decrease for Site A respondents as they feel more motivated at work. Site A respondents who felt neutral or motivated at work had similar average of standups at approximately 13 standups per day. Those who felt highly motivated at work in Site A had 60% less number of standups than their 'neutral' or 'motivated' peers and had the lowest number of standups at about 8 standups per day.

Site B respondents who felt neutral about their work had the highest average number of standups at about 17 times per day. The numbers of standups of 'motivated' and 'highly motivated' groups significantly declined by 60% from the 'neutral' group at an average of 10 times per day.

Figure 72. Job Satisfaction and Number of Standups by Site

ANOVA Analysis of Spatial Satisfaction and Average Standups

The spatial satisfaction and average number of standups vary significantly across Site A and Site B. Site A respondents who were not satisfied with their work environment have the lowest number of standups at an average of 5 times per day. The average number of standups continued to climb up for those who feel more positively about the space. Site A respondents who felt neutral had an average of 9 standups per day and continued to peak at about 22 average standups per day for those who felt more satisfied. This result from Site A drops to about 11 times of standing up per day for those feeling most satisfied with the work environment.

Contrary to Site A results, Site B respondents who felt very dissatisfied with their work environment had the highest number of standups at an average of 21 standups per day. The average standup continues to consistently decline as individuals reported higher satisfaction level with their work environment. Individuals reported feeling not satisfied and neutral about their space had a consistent average of 14 standups per day. Respondents who felt satisfied

with their environment had about 25% less standup times than those who felt not satisfied or neutral at 11 average standup times. Those who reported the highest satisfaction with Site B work environment had the lowest number of standups at approximately 9 times at any given day. There seems to be an interaction between average number of standups by spatial satisfaction level in both two sites, particularly an opposite impact of spatial satisfaction on the number of standups, however data from Site A was not sufficient to prove this interaction.

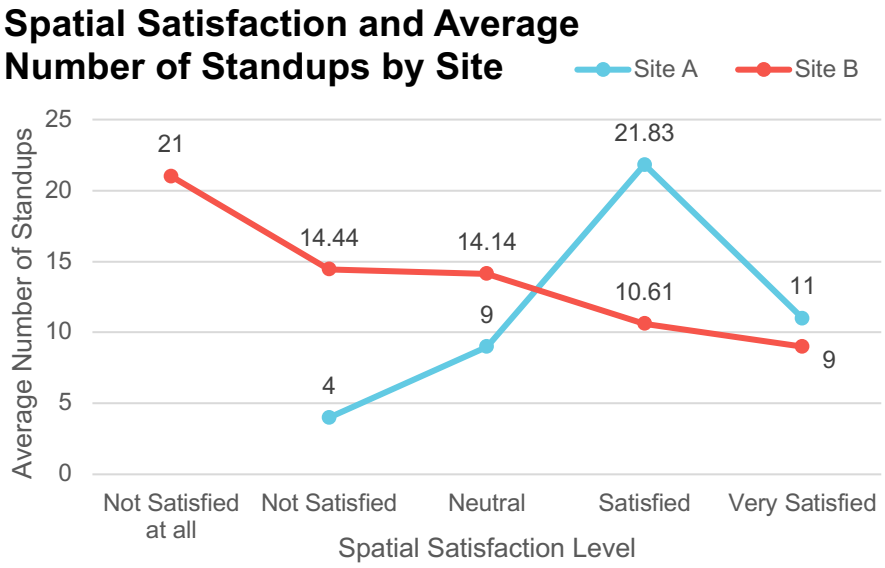


Figure 73. Spatial Satisfaction and Average Number of Standups by Site

ANOVA Number of Standups and Spatial Satisfaction

		Not Satisfied at all	Not Satisfied	Neutral	Satisfied	Very Satisfied	P-value
Site A	Average Standups	-	4	9	21.83	11	0.0631
	N	-	1	6	6	17	
Site B	Average Standups	21	14.44	14.14	10.61	9	0.0943
	N	3	8	11	14	4	

Figure 74. ANOVA Number of Standups and Spatial Satisfaction

Chapter 7: Discussion

7.1. Comparison of Building Design and Site Attributes

Initial analysis of building attributes shows distinctive elements between the two workplace environments, particularly in the building configuration, office design, and workplace layout. Detailed building data provided an evaluation of the physical environment or design attributes that impact physical movement in the workplace. This comparison evaluates the following data: physical environment rating, initial floor plan analysis, site observations, and survey results. Several key design elements evaluated that may have some correlations to user physical activity were: layout, size, accessibility, visibility, and condition of work environment.

7.1.1. Physical Environment Ratings

The key determining physical environment factors to physical movement were: accessibility of spaces and spatial quality of key community spaces. Site A Physical Environment Ratings showed limited visibility and direct access to the shared community spaces, which may lead to a lower utilization of community spaces and reduced movement in the workplace (more concentrated activities within individual workspace area). Accessibility to natural light and wide circulation paths encouraged movement and impromptu collaboration in the workspace areas.

Site B Physical Environment ratings indicated highly-visible and proximate community spaces to the workspace areas. Emergency staircase was highly visible and accessible from the elevator waiting area. The environment ratings in Site B showed a high potential for increasing physical activity level and number of stairs climbed.

		Site A 36/60	Site B 44/60	Predicted Outcomes
Physical Environment Ratings	**Work Environment**	↑ Greater access to outside views ↑ Wider circulation paths ↓ Deep floor plate reduces daylight	↑ Greater daylight penetration ↓ Narrow circulation path	**<u>Site A:</u>** Site A may **have a lower utilization of community spaces** (pantry) and **low stair activity occurrences** **<u>Site B:</u>** Higher ratings for visibility and proximity of community spaces may**increase physical movement**. Accessibility and proximity of emergency stairs may result in **higher utilization of stairs as the main vertical transportation path.**
	Shared Spaces	↓ Enclosed, distant shared pantry ↓ Inaccessible, not visible stairs ↓ Low visibility and proximity of stairs elevators	↑ Open, highly-visible, accessible shared pantry ↑ Accessible emergency stairs ↑ High visibility and proximity of stairs elevators	
	Individual Workspace	↓ Better quality of natural light only for a portion of seats ↓ Views are only accessible to approximately 70% of seats	↓ Inconsistent daylight quality across different seat types ↑ More equitable outside views in the open workspace areas	
	Overall Score	**36/60** (60/100) Higher rating in work environment, however fell short in shared spaces ratings, specifically in accessibility, proximity and visibility of stairs and community spaces.	**43/60** (72/100) Similarly rated building attributes, however had higher ratings in the visibility, proximity, and accessibility of stairs to promote physical activities in the office.	

Table 47. Comparison of Physical Environment Ratings

7.1.2. <u>Building Design Attributes</u>

Building design attributes combined with in-depth floor plan analysis of both sites show different types of expected activities and movement between the two sites. Site A's larger floor plate size and configuration will promote greater interaction (both sitting and standing) between team members along the main circulation aisle, however fewer walking activities between spaces. Site B's narrower circulation path will discourage impromptu interactions between groups, however promote more physical movement from one space to another.

		Site A	Site B	
Building Design Attributes	**Building**	Recently renovated, higher user satisfaction of work environment (4.3/5 average satisfaction)	Older renovation with lower user satisfaction (3.2/5 average satisfaction)	**Site A:** Larger floor plate with wider circulation paths may result in **lower movement between spaces but greater impromptu collaboration along main circulation paths.** **Site B:** Community spaces distributed along main circulation path may result in **more activated community spaces.** Accessible staircase will **increase the physical activity level and number of stairs climbed.**
	Floor Location	↓ Located in higher floor (6th) results in perception of far proximity to ground floor	↑ Located lower on the 4th floor allows for better perception of proximity to ground floor	
	Floor Plate Size	Larger floor plate with more circulation paths	Smaller floor plate with one single main circulation path	
	Layout/ Configuration	Centralized community hub, equally accessible from workspace areas	Centralized community spaces along circulation paths allow for maximum visibility from workspace	
	Access to Stairs	Limited accessibility, emergency stairs only available for descending the stairs.	Accessible to employees, close proximity and high-visibility from elevator lobby.	

Table 48. Comparison of Building Design Attributes

7.1.3. Workplace Metrics

Workplace metrics were used to understand the relationship between distribution of spaces and quality of work environment to support work. High density floor plans are affected by the individual desk footprint, amount of collaborative and community spaces, and the amount of circulation on the floor. Typically, a denser floor plan and smaller footprint would result in greater quantity of collaborative spaces, which will promote physical movement in the workplace. Site A has a higher density floor plan with smaller footprint of desks, however lower collaboration ratio and smaller community spaces. Lower allocation of shared collaborative and community spaces in Site A will result in individuals utilizing their desk for most their work activities and in turn result in less physical movement. Site B has significantly greater allocation of collaborative seats and higher share of community spaces, which may encourage more movement and foot traffic across the floor.

		Site A	Site B	
Workplace Metrics	**Density** *(USF/seat)*	130 USF/seat Density is lower than benchmarked density among Arch/Design industry at 168USF/seat (GSA, 2012)	184 USF/seat Density is higher than benchmarked companies (GSA, 2012)	**Site A:** Greater floor density and smaller desk footprint may **encourage users to move often,** however lower collaboration ratio may increase amount of time spent at desk and subsequently lower physical movement. **Site B:** Greater availability of collaboration seats may result in **higher utilization of meeting spaces and in turn more physical movement.**
	Workstation Size	36 SF (6' x 6' footprint) Smaller footprint encourages users to utilize collaborative spaces in the office.	42 SF (6' x 7' footprint) Larger footprint allows other activities to take place in desk area (one-on-one conversations, etc.)	
	Collaboration Ratio	1 : 2.4 workplace seats	1 : 1.8 workplace seats	
	Community Space Allocation	440 SF 12 seats / 7% of total seats	410 SF 8 seats / 8.5% of total seats	
	Proportion of Community Space	2.5 SF/seat Below industry average (at approximately 4sf/seat)	4.4 SF/seat Approximately 2.4% of total floor plate	

Table 49. Comparison of Workplace Metrics

7.1.4. Distance of Community Spaces

Distance between community spaces and workspace areas were measured by the range of distance from the closest and furthest workspace desks. Both sites have a similar range for the maximum distance at approximately 10 times further from the closest workspace areas. At its furthest, community spaces in Site A were located twice as far as that of Site B, which may have resulted in the lower trip occurrences in Site A and greater trip occurrences among Site B respondents.

		Site A	Site B	
Distance of Comm. Spaces	**Min. Distance** *(Workspace to Community Spaces)*	20 feet	10 feet	**Site A:** Wider distance range and further proximity of community space may result in **fewer number of standups.** **Site B:** Narrower distance range and closer proximity of community space may result in **greater number of standups.**
	Max. Distance *(Workspace to Community Spaces)*	210 feet	124 feet	

Table 50. Comparison of Distance of Community Spaces

7.1.5. Activities Mapping (Actual Utilization)

Floor plan analysis and activities mapping showed the opposite trend of hypothesis from Site A, showing the highest concentration of foot traffic occurring in the shared community spaces and the narrow secondary circulation path. Users only utilized the narrower secondary circulation paths as connecting points, and instead utilized the wider primary circulation as merely circulation paths. These may be caused by the level of formality in the client meeting areas at the end of the primary circulation path that discourages lingering use of this path as informal collaborative areas. The café was highly utilized during peak lunch hours between 12pm - 2pm despite the initial environment rating hypothesis for low café utilization due to the perception of distance. As expected, survey results revealed very low utilization of emergency staircase given the low visibility and limited accessibility of the staircase.

Similarly, as predicted, Site B respondents mainly utilized the main corridor only for circulating around the office environment. Given the corridor width, users were hesitant to utilize this path for longer conversations. Small group meetings of two to three people occurred in the open workspace team pod areas. As predicted, users utilize community spaces for socializing and interacting with colleagues. These community spaces were highly utilized during peak lunch hours and intermittently throughout the afternoon. The openness of the staircase facilitated better utilization of the emergency staircase and eliminate the use of elevator. Through interviews, users reported working on computer at their desks with occasional meetings throughout the day. Generally, users opt for elevators as their first option for vertical transportation.

7.2. Key Survey Findings

The majority of respondents from both sites were highly active and engaged in an adequate amount of physical activity. PA levels in both sites were consistently distributed with no significant difference. More than 90% respondents from both sites were identified with high or moderate level of physical activity per the IPAQ (International Physical Activity Questionnaire) standard. Both sites have similar proportion of PA level at approximately 45% respondents with high PA, 45% with moderate PA, and 10% with low PA level. Site A respondents with low PA level reported an average 30 minutes of moderate activities and average 80 minutes of walking per week. Site B respondents with low PA level reported an average 30 minutes of moderate activities and average 80 minutes of walking per week.

7.2.1. Respondent Habits

	Site A	Site B	Notes
Hours Spent in Building	8 hours (average)	9-10 hours (average)	P=0.0401 Significant at <0.05
Stories Climbed / Week	1.23	11.61	P=0.0003 Significant at <0.05
Building Tenure	2.9 years	4.7 years	

Table 51. Site A and B Respondent Habits Comparison

Survey outcomes for both sites demonstrated key significant differences in site respondent profiles. Average number of hours spent in the building per week significantly varied. Site A respondents, on average, spent less hours in the building than average Site B respondents and also spent less time in the office than their counterparts in Site B. Site B respondents on average have been working in the building much longer than those of Site A and regularly spent more time in the building. The number of stories climbed per week was also highly varied, with Site B respondents climbed almost 10 more times than Site A respondents. This result is

\aligned with the interview and survey findings on stair access; Site A only had limited stair access (exit only), compared to full stair access in Site B.

7.2.2. Building Attributes

	Site A	Site B	Notes
Availability of Signage	No	Yes (seasonal)	
Number of Turns	3-4 turns (majority)	1-2 turns (majority)	0.0585 chi square Significant at <0.1
Perceived Stair Access	2.76/5	3.93/5	P=<.0001 Significant at <0.1
Community Spaces Distance	>120 feet (majority)	Evenly distributed between 0-120 ft.	0.0072 chi square Significant at <0.1

Table 52. Building Attributes Comparison

Above four distinct attributes (signage availability, visibility of community spaces, stair accessibility, and proximity of community spaces) significantly differ among Site A and B. Site A does not have any signage promoting physical movement compared to temporary health-related campaign signage in Site B. Visibility of community spaces is low in Site A with an average of 3 to 4 turns from individual desks, compared to 1 to 2 turns in Site B. Perceived stair accessibility is low in Site A compared to Site B's highly visible stairs. Community spaces was mainly located more than 120 feet away from a high proportion of workspace in Site A, whereas Site B seats were more dispersed evenly across multiple distance groups.

7.2.3. Overall Physical Activity Level

During the stakeholder interviews, participants from both sites emphasized that overall building occupants have highly active lifestyles given the urban office location. The surrounding neighborhoods of both Site A and B have limited supply of public parking with costly parking rates. Interviewees from both sites reported that

most their office population walk or utilizes public transportation as their primary means of coming in and out of the office.

7.2.4. Satisfaction

	Site A	Site B	Notes
Overall Satisfaction	77% satisfied* 4.30/5.0	45% satisfied* 3.2/5.0	
Ability to support work	4.33/5.0	3.48/5.0	P=.0094 Significant at <0.1
Support Communications	4.2/5.0	3.63/5.0	P=.0045 Significant at <0.1
Overall Work Environment	Higher ratings across questions	Lower ratings across all questions	
Individual Workspace	3.8/5.0	3.1/5.0	
Ambient Environment	3.05/5.0	2.92/5.0	
Ergonomics	3.53/5.0	3.22/5.0	
Pantry	3.32/5.0	3.05/5.0	
Conference Rooms	3.35/5.0	3.08/5.0	

**percentage of respondents rated 'satisfied' or 'very satisfied'*
Table 53. Satisfaction Comparison

Overall satisfaction of the workplace environment varied significantly between the two sites. More than three quarter of Site A respondents reported satisfaction compared to less than half in Site B; this finding was significant (p=<.0001). Overall satisfaction of work environment also correlates with the workplace ability to support work and communications, as shown in the consistent ratings across two sites for these questions. Site A respondents also rated all "Overall Work Environment" attributes more favorably than those of Site B. Site A was also rated higher satisfaction for individual workspace than Site B, although the satisfaction margin in

this category narrowed (10% margin). “Ambient Environment”, “Ergonomics”, “Pantry”, “Conference Rooms” were rated consistently with higher reported satisfaction in Site A (5- 10% satisfaction margin).

7.2.5. Demographics

	Site A	Site B
Gender (Male/Female)	Majority Female 36 / 62 (%)	Majority Male 55 / 45 (%)
Generation	Majority Millennials and GenX	Majority GenX and Baby Boomers
Weight	57% Normal 23% Overweight 7% Obese	51% Normal 24% Overweight 10% Obese

Table 54. Site Demographics Comparison

Both sites have opposite composition of males and females. Site A having a slightly higher female population at 62%, whereas Site B has higher proportion of males at 55%. Site A has younger survey respondents, comprising of Millennials and Gen X, compared to Site B with Gen X and Baby Boomers in majority. Site B also has a higher proportion of Obese and Overweight respondents, at about 34% of total population. Additionally, a higher proportion of males were found in the Overweight or Obese category, nearly four times more than females in this study. Education levels are associated with weight category. Respondents in this study who had Associate/High School education were all classified under Overweight or Obese category. This observation may imply relationship between education level, awareness of physical activity, and individual lifestyles. Both sites have high proportion of participants graduated with bachelors or higher in addition to a predominantly healthy profile.

7.3. Hypothesis Discussion

Multiple data points in this study indicated the built environment as one of the key defining factors for encouraging physical movement in the workplace. Without a doubt, individual physical activity habit is still critical in determining physical movement in the workplace. However, there are design opportunities in which in the built environment could extend physical movement in the workplace. Strategic placement of community spaces and workspaces was one of the key contributors in addition to improved aesthetics of stairs and corridor spaces. Data collected in this study from focus groups, observations, surveys, and secondary data analysis outlined three key design findings and opportunities for encouraging workplace physical movement: visibility of community spaces, proximity of community spaces, and visibility and accessibility of staircase.

7.3.1. Hypothesis 1: Building occupants who are seated further away from shared community spaces will have higher sedentary behaviors than those seated closer to community spaces due to distance perception.

	Site A	Site B	Notes
Hours Spent in Building	8 hours (average)	9-10 hours (average)	P=0.0401 Significant at <0.1
Avg Standups & Avg Min	12.5 standups 4.3 min	13 standups 3.6 min	P=0.8784 Significant at <0.1
Stories Climbed / Week	1.23	11.61	P=0.0003 Significant at <0.1
Perceived Stair Access	2.76/5	3.93/5	P=<.0001 Significant at <0.1
Community Spaces Distance	20-210 ft >120 feet (majority)	10-124 ft Evenly distributed across distances	0.0072 chi square Significant at <0.1

Table 55. Distance and PA Variables Comparison

Significant PA attribute differences (hours sitting and number of standups) were noted among users from variety of seats across Site A and Site B. Site B

respondents generally spend more time in the office with an average of 9-10 hours per day. Consistent among both sites, individuals stand up for an average 13 times a day for 4-5 minutes each. Number of stairs climbed per week differ greatly from Site A to B, with Site B respondents climbed almost 10 more times than those of Site A. As mentioned previously, number of stairs climbed in Site A may be skewed due to the limited accessibility of emergency stairs. Range of community spaces distance to workspace area in Site A almost doubled the distance of Site B, which indicated Site A's significantly larger floor plate.

Pearson Correlation Between Distance and Visibility of Community Spaces and PA Variables

	Stories Climbed/Week	Number of Standups	Hours Sitting	Physical Activity Level
Site A				
Distance from Community	--	--	--	--
Visibility of Community (Number of Turns)	--	--	0.3769 (p=.0577**)	--
Site B				
Distance from Community	--	0.2976 (p=.007*)	--	--
Visibility of Community (Number of Turns)	--	--	--	--

* Significant at p=.05 (two-tailed)

** Significant at p=.1 (two-tailed)

Figure 75. Pearson Correlation Summary: Distance and Visibility of Community Spaces

Site A results do not show any significant correlations between distance and PA variables. At Site B, distance from community spaces is strongly correlated with average number of standups. As distance from desk to community spaces increased, the number of standups increased, hours spent sitting stayed constant. This finding indicates that distance to community spaces does not impact sitting hours but has some influence in impacting individual decisions for standing up

throughout the workday. Interview participants confirmed that accessibility and visibility of community spaces impacted their decisions for moving around the office. This finding is rejects Hypothesis 1 (higher sedentary behavior among workers seated further from community spaces) and is contradictory with previous literature (Hua et al, 2012). The conflicting site results may have been due to different building configurations included in this study. This may also offer more insight around how layout or visibility of built spaces can be the mediator between distance and sedentary behavior.

7.3.2. Hypothesis 2: Building occupants will have higher sedentary behaviors if their seats have higher number of directional turns (which indicated lower visibility) to shared community spaces.

A strong correlation was found between visibility of community spaces (as measured by the number of turns) and number of hours spent sitting in Site A. This finding suggests that individuals occupying workspace with higher number of turns from community spaces will be more likely to sit more and be sedentary than their counterparts seated in seats with greater visibility.

There is a sharp contrast between Site A and B correlations: Site A with its larger floor plate and less visible community spaces resulted in a greater number of hours spent sitting as visibility of community spaces decreases. On the other hand, Site B with its smaller floor plate and higher visibility of community spaces resulted in a higher number of standups as distance increases.

These findings seem to suggest that in larger-scale workplace floor plate, visibility of destination (community) spaces play a more critical role in determining number of hours spent sitting. Minimizing twist and turns along the circulation paths will enable

users to sit less and move more often. There seems to be a relationship between visibility of community spaces and the number of standups per day, however the result was not significant. In smaller scale workplace environment (Site B) with more visible community spaces, distance play a greater role than visibility in impacting individuals' decision-making process of getting up and down from their desks.

Data Synthesis and Outcomes

Predicted Outcomes based on design:

Site A:

» **Physical Environment Ratings:**
Lower utilization of community spaces and stair activities. Higher ratings for visibility and proximity of community spaces will increase physical movement in and out.

» **Building Design Attributes**
Larger floor plate will decrease movement between spaces but higher utilization of main circulation paths.

» **Floor Plan Analysis**
Greater floor density and smaller desk footprint encourage more movement, however lower collaboration ratio will limit utilization of these rooms and increase hours spent sitting.

Site B:

» **Physical Environment Ratings:**
Accessibility and proximity of emergency stairs will result in higher utilization of stairs as the main vertical transportation path.

» **Building Design Attributes**
Community spaces situated along main circulation path will result in more activated community spaces. Accessible staircase will increase the physical activity level and number of stairs climbed.

» **Floor Plan Analysis**
Site B: Greater availability of collaboration seats result in higher utilization of meeting spaces and in turn more physical movement.

Observed Outcomes: Distance + Visibility of Community Spaces:

» **Survey**
Highly active individuals with an average of 12.5 standups and 8.6 hours spent sitting per day. High spatial satisfaction.

» **Interviews**
Cafe and community spaces are highly-utilized during peak lunch and afternoon hours. Meeting rooms are always booked; employees typically meet at their desks.

» **Outcomes:**
Distance to community spaces do not have impact on PA variables, however lower visibility of community spaces (as indicated by increasing number of turns) resulted in an increase in hours sitting. Perception of distance by lack of visibility may also be exarcebated by the scale of floor plate that is larger than Site B.

Site B:

» **Survey**
Highly active individuals with an average of 13 standups and 8.7 hours spent sitting per day. High spatial satisfaction.

» **Interviews**
Slow elevator and easily accessible staircase were the main reasons for utilizing emergency staircase. Small corridor path discourages impromptu collaboration, most meetings occur in meeting rooms and dedicated open meeting areas.

» **Outcomes:**
Greater floor density and smaller desk footprint encourage more movement, however lower collaboration ratio will limit utilization and lower physical movement.

Figure 76. Synthesis of Distance and Visibility of Community Spaces

7.3.3. Hypothesis 3: Perception of sitting too much and individual awareness towards sedentary behavior topic have an impact on individuals' physical movement in the workplace.

Awareness of sedentary behavior and perception of sitting too much do not have an impact on lateral movement in the workplace, however have some impact in stair-climbing activity. At Site B, a significant correlation found between perception of sitting too much and number of stories climbed per week. Those who felt they 'sit more than they should' also climbed more stairs in a week. Awareness of sitting too much is not correlated with any other PA variables (number of hours sitting, number of standups, PA level). At Site A, there is no correlation between perception of sitting and number of stair climbed, however these results may have been affected by limited stair accessibility. A neutral relationship between spatial satisfaction and number of stand-ups was observed in Site A; this result was significant. While there was no previous literature that directly address the impact of sitting too much perception on physical movement or sedentary behavior, this finding is somewhat aligned with study by Trost et al. (2000) concluding that self-efficacy (personal drive for physical movement) is one of the key determinants for making healthy choices.

7.3.4. Hypothesis 4: Satisfaction with the work environment and positive outlook of the organization are positively associated with physical movement in the workplace.

Both sites indicated a positive association between job and spatial satisfaction, individuals who felt motivated at work also felt more satisfied towards their work environment. This finding is especially pronounced and significant in Site A (0.5, $p<0.05$). While these findings were not consistent across sites (correlations between

job or spatial satisfaction and physical movement were not evident in Site A), significant correlation was found between spatial and job satisfaction and number of standups in Site B. This inconsistent finding may have been due to the insufficient responses from Site A which resulted in insignificant finding.

As individuals felt more satisfied with their job or felt motivated at work, number of standup decreases and sedentary behavior pronounces (0.4, $p<0.05$). Similarly, as individuals felt more satisfied with their spatial environment, number of standups decreases, sedentary behavior increases (0.4, $p<0.05$). Individuals who felt unmotivated at work or unsatisfied with their work environment are more likely to get up more often than those who feel more satisfied.

Chapter 8: Conclusion and Design Recommendations

8.1. Research Findings and Conclusion

Distance and visibility of community spaces have distinct impacts on floor plate of different sizes. Visibility of community spaces seem to have strong impact on the number of hours spent sitting daily among users from Site A with the larger workplace footprint. In a larger workplace floor plan with greater distances across all spaces, visibility plays a primary role in determining sedentary behavior, particularly in the number of hours spent sitting. Individuals seated in areas with lower visibility to the community spaces were more likely to spend more hours sitting. As number of turns from desk to community spaces decreases, visibility of community spaces is greater, number of hours spent sitting decreases.

Results from site B that has more visible community spaces indicated that distance plays an important role in determining the frequency of stand ups. In smaller workplace floor plans, where community spaces are mostly visible and easily accessible, distance plays a primary role in advocating for standing up and down throughout the work day. As distance to community spaces increases, the average number of standups also increases. This indicates that individuals seated further away from community spaces will stand up more often than those seated nearby community spaces.

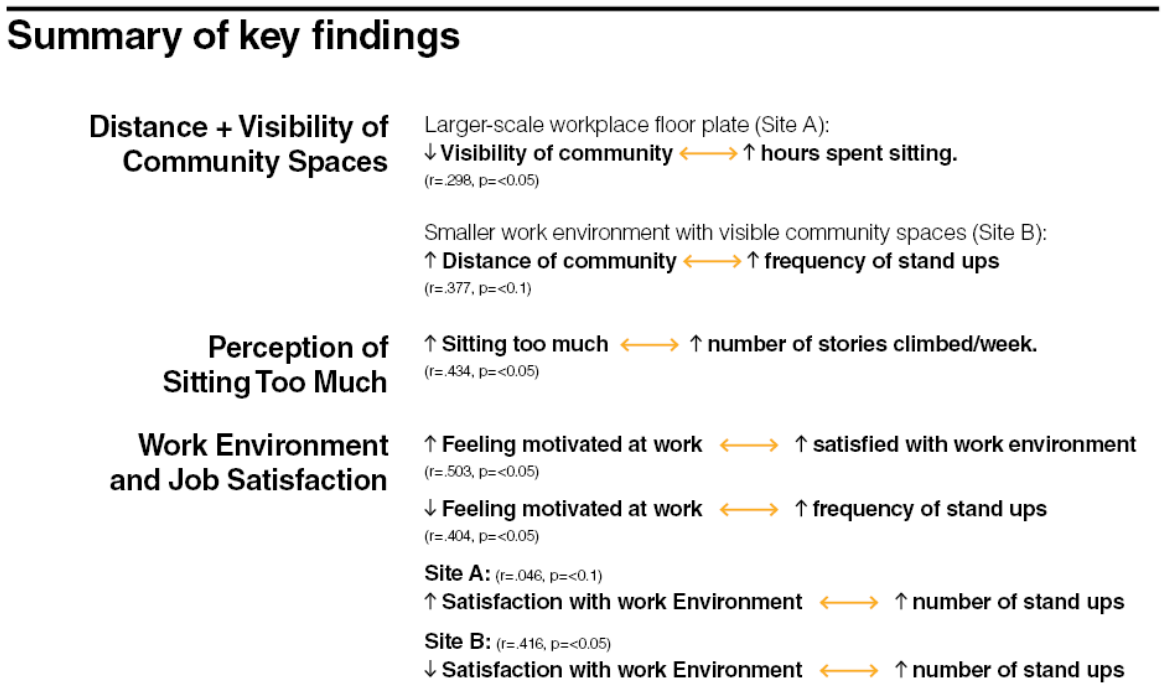


Figure 77. Summary of Research Findings

There is an evident relationship between awareness of sedentary behaviors and perception of sitting too much with our daily decision-making process for taking stairs or elevators. Individuals tend to make conscious decisions for being physically healthy by opting for stairs based on the perception of sitting too much in addition to any other personal factors. A trend found in this study showing highest stories climbed were among individuals feeling neutral about their sitting behavior may indicate a false interpretation. Perception of frequency of climbing stairs may have impacted individuals' perception of sitting too much, in which individuals tend to underestimate the amount of sitting they do given the perception of being active or high stair climbing activity. Job satisfaction as measured by individuals feeling motivated at work correlates with satisfaction with work environment. Interestingly, individuals in the study who felt more motivated at work are less likely to stand up frequently. In order to encourage more movement, combination of sit-stand desk and planning strategies will encourage more stand-ups throughout

the workday. Additionally, correlation between satisfaction with work environment and number of stand ups was inconclusive, yielding opposite results from Site A and B.

8.1. Workplace Planning Recommendations

8.1.1. Location, Sizing, and Visibility of Community Spaces

Visibility of community spaces is critical in encouraging movement across floor plans of all sizes, therefore ensuring that a high percentage of floor occupants have some visibility to these spaces should be a top priority in the planning process. The planning approaches spectrum is broken down into four quadrants with two axes identifying the work neighborhood scale or size and the location of a Community Hub.

Work neighborhoods are described as smaller zones within the overall workplace environment that may be anchored by built enclosed spaces or local support hubs to service each neighborhood, which may include but not limited to: copy/print area, meeting spaces, offices, etc. Community Hub is defined as a larger community area within the floor that are shared and intended to support occupants within the entire floor or workplace. Community Hub may consist of smaller shared spaces clustered within a larger zone that becomes the central gathering space for the organization; spaces within the Hub may include but not limited to: café, kitchen, meeting spaces, gym, hosting spaces, and others.

With the previously reported findings, there are different priorities in planning to encourage movement within the shape and scale of floor plans. Figure 84 illustrates a few planning approaches to achieve a balance between a centralized community hub and localized support hubs to encourage increased traffic from all workspace neighborhoods. The two following

sections will show some examples of active planning and design for floor plans of various sizes and with different configurations of building core design. These diagrams are intended to illustrate planning concepts that can be adapted into more detailed planning scenarios.

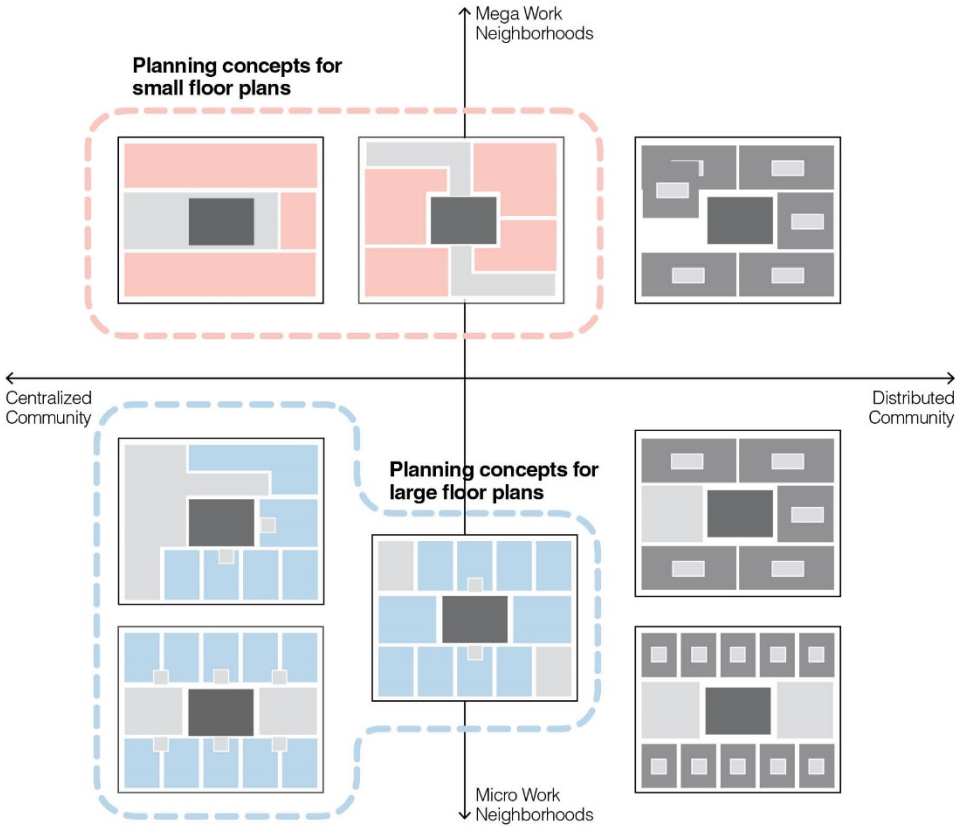


Figure 78. Range of Planning Strategies for Physical Movement

8.1.2. Small Floor Plate Planning Concepts

When designing a smaller workplace floor plan, the highest priority for optimal movement was to minimize distance from Community Hub(s) from workplace seats. Visibility of Community Hub(s) from variety of seat direction also needs to be maintained. Figure 85 illustrates a number of ways to optimize distance while maintaining visibility of these shared destination spaces. Given the scope of this study, there is not specific direction on the threshold of distance

from workplace seats to Community Hub. It is imperative to keep this distance to a minimum; Site B findings indicated that higher distance yielded a higher number of stand-ups per day for up to about 120 feet away from workspace area. Future planning concepts should maintain a maximum of 100 feet distance in order to balance between maintaining efficiency and encouraging breaks in sedentary behavior.

For all planning layouts in both Central and Offset building core configuration, the concepts suggest a placement of reception and community spaces adjacent to the elevator lobby to offer continuity between spaces. Two approaches that can start to offer distinct experience were to create either a centralized Community Hub or Dual Community Hubs. Centralized Community Hub offers a higher buzz of activities that can be appealing to energize the work environment and culture. Dual Community Hubs offers a better zoning between activities in the workplace, for instance, distinguishing between a more formal client meeting hub and a more relaxed ambiance of employee café area. Illustrated planning concepts below indicates a couple strategies for maximizing reach of Community Hub(s) and minimizing distance through a connected parti of shared spaces with elevator lobby/core area being the connective center.

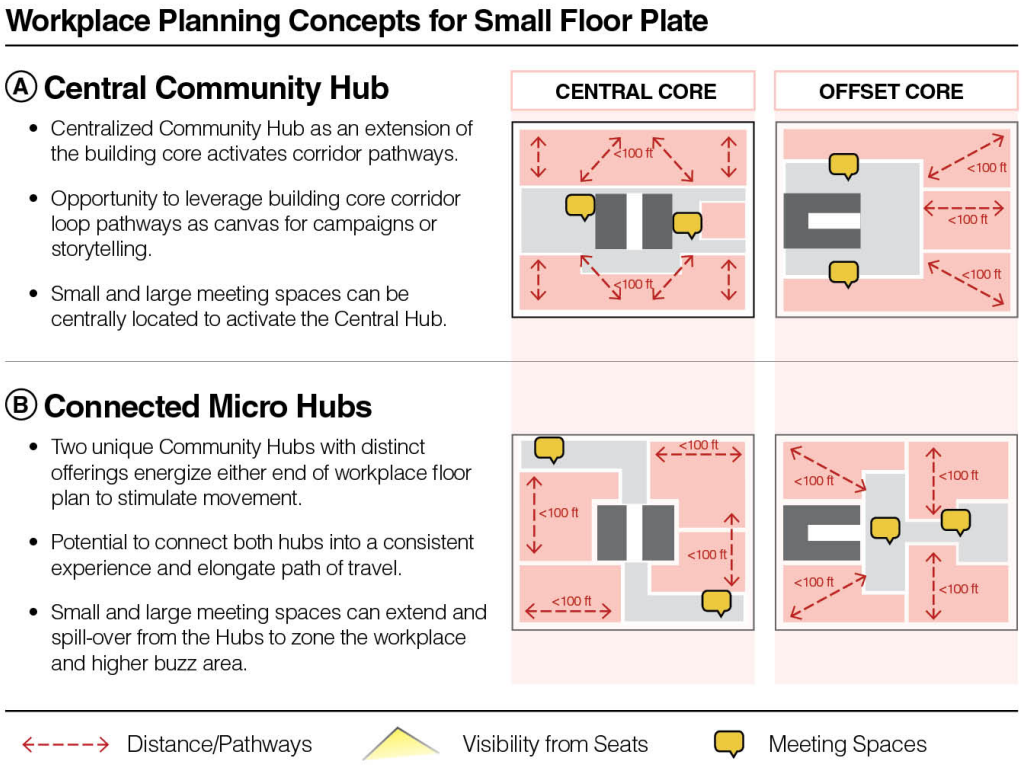


Figure 79. Workplace Planning Suggestions for Small Floor Plates

8.1.3. Large Floor Plate Planning Concepts

When designing a larger workplace floor plan, the highest priority for optimal movement was to maintain visual connection from seats to the Community Hub(s). Across large floor plans, longer distance between seats and Community Hub(s) is inevitable; more enclosed built spaces will result in lesser visibility from seats. Recommended planning concept lies on the location and reach of community spaces to ensure visibility from the majority of workplace seats. Similar to small floor planning concepts, the Community Hub becomes the organizing zoning principles. Elevator lobby will still be leveraged to become the central connective parti. The distinct difference would be the zoning of Dual Community Hub concept, in which one can

become more connected through a series of spaces and connective pathways (as illustrated in figure 80 diagram E).

Support spaces that are typically distributed into neighborhoods (printers, coffee/tea) should be kept at a lower quantity and when possible be more centrally-located nearby the Community Hub. While this strategy may be perceived as inefficient and inconvenient to some, more active movements throughout the workplace will result in reduction in sedentary behavior, greater serendipitous interactions, in addition to improved overall health and well-being.

Areas highlighted in darker blue below indicate potential locations for enclosed spaces to minimize disruption of sightlines between workplace seats and main Community Hub(s). Placing enclosed spaces closer towards building core and carefully around workplace seats could also be beneficial to create smaller neighborhoods while optimizing views for the extent of workplace area.

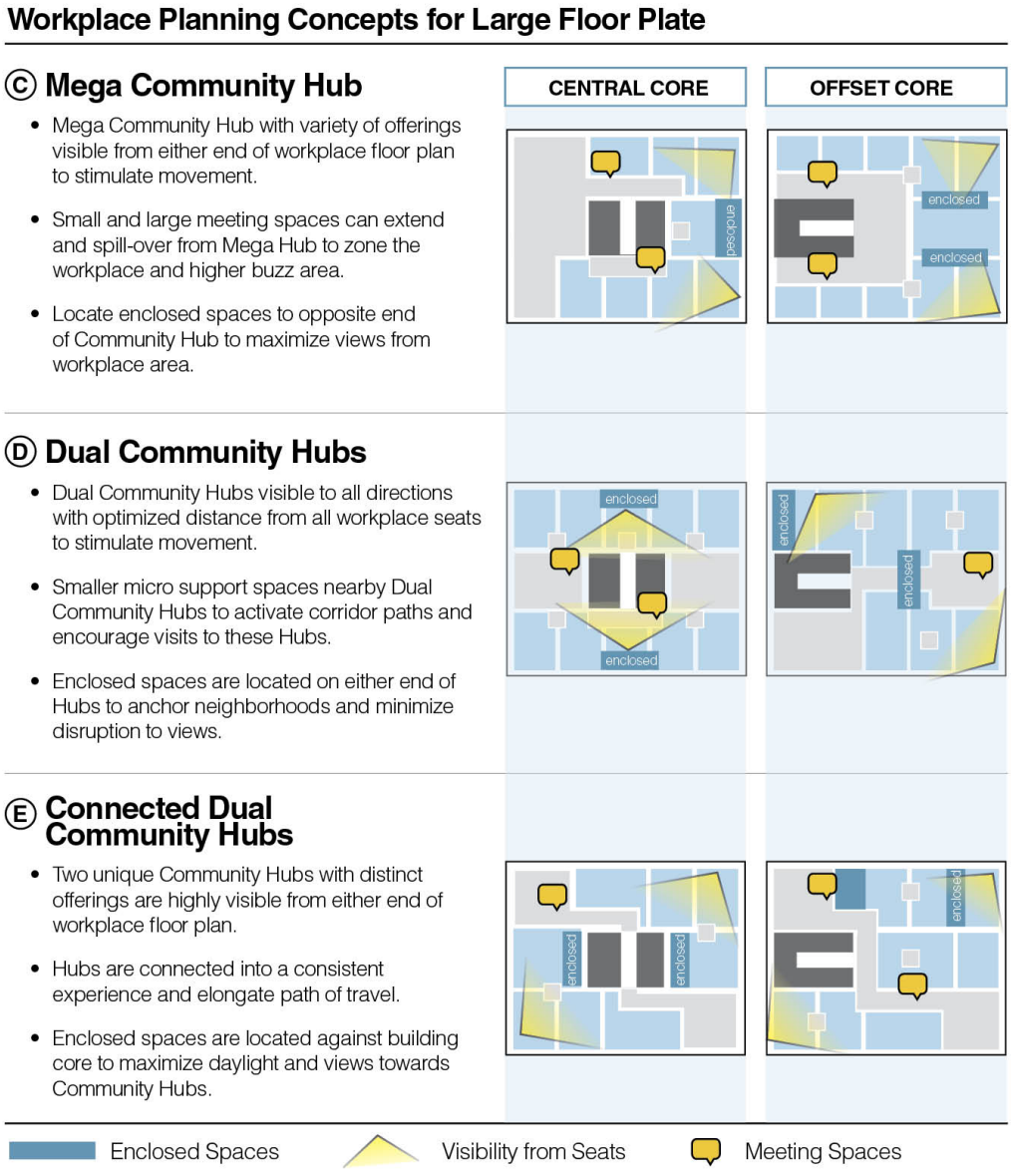


Figure 80. Workplace Planning Suggestions for Large Floor Plates

8.1.4. Other Planning Considerations

Additionally, spaces should be sized accordingly based on the office population. Providing the right size, types and quantity of meeting and community spaces are imperative for appropriate utilization and functionality. Initial demand programming scenario development must consider amount of people expected in the space, level of collaboration, and anticipated activities. Workplace planning must also address employees' workstyles and respond to the organizational culture of the office. The key is to ensure there is enough space for group to utilize; perception of insufficient space or size may discourage users from fully utilizing these spaces. Industry benchmarking information from reputable sources, such as: GSA, and other publications, can be utilized to evaluate and determine appropriate quantity, sizing, and variety of community, collaborative, and individual spaces.

8.2. Workplace Design, Program, and Service Recommendations

Proper workplace planning can only be successful when accompanied with use programming and culture adaptation strategies. Below are several complementary approaches for encouraging greater mobility and promoting sedentary breaks:

8.2.1. Create network of alternative workspaces as third space to encourage experimentation in choosing where to work.

In addition to the traditional approach to Community Hub, such as: café, fitness, Community Hubs should also offer unique workspace areas that can complement typical workplace seats. These network of destination spaces should feel familiar but offer distinctive experience. The developing trend of 'activity-based work' is an opportunity to introduce choices in the workplace

based on the activities users are performing, which will allow users to break the barrier of 9-5 work schedule spent sitting. In addition to segmenting work schedule into more active progressions throughout the day, users will also be able to take a moment of private meditation and respite as they select workspace that is most appropriate to the activity being performed. Activity-based zones should consider variety of seating types, acoustic levels, lighting levels, and technology to enable working anywhere. These activity-based zones may include:

- **Focus Pods:** micro space (can be furniture or enclosed space) dedicated for individuals needing space to do focus heads-down work.
- **Lounge Zones:** multiple arrangements of furniture that are more casual with 'coffee shop' feel as counterpoint to workstation set-ups.
- **Casual Group Zones:** unique design and layout of group meeting spaces are appealing for small groups to take their conversations beyond workstation areas

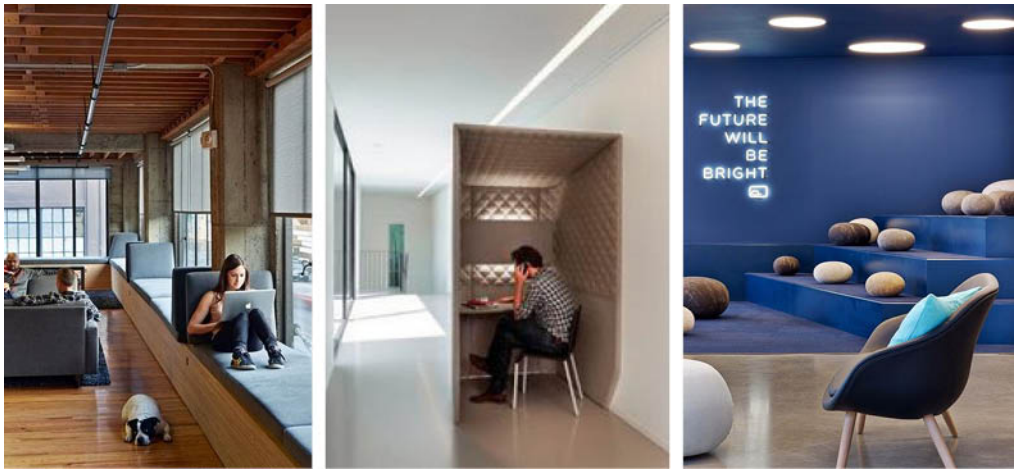


Figure 81. Third Spaces as Alternative Workspaces (Lounge, Focus Pod, Casual Group)

8.2.2. Offer unique 'landmark' spaces to anchor Community Hub(s) and become a 'destination' space

Community Hubs should not only have variety of spaces, but the look and feel of these spaces should be iconic, fun, and welcoming for users to utilize throughout their workday. Spaces like internal connecting stairs, central café, meeting hub, or community activation area like illustrative images shown below can serve as a counterpoint to typical workspaces to provide moments of respite and relaxation to break up a workday. Studies have shown that users anticipate elements of surprise that also come with some familiarity to that experience. For example, a workplace treehouse is iconic and attractive to users as it is reminiscent to childhood memories. When possible, integrate landmark spaces into connecting stairs to encourage both lateral and vertical movement in the workplace. Combination of high activity spaces within interconnecting stairs zone will create a center of gravity that pulls users to participate and be part of the activities.

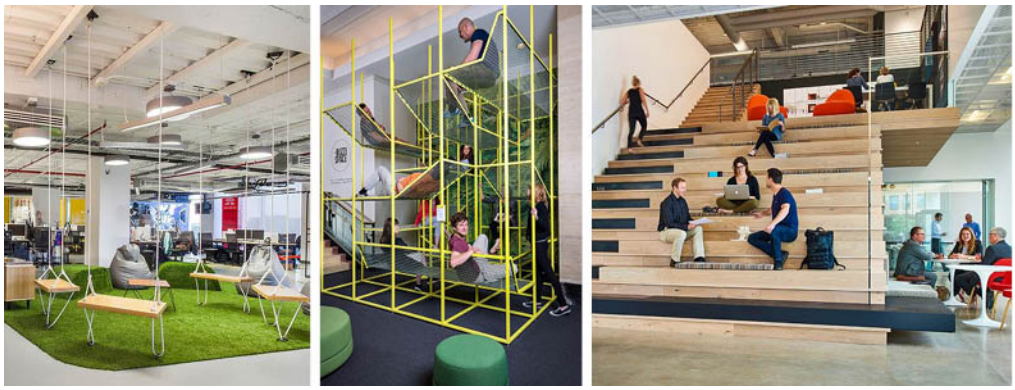


Figure 82. Creating a center of gravity through a unifying design element

8.2.3. Promote healthy initiatives by optimizing connective spaces

Connective spaces like corridor, pathways, and hallways are all opportunities for promoting healthy activities and physical movement. These culture-focused activation can be implemented through three key areas: health campaign messaging, storytelling engagement, and stimulating connective spaces. Integrating smart health campaign messages or tangible impact of physical movement can be more relatable than suggestive health and wellness poster messaging. For instance, integrating fun facts about distance to a conference room will remind users to log their steps throughout the day and encourage users to walk more to reach their daily goals. When done right, connective spaces are great opportunities for telling story about the organization's accomplishments, individuals who make up the office culture, or impact to the community. While storytelling does not directly encourage physical movement, impactful storytelling in corridor spaces will allow users to engage with the space and perceive their time spent walking as being 'productive' instead of being inefficient. Additionally, stimulating corridor paths through visually-pleasing graphics or participatory graphics can start to break circuitous pathways; a few examples of these include: company mission wall, community boards, changeable participatory tools (see figure 89). Ultimately these types of interventions have to stay authentic to each organizational culture, therefore it is important to evaluate the right method for each space.

Figure 83. Stimulating Connective Spaces (Participatory)

8.2.4. Introduce strategic service offerings in community spaces for pop-up activation

Providing an element of surprise through activities programming, like health/wellbeing educational events or healthy snack offerings, would encourage users to get up from their desk. Consider the right timing and 'attractors' for these programmed activities. Health and wellbeing educational events could also become a campaign platform for holistic health and well-being beyond encouraging physical movement, such as: mindfulness, mental health, etc. One case study was a company that introduced meditation session during lunch break to promote employees' overall wellbeing. Conference rooms can be flexibly configured to accommodate these types of pop-up events for employees to participate. The results for these types of interventions extend beyond employees' overall health and help employees to be more engaged and connected to the organizations that pay attention to their wellbeing. This strategy is just one example of activating the workplace to encourage movement and chance encounters.

Others have implemented healthy snack offerings that are only available a few times a day during specific timeframes (i.e. morning and afternoon for limited amount); these strategies created a call to action and sense of anticipation

among users. MIT Medialab has revolutionized a technology to leverage free food as the main draw for gathering community through its Foodcam, which is essentially a web camera placed above a central kitchen counter. The camera has a sensor that automatically sends email notification with to all users in the building with a photo of food offerings placed at the counter. A solution that was initially started by solving a simple problem, to reduce food waste, has motivated users to get up to the centralized kitchen and helped lab users interact more with others from other departments.

8.2.5. Selection of Furniture and Finishes

More active furniture selection can reinforce breaks between sedentary behaviors throughout the day. A standing meeting room configuration allows groups to hold more efficient standing meetings instead of a prolonged seated meeting. Similarly, open collaboration areas can also benefit from stranding layout with minimal seating to encourage movement and impromptu conversations. Both enclosed and open standing meetings are equally beneficial; standing meetings have been proven to also reduce meeting time by up to 34% while maintaining the quality of meeting conversations (Bluedorn et al, 1998). Several corporate companies have promoted more standing meeting spaces into their workplace standards given its impact on meeting efficiency and individual's health.

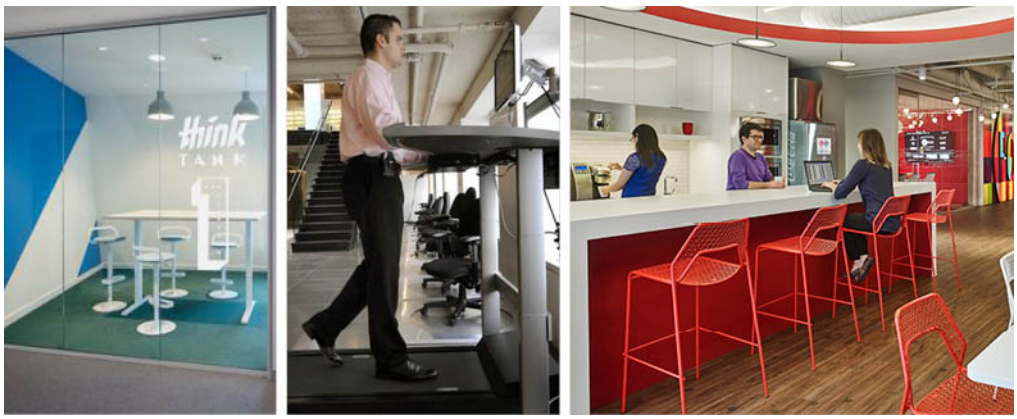


Figure 84. Stand-up Configurations

Other individual furniture that have started to saturate office furniture industry were the treadmill workstations (also referred as 'walkstations') and adjustable sit to stand workstations. The adjustable sit to stand workstations have shown promise in significantly reducing sitting time by as much as one hour per day within four-week period (Chau, 2012), however it is still unclear whether these interventions cause a long-lasting impact. Whilst long-term impact of furniture solutions is yet to be proven, these are still great options for promoting standing behaviors and improving overall health and well-being (Straker, 2013, Chau et al., 2014)

8.3. Limitations of the study

Several limitations persist due to the limited timeframe and resources available for this study, namely research apparatus, sample size, site selection, environmental ratings, statistical analyses, and data cleaning. These limitations should be used to help inform future studies in this subject:

8.3.1. Research apparatus:

The outcomes of the study were mainly based on subjective perception of individuals working in the buildings in addition to the researcher's experience in

analyzing workplace environment. Future studies seeking to understand sedentary behaviors must consider utilizing a more objective measure of physical activity level, such as: accelerometer or pedometer, to reduce subjective data and individual perception bias.

8.3.2. Sample size

One of the main limitations of the study is the small data sample with two building typology layouts and about 30 survey participants from each site. This sample size did not yield significant correlations and the data points cannot yet be used as a baseline criteria for future design. Understanding different space typologies and the associated individual habits will result in more statistical power and will show a deeper understanding of correlation between physical environment attributes and individual choices.

8.3.3. Site Selection

Two buildings included in this study is situated in a highly walkable, transit-oriented urban environment, in which may affect daily activities of users and how the workplace design impact their decisions. Future studies should look at multiple building demographics to understand unique effect of built environment across different geographic locations. It should address unique characteristics of sites that may have an impact on daily walking or physical activity habits, whether is suburban or urban, car-oriented or transit-oriented environment, cold climate or warmer climate, etc.

8.3.4. Organizational Culture

Comparing two different companies within the same industry may not appropriately address distinct organizational culture that may play a broader impact in influencing physical movement or sedentary breaks in the workplace. Societal company-wide norms in welcoming more fluid transition between work activities may differ by companies or industry. It will be beneficial for future studies to compare either a before or after behavioral change post workplace renovation to control for samples and culture. Alternatively, future study could compare two satellite locations of an organization for a more consistent policies or cultural values.

8.3.5. Environmental Ratings:

Environmental characteristics affect how one perceives and interacts with the built environment. Attributes like access to natural daylight, sufficient indoor air quality, satisfaction of work environment have an immediate impact on how one's short-term decision-making in being more active at work. Environmental ratings assessed this study were mainly based on researcher's perception of the environment. Future study should utilize more objective measures for environmental quality of space, i.e. measure of indoor air quality.

8.3.6. Statistical Analyses

Another limitation of the study is the extent of statistical analyses conducted in this study with the workplace survey results. Future studies should employ a more automated approach in accessing the following key data variables: average of standups, individuals' PA level, length of walking trips throughout workday, and number of hours sitting. Ability to measure precise variables will allow for a much robust statistical analysis in comparison to self-reported survey information.

8.3.7. Data Cleaning

Proposed solutions outlined in this study have not also been tested in an empirical research environment and thus has not proven the efficacy of these strategies in encouraging physical movement in the workplace. Data compiled in this study is a combination of employees' physical activities inside and outside the workplace and thus made it difficult to segregate individuals' exercise or commute habits and their activities in the workplace.

Lastly, the study assumes that individuals included in the study have a similar baseline understanding the issue of sedentary behavior in the workplace and excludes the possibility of individual habits were affected more by their increasing awareness of the issue and less about the design of the built environment. Physical activity and satisfaction insights derived from the two buildings observed may have also been impacted by other unique aspects of the office culture that affect employees' behaviors beyond the impact of the built environment.

8.4. Recommendations for Future Study

8.4.1. Quantitative Methodology

Future studies should employ a more rigorous quantitative methodology and comprehensive workplace analyses. Quantitative data analysis can be improved by utilizing a more integrated mode of accessing physical movement that will provide greater access to holistic health and wellbeing information outside working hours. Future studies should consider utilizing a readily-accessible mode of measuring PA level, for instance: wearable devices (Apple Watch, FitBit, etc) which may be an appropriate substitute to typical accelerometer to reduce potential observation bias.

8.4.2. Variety of Samples

A more comprehensive auditing of workplace settings can be improved through greater variety of floor plan layout samples across multiple industries to determine whether indeed there is a correlation between the design of the built environment and amount of physical activity that takes place in it. This will require expanded studies in multiple buildings and through different types of data-gathering methods to segregate social and environmental impacts on sedentary behaviors. The development of technology and wearable sensors may bridge the gap between user input and observation information by providing a more reliable information about space utilization. These technologies will enable future studies to further reveal the extent to which the proposed strategies described herein are appropriate for broader application across different industries, job functions, and other demographics.

8.4.3. Efficacy of Active Design Attributes

This study's premise was to compare two research sites with distinct design attributes, in which enabled a comparison of two design elements during similar period and season. The downside with this approach is the ability to objectively measure individual habit as determined by only design attributes considering other variables that are difficult to control, such as: tenure in building, internal office culture, and anticipated workstyles by office. Future studies should look at opportunities for measuring pre- and post-design interventions as a case study of spatial design attributes to control for group variability. For example, it may be beneficial to assess one organization currently occupying a more static work environment relocating into a new

space with active design strategies, such as: inviting internal staircase, highly-visible community spaces, etc.

8.4.4. Threshold for Design Encouraging Being Active or Staying Idle

Future studies should ultimately uncover insights on the attributes of floor plan layouts that balance physical movement and planning efficiency. One might assume that circuitous paths may be beneficial to increasing physical activities, however the perception of distance may discourage movement. Future studies will also need to address and explore: 1) the relationship between floor plan layout perception and the satisfaction of the physical environment, such as the perception of materials, finishes, and look and feel; 2) the extent of layout and perceived spatial efficiency; 3) key attributes of space that play the most significant role in determining short-term decision-making process for physical movement that inherently reduces sedentary behavior at work

8.5. Closing Comment

The field of environmental design is still finding its position to more proactively support human's health and wellbeing, particularly in the realms of sedentary behavior and occupational health. Previous interventions had been focused on behavioral interventions in addition to peripheral initiatives (such as furniture solutions to minimize sitting behavior) which have been beneficial in educating the workforce about this epidemic issue. Beyond these interventions, reduction in sedentary behavior has been largely dependent on personal initiatives. A few recent studies including this study have proven potential immense benefits from spatial design that would condition more active behaviors in the workplace. Whilst spatial factors play important roles, it is important for

future research to consider personal and cultural factors that may have impact on individual sedentary behavior, such as: education level, company culture, local demographics, and others. Future research should continue to test these suggested planning concepts and design strategies to evaluate their efficacy in reducing sedentary behavior in the workplace.

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Chapter 10: Appendix

10.1. International Physical Activity Questionnaire

Workplace Physical Activities Survey

The purpose of this survey is to assess the effects of workplace design on the sedentary behavior of occupants. The following survey should take approximately 15-20 minutes to complete. We assure you that your answers will be treated in the strictest of confidentiality.

SECTION I. Level of Physical Activity

1. During the **last 7 days**, how many days did you do **vigorous** physical activities **(at least 10 minutes at a time)**?

Vigorous activities make you breathe much harder than normal. These may include things like heavy lifting, digging, heavy construction work, or climbing up stairs.

_____Days per week *[If respondent answers 0, skip to Question 3]*
_____Not Applicable *[Skip to Question 3]*

2. During the **last 7 days,** how much time **on average** did you spend on doing **vigorous** physical activities?

_____ Hours and _____ Minutes per day.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities **(at least 10 minutes at a time)**?

Moderate physical activities make you breathe somewhat harder than normal and may include activities like carrying light loads. Do not include walking.

_____Days per week *[If respondent answers 0, skip to Question 5]*
_____Not Applicable *[Skip to Question 5]*

4. During the **last 7 days,** how much time **on average** did you spend on doing **moderate** physical activities?

_____ Hours and _____ Minutes per day.

5. During the **last 7 days**, how many days did you **walk (at least 10 minutes at a time)**

_____Days per week *[If respondent answers 0, skip to Question 7]*
_____Not Applicable *[Skip to Question 7]*

6. During the **last 7 days**, how much time **on average** did you spend on **walking**?

_____ Hours and _____ Minutes per day.

7. During the **last 7 days**, how much time **on average** did you spend **sitting**?

_____ Hours and _____ Minutes per day.

10.2. Workplace and Physical Activities Survey

SECTION II. Satisfaction

1. How much time on average do you spend in **this building** during **a typical week**? _____Hours.

2. Please indicate, to what extent do you agree or disagree with the following statements according to your experience in **this building.**

	Not at all	Somewhat Not	Neutral	Somewhat	Very much
How satisfied are you with the spatial environment of this building?	☐	☐	☐	☐	☐
Overall, does the spatial environment of this building support your ability to get your work done?	☐	☐	☐	☐	☐

SECTION III. Staircases and Elevators

*(Please answer the following questions according to your experience in **this building**.)*

1. How often do you walk the stairs during a typical weekday? _____times; on average _____stories **each time**.

2. Please indicate, to what extent do you agree or disagree with the following statements.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The staircase entrance(s) are visible from where I enter the building.	☐	☐	☐	☐	☐
The elevator(s) are visible from where I enter the building.	☐	☐	☐	☐	☐
The staircase(s) are easily accessible from my office/work space.	☐	☐	☐	☐	☐
The elevator(s) are easily accessible from my office/work space.	☐	☐	☐	☐	☐
The elevator waiting time is long.	☐	☐	☐	☐	☐
The staircase(s) are safe to walk.	☐	☐	☐	☐	☐
The staircase(s) look pleasant.	☐	☐	☐	☐	☐
I run into colleagues often when I walk the stairs.	☐	☐	☐	☐	☐
The staircase is located along the primary travel path of my daily work.	☐	☐	☐	☐	☐
The staircase entrance(s) are visible from elevator waiting area.	☐	☐	☐	☐	☐
The staircase has entry door(s).	☐	☐	☐	☐	☐
The staircase(s) are well maintained.	☐	☐	☐	☐	☐
I have conversations with my colleagues when I walk the stairs.	☐	☐	☐	☐	☐
The staircase entry door(s) are often held open.	☐	☐	☐	☐	☐
I am comfortable with the height of steps.	☐	☐	☐	☐	☐
I am comfortable with the temperature in staircase(s).	☐	☐	☐	☐	☐
There is natural daylight in staircase.	☐	☐	☐	☐	☐
Daylight in the staircase(s) encourages me to use stairs.	☐	☐	☐	☐	☐
The staircase(s) are wide enough for conversations to take place.	☐	☐	☐	☐	☐
The staircase(s) are clean.	☐	☐	☐	☐	☐

SECTION IV. Support Spaces and Office Environment

1. How many times do you stand up from your desk during a typical weekday? _____times; on average _____minutes of walking **each time**.

2. Please indicate, to what extent do you agree or disagree with the following statements.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Overall Work Environment					
The office environment sufficiently supports me to get tasks done.	☐	☐	☐	☐	☐
The floor layout is efficient enough for me to get to most spaces.	☐	☐	☐	☐	☐
The building layout is efficient enough for me to get to most spaces.	☐	☐	☐	☐	☐
The office environment allows me to communicate effectively with my colleagues.	☐	☐	☐	☐	☐
Informal spaces are available to use for collaboration sessions.	☐	☐	☐	☐	☐
The office design motivates me to spend more time in the office.	☐	☐	☐	☐	☐
I typically spent most of my workday at my desk.	☐	☐	☐	☐	☐
The office environment supports collaborative work.	☐	☐	☐	☐	☐
I typically spend more than 50% of my workday away from my desk.	☐	☐	☐	☐	☐
The office environment supports work that requires concentration.	☐	☐	☐	☐	☐
Individual Work Environment					
My desk has enough work surfaces to support my work.	☐	☐	☐	☐	☐
The design of my office/workspace helps me to work efficiently.	☐	☐	☐	☐	☐
There is enough storage space in my office/work space.	☐	☐	☐	☐	☐
I have sufficient control over my work environment.	☐	☐	☐	☐	☐
I personalize my office/workspace.	☐	☐	☐	☐	☐
I like the aesthetics of my office/workspace.	☐	☐	☐	☐	☐
Ambient Environment					
The office is well ventilated.	☐	☐	☐	☐	☐
The temperature in my own office/work space is comfortable.	☐	☐	☐	☐	☐
I tend to feel sick after spending many hours in the office.	☐	☐	☐	☐	☐
There is glare from lighting fixtures.	☐	☐	☐	☐	☐
There is glare from daylight.	☐	☐	☐	☐	☐
I have hard time concentrating due to poor acoustics.	☐	☐	☐	☐	☐
I have a view towards the outside from where I sit.	☐	☐	☐	☐	☐
I have access to daylight from my desk.	☐	☐	☐	☐	☐
There is sufficient artificial lighting to support my work.	☐	☐	☐	☐	☐
The computer causes me eyestrains.	☐	☐	☐	☐	☐
I have personal control over the lighting on own my office/work space.	☐	☐	☐	☐	☐
I have the ability to adjust the temperature in my own office/work space.	☐	☐	☐	☐	☐
Ergonomics					
My chair is comfortable and fits my shape.	☐	☐	☐	☐	☐
The chair back-rest is large enough to provide good back support.	☐	☐	☐	☐	☐
My chair has a comfortable lower back-rest support.	☐	☐	☐	☐	☐
I experience back and lower back pain after prolonged sitting.	☐	☐	☐	☐	☐
My seat is height-adjustable.	☐	☐	☐	☐	☐
	Strongly	**Disagree**	**Neutral**	**Agree**	**Strongly**

	Disagree				Agree
My chair has lumbar support.	☐	☐	☐	☐	☐
The height of my desk fits my height.	☐	☐	☐	☐	☐
My desk is height-adjustable.	☐	☐	☐	☐	☐
I sometimes do my work standing up.	☐	☐	☐	☐	☐
I can make request to have my chair replaced with one that suits me best.	☐	☐	☐	☐	☐
I have task light on my desk.	☐	☐	☐	☐	☐
Personal Habits					
I sit way more than I should during workday.	☐	☐	☐	☐	☐
I take a walk break every 60-120 minutes of sitting.	☐	☐	☐	☐	☐
I take coffee or smoking breaks outside the office.	☐	☐	☐	☐	☐
I exercise every day.	☐	☐	☐	☐	☐
I spend more than 30 minutes walking on a typical day.	☐	☐	☐	☐	☐
I have snacking habit while sitting and/or working at my desk.	☐	☐	☐	☐	☐
My colleagues or friends told me that I am physically active.	☐	☐	☐	☐	☐
I am conscious about my weight.	☐	☐	☐	☐	☐
I use public transit on a daily basis.	☐	☐	☐	☐	☐
I frequently stay in office for more than 8 hours a day.	☐	☐	☐	☐	☐
I prefer walking to driving for shorter distance trip.	☐	☐	☐	☐	☐
I enjoy taking a walk both outdoors and indoors.	☐	☐	☐	☐	☐
My occupation requires me to walk frequently throughout workday.	☐	☐	☐	☐	☐
Job Satisfaction					
I am well compensated for my work.	☐	☐	☐	☐	☐
The company has physical activity initiative, such as: gym, biking, etc.	☐	☐	☐	☐	☐
The company pays attention to my well-being.	☐	☐	☐	☐	☐
I have heavier workload than I expect.	☐	☐	☐	☐	☐
I have the resources I need to do my job well.	☐	☐	☐	☐	☐
I feel motivated at work.	☐	☐	☐	☐	☐
I participate in-group physical activity initiative.	☐	☐	☐	☐	☐
I embrace the culture of the office.	☐	☐	☐	☐	☐
I made good friendships with people in the office.	☐	☐	☐	☐	☐
I receive the appreciation I deserve at work.	☐	☐	☐	☐	☐
Pantry					
I use the pantry in the office frequently throughout the workday.	☐	☐	☐	☐	☐
The pantries have sufficient appliances and supplies.	☐	☐	☐	☐	☐
The appliances and space are clean and well maintained.	☐	☐	☐	☐	☐
I only utilize the pantry during lunch time.	☐	☐	☐	☐	☐
I have my own coffee/tea maker/fridge in my own office/work space.	☐	☐	☐	☐	☐
Copy/Printer Station					
I have printer(s) in my own office/work space.	☐	☐	☐	☐	☐
The printer is located too far away from where I sit.	☐	☐	☐	☐	☐
I frequently utilize copy/printer station throughout the day.	☐	☐	☐	☐	☐
My job requires me to go to the copy/printer station frequently.	☐	☐	☐	☐	☐

	Strongly	Disagree	Neutral	Agree	Strongly

	Disagree				Agree
Conference Rooms					
Conference rooms are located in central area of the office.	☐	☐	☐	☐	☐
Most individual offices and work spaces have equal distance to the conference rooms.	☐	☐	☐	☐	☐
I spend a great amount of time in conference room(s) in a typical work week.	☐	☐	☐	☐	☐
I use the conference room as secondary workspace.	☐	☐	☐	☐	☐
The conference room(s) have a nice view to the outside or to the overall work areas.	☐	☐	☐	☐	☐
When not in use, I tend to utilize the conference room for conducting collaborative work with colleagues.	☐	☐	☐	☐	☐
There is a reservation system to book the conference room.	☐	☐	☐	☐	☐
Informal Meeting Spaces					
I often socialize with my colleagues in the informal meeting area.	☐	☐	☐	☐	☐
Informal meeting area(s) are centrally located within the office.	☐	☐	☐	☐	☐
I utilize informal spaces as my secondary work space.	☐	☐	☐	☐	☐
The informal meeting spaces are distributed around the office.	☐	☐	☐	☐	☐
Certain groups utilize these spaces more than others.	☐	☐	☐	☐	☐

5. What are the main reasons for you to stand up from your desk in a typical workday? (Please check all that apply.)

☐ Routine job-related tasks (retrieve printed materials, mail, etc.)
☐ Habit
☐ Try to relieve back pain
☐ To take coffee/tea breaks
☐ To socialize with colleagues
☐ To work with colleagues
☐ Attend meetings
☐ Too much sitting
☐ Lunch
☐ Go to restroom
☐ Head out from the office
☐ Other. Please specify_____

SECTION IV. Experience and Other Habits

1. How long have you been working in this **building**?

☐ < 1 month ☐ < 6 months ☐ 1- 3 years
☐ 1-3 months ☐ < 12 months ☐ > 3 years

2. How long have you been working in your **work space/ individual office**?

☐ < 2 weeks ☐ 1-3 months ☐ < 12 months ☐ > 3 years
☐ < 1 month ☐ < 6 months ☐ 1- 3 years

3. How many miles do you travel to work? **(one way)** _____ miles

4. On average, how many minutes does it take to:

Going to work _____ minutes
Going home _____ minutes

5. I work _____
☐Full time
☐Part time
☐Compressed work-week
☐A Flex Schedule (avoiding commute peak times 7-9am/4-6pm)

4. How do you travel to work each day **LAST WEEK**?
*(Pick the number below for the mode of transportation **OR** reason you did not commute for each day of the week and enter into the boxes below. If you used more than one mode for the trip to work, choose the number for the longest segment of your trip.)*

Day of the Week	Commute Solution or Mode	Reasons not commuting to work
___ Monday	1. Drive Alone	13. Teleworked
___ Tuesday	2. Public Transit (bus/rail)	14. Commuted to another location
___ Wednesday	3. Vanpool (# members _____)	15. Traveling on business
___ Thursday	4. Carpool (# members _____)	16. Day off
___ Friday	5. Bicycle	17. Compressed work week day off
___ Saturday	6. Walk	18. Other day off (vacation, sick)
___ Sunday	7. Bike/Walk + Bus (Combo)	
	8. Motorcycle/Gas-Powered Scooter	
	9. Special Transit Service for the disabled	
	10. Hybrid Vehicle (drive alone)	
	11. Hybrid Vehicle (carpool)	
	12. Electric Scooter	

SECTION V. Comments and Insights

Would you provide comments on the overall workplace spatial design in this building?

SECTION VI. Personal Description

1. What is your gender?
   ☐Male ☐Female

2. What is your age?
   ☐18-24 ☐25-29 ☐30-34 ☐35-39 ☐40-44
   ☐45-49 ☐50-54 ☐55-59 ☐60-64 ☐ >65

3. What is your weight (in pounds)?
   ☐ <120 ☐120-140 ☐141-160 ☐161-180 ☐181-200
   ☐201-220 ☐221-240 ☐ >240

4. What is your BMI? _____(Please refer to appendix.)

5. How do you describe your race/ethnicity?
   ☐White ☐Black or African American ☐Asian ☐Native Hawaiian or Pacific Islander
   ☐Hispanic ☐American Indian or Alaska Native ☐Other

6. What is your highest level of education?
   ☐Some high school or less ☐High school graduates ☐Attended some college
   ☐Associate degree ☐Bachelor's degree ☐Postgraduate degree

7. How do you rate your overall health?
   ☐Very good ☐Good ☐Fair ☐Poor ☐Very poor ☐Don't know

8. Do you feel you get as much exercise as you need?
   ☐As much as I need ☐Less than I need ☐Don't know

9. How many days per week do you achieve 30 min of moderate physical activity (e.g., walking for pleasure, jogging, bicycling, swimming or water aerobics, dancing, etc.)??
   ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐ Don't know

10. How many days per week do you walk at least 10 min at a time?
    ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐ Don't know

Thank you so much for your participation!

For questions or concerns, please contact Cerise Marcela at cm485@cornell.edu.