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Occupancy evaluations – Ontario Association of Architects (OAA) case study

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Glossary of Abbreviations

ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
CMU	Carnegie Mellon University
COPE	Cost-effective Open-Plan Environments (prior research conducted by NRC)
GOC-2020	Government Operations Centre 2020 evaluation (data in this report)
GPOE	POE of Green Buildings (prior research conducted by NRC)
HVAC	heating, ventilating, and air conditioning
IES	Illuminating Engineering Society
iiSBE	International Initiative for a Sustainable Built Environment
IWBI	International WELL Building Institute
NICE Cart	National Research Council Indoor Climate Evaluator Cart
NRC	National Research Council Canada – Construction Research Centre
PM _{2.5} , PM ₁₀	particulate matter <2.5 microns, or <10 microns, in diameter
POE	post-occupancy evaluation
ppb	parts per billion
ppm	parts per million
PSPC	Public Services and Procurement Canada
REB	NRC Research Ethics Board
RH	relative humidity
RTD	resistance temperature detector
SBS	sick building syndrome
SD	standard deviation
SII	speech intelligibility index
TVOC	total volatile organic compounds
VDT	video display terminal (computer screen)
VOC	volatile organic compounds

Executive Summary

In response to Challenge 2030, which outlines requirements for zero carbon emissions for new buildings, the Ontario Association of Architects (OAA) retrofitted its headquarters building, located in Toronto, Ontario, Canada. The main aim was to demonstrate leadership with respect to energy consumption and sustainability, while also aligning with the company's cultural and financial goals, and preserving the original architectural structure of the building. The objective was not only to meet, but also to exceed the Challenge 2030 carbon neutral goals and position the project as a pioneering example of sustainable design. Along with achieving a net-zero building performance, the OAA also aimed to improve the overall indoor environmental conditions for its employees and visitors.

The OAA occupies three floors of a 25 years old office building with a total gross floor area of 2,045 m² (22,000 ft²). Before the renovation, the building consisted primarily of office spaces, a two-story atrium, commercial kitchen, lounge and meeting rooms. It housed 45 regular full-time employees (27 OAA employees and 18 employees of a tenant organization), as well as infrequent, but regular, occupants working on OAA committees (N~160), as well as other occasional visitors. The building renovation resulted in more open work areas, additional social networking spaces, numerous small and large meeting rooms, atrium and kitchen area, all with modern interior design features. The OAA building is currently the workplace of 37 permanent employees, the majority of which have adopted a hybrid work model, working in the office around 2-3 days per week.

This document reports on the pre- and post-renovation evaluation conducted by the National Research Council Canada (NRC) at the OAA headquarters to measure the change in indoor environmental quality and occupant well-being triggered by the OAA building retrofit. The data collected consisted in measurements of the physical indoor environment and questionnaires examining the building occupants' satisfaction with thermal, lighting, air quality and acoustical conditions, as well as with privacy, workstation features, job satisfaction, organizational commitment and overall well-being.

The pre-renovation study took place in February 2017, and the post-renovation evaluation was conducted in February 2023. During the pre-renovation evaluation, 45 permanent occupants and 56 infrequent occupants completed the survey (~55% response rate), while detailed snapshot measurements of the physical indoor conditions were collected during daytime in 22 workstations. During the post-renovation evaluation, 20 permanent occupants and 23 infrequent occupants completed the survey (~55% response rate for permanent occupants; 100% response rate for infrequent occupants participating in OAA meetings across 2 days). Snapshot measurements of the physical environmental conditions were collected in 26 workstations, and a sub-set of physical variables were measured in specific locations over a longer period.

This report presents the measured physical conditions and the distribution of the responses collected via the occupant surveys pre- and post-renovation. However, due to the change in work model adopted by the OAA employees in 2023 (2-3 days per week onsite) compared to 2017 (5 days per week onsite), a comparison between the participants perceptions of the OAA's work and indoor environmental conditions could not be directly inferred. Furthermore, the survey was completed by different individuals on each occasion, and only four participants completed both the 2017 and 2023 surveys. Instead, the data collected at OAA was compared with data collected by NRC in other case-studies of conventional and green buildings, where a similar, or an equivalent, research protocol was used (i.e. NRC benchmark building dataset).

Table ES1 compiles the pre- and post-renovation results, indicating that the net-zero renovation had a positive impact on the building occupants and their overall ratings of satisfaction with the indoor environment. The pre-renovation data clearly indicated areas for improvement in terms of lighting, ventilation, temperature, overall environmental satisfaction and perceived corporate values (workplace image), which trended at the lower end of the average ratings found in the buildings included in the NRC dataset, indicating low satisfaction. Similarly, some of the pre-renovation physical measurements were below the target/optimum levels, with the indoor air quality metric (CO₂) being above the recommended range, and the air speed and desktop illuminance being

well over the recommended range. After the renovation, most of these dimensions improved, suggesting that the renovation had a positive effect on the occupants' satisfaction with the environmental conditions. The highest ratings were given by the participants for job satisfaction, internal communications and organizational commitment. The lowest absenteeism, the second lowest intention to turnover (i.e. people wanting to be employed by the organization) and the third best workplace image were also reported by the OAA staff when compared to the average ratings reported in other buildings. Although the OAA respondents reported slightly higher job demand after the renovation, the overall average was still at the lower end of the NRC building dataset scale.

The OAA employees perceived the overall light levels in the building to be comfortable after the renovation, and appreciated the improved access to natural lighting and outside views. However, the light levels in the workstations were not always rated as satisfactory, with some respondents indicating a preference for a more flexible lighting arrangement that would allow them to reduce brightness and glare. Measurements of the desktop illuminance confirmed this finding, indicating the presence of high illuminance levels pre-renovation and even higher levels post-renovation. Note that the presence of direct sunlight within the office spaces may have also contributed to these ratings.

Providing a good acoustical environment in an open-plan space is a challenge in most buildings, as evidenced by the average speech intelligibility index in the NRC building dataset, which trends generally higher than the target/optimum value. Pre-renovation, the average sound levels at OAA met the criterion levels, but there were spikes in some locations that far exceeded the target, with some locations being at the highest end of the acceptable range. After the renovation, the average satisfaction with acoustics and privacy improved significantly, however, some occupants indicated a preference for even better acoustics and privacy in their workspaces.

Table ES1. Results summary

Surveys		OAA-2017	OAA-2023	2017	2023	
Concept	Scale	Average (SD)	Average (SD)	Benchmark rank (1 is best)	Benchmark rank (1 is best)	Comments
Job Demand	1-7	3.8(1.58)	4(1.4)	1 of 24	4 of 24	Increased job demand in 2023, but still less demanding than most workplaces in the NRC database
Allocation of work time	%	68.7	66.2	N/A	N/A	Mostly computer and quite work - similar across both time points for data collection
Satisfaction with Acoustics and Privacy	1-7	3.9 (1.5)	5.1 (0.86)	60 of 94	5 of 94	Improved in 2023, in top 5 highest scores in the NRC database
Satisfaction with Ventilation and Temperature	1-7	3.1(1.56)	4.8(1.35)	88 of 94	22 of 94	Improved in 2023, clustered at the higher end of the scale in the NRC database
Satisfaction with Lighting	1-7	4.2(1.30)	5.1(1.62)	87 of 94	35 of 94	Improved in 2023, in 2017 at the low end of the NRC database, 2023 slightly above the midpoint in the NRC database
Overall Environmental Satisfaction	1-7	4.1(1.53)	5.3(0.78)	50 of 71	7 of 71	Improved in 2023, on the higher end of the scale in the NRC database
Job Satisfaction	1-7	5.8(1.220)	6.5(0.61)	13 of 66	1 of 66	2017 and 2023 both on the higher end of the scale, 2023 the highest

						(Highest in NRC dataset)	satisfaction recorded in the NRC database
Satisfaction with amenities Net % (Satisfied-dissatisfied)	Worst 5	N/A					OAA-2023 only: <ul style="list-style-type: none"> • Speed and availability of elevators. 15% • Natural materials and elements (real or simulated) in the workplace. 35% • Secure storage for personal items. 45% • Comfort of your chair. 65% • Access to water fountain/bottle refill stations. 75%
Satisfaction with amenities Net % (Satisfied-dissatisfied)	Best 5	N/A					OAA-2023 only: <ul style="list-style-type: none"> • Availability of small meeting rooms. 100% • Availability of large meeting rooms. 100% • Ability to find your way inside the building. 100% • Access to waste collection, recycling and composting points. 100% • Places to eat and socialize with colleagues. 100%
Most-mentioned best things:		N/A					<ul style="list-style-type: none"> • Communication and social interaction with coworkers • Window views and natural lighting • Good leadership/coworkers
Most-mentioned things needing change:		N/A					<ul style="list-style-type: none"> • Flexible lighting – to reduce glare, brightness, add blinds • Acoustics privacy/sound proofing • Heating and ventilation
Organizational Commitment	1-7	5.3 (1.1)	5.6 (0.61)	2 of 21	1 of 21		High rating in 2017, even higher in 2023, highest ratings in the NRC database
Intent to Turnover	1-7	2.4 (1.38)	1.6 (0.83)	12 of 21	20 of 21		Improved in 2023, 2nd lowest in the NRC database indicating low turnover intentions
Workplace Image	1-7	3.1 (1.51)	5.4 (1.11)	20 of 22	3 of 22		Improved in 2023, in top 3 in the NRC database
Internal communications	1-7	6 (1.05)	6.8 (0.45)	4 of 18	1 of 18		High rating in 2017, improved in 2023 - highest rating in the NRC database
Lighting comfort		N/A					80% light is comfortable, 30% light not well distributed
Hours of sleep	hr.	7.4 (0.7)	7.9 (1.3)		N/A		Many respondents reported acceptable sleep duration, comparable results between 2017 and 2023
Sleep quality	1-7	5 (1.41)	4.85 (1.27)		N/A		Comparable ratings for sleep quality between 2017 and 2023
Sleep - ease	1-7	5.1 (1.58)	5 (1.34)		N/A		Comparable ratings for ease of going to sleep between 2017 and 2024

Visual Discomfort	0-16	2.8 (2.62)	1.83 (2.09)	16 of 21	8 of 21	Improved in 2023, below midpoint in the NRC database
Physical Discomfort	0-16	3.3 (2.03)	2.47 (1.73)	15 of 21	6 of 21	Improved in 2023, below midpoint in the NRC database
Self-reported sickness absenteeism (personal reason)	0-5 days	0.81 (1.14)	0.5 (1.19)	15 of 21	10 of 21	Improved in 2023, just below midpoint in the NRC database
Self-reported all-cause absenteeism (any reason)	0-5 days	1.6 (1.89)	0.74 (1.24)	12 of 21	21 of 21	Improved in 2023, the lowest number of missed days reported in the NRC database, consideration for hybrid work model is needed
Physical environmental measurements						
Temperature	deg C	24	22	30 of 33	4 of 33	Improved in 2023, 2017 above recommended range, 2023 right on target
RH	%	9.7 (0.59)	10.8 (1.130)	2 of 33	3 of 33	Far below recommended range in 2017 and 2023
Air movement	m/s	0.39 (0.39)	0.09 (0.05)	33 of 33	8 of 33	Improved in 2023, 2017 well above recommended range, 2023 improved, below recommended range
Thermal comfort						
Predicted mean vote (PMV)	-3 to +3	-0.01	-0.38			Thermal comfort calculated in neutral range at both times, 2017 and 2023, with acceptable levels of predicted % discomfort
Predicted % dissatisfied (PPS)	%	37 (0.49)	8.87 (3.68)			
CO₂	ppm	668 (48.49)	606 (104.02)	23 of 33	6 of 33	Improved in 2023, below the limit of 625 ppm
PM_{2.5}	µg/m ³	0.81 (0.27)	2.22 (1.32)	5 of 24	19 of 24	Increased in 2023, but still well below the limit
PM₁₀	µg/m ³	9.59 (9.55)	57.62 (22.5)	3 of 24	24 of 24	Increased in 2023, just above the limit
Light level	lx	815 (1200.68)	913 (681.74)	28 of 36	33 of 36	Values are well above the range recommended in 2017 and 2023 (too bright)
Sound level	db(A)	40.94 (3.09)	44.2 (3.46)	12 of 33	18 of 33	Within range, but some measurements on certain location can be deceptive
Speech intelligibility	SII	0.27 (0.17)	0.31 (0.14)	4 of 33	9 of 33	All benchmark locations had values higher than the recommended SII, indicating poor speech privacy in open offices generally.

The data collected from the OAA building visitors (infrequent occupants) further supported the results shown in Table ES1. After the renovation, the respondents' satisfaction improved on most dimensions, and the best features of the new OAA design were thought to be the prevalent access to natural lighting, the window views, and the open collaboration space. The OAA visitors reported acceptable thermal comfort levels, although many reported a preference to feel warmer while participating in meetings during two cold winter days. Having a more flexible lighting system and better shading devices in the meeting rooms, better acoustics and improved heating would further enhance the visitors' overall experience in the OAA building.

Overall, the results of this study show that embarking on the net-zero building renovation and primarily focusing on improving its indoor environmental conditions benefited the building occupants. This was evidenced by the improved occupant satisfaction with the workplace, and connection with the organization in terms of shared values and mission. This project demonstrated that buildings with historic significance can be successfully renovated to meet contemporary needs, including meeting net-zero and carbon neutrality targets, while at the same time ensuring high occupant satisfaction, comfort and well-being.

1 Introduction

In response to Challenge 2030, which outlines the requirements for zero carbon emission for new buildings, the Ontario Association of Architects (OAA) embarked on a journey to retrofit its headquarters building (Figure 1). The aging infrastructure of the building and its outdated mechanical systems that were approaching their end-of-life cycle caused a significantly higher energy consumption when compared to the energy used in similar buildings.

The OAA approached the National Research Council Canada (NRC) to advance the net-zero renovation project and confirm the building performance in terms of energy use and indoor environment quality pre- and post-renovit. During the course of the project, the two organizations:

- Engaged in workshops to discuss and review the range of design options;
- Identified the technologies and provided energy performance monitoring and design validation of the selected technologies;
- Conducted pre- and post-renovation occupancy evaluations to determine the renovation effects in terms of indoor environment KPIs relevant to organizational productivity, job satisfaction and well-being;
- Agreed to support the development of best practice materials and knowledge dissemination to key stakeholders upon the project completion.



Figure 1 A – OAA building before the renovation (2017); B – OAA building after the renovation (2023).

The renovation began in 2017 and was completed in 2019, however, due to the COVID-19 pandemic, the building occupancy could not resume until 2022. The renovation included:

- Improved insulation of the building envelope;
- Installation of a geothermal heating and cooling system;
- Improved indoor ventilation system;
- Installation of triple glazed windows and electrochromic glazing;
- Installation of high efficiency LED occupancy-activated lighting;
- Installation of solar panels;
- Upgrades to the interior design, resulting in doubling the overall capacity of the building.

Figures 2 and 3 show the interior of the OAA building after the renovation.

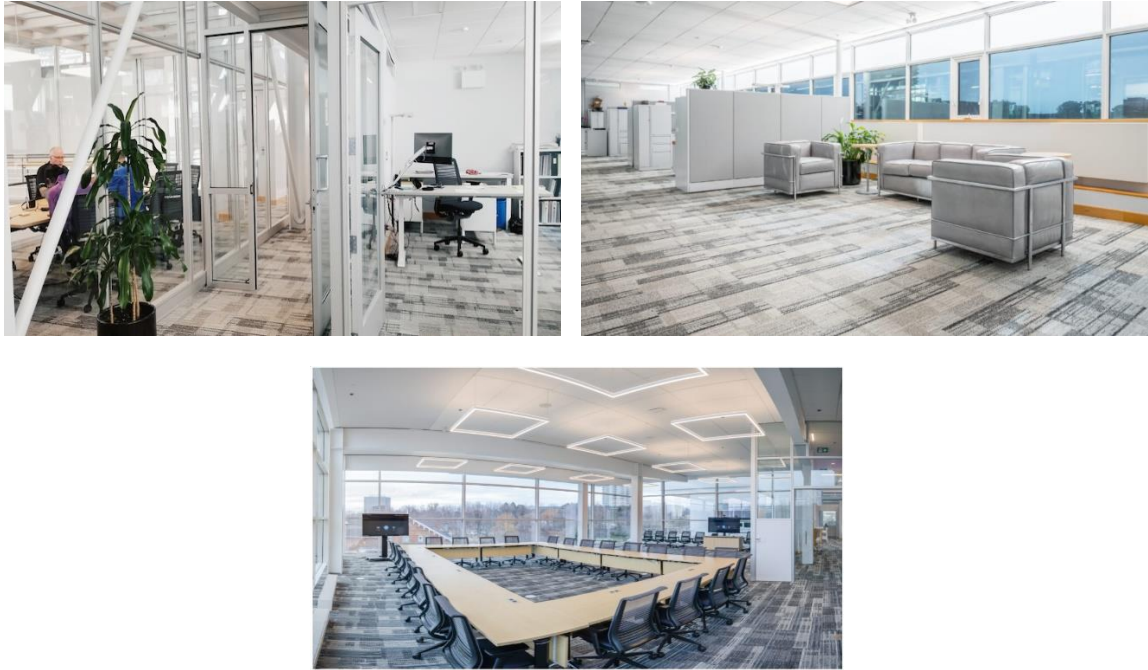


Figure 2 OAA building after the renovation – office and conference room views.

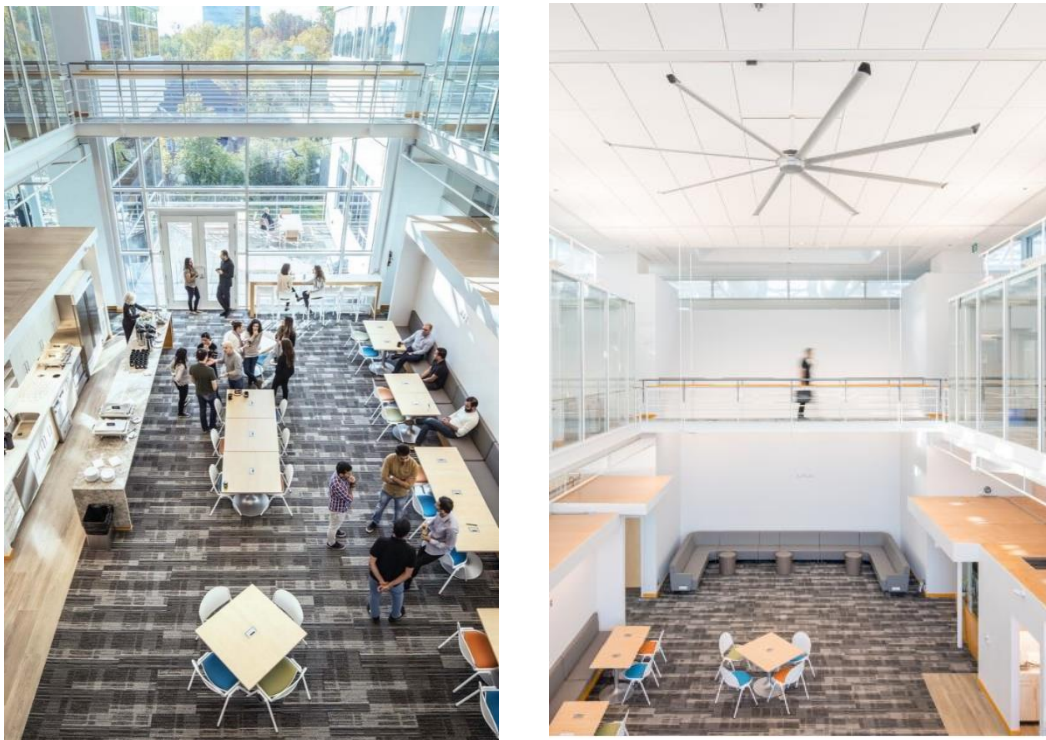


Figure 3 OAA building after the renovation – cafeteria and atrium views.

The pre-renovation study was conducted in February 2017 and the post-renovation evaluation was conducted in February 2023. The data included measurements of the physical environment (e.g. thermal, acoustic, air quality, lighting) and an occupants' survey including questions related to environmental and job satisfaction, health and well-being, work patterns and facilities, building amenities, workstation features, job satisfaction, organizational commitment and corporate values (workplace image). The data collected during the OAA project was compared to data included in the NRC benchmark building database, comprising of large data sets of conventional and green buildings, where equivalent field investigations and similar data collection protocols were used. The NRC also collected pre- and post-renovation data related to energy performance, which was reported in separate reports (A1-00728.01 and A1-019102.01).

2 Method

2.1 Site

The Ontario Association of Architects (OAA) occupies three floors of a 25-year-old building located in Toronto, Ontario, Canada. The building has a total gross floor area of 2,045 m² (22,000 ft²) and consists primarily of office spaces, conference and meeting rooms, and a two-story atrium, kitchen and lounge area. In 2017 the building was occupied by 45 regular full-time personnel (27 OAA employees and 18 employees of a tenant organization), as well as occasional visitors engaging in workshops, training and committee meetings. In 2023, the building is the workplace of 37 permanent OAA employees, however, due to a new hybrid work model adopted by the OAA post-pandemic, most of the regular staff works onsite only 2-3 days per week.

2.2 Procedure

This study used a pre-post research design. The evaluation was multi-dimensional, including both an online occupant questionnaire and detailed physical measurements of the indoor environmental conditions. The research design, methodology and treatment of human subjects was reviewed by the NRC Research Ethics Board (REB) under protocol 2016-55.

Occupants of the OAA building were briefed about the upcoming evaluation by their managers during regular meetings and by e-mail. The survey invitations were sent from the NRC Construction Surveys e-mail account directly to the individual building occupants. Responses were collected from both permanent OAA building occupants and occasional visitors working in the building (e.g. participating in meetings, workshops, etc.). In 2017, both permanent and occasional visitors (infrequent occupants) received e-mail invitations including personalized passwords and links to the online survey. The survey was open for three weeks. Similarly, in 2023, the regular OAA employees received an invitation e-mail with a personalized password and a weblink to the online survey, which they could complete over a three weeks period. However, in 2023, the data from the infrequent occupants was collected onsite during a 2-day meeting held in the OAA building.

2.3 Questionnaire

The online survey was hosted on a secure NRC server in Ottawa, Ontario, accessible only to the NRC research team. There were 138 items in the questionnaire, which were chosen to address elements that buildings are thought to affect, based on prior research or common hypotheses. The large majority of the questionnaire items were drawn from prior studies that showed them to be valid and sensitive measures of assessment for the change in conditions caused by building retrofits in terms of occupant health and well-being, indoor environment satisfaction, job demand, organizational productivity, organizational commitment, job satisfaction and intent to turnover (Newsham et al., 2013; Veitch et al., 2007; Veitch et al., 2010). Additional information on the derivation of questionnaire items is provided in Appendix A, and the full questionnaire is shown in Appendix B.

2.4 Physical measurements of the indoor environment

2.4.1 Local workstation snapshots: the NICE cart

The National Research Council Indoor Climate Evaluator (NICE cart), shown in Figure 4, is a mobile custom-built integrated sensor platform designed to take a detailed snapshot of indoor environment conditions over a 10–15 minute period at selected locations in a building.

Table 1 summarizes the instruments and sensors on the NICE Cart. The cart is designed to match the specifications of various standards, but in a few cases design choices resulted in small deviations. For example, ASHRAE Standard 55 (American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE), 2017) specifies that the measurement positions above ground appropriate for the determination of thermal comfort for seated occupants are 0.1 m (ankle), 0.6 m (torso) and 1.1 m (head) for air temperature and air speed, and 0.6 m for RH. The measurement positions on the NICE cart differ from these by 0.1 – 0.3 m. The various sensors cannot all be mounted in one location because of size limitations and the potential for interference with each other's measurements. However, our previous experience with similar measurements in the Cost-effective Open-Plan Environments (COPE) field study (Veitch et al., 2003) suggested that height variations of this size are unlikely to have a large effect for typical office spaces.

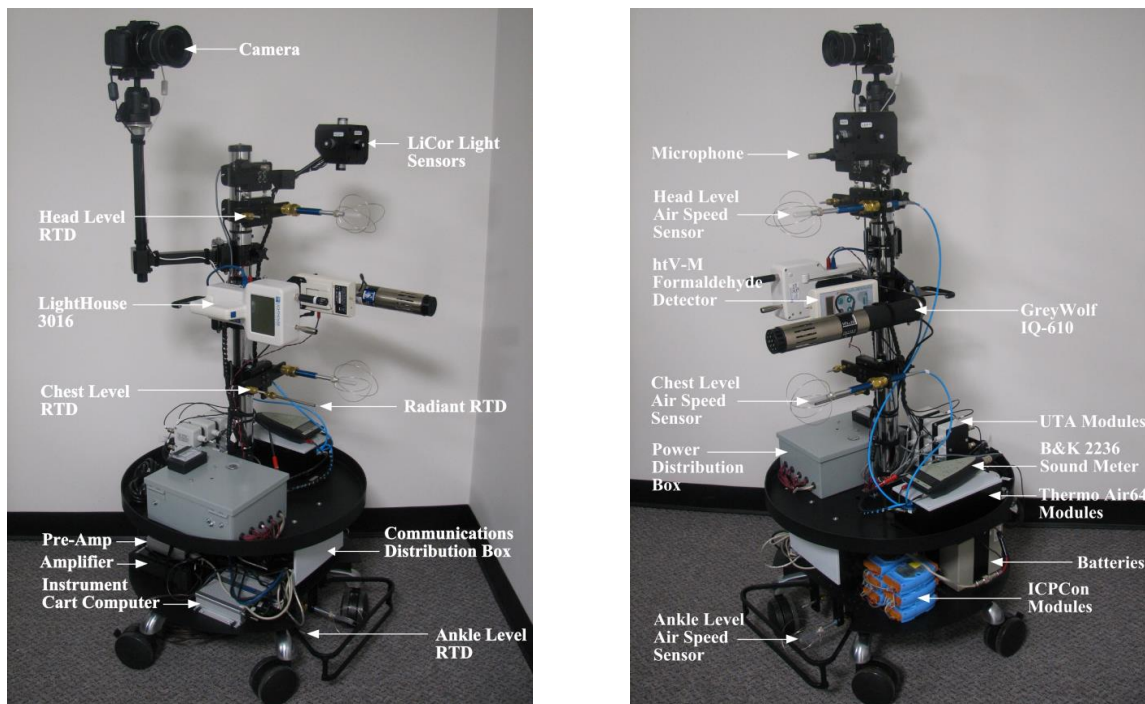


Figure 4 NICE cart, height ~ 1.5m.

Cart-based measurements are made during normal working hours. The workspace measurement location is mostly that of a seated occupant, with the chair temporarily moved out of the way. While the instrument is recording, the researcher manually records other workstation characteristics, including: height of walls; length and width of workstation; ceiling height; floor, ceiling and wall finishes; lighting type; distance to a window, window orientation, sky condition, and whether window was open; distance to printer/copier; shade type, opacity, and position. Supplementary information is collected at a smaller set of representative locations, including: furniture type; ceiling plan; and reflectance measurements of all major surfaces; luminaire and lamp type; air supply/return location; and, window and shading type.

Table 1 Summary information related to NICE Cart instruments/sensors.

Instrument/sensor	Parameter measured	Range	Accuracy	Mounting Height
Htv-M	Formaldehyde	0 to 10 ppm	25%	0.9 m
Htv-M	Temperature	-40° to +128°C	± 0.4°C	0.9 m
Htv-M	Relative humidity	0 to 100% RH	±3% RH	0.9 m
GreyWolf IQ 610	Carbon dioxide	0 to 10000 ppm	±3% reading ±50 ppm	0.9 m
GreyWolf IQ 610	Carbon monoxide	0 to 500 ppm	±2 ppm<50 ppm, ±3 % reading>50 ppm	0.9 m
GreyWolf IQ 610	VOCs	5 to 20000 ppb		0.9 m
GreyWolf IQ 610	Relative humidity	0 to 100% RH	±2% RH <80% RH, (±3% RH >80% RH)	0.9 m
GreyWolf IQ 610	Temperature	-10° to +70°C	±0.3°C	0.9 m
LightHouse 3016	Particle count	0.3 to 10.0 µm	10% (20% for 0.3µm)	0.9 m
LightHouse 3016	Temperature	0° to 50°C	±0.5°C	0.9 m
LightHouse 3016	Relative humidity	15 to 90% RH	±2% RH	0.9 m
ThermoAir 6/64	Air speed	0 to 1 m/s	1.5% + 0.5% of full scale	0.1 m, 0.7 m, 1.1 m
LiCor LI-210	Illuminance	0 to 60000 lux	5%	Desktop (x2), cube @ 1.25 m
RTD	Air temperature	-50 to 250 °C	0.12%	0.1 m, 0.7 m, 1.1 m
RTD	Radiant temp.	-50 to 250 °C	0.12%	0.7 m
B&K 2236	Sound level	18 to 140 dB	Type 1	1.2 m
Camera with wide-angle lens (not used at OAA)	Luminance	0 – 6000 cd/m ²	~15%	1.5 m

For most buildings, practical considerations prevent the team from using the cart to collect data at all possible occupant locations in the building.

Before each data collection, the NRC team reviewed the building plans prior to the visit to identify the locations from which to sample, and modified the choice of location on site to try to cause the least possible disruption to the building occupants. Therefore, when on site, the team first looked for measurement locations that were temporarily unoccupied (e.g. usual occupant at a meeting, on vacation), so as to not have to disturb an occupant to make the measurement. Because this unoccupied space was usually surrounded by other occupied spaces, and because these spaces were all served by common building systems, it was assumed that the measurements would be representative of those experienced by the occupants. For acoustics-related measurements, a loudspeaker was placed in an adjacent space. This loudspeaker briefly generated a standard noise signal (picked up by the microphone on the cart), and thus required that the adjacent space was also unoccupied, or had an occupant who was willing to be disturbed for a few minutes.

The measurements were made with the cart placed in the location the occupant would be in if they were working on their computer. Figure 5 shows a schematic diagram of the cart location.

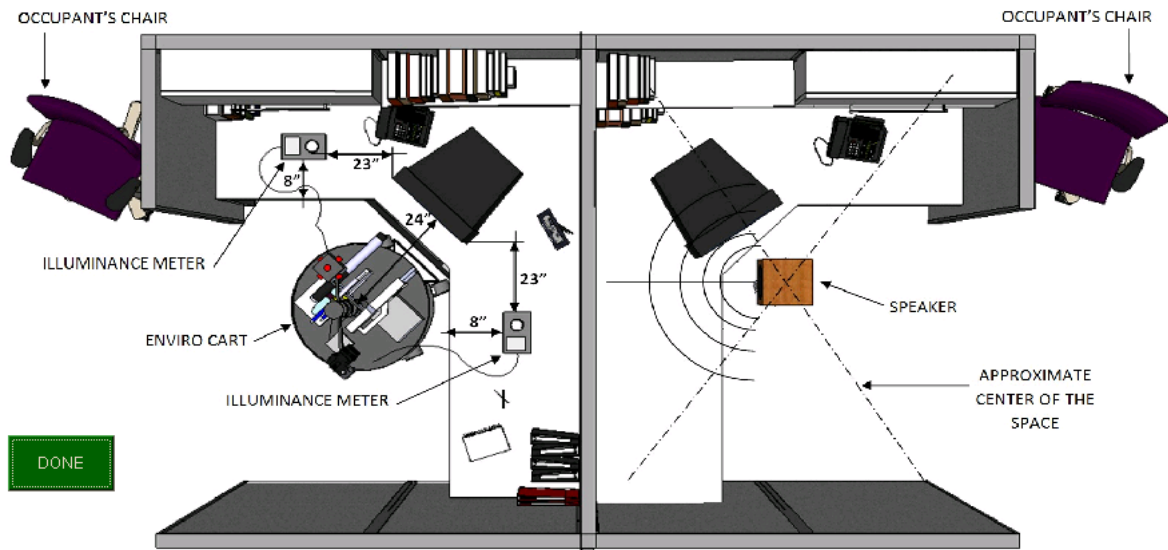


Figure 5 Schematic diagram of cart location during the measurement procedure.

Data collection from the instruments and sensors was semi-automated via software controlled by the researcher from a laptop computer that communicated wirelessly with the cart. During this process, the researcher also manually recorded several other workstation characteristics:

- Relative location of office entrance and occupant’s computer.
- Height of walls (and whether workstation was enclosed).
- Length and width of workstation.
- Ceiling height.
- Floor, ceiling and wall finishes.
- Lighting type.
- Distance to a window, window orientation, sky condition, and whether window was open.
- Distance to printer/copier.
- Shade type, opacity, and position.

2.4.2 Longer-term monitoring: Pyramids

The Pyramids (Figure 6) are custom-built sensor platforms designed to be left in place for long-term monitoring of a limited set of environmental conditions. These are a subset of the parameters collected by the cart, but at a fixed location and in a longitudinal manner, recording each parameter every 15 minutes. The instruments and sensors used on the pyramid are shown in Table 2. Six (6) pyramids were deployed for this study, each placed in specific locations during the data collection. During the February 2017 data collection, the pyramids collected data across two weeks. During the February 2023 data collection, the pyramids were used across 2 days.

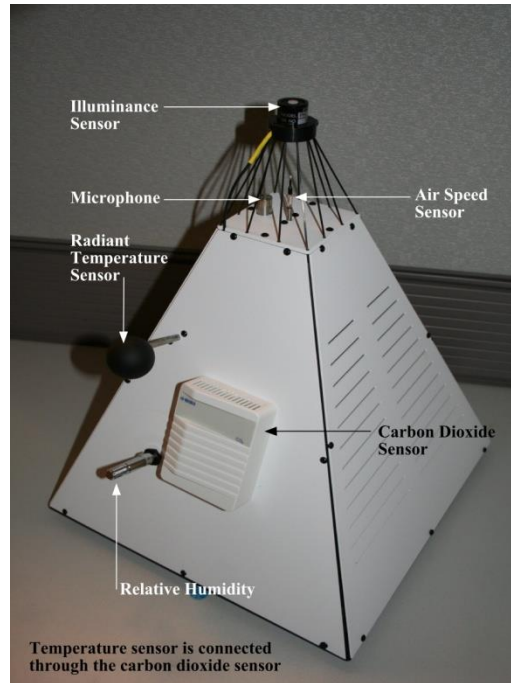


Figure 6 Pyramid, height 0.5m.

Table 2 Summary information related to pyramid instruments/sensors.

Instrument/sensor	Parameter measured	Range	Accuracy
Vaisala GMW86P	Carbon dioxide	0 to 2000 ppm	± 30 ppm CO ₂ +2% of reading]
Vaisala HMP50	Relative humidity	0 to 98 % RH	0 to 90 % RH = ± 3 %RH, 90 to 98 % RH = ± 5 %RH
TSI 8475	Air speed	0.05 m/s to 0.5, 0.75, 1.00, 1.25, 1.50, 2.0, 2.5 m/s	$\pm 3.0\%$ of reading ± 1.0 % of range
LiCor LI-210	Illuminance	0 to 60000 Lux	5 %
RTD	Air temperature	-50 to 250 °C	0.12 %
RTD	Radiant temp.	-50 to 250 °C	0.12 %
Norsonic Nor131	Sound level	17 to 140 dB	Class 1

2.4.3 Ventilation poles

The ventilation poles (Figure 7) were designed based on the AHSRAE 55 standard. Similar to the pyramids, the ventilation poles were built to collect a subset of parameters at a fixed location and in a longitudinal manner, and can be left in place for long-term monitoring. Table 3 shows the instruments and sensors used on the pole.

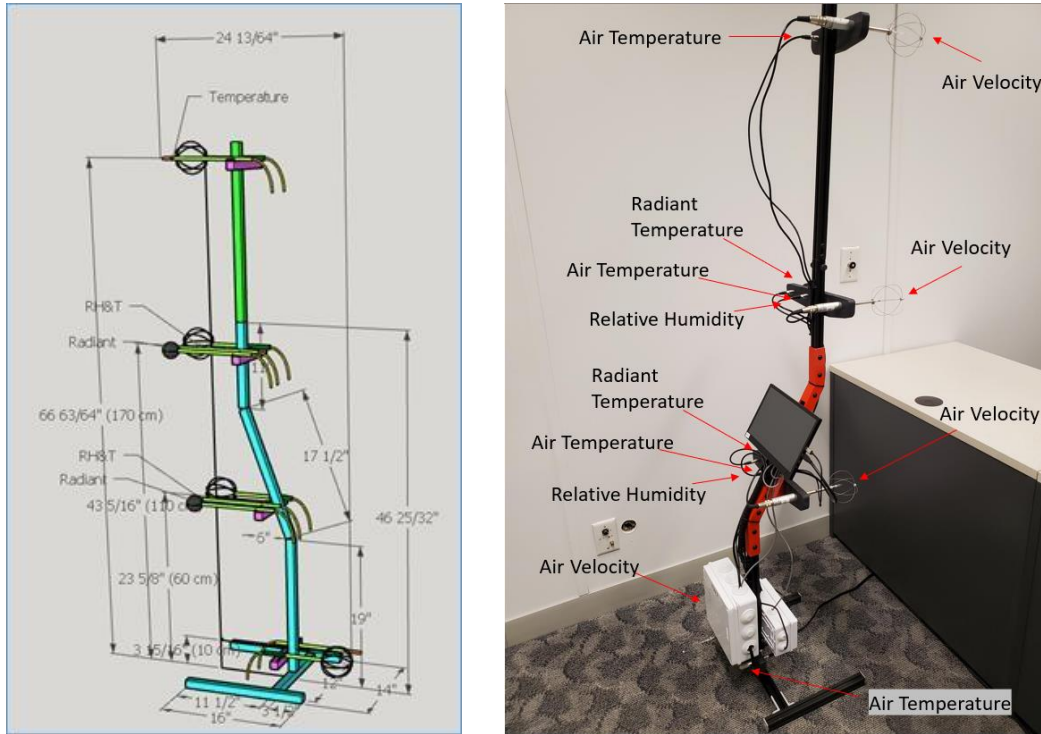


Figure 7 Ventilation pole, 1.6m.

Table 3 Summary information related to ventilation pole instruments/sensors.

Instrument/sensor	Parameter measured	Range	Accuracy	Mounting Height
Vaisala HMP110	Ambient Temp	-40 - 80°C	±0.1°C ¹	0.1m, 1.7m ²
Vaisala HMP110T	Ambient Temp	-40 - 80°C	±0.1°C ¹	0.1m, 1.7m ²
Vaisala HMP110T	Radiant Temp	-40 - 80°C	±0.1°C ¹	0.6 m, 1.1m
Vaisala HMP110	Relative Humidity	0-100%RH	±1.5 %RH (0-90 %RH) ±2.5 %RH (90-100 %RH) ³	0.6m, 1.1m
Swema03	Air Speed (omni-directional)	0.05-3m/s at 15-30°C	*@20°C -25°C, ±0.03m/s from 0.05-1m/s or 3% of reading from 1-3m/s *@15°C -30°C, ±0.04m/s from 0.05-1m/s or 4% of reading from 1-3m/s	0.1m, 0.6m, 1.1m, 1.7m ²

¹Accuracy range for measurements from 15°C to 25°C using digital outputs. Accuracy from 0°C to 15°C and 25°C to 40°C is ±0.15°C. Accuracy at every other portion of range is ±0.4°C.

²Optional height attachment.

³ Accuracy range for measurements from 0°C to 40°C. Accuracy from 0°C to 40°C and 40°C to 80°C is ±3%RH from 0 - 90 %RH and ±4 %RH from 90 - 100 %RH.

3 Results

3.1 General information

During the pre-renovation evaluation (2017), 45 permanent OAA building occupants were invited to complete the survey and 30 occupants completed the survey (67% response rate). Invitations were also sent to 55 infrequent occupants and the response rate was 73% (39 OAA visitors completed the survey).

During the post-renovation evaluation (2023), invitations were sent to 37 permanent OAA staff and 20 individuals completed the survey (55% response rate). Data was also collected onsite from 23 infrequent occupants, participating in two meetings held on two separate days: Day 1 (between 4.00pm and 6.00pm); Day 2 (between 9.00am and 12.00pm). In this case the survey response rate was 100%.

Due to the different work model adopted by the OAA employees in 2023 compared to 2017, no direct comparison between the data collected during the two evaluation periods was possible. Pre-renovation, the OAA building occupants worked onsite 8 hours per day, 5 days per week. After the renovation, the OAA staff adopted a hybrid work model, working in the building 2-3 days per week and fewer hours per day onsite (e.g. 4-6 hours per day). Therefore, in this report the results are reported separately for the 2017 and 2023 evaluation periods, and compared to values drawn from the recommended practice, benchmarks, or findings from other research projects with similar contexts, conducted by the NRC and by others. Only buildings in which the same survey questions had been asked and at least 20 occupants had completed the survey were included in the analysis. Although the number of comparison buildings for each question varied because there were some differences between the questionnaires used in each study, the following core environmental features ratings (Veitch et al., 2007) were common to all:

- NRC COPE field study, administered in nine typical, non-green, office buildings, both public- and private-sector, in Canada and the US (Veitch et al., 2003)
- NRC Post-occupancy evaluation of green buildings field study (GPOE) in >20 office/institutional buildings, both public- and private-sector, in Canada and the US (Newsham et al., 2013)
- NRC Light Right field study, in three office buildings in British Columbia, using data from the first survey response from any individual (Veitch et al., 2010)
- NRC study of a professional association office building in southern Ontario
- iiSBE Canada 2014 Challenge field studies in eight Canadian, office/institutional buildings in both the public- and private-sector (Bartlett et al., 2014)
- Twenty-one private-sector office buildings in Switzerland, using data from the first survey response from any individual (Feige et al., 2013)
- Two private-sector office buildings in Germany (Herbig et al., 2016)
- A subset of data from field studies conducted by Carnegie Mellon University (CMU) at 73 buildings, both public- and private-sector in the US, Brazil and France (Park et al., 2016).

In addition, the physical measurements collected at OAA were compared with data collected in other buildings by the NRC, where the same or equivalent equipment and protocols were used.

The results section presents descriptive results from both survey and physical data. The survey data includes both the responses collected from the regular OAA building occupants, as well as those collected from the infrequent building occupants. A few additional questionnaire items were added to the post-renovation survey compared to the pre-renovation survey, and the N/A label was used to indicate the missing data.

The comparisons show a rank ordering of all of the available building averages for the measurement in that section. The OAA-2017 label was used in the tables that follow for the pre-renovation data, and the OAA-2023 label was used for the post-renovation data.

In the graphs where the OAA data is compared to the NRC building database, the pre-renovation OAA data is indicated with a yellow triangle (OAA-2017), while the post-renovation data is highlighted with a yellow triangle with a green outline (OAA-2023). Note that the comparison NRC building data includes circles of varying fill colors related to the original data source. The data from certified green buildings is indicated with circles with a thick green border.

The data collected from the participants who attended two OAA meetings held on two separate days (OAA-2023) was separated into two time points, to indicate that the participants answered the survey under different daylighting or sky-conditions; afternoon/evening hours (Day 1) and morning hours (Day 2).

3.2 Questionnaires

3.2.1 Demographics, locations, and work characteristics

Table 4 shows where the participants were located when they answered the survey. In 2017, 96.7% of the respondents completed the survey at their assigned desk in the OAA building. In 2023, 28.6% of the respondents completed the survey in the OAA building, 66.7% completed the survey at home, and 4.8% completed the survey in another location.

Table 4 Responses to question: *Where are you completing this survey?*

	OAA-2017		OAA-2023	
	Frequency	Valid Percent	Frequency	Valid Percent
At my own desk in the OAA Building	29	96.7	6	28.6
Elsewhere in the OAA Building	1	3.3	0	0
Home	0	0	14	66.7
Other remote location	0	0	1	4.7
Total	30	100	21	100

Table 5 shows the type of workspace the respondents occupied in 2023. This question was not included in the 2017 survey. Open-plan offices with ‘seated visual privacy’ were the most common office type (occupied by 52.4%), followed by ‘no-privacy’ (19%). Fewer than 15% of respondents occupied private offices.

Measurements showed that the average size of the cubicle workstations in 2017 was 6.8 m² (SD = 3.4), ranging from 4.2 to 13.5 m². The enclosed offices were larger, with an average area of 17.5 m² (SD = 6.14) and a range from 8.6 to 27 m².

Table 5 Responses to question: *What kind of individual workspace are you presently occupying?*

	OAA-2017		OAA-2023	
	Frequency	Valid Percent	Frequency	Valid Percent
Enclosed single-person office	N/A	N/A	3	14.3
Enclosed multi-person office	N/A	N/A	2	9.5
Workstation with dividers high enough that most people cannot see over when standing	N/A	N/A	0	0
Workstation with dividers high enough that most people cannot see over when seated but can see over when standing (seated visual privacy)	N/A	N/A	11	52.4
Workstation with dividers that most people can see over when seated, or no dividers	N/A	N/A	4	19
Other	N/A	N/A	1	4.8
Total	0	0	21	100

Table 6 shows the number of hours the respondents worked in the OAA building in 2017 and 2023. In 2017, a large majority (80%) of the occupants worked at least 8 hours per day onsite. In 2023, only 62% worked 8 hours per day onsite, while 38% worked onsite between 4-8 hours per day.

Table 6 Responses to question: *When in building on a given day, how long do you typically spend there?*

	OAA-2017		OAA-2023	
	Frequency	Valid Percent	Frequency	Valid Percent
8 or more hours	24	80	13	61.9
4-8 hours	6	20	8	38.1
2-4 hours	0	0	0	0
1-2 hours	0	0	0	0
1 hour or less	0	0	0	0
Total	30	100	21	100

Table 7 shows information on whether the respondents have changed their work arrangement recently. This question was asked only in 2023. Ninety (90%) of the respondents reported experiencing no change in the past three months.

Table 7 Responses to question: *Have you moved to a new work arrangement in the past three months?*

	OAA-2023	
	Frequency	Valid Percent
Yes	2	10
No	18	90
Total	20	100

Table 8 shows information about the proximity of the respondents to a window. In 2017, 56.7% reported having a window in their workstation and 36.7% responded having no access to windows, unless in the corridor. In 2023 around 90% reported having a window in their workstation, and only 5% reported having no window access.

Table 8 . Responses to question: *Do you have a window to the outside nearby?*

	OAA-2017		OAA-2023	
	Frequency	Valid Percent	Frequency	Valid Percent
Yes, in my workstation	17	56.7	18	90
Yes, in the workstation next to me	2	6.7	1	5
No, but there is a window across the corridor	11	36.7	1	5
No, there is no window visible from my workstation	0	0	0	0
Total	30	100.1	20	100

Information on demographics, job demand (average of four questions), and division of work are used to establish the similarity of the OAA building population to other workplaces. Table 9 shows the demographic information for the permanent OAA building occupants in 2017 and 2023. Compared to the Canadian public service data, the OAA respondents are similar in terms of age, sex, and job category, but are more educated (fewer people with only high school or community college credentials) and have a higher number of years in the organization. In 2023, around 62% of the respondents indicated teleworking at least 3 days per week, and 24% of them reported teleworking 1-2 days per week (hybrid work model).

Table 9 Demographic information, OAA-2017 and OAA-2023, permanent occupants

OAA-2017	%	%	%	%	%
Sex	Female 83.3	Male 16.7	Other 0	Prefer not to say 0	
Age	18-29 26.7	30-39 20	40-49 16.7	50-59 20	60 or over 16.7
Job category	Admin. 60	Technical 0	Professional 23.3	Managerial 16.7	
Highest education	High school 3.3	Community college 23.3	Some university 10	Bachelor degree 40	Graduate degree 23.3
Years in workforce	< 1 year 2.4	1-5 years 14.3	5-10 years 7.1	10-15 years 14.3	>15 years 61.9
Years with this organization	< 1 year 4.8	1-5 years 57.1	5-10 years 9.5	10-15 years 19.0	>15 years 9.5
Years of working	< 1 year 0	1-5 years 8.6	5-10 years 4.3	10-15 years 4.3	>15 years 82.9
Years in organization	< 1 year 8.6	1-5 years 12.9	5-10 years 10	10-15 years 7.1	>15 years 61.4
OAA-2023	%	%	%	%	%
Sex	Female 23.8	Male 76.2	Other 0	Prefer not to say 0	
Age	18-29 4.8	30-39 28.5	40-49 28.5	50-59 23.5	60 or over 14.3
Job category	Admin. 52.4	Technical 4.8	Professional 19	Managerial 23.8	
Highest education	High school 4.8	Community college 9.5	Some university 4.8	Bachelor degree 42.9	Graduate degree 38.1
Years in workforce	< 1 year 1.4	1-5 years 0	5-10 years 1.4	10-15 years 0	>15 years 97.1
Years with this organization	< 1 year 10	1-5 years 11.4	5-10 years 4.3	10-15 years 2.9	>15 years 71.4
Telework	I do not telework 9.5	Once in a while, but not regularly 0	1-2 days per week 23.8	3 days a week (or more) 61.9	It varies, please specify: 4.8

In 2017, 51% of the infrequent occupants completed the survey in the gallery and 36% completed the survey in a boardroom in the OAA building. Most participants reported visiting the OAA building once per month (30.8%) or less, and 51.3% of the respondents worked in the building less than once per month. In terms of time spent in the building, 69.2% of the participants reported 4-8 hours per day and 20.5% reported 2-4 hours per day. The majority of the respondents (66.7%) reported completing the survey at their regular workplace outside of the OAA building, 7.7% completed the survey in the OAA building, and 25.6% completed the survey elsewhere.

In 2023, all the infrequent occupants completed survey in the OAA building. Out of these respondents, 57.1% reported spending 2-4 hours in the building, 45.2% reported 4-8 hours, and 23.8% reported 8 hours or more. Table 10 shows the demographic information for the infrequent occupants in 2017 and 2023.

Table 10 Demographic information for infrequent occupants, OAA-2017 and OAA-2023.

OAA-2017	%	%	%	%	%
Sex	Female 20.5	Male 79.7	Other 0	Prefer not to say 0	
Age	18-29 5.3	30-39 13.2	40-49 23.7	50-59 23.7	60 or over 34.2
Years of working	< 1 year 1.2	1-5 years 1.2	5-10 years 6	10-15 years 1.2	>15 years 90.5
Years in organization	< 1 year 11.9	1-5 years 17.9	5-10 years 7.1	10-15 years 6	>15 years 57.1
OAA-2023	%	%	%	%	%
Sex	Female 66.7	Male 33.3	Other 0	Prefer not to say 0	
Age	18-29 0	30-39 21.4	40-49 21.4	50-59 21.4	60 or over 35.7
Years of working	< 1 year 0.6	1-5 years 0	5-10 years 0.6	10-15 years 2.4	>15 years 96.4
Years in organization	< 1 year 5.4	1-5 years 13.1	5-10 years 3	10-15 years 1.2	>15 years 77.4

Job Demand

Figure 8 shows how the participant responses related to job demand in 2017 and 2023 compared to the NRC building dataset. This scale is primarily used to establish the similarity of the work demand in the study workplace compared to those reported in other studies. An unusually demanding (or undemanding) work profile might affect the interpretation of the other survey variables.

The average job demand at OAA (for both surveys) were below the average midpoint when compared to other buildings in the NRC dataset. The job demand slightly increased after the renovation ($M = 4.0$, $SD = 1.4$) when compared to the average rating of job demand before the renovation ($M = 3.8$, $SD = 1.58$). However, both ratings were still lower than those reported in most of the conventional and green office environments included in the NRC dataset.

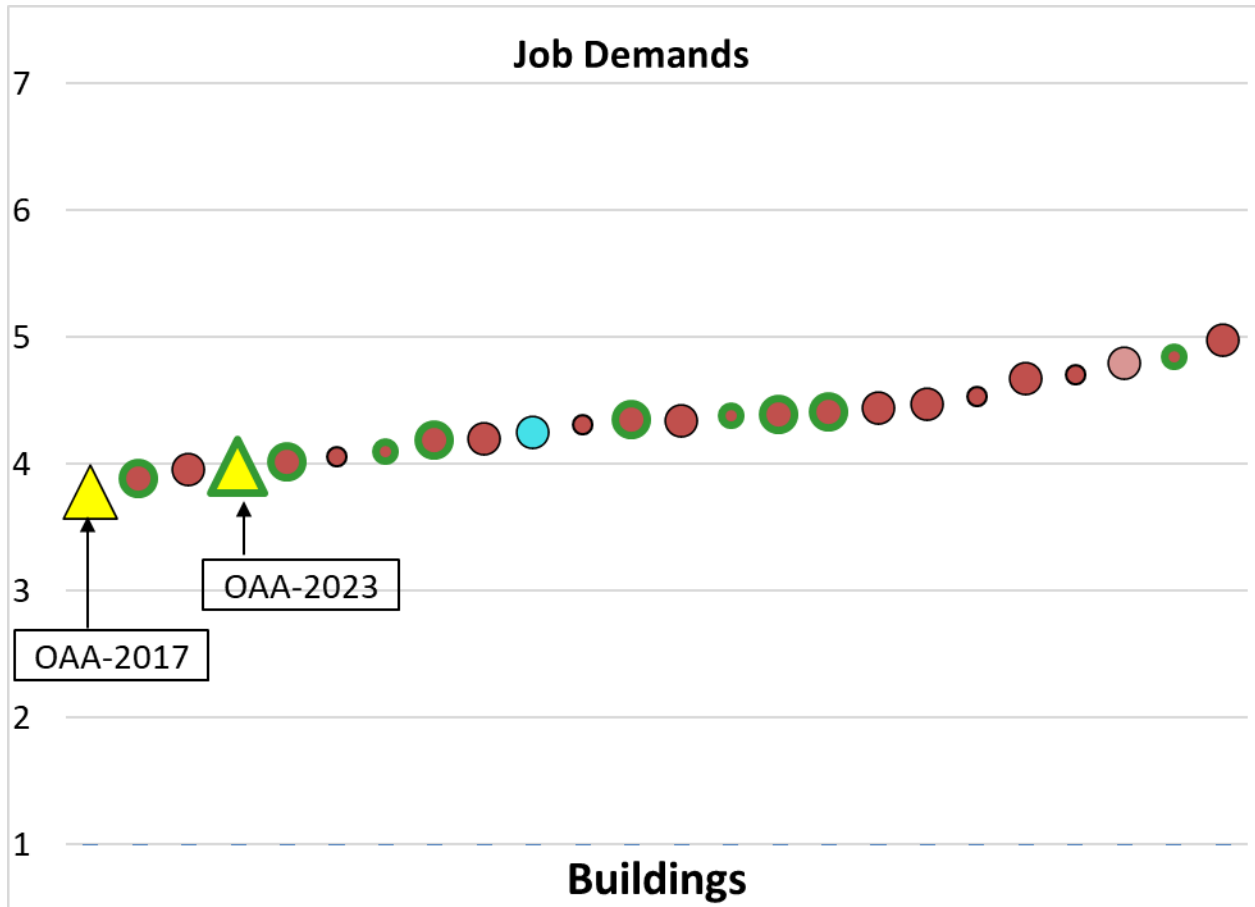


Figure 8 Average ratings of job demand at OAA compared to other NRC building case studies (mean value recorded in each building).

Figure 9 and 10 show pie charts indicating the reported division of work in the OAA building during the 2017 and 2023 surveys. As expected, the single biggest category was computer and quiet work, which would likely be solo work in a workstation (61.4% in 2017 and 56.6% in 2023), followed by telephone work (10.4% in 2017 and 11.9% in 2023). Adding the time spent in the workstations in meetings and interacting with others, indicates that activities in the workstation accounted for 66.2% in 2023 and 68.7% in 2017.

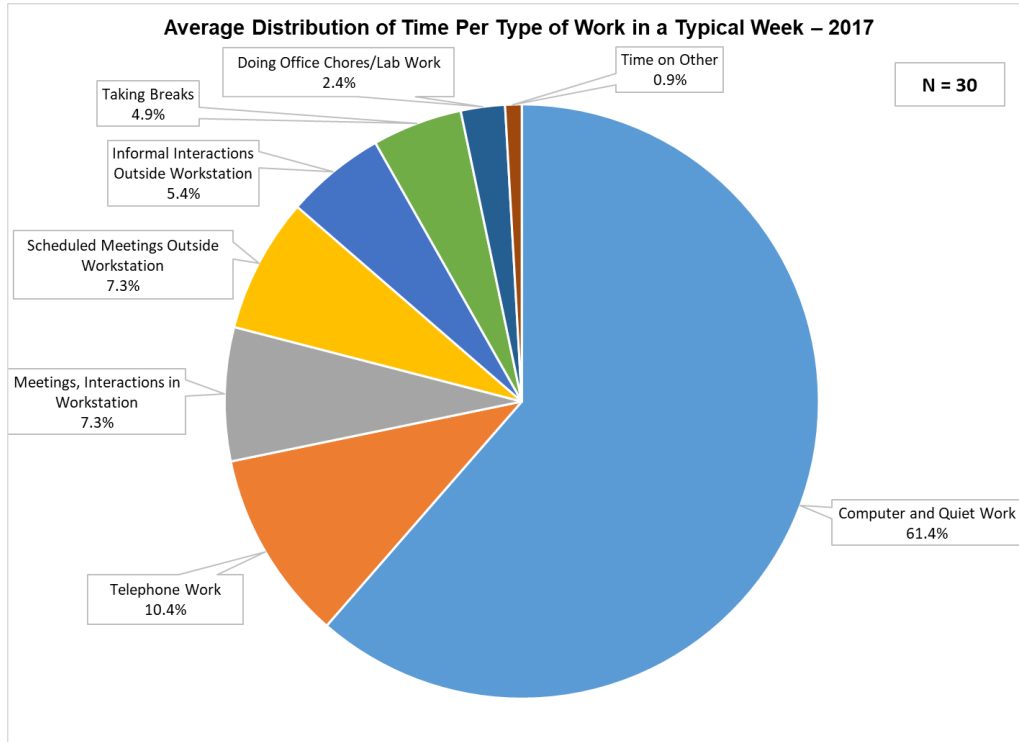


Figure 9 Division of time on work activities and locations, self-assessed in 2017.

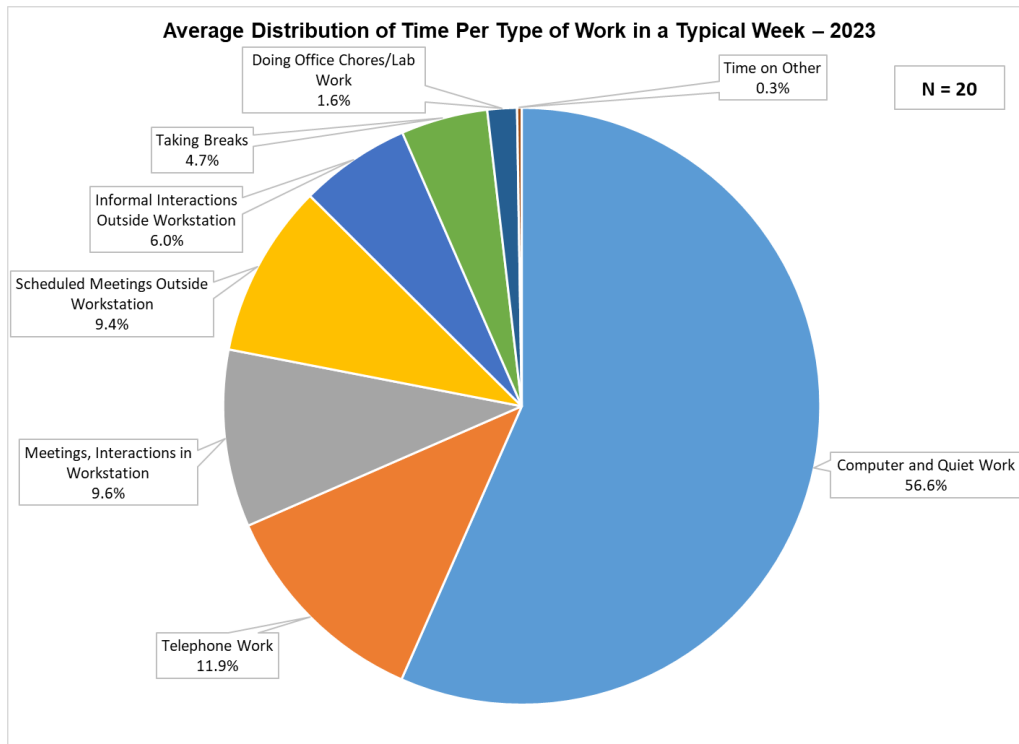


Figure 10 Division of time on work activities and locations, self-assessed in 2023.

3.2.2 Environmental and job satisfaction

This section presents the results related to satisfaction with the work environment and the job.

In 2017, the average satisfaction of the regular OAA building occupants with privacy and acoustics was below the midpoint of the distribution reported for other buildings in the NRC dataset ($M = 3.9$, $SD = 1.5$). However, the average satisfaction in 2023 was well above the midpoint of this dataset ($M = 5.1$, $SD = 0.86$), which suggests that satisfaction with privacy and acoustics improved after the renovation. This rating is among the highest ratings captured in the NRC database (Figure 11).

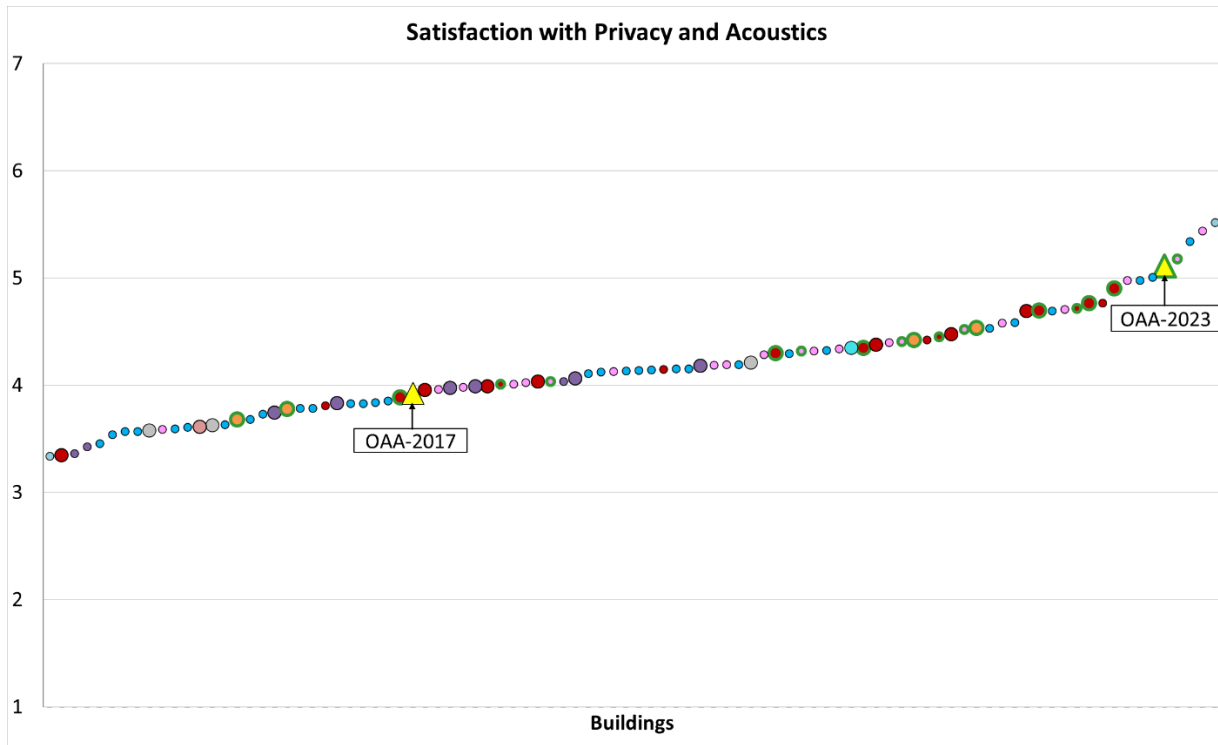


Figure 11 Satisfaction with privacy and acoustics at OAA compared to other NRC building case studies (mean value recorded in each building).

In 2017, the average satisfaction with ventilation and temperature was also below the midpoint of the distribution reported in the NRC dataset (Figure 12). OAA regular building occupants' rating was close to the lowest score ($M = 3.1$, $SD = 1.56$). The average satisfaction improved in 2023 ($M = 4.8$, $SD = 1.35$) and was above the midpoint of the scale, suggesting that the satisfaction with ventilation and temperature improved after the renovation.

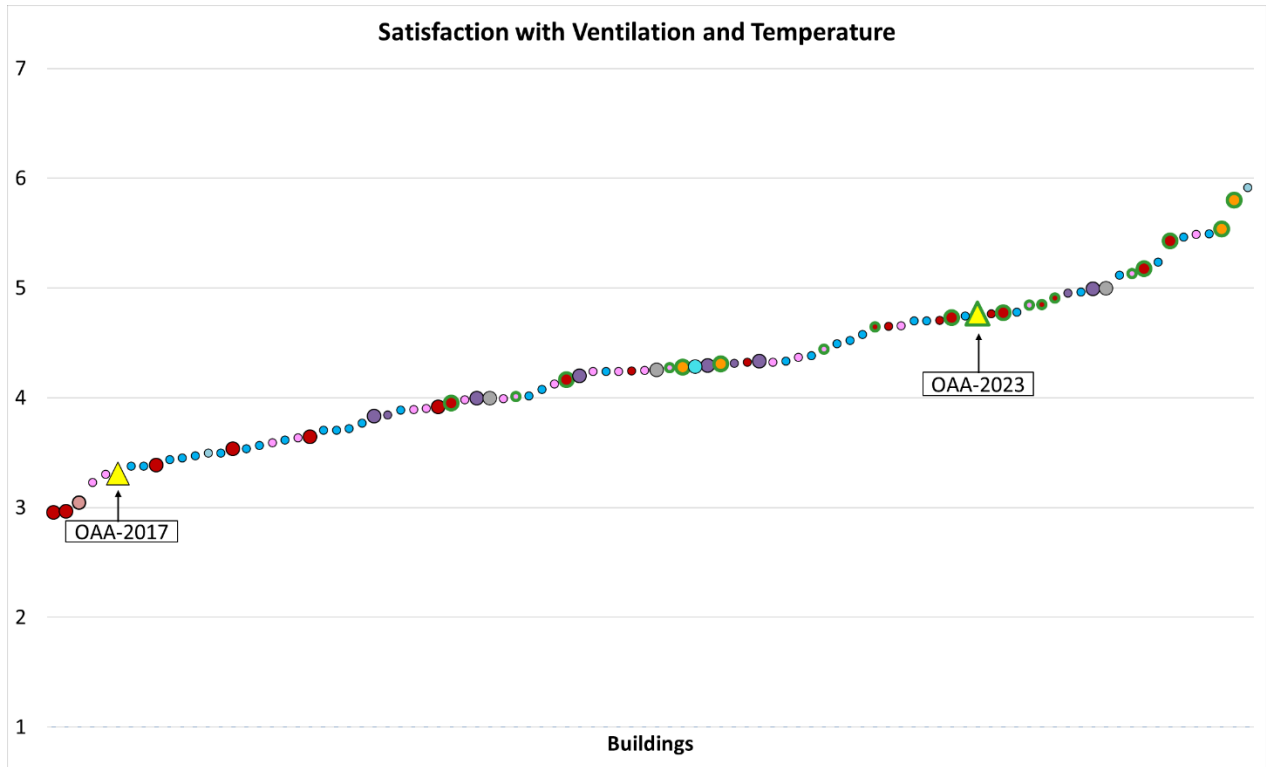


Figure 12 Satisfaction with ventilation at OAA compared to other NRC building case studies (mean value recorded in each building).

In 2017, the average satisfaction with lighting of the regular OAA building occupants was also towards the lower end ($M = 4.2$, $SD = 1.3$) of the NRC dataset (Figure 13). The participants' satisfaction with lighting improved in 2023 ($M = 5.1$, $SD = 1.62$) and was above the midpoint of the scale, suggesting that the satisfaction with lighting improved after the renovation.

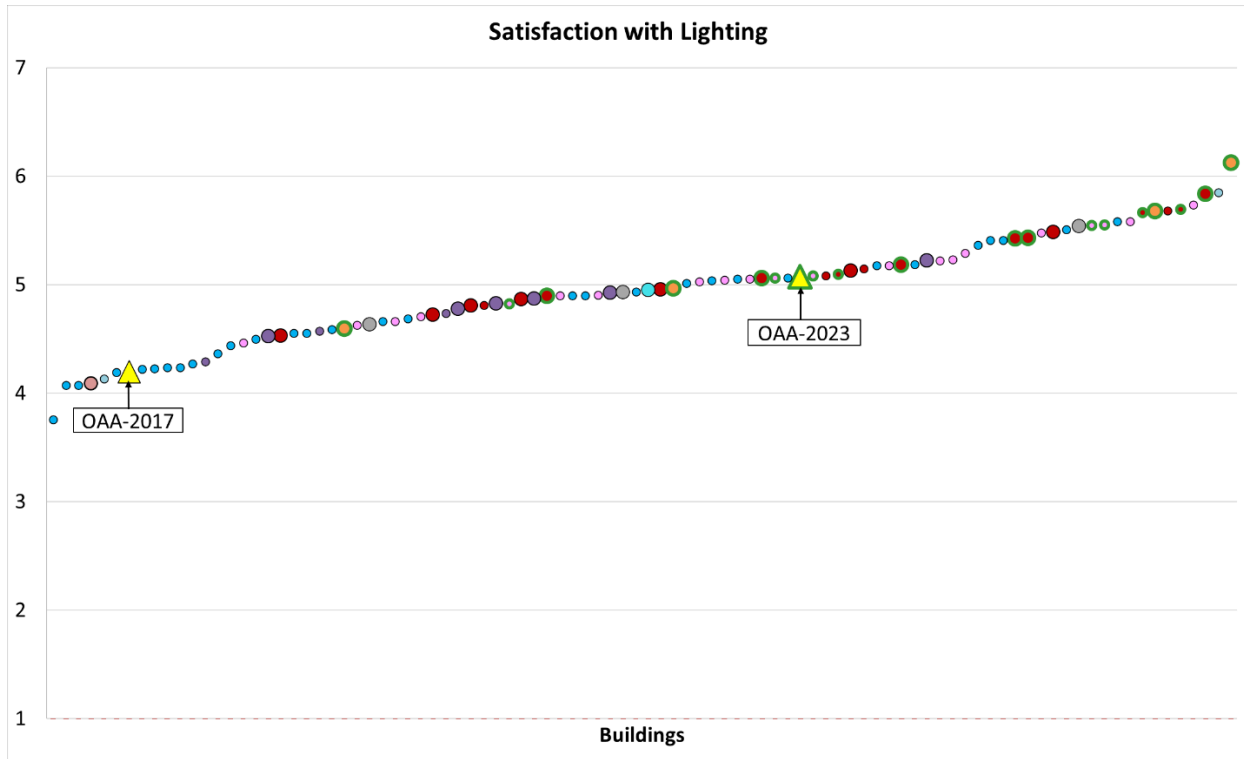


Figure 13 Satisfaction with lighting at OAA compared to other NRC building case studies (mean value recorded in each building).

In 2017, the average overall environmental satisfaction of the OAA regular building occupants was just below the midpoint of the NRC dataset and comparable to other buildings in this category (Figure 14; $M = 4.1$, $SD = 1.53$). In 2023, the survey participants' average rating improved ($M = 5.3$, $SD = 0.78$) and was above the midpoint of the scale, indicating that the overall environmental satisfaction improved after the renovation.

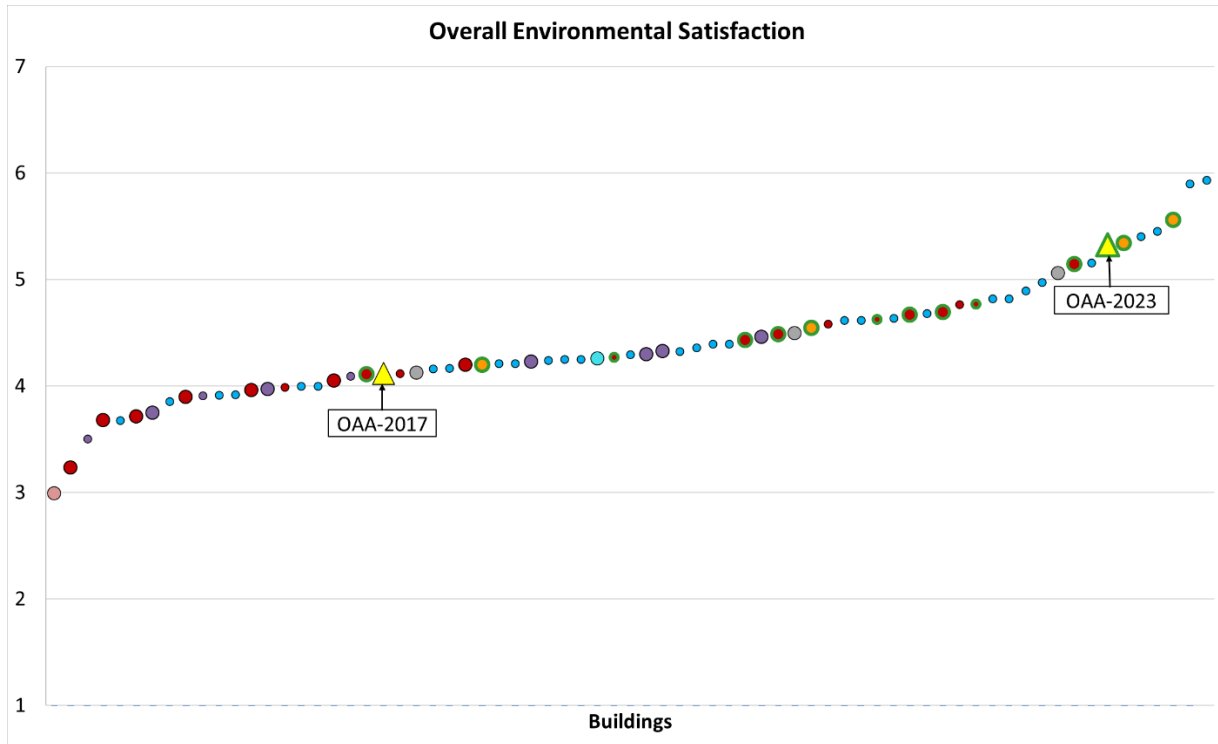


Figure 14 Overall environmental satisfaction at OAA compared to other NRC building case studies (mean value recorded in each building).

At both timepoints of the data collection, the average job satisfaction rating of the OAA permanent building occupants was above the midpoint of the NRC dataset distribution (Figure 15). The average job satisfaction was already above the midpoint in 2017 ($M = 5.8$, $SD = 1.22$), and slightly improved post renovation ($M = 6.5$, $SD = 0.61$).

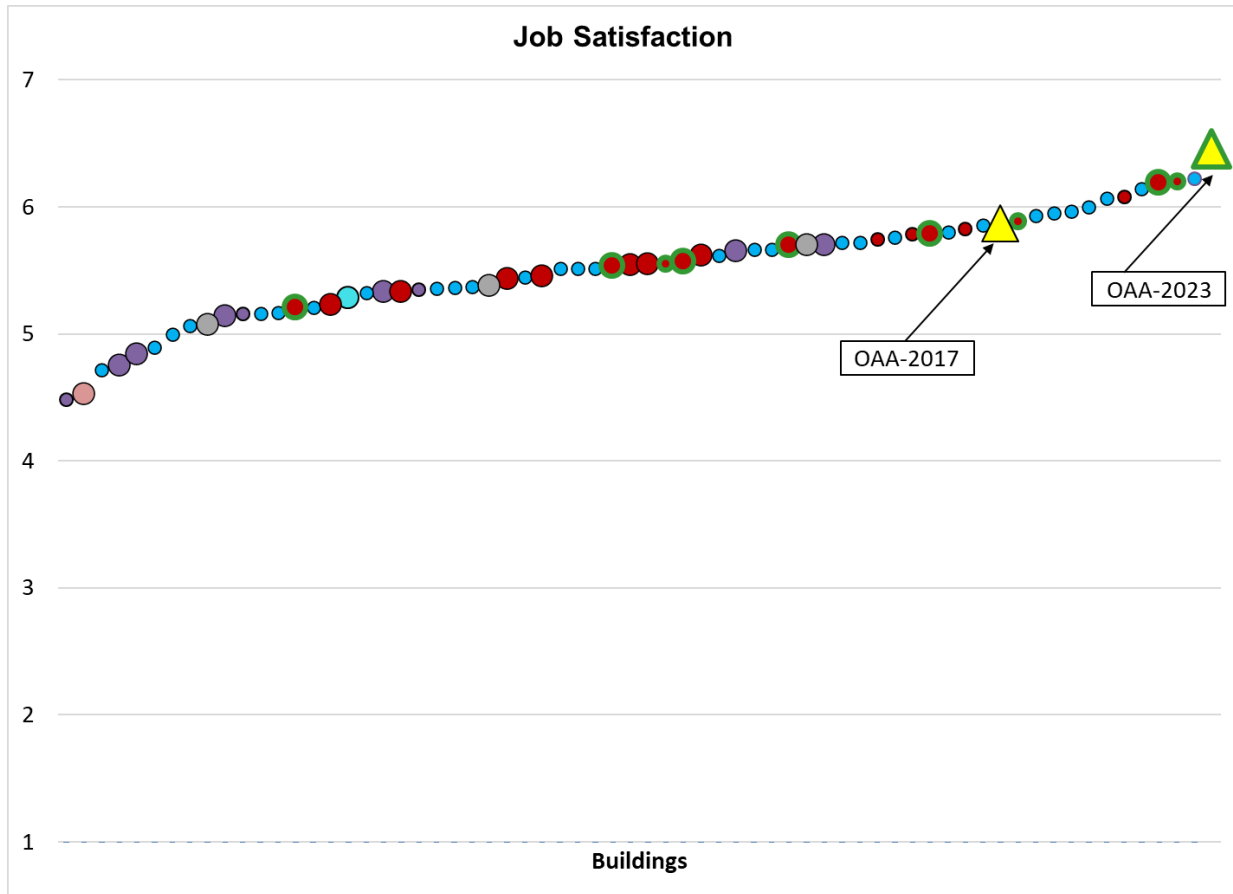


Figure 15 Overall job satisfaction at OAA compared to other NRC building case studies (mean value recorded in each building).

Table 11 presents a summary of the responses collected from the infrequent occupants on four dimensions of environmental satisfaction. In 2017, the satisfaction levels across all dimensions were already above the midpoint of the NRC dataset. After the renovation, the infrequent occupants reported even higher satisfaction on these dimensions. The average satisfaction ratings collected post-renovation during the evening and morning meetings were comparable.

Table 11 Responses from infrequent occupants related to environmental satisfaction, OAA-2017 and OAA-2023.

Categories (composite scores)	OAA-2017 Mean (SD)	OAA-2023 Mean (SD)
Satisfaction with Acoustics and Privacy	4.79 (1.11)	5.51 (1.13)
Satisfaction with Ventilation and Temperature	4.93 (1.31)	5.71 (1.17)
Satisfaction with Lighting	5.47 (0.81)	6.00 (1.00)
Overall Environmental Satisfaction	4.68 (1.12)	5.78 (0.84)

Post renovation, both permanent staff and OAA visitors were asked to identify one thing they liked best about their workplace in the OAA building and why. Table 12 outlines the main responses collected from the permanent OAA building occupants. Note that 19 individuals responded, but some responses were assigned to more than one category. Overall, the respondents liked the social aspect that the OAA building provides,

including easy to see coworkers, good coworkers and leadership (26%). They also liked the windows and the natural lighting available in the building (68%), the adjustable desks (16%), the high ceilings, the building layout and the overall feeling of openness and spaciousness (26%).

Table 12 Responses from OAA regular building occupants to: "Please identify one thing you like best about your workspace and why?" (OAA-2023)

Categories	Individual responses	Total N
Social		4
• Easy to see coworkers	2	
• Informal nature	1	
• Good leadership/coworkers	1	
Infrastructure		22
• Windows-nice view	4	
• Windows-natural light	9	
• Desk space	1	
• Adjustable desk height	3	
• High ceilings	1	
• Building layout	1	
• Feeling of openness/spaciousness	3	

The building occupants were also asked to identify one thing they would change about their workplace and why. Table 13 outlines the main responses provided by the OAA regular staff. Note that 18 individuals responded, but some responses were assigned to more than one category. Overall, 40% of the respondents indicated a preference for additional light sources installed above their desktops. Around 30% would also like to have better acoustics in their workplace, and 10% mentioned improved thermal comfort.

Table 13 Responses from OAA regular building occupants to: "What is one thing you would change about your workspace and why?" (OAA-2023)

Categories	Frequency	Total N
Lighting		11
• Reduce glare on screen	3	
• Light source above computer/flexible lighting positioning	5	
• Blinds in meeting room	1	
• More sunlight through tinted windows	1	
• Photolight for better camera quality	1	
Physical Comfort		1
• Better chair	1	
Acoustics		6
• Privacy/soundproofing	6	
Ventilation		1
• Better airflow	1	
Thermal Comfort		2
• Better heating	2	

Other		4
• Better view	3	
• Access outdoors	1	

Table 14 presents additional areas for improvement highlighted by the respondents when asked to provide comments about their ability to perform their work effectively in their work areas. Better heating, lack of desktop lighting, better acoustics and more privacy in the individual workstations were once again highlighted as areas for improvement. Note that 19 individuals responded, but some were assigned to more than one category.

Table 14 Responses from OAA regular building occupants to: "Please share any final thoughts you may have regarding your ability to perform your work effectively in your work area in the OAA building". (OAA-2023)

Categories	Frequency	Total
Ventilation/Thermal comfort		2
• UV treatment of supply air stream	1	
• Better heating	1	
Satisfaction		7
• Able to perform well in current work area	7	
Lighting		3
• Satisfied with natural light	1	
• More flexible lighting	2	
Acoustics		2
• Better acoustics	1	
• More privacy	1	
Other		2
• Composting	1	
• Drying rack for dishes	1	

Table 15 show the responses collected from the participants attending the two meetings in the OAA building on two separate days. Forty (40) individuals completed the survey and some responses were assigned to more than one category. In general, the participants liked the openness of the building, which was perceived as being good for collaboration. The respondents also enjoyed the natural lighting (77%) and the outside views (20%). Other aspects that were appreciated included the quality of the interior design, the choice of furniture, the overall freshness and the spaciousness of the space.

Table 15 Responses from meeting participants to: "Please identify one thing you like best about your workspace and why?" (OAA-2023)

Categories	Frequency	Total N
Social		1
• Good for collaboration	1	
Infrastructure		57
• Windows-nice view	12	
• Windows-natural light	19	
• No sound issues	2	
• Comfortable chair	1	
• Adjustable desk height	1	
• High ceilings	1	
• Adaptability	1	
• Feeling of openness/spaciousness	4	
• Nice boardroom	2	
• Office views	8	
• Freshness of air/air quality	2	
• Net zero/aligning with OAA plan	1	
• Internet	1	
• Clearly identifiable	2	

When asked about one thing that they would change about their workspace in the OAA building (Table 16), 22% of the meeting participants highlighted the need for more flexible lighting (both light sources and blinds), as well as better acoustics (18,5%). The respondents also mentioned improvements to ventilation and heating (48%) as well as the overall space use (18%). Note that 27 individuals responded and some responses were assigned to more than one category.

Table 16 Responses from meeting participants to: "What is one thing you would change about your workspace and why?" (OAA-2023)

Categories	Frequency	Total
Lighting		6
• Light source above computer/flexible lighting positioning	3	
• Blinds in meeting room	2	
• better visuals for online meeting attendees	1	
Physical Comfort		2
• Larger work surface	2	
Acoustics		5
• Layout - hearing others better	3	
• Privacy/soundproofing	2	
Ventilation		5
• Better airflow	4	

• Add window	1	
Thermal Comfort		8
• Better heating	8	
Other		6
• More welcoming entrance	2	
• Ground level entrance	2	
• Birds	1	
• Space under utilized	1	

In their final comments (Table 17), the meeting participants mentioned similar areas for improvement as the regular OAA staff, i.e., need for better ventilation, heating and more adjustable lighting. Survey respondents appreciated OAA's orientation towards net-zero operations and suggested other potential areas for improvement, such as the installation of biophilic design components around the building, and additional composting and water filling facilities.

Table 17 Responses from meeting participants to: "Please share any final thoughts you may have regarding your ability to perform your work effectively in your work area in the OAA building. (OAA-2023)"

Categories	Frequency	Total
Ventilation/Thermal comfort		3
• Better ventilation	1	
• Better heating	2	
Satisfaction		16
• Able to perform well in current work area	16	
Lighting		2
• More flexible lighting	2	
Acoustics		4
• Better acoustics	3	
• More privacy	1	
Other		9
• More welcoming entrance - biophilia	2	
• Composting	1	
• More water-filling facilities	1	
• Oriented to net-zero	2	
• Better signage (including glass doors)	2	
• Upgrade elevator	1	

Satisfaction with amenities

The overall satisfaction with various OAA building amenities was captured post-renovation only (Table 18). The questions are sorted by the size of the difference between the percentage of satisfactory (5-7) and unsatisfactory (1-3) responses, with the most positive responses at the top and the most negative responses at the bottom of the list.

Table 18 Responses from OAA regular building occupants to questions related to satisfaction with various building amenities.

Question	Percentage of Respondents							N	Net difference, Satisfaction% - Dissatisfaction
	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory		
Availability of small meeting rooms.	0	0	0	0	0	50	50	20	100
Availability of large meeting rooms.	0	0	0	0	0	50	50	20	100
Ability to find your way inside the building.	0	0	0	0	5	45	50	20	100
Access to waste collection, recycling and composting points.	0	0	0	0	10	40	50	20	100
Access to stairs to move between floors.	0	0	0	0	5	45	50	20	100
Places to eat and socialize with colleagues.	0	0	0	0	5	25	70	20	100
Spaciousness of your workspace surroundings.	0	0	0	5	10	35	50	20	95
Access points from the building to the outside.	0	0	0	5	15	55	25	20	95
Cleanliness and maintenance of public spaces.	0	0	5	0	0	25	70	20	90
Ability to display personal items in your workarea.	0	0	0	15	10	40	35	20	85
Facilities to store and prepare food.	0	0	5	5	10	30	50	20	85
Facilities to wash and store reusable dishes/utensils.	0	0	5	5	15	15	60	20	85
Availability of preferred work locations.	0	0	5	20	10	35	30	20	70
Ability to locate co-workers when needed.	5	0	5	10	5	45	30	20	70
Access to water fountain/bottle refill stations.	0	5	0	20	25	25	25	20	70
Comfort of your chair.	5	0	5	15	5	50	20	20	65
Secure storage for personal items.	5	0	15	15	10	35	20	20	45
Natural materials and elements (real or simulated) in the workplace.	5	0	10	35	10	25	15	20	35
Speed and availability of elevators.	0	15	20	15	15	25	10	20	15

Post-renovation, the overall satisfaction with most of the OAA building amenities trended generally high on the 7-point Likert satisfaction scale. Areas, where the frequency of dissatisfied ratings were present, were: speed and availability of elevators (35%); natural materials and elements (real or simulated) in the workplace (15%), secure storage for personal items (20%), comfort of chair (10%), access to water fountain/bottle refill stations (5%). Interestingly, the ability to locate co-workers when needed also received some dissatisfactory ratings (10%), as well as the availability of preferred work locations (5%).

The highest satisfaction ratings were associated with the availability of small and large meeting rooms, the ability to orient oneself inside the building, access to waste collection, recycling and composting points, access to stairs to move between floors, and places to eat and socialize with colleagues, which all accounted for 100% net satisfaction. The areas of spaciousness of workspace surroundings and access points from the building to the outside scored a 95% of net satisfaction rate.

The ratings for sustainability practices were also collected during the post-renovation study only. These questions asked about the respondents' level of awareness of OAA's operations, as well as in regard to personal sustainability actions. Table 19 shows that only a limited number of respondents were aware of the OAA's practices related to water use and waste management (5%). In terms of personal actions (Table 20), about 50% of the participants reported often having sustainability in mind (50% for water use; 50% for energy use; 60% for waste management).

Table 19 Responses from OAA regular building occupants to: *How knowledgeable are you about how the OAA building operates in terms of...?*

	Percentages of responses					N
	Not at all	A little	Somewhat	Knowledgeable	Very knowledgeable	Total
Water use	40	20	20	15	5	20
Energy use	25	20	20	25	10	20
Waste management	25	40	25	5	5	20

Table 20 Responses from OAA regular building occupants to: *When at work, how hard do you try to act sustainably with regards to...?*

	Percentages of responses					N
	Very rarely or never	Rarely	Sometimes	Often	Very often or always	Total
Water use	5	10	20	50	15	20
Energy use	5	10	20	50	15	20
Waste management	0	0	25	60	15	20

Satisfaction ratings related to the availability of programs and design features that support a healthful and sustainable working environment were also collected post-renovation from the OAA regular staff using the 7-point Likert satisfaction scale (Table 21). The average rating associated with a healthful work environment was 5.85 (SD = 0.99), while the average satisfaction with a sustainable work environment was 5.9 (SD = 1.02).

Table 21 Responses from OAA regular building occupants to: *How satisfied are you with the availability of programs and design features in the OAA building that support...?*

	Percentage of Respondents							N	Net difference, Satisfaction% - Dissatisfaction
	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory	Total	
A more healthful working environment.	0	0	0	15	10	50	25	20	85
A more sustainable working environment.	0	0	5	5	10	55	25	20	85

Satisfaction ratings with the OAA building amenities were also collected from the participants attending the two morning and afternoon meetings (Table 22). The questions are sorted by the size of the difference between the percentage of satisfactory (5-7) and unsatisfactory (1-3) responses, with the most positive responses at the top and the most negative responses at the bottom of the list. The results show that the meeting participants rated positively the cleanliness and maintenance of the public spaces, places to eat and socialize with colleagues, and the availability of large meeting rooms (95-86% net satisfaction). Conversely, the access to water fountain/bottle refill stations, secure storage for personal items and the availability of preferred work locations was scored the lowest (33-21% net satisfaction). However, the net-satisfaction on all categories trended positively, which suggests that the visitors to the OAA building are generally satisfied with the amenities of the OAA building.

Table 22 Responses from meeting participants to questions related to satisfaction with various OAA building amenities.

Question	Percentage of Respondents							N	Net difference, Satisfaction% -
	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory	Total	
Cleanliness and maintenance of public spaces.	0	0	0	4.55	2.15	13.65	79.65	44	95.45
Places to eat and socialize with colleagues.	0	0	0	6.75	0	18	75.3	44	93.3
Availability of large meeting rooms.	0	0	0	13.35	4.65	21.2	60.75	43	86.6
Comfort of your chair.	4.55	0	2.15	4.35	13.65	32.1	43.2	44	82.25
Spaciousness of your workspace surroundings.	0	0	2.15	13.85	2.15	22.55	59.2	44	81.75
Access to stairs to move between floors.	0	0	2.4	13.85	11.1	24.7	47.95	44	81.35
Availability of small meeting rooms.	0	0	0	22.15	9.3	9.3	59.2	44	77.8
Access to waste collection, recycling and composting points.	0	0	4.55	22.15	9.1	23	41.2	44	68.75
Access points from the building to the outside.	0	0	9.1	20.35	8.9	18.4	43.2	44	61.4
Facilities to wash and store reusable dishes/utensils.	0	0	0	38.6	2.15	16	43.2	44	61.35
Facilities to store and prepare food.	0	0	0	38.6	2.15	13.85	45.35	44	61.35
Ability to find your way inside the building.	0	2.15	11.5	11.5	4.35	20.35	50.1	44	61.15
Natural materials and elements (real or simulated) in the workplace.	0	2.4	4.65	25.55	2.25	23.25	41.9	43	60.35
Speed and availability of elevators.	0	4.75	13.65	29.3	13.65	15.85	22.75	44	33.85
Access to water fountain/bottle refill stations.	0	9.1	6.9	42.95	4.55	22.35	14.05	44	24.95
Secure storage for personal items.	2.25	2.4	23.15	23.25	9.3	23.4	16.25	44	21.15
Availability of preferred work locations.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Ability to locate co-workers when needed.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ability to display personal items in your workarea.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Satisfaction ratings related to the availability of programs and design features in the OAA building that support a healthful and sustainable working environment were also collected from the meeting participants (Table 23). The average satisfaction related to a healthful work environment was 6.32 (SD = 1.05), and the average satisfaction related to a sustainable work environment was 6.45 (SD = 0.9).

Table 23 Responses from meeting participants to question: *How satisfied are you with the availability of programs and design features in the OAA building that support...?*

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory	Total	Net difference, Satisfaction% - Dissatisfaction
A more healthful working environment.	0	0	2.15	9.1	2.15	27.35	59.2	44	86.55
A more sustainable working environment.	0	0	0	6.9	6.5	20.35	66.15	44	93

3.2.3 Organizational commitment, turnover intent, workplace image and internal communications

The average organizational commitment ratings were well above the midpoint of the distribution reported in the NRC buildings dataset (Figure 16). Pre-renovation, the average rating was already higher than those reported by occupants in other buildings (M = 5.3, SD = 1.1) and after the renovation, the organizational commitment improved even further (M = 5.6, SD = 0.61).

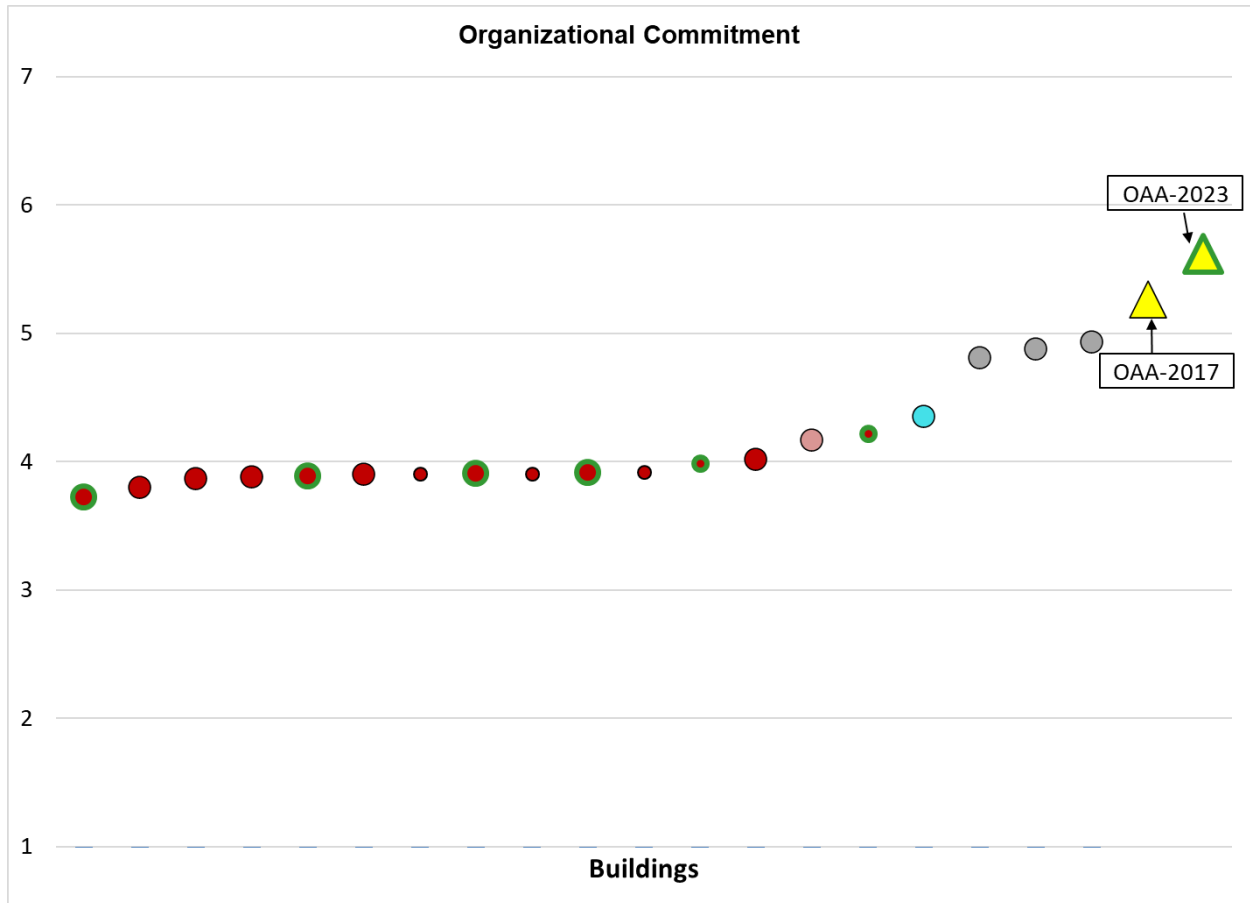


Figure 16 Ratings related to organizational commitment at OAA compared to other NRC building case studies (mean value recorded in each building).

The average intent to turnover (higher rating indicates higher intent to turnover) at OAA (Figure 17) was just at the midpoint of the NRC dataset distribution ($M = 2.4$, $SD = 1.38$), suggesting that this could have been an area of concern before the renovation. However, after the renovation, the intent to turnover decreased ($M = 1.6$, $SD = 0.83$), being now at the lowest end of the scale (i.e. second-best rating in NRC's database).

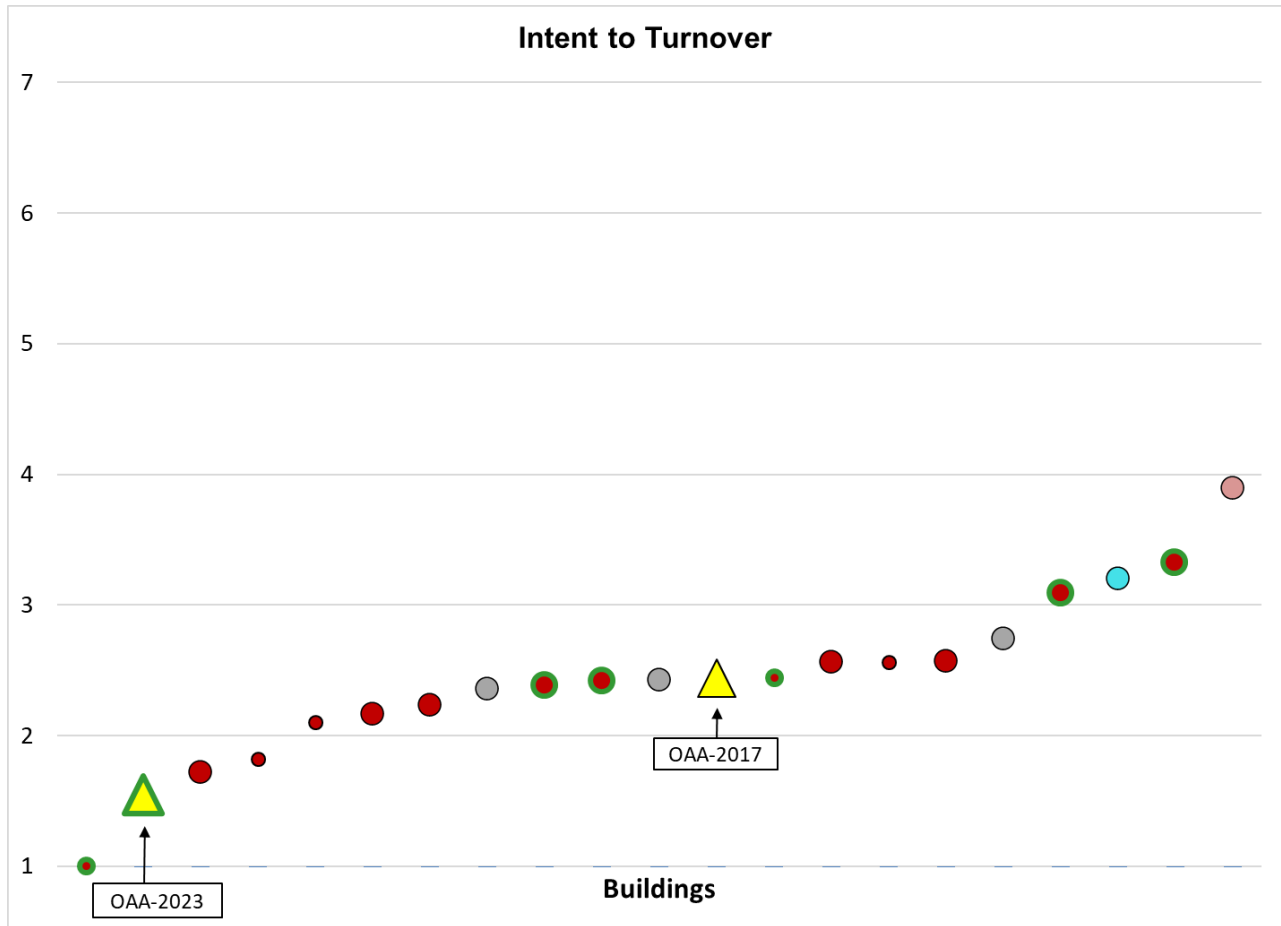


Figure 17 Ratings related to intent to turnover at OAA compared to other NRC building case studies (mean value recorded in each building).

The average workplace image rating varied greatly between the pre- and post-renovation surveys (Figure 18). Before the renovation, the average rating provided by the OAA regular building occupants trended towards the lower end of the NRC dataset scale ($M = 3.1$, $SD = 1.51$; second worse rating). After the renovation, the average workplace image rating improved significantly and positioned the OAA building as third best among the buildings included in the NRC dataset ($M = 5.4$, $SD = 1.11$).

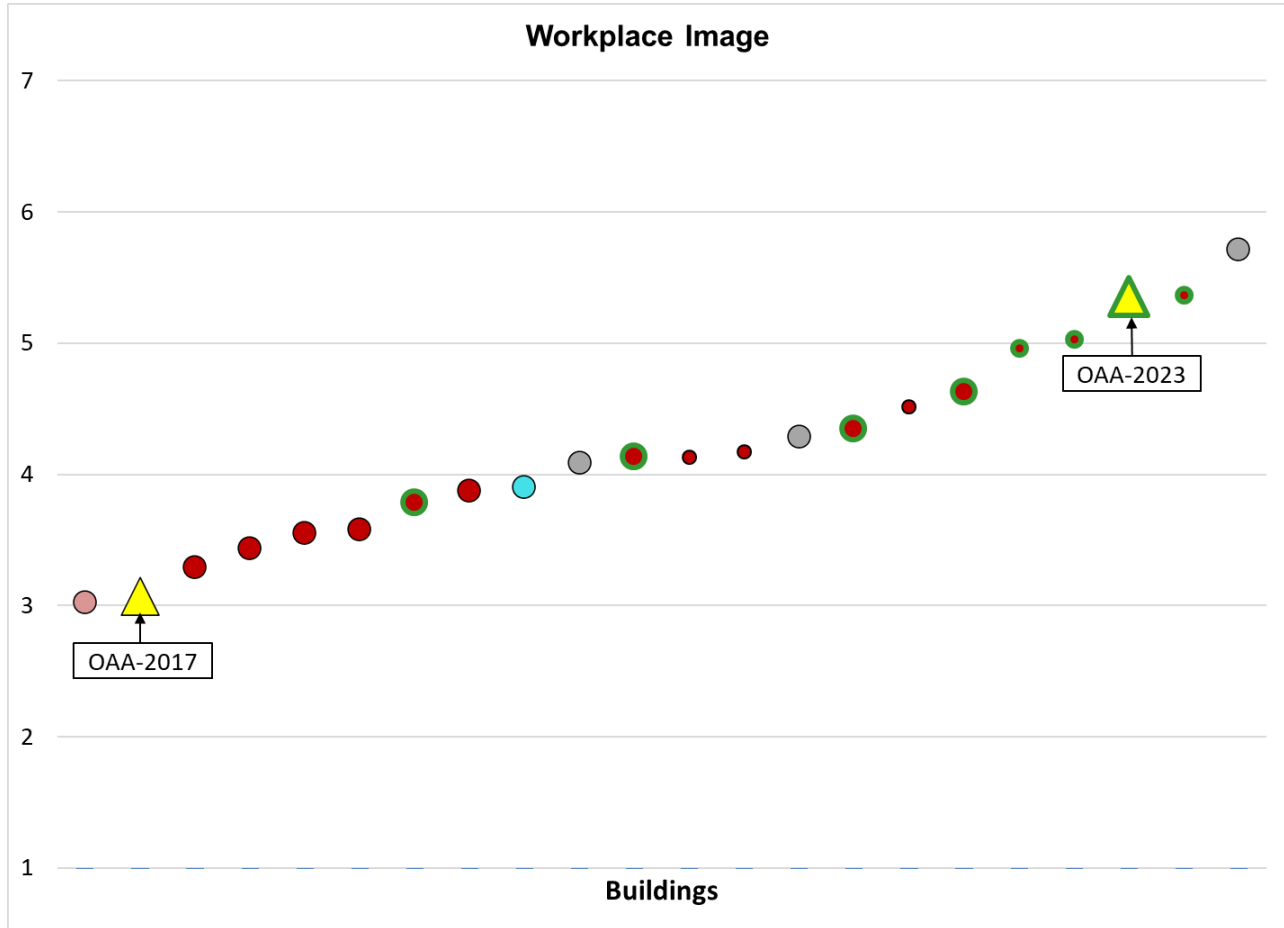


Figure 18 Ratings related to workplace image at OAA compared to other NRC building case studies (mean value recorded in each building).

Similarly, the workplace image ratings received from the infrequent building occupants improved greatly after the renovation. Pre-renovation, the average score received from this group of respondents was 4.0 (SD = 1.7), while after the renovation, the workplace image improved to 6.5 (SD = 1.1). The majority perceived the OAA workplace image, ethics and culture as very satisfactory (Table 24).

Table 24 Infrequent respondents reporting on workplace image, OAA-2023.

Question		Percentage of Respondents							N
		Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory	
How satisfied are you with the availability of programs and design features in the OAA building that support: A more healthful working environment.	2023 Day 1	0	0	4.3	8.7	4.3	26.1	15.5	23
	2023 Day 2	0	0	0	4.3	13.0	21.7	60.9	23
How satisfied are you with the availability of programs and design features in the OAA building that support: A more sustainable working environment.	2023 Day 1	0	0	0	9.5	0	28.6	61.9	21
	2023 Day 2	0	0	0	9.5	0	19.0	71.4	21

On both survey occasions, the average internal communication ratings at OAA were well above the midpoint of those reported in the NRC buildings dataset (Figure 19). Pre-renovation, the average rating was already above the midpoint (M = 6, SD = 1.05). After the renovation, the average rating for internal communication further improved (M = 6.8, SD = 0.45), positioning the OAA building with the highest rating among other buildings included in the NRC distribution.

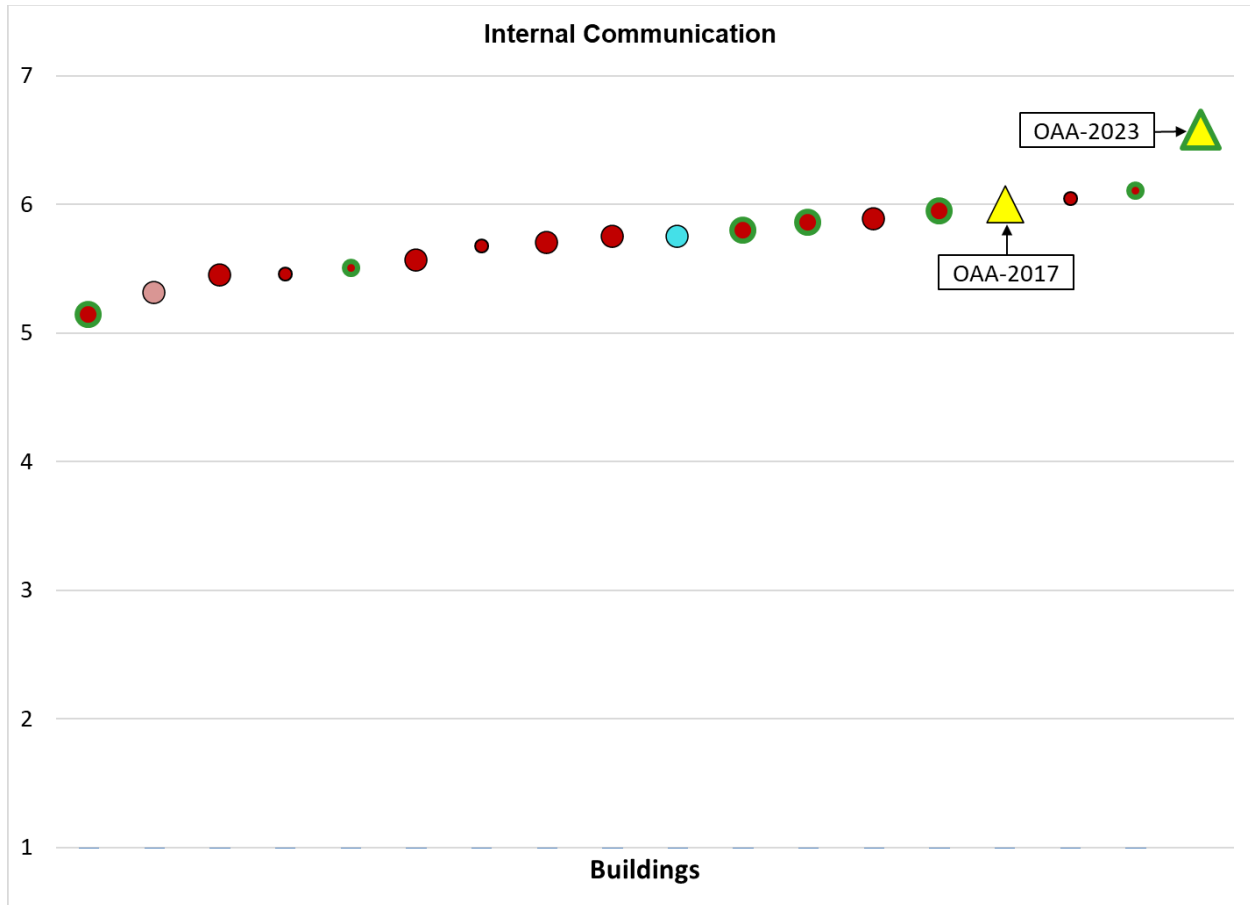


Figure 19 Ratings related to internal communication at OAA compared to other NRC building case studies (mean value recorded in each building).

3.2.4 Comfort-related modifications

Noise and Privacy comfort

Table 25 shows the responses collected from the regular OAA staff to questions related to disturbing noise and sounds heard in their workstations post-renovation. Some participants (53.3%) reported hearing moderate noise levels due to the heating, ventilating and cooling system, followed by sound speech from others in the building (37.5%) and noise from office equipment (28.6%).

Table 25 Responses to questions asking about disturbing noises/sounds in the workstations, OAA-2023, permanent occupants.

OAA-2023	Percentage of Respondents							N
	Very			Moderately			Not at all	
Noise from heating, ventilating and cooling systems.	0	0	0	53.3	0	0	46.7	20
Noise from office equipment (e.g. printers, computers, telephones ringing).	0	0	0	28.6	0	0	71.4	20
Noise from washrooms and other plumbing noises.	0	0	0	6.3	0	0	93.8	20
Noise from outdoors (e.g. road traffic).	0	0	0	6.7	0	0	93.3	20
Speech sounds from others in your building.	0	0	0	37.5	0	0	62.5	20
Non-speech sounds generated by others in your building (e.g. footsteps, shuffling papers).	0	0	0	16.7	0	0	83.3	20

Table 26 summarizes the responses obtained from the infrequent occupants when asked about noise coming from the heating, ventilating and cooling system. Pre-renovation, 63.6% of the participants reported that the noise was not disturbing at all, while 36.4% reported this noise to be moderately disturbing. After the renovations, a higher percentage of respondents reported that the noise was not disturbing at all (73.9%).

Table 26 Infrequent occupants' responses to: *How disturbing would you rate the noise from heating, ventilating and cooling systems that you hear when working in the OAA building?*

How disturbing would you rate the noise from heating, ventilating and cooling systems that you hear when working in the OAA building.							
	Very			Moderately			Not At All
OAA-2017	0	0	0	36.4	0	0	63.6
OAA-2023	5.9	0	0	46.2	0	0	73.9

Table 27 shows responses to a question asking about the overall privacy in the workstations. This question was asked post-renovation only, and 63.5% of the respondents reported not having any privacy at all, while 27.3% reported having moderate privacy. These findings were expected as the new design of the OAA building consists mostly of open-plan offices.

Table 27 Responses to questions asking about workstation privacy, OAA-2023, permanent occupants.

OAA-2023	Percentage of Respondents							N
	Not at all private			Moderately private			Very private	
The privacy of your workstation (e.g. do you feel you can have a private conversation or phone call at your workstation?).	63.6	0	0	27.3	0	0	9.1	11

Table 28 reports on different aspect of privacy, specifically focusing on how much the overheard speech and the noise outside one’s workstations interferes with their ability to do their job. Only one question was asked pre-renovation (noise other than speech), while all the other questions were asked part of the OAA-2023 survey only.

Pre-renovation, noise other than speech moderately impacted the work of 24.1% of the survey respondents, while 10.3% of the participants reported this noise to have impacted their job considerably. Post-renovation, noise was not prevalent for 75% of the respondents and 55% reported not being impacted by overheard speech. However, 15% felt that overheard speech affected their work moderately, while 5% reported considerable interference of overheard speech on their job (very). Overheard conversations were predominantly reported as considerably interfering with a respondents’ ability to complete their work (91.5%, very). These findings are not surprising due to the open-plan design of the OAA building.

Table 28 Responses to questions asking about how noise other than speech heard in the workstations (OAA-2017 and OAA-2023); speech from others (OAA-2023); and understandable conversation interference with ability to complete work (OAA-2023), permanent occupants.

OAA-2017	Percentage of Respondents							N
	Not at all			Moderately			Very	
Noise (from all sources other than speech) that you hear at your workstation	13.8	20.7	10.3	24.1	10.3	10.3	10.3	29
OAA-2023	Not at all			Moderately			Very	Total
Noise (from all sources other than speech) that you hear at your workstation.	35	40	15	5	5	0	0	20
Overheard speech from others in your office.	10	45	25	5	10	0	5	20
At your workstation, how understandable are overheard conversations and phone calls from others in your office?	0	0	0	8.3	0	0	91.5	12

Lighting comfort

The respondents provided ratings across 10 additional lighting questions, as shown in Table 29. Questions from 1 to 9 were rated as either “agree” or “disagree”, while Question 10 was rated as “worse”, “the same” or “better”. The majority of the occupants (80%) found the overall lighting to be comfortable, however 30% of the respondents found the lighting to be poorly distributed, or uncomfortably bright (10%) or dim (25%) for the tasks they performed. No one reported flicker or light fixtures that are too bright. When the respondents compared the lighting in the OAA building with the lighting in other building workplaces, 50% reported better lighting at the OAA (Table 30).

Table 29 Responses to questions related to lighting quality, permanent occupants.

	Norm	OAA-2023 N=20
Item	Agree %	Agree %
1. Overall, the lighting is comfortable.	69	80
2. The lighting is uncomfortably bright for the tasks that I perform.	16	10
3. The lighting is uncomfortably dim for the tasks that I perform.	14	25
4. The lighting is poorly distributed here.	25	30
5. The lighting causes deep shadows.	15	5
6. Reflections from the light fixtures hinder my work.	19	10
7. The light fixtures are too bright.	14	0
8. My skin is an unnatural tone under the lighting.	9	5
9. The lights flicker throughout the day.	4	0

Table 30 Responses to statement related to lighting quality, OAA compared to other buildings, permanent occupants.

Item	Norm (%)	N	Worse	Same	Better
			%	%	%
			19	60	22
10. How does the lighting compare to similar workplaces in other buildings?	2023	20	15	35	50

Note. * $p < .01$. For comparisons between that group and the normative North American data.

Post-renovation, data about lighting quality was also collected from the meeting participants. The results are shown in Table 31, separately for Day 1 (evening) and Day 2 (morning).

Overall, 91% of the respondents found the lighting to be comfortable on both days. During the evening meeting (Day 1), 13% found the lighting fixtures to be too bright, and 9% found them uncomfortably bright or dim for their task, or poorly distributed. These ratings somewhat improved for the morning meeting. Nevertheless, overall, all lighting comfort ratings were significantly better when compared to normative North American data. Furthermore, as shown in Table 32, on both days, 77% of the respondents considered the lighting at OAA to be much better than that in other workplaces.

Table 31 Responses to statements related to lighting quality, infrequent occupants.

	Norm	2023 Day 1 N=23	2023 Day 2 N=22
Item	Agree %	Agree %	Agree %
1. Overall, the lighting is comfortable.	69	91*	91*
2. The lighting is uncomfortably bright for the tasks that I perform.	16	9	5
3. The lighting is uncomfortably dim for the tasks that I perform.	14	9	9
4. The lighting is poorly distributed here.	25	9	9
5. The lighting causes deep shadows.	15	4	5
6. Reflections from the light fixtures hinder my work.	19	0*	5
7. The light fixtures are too bright.	14	13	5
8. My skin is an unnatural tone under the lighting.	9	0	5
9. The lights flicker throughout the day.	4	4	5

Note. * $p < .05$ for comparisons between that group and the normative North American data.

Table 32 Response to statement related to lighting quality, OAA compared to other buildings, infrequent occupants.

Item		N	Worse %	Same %	Better %
			Norm (%)	19	60
10. How does the lighting compare to similar workplaces in other buildings?	2023 Day 1	23	9	14	77
	2023 Day 2	22	0	23	77

Note. * $p < .001$. For comparisons between that group and the normative North American data.

Thermal comfort

The level of thermal comfort was reported by the respondents at the moment of survey completion; therefore, this data is reported only for those who confirmed being physically present in the OAA building at that time (N = 6). Tables 33 and 34 show a breakdown of responses to two questions related to thermal comfort, i.e. current thermal sensation and preferred thermal sensation.

Pre-pandemic, 28.5% of the respondents felt neutral, while others felt slightly cool (21.4%) or cool (14.3%). Nearly 41% of the respondents would have liked to feel warmer and 18.5% preferred to feel cooler.

After the renovation, the respondents rated their thermal comfort on the same scales, and 50% reported feeling neutral, while 16.7% reported feeling either cool, slightly cool or slightly warm; 83.3% reported wanting no change in their thermal condition, and 16.7% indicated a preference to feel warmer. When asked about what they would change to improve their thermal comfort, 25% of the participants mentioned preheating the room with a timer, while 4.5% reported putting on an additional piece of clothing. Note that these results should be interpreted with caution because only a small number of respondents (N=6) were included in the analysis, and no individual differences among the respondents were considered in terms of thermal comfort.

Table 33 Permanent occupants' responses to question: *At the moment I feel...?*

Respondents who filled the survey at OAA workstation only	Percentage of responses							N
	Cold	Cool	Slightly Cool	Neutral	Slightly Warm	Warm	Hot	
OAA-2017	10.7	14.3	21.4	28.6	7.1	3.6	14.3	28
OAA-2023		16.7	16.7	50	16.7			6

Table 34 Permanent occupants' responses to question: *At the moment I would like to feel...?*

Respondents who filled the survey at OAA workstation only	Percentage of responses			N
	Cooler	No Change	Warmer	
				Total

OAA-2017	18.5	40.7	40.7	29
OAA-2023		83.3	16.7	6

All the infrequent occupants completed the survey in the OAA building on two different days: Day 1 – during an evening meeting) and Day 2 – during a morning meeting. Data shown in Table 35 shows that the thermal comfort levels were acceptable across both days. During the evening meeting, 30.4% of the respondents reported feeling slightly cool, and 69.6% would have preferred to feel warmer. During the morning meeting, 31.8% of the respondents reported feeling neutral and 40.9% would have preferred to feel warmer. No change was selected by 59.1% of the respondents. When asked about how they would adjust to improve their thermal comfort, 10% reported dressing more warmly, while 75% would have preferred to have the option to adjust the temperature in the room manually or automatically.

Table 35 Infrequent occupants’ responses to thermal comfort questions, OAA-2023.

At the moment I feel...							
	Cold	Cool	Slightly Cool	Neutral	Slightly Warm	Warm	Hot
Day 1 – evening meeting (N=23)	26.1	21.7	30.4	21.7	0	0	0
Day 2 – morning meeting (N=22)	9.1	13.6	27.3	31.8	13.6	4.5	0
At the moment, I would like to feel...							
	Cooler	No change	Warmer				
Day 1 - evening meeting (N=23)	0	30.4	69.6				
Day 2 - morning meeting (N=22)	0	59.1	40.9				

Tables 36 and 37 shows the main actions that permanent respondents reported doing to adjust their thermal comfort levels. Pre-renovation, frequent actions included having a hot or cold drink several times per day (27.6%), use a portable heater several times per day (13.8%), and adding or removing a piece of clothing several times per day (10.7%). Post-renovation, the most frequent actions used to adjust thermal comfort were having a hot or cold drink (10% several times per day, 30% once per day), add or remove piece of clothing (20% several times per day, 30% once per day), change the local temperature settings (5% several times per day, 15% once a day), change the local electric light level (10% several times per day, 15% once a day). Interestingly, 5% of the OAA permanent occupants reported adjusting the tint level on the windows several times per day, with 10% adjusting the tint on the windows at least once a day. Changing the local temperature or the light settings, and/or adding or removing a piece of clothing were the most frequent actions used to adjust thermal comfort.

Table 36 Permanent occupants’ responses to question: *How often do you take the following actions to improve your thermal comfort in your workspace?* OAA-2017

OAA-2017	Percentage of Respondents							N
	Never/not an option	Once/Month	2-3/Month	Once/Week	2-4/Week	Once/Day	Several times per day	Total

Have a hot or cold drink	34.5	3.4	3.4	3.4	6.9	20.7	27.6	29
Use a portable heater	55.2	10.3	3.4	0	6.9	10.3	13.8	29
Use a portable fan	65.5	17.2	3.4	3.4	3.4	3.4	6.9	29
Change the local temperature setting	44.8	24.1	3.4	3.4	13.8	6.9	3.4	29
Add or remove a layer of clothing	20.7	20.7	0	10.3	13.8	24.1	10.3	29
Open or close a window	65.5	20.7	3.4	3.4	3.4	3.4	0	29
Adjust a window blind or curtain	51.7	17.2	10.3	3.4	0	17.2	0	29
Change the local electric light level	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Open or close a door	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Adjust the furniture	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Change my work location	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Adjust the window tint level	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 37 Permanent occupants' responses to question: *How often do you take the following actions to improve your thermal comfort in your workspace?* OAA-2023

OAA-2023	Percentage of Respondents							N
	Never/not an option	Once/Month	2-3/Month	Once/Week	2-4/Week	Once/Day	Several times per day	
Have a hot or cold drink	20	5	10	0	25	30	10	20
Use a portable heater	100	0	0	0	0	0	0	20
Use a portable fan	90	5	5	0	0	0	0	20
Change the local temperature setting	20	20	5	20	15	15	5	20
Change the local electric light level	65	0	0	10	0	15	10	20
Open or close a door	75	0	0	10	5	0	10	20
Adjust the furniture	75	5	5	0	15	0	0	20
Add or remove a layer of clothing	5	10	5	25	20	20	15	20
Open or close a window	60	20	5	5	0	10	0	20
Adjust a window blind or curtain	80	5	5	5	0	5	0	20
Change my work location	75	10	15	0	0	0	0	20
Adjust the window tint level	80	0	0	5	0	10	5	20

Mood

The permanent OAA occupants also answered questions related to their general mood, calculated from multiple questions related to positive and negative feelings. Pre-renovation, the respondents reported a positive overall mood ($M = 9.8$, $SD = 7.57$), which was very comparable to the overall mood reported after the renovation, although with a slightly lower average score ($M = 8.6$, $SD = 5.38$). Figure 20 shows the position of

the OAA average mood scores on the NRC buildings dataset. The average pre-renovation rating is towards the higher end of the scale, while the average post-renovation rating is at the midpoint of the scale.

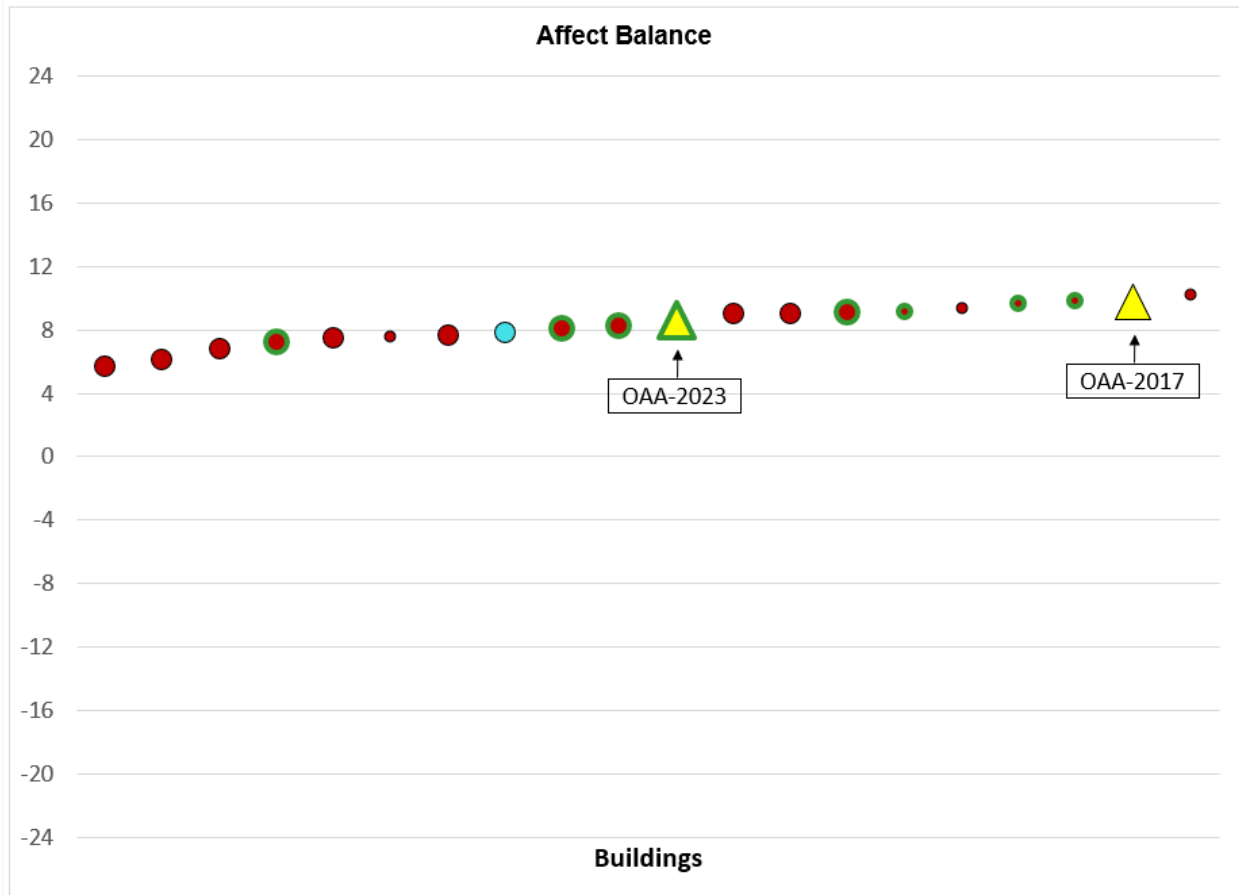


Figure 20 Ratings of positive and negative feelings at OAA compared to other NRC building case studies (mean value).

3.2.5 Sleep Quality

Some studies have shown a relationship between building conditions and sleep quality (MacNaughton et al., 2018; Newsham et al., 2013). Sleep quality is linked to many other aspects of human well-being (Alhola & Polo-Kantola, 2007; Zammit et al., 2010).

Figure 21 shows the respondents' sleep duration pre- and post-renovation. This was calculated as the elapsed time between the time at which the respondent reported having gone to bed and the time at which they reported getting up during the sleep period before answering the question. Pre-renovation, most respondents reported having 7 to 8 hours of sleep ($M = 7.4$, $SD = 0.7$). Similar results were reported by the participants completing the survey post-renovation ($M = 7.9$, $SD = 1.3$), with a slightly wider spread (6.5 to 8.5) hours of sleep.

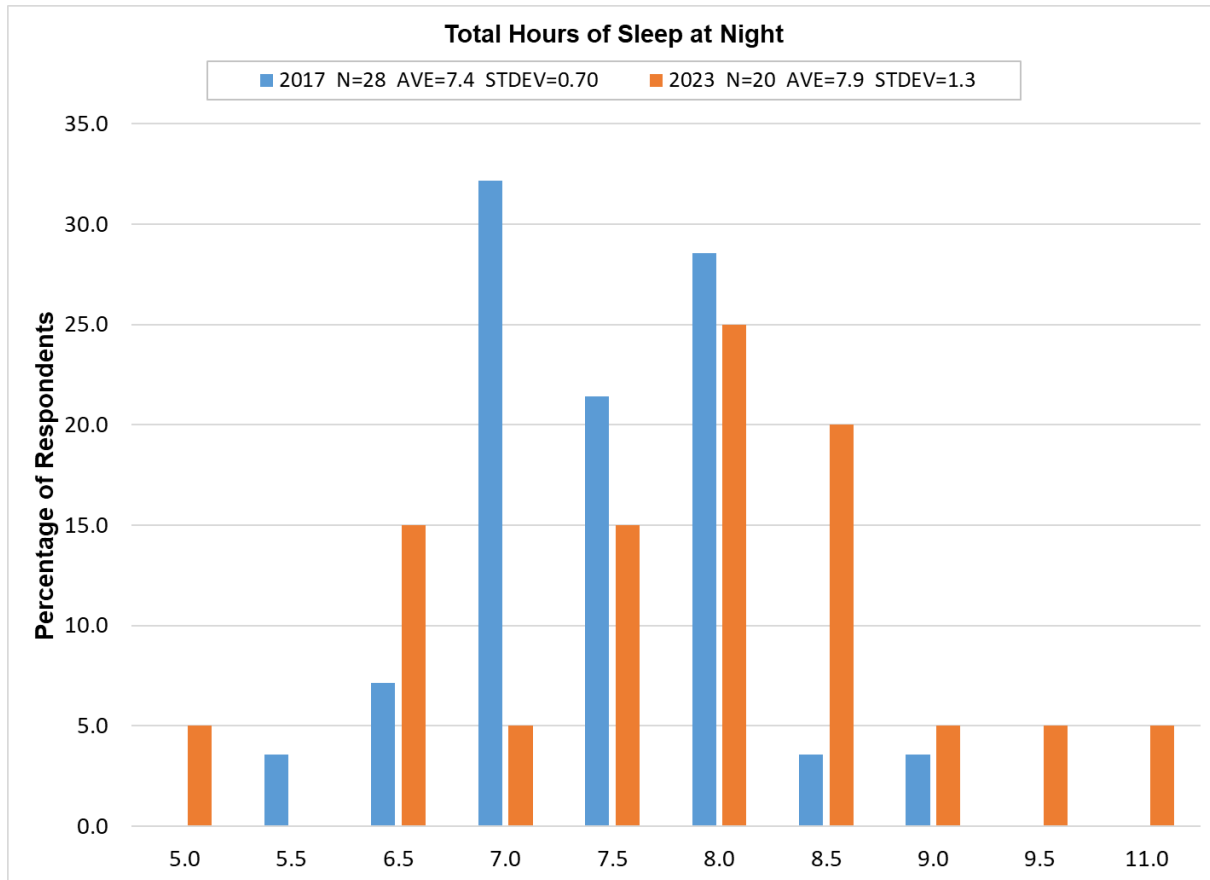


Figure 21 Reported sleep duration (in hours) in the sleep period before completing the survey, OAA-2017 and OAA-2023.

Tables 38 to 41 show the participants’ responses to questions about sleep quality and the ease of falling asleep. If both sleep quality scales are enumerated from 1-7, then pre-renovation, the average reported sleep quality was 5.00 (SD = 1.41), and the average reported ease of getting to sleep was 5.14 (SD = 1.58). After the renovation, the average reported sleep quality was 4.85 (SD = 1.27), and the average reported ease of getting to sleep was 5.00 (SD = 1.34). Overall, acceptable sleep quality levels were reported for both data collection timepoints, and the average ratings were comparable.

Table 38 Reported sleep quality the night before completing the survey, OAA-2017.

Question	Percentage of Respondents							N
	Very Badly 1	Badly 2	A Little Badly 3	Neutral 4	OK 5	Well 6	Very Well 7	
How well did you sleep last night?	0	3.4	17.2	13.8	17.2	37.9	10.3	29

Table 39 Reported ease of getting to sleep the night before completing the survey, OAA-2017.

Question	Percentage of Respondents							N
	Very Difficult	Difficult	A Little Difficult	Neutral	Somewhat Easy	Easy	Very Easy	
How easy or difficult was it for you to get to sleep last night?	3.4	0	17.2	10.3	13.8	37.9	17.2	29

Table 40 Reported sleep quality the night before completing the survey, OAA-2023.

Question	Percentage of Respondents							N
	Very Badly 1	Badly 2	A Little Badly 3	Neutral 4	OK 5	Well 6	Very Well 7	
How well did you sleep last night?	0	0	20.0	15.0	35.0	20.0	10.0	20

Table 41 Reported ease of getting to sleep the night before completing the survey, OAA-2023.

Question	Percentage of Respondents							N
	Very Difficult	Difficult	A Little Difficult	Neutral	Somewhat Easy	Easy	Very Easy	
How easy or difficult was it for you to get to sleep last night?	0	5.0	10.0	15.0	30.0	30.0	10.0	20

3.2.6 Health

Figures 22 and 23 show the pattern of responses to questions concerning the experience of symptoms of visual and physical discomfort, rated in terms of their frequency and intensity. The combined measure of frequency x severity is compared to those measured in other buildings where NRC used the same scales. The lower rating indicates less visual discomfort. The visual discomfort was close to the midpoint on the scale pre-renovation (M = 2.8, SD = 2.61). After the renovation, the visual discomfort decreased (M = 1.8, SD = 2.09). The physical discomfort (Figure 23) was also closer to the midpoint of the scale pre-renovation (M = 3.3, SD = 2.02). After the renovation, the ratings of physical discomfort also decreased (M = 2.47, SD = 1.73).

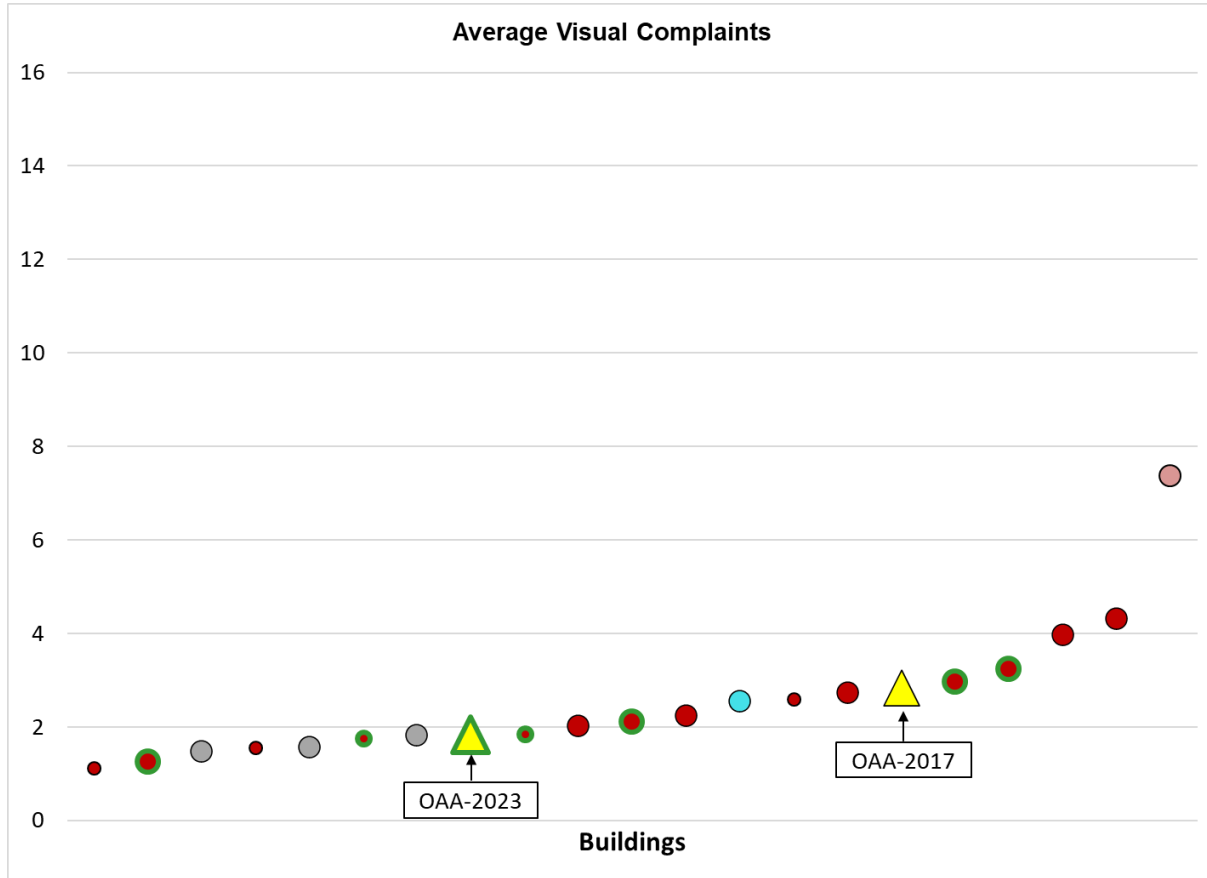


Figure 22 Ratings of visual discomfort at OAA compared to other NRC building case studies (mean value recorded in each building).

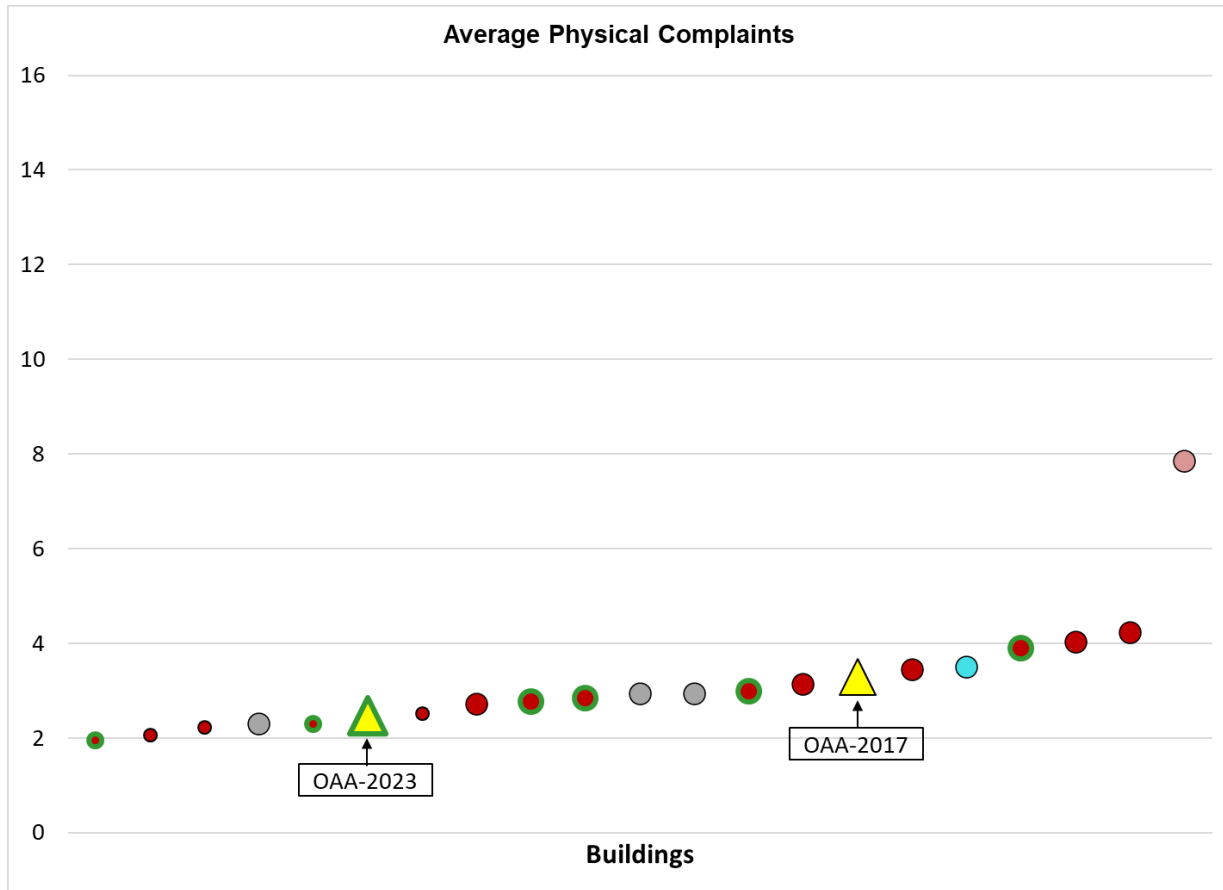


Figure 23 Ratings of physical discomfort at OAA compared to other NRC building case studies (mean value recorded in each building).

Absence due to illness is partly dependent on season; for example, the common cold is more frequent in the winter, although it can occur in any season. Note that the OAA-2017 survey was conducted before there was evidence of community spread of the SARS-coV-2 virus internationally, so the illness absences cannot be attributed to COVID-19. The OAA-2023 survey was conducted after the major waves of the SARS-coV-2 virus internationally, and there is a possibility that some of the illness absences recorded in OAA-2023 could be attributed to COVID-19.

Absences for any reason may also be strongly affected by popular vacation periods in the previous month. Neither OAA survey took place in parallel with a school holiday, but we do not know what holidays, if any, had taken place in the location of most of the comparison buildings included in the NRC dataset.

Figure 24 shows responses to a question asking about how much leave was taken during the past month due to any reason. Pre-renovation, the average of missed days in the last month due to any reason was at the midpoint ($M = 1.6$, $SD = 1.89$) of the NRC scale. After the renovation, the number of missed days decreased ($M = 0.74$, $SD = 1.24$) to the lowest amount in NRC’s dataset. However, this finding should be interpreted with caution as most OAA building occupants currently work hybrid, which means that they might have not considered absences due to illness on the days when they worked from home.

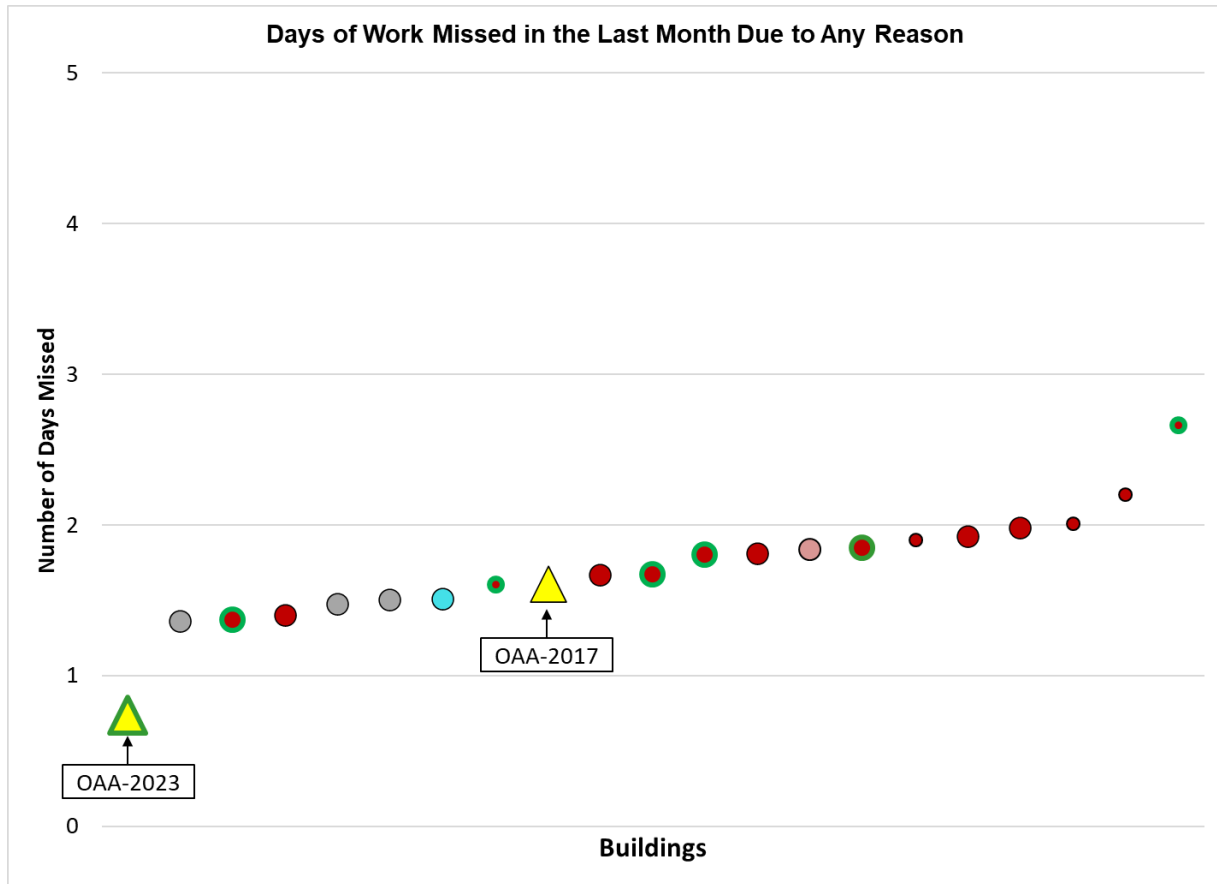


Figure 24 Days absent in the past month due to any reason at OAA compared to other NRC building case studies.

As a point of comparison for illness absence, Table 42 shows illness absence data for Canada in 2015, derived from the Canadian Labour Force Survey. There is a range of absenteeism by broad industry type. Data from GOC-2020 shows a mean absence of 1.05 days/month due to illness, which by simple extrapolation equates to 12.6 days/year, which is above the average public administration value from the Labour Force Survey. Public sector absences are commonly observed to be higher than in other industries, which may be related to better sick leave compensation, as well as more exposure to potential sources of illness (e.g. health care workers, teachers).

Table 42 Absenteeism data for Canada in 2015, by major industry with office employees.

	Illness or disability absence (days/person/year)
Professional, scientific and tech services	3.5
Real estate and rental and leasing	4.8
Finance and insurance	6.6
Business, building and support services	7.5
Public administration	10.7

Days taken because one was personally ill is compared in Figure 25 to data from the same question asked in other NRC studies. Pre-renovation, the average number of days absent due to personal illness ($M = 0.81$, $SD = 1.14$) was towards the highest end of the distribution of average responses from other buildings. Post-renovation, on average the respondents reported a lower number of days absent due to personal illness ($M = 0.5$, $SD = 1.19$), however, this average was at the midpoint of the scale when compared to other buildings in the NRC dataset.

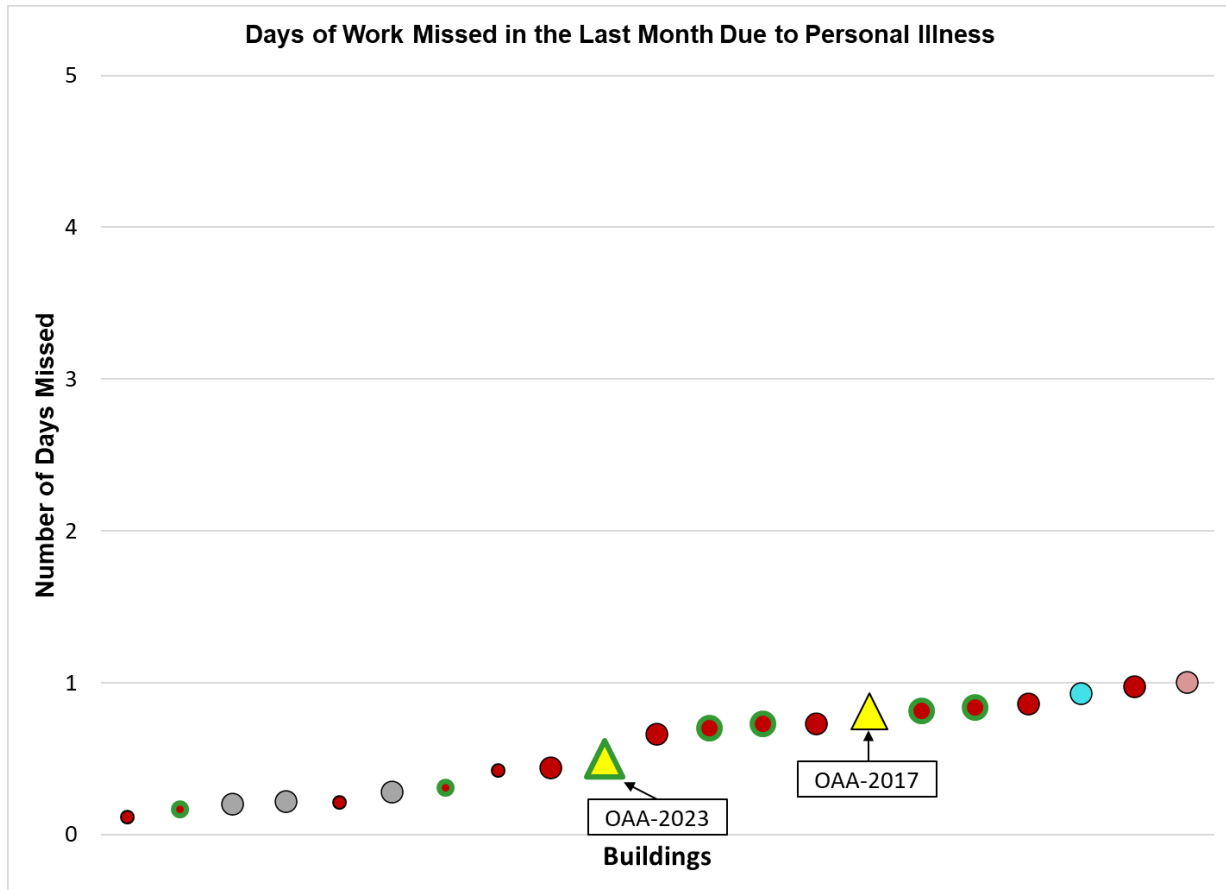


Figure 25 Days absent in the past month due to personal illness at OAA compared to other NRC building case studies.

3.3 Physical measurements of indoor conditions

The physical measurements were collected in the OAA building during the same season, pre-renovation (February 2017) and post-renovation (February 2023). In 2017, the physical conditions were measured in 22 locations. In 2023, the physical measurements were collected in 26 workstations. The wide gap between the pre- and post-measurements was due to the COVID-19 pandemic, which impacted the completion of the renovation, as well as the reinstatement of the building occupancy.

The data presented in this section was collected using the NICE cart, the pyramids and the ventilation poles. The NICE cart was used to collect data in open plan workstations, private offices and meeting rooms located on the second and third floors of the OAA building. Six pyramids and two ventilation poles were located at fixed locations in meeting rooms, workstations and common social areas (atrium).

In 2017, the data was collected on February 2 and February 3, and all the cart measurements were taken on February 3. In 2023, the data was collected between February 1 and February 3, and the cart measurements were split between February 2 and February 3.

In describing the results, commentaries are provided with reference to the relevant standards, recommended practice or previous research studies. It is important to remember that the measurement locations were chosen to be representative, but not all possible locations were measured. Furthermore, measurements were limited to a relatively short period of time. Thus, just because a measurement at a specific location may have violated (or met) a standard during the collection period, does not mean that these conditions necessarily persisted outside of the study period, nor does it imply anything about the conditions in locations in which measurements were not conducted. Note also that this study did not have the objective to identify or diagnose particular building performance issues, nor to remedy any emerging issues. Thus, while this information may be useful to building operators and the occupants in identifying potential building performance issues (good or bad), if a specific issue is to be pursued, a more comprehensive (both spatially and temporally) supplementary set of measurements should be collected.

3.3.1 Temperature

The most commonly referenced standard related to thermal comfort in North American offices is ASHRAE Standard 55 (ASHRAE, 2017). This standard recommends that the interior temperature for typical office workers be maintained in the range of (approx.) 21-26°C.

The temperatures measured with the NICE cart were primarily in the range of 22-24°C. Pre-renovation, the average temperature was above the midpoint of the range of average temperatures measured by NRC in other buildings using the same/equivalent protocol, and below the midpoint after the renovation (Figure 26). The dotted lines in Figure 26 mark the upper and lower bounds of acceptable indoor air temperatures according to ASHRAE Standard 55 (ASHRAE, 2017).

The overall mean temperature measured by the NICE cart was 24°C in 2017, which is higher than the usual winter target of 22°C. In 2023, the mean temperature was 22°C, which is right on the target. Note that the indoor temperatures are somewhat dependent on the outdoor conditions, as well as on local operations. In 2017, the average outdoor temperature was between -5 and -7°C. In 2023, the average outdoor temperature ranged between -1 to -15°C.

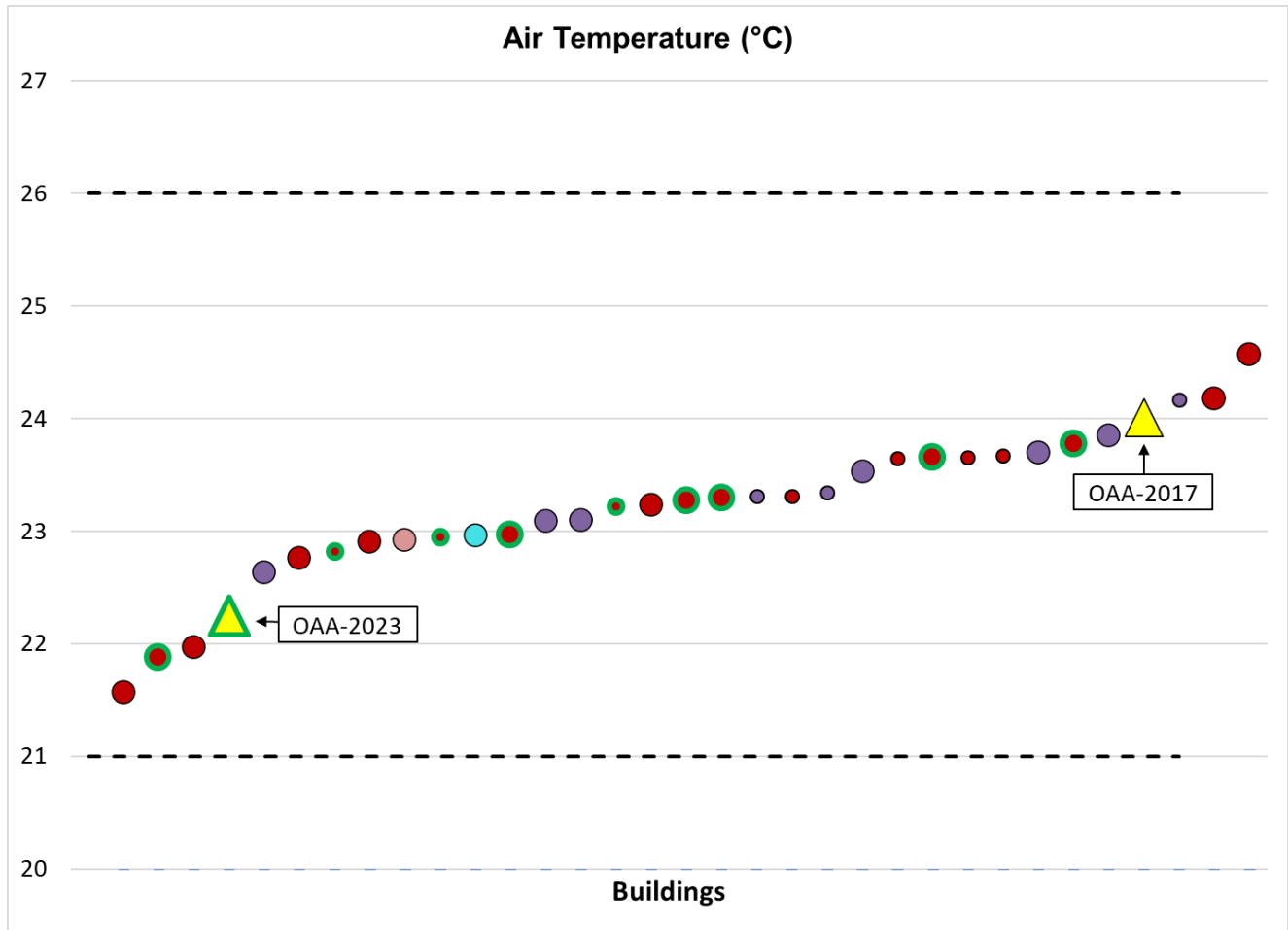


Figure 26 Air temperature (°C) at head height at OAA compared to other NRC building case studies (mean value recorded in each building).

Figures 27 and 28 show measured indoor and outdoor temperature data measured pre-renovation (February 3, 2017) and post-renovation (February 2 and February 3, 2023). The hourly outdoor temperature data was downloaded from the online archives of Environment Canada (<https://weather.gc.ca/>), for the nearest weather station to the OAA building, located approximately 11km to the South-West of OAA (i.e. Toronto City; TC ID: XTO).

Figure 27 shows the data collected by 4 pyramids located in four office spaces pre-renovation. The continuous lines illustrate the indoor temperatures (left-hand temperature scale); the dashed black line shows the outdoor temperature (right-hand temperature scale); the blue lines show the upper and lower bounds of acceptable air temperatures according to ASHRAE Standard 55 (ASHRAE, 2017). The indoor temperature was mostly within the recommended range, except for some short periods of higher temperatures. The average temperature recorded across two days of data collection was 24°C (SD = 1.44), with a minimum temperature of 20.7°C and a maximum temperature of 26.5°C.

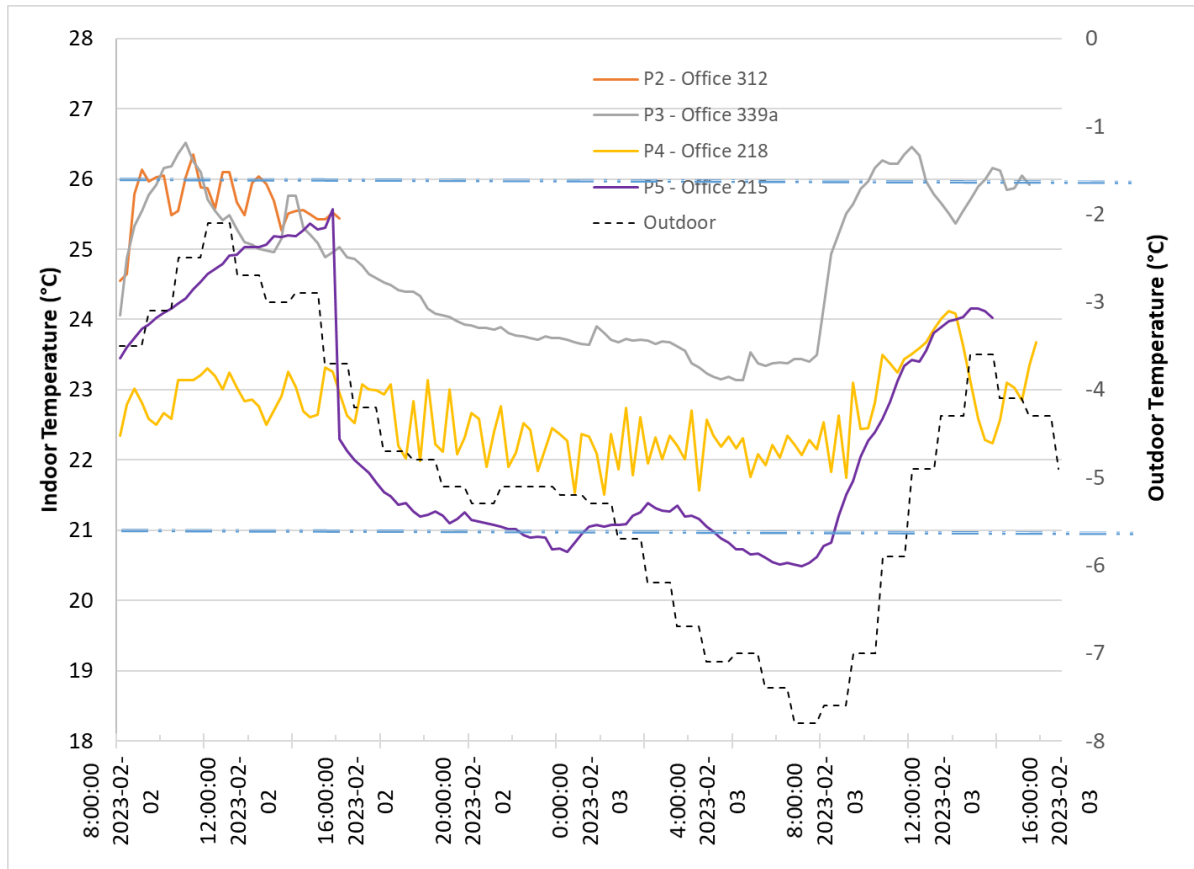


Figure 27 Air temperature measured by the pyramids, OAA-2017.

Similarly, Figure 28 shows the data collected post renovation with 6 pyramids located in open office/cubicle spaces (P2, P4 and P5) and meeting rooms (P1, P3, and P6). Measurements show that the indoor temperature was at times below the comfort limit recommended by ASHRAE Standard 55 (ASHRAE, 2017), specifically during the morning hours in some office spaces (Pyramid 2 and 4). Generally, the indoor temperature trended below the lower bound of the ASHRAE Standard 55 comfort set point. The average temperature in the office spaces was 21.7°C (SD = 1.58) and the average temperature in the council meeting room was 21°C (SD = 0.77), ranging between a minimum of 20.5°C and a maximum of 23°C (Pyramid 3).

During the meeting held late afternoon (4.00 pm-6.00 pm) on February 2, 2023, the average indoor temperature was 20°C (SD = 0.09), which is below the acceptable level for thermal comfort (ASHRAE, 2017). It is therefore not surprising that 70% of the participants reported a preference for feeling warmer. The next day, the average indoor temperature during the morning meeting (9.00 am -12.00 pm) held in the same meeting room was 21°C (SD = 0.10) and, this time, the majority of the respondents reported acceptable thermal comfort (65% indicating no change), and only a few respondents desired to feel warmer.

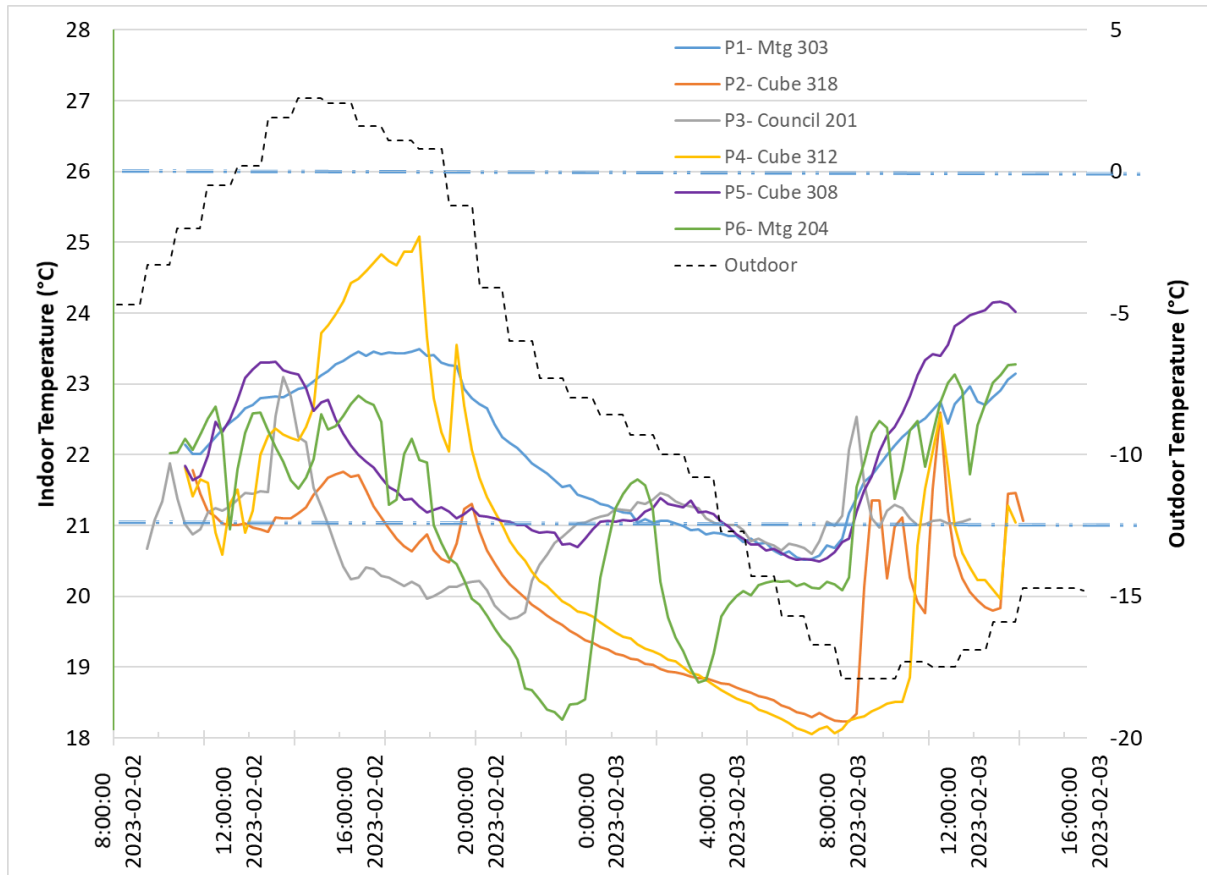


Figure 28 Air temperature measured by the pyramids, OAA-2023.

Figure 29 shows the indoor temperature recorded with the ventilation poles (data measured only in 2023). Pole 1 was located in the atrium; Pole 2 was located in the meeting room where the council meeting was held on two separate days. The continuous lines show the indoor temperatures (left-hand temperature scale); the dashed black line shows the outdoor temperature (right-hand temperature scale); the blue lines show the upper and lower bounds of acceptable air temperatures according to ASHRAE Standard 55 (ASHRAE, 2017).

The indoor temperature once again trended below the lower bound of the ASHRAE Standard 55 comfort set point. The temperature in the atrium was mostly within the acceptable levels for thermal comfort with an average temperature of 22°C (SD = 0.92). The average temperature was 20°C (SD = 0.32) during the evening meeting (Day 1 - 4.00 pm-6.00 pm), and 22°C (SD = 0.33) during the morning meeting (Day 2 – 9.00 am-12.00 pm).

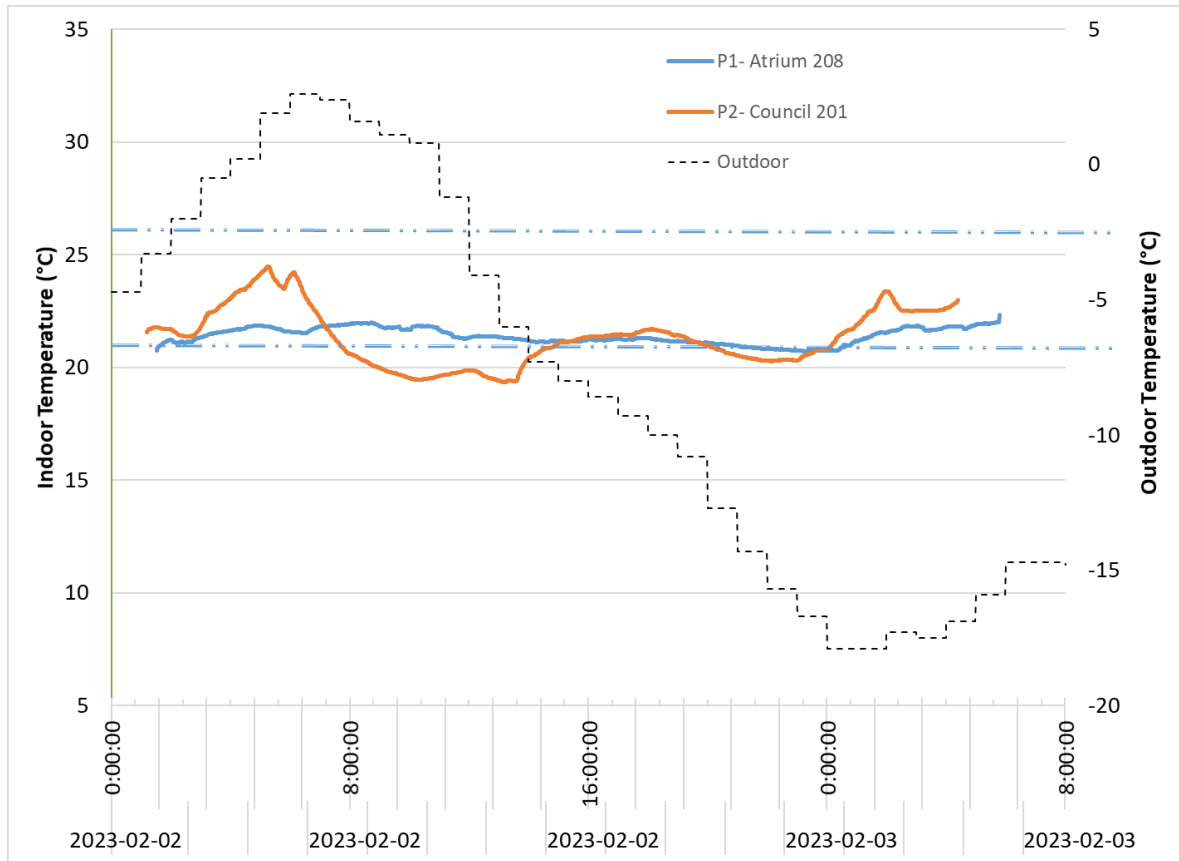


Figure 29 Air temperature recorded by the ventilation poles, OAA-2023.

3.3.2 Relative humidity

Relative humidity (RH) measurements collected with the NICE cart are shown in Figure 30. In general, both pre- and post-renovation, the RH values in the OAA building were well below the recommended levels. Low RH levels are not unusual for Canadian interiors during the heating season, however, the average RH in the OAA building, were at the lowest end of the NRC building dataset distribution.

In terms of thermal comfort, most people are comfortable with a relative humidity level between 30-50% (Charles et al. 2005). ASHRAE Standard 62.1-2016 recommends a relative humidity in occupied spaces of less than 60-65% to reduce the likelihood of conditions that can lead to microbial growth. A minimum level of 25-30% is recommended to avoid static electric shocks, drying of the mucus membrane, and break-up of the tear film in the eyes (McIntyre, 1978). These upper and lower limits of acceptable indoor relative humidity limits are shown in Figure 30 as dashed lines.

Pre-renovation, the overall mean RH in the OAA building was 9.7% (SD = 0.59). After the renovation, the overall mean RH was 10.8% (SD = 1.13). Both of these measurements are well below the recommended values outlined in the literature.

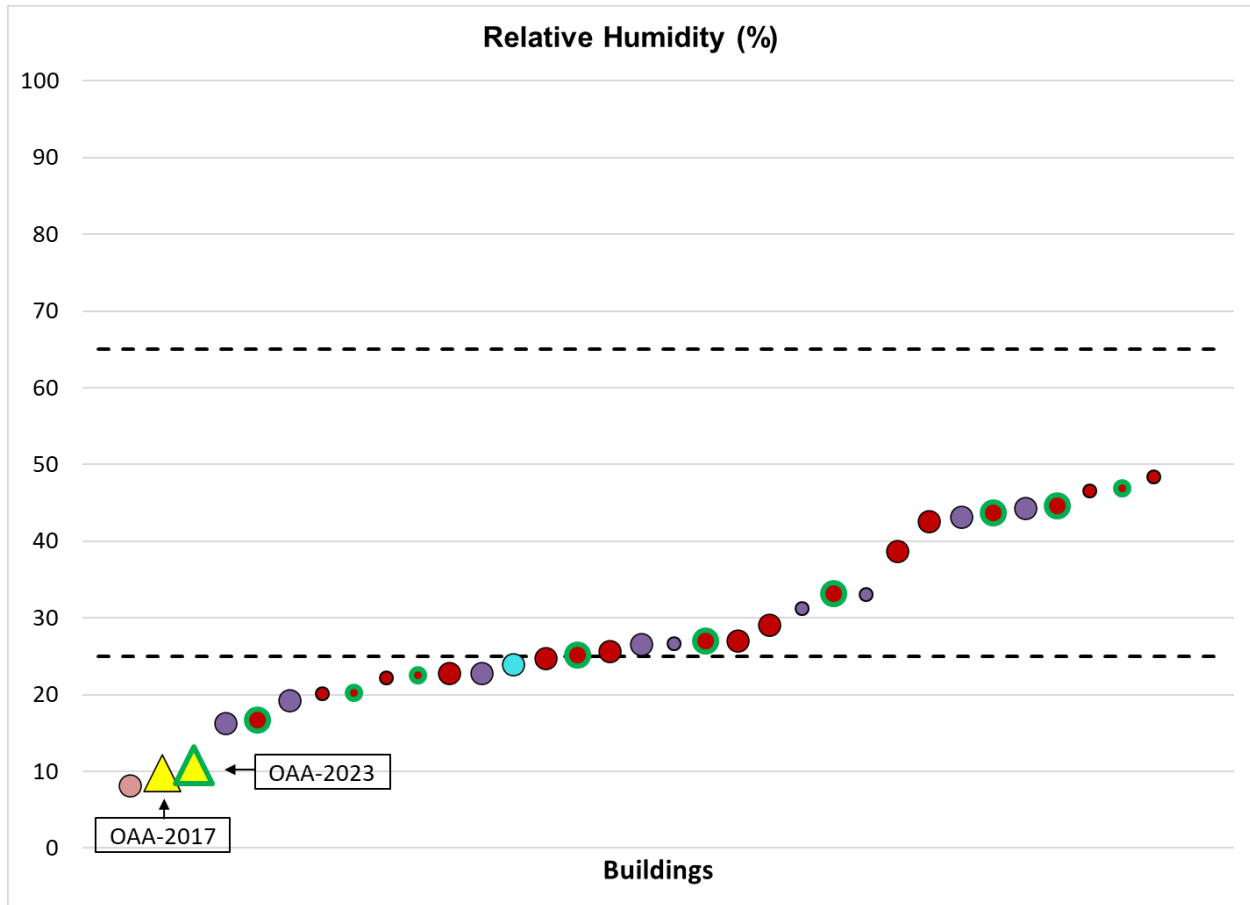


Figure 30 Relative humidity at head height at OAA compared to other NRC building case studies (mean value recorded in each building).

Figure 31 shows the indoor RH values recorded by the pyramids and the hourly outdoor RH values downloaded from the online archives of Environment Canada (<https://weather.gc.ca/>), for the nearest weather station to the OAA building, located approximately 11km to the South-West of OAA (i.e. Toronto City; TC ID: XTO). The outdoor RH varied greatly during both site visits, showing a diurnal variation. Indoors, the RH values were always low in the office spaces, on average 10.45% (SD = 1.05) pre-renovation, and 10.63% (SD = 1.07) post-renovation. During the council meetings in 2023, the average RH was 15% (SD = 0.46) during the evening meeting (4.00 pm-6.00pm), and 12% (SD = 0.86) during the morning meeting (9.00 am-12.00 pm).

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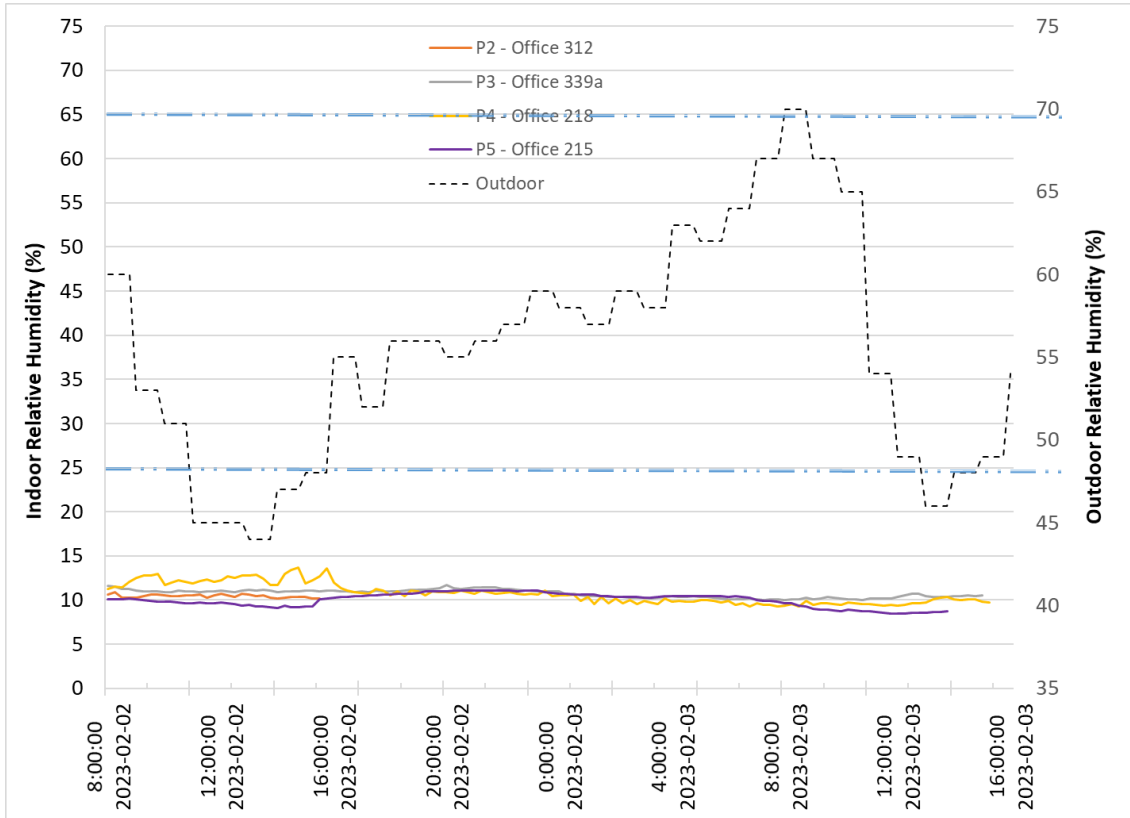


Figure 31 Relative humidity measured by the pyramids, OAA-2017.

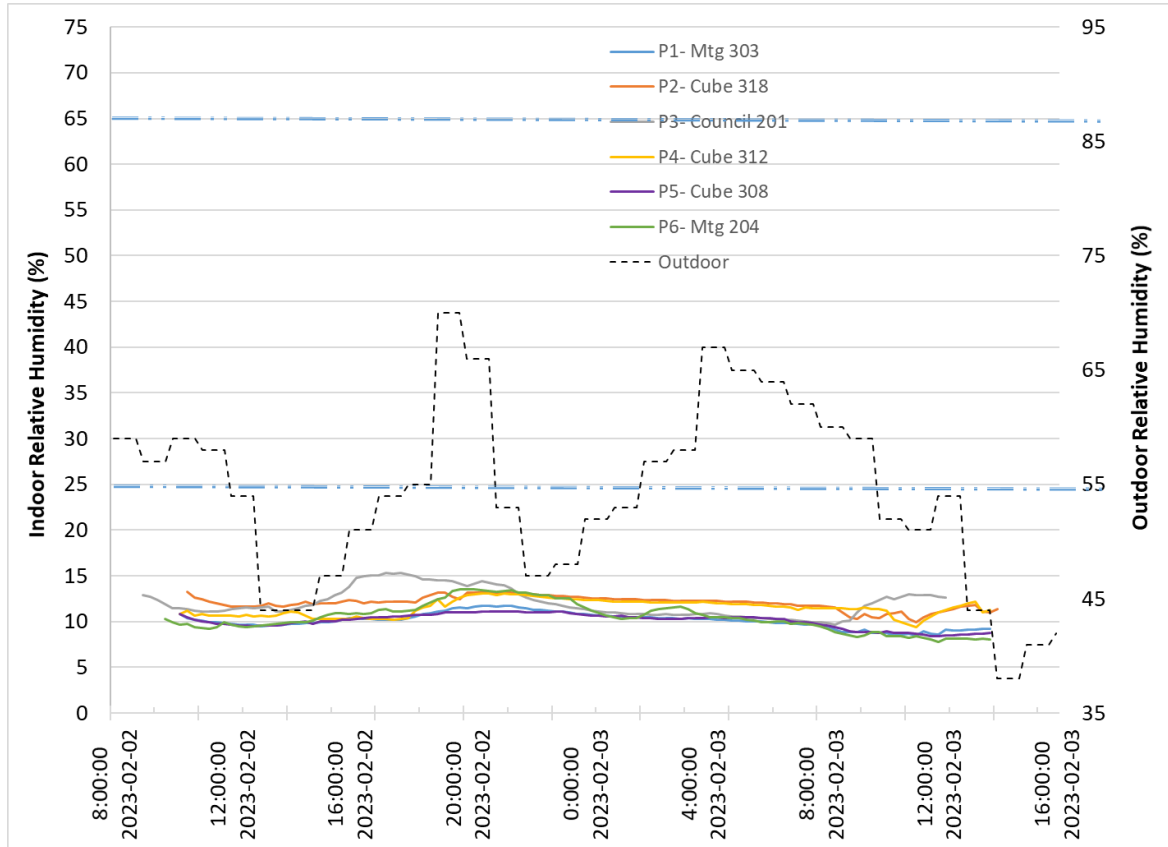


Figure 32 Relative humidity measured by the pyramids, OAA-2023.

The relative humidity measured by the ventilation poles (in 2023 only) showed a similar distribution (Figure 33). During the council meetings the average RH was of 19% (SD = 1.25) during the evening meeting, and 13% (SD = 0.65) during the morning meeting. In the atrium the average RH was 13% (SD = 1.11). Pole 1 was located in the atrium; Pole 2 was located in the meeting room where the council meetings were held on two separate days. Continuous lines show the indoor RH (left-hand temperature scale); dashed black line shows the outdoor RH (right-hand temperature scale); blue lines show the upper and lower bounds of acceptable RH according to ASHRAE Standard 55 (ASHRAE, 2017), McIntyre, 1978, Charles et al. 2005.

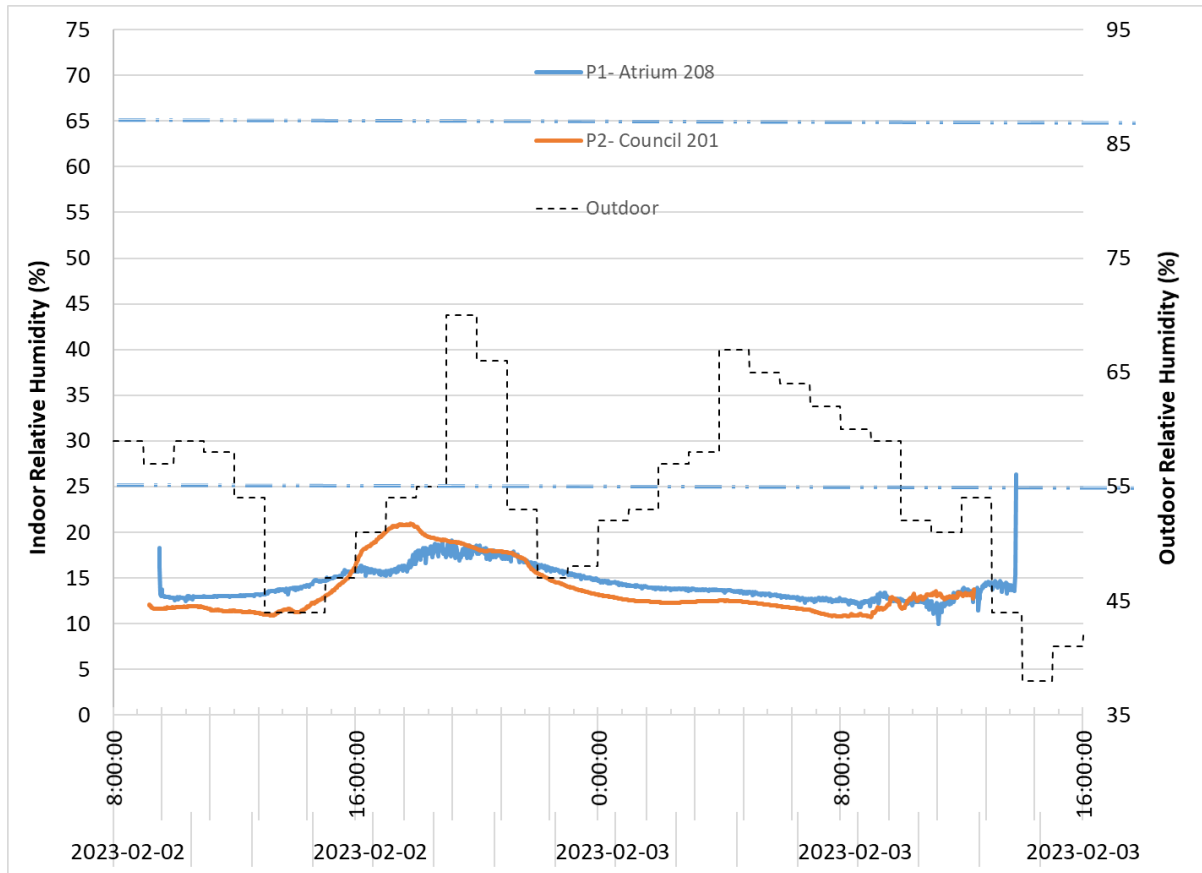


Figure 33 Relative humidity measured by the ventilation poles, OAA-2023.

3.3.3 Air movement

The air speed measured pre- and post-renovation using the NICE cart and the pyramids are shown in Figures 34 to 36. In 2017, the average air speed was at the higher end of the range of average air velocities measured by NRC in other buildings, and well above the recommended upper limit for air movement. The air speed measured at OAA was actually the highest ever recorded in the NRC database (M = 0.39, SD = 0.39). Note that the high-end outlier in the comparison sample was a building in which the occupants could open the windows. After the renovation, the average air speed improved (M=0.09, SD = 0.05).

To limit the risk of uncomfortable drafts, ASHRAE Standard 55 (ASHRAE, 2017) recommends air velocities below 0.2 m/s. CSA Z412-17 Office Ergonomics sets the criteria for optimum thermal comfort at an average air speed below 0.15 m/s, a relative humidity of 50%, a temperature of 24.5°C (with an acceptable range of 23-26°C) for summer conditions, and a temperature of 22°C (with an acceptable range of 20-23.5°C) for winter conditions. ASHRAE Standard 55 - 2013 Thermal Environmental Conditions for Human Occupancy specifies that these ranges meet the thermal comfort needs of at least 80% of individuals¹.

In Figures 34-36, the dotted line marks the upper bound of acceptable indoor air speed according to ASHRAE Standard 55 (ASHRAE, 2017) and CSA Z412-17 Office Ergonomics.

¹ https://www.ccohs.ca/oshanswers/phys_agents/thermal_comfort.html

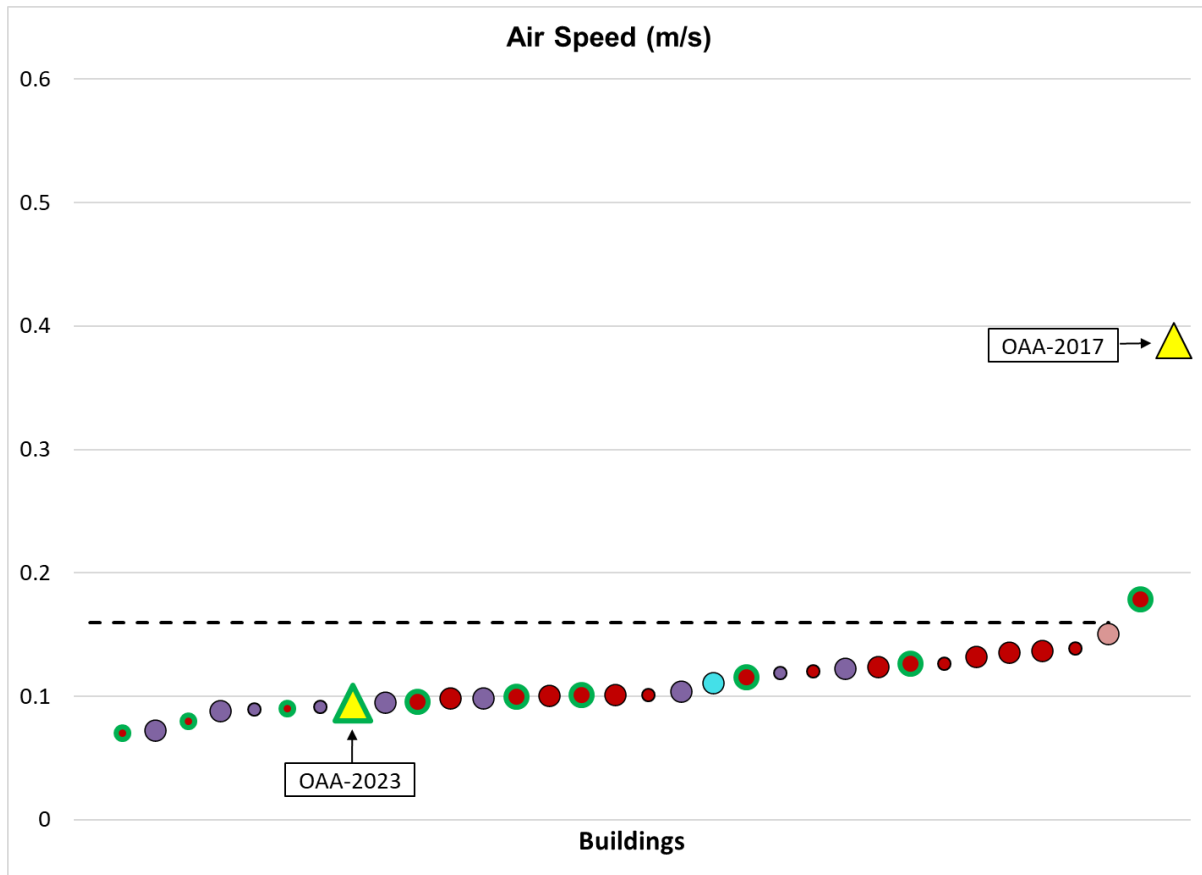


Figure 34 Air speed at head height at OAA compared to other NRC building case studies (mean value recorded in each building).

The pyramid data (Figure 35, P3 and P5) confirms high air movement in some office spaces in 2017, while in the locations measured with P2 and P3, the air speed never rose above the recommended value. The average air speed for these office spaces was 0.11 m/s (SD = 0.03).

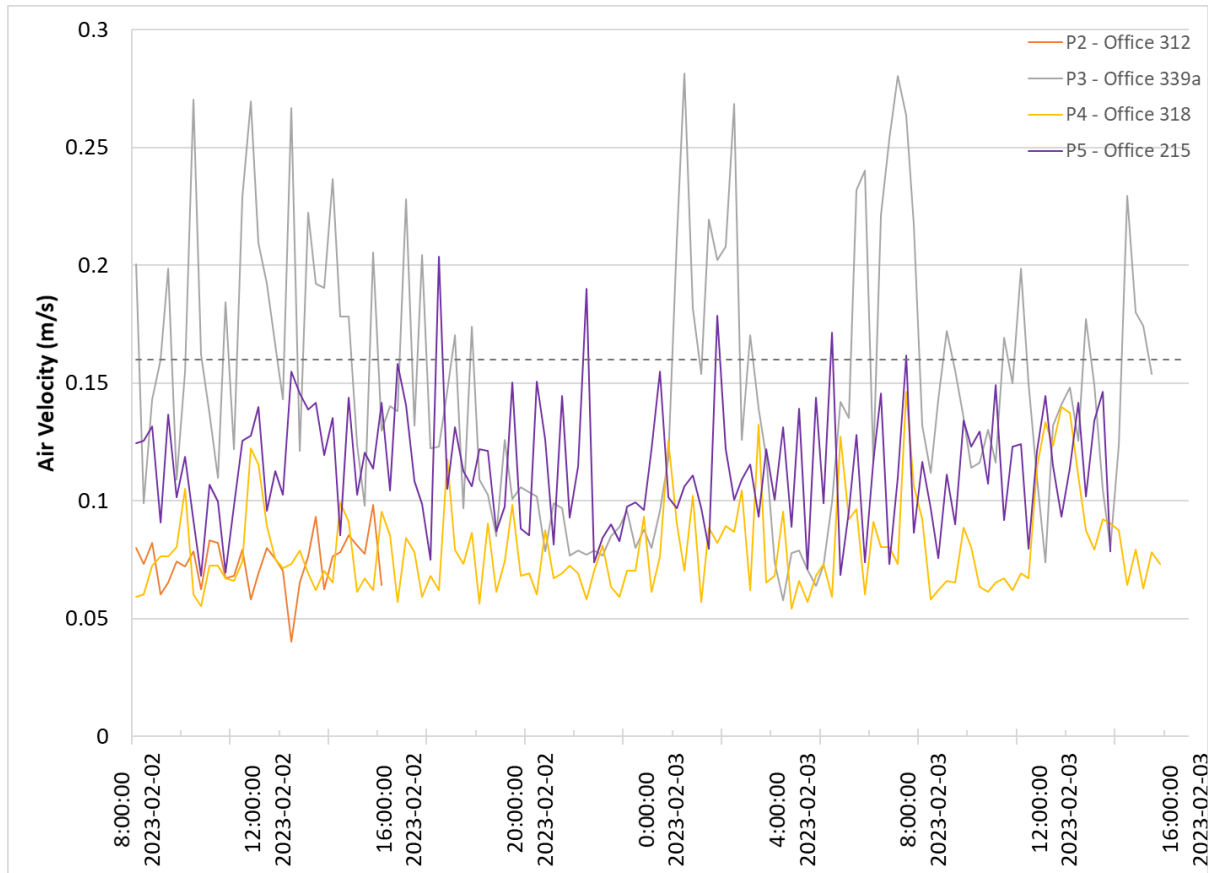


Figure 35 Air speed measured indoors by the pyramids, OAA-2017.

The indoor air speed improved in 2023, as seen in Figure 36. Most values were within the recommended levels, except for the location where P6 was located, which experienced a high level of air movement. This pyramid was positioned in one of the small meeting rooms.

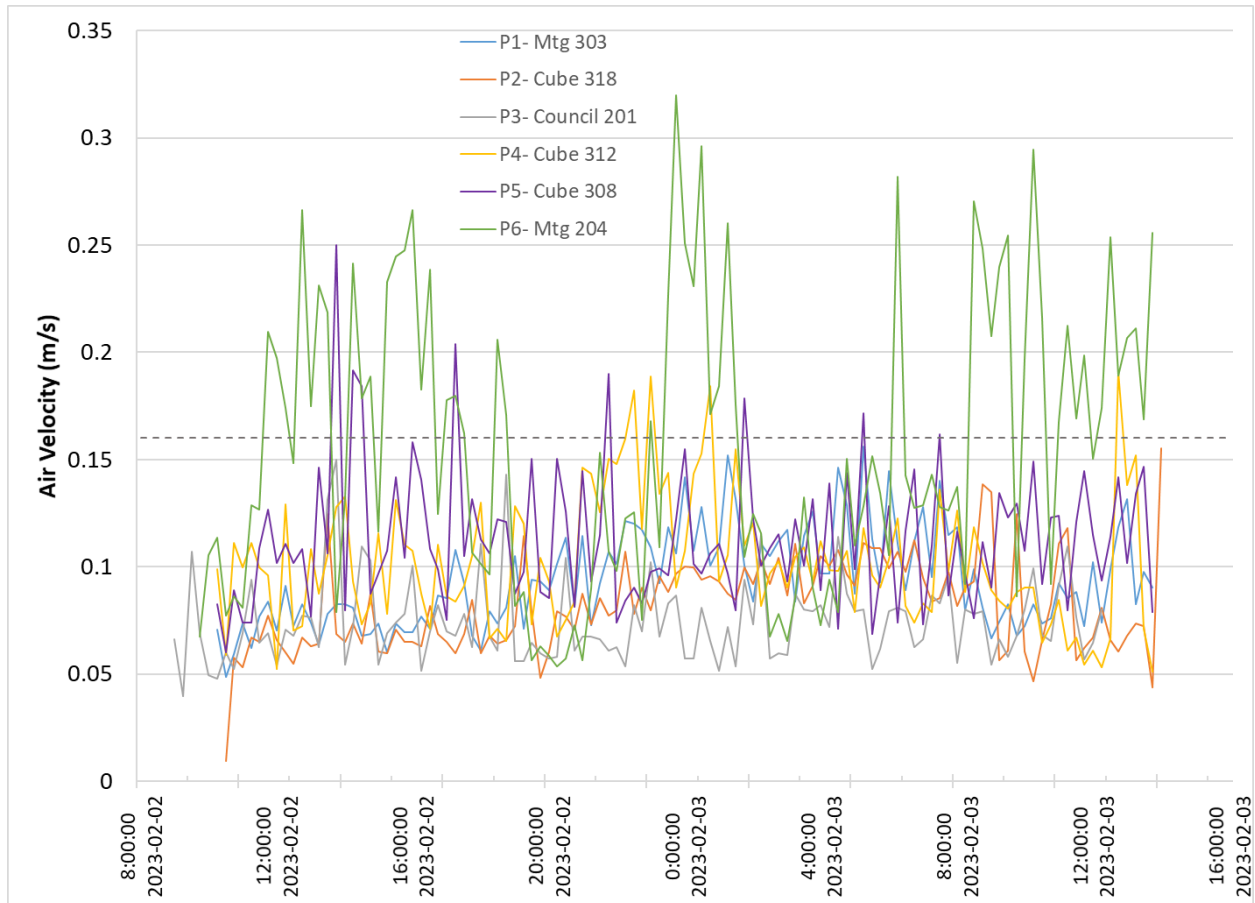


Figure 36 Air speed measured indoors by the pyramids, OAA-2023.

The air speed measurements recorded by the ventilation poles show a similar distribution to that of the pyramids (Figure 37). The ventilation poles record data more frequently than the pyramids and as such the graph shows more data. The air speed measurements during the council meetings were within the recommended range, with an average value of 0.03 m/s (SD = 0.03) during the evening meeting, and average value of 0.04 m/s (SD = 0.03) during the morning meeting. The air movement in the atrium was mostly stable across the measurement period, apart from a slight increase during the lunch and early afternoon hours, which could have been caused by increased human traffic during these hours.

In Figure 37, the black dotted line marks the upper bound of acceptable indoor air movement according to ASHRAE Standard 55 (ASHRAE, 2017) and CSA Z412-17 Office Ergonomics.

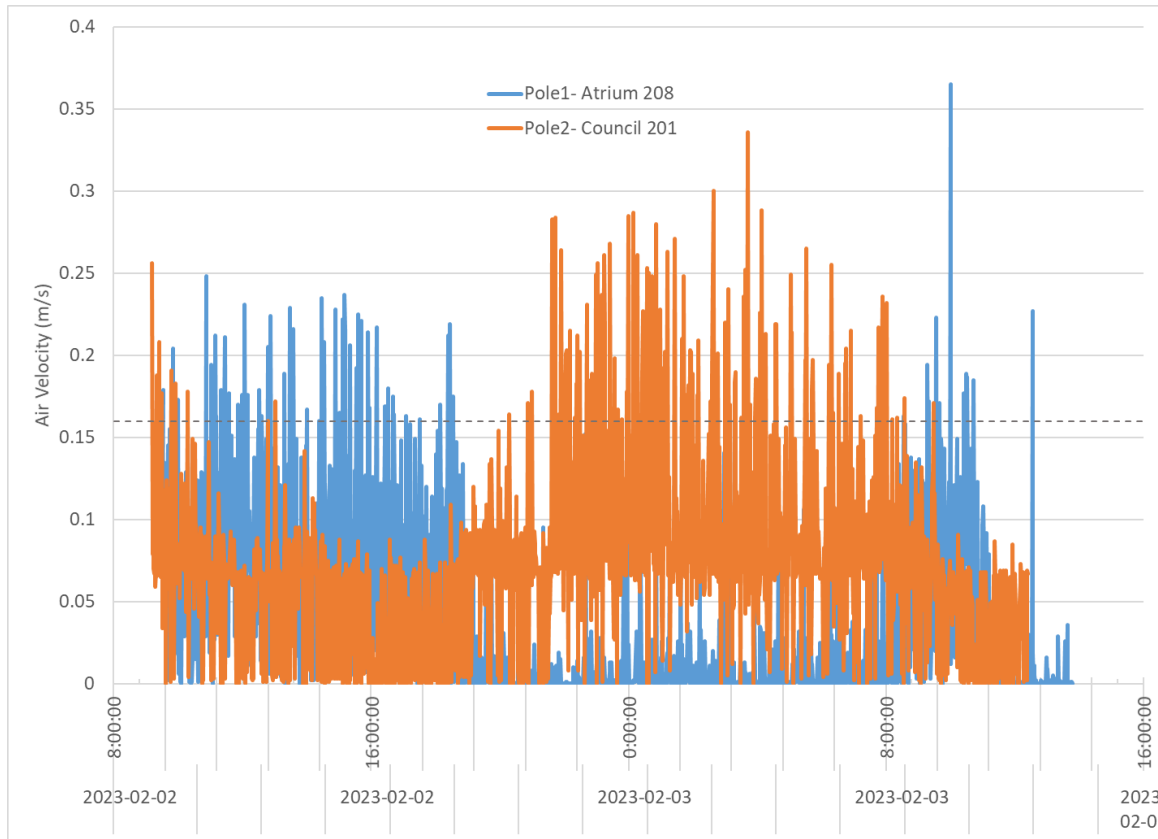


Figure 37 Air speed measured by the ventilation poles, OAA-2023.

3.3.4 Thermal comfort indices

Two thermal comfort indices were calculated for both time points based on the physical data measurements: Predicted Mean Vote (PMV) and Predicted Percentage Dissatisfied (PPD). The PMV predicts the mean value of the thermal sensation votes (self-reported perceptions) of a large group of people exposed to the same environment, calculated based on measured values for air temperature, radiant temperature, air speed and RH and with assumptions for clothing ensembles and activity (ASHRAE, 2017).

Pre-renovation, the average PMV was - 0.01 (SD=0.14) on a scale from -3 to +3, for which 0 is the neutral point. Post-renovation, the average PMV was -0.38 (SD=0.21). ASHRAE Standard 55 (ASHRAE, 2017) specifies that the comfort zone is achieved if at least 80% of the occupants can be expected to not object to the ambient condition, which means a PMV index between -0.5 and 0.5. At OAA, in 2017, the minimum PMV was -0.27 and the maximum was 0.27. In 2023, the minimum PMV was -0.80 and the maximum was 0.06.

The PPD index establishes a quantitative prediction of the percentage of thermally dissatisfied people who feel too cool or too warm. According to ASHRAE 55 (ASHRAE, 2017), a 10% PPD index is an indicator of acceptable thermal comfort. Local discomfort effects are assumed to contribute an additional 10% PPD to the discomfort predicted by PMV, so that the total PPD expected in a building with a PMV ± 0.5 will be 20%. At OAA, the average PPD in 2017 was 5.37% (SD = 0.49), while in 2023 it was 8.87% (SD = 3.68). Both values are within the ASHRAE acceptable range of thermal comfort.

3.3.5 Indoor air quality

Figure 38 shows the CO₂ concentration measured with the NICE cart and the pyramids at both time points (2017 and 2023). Typical CO₂ concentrations outdoors are around 400 ppm, with elevated values indoors primarily due

to human respiration. High levels of CO₂ indoors may indicate poor overall ventilation effectiveness, with potentially negative consequences for the dilution of other, more harmful, pollutants.

In 2017, the average CO₂ concentration was 668 ppm (SD = 48.49), which is just above the midpoint of the range of average CO₂ concentrations measured by NRC in other buildings. In 2023, the average CO₂ concentration was 606 ppm (SD = 104.02), which indicates an improvement, as this value is positioned at the lower end of the NRC scale and below the bound of acceptable CO₂ levels according to ASHRAE Standard 55 (ASHRAE, 2017).

The indoor CO₂ concentrations in a building are somewhat dependent on the outdoor conditions at the time of measurement, which is a factor, among others, in local operational decisions regarding ventilation rates and HVAC control. The ASHRAE Standard 62.1 (American Society of Heating, 2019) ventilation rates are based on maintaining indoor CO₂ concentration below 700 ppm above ambient (i.e. ~1100 ppm). Seppänen et al. (1999) noted that several studies suggested decreases in symptoms related to Sick Building Syndrome (SBS) below 800 ppm. Apte et al. (2000) found significantly increased odds ratios for some SBS symptoms with CO₂ levels 250 ppm above outdoor levels, or about 625 ppm (at the time), and Newsham et al. (2008) demonstrated a lower risk of dissatisfaction with CO₂ levels below 650 ppm. In the OAA building, almost 80% of the NICE cart CO₂ measurements were below the more stringent value of 625 ppm.

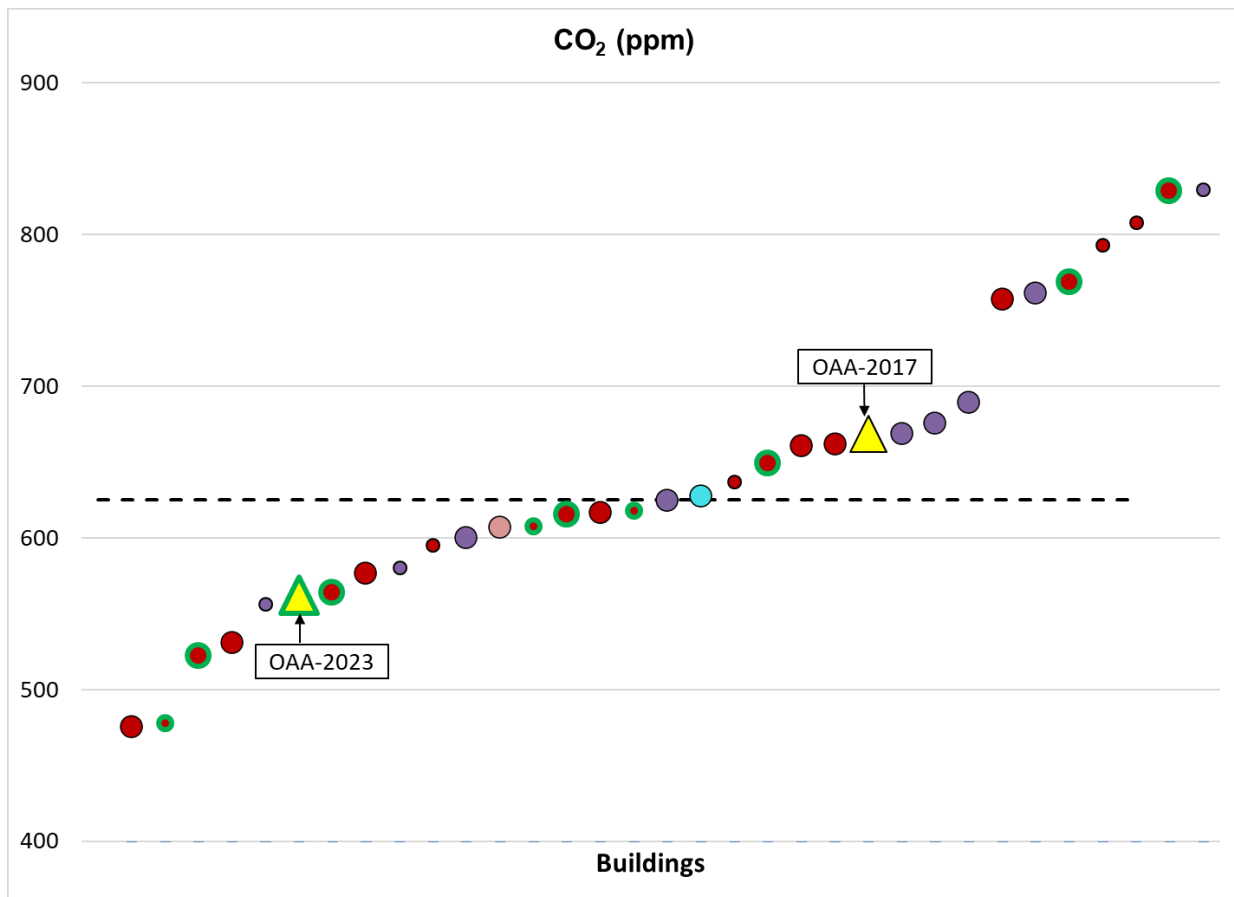


Figure 38 CO₂ concentration at head height at OAA compared to other NRC building case studies (mean value recorded in each building).

Figure 39 shows the measured CO₂ concentration levels in 2017 during regular work hours. The highest CO₂ levels were recorded during the day and lower levels were recorded at night. The dotted line marks the upper bound of acceptable indoor air CO₂ concentration according to ASHRAE Standard 55 (ASHRAE, 2017).

On average the CO₂ concentration in the office spaces was 601.41 (SD = 72.82). Note that most pyramid recordings were consistent with the NICE cart measurements.

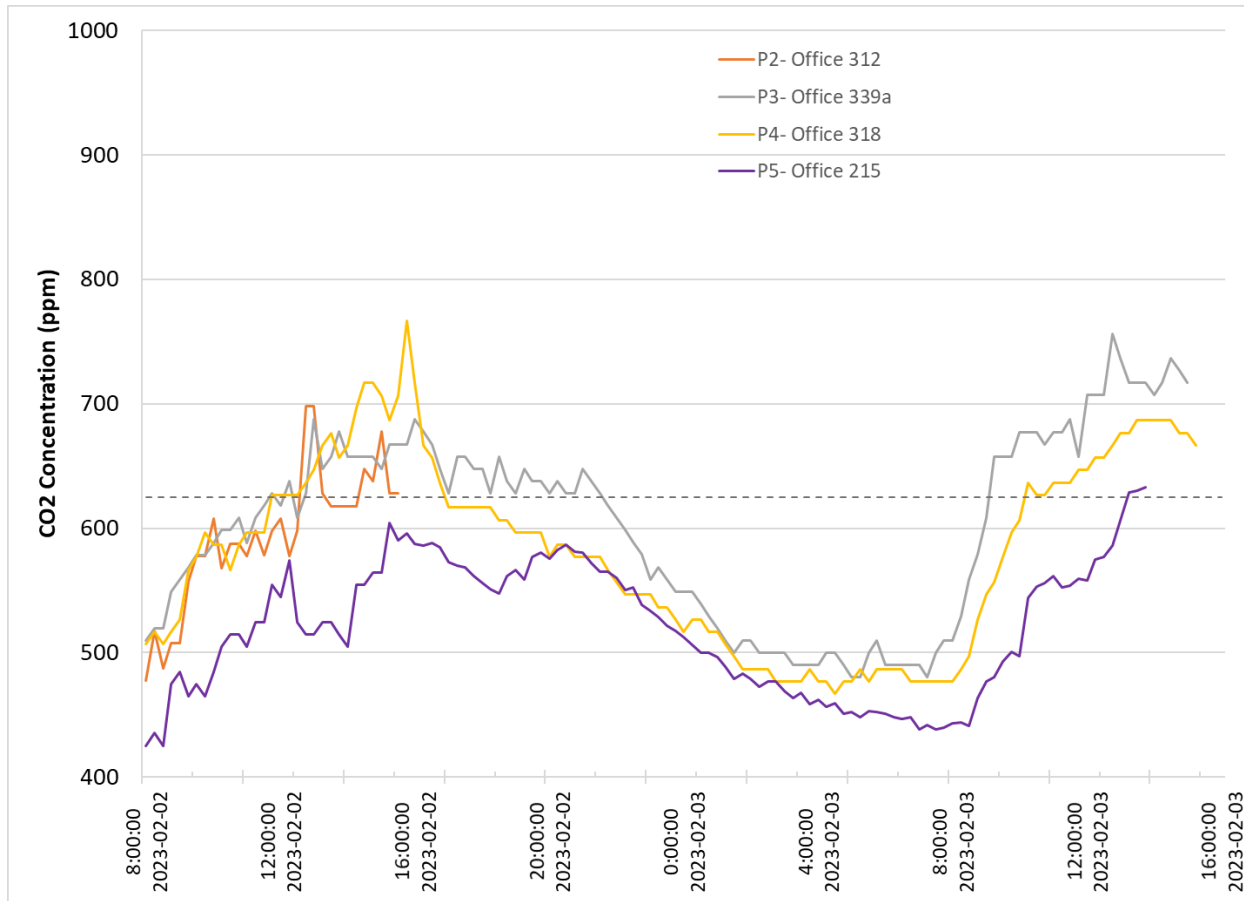


Figure 39 CO₂ concentration measured by the pyramids in 2017.

In 2023, the levels of CO₂ decreased on average (Figure 40), however a few CO₂ spikes were recorded by pyramids P2 and P3. Pyramid 2 was located in an office space shared by three employees, and the average CO₂ concentration in this room was 557 ppm (SD = 98.73). Pyramid 3 was located in the main meeting room during the council meetings, and the CO₂ levels reached higher levels than 625 ppm on both days. The average CO₂ concentration was 774.13 ppm (SD = 64.43) during the evening meeting, and 811.09 ppm (SD = 127.59) during the morning meeting. These spikes in CO₂ can be attributed to the number of people within one room.

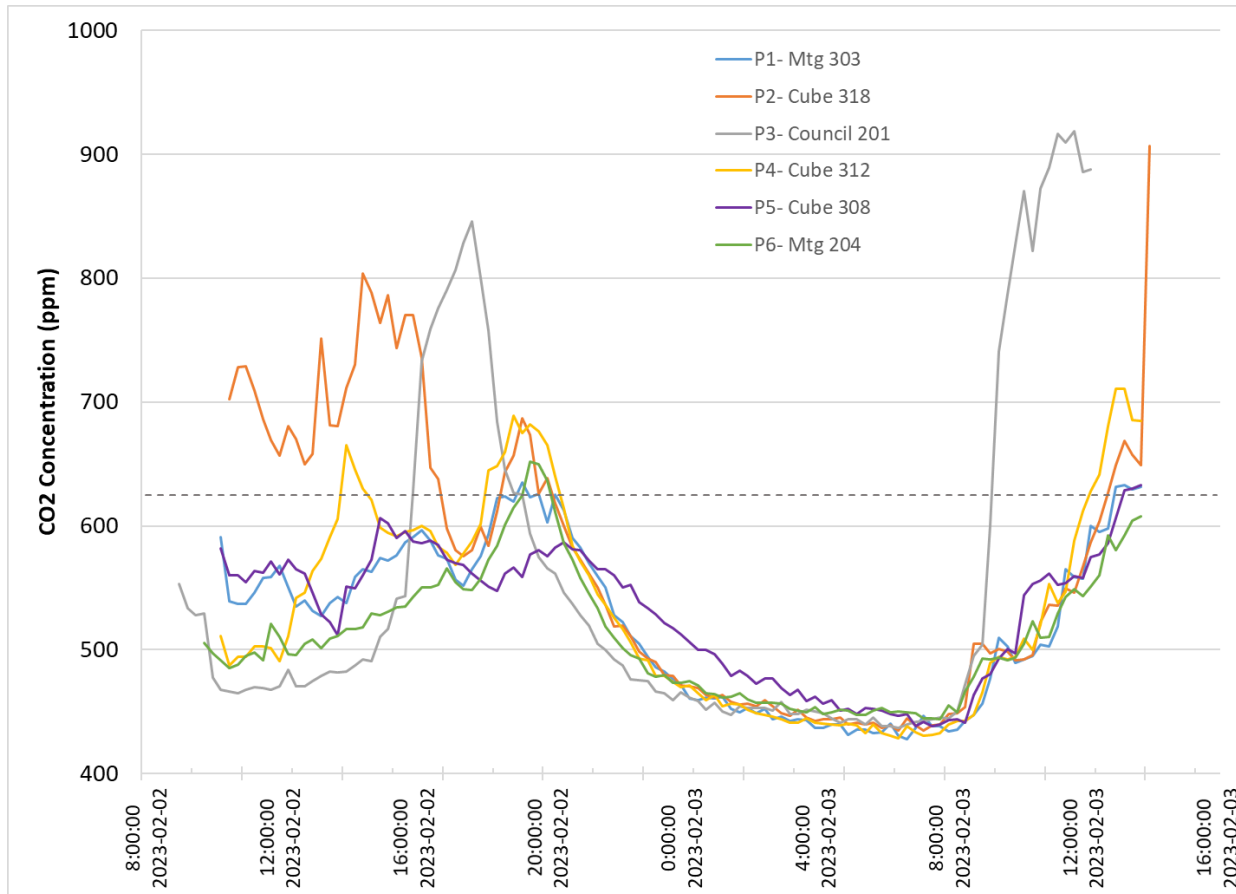


Figure 40 CO₂ concentration measured by the pyramids in 2023.

Figures 30 and 31 show data related to particulates measured in the indoor air at the OAA building. Standards and recommendations typically apply to the mass of particulates ≤ 2.5 microns in diameter ($PM_{2.5}$) and ≤ 10 microns in diameter (PM_{10}); respirable particles in this size range have been associated with negative health outcomes (Newsham et al.2008). The instrument used at OAA provided cumulative particle counts $\geq 0.3, 0.5, 1.0, 2.5, 5, 10$ microns. To convert these counts into mass, the number of counts in each size bin were calculated assuming that the particles were spherical, the diameter was the mid-point of the bin, and the particle specific gravity (density) was 2800 kg/m^3 . This calculation returns values in units of $\mu\text{g/m}^3$, and uses a method by Levy et al (2000), which is a simplified approach to a complex process (Binnig et al., 2007).

ASHRAE Standard 62.1 (2019) summarizes acceptable threshold values for particulates measured in the indoor air in various jurisdictions. In the US the most stringent regulations² require $PM_{2.5}$ to be less than $15 \mu\text{g/m}^3$ for 1 year and less than $35 \mu\text{g/m}^3$ for 24 hours, and PM_{10} to be less than $150 \mu\text{g/m}^3$ for 24 hours. Environment Canada standards³ require $PM_{2.5}$ to be less than $28 \mu\text{g/m}^3$. Indoor PM concentrations in a building may have some dependence on outdoor conditions at the time of measurement, as well as on local operational

² See Table C-1 in the Standard, and <https://www.epa.gov/criteria-air-pollutants/naaqs-table>.

³ See <http://www.ec.gc.ca/default.asp?lang=En&n=56D4043B-1&news=A4B2C28A-2DFB-4BF4-8777-ADF29B4360BD>. General guidance is also provided by Health Canada, see: <https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidance-fine-particulate-matter-pm2-5-residential-indoor-air.html>.

decisions regarding ventilation rates, economizer usage, and other factors. Note, that the values in Figures 41 and 42 depend directly on the assumptions made in the calculation of the mass from the particle count. In particular, the mass scales linearly with assumed specific gravity. Others have suggested lower specific gravities; for example, Tittarelli et al (2008) used 1650 kg/m³ for outdoor air measurements. If this value was used instead, the measured mass values at the OAA building would be lower.

The particulates count in OAA-2017 for the PM_{2.5} and PM₁₀ values were below the midpoint of the NRC building dataset distribution (M = 0.811, SD = 0.27; M = 9.59 SD = 9.55, respectively) of the range of average PM concentrations measured by NRC in other buildings (Figures 41 and 42). In OAA-2023, the average PM concentrations for PM_{2.5} and PM₁₀ values were below and above the midpoint of the NRC database scale (M = 2.22, SD = 1.32 (below) and M = 57.62 SD = 22.5, (just above) respectively).

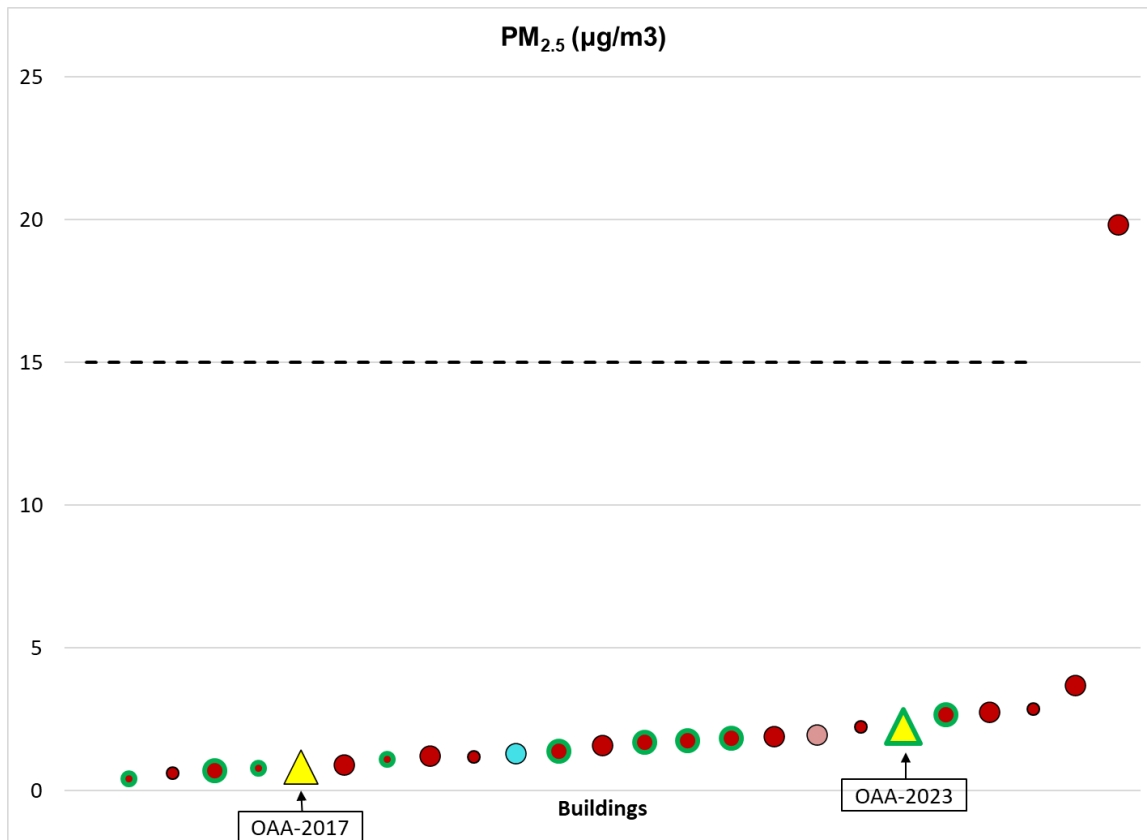


Figure 41 PM_{2.5} concentration at OAA compared to other NRC building case studies (mean value recorded in each building)

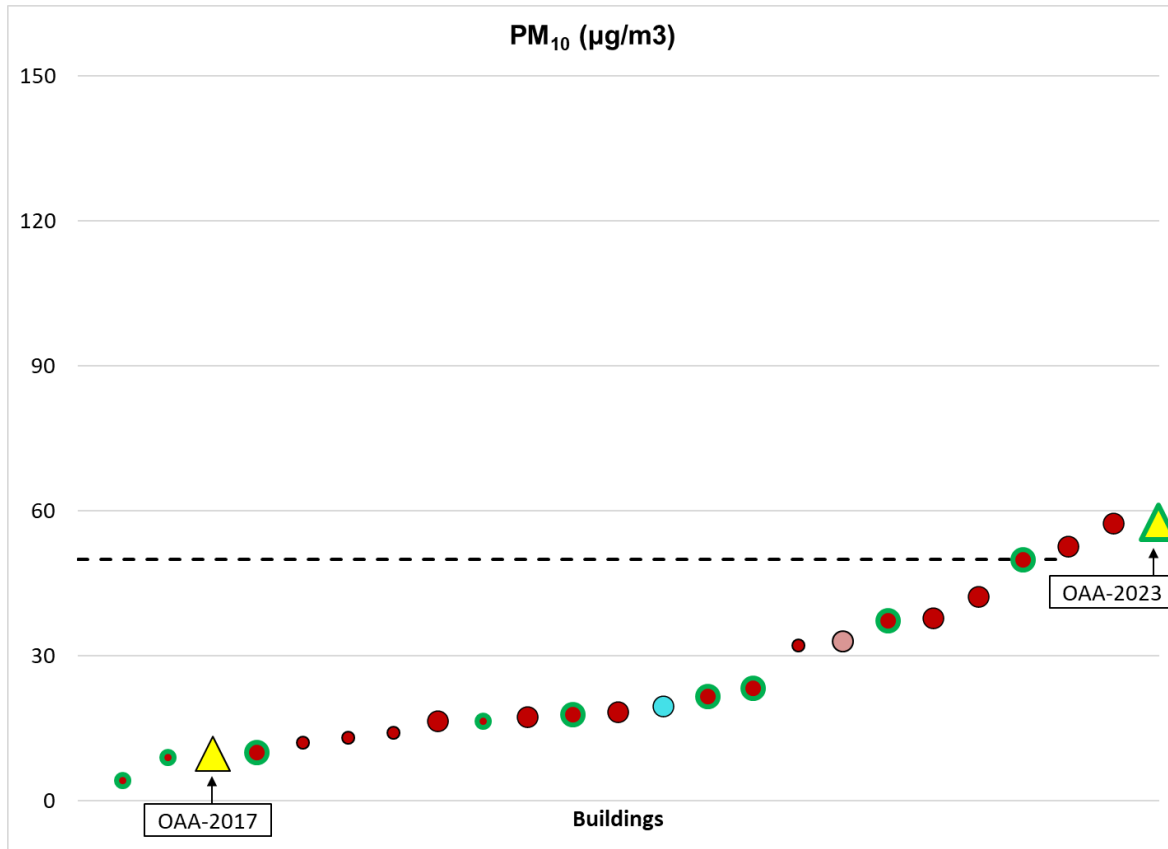


Figure 42 PM10 concentration at OAA compared to other NRC building case studies (mean value recorded in each building).

3.3.6 Lighting

The Canadian Occupational Safety and Health Regulations ("Canada Occupational Health and Safety Regulations," 2019), and ANSI/IES RP-1 (Illuminating Engineering Society (IES), 2013) recommend desktop illuminances in offices in the range 300 – 500 lx for general office work, and less than 500 lx for computer-based (VDT) work.

Figures 43 to 45 show the desktop illuminance levels measured at the OAA using the NICE cart and the pyramids, calculated based on the mean of two measurements made on the left and right sides of the desktops. The dotted lines mark the range of IES recommended illuminances for computer workstations with high-contrast visual tasks (IES, 2013). The sample size at OAA was small and, therefore, the lighting data was not separated by the presence or absence of a window in the office space.

The average desktop illuminance both pre- and post-renovation were at the higher points on the distribution measured by NRC in other buildings using the same, or equivalent, protocol. In 2017, the average desktop illuminance was 815 lx (SD = 1200.68), while in 2023 the illuminance was even higher and averaged 913.7 lx (SD = 681.74). This was also reflected in the occupants' overall satisfaction with lighting, which was at the lower end of the NRC building dataset scale.

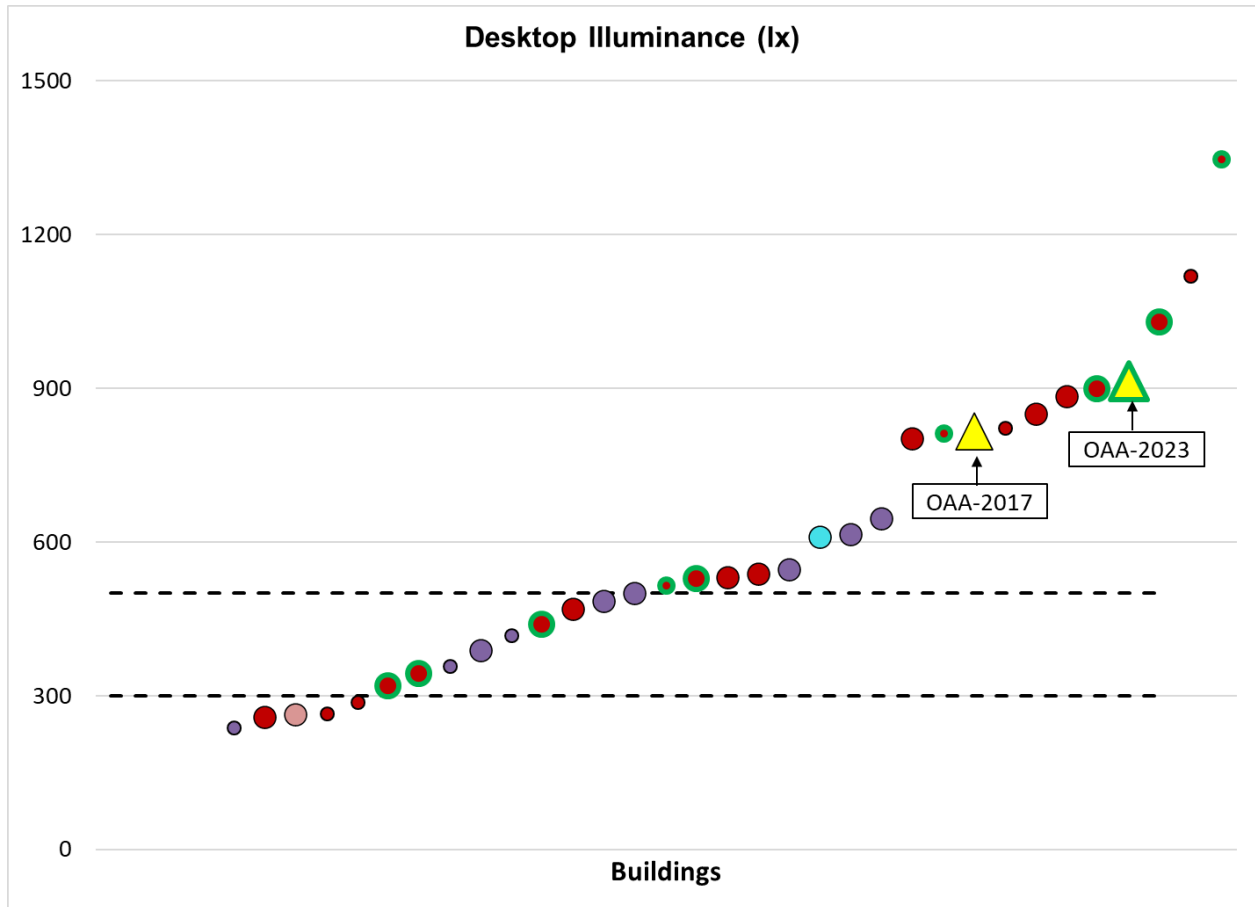


Figure 43 Average desktop illuminance at OAA compared to other NRC building case studies (mean value recorded in each building).

The pyramids data also shows that in 2017, the illuminance levels were higher than the recommended range (Figure 44). Pre-renovation, the average desktop illuminance level in the office spaces was 630 lx (SD = 506.38), which is above the recommended range (IES, 2013). Some pyramids recorded spikes in illumination due to direct sunlight coming through the windows, especially during the morning and lunch hours.

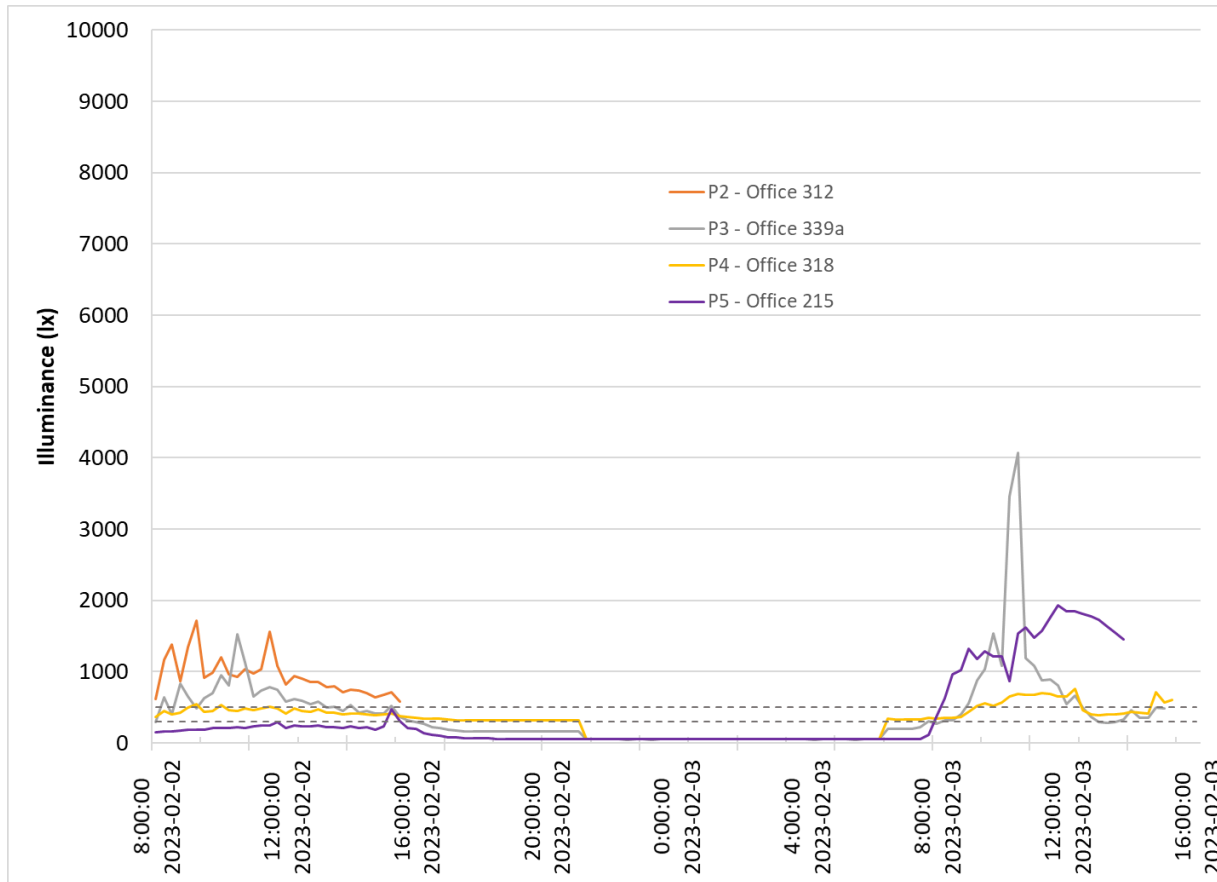


Figure 44 Illuminance levels measured by the pyramids in 2017.

The desktop illuminance levels after the renovation are shown in Figure 45. During regular work hours, the illuminance was again above the recommended range in many locations. In this space, the average illuminance level was 774 lx (SD = 64.43) during the evening meeting, and 811.09 lx (SD = 127.59) during the morning meeting.

The average illuminance levels measured by the pyramids in the office spaces was 607 lx (SD = 533.22), while in the meeting rooms #204 and #303 it was 766 lx (SD=356.14). All these measurements were well above the recommended values and validate the occupants desire to have more control over the lighting and ability to reduce glare in their workspaces.

In Figure 45, the dotted lines show the recommended range for workstation illuminance (IES, 2013). High spikes on the graph could be attributed to direct sunlight coming through the windows. Particularly, pyramid P3, which was positioned in the council meeting room, showed spikes during the afternoon hours, caused by direct sunlight.

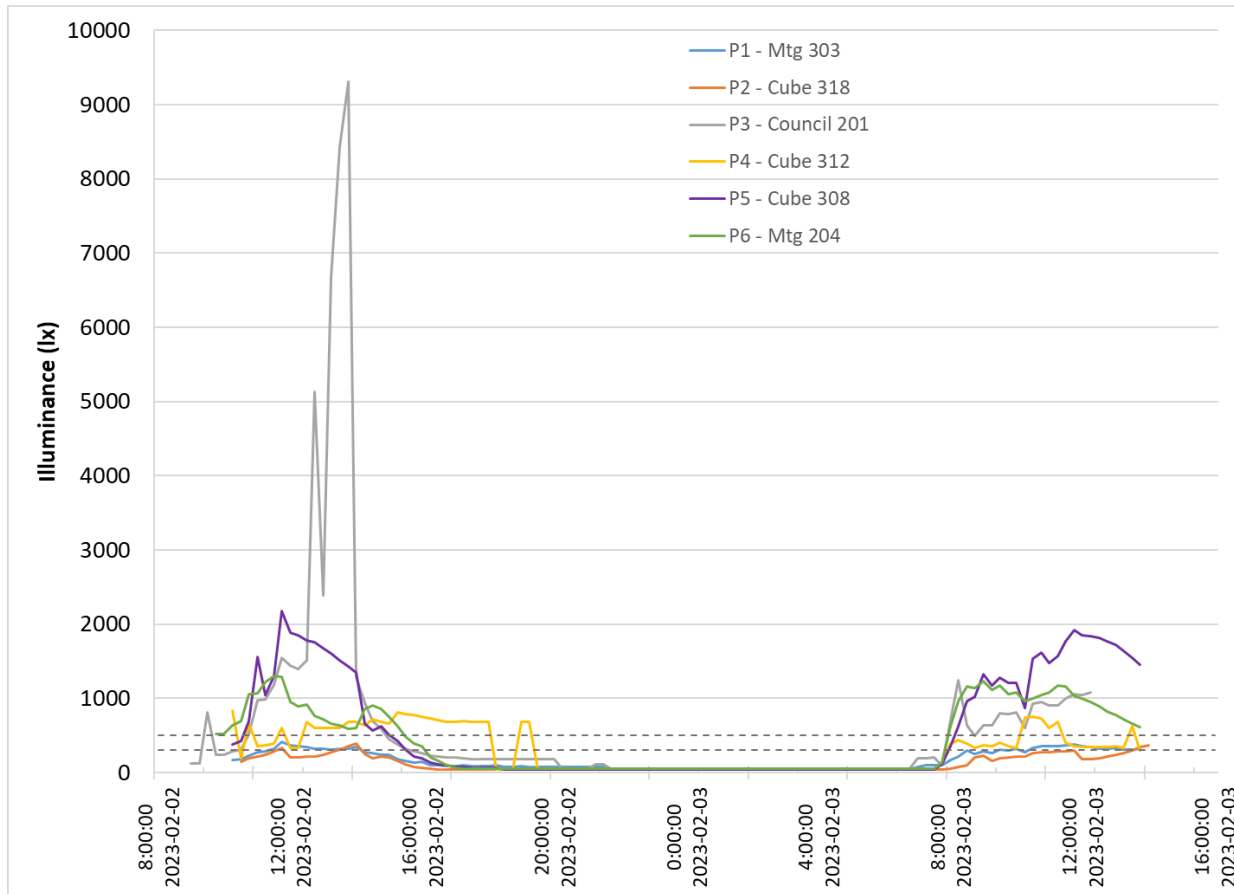


Figure 45 Illuminance levels measured by the pyramids in 2023.

3.3.7 Acoustics

Exposure to noise at work is a well-established stressor that has adverse physiological and behavioral consequences (Evans & Johnson, 2000), especially for people experiencing high job strain (Leather et al., 2003). Bradley and Gover (2004) recommended an ambient sound level high enough to provide some masking of distracting speech sounds, but not so loud that it becomes annoying in itself; they suggested 45 db(A), with 48 db(A) considered too high.

In 2017, the overall average for acoustics was 40.94 (SD = 3.09) and in 2023 the average was 44.2 (SD = 3.46). Both of these measurements are below the recommended ambient sound levels, with OAA-2017 being on the lower end of the scale and OAA-2023 being more in the midpoint of the range of average sound levels measured by NRC in other buildings using the same, or equivalent, protocol (Figure 46). This was expected as the new office design is open plan and the audio level can be higher. However, both pre- and post-renovation, the sound levels in the OAA building were below 45 db(A).

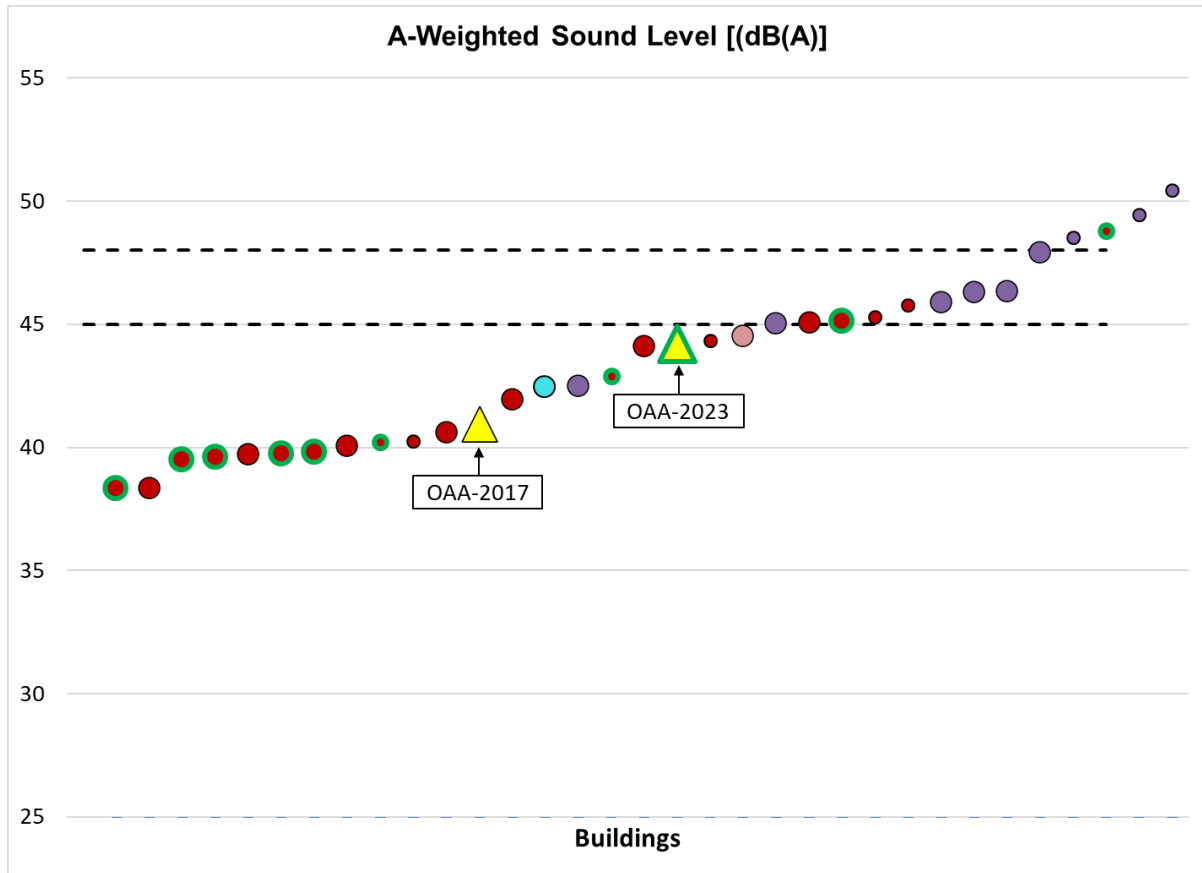


Figure 46 A-weighted sound level at OAA compared to other NRC building case studies (mean value recorded in each building).

The pyramids data in 2017 and 2023 suggests that mainly during the worktime hours the high ambient noise levels might be slightly more prevalent than the NICE cart indicates. Figure 47 shows that most locations experienced the expected diurnal patterns during the day, and lower levels at nights, consistent with noise from occupancy and HVAC operation.

In 2017, the average sound levels over all the pyramid measurements during daytime was 42.19 dB(A) (SD = 6.53), and the range was 29.80 to 63.20 dB(A). Figure 47 clearly shows many peak values that considerably exceed the recommended levels, although overall they remained below 45 db(A).

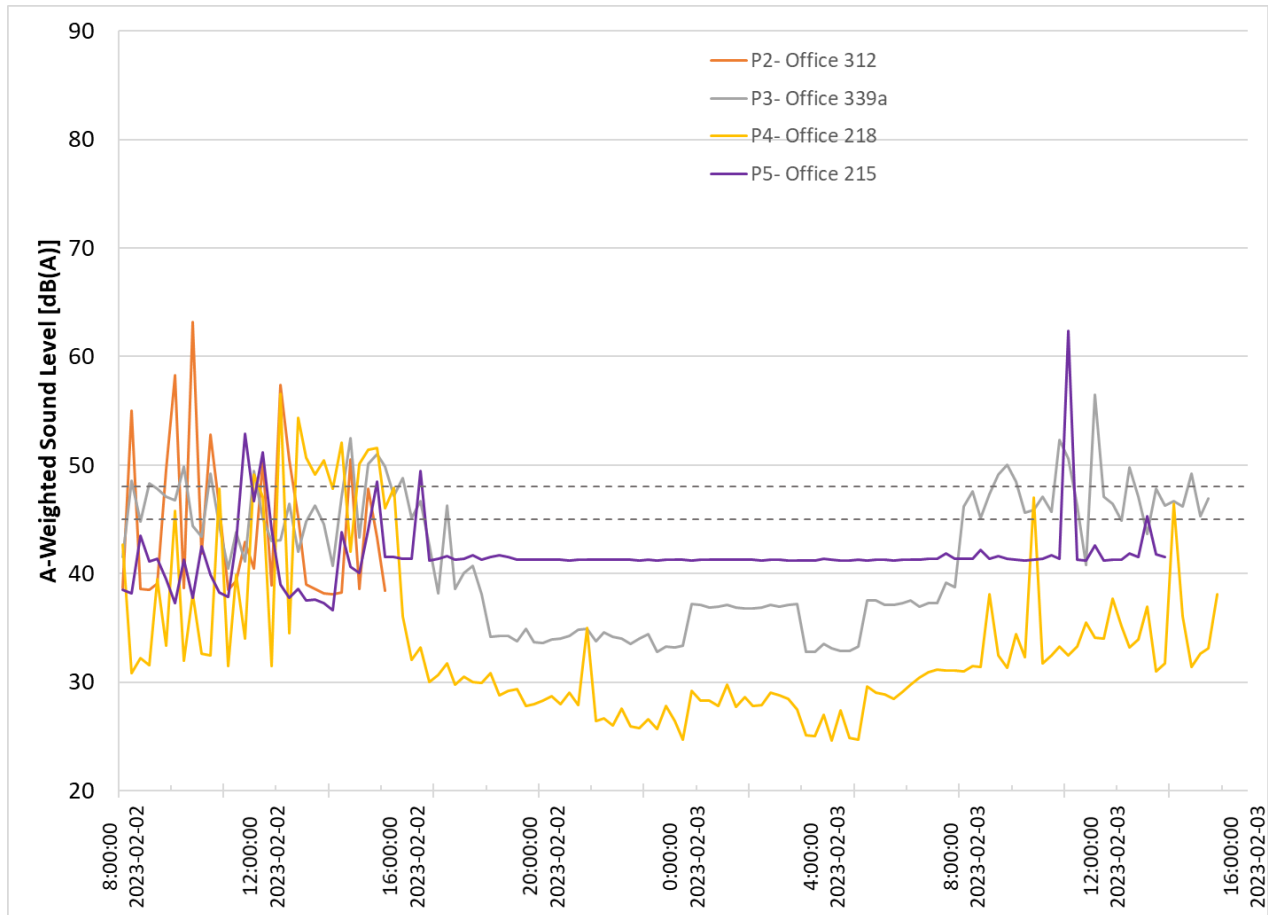


Figure 47 A-weighted sound level measured by the pyramids in 2017.

In 2023, the average sound levels over all pyramids in office spaces was 40.36 dB(A) (SD = 5.29) and ranged between 32.20 to 62.40 dB(A). The highest spikes in sound measurements were recorded in the council meeting room during the meetings. The average sound levels were 50.74 dB(A) (SD = 9.48) during the evening meeting, and 49.9 dB(A) (SD = 4.71) during the morning meeting.

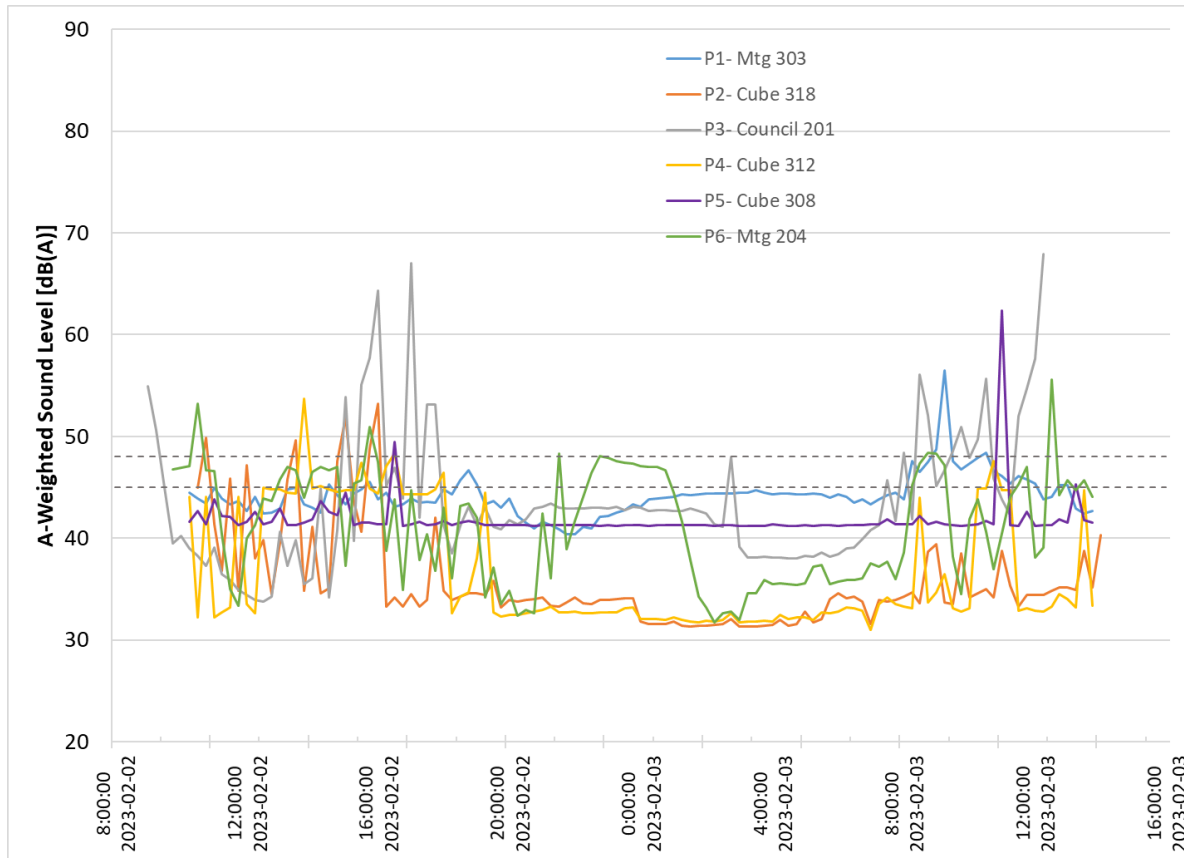


Figure 48 A-weighted sound level measured by the pyramids in 2023.

The Speech Intelligibility Index (SII) is an indicator of how well speech generated in one location is understood in another, in this case from a neighboring location to the study location. It ranges from 0 (perfectly incomprehensible) to 1 (perfectly comprehensible). For general office work an SII of 0.2 or lower is recommended for a reasonable level of speech privacy (Bradley, 2003).

In 2017, on average, the SII values between neighboring open-plan offices were slightly above the recommended range ($M = 0.27$, $SD = 0.17$). In 2023, on average, the SII values between neighboring open-plan offices slightly increased to 0.31, ($SD = 0.14$). Both of these values are on the lower end of the range of average sound levels measured by NRC in other buildings using the same, or equivalent, protocol (Figure 34). Note that most of the buildings in the comparison sample, have a mean SII value higher than the target value of 0.2. Contemporary offices generally do not deliver good acoustic privacy.

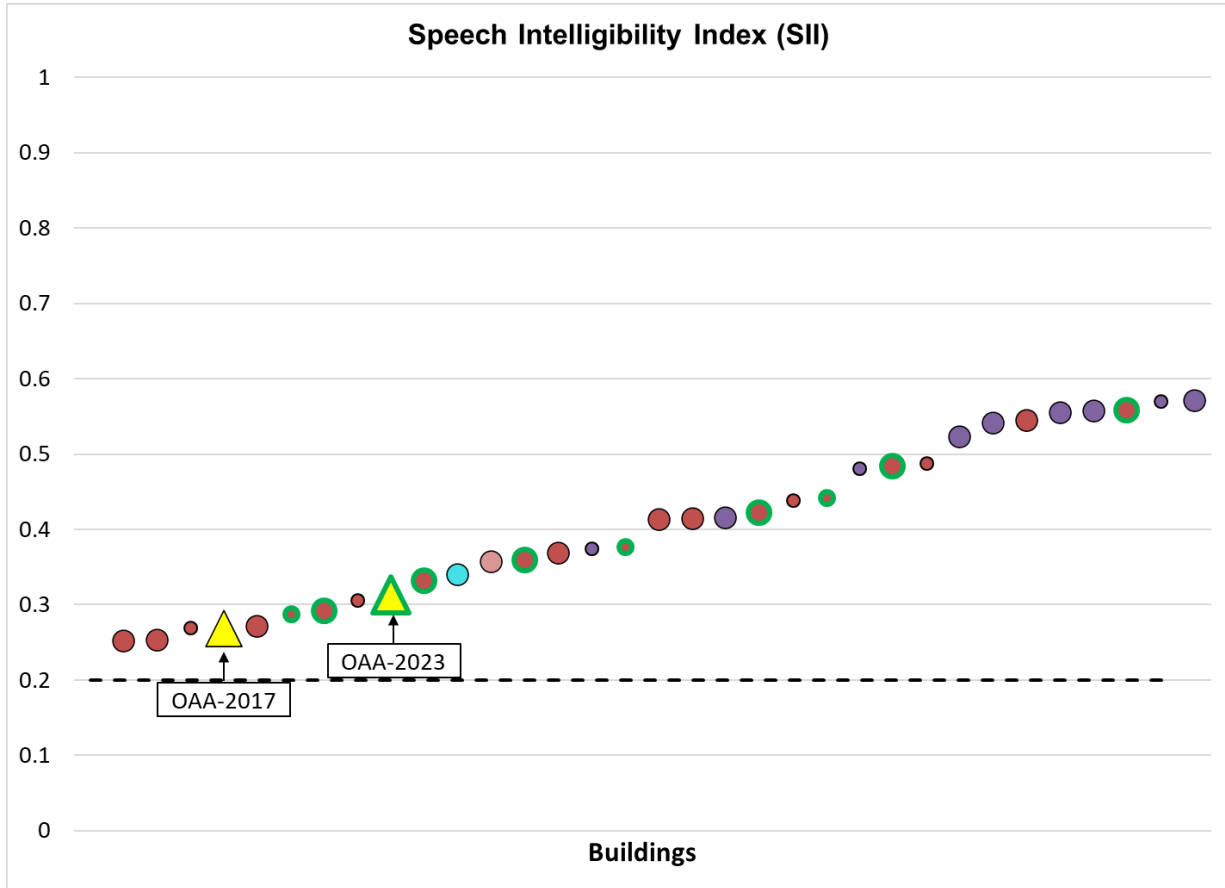


Figure 49 Speech Intelligibility Index at OAA compared to other NRC building case studies (mean value recorded in each building)

4 Summary and Conclusion

Pre-renovation, the physical measurements were collected at OAA in February 2017. Detailed snapshots of the OAA building indoor environment were collected during daytime in 22 locations, while four pyramids collected data continuously across two weeks, in four offices located on the 2nd and 3rd floor.

The post-renovation measurements were collected in February 2023, and detailed measurements were collected in 26 workstations. Six pyramids were placed in 3 open-plan workstations and 3 meeting rooms, including the council room, where meetings took place on February 2 (4.00pm-6.00pm) and February 3 (9.00am-12.00pm). In addition, two ventilation poles collected a subset of environmental parameters in the council meeting room and the atrium.

During the pre-renovation evaluation, 45 permanent occupants and 56 infrequent occupants (~55% response rate) completed detailed questionnaires, examining the building occupants' environmental satisfaction with lighting, thermal comfort, air quality, acoustics and privacy, workstation features, building amenities, job satisfaction, organizational commitment and well-being. During the post-renovation evaluation, 20 permanent occupants and 23 infrequent occupants completed the survey (~55% response rate for permanent occupants; 100% response rate for visiting occupants participating in meetings across 2 days).

Evidence from building case studies investigated by NRC, using the same or an equivalent protocol, shows that satisfaction with the environmental conditions positively predicts job satisfaction and organizational commitment, and negatively predicts intent to turnover (Veitch et al., 2010). This suggests that by paying attention to working conditions with the aim of increased satisfaction, there is potential to improve these key indicators of organizational success. Furthermore, satisfaction with building amenities (i.e. features beyond individual workstations) can contribute to organizational productivity outcomes. Across several categories of amenities, satisfaction with amenities related to health and well-being (e.g. natural elements in the workplace; access to water fountains; cleanliness) was shown to influence organizational commitment, intent to turnover, job satisfaction and absences due to illness.

Pre-renovation, the physical and survey data clearly identified some areas for improvement. Although some of the dimensions of satisfaction were rated positively (e.g. job demand, internal communication, organizational commitment), the satisfaction with workplace image and privacy, acoustics, lighting, ventilation and temperature, positioned the OAA building at the lower end of the satisfaction scale among the green and conventional buildings included in the NRC comparison dataset.

After the renovation, the OAA employees reported higher levels of overall environmental satisfaction and very high satisfaction with their job, positioning the OAA building at the highest average job satisfaction rating recorded in the NRC dataset.

The internal communication rating also improved after the renovation, reflecting the fact that the OAA employees continue to feel well connected with their employer and coworkers. Organizational commitment was high both pre- and post-renovation, which placed the OAA at the highest rating among the NRC comparison building sample. This shows that the OAA employees display pride in the societal importance of their work.

The ratings of job demand increased in 2023 compared to 2017, however, at both times, the OAA ratings for this dimension trended lower than that of other buildings included in the NRC dataset. This may be due to the difference in the work model in 2017 compared to 2023. Working from home, instead of primarily in the OAA office, might have contributed to the staff's perception of higher job demand in 2017.

Although the overall satisfaction with most of the environmental conditions also improved after the renovation, the data suggests that the overall indoor temperature could be further improved to provide acceptable thermal conditions to all building occupants. The satisfaction with lighting was rated very positively post-renovation and, generally, the building occupants perceived the light levels to be comfortable, and appreciated having access

to daylight and window views. However, at times, the light levels in the work areas were poorly distributed and uncomfortably bright or dim, and some occupants expressed the need for more flexibility to reduce brightness and glare. Nonetheless, when asked to compare how the overall lighting levels at the OAA compare to that in other buildings, the majority reported better lighting conditions in the OAA building. The air temperature, relative humidity and indoor air quality (particulates) also improved after the renovation. The overall sound levels also met the criterion levels both pre- and post-renovation. However, the speech intelligibility index trended above the recommended levels, and some respondents indicated a desire for better acoustics and privacy in their workspaces. Exposure to noise at work is a well-established stressor that has adverse physiological and behavioral consequences (Evans & Johnson, 2000), however, providing good acoustics in an open-plan space is generally a challenge, as documented in the NRC comparison building sample.

Table 44 shows a summary of the permanent building occupants' satisfaction and the physical measurements collected in 2017 and 2023. The table also shows how the OAA building ranked in the NRC database of buildings, before and after the renovation.

Table 43 Summary of results – Satisfaction, Permanent building occupants; Physical environmental measurements (OAA-2017 and OAA-2023).

Surveys		OAA-2017	OAA-2023	2017	2023	
Concept	Scale	Average (SD)	Average (SD)	Benchmark rank (1 is best)	Benchmark rank (1 is best)	Comments
Job Demands	1-7	3.8(1.58)	4(1.4)	1 of 24	4 of 24	Increased job demand in 2023, still less demanding than most workplaces in NRC database
Allocation of work time	%	68.7	66.2	N/A	N/A	Mostly computer and quiet work - similar across both time points for data collection,
Satisfaction with Acoustics and Privacy	1-7	3.9 (1.5)	5.1 (0.86)	60 of 94	5 Of 94	Improved in 2023, one of the highest scores in NRC datasets
Satisfaction with Ventilation and Temperature	1-7	3.1(1.56)	4.8(1.35)	88 of 94	22 Of 94	Improved in 2023, clustered at the higher end of scale on NRC datasets
Satisfaction with Lighting	1-7	4.2(1.30)	5.1(1.62)	87 of 94	35 of 94	Improved in 2023, in 2017 at the low end of NRC database, 2023 slightly above the midpoint in NRC database
Overall Environmental Satisfaction	1-7	4.1(1.53)	5.3(0.78)	50 of 71	7 of 71	Improved in 2023, 2023 average one of the highest in NRC database
Job Satisfaction	1-7	5.8(1.220)	6.5(0.61)	13 of 66	1 (highest in NRC dataset)	2017 and 2023 both on higher end of the scale, 2023 the highest satisfaction recorded in NRC database

Satisfaction with amenities Net % (Satisfied-dissatisfied)	Worst 5	N/A				OAA-2023 only: <ul style="list-style-type: none"> • Speed and availability of elevators. 15% • Natural materials and elements (real or simulated) in the workplace. 35% • Secure storage for personal items. 45% • Comfort of your chair. 65% • Access to water fountain/bottle refill stations. 75%
Satisfaction with amenities Net % (Satisfied-dissatisfied)	Best 5	N/A				OAA-2023 only: <ul style="list-style-type: none"> • Availability of small meeting rooms. 100% • Availability of large meeting rooms. 100% • Ability to find your way inside the building. 100% • Access to waste collection, recycling and composting points. 100% • Places to eat and socialize with colleagues. 100%
Most-mentioned best things:		N/A				<ul style="list-style-type: none"> • Communication and social interaction with coworkers • Window views and natural lighting • Good leadership/coworkers
Most-mentioned things needing change:		N/A				<ul style="list-style-type: none"> • Flexible lighting - reduce glare, brightness, add blinds • Acoustics privacy/sound proofing • Heating and ventilation
Organizational Commitment	1-7	5.3 (1.1)	5.6 (0.61)	2 of 21	1 of 21	High rating in 2017, even higher in 2023, highest ratings in NRC database
Intent to Turnover	1-7	2.4 (1.38)	1.6 (0.83)	12 of 21	20 of 21	Improved in 2023, 2017 at midpoint on NRC database, 2023 ratings 2nd lowest in NRC database
Workplace Image	1-7	3.1 (1.51)	5.4 (1.11)	20 of 22	3 of 22	improved in 2023, in top three in NRC database
Internal communications	1-7	6 (1.05)	6.8 (0.45)	4 of 18	1 of 18	High rating in 2017, improved in 2023 - highest rating on NRC database
Lighting comfort		N/A				80% light is comfortable, 30% light not well distributed
Hours of sleep	hr.	7.4 (0.7)	7.9 (1.3)		N/A	Many respondents reported acceptable sleep duration, no comparable difference between 2017 and 2023
Sleep quality	1-7	5 (1.41)	4.85 (1.27)		N/A	Comparable ratings for sleep quality between 2017 and 2023
Sleep - ease	1-7	5.1 (1.58)	5 (1.34)		N/A	Comparable ratings for ease of going to sleep between 2017 and 2024
Visual Discomfort	0-16	2.8 (2.62)	1.83 (2.09)	16 of 21	8 of 21	Improved in 2023, below midpoint in NRC database

Physical Discomfort	0-16	3.3 (2.03)	2.47 (1.73)	15 of 21	6 of 21	Improved in 2023, below midpoint in NRC database
Self-reported sickness absenteeism (personal reason)	0-5 days	0.81 (1.14)	0.5 (1.19)	15 of 21	10 of 21	Improved in 2023, just below midpoint on NRC database
Self-reported all-cause absenteeism (any reason)	0-5 days	1.6 (1.89)	0.74 (1.24)	12 of 21	1 of 21	Improved in 2023, lowest number of missed days in NRC database, consideration for hybrid work model is needed
Physical environmental measurements						
Temperature	deg C	24	22	30 of 33	4 of 33	Improved in 2023, 2017 above recommended range, 2023 right on target
RH	%	9.7 (0.59)	10.8 (1.130)	2 of 33	3 of 33	Far below recommended range in 2017 and 2023
Air movement	m/s	0.39 (0.39)	0.09 (0.05)	33 of 33	8 of 33	Improved in 2023, 2017 well above recommended range, 2023 improved, below recommended range
Thermal comfort						
Predicted mean vote (PMV)	-3 to +3	-0.01	-0.38			Thermal comfort calculated in neutral range at both time 2017 and 2023, with acceptable levels of predicted % discomfort
Predicted % dissatisfied (PPS)	%	37 (0.49)	8.87 (3.68)			
CO₂	ppm	668 (48.49)	606 (104.02)	23 of 33	6 of 33	Improved in 2023, below the limit of 625 ppm
PM_{2.5}	µg/m ³	0.81 (0.27)	2.22 (1.32)	5 of 24	19 of 24	Increased in 2023, but still well below the limits
PM₁₀	µg/m ³	9.59 (9.55)	57.62 (22.5)	3 of 24	24 of 24	Increased in 2023, just above the limit
Light level	lx	815 (1200.68)	913 (681.74)	28 of 36	33 of 36	Values are well above the range recommended in 2017 and 2023 (too bright)
Sound level	db(A)	40.94 (3.09)	44.2 (3.46)	12 of 33	18 of 33	Within range, but some measurements on certain location can be deceptive
Speech intelligibility	SII	0.27 (0.17)	0.31 (0.14)	4 of 33	9 of 33	All benchmark locations had values higher than the recommended SII, indicating poor speech privacy in open offices generally.

Tables 45 and 46 show a summary of the responses collected from the occasional visitors to the OAA building, who have their permanent workplace elsewhere. Similarly, to the permanent occupants, the overall environmental satisfaction of these occasional building occupants also improved after the renovation.

Table 44 Summary of results – Satisfaction, Infrequent building occupants (OAA-2017 and OAA-2023).

Categories	OAA-2017	OAA-2023
	Mean (SD)	Mean (SD)
Satisfaction with Acoustics and Privacy	4.79 (1.11)	5.51 (1.13)
Satisfaction with Ventilation and Temperature	4.93 (1.31)	5.71 (1.17)

Satisfaction with Lighting	5.47 (0.81)	6.00 (1.00)
Overall Environmental Satisfaction	4.68 (1.12)	5.78 (0.84)
Satisfaction with contribution to the committee/meeting	5.59 (1.09)	6.14 (1.12)

The infrequent occupants generally reported acceptable thermal comfort levels, although during the evening meeting held on February 2, 2023 (4.00pm-6.00pm), some wished to feel warmer. The ratings of thermal comfort improved during the daytime meeting (9.00am -12.00pm), when the majority of the respondents found the thermal conditions to be comfortable, while only a few participants indicated a preference for warmer conditions. The OAA visitors also mentioned the natural lighting and the window views as the best features of the new OAA building design, and appreciated the open space concept, which was thought to support and encourage collaboration. However, having access to a more flexible lighting system and improved window shading, heating and acoustics would further enhance the overall perception of the OAA building space.

Table 45 Summary of results – Infrequent building occupants, Thermal comfort and environmental preferences (OAA-2023 only).

Thermal comfort	OAA-2023 only
evening meeting (4.00-6.00pm)	30% no change, 70% wanted to feel warmer
morning meeting (9.00-12.00pm)	60% no change, 40% wanted to feel warmer
Most-mentioned best things:	<ul style="list-style-type: none"> • Open space • Good collaboration • Windows and natural lighting
Most-mentioned things needing change:	<ul style="list-style-type: none"> • Flexible lighting, blinds • Acoustic/privacy • Thermal comfort
Satisfaction with amenities (Net % (Satisfied-dissatisfied))	
Best 5	<ul style="list-style-type: none"> • Cleanliness and maintenance of public spaces 95% • Places to eat and socialize with colleagues 93% • Availability of large meeting rooms 87% • Comfort of your chair 82% • Spaciousness of your workspace surroundings 82%
Worst 5	<ul style="list-style-type: none"> • Secure storage for personal items 21% Access to water fountain/bottle refill stations 25% • Speed and availability of elevators 34% • Natural materials and elements (real or simulated) in the workplace 60% • Ability to find your way inside the building 61%
Final comments	
Positive	<ul style="list-style-type: none"> • Oriented to net-zero • Good overall satisfaction with space
Negative	<ul style="list-style-type: none"> • Better ventilation and heating • More flexible lighting • Better acoustics • More biophilia in space • Updated elevators and water stations

Overall, the results of this study suggest that the OAA renovation improved the occupants' satisfaction across all the dimensions investigated. The respondents reported relatively low job demand, while satisfaction with the indoor environmental conditions improved significantly compared to those reported pre-renovation. The company corporate values, mission, as well as internal communication were all highly rated, reflecting the respondents' strong commitment to the organization. Some areas that were identified for further improvement include access to a more flexible lighting system in the workstations, as well as better heating and ventilation to ensure acceptable and adaptable levels of thermal comfort for all building occupants. These aspects should be addressed directly with the occupants to meet their needs for a comfortable and productive work environment.

The OAA case study successfully demonstrated that buildings with historic significance and challenging designs can be deep-retrofitted into climate-resilient, net-zero carbon facilities, that also support the occupants' comfort, well-being and satisfaction with the indoor environmental conditions.

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Appendix A – Source of questionnaire content

<i>Questionnaire Variable</i>	<i># questions</i>	<i>Description</i>	<i>Source</i>
Where completed, Usual work location & workstation type	7	assigned desk/reserved desk/home/other work/other Usual shift schedule Floor enclosed, cubicle, etc.	
Satisfaction with Lighting	5	Five-item composite measure related to lighting satisfaction in the workstation	(Veitch et al., 2007)
Satisfaction with Acoustics and Privacy	10	Ten-item composite measure related to acoustics and privacy satisfaction in the workstation	(Veitch et al., 2007)
Satisfaction with Ventilation and Temperature	3	Three-item composite measure related to ventilation and temperature satisfaction in the workstation	(Veitch et al., 2007)
Overall Environmental Satisfaction	2	Two-items related to overall conditions in the physical environment	(Veitch et al., 2007)
Job Satisfaction	1	Single-item measure of overall job satisfaction	(Dolbier et al., 2005)
Demographics	6	gender identity, age, job type, highest education, years working, tenure	
Satisfaction with amenities	24	24 items on 7- point Likert scales: cleanliness, waste management, storage, meeting rooms, food & social spaces, wayfinding, biophilia elements, type of devices used, how many	Adapted from (Veitch et al., 2007)
Computing	2		
Job Demands	4	4 items, 7-point scale	(Lowe et al., 2003)
Window access	1		
Workstation changes	2	moved in last 3 months? # distinct locations per day	
Allocation of work time	9	distribute 100% across 9 categories of time allocation	(Brill et al., 2001)
Open-ended comments	2	One thing you like and why One thing you would change and why	
Organizational Commitment	6	Six-item scale of affective organizational commitment	(Meyer et al., 1993)
Intent to Turnover	3	Three-item scale of employee intent to turnover (look for another job)	(Colarelli, 1984)
Workplace Image	3	Three-item scale on employee opinions concerning the match between physical work environment and their understanding of corporate values	(Laing, 2005)
Internal communications	4	4-item scale on quality of internal communications	(Lowe et al., 2003)
Change requests	3	yes/no open text for details of most recent request 2-item, 7-point Likert scale satisfaction with response to request	adapted from (Leaman & Bordass, 1999)
Break activities	9	% of break time/week on 9 activities (one open comment)	
Desired break activities	9	checklist of same 9 activities	
Chronotype	6	6 questions, 5-point ratings	(Di Milia et al., 2008)
Sleep	4	Time to bed, time to wake, sleep quality, ease of sleeping	Adapted from (Smolders et al., 2013)

Visual Discomfort	4	Short version of visual discomfort scale (4 items)	(Wibom & Carlsson, 1987)
Physical Discomfort	7	Adapted from literature and placed in same format as visual discomfort symptoms	(Hedge et al., 1992)
Self-reported absenteeism	2	2 items, 6 categories	(Veitch et al., 2010)

Appendix B – Questionnaire items

OAA-2017 – Permanent occupants

Evaluation of the OAA Building

Why have you been invited to participate?

You are invited to participate in an online survey that is part of a larger project evaluating the performance of the OAA building before and after renovation. The survey includes questions about your satisfaction with the space you normally occupy at the OAA Building and your general well-being.

The information on this page is intended to help you understand exactly what we are asking of you so that you can decide whether or not you want to participate in this study. Please read this consent form carefully before deciding whether or not to participate. Please take whatever time you want before reaching a decision. Your participation in this study is entirely voluntary, and a decision not to participate will not in any way be used against you.

Project team and sponsors

The project is led by Dr. Guy Newsham, National Research Council Canada (NRC). It is sponsored by NRC, OAA, and the Independent Electricity System Operator (IESO).

Why is the study being done?

With increasing attention being paid to environmental sustainability, various building design and operation strategies have been adopted to try to reduce building energy consumption while maintaining or improving indoor environmental conditions. The OAA is undertaking a renovation on its own building with these goals. This study will compare the indoor environment of the OAA building before and after the renovation. It is part of a larger project that will evaluate the performance of the renovated building more broadly.

What will you be asked to do?

Participation in the online survey will take approximately 15-20 minutes. Participation in this research is voluntary and whether you choose to participate or not is entirely your decision. Should you decide to participate in this research, you always have the right to end your participation at any time and for any reason. You may do so simply by closing your browser window.

Potential harms / inconveniences / benefits

There are no known harms associated with your participation in this research. You will not benefit directly from your participation in this study, but you will contribute to the development of knowledge about how to better design and operate buildings. A report on the findings will be made available at the completion of the study.

Privacy and confidentiality

All data will be transmitted by a secure, encrypted internet connection and stored on a server in Ottawa. Only personnel authorized by NRC will have access to the raw data. All information gathered from you will be confidential. Unless required by law, no information that might directly or indirectly reveal your identity will be released or published without your specific consent to the disclosure. NRC's Research Ethics Board will have access to the individual data, for monitoring purposes. Your employer will not be given access to the individual responses. Information will only be published based on group average data. Further details of our privacy policy are given [here](#).

You have the right to change your mind

Your participation is entirely voluntary. Should you decide to participate in this research, you always have the right to end your participation at any time and for any reason. You may do so simply by closing your browser window.

Who to contact if you have any further concerns or questions?

Should you have any concerns or questions please contact Dr. Guy Newsham at workplace.research@nrc-cnrc.gc.ca or call +1 (613) 993-9607.

Ethics review

This study has been reviewed by the NRC Research Ethics Board, as protocol 2016-55. REB review seeks to ensure that research projects meet Canadian standards of ethics. Any questions or concerns about the ethics of this study may be directed to the REB Secretariat at REB-CER@nrc-cnrc.gc.ca, or by calling +1 (613) 949-8681.

How to participate

If you agree to participate in this survey, please enter the access code from your e-mail invitation below, and click the "Start Survey" button.

Please note that if you are unable to complete the survey in one session, you can close your browser and, at a later time, continue from where you stopped. Just click on the link in your e-mail invitation and enter your access code.

If you are an employee of the OAA with a dedicated workstation in the building, for questions relating to work space conditions, please consider conditions at your own workstation.

Please enter your access code

How often do you typically spend time in the building?

- Most days
- Once per week
- Once per month
- Less than once per month

When in the building on a given day, how long do you typically spend in the building?

- 8 or more hours
- 4-8 hours
- 2-4 hours
- 1-2 hours
- 1 hour or less

Where are you completing this survey?

- At my own desk in the OAA Building
- Elsewhere in the OAA Building
- Other

For the following questions, please select the button that best expresses your satisfaction with the...

	Very Unsatisfactory	Unsatisfactory	Somewhat unsatisfactory	Neutral	Somewhat satisfactory	Satisfactory	Very Satisfactory
Amount of lighting on the desktop	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall air quality in your workstation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Temperature in your workstation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

For the following questions, please select the button that best expresses your satisfaction with the...

	Very Unsatisfactory	Unsatisfactory	Somewhat at Unsatisfactory	Neutral	Somewhat at Satisfactory	Satisfactory	Very Satisfactory
Aesthetic appearance of your workstation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Level of privacy for conversations in your workstation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Level of visual privacy at your workstation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Amount of noise from other people's conversations while you are at your workstation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Size of your workstation to accommodate your work, materials, and visitors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Amount of background noise (i.e. not speech) you hear at your workstation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Amount of light for computer work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Amount of reflected light or glare on the computer screen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Air movement in your workstation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ability to alter physical conditions in your workstation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Access to a view of outside from your workstation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Distance between you and other people you work with	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality of lighting in your workstation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frequency of distractions from other people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Degree of enclosure of your workstation by walls, screens or furniture	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please select the button that best estimates how you think your personal productivity at work is increased or decreased by the physical environmental conditions.

-30 %	-20 %	-10 %	0 %	+10 %	+20 %	+30 %
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Considering all of the environmental conditions in your workstation, what is your degree of satisfaction with the indoor environment in your workstation, as a whole?

Please select the button that best estimates how you think your personal productivity at work is increased or decreased by the physical environmental conditions.

-30 %	-20 %	-10 %	0 %	+10 %	+20 %	+30 %
Very		Somewhat		Somewhat		Very
Unsatisfactory	Unsatisfactory	Unsatisfactory	Neutral	Satisfactory	Satisfactory	Satisfactory
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Taking everything into consideration, what is your degree of satisfaction with your job as a whole?

Very		Somewhat		Somewhat		
Unsatisfactory	Unsatisfactory	Unsatisfactory	Neutral	Satisfactory	Satisfactory	Very Satisfactory
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What is your gender identity?

- Female
- Male
- Other

What is your age?

- 18-29
- 30-39
- 40-49
- 50-59
- 60 or over

What type of job do you have?

- Administrative
- Technical
- Professional
- Managerial

What type of computer monitor are you working on?

CRT display

Flat-panel / LCD monitor

For how many years have you been in the paid workforce? _____

For how many years have you been working for this organization? _____

What is the highest level of education that you have completed?

- Secondary/ high school graduation certificate or less
- Diploma or certificate from a community college, CEGEP, institute of technology, etc.

What is the highest level of education that you have completed?

- Some university courses or a university certificate below the Bachelor level
- Undergraduate (Bachelor's) degree
- Graduate or professional degree

To what extent do you agree or disagree that each statement describes your job?

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree
My job is very stressful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My job is hectic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have difficulty keeping up with the workload	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often experience conflicting demands from other people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you have a window to the outside nearby?

Yes, in my workstation	Yes, in the workstation next to me	No, but there is a window across the corridor	No, there is no window visible from my workstation
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Have you moved to a new work arrangement in the past three months? A change could be (for example) from one fixed workstation to another, or from one building to another, or from a fixed workstation to an alternative work arrangement.

- Yes
- No

What percentage of your time at work do you spend doing each activity in a typical week (total 100%)?

Computer and quiet work	_____
Telephone work	_____
Meetings, interactions in one's workstation	_____
Scheduled meetings outside one's workstation	_____
Informal interactions outside one's workstation	_____
Taking breaks	_____
Doing office chores/lab work	_____
Work tasks at another site	_____
Other	_____

For each statement, please select the appropriate button to indicate your agreement or disagreement:

	Strongly Disagree	Modera tely Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderat ely Agree	Strongly Agree
I would be very happy to spend the rest of my career with this organization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I really feel as if this organization's problems are my own	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I do not feel a strong sense of "belonging" to this organization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I do not feel "emotionally attached" to this organization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I do not feel like "part of the family" at this organization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This organization has a great deal of personal meaning for me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

For each statement, please select the appropriate button to indicate your agreement or disagreement:

	Strongly Disagree	Modera tely Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderat ely Agree	Strongly Agree
I am planning to search for a new job outside of this organization during the next 12 months	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often think about quitting this job	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I have my own way, I will be working for this organization one year from now	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

For each statement, please select the appropriate button to indicate your agreement or disagreement:

	Strongly Disagree	Modera tely Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderat ely Agree	Strongly Agree
This office environment is a good expression of the Government of Canada's corporate values	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This office environment was designed with us in mind	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This office environment is consistent with the Government of Canada's mission	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

To what extent do you agree or disagree that each statement describes your job?

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree
Communication is good among the people I work with	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The people I work with are helpful and friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have a good relationship with my supervisor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I receive recognition for work well done	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How disturbing would you rate the noise from heating, ventilating and cooling systems that you hear at your workstation?

Very	Moderately	Not at all
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

With respect to your thermal comfort...

At the moment I feel...

Cold	Cool	Slightly Cool	Neutral	Slightly Warm	Warm	Hot
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

At the moment, I would like to be...

Cooler	No Change	Warmer
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How often do you take the following actions to improve your thermal comfort in your workstation?

	Never	Once per month	2-3 times per month	Once per week	2-4 times per week	At least once per day	Several times per day	Not an option for me
Have a hot or cold drink to improve my thermal comfort	i	i	i	i	i	i	i	i
Use a portable heater to improve my thermal comfort	i	i	i	i	i	i	i	i
Use a portable fan to improve my thermal comfort	i	i	i	i	i	i	i	i
Change the thermostat to improve my thermal comfort	i	i	i	i	i	i	i	i
Add or remove a layer of clothing to improve my thermal comfort	i	i	i	i	i	i	i	i
Open or close the window to improve my thermal comfort	i	i	i	i	i	i	i	i
Adjust a window blind or curtain to improve my thermal comfort	i	i	i	i	i	i	i	i

Please give us details about other actions you may take to improve your thermal comfort

What time did you go to bed in your last sleep before this work shift? [- Select One -]

What time did you wake up? [- Select One -]

How well did you sleep in your last sleep before this work shift?

Very badly	Badly	A little badly	Neutral	OK	Well	Very well
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How easy or difficult was it for you to get to sleep in your last sleep before this work shift?

Very difficult	Difficult	A little difficult	Neutral	Somewhat easy	Easy	Very easy
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please think about what you have been doing and experiencing during the past 4 weeks. Then report how much you experienced each of the following feelings, using the scale below. Please select one of the options for each feeling.

	Very rarely or never	Rarely	Sometimes	Often	Very often or always
Positive	i	i	i	i	i
Negative	i	i	i	i	i
Good	i	i	i	i	i
Bad	i	i	i	i	i
Pleasant	i	i	i	i	i
Unpleasant	i	i	i	i	i
Happy	i	i	i	i	i
Sad	i	i	i	i	i
Afraid	i	i	i	i	i
Joyful	i	i	i	i	i
Angry	i	i	i	i	i
Contented	i	i	i	i	i

Please think back over the past few months. For each of the symptoms listed below, please tell us how frequently you have experienced the symptoms at work (buttons on the left) and the intensity of that feeling (buttons on the right).

<u>Frequency</u>					<u>Intensity</u>					
Never	Very rarely	Monthly	Weekly	Daily	None	A little uncomfortable	Somewhat uncomfortable	Uncomfortable	Very uncomfortable	
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Smarting, itchy, or aching eyes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Dry, irritated skin	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Tearful eyes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Dry eyes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Sore back, wrists or arms	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Stuffy, congested, or runny nose	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Headache	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Sore, irritated throat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Sensitivity to light	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Excessive fatigue	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Wheezing, chest tightness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

During the past month, how many work days did you miss...

	0	1	2	3	4	5 or more
Because you personally were ill	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

During the past month, how many work days did you miss...

	0	1	2	3	4	5 or more
For any reason (illness, vacation, personal, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Thank you. You have now completed the survey.

Please click on the button below to submit your responses.

Please note that once you have submitted your responses you will not be able to revisit this survey.

If you have any questions about this project, please contact Dr. Guy Newsham at workplace.research@nrc-cnrc.gc.ca or call +1 (613) 993-9607.

OAA-2017 – Infrequent occupants

Evaluation of the OAA Building

Why have you been invited to participate?

You are invited to participate in an online survey that is part of a larger project evaluating the performance of the OAA building before and after renovation. The survey includes questions about your satisfaction with the space you normally occupy at the OAA Building and your general well-being.

The information on this page is intended to help you understand exactly what we are asking of you so that you can decide whether or not you want to participate in this study. Please read this consent form carefully before deciding whether or not to participate. Please take whatever time you want before reaching a decision. Your participation in this study is entirely voluntary, and a decision not to participate will not in any way be used against you.

Project team and sponsors

The project is led by Dr. Guy Newsham, National Research Council Canada (NRC). It is sponsored by NRC, OAA, and the Independent Electricity System Operator (IESO).

Why is the study being done?

With increasing attention being paid to environmental sustainability, various building design and operation strategies have been adopted to try to reduce building energy consumption while maintaining or improving indoor environmental conditions. The OAA is undertaking a renovation on its own building with these goals. This study will compare the indoor environment of the OAA building before and after the renovation. It is part of a larger project that will evaluate the performance of the renovated building more broadly.

What will you be asked to do?

Participation in the online survey will take approximately 5-10 minutes. Participation in this research is voluntary and whether you choose to participate or not is entirely your decision. Should you decide to participate in this research, you always have the right to end your participation at any time and for any reason. You may do so simply by closing your browser window.

Potential harms / inconveniences / benefits

There are no known harms associated with your participation in this research. You will not benefit directly from your participation in this study, but you will contribute to the development of knowledge about how to better design and operate buildings. A report on the findings will be made available at the completion of the study.

Privacy and confidentiality

All data will be transmitted by a secure, encrypted internet connection and stored on a server in Ottawa. Only personnel authorized by NRC will have access to the raw data. All information gathered from you will be confidential. Unless required by law, no information that might directly or indirectly reveal your identity will be released or published without your specific consent to the disclosure. NRC's Research Ethics Board will have access to the individual data, for monitoring purposes. Your employer will not be given access to the individual responses. Information will only be published based on group average data. Further details of our privacy policy are given [here](#).

You have the right to change your mind

Your participation is entirely voluntary. Should you decide to participate in this research, you always have the right to end your participation at any time and for any reason. You may do so simply by closing your browser window.

Who to contact if you have any further concerns or questions?

Should you have any concerns or questions please contact Dr. Guy Newsham at workplace.research@nrc-cnrc.gc.ca or call +1 (613) 993-9607.

Ethics review

This study has been reviewed by the NRC Research Ethics Board, as protocol 2016-55. REB review seeks to ensure that research projects meet Canadian standards of ethics. Any questions or concerns about the ethics of this study may be directed to the REB Secretariat at REB-CER@nrc-cnrc.gc.ca, or by calling +1 (613) 949-8681.

How to participate

If you agree to participate in this survey, please enter the access code from your e-mail invitation below, and click the "Start Survey" button.

Please note that if you are unable to complete the survey in one session, you can close your browser and, at a later time, continue from where you stopped. Just click on the link in your e-mail invitation and enter your access code.

Please enter your access code

If you are a regular visitor to the OAA building (e.g. as part of an OAA committee), for questions relating to work space conditions, please consider conditions in the space you most commonly occupy at the OAA.

Which space do you typically occupy when you work in the OAA building?

- Conference Room
- Boardroom
- Meeting Room #1
- Meeting Room #2
- Gallery (Presentations and special events)
- Other

How often do you typically spend time in the OAA building?

- Most days
- Once per week
- Once per month
- Less than once per month

When in the building on a given day, how long do you typically spend in the OAA building?

- 8 or more hours
- 4-8 hours
- 2-4 hours
- 1-2 hours
- 1 hour or less

Where are you completing this survey?

- At my regular workplace (outside of the OAA Building)
- In the OAA Building
- Other

For the following questions, please select the button that best expresses your satisfaction with these aspects of the OAA building:

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
Amount of lighting on the desktop	i	i	i	i	i	i	i
Overall air quality in your work space	i	i	i	i	i	i	i
Temperature in your work space	i	i	i	i	i	i	i
Aesthetic appearance of your work space	i	i	i	i	i	i	i
Level of privacy for conversations in your work space	i	i	i	i	i	i	i
Level of visual privacy in your work space	i	i	i	i	i	i	i

For the following questions, please select the button that best expresses your satisfaction with these aspects of the OAA building:

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
Amount of noise from other people's conversations from outside your work space	i	i	i	i	i	i	i
Size of your work space to accommodate your work, materials, and visitors	i	i	i	i	i	i	i
Amount of background noise (i.e. not speech) you hear at your work space	i	i	i	i	i	i	i
Amount of light for computer work	i	i	i	i	i	i	i
Amount of reflected light or glare on the computer screen	i	i	i	i	i	i	i
Air movement in your work space	i	i	i	i	i	i	i

For the following questions, please select the button that best expresses your satisfaction with these aspects of the OAA building:

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
Your ability to alter physical conditions in your work space	i	i	i	i	i	i	i
Your access to a view of outside from your work space	i	i	i	i	i	i	i
Distance between you and other people you work with in other work spaces	i	i	i	i	i	i	i
Quality of lighting in your work space	i	i	i	i	i	i	i
Frequency of distractions from other people	i	i	i	i	i	i	i
Degree of enclosure of your work space by walls, screens or furniture	i	i	i	i	i	i	i

Please select the button that best estimates how you think your personal productivity in contributions to your OAA meetings is increased or decreased by the physical environmental conditions in the OAA building.

-30 %	-20 %	-10 %	0 %	+10 %	+20 %	+30 %
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Considering all of the environmental conditions in the OAA building, what is your degree of satisfaction with the indoor environment, as a whole?

Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Taking everything into consideration, what is your degree of satisfaction with your contribution to your OAA committee as a whole?

Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What is your sex?

<input type="radio"/> Female
<input type="radio"/> Male

What is your age?

<input type="radio"/> 18-29
<input type="radio"/> 30-39
<input type="radio"/> 40-49
<input type="radio"/> 50-59
<input type="radio"/> 60 or over

For how many years have you been in the paid workforce? _____

For how many years have you been working on OAA committees? _____

For each statement, please select the appropriate button to indicate your agreement or disagreement:

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree
The OAA office environment is a good expression of OAA's corporate values.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The OAA office environment was designed with us in mind.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The OAA office environment is consistent with OAA's mission.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How disturbing would you rate the noise from heating, ventilating and cooling systems that you hear when working in the OAA building?

Very			Moderately			Not at all
i	i	i	i	i	i	i

Thank you. You have now completed the survey.

Please click on the button below to submit your responses.

Please note that once you have submitted your responses you will not be able to revisit this survey.

If you have any questions about this project, please contact Dr. Guy Newsham at workplace.research@nrc-cnrc.gc.ca or call +1 (613) 993-9607.

OAA-2023 – Permanent occupants

Evaluation of the OAA Building

Why have you been invited to participate?

You are invited to participate in an online survey that is part of a larger project evaluating the performance of the OAA building before and after renovation. The survey includes questions about your satisfaction with the space you normally occupy at the OAA building and your general well-being.

Project team and sponsors

The project is led by Dr. Farid Bahiraei, National Research Council Canada (NRC). It is sponsored by the NRC and the OAA.

Why is the study being done?

With increasing attention being paid to environmental sustainability, various building design and operation strategies have been adopted to try to reduce building energy consumption while maintaining or improving indoor environmental conditions. The OAA undertook a renovation on its own building with these goals, and this study will compare the indoor environment of the OAA building before and after the renovation. It is part of a larger project that will evaluate the performance of the renovated building more broadly.

What will you be asked to do?

Participation in the online survey will take approximately 15-20 minutes. Participation is voluntary and whether you choose to participate or not is entirely your decision. Should you decide to participate in this research, you always have the right to end your participation at any time and for any reason. You may do so simply by closing your browser window.

Potential harms / inconveniences / benefits

There are no known harms associated with your participation in this research. You will not benefit directly from your participation in this study, but you will contribute to the development of knowledge about how to better design and operate buildings. A report on the findings will be made available at the completion of the study.

Privacy and confidentiality

All data will be transmitted by a secure, encrypted internet connection and stored on a server in Ottawa. Only personnel authorized by NRC will have access to the raw data. All information gathered from you will be confidential. Unless required by law, no information that might directly or indirectly reveal your identity will be released or published without your specific consent to the disclosure. NRC's Research Ethics Board will have access to the individual data, for monitoring purposes. Your employer will not be given access to the individual responses. Information will only be published based on group average data. Further details of our privacy policy are given [here](#).

Who to contact if you have any further concerns or questions?

Should you have any concerns or questions please contact the research team at NRC.ConstructionSurveys-SondagesConstructionsCNRC@nrc-cnrc.gc.ca.

Ethics review

This study has been reviewed by the NRC Research Ethics Board (REB) under protocol 2016-55. REB review seeks to ensure that research projects meet Canadian standards of ethics. Any questions or concerns about the ethics of this study may be directed to the REB Secretariat at NRC-REB@nrc-cnrc.gc.ca.

How to participate

If you agree to participate in this survey, please enter the access code from your e-mail invitation below, and click the "Start Survey" button. Please note that if you are unable to complete the survey in one session, you can close

your browser and, at a later time, continue from where you stopped. Simply click on the link in your e-mail invitation and enter your access code.

Please enter your access code: _____

Please tell us about yourself...

What type of job do you have?

- Administrative
- Technical
- Professional
- Managerial

Do you identify as:

- Male
- Female
- Other
- Prefer not to say

What is your age?

- 18-29
- 30-39
- 40-49
- 50-59
- 60 or over

For how many years have you been in the paid workforce? _____

For how many years have you been working for this organization? _____

What is your highest level of education?

- Secondary/high school graduation certificate or less
- Diploma or certificate from a community college, CEGEP, institute of technology, etc.
- Some university courses or a university certificate below the Bachelor level
- Undergraduate (Bachelor's) degree
- Graduate or professional degree

How often do you telework?

- I do not telework
- Once in a while, but not regularly
- 1-2 days per week
- 3 days a week (or more)
- It varies, please specify: _____

When in the building on a given day, how long do you typically spend in the building?

- 8 or more hours
- 4-8 hours
- 2-4 hours
- 1-2 hours
- 1 hour or less

Where are you completing this survey?

- At my own desk in the OAA Building
- Elsewhere in the OAA Building
- At home
- Other remote location

What type of workstation or work area do you commonly work in when onsite?

- Enclosed single-person office
- Enclosed multi-person office
- Workstation with dividers high enough that most people cannot see over when standing
- Workstation with dividers high enough that most people cannot see over when seated but can see over when standing (seated visual privacy)
- Workstation with dividers that most people can see over when seated, or no dividers
- Workshop/Warehouse/Maintenance/Mechanical/Operations area
- Classroom/Meeting room
- Other, please specify: _____

If you are an employee of the OAA with a dedicated workstation in the building, for questions relating to workspace conditions, please consider conditions at your own workstation.

For the following questions, please select the button that best expresses your satisfaction with the...

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
Amount of lighting on the desktop	i	i	i	i	i	i	i
Overall air quality in your workstation	i	i	i	i	i	i	i
Temperature in your workstation	i	i	i	i	i	i	i
Aesthetic appearance of your workstation	i	i	i	i	i	i	i
Level of privacy for conversations in your workstation	i	i	i	i	i	i	i
Level of visual privacy at your workstation	i	i	i	i	i	i	i

For the following questions, please select the button that best expresses your satisfaction with the...

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
Amount of noise from other people's conversations while you are at your workstation	i	i	i	i	i	i	i
Size of your workstation to accommodate your work, materials, and visitors	i	i	i	i	i	i	i
Amount of background noise (i.e. not speech) you hear at your workstation	i	i	i	i	i	i	i
Amount of light for computer work	i	i	i	i	i	i	i
Amount of reflected light or glare on the computer screen	i	i	i	i	i	i	i
Air movement in your workstation	i	i	i	i	i	i	i

For the following questions, please select the button that best expresses your satisfaction with the...

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
Ability to alter physical conditions in your workstation	i	i	i	i	i	i	i
Access to a view of outside from your workstation	i	i	i	i	i	i	i
Distance between you and other people you work with	i	i	i	i	i	i	i
Quality of lighting in your workstation	i	i	i	i	i	i	i
Frequency of distractions from other people	i	i	i	i	i	i	i
Degree of enclosure of your workstation by walls, screens or furniture	i	i	i	i	i	i	i

Please select the button that best estimates how you think your personal productivity at work is increased or decreased by the physical environmental conditions.

-30 %	-20 %	-10 %	0 %	+10 %	+20 %	+30 %
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Considering all of the environmental conditions in your workstation, what is your degree of satisfaction with the indoor environment in your workstation, as a whole?

Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Taking everything into consideration, what is your degree of satisfaction with your job as a whole?

Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

To what extent do you agree or disagree that each statement describes your job?

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree
My job is very stressful.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My job is hectic.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have difficulty keeping up with the workload.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often experience conflicting demands from other people.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you have a window to the outside nearby?

- Yes, in my workstation
- Yes, in the workstation next to me
- No, but there is a window across the corridor
- No, there is no window visible from my workstation

Have you moved to a new workstation in the past three months?

- Yes
- No

What percentage of your time at work do you spend doing each activity in a typical week (total 100%)?

Computer and quiet work	_____
Telephone work	_____
Meetings, interactions in one's workstation	_____
Scheduled meetings outside one's workstation	_____
Informal interactions outside one's workstation	_____
Taking breaks	_____
Doing office chores/lab work	_____
Other	_____

For each statement, please select the appropriate button to indicate your agreement or disagreement:

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree
I would be very happy to spend the rest of my career with this organization.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I really feel as if this organization's problems are my own.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I do not feel a strong sense of "belonging" to this organization.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I do not feel "emotionally attached" to this organization.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I do not feel like "part of the family" at this organization.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This organization has a great deal of personal meaning for me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

For each statement, please select the appropriate button to indicate your agreement or disagreement:

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree
I am planning to search for a new job outside of this organization during the next 12 months.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often think about quitting this job.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I have my own way, I will be working for this organization one year from now.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

For each statement, please select the appropriate button to indicate your agreement or disagreement:

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree
This office environment is a good expression of OAA's corporate values.	i	i	i	i	i	i	i
This office environment was designed with us in mind.	i	i	i	i	i	i	i
This office environment is consistent with OAA's mission.	i	i	i	i	i	i	i

To what extent do you agree or disagree that each statement describes your job?

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree
Communication is good among the people I work with.	i	i	i	i	i	i	i
The people I work with are helpful and friendly.	i	i	i	i	i	i	i
I have a good relationship with my supervisor.	i	i	i	i	i	i	i
I receive recognition for work well done.	i	i	i	i	i	i	i

How disturbing would you rate the following sounds at your workstation?

	Very	Moderately	Not at all
Noise from heating, ventilating and cooling systems.	i	i	i
Noise from office equipment (e.g. printers, computers, telephones ringing).	i	i	i
Noise from washrooms and other plumbing noises.	i	i	i
Noise from outdoors (e.g. road traffic).	i	i	i
Speech sounds from others in your building.	i	i	i
Non-speech sounds generated by others in your building (e.g. footsteps, shuffling papers).	i	i	i

Please rate the privacy of your workstation (e.g. do you feel you can have a private conversation or phone call at your workstation?).

Not at all private				Moderately private			Very private
i	i	i	i	i	i	i	i

At your workstation, how understandable are overheard conversations and phone calls from others in your office?

Very				Moderately			Not at all
i	i	i	i	i	i	i	i

How much do the following aspects of your workstation interfere with your ability to do your job?

			Very		Moderately		Not at all
Noise (from all sources other than speech) that you hear at your workstation.	i	i	i	i	i	i	i
Overheard speech from others in your office.	i	i	i	i	i	i	i

Please rate your typical thermal sensation in your workspace in the winter:

Cold	Cool	Slightly Cool	Neutral	Slightly Warm	Warm	Hot
i	i	i	i	i	i	i

Please rate your typical thermal sensation in your workspace in the summer:

Cold	Cool	Slightly Cool	Neutral	Slightly Warm	Warm	Hot
i	i	i	i	i	i	i

At the moment I feel...

Cold	Cool	Slightly Cool	Neutral	Slightly Warm	Warm	Hot
i	i	i	i	i	i	i

At the moment, I would like to be...

i	Cooler
i	No Change
i	Warmer

How often do you take the following actions to improve your thermal comfort in your workspace?

	Never	Once per month	2-3 times per month	Once per week	2-4 times per week	At least once per day	Several times per day	Not an option for me
Have a hot or cold drink	i	i	i	i	i	i	i	i
Use a portable heater	i	i	i	i	i	i	i	i
Use a portable fan	i	i	i	i	i	i	i	i
Change the local temperature setting	i	i	i	i	i	i	i	i
Change the local electric light level	i	i	i	i	i	i	i	i
Open or close a door	i	i	i	i	i	i	i	i
Adjust the furniture	i	i	i	i	i	i	i	i
Add or remove a layer of clothing	i	i	i	i	i	i	i	i
Open or close a window	i	i	i	i	i	i	i	i
Adjust a window blind or curtain	i	i	i	i	i	i	i	i
Change my work location	i	i	i	i	i	i	i	i
Adjust the window tint level	i	i	i	i	i	i	i	i

Please give us details about other actions you may take to improve your thermal comfort: _____

Is there anything you would change in your environment to improve your thermal comfort?

- No
- Not sure
- Don't know
- Yes, please specify: _____

For each statement, please answer "agree" or "disagree".

	Agree	Disagree
Overall, the lighting is comfortable.	i	i
The lighting is uncomfortably bright for the tasks that I perform.	i	i
The lighting is uncomfortably dim for the tasks that I perform.	i	i
The lighting is poorly distributed here.	i	i
The lighting causes deep shadows.	i	i
Reflections from the light fixtures hinder my work.	i	i
The light fixtures are too bright.	i	i
My skin is an unnatural tone under the lighting.	i	i
The lights flicker throughout the day.	i	i

How does the lighting compare to similar workplaces in other buildings?

- Worse
- The same
- Better

Please identify one thing you like best about your workspace and why?

What is one thing you would change about your workspace and why?

How knowledgeable are you about how the OAA building operates in terms of...

	Not at all	A little	Somewhat	Knowledgeable	Very knowledgeable
Water use	i	i	i	i	i
Energy use	i	i	i	i	i
Waste management	i	i	i	i	i

When at work, how hard do you try to act sustainably with regards to...

	Very rarely or never	Rarely	Sometimes	Often	Very often or always
Water use	i	i	i	i	i
Energy use	i	i	i	i	i
Waste management	i	i	i	i	i

Thinking about the OAA building, please select the button that best expresses your satisfaction with the...

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
Natural materials and elements (real or simulated) in the workplace.	i	i	i	i	i	i	i
Availability of preferred work locations.	i	i	i	i	i	i	i
Ability to locate co-workers when needed.	i	i	i	i	i	i	i
Comfort of your chair.	i	i	i	i	i	i	i
Availability of small meeting rooms.	i	i	i	i	i	i	i
Availability of large meeting rooms.	i	i	i	i	i	i	i

Thinking about the OAA building, please select the button that best expresses your satisfaction with the...

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
Speed and availability of elevators.	i	i	i	i	i	i	i
Secure storage for personal items.	i	i	i	i	i	i	i
Ability to display personal items in your workarea.	i	i	i	i	i	i	i
Spaciousness of your workspace surroundings.	i	i	i	i	i	i	i
Access points from the building to the outside.	i	i	i	i	i	i	i
Ability to find your way inside the building.	i	i	i	i	i	i	i

Thinking about the OAA building, please select the button that best expresses your satisfaction with the...

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
Cleanliness and maintenance of public spaces.	i	i	i	i	i	i	i
Access to waste collection, recycling and composting points.	i	i	i	i	i	i	i
Access to water fountain/bottle refill stations.	i	i	i	i	i	i	i
Access to stairs to move between floors.	i	i	i	i	i	i	i
Places to eat and socialize with colleagues.	i	i	i	i	i	i	i
Facilities to store and prepare food.	i	i	i	i	i	i	i
Facilities to wash and store reusable dishes/utensils.	i	i	i	i	i	i	i

How satisfied are you with the availability of programs and design features in the OAA building that support:

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
A more healthful working environment.	i	i	i	i	i	i	i
A more sustainable working environment.	i	i	i	i	i	i	i

What time did you go to bed last night? [- Select One -] (24-hour clock)

What time did you wake up? [- Select One -] (24-hour clock)

How well did you sleep last night?

Very badly	Badly	A little badly	Neutral	OK	Well	Very well
i	i	i	i	i	i	i

How easy or difficult was it for you to get to sleep last night?

Very difficult	Difficult	A little difficult	Neutral	Somewhat easy	Easy	Very easy
i	i	i	i	i	i	i

Please think about what you have been doing and experiencing during the past 4 weeks. Then report how much you experienced each of the following feelings, using the scale below. Please select one of the options for each feeling.

	Very rarely or never	Rarely	Sometimes	Often	Very often or always
Positive	i	i	i	i	i
Negative	i	i	i	i	i
Good	i	i	i	i	i
Bad	i	i	i	i	i
Pleasant	i	i	i	i	i
Unpleasant	i	i	i	i	i
Happy	i	i	i	i	i
Sad	i	i	i	i	i
Afraid	i	i	i	i	i
Joyful	i	i	i	i	i
Angry	i	i	i	i	i
Contented	i	i	i	i	i

Please think back over the past few months. For each of the symptoms listed below, please tell us how frequently you have experienced the symptoms at work (buttons on the left) and the intensity of that feeling (buttons on the right).

<u>Frequency</u>					<u>Intensity</u>				
Never	Very rarely	Monthly	Weekly	Daily	None	A little uncomfortable	Some what uncomfortable	Uncomfortable	Very uncomfortable
i	i	i	i	i	i	i	i	i	i
i	i	i	i	i	i	i	i	i	i
i	i	i	i	i	i	i	i	i	i
i	i	i	i	i	i	i	i	i	i
i	i	i	i	i	i	i	i	i	i
i	i	i	i	i	i	i	i	i	i
i	i	i	i	i	i	i	i	i	i
i	i	i	i	i	i	i	i	i	i
i	i	i	i	i	i	i	i	i	i
i	i	i	i	i	i	i	i	i	i
i	i	i	i	i	i	i	i	i	i
i	i	i	i	i	i	i	i	i	i
i	i	i	i	i	i	i	i	i	i
i	i	i	i	i	i	i	i	i	i
i	i	i	i	i	i	i	i	i	i

During the past month, how many work days did you miss...

	0	1	2	3	4	5 or more
Because you personally were ill	i	i	i	i	i	i
For any reason (illness, vacation, personal, etc.)	i	i	i	i	i	i

Please share with us any final thoughts you may have regarding your ability to perform your work effectively in your work area in the OAA building:

You have now completed the survey.

Please click on the button below to submit your responses.

Please note that after you submit your responses you will no longer be able to review or change your answers.

Thank you for your participation.

OAA-2023 – Infrequent occupants

Evaluation of the OAA Building

Why have you been invited to participate?

You are invited to participate in a survey that is part of a larger project evaluating the performance of the OAA building before and after renovation. The survey includes questions about your satisfaction with the space you normally occupy at the OAA building and your general well-being.

Project team and sponsors

The project is led by Dr. Farid Bahiraei, National Research Council Canada (NRC). It is sponsored by the NRC and the OAA.

Why is the study being done?

With increasing attention being paid to environmental sustainability, various building design and operation strategies have been adopted to try to reduce building energy consumption while maintaining or improving indoor environmental conditions. The OAA undertook a renovation on its own building with these goals, and this study will compare the indoor environment of the OAA building before and after the renovation. It is part of a larger project that will evaluate the performance of the renovated building more broadly.

What will you be asked to do?

Participation in the online survey will take approximately 10-15 minutes. Participation in this research is voluntary and whether you choose to participate or not is entirely your decision. Should you decide to participate in this research, you always have the right to end your participation at any time and for any reason.

Potential harms / inconveniences / benefits

There are no known harms associated with your participation in this research. You will not benefit directly from your participation in this study, but you will contribute to the development of knowledge about how to better design and operate buildings. A report on the findings will be made available at the completion of the study.

Privacy and confidentiality

This survey is anonymous and no information that might directly or indirectly reveal your identity is retained. Only personnel authorized by NRC will have access to the raw data. All information gathered from you will be confidential and results will only be published based on group average data.

Who to contact if you have any further concerns or questions?

Should you have any concerns or questions please contact the research team at NRC.ConstructionSurveys-SondagesConstructionsCNRC@nrc-cnrc.gc.ca.

Ethics review

This study has been reviewed by the NRC Research Ethics Board (REB) under protocol 2016-55. REB review seeks to ensure that research projects meet Canadian standards of ethics. Any questions or concerns about the ethics of this study may be directed to the REB Secretariat at NRC-REB@nrc-cnrc.gc.ca.

How to participate

If you agree to participate in this survey, please click the "Start Survey" button.

Please tell us if you are:

- An employee of the OAA whose primary workspace is located in the OAA building
- A visitor to the OAA building whose primary workspace is located elsewhere

Where in the OAA building are you completing this survey?

- Meeting Room 201 (Council Room)
- Meeting Room 202
- Meeting Room 203
- Meeting Room 204
- Meeting Room 205
- Meeting Room 301
- Meeting Room 302
- Meeting Room 303
- Meeting Room 304
- Meeting Room 305
- Atrium Café
- Other, please specify: _____

How much time will you spend in the OAA building today?

- 8 or more hours
- 4-8 hours
- 2-4 hours
- 1-2 hours
- 1 hour or less

Do you identify as:

- Male
- Female
- Other
- Prefer not to say

What is your age?

- 18-29
- 30-39
- 40-49
- 50-59
- 60 or over

For how many years have you been in the paid workforce? _____

For how many years have you been working with the OAA? _____

For the following questions relating to workspace conditions in the OAA building, please consider the conditions in the space where you are completing this survey.

Please select the button that best expresses your satisfaction with the...

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
Amount of lighting on your worktable	i	i	i	i	i	i	i
Overall air quality in your workspace	i	i	i	i	i	i	i
Temperature in your workspace	i	i	i	i	i	i	i
Aesthetic appearance of your workspace	i	i	i	i	i	i	i
Level of privacy for conversations in your workspace	i	i	i	i	i	i	i
Level of visual privacy in your workspace	i	i	i	i	i	i	i

Please select the button that best expresses your satisfaction with the...

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
Amount of noise from other people's conversations from outside your workspace	i	i	i	i	i	i	i
Size of your workspace to accommodate your work, materials, and visitors	i	i	i	i	i	i	i
Amount of background noise (i.e. not speech) you hear at your workspace	i	i	i	i	i	i	i
Amount of light for computer work	i	i	i	i	i	i	i
Amount of reflected light or glare on the computer screen	i	i	i	i	i	i	i
Air movement in your workspace	i	i	i	i	i	i	i

Please select the button that best expresses your satisfaction with the...

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
Ability to alter physical conditions in your workspace	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Access to a view of outside from your workspace	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Distance between you and other people you work with in other workspaces	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality of lighting in your workspace	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frequency of distractions from other people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Degree of enclosure of your workspace by walls, screens or furniture	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How disturbing would you rate the noise from heating, ventilating and cooling systems that you hear when working in the OAA building?

Very	Moderately			Not at all
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please rate your current thermal sensation. At the moment I feel...

Cold	Cool	Slightly Cool	Neutral	Slightly Warm	Warm	Hot
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

At the moment, I would like to be...

- Cooler
- No Change
- Warmer

Is there anything you would change in your environment to improve your thermal comfort?

- No
- Not sure
- Don't know
- Yes, please specify: _____

For each statement, please answer "agree" or "disagree".

	Agree	Disagree
Overall, the lighting is comfortable.	<input type="radio"/>	<input type="radio"/>
The lighting is uncomfortably bright for the tasks that I perform.	<input type="radio"/>	<input type="radio"/>
The lighting is uncomfortably dim for the tasks that I perform.	<input type="radio"/>	<input type="radio"/>
The lighting is poorly distributed here.	<input type="radio"/>	<input type="radio"/>
The lighting causes deep shadows.	<input type="radio"/>	<input type="radio"/>
Reflections from the light fixtures hinder my work.	<input type="radio"/>	<input type="radio"/>
The light fixtures are too bright.	<input type="radio"/>	<input type="radio"/>
My skin is an unnatural tone under the lighting.	<input type="radio"/>	<input type="radio"/>
The lights flicker throughout the day.	<input type="radio"/>	<input type="radio"/>

How does the lighting in the OAA building compare to similar workplaces in other buildings?

<input type="radio"/> Worse
<input type="radio"/> The same
<input type="radio"/> Better

Please select the button that best estimates how you think your personal productivity in contributions to your OAA meeting is increased or decreased by the physical environmental conditions in the OAA building.

<input type="radio"/> -30 %	<input type="radio"/> -20 %	<input type="radio"/> -10 %	<input type="radio"/> 0 %	<input type="radio"/> +10 %	<input type="radio"/> +20 %	<input type="radio"/> +30 %
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Considering all of the environmental conditions in the OAA building, what is your degree of satisfaction with the indoor environment, as a whole?

<input type="radio"/> Very Unsatisfactory	<input type="radio"/> Unsatisfactory	<input type="radio"/> Somewhat Unsatisfactory	<input type="radio"/> Neutral	<input type="radio"/> Somewhat Satisfactory	<input type="radio"/> Satisfactory	<input type="radio"/> Very Satisfactory
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Taking everything into consideration, what is your degree of satisfaction with your contribution to your OAA meeting as a whole?

<input type="radio"/> Very Unsatisfactory	<input type="radio"/> Unsatisfactory	<input type="radio"/> Somewhat Unsatisfactory	<input type="radio"/> Neutral	<input type="radio"/> Somewhat Satisfactory	<input type="radio"/> Satisfactory	<input type="radio"/> Very Satisfactory
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For each statement, please select the appropriate button to indicate your agreement or disagreement:

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree
This office environment is a good expression of OAA's corporate values.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This office environment was designed with us in mind.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This office environment is consistent with OAA's mission.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please identify one thing you like best about your workspace in the OAA building and why?

What is one thing you would change about your workspace in the OAA building and why?

Thinking about the OAA building, please select the button that best expresses your satisfaction with the...

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
Natural materials and elements (real or simulated) in the work space.	i	i	i	i	i	i	i
Comfort of your chair.	i	i	i	i	i	i	i
Availability of small meeting rooms.	i	i	i	i	i	i	i
Availability of large meeting rooms.	i	i	i	i	i	i	i
Speed and availability of elevators.	i	i	i	i	i	i	i
Secure storage for personal items.	i	i	i	i	i	i	i

Thinking about the OAA building, please select the button that best expresses your satisfaction with the...

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
Spaciousness of your workspace surroundings.	i	i	i	i	i	i	i
Access points from the building to the outside.	i	i	i	i	i	i	i
Ability to find your way inside the building.	i	i	i	i	i	i	i
Cleanliness and maintenance of public spaces.	i	i	i	i	i	i	i
Access to waste collection, recycling and composting points.	i	i	i	i	i	i	i

Thinking about the OAA building, please select the button that best expresses your satisfaction with the...

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
Access to water fountain/bottle refill stations.	i	i	i	i	i	i	i
Access to stairs to move between floors.	i	i	i	i	i	i	i
Places to eat and socialize with colleagues.	i	i	i	i	i	i	i
Facilities to store and prepare food.	i	i	i	i	i	i	i
Facilities to wash and store reusable dishes/utensils.	i	i	i	i	i	i	i

How satisfied are you with the availability of programs and design features in the OAA building that support:

	Very Unsatisfactory	Unsatisfactory	Somewhat Unsatisfactory	Neutral	Somewhat Satisfactory	Satisfactory	Very Satisfactory
A more healthful working environment.	i	i	i	i	i	i	i
A more sustainable working environment.	i	i	i	i	i	i	i

Please share with us any final thoughts you may have regarding your ability to perform your work effectively in the OAA building:

You have now completed the survey.

Please click on the button below to submit your responses.

Thank you for your participation!

