



Informed planning, design, and evaluation of an interdisciplinary science building

North Carolina State University
Plant Sciences Building

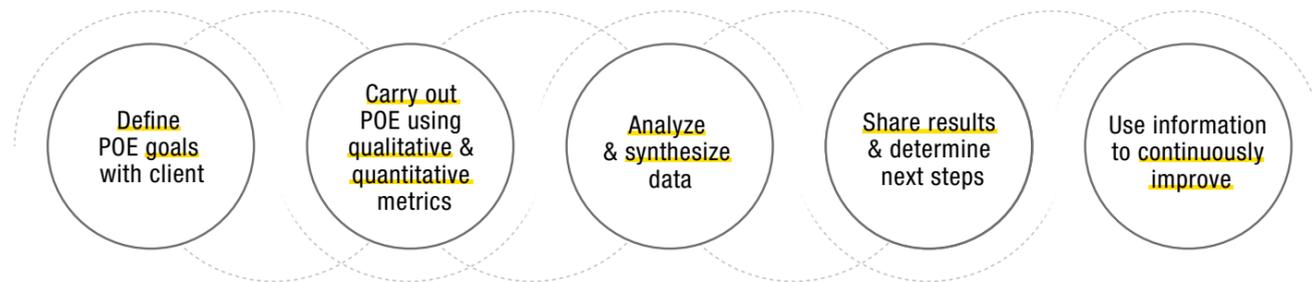
Flad

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our approach

We believe it is our responsibility as architects and planners to promote the health, well-being, safety, and productivity of users of the buildings Flad designs. Just as we plan, detail, document, and monitor the construction of our projects with great care, we also approach evaluating our buildings after delivery with intention to provide the best possible outcomes for our clients. For this performance assessment, Flad utilizes a post occupancy evaluation (POE).



What is a POE?

A post occupancy evaluation is defined as “the process of systematically and rigorously evaluating buildings after occupancy and providing feedback for improvement.”
- Preiser, Rabinowitz, & White (1998).

Why conduct a POE?

Conducting a POE is a mutually beneficial activity that allows clients, building occupants, and firms to:

- Measure how well the building meets established guiding principles and overall project goals
- Inform and enhance future facility designs
- Promote a culture of continuous improvement and ongoing learning
- Foster a high level of engagement by hearing directly from building occupants
- Identify opportunities for improvement



the project

North Carolina State University Plant Sciences Building

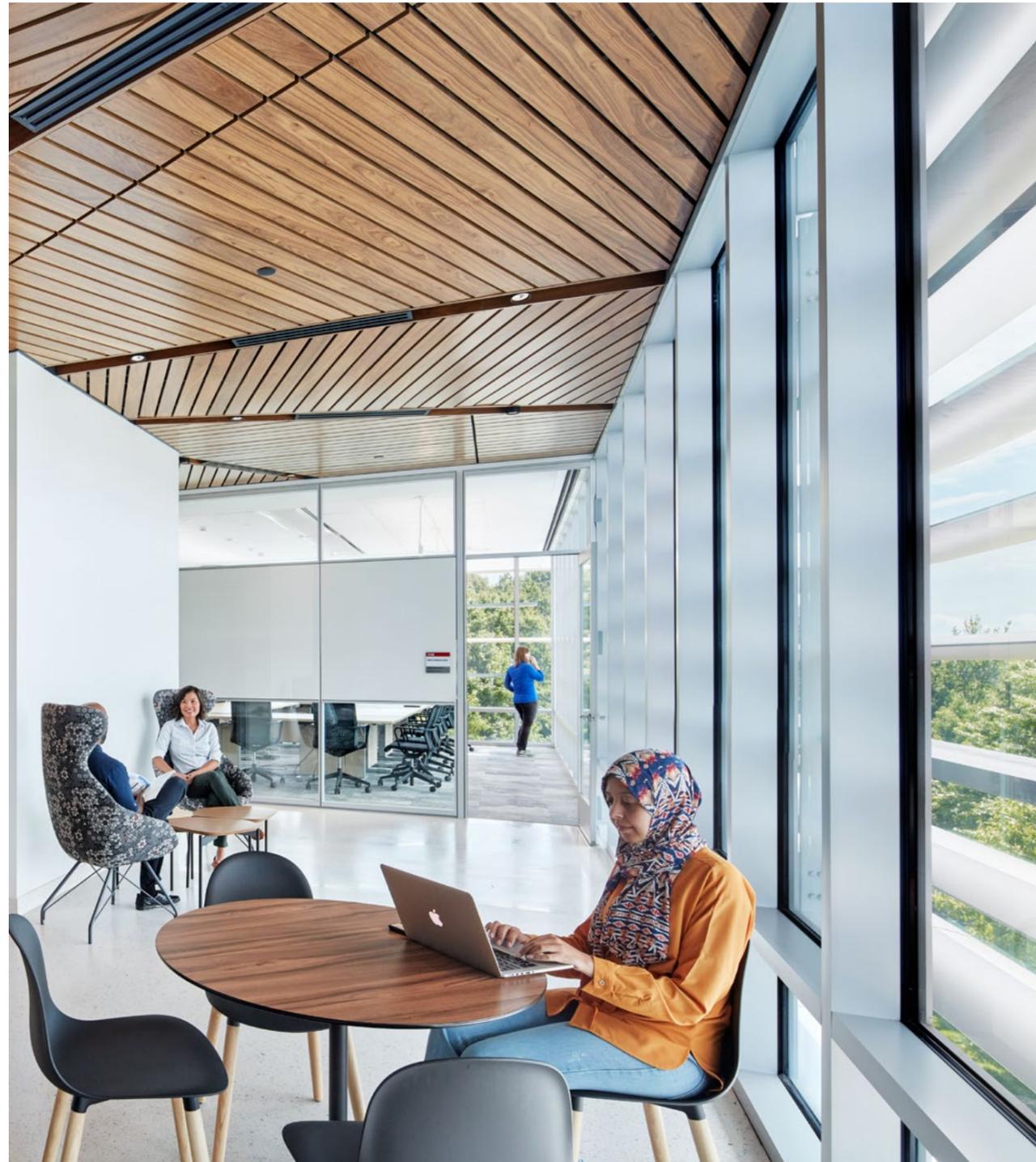
Located on NC State's Centennial Campus, the Plant Sciences Building (PSB) is the iconic new home for the North Carolina Plant Sciences Initiative (PSI). This research program began in 2014 with the mission to improve the world through innovations that solve grand agricultural challenges. Opened in 2022, the modern infrastructure of this 185,000-square-foot interdisciplinary science hub brings experts from across campus into an environment that supports collaborative, team-based problem solving within the university as well as with corporate and government partners.

Considering the unique nature of the program where teams will continue to change as research initiatives evolve, spaces were developed around scientific capabilities ensuring flexibility for a variety of collaborations in addition to private-public partnerships.

The PSB's scientific workplace consists of wet lab, dry lab, collaboration spaces, office components and a rooftop greenhouse. Here, the worlds of academia and corporate bio-agriculture merge to partner with growers – supporting a diverse range of people working on innovations that improve businesses and change lives.

Because planning and design occurred prior to the pandemic, NC State and Flad were interested in studying the functionality of the building's design within the new paradigm of post-pandemic work routines. The office areas are of particular interest due to many lab groups employing a hybrid work model – staying on campus for lab work and conducting heads-down analyses from home.

Flad's POE provided a thorough assessment and validation of occupants' real needs, and recommendations for continuous improvement.



study goals and scope

Flad's POEs are customized to the individual goals of each study and the information the client is interested in gathering. Project-specific POE goals:

Utilization

Understand the utilization of workspaces and select associated areas in the Plant Sciences Building.

The sensor study included: workspaces, formal conference rooms, huddle rooms, quiet rooms, computational labs (Think Tank), and other select areas.

Occupant Experience

Understand occupant satisfaction of individual workspaces and overall building.

Study the impact on interdisciplinary learning, research, and overall increased connectivity with the Ag Science community.

Definitions:

Utilization Rate: percent of time that the space was occupied during business hours (8am-5pm M-F)

Seat Fill Rate: percent of available seats filled when occupied



Space Types Evaluated

Workspace/Office space

(assigned cubicle quads, private offices, and unassigned touchdown spaces)

Formal Collaboration

(board room, conference rooms, huddle rooms, and quiet rooms)

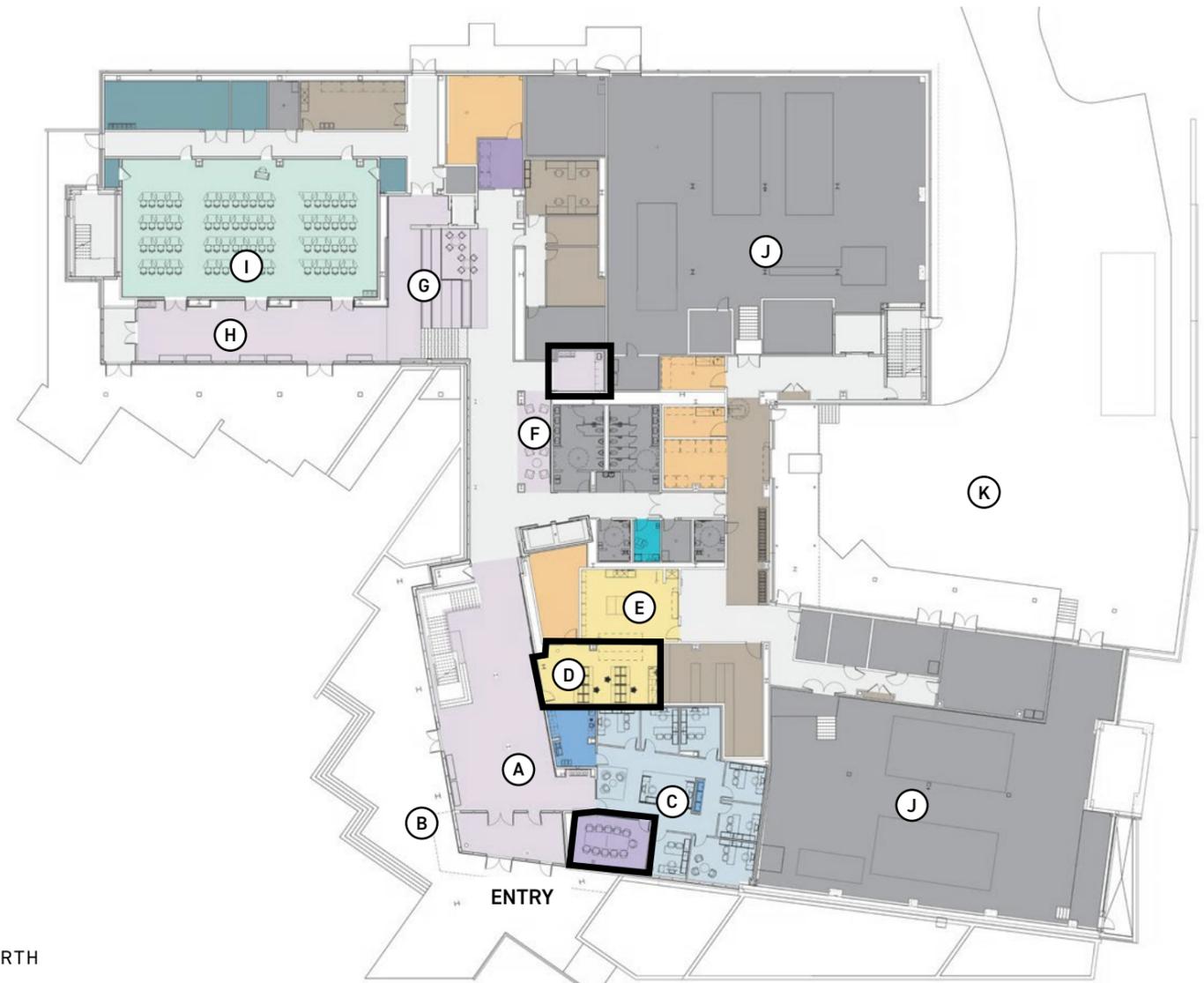
Computational/Lab

(Think Tank)

Other spaces

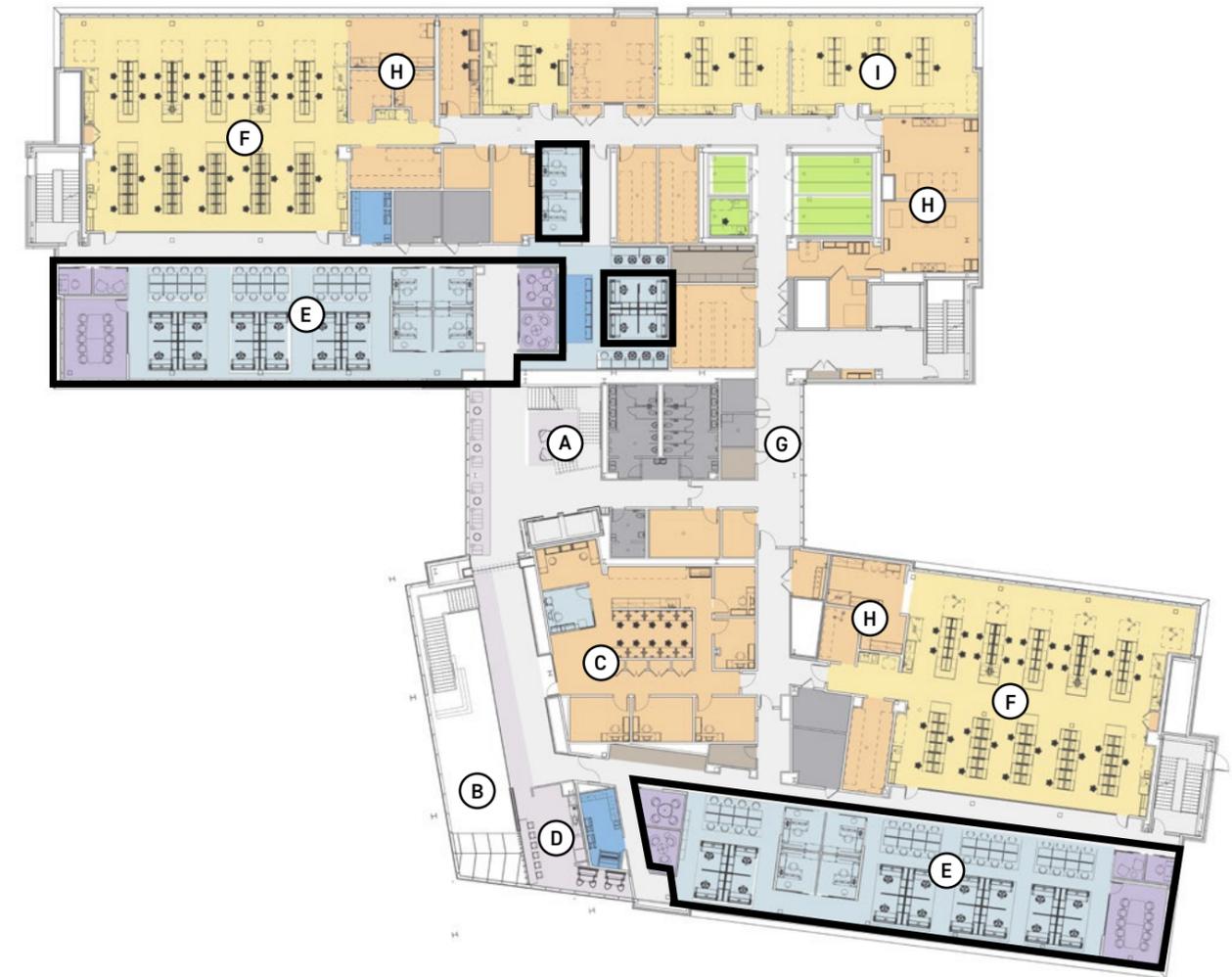
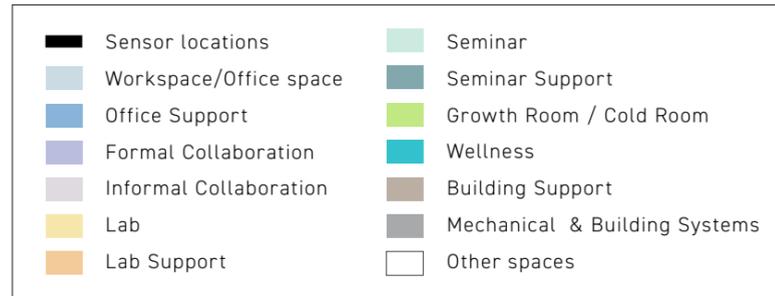
(coffee bar, demo lab, break areas, lounges, and waiting areas)

** wet labs were not a primary focus of the sensor study*



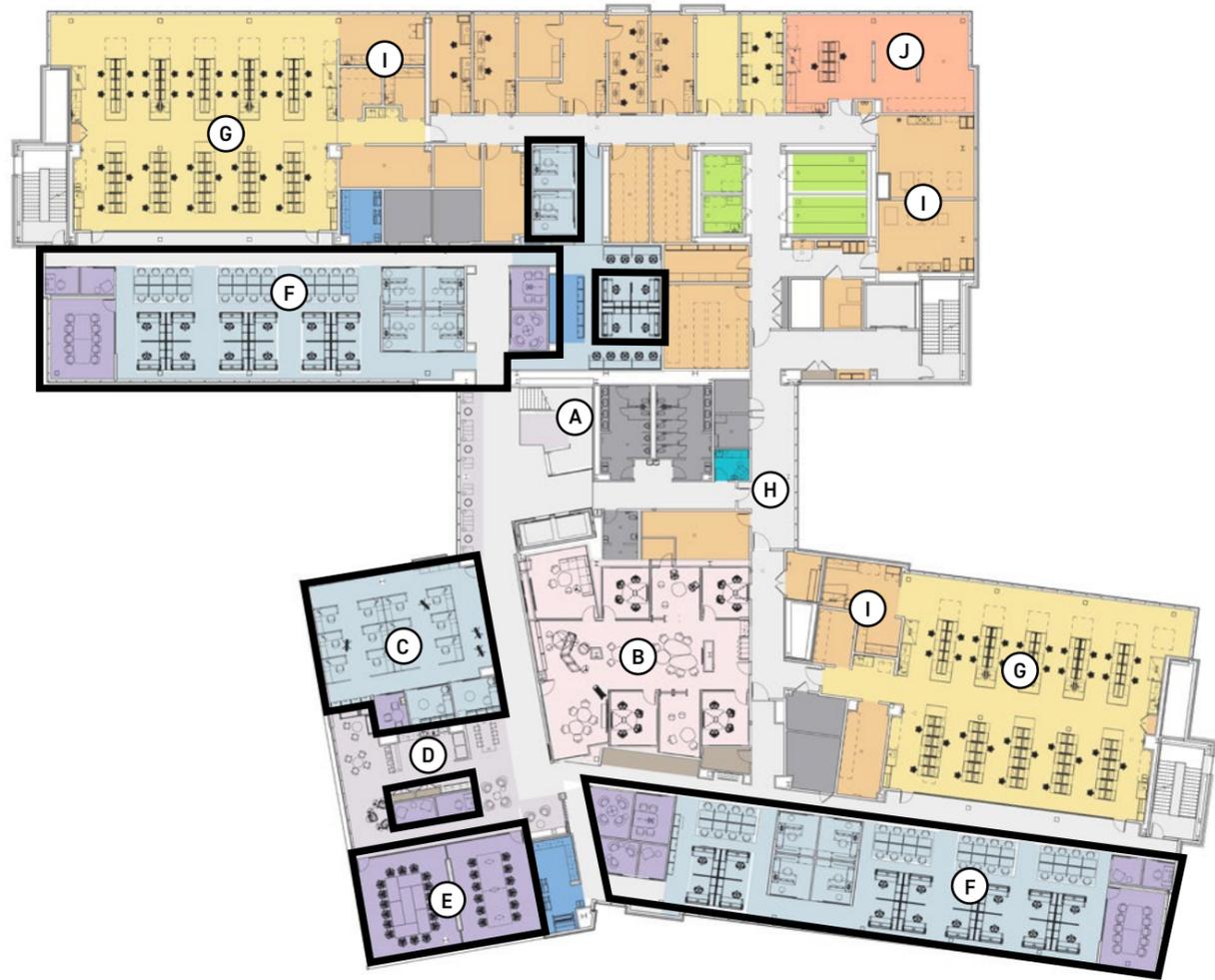
Level 1

- A HEARTH
- B PORCH
- C ADMINISTRATION SUITE
- D DEMO LAB
- E FIELD LAB
- F GALLERY
- G EDUCATION
- H PRE-FUNCTION
- I SEMINAR
- J MECHANICAL
- K SERVICE YARD



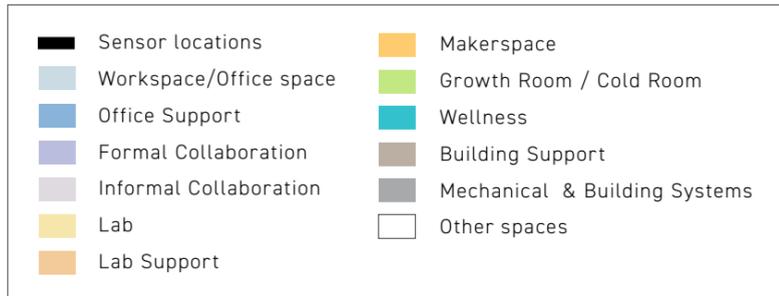
Level 2

- A COMMUNAL STAIR
- B HEARTH (BELOW)
- C CELLULAR AND MOLECULAR IMAGING FACILITY (CMIF)
- D BREAK AREA
- E OPEN OFFICE
- F OPEN LAB
- G SERVICE CORRIDOR
- H LAB SUPPORT
- I CORE LABS



Level 3

- A COMMUNAL STAIR
- B INDUSTRY PARTNER SUITE
- C COMPUTATIONAL LAB
- D BREAK AREA
- E CONFERENCE ROOMS
- F OPEN OFFICE
- G OPEN LAB, SCIENCE AND TECHNOLOGIES FOR PHOSPHORUS SUSTAINABILITY (STEPS)
- H SERVICE CORRIDOR
- I LAB SUPPORT
- J MAKERSPACE



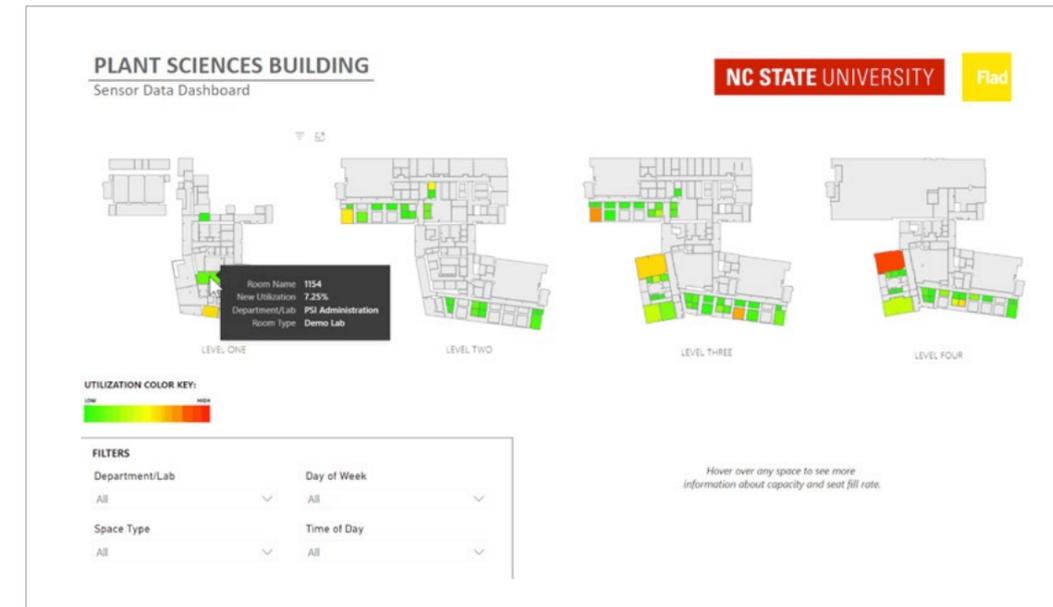
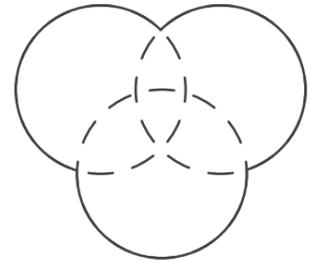
Level 4

- A COMMUNAL STAIR
- B INCUBATOR LAB SUITE
- C OFFICE
- D BREAK AREA
- E BOARDROOM
- F OPEN OFFICE
- G OPEN LAB
- H SERVICE CORRIDOR
- I LAB SUPPORT
- J GREENHOUSE MECHANICAL

Level 5 (not shown)

GREENHOUSE

data collection methods



Electronic Survey

- A 17-question survey was sent to building occupants
- Average completion time of the survey was 9 minutes
- Response rate was 30 percent with a total of 100 responses

Time-Lapse Videos

- Captured informal common spaces such as break rooms and corridors to gain a high-level understanding of utilization and flow
- Also captured huddle rooms, open offices, and wet labs to gain a high level understanding of utilization

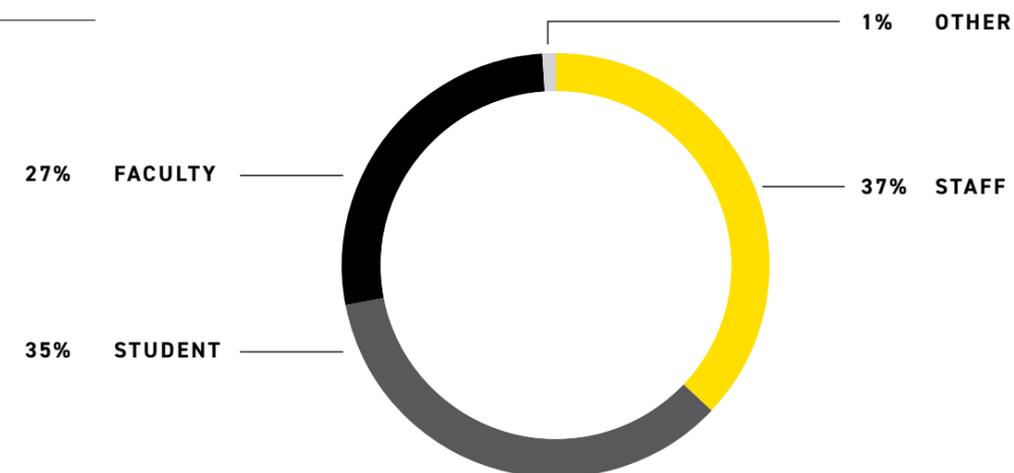
Occupancy Sensors

- 146 Bluetooth sensors were installed to study utilization rates of office and collaboration areas
- Data was collected over 12 weeks in phases

key survey findings



Survey Respondents by Role



- The PSB's design has a strong positive impact on the Ag Science field by playing an important role in **increasing collaborations within the agricultural community** which in turn is **increasing visibility to the world's most innovative agricultural research programs**.
- When not working in the PSB, **50 percent of respondents work from home**, about **25 percent work at other NC State campus locations**, and approximately **20 percent work at research stations or in the field**.
- The top three reasons for faculty, students, and staff to work/study in the PSB are **access to colleagues/faculty, a collaborative atmosphere, and access to lab research spaces**.
- The PSB provides occupants **access to a variety of collaboration spaces**.
- The **lack of acoustic privacy, visual privacy, and ability to control environment** (temperature, fresh air, lighting) in open office/ touchdown spaces **negatively impact work effectiveness and productivity**.
- Building occupants benefit from **spontaneous interactions with colleagues within informal collaboration spaces**. Removal of the coffee machine has reduced the number of such spontaneous interactions and resulted in decreased utilization of Room 1234.

Qualitative Feedback

“ *The space is really well laid out to maximize light, pleasant atmosphere, and collaboration.* ”

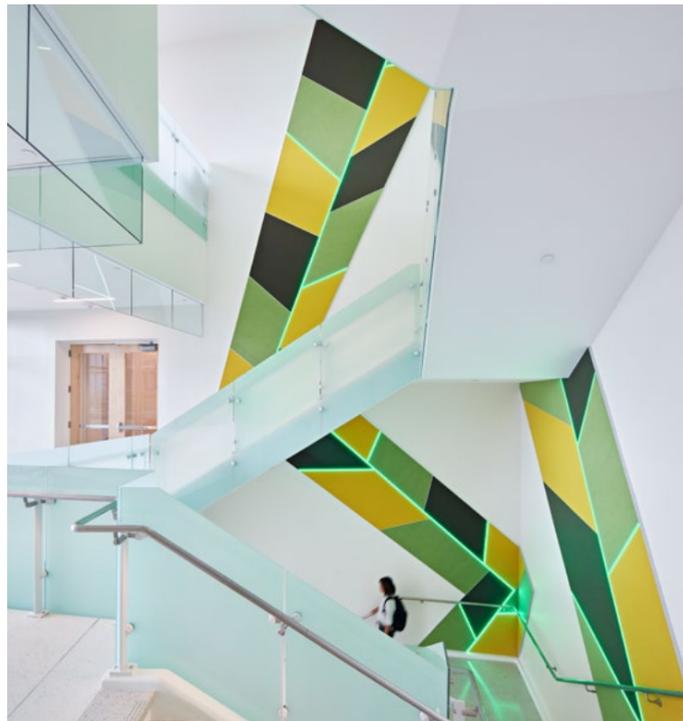
Sharing this new, beautiful workspace accessible to students and staff through tours and promotion is very important to increase public-private partnership and foster a next generation of students interested in agricultural jobs.

I think the building does help with interactions among different groups, but I feel that we need more collaborative events with purposeful activities to help people meet one another.

I have found my time at the PSB to be enjoyable and has only enhanced my program. ”

Natural light is amazing and brightens up my day.

The best thing about the building is that it provides a central location for a wide range of resources, from faculty to analytic equipment to growth spaces. ”



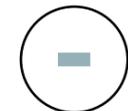
“ *Would like to see the growth spaces up and running.* ”

Would have been nice to have more independent office spaces like the Think Tank.

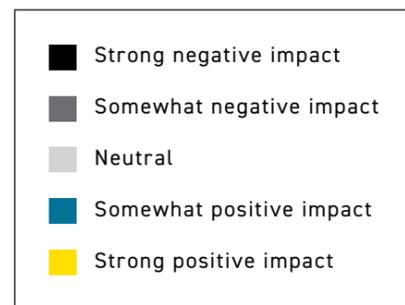
I do not think open plan is the most ideal for productivity and collaboration. People interact and collaborate more when they have a place to recharge in privacy in between interacting with others.

Some programs have considerable footprints in both the Think Tanks and open offices. Some equity for folks in other programs would be desirable.

I have concerns about security of the building. We have noted people that are not residents of the building stay after hours to use the kitchen spaces, which can be worrisome. ”

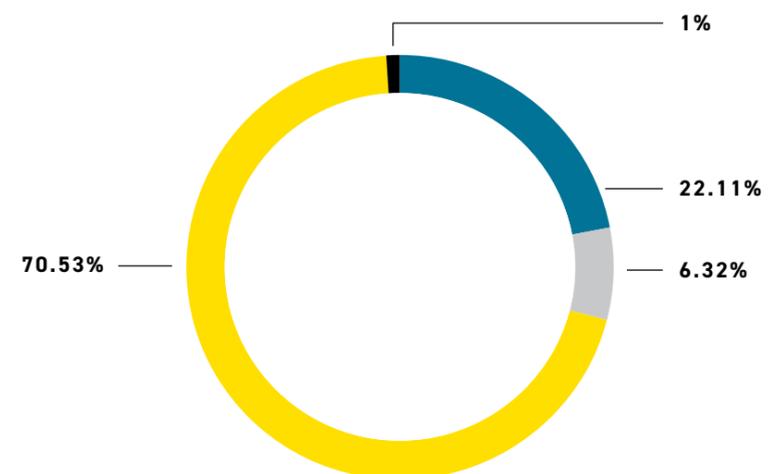


Impact on Innovation



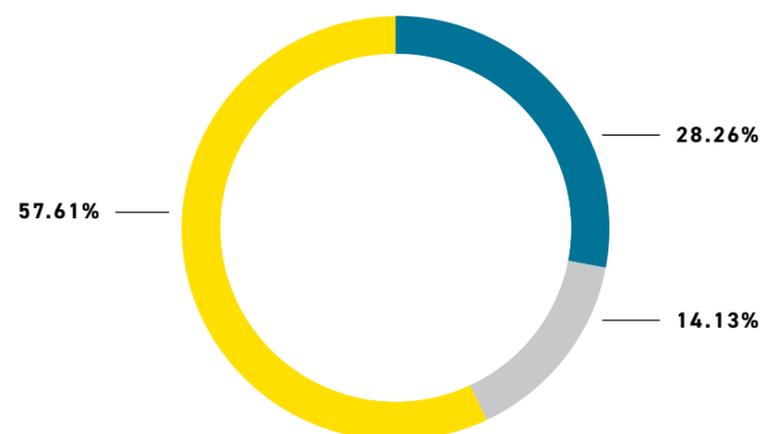
“
”
All high marks here, I was very skeptical on the PSI when it was first announced years ago, but I now think this is going to be a very successful initiative. I think the PSI leadership has worked hard in creating the right culture to foster collaborations and it is going to pay off.

Creating a welcoming environment for the community

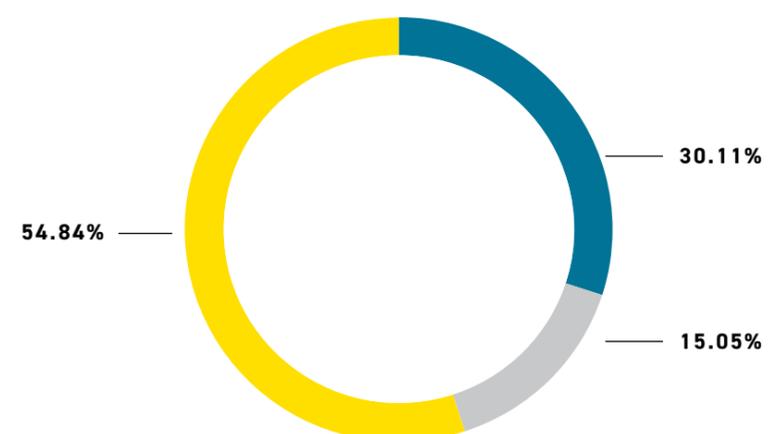


“
”
I am constantly learning new things due to the interdisciplinary aspect and feel empowered to move my ideas forward due to collaborations.

Fostering innovation in the Ag Science field



Promoting collaborations among the Ag community



Utilization Interest

Top 3 reasons to work/study in the PSB.

1

Access to colleagues/faculty



2

Collaborative atmosphere



3

Lab research spaces

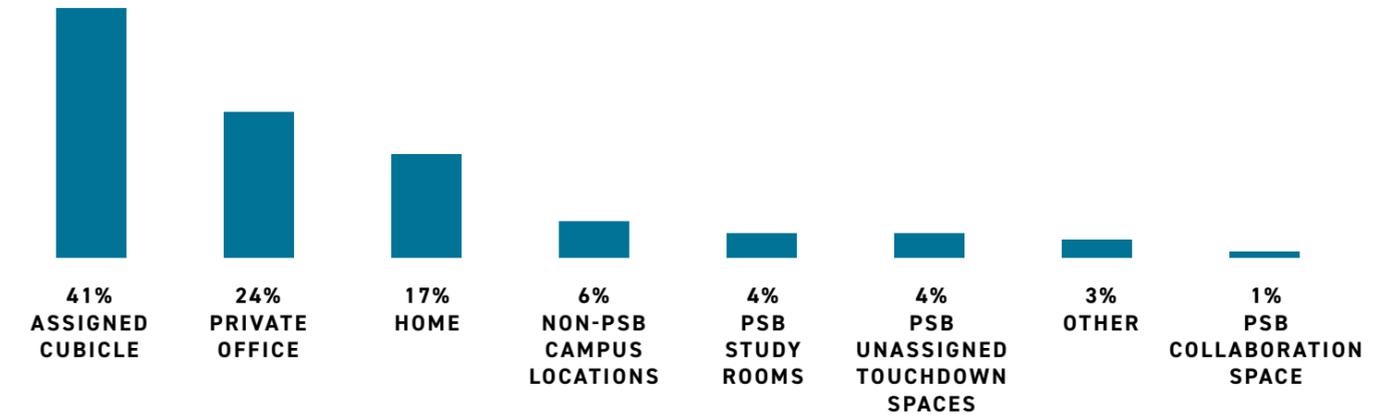


workspace evaluation

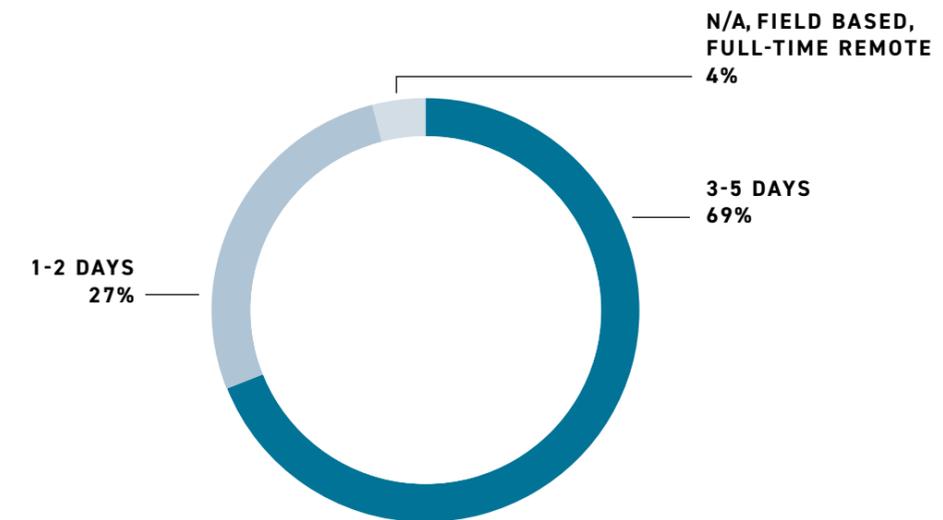
Workspace defined as private offices, assigned cubicle quads, and unassigned touchdown spaces



Where do occupants most often conduct heads-down computer work?



Days in the PSB in a typical week





Average

Space type	Utilization rate	Utilization hrs/day	Seat-fill rate
Assigned Cubicle Quads	15%	1.4	100%
Private Offices	8%	0.7 (≈43 min)	100%
Unassigned Touchdown Spaces	6%	0.5 (≈32 min)	54%

Insights

- Overall utilization rate was highest in assigned cubicle quads followed by private offices while lowest utilization was measured in unassigned touchdown spaces.
- Fourth floor unassigned touchdown spaces had a higher utilization rate than those on the second and third floors.
- These findings support the POE's initial hypothesis that the workspaces appeared to be underutilized, despite labs seeing sustained levels of occupancy.

Workspaces - Access and Comfort

How satisfied are occupants with their workspace?

ACCESS TO COLLEAGUES



TECHNOLOGY



ACCESS TO ASSIGNED DESKING/CUBICLES



ERGONOMICS



● Very Dissatisfied ● Dissatisfied ○ Neutral ● Satisfied ● Very Satisfied

Insights

- Overall, workspaces are very comfortable and functional.
- Occupants desire a workspace that gives them a sense of ownership and a level of control over their environment.
- Some responses indicate that many assigned cubicles and private offices are unoccupied but continue to be unavailable for others to use.

“ I don't like hoteling desks. They may work swimmingly for some but as someone who intends to be here a long time, a more permanent feeling workspace to anchor folks like me would be nice.”

I love how close the labs and office spaces are.

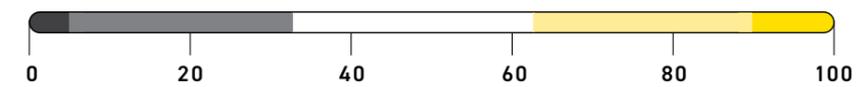
“ It is a comfortable, functional, and inviting workspace.”

I want to give a shout out for facilities provided such as the lactation rooms and family restrooms.

Workspaces - Privacy and Control

How satisfied are occupants with their workspace?

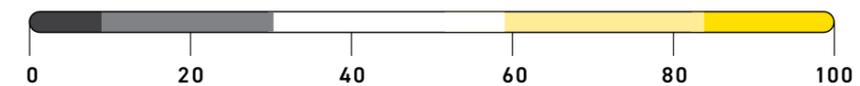
VISUAL PRIVACY



ACOUSTICAL PRIVACY



ABILITY TO CONTROL MY ENVIRONMENT (TEMPERATURE, FRESH AIR, LIGHTING)



● Very Dissatisfied ● Dissatisfied ○ Neutral ● Satisfied ● Very Satisfied

Insights

- While occupants enjoy collaborating in person, they prefer conducting heads-down computer work in spaces that are conducive to quiet work.
- Open office layouts are great for interactions, but negatively affect work efficiency due to lack of acoustic and visual privacy.
- People with neurodiverse needs find it especially hard to focus in open workspaces.

“ Access to quieter spaces are required for people with neurodiverse needs who are challenged by open floor plans affecting their productivity.

The clear glass is nice, but the lack of privacy has reduced the quality of my quiet time to work since everyone sees you are there, assume you are not busy, and come right in.

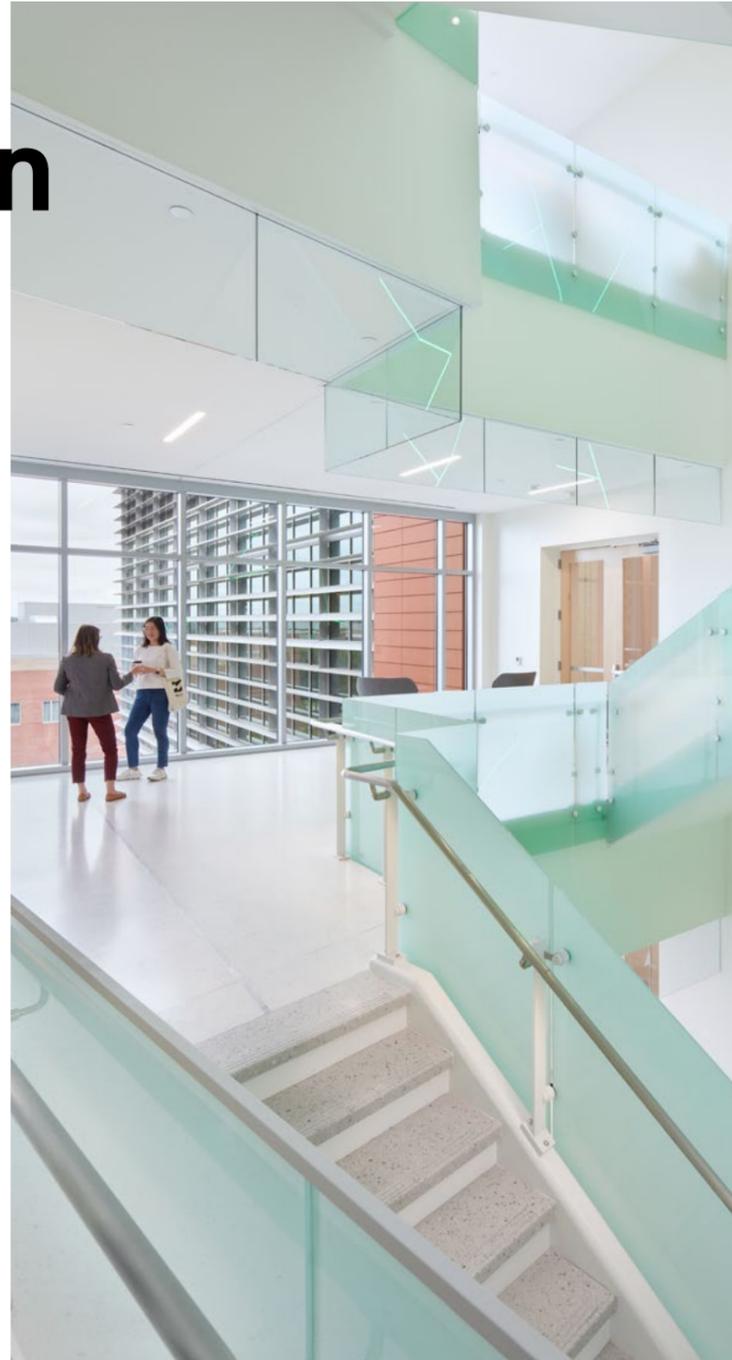
I don't love how the visual transparency of the office spaces makes it feel like there is no ownership of any space.



collaboration spaces

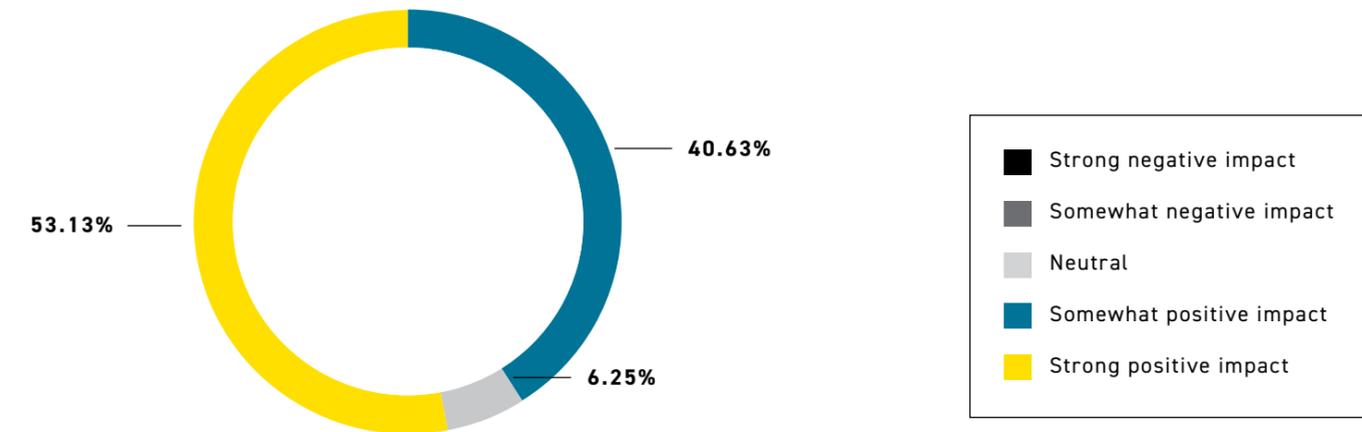
Formal Collaboration:
conference rooms, huddle rooms, quiet rooms, and the Think Tanks

Informal Collaboration:
break rooms, coffee bar area, corridors



Formal Collaboration - Satisfaction

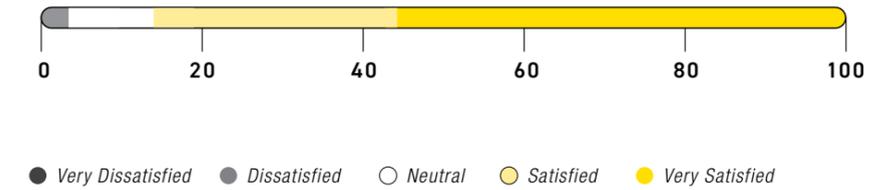
Does the building layout provide access to a variety of collaboration spaces?





Having seminar rooms and conference spaces scattered throughout the building near labs and offices works great for quick collaborative discussions. ”

COLLABORATION SPACES



“ *It can be difficult to fit a laptop and mouse on tiny desks and therefore challenging to have zoom meetings in these spaces. (study and huddle rooms)*

For someone who is neurodivergent, the color yellow is overstimulating to work in.

I like the cubicle space in the Think Tank. I feel more productive when I feel I have space to work, and my lab mates are not on top of each other.

I was very happy with the third floor conference room and technology where I taught a class. ”

Insights

- Building occupants appreciate formal collaboration spaces scattered throughout the building alongside offices and labs that allow for quick collaborative discussions.
- These spaces support a high level of cohesiveness among researchers.
- Smaller collaboration spaces such as huddle rooms are often hard to find as they are occupied.
- Huddle rooms and quiet rooms are used for both quiet work as well as virtual meetings.
- Some conference rooms have technology issues.

Formal Collaboration - Utilization

- Larger collaboration rooms have a higher utilization rate but lower seat-fill rate than smaller collaboration spaces.
- The lower seat-fill rate in conference rooms indicates that larger collaboration spaces are more often being used for smaller group meetings rather than at maximum capacity.

Average

Space type	Utilization rate	Utilization hrs/day	Seat-fill Rate
Large Conference Rooms (18-28 person)	19%	1.8	25%
Small Conference Rooms (10-12 person)	17%	1.5	27%
Huddle Rooms	5%	0.5 (≈27 min)	43%
Quiet Rooms	6%	0.5 (≈33 min)	100%
Think Tanks (12 person)	36%	3.2	23%



Timelapse Video

- Huddle rooms are seen as highly utilized by groups of 2-4 people.
- [View the video >](#)

future opportunities



Workspace Opportunities

Operational changes can help optimize use of workspaces by potentially including the following:

- Increase communication about access/reservations/availability of various workspace types and offer transparency about the private office/assigned cubicle allocation process.
- Consider re-assigning workspaces based on primary needs or another relevant allocation system.
- Add a seat reservation system for assigned workspaces when not in use for long periods of time.
- Provide seating charts (for assigned seats) to help employees locate each other.
- Be mindful that personalization of primary workspaces lends a sense of ownership to some occupants.
- Offer flexibility to remove felt panel partitions at unassigned touchdown desks for occupants that desire more workspace and/or increased visual and acoustic privacy and add PCs, if needed.
- Repurpose private offices to function as huddle rooms or small group workspaces, if required.
- Provide desk signage indicating status (in meeting, available, etc.) for open workspaces to discourage interruptions while working.
- Be cognizant of the neurodivergent needs of all users to support their health and well-being. Examples include providing quiet areas to recharge during the day.





Collaboration Space Opportunities

- Encourage use of informal collaboration spaces for individual work as well as collaborative work when huddle rooms are unavailable.
- Refurnish quiet rooms and huddle rooms with setup suitable to working with a laptop for virtual meetings that are more common post-pandemic.
- Incorporate room reservation system for huddle and quiet rooms, if not already present.
- Consider sensory experiences to accommodate the neurodiverse needs of occupants with relation to colors.
- Provide training/easy-to-understand technical manuals in conference rooms for equipment usage, keeping in mind the various user groups.
- Discourage single person conference room usage.

Executive Summary of Insights

- With hybrid work becoming more widely accepted post-pandemic, the building continues to see maximum utilization primarily for research activities and collaborations as many occupants prefer conducting heads-down work from home. The unique nature of the program, which ensures flexibility between public- and private-sector collaborations along with other PSB research groups, will also continue to affect the utilization of the building.
- Spontaneous interactions with colleagues and faculty are vital in creating an overall positive experience for PSB occupants. Incorporating social gatherings and other events on a regular basis would facilitate these much-desired interactions.
- Controlling access to areas of the building restricted to PSB residents / NC State ID holders only could help with existing security concerns while continuing to welcome the community into the PSB's public spaces.
- Considering that an estimated 15-20 percent of the world's population exhibits some form of neurodivergence, incorporating spaces that respond to the various workstyles, sensory considerations, and circadian needs of the human body and mind would support a more inclusive and diverse group of people.



innovation & analytics

Our multidisciplinary innovation and analytics team leverages leading-edge and novel technology, predictive tools, applied research, and data science to explore, test, and implement enhanced design solutions that help our clients do what they do best. This integrated team brings together architects, researchers,

data analysts, industrial engineers, computer scientists, developers, and computational designers to collaborate on innovative, sustainable, and client-centric outcomes.

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