



R + B

RESEARCH AND BENCHMARKING



HOW BUILDINGS SHAPE US

Insights and ideas on how buildings, and designs for them, can support and improve our lives



Why we do Research and Benchmarking

BY LAURA FLANNERY SACHTLEBEN

Laura is the Global Education and S&T Leader at Stantec, and also leads the Stantec R+B Program.

At its core, Research + Benchmarking (R+B) at Stantec acknowledges that our expertise is not static, it's dynamic. To remain experts in our fields (architecture, planning, interior design, engineering) we must engage in a culture of learning to continually seek new information and ways to make our approach and our projects better. The more informed we are, the better outcomes we can provide for our clients and the people that use the environments we design. Knowledge is power to do good.

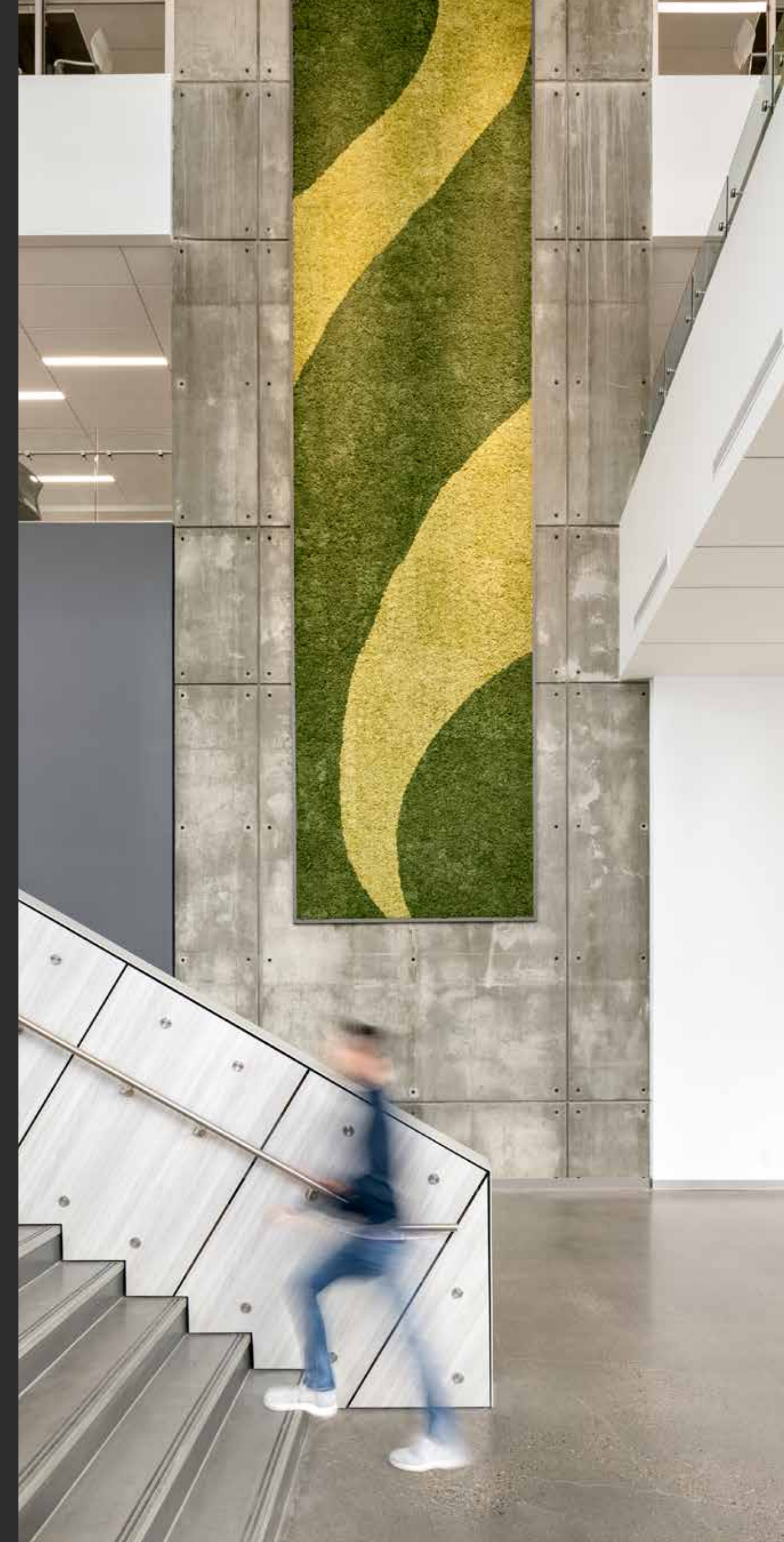
R+B is a conduit for our application of evidence-based design. We want to make informed decisions, so it makes sense for us to analyze what our teams and others have done in the past in order to gather data and identify emerging trends. We use the data to either validate our design decisions or as confirmation that we should move in a different direction to create better solutions. Our analysis and lessons learned from our previous design informs our future work.

R+B is also a professional development tool that helps our team members build their expertise. The knowledge gained from R+B doesn't come free or quickly; it requires the investment of time and money. But, ultimately it helps us deliver better design to better serve you.

This publication celebrates and showcases the research and findings of our R+B group at Stantec Buildings. Through it our dedicated team members share more about the design solutions we've realized and what we've learned from them. By continuously learning to better our offerings and solutions, we aspire to find new opportunities for innovation and to better ourselves and the work we do for our clients. With this publication we intend to thoughtfully highlight our culture of learning.

Edmonton, AB

Students' Association of MacEwan University Building (SAMU)



IN THIS ISSUE

HOW BUILDINGS SHAPE US

As designers, we take responsibility for how buildings impact lives. Doing better and making sure the buildings we design support and improve human life is a constant driving factor behind our research and our work. From finding links between learning spaces and student engagement to understanding library trends, benefits of biophilic design, and improving indoor air quality, we trust our research insights will showcase the many ways our buildings shape us.



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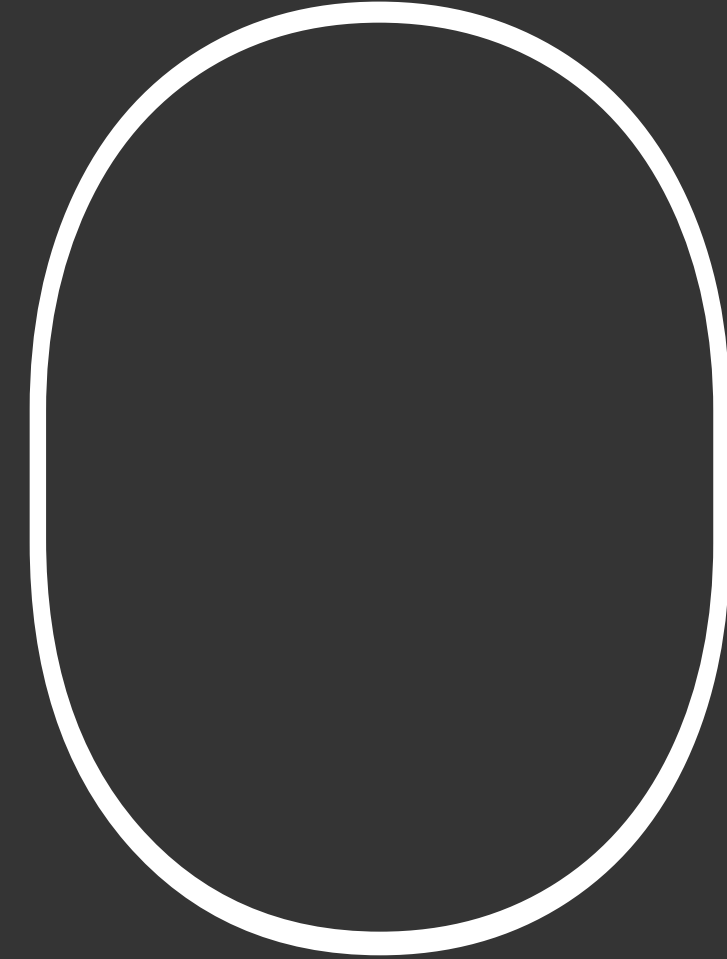
BY ZACHARY VAUGHN AND EZRA RENDALL



NATURAL CONNECTIONS

Reducing student stress through biophilic design

BY ALAYNA SKORGE AND SHIVANI LANGER



ur buildings have a long-lasting impact on the experiences of the people that use them. In the age of school violence and now with COVID-19, students are experiencing added mental stress. Biophilic design can help reduce that stress and promote physical and mental well-being.

Learning environments have a role to play in reducing stress and promoting physical and mental well-being in students. With the experience of the COVID-19 pandemic in mind, however, we have a new reason to look at the ways we can incorporate biophilic design features in educational facilities. >

Stress increasing

The pandemic has overturned a sense of normalcy for students while months of stay-at-home orders and remote learning have reduced their ability to access the all-important social connections to friends, educators and mentors.

Many students returning to in-person instruction are experiencing higher than normal stress levels. Face coverings are a requirement, communication happens through shields, and no physical contact is allowed. Faculty and administrative staff are also experiencing high levels of stress. While they are trying to ensure the safety of their students, some fear bringing infection back to their families.

Stress is a natural human response that helps humans survive, but unmitigated stress can be harmful both to our mental health and our immune system. Dr. Esther Sternberg, professor of Medicine in the University of Arizona College of Medicine, has done an extensive amount of research on the link between the central nervous system and the immune system. Dr. Sternberg's research, documented in her book, *"The Balance Within-The Science Connecting Health & Emotions,"* shows how stress weakens the immune system. Globally, health officials are emphasizing the need to increase immune systems to be better prepared for COVID-19, and reducing mental stress is a step forward in that direction. ▶

San Antonio, TX

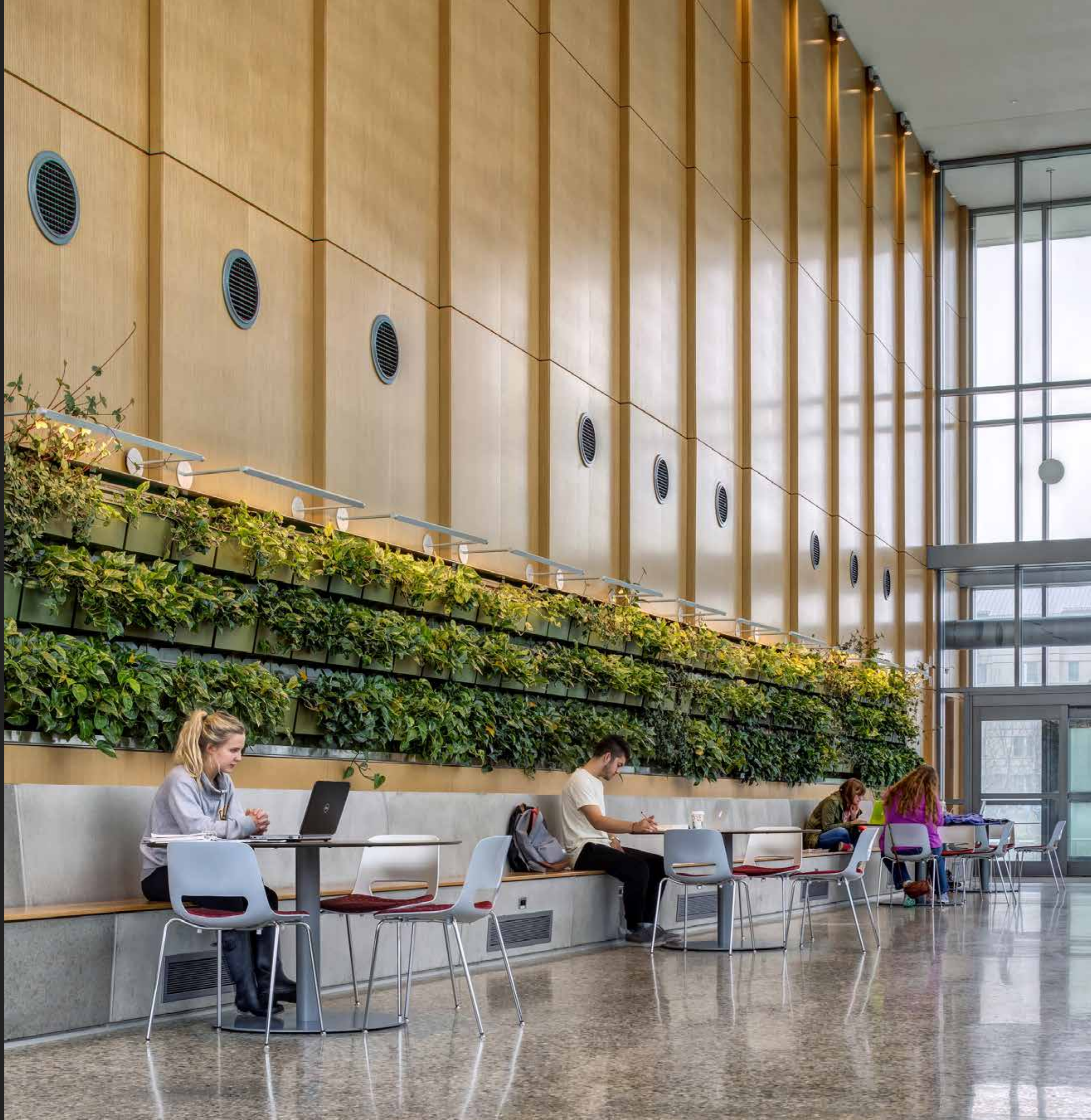
Sheldon Lake Elementary School



Lock-down conditions are negatively impacting students' mental health. In **one study** out of China, published in JAMA Pediatrics, researchers in Hubei province, where the pandemic originated, examined a sample group of 2,330 school-aged children for signs of emotional distress.

The kids had been locked down for a relatively short period—an average of 33.7 days. Even after that single month, **22.6% of the children reported depressive symptoms** and 18.9% were experiencing anxiety.





Biophilic design

How can we design to mitigate stress during this time of elevated strain? Biophilic design offers great opportunities. Studies have shown that being in nature, or even viewing scenes of nature, reduces fear and stress in humans. That's evidence for the theory of biophilia, that humans have an affinity for natural images and settings and have a physiological need to be around life and life-like processes. We can incorporate biophilia in building design to increase occupant connectivity to the natural environment. Exposure to nature not only makes one feel better emotionally, research shows that it also reduces the production of stress hormones.

Biophilia is gaining acceptance in the design industry. The [WELL building standard](#) certifies built environments that support human health and well-being. WELL has included biophilic design as part of one of the pre-conditions for achieving certification. It requires designers to provide a narrative of how they have incorporated nature in their designs. WELL also rewards designs that distribute biophilic elements across a project and incorporate all necessary types of biophilic design components. >

A look into how we incorporated biophilia at Thornton Elementary School



ACCESSING NATURE

Outdoor play areas include natural play structures while eco-gardens, rainwater collection systems, and solar panels offer learning opportunities.



NATURE IN THE SPACE

Spaces are designed to bring in natural light, and nature-themed wayfinding graphics give students a connection to the environment even while indoors.



NATURE ANALOGUES

Flooring patterns represent natural elements, like water or moss.



NATURE OF THE SPACE

Color selections, including shades of blues, greens, and browns, mimic nature.

Implementing biophilia to reduce stress

Designers can incorporate biophilia in a variety of ways. Here are four types of biophilic design that can mitigate the stress of returning to learning environments.

1

Accessing nature

The quickest and best way to tap into biophilia is to create direct access to nature. When all our senses interact with nature simultaneously, it helps lower our blood pressure and stress while improving mental awareness. Examples include:

- Outdoor spaces, playground areas, and fields
- Natural play structures instead of pre-manufactured ones
- A secure exterior balcony, roof patio, or roof garden
- Eco gardens that double as learning opportunities—students can maintain the garden which gives them an opportunity to learn about growing plants, community gardens, and local food production
- Sundials offer learning opportunities about time, climate, solar path, shadows, and more.
- Rainwater collection systems and rain gardens can be used to teach conservation and resource use.

2

Nature in the space

Providing physical and metaphysical elements of nature in an interior space is the next best and most economical way we can give students a connection to the environment. We can easily implement most of these approaches in existing learning environments to promote wellness.

- A plant wall is a great solution for existing buildings.
- Window seats and areas of refuge with views to nature, such as layered planting, natural water features, and winding paths rather than football fields, campus lawns, and parking lots.
- Natural light
- Water views and sound
- Connections to animals >

3

Natural analogues

Natural analogues are representations of nature—patterns, colors, textures, geometries—which can include natural building materials such as wood and stone. Users can touch and engage with these analogues, activating human senses, as they would in nature. Natural analogues might include:

- Creating patterns with color or textures that mimic the unevenness of the ground or other natural visuals. This can be done with carpet tile, for example.
- Using natural building materials such as wood, stone, bark, etc.
- Providing places of refuge like built-in reading nooks and similar places that appeal to our innate desire to find cave-like shelter for safety and security.
- Creating spatial hierarchies in spaces or furniture to mimic the hierarchy in the natural environment just like we see in plants, from bushes to large trees.

4

Nature of the space

Furniture and finishes can mimic properties of natural elements without the expense of a garden or outdoor learning space. How can they work?

- Provide furniture with natural shapes and lay it out in forms to mimic the irregularity that nature creates.
- Incorporate color that can evoke emotion and mimic colors found in nature. For example, blue for calming, yellow for happiness, or brown to mimic a tree trunk.
- Provide organized complexity in a project by incorporating flexible, adaptable spaces and furniture.

As demonstrated, there are many ways we can incorporate biophilic design in both new and existing buildings. We know that making a connection to nature results in benefits to mental and physical well-being of students and staff. If we can go the extra mile and regularly incorporate biophilic concepts and natural elements in our designs, we can enhance our educational spaces to help reduce stress and improve well-being within our learning communities. [®]



Austin, TX

Doss Elementary School



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LEARN MORE ABOUT OUR BIOPHILIC DESIGN RESEARCH.

A sustainability leader and principal, **Shivani Langer** is a LEED and WELL Accredited architect. **Alayna Skorge** is an architectural designer focusing on sustainable educational facilities.



Charles Library at
Temple University
Philadelphia, PA
Stantec / Snøhetta

Turn of the page

TEN FACTORS

SHAPING TODAY'S

LIBRARIES

BY SAMANTHA
SZESZULSKI AND
LENDI STURDIVANT,
DAVID ROSE AND
PATRICK CALHOUN,
CONTRIBUTORS.

Libraries play a crucial role in shaping the intellectual development of patrons; however, as library offerings continue to grow and evolve beyond the traditional towards more community- and service-focused approaches, the extent of their impact is growing as well. Libraries are becoming even more invaluable in the contributions they make to shaping the social, emotional, and intellectual welfare of communities.

To identify best practices and trends in libraries, we interviewed library experts across the country with a focus on those within higher education. From this research we identified the top ten factors these experts are focused on today.



The results of our research are grouped into three major categories:

- **Big picture** themes influence all aspects of what libraries seek to offer users.
- **Collections-related** factors focus on provisions in materials and space.
- **Service and experiential** factors describe how library spaces are perceived and experienced by their communities.

01 DIVERSITY & INCLUSION

As library spaces are created or updated, librarians are turning to universal design principles to address the needs of all users. By intentionally prioritizing and serving minority populations—recognizing and responding to variations in abilities, race and socioeconomic status—libraries can fulfill the needs of more potential users and provide an inclusive space for all. For example, the “quality of life” rooms that a library provides as a space for nursing mothers may also serve as prayer or meditation rooms, and quiet rooms for those suffering from anxiety or migraines. This prioritization may include adjustments to both physical space and library operations. By implementing aesthetics that welcome all cultures, these library designs improve physical inclusivity and create inviting spaces that balance independence and privacy with community and togetherness.



02 POSITIONING INWARD VS OUTWARD

Higher education libraries are challenged to balance their role within the institution and within the context of the larger community. Inwardly, they aim to increase the value proposition for enrolled students. The library supports cross-collaboration between programs and colleges and between students and faculty. Outwardly, libraries serve as the point of intersection between surrounding community members and the institution as events, services, resources, and exhibits are more frequently promoted to local neighbors and businesses. ➤



PROMOTING SELF-SERVICE AND PERSONALIZED SERVICE MODELS CAN REDUCE LIBRARY ANXIETY, PARTICULARLY FOR INEXPERIENCED USERS.

03 PUBLISHING, RESEARCH & DIGITAL SCHOLARSHIP

Academic libraries support the needs of faculty and students in scholarly research, traditional publishing, and self-publishing, but are challenged with spreading the word about their services. Until the opening of Hunt Library in 2013, North Carolina State University (NCSU) found online resources were in high demand, but in-person library visits were low. NCSU now provides more spaces dedicated to supporting research and publishing services and have increased their focus on the lifecycle of scholarship, including access to shared scholarly resources between institutions.

04 DATA COLLECTION, STORAGE AND USE

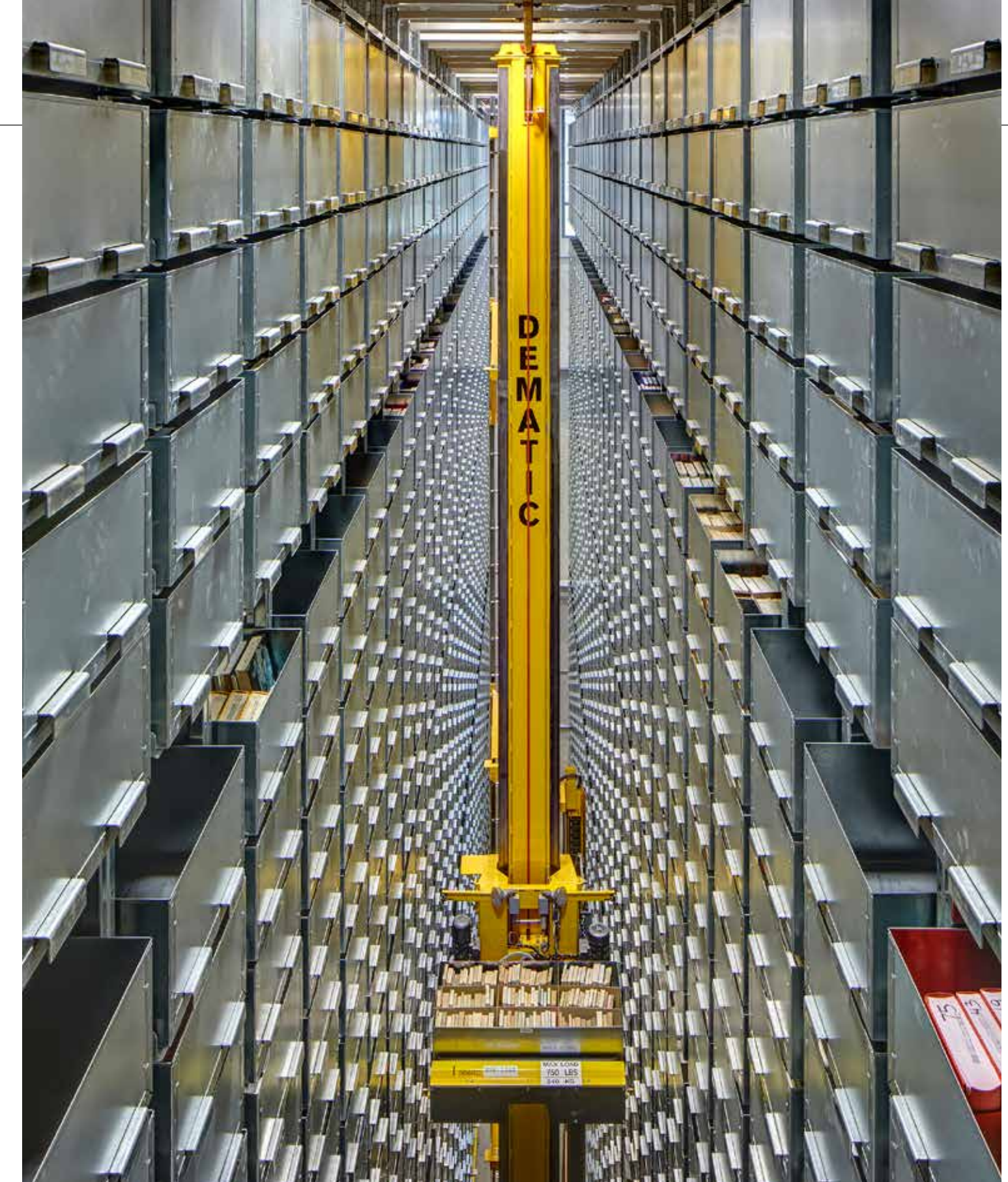
Today's technology allows libraries to collect ambient data continuously. This data helps library systems determine how to better serve their users, from curating offerings to identifying which materials are frequently accessed. However, it also creates issues of privacy surrounding the storage and use of data sets. As custodians of this data, librarians face the challenge of determining what is appropriate to store and use.

05 BALANCING FLOORSPACE

Floorspace is in great demand at libraries. Libraries must balance providing space for user activity with the space traditionally required for housing collections. Many must strategically purge their materials to reduce stacks and increase study and collaboration areas. Facing this challenge, the University of Michigan prioritized natural light for study space, pushing study spaces to the perimeter while centrally locating collections. Others have implemented automated storage and retrieval systems or off-site storage to maintain their collections and open floor space for users. To be useful, however, collections must remain convenient to access.

06 BALANCING INVESTMENT

By offering digital and electronic resources, libraries are changing how their collections are accessed. Digital collections can be retrieved remotely and simultaneously by multiple users, providing a greater return on investment. However, offering collections digitally creates equity concerns related to technology availability. Libraries must augment digital access with robust programs for device lending and digital literacy to truly increase access. Furthermore, open access resources bring hurdles in defining the extent of the library's collection. ➤



THE BOOKBOT AT GRAND VALLEY STATE UNIVERSITY'S MARY IDEMA PEW LIBRARY LEARNING & INFORMATION COMMONS FREES UP SPACE THROUGH THE LIBRARY FOR STUDENTS AND USERS TO COLLABORATE IN NEW WAYS.

07 COMMUNITY-FACING RESOURCES AND SERVICES

Increasingly, libraries serve as quality-of-life resources for their communities. Going beyond traditional library services, they support well-being and mindfulness by providing virtual and physical spaces for meetings, programs, and resources for individuals, businesses, and non-profits. Libraries elevate their community members' voices by archiving stories and history from their own perspectives; some provide "one-button studios" for video recording. Many provide services and spaces to support early literacy, technology, training, and continuing education. Successful libraries aspire to respond to the changing needs of the communities they serve.

08 FOCUS ON THE SERVICE EXPERIENCE

Librarians are focusing on both the in-person and virtual service experiences. A robust service mentality around creating seamless experiences means rethinking where and how patrons look for information. Libraries are finding that promoting self-service and personalized service models can reduce library anxiety, particularly for inexperienced users. Institutions like the University of Michigan approach service by focusing on the whole student. Beyond offering academic support, the Michigan library addresses the larger context of student development and transition to adulthood with programs on research and visual and digital literacy. University of Michigan's librarians approach user experience holistically by considering a full day of library use. ➤



Grand Valley State University - Mary Idema Pew Library Learning & Information Commons
Allendale, MI



COVID-19 has demonstrated the value of outdoor spaces to the future of libraries, much like this flexible outdoor space at Grand Valley State University's library.

09 SPACES FOR EXPERIMENT

Before they implement across their facilities, university library departments are experimenting at the small scale with the library environment design and addressing underutilized spaces. Greg Raschke, Director of Libraries at NCSU, explained how the team prioritized “getting the recipe right.” They recognize the Hunt Library’s need to be ever-changing, acknowledging that at any time 90% of the building may work perfectly, while 10% could be improved. To identify the right spaces, librarians increasingly recognize the value of design tools and processes. Library vendor and supplier partnerships present often overlooked opportunities for experimentation.

10 THE IMPACT OF COVID-19

COVID-19 has made designers and librarians look at how future pandemics or widespread emergencies can impact the library experience in both the short- and long-terms. Initial responses in our research recognize the importance of remote user experiences and the significance of digital resources during the pandemic. As spaces are reoccupied, libraries are planning to adapt to distanced in-person services and seating. And they are making building and mechanical system modifications to address air quality. Ultimately, success in the post-pandemic world for libraries will be measured by the ability to apply lessons learned from the short-term towards a sustainable approach for healthy and effective library experiences. For now, we expect healthy building systems, remote user experiences, and flexible indoor/outdoor spaces will be top priorities for libraries and library design. [®]

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LEARN MORE ABOUT OUR LIBRARY RESEARCH.

Samantha Szeszulski is an architect and planner leading Stantec's Libraries & Learning Commons R+B group. Based in Plano, TX, **Lenda Sturdivant** is a Senior Interior Designer with 13 years of experience in libraries and educational facilities design.



DID YOU KNOW?

Student engagement is a reliable indicator of student success.


Where students learn

Studying the link between space, academic performance, and student engagement

BY DIEGO BARRERA



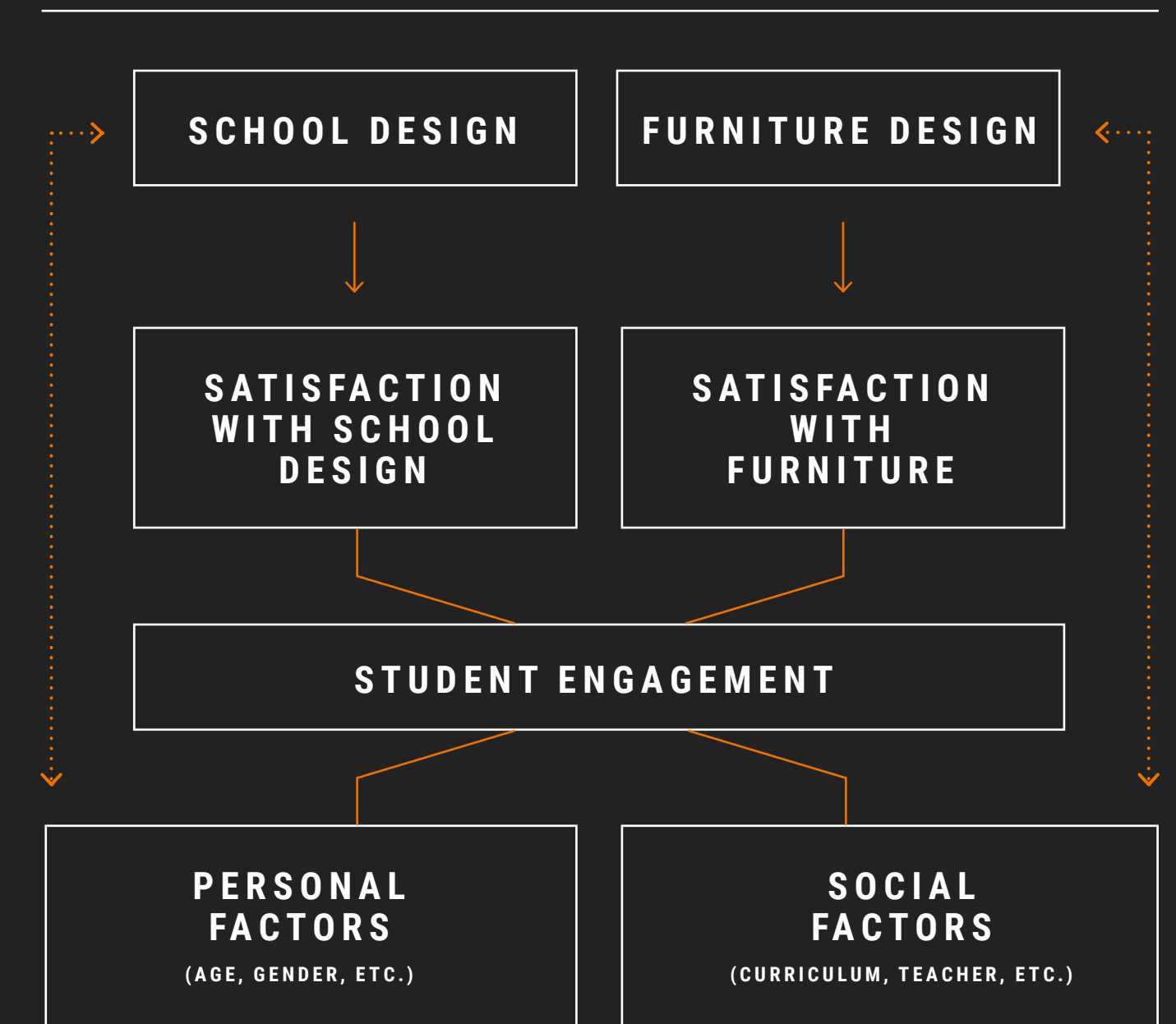



Shadow Creek High School
 Pearland, TX

One lesson we have learned from the pandemic is that most students learn better in person. Schools are important settings where students have valuable social interactions that are fundamental to their development. The spaces they inhabit shape their experiences and help (or hinder) their social and educational successes. Young children don't only learn in these environments, but they also develop their social emotional skills and build important relationships.

But have we designed schools to optimize learning? We must understand the effectiveness of the spaces we create for our students to ensure that our facilities are providing the right environments for students to succeed. How do we know what's working and what isn't? We need to gather data from the students to evaluate school design and validate our ideas about what makes an engaging learning environment day-to-day. So, we created a survey instrument with embedded mapping tools—to get that data directly from the source, the students. >

SCHOOL SURVEY



Our research surveyed student satisfaction, engagement, and performance and includes multiple factors, demonstrated in this model, influencing engagement.

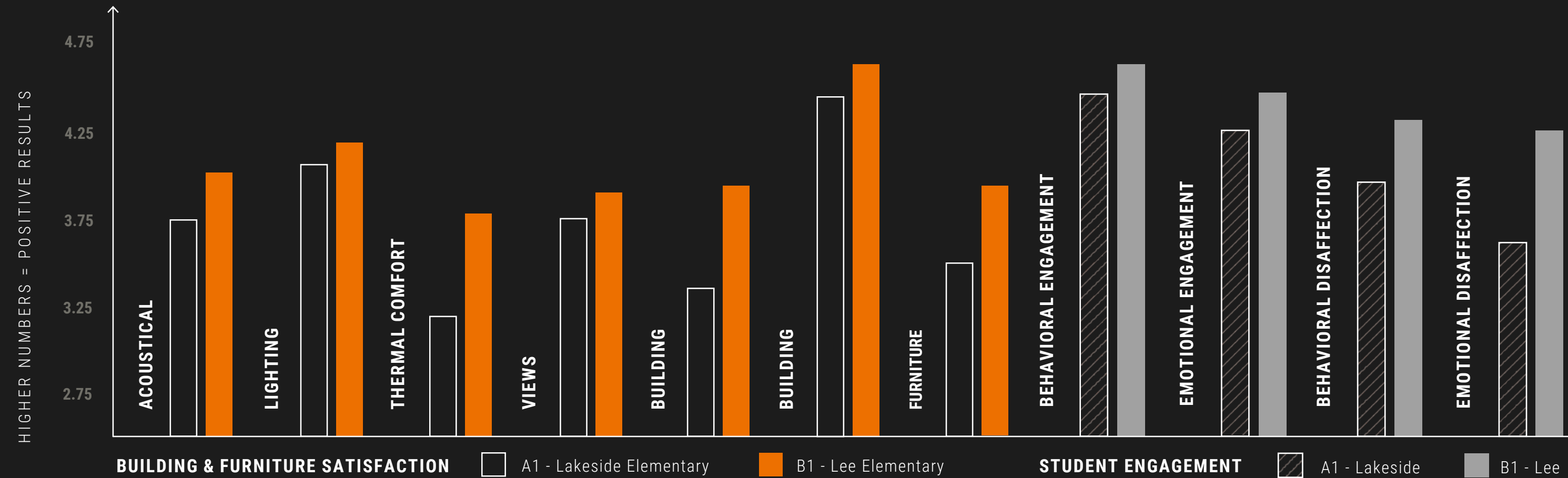
Surveying satisfaction, engagement, and performance

In 2014, Stantec’s Innovative Learning Environment (ILE) Research + Benchmarking (R+B) Team began working on a series of elementary school, middle school, and high school research projects to examine the relationship between innovative school design, student satisfaction, engagement in learning, as well as academic performance. As part of this effort, we developed a survey instrument with embedded mapping tools to ultimately build a database of school design and research projects (with consistent measurement metrics) which would allow us to share our findings of successful design solutions.

The study is intended to help both designers and school administrators better assess the impact of school design on student learning. It examines the following questions:

- How do students use different spaces for diverse learning activities within the school?
- How do these spaces meet students’ needs for learning?
- How engaged are the students in the learning process?
- What impact do physical learning environments have on students’ engagement and performance in learning, while accounting for the roles of personal and social factors? ➤

Our first study compared student engagement within two high performing schools, one new and one old, with a project-based learning curriculum. Our survey tools helped us discover meaningful connections between higher levels of satisfaction with the building and furniture and higher levels of student engagement.





Richard J. Lee
Elementary School
Coppell, TX

Our first study, published in 2016, was a comparison of Richard J. Lee Elementary School, the first Net Zero Energy elementary school in Texas, and of Lakeside Elementary, which opened in the district in 1986. Lee Elementary School is innovative in many ways beyond its sustainable features. Both Lee and Lakeside are high performing schools with a project-based learning curriculum. The similarities from these two schools provided our researchers with an opportunity to conduct a “natural experiment” to examine the impacts of collaborative learning spaces and furniture on user satisfaction and student engagement in the learning process. Even in its early stages, our survey instrument helped us discover meaningful connections between higher levels of satisfaction with the building and furniture and higher levels of student engagement. [Read more about our innovative school design study at *stantec.com*.](https://www.stantec.com/resources/articles/innovative-school-design-study)

In 2018, we launched a more robust version of our survey instrument with the aim of understanding what specifically about the design was promoting higher levels of satisfaction among users, leading to higher student engagement. Our updated survey tool includes the ability for students to map where they like to do focus work, or collaborate, present, and more. It also captures how well these spaces serve those needs. >




2020 study

Our current study includes three schools: [Shadow Creek High School](#), an award-winning school with an innovative design, and Hughes Middle School and Kerr Middle School, both older traditional schools at the time of our study that have now been completely renovated as innovative learning environments. The first set of survey data was collected before Hughes and Kerr were renovated. Early results show us that Shadow Creek High School (with the new building) significantly outperformed the old buildings of two middle schools in most of the items related to satisfaction with school environments. The greatest difference we observed in the data was related to perceptions of views, common work/collaboration spaces, and the overall school building. For Shadow Creek High School, respondents rated visual openness and preference of views an average of 1.30 and 0.94 points higher, respectively ($p < 0.001$) on a five-point scale as compared with the combined sample from two middle schools; satisfaction with common work/collaboration spaces was 1.01 higher on a five-point scale.

2021

We are continuing this research with a follow-up survey and additional research activities (i.e., gap analysis and activity mapping) planned for 2021. The follow-up survey will capture the evaluation of the renovated Hughes and Kerr Middle Schools, giving us a valuable pre- to post-renovation comparison. The results from the 2018 survey demonstrate the significant impacts of physical learning environments on student learning and the advantages of innovative design solutions as compared to those of the older traditional school facilities.

For us, better data means better designs for students and learning communities. With the post-intervention data we plan to collect in 2021 we can further examine the actual impacts of environmental interventions on student engagement and academic performance. This data will help designers and school leaders create schools that truly and accurately serve student needs and preferences. The better we can understand how students use their schools and its spaces, the better we can craft the spaces that truly engage and inspire them. 

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LEARN MORE ABOUT OUR INNOVATIVE LEARNING ENVIRONMENTS GROUP.

Diego Barrera is a Principal focused on design with more than a decade of experience in educational facilities. He leads Stantec's Innovative Learning Environments R+B group.



Shadow Creek High School
Pearland, TX

CHEMICALS

CO²

ALLERGENS

DANDER

VIRUSES

DUST MITES

VOCs

A breath of *fresh?* air

A new focus on achieving quality indoor air

BY ZACHARY VAUGHN AND EZRA RENDALL



More than 30 years ago, the United States Environmental Protection Agency (EPA) issued a [report](#) to Congress on indoor air quality stating that "Americans, on average, spend approximately 90 percent of their time indoors." A noble truth no doubt, but one that hides a weighty, personal realization for those of us involved in building design. We create the boxes that people occupy and determine the conditions they experience. We choose the light they see, the surfaces they touch, and even the very air they breathe. And in schools, [research](#) has shown environmental factors like indoor air quality (IAQ), directly affect our students' health and performance. It's this IAQ that we bring forward, to establish its powerful impact and explore the options available to us as designers.

Let's talk about air

The EPA [estimates](#) that the indoor concentration of some air pollutants is two-to-five times higher than the typical concentrations we find outdoors. Building envelope degradation can lead to moisture and mold growth. Improper or low ventilation rates can lead to higher levels of carbon dioxide and low outdoor air supply. Construction materials can off-gas over time and leak volatile chemicals into the breathing zone. These allergens, dust, microorganisms, volatile organic compounds (VOCs), and more are suspended in the air in what is collectively called the IAQ.

Air is bad for me?

Students and teachers are exposed to this captured air for roughly more than six hours a day, 180 days a year. This significant exposure has prompted numerous studies into the impacts of a building's IAQ. A growing body of research, including ["A Preliminary Study on the Association Between Ventilation Rates in Classrooms and Student Performance"](#), for instance, shows the correlation between poor IAQ, illness, absence, and reduced performance in students and teachers.



These studies indicate that if you improve the quality of air supplied to the occupants, performance indicators like test scores and retention will subsequently increase.

Additional studies, for example ["The Effects of Outdoor Air Supply Rate in an Office on Perceived Air Quality, Sick Building Syndrome \(SBS\) Symptoms and Productivity"](#), show that schools and office buildings with higher ventilation rates and better IAQ report lower rates of

respiratory illnesses; a notable finding in the light of our current pandemic. The strongest tool we have to tackle this IAQ problem is the heating, ventilation, and air conditioning (HVAC) systems of our buildings.

How we can breathe better

There are four main pillars for treating particulates and pollutants in the airstream: dilution, deactivation, distribution, and filtration. ➤

Dilution

Dilution, also known as ventilation, is the primary method listed utilized in ASHRAE Standard 62.1 – Ventilation for Acceptable IAQ. As you recirculate and condition the room's air, you exhaust a fraction of it to be replaced with fresh outdoor air. Over time, this fraction of outdoor air supplied dilutes the room's stagnant air filled with exhaled and off-gassed pollutants and replaces it with fresh air. Engineers quantify how quickly a room is replaced entirely with outdoor air as air-changes-per-hour (ACH).

Deactivation

Deactivation is the treatment of an airstream through the use of active devices and chemical reactions. An example of this system would be Ultraviolet Germicidal Irradiation (UVGI), which utilizes a specific wavelength of UV light to disrupt the DNA of microorganisms in the airstream and on surfaces. If designed properly it will disable their ability to reproduce, rendering them harmless. Another system is called Bipolar Ionization, which produces and utilizes ions to neutralize pathogens, odors, and VOCs. These ions can increase airborne particle size for better filtration, inhibit pathogens' ability to reproduce, and oxidize odors and VOCs. These deactivation methods are typically used as a solution to a specific concern, rather than a whole-air solution.

Distribution

Distribution of the airstream can have a notable impact on the occupant's exposure to airborne pollutants. Utilizing the fundamentals of fluid dynamics, HVAC systems can be designed to create specific airflow patterns that minimize pollutant exposure and isolate contaminant sources. Displacement ventilation is such a system. Low velocity air is supplied through diffusers located near the floor and extracted

through grilles located above the occupied zone, typically the ceiling. This creates a linear air path for exhaled and off-gassed pollutants, bringing these pollutants straight to the ceiling. This vertical airflow allows pollutants to collect above the breathing zone and return to the HVAC unit for processing, preventing mixing in the space and cross contamination of occupants.

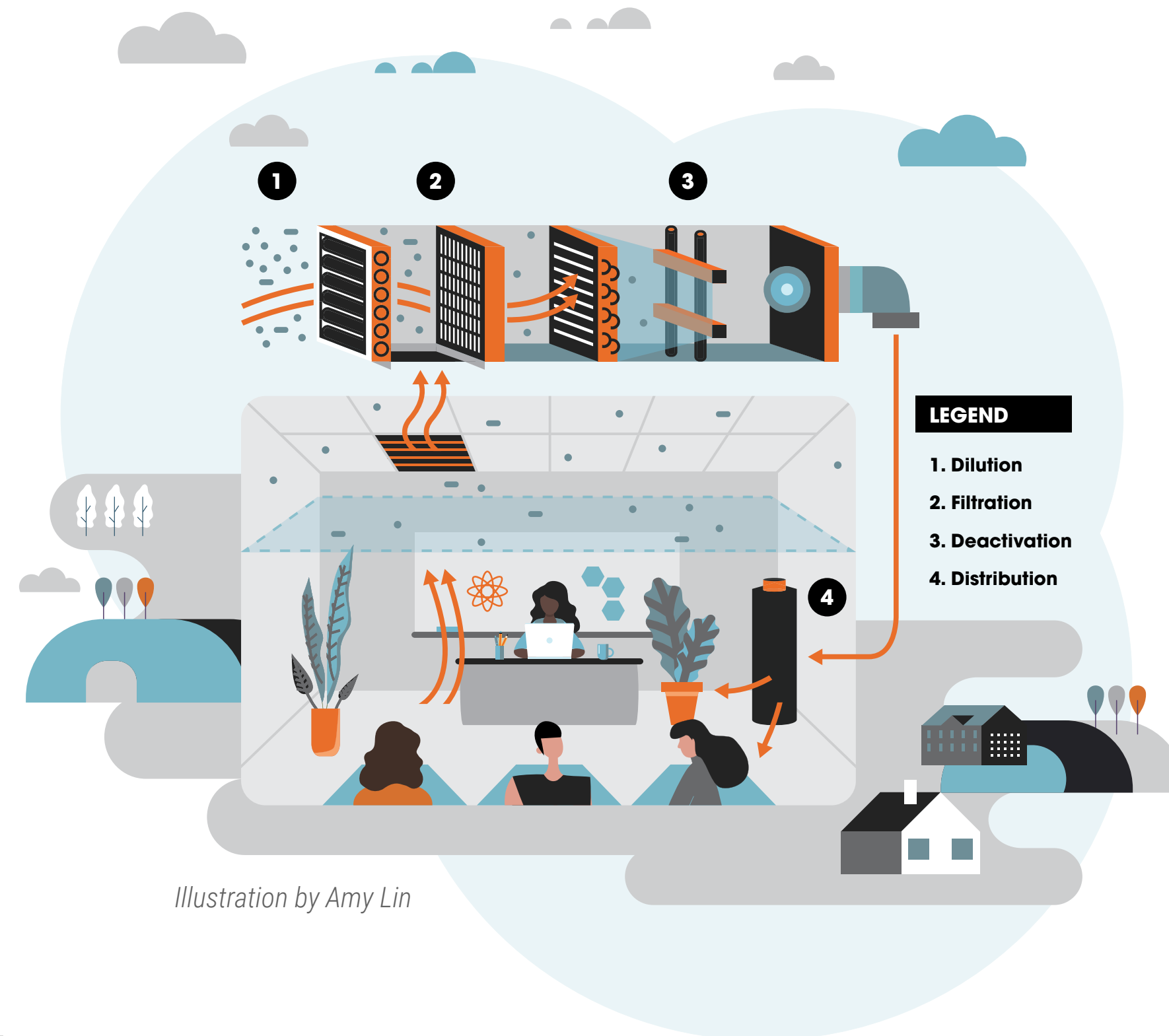


Illustration by Amy Lin

Filtration

Filtration is a universal strategy for improving IAQ and is rightly codified in every international building code and standard. Rather than deactivating the airborne pollutants, filtration focuses on removing the particles from the airstream entirely. Depending on its rating, a filter can effectively trap particles of varying sizes, from dust and dander to viruses and smoke. In reality, the particles trapped in the filter are only truly removed from the airstream when the filter is replaced with a new one.

Maintenance is not simply a pillar of high IAQ, but the foundation to it. No system or strategy can effectively address IAQ concerns unless it is coupled with a regimented maintenance plan. Without diligent maintenance, systems fall into disarray, filters remain loaded and ineffective, and microorganisms build up in the coils and ductwork. Unreliable maintenance and poor IAQ strategies lead to many of the air quality concerns we see in today's buildings.

But wait, there's more

It is important to note before we sail off into the sunset, that none of these strategies are the Holy Grail of IAQ; each of these methods has its drawbacks and gaps in effectiveness. Dilution operates on the assumption that the outdoor air is clean; a nearby manufacturing facility could result in pumping additional

WHAT'S IN THE AIR?

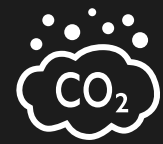
Common indoor air pollutants



DANDER



SMOKE



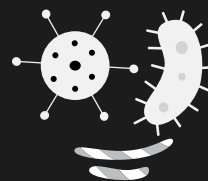
CO₂



VOCs



DUST



VIRUSES &
BACTERIA



DUST MITES



POLLEN



CHEMICALS

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MORE ON
BUILDINGS
ENGINEERING

Zachary Vaughn is an EIT seeking to improve communities through the applications of engineering and research. A mechanical engineer and LEED AP, **Ezra Rendall** works closely with teams to develop sustainable building system concepts.



Sandy Spring Friends School in Maryland, MD is seeking certification under the WELL Building pilot program for educational facilities to ensure a healthy, peaceful, and beautiful facility for all occupants.

pollutants in our building. As [research](#) indicates, higher ventilation rates require a discussion of cost and energy usage. Deactivation strategies like UVGI treat only pathogens but neglect dust and other particulates. Newer technologies like bipolar ionization create their own “magic particles” that may neutralize pollutants but could create unstudied reactions with currently unknown long-term effects. Distribution strategies, while fairly resilient and maintenance-free, do require buy-in from both owner and architect as it often requires changes to room layouts and wall sizes. Finally, filtration is maintenance dependent and can require a sizeable annual budget for filters depending on their rating; healthy, effective filters are not cheap.

Breathing life into our buildings

For years energy conservation certifications like LEED were at the forefront of building design; the health of the occupant played second fiddle to the health of the environment. With advances in green technologies and energy conservation codes, now indoor environmental quality is taking priority in certifications like the [WELL Building Standard](#). Research has documented the importance of IAQ, now designers need to step up and achieve it. No single solution does it all; no single individual can fix it all. A committed owner, a knowledgeable design team, and an educated maintenance staff together create a better breathing building. [®]



RESEARCH AND BENCHMARKING

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