Improving indoor air quality boosts productivity

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High performance buildings (HPB) are designed to enhance indoor air quality (IAQ), in order to optimize energy usage and protect the environment. An increasing number of new construction and renovation projects incorporate an integrated process in an effort to achieve these goals. But there are still challenges to overcome. One is the perception that these facilities are costly, with limited results.

IAQ research in the last 20 years has produced enough technical data to convincingly demonstrate that enhanced IAQ, thermal and visual comfort, some of the factors that impact productivity, can not only realize a net productivity gain for occupants of HPBs – but also generate a return on investment beyond the obvious energy and water savings.

Indoor Air Quality and Thermal Comfort

We spend more than 90% of our time in indoor environments — either at home or work, in shopping centers or in our vehicles — a pattern that negatively impacts our health and productivity.

In a survey of 100 U.S. office buildings, 23% of office workers experienced frequent symptoms of Sick Building Syndrome (SBS), such as respiratory ailments, allergies and asthma. The economic impact in terms of sick days, lower productivity and medical costs is enormous, with an estimated 2% decrease in productivity nationwide, resulting in an annual cost to this nation of approximately $60 billion.

A researcher at California's Lawrence Berkeley National Laboratory, in one of the early efforts to relate IAQ affects to health and productivity, established a baseline for quantifying benefits from improved IAQ and demonstrated that improvements in IAQ can:

• Reduce SBS symptoms by 20-50%, saving an estimated $10 to $100 billion

• Reduce asthma alone by 8-25%, saving an estimated $1 to $4 billion

• Reduce other respiratory illnesses by 23-76%, saving an estimated $6 to $14 billion

• Improve office worker productivity by 0.5-5%, saving an estimated $20 to $200 billion

A recent study by the International Center for Indoor Environment and Energy (ICIEE) in Denmark demonstrated that improved thermal comfort, reduction in indoor pollutants, and enhanced ventilation rates and effectiveness can increase productivity by 5-10%. Conversely, the research indicates that a 10% decrease in tenant satisfaction with IAQ results in a 1% drop in productivity. Three separate studies documented an increase of productivity at 5% or more through IAQ improvements.

Indoor Temperatures Alone Affect Performance

To estimate cost effectiveness based on improved indoor environment, a researcher at Finland's Helsinki University of Technology developed a conceptual model that demonstrates a decrease in performance by 2% for each degree increase of space temperature ranging between 77˚F and 89.4˚F. Optimal productivity performance was found to occur at a space temperature of 72˚F.

Two other studies support these findings. Studying office spaces with moderately high temperatures –Japanese law mandates that office building thermostats be set at 28˚C (83.4˚F) in the summertime–aa professor at Japan's Waseda University demonstrated that productivity dropped by 2.1% when the average indoor air temperature increased by 1˚C (1.8˚F), and that individual air velocity control reduced the perception of workers' mental fatigue.

According to a recent study by Cornell University, office temperatures that were too low also had a negative impact on productivity. The report stated, "Chilly workers not only make more errors, but cooler space temperature could increase the hourly labor cost by 10%."

Visual Comfort and Views

Studies have also demonstrated the positive impact of natural light on performance. Lawrence Berkeley National Laboratory completed several studies on the effect of daylight on student performance. A study at a San Juan Capistrano, Calif. school demonstrated that students with the most daylight in their classrooms progressed 20% faster on math comprehension and 26% faster on reading comprehension tests in one year, compared with those with minimal exposure to natural light. Similarly, students in classrooms with the largest window surface areas progressed 15% faster in math and 23% faster in reading than those in classrooms with minimal window surface areas. Students in a space with a well-designed skylight improved 20% faster than students without a skylight.

A Rocky Mountains Institute report relating "green" or sustainable buildings to human productivity reviewed eight case studies, two of them with remarkable results. The first concerned a new Wal-Mart, in Lawrence, Kan., designed to harvest optimal daylight through skylights installed on half of the roof. According to Wal-Mart, the sales per square foot located within the departments with access to natural light are significantly higher compared with sales in departments located under the conventional roof. Sales were also higher than in identical departments in other stores without access to skylights. In fact, Wal-Mart employees prefer to work in the departments with daylight.

In the new Lockheed Building 157 in Sunnyvale, Calif., several daylight strategies were used to enhance visual comfort — and they reduced Lockheed's artificial lighting cost by 75%. With daylight generating less heat than artificial lighting, space cooling loads have also been reduced. Lockheed has not directly published its data related to productivity gain, but the project architect reported that Lockheed officials have indicated an increase in productivity by 15% on the first major project undertaken in the new facility compared with previous experience in their old facility.

As we look for ways to save energy and protect the environment, it is encouraging to see that an investment in HPBs yields quantifiable productivity gains that are increasingly appreciated by potential building tenants as a premium attraction for building projects.

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