ARCHITECTURE AND THE CHALLENGES OF INDOOR AIR QUALITY

Dietmar Feichtinger
Architect, Feichtinger Architectes

Pilot project to extend the French Lycée and renovate the Studio Molière in Vienna, Austria (2016) ©Dietmar Feichtinger Architectes

As an architect who designs buildings and engineering structures, Dietmar Feichtinger feels that architecture is an art that must serve wellbeing. After graduating in 1988 from the University of Graz in Austria, he started working in France in 1989. He began as a project leader with Philippe Chaix and Jean-Paul Morel, then founded Dietmar Feichtinger Architectes in 1994. The firm has led a number of award-winning projects in France and Austria, including the Simone-de-Beauvoir footbridge in 2006 (Equerre d'Argent, commended; Mies van der Rohe Award 2007, nomination; Footbridge Award), the Lucie Aubrac school complex in Nanterre in 2012 (Equerre d'Argent, commended) and the Mont-Saint-Michel jetty in 2015 (Equerre d'Argent for an engineering structure, Trophée Eiffel for steel architecture).

When designing a building, the indoor air quality solutions proposed must reflect specific contexts and uses. Choices and trade-offs in terms of ventilation systems and the volume and rate of air flow are heavily conditioned by the type of building in question. There is no ready-made response. Constraints and imperatives have to be examined in great detail so that appropriately scaled corrective solutions can be suggested.

The quality of indoor air depends on a great many factors. Beyond a building's technical characteristics, improving indoor air quality necessarily involves ambitious measures to cut outdoor pollution. But it also requires efforts to raise awareness and alter habits and behaviors in the ways a building is used every day.

We can identify two core challenges that relate to air quality in future construction projects: the difficulty in putting forward a solution that matches the requirements as well as the comfort-tolerance levels of all users combined with increasing litigiousness when it comes to air quality; and how we go about combining high-tech with low-tech to limit our dependence on all-electronic solutions. However, thinking about these issues must not lead us to arrangements that make no sense from an architectural standpoint, which can happen in other building-related areas, such as energy efficiency. One approach might be to focus on simplicity and coherency; every construction or renovation project must seek out the essentials, favoring raw materials and respecting their fundamental nature.

How does air quality interact with other challenges inherent to an architectural project?

Dietmar Feichtinger: The difficulty in an architectural project lies in striking a balance between various competing constraints. A building's primary function is to provide space for use as housing, offices, open space, public reception areas and so on, or a combination of these uses. It has to be integrated into a specific space as well as fit in with its immediate environment.

The trend in recent years has been to overemphasize energy performance and thermal insulation. There is nothing wrong with this as such, because mistakes were made in the past involving use of materials with a large environmental footprint or that did not sufficiently reflect the importance of energy efficiency. But we've ended up leaning too far the other way, with public sector clients now specifying energy-positive buildings that generate more energy than they consume. What's the point of constructing a building that behaves like a battery? Overemphasizing energy performance can negatively impact occupants' comfort and experience, for example, by heavily restricting the amount of natural light in a building. Another example is that, for reasons to do with HQE criteria,[1] you may consider positioning a building entrance on the southern façade to limit energy losses. But if the street address is on the north side, this is not an option.

This is the danger of becoming overly specialized and too focused on energy performance alone. Thinking in silos can lead to situations that don't add up. The value-added that architects bring lies precisely in incorporating all the elements and coming up with a coherent solution, something achieved through a holistic approach.

Architecture is regularly prey to fashion and trends that, taken to extremes, lead to exactly the opposite of the original intention. This means that we need to remain reasonable and look ahead to see where the limits may lie. In the 1980s through to the 2000s, office buildings were very energy-hungry, heavily glazed and mechanized, leaving occupants with very little room for maneuver. The opposite applies today: people want windows that open and materials that reassure, such as wood. But we need to understand that the next set of challenges in architecture will very likely center on very tall buildings, because of skyrocketing land values. Wood, although a reliable structural material perfectly suited to traditional homes, cannot bridge large spans and questions remain about its behavior when used in high-rise constructions, for example concerning its deflection behavior.

There is no one ready-made answer and air quality, like everything else, needs to be studied case by case if a suitable solution is to be identified.

Indoor air quality depends on so many factors: the materials used in the building's structure as well as its equipment, the ventilation system and how occupants behave

How do you think about air quality when designing a project? What are the aspects and decision-making criteria to consider?

D. F.: Solutions for indoor air quality must reflect specific contexts and uses. There are places where we live, and other places that we visit for shorter periods. You're not going to propose the same ventilation system for a performance space that hosts large crowds for a short time as for an office building that is occupied all day but with endlessly varying rates of occupancy. In the first case, you need a very powerful system able to filter and supply quality air to a large space. The second case demands a tailored approach. You have to analyze in great detail how each room in the building will be used so that you can propose suitably scaled corrective solutions, avoiding needless energy use while guaranteeing optimum air quality.

One interesting example we worked on dealt with indoor air quality in schools. This is an important issue when you consider that it has been shown that overly high concentrations of pollutants, particularly CO_2, caused by poor ventilation have an adverse impact on children's cognitive capacities. But most current solutions have their drawbacks, either in the form of excessive energy use when the ventilation system runs night and day, even when there are no classes, or as degraded air quality because of poor maintenance leading to clogged filters. The reality is that the most effective solutions look nothing like people's expectations: countless ventilation systems are hidden behind suspended ceilings, creating an illusion of cleanliness. But these systems are actually hotbeds of bacteria and dust, hard to reach and difficult to maintain. We advocate exposed ducting as it makes maintenance easier.

Returning to the issue of schools, we designed a hybrid solution for a pilot project, one that combines cutting-edge technology — an automated dual-flow ventilation system in each classroom — with giving teachers the ability to open windows to the outside if they want to. What we propose combines two key strategies: 1/ treating every room separately, each with its own appropriately sized ventilation system, 2/ automating part of the ventilation system while also leaving space for people to intervene.

1 An HQE (High Quality Environmental standard) building is one where environmental criteria are designed-in from the start of the construction or renovation process. HQE is not really a label based on regulatory standards, it is simply a quality process led by a set of guidelines. Established in France in 2002 by the HQE non-profit that oversees the trade name, the HQE™ approach gradually evolves as guidelines are revised and updated. Aligned with the principles of sustainable construction, or ecoconstruction, an HQE building must provide optimum comfort for its occupants while also respecting the environment, being cost-effective to operate and delivering high-level energy performance.

Pilot project to extend the French Lycée and renovate the Studio Molière in Vienna, Austria (2016) ©Dietmar Feichtinger Architectes

How can a building's air quality be improved?

D. F.: It's a vast question. Indoor air quality depends on so many factors: the materials used in the building's structure as well as its equipment, the ventilation system, how occupants behave and, above all, you have to bear in mind that the quality of indoor air is extremely dependent on the quality of outdoor air. This is absolutely central.

Is the best driver for better indoor air quality simply better outdoor air quality?

D. F.: There's no denying that better air quality can only be delivered through ambitious measures to reduce outdoor pollution. I feel this is something that has to be looked at when thinking about what the city should be like, favoring initiatives like the one in Bratislava, capital of Slovakia, a small city of approximately 420,000 that has banned cars from its center. But it requires political courage.

In terms of buildings themselves, it is important to understand that the keys do not lie in the design stage alone, you also have to take account of how buildings are used. You might have a building that has been extremely well thought out and built to optimize air quality, but if toxic cleaning products are used in it every day then your efforts will all be in vain. This underlines how important it is to raise awareness and alter habits and behaviors.

The keys do not lie in the design stage alone, you also have to take account of how buildings are used

What are the coming air quality challenges that construction projects will face?

D. F.: The first challenge I see centers on people's ever-increasing awareness of nuisances, making it harder to propose solutions that meet everybody's requirements without impinging on their wellbeing and tolerance thresholds. Some people feel cold very quickly if the ventilation is too powerful or a window is left open, others find it oppressive if windows are firmly shut all the time. This inevitably becomes complex as soon as both categories of people have to share the same space. At a hospital where we worked, the solution was to provide individual air nozzles for each bed. But it's not always possible to offer these types of solution in every situation, and they come at a price. This brings us to the question of equal rights to breathe good quality air, but also to the challenges of ever-greater litigiousness when it comes to air quality: at some private schools, parents are starting to raise the possibility of schools being responsible for a pupil failing an examination on the basis that the quality of the air was inadequate.

Pilot project to extend the French Lycée and renovate the Studio Molière in Vienna, Austria (2016) ©Dietmar Feichtinger Architectes

The second issue revolves around the current trend that tries to measure and control everything, with all the excesses this can entail. In air quality, this takes the form of the increasing trend to fit sensors to measure the concentration of pollutants in a building. I think these technologies are valuable for identifying the cause of pollution and finding solutions. However, they should not dictate how occupants behave, nor should they cause people to experience feelings of stress. Imagine the situation in a classroom if teachers regularly see red warning lights indicating that toxicity thresholds have been exceeded. It would be a major source of anxiety and very disruptive, as well as utterly counter-productive.

[There arises] the question of equal rights to breathe good quality air, but also [that of] the challenges of ever-greater litigiousness when it comes to indoor air quality

All of this points to the need to look for ways to combine high-tech with low-tech, limiting our reliance on all-electronic solutions. One approach might be to focus on simplicity and coherency. Every construction or renovation project must seek out the essentials, favoring raw materials and respecting their fundamental nature. This principle of simplicity delivers a number of positives: it limits toxic components, solvents and paints that damage air quality and restrict the technical performance of materials, and it facilitates the deconstruction and reuse necessary for sustainability. It's a virtuous model.