# DESIGNING FLEXIBLE, COMPLEX OFFICE BUILDINGS: SUSTAINABLE BUILDINGS/ENERGY EFFICIENCY

By Consulting-Specifying Engineer

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*Mixed-use office buildings demand a great deal of expertise, flexibility, and complex technology, making them more challenging than one might expect. Engineers with experience handling office buildings share advice and a glimpse into the future regarding sustainability and energy efficiency.*

**Figure 1**

*Enhanced air quality, and using outside air to boost system productivity, is a trend engineers are noticing. DLR Group engineers incorporated this concept on the Google Kirkland project; project owners requested two times the amount of outside air required by ASHRAE 62. Options included an active chilled-beam system, which would require more than the ASHRAE 62 minimum outside air and reduce fan energy consumption. Courtesy: DLR Group*

Respondents:

Jason Gerke, PE, CxA, LEED AP BD+C, Mechanical & Plumbing Group Leader |, Principal, Graef, Milwaukee

Jason Majerus, PE, CEM, LEED AP, Senior Engineering Leader | Principal, DLR Group, Cleveland

Pui-Yee So, PE, LEED Green Associate, Electrical Engineer, Design Team Lead, Page, Austin, Texas

John Yoon, Lead Electrical Engineer, McGuire Engineers Inc. (MEPC), Chicago

**CSE: What unusual systems or features are owners requesting to make their office facilities more efficient?**

**Majerus:** We are seeing an increasing interest in using Power over Ethernet lighting systems to create a highly controllable user experience with real-time data collection that can be used to further optimize the environment. We are also seeing interest in room-scheduling systems that can be integrated with building system operation to reduce energy use.

**CSE: What types of renewable or alternative energy systems have you recently specified to provide power? This may include photovoltaics (PV), wind turbines, etc. Describe the challenges and solutions.**

**Yoon:** The cost of electricity is dramatically lower in the Midwest than on the East and West Coasts. That, in combination with the less-than-optimal conditions for PV, mean that deployment of PV on commercial buildings is relatively rare for anyone other than a client looking for a highly visible form of green marketing. Midwest states, such as Illinois, have adopted climate action plans that incorporate carbon neutrality requirements, which in theory should dramatically increase the adoption of all renewable energy sources. However, that has not necessarily been the case for numerous reasons. In areas where PV is financially more attractive, such as California and Hawaii, the exact opposite is true. This brings about its own set of problems, such as the infamous "duck curve." An excellent primer on this subject is available from the U.S. Department of Energy.

**Majerus:** We continue to specify a significant number of PV systems, in ever-increasing system capacities. This is driven by multiple reasons including alignment with an institution's sustainability commitments, to increase resiliency, or to support green building rating system certification. For a recent 5-MW rooftop solar project, we were required to reduce the system's size due to interconnection concerns by the utility. In some regions of the country, like California, renewable power generation is becoming a concern, as the time of peak generation is not aligned with the time of peak demand, forcing more extreme ramping requirements for fossil fuel power plants. Building designers need to consider not only overall energy efficiency, but the benefits of load shifting using thermal mass, thermal storage, or controls strategies.

**CSE: What are some of the challenges or issues when designing for water use in such facilities?**

**Majerus:** We are currently performing several sanitary system studies for clients due to poor system performance of aging systems. Often, restrooms will be fully renovated with new low-flow fixtures, but main piping will be left in place. The reduced waterflow results in the potential acceleration of mineral build-up.

**CSE: How has the demand for energy recovery technology influenced the design for these kinds of projects?**

**Gerke:** There are a number of project types that do not make sense for energy recovery; however, an office building is a prime target and does not require a significant amount of design effort to incorporate these systems. An office building will have a high density of occupants during normal business hours. All these people create a significant outside-air ventilation demand. All this outside air could be pretreated by an energy-recovery system. Energy recovery could also be used to move the heat generated in other building processes to preheat domestic water or provide preheating or precooling to HVAC hydronic systems.

**Majerus:** The requirement for energy recovery with more than 50% total effectiveness generally means the use of enthalpic-membrane heat exchangers or enthalpy wheels. These systems require adjacency between outdoor-air and exhaust-air pathways, requiring early and careful design of mechanical rooms.

**CSE: What level of performance are you being asked to achieve, such as WELL Building Standards, LEED certification, net–zero energy, Passive House, or other guidelines? Describe a project and its goals, identifying the geographic location of the building.**

**Yoon:** While our company was the engineer of record for one of the first WELL-certified commercial office spaces in 2015, we find that WELL-certified projects are still extremely rare. This is in contrast to the explosion in the number of LEED projects when LEED 2009 was introduced. There is still strong interest in the WELL standard, but ultimately, clients who have chosen to actively pursue certification are extremely rare. This is generally attributed to uncertainty regarding documentation, cost of compliance, and the perception that portions of the standard overreach into areas that limit the choices of their employees and business activities (for example, mind and nourishment categories). As engineers, our focus is often extremely limited, but the WELL standard challenges us to expand those perceptions beyond typical life safety and functional concerns to think about our role in a larger holistic design process.

**CSE: How have energy–recovery products evolved to better assist in designing energy–efficient office buildings?**

**Majerus:** The availability of energy-recovery products includes a range of sizes and configurations, allowing units to be broken up into smaller application sizes versus using a single unit to serve an entire building.

**Gerke:** Energy-recovery products have not had a major advance in technology for a number of years. The efficiency of media for air-to-air heat recovery continues to increase in single-digit percentage values. However, no major products have been brought to the mainstream HVAC market to recover energy in a novel way. It is up to the design engineers to mix and match, using their experience and knowledge to design systems maximizing the energy-recovery possibilities.

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