ENERGY & ENGINEERING

2017 Design Review
Welcome

Happy New Year! Before we get too far down the path in 2018, I think it’s important to stop, look back, and take the time to thank you for making 2017 a banner year for Energy and Engineering design at DLR Group.

As I look back on the year, I am more than aware of the amazing strides we have made in growing our Energy Services Studio and engineering practice. Here are the three things I am happy to report from 2017:

1. Last year we grew in every way, including the number of engineers integrated into our design teams. We acquired five new firms which increased our design, engineering, and energy expertise and resources. This gives us more bench depth to deliver more services than ever before. You can read some of that expert thought leadership in the Insight articles you’ll find inside this document.

2. We’re proud of our ever-expanding relationships with clients, new and old, who allow us to design renewable energy solutions and deliver energy services through enhanced commissioning and retro-commissioning, energy modeling, and MEP upgrades.

3. Innovative research is opening doors to greater evidence-based design solutions across all market sectors. This means we understand more about the connections between sustainable practices, building efficiencies, and healthy environments, in the most pragmatic applications.

Team power is always greater than the power of one. To that end, we are grateful to you for teaming with us to create safe, healthy, sustainable facilities. You are the reason we love to come to work every day, and do the things we do. We’re excited to continue our partnerships in 2018, and can’t wait to see what we can accomplish together.

Here’s to another great year,

Dan Munn, SE
Global Energy & Engineering Leader
Energy & Engineering Leadership
Energy & Engineering Insights

DLR Group experts share their point of view on timely topics in the energy and engineering industry. Browse through the next few pages to read what our design professionals are saying about the latest developments and insights to take integrated design to the next level.
Today’s Global Engineering Themes

Three key factors are shaping the way our buildings function and perform.

by Dan Munn, PE, SE, LEED AP
Based in Seattle, Dan is DLR Group’s Global Energy & Engineering Leader and a member of the firm’s executive leadership team.

These are three of the most significant themes shaping the engineering design industry and, subsequently, our practice:

1. There has been a noted shift from prescriptive-based to performance-based design.
2. The next evolution in sustainable building design is WELL Building standards, embracing fresh air, natural light, health, and wellness.
3. Technology and engineered systems are playing a much larger role in a building design than ever before.

Performance-Based Codes

Whether driven by architectural intent or an owner’s interest in tighter indoor air temperatures, more project teams are embracing performance-based design (PBD) over prescriptive-based codes. Providing designers with a greater palette of tools to meet code requirements, PBD embraces innovation, freeing building teams from the design restrictions imposed by a prescriptive approach.

Performance-Based Codes

However, taking the PBD route requires a very different project process, necessitating a certain level of skill and expertise on the part of designers and engineers.

As opposed to the traditional approach, which verifies code compliance at the building design phase, PBD approval is deferred until after the building is already operational, at which point measurement and verification must be performed to validate that the facility is performing as intended. This, in effect, is bringing designers to a new phase of post occupancy involvement with building owners through the process of monitoring performance, energy consumption and operations.

To avoid costly adjustments or changes to the original design, accurate assumptions must be made in order to model the building as closely as possible to how it will ultimately be built and operated. To achieve this delicate balancing act, the engineering team must possess an in-depth understanding of anticipated building operations. Furthermore, it takes experienced and skilled building designers to navigate the subtleties of building infiltration rates, control setpoints, hours of operation, and more.

Successfully executing this performance pathway requires a greater understanding of buildings in all aspects including design, construction, and operations, but this is the future of code compliance, and one that DLR Group embraces as an additional way to design and verify building compliance.

All is WELL

Bringing sustainable building design to the next level, WELL Building standards are prioritizing the health, satisfaction, and wellness of building occupants.

In response to the green building movement, the design industry has become adept at tightening up the building envelope and ramping down energy consumption, but building occupant performance has not always been the focus—until now.

Backed by recent scientific studies establishing the fact that employee and student alertness, productivity, and performance is directly linked to fresh air, views, day lighting, and thermal comfort, WELL Building Standards are shaping the way today’s buildings are being designed from a health and wellness perspective.

Essentially “codifying” the aspects of buildings that can’t be seen, DLR Group is engaged with these evolving building metrics and embraces a designer’s obligation to design spaces which prioritize occupant wellbeing and performance. Championing this cause, knowledgeable DLR Group professionals are on hand to help owners figure out how to best invest their building facility dollars to achieve these important standards.

Technology’s Growing Role

As the third leg of the major themes influencing the engineering industry, technology is playing an ever increasing role in building design. Contrasted with the master architect dictating the vast majority of building design in past decades, the technical and engineering aspect of building design now encompasses a much greater share of today’s building designs.

With growing prominence of the Internet of Things, wireless and wired low-voltage technology, rapidly advancing audio-visual systems, acoustics and lighting—namely programmable LED lighting systems and controls—having experts who intimately understand these individual pieces of technology is essential for today’s building design teams.

Consequently, A/E firms must provide a wide range of specialists who can help navigate the increasingly sophisticated, complicated and interrelated building system designs for today’s modern facilities.
With the advent of solid state lighting, often referred to as LEDs, and the digital controls that accompany it, tuning in to a specific “color” of white light is now possible. In the past, a light source’s color was fixed based on either technology, or a mix of phosphors specific to a bulb, or lamp. Now a single light source can be tuned to output a specific “color” of white light is now possible. In retail environments, where warmer light can help younger children calm down after coming in from a rowdy recess. In education environments, cooler lighting contributes to a calmer, more relaxing environment. In an education environment, digital white lighting can provide some of the benefits of circadian mimicry to aid healing. Certain therapies and treatments are linked to greater efficacy when applied at certain times of the day, so design is experimenting with lighting solutions that mimic the sky outside. This same design approach can be used to limit or treat the symptoms of Seasonal Affective Disorder in locations where weather or latitude may limit sunlight exposure during winter months.

Dynamo Dynamic White Lighting

LED color-tuning capabilities simulate natural circadian rhythms for enhanced productivity.

by Sean Avery, PE, LEED AP

Based in Seattle, Sean is an electrical engineer whose experience spans power, controls, and lighting design.

With the advent of solid state lighting, often referred to as LEDs, and the digital controls that accompany it, tuning in to a specific “color” of white light is now possible. However, that same cool blue light can help reset your daily clock if received earlier in the day. When it comes to the built environment, nothing does a better job of delivering the right light at the right time than daylight. However, it’s not always possible for architects to bring in as much natural light as might be desired. Although the technology has some room for improvement in regards to circadian response, dynamic white lighting can provide some of the benefits of day lighting where natural light is unavailable. In healthcare, dynamic lighting is focused on circadian mimicry to aid healing. Certain therapies and treatments are linked to greater efficacy when applied at certain times of the day, so design is experimenting with lighting solutions that mimic the sky outside. This same design approach can be used to limit or treat the symptoms of Seasonal Affective Disorder in locations where weather or latitude may limit sunlight exposure during winter months.

How it’s Done

While LED fixtures and controls technology are available for designing and programming desired CCTs based on the time of day and season, it is not always a simple endeavor. Controls for dynamic white systems come in two technologies: analog and digital. Analog systems are generally better understood by most installers and end users. However, dynamic white lighting requires twice the number of control zones compared to a standard dimming system, and are tied to the wiring design requiring an electrician to make changes. With digital systems, dimming and zones are independent of the wiring and can be modified after installation without an electrician, but the control software and system troubleshooting can be more complicated.

Hesitancies and Limitations

Despite the fact that a number of building owners are pleased with the way dynamic white lighting is boosting alertness and productivity in their facilities, many are hesitant to adopt the technology. For starters, the CCT many people find acceptable is tied to culture and experience. In the states where warmer CCTs have been commonplace, building occupants are not used to or accepting of the appearance of cool white light. The increased complexity of the control systems required to dynamically alter the CCT may not be something facility managers are accustomed with. Furthermore, the increase in complexity and capability are typically tied with added cost for both the products and the installation labor. In addition, scientists and the lighting community are still working to determine the specific blue light wavelengths and intensities required for stimulating circadian rhythms. And at this point, those levels are only an estimation.

At the same time, some groups have released blue light exposure warnings without covering pertinent information like time of day and hazardous wavelengths. Last year, the American Medical Association released information detailing blue light hazards such as eye damage, impaired sleep, and more. While the article was probably intended to encourage lighting designers to consider the potential hazards of lighting design, the lack of detail likely provided confusion and general distaste to the public.

What’s to Come

Although technical limitations currently exist, it won’t be long before lighting manufacturers can tune the spectrum to achieve desired circadian benefits with a variety of futures from which to choose. And as researchers work to define the specific blue light levels of natural circadian rhythms, it is anticipated that LED lighting technology will be able to more accurately simulate the desired biological response. Aside from the potential circadian benefits, there are plenty of other known benefits of dynamic white lighting.

As for the controls systems, easier to use and more simplified user interfaces with greater automation are simplified user interfaces with greater automation are expected to encourage lighting designers to consider the potential hazards of lighting design, the lack of detail likely provided confusion and general distaste to the public.

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As for the controls systems, easier to use and more simplified user interfaces with greater automation are emerging, making the whole dynamic lighting process less daunting and more accessible.
One Mechanical Solution Does Not Fit All

The best HVAC solution for your facility comes from the earliest possible integration in your design project.

by Jon Rasmussen, PE, LEED AP BD+C

Based in Denver, Jon is responsible for guiding the engineering disciplines in the Arizona and Colorado offices.

With an understanding of the goals, concerns, and limitations, system options can be filtered down into viable solutions and reviewed with stakeholders. We consider factors such as installation costs, maintenance responsibilities, limitations of the equipment, and other aspects that impact the final deliverable. Even the smallest factors should be addressed. According to the Consortium of Energy Efficiency, at least 25% of all rooftop HVAC units are oversized. This can directly affect first-installation costs, lost efficiency savings, and long-term operating and maintenance costs. Regardless of the final design, it’s important to understand as many contributing factors as possible.

Early discussions should include needs, feedback on options, and committed stakeholder decisions ranging from facility standards to site conditions that require explicit temperature and humidity levels. This will help the mechanical team make informed recommendations. Then the engineering team does what they do best: Design, size, and specify the best equipment and infrastructure to keep a building’s indoor environment comfortable, reliable, and supportive of the users’ needs.

Leveraging an integrated design team ensures that smart, experienced engineers are part of the early conversations shaping the course of a project. The *Whole Building Design Guide* estimates that the use of high performance HVAC equipment can result in considerable energy, emissions, and between 10 and 40 percent in cost savings. Alternatively, a whole building design—or what we refer to at DLR Group as integrated design—coupled with an extended comfort zone approach, can produce much greater savings of 40 to 70 percent. Early discussion of possible options and project factors facilitates team-wide endorsement of the chosen solutions and achievement of the highest level of performance.

I recently discussed system selection for the design of K-12 schools during a Q&A with *Consulting-Specifying Engineer* magazine (CSE):

**CSE:** What are the current challenges when specifying HVAC systems for educational facilities?

**JR:** Schools today are striving for flexible learning environments. Flexible and adaptive spaces present a distinctive challenge to a mechanical system. Defining space zones, how they’re used, and establishing acceptable comfort ranges is how equipment is sized. Controls systems drive the equipment to supply the spaces as they’ve been defined. Variety and adaptability are great for space planning and programs, but require versatility in a mechanical system and sophistication in its controls. This doesn’t necessarily mean complexity, but a system designer needs to be aware that target environments will change. These are not impossible solutions through closed-loop refrigerant, ducted airflow, radiant flooring, chill beams, heat pumps—the possibilities are seemingly endless.

In order to sift through the opportunities and calculations, an engineer must first gain an understanding of the stakeholders’ goals. During the pre-design phase, we make sure to ask poignant questions such as:

- What is important to the design program, the facility, and its users?
- Is high efficiency, low-energy the utmost priority?
- Does equipment need to stay off the rooftop? Are there areas on the ground that need to be avoided?
- Is ambient noise a concern?

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**CSE:** What unique HVAC requirements do such projects have that you wouldn’t encounter in other projects?

**JR:** Energy recovery units are dependent on interior loads for redistribution or re-application. If spaces aren’t used with consistency or regularity, they aren’t good candidates to participate in an energy recovery scheme. Similarly, schools and the learning environment have a critical focus on noise. Our design must take into account solutions for sound attenuation. By performing acoustical analysis studies, we can implement mitigation strategies such as locating HVAC systems away from classrooms or adding additional sound barriers, so that systems can meet goals without disrupting education.

**CSE:** What are some of the challenges or issues when designing for energy efficiency in such buildings?

**JR:** Specialty-type solutions like VRF, radiant slabs, and chilled beams require extensive early coordination and discussion with all of the stakeholders. VRF has great advantages, such as allowing simultaneous heating zones and cooling zones, reduced distribution space requirements, such as piping versus ducting, and easy expandability. But a project also needs to have experienced installers and a willingness to support a manufacturer’s proprietary system. Radiant heating and cooling systems can greatly reduce a building’s energy usage, but users need to be educated on the response times and shift familiarity with airflow. Chilled-beam systems tackle loads extremely well, but attention has to be paid to operable windows and varying dew points. All of these factors are easily managed and accommodated by effective design, but only when understood and embraced by the entire project team in the early stages. This eliminates surprises and helps prepare facility operators for their new systems.
Operations & Sustainability: The Ultimate Goal

Commissioning achieves sustained energy reductions and reduces greenhouse gas emissions.

by Tracey Whaley, PE, CCP

Based in Denver, Tracey is a commissioning project manager with more than 25 years of experience.

What is Commissioning?
Commissioning is a quality assurance process applied to the delivery of a building that begins at pre-design and continues through the end of the construction warranty period. The benefit is a new construction or renovation delivered at peak operating condition, and operations and maintenance staff prepared to operate your building successfully to meet occupant needs.

Mounting Pressure
Commissioning was developed as a response to advances in technology, materials, and methods of design and construction. In the 21st century, technological advances are more common than ever as we witness the rise of smart buildings and IoT. Commissioning authorities allow for a smooth implementation of these technological advances. This application is crucial to the efficiency of the building.

Meeting Occupant Expectations
In addition to the technological advances enabling buildings to be highly efficient, there is huge social pressure to build sustainably responsible buildings. The United States Green Building Council (USGBC) reports that "the global green building sector continues to double every three years, with...70 countries reporting 60 percent of their projects will be green by 2018." In other words, sustainable building practice is rapidly becoming the worldwide standard, and many of today’s design and construction innovations intersect sustainability and technology.

Exponential Outcomes
A successful commissioning authority can shepherd outcomes with a multitude of benefits, like a reduced carbon footprint due to efficient operating systems, a healthier indoor environment, and effective daylighting. Commercial buildings can see energy efficiency degrade by 10 percent to 30 percent over a one- to two-year period, according to research from Texas A&M University and the Lawrence Berkeley National Laboratory. By accurately monitoring and controlling building systems with a building automation system, we can sustain the outcomes for years of optimal building life. Through the commissioning process by dedicated commissioning providers we demonstrate that the ultimate goal is achievable: long-lasting sustainability.
Performance Design
How DLR Group delivers sustainable buildings that optimize energy and water use.

by
Amarpreet Sethi, CEM, HBDP, BEMP LEED AP
Based in Seattle, Amarpreet leads DLR Group’s Performance Design Team.

Amarpreet Sethi believes performance design must deliver buildings that enhance productivity, attentiveness, and the wellbeing of users within the space.
WELL Building Certification Can Support the Total Needs of Occupants

The built environment can improve the nutrition, fitness, mood, and performance of occupants.

The WELL Building Standard is the first building standard to focus exclusively on building design, and its impacts on the health and wellness of building occupants, while addressing social responsibility through design. WELL-certified spaces create built environments that improve the nutrition, fitness, mood, sleep patterns, and performance of its occupants, which translates into happier, healthier, more productive employees.

WELL is the culmination of seven years of research by the International WELL Building Institute, a public benefit corporation that donates more than half of its certification fees to charitable contributions.

WELL certification is unique in that its projects must go through on-site performance verifications every three years that test water, air, light, acoustic quality, and other metrics. This ensures that the original design techniques employed to create a healthy work environment are maintained throughout the life of the building. WELL certification includes unique metrics that set it apart from other green building standards.

The Nourishment category requires the availability of fresh, wholesome foods, limits unhealthy ingredients, and encourages better eating habits and food culture. This helps combat a rise in obesity, heart disease, diabetes, liver disease and cancer.

The Fitness category promotes the integration of exercise and fitness into everyday life through the built environment. Physical design features, such as stairs instead of elevators, support an active and healthy lifestyle.

The Mind category requires design, technology and treatment strategies that optimize cognitive and emotional health.

Recognizing that healthy, happy employees are more productive and creative, DLR Group’s new downtown Los Angeles office—home to 150 employee-owners—has achieved WELL Silver certification.
Across every sector, our integrated design professionals deliver innovative energy and engineering solutions to create efficient, sustainable, high performance buildings.
Agua Fria High School District’s new Canyon View High School presents several innovative, energy-focused solutions in addition to a beautiful, modern classroom setting. This new campus is the home for research on a new, heat-storing material known as bio-phase change material (Bio-PCM). Starting at the construction phase, we will research how the material helps to efficiently heat and cool the facility. Overall, the building is estimated to operate 76 percent more energy efficient than a traditional high school. Additionally, a space known as the Agora will highlight passively conditioned space using green walls to reduce heat and provide moisture.

This research, known as Thermal Mass 2.0, is a partnership between DLR Group, the school district, Arizona State University, Chasse Building Team, and Phase Change Energy Solutions.
Technology Leadership

The new State of Nebraska New Data Center serves the ever-broadening changes in information technology services.

Lincoln, Neb.

The State of Nebraska exemplifies technology leadership as it embarks on a complete replacement of its 65,000-SF primary data center and technological hub, which was originally constructed in 1989. Known as the 501 Building, it serves as the primary home to the Office of the Chief Information Officer (OCIO) and the technology workforce for the state’s business. DLR Group’s design creates a shielded area within the secure, mission critical facility to house the primary 22,000-SF data center. This major upgrade and expansion will continue to serve ever broadening information technology services into the future.
New Beginnings

225 West Madison, formerly known as Madison Street Jail, improves energy delivery to a former courts complex.

DLR Group's design for the Madison Street Jail Adaptive Reuse project reconnects the building to its urban context and enhances the pedestrian environment. Vacated initially due to overcrowding and infrastructure failure, Maricopa County chose the highest form of sustainability by re-purposing the existing facility. This project requires the demolition of an old evaporative cooling tower and reconnection of all heating and cooling systems to a district energy loop in the adjacent courts complex. This upgrade will ultimately save the county thousands of dollars annually due to improved system efficiencies.
Challenge of the Century
One of the most pressing challenges of this century is to mitigate climate change caused by greenhouse gas emissions from human activities. The DLR Group Sustainability Report for 2017 reflects our progress toward meeting the 2030 Challenge. We extract this information from the estimated operational energy consumption, energy production, and energy optimization of DLR Group designs in 2017. Beyond these typical metrics of achievement, we are further beginning to consider the “water-energy nexus,” calculating not only how much water is used to create the energy we use but how to reclaim or conserve it.

Validate Performance
DLR Group continues to complete data research to verify actual performance of our designs. We are excited to have submitted three additional buildings into the process of recognition by the New Buildings Institute in 2017 for exemplary energy performance. Once finalized, it will bring our total NBI-recognized buildings to a total of 1.5 million square feet of emerging zero energy and ultra-low performing buildings.

Raise the Bar
DLR Group’s average reduction targets of predicted energy use for our high performance designs have consistently exceeded the national peer group average. We set an aggressive goal of 10 percent improvement from where we were the previous year. In 2017, our reduction target came in at 40 percent compared to the average building. A 10 percent improvement set our goal at 44 percent for this past year. DLR Group is thrilled to report that we exceeded that goal and reached a 48 percent reduction in 2017. Additionally, in 2016 we reported that 16 percent of our entire portfolio by gross square footage met the 2030 Challenge goal. This past year we achieved 36 percent of our portfolio meeting this milestone.

However, as a global design leader, we aim for continuous improvement in meeting 2030 Challenge reduction targets. The trend in our AIA 2030 Commitment reporting shows tangible progress in achieving these goals through broader participation across all DLR Group studios. Both renewable energy and building optimization projects are significantly contributing toward our efforts to achieve the benchmarks of Architect 2030.

Through our performance design practice, DLR Group is poised to meet 2030 Challenge goals on every new project by 2020.

Click to read our Environmental Stewardship Summary.
Awards

SRM Technology Campus Office Building
Kirkland, Wash.
Award of Excellence
ENR magazine Best of the Best 2017 Awards
Sustainable Design and Innovative Technologies Silver Medal Winner
American Council of Engineering Companies

Miami Heat Solar Canopy (NRG)
Miami, Fla.
Innovative Design and Public Awareness Gold Medal Winner
American Council of Engineering Companies

DLR Group Chicago Office
Chicago, Ill.
RESET Certified Company
RESET

Nolan Lenahan, PE, LEED BD+C AP
Los Angeles, Calif.
40 Under 40 Recognition
Consulting-Specifying Engineer magazine
In the News

May 2017
Rod Oathout, PE, pens a guide to achieving performance-based goals for energy design in Consulting-Specifying Engineer.

September 2017
ASHRAE Journal publishes DLR Group Engineers Omar Hawil, PE, and Trevor Jaffe, PE, perspectives on water-energy nexus and heat rejection systems.

September 2017
The AIA profiles our ongoing commitment to the 2030 Challenge as part of the firm DNA.

December 2017
An Arizona school district gets its first, newly built high school in a decade that will be the basis for Bio-PCM research.
2017 was an exciting and very eventful year for DLR Group. We launched the year with 810 design professionals in 24 offices and with demonstrated expertise in 11 building types.

During the year, Westlake Reed Leskosky, Momenta, Studio Hive, Kwan Henmi, and Staffelbach joined DLR Group.

We closed the year with 1,150 design professionals in 29 offices with demonstrated expertise in 15 building types, and added an array of new specialized design services and experts.

In many ways, this acquisition blitz was serendipitous. DLR Group is always looking to add design talent and access to new geographies, and during the year a multitude of factors aligned to enable DLR Group to substantially grow via acquisition. While adding new geographies and expertise is the aim, ensuring a cultural fit is always the strategic imperative. Each of the firms joining DLR Group share beliefs that align with our core values; a commitment to integrated design, sustainability, and design excellence.

The depth of design resources, experience, and expertise that have joined our 100 percent employee-owned firm is remarkable. This includes specialized engineering, theatrical design experts, and internationally recognized interiors, preservation, and planning practices. And new Culture+Performing Arts, Multi-Family Housing, Museum, and Transportation studios, along with enhanced expertise in Education, Justice, Workplace, and sustainable design strengthen our competitive position in the marketplace.

The vision is to be a global design leader with resources, reach, and the wherewithal to serve clients wherever, however, and whenever our design services are needed.

Our goal is not to be a big firm. It’s to be a great firm. A highly-differentiated, deeply integrated, global design leader. All our recent acquisitions—WRL, Momenta, Studio Hive, Kwan Henmi, and Staffelbach—further the design ambitions of our employee-owners and our ability to elevate the human experience through design.

Griff Davenport, AIA
CEO, DLR Group
Elevate the human experience through design