BIOPHILIA IN THE BUILT ENVIRONMENT GLUMAC GREEN PAPER

GREEN SPACES THE BENEFITS OF BIOPHILIC DESIGN

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NATURE + WELLNESS

Bringing nature into the places where we live and work is more than just a value-added amenity. Biophilic design is now proving to provide direct benefits to occupants of office spaces and healthcare facilities alike.

Where is your favorite place? When we ask people this question, they often respond with a location that is outdoors. So, why is this true? Why do certain places make us feel so good? This innate human attraction to nature and other living things is a phenomenon that is captured in a concept called biophilia, which means "love of life." In the building industry, biophilic design is an emerging philosophy that enables people to enjoy this affinity to nature inside buildings. Today, people can spend upwards of 90 percent of their time indoors. So, the importance of a connection to nature is now more critical than ever. And even the smallest design interventions can lead to measurable health benefits and economic value.

THE ECONOMIC VALUE

Numerous studies indicate that connecting building occupants with nature raises productivity levels because nature stimulates brain activity, thus reinvigorating cognitive function and reducing psychological stress. Considering that salaries and benefits comprise more than 90 percent of the average business' operating expenses, compared to only 1 percent for energy consumption, designing buildings to optimize occupant productivity levels holds enormous economic value, especially as building systems become increasingly efficient.

One study of a call center in California concluded that employees with views of nature handled calls at a rate of 6 to 7 percent faster than those with no direct sightline to a natural environment (Heschong, 2003a). In this study, construction costs for operable windows and the increased square-footage required to rearrange desks toward windows totaled \$1,000 per employee, whereas annual productivity savings averaged \$2,990 per employee, with an initial investment payback of 4 months.

Biophilic design has also been shown to have positive impacts in other settings. For example, more than 17 studies have demonstrated that access to daylight and views improves a student's ability to learn and retain new information. Similarly, more than 50 studies have shown that natural daylight and views to nature accelerate healing rates in hospital patients and reduce staff and family stress.

The retail industry is yet another sector profiting from biophilic design. A study that tracked the increase in retail sales across 73 stores in California and showed that gross sales increased 40 percent after installing skylights. In fact, the profit from the increase in sales was estimated to be 19 times greater than the energy savings from reduced electrical lighting (Heschong, 2003b).

ENGINEERING SOLUTIONS

American psychologists have summarized the five most important physical conditions for humans to perform well in their environment, and interestingly, the list is similar to what one may experience in natural settings. We believe these conditions provide a template for engineering solutions that elicit a biophilic response in buildings. The conditions include

LIVING WALL AT GLUMAC SHANGHAI

A important element of biophilic design is a visual connection with nature. Our eyes are attracted to the naturally occurring fractal patterns that exist in nature. Think wind blowing through leaves or waves washing over a beach. This can be achieved in the built environment most easily through a direct sight-line to the outdoors. However, in urban environments we sometimes need to be more creative. "Living Walls," like the one in our Shanghai office, are becoming a popular solution.



the ability for occupants to:

- Experience change (varying temperature, air, light, and smell).
- Act on the environment and see the effects.
- Enjoy stimuli to curtail stress and fatigue.
- Seek spaces that provide safety, identity, and protection.
- View the outside world.

The simplest way to satisfy one or all of these conditions inside buildings is to connect people

directly with the outdoors. But when this isn't possible, bringing nature indoors, or mimicking its forms and processes with design and material finishes can also yield meaningful results.

What follows is a brief list of design interventions across three crucial building systems: MEP design, envelope, and lighting. These can be applied to new and existing buildings alike, and, in addition to benefiting occupants, can result in significant energy and water savings:

DESIGNING FOR THE NATURAL ELEMENT

CAPTURING DAYLIGHT Atria, skylights, and floor-to-ceiling windows help bring natural sunlight into the built environment. Glumac's lighting studio specializes in creating 3D renderings of lighting systems, like this one of the Vestas North American Headquarters in Portland, Oregon, (left), to demonstrate the effect before construction begins.



RENDERING

FINAL PRODUCT

OPERABLE SHADES Mimicking the sun's movements throughout the day can help optimize occupant efficiency by tapping into their circadian rhythms. LED lighting, louvers, and operable shades can combine to go beyond simply capturing daylight, and actually recreate throughout the day the intensity and angle of sunlight, making it more comfortable, efficient, and livable.



RENDERING

FINAL PRODUCT



Hassalo on Eighth in Portland, Oregon, features a tidal wetland that captures waste water for reuse in plumbing and landscaping. The result is a lush green exterior that provides occupants views to nature.

- **Daylight** balances hormonal levels in building occupants, maintaining physical energy and cognitive function. Daylight can be coupled with electrical lighting to create variable and playful lighting conditions that stimulate the senses and save energy. People don't 'see' light. They see light bounce off surfaces, so consider material finishes in lighting design to enhance this experience.
- Views to nature, particularly of nature in movement, relax muscles in the eyes and reduce occupant stress levels.

"PROVIDING OCCUPANTS WITH CONTROL OVER TEMPERATURE, AIR MOVEMENT, AND LIGHT INCREASES OCCUPANT SATISFACTION, AND ALLOWS OVERHEAD SYSTEMS TO OPERATE AT A WIDER RANGE, SAVING ENERGY."

- Lighting quality makes a big difference when it comes to occupant satisfaction. Natural daylight changes color from yellow in the morning, to blue mid-day and to red in the evening. Modulated indoor lighting that mimics outdoor light wavelengths can help keep occupants alert and productive.
- Water features disrupt the typical indoor 'hum' in buildings and serve to stimulate the senses. Moving water also creates fractal patterns that mesmerize viewers, stimulating brain activity for improved cognitive function. This intervention can be a simple fountain in the reception or break room. Or, it can be multifunctional and connect with plumbing systems to capture, convey and/or recycle water such as with a rainwater collection system or a natural wastewater treatment system.
- Personal comfort controls allow occupants to quickly vary and personalize their local environment. Studies have shown that providing occupants with control over temperature, air movement, and light, for example, increases occupant satisfaction, and in the case of heating and cooling, allows overhead systems to operate at a wider temperature range, saving energy.
- Living walls serve to filter and recycle indoor



Natural ventilation is an ease way to provide the variable air flow that's a key element to biophilic design, and a major aspect of achieving net-zero energy.

air. Studies have shown that the human brain can differentiate between real and fake nature (e.g., artwork or photographs). Bringing nature inside stimulates the brain and can augment building air intake systems and help to improve indoor air quality.

- Natural ventilation is the easiest way to provide thermal and air flow variability in buildings. It can be coupled with mechanical systems to provide sufficient airflow in larger buildings. Biophilic design helps to better define the case for naturally ventilated buildings because of the associated health and productivity benefits, not to mention its role in net-zero energy designs.
- Varied air movement in buildings avoids what is called "thermal boredom" from mechanically driven ventilation systems. These systems introduce puffs of air into spaces at intervals to break up the monotony of air movement, mimicking physical conditions associated with natural ventilation.

COST

Creating opportunities for people to connect with nature in buildings does not have to cost much. Often it is simply creating this condition at every opportunity during the design or renovation of a building or space. These interventions can be as small as a personal fan or task light, or, they can be as large as a natural wastewater treatment system that is more expensive, but serves multiple building functions. The range of solutions used depends on the project goals, budget, and the owner's tolerance for new ideas.

Our belief is that biophilic design should more appropriately be considered insurance to protect extremely valuable human resources. The research demonstrates that the health benefit and economic value is significant enough to warrant design consideration, especially in buildings where occupant productivity and performance are essential to the business. G