

## PICTURES OF HEALTH: HOW SIMULATED NATURE IS REDEFINING BIOPHILIC DESIGN



*BOSCO VERTICALE*  
by Stefano Boeri Architects

Towering above Milan is one of the most remarkable monuments of architecture ever constructed—the Bosco Verticale, the “Vertical Forest” by Stefano Boeri Architects. Its two residential towers feature facades festooned with more than 900 living trees, 5,000 shrubs and 11,000 perennials spread across 8,900 square meters of terraces.<sup>1</sup> The project’s gorgeous explosion of greenery brings densely planted nature into a densely built urban environment.

Beyond its aesthetic appeal, the development promises a host of environmental benefits. The trees are claimed to be capable of transforming 44,000 pounds of carbon dioxide into oxygen each year.<sup>2</sup> They filter out dust, cool the building, and keep out noise, as well as shelter a diverse new ecosystem of birds, butterflies and other arboreal creatures.

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<sup>1</sup> Stefano Boeri Architetti, stefano boeri.net

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<sup>2</sup> Jenny Xie, How the team behind Milan’s Bosco Verticale used over 11,000 plants to improve air quality and increase housing, The Verge, August 9, 2017. <https://www.theverge.com/2017/8/9/16112758/milan-vertical-forest-stefano-boeri-video>

The Vertical Forest is touted as a triumph of biophilic design, offering a host of benefits for its inhabitants and neighbors. As defined by Stephen R. Kellert, biophilia is “the inherent human inclination to affiliate with nature that even in the modern world continues to be critical to people’s physical and mental health and wellbeing.”<sup>3</sup>

Biophilic design seeks to restore our connection to the natural environment, and its psychological and economic benefits seem well established: boosting productivity in office environments, increasing the value of hospitality accommodations, improving educational testing scores, shortening patient recovery times in healthcare settings, reducing local crime rates and more.<sup>4</sup> Under its influence, architects have increasingly introduced organic, nature-patterned shapes to their projects and incorporated more natural elements like water, stone, and wood into urban interiors.



*There can hardly be a more spectacular way to bring the natural beauty of wood to a twenty-sixth-floor apartment than to surround it with a living forest. In some sense, Bosco Verticale is the literal and figurative pinnacle of biophilic design.*

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<sup>3</sup> Stephen R. Kellert, Elizabeth F. Calabrese, *The practice of biophilic design*, 2015, p. 3.

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<sup>4</sup> World Green Building Council, *Health & Wellbeing Framework, Principle 3: Prioritise Access to Nature*, <https://www.worldgbc.org/principle-3-prioritise-access-nature>



## WHY THE PINNACLE OF BIOPHILIC DESIGN IS SO DIFFICULT TO REACH

Bosco Verticale is truly an icon. Yes, other forest towers have sprung up in cities from Montreal to Singapore to Sidney. Stefano Boeri himself is bringing his concept of urban forests to China, Albania, and elsewhere in Italy. But the two towers of the Vertical Forest together house a mere 400 condominiums. When completed, all the urban forest projects now underway will represent only a minuscule fraction of the housing stock in their respective cities. If the goal is to bring environmental sustainability and biophilic design to the world, marquee high-profile green landmarks will not be enough.

A closer examination of the Bosco Verticale reveals why. The project represents an extraordinary feat of engineering, horticulture, and forestry. Plantings were specified floor by floor and side by side. Sun-loving olive trees were chosen for the south side, while deciduous trees were placed to the north, where the sun could penetrate their bare branches in winter. The design team took into account changes in humidity and wind speed at varying levels, even testing the stability of mature trees inside a wind tunnel in Florida. Quarterly pruning is required, paid for by condo fees. The infrastructure is even more impressive. A solar pump powers a custom irrigation system.<sup>5</sup> Cantilevered concrete terraces were needed to support the added weight

of the plantings. To contain the carbon and resource footprint of all these extra building materials, the design team adjusted the composition of the planting soil to reduce its weight and performed a comprehensive analysis of the carbon emissions saved through vegetation.

### *Scale is the Achilles' heel of biophilic design.*

The final result is stunning, but hardly easy to scale. Scale is frequently the Achilles' heel of biophilic design. The approach offers a multitude of documented benefits, from improved thermal performance to enhanced wellness to increased pro-environmental behavior. Yet even biophilic designs that are far more down to earth than the Bosco Verticale also impose serious burdens on construction and operations.<sup>6</sup> That is why the most widely known case studies in biophilic design tend to feature high-ticket, institutional installations at marquee hotels, gyms, schools, universities, hospitals, and offices, where budgets are ample and creative license is at its greatest. Too rarely does one read about a biophilic affordable housing project, suburban production home, or delivery warehouse. Yet the imperative of biophilic design is to create spaces that are not only better for humans, but for all humans; not only to incorporate natural environments into human spaces, but to better incorporate humans into nature.

<sup>5</sup> Ellis Woodman, Bosco Verticale by Stefano Boeri, Architects' Journal, February 25, 2015. <https://www.architectsjournal.co.uk/buildings/bosco-verticale-by-stefano%E2%80%86boeri-architetti>

<sup>6</sup> Niranjika Wijesooriya, Arianna Brambilla, Bridging biophilic design and environmentally sustainable design: A critical review, Journal of Cleaner Production, Volume 283, 2021, 124591, ISSN 0959-6526, <https://doi.org/10.1016/j.jclepro.2020.124591>.





## BRINGING INSPIRATION DOWN FROM THE MOUNTAINTOP

As beautiful and successful as landmark biophilic projects may be on their own terms, they also inspire us to ask further questions:

How can we make the benefits of biophilic design more accessible to all?

Does incorporating biophilic elements like vegetation, water, and overscaled fenestration always require over-engineering a structure?

Can costs become competitive with traditional design and construction approaches?

Is it possible to build sustainable and waste-free biophilic projects without relying on offsets?

Does biophilic design always rely on custom applications, or is it possible to employ standard materials and construction techniques?

How can we reduce the ongoing maintenance that natural elements so often require?

## PROPOSING A MORE HOLISTIC MODEL OF BIOPHILIC DESIGN

It's time for a more holistic approach—one that integrates people-centric benefits with planet-focused sustainability and the kind of execution-level practicality that will enable the wider adoption of biophilic principles.



**PEOPLE**  
Restorative



**PLANET**  
Sustainable



**PRACTICALITY**  
Scalable

## EXAMINING BIOPHILIC DESIGN ELEMENTS THROUGH A WIDER LENS

To be scalable and sustainable, biophilic design elements should meet the following criteria



**COMPETITIVELY PRICED**  
Accessible both at installation, and over the lifetime of the asset



**DURABLE**  
Requiring minimal maintenance to sustain



**SUSTAINABLE**  
Recycled, recyclable and waste-free, independently of offsets



**STANDARDIZED**  
Easy to install and service by regular professionals, rather than custom and specialized

# SCALABLE, SUSTAINABLE BIOPHILIC SOLUTIONS USING WOOD ALTERNATIVES

Urban forests represent one extreme of biophilic designs. They bring natural elements like wood into built environments in the most authentic yet costly, custom, and materials- and labor-intensive manner possible, literally hoisting a living forest twenty floors up the side of a tower. The opposite end of the spectrum is occupied by products that are simulated rather than authentic, but much more affordable and accessible, such as wood alternatives.

## Is it possible to achieve the benefits of biophilic design using such accessible everyday materials?

Theory suggests it is. According to Stephen Kellert, biometric design embraces both direct and indirect experiences of nature. Direct experiences include light, air, plants and natural landscapes—the elements featured by urban forests. Indirect experience includes not only natural materials but images of nature in photographs, paintings, and other representation, as well as biomimicry of form and function.



## REAL NATURE

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COSTLY

MATERIALS-INTENSIVE

MAINTENANCE-HEAVY

UNIQUE

DIFFICULT TO SCALE

TAX ON THE ENVIRONMENT

## SIMULATED NATURE

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COMPETITIVELY PRICED

COMPARABLE TO TRADITIONAL BUILDING MATERIALS

DURABLE

STANDARDIZED

EASILY SCALABLE

LOW MAINTENANCE, LOW REPLACEMENT COSTS



## THE SURPRISING PREHISTORIC TRAIL LEADING TO MODERN BIOPHILIC MATERIALS

How can manufactured new materials like wood alternatives provide a “natural” experience? The answer may lie in prehistory.

The premise of biophilia is that humans evolved to respond positively to stimuli that signaled food, water, shelter, and other necessities. Cool green shade, the sound of running water, and the smell of soil after rain are signposts to survival for hunter-gatherers, which is why modern humans feel an affinity toward them. If the premise holds true, mimicking natural stimuli artificially should elicit the same response as the real thing. In other words, if a real tree makes a person feel good, a picture of a tree should do the same.

In fact, it does, according to numerous published studies. For example, half an hour relaxing indoors in a simulated natural environment reduces stress as much as spending the same amount of time outdoors in nature.<sup>7</sup> Posters with pictures of landscapes can ratchet down levels of stress and anger in office environments.<sup>8</sup> Watching nature scenes on television is less stressful for blood donors than viewing urban environments.<sup>9</sup> Sometimes artificial nature works even better than the real thing, as when students preferred pictures with water views to looking out a window at an actual nature scene that didn't include any water.<sup>10</sup> Even immersion in a virtual-reality forest offered benefits similar to a natural setting.<sup>11</sup> The phenomenon isn't just limited to visual stimuli. Recordings of nature sounds help people recover after experiencing psychological stress.<sup>12</sup>

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<sup>7</sup> Anette Kjellgren, Hanne Buhrkall, A comparison of the restorative effect of a natural environment with that of a simulated natural environment, *Journal of Environmental Psychology*, Volume 30, Issue 4, 2010, Pages 464-472, ISSN 0272-4944, <https://doi.org/10.1016/j.jenvp.2010.01.011>.

<sup>8</sup> Kweon, B.-S.; Ulrich, R.S.; Walker, V.D.; Tassinari, L.G. Anger and stress: The role of landscape posters in an office setting. *Environ. Behav.* 2007, 40, 355-381.

<sup>9</sup> Ulrich RS, Simons RF, Miles MA. Effects of environmental simulations and television on blood donor stress. *Journal of Architectural & Planning Research* 2003; 20:38-47.<sup>10</sup> Felsten, G. Where to take a study break on the college campus: An attention restoration theory perspective. *J. Environ. Psychol.* 2009, 29, 160-167.

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<sup>11</sup> Restorative Effects of Virtual Nature Settings, Deltcho Valtchanov, Kevin R. Barton, and Colin Ellard, *Cyberpsychology, Behavior, and Social Networking* 2010 13:5, 503-512, <https://doi.org/10.1089/cyber.2009.0308>

<sup>12</sup> Alvarsson JJ, Wiens S, Nilsson ME. Stress Recovery during Exposure to Nature Sound and Environmental Noise. *International Journal of Environmental Research and Public Health.* 2010; 7(3):1036-1046. <https://doi.org/10.3390/ijerph7031036>





## A FIELD GUIDE TO USING SIMULATED NATURE LIKE WOOD ALTERNATIVES TO PRODUCE BIOPHILIC EFFECTS

While simulated nature can achieve the benefits of biophilic design, it must look realistic. For example, the more a wood alternative looks and feels like wood, the more benefit it offers occupants.

Repeat patterns should not be obvious and the surface should appear to be real. This is essential for walls, as they are seen from up close, whereas ceilings are viewed at more of a distance.<sup>13</sup>

Realism is one criterion for evaluating whether a manufactured material like a wood alternative provides biophilic benefits, but there are others. Kellert explains: “If a design doesn’t focus on aspects of the natural world that contribute to human health and productivity in the age-old struggle to be fit and survive, it’s not biophilic.”<sup>14</sup> He proposes a five-factor test for evaluating whether an element is biophilic or not—a test that has practical applications in the usage of manufactured materials with simulated natural characteristics.

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<sup>13</sup> Barbara Horwitz-Bennett, Natural materials in biophilic design, *Architectural Record*, May 2020.

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<sup>14</sup> Stephen R. Kellert, What Is and Is Not Biophilic Design? *Metropolis Magazine*, October 26, 2015. <https://metropolismag.com/projects/what-is-and-is-not-biophilic-design/>



## WHAT BIOPHILIC DESIGN INCLUDES (FOLLOWING KELLERT)

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### Natural elements that relate directly to human survival and success.

Biophilic design incorporates aspects of the natural world that shaped our evolution and advance our health, fitness and wellbeing. For example, an environment that features dappled sunlight, soft breezes, the sound of running water and the smell of a forest suggest the ready availability of food, potable water, and shelter. Knowing these resources are nearby puts us at ease.

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### Repeated and sustained encounters with nature.

The success of biophilic design depends on ongoing engagement with natural elements.

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### Design that's immersive and fully integrated within an overall space and setting.

The point of biophilic design is to make built spaces look, feel and function more like healthy natural habitats, where various elements work together in a connected ecosystem that supports a variety of organisms.

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### Design that fosters emotional attachment to particular settings and places.

Touching the chords of our connection with nature encourages people to identify with and care about the places they inhabit.

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### Design that fosters positive and sustained interactions and relationships among people and the natural environment.

We are a social species, and our security and productivity depend on a sense of belonging.

## WHAT IT EXCLUDES

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Natural features which have no relationship to human survival. A model of a hydrogen atom hanging in a lobby is not biophilic design, despite being a representation of "nature." Nor is a material that evokes a barren desert or the bottom of the ocean, since such materials were never encountered by our ancestors.

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Occasional, transient, or isolated encounters with nature. These encounters make only fleeting, superficial impacts, and may even be counterproductive—e.g., the "January Blues" when Christmas greenery comes down. The same effect may be seen when biophilic elements are used primarily for spaces that occupants use only seldom or briefly, such as entries, guest quarters, conference rooms, or out-of-the-way solaria or sunrooms.

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Exposures to nature that are disconnected from the rest of the environment. There is no benefit to placing a lone potted plant in a sleek minimalist office.

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Generic design elements that lack a sense of place, such as an internationalist building that would look equally at home in L.A. or Abu Dhabi.

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Isolating elements that make interaction difficult. Acoustically active materials such as glass and tile make communications difficult, while unpleasant textures and cold surfaces discourage lingering.

## IMPLICATIONS FOR SPECIFYING MATERIALS

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Choose materials that convey a safe, hospitable yet interesting environment. For example, the grain, texture, and warmth of wood frequently rank among the most stress-reducing stimuli.

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Rather than add a few precious features to lobbies or executive suites, employ durable biophilic materials that can sustain heavy wear and daily use over extended periods of and features them liberally throughout a built environment.

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Select biophilic materials that can transform a space and be integrated throughout the environment, such as flooring, decking and siding.

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From a biophilic perspective, uniqueness is a virtue. Look for materials that can be easily sculpted, shaped, worked or otherwise customized onsite with minimal skill or use of specialized technologies.

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Choose materials that are warm, friendly, attractive, and conducive to lengthy stays.

# THE FINAL TEST OF HOLISTIC BIOPHILIC DESIGN

After evaluating the biophilic efficacy of a given manufactured wood alternative, we must next assess whether it is sustainable and scalable—the very reasons for considering simulated natural materials in the first place. We propose a simple three-part test for determining how well a wood alternative product contributes to our holistic approach to biophilia.

## RESTORATIVE



Does the material meet Kellert's criteria for biophilic design (above)?

Does it produce byproducts harmful to health, such as off-gassing?

Can it be easily shaped, sculpted or customized?

## SUSTAINABLE



Is the material manufactured from a renewable resource?

Is the manufacturing process zero waste?

Is the product recycled and recyclable?

Does it harm forests?

## PRACTICAL



Is it durable—does it resist rot, fire, and weather, or will it warp, crack or swell over time?

How long is the materials warranty?

Does it require specialized tools and expertise to install?

Does it come in standard dimensions?

Is it available through regular distribution channels?

## A NEW, BROADER VIEW OF BIOPHILIC DESIGN

Biophilic design has helped architects awaken our innate human responses to our built environment. Its insights empower structures to go beyond their roles in sheltering us to create environments that are also healing and restorative. Until now, attention has focused primarily on high-profile biophilic projects with significant costs in money, labor, materials, and environmental impact. Those projects have redefined boundaries and inspired innovation. The time has come to bring practicality, accessibility and sustainability into the discussion. As it turns out, simulated nature may play a surprising role in helping us protect the real thing. By democratizing biophilic design while narrowing its environmental footprint, materials like sustainable wood alternatives can help create projects that are better for humans, better for society, and better for the planet.

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