Sustainable Materials

Jared Green

Meg Calkins, FASLA

Meg Calkins, FASLA, is the department head and professor of landscape architecture at North Carolina State University. She is a contributing editor to Landscape Architecture Magazine*, a founding member of the Sustainable SITES Initiative® (SITES®), and author of* Materials for Sustainable Sites: A Complete Guide to the Selection, Evaluation

and Use of Sustainable Construction Materials *and* The Sustainable Sites Handbook: A Complete Guide to the Principles, Strategies and Best Practices for Sustainable Landscapes.

Interview conducted at the ASLA 2019 Conference on Landscape Architecture in San Diego.

Over the past few decades, how much progress have we made towards achieving sustainable landscapes? What practices promoted through the Sustainable SITES Initiative® (SITES®) have landscape architects now widely adopted? What low-impact material alternatives do landscape architects now widely use?

In general, we have made strong progress toward sustainable landscapes in some areas. Green infrastructure — including bioretention, bioswales, rain gardens, even green roofs — are now pretty widely used, especially in urban environments. Their performance and cost benefits are well-documented.

Landscape architects are getting a handle on how to employ them in a functional and artful way. Landscape architects are also starting to speak the language of civil engineers and doing great collaborations in the area of stormwater management. This whole area of SITES and sustainable site design has been really successful.

ASLA 2019 Professional General Design Honor Award. Chulalongkorn University Centenary Park, Bangkok, Thailand / LANDPROCESS

Landscape architects are also designing with native plants and plant communities in mind, and many are avoiding invasive plants. If only we could get the nursery industry to not stock invasive plants, we would be OK. But even in urban settings, landscape architects are conceiving of plant communities as habitat as well as having aesthetic value.

Where are the major gaps? Where does progress need to happen the most?

Use of materials with reduced environmental and health impacts are lagging behind. This is because clear and comparable information about the carbon footprint, resource use, manufacturing impacts, and toxicity of materials and products is not widely available.

Information transparency is perhaps the biggest challenge when trying to reduce the environmental and human health impacts of materials and products. LEED, SITES, and the Living Building Challenge offer credits encouraging information transparency, but these credits are still among the least achieved.

Product manufacturers do not provide information on embodied carbon, resource use and waste, energy and water use, and toxicity impacts. Human health impacts may be the most challenging to identify given many manufacturers claim the constituents of their products are proprietary and therefore will not release information on the types of chemicals used or produced and their quantities.

The habitat and cultural impacts of raw material extraction are often an out of sight out of mind issue. For example, we don't see the impacts of harvesting tropical hardwood lumber from the Amazon, so it doesn't seem so problematic to use it. We don't see the ecosystem decline after the removal of the keystone species tree that is cut to make tropical hardwood lumber. We don't hear about the murders of indigenous people to intimidate them to leave their protected land so tropical hardwoods can be harvested. And we don't know that there is a 78 percent chance that the tropical hardwood we are using was harvested illegally (Greenpeace 2014).

Through Climate Positive Design, Pamela Conrad, ASLA, has devised a comprehensive approach for designing and constructing landscapes so they sequester more carbon than they emit over their lifespans, transforming them into net carbon sinks. Through her design toolkit, she recommends swapping carbon-intensive materials with lower-carbon options and planting more greenhouse gas-absorbing trees and shrubs. As you just mentioned, one of the issues you have identified is the lack of third party-verified environmental product declarations with publicly accessible data. How can we get full transparency around the environmental impact of landscape products?

First, I want to say that balancing carbon onsite is a critical aim, and Conrad's design toolkit is wonderful. It's going to have a transformative impact on site design and material and product specifications.

Embodied carbon of materials is a far more accurate indicator of the impact of producing a building material or product than embodied energy. Embodied energy is not as accurate because all energy sources do not have equal impact on the environment. Some will be almost carbon neutral, like wind power, and others, like coal, will have very high embodied carbon and a substantial environmental footprint.

But while carbon considerations are heavily prioritized in decision making in the building fields, they do not tell the whole story. The human health impacts of materials and products, which can be very substantial, tend to fly under the radar.

PVC, a plastic that is used in countless construction products, has lower embodied carbon than some other plastics, but it can be extremely toxic to humans in manufacture, use and disposal, particularly if it is burned or heated to very high temperatures. Designers need to consider these impacts, but the only way they're going to know about them is for manufacturers to tell us exactly what is in the products and what by products are produced.

Information transparency by product manufacturers is an area that lags behind other sustainability considerations. I did a content analysis study back in 2012 of the websites of all exhibitors at the 2012 ASLA conference. We looked at what kind of information they're providing on the impacts of their materials and products, and the steps they're taking to make them more sustainable. Less than 1 percent provided either life cycle assessment (LCA) or environmental product declarations (EPD).

I'm replicating that study right now, seven years later. I don't have the results yet, but I suspect it's going to be closer to 10 percent providing that kind of information. There is progress being made, but we still not enough information for designers to use to compare similar products.

SITES and LEED have likely had a slight transformative impact on the information that product manufacturers provide. But the fields of architecture and interior design are ahead of us. If we did a content analysis of their product websites, we would probably find somewhere between 20 and 30 percent provide environmental product declarations.

The main way to address the lack of information is for landscape architects and designers specifying site construction products to talk to product manufacturers and ask for information about the environmental and human health impacts of their products. Telling manufacturers — "Well, I'm considering using your product but your competitor, Company X, has an environmental product declaration, so I'm going to go with them" — is only way to make it happen.

Of course, one can earn LEED and SITES credits for companies that offer some material transparency. But I don't know if that's making change as much as designers constantly asking for that information.

Concrete production accounts for around 8 percent of global greenhouse gas emissions. Cement, which is a primary ingredient in traditional concrete, is the second-most used natural resource after water. You have written about the many low-carbon concrete options companies are developing, including carbon-sequestering concrete, concrete that requires lower amounts of energy to produce, and concrete primarily made up of fly ash and other waste products. What will it take to replace the conventional polluting concrete with these new alternatives?

These alternatives are so new that many are not widely available on the market yet. Some are still in development. But of those on the market, only the earliest adopters are specifying them. They're better used in Europe, because many are European technologies.

In the U.S., landscape architects oftentimes don't specify concrete mixes. Landscape architects need to convince the people who do — the engineers, the contractors and the Departments of Transportation — to do it.

Contractors are understandably nervous about using new concrete mixes and are not easily convinced to change. Durability is such a key consideration in the performance of concrete, and it is still a question with the new low carbon technologies and mixes. It's just going to take time and experimental applications. If the applications are monitored and the data on performance published, adoption of these technologies will happen.

Solidia Technologies' Solidia cement (low Portland Cement) and Solidia concrete (injected with carbon) was successfully tested in multiple applications by the Federal Highway Administration (FHWA) in east coast locations. This is one way that these technologies can trickle down into the site construction market. If the FHWA or U.S. Department of Transportation believes in it and has it as either a standard or alternative specification, then the contractors in that area are much more likely to want to use that product.

D.I.R.T. Studio artfully integrated recycled concrete, bricks, and rusted metal found onsite at the Urban Outfitters headquarters at the Philadelphia Navy Yard, creating a rich, layered environment that demonstrates sustainable values. Do you see this recycled landscape aesthetic becoming more popular? What trends do you see in the use of recycled materials?

The answer is both yes and no. There's a type of project that can use reclaimed material successfully. Not all clients want that aesthetic and not all project budgets can afford it.

Some projects will never be able to incorporate reclaimed materials because of the budget and bid structure. In a public bid project where the contractor is not onboard until after the bid set is complete, there may be insurmountable obstacles to use of reclaimed materials. It is best if one can design with reclaimed materials in hand, rather than setting out to find them after the bid documents are complete. If you set out to find a nine-by-nine reclaimed cypress post for the pergola that is fully detailed, you're never going to find it. You need to find the material first and then design with it.

Cost can also be an issue. Once located, reclaimed materials sometimes need to be stored for several months until construction. And the material may need work such as removal of nails, cleaning, resurfacing and even regrading.

I don't want to discourage this: if it's a landscape architect can pay this kind of attention to the reclaimed materials, that's great, but it's just not feasible for every project.

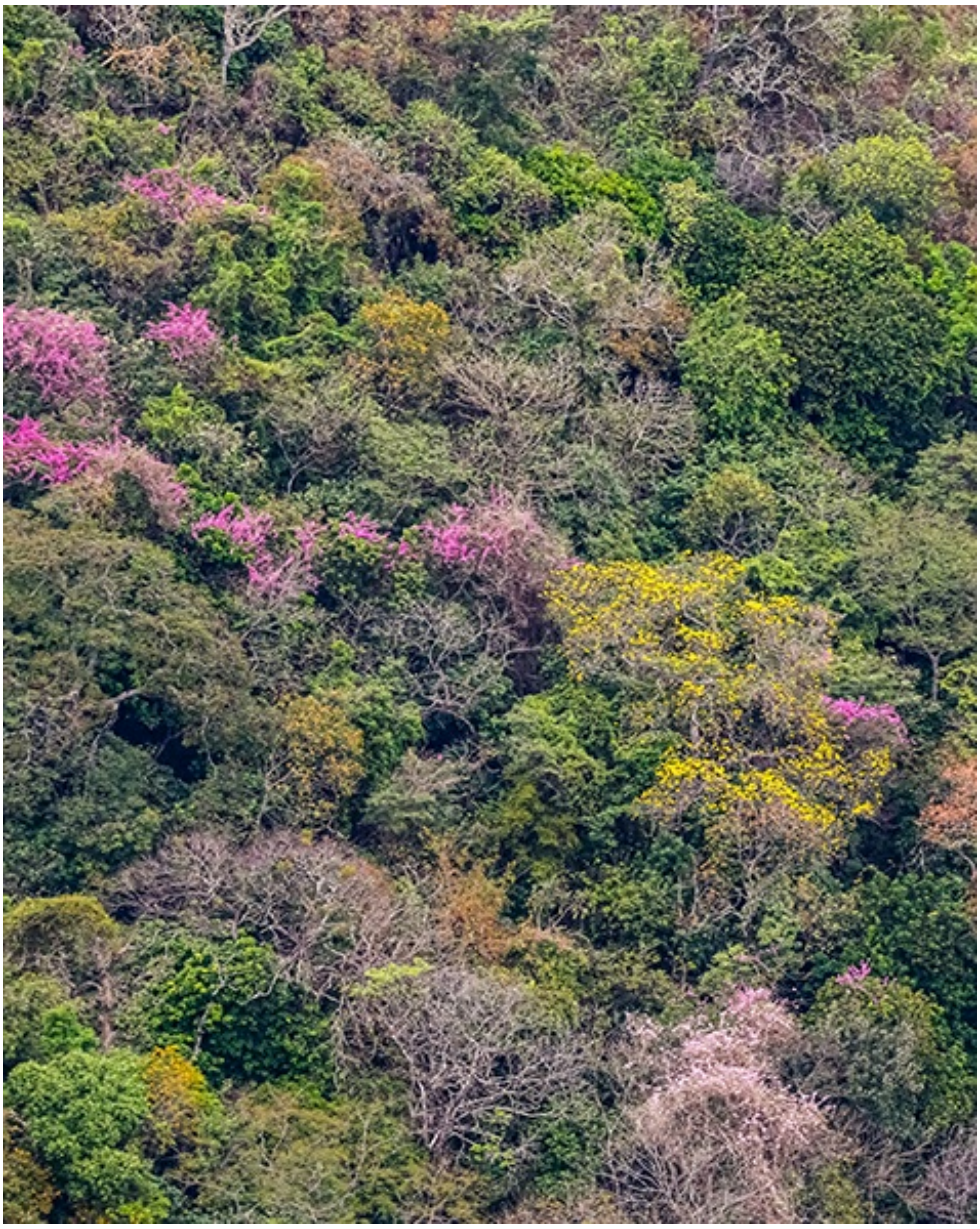
Concrete was broken into pieces and reused as pavers in a garden. ASLA 2014 Professional General Design Honor Award. Urban Outfitters Headquarters at the Philadelphia Navy Yard, Philadelphia, Pennsylvania / D.I.R.T. Studio

Steel from the site was reused as low walls for planters. ASLA 2014 Professional General Design Honor Award. Urban Outfitters Headquarters at the Philadelphia Navy Yard, Philadelphia, Pennsylvania / D.I.R.T. Studio

There has been a growing movement to end the extraction of Ipe and other tropical hardwoods, which is highly destructive to rainforest ecosystems. Landscape architects like yourself and Michael van Valkenburgh, FASLA, have instead promoted the use of native hardwoods like black locust. There are also composite, thermally modified, polymerized, and acetylated wood products. Help us navigate the landscape of tropical hardwood alternatives. How should landscape architects make a decision?

There is absolutely NO reason to use tropical hardwood lumber anymore. There are good alternatives that exist that perform in some cases better than tropical hardwoods and have far lower impacts to ecosystems. Ipe, Cumaru, some of the other tropical hardwoods are keystone or umbrella species in their ecosystems.

Once that one tree is removed, studies show that the forest, plants, and animals for acres around it that depended on that one tree will decline. Within five years that land is usually turned over to grazing land for cattle. Because of this fact, even selective harvesting is not a good practice for rainforest trees.



Ipe trees bloom in yellow and pink in the Brazilian rainforest / iStockPhoto.com

There are also unseen social impacts to using tropical hardwood lumber. Tropical hardwood extraction has devastating social impacts to indigenous communities. Few designers know that since 1985 there have been 1,700 deaths in the Amazon over land disputes that primarily have to do with illegal logging. Also, tropical hardwoods are not a renewable material because it takes 90 to 200 years to grow a comparable tree, but the lumber from that tree is only going to be in use for about 30 years.

There are many alternatives to tropical hardwoods now on the market. Thermally modified wood, acetylated wood, polymerized wood– all three of those use heat and either steam or acetic anhydride or a polymer cross-linking agent, furfuryl alcohol, to modify the sugars of the wood, so that decay organisms no longer recognize them as food. All three of these lumber treatments are non-toxic. They make the wood more dimensionally stable, harder, and much more competitive with the durability of tropical hardwoods. And they are easier to build with than the extremely dense tropical hardwoods.

Another alternative to tropical hardwoods is fused bamboo, which has been on the market in China for close to ten years. It's a really hard product similar to Ipe, so it needs carbide blades to cut and drill it. It's a very durable product, and unlike, Ipe, uses a clip system that avoids the pre-drilling and screwing necessary for Ipe boards. It is a rapidly renewable product, with rapid growth of the bamboo every three to five years.

Fused bamboo is essentially stripped, carbonized, and impregnated with phenolic resin, which may or may not have some toxicity issues. It does contain formaldehyde, but the jury's still out on that. Anyway, it performs and weathers really well. It's easily oiled and rejuvenated, guaranteed for 10 years in commercial applications and 30 years in residential applications.

And then of course black locust is also a good alternative. It can be challenging to use because black locust trees do not grow straight, so when you cut it into lumber, it tends to want to return to its irregular form. But it is starting to be grown on plantations and should have a straighter habit when farmed. Also, use of shorter lengths can prevent its tendency to warp.

Black locust planks make up a walkway in an atrium garden. ASLA 2006 Professional General Design Honor Award. Small is Beautiful, Millburn, New Jersey. Michael Van Valkenburgh Associates / Elizabeth Felicella

Innovative new materials in development include concrete that can absorb air pollution and clean the air, bricks that can be grown, and plants that can be engineered to produce light. What emerging material technologies are you most excited about? Which have the greatest potential to improve our built environment?

I'm the most excited a process called electrically modified cement (EMC) activation. It's essentially a process that modifies the surface of hydraulic waste materials like fly ash and blast furnace slag, or even some natural pozzolans like silica sands and metakaolin.

The process increases the surface area of these particles, creating micro-cracks and dislocations of structure at the nano scale, allowing for greater surface area and greater reactivity with respect to the processes of cement. It's possible to achieve a concrete with 70 percent fly ash and just 30 percent cement. Once this finds its way into the market, it's

going to really transform concrete. That said, fly ash is only around as long as we're burning coal. In Europe, for instance, they're burning a whole lot less coal, so fly ash is not nearly as prevalent as it is in the U.S. anymore.

The other thing I'm excited about is recycled plastic aggregate concrete (RPAC), which is in the testing and case study application phase. There's a whole lot of waste plastic in this world and if we can find a way to use it instead of non-renewable virgin aggregates, we should. The technology is still in the research phase, but preliminary results of RPAC as fine aggregate show an increased flexural strength, tensile strength, and density. There is so much on the horizon to improve the environmental and human health footprint of concrete.

ASLA 2017 Professional Communications Honor Award. Ecology as the Inspiration for a Presidential Library Park. Black Locust bridge. Michael Van Valkenburgh Associates / MVVA Inc

With the General Service Administration (GSA) and now the state of Rhode Island adopting the use of the Sustainable SITES Initiative™ (SITES®) certification system for landscape projects, SITES is gaining momentum. The system now has the potential to transform the marketplace for landscape products as well, explained Hunter Beckham, FASLA, a landscape architect; Meg Calkins, ASLA, a professor of landscape architecture at Ball State University; and April Phillips, FASLA, principal of April Phillips Design Works, in a session organized by ASLA professional practice manager Linette Straus, ASLA, at the 2017 Greenbuild in Boston.

Given SITES v2, which covers landscapes, and LEED v4, which covers all types of buildings, now have a number of synergies designers and developers can take advantage of, the potential market impact of SITES is even greater, Beckham said.

Calkins argued that it's critically important landscape architects and designers leverage SITES to reduce the harvesting of Amazonian hardwoods for seating, decks, and boardwalks. "Some 18 percent of the Amazon has been cut down in the past 20 years." With SITES, "we can transform the market away from tropical hardwoods." SITES incentivizes this transformation with its prerequisites that "eliminate the use of wood from threatened tree species."

For example, Ipe, a rare hardwood that appears once every 7-30 acres and is a signature species in the Amazonian rainforest, has often been used in landscapes because of its durability. But SITES — which refers to plants on the Convention on International Trade in Endangered Species (CITES)'s list of those threatened with extinction and the International Union for Conservation of Nature (IUCN) "red list of threatened species" — prevents the use of this endangered tree species in SITES-certified landscapes.

One big problem with the current approach, Calkins explained, is the "IUCN list is dreadfully behind." Many tree species were last assessed more than a decade ago, so it allows many woods that are no longer plentiful, like Cumaru.

Another issue: In the Pará state of Brazil, some 28 percent of hardwoods are harvested illegally. Even some Forest Stewardship Council (FSC)-certified woods' documentation is forged, with "shady chains of custody." And while the Lacey Act is designed to prevent American companies from purchasing illegally-harvested rare Amazonian hardwoods, "fraud still happens."

Instead of trying to find the few sustainably-harvested rainforest hardwoods, Calkins called for using alternatives like fused bamboo lumber, which is rapidly renewable and outperforms Ipe in durability; American Black Locust lumber, a hardwood native to the Ozarks and Appalachian regions and can be harvested in one-third the time of Ipe;

thermally-modified woods, which are heated so they are twice as hard as the original wood and are disease resistant; polymerized woods, which has been developed in the European Union; and acetylated woods.

Furthermore, "landscape architects need to see environmental product declarations and quantifiable data" for all the products they are considering specifying. The architecture field is "way ahead" of the landscape architecture field in this regard of measuring and verifying the life cycle of products, as there are already a number of independent 3rd party product verification systems.

For Calkins, who researches the sustainability of landscape products, just finding basic information on wood products for landscapes is a challenge. "Corporate sustainability reports are a source of information, as are marketing brochures." But, again, she is looking for independent 3rd party verification of any sustainability claims, and those don't seem to exist for landscape products.

To shift the marketplace, landscape architects need to "ask more questions of product manufacturers, demand they disclose information and be transparent, and use environmental product declarations when specifying."

According to landscape architect April Phillips, who has designed and built SITES-certified projects, the key is to track the sourcing of all materials from the get-go. In a "living roof native landscape" she created for 38 Dolores in San Francisco, she used 44 percent recycled materials and 60 percent regional ones.

38 Dolores / April Phillips Design Works

38 Dolores / April Phillips Design Works

And for a new, 1,500-acre landscape on the site of a former airport in Alameda, California, Phillips is reusing found logs as benches.

Phillips also made the case for environmental product declarations, claiming that too often the only ones she can find are from products made in the Netherlands or New Zealand. And importing these products to the U.S. only adds to projects' carbon emissions and is discouraged in SITES.

The landscape architect mined elements from the cannery structure, including abandoned machinery, for repurposing in the new gardens. The recycled tumbled glass riverbed in the Dining Room Court, and stone columns in the Lew Hing Garden add to the historic character. Hand crafted site furnishings made from FSC-certified wood, concrete, steel, and glass were designed by the landscape architect and crafted by Miller Company Landscape Architects' in-house installation team. ASLA 2010 Professional Residential Design Honor Award. Pacific Cannery Lofts / Miller Company Landscape Architects.

New and non-recyclable materials used in homes and landscapes are often not designed to be recycled. These materials can consume enormous amounts of resources to produce and distribute and create additional waste when they are demolished. Waste materials create waste landscapes: landfills, massive incinerator systems, and multi-square-mile floating plastic garbage islands in the world's oceans.

ASLA has created a new guide to using low-impact materials at home, which contains research, projects, and resources on how to better source materials for residential landscapes. Developed for homeowners and landscape architects and designers alike, the

guide is designed to help spread more sustainable and resilient practices.

To avoid sending useful materials to landfills and cut down on materials that release toxic substances, The Sustainable SITES Initiative™ (SITES®) recommends reusing or recycling existing materials.

Homeowners can also specify local materials to support local economies and cut down on the energy use from the transportation of materials.

But beyond reused, recycled, or local materials, there are other important ways to reduce the impact of materials on our health and environments.

Sustainable residential landscape design can increase the health of environment through the use of innovative low-impact materials that are permeable and reflective (high albedo).

Permeable materials allow water to infiltrate and recharge aquifers, instead of being sent to combined stormwater and sewer systems.

Reflective, "cool," or white materials help reduce air temperatures, particularly in cities dealing with the challenges of the urban heat island effect, and energy costs by minimizing the use of air conditioning to cool buildings.

There are also more sustainable wood and concrete options out there that minimize consumption of newer materials or extend the life of existing materials.

SITES recommends building with certified, sustainably-harvested woods; recycled woods; and recycled plastic or composite lumber to preserve forests, which are critical to sequestering greenhouse gas (GHG) emissions.

To avoid sending useful materials to the landfill, conserve natural resources, and reduce a project's carbon footprint, SITES also recommends landscape architects source sustainable concrete from manufacturers using supplementary cementing materials, like fly ash – a byproduct of coal-fired power plants. Landscape architects should reuse concrete from structures on the existing site, like crushed concrete as an aggregate base. Concrete that incorporates recycled materials, like crushed glass or wood chips, are a more sustainable and use less cement than traditional pavers.

Used in both landscapes and buildings, low-impact materials can reduce GHG emissions and create a healthier environment.

Local governments can partner with non-profit organizations and landscape architects and designers to increase public awareness about why it's important to use low-impact materials.

While we have all experienced the effects of the information technology revolution now underway, we may be less aware of the impact of the new "materials revolution," argues University of Minnesota professor Blaine Brownell in his excellent new book *Transmaterial Next: A Catalog of Materials That Define Our Future*. Building materials are being transformed to respond to our planetary environmental crisis, lower costs and boost efficiency, and provide new media for creative expression. Given the serious problems facing the Earth, the scale of the ambition is heartening.

Brownell has been documenting the evolution of building materials for some time. Over the past decade, he has written *Material Strategies: Innovative Applications in Architecture*; *Hypernatural: Architecture's New Relationship with Nature* (read *The Dirt* review); and three books in the *Transmaterial* series.

Transmaterial Next is rich with interesting details and well-organized, with sections on concrete, mineral, metal, woods and biomaterials, plastic and rubber, glass, paint and coatings, fabric, light, and digital materials. More than 100 brief case studies on materials offer brief summaries, images, the state of commercial readiness, and future possible impacts. He also defines the materials in terms of the trends they represent.

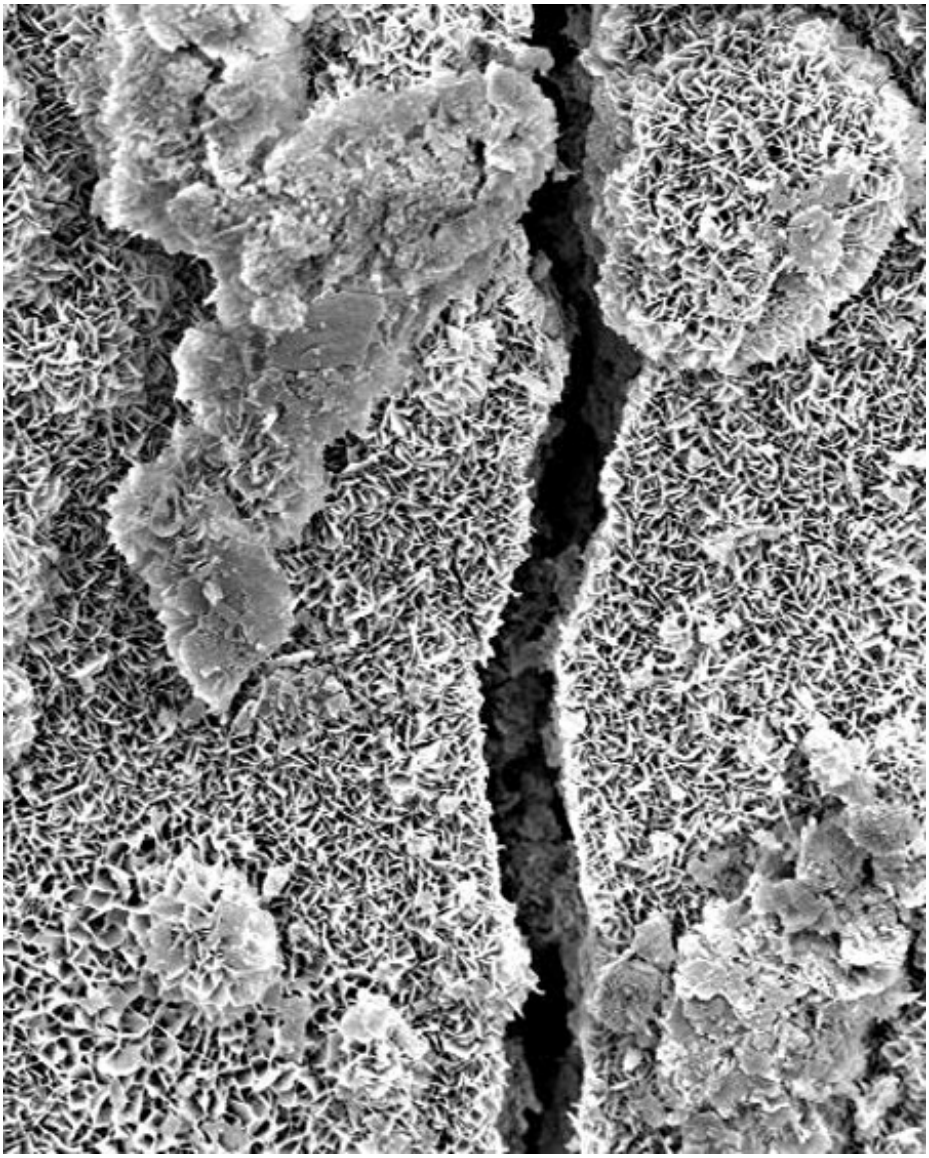
For example, future materials may be ultra-performing, meaning they are "stronger, lighter, more durable, and flexible than their conventional counterparts;" multi-dimensional, "with greater depth and richness;" re-purposed, as they often "replace precious raw materials with less endangered, more plentiful ones, and divert products from the waste stream;" recombinant — because "two or more different materials act in harmony to create a product whose performance is greater than the sum of its parts;" intelligent, because they "take inspiration from biological systems and are therefore less wasteful;" transformational, because they "undergo a physical metamorphosis based on environmental stimuli;" and interfacial — as they can serve as a linkage between the "physical and virtual worlds."

Brownell does a great job of explaining the environmental costs of our exploding resource use and how new, less wasteful materials will help.

Concrete, which was used by the Romans before falling out of favor for centuries, is now the "most heavily used material on Earth after water." Concrete production accounts for some 5-10 percent of global carbon dioxide emissions, and its use is growing 2-4 percent year, given its relatively short life-span and difficulty to recycle.

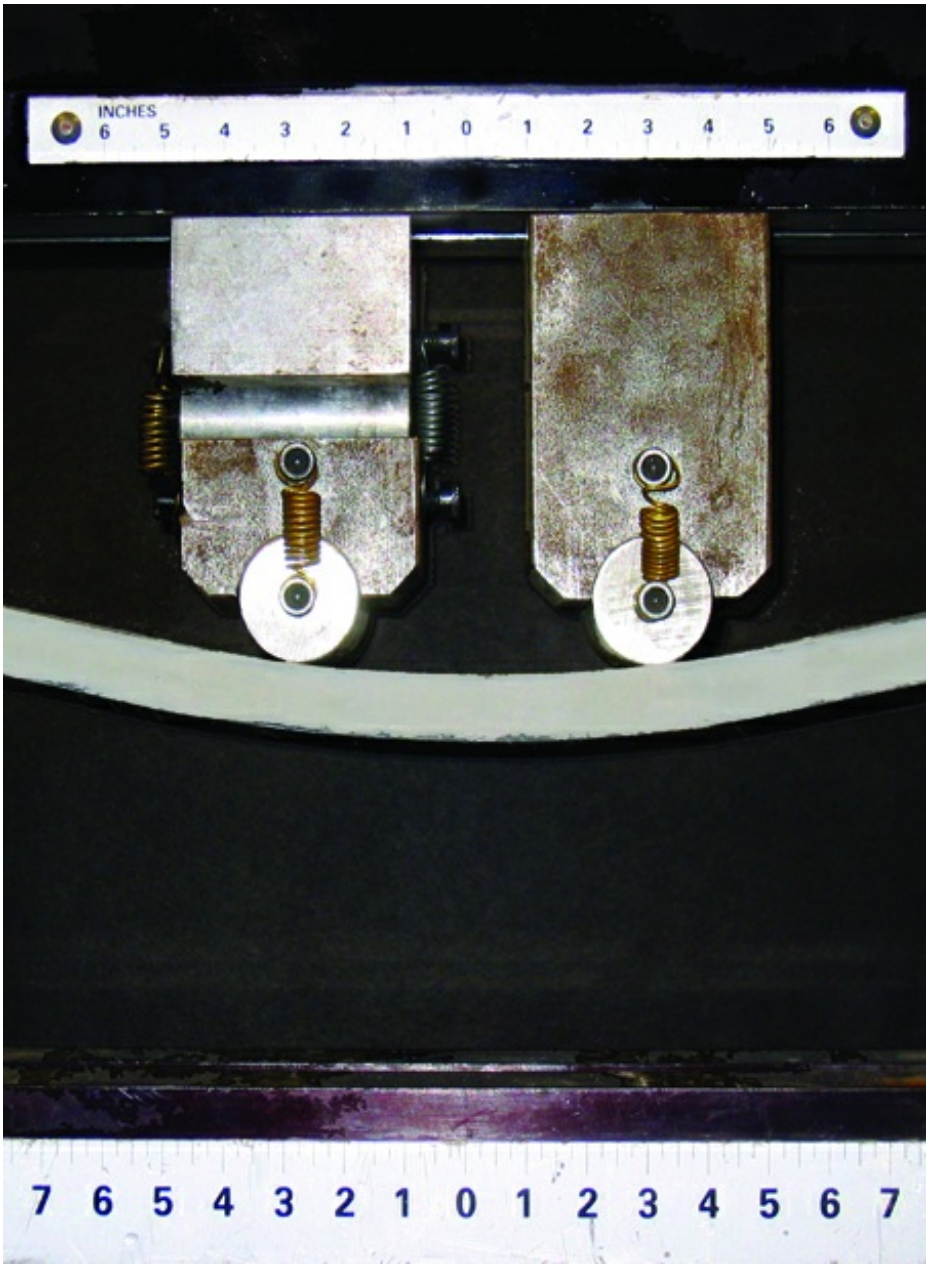
Concrete production can be far less polluting. Brownell identifies how simply replacing some of the Portland cement portion of cement with "alternative cementitious materials, such as fly ash or slag" can reduce emissions by some 46 percent. He calls for replacing problematic steel, which is used as a reinforcement in some structural concrete, with fibers or other materials.

Concrete emissions can also be reduced by lengthening the useful life of concrete as well — through “self-maintaining” or “self-healing” technologies that reduce maintenance. For example, BacillaFilla is an “engineered microbial glue” that can repair cracks in concrete. The microbes are grown in a bioreactor. After they are applied with a spray, the microbes quickly bind and come with a kill switch so the “germination process may be terminated.”



BacillaFilla / Wonderful Engineering

And then there’s bendable concrete, which is “far less brittle than conventional concrete.” While bendable concrete does form micro-cracks if bent too far, it can “self heal in the presence of air and water.”



Bendable Concrete / The ACE-MRL, University of Michigan. From Transmaterial Next by Blaine Brownell, © 2017 Princeton Architectural Press, reprinted with permission of the publisher.

In the minerals section, Brownell sees the need to reduce carbon dioxide emissions from the brick industry, which spews out high amounts of black carbon. One way to do that is growing bricks via biochemical processes. Mason, a company out of North Carolina, seeks to do this with BioBrick, which uses bacteria to generate bricks out of sand or another aggregate.

BioBrick / bioMASON. From Transmaterial Next by Blaine Brownell, © 2017 Princeton Architectural Press, reprinted with permission of the publisher.

Another fascinating application — Stone Spray, a sort of 3D printer that "collects direct and sand located on sites and mixes them with a binder ingredient." The vision of nearly-instantaneously printing a structure using nearby materials is awe-inspiring. The technology is in very early stages, and there would be limitations — the load-bearing capabilities of nearby materials would determine the capacity of the structure.

Stone Spray / Institute for Advanced Architecture of Catalonia. From Transmaterial Next by Blaine Brownell, © 2017 Princeton Architectural Press, reprinted with permission of the publisher.

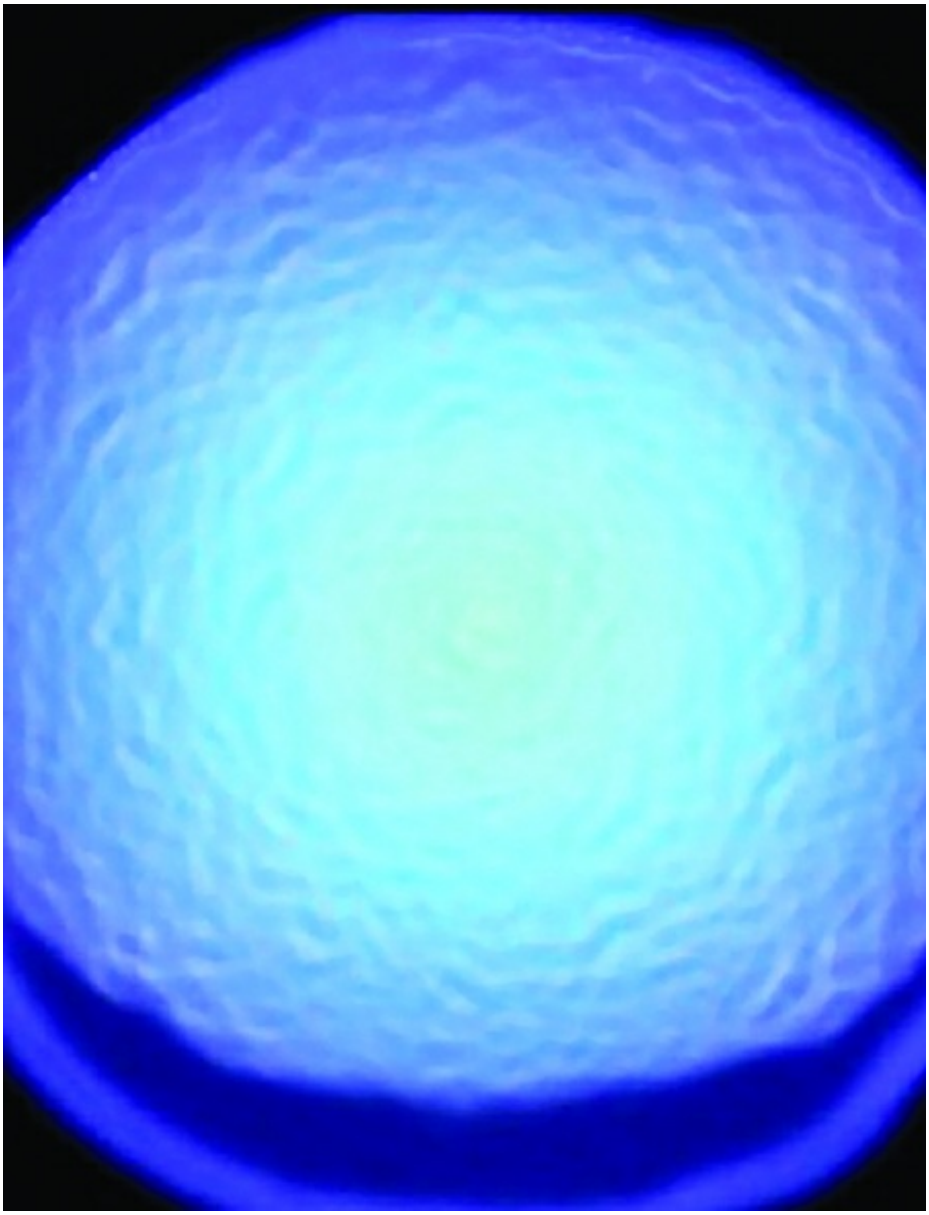
Over the past 500 years, some 4.45 billion acres of forest have been cleared. If the planet keeps going at the rate it has been, we will lose the world's rainforests in a century. "This resource crisis suggests that forests must be preserved as much as possible." To slow or stop deforestation, Brownell offers up some novel technologies, such as NewsPaperWood, a Dutch product, that is made out of recycled newspaper and is gorgeous.

Newspaperwood / Raw Color. From Transmaterial Next by Blaine Brownell, © 2017 Princeton Architectural Press, reprinted with permission of the publisher.

In the paints and coatings section, we learn about the potential of next-generation surfaces with coating technologies that enable “light harvesting, electricity production, and structural monitoring.” One brilliant example is the photo-luminescent paint found in the Dutch Smart Highway Project. A team from Studio Roosegaarde and Heijmans created a test bed with photo-luminescent strips that “absorb daylight and emit light during the evening for up to eight hours.” Think of the cost savings for lighting and the creative opportunities.

Van Gogh Path / Pim Hendriksen. From Transmaterial Next by Blaine Brownell, © 2017 Princeton Architectural Press, reprinted with permission of the publisher.

A related idea in the lighting section: A team of researchers at the University of Wisconsin harnessed genetically-modified *E.coli* bacteria, algae, and protists to create a biolumenescent light source that will run on sunlight and its own waste. Still in early development, the bulb designers face challenges in making it reliable, Brownell argues.



BioBulb / AnaElise Beckman, Alexandra Cohn, and Michael Zaiken. From Transmaterial Next by Blaine Brownell, © 2017 Princeton Architectural Press, reprinted with permission of the publisher.

And there's also Starlight Avatar, a strange plant that gives off light. Its chloroplast gene has been genetically modified with elements of marine bacteria. Bioglow, the firm behind this new organism, wants to "create foilage that can double as low-energy light sources." The plant, which Brownell thinks could be used alongside paths for nighttime navigation, is ready for the market and available in the U.S. Whether there is a future market for glow-in-the-dark plants is unknown.

Now these new materials need to be scaled up. In particular, the planet is way past due more efficient and longer-lasting concrete.

A newly expanded and now mobile-friendly version of ASLA's Designing Our Future: Sustainable Landscapes online exhibition highlights real-world examples of sustainable landscape design and its positive effects on the environment and quality of life. These spaces use natural systems to provide ecosystem services, transform untapped assets into

Sherbourne Commons / ASLA 2013 General Design Honor Award. Sherbourne Common / Phillips Farevaag Smallenberg

vital community spaces, and create new economic opportunities — they ultimately provide significant environmental, social, and economic value.

Ten new case studies that range from a coastal ecological restoration project to a volunteer-run urban farm illustrate just what sustainable landscapes are and how they provide important benefits on a variety of scales. In the process, the case studies, written in clear, understandable language, also introduce users to what exactly landscape architects do.

The new case studies were carefully selected to show a diversity of landscape types and scales and reflect geographical diversity. There are now a total of 40 case studies.

New case studies include:

Burbank Water & Power Eco-campus, Burbank, California, a sustainable landscape for employees and visitors in the midst of a working power plant.

Drs. Julian and Raye Richardson Apartments, San Francisco, California, a safe and welcoming apartment complex, with beautiful design elements, for the chronically homeless.

Lafayette Greens, Detroit, Michigan, a volunteer-run urban farm in downtown Detroit where 800 pounds of fresh fruit and vegetables are grown every year.

Living Breakwaters, New York, New York, an innovative coastal ecological restoration project that won $60 million in the Rebuild by Design competition sponsored by the U.S. Department of Housing and Urban Development (HUD).

Pete V. Domenici U.S. Courthouse Sustainable Landscape Renovation, Albuquerque, New Mexico, an underused plaza that has become a model of sustainable landscape design in the desert.

Quarry Garden, Shanghai, China, a derelict, polluted quarry that was transformed into a garden visited by more than 3 million people in its first year.

Sherbourne Common, Toronto, Cananda, a multi-functional park and wastewater treatment plant that includes an underground Ultraviolet (UV) water purification system.

The Steel Yard, Providence, Rhode Island, an abandoned steel manufacturing facility that has become a beloved community arts space.

Sunnylands Center and Gardens, Rancho Mirage, California, an extension to the Annenberg Estate that captures every drop of stormwater, with some collected in underground cisterns for later use.

Woodland Discovery Playground, Memphis, Tennessee, an immersion in nature play for children that features surfaces made of recycled athletic shoes.

The Web site also 30 other case studies; 10 animations created by Daniel Tal, ASLA, using Google Sketchup; and companion sustainability education resources that enable users to explore sustainable design concepts in greater depth.

Founded in 2005 by landscape architect John Bela, ASLA, a founding principal of Rebar, PARK(ing) Day is September 18 this year. PARK(ing) Day is a global, open-source phenomenon in which landscape architects and other designers transform metered parking spaces into temporary mini-parks, or parklets. The event helps the public visualize just how much of our public realm is given over to cars and all the other potential ways these spaces could be used by communities.

The American Society of Landscape Architects (ASLA) encourages its professional and student members to lead the design and installation of parklets and show the public how surprising designed parklets can be.

Whether it's simply a new place to sit and relax, or play a game, parklets will draw a crowd.

PARK(ing) Day is an excellent opportunity to teach the public about landscape architecture. Parklets offer a glimpse of what landscape architects or designers can do, and the value design adds to public spaces. People passing-by will stop to check out your parklet and learn about its designers.

AUB Landscape Society celebrates Park(ing) Day / outlookaub.com

PARK(ing) Day can earn you plenty of local attention, but ASLA wants to show you and your parklet to the world. On September 18, post a picture of your parklet with #ASLAPD on Facebook, Twitter, or Instagram, and ASLA will share it. We'll put our favorite student and professional-designed parklets in an ad in *Landscape Architecture Magazine*.

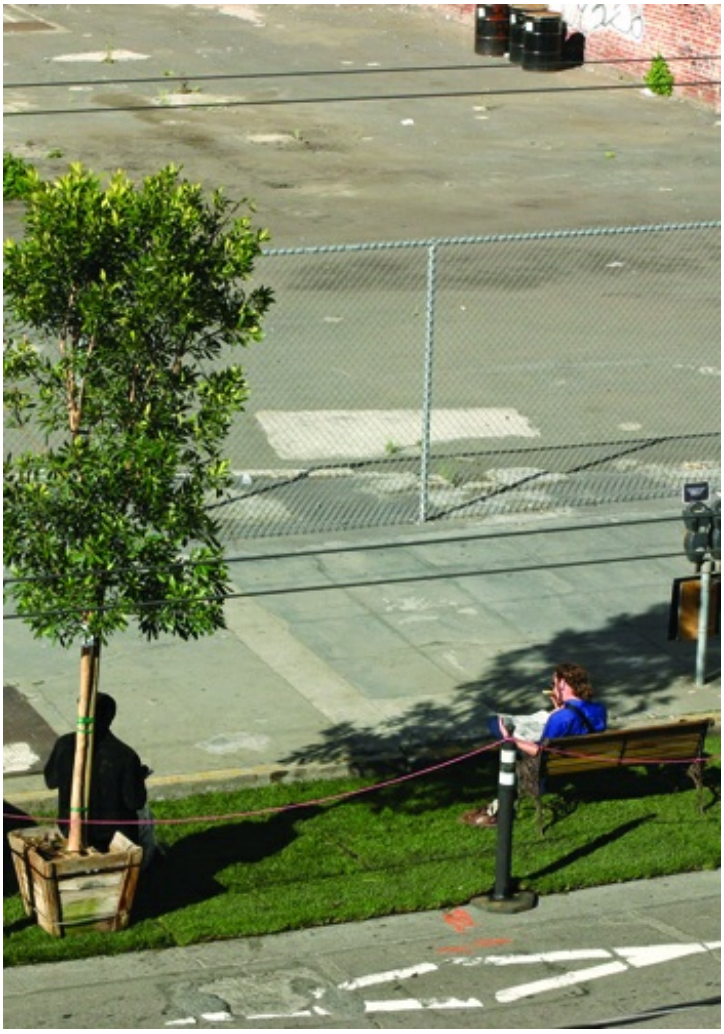
If you would like to participate in the event, visit ASLA's PARK(ing) Day site to get started and learn about local permitting and insurance. For inspiration for your parklet, read our PARK(ing) Day 2014 recap or contact your local ASLA Chapter. Have questions? Send them to jtaylor@asla.org.

"What gives you hope that a sustainable future is possible?" In *Designed for the Future: 80 Practical Ideas for a Sustainable World*, Jared Green — the same Green who edits this blog, and, full disclosure, was my boss when I was a communications intern at ASLA — offers 80 thought-provoking and frequently inspiring answers to this question from landscape architects, urban planners, architects, journalists, artists, and environmental

leaders in the U.S. and beyond. The book's tone is highly conversational and reflects the voices of the book's contributors. Each passage is the result of an interview with Green, who serves largely as curator for this reading experience.

To those in the field, the names are like a who's who of respected leaders in these professions. But while professionals will certainly enjoy it, this book is aimed squarely at the public, as it's as scrubbed-free of design jargon as possible and offered in bite-size pieces easy to pick up for a few minutes at a time or read entirely through on a weekend afternoon.

It's largely successful in this aspect, capturing the essence of the ideas at the core of each real world example without losing the reader in technical terms and excess detail. However, in a few cases, the description is so sparse as to leave uncertain exactly what the project is about.



Rebar's original PARK(ing) Day in San Francisco, 2005 / parkingday.org

Some of the projects feature new technologies applied in innovative ways. Lighting designer Leni Schwendinger, now with Arup, is inspired by Illuminate, a three-year research program in six European countries showing the way to the future of light-emitting diode (LED) lighting in public spaces. The study examined not only at energy savings and carbon reductions, but also the quality of light in terms of brightness, color temperature, and color rendition (whether the object illuminated looks true to life). It's the artificial nature of these latter qualities that tend to sway many designers away from LEDs, despite their energy savings, but this study shows they are being improved, and LEDs may soon be able to use "intelligent controls to create malleable lighting" in our parks, plazas, and museums.

Jonsara Ruth, a professor at The New School / Parsons, discusses Mushroom Board from the firm Ecovative, a product that uses mycelium, the "roots" of mushrooms, to literally grow an organic Styrofoam replacement. Styrofoam is an incredibly polluting material, but Mushroom Board, a cutting-edge use of bioengineered materials that can be grown to almost any shape and size, is completely biodegradable. Imagine appliances coming packed in Mushroom Board or homes insulated with mushroom in the walls instead of spray-in foam.

HBB Landscape Architecture parklet / Seattle Daily Journal of Commerce

Many projects feature materials and infrastructures from the past that have been given new life to serve contemporary needs. Landscape architect Thomas Woltz, FASLA, Nelson Byrd Woltz, describes how Braddock, Pennsylvania, is in the process of transforming much of its abandoned and toxic industrial lands, re-envisioning them as a place for urban farming and healthy community initiatives.

And Peter Harnik, Hon. ASLA, director, Center for City Park Excellence, Trust for Public Land, describes how Midtown Greenway in Minneapolis is a railway that has been converted into one of the most successful trails for cyclists and pedestrians. Built in a trench to not interfere with auto traffic, it's a delight for its users who can go for long stretches without having to negotiate intersections and vehicle conflicts.

One overarching theme is the need to further connect social, environmental, aesthetic, and economic benefits that have been considered for too long in isolation. For decades, we've known, in theory, that achieving quadruple-bottom line benefits is essential for sustainability. These existing projects show how multiple benefits can be achieved in the

real world, and the positive impact they can have on communities and the environment.

Green offers a lovely quote in his introduction from science fiction writer William Gibson: "The future is already here, but it's just not evenly distributed." Environmental advocacy and action can so easily just focus on the negative or emphasize only the compromise and sacrifice necessary for "saving the planet." The examples in *Designed for the Future* show that not only is our future not all doom and gloom, but there's plenty to be excited about here and now. The future is here. Now let's start spreading today's successes around as widely as possible.

SWA Group Landscape Architecture teamed up with the Bentley Reserve to set up a pop-up bocce ball court

"People now want to be comfortable when they sit on a bench," said Erik Prince, ASLA, Stoss Landscape Urbanism, in a session on urban furniture at the 2013 ASLA Annual Meeting in Boston. "It's no longer about making benches uncomfortable for vagrants and the homeless." In a tour of the humble public bench's past — and its potential future — Prince, along with Jane Hutton, assistant professor of landscape architecture, Harvard University, and architect Robyne Kassen, Urban Movement Design, explained how a shift

in public furniture design may reflect broader societal changes and could be leading us towards healthier, more inclusive public spaces.

Prince said some contemporary benches, like the one Stoss just hand-designed and fabricated for The Plaza at Harvard University, provide a "new organization of social space" (see image above). These "more ergonomic" benches allow for "multiple functions, like stretching, playing, and lounging." These new functions are only made possible through a revolution in design practices, like 3D modeling and fabrication. Some of these new benches are designed to be inherently flexible, with "changeable forms" that can create a "new sense of community."

Happy PARK(ing) Day / The Penn Stater

The History of Public Furniture

Hutton said the many types of benches throughout history have offered unique ways of sitting and interacting with the surrounding environment. "Different materials and inclines generate different social realities." Benches can either be "solitary or social, exclusive or inclusive." While they are often "invisible in the landscape," public benches are actually central to our appreciation of landscapes, as they "organize the scope and our scoping strategy."

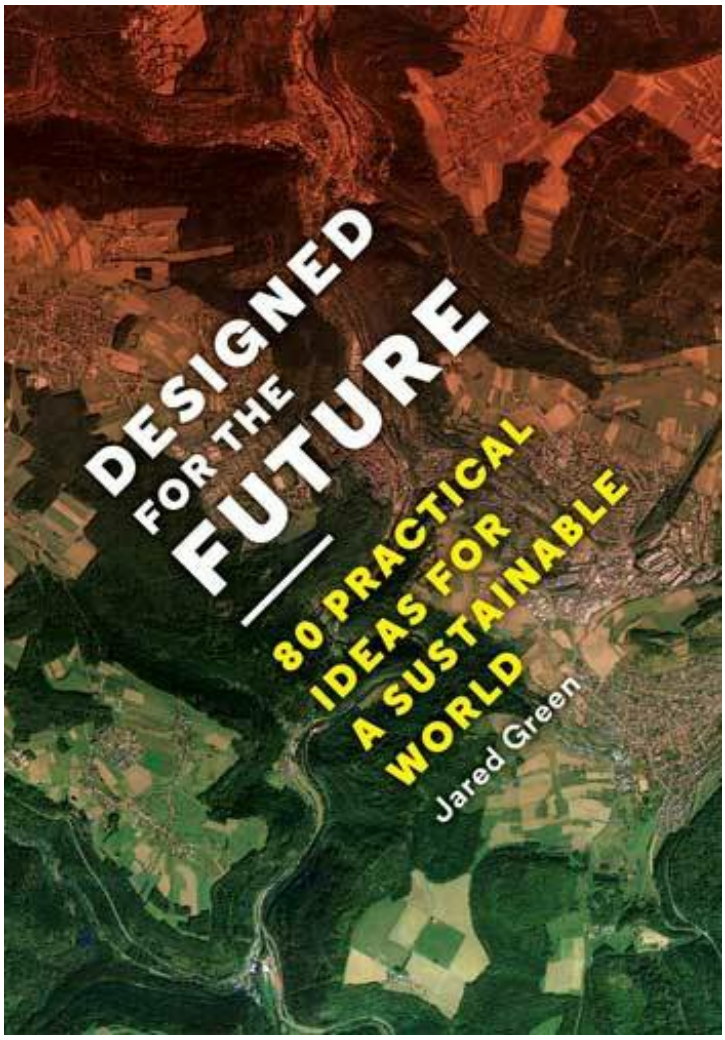
In the 14th century, Tuscan civic benches were built into plazas, enabling small public spaces to form for "theatrical or tribunal purposes." These benches helped "convey the sense of civic action and stimulated popular use." They were about half a meter wide, so you couldn't sleep on them.

In the 18th and 19th centuries, communities started creating the "rustic twig bench," which reflected a "transcendental, natural philosophy." As an example, "crude" benches in Central Park, NYC, worked with a "pastoral ideology."

In the 19th and 20th centuries, garden chairs started to be mass produced. Carved wood chairs, which were never comfortable, were now made out of iron, with “intricate plant and animal motifs.” Hutton said these were “very uncomfortable,” largely because they were meant to be “show seats when not occupied.”

In the 1860s, the first comfortable, mass-produced, iron garden chair was created, along with a low-cost folding chair, which was iconic in the military arena and also featured prominently among colonizers in Africa and Asia. These light-weight garden or foldable chairs were soon available for rent in public parks. In the gardens of Versailles, there was a garden chair with a fold-able back.

The Central Park settee, one of the first designed, stationary public benches, was made with a mix of iron handles with wood slats. “It was just under relaxing,” Hutton added. From then, there was a proliferation of “benches in street furniture.” None were particularly comfortable because then the thought was “you should hold your own posture, not rely on the chair.”



Designed for the Future / Princeton Architectural Press

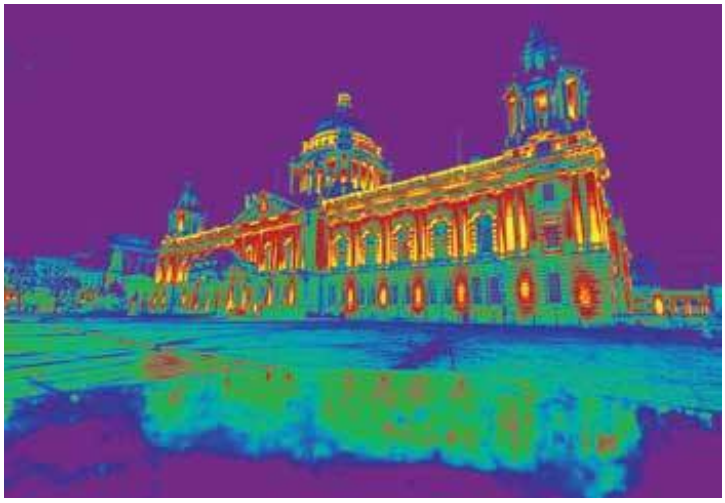
In the 20th century, there were experiments about the human figure and ideal reclining positions. Furniture studios examined “free-form ergonomics,” exploring how a mix of “rigid and contoured” cement and fiberglass could be created to create an ideal form. This era led to some of the “iconic chaise lounges” that populated Garrett Eckbo’s “modern landscapes for living.” Marcel Breuer created his famous lounge recliner. Later, Panton explored the use of plastics. “These were for play and pleasure.”

For a period of time, public benches were purposefully made uncomfortable in order to deter unwanted elements. “They were defensive or deterrent furnishings.” But today,

Hutton said, the shift is towards more comfortable and relaxing public furniture, which even enable "splaying in public," a posture once only allowed in the "medical or residential spheres." There's now a potential for "new positions in public spaces."

Ergonomic Positions Made Possible by New Technology

With 3D modeling and fabrication, new possibilities like Stoss' benches for Harvard are now possible. The bench, Prince said, has "numerable, inter-changeable seating positions," which were mapped out using the software program Rhino, with a Grasshopper add-on. "We use parametric modeling tools."



There are 17 benches, made up of 7 types, each with similar ergonomically-sound geometries. Some have high backs, some have low. Some are upright, while others are low-to-the ground. Prince said Stoss "applied rules to the types."

Each bench type was created as a 1-to-1 prototype to "incredible precision" using advanced fabrication technologies. Getting all the joints to meet properly required an incredible attention to detail.

The wood used was found in one of Harvard's depots. Leftover from a new Renzo Piano-designed building, the "temple-grade cedar wood" was Alaskan first-growth forest wood. While he said they would never usually use wood like this, it was local sourcing of reusable

materials in this instance.

The Bench That Boosts Your Health

Robyne Kassen, an architect and yoga instructor, said a bench or chair changes your body as you sit in it. She said we are "constantly becoming our bodies," so a chair or bench has significant impact.

Luminance Map, Belfast / Guilio Antonutto

Sitting at a computer all day long — and not getting up to move around — is the health equivalent to smoking a pack of cigarettes a day. Spending all that time in one position is particularly dangerous, given we are "always training our bodies and they are becoming. We are the filters through which we experience the world."

Our nervous system — a key part of how our bodies experience the world — is also taxed all day long. Blinking, loud signage affects our nervous systems. Too much stress from the built environment can damage our sympathetic systems' flight or fight response. Our para-sympathetic system, which enables relax and release, can then get out of balance, causing illnesses.

To maintain health and well-being, "we must nourish our para-sympathetic system," which she said involves sitting at your "zero point" for a period of time during the day.

To enable the public to reach their zero point more often, Kassen and her team created *Unire/Unite*, an installation in a plaza near the new MAXXI Museum in Rome. The plaza's benches are made of wood frames covered in "concrete canvas," a special material that has concrete on the inside and canvas on the outside. The material was invented to help with water conveyance in infrastructure projects.

The installation features an "infinity system," which enables visitors to take on a variety of body positions and do yoga-inspired exercises meant to "activate, strengthen, cleanse, and balance the mind and body." Here's Kassen's zero point:

The plaza was purposefully designed to be accessible to everyone, with pathways of recycled rubber and low access points that enable even visitors in a wheelchair to transfer

to the edge of the benches. “This landscape, play, park, space enables 66 different positions,” said Kassen.

In contrast with the 14th-century Tuscan plaza-bench or the purposefully-uncomfortable iron garden chair, these zero-point-inducing benches clearly reflect today’s obsessions with comfort, technology, health and well-being.

Image credits: (1-2) The Plaza bench / Stoss Landscape Urbanism, (3) Park Bench by William Merritt Chase / Wikipaintings, (4) Central Park settee / Central Park Conservancy, (5) Panton Chair / Wikipedia, (6-8) The Plaza bench / Stoss Landscape Urbanism, (9) Unire/Unite / © Cecilia Fiorenza via Urban Daily, (10) Unire/Unite / Urban Movement Design, (11) Unire/Unite / © Cecilia Fiorenza via Urban Daily

Mushroom Board by Ecovative / Jonsara Ruth

We often hear from landscape architects about the cutting-edge sustainable design practices they are bringing to their latest Sustainable Sites Initiative™ (SITES®)-certified works, but we rarely hear from their clients. In a session at the ASLA 2013 Annual Meeting in Boston organized by Liz Guthrie, ASLA, professional practice manager at ASLA, landscape architects and their clients together discussed their motivation to become certified Sustainable Sites Initiative (SITES) projects, the challenges involved in working with this new 200-point rating system, and the lessons learned.

Why a Sustainable Landscape?

For Richard Piacentini, Phipps Conservatory and Botanical Gardens, the goal was to apply “systems-thinking” to their new Center for Sustainable Landscapes, which received the first four-star rating from SITES (see image above). “We wanted to know how we could truly integrate the building and landscape.”

He said too many buildings are "completely isolated nature." This is a real problem because humans now spend about 80 percent of their lives in buildings of some kind. With the new center designed by landscape architecture firm Andropogon Associates, "nature is now not that far away."

In the Bronx, Hunts Point Landing, a two-star SITES-certified landscape developed by the New York City Economic Development Corporation (NYCEDC) and designed by Mathews Nielsen Landscape Architects, shows how a "dead-end" in an isolated and unhealthy neighborhood can be turned into a park, said Kate Van Tassel, NYCEDC. The park is meant to ameliorate some of the health problems in the community, which has some of the highest rates of asthma and obesity in New York City.

The new Hunts Point Landing took shape on the site of an old coal gasification plant. Van Tassel said this little bit of "green space amid industry is very important." To boost neighborhood health, NYDEC wanted a sustainable park. Old local materials were re-used within the park. Stones from a nearby bridge taken down were turned into blocks to sit on. The waterfront park helped "transform the shoreline into a recreation area."

In the case of Taylor Residence in Chester, Pennsylvania, Margot Taylor, ASLA, is both the client and landscape architect. Taylor wanted to

Braddock, Pennsylvania / Kristen Taylor, Creative Commons, Flickr

create a public demonstration project for sustainable landscape best practices on her own property. Her property includes wood systems and meadows. Ecological systems were re-established, with a focus made on soil and plant health. The landscape, which used to be a farm, now "directs, holds, absorbs, and cleans water." She now has hundreds of people, including lots of school groups, touring the landscape each year.

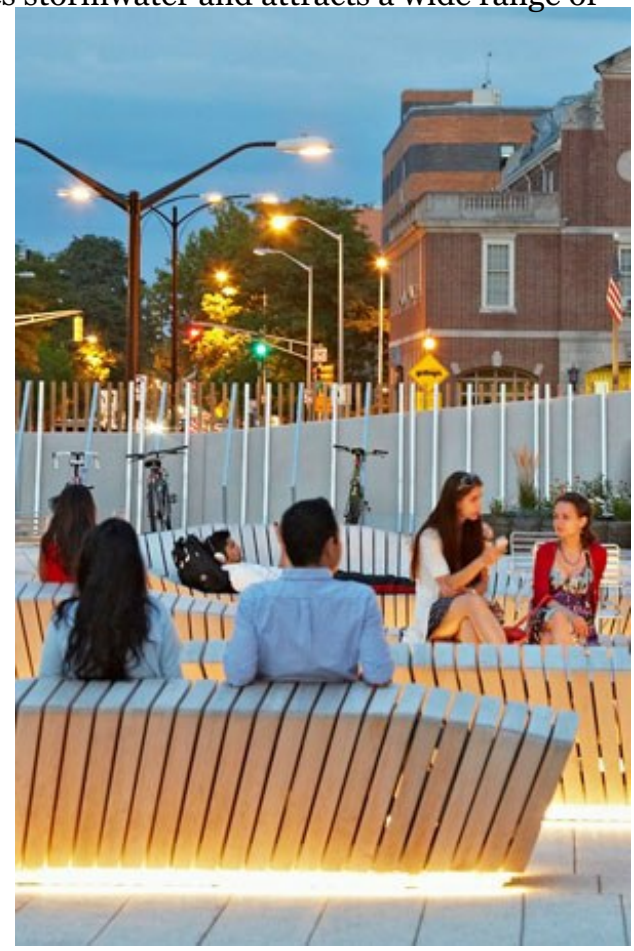
Midtown Greenway, Minneapolis / Ed Kohler, Creative Commons, Flickr

One of Taylor's goals in the move to a sustainable residential landscape was to reduce annual maintenance. She wants to get maintenance down to 55 hours a year. She has also "completely gotten mowing out of the system."

Representing both himself and his client, Hunter Beckham, ASLA, SWT Design, described the design of the Novus International campus in St. Charles, Missouri. He said a "huge number of stakeholders" were involved in creating a sustainable campus, which was designed to yield many benefits for both employees and the environment. There's a productive, edible landscape: a vegetable garden with bee-friendly plants. There are two bee blocks that provide home to seven different local species. In the first year, the landscape yielded 65 pounds of honey.

This vegetated garden terrace is accessible via a walking loop that circles the entire campus. The loop enables both employees and visitors to take a break from the office and get out in nature. Within the landscape, an old concrete-lined water detention pit was

turned into a natural water habitat that manages stormwater and attracts a wide range of wildlife, including snakes.



What Were the Challenges?

For Jose Alminana, FASLA, a principal at Andropogon and one of the guiding forces behind SITES, the benefits far outweighed the challenges. He said achieving 4-stars for the Phipps' Center for Sustainable Landscapes was no small feat, but perhaps made possible by the fact that "we started with no site." The design team then had "complete control over the materials used," which helped them improve site performance and earn points under SITES.

Still, "procuring the sand-based soils was a challenge, given the firms involved in fracking are very interested in applying the same soils to sites where they are extracting gas." Separately, he added that it was "hard to change the plant palette to accommodate the new soil pH."

For Signe Nielsen, FASLA, SITES seemed to be an exercise in frustration. She said there were three categories of SITES credits that deeply-urban brownfield sites like Hunts Point Landing "couldn't take advantage of," so the project could only get two stars.

She said she couldn't preserve existing soils and vegetation because "they were highly contaminated." There was "no structure to adaptively reuse," so points couldn't be gotten there either. Lastly, there were no "cultural resources to reuse or enhance."

She added that working with public authorities, in effect, means "limited opportunities for integrated site design teams," as many local governments don't incentivize such groups.

More broadly, she thought that achieving many of the credits related to "recycled content materials will be challenging given the landscape industry has very few competitive vendors in this field."

Urban public projects may have a challenge earning maintenance points as well, as the landscape architecture firms creating these projects often have "no control over future maintenance." A firm could create a detail maintenance manual for a park, but then that's

it.

Taylor said working with a historic farm was a challenge in itself. The native vegetation had been stripped and topsoil eroded or compacted. The solution was to “rebuild healthy soil and native plant communities appropriate for different micro-climates.” SITES, she said, “didn’t want to give credits for the landscape’s past use as pastureland.”

She certainly ended up getting credits, though, for the 27 tons of barn stone she cut up and re-purposed on site by hand. “I lost about 15 pounds shifting all that stone out of the dirt.” Still, she thinks she needs to find a “smarter way to manage materials that were unearthed.”

What Lessons Were Learned?

Alminana believes that “integrated design is really the key” to achieving a return on investment for your clients and site performance. “SITES really puts an emphasis on this.” He said, unfortunately, this approach is still not “happening among a majority of the profession or in the public sector.”

Directing himself to those who complain they haven’t earned enough points for their projects using SITES, he said “if you are only focused on points, you are missing the point.”

Nielsen believes SITES can have a potent impact, given “metrics are crucial” and SITES really forces landscape architects to collect data and measure themselves against benchmarks. She said putting all that time into collecting metrics was worth the effort because it helps “clients understand the value of our work.” Landscape architects can measure how well they’ve “reduced noise, saved water, and reused materials.” Beckham reiterated how valuable SITES is as a “framework for accountability.”

Taylor learned that it’s important to “integrate a long-term land management perspective from the beginning,” something that SITES promotes.

The landscape architects all hoped that governments — both local and national — will get moving on incorporating SITES guidelines into their request for proposals (RFPs), which

can also help push the landscape materials industry to provide more sustainable options. It will be a back-and-forth process to make SITES more mainstream: landscape architects, and their clients, must push for change

among providers of landscape materials, but the market must also provide opportunities to enable that change.

Image credits: (1) Phipps' Center for Sustainable Landscapes / Denmarsh Photography, (2) Hunts Point Landing / Mathews Nielsen Landscape Architecture, (3) Taylor Residence / Mark Gormel, (4) Novus International / SWT Design

Landscape architects in Europe are doing really innovative things with pavers, perhaps more so than in the United States. Some recent contemporary urban plaza projects from Amsterdam, Copenhagen, and Barcelona show the amazing visual effects that can be achieved with bold paving patterns.

In a barren lot where there used to be a railway station, just west of Amsterdam's city center, LANDLAB created Funenpark, a new courtyard for a residential complex. The standard Dutch courtyard, which usually has separate streets, pavement, parking and front and back-gardens, instead gets a contemporary take, created as one "continuous, luxurious" place. This Dutch landscape architecture firm purposefully kept things simple in order to create a distinct space residents and passers-by can easily wander through.

To achieve this, the firm writes in *Landezine*, "we designed an intensive network of paths made of two specially designed pentagonal concrete paving stones in three shades of grey. These were laid down in a random fashion which resulted in a directionless, rugged pattern that looks like an unidirectional stretched fishnet from above." The green parts of their landscape also really make the pavers pop. Among the grass are scattered groups of *Robinia pseudoacacia* and odd daffodils.

In Copenhagen, a busy downtown shopping street gets a contemporary update. A long, curved street set in the "labyrinthine medievel city center," Købmagergade shopping street uses "strong materials such as natural stone" in a few different colors to create a "harmonious appearance," writes Karres en Brands and Polyform in *Landezine*.

There are reasons behind the use of different colors: “The layout of the three squares is varied, just as their historical situation and their location in the city are varied. On the Kultorvet the dark – almost black – paving pattern of the stone is inspired by the 18th century coal trade. On the rather more peaceful Hauser Plads square, the exciting grass play mounds form a green oasis in the urban fabric. At night, the Trinitatis Church square with its famous observatory Rundetårn is transformed by artificial lighting into an enormous starry sky. The three squares are diverse in colour, from dark coal to bright stars: ‘From Kultorvet to the Milky Way’.”

Finally, Passeig de St. Joan boulevard, a project in Barcelona, makes wonderful use of grass and pavers together to create a stunning visual effect. The boulevard was first laid in 1859. Over the years, it began to fall apart, creating accessibility problems. In remodeling the street, the Barcelona city government also wanted to revitalize Ciutadella Park, a set of small urban parks alongside it.

In *Landezine*, landscape architects with Spanish firm Lola Domènech write that they first re-organized the pedestrian routes. “Some 17m of pavement have been organized so that 6m are allocated to a pedestrian pavement, while the remaining 11m under the rows of trees are for recreational uses (benches, children’s play areas and bar terraces). As part of the new layout, the two-way 4m bicycle lane is physically segregated, protected and signposted, located in the middle of the road.”

Together with the new street, the park was revamped to be more sustainable. The use of pavers and vegetation works together in the park to aid in stormwater management. “In order to guarantee the sustainability of this new layout, we needed to ensure proper drainage of the subsoil and take on the challenge of incorporating a mixed pavement system in the tree-lined zone. The treatment of the soil with mixed pavements and the automatic watering system that uses phreatic water are key to ensuring substrata drainage

that will guarantee the survival of the vegetation. The incorporation of local shrubs to this tree lined zone will contribute to enriching subsoil biodiversity."

Different pavers are also associated with different human uses: "The pedestrian section the pavement is made of 'Panot' paving slabs (typical ensanche paving), while, in the recreational zones, a new prefabricated pavement with draining joints was laid down."

See more interesting uses of pavers in Europe.

Image credits: (1) Funenpark / Anne ten Ham, (2) Funenpark / Jeroen Musch, (3) Funenpark / Anne ten Ham, (4) Købmagergade shopping street / copyright Ty Stange, (5-6) Købmagergade shopping street / KBP, (7-10) Passeig de St. Joan, Barcelona / Lola Domènech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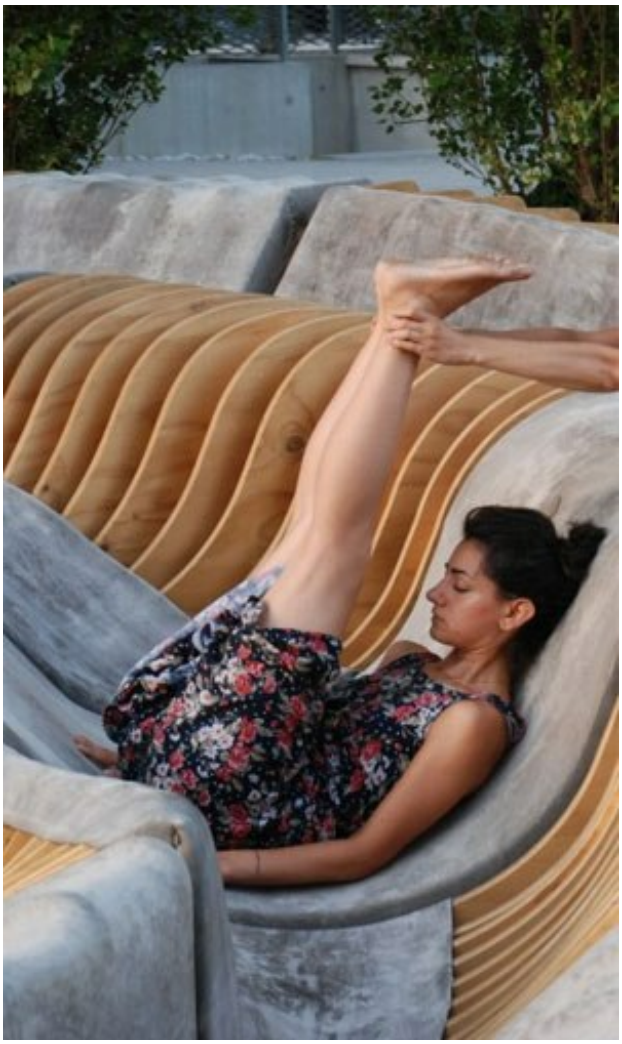

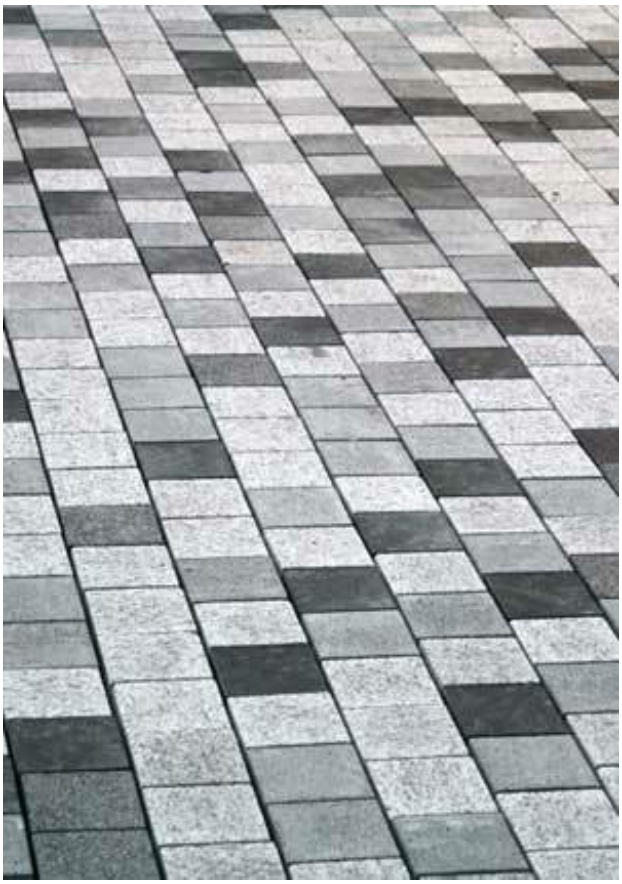


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