

The West Seattle Bridge  
Reimagined in Mass Timber

# BRIDGING SEATTLE

B+H | SMEC | RBG

**B+H**

Summer 2020

# A RENEWABLE RESOURCE BUILT FOR LONGEVITY



# WHY MASS TIMBER?

## KEY ADVANTAGES:

- + Sequester carbon, with a 100+ year lifespan
- + Create a higher standard of design for infrastructure
- + Light-weight mass timber maximizes ability to reuse existing foundation
- + Prefabricated steel and timber manufacture and assembly significantly compress schedule and reduce cost
- + Maximize safety & minimize risk: visible components can be easily monitored and replaced over time
- + Put Seattle on the map for fueling an economy based on renewable resources
- + Revitalize the Washington State timber industry
- + Generate well-paid jobs and strengthen local labor pool

## OUR INFRASTRUCTURE IS FAILING US

In the United States, we have thousands of crumbling post-WWII bridges. They are either reaching the end of their useful, engineered design-life, or the concrete-and-steel components are deteriorating much earlier than expected. With B+H's experience in urban master planning and design, and the infrastructure and bridge engineering expertise of SMEC and RBG, we can design a state-of-the-art, long-lasting and sustainable viaduct specific to the strengths and history of the Pacific Northwest.

## WE ARE PIONEERS: INNOVATION DEFINES SEATTLE

Momentum for the use of mass timber in building structures in Seattle is growing, but using mass timber on a major highway crossing in the United States is a novel idea- so it's easily dismissed. We put the challenge to the SJ Group involving bridge, structural, and construction experts from the US, UK, Australia, and South Africa. The challenges of long spans are not easily solved with timber, but in testing the ideas, we realized that mass timber elements present exciting structural and design



opportunities. They also give the bridge a unique natural texture, a perfect fit for Seattle. We know from experience that conceptualization and design of a new bridge is a long and involved process that includes many competing issues. We're submitting this vision as a baseline for the idea that mass timber could be used to create a signature structure for our region.

We have a labor force in the Pacific Northwest that continually influences technologies and techniques worldwide- with life-changing advancements in technology around software, e-commerce, material science, and fabrication coming from our region. Incorporating mass timber into the design of the West Seattle Bridge would create industry-leading jobs in our region. Given that our State is the number two timber producer in the United States, the downstream ramifications of building out mass timber manufacturing and assembly capabilities are significant.

## TIMBER IS OUR LEGACY — IT CAN BE OUR FUTURE

Mass timber design, manufacturing, and assembly has significant cost and schedule advantages compared to more traditional

construction in concrete and steel. Volumetrically, the material is more expensive; however, cost savings are derived from shorter construction schedules, fewer on-site workers, and less associated project overhead. In environmental terms, timber serves as a carbon sink with a comparatively low embodied energy footprint; **it is the only renewable building material.**

With an abundance of sustainable forest lands, the Pacific Northwest is destined for prolific mass timber construction. Humans are happier around wood. From an aesthetic and emotive perspective, structures designed with mass timber are highly attractive to users in urban, nature-deprived environments. Modern city residents and visitors seek out the raw materiality and proven health-promoting aspects of exposed timber. Exposure to wood establishes emotional connections and triggers physiological responses in humans synonymous with the positive experiences derived from interaction with natural systems.

# THERE IS A BETTER WAY TO DO THIS.



**You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete.**

## **BUCKMINSTER FULLER**

Our region, like the rest of the world, is experiencing an event that has challenged many of our traditional assumptions about the economy, our jobs, our lifestyles and our values. At the same time the spotlight is firmly on societal injustice and the urgent need for meaningful change. If we are to find a silver lining in tragedy, it is the opportunity to emerge stronger and more resilient into a healthier, equitable society. What better symbol of hope and change for our region than a bridge? Linking our past to our present, uniting

communities, and celebrating the emergence of a powerful new economic engine that will drive innovation, create jobs and ensure the sustainable use of our legacy resource: timber.

In the New Mobility Playbook, published in September 2017, the Seattle Department of Transportation (SDOT) outlines its vision to advance mobility by blending innovative technologies and policies with a commitment to equity and social justice. One of the first steps acknowledged in the Playbook is the need to actively gather proposals from stakeholders and invites creative thinkers to contribute ideas.

## **Here is ours.**

We envision the West Seattle Bridge as a functional, beautiful monument to the innovative and conscious populace it serves. It can push the advancement of new material

technologies and facilitate the growth of a new industry by incorporating mass timber in its design. Sustainably harvested timber is a renewable resource that makes humans calmer, happier, and less stressed.

As we ideated on concepts and different options for this bridge and explored the use of mass timber, it became clear that the benefits of this material to this specific project are significant, and present a once-in-a-generation opportunity. The design speaks to the resiliency and culture of this region, and we have the expertise to make it succeed.

Seattle is a global destination city that is home to a generation of design-conscious professionals in various service sectors from cloud computing to aerospace who place tremendous value on preserving their environment. The West Seattle Bridge can be a pioneering work of urban infrastructure design

that the talent and resources of this City and our Region make uniquely possible. We have the opportunity to reimagine the West Seattle Bridge as the first link in a new class of long-lived infrastructure with a multi-modal community impact, serving Sound Transit Light Rail, Seattle Metro, bicycle and pedestrian traffic, cars, and freight and access to the improved International Container Terminal 5.. Multiple long-span bridge elements could open precious land for urban redevelopment and revitalize an area currently dominated by a cement plant that accounts for 10 percent of the city's carbon footprint.

We are asking you to partner with us to realize a once-in-a lifetime opportunity born from the confluence of a pandemic, climate crisis, social injustice, and failing infrastructure.

Join your support, advocacy, creativity, talent and resources with ours so that we can build a bridge to Seattle's future.

# AN OPPORTUNITY TO RESET



# DESIGNED FOR THE FUTURE

Designing and constructing a viaduct, particularly a highly traveled, visible crossing such as the West Seattle Bridge, is ideally a once-in-a-century effort. We are proposing the use of mass timber in our bridge design, a material already used for vehicular bridges in Canada and Norway, that has a design-life of 75-100 years. The use of trees for bridge building, combined with modern technology, will strengthen Seattle's identity as an environmentally conscientious, grounded, and future-forward city. It is also an opportunity and invitation to reinforce cultural and geographic authenticity, both in form and material.

A continuous, sinuous form of arches above and below the drive deck connect at the piers and enable the 590ft (180m) and 375ft (115m) spans of the structure. The resulting form is a visual continuum, echoing the spirit of Seattle, our place between the mountains and the sea. The waveform is highly visible and experienced from long vistas, including Puget Sound ferries and close-up "by riding the wave" across the viaduct. The bridge is designed for multi-modal uses but also boasts expansive city, harbor and mountain views

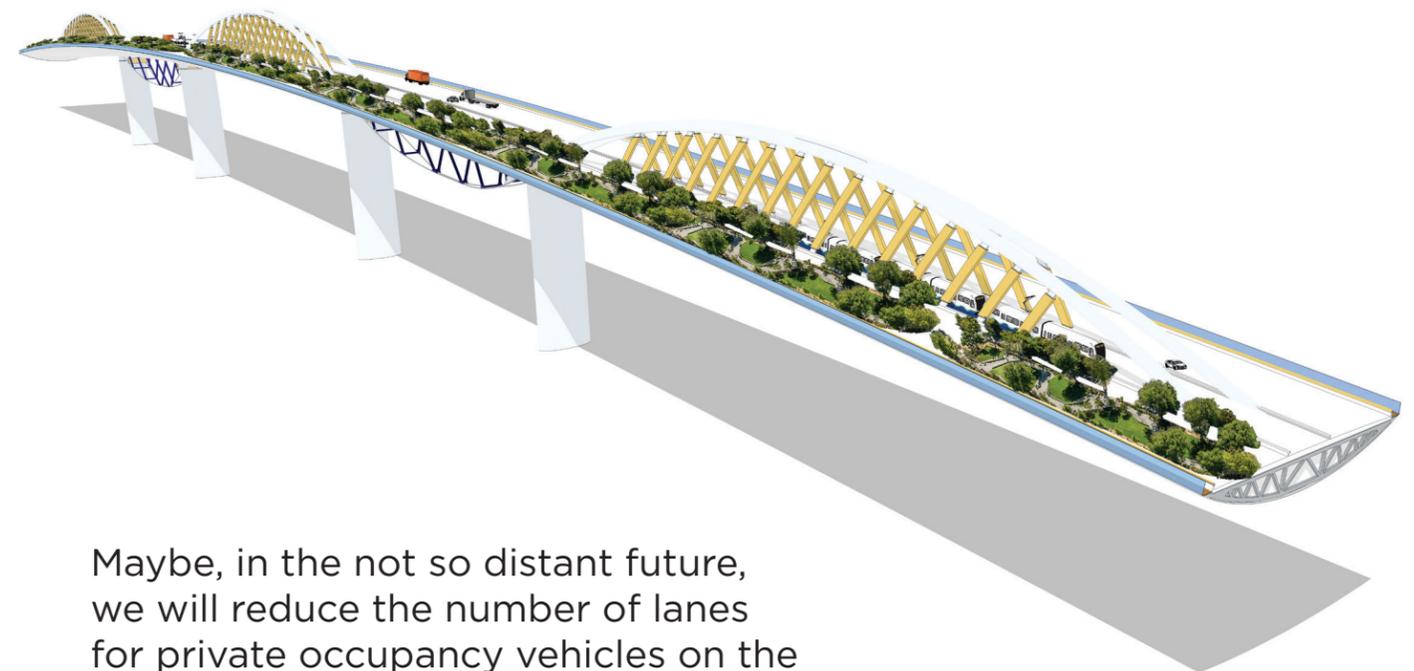
for car and light-rail passengers, bicyclists, runners, and pedestrians alike.

Innovative use of mass timber is a prominent characteristic of the bridge design. Mass timber performs well under compression parallel to the wood grain. The proposed use in hybrid mass timber-steel hangers responds to typical, asymmetric loading conditions of a bridge where tensile, galvanized steel hangers experience periodic, momentary compression forces. Carbon fiber strands could potentially replace the galvanized steel sections, an alternative that will require further evaluation and testing.

Mass timber is the only renewable building material. A long-span crossing like the West Seattle Bridge can be a cultural manifestation of the climate-change consciousness of a nature-inspired population that seeks a socio-ecological reset and the boost of local forest industries and timber economies. The cross profile of the drive deck is convex, resulting in slender sightlines longitudinally. This double curvature strengthens the overall structure and

enhances its compositional elegance, technological sophistication, and lightweight character. The inclined twin steel arches above the deck are treated with a high-gloss, self-cleaning pearl white protective system. The underslung girders feature blue-metallic steel members with tensile pairs of stainless-steel cables or carbon fiber strands. The use of structural reinforced concrete is limited to the piers of the bridge. The elliptical planform of the piers further compliments the bridge's narrow sightlines.

The bridge's sculptural qualities will be enhanced at night and during Seattle's overcast season with indirect architectural and traffic LED lighting. Photovoltaic panels along the guardrail of east-bound lanes harvest enough electricity to provide the necessary sparkles.



Maybe, in the not so distant future, we will reduce the number of lanes for private occupancy vehicles on the bridge and turn some of the roadway into a **high-rise bridge park** that overlooks Seattle and Puget Sound.

# A STRUCTURAL INNOVATION

## MASS TIMBER-STEEL COMPOSITES

### TYPICAL DESIGN CHALLENGE WITH ARCH BRIDGES

Dealing with asymmetrical traffic loading patterns and the resulting bending moments caused in the arch section

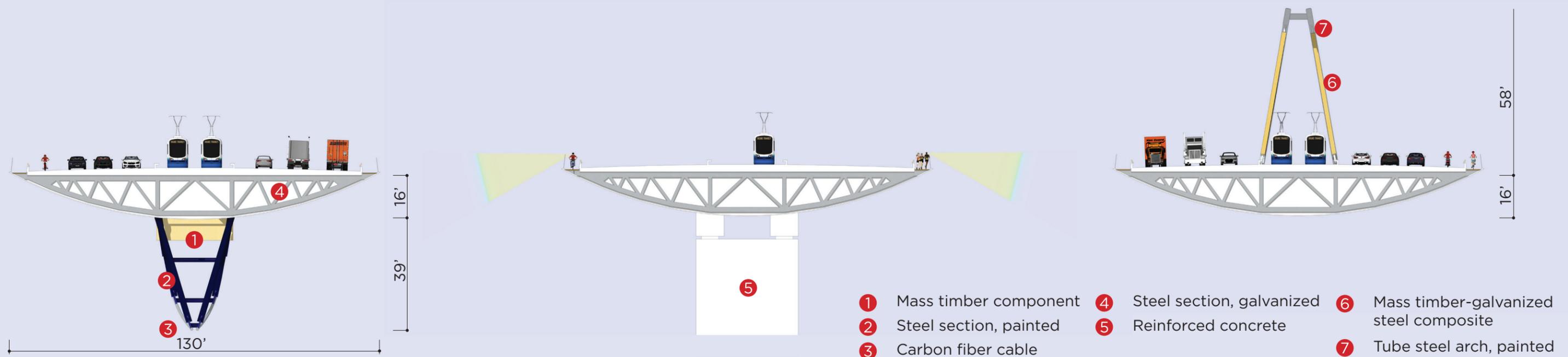
### OUR DESIGN

Mass timber-steel composites can reduce the stress range in the hangers and potentially improve their fatigue performance

Arch bridges are a conventional choice for the required maximum span of 590 feet (180 m). The unconventional design aspect of the bridge would be the use of mass timber around the steel hangers. The typical design challenge with arch bridges is dealing with asymmetrical traffic loading patterns and the resulting bending moments caused in the arch section. One standard solution is to use closely spaced inclined arch hangers that cross at least once. This causes the arch to behave more like a truss, reducing the impact of bending moments. The visualizations presented show how the bridge design might benefit from the use of mass timber.

In our design approach, mass timber-steel composite hangers would create a unique aesthetic and texture on the bridge, and there is an idea that mass timber-steel composites can reduce the stress range in the hangers and potentially improve their fatigue performance.

The underdeck cable-supported spans maintain the rhythm created by the arch spans on the 375 feet (110 m) long intermediate spans. Its use allows the main steel deck girder to run as a continuous element along the crossing.



# SHARE YOUR VOICE



## BRIDGING SEATTLE WITH YOU

Tell us about your ideas in urban transportation, design and outdoor experiences. How can we arrive at a bridge solution that is inclusive and works for all of us — all colors, all genders, all cultures, all needs? We would like to hear from you!

+ Support a progressive, local infrastructure solution with your signature.

[Change.org petition](#)

+ Join our team as a member of the public.

[Share your comments with us on Facebook](#)

+ Join our design team as a professional consultant.

[Contact Matthias](#)

+ Join our team as an underwriter.

[Contact Doug](#)

+ Ask general questions about this project.

[Contact Allison](#)



## A GLOBAL TEAM THAT BUILDS WORLD-CLASS INFRASTRUCTURE

We're an international team with local champions. B+H Architects, SMEC, and Robert Bird Group are members of the **Surbana Jurong Group (SJ)**. With over 50 years of track record in successful project delivery, SJ has grown to become one of the largest industrial, infrastructure, urban design, and architecture consulting firms. SJ is headquartered in Singapore, and its global workforce of 13,500 employees across more than 120 offices are driven by progressive thinking and creative ideas.

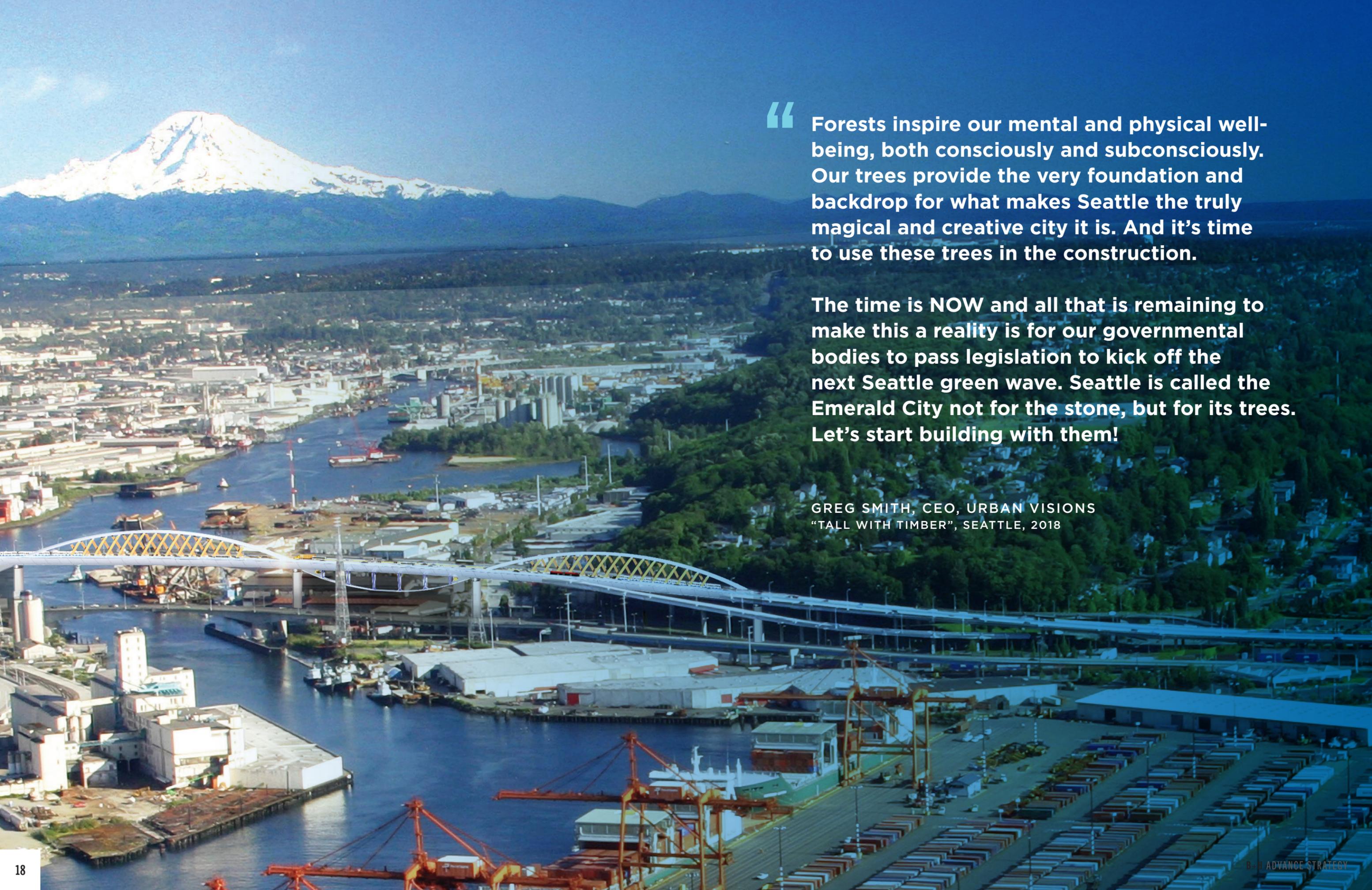
The **B+H Architects** Seattle studio was established in 2013. For the last 65 years, we've been growing from our Toronto headquarters and we're operating in offices around the world. We combine strategic thinking with a bold and inspiring design to transform spaces, communities, and economies. We've worked with clients across the globe to design buildings and environments that are inspiring, functional, and contextual, and we have several first-of-kind projects that pioneered materiality and sustainability. The local Seattle office, which functions as the U.S. headquarters of our global consulting practice, leads the West Seattle Bridge effort.

**SMEC**, our sister company, is a recognized global expert in long-span bridge structures. Consistently recognized for technical excellence and design innovation by the world's leading engineering bodies, SMEC's strength in major infrastructure projects enables us to provide critical value chain services to clients across the globe.

**Robert Bird Group (RBG)** is our global consulting engineering arm, established in 1982 with over 600 staff across eleven offices. Our relentless pursuit of engineering excellence is underpinned by focusing on our client's needs and delivering their vision. We believe passionately in integrating engineering design excellence with construction and delivery expertise to achieve significant benefits for our client, notably those related to cost, program, and risk.

LOWER RIVER TERRACE VELOBRIDGE QUEENSLAND, AUSTRALIA (SMEC, IN-PROGRESS)

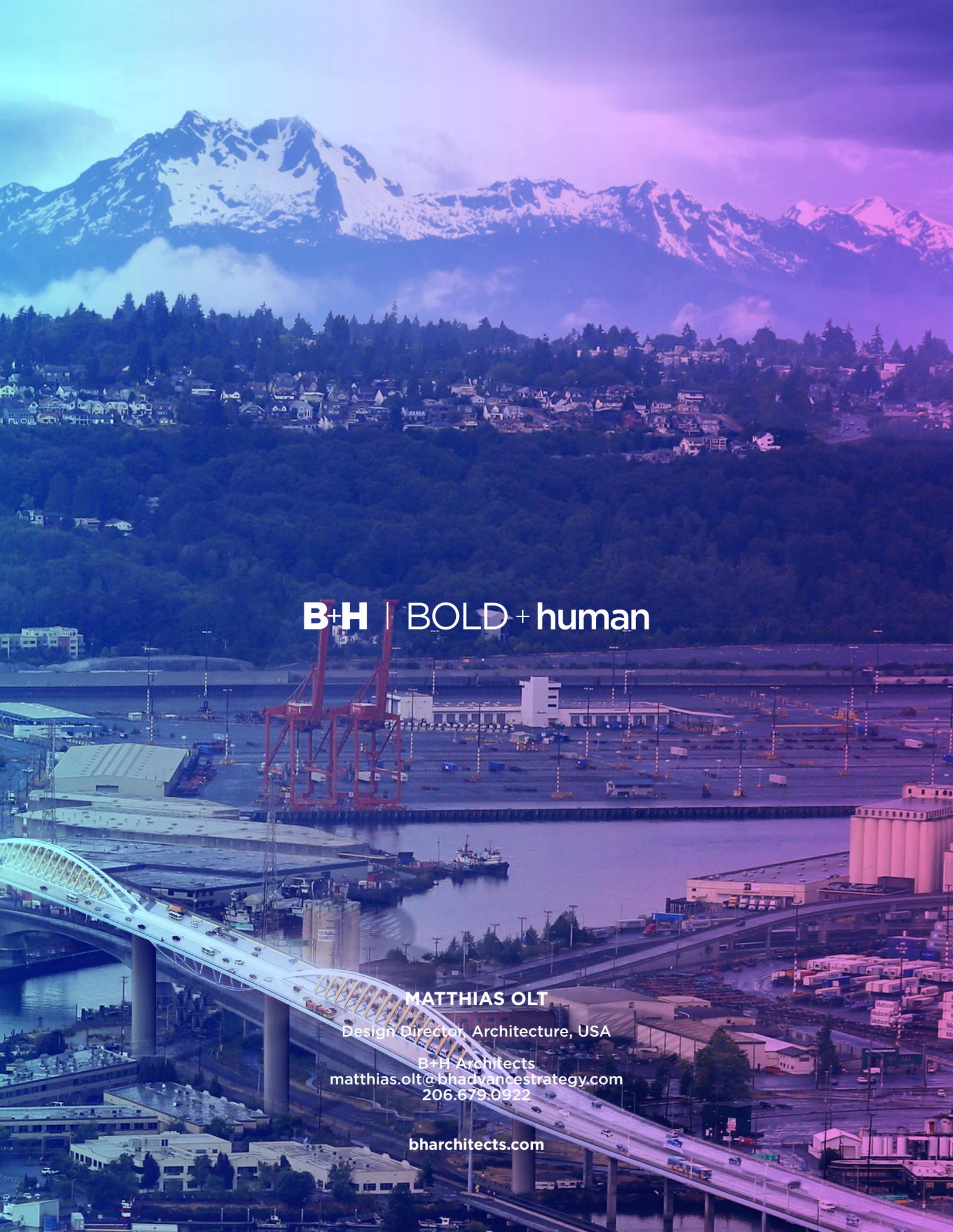
NORTH WEST RAIL LINK SYDNEY, AUSTRALIA (SMEC, 2017)



“ Forests inspire our mental and physical well-being, both consciously and subconsciously. Our trees provide the very foundation and backdrop for what makes Seattle the truly magical and creative city it is. And it’s time to use these trees in the construction.

The time is NOW and all that is remaining to make this a reality is for our governmental bodies to pass legislation to kick off the next Seattle green wave. Seattle is called the Emerald City not for the stone, but for its trees. Let’s start building with them!

GREG SMITH, CEO, URBAN VISIONS  
“TALL WITH TIMBER”, SEATTLE, 2018



**B+H** | BOLD + human

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