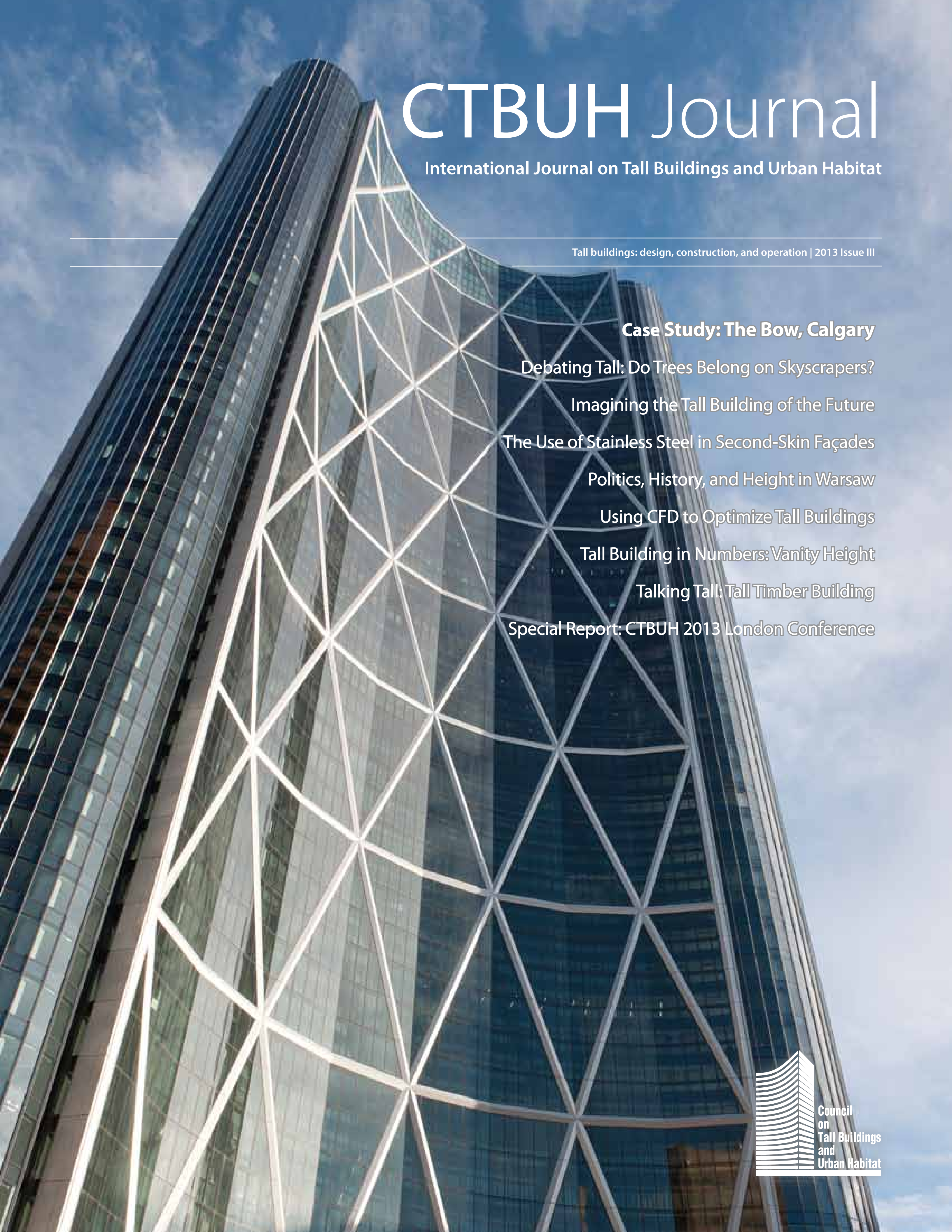

CTBUH Journal

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Case Study: The Bow, Calgary

Debating Tall: Do Trees Belong on Skyscrapers?

Imagining the Tall Building of the Future

The Use of Stainless Steel in Second-Skin Façades

Politics, History, and Height in Warsaw

Using CFD to Optimize Tall Buildings

Tall Building in Numbers: Vanity Height

Talking Tall: Tall Timber Building

Special Report: CTBUH 2013 London Conference

Council
on
Tall Buildings
and
Urban Habitat

Inside

News and Events

Case Study

Research

Features

CTBUH

20

26

32

"We have a 'wood first' policy in British Columbia, where public buildings have to consider the use of wood first and effectively prove why they can't use wood in the building design in order to proceed."

Michael Green, page 46

Finding the Forest Through the Trees: Building Tall with Timber

Michael Green

Interviewee

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Michael Green
Michael Green is dedicated to bringing attention to several of the overwhelming challenges in architecture today. The first is climate change and how the built environment is an enormous contributor to the factors damaging the very environment designers and architects are seeking to improve. The second is the profound reality that over the next 20 years, 3 billion people, or 40% of the world, will need a new affordable home. Michael believes in championing a shift to new ways of building that will complement the intersection of man's greatest building challenges.

The pursuit of new technologies for building tall has fostered a new perspective on one of mankind's oldest building materials: wood. Through research such as the recently-published ***The Case For Tall Wood Buildings,*** Vancouver architect Michael Green has been singing the praises of using mass timber to build tall structures for years, and has just broken ground on what will be the tallest wood building in North America. Green spoke with CTBUH Editor Daniel Safarik about the critical role wood will play as a practical and sustainable building material in a dense urban future.

How did you develop an interest in pushing the limits of building tall in wood?

It comes from building with my grandfather in his shop as a kid. He loved to woodwork. I've been around wood all my life.

Later, I was working for Cesar Pelli, and we were doing things like the Petronas Towers. I thought steel and concrete were interesting, but the innovations were just building on previous engineering breakthroughs.

It was informative to see how inspired communities became by building tall. I watched the excitement in Malaysia about the Petronas Towers, and how that kind of transformed the image of the country.

Figure 1. North Vancouver City Hall, Canada. © Michael Green Architecture

The role of tall buildings as icons for their communities is an interesting one. It creates a competitive spirit between communities, allowing us to push the limits.

What made you think about building tall with wood?

I started building more and more with wood, realizing that it was an absolute land of opportunity from an innovation point of view.

About 10 years ago in Central Europe, the introduction of cross-laminated timber (CLT) panels started to change the way buildings could be done at a larger scale. CLT is a great product, but is really just one of many mass timber panels that would allow us to really dramatically change the scale of what we can build with.

CLT is made by taking boards that can be 1x4s, or 2x4s, or 2x6s. These are laid down side by side, pasted with glue, and then another set is laid on top at 90 degrees, creating what is like a jumbo piece of plywood.

It creates a panel that has great inherent strength and allows you to use a wood grade that you would never use for structural material on its own, because it's of poor quality. When you start gluing it together in this way it gets the inherent benefit of this cross-laminated strength. So it allows us to use trees that are of a lower quality.

Why would we want to use lower-quality trees?

In North America we are losing huge tracts of our boreal forests to the mountain pine beetle. If you fly over British Columbia, Washington, Colorado, and Idaho, there are huge tracts of dead trees. They typically go from being a deep green to red. The mountain pine beetle used to die off every winter because of cold. Now, because of climate change, it's not dying off. So the beetle has just devastated the forest.

CLT gives us a chance to use this otherwise dead forest as a building material that sequesters carbon. Otherwise, the trees just fall back to the forest floor and rot, releasing all the carbon that they've ever sequestered during their life back to the atmosphere.

How do wood buildings "sequester" carbon?

These are vast tracts of dead forest. And so when you use them for forestry, that carbon stays in that product, until we put it in a building and it burns, or the wood rots. As long as it's in a protected building, it becomes a great sequestration vehicle. When you clear the trees then you're giving opportunity for new trees to grow back and increase the return of an otherwise dead forest. Today, it often ends up being shipped to China, and used to make formwork for concrete buildings. So, the idea that somehow we're saving trees by going with concrete is completely not true.

What was your breakthrough project with mass timber?

The North Vancouver City Hall project is not a tall building, but uses laminated strand lumber (LSL) in a really new way (see Figure 1). Ironically, it came with the downturn in the world economy. The wood industry, which hadn't been very focused on innovation, realized they could sell the full panels.

They lightened up their attitude, and then we showed them what could be done. I was down at Weyerhauser talking to their CEO and they're just kind of waking up and going, "Wow, this is exciting."

Why did we not identify this opportunity earlier?

To me, architects have been focused on the future of sustainable building at a very suburban scale. You see a lot of straw-bale, rammed earth and stacked containers. But to say "that's the future" is nonsense. Those are great, interesting, fun stories, but that's not where the energy is. The energy has to be an urban environment. Big buildings are the future. There's no question. So we needed to kind of step back and say, "How can we build in the future, using a rapid renewable, carbon sequestering material, at a big scale?" And mass timber panels are what allow us to do it. We still are going to use glue-lam beams and columns, but now we have the panels, and that means our floors can be built out of something completely different.

Were there any precedents to your concept?

CLT platform construction has been done before, but that approach requires a whole lot of load-bearing internal walls and doesn't do well with lateral loads at height. It doesn't work in an environment where you want lots of planning flexibility. A developer doing a tower wants the freedom to say, "I want the walls here, or I want to grow this suite and shrink this suite." They don't want to be hemmed in by load-bearing structural walls. So that became an important goal for me.

How was your approach different?

I wanted to show that tall office buildings could be made of wood. To do that, we had to develop a whole new structural approach, which developed into Finding the Forest Through the Trees (FFTT).

I got together with Equilibrium Consulting, who are world-class wood engineers, and I said, "Guys, has anybody done something like this before?" It's a very simple structure, but it is really much more akin to balloon framing, where the walls go all the way through and the floors are hung between the walls, rather than stacked on top of the floors.

That does two things. It dramatically reduces the shrinkage. And it allows us to have these long vertical walls in the cores, which creates this great lateral bracing, and allows us to have an open column plan for each floor plate, allowing it be an office building or a flexible residential building.

When we tested this theory, what we found is that we got to 30 stories, and we actually just stopped even trying to go higher, because we knew people were talking about "tall" wood buildings being 10 stories.

What is your major proof point?

Wood is significantly lighter than concrete. That means you're not fighting the types of forces that you have in a seismic event, as you would be with a heavier concrete structure.

The really rigorous work we put into the tall wood study was focused around important questions. How is this going to work structurally? What's the market for it? What kind of flexibility do you need in a plan like I just described to make this work in a real marketplace? What's the cost of one of these buildings, and how does that compare to concrete? What's the carbon footprint, what's the energy footprint? What are the implications for envelope design, what are the implications for acoustic design?

So we did *The Case for Tall Wood Buildings* to say, "Here's why this makes sense and here are the parameters for measuring it as a successful solution."

Has that led to projects?

I have a brand new 12-story residential wood

> "Cross-laminated timber gives us a chance to use this otherwise dead forest as a building material that sequesters carbon. Otherwise, the trees just fall back to the forest floor and rot, releasing all the carbon that they've ever sequestered…"

building project on Vancouver Island. And we broke ground last week on what sounds like it's going to be the world's tallest wood building, the Wood Innovation Design Center (WIDC) in Prince Georges, British Columbia (see Figure 2).

It's just short of 30 meters in height. It's got a university program in the lower half, and it's technically only six stories, but it has a mezzanine and a mechanical penthouse that puts it to that height, and the floor-to-floor dimensions are really high, because it's an academic building.

How is it being constructed?

We're using some really innovative connectors that are wood-to-wood connectors, so not very much steel. Wherever we do use a steel piece to connect wood together, we actually embed the steel connection in the middle of the wood, because a metal plate slapped on the outside of the wood is actually the most vulnerable to fire. So we use the wood to protect the steel. That's critical to the success of the project.

That's counterintuitive.

It's counterintuitive for a lot of people, but it's not unusual. It's actually a big part of the success. We did it here in Vancouver over 100 years ago – we used to protect all the steel with wood.

Figure 2. Wood Innovation Design Center, British Columbia, Canada. © Michael Green Architecture

"If you are going to make more money by cutting down your trees to grow crops, you're going to do that. But if you are incentivized to re-grow trees and turn them into laminated-strand lumber you're really talking about farming buildings. We grow our food; the earth has got to grow our homes as well."

The truth is, when you start embedding all your plates and using push-pin connectors, you end up with just a little dowel that makes a dot of steel in the wood, holding it all together. To me it's much more beautiful and elegant, and interestingly enough it's much more fire resistant, because the steel's hidden away.

So, assembling a building in heavy wood with small steel connections actually improves its fire rating?

To make these towers work, we have to use two-hour fire rated assemblies. That would be true of concrete, steel, or wood. It's the same as those materials. We can meet all the code requirements.

How are you dealing with objections?

At some point, there may be some resistance from the steel and concrete industries if they start to get concerned that this is a competitive system to their market share. But I don't think that's based on science, I think that's based on a business market position. It's a matter of education, of using science, not emotion to carry the discussion.

My harshest critics are the architects in my own community. We have a thing here that's a little bit like what the Australians call the "tall poppy syndrome": If anyone gets a little more attention than the next, then you've got to cut them down, right? So I get a little of that.

But interestingly enough, elsewhere in the world, everybody's been very positive about these ideas. I've been this year to Finland, Denmark, Italy, and I have upcoming trips in France and Belgium. You're seeing architects from these communities start to explore these ideas.

So is code the real obstacle?

Yeah, the building code is an obstacle because this is the first new way to build a tall building in a hell of a long time. Of course people are going to go, "What? That's strange." So I often say the hardest part of the job isn't the engineering, it's the managing of the public perceptions of the issues, and it's education. And that applies to getting code authorities to understand the issues and to get all of the scientific testing done to illustrate how it all works.

Assuming the science works out, what about cost-effectiveness?

Our FFTT system is one approach. And there will likely be many more. It'll take us a while before we figure out the most cost-effective, buildable and universal systems. But those will come, just like they did with concrete and steel.

BTY Group, a cost estimator that worked with us on ***The Case for Tall Wood Buildings,*** did a whole cost section. It's really challenging, because even figuring out which trades are going to do different portions of the work is new. There is no trade for these kinds of solutions, so there's real complexity in figuring out the costs.

But when we do figure it out, the big game-changer is speed. Wood building goes so much faster than steel or concrete. It allows for a better life cycle, because you can actually deconstruct these buildings really effectively and reuse these panels for centuries, which is great.

In Vancouver, we're probably a few bucks cheaper per square foot than doing the same building in concrete. It's "cost competitive," not dramatically better. But when we got into other parts of British Columbia, we can be significantly cheaper.

When you reduce the duration of construction significantly, beyond materials and erection, you have lower carrying costs for your construction loans and mortgage on the land and so forth.

Over time, energy prices will go up. Every major economist in the world will tell you we need to assign a cost to carbon, and yet we're somehow politically unable to do it. If we are able to get our heads around that, then wood will become significantly cheaper than concrete and steel.

What policy changes would help speed the use of wood in tall buildings?

We have a "wood first" policy in British Columbia, where public buildings have to consider the use of wood first and effectively prove why they can't use wood in the building design in order to proceed.

I've advised the government to change that to a "carbon-first" policy. If you chose one industry over another, you have a political problem. But if you chose "lowest carbon" as your top priority, wood will automatically win. But also it's going to push the concrete and steel industry to improve their stories.

With a carbon-first policy, we can turn around to developers and say, "If you choose to build a wood structure, we'll give you a tax credit based on carbon sequestered and density achieved." We have a significant carbon-reduction goal, in Vancouver in particular. As we move towards that, we're going to improve the envelope performance of our buildings and our energy performance dramatically.

Then, the material choices in building become that much more important. And that's why we need to be pushing this so hard right now, even though it's not the biggest piece of the pie now, it will become the biggest piece. We'd better have the answer long before it crosses over to being the biggest piece.

And that's why I believe so passionately that this is the time. This conversation would not be happening on these tall wood buildings if it wasn't for climate change.

How can architects help?

Climate change has triggered a demand for us to change the way we think. But the conversation about "innovation" still seems to be about parametric modeling and BIM and shapes. It isn't about the fact that buildings are 50% of the energy use and climate issues in North America. This is why we as a profession are losing our credibility, because we're talking about pretty shapes, not about societal and environmental benefit. Beauty is something we should do in our sleep as architects.

Meaning is what we should be working hard for. That is what will rebuild our role in society, because our role is, I think, the most potent profession in the world right now. If half of climate and half of energy is on the shoulders of the building industry, then who's going to solve that better than an architect?

We have to regain this role. And that means letting go of some of the preconceptions of what's possible. Just as the Industrial Revolution shifted us so quickly from one way of building to the next, we have to do it again.

The scale of the need is even bigger. But we can change in very short order. If you look at the evolution of the skyscraper, it's incredible how quickly it changed. Of course it's possible. We need people to embrace the idea and invest in the idea and get excited about it.

In the future, we're not just going to celebrate towers because they're a cool shape; we're going to celebrate them because they actually have meaning again. It's an incredible statement of a community to build a legitimately carbon-neutral building. Height is amazing. It pushes our imagination and creativity. But it has to be done for meaning, not just for aesthetics.

It sounds like this could change the economics of logging, too.

Ultimately, the only way to reverse deforestation is to change the value of the land under the forest.

If you are going to make more money by cutting down your trees to grow crops, you're going to do that. But if you are incentivized to re-grow trees and turn them into Laminated Strand Lumber you're really talking about farming buildings. We grow our food; the earth has got to grow our homes as well.

If that environmental case becomes a business case, it could be the game-changer you're talking about.

And that's why we have to start talking about it as a thrilling opportunity. Not because we know all the answers, but because we've got to get a lot more people excited about chasing the answers. ■

Further Reading

GREEN, M. 2012. ***The Case for Tall Wood Buildings.*** mgb Architecture + Design.