ARE WE THERE YET?

CLOSING THE GAP, REMOVING BARRIERS: THE ROLE OF AI AND AEC SOFTWARE

Our ambition is to change the industry,
not just build cool tools that make people 5% faster.

—Matt Campbell, Hypar[1]

WILL HILDESLEY
+coordinates strategy

CLOSING THE GAP

Three strategies have emerged as the mass timber ecosystem seeks to resolve product-market fit, level the playing field, and "close the gap"—real or perceived—with traditional construction pricing and risk management: standardization, productization and customization.

1. **Standardization:** Limit choice, maximize predictability
2. **Productization**: Buildings as products and platforms
3. **Customization**: Exploit mass timber's unique Computer Numerical Control (CNC) efficiencies

Each route has the potential to address persistent barriers to adoption. Each also has benefitted tremendously from developments in automation; machine learning; and Architecture, Engineering, and Construction (AEC) design tech. And each will find ways to exploit the rapid evolution of artificial intelligence (AI).

Whether helping to remove friction, improve predictability, reduce risk, or facilitate collaboration, advances in these technologies have made significant headway, chipping away at legacy dynamics that restrict innovation in AEC.

These advances are impressive, but in isolation they remain essentially incremental. The AEC sector is the poster-child tortoise in Aesop's fable, not least because plenty of wise "tortoises" throughout the industry can readily point to early-adopter hares who met their untimely ends by jumping on new technologies.

Emerging leaders who have successfully navigated the roller-coaster ride of mass timber's adoption curve to date may be best served by blending these animals' character traits. Addressing the significant remaining barriers to scaling mass timber will continue to demand the bold embrace of new approaches and technological innovation. But those at the coalface challenging the legacy habits of a highly conservative, risk-averse construction sector are also forced to accept its realities: if there's a revolution coming in AEC, it won't be happening overnight.

1 Hypar is a cloud-based design platform aimed at streamlining design and construction workflows founded in 2018 by Ian Keough and Anthony Hauck.

Will mass timber's unique properties as a construction material play a role in unlocking the ingenuity necessary to reshape an entire industry?

The question summons a tantalizing 2-part prospect: (1) Will rapid advances in AI and AEC tech themselves help remove remaining barriers to mass timber's adoption, closing the gap on the actual or perceived benefits and pricing of traditional construction? (2) In doing so, will an evolving combination of these emerging technologies and mass timber's unique characteristics help unleash a wholesale reimagining of how the AEC community envisions, designs, constructs, and collaborates?

TACKLE THE MONKEY FIRST

Some of the constraints on mass timber's uptake represent generic challenges typical of any new technology or innovation, others are more specific to the AEC and forest sectors, and the remainder are unique to the properties and evolution of mass timber and Cross-Laminated Timber (CLT) as a product.

Closing the gap with traditional construction methods and accelerating adoption of mass timber requires accurately identifying these barriers, grappling with their practical implications effectively, and assuring consumers that they have been tackled comprehensively.

In broad terms, 3 interventions have emerged to take on the barriers: (1) early adopters prepared to assume a degree of risk while pushing the envelope, (2) "accelerator" organizations convening or coordinating efforts across the value chain, and (3) AEC tech developers exploiting rapid advances in robotics, machine learning, design tech, and AI that introduce new efficiencies, improve collaboration, remove friction, or tackle legacy approaches.

Alphabet's Moonshot Factory X was intentionally designed from the ground up to systemize innovation within its culture and business practices; it is essentially a constraint removal machine.[2] To that end, team members are frequently admonished to stay relentlessly focused on the hardest challenges inherent to any project by "tackling the monkey first."[3]

As X's CEO Astro Teller says, when tasked with teaching a monkey to stand on a pedestal and recite Shakespeare, it might feel productive to start by building the pedestal: demonstrate progress to your peers and enjoy the dopamine hit of checking a task off the to-do list. Meanwhile, the riskiest, most critical challenge remains precisely as hard as it was on day one. You still have to teach a monkey to recite *Hamlet*, and that didn't get any easier while you spent valuable time and resources building your pedestal.

The rank order may vary according to budget, building typology, or client, but the key barriers to adoption for mass timber appear to maintain considerable fidelity across geographies. Ask any developer, insurer, architect, or general contractor to play "barrier bingo," and you'll see remarkable consistency: the mass timber community still has a troop of recalcitrant monkeys to deal with, barriers demanding focused attention and collaborative effort to resolve.

2 For a fascinating look under the hood of what this approach implies, see "The Gimbal" at https://storage.googleapis.com/x-prod.appspot.com/files/the_x_gimbal_v2.10_web.pdf.

3 Medium, "Tackle the Monkey First," https://blog.x.company/tackle-the-monkey-first-90fd6223e04d.

Dealing with these barriers may not be as hard as teaching monkeys to recite Shakespeare, but dealing with the practical implications and ensuring consumers perceive that they have been addressed remains an ongoing task.

ARE WE THERE YET? IDENTIFYING THE BARRIERS.

With the support of the US Forest Service, the Mass Timber Tipping Point, a 2-year endeavor led by Pilot Projects and Architecture 2030, convened North American architecture, engineering, construction, and planning firms to explore and better understand the full range of views, visions, and challenges of the use and uptake of mass timber projects. The project involved 43 firms representing over 409 North American offices, providing a snapshot of North America's mass timber landscape.

Asked to list reasons behind a client requesting or agreeing to use mass timber in their projects, factors such as aesthetics, environmental goals, and carbon reduction led responses. Asked which factors prevent consideration, the firms pointed to cost for the firm and the client, and/or a lack of available and suitable material. Asked what major challenges they face in utilizing mass timber, they highlighted factors such as cost, material availability, risk-averse clients and partners, design knowledge gaps, and a lack of experience.

Erica Spiritos, a contributor to the project (and to this report) and Director of the Washington State Mass Timber Accelerator (Masstac), shares her summary of key barriers to accelerated adoption of mass timber, below:

1. **Cost premium:** Mass timber is still often believed to be a more expensive option than concrete and steel construction.
2. **Learning curve**: It takes time and commitment to learn a new structural system and a new process to deliver it to market.
3. **Carbon accounting:** We lack standard approaches to assessing the carbon impacts of mass timber construction.
4. **Insurance coverage:** A scarcity of affordable insurance coverage prevents owners from choosing mass timber.
5. **Supply stalemate:** The perception of limited supply, paired with low utilization of operating manufacturing facilities, thwarts progress.
6. **Market forces:** Tariffs, subsidies, exchange rates, and relative industry maturity result in a higher cost of regional mass timber relative to imported products.

We can debate the contents of the list, its ranking, or the relative weight of one barrier versus another, but it provides a simple, practical framework to ask the relevant follow-up question: What part will the growing investment in and rapid evolution of AI and AEC tech play in removing these barriers, accelerating adoption, and helping close the gap on traditional construction?

THE GOALPOSTS: WHAT CAN AI AND AEC TECH BRING TO THE TABLE?

Rapid escalation in the development of AEC software reflects 5 trends relevant to mass timber's adoption:

1. Global construction spending is projected to grow from $13 trillion in 2023 to $22 trillion in 2040.[4] Production efficiencies are essential to meet this demand.
2. An estimated $50 billion was invested in AEC tech from 2020 to 2022, an 85 percent increase over the previous 3 years.[5]
3. AEC software that is either "mass timber enabled" or, in a couple of cases, "mass timber specific" is finally emerging to enable the standardization, productization, and customization pathways.
4. Generative AI and related technologies, including large language and diffusion models, are rapidly evolving.
5. Recognition of the potential to reduce carbon emissions by looking for ways to improve carbon accounting throughout construction's value chain is growing.

Stjepan Mikulić, founder of AEC AI Hub, tracks the growth of AEC-related AI applications. As of December 2024, his database includes 1,500 sector-specific entries. He notes that many companies he currently works with face a common dilemma: getting lost in the plethora of options, choosing not to engage with AI at all, or going all in and taking on too many initial projects to handle.

His advice? Start with one problem central to a firm's priorities that will benefit from these technologies' primary capacities:

- Enhancing project delivery
- Reducing repetitive tasks
- Improving analysis of large datasets

Asked to summarize how advances in AEC tech are revolutionizing mass timber, a basic prompt to Anthropic's Claude 3.5 provides the following list:

1. Improved interoperability, integrated design, and collaboration
2. Parametric design optimization
3. Using diffusion models for form finding and rapid prototyping
4. Advanced finite element analysis and machine learning
5. Digital fabrication and robotic assembly
6. Project management and supply chain optimization

In an October 2023 ArchDaily article,[6] Marília Matoso lists 11 categories in which AI can complement and enhance the work of architects more specifically: "Just as Revit and 3D Software did not replace architects but only transformed their workflows, the same principle holds for AI tools. AI is poised to bring about new tasks, such as AI management, alongside existing responsibilities, signaling a shift in how architects work."

1. Design options based on specific criteria

4 McKinsey & Company, "Delivering on Construction Productivity Is No Longer Optional," August 9, 2024, https://www.mckinsey.com/capabilities/operations/our-insights/delivering-on-construction-productivity-is-no-longer-optional.

5 McKinsey & Company, "From Start-Up to Scale-Up: Accelerating Growth in Construction Technology," May 3, 2023, https://www.mckinsey.com/industries/private-capital/our-insights/from-start-up-to-scale-up-accelerating-growth-in-construction-technology.

6 Marília Matoso, "Will Artificial Intelligence Replace Architects?" ["A inteligência artificial vai substituir os arquitetos?"] ArchDaily, (Trans. Simões, Diogo), October 18, 2023.

2. Site analysis and mass studies
3. Generative design
4. Pattern recognition
5. Coding (custom apps, programs, and plug-ins)
6. Energy efficiency and sustainability
7. Data summarization
8. Building maintenance
9. Building Information Modeling (BIM) and project management
10. Virtual reality and augmented reality
11. Cost estimation and material selection

With this basic introduction to the breadth of possibilities being explored, we can turn to current-use cases and make a relatively superficial examination of the emerging Venn diagram. Given the state of advances in these technologies, who is breaking new ground as relevant providers to the mass timber value chain, and how are their products being employed to reduce barriers to adoption?

ON DECK: CURRENT APPLICATIONS OF AEC TECH AND AI

The landscape of technology in construction is evolving rapidly, with AI-informed solutions filling out the roster of applications in project software, field solutions, building tech, reconstruction, and robotics.[7]

Although the transformation of all of these disciplines will continue to impact mass timber projects, perhaps the most transformative impacts will be those that either address specific barriers to adoption or are built from the ground up to service mass timber's value chain. While it is beyond the scope of this article to address the potential to overcome every barrier, we can sample the playing field by looking at how AI is breaking ground in carbon accounting and cover emerging mass timber applications for pointers.

Sourcing and Carbon Accounting

Tangible's offering streamlines data collection to provide real-time carbon data, smart recommendations to help users find opportunities to cut carbon and cost at different construction stages, and real-time data on specific buildings and portfolios to meet regulatory requirements and sync up with other sustainability data.

Pathways has set out to "build the data layer needed to decarbonize manufacturing." Using proprietary AI to parse, extract, and transform customer data, Pathways takes raw data about raw materials, transportation, and manufacturing processes and creates real-time Environmental Product Declarations (EPDs) and Life Cycle Analyses (LCAs).

Cove is a full-service sustainability consultancy leveraging a simulation engine and AI that has been used across 60,000 projects worldwide, providing services such as analysis of embodied carbon, sustainability analysis, and certification and compliance services.

7 BuiltWorlds, "25 AI-Powered Solutions Transforming the Built World," https://builtworlds.com/news/25-ai-powered-solutions-transforming-the-built-world/.

Mass Timber-Specific Tech

Given the risk and switching costs of changing design tech and the limited availability of applications that incorporate CLT-specific models and data, practitioners across the board are still turning to tools originally designed for steel and concrete applications. Providers such as **Dlubal** have made inroads with tools such as **Rfem** by making sure they include CLT-specific data and models. Others have gone a step further—building out tools designed from the ground up to fully integrate mass timber construction.

Founded in 2021 by a cross-disciplinary team at Massachusetts Institute of Technology (MIT), **Generate** has assembled a team of architects, engineers, and computer scientists to deliver a platform that allows project teams to design and iterate in a "code, cost and carbon-aware space."

Generate promises to streamline mass timber design by rapidly generating design options and then identifying suitable systems for a specific project. The platform will automatically compile a quoting package using an automated digital workflow and then connect clients with suppliers for competitive bids. Generate will also analyze suppliers' bids, providing comparisons and highlighting differences in scope.

Branch, a software start-up nested directly within StructureCraft's engineering team, may represent the most ambitious attempt yet to create an end-to-end design tool that blends real-time structural analysis with fabrication, seamlessly integrating design and construction in one cohesive platform.

Branch's development has benefitted tremendously from its development "in house" and real-time feedback from StructureCraft's project teams.

The Branch platform has already been used to deliver more than 1 million square feet of timber construction. The platform aims to allow all stakeholders—from owners and architects to engineers and fabrication experts—to collaborate in a unified design space, enabling real-time cost and carbon feedback on design changes, and exploring high-level design concepts like building massing while instantly understanding the impacts of those changes on shop drawings, bills of materials, and CNC files.

Marne Zahner, Branch's director since 2022, has had a front-row seat to see how new AI models impact these developments and the work of his team. He notes that the degree to which AI is changing different aspects of the development game in mass timber applications parallels its use in other scenarios and domains. Just as many engineers, insurers, or general contractors have limited experience working with CLT, training datasets for AI have extremely limited access to mass timber case studies. Accordingly, when the Branch team is working on aspects of development that are CLT-specific, AI doesn't tend to bring its A game. In contrast, for aspects of development where coding problems are more generic, such as user interface design or queries, AI is already proving to be a game changer.

Where Zahner sees the greatest leaps in current applications of AI is customization. Although customizing AEC software to perform specific operations used to require deep domain knowledge and wizard-level coding skills, AI is making customization plausible for more general users. He highlights **CLT Toolbox** as doing extraordinary work filling gaps in mass timber-specific models and points to the data-wrangling capacities of programs such as **Speckle** as a great example of the potential to impact AEC tech and its development.

PULLING ON THE AEC TECH THREAD

Aaron Willette, now director of digital fabrication for Fabric Workshop Mass Timber, has worked with the likes of Intelligent City, WeWork, and Apple. He specializes in the integration of design, technology, and advanced manufacturing but proved in our interview that his real superpower is explaining the implications of AEC tech to those of us peering naively into that world from the outside.

His response to the question of how AEC tech will help mass timber close the gap with traditional construction was eloquent:

"In the long run, AEC tech is the thread by which all of this gets pulled together and we solve these remaining barriers. We're getting there, but it's a long and necessarily incremental process. In the short run, the implications should be equally clear: we all need to take hold of that thread and keep pulling."

Links

Branch: https://www.branch3d.com/

CLT Toolbox: https://clttoolbox.com/

Cove: https://cove.inc/

Fabric: https://fabricmasstimber.com/

Generate: https://www.generate.design/

Pathways: https://pathwaysai.co/

Rfem (Dlubal): https:// dlubal.com

Speckle: https://www.speckle.systems/

Tangible: https://tangiblematerials.com/