LICENSED ARCHITECT

Association of Licensed Architects

A Publication of the Association of Licensed Architects

Summer 2024

Spring Signature Conference

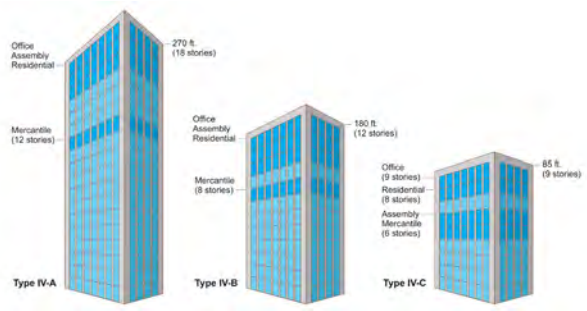
Think Wood

GFRC Panels

Concrete Moisture

CONTENTS

Articles



Departments

Cover Photo: McGuane Park Fieldhouse, Chicago, IL
Courtesy RADA Architects
Photo by James Steinkamp Photography

PRESIDENT'S message

Welcome to the summer issue of Licensed Architect Magazine!

For those of you who attended our recent Spring Conference, you experienced an impressive lineup of speakers. From Oliver Bray of Zaha Hadid Architects to Benjamin Skelton of Cyclone Energy, and from Ralph T. Muehleisen of Argonne National Labs to Laura Cooley of With Purpose, On Purpose, we had outstanding sessions. Wiss Janney Elstner also delivered two important presentations that sparked insightful discussions and inspired innovative ideas. The energy and enthusiasm at the conference were truly remarkable, and I want to extend my heartfelt thanks to everyone who contributed to making it such a success.

We are excited about the 2024 Design Awards Program. A big thank you to the 44 members who entered. With over 100 projects to judge, we look forward to a fantastic celebration at the University Club in Chicago on November 7. This event will be an excellent opportunity to showcase the exceptional talent and creativity within our community, and I am eager to see the innovative designs our members have produced.

I want to extend a warm welcome to our new members. We are thrilled to have you as part of the ALA family. Look for upcoming news on how to become an ALA Mentor or ALA Mentee. Sign up to work with those seeking career and professional development, or request to be matched with a Mentor. This program is designed to connect experienced professionals with those looking to grow and advance in their careers, providing valuable guidance and support. I encourage all members to consider serving on an ALA Committee or becoming a Board member. No previous board experience is necessary, just a passion for our profession and a willingness to contribute. If interested, please contact Joanne Sullivan at ala@alatoday.org. Our next two-year term begins on January 1, 2025.

Be sure to check out this summer issue for a recap of our Spring Conference. The feedback on the keynote address and presentations has been overwhelmingly positive. We received numerous comments highlighting the value of the insights shared and the opportunities for networking and professional growth.

Looking ahead, save the date for the Fall Conference on September 17. We are also rolling out new programs to foster camaraderie and community among our members. These initiatives are designed to enhance the sense of belonging and mutual support within our organization. Additionally, we are committed to meeting the needs of our national members by enhancing our virtual content and resources. We understand the importance of providing accessible and high-quality educational and professional development materials, and we are working hard to ensure that all our members, regardless of location, have access to these valuable resources.

Thank you for your continued support and dedication to ALA. Together, we are building a stronger community and a brighter future for all architects. Your involvement and enthusiasm are what make ALA such a dynamic and forward-thinking organization. I am excited about the opportunities ahead and confident that, with your help, we will continue to thrive and grow.

LICENSED ARCHITECT

Association of Licensed Architects
21200 South La Grange Rd., Suite 163
Frankfort, IL 60423
Phone: (847) 382-0630
E-mail: ALA@alatoday.org
Web Site: www.alatoday.org

BOARD OF DIRECTORS
Jeffrey N. Budgell, FALA, LEED AP - President
Rick E. Gilmore, FALA - Vice President
Carissa Wendt, ALA - Treasurer
William Huchting, ALA - Secretary
Steven H. Pate, FALA - Past President
Joanne Sullivan - Executive Director

DIRECTORS
Craig T. Cernek, ALA
Michael Coan, ALA Emeritus
Jay Cox, ALA
Robert Davidson, FALA
Howard Hirsch, ALA
David Koscielniak, ALA
Jeffery Stoner, ALA

ASSOCIATE ADVISOR
Tamsan Mora

EDITORIAL COMMITTEE
Joanne Sullivan
Jeffrey N. Budgell, FALA
Robert Davidson, FALA
Steven H. Pate, FALA

A TO B PUBLISHING INC.
662 Dudley Avenue
Winnipeg, MB CANADA
R3M 1R8

EDITORIAL
Andrew Pattison
204.275.6946
marcomap@shaw.ca

ADVERTISING SALES
Bert Eastman
204.997.6371
bert@atobpublishing.com

Wayne Jury
204.803.1300
waynej@atobpublishing.com

PRODUCTION TEAM
harper media
your social media strategy & web marketing partner
700 - 200 Main Street
Winnipeg, MB
R3C 1A8

DIRECTOR
Aaron Harper
204.318.1121 xt. 101
aharper@harpermedia.ca

LAYOUT & DESIGN
Joel Gunter
204.318.1121 xt. 108
joel@harpermedia.ca

Spring 2024 ALA Signature Conference a Big Hit!

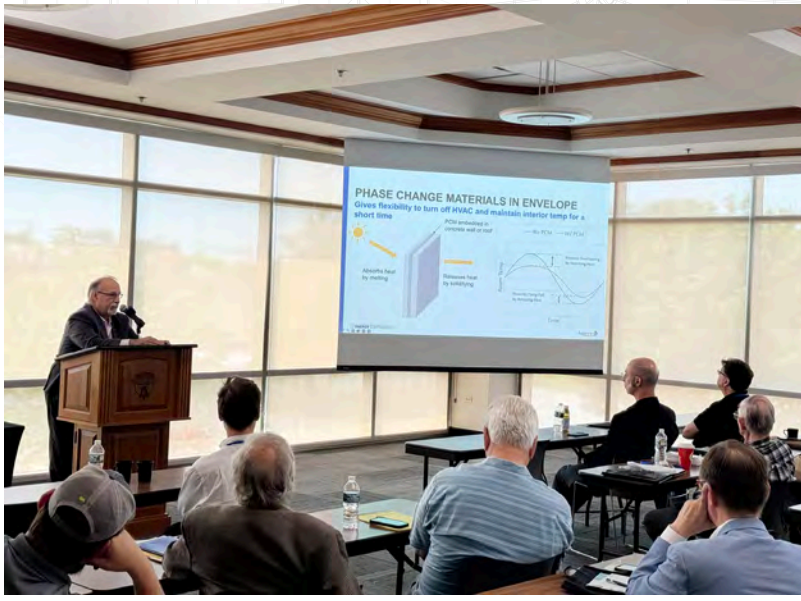
Association of Licensed Architects

On On May 31, 2024, the Association of Licensed Architects (ALA) hosted its Spring Signature Conference, "**The Future of Design is Here**." Held at the Mid-America Carpenters Regional Council Apprentice and Training Center in Elk Grove Village, IL, the event brought together over 120 architects and design fans. It was a full day of learning and networking, both in-person and online. Attendees enjoyed talks from experts, learned about new tools and technologies, and connected with others in the field. This recap covers the highlights and key moments from an exciting and informative conference.

Benjamin Skelton, President, Cyclone Energy Group, delivers a presentation on "Understanding Blower Door Testing for Commercial and Multifamily Buildings"

Jeff Budgell, ALA President (left) thanked and presented plaques to Kurt Hezner (right) and Lew Wilson (far right) for their years of Board service

Laura Cooley, Operational Learning and Development Consultant, of With Purpose, On Purpose, gave an enriching session on how to "Boost Communication Styles", giving delegates a deeper understanding of themselves and those around them



Ralph T. Muehleisen, Chief Building Scientist, Argonne National Laboratory updates conference attendees on "New Technologies for New Buildings in a New Climate World"

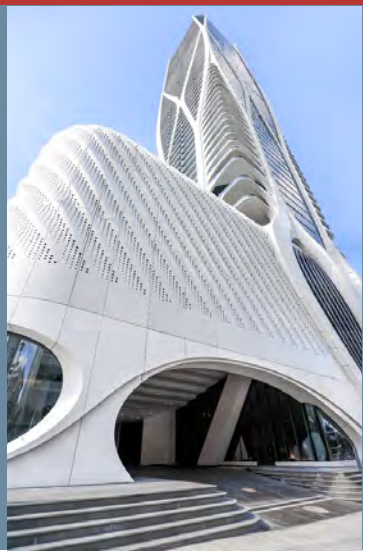
This full-day professional development program featured practical education with a real-world focus. The day included a stimulating keynote presentation along with five other presentations, and opening and closing remarks from ALA President Jeff Budgell. Exhibitors and sponsors also shared the latest products, services and developments in the field.

Overall the ALA Spring Signature Conference was an excellent opportunity to gain knowledge and network with some of the best in the industry. In-person attendees earned up to 6.5 LUs, most HSW, with the online participants earning up to 5 LUs/HSW. Stay tuned for information on the upcoming ALA Fall Signature Conference, to be held on Tuesday, September 17th at the same venue.

KEYNOTE PRESENTATION

One Thousand Museum - Crafting a Concrete Vision

Oliver Bray from Zaha Hadid Architects started the day with a fascinating keynote. He shared the story behind the One Thousand Museum in Miami, a building known for its unique concrete exoskeleton. Bray explained the challenges they faced and the innovative solutions they used to create this impressive skyscraper.



PRESENTATIONS

Benjamin Skelton:
The President of Cyclone Energy Group talked about blower door testing for commercial and multifamily buildings. He provided useful tips on how to improve energy efficiency and meet regulations.

Ralph T. Muehleisen:
From Argonne National Laboratory, Muehleisen shared information about new building technologies for our changing climate. He highlighted the latest advancements in sustainable building practices that architects can start using now.

Laura Cooley:
As Operational Learning and Development Consultant, Cooley spoke about improving communication styles. Her session offered practical advice on understanding and interacting better with colleagues and clients.

Wiss, Janney, Elstner Team: This team discussed converting offices to residential spaces and navigating the new 2024 International Building Code (IBC) changes. They shared real-world examples and practical tips to help architects succeed in these projects.

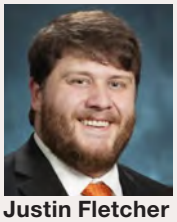
Office-to-Residential Conversions: Planning from Experience

Peter Tarara
Associate Principal and Unit Manager

Nick Ozog
Associate Principal

Anthony K. Dukes
Senior Associate

Navigating the New 2024 International Building Code (IBC) Changes



Justin Fletcher
Associate II

Nick Ozog
Associate Principal

THANK YOU!

The ALA Board of Directors thanks everyone for their participation in a very successful Spring 2024 Signature Conference.

Special appreciation to our exhibitors and sponsors, and to the Mid-America Carpenters Regional Council Apprentice and Training Center in Elk Grove Village, IL for providing such an excellent venue, and for sponsoring lunch.

We look forward to seeing you later this year for the ALA Fall Signature Conference Tuesday, September 17 at the same place.

Details and registration information to follow in August.

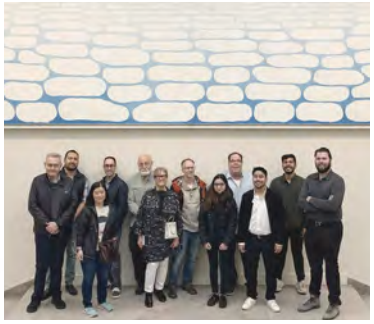
FALL SIGNATURE CONFERENCE: TUESDAY, SEPTEMBER 17, 2024

Save the date for our Fall Signature Conference, to be held on Tuesday, Sept. 17th.

Details on purchasing a tabletop or sponsoring a speaker will be released in August.

For more information on ALA Conference sponsorships, contact Joe Lombard, at (847) 382-0630 or email ala@alatoday.org

RADA ARCHITECTS Better Lives, By Design



Rada Doytcheva, PHD, FAIA, ALA - Recognized as one of Crain's 2020 and 2021 NOTABLE WOMEN IN CONSTRUCTION AND DESIGN

Following the firm's mantra "Better Lives, by Design," RADA Architects have worked closely with large institutions and organizations, putting heart and mind into the colossal building and planning issues of Chicago. With passion for what is right, socially responsible, and sustainable, RADA's projects transformed educational environments at University of Chicago, UIC, UIUC, ISU; in health care and research - at Rush University, University of Toledo and UIH.

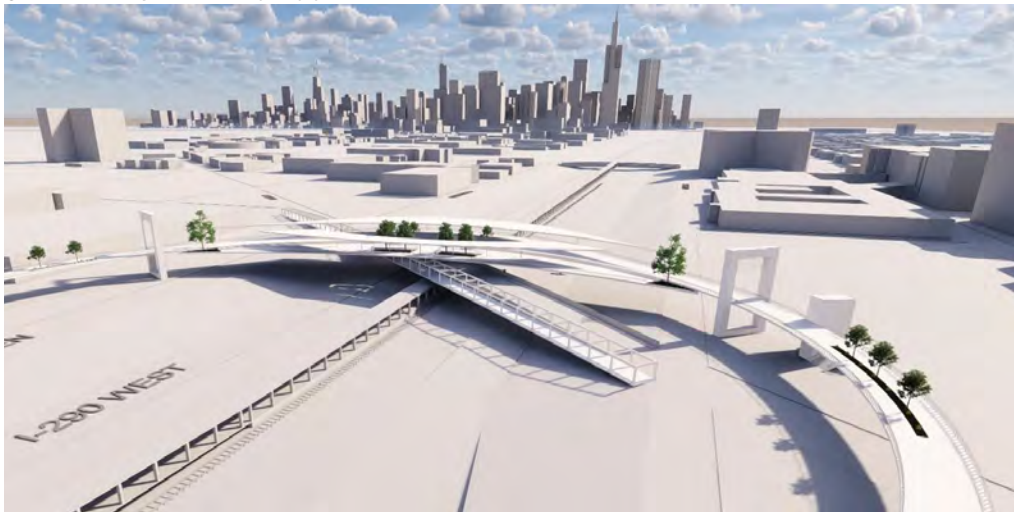
RADA's workplace designs brought new energy to people working at companies like ComEd and Systems Research. The firm's innovative work elevated quality of outcomes for Capital Development Board State of Illinois, Cook County, CPS and other public agencies projects.

Credit: Photo by Michael Lipman Photography

CDB IDOT DISTRICT ONE Material Testing Labs, Schaumburg, IL

High-efficiency planning for laboratories, offices and training with visual connection between areas of collaboration. The exterior design of bold and distinct expression is a recall of L-shaped bridge and roadway construction.

Credit: Rendering by RADA Architects



ILLINOIS MEDICAL DISTRICT Pedestrian Bridge Concept for CCDOTH, Chicago, IL

Connecting historically divided communities, the Pedestrian Bridge provides equitable and safe transit for 100,000 visitors a day into the area. It extends quality of improvements to the Near West Side of Chicago

Credit: Photo by RADA Architects

PROMEDICA TOLEDO HOSPITAL Heart Rhythm Center, Toledo, OH

Softer humanized approach to design of hi-tech electrophysiology department. Standard modules of Hybrid ORs achieved within existing building, for ease of operation. Rational planning contributes to the reduction of inner hospital infections.

Credit: Photo by James Steinkamp Photography

AMBULATORY CLINIC in Wicker Park, Chicago, IL

Contemporary bright look to this facility makes patients feel relaxed coming for care and attention. It is a welcome addition to neighborhood and community.

Credit: Photo by James Steinkamp Photography

CHICAGO PARK DISTRICT McGuane Park Fieldhouse, Chicago, IL

Connecting communities within new multi-use spaces while revitalizing and adding to an existing 1970s structure.

Credit: Rendering by RADA Architects

FORENSIC SCIENCE LABORATORY FOR ISP, Joliet, IL

New state-of-the art laboratory building, designed to address most advanced scientific methods in forensic science, serving the state law enforcement system. Bright and welcoming, it is designed to incorporate nature in people's workday.

Yoko Yarita, ALA, AIA

ROKK Architecture is a small design practice located in Alexandria, Virginia, led by Yoko Yarita, AIA, and has been serving commercial clients in Virginia, the District of Columbia, and Maryland since 2015. With a history of large project experience, including the completion of several build-to-suits prior to starting ROKK, Yoko brings base building knowledge to Building Repositioning, Renovations, and Interior Tenant projects.

We pride ourselves in delivering a superior level of service to our clients on projects of all types and offer services from the pre-lease or pre-purchase phase through construction completion. We listen, observe, document, strategize, develop design solutions, and meticulously execute while managing risk and cost.

12601 Fair Lakes Circle, Fairfax, VA

Project entailed the development of a tenant retention strategy through targeted updates to a 1980s office building. The scope of work included elevator cab renovation, a cafe refresh, lobby renovation, and the addition of two outdoor amenity areas.

PHOTOGRAPHER: JUDY DAVIS, ARCHITECTURAL PHOTOGRAPHER

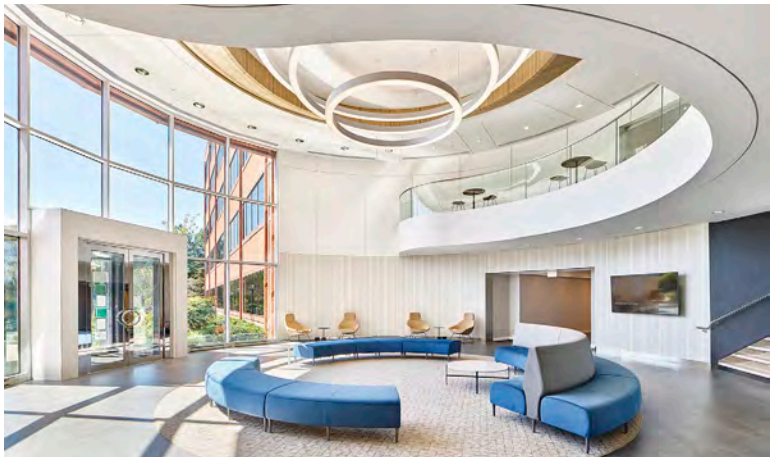
HESS Construction Offices, Rockville, MD

ROKK provided comprehensive Interior Design & Architectural services to HESS Construction for the build-out of their new offices at 1445 Research Blvd., Rockville, MD. The building permit was approved with zero comments.



MVP Vet Clinic, Boarding & Daycare, Fairfax, VA

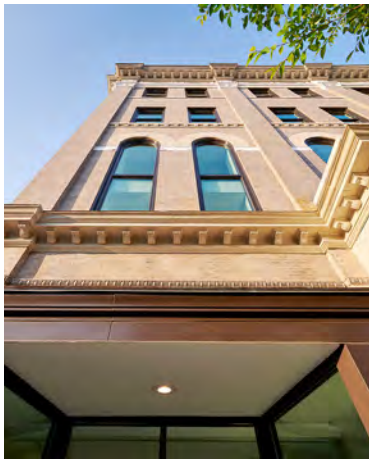
ROKK, in collaboration with Redteam Strategies who provided interior design services, transformed this former furniture showroom/warehouse and automotive body shop into a 12,000 sf vet clinic and a 10,000 sf dog and cat daycare and boarding facility. It was a complex, fast-tracked, phased renovation, completed in 2023.



The Offices at Research Row, Rockville, MD

ROKK served as the Architect of Record and provided full architectural services for this Building Repositioning project. The scope of work included elevator lobby, corridors, toilet room upgrades, as well as the expansion and renovation of interior amenities and the addition of an exterior amenity in the parking lot.

PHOTOGRAPHER: JUDY DAVIS, ARCHITECTURAL PHOTOGRAPHER


Public Welfare Foundation, Washington, DC

Completed in 2022, ROKK assisted the Property Manager for the Public Welfare Foundation, Stout & Teague, with this window replacement project.

The Evolution of Building Bigger and Taller with Wood Construction

BY: THINK WOOD

In this article, you'll learn about the 2021 International Building Code (IBC) changes related to tall wood construction, including three new building types that allow for wood buildings up to 18 stories and even taller using an Alternate Materials and Methods Requests (AMMR). Rigorous fire testing was conducted as part of these code changes to validate the safety of tall mass timber construction. Along with advancements in tall mass timber construction, the article explores design tactics and relevant code applications used to boost the density of light-frame wood construction. Finally, this article will review the science related to wood's embodied carbon and life cycle assessment in the context of curbing a building's impact on climate change, including a growing body of research demonstrating how building with timber represents an opportunity to increase the long-term storage of carbon in today's built environment.

The built environment in the U.S. is growing at a rapid rate as a result of an ever-rising need for housing and infrastructure. It's estimated that America is short more than 5 million homes,[1] and a boost in infrastructure spending is further accelerating new construction.[2] At the same time, buildings and their construction account for more than a third of global carbon dioxide emissions,[3] with 11% of carbon emissions generated from the building materials and construction.[4] This embodied carbon can account for half of the total carbon footprint over the lifetime of a building.[5]

To address these concerns, some policymakers[6] and design teams[7] are turning, in part, to timber – a naturally renewable building material that, being 50% carbon by dry weight,[8] can lock in carbon over the lifetime of a building.[9] Product advancements, new capabilities of hybrid-timber construction, fire testing, and fire-resistant designs have all contributed to an increased capacity to build larger and taller buildings using low-carbon wood products.

In this course, you'll learn about the 2021 International Building Code (IBC) changes related to tall wood construction, including three new building types that allow for wood buildings up to 18 stories[10] and even taller using an Alternate Materials and Methods Requests (AMMR).[11] Rigorous fire testing was conducted as part of these code changes to validate the safety of tall mass timber construction.

Along with advancements in tall mass timber construction, the course explores design tactics and relevant code applications used to boost the density of light-frame wood construction. Finally, this course will review the science related to wood's embodied carbon and life cycle assessment in the context of curbing a building's impact on climate change, including a growing body of research demonstrating how building with timber represents an opportunity to increase the long-term storage of carbon in today's built environment.[12]

Global Trend Towards Tall Mass Timber Buildings

Over the past 15 years, there has been a growing interest in tall buildings constructed from mass timber materials. This has been coupled with technical advancements that one architect described as "a timber renaissance, with new milestones in timber construction being reached at a breakneck pace."[13] Around the world there are now dozens of timber buildings constructed above eight stories tall. International examples include Brock Commons in Vancouver, BC (18 stories), Mjøstårnet in Norway (18 stories), and HoHo Wien in Austria (24 stories).

In the United States, such buildings have been constrained by a strong reliance on prescriptive building code limits and less willingness to use performance-based fire protection engineering. That said, mass timber construction has grown significantly, and changes to the 2021 IBC have greatly increased the pace at which new tall mass timber projects are being proposed. As of early 2022, more than 1,300 mass timber projects have been built, are under construction, or in design in the US;[14] more than 160 of these are considered tall mass timber projects, exceeding the height and/or story limits for mass timber under the 2018 IBC.

The Path to 2021 Code Changes: ICC Tall Wood Building Ad Hoc Committee

In response to the growing interest in tall wood buildings, particularly those constructed from new mass timber materials,the International Code Council (ICC) chartered the Ad Hoc Committee on Tall Wood Buildings (TWB) in December 2015. The purpose of this committee was to "explore the building science of tall wood buildings and investigate the feasibility of and take action on developing code changes for tall wood buildings." Initial activities included reviewing the technical state of mass timber knowledge and building performance and developing a series of compartment fire tests to test the proposed construction types.

In January 2018, the Committee submitted a set of 14 IBC code change proposals to the ICC 2018 Group A code development process, targeting changes to the 2021 IBC. In January 2019, 3 additional code change proposals were submitted by the TWB as part of the Group B cycle. All 17 code change approvals were approved for inclusion in the 2021 IBC, some as submitted and some with modifications.

Concurrently with the development of the IBC code change proposals, the committee overseeing the code-referenced CLT product standard, ANSI/APA PRG-320 Standard for Performance-Rated Cross-Laminated Timber (PRG-320), responded to the desire by fire service representatives on the TWB for higher assurances of CLT behavior in high-rise construction by incorporating a new required test for adhesives used in CLT production. Passing this test is required for adhesives used in all CLT complying with the 2019 edition of PRG 320, referenced in IBC 2021. This test is based on a 4-hour compartment-like fire test designed "to identify and exclude use of adhesives that permit CLT char layer fall-off resulting in fire regrowth during the cooling phase of a fully developed fire."

2021 IBC Code Changes for Wood Construction

New Tall Timber Construction Types

In looking at the existing tall wood buildings proposed and built around the country and world, the TWB decided to propose expanding the existing Type IV construction by adding three new sub-types—IV-A, IV-B, and IV-C—and renaming Type IV as Type IV-HT. Similar to the noncombustible construction types I and II, the four "mass timber" construction types are arranged from the highest fire resistance and safety requirements (IV-A) to the lowest (IV-HT).

These three new construction types introduced in the 2021 IBC each have different maximum allowable heights, stories, and areas. Type IV-A allows the greatest height and area and has the most stringent fire protection requirements (e.g., fire-resistance ratings, noncombustible protection, etc.), followed by Types IV-B and IV-C. Conceptually, Type IV-A is similar to the existing construction Type I-A (which requires a fully non-combustible structure), with equal or greater fire-resistance rating requirements and no exposed mass timber.

Type IV-C is similar to Type IV-HT with almost all of the interior mass timber permitted to be exposed; however, most structural building components have a 2-hour FRR in addition to minimum heavy timber sizes, resulting in an increase in the allowable number of stories when compared to IV-HT. The TWB also determined that an intermediate construction type between IV-A and IV-C was needed, resulting in Type IV-B. For multi-family occupancies, Type IV-A permits a timber structure of up to 18 stories and 270 feet, Type IV-B permits up to 12 stories and 180 feet, and Type IV-C permits up to 8 stories and 85 feet.

Fire-Resistance Design

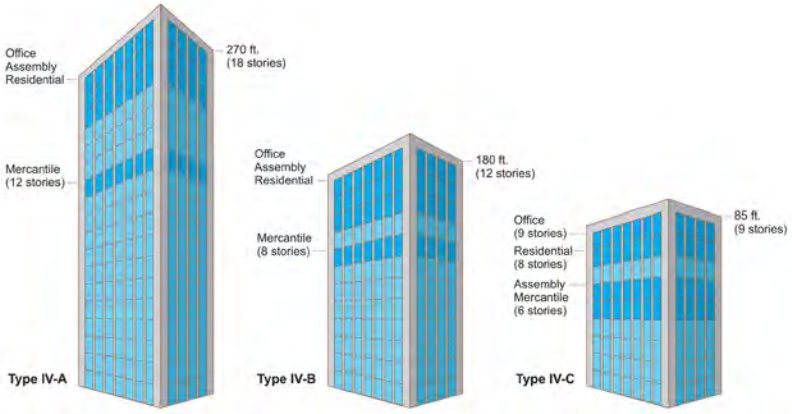


Image courtesy: WoodWorks

A requirement unique to the new construction types is noncombustible protection for some mass timber elements. This noncombustible material applied to the mass timber helps determine fire behavior by delaying the contribution of the mass timber structure in a fire and has an added benefit of increasing the fire-resistance rating of the overall assembly or member. A summary of the fire-resistance rating for the new construction types is shown in Table 1. Allowances for Type I-A and I-B are included for comparison.

TABLE 1: FRR Requirements (Hours) for Tall Mass Timber Construction Types and Existing Type I

Building Element	I-A *Unlimited stories, heights and areas**	IV-A *Max. 18 stories, 270 ft, 324,000 sf***	I-B *Max. 12 stories, 180 ft, unlimited areas**	IV-B *Max. 12 stories, 180 ft, 216,000 sf***	IV-C *Max. 9 stories, 85 ft, 135,000 sf***
Primary Frame	3	3	2	2	2
Exterior Bearing Walls	3	3	2	2	2
Interior Bearing Walls	3	3	2	2	2
Roof Construction	1.5	1.5	1	1	1
Primary Frame at Roof	2	2	1	1	1
Floor Construction	2	2	2	2	2

Assumes an NFPA 13 automatic sprinkler system throughout building. Source: 2021 IBC Tables 504.3, 504.4, 506.2 and 601

*Unlimited building size permitted for most occupancies

**Area limits indicated are per level, assuming no frontage increase; see IBC Tables 504.3, 504.4 and 506.2 for additional details

A provision commonly used in Type I construction for high-rise buildings that do not exceed 420 feet in height allows a reduced FRR if the building has sprinkler control valves equipped with

supervisory initiating devices and water-flow initiating devices for each floor (per IBC Section 403.2.1.1). With this provision, the FRR requirements for elements in a Type I-A building may be reduced to the lesser requirements of Type I-B construction (with the exception of columns that support floors), and the requirements for a Type I-B building may be reduced to the lesser requirements of Type II-A construction. These reductions are not available for the new construction types, making them more conservative than Type I requirements.

In addition to meeting FRR requirements, all mass timber elements used in Types IV-A, IV-B and IV-C construction must meet minimum size criteria prescribed in IBC Section 2304.11.

Definitions of the new construction types (found in IBC Sections 602.4.1, 602.4.2 and 602.4.3) dictate that only mass timber or noncombustible materials can be used for the structural systems. Where mass timber elements are used, the definitions also include guidelines for whether the wood may be exposed on the building's interior or must be covered with noncombustible protection. General allowances for exposed timber are:

- Type IV-A: No exposed timber permitted
- Type IV-B: Limited exposed timber permitted as follows:
    - o Ceilings (including integral exposed beams) up to 20% of floor area in dwelling unit or fire area,* or
    - o Walls (including integral exposed columns) up to 40% of floor area in dwelling unit or fire area,* or
    - o A combination of each using sum of ratios (actual exposed/allowable exposed wood) not to exceed 1.0
- Type IV-C: All exposed timber permitted*

*Exceptions: No exposed timber is allowed at shaft walls, within concealed spaces or on the exterior side of exterior walls.

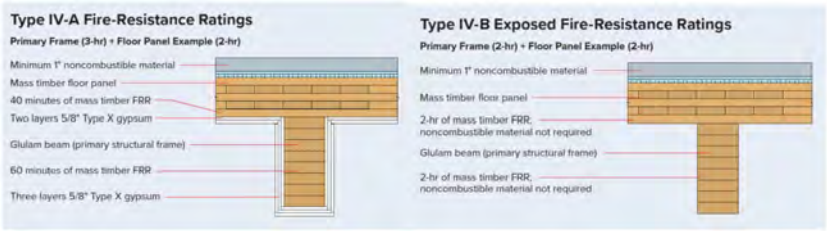
When noncombustible protection is required to cover timber elements, it must provide at least two thirds of the FRR. For example, a beam that requires a 2-hour FRR and requires noncombustible protection must achieve at least 80 minutes of protection from the noncombustible coverings. Section 722.7, which is new to the 2021 IBC, has been introduced to codify the demonstration of FRR using a combination of time assigned to the noncombustible coverings and inherent fire resistance of the mass timber framing members.

Any noncombustible material used as protection of mass timber elements can be tested by following the procedure outlined in IBC Section 703.6 to determine its contribution to FRR. However, two prescriptive options are presented in IBC 2021 Section 722.7.1. These options are 25 minutes per layer of ½-inch Type X gypsum board or 40 minutes per layer of 5/8-inch Type X gypsum board. Using these options, where mass timber is required to have noncombustible protection, two layers of 5/8-inch Type X gypsum board covering would meet the noncombustible protection requirements for a 2-hour FRR, and three layers would meet the noncombustible protection requirements for a 3-hour FRR.

FRR of Building Element (hours)	Minimum from Noncombustible Protection (minutes)
1	40
2	80
3 or more	120

Source: 2021 IBC Table 722.7.1(1)

The remaining one third of the mass timber member's FRR must be achieved through inherent fire resistance of the mass timber element. For example, a mass timber floor assembly requiring a 2-hour FRR would require 80 minutes of noncombustible protection, with the remaining 40 minutes achieved from the mass timber. In applications where the timber is exposed, the full FRR must be achieved through inherent fire resistance of the mass timber element.



There are several options for demonstrating the contribution of various elements to the FRR. One method is to provide the results of testing undertaken in accordance with ASTM E119 (or UL 263). However, if the exact assembly has not been tested, IBC Section 703.2 provides a number of alternatives. These alternatives are all founded on ASTM E119 testing. Item 3, which permits the use of calculations in accordance with Section 722, is frequently used to demonstrate the fire-resistance rating of exposed mass timber. IBC Section 722.1 notes that the fire resistance of exposed wood members and wood decking shall be permitted to be calculated in accordance with Chapter 16 of the ANSI/AWC National Design Specification® (NDS®) for Wood Construction. Chapter 16 of the NDS can be used to calculate up to a 2-hour fire resistance rating for a variety of exposed wood members including solid sawn, glulam, and CLT.

Hybrid Construction for Shafts & Lateral Resistance

Provisions addressing materials permitted in shaft wall construction can be found in both the shaft enclosures

section (713.3) and fire barriers section (707.2) of the IBC. These sections state that shaft walls can be constructed of any material permitted by the building's type of construction. As noted, construction Types IV-A, IV-B and IV-C permit the use of mass timber or noncombustible materials (or a combination thereof). This would indicate that the use of mass timber shaft walls in tall buildings is also permitted. This is true with one exception. Section 602.4 of the 2021 IBC notes that shaft walls in buildings taller than 12 stories or 180 feet must be constructed of noncombustible materials. Tall mass timber buildings which do not exceed these limits may utilize mass timber shaft walls; however, those shaft walls must have noncombustible protection on both faces of the wall.

While the code permits the use of mass timber shaft walls in many instances, worth noting is that most tall timber buildings are hybrids, utilizing non-wood materials for shaft enclosures such as concrete cores or steel braced frames with infill light gauge steel stud walls. One of the primary reasons for this is to use these materials as the building's vertical lateral force resistance system. Until recently, the IBC and referenced standards, such as the American Wood Council's *Special Design Provisions for Wind and Seismic* (SDPWS) and ASCE *7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, did not prescriptively recognize mass timber as an allowable seismic force resisting system. While this did change in the 2021 version of SDPWS and the 2022 version of ASCE with new options for the use of CLT shearwalls, the current provisions limit the overall system height of CLT shearwalls to 65 feet in areas of high seismic hazard. Mass timber vertical lateral force resisting systems have not been implemented to date on tall mass timber buildings in the US, with project design teams choosing to use primarily either concrete cores as shearwalls or structural steel-braced frames.

Image courtesy: WoodWorks

Trends for Increased Density in Light Wood-Frame

Although not specific to a change within the 2021 IBC, the past several years have continued to see an increasing trend of light wood-frame projects using innovative approaches to achieve greater density, site utilization and value. Several examples of how this has been done include more incorporation of amenity spaces (roof top decks, fitness centers, retail) as well as on-site parking, all located within the same building. Below is a discussion of the code provisions and design methodologies implemented to achieve these innovative projects.

For years, the IBC has allowed light wood-frame buildings up to five stories for residential occupancies (and six stories for office use) over a single-level podium. The 2015 IBC evolved to recognize multi-level podiums, which had been permitted in the Seattle Building Code for some time. Across the country, designers began maximizing the value of their midrise projects with 5-over-2 and 5-over-3 configurations; however, for one Sacramento project called 1430 Q, 5-over-2 still wasn't sufficient to make the investment in pencil out. Sacramento's competitive building market required that 1430 Q have at least six floors of wood-frame residential units to make the project profitable, in a 6-over-2 configuration. By using the City's Alternate Means and Materials Request (AMMR) process, the design team was able to successfully achieve the extra height and, in so doing, build the country's tallest light wood-frame building. Several additional projects in Sacramento, which are currently under construction, have been permitted and are using a similar 6-over-2 approach.

In Washington, six stories of Type IIIA construction are permitted when certain criteria are met. Two example projects which are leveraging these code allowances are called Analog and Moraine, both of which are located in Tacoma.

Incorporating Parking in Light Wood-Frame Mid-Rise

A common configuration in multi-story, multi-family wood-frame construction is parking on the first level(s) with three to five stories of wood-frame residential on top. Many designers assume that the parking level is required to be noncombustible and utilize the podium provisions within IBC 510.2; however, there are several opportunities for alternate provisions and/or wood framing within the parking levels that can offer significant cost savings.

Section 406 provides several provisions specific to motor vehicle-related occupancies. Section 406.5 provides requirements for open parking garages. The natural ventilation requirements for a garage to qualify as open are discussed

in Section 406.5.2 and generally require openings on at least 40% of the garage's perimeter, with some exceptions specified. Section 406.5.1 permits open parking garages to be of Types I, II, or IV construction.

Enclosed parking garages are covered by Section 406.6 and require both mechanical ventilation and NFPA 13 sprinklers, per Section 903.2.10. There are no limitations on construction type for enclosed parking garages, indicating that parking garages of Types III, IV or V construction can be used and framed with wood, concrete, steel and all other materials as permitted for each of these types of construction per the IBC Section 602 definitions.

Occupancy separation is a cost-effective design option frequently overlooked when a parking garage is classified as enclosed. This design route utilizes a single construction type for the entire building (i.e., the Type I-A podium of Section 510.2 is not necessary). The parking garage can still be framed with concrete or steel, for example, but there is no code requirement to use Types I or II simply due to the presence of noncombustible materials.

In a building that has an NFPA 13 sprinkler system throughout, only a 1-hour rating is required when separating parking from occupancies such as Group B, M and R, per Table 508.4. This indicates that a mixed-use building consisting of an enclosed parking area and other occupancies could be completely framed with wood if allowable building size calculations permit the use of Types III, IV or V construction. Even if other materials are used in the building (perhaps as columns, beams or walls on lower levels), there is economic value in using Section 602.1.1 to classify the entire building as the lowest construction type allowed.

Utilizing the options presented in Section 510.4 offers the ability to capitalize on an increased number of stories—similar to the horizontal separation provision of Section 510.2—by stacking a Group R building on top of a single-story Group S-2 parking garage, gaining an additional story.

The main benefit of utilizing Section 510.4 is that it provides the benefit of an additional story while not requiring the full podium provision limitations of Section 510.2 (i.e., the lowest level doesn't have to be Type I-A with a 3-hour podium slab). Specifically, this provision allows the use of a heavy timber-framed parking level (if open) and only requires a 1-hour rating (if the parking level is Type IV) or 2-hour rating (if the parking level is Type I) to separate the parking from adjacent residential units above.

Incorporating Occupied Roof Decks in Light Wood-Frame Mid-Rise

Occupied roof decks are becoming more common in multi-family and commercial buildings as designers and owners seek to increase the marketability of their rental spaces with more amenities. In most instances, these roof decks are open-air, without roof coverings, and have partial-height guards or wall parapets around their perimeter. Designers often wonder if a roof deck of this kind needs to be included as a story when calculating required construction type, building area, and number of stories. Language was added to the 2018 IBC stating that a roof occupied in full or in part with the same occupancy as the story immediately below does not need to be included in the building area regulated by Section 506. Further, if the building is fully equipped with an NFPA 13 or NFPA 13R sprinkler system and an occupant notification system in accordance with section 907.5, the roof occupancy is not restricted to the occupancy of the story below.

In most instances, an occupied roof deck with a roof covering or walls that are taller than 48 inches is considered a separate story and must be included in building area calculations. If considered a mezzanine or accessory occupancy (Sections 505.2 and 508.2), it may be possible to exclude the occupied roof deck (and its enclosing elements) as a separate story when determining the construction type.

2024 IBC Code Changes

While the 2021 IBC has been adopted by several jurisdictions, with others in the process of updating as discussed below, the code development cycle for updates to the 2024 IBC is now under way. Most notably with respect to tall mass timber is a proposed change to the ceiling exposure allowances for Type IV-B. Under the 2021 IBC, Type IV-B is permitted up to 20% ceiling exposure as noted. However, a planned update would allow 100% ceiling exposure in the 2024 IBC. Several projects currently in design are looking to leverage these future code allowances, and several jurisdictions are including this change in their code amendments and code adoption processes.

Jurisdictional Code Adoptions

While the list is constantly changing, the following jurisdictions have adopted the tall mass timber provisions in the 2021 IBC, either in whole or with local amendments.

• Oregon	• Maine
• Washington	• Georgia
• City of Denver	• Idaho
• Utah	• Connecticut
• California	• Maryland
• Virginia	• New Jersey
• City of Austin, Texas	• South Carolina
• City of Bryan, Texas	• South Dakota

Several other jurisdictions are considering or are in the process of adopting the tall mass timber provisions or the 2021 IBC in whole. Note that several jurisdictions including Denver and Oregon have already adopted the tall mass timber provisions of the 2021 IBC and will be adopting the 2024 IBC allowance for 100% ceiling exposure under the 2022 Denver Building Code, scheduled to be adopted in the summer of 2022.

The Urgent Need to Lower Building Carbon Footprints

Advancements in tall wood construction and codes are being made just as the call for low carbon construction reaches new levels of urgency. The built environment is growing at a record pace in the United States. It is estimated that 2.5 million new housing units are needed to make up for the nation's housing shortage.[15]

Buildings and their construction account for 39% of global carbon dioxide emissions; 28% of those emissions come from operational carbon—the energy used to power, heat and cool a building.[16] Buildings' operational carbon can be reduced through energy efficiency measures and policymakers, architects, developers, and engineers have made significant advances in this arena. The remaining 11% of carbon emissions are generated from building materials and construction.[17] This embodied carbon can account for half of the total carbon footprint over the lifetime of the building.[18]

Embodied carbon is a priority for many environmental, architecture, and urban planning organizations including C40 Cities,[19] Architecture 2030,[20] Urban Land Institute,[21] and the World Green Building Council.[22] Many experts believe addressing embodied carbon for buildings and building materials is critical to achieve the goals of the Intergovernmental Panel on Climate Change (IPCC) and the 2016 Paris Climate Agreement.

Embodied Carbon in a Building's Lifecycle

Embodied carbon is determined by conducting a life cycle assessment (LCA) of a product, assembly or the building over declared life cycle stages. An LCA study returns results for a number of environmental metrics, including the potential to impact climate or "global warming potential" (GWP). Embodied carbon is the GWP result. Embodied carbon is measured for each stage of the product's life cycle, allowing comparisons across any combination of stages.

As buildings become more energy efficient, the upfront embodied carbon from materials begins to account for a higher proportion of a building's carbon footprint.[23] Very soon, embodied carbon is likely to become the dominant source of building emissions.

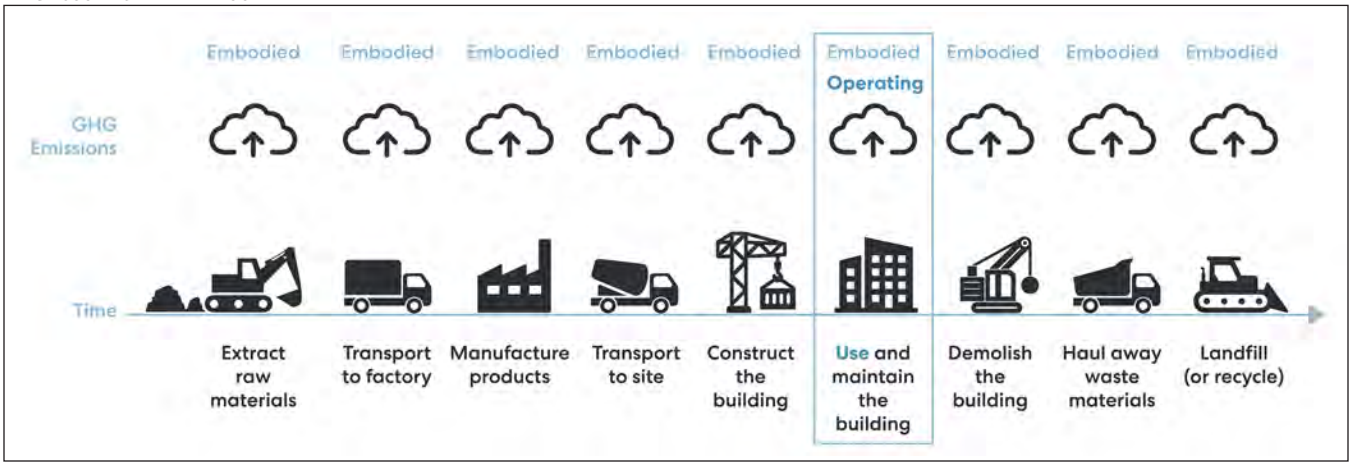
Embodied carbon varies dramatically between concrete, steel and wood, making product decisions key in achieving lower carbon buildings. Manufacturing wood products requires less total energy, and in particular less fossil energy, than manufacturing alternative structural materials including metals, concrete, or bricks.[24]

Stored Carbon in Wood Products

Wood products are approximately 50 percent carbon by dry weight.[25] The use of wood products in buildings provides an additional environmental benefit by storing carbon removed from the atmosphere. This ability to store carbon sequestered during tree growth in the forest makes wood an ideal product for buildings, which are designed for long service lives. Essentially, a wood building is a large carbon sink.[26]

Timber as a tactic for curbing climate change is backed by a growing body of research and advancements in calculating the carbon footprint of building materials.[27]

Image courtesy: Think Wood



In a recent paper published in the journal *Nature Sustainability*, experts at the Potsdam Institute for Climate Impact Research[28] in Germany delved into four possible scenarios of timber use in buildings over the next 30 years. In the first case, "business as usual," 0.5 percent of buildings are made with wood while the vast majority remain constructed of concrete and steel. There's a 10% timber building scenario; a 50 percent timber building scenario; and a fourth in which the vast majority—90 percent of new construction—is made with wood. Their findings suggest that the lowest scenario could result in 10 million tons of carbon stored per year and in the highest, nearly 700 million tons.[29] "Buildings, which are designed to stay for decades," researchers write in the paper, "are an overlooked opportunity for a long-term storage of carbon, because most-widely used construction materials such as steel and concrete hardly store any carbon."[30]

The Role of Wood Construction Now and in the Future

There is an urgent need to decarbonize the built environment, combat climate change and find advanced ways to reduce and store carbon emissions. The exigency to cut carbon is demonstrated by the environmental priorities set by such organizations as C40 Cities,[31] Architecture 2030,[32] Urban Land Institute,[33] and the World Green Building Council[34] advocating for significant changes in how we plan, build, manage, and power cities and towns—including a reduction in embodied carbon over a building's life cycle. Wood has an increasing role to play as design professionals look to tackle the climate crisis and reduce the environmental footprint of buildings, now and in the future.

Buildings and infrastructure built from bio-based materials such as timber that store carbon during their service lives can serve as constructed carbon sinks. They could increase the existing carbon pool of urban areas (1–12 GtC) by 25 to 170 percent.[35] Backed up by testing and research, code changes in jurisdictions across the country are making it possible to increase the height and density of wood construction. With a comprehensive understanding of these code changes, design teams can bring innovation and ingenuity to the buildings they design.

Additional Resources:

To help building designers compare options, WoodWorks has compiled a web-based inventory of completed mass timber fire tests. The Inventory of Fire Resistance Tested Mass Timber Assemblies & Penetrations is updated as new tests become available and can be found at **www.woodworks.org**.

For additional information on both the calculation-based method and the ASTM E119 testing method of demonstrating FRR of mass timber elements, see the WoodWorks publication Fire Design of Mass Timber Members.

FOOTNOTES/REFERENCES

[1] https://www.cnbc.com/2021/09/14/america-is-short-more-than-5-million-homes-study-says.html

[2] https://www.gep.com/blog/mind/infrastructure-bill-impacting-the-us-construction-industry

[3] New report: the building and construction sector can reach net zero carbon emissions by 2050, World Green Building Council, https://www.worldgbc.org/news-media/WorldGBC-embodied-carbon-report-published

[4] https://www.worldgbc.org/sites/default/files/UNEP%20188_GABC_en%20%28web%29.pdf

[5] https://2os2f877tnl1dvtmc3wy0aq1-wpengine.netdna-ssl.com/wp-content/uploads/ULI-Documents/Greenprint-Embodied-Carbon-Report_FI

[6] https://www.weforum.org/agenda/2021/11/sustainable-mass-timber-green-building/

[7] https://citymonitor.ai/economy/commercial-real-estate/into-the-woods-why-architects-are-turning-to-timber

[8] FPInnovations and Think Wood: The Impact of Wood Use on North American Forests

[9] Churkina, Buildings as a global carbon sink, Nature Sustainability, January 2020, page 4. Supplemental chart #10.

[10] https://www.woodworks.org/resources/status-of-building-code-allowances-for-tall-mass-timber-in-the-ibc/

[11] https://www.woodworks.org/resources/getting-to-yes-making-effective-use-of-the-alternate-means-process/

[12] *Cities as carbon sinks—classification of wooden buildings*, https://iopscience.iop.org/article/10.1088/1748-9326/aba134; Building with timber instead of steel could help pull millions of tons of carbon from the atmosphere, Fast Company, https://www.fastcompany.com/90456328/building-with-timber-instead-of-steel-could-help-pull-millions-of-tons-of-carbon-from-the-atmosphere

[13] Henning Larsen Reveals All-Timber Experience Center For World Of Volvo In Swedish Landscape, https://worldarchitecture.org/article-links/emnen/henning-larsen-reveals-all-timber-experience-center-for-world-of-volvo-in-swedish-landscape.html; "Architecture is currently in the midst of a timber renaissance, with new milestones in timber construction being reached at a breakneck pace," explained Filip Francati, Lead Design Architect at Henning Larsen.

[14] WoodWorks, https://www.woodworks.org/resources/u-s-mass-timber-projects/

[15] http://www.freddiemac.com/research/insight/20181205_major_challenge_to_u.s._housing_supply.page?

[16] New report: the building and construction sector can reach net zero carbon emissions by 2050, World Green Building Council, https://www.worldgbc.org/news-media/WorldGBC-embodied-carbon-report-published

[17] https://www.worldgbc.org/sites/default/files/UNEP%20188_GABC_en%20%28web%29.pdf

[18] https://2os2f877tnl1dvtmc3wy0aq1-wpengine.netdna-ssl.com/wp-content/uploads/ULI-Documents/Greenprint-Embodied-Carbon-Report_FINAL.pdf ; https://americas.uli.org/wp-content/uploads/sites/2/ULI-Documents/Greenprint-Embodied-Carbon-Report_FINAL.pdf

[19] https://www.c40.org/

[20] https://architecture2030.org/new-buildings-embodied/

[21] https://americas.uli.org/wp-content/uploads/sites/2/ULI-Documents/Greenprint-Embodied-Carbon-Report_FINAL.pdf

[22] https://www.worldgbc.org/embodied-carbon

[23] http://www.athenasmi.org/wp-content/uploads/2015/09/Advancing_Sustainable_Design_with_LCA.pdf

[24] https://www.canfor.com/docs/why-wood/tr19-complete-pub-web.pdf, pg. 3

[25] *FPInnovations and Think Wood*: The Impact of Wood Use on North American Forests

[26] https://www.fastcompany.com/90574889/wood-buildings-should-be-a-requirement-of-any-climate-change-policy

[27] N.B. Growing body of research and practical studies exploring the benefits of timber include but not limited to: Buildings can become a global CO2 sink if made out of wood instead of cement and steel; High-rise Timber Buildings as a Climate Change Mitigation Measure – A Comparative LCA of Structural System Alternatives; Carbon footprint of prefabricated wood buildings

[28] N.B. *Cities as carbon sinks—classification of wooden buildings*: This study aims to estimate the carbon storage potential of new European buildings between 2020 and 2040. While studies on this issue exist, they mainly present rough estimations or are based on a small number of case studies. To ensure a reliable estimation, 50 different case buildings were selected and reviewed. Results estimate a gradual increase of wood in new buildings over the course of two decades, and specifically at the average amount of new housing built annually in Europe. The researchers found that stored carbon could hit a total of 420 million tons by 2040. While there are opportunities for wood harvesting in the world.It should be noted that wood harvesting is only reasonable if forests are managed efficiently. Otherwise, using wood for construction will result in the disappearance of forests. Read the full study here.

[29] *Cities as carbon sinks*—classification of wooden buildings, https://iopscience.iop.org/article/10.1088/1748-9326/aba134

[30] Building with timber instead of steel could help pull millions of tons of carbon from the atmosphere, Fast Company, https://www.fastcompany.com/90456328/building-with-timber-instead-of-steel-could-help-pull-millions-of-tons-of-carbon-from-the-atmosphere

[31] https://www.c40.org/

[32] https://architecture2030.org/new-buildings-embodied/

[33] https://americas.uli.org/wp-content/uploads/sites/2/ULI-Documents/Greenprint-Embodied-Carbon-Report_FINAL.pdf

[34] https://www.worldgbc.org/embodied-carbon

[35] Churkina, Buildings as a global carbon sink, Nature Sustainability, January 2020, page 4. Supplemental chart #10.

[36] Mass timber makes its move, HBSD - May 2020 by ensembleiq - Issuu, p. 16

[37] Ascent - Challenges and Advances of Tall Mass Timber Construction, https://global.ctbuh.org/resources/papers/download/4373-ascent-challenges-and-advances-of-tall-mass-timber-construction.pdf

CASE STUDY:
Ascent - Mass Timber Reaches New Heights in Milwaukee

Image courtesy: Korb & Associates, New Land Enterprises

Location: Milwaukee, WI
Size: 493,000 ft²
Architect: Korb + Associates Architects
Developer: New Land Enterprises LLP & Wiechmann Enterprises
Structural Engineer/Mass Timber Design Program: Thornton Tomasetti
Contractors: C.D. Smith Construction (leader builder) and Catalyst Construction

This Milwaukee-based mass timber residential tower reaches a record-setting 25-story height and exposes more timber through the use of fire testing while also realizing faster construction time with the extensive use of BIM and numerical coding.

At 25 stories, Ascent is a record-setting height for hybrid wood construction and is considered the tallest timber tower in the world at the time of its completion. The 493,000-square-foot mixed-use building in Milwaukee's East Town neighborhood includes 259 apartments, a wellness and fitness center, and a top-floor amenity level. Extensive use of BIM and numerical coding of every mass timber component helped to speed up construction. According to the project's general contractor, a conventional concrete and steel structure of this kind would typically take 8 days per floor to complete—but with mass timber, the project team completed a new floor every 5 to 6 days. Due to its expansive use of wood, Ascent represents a carbon benefit equal to removing 2,350 cars from the road for one year.[36]

Nineteen residential stories are constructed from mass timber above a five-story concrete parking garage. A system of glulam beams and columns support 5-ply CLT floors while two concrete cores provide lateral stability.

To reach its planned height and expose the mass timber structure allowed by code (50%), the City of Milwaukee required the project team to demonstrate that Ascent could meet the rigorous fire safety standards of a Type I building. Subsequent fire testing proved that the timber structural members not only met, but exceeded fire rating requirements, clearing the pathway to approvals.[37]

Images courtesy: New Land Enterprises & LCP 360

CASE STUDY:
Tall Timber Adds Distinction to Cleveland Locale

Image courtesy: ImageFiction

Location: Cleveland, OH
Size: 512,000 ft2
Owner: Harbor Bay Real Estate Advisors
Architect: Hartshorne Plunkard Architecture (HPA)
Structural Engineer: Fast+Epp
Contractor: Panzica Construction
Completion: Spring 2022

Image courtesy: Hartshorne Plunkard Architects/Harbor Bay Real Estate Advisors

Just-in-time prefabricated tall wood construction speeds up assembly, while an alternate-means process boosts the amount of timber exposed in this 500,000+ square-foot Cleveland-based residential project.

When Chicago-based Harbor Bay Real Estate Advisors acquired a coveted corner lot adjacent to Cleveland, OH's well-known West Side Market, they embraced the opportunity to honor the cultural prestige of their historic surroundings.

Partnering with design firm Hartshorne Plunkard Architecture (HPA), Harbor Bay's 115-foot tall, 512,000-square-foot, nine-story mass timber complex provides 300 apartments—many with unobstructed lake and skyline views. The resulting mass timber structural system consists of 3,000 cubic meters of blond hem-fir and spruce trees. Eight of the nine stories, set atop a one-story concrete podium, use mass timber.

The design team considered traditional concrete and steel construction, but then looked to mass timber as an opportunity to achieve project goals including aesthetics, speed of construction, and environmental performance. According to Harbor Bay, INTRO's construction time has been about 25 percent faster than typical concrete or steel construction, which was achieved by streamlining the project's workflow and carefully managing just-in-time delivery and trade coordination.

Nearly half of the building's interior surfaces feature exposed structural wood, including precisely cut glulam beams and columns, as well as CLT floors and ceilings in the units' bedrooms and living rooms. This approach was guided by an Alternatively Engineered Design report specifying how the tall wood building could safely include an exposed timber interior.

CASE STUDY:
80 M STREET - First Mass Timber Vertical Addition Differentiates in DC

Image courtesy: Hickok Cole

Image courtesy: Hickok Cole

Location: Washington, D.C.
Size: 100,000 ft2
Owner: Columbia Property Trust
Architect: Hickok Cole
Structural Engineer: ARUP
Contractor: Davis Construction
Completion: Spring 2022

A nimble, lightweight and prefabricated mass timber structure helps make a 100,000 square foot vertical addition possible while boosting the value of this DC-based commercial office complex.

As vacant parcels become harder to find in densifying urban centers and business districts, developers are looking at expansion through vertical additions. At a current height of 90 feet (seven stories), 80 M Street was a perfect candidate for vertical expansion, but it also needed to appear unique in the District's crowded commercial market. To accomplish both goals, architect Hickok Cole chose mass timber for their 100,000-sf addition, a first of its kind for the city and the design team. Glulam forms the beams, columns, arches and trusses, while CLT forms the walls, floors and ceiling.

The design team's decision to use mass timber was driven by a number of factors. Chief among them was timber's light weight, as the existing building could not handle the load of a traditional concrete addition. Timber's light weight also proved advantageous by allowing the team to deliver the project more quickly and with less impact to the occupied building.

Once completed, the addition will add two full floors of office space atop the existing 286,000-square-foot building as well as an occupied penthouse level and rooftop terrace for social space. Other design highlights include exposed CLT ceilings and an abundance of connected outdoor spaces that will add nearly 4,000 square feet of outdoor amenity space atop the building.

Fire Testing at ATF to Validate Tall Mass Timber Construction Types

The TWB committee determined early in the process that fire tests of the proposed construction types would be instrumental in validating the proposals. To this end, the committee designed (and AWC and the US Forest Products Laboratory managed) a series of five compartment fire tests on a structure at the US Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) Fire Research Laboratory. The two-story structure was built (and repaired between tests) conforming to the new construction types. CLT was used for construction of the floors, perimeter walls of the dwelling units, and walls of the corridor and stair enclosure. Interior to the dwelling unit were glulam beams and columns supporting the levels above. The interior partition walls were built of non-rated light-gauge steel framing.

Five natural fires were performed. Test 1 included a fully protected mass timber structure meeting the requirements of Type IV-A. Test 2 had 30% of the room ceiling area exposed (20% of the unit floor area), and Test 3 had two perimeter walls of the dwelling exposed with an exposed surface equal to 40% of the unit floor area. In tests 1 to 3, no sprinklers were activated after the fire was initiated and the fires were left to burn naturally for at least three hours. In each case, the fire was contained within the unit of origin, the contents were consumed, there were no structural failures, and where CLT was exposed, it self-extinguished.

Tests 4 and 5 exposed almost all of the CLT in the ceilings and walls of the units. These tests were performed to demonstrate the impact of active fire sprinkler suppression. In Test 4, the sprinklers self-activated at around 2-1/2 minutes and quickly controlled the fire. In Test 5, the sprinklers were manually activated after approximately 22-1/2 minutes; after 2-1/2 minutes, the fire in the kitchen grew significantly, but it was quickly extinguished when the sprinklers were activated.

Successful fire tests completed on numerous mass timber elements and assemblies have substantiated fire-resistance ratings of 3 hours more. Additional tests by manufacturers and others are ongoing.

Test Questions

Understanding Building with Low Carbon Wood

1. Mass timber construction is growing significantly due to changes in the:
   a. 2021 IACC
   b. 2021 IBC
   c. 2021 AAMA
   d. 2021 ICC

2. The TWB proposed expanding Type IV construction by adding:
   a. Three new sub-types – IV-A; IV-B; IV-C
   b. Two new sub-types – IV-A; IV-HT
   c. One new sub-type – IV-A
   d. None of the above

3. In _____, the general allowance for exposed timber allows for all exposed timber to be permitted with the exception of shaft walls, within concealed spaces or on the exterior side of walls.
   a. Type IV-HT
   b. Type IV-A
   c. Type IV-C
   d. Type IV-L

4. A requirement unique to the new construction types is:
   a. Faster project completion – a new floor was completed every 5 to 6 days
   b. Minimum height requirements that do not exceed 150 feet
   c. Noncombustible protection for some mass timber elements
   d. Increased awareness of carbon sequestration

5. A beam that requires a 2-hour FRR and requires noncombustible protection must achieve at least ____ minutes of protection from the noncombustible coverings.
   a. 40
   b. 50
   c. 60
   d. 80

6. According to the case study, the INTRO design team chose mass timber construction to achieve which of the following project goals?
   a. Aesthetics
   b. Speed of construction
   c. Environmental performance
   d. All of the above

7. The IBC has allowed the integration of light wood-frame materials in residential occupancies over a single-level podium with up to:
   a. 5 stories
   b. 12 stories
   c. 18 stories
   d. 24 stories

8. A planned update to the 2024 IBC would include allowing _____mass timber ceiling exposure.
   a. 20%
   b. 45%
   c. 85%
   d. 100%

9. The use of wood products in building provides an additional environment benefit by storing carbon removed from the atmosphere because:
   a. wood products are approximately 25% by dry weight
   b. wood products are approximately 50% by dry weight
   c. wood products are approximately 75% by dry weight
   d. wood products are approximately 100% by dry weight

10. _____, carbon emissions generated from building materials and construction, is determined by conducting a life cycle assessment of a product, assembly or the building over declared life cycle stages.
    a. Environmental product declaration
    b. Climate change protocol
    c. Embodied carbon
    d. Carbon sequestration

This article is approved by ALA and AIA for 1 LU/HSW.
Please email ala@alatoday.org for status. Valid through August 2025.

Contact Information:_____

Last Name:_____

First Name:_____ Middle Initial: _____

AIA # if applicable:_____

Firm Name: _____

Address:_____

City:_____ State:____Zip:_____

Tel.: _____Email: _____

Credit Card No:_____

Expiration Date:_____

PAYMENT: ALA/AIA/CEP Credit or Certificate of Completion:
Cost: $15 (ALA Members) $20 (non-members)
❑ Check or ❑ Credit Card

❑ Please send me a certificate of completion (required by certain states & organizations) that I may submit.

Your test will be scored. Those scoring 80% or higher will receive 1 LU Credit.

Address: Association of Licensed Architects,
21200 South La Grange Rd., Suite 163
Frankfort, IL 60423
Attn: ALA/CEP Credit
Scan & Email: ala@alatoday.org

Certification: (Read and sign below)
I hereby certify that the above information is true and accurate to the best of my knowledge and that I have complied with the ALA Continuing Education Guidelines for the reported period.

Signature: _____ Date: _____

GFRC Panels Help Support Natural, Efficient Design

The eye-catching architecture of the Parker Water & Sanitation building is punctuated by glass fiber reinforced concrete (GFRC) panels

BY: ERIC PETERSON, ENGINEERING NEWS-RECORD

Construction is progressing on a $52-million operations, maintenance and administrative building for Parker Water & Sanitation District (PWSD) near Rueter-Hess Reservoir, three miles west of Parker, Colorado.

Rebecca Tejada, PWSD's director of engineering, says a new headquarters is necessary for operational efficiency and long-term growth. "We've got an entire department working in trailers," she says. "We knew we had to take that next step in figuring out what to do for more space."

Chicago-based design firm Perkins&Will won the project through an RFP process, and Englewood, Colorado-based JHL Constructors broke ground in April 2022. Substantial completion of the two-story, 127,000-sq-ft building is scheduled for October.

The radial design of the PWSD building in Parker, Colo., takes advantage of the site's natural features by wrapping around a hillside instead of leveling it.
(Image courtesy Perkins&Will. Photographer: Parrish Ruize De Velasco)

Design Inspiration

When PWSD excavated Rueter-Hess Reservoir in 2005, crews discovered the remnants of a small village established by Native Americans about 5,000 years ago. The team at Perkins&Will leaned on this history as it developed the design.

"Some of the primary inspirational elements that we found during that exploration were Native American tipi rings," says Robin Ault, principal and design director at Perkins&Will's Denver office. "These are rings that are assembled with stone where tribes would establish their home base for a while."

The design team also drew from PWSD's droplet-shaped logo. "It just became natural for us to take the drop of water and the inspiration from the rings and place it on the top of the hillside and let those concentric rings embrace the landscape," Ault says.

The initial conceptual sketches "instantly resonated with us, because we're so very aware of the history and the culture of the property," Tejada says.

She also liked what she saw from an engineering perspective; PWSD initially envisioned a rectangular building, not the semicircle that is now under construction. "In their proposal, Perkins&Will said, 'What if you just put a little 45-degree bend in this building?' It actually sits into the hill, and you're not just trying to put it on the hill."

The design meant construction would need to adhere to a perfect circle, even if most of that circle was part of the hill. “I realized that what we were giving our contractor was a radial building,” Ault explains. “The only way to really pull it off successfully was to give them a diagram that explained how all the lines of the structure and the material elements needed to follow this radial diagram, with its center point at the top of the hill. This diagram was jokingly referred to as the Rosetta Stone, and I think it’s still pinned up in the construction trailer.”

Composite Concrete

PWSD worked with Perkins&Will on the selection of JHL as the general contractor for the project. “We have really gelled as an owner and an architect team,” says Kris Kreymborg, senior project manager at JHL. “It really felt more like a design-build on the way we worked together on issues trying to find the most cost-effective solutions.”

At the top of the list: using glass fiber reinforced concrete (GFRC) panels for the skin instead of bulky precast forms. “The steel structure needed to support the precast concrete was going to be cost-prohibitive, so we started looking at GFRC, which is a little lighter and a little less demanding as far as the steel frame is concerned,” Ault says.

“The characteristics of the material are unique. We’ve got a lot of what looks like natural material with these GFRC panels.”

- Kris Kreymborg, JHL Constructors

“A little lighter” is a bit of an understatement. “GFRC is probably 20 percent the weight of precast, and when you figure in those shapes that would have been solid, it’s almost no comparison,” says Mike Ruth, senior vice president of sales at GFRC Cladding in Garland, Texas, the fabricator of the panels. “It’s precast concrete, but it’s not a solid poured material. We spray it. By spraying it, we’re able to achieve a constant thickness of about three-quarters of an inch, so it really lightens up the weight.”

Because GFRC is denser than precast, it is also able to achieve sharper corners, Ruth says.

“The characteristics of the material are unique,” echoes Kreymborg. “We’ve got a lot of what looks like natural material with these GFRC panels. We have board-formed concrete walls that are exposed on several areas of the building, then the metal panels are situated in such a way that they’re intended to look like ripples of water.”

Perkins&Will had worked with GFRC on a pair of previous projects at Baylor St. Luke’s Medical Center in Dallas and Fermilab near Chicago, so the design team was well versed on the benefits of the material. For the PWSD project, they enlisted Anaheim, Calif.-based KHS&S to aid in the design and installation of the 380 panels.

Perkins&Will “had done a pretty good job [designing] panels, then we just helped them get all the dimensions right,” says Shane Hastain, senior preconstruction manager with KHS&S. “One of the biggest things they didn’t have their head around was what a system looked like as a performing system. They knew they wanted GFRC because they liked the product when it was finished, but they didn’t know how it would be waterproofed, how it would perform thermally. There are a lot of different systems and ideas, so we helped them through that.”

GFRC was a good fit for the PWSD project due to both form and function, he adds. “In general, design teams and owners like GFRC because it’s a very durable, long-lasting product that, as an architectural material, is pretty flexible. It doesn’t just have to be flat; you can make it into most any shape you want.”

That doesn’t mean there isn’t quite a bit going on behind the scenes on the

The project’s skin of glass fiber reinforced concrete panels achieves the desired aesthetics at a fraction of the weight of precast concrete.
(Image courtesy Perkins&Will. Photographer: Parrish Ruize De Velasco)

panels. “We have to come up with the system you are going to build that can support the GFRC but attach back to the structure [and] perform and coordinate with the other trades that are around it,” says Hastain. “This is usually why this becomes a breakout design package where they want us to resolve all that stuff: interior finish and electrical, any plumbing in there and all the continuous installation, thermal, water-performing, window transitions. It’s just all that stuff they look to KHS&S to support.”

Ault likens building with GFRC panels to a piece of music. “We generated nine unique GFRC forms,” he says. “Those nine forms are laid up in an A, B, C, D, E, F, G kind of rhythm, and we vary that rhythm in order to highlight the shade and shadow of the overlapping rings as the sun moves around the building.”

With the Rosetta Stone diagram as a guidepost, precision has been critical. “Everything goes back to one central point, and off that, everything is faceted,” says Ault. “It all starts from Day 1. You’ve got to be essentially perfect with your layouts.”

Sustainable Approach

Jamie Benallo, Perkins&Will project manager, says the building is designed to be equivalent to LEED Gold without seeking certification, “That’s the direction the team decided to take things,” she says. “There are a few strategies that won’t be realized

The panels resemble flowing water, and the details in relief interplay with varying levels and angles of sunlight. (Image courtesy JHL Constructors)

Substantially less structural steel is needed to support the glass fiber reinforced panels compared with what would have been necessary for precast. (Image courtesy JHL Constructors)

The building takes design cues from Native American tipi rings that were found during the excavation of nearby Rueter-Hess Reservoir.
(Image courtesy Perkins&Will. Photographer: Parrish Ruize De Velasco)

"It all starts from Day 1. You've got to be essentially perfect with your layouts".

- Robin Ault, Perkins&Will

from Day 1 but are available for the client when they decide in five to 10 years that they want to go more electrified; they've got the ability to add a [photovoltaic] array on the roof."

Ault says the design is all about picking low-hanging fruit like solar orientation: "We were able to rotate the building to such a degree that we were able to take advantage of the northeastern light and then essentially bury the building into the ground to minimize the southwest exposure.

The design also emphasizes water efficiency. PWSD "wanted to set good examples for the community and be good stewards of water usage, so we were careful with the plant selection to use plants that don't necessarily need irrigation once established," says Benallo.

A Team Effort

"When we started the project, we sat down and said, 'We really want to be a team here.' I think it's one of the big successes of the project, that we've maintained that team dynamic throughout," Benallo says.

"It all goes back to the collaboration that this team has fostered, and I think that's our cornerstone out here," Kreymborg adds. He credits both PWSD and Perkins&Will as well as subcontractors Total Welding, Front Range Steel, Metro Glass and BrightView Landscape.

"They've done a good job of working with our team while protecting the long-term vision of the project. They're not making sacrifices that are going to affect things 10, 15 years down the road."

Tejada says PWSD's employees are anxious to move into the new headquarters. "As cool and beautiful as it is, we've really approached the design and construction of it with our business in mind. It is an extremely functional building the way we've set it up."

UPDATE: Since this article's publication in May 2023, the Parker Water & Sanitation District's Operations, Maintenance, and Administration facility officially opened in December 2023. The facility is now fully functional, serving its intended purpose as a major water resource for the town of Parker, Colorado, and the surrounding region.

Engineering News-Record *provides the engineering and construction news, analysis, commentary and data that construction industry professionals need to do their jobs more effectively. ENR reports on the top design firms, both architects and engineers, and the top construction companies as well as projects in the United States and around the world.*

The Future of Concrete Moisture Monitoring

BY: JASON SPANGLER, WAGNER METERS

As an architect, you may not get your hands dirty pouring concrete or installing flooring. But your role in the prep work is crucial to prevent moisture damage to a building. Concrete, once poured, still releases significant amounts of moisture from its surface. If not dealt with, this moisture will continue to evaporate as the relative humidity (RH) in the concrete interacts with ambient relative humidity. Low ambient RH levels lead the concrete to release water vapor, while very high ambient levels can even lead the concrete to absorb water vapor.

With this knowledge, you can recommend that contractors and installers monitor RH levels before, during, and after construction.

One of the best ways to monitor levels per ASTM standards is to use a remote monitoring and data logging system. This allows everyone involved in the job to keep track of concrete relative humidity and ambient conditions.

We're going to look at reasons this kind of tool can make a difference in your role as we explore:

- The evolution of concrete moisture monitoring
- What remote concrete monitoring is
- How it can benefit your work

The Evolution of Concrete Moisture Testing

Concrete moisture testing began in the 1950s with the calcium chloride test. This test involved calculating the moisture vapor emission rate (MVER) by weighing calcium chloride crystals before and after their placement on the concrete.

That was the way things were done for 40 years.

But then in the 1990s, breakthroughs in research began to show calcium chloride wasn't the most accurate method—or very accurate at all. Floors had failed, even with tests indicating that the moisture levels were acceptable. Something had to be done.

"Prep work is crucial to prevent moisture damage to a building."

By this point, it was clear that accurate concrete moisture testing was vital to a successful building and floor. Otherwise, floor installers could unknowingly install flooring over concrete before it finished drying and possibly ruin the floor.

The Technical University of Lund in Sweden conducted some of the first research to address the need for better moisture testing. Eventually, they came up with a solution: the NordTest, which was the basis for relative humidity (RH) testing.

Per ASTM F2170, RH testing involves drilling into the concrete at 40 percent depth and inserting probes that help determine RH levels *within* the concrete, not just on the surface. This way, contractors and floor installers know how much moisture will evaporate to the surface over time and can make important construction and installation decisions with greater confidence.

Since then, concrete moisture testing has continued to advance. Digital technology has been integrated more and more into our lives over the years, and concrete moisture testing has gone digital too.

That's where remote monitoring options come in.

Concrete, even after curing, continues to release moisture and interact with the ambient relative humidity. For this reason, it's especially important to monitor concrete RH levels

What Remote Concrete Monitoring Is

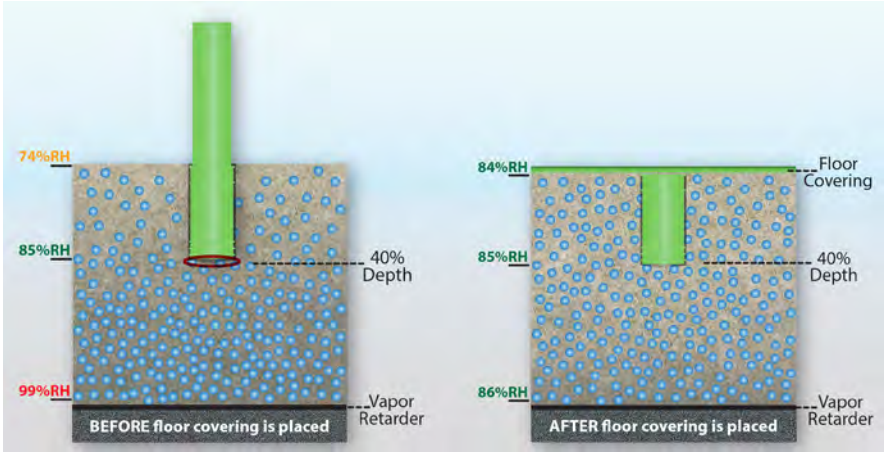
Remote concrete monitoring allows contractors and floor installers to monitor North American-based concrete relative humidity from anywhere in the world (as long as they have cellular network connectivity or some other form of internet).

Typically, the technology will monitor:

- Ambient climate conditions
- Relative humidity in the concrete
- Temperature
- Dew point

The data is transmitted to a cloud database, where it can be compared against manufacturers' specifications and used to determine the next course of action.

Recommending the use of this tool gives you, as an architect, peace of mind that both ambient and concrete conditions are meeting specifications and being



Drilling into the concrete at 40 percent depth and placing RH probes allows contractors and floor installers to know how much moisture will migrate to the surface of the concrete over time

RH testing, approved by ASTM F2170, is the most accurate way to ensure that a concrete slab meets relative humidity specs for a damage-free installation

documented properly. With your recommendations, installers can know exactly when the floor is ready to go down.

How Remote Concrete Monitoring Can Benefit Your Work

Remote concrete moisture monitoring has so many advantages over regular moisture monitoring. It helps with following standards and manufacturer specifications for concrete, monitoring ambient conditions, and sharing that data without going to the jobsite.

Let's zero in on what that means for all involved:

Time and cost efficiency

Remote monitoring allows access to jobsite environmental data and concrete slab readings from anywhere in the world. Floor installers and contractors can share this information with you, the architect, and other involved parties without having to make trips to the jobsite. Or if you are so inclined, you could request a "seat" yourself and view the project anytime you desire.

As a result, you can ensure that the construction and installation crew are following specifications for site ambient conditions (relative humidity and temperature) and concrete relative humidity.

Professionalism and quality enhancement

Remote monitoring raises the bar for floor installation. Rather than guesswork or frequent checks, the technology works passively in the background, monitoring the concrete slab and jobsite conditions for you.

Collaboration and data management

Remote monitoring also makes communication on the jobsite easier.

Jobsite and concrete data can be shared with all of the parties—from general contractors to architects to laborers. Then, they too are aware of the details, allowing them to plan their schedules better and more efficiently. The data are also clear and concise, providing accurate rather than vague information.

Clear language, data, and scheduling improve communication between general contractors, those directly involved in the project, and other stakeholders who might want to know what's happening.

Along with that, your data are more organized and secure when it's shared across the cloud.

Recommend Remote Concrete Monitoring in Your Design Plans

The way things are done is always changing in this digital age. Remote concrete monitoring is another tech tool that answers the call for improvement.

Ensuring appropriate documentation or validation for a project becomes easier for you when contractors and installers use this type of tech. This way, you can help mitigate the risks posed by moisture for construction and flooring projects.

Learn more about remote concrete monitoring by visiting WagnerMeters.com.

About the Author: *Jason Spangler is Wagner Meters' Sales Manager, with more than 25 years experience in sales and sales management across a broad spectrum of industries. He has successfully launched a variety of products to the market, including the original Rapid RH® concrete moisture test. Jason, who received an MBA from West Texas A&M University in November 2018, has extensive industry involvement, including the National Wood Flooring Association (NWFA), the International Certified Flooring Installers Association (CFI), and is Vice Chairman of Associations for The Flooring Contractors Association (FCICA).*

ALA CE Providers

Please call upon our CE Providers to present seminars for you and your office.

APA – The Engineered Wood Association

Alside

Bricks, Inc.

PCI of Illinois & Wisconsin

The Building and Fire Code Academy

Zepole Supply Company

ALA Welcomes New Members

Affiliate

Anne Gadon
Zepole Restaurant Supply Co.
Bolingbrook, IL

Allied Professional

Karen A. Sabich
Harwood Engineering Consultants
Milwaukee, WI

Professional

Mr. Raji N. Maalouf
ALA, AIA
Build Well Middle East Ltd.
London, England & Wales

Mr. Hector Castillo
ALA, NCARB, RA
Specialty Consulting Inc.
Chicago, IL

Michael Patrick OBoyle
ALA, AIA
Arquitectonica
Los Angeles, CA

Mr. Peter J Biskupski
ALA
Norris Design Productions
Traverse City, MI

Mr. Andrew James Myren
ALA , AIA
Hirsch MPG LLC
Chicago, IL

Sergio Claure
ALA
Sergio Claure Architect
Chicago, IL

Mr. Jason Vetne
ALA
DLZ Michigan Inc.
St. Joseph, IL

Associate

Csilla Viktoria Gal
Csilla V. Gal
Chicago, IL

New Graduate

Mr. Tuyen Le
KCDA - Architecture
Lawrenceville, GA

Mr. Peter Gerace
Gerace Architecture Studio
Islip Terrace, NY

Jerez Rinehart
GMB Architecture Engineering
Royal Oak, MI

Rebecca Fuller
DLZ Michigan Inc.
St. Joseph, MI

Senior

Mr. Paul V. Machalek
ALA, AIA, NCARB
Paul V. Machalek, Architect
Bloomingdale, IL

Index of Advertisers

Association of
Licensed Architects

ALA CAREER CENTER

Find and Post Architecture Jobs

The ALA Career Center was created to give employers
and job seekers a better way to find each other and make that perfect fit.

Create an Account Today: alatoday.org/careers

Employers

- Create an account
- View job posting packages
- Post a job (Starting at $50)
- New! Post internships for FREE for 60 days!

Job Seekers

- Create an account
- Upload your resume
- Browse jobs
- FREE resume review by TopResume

Call for Assistance: 888.491.8833

Customer service team: employersupport@naylor.com | candidatesupport@naylor.com