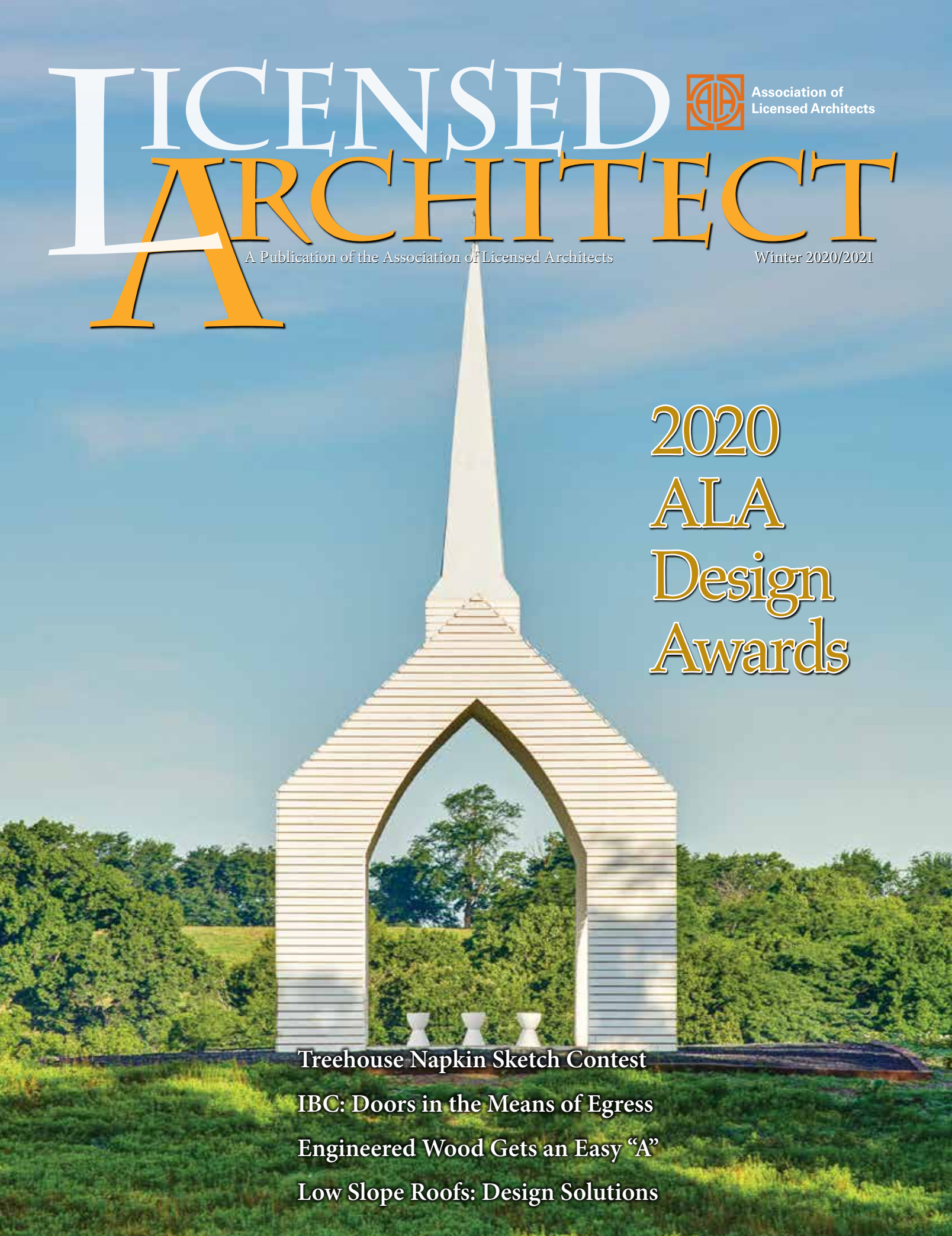
LICENSED ARCHITECT

Association of Licensed Architects

A Publication of the Association of Licensed Architects

Winter 2020/2021



2020 ALA Design Awards

Treehouse Napkin Sketch Contest

IBC: Doors in the Means of Egress

Engineered Wood Gets an Easy "A"

Low Slope Roofs: Design Solutions

Show Your Best Work



Fraesfield Trailhead McDowell Sonoran Preserve, SmithGroup Architects



Photos: Matt Winquist

Metal Architecture Design Awards
Deadline: April 30, 2021
For more information, go to www.metalarchitecture.com/contests

Ma Metal architecture

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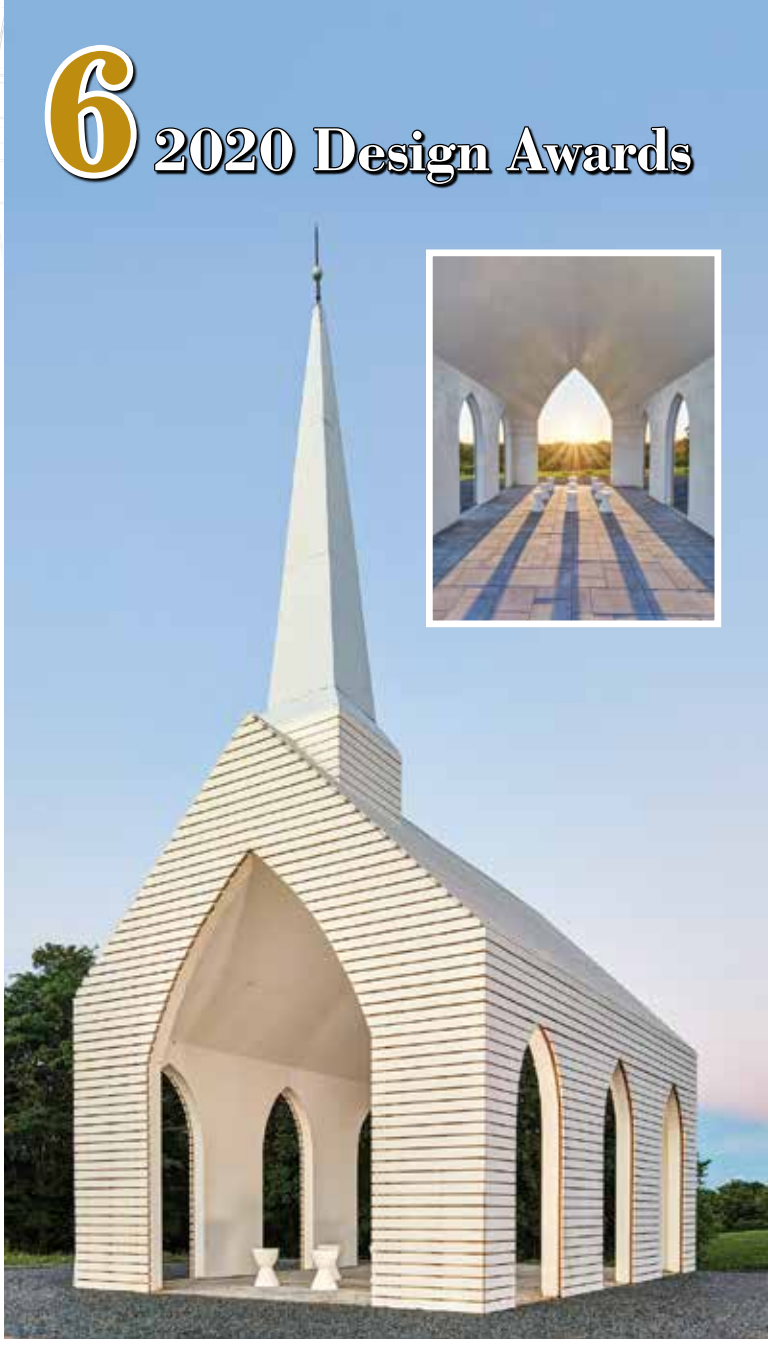
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Cover: Ullem Chapel, Moravia IA
Designer: ASK Studio – Brent Schipper
Owner: Ullem Family
Photographer: Integrated Studio, Cameron Campbell



Happy New Year 2021

On behalf of all of us at ALA, we would like to wish you a happy and healthy 2021 that's filled with greater opportunities. We all learned how fast life can change and how difficult it is to predict anything, but it's important to remain agile and ready to adapt to a post-COVID environment.

In December we announced the winners of ALA's Back to Nature Treehouse Napkin Sketch. This was the first time ALA held a napkin sketch contest and it was great fun and a high note seeing all the sketches by talented students and architects. We plan to make this an annual event. Sketches were judged by an outstanding panel of educator-practitioners who have more than 100 years of service as faculty members at Ball State University's College of Architecture & Planning. Contest judges included Anthony Costello, FAIA, Irving Distinguished Professor Emeritus of Architecture & Principal, Costello+ Associates; Lohren Deeg, Associate Professor of Urban Planning and Member of the American Society of Architectural Illustrators and Harry Eggink, RA, Professor of Architecture.

The ALA 2020 Virtual Design Awards Celebration, held on January 14, kicked off with a slide show of all of the awards submissions, followed by the announcement of the 23 award winners by emcee Tony Costello. At the virtual celebration, I presented the Don Erickson Presidential Award to ASK Studio and Brent Schipper, designer, for Ullem Chapel in Monrovia, IA. View the inspiring project in this issue of the magazine and view all of the winning projects on the ALA website at alatoday.org/awards.

Since we are still navigating a virtual world, ALA will continue to offer monthly webinars. Also, in March we will hold our 2020 Annual Meeting virtually to affirm the board elections and talk about ALA's strategic plan.

We published new contracts last year; they are free to members. You can access them after you log in to your member profile on the website. We have also started planning for the annual ALA Midwest Architecture Conference.

Thanks to all of the ALA board members – I appreciate all you do. If you are interested in becoming a board member in 2022, please contact Joanne Sullivan for more information.

We're looking forward to seeing you, virtually of course, at the Annual Meeting in March. Look for the announcement in your email or on the ALA website.

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Melvin Markson, FALA, ALA Founding Member and Lifetime Achievement Award Recipient, Dies at 92







Melvin Markson, FALA, 92, one of the founding members of the Association of Licensed Architects and recipient of the ALA Lifetime Achievement Award, passed away in September, 2020, after a long illness. "Mel was a true promoter of the practice of architecture," says retired attorney and architect James Zahn and founding member of ALA. "He loved being an architect and was an exceptional inspirational leader and role model for generations of architects. The ALA Lifetime Achievement Award is the ALA's highest honor, given to only five members since the organization was founded in 1999."

Before 1999, Markson noted that architect associations tended to direct their efforts and benefits to large firms and did little to support sole practitioners or smaller architecture practices. After discussing the need for a professional architectural association that would address the needs of smaller firms, he became a founding member of the Association of Licensed Architects.

Markson spent decades educating the public about the benefits of hiring an architect for all construction projects, developing easy-to-understand short form contracts for architects and suppliers to use and educating architects about the current rules and regulations affecting the practice of architecture. He also promoted new legislation that would benefit not only the architect, but also the public.

Born in Chicago in 1928, Markson studied architecture at Crane Technical High School. He served in the Illinois Air National Guard as a cryptographic technician in 1948-1949 and served with the Army Corps of Engineers during the Korean War from 1952-1954. He worked at Schwinn Bicycle Company and Western Electric as an engineering draftsman before attending the University of Illinois, where he became the cofounder of the first student chapter of AIA. He attended the Art Institute of Chicago before graduating with a B.S. in Architecture in 1955 from the University of Illinois.

Markson became an architect in 1956, was named a principal in Busche & Markson, Inc. in 1962 and became a senior consultant with Architectural Consultants (ACL) in 1980. His work at ACL included expert witness testimony and due diligence inspections of large commercial projects throughout the U.S. At Busche & Markson he was responsible for the design of more than 2,000 industrial and commercial buildings in several states. He retired from practice in 2000.

Markson, from Mount Prospect, IL, leaves his wife, Vivian, daughters Andrea Markson and Cheryl Sinclair and grandchildren Jason and Adam Sinclair.

2020

ALA Design Awards

Twenty-three projects were recognized by our judges in the 2020 ALA Design Award Program for their outstanding achievements with a Gold, Silver or Merit Award. ALA wishes to thank the judges and Design Awards Committee for their time and dedication to the program and profession.

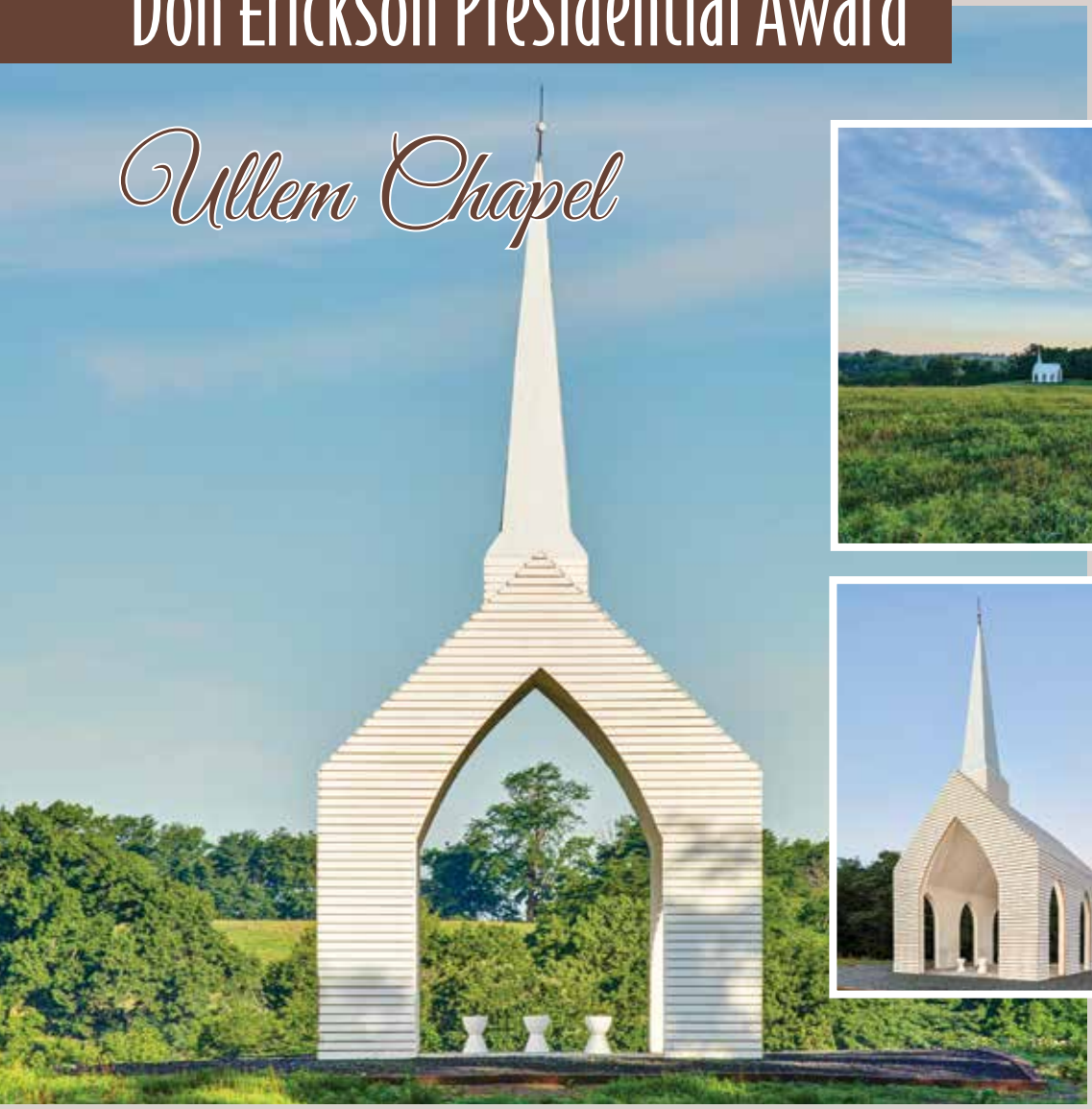
Judges:
Karl P. Griffith, ALA, Principal, BCA Architects & Engineers
Mike Groth, ALA, AIA, NCARB, Groth Design Group
Mark L. Hansen, ALA, AIA, NCARB, LEED AP
Dwayne MacEwen, AIA, NCARB, DMAC Architecture
Belinda O'Kelly, ALA, AIA, LEED AP, O'Kelly Kasprak LLC

Design Award Committee:
Howard Hirsch, ALA - Chairman
Jeffrey Budgell, FALA - ALA President
LeRoy B. Herbst, III, FALA - Jury Chairperson
Alejandro Cruz - ALA Intern from Judson University

The ALA Design Awards Program is our annual showcase of the power of design by our members. The 2020 ALA Virtual Design Awards Celebration was held on Thursday, January 14, 2021 from 4:00 - 5:30 PM. All 23 award winners were announced by emcee Tony Costello, FAIA, Irving Distinguished Professor Emeritus of Architecture & Principal, Costello + Associates. To conclude the proceedings, ALA President Jeffrey Budgell presented the prestigious Don Erickson Presidential Award to Brent Schipper at ASK Studio for design of Ullem Chapel in Moravia IA.

Congratulations to all of the winners and to those who submitted their projects. We hope you enjoy viewing the winning projects on the following pages. Thanks to our Program Sponsors Andersen Windows & Doors and Exclusive Windows, Inc.!

Don Erickson Presidential Award







Ullem Chapel
Moravia, Iowa

Category: Religious

Designer: ASK Studio – Brent Schipper

Owner: Ullem Family

Photographer: Integrated Studio, Cameron Campbell

Description: It was imagined as a place to consider a place. The focus of the frame is a century tree that is the ranch marker used for wayfinding throughout the hills. The structure is to be spiritual. A chapel without denomination or creed; simply considering a place. The materials speak of agrarian frugality; sensible for a temporal insertion on a land that hides the ruins of houses belonging to past stewards in the nearby trees.

It is white because that is the color of churches and corn cribs in this plain-spoken part of the Midwest.

The march of the horizontal wall slats feels familiar, but in this context with gothic arches, there is a tension. When the horizontal slats begin to form the roof plane, the tension approaches heresy. The structure appears vernacular on the horizon, but upon examination its amalgam of materials and systems can be understood as novel; an understanding which is only known to those that visit. It is a crib. It is a chapel. It is not to be readily understood. Spirituality is complex. It is a considered place to consider.

Gold Awards



4000 Ingersoll
Des Moines, Iowa

Category: Multi-Family Homes

Designer: ASK Studio – Kurtis Wolgast, Brent Schipper

Owner: Newbury Living

Contractor: Nelson Construction

Photographer: Integrated Studio, Cameron Campbell

Developer: Newbury Living

Description: The project statement read like an architect's nightmare: Design 25 units of market rate housing to fit on two residential lots in a historic district of an affluent neighborhood. One lot is currently occupied by a house "contributing" to the historic district and the other has been dedicated as a peace park for the past decade. Our instinct told us to run. The opportunity made us stay.



Akuna Capital
Chicago, Illinois

Category: Interior Architecture

Designer: Earles Architects & Associates – Stephanie McClelland, Aliana Ramos, Lauren Peyron

Description: Akuna Capital, a trading firm with roots in Sydney, Australia, decided to collaborate for its new Chicago office expansion. With Akuna's goal of creating a "Developer's Wonderland", the team worked to design a space that looked towards the future of the workplace, and what that means for the live/work experience. Woven throughout the space one finds a multitude of hybridized amenity spaces that blur the lines between work and play.

Gold Awards



Hotel Zachary
Chicago, Illinois

Category: Commercial/Industrial

Designer: Stantec Architecture –
David Stetler, AIA
William Ketcham, AIA

Contractor: Walsh Construction

Photographer: Dave Burk

Description: Our team rounded-out the Wrigley experience by incorporating a new destination hotel on the west side of the stadium. The design evokes a sense of nostalgia through the use of familiar residential details typical of early 20th century Chicago while capturing Wrigley Field's progressive spirit with clever accents blending classic elements with a modern aesthetic.

Mountain Modern
Aspen, Colorado

Category: Single Family Homes

Designer: Robbins Architecture

Contractor: Harriman Construction

Photographer:
Steve Hall, Hedrich Blessing;
Steve Freihon, Tungsten LLC

Description: Nestled within 89 acres of Colorado ranch land and surrounded by the Rocky Mountains, this home responds to its site with a sweeping, modern design, balancing the strength and permanence of the mountains with the elegance and serenity of the wild grasses blanketing the valleys. Expanses of glass wrap the home to introduce light and blur the separation between indoors and out.



Gold Awards



Woven House
Pukwana Beach, Wisconsin

Category: Single Family Homes

Designer: Bruns Architecture – Stephen Bruns

Owner: Lindsay Pauly, Daniel Ohrtman

Contractor: Tielens Construction

Photographer: Tricia Shay Photography

Description: Woven House is the pure distillation of what a house is—every detail emphasizes the basic elements and forms of a familiar residential structure while creating a cohesive design that celebrates the modern home. Located on the eastern edge of Lake Winnebago, this dynamic structure is a beacon at the end of a narrow farm road that punctuates the shoreline.



Ullem Chapel
Moravia, Iowa

Category: Religious

Designer: ASK Studio – Brent Schipper

Owner: Ullem Family

Photographer: Integrated Studio, Cameron Campbell

Description: It was imagined as a place to consider a place. The focus of the frame is a century tree that is the ranch marker used for wayfinding throughout the hills. The structure is to be spiritual. A chapel without denomination or creed; simply considering a place. The materials speak of agrarian frugality; sensible for a temporal insertion on a land that hides the ruins of houses belonging to past stewards in the nearby trees.

Silver Awards



647 W. Melrose
Chicago, Illinois

Category: Multi-Family Homes

Designer: SGW Architecture & Design –
Jeffrey Goulette, Christopher Bremer

Interior Designer: Pawel Witowski, 2 Design Group

Owner: Jennifer and Eric Rockhold

Contractor: GVP Development

Developer: Jennifer and Eric Rockhold, GVP Development

Photographer: SGW Architecture & Design (exterior),
GVP Development (interior)

Description: 647 W. Melrose Street is a new five-unit multi-family building in the Lakeview neighborhood of Chicago. It features an elevator-served retirement home for the clients on the top floor along with four other apartments below. The front façade is ordered according to classical principles in brick and stone.

American Airlines O'Hare Hangar 2
Chicago O'Hare International Airport, Illinois

Category: Commercial/Industrial

Designer: Ghafari Associates –
Joseph Gonzalez, FAIA

Owner: American Airlines

Contractor: W E O'Neil Construction

Photographer: Tom Rossiter

Description: To support the modernization program at Chicago O'Hare International Airport, American Airlines - the world's largest airline - pursued the development of a new double wide-body aircraft maintenance hangar. The structure improves and consolidates line and base maintenance operations at one of the airline's busiest hubs.



Silver Awards



National Training Center
Chicago, Illinois

Category: Interior Architecture

Designer: Stantec Architecture – Christopher Keller

Photographer: Dave Burk

Description: Our global technology client needed a training center where it could welcome visitors from all over North America, host events and represent its brand. We designed the 12,000 SF training center on the first floor of its regional headquarters to marry brand, culture, and optimal performance.



Eco Shelter
Fresno, California

Category: Single Family Homes

Designer: Arthur Dyson Architect – Arthur Dyson

Owner: Fresno Eco Village

Contractor: Gerry Bill

Photographer: David Swann

Description: This public service project is an attempt to provide an alternative shelter that is holistically conceived and psychologically uplifting to the City of Fresno. The structure was designed as a pro bono architectural project and utilized donated materials such as a sliding glass door panel, floor tile and decking.

Silver Awards



Hubbard 221
Chicago, Illinois

Category: Multi-Family Homes

Designer: Hirsch MPG LLC – David Genc, Andrew Myren

Owner: Centrum Partners LLC

Contractor: Linn-Mathes Inc.

Photographer: Anthony May (exterior), Mike Schwartz (interior)

Add'l Designers: Harken Interiors – Interior Design

Developer: Centrum Partners LLC

Description: Transit-Oriented Developments help bring needed density to transit nodes of the city of Chicago, providing a positive impact on city planning. This impact can be felt in the design of Hubbard 221, a 23-story, 265,000 square foot mixed-use building located with elevated tracks along its entire frontage. The building's design responds to these elevated tracks.

National Concert Hall
Vilnius, Lithuania

Category: Unbuilt Design

Designer: Myefski Architects – John Myefski

Add'l Designers: Michael Karkowski, Joshua Sacks, Matthew Carlton, Chris Myefski, Ellis Wills-Begley, Aniella Goldinger

Description: The concert hall rises from below, shatters the earth, fracturing the surface. The broken shards are frozen and elevated to form the rooflines of the hall. A dance of light penetrates through the openings during the day, and beams of light escape the interior at night, creating a welcoming beacon on the hill. This play of light grants life to the structure.



Silver Awards



OSO Apartments
Albany Park, Chicago, Illinois

Category: Multi-Family Homes

Designer: Canopy/Architecture + Design

Owner: Evergreen Real Estate Group

Contractor: Evergreen Construction Company

Photographer: Christopher Barrett

Developer: Evergreen Real Estate Group

Description: OSO Apartments serves as a catalyst for innovative affordable housing in Chicago. OSO is a new construction, 5-story 48-unit affordable housing project in the Albany Park neighborhood. OSO is the Spanish word for "bear", fitting name to express resiliency and strength for one of the nation's most culturally diverse communities.

Ravine House
Glencoe, Illinois

Category: Single Family Homes

Designer: Robbins Architecture

Contractor: Goldberg General Contracting, Inc.

Photographer: Steve Hall, Hedrich Blessing

Description: Set atop a ravine along Lake Michigan, the owners of this home sought to capture views of the site's tree canopy and the lake beyond, while also meeting the needs of their active young family. Because the front of the home faces the street, the architects designed an intermittent pattern of carefully composed slot windows within a limestone-paneled wall. The composition mimics the patterning of the trees, extending beyond the home to a site wall and creating the illusion of a light and open façade.



Merit Awards



American Academy of Pediatrics
Itasca, Illinois

Category: Commercial/Industrial

Designer: Stantec Architecture – Christopher Keller

Photographer: Christopher Barret

Description: The building's curved façade features a gradated pattern of lively yet softly colored glass panels that make their way around the building, catching sunlight and highlighting hues. In the interior, offices and conference rooms are centrally located, both affording employees access to daylight and views and promoting collaboration by establishing meeting zones within neighborhoods.

Broadview Public Library Renovation and Addition
Broadview, Illinois

Category: Institutional

Designer: Dewberry Architects

Owner: Broadview Public Library District

Photographer: Mariusz Mizera

Description: The renovation of the Broadview Public Library equates to a complete transformation of all aspects of the original 1965 library building. A 3,300 SF wrap-around addition creates a new public image and entrance while increasing collection areas and adding a dedicated Children's Program Room and more efficient staff space. The conversion of 6,000 SF of existing lower level storage space adapted under-utilized square footage into programmable area for both patron and staff use.





Dakota Prairie Residence
Fargo, North Dakota

Category: Single Family Homes

Designer: Peterssen/Keller Architecture –
Bob Le Moine, AIA, NCARB – Project Manager/Architect;
Kristine Anderson, Managing Principal/Designer

Contractor: Tomlinson Schultz

Photographer: Spacecrafting

Add'l Designers: Martha Dayton Design

Description: This new modern home is the second project the architect designed for the clients. The first was a modern lake cabin reflecting the couple's sophisticated urban aesthetic. They enjoyed the collaboration and asked the architect to design a new family home in West Fargo. The wife had fond memories of growing up in a spacious one-story rambler, so she and her husband wanted to raise their young children in a single-level modern environment. They also wanted a strong connection between indoors and out and a balance of public and private spaces.

Merit Awards



Enlace Offices and Community Center
Little Village, Chicago, Illinois

Category: Commercial/Industrial

Category: Canopy/Architecture + Design

Owner: Enlace Chicago

Contractor: Blackwood Group

Photographer: Sarah Crowley

Description: The project site aimed to establish a new neighborhood icon, expressive of culture and place, while creating a new headquarters facility for the growing organization. The new four story building uses a simple palette of materials common to the neighborhood– brick and glass block. The building features operable door panels that open the interior community space to the street to strengthen the relationship between Enlace and the community while blurring the relationship between interior and exterior.

Goose Island North Branch - Chicago, Illinois

Category: Unbuilt Design

Designer: Myefski Architects – John Myefski, Joshua Sacks, Brian Wagner, Joel Norton, Ellis Wills-Begley

Description: Located on the North Branch of Chicago's Goose Island, the concept design for this commercial development involves the conversion of a former furniture warehouse into a destination office experience. Taking inspiration from the building's original industrial style, the red brick facade is beautifully contrasted against the stunning glass atrium that connects the four existing structures, the steel floor-to-ceiling window frames and the enclosed glass balconies.





Lapp Residence - Sanger, California

Category: Single Family Homes

Designer: Arthur Dyson Architect – Arthur Dyson

Owner: Greg and Deborah Lapp

Contractor: Sidney Mukai

Photographer: David Swann

Description: The principal architectural character of the house is felt through the many clear glass apertures, so the view extends outward unencumbered. Each room in the home frames a specific tableau – either clusters of native oaks, or geological features in the surrounding landscape and the sinuous Kings River. Two cantilevered steel beams temper the 16-foot arched ceiling and accentuate and extend the eye outward into the landscape.

Merit Awards



Learning Hub
Chicago, Illinois

Category: Unbuilt Design

Designer: Bailey Edward Design, Inc.

Owner: University of Illinois at Chicago

Description: The building's curving walls and multiple entry points follow the flow of the crossing pathways surrounding it, while its texture expresses virtual erosion. Glazed entries become an opening in a canyon while punched windows become crevices in cliffs created over time. The diversely shaped environment creates a natural flow, encouraging incidental, energizing human interaction, personal connections, and community at multiple levels. Ultimately, the building design expresses and unifies students while reflecting its core purpose: education.

Meadow House
Winnetka, Illinois

Category: Single Family Homes

Designer: Fraerman Associates Architecture - James Fraerman

Contractor: SH Builders

Photographer: Eric Hausman Photography

Description: The house reflects the client's desire to have an airy, open house with every room contributing to a feeling of comfortable and relaxed family living. Built on a rise in a large meadow, the home is positioned to maximize the view of the spacious property. Designed to contrast with the expansive character of the site, the approach to the house is through an intimate courtyard flanked by two identical gabled structures housing a garage and a sport room.





O'Hare Aircraft Rescue + Fire Fighting Station No. 2
Chicago O'Hare International Airport, Illinois

Category: Institutional

Designer: Ghafari Associates – Joe Gonzales, FAIA – Project Designer

Owner: Chicago Department of Aviation

Contractor: F.H. Paschen

Photographer: John Steinkamp

Description: The new 19,000 SF facility integrates spaces for apparatus operations, training the administration, and firefighter housing and recreation. Essential to the design was the careful organization of these functions for both expedient dispatch and the well-being of personnel. The apparatus bay is the spatial centerpiece of the plan, accommodating eight vehicles in a drive-through configuration to increase safety and flexibility. Now complete, the new ARFF station syncs equipment, technology, and training to heighten functionality and efficiency, in order to reduce emergency response times. For years to come, it will play a pivotal role in the health and safety of its inhabitants and the surrounding community.

Treehouse Napkin Sketch Contest Winners

This contest was an opportunity for licensed architects, architecture associates, architecture students, and suppliers to the built environment to showcase their design expertise. A panel of experts judged the 5-inch by 5-inch sketches based on creativity, originality, and technical skill. An outstanding panel of educator-practitioners who have more than 100 years of service as faculty members at Ball State University's College of Architecture & Planning were assembled to adjudicate the entries. Collectively, they have been recognized with awards in the annual *ARCHITECTURAL RECORD Napkin Sketch Contest*, Ken Roberts Memorial Delineation Competition (KRob), and have also made dozens of invited presentations at professional and educational conferences.

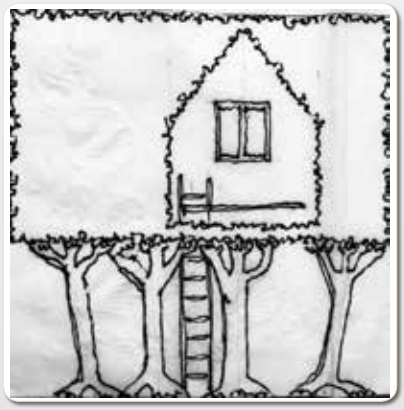
JUDGES:
CHAIR – Tony Costello, FAIA, Irving Distinguished Professor Emeritus of Architecture & Principal, Costello + Associates
Lohren Deeg, Associate Professor of Urban Planning and Member of the American Society of Architectural Illustrators
Harry Eggink, **RA**, Professor of Architecture



1st Place - Honor Award

Gregory L. Klosowski
Pappageorge Haymes Partners

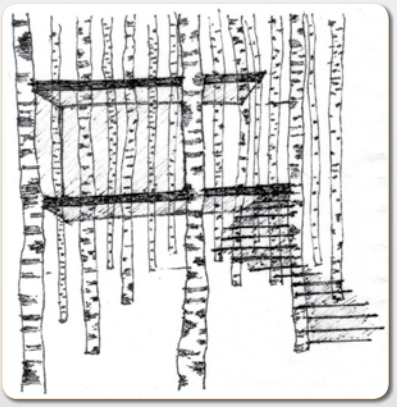
"From the initial review to the final determination of awards, this sketch stood out as 'the best of the best'." Informed by the verticality inherent in the forest context, the design concept and quality of the sure hand displayed in the sketch technique both sustain this assessment."



Runner Up

William Ketcham
Stantec Architecture, Inc.

"Really enjoy this sketch for using the 5" X 5" cocktail napkin size to interpret and create the tree and frame the sketch. Single, strong ink line and embossed seashells add to texture of drawing."



Runner Up

Lindsay Boley
Stantec Architecture, Inc.

"Transparent decks that allow the trees to visually read through and create a 'graphic grid' as well as an implied White Birch forest were lauded by the jury."



Runner Up

Brian Kidd
Kidd Architects

"The jury lauded both the unique design that is informed by the hanging 'bird nest' image and a high degree of professional competence displayed in the sketch technique."



Honorable Mention

Michael Henning
Pappageorge Haymes Partners

"Bold use of color recognized by jury."



Honorable Mention

Sangita Santhanam
Rasa Design Inc.

"Enjoyed use of multiple vanishing points."



Honorable Mention

Sam Salahi
AP&S, Ltd. Architects

"The jury lauded this sketch for 'story telling'."



Honorable Mention

Thomas Hickey
Thomas Hickey & Associates

"The jury lauded this sketch for 'story telling'."

STUDENT AWARDS



First Place Honor Award

Sarah Fellingham
Syracuse Architecture

"The jury lauded both the unique design that is informed by the hanging 'bird nest' image and a high degree of professional competence displayed in the sketch technique."



Runner Up

Qiying Ruan
Syracuse Architecture

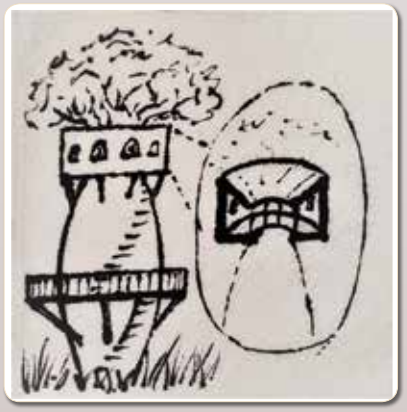
"Enjoyed minimalist approach to forest context."



Runner Up

Anindita Laz Banti
Miami University

"Noted design that truly 'wrapped around' the main tree."



Runner Up

Mariah Guyot
University of Illinois at Urbana Champaign

"Interesting concept."

Doors in the Means of Egress Electrical Locking Systems Permitted By the Codes

BY: JOHN WOESTMAN

The International Building Code (IBC) has provisions for several "shall be permitted" electrical locking systems on doors in the means of egress. These provisions cover controlled egress, delayed egress, sensor release, and door hardware release electrical locking systems. These electric locking systems are in the 2018 IBC under "Controlled egress doors in Groups I-1 and I-2, "Delayed egress locking systems," "Sensor release of electrically locked egress doors" and "Door hardware release of electrically locked egress doors" in Sections 1010.1.9.7 through 1010.9.10, respectively.

Controlled Egress Locking Systems

Controlled egress locking systems are designed and function as the name implies: egress is controlled by another individual, such as staff, via an electrical locking system. Controlled egress locking systems are most commonly placed on interior doors in healthcare facilities to control egress from specific areas of the building.

Controlled egress locking systems are only permitted in institutional occupancy Groups I-1 and I-2 where the clinical needs of the persons receiving care within this institution require this type of locking system. Some healthcare facilities, such as assisted living facilities, nursing homes, dementia units, Alzheimer's units, pediatric units, and newborn nurseries have special safety needs for patients. This locking system is only permitted within buildings that have an automatic sprinkler system or an automatic smoke or heat detection system, and require the doors to unlock for immediate egress upon activation of these systems.

Additional requirements for controlled egress locking systems, including unlocking upon loss of power to the locking system, are included in section 1010.1.9.7 of the IBC. In the 2012 IBC and previous editions, these locking systems were titled "Special locking arrangements in Group I-2": the name was revised to the current title, "Controlled egress doors in Groups I-1 and I-2," with the 2015 IBC to have a name more descriptive of their application.

Delayed Egress Locking Systems

Delayed egress locking systems also function according to their name: egress through the door is delayed by the electronics of the delayed egress locking system. Doors with delayed egress locking systems are often equipped with mechanical latches and locks that keep the door in a locked condition thus controlling ingress in addition to the delayed egress electrical locking system.

Delayed egress locking systems are permitted in most occupancies, but not in Group H nor Group A occupancies with the exception of Group A-3 courtrooms. For example, delayed egress locking systems may be used on required exit doors of retail establishments to reduce pilferage. Another application of this locking system includes use in health care facilities to provide an early warning to the staff that an occupant is attempting to open an exit door. As with controlled egress, delayed egress locking systems are only permitted where the building has an automatic sprinkler system or automatic smoke or heat detection system. If the sprinkler system, or the smoke or heat detection system, is activated the delay component of the delayed egress locking system is required to be eliminated to facilitate immediate egress. Furthermore, international signs are required on delayed egress doors communicating how the door hardware functions for egress. Additional requirements for this locking system are included in section 1010.9.8 of the IBC.

Sensor Release Locking Systems

Sensor release locking systems are designed to facilitate immediate unencumbered egress at all times. These locking systems function by placing one or more sensors near the door, and the system's electronics unlock the electric lock on the door for egress upon sensor activation. The sensors are triggered once an occupant approaches the door for egress.

Excluding Group H, sensor release locking systems are permitted in any occupancy. The operation of these electrical locks should not impede egress to any extent, and the occupants of a building may not even realize these locking systems are installed on a door.



In the event that the control system of these electrical locks fail, a manual unlocking device, such as an electric push button, is required to be installed near the door. Moreover, the power to the electrical door locks is required to be interrupted directly by this manual unlocking device. Doors with sensor release locking systems may or may not be equipped with mechanical latches and locks which keep the door in a locked condition, thus controlling ingress, should the power to the electrical locking system fail. In the 2012 IBC and previous editions, their locking systems were titled "Access-controlled egress doors." The name of these locking systems was revised to "Sensor release of electrically locked egress doors" with the 2015 IBC to reduce confusion with access control systems (ingress control systems).

Door Hardware Release Locking Systems

Just as with the sensor release locking systems, door hardware release locking systems are also designed to facilitate immediate unencumbered egress at all times. The electrical switch integrated in the door hardware is set in motion by the manual action of opening the door for egress such as by pushing on a panic bar or turning a lever handle. Once activated, the electrical switch incorporated in this locking system directly interrupts power to the electrical lock causing it to unlock.

Door hardware release locking systems are permitted in any occupancy except Group H. Similar to the sensor release locking systems, the occupants may not realize door hardware release locking systems are installed on the door as the operation of the electrical locks should not impede egress. The electrical switch incorporated in the door hardware directly interrupts power to the electrical door lock and enables immediate egress. Doors with door hardware release locking systems are typically equipped with mechanical latches and locks which keep the door in a locked condition controlling ingress should the power to the electrical locking system fail.

Each of these four electrical locking systems may be installed in concert with access control (ingress control) locking systems for enhanced security. The IBC requires that egress be accomplished as required and permitted by the code regardless of the methods employed for access control (ingress control). More information on these electrical locking systems can be found in sections 1010.1.9.7 through 1010.1.9.10 of the IBC. The Builders Hardware Manufacturers' Association interacts with stakeholders in an effort to understand the balance of how doors, door hardware, and door locking systems are used, desired to be used, and should be used. With the Codes, Government, and Industry Affairs (CGIA) Committee, the association is a part of the code development process for the various building-oriented codes. The association works to review and modify building code language with the technical expertise of door hardware industry leaders to express safety requirements in language that is clear and concise.

The CGIA Committee initiated its work as a codes task force in response to 9/11, and focused on code enforcement regarding exit doors. At the time, there were no methods to ensure that a door maintained code-compliancy one, 10, or 50 years after the day it received its certificate of occupancy. Annual inspections – or some other oversight protocol, such as as something matching the fire extinguisher certification – was in order. Currently, the CGIA Committee receives requests for codes-related insight as a response to modern events and has become the go-to source for other groups within the industry regarding code proposals.

About the Author: *John Woestman, director of codes and regulatory affairs for the Builders Hardware Manufacturers Association, provides technical expertise and services pertaining to building codes and advocacy. Woestman has a mechanical engineering degree from Iowa State University and an MBA from the University of Iowa. He is a member of the International Code Council, the National Fire Protection Association and ASTM International.*

Engineered Wood Gets an Easy "A"

Two Washington Schools Expose the Benefits of Engineered Wood

BY: KARYN BEEBE, P.E., LEED AP, WEST REGION FIELD SERVICES MANAGER, APA – THE ENGINEERED WOOD ASSOCIATION



PHOTO COURTESY OF TACOMA PUBLIC SCHOOLS

Birney Elementary totals 56, 055 square feet and incorporates exposed LVL and glulam throughout four classroom wings and a communal learning common

Engineered wood is never too cool for school. Sustainable, cost-effective, and aesthetically appealing, wood is ideal for school construction. Two Washington school districts creatively leveraged the benefits of exposed wood products in their newly constructed schools.

VANCOUVER SCHOOLS

The McLaughlin Middle School/Marshall Elementary School located in Vancouver, Washington is one of the largest mass timber projects in the Pacific Northwest, at an astonishing 203,000 square feet.

The project was carried out by Western Wood Structures, a local construction company based out of Tualatin, Oregon that specializes in mass timber installation.

Mike Dyer, project manager for Western Wood Structures, is no stranger to the benefits of engineered wood products. Western Wood Structures has been building with engineered wood for more than 50 years. "We love the product because it doesn't have the natural flaws of traditional timber," Dyer said. "It's a very consistent building material."

Vancouver Public Schools wanted to begin incorporating wood into its schools. "People are moving toward wood because of the environmental benefits," Dyer said. "It's sustainable and renewable, and people feel good about that."

Environmental Benefits of Engineered Wood

Increased demand for wood products encourages healthy forest maintenance, and the regeneration absorbs more greenhouse gases. Wood sequesters carbon from the environment as the tree grows, and buildings made

with engineered wood continue to have a net benefit on the environment.

In addition to sustainability, the school district was also enamoured by the warmth, and natural aesthetic of the mass timber. The school district chose to leave the wood exposed, so people could see its natural beauty and the structural elements, creating a strong focal point.

Biophilia and Learning

Wood products can positively affect the learning environment. The natural beauty and aesthetic of exposed wood creates a warm and enriching atmosphere. More research is backing the hypothesis of "biophilia," or the tendency for humans to prefer natural materials. Research suggests that natural materials, like engineered wood, support increased focus and productivity that is conducive to an effective learning environment. Read more about biophilia and the research behind it at: www.apawoord.org/biophilia

Optimizing Efficiency

The Vancouver school project used multiple engineered wood products, including cross-laminated timber (CLT), glulam, and laminated strand lumber (LSL). Using mass timber significantly increased the speed of erection.

"Our crew was able to set entire floors of CLT panels in just a few days, which would normally take a week or two with traditional framing," Dyer said.

"The beauty of mass timber is that all the fabrication required for the project is done when it shows up. It's much more precise and very beneficial for the timeline of the project."

Engineered wood products can be manufactured in dimensions specific to the project, resulting in less wasted scrap materials. Traditional lumber requires cutting, drilling and tooling on location, which requires more labor hours, produces more waste and creates more room for errors.

The mass timber improved safety on the job site. "It allowed our crew to spend less time preventing safety issues and constructing components to walk on, because instead, they had a large, sturdy panel to walk on," Dyer said. "It reduced the number of our crew members that were in the air."

The project was met with innovation by Western Wood Structures.

"We developed a special rigging form for lifting the different sized CLT panels and ensuring they were precisely set in place," explains Dyer.

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PHOTO COURTESY OF WESTERN WOOD STRUCTURES

A special rigging system was designed to set the cross-laminated timber panels into place

With over 800 CLT panels, and more than 700 different shapes and weights, the company needed a rigging system that was simple but could accommodate the variety. Western Wood Structures' project engineers designed, developed and manufactured a rigging system that allowed the crew to install over 30 panels, or 10,000 square feet of floor or roof a day.

"It's hard to move the panels once they are set, and this rigging form allowed us to increase our crew's productivity and improve their safety on the job."

TACOMA SCHOOLS

About 175 miles north, Tacoma Public Schools also discovered the benefits of incorporating exposed engineered wood into their new school. Birney Elementary is home to one of Tacoma, Washington's deaf and hard of hearing programs.

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PHOTO COURTESY OF TACOMA PUBLIC SCHOOLS



Instead of needing to layer finish products over the structural members, the glulam and laminated veneer lumber served as both

Its existing building was replaced by a brand new 56,055-square-foot structure featuring four classroom wings and a communal learning commons. The school opened fall of 2020 and was completed by Turner Construction Company.

Aesthetic Appeal and Acoustic Advantages

For Tacoma Public Schools, engineered wood was an easy choice. According to Kris Stamon, project manager for McGranahan Architects, early in the project, mass timber components were chosen instead of steel because of wood's inherent beauty.

"The design expresses the warmth and beauty of the wood products, specifically via the exposed roof structure that unifies the main circulation spaces throughout the school," said Stamon.

One of the main drivers of the project was being able to maximize the openness of the building. "The visual openness unifies the school," Stamon said.

The wood products also offered some acoustical advantages for the deaf and hard-of-hearing students. Wood doesn't reverberate sound as much as its steel or concrete counterparts. The wood helps soften the noise and makes sound easier to control, creating an enhanced learning experience for the students.

A Cost-Effective Solution

But for Tacoma Public Schools, choosing engineered wood was about more than just good looks. For the single-story building, wood products were also the most cost-effective solution. Instead of needing to layer finish products over the structural members, the glulam and laminated veneer lumber (LVL) used on the project served as both.

"We were able to use the structural wood as the finish material, which reduced our costs when compared to a

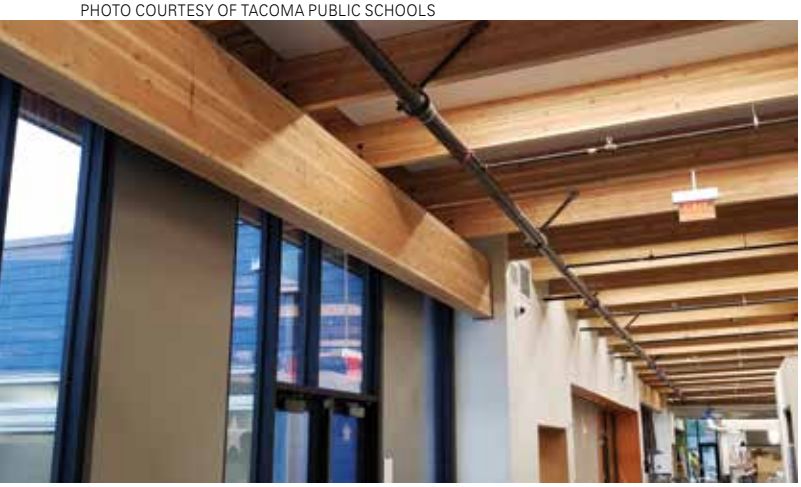
layered approach," said Tacoma Public Schools Project Manager Greg Stidham. "The fact that many of the wood elements could be left exposed and expressed structurally had added benefits. The ability for the students to see the structural and exposed connections can also be used as an educational tool."

The structural design was intentionally repetitive and allowed the construction process to be sequenced for improved efficiency.

"We were able to pre-construct panelized walls, which allowed for mass installation. Using the sequencing system improved our crew's productivity," said Turner Construction Engineer Karen Lawton.

"Glulam served as the main beams, which we installed first with plywood spans, then we installed the roof system. The exposed glulam beams and plywood provide roof structural support and horizontal stability throughout the main hallways of the school," Lawton continues. "These beams can span longer distances for flexibility of design and construction."

PHOTO COURTESY OF TACOMA PUBLIC SCHOOLS



Glulam beams provide structural support and stability throughout the main hallways of Birney Elementary

PHOTO COURTESY OF TACOMA PUBLIC SCHOOLS



By sourcing engineered wood from local suppliers, the construction company was able to cut labor costs and shipping time

The Local Advantage

By using wood on the project, Turner Construction was able to cut labor costs and support the local economy by sourcing the wood materials from local suppliers.

"We were able to tap into the large, local carpentry force," said Amanda Packer, project manager for Turner Construction. "We were also able to save on labor costs because we didn't need to hire additional welders or ironworkers, whose wages are typically more expensive."

"The wood products were local and readily available, so we didn't need to wait for shipping from another country, which was a big advantage," Packer added.

"Engineered wood products and traditional materials were combined to form a beautiful, cost-effective and safe learning environment for the students," Stidham said. "The exposed wood makes this school unique; it makes it stand out."

It's clear that for these two school districts, engineered wood gets an easy A.

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Low-Slope Roofs: Design Solutions for Building Code-Permitted Low-Slope Applications That Cause Ponding Water

BY: SCOTT D. COFFMAN, P.E., SECB, AND THOMAS G. WILLIAMSON, P.E.

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Chapter 15 in the 2015/2018 International Building Code (IBC) contains installation guidelines that permit a design slope of 1/4 in 12 for certain types of roof covers. Specifically, the code text typically reads, "…roofs shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2 per cent slope) for drainage." The stated and intended purpose of the code-specified 1/4 in 12 slope is to provide drainage; however, ponding water is often observed in these low-slope roofs. The standing water is a primary source of roof cover discoloration and deterioration that may result in framing member damage and contribute to premature failure of the structural system.

Additionally, building code deflection ratios fail to consider the short-term deflection that exacerbates the potential for ponding water. Therefore, the 1/4 in 12 code-permitted slope requires further investigation by the building design professional. The focus of this article is wood framing members; however, the principles presented are applicable to framing members of any material.

IBC and ASCE

The reason water ponds on a low-slope roof is a possible misinterpretation of the 1/4 in 12 minimum slope by the building code. Significant insight may be found in ASCE 7 Section 8.4 as referenced in IBC Section 1611.2. ASCE 7-10 (2015 IBC) attributes ponding water to the deflection of relative flat roofs and identifies a susceptible bay for ponding as a "roof slope" less than 1/4 in 12. ASCE 7-10 further clarifies, "Roof surfaces with a slope of at least 1/4 inch per foot (1.19°) towards points of free drainage need not be considered a susceptible bay."

ASCE 7-10 recognizes that relative flat roofs deflect when subjected to load. A structural member designed and installed to a 1/4 in 12 "design slope" deflects under the initial short-term dead load to create a roof surface (slope) less than 1/4 in 12. The 1/4 in 12 design slope is reduced more from live load and long-term dead load (creep) to exacerbate water retention. Therefore, a roof designed and installed to a 1/4 in 12 slope deflects downward and needs to be analyzed as a susceptible bay, according to ASCE 7-10.

ASCE 7-16 (2018 IBC) omits the ASCE 7-10 sentence that attributes ponding water to the deflection of flat roofs. However, ASCE 7-16 continues to identify a susceptible bay to include:

- bays with a roof slope less than 1/4 inch per foot (1.19°) when the secondary members are perpendicular to the free drainage edge;" and
- bays with a roof slope less than 1 inch per foot (4.76°) when the secondary members are parallel to the free drainage edge."

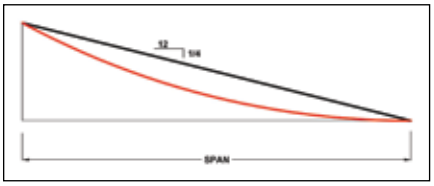


Figure 1: Wood members installed to a design slope of 1/4 in 12 often deflect from the initial dead load to create a "flat" area toward the low end.

Secondary members are defined as structural members not having direct connection to the columns (e.g., joists, purlins, or rafters). Commentary for ASCE 7-16 Section 8.4 alludes to ponding from secondary member deflection and states the 1/4 in 12 limit is based on a maximum deflection-to-span ratio of L/240. The authors interpret the words "maximum deflection" to be total load that includes short-term and long-term deflection from dead load in addition to live-load deflection.

Therefore, framing members designed to a 1/4 in 12 slope should be analyzed for the total load at a minimum deflection ratio of L/240. This deflection criterion is more stringent than required by the IBC deflection table. However, footnotes to the IBC deflection table caution that the published deflections do not ensure against ponding. ASCE 7-10 and ASCE 7-16 recognize that structural members deflect and sufficient member stiffness is necessary to promote free drainage of a 1/4 in 12 design slope. Additionally, ASCE 7-16 requires a minimum 1 in 12 roof slope to promote free drainage for secondary members parallel to a free drainage edge. The 1 in 12 is significantly more than the commonly

specified 1/4 in 12 and reflects the need of an increased slope to promote free drainage.

Analysis

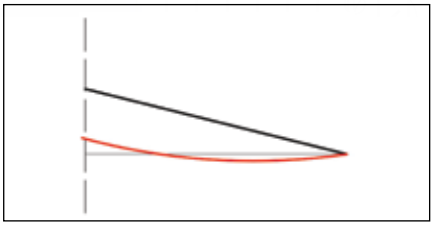


Figure 2: As the code-permitted L/120 or L/180 ratios are approached, the deflection curve extends below a horizontal datum to create a "bowl."

There is a significant difference between "design slope" found in IBC Chapter 15 and "roof slope" used in ASCE 7. A specified design slope is absent of member deflection whereas the roof slope reflects the actual in-service deflection. The authors investigated the deflected shape of a member using the properties of a circle. The maximum midspan deflection was set to published code deflection ratios. This method is reasonable for wood since member design approaches published deflection ratios for economy.

Field observations and investigations by the authors have found wood members installed to a design slope of 1/4 in 12 often deflect from the initial dead load to create a "flat" area toward the low end (Figure 1). The relative "flat" region retards and/or prevents free drainage. As the code-permitted L/120 or L/180 ratios are approached, the deflection curve extends below a horizontal datum to create a "bowl" (Figure 2). (The same deflection principles apply to any material.) The bowl becomes more prominent for structural members that support roof-top units and/or for long-term deflection (creep). The authors found the bowl is eliminated for members designed to the ASCE 7-16 maximum deflection-to-span ratio of L/240. However, the deflection curve remains relatively flat (less than 1/4 in 12) for a distance of approximately L/6 to inhibit free drainage.

Additionally, deflection tables published by the IBC are limited to live load and a long-term deflection (creep) component. The omission of a short-term dead load deflection component combined with IBC published L/180 or L/120 ratios permit calculated deflection numbers to exceed the L/240 maximum found in the ASCE 7 commentary.

According to the AITC Timber Construction Manual (TCM), actual measurements of ponded water found the deflection curve to be more parabolic. The deflection at any point may be found from the equation:

$$\Delta_x = \Delta_{max} \sin \frac{\pi x}{L}$$

From this equation, the deflection curve does not extend below a level datum to create a bowl for the L/180 and stiffer ratio. However, the deflection curve remains relatively flat (less than 1/4 in 12) for a distance of approximately L/4, and this can inhibit free drainage. Therefore, water-retention/ponding can be expected for the commonly specified 1/4 in 12 design slope.

Solution 1: Increase Design Slope

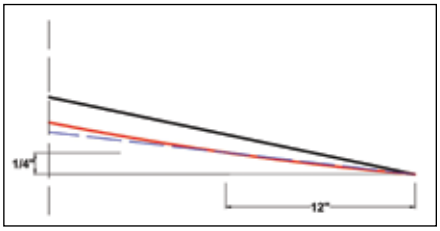


Figure 3: Increasing the code minimum 1/4 in 12 design slope to compensate for member total load deflection promotes free drainage and helps mitigate the potential for ponding by deflecting below a 1/4 in 12 surface.

Increasing the code minimum 1/4 in 12 design slope to compensate for member total load deflection will promote free drainage and help mitigate the potential for ponding by deflecting below a 1/4 in 12 surface (Figure 3). This approach is consistent with the 1 in 12 roof slope requirement found in ASCE 7-16. Table 1 summarizes the minimum design slope necessary to achieve a minimum 1/4 in 12 residual surface for common deflection ratios. The deflection ratios are for Total Load, which include short-term and long-term dead load in addition to the live load.

A precedence exists to increasing the minimum design slope to a value greater than 1/4 in 12 for drainage. The U.S. Department of Defense (DOD) published the Unified Facilities Criteria (UFC) for planning, design, and construction criteria for all DOD projects. The 2017 UFC Roofing section was updated to coordinate with the latest editions of the National Roofing Contractor's Association Roofing Manual and Metal Building Manufacturers Association Roofing manual to meet the latest DOD requirements.

UFC Section 2-3 pertains to low-slope roofing requirements and addresses minimum slope for positive drainage. Specifically, "The minimum slope for construction of new buildings is 1/2:12 to achieve positive drainage." The UFC requirement is consistent with the authors' belief that the 1/4 in 12 design slope found in the building code should be increased to provide free drainage of a roof surface. The 1/2 in 12 design slope is also consistent with the authors' findings for L/180 and stiffer deflection ratios.

Solution 2: Camber

The AITC TCM and National Design Standard for Metal Plate Connected Wood Truss Construction (TPI) recognize camber as a means to ensure adequate drainage. The building designer specifies the amount of camber to be fabricated into a structural component (e.g., glued laminated timber members and wood trusses) by introducing curvature, circular or parabolic, opposite to the anticipated deflection. For low-slope applications, the

camber must be sufficient to mitigate the likelihood of a structural framing component to deflect below the 1/4 in 12 plane. Additionally, the camber is to promote free drainage. Minimum camber recommendations found in the AITC TCM for glued laminated timber beams in roof applications is 1.5 times the dead load deflection. The TPI commentary for Section 7.6.2 also recognizes a camber amount equal to 1.5 times the dead load due to deflection. Other proprietary wood truss products publish camber criteria as a function of dead load and live load. Extreme care is necessary when camber is specified, and an experienced wood design professional and/or fabricator should be consulted. In the absence of specific camber criteria, a minimum amount equal to 1.5 times the dead load deflection is recommended for roofs when a camber solution is desired.

T.L. Ratio	Slope in 12
L/120	0.75
L/180	0.625
L/240	0.5
L/360	0.5
L/480	0.375

Table 1: Design slope for residual 1/4 in 12 surface

Solution 3: Ponding design for a 1/4 in 12 design slope

The most effective method to prevent ponding is to provide adequate slope to achieve positive drainage. However, design constraints may exist that limit the design slope to 1/4 in 12 as permitted by the building code. When the 1/4 in 12 design slope is specified, a building designer should use an acceptable design method to ensure wood framing members have adequate strength and stiffness to mitigate potential ponding. For members without camber, an acceptable method is to increase calculated deflections and design stresses by a magnification factor for the wood member. The magnification factor, C_p, is:

$$C_p = \frac{1}{1 - W'L^3/\pi^4 EI}$$

Where:

W' = total load of 1 inch of water on the roof area supported by the member (pounds). One inch of water weighs approximately 5.2 pounds per square foot.

L = member span (inches)

E = modular of elasticity of the member (pounds per square inch)

I = moment of inertia of member (in^4)

The calculated design stresses are increased by Cp and compared to the published allowable stresses. Likewise, the calculated deflection is increased by Cp and compared to the total load deflection ratio. The wood component is acceptable for anticipated ponding loads if the design stresses and deflection values increased by Cp are less than allowable values. An abbreviated example for bending moment and deflection is shown for a sawn lumber member:

$$C_p = 1.082$$

$$F_b = 750 \text{ psi}$$

$$L/240 = 0.83$$

$$f_b = 659 \text{ psi} \times 1.082$$

$$= 713 \text{ psi} < 750 \text{ psi (OK)}$$

$$\Delta_{TL} = 0.58 \text{ inches} \times 1.082$$

$$= 0.63 < 0.83 \text{ inches (OK)}$$

The total load deflection ratio is limited to L/240 to be consistent with ASCE 7.

The magnification factor may also be applied to a wide range of proprietary engineered wood products such as structural composite lumber (SCL) and prefabricated wood I-joists. The design shear and moment values are increased by the magnification factor and compared to the manufacturer's published allowable values. The calculated total load deflection is also increased by the magnification factor and compared to a total load deflection ratio of L/240 or stiffer.

Modulus of Elasticity (E) Adjustment

The values of "E" published in the National Design Specification for Wood Construction (NDS) are average values. All wood strength properties, including the modulus of elasticity, are variable expressed by the coefficient of variation, COVE. The variations of the modulus of elasticity (E) for wood approaches a statistical normal distribution. Therefore, when a designer desires to estimate a lower value for "E" at some percentile of the total population, such as the fifth percentile, it may be calculated by the following equation:

$$E_{0.05} = E - 1.645\, E\, COV_E$$

Where:

$E_{0.05}$ = estimated "E" at lower fifth percentile (psi)

E = published modular of elasticity of the member (psi)

1.646 = statistical constant to determine values at the fifth percentile

COV_E = 0.25 for visual grade lumber; 0.15 for machine evaluated lumber (MEL); 0.11 for machine stress-rated (MSR), and 0.10 for glued laminated timber (NDS Appendix F)

For example, the NDS published "E" value for No. 2 Grade southern yellow pine lumber is 1,400,000 psi. Therefore, the $E_{0.05}$ is:

$E_{0.05}$ = 1,400,000

– (1.645 x 1,400,000 x 0.25)

= 824,250 psi

This variation of "E" should be considered by a building designer when specifying a design slope of 1/4 in 12 because members with a lower "E" will deflect more. The $E_{0.05}$ is appropriate to calculate the magnification factor, C_P, and deflection of wood truss members with a 1/4 in 12 design slope. The $E_{0.05}$ is the average of the top chord and bottom chord lumber in wood truss design.



Standing water is a primary source of roof cover discoloration and deterioration that may result in framing member damage and contribute to premature failure of the structural system on low-slope roofs.

Recommendations

The intent of the IBC and ASCE 7 is to provide adequate slope for drainage and to mitigate ponding. The authors recommend that design professionals consider the following design slopes to be specified for nearly flat, low-slope applications:

- Roofs — 1/2 in 12 and a total load deflection of L/180 and stiffer.
- Exterior balcony — 3/8 in 12 and a total load deflection of L/480 and stiffer.

When design constraints necessitate a 1/4 in 12 design slope be used, the framing members should be cambered or investigated for ponding. A building designer should reference wood industry standards or contact the product fabricator when specifying camber to prevent ponding. As previously noted, only products such as glued laminated timber and metal plate connected wood trusses can be cambered. The minimum recommended camber for roofs is an amount equal to 1.5 times the dead load deflection.

Design stresses and deflection should be increased by a magnification factor for wood members that are not cambered, such as sawn lumber and timbers. The increased design stresses are to be less than the published values and the increased deflection value is compared to the L/240 ratio consistent with ASCE 7. A similar approach may be used for proprietary products such as SCL and prefabricated wood I-joists by increasing the design moments and shears by the magnification factor and comparing them to allowable values published by the manufacturer.

The designer should increase the stiffness of wood trusses designed without camber for a 1/4 in 12 slope. The $E_{0.05}$ is determined for the truss chord material and used in the deflection analysis. The calculated deflection is compared to L/240 or stiffer ratio.

Conclusion

Building designers routinely stipulate a 1/4 in 12 design slope for roofs and exterior balconies. This practice, on the surface, appears to satisfy the IBC requirement for drainage and eliminate special analysis for ponding. However, ASCE 7 indicates a 1/4 in 12 roof surface is necessary for free drainage and to mitigate ponding. The need to consider member deflection is the subtle difference between "design slope" and "roof slope." A member designed to a 1/4 in 12 design slope deflects when subjected to load that creates a surface less than 1/4 in 12. This is considered to be a primary reason roof and balcony surfaces fail to drain and ponding is often observed.

The most effective method to minimize the effects of ponding is to increase the recommended minimum design slope to 1/2 in 12 for roof applications and 3/8 in 12 slope for floor applications. The total load deflection limit is L/180 and L/480 for the roof and floor, respectively. The increased slope for drainage mitigates ponding and helps prolong the lifespan of the roof cover. When a 1/4 in 12 design slope is a design constraint, using camber or increased member stiffness and stresses should be considered using acceptable wood industry methods. Additionally, the total load deflection ratio of L/240 or stiffer should be used for secondary wood members installed to a 1/4 in 12 design slope to meet ASCE 7 criteria.

About the Author:
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Test Questions

CE Quiz - Design solutions for building code-permitted low-slope application

1. What is one main reason why low slope roofs of a ¼" to 12" can result in ponding?
   a. The slope is too low for proper drainage
   b. Imperfections in roof construction / assembly
   c. Deflection of structural members over time can result in a less than ¼" to 12" roof slope
   d. Debris build up on the roof

2. Framing members designed for a ¼" to 12" slope should be analyzed for the total load at a minimum deflection ratio of:
   a. L/120
   b. $wL^2/8$
   c. L/w^3
   d. L/240

3. What professional specifies camber?
   a. Building Designer
   b. Structural Engineer
   c. Experienced wood design professional
   d. All of the above

4. True or False, Two potential solutions to eliminate ponding water on low slope roofs are: Increase the design slope, and camber the roof elements.
   a. True
   b. False

5. What is the minimum recommended camber for roofs?
   a. .75 times the dead load deflection
   b. Compensating for the dead and live load deflection
   c. 1.5 times the live load deflection
   d. 1.5 times the dead load deflection

6. True or False, Standing water is a primary source of roof membrane discoloration and deterioration?
   a. True
   b. False

7. What potential flaw in the Building Codes exacerbates the potential for ponding water?
   a. Failure to consider short-term deflection
   b. Misinterpretation of the ¼ in 12 minimum slope
   c. Live load and long -term dead load (creep)
   d. All of the Above

8. What are the goals associated with providing a camber?
   a. Mitigate Deflection
   b. Promote free drainage
   c. Both A & B
   d. Neither A nor B

9. In this article how is "maximum deflection" defined?
   a. Environmental loads such as snow load, plus dead load
   b. Live load
   c. Dead load
   d. Total load including short-term, long term deflection from dead load

10. Wood members installed to a design slope of ¼" to 12" slope often deflect from the initial dead load and create a "flat" area toward which side of the roof?
    a. High end of the roof
    b. Mid point of the roof
    c. Low end of the roof
    d. It does not create a "flat" area

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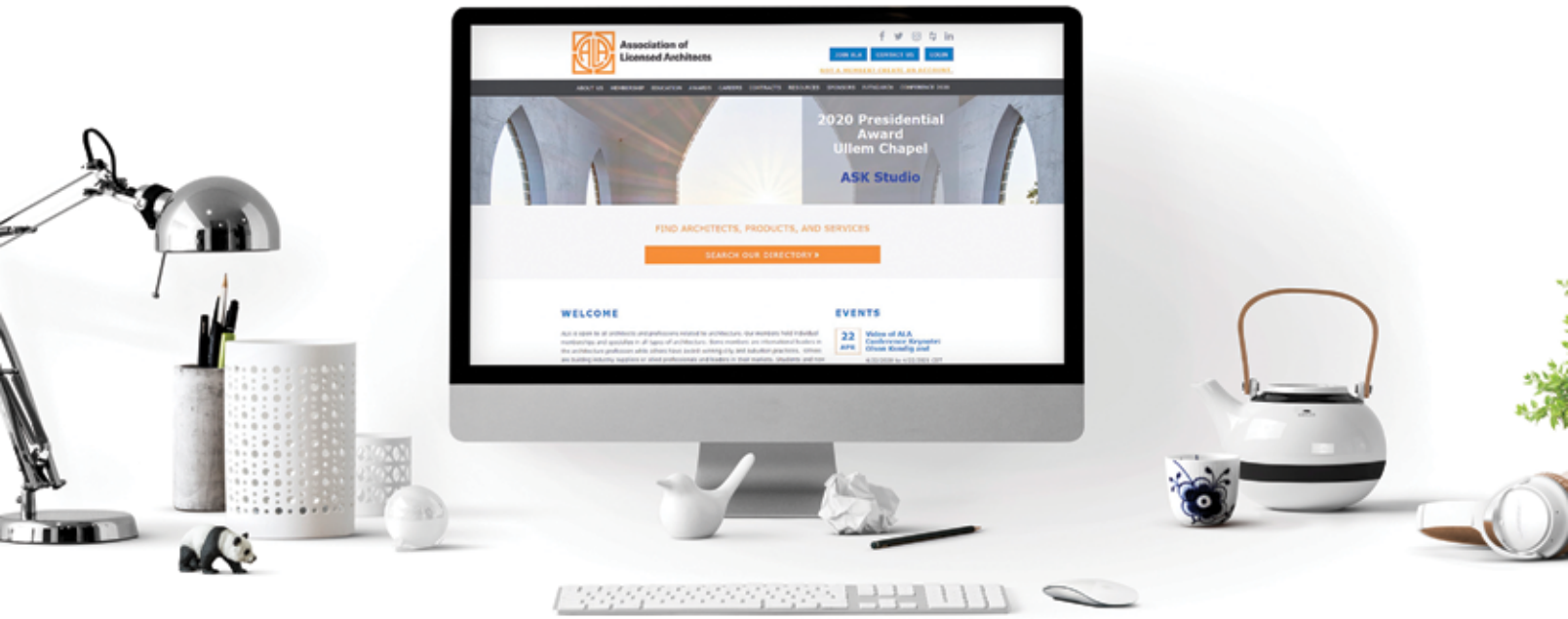
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