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Fall 2015 — Number 71

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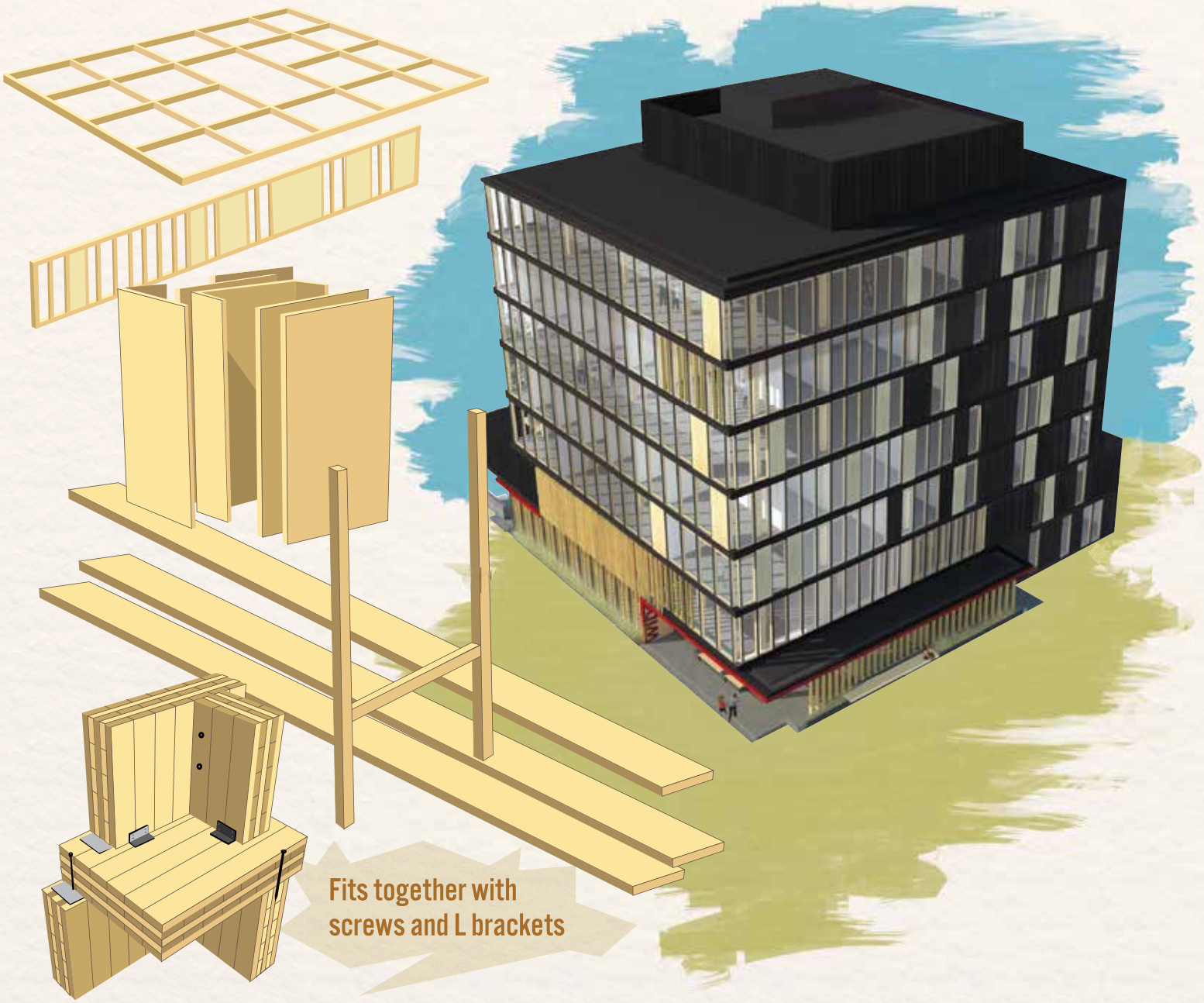

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Above and **on the cover:** BSKYB, LONDON, ENGLAND
PHOTO CREDIT: Arup Associates

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Would you like to see your project in the pages of our 2015-16 ***Celebrating Excellence in Wood Architecture book?***

Enter the *Wood Design & Building* awards.
Go to **www.wooddesignawards.com** and
SUBMIT YOUR ENTRIES ONLINE.
The deadline is midnight, Dec. 4, 2015.
Good luck! And don't forget to follow along on Twitter @WoodDesignAward !

Commercial Wood Design

I've been working all summer on our *Celebrating Excellence in Wood Architecture* awards book and seeing the number of commercial wood projects in it struck me. The same was true as I was sourcing profile projects for this issue. There are more and more commercial projects to choose from!

Most certainly, we've entered a new generation of wood design and construction, one that is seeing an increase in the number of commercial projects being undertaken. This is an important construction trend because commercial buildings are ubiquitous and offer countless opportunities to showcase wood systems and expand their use in non-traditional building types.

This issue features some outstanding commercial projects. Silicon Valley's Venture Capital Office Headquarters uses cedar and fir finishes to create a warm, understated office environment. The architect hopes the use of certified wood exemplifies sustainability while the use of prefabricated components pushes the limits of wood construction in commercial buildings.

The BC Passive House manufacturing facility is an all-wood construction demonstration project. It demonstrates the efficacy of using wood in buildings that are often "both plain in appearance and poor in performance."

Designed and constructed in less than a year, London's BSkyB was created with occupant well-being in mind. It is the first multi-storey timber commercial office in the UK and demonstrates how the use of modern timber construction systems can achieve a unique workplace in half the regular timeframe.

All of these commercial projects clearly demonstrate the versatility of wood construction and in the words of our awards judges, raise society's consciousness of what wood can do in an urban environment.

The other commonality I notice is that wood is more than an afterthought; these projects celebrate the fact that wood is the method for holding us up, covering us outside and covering everything on the inside. With this comes interesting and surprising results.

Now the world is seeing what we've always known: no longer is wood only for residential or even institutional projects such as schools and hospitals. Wood is for everything.

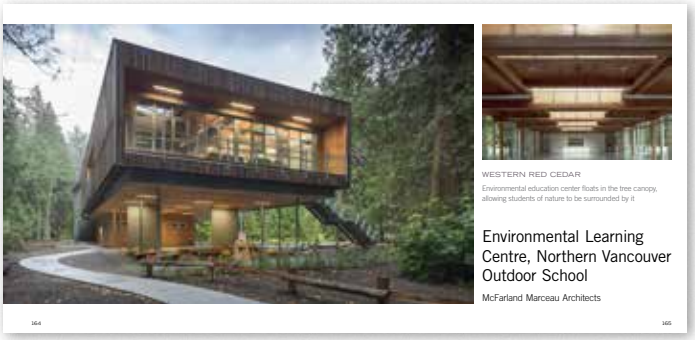
Theresa Rogers
Executive Editor
trogers@dvtail.com

Wood Design & Building magazine invites you to submit your project for consideration and possible publication. We welcome contributed projects, bylined articles and letters to the editor, as well as comments or suggestions for improving our magazine. Please send your submissions to Theresa Rogers at trogers@dvtail.com.

inspiration BOARD

WHAT I'VE FALLEN FOR THIS MONTH...

Wood Decor
It's Fall and that means lots of woodsy, outdoorsy-themed decor.
I like the warmth and texture it adds.
www.simons.ca



Celebrating Excellence in Wood Architecture 2014/15
Sneak preview from our new book, available soon.
Watch for details on how to order your copy!

Wood Solutions Fairs and Events
Fall also means it's event time and our U.S. WoodWorks and Canadian Wood *WORKS!* groups know how to do it right.
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TABBIES 2015 Award Winner

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Art Installations

Hermione Wilson

Wood is a flexible, sustainable building material that serves many functional purposes. As an artistic medium, wood possesses the fluid and organic beauty of the natural world shaped by human hands. The art installations featured here are beautiful pieces designed to delight the eye of the viewer and are also functional structures that encourage interaction.

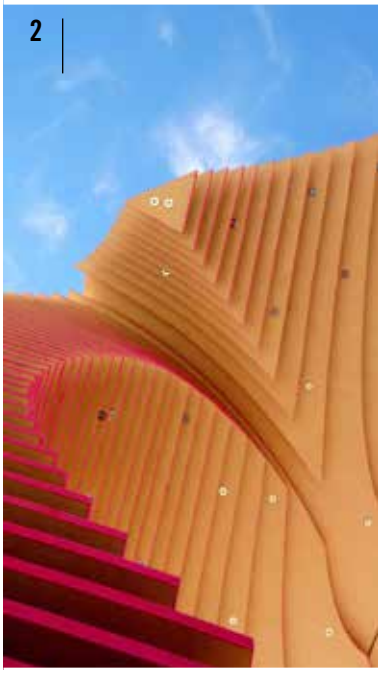
The Joseph Walsh Studio's Magnus Celestii means "great and heavenly" in Latin. Winding like an unfurled ribbon throughout the Artists' House at the Roche Court New Art Centre in England, the piece forms a desk and comes to an end in a shelf that runs along the wall of the gallery. Magnus Celestii was constructed of olive ash with a white oil finish.

In La Grande-Motte, France, The PortHole offers a uniquely framed view of the waterfront. From some angles, the installation appears to be a perfect circle. Observed from another point, its sharp corners can be perceived. Constructed from layers of 120 MDF boards in a pattern that mimics wind erosion, The PortHole was designed to be a shelter from which to view the coastal landscape.

The beehive-shaped installation, Night Blooming, at the Bellevue Arts Museum in Washington, invites visitors to step through its door and look up to see a spectacular illusion of the wheeling cosmos. Standing at 13 ft. high, and 10 ft. across, the dome was constructed from timber salvaged by Washington State University architecture and interior design students.

Arne Quinze's sprawling wooden sculpture, The Passenger, symbolizes the chaotic, steady flow of people through the urban center of Mons, Belgium. At 278 ft. long and 52 ft. high, the piece acts as the entrance to a city square that was once a major trading hub in the Middle Ages.

1



2

3

4

1. Magnus Celestii (2014)
Artist/Architect: Joseph Walsh Studio
Location: Roche Court New Art Center, UK
PHOTO CREDIT: JAMES HARRIS

2. The PortHole (2015)
Artist(s)/Architect(s): Antonio Nardozzi & María Dolores del Sol Ontalba of TOMA!
Location: La Grande-Motte, France
PHOTO CREDIT: ANTONIO NARDOZZI & MARÍA DOLORES DEL SOL ONTALBA

3. Night Blooming (2014)
Artist(s)/Architect(s): Taiji Miyasaka and David Drake
Location: Bellevue, WA
PHOTO CREDIT: VLANKA CATALAN

4. The Passenger (2014)
Artist/Architect: Arne Quinze
Location: Mons, Belgium
PHOTO CREDIT: ARNE QUINZE STUDIO

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U.S. Tall Wood Building Prize Competition Winners Announced

Framework and 475 West 18th, the two winning project proposals in the U.S. Tall Wood Building Prize Competition, were awarded a combined $3 million in funding to move forward with their projects. Announced by the U.S. Secretary of Agriculture Tom Vilsack, in partnership with the Softwood Lumber Board and the Binational Softwood Lumber Council, the funding will support the development of these proposed tall wood demonstration projects in New York and Portland. The two winning projects met the competition criteria to use mass timber, composite wood technologies and innovative building techniques, while showcasing the safe application, practicality and sustainability of a minimum 80-ft. structure. The winning development teams will begin the necessary research and development stage of their respective projects.
www.tallwoodbuildingcompetition.org

International Contest Called for Innovative, Affordable Solutions for Growing Urban Population

At the United Nations Food and Agriculture Organization's XIV World Forestry Congress in Durban, South Africa, the International Council of Forest & Paper Associations (ICFPA) recently announced the winners of the TREEHOUSING International Wood Design Competition. The prizes, in support of students and young professionals in the global forest products sector, were awarded in a variety of categories. Monica Wozniak of Poland won the student prize for her design, Natural Wood Skin, in the Affordable Wood Housing category. Tatiana Chaatziioannou of France and Soufiane Chibani of Germany won the Tall Wood Buildings category for their design, The Social Net Wood. Representing more than 90 per cent of global paper production and more than half of global wood production, the ICFPA and its members work to support and celebrate the future of the industry.
www.treehousing-competition.com

Columbia Forest Products Completes $15-million Facility Conversion

A $15 million investment has transformed Columbia Forest Products' North American core-peeling facilities. The now state-of-the-art facilities in Hearst, ON, have been bustling with activity over the course of the summer as engineers, electrical technicians, installation laborers and technicians from Japan worked on the installation of a 200-ft. long Meinan lathe line. The entire lathe line was first assembled, tested and disassembled in Japan, then shipped to BC and transported across the country. This investment is in addition to more than $5 million spent on capital projects over the past seven years. The company says the new facilities will ensure Columbia, which supplies decorative hardwood plywood veneer panels to North American fabricators, has the best hardwood plywood core peeling system available and will provide employment for more than 200 people.
www.columbiaforestproducts.com

Quebec Publishes Guide to Constructing 12-storey Wood Buildings

The Government of Quebec and FPInnovations have published a technical guide outlining the principles required to design and construct wood buildings up to 12 stories using mass timber. Quebec expects the guide, entitled, *Bâtiments de construction massive en bois d'au plus 12 étages* (Construction of Mass Timber Buildings Up to 12 Storeys), to provide a technical framework for the tall wood building construction industry. The province is following in the footsteps of European countries, where similar wood-based construction methods are permitted. Quebec has recently seen an increase in wood construction, with a local consortium announcing the development of a 13-storey timber residential building in Quebec City.
www.rbq.gouv.qc.ca/bois

Using Cyprus to Meet the Living Building Challenge

A new case study, published by the Southern Cypress Manufacturers Association (SCMA), looks at the ability of reclaimed cypress to meet the Living Building Challenge, a green building certification program that requires a building to have a net-zero impact on the environment. Developed by the International Living Future Institute, the Living Building Challenge is the most advanced measure of sustainability in the industry. Working toward this recognition is Chesapeake Bay Foundation's 10,500-sq. ft. Brock Environmental Center in Virginia Beach, VA, the facility featured in the case study. The team set out to build a facility that had the smallest environment impact possible; by salvaging wood and reclaiming materials which were considered waste, the project actually helped improve the environment.

www.CypressInfo.org

Report on the Hygrothermal Behavior of Different Wall Assemblies Available

The APA – The Engineered Wood Association, and the USDA Forest Service, have published a report summarizing the findings of a joint research project that evaluated the hygrothermal performance of wood structural panel sheathing and rigid foam plastic insulation in different full-scale wall assembly configurations. The project took place over a two-year period in Climate Zone Marine 4 and also looked at the lateral load resistance of these walls with wood structural panel sheathing and rigid foam plastic insulation.

www.apawood.org

American Wood Council Launches New Website

The American Wood Council (AWC) has redesigned its website to create a more responsive and mobile-friendly experience for visitors. The site, which receives more than 500,000 visitors annually, has been updated to include links to all AWC activities. Portions of the website have also been restructured. The "Education" section now allows courses to be sorted by topic, category, presentation type or accreditations. As an American Institute of Architects Continuing Education System Approved Provider with education programs registered with the National Council of Structural Engineers Associations Diamond Approval Program, the AWC's website improvements are expected to help users find courses that meet their education credit needs.

www.awc.org

Canada Tops LEED Green Building Rankings

The U.S. Green Building Council (USGBC) recently announced its international rankings of the Top 10 Countries for LEED, the world's most widely used and recognized green building rating system, and Canada is ranked first on the list. This is the second year in a row that Canada has topped the list. The top 10 is rounded out with countries outside of the U.S., representing seven of the world's largest single-nation economies (China, Germany, Brazil, India, Canada, South Korea and Turkey), as well as six of the top 11 emitters of greenhouse gases (China, India, Germany, South Korea, Canada and Brazil). The rankings position Canada as a world leader in the international green building and environmental sustainability movement.

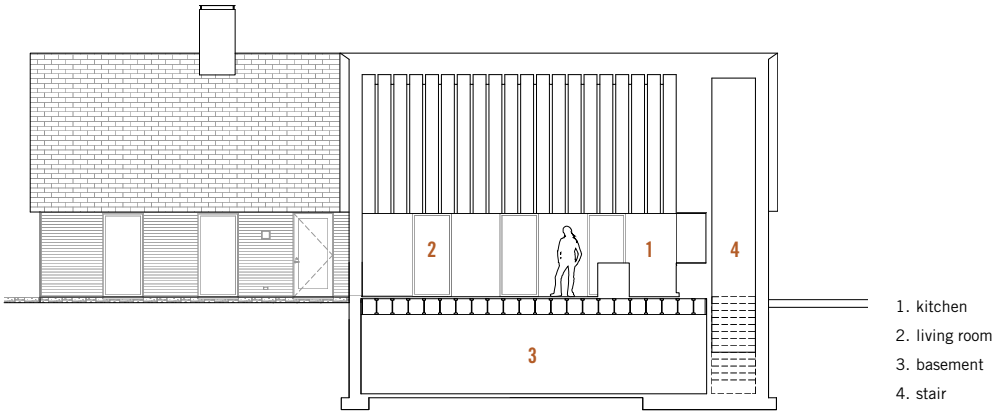
www.usgbc.org

GSM – Gross square meters (millions)

Marlboro Music Cottages

Humble dwellings capture the sound of music and the beauty of their surroundings

Marlboro, VT



SIDE ELEVATION

Since 1951, generations of the world's most talented classical musicians have come together to participate in the Marlboro Music Festival, a seven-week summer festival where young musicians collaborate alongside master artists in an environment removed from the pressures of performance. Located on the tiny campus of Marlboro College in the foothills of Vermont's Green Mountains, Marlboro Music offers a communal way of living where musicians, staff, their spouses and children share meals, seminars, chores and social events, creating a unique musical community.

With a shortage of residential space for senior musicians, Marlboro Music developed plans for five new cottages on a 15-acre site adjacent to the college. Wood was the natural choice because of precedent, program, context, and aesthetic expectations. Many of the campus buildings are white clapboard farm buildings from the 18th century.

The cottage design was inspired by a Cape Cod cottage, a 400-year-old typology derived from settler's dwellings in New England and the primary inspiration for Marlboro College's centuries-old farm buildings. Born of necessity with an aesthetic of restraint, this simple gabled form is closely tied to Marlboro's identity. The cottages' small footprints, sloped roofs, compact volumes and indigenous materials affirm Marlboro Music's place amidst the lush Vermont landscape of rolling hills and streams.

Rather than mimic the Cape's ubiquitous white clapboard, each cottage is clad in red cedar siding to blend into the woodland site. Large windows frame views of the forest and fill each room with abundant daylight. Operable windows combined with overhead ceiling fans eliminate the need for air conditioning, allowing fresh summer breezes inside. The proportions of an original Cape Cod cottage are noticeably smaller than today's residential standards. These classic proportions of small floor plates, seven-foot spring lines for the gable and the 60:40 roof-to-wall ratio were adopted for the new

cottages and work well with the unpretentious and humble spirit of the music festival. The overall massing reinforces the intimate scale of each cottage in relation to the surrounding woodland site.

The predominant structural and finish material for the cottages is wood. Exterior materials of wood and slate were chosen, requiring very little maintenance over time. On the interior, all the walls and ceilings are wood. The locally sourced white pine interiors provide a sense of warmth inside while visually connecting to the surrounding forest. The gabled ceilings seem expansive, gesturing toward the sky with a rhythmic pattern of white pine rafters that modulate the space inside. A wood and steel flitch beam combined with thicker-than-average wood walls creates a gabled structure with no horizontal tie-rods. The wood interiors are acoustically tuned for playing music and each living room can accommodate a Steinway piano for the musician's use. Arranged around meandering 150-year-old stone walls on the site, each cottage was placed to minimize site disturbance, take advantage of forest and wetland views, and maximize daylight. Over time, the forest will continue to grow up around the cottages, blending the forms seamlessly into the natural landscape.

Marlboro Music is a place of great humility, generosity and modesty. For each cottage, the root of this modesty comes from its physical and spiritual form: humble dwellings constructed of common materials that are filled with light, music and the beauty of their surroundings.

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HGA
Minneapolis, MN

STRUCTURAL ENGINEER
HGA
Minneapolis, MN

GENERAL CONTRACTOR
Courtland Construction
West Chesterfield, NH

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Venture Capital Office Headquarters

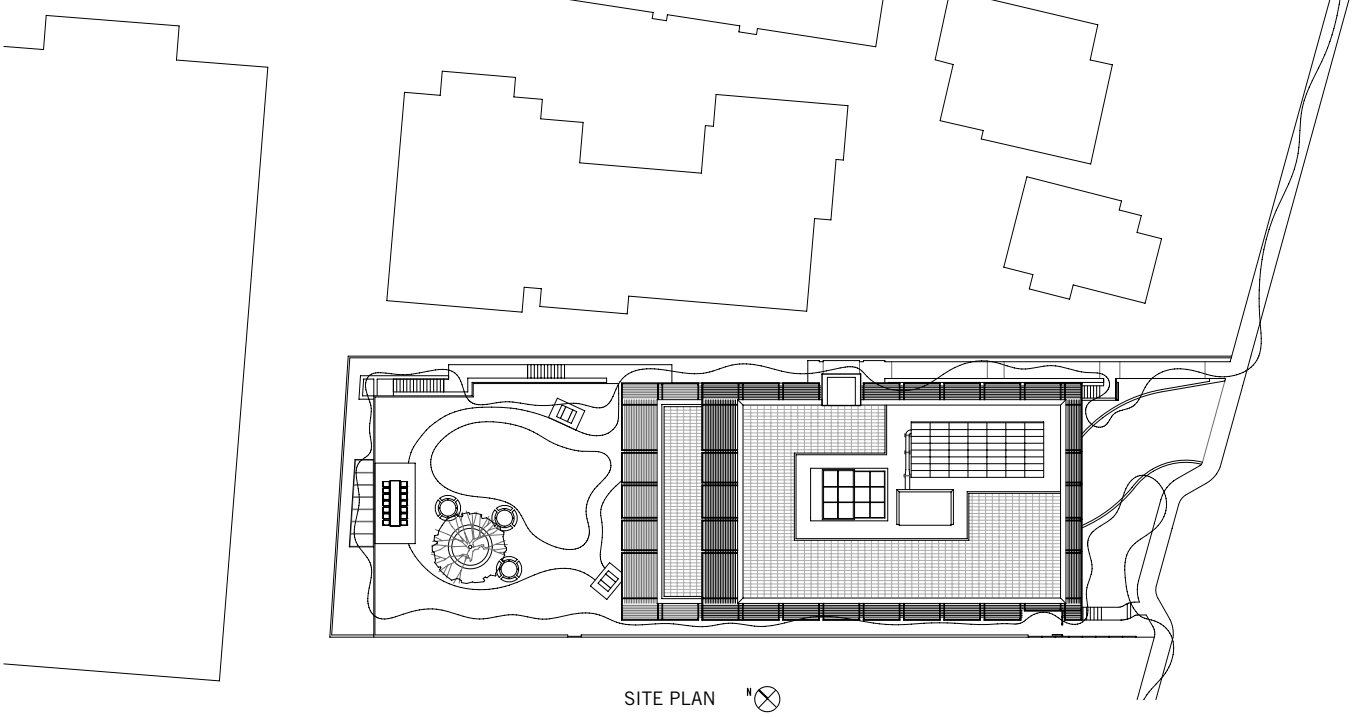
Cedar and fir finishes express sophistication in office environment

Menlo Park, CA

The office headquarters for a venture capital firm on Sand Hill Road in Silicon Valley occupy some of the most expensive real estate in North America. The building's use of wood recalls a tradition of wood construction in northern California but with a refreshed interpretation. Sustainably harvested, straight-grained cedar and fir finishes exude sophistication and create a warm, understated office environment, while interior color accents signal the company's bold entrepreneurship.

Because the site is small, the interior layout needed to make the most of its footprint in a way that was highly efficient without feeling cramped or claustrophobic. In response, the building envelope is predominantly glass to maximize daylighting and views of the surrounding gardens. Wood trellises and facade screens shade the glass, improving energy performance and occupant comfort, and provide visual continuity by extending the linear rhythm of the wood slat ceiling from inside the building to the outdoors.

Since the small infill site had a similarly small construction staging area and minimizing disruption to adjacent neighbors was critical, the office building was constructed with prefabricated components –



both structural wood and steel modules – that were stacked by crane on top of a concrete podium. Other prefabricated wood elements include trellises, facade screening, cladding panels, doors, ceilings, and interior wall paneling.

The interior fittings, which include custom desks, workstations and conference tables, use the same wood finishes as the structure, echoing the architectural expression of the building to present a pleasingly integrated whole. The wood creates a warm, intimate work environment that is not only refined but also a beautiful foil for the colored glass finishes that are well suited to a business focused on bold, risk-taking ventures.

The use of certified wood exemplifies sustainability while the use of a full range of prefabricated components pushes the limits of wood construction in commercial buildings.

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Eric Staudenmaier Photography
South Pasadena, CA


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BC Passive House

Canada's first manufacturing plant to meet rigorous Passive House Standard uses wood

Whistler, BC

The BC Passive House (BCPH) manufacturing facility is an all-wood construction demonstration project. The building was the vision of a company dedicated to the concept of truly sustainable construction methodologies. BCPH wanted a facility that would exemplify its commitment to wood design and sustainable construction practices. With this mandate, BCPH envisioned a high-quality, modern alternative to traditional warehouse and big box store construction.

The building consists of a large, open workspace divided into two distinct bays used for manufacturing. There is also a conference room and office mezzanine in the southwest corner of the plant. The building utilizes its southern exposure to harvest solar energy for the offices and showroom. The 360-degree clerestory windows in the workspace provide natural daylight and spectacular mountain views.

The natural daylight and exposed wood finishes within the building provide a warm, comfortable and inspiring workspace. The main motivation for the project's design was to demonstrate that industrial or everyday buildings, which make up a vast amount of the built environment, are just as important and well considered as more public and architectural buildings. The quality and design of the building brings value to BCPH in achieving a better working environment, which translates into measurable long-term benefits to the organization through greater staff satisfaction.

The mezzanine offices, support spaces, and showroom were designed and built to meet the Passive House (PH)

Standard, currently the world's most rigorous energy standard. The PH Standard requires that the annual energy use to heat or cool the structure does not exceed 15 kWh (m^2a). The analysis of the space using the PH Modeling Software suggests that, by constructing this area to the PH Standard, BCPH saves approximately 80 per cent on energy for heating and cooling compared to an equivalent space built to code.

A wood-fed boiler utilizes the wood waste from the manufacturing process to provide heat that is distributed to the plant through an in-floor radiant heat system. This system provides the facility with a cost effective, renewable, and carbon-lean heat source that enables BCPH to use waste material for heating.

The main structural elements of the building consist of Douglas fir glulam post and beam with solid wood (SPF), cross-laminated timber (CLT) panel walls, all manufactured in BC. The roof assembly consists of prefabricated panels that assisted the erection of the glulam structure by offering permanent bracing for the columns and beams during assembly. The use of these prefabricated structural components enabled the building's superstructure to be set up on-site in eight days, dramatically reducing the on-site construction window. In addition, prefabrication meant the building components were fabricated in a controlled environment, increasing efficiency, quality control, and precision while reducing the occurrence of changes (swelling, mold growth, warping) in the material from exposure to weather.

Three-ply CLT panels were chosen for the wall elements because they provided a robust, finished surface that also satisfied wind and seismic considerations. The double bay configuration of the facility has shorter spans that permitted the use of simple, cambered glulam beams on glulam columns. Through the use of wood and other ecologically responsible materials, significant environmental and architectural value was achieved for a modest premium compared to conventional construction.

The building exterior is finished in pre-assembled fir and larch wood "screens" that cover the entire facade. The wood utilized for the exterior screens was left untreated with the intention that it gray with each passing season. This provides a natural, no-maintenance siding solution.

The screens vary in density, or openness, over the clerestories to provide solar shading on the south and west facades while maintaining the mountain views on the east and north faces. The result is a simple, cost-effective facade that subtly responds to its unique and beautiful surroundings.

Interior products and materials were also chosen for their low environmental impact. The conference room, for example, is finished with cedar milled from trees salvaged from a 1930s burn site. Plant storage, desks, shelves, and staircases are constructed from the leftover CLT panels.

The facility is the first of its kind in North America and will assist the company in its promotion of the Passive House standard and sustainable, energy-efficient construction methodologies that use innovative wood-based construction materials. Moreover, it demonstrates the efficacy of using wood in buildings that typically have been both plain in appearance and poor in performance.

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GENERAL CONTRACTOR
Dürfeld Constructors
Whistler, BC

PHOTOGRAPHY
Ema Peter Photography
Vancouver, BC

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BSkyB

Multi-storey office communicates the benefits of modern engineered timber systems to other commercial developers

London, England

Sky's new Believe in Better Building is an office and training facility with a clear social imperative. Planned with a community focus, it is designed to enhance the well-being of the users. The client aspired to achieve a building that would be an exemplar of sustainable design, utilizing off-site prefabrication to realize an ambitious delivery program. It is the first multi-storey timber commercial office in the UK and it succeeds in demonstrating how the use of precision-engineered modern timber construction systems can achieve a unique workplace in half the regular timeframe.

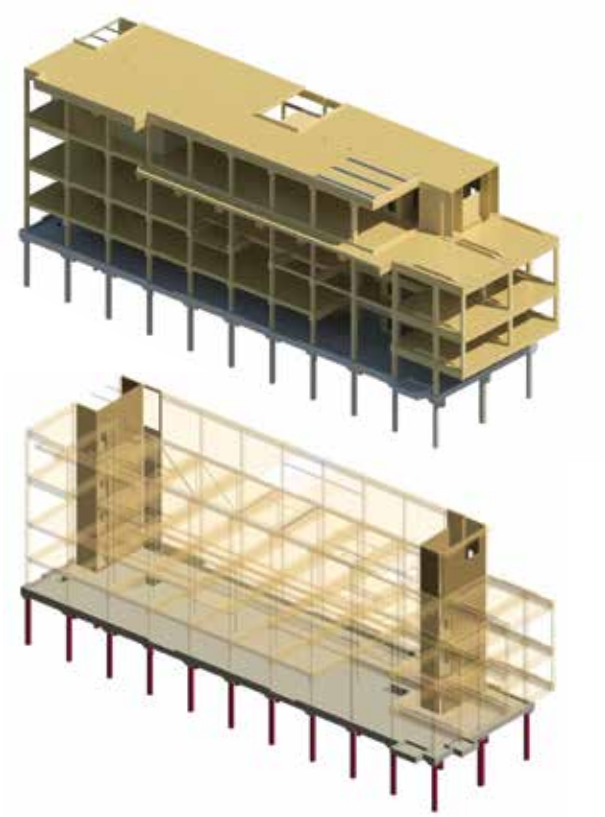
The 43,055-sq.ft. building is anchored around a cantilevering staircase that runs the full height of the building, connecting a range of collaborative breakout spaces and office plates. A restaurant and roof terrace on the top floor offer views across the Sky campus. The interiors are fresh and fun, expressing a young, dynamic and engaged corporate culture. The exposed timber and use of interior and exterior planting provides a natural environment, improves air quality and offers biophilic benefits.

The building was designed and constructed in less than one year. The use of timber systems in a tight site provided practical advantages that included minimizing noise and disruption to the neighbors, minimizing material deliveries, and reducing the number of staff on-site.

To achieve this program, the architect proposed an engineered timber system to eliminate wet trades. The emerging design was discussed with potential suppliers at the concept stage to seek their advice on how to optimize the construction speed of the frame and envelope. The natural beauty of the timber is exposed throughout the building, with finished ceilings only provided in restrooms. The use of timber as a structural frame also benefitted the fit-out trades, since fixing to timber is much quicker than shotfiring fixings into concrete.

The co-located design team was able to agree and define all the major openings through the timber elements at the schematic design stage using a coordinated BIM model. This enabled an early release of the timber frame for fabrication, accelerating the schedule.

The design is packed with innovations from every discipline. The 450mm-deep raised floor provides a zone for the intense IT and MEP systems associated with media buildings, while also providing a plenum for underfloor air supply. The deep raised floor also provides an added benefit of enhanced acoustic separation between floors with the lighter weight



Floor diaphragms transfer lateral loads to stability cores between gridlines B-C and J-K.

timber slabs below. This meant that no further acoustic treatment of the timber was needed.

Concentrating the services in the floor void minimized the services exposed on the soffits below which meant that ceilings were not needed and the timber soffits could be exposed. The majority of the services distribution occurs in the floor, making it simple to access for maintenance or to reconfigure floors for new layouts in future.

There was a significant buzz around Sky throughout the process and the building has been such a success that management has chosen to commission the next building, a health and fitness center, using similar timber construction techniques. This project successfully demonstrated to Sky and other UK developers the significant benefits of using modern engineered timber systems for commercial buildings.

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Think Outside the Rectangle

Open-web roof trusses offer creativity

Mary M. Eun

Parallel chord trusses create extreme roof profiles for Las Vegas Cyclery
PHOTO CREDIT: RedBuilt

Who says that commercial roofs need to be flat? Sure, a ridge beam and sloping members yield all kinds of slopes, but they still provide nothing more than flat planes. With wood-manufactured open-web trusses, structures gain a wide range of available truss profiles allowing for design creativity that will get you thinking "outside the rectangle."

Open-web trusses are pin-connected trusses constructed of wood chords, tubular steel webs, and high-grade pin connections. The wood is typically a high-grade machine stress-rated lumber, though in some cases the chords are manufactured with a laminated veneer lumber. Pin-connected trusses have a long-span capability of up to 120 ft., offering the design flexibility needed for complex commercial construction. Pin-connected open-web trusses are commonly used in offices, schools, banks, and retail structures.

Beyond the benefit of long spans, open-web trusses come in a variety of profiles. These trusses offer an excellent strength-to-weight ratio and can be left exposed for the warm look of a wood structure. All of these features result in creative and visually interesting roof systems.

These heavy-duty, long-span pitched trusses are installed modularly.
PHOTO CREDIT: RedBuilt

These scissor trusses help create multi-purpose space for Taylor Middle School.
PHOTO CREDIT: RedBuilt

PARALLEL CHORD: This economical workhorse provides lightweight, long spans in hundreds of flat roofs and floors. They can also be built with camber to compensate for deflection. Parallel chord trusses created the extreme roof design for the two-storey, 9,793-sq.ft. Las Vegas Cyclery, a LEED Platinum building. Exposed parallel chord open-web trusses contributed to both aesthetics and the building's Platinum LEED certification.

TAPERED: Tapered open-web trusses allow for built-in roof drainage, but give a dramatic look when designed with a more extreme depth differential. There are select manufacturers that can build a truss that uses a minimum depth as low as 14 in. on one end and a maximum depth of 60 in. on the other.

PITCHED AND RADIUS PITCHED: Varying slopes create different looks while still allowing for roof drainage. A radius-pitched profile is a pitch, but rounded off at the ridge.

BOW STRING: This profile smoothes out the radius pitch into a single arc on the top chord while still providing a flat interior ceiling at the bottom chord. This under-used roof shape is graceful and elegant. See the photo on page 34 of a standalone restaurant near Beaverton, OR that uses a bow string truss to create curb-appeal.

BARREL AND COMPOUND BARREL: For these two profiles, both the top and bottom chords are radiused, providing curved ceilings that look great in both commercial and residential applications. A compound barrel profile is created when there is a different radius on the top chord than the bottom. The barrel truss provides dramatic rooflines for the ultra-modern Yogurtland in southern California. Here, the barrel trusses are 74 ft. long with a 7-ft. camber. In a luxury home near Scottsdale, AR, 3,400 lineal feet of barrel trusses were used in the main living area to provide architectural drama – and room for recessed lighting, 12 in. of insulation, and other mechanical lines – all while staying under height restrictions.

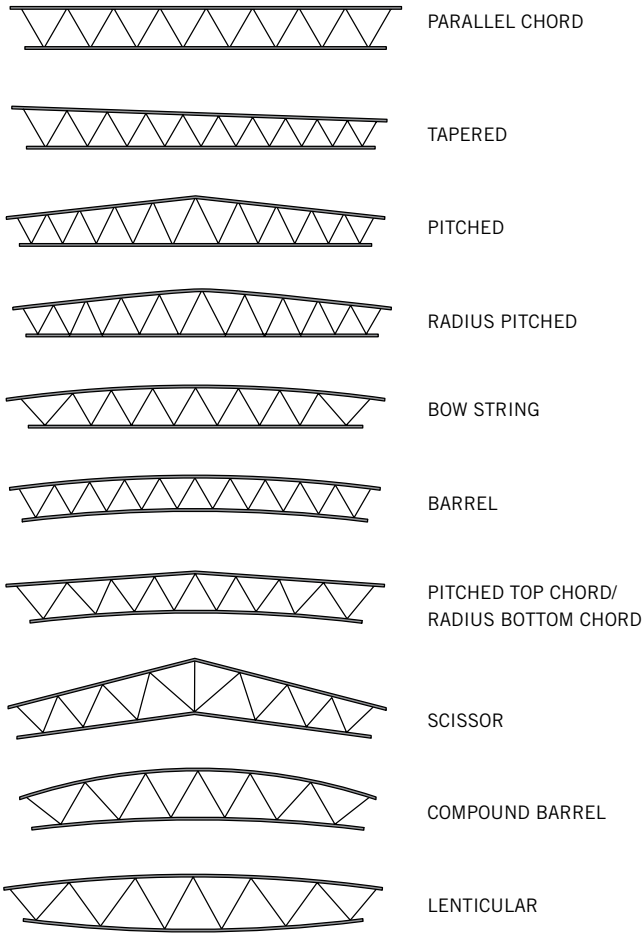
PITCHED TOP CHORD/RADIUS BOTTOM CHORD: This unusual profile combination provides an original look. In the historic Duluth Depot Train Shed, part of the Lake Superior Railroad Museum, 38-ft. gable pitch top chord and radial curved bottom chord trusses were added to the original legacy trusses. The sister trusses were installed to carry the live loads of drifting and sliding snow while maintaining the historic rail station look.

SCISSOR: Providing highly vaulted interiors over a long span, scissor trusses offer interior drama, especially when left exposed. For the Taylor Middle School cafeteria, scissor trusses span 85 ft. to create an open-space with lots of visual appeal. The column-free area does double duty not only as a cafeteria but also as a multi-purpose space for graduations, community meetings, and basketball and volleyball games.

LENTICULAR: This is a lens-shaped truss – some call this shape 'parabolic' – which offers a different aesthetic to any structure. It turns heads when used in retail and restaurant applications.

Open-web trusses provide options. Whether used in commercial or custom residential applications, these pin-connected wood trusses create unique roof lines. Note – these trusses are custom-designed, detailed and manufactured to meet the structural needs and design intent of each specific application. As such, architects, engineers and builders will need to find an open-web truss manufacturer with the service and technical support needed to design and build these unique structural products. "Think outside the rectangle" and enjoy the freedom of designing a visually appealing roof system.

Mary Eun, PMP, is a technical representative with RedBuilt LLC, and has been working with open-web trusses since 2006. RedBuilt is a leading manufacturer of engineered wood products for commercial and multi-family construction. Products include RedBuilt open-web trusses, Red-I joists, and RedLam LVL beams. For more information, go to RedBuilt.com.



Bow string trusses add curb appeal.
PHOTO CREDIT: RedBuilt

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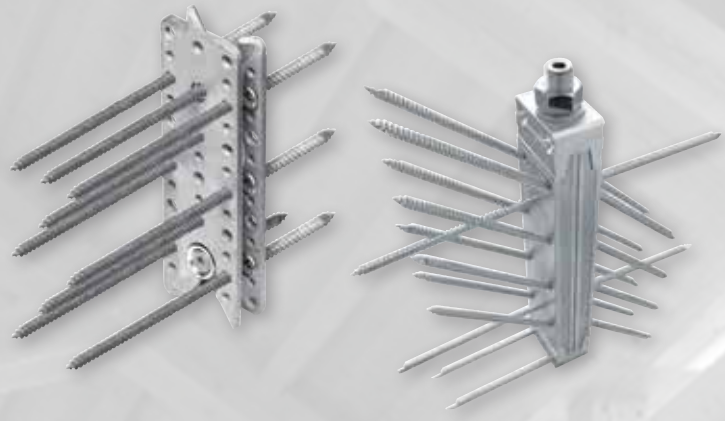

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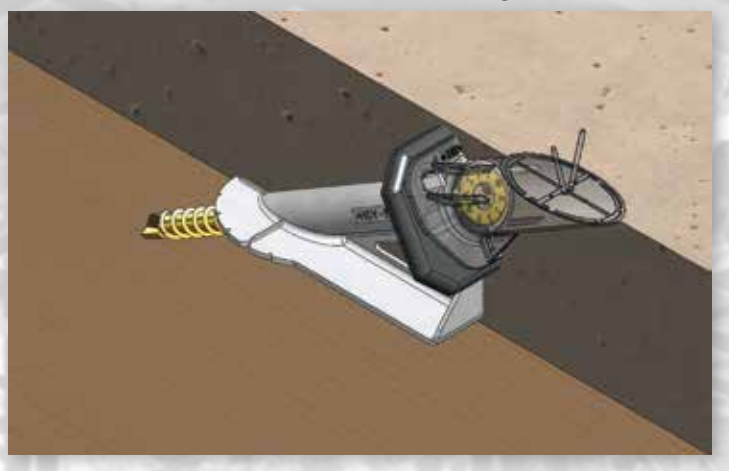

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Versatile Treated Glulam Stands Up to Demanding Applications

Thomas D. Skaggs

The Lone Survivor House in Crystal Beach, TX, was designed with accessibility, flexibility and healing in mind. The living area is connected to conference space via an elevated boardwalk.

Glulam beams are one of the building material industry's most versatile and trusted products. Their capacity to span long distances and support heavy loads makes them a popular option for a range of framing applications. Those benefits also extend to the exterior and to moist-environment interiors. There are several pressure-treating options for glulam that make it ideal for designs ranging from residential decks to indoor pool roofs to bridges.

Although glulam does not require treatment for most uses, certain applications may present environmental conditions conducive to decay, insect, or marine borer attack. Applications vulnerable to decay or insects are typically controlled through recognized design principles and construction techniques, such as overhangs, flashings, ventilation, and proper joint connection details. But when these conditions cannot be avoided, glulam must be pressure-preservative treated, or a naturally durable wood species must be used. These conditions include direct exposure to weather, ground contact (including direct contact with concrete foundations and footings), contact with fresh or saltwater, and exposure to excessive condensation.

Outdoors, preservative-treated glulam is used in projects such as bridges, utility structures, marine applications, highway noise barriers, and decks. Indoor uses that may require pressure treatment include environments subject to high humidity or condensation, such as indoor swimming pools or greenhouses, where moisture content of the wood may exceed 20 per cent. Indoor applications, such as post-frame construction in some agricultural buildings, may also involve ground contact, and thus require preservative treatment for those members in contact with the ground.

Types of Preservatives

Preservative treatments fall into two categories: organic and inorganic.

Organic preservatives include creosote, pentachlorophenol (penta), copper

Glulam beams combined with trusses create an open, flexible floor plan.

Shown during construction, treated glulam beams are set on piers to support the floor system above.

naphthenate, and oxine copper.

Creosote-treated glulam is effective for commercial, industrial, or marine applications when there is severe exposure to decay, insect attack, or marine borers in saltwater environments; it cannot be used in residential applications. It has an odor and a dark, "oiled" surface appearance and therefore is not recommended where painting is required.

Penta-treated glulam is suitable for ground contact or above-ground uses; it, too, is not available for residential use and also has an odor. Oil-based penta has an oiled surface which makes it unsuited to painted applications; however, if a painted finish is desired, specify a solvent- or water-borne penta treatment, which results in an oil-free surface and a natural wood appearance.

Copper naphthenate (CuN) treatment can be used for above-ground uses and ground contact when treated to a proper retention level. It may have a light-green coloration that diminishes during weathering. After thorough drying, this treatment can be stained or painted, but a stain-blocking primer is recommended for finishing to minimize discoloration of the finish.

Oxine copper (Cu8) is suitable for above-ground use. It may leave a greenish-brown coloration, weathering to gray, and it can be stained or painted with an oil-base finish after thorough drying.

Inorganic preservatives include waterborne treatments such as acid copper chromate (ACC), ammoniacal copper zinc arsenate (ACZA), alkaline copper quat-type-C (ACQ-C), and chromated copper arsenate (CCA). These are not recommended for glulam timbers that are to be treated after gluing, but may be applied to southern pine laminations prior to gluing. Check with the glulam manufacturer for availability and usage limitations.

When waterborne treatments are specified for glulam after gluing, the members must be redried after treating. This process may cause dimensional changes, such as warping and twisting, or may lead to excessive checking, splitting, or raised grain, resulting in a finished product with an unacceptable appearance.

Installation Considerations

Treated glulam performs and installs similarly to untreated glulam, but does require some additional considerations during handling and installation.

FIELD CUTS: Fabrication, trimming, and boring of glulam should be performed prior to pressure treating. If there is any field fabrication or surface damage to the glulam, be sure to field-treat all cuts, holes, or damaged areas to protect the exposed wood material.

FASTENERS: Installers should use fasteners that meet the requirements of the major model building codes, which specify that fasteners (including nuts and washers) in contact with preservative-treated wood be hot-dipped zinc-coated galvanized steel, stainless steel, silicon bronze, or copper. Connectors that are used in exterior applications and in contact with preservative-treated wood should have coating types and weights in accordance with the treated wood or connector manufacturer's recommendations. In the absence of manufacturer's recommendations, a minimum of ASTM A653 Type G185 zinc-coated galvanized steel, or equivalent, should be used.

HANDLING: Throughout the process, installers should follow recommended handling guidelines from the manufacturer and government agencies. The chemical formulations used for preservative treatment of glulam are registered with the U.S. Environmental Protection Agency in the U.S. and Health Canada's Pest Management Regulatory Agency in Canada.

FINISHING: Always follow the manufacturer's recommendations for finishes. As mentioned previously, creosote and penta-in-oil treatments are not suitable for painted finishes. Penta in light solvents can take a natural finish, such as a clear water repellent or an oil-based semitransparent stain.

Clear film-forming finishes such as lacquers, varnishes, or urethanes are not recommended for glulam use outdoors. These finishes have a short service life and require extensive surface preparation prior to refinishing.

For glulam treated with waterborne preservatives, use clear water repellants, oil-based semitransparent stains, or film-forming finishes, such as solid-color stains or paint systems. Note that if the treatments have left a green or brown color on the surface, this may affect the color and appearance of the finish.

If an opaque coating is desired, the most durable option is a top-quality paint system, such as a stain-blocking acrylic latex primer followed by two all-acrylic latex topcoats, preferably from the same manufacturer. A stain-blocking primer may also be required under light-colored acrylic latex or solid-color stains to help minimize discoloration of the finish.

For treated wood indoors, follow health agency recommendations for appropriate sealing of the wood.

Treated Glulam in Action

The use of preservative treatments in glulam takes an already versatile product and extends its capabilities to exterior applications where strength and span, along with insect and exposure resistance, are required.

That was the case for a coastal project recently completed by Brint Construction in Crystal Beach, Texas, for the Lone Survivor Foundation. The retreat house helps to carry out the Foundation's mission, offering therapeutic healing and educational support for service members and veterans suffering from post-traumatic stress disorder and other invisible wounds associated with combat. Due to its location near the water, the house was built on piers and, in a fitting nod to the U.S. armed

forces' most recognizable symbol, it was designed in a pentagon shape.

To accommodate the unique shape of the building and its unusual point loads, engineers Chandra Franklin Womack, PE, and Rachel Riley, both of Aran and Franklin Engineering, switched from traditional dimension lumber to treated glulam beams. The treated glulam serves as the stringers around the perimeter, with a multitude of beams supporting the center of the house, left open to allow for parking below. The custom, thinner stringers were made with 5-1/2-inch glulam beams resawn in half to a finished width of 2-7/16 inches. All glulam beams in the structure were engineered and designed with the manufacturer's software.

The long-span capabilities of the glulam helped the engineer reduce the number of piles and design the piers in a simple grid pattern, thereby reducing point loading and opening up more room under the house. Had dimension lumber been used instead, the obtuse interior angles dictated by the pentagon shape and limitations on notching of beams would have required more pilings.

Inside, Womack used untreated glulam beams in certain areas of the floor system, including end walls and where a wall is supporting a beam, to transfer loads from the floor system to stringers and pilings. On the second level, glulam beams span the width of the living room, supporting the trusses while ensuring an open, flexible layout below.

Treated glulam also played a key role for the Pocono Solar Project, a 25-acre solar field at the Pocono Raceway in Pennsylvania projected to produce approximately 72 million kWh during its first 20 years of service. The solar project used treated glulam beams to support nearly 40,000 photovoltaic modules. Using glulam beams ensured the support for the modules was straight and true, with the preservative treatment helping the wood to shrug off the extremes of mid-Atlantic humidity, insects and weather.

For more information on the Lone Survivor and Pocono projects, and to download APA's guide, Preservative Treatment of Glued Laminated Timber, Form S580, visit www.apawood.org.

Thomas D. Skaggs, Ph.D., P.E., is Manager, Product Evaluation, Technical Services Division, APA – The Engineered Wood Association. He can be reached at tom.skaggs@apawood.org.

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Structural Engineering Mid-rise Buildings

Engineers consider additional design and costing considerations for mid-rise wood-frame structures

Michael Baldinelli

5-Storey Wood-Framed Building, Oak Park, Oakville, ON
PHOTO CREDIT: Q4 Architects

Lightweight wood-framed (LWWF) construction has gained significant popularity over the past decade as a sustainable, cost-effective solution for low-rise multi-level buildings. More recently, the push has been to extend the use of LWWF to mid-rise construction for increased density on urban or rural projects. In 2009, British Columbia amended the building code to allow five- and six-storey residential wood-framed buildings, and in September of 2014, the Province of Ontario passed legislation to permit wood-framed buildings up to six storeys in the next Ontario Building Code amendment (effective January 1, 2015).

Clients have seized the opportunity to begin building taller with wood. Wood *WORKS!* Ontario, a program of the Canadian Wood Council, organized a visit to BC for design professionals interested in learning more about LWWF mid-rise design and construction. The tour included visits to several mid-rise wood buildings under construction, which aimed to highlight the structural design considerations, fire issues during construction, implications of wood shrinkage, and cost implications for five- and six-storey LWWF buildings.

When designing mid-rise LWWF structures, it is necessary to perform additional engineering analysis and design, which is typically not required for single-family housing and small buildings. The design must also account for material and labour costing. When designing a LWWF mid-rise building, structural engineers must account for:

a) All wind and seismic loading on the building.
b) Distribution of forces assuming both rigid and flexible floor diaphragms.
c) The overall building deflection and inter-storey drift at any location in the structure.
d) The relative stiffness of other building materials (concrete masonry units, cast in place concrete, steel cross braced frame, etc.).

6-Storey Wood-Framed Building
PHOTO CREDIT: Strik Baldinelli Moniz

6-Storey Wood-Framed Building,
Templar Flats, Hamilton, ON
PHOTO CREDIT: Strik Baldinelli Moniz

e) The building's natural frequency and torsional sensitivity.
f) The cumulative effect of hold-down anchor slippage and nail slippage in deflection calculations.

The goal of the structural engineer is to select the most cost-efficient, code-compliant design to resist the gravity and lateral loads induced on the building. Our experience on five wood buildings in Ontario, Canada has found estimated construction cost savings of 10 to 15 per cent versus traditional design methods.

Structural Design: Constraints and Observations

Over the past eight months, the design of three mid-rise buildings ranging from five to six storeys has been completed. The buildings will be located in Oakville, Hamilton and London, Ontario. Because of the different geographical locations, each building's performance and analysis differs depending on the seismic and wind loading values provided for each city. A brief summary of the findings and observations:

a) In Hamilton and Oakville (Golden Horseshoe Area), the seismic load cases governed the strength aspect of the design, while the wind load cases governed the overall building deflection analysis.
b) Both the rigid and flexible floor diaphragm force distribution needs to be analyzed for each building, with loads and deflections enveloped.
c) Earthquake drift infrequently governs the design, but often is high enough that the gypsum wall board cannot be relied upon to brace the studs on the lower stories (drift>hs/100).
d) Small (narrow) shear wall segments (ex. walls between exterior windows) are often governed by wind deflection (H/400) and inter-storey drift limits (h/40) resulting from seismic loads.
e) The weak link in a typical shear wall assembly (i.e. six levels of stacked shear walls) is the connection of the walls through the diaphragm, the cumulative shear load at floors one and two are extremely high requiring through bolts or other means to transfer loads.
f) The structural separation of the concrete block (stair shafts) from the wood structure greatly reduces the seismic loads on the building.
g) In most cases, a continuous tension rod system is required in both five and six-storey buildings to control building deflections.
h) For a wood structure bearing on a concrete podium, the concrete podium structure is to be designed for the capacity of the wall, not the load on the walls (in reference to lateral loads). In reference to the gravity loads, the actual true loads are to be considered on the podium structure.

6-Storey Wood-Framed Building PHOTO CREDIT: Lintack Architects

Next Steps

It is often necessary to employ structural engineering software to accurately calculate building deflections, inter-story drift, overcapacity ratios, and a building's natural frequency and strength parameters. Software tools provide efficiency and confidence that the designs meet all CSA O86-14 and local building code requirements. A parametric study on building performance is scheduled to be completed by January 2016, in which an eight-storey LWWF building will be designed and parameters such as deflection, drift, shear load interaction at floor diaphragms, and other structural strength considerations will be reviewed and vetted. Research into a finite element method (FEM) for mid-rise LWWF design is beginning in conjunction with National Research Council Canada and Western University. Phase I of the research aims to create a FEM shell element that can properly model wood shear walls and floor diaphragms, taking into account nail slippage and hold-down elongation.

Michael Baldinelli is a principal with Strik Baldinelli Moniz, Civil and Structural Engineers. He has been involved in the design of 35+ commercial LWWF buildings in Ontario. His firm has won numerous awards for low-rise wood construction and in 2013 won Best Design for Multi-Level Wood Building by the Canadian Wood Council. Michael has recently lectured on behalf of Ontario Wood *WORKS!* on the Structural Design and Optimization of Multi-Level Wood Buildings. The firm has recently (2015) been awarded six mid-rise LWWF buildings ranging in size from four to six storeys. He can be reached at mike@sbmltd.ca or www.sbmltd.ca.

Wood WARE

Honda Birdhouse Project

In 2012, Ryuichiro Sakino, Producer of the Hello Woods Forest nature experience center, and Yoshikazu Kigoshi, General Manager of Design Division, at Honda's Automobile R&D Center, developed a plan to build creative birdhouses for the forest out of reusable scrap timber. Located outside the Twin Ring Motegi race track in Motegi, Japan, the Hello Woods Forest is designed as a satoyama, a place of balance where nature meets human activities. Now in its third year, the Honda Birdhouse Project provides beautiful and environmentally safe accommodations for the forest's many species of birds without disrupting the more than 1,000 plant and animal species that call the forest home. The project also gives the Automobile R&D Center's staff of designers an artistic outlet, boosting creativity and reenergizing their passion for design.

www.world.honda.com/design/birdhouseproject