mahlum

Solid Wood: New Trends in Mass Timber Architecture, Technology and Design

Joe Mayo, AIA, LEED AP

Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Course Description

Through the rise of mass timber, one of the world's oldest building materials has been reimagined as a sustainable alternative to concrete and steel. Innovations in solid wood building systems, which include large engineered wood members such as glue-laminated timber (GLT), laminated veneer lumber (LVL) and cross-laminated timber (CLT), have created new opportunities for wood, whether that means going taller, spanning farther, or building faster. Driven by wood's light environmental footprint, large-scale wood buildings around the world are helping to spur building code changes, improve wood-based economies and demonstrate the untapped potential of this versatile material. This presentation will provide insight into these new, exciting architectural developments through detailed case studies that will expand your perception of wood's possibilities.

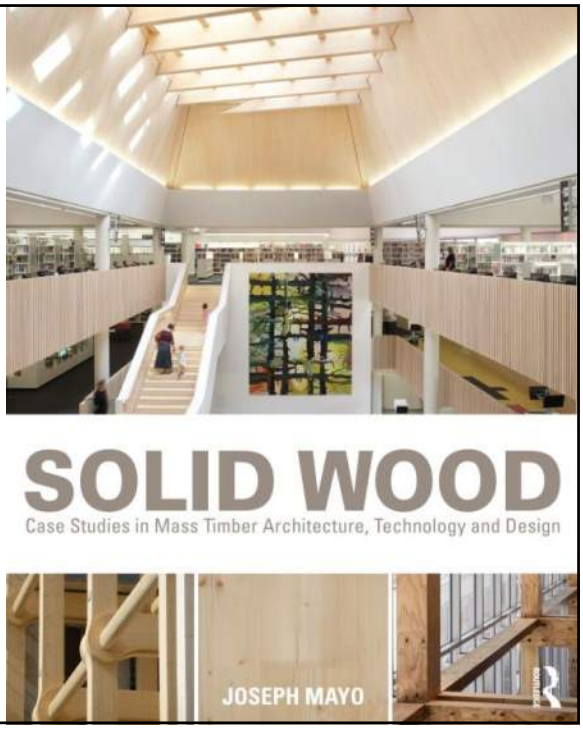
Learning Objectives

1. Apply principles of carbon accounting for sustainable material selection.
2. Identify challenges and opportunities with using wood as both structure and finish to reduce material use.
3. Consider mass timber material options and how to choose between them for material efficiency and optimization in design.
4. Evaluate different mass timber building systems in order to choose the most appropriate system for specific project needs.

"The first proper book about timber construction this century.

As we come to terms with the consequences to the planet of our fossil fueled civilization, an urgent rethink is needed in how we design and build our buildings."

ANDREW WAUGH
WAUGH THISTLETON ARCHITECTS



CLT and Mass Timber


PHOTO: MERK TIMBER


PHOTO: SALZBURG FH

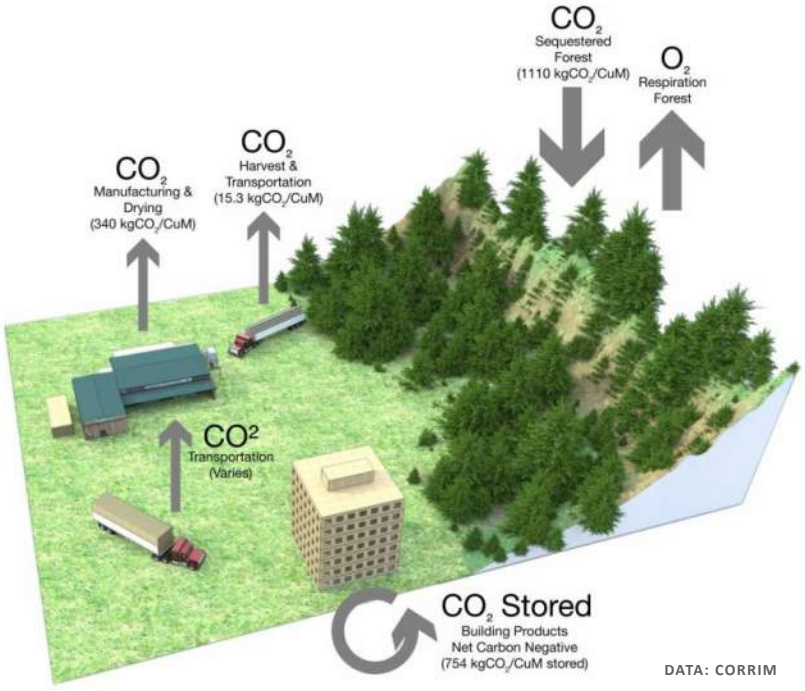
Why Engineered Timber?

PHOTO: SIMONE DE MENIS

PHOTOS: MERK-TIMBER

Slide 7

JM1 Joseph Mayo, 3/13/2016

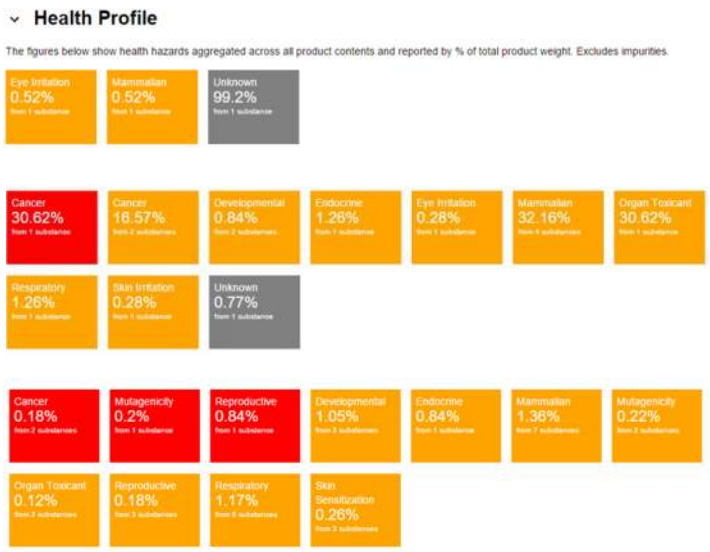


DATA: CORRIM

CLT

Concrete

Structural Steel



SOURCE: QUARTZ DATABASE

It's 2009

What does timber in the city look like

PHOTO: BENJAMIN BENSCHNEIDER

PHOTO: BERND BOCHARDT

University of Washington Student Housing

Mahlum

Seattle, 2009

PHOTO: WG CLARK

E3

Kaden + Partner

Berlin, 2009

PHOTO: BERND BOCHARDT

Jurisdictional requirements:

SOURCE: KADEN + PARTNER

1. Feasibility research
2. Approval from the fire department
3. Approval from the building authority
4. Approval of fire protection concept
5. Acquisition of multiple permits
6. Approval for not using a sprinkler system
7. A withdraw of responsibility from the building authority
8. Use of outside engineer for verification of the fire protection system
9. Test of structural components at the Technical University of (TU) Munich
10. Fire testing and expert statement of façade safety from testing facility MFPA Leipzig
11. Certification by experts of HBV timber, concrete floor / ceiling system
12. Proof by test that the floor system could support 6.5 tons of weight

PHOTO: BERND BOCHARDT

PHOTO: BERND BOCHARDT

PHOTO: BERND BOCHARDT

PHOTO: KADEN + PARTNER

IMAGES: www.kadenundpartner.de

SOURCE: Tallwoodbuildingcompetition.org

TECHNICAL JUSTIFICATION

IBC – 2012

Undefined Systems
Code Alternative Pathway
Performance-based Procedures
Physical Testing
Peer Review

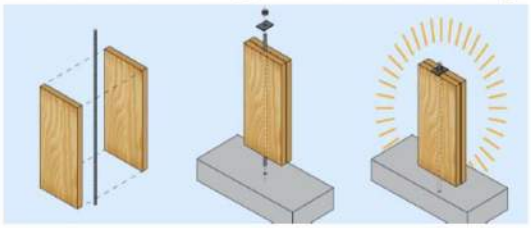
STRUCTURAL – Lateral Systems
FIRE & LIFE SAFETY – Combustible Construction
ACOUSTICS – Impact and Sound Transmission

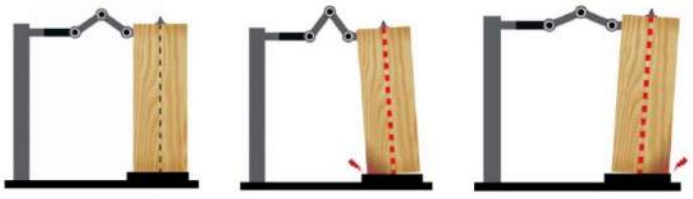
SOURCE: HANS-ERIK BLOMGREN, ARUP

PHILAIADELPHIA! AIA Convention 2016 May 19-21, Philadelphia

Structural testing – lateral systems

- **CLT/FEMA P696**
- **National Institute of Building Science's Building Safety Council**
- **American Society of Civil Engineers ASCE 7**
- **AHJ**

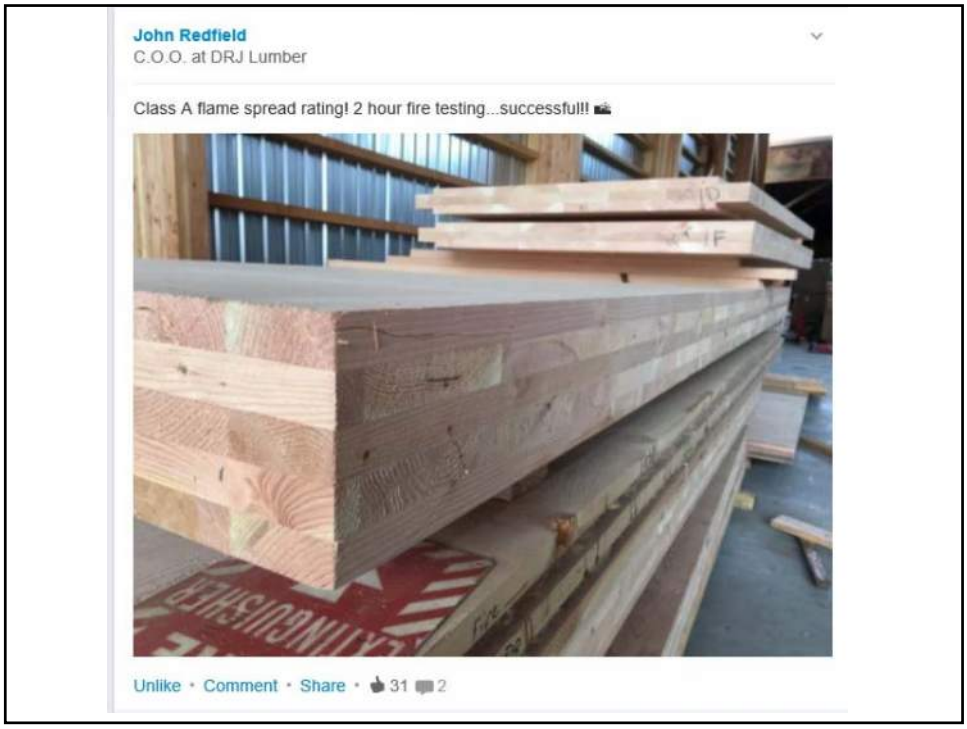




Cross-Laminated Timber Post-Tensioned Rocking Shear Walls

SOURCE: HANS-ERIK BLOMGREN, ARUP

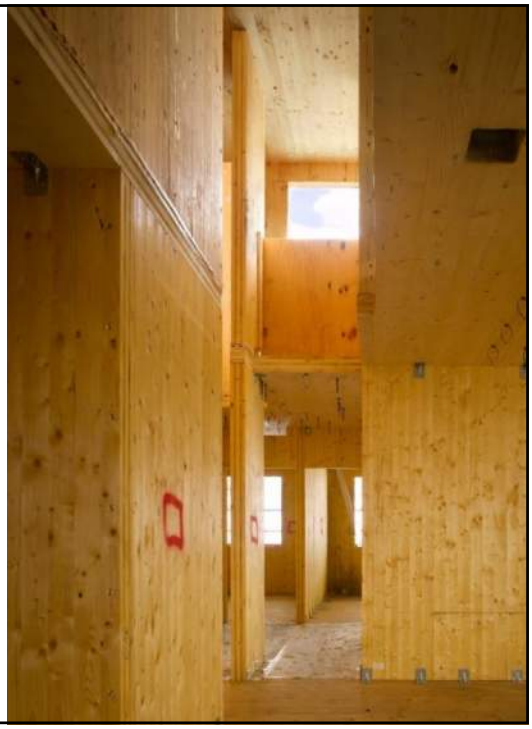
PHILAIADELPHIA! AIA Convention 2016 May 19-21, Philadelphia



Mass Timber: Global Overview

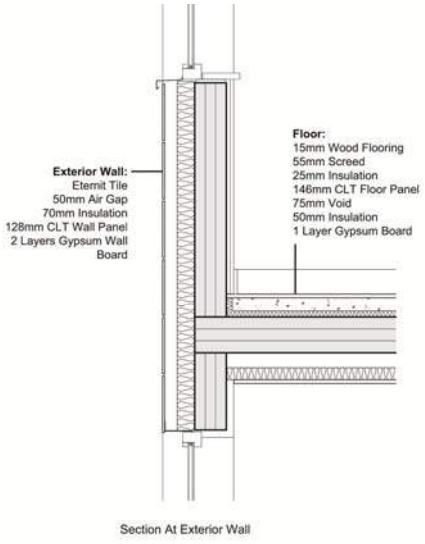
Graphite Apartments

Waugh Thistleton
London [2009]



PHOTOS: WILL PRYCE

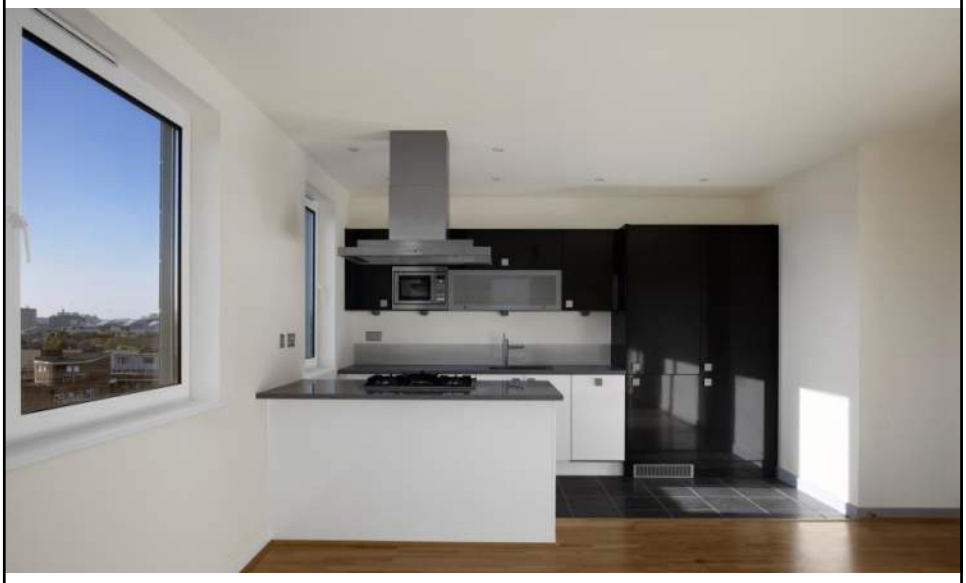
PHOTO: KLH UK



Section At Exterior Wall

DETAIL: WAUGH THISTLETON ARCHITECTS

PHOTO: KLH UK



PHOTOS: WILL PRYCE

Brideport House

Karakusevic Carson Architects (KCA)
London [2012]

BUILDING SECIONT: KCA

PHOTO: IOANA MARINESCU

PHOTO: KCA

PHOTO: STORA ENSO

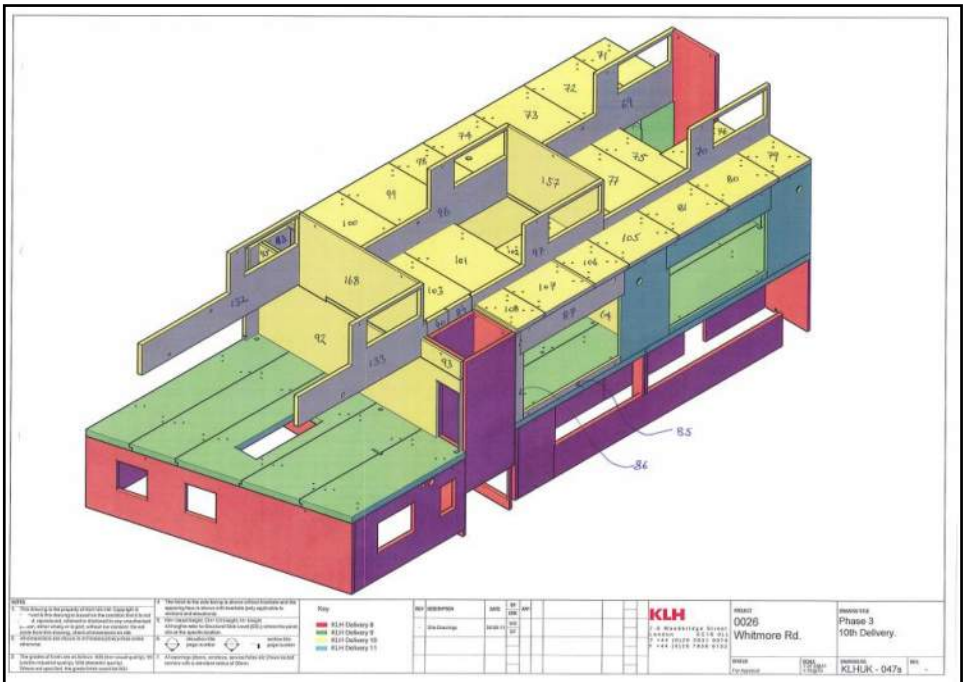
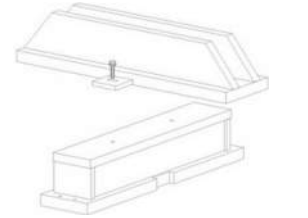
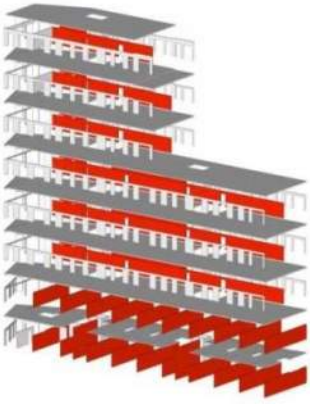


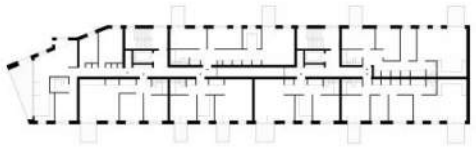
IMAGE: KLH UK

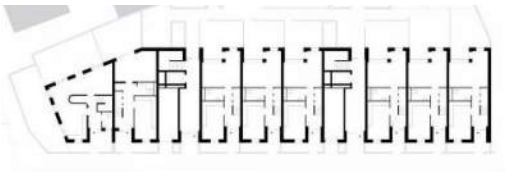
PHOTO: EURBAN

PHOTO: WILMOTT DIXON









IMAGES: EURBAN

FLOOR PLANS: MKA

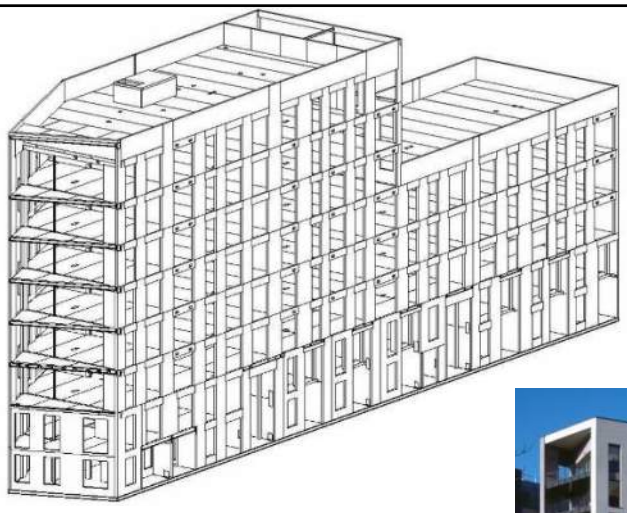


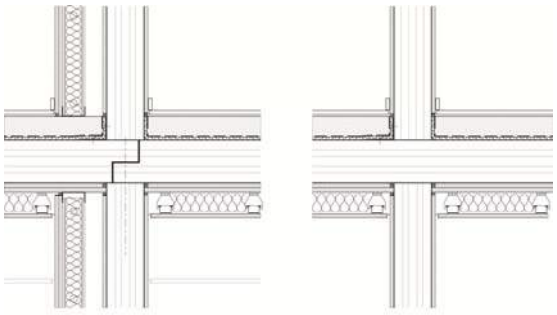
IMAGE: EURBAN

PHOTO: IOANA MARINESCU

Forté

Lend Lease
Australia [2013]

PHOTOS: LEND LEASE



PHOTOS & DRAWING: LEND LEASE

PHOTO: LEND LEASE

City Academy

Sheppard Robson England [2012]

PHOTOS: HUFTON + CROW

PHOTO: SHEPPARD ROBSON

PHOTO: SHEPPARD ROBSON

PHOTOS: HUFTON + CROW

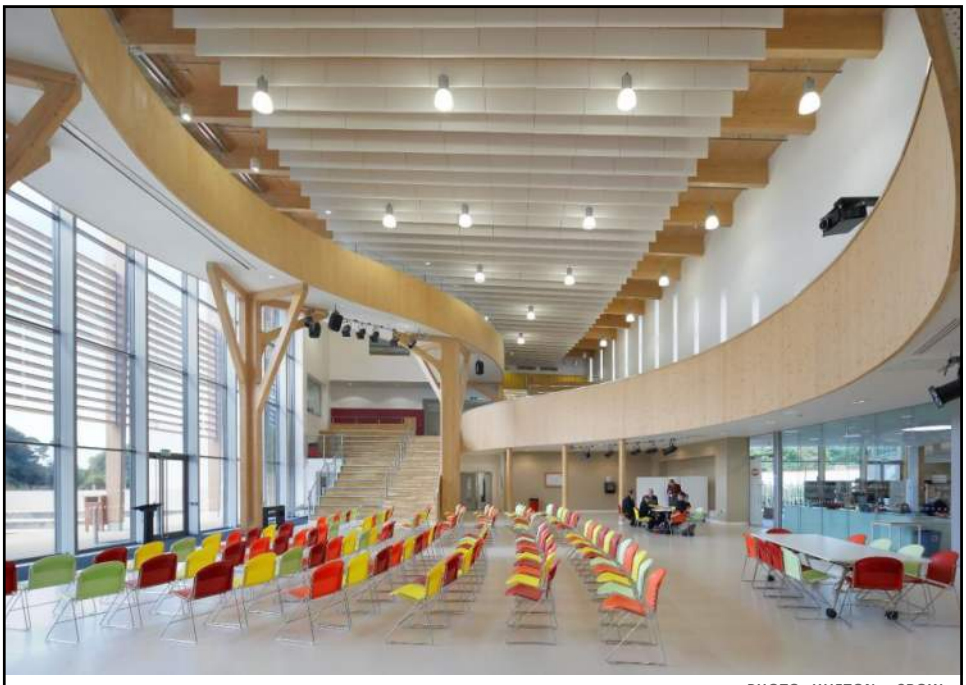


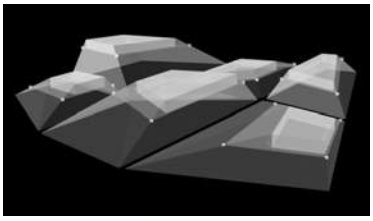
PHOTO: HUFTON + CROW

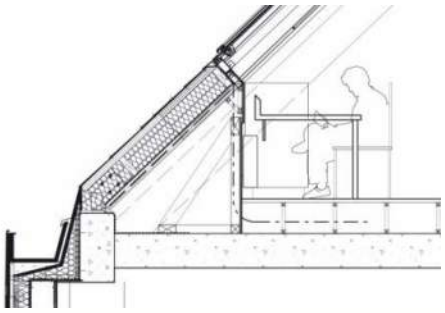
The Hive

FCB Studios
England [2012]

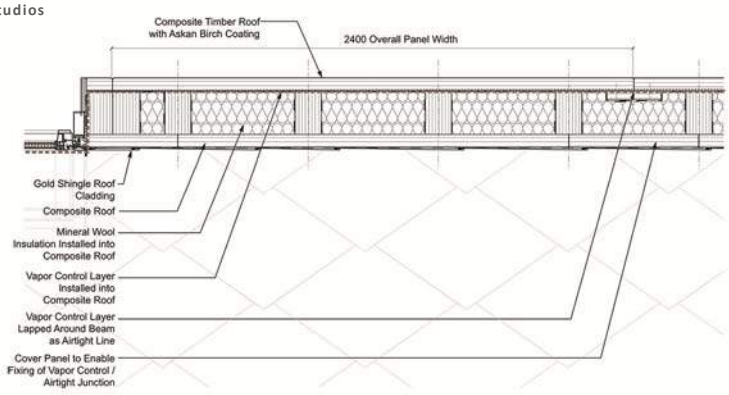
PHOTO: HUFTON + CROW

PHOTO: KLH UK



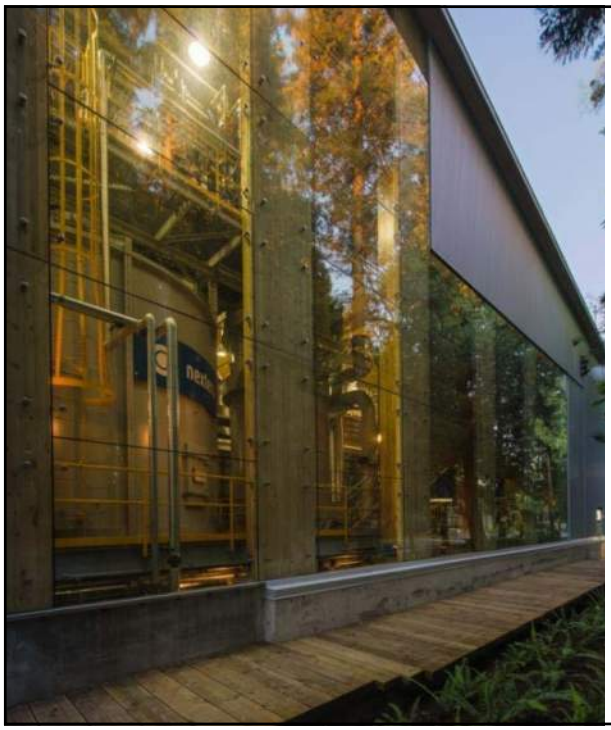


Drawings: FCB Studios



PHOTOS: KLH UK

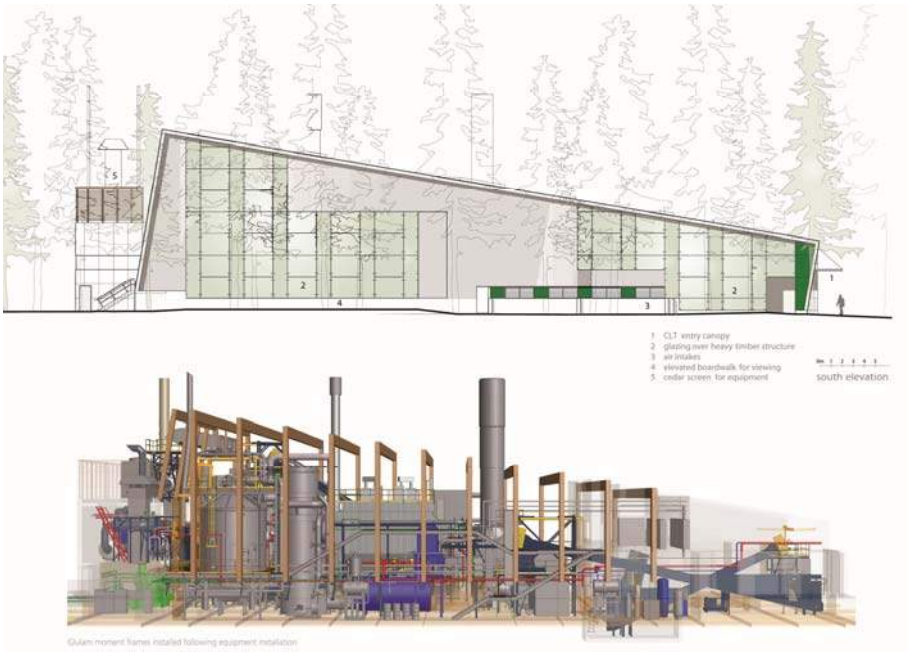
PHOTO: HUFTON + CROW



BRDF

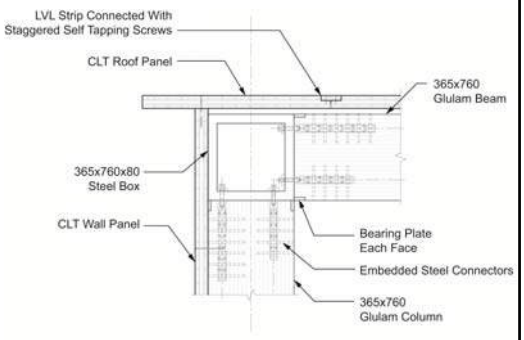
McFarland Marceau Architects
Vancouver [2012]

PHOTO: MCFARLAND MARCEAU ARCHITECTS, DON ERHARDT



IMAGES: MCFARLAND MARCEAU ARCHITECTS

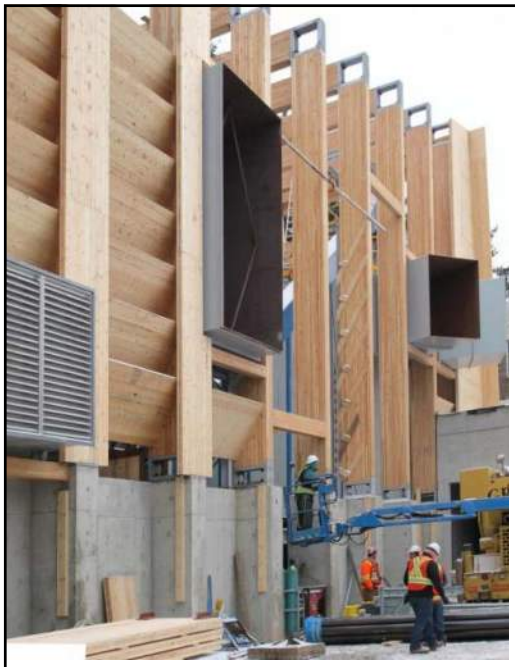
PHOTO: MCFARLAND MARCEAU ARCHITECTS

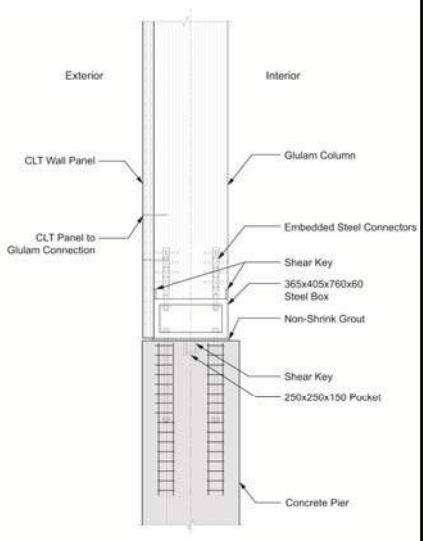


Column to Beam Box Connector on Moment Frames

DETAIL: EQUILIBRIUM

PHOTO: DON ERHARDT





Moment Frame Base Connector at Foundation

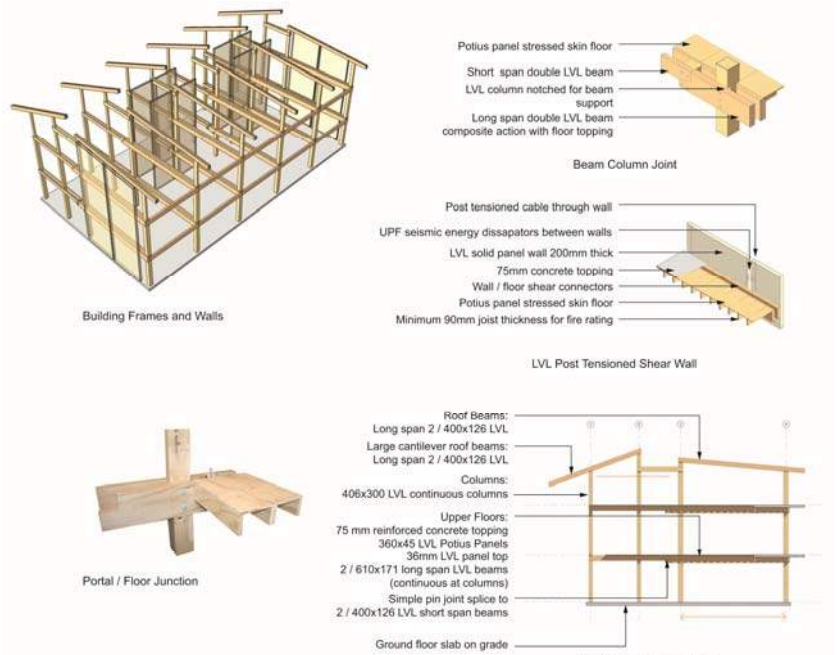
DETAIL: EQUILIBRIUM

PHOTO: MCFARLAND MARCEAU ARCHITECTS

NMIT

Irving Smith Jack Architects
Nelson [2011]

PHOTOS: PATRICK REYNOLDS



IMAGES: ISJ ARCHITECTS

IMAGE: ISJ ARCHITECTS

IMAGES: ANDY BUCHANAN

PHOTO: ISJ ARCHITECTS

PHOTO: TIM CUFF

PHOTOS: PATRICK REYNOLDS

Richard Woodcock Center for Education

Mahlum Architects
Oregon [2016]

RENDERING & PHOTO: MAHLUM

At a Glance

- Location: Western Oregon University, Monmouth
- Construction Cost: 14.5 million
- Project Cost: 18.6 million
- Area: 52,000sf
- Cost/SF: ~$280
- Height: 2-stories (~45' tall)
- Occupancy: B
- Construction: Type VB (mass timber + light wood framing)

Wood Components: As much wood as possible!

:: CLT walls

:: Prefabricated light wood stud walls (panelized in shop)

:: Solid wood columns (6x6 or 6x8 posts; HSS columns at heavily loaded areas)

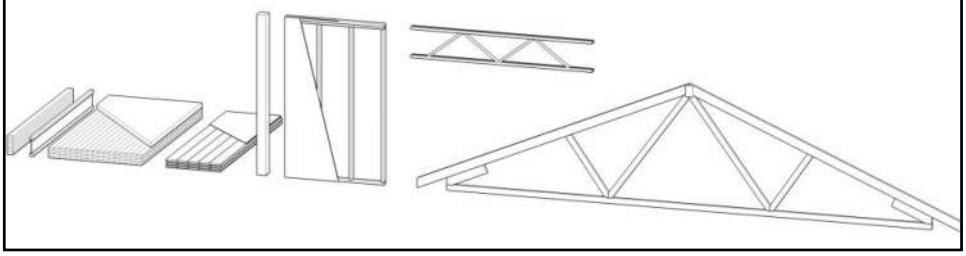
:: Glue-laminated beams

:: Wood OWT & Wood I Joist floors with plywood sheathing & concrete topping

:: CLT floors & concrete topping

:: Lock-Deck wood floor decking, plywood & concrete topping

:: Prefabricated wood roof trusses (panelized on site)



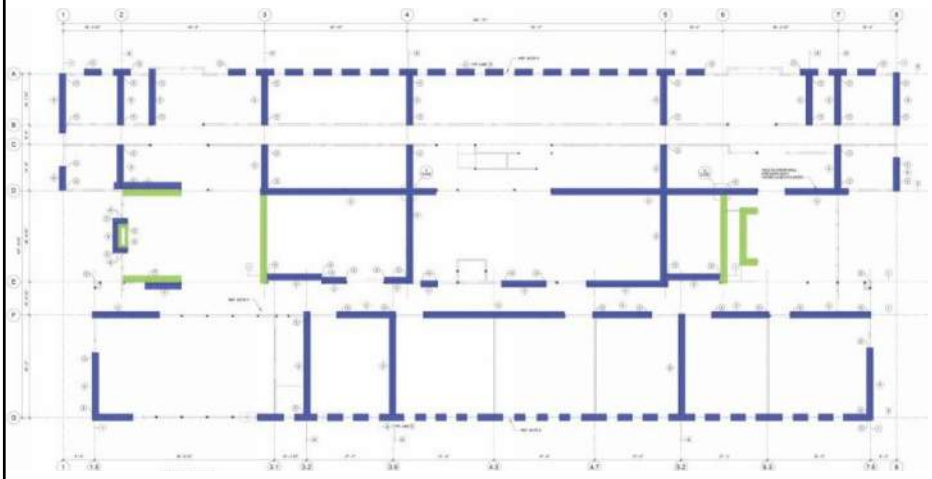
First Floor Plan

First Floor Plan

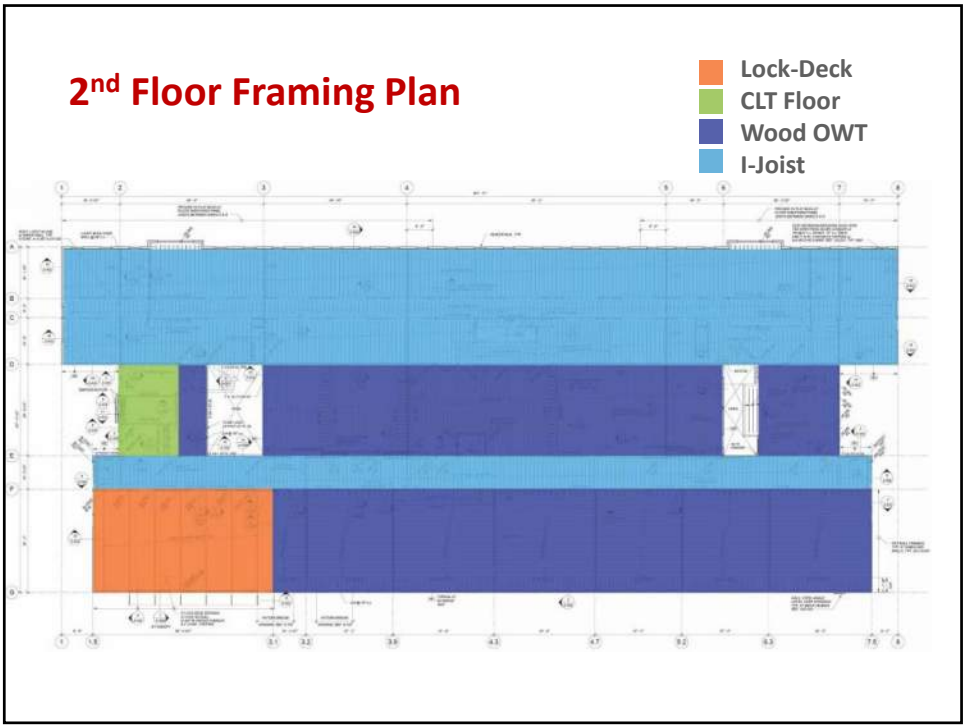
Second Floor Plan

Shear Wall / CLT Plan

Plywood shear wall
CLT wall

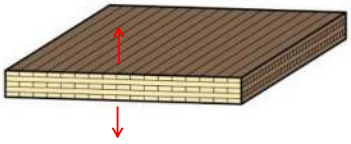


2nd Floor Framing Plan

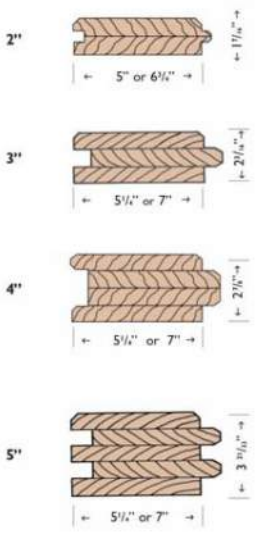


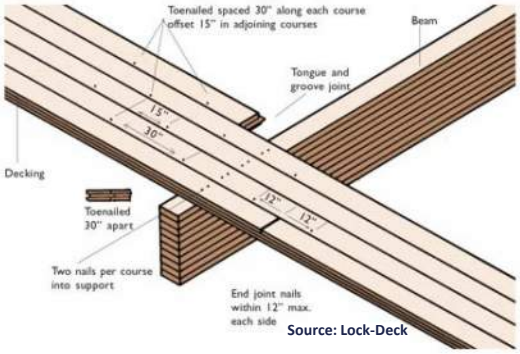
Lock-Deck

:: CLT – Movement in Two Directions



:: Dimensional Lumber – Movement in all Four Directions





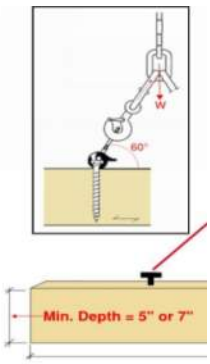
Source: Lock-Deck

Image: Equilibrium Engineers

CLT Wall Elevations


Image: Equilibrium Engineers

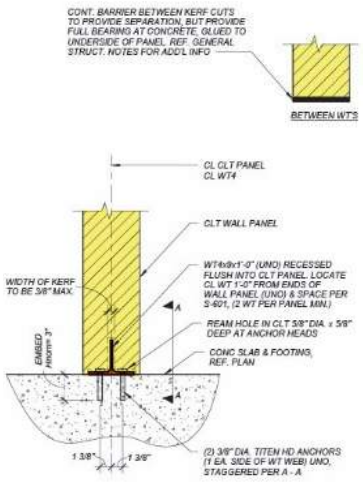
CLT Delivery



ABOVE: MYTICON

CLT Erection

CLT Wall Base Detail

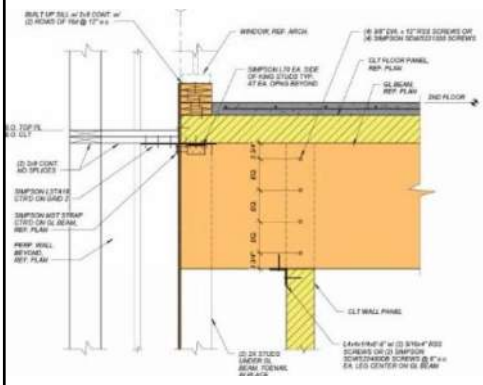


DRAWINGS: EQUILIBRIUM (OR)

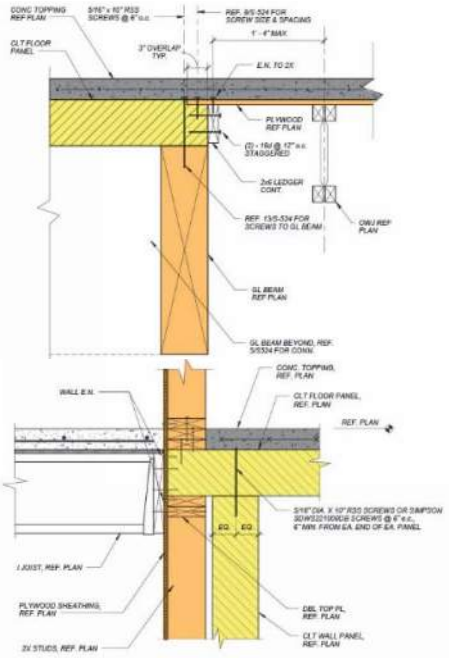
CLT Wall Base Detail

CLT Wall Base Detail

CLT to Glulam



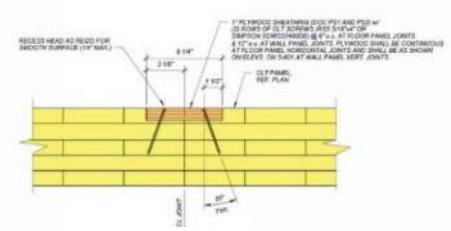
Drawing: Equilibrium Engineers



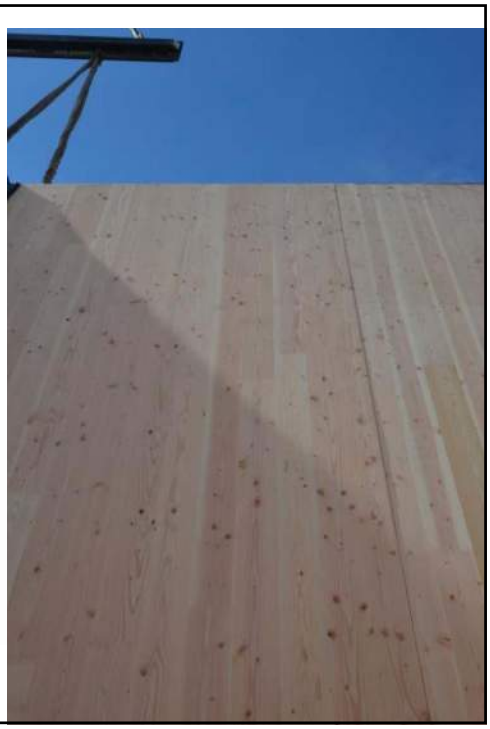
Drawing: Equilibrium Engineers

CLT to Glulam

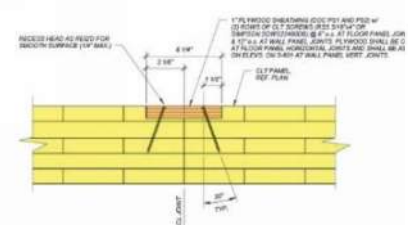
CLT Panel to Panel



Drawing: Equilibrium Engineers



Screws



Drawing: Equilibrium Engineers

EVALUATION REPORT Number: 192

Originally Issued: 08/03/2010 Revised 02/29/2016 Valid Through: 02/28/2017

EVALUATION SUBJECT:
SIMPSON STRONG-DRIVE® SDW22, SDWS22DB, SDWH19DB, SDWS22, SDWS19, SDWH27G, and SDWS16 WOOD SCREWS

REPORT HOLDER:
Simpson Strong-Tie Company Inc.
5956 West Las Positas Boulevard
Pleasanton, California 94588
(800) 999-5099
www.strongtie.com

CSI Division: 06 – WOOD, PLASTICS, AND COMPOSITES
CSI Section: 06 05 23 – Wood, Plastic, and Composite Fastenings

1.0 SCOPE EVALUATION SCOPE

1.1 Compliance with the following codes:
- 2012 International Building Code® (IBC)
- 2012 International Residential Code® (IRC)
- 2009 International Building Code® (IBC)
- 2009 International Residential Code® (IRC)
- 2006 International Building Code® (IBC)
- 2006 International Residential Code® (IRC)

1.2 Evaluated in accordance with:
- ICC-ES AC233, approved June, 2014.
- ICC-ES AC257, approved October 2009 (Editorially revised May 2012)

1.3 Properties assessed:
- Structural
- Corrosion Resistance

2.0 PRODUCT USE

Simpson Strong-Drive® SDW TRUSS-PLY and SDW EWP-PLY Screws (SDW22), SDWS TIMBER Screws (SDWS22DB), SDWH TIMBER-HEX Screws (SDWH19DB), SDWS LOG Screws (SDWS22), SDWS19, SDWH TIMBER-HEX HDG Screws (SDWH27G), and SDWS FRAMING Screws (SDWS16) described in this report are dowel-type threaded and self-drilling fasteners used for wood-to-wood connections.

The Simpson Strong-Drive SDW22, SDWS22DB, SDWH19DB, SDWS22, SDWS19, and SDWS16 wood screws have proprietary corrosion-resistant coatings and may be used where fasteners are required to exhibit corrosion resistance when exposed to adverse environmental conditions and/or in chemically-treated wood, which are subject to limitations of Section 5.3 of this report, and are alternatives to hot-dipped, zinc-coated, galvanized fasteners with a coating weight in compliance with ASTM A153, Class D. Screws with these proprietary corrosion-resistance coatings were evaluated for contact with wood chemically treated with waterborne alkaline copper quaternary, Type D (ACQ-D), to a maximum retention level of 0.40 pcf (6.4 kg/m³), which was shown to be more corrosive than Chromated Copper Arsenate, Type C (CCA-C), Micronized Copper Azole (MCA), and Dispersed Copper Azole (µCA-C). The SDWH27G wood screws are coated with a hot-dipped, zinc-coated, galvanized finish in accordance with ASTM A153, Class C.

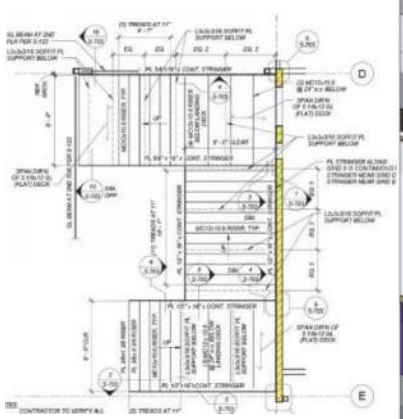
3.0 PRODUCT DESCRIPTION

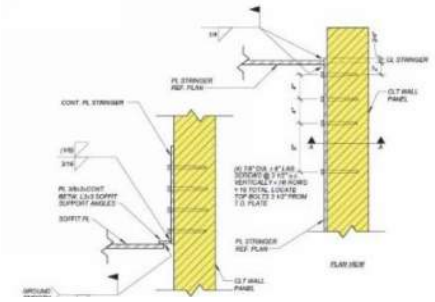
3.1 General: The SDW22, SDWS22DB, SDWH19DB, SDWS22, SDWS19, SDWH27G, and SDWS16 wood screws are manufactured using a standard cold-forming process and consist of heat treated carbon steel. The SDW22, SDWS22DB and SDWS22 screws have rolled threads, spaced approximately 5 threads per inch and a flat head with a T-40 recess. The SDWH19DB and SDWS19 screws have rolled threads spaced approximately 6 threads per inch. The SDWH19DB screws have a 5/16-inch hex head with an integral washer. The SDWS19 screws have a flat head with a T-40 recess. The SDWH27G screws have rolled threads, spaced approximately 5 threads per inch and a 1/2-inch hex head with an integral washer. The SDWS16 screws have rolled threads spaced approximately 9 threads per inch and a flat head with a T-25 recess. All screws have serrated threads and a proprietary point. The SDW22 screws have 8 screw lengths ranging from 2 15/16 inches to 6 1/16 inches with thread lengths ranging from 1 1/16 to 1 15/16 inches. The SDWS22DB screws have 6 screw lengths ranging from 3 to 10 inches with thread lengths ranging from 1 ½ to 2 ¾ inches. The SDWH19DB screws have 5 screw lengths ranging from 3 to 10 inches with thread lengths ranging from 1 7/8 to 2 7/8 inches. The SDWS22 screws have 6 screw lengths ranging from 8 to 15 inches with thread lengths of 2 5/16 inches. The SDWS19 screws have 2 screw lengths of 6 and 7 1/2 inches with thread lengths of 2 5/16 inches. The SDWH27G screws have 5 screw lengths ranging from 4 to 12 inches with thread lengths of 3 inches. The screws have a proprietary coating except for the SDWH27G screws, which have a hot-dipped, galvanized coating in accordance with ASTM A153, Class C. The SDWS16 screws have 2 screw lengths of nominally 2½ and 3 inches with thread lengths of 1 5/8 and 1 5/8 inches, respectively. Table 1 of this report provides a description of the screws recognized in this report, and specifies the allowable bending yield strengths as well as allowable tensile and shear loads.

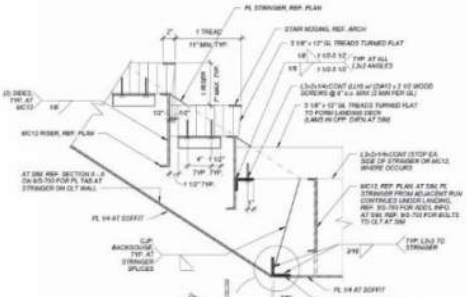
3.2 Materials:

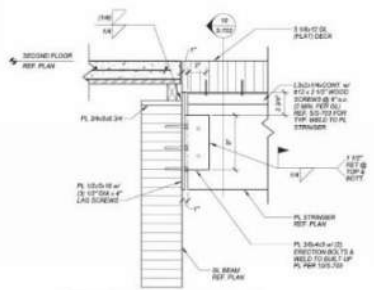
3.2.1 SDW22, SDWS22DB, SDWH19DB, SDWS22, SDWS19, SDWH27G, and SDWS16 Wood Screws: The

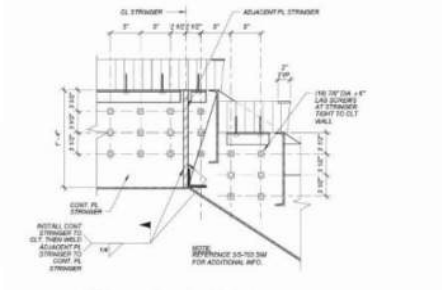
CLT Wall / West Stair





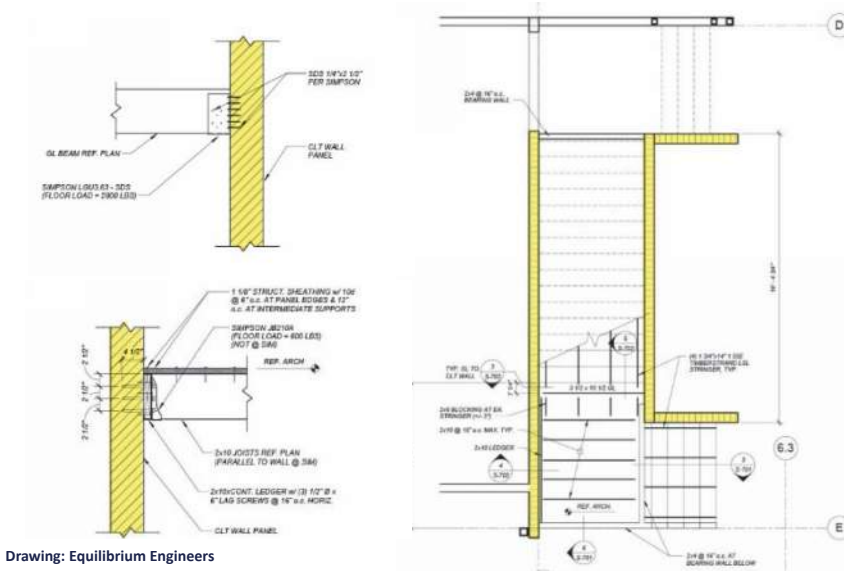






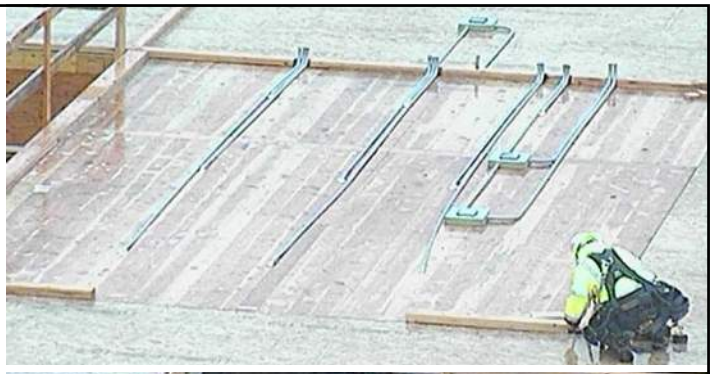
Drawings: Equilibrium Engineers

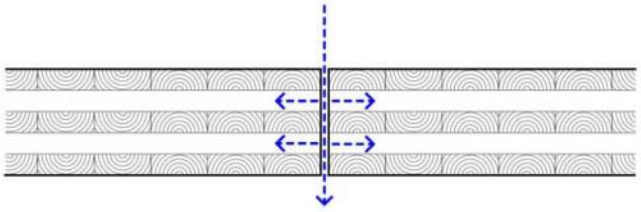
CLT Wall / East Stair



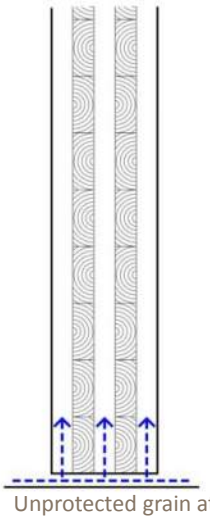
Drawing: Equilibrium Engineers

Challenges

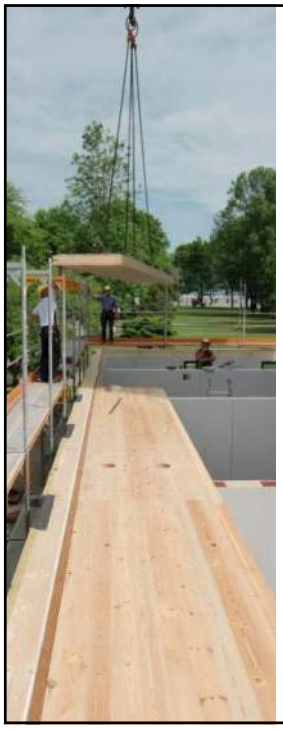




Unprotected joints at horizontal surfaces



Unprotected grain at vertical panels



PROJECT: H8
PHOTO: HUBER & SOHN
SCHANKULA ARCHITECTS

European Examples

PROJECT: CITY ACADEMY
SHEPPARD ROBSON

Questions?

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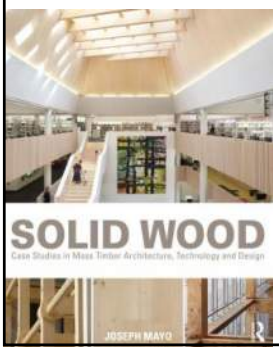

PHOTO: HUFTON + CROW