Mass Timber Construction: Products, Performance and Design

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MFPC Meeting, September 19, 2016
University of Maine
FUNDING PARTNERS

SLB
SOFTWOOD LUMBER BOARD

FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

Canada

Forestry Innovation Investment
**2015 PROGRAM HIGHLIGHTS**

- Technical support for 220 projects that went to construction this year
- Technical support on an additional 488 projects that are still in design phase
- 43,300 practitioner education hours through Wood Solutions Fairs, workshops, webinars and other education events

**Growth in Number of Direct Projects Supported**

**Educational Outreach to Support Project Assistance**

- 5 Wood Solution Fairs for 1,919 design and building professionals
- 152 lunch & learns for 1,797 design and building professionals
- 67 lunch seminars for 1,807 attendees
- 24 workshops for 1,259 attendees
- 62 third-party event presentations
- 12 webinars for 10,557 practitioners, each attracting an average of 880 practitioners
Mass timber is a category of framing styles often using small wood members formed into large panelized solid wood construction including CLT, NLT or glulam panels for floor, roof and wall framing.
BUILDING FRAME SYSTEMS

Post and Beam

Light Frame

Mass Timber
MASS TIMBER PRODUCTS

VERTICAL FRAMING

GLULAM BEAMS & COLUMNS

CROSS LAMINATED TIMBER (CLT) WALLS
Mass timber products include:

- Nail-laminated timber (NLT)
- Cross-laminated timber (CLT)
- Glue-laminated timber (GLT)
- Tongue & groove decking (T&G)
- Timber concrete composite
- Structural composite lumber

Image source: Structurecraft
MASS TIMBER PRODUCTS

GLULAM

PHOTO CREDIT: ALEX SCHREYER
Mass timber products

**Glulam** = A structural composite of lumber and adhesives

- Recognized in IBC 2303.1.3 using ANSI/AITC A 190.1 and ASTM D 3737
- Can be used for floor, roof purlins, beams, arches, columns
FLEXIBILITY OF SPANS AND SHAPES

RICHMOND OLYMPIC OVAL, RICHMOND, BC, CANADA
DESIGN TEAM: CANNON DESIGN ARCHITECTURE, FAST + EPP, GLOTMAN SIMPSON
PHOTO CREDIT: STEPHANIE TRACEY, CRAIG CARMICHAEL, JON PESOCHIN, KK LAW CREATIVE,
ZIGGY WELSch
104’ Span Glulam Arches
Glulam Purlins @ 4’ O.C
MASS TIMBER PRODUCTS

NAIL-LAMINATED TIMBER (NLT) PANELS

PHOTO CREDIT: STRUCTURECRAFT

PHOTO CREDIT: JONATHAN CHRISTIAN
NAIL-LAMINATED TIMBER (NLT) = A STRUCTURAL PANEL OF SQUARE-EDGED DIMENSIONAL LUMBER LAMINATIONS (USUALLY 2X) SET ON EDGE AND NAILED WIDE FACE TOGETHER

- Recognized in IBC 2304.8.3 (mechanically laminated decking)
- NDS 15.1.1 provides distribution factors for concentrated loads
- Can be used for floor, roof decking. Occasionally used for shaft walls
MASS TIMBER PRODUCTS

NAIL-LAMINATED TIMBER (NLT) PANELS

Often exposed on underside
Structure is finish

Photo credit: Woodworks
STRUCTURAL FRAME:
DOUGLAS-FIR GLULAM BEAMS AND COLUMNS
5-1/8”X15” TO 12-1/4”X21”
2X6 NLT FLOOR DECK
2X4 NLT ROOF DECK
FLOOR ASSEMBLY TOP TO BOTTOM:
3” CONCRETE TOPPING, ACOUSTICAL MAT, WSP, 2X6 NLT
Nail-laminated timber decks provide:
Maximized spans, reduced number of columns, more open space
Flexibility, minimized structure depth
MASS TIMBER PRODUCTS

GLUE-LAMINATED TIMBER (GLT) PANELS
MASS TIMBER PRODUCTS

GLUE-LAMINATED TIMBER (GLT) PANELS

GLULAM DECKING:

• SIMILAR TO DEEP GLULAM BEAMS LAID ON THEIR SIDE
• SAME CODE REFERENCES AND MANUFACTURING STANDARDS AS GLULAM BEAMS AND COLUMNS
• BE CAREFUL OF DESIGN STRESSES AND LAYUPS USED – SPEC UNIFORM LAYUP (ALL LAMS SAME SPECIES & GRADE)

Image source: MANASC ISAAC ARCHITECTS/FAST + EPP
MASS TIMBER PRODUCTS
CROSS-LAMINATED TIMBER (CLT)
WHAT IS CLT?
SOLID WOOD PANEL
3 LAYERS MIN. OF SOLID SAWN LAMS
90 DEG. CROSS-LAMS
SIMILAR TO PLYWOOD SHEATHING

MASS TIMBER PRODUCTS
CROSS-LAMINATED TIMBER (CLT)

MAJOR AXIS
MINOR AXIS

4 1/8” TO 19 1/2”
10’X40’
8’X64’
MASS TIMBER PRODUCTS
CROSS-LAMINATED TIMBER (CLT)

Perpendicular Layer

Parallel Layer

Strength Axis of CLT
CANDLEWOOD SUITES

REDSTONE ARSENAL, AL

IMAGE CREDIT: LEND LEASE
• 62,600 SF, 4 STORY HOTEL, 92 PRIVATE ROOMS
• CLT UTILIZED FOR WALLS, ROOF PANELS, AND FLOOR PANELS
• 1,557 CLT PANELS; TYPICAL FLOOR PANEL IS 8’X50’ & WEIGHS 8,000 LBS
• COMPLETED LATE 2015
UMASS DESIGN BUILDING

AMHERST, MA

IMAGE CREDIT: LEERS WEINZAPFEL ASSOCIATES
UMASS DESIGN BUILDING

Amherst, MA

4 story, 87,500 SF facility with: Classrooms, lounges, meeting rooms, materials-testing lab, green-building lab, wood shop, digital fabrication lab, cafe, exhibit space, and library.
UMASS DESIGN BUILDING

AMHERST, MA

Currently under construction, expected opening date: January 2017.
TYPE IV CONSTRUCTION
7 STORIES (6 TIMBER ON 1 CONCRETE)
234,000 SF
2X8 NLT FLOOR PANELS W/3” CONCRETE TOPPING
GLULAM BEAM AND COLUMN FRAME
20’X25’ GRID
MASS TIMBER CONSTRUCTION
THE FUTURE’S LOOKING UP

PHOTO CREDIT: NATURALLY: WOOD
TALL MASS TIMBER
BUILDING COMPETITION

- Originally a $2 million project competition
- So many high quality submissions resulted in 2 projects awarded $1.5 million each
- Lumber industry via SLB is contributing $2M of $3M

Framework Project Team
Portland, Oregon
Owner: The Framework Project, LLC
Land Owner: Beneficial State Bancorp
Development Team: project^+
Architect: LEVER Architecture
Structural Engineer: KPFF Consulting Engineers
M/E/P: PAE Consulting Engineers
Affordable Housing/Investor: Home Forward
Fire/Timber & Environmental Engineer: Arup
General Contractor: Walsh Construction

475 West 18th Project Team
Chelsea, New York
Owner: 130-134 Holdings LLC
Development Team: 130-134 Holdings LLC and Spiritos Properties LLC
Architect: SHoP Architects
Structural Engineer: Arup
M/E/P: ICOR Consulting Engineers
Environmental Consultant: Atelier 10
Fire and Timber Engineer: Arup
General Contractor: Not yet selected
Tall Mass Timber

Framework: An Urban + Rural Ecology

- Tall Wood Competition Winner
- Location: Pearl District, Portland, OR
- Height: 130’ / 12 stories
- Total Building Area: 90,000 square feet
- Building Uses: Ground floor retail; 5 office floors; 5 apartment floors; Rooftop amenity
- Materials: Cross laminated timber floors and lateral force resisting system; Glue laminated beams and columns

OWNER: BENEFICIAL STATE BANCORP
ARCHITECT: LEVER ARCHITECTURE
ENGINEER: KPFF
TALL MASS TIMBER
BUILDING COMPETITION

475 West 18th: Setting the Stage for Innovation, Engineering and Architecture

- Tall Wood Competition Winner
- Location: West Chelsea, Manhattan, NY
- Height: 120’ / 10 stories
- Total Building Area: 50,000 square feet
- Building Uses: Residential condominium with ground floor commercial space
- Materials: Mass timber columns, beams, shear walls and floors

OWNER: SPIRITOS PROPERTIES
ARCHITECT: SHoP ARCHITECTS
ENGINEER: ARUP
TALL WOOD PROJECTS

Murray Grove
London, United Kingdom
8 Stories
2009

Forté
Melbourne, Australia
10 Stories
2012

TREET
Bergen, Norway
14 Stories
2015

Brock Commons
Vancouver, Canada
18 Stories
2017

HpHo
Vienna, Austria
24 Stories
2017

SOURCE: RETHINKWOOD
TREET APARTMENTS
BERGEN, NORWAY

COMPLETED 2015
14 STORIES
173 FT
~63K SQ.FT.

SOURCE: TOWARD TALLER WOOD BUILDINGS SYMPOSIUM 2014
EXPECTED COMPLETION:
SUMMER 2017
18 STORIES
174 FT
156K SQ.FT.
BROCK COMMONS

VANCOUVER, BC

17 STORIES OF TIMBER INSTALLATION
STARTED JUNE 6, 2016
FINISHED AUGUST 10, 2016
Questions?

This concludes The American Institute of Architects Continuing Education Systems Course

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