MASS TIMBER:
CONSTRUCTION CONSIDERATIONS

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

PCL CONSTRUCTION

Agenda

- Procurement
- Design Coordination
- Construction Considerations
- Cost Analysis

Procurement

Supply Chain

Manufacturer Selection

- Domestic vs. International Sourcing
- Varying Panel Fabrication Size Limits
- Engineering Support to Optimize Column Grid
- Panel Width Shipping Constraints – Land vs. Sea
- Proximity to Jobsite / Shipping Costs
- Supplier Only vs. Turn-Key
- Sustainability – FSC vs. SFI Certification
- Aesthetic Considerations
- Wood Species & Stains

CLT Layup Combinations

CLT

NORDIC X-LAM

NORDIC X-LAM
CROSS-LAMINATED TIMBER

Nordic X-Lam cross-laminated timber is made of at least three orthogonal layers of graded sawn lumber that are laminated by gluing with structural adhesives.

SLABS AND PANELS

Layup combinations
89-3s, 105-3s,
143-5s, 175-5s,
197-7s, 213-7l, 244-7s, 244-7l
and 287-9l

Maximum sizes
2.44 × 19.5 m (8 × 64 ft)

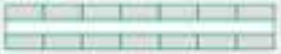
Stress grade
E1 (1, 1950Fb and T No. 3/Stud)

NORDIC X-LAM LAYUP COMBINATIONS

3 LAYERS

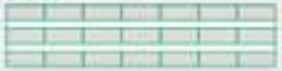
89-3s

105-3s

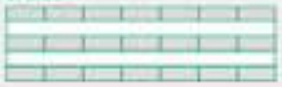


5 LAYERS

143-5s

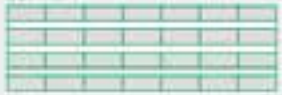


175-5s

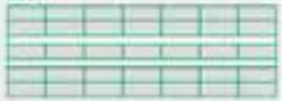


7 LAYERS

197-7s



213-7l



244-7s

244-7l

9 LAYERS

287-9l

Procurement Best Practices

- Early Go/No-Go Decision on Mass Timber
- CM/GC design-assist
- Early Supplier Selection vs. Competitive Bid
- Layout column grid with supplier input
- Maximize time for design coordination
  - Shop drawing release
  - Connection details
  - MEP coordination
- Transfer of Revit model to contractor

Procurement Best Practices

Mass Timber is not a Commodity Material!

Design Coordination

MEP Coordination

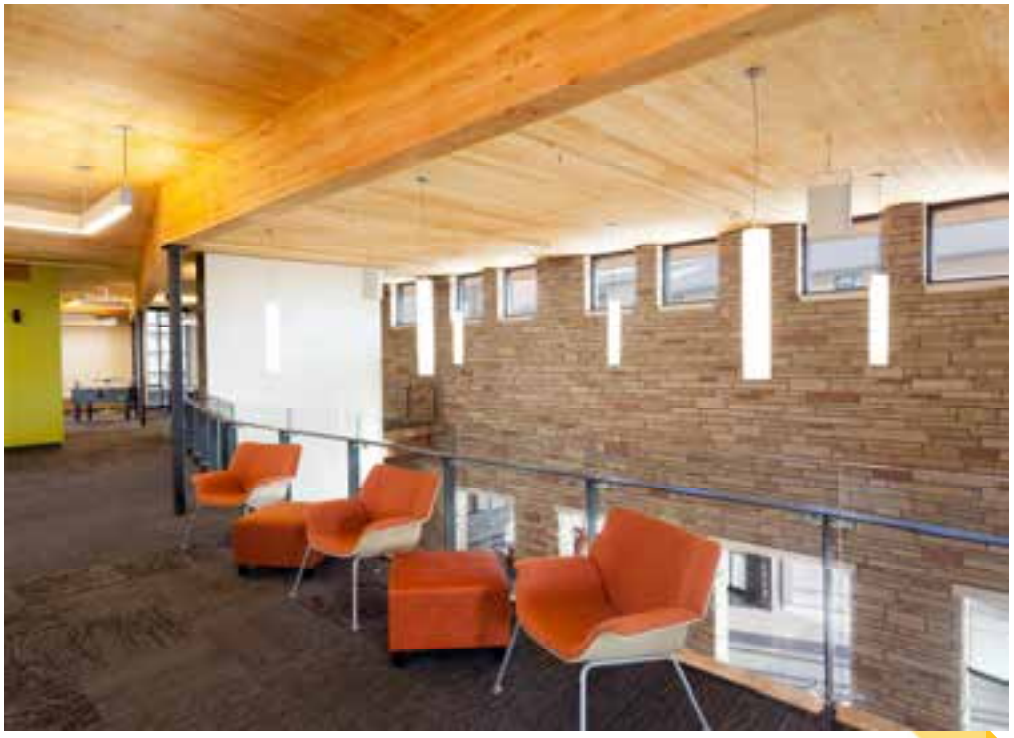
- MEP systems are primarily exposed
- Heightened focus on MEP routing
- Prefabrication coordination
- Coordinated ceiling/soffit locations

MEP Coordination

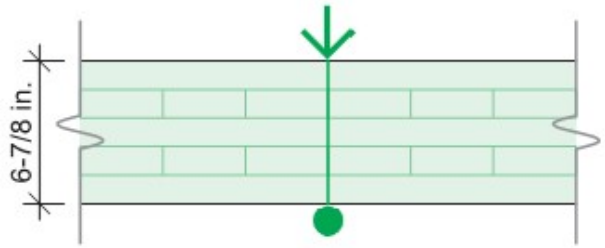
MEP Coordination

MEP Coordination Best Practices

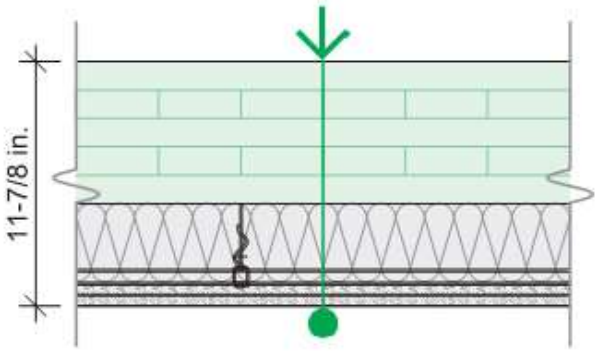
- Identify aesthetic MEP routing goals early
- Determine extent of future flexibility required
- Optimize REVIT model criteria & timing of handoff
- Prioritize MEP penetration coordination
- Consolidate MEP systems in soffits/dropped ceilings
- Maximize shop penetrations made with CNC machine
- Minimize field penetrations



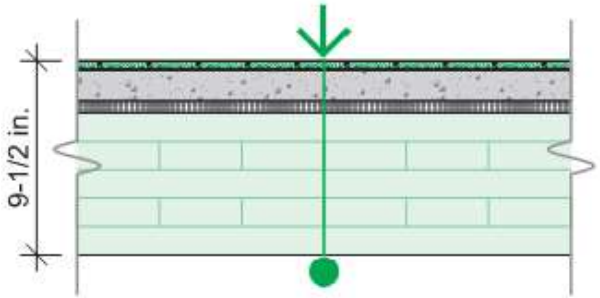
Acoustic Assemblies



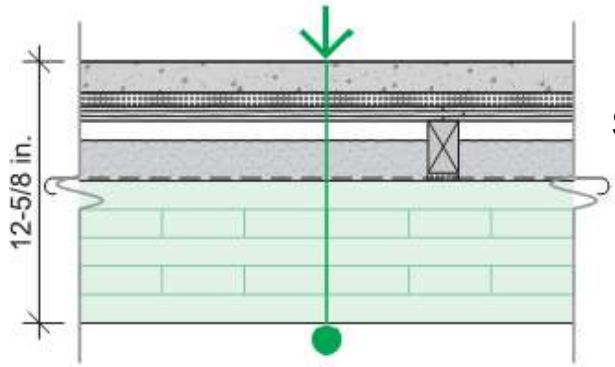
STC 39
IIC 27



STC 64
IIC 59



STC 55
IIC 51



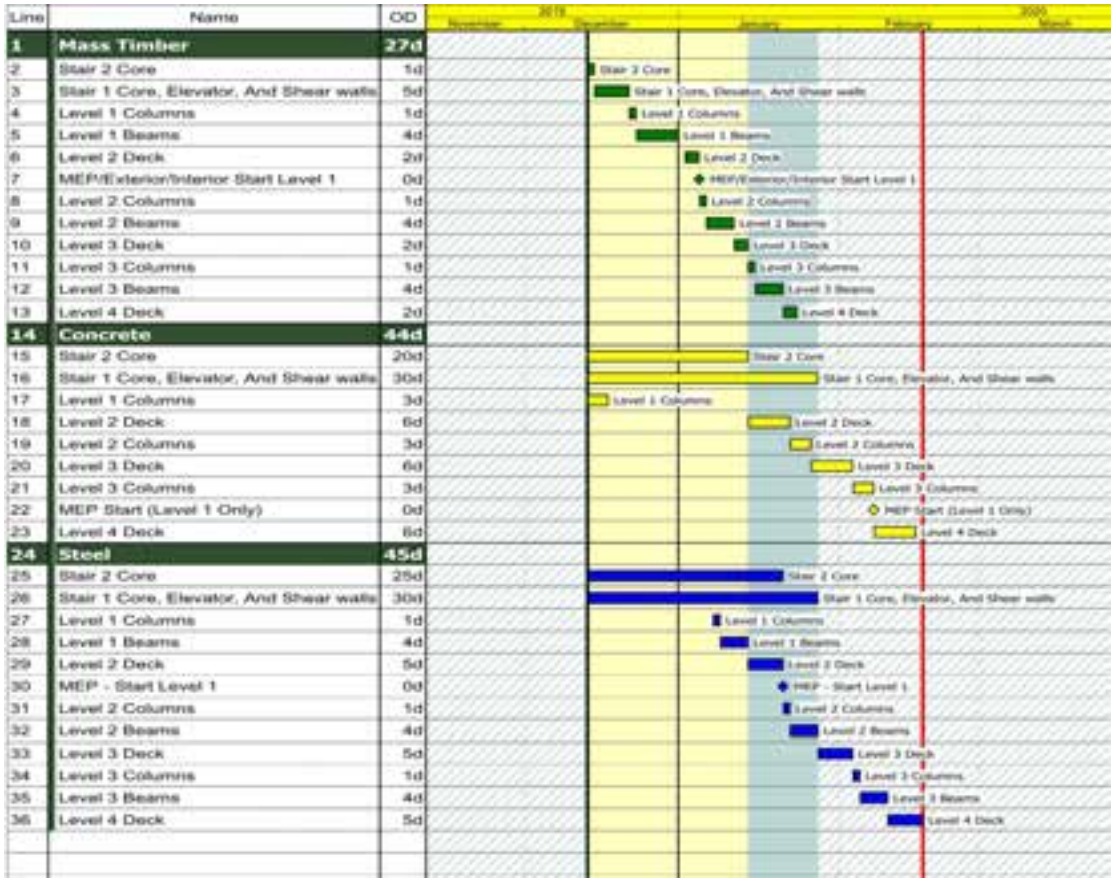
STC 66
IIC 60

Construction Considerations

Faster Construction Schedule

Up to 40% Faster than Concrete

- Concurrent CLT core wall erection
- Eliminate re-shores
- Accelerated start of MEP rough-in
- No field welding
- Reduced manpower & crew size
- Prefabrication / precision-fit
- Minimal weather protection
- No temp heat required



Line	Name	OD
1	**Mass Timber**	**27d**
2	Stair 2 Core	1d
3	Stair 1 Core, Elevator, And Shear walls	5d
4	Level 1 Columns	1d
5	Level 1 Beams	4d
6	Level 2 Deck	2d
7	MEP/Exterior/Interior Start Level 1	0d
8	Level 2 Columns	1d
9	Level 2 Beams	4d
10	Level 3 Deck	2d
11	Level 3 Columns	1d
12	Level 3 Beams	4d
13	Level 4 Deck	2d
14	**Concrete**	**44d**
15	Stair 2 Core	20d
16	Stair 1 Core, Elevator, And Shear walls	30d
17	Level 1 Columns	3d
18	Level 2 Deck	6d
19	Level 2 Columns	3d
20	Level 3 Deck	6d
21	Level 3 Columns	3d
22	MEP Start (Level 1 Only)	0d
23	Level 4 Deck	6d
24	**Steel**	**45d**
25	Stair 2 Core	25d
26	Stair 1 Core, Elevator, And Shear walls	30d
27	Level 1 Columns	1d
28	Level 1 Beams	4d
29	Level 2 Deck	5d
30	MEP - Start Level 1	0d
31	Level 2 Columns	1d
32	Level 2 Beams	4d
33	Level 3 Deck	5d
34	Level 3 Columns	1d
35	Level 3 Beams	4d
36	Level 4 Deck	5d

Reduced Construction Waste

- Prefabricated components
- Precision-fit
- No scrap material or field cuts
- Less deliveries / construction traffic
- Smaller onsite workforce
- Less impact on water quality

Construction Tolerances

Dissimilar structural material tolerances

- Allowable tolerances – ACI, AISC
- Steel: +/- 1/2”
- Concrete: 1/4” in 10 ft., up to 1’
- Mass Timber: 1/16”

Quality Control

- Build tolerance into the interface detail
- Base plate layout & verification
- Overlay field scan with 3D model

Hybrid Structures

Erection Sequence

- Shear wall bracing plan
- Early establishment of diaphragm – lock the building in
- Coordination w/ Just-in-Time material delivery
- Ensure erection sequence aligns with details

Site Logistics

- Alignment with supplier fabrication sequence
- Optimize lay down area & crane placement
- Onsite vs. Offsite Marshalling Yard

- Goals:
  - Pick CLT panels directly off the trailer
  - Eliminate double-handling
  - Eliminate onsite storage of material

Protection of Finishes

- Working around finished material earlier than typical
- Communicate expectations with craft workers
- Padded rigging & dunnage
- Protection in high traffic areas
- Column protection
- Manage UV light exposure

Moisture Management

- Stain mitigation – rust bleed, water, oil, grease
- Prime all steel connections
- Eliminate standing water
- Eliminate trapped moisture
- Seal joints in CLT panels
- Temp roofing membrane

Cost Analysis

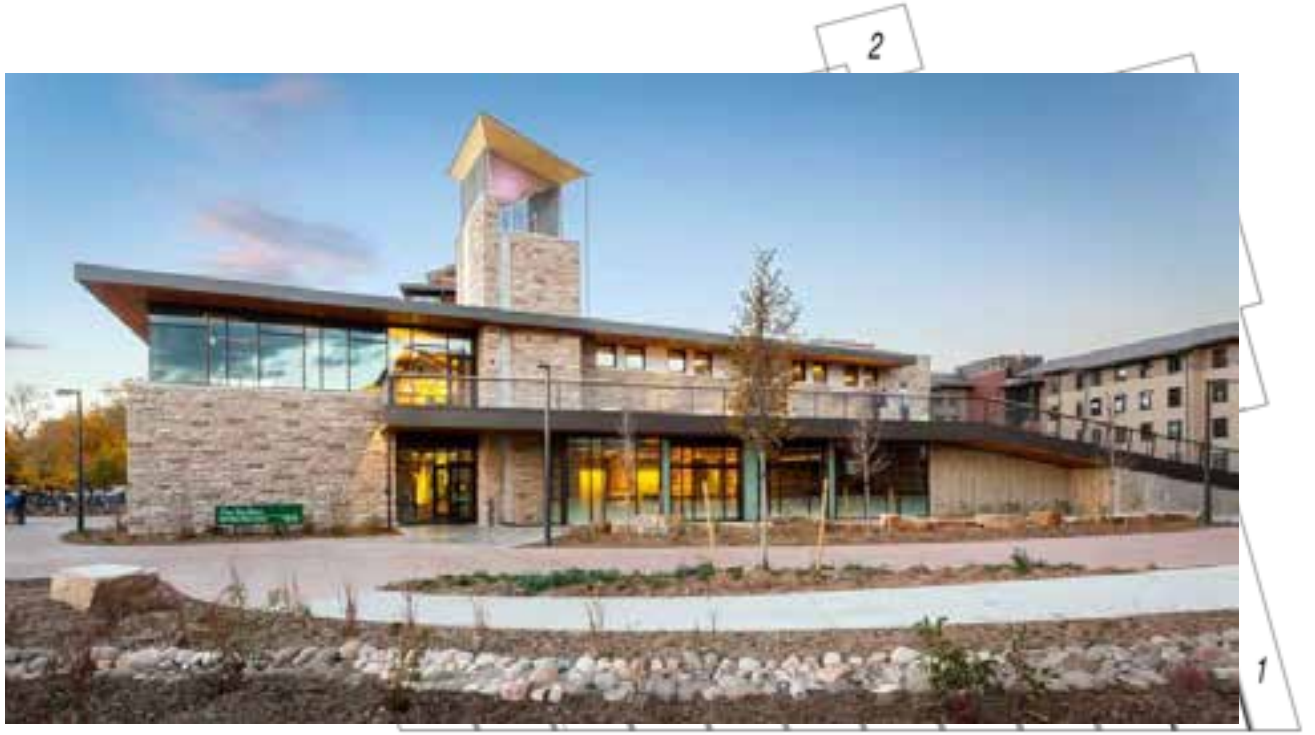
Pavilion at Laurel Village

Construction Type
2-stories, 11,500 SF
Type V-B – unprotected wood frame

Hybrid Structure
Floor Panels – 5-ply CLT
Roof Panels – 7-ply CLT
Frame – Glulam beams & HSS Columns
Lateral System – CMU Walls

Cost Drivers
Unique geometry
Asymmetrical column grid
Limited full size CLT panels
Long roof spans – thicker CLT panels

Superstructure Cost
$82/SF (2020 dollars)



Level 2 CLT Panel Layout

Burwell Center for Career Achievement

Construction Type
3-stories – 23,300 SF
Type III-B – Unprotected Combustible

Mass Timber Structure
Floor Panels – 3-ply CLT w/ 3” concrete toppi
Roof Panels – 3-ply CLT
Frame – Glulam beams & columns
Lateral System – 5-ply CLT wall panels

Cost Drivers
Unique geometry – radiused perimeter edge
Optimized column grid & beam sizes
Exposed connections
Small footprint w/ limited repetition

Superstructure Cost
$53/SF (2020 dollars)

Impact of Construction Type

Location of Event Space	Rooftop	1st Floor
Construction Type	III-A	III-B
Assembly Group	A-3	A-3
Fire Resistive Rating	1-Hr	Not required
Connections	Concealed	Exposed
CLT Panel Thickness	5-Ply	3-Ply
Superstructure Cost/SF	**$65/SF**	**$53/SF**

TMBR Condominiums

Construction Type
10-stories – 120’ tall
217,000 SF
Type IV-B

Mass Timber Structure
Floor Panels – 5-ply CLT w/ 2 ¼” concrete topping
Roof Panels – 7-ply CLT
Frame – Glulam beams & columns
Lateral System – Concrete core walls

Cost Drivers
7-ply CLT band-beams at column lines
Efficient geometry & column grid
Limited exposure of CLT ceilings

Mass Timber Superstructure Cost
$46/SF (2020 dollars)

Cost Drivers

Superstructure Costs	Mass Timber	Concrete	Structural Steel
Low Range	$40/SF	$38/SF	$36/SF
High Range	$70/SF	$52/SF	$45/SF

Superstructure Cost Drivers

- Construction type & fire rating
- Size & geometry of building
- Structural column grid
- CLT panel spans & thickness
- Panel size & shapes
- Depth of glulam beams
- Connection details
- Acoustic floor assembly

Offsetting Factors – Beyond Superstructure

- Schedule reduction – up to 40% faster on superstructure work
- Enhanced trade flow – no re-shores
- Smaller foundations
- Reduced floor to floor height
- Reduction in ceiling finishes
- Smaller crane size
- Reduce temp heating costs

Thank you!

Ankit Sanghvi
Preconstruction Manager
PCL Construction Services
asanghvi@pcl.com

PCL CONSTRUCTION