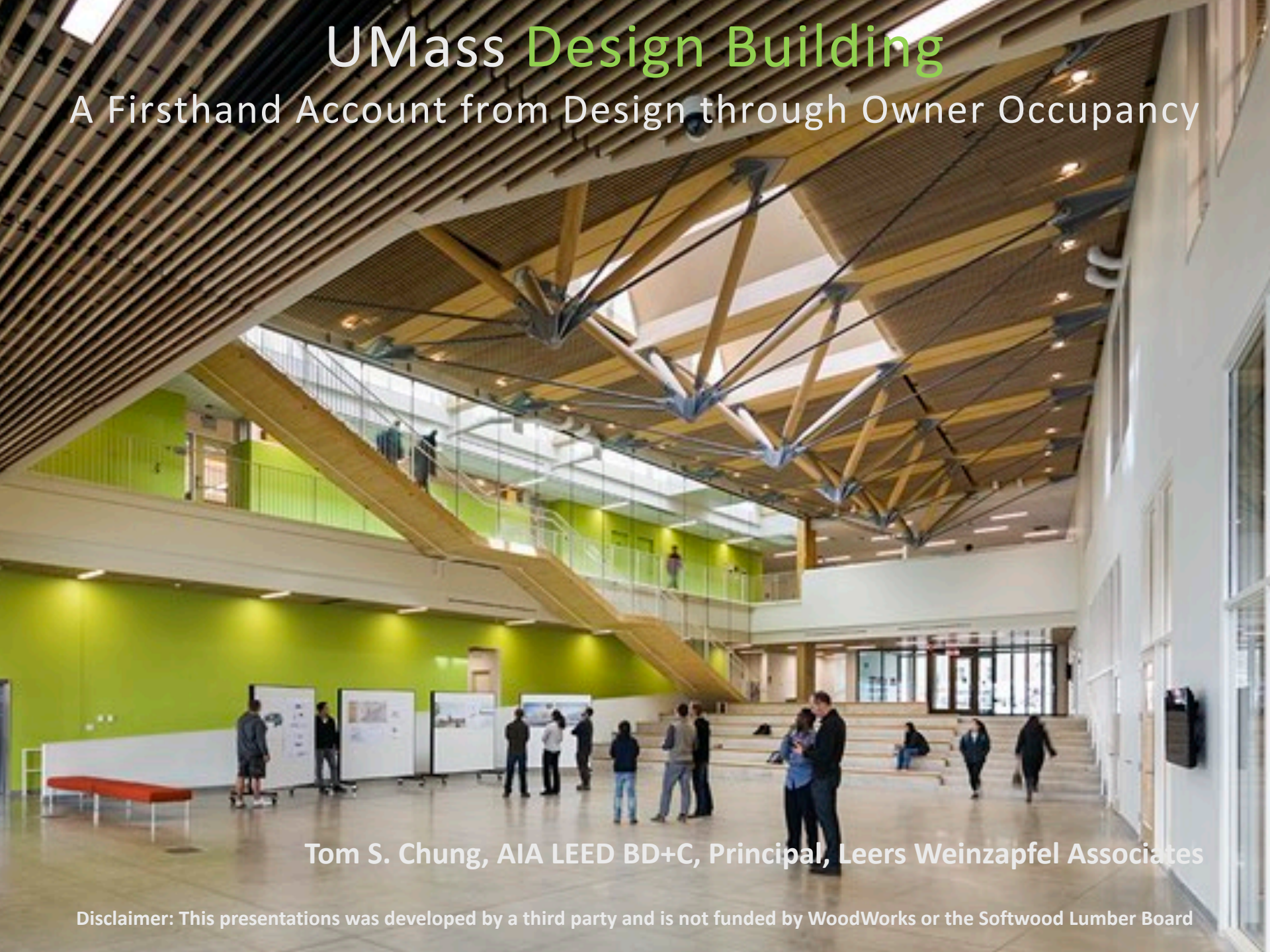


UMass Design Building

A Firsthand Account from Design through Owner Occupancy



Tom S. Chung, AIA LEED BD+C, Principal, Leers Weinzapfel Associates

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

LEERS WEINZAPFEL ASSOCIATES



LEERS WEINZAPFEL ASSOCIATES

Design Distinction

**National AIA Firm
Award**

**Ranked in
ARCHITECT
Magazine's Top 50
Firms, 2015-2018**

**Over 95 National &
Regional Design
Award**

**Over 100 National
& International
Publications**



LEERS WEINZAPFEL ASSOCIATES

Sustainability Leadership

Pioneering Use of CLT
for Campus Buildings

University of Arkansas
Largest CLT Building in
the U.S.

Harvard's 1st LEED Gold
New Construction
Project

Boston's 1st LEED Gold
Public Project

Adopters of the 2030
Challenge

UMASS AMHERST JOHN W. OLVER DESIGN BUILDING

JOHN W. OLVER
DESIGN BUILDING



UMass Design Building

A Firsthand Account from Design through Owner Occupancy

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Tom S. Chung, AIA LEED BD+C, Principal, Leers Weinzapfel Associates

UMass Design Building

A Firsthand Account from Design through Owner Occupancy

Course Description

Completed in early 2017, the Design Building at the University of Massachusetts Amherst is the first of its kind in the U.S. At four stories and 87,500 sf, this mass timber project features a glued-laminated (glulam) timber column-and-beam frame, mass timber lateral force-resisting system, hybrid cross-laminated timber (CLT)/concrete floor system, and unconventional cantilevered forms.

This presentation will highlight two aspects of the project: the design process will be discussed by the principal architect and the construction and occupancy phases will be reviewed by an associate professor who was close to the process and now works in the building. From code approval through occupancy, this session will address the process and collaboration required to see this groundbreaking structure to fruition in a steel-dominated construction industry.

Tom S. Chung, AIA LEED BD+C, Principal, Leers Weinzapfel Associates

UMass Design Building

A Firsthand Account from Design through Owner Occupancy

Learning Objectives

- Explore the design team's approach to material and construction selection for a mass timber building in lieu of traditional steel systems.
- Review the code approvals and procurement steps taken to achieve compliance for and construction of a first-of-its-kind mass timber building.
- Highlight innovative structural solutions such as composite CLT floor systems, researched at the University and implemented by the design team.
- Demonstrate the benefits realized by tenants of a mass timber building including aesthetics and occupant comfort.

Tom S. Chung, AIA LEED BD+C, Principal, Leers Weinzapfel Associates

UMass Design Building

A Firsthand Account from Design through Owner Occupancy

AGENDA/ OUTLINE

Introduction

- Background, Context, & Design Concept

Design Process

- Structure & Architecture
- Central Commons
- Assuring the Client: Budget, Procurement & Code

Construction

- Mass Timber compared to Steel Construction
- Post&Beam Construction, Composite Floors, Shaft Walls, & Bracing
- Zipper Truss Mid-air Assembly

Occupancy Phase and Benefits of Mass Timber

- User Experience and Intangibles of Wood and Architecture
- Forestry & Sustainability Benefits

Tom S. Chung, AIA LEED BD+C, Principal, Leers Weinzapfel Associates

Project Background & Design Concept



View of campus at upper left, from Connecticut River

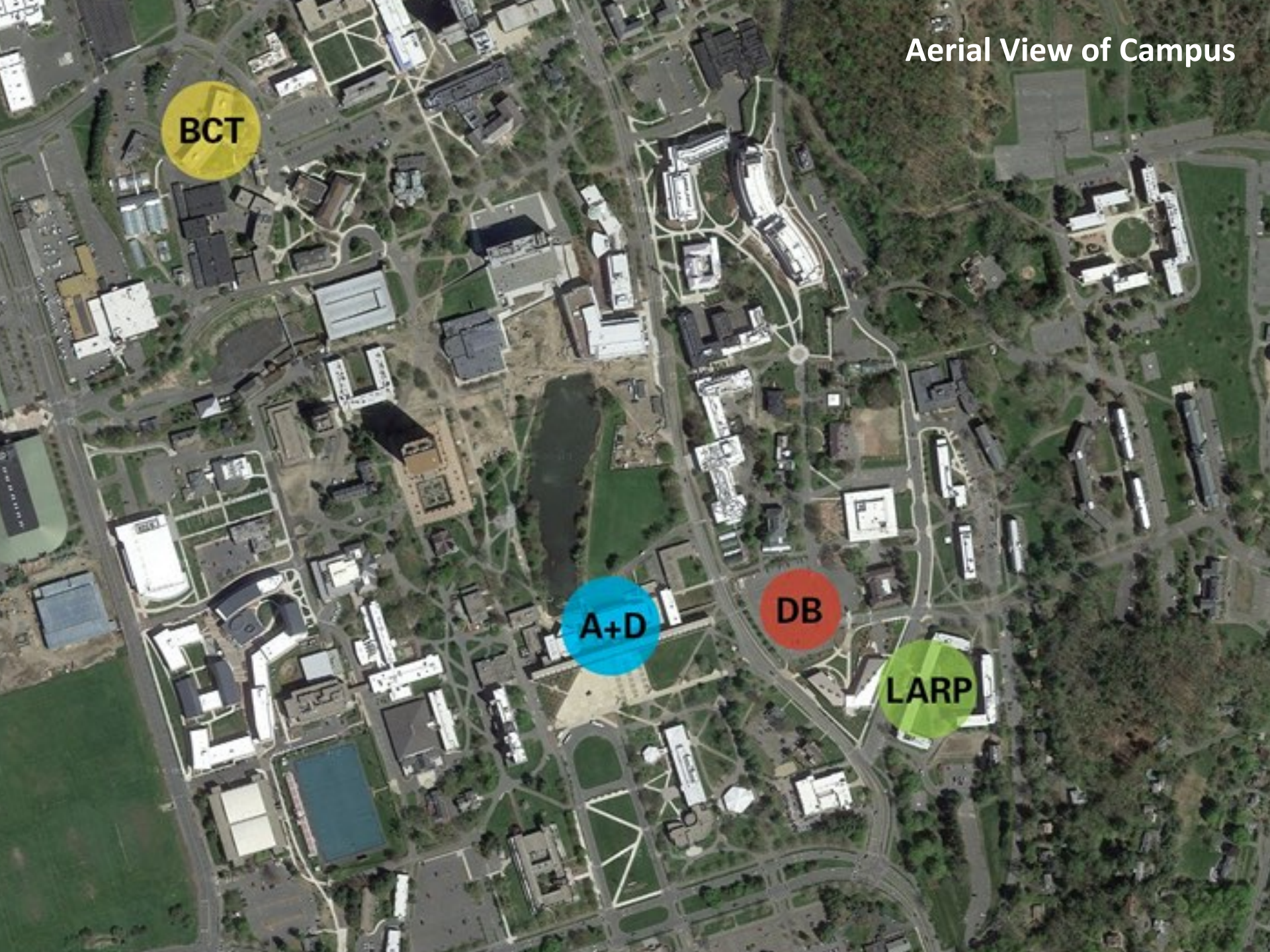
Aerial View of Campus

BCT

A+D

DB

LARP



Campus Circulation





Context

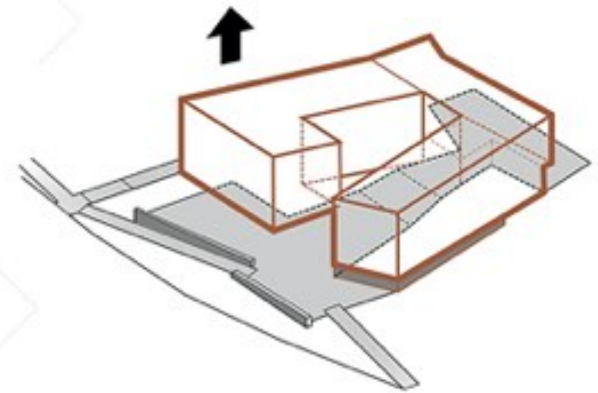
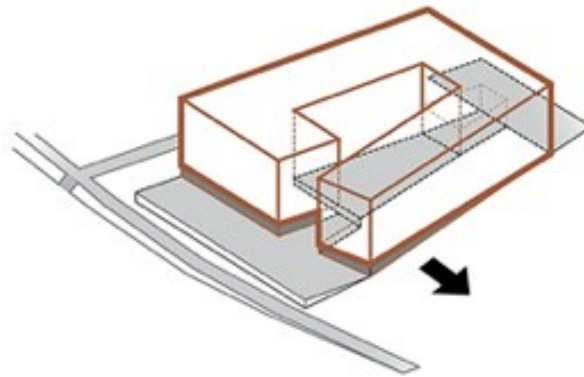
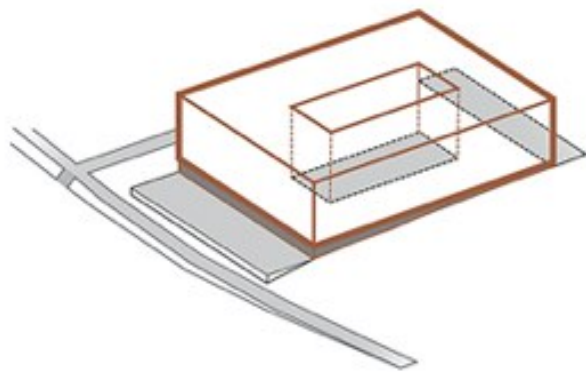


Haigis Mall

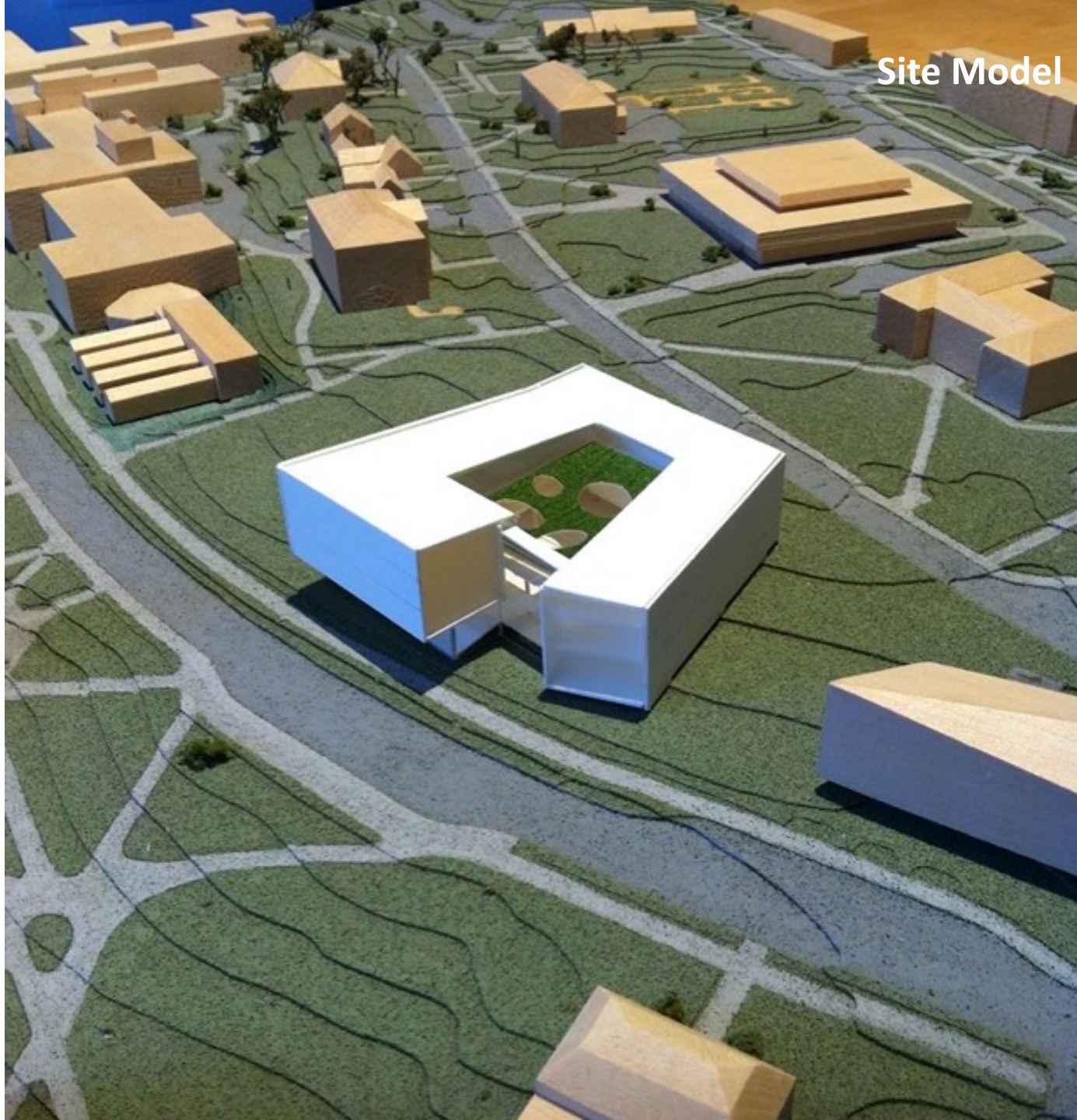


Stockbridge Way

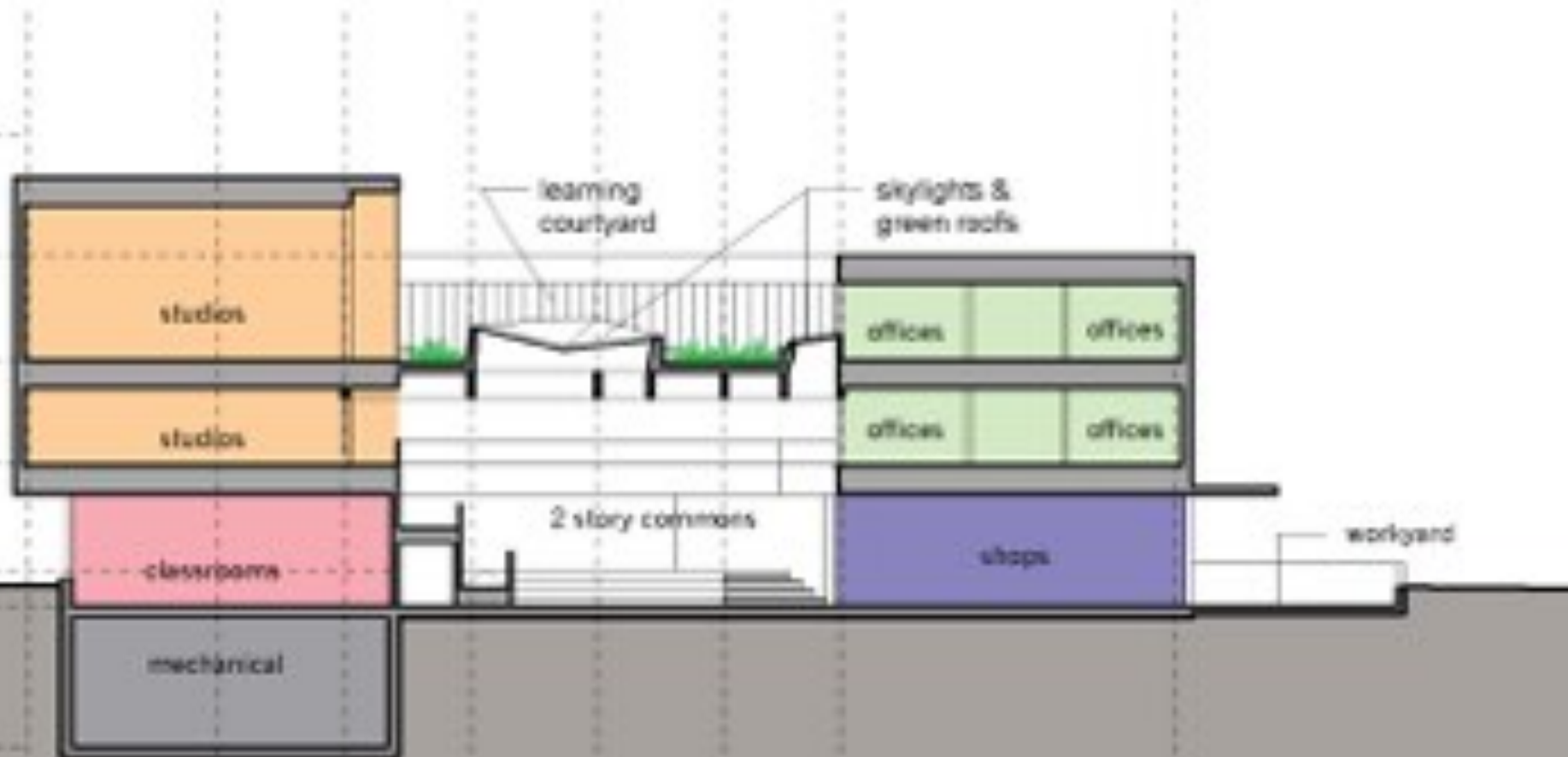
Building Concept Diagram



Site Model



Program Organization



2 STORY COMMONS
WITH LEARNING COURTYARD ABOVE
STACKED STUDIOS/ STACKED OFFICES

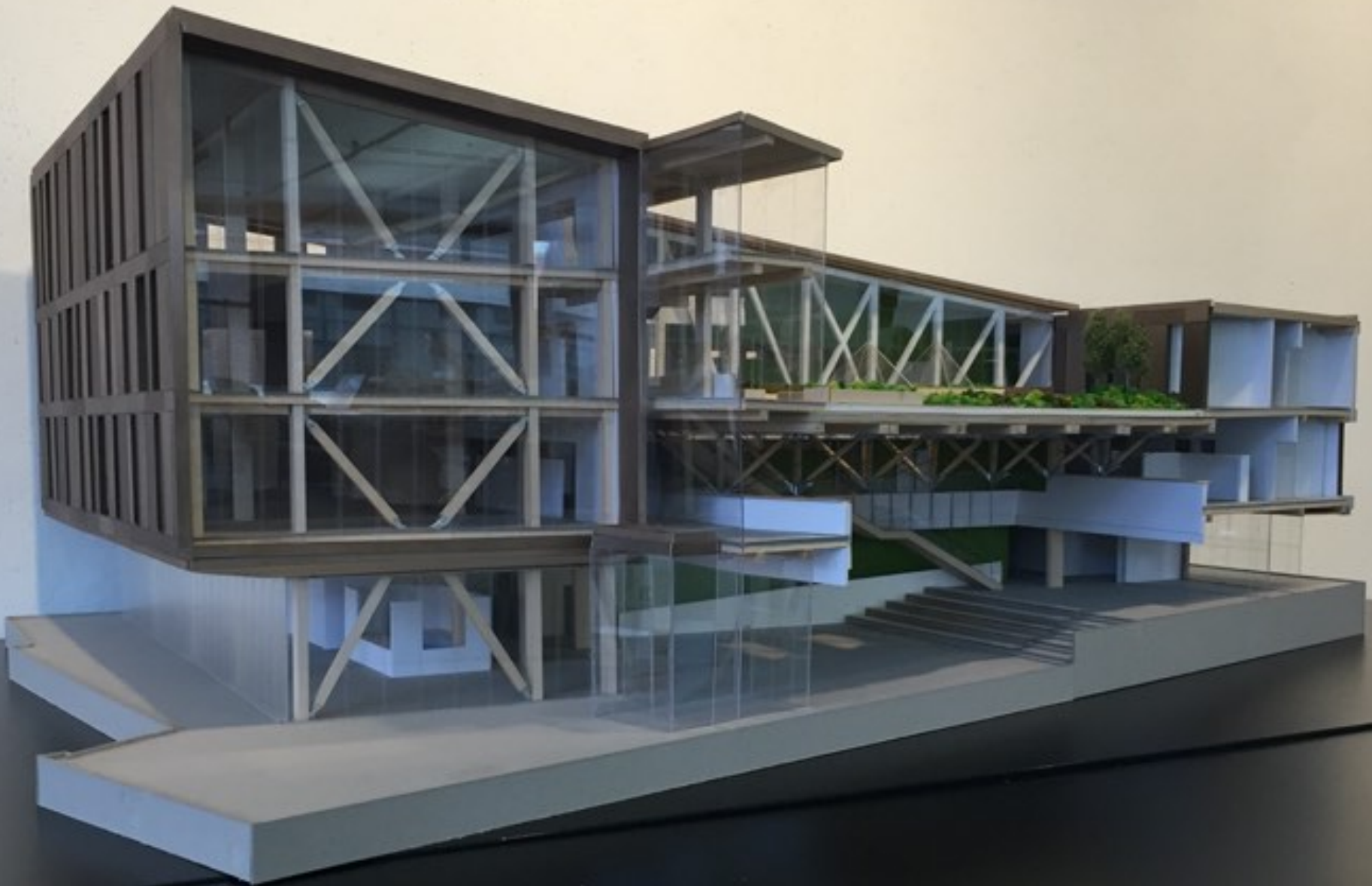


Section Through Commons and Learning Courtyard



Section Perspective

Cutaway Model



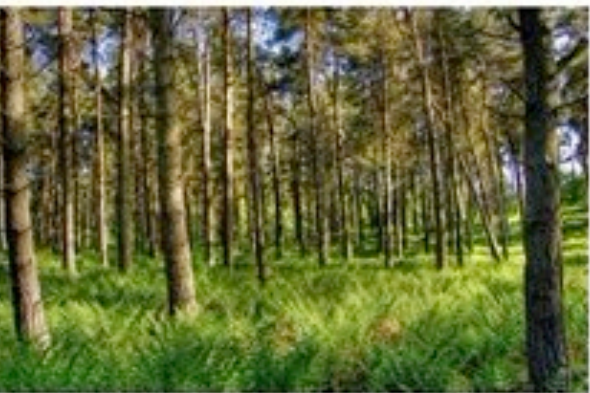
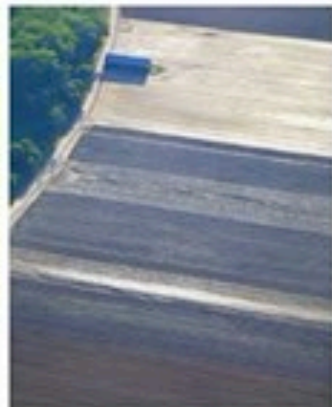
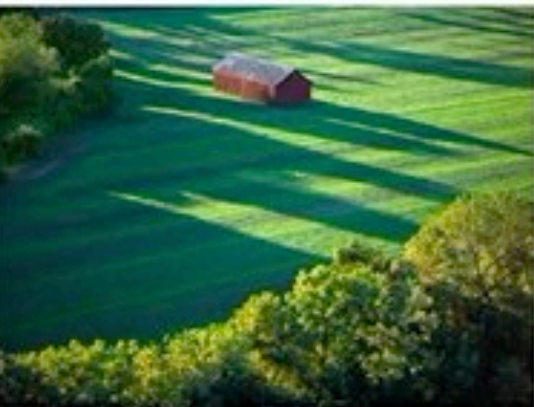
Central Commons



Learning Courtyard



Regional Context



View from Campus Core



View from Historic Stockbridge Way



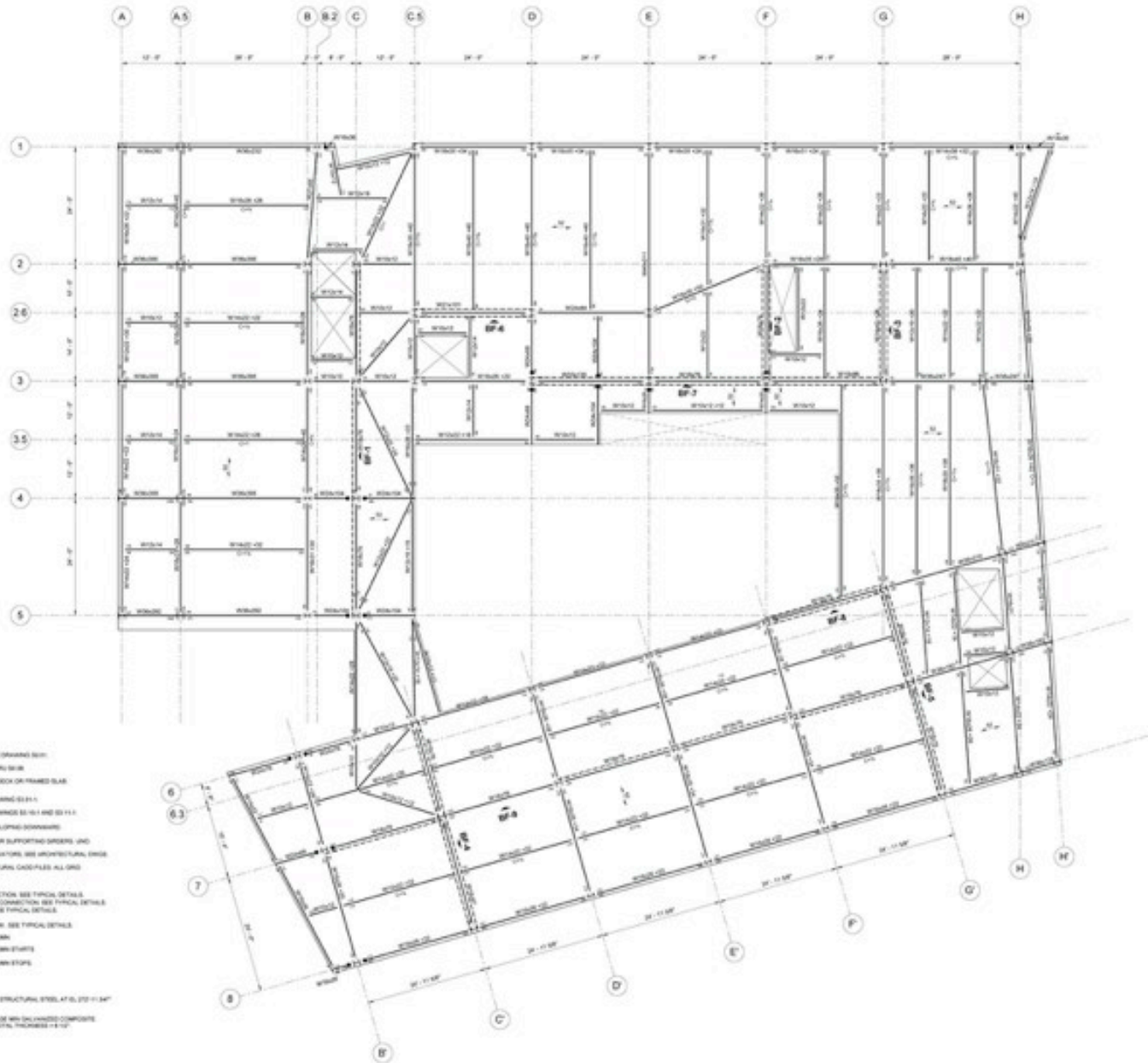
View from North Approach



Design Process

Typical Floor Plan





NOTES-GENERAL

01. FOR GENERAL NOTES AND ABBREVIATIONS SEE DRAWING 01-01.
02. FOR TYPICAL DETAILS SEE DRAWING 01-02 THRU 01-08.
03. \rightarrow INDICATES SHIP DIRECTION OF STEEL DECK OR FRAMED SLAB.
04. FOR COLUMN SCHEDULE AND DETAILS SEE DRAWING 01-11.
05. \rightarrow INDICATES SHEAR WALL, SEE DRAWING 01-11 AND 01-12.
06. \rightarrow INDICATES DIRECTION OF FRAMING (SLOPED DOWNWARD).
07. BEAMS SHALL BE EQUALLY SPACED ALONG THEIR SUPPORTING COLUMNS, AND FOR DIMENSIONS TO STAIR FRAMING AND ELEVATIONS, SEE ARCHITECTURAL DRAWING.
08. DIMENSIONS ARE TAKEN FROM ARCHITECTURAL GRID LINES. ALL DIMENSIONS SHALL BE VERIFIED.
09. \rightarrow INDICATES GRAVITY MOMENT CONNECTION, SEE TYPICAL DETAILS.
10. \rightarrow INDICATES MOMENT RESISTING CONNECTION, SEE TYPICAL DETAILS.
11. \rightarrow INDICATES TORSION CONNECTION, SEE TYPICAL DETAILS.
12. \rightarrow INDICATES SHEAR PLATE CONNECTION, SEE TYPICAL DETAILS.
13. \rightarrow INDICATES STRUCTURAL STEEL COLUMN.
14. \rightarrow INDICATES STRUCTURAL STEEL COLUMN-TO-BEAM.
15. \rightarrow INDICATES STRUCTURAL STEEL COLUMN-TO-WALL.

NOTES-SECOND FLOOR

1. TOP OF STRUCTURAL SLAB AT 8L 210'-0" TOP OF STRUCTURAL STEEL AT 8L 210'-0" UNLESS NOTED TO THE CONTRARY.
2. \rightarrow INDICATES SHIP DIRECTION OF 1/4" GAUGE W/ UNPAINTED COMPOSITE STEEL DECK TO 1/4" LIGHT WEIGHT CONCRETE, TOTAL THICKNESS 4-1/2" REPAIR IN HALL BAY 2 REPAIR THROUGHOUT.

DESIGN BUILDING
UNIVERSITY OF MASSACHUSETTS,
AMHERST, MA



ARCHITECTURAL FLOOR
UMH (2-10)

DATE

DESIGN DEVELOPMENT COST
ESTIMATE
11 AUGUST 2014

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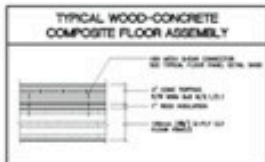
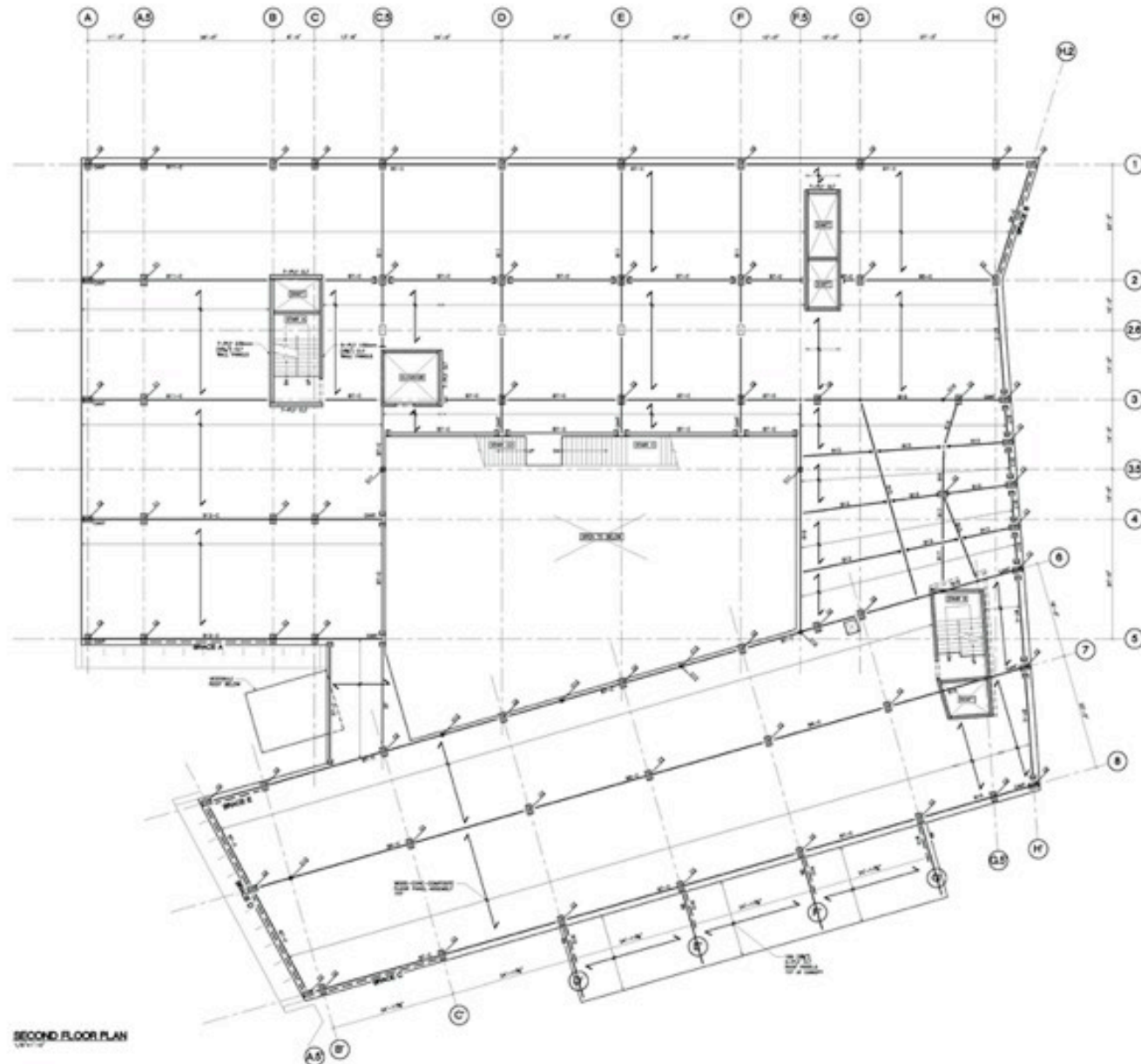
NAME

DATE

S2.02

© 2014 MASSACHUSETTS ARCHITECTS ASSOCIATION

Timber Column Grid



NO.	SECTION	TYPE & SIZE	SPACING
B1	WOOD	6" x 10" S.D.	24" OC
B2	WOOD	6" x 10" S.D.	24" OC
B3	WOOD	6" x 10" S.D.	24" OC
B4	WOOD	6" x 10" S.D.	24" OC
B5	WOOD	6" x 10" S.D.	24" OC
B6	WOOD	6" x 10" S.D.	24" OC
B7	WOOD	6" x 10" S.D.	24" OC
B8	WOOD	6" x 10" S.D.	24" OC
B9	WOOD	6" x 10" S.D.	24" OC
B10	WOOD	6" x 10" S.D.	24" OC
B11	STEEL	W6 x 15	36" OC
B12	STEEL	W6 x 15	36" OC
B13	STEEL	W6 x 15	36" OC
B14	STEEL	W6 x 15	36" OC
B15	STEEL	W6 x 15	36" OC
B16	STEEL	W6 x 15	36" OC
B17	STEEL	W6 x 15	36" OC

* IF JOISTS MADE OF STEEL, JOISTING BEAM
 TYPE & SIZE
 TYPE & SIZE
 TYPE & SIZE

COLUMN SCHEDULE			
NO.	SECTION	TYPE & SIZE	SPACING
C1	WOOD	6" x 10"	12-18" DIA.
C2	WOOD	6" x 10"	12-18" DIA.
C3	STEEL	100" x 100"	WIDE OPEN, SPACED 1
C4	STEEL	100" x 100"	WIDE OPEN, SPACED 1
C5	STEEL	100" x 100"	WIDE OPEN, SPACED 1
C6	STEEL	100" x 100"	WIDE OPEN, SPACED 1
C7	STEEL	100" x 100"	WIDE OPEN, SPACED 1

EQUILIBRIUM
 Equilibrium Consulting Inc.
 Structural Engineers
 1000 Highway 101, Suite 100
 North York, Ontario M2H 3B9
 Tel: (416) 491-1111
 Fax: (416) 491-1112
 Email: info@equilibrium.ca
 Website: www.equilibrium.ca

**UMASS
 INTEGRATED
 DESIGN BUILDING**
 University of Massachusetts
 Amherst, MA

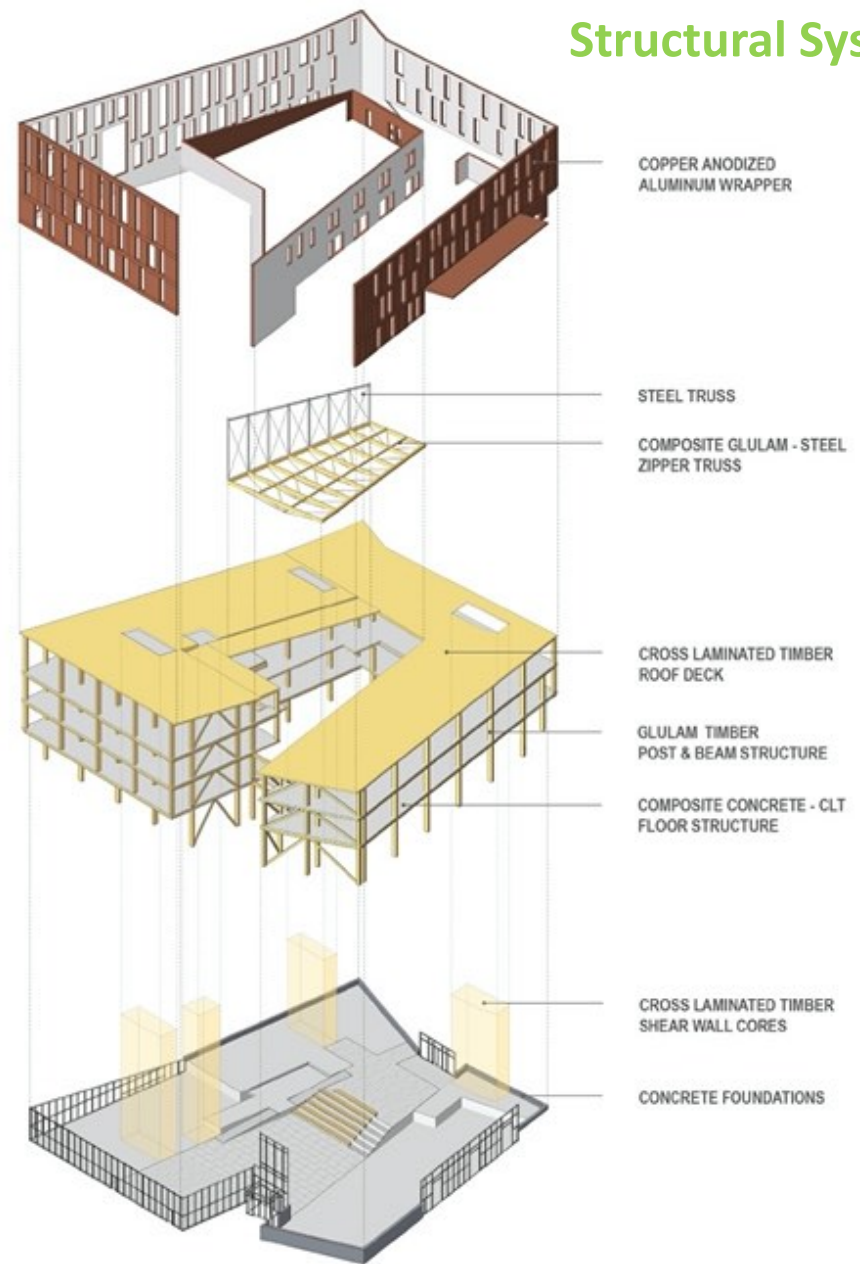


Project #12-A3
 UMASS BUILDING #720



Project No.	12-A3
Client	UMass
Architect	Woods
Engineer	Equilibrium
Date	01-11-12

Structural Systems





CLT



GLULAM



NLT



DLT



LVL



LSL



PSL



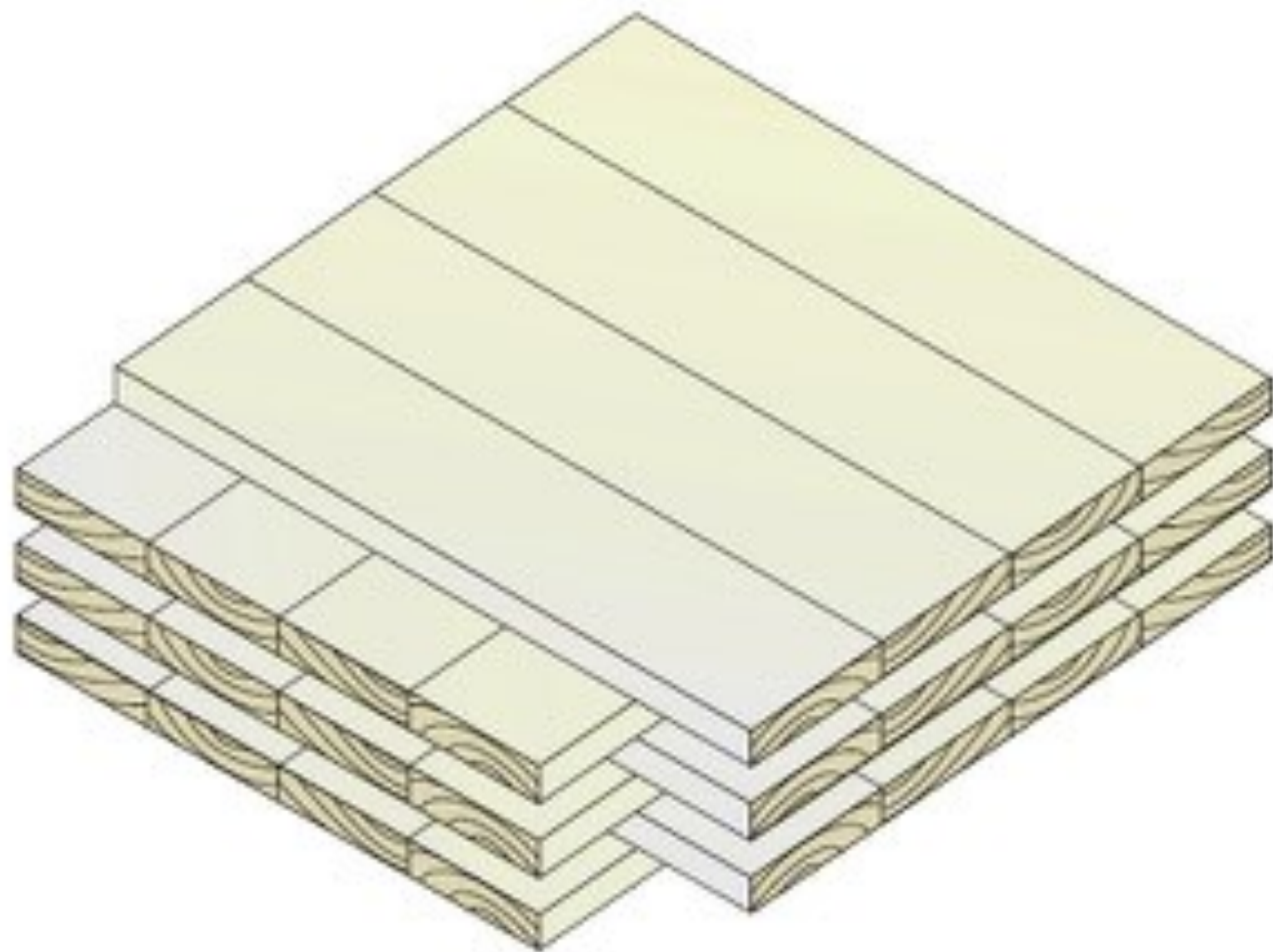
MPP

**Glue Laminated (Glu-lam)
Beams, Columns, and Diagonal Bracing**

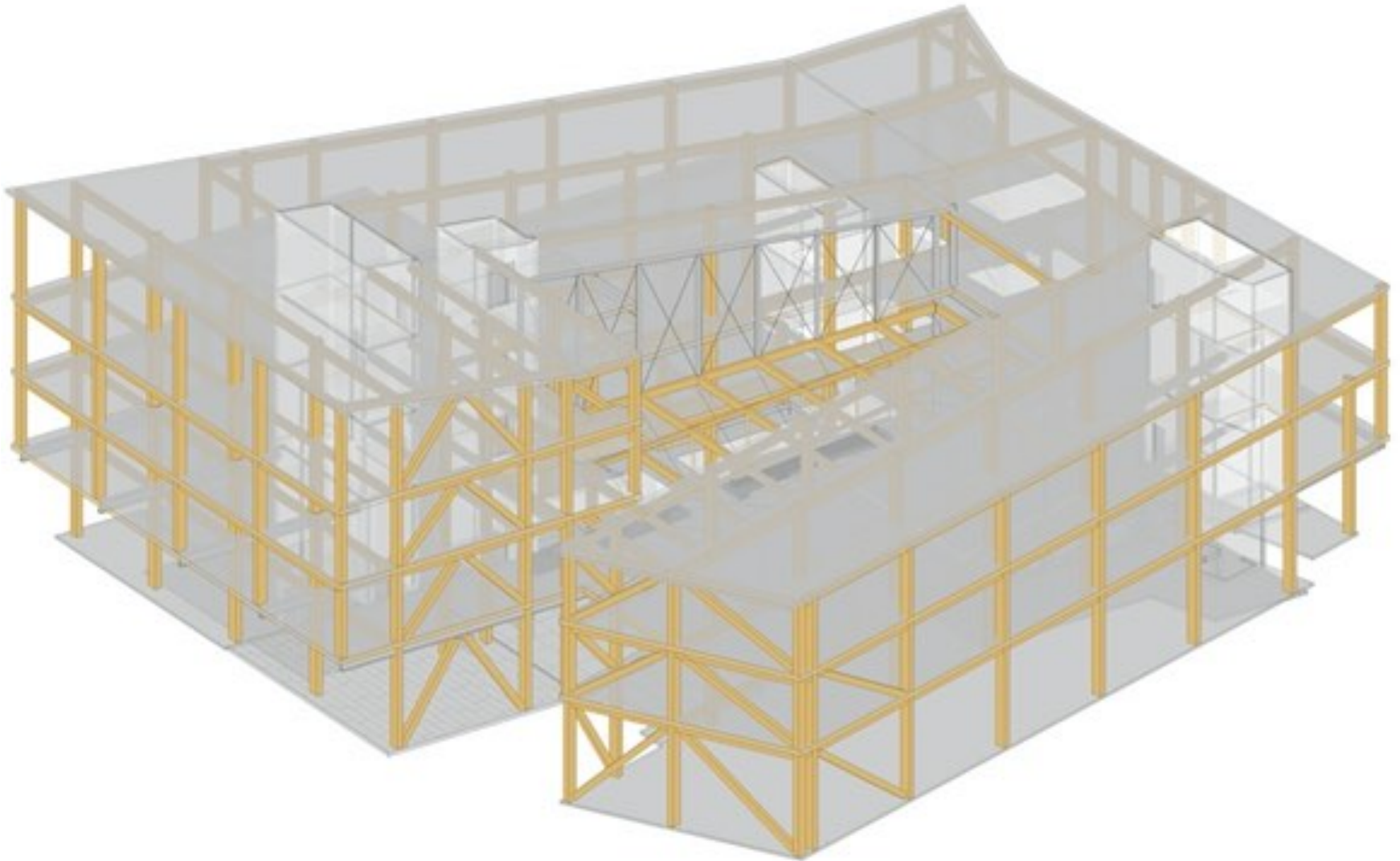


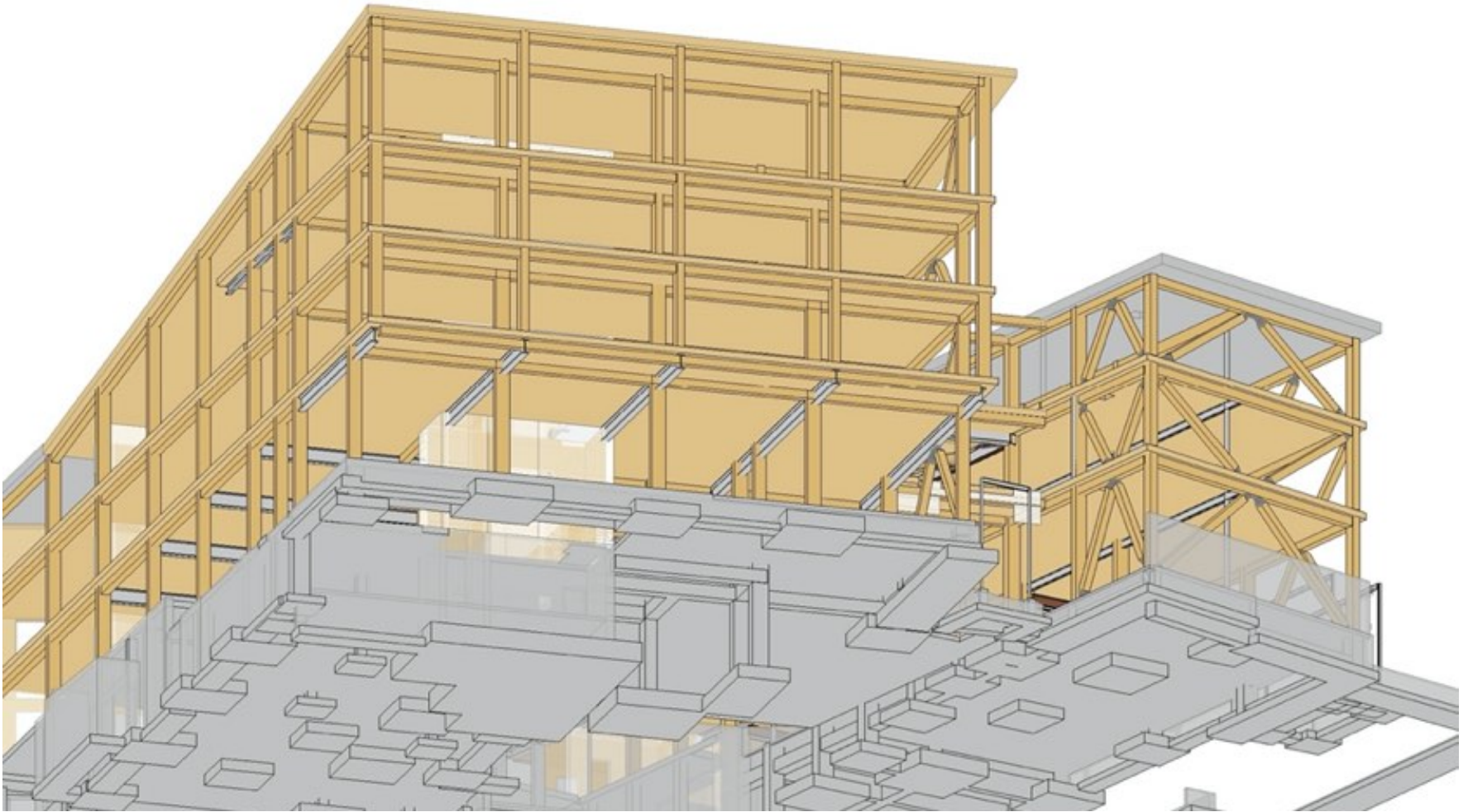
Cross Laminated Timber (CLT)
for Floor Panels and Shear Walls





Post and Beam Structural Framework







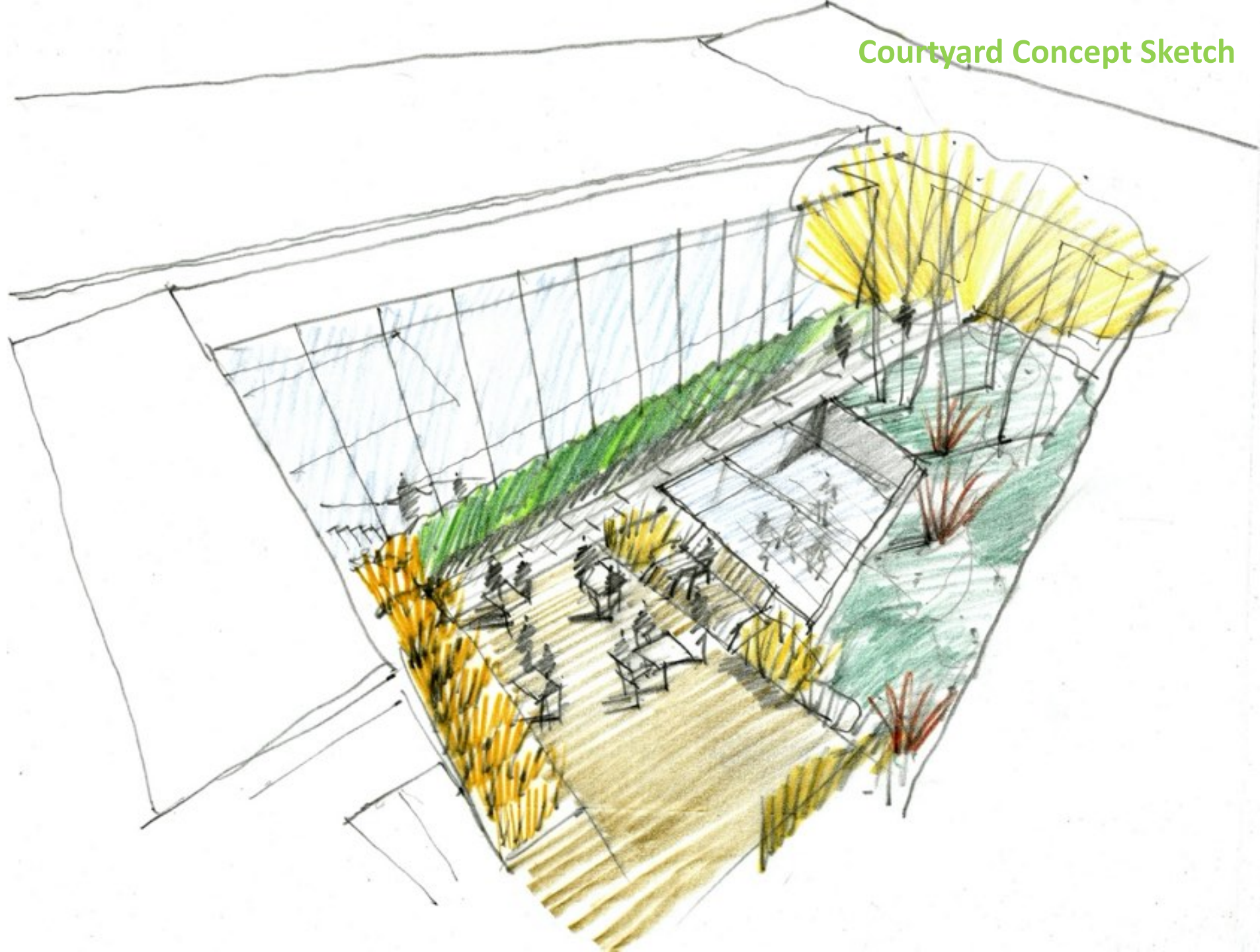
Central Commons and Courtyard Design

Structural Challenges:

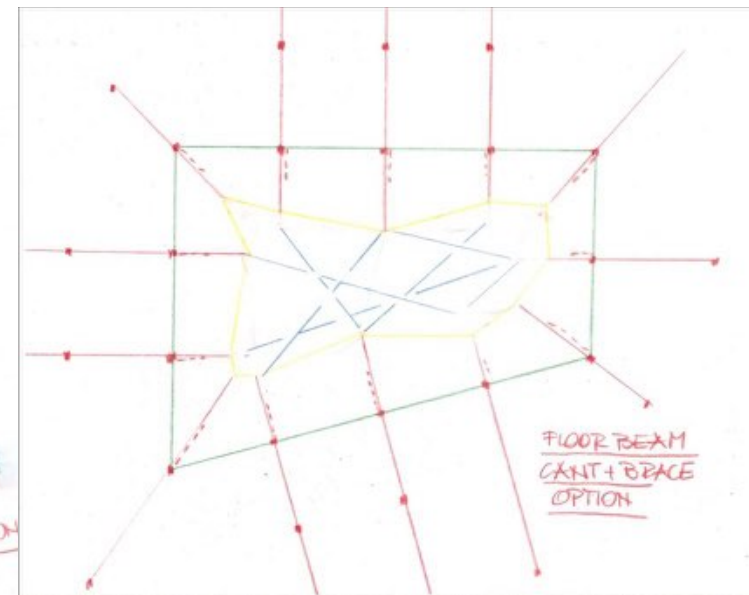
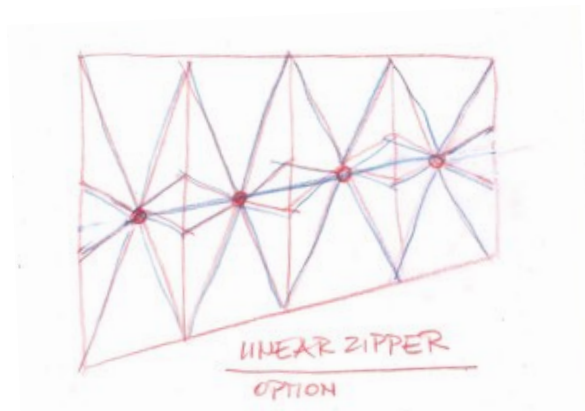
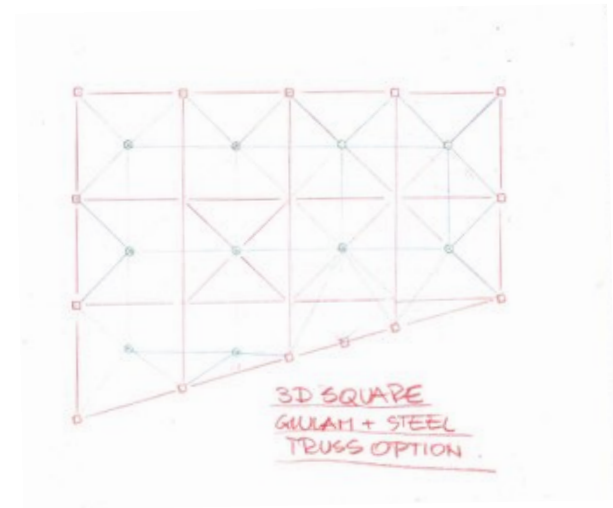
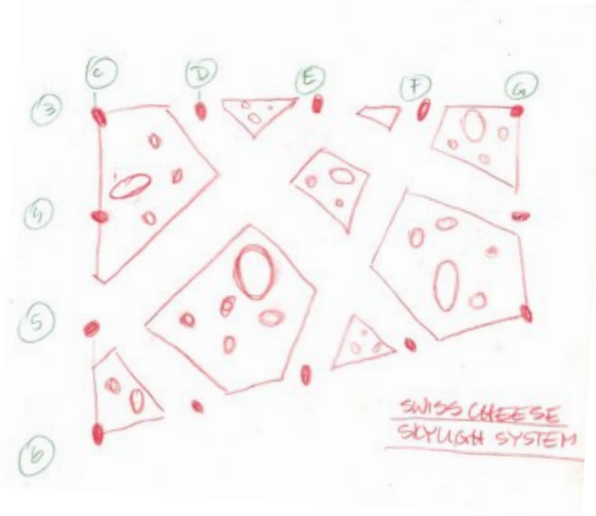
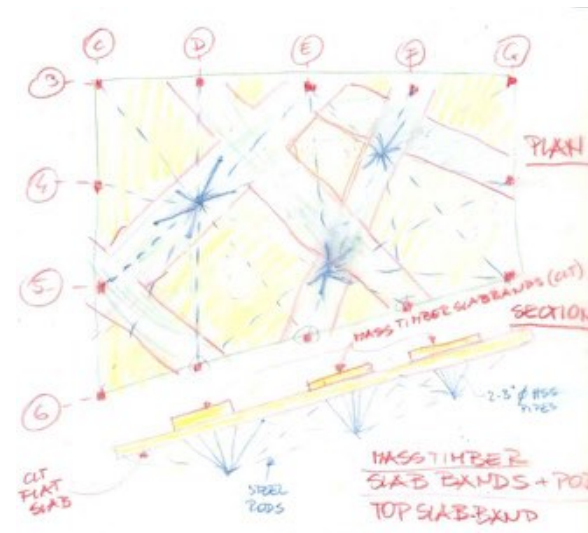
- Longest span with heavy loading above
- Minimize structural depth
- Wet garden on a wood structure



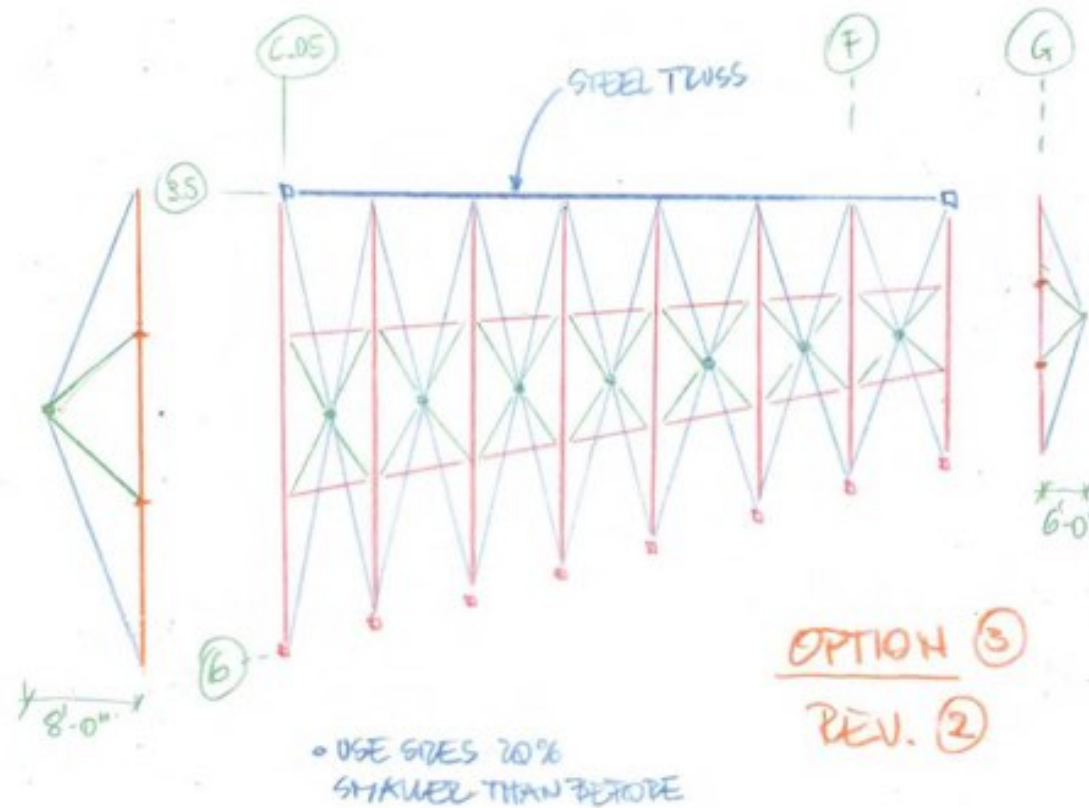
Courtyard Concept Sketch



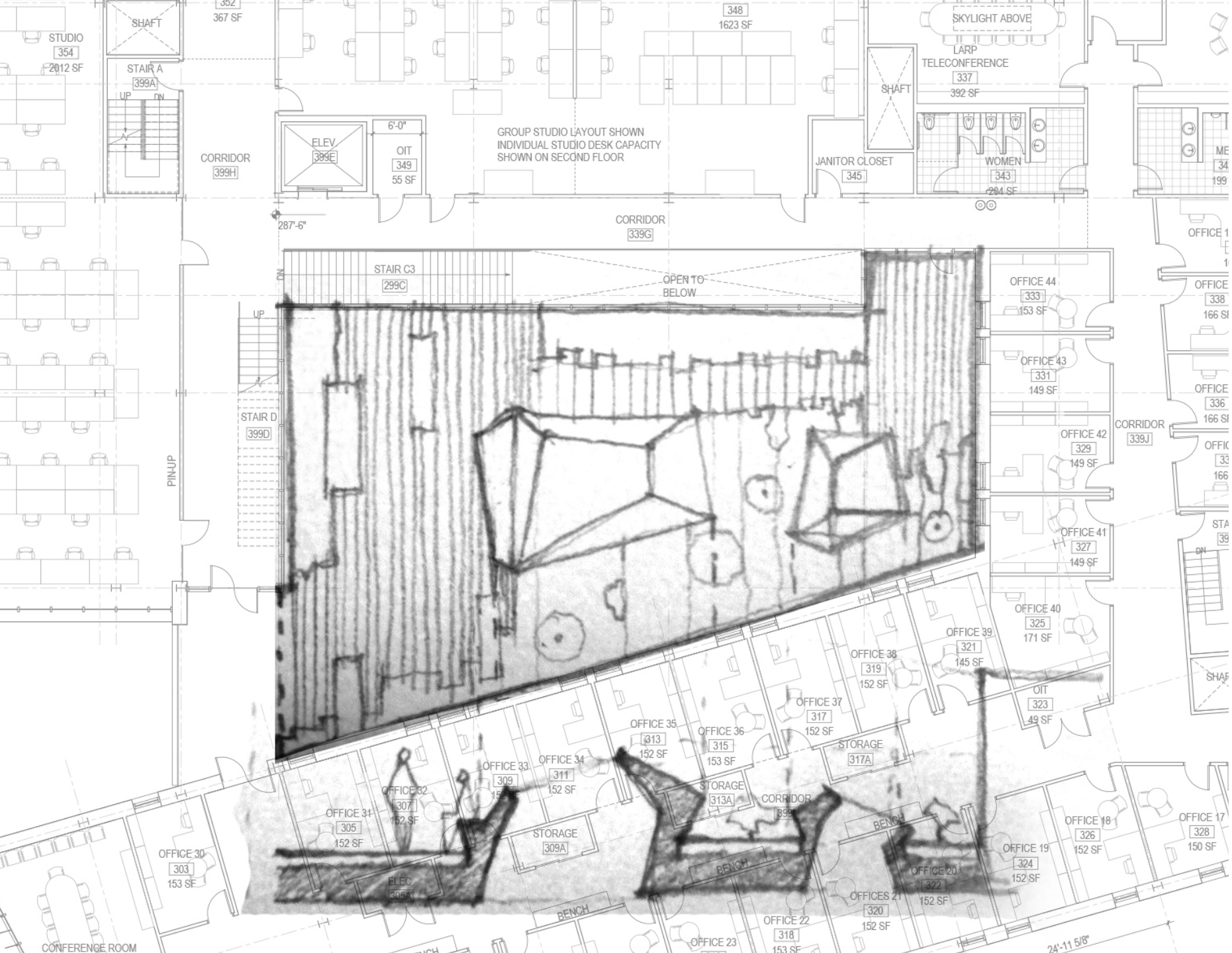
Central Space Structural Concepts



Zipper Truss Final Concept

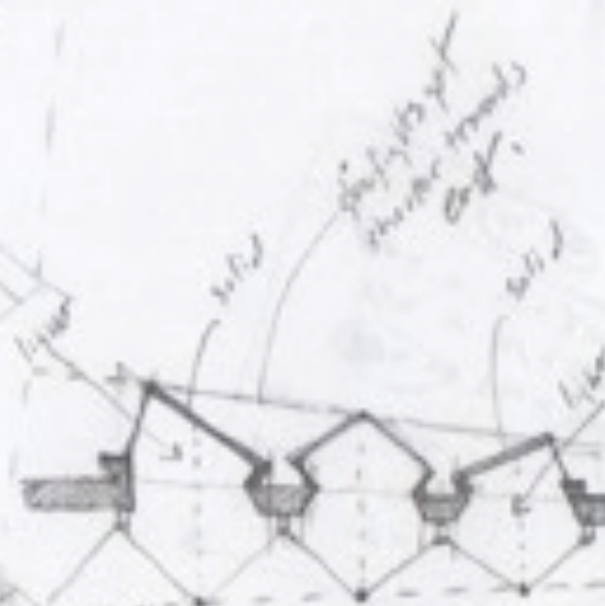
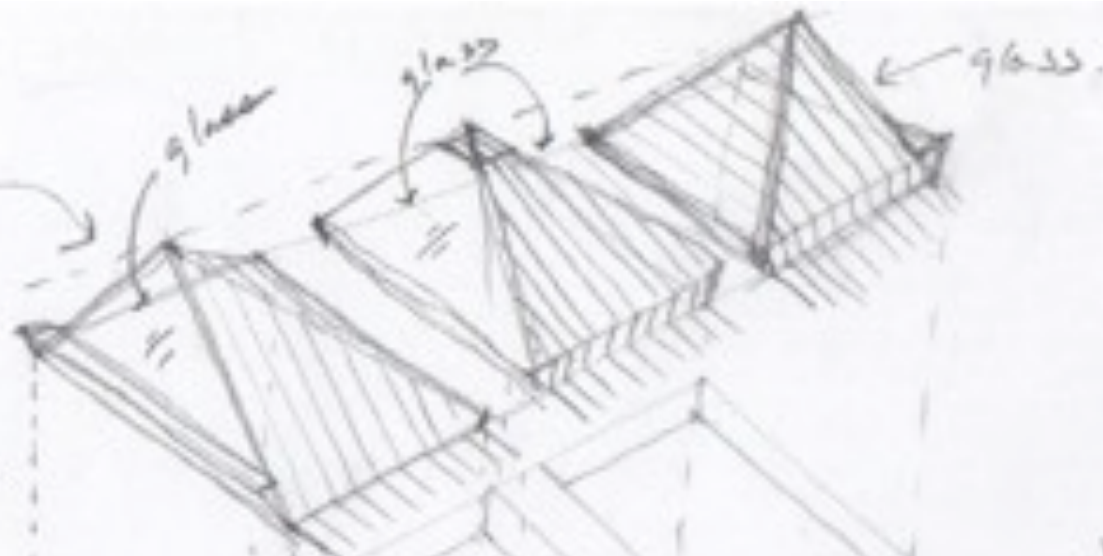






Variations
on
the
reverse pyramid
geometry of
zipper brass
below.

but still has
a more symmetrical
form.

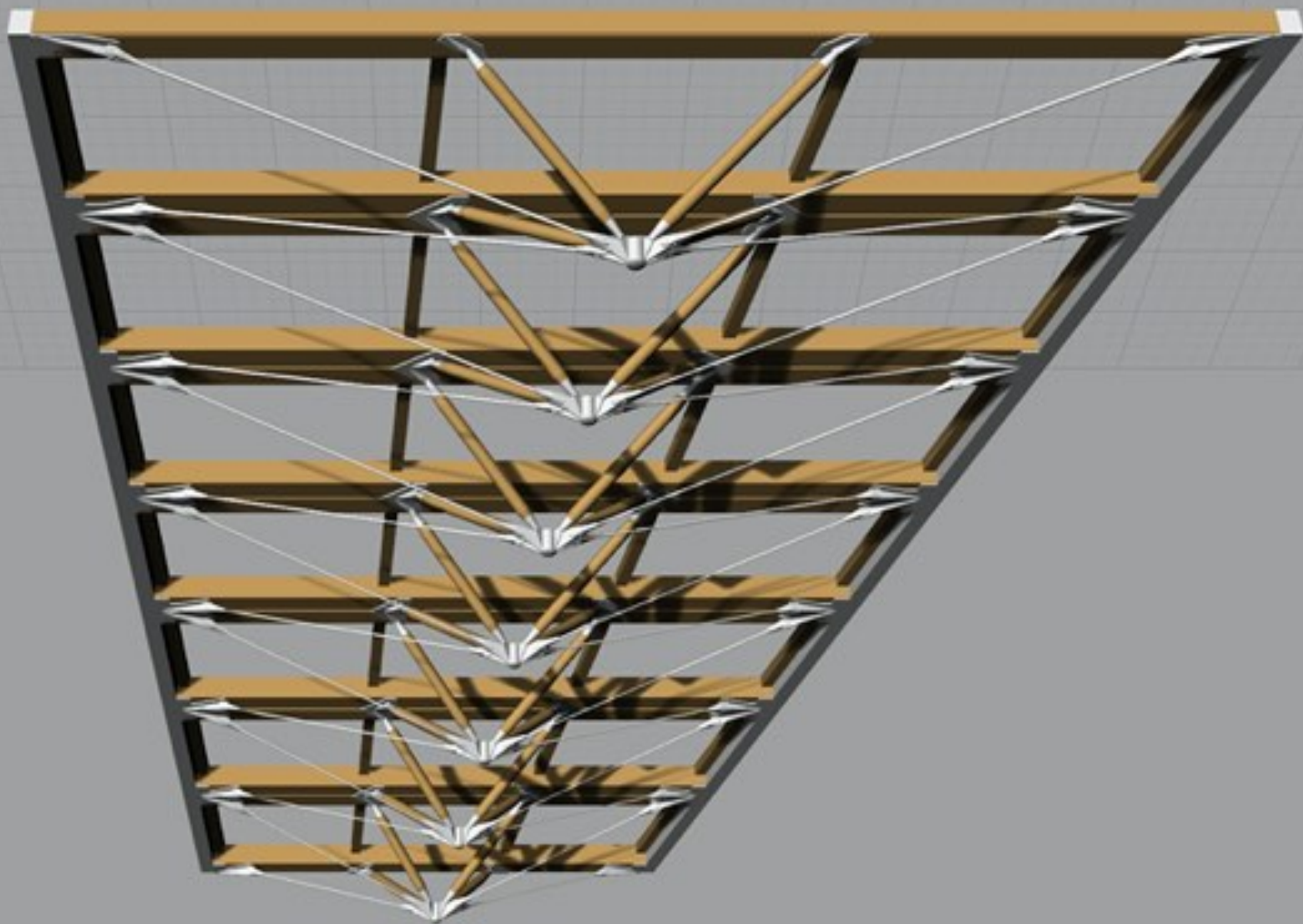


zipper gets shallower
towards east.

Courtyard Model Views

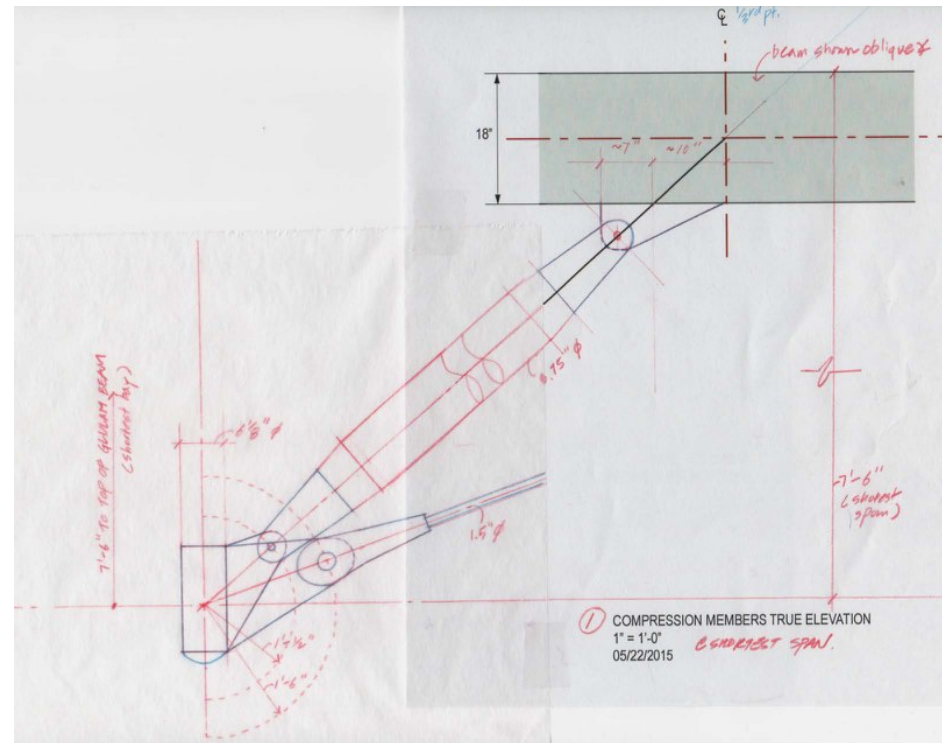
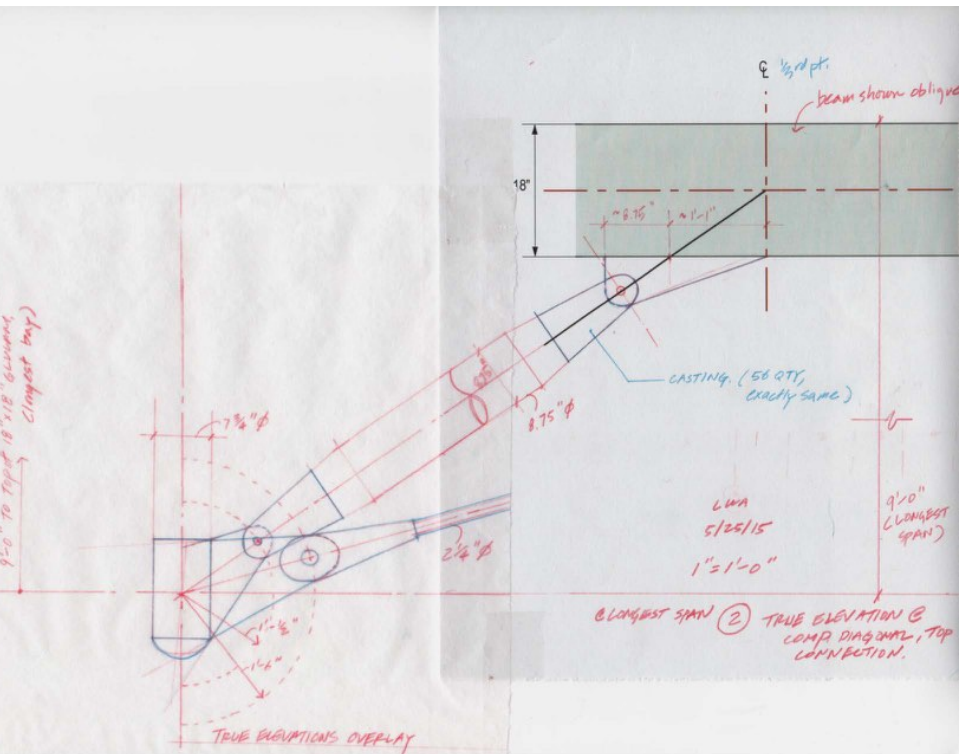


Zipper Truss Model





Central Connector Studies





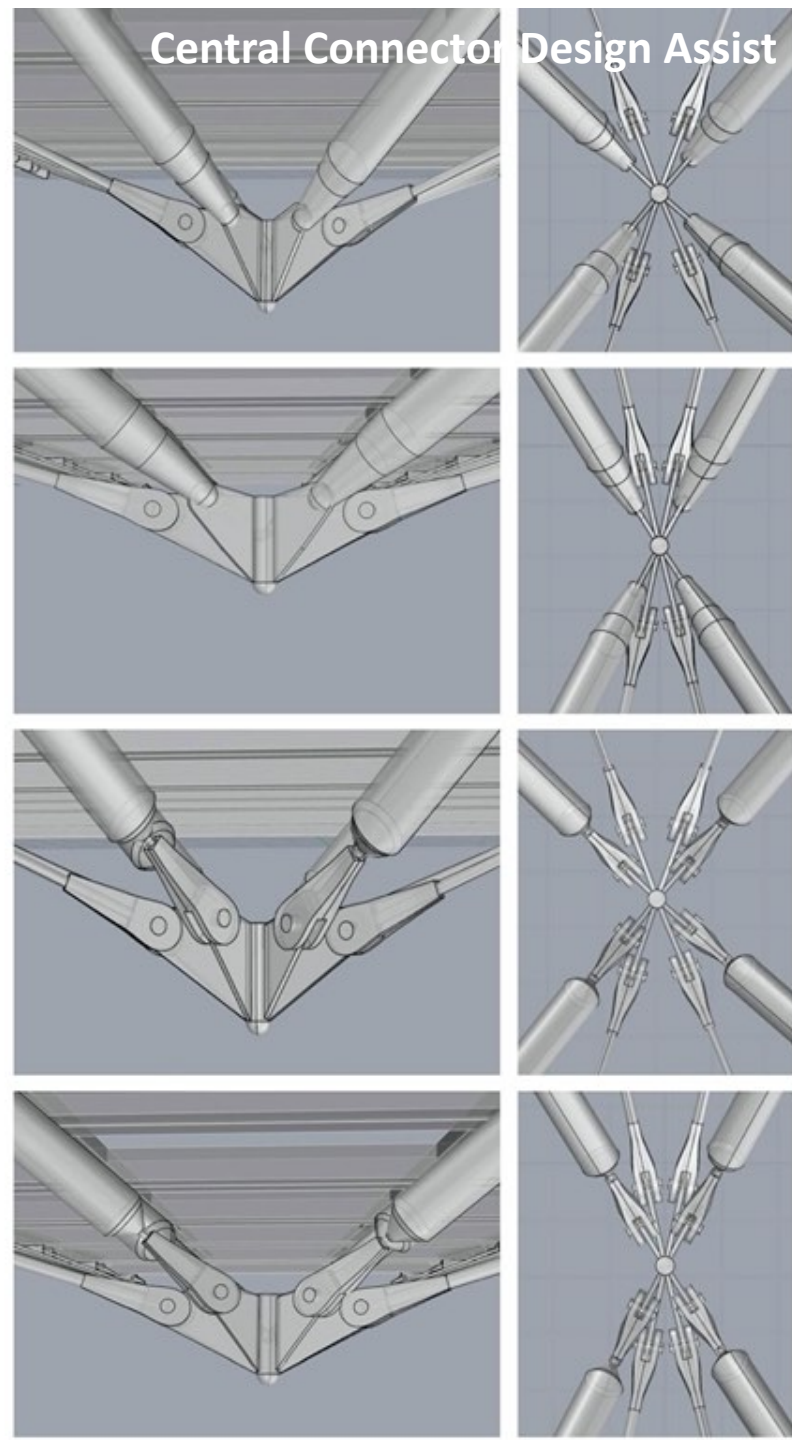
SHORTEST SPAN
CAST ENDS

LONGEST SPAN
CAST ENDS

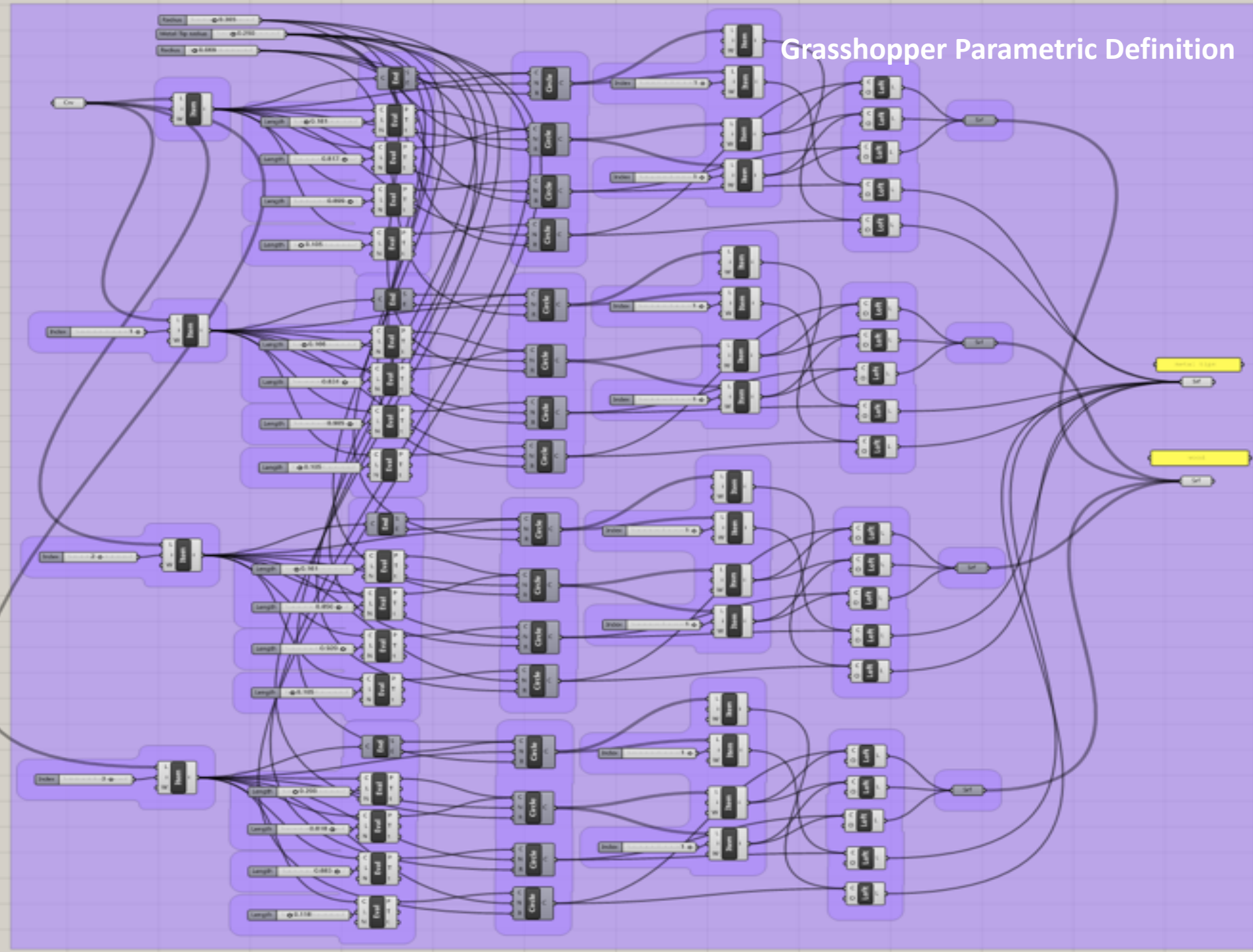
SHORTEST SPAN
RESISTA COMPRESSION CONNECTORS

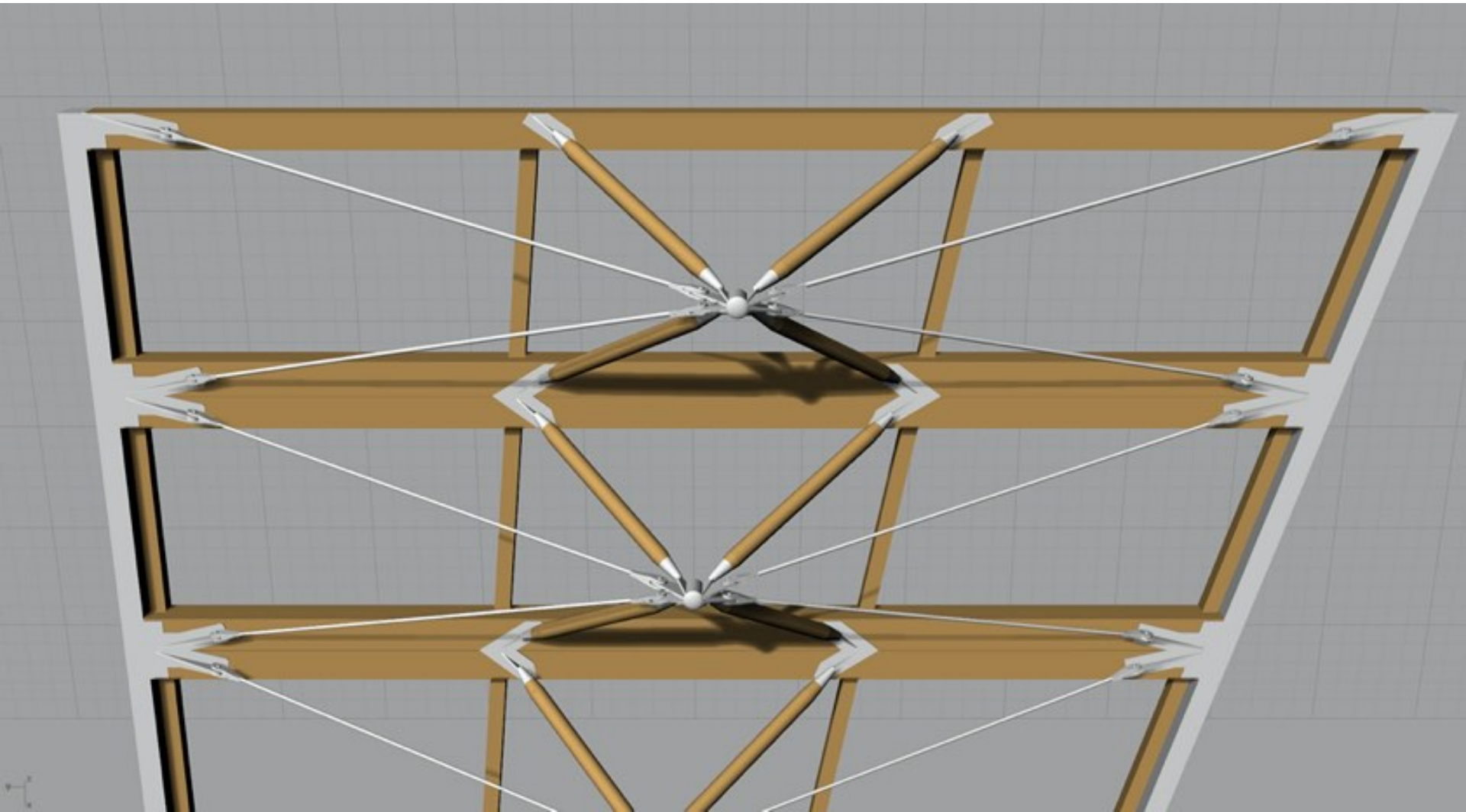
LONGEST SPAN
RESISTA COMPRESSION CONNECTORS

Central Connector Design Assist

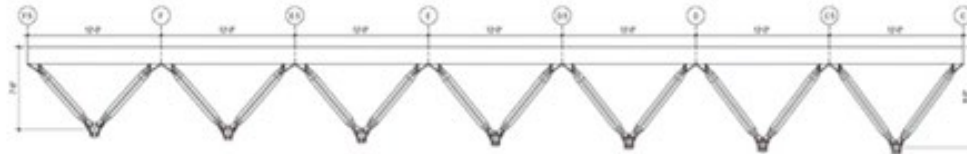


Grasshopper Parametric Definition

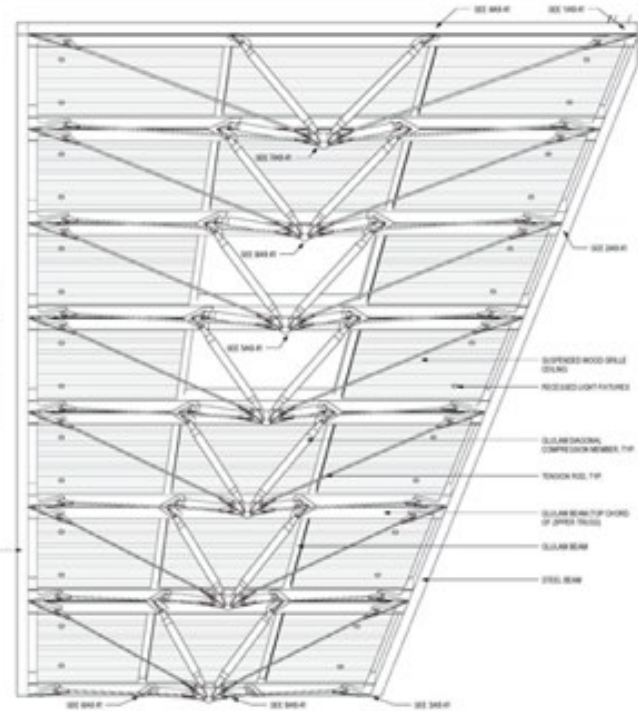




Profile and Layout



4 Upper Trunk, Elevation View from North, Looking South
1000 475



3 Zipper Truss, General View From Below (Zipper Truss & Suspended Wood Gills Ceiling Shown Only)



2 Zapper Truss, Elevation View From East Looking West
1994, 1995

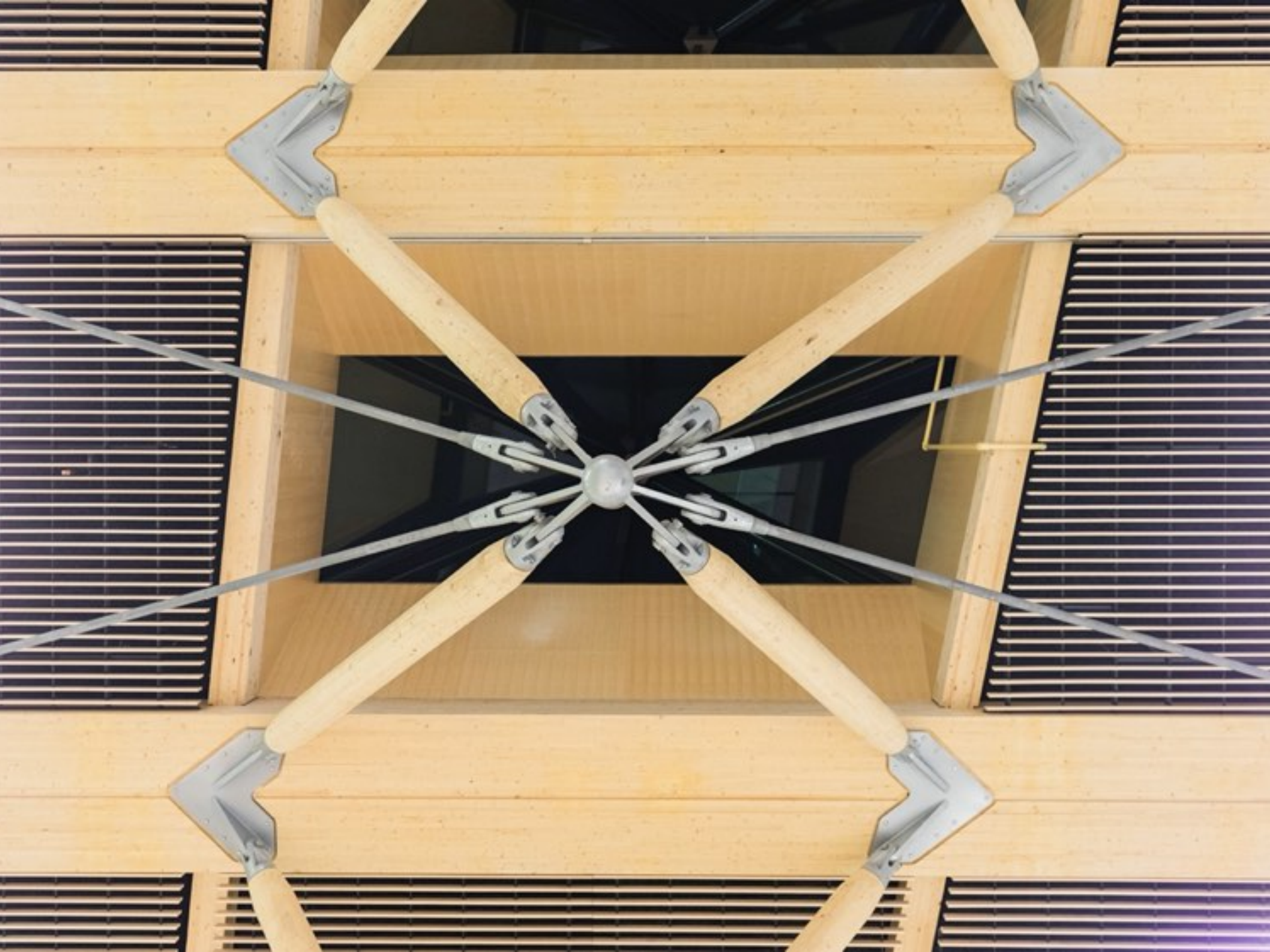


1 Upper Truss, Elevation View From West, Looking East
2001, 2012

GENERAL NOTES

- [illegible]













Project Team

- **Client: University of Massachusetts Building Authority**
- **User: University of Massachusetts, Amherst
Architecture & Design, LARP, Building Construction & Technology**
- **Architectural / Structural Design Team:**
Architect: Leers Weinzapfel Associates
Structural Design Engineer: Equilibrium Consulting
SER: SGH
- **AHJ:**
MA State Building Inspector
MA Board of Appeals
- **Construction Team:**
Construction Manager
Timber Fabricator and Installer

Key Issues

- **Danger of “Over Estimating Contingency” by Construction Managers or Cost Estimators due to the “Unknown”**
- **Importance of multiple Bidders**
- **Coordination of Fabricator and Installer Team**

CLT roof/floor
panels and shear
walls

CLT floor panels
and glulam beams
with composite
concrete



Process: Code Review & Variance



TESTING



Process: Code Review & Variance

Proposed Alternate Structural Systems

Cross Laminated Timber (CLT) roof and floor decks and shear walls

- 20 + years in Europe, recent projects in Canada similar to IDB
- Recognized in 2015 International Building Code and 2015 National Design Specification for Wood
- ANSI/APA PRG -320: current material fabrication requirements and stress grades
- CLT Handbook US Edition : Guidelines for CLT design and construction published by FPI, FPL and APA
- Connections between CLT panels similar to traditional wood frame construction
- Employing high strength, ductile HSK connections as shear wall anchors

CLT floor decks and glued laminated timber beams with composite concrete deck

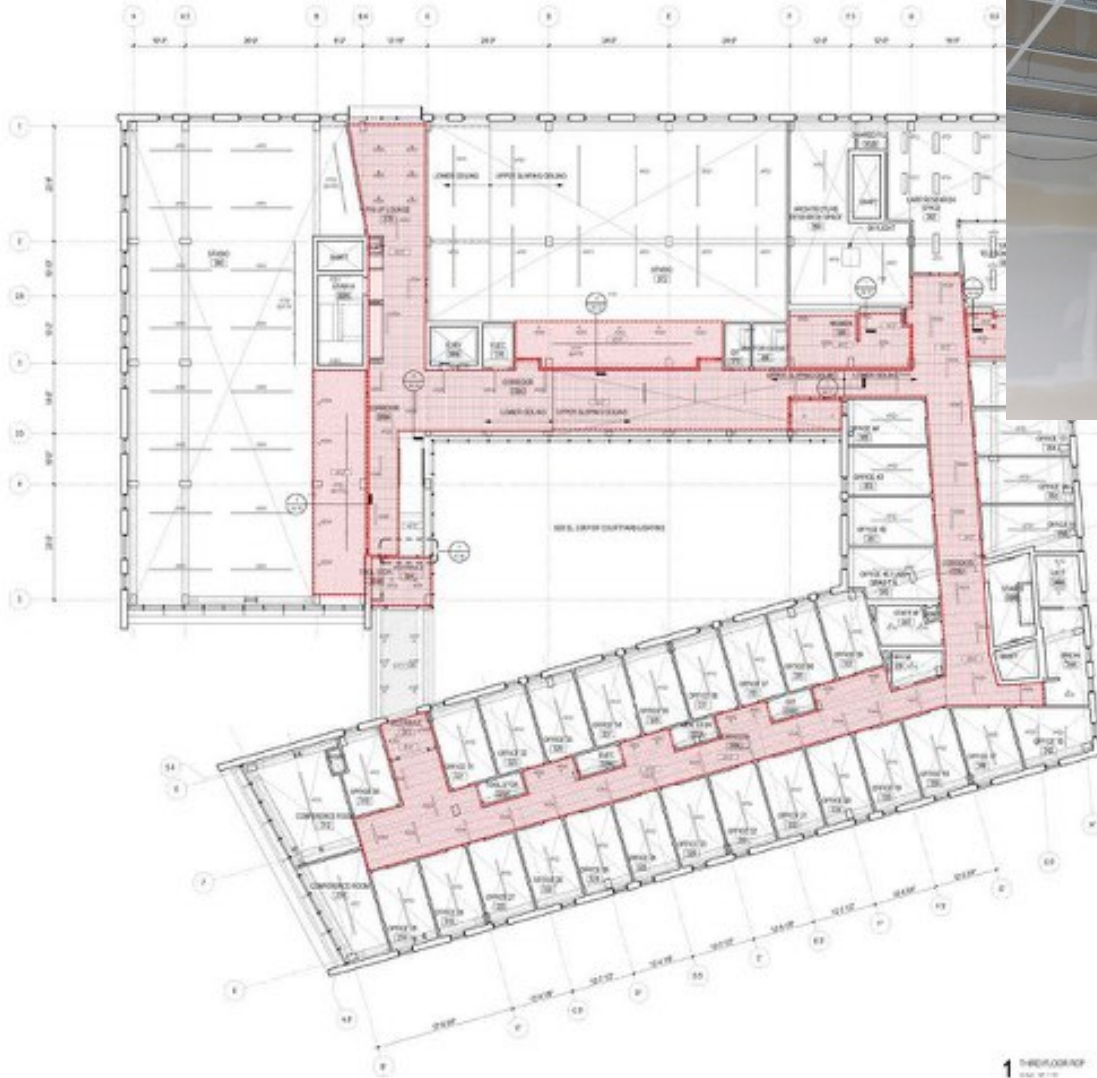
- 20 + years in Europe, extensive research and testing in Germany with HBV connector system
- CLT units provide required strength, concrete decks only counted on for stiffness

Alternative Structural Systems



Process: Code Review & Variance

Concealed Ceiling Areas



5318 SF CONCEALED SPACE
23.8% OF FLOOR AREA HAS
CONCEALED SPACE

1 THE BROWLDER GROUP

NOTES
1. SEE ELECTRONIC SUPPLEMENTARY MATERIALS
ON WWW.RSC.ORG FOR FULL TEXT OF
ARTICLE AND COMMENTS.

THIRD FLOOR
REFLECTED
CEILING PLAN

A6.03

CONSTRUCTION


How is it Constructed?

Very Much like a Steel Building

Steel Post & Beam  **Glulam Post & Beam**

Steel/Concrete Floors  **CLT/Concrete Floors**

Steel Deck Roof  **CLT Roof**

Concrete Shafts  **CLT Shafts**

Steel Braces  **Glulam Braces**

Post and Beam Structural Framework

Steel



Post and Beam Structural Framework





Glulam Beam to Column Connection



Glulam Beam to Column Connection



Steel-Concrete Composite



Steel – Concrete Composite



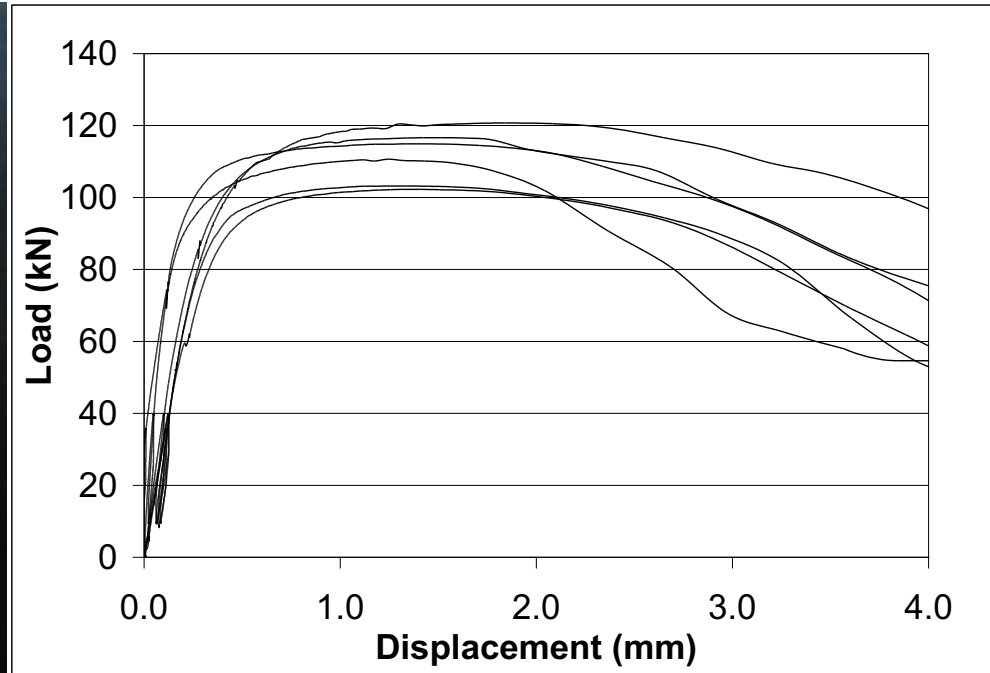
CLT – Concrete Composite



CLT – Concrete Composite



UMass research on HBV Shear Connector



- Clouston P, Bathon L, Schreyer A. 2005. "Shear and Bending Performance of a Novel Wood-Concrete Composite System". *ASCE Journal of Structural Engineering*. 131(9), pp.1404-1412
- Clouston P, Schreyer A. 2008. "Design and Use of Wood-Concrete Composites". *ASCE Practice Periodical on Structural Design and Construction*, 13(4), pp. 167-175

CLT - Concrete Composite Floor



CLT - Concrete Composite Floor



CLT - Concrete Composite Floor



CLT - Concrete Composite Floor



Concrete Shaft

Shear Walls



CLT Shaft

Shear Walls







Photo credit: A. Schreyer





Steel Bracing



Lateral Cross Bracing

Glulam Bracing



Lateral Cross Bracing

Lateral Cross Bracing



Lateral Cross Bracing



Zipper truss mid-air assembly







Photo credit: A. Schreyer



Photo credit: A. Schreyer





OCCUPANCY PHASE & BENEFITS



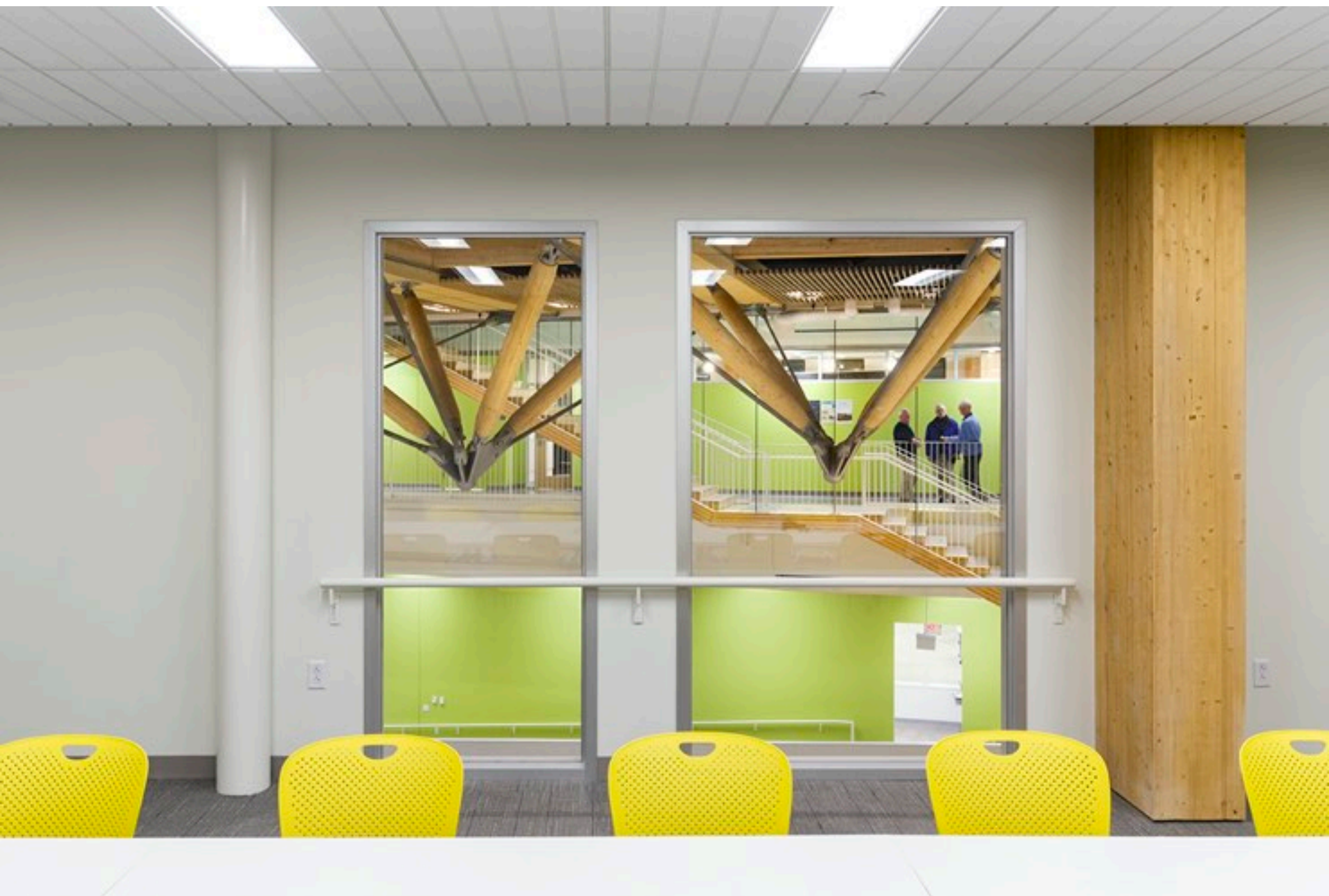


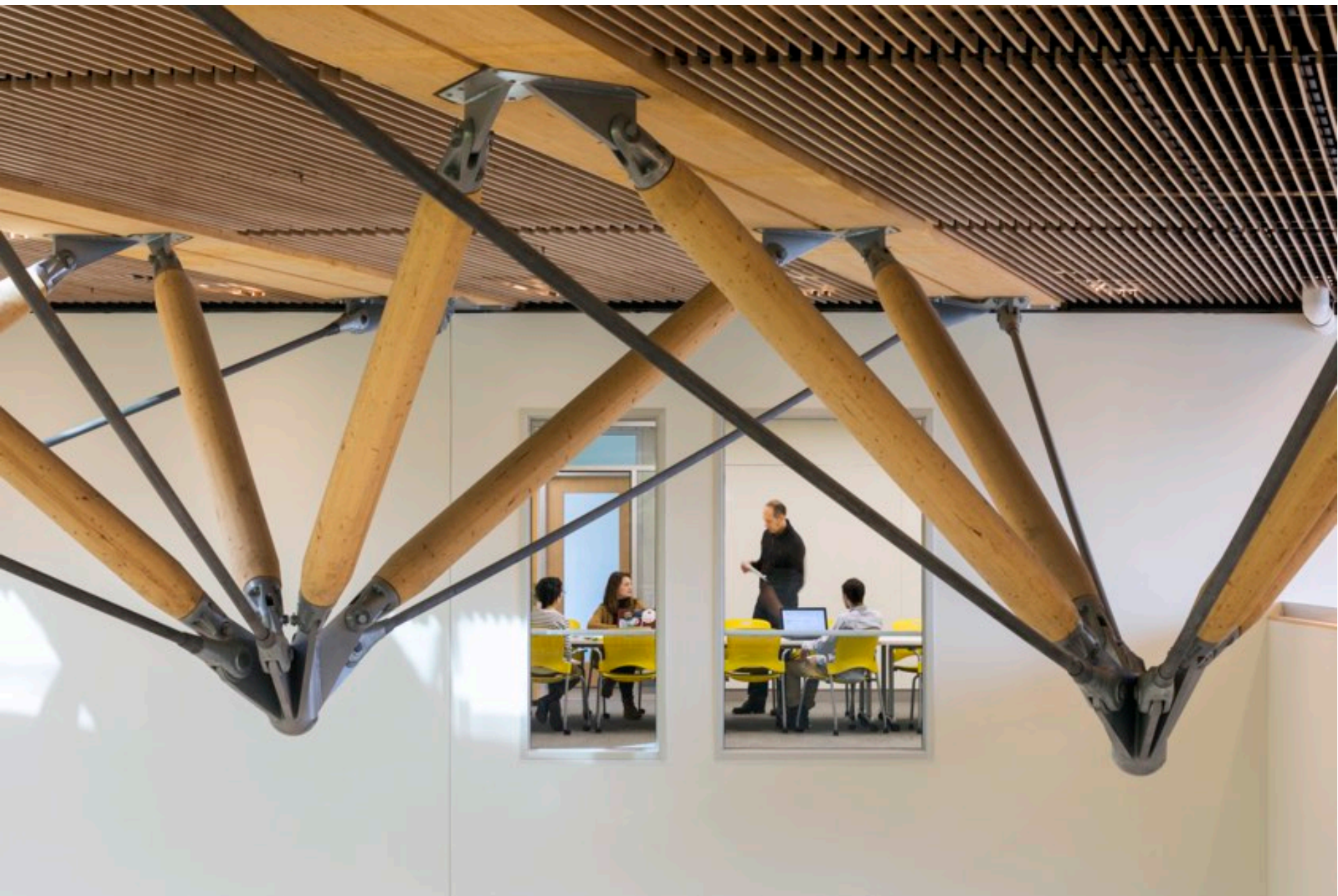






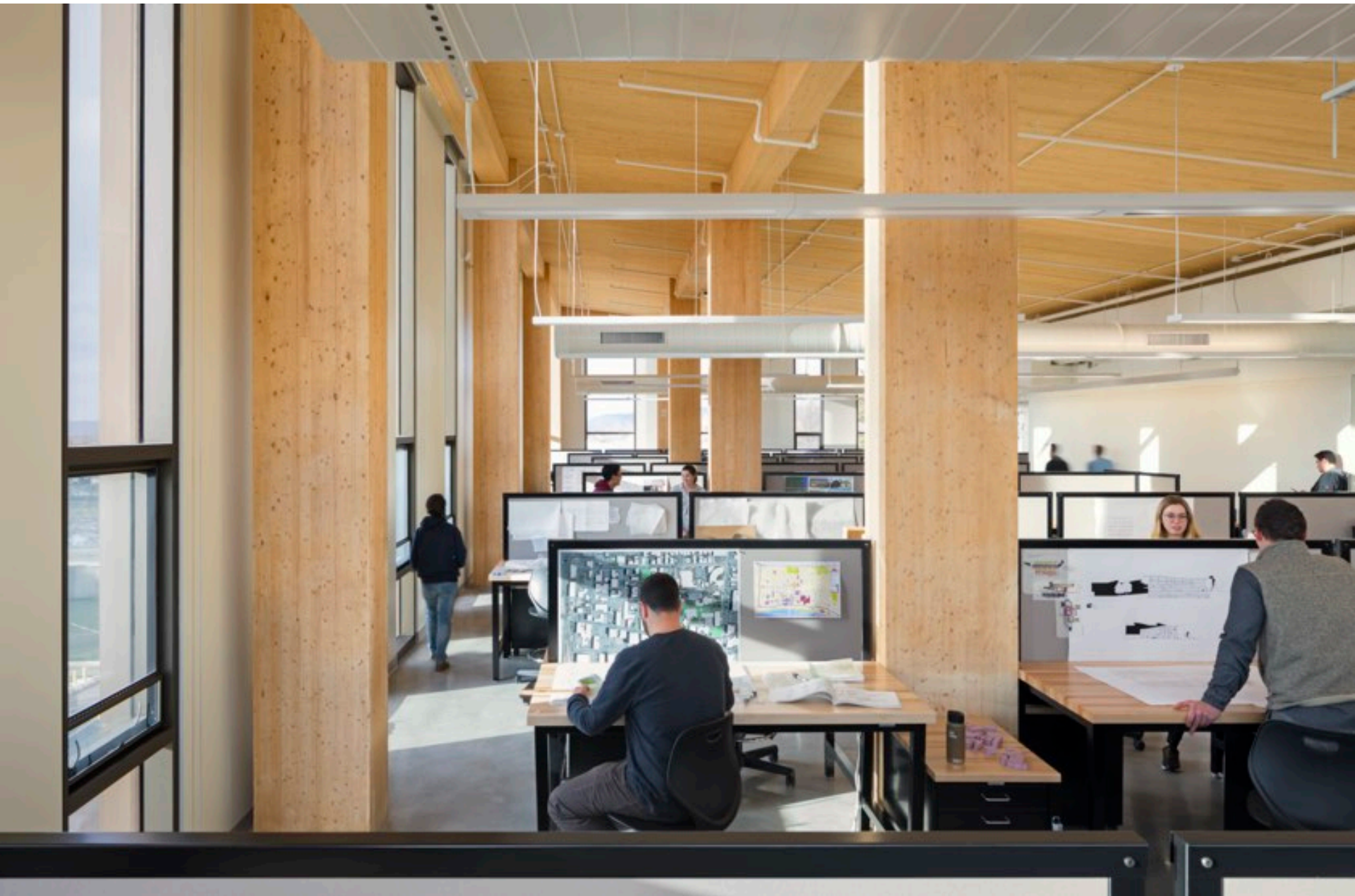




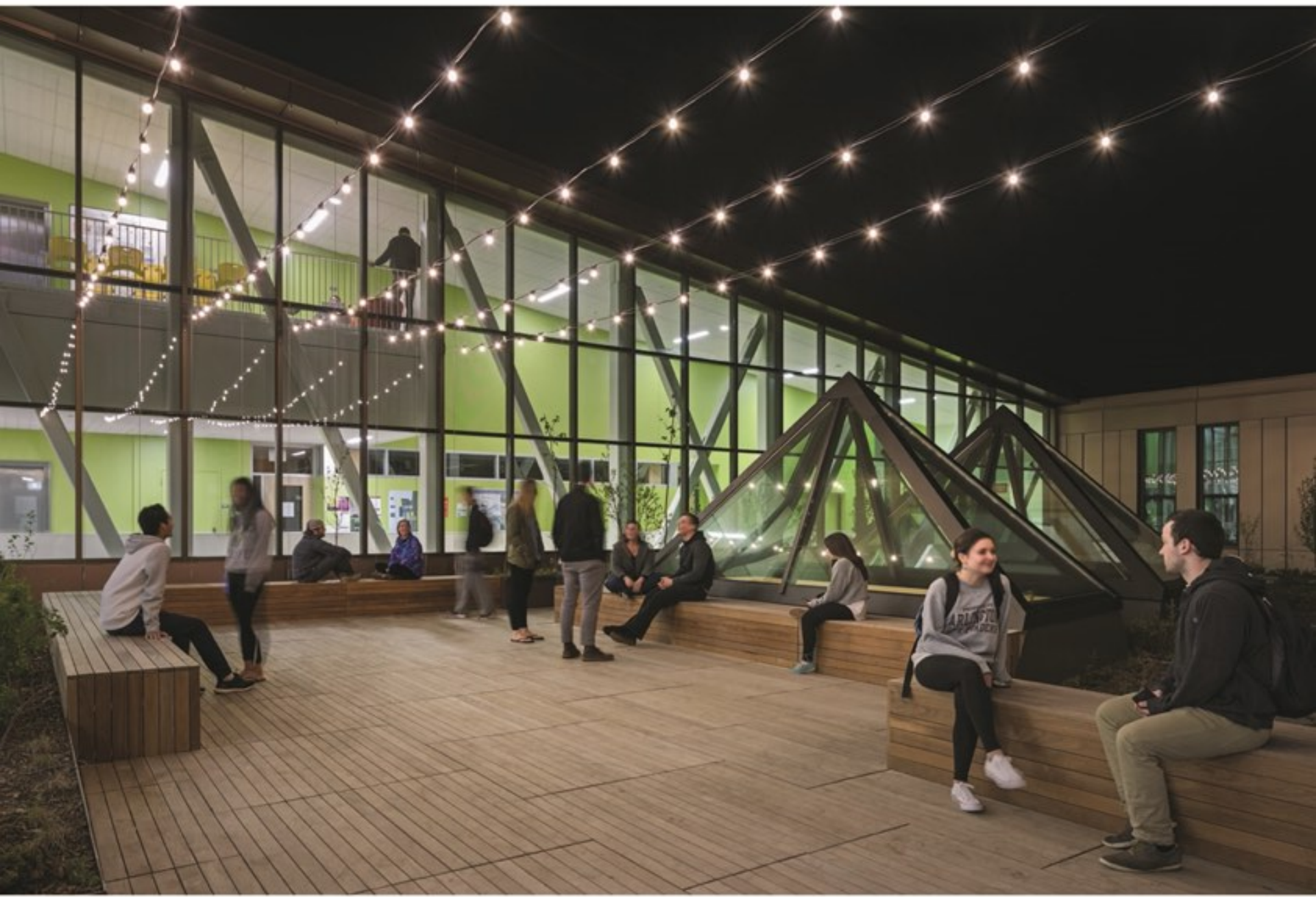


Conference rooms offer sweeping views of campus and opportunities for close-up views of the structural timber.

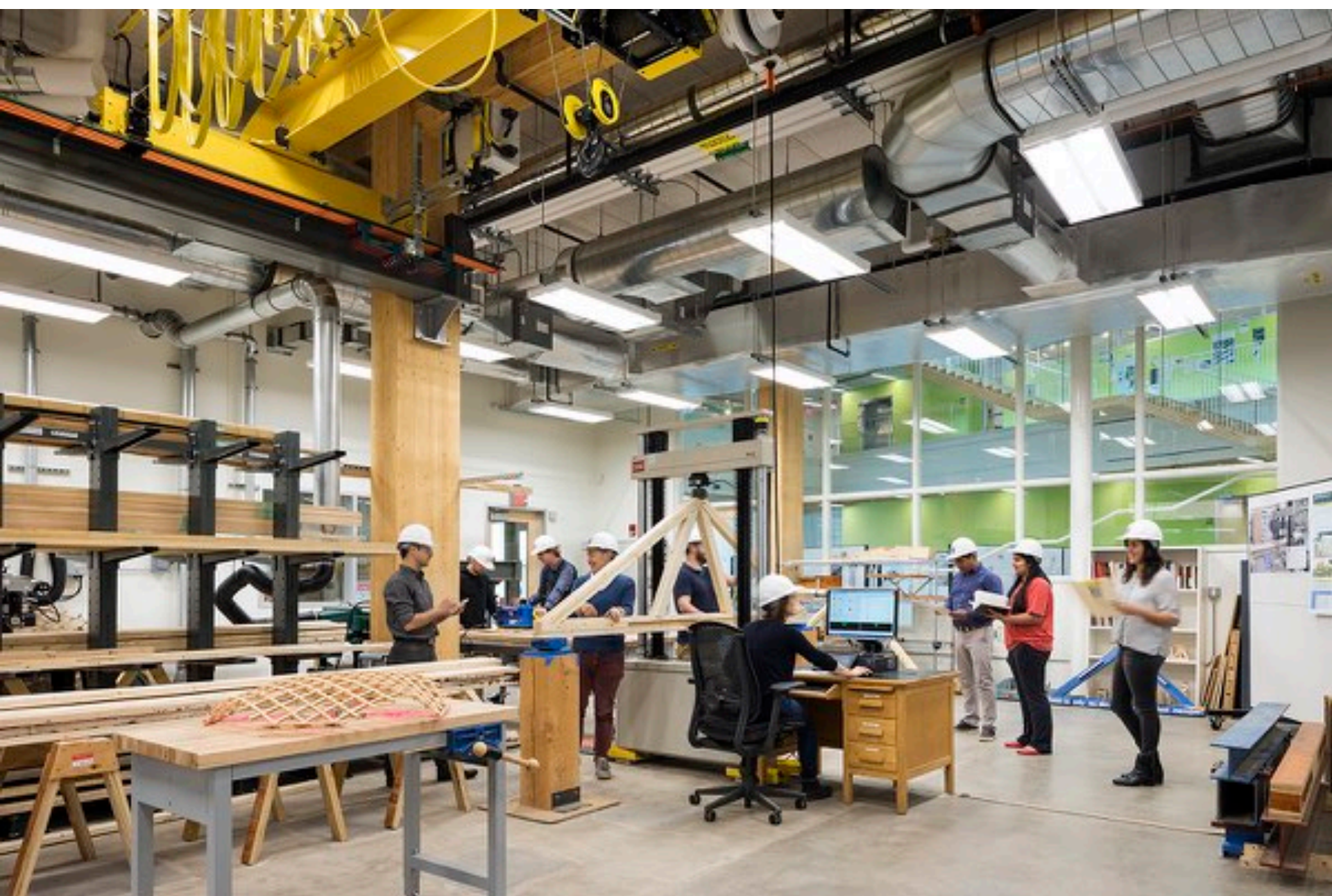








Rooftop courtyard



Panel Manufacture



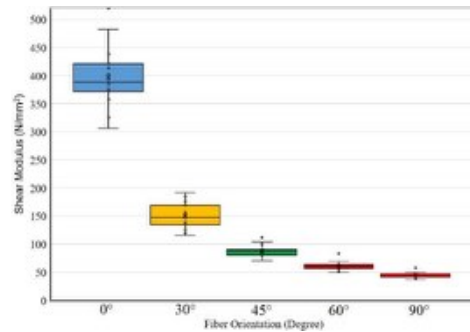
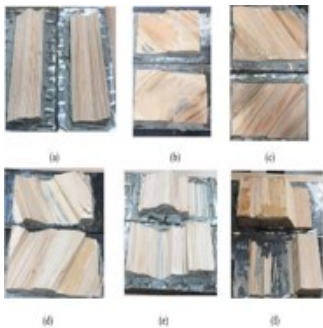
Experimental Testing and Evaluation



Table 8 4-point bending test results and analytical predictions

	Test Result					Analytical Prediction		
	Pmax (lb.)	Δ max (in)	El_{app}^* ($10^6 \text{ lb. in}^2/\text{ft}$)	$f_b S_{eff}$ (lb.ft/ft)	$f_s(lb/Q)_{eff}$ (lb/ft)	Pmax (lb.)	Δ max (in)	El_{eff} ($10^6 \text{ lb. in}^2/\text{ft}$)
EH-CLT-1	14,118	3.94	95.05	17,068	4,642	15,659	5.60	95.68
EH-CLT-2	13,705	5.62	84.79	18,897	5,139	13,587	5.64	99.86
EH-CLT-3	13,247	4.11	91.73	17,652	4,996	13,514	5.62	99.07
Mean	----	----	90.52	17,872	4,926	----	----	98.20
COV (%)	----	----	5.78	5.23	5.19	----	----	2.26
Characteristic Value	----	----	90.52	17,126	4,677	----	----	98.20

$$* El_{app} = \frac{Pa(3L^2 - 4a^2)}{48\Delta}$$



Carbon Summary

CASE STUDY

UNIVERSITY OF MASSACHUSETTS OLVER DESIGN BUILDING

Inspiration through Innovation

At UMass Amherst, an Exposed Mass Timber Structure is a Teaching Tool



WoodWorks™
WOOD PRODUCTS COUNCIL



Volume of wood products used (m^3):

2081 m^3 (73482 ft^3) of lumber and sheathing



U.S. and Canadian forests grow this much wood in:

6 minutes



Carbon stored in the wood:

1463 metric tons of CO_2



Avoided greenhouse gas emissions:

1218 metric tons of CO_2



Total potential carbon benefit:

2681 metric tons of CO_2

Equivalent to:



512 cars off the road for a year ⁱ



Energy to operate a home for **228** years ⁱ

reTHINK
WOOD®

A photograph of the Olver Design Building at UMass, Amherst. The building is a modern structure with a prominent glass facade and a copper-clad exterior. It features a series of vertical glass panels and a large, multi-story glass wall that reflects the sky and surrounding environment. The building is set against a clear blue sky.

Olver Design Building, UMass, Amherst

Awards

- 2018 **Wood Design Awards Jury's Choice for Wood Innovation**, WoodWorks
- 2017 **Building of the Year**, world-architects
- 2017 **Most Innovative Project Award** (less than \$100 million), Architectural Engineering Institute
- 2017 **Excellence in Structural Engineering Award** (New Buildings \$20 to \$100 Million), National Council of Structural Engineering Associations
- 2017 **Awards of Merit for Structural Systems Design and Architectural Engineering Integration**, Architectural Engineering Institute
- 2017 **Award of Merit, Higher Education/Research Category**, ENR New England
- **+ 6 more!**

Read all about it

<https://bct.eco.umass.edu/about-us/the-design-building-at-umass-amherst/design-building-press-review/>

Secure | <https://bct.eco.umass.edu/about-us/the-design-building-at-umass-a...>

DESIGN BUILDING PRESS REVIEW

Home > About us > The Design Building at UMass Amherst > Design Building Press Review

The UMass Design Building has received quite a bit of media attention. The following is a listing of what has been written and posted about it.

(updated on Aug)

- [Teaching Tool](#) - Design New England (December 2017)
- [UMass Amherst design building named for former Congressman John Oliver](#) - MassLive / Republican (10/30/2017)
- [A New Teacher on Campus](#) - Learning by Design (Fall 2017)
- [Leers Weinzapfel Associates Completes America's First Cross Laminated Timber Academic Building](#) - Timber Design & Technology (June 2017)
- [Raising the roof with CLT](#) - World Architecture News (5/16/2017)
- [University of Massachusetts Amherst Design Building / Leers Weinzapfel Associates](#) - ArchDaily (5/25/2017)
- [Design Building at the University of Massachusetts Amherst](#) - World Architecture (5/5/2017)
- [Leers Weinzapfel completes America's first cross laminated timber academic building](#) - GreenSource (4/28/2017)
- [UMass Amherst completes cross laminated timber Design Building for architecture, other programs](#) - Architects Newspaper (4/27/2017)
- [This Week in Tech: New England Gets Its Largest Modern Wood Structure](#) - Architect Magazine (4/27/2017)
- ["Most advanced" engineered wood building in the U.S. opens at UMass](#) - Woodworking Network (4/27/2017)
- [UMass Amherst is home to America's first CLT academic building](#) - Building Design & Construction (4/26/2017)
- [UMass opens largest engineered wood building in northeast US](#) - Construction Dive (4/26/2017)
- [Why UMass Amherst's newest building is made almost entirely of wood](#) - Boston Globe (4/25/2017)
- [UMass celebrating opening of modern, all-wood building](#) - WWLP (4/25/2017)
- [Photos: UMass Amherst opens new Design Building, largest modern wood structure in the Northeastern US](#) - MassLive/Republican (4/25/2017)
- [Into the Wood](#) - Architectural Record (SNAP) (March/April 2017)
- [UMass Amherst Design Building Zippers Trusses](#) - Architecture Magazine (3/2/2017)
- [Game Changers](#) - Building Design + Construction (January 2017)
- [Not your grandfather's tree-to-four: A new exhibition showcases modern wood construction](#) - Architects Newspaper (11/3/2017)
- [Direct opens made of wood? NIM show argues for alternative to steel, concrete](#) - Washington Post (11/24/2016)
- [Full Wooded Buildings Will Building Codes Allow Them?](#) - WoodSource (12/16/2016)
- [Timber City to Show Mass Timber's Potential for Construction, Job Creation](#) - Architect Magazine
- [UMass wood construction expertise has Canadian roots](#) - Daily Commercial News
- [We Can Turn Climate Change Around](#) - UMass Center for Agriculture, Food, and the Environment (CAFE) Newsletter
- [Leers Weinzapfel Associates designs timber architecture building for UMass Amherst](#) - Architects Newspaper (3/31/2016)
- [New Integrated Design Building incorporates sustainability, resilience and aesthetics](#) - The Daily Collegian
- [Design Building Progress](#) - UMass Amherst video
- [Leers Weinzapfel Associates: On Collaboration, Sustainable Buildings, and Timber Structures](#) - Skidley Blog
- [Watch: High-tech timber erected at UMass](#) - Suffolk BuildSmart Blog (watch [video on YouTube](#))
- [UMass Amherst's Design Building, a Model of Sustainable Architecture](#) - UMass On The Move
- [Green Design: The Design Building gives sustainable research, education, and construction high visibility](#) - UMass ResearchNews
- [UMass celebrates groundbreaking of new \\$52 million Design Building](#) - Daily Collegian
- [Innovative UMass Design Building 'designed by designers for designers to teach design'](#) - Masslive
- [UMass celebrates construction of Design Building using engineered timber instead of structural steel](#) - Hampshire Gazette
- [Campus Celebrates Construction of Sustainable Design Building](#) - UMass Media (watch [video on YouTube](#))
- [Wood construction research at UMass](#) - Suffolk BuildSmart Blog
- [Timber's Transformation: An Old Building Material Is Reborn](#) - Metropolis Magazine

BUILDING DESIGN & CONSTRUCTION

GAME CHANGERS

Presented by UMass Amherst
The Design Building at UMass Amherst

STUDY IN BCT

- [WUOL in BCT \(BCT\)](#)
- [WUOL in BCT](#)
- [PROFESSIONAL YET](#)
- [RESEARCH AND PhD](#)
- [CONTINUING EDUCATION](#)

BCT NEWS

- 47th Oliver Wright receives an important first academic house construction
- Design Building at UMass Amherst named for former U.S. Rep. John D. Oliver
- Alumni & Friends join BCT at NEU Commencement on 11/9
- Bring your resume to BCT in Reading Hall job fair on October 26th
- BCT's "Color Color" Exhibit is Open

[Join the BCT](#)

UMass Design Building

A Firsthand Account from Design through Owner Occupancy

THANK YOU!

Tom S. Chung, AIA LEED BD+C, Principal, Leers Weinzapfel Associates

Peggi L. Clouston, PEng, MAsC, PhD, University of Massachusetts

QUESTIONS?

**This concludes The American Institute of Architects
Continuing Education Systems Course**

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Peggi L. Clouston, PEng, MAsC, PhD, University of Massachusetts