DESIGN ENGAGEMENT

Building the Team and Managing the Design

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

ANDERSEN CONSTRUCTION

PORTLAND, OR • SEATTLE, WA • BOISE, ID







BENSONWOOD

KEENE, NH







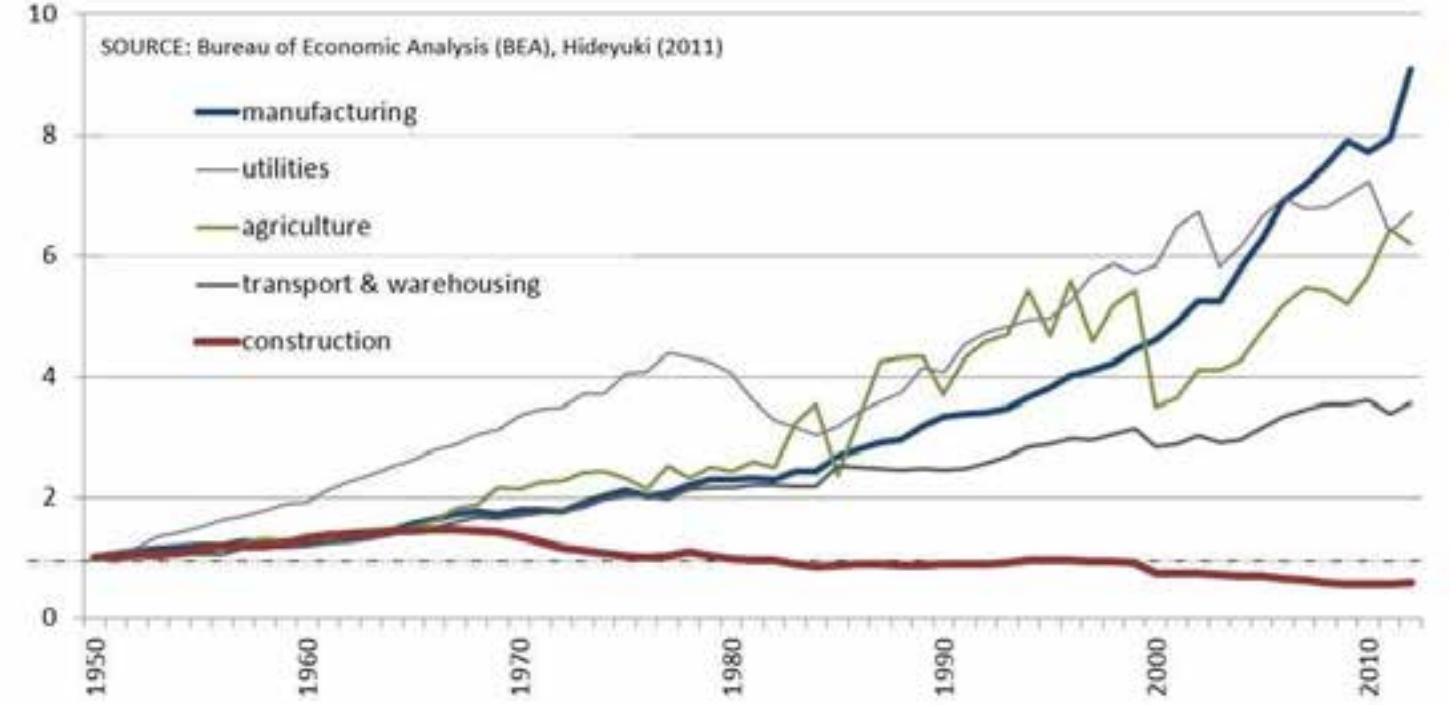
Bensonwood
Keene, NH

Big breakthroughs happen when what is suddenly possible meets what is desperately necessary.

Thomas Friedman

Construction productivity 1950-2012

Real productivity (GDP value-add per employee) by industry in the US
Indexed; 1950 = 1.0



[www.curt.org]

INDUSTRY CHALLENGES

- What solutions can the construction industry adopt from other industries to improve quality and address our biggest challenges?
- What are the challenges?
- What are the possible solutions?

A Challenged History:

Built-in Inefficiency

- Weather-based delays and shutdowns
- Linear Process
- Raw materials to finished product under difficult conditions

Skill Degradation

- Extreme personnel turnover rates (20%-60%)
- Majority of workers have minimal education
- Lack of education, skills & attitude for new demands
- Minimal or zero requirements

Poor Quality

- Buildings are the most defective products consumers purchase.
- 15% - 80% serious defect rate
- Decades-long industry culture of accepted compromise

CHALLENGES:

Field Labor
- Availability
- Skill
- Cost
- Productivity

Construction Materials
- Cost
- Availability
- Sustainability

- *2014, Portland, OR*
- *Fully digitized concrete structure*
- *100% prefab facade without the possibility of field verification*

SOLUTIONS:

Fully “Digitized“ Structure

- Model based survey & layout
- Subtrade Coordination
- Machine Files
- Off-site fabrication

Collaborative Delivery

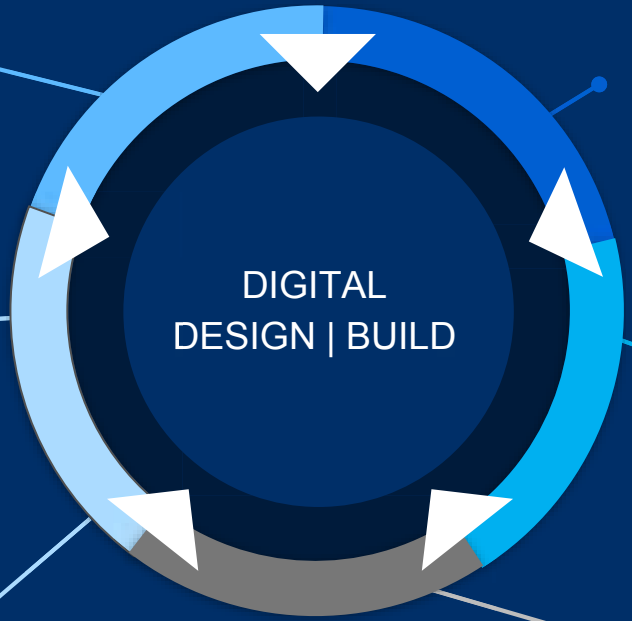
- Design team buy-in
- Contractor buy-in
- Early trade partners
- All elements modeled
- Early and continuous planning

Other Industries Get It

Cruise ship bathroom pod

Subassemblies built in a controlled environment

Learn From Everywhere



SCANDINAVIA
Optimization
Most Off-Site
Construction Appropriate
Technology Best Energy
Standard Building
Science
Montage Design

NEW ENGLAND
TF Legacy Building
Off-site Benefits and
Skills
3D Modeling Value
Discipline of Connections
Site Efficiency
Tools & Logistics
Discipline & Skills

GERMANY | AUSTRIA | SWITZERLAND
CNC Tools
Software Lead
Technology Adaptation
Modern Manufacturing
Advanced Education for Trades
Durable Building Standard

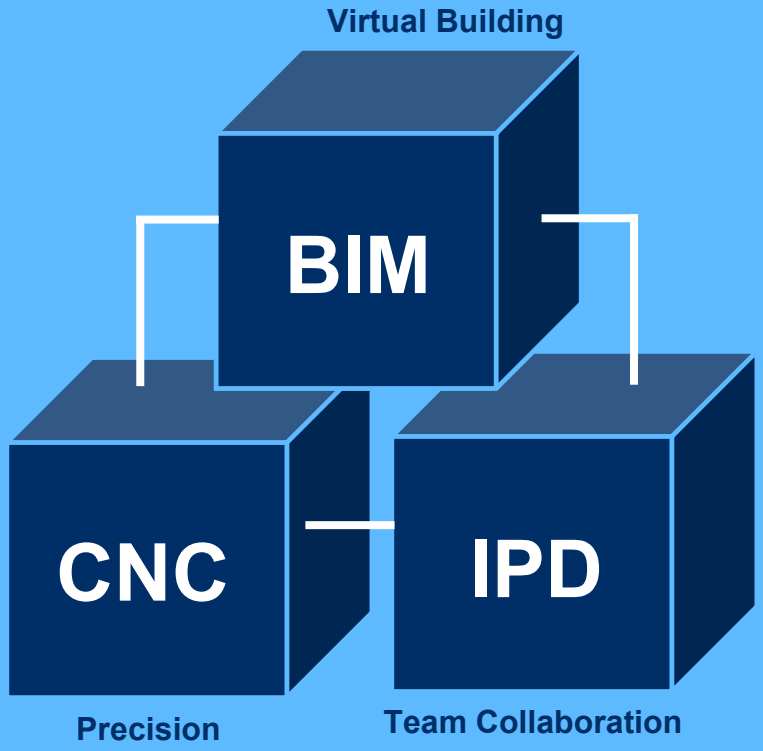
JAPAN
Lean Manufacturing
Kaizen
Precision
Power of Modularity
Tradition of Perfection

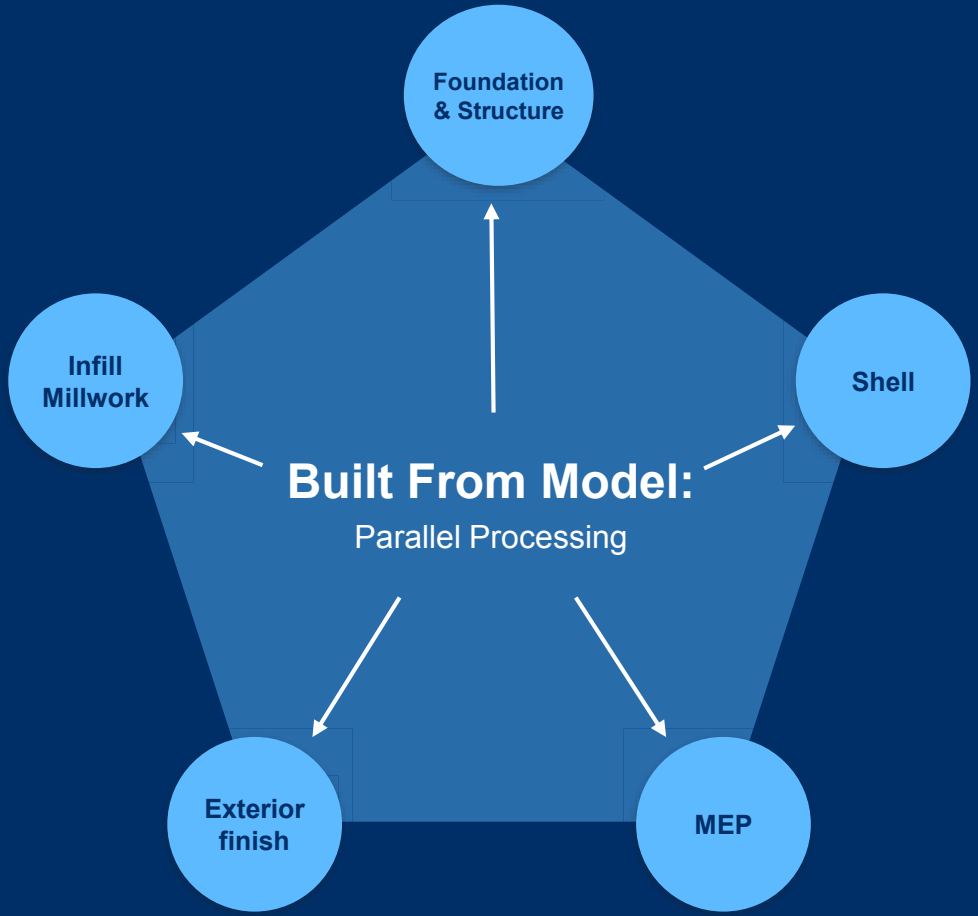
HOLLAND
Open Building
Lives Must Prevail
Rational Design &
Building
Time based organization
Sustainability through
Adaptability
Dimensional Coordination

FRANCE
Pride in Craft/Training
Craft Knowledge
Personal Discipline
Humility
Historical Perspective

Intersection of Strategies

Design | Build | Deliver | Digital Fabrication | Offsite





VS

Site Process

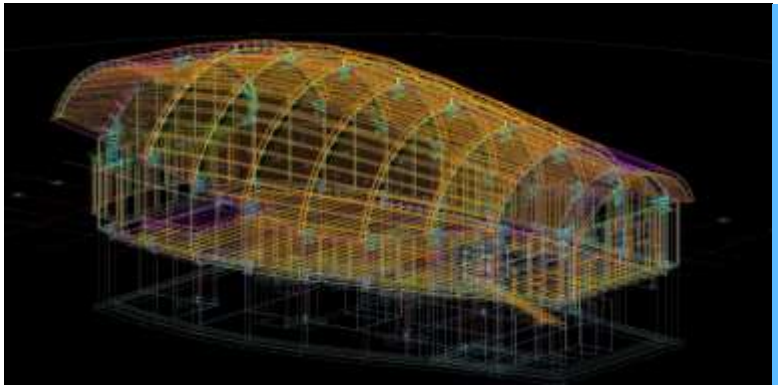
1. Layout from plans
2. Cut
3. Attach
4. Measure
5. Order
6. Wait
7. Install
8. Measure
9. Cut
10. Fit
11. Repeat…

Everything Modeled

Plan, Deliver, and LEAD

THE POWER OF BIM

- Design = simulated building
- Automated PM information - costs, supply chain, shipping, etc.
- Automated cutting and shaping machine code



North Adams, MA
Bensonwood, Randall Walter, Architect

MADE IN THE SAME SHOP

Models now drive woodworking tools and off-site fabrication - from cheese boards, to shear walls, to facade panels.

Material Handling

Automated inventory management

Bensonwood
Keene, NH

BIM to CNC

Our Tireless Workers

Bensonwood • Keene, NH

Bensonwood • Keene, NH

Layout, cutting & optimization

Bensonwood
Keene, NH

Rubner Holzbau
Bressanone, Italy

More Advantages of Mass Timber:

Calls for new strategies, because it is a new sub-industry.

Can it leapfrog the current processes and be the new standard?

- Increased productivity
- Reduced site impact
- Speed of construction
- Less waste
- Sustainable materials

3D modeling is the origin of the work

- The shared work space for all contributors & team members
- First built in the model, and then assembled in the field
- Machine files are as close as we can get to 3D printing




Model based timber designs - Northern Italy

New mindset for contractors

Must understand the digitization of design because it provides the potential for full offsite fabrication

Oregon State University • Corvallis, OR

Project delivery shift from Design-bid-build to Integrated Project Delivery

Fully “Digitized“ Structure

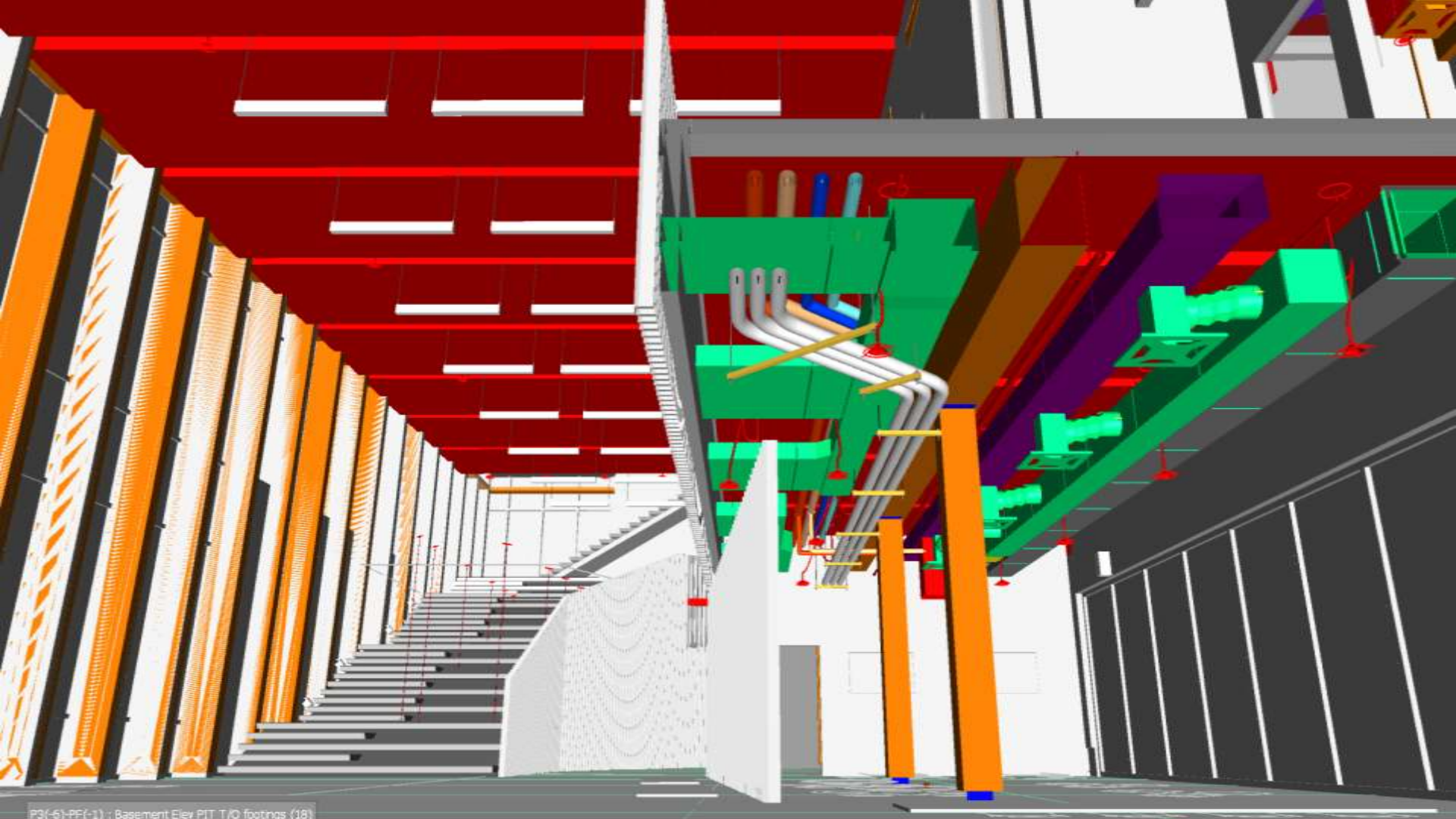
- Model based survey & layout
- Subtrade Coordination
- Machine Files
- Off-site fabrication

Collaborative Delivery

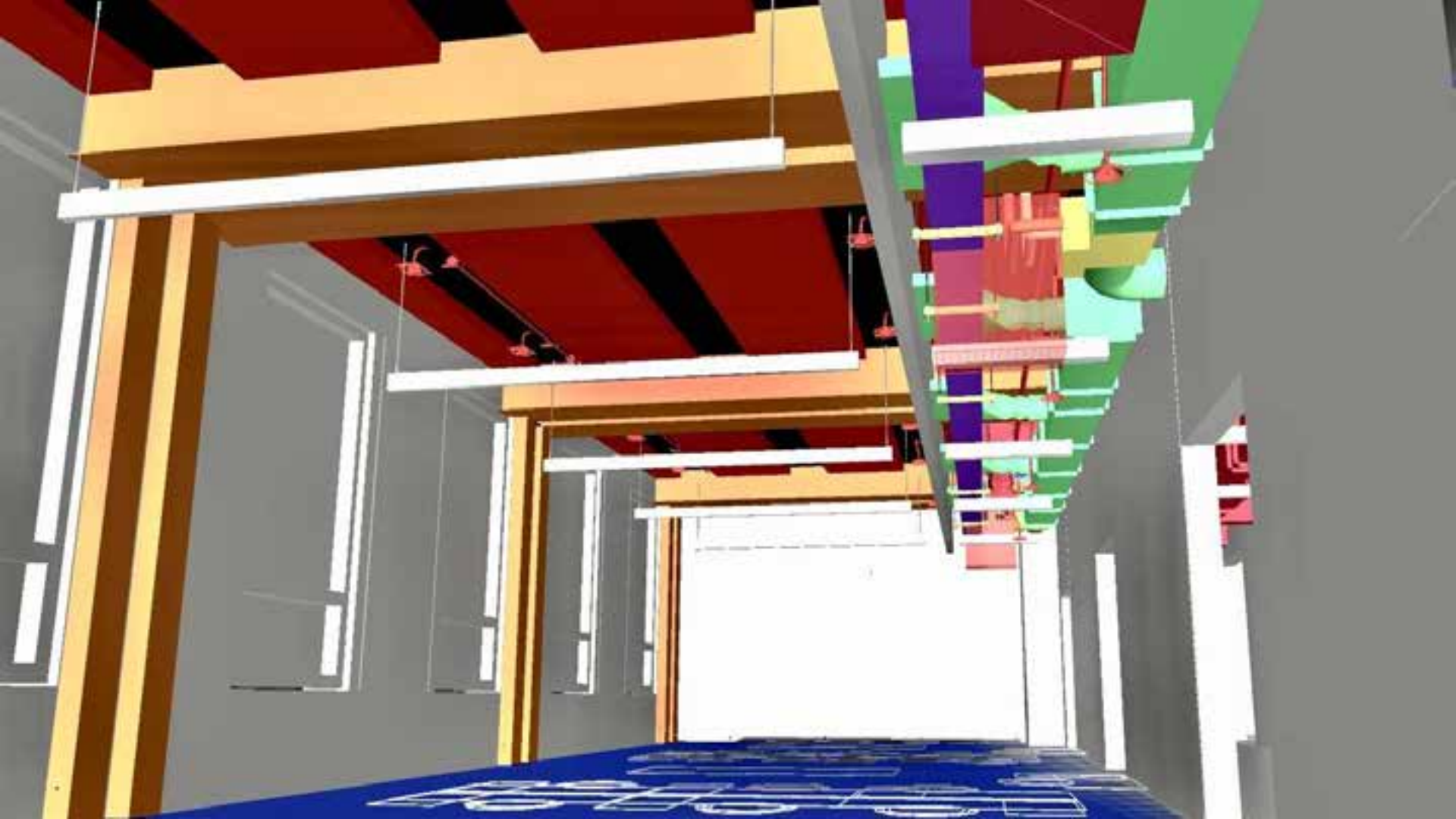
- Design team buy-in
- Contractor buy-in
- Early trade partners
- All elements modeled
- Early and continuous planning

If part of the building, it MUST be included in the model.

- What is the source of the model?
- Interface surfaces
- Un-modeled elements lead to issues
- Components of light weight
- Appropriately timed coordination is the key
- Figure out the MEP strategy along with the structural frame


P3(-6)-PF(-1) : Basement Elev PIT T/O footings (18)


Oregon State University • Corvallis, OR



Oregon State University • Corvallis, OR

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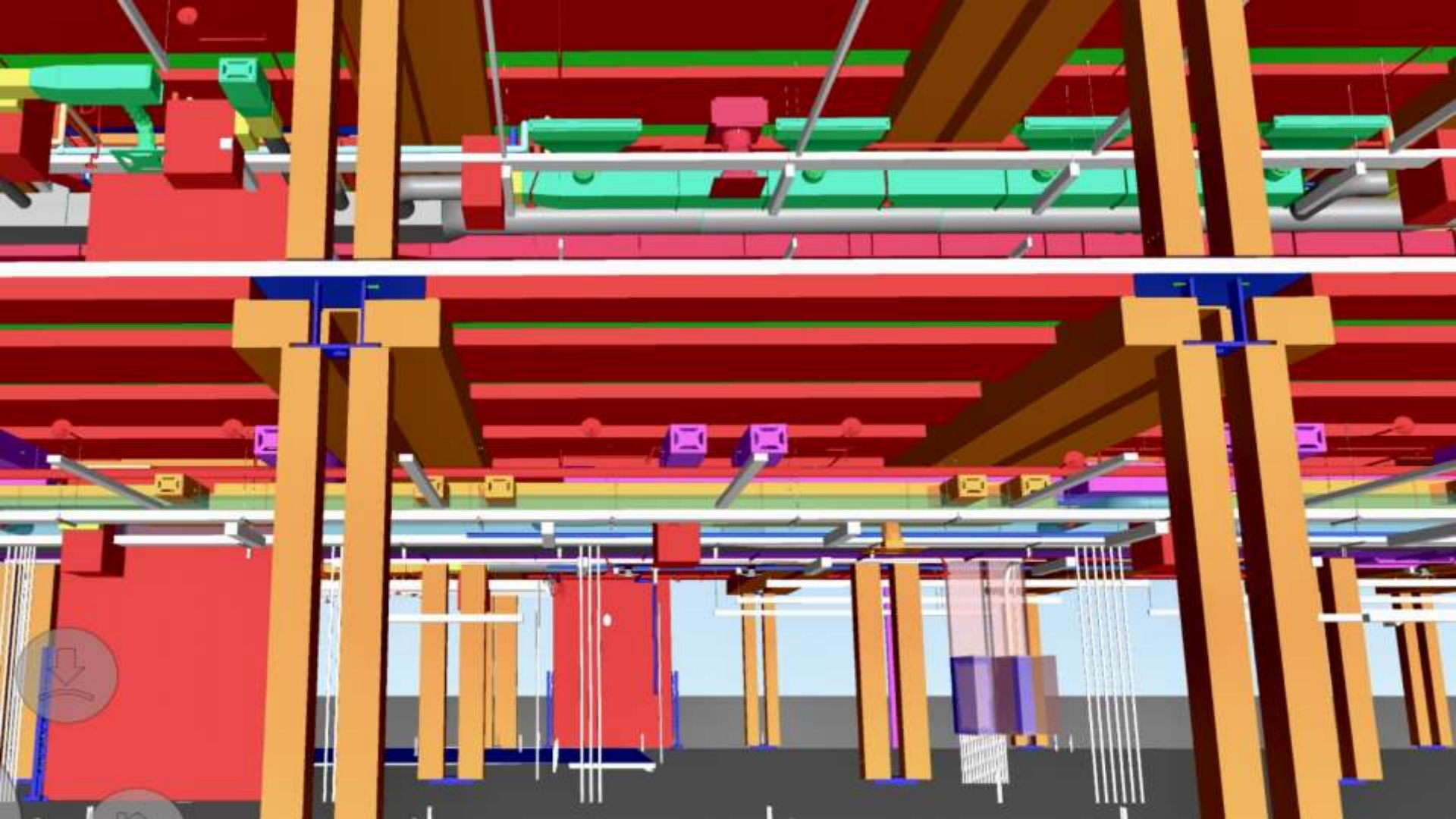


Engagement of Team for System Decisions

- Project Goals
- Code Constraints
  - Building Type
  - 1 or 2 hour frame?
  - Allowable Height
- Energy performance
- Carbon Sequestration
- Third party certifications

- Lateral system selection
  - Braced frames
  - Concrete cores
  - CLT shear walls
- All timber structure
- Composite structure
- Bay layout & beam orientation
- Preferred details
- Schedule

Case Studies & Examples

MEP organization determined with the framing layout. Utility gap and beam-free colonnade.

District Office, HACKER - Portland, OR

Portland, OR

Site Assembly

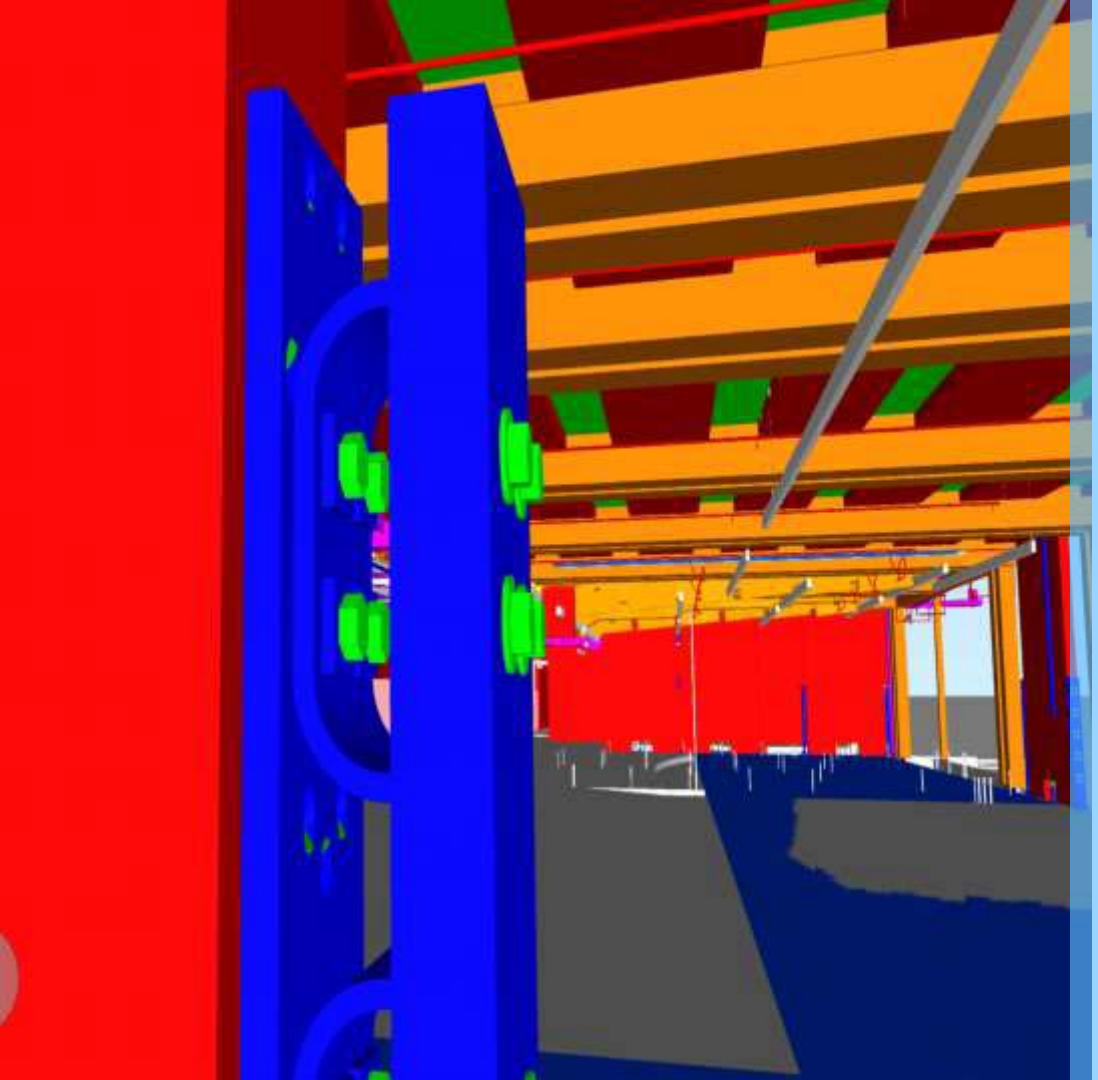
North Adams, MA

North Adams, MA

North Adams, MA

Case Studies & Examples

Rocking Shearwall Boundary Anchorage and Energy Dissipation System Installation

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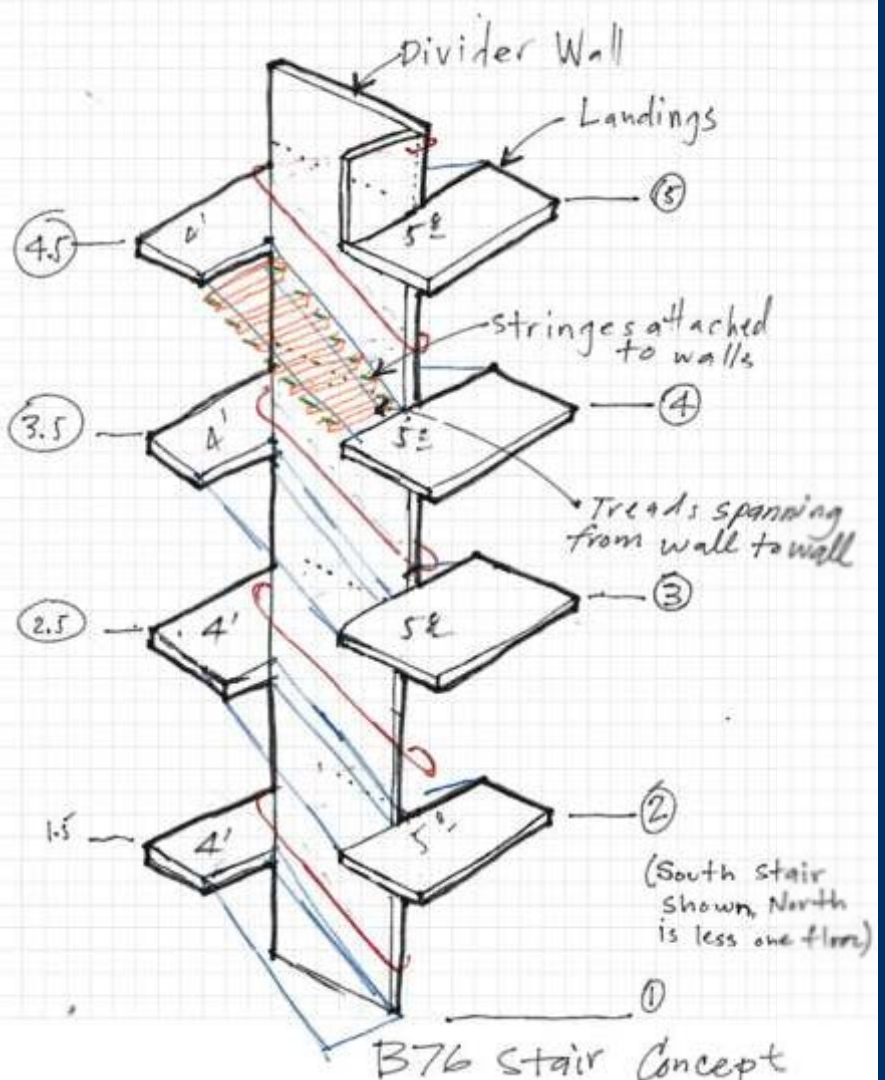
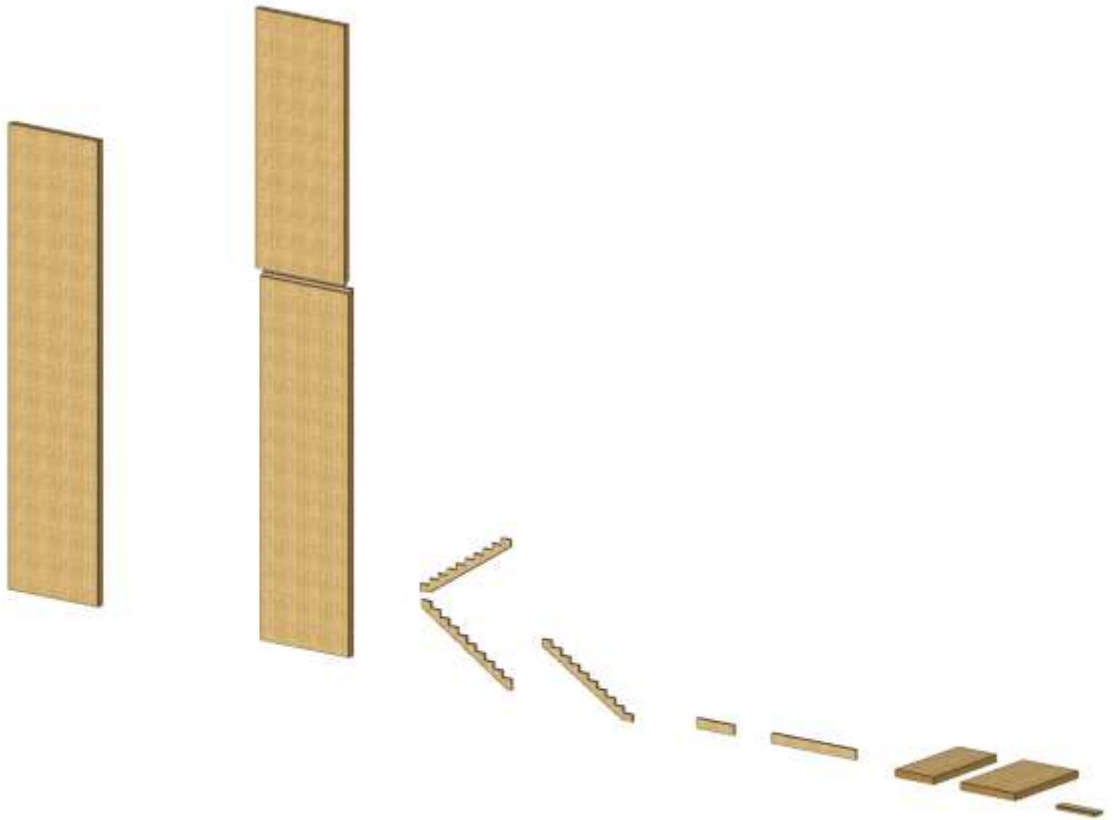


Case Studies & Examples

Design/Build Mass Plywood Stair
Portland, OR

Design, Sketch, Model, Review, Correct, Final Review, Final Check, Prepare Machine Files, Prototypes, Fabrication, Installation.



Model snapshot of all pieces for nine flights of stairs made into machine files

All components factory cut based on modeled machine files

Feature Stair
HACKER
Portland, OR

Freres Plywood,
Lyons OR

Prototype Development

- First-time Components
- Engineering Verification
- Machine and material limitations

Bath & Mechanical Room Pods

Bensonwood
Walpole, NH

Bathroom Pods Montage

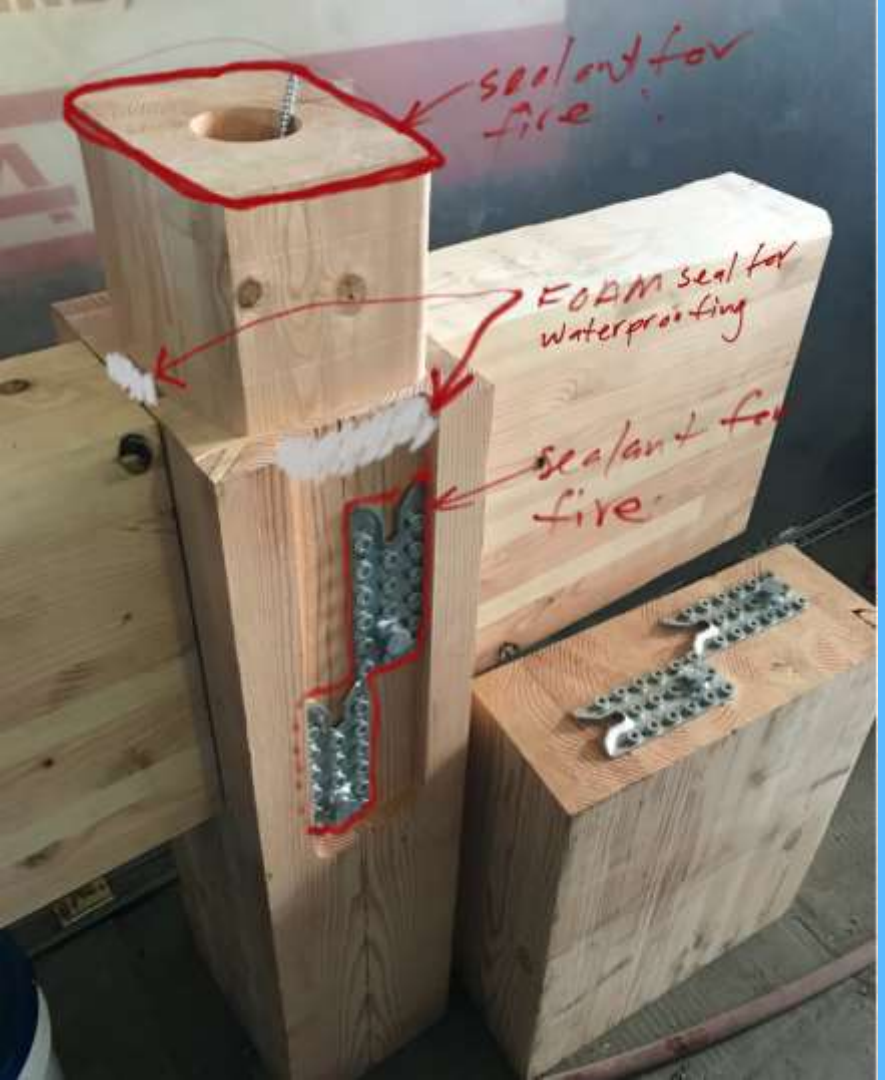
Bensonwood
Walpole, NH

Cartridge assembly

On-Site

Cartridge Installation

Bensonwood • Walpole, NH



More Prototype Development

Detail mock up based on the final model

Objectives:

1. Demonstrate connector fire protection measures for the local code authority.
2. Further the team understanding of the frame assembly.
3. Fit and finish confirmation.

Delivering the promise of an integrated design phase

- Increased productivity
- Reduced sitework impact
- Speed of construction
- Less waste

Block 76
SKYLAB
Portland, OR

Portland, OR

Portland, OR


SJ16


SJ16


Portland, OR
STAR
SJ16

The power of early digital collaboration:
Benefits to schedule, quality, and budget

Allows for the early development of:

- Exposed structure strategy
- Mechanical system selection
- Mechanical systems distribution strategy
  - Vertical risers
  - Horizontal Distribution
- Assigned Systems pathways
  - Sprinklers
  - Vertical Electrical
  - Horizontal Electrical
  - Plumbing
  - Fire alarm and electrical
- Constructability
  - Timber connection details
  - Moisture Mitigation Planning

Elsewhere: European Mass Timber

3D models are used an extension of their in-house skill/capacity

Swatch Omega - Shigeru Ban Architect, Blumer Lehmann - mass timber design, fabrication and installation

Switzerland

Keene, NH

How to Get Started

NEED SITE SPACE
- Deliveries
- Boom truck or crane
- Evaluate Access

PARTNERS
- Build a team
- Decide where info will live

DECISION MAKING & COMMITMENT
- Get everything in model early
- Work the model
- Rely on model

Important Differences

ON-SITE

- Schedule allows for field changes
- Each step adjusts to previous dimension and (in)accuracy

VS

OFF-SITE

- Less design flexibility
- Accuracy is paramount - site portion affect install fit
- Cost may or may not be higher, however time=$
- Anticipate need to protect installed finish materials
- Design the schedule and share extensively

Conclusion

Is every mass timber project that we build a unique prototype where design and execution are isolated activities, where hard lessons are learned, and poor choices cannot be corrected?

- OR -

Is each mass timber project an opportunity to deliver inspired design in a context of collaboration where decisions are reviewed and optimized early, and often, with the right combination of design and execution expertise?

Thank you for your participation.

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QUESTIONS?

This concludes The American Institute of Architects Continuing Education Systems Course

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