DESIGN ENGAGEMENT

Building the Team and Managing the Design

Randall Walter
Bensonwood

BRAD NILE, AIA
Andersen Construction

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ANDERSEN CONSTRUCTION

PORTLAND, OR • SEATTLE, WA • BOISE, ID







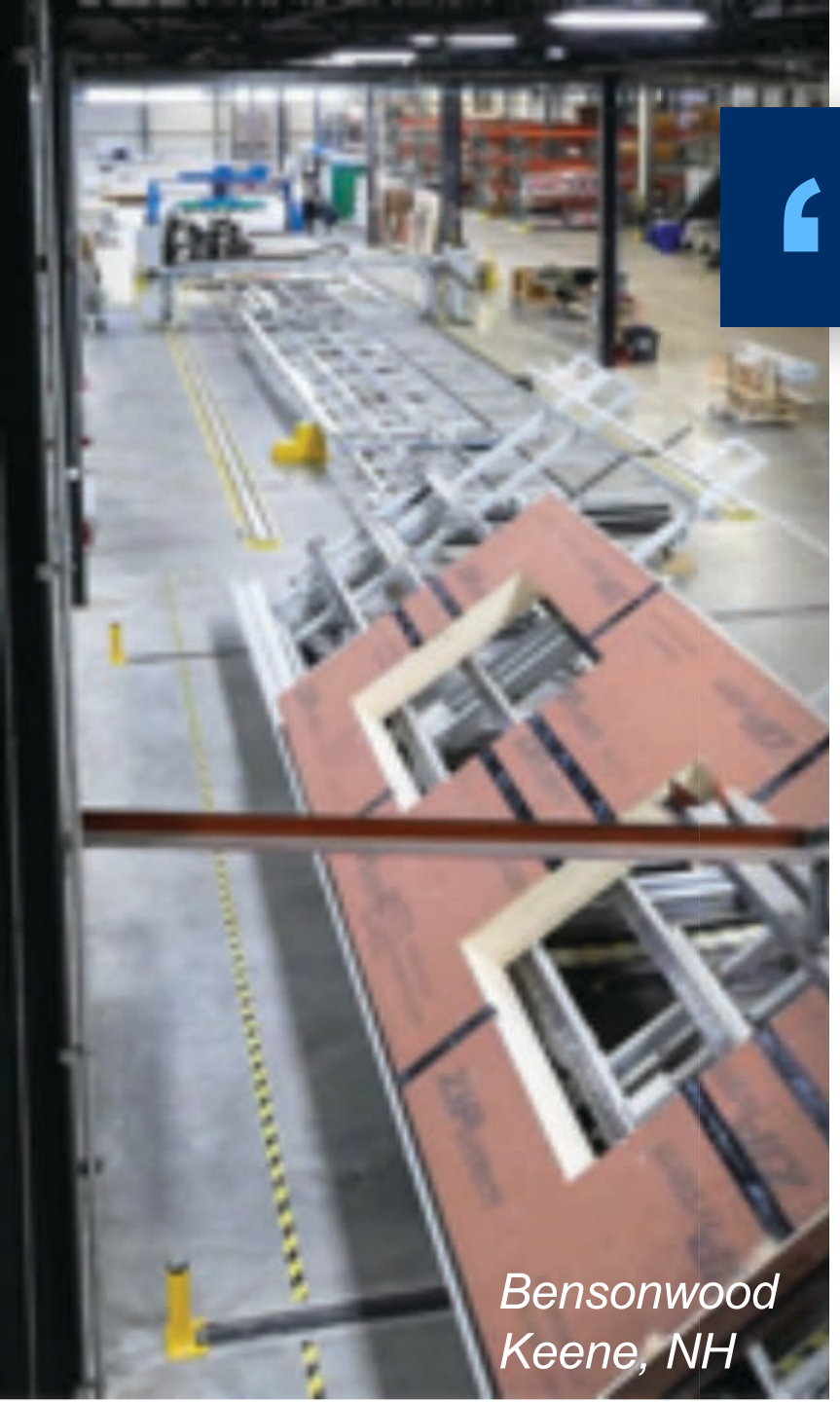
BENSONWOOD

KEENE, NH







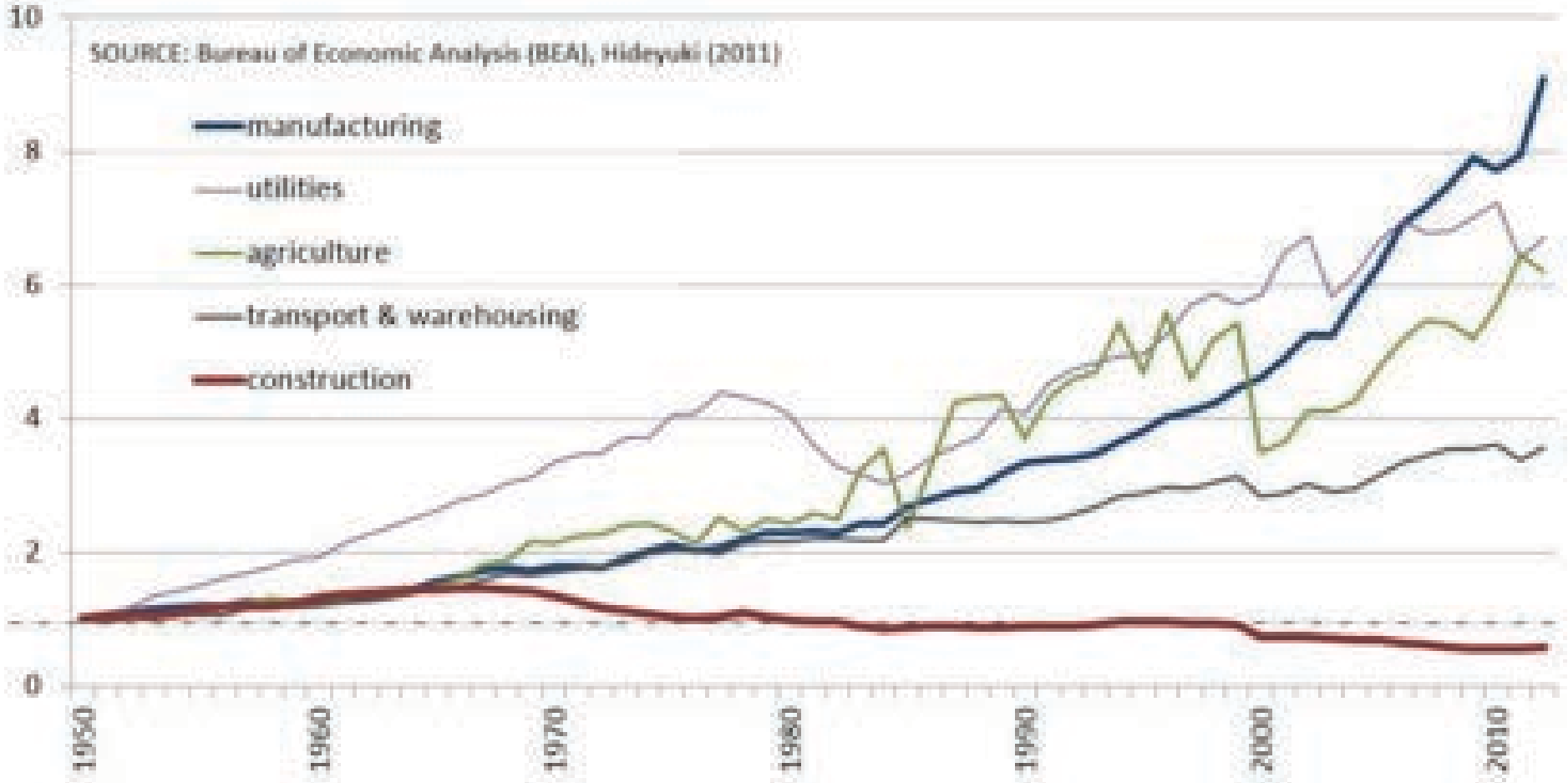


Big breakthroughs happen when what is suddenly possible meets what is desperately necessary.

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 we adopt from other industries?

- What are the challenges?
- What are the 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:

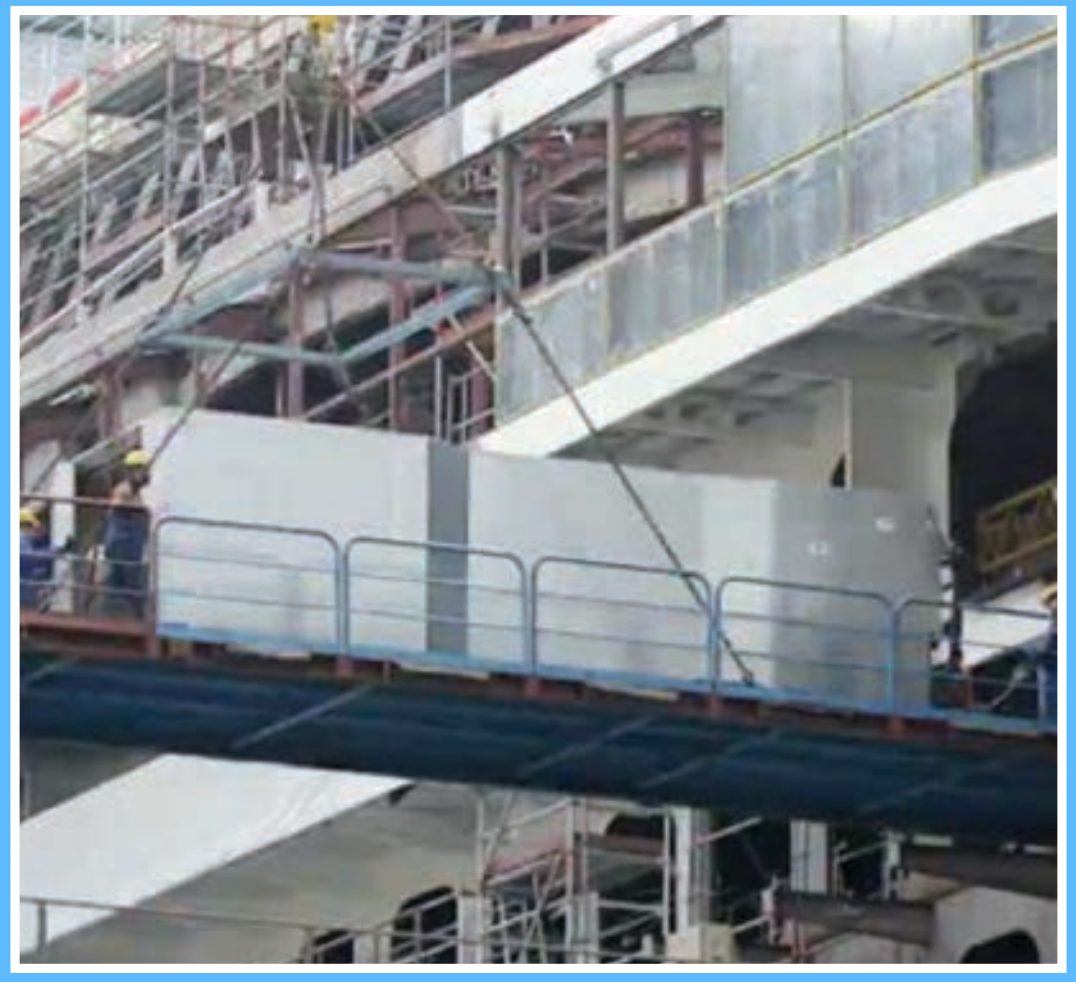
Fully “Digitized“ Structure

- 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

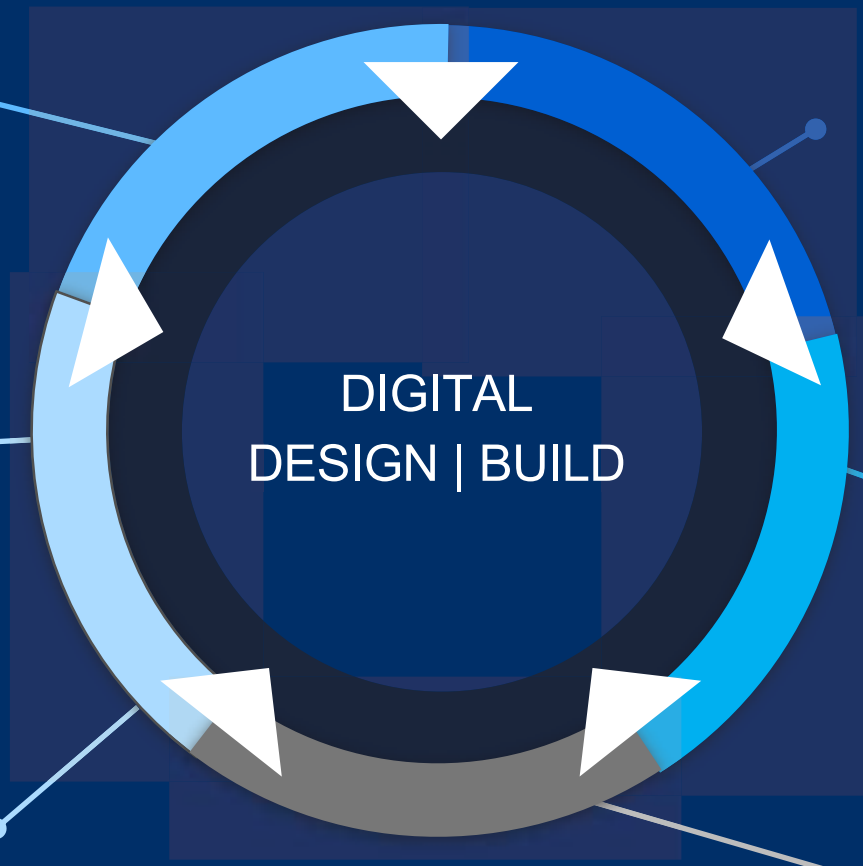
Other Industries Get It



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

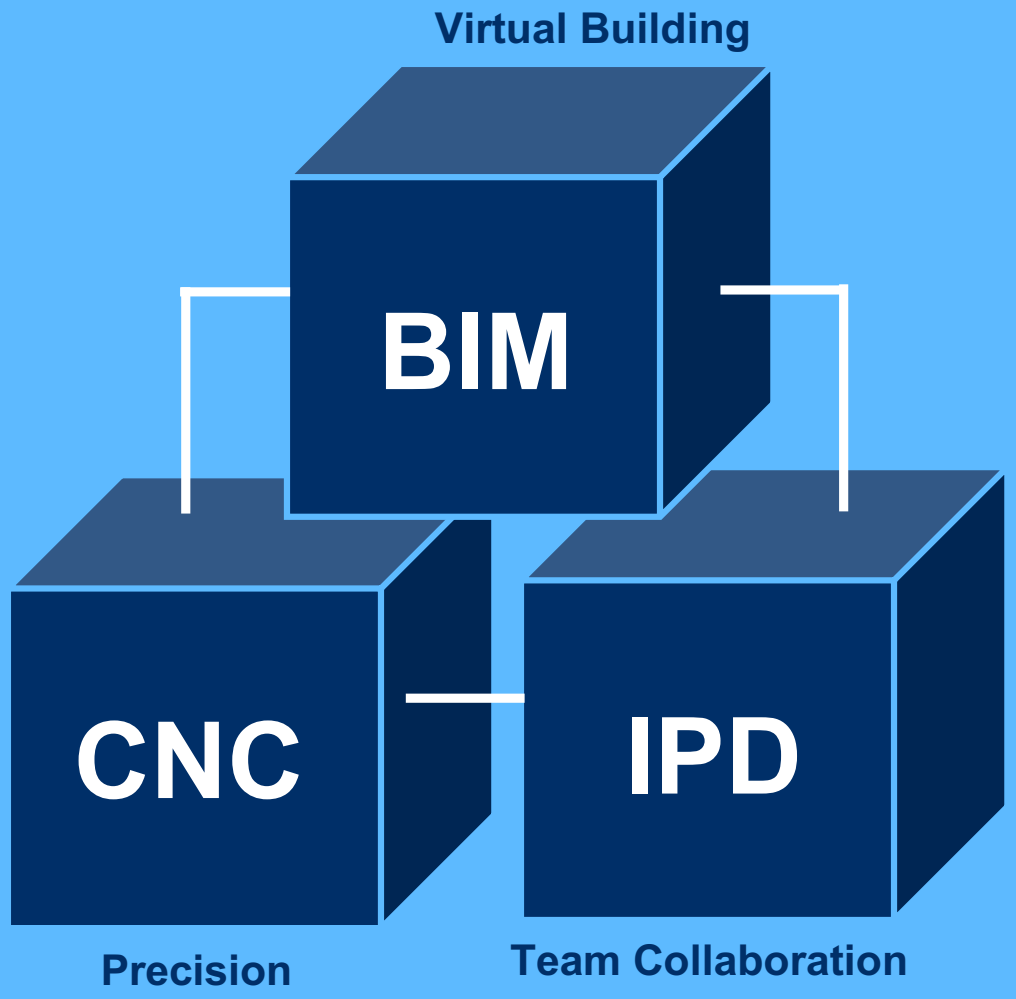
JAPAN
Lean Manufacturing
Kaizen
Precision
Power of Modularity
Tradition of Perfection

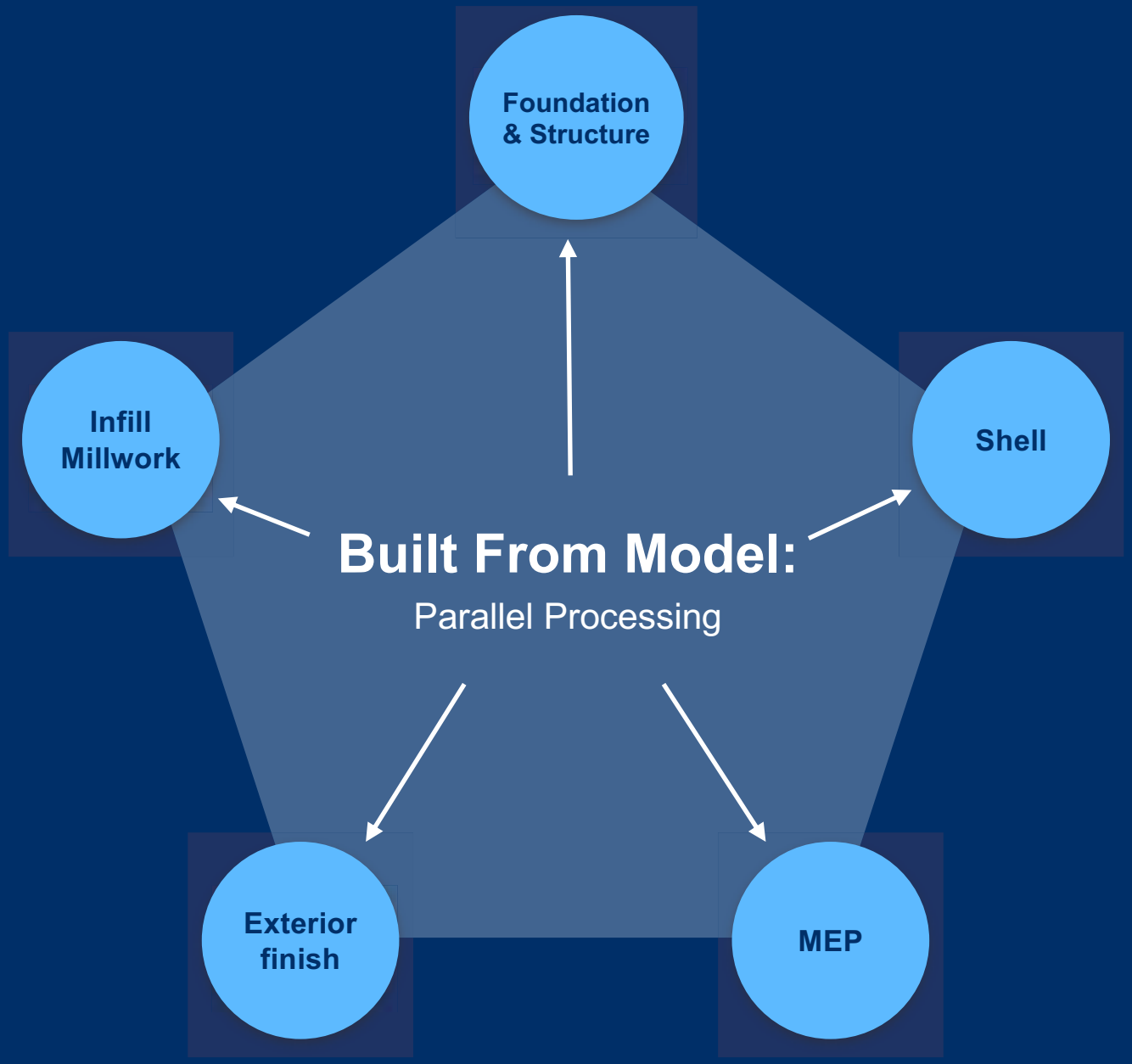
HOLLAND
Open Building
Lives Must Prevail
Rational Design &
Building
Time based organization
Sustainability through
Adaptability
Dimensional Coordination

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

Intersection of Strategies

Design | Build | Deliver | Digital Fabrication | Offsite





VS

Site Process

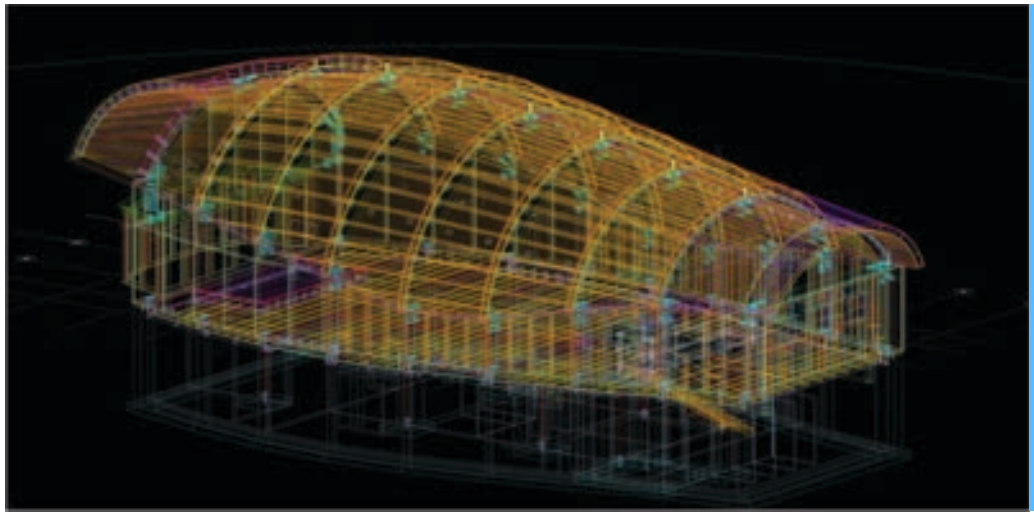
1. Layout from plans
2. Cut
3. Attach
4. Measure
5. Order
6. Wait
7. Install
8. Measure
9. Cut
10. Fit
11. Repeat…

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.

BIM to CNC

Our Tireless Workers

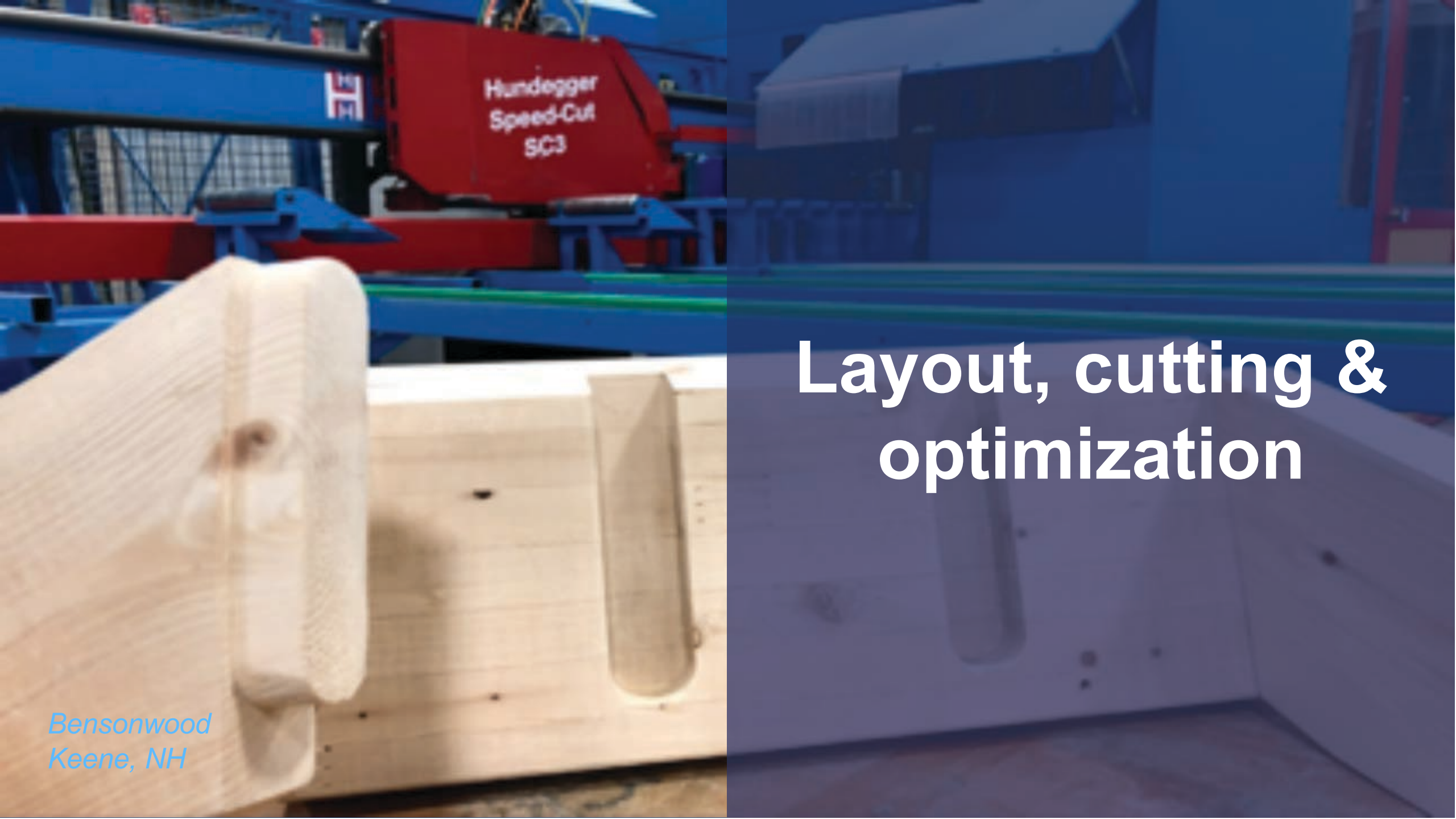
Bensonwood • Keene, NH

Bensonwood • Keene, NH

THE MODEL BECOMES THE BUILDING

- 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



Layout, cutting & optimization

Bensonwood
Keene, NH

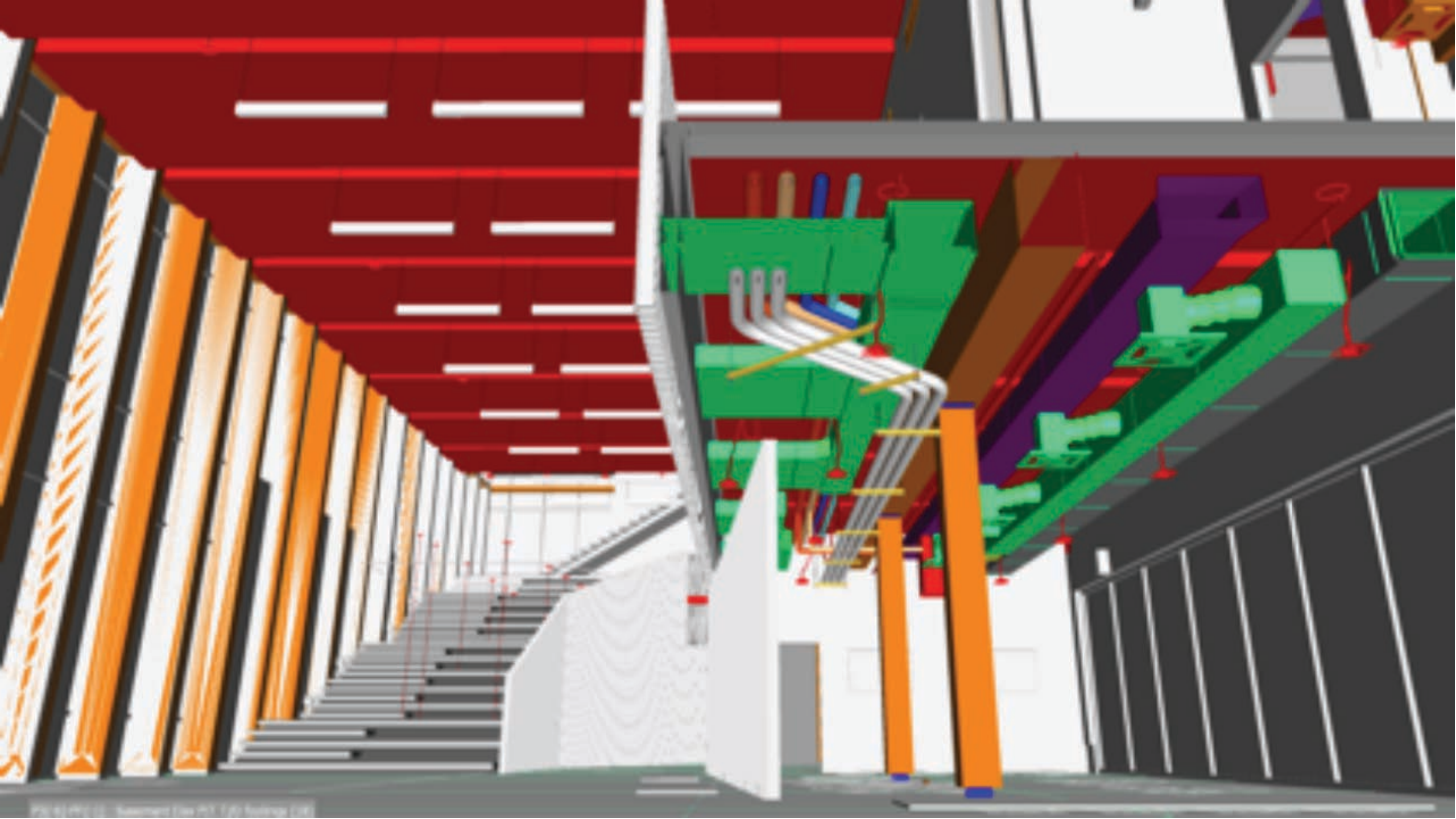
Material Handling

Automated inventory management

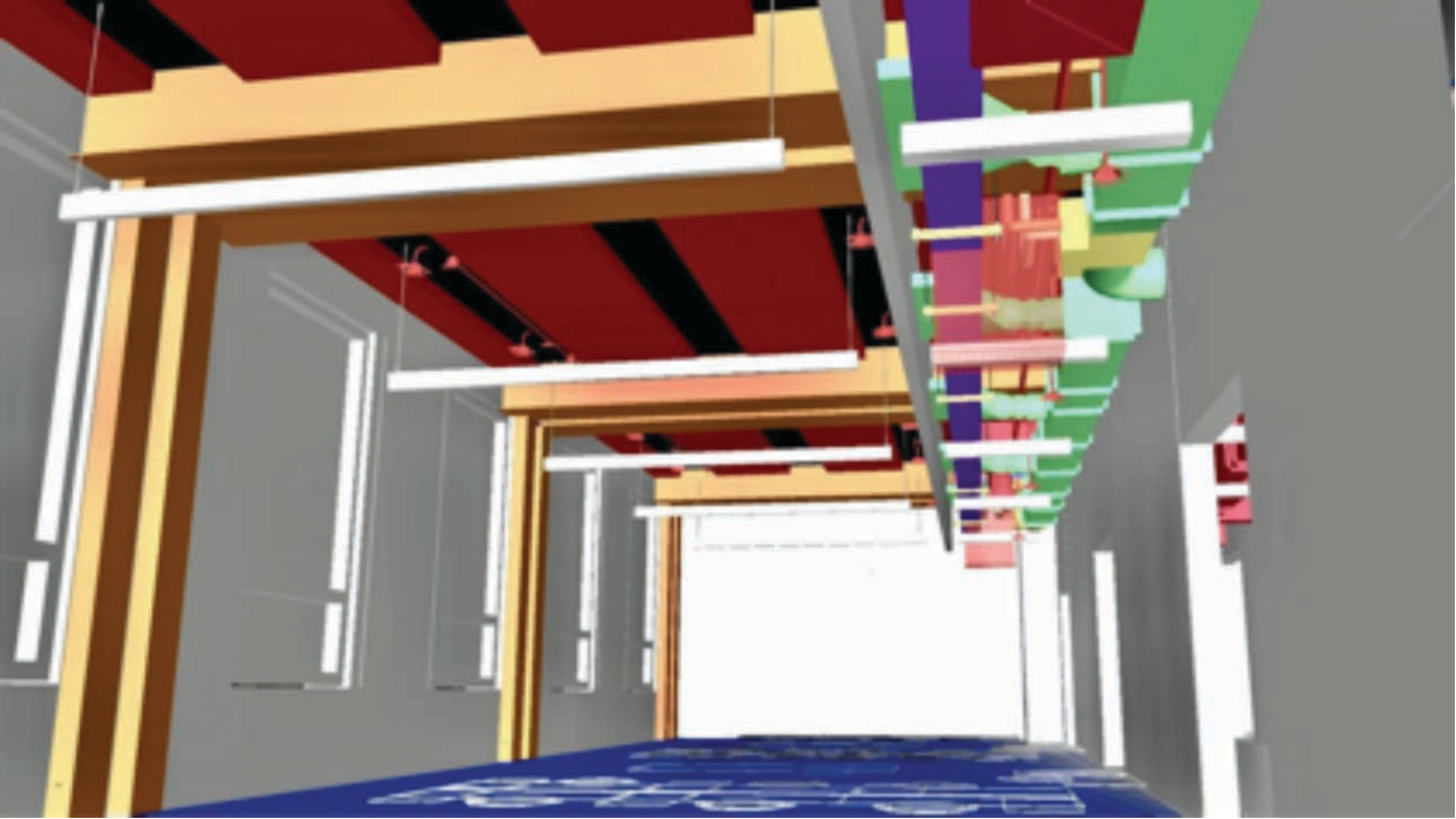
Bensonwood
Keene, NH

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




Oregon State University • Corvallis, OR



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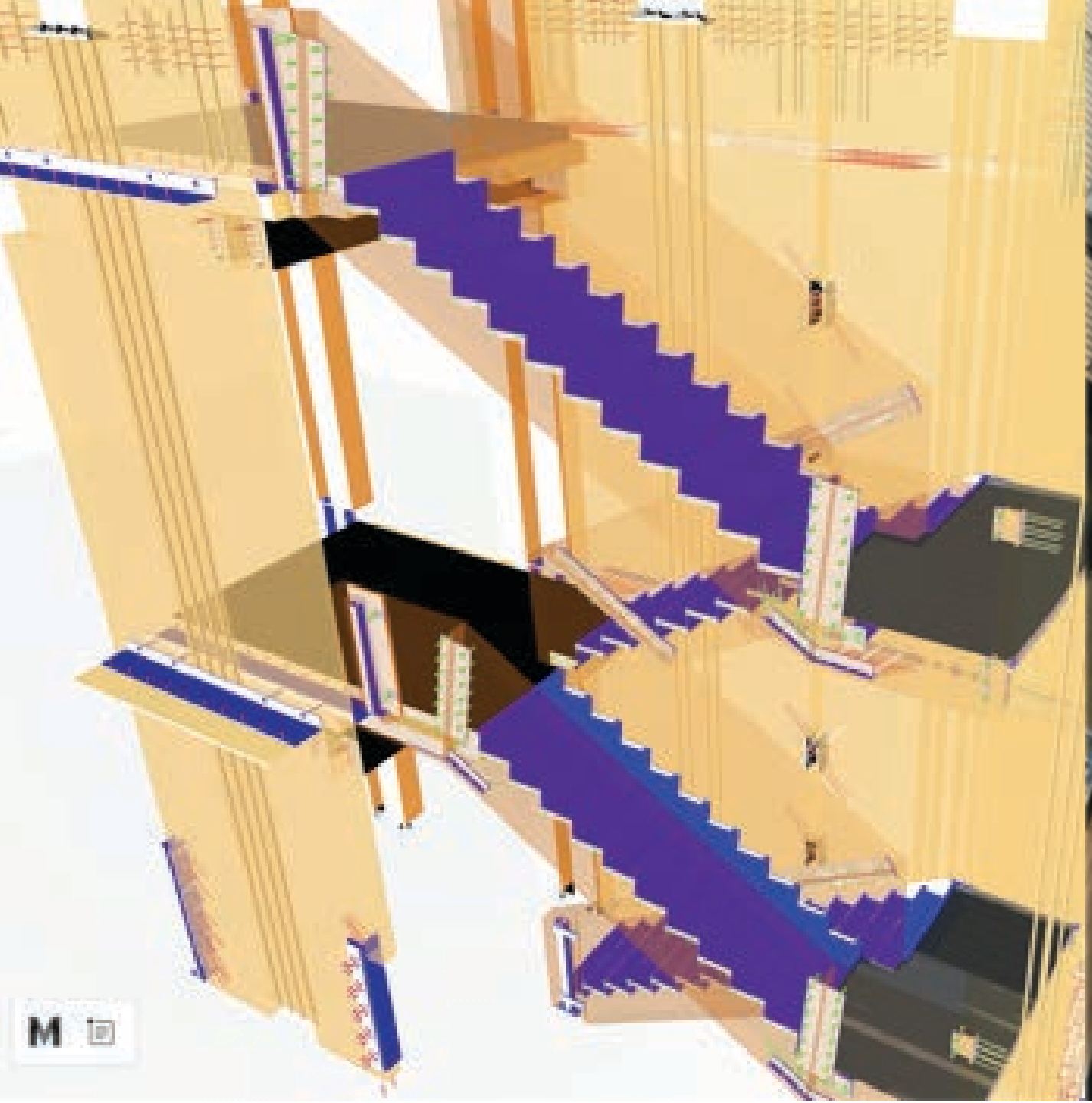


Oregon State University • Corvallis, OR

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 routing designed WITH the framing layout design.

Utility gap and beam-free colonnade.

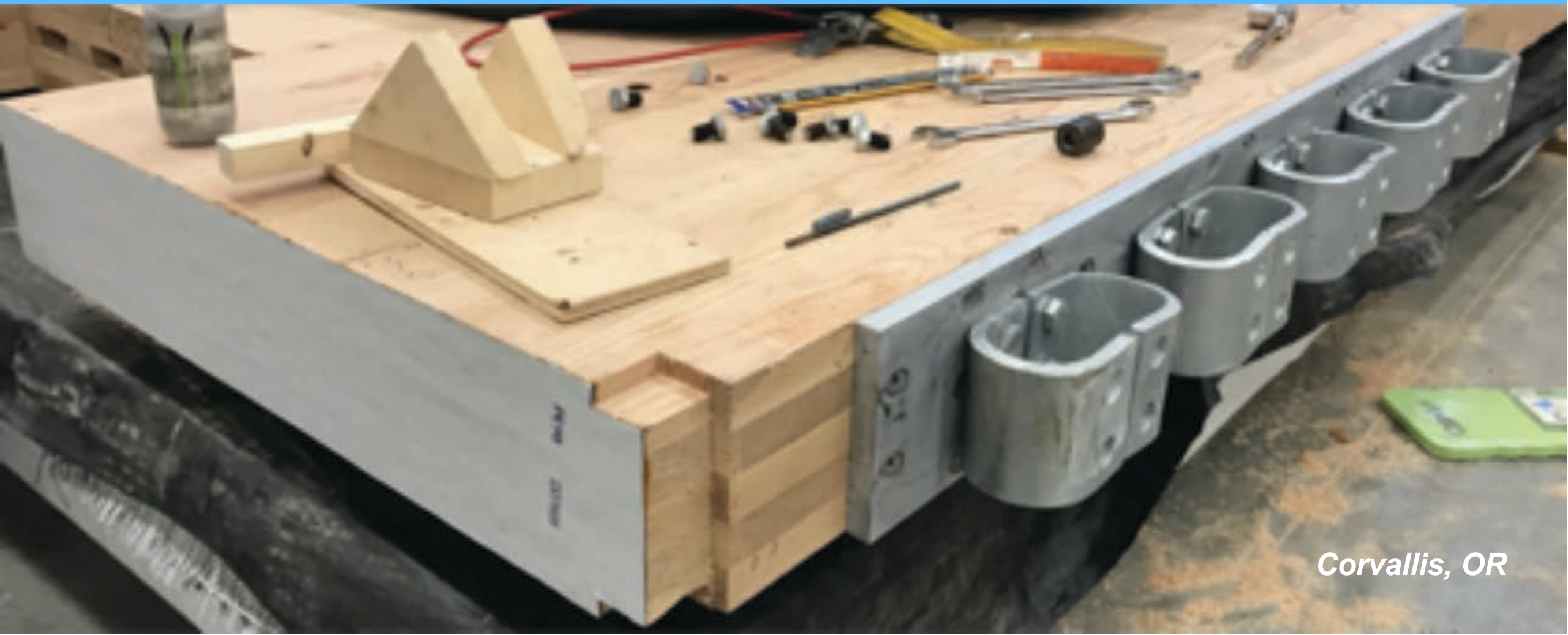
District Office, HACKER - Portland, OR

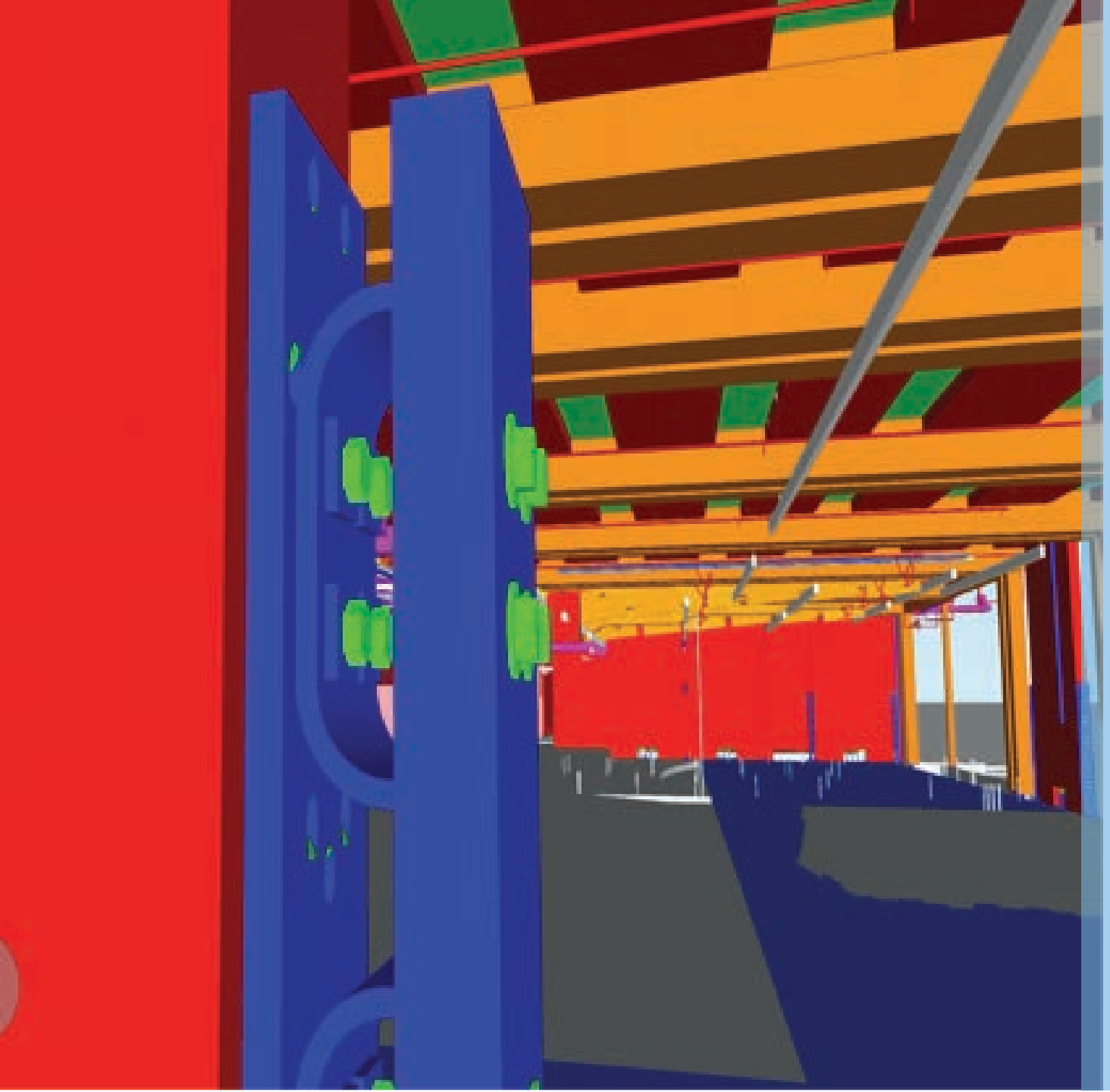
Portland, OR

Case Studies & Examples

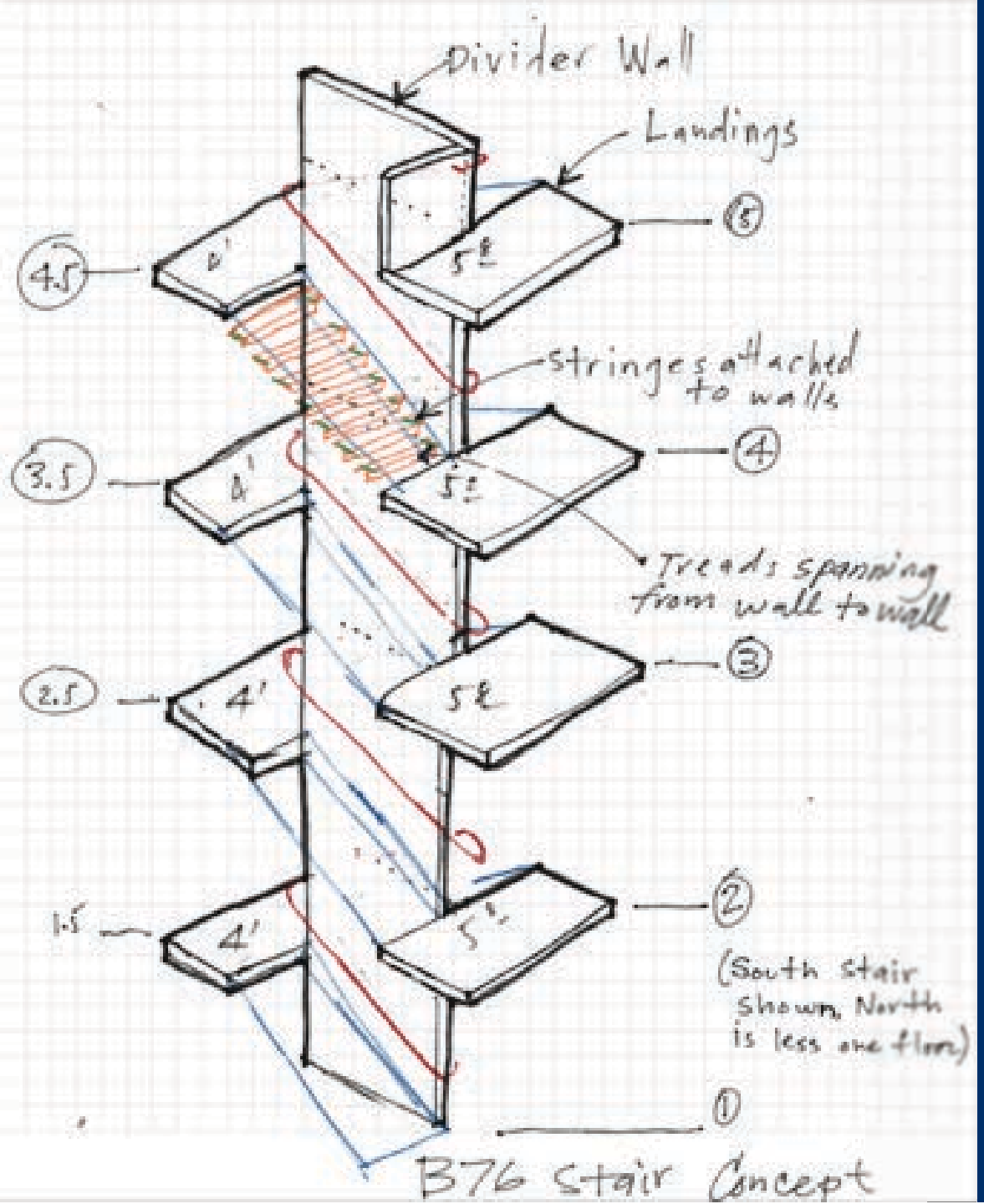
Rocking Shearwalls – Shop installation

Boundary Anchorage and Energy Dissipation System





Corvallis, OR

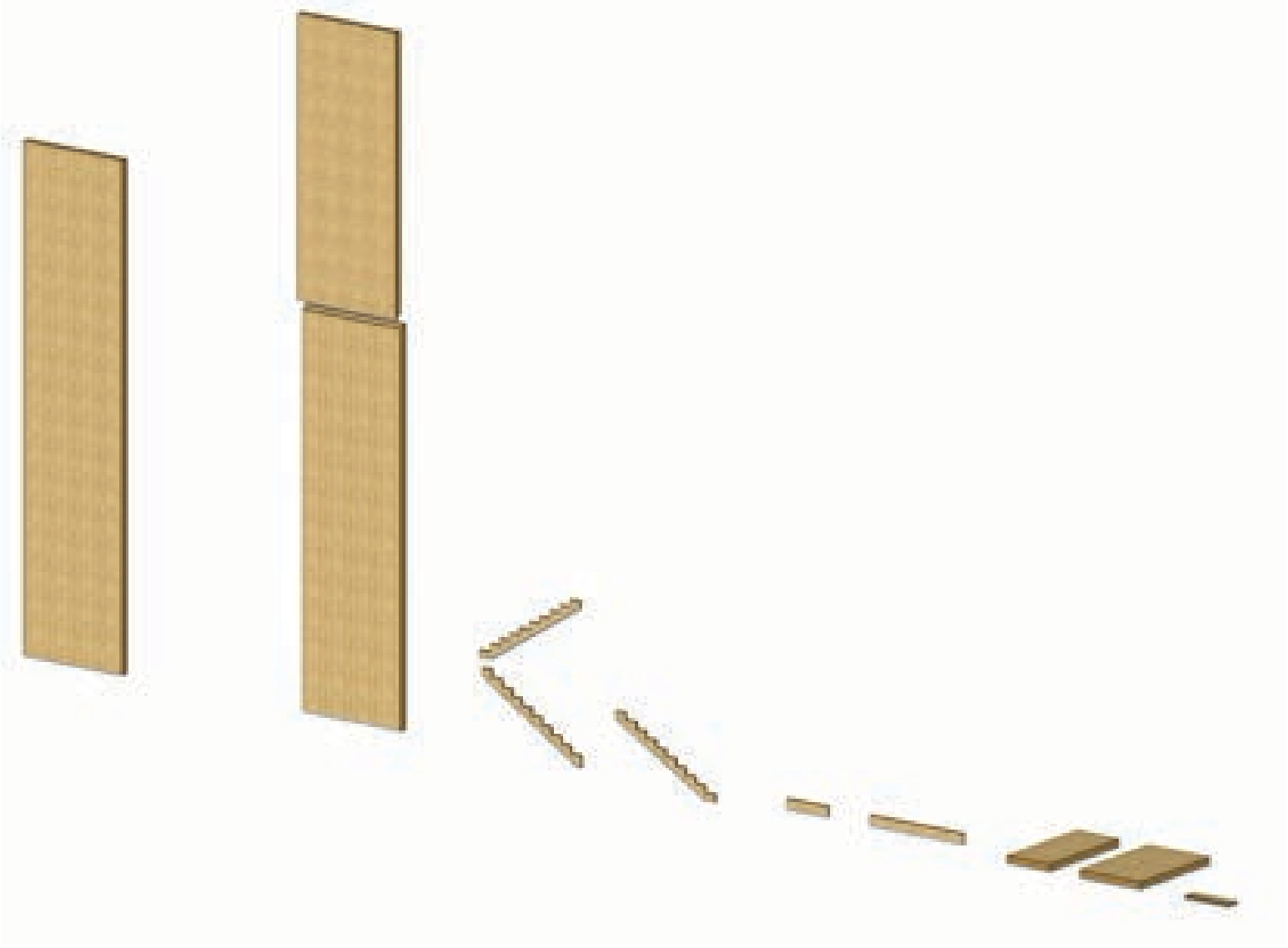


Case Studies & Examples

Design/Build Mass Plywood Stair

Portland, OR

1. BIG IDEA
2. Sketch
3. Model
4. Review
5. Correct
6. Final Review
7. Final Check
8. Prepare Machine Files
9. Fabricate
10. Install



Model snapshot of the machine files

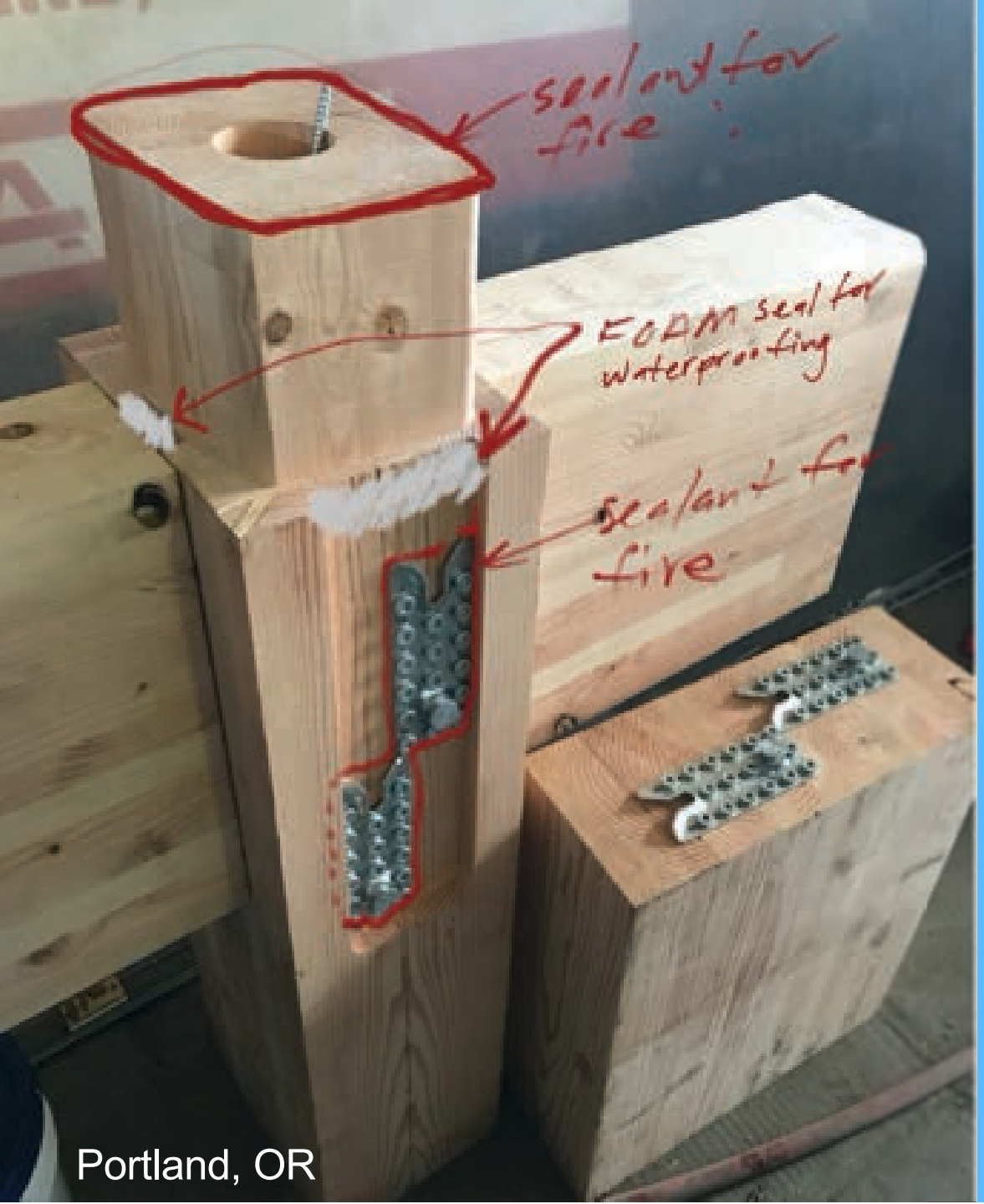
All components factory cut…

Feature Stair
HACKER
Portland, OR

Freres Plywood,
Lyons OR

Prototype Development

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



Prototype Development

Detailed mock from the final model

Objectives:

1. Validate connector fire protection.
2. Further the team understanding.
3. Fit and finish confirmation.

Bath & Mechanical Room Pods

Bensonwood
Walpole, NH

Bathroom Pods Montage

Bensonwood
Walpole, NH

Cartridge assembly

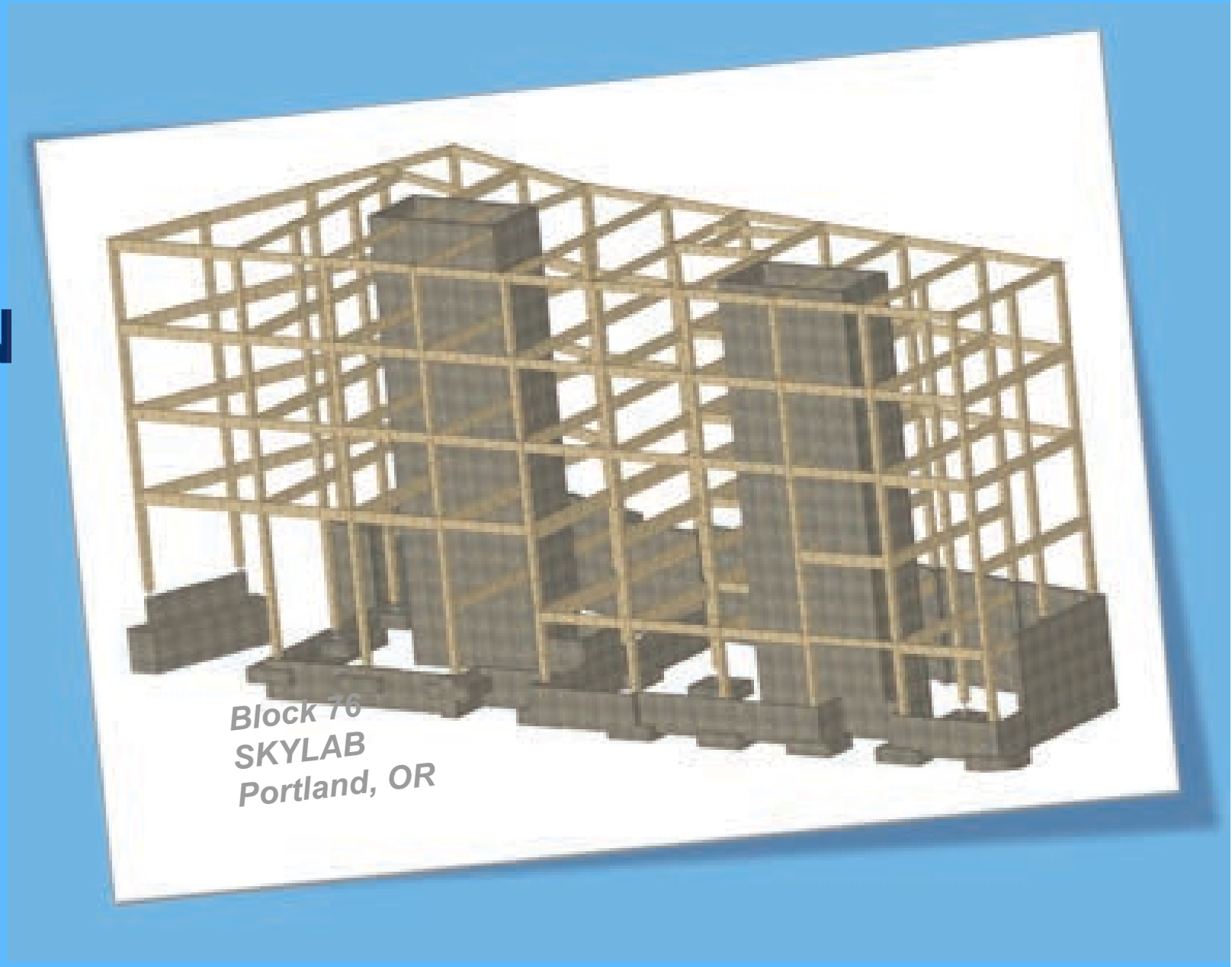
On-Site

Cartridge Installation

Bensonwood • Walpole, NH

An integrated design phase = EFFICENT CONSTRUCTION

- Productivity
- Reduced site impact
- Less waste



Portland, OR

Portland, OR

Portland, OR

Site Assembly

North Adams, MA

North Adams, MA

North Adams, MA

Early digital collaboration mean better decisions…

EXPOSED STRUCTURE STRATEGY

MECHANICAL SYSTEM SELECTION

SYSTEMS DISTRIBUTION STRATEGY

- Vertical risers
- Horizontal Distribution

CONSTRUCTABILITY

- Timber connection details
- Moisture Mitigation Planning

ASSIGNED SYSTEM PATHWAYS

- Sprinklers
- Vertical Electrical
- Horizontal Electrical
- Plumbing
- Fire alarm and electrical

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

How to Get Started

NEED SITE SPACE

- Deliveries
- Boom truck or crane
- Evaluate Access

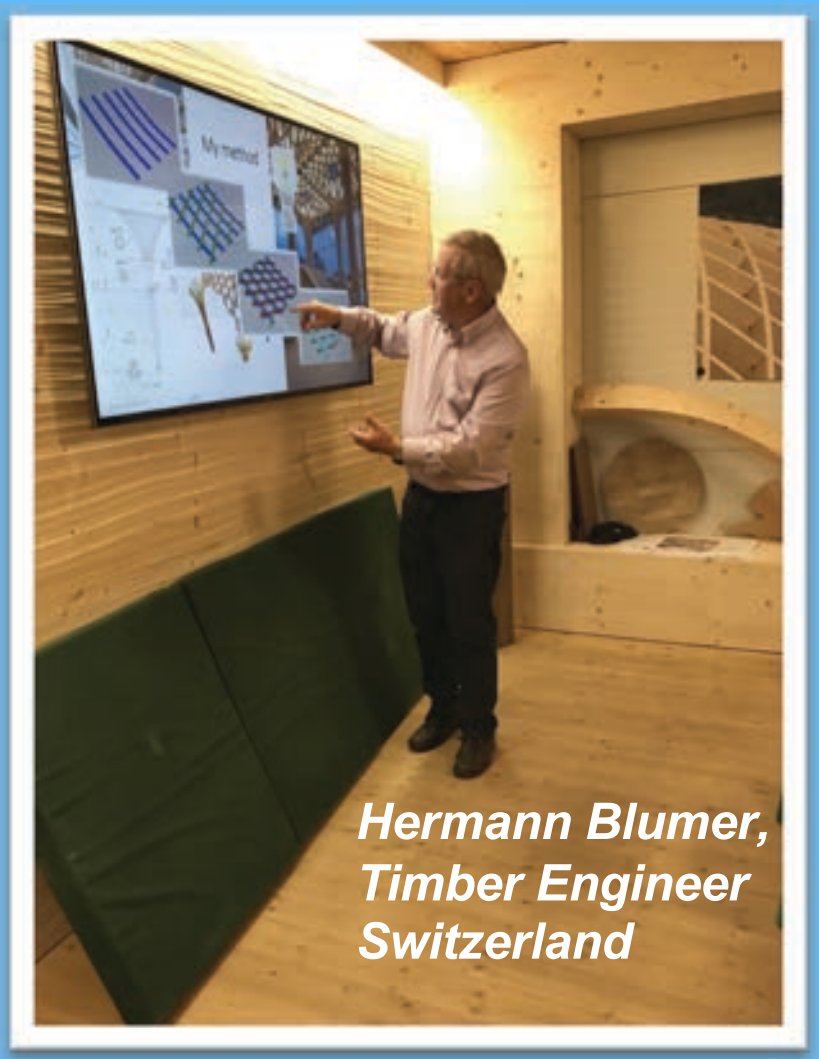
PARTNERS

- Build a team
- Decide where info will live

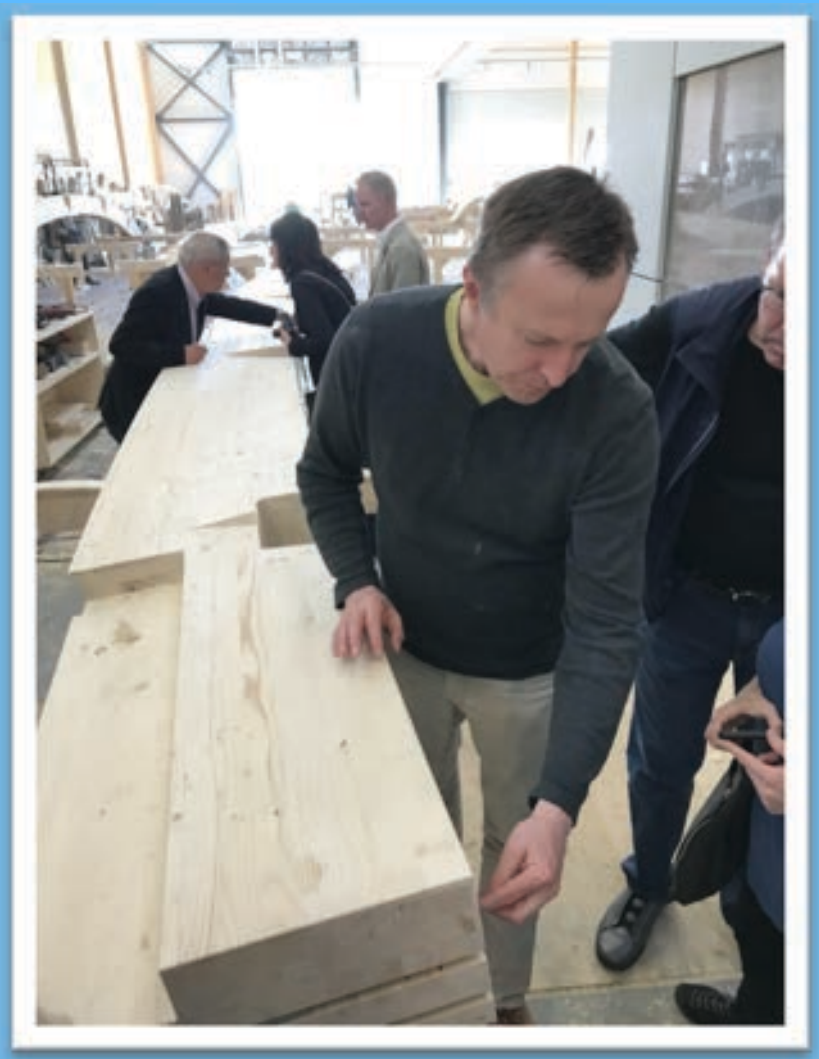
DECISION MAKING & COMMITMENT

- Get everything in model early
- Work the model
- Rely on model

Elsewhere: European Mass Timber



Hermann Blumer,
Timber Engineer
Switzerland



Models are an extension of their design and carpentry expertise.

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

Concluding Thoughts:

What is each mass timber project?

- **A unique prototype…**
- **With design and execution as isolated activities…**
- **Where hard lessons are learned…**
- **And, poor choices cannot be corrected?**

- OR -

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.

Randall Walter
Bensonwood

randall@bensonwood.com

BRAD NILE, AIA
Andersen Construction

bnile@andersen-const.com