DESIGN ENGAGEMENT

Building the Team and Managing the Design

BRAD NILE, AIA
Andersen Construction

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

SOURCE: Bureau of Economic Analysis (BEA), Hideyuki (2011)
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
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

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

Virtual Building

BIM

CNC | IPD

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

Site Process

Built From Model:
Parallel Processing

VS

Infill Millwork
Foundation & Structure
Shell
Exterior finish
MEP

Exterior finish
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
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
Layout, cutting & optimization

Bensonwood
Keene, NH
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
New mindset for contractors

Must understand the digitization of design because it provides the potential for full offsite fabrication
Project delivery shift from Design-bid-build to Integrated Project Delivery

Fully “Digitized“ Structure
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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
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
Site Assembly

North Adams, MA
Case Studies & Examples

Rocking Shearwall Boundary Anchorage and Energy Dissipation System Installation

Corvallis, OR
Case Studies & Examples

Design/Build Mass Plywood Stair
Portland, OR

Model snapshot of all pieces for nine flights of stairs made into machine files
All components factory cut based on modeled machine files
Prototype Development

- First-time Components
- Engineering Verification
- Machine and material limitations
Bath & Mechanical Room Pods

Bensonwood
Walpole, NH
Bathroom Pods Montage

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
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 as an extension of their in-house skill/capacity

Hermann Blumer, Timber Engineer Switzerland
Swatch Omega
- Shigeru Ban Architect,
Blumer Lehmann -
mass timber design,
fabrication and installation

Switzerland
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

Keene, NH
Important Differences

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

**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.

BRAD NILE, AIA
Andersen Construction
bnile@andersen-const.com
This concludes The American Institute of Architects Continuing Education Systems Course

Brad Nile
Andersen Construction
bnile@Andersen-const.com