DESIGN ENGAGEMENT Building the Team and

Managing the Design

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

Thomas Friedman

ANDERSEN CONSTRUCTION PORTLAND, OR • SEATTLE, WA • BOISE, ID

BENSONWOOD KEENE, NH



Construction productivity 1950-2012

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



[www.curt.org]

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







Yesterday's Building Teams

Today's Building Team





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

GERMANY | AUSTRIA | SWITZERLAND

CNC Tools Software Lead Technology Adaptation Modern Manufacturing Advanced Education for Trades Durable Building Standard

HOLLAND

Open Building Lives Must Prevail Rational Design & Building Time based organization Sustainability through Adaptability Dimensional Coordination DIGITAL DESIGN | BUILD

NEW ENGLAND

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

JAPAN

Lean Manufacturing Kaizen Precision Power of Modularity Tradition of Perfection

FRANCE

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

Elsewhere: European Mass Timber





Models are an extension of their design and carpentry expertise.





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



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 • Walpole, 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

Hundegger Speed-Cut SC3

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Layout, cutting & optimization

Bensonwood Keene, NH

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Material Handling

Automated inventory management

Bensonwood Keene, NH

Case Studies & Examples

Rocking Shearwalls – Shop installation

Boundary Anchorage and Energy Dissipation System

Oregon State University • Corvallis, OR

- Section in the section of

ME

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
- Appropriately timed coordination is the key
- Figure out the MEP strategy along with the structural frame

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DG

Oregon State University • Corvallis, OR

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Engagement of Team for System Decisions

- Project Goals
- Code Constraints
 - Building Type
 - I 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, OR₃₀

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

10-

Model snapshot of the machine files

All components factory cut...

Bath & Mechanical Room Pods

Bensonwood Walpole, NH

Bathroom Pods Montage

Bensonwood Walpole, NH

Cartridge assembly **On-Site**

Cartridge Installation

Bensonwood • Walpole, NH₃₇

An integrated design phase = EFFICENT CONSTRUCTION

- Productivity
- Reduced site impact
- Less waste

Site Assembly

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North Adams, MA

North Adams, MA

North Adams, MA

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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

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.

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