

The 21st Century Craft of Sustainable Homebuilding:

Culture, Technology & Methods Toward a Better Way to Design & Build

Tedd Benson

Steward

Bensonwood

Unity Homes

A Tedd Talk



Bensonwood (1972) & Unity Homes (2012)

110 associates: carpenters, woodworkers, timber framers, architects, engineers, building science, designers, project managers, software & IT, sales



Three production facilities:
Timberframe, Wall & Floor assemblies, Roof panels,
Millwork & Woodworking



Bensonwood



Bensonwood



Unity Homes









1820



CAMP BUILDINGS

Carpenters at work on a dormitory at Waiouru in September 1940

1940



2006





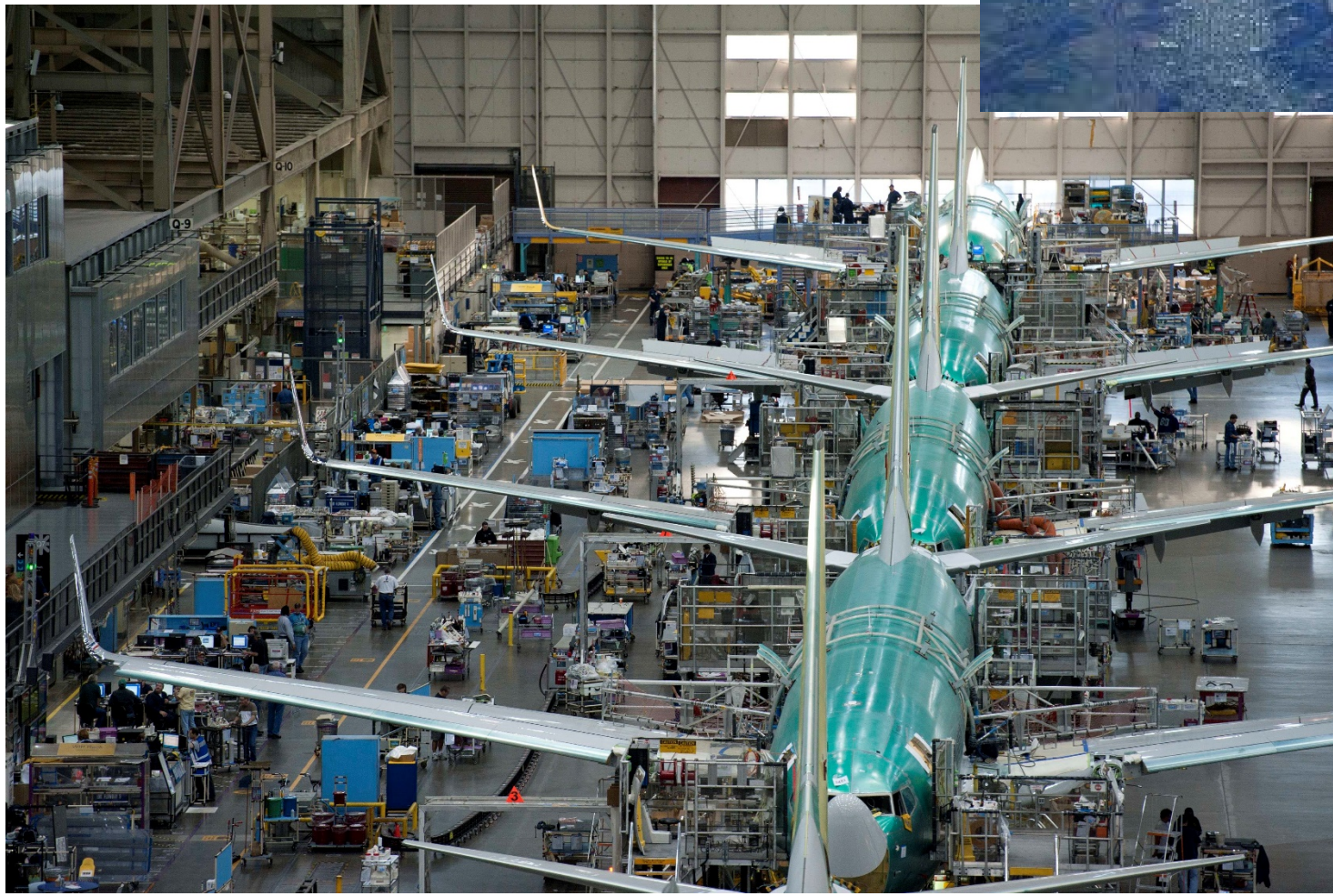
For \$20,000



For \$20,000



Them



Us





MASCO

LUTRON



uponor



American Standard



Dissing the U.S. Homebuilding Industry

- **Disorganized**
 - *Teamwork nearly non-existent*
- **Disintegrated**
 - *Siloed, Fragmented*
- **Dysfunctional**
 - *Poor communication*
 - *Adversarial*
- **Disenfranchised**
 - *Non-inclusive hierarchy*
- **Disinterested**
 - *Waning skill level*
 - *Lack change & improvement*
- **Disposable**
 - *Defective work product*
 - *Low quality fuel hogs*



A Challenged Industry

Built-in inefficiency

- Weather-based delays, shutdowns
- Linear Process
- Raw materials to finished product under difficult conditions, with inadequate tools

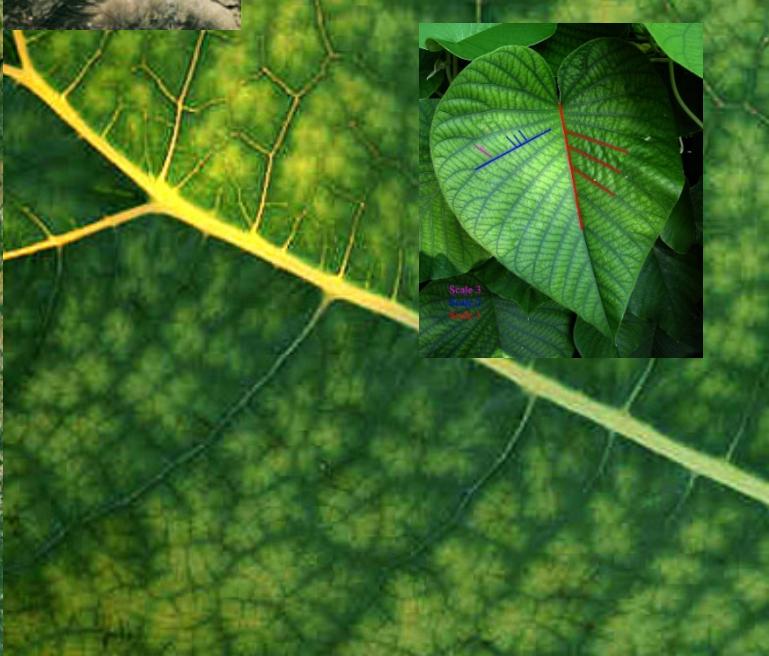
Skill degradation

- 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

- Most defective products consumers purchase..
- 15% - 80% serious defect rate
- Decades long industry culture of accepted compromise









Naomi Oreskes
Merchants of Doubt



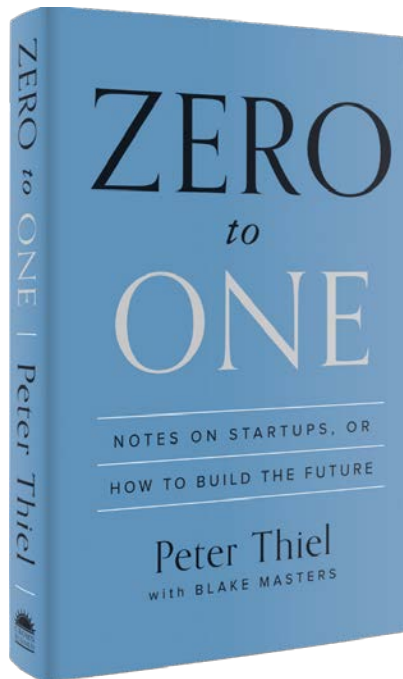
Elizabeth Kolbert
The Sixth Extinction



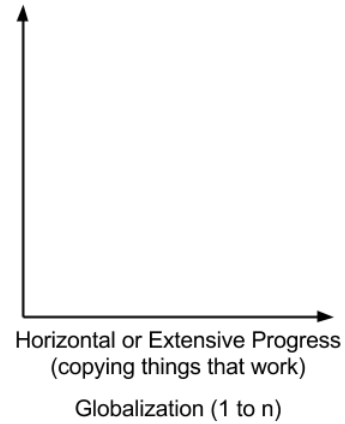
Naomi Klein
This Changes Everything



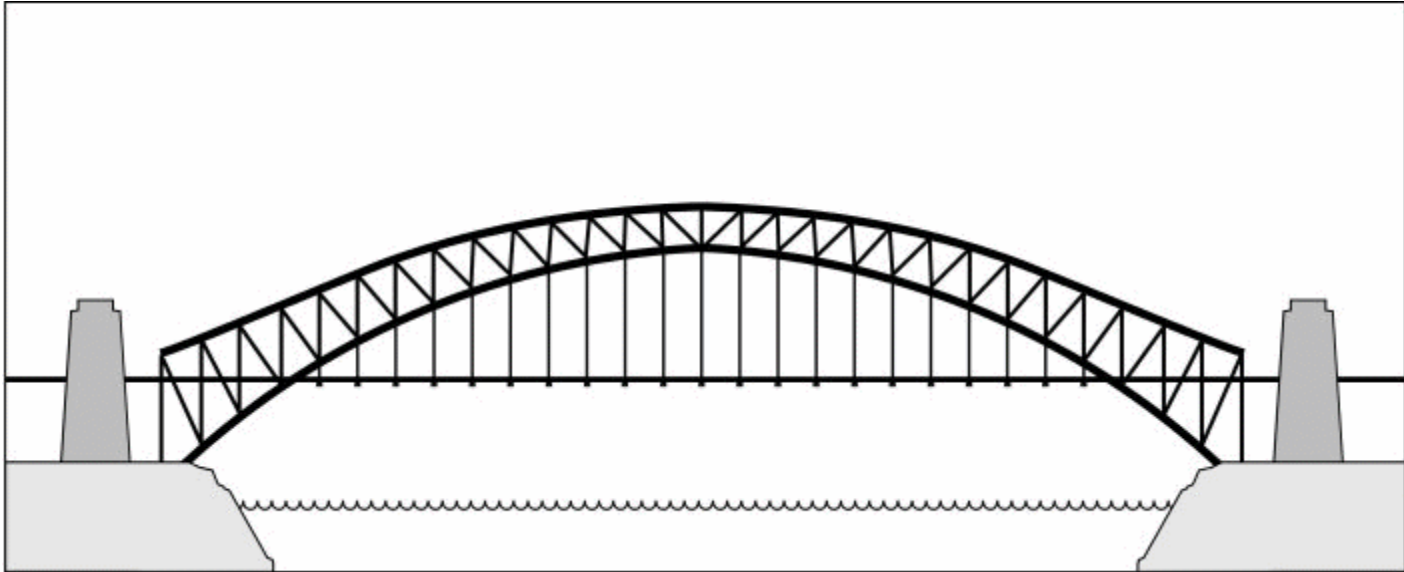




Vertical or Intensive Progress
(doing new things)
Technology (0 to 1)



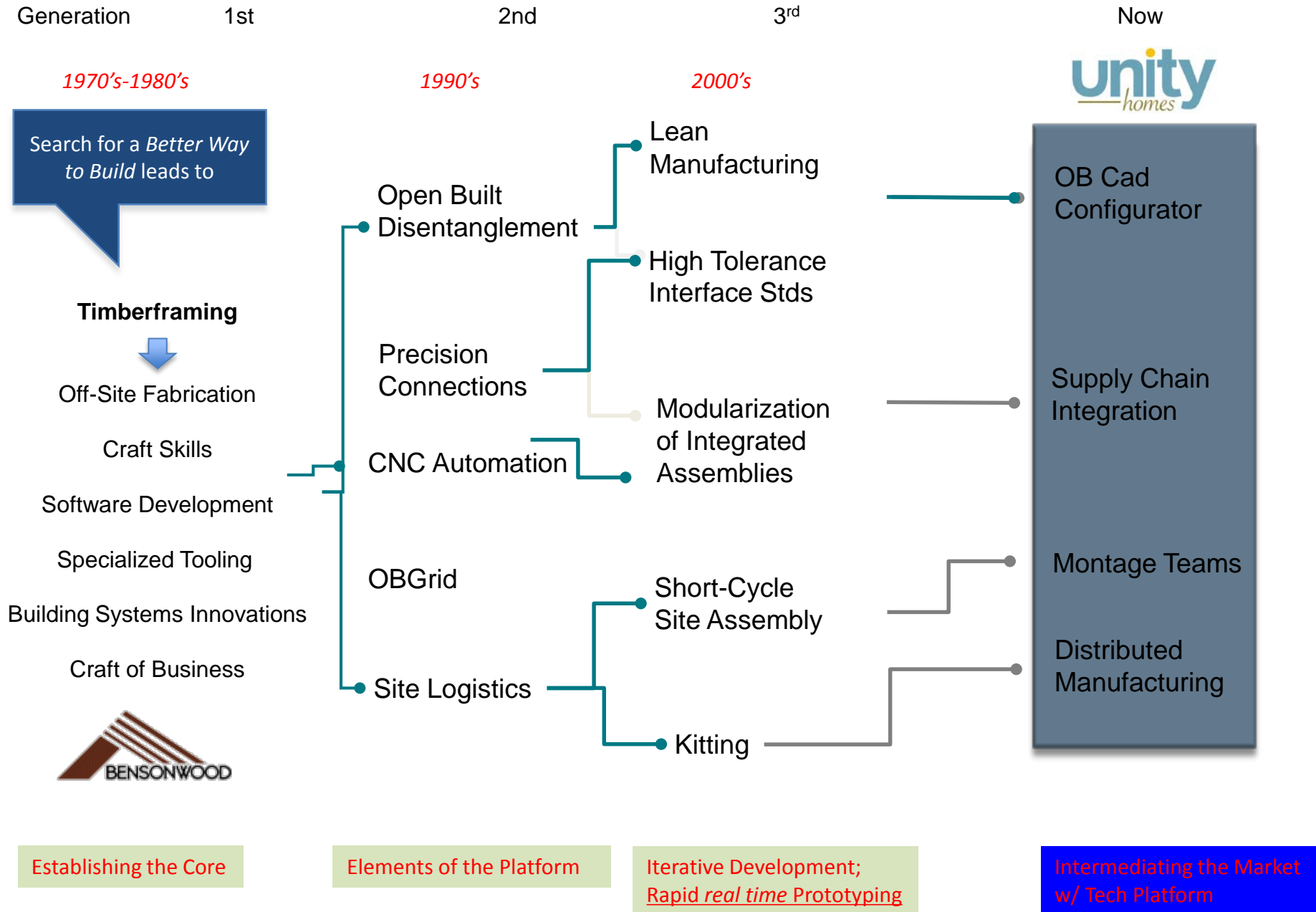
Two Forms of Progress



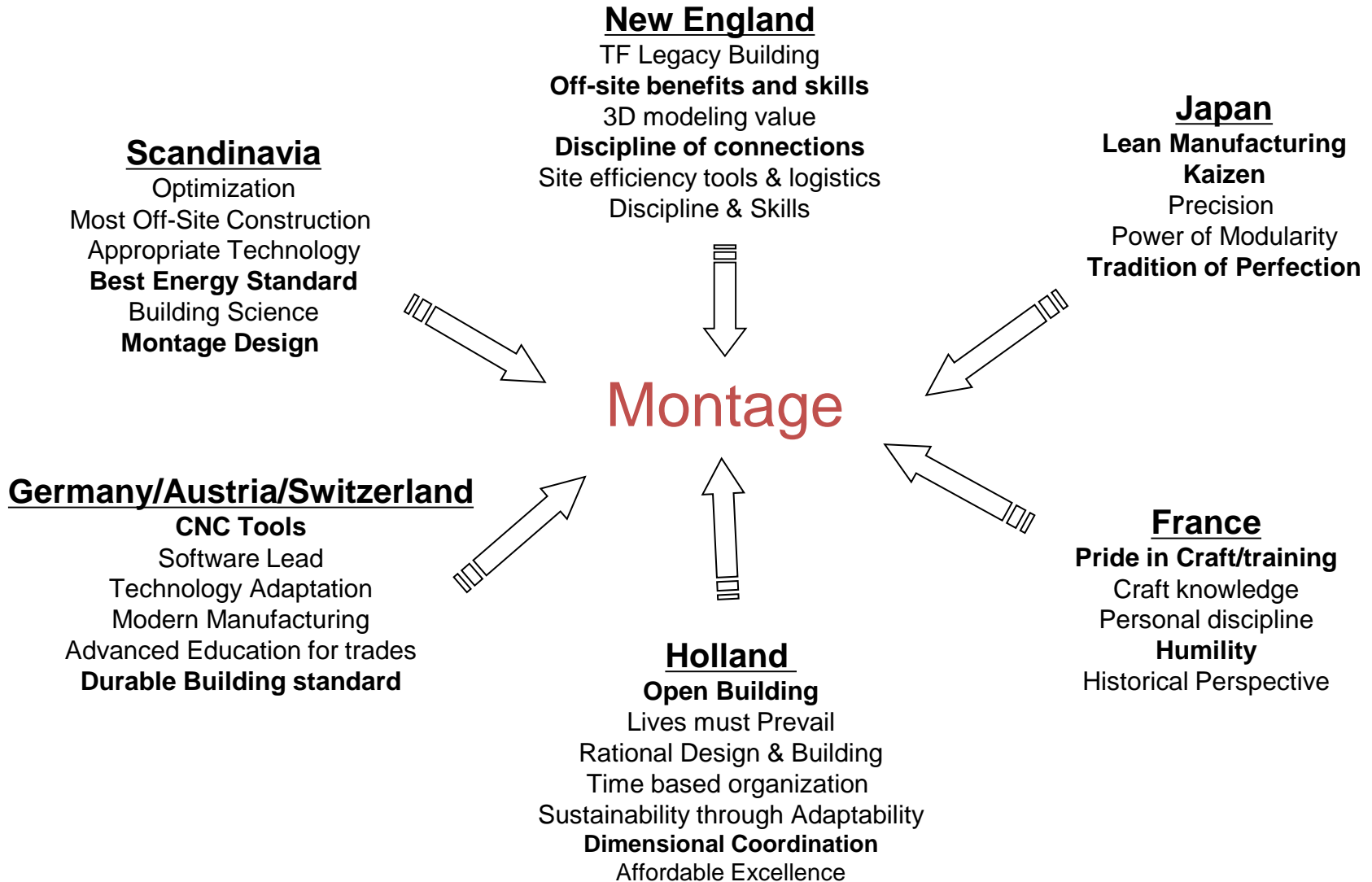
Abutments
Arch structure
Struts
Bridge deck

**Principles and Practices
for
21st Century Homebuilding**

BW2B Family Tree



Learn from Everywhere



Off Site Fabrication and Assembly

Learning from timberframing

- Shop for cutting and shaping; site for assembly
- Precise fits once
- Appropriate tolerances
- The art and discipline of connections
- 3D digital plans for precision and efficiency
- Every day is beautiful for building
- Organizing, bundling, shipping
- Value of a well-executed plan and teamwork
- Working with cranes: rigging, safety





Rediscover the *Noble Profession*

The “Telos” of Homebuilding

- Good houses can only be built in a culture of discipline, training and pride
- Higher expectations in skills, efficiency, values, integrity
- High involvement
 - Experience, craft, knowledge trumps hierarchy
 - .



Firmitas

strong, refuge of security,
built for the ages

Utilitas

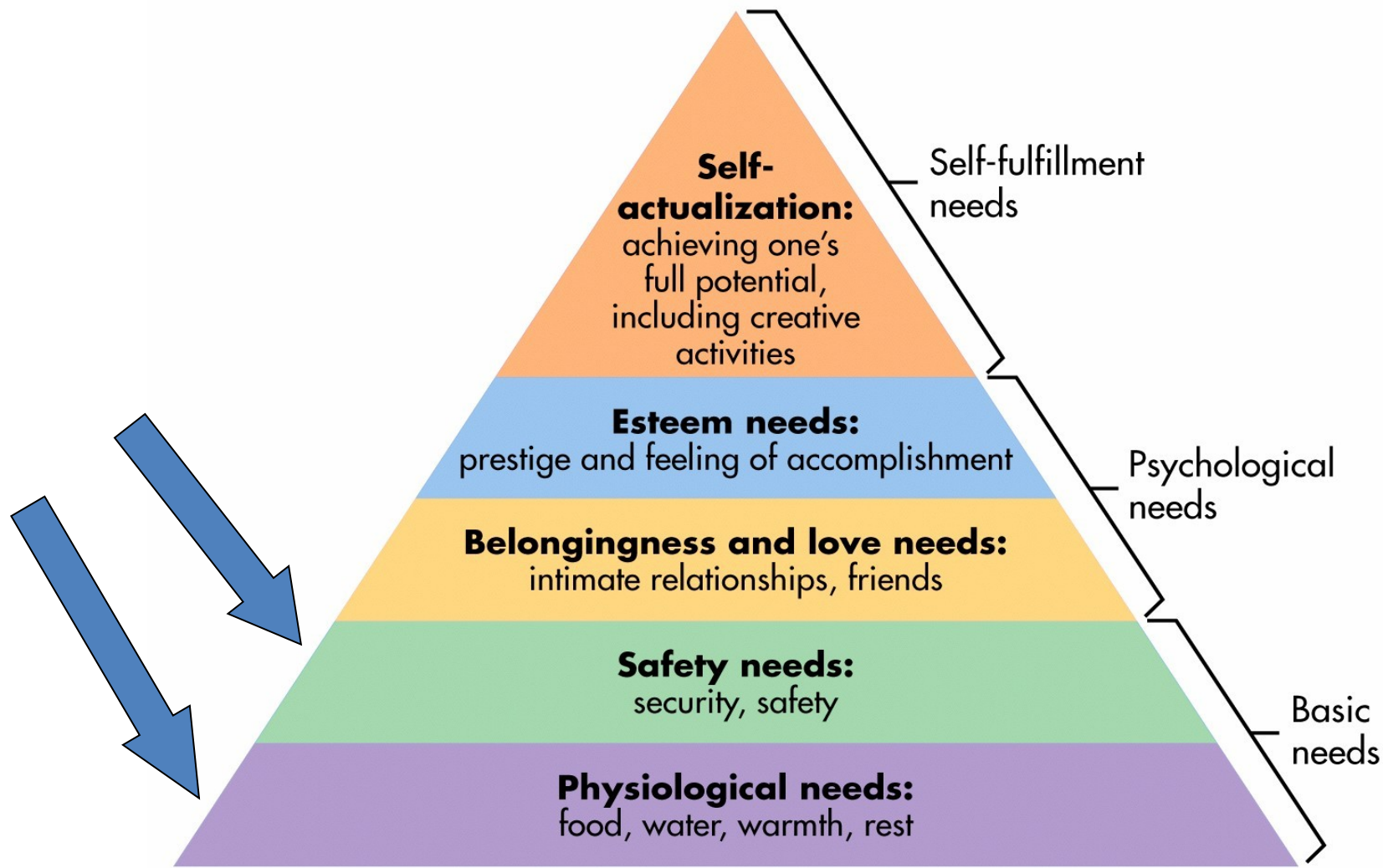
functional, adaptable,
personal, healthy

Venustas

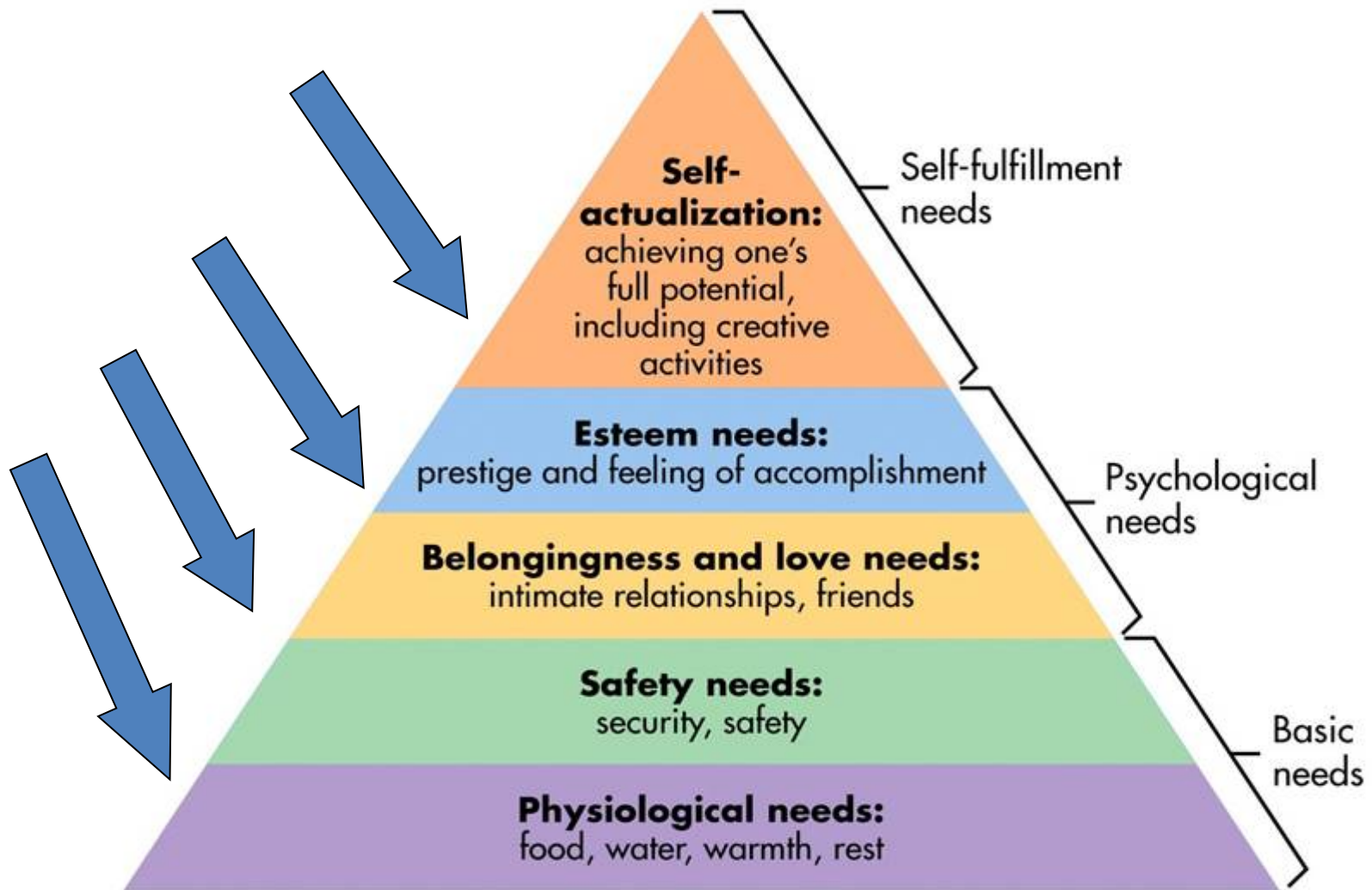
beauty, harmonious
proportions, sustainable
aesthetic

Parsus

frugal, affordable, high
performance, minimal
impact



Vitruvian Imperative Aim



Lean Manufacturing Practices

Raising quality

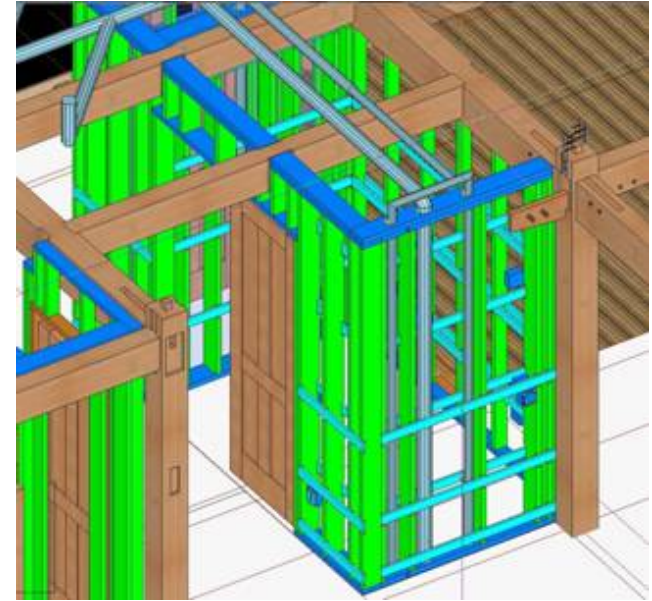
Eliminating waste

Applying kanbans, kaizens and Value Stream Mapping
to get rid of muda, mura and muri*



*uneven production) [muda](#), waste [mura](#), overworking [muri](#)

Build it Twice: Virtual before Actual BIM to BPM



BPM to CNC



Open Building Disentanglement

Months

- Furniture
- Life's junk



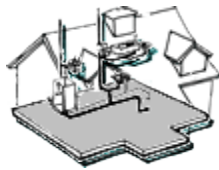
Stuff



Site

Geological time

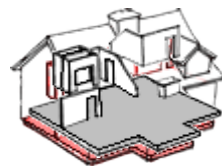
- Placement
- Disturbance



Services

1-10 years

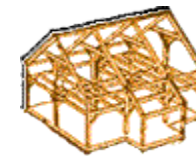
- Plumbing
- HVAC
- Electrical
- Network/audio



Space plan

10-50 years

- Interior Partitions
- Cabinets
- Finishes



Structure

200-500 years

- Foundation
- Framework
- Engineering



Skin

75-150 years

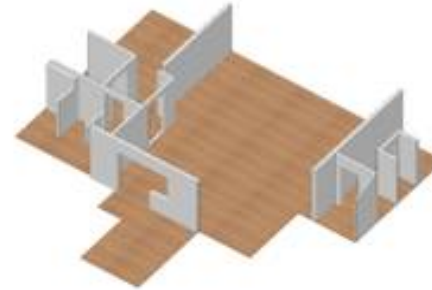
- Building Science
- Roof, Walls
- Windows & Doors
- Siding & Trim

Open Built Disentanglement

Skin
50-100 years



Space plan
10-50 years



Structure
200-400 years



Services
1-20 years



Site
Forever



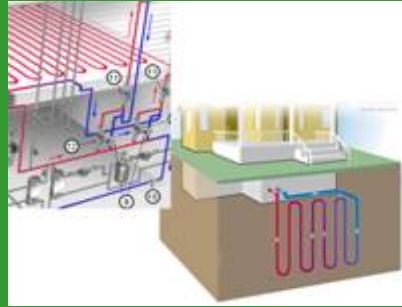
Stuff
Months-10 years



SHELL

INFILL

Open Built Disentanglement



Structure, Insulation, Energy Systems, Skin = Shell 250 yrs.



Services, Partitions, Fixtures, Finishes, Amenities = Infill 5-30 yrs

Environmental, Public Needs

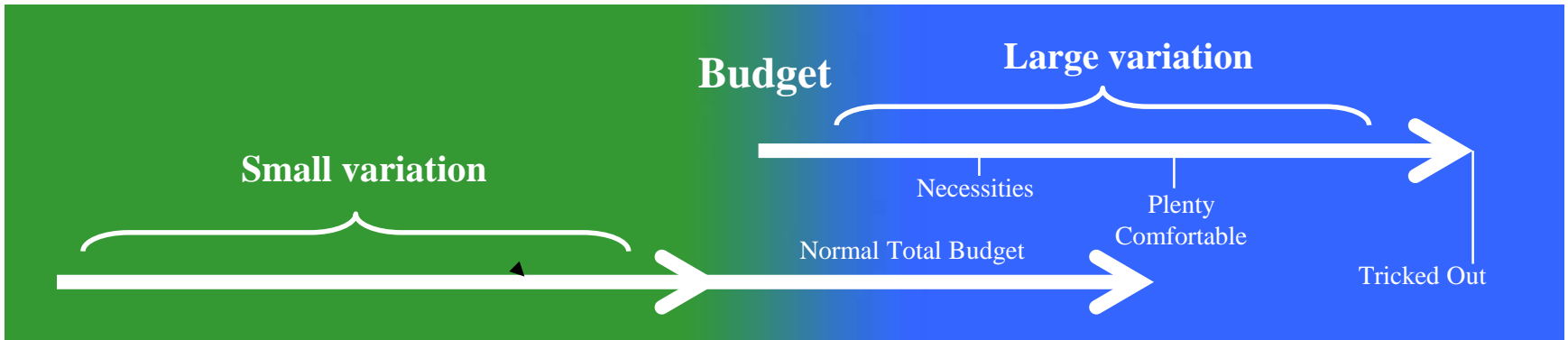


Personal Needs & Desires



Shell

Infill

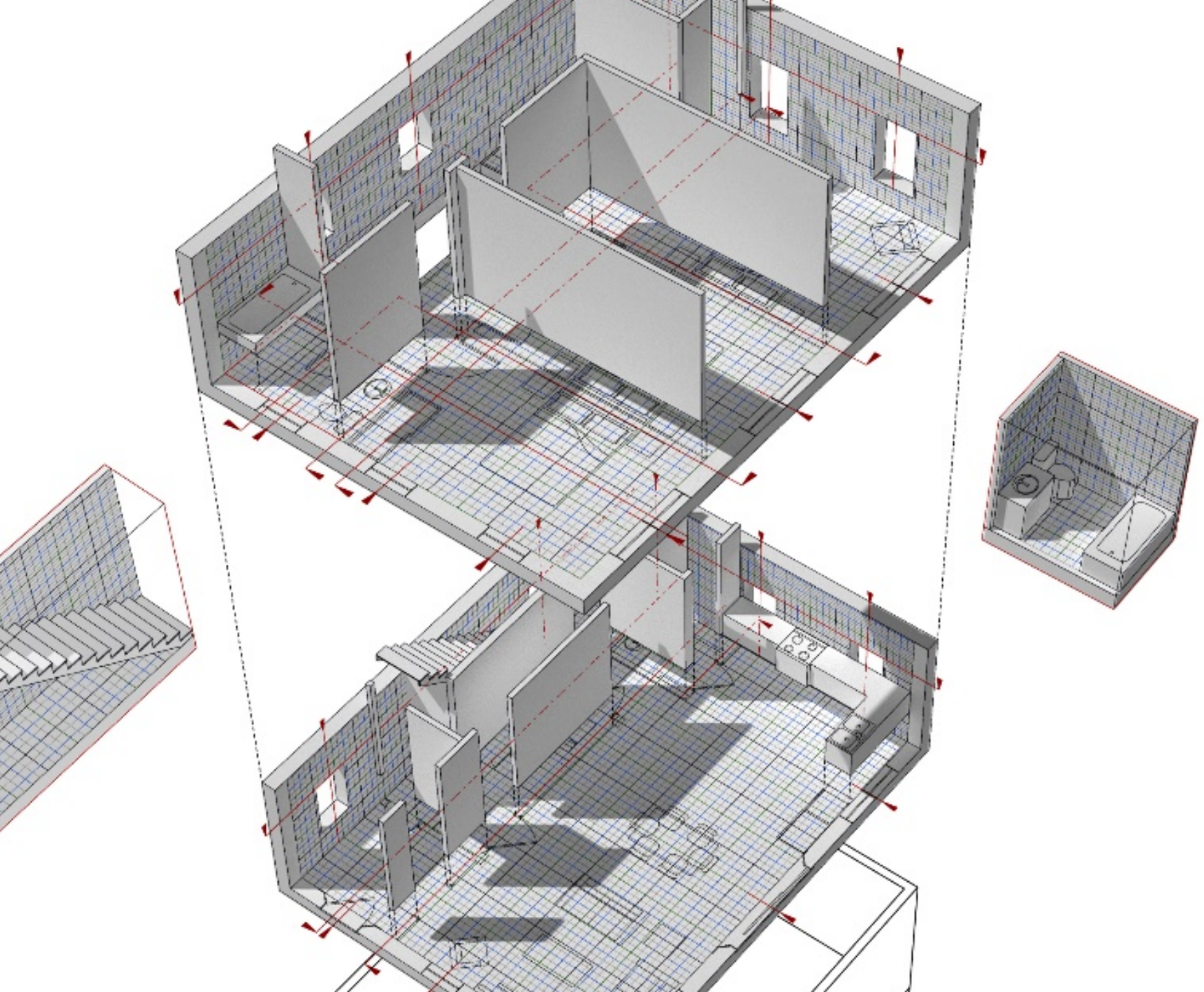


Montage building

“any combination of disparate elements that forms or is felt to form a unified whole”

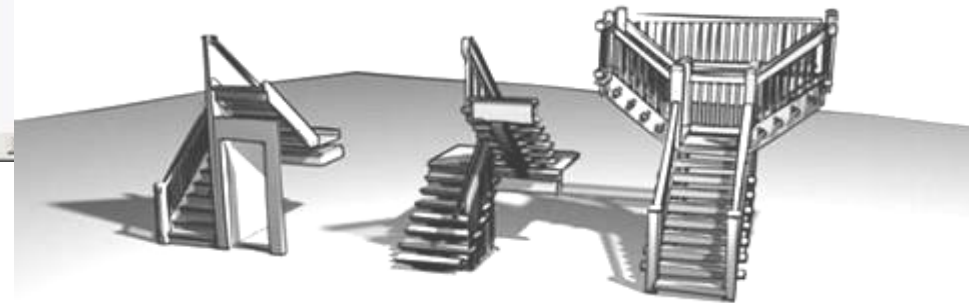
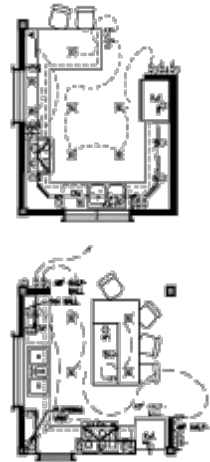
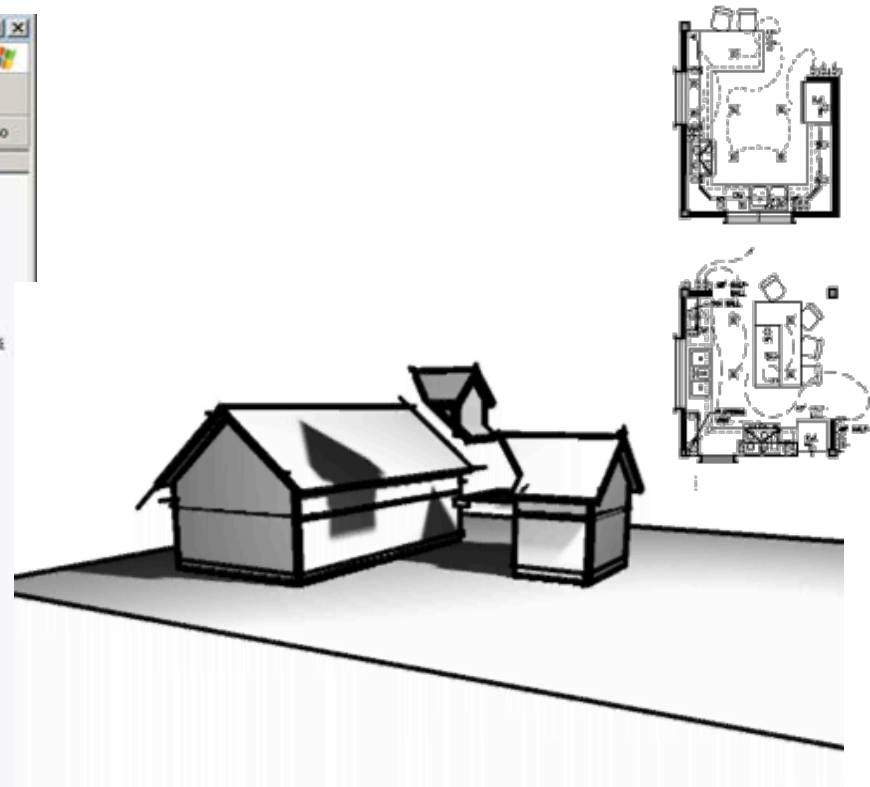
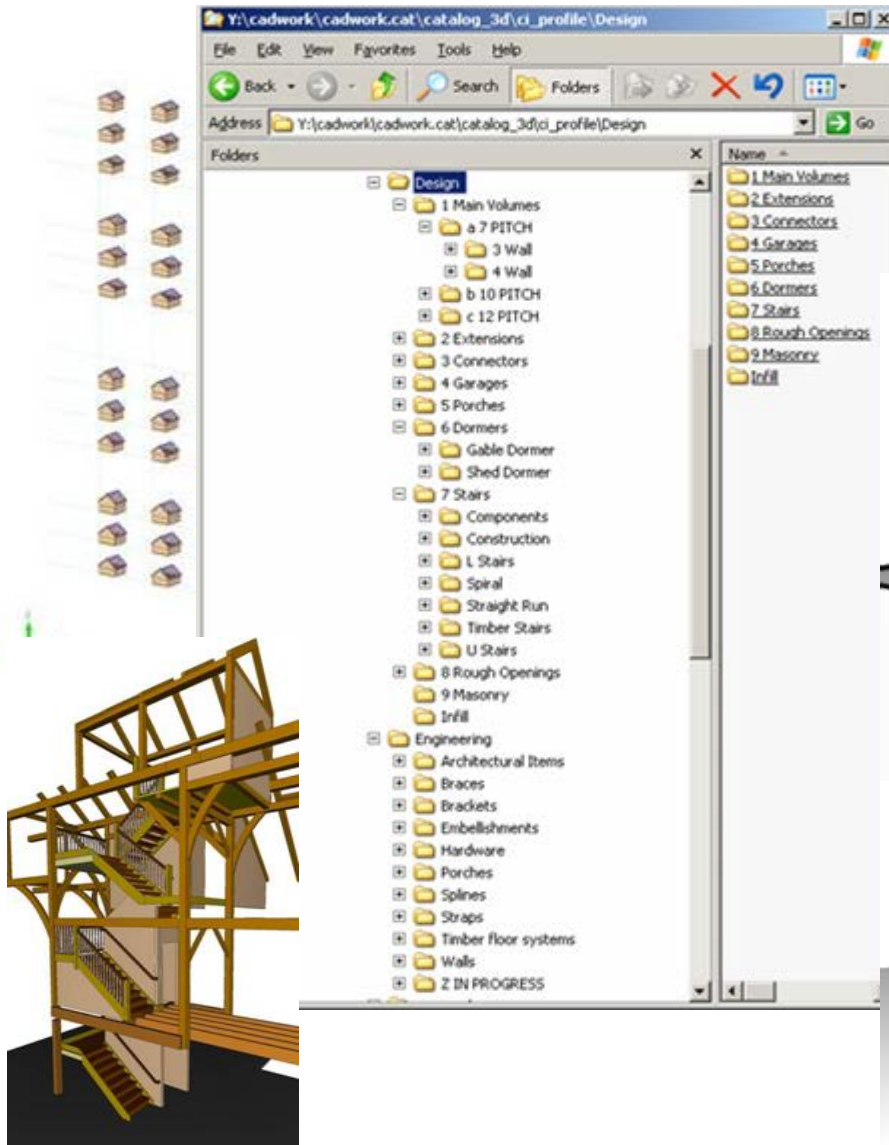
A building approach with a plan
Only Optimize, Never Compromise

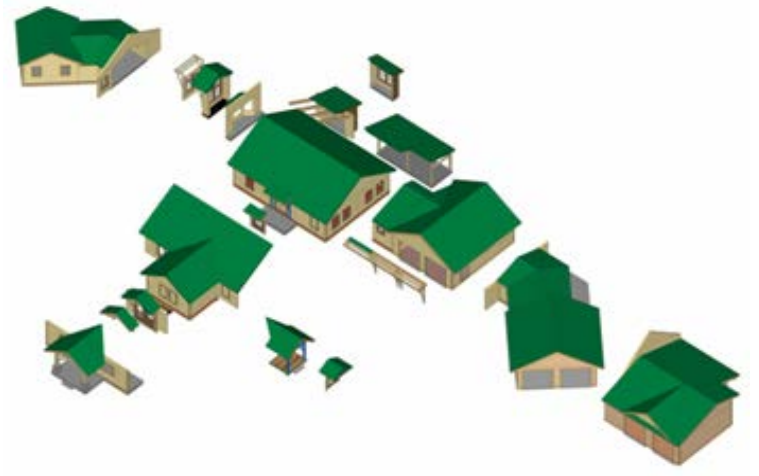


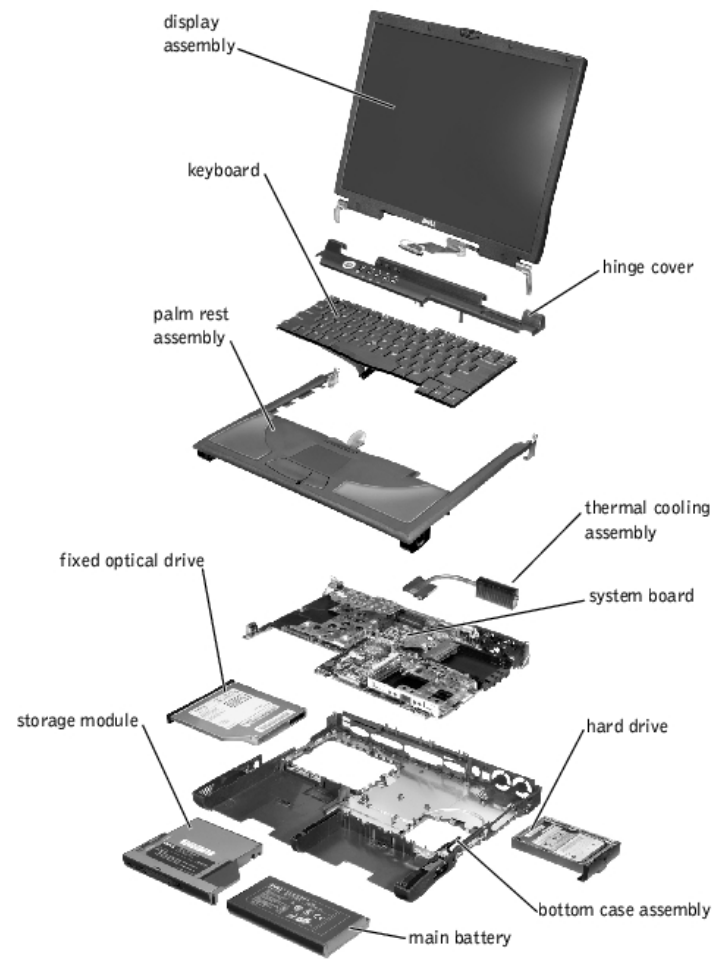
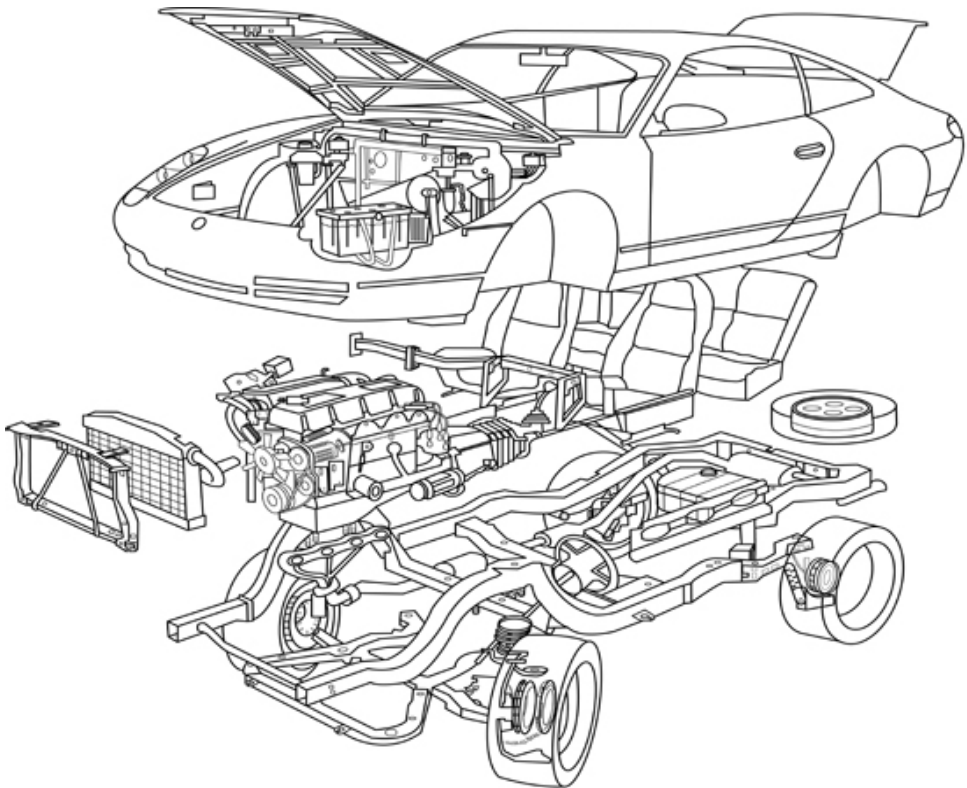


Montage Design

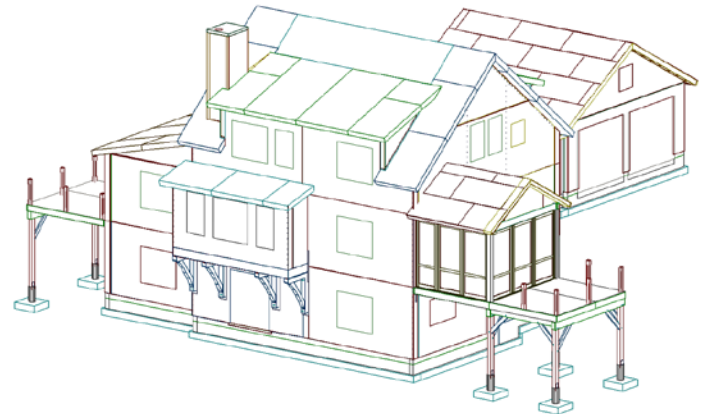
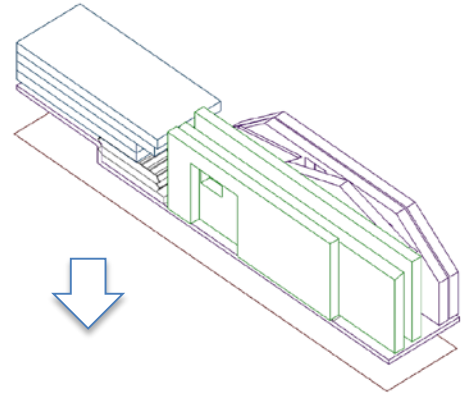
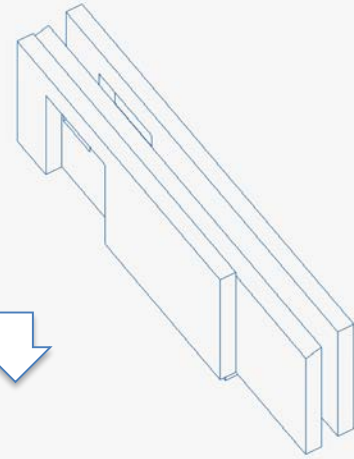
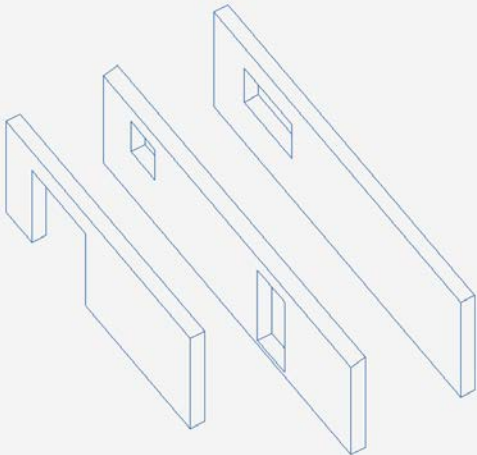
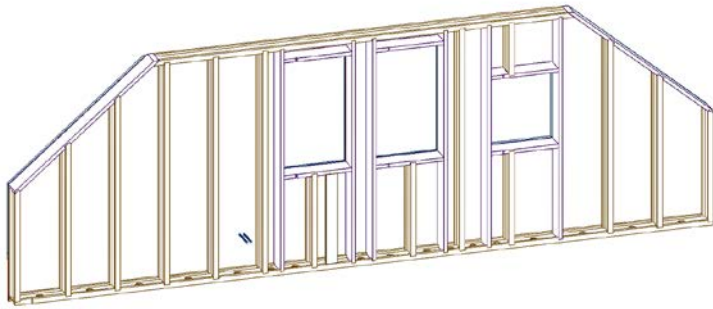
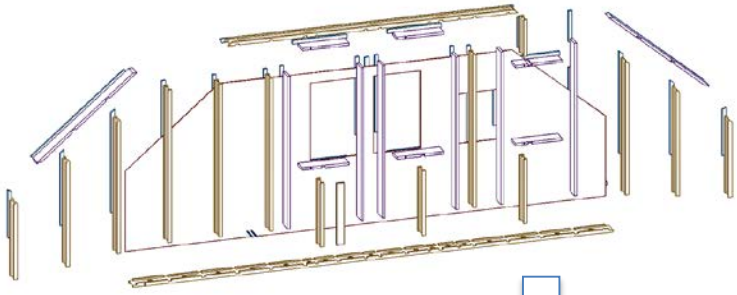
Design Assemblies, “Compose” Designs







50,000 to 50



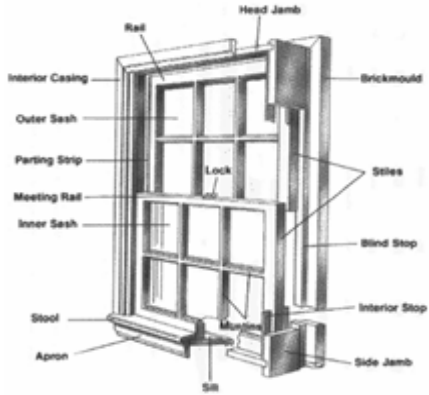


GREENBUILD TAKE THE TOUR
2014
UnityHome
#greenbuildunity
h2o

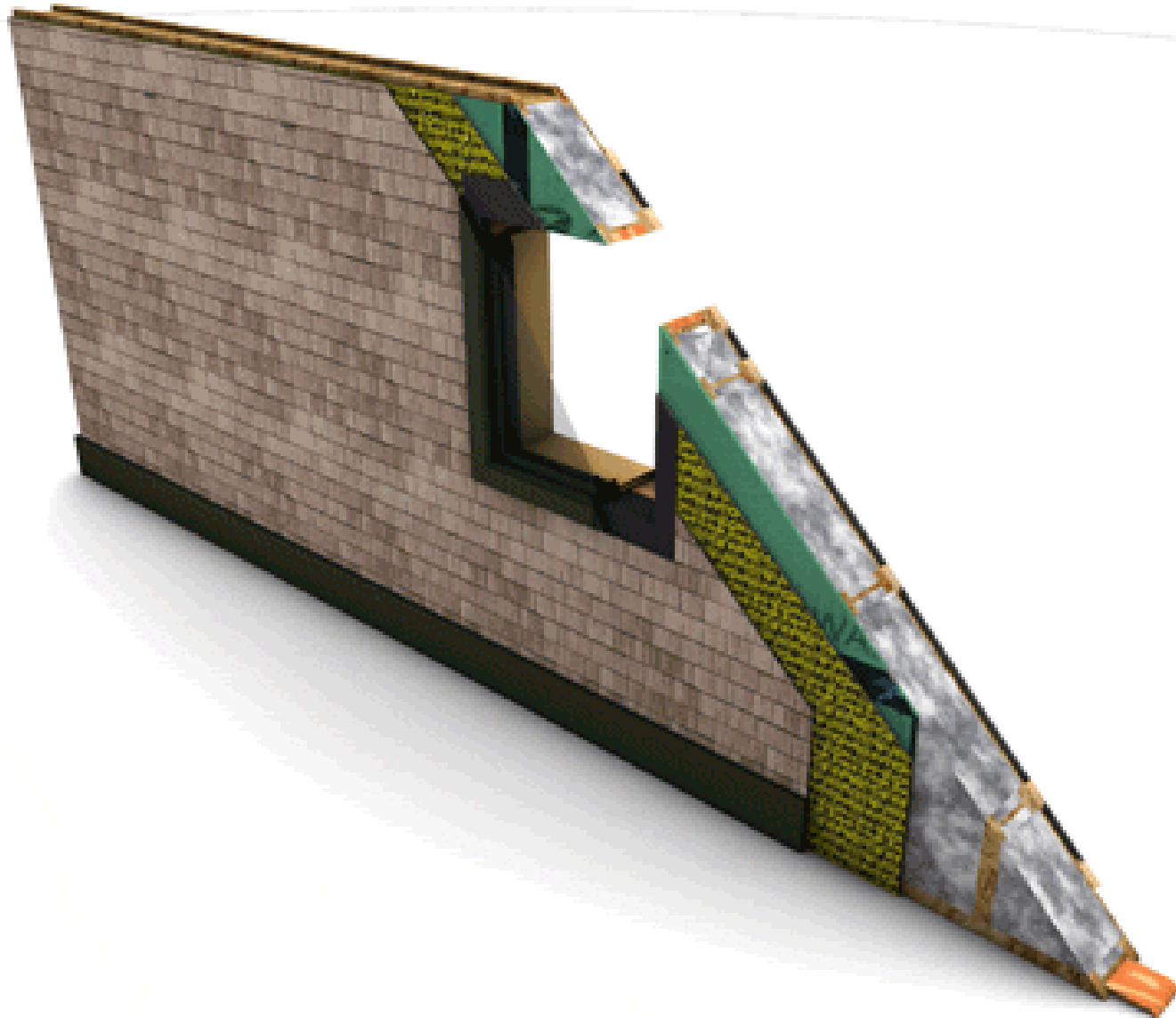


Building Component Fabrication

Anatomy of a Window



OBPlus Wall System







Site Montage

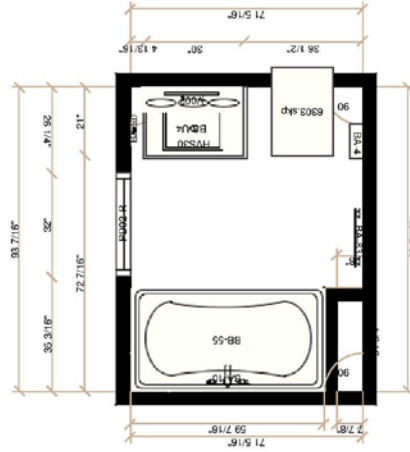
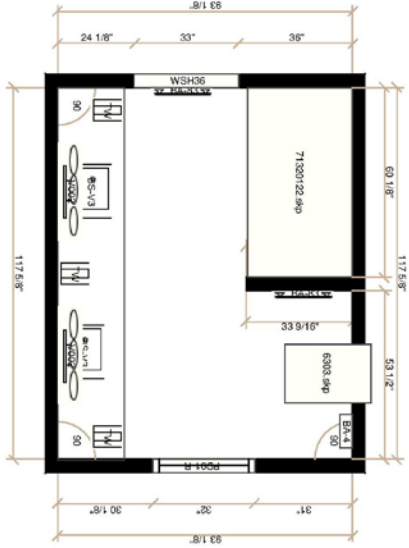
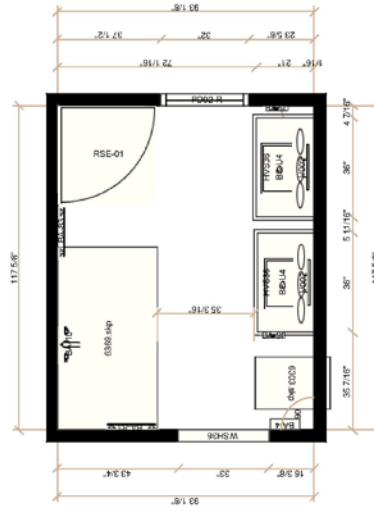
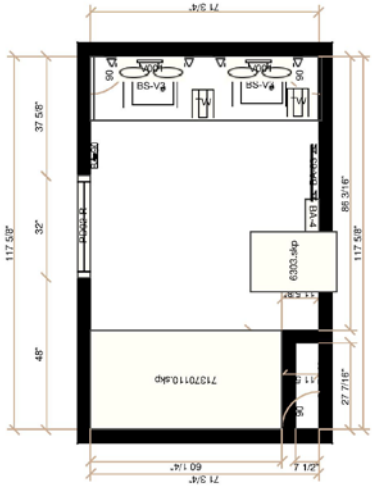


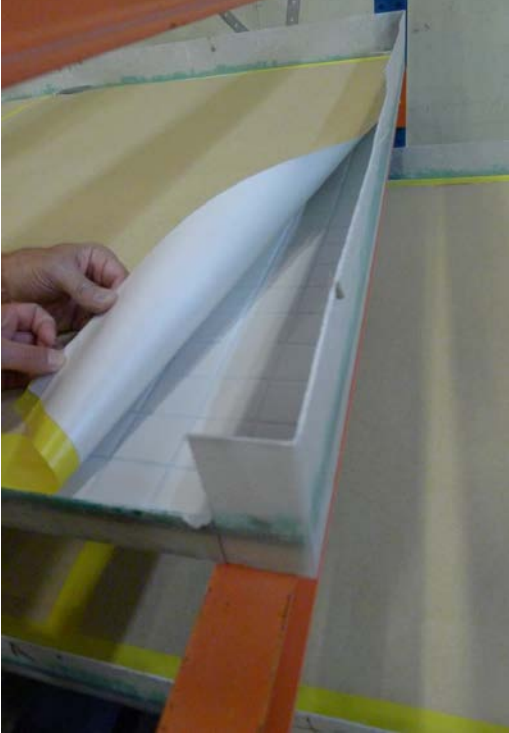
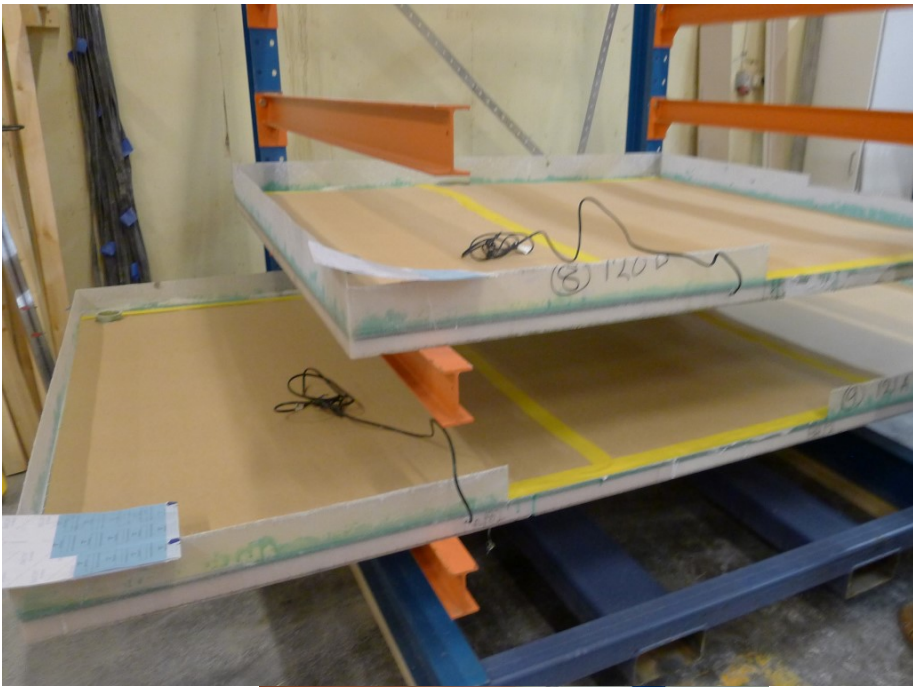
Bath and Mechanical Room Pods



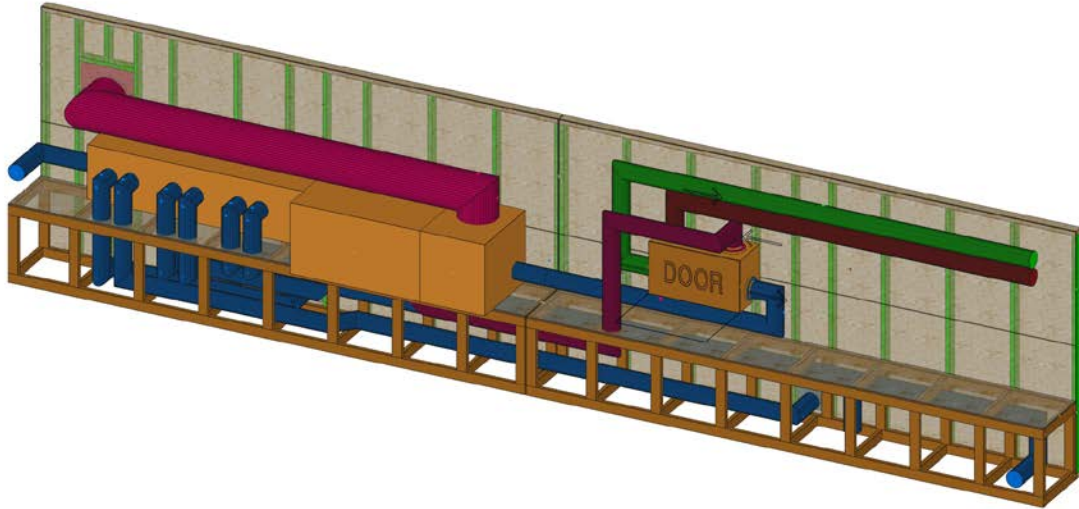
Bathroom Pods Montage







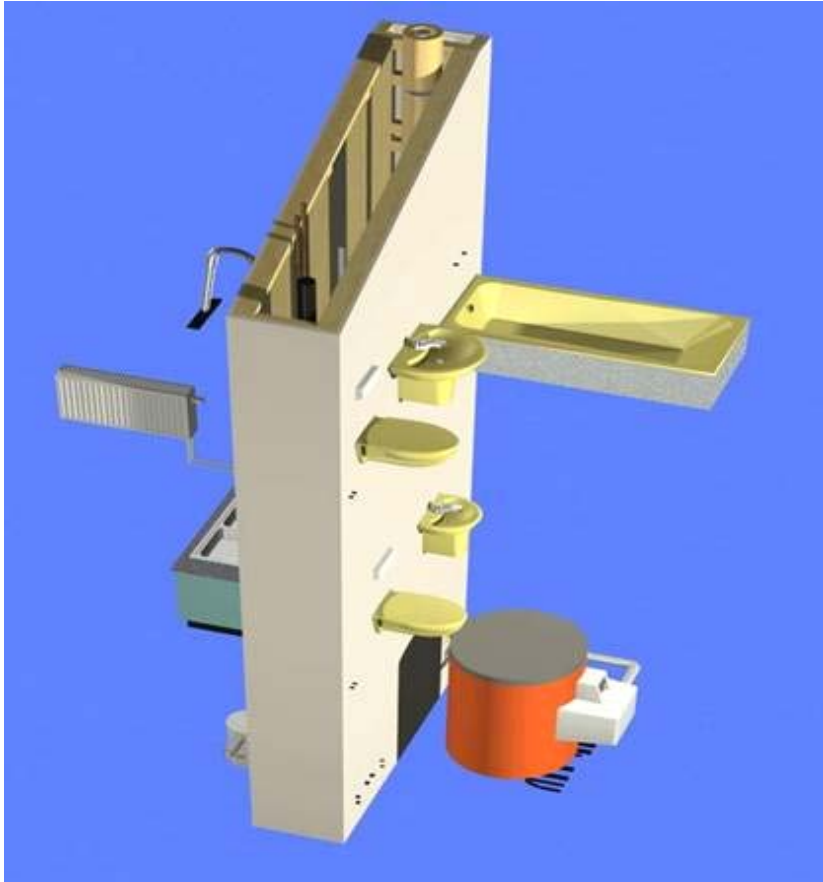
Mechanical Cartridge



Cartridge Installation

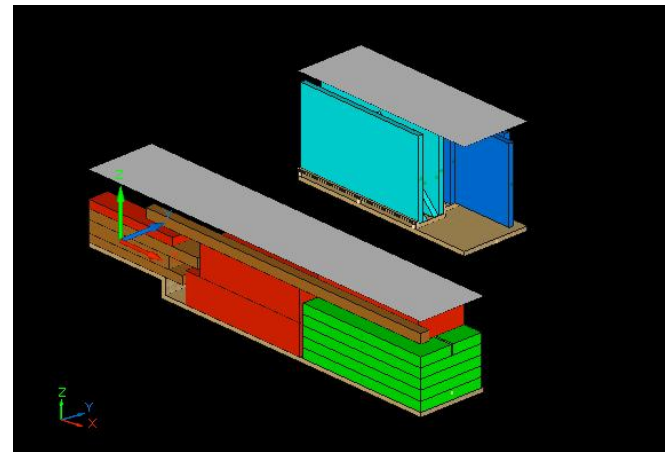


Core-Wall



Flat Pack Virtual and Actual Shipping

Recycled wrapping



Montage Building

Site for assembly only; avoid cutting and shaping

- Site is the **worst** place to attempt to control
 - Quality
 - Efficiency
 - Cost
 - Time



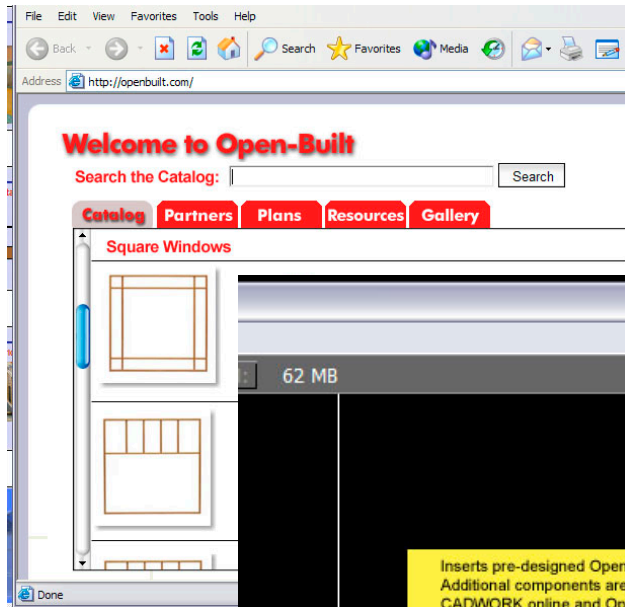
Montage Building Recipe:

21st Century Skills, Old World Craft Attitude

- Operating System
 - *3D software automation*
 - *OBGrid: Montage Design*
 - *CNC cutting and shaping*
 - *Open-Built disentanglement*
- Lean Manufacturing
 - *Constant improvement*
 - *Custom production*
 - *Mass Customization*
- High skills/craftsmanship
 - *Discipline, Pride*
 - *Service to society*
- Building Science
 - *High performance*
 - *Net Zero*



Open-Built® Future vision

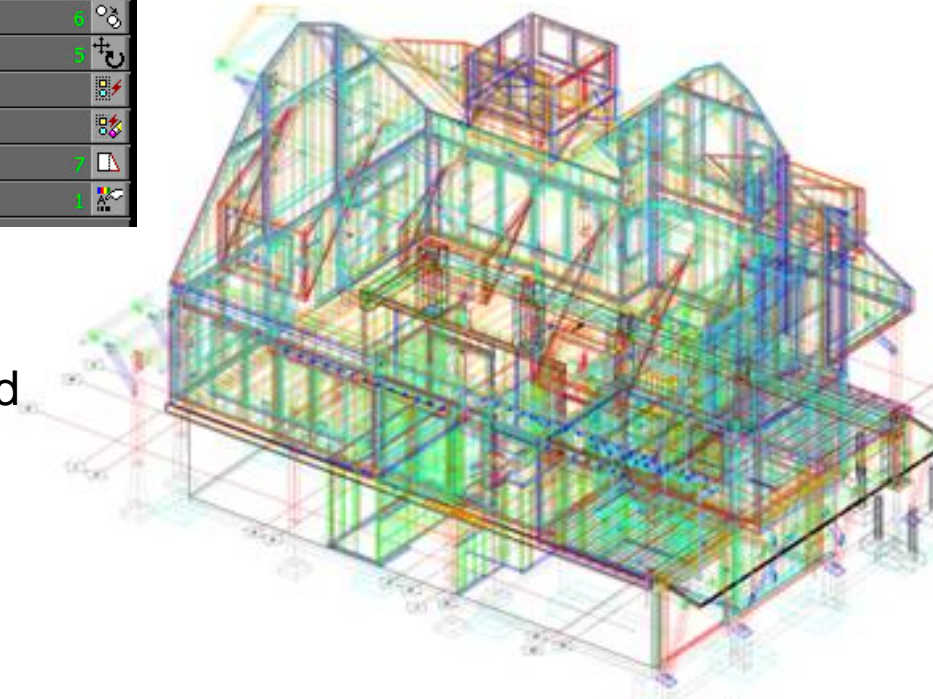


Open-built online catalog:

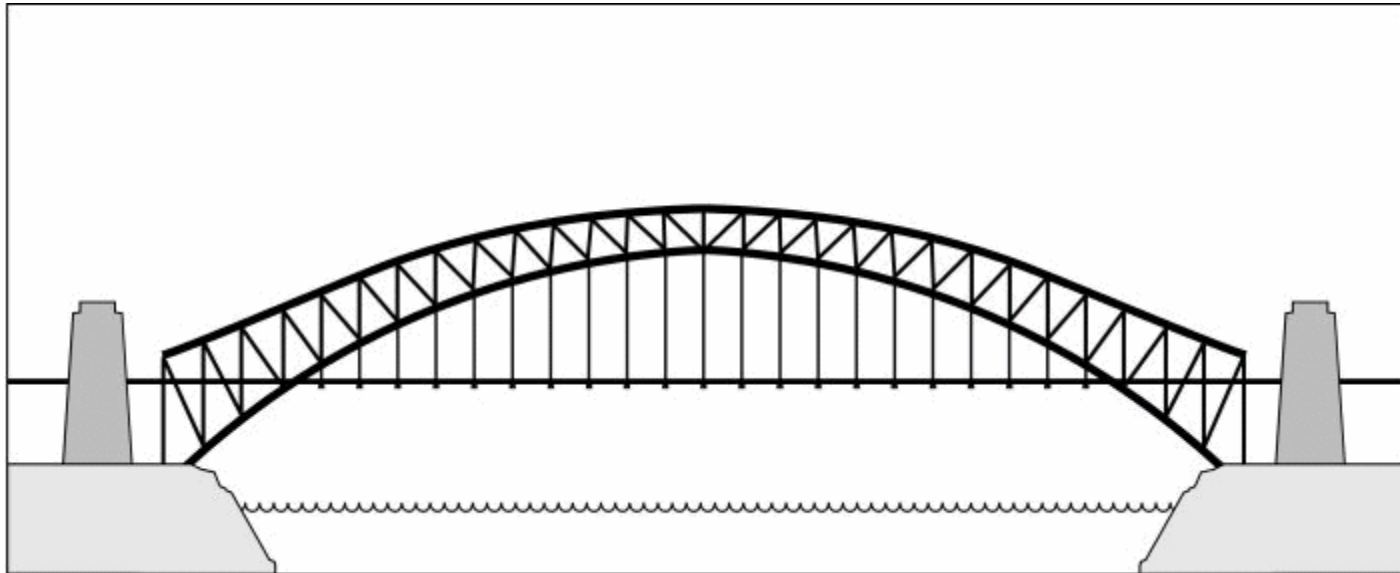
Distributed design tools:

Web-based applications to capture client decisions

Backend data sharing between manufacturers, designers, installers, and customers







19th – 20th
Century Building

21st Century
Building

Training, Education: Trade Pride
3D Software Automation
Open Built Disentanglement
OB Grid: Montage Design
Lean, Distributed Manufacturing
Industry-Connecting Platform

Unity Homes

unityhomes.com

The screenshot shows the Unity Homes website homepage. At the top left is the Unity logo with the tagline "FOR ADVANCED HOMES". Navigation links include "The Homes", "Why Choose UNITY?", "About Unity", "Press", and "Contact". A search bar is located in the top right. The main content area is divided into two columns. The left column features a large image of the interior of the "Värm" model, showing a modern kitchen with a large island and a dining area. Below this are three smaller images of the "Tradd" model, labeled "Tradd 112" (2056 Sq. ft.), "Tradd 123" (2056 Sq. ft.), and "Tradd 134" (2450 Sq. ft.). The right column contains a "Welcome" section with a paragraph of text describing the Unity collection as high-performance houses designed by architects and engineers. Below this is a "Families" section with a "Welcome" sub-section and a paragraph describing the Tradd model as classic, two-story traditional style homes with 2 to 4 bedrooms.

unity
FOR ADVANCED HOMES

The Homes | Why Choose UNITY? | About Unity | Press | Contact

Enough? Save Home

Värm

Welcome

The Unity collection of high performance houses have been artfully created and optimized by our team of architects, professional designers, and engineers. With four distinct "families," these homes have multiple configurations for size and function, and also have numerous features and finish options for both the exterior and interior to fulfill your needs and preferences. Most Unity homes can be configured with walk-out ground floors for hillside sites, and all can be mirrored or flipped when appropriate.

Tradd

Tradd 112
2056 Sq. ft.

Tradd 123
2056 Sq. ft.

Tradd 134
2450 Sq. ft.

Families

Welcome

Tradd: Classic, two-story traditional style homes with 2 to 4 bedrooms, offering the most flexibility of styles and space plans, including first floor living options, and dramatic timber expression.

The screenshot shows a different view of the Unity Homes website. At the top left is the Unity logo. Navigation links include "The Homes", "Why Choose UNITY?", "About Unity", "Press", and "Contact". A search bar is located in the top right. The main content area features a large image of the exterior of the "Zönn" model, a modern two-story house with large windows and a covered porch. Below the image is a "Quality of life begins at home." message. To the right of this message is a box titled "Unity's DNA: Bensonwood Inside" with a sub-section "A long legacy: Unity Homes™ by Bensonwood and the result of 100+ years of research, innovation, and building. Our legacy was founded on the promise that every home is a home."

unity
FOR ADVANCED HOMES

The Homes | Why Choose UNITY? | About Unity | Press | Contact

Enough? Save Home

Zönn

Quality of life begins at home.

Your health and well-being are the foundations upon which we build.

Unity's DNA: Bensonwood Inside

A long legacy: Unity Homes™ by Bensonwood and the result of 100+ years of research, innovation, and building. Our legacy was founded on the promise that every home is a home.

Fossil-fuel free; net zero capable; more accessible, affordable
“Neither compromise nor maximize; only optimize.”

Unity Platforms

Exponential Variation

Get Started

Browse the available plans to see which one is best for you. If it only comes close, don't worry, we can customize it for you.



Tradd: Classic, two-story traditional style homes with 2 to 4 bedrooms, offering the most flexibility of styles and space plans, including first floor living options, and dramatic timber expression.



Xyla: Single-story, cottage style homes with featuring a spacious living area and efficient floor plans; our lowest cost home offerings.



Värm: Two-story, Swedish inspired homes with 2 to 4 bedrooms, designed for maximum value, living space, and energy efficiency.



Züm: Modern single-story homes with 2 to 4 bedrooms, natural light-filled living spaces, designed for maximum passive solar benefit.



Our extensive architectural library of building elements allows you and our designers to create a custom plan while controlling the schedule and the budget.

Design Flexibility





Tradd



Xyla



Värm



Züm



A Better Way to Build

Montage = Combination of Disparate Elements that Forms or is Felt to Form a Whole, **Unified**, Singular Image

- Build time will be 20 days *vs* 100 – 260 days
- Off-Site Impact: 75% *vs* 10% to 30%
- Safe working conditions
- Consistent working conditions
- Good Jobs:
 - Discipline, Training, Skills
 - Empowerment; low turnover



A Better Standard of Cost & Finance

Cost cut; standards raised

- Architect-developed custom home design will be free
- Cost estimates will be accurate
- Advantaged financing available
- Higher standard at a price competitive with existing homes & new construction
- Total cost of ownership a fraction of competitive alternatives
- Home value increased with brand standard

Featured Properties

333 Old Fall Road
Telluride, Colorado 81415

MLS#: Non-MLS
Price: \$2,995,000

For more information, please contact
Dirk de Puyter
970-708-3918
dch@deputy.com | telluride@colorado.net



Description
This beautiful Tedd Benson Timber-Frame Home is located in a quiet, small subdivision on Deep Creek Road, only ten minutes away from Historic Telluride. It has huge, amazing views from the 360 view to the ski area. Dogs are welcome and the subdivision gets free cable TV & internet from Time Warner Cable.

“This beautiful Tedd Benson (Unity) home...”



A Better Standard for Energy

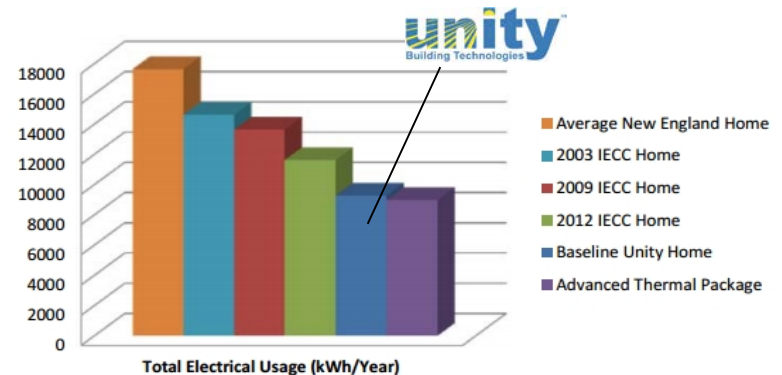
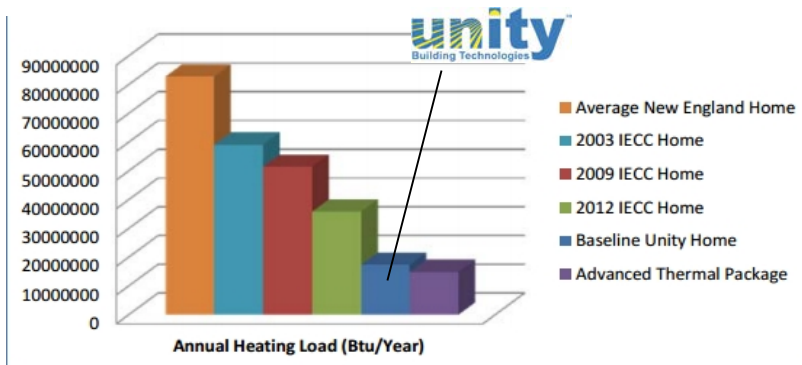
Optimized to highest home energy standard

Air-Infiltration: < .6 @50Pa

No fossil fuels required

Net-zero capable

Home can generate surplus energy



A Better Standard of Air Quality

- Organic materials
 - Choosing materials with fewest chemical additives
- Low VOC manufactured materials
 - Carefully researching for lowest indoor air impacts
- Constant ventilation for air-change and purification
 - Rigorous science of Indoor air quality
- Hypoallergenic home:
 - All materials Greenguard Certified
 - Added filtration

Unity: A New Class of Home

(a cathedral dressed down for the common person)

- Low defect rate
 - 10 yr structure & infrastructure guarantee
- Rugged, Secure, Safe
 - “hell for stout,” Resilient, healthy
- Minimal maintenance
 - High standard material, equipment, and construction quality
- Home life expectancy 200-300 years
 - Community Legacy asset
- Systems continually upgraded and altered by homeowner
 - Plug & Play access
- Continuous home performance monitoring
 - Web connected

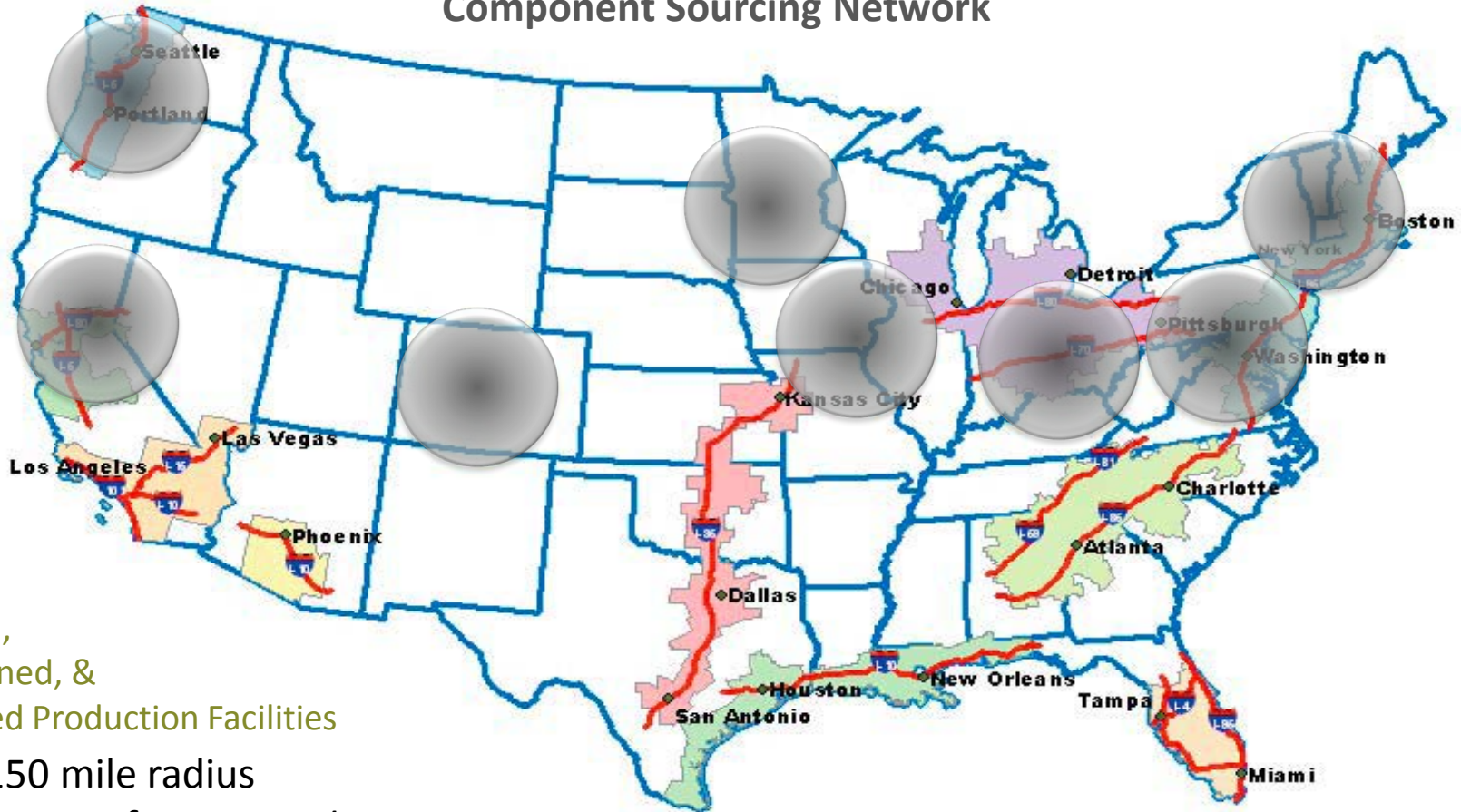
Beyond Proof of Production

Scaling Unity



Extending *Geographic Reach*, Deepening *Market Penetration*, Expanding *Product & Services* Portfolio

Component Sourcing Network



thru
Owned,
Co-Owned, &
Licensed Production Facilities

150 mile radius

Nexus of *Unity Production Capacity*



Google™ Custom Search



[Great Homes](#) ▾

[Enduring Values](#) ▾

[Discover Unity](#) ▾

Life Is Your Most *Important Asset.*

What's Different about Unity Homes:

Part two of a two part series about Unity Homes on [buildinggreen.com](#)

[Client Login](#)

[Contact](#)

[News](#)

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Email: tedd@bensonwood.com

tedd@unityhomes.com

Blog: teddbenson.com

Websites: unityhomes.com

bensonwood.com

The Pursuit:

A Better Way to Build



Timberframe

- Timeless, beautiful, durable
- Future oriented: past inspired
 - Craft Ethos
 - Inherent discipline
 - Life-long learning
- Cabinetmaking and building
 - Better work environment
 - Less on-site time
 - Fabricating off-site

Rekindling Ethos of a Noble Profession

Like health care and education, high quality homebuilding is essential to improving our collective living standard

The practice of homebuilding should be appropriately elevated to achieve higher standards



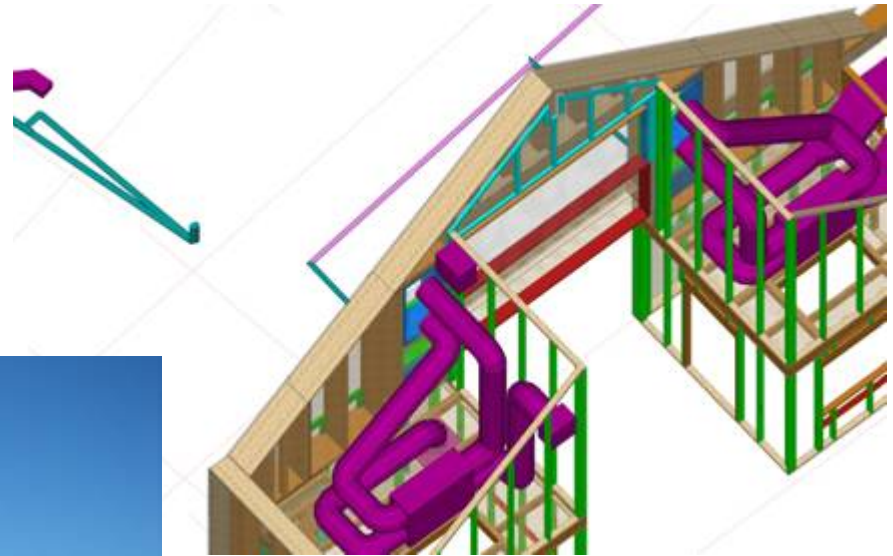
The Craft of Business

- Good houses can only be built in a culture of discipline, training and pride
- Higher expectations in skills, efficiency, values, integrity
- High involvement
 - Experience, craft, knowledge trumps hierarchy
 - .



Our Story

In which I have amnesia about everything that was bad and hard over 41 years of blind perseverance



Born in Energy Crisis

Bensonwood--1973



Unity--2012



Timberframe--1975



- Infill stud panels
- Timberframe
- Cabinets
- Doors

12 days to raise timberframe



Timberframe--2004



- BEF
 - Timberframe
 - Off-site Insulated wall panels,
 - SIP roof panels
 - OB floor panels
 - Millwork: Cabinets, doors, stairs, trim, paneling, ceiling panels

15 days to complete insulated shell

Timberframe hybrid--2008



OSF

Timberframe
Insulated, prefinished wall panels,
Sips roof panels
OB floor panels
Bath modules
Millwork: stairs, trim, paneling, ceiling panels

15 days to enclose

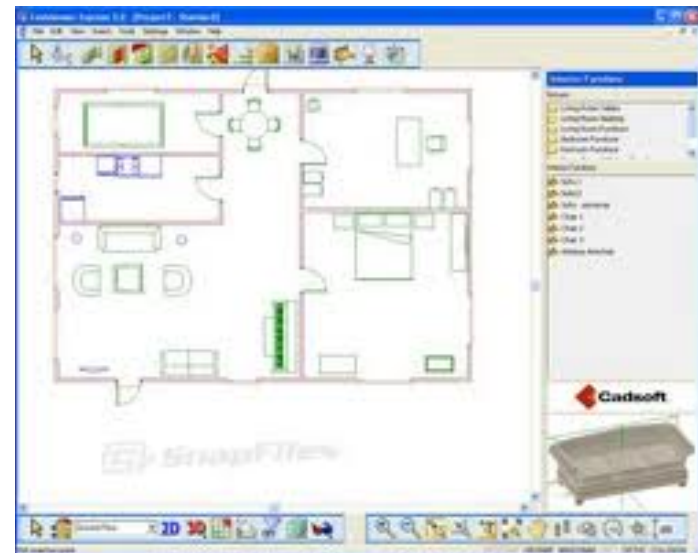


Lyndonville, VT—4 Days, 2 wks ago



Guilford, CT—3 Days, last week

- Mortising Machine
- Software development
- Spline use and development of keyed beams



1998-2008

- Off-site Manufacture of insulated walls systems
- JDA's with Huber International and DOW
- Partnership with MIT on Open-Prototype Initiative
 - openprototype.com



2006-2008

- Built LEED Platinum, Net-Zero UNITY
- Launched 3B Matrix design/build system
- First Vermont Passive House



Black Box Production System & Regional Hubs



Distributed Production Network Serving High-Density Trade Areas

Centralized File Security & Controls



Virtual-Actual Feedback Platform Optimization



Regions Share:

- Element Libraries
- Supply Chain
- Market Development Resp

150 mile radius

Nexus of *Unity Production Capacity*

Montage buildings examples



Lyndonville, VT—4 Days, 2 wks ago



Guilford, CT—3 Days, last week

Small house, MA (netzero)



Data provided by owner:

Total electrical energy generated in first year:
11,535 kWh

Total electrical energy used in first year:
4,832 kWh

Large house, ME



10 kW solar system

Estimated annual
use for heating and
cooling:

10,556 kWh

Annual production
2012:

10,492 kWh

Annual production
2013:

9,852 kWh

School house, VT (netzero)



Month 2013	Net use in kWh
January	1163.733
February	606.208
March	433.132
April	-211.666
May	-223.239
June	-675.952
July	-929.216
August	-522.811
September	-210.249
October	223.414
November	171.315
December	645.81
Running total	470.479



Data provided by owner:

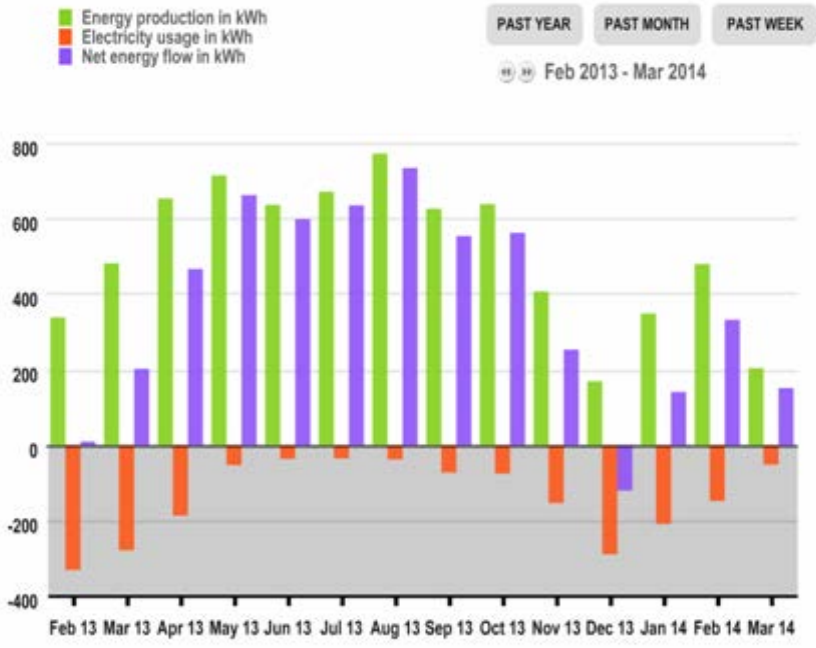
Passivhaus, VT

Annual HRV usage 2013:
366.8kWh

Annual other heat 2013:
379.5kWh



Studio, ME (net positive)



Data from: brightbuiltbarn.org

Educational facility, ME (netzero)



Data per submission to
NESEA netzero award:

PV system: 45 kW

Predicted usage:
35,778 kWh

Actual use first year: 41,958 kWh

Actual production first year
49,924 kWh

Excess produced year 1:

7,966 kWh



Amherst, MA





Floor panel installation



Wall panel installation



Bathroom module



Roof panel installation





Open-Built Base Chase



Amherst complete



Weston House



Shop wall production



Site assembly



Cupola



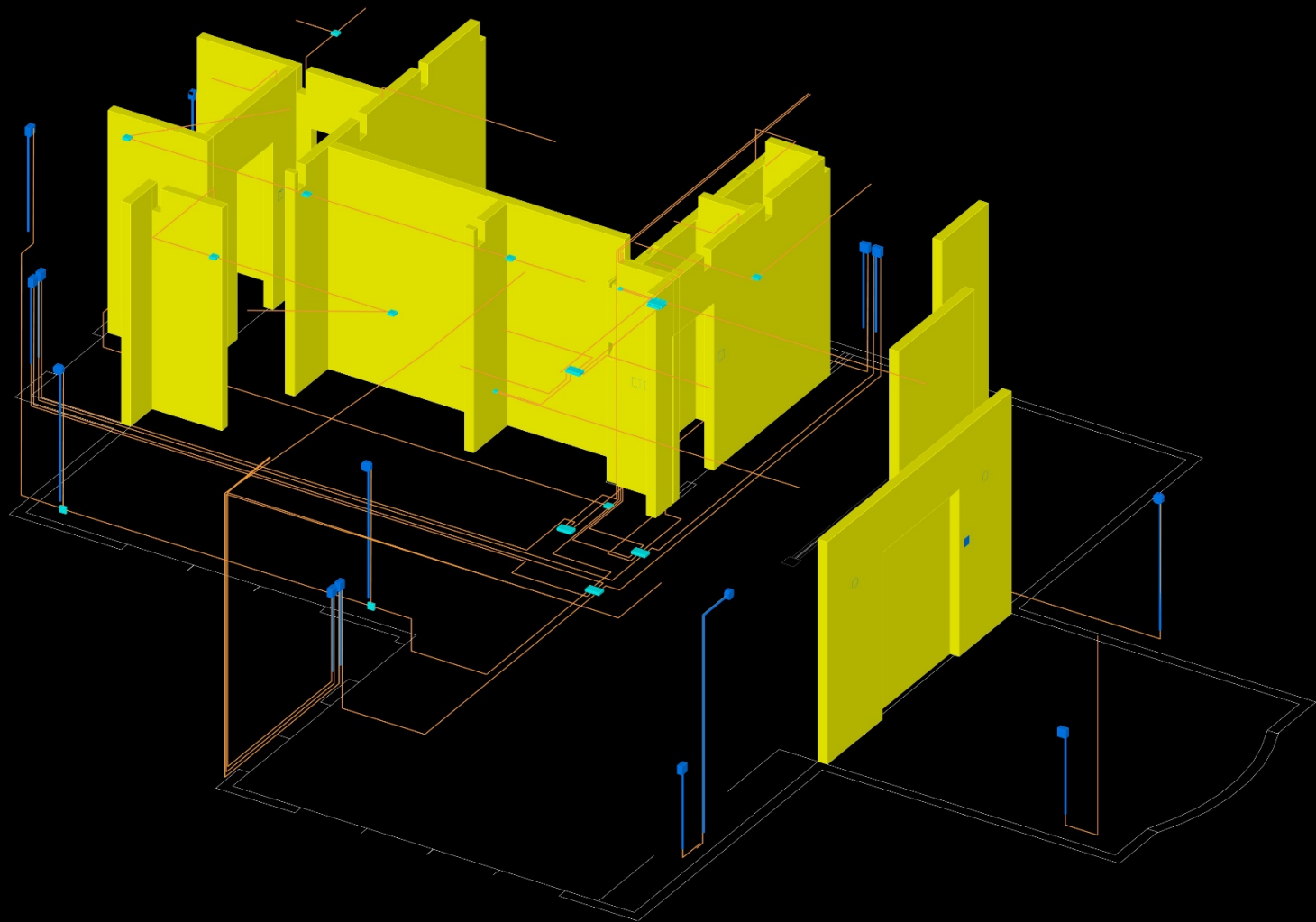


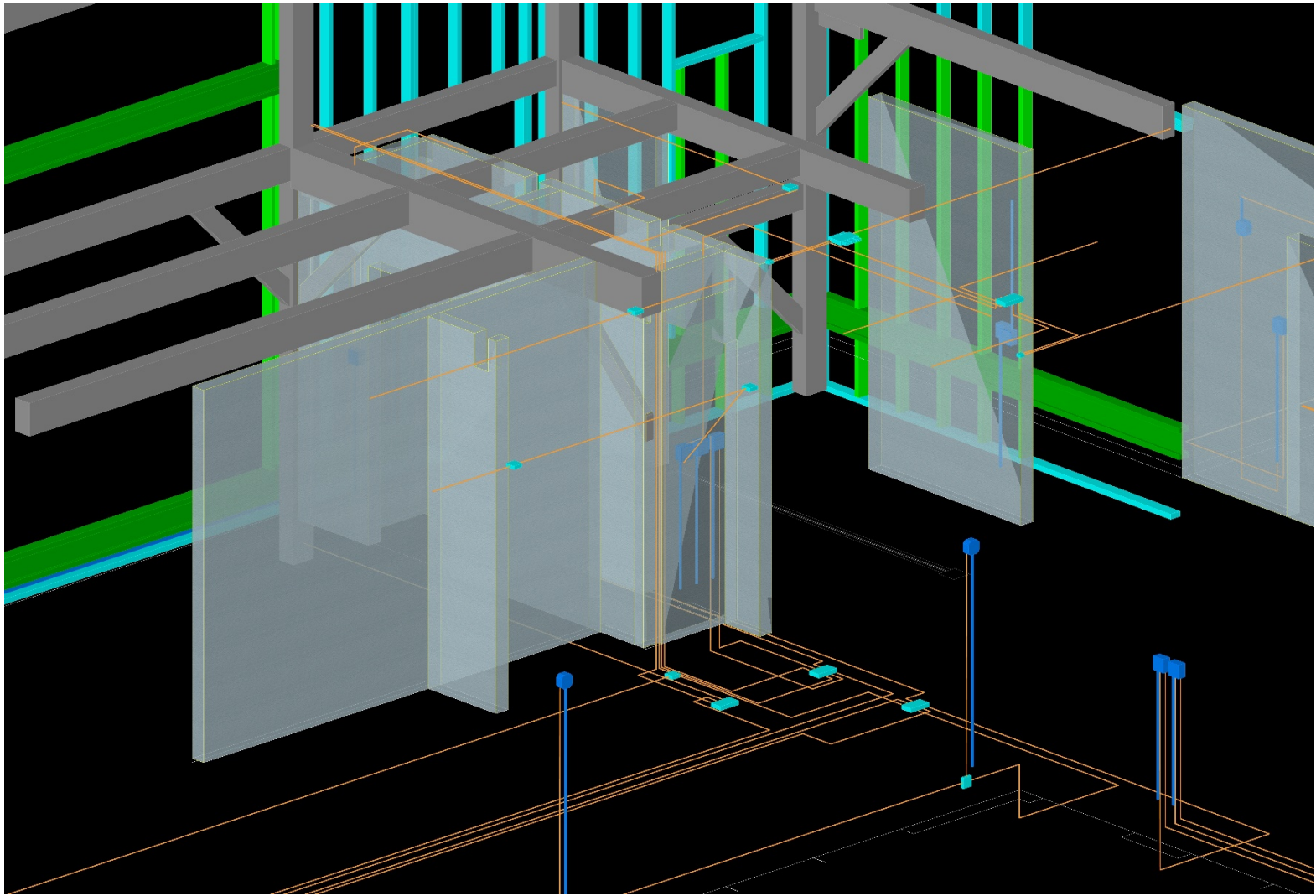


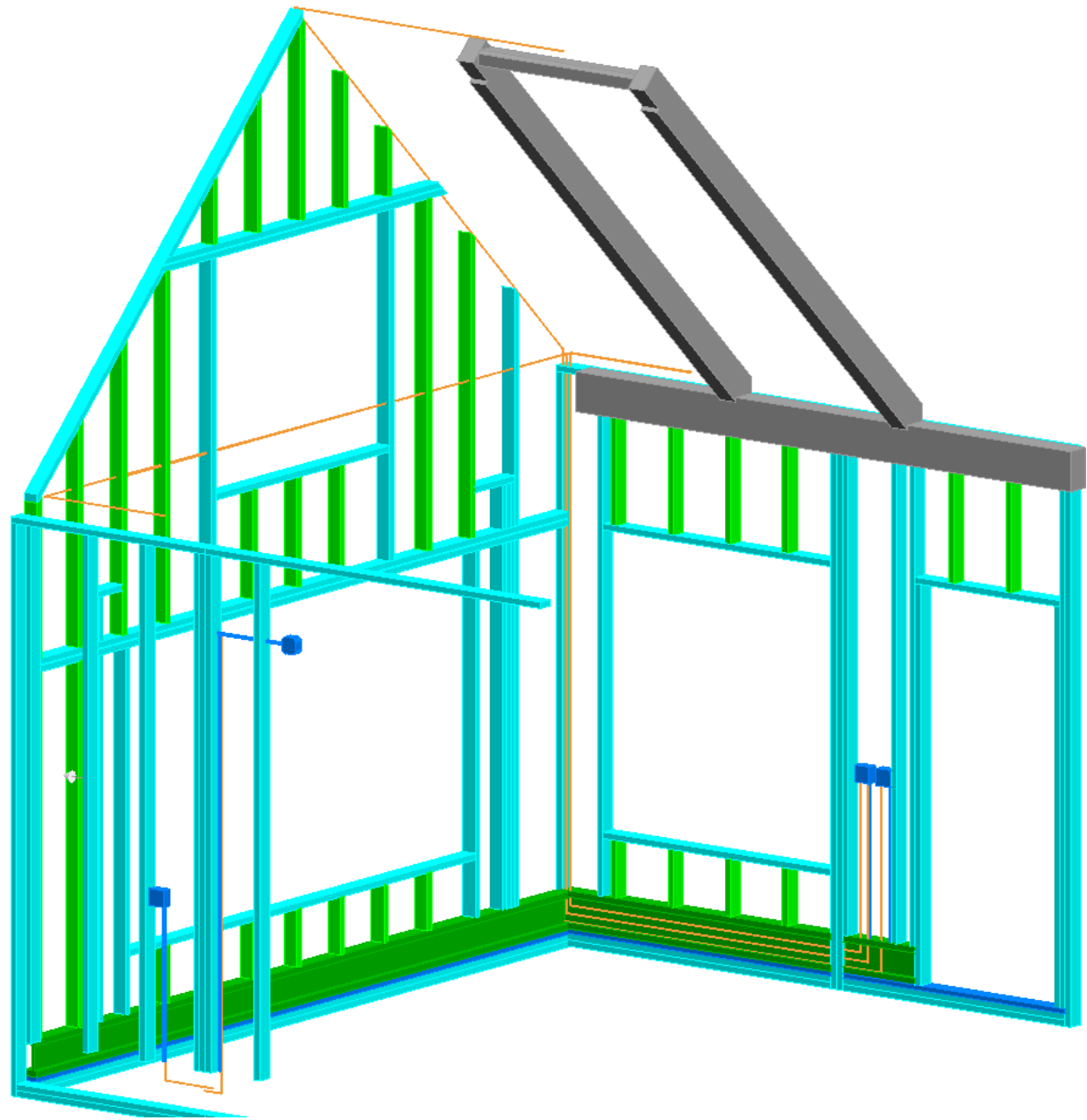


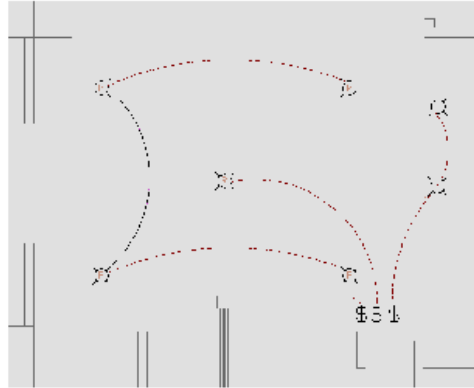




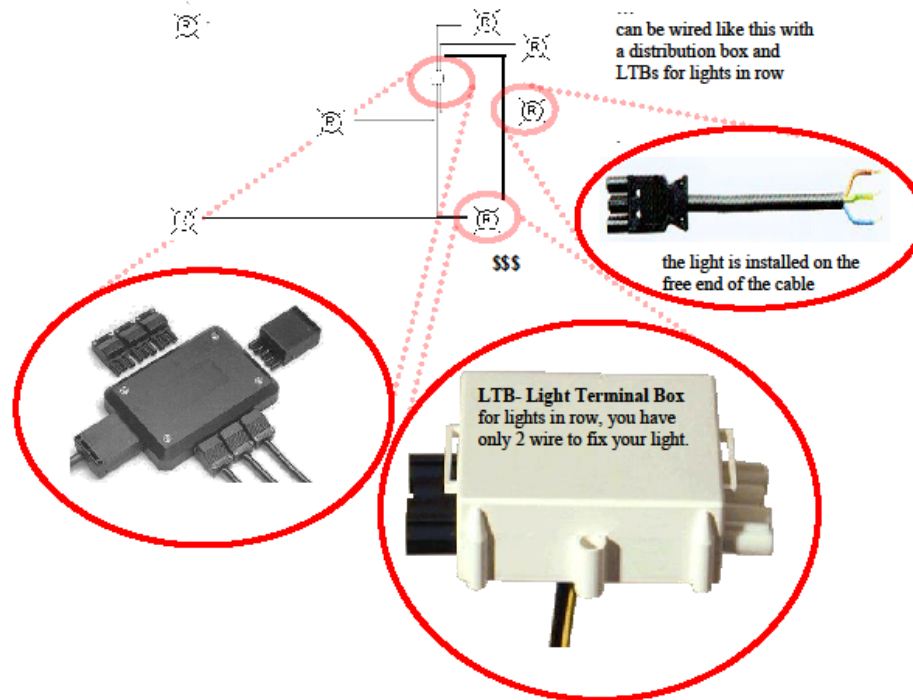








What looks like this in the architectural plan...



... can be wired like this with a distribution box and LTBs for lights in row

the light is installed on the free end of the cable

LTB- Light Terminal Box
for lights in row, you have only 2 wire to fix your light.

