Green Construction

Developed by Paul Francisco and his team at the Indoor Climate Research & Training program of the University of Illinois at Urbana-Champaign. "Illinois Green Economy Network (IGEN) Curated Materials," through funding from the Illinois Environmental Protection Agency, is licensed under CC BY NC 4.0.
Learning Objectives

At the end of this module, students will be able to:

• Define Green Construction
• Discuss Green Construction Fundamental Principles
• Explain customer benefits of Green Construction
• Describe advanced framing
• Describe career pathways related to Green Construction
Outline

• Introduction
• Information about Standards
• Growth trends in Green Construction
• Benefits
  • Incentives and tax rebates
  • Resilient New Construction
  • Advanced framing techniques
• Careers, professional certifications, & trainings
• Business opportunities
• Resources
• Summary
Introduction to Green Construction (GC)

• Also known as green, sustainable, or high-performance building

• It is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle.

• Environmentally responsible

• Resource efficient
GC Fundamental Principles

• Use less materials

• Choose materials with lower negative impacts

• Design buildings that will be efficient to operate

• Build resilient structures that can adapt and will survive
Materials

- Houses are made from:
  - Wood-US & Africa
  - Cement-Asia & Europe

Figure 19 • Global residential building structure material and material intensity, 2017
Materials – Embodied Energy

- **Aluminum**
  - HIGH MJ/kg
  - light
  - Moderate usage

- **Concrete**
  - LOW MJ/kg
  - HEAVY
  - Ubiquitous

2% of Global GHG emissions

11% of Global GHG emissions

SOURCE: mysmart.com (image); Lawson 1996 (data)
GC Standards

LEED (1993)

WELL (2013)

RESET (2013)

FITWEL (2016)
GC Growth Trends

• Strong growth curve through 2018
• 24,000 units in 2020
  • \( \frac{1}{3} \) of 2018 level

SOURCE: US Green Building Council – LEED In Motion, 2019
Case Study

• Mirabella
Case Study

- **Building Academic Skills & Experience**
Case Study

• Edelweiss House
LEED in IL

**USGBC State Market Brief: Illinois**

- Ranked 2nd among the 2019 Top 10 States for LEED
- Last updated on 5/2/2022 7:21:06 PM

**Number of Certifications**
- 1,979

**Gross Square Footage of Certifications**
- 520,688,532

**LEED Achievement**
- 125 Platinum (6.32%)
- 750 Gold (37.90%)
- 701 Silver (35.42%)
- 403 certified (20.38%)

**LEED Certifications by Rating System**
- BDC
- IDC
- OM

**Number of Certifications**

![Map of Illinois with LEED Certifications by City]
LEED in IL

Top 10 Space Types for Certifications

Certifications by Owner Sector

USGBC Member Organizations Located In Illinois

Professionals with LEED Credentials

LEED project data only includes commercial rating systems. The underlying data does not include LEED ND or LEED for Homes projects. LEED®, and its related logo, is a trademark owned by the U.S. Green Building Council®.
LEED Economics

- **Fee$**
- **Costs vs standard bldg. (2018)**
  - +7.4% **LEED Gold**
  - +9.4% **LEED Platinum**
- **Gains**
  - 21.4% higher sale price /ft²
  - 11% higher rents

### Residential Fees

Note: Additional fees will be charged by the verification team – contact your team for more information.

<table>
<thead>
<tr>
<th>Residential Fees</th>
<th>Silver, Gold and Platinum Level Members</th>
<th>Organizational or Non-members</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family (per home)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Registration (1-25 homes)</td>
<td>$150</td>
<td>$225</td>
</tr>
<tr>
<td>Registration (&gt;25 homes)</td>
<td>$50</td>
<td>$125</td>
</tr>
<tr>
<td>Certification (1 home)</td>
<td>$225</td>
<td>$300</td>
</tr>
<tr>
<td>Certification (per batch submittal)</td>
<td>$175 per batch</td>
<td>$225 per batch</td>
</tr>
<tr>
<td>Expedited review (reduce from 20-25 business days to 10-12)</td>
<td>$1,000 per project</td>
<td></td>
</tr>
<tr>
<td>Appeals</td>
<td>$175 per project</td>
<td></td>
</tr>
<tr>
<td>Formal Inquiries (Project CIRs)</td>
<td>$220 per credit</td>
<td></td>
</tr>
</tbody>
</table>
LEED - Criticism

• 2005, *LEED is Broken; Let's Fix It*

• 2013, *USA Today*

• 2013, *Washington Examiner*

"LEED gives out points to applicants for taking different actions. Get enough points and you'll be certified silver, gold or platinum, or, if you don't score high enough, you won't be certified. But is there actually any relationship between a high LEED score and using less power? If so, these dots would approximately follow the shape of the blue line, with energy metrics getting better as points got higher. Instead, they largely appear random."

source: https://www.washingtonexaminer.com/exography-leed-certification-doesnt-guarantee-energy-efficiency-analysis-shows
WELL
FITWEL

- Impacts surrounding community health
- Reduces morbidity & absenteeism
- Instills feelings of well being
- Supports social equity for vulnerable populations
- Enhances access to healthy foods
- Promotes occupant safety
- Increases physical activity
RESET

Embodied

1. RESET Materials  Establish transparency and risk management of what goes into your spaces.

Operations

2. RESET Air  Make visible the invisible factor that impacts all indoor spaces in regards to health, productivity, and sustainability.

3. RESET Water  Generate awareness around water conservation and improve water use efficiency and water quality.

4. RESET Energy  Bring to the forefront the carbon operating costs of the built environment and leverage the faster feedback loops to improve.

5. RESET Circularity  Track and understand the lifecycle input and output of waste; where and how much it is generated and consumed.
GC Benefits

• Less material waste

• Efficient buildings

• Healthier homes
US Incentives and Rebates

Database of State Incentives for Renewables & Efficiency

https://www.dsireusa.org/
United States Renewable Energy Systems Tax Rebates

Existing Home and New Construction Qualifying Systems

- Geothermal Heat Pumps
- Small Wind Turbines Residential
- Solar Energy Systems
- Fuel Cells
- Biomass Fuel Stoves

Tax Credits

- 30% for systems placed in service by 12/31/2019
- 26% for systems placed in service after 12/31/2019 and before 01/01/2023
- 22% for systems placed in service after 12/31/2022 and before 01/01/2024
Solar Rebates

Federal Solar Tax Rebate:

- 26% tax credit for systems installed in 2020-2022
- 22% tax credit for systems installed in 2023-2024
In previous years residents could deduct home expenses related to energy efficiency upgrades. These tax credits expired in 2021. Congress has not renewed these tax credits in 2022.
Illinois Incentives and Rebates

- Utility Residential Incentives
- Utility Commercial and Public Sector Incentives
- Solar Incentives
- Electric Vehicle Incentives
Resilient New Construction
Advanced Framing

• September 1978
Advanced Framing—What is it?

• Techniques to reduce the amount of lumber in wood frame construction.

• Began as Optimum Value Engineering (OVE) in 1978. Research was done by the National Association of Homebuilders Research Center, under contract to US Dept. of Housing and Urban Development (HUD)

The table below highlights the differences between conventional framing and advanced framing techniques.

<table>
<thead>
<tr>
<th>CONVENTIONAL FRAMING</th>
<th>ADVANCED FRAMING</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x4 or 2x6 wood framing spaced 16 inches on center</td>
<td>2x6 wood framing spaced 24 inches on center</td>
</tr>
<tr>
<td>Double top plates</td>
<td>Single top plate</td>
</tr>
<tr>
<td>Three-stud corners</td>
<td>Two-stud corners</td>
</tr>
<tr>
<td>Multiple jack studs</td>
<td>Minimal jack studs</td>
</tr>
<tr>
<td>Double or triple headers</td>
<td>Single headers</td>
</tr>
<tr>
<td>Multiple cripple studs</td>
<td>Minimal cripple studs</td>
</tr>
</tbody>
</table>

Source: https://www.apawood.org/advanced-framing
Typical elements

- Single header leaving room for insulation.
- Insulated 3-stud corner or 2-stud corner with blocking.
- Inline or stacked framing when single top plates are used.
- Single top plate when studs and joists are aligned.
- 2x6 wood studs spaced 24” on center (versus 2x4 studs at 16” o.c.)
- Walls continuously sheathed with plywood or OSB.
- Jack studs and cripples at openings only where needed.
Stack Framing
Outside Corner and Partition Lead

TWO-STUD CORNERS
- Corner stud
- 2x ladder blocking at 24" o.c. or drywall clips

TWO-STUD CORNER (WITH DRYWALL CLIPS)
- Outside corner
- Drywall clip to hold drywall in place

TWO-STUD INSIDE CORNER (FOR WALL PANELIZATION)
- Outside corner
- Sheathing installed by wall panelizer
- Use plywood or OSB sheathing for siding attachment per siding manufacturer’s ES Report

INTERIOR WALL INTERSECTION OPTIONS

LADDER JUNCTION
- Single top plate
- Interior wall plate tight to exterior wall plate
- 2x ladder blocking at 24" o.c. Install blocking with wide face vertical for maximum backing to wall finish materials and for maximum insulation to exterior walls.

JUNCTION FOR CONTINUOUS DRYWALL APPLICATION
- 3" x 6" x 0.036" galvanized steel plate (see: PRESCRIPTIVE AND ALTERNATE CONNECTION DETAILS, Figure 6)
- Drywall
- Interior stud set in 3/4" to 1" from exterior wall studs
- Single top plate

https://www.apawood.org/advanced-framing
Insulated Header & Window Framing

ROUGH OPENING PLACEMENT

The placement of openings in load-bearing walls and the layout of framing members above openings have significant impact on header sizing for advanced framing.

- 24" wide tributary load
- 24" wide tributary load
- 48" wide tributary load

BEST PLACEMENT

36" wide opening

24" layout module + 3/4" + (rough opening width/2) for 23"- to 46-1/2"-wide rough openings

Continuous bearing as provided by load-bearing sill beam or foundation wall.

- Minimum required materials to frame rough opening
- Structure above imposing tributary loads on header
- Potential increased header size—increased load from structure above
- Excess materials due to inefficient opening placement
References (Advanced Framing)

• American Plywood Association *Advanced Framing Construction Guide*  
  [https://www.apawood.org/advanced-framing](https://www.apawood.org/advanced-framing)


• *US Department of Energy. Advanced Wall Framing*.  
  [https://www.energystar.gov/ia/home_improvement/home_solutions/doeframing.pdf](https://www.energystar.gov/ia/home_improvement/home_solutions/doeframing.pdf)
GC Careers

• Sales
• Consultants
• Developers
• Design
  • Architects
  • Engineers
  • Urban Planners
• Construction
  • Construction Management
  • Tradespeople
GC Certifications

- LEED AP
- LEED Green Associate
- NCCER – Sustainable Construction Supervisor Training & Cert. Program
- Professional Engineer (PE)
- Trades licensing
- BPI: Building Analyst (BA), more
- RESNET – Home Energy Rater
GC Business Opportunities

• Differentiate yourself and grow your business by being a green builder

• Become known as a specialist for green building

• Consult on building designs to make them greener

• Educator
Summary-Green Construction...

• ...creates structures that are environmentally responsible and resource-efficient throughout a building's life-cycle.
• ...can be certified by multiple agencies that have established specific criteria for, and evaluation of, all aspects of a building’s design and construction.
• ...benefits include less material waste, better energy efficiency, and healthier building occupants.
• ...is encouraged by national and state rebates and incentives.
• ...encompasses the use of advanced framing.
• ...offers many career opportunities.