Wood Scores A+ for Schools & Student Housing

Natural building material takes top honors for cost, aesthetics, and performance

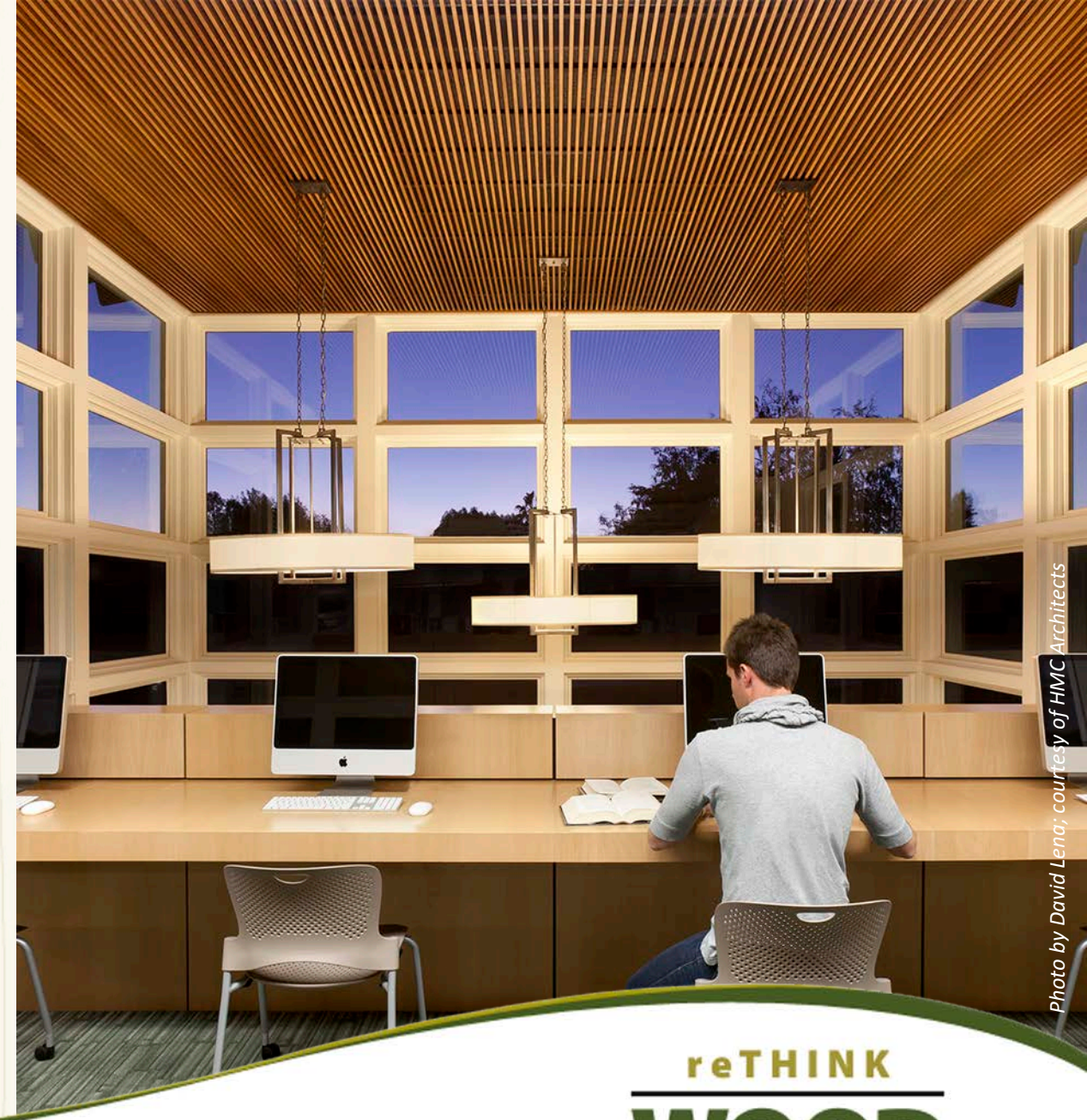

Photo by David Lena; courtesy of HMC Architects

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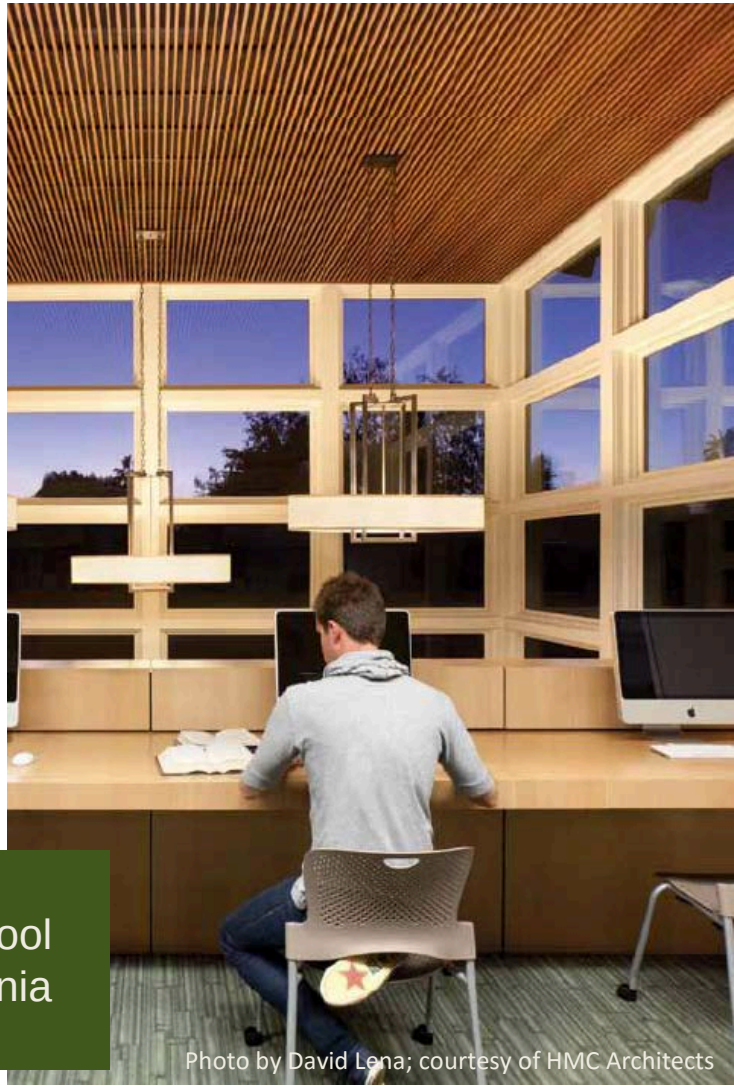
Learning Objectives

- Discuss how wood has been used as a structural and finish material in schools.
- Consider the effects of wood on human health and well-being in an educational environment.
- Describe the environmental and economical advantages wood brings to educational facilities and student housing projects.
- Explain how wood contributes to a project's green building goals.



Polytechnic School
Pasadena, California

Photo by David Lena; courtesy of HMC Architects

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SECTION 1

WOOD SAVES MONEY

Helps the Bottom Line

- Lower material costs
- Cost less to install
- Construction is fast

At El Dorado High School in Arkansas designed by CADM architects; switching to wood framing from the original design saved $2.7 million

Photos: W.I. Bell (under construction); Dennis Ivy, courtesy WoodWorks

Helps the Bottom Line

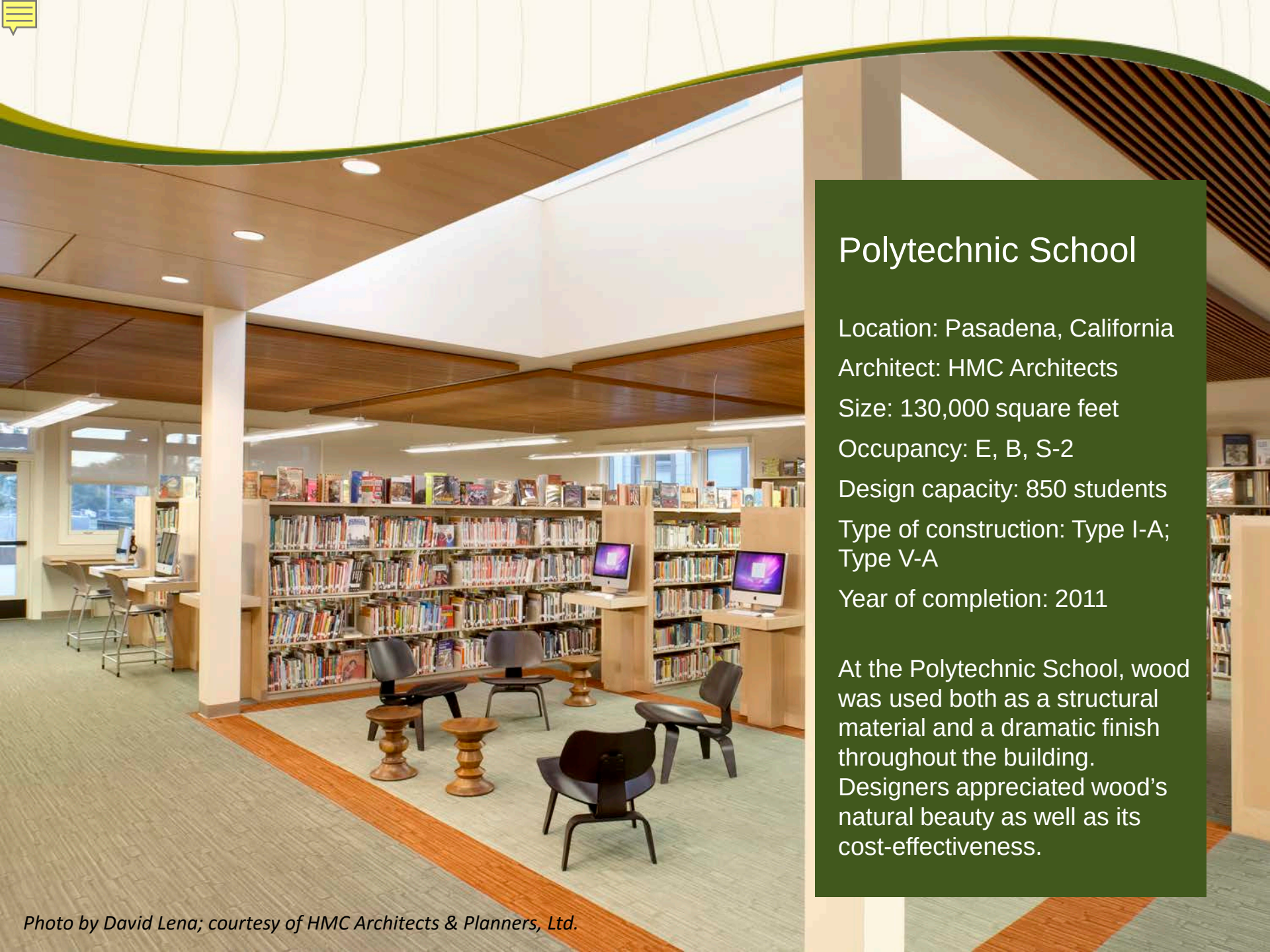
- Relative light weight may reduce the need for foundation capacity
- Wood-frame walls used as load-bearing walls can eliminate need for additional beams
- Sloped wooden roof system can house mechanical systems, reducing HVAC requirements

Mid-Rise Wood-Frame Housing Makes the Grade

University of North Carolina at Greensboro

Wood saved $15 a square foot on one student housing project, Spartan Village Phase I, compared to a metal and concrete alternative.

Rendering courtesy of Lord, Aeck & Sargent Architecture



Polytechnic School

Location: Pasadena, California

Architect: HMC Architects

Size: 130,000 square feet

Occupancy: E, B, S-2

Design capacity: 850 students

Type of construction: Type I-A; Type V-A

Year of completion: 2011

At the Polytechnic School, wood was used both as a structural material and a dramatic finish throughout the building. Designers appreciated wood's natural beauty as well as its cost-effectiveness.

Photo by David Lena; courtesy of HMC Architects & Planners, Ltd.

SECTION 2

SCHOOL SAFETY

Fire Protection

- Plywood or oriented strand board (OSB) sheathing provides ample fire safety
- Meets requirements of the International Building Code (IBC)
- Larger wood-frame schools: protected construction, heavy timber construction, or fire-retardant-treated construction on exterior walls may be required
- Unique charring properties – when exposed to fire, surface char insulates the member so it can continue to support its load

ICC
INTERNATIONAL CODE COUNCIL®

Seismic Performance

- Wood is lightweight relative to other construction materials
  - Light weight correlates to lower seismic forces and better performance during seismic events
- Wood-frame structures have numerous nailed joints
  - More ductile than those with rigid connections, making them more flexible and able to dissipate energy in an earthquake
  - Numerous load paths helps avoid collapse should some connections fail

K-12 Polytechnic School in Pasadena, California took an ingenious approach to meeting California's seismic criteria

Photo by David Lena; courtesy of HMC Architects & Planners, Ltd.

Performance in High Winds

- Wood buildings can be effectively designed to resist high winds
- Sheathing products (wood structural panels, structural fiberboard, particleboard, and board sheathing) can be used to create diaphragms and shear walls that transfer loads into the foundation
- Rigid-frame construction can be used to transfer lateral loads
- Wood is able to resist higher stresses when loads are applied for a short time

School Construction and the IBC

Type V	Most common type of wood construction and is allowed for school design. Type V is typically a cost-effective type of construction, particularly when load-bearing walls are wood. The IBC allows use of untreated wood throughout a Type V structure. Under the IBC, one-story Type V schools can be up to 87,875 square feet and two-story schools may be as large as 138,750 square feet. If additional square footage is required, two-hour rated fire walls can be used.
Type IV	Also known as heavy timber construction, allows use of solid or laminated wood members such as glulam, wood decking, and structural sheathing when there are no concealed spaces. Fire-retardant-treated (FRT) wood can be used to frame exterior walls.
Type III	Type III construction allows wood roof and floor systems as well as interior wood-frame walls. FRT wood is required to frame exterior wood-frame walls.
Types I and II	Allow the use of heavy timber construction in roof construction and for secondary members. FRT wood can also be used in certain applications. *Designing Schools with Wood* from APA – The Engineered Wood Association details the approved use of wood in school construction by IBC building type.

SECTION 3

HUMAN HEALTH AND WELL-BEING

Connection to Nature

- Connection to nature improves our sense of well-being while indoors
- Studies surrounding biophilia support the use of wood and natural building products in a learning environment
  - Warm and natural attributes of wood
  - Users respond well to a visual or tactile connection with exposed wood products

Photo courtesy naturallywood.com

South Tahoe High School

Location: South Lake Tahoe, California

Architect: LPA, Inc.

Size: 67,500 square feet

Occupancy: E, A1, A3

Design capacity: 1,200 students

Type of construction: IIIB, VB

Year of completion: 2011

Wood beams and clerestory lighting make the South Tahoe High School a natural fit in a mountain setting. According to the designer, wood was the only material capable of creating the aesthetic desired by the client and the community.

Photo by Costea; courtesy of LPA Inc. & Planners, Ltd.

Reducing Stress Reactions

- Study at the University of British Columbia and FPInnovations established a link between wood and human health
- Presence of visual wood surfaces in a room lowered activation of the sympathetic nervous system
- Concluded that wood is one way to create a healthier built environment
  - by adding natural elements back into the built environment, these stress reactions can be reduced

Wood has a strong presence at the South Tahoe High School in California. It was used for the school's main structural system as well as exposed elements.

Photo by Costea Photography; courtesy of LPA Inc.

University of Washington West Campus Student Housing – Phase I

Location: Seattle, WA

Architect: Mahlum Architects

Size: 668,800 square feet (five buildings)

Design capacity: 1,700 students

Type of construction: Type VA

Year of completion: 2012

This student housing project includes five buildings, each with five stories of wood-frame construction over a two-story concrete podium.

Photo courtesy of Benjamin Benschneider, Mahlum Architects

SECTION 4

A SMART ENVIRONMENTAL CHOICE

Wood as a Green Building Material

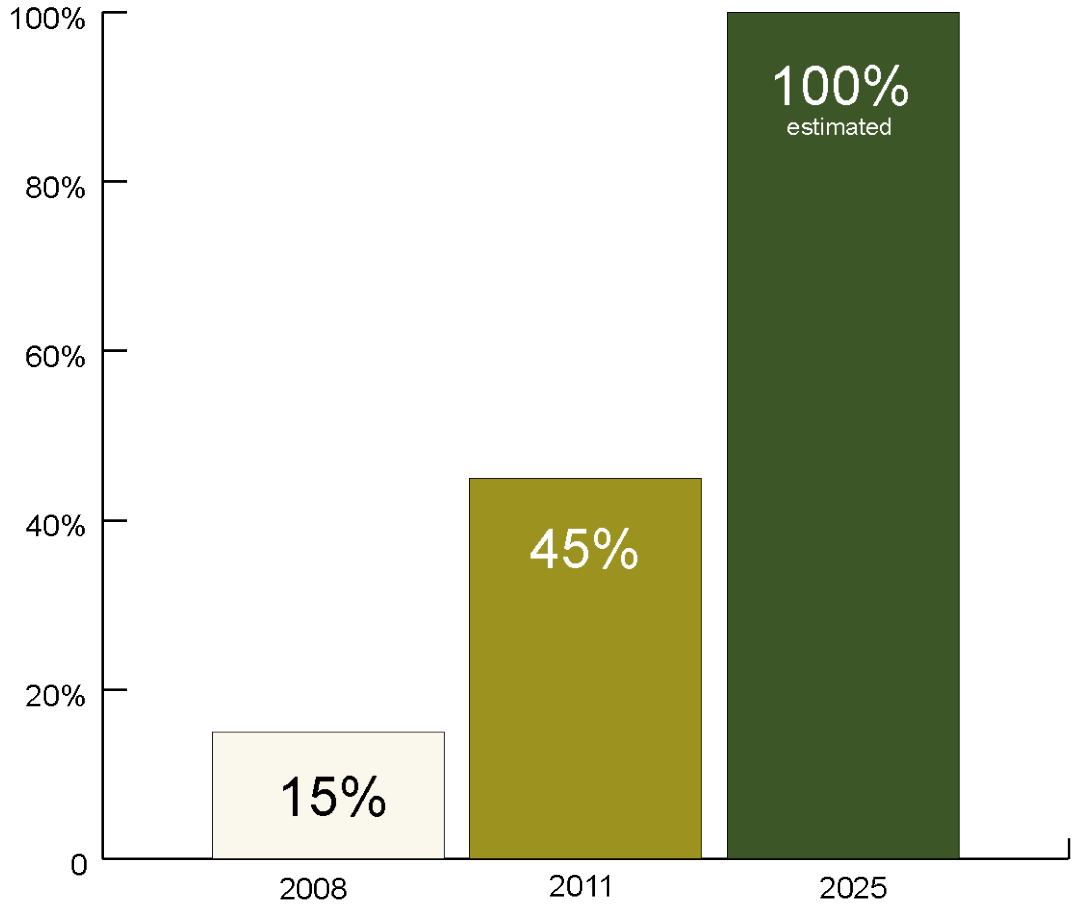
"Wood has a vital role to play. U.S. Forest Service studies show that wood compares favorably to competing materials."

- Tom Vilsack, Agriculture Secretary
  U.S. Department of Agriculture

Education Green Construction

Green Share of Education Construction

As a % of construction starts by value



- Green building is largest opportunity by dollar value
- All new construction to be green by 2025

2013 McGraw Hill study

Energy Efficiency

- Wood-frame buildings can meet or exceed the most demanding energy-efficiency requirements
- May result in operational savings over time
- Wood studs do not transfer heat and cold the way metal studs do – helps the energy efficiency of the exterior envelope

The Bethel School District uses wood-frame construction to save construction costs while achieving high levels of energy efficiency. The district reports an 81 percent ENERGY STAR rating overall, and several of their elementary and middle schools have ratings between 95 and 98 percent.

Photo courtesy of Erickson McGovern Architects, Bethel School District

Clover Creek Elementary School

Location: Tacoma, WA

Architect: Erickson McGovern

Size: 63,121 square feet

Design capacity: 645 students

Type of construction: Type VB

Year of completion: 2012

With its use of wood framing, Bethel School District proves that cost effectiveness and energy efficiency can be complementary objectives.

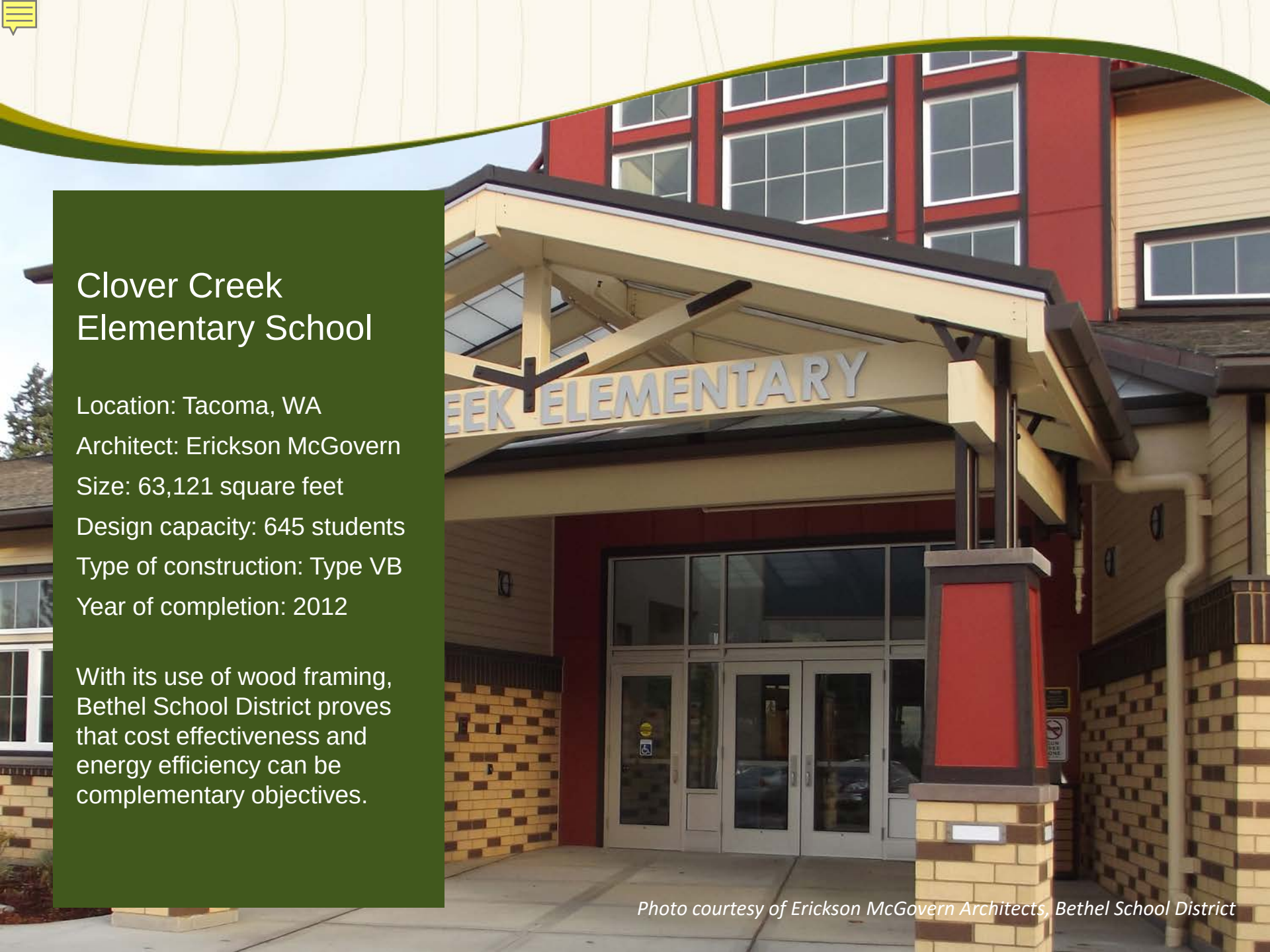


Photo courtesy of Erickson McGovern Architects, Bethel School District

Thermal Benefits

Study: Steel v. Wood, a Cost Analysis of Superstructures

- By Keith Kothmann, CPE
- Exterior wall systems also offer thermal benefits when using wood studs instead of metal
- Depending on wall height, a metal drywall system can accelerate thermal conductance for 12-15% of the wall surface, regardless of the amount or thickness of insulation in the wall

Duke School

Location: Durham, North Carolina

Architect: DT W Architects & Planners, Ltd.

Size: 42,060 square feet

Occupancy: E

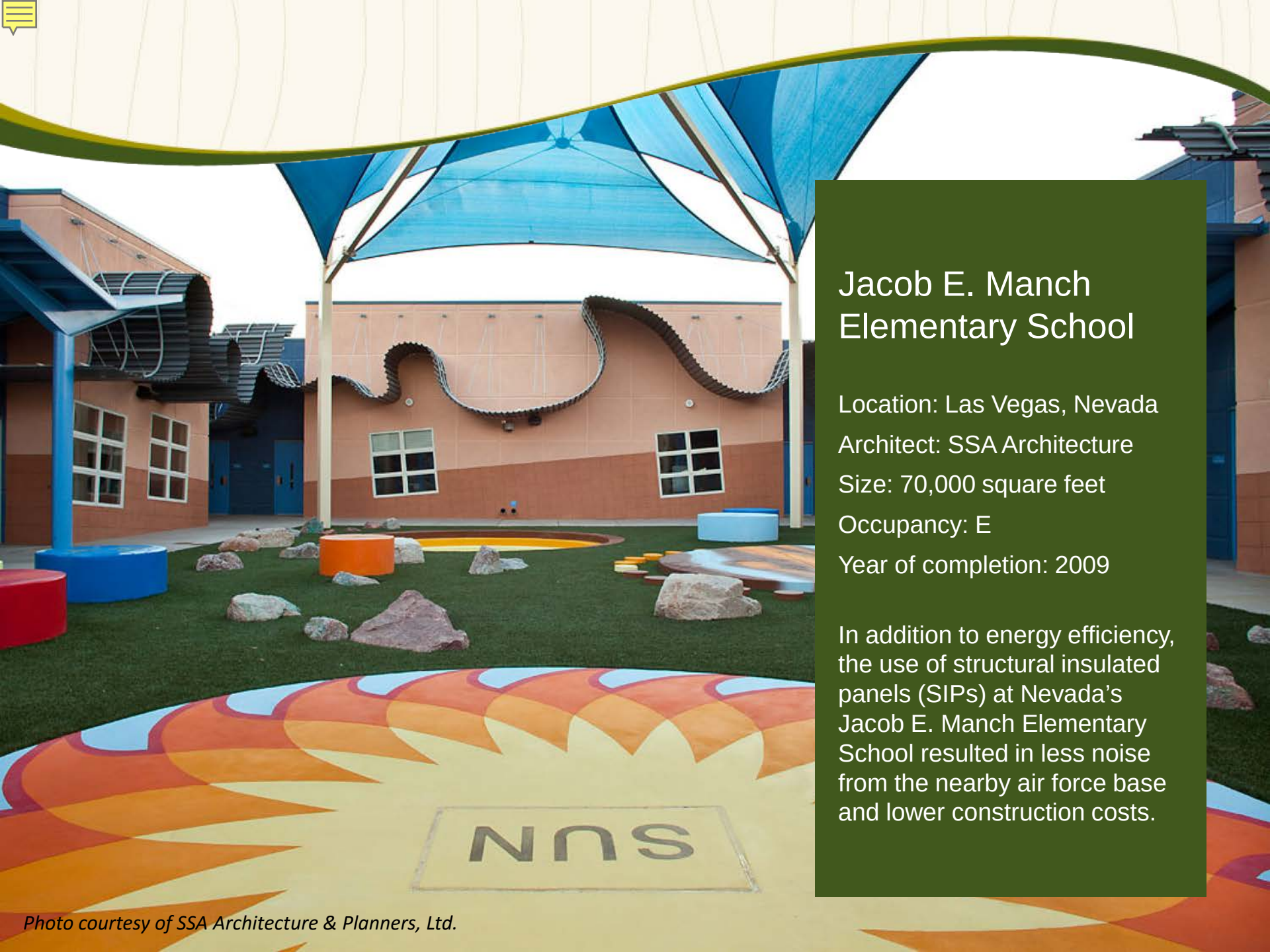
Design capacity:
Lower School – 128 students
Middle School – 200 students

Type of construction: Type VB

Year of completion: 2009

At the Duke School, designers took advantage of a glulam timber structure and wood stud walls to achieve high insulation values in the exterior building envelope, and a warm, rich aesthetic was created using a variety of complementing woods.

Photo by Jerry Markatos; courtesy of DTW Architects & Planners Ltd.



Jacob E. Manch Elementary School

Location: Las Vegas, Nevada

Architect: SSA Architecture

Size: 70,000 square feet

Occupancy: E

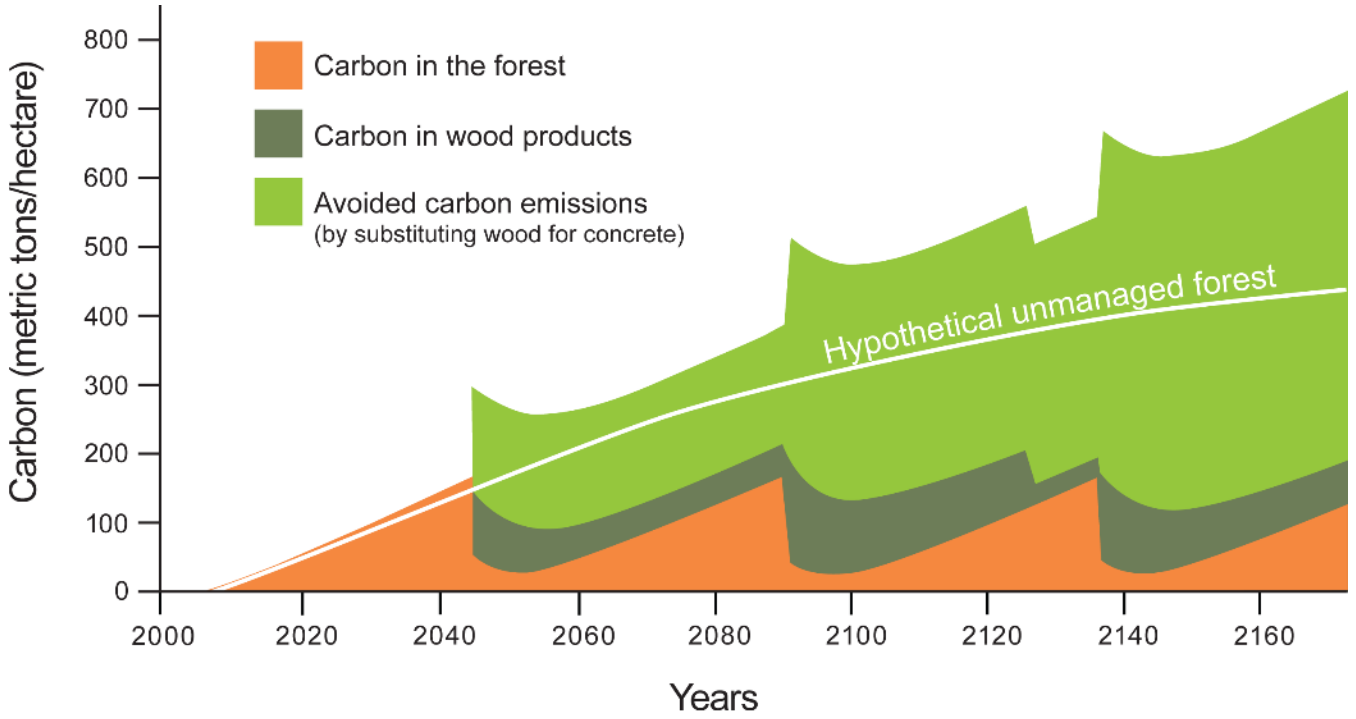
Year of completion: 2009

In addition to energy efficiency, the use of structural insulated panels (SIPs) at Nevada's Jacob E. Manch Elementary School resulted in less noise from the nearby air force base and lower construction costs.

Photo courtesy of SSA Architecture & Planners, Ltd.

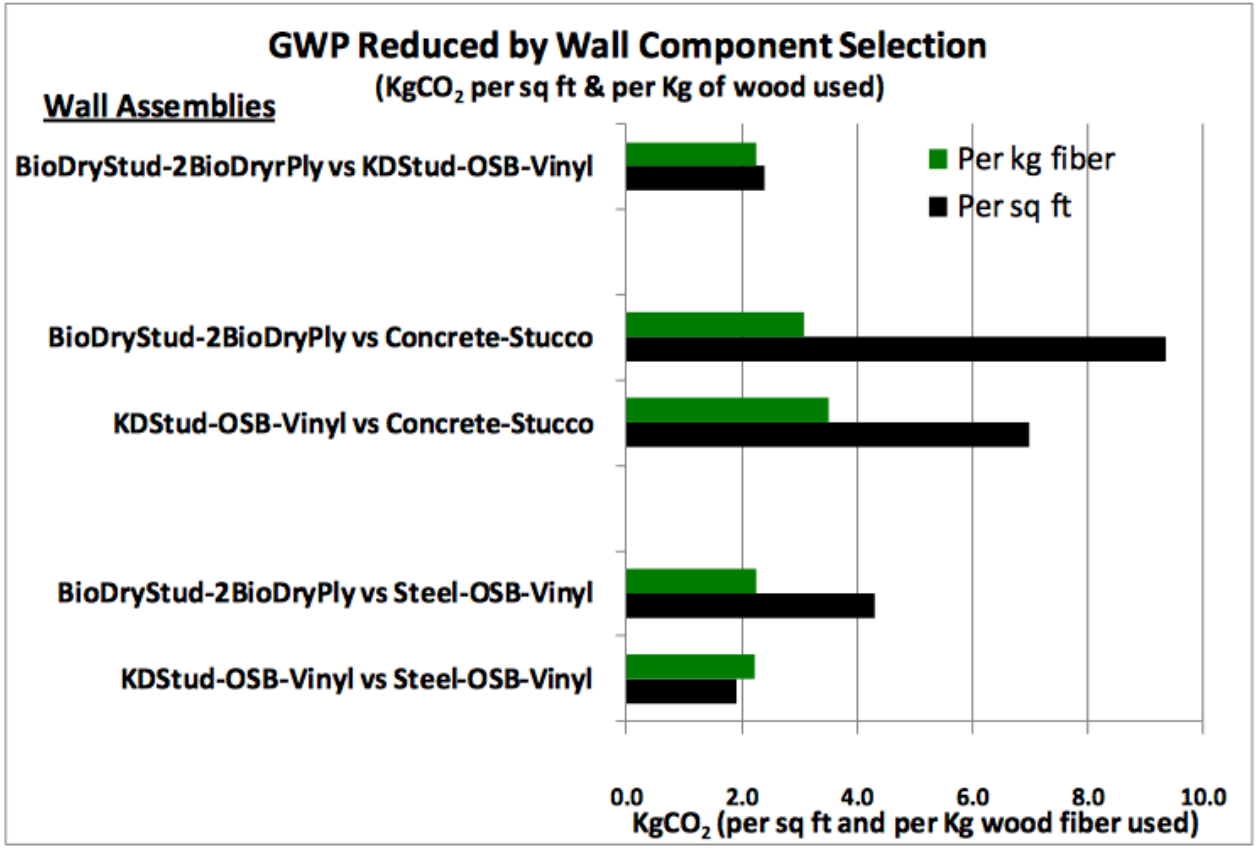
Carbon Footprint

- Wood continues to store carbon absorbed by the tree during its growing cycle
- This carbon is kept out of the atmosphere for the lifetime of the structure



Avoided Greenhouse Gas Emissions

- Manufacturing wood into products requires less energy than other materials
- Results in avoided greenhouse gas emissions

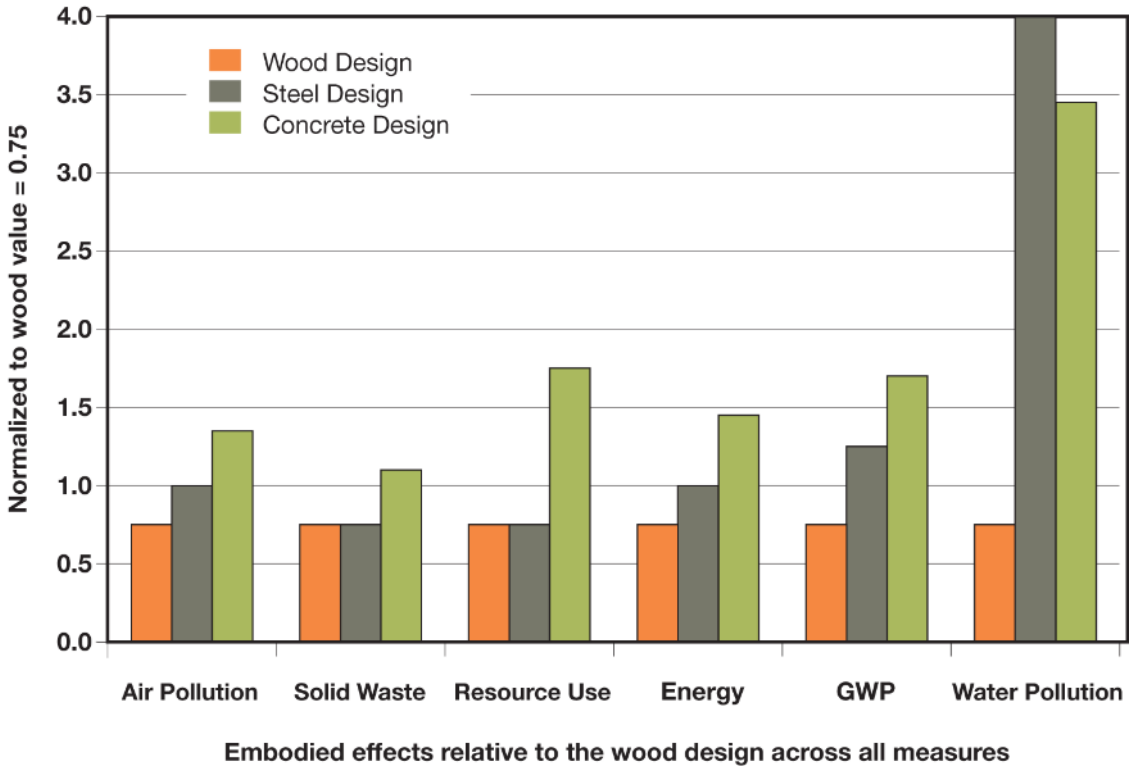


Source: www.corrim.org

Figure 4: Reducing Global Warming Potential by Selecting Components in Wall Assemblies (per square ft of wall and per unit of fiber used) **from Lippke & Edmonds 2009.**

Life Cycle Assessment

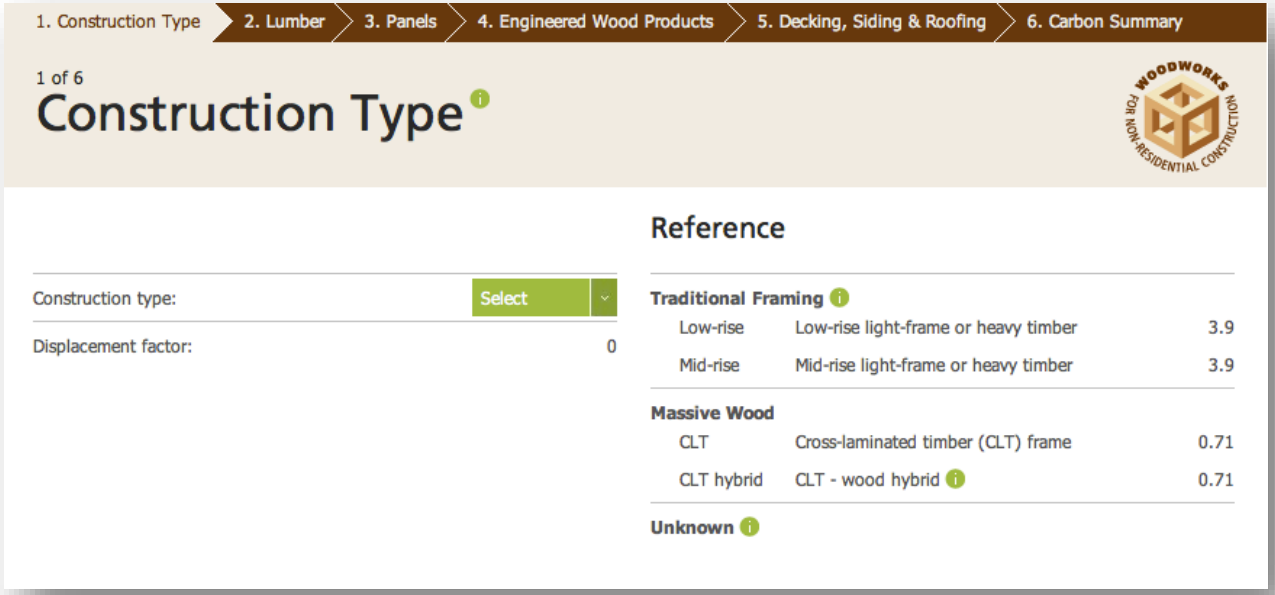
- LCA studies consistently show that wood outperforms other materials in terms of
  - embodied energy
  - air and water pollution, and
  - greenhouse gas emissions



Source: Data compiled using the Athena EcoCalculator www.athenasmi.ca

Calculating a Building's Carbon Storage

- Online tool to estimate the carbon benefits of their wood buildings
- Uses volume information to estimate
  - Carbon stored in the wood products
  - Greenhouse gases avoided by not using steel or concrete
  - Time it takes North American forests to grow that volume of wood



Source: woodworks.org

Carbon Benefits of Mercer Court

Photo: Ankrom Moisan Architects, courtesy of W.G. Clark Construction

Mercer Court

Five Buildings • 1,800,000 bf dimension lumber

Volume of wood:
1,788,924 million board feet (equivalent)

U.S. and Canadian forests grow this much wood in:
12 minutes

Carbon stored in the wood:
3,650 metric tons of CO_2

Avoided greenhouse gas emissions:
7,759 metric tons of CO_2

TOTAL POTENTIAL CARBON BENEFIT:
11,409 metric tons of CO_2

EQUIVALENT TO:

Source: US EPA

2,179 cars off the road for a year

Energy to operate a home for 970 years

Estimated by the Wood Carbon Calculator for Buildings, based on research by Sarthre, R. and J. O'Connor, 2010, A Synthesis of Research on Wood Products and Greenhouse Gas Impacts, FPInnovations. Note: CO_2 on this chart refers to CO_2 equivalent.

SECTION 5

DECADES OF DURABILITY

Versatile System

- Wood framing is a versatile system
- Allows for a variety of affordable options in protecting and treating surfaces

Revelstoke High School
British Columbia, Canada
Architect: DIALOG

Photos courtesy of Revelstoke School District

Longevity of Materials

- Elementary schools typically have an expected lifespan of 50+ years – wood framing can help extend that
- Many buildings are demolished before the end of their useful service lives due to changing needs
- Wood is adaptable through renovation or deconstruction and reuse

THANK YOU!

For more information on building with wood, visit rethinkwood.com

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