Eco-Wood

The Ecological Benefits of Building with Wood

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As I speak on this topic you will be viewing images of projects for which I have used wood for both structural components and details. This pamphlet includes eight such projects that I have designed.

Note: The powerpoint presentation includes many more images than are in this pamphlet.

Introduction

As an architect, builder and carpenter, I have been designing and building with wood for many years. Because working with wood is so enjoyable, I want to make sure that my grandchildren can do the same, so I continue to do whatever I can to insure that trees, the source of wood, remain a renewable resource for many generations to come. One of my biggest motivations comes from the knowledge that, together with oceans, trees absorb 50% of the 8 billion metric tons of carbon contributed to the air by humans as a result of energy use in their daily lives.

With this in mind, I do what I can to make a difference. I am a member of the National Arbor Foundation and plant the seedlings which they send to me on a regular basis. Also, I practice sustainable design through our firm, T.I.A. Architects, as well as teach and promote Principles of Ecological Architecture through our non-profit Nacul Center for Ecological Architecture which I began in 1972. One of the

T.I.A. Architects

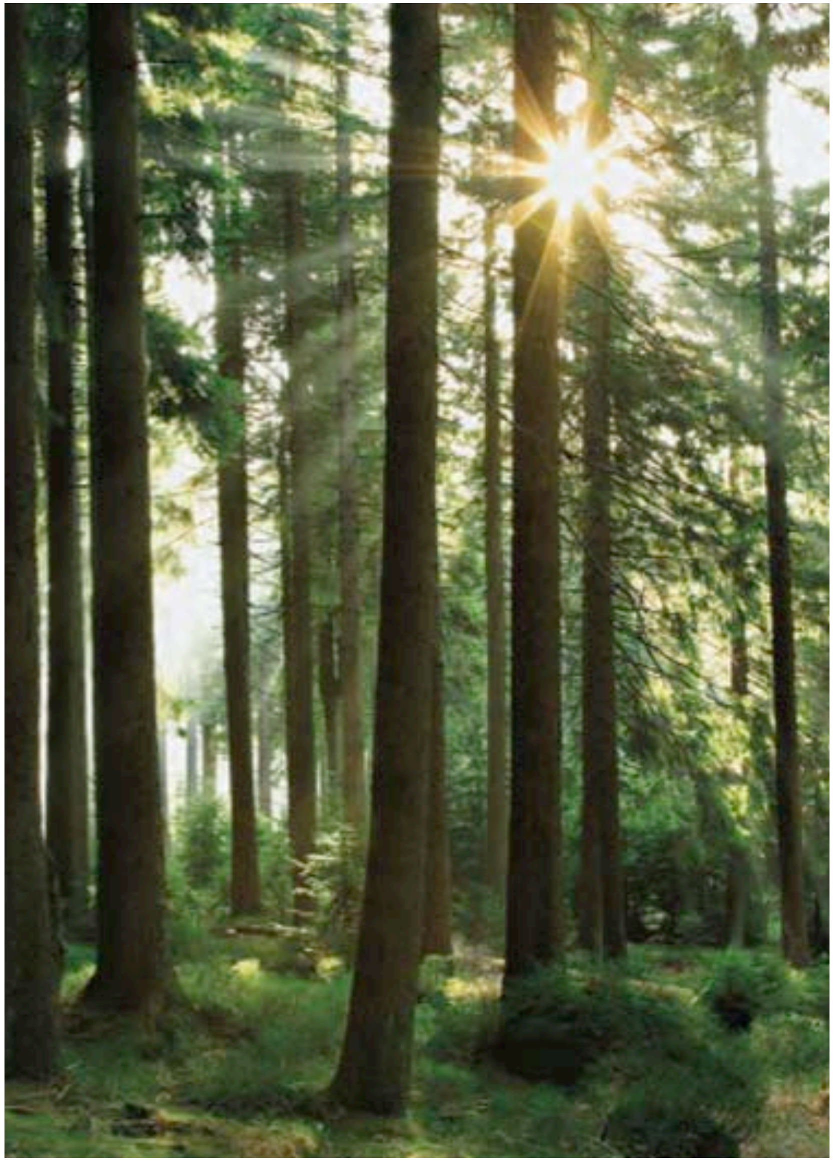
principles, Appropriate Materials and Methods, encourages the use of wood in construction because it is an environmentally friendly material when harvested and processed sustainably.

The following will discuss how wood use decreases carbon dioxide levels in the atmosphere, lowers energy consumption and pollution, and provides longevity and adaptability.

Wood: Decreasing Levels of CO2 in the Atmosphere

Most of us are familiar with the common advocacy to reduce our carbon footprint by planting a tree. We are aware that trees remove carbon dioxide from the air. Lesser known is the fact that if we do not actually cut down and use the trees that are grown, we allow most of that carbon dioxide to be released back into the air in the decomposition process. On the other hand, if that wood is utilized to build a house or product, the sequestered carbon remains stored in the wood.

The more we build with wood, the more carbon we sequester indefinitely, and the more we increase the demand for



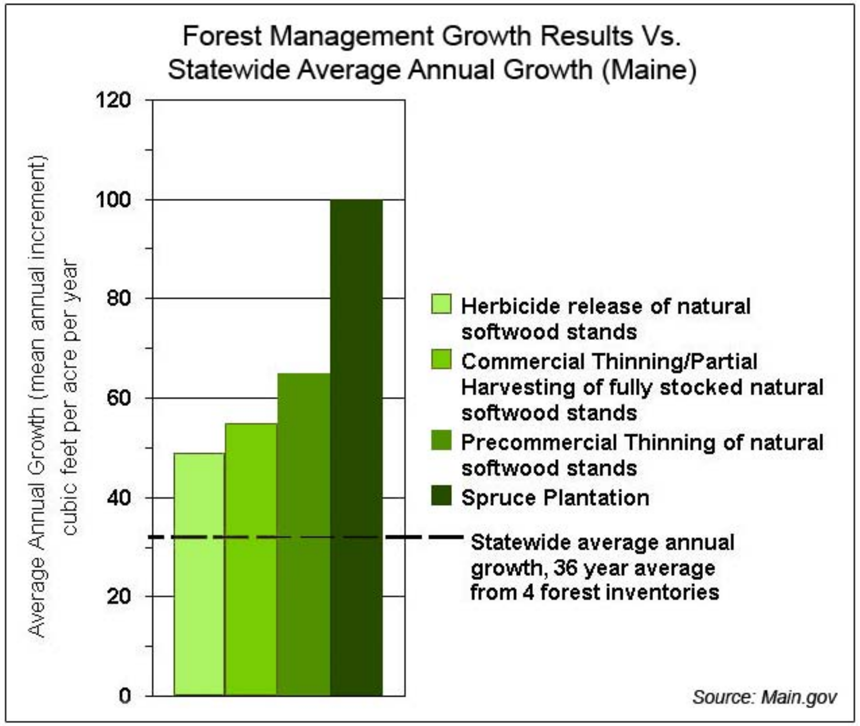
Source: Sustainable Forestry Initiative

wood. An increase in demand leads to the need for more managed forests, which actually have a greater CO_2 impact than unmanaged forests. Managed forests have younger, stronger, healthier trees; such trees grow more vigorously, sequestering more carbon. Properly harvesting old growth trees enhances new growth, especially of deciduous trees, because more sunlight can reach the saplings which may have sprouted naturally. Large trees with fast growth rates sequester the most carbon, as half of a tree's dry weight is carbon.

It is important, of course, that forest management companies include environmental impact statements of their harvesting operations, especially with regard to the effects on wildlife habitats, clean air and water, and any new growth.

Wood: Lowering Energy Consumption & Pollution

Trees are ubiquitous. With the exception of oceans, deserts and arctic regions, they cover most of the planet. In



Source: Sustainable Forestry Initiative

This graph shows that various forest management practices can substantially increase annual tree growth above state averages, doubling and even tripling the amount of growth.

many areas, therefore, they are a local resource requiring relatively little transportation from source to mills to construction site. This saves on energy. In contrast, iron ore, the basic mineral refined for the production of steel, is mined in only a few places. It then must be transported considerable distances to the few existing refineries – using millions of gallons of gasoline – not to mention the resultant carbon dioxide dumped into the atmosphere. Furthermore, especially in the case of surface mining, the process is often devastating to the natural environment.

The Life Cycle Analysis has been developed as a method to compare the environmental impact of various building materials throughout their lifespan, from source extraction and manufacturing to transport, construction, use and disposal/ recycling. In this regard, wood, compared to steel or concrete, has a much friendlier environmental footprint. Wood has less embodied energy, produces less air and water pollution and less emissions.

Montague House

Harwood Stone House

Compare the energy used to produce one ton of wood to that of other construction materials: 5 times more energy is required for one ton of cement; 14 times more energy for the same amount of glass; 24 times more energy for steel; 126 times more energy for aluminum.

Wood products are equal to 47% of all industrial raw materials manufactured in the U.S. yet consume only 4% of the total energy needed to manufacture. This is because wood is continually being 'manufactured' naturally. Through photosynthesis, trees absorb the sun's energy and 'store it' as bio-mass which, when sustainably harvested, can remain an endless resource.

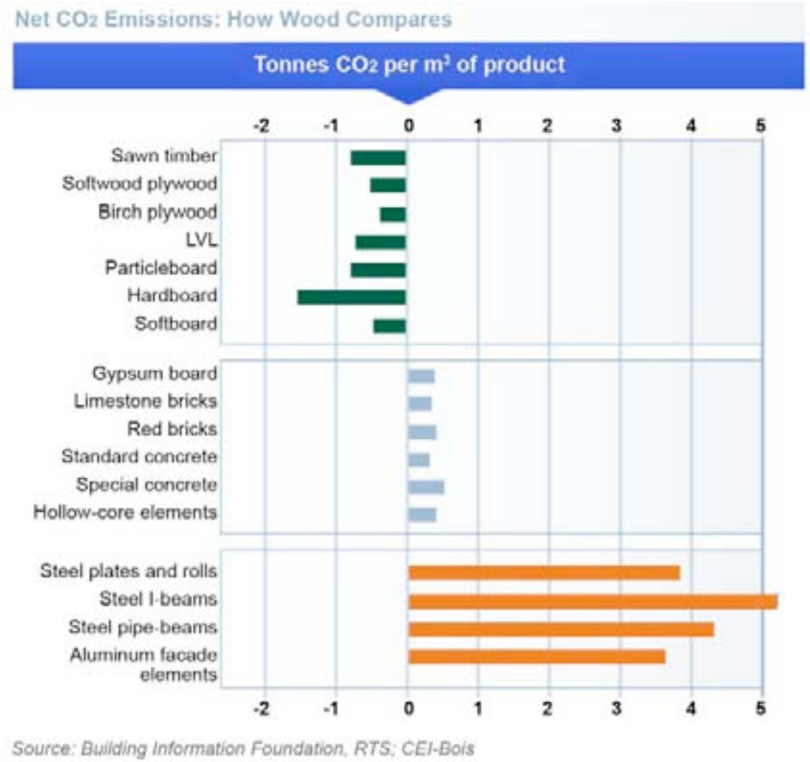
Also worth noting is the insulative property of wood which allows it to outperform steel and concrete in energy conservation tests. Wood is a natural insulator due to its cellular structure which traps air pockets. In contrast, steel is incredibly conductive of heat due to its density. Tests have shown that wood is 400 times more resistant to heat flow than steel, and 10

Conway House

times more resistant than concrete. Therefore, a wood frame house requires much less insulation to achieve the same thermal performance as a steel or concrete house of equal dimension.

Not only does wood require less energy throughout its life cycle, but it also emits less carbon dioxide into the atmosphere than any other material. The amount of carbon emitted during the manufacture of aluminum, steel, and wood respectively is 6,325 Kg per M3, 8,117 Kg per M3 and -228 Kg per M3. Wood has a negative impact because the carbon it sequesters in product form more than cancels out the small amount of carbon released during its manufacture, transport and construction.

In general, wood buildings produce much less air and water pollution than their counterparts. One study performed by the Canadian Wood Council provides statistics based on a comparison of three 2,400 ft^2 homes over the first twenty years of their lifespan. One home is wood frame, one is steel and the other concrete. The study showed that, compared to the wood design,



Wood has a negative impact because the carbon it sequesters in product form more than cancels out the small amount of carbon released during its manufacture, transport and construction.

the steel design produced 8% more solid wastes, released 24% more air pollution, and discharged 400% more water pollution. The concrete design produced 23% more solid wastes, released 47% more air pollution, and discharged 350% more water pollution. With regard to greenhouse gases emitted, the steel design released 34% more than its wood counterpart, and the concrete design took the lead with 81% more than wood.

Fairbanks House - Dedham, Massachusetts

Wood: Durable & Adaptable

Our focus now brings us to the end of the life cycle of wood, in which the durability and adaptability of the material further increase its value. Wood structures that have remained standing for hundreds of years attest to the long-lasting nature of the material. The Fairbanks House in Dedham, Massachusetts has stood for 374 years, and is the oldest timber frame house in North America. Nearly 80 wood homes from this era still remain in New England. The

Urnes Stave Church - Norway

Horyu-ji temple - Nara, Japan

Urnes Stave Church has stood in Norway for about 860 years, and the Horyu-ji temple in Nara, Japan has stood for about 1300 years, both wooden structures.

Most wooden structures, however, are torn down long before they reach their prime, often due to failure to accommodate new uses, lack of non-structural maintenance, or changing land values. As a result, it is perhaps even more important that wood be an adaptable material. Reclaimed wood can easily be reused or resized, and requires little to no energy for a new beginning.

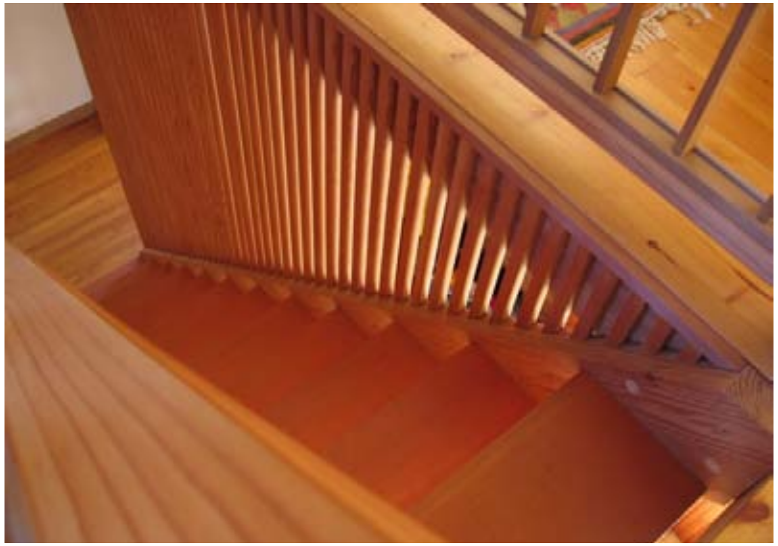
There are numerous ways to recycle wood. Entire structures have been built of reclaimed wood. Such wood can also be used for interior details, flooring, furniture, products, or even firewood. In our construction we make an effort to use recycled wood. The queen post trusses in our own house, for example, are made of timbers from a mill that had collapsed. No wood need ever be wasted, although even this is not such a serious matter as wood is biodegradable.

Inglese Queen Truss House

Conclusion

The benefits of using wood are many:

1. In most places it is a local material because trees grow on many parts of the planet. This reduces transportation costs and the resultant carbon dioxide emissions from trucks and trains which effect global warming.
2. Trees absorb carbon from the air, alleviating global warming. Wood products keep that carbon sequestered indefinitely.
3. It is the most energy efficient building material to manufacture.
4. Wood byproducts can be used for heating, landscaping and mulch.
5. It is the most environmentally friendly material in terms of air and water pollution.
6. It is easy to work with, requiring only basic tools and providing the flexibility for modifications during construction. Wood is versatile in creating unique forms and structures.
7. It is a good insulator and has good acoustical properties.
8. It looks, smells, feels, and ages beautifully in all applications.
9. It is easy to reuse and recycle. Wood waste is actually a resource.



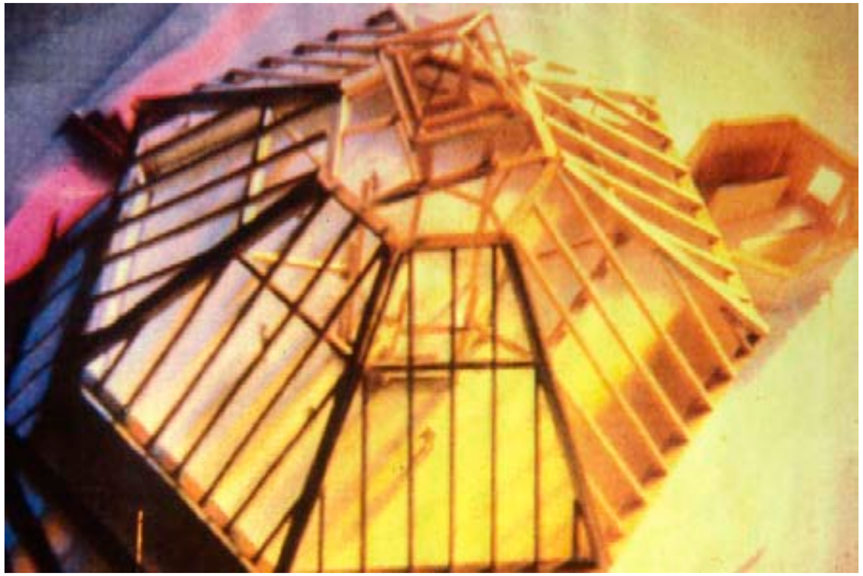
Westhampton House

10. Finally, less desirable wood products and byproducts can be made into engineered lumber which has the structural capacity to perform extremely well. Here are a few examples of the projects our office has designed using both engineered and natural lumber:

• Sunray Meditation Society

Sunray is a Native American spirituality that stems from the Cherokee Indian Nation. The various Indian tribes associate with particular constellations. The constellation of the Cherokee's is Pleaedes, or Sabaru in Japanese, which has seven stars. For this reason, Cherokee 'roundhouses,' as they are called, are traditionally heptagonal or seven-sided. Typically they include a central fire pit around which they dance and perform ceremonies.

In our design, the parallam rafters are intercepted by a purlin supported by diagonal braces which transfer the roof load down to seven columns surrounding the fire pit.



Sunray Meditation Society

Brookfield Farm Market

Brookfield Farm Market

This fairly large market place was designed using parallam beams and columns to support the large loads, (about 120 pounds per square foot), of the green roof. The structure is a basic grid, framed to receive structural insulated panels (SIP's) on the roof which includes planting beds and a greenhouse for the farm.

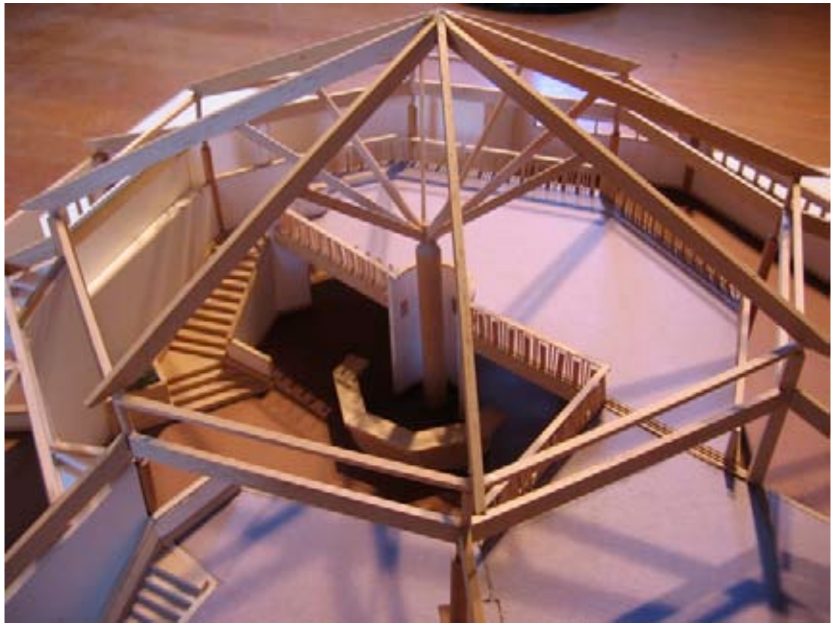
- Harwood Stone House

Usually I design compact, modest homes, but this is the largest house I have designed. It is composed of two connected octagons, each one held up by two octagonal parallam columns. The ridge spans thirty feet and requires a secondary ridge with diagonal braces supporting a purlin used to reduce the rafter span.

.• Leverett Town Library (Proposal)

This is our proposal for a small town library also constructed of engineered lumber. The concentric plan works

Harwood Stone House



Leverett Library

extremely well for library circulation. Diagonal braces originating from a central column support the hip rafters of the octagon. The loft is open to the main floor below.

• Bow Truss House

For smaller residential projects I use local wood when possible, as is the case for the Bow String Truss House in Sante Fe, New Mexico. The truss is made of three pieces of straight lumber that are laminated together and then cut into an arc. The roof deck is made of tongue and groove planks and is shallow enough to receive a living roof.

• Queen Truss House

The queen post trusses in this house are made of recycled douglas fir. The wood came from an old mill that had collapsed. My houses have a Japanese influence and incorporate shoji screens, engawas and even a tokonoma.

Bow Truss House

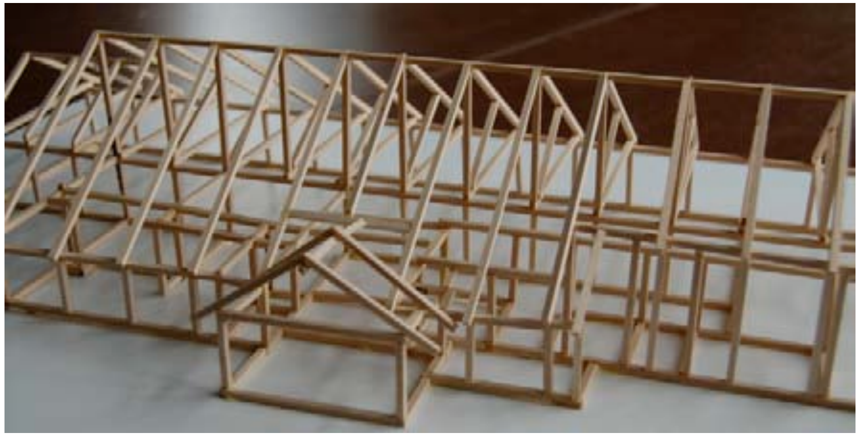
Queen Truss House

- Shutesbury Library (Proposal)

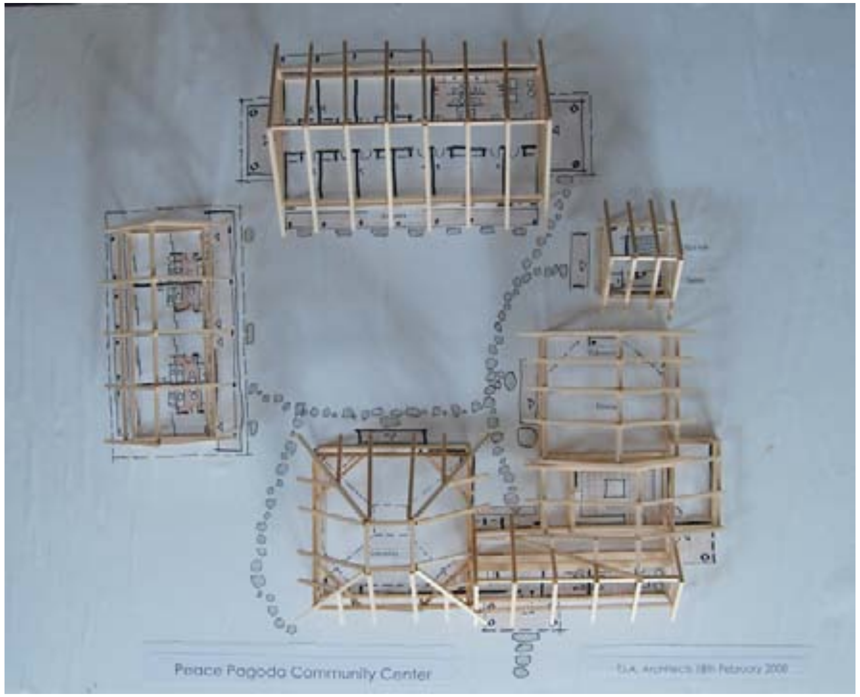
  Most recently we are designing sustainable buildings which various building communities can pass on to their architects. The projects such as the Shutesbury Library incorporate Principles of Ecological Architecture, including geothermal heat, photovoltaic panels, passive solar heating, non-toxic materials, double exterior walls and optimum orientation.

- Peace Pagoda Community Center

  We are currently working with Kato Shonin and the Buddhist monks in Leverett, Massachusetts on a timber-framed complex of buildings which will serve as their community center. The sustainable wood structures include an assembly hall, retreat house, senior monks house, kitchen and dining room. The buildings enclose an intimate, traditional Japanese garden.



Shutesbury Library



Peace Pagoda Community Center

Sources

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- Canadian Wood Council, “Wood’s Heritage”
- Colorado Tree Coalition, “Tree Benefits”
- DEC of New York State, “Trees: The Carbon Storage Experts”
- Forestry Insights, “Wood to the Rescue”
- Main.gov, “Timber Supply Outlook for Maine”
- The BC Forestry Climate Change Working Group, “Wood Products”

Tea House Tokonoma T.I.A.

More information is available on the Life Cycle Assessment (L.C.A.) of wood from B.E.E.S. (Building for Environmental and Economic Sustainability) and Athena Environmental Impact Estimator (E.I.E.).

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