

Trex- A More Sustainable Wood?

The total energy budget for a building is a function of its operational and embodied energy. The operational energy that is consumed by a building refers to all the energy, measured in Btu's, used during the building's occupation. While typically this would refer to heating, lighting, cooling, etc., maintenance activity should also be considered. Materials which required greater maintenance are less desirable than ones which don't. The embodied energy is the total energy that is used in material or component production, construction of the building, and eventually its demolition and disposal. While adaptive re-use projects are commendable, there are many buildings which are simply disposed of in order to make way for a new development. The usage of certain materials to construct a building may have impacts upon how much energy is consumed in its disposal. In the past, just about all buildings constructed had some form of asbestos in them. At the end of an asbestos containing building's life cycle, special efforts must be made to demolish and dispose of asbestos laden components.

According to the Sourcebook for Sustainable Design, the amount of embodied energy has increased, relative to operational energy¹ since 1972. However, the total amount of energy consumed has decreased. Therefore, much of the energy savings has been attributed towards reducing the energy consumed during building operations. Sustainable building practices need to focus on reducing the embodied energy.

One of the primary principals of sustainable development is to retain as many resources as possible. In other words, be conservative of our resources. In order to do so, those involved in the construction industry need to rethink standard practices and procedures. One of the primary ways of altering the amount of resources consumed by the activity of building is to re-evaluate the logic of selecting materials.

¹ St. John, Andrew ed. The Sourcebook for Sustainable Design. Boston: Boston Society of Architects. 1992 1.4

Architects, builders, and the related professions have a significant role as arbiters of style for buildings. In the past, this role has primarily been related to aesthetics of a building's appearance. However, it is possible to develop a new kind of building aesthetic, one based on the complex criteria of sustainability; a new building ethic.² Materials may be selected on the basis of cost, availability, and durability, rather than primarily on appearance. While initially material selection may be somewhat one dimensional, eventually the criteria may include energy accounting and carbon emissions from raw material harvesting, through production, and installation.

In the beginning... Wood

Wood is perhaps the first building material. Going back to the primitive hut, which relied on the tree for its structure, wood transcends the label of building material. There is something intrinsically significant about its place in cultures around the world.³ Elements of building ornament can be traced back to the methods of construction utilized in wood working. In neoclassical architecture, the striated rectangles which project just below the cornice are the remains of the triglyphs of Greek temples. While eventually reduced to ornament, they originated with the timber beams, projecting onto the building's front elevation. The allure of wood is so great that it is even evoked as pattern on televisions, microwaves, and car interiors. There is perhaps more collective knowledge about working with wood than any other material in the world.

Because wood is such an accessible material, before delving into some of the research, there is the common understanding of wood that should be discussed. There is the idea that while wood is a renewable resource, it's being consumed faster than it can be produced. That, coupled with the inefficient manner in which wood is used, results in a sustainable material subject to unsustainable practices.

² St. John, Andrew ed. The Sourcebook for Sustainable Design. Boston: Boston Society of Architects. 1992 6.1

³ St. John, Andrew ed. The Sourcebook for Sustainable Design. Boston: Boston Society of Architects. 1992 6.1

The lumber and wood products industry is a complex organization across seventeen industrial categories.⁴ The organization which represents those firms involved, is the American Forest & Paper Association (AFPA). The association's website has several pages and documents addressing sustainability. One of the chief points is that wood is one of the most sustainable building materials. Concerns about the way wood is produced are further addressed by AFPA's "A Code to Live By: Environmental, Health, and Safety Principles". The principles are wide ranging, but are the beginnings of an ethical code for wood processing. While not explicit, the principles state the need to improve efficiency in product development and manufacture.⁵ This attempt is carried even further with the "Sustainable Forestry Initiative" program (SFI).

According to AFPA, the SFI program was brought about by the necessity of balancing consumption of resources with environmental stewardship. The success of this set of initiatives is proven by the fact that there is today more wood growing in AFPA member controlled forests than there has been in the last century.⁶ Adherence to SFI standards has been monitored by an independent non-profit group since year 2000.

The Alternative

In 1996, the alternative-lumber manufacturing division of Mobil Corporation became Trex Company, Inc. The firm is the leading manufacturer in North America of alternative-lumber decking, selling several million pounds of product each year.⁷ The Virginia based company is projecting sales for 2006 will total \$320-\$330 million. This is an increase over the previous year.

An evaluation report written by ICC Evaluation Service (a company which tests building products for code compliance) describes Trex as a wood thermoplastic composite material, manufactured from 50% recycled wood and 50% recycled polyethylene. The ingredients are mixed into a dough like consistency and then extruded

⁴ "Labor Market Information". Labor Market & Analysis

<http://www.wa.gov/esd/lmea/sprepts/indprof/lumber.htm> 11-9-06

⁵ AFPA. "A Code to Live By: Environmental, Health, and Safety Principles"

http://www.afandpa.org/Content/NavigationMenu/Environment_and_Recycling/Environment_Health_and_Safety/Reports/EnvironmentalHealthSafetyPrinciples.pdf 11-9-06

⁶ AFPA. "Sustainable Forestry Initiative"

http://www.afandpa.org/Content/NavigationMenu/Environment_and_Recycling/SFI/SFI.htm 11-9-06

⁷ Trex <http://www.trex.com> 11-9-06

in standardized sections. Trex is sold in a combination of seven colors and two textures.⁸ Trex's website states the company purchases approximately 300 million pounds of used polyethylene and another 300 million pounds of hardwood sawdust each year in order to manufacture its decking and railing products⁹. About half of the polyethylene, by the company's estimation, comes from used plastic grocery bags.

While Trex is declared as an environmentally friendly material, that is not the chief message from its marketing. Rather, the product is promoted as very low maintenance, durable material well suited for outdoor use. The product composition is said to result in Trex having only the best properties of each material. The thermal properties of wood make it ideal for assembling with wood framed construction. The material will not expand and contract much different from the natural wood structural members. The plastic used in Trex makes it resistant to moisture and insects. One of the material weaknesses in plastics is that they degrade with sun exposure, the UV slowly damages the material. While this is a problem in vinyl siding and other building components, in Trex, the wood shields the plastic from damage (at least according to the company selling it)¹⁰.

Tests show that when used according to manufacturer's specifications and recommendations, Trex is as durable as treated lumber with regard to weathering, insects, and other decaying elements.¹¹ One of the primary shortcomings of Trex is that it is non-structural. The product may not be used for anything other than decking or railing systems. The ES Report indicates that the material has a compressive strength of 550 psi parallel to the grain, and 625 psi perpendicular to the grain.¹² By comparison, the average physical properties of wood are 1,000 psi parallel to the grain and 300 psi perpendicular to it.¹³ Trex has a modulus of elasticity (E) of 1×10^5 while wood typically

⁸ "ES Report" ICC, Evaluation Service. http://www.trex.com/Universal/technical_info/ESR-1190.pdf 11-9-06

⁹ "About Trex Company" <http://www.trex.com/About/default.asp#topnav> 11-9-06

¹⁰ "What is Trex" <http://www.trex.com/products/whatistrex.asp#topnav> 11-9-06

¹¹ "ES Report" ICC, Evaluation Service. http://www.trex.com/Universal/technical_info/ESR-1190.pdf 11-9-06

¹² Ibid

¹³ Guthrie, Pat The Architect's Portable Handbook 3rd Edition. New York: McGraw-Hill 2003. 358

has an E of 1.2×10^6 . This means that Trex is more likely to bend than wood, given the same amount of loading placed on the two materials. Some general contractors, when installing Trex on a project, change the joist spacing from 16" on center, which is typical of wood construction, to 12" on center, in order to account for the difference.¹⁴ That means that in order to use Trex, the contractor may be using 25% more wood for framing.

Some of the other shortcomings of Trex are more qualitative. The material is priced at a premium over wood decking. In order for this material to be sustainable, the cost must be addressed. Additionally, according to the AFPA, plastic materials use six times the amount of energy during the manufacturing process than wood.¹⁵

One of the main criticisms of using treated lumber in applications where Trex might be installed is the process by which the wood is protected from water and insect damage. Pressure treated lumber has been produced using chromated copper arsenate (cca) since the 1930s. Studies have found that cca leaches out of the wood and can possibly infiltrate the soil and groundwater.¹⁶ However, the primary danger associated with cca occurs when the material is burned. Serious and even fatal poisoning of humans and animals have occurred after victims unknowingly ingested the ash of the burning wood. Therefore the problem of cca is similar to the problems of asbestos. While used as a building component, the material may not be very dangerous, but it's handling post-use needs to be carefully monitored and controlled. At this time, there is no standard protocol for disposing of pressure treated lumber. So one of the most important selling points for Trex is that the product is cca-free. Consumers who are educated may often choose the composite product, rather than risk the danger of treated wood. On the other hand, since plastics are produced through oil refining by-products, perhaps burning a Trex deck would be no safer than a pressure treated one.

In the end, it is difficult to say that Trex is a more sustainable material than real lumber. However, the product does make practical use from waste material. While the

¹⁴ David Ginfriada

¹⁵ "Benefits of Wood Use" AFPA

http://www.afandpa.org/Content/NavigationMenu/Forestry/Forestry_Facts_and_Figures/products_products_on.pdf 11-9-06

¹⁶ "Chromated Copper Arsenate" Wikipedia http://en.wikipedia.org/wiki/Chromated_copper_arsenate

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AFPA may reach its goals of sustainable forestry, there will always be wasted material in manufacture of wood products. The fact that the waste will go into making a new material offsets some of its drawbacks. It may not be the highest and best use of either the wood or plastic that go into Trex, but it is certainly a good use of waste products.

Illustrations



Triglyph

Source: wikipedia



Trex deck

Source: Trex Deckscape Magazine (Company literature)

Sources

American Forest & Paper Association <http://www.afandpa.org/> 11-9-06

“ES Report” ICC, Evaluation Service.

http://www.trex.com/Universal/technical_info/ESR-1190.pdf 11-9-06

“Chromated Copper Arsenate” Wikipedia

http://en.wikipedia.org/wiki/Chromated_copper_arsenate 11-9-06

Ginfrida, David. Personal Interview. 11-9-06

”Greek Temples”. Odyssey, Adventures in Archeology

http://www.odysseyadventures.ca/articles/greektemple/greek_temple.htm 11-9-06

Guthrie, Pat The Architect’s Portable Handbook 3rd Edition. New York: McGraw-Hill
2003

“Labor Market Information”. Labor Market & Analysis

<http://www.wa.gov/esd/lmea/sprepts/indprof/lumber.htm> 11-9-06

“Triglyph” Wikipedia <http://en.wikipedia.org/wiki/Triglyph> 11-9-06

St. John, Andrew ed. The Sourcebook for Sustainable Design. Boston: Boston Society of
Architects. 1992

Sustainable Design Resource Guide. AIA-Denver

<http://www.aiacolorado.org/SDRG/div06/index.html> 11-9-06

Trex <http://www.trex.com> 11-9-06

“Wood Plastic Composite” Wikipedia

http://en.wikipedia.org/wiki/Trex_%28Composite_Material%29 11-9-06