Sustainable Buildings, Sustainable Future

WOOD AND THE ENVIRONMENT





CHOOSE
RESPONSIBLE
CHOOSE
RENEWABLE
CHOOSE WOOD

In our quest for environmentally responsible building solutions, it's hard to keep track of all the options. But many building professionals are finding old answers to the new question of how to build sustainable buildings for a sustainable future.

THEIR ANSWER? WOOD.

While wood is one of mankind's oldest building materials, today's engineered wood products have been designed to meet modern building challenges, including the need for sustainability. The wood products industry is using advanced research to develop new technologies for wood building components and systems, all while providing strong, long-lasting performance with reduced environmental impact.

Wood is one of the world's most sustainable building materials. It is completely renewable. Its growth actually helps reduce the impacts of global warming and, once harvested, carbon is held in the wood instead of being released to the environment.

Compared to other building materials, manufacturers require minimal energy to fabricate wood structural components. Wood is durable, which means a building made with wood is likely to outlive its original purpose. Yet it is versatile; a wood-framed structure can be easily modified to give an old building new life. Wood is recyclable and biodegradable. And even in its most natural state, wood is both strong and beautiful enough to provide both form and function.

Because most structures are built to last, it is important to use sustainable construction materials and designs to maximize not only the long-term functionality of the building itself, but the resource usage of the materials that form its framework. Wood maximizes both.

Sustainable design begins with sustainable building products. Few building materials can claim to be more sustainable than wood, making it one of the most environmentally-friendly building products available.

Vigorous, healthy forests produce more oxygen and absorb more CO_2; both benefit the environment.

THE WORLD IS GREENER THAN YOU MIGHT THINK

Don't believe it when they say the world is running out of trees. A 20-year study published in 2015[d] provided new insights into the global carbon story. From 1993 to 2002, the amount of the world's plant matter (aboveground biomass) declined, primarily due to deforestation in Brazil and Indonesia. But between 2003 and 2012, that trend reversed itself, due in part to forest growth in China and Russia and a drop in tropical deforestation. The result was a net overall gain in the amount of carbon-absorbing green matter on earth—good news for the environment. Closer to home, North America's total forested area remains stable, and the actual volume of wood on that land is increasing[e].

GREEN STARTS WITH TREES

Wood's environmental benefits take root in the forest.

Growing trees produce oxygen while absorbing carbon dioxide, purifying the environment for years before the tree ever becomes a building material. Grown using solar energy, young forests remove millions of tons of carbon from the atmosphere each year by absorbing CO_2, helping to offset the carbon we add to the atmosphere though fossil fuel energy use.

As a young forest matures, its growth slows; its CO_2 absorption rate slows as well. While timber harvesting may seem ecologically disruptive, a sustainably managed and harvested forest actually benefits from logging and subsequent regeneration, as young trees breathe new life into the atmosphere.

Demand for Wood Keeps Forests Growing

Harvest of a mature forest allows replanting of young trees, allowing a continuous cycle; their vigorous growth increases oxygen production and CO_2 absorption. And when the tree is harvested, the carbon is stored (or sequestered) in the wood, which keeps it from being released into the atmosphere. In fact, a 2,400-square-foot wood-frame house locks carbon from 28.5 tons of CO_2 in the wood. This is the same as neutralizing seven years of CO_2 emissions from a small car[a].

Wood is renewable, and the forest products industry takes full advantage of that benefit. In fact, as a result of forest management and extensive replanting, timber volume has steadily increased during the past 50 years; there are more trees in the U.S. today than there were in the early 1900s[b].

It is also important to note that wood products manufacturing is more resource and energy efficient than ever before. In the U.S., nearly 80 percent of the energy used to manufacture wood products comes from wood-based biomass fuels such as tree bark, sawdust and other harvesting by-products[c]. Compared to other building materials, very little of the energy used to manufacture wood building components comes from fossil fuels. Plus, modern manufacturing methods allow us to get more out of each log, ensuring that very little of the forest resource is wasted.

a. Canadian Wood Council, *Sustainable Building Series; Wood Products and Carbon Sequestration*

b. *National Report on Sustainable Forests* – 2010, U.S. Department of Agriculture, U.S. Forest Service

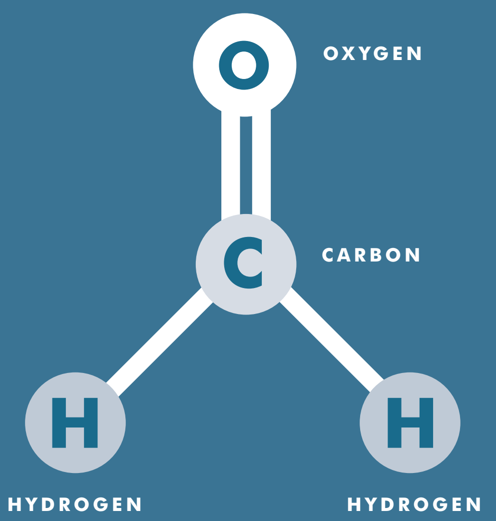
c. *2012 American Forest & Paper Association Sustainability Report*

d. Nature Climate Change; March 30, 2015

e. *National Report on Sustainable Forests* – 2010

GREEN RECOVERY

In what some might consider the ultimate environmental product choice, the CLT used for Washington State University's Brelsford Visitor Center was manufactured from locally sourced wood that would have otherwise been discarded because the trees had been damaged by mountain pine beetles. Though some pieces were discolored, the wood was still structurally sound and therefore could still be used for the CLT panels. In most cases, the natural blue stain added visual interest to the project.



FORMALDEHYDE

Because the vast majority of North American construction involves site-built conditions where exposure to weather is expected, engineered wood product manufacturing standards require the use of moisture-resistant adhesives. Their unique chemistry makes these water-resistant adhesives highly durable and stable, resulting in negligible formaldehyde emissions. Manufacturers must meet stringent production standards to ensure adherence with mandated emission limits. Green building rating systems often include criteria to address indoor air quality, including mitigation of formaldehyde concentrations or formaldehyde-emitting products. Engineered wood products meet criteria covered under LEED v4 (Leadership in Energy and Environmental Design), 2012 National Green Building Standard ICC 700-2012 and CALGreen.

FOR MORE INFORMATION:
Formaldehyde and Engineered Wood Products, Form J330, from
APA – The Engineered Wood Association,
www.apawood.org.

Forest Certification

Renewability is a key contributor to wood's environmental advantage, and North American forest management certification programs work to verify that landowners follow sustainable forest management practices. These programs include the Forest Stewardship Council (FSC), the American Tree Farm System (ATFS), the Canadian Standards Association (CSA) Group Sustainable Forest Management System Standard, and the Sustainable Forestry Initiative (SFI).

While each program was founded with a unique mission, they have many similarities and common objectives, ranging from maintenance of wildlife habitat to third-party audits, and all provide guidelines that support and demonstrate sustainable forest management.

Not all wood building products come from certified forests, but that's not necessarily a bad thing. Some forest management entities have followed sustainable forest management practices on their own for years, but do not participate in the certification programs—not because they don't comply, but because of other reasons, such as the expense involved with certification. Others are guided by state or provincial programs. Regardless, North American forest managers are working together to sustain a vibrant forest resource, making U.S. and Canadian forests among the healthiest and most productive in the world.

WOOD PRODUCTS ARE NATURALLY GREEN

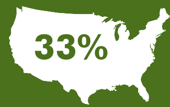
Wood is the only major building material that grows naturally. Since trees are renewable, wood is the ultimate environmentally friendly building product.

APA – The Engineered Wood Association represents manufacturers of a wide variety of wood products, including plywood, oriented strand board (OSB), glued-laminated timber (glulam), wood I-joists, cross-laminated timber (CLT), laminated veneer lumber (LVL), laminated strand lumber (LSL), oriented strand lumber (OSL) and others.

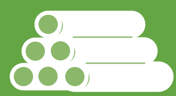
These structural wood products can be used in a range of residential and commercial construction systems, including energy-efficient wall assemblies, floor systems and roof structures, as well as for remodeling. They provide durable performance in innovative framing applications, including headers, floor beams, tall walls, roof trusses and many others.

All have one thing in common: They are engineered and manufactured to make the most efficient use of the wood resource while meeting specific structural needs, such as lateral strength and load-bearing capabilities.

Forest land comprises about **33 percent of the total land** area of the United States[f].



But only about **one-third** of that is open to logging[g].



The volume of annual net timber **growth in the U.S. is 36 percent higher** than the volume of annual timber removals[h].

American landowners **plant more than 2.5 billion trees** every year[i].

A young, growing forest **produces 1 ton of oxygen** and **absorbs 1.4 tons of CO_2** for every 1 ton of wood[j].

Forests in the United States continue to sequester more carbon than they emit each year, and combined with urban forests and harvested wood products, **offset nearly 15 percent** of total greenhouse gas emissions in 2012[f].

BENEFITS EXTEND BEYOND THE FOREST

One of the key objectives in sustainable design is selection of environmentally-responsible building products. While the inherent features of wood itself contribute to earth-friendly design and construction, wood building components offer a number of additional environmental benefits:

- They make efficient use of the natural resource. The industrial output per unit of wood input has increased by 40 percent over the last 50 years[g], which means a higher percentage of the wood fiber ends up as a usable building component.
- The manufacturing process itself is efficient. Almost 98 percent of mill residues generated in the United States are currently used as fuel or to produce fiber products, such as hardboard, medium-density fiberboard, particleboard and other wood composites or products[k].
- Engineered wood products can be manufactured from smaller, fast-growing trees or species not commonly used for construction; some can even use insect-damaged lumber that would otherwise be wasted.
- Wood products make up 47 percent of all industrial raw material manufactured in the U.S., yet consume only 4 percent of the energy needed for manufacture[g]. The manufacturing processes used also result in lower greenhouse gas and other air-polluting emissions.
- Engineered wood products deliver predictable strength properties and are produced under exacting quality assurance standards, which allows efficient assemblies and helps reduce the need for design redundancy.
- Wood has low thermal conductivity compared to steel and concrete, which makes wood buildings more efficient to insulate.
- Engineered products such as CLT can be manufactured to tight tolerances, which helps lead to an airtight building envelope. In addition, their dimensional stability helps the building stay airtight over time.
- Many wood components can be designed and ordered to specifications, which reduces construction waste.

f. *U.S. Forest Resource Facts and Historical Trends*, U.S. Department of Agriculture, U.S. Forest Service, 2014

g. Consortium for Research on Renewable Industrial Materials (CORRIM)

h. Alvarez, M. 2007. *The State of America's Forests:* Society of American Foresters

i. Jones, S. *Creating a Sustainable Supply for Woody Biomass*, Forest Landowners Association, 2011

j. The American Hardwood Information Center, Hardwood Manufacturers Association

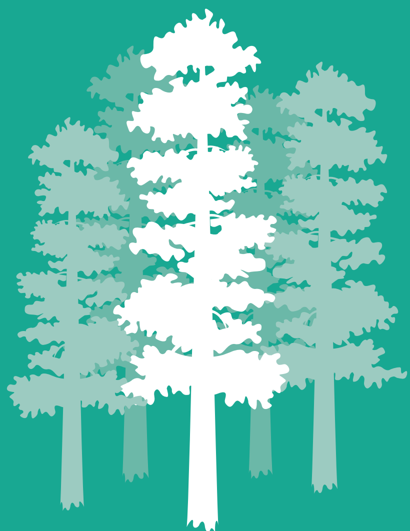
k. U.S. EPA, *Biomass Combined Heat and Power Catalog of Technologies*, 2007

ENERGY EFFICIENCY FUNDS BETTER EDUCATION

The thermal benefits of wood framing extend over the life of the structure. Thermal bridging through framing components reduces envelope insulation performance by as much as 45 to 60 percent in metal-frame construction, but only by 15 to 20 percent in wood-frame construction. Bethel School District in Washington takes full advantage of wood's natural insulating properties to improve energy efficiency in their schools, which saves them millions of dollars every year[1].

Photo Credit: Erickson McGovern Architects

1. Northwest Energy Efficiency Council



STUDY CONFIRMS TIMBER AS A MORE ENVIRONMENTALLY FRIENDLY CHOICE

A 2015 study in Australia[m] compared the life cycle environmental impacts of two apartment structures—one constructed with a lightweight timber frame and the other with concrete. The study measured factors ranging from greenhouse gas emissions to release of chemicals which contribute to acid rain. The wood structure scored better in three of the five categories, with the majority of the impacts occurring during the (assumed) 60-year life of the buildings. The study concluded that wood construction provides a more environmentally friendly building option over the life of a building. The study also found that much of the environmental advantage of the wood option was due to its lightweight design—a design benefit that offers many advantages, including cost savings.

LCA: THE ENVIRONMENTAL CALCULATOR

Much has been written on Life Cycle Assessment (LCA), a performance-based method used to quantify and evaluate the environmental impact of a product, assembly or structure. LCA works by measuring the energy required for a product or structure over its period of use due to raw material extraction and manufacture through distribution, use, maintenance and disposal.

The LCA methodology takes a holistic view, although the complexity of modern building products can make it difficult to measure overall sustainability. While the methodology has some critics, LCA has emerged for many as the accepted way to determine the true environmental impact of building products by providing a cradle-to-grave measurement of the product's environmental effects.

And while not everyone agrees over the algorithms or assumptions used for LCA analyses, one thing is clear. LCA studies consistently show that wood has numerous environmental advantages over other building materials such as steel or concrete in terms of embodied energy from production, greenhouse gas emissions, air and water pollutants and solid waste production.

Overall, wood-based building components store more carbon than is released during their production. While composite lumber products like OSB, plywood, LVL and glulam require more manufacturing energy than dimension lumber, they make more efficient use of the fiber, leading to reduced waste because they can be ordered cut to length. Regardless, both solid wood and engineered wood outperform steel and concrete in terms of environmental sustainability.

The net carbon impact of using wood products (which equals carbon emissions from energy used to manufacture the product, less the carbon stored in the product over its lifetime) is substantially better than carbon neutral. In other words, wood benefits the environment.

LCA Tools

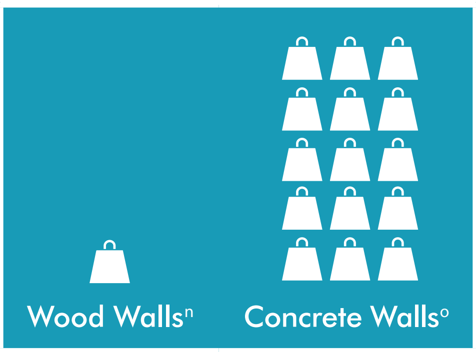
LCA tools allow building professionals to compare different products, assemblies and building designs based on their environmental impacts, which allows them to make better, more informed choices about the materials they use. The two most commonly-used LCA tools are BEES and the Athena Environmental Impact Estimator.

m. Forest & Wood Products Australia, *'A Comparative Life Cycle Assessment of Two Multi Storey Residential Apartment Buildings,'* July 2015

CO_2 SAVINGS ADD UP

WALL CONSTRUCTION

WOOD SAVES 15 POUNDS
of avoided CO_2 emissions for every square foot of wall area



n. Kiln-dried wood studs, OSB sheathing and vinyl siding
o. Concrete with an exterior stucco coating

FLOOR CONSTRUCTION

WOOD SAVES 22 POUNDS
of avoided CO_2 emissions for every square foot of floor area

p. Engineered wood I-joists with OSB subfloor
q. Steel joists and OSB subflooring

Source: Lippke, B. and Edmonds, L. Environmental Improvement Opportunities for Alternative Wall and Floor Design. 2009. CORRIM Phase II Research Report

The Building for Environmental and Economic Sustainability (BEES) software evaluates the environmental performance of individual products. Architects and specifiers often use BEES during the specification phase of a project to evaluate commonly used products such as siding and sheathing.

The Athena Environmental Impact Estimator evaluates the environmental footprint in the design or material make-up of a building, allowing designers to optimize operating and embodied energy effects. Building professionals find this tool particularly useful early in the design process, when they are making choices that will impact both the overall design and the structure's ultimate environmental consequences. With the Athena tool, users can look at the entire life cycle of a building, make functionally equivalent material comparisons, and recognize trade-offs in materials selection.

Environmental Product Declarations

Even with advanced LCA tools, sustainability can be difficult to quantify. Environmental Product Declarations (EPDs) give building professionals a way to evaluate a product's lifetime environmental impacts in terms of embodied energy and global warming potential, and by measures such as use of natural resources; emissions to air, soil and water; and waste generation.

The North American wood products industry has taken its EPDs one step further by obtaining third-party verification from UL Environment, a business unit of Underwriters Laboratories and an independent certifier of products and their sustainable attributes.

The American Wood Council (AWC) and Canadian Wood Council (CWC) have published EPDs and Transparency Briefs (which summarize the most critical data presented in an EPD) for LVL and wood I-joists, softwood lumber and plywood, OSB, glulam and a few other wood building materials. When these EPDs are considered with other factors such as forest management certifications, they provide helpful information regarding wood's positive environmental performance, allowing building teams to make more informed building material choices. In addition, use of products with verifiable EPDs can be used toward LEED v4 credit. Similar incentives can be found in Green Globes, the International Green Construction Code (IgCC) and the Architecture 2030 Challenge.

North American wood product EPDs and transparency briefs are available for free download from the American Wood Council, www.awc.org/greenbuilding/epd.

SANTA BARBARA APARTMENTS IN RIALTO, CALIFORNIA

Although demand for area housing was rising, development of this new apartment complex, built in 2016, had stalled. Framing estimates for the 120-unit, seven-building complex were coming in high, and the project just wasn't going to meet profit expectations. The original design included a foundation with expensive grade beams and costly prefabricated steel shear wall frames surrounding each garage. So the developer had the complex re-engineered, and a switch to I-joist compatible glulam beams and cost-effective, double-sided wood structural panel portal frames using force transfer around openings (FTAO), a shear wall analysis method, helped make the project more affordable. The end result is a high-quality structure and the developer saved money, which allowed them to invest in aesthetic features that make the project more attractive to tenants.

CLEAR COMPARISON, CLEAR ADVANTAGE

Wood adds environmental value throughout the life of the structure by creating a more energy-efficient space. As an insulator, wood is six times more efficient than an equivalent thickness of brick, 105 times more efficient than concrete, and 400 times more efficient than steel[r].

WOOD CONSUMES LESS ENERGY, EMITS LESS POLLUTANTS TO THE ENVIRONMENT

More is not always better. Both steel and concrete use more energy, emit more greenhouse gases, and release more air and water pollutants during manufacturing than wood, giving wood the clear environmental advantage.

NET CARBON EMISSIONS

Use of wood building materials from sustainably managed forests can reduce the net carbon impact of a project in many ways, partly because wood emits significantly less CO_2 emissions from production than other building materials. When its carbon storage capabilities are factored in, the benefits of wood become even more significant.

Energy Consumed

STEEL
Consumes **12%** more than wood

CONCRETE
Consumes **20%** more than wood

Greenhouse Gases Emitted

STEEL
Emits **15%** more than wood

CONCRETE
Emits **29%** more than wood

Air Pollutants

STEEL
Pollutes **10%** more than wood

CONCRETE
Pollutes **12%** more than wood

Water Pollutants

STEEL
Pollutes **300%** more than wood

CONCRETE
Pollutes **225%** more than wood

Source: American Wood Council

NET CARBON EMISSIONS

MATERIAL	NET CARBON EMISSIONS FROM PRODUCTION*
Framing lumber	**33**
Brick	88
Glass	154
Recycled steel (100% from scrap)	220
Concrete	265
Concrete block	291
Recycled aluminum (100% recycled content)	309
Steel (virgin)	694
Plastic	2,502
Aluminum (virgin)	4,532

FRAMING LUMBER:

With carbon sequestration within the wood, net emissions are **-457 kg C/metric ton**.

OTHER MATERIALS:

Have no carbon storage to mitigate emissions

**kg C/metric ton*

Source: U.S. EPA (2006). Values are based on life cycle assessment and include gathering and processing of raw materials, primary and secondary processing, and transportation. Study assumed carbon content for wood at 49 percent.

r. *Your Home Technical Manual,* Fourth Edition, 2010. Produced for the Commonwealth of Australia by the Institute for Sustainable Futures, University of Technology, Sydney

ENERGY-USE COMPARISON OF WOOD VS. STEEL AND CONCRETE

RESULTS OF A LIFE CYCLE INVENTORY OF A LARGE OFFICE BUILDING

TYPE OF CONSTRUCTION	**WOOD***	STEEL	CONCRETE
TOTAL ENERGY USE (GJ x 10^3)	**3.80**	7.35	5.50
ABOVE GRADE ENERGY USE (GJ x 10^3)	**2.15**	5.20	3.70
CO_2 EMISSIONS (kg x 10^3)	**73**	105	132

**Wood = Composite Lumber [PSL] Columns and Beams*

Source: Forintek Canada/Canadian Wood Council, 1997

GJ = gigajoules

GREEN BUILDING RATING SYSTEMS

There are many green building standards, certifications and rating systems for sustainable design; the U.S. has close to 100 green building programs. The most well-known national programs are Leadership in Energy and Environmental Design (LEED®) from the U.S. Green Building Council, Green Globes from the Green Building Initiative, National Green Building Standard and the International Green Construction Code (IgCC). Others include ENERGY STAR for Buildings, Home Energy Rating System (HERS), Net Zero Energy Building (NZEB), and Passive House.

All are designed to promote efforts that positively impact the environment by allowing building professionals to compare environmental data on various aspects of their project, from products and assemblies to whole structures.

While a project can certainly be built to sustainable standards without a label, green building certifications help design and building professionals raise the profile of their efforts while educating the public on the benefits of sustainable design.

MANY SHADES OF GREEN

No building product is entirely green. Every construction professional—from the architect and specifier to the developer and builder—makes trade-offs when they choose one component or assembly over another.

There is no environmentally perfect building material, but for many residential and commercial building applications, wood is an intelligent, informed choice—a choice that can be well-supported. And as the engineered wood industry continues to use innovative product developments to improve on one of mankind's oldest building materials, the earth's environmental future looks brighter green.

ENGINEERED WOOD PRODUCTS

PLYWOOD

Made by peeling veneers from logs, some as small as 10 inches in diameter; these veneers are glued with moisture-resistant adhesives for durability, dimensional stability and excellent strength-to-weight ratio.

I-JOISTS

Engineered component comprised of top and bottom flanges (typically LVL or dimension lumber) which resist bending, combined with vertical webs (plywood or OSB), which provide excellent bending and shear resistance.

ORIENTED STRAND BOARD (OSB)

Strands used to form OSB can be cut from small trees; these rectangular-shaped wood strands are laid down in alternating layers and glued for a panel that resists deflection, delamination and warping.

CROSS-LAMINATED TIMBER (CLT)

Prefabricated, solid wood panel used for long spans in walls, floors and roofs. Layers of kiln-dried boards are stacked in alternating directions, bonded with adhesives, and pressed to form a solid panel.

GLULAM

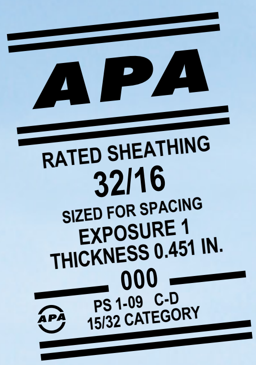
Made by gluing dimensional lumber together, glulam can be made to specification, or beams can be manufactured in commonly-used dimensions and cut to length when the beam is ordered from a distributor or dealer.

STRUCTURAL COMPOSITE LUMBER (SCL)

Includes laminated veneer lumber (LVL), parallel strand lumber (PSL), laminated strand lumber (LSL) and oriented strand lumber (OSL). All are created from smaller trees by layering dried and graded wood veneers, strands or flakes bonded with moisture-resistant adhesive into blocks of material, which are then re-sawn into specified sizes.

About APA

APA – The Engineered Wood Association is a nonprofit trade association of and for structural wood panel, glulam timber, wood I-joist, structural composite lumber, cross-laminated timber, and other engineered wood product manufacturers. Based in Tacoma, Washington, APA represents approximately 165 mills throughout North America, ranging from small, independently owned and operated companies to large integrated corporations.



Always insist on engineered wood products bearing the **mark of quality**—the *APA* trademark. Your APA engineered wood purchase is not only your highest possible assurance of product quality, but an investment in the many trade services that APA provides on your behalf. The Association's trademark appears only on products manufactured by member mills and is the manufacturer's assurance that the product conforms to the standard shown on the trademark.

APA's services go far beyond quality testing and inspection. Research and promotion programs play important roles in developing and improving construction systems using wood structural panels, glulam, I-joists, and structural composite lumber, and in helping users and specifiers to better understand and apply engineered wood products. For more information, visit www.apawood.org.

Sustainable Buildings, Sustainable Future: Wood and the Environment

We have field representatives in many major U.S. cities and in Canada who can help answer questions involving APA trademarked products. For additional assistance in specifying engineered wood products, contact us:

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Form No.F305B/Revised December 2016

APA

REPRESENTING THE ENGINEERED WOOD INDUSTRY