BENEFITS FROM WOOD ENGINEERING RESEARCH

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Forests play a critical role in the environmental and economic health of the world. The world population continues to grow with an associated increase in demand for paper and wood products. Increasingly, forests are being recognized as more than simple photosynthesis factories. Forests are recognized as the "environmental capital" that provides the basis for a wide spectrum of benefits. Forest ecosystems provide watershed protection, nutrient cycling, a moderating influence on global climate, and serve as a repository for biological and genetic diversity. Many of these uses and benefits are complimentary. However, some are not and this leads to increased competition and conflicts, especially between meeting the nation's need for wood and fiber versus meeting society's expectation for a healthy environment. Throughout the 1970s and 1980s, the competing uses of U.S. forests have been the source of a persistent and often acrimonious debate. That same debate took place on a global scale at the United Nations Conference on environment and Development (UNCED) in 1992. Follow-up discussions have lend to formal recognition of substainability as the over arching issue facing the world and the fact that environmental and economic issues cannot be easily separated.

In the future, this same acrimonious debate is anticipated to move beyond the stage of debate and into the realm of public policy. Thus, as we develop research needs in wood engineering, we know that three primary issues will affect the use of wood as a building material. These three primary issues are (1) increasing the demand for all uses of forests, (2) changing the forest resource base, and (3) increasing environmental concerns that production and use of wood are causing deterioration of the environment.

Increased Demand

In the United States, the wood and fiber portion of the forest products sector is a significant component of economic activity, employing approximately 1.4 million people. In 1994, primary forest products were valued at more than $19

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billion, and secondary forest products at nearly $75 billion. This represents about 2% of the Gross Domestic Product (GDP) for goods and services and about 1% of the total GDP. Thus, forest products provide a significant contribution to the economic vitality of the United States.

The demand for fiber and wood products has not abated. The total world economy is growing faster than population growth. The World Bank estimates that within the next 30 years, average per capita income worldwide could reach the same level as the top 20% of the countries of the world. Jaakko Poyry forecasts that consumer demand for fiber in developing countries will grow as a function of increasing population, literacy rates, and the standard of living. The expanding population and world economy are also influenced by the increasing demand for housing. One-tenth of the global economy is derived from constructing homes and offices, and a significant amount of people live and work in wood-frame buildings, Globally, housing construction accounts for more than 25% of the world's demand for solid wood in products, ranging from lumber to oriented strandboard. Residential construction is the dominant market for the solid-wood sector in the United States. Although anticipated demand for U.S. housing starts is expected to he relatively stable for the next several decades, the size of houses is changing. During the last 40 years, the average size of single-family housing units has nearly doubled, offsetting any trend of declining wood used per square meter of floor area. Thus, this offsetting results in a trend toward increasing average lumber used per single family unit.

Resource Base

Forest conditions in the United States have changed over time. Today, the growth to harvest ratio for all species is 1.33, but the species and the mix have changed, material is smaller and often of lower quality. The growth to harvest ratio for softwoods is 1.09, for hardwoods 1.80. The vast, unreserved volume of softwood timber in the United States does not exist any more. Also, concern regarding the health of U.S. forests is increasing. Between 1986 and 1991, timber mortality increased almost 25%. Many second-growth stands in the West, where fire has been excluded for many decades, now contain dense, overstocked understories. Infestations by insects and pests have left some stands with significant amounts of dead and dying material, causing tremendous build-up of fuel loadings. In the North and East, there are significant quantities of mature hardwoods. In addition, these Forests have been high-graded over the centuries. Therefore, we need to remove some of these lower quality hardwoods to restore these stands to healthy ecosystems.

Thus, the primary characterization of tomorrow's forest resources is variability. We still see many different species, from a variety of sources, as our raw material. We will see the average diameter of the logs, at least for the next 50 years, remain on its decreasing trend, especially in the West. The norm will become mixed species of lower quality rather than the traditional quality used. Increasing quantities of lower quality hardwoods will be used for structural applications, primarily produced on nonmanaged, nonindustrial private lands. At the same time, we will

also see an increase in the use of plantation logs, both domestic and imported, as well as increased quantities of recycled wood, which may contain contaminants. In the forests, we will see more selective harvesting, less clearcutting, increases in the numbers of snags and old-growth trees left standing, and greater attention to increasing the biodiversity of the forest.

Environmental Concerns

People want clean air, clean water, unspoiled lands, and healthy forests. However, increasing perceptions link environmental degradation with product and use of wood and fiber products. The U.S. Clean Air Act of 1992 placed great emphasis on eliminating ozone and other noxious gas components, such as volatile organic compounds (VOCs). The forest products industry is one of the largest manufacturing sectors contributing to the emission of VOC's, primarily through drying of wood and chips. The Clean Water Act of 1972 brought point sources of pollution under control. Nevertheless, non-source pollution, which can be caused from sedimentation resulting from forest roads and timber harvesting, are often identified as a key problem.

Addressing the Issues

People need products and services from forests, they want jobs, and they expect a clean environment. These needs and expectations puts us heading for a collision course. However, history has shown that technological advances have often helped mitigate such collisions. Technological advances in wood engineering are no exception. However, the technological advances in wood engineering will need to simultaneously address the following issues:

- Conserve wood and fiber resources
- Help restore healthy and resilient forest ecosystems.
- Avoid or miligate environmental impacts

Improvements in wood utilization from the tree to the final product have demonstrated significant savings in the forest resource by reducing material losses during, harvesting and processing. Since the turn of the century, the ratio of product output to resource input has been increasing. The efficiency has increased because of technologies that have improved the proficiency of converting trees and logs into products. Today, and in the near-term future, improvements in wood utilization to conserve our forest resource will depend on technological advances in the ways that we "use" our forest resources, while helping to restore forest ecosystems and minimize environmental impacts. Recent trends in the wood-frame housing area highlight some of the improvements in how we use wood products.

Changes are also anticipated in the type of wood products that will be used for housing. Much of the increased demand in the United States will occur in the Structural and nonstructural engineered wood products markets. Oriented strandboard and waferboard are increasingly being substituted for softwood plywood. The use of other engineered wood products is also increasing dramatically.

Laminated veneer lumber has also steadily increased, with capacity at about 1 million cubic meters in 1996. The primary reason for such growth is that these products are more flexible in using a diverse raw material base. The traditional lumber market is expected to remain stable or maintain a slight growth.

Challenges

What does this mean to those of us involved in wood engineering? The challenge for wood engineers is to develop cost-effective technologies that allow the forest products industry to make wood products from a raw material that is lower in quality, contains more variability, meets late 20th century end-use performance specifications, and still turns a profit. Technological advances in wood engineering that need to be accomplished to meet this challenge (while using the diverse resource anticipated) can he classified in the following four areas: (1) engineering wood composites to meet specific end-use performance requirements; (2) improving engineering design to reduce dependence on "redundancy" as a safety factor; (3) developing ways to ensure quality and in-service performance for wood components, assemblies, and structures; and (4) increasing the durability of wood components and structures.

The consequences of "not" meeting the challenge will effect everyone. If we do not remove the excessive, low quality biomass that exists in both our public and nonindustrial private forests, then we are placing our forests at a greater risk of attack by insects, diseases, and ultimately catastrophic wildfires, particularly in the West. The consequences of such wildfires include greater erosion, less capability of the soil to hold water, increased sedimentation of streams, increased runoff into watersheds, increased mortality to freshwater fish and those above fish on the foodchain, delayed regeneration of our forests, increased air pollution, and significant impact on climate changes. These are major environmental consequences that affect everyone's quality of life.

Wood engineering disciplines have a major technological challenge. However, the challenge to policymakers and others who provide financial support is greater. There are two ways to mitigate the threats to our forests:

- Money could be allocated to remove the sign)e buildup of excessive biomass, with treatment costs tanging from, about $300 to 500/acre. With approximately 39 million acres of public lands that need such treatment, revenues needed are $15 billion.
- Uses for this excessive biomass will help offset some of the costs
- This document highlights the technical challenges that lay ahead for wood engineers. As you read this document, it clearly shows that the challenges are indeed significant. However, I believe that the wood engineering community has the technology and skills to accomplish the task. Of greater concern are the financial and policy decisions by those who will provide Funding to support the outlined research needs. The question now becomes, "How can we afford the consequences of not funding such research efforts?"

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