Committee Name:
Assembly Committee – Rural Affairs and Forestry (AC–RAF)

Appointments

01hr_AC–RAF_Appt_pt00

Committee Hearings

01hr_AC–RAF_CH_pt00

Committee Reports

01hr_AC–RAF_CR_pt00

Clearinghouse Rules

01hr_AC–RAF_CRule_01–

Executive Sessions

01hr_AC–RAF_ES_pt00

Hearing Records

01hr_ajr0051_pt01a

01hr_sb0000

Misc.

01hr_AC–RAF__Misc__pt00

Record of Committee Proceedings

01hr_AC–RAF_RCP_pt00

04-19-01 PH-AJR51
Exec - AB114

AJR-51

Committee Meeting Attendance Sheet

Assembly Committee on Rural Affairs and Forestry

Date: April 19, 2001 Meeting Type: Public Hearing

Location: North Hearing Room - State Capitol

Committee Member	Present	Absent	Excused
Rep. John Ainsworth, Chair	☑	☐	☐
Rep. Donald Friske	☑	☐	☐
Rep. Stephen Freese	☑	☐	☐
Rep. Gabe Loeffelholz	☑	☐	☐
Rep. Tom Sykora	☑	☐	☐
Rep. Barbara Gronemus	☑	☐	☐
Rep. Mary Hubler	☑	☐	☐
Rep. Marlin Schneider	☑	☐	☐
Totals:	8	0	0

Kristina Boardman

Kristina Boardman, Committee Clerk

SALVAGING WOOD FROM BUILDINGS

Alternatives to Demolition

Robert H. Falk, Ph.D, P.E.
Research Engineer

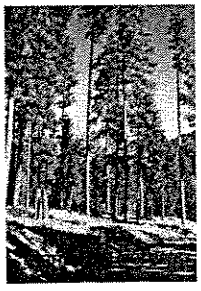
Advanced Housing Research Center
USDA Forest Service - Forest Products Laboratory

Forest Products Laboratory

- USDA Forest Service
- National Lab for Wood Products Research
- Established in 1910
- In Cooperation with University of Wisconsin

Advanced Housing Research Center
USDA Forest Service - Forest Products Laboratory

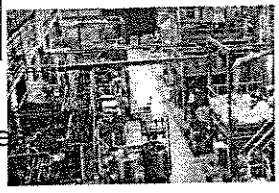
We evaluate the.....



changing wood resource....

Advanced Housing Research Center
USDA Forest Service - Forest Products Laboratory

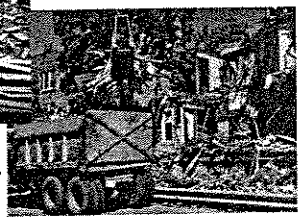
Developing more efficient and.....



environmentally
friendly technologie

Advanced Housing Research Center
USDA Forest Service - Forest Products Laboratory

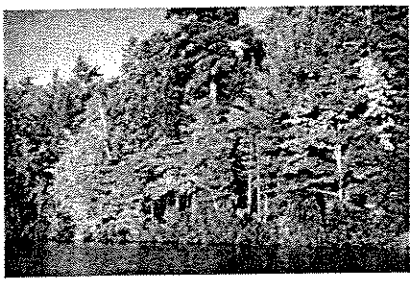
Adding value to the waste wood



resource.....

Advanced Housing Research Center
USDA Forest Service - Forest Products Laboratory

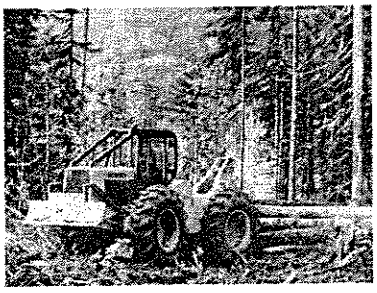
We have a vast forest resource.....



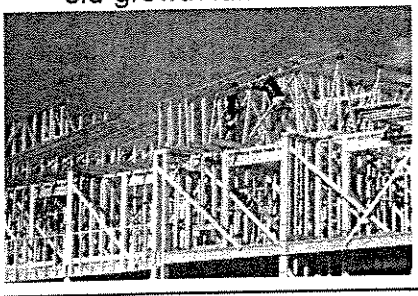
However, most of our old-growth forests are gone.....

Lumber quality is generally higher from large diameter trees

Today's trees are smaller in diameter



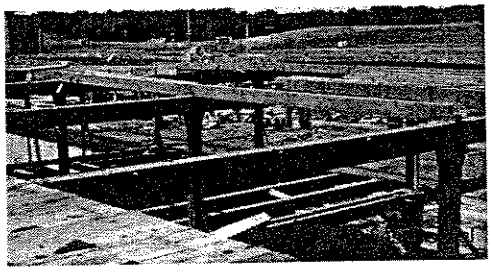
Where is all that high-quality old-growth lumber?



Over 250,000,000 board feet in Army buildings currently slated for disposal.

Demolition and landfill waste our high-quality old-growth lumber!

If we deconstruct rather than demolish we can reuse this valuable resource!



Larger timbers are in demand for Timber Framing……

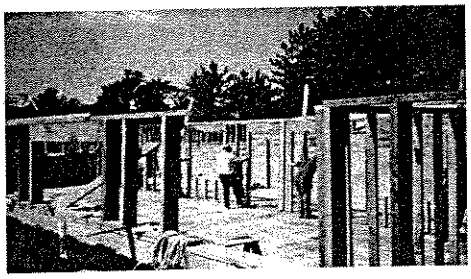
and flooring…….

Reclaimed Southern Pine $3 - $11 per sf

Salvaged lumber can be reused in new construction……

Other materials can be recovered…

Deconstruction is often cheaper than demolition!



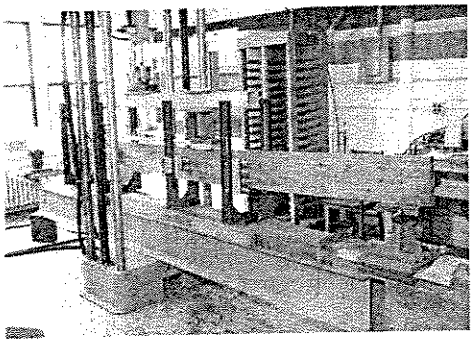
Fort McCoy, WI

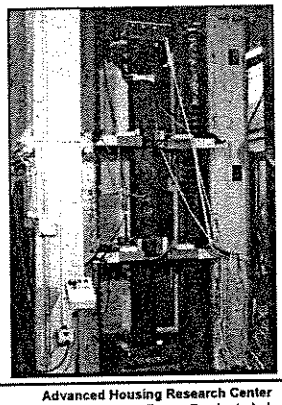
Commercial Demolition: $40,000 each bldg

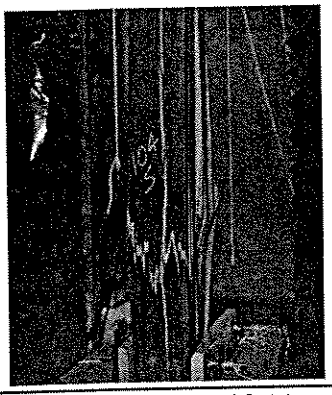
Building Deconstruction: $2,000 - $4,000 ea.

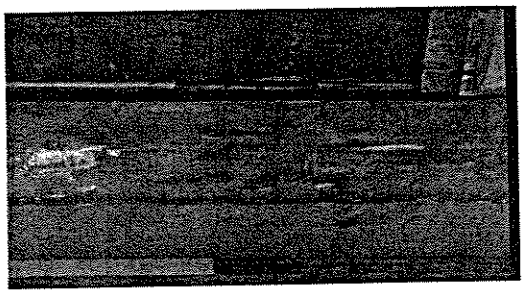
Increasing Marketability

- Develop grade stamp specific to salvaged lumber.
- Evaluate effects of damage on engineering properties.
- Develop reuse options for construction.









Fort Chaffee
Deconstruction Project

- Cooperative Project
  - Fort Chaffee Redevelopment Authority
  - Habitat for Humanity - Austin
  - USDA Forest Products Laboratory
  - University of Florida - Center for Construction and Environment
  - US Army Corps of Engineers - Construction Engineering Research Laboratories

Fort Chaffee
One and Two Story Buildings in Hospital Complex

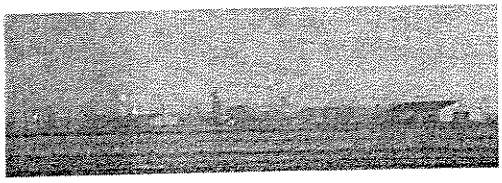
Overall Project Objectives

- Evaluate deconstruction as an alternative to demolition at Fort Chaffee.
- Train and utilize Habitat for Humanity staff and volunteers for building deconstruction and material salvage.

Benefits

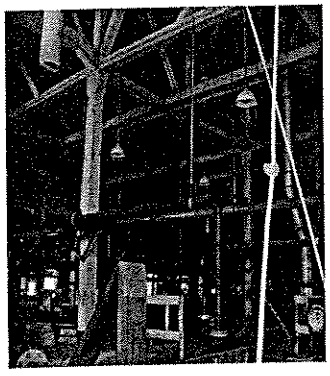
- Fort Chaffee solves building removal problem in an environmentally positive way.
- Lower costs ?
- Habitat for Humanity generates income from material sales.
- Recovered materials are utilized by low-income families for new construction.

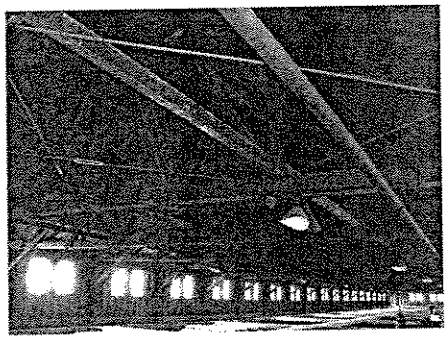
Can this Model Work at Badger Arsenal?

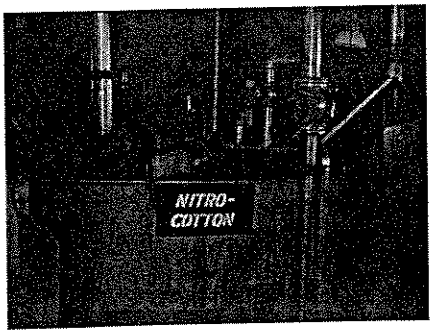


Badger Arsenal

- Many different building types
- Industrial manufacture and potential contamination
- Several building removal methods may be required
  - **traditional demolition**
  - **deconstruction & demolition**
  - **deconstruction**







Building Deconstruction at Wisconsin's Badger Arsenal: Salvaging Lumber for Reuse in Low-Income Home Construction

- Phase 1 – Deconstruction Feasibility
- Phase 2 – Actual Deconstruction

Partners

- USDA Forest Products Laboratory
- US Army Corps – Construction Engineering Research Laboratory
- Habitat for Humanity – Austin and local affiliates
- University of Wisconsin, University of North Dakota, University of Florida

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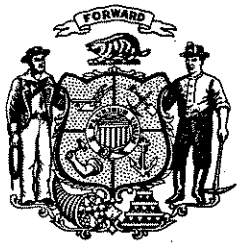

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Building Deconstruction at Wisconsin's Badger Arsenal: Salvaging Lumber for Reuse in Low-Income Home Construction

Project Overview

The Badger Arsenal in Baraboo, Wisconsin, contains a wealth of salvageable building materials. The aim of the proposed project is to use deconstruction to salvage lumber from Badger Arsenal buildings. This project will benefit the U.S. Army through solving the problem of building disposal, will help conserve the Nation's forest resource, will provide opportunities for job training and economic development, and will help create housing for low-income families.

Introduction

Like many of the U.S. Army's industrial manufacturing and infantry training facilities, Badger Arsenal was built in the early years of WWII. Because metal was in great demand for the war effort, many of the military's buildings were built wholly or partially from wood. Quite literally, the standing timber in these military structures is some of the last remaining of our Nation's once vast old-growth forests. The Badger Arsenal is rich in salvageable building materials, especially the structural lumber contained in the vast number of timber buildings.

Deconstruction is a building dismantlement method based on the separation and recovery of building materials and components for reuse and recycling. In contrast to demolition, which focuses on the mechanical reduction of the building for easy transportation and disposal in a landfill, deconstruction allows a greater degree of salvage and reuse of building materials and components. Wood-framed buildings are particularly good candidates for deconstruction because wood members are easily damaged using conventional demolition techniques.

Background

For some time, USDA Forest Service, Forest Products Laboratory (FPL) has been working with the Department of Defense to evaluate the quality of lumber and timber salvaged from buildings at several military installations, including the Twin Cities Army Arsenal in St. Paul, MN, Fort Ord in Marina, CA, and the U.S. Navy's Naval Supply Center in Oakland, CA. Currently, through its Advanced Housing Research Center, the FPL is part of a collaborative R&D team performing a pilot deconstruction project that will remove 126 excess wood-framed buildings from Fort Chaffee in Fort Smith, AR. (See attached newspaper article.) This team consists of government, university, non-profit, and private sector organizations with deconstruction, material salvage, and wood construction expertise, including the Fort Chaffee Reuse Authority, Habitat for Humanity International (HfH)–Austin, the Army Corps of Engineer's Construction Engineering Research Laboratory, University of Florida's Center for Construction and Environment, and the Army Environmental Policy Institute. HfH is serving as the contractor to remove the buildings at Fort Chaffee with assistance from other team members. HfH will either sell the salvaged lumber in their REStore outlets and/or use the lumber for construction of new low-income homes.

Proposed Project

In principle, a similar project could be performed in Wisconsin at the Badger Arsenal. However, unlike Fort Chaffee (which consists of relatively simple one- and two-story wood-framed barracks, hospital wards, kitchens, and small administration buildings), Badger Arsenal is an industrial plant with many large, complex buildings that were used for the chemical manufacture of nitrocellulose and TNT. A major issue at Badger is the potential contamination of the wood members in some buildings due to the chemical processes used in the manufacture of explosives. Both the level of contamination and the risk associated with the contamination need to be evaluated.

While there is great potential for the use of deconstruction and material salvage at Badger, we feel the best approach is a two-phase project. Phase 1 would involve a deconstruction feasibility study. Phase 2 would be executed based on the outcome of Phase 1 and would focus on the actual deconstruction of buildings.

Approach

The proposed project is a collaborative effort involving government, university, military, and community organizations. The partners are USDA Forest Service, Forest Products Laboratory; U.S. Army Corps of Engineers, Construction Engineering Research Laboratory (CERL); University of Wisconsin–Madison (UW), Civil Engineering Department; University of North Dakota, Chemical Engineering Department; University of Florida, Center for Construction and Environment (UF–CCE); and Habitat for Humanity International (HfH), Austin, Texas.

Phase 1: Deconstruction Feasibility

The partner organizations will work with Badger Arsenal staff to evaluate the potential to remove excess wood-framed military buildings using deconstruction methods. The main objective of Phase 1 is to evaluate the feasibility of using deconstruction as an alternative to building demolition. Meeting these objectives would involve the following tasks:

1. Inventory the quantity and quality of lumber and other recyclables at the Badger Arsenal.

   The volume, size, and condition of lumber in the buildings will be quantified through field surveys. To evaluate the value of the reclaimed materials and the corresponding savings in building removal costs, a complete survey of the buildings and building components needs to be conducted. This effort will be performed by UW Civil Engineering staff and students, CERL, HfH, and FPL.

2. Evaluate the extent, level, and consequence of contamination from nitrocellulose and other explosive manufacture on the salvage of lumber at Badger.

   This evaluation will be performed in cooperation with Army Corp of Engineers explosives experts, North Dakota University Chemical Engineering staff (expertise in contamination in wood), and FPL. Field sampling and analysis of suspect buildings will be performed.

3. Develop recommendations on the appropriate level of deconstruction for the buildings at Badger.

   Because of the industrial nature of the Badger Arsenal, it may not be appropriate to utilize HfH volunteer labor for the deconstruction of all building types. The larger industrial buildings may require deconstruction using heavy equipment and more traditional demolition contractors (as was done at the Twin Cities Arsenal). All options will be evaluated and recommendations developed in cooperation with CERL, UW, UF–CEE, and FPL.

Phase 2: Actual Deconstruction

Because the full scope of Phase 2 can only be described after Phase 1 is completed, only a brief description is given here. Phase 2 will encompass the actual deconstruction of wood-framed buildings at Badger Arsenal. Where possible and practical, work to be accomplished by HfH and other volunteer forces such as Americorps*NCCC. Activities and layouts for work sites will be developed. Deconstruction schedules and resource requirements, safety and quality management, waste disposal, and environmental protection plans will be developed in coordination with Badger Arsenal staff. A logistics plan for removing the recovered materials will be developed that will include defining material processing and storage areas on Badger property, establishing distribution networks, and arranging transportation. Outlets and markets for recovered and recyclable materials through HfH, local markets, and other industry outlets will be identified. A training curriculum for local HfH and other volunteer personnel will be developed. Work crews will be trained in deconstruction skills on site; instructors will also train trainers.

Roles of Partners

All participants have significant experience in deconstruction or material reuse. The specific roles of the partners are as follows.

Habitat for Humanity (HfH). In Phase 1, the Austin Affiliate of HfH International will help evaluate the feasibility of deconstruction at Badger. In Phase 2, HfH will coordinate and execute (where appropriate) building removal, under the guidance of Badger Arsenal staff and with the assistance of other project participants. HfH will obtain, coordinate, and manage the labor force required for removing the buildings.

University of Florida, Center for Construction and Environment (UF–CCE). In Phase 1, UF–CCE staff will help evaluate the actual site for deconstruction. In Phase 2, they will help with training both trainers and trainees in cooperation with HfH. UF–CCE will provide supervisory and construction management technical assistance as needed, will develop and implement data collection methods, and will assist with data analysis, preparation of final reports, and presentations.

University of Wisconsin, Civil Engineering Department. The UW Civil Engineering Department has long experience in wood engineering. Staff and students will assist in conducting material quantity surveys and performing data analysis.

University of North Dakota, Chemical Engineering Department. The Chemical Engineering Department has significant expertise in the contamination of wood building products by various chemicals. In cooperation with the U.S. Army and Badger Arsenal staff, Chemical Engineering staff will assist in Phase 1 by evaluating the contamination levels of wood products sampled from Badger Arsenal buildings.

USDA Forest Service, Forest Products Laboratory (FPL). Advanced Housing Research Center staff at FPL will provide project management, coordination of activities, and information transfer for Phase 1. Working in collaboration with lumber grading bureaus, FPL will evaluate the quantity and quality of structural lumber existing on site.

U.S. Army Corps of Engineers, Construction Engineering Research Laboratory (CERL). CERL will provide a liaison with Badger Arsenal staff for project logistics, assist in the environmental permit processes, and evaluate contracting, management, technical, and economic information for the project. This information will help CERL develop internal department of defense policies, codes, and "best practices" for the deconstruction of wood-framed military buildings.

Benefits

Deconstruction has the potential to turn the problem of building disposal into an economic opportunity. This is particularly the case for military bases closed under the Base Realignment and Closure Act (BRAC). The Badger Arsenal could provide an excellent opportunity to demonstrate a large-scale deconstruction project while disposing of excess buildings.

Using building deconstruction as a building removal method instead of demolition results in several positive environmental and societal effects. First, all recovered materials are diverted from the waste stream. Second, secondary markets (and businesses) can be created from the value of the recovered materials. Third, the reuse of these wood materials effectively reduces the amount of "new" timber that has to be cut to meet the current demand for building materials.

Together with Advanced Housing Research Center staff at FPL, the UW Civil Engineering Department recently conducted a preliminary survey of some of the larger wood-framed buildings at Badger Arsenal. Of the 1,500 buildings on site, the largest 77 contain about 4 million board feet of structural lumber. *This is enough lumber to build more than 300 new HfH 1100-ft^2 single-family wood-framed homes.* Even more lumber could be salvaged from the hundreds of smaller buildings. The salvage and reuse of the lumber at Badger will also help conserve our nation's natural resources and ease harvesting pressure on our existing forest resource. *The FPL estimates that reusing the 4 million board feet of lumber at Badger will save the clear cutting of more than 17,000 trees on 600 acres of forestland.*

Finally, we believe the collaborative approach to this project is a win–win situation for the U.S. Army, the State of Wisconsin, and HfH. First, using deconstruction removes excess Army buildings cheaper and with less environmental impact than does demolition, solving a disposal problem while saving taxpayer money. Secondly, deconstruction of the buildings by HfH will provide an opportunity for job training and economic development in accordance with the goals and objectives of Badger Arsenal staff. In addition, this effort will benefit the local community though partnerships developed with local HfH affiliates.

Finally, the materials salvaged are redirected from the landfill and used for new construction through the HfH system, helping solve a housing problem for low-income families.

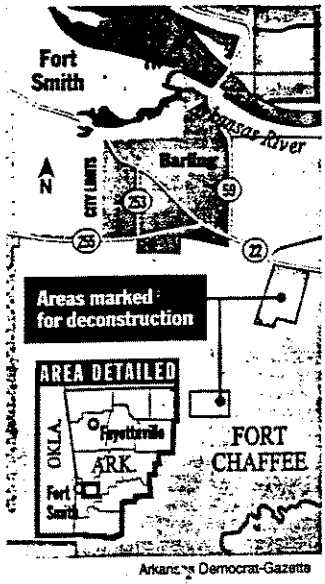
Budget

Because the costs for conducting Phase 2 are dependent on the outcome of Phase 1, they are not given here. However, we anticipate that the costs of building removal using deconstruction will be less than the costs of conventional demolition. Requested funding for Phase 1 is $475,000.

Schedule

A two-year project schedule is proposed for Phase 1.

For more information, contact: Dr. Robert H. Falk, Research Engineer, Advanced Housing Research Center, USDA Forest Service, Forest Products Laboratory (FPL), One Gifford Pinchot Dr., Madison, WI 53705, Tel: (608) 231–9255, Fax: (608) 231–9303, rfalk@facstaff.wisc.edu



Groups salvage lumber to spare from Fort Chaffee

BY DAVE HUGHES
ARKANSAS DEMOCRAT-GAZETTE

FORT CHAFFEE — A pine is a terrible thing to waste, so a partnership of public and private entities are working to save some wood as they remove obsolete buildings at Fort Chaffee.

The Army Corps of Engineers, U.S. Department of Agriculture, Habitat for Humanity and others are removing hundreds of World War II buildings from Fort Chaffee.

The coalition and the Fort Chaffee Redevelopment Authority are working on agreements that will allow Habitat for Humanity, with assistance from the University of Florida and various consultants, to disassemble the 126-building hospital complex at the fort and salvage the lumber used to build them six decades ago.

Officials have high hopes that the wood from the Fort Chaffee buildings will be reusable because of its good quality. Much of it is old-growth southern pine, hewn from virgin forests that no longer exist. Old-growth pine is stronger and cleaner than pine being produced for construction today, authorities in the field say.

"I think this is good-quality wood. There's no question we can use it again and it will perform just fine for home construction," said Robert

See **CHAFFEE,** Page 6B

Chaffee

• Continued from Page 1B

Falk, a research engineer for the Agriculture Department's Forest Products Laboratory in Madison, Wis.

Falk said he is beginning to test the wood from the Chaffee buildings so it can be graded on the lumber market. He said the quality of the wood probably will have suffered from the construction process, the 60 years it has stood and from deconstruction.

"We want to know how that affects residual strength and the ability to reuse it," he said.

Habitat for Humanity's Austin, Texas, affiliate, which has been developing deconstruction techniques elsewhere during the last 18 months, will provide the labor. It plans to sell the salvaged lumber and use the proceeds to build homes in Arkansas, Texas and the Mississippi Delta. Habitat for Humanity's productivity could go up 20 percent from the benefits gained from the Chaffee project, according to the Texas office.

"It's a project that everyone wins on, especially the depressed economic area," said Executive Director Phil Reeves of the Redevelopment Authority.

Reeves said Habitat for Humanity, using its own volunteers and those from other organizations like VISTA and AmeriCorps, will begin work on the hospital complex this spring. It could take a year to finish. The volunteers will be trained by members of the Center for Construction and Environment at the University of Florida.

If the deconstruction works on the hospital complex, the group could tackle the other 300 buildings during the next four years that the Redevelopment Authority wants to dismantle, Reeves said.

The Redevelopment Authority, also known as the Fort Chaffee Public Trust, is trying to get rid of the World War II vintage buildings so it can market the land to prospective industrial, commercial and residential developers.

The Department of Defense closed the western portion of Fort Chaffee as part of the Base Realignment and Closure Commission's effort to downsize the military. The Defense Department charged the Redevelopment Authority with devising and overseeing a redevelopment plan for the 7,100 acres of surplus Chaffee land.

One of the biggest obstacles has been the 440 buildings the Redevelopment Authority inherited. Most of them are too old to use again and they must be removed before the Redevelopment Authority can sell the land for redevelopment.

"It's key to us to get it done because it's something that will help us with the redevelopment," Reeves said.

Reeves and the Public Trust considered demolishing the buildings and sending the lumber, about 250 million board feet, to a landfill. They also looked briefly at burning the lumber.

But the Corps of Engineers, after meeting with the Austin, Texas, Habitat for Humanity chapter, suggested that disassembling the buildings and selling or reusing the salvaged lumber could be a viable, more environmentally friendly alternative.

People connected with the project are excited about the possibilities that deconstruction could offer all the parties involved.

Habitat for Humanity, which has 50 lumber resale shops in the United States and Canada, sees Fort Chaffee as a training ground for its volunteers and a source of lumber and revenue for its building program.

The Arkansas Valley Habitat for Humanity, based in Fort Smith, has not taken a role in the project yet. Executive Director Brian Fields said the chapter approves of the project and is studying how it can become involved.

Under a plan for the hospital deconstruction, the Redevelopment Authority would provide housing for workers and storage space for the salvaged wood. It also could shoulder some of the cost of removing asbestos and lead paint from the buildings. Reeves said agreements setting out each participant's responsibilities are still being negotiated.

The Corps of Engineers and Agriculture Department would provide expertise and guidance on the actual deconstruction. The two agencies also are evaluating the quality of the wood for construction grading purposes.

In addition to the need to remove buildings at bases that are being closed, the Army is planning a massive modernization program for its active bases, said Stephen Cosper, environmental engineer for the Corps' Construction Engineering Research Laboratory in Champaign, Ill.

All of the debris from demolition and construction, though, would choke the military's landfills and be a waste of potentially reusable material, he said.

"All this construction and demolition activity creates of huge amount of solid waste that could be as much as 80 percent of a fort's waste stream. It's just not good waste," Cosper said.

So, the Army is using Fort Chaffee as a test case on the pros and cons of deconstructing buildings instead of demolishing them, Cosper said. He said the Army also wants to write a handbook of deconstruction lessons learned at Chaffee that could be applied to any other post around the nation.

"The concept was: If it can work at Chaffee, it can work anywhere," Reeves said.

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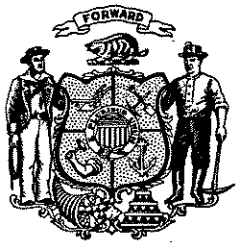

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GRADING RECOVERED WOOD

THE U.S. Department of Housing and Urban Development and the Department of Defense aren't the only federal agencies with an interest in deconstruction. The U.S. EPA also has contributed assistance to several pilot projects. Because so much of the material that comes from deconstruction projects is wood, another agency heavily involved is the U.S. Forest Service, particularly its Forest Products Laboratory (FPL) in Madison, Wisconsin. In the early 1990s, Dr. Bob Falk, research engineer at the FPL, started looking for uses for wood residuals in value-added products. "It didn't take long to realize that we should reuse wood in its solid form, where possible, rather than turning it into lower-value chips or mulch," says Falk.

About that time, some of the buildings at an Army ammunition facility in Minnesota were being demolished. The FPL helped the Army develop a deconstruction plan and the Army donated some of the timbers (six-by-eight to ten-by-eighteen inches in size) to the FPL so that Falk could do strength testing. "We wanted to see how damage inflicted on the timbers, such as from nail and bolt holes and splits, affected residual strength," he says. Using test results, Falk worked with the West Coast Lumber Inspection Bureau to develop a proposed amendment to grading rules that would formally recognize larger recycled timbers. The American Lumber Standards Committee, which reviews changes to the National Grading Rules, voted against accepting these changes, citing an overall lack of data. "I'm not really surprised, since to date we have only done a limited amount of testing," says Falk.

After his work in analyzing the strength of reused timbers, Falk became involved in the grading and testing of dimensional lumber (two-by-fours, two-by-sixes, etc.) that came from deconstructing residential units at Fort Ord, California. Falk believes that the work with the dimensional lumber will have broader impact than his analysis of larger timbers. "While there is a limited number of buildings constructed with larger timbers, there are large volumes of two-by lumber potentially available for reuse," he says. "And there already is a market for the larger timbers for use in timber framing, flooring, and millwork."

This is not the case for two-by lumber. Marketing of this material is hampered by the lack of a grade stamp specific to it. "An approved stamp will provide building inspectors a means to check that the material is acceptable at the job site and allow individual pieces to be sold. However, before we can propose a grade stamp for approval, we must do a lot of testing and develop reuse options that will assure that the lumber will perform safely the second time around," says Falk.

He is working to obtain funding that will allow the FPL to expand its testing efforts, with the ultimate goal of generating the data needed to gain approval for the reuse of lumber in construction. "If all goes well, I hoping that in the next few years, we will see recycled lumber approved for use in home construction," says Falk.

Since some of the buildings the company deconstructs are older, another element of the business is reselling architectural antiques. Litchfield does this through a new store (constructed with recycled building materials, of course). It also sells the antiques and general building materials through an Internet website. To further its market reach, Litchfield recently installed a sawmill to rework larger timbers into products such as flooring, laminated beams and fencing.

OTHER SOURCES

While much of the material it sells through the yard and store is from salvage work performed by Litchfield's own crews, that isn't its only source. "About 75 perce of the material is from our own project says Fulton. The other 25 percent is fro contractors and homeowners that bring m terials for salvage.

At Happy Harry's, more than 50 perce of the materials are from outside source with the remainder coming from crev that work for the company. The reliance others for the bulk of its used building m terials may well be rooted in the start-u of the company.

Unlike Litchfield, Harry Bohna's bac ground wasn't in demolition, but rather construction and building management. H developed Happy Harry's during a dow turn in the construction business as a mea of keeping food on the table and hasn looked back.

The original store and yard, now close were located in Manitoba. Bohna moved h headquarters to British Columbia and ha licensed 11 stores throughout Canada, eac with individual owner-operators.

All of the operations function in a simila manner. In addition to the walk-in trad crews work with contractors to procure ma terial. While Harry's does salvage and sel timbers, flooring and other wood, it concer trates more on products like windows, door toilets and kitchen cabinets.

SPECIALIZED OPERATIONS

Many deconstruction companies specia ize in specific types of projects. Bob Johnso started one such company about 12 year ago in Wisconsin. "I was looking for some thing different," he says.

Johnson's firm, North Coast Enterprise focused on removing lumber from home steads at least 75 years old. He and his crev of four to five people spend the summe months razing 20 to 30 buildings. Recentl Johnson has been working on a deal with firm that would take the bulk of the woo reclaimed each year.

Two other firms that take things a few steps further are Aged Woods o York, Pennsylvania and Mountain Lumbe of Ruckerville, Virginia. Aged Woods pur chases timbers and siding from barn being dismantled throughout the East. I then inspects the wood and remills it. Th lumber, much of it chestnut and hear pine, is sold as premium flooring, panel ing and molding. Mountain Lumber ha a similar operation, but it actually salvage much of the wood it remills and doesn' deal exclusively with barns as a source of material.

FEDERAL ACTIVITY

One of the keys to renewed interest in de construction is the involvement of the fed eral government, both as a source of mate rials and as a catalyst. On the supply side the Department of Housing and Urban De velopment (HUD) is constantly pouring dollars into renovation and demolition o the residential building stock it controls. And with the closing of military bases

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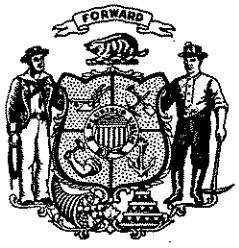

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Knock on wood: Real recycling opportunities are opening up

by Preston Horne-Brine and
Robert Falk, Ph.D.

The development of grade standards for recycled timber and lumber will aid in reclaiming the value of wood.

Recycled wood represents a value-added opportunity with tremendous potential for use in a massive market — that of lumber. As it comes of age, the recovered timber and lumber industry is positioned for strong growth, kicked off by recent efforts to develop industry standards.

Six major factors set the stage for the recovered timber industry to take off in a big way:

- **A large market exists.** The North American construction industry is huge, consuming over 60 billion board feet of lumber per year. This industry has been going full bore for much of the '90s. Single-family home-building is steaming along at the fastest pace of the last decade, and current lumber pricing remains at the higher end of the five-year range (nearly $400 per 1,000 board feet).
- **Wood recycling is happening already.** Within this broad lumber market, strong niches have been carved out for recycled wood products in recent years. Demand has been stimulated because of the "sustainable development," "green building" and "sustainably harvested wood" trends. In many communities, very-high-value but very-small-volume niche markets exist for timbers and milled products.
- **Reclaimed wood has performance advantages.** Wood available in older buildings has many benefits. Much of the virgin lumber on the market today is from second- and third-growth forests that were grown faster and harvested earlier than the old-growth wood that can be reclaimed from older structures. Many candidates for demolition were built with lumber and timbers considered oversized by today's standards. Some reclaimed timbers are available in sizes (cross sectional and lengths) that are not available in virgin timbers.

  In addition, reclaimed lumber contains dense, tight-grain wood; is often remarkably free of knots and defects; and is dry and therefore dimensionally stable.
- **The supply is vast.** Since the turn of the century, over three trillion board feet of lumber and timber have been sawn in the U.S., much of it still standing in existing structures. If only 2 percent of wood buildings now standing were decommissioned each year, and 25 percent of the lumber in them were reclaimed, it would supply up to one-fourth of the overall lumber market in this country for over 50 years.
- **The recovery infrastructure is increasing.** The demolition industry is large and well established. Until recently, it downplayed materials recovery, but now is undergoing a reorientation toward recovery, reclamation and sale of concrete, metal, wood, timbers and other materials.

  In addition to demolition contractors, a new sector — the deconstruction industry — has grown steadily. The deconstruction business always has existed, but at a small scale. And, it primarily was involved in recovering hardware and specialty millwork from old buildings in

Preston Horne-Brine is President of Fluxion Enterprises and a Senior Associate at ReSourcing Associates (both of Seattle). Robert Falk, Ph.D. is a Research Engineer for the U.S. Forest Products Laboratory (Madison, Wisconsin).

select situations. It now is ballooning into a mainstream industry that can salvage a far higher percentage of materials in old buildings.

Also, the new-construction and remodeling sectors have expanded their capacity to recover material and to reuse them in new construction.

- **Markets are improving.** Numerous recycled wood markets are being developed (for example, see "High-value Markets for Deconstruction Wood" in the August 1998 issue of this magazine). Several of these markets are of particular importance. A number of independent lumber mills, experiencing difficulty in the last 10 years in sourcing logs, have retooled their operations to process reclaimed timbers and essentially have reinvented themselves. Creative mills have developed glue composite fabrication, fingerjointing and veneer lamination techniques to eliminate defects, enhance the value of individual pieces, and fabricate specialty shapes. In addition to the milled-timber market, some companies have discovered that small solid-wood recycled pieces can be used feasibly. A reclaim operation sources recycled wood and processes it to billets and blanks of specific size, species and quality. These then are supplied to a production plant making an engineered, prefabricated product, such as furniture, fixtures and flooring.

Moving forward

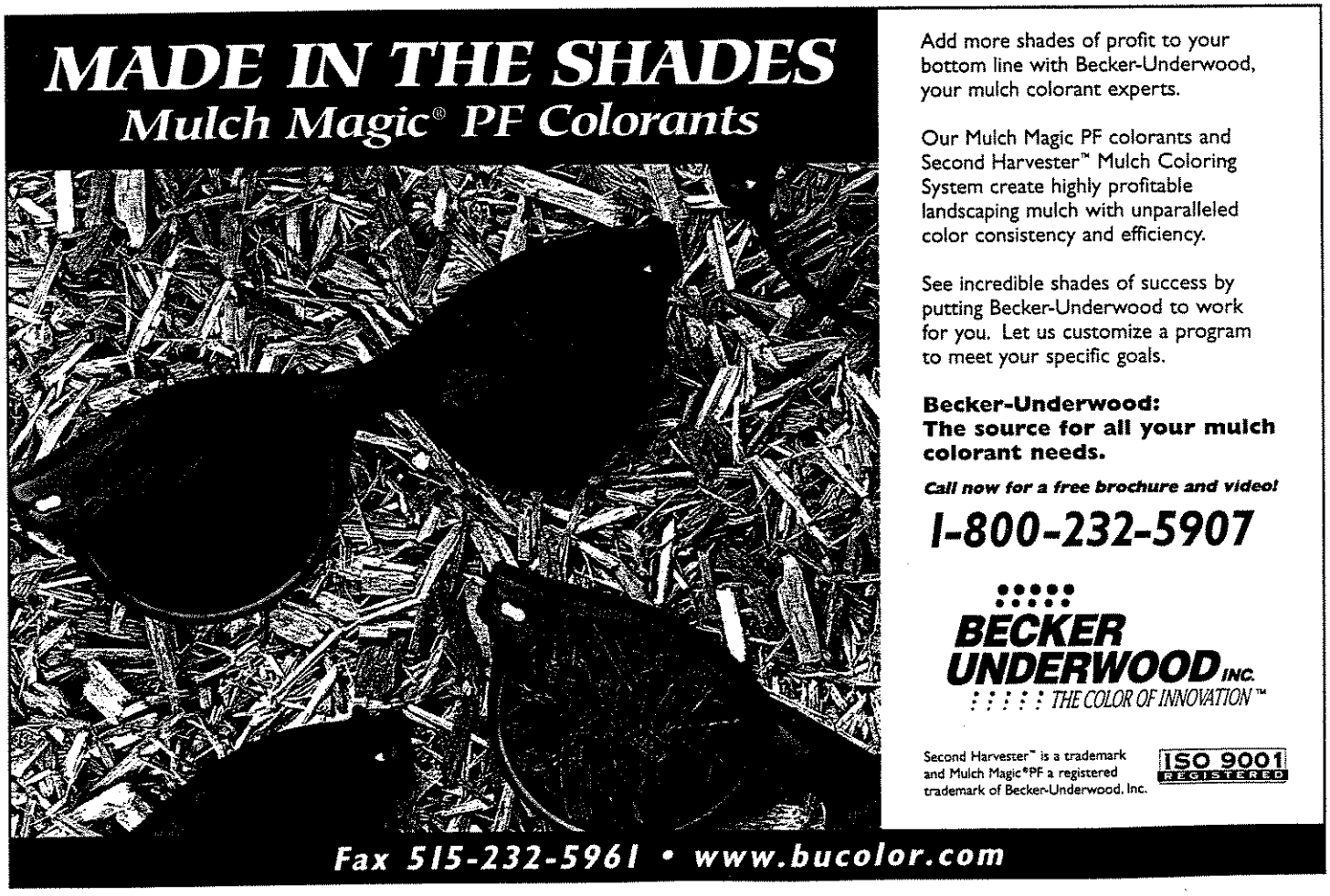
All this activity is not to suggest that reclaimed wood is without problems, particularly in the area of aesthetics. However, strategies are being developed to address such concerns.

In the open, price-competitive lumber market, much more work must be done to validate recycled wood products. Performance testing must be conducted and standards established to provide necessary market assurances. Grade standards will not only provide assurance as to structural integrity, but also are necessary for market acceptance and penetration of the commodity lumber market.

This is especially true for the largest undeveloped market for recovered wood: remilled or finger-jointed dimensional lumber, primarily in two-inch sizes. Tremendous potential exists to use reclaimed lumber again, as structural framing in new construction and remodeling. To date, however, it has remained the smallest segment of the reclaimed wood market and a minuscule segment of the overall lumber market.

Fundamental barriers remain to consumer acceptance and widespread penetration of the dimensional-lumber market at volume levels that are significant. They are:

- **Recognized assurance.** The minimum quality of grades of recycled wood products needs to be assured.
- **Cost.** Lumber is a commodity, with a fiercely competitive market in which low prices often prevail. In this market, reclaimed wood still is too expensive.
- **Inefficient distribution.** Recovered lumber markets must compete against the highly efficient distribution system established for virgin lumber, with the prevalence of very large building-products suppliers, numerous large big-box building-product retailers (such as Home Depot) and thousands of local lumberyards. This supply network does not work very well for recycled lumber because it requires grade-stamp assurances, tends to work on a very-large order basis, and is very sensitive to traditional contractor perceptions of product quality.
- **Insufficiently developed recovery standards.** Deconstruction and demolition specialists lack the necessary knowledge to optimize their reclamation efforts. They need to know which specific reuse markets are available to them, what each



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market specification is, how to estimate recovered lumber value accurately in their bids, and how to utilize various recovery options to maximize yield and value.

Grading standards are needed

The lack of grading standards for reclaimed lumber products is a primary obstacle to expanded trade. Such standards include grading rules, engineering properties and a grade stamp. Creation of acceptable grading standards and a stamp for recycled wood will provide the confidence and product assurance that will allow lumber and timbers to move readily through distribution channels to market, and then through the permitting and construction process. It will significantly expand the value, volume and types of recycled wood that flows through the system. Recovery operators will have much clearer product specifications and will be able to optimize their operations. Overall unit costs will come down, while acceptance of this product by designers, builders, inspectors and consumers will rise.

Why not use existing grading standards?

Recycled timbers currently are graded according to the same criteria as virgin timbers. Existing grading rules, which were developed for virgin wood, often do not consider, or sometimes disallow, defects commonly found in recycled wood. It is not clear that these reclaimed defects, while visually apparent, significantly affect wood structural properties. As a result, much recycled timber or lumber is downgraded or disallowed.

Moreover, a grade stamp allows each piece to be sold individually. Using existing rules to grade recycled lumber typically requires that a grading certificate be issued for each batch of graded material. This certificate limits the sale of the entire batch of that lumber to a single order, a highly constrictive situation.

What needs to happen

If rational grading criteria are to be developed, the following three tasks must be accomplished:

Rules need development. Although existing grading rules can be used, they do not reflect a technical understanding of recycled wood, its particular advantages and its common defects. Rules specific to recycled wood are needed.

Engineering properties need to be determined. The grading criteria for the new rules must be based upon technical research that substantiates the effect of age, exposure and defects upon the structural integrity and performance of recycled lumber and timbers. This can be determined only by experimental testing and analytical modeling.

A new grade stamp must be approved. Efforts will be required to make the grading stamp an industry standard.

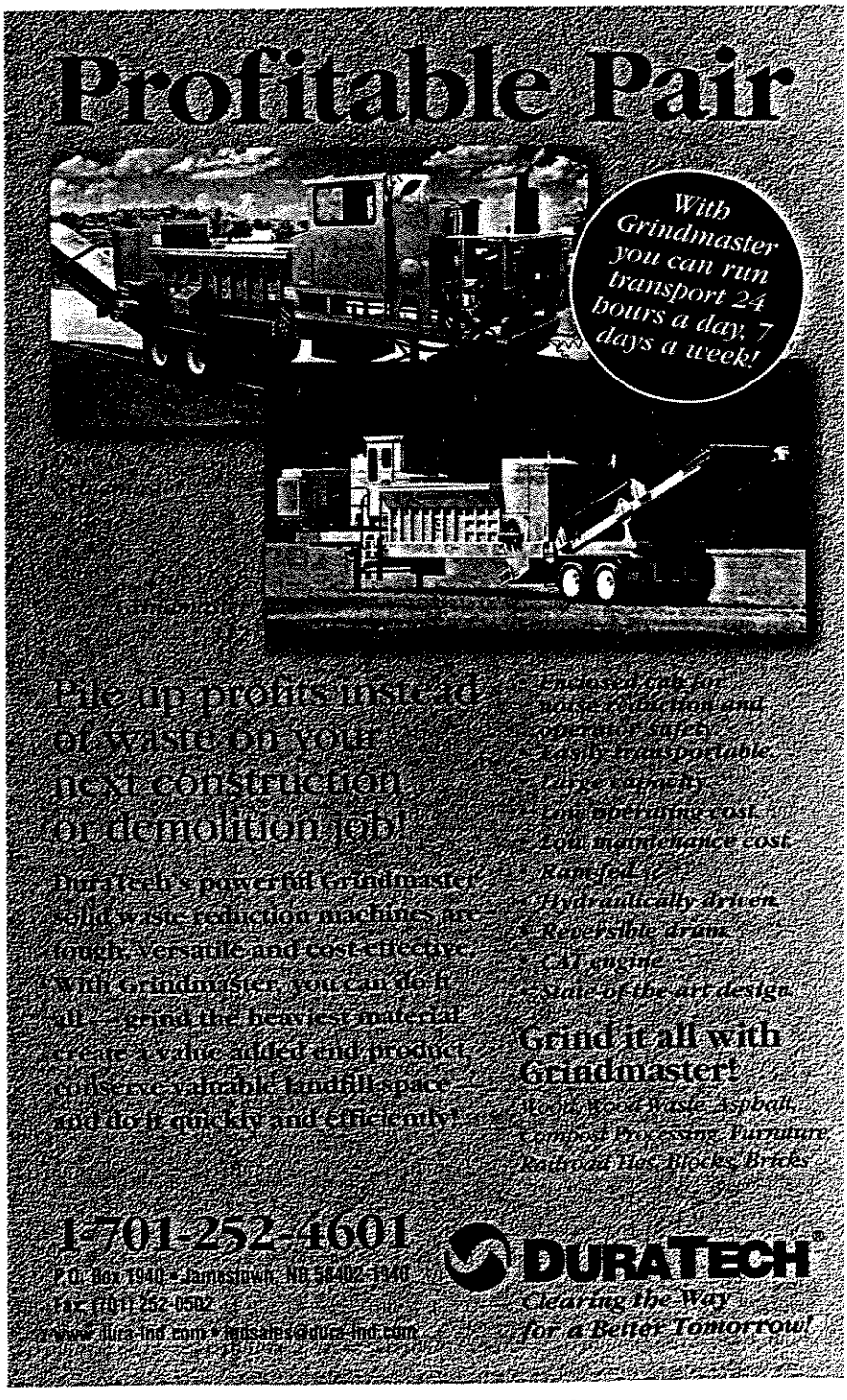
The work is underway

Technical performance testing on recovered material must be performed, and reclamation protocols must be developed.

Testing has been conducted at the U.S. Forest Products Laboratory (Madison, Wisconsin) over the last five years, with support from a wide assortment of interested parties. Reclaimed wood has been tested for structural integrity in the presence of checks, splits, and bolt and nail holes. Larger timbers and smaller lumber have been tested. The results have been positive and are adding to the accumulated body of data on recycled wood characteristics and performance in various applications.

Additional research needed

A first attempt at gaining approval for a recycled wood grading stamp was made in late 1998 based on experimental and analytical



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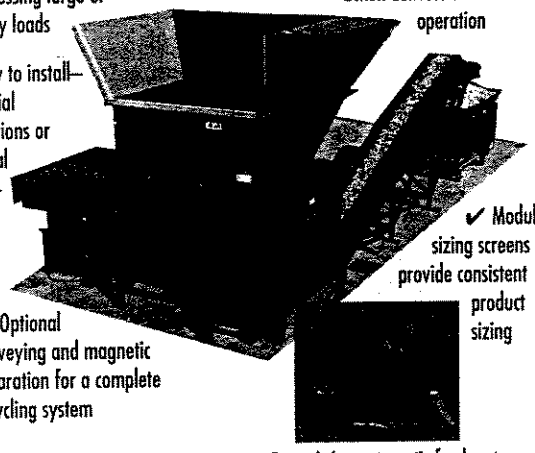

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test results with large timbers.

Working with a variety of parties, the West Coast Lumber Inspection Bureau (Tigard, Oregon) proposed a change in grading rules to the American Lumber Standards Committee Board of Review. The board deferred action in October 1998, citing the overall lack of data on the engineering performance of recycled lumber and timber.

In response, a major research effort is underway, directed by the Forest Products Laboratory. It is funded under a White House initiative called Partnership for Advancing Technologies in Housing and is administered, in part, by the U.S. Department of Housing and Urban Development (Washington). It entails securing, selecting and transporting reclaimed lumber samples from a broad base of sites across the country, with a focus on two-inch lumber from urban and military deconstruction projects. This material will be graded by existing rules to set a baseline. The recovered material will undergo extensive testing and modeling according to established industry procedures. The data will be analyzed to substantiate recommendations on the engineering properties of reclaimed lumber and facilitate development of grading rules, reuse options and recovery protocols, including a field manual for graders and deconstruction and demolition specialists.

This collaborative, federally funded program will be coordinated with ongoing or planned deconstruction projects around the country over the next several years.

No wooden nickels here

With the completion of this new study, grade stamps for recycled lumber and reclaimed timber may be approved. For this to happen, the testing results will need to be positive, and industry players will have to agree on the appropriate role that recycled wood products then will play in this large and competitive marketplace. **RR**

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Feasibility of Recycling Timber from Military Industrial Buildings

Scott F. Lantz
Robert H. Falk

Abstract

This paper discusses an alternative to the demolition and landfilling of conventional timber frame buildings—the dismantlement and recycling of lumber and timber. A case study is presented in which two large buildings at the Twin Cities Army Ammunition Plant were successfully dismantled and a substantial volume of the timber and lumber recycled. This case study illustrates several aspects of the recycling process: factors that influence the decision to recycle, regulatory and contractual challenges, labor and safety issues, economic factors that affect the emerging market for recycled timber and lumber, short- and long-term advantages and disadvantages of dismantlement as opposed to conventional demolition, and recommendations for making the recycling of timber and lumber elements of excess buildings a feasible disposal option.

Introduction

A significant number of U.S. military industrial facilities are of timber frame construction. Because many of these facilities were built during the World War II era, when steel and masonry building materials were being redirected to other parts of the war effort, timber was the common choice for the construction of industrial facilities. With the end of the Cold War era in the early 1990s, many of these facilities were classified as surplus to the nation's defense requirements.

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Without mobilization missions to justify their continued maintenance, many of these buildings have been standing idle, awaiting disposal. These buildings are estimated to contain hundreds of millions of board feet of old growth timber and lumber, as well as a myriad of other components; some of these components are valuable and/or highly regulated with regard to disposal.

The current situation in the military is contrary to the past trend of adding buildings to the industrial inventory and continuing to use existing buildings. In the past, any disposal of buildings was incidental to other ongoing operations and as such was often handled on an individual basis, both administratively and with regard to disposal practices. The typical disposal practice for such facilities has been demolition, with the debris placed in a landfill.

The disposal of military industrial facilities has the potential to increase dramatically. It is timely to review disposal practices used for these assets in order to minimize costs and the potential liability associated with various practices.

This paper discusses the dismantlement of timber frame buildings and the recycling of the timber and lumber content as an alternative to conventional demolition and landfilling. A case study is presented in which two large buildings, representing more than 900,000 ft.^{2} (83,610 m^2) of manufacturing space at the Twin Cities Army Ammunition Plant (TCAAP), were successfully dismantled and a substantial volume of the timber and lumber recycled. This case study illus-

trates several aspects of the recycling process: factors that influence the decision to recycle, regulatory and contractual challenges, labor and safety issues, economic factors that affect the emerging market for recycled timber and lumber, short- and long-term advantages and disadvantages of dismantlement as opposed to conventional demolition, and recommendations for making the recycling of timber and lumber elements of excess buildings a feasible disposal option.

The decision to recycle

The decision to dismantle buildings 501 and 503 at the TCAAP was not automatic or unanimous. In the early 1990s, this decision eventually came be regarded as the disposal option consistent with various missions and directives. The primary event that precipitated the dismantlement of these manufacturing buildings was the end of the Cold War era. Subsequently, in fiscal year 1992, the decision was made to terminate TCAAP's small caliber (5.56- and 7.62-mm) ammunition manufacturing mission and the artillery metal parts (105- and 155-mm) mission. While there were then and still are other Army missions on the TCAAP Installation, the majority of the buildings had been dedicated to manufacturing and support of the terminated missions. This is significant in that it is a violation of federal procurement law and military regulations to spend federal tax dollars to maintain facilities that are surplus to the military's needs.

With no mission to justify the continued upkeep of many of the Installation's buildings, both heating and maintenance of excess buildings were suspended. While this strategy was acceptable in the short term, it was not acceptable for the indefinite future. A phasedown plan was developed to address the long-term risk of no maintenance while the Army determined its future plans for the Installation. This phasedown plan took the shape of more than 70 projects that addressed various aspects of the manufacturing buildings and machinery and the supporting infrastructure with the intention of proactively eliminating or minimizing the potential long-term risk associated with little or no maintenance or surveillance.

In a process known locally as "killing the building," equipment, personal property, and components that could deteriorate and release hazardous or otherwise regulated substances were removed from the buildings. All utilities were positively disconnected. Finally, all exterior openings were secured and signs were posted in keeping with fire regulations. The utility infrastructure of the Installation was likewise properly abandoned if inactive, and in the case of the electric and natural gas distribution systems, sold to a local public utility company.

For most Installation buildings, this was an acceptable short-term endpoint. The large timber-frame buildings posed an exception. Containing well over a million board feet of wood materials each, these buildings represented a substantial fire hazard to active Installation facilities as well as to the neighboring community. Therefore, a choice had to be made between maintaining a multi-zone fire sprinkler system for each building or disposing of the buildings. The cost to maintain the sprinklers represented several thousand dollars per year per building, indefinitely. A decision was made to remove the buildings and the associated fire hazard.

Once this decision was made, discussion followed on how disposal was to be accomplished. Conventional disposal would have resulted in demolishing the buildings and disposing of the debris in a demolition landfill. The question then arose as to the feasibility of salvaging the timber and lumber. This possibility was met with skepticism because of lack of experience and consequent lack of knowledge about whether 1) any contractors were available who actually salvaged timber and lumber; 2) there was a market for nonvirgin wood materials; and 3) the additional effort on the part of the Army as owner would be justified.

Research on the feasibility of salvaging the timber and lumber was finally decided to be worthwhile for the following reasons. First, minimizing landfill disposal was consistent with the Army's waste minimization goals. Second, the Installation was already a potentially responsible party at several landfills and disposal site clean-up operations in the area. The financial responsibility for the associated remediation efforts at these landfills and disposal sites underscored the fact that although the disposal methods had been legal, there is a long-term risk of future liability for disposal practices that simply store discarded materials. Third, we speculated that if these materials had value, they might subsidize the overall disposal costs of the buildings, thereby lowering funding requirements.

The TCAAP contacted several wood-related organizations, including the Forest Products Laboratory of the USDA Forest Service, timber salvage companies, and timber framing contractors. As a result of discussions with these organizations, salvaging timber from the buildings appeared to be feasible. Although opinions about timber recycling were more often quantitative than qualitative, the following conclusions were reached prior to beginning timber salvage:

1. At the very least, the large timber elements were recyclable. It was unclear if there would be a ready market for the smaller timbers or the dimension lumber. Quotations on purchase price ranged from $50 to $200 per thousand board feet (MBF) for the standing timber members.
2. While there were some outlets for the large timbers through brokers, the kinds of markets were speculative to a great extent. The fact that the materials were used seemed to pose an obstacle since they would not carry a grade stamp to satisfy a building inspector for subsequent uses.
3. Those in the timber salvage business apparently were not particularly oriented to performing other kinds of disposal activities, especially those involving regulated wastes. Interestingly, metal salvage contractors and timber salvage contractors were apparently not particularly interested in the other material.

Building and disposal data

The characteristics of the buildings dismantled at the TCAAP and data generated by the dismantlement process are listed in Table 1. The range of nominal timber dimensions included 2×8 to 2×14; 3×10 to 3×14; 4×10; 6×12 to 6×18; 8×14 to 8×18; 10×18. The estimated value of the recycled timber per board foot was as follows:

- Received by owner for timber in place: $0.05 to $0.20.
- Received by dismantler—smaller dimensions: $0.40 to $0.60.
- Received by dismantlers/brokers—larger dimensions: $2.00 to $3.00.

Note that there does not always appear to be a direct correlation between some values, for the following reasons:

Table 1.—Characteristics of dismantled TCAAP buildings.

Characteristic	Building 501	Building 503
Floor space	377,000 ft.^{2}	548,000 ft.^{2}
Timber	1,250 MBF	1,875 MBF
Wood recycled	750 MBF	1,500 MBF
Transporation & tipping fees avoided	$35,000	$70,000
Future liability avoided	--	--
Estimated cost to demolish and landfill	$300,000	$440,000
Cost to dismantle	$50,000[a]	$283,000[b]

[a] Roofing disposal not part of dismantlement contract.
[b] Roofing disposal part of dismantlement contract.

- Each building had parts of a masonry-type construction, which result in a disposal cost to the owner.
- Disposal of building 503 included a built-up roof; that of building 501 did not.
- Building 501 was dismantled at higher labor rates than was building 503.
- Application of materials from building 501 into new timber framing and millwork projects created a demand for the material in building 503. As a result, the contractor recovered a greater portion of building 503's timber elements.

Regulatory challenges

Buildings 501 and 503 were used for manufacturing, and contained various building elements, equipment components, and supplies that are currently regulated in regard to disposal. The following materials were encountered on this project:

- asbestos
- polychlorinated biphenols (PCBs)
- mercury-containing instruments and controls
- mercury/cadmium fluorescent light tubes
- treated timber: creosote and pentachlorophenol (PCP)
- lead-based paint
- assorted lubricants, hydraulic oils, and quench oils
- explosives: powder, primer tracer, and incendiaries
- partial containers of paints, solvents, and preservatives

Because of the diversity of materials, a substantial and continuous effort went into evaluation and proper disposal as the materials were encountered during the decommissioning and disposal of the facilities.

Contractual issues

All activities undertaken from the time the buildings were production-ready to the time they were reduced to floor slabs on the prairie would have had to have been performed whether the buildings had been dismantled or demolished. The primary difference was that the various steps were handled through a series of contracts, each with a contractor who dealt with separate aspects of the disposal. This allowed the owner better control of the disposal process and to a great extent lifted the burden from specialty contractors. Since dismantling left the buildings devoid of anything but timber and a built-up roof, the contractual procedure gave the TCAAP an opportunity to determine if dismantling and subsequent timber recovery would lower disposal costs. For each building, competition for a disposal contract was open, with no

recycling requirement. The low bidder was chosen, one who could complete the work on time and within budget.

Two categories of contractual issues arose during this project:

1. To what extent should general, all-inclusive disposal contracts be used?
2. What aspects of a building disposal contract are important if dismantlement and recycling of the building are desired?

General versus multiple contracts for disposal

The disposal of buildings 501 and 503 was accomplished through a series of contracts, rather than one. This arrangement is similar to what construction managers refer to as "multiple prime contracts." Although the Army and its operating contractor had to prepare and manage more contracts, this was the most effective way to accomplish the project for the following reasons:

1. The disposal of personal property (production equipment) is a separate action from the disposal of real property.
2. Directly contracting with various types of contractors provided the Army with more effective and expeditious control of the overall disposal effort; they could work directly with the contractors rather through a general contractor. Since there were some instances where change in scope was probable, multiple mark-ups could be avoided if the scope were expanded.
3. It was prudent to contract directly with abatement and hazardous waste contractors. In this situation more than in any other disposal activities, it was important to have a direct relationship with these contractors to ensure compliance with the scope of work as well as better ability to verify the final disposal point of regulated materials.
4. Competition was increased by dividing the overall disposal project into smaller components by specialty or industry. Feedback from bidders indicated that it was better to avoid a contractual chain of custody for hazardous waste, which would result from subcontracting that work. Also, we attempted to frame the work by size and nature so that contracts were large enough to be of interest to bidders, but not so large or outside their primary kind of work as to create bonding or insurance problems that would inhibit bidding.

Dismantlement issues

Several contractual issues affect the feasibility of building dismantlement and subsequent recycling of the materials:

1. The contracts for the disposal of buildings 501 and 503 were just that—contracts for disposal. Recycling was not mandated because a) it was unclear what types of or how much material could be marketed for reuse; and b) under the circumstances, there was apparently no meaningful way to enforce such a requirement. The buildings were cleared of production equipment and hazardous materials prior to setting the disposal contract, making it feasible to dispose of the empty buildings either by conventional demolition or dismantlement. In a competitive bidding situation, the successful low bidder chose to dismantle significant portions of each building.
2. To make dismantlement a viable option, the contract must contain a sufficient performance period. A good rule of thumb is to allow twice the time for dismantlement as for demolition. Dismantlement is more labor-intensive than is demolition, which tends to be more machine-intensive.
3. Some contract bid forms have a subtotal line for a credit for the salvage value of building materials. The bid total is then the total of disposal items on the bid sheet less the salvage credit. It was prudent to require bonding and insurance reflecting the total price of the disposal effort, not including the salvage credit. In a default or other situation potentially involving the contractor's surety or insurance, the cost of replacing the building disposal performance should not include the salvage credit. Depending on a contractor's outlets for various materials, what is feasible to salvage may change with the contractor. This is a function of the fact that markets for some used building materials are in the process of development.
4. Specifically regarding federal and federally funded projects, the contract documents should state whether the project is a "Davis-Bacon" project. The Davis-Bacon Act is a federal labor law that when applicable to a contract significantly affects the cost of labor on that contract. Since dismantlement as a disposal option is labor-intensive, it is crucial to make a correct determination as to whether Davis-Bacon applies to a particular project. A more complete discussion of the Davis-Bacon Act is found in the next section.

Safety and labor issues

Safety

Generally speaking, dismantlement is labor-intensive. The nature of dismantlement is to separate and usually recover building materials in a condition in which they can be reused for the same or similar purpose. This process usually involves "deconstructing," that is, manually disassembling parts of the building.

Demolition, on the other hand, is an equipment-intensive operation, with a large percentage of the crew physically separated from the material being handled. Although materials may be separated during demolition (usually metals, sometimes concrete and masonry), this is usually done mechanically. Typically, it is not critical that the building elements be preserved since the recovery is for the material content. Even though dismantlement is similar to demolition in the respect that both are disposal methods, dismantlement is more like construction relative to the number of persons that may be on site, where they are likely to be located, and the activities in which they are engaged.

As such, it is imperative that for dismantlement to have a net benefit to a building owner, emphasis must be given to safety—not only in the contract document, but through active and regular oversight and enforcement in the field. Issues that recur on dismantlement projects include the following:

1. ***Awareness.*** People must be aware of what kind of activities are happening, on all levels.
2. ***Fire.*** The danger of fire should be emphasized at regular "tool box" safety meetings. Fire is a very real hazard on dismantlement sites, primarily as the result of the use of cutting torches. Wood materials are typically extremely dry and will ignite readily. A requirement that a fire extinguisher be kept with each cutting torch is extremely useful; this practice is not as common as it should be. An enforced no smoking policy, except in designated areas provided with "butt cans," will help prevent what is probably the second greatest source of fire. Finally, there should be provision in the contract that all fires be reported to the fire department and the owner, regardless of whether the contractor thinks that the fire has been extinguished. Besides the potential destruction of valuable materials, fire poses a significant danger to people on the site. When a building is being dismantled, utilities are eventually cut off. These include telephone, electricity, and water—all necessary for fire detection, alarm, and sprinkler systems. Especially in multi-level buildings, the prevention of fire is critical to the safety of workers.
3. ***Change from "inside" to "outside" work.*** As dismantlement progresses, inside work becomes outside work and potentially can become aerial work. Proper barricading, personal safety equipment, and lifting equipment pursuant to Occupational Health and Safety Administration (OSHA) and other relevant standards must be followed as applicable.
4. ***Dismantlement plan.*** A plan should precede dismantlement. This plan may be relatively simple or quite detailed, depending on whether the original construction was complex or not otherwise obvious. In some cases where buildings are small and simple in design, the dismantlement plan may be approved by in-house personnel of average technical competence. In more complex cases, it is worthwhile to have the plan developed or reviewed by a qualified structural engineer or architect. The point of this effort is to avoid collapse of the building during dismantlement. The other effort necessary to avoid collapse is to enforce the dismantlement plan.
5. ***Airborne dust.*** This may be a significant hazard or at least an irritant to workers on dismantlement projects. Precautions need to be taken if roof decking and joists are being recovered. Since older built-up roofing may contain asbestos and/or coal tar, it is prudent to sample roofing materials prior to building disposal to determine the proper method of disposal and methods or items of personal protection equipment needed to ensure worker safety. Besides protecting workers, these steps also create a record of positive steps taken to determine what constituents were contained in the roofing materials and what action was taken in light of that knowledge. Such actions are prudent given the current levels of litigation, particularly in relationship to asbestos exposure.
6. ***Housekeeping.*** Housekeeping is a very basic safety issue. Besides directly affecting the hazards described here, good housekeeping minimizes trip and puncture hazards. It also helps prevent loose debris crossing an opening in a floor to give the appearance of a solid floor. Walking across such an area can result in a serious fall.

Labor

As mentioned earlier, federal and federally funded construction projects must comply with the requirements of the Davis-Bacon Act (40 USC 276a, *et seq.*). This federal labor law requires the payment of "pre-

vailing" wages on construction-type work, including new construction, alterations, and repair of buildings and sites of new work. The U.S. Department of Labor issues wage determinations for various job classifications in a given geographical area considered for prevailing wages. In many areas, this is determined to be union wages based on union classifications.

Typically, federal construction-type contracts fall within the purview of the Davis-Bacon Act. Therefore, there is a tendency to assume that all contracts of this nature need to be certified as Davis-Bacon projects. In performing a Davis-Bacon review for applicability, we reviewed the federal regulations on labor and procurement. The Code of Federal Regulations (29 CFR 3) generally discusses labor regulations with regard to contractors and subcontractors on federally financed public works projects. More germane to this discussion is the Federal Acquisition Regulation (FAR) in part 22, *Application of Labor Laws to Government Acquisition*. In subpart 22.402, *Applicability*, paragraph (a)(1)(ii), the regulation includes dismantling, demolition, or removal of improvements **where those improvements are part of a construction contract or further construction is anticipated under a subsequent contract pursuant to Subpart 37.3.** Part 37 of the FAR, *Service Contracting*, includes subpart 37.3, *Dismantling, Demolition, or Removal of Improvements*. In paragraph 37.301 on labor standards, the regulation indicates that these activities could fall under either the Davis-Bacon Act or the Service Contract Act (41 USC 351, *et seq.*). It further indicates that the **Service Contracts Act applies if no further Federal construction or improvement is planned**. The significance is that the Service Contracts Act requires the payment of a minimum wage in contrast to the Davis-Bacon prevailing wage. This makes labor less expensive in this situation.

Thus, where there is no foreseeable follow-up on federal construction occurring on a site, the disposal contract does not have to be certified as a Davis-Bacon project. Since dismantlement is more labor-intensive than demolition, the feasibility of recovering significant amounts of materials through dismantlement is directly related to labor costs. Again, this issue applies to the federal arena. This issue may not be pertinent to all situations, but some may require the use of a prevailing wage structure to evaluate dismantlement. In instances where the exception cited above can be applied, the feasibility of recovering more material increases dramatically. It is definitely worth exploring the issue of use of prevailing wages where applicable.

Feasibility of recycling timber and lumber

For the purpose of this report, feasibility falls into two categories: material recovery and marketability.

Material recovery

The feasibility of recovering timber and lumber from buildings is dependent on both physical and economic factors, which include the following:

- condition, dimensions, and species of wood
- type and number of fasteners per element
- exposure or protection of elements
- cost of labor
- performance period allowed for building disposal
- building height and site configuration
- time allowed to store recovered materials on site

Marketability

Although the markets for some recyclable materials are well established, this has not been the case for timber and lumber recovered from building disposal projects. For the most part, traditional markets have been local in nature and speculative at best. The use of recovered timber and lumber has often not approached its potentiality. Typically, recovered timber and lumber have been used for compost, livestock pens, concrete forms, and dunnage. However, recent developments have resulted in an emerging market for recycled wood elements. Factors that favor an increase in demand for nonvirgin timber and lumber include:

- restrictions on harvesting high-quality, large-diameter old-growth timber, thereby restricting its availability at any price;
- general trend of increased prices for forest products;
- demand for high-quality large timber for exposed timber frame construction;
- demand for species-specific millwork for use in new log home construction and interior remodeling of older buildings where consistency with period building materials is desired;
- foreign demand for North American species that represent "exotic" species in those markets;
- increased familiarity of buyers, designers, and builders with nonvirgin timber and lumber.

Factors that restrict the demand for nonvirgin timber and lumber include:

- lack of grading standards and design rules specifically for nonvirgin wood materials; application of virgin material standards and rules may have the effect of downgrading nonvirgin materials;
- at the job site, lack of a specific grade stamp for nonvirgin wood elements, which designers and inspectors rely on for acceptance; unless a timber

grader is specifically hired to visually inspect material on a particular job, the material is often rejected for use;
- in general, lack of consistent supplies and markets for nonvirgin timber and lumber;
- lack of awareness by owners and their disposal contractors regarding the potential value of nonvirgin timber and lumber, with the result that no attempt is made to recover them.

Dismantlement as an alternative to demolition

All disposal alternatives have their advantages and disadvantages. Dismantlement is no exception. The decision to use dismantlement or conventional demolition as a disposal option will depend on the relative weights assigned to the various factors considered here.

Advantages

- Dismantling and subsequent reutilization of building elements result in avoidance of some landfilling costs, primarily transportation and tipping fees.
- Reduced use of landfills should result in reduced future liability, should a landfill fail and remediation costs be assigned to former landfill contributors.
- There is a demand for large old-growth timber. Properly recovered timber from older buildings is gaining acceptance to meet this demand.
- In addition to reducing disposal costs by not requiring some disposal fees, in many instances recovery of materials will generate a credit or otherwise subsidize the overall building disposal costs.

Disadvantages

- Building disposal may be more management-intensive for the building owner if multiple contracts are let for various types of abatement and disposal, in contrast to one overall disposal contract.
- Dismantlement takes longer than demolition. An owner must plan ahead and allow approximately twice as long for dismantlement as for demolition.
- Dismantlement is more labor-intensive than is demolition, which tends to be machine-intensive. Emphasis on site safety and coordination tend to increase in direct proportion to the number of workers on the same site.
- Markets for nonvirgin building materials have not fully matured. These markets are in transition from strictly local to national and international. Therefore, it is difficult to predict the type, percentage, and value of recovered materials an owner might expect with a particular disposal project if similar projects have not been performed in that area.

Recommendations

Several factors are critical when determining the feasibility of dismantlement. The following recommendations are based upon information gained in the case study described in this paper. Working with the contractor on these issues should result in benefits to the owner in decreased landfill volumes and costs, as well as increased proceeds or credits for the recovered timber.

1. Timber dismantlers and recyclers are not metal salvagers or hazardous waste abatement contractors, and they are typically not set up as a business to act as a general contractor, who can effectively subcontract other disposal activities.
   Recommendation: Building owners should prepare a building for dismantlement by contracting directly for all other necessary disposal activities.
2. Although not recyclable itself, roofing offers protection of flat assets (decking and flooring) from precipitation and subsequent buckling.
   Recommendation: Do not "help" the timber-dismantling contractor by removing the roofing materials prior to dismantlement.
3. The timber-dismantling contractor requires adequate performance time to maximize the volume of material recovered.
   Recommendation: A good rule of thumb is to allow twice as long a performance period for dismantlement as is necessary for demolition.
4. Allowing the contractor to process and store materials on site (within reason) minimizes handling and transportation costs.
   Recommendation: Provide the timber-dismantling contractor with adequate room to lower, sort, clean, and store recovered materials.

Summary of findings

The following key points summarize the findings of this case study:

1. Dismantling existing buildings and recycling timber and lumber elements reduce short-term disposal costs by reducing demolition landfill volume.
2. Dismantlement, and the resultant recycling of timber and lumber elements, reduces landfill use and should therefore reduce potential long-term liability associated with landfill contribution, should the cost of maintenance or remediation be assigned to past users.

3. Proceeds an owner can expect to receive from recycling timber and lumber may not cover the cost to completely remove and dispose of a building. However, the proceeds can provide a subsidy against those costs.
4. Recycled timber and lumber are being used where there is a demand for certain old-growth wood products, both as structural elements in new timber-frame structures and nonstructural elements such as millwork.
5. The growing market for recycled timber and lumber should result in a decision by owners and contractors to recycle rather than landfill, as outlets for these materials become less speculative. Concurrently, the price or credit owners and contractors receive in the marketplace should increase.
6. Grading standards for nonvirgin materials should be developed and adopted to facilitate the marketability and maximize the value of nonvirgin timber and lumber, which will in turn make recovery and recycling more feasible.

The Use of Recycled Wood and Paper in Building Applications

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