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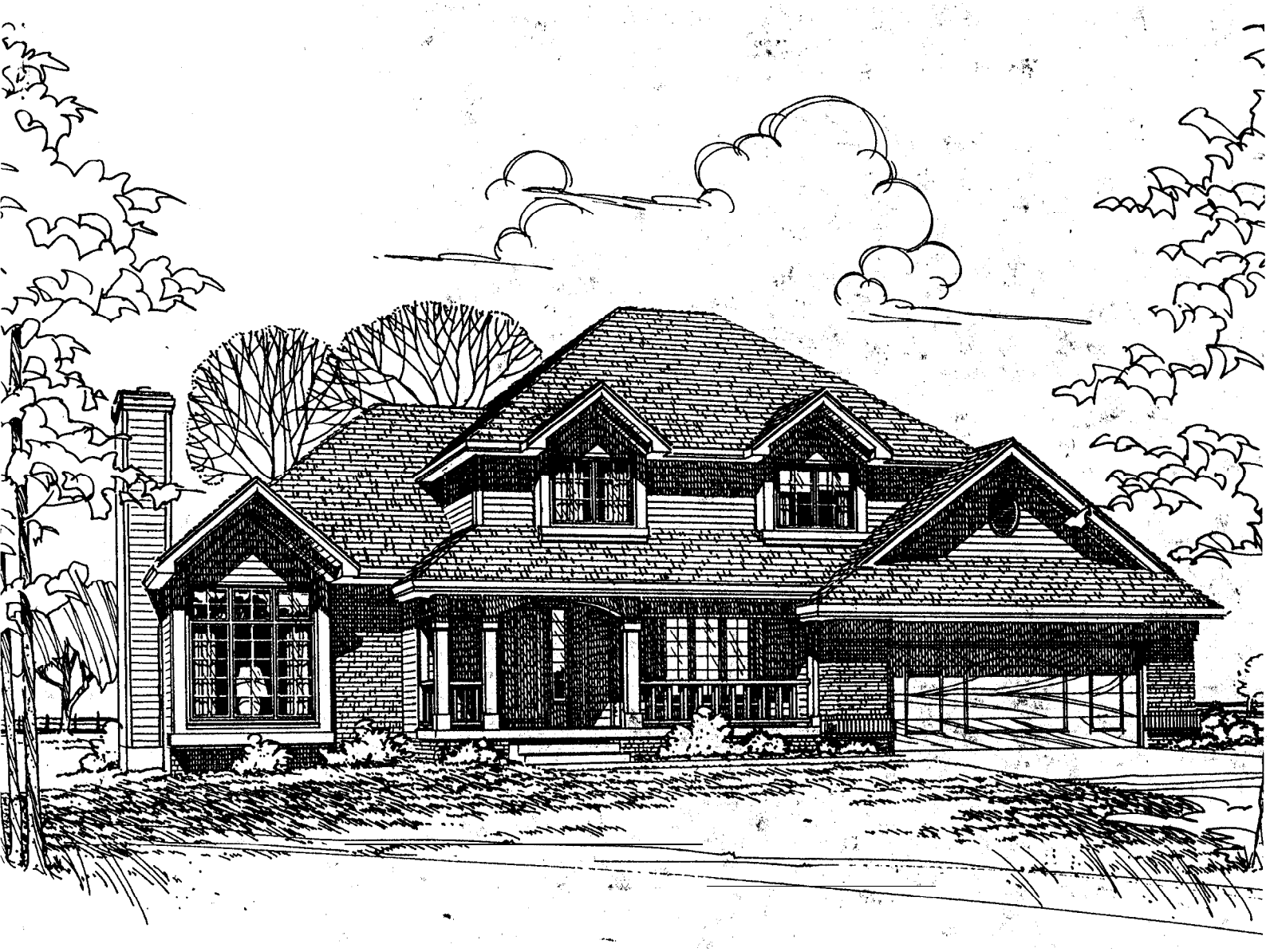

PARTNERSHIP FOR ADVANCING TECHNOLOGY IN HOUSING

THE NATURAL RESOURCE FOR THE FOREST PRODUCTS INDUSTRY

Advanced Housing Research Center

Forest Products Laboratory
Madison, Wisconsin

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Feature

Partnership for Advancing Technology in Housing

By Elizabeth Burdock, Michael Ritter, Jean Livingston, and Stephanie Carnes

Advanced technologies and alternative building methods can radically improve the energy efficiency, affordability, durability, environmental performance, disaster resistance, and safety of our nation's housing. However, although many of these technologies and building methods exist, adoption of innovation in the housing industry is not so easy to accomplish. The U.S. housing industry is an incredibly fragmented industry, making widespread change difficult to achieve.

The Partnership for Advancing Technology in Housing (PATTI) program was created to address these issues of innovation adoption. PATH is an umbrella organization that integrates the efforts of 13 different federal agencies and more than 300 industry partners to encourage the creation and adoption of advanced housing technologies and alternative building materials to improve the nation's housing. Specifically, PATH has the following four goals to accomplish by the year 2010:

1. Reduce the monthly cost of new housing by 20 percent or more.
2. Cut the enviromnental impact and energy use of new housing by 50 percent or more and reduce energy use in at least 15 million existing homes by 30 percent or more.
3. Improve durability and reduce maintenance costs by SO percent.
4. Reduce by at least 10 percent the risk of loss of life, injury, and property destruction from natural hazards and decrease by at least 20 percent residential construction work illnesses and injuries.

The PATH program works to accomplish these goals by drawing on the resources and knowledge of the federal government and representatives from all sectors of the housing industry, including construction, finance, and insurance professionals. PATH coordinates the activities of these participants using a three-pronged approach: research and development, policy formulation, and information dissemination.

Creating and Evaluating Technologies

PATH strives to stimulate advances in housing technology research and development. The PATH Program participates in cooperative research agreements with industry to develop new materials with the potential to improve housing. PATH also works with academia through the National Science Foundation grant program to develop the fundamental research base that will lead to new technologies to support the next generation of American housing and strengthen and increase the building industry's use of advanced technologies in new and existing housing.

The PATH program sponsors field demonstrations of new technologies all across the United States. In cooperation with the National Association of Home Builders (NAHB) Research Center and others, technologies are evaluated in "real life" settings, data are gathered, and information is posted on the Toolbase website (www.toolbase.org). Some of the technologies evaluated on Toolbase include insulating concrete forms, structural insulated panels (SIPs), and wood foundations.

Steering the Course

A key strategy of PATH is to construct the best method of approaching future research investments. The PATH program strives to create the appropriate direction for technology investment as well as find ways of encouraging market acceptance - and that means breaking down the existing barriers to. adoption. Investment in research and development is not meaningful unless the most useful technologies are created and the technology is adopted by the industry. It is not advantageous to make an investment in housing technologies without a road map or a clear plan directed by industry - the key implementers - that identifies which technologies and building methods deserve the most attention.

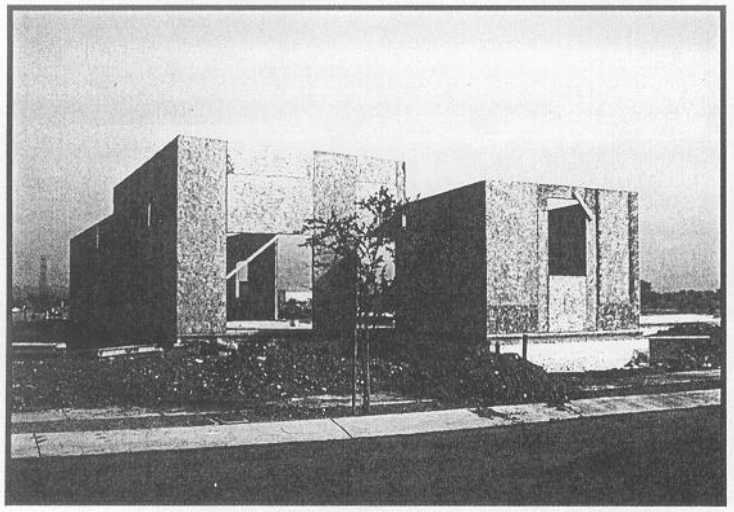
Homebuilders will not feel compelled to use a new material if there is a lack of consumer demand for new technologies. Consumer demand will not occur unless consumers are made aware of the benefits of these technologies so they can ask for them when

This Carl Franklin Demonstration project in Dallas, Texas, includes 2.5 homes. These projects are used to illustrate and evaluate how PATH technologies perform on a community-wide or mass-production scale.

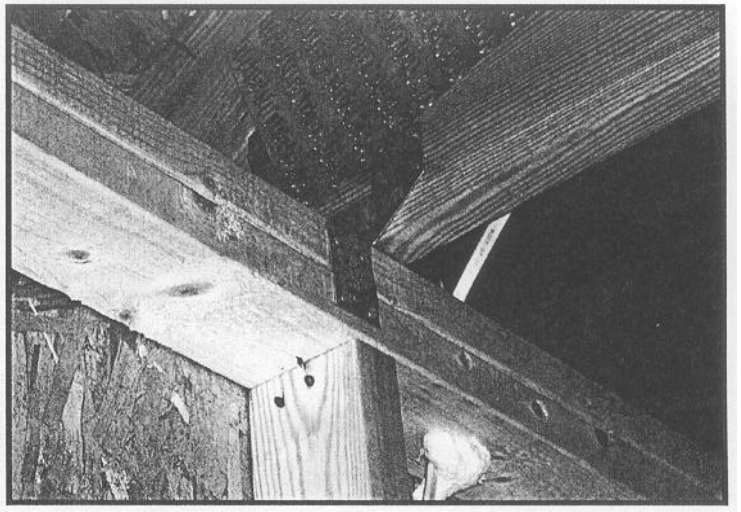
they build their homes. Furthermore, insurance companies and finance professionals need to recognize the long-term value of these technologies so they can perhaps provide incentives for their use. Proper installation procedures must also be emphasized so that consumers will indeed benefit from the new housing technologies.

The PATH program recognizes these issues associated with advanced technology dissemination and seeks to find solutions from the people that focus on these issues every day - representatives from all sectors of the housing industry and government, including finance, insurance, and realty professionals. Industry and government come together to solve the critical issues that prevent market acceptance and create policy recommendations that will guide the housing industry to a new understanding of technology. These representatives are organized into five working groups, differentiated by issue area: technology roadmapping, consumer education, insurance, quality, and finance. The working groups include government and private sector representatives who coordinate public and private efforts to conduct housing technology research and development work and accelerate market acceptance of advanced housing technologies. Each group is co-chaired by a representative from each sector.

The working groups have made strides in providing solutions to overcoming the barriers to market acceptance. The technology roadmapping working group is finding the best investments in technologies and has focused attention on three portfolios: 1) information technology to accelerate and streamline home building; 2) advanced panelized-type systems; and 3) whole-house and building



Structural insulated wall panels are an example of the innovative systems that were demonstrated at the Hands-On *BUILDER* workshop in Tucson, Arizona.



Residential wall-to-roof connector to resist uplift forces from high winds.

process redesign. The consumer education group is constructing a communications plan that plots the best course for describing the benefits of advanced technologies to homebuyers. The insurance working group is discussing how to best work with insurance companies regarding homeowner's insurance. The quality working group is compiling the best quality management techniques to ensure proper and consistent installation of technologies by trade contractors. The finance working group is helping mortgage lenders devise ways to use the mortgage process to encourage the construction of homes that incorporate energy-efficiency and other PATH-identified technologies.

Getting the Word Out

PATH also works to explain the benefits of advanced housing technologies to a wide range of audiences, including consumers, builders, government, and other stakeholders. PATH sponsored the Hands-On *BUILDER* workshop in Tucson, Ariz., in May 2000, with Fannie Mae (a government-sponsored mortgage program) and *BUILDER* magazine. The Hands-On *BUILDER* workshop provided installation and other product information about several alternative building systems such as adobe, straw bales, and SIPs.

Private Industry Partners

Participation from all sectors of the housing industry is crucial to the achievement of the PATH goals. Without the input of organizations like the National Association of Home Builders, PATH could not have a finger on the pulse of the industry. PATH works with the following private industry partners in a variety of ways, including working groups and demonstration projects.

- **Home Builders and Developers**
- **Remodelers**
- **Industry Trade Associations**
- **Product Manufacturers**
- **Home Systems Producers**
- **Non-profit Housing Providers**
- **Code Organizations**
- **Financial Institutions**
- **Utility Companies**
- **Insurance Providers**
- **Academic Institutions**

Representatives from PATH attend more than 18 conferences annually across the nation to explain the purpose of the program and the benefits of advanced technologies. PATH offers over 30 technical publications, which are available from the PATH website (www.pathnet.org). The PATH technical information site is www.toolbase.org.

Working With Forest Products

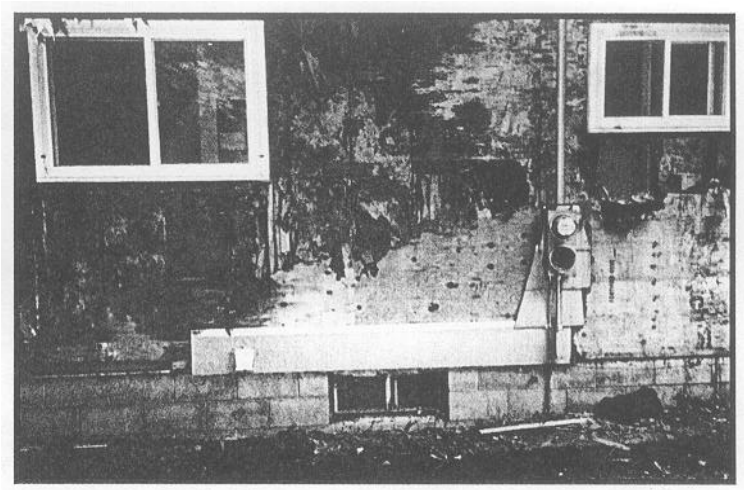
Ninety percent of America's housing is built from wood, so research on forest products is paramount. The USDA Forest Service is a full partner in the PATH program and has the lead role in wood-frame housing research through the Advanced Housing Research Center located at the Forest Products Laboratory (FPL) in Madison, Wisconsin.

Advanced Housing Research Center

Research at FPL's Advanced Housing Research Center evaluates and develops technology for both new and existing housing and encompasses all types of residential structures in which wood and/or wood-based products are used as primary or secondary building components. Emphasis is on the improved use of traditional wood products, the use of recycled and engineered wood composite materials, energy and sound efficiency, indoor air quality, an improved living environment, and natural disaster resistance. The Advanced Housing Research Center is focusing not only on the housing structure, but also on the latest theories and ideas in landscape design, options for water conservation and recovery, and an improved surrounding environment to make urban housing more livable.

FPL's Housing Center relies heavily on partnerships and alliances with universities, industry, interest groups, other branches of the Forest Service, and federal, state, and local agencies. The pool of technical expertise and a broad approach to problem solving is facilitated through consortiums that will further the objectives, effectiveness, and efficiency of the Advanced Housing Research Center.

One such group is the PATH Consortium for Wood-Frame Housing. It is composed of members from the National Planning Committee for Forest Products (NPC), a forest products subset of the National Association of Professional Forestry Schools and Colleges, the American Wood Council (AWC) of the American Forest and Paper Association, the NAHB Research Center, APA–The Engineered Wood Association (APA), and the USDA Forest Service, Forest Products Laboratory (FPL). In 2000, the PATH Consortium for Wood-Frame Housing helped sponsor several noteworthy conferences.



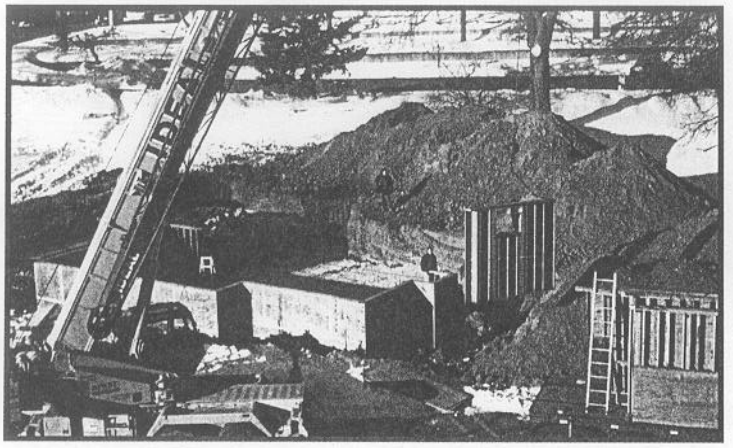
Example of major damage due to excessive build up of moisture.

Termites

A conference with the title "Residential Construction Materials and Practices to Protect Homes From Formosan Subterranean Termites" was held May 31 to June 1, 2000, in Baton Rouge, Louisiana. The Louisiana State University AgCenter and the Louisiana Department of Agriculture and Forestry hosted the conference. This conference brought together experts from Hawaii and around the continental United States to share information on methods and 'materials that will protect homes from destructive and aggressive termites, such as the Formosan subterranean termite.

Considered a "supertermite" by entomologists, Formosan subterranean termite colonies can contain more than 10 million termites and have been found in Louisiana, California, Mississippi, Alabama, Florida, Georgia, South Carolina, North Carolina, Tennessee, and Hawaii. Even though this termite was introduced more than 50 years ago by ships returning from the Pacific after World War II, the extent of their destructive force is only now being fully realized. This pest is unlike our native termite because it is much more aggressive and very difficult to control. The Wood Protection Council of the National Institute of Building Sciences has estimated that Formosan subterranean termites have caused more than $1 billion in losses per year, including $300+ million per year in New Orleans alone.

Because their numbers are increasing, these termites have become a serious problem in residential construction. One of PATH's goals is to increase the durability of housing; therefore, PATH and FPL's Advanced Housing Research Center are working on developing and advancing building systems that can protect homeowners from this devastating insect.



FPL's Advanced Housing Research Center's Research Demonstration House in Madison, Wisconsin, is showcasing a Permanent Wood Foundation (PWF). The PWF system is built in a factory, then transported to the construction site for installation.

Durability and Disaster Mitigation

On November 6 to 8, 2000, the "Durability and Disaster Mitigation in Wood Frame Housing" conference was held at the Monona Terrace Convention Center in Madison, Wisconsin. At this conference, design professionals, builders, code officials, researchers, and educators shared the latest information on issues related to housing durability and disaster mitigation.

Conference participants focused on the following: case studies of product and systems durability performance; national durability programs; wind, fire, flood, seismic, pest, mold, and rot issues; new products and technologies; construction quality assurance and implementation; and builder perspectives on durability and disaster mitigation. The conference **also** included a suppliers' showcase, displays of products, and poster presentations on subjects related to durability and disaster mitigation.

Current Research

There are a number of research projects currently in progress at FPL's Advanced Housing Research Center. The following descriptions highlight three of these projects.

Moisture decay. - Wood is usually a durable material if kept dry. However, many wood-based products used in buildings above the ground (e.g., wood siding and trim) can get wet regularly or sporadically from such things as plumbing leaks, roof leaks, floods, and rain penetration. Whether the wood survives such wetting is largely dependent on how long the wood remains wet, the temperature while it is wet, and whether decay fungi are already present.

It is well known that wood decays when its moisture content (MC) stays above the fiber saturation point for lengthy periods. However, it is not known how long the MC has to be above fiber saturation before decay will set in. Also, little is known about the susceptibility to decay of composite wood products, such as oriented strandboard (OSB) and hardboard,

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Public Sector Partners

Fundamental to the achievement of the PATH goals is the extraordinary contribution by federal government partners, who have taken an active and coordinated role to improve the nation's housing attributes, save homeowner's money, an even save lives. The following are federal government partners.

- **White House Office of Science and Technology Policy**
- **Department of Housing and Urban Development**
- **Department of Energy**
- **Department of Agriculture**
- **Environtnental Protection Agency**
- **Department of Commerce/National Institute of Standards and Technology**
- **Department of Labor/Occupational Safety and Health Administration**
- **Federal Emergency Management Agency**
- **Department of Interior**
- **Department of Transportation**
- **Department of Defense**
- **National Science Foundation**
- **Federal Housing Finance Board**

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under cyclical wetting. There are some unofficial rules of-thumb that use MC readings to assess the potential for damage, but unambiguous and well-founded guidelines to predict the future performance from these measurements do not exist, especially not for wood products such as OSB, which is increasingly being used as a replacement for plywood in roof and wall sheathing.

Research on preventing moisture decay of wood and wood composites will provide information on when decay occurs in wood aboveground in buildings. This is critical knowledge for the development of inspection guidelines, for improved use of wood in buildings, and will help in the development of durability standards.

Reclaimed lumber. — Since the turn of the century, more than 3 trillion board feet of lumber have been produced. Much of it has been used to construct buildings that eventually require repair or demolition. Reclaiming lumber during demolition can conserve forests and ease pressure on landfills. However, because no grade stamp exists for reclaimed lumber, the wood is difficult to market. Currently, the only option for builders using reclaimed lumber is in low-market-value applications that do not require grade stamps.

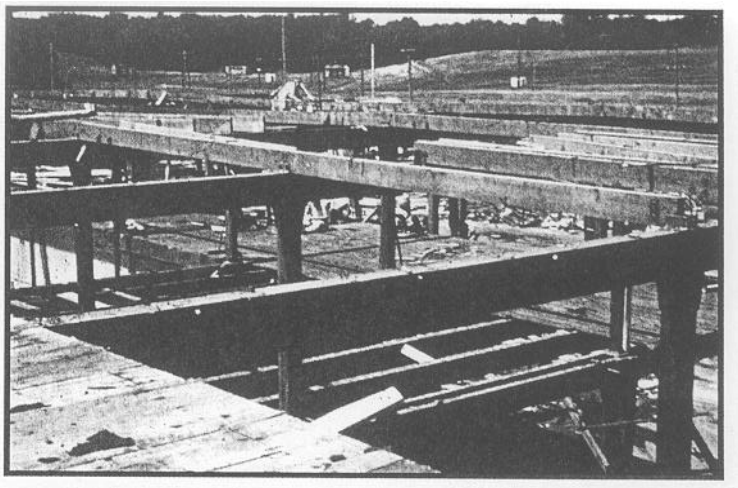
The development of grade stamp standards for reclaimed lumber is in progress. These standards should help expand the options for builders using reclaimed lumber and build broad acceptance among engineers, architects, and building officials.

High wind effects.— Hurricanes, thunderstorms, and tornadoes can wreak havoc where they strike. Researchers do not have a full understanding of how the wall and floor systems of light-frame homes behave during extreme wind events. Research is being conducted that focuses on uplift and the development of a reliability analysis procedure for load-path resistance and roof-wall loading.

Demonstration House

FPL's Advanced Housing Research Center has partnered with APA-The Engineered Wood Association, Tacoma, Washington, and the Southern Forest Products Association, Kenner, Louisiana, to build a 2,000-ft.^{2} demonstration house on the grounds of FPL. The project is part of the Build A Better Home® program launched this year by APA in response to growing concerns about building envelope performance issues, particularly those related to moisture intrusion.

In keeping with the mission of PATH, there are three objectives of the research demonstration house:



Reconstruction at the Twin Cities Arsenal, St. Paul, Minnesota.

- Illustrate proper design and construction practices that will help ensure the longevity and durability of wood-frame house construction.
- Serve as a field laboratory for research projects that will lead to improved wood-frame housing performance.
- Feature new housing technologies, which will increase implementation and marketability.

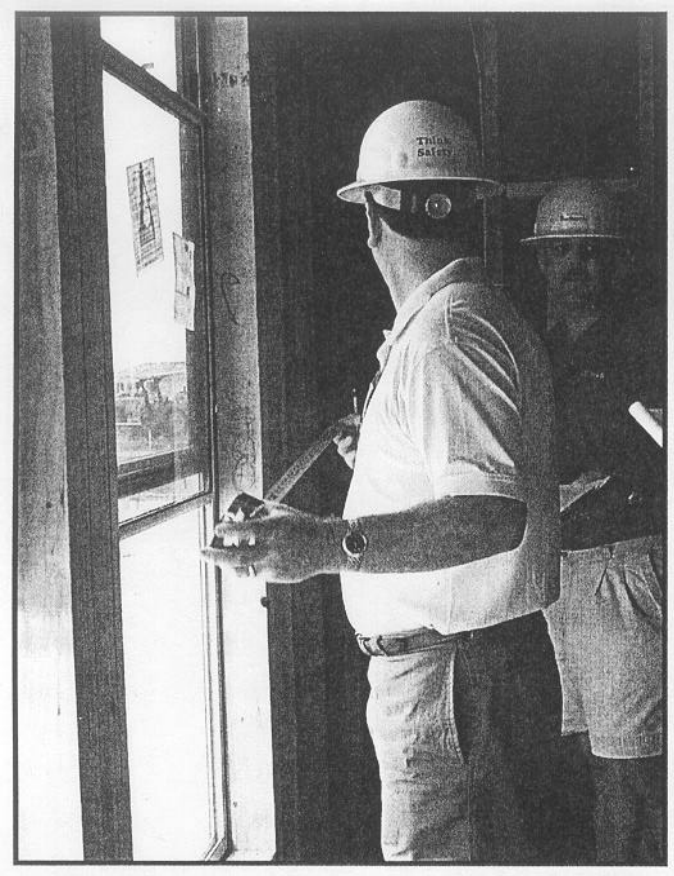
Throughout the construction process, the demonstration house will serve as an ongoing classroom of proper building practices, for example, assuring proper drainage around the foundation; choosing an appropriate housewrap, and using flashing around openings. Plans call for four different exteriors: lap siding, panel siding, stucco, and brick. The house will be built with moisture prevention techniques suitable for a variety of exteriors and it will demonstrate several innovative features and products.

The house will feature new engineered wood products, building systems, and application methods. One intriguing feature of the house is the use of a Permanent Wood Foundation (PWF). The PWF system uses lumber-framed foundation walls sheathed with plywood; all the lumber and plywood is pressure-treated to prevent decay from moisture and attack by termites.

In phase I of the project, the house will be framed and enclosed. Phase II will commence in the spring when an FPL research team begins installing instruments that will measure interior and exterior moisture and wind, and how the wind loads relate to the connectors in the walls, roof, and foundation.

Encouraging Quality in Wood-Frame Housing

PATH is also engaged in the Quality Assurance Program for Wood-Frame Housing, a program that



Builders making a quality assurance check on a construction site in Phoenix, Arizona.

applies internationally recognized principles of quality assurance to the residential framing industry. This program applies ISO 9000 principles to the framing process to ensure compliance with building codes, product installation requirements, and builder specifications. Expected results of implementing the ISO 9000 Quality Management system include reduced construction costs, increased durability, and fewer losses due to natural disasters.

PATH, FPL, and FEMA (U.S. Federal Emergency Management Agency) are all partners in the effort to increase the quality of framing. Industry participants include the NAHB Research Center, the Wood Truss Council of America (WTCA), All-Tech Construction, Del Webb, K. Hovnanian Companies, and Schuck and Sons Construction Company, Inc.

Framing was chosen as the project starting point because of its important role in construction. Currently, framing' accounts for 15 to 20 percent of the total cost of the average house. Framing is one of the most critical factors in construction because it affects cost, cycle time, quality, and durability.

With PATH funding, the NAHB Research Center developed the *ISO 9000 Quality Manual* for *Residential Framing*, which can be used by any framing company or builder. The manual contains a complete set of quality assurance procedures and forms, including procedures for qualifying carpenters and their work processes; ways to control the use of materials, tools, and equipment; jobsite inspection requirements; and quality improvement methods.

PATH also helped WTCA create a framing-carpenter training manual for builders, training workshops, and on-the-jobsite toolbox talks. Carpentry crew leaders who complete a training program receive a certificate that shows they have learned the ISO 9000 principles.

Builders who use the ISO 9000 Quality Management system will be assured that their homes are correctly framed i.e., that roof sheathing, connectors and fastening systems, and floor, wall, and roof components are properly installed. Design plans are accurately executed through this process. The cost of correcting structural defects after the house is built should be significantly reduced. An improved, more accurate construction process will also reduce the need for on-site custom fitting of building components (such as countertops, carpets, and cabinets), which in turn will reduce wasted time.

The next steps of the quality assurance program include 1) presenting the quality system to other trade contractors; 2) demonstrating the combined use of new building technologies and jobsite quality assurance methods to improve the disaster resistance and durability of single-family detached housing; and 3) continuing to provide information on the benefits of the program to the housing industry.

Building America's Homes Even Better

Through its partnership with industry and government, the PATH program is working to improve the housing industry. Drawing on its substantial diversity of participants, PATH is continually seeking new ways to make housing more energy efficient, durable, disaster resistant, environmentally sensitive, and affordable.

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