

M A N U F A C T U R E D H O U S I N G
TECHNOLOGIES

Humid Climates Spur New Research

Moisture problems due to condensation are not unique to manufactured homes. Many homeowners in hot and humid climates, such as the Gulf Coast region of the U.S., have reported incidences of moisture problems in their homes and manufactured homes are not immune to this concern.

Since water vapor is readily absorbed by some interior building materials, it can cause warping, swelling, cracking and other damage when present in critical levels.

In order to address this concern, MHRA first published a report in 2000 titled, **Moisture Problems in Manufactured Homes: Understanding Their Causes and Finding Solutions** and in 2001 it began a moisture field study to further study moisture problems in manufactured homes located in hot and humid climates.

According to Mike McKittrick, chairman of the MHRA moisture study committee and product manager for Nevamar Company, LLC, “Most conventional building techniques for housing were optimally developed for homes in colder climates. Studies like this offer ‘cutting-edge’ research to advance the knowledge about the performance of residential buildings in hot and humid climates.”

The purpose of the moisture field study was twofold: determine the key causes of moisture problems by gathering reliable performance data; and identify significant measures that would result in fundamental remedies to the problems. The possible problems that were tested fell into the categories of design considerations, homeowner behavior and installation (see figure 1).

Current suggestions for mitigating moisture damage typically include reducing shell and duct leakage, improving air distribution and pressure balance, upgrading ventilation systems to provide positive pressurization, including automatic controls for mechanical systems, installing correctly sized cooling equipment, sealing bottom board holes and placing the vapor retarder outside the insulation. While such recommendations are likely to be successful, this shotgun approach can be costly and fails to address the root cause of moisture damage.

Moisture Field Study continued on page 3

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Figure 1. Possible Contributing Factors Tested in Study

Design Issues	Installation	Consumer Behavior
<ul style="list-style-type: none"> Negative air pressure due to air handling system Imbalanced distribution of conditioned air leading to negative pressures Supply air that bypassed dehumidification system Duct leakage to the outside Oversized A/C equipment Vapor retarder location 	<ul style="list-style-type: none"> Lack of, or damaged, ground cover under home Damage to bottom board Integrity of marriage line and other penetrations of the shell leading to high rate of shell leakage 	<ul style="list-style-type: none"> Setting thermostat well below the dew point, usually 70 degrees Fahrenheit or less

The Factory of the Future

As part of the PATH roadmapping effort being conducted by MHRA to determine the future research agenda of the industry, a meeting on manufacturing plant design and process engineering was held during MHI's Summer Meeting in Washington, D.C.

The plant design and engineering session included four presenters, Michael Mullens, Ph.D., University of Central Florida; Matt Syal, Ph.D., Michigan State University; Bob Harwood, Southern Energy Homes; and Robert Van Pope, Fleetwood Enterprises. Each of the presenters gave a short presentation outlining new ideas for improving manufacturing methods.

PATH has held roadmapping meetings over the past few years to identify key technology needs for new and existing home construction. For all housing production sectors, PATH has targeted the areas of information technology that streamlines the homebuilding process; the use of advanced, panelized-type systems; and whole-house and building-process redesign as target areas. The manufactured housing roadmap is the latest in its series of focus areas.

MHRA is working to identify which technology

areas have the greatest need and potential for development and in which to target research and development funds provided by both governmental and private sources. Manufacturing process is one of ten areas that will be part of the manufactured housing roadmap. The roadmapping effort will focus on key industry needs and set out strategies, timelines, and tasks for PATH and the industry as a whole.

Some of the ideas suggested for integration into manufactured housing production were: processes to mechanically deliver materials to the point of production; new pre-assembled components that are ready to install; real-time computerized systems on the production floor to monitor labor productivity; and new factory designs based on computerized simulation modeling that allow flexibility and a larger range of floor plans.

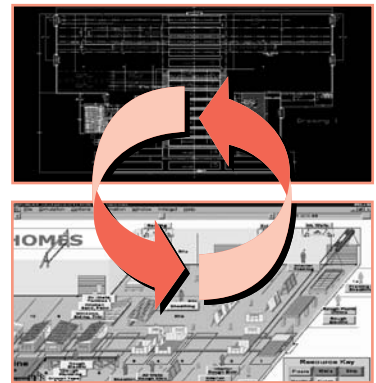
Dr. Mullens, one of the presenters, has already helped several modular builders to improve their processes through computerized modeling.

"I see a direct translation of the types of techniques and recommendations we have used for the modular market in HUD Code homes. In fact, it might even be easier [to implement] in the HUD Code environment," he said.

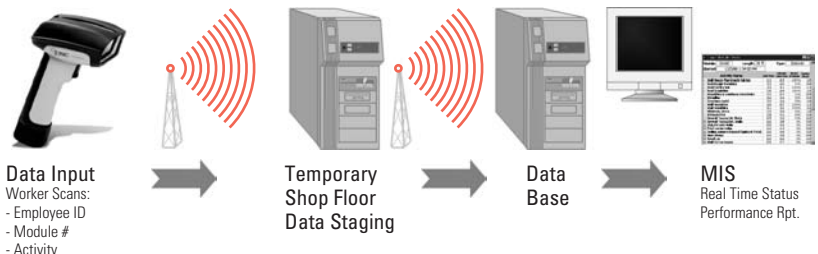
Robert Van Pope, also a presenter, put it this way, "We need the ability to move with the market and design our facilities to remain flexible."

Those who attended, such as Chuck Fanaro, president of Hi-Tech Housing, were intrigued by the possibilities. "I am all ears for any way that we can improve the efficiencies and quality of the product," he said.

In the coming months, MHRA will be developing a plan for conducting research in the area. For further information, contact Emanuel Levy at elevy@research-alliance.org.



Dr. Mullens uses real-time computerized systems and simulation modeling can be used to design factories that are more lean and agile.



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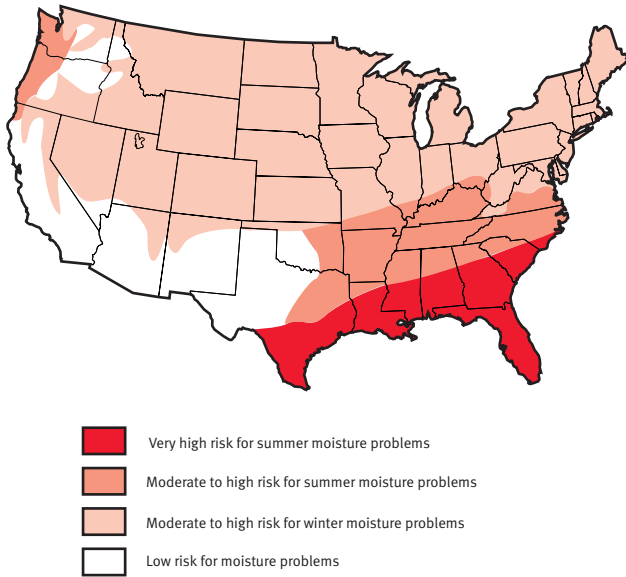
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Moisture Damage Risk by Zone

Through the study, the MHRA moisture committee hope to assist manufacturers, installers, servicers and homeowners in making rational, constructive and cost-effective decisions to mitigate damage from condensation.

The study looked at homes located in the Gulf Coast, including 65 homes with reported moisture problems and five homes without any problems. The initial results of the study seem to suggest that a number of factors may contribute to moisture problems, and that no one single element had an overwhelming influence on the incidence of moisture problems—making an integrated approach to solving long-term moisture problems more likely.

This fall, the moisture study committee will interpret the raw data and develop a list of its most compelling findings. They will also develop recommendations that can be applied by manufacturers, installers and consumers to help reduce moisture damage from condensation.

After recommendations are identified, MHRA will seek manufacturers to participate in testing to determine the most effective way to mitigate condensation build-up in hot and humid climates.

“While this study won’t answer all the questions, it brings the industry closer to addressing the root cases of moisture damage in hot and humid regions,” said McKittrick. 🏠

Unventilated Attic Design

Since the 1940s, conventional wisdom has maintained that proper moisture control in the attic cavity requires continuous ventilation with outside air. Additionally, energy conservation, mitigation of high temperatures on roof surfaces and prevention of ice dams are also thought to be further reasons to ventilate the attic cavity.

However, an MHRA committee with a broad-based membership from a variety of disciplines and chaired by Mike Zieman of RADCO Inc., conducted a thorough literature review of the extant research on the subject. They found that in the case of hot and humid climates, the attic might perform better if it were tightly sealed.

The initial research establishing attic ventilation was conducted exclusively in colder climates and ultimately became the standard practice in all building codes. However, in hot, humid climates, the combination of cooler ceiling temperatures meeting with hot humid air can conspire to cause condensation, which in turn can be absorbed into the ceiling materials—possibly causing damage. The venting of attics, at least for multisection homes, is a HUD Code requirement.

The committee recommended the study of four attic designs: a vented attic as a control, a sealed attic, a sealed attic with vapor retarder at the roofline, and a sealed attic with an insulated roof deck. They suggested homes be tested by exposing them to the seasonal extremes experienced in a typical home.

“When we move forward with the field research portion of this project, the study could turn out to validate a design concept that is less prone to condensation in the attic,” said Zieman.

For further information, visit MHRA’s Web site at: www.mhrahome.org or contact Jordan Dentz at (212) 496-0900 or jdentz@research-alliance.org. 🏠



Research-Based Publications

MHRA produces a number of publications to help its members utilize the research it conducts. Here are a few of the publications that apply to the articles in this issue of **TECHNOLOGIES**. A full listing of MHRA publications can be found online at www.mhrahome.org. You can also order MHRA publications from the MHI Bookstore at www.manufacturedhousing.org or by calling (703) 558-0400. Prices do not include shipping. Note: *All MHI Members are MHRA members and qualify for the discount prices.*

- **Moisture Problems in Manufactured Homes: Understanding Their Causes and Finding Solutions**, This 60-page guide is designed to assist manufacturers, retailers, installers, and homeowners recognize the movement, accumulation, and sources of moisture, offering strategies for avoidance and repair. (Members, \$35; Non-members, \$70)
- **Measured Permeance Values for Selected Interior Wall Assemblies**, This guide includes the results of tests of perm ratings in wall systems currently in use in hot and humid climates. (Members, \$15; Non-members, \$30)
- **Manufactured Housing Duct Systems: Guide to Best Practices**, This guide provides information for improving air distribution system performance in manufactured housing and



includes design, installation, and material selection recommendations to increase system efficiency. (Members, \$35; Non-members, \$70)

- **Guide to Foundation and Support Systems for Manufactured Homes**, This 112-page guide offers a compilation of practical and cost-competitive foundation solutions culled from experts and practitioners across the nation. (Members, \$35; Non-members, \$70)
- **ENERGY STAR Labeled Manufactured Homes: Design, Manufacturing, Installation and Certification Procedures**, This definitive guide to ENERGY STAR manufactured homes features all of the information needed to design, manufacture, label, and install homes under the ENERGY STAR program. (Members, \$35; Non-members, \$70)



GET INVOLVED...

North Carolina ENERGY STAR Certification


Qualifying a manufactured home plant to build ENERGY STAR Labeled Homes just got a little easier in North Carolina. Carolina Power and Light (CP&L) is working with MHRA to secure some of the funding necessary to assist manufactured home plants in North Carolina to become ENERGY STAR-compliant.

Since about one-third of all new homes connected by CP&L are manufactured homes, it makes sense to assist both the manufacturing plants who build to ENERGY STAR standards and the customers who purchase them. CP&L customers who purchase an ENERGY STAR-compliant home will receive a 5 percent energy conservation discount as a part of CP&L's new Energy Efficient Home Program.

"We are interested in the comfort, convenience and peace of mind of our customers," said Russell W.

Duncan, energy efficiency supervisor in the Energy Services department at CP&L, a Progress Energy company.

"Our goal is to certify every N.C. manufactured home plant," said Duncan. "Because manufactured homes are built in the controlled environment of a factory, ENERGY STAR inspection, compliance and certification is more efficient and cost-effective. Also, it means that the manufactured home leaves the factory with an ENERGY STAR label versus doing an inspection in the field."

For more information about this program, contact MHRA's Ian Klose at 212-496-0900 x15 or jklose@research-alliance.com. 



Partnership of Knowledge

Before the Manufactured Housing Research Alliance (MHRA) came into existence, coordinated industry research was usually conducted under the umbrella of the Manufactured Housing Institute's (MHI) Technical Activities Committee (TAC).

The research conducted by MHI sought to give guidance to government agencies as they made regulations that affected the industry. While this research was useful, it was limited.

For instance, in 1992 MHI worked with the Department of Housing and Urban Development after Hurricane Andrew to evaluate the impact on the manufactured housing industry of strengthening wind loads. According to Frank Walter, MHI vice president of technical activities, these types of issues formulated the main thrust of the research program.

In 1995, the burgeoning MHRA, with a small membership of utilities and industry companies, sought to expand its activities with additional support from MHI. In 1999, MHI became an underwriter of MHRA operations while giving the organization full freedom with its own board of directors and bylaws.

Today the two organizations work closely together to advance new technologies in manufactured housing. MHI provides some financial support and the knowledge of important industry representatives and MHRA provides credible research expertise and seeks additional funding from public and private sources. In addition, MHI's vice president of technical activities serves as MHRA's permanent secretary.

"MHRA has initiated a more broad-based and sophisticated process of bringing the industry, the consumer and government together to solve complex research questions. MHRA is held in high regard by everyone involved because of this process," said Walter.

MHRA has also been able to successfully transi-



tion into research areas originally started by MHI.

In 1997, a movement in government circles sought to look at foundation systems. MHI felt that MHRA would be the ideal forum for this research initiative. This eventually resulted in the newly released **Guide to Foundation and Support Systems for Manufactured Homes** developed by an MHRA committee chaired by Bill Farish of Fleetwood Enterprises, who also chaired the MHI TAC at the time.

But the research at MHRA goes beyond that which impacts regulatory action. MHRA's mission of "develop-

ing new technologies to enhance the value, quality and performance of manufactured homes," gives the organization a focus on research initiatives that create a market advantage.

Such research programs as the initiative to reduce duct leakage and the ENERGY STAR Labeled Homes program, have helped manufacturers to improve the quality and energy-efficiency of

homes. Other programs, such as the steel framing initiative and the condensation mitigation programs have advanced new technologies.

"Because MHRA works in the national research arena, it brings new ideas to the industry," said Walter.

"While MHI and MHRA have separate charters and directors, the synergy between the two organizations and close working relationship is crucial to providing a balanced view and relevant research," says Emanuel Levy, executive director of MHRA. 🏠

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Frank Walter, MHI



Installation in Flood Hazard Areas

The Federal Emergency Management Agency (FEMA) is in the midst of a process to update FEMA 85, **Manufactured Home Installation in Flood Hazard Areas**, originally released in 1985.

The industry is currently participating as an advisor to the federal steering committee, who will then forward the draft document to FEMA's Oversight and Technical Review Committees later this year. FEMA has also contracted with an engineering firm Greenhorne and O'Mara to complete generic design guidelines.

Preliminary designs already completed include a reinforced masonry perimeter wall, a wood-framed perimeter wall, braced masonry piers, and a wood-braced H-Frame. MHRA and its engineering consultant Gillans Inc., are critiquing and "value engineering" the designs. Industry representatives have recommended that ground anchor systems be included. The process of preparing the argument to include ground anchors

included gathering information about installation design and cost, and testing ground anchors in saturated soils.

Once the designs are completed, MHRA will test three or four of the recommended designs and will publish the results in an addendum to the recently-released **Guide to Foundation and Support Systems for Manufactured Homes**.

For further information contact Jordan Dentz at (212) 496-0900 or jdentz@research-alliance.org.

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