

**Safety Hazards to
Workers in
Modular Home Construction**

© 2003, The Center to Protect Workers' Rights. All rights reserved. CPWR is a research, development, and training arm of the Building and Construction Trades Dept., AFL-CIO: CPWR, Suite 1000, 8484 Georgia Ave., Silver Spring, MD 20910. This report is based on a small study supported by grant number CCU317202 from the National Institute for Occupational Safety and Health, NIOSH. The contents are solely the responsibility of the authors and do not necessarily represent the official views of NIOSH.

Abbreviations

BLS	U.S. Bureau of Labor Statistics
HUD	U.S. Department of Housing and Urban Development
NAICS	North American Industry Classification System
SIC	Standard Industrial Classification
WVU	Safety and Health Extension, West Virginia University

Video/CD ROM

A short video provides some of the information in this report – in VHS or CD-ROM format. Contact Mark Fullen, 1-800-626-4748, m.fullen@mail.wvu.edu The report and video will be posted at www.elcosh.org.

Contents

Background, <i>Page 1</i>	
Data on Injuries and Deaths from Injuries, 2	
Legislation, 3	
Research Methods, 3	
Participants, 3	
Job Safety Analyses, 4	
Questionnaires, 4	
Interviews, 4	
Findings, 5	
Job Safety Analyses, 5	
Hazards Typical of Residential Construction, 5	
Procedures and Hazards Unique to Modular Home Construction, 5	
Questionnaire Responses, 7	
Industry Relationships, 8	
Conclusions and Recommendations, 8	
Tilt-Up Roof Hazards, 8	
Fall Hazards, 9	
Hoisting and Rigging Hazards, 10	
Ladders, 10	
Statistical Classification (NAICS), 10	
Future Research, 11	
References, 12	
Figures 1- 19	

While conducting fall protection training, staff of the Safety and Health Extension, West Virginia University, learned of hazards that are unique to modular home construction and investigated them as part of a pilot study. The literature shows that not much research has been done on the modular home industry and that what has been done focuses on manufacturing, rather than installation. This report, based on observation, interviews, and a questionnaire, lists the hazards faced by workers that appear to be specific to modular home installation, recommends ways to improve worker safety, and suggests areas for future research.

Background

A modular home is best defined as:

Finished three-dimensional sections of a complete dwelling, built in a factory, [and] transported to [a] site to be joined together on a permanent foundation. The modular home meets conventional building codes and zoning requirements.¹

Modular homes are distinct from HUD Code manufactured homes, which are known as mobile homes. Unlike mobile homes, modular homes do not have integrated frames and axles. On a mobile home, the metal frame that the house is hauled on is also the structural floor support of the home and stays as part of the home after installation. A modular home, after it is transported to a site, is hoisted off of a metal-frame trailer. The structural portion of the house is timber and similar to typical “stick-built” construction. (Modular manufacturing is used for everything from outbuildings to large resorts and hotels.)

Modular homes are not new. Factory-built houses have been produced for a century. Sears, Roebuck and Co. sold 100,000 factory-built mail-order homes from 1908 to 1940.² Over time, the technology and quality has improved to the point where, after installation, it is sometimes hard to tell the difference between a stick-built and a modular home.

Of the industrialized housing-market segments – panelized, production builder, HUD code (mobile), and modular – modular home production is the smallest. Still, modular homes have seen the greatest growth in terms of percentages, averaging 12% per year in the number of homes in 1991-2001.³

Production data for the modular home industry are not readily available. However, in 1996, about 37,000 modular homes were produced and industry forecasters see the modular housing industry continuing to increase in its market share.⁴ All American Homes, the nation’s largest

¹Don O. Carlson, *Automated Builder Encyclopedia, Third Edition*. Carpenteria, CA 1995.

²Why buy a modular home. <http://www.the-homestore.com>

³Terry Traynor, Total Housing Even in 2001 at 2.219 Million, *Automated Builder*, January 2001, pages 19-21.

⁴Fast Facts on Building Systems. <http://www.nahb.org>

Legislation

Recently, Congress has moved to reform and modernize the 25-year-old federal regulatory program that governs construction standards for manufactured (mobile) homes.⁸ On December 27, 2000, President Clinton signed the Manufactured Housing Improvement Act into law (P.L. No. 106-569). It requires each state to institute an installation standard by December 27, 2005.

Under the new federal law, installation standards are “reasonable specifications for the installation of a manufactured home, at the place of occupancy, to ensure proper setting, the joining of all sections of the home, and the installation of stabilization, support, or anchoring systems.”

An attempt to set minimal safety requirements at the state level, The Manufactured Housing Installation Standards Act, was introduced by Sen. Keith Goodenough in the Wyoming senate in 2001, but failed by a vote of 12 to 18. The proposed law, while not specifying penalties, would have required that installers register with the state and comply with manufacturers’ requirements, among other things.

Research Methods

Participants

Four organizations participated in this research project (The companies installing the homes agreed to cooperate with the research on condition that they not be identified in the report.):

1. A new land and real estate development company, which had plans to buy land and produce housing developments made up mainly of high-end modular homes. The house that was installed during the study was to be the company’s model home to show potential buyers. So, they purchased the house from the manufacturer and then hired a contractor that specialized in “modular home sets.” This specialty contractor spoke of other projects where his company

⁸Manufactured Housing Institute. Summary of the manufactured housing improvement. Act P.L. 106-569. www.manufacturedhousing.org/government_affairs

Pilot study participants: Industry roles

Company or organization	Manufacturer	Buyer	Reseller	Installer	Subcontracts out installation
1		x	x		x
2	x		x	x	
3		x	x	x	
4		x	x		x

Job Safety Analyses

This study was based on job safety analyses of four modular home installations between June 2001 and April 2002. Staff of the Safety and Health Extension, West Virginia University (WVU) videotaped the installation processes with two cameras, while documenting the job tasks. Each sequence was videotaped for more-detailed analysis at a later time and also to compile a short informational video showing safety hazards in the modular home industry. (The video is to be posted at www.elcosh.org or contact m.fullen@mail.wvu.edu.)

The detailed analysis consisted of two members of the research team independently viewing the footage. After each completed a preliminary analysis, the two would meet and compile the data for a final analysis.

The videotaping was used also to help develop conceptual engineering controls for the hazards that were found to be specific to the modular home industry.

Questionnaires

While on site, WVU asked employees and employers to complete questionnaires about the experience and knowledge of the workers and companies involved; completion of the questionnaires was voluntary.

Interviews

At the same time, WVU interviewed the companies' on-site personnel to better determine the industry relationships and how the companies interact.

Findings

In one installation that was observed, the crane was overloaded and the operator was hoisting the module barely above the foundation, in case it had to be set down quickly. Eventually, the operator hoisted the house back toward the crane so the employees could enter the house, while suspended in air, and remove bundles of shingles to bring the total weight down so the module could reach its set point.

On the same installation, the set crew consisted of two employees (fewer than other companies in the study whose crews ranged from 5 to 10 employees). At various times during the day, both workers would work under and pass under the house as it was suspended above them (fig. 11).

When the house is set, the employees climb up on the roof. The reason: Most new modular homes have tilt-up roofs to accommodate U.S. Department of Transportation height restrictions. The roofs are tilted up on site (*see* figs. 12-18). Once the employees have accessed the roof, they use a special hook to rig

fourth contractor had a rigging assembly pull up through the house because the rigging holes were not set up to account for an uneven load. That mistake delayed the completion of that job by two months.

Differing procedures among the four companies could be explained by these factors:

- ◻ Manufacturer of the house
- ◻ Style of house
- ◻ Company experience
- ◻ Supervisor experience
- ◻ Worker experience
- ◻ Crane operator experience
- ◻ Site conditions
- ◻ Weather.

Questionnaire Responses

Two of the 4 employers and 17 of 25 employees (68%) chose to complete the questionnaire. The numbers of contractors and workers reported here are so small that they are not necessarily typical for the industry. Nonetheless, the following patterns were observed.

Experience and training. The questionnaire was used to determine employers' and employees' modular home installation experience, as well as their training related to modular home installations and safety. Questions were used also to ascertain what employers and employees believed to be the major hazards in the work and to identify their safety concerns.

Most of the employees reported receiving some type of on-the-job training; the survey did not ask about the duration or frequency of this training. One employee referred to the training as "common sense." Other employees and one employer indicated that the only training performed was in the manufacturing facility and not at the installation site.

Most modular homes now use **tilt-up roofs**, yet only 7 of the employees (40%) stated that they had received some type of training on such roofs. This questionnaire didn't ask participants to indicate duration or frequency of the training. Both employees and employers noted that tilt-up roofs present fall and crushing hazards, some of them fatal.

Likewise, with regard to **rigging**, only 50% of the employees had received training, yet 75% had rigged a modular home. More than 80% of the employees stated that **crushing** and **pinching** hazards, as well as potential damage to the house were pertinent concerns. Employers felt damage to the house was the major concern because of improper rigging.

Injuries. Five (29%) of the 17 employees responding said they'd been injured on a modular home installation jobsite in their careers, with these injuries: broken leg, finger amputation, strained back, sprained ankle, and an electric shock.

Safety equipment. Employees indicated that they thought they were provided with necessary safety equipment but that they would like to see personal protective equipment such as fall, eye, head, and foot protection. The employers did not respond to questions regarding safety equipment provided by the company and the researchers were unable to follow up.

The conceptual design that would reduce or eliminate this hazard is a support system that at any point in the lift of the tilt-up roof would have the ability to be secure and prevent the roof from collapsing. Conceptually, this design would be a telescoping support that at specific points in the extension would lock the previous section into place and, if the roof collapsed, would only slip back to the last locked section. This support could be designed to be an integral part of the home that is permanently secure to the ceiling joists and to the roof joists that once in place becomes the roof support.

Fall Hazards

The risk of falls from the roof and the attic area during the installation of a modular home is high. The residential construction industry currently follows OSHA's Interim Guidelines on Fall Protection for Residential Construction. The problem is that the roofing, attic and foundation wall work involved in the modular home industry differs greatly from that of stick-built residential construction.

Example 1: The residential fall protection guidelines require a safety monitor on a roof with a

Hoisting and Rigging Hazards

The hazard of making large lifts on a residential jobsite without adequately trained employees is another concern. Again, this differs greatly from other residential construction. As noted earlier (page 6), two employees worked under the house while it was suspended; one module weighed 22,000 pounds. On another site employees worked under the house while it was suspended to knock loose the wheels and axles before continuing the lift.

The solution to this hazard is to train employees in the safe procedures related to rigging these homes and working around them during the lift. The industry would also benefit from an OSHA guideline similar to that of setting precast concrete that is addressed in the Subpart M – Fall Protection Standard.

Ladders

Although common in all types of construction, ladders are used in numerous spots around the modular house for very short durations. In some cases, a ladder cannot extend above the foundation wall – as required by OSHA – because the house is about to be set on the foundation.

WVU would recommend a thorough review of existing ladder designs and ladder accessories that could benefit the industry. Also, employees need to be trained in the proper use and inspection of ladders.

WVU has developed the design of a ladder that could be used against foundation walls that would have a hinged arm that when not in use would fold down parallel to the ladder. When engaged, it could be hinged up to a vertical position above the top of the ladder and could act as a handhold to access the foundation wall and the ladder. This ladder would need to incorporate some other ladder accessories that are currently available, such as rubber grips on the top ends of the ladder to keep the ladder from slipping down the wall and a balance system at the bottom of the ladder to keep it from slipping out from under the worker (fig. 19).

Statistical Classification (NAICS)

In conducting this research it was apparent that, for a modular home, the construction process is completely different from that of traditional residential construction. Tracking of industry hours, injuries, deaths, and compliance with government safety regulations would be feasible if the modular home classification code was moved up one level in the SIC/NAICS, so modular installation is equal to residential construction, and not a subset.

Future Research

Research is needed into industry relationships, the economics of the industry, and the true injury and death statistics. There is a need also to complete designs of the proposed safety systems described in this report.

* * *

The many different roles that exist and all of the potential combination of “players” that can or cannot be involved with a project makes studying and, more important, changing the safety of the industry difficult. There may be a move for positive change in the industry, however. Elliott Fabri, President of New Era Homes, called for the Modular Industries to “come of age” in an acceptance speech after receiving the Automated Builder/James R. Price Achievement in Housing Award for 2001. Some of his goals for the industry included no longer shipping out boxes and hoping that they are installed properly on site. He sees the industry moving to more “turnkey” projects, where the manufacturer assures not just a quality-built home, but a quality-installed home. Safety wasn’t addressed specifically, but quality of products, thinking outside of the “box,” and new design methods were, which leaves room for interpretation that if the industry is in the middle of a dramatic change, this would be an appropriate time to reassess the risks to the modular home installers and develop innovative ways to control those risks.

References

Carlson, Don O. 1995. *Automated Builder Encyclopedia, Third Edition*. Carpinteria, CA, Automated Builder Magazine Publications.

Fast Facts on Building Systems. no date. www.nahb.org.

Manufactured Housing Institute. 2003. Summary of the manufactured housing improvement. Act P.L. 106-569. www.manufacturedhousing.org/GA_summary.html

OSHA, Occupational Safety and Health Administration, U.S. Department of Labor. Inspections within SICs. <http://155.103.6.10/cgi-bin/sichq/sic1> (as of March 12, 2002)

Personick, Martin E., and Judy R. Daley. 1989. Profiles in safety and health: Work hazards of mobile homes. *Monthly Labor Review*, 112(7): 15-20, July.

Sharon Stangenes. 2000. Home Delivery. *Chicago Tribune Internet Edition*, www.chicagotribune.com/marketplaces/homes, April 8.

Tilt-Up Roofs for Manufactured and Modular Homes. www.nahb.org

Why buy a modular home. www.the-homestore.com