FIELD EVALUATIONS AND RECOMMENDATIONS FOR STEEL FRAMED HOMES

Jordan Commons Project

Prepared for:

U.S. Department of Housing and Urban Development
Office of Policy Development and Research

Prepared by:

NAHB Research Center, Inc.
Upper Marlboro, Maryland

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JORDAN COMMONS PROJECT

BACKGROUND

In 1993 and 1994, the NAHB Research Center, Inc. prepared two reports for the U.S. Department of Housing and Urban Development (HUD) on alternative framing materials for residential construction.[1] In both of these reports, steel framing was identified as a commercially available material that could provide a cost-effective structural frame for homes. In 1994, under a cooperative agreement with HUD, the National Association of Home Builders (NAHB), the American Iron and Steel Institute (AISI), and the NAHB Research Center began work to develop prescriptive methods for framing with cold-formed steel, with the ultimate goal of having these methods recognized by building codes.

Concurrent with this work, a series of related activities have been initiated by different sectors of government and industry. For example, the NAHB Research Center initiated a Steel Framing Hotline under contract with the American Iron and Steel Institute in 1994. Engineers staffing the hotline provide technical assistance to builders and other callers on steel framing. A graph showing the types of information most often requested is shown in Figure 1.

From the feedback obtained on steel framing, it has become apparent that field evaluations will play an important role in addressing issues that could make steel a more cost-effective material. An opportunity to conduct field evaluations surfaced in 1995 with the initiation of an affordable housing project in south Florida.

Habitat for Humanity (HFH) in Homestead, Florida started construction in 1995 of a 187 unit community called Jordan Commons. Among the many unique features of this development is the inclusion of cold-formed steel as the framing material for the homes. This HFH project is part of an overall effort to rebuild parts of south Florida damaged by Hurricane Andrew in 1992.

With support from AISI and NAHB, builders and others have been traveling to the Jordan Commons project to take part in week-long training programs where they get to actually help erect a steel framed house in the course of the training. This type of hands-on experience has proven invaluable to the builders and is often the last step that builders need before implementing some of the practices on their own projects.

A research project was developed by the NAHB Research Center under support from HUD to interview builders taking part in this training program to get their reactions to the problems they encountered working with steel framing for the first time. With the cooperation of many tool and fastener manufacturers, the researchers conducting the program were able to identify many problems and issues that could be easily changed in the field. Other problems, which were larger in scale,

[1] **Alternative Framing Materials in Residential Construction: Three Case Studies**; Prepared for U.S. Department of Housing and Urban Development; July 1994.
Alternatives to Lumber and Plywood in Home Construction; Prepared for U.S. Department of Housing and Urban Development; April 1993.

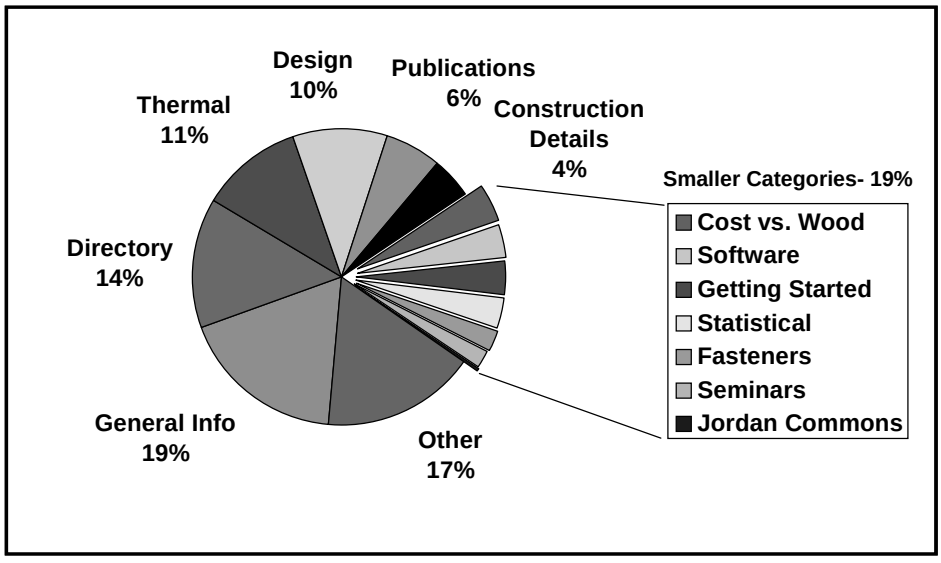
were brought to the attention of the manufacturers in the form of telephone conversations or through two workshops that were set up by the NAHB Research Center. The HFH site gave the researchers an opportunity to bring the manufacturers together in a "living laboratory."

Through the results of this study and future research efforts, the ultimate goal is to improve the cost-effectiveness of cold-formed steel framing for residential construction. Although there are many advantages in using steel as a framing material, this study focuses on the practical installation problems builders encounter working with cold-formed steel. Advantages are not discussed, since the purpose is to increase the efficiency of steel framing by identifying immediate solutions to builder problems where possible, and to motivate manufacturers to initiate product improvement research to address longer-term problems.

FIGURE 1

STEEL HOTLINE CALLS–1995

Summary of Issues Identified by Callers



PLANNING AND DESIGN

The initial step in the training program was to settle on a design that would give builders the opportunity to work on homes where their experience would be transferrable to other parts of the U.S.. However, Hurricane Andrew had a significant impact on the way houses in Dade County are built today. The county changed their building code in an effort to minimize losses in the next storm event. Houses must be designed to resist wind loads of 110 miles per hour and coastal wind exposure ratings. All building materials must now be approved by Metro-Dade Product Control, and withstand several tests conducted at a Dade County approved laboratory. All of these requirements add considerably to the cost of building a house in south Florida. The steel frames that were initially designed for Jordan Commons are much heavier than those found in other parts of the country.

In an effort to reduce energy costs, many features were included in the Jordan Commons houses that are typically not found in other Habitat for Humanity projects. For instance, the houses were designed with nine-foot ceilings, three-foot roof overhangs, vaulted ceilings, and hip roofs with white reflective metal roofs. This, in combination with the tighter building code, had a direct impact on the size of the steel members in the design. For example, the wall studs had to be 2 x 6 studs, 43 mils, rather than 2 x 4s, 33 mils. Also, six-inch top chords, 54 mil thick, were required on the scissor trusses in the vaulted ceilings.

After the first training program in July, 1995, it became apparent that builders were experiencing a much more difficult framing process than for homes in other parts of the country. Working together with the Homestead Habitat staff and AISI's cold-formed steel engineer, the NAHB Research Center provided recommendations on how to value engineer the steel framed homes to more efficiently use steel, and to give the builder volunteers a better experience.

The following recommendations were implemented in the new steel house design:

- Change the roof configuration from a full hip to a Dutch hip, which better utilizes a standard truss for most of the roof.

- Eliminate the vaulted ceilings and provide flat bottom chord trusses.

These recommendations resulted in reducing the amount of steel per house from eight tons to four tons. The roof trusses were reduced to four-inch members with 43 and 33 mil steel, which accounted for the greatest savings of material in the houses. This also resulted in a savings of labor hours that were previously devoted to complicated hip and girder truss details, and the extra time it took to assemble trusses. These modifications made it possible with a crew of ten volunteers to completely frame the house in five days.

In addition to design changes, it was noted that the delivery of the steel was slowing down the initial group of builders. This was mostly due to inconsistent packaging and cutting of the materials. The NAHB Research Center, along with AISI, identified a local roll former in south Florida who was

willing to pre-cut the steel to length, and properly identify and bundle all the steel. This saved the field crew considerable time and effort framing the homes.

With an efficient design and delivery system in place, the NAHB Research Center proceeded to recruit builders for the evaluations. The following sections contain the results from each builder week.

RESULTS OF BUILDER EVALUATIONS

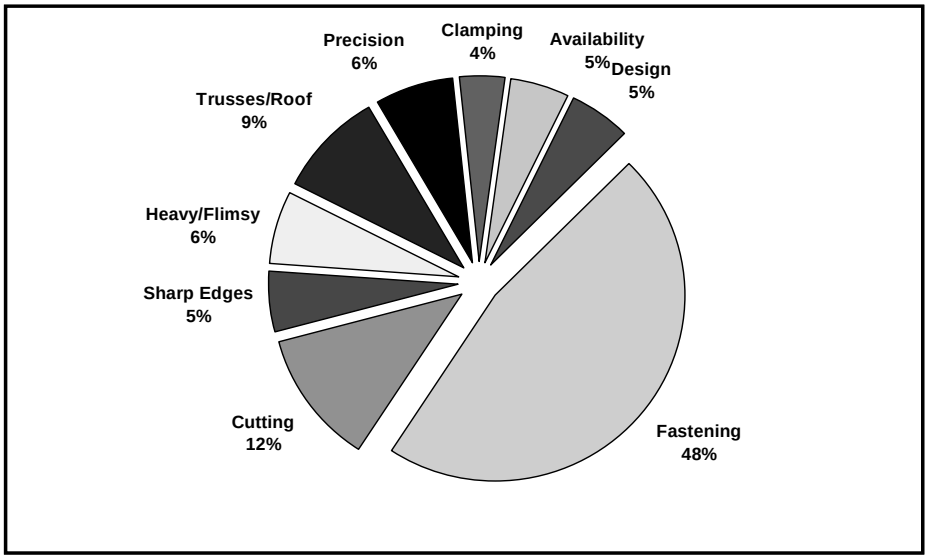
For the first six weeks of the project (one week per month from July through December, 1995) a researcher monitored the construction of the homes at Jordan Commons. Most of the builders had never worked with steel before. Builders came from all over the United States and as far away as Columbia, South America.

Near the end of each training week, the builders and other participants were interviewed and asked for their input on any problems they encountered working with steel. The builders were asked for their recommendations and possible solutions for both the short- and long-term. The data from the interviews was recorded and entered into a database. A total of 51 builders were interviewed. The results of the interviews are included in Appendix A.

Problems that the builders identified while working with steel at Jordan Commons are shown in Figure 2. The following section discusses the problems in more detail and how they were addressed.

FIGURE 2

SUMMARY OF PROBLEMS AT JORDAN COMMONS

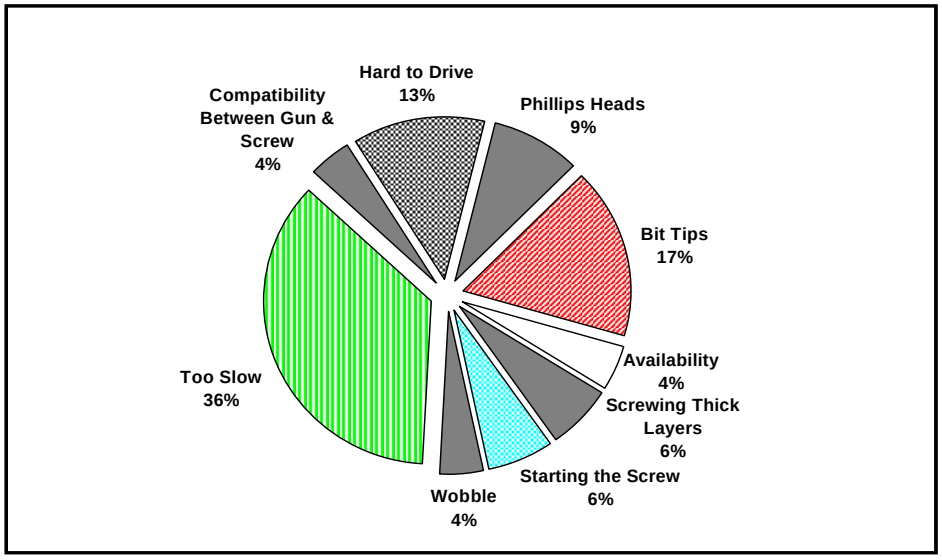


Fastening

The single largest problem that builders identified was fastening the steel members together. This category was so large, it was broken into subcategories of individual fastening problems as shown in Figure 3.

FIGURE 3

SUMMARY OF FASTENER PROBLEMS



Thirty-six percent of the builders commented that the process of screwing steel together was too slow compared with wood framing. Most of the builders compared the screwgun and screw to the pneumatic nailing system commonly used in wood framing today. There was no comparison made to nailing with a hammer. Some of the builders admitted that they were new to using a screwgun, and that they became more efficient later in the week. Other builders commented that it was an awkward process and it would never become faster than end nailing a wood plate into a 2 x 4 stud. The instructor at the site applied screws with little difficulty and made the job look easy. However, he has been working with steel for almost 20 years.

Collated systems are being developed by different manufacturers that will increase speed. These were not introduced into the training program because of the instructor's belief that beginners should learn the proper way of using a screwgun before moving on to more expensive attachments. Manufacturers of these tools will be encouraged to try their products at the jobsite in the future with the Habitat for Humanity staff.

Some builders commented that welding should be considered as an alternative for fastening. Welding is not widely used in residential construction today because of uncertainties of how the

welds will be inspected, and the galvanized coatings at and near the weld will have to be re-coated where they are destroyed from the heat. Other fastening techniques such as clinching, crimping, and press jointing are being used in other countries, but have not been widely accepted in the United States. Many of these newer techniques may have the greatest potential for panelized construction.

Seventeen percent of the builders commenting on fastener problems identified bit tips as another problem. The Phillips bit tips supplied on this project frequently broke off in the head of the screw. Other times, the bit tip would slip out of the holder and remain in the screw. Builders frequently had to stop to retrieve the bit tip and put it back in the holder. Breaking bit tips are caused by metal fatigue and over-torquing the screw with the screwgun. Losing bit tips in the screw is caused by the slip anchor in the bit tip holder wearing out and no longer providing enough grip to hold the bit tip in place. As for the hex head drivers, builders complained that the magnetized driver would fill up with steel shavings and get in the way of holding the hex head screws. It was difficult to clean out the driver of the shavings, and considerable time was lost keeping the drivers clean.

Thirteen percent of the builders complained that it was difficult to drive the screws through the steel. This process is particularly difficult when the framer is in an awkward position or has to screw upward, or towards himself. There is a certain amount of pressure a framer must apply to start the screw to drill through the steel. Once the self-drilling tip of the screw penetrates the steel, the threads engage and pull the screw tight to the steel. Learning to apply the correct amount of pressure to penetrate the steel takes practice. Once the builder learns to operate a screwgun properly the process becomes more efficient. Some manufacturers are working on improvements to the screwgun so that the tool will apply the pressure rather than the framer. Unfortunately this technology is not currently available.

Nine percent of the builders commented that the Phillips head screws were difficult to use. The self-drilling Phillips screw often took too long to penetrate the steel. It took considerable time to get through not only the first layer of steel, but subsequent layers as well. Many times the tips would burn up before completely fastening the steel. The engineer called out #10 screws for all applications on the first model due to the wind loads. A #10 low profile screw could not be easily located on the east coast and had to be special ordered. With the help of one manufacturer, a #10 screw that better penetrated the steel was located and used to complete the first model. The engineer changed back to the #8 low profile screw for subsequent models.

Six percent of the builders had difficulty starting the screw, but this usually was overcome as they gained more experience on the jobsite. Others had difficulty screwing through thick layers of steel, especially on the scissor trusses. This problem was eliminated once we switched to the lighter house design.

In other locations, builders have had difficulty installing doors and windows directly to steel frames. The steel window and door openings at Jordan Commons were lined with 2 x 4 wood bucks. Therefore, the windows and doors were installed the same as conventional wood framing.

Cutting

Cutting steel on the jobsite was accomplished by three different methods. A chop saw was used for repeated production type cuts. Electric shears were used to make miscellaneous cuts and to cut gusset plates for the trusses. Aviation snips were used for small cuts on the flanges of studs.

The electric shears were used to do the majority of the cutting. Eighteen- and 14-gauge shears were the two types of shears used at Jordan Commons. Electric shears are quieter than the chop saw, and faster than aviation snips. However, they must be used correctly and many builders struggled when they first started using them. When applying too much pressure on the shears they would not cut properly, and if they were not held at the right angle, they seemed to stall. It was difficult to cut around the radius of the flange of a stud. Many times the builder would force the shears, causing the blade to break.

When the shears were first used at the jobsite, there was no way to repair them. Almost every week, two or three pairs of shears would become dull or be broken. Later, a supplier was located to provide a new supply of blades to keep the shears in good condition.

Despite the progress that was made on using the electric shears, twelve percent of the builders commented that the process was awkward and more difficult than using a circular saw with wood. Many commented that the blades broke too frequently, and the shear pins holding the blades together also broke often. The manufacturers were made aware of these problems.

Trusses and Roof Construction

With steel framing today, roof trusses are generally designed by an engineer retained by the builder. The builder typically submits a cutlist to the manufacturer and assembles the trusses at the jobsite. This is much more involved and more expensive than simply ordering pre-engineered roof trusses and having them delivered to the site. Builders are not accustomed to building trusses. Therefore, they typically have not gone through the effort of laying out trusses and ordering the material. Some of the builders complained that assembling trusses was a problem. However, most of the builders found the process easy once a jig table was built and the members were all pre-cut. They found that two or three men could assemble a truss in three to five minutes.

About nine percent of the builders complained that either the trusses were too heavy to work with, or the hip roof framing was difficult to frame. Both of these problems were solved when we simplified the design and moved to a Dutch hip roof. This resulted in much lighter trusses, and less detailed connections in the hip framing.

Fortunately, many wood truss manufacturers are considering and already developing steel trusses and will be marketing them soon. One truss manufacturer has teamed up with a roll-former to fabricate steel trusses in south Florida. Representatives from these companies visited Jordan Commons to explore the possibility of manufacturing steel trusses for the project.

Other Categories

Six percent of the builders felt that steel was either too heavy or too flimsy to work with. Those that felt it was too heavy worked on the heavy model that was later redesigned. Wall panels were fabricated on a jig table in full 40 foot lengths. Using 43 mil 2 x 6 studs, these panels were very heavy. While there was plenty of labor in the field at Jordan Commons, some builders commented that on jobsites where only four or five men are working, the panels should be broken into shorter walls. Those that felt it was too flimsy framed interior partition walls out of 18 mil material. Eighteen mil material is easily bent during construction, however, once the gypsum wallboard is attached it provides a sturdy wall section.

Another six percent of the builders mentioned that steel is unforgiving and therefore they needed to be precise with their measurements. Wall studs were cut to nine feet in length. If the studs were not screwed tight against the track, a bend in the track would occur. Also, if the trusses were not set accurately in place, one truss could be noticeably sticking above the rest. Inaccuracies like these have a tendency to be very visible. However, because greater attention was given to accuracy, the result was generally a very straight wall or roof assembly.

About five percent of the builders complained that they could not get complete steel framing services in their area. Issues included difficulty in locating a supplier, engineering services, and framing crews. Another five percent complained that they could not find design professionals that were familiar with cold-formed steel design. These builders were given lists of manufacturers and design professionals provided by AISI.

Yet another five percent complained about sharp edges and frequent cuts working with steel. They were concerned about workmen's compensation rates. Safety guidelines working with steel were reviewed the first day to reduce the potential for jobsite injuries.

Finally, about four percent of the builders did not like to take the extra step of clamping the steel together to prevent the steel from separating during attachment. Sometimes they found it difficult adjusting the clamps since both their hands were full. Part of this was overcoming the learning curve. In the meantime, a clamp manufacturer is working on easier, lighter C-clamps to use in the field.

MANUFACTURER INVOLVEMENT

Many manufacturers have been involved in the Jordan Commons project, not only donating product to the job, but working with builders to find easier ways to frame with steel. Some of the manufacturers sent their representatives to help work at the jobsite. Others came to the meetings that were held with Dade County to help in the approval process. Still others participated in the two workshops that the NAHB Research Center coordinated as a part of this project.

Manufacturers at Training Weeks

On two different occasions, representatives from major tool companies were invited to work alongside builders at Jordan Commons to learn more about framing with steel and how they could improve or develop new tools. One manufacturer sent their representatives during the first week of training.

The first manufacturer produces hand tools such as aviation snips, C-clamps, and accessories like saw blades. In addition to donating all the hand tools for this project, they sent five representatives from their company to help frame with steel. They had several ideas on how to improve their locking C-clamps to make them easier for builders. They brought a prototype of a lighter clamp, and they explained to the builders how the locking C-clamps work. They also brought with them several prototype saw blades to use in circular saws to cut steel. While the blades cut through the steel quickly, they produced a lot of noise and threw a lot of metal chips and sparks. They indicated that they were going to continue their work to improve the blades.

During the fifth training week, five representatives from a second manufacturer came to Jordan Commons. This manufacturer donated all of the screwguns, chop saws, roto-hammers, and electric shears to the project. The manufacturer's representatives were interested in finding out for themselves how their tools were performing on the jobsite. They also brought prototype power tools to the project for experimentation, including a circular saw with a cover to capture the metal chips. This saw was much quieter and cut steel with no difficulty. They used the saw to cut rafter tails and other cuts which greatly increased the production time.

The second manufacturer spent considerable time monitoring how their adjustable clutch screwgun was performing. They noticed the problem builders were experiencing with the Phillips head screws. The manufacturer's representatives explained that while they manufacture the tool to drive the screws, they do not manufacture the bit tip holder, the bit tip or the screw. They explained that the Phillips screw-driving system was designed to slip or "cam out", to prevent over-torquing. This "caming" action is caused by the tapered slots on the Phillips screws. They refer to this screw system as a "negative drive system". The "caming action" of the Phillips drive system introduces a second clutch to the adjustable-clutch screwgun which makes it very difficult to drive the screw. The manufacturer's representatives suggested that a new screw should be developed with a "positive drive system" such as torque or square drive system.

Another suggestion was to develop a low profile hex drive system with a mechanical bit tip holder which would grab and release the screw upon reaching a desired torque.

The second manufacturer's representatives related the problems with the "negative drive system" to the frequent breaking of the bit tips. The reason for the rapid wearing of the bit tips was the constant slipping or "caming" of the bit tip in the screw. This problem should be resolved with the development of a positive screw-driving system.

The second manufacturer also plans to make the screwgun shorter, thinner, more compact, and easier to read and adjust. They brought prototypes out to the field for builders to try several times. One area that they felt they could not improve on at this time was making the screwgun lighter.

The second manufacturer's representatives found that the shearing pin connecting the drive linkage to the drill motor of the electric shears was too weak. They also thought that the manufacturer of the electric shear should replace the shearing pin concept all together with a clutch system to prevent damage. They also found that the turning radius of the shear should be smaller for tighter areas.

To address the frequent clogging of the magnetic hex drivers, the second manufacturer's representatives suggested builders carry a high power magnet with them to clean out the drives.

Thermal Workshop

One of the issues that builders at Jordan Commons and elsewhere are concerned about is the thermal performance of steel frames. Since the HFH homes did not result in an opportunity to address thermal issues such as attachment of exterior foam insulation, a Thermal Workshop for Steel Framing was held in March, 1996, for experts in the industry to gather to help builders meet energy codes and to fasten foam insulation to steel framed houses. A workshop summary is included in Appendix B.

One problem builders at the workshop have with adding foam board insulation to a home is the method of attachment and working with different types of siding. For instance, where stucco is popular, builders have difficulty attaching the metal lath to the foam board. One of the builders that attended the workshop is working with a screw manufacturer to develop a new device to "grab" the lath and hold it in place. Other builders expressed concern with attaching vinyl siding over the foam board, stating that many siding installers charge more to apply the vinyl over foam.

Several experts from the steel, insulation and fastening industries participated in the workshop, along with researchers that have conducted thermal testing on steel framed walls, and experienced steel framers. The participants mentioned the foam and fastener products they have today and the products they are developing to make it easier to deal with the thermal problems associated

with steel framing. The group concluded the workshop by listing their current ideas to help builders, and also their long-term ideas that may be implemented in the future.

Another product of the workshop was the drafting of a "Fact Sheet" for builders. This "Fact Sheet" provides recommendations on the types of insulation and fasteners that are currently available to use for steel framing. A copy of the "Fact Sheet" is included in Appendix C.

Tool and Fastener Workshop

Based on results from the interviews the NAHB Research Center conducted at Jordan Commons, fastening methods are the top issues that builders were concerned about in the field. For this reason, a Steel Framing Workshop on Tools and Fasteners was held in April, 1996, for the experts in the industry to gather to help builders deal with fastening problems and speed up their production. The participants mentioned the tool and fastener products they have today and the products they are developing to make it easier to deal with attachment issues.

During the workshop builders expressed many concerns regarding the fasteners they use in steel framing. Some of the builders had encountered corrosion problems with the screws. Others were concerned with the performance of the fasteners during framing. They wanted to make sure that they were using the correct fastener for each application. Builders also pointed out the higher cost and lack of availability of the fasteners. Fastener manufacturers were present to provide recommendations to the builders and receive some feedback for possible modifications to their fasteners.

Power and hand tool manufacturers were also present to explain their products and introduce new tools and future technology to the builders. Manufacturers introduced a prototype screwgun and many new clamps. Future technology for cutting steel framing members was also discussed. The builders discussed the proper techniques for using the current tools available and provided excellent feedback to the manufacturers on their prototypes. A copy of the workshop summary is included in Appendix D.

As with the Thermal Workshop, a "Fact Sheet" was developed for builders dealing with the fastening issues. This "Fact Sheet" provides recommendations on the types of tools and fasteners that are currently available to use for steel framing. A copy of this "Fact Sheet" is included in Appendix E.

CONCLUSIONS

As builders begin to use steel, they face many challenges. In order to effectively enhance the development of this alternative material, close field observations and monitoring of builder problems coping with new methods of framing needs to occur. There is a direct benefit of talking to builders going through training programs like Jordan Commons to get their reactions to steel framing. Many manufacturers like those who have participated in this project have identified the steel framing market as one they wish to be a part of and provide tools and product for the industry. It is encouraging to see such a large part of the industry work together to design new tools, fasteners, and insulation products as steel frame construction begins to take hold.

Builders can benefit from all the ingenuity and entrepreneurs we are seeing in this industry. They also can learn from other steel framers who have mastered a major part of the learning curve. Based on the experiences gained in this project, several recommendations can be made for the construction of new steel framed homes:

- Research is needed to develop practical solutions to thermal issues, including the best ways to cost-effectively attach foam insulation to steel framing members. This issue is starting to be addressed in other research funded by the steel industry.

- Manufacturers must continue to develop tools and fasteners that will increase the speed of construction. This report will help motivate manufacturers by summarizing the issues important to builders.

- Research is needed to explore how panelization can help speed up framing by providing a factory setting to save time assembling walls and trusses.

- In the short term, it appears that education will also be important in helping to lower costs. The two fact sheets developed under this project should be widely distributed to help builders overcome the frustrations associated with using the incorrect tools or fasteners and to help them select appropriate materials to meet thermal requirements.

APPENDIX A

RESULTS OF BUILDER EVALUATIONS

(Appendix A is not available in the electronic version.)

APPENDIX B

THERMAL WORKSHOP SUMMARY

Thermal Workshop for Steel Framing

U.S. Department of Housing and Urban Development

American Iron and Steel Institute

NAHB Research Center, Inc.
Upper Marlboro, MD
March 8, 1996
10:00 a.m. - 4:00 p.m.

Workshop Summary

Welcome and Introduction

Tim Waite of NAHB Research Center, Inc. opened the workshop at 10:00 a.m. and welcomed all of the participants. Tim stated that the objective of the workshop was to help builders meet the energy code and to fasten foam board to steel-framed houses. The goal is to write a fact sheet for builders on available methods and materials.

Comments from the Steel Industry

Jay Larson (Bethlehem Steel) commented that thermal studs have been used in the past, and are currently manufactured in Europe. Thermal studs have a portion of their webs removed either by slitting or louvering. He suggested that these studs should be re-examined. Ken Vought (USS/POSCO), Ray Frobosilo (Super Stud), and Rick Haws (AISI) all stressed the need to work together to provide solutions.

Builder Problems Complying with the Energy Code

Bruce Ward (Res-Tek) commented that energy bills for his steel-framed houses were ten percent less than comparable wood-framed houses. He suggested we focus our attention on energy bills rather than R-values. Mike Whitticar (Enertech) also mentioned that we should look at the whole-house performance because he felt there were gaps between theory and experience. Bruce Ward also commented that when he applies for a building permit, there is a penalty for steel framing with R-value deductions applied to energy requirements. He stated that this is not done for wood construction. John McDonald (The House Factory) added that while his insulation requirements were different in the Southwest, he is very much concerned about what he may be required to do in the future.

Requirements for Meeting the Model Energy Code with Steel Framing

Bill Farkas (NAHB Research Center, Inc.) discussed the requirements for meeting the CABO Model Energy Code today and compared them to the *AISI Thermal Design Guide*.

Jeff Christian (ORNL) discussed the *Modified Zone Method for R-Value Calculations of Metal-Frame Walls*. He also discussed why the tested R-value is the nationally accepted method of looking at thermal performance, and the impact this has on steel framing. He discussed other issues that affect the energy efficiency of a home: whole wall vs. clear wall analysis, thermal mass, air tightness, and moisture tolerance. Jeff compared steel thermal bridges which may reduce the R-value of a wall by 60%, to wood thermal bridges which can reduce the R-value by as much as 30%.

Merle McBride (Owens Corning) presented the results of roof testing he performed. His results showed the R-value reduction for steel trusses was a function of truss length, and steel penetrations through the insulation. Correction factors varied from 28 to 64 percent, with a diminishing return of R-value associated with thicker layers of ceiling insulation. Merle works with ASHRAE and his input in the past has been influential in developing the correction factors for steel framing in the Model Energy Code.

Products Available for Code Compliance Today and Tomorrow

The insulation companies present discussed their on-going work with steel frames. Herb Slone (Owens Corning) discussed his company's work on thermal testing of steel frames. Jim Patin and Deborah Kocsis (Dow Chemical) represent suppliers of foam insulation and discussed their interest in steel framing. Dave McCaa (CertainTeed Corporation) discussed the importance of using full width batts for cavity insulation. Dave serves on the ASTM C-16 Systems Subcommittee, and suggested that more builders and contractors join to provide more of a balance with the insulation companies. Graeme Kirkland (Icynene, Inc.), gave a slide presentation of his spray-in product that has an R-value of 3.6 per inch. Bill Hodge (Shadwell) markets a thermal tape that has an R-value just over 1.

Builder Problems Attaching Foam Insulation

Bruce Ward discussed his experiences fastening foam to steel framing. He has no problem attaching foam to wood sheathing using roofing nails. For foam to steel studs, there is a problem with screws flipping over, and screws and washers are expensive. Attaching metal lath to foam for stucco houses is a difficult process. He is working with a manufacturer to develop a special "claw" to grab the lath. Bruce mentioned that it would be great to develop a higher R-value in thinner foams. Mike Whitticar also mentioned that attaching foam to steel is an application problem. Because attaching foam to the outside of a house is not like wood construction, many trades want more money to deal with the foam, especially those that install vinyl siding. John McDonald suggested the development of a large head screw or the use of more adhesives.

State-of-the-Art in Installing Foam Insulation to Steel Framing

Marge Spencer (Compass International) mentioned the different types of products her company has available. Rich Holmberg (Grabber) talked about his company's development of collated systems and work on air-driven screws. He suggested that the Association of the Wall and Ceiling Industries (AWCI) and NAHB Research Center, Inc. work closer together. Dave Nolan (ET&F Fastening

Systems, Inc.) discussed the work his company is doing with air-driven nails. They are looking at a new nail to use with foam insulation.

Jim Patin suggested that adhesives could be used to temporarily hold the foam against the wall until the siding is installed. Jay Larson suggested an insulation product should be developed that has shear strength, combining the functions of the foam and plywood sheathing, which would save on installation time.

Open Discussion and Summary

The participants summarized what could be done to help make insulating steel frames easier for home builders. The summary was divided into two groups: what can be done today, and what can be done long term. The following lists were developed by the participants:

Current Ideas:

1. Work with code officials to help them understand that there are penalties for using wood framing also.

2. Generate a list of pros and cons to help builders see the whole picture–not just R-values.

3. Deliver a positive message for steel framing including quality issues and reductions in air leakage due to air tightness.

4. Obtain support from the insulation industry by helping to educate builders on the variety of materials available today, their costs and R-values.

5. Generate a list of currently available insulation products that work well with steel framing. Include, if available, R-21 for 5½" walls and R-15 for 3½" walls. Provide information on what regions these products are available in.

6. Respond to negative articles appearing in the magazines.

7. Provide a fact sheet informing builders how to examine the whole house for energy efficiency.

8. Establish a better relationship with AWCI.

9. Provide information to builders on new developments with fasteners, i.e., the "claw", adhesives, plastic washers, screws, and pins.

Long-Term Ideas:

1. Submit a code change to look at steel framing for energy efficiency based on economic criteria.

2. Use new criteria other than R-values for measuring thermal performance of steel, i.e. comfort, etc.

3. Build demonstration homes to illustrate energy efficiency.

4. Develop energy programs with utility companies to demonstrate the efficiency of steel framed homes.

5. Create a task group involving AISI, NAHB Research Center, insulation companies, and Model Energy Code participants to work together to keep steel framing from being unfairly penalized and to prevent adoption of unfair code standards.

6. Produce a document showing the economic potential of steel framing over other framing methods over the life of the home.

7. Prepare an energy guide showing the good and bad features of a steel-framed house over the life of the home.

8. Measure the performance of different homes and compare all factors which impact energy performance, energy consumption, air tightness, etc.

9. Work with the Department of Energy and other agencies to further develop steel framing.

10. Overcome the negative perceptions that steel framing has through fact sheets, positive articles, etc.

11. Develop a construction guide on how to properly insulate a steel-framed home and how to attach the insulation.

12. Identify fastening needs and their application, and work with fastening companies to develop new products.

13. Work with energy codes at the state level so that steel framing is recognized and fairly evaluated.

14. Improve insulation materials to make it easier for builders to install, e.g., thinner foam board with higher R-values.

15. Develop a catalog of wall systems showing details and R-values suitable for code compliance.

16. Develop new steel studs that have better thermal properties.

17. Develop new cavity insulation that helps provide a higher R-value, e.g., R-15, R-21, and R-25.

APPENDIX C

FACT SHEET FOR INSULATING STEEL-FRAMED WALLS

STEEL FRAMING FACT SHEET

Insulating Steel-Framed Homes

No.1 NAHB Research Center March 1996

INSULATING STEEL-FRAMED HOMES

One of the more frequent questions builders and others have regarding steel framing relates to meeting the requirements of energy codes. Fortunately, a steel-framed home can be built to comply with energy codes, although the approach may be somewhat different than with other framing materials.

The American Iron and Steel Institute's *Thermal Design Guide* provides suggested R-values for steel framed homes to be able to meet the CABO Model Energy Code. A summary of the recommendations is provided in Table 1. Since steel studs are usually C-sections, the cavity is wider than wood framing. Thus it is important to select batts that are full width or to use spray-applied insulation that completely fill the cavity.

Table 2 shows some of the products that are available from various manufacturers. In colder regions the guide recommends additional insulation on the outside of the home using foam sheathing. Depending on the extra R-value required, the thickness of the foam will vary.

Table 3 shows some of the foam products available today.

The foam board is attached to the exterior of the house using screws, adhesives or nails, depending on the type of sheathing or siding that is installed.

TABLE 1
Effective R-Value for Various Types of Steel-Framed Construction

Effective Wall R-Value	Wall Construction	Cavity Insulation	Exterior Insulated Sheathing
20	2x6	R-19	R-10
21	2x4	R-11	R-13
15	2x6	R-19	R-5
15	2x4	R-11	R-7
12.5	2x6	R-19	R-2.5
13.5	2x4	R-11	R-5.0
10	2x6	R-19	0
8.5	2x4	R-11	0

TABLE 2
Representative Cavity Insulation Products for Steel Framing

Manufacturer	Product Type	R-Value	Thickness	Width	Length	Face
CertainTeed	Batt	R-19	6¼"	24	48"	Unfaced
CertainTeed	Batt	R-19	6¼"	16 & 24	96"	Unfaced
CertainTeed	Batt	R-19	6¼"	16 & 24	96" or 48"	Kraft or Foil
CertainTeed	BIBS	R-15	3½"	Variable	Variable	Unfaced
CertainTeed	Batt	R-13	3½"	16 & 24	96"	Unfaced or Kraft
CertainTeed	Batt	R-11	3½"	16 & 24	96" or 48"	Kraft or Foil
Owens Corning	Batt	R-22	6¾"	16 & 24	96"	Unfaced, Kraft, or Foil
Owens Corning	Batt	R-19	6¼"	16 & 24	96"	Unfaced, Kraft, or Foil
Owens Corning	Batt	R-13	3½"	16 & 24	96"	Unfaced, Kraft, or Foil
Owens Corning	Batt	R-11	3½"	16 & 24	96"	Unfaced, Kraft, or Foil
Icynene	Spray-applied foam	R 3.6 per inch	Applied to fit	Applied to fit	Applied to fit	Unfaced
Knauf Fiber Glass	Batt	R-11	3½"	16 & 24	96"	Unfaced, Kraft, or Foil
Knauf Fiber Glass	Batt	R-13	3½"	16 & 24	96"	Unfaced, Kraft, or Foil
Knauf Fiber Glass	Batt	R-15	3½"	16 & 24	96"	Unfaced, Kraft, or Foil
Knauf Fiber Glass	Batt	R-19	6¼"	16 & 24	96"	Unfaced, Kraft, or Foil

STEEL FRAMING FACT SHEET

Insulating Steel-Framed Homes

For stucco houses, the foam is attached to the steel using a long screw with a plastic washer. The metal lath is attached to the foam using a screw with a special attachment that holds the lath in place. For houses that are sheathed with plywood or OSB, the foamboard is attached to the sheathing with roofing nails or adhesives. The siding is attached over the foam with nails or screws that penetrate through the foam into the sheathing or studs. For vinyl siding, nails or screws may be used to attach the siding into the sheathing or studs in accordance with manufacturers' recommendations.

Table 4 shows some of the available fasteners for these applications.

The information in this fact sheet is a partial list of products available from a group of manufacturers who participated in a workshop in March 1996. It is not intended as an endorsement of the products listed here. These products are representative of the group of products used for insulating steel-framed homes. For more information on the thermal performance of steel framing call the Steel Hotline at 800-79-STEEL.

TABLE 3
Representative Foam Sheathing Products

Product	Nominal Board Thickness ½"	¾"	1"	1½"	2"
Celotex Tuff-R	4.0	5.6	8.0	12.0	16.0
Celotex Thermax	3.6	5.4	7.2	10.8	14.4
Dow Styrofoam	3.0	4.0	5.0	7.5	10.0
Owens Corning Foamular	2.5	3.8	5.0	7.5	10.0
Owens Corning Foamular IS	3.0	4.0	5.0	—	—

TABLE 4
Fasteners for Various Exterior Finishes Using Foam Sheathing[1]

Application	To Structural Sheathing[2]	To Steel Studs
Foam Sheathing	Roofing Nails	Grabber Bugle Head Self-Drilling #6 min with plastic washer Compass Darts 'SD' Point Bugle Head Phillips #6 min with plastic washer
Vinyl Siding	Roofing Nails Grabber Wafer Head Streaker #8 Compass Self-Piercing Modified Truss Phillips #8	Grabber Wafer Head Self-Drilling #8 Compass Darts Self-Drilling K-Lath #8
Lap Siding, Hardboard/OSB	Ribbed Head Deck Grabber #8 Compass CW-Drill #8	Ribbed Head Exterior Grabber Gard Driller with #3 pt #8 Compass C-Wing #8
Fiber Cement Board	Ribbed Head Deck Grabber #8 Compass CW-Drill #8	Ribbed Head Exterior Grabber Gard Driller with #3 pt #8 Compass C-Wing #8
Panel Siding	Ribbed Head Deck Grabber #8 Compass CW-Drill #8	Ribbed Head Exterior Grabber Gard Driller with #3 pt #8 Compass C-Drill #8
Stucco with Metal Lath	Grabber Wafer Head Streaker #8 with Grabber Claw Compass Self-Piercing Modified Truss Phillips #8	Grabber Wafer Head Self-Drilling #8 with Grabber Claw Compass Darts Self-Drilling K-Lath #8
Brick Ties	Grabber Hex Head Streaker #8 Compass RPS Self-Piercing Hex Washer Head #8	Grabber Hex Head Self-Drilling #10 Compass Darts 'SD' point Hex Washer Head #10
Wood Shingles	Grabber Bugle Head Streaker #6 Plated Compass Marker 'S' point Bugle Head Phillips #6 Plated	N/A

[1] Screw length is determined by thickness of materials. It must penetrate siding, foam, structural sheathing, steel studs plus a minimum of exposed 3 threads. No. of screws to be specified by engineer. Plated screws recommended.

[2] Where structural sheathing is used, foam and exterior finishs may not be required to be fastened to the stud. Refer to the manufacturers' recommendations for fastening requirements of siding.

APPENDIX D

TOOL & FASTENER WORKSHOP SUMMARY

Tool & Fastener Workshop for Steel Framing

U.S. Department of Housing and Urban Development

Homestead, Florida
April 16, 1996
9:00 a.m. - 4:00 p.m.

Workshop Summary

Welcome and Introduction

Tim Waite opened the workshop at 9:00 a.m. and welcomed the participants. Tim described the objectives of the workshop. They included discussing the problems builders face with fasteners and tools. All manufacturers were encouraged to share any new technology and developments for discussion among the participants.

Comments from the Steel Industry

Mike Meyers (U.S. Steel) expressed the importance of tool and fastener issues to steel framing's future in residential construction. Ken Vought (USS/POSCO) reaffirmed Mike's position and added that he has seen marked improvement since 1993 when he became involved in residential steel framing.

Screws

Quality and Corrosion

The workshop began with a discussion of screws and issues involving their quality and performance during assembly. Bruce Ward (RES-TEK International) used the house to point out where many screws had rusted. Doug Holmberg (Grabber), representing the screw industry, commented that the screws used in typical wall framing construction were protected from corrosion by a clear zinc coating. Typical framing screws are designed and tested to withstand a 24-hour salt spray test according to ASTM C-113. Exterior screws are required to hold up under the same conditions for 1,000 hours. The house we were in had been open to the harsh south Florida weather for at least eight months. Thus, he attributed the rusting to the abnormal conditions to which the fasteners had been exposed.

Heads Popping Off

Another problem that Bruce pointed out was that some of the heads had popped off the screws both during and after installation. The cause of the breakage during installation was determined to be the steep thread design which causes the screw to accelerate after the drill point penetrates the steel.

Clay Furtaw (Black & Decker) and Doug Holmberg both stated that if the clutch on the screwgun is set properly, the clutch should "cam out" before the screw is damaged. Bruce Ward and Mark Mengel (Crown Building Systems) suggested that perhaps a finer thread could slightly increase the time between when the threads engage and when the screw is driven tight. Doug Holmberg explained that the time it takes to apply a screw would be compromised. In addressing why a small number of screw heads may pop off after installation, he explained that hydrogen bubbles may become trapped in the screw during production and may weaken the screw so that it pops off. He emphasized that this was a rare occurrence and most agreed that this was also their experience. A 2500 rpm screwgun also helps reduce the speed of the screw to help keep heads from breaking off.

Drilling and Piercing

The discussion on screws also included problems with drilling and piercing the steel, wobbling, and drilling on an angle. The screw and tool manufacturers indicated that they were trying to improve on the fastener's piercing ability both on flat surfaces and on an angle. Doug Holmberg stressed the importance of having a long enough drill point when screwing through multiple layers of steel. If the point is not long enough the threads will engage before all the layers of steel have been pierced. This will cause the upper layers to ride up the threads and can cause the head of the screw to break. Bruce Ward explained that drilling on an angle with a Phillips head was practically impossible, and demonstrated the correct way for driving a hex head fastener at an angle. He illustrated that you must firmly brace the bit holder in the screwgun with your other arm, and apply pressure to the gun and trigger to get the fastener started. The problem with screws wobbling when trying to get them started is primarily caused by a slightly bent bit tip holder. These holders bend easily when the drill is dropped. The best solution to the problem is the replacement of the bit tip holder.

Cost and Availability

The final discussion on screws concerned their cost and availability. The builders expressed some frustration with the lead time manufacturers require to procure screws and the price of their screws. Doug Holmberg explained that the higher price was partially due to the higher quality of domestically-produced screws and higher labor rates. The builders agreed that the quality of domestic fasteners was better than foreign-produced fasteners. Eric Norwich (Grabber) explained that the one-week lead time required on some screws was due to the lack of demand for some types of screws used in steel framing. He stated that as the demand for the steel framing screws increases the lead time for these products will decrease.

Bit Tips and Holders

Builder problems with the bit tips and holders were discussed by Bruce Ward and Mark Mengel. They expressed concern that the Phillips tips were wearing out too quickly and the hex tips were clogging up with metal chips. Doug Holmberg commented that the quality of the Phillips tips varies among manufacturers. High quality Phillips tips should hold up for a fairly long time, but will

eventually wear. The Phillips drive system slips when the torque increases to a certain level. This process keeps the screws from breaking, but will inevitably cause the tip to wear. Hex head screws, although much easier to drive, often clogged with metal shavings. Mark Mengel de-magnetized the bit tips to remove the metal and then re-magnetized them. Bruce Ward used a utility knife to pick out the shavings. Tom Brockway (Homestead Habitat for Humanity) found that putty will remove the metal shavings.

There were two major problems that builders experienced with the bit tip holders. Steel framing requires frequent switching between hex and Phillips bits. The builders expressed difficulty in removing and installing the bit tip holders in the drywall screwguns. Clay Furtaw (Black & Decker) told builders that when they are framing, they should use a versa-clutch screwgun with a quick release sleeve that allows the bit tip holder to be changed easily. He said that their drywall screwguns were more difficult to change because they were not designed for frequent removal of the bit tip holders. Builders also had experienced problems with the bit tips falling out of the holders. Clay Furtaw explained that the bit tip holders use a snap ring to hold the tips in place. After changing bit tips many times, these snap rings wear out and the holder must be replaced. He explained that Black & Decker had experimented with a holder that utilized a mechanical release, but builders often neglected to use it. This caused the holder to wear out even faster. It was determined that the present design, given its problems, was still the most effective.

Screwgun

Clay Furtaw lead the discussion on the screwguns. Builders expressed the need for a lighter, shorter, more portable screwgun. Clay discussed the mechanics of screwguns and explained the limitations that the manufacturers faced when trying to lighten and shorten them. He did reveal a prototype screwgun which will be available in about six months and utilizes a more ergonomic design. The gun is shorter and weighs about the same amount as previous screwguns. It has a re-designed grip that allows for more comfortable operation. A re-designed clutch in the front of the drill is much quieter than previous guns. The clutch is replaceable without removing the motor housing and is good for between 150,000-200,000 screws. The builders expressed a need for a long-life, battery-operated screwgun. Clay explained that battery technology has come a long way, but current limitations on batteries and motor sizes will take a long time to overcome. He stressed that, with the new quick-charging systems, a screwgun could be used all day by interchanging the batteries.

Cutting Steel

Cutting steel is a major concern for builders. Present methods for cutting steel are either fairly slow or very loud. Aviation snips are good for coping the flanges of studs or cutting 27 or 18 mil material, but it takes too much strength to cut thicker material. An abrasive chop saw is a quick method for cutting all types of steel, but it is very loud and burns the steel. The burning steel emits an unpleasant odor, thus builders try to avoid using it. Instead most builders choose to make most of their field cuts with electric shears which are a little bit harder to use, but make a clean quiet cut. Bruce Ward explained the correct procedure for guiding the shears around a C-section. If the shears

are forced around the corners of the stud the shear pin holding the cutting blade will break frequently. Most electric shears are capable of cutting up to 68 mil material. Nibblers are also available for cutting studs, but they break easily and are twice as expensive. They are generally used for making curved cuts in flat sheet material.

New Technology

Clay Furtaw described a new circular saw that his company is developing. This saw will use a carbide blade to cut steel in the same manner that a builder cuts wood. The saw was used to cut rafter tails during a previous training session at Jordan Commons. This new technology is very promising and the builders at the meeting were excited about it.

Manufacturer Cuts

Even with the new technology, the most cost effective method for cutting steel is to have the manufacturer cut the material on the roll-forming line. Bruce Ward stated, that with a detailed cut list, a builder could get the majority of his material pre-cut. Headers, jack studs, truss members and even trimmer studs could be cut by the manufacturer. He stressed the importance of finding a manufacturer that is willing to work with the builder.

Hand Tools

Clamps

Gene Tyser and Tom Chervenak (American Tool Company) were present for the discussion of hand tools. They had previously participated in a training session at Jordan Commons, where they had the opportunity to test the clamps that they manufacture. During their training they discovered that the clamps were heavy, especially when each framer carried several pairs of clamps attached to their tool belt. They came to the workshop with several new prototype clamps. One pair utilized larger jaws with a small pliers grip. The builders thought that the decrease in weight was good, but the small pliers were hard to release. A suggestion was made to move the release on the clamps to the exterior of the pliers to make it easier to reach. The new clamps were also self-adjusting. Once the screw adjuster on the handle was set, the clamps would clamp material of the same thickness or greater without adjustment. The builders thought that this would save a lot of time. A new version of American Tool's "Quick Grip" bar clamp was also shown to the builders. It had jaws with a larger capacity, capable of firmly clamping a box header. The builders thought that this would be very useful in header and wall assemblies.

Hand Seamer

Members of the Habitat for Humanity staff expressed some interest in improving the hand seamers used to bend the flanges and webs of studs and track during framing. The Habitat staff preferred the locking seamers made by American Tool because they required less strength and effort to bend the

steel. They said that these seamers bent easily when too much force was applied. They suggested that perhaps some reinforcement could help prevent this bending.

Attaching Plywood to Steel

Nails

John Tillman (Erico Tool and Fastener) demonstrated his company's pneumatic nail gun for attaching sheathing and sub-flooring to steel frames. This system utilizes an air-powered coil nailer and steel pins with ballistic points. The gun requires a compressor capable of providing 4.5 cfm at 110 psi. The gun costs approximately $700 and the pins about 5-1/2 cents each which is slightly less than the screws used for the same applications. The pins are manufactured in lengths of 1-1/2, 2, and 2-1/2 inches. They are capable of penetrating up to 54-mil material. The gun operates utilizing a system which allows the operator to hold the trigger down and fire a nail every time the gun is set down on the material. This system is fast and substantially decreases the time required to attach sheathing and subflooring.

The pins used in this system have good shear values, but do not perform as well as screws regarding pull-out capacity. As with screws, these pins do not perform well in cyclic testing. The builders working with this system also found that the pins would not pull the sheathing tight to the framing. They first used a few screws to hold each sheet in place and then used the pins to finish fastening. Erico Tool and Fastener is working with other manufacturers in developing a type of pneumatic screw nailer that will provide better results in the pull out and cyclic testing. It will also be more effective in pulling the sheathing tight to the frame.

Screws

Screws are the most common fastener used in the attachment of sheathing. Most builders use either a pilot point or a winged-drill point screw with a Phillips drive system. When using the pilot point screw it is important to have the smooth shank of the screw long enough so that it can penetrate the sheathing and the steel before the threads engage. If the shank is too short the threads will engage and the sheathing will "jack" or "climb" the screw before it penetrates the steel. This problem was experienced by the Habitat staff at Jordan Commons especially because they are required to use 5/8-inch plywood. Bruce Ward uses a sharp point screw for attaching sheathing. These screws are less expensive, but require a lot of skill to install. The Habitat staff expressed interest in using a hex head fastener that could be used for sheathing. The present hex screws break the skin of the plywood and void the plywood warranty and create problems with the code officials. Doug Holmberg said that he could probably develop this type of screw, but it's demand would be so small that it would not pay for his costs.

Collated screw systems are available and speed the fastening of roofing and floor sheathing. These systems can be used for the wall sheathing, but are more effective when the operator is standing and driving the screws downward.

APPENDIX E

FACT SHEET FOR STEEL FRAMING TOOLS & FASTENERS

TOOLS AND FASTENERS

Builders ask many questions concerning the type of fasteners and tools that are required to frame with cold-formed steel. Fortunately, the builder is already familiar with most of the fasteners and tools required, because many of them are also used in wood construction.

The majority of fasteners used in steel framing are screws. Many of the screws are equipped with a drill point that allows the screw to tap through multiple layers of steel without the need for pre-drilling. When attaching to thin steel, a sharp pointed screw will penetrate the steel without the need for a drill point. Recent developments have allowed the use of pneumatic pins for attaching sheathing and sub-flooring.

Table 1 matches different types of fasteners with their specific applications in steel framing. Many builders already own many of the tools required for steel framing. A screwgun, shears and locking C-clamps are some of the most frequently used tools.

Table 2 provides a complete list of tools recommended to frame with steel. (See Table 2 on reverse side).

TABLE 1

Fasteners Used in Steel Framing

APPLICATION	FASTENER[1]
Steel to Steel Non-Load Bearing (less than 33 mils)	#6 minimum, sharp point, low profile.
Steel to Steel Load Bearing	#8 minimum, drill point, low profile where gypsum board and sheathing is installed; hex head elsewhere.
X - Bracing	#8 minimum, drill point, low profile.
Gypsum Board	#6 minimum, sharp point for 33 mil and thinner. Drill point for 33 mil and thicker, bugle head.
Interior Trim	#6 trim head screws, or finishing nails and adhesive. For wood blocking, finishing nails.
Foam Insulation	Roofing nails to structural sheathing, or #6 minimum, drill point, bugle head screws with washer to steel.
Structural Sheathing (OSB/Plywood)	#8 minimum, drill or winged drill point, bugle head screws or pneumatic pins.
Stucco Lath	Roofing nails for structural sheathing, or #8 minimum, drill point, low profile screws to steel.
Siding- Hardboard, fiber cement, or panel[2]	#8 minimum, drill or winged drill point, bugle head screws to steel, sharp point to structural sheathing.
Vinyl Siding[2]	#8 minimum, sharp point to structural sheathing, drill point to steel.
Brick Ties	#8 minimum, drill point, hex head screw.

[1] Length of the fasteners varies depending on the thickness on the material being fastened. Screw connections require that the fastener penetrate all layers of material, plus a minimum of three exposed threads. Number of fasteners to be specified by the code or engineer.

[2] Refer to manufacturers recommendations for fastening requirements.

The information in this fact sheet is a partial list of products available from a group of manufacturers who participated in a workshop in April 1996 at Jordan Commons in Homestead, Florida. It is not intended as an endorsement of the products listed here. These products are representative of the group of products used for framing steel homes. For more information on framing with steel call the Steel Hotline at 800-79-STEEL.

TABLE 2

Tools Recommended For Use With Steel Framing

Fastening

- Black & Decker 2054 VSR Versa Clutch Screwgun - with 5.4 amp motor, 0 - 2,500 rpm variable speed reversible, bit tip holder release, adjustable torque control for framing.
- Black & Decker 2037 Drywall Screwgun - with 5.4 amp motor, 0-4000 rpm variable speed, reversible, with depth locating nose piece for sheathing and gypboard installation.
- Magnetic Bit tip holder and #2 Phillips bit tips.
- 5/16 inch magnetic hex driver.
- Two pair of Vise-Grip 6R locking C-clamps with regular tips, one pair of 11R's, and one pair of 18R's for clamping steel together while fastening.
- Quick-Grip 524 Bar Clamp - clamping headers in wall sections while fastening.

Cutting

- Prosnip Aviation Snips (Left Cut [101] for right handed framers, Right Cut [102] for left handed framers) - for cutting up to 43 mil material and making cuts for coping track.
- Black & Decker 3208, 14 Gauge Swivel Head Electric Shear - cuts up to 68 mil material, including C-sections and flat material.
- Black & Decker 3935, 14 inch Chop Saw - good for cutting multiple sections simultaneously, especially bundles of gypboard studs.
- Unibit Step Drill Bit, 1 inch - for drilling holes in studs in track for anchor bolts, etc.
- Caddy Hole Punch, 1-1/4 inch - punching holes for the installation of electrical and plumbing systems.

Miscellaneous

- Wiss 3 1/2 and 5 inch Hand Seamers - bending and coping track.
- Bull nose pliers - removing screws.
- Magnetic level - frees hands during wall leveling.
- Felt marker - makes clear marks for layout and cuts (Black and Red).
- Other Miscellaneous tools include: Tape Measure, Speed Square, Utility Knife, Wallboard ax, and 50 foot grounded extension cords.