

Workshops & Outbuildings



DAVID H. JACOBS JR.

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David H. Jacobs, Jr.

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For the wide assortment of hand tools needed during our workshop construction project, I turned to Francis Hummel, director of marketing for The Stanley Works. The hammers, handsaws, tape rules, levels, chalk lines, Stanley Goldblatt concrete tools, Bostitch pneumatic staplers, and other essentials performed as expected time and again. For hand tools you can depend on, I suggest Stanley.

David Martel is marketing manager for Central Purchasing, Inc. (Harbor Freight Tools). His support for this project was greatly appreciated. Harbor Freight Tools offer a huge variety of supplemental tools and accessories that will help make almost every home-improvement endeavor easier to accomplish.

Windows and doors are generally perceived as permanent home-improvement fixtures. For that reason, we chose to install high-quality and technically advanced Eagle windows

and doors. I want to thank Tom Tracy, advertising manager, and Ron Reinhardt, customer service representative, for their enthusiastic support. Eagle windows and doors are excellent products and I encourage you to contact an Eagle representative before you start any home-improvement project that will include window or door installations.

In addition to the above, many other nationally recognized companies provided assistance to this book and the featured construction project. I would like to thank the following people and the companies they represent for their support: Tom Marsh and Daryl Hower from Leslie Locke, Inc.; Betty Talley and Jeff Barnes from American Tool Companies, Inc.; Hilarie Meyer from Campbell Hausfeld; Dave Shanahan from Keller Ladders; Rob Guzikowski from Simpson Strong-Tie Connectors; Dick Warden from Structron Corporation; Patricia McGirr from Alta Industries; Peter Wallace from McGuire-Nicholas; Sue Gomez from Zircon Corporation; Dana Young from PanelLift Telpro; Jim Brewer from Freud; Surekha Reddy from Autodesk Retail Products; Jim Poluch from the Eastwood Company; Don Meucci from the Cedar Shake and Shingle Bureau; Timm Locke from the Western Wood Products Association; Maryann Olson from the American Plywood Association; Jim Richeson from Sta-Put Color Pegs; Gregg Hook from Plumb Shop, Mike Cunningham from General Cable Company (Romex®), Peter Fetterer from Kohler Company; Victor Lopez from Behr Process Corporation; Kim Garretson from DAP, Inc.; Matt Ragland from Empire Brush, Inc.; Mario Mattich from Leviton Manufacturing Company, Inc.; Ruth Tudor from NuTone; Bob McCully from SIMKAR-Power Products Company; Bill Cork from Plano Molding Company; Marty Sennett from DuPont TYVEK; and Beth Wintermantel from Weiser Lock.

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ALMOST EVERY HOMEOWNER CAN USE AN EXTRA PLACE TO store things. Ambitious do-it-yourselfers with a growing assortment of hand and power tools and equipment might need a full-size workshop with ample room for storage, workbenches, and open work areas. On the other hand, for those with an assortment of outdoor items stacked against fences or house walls, like lawn mowers, garden tools, bicycles, and so on, a small outbuilding constructed on a side or rear yard might be ideal. The exterior of either structure might be designed to match an existing home in order to offer visually attractive remedies to otherwise cluttered or inadequate storage areas.

Constructing wood-framed workshops or outbuildings might seem overwhelming at first. However, once the basic logic behind simple wood-framed structures is understood, you should be able to envision how units are put together from beginning to end. There is a definite pattern to follow—you start from the ground and build up. As you become more familiar with this pattern, it should be easy to graduate from construction of a small 4×8-foot outbuilding to a much larger storage or workshop facility.

This book is *not* intended to be the *last word* on all workshops and outbuildings. Rather, it is designed as a basic guide to help inexperienced do-it-yourselfers understand the simple concepts of standard wood-framed construction and gain enough confidence to *safely* build suitable home-improvement workshops or outbuildings using normal home-improvement tools, equipment, and materials.

Along with all the following photos, illustrations, text, and instruction, do yourself a favor and visit a local building project. On late afternoons when workers have quit for the day, ask to look at foundations, floors, walls, and roofs. See firsthand how everything is positioned and secured together. Except for unusually intricate or elaborate designs that require special support components or complex angles, wood-framed structures are all put together in the same basic fashion: boards cut to certain lengths and then nailed together on top of a solid support base (foundation and floor).

Many local home-improvement centers and lumberyards offer small wood-framed outbuildings for sale. Frequently these models are on open display. Take advantage of this opportunity to inspect the interior and exterior of such units to determine how they were put together. Bring along a tape rule to measure lengths, widths, and ceiling heights. These visual inspections will give you a first-hand perspective of what it is you are planning to build. This will also help you determine which dimensions might best serve your overall storage needs.

Although this book presents a lot of information on small buildings, the featured construction project was a first-floor, multipurpose workshop facility and second-floor family living area. The only difference between our featured project and small outbuildings is the size of the footings, foundations, walls, windows, and roof structures. Basic construction techniques are all the same: a suitable building site; a solid and level foundation and floor; wood-framed walls stood vertically upright and securely connected together; an angled roof that will cause rainwater to run off; and progressive finish work that entails roof coverings, exterior siding, doors, and windows.

Our multipurpose structure is presented as this book's main focal point because I felt it would be unfair to simply describe the construction of just small outbuildings and leave things at that. I wanted to offer you sufficient information to help you build larger structures after you have successfully completed the construction of your first small outbuilding.

Please follow all of the operating instructions that accompany your power tools and heed the safety recommendations presented throughout this book. Suffering any kind of injury from the haphazard use of tools or pieces of equipment will not only cause you physical pain and grief, it will also negate most of the satisfaction you could have otherwise derived from a safe and rewarding experience.

THE CONSTRUCTION INDUSTRY BASICALLY IDENTIFIES FIVE different building construction types. Differences between them relate to the kinds of materials used for walls, floors, roofs, and other structural components. While modern high-rise buildings might be constructed of heavy, concrete “tilt-up” walls and concrete floors, older warehouse-type structures might be put together with heavy wooden timbers and brick facades. Other commercial buildings might include heavy steel beams and masonry, while some might be constructed entirely with metal materials.

Except for those homes built entirely of bricks or cement blocks, most family residences fall under the category of *wood-framed* structures. This means that all of their walls and roof members were initially constructed with *dimensional* lumber: 2×4s, 2×6s, 2×8s, and so on. While the main components of wood-framed walls are constructed with 2× material, larger timbers called *headers* are used to support upper openings over windows and doors. Depending on the opening span of each window or door, headers ranging in size from 4×6 to 6×12, and larger, are required by specific *building codes*. Wider spans require larger-size header material so that the headers adequately support the amount of weight resting on top of them from upper floors and/or roofs.

Wood-framed walls are initially covered on the outside by *sheathing*, which is generally sheets of ½-inch plywood or similar types of wood products. The sheathing is then covered with building paper or another kind of moisture barrier. That, in turn, is covered with a final siding of decorative plywood, horizontal or vertical wooden or metal panels, plaster, and so on. Interior surfaces are covered with *drywall* (sheet rock), plaster, or decorative wooden paneling.

Until the issue of energy conservation became such an important consideration, most homes were constructed entirely of 2×4 walls. Today, 2×6 exterior home walls are commonly required by building departments because they can incorporate thicker insulating materials between *studs*. Studs are those boards that are erected upright to constitute walls. Interior

walls surrounded on both sides by interior living spaces are still generally constructed with 2×4 material.

Requirements for the inclusion of insulating materials, heating units, specific exit ways, and minimal-size window openings are *reserved* generally for those structures planned for *human habitation*. Outbuildings, sheds, and small storage units designed under certain total square footage (length × width) limitations are normally exempt from most national and local building codes.

Many times, people worry about tackling home-improvement projects because they do not understand how certain things are fitted and secured together. You might not be familiar with building terminology, materials, or tools, and might be intimidated by home-improvement center or lumberyard employees who rattle off words and dimensions completely foreign to you. Relax! On the following pages you'll learn the difference between *sheathing* and *siding*, 16d and 8d nails, ACX and CDX plywood, T1-11 and *subflooring*, joists and *trusses*, *plates*, *studs*, *blocking*, and a lot more. You have seen all of these things but probably never knew what tradespeople called them.

Once you are over the hurdle of understanding that anybody with basic construction knowledge, a little advice, and some common sense can safely put together a wood-framed structure, you will be well on your way to constructing a workshop or outbuilding that will look great and serve all of your intended purposes.

Personal & job-site safety

Construction projects all over the world have claimed many lives. Your first impression of that statement might lead you to think of enormous structures like dams, towering high-rise buildings, and bridges. You might be surprised at the amount of injuries and deaths that occur every day as the result of do-it-yourselfers attempting home-improvement projects with total *disregard* to all safety warnings and recommendations provided by tool, equipment, and material manufacturers, how-to book authors, and do-it-yourself magazine writers and editors. Neither I, TAB/McGraw-Hill, nor any of this book's sponsors want you to be an injured do-it-yourselfer. Conversely, we all

want you to enjoy successful workshop and outbuilding construction endeavors.

Therefore, make sure that you and your family members wear *safety goggles* whenever engaged in any type of striking, cutting, drilling, or otherwise atmospheric polluting activity. Safety goggles are very inexpensive. So are dust masks and hearing protectors.

All Stanley hammers are embossed with a warning on their heads that recommend users wear safety goggles. All Makita power-tool operating instructions also stress the use of safety goggles whenever tools are put to use. A full face shield is ideal when working with grinders and on other occasions when lots of debris will be dispersed from any type of work activity.

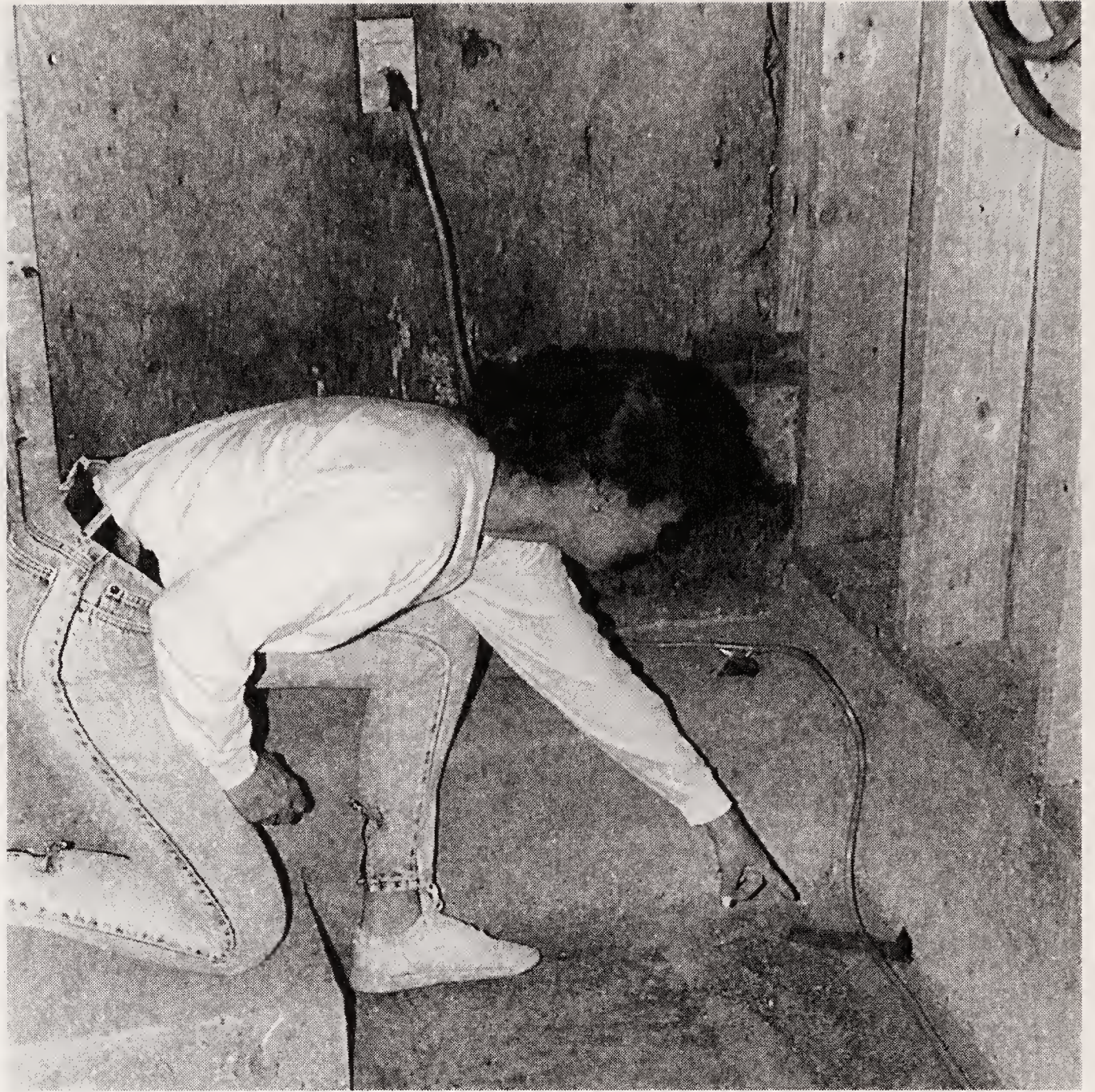
Inexpensive dust masks are available at lumberyards, hardware stores, home-improvement centers, and lots of other places. Plan to wear one when you tear out old insulation, install new insulation, sand any type of wood, and whenever your working atmosphere might become polluted. For special painting projects, read paint product labels to determine which type of respiratory equipment is best suited for the process.

A great deal of sawdust debris might linger on every board after it has been removed from an original load.

Plan to wear safety goggles to prevent debris from falling into your eyes, especially when handing material up to people on upper floors or roofs. Along with sawdust, you might find small pebbles and other hard objects that are dislodged from boards and fall down during the course of material handling. It might also behoove those working below to wear hard hats. You'll find them at local home-improvement centers for as little as \$5.

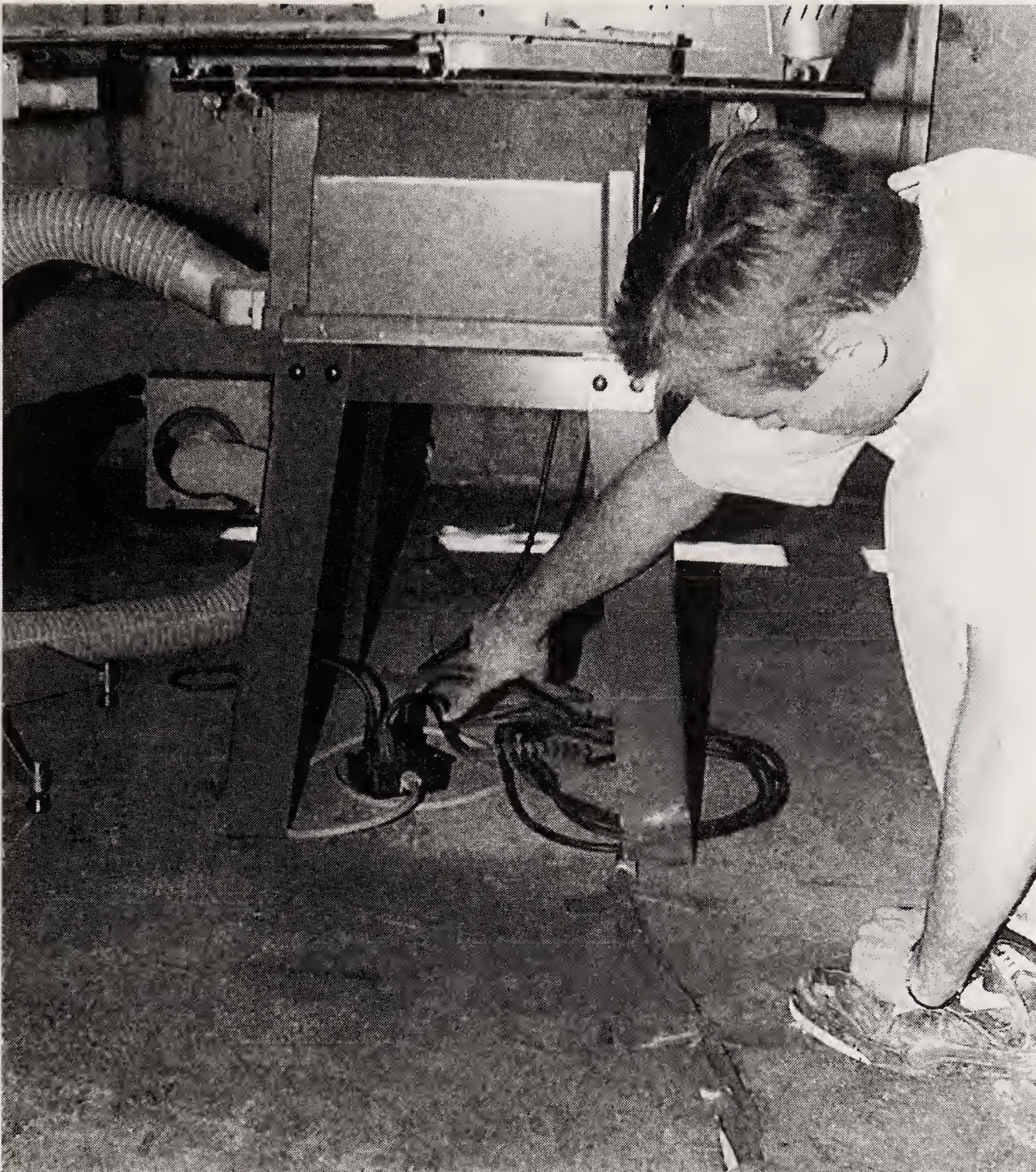
Extension cords and stretched air lines used with electrical or *pneumatic* (compressed air) power tools and equipment should always be a concern. It is easy to forget about such lines coiled up or strung out in your path. Tripping over lines while you are carrying long boards, heavy tools, or sheets of plywood might result in serious injuries.





Janna found that taping extension cords and air lines to floors and next to walls or foundations worked well to keep them flat and prevent loops from becoming hazards. Out in the yard she tried to keep the cords strung straight and away from active work areas. If need be, she used a few scraps of lumber to hold down loops and then placed longer boards parallel to them as a signal to everyone that cords or air lines were in their path.

Joey is pointing to a multiple outlet extension cord from Harbor Freight Tools that was positioned under the Makita 10-inch table saw. Another cord plugged into the outlet served the Makita dust collection system that was hooked up to the saw. Since a piece of plywood was secured carefully to the bottom of this table saw to enhance the dust collection unit's ability to draw away sawdust, nothing could fall through the saw to



damage this outlet. The cord and outlet's position under the saw kept them away from active work spaces and prevented them from being a tripping hazard when wood was cut. Notice that the exposed electrical cord is taped to the workshop floor to negate a tripping hazard.

This table (see next page) and the extension leading off its left-hand side were used to cut numerous studs to prescribed lengths. We needed Ashleigh to cut a few short 2×4 blocks and set her up with a worktable that was perfectly matched for her size. Notice that the Makita slide compound saw, which was bolted securely to the worktable above, was unplugged from its



power source and that the board she is cutting was secured to the lower work surface with a couple of handy quick-grip bar clamps. Her hands are well away from the active cutting area and she is wearing safety goggles to prevent wooden slivers from flying up and into her eyes.

Teaching young family members the importance of wearing personal safety gear and utilizing the safety guards and components of power equipment cannot be overemphasized. If we teach and instill mandatory personal and overall safety procedures to our young people today, they will form the habit of wearing eye, ear, and respiratory protection and make full use of power tool guards and safety devices. They will then pass these well-learned safety habits along to our grandchildren and great-grandchildren.

Basic designs & ideas

JUST ABOUT EVERY HOME-IMPROVEMENT DO-IT-YOURSELFER who has a home-based workshop will generally agree that workshops can never be too big! As skills and projects grow in size and number, owners frequently discover that shops simply don't have enough room for their assortment of tools, pieces of equipment, supplies, building materials, and so on. And, as other family members learn how to build and repair things themselves, they often request shop space for their projects and material storage needs.

As a general rule, adequately sized do-it-yourself home workshops should be at least as big as a regular two-car garage: 20×20 feet with a ceiling no less than 8 feet tall. Such a facility should provide users with enough room to maneuver sheets of plywood that measure 4×8 feet. If possible, make ceiling heights taller than 8 feet so that plywood sheets can be moved about without becoming wedged against ceiling finishes.

Outbuildings should be built to sizes that satisfactorily accommodate their intended storage needs. Most units are constructed to dimensions that take fullest advantage of 4×8-foot plywood sheets. In other words, an outbuilding that measures 8×12 feet will utilize full sheets of plywood on the floor and walls with no waste. Because most outbuildings use plywood for floors, sides, and roofs, you will find that their dimensions generally measure at even increments: 4×8 feet, 6×10 feet, 8×12 feet, and so on.

Since firewood is generally sold by the cord, which measures 4×4×8 feet, this firewood storage unit was built 4×8. The roof is two sheets of plywood, which provides a wide overhang at the front and an even wider one in back. The front overhang helps keep folks dry when they retrieve firewood during rainy weather; the rear overhang provides cover for additional firewood storage.

Outbuilding designs



This simple firewood storage unit was built with 2×4s and ½-inch-thick CDX plywood. Plywood is graded by letters: “A” means a very smooth, finished surface; “B” less smooth than “A”; “C” is rougher still; and “D” is very rough; “X” designates that an exterior grade glue was used to make the plywood sheet.

Plywood roof sheathing must be covered with rolled roofing. Rolled roofing is like regular asphalt shingles except that it comes in rolls 3 feet wide. Although most wood-framed structures are built with studs spaced at 16 inches on center (16 inches from the center of one stud to the center of the next), this unit’s studs are spaced on 2-foot centers because of the minimal weight placed on walls by the lightweight roof and

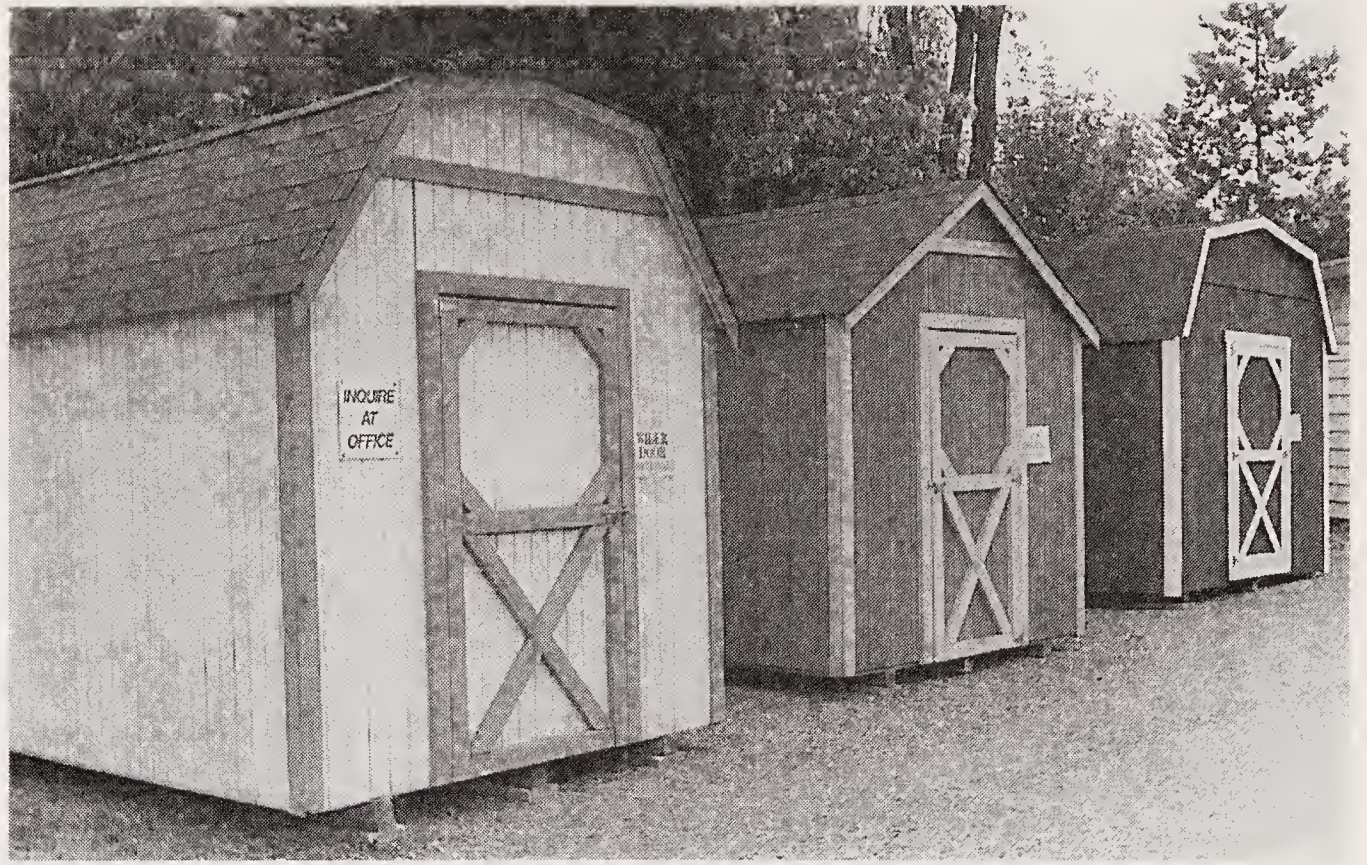
because no extra structural strength was required to support doors or windows.

One sheet of ½-inch CDX plywood was all that was needed to cover the 4-foot side of the firewood storage unit. Plywood was cut at an angle along its top edge before it was nailed in place. Once studs and roof rafters were nailed together, vertical measurements were taken at the front and back corners and then marked on each 4-foot side of the plywood sheet. A long 2×4 was used as a guide to help make a straight pencil line connecting both measurement marks. Plywood was then cut on that line to effect the top edge angle.

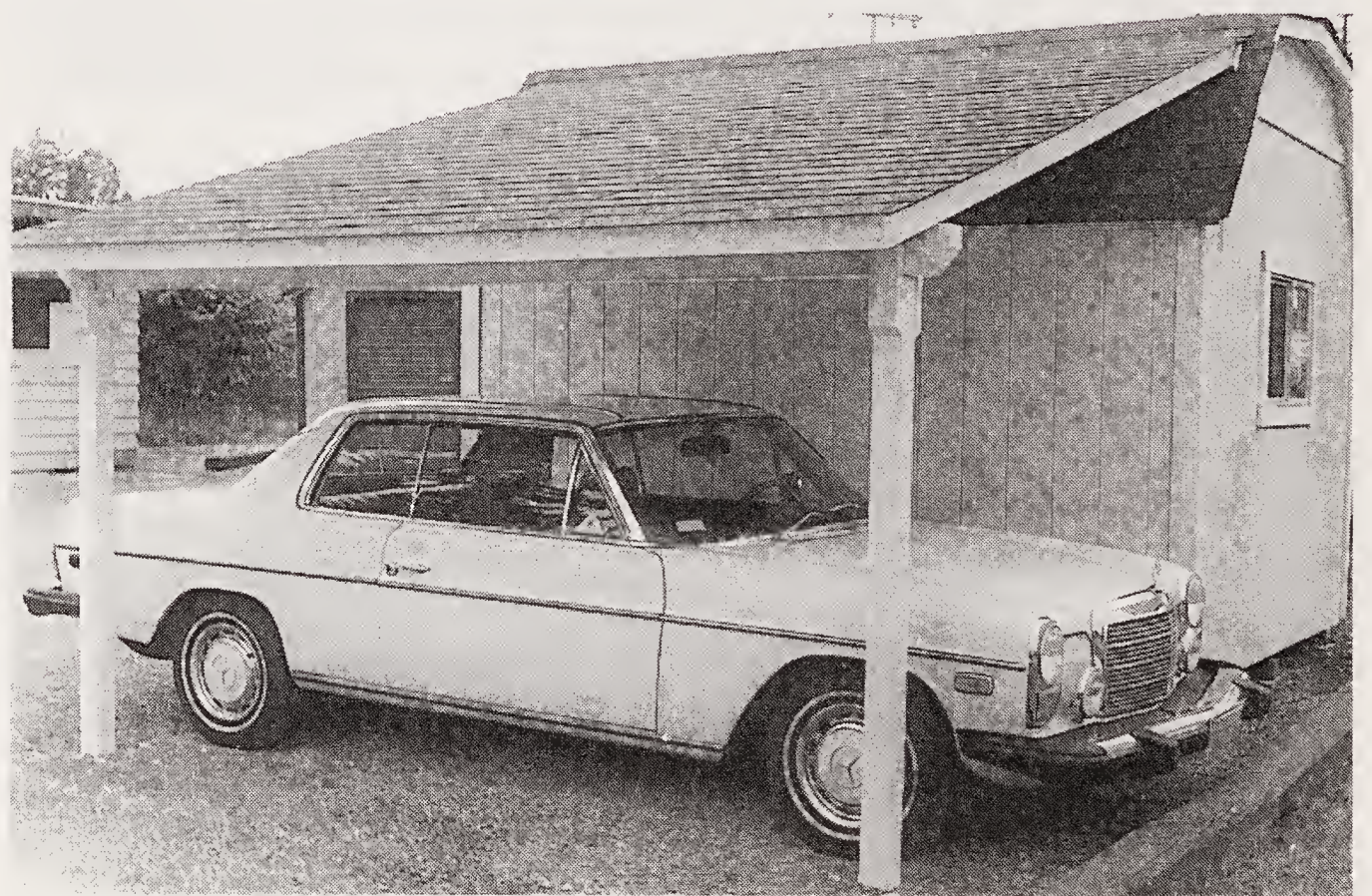
The rear section of the firewood storage unit rests on top of a large 4×8 timber. The 4×8 sits on top of two *pier blocks*—concrete blocks outfitted with metal anchors, which were inserted into the anchor mold before concrete was poured. The storage unit's front section is supported by two pressure-treated 4×4 posts that were buried into the ground about 18 inches deep. A long 2×4 runs from one 4×4 post to the other at ground level. A series of 4-foot-long 2×4s then rest horizontally on top of the 4×8 beam and long 2×4 to make up this unit's floor structure.

Outbuildings can be built in many different styles to best blend in with existing home and landscape designs. These Mini Barns are constructed basically alike with 2×4s used as floor joists, *studs*, and *rafters*; ¾-inch-thick plywood for floors and roof sheathing; and ⅝-inch-thick T1-11 plywood for exterior wall sheathing and doors. To add a decorative flair and cover the exposed plywood edges, 1×4 boards were nailed upright at the corners. A single 1×4 was nailed horizontally across the front upper sections to cover gaps between the plywood edges. These horizontal 1×4s mark an 8-foot-tall dimension, as the plywood sheets were installed vertically. (See top of next page.)

Outbuilding walls constructed of 2×4 studs can be covered with exterior-grade plywood, decorative grooved T1-11 plywood, or any other type of wood desired. They can be outfitted with doors, windows, and other accessories to best accommodate overall storage or other needs. Some ingenious people have installed large awnings off the sides of outbuildings to serve as covers for firewood, boats, motorcycles, and the like.



A simple awning like this can be made by attaching 2x4 rafters to the roof and supporting the open end with 4x4 posts and a 4x4 header. The posts were secured to pier blocks at ground level. Shingles or rolled roofing cover 2x4s sheathed with plywood.

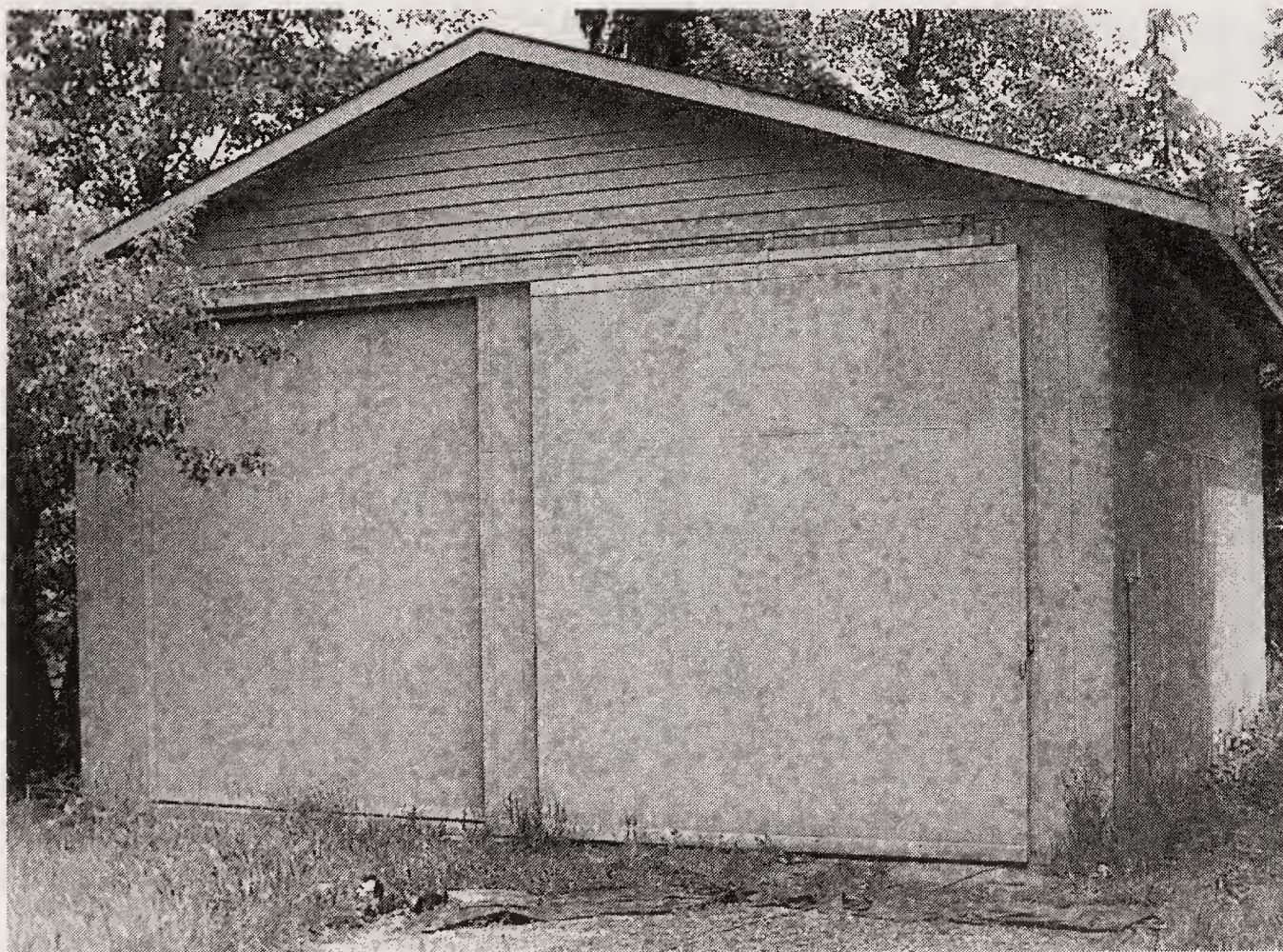


To prevent rain or melting snow from running into the covered awning area, plywood was positioned past the ledger edge until it met with the actual roof. The last row of awning shingles were then slipped under those adjoining on the building roof to ensure water continues to flow down and away from the awning/roof juncture.

Although most outbuildings are constructed with simple designs, you can make additions or alterations to help otherwise plain-looking structures look more attractive.

Construction of a full-size, do-it-yourself home-improvement workshop requires plenty of consideration with regard to size, design, security, access, conformation to local and national building codes, electrical and plumbing utilities, overall appearance, and so on. Budget constraints and lot-size limitations generally will dictate the overall size of new home workshops, but don't overlook other features that you might be able to add at a later date, like bathroom facilities, slop sinks, attic storage, skylights, large pieces of woodworking equipment, and so on.

Workshop designs



A large backyard and wide access along one side of an existing home made it possible to construct this good size 30×40-foot family workshop. Because the do-it-yourself homeowner who built this shop is also a boating enthusiast, wide sliding doors were installed to accommodate big boats on wide trailers. A door on the right has its sliding hardware mounted outside, while the left-hand door's hardware is mounted inside. The ceiling height measures 12 feet to allow plenty of working room for all sorts of home-improvement endeavors.

Notice that this workshop has no windows. They were purposely left out of the design as a security measure. Many workshop owners believe windows offer easy access for burglars and other thieves.



Designing a viable workshop for our house was hampered by minimal access along either side of the existing home. The available space was limited to a narrow patch of level rearyard bordered by the home on one side and a ravine and creek on the other. In addition, ceiling height for the daylight basement area of our home only measured 7 feet 3 inches.

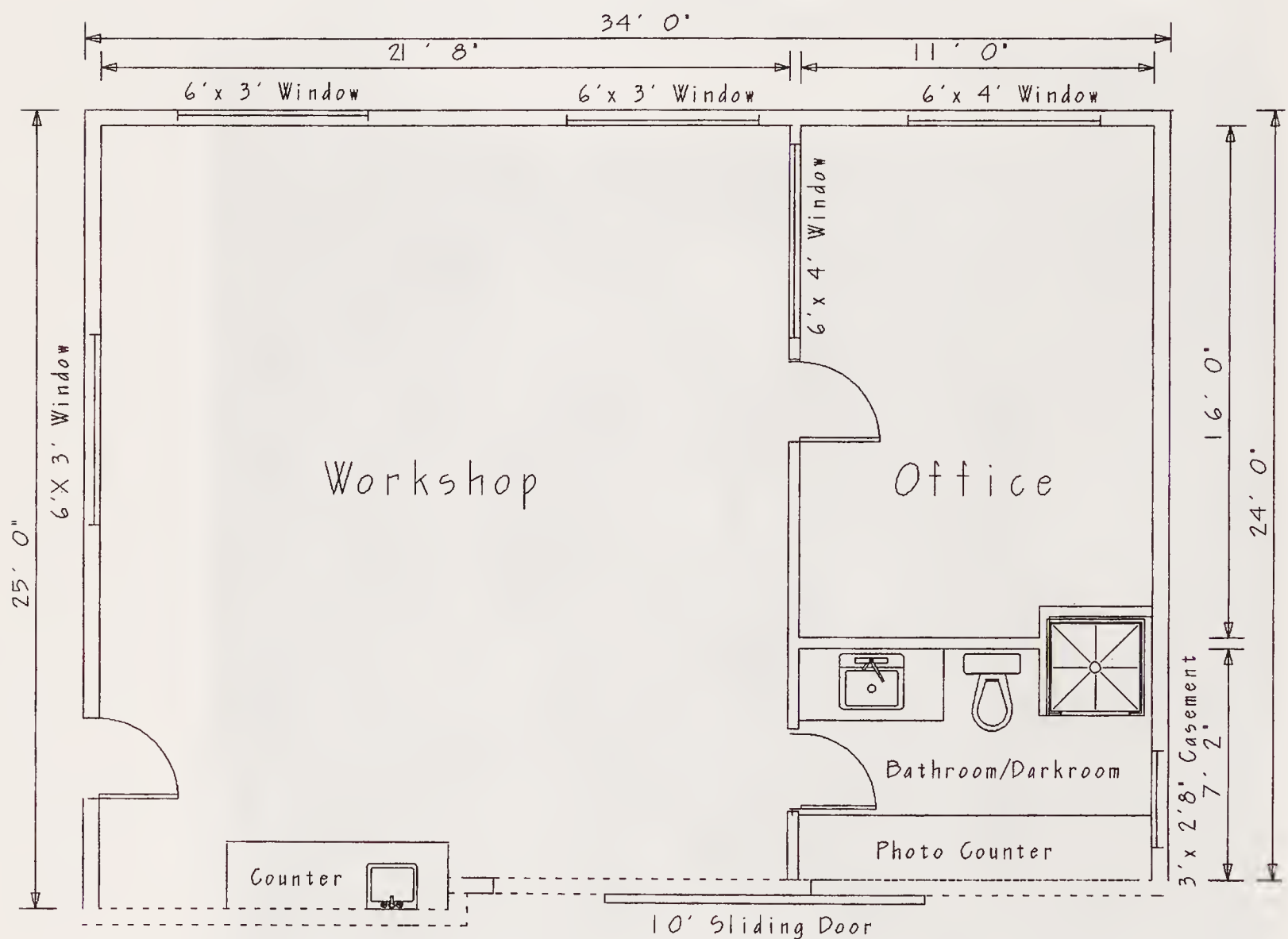
The building was constructed directly behind a two-car garage allowing direct access to the main workshop. In order to arrive at an 8-foot-3-inch ceiling height, the ground-level foundation and floor were constructed 1 foot below the existing home's daylight basement floor. A series of two-wide concrete steps accommodated workshop access to the garage floor area, which rests 1 foot higher than the workshop floor.

Along with all the other considerations when you design and build a home-based workshop, the new building's exterior must be compatible with that of the existing house in order for the new structure to attractively blend in with all of its surroundings. In this case, because the only site available for the workshop was directly off our existing home's back wall, it was decided that a second-floor living area on top of a first-floor workshop would best serve the overall structural design.



Large Eagle windows were installed in the first-floor workshop, because security was a minimal concern at this workshop site. The second-floor family room also enjoys attractive Eagle windows. Eagle windows and doors were selected for this building project because of their excellent quality and long-lasting value. We could have chosen less expensive windows and doors, but opted to install attractive and energy-efficient Eagle wood products because these home attributes will be permanent installations for decades.

Deciding on specific window and door locations, opening sizes, and styles is not always easy. Workshop windows set too low might be broken when you maneuver long boards or other objects.



The best way to design a new workshop or outbuilding is to make plenty of drawings of both the exterior appearance and interior layout. Once you have developed a reasonable plan,

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sketch the idea to scale: $\frac{1}{4}$ inch on paper equals 1 foot in actual building size. A $\frac{1}{4}$ -inch scale ruler, available at variety stores, can help you draw to scale. Measure different pieces of equipment and household counters to get a good idea of how these things will fit inside your new workshop. If household counters are too narrow for your workbenches, adjust your drawing plans accordingly.

One of the easiest ways to make building-plan drawings to scale is to use the Autodesk Retail Products Home Series computer software. The program is simple to use and comes with complete instructions. In addition, you can talk to an Autodesk Retail Products technical support person on the telephone to get answers to any questions you might have about how to operate the programs. Along with drawing in walls of various lengths and thicknesses, the Home Series can be programmed to draw in doors, windows, bathroom fixtures, furniture, and lots more.

The more time you spend perfecting your building plans, the better your project will progress and the happier you will be with the overall results. To learn more about different workshop and outbuilding designs and styles, look through home-design magazines and go for walks around your community. Look at what other folks have constructed and talk with friends and neighbors who have built workshops or outbuildings on their home sites. They should be able to share with you their thoughts on how their workshop or outbuilding could have been improved. Note these ideas and incorporate them into your building plans.

Plans, permits, & organization

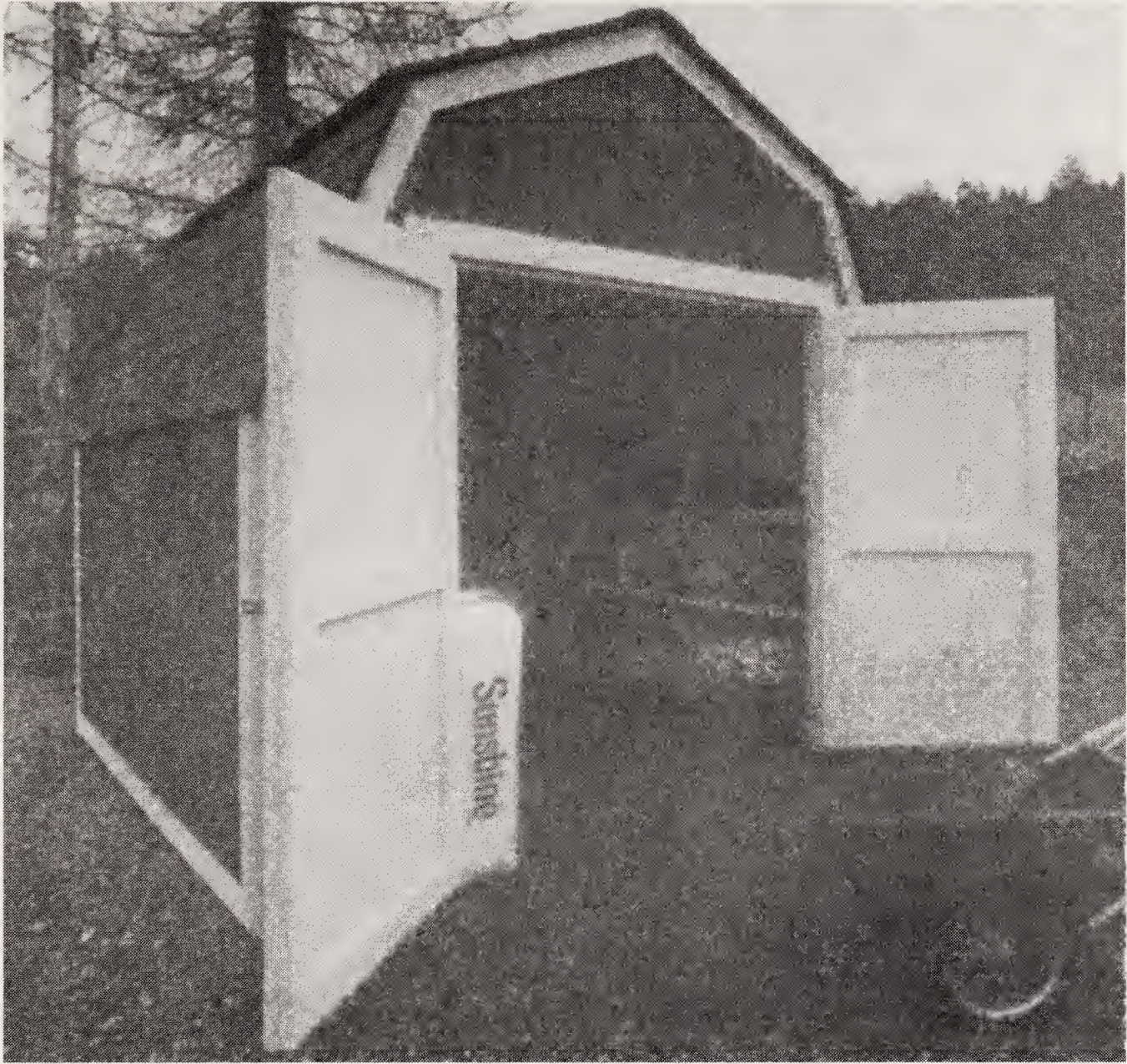
NOVICE DO-IT-YOURSELFERS MIGHT ENVISION ALL *BUILDING plans* as elaborate sets of blueprints, drawn to scale by professional architects, that include in-depth information they could never hope to understand. Although this might be true for large residential and commercial construction projects, it is not always a prerequisite for home-improvement projects.

Plans for small outbuildings do not have to be perfected blueprints drawn to scale. They can be simple sketches that include dimensions and a basic outline of the structure's conceived design. Experienced do-it-yourselfers might be able to get by with just a few rough sketches that serve as a checklist. But novices should write down on drawn plans as much information and instruction as possible before starting construction. Use these notes as a constant reminder of how the building process should progress.

Sample outbuilding plans

An abundant supply of simple and inexpensive outbuilding and other home-improvement building plans are available. Plans can be found in articles and advertisements in home-improvement and woodworking magazines, in literature printed by some manufacturers of home-improvement tools and equipment, and from organizations like the American Plywood Association (APA) and Western Wood Products Association (WWPA).

The following is one page from a set of plans for a store-it-all barn available from the APA for less than \$5. Lots of other do-it-yourself plans for different projects are also available, some for as little as 50¢ or \$1. Contact the APA and ask for the publication that lists all available plans.



MATERIALS LIST - Store-It-All Barn

Recommended Panels:

QUANTITY	DESCRIPTION
4	APA Rated Sheathing Size: 1/2 in. x 4 ft. x 8 ft.
6	APA Rated Siding Size: 5/8 in. x 4 ft. x 8 ft. (The example shown uses APA T1-11 siding with grooves 4 in. o.c.)

Other Materials:

QUANTITY	DESCRIPTION
32 ft.	2x4 framing, pressure-preservative-treated
28	2x4 studs, 8 ft. lengths
1	2x6 ridge beam, 8 ft. long
22	1x4, 8 ft. lengths
18	1/4 x 2-1/2 in. galvanized bolts
18	1/4 x 4 in. galvanized bolts
5.5 ft.	3/4 in. steel pipe (needed for 16 in. long pieces)
3 pair	4 in. T-hinges for doors
1	3 in. lock hasp
As required	Roofing material to cover 96 sq. ft.
As required	8d common nails and 8d finishing nails, nonstaining
As required	Paint or stain. Follow manufacturer's application recommendation.

Project Notes:

Select a level site for the Store-It-All Barn. A concrete slab or a bed of gravel can be used for the foundation. Begin construction with side walls D and J. When cutting, keep in mind that all sections are connected with shiplap edges. Cut and attach 2x4s to interior of side walls. Use treated lumber for the footing plate.

Next, fabricate front and back walls, sections B and K. Cut 2x4s and nail to interior of wall. Again, use treated lumber for the footing plate. In section B, run a footing plate all the way across the bottom for stability during construction. A threshold will be cut later.

Attach side walls to back walls with four screws at each corner. Attach side walls to front walls in the same way.

With 6d nails, connect lumber sections to roof panels. The 2x6 ridge beam is fastened to the edge of an upper roof panel. See plan details for lumber length and placement. Apply roofing material before attaching roof sections. Follow roofing manufacturer's recommendations for roofing installation. Screw roof panels to front, back and sides of barn. Install E and H in lower roof positions first, then put up F and G. Upper roof section will overlap lower. When all roof panels are in place, install a roof cap.

Install trim on the sides, front and back. Nail trim to door panels. Anchor the four corners of the barn to the site with steel pipe. Cut out the threshold. Hang the doors with strap hinges.

Finishing

Paint or stain as you like. Interior can be finished with shelves or bins.

Designer: American Plywood Association

If you have never built any type of wood-framed structure, this set of plans might be a bit confusing. This is understandable. Give yourself a chance to grasp general building concepts before you expect to become a full-fledged professional carpenter. Find a friend or neighbor who has an outbuilding or small structure on their property, or locate a home-improvement center that has a similar model on open display.

With this book or a set of outbuilding plans in hand, go to that structure and compare your plan sketches with the actual boards used to make the display unit. Seeing real lumber nailed in place while you look at a set of plans should help you envision how wood-framed buildings are put together.

While at your local home-improvement center, don't be afraid to seek assistance from a salesperson. Most home-improvement centers train their employees on various aspects of home-improvement repair and construction. It is their philosophy that more and more homeowners are choosing to complete home-improvement projects themselves, so the better they assist you, the more building material and supplies you will buy.

Ask about the terminology on your plans if you don't understand the meaning. I have included some basic terms—ask about any others! A *dowel* is a piece of wood that is round, like a closet rod; 1×2, 2×2, and ½×2¼ refer to lumber-board sizes: 1 inch thick by 2 inches wide, 2 inches thick by 2 inches wide, and so on; ⅝-inch T1-11 refers to a specific type of attractive plywood sheathing, which is ⅝ inch thick; t&g refers to boards that have been milled (sawn and shaped) into a *tongue and groove* design—one edge features a slot down the middle; the other edge has a strip of wood sticking out of it that fits into a slot on another board; *rabbeted* (rabbet) is a term used to describe how the corner of a board is cut away at a 90-degree angle so that another board's corner can fit neatly into it. Rabbeted boards are used for door jambs and cabinet door edges.

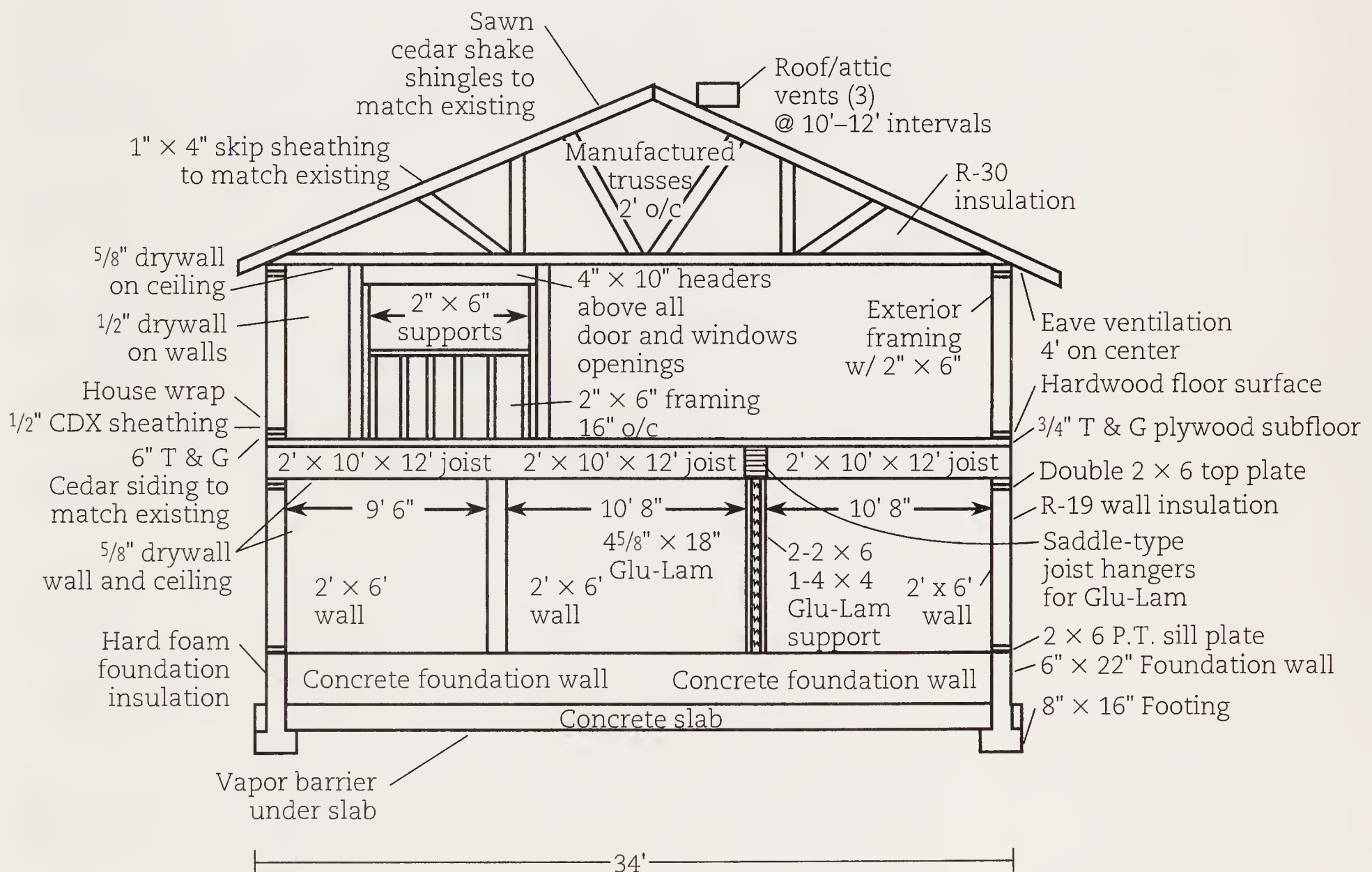
As you begin to understand the meaning behind all the numbers, arrows, lines, and other markings on building plans, you will become more confident. Certainly, building an attractive outbuilding with an intricate roof design might tax your abilities at first, but as you gain experience cutting and

nailing together boards, you'll soon discover that there is nothing secret about the wood-framed building process. It just takes time, patience, and practice.

For the most part, outbuildings that measure 120 square feet or less do not require local building permits. Rules, however, regarding building permits are mandated by local authorities and you should contact your local building department for factual and up-to-date information about your project.

Building permits

Structures larger than 120 square feet almost always require building permits. Therefore, should you be contemplating the construction of a large workshop or outbuilding, visit your area's building department to find out exactly what kind of plans and forms you'll need to complete and submit. Ask how much permits will cost.



This is a plan drawing (see page 13) that shows how a structure will be built. It includes the types and sizes of building materials that will be used, and where specific insulation and ventilation products will be located. The exterior walls for most new-construction structures are now required to be framed with 2×6-inch studs because they are wider than standard 2×4s and will allow more insulation material between them.

The size of other dimensional lumber, like that for window and door headers and floor joists, is determined by the distances they must span over open areas. Building material guides that include tables that show which size beams are required for specific spans are available from the Western Wood Products Association (WWPA), manuals at the library, and local lumberyards and home-improvement centers.

Along with an outline of your homesite's property lines, including where your house sits on the lot, you might have to draw in the location of concrete walkways and driveways, trees, watercourses (creeks, ponds, and so on), site elevations, rockeries or walls, and the like. All plan drawing requirements should be explained to you by your building department representative. All jurisdictions have their own sets of guidelines. You will have to conform to their rules in order to obtain permits.

Once you have drawn your plans to scale, bring them to a copy center and have them enlarged and printed. There is no big secret to having a set of building plans printed on large sheets of paper, bound together, and then rolled up like you see professional contractors carrying around. The cost is minimal, generally around \$25 or \$30 for two complete sets.

Depending on your building project, you might have to include electrical, plumbing, ventilation, insulation, roofing, and other specifics as they relate to the overall project. If your building entails a great deal more than just four walls and a roof, like having to tie-in with your existing home, seriously consider having a professional architect look over and modify your plans as needed. This will save you a lot of time and frustration when you attempt to obtain necessary building, plumbing, electrical, and other pertinent permits.

A building inspector might visit your proposed job site to ensure no major site problems exist before approving your permit. Although they might not be authorized to offer actual building advice, they might be able to pass along helpful suggestions that could save you time, money, and frustration. Try to build a rapport with the inspectors because you will be calling them out to your job site numerous times during the construction process in order for them to inspect and then sign off on different stages of construction.

Once your permit has been issued, you are not supposed to make any structural alterations without permission. You can change interior layouts with no problem, but increasing the size of a structure, raising its roof height, making doors or windows bigger, or changing any other part of the main support structure might not be allowed without specific building department approval.

Every construction project requires a real sense of organization. Without organization, it might take months to acquire building permits, inspectors might have to be called out numerous times to approve basic segments, footings might be dug too wide or too deep and require extra concrete to fill them, building materials might be unnecessarily wasted, and you or the people who help you might become injured as a result of haphazard work habits. A lack of overall worksite organization, therefore, will most probably result in wasted time, energy, and money.

Perhaps the primary function of any professional building contractor is worksite organization. He or she must coordinate the timely arrival of specific building materials, workers, and special equipment in order to have the job progress smoothly and uniformly. It makes no sense to have a concrete truck parked out front when only half of the forms are in place, nor is it wise to have roof trusses delivered when none of the building walls have been erected. With that in mind, envision the progression of activities that will take place during the construction of your workshop or outbuilding. Plan for each day's work ahead of time, so that sufficient materials and helpers will be on site when needed.

Organization

Lumber and wood storage

Stack lumber on top of 2×4s or 2×6s positioned flat and spaced no more than 2 feet apart. Placing lumber on top of bare, uneven ground will cause the wood to bow and warp. Putting plywood down on top of moist dirt will cause its thin wood plies to warp and will weaken the glue used to hold the plies together, which might result in plywood separations, buckling, and other damage.

New wood, fresh from a lumberyard or home-improvement center, must be stacked off the ground and flat to keep otherwise straight material from bowing or warping.



In order to keep dimensional lumber (2×4s, 2×6s, and the like) stacked neatly, you might need to pound in a few tall stakes around the perimeter of the pile. Stakes help keep end boards from falling off as more wood is placed on top of them.

For convenience, stack 2×4s, 2×6s, and plywood sheets separately. This way, you can easily retrieve properly sized materials when needed without having to move other pieces. In addition, try to refrain from stacking short boards on top of

longer ones. Chances are you'll need the longer ones before you use up all the shorter ones on top.

Building wood-framed structures always results in at least some wood waste—scraps of cut-off boards scattered about work areas. This dilemma is especially prevalent with remodeling jobs and additions where portions of an existing structure must be cut off or removed to make room for new walls, roofs, and so on.

Designate a specific area at your job site to be used as a debris pile. Sections of old sheathing and other waste should be tossed in that out-of-the-way pile in an effort to avoid mounds of splintered or nail-embedded materials from obstructing construction activities.

If the workshop or outbuilding you are constructing will permanently house large pieces of equipment or will be equipped with a wide shower unit, be sure that you will be able to get them into the structure after it has been built.

This new workshop will feature a corner bathroom that includes a 3×3-foot shower stall. Because an interior wall, which separates the bathroom from its adjoining workshop, had to be built as part of the second-floor support system, there was no way to fit a 36-inch-wide shower unit through the bathroom's 30-inch interior-door opening. To accommodate the shower unit, a section of exterior wall designed for a 3-foot-wide window was left incomplete. This opening will be finished after the shower unit has been put in place.

Small openings, no more than 3 feet wide, can generally be left open on some exterior walls providing there won't be any unusually heavy objects placed or construction done above them. In cases where wider openings will be needed to move large objects, nail studs in place with *duplex* (double-headed) nails. The nails can then be pulled away easily when you need to remove them later for access.

Demolition considerations

New construction access



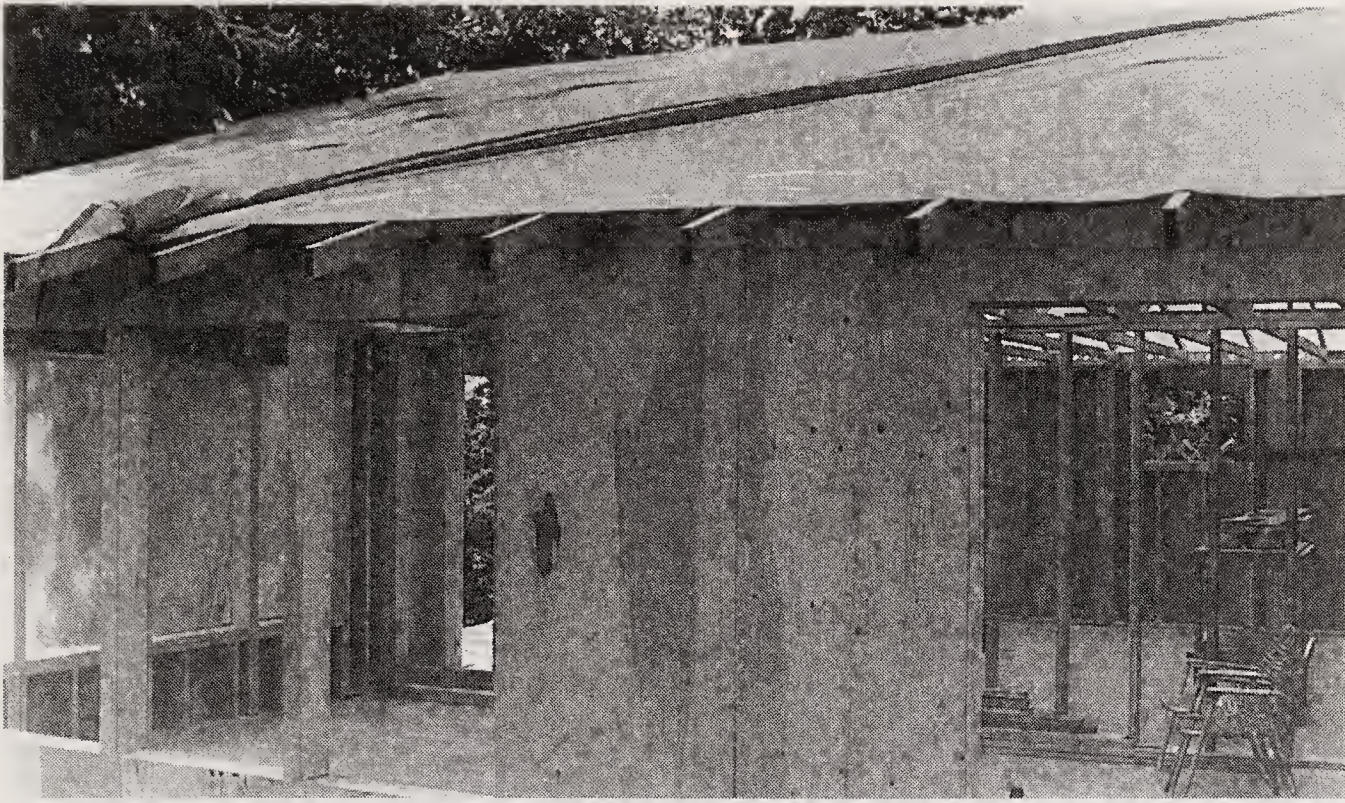
Inclement weather preparations

Talk to just about anyone who has ever constructed an outbuilding, workshop, or other structure and they can probably relate a story about how it rained or snowed during their project. Our multipurpose workshop project was no exception. This job began on April 1st. By April 30th, all records had been broken with regard to the number of days that received measurable rain—26 out of 30.



We were fortunate to get a five-day window of dry weather that enabled us to pour our workshop floor. Soon after, the rains returned. Pools of rainwater developed overnight on the concrete floor and had to be removed with a Makita wet/dry vacuum. This was important because standing in puddles of water when operating electrical tools is very hazardous. You could be electrocuted.

Walls and roof trusses were built during another short dry spell. Because of wet-weather forecasts, a decision was made the day before the trusses were installed to secure the trusses in place and then cover them with a tarp. As we were securing



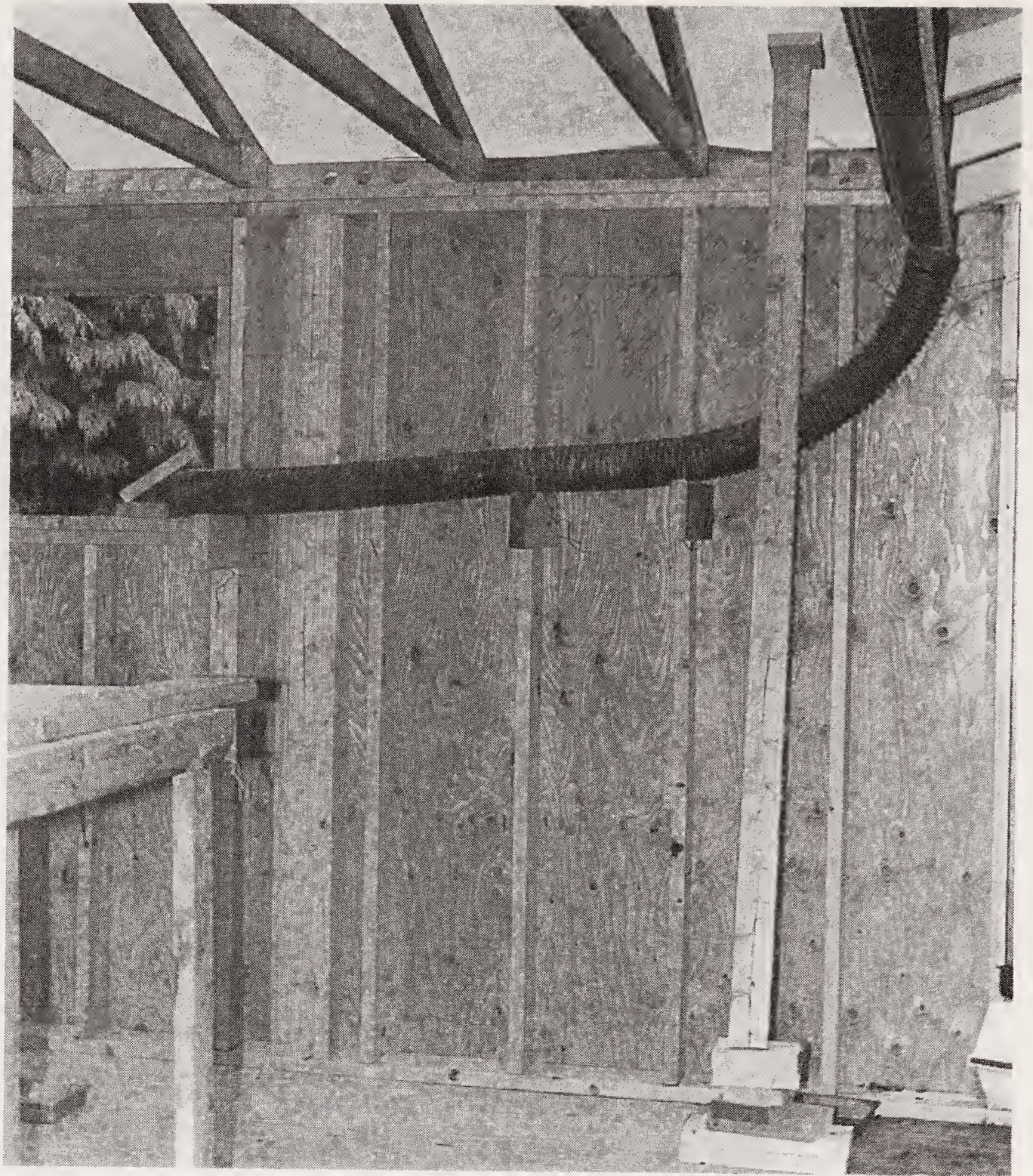
the perimeter edges, after draping the tarp over the structure, Mother Nature let loose with a torrent of rain. What timing! The second-level subfloor and its interior surroundings were spared from a complete and total drenching.

Until your structure is weather-tight and ready for windows and doors, wrap the ends of plastic sheets around thin strips of lath and nail them over window openings to prevent driving rain from penetrating the building's interior space.

Another consideration to keep in mind when you attach workshops to the walls of your house is to maintain an existing rain gutter system until you are ready to tie-in a new roof unit over it. (See next page.)

In this case, stick framing a new roof section over the home's existing rear roof area was necessary in order to tie in to the building's trusses and make our workshop addition look as if it was part of the original structure. Because rain had been predicted for the next few days (weeks), only the far end of this rain gutter and eave section was cut out to allow for the installation of the new perpendicular wall.

A section of flexible drain pipe was secured under the gutter's cut-off section with tie wire. The drain pipe was then directed out a window opening. All of the rain that fell on the existing rear roof



area eventually flowed into this gutter, through the pipe, and out the window. As with the tarp, this simple solution saved our new subfloor from exposure to hundreds of gallons of rainwater.

Bad weather is notorious for disrupting or hampering construction activities. Should you find that rain is forecast for your area, make plans to have tarps and/or rolls of plastic on hand to cover your building project, stacks of new lumber, ground being prepared for concrete, and so on. No idea is too strange, as long as it works. Just look at that flexible drain pipe sticking out the window!

Tools & materials

PROFESSIONAL CARPENTERS AND TRADESPEOPLE FREQUENTLY accumulate a number of hand and power tools in order to complete jobs in a timely manner. To them, time is money. Do-it-yourselfers, on the other hand, tackle home-improvement projects as a means to save labor costs and enjoy the experience associated with doing things themselves. To them, extra time spent building a project does not cost them nearly as much as a large, state-of-the-art power tool supply.

Therefore, understand that most of the tasks required to construct workshops and outbuildings only require a minimal tool inventory. However, as your do-it-yourself skills advance, so will your tool needs. Select quality tools, like those featured here, that will provide you with superior performance and long-lasting durability.

Building material quality is just as important as price. Although you might initially attempt to find the least expensive lumber and supplies, realize that cheap lumber, nails, roofing, skylights, windows, doors, and other products might hamper your efforts to construct attractive and sturdy structures. Warped and bowed 2×4s are impossible to work with when you try to build straight walls. Cheap nails will bend or break, skylights and windows might leak, and so on.

Shop around for good deals, but understand that paying a little more for quality products will make your building projects simpler to complete and easier to maintain.

Unless you're planning to build a treehouse, you will need to move around some dirt in preparation for a foundation. The Structron Corporation offers excellent tools that are strong and comfortable to use.

Common hand
tools



A spading fork breaks up soil and clods of clay. Easier to use than a pick, consider using it initially to prepare footing trenches.

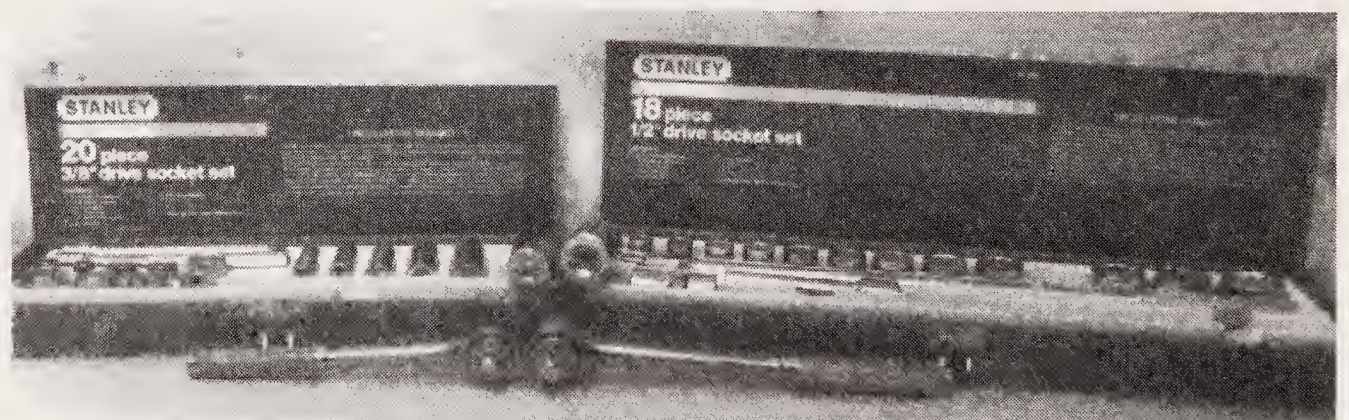
A Structron D-handled square-point shovel is perfect for moving concrete around slab sites. Its shorter handle makes the tool very maneuverable. Be sure to wash tools thoroughly after you use them with concrete. Hardened concrete will make them heavier and debris on the handles will be uncomfortable.

Every do-it-yourselfer should have at least a small toolbox equipped with essential tools like screwdrivers, wrenches, pliers, and so on. A good way to start out is with sets of related tools.



These Stanley screwdrivers are offered as a 10-piece set. Different sizes in both slot and Phillips-head are provided. Never try to tighten or loosen screws with a screwdriver that is too big or too small. You will end up ruining the screw heads. Use a properly sized tool that fits easily and snugly into the screw head.

Along with screwdrivers, you'll need a heavy-duty carpenter's pencil and a utility knife to sharpen it. Carpenter pencils have thick lead inserts that hold up much better than ordinary pencils. A utility knife will come in handy for cutting building paper, trimming splinters off wood edges, scoring asphalt shingles, and the like.



Every enthusiastic do-it-yourselfer needs a quality ratchet and socket set. A $\frac{3}{8}$ -inch drive set is sufficient for most purposes. This 20-piece set from Stanley includes the most frequently needed sockets and extensions. For heavy-duty applications, use a Stanley $\frac{1}{2}$ -inch drive set. The larger and more sturdy ratchet and sockets will tighten heavy-duty, extra large nuts and bolts that might be required to secure big beams to metal connectors.

Vise-grip locking pliers from the American Tool Companies are capable of hundreds of applications when you need to grip something extra tight and then twist or turn it. They are especially handy for loosening nuts or bolts with stripped or damaged heads.



Vise-grip locking pliers are available in a range of sizes and jaw designs, as seen here. To release their grip, simply depress a small lever located inside one handle. The threaded rod and knurled knob on the other handle is used to adjust the tools for a proper fit.

One of the best tool inventions of recent times is the Quick-Grip bar clamp from American Tool Companies. Available in lots of different sizes, these one-hand-clamps are worth their weight



in gold. While holding two boards together with one hand, you can apply a Quick-Grip clamp with the other. No longer do you need three or four hands to accomplish simple clamping tasks.

Accessories

Carrying an assortment of tools to a worksite can be cumbersome, especially if you plan to use a number of different tools throughout the day. One simple solution is the tool organizer from McGuire-Nicholas. The unit adjusts tightly over a 5-gallon bucket and is equipped with lots of pockets for tool storage. In addition, you can fill the bucket with tools, extension cords, materials, and so on. The pouch comes separate, you'll have to provide your own bucket.

Early sunsets during winter and the lack of ceiling lights in new outbuildings or workshops will require you to quit work early or set up portable lights. A super-bright halogen light mounted on an adjustable stand from Harbor Freight Tools offers ideal illumination for those and other dark occasions. Also consider using Harbor Freight's four-outlet extension cord for tasks that require the use of more than one electrically operated power tool. A long-handled Structron push broom will make quick work of sawdust and other debris at the end of the workday. Don't forget to store tools like these out of the way when they are not in use.

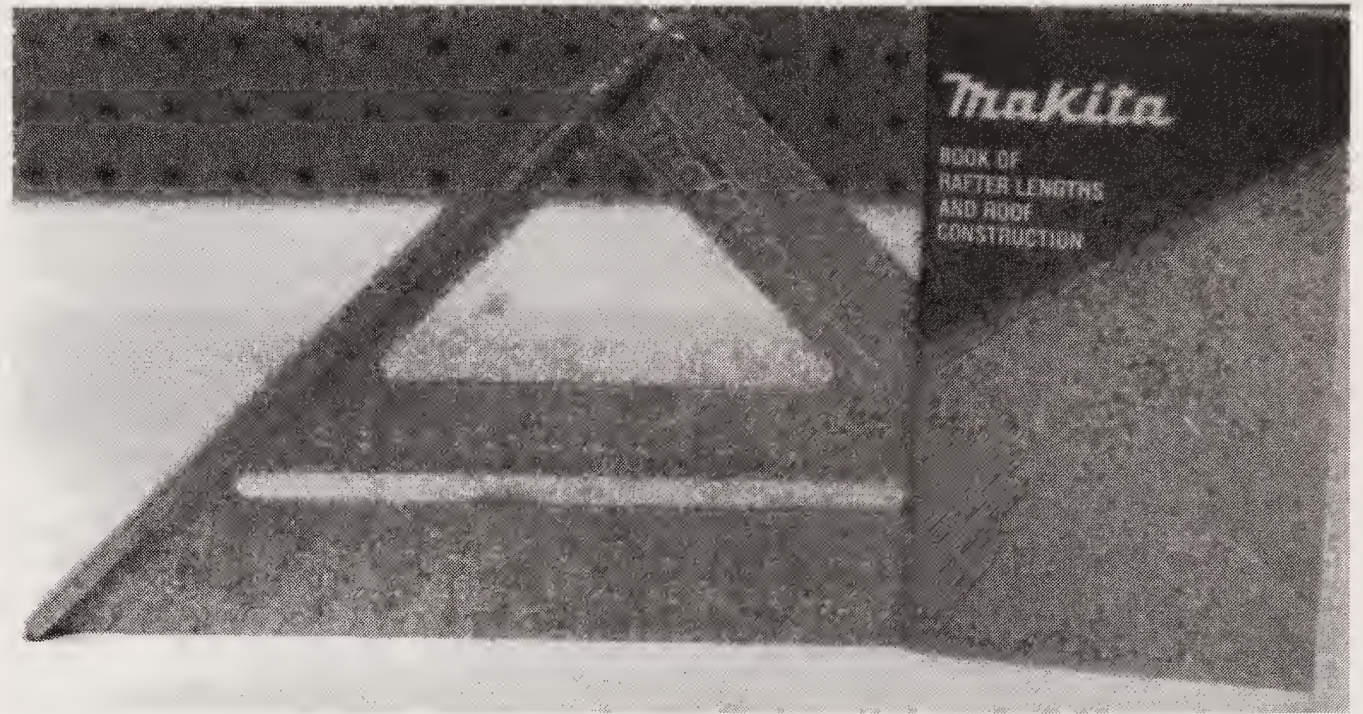
If you have ever had to carry a lot of lumber to a job site, you can imagine what a dream come true a McGuire-Nicholas leather shoulder pad unit is. Outfitted with a harness and suspenders that attach to your McGuire-Nicholas tool belt, these shoulder pads are comfortable and stay in place all day. Your shoulders will thank you for weeks.

Along with the shoulder pads, an adjustable McGuire-Nicholas back support made me feel like I was 20 years old again! It was comfortable to wear, offered plenty of support, and my back felt great all day, even the next morning when I woke up. During any activity where you will be doing a great deal of lifting, seriously consider the use of an adjustable back support.

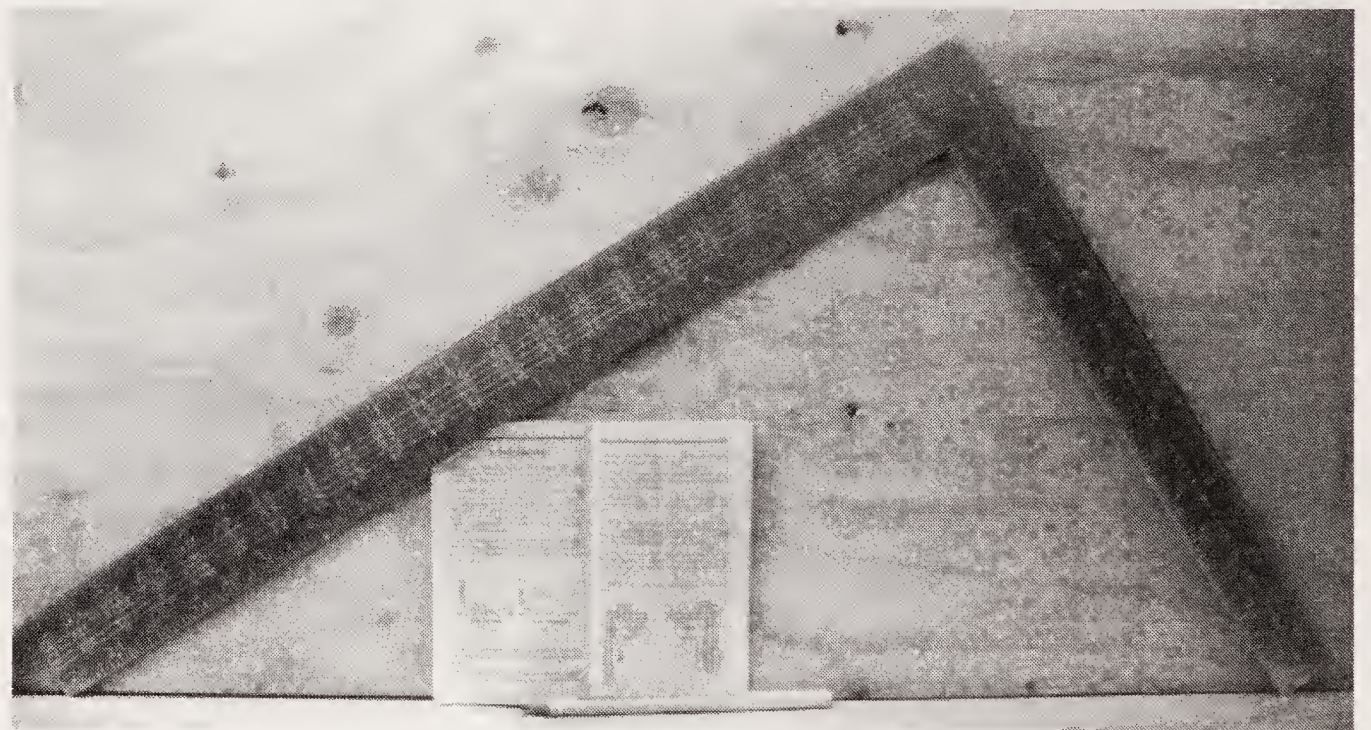
In order to build anything straight, square, *plumb* (perfectly vertical), and perpendicular, you will need to use a square. The Makita speed square is handy for use as a guide to make straight pencil marks across dimensional lumber that must be cut. You can also use it for making 45-degree markings. Along with those useful qualities, this tool is outfitted with numerous

Squares and levels

embossed numbers and indicators that will even show you how to cut rafters for roof-framing projects.



In order to learn how to put this square to use, you will have to study the little booklet that comes with it. Although the theory behind cutting rafters is simple, it takes a while to comprehend. Have patience and read your booklet a few times until everything clicks inside your head and the information becomes crystal clear.



To make straight pencil marks on larger boards, you will need to use a full-size square. This particular model is a roof-framing square. It comes with its own informational booklet, too. It

might take a while to figure out the relationship between all of the numbers and markings, but once you do, you should be able to build any type of wood-framed roof imaginable.

One of the most precise leveling tools for gauging horizontal adjustments is a water level. Non-confined water will always rest at a perfectly level position. For years, masonry workers and carpenters have relied on simple, clear tubes filled with water to determine if one section of a wall is level with another. If the sections are level, the water at each open end of the water level is at the same height, as long as no air bubbles are inside the tube and both ends are open to free air.

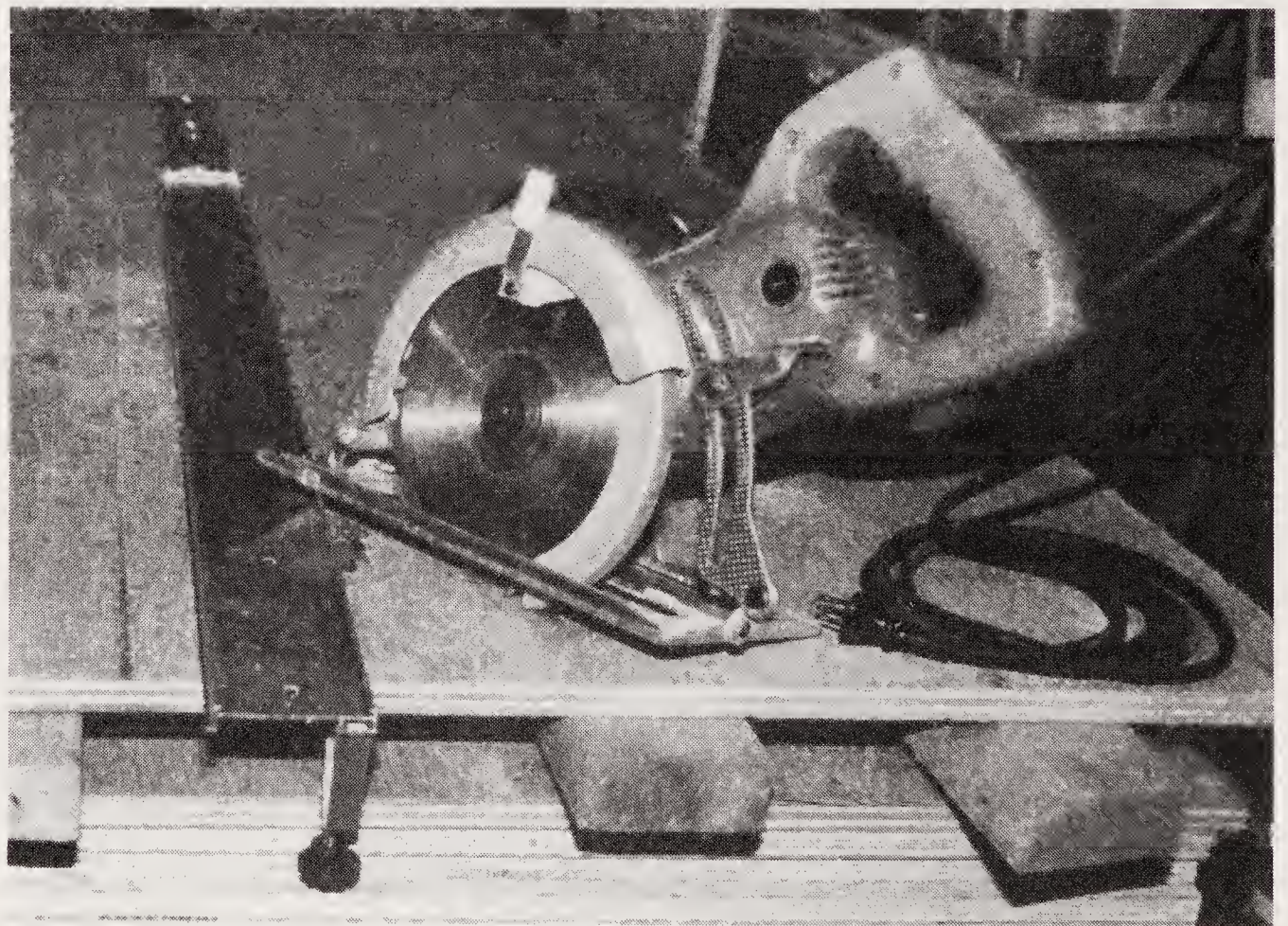


The Zircon Corporation offers an electronic water level that can be used by one person. Secure the base unit in position with a Quick-Grip clamp or hang it from a nail driven into a support at precisely the spot where one part of a wall or object is being

leveled. Then move the open end of the water-filled clear tube to a spot at the other end of the wall or object where a level measurement is needed. Once the water is level at both ends of the tube, a loud audible alarm will sound. At that point, you know exactly where the level mark is located.

For smaller leveling jobs, like setting footing forms, use a 2-foot Stanley all-purpose level. A vial in the middle of this unit indicates horizontal level; vials at both ends indicate vertical level. When the air bubble steadily rests between the two lines painted on the water-filled tube, you know that whatever it is you are adjusting is level.

Saws Regardless of the size of your workshop or outbuilding, you will have to use a saw to cut wood. Sharp handsaws work well for lots of tasks, but power circular saws are much faster and more efficient for wood framing.



This 7¼-inch Makita hypoid saw has been adjusted so that its blade will cut through only the ¾-inch plywood. Adjusted differently, it will cut through 2× material with ease. Be sure to

read and comprehend the operating instructions that accompany the hypoid saw because the tool creates a great deal of power and torque. Along with this saw, notice that an all-purpose cutting guide from Harbor Freight Tools was set up to help the operator make a perfectly straight cut down the length of this plywood sheet.

Cutting away sheathing with a power circular saw is a bit awkward, especially when you use a heavy-duty hypoid model. A lightweight, but powerful Makita cordless 6¼-inch circular saw makes this job a snap to complete. The tool is compact, easy to maneuver, and efficient. Be sure all nails and other hard objects are removed from the path of the saw blade before you cut.

Many times studs have to be cut to precise lengths in order to accommodate certain building sizes. This is especially true when you try to match new-construction wall heights to existing structures. The task of cutting numerous studs all the same length is made easy with the Makita 10-inch slide compound saw.



We built a temporary work table and extension for our slide compound saw. Note the Quick-Grips that hold this board in place as it is cut. This saw will make straight cuts on boards up to 12 inches wide. It will also make both vertically and horizontally angled cuts at the same time, called compound cuts. This is an important feature, especially when you have to cut *valley rafters*—roof areas where two opposing slopes meet at a valley and then angle down toward the eaves. Please notice that Joey is wearing safety goggles and hearing protectors.



Cutting pieces of plywood and other boards is done precisely with this Makita 10-inch table saw. A roller stand from Harbor Freight Tools at the rear of the saw helps support the long boards after they pass through the saw blade. The dust collection system does an outstanding job of vacuuming sawdust into its large collection bag. Such a dust collection system should be considered a primary accessory, especially for

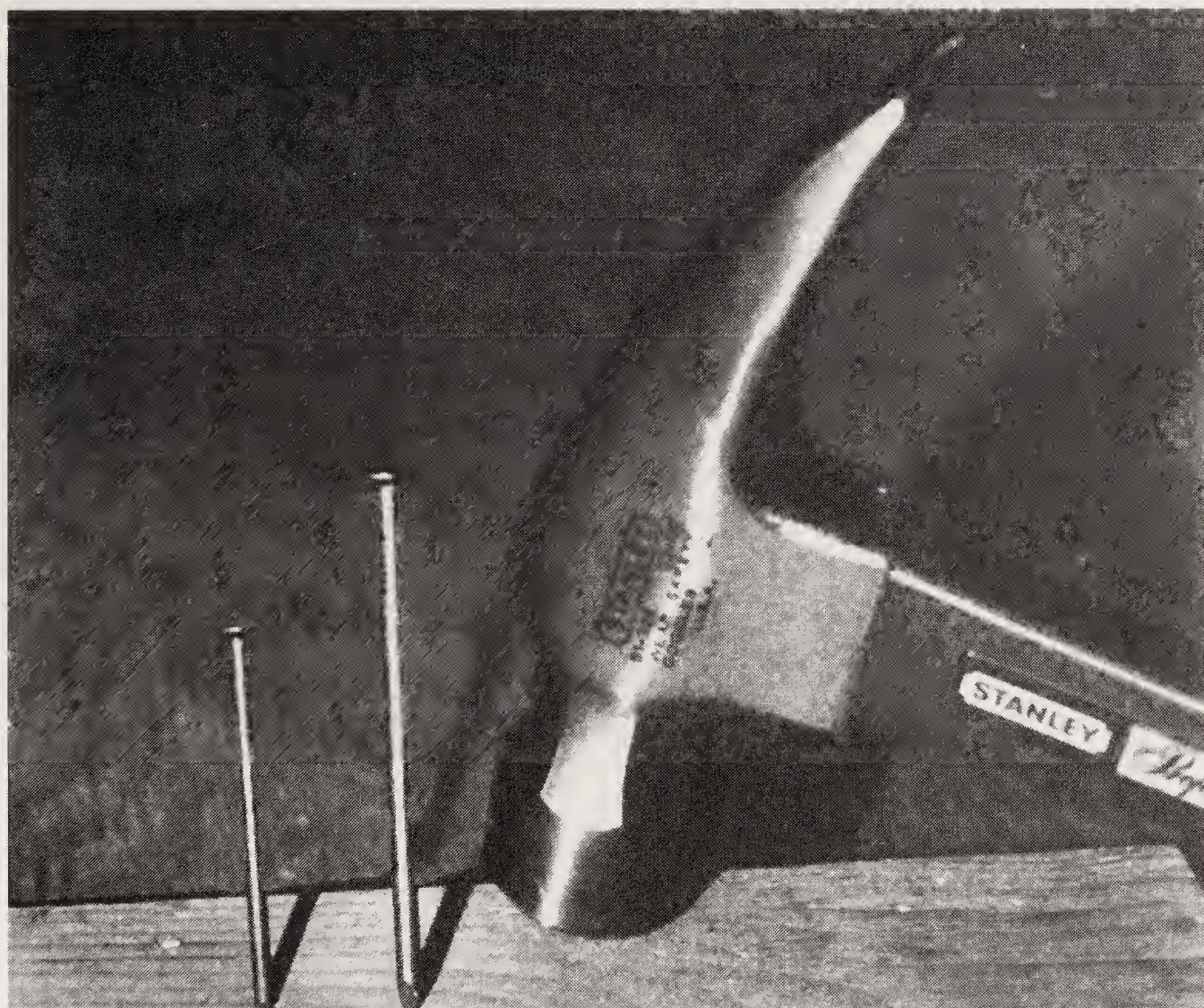
smaller workshops. Again, notice that Joey is wearing safety goggles and hearing protection.

Cutting through wood is easiest with sharp saw blades. Dull blades slow down work, burn wood, and might cause uneven cuts. For rugged outdoor work, consider using a carbide-tipped blade.

The pointed tip on each saw tooth is equipped with a small rectangular block. These blocks are the carbide tips. Carbide-tipped saw blades stay sharp longer than their counterparts. Should you inadvertently run your saw blade into a staple or nail, most steel-tipped blades will dull instantly. Carbide tips won't dull quite as quickly.

Home-improvement projects require lots of different nail sizes and styles. Galvanized nails are used for outdoor projects, skinny small-head finish nails are used for cabinets and small woodworking projects, duplex nails are used for temporary work like concrete forms, and sinker nails are commonly employed for wood-framing tasks.

Hammers and nails



On the left is an 8d (eight penny) sinker nail, on the right a 16d (sixteen penny) sinker. They are both coated with a vinyl material that makes them easier to drive into lumber. You can purchase them by the pound, in 5 and 50-pound boxes. Expect to use at least 50 pounds of 16d sinkers for a medium-size, single-story workshop building.

Hammers are also a consideration. Our 22-ounce Stanley framing hammer, shown with the sinker nails, is ideal. It is not too heavy, yet has enough balanced weight to make driving 16d nails a snap. A criss-cross, waffle-like pattern cut into the hammer's striking head helps it maintain contact with nails. Whenever you use a hammer, follow Stanley's advice and wear safety goggles.

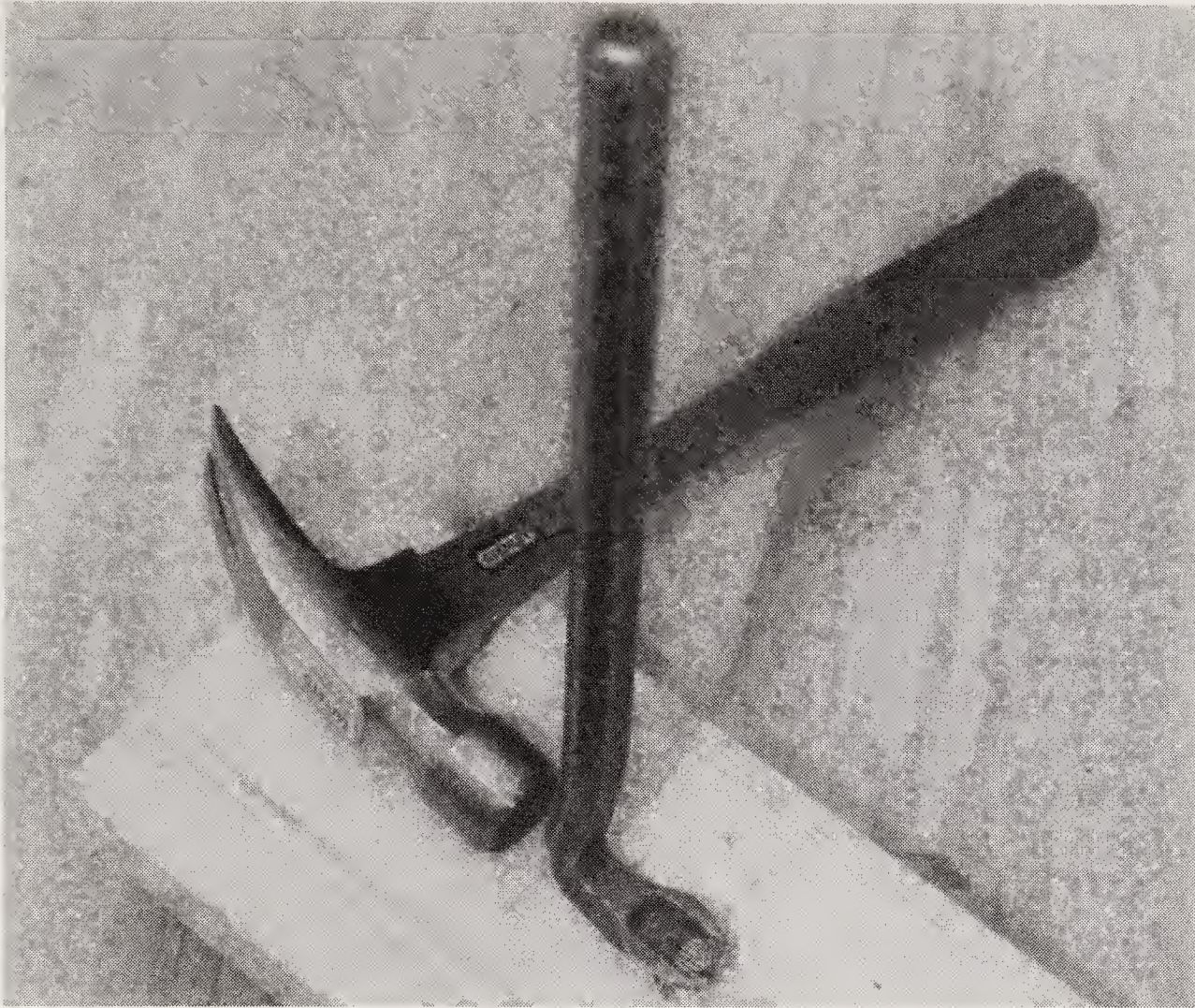
For small applications, like securing plywood sheathing to studs, you will generally use 8d sinker nails. A lighter hammer might be good for this application, especially if it is being used by a younger family member. 16d nails are used primarily to secure studs to top and bottom plates.

At least two 16d sinkers should be driven into each 2×4 stud. Many carpenters feel three should be used for 2×6 studs. Expect to drive at least three 16d sinkers into horizontally placed bottom window plates, and at least four through those studs that are adjacent to header ends above windows and doors.

No matter how hard you try, there will always be occasions when perfectly driven and secured nails must be removed. Position the tapered claw end of the cat's paw at a downward angle and strike the back of it with a hammer to move it just under the nail head. Once you have a grip on the nail, force the handle down to leverage the nail up. (See top of next page.)

Pneumatic fasteners

The use of *pneumatic* (compressed air) powered nailers and staplers will really speed up wood-framing endeavors. When you pull the trigger and depress the tip of the tool against the workpiece, staples or nails are driven rapidly into the wood. These kinds of versatile and powerful tools are not required for all workshop or outbuilding construction jobs, but are sure nice to have when lots of staples or nails need to be driven.



Our heavy-duty Makita generator (shown on bottom of previous page) is equipped with four different electrical outlets. Three are specifically designed for locking twist plugs rated at 20 and 30 amperes. It is extremely important that you read, comprehend, and follow all operating instructions before using a generator. Incorrect amperes drawn through inadequate plugs or extension cords could result in damage to the plugs, extensions, or the machine.

A regular, three-pronged electrical outlet on a generator is actually a *ground fault circuit interrupter (GFCI)*. Should a short or other problem occur in the line, this plug automatically shuts off power to prevent further damage or injury. GFCIs are excellent pieces of equipment and should be installed on every circuit in your workshop and outbuilding. Although regular circuit breakers, located inside regular electrical panels, are designed to trip whenever excessive electricity is drawn through them, GFCIs serve as an added safety feature by cutting electricity even before circuit breakers can sense there is a problem.

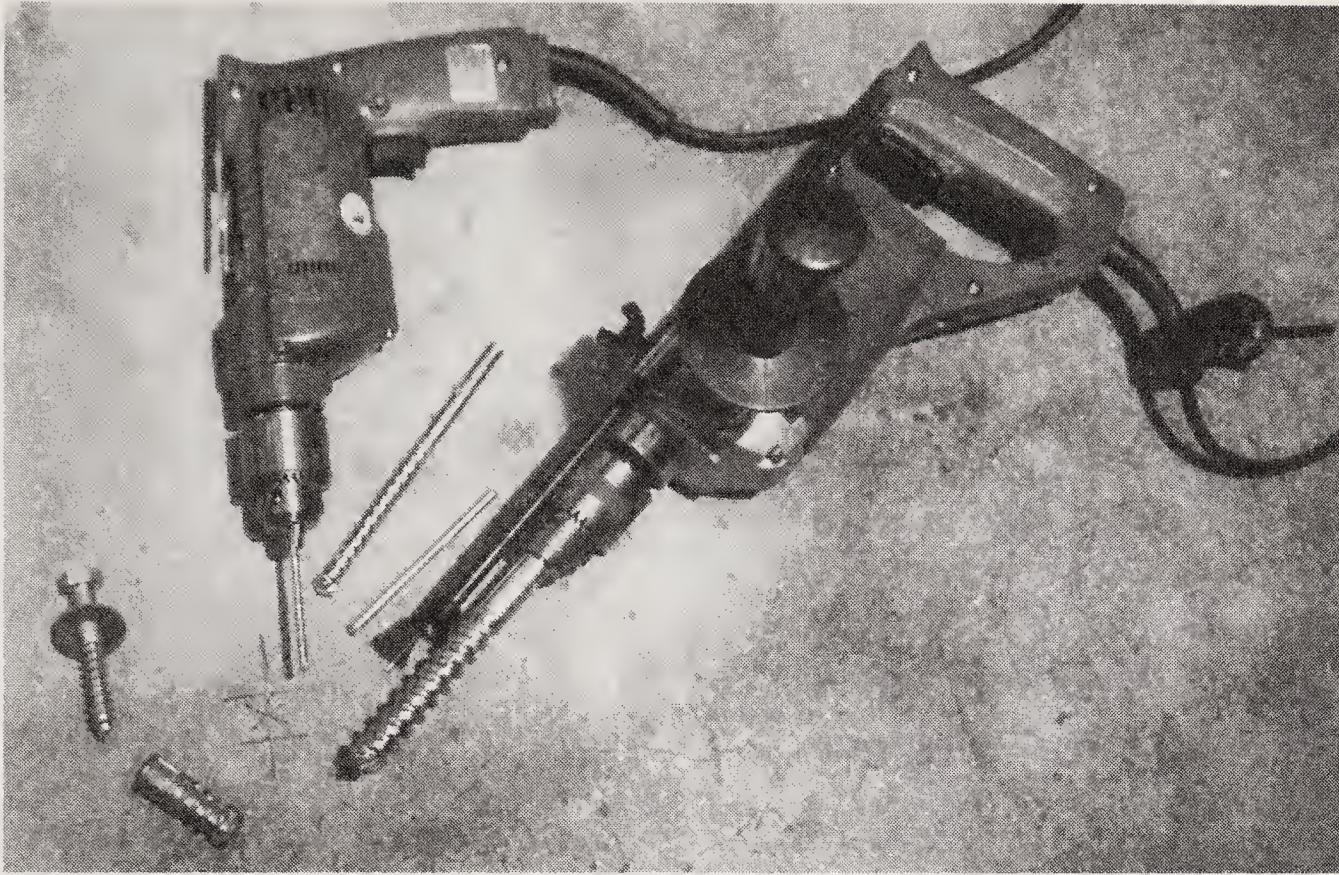
Power drills

Numerous construction activities will require the use of a power drill and wood- or concrete-boring drill bits. It is best to rely on quality power tools to ensure your job is completed as expected. Using small drill motors for large jobs will cause frustration as bits dull, motors heat up, and wood splinters.

A heavy-duty Makita ½-inch power drill is an excellent tool to use for drilling large-diameter holes in studs and plates. Efficient self-feed bits will chew through wood with little effort.

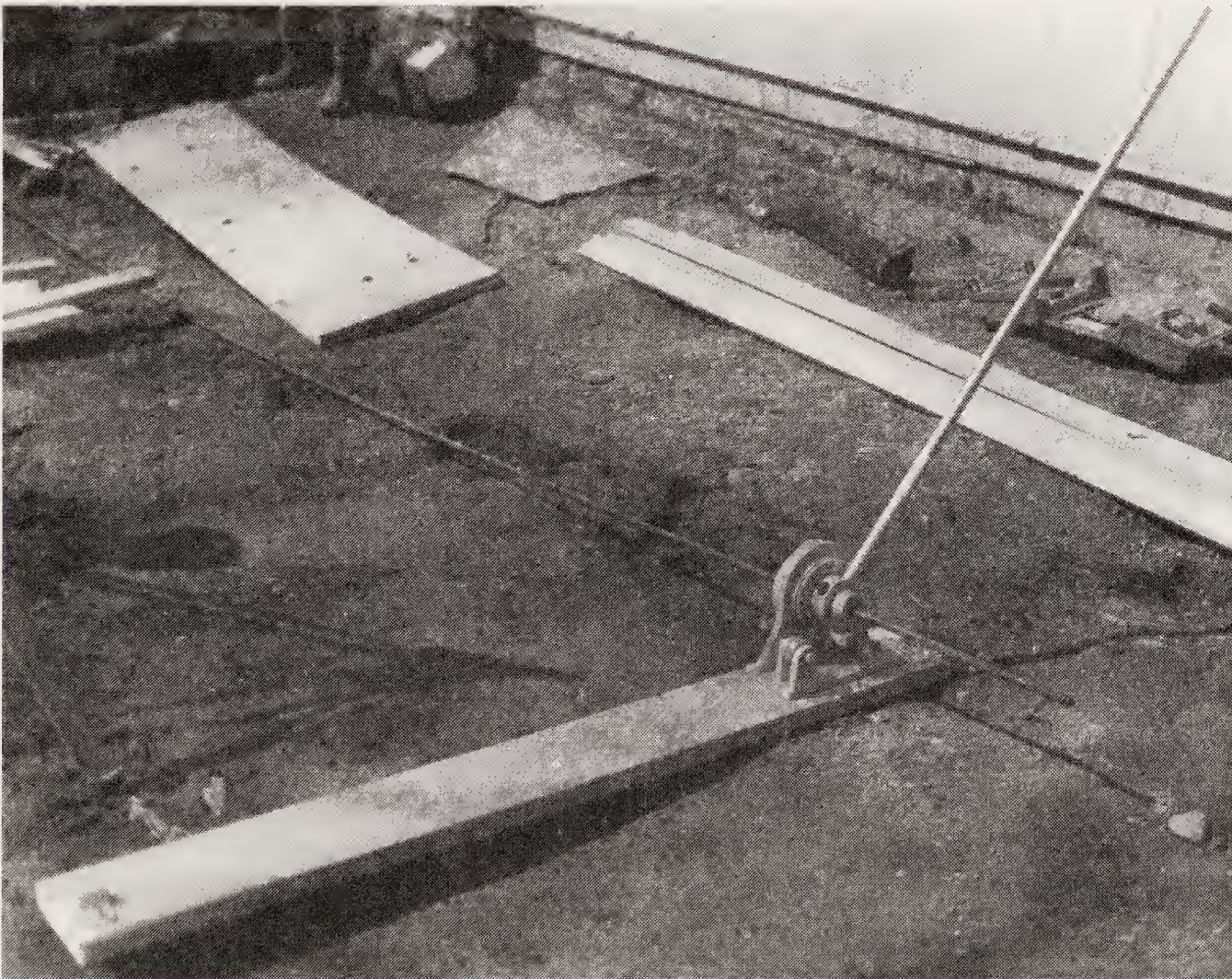
Drilling holes in concrete for the installation of anchors is easily accomplished with a Makita rotary hammer. This tool forces special S.D.S. drill bits to hammer away at concrete while at the same time spinning to force debris out of drilled holes.

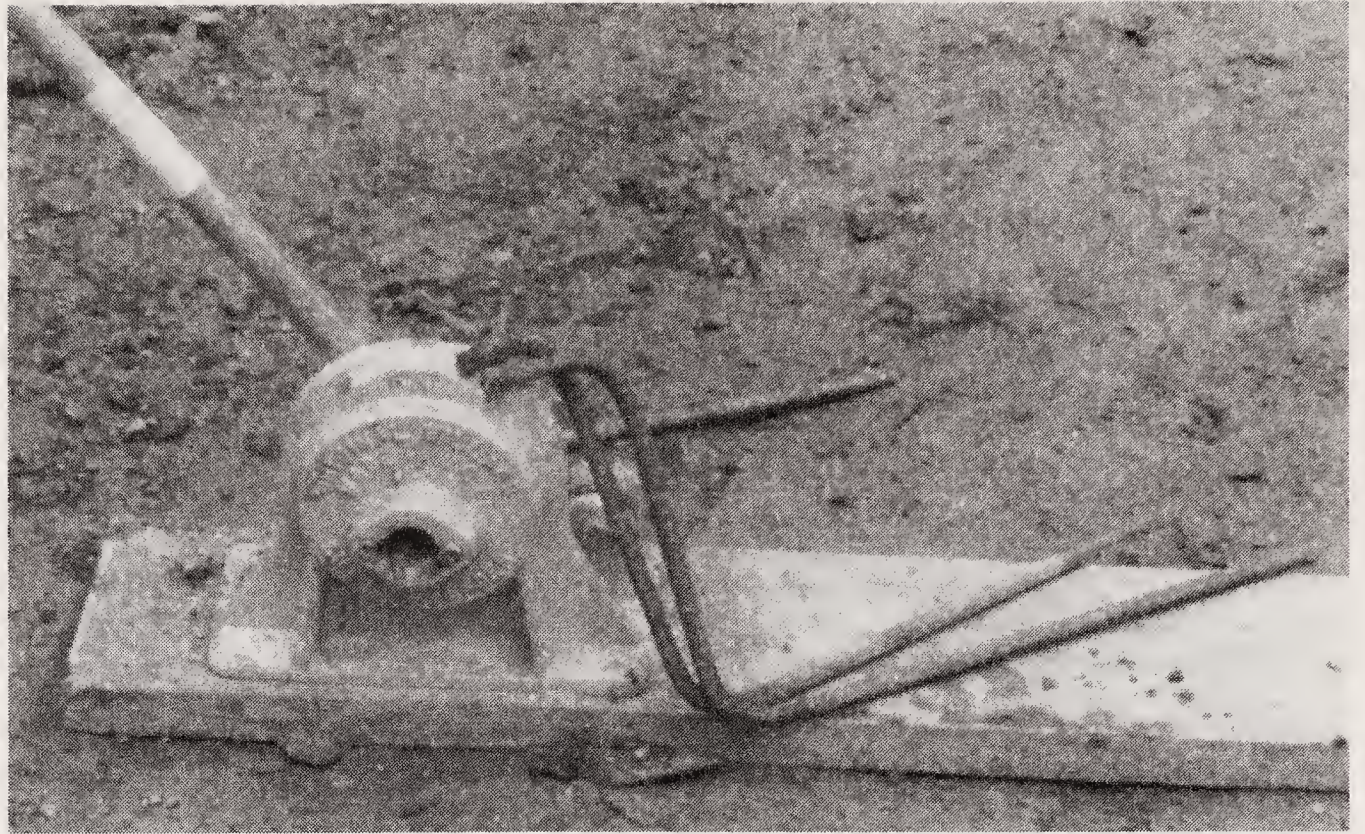
In lieu of a rotary hammer and special SDS drill bit, you can use ordinary concrete drill bits for concrete boring. This setup is not nearly as quick or efficient, but is quite handy when no SDS bits are available. For smaller concrete boring jobs, consider using a ¾-inch power drill with appropriate concrete drilling bits.



All concrete footings and foundation walls must be outfitted with rebar—heavy-duty rods designed to add strength to concrete structures. It is common to put $\frac{5}{8}$ -inch rebar in footings and $\frac{1}{2}$ -inch rebar in foundation walls. Contact your

Concrete tools





local building department to learn about the exact rebar size and spacing patterns required for footings and foundations in your area.

Rebar can be cut with a hacksaw, torch, or grinder, but the task is easiest with a Stanley Goldblatt rebar cutter/bender. With the handle upright to open the cutter head, slide a section of rebar into the slot and then force the handle down to effect a clean, straight cut. This tool is capable of cutting rebar up to $\frac{5}{8}$ -inch thick. If you cannot afford to purchase one, seriously consider renting a rebar cutter/bender at a local rental facility.

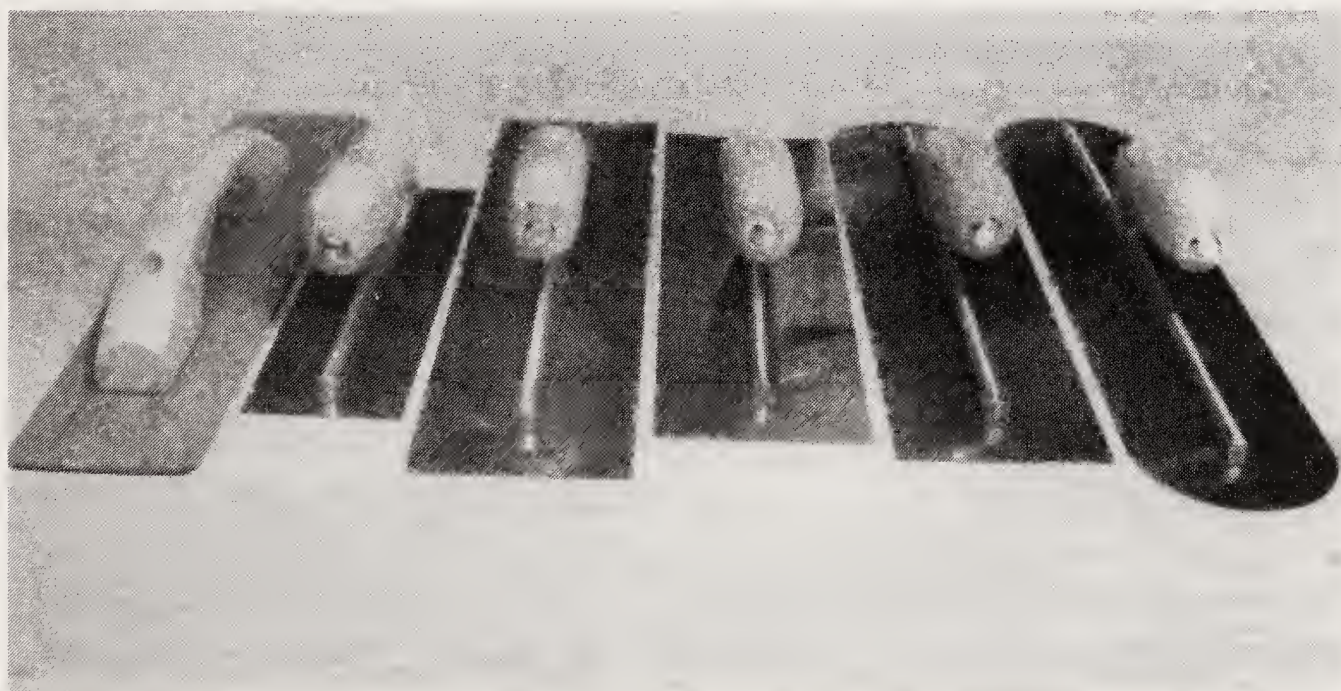
Installing rebar around footing corners and up through footings and into foundation or wall cavities will require sections to be bent at an angle. The rebar cutter/bender accomplishes these tasks simply, efficiently, and quickly. Without a unit like this, you will have to struggle with pipes, pry bars, and other tools to bend tough rebar.

Pouring concrete is physically demanding. The material is heavy and must be placed correctly or entire slab finishes might be jeopardized. Along with square-point shovels and rakes, a Structron Come Along makes it easy to push and pull concrete in toward or away from screed boards.



The wide blade on this tool is capable of moving a lot of concrete mud. The hook featured on top works great for pulling wire mesh or rebar up into the concrete.

Pulling screed boards to flatten and level concrete is hard work. If you have any back problems, I highly recommend that you use a McGuire-Nicholas back-support brace. During the entire concrete pour for our job, I wore the back-support brace and felt as if I was using somebody else's back.



On the previous page is an assortment of Stanley Goldblatt trowels. On the far left is a magnesium hand float used for initial concrete placement and smoothing. The steel finishing trowels are used after the concrete sets up and will accept a smooth finish. The rounded edges on the two right-side models are perfect for beginners and experienced do-it-yourself concrete finishers. The rounded side prevents the trowel from leaving behind obvious ridges or lines when it is used on soft surfaces.

Wooden hand floats work well on wet concrete to move mud into tight spaces and smooth extra rough surfaces.

Building materials

Three excellent sources of information for just about every aspect of wooden building products imaginable are: the Western Wood Products Association (WWPA), American Plywood Association (APA), and the Cedar Shake and Shingle Bureau (CSSB). You can also learn a great deal about building materials by visiting a large home-improvement center or lumberyard. Manufacturers of different materials frequently provide these outlets with free literature, which they offer to their customers.

Dimensional lumber does not measure exactly what you would expect. A 2×4 really measures 1½ inches by 3½ inches; 2×6s are really 1½ inches by 5½ inches; 2×10s are 1½ inches by 9¼ inches; and so on. All 2× dimensional lumber measures 1½ inches thick. This is standard.

Therefore, when you calculate exact room dimensions, realize that a 2×4 wall will actually be only 3½ inches wide. With ½-inch drywall placed on each side, the end result will be a 4½-inch-thick wall.

In addition, dimensional lumber does not always measure to lengths equal to what they are supposed to be. A 10-foot 2×4, for example, might actually measure 10 feet ¾ inches, more or less. Therefore, always measure the boards before you nail them. You might get into a hassle when you use lumber of prescribed lengths that are in reality longer than expected.

Pressure-treated lumber is regular wood that has been treated to make it less susceptible to damage or decay. Different pressure

treatments render wood designed for various outdoor uses, like decks, or extra protected for applications in, on, or next to ground surfaces. Be sure to read the label affixed to the lumber that specifies the application the board has been treated for—decking or ground contact.

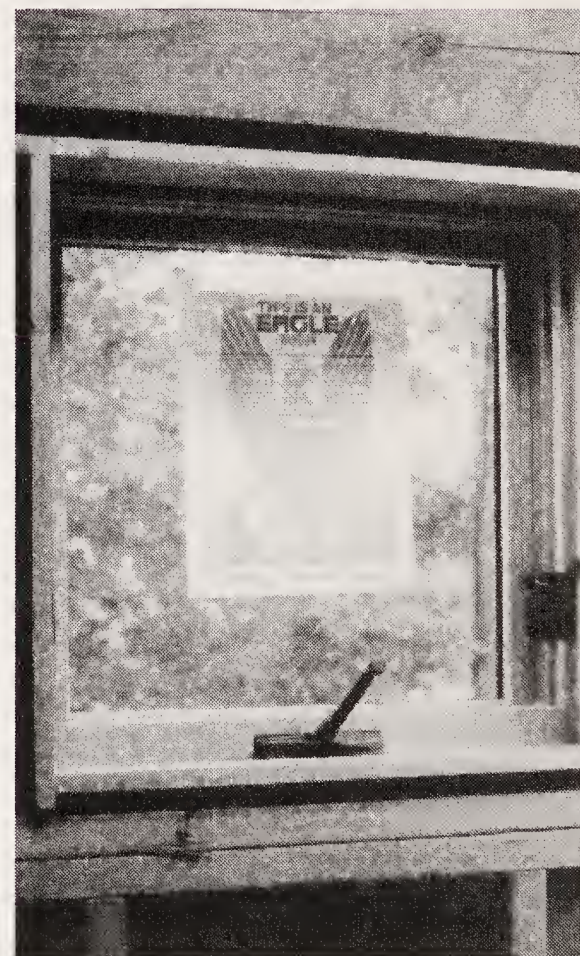
Pressure-treated lumber is clearly different from regular lumber. The boards are generally much darker in color and are impregnated with hundreds of small surface slits spaced evenly apart. These slits are indicative of the machinery used in pressure treatment. Pressure-treated lumber is available in all dimensional lumber sizes: 2×4s, 2×6s, and the like.

Ron Reinhardt has been in the construction business for decades. From experience, he has seen homeowners who have made the mistake of purchasing inexpensive windows and doors and then spending extra money for top-of-the-line light fixtures, floor coverings, and other more easily changed and inexpensive home accessories. Because windows and doors are permanent fixtures in any home, workshop, or attractive outbuilding, seriously consider purchasing high-quality products, like Eagle, in lieu of cheaper and less efficient models.

Windows must not be installed in your new structure until the building is weathertight with roof, roof covering, skylights, sheathing, and house wrap (building paper or other commercial moisture barrier) in place. This prevents rainwater from staining or damaging the wood that surrounds the glass. Therefore, if your windows are scheduled for delivery before your structure is ready, be certain you have a weather-safe place for their storage.

Selecting windows for any structure can be confusing. Living areas, especially bedrooms, must have a certain amount of opening space to provide for emergency escape. Exact dimensions are available from your local building department and most lumberyards and home-improvement centers. Along with that, there are so many different styles, shapes, sizes, energy-efficiency options, colors, and so on to choose from, anybody new to the window market might get confused.

Windows

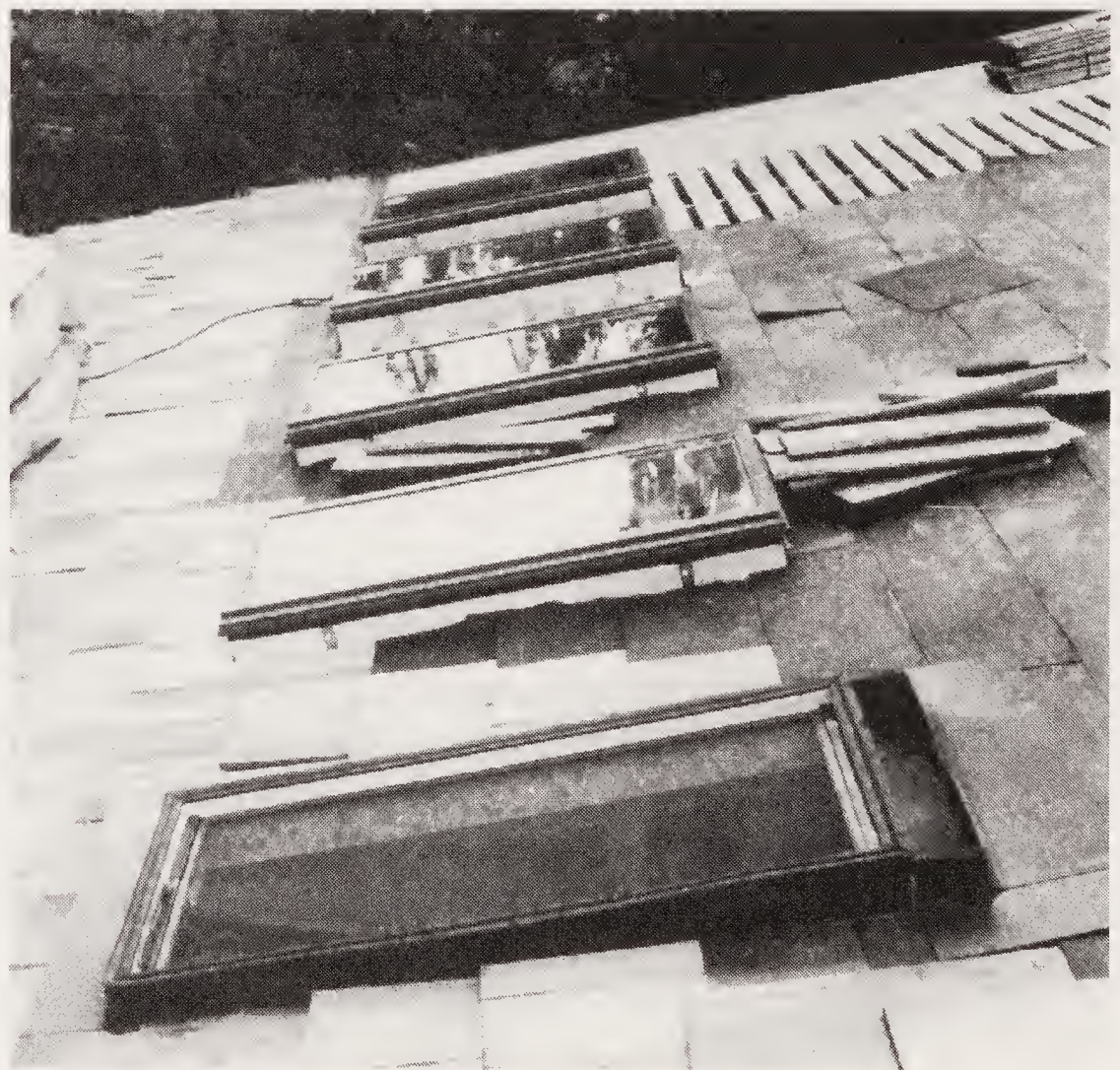


My advice is to talk with your local Eagle Window and Door representative. He or she will be able to explain and describe the benefits or pitfalls of one style over another, and why certain models might be better than another for your workshop or outbuilding.

Skylights and roof windows

In most cases, skylights are fixed plastic units, while roof windows are composed of real glass that can be opened, just like windows. Leslie-Locke offers a number of different styles and sizes for just about any application.

As with windows, carefully consider the intended use of the skylight or roof window before you make a purchase. A skylight might provide needed light to a building without electricity. Your workshop might be better outfitted with roof windows that open for ventilation. Operating roof windows allow built-up heat, as well as accumulated sawdust and other airborne debris, to escape. You might appreciate the ventilation offered by roof windows when you are working on a project during hot summer months. Roof windows might work well for your workshop if you chose to make the structure window-free for security reasons.



Preliminary plumbing & electrical

WORKSHOPS MUST HAVE ELECTRICITY TO POWER VARIOUS tools and pieces of equipment, but what about plumbing? It would be ideal to have a bathroom facility in your workshop, if for no other reason than you would have a place to go when you are too dirty to safely use facilities in your house. It is also wise to have a sink with running water in a workshop in case of an emergency when eyes or other body parts need to be flushed with lots of clear water.

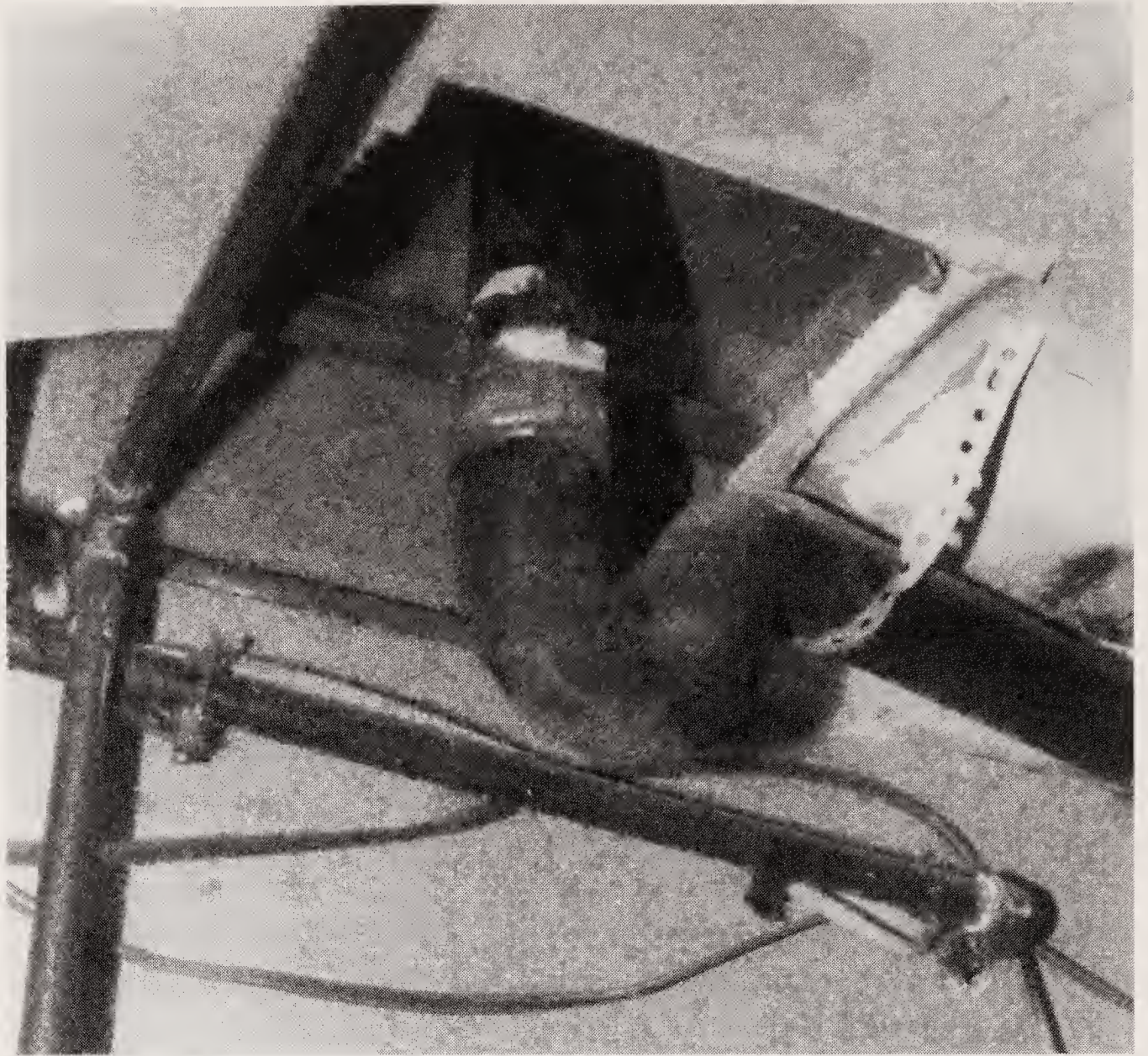
Setting up for a bathroom facility in a workshop is relatively easy. All you have to do is provide underground plumbing to the site. An official bathroom complete with walls and fixtures could be provided later, as your budget allows.

At first glance, plumbing might appear alien with lots of different components and connections, fittings and angles. However, the basic premise behind drain pipes is that they run downhill. All of the various fittings and connections are designed to assist installers in achieving downhill runs.

The main drain pipe runs vertically. Other drain pipes from sinks, showers, and toilets, attach to it. Sinks feature P-traps just under the basins. These units maintain a level of water in them at all times to prevent sewer gas from escaping. Toilets feature built-in P-traps and, therefore, do not require plumbed ones. Showers do require P-traps to be attached directly to main shower drains. (See next page.)

P-traps for showers can be installed under workshop floors, as can other drain pipes. They must angle down to main sewer

Preliminary plumbing



lines in order for gravity to cause sewage to run away from the shower and toward the main line.

The installation of preliminary drain lines must be done according to overall bathroom design plans. Pipes have to exit workshop or outbuilding floors in line with scheduled fixture installations and walls. (See top photo, next page.)

The first opening on the right is a main vertical sewer line that rises through a wall and services a second-level bathroom. In front of it is the main drain for the workshop bathroom toilet. Shooting off to the left is a drain for a proposed workshop shower stall. The tall pipe will serve as a drain. The shorter one will be directed to a point in line with the main sewer line. It will serve as a vent to prevent shower water from creating a vacuum as it runs through its drain pipe. All of these pipes will



be outfitted with extensions so that they exit up through the concrete workshop floor.

Cardboard was formed around the workshop toilet and shower drain pipes. This was done to allow some maneuvering room when the toilet and shower are installed. Had they been embedded completely in concrete, there would be absolutely no room for any final adjustments.

Note that the main vertical drain pipe and shower vent pipe are in line with each other. They will both rise into a wall where the



vent pipe will be outfitted with connections to allow it to properly connect with the main drain. The main drain pipe will extend through the roof so that it is vented to free air. This is a basic building code requirement.

Install toilet flanges after concrete floors are poured. Special plumbing tools are available to cut these kinds of pipes off at prescribed levels to facilitate installation. Wax rings are affixed to toilets to seal their connections to these types of toilet flanges. Note the sewer drain stack rising up inside the wall just behind the toilet flange.

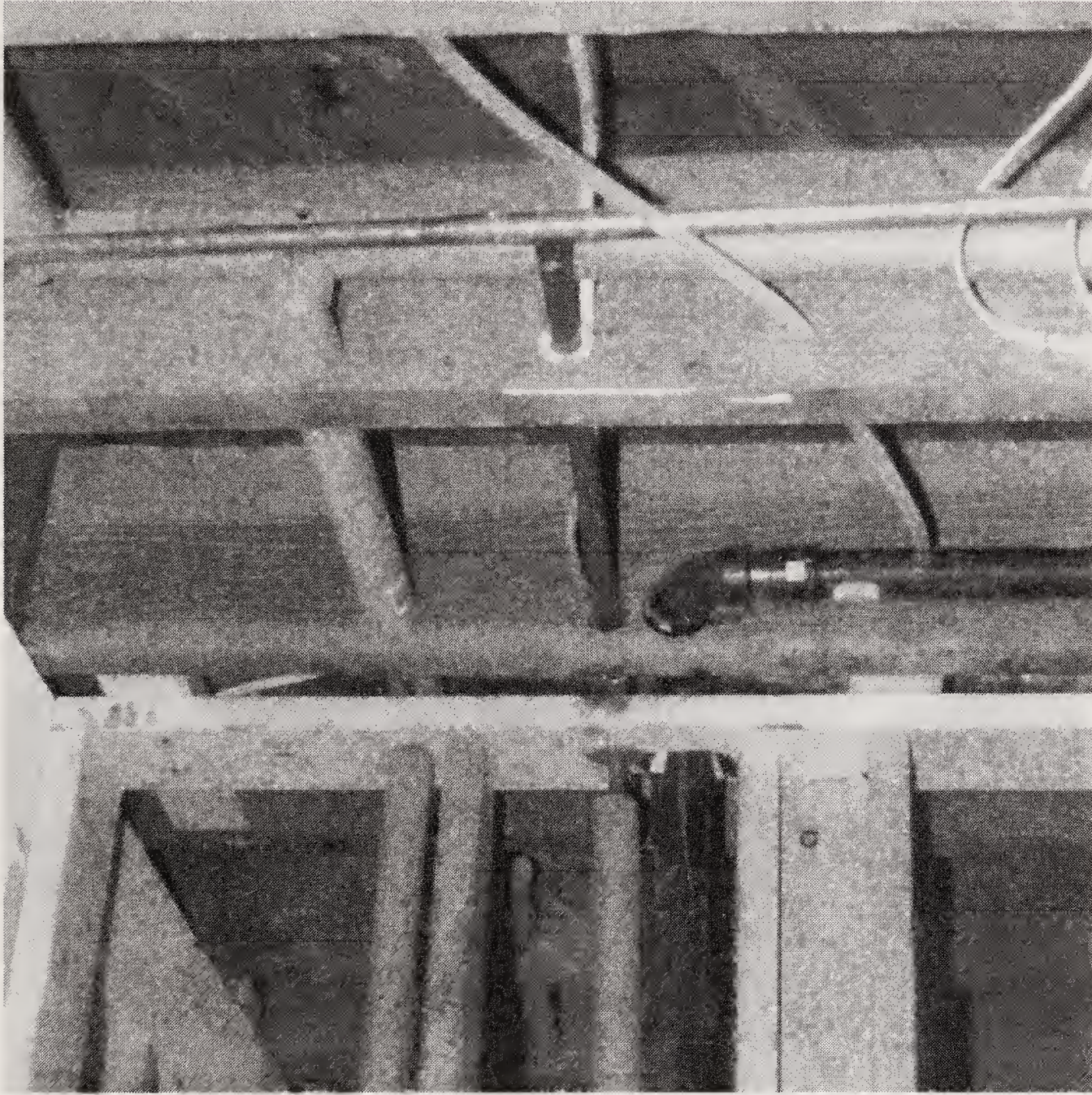


Water supply

Domestic water supplies from public utilities are piped into homes underground. Locate the main water line so your new connections can be made to it. Well water supplies most often serve pump houses where additional lines can be attached. If you plan to include any sort of running water supply in your structure, it is best to run the water supply line before you pour concrete footings, foundations, or slabs.

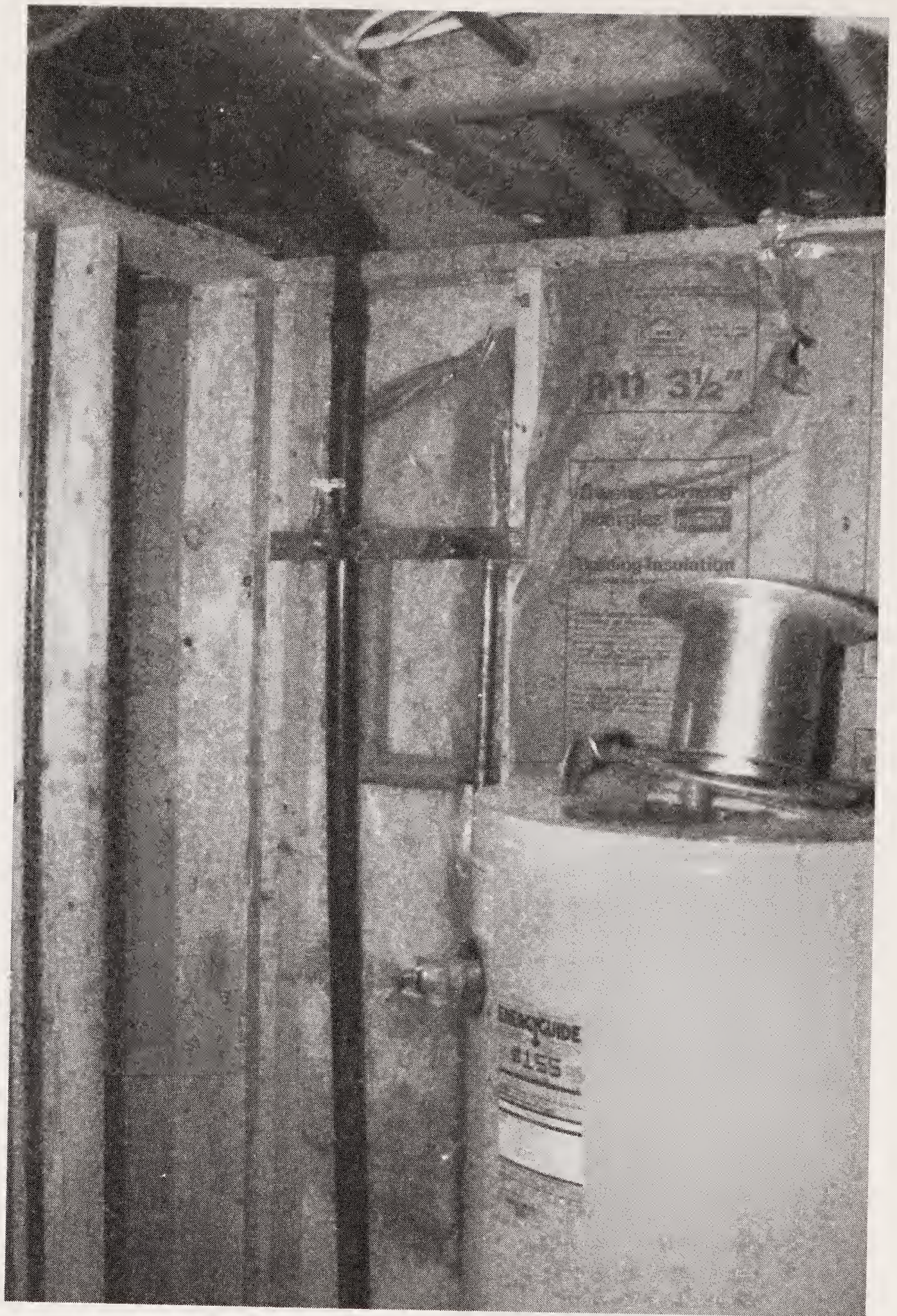


The main water-supply line exits the concrete floor and is equipped with a shut-off valve on its back side. The line running off to the left supplies an outdoor water spigot. Once water is supplied to a structure, other lines can be routed through ceiling spaces and walls.



Water and drain pipes travel through holes drilled in wall plates and joists. These will supply a bathroom and laundry room facility. Notice that the hot water pipes have been outfitted with insulation. A plastic insert holds the water pipe in position to help eliminate water hammer and pipe rattling.

If you will need hot water in a remote workshop or outbuilding, you might have to provide a hot water tank. Hot water tanks are served cold water from a main water line and then send out



hot water through a separate pipe. Normally, water pipes are connected to the top of the hot water heater. Service pipes for this installation are visible to the left of the yet-to-be-installed hot water tank.

Most drain pipe connections can be made with plastic, as they will not incur any internal working pressure. Water pipes will experience pressure as water is forced through them. Therefore, water lines generally are composed of copper pipe.

Electrical wiring is routed through wall studs and then into electrical boxes. Outlets and light switches are then hooked up to wires and connected to those boxes with screws.

Plastic or metal outlet boxes are available. The plastic ones are inexpensive. You can often find them on sale at the local home-improvement center five for \$1. Except for high current applications, plastic boxes are generally permitted for most regular installations.

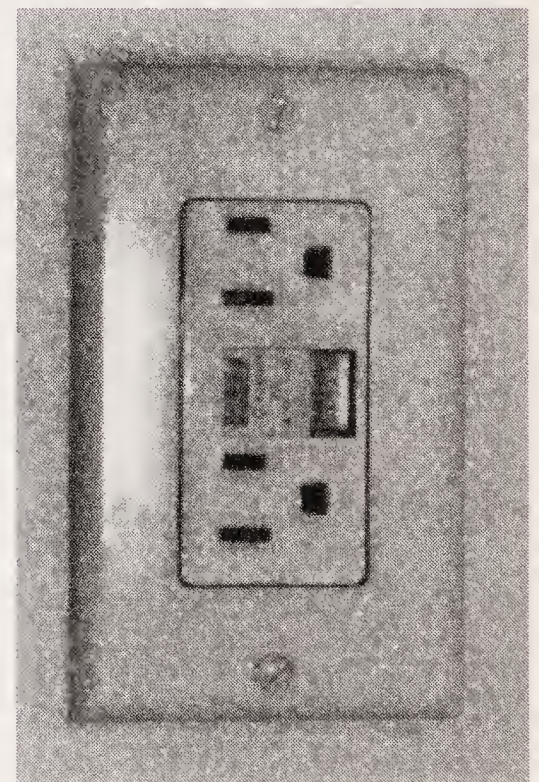
Although placing electrical outlets low on walls is common for household applications, it might not be best for workshops or outbuildings. Consider locating electrical outlets toward the middle of walls right above workbench level. They will be easier to access when you use power tools or other electrical accessories.

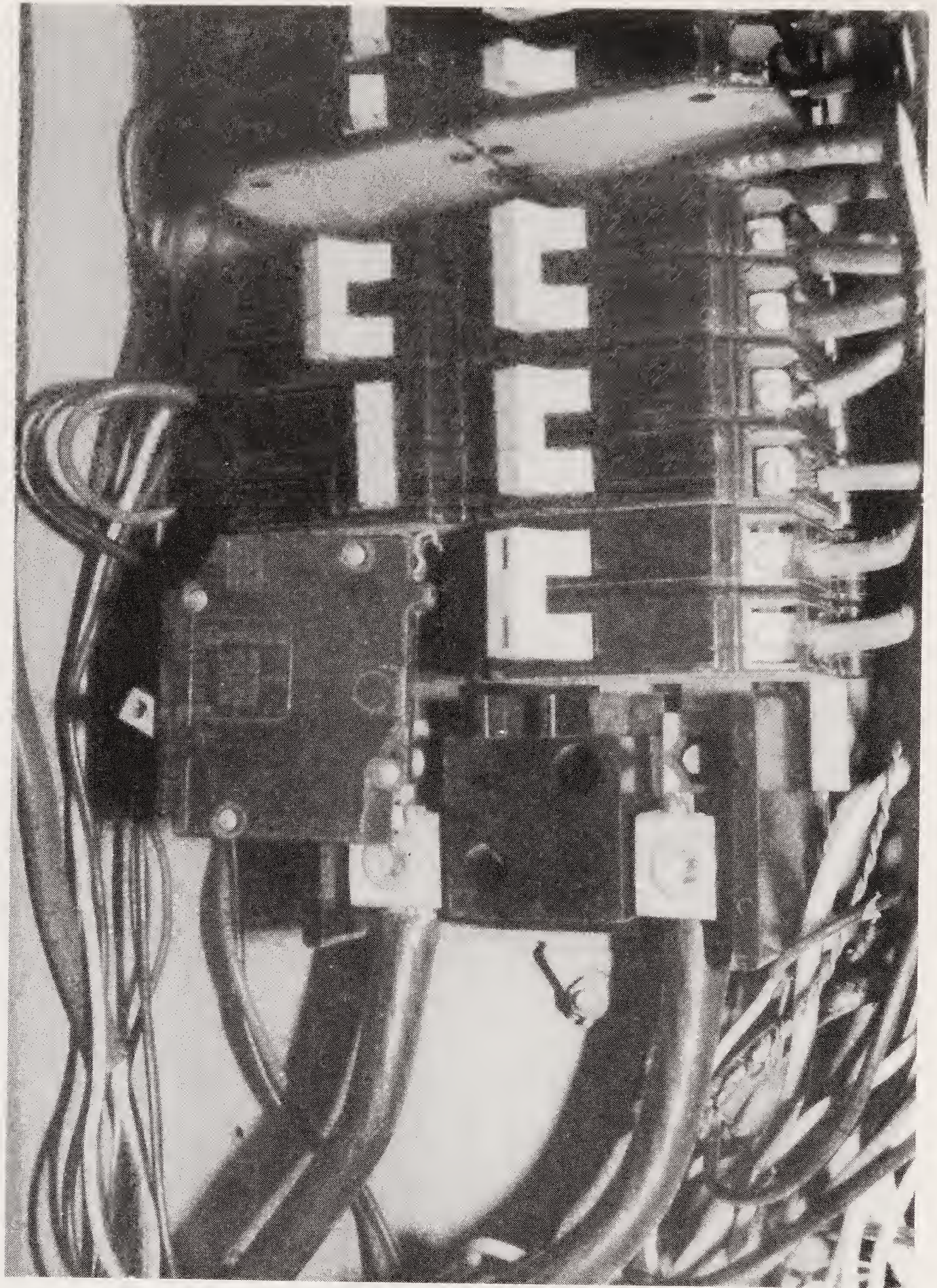
The very first outlet placed on an electrical line should be a ground fault circuit interrupter (GFCI). This device operates like any ordinary outlet except that it will immediately sense any irregular use of current, such as a short, and shut down power to the line.

One GFCI placed at the head of the line will service all outlets behind it. Regular household circuits normally serve eight outlets. You will have to confer with a certified electrician to determine how many outlets can be provided per circuit based on your usage requirements.

Typical GFCIs feature “test” and “reset” buttons on their faces. Should they activate for any reason, investigate why. If the problem is too many appliances in operation at the same time, turn some of them off before pushing the GFCI reset button. Should that not be the case, you might have a faulty electrical tool or appliance, or you could have problems in the electrical

Preliminary electrical





system. Serious electrical problems must be repaired by qualified electricians.

Circuit breakers are safety devices that shut current off when too much starts passing through it. Too much electricity flow is generally an indication of a short in an appliance or too many

electrical items being used all at once on one circuit. This is why you should confer with an electrician before you install wires to proposed electrical outlets. You might want to alternate circuits that serve active workbench areas so that one circuit does not become overloaded.

Circuit breaker switches also can be turned off at any time, especially when work is being done somewhere along the circuit it services.

Setting up preliminary installations for plumbing and electrical services requires planning. You must provide all underground resources before footings, foundations, and concrete floors are installed. You will have to know ahead of time where plumbing pipes will be placed. Should you have any questions about the utility needs for your workshop or outbuilding project, consult a professional plumber or electrician.

Site preparation

YOUR EFFORTS TO CONSTRUCT A SOLID, SQUARE, PLUMB, and perpendicular workshop or outbuilding might be thwarted if the structure is built on an unstable base. Therefore, it is paramount that pier blocks, post anchors, footings, and foundations rest on solid ground. This might require that you dig through topsoil and other loose material until you reach *hardpan*, or solid earth. In cases where solid ground is too deep, additional pier blocks or extra-wide footings might be needed.

Other site preparations should take into account rainwater runoff, the need to provide underground plumbing pipes or electrical *conduit* (protective pipe surrounding electrical wires), the distribution or removal of dirt dug out for footings, and overall ground leveling for the concrete floor.

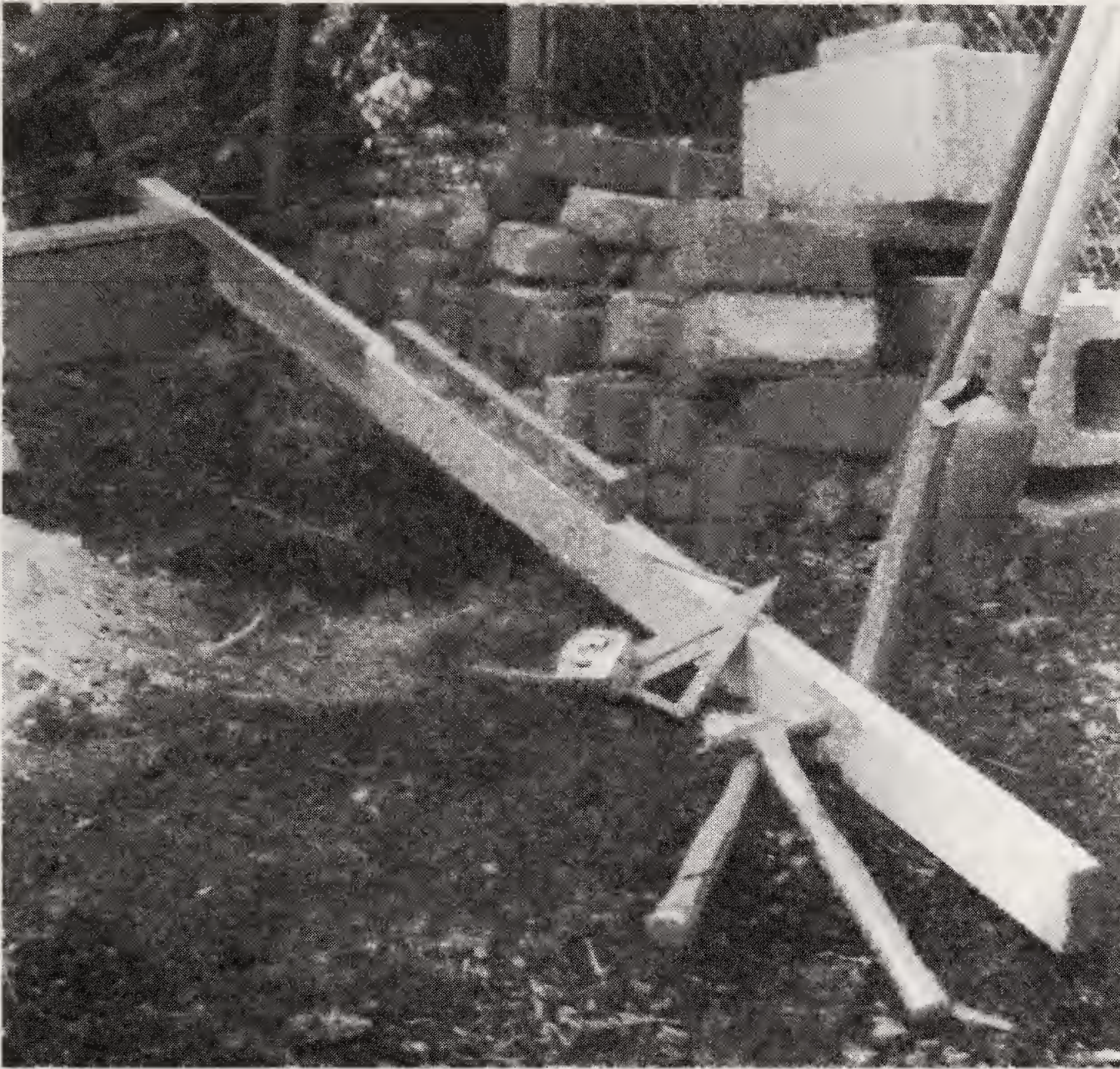
Small outbuilding bases

A square-point shovel works great for scraping away dirt to make a level base for pier blocks. For this shed's 4×8-inch rear-beam support, both pier blocks were positioned level with each other. This was accomplished by resting a straight 2×4 on top of each post anchor and reading the level placed on the board.

It took a few attempts to pick up the block that sat too high and to scrape away small amounts of dirt under it until the blocks were positioned level with one another. Once that task was completed, dirt was compacted around each block for support, and the 4×8 beam was nailed into place.

With the pier blocks and rear beam solidly in position, we worked with a straight 2×4, square, level, and other tools to prepare the site for front 4×4 posts. It was important that the posts be set square with the beam so that the shed was built with square walls.

One end of a straight 2×4 was nailed to an end of the 4×8 beam. The other end was maneuvered square to the beam and then



secured by a wooden stake driven into the ground and nailed to it. This 2×4 designated the position for the outside edge of a corner 4×4 post. The post hole was dug about 4 feet away from the beam and then secured with its outside edge resting against the 2×4. This guaranteed it was square with the beam.

Note: The distance from the back edge of the beam and front edge of the 4×4 should measure exactly 4 feet, so that a 4-foot-wide sheet of plywood fits perfectly flush with the ends of both components.

Another way to set post anchors, in lieu of pier blocks, is to dig a post hole at a designated spot and fill it with concrete. Then insert a Simpson Strong-Tie wet post anchor into the wet concrete for a permanent installation.

We used a Structron post-hole digger and shovel to dig a post hole about 18 inches deep. Dirt surrounding the hole was leveled so that the concrete surface was flat. When you install a wet-post anchor, be certain the square flange, onto which the post will be nailed, is set straight and at the correct height.

Rounded strips of metal formed from slots in the base of the wet-post anchor helps it remain secure while embedded in concrete. To ensure these types of anchors are positioned square and at the correct height, use stakes and strings as guides. Position stakes out from the post holes to the sides in such a way that the string stretched between them forms a perfectly straight line to which other anchor flanges are then butted.

Wet-post anchors set in line with each other allow wooden posts to be positioned on top of them and in a straight line with each other. Secure the post to the anchor flange with nails, screws, or bolts.



Concrete slab preparations

While minimal site preparations are required for outbuildings that are supported off the ground by posts, those that entail concrete floors require careful ground leveling. Concrete should be poured at an even depth, generally 4 inches. If some parts of a slab are poured deeper than others because of uneven ground, the potential for cracks in the concrete increases.

This area, scheduled for a small storage outbuilding and adjoining patio, has been leveled by removing large mounds of



dirt and filling in holes. Additional site preparations using straight 2x4 guides and forming material will render this grade a flat and even surface ready for concrete.



The outer form for our storage area and patio slab was positioned with minimal digging and the use of a 4-foot-long level. The form is secured with wooden stakes. Pressure-treated 2×4s were situated and secured in the middle of the slab for both appearance and to function as expansion joints. The 2×4s will absorb the expansion and contraction pressure of the concrete to prevent cracks. With these boards in place, another straight 2×4 was laid on top to serve as a guide to determine grade level. Once the ground was leveled to a uniform 4-inch depth, concrete was poured.

Wooden stakes used for site preparation and concrete forms are commonly available at lumberyards and home-improvement centers. You can use metal stakes, which are available from rental yards or can be purchased from concrete tool supply stores. An economical means of obtaining wooden stakes is to make them yourself.

Large site preparations

Full-size outbuildings and workshops that require building permits, along with footings and foundations, call for more than simple surface grading. Considerations must include underground utilities and the movement of lots of dirt. If a great deal of soil will be removed from the worksite, you must make plans to have it hauled away or piled in an out-of-the-way location. Conversely, should additional material be needed to bring a grade up to a flat and level position, you must make arrangements to have fill dirt brought in.

Because the ceiling height of the first-floor-level daylight basement of our house was only 7 feet 3 inches and the proposed workshop addition was designed with an 8-foot-3-inch ceiling height, many yards of dirt had to be removed from the worksite so the new workshop floor could be built 1 foot lower than the house floor. We brought in a small tractor for excavation. Dirt was piled up in an uninvolved corner and was used later for landscaping and retainer wall projects.

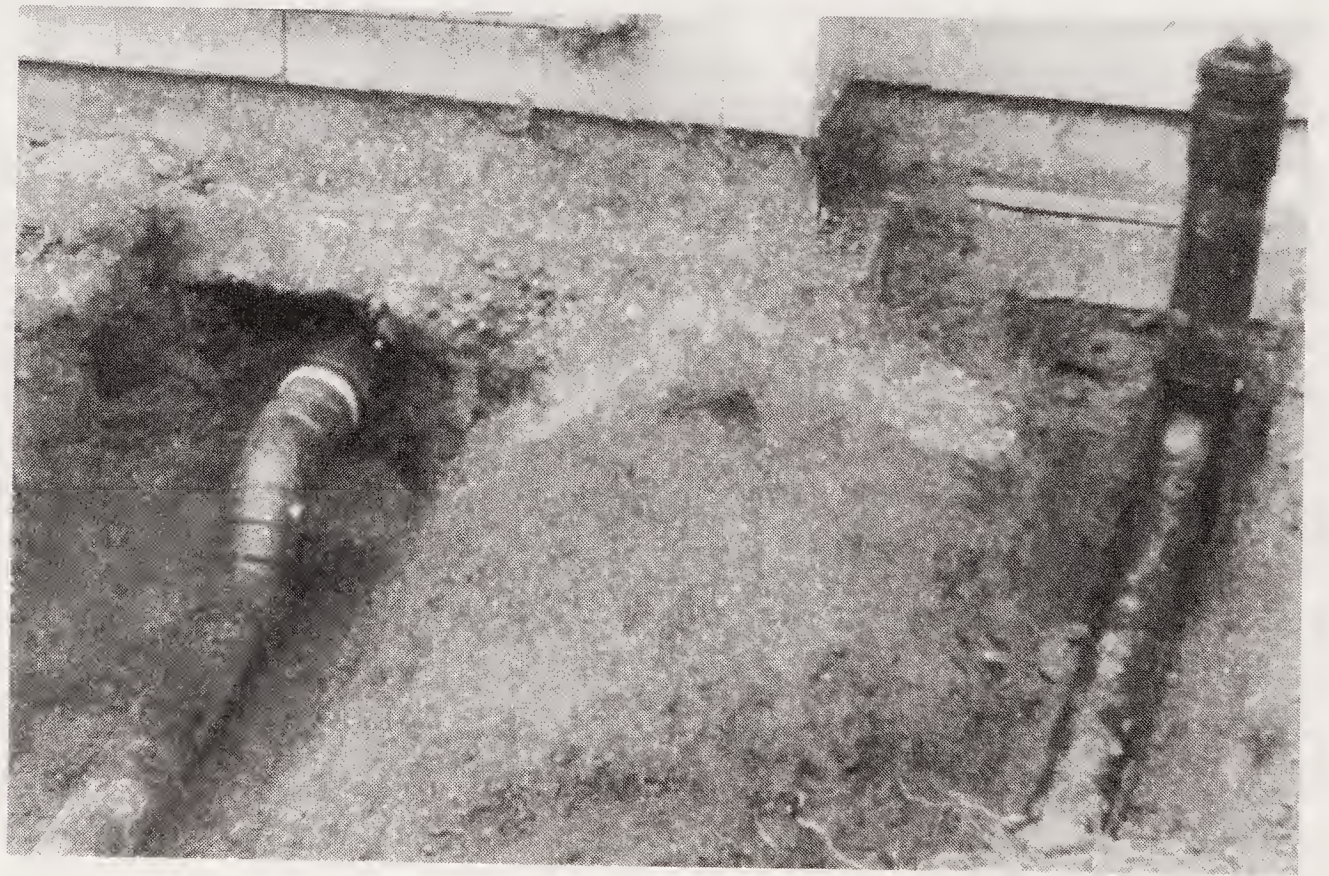
Once the tractor leveled out the building site and moved enough dirt to accommodate a dropped floor, we used shovels to dig footings and to replace the sewer pipe. Because the new



workshop was built on top of a main sewer line, the existing concrete sewer pipe had to be replaced with stronger ABS plastic material.

An original section of concrete sewer pipe sits just to the left of the trench from which it was removed (see top of next page). An ABS plastic line was installed and glued together. This portion of the site preparation work was required by the building department. A building inspector had to inspect and approve the installation before the sewer-line trench could be filled.

As all drain lines should, this one runs downhill so gravity will pull the sewage away from the structure. The short section of pipe that points upward will serve as a main service connection for a proposed bathroom facility to be built above it. The other short vertical section of pipe situated away from the first is positioned at a point outside of the building foundation. It will serve as a *clean out*—a means of accessing the sewer line in case the pipe becomes clogged and a plumber needs to run a *snake* (pipe cleaning tool) through it (see next page, left).



At the back wall of the existing house, ABS plastic pipe on the left was connected to the main sewer line that runs under the house (page 56, bottom right). To the right, an additional clean out was provided just in case the line clogs under the concrete floor of our new workshop. The clean-out pipe makes a bend about 4 feet out from this wall where it connects to the main sewer line. The screw-on cap assembly on top of the clean out has not been glued in place. Once concrete forms were positioned and secured around it, the pipe was cut to length at the concrete surface and then the cap was permanently glued in position.

Dirt used to fill trenches dug out for plumbing work must be compacted in order to avoid excessive settling once a concrete floor has been poured on top of it. Gasoline-powered compactors are available at rental yards for large-scale needs. For minimal pipe-trench work, a hand-held compactor works fine.

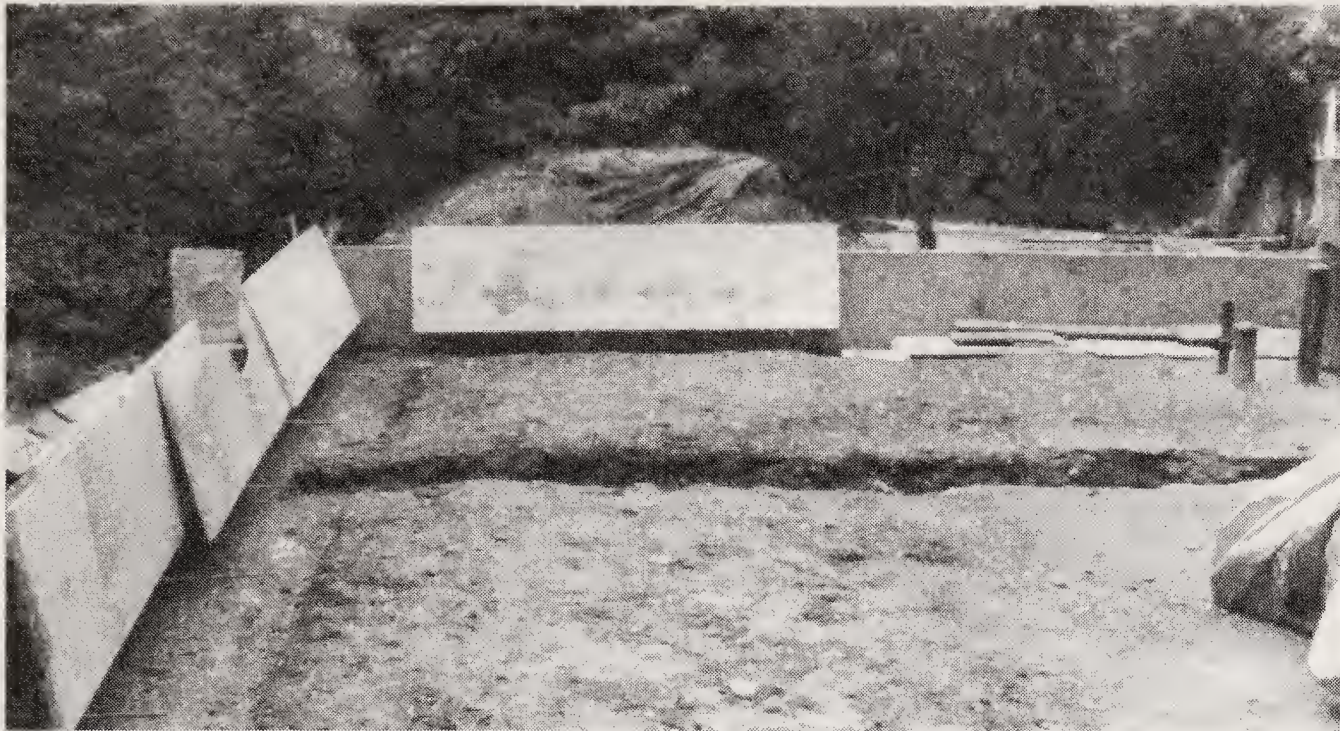
Operating a hand-operated dirt compactor is as simple as raising it up and dropping it down. For maximum results, fill the trench with a few inches of dirt, compact it, add a few more inches of dirt, and compact. Repeat a few inches at a time until the trench is filled.



Both the main sewer pipe and clean-out trenches have been covered with dirt and compacted. Notice that the side of the footing for this house wall is completely exposed. In order to protect it and to hold the dirt under it in a secure position, a 6-inch-thick concrete foundation wall was poured against it. In addition, since a wide opening was made in this wall for access to an existing garage, concrete was poured over the top of the footing, right next to the foundation, to make the new wall 12 inches wide. This served as a step at the wall opening.



An area next to the house footing and foundation was dug away to make room for concrete forms. Notice the excavation includes a wider notch in the middle. This is to make room for additional concrete forms for a second step at the point where access is made through the house wall and into the workshop. Remember, the new workshop floor will be 1 foot lower than the house's first floor in order to allow for a taller ceiling height. The steps and concrete wall next to the house footing and foundation is unique to this workshop design.



The footings and foundation for our new workshop were poured and cured. Notice the new bathroom plumbing pipes rising out of the ground at top right. They connect to the main sewer line by means of angled pipe fittings. Large panels of hard-foam insulation were placed flat on the ground around the perimeter of the floor next to the foundation walls and concrete was poured over them. A footing trench running across the floor area was located under a proposed interior wall, which was used as a support wall for the second-story floor joists.



An engineer's level, a telescope-type device with crosshairs, affixed to a tripod was used as a precise grade-level measuring tool. You look through the tool and focus on a tape rule or long wooden ruler held by a helper. An initial sighting is made at a point where grade level is known. In this case, the sighting was made through a rear-wall window where a tape rule was held down on the existing garage floor. Notation was made of the measurement seen at the crosshairs through the engineer's level. Since the grade for this workshop's concrete floor had to be 12 inches lower than the garage floor and an extra 4-inch depth was needed to accommodate the thickness of the concrete slab, we knew that the dirt grade for this worksite must measure 16 inches lower than the garage floor.

The first sighting from the existing garage floor was noted at 52 inches, so the dirt grade for the new workshop had to be brought down until the engineer's level sighting read 68 inches. Numerous sightings were made to determine how much dirt had to be removed from the work area. As dirt was dug out, additional sightings were made to ensure accurate excavation. Straight 2×4s were laid out and positioned for use as guides, according to the level sightings. Once grade was established, the site was prepared for concrete.

NOTE: Each time an engineer's level is physically moved to a different location or set up for a new workday, readings must start from the beginning at a spot where an original level is known to be absolutely correct, like the floor of our existing garage.

Footings & foundations

CONSTRUCTION OF A FULL-SIZE WORKSHOP OR LARGE outbuilding will require careful planning and accurate measurements and grade-level readings to ensure footings and foundations are built square, plumb, and perpendicular. Since foundations are the base for any building, they must be built correctly. Mistakes that result in off-square corners or off-level top surfaces will cause lots of frustration when you go to build square and plumb walls on top of them.

If you are hesitant about tackling a major footing and foundation job yourself, hire a professional contractor to help you with this segment of the building process. Unlike wood-framed walls that can be torn apart and rebuilt, concrete footings and foundation walls, once poured, are in place to stay.

Footings basically are trenches dug in the ground and filled with concrete. They are located under every ground-level *bearing* wall—any wall that is designed to support an upper floor or roof weight. Footing size requirements are not necessarily standard. Each building department mandates those dimensions as dictated by soil types, earthquake hazards, and numerous other factors. Obtain accurate footing dimensions for your job from your local building department.

Footings and foundations must be straight and square with any existing structures onto which they will be added. One way to ensure exterior side walls run in line with existing walls is to use a string guide.

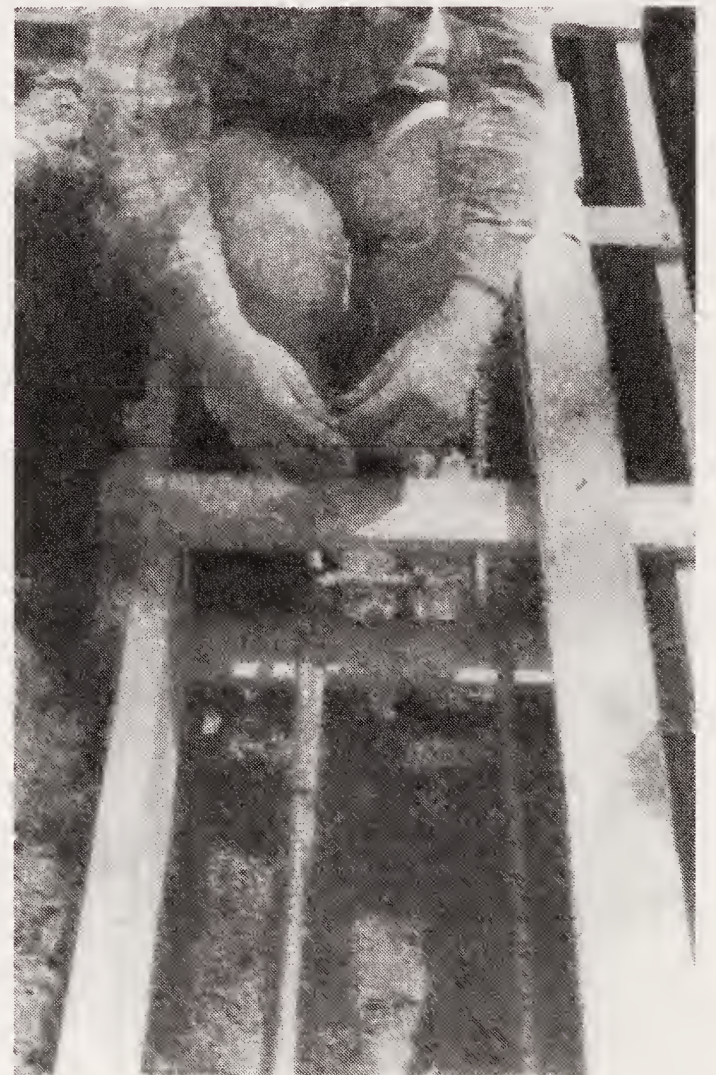
Place a stake in the ground next to the far end of the existing structure's side wall. Place this stake far enough away from the wall so that a string attached to it and strung out to the far end of the proposed building can run unobstructed. Attach one end

Footing applications



of the string to the stake, then have a helper run it out past the far end of your new building. Measure the distance from the existing house wall to where the string is attached to the stake. Note the measurement.

Then go to the far end of the existing house wall and have your helper move the free end of the string until its distance at your position matches the distance from the wall to the string where it attaches to the stake. In other words, make certain the tightly stretched string is positioned away from the existing house wall at an equal distance along the entire wall. This should



guarantee that the string runs exactly parallel to the house wall.

This footing was designed to be 16 inches wide. The forms were made with 2×8s; 1×4 pieces were used to hold the forms together. The forms were nailed in place with 8d duplex nails. These 1×4s were cut 19 inches long to accommodate a 16-inch footing width and also to fit fully on top of each form: 16 inches width plus 1½-inch width of one form plus 1½-inch width of other form equals 19 inches. Once the footing forms were nailed together with 1×4s on top and bottom, they were positioned and held in place with stakes.

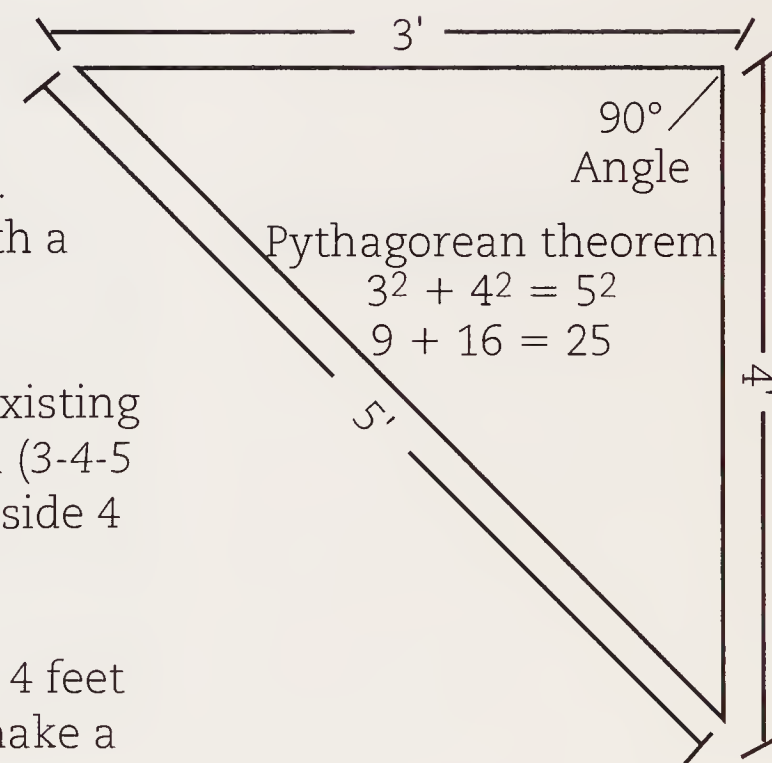
Footings are generally about 8 inches deep and 16 inches wide, but remember that your local building department might require them to be deeper and wider. Foundation walls built vertically on top of footings need only be 6 to 8 inches wide.

Foundation walls should be constructed in the center of the footings so the footings actually stick out on both sides at the bottom of the foundation walls. Therefore, when you position footings according to your string guide, remember that the measurement from the existing house wall to the string will indicate where the outside face of the foundation wall should be located. Center the footings accordingly.

Footing forms must be straight and level. Use a 4-foot level for accuracy. Shorter levels do not span as far as longer ones and, thus, might not offer equally precise readings. Level the footing width and length. If need be, sink a stake next to the forms and drive a nail through the stake and into the form so that the form rides a little too high. Lower the form into position by tapping on the stake with a small sledge hammer.

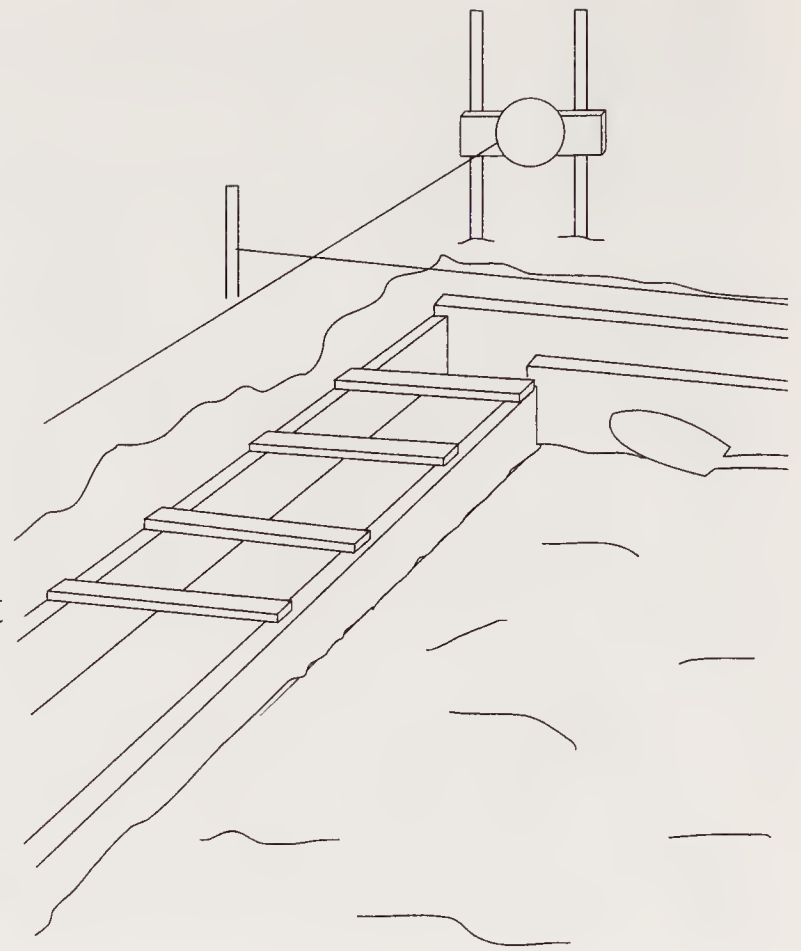
To ensure string guides come away from the middle of existing walls at 90-degree angles, use the Pythagorean Theorem (3-4-5 rule): a right triangle with one side 3 feet long, the other side 4 feet long, and the hypotenuse 5 feet long.

Tie a small ribbon on the string to indicate a distance of 4 feet from the existing wall. Then at a perpendicular angle, make a



pencil mark on the wall 3 feet away from the string. The distance from the ribbon to the pencil mark should be 5 feet. If not, adjust the free end of the string until a 5-foot hypotenuse is reached. Then secure the free end of the string to a stake.

Footing forms that connect to make corners must be as square as those that attach to existing house walls. Again, use the 3-4-5 rule and a full-size square.



Once the footing forms are in position and secured to stakes on their outside faces with 8d duplex nails, fill in void areas next to their outside faces with dirt. This will help hold them in place when concrete is poured.

Notice the string running on the left. It is tied to a piece of wood nailed horizontally to two stakes. As one person measures for a 5-foot hypotenuse at the existing wall end, another slides the free end of the string across the horizontal cross piece until the 5-foot hypotenuse is reached. When that occurs, the string is tied tightly to the cross piece.

Footing rebar

All footings must include rebar. Generally two $\frac{5}{8}$ -inch rods are spaced evenly apart in the middle of a footing area. You also will have to form corner pieces that will be inserted into footing corners. Rebar is tied with pliable tie wire.

Tie wire comes in rolls. It is inexpensive and very easy to use. To connect rebar sections, cut off a piece of wire, wrap it around the rebar, and then use pliers to twist the ends of the wire into a tight spiral. Snip off any excess wire and tap the spirals down so they don't get caught on the concrete vibrators or cause

concrete to hang on them. To hold rebar up and in the middle of the footing forms, wrap a piece of wire around the rebar and then over the 1x4 boards. The wire will keep the rebar suspended.

Pouring a concrete footing or foundation wall against an existing footing or foundation requires the rebar to be anchored solidly. Here, a roto hammer was used to bore a hole in an existing concrete footing. Then a threaded anchor bolt was driven in and a threaded connector screwed onto it. The end of this piece of rebar was ground smooth with a Makita grinder and the threads were cut into it with a die. Rebar was then screwed onto the connector to make a solid anchor.

Use a lubricant on the rebar end when cutting threads. In addition, wear safety goggles whenever you work with a grinder and be certain rebar pieces are securely held in place when you work on them.



Wood-framed walls should be positioned at least 6 inches above the ground. This prevents rain, snow, and surface moisture from contacting wall components. Concrete foundations accomplish this requirement and provide a solid base for walls. Essentially, foundations are short walls of concrete that rest on top of footings and serve as a base for first-floor exterior walls.

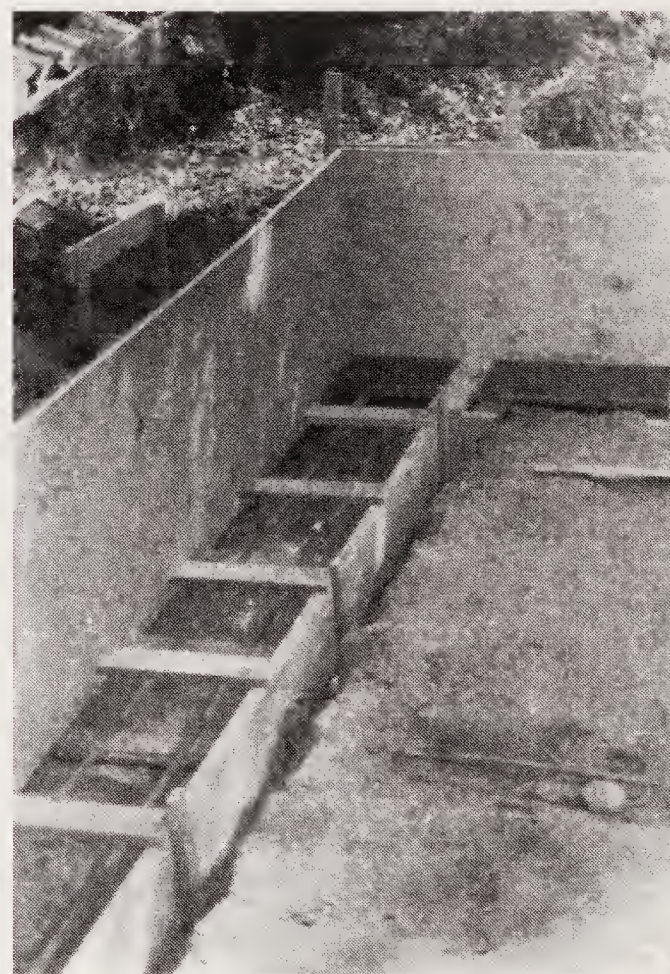
Setting up foundations

Wood-framed floors, as opposed to concrete slabs, also require a foundation base. Wooden beams and posts that hold up inner wooden floor areas might be supported by *stub* walls poured inside areas bordered by foundations. Stub walls look like and are built just like foundations.

When the footing forms were secured in their proper position, straight 2x4s were nailed on top of the 1x4 braces to serve as an anchoring point for the foundation panels. The 2x4s were set according to string guides so that they were straight in line with or parallel to existing walls.



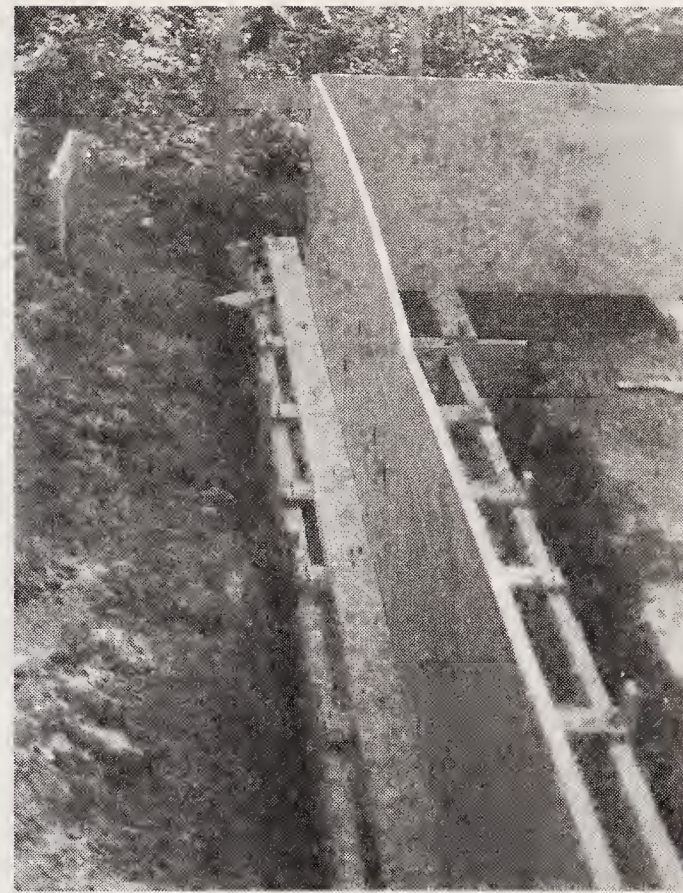
In order to position the outside face of the side foundation walls perfectly in line with existing walls, calculate where to place the 2×4s to account for plywood panel thickness. In other words, if the string guide running along an existing house wall is 2 feet away from that wall, the inside edge of the 2×4 on top of the footing should be placed $23\frac{1}{4}$ inches away from the string. This way, once a $\frac{3}{4}$ -inch plywood foundation form is nailed to the inside edge of that 2×4, its inside face will be exactly 2 feet away from the string. Thus the outside face of the foundation wall will be 2 feet away from the string, just like the existing house wall.



The bottom edges of these outside foundation form panels were nailed to 2×4s that were in turn nailed to the top of the footing forms' 1×4 braces. Notice the rebar in the footings. The rebar was installed before the panels simply for ease of installation. Also notice the two stakes with the cross piece toward the upper left. They were used to adjust and tie the guide string.

The tops of these panels were straightened later. Notice the string that served as a straight guide and the 2×4 nailed to the top of the footing form with 16d duplex nails. Plenty of stakes were used to secure these footing forms.

Once a panel is positioned and nailed to the bottom 2×4s, nail another 2×4 horizontally across the panel top. Since concrete will force the panel out, there is no need to use



heavy-duty nails to secure the top 2×4s. Drive small-headed 8d finishing nails through the plywood and into the 2×4 edges. This will keep the 2×4s in place while additional bracing is installed, like the vertical 2×4 seen here. It was nailed on top and bottom with 16d duplex nails.

To keep both front and back panels equally spaced apart and secure during concrete pours, use special devices called ties.

A Simpson Strong-Tie wedge tie, inserted through holes or slots cut in the panels, has tangs on the inside to keep the panels from moving inward against each other. Slip wedges into slots on the outside to keep the panels from falling outward.



These ties can be used with $\frac{3}{4}$ -inch plywood panels or dimensional lumber. Along with 2×4 bracing, wedge ties do an excellent job of holding panels together. They are commonly available at lumberyards and home-improvement centers. Wedge ties should be evenly spaced horizontally on no more than 2-foot centers and vertically on 1-foot centers.

Position and secure outside foundation panels and install rebar grids before you attach inside panels. Outside foundation walls will serve as supports for the inside walls. You will not be able to install rebar with both panels in place.

Use finishing nails to secure horizontal 2×4s across the tops of all outside foundation panels. Insert 2×4s between top and bottom horizontal 2×4s to serve as braces. Minimally, these braces should be positioned at every point where two panels meet and on 2-foot centers thereafter. Use 16d duplex to secure them. Nail straight down from the top 2×4s and toe nail braces into the bottom 2×4s.

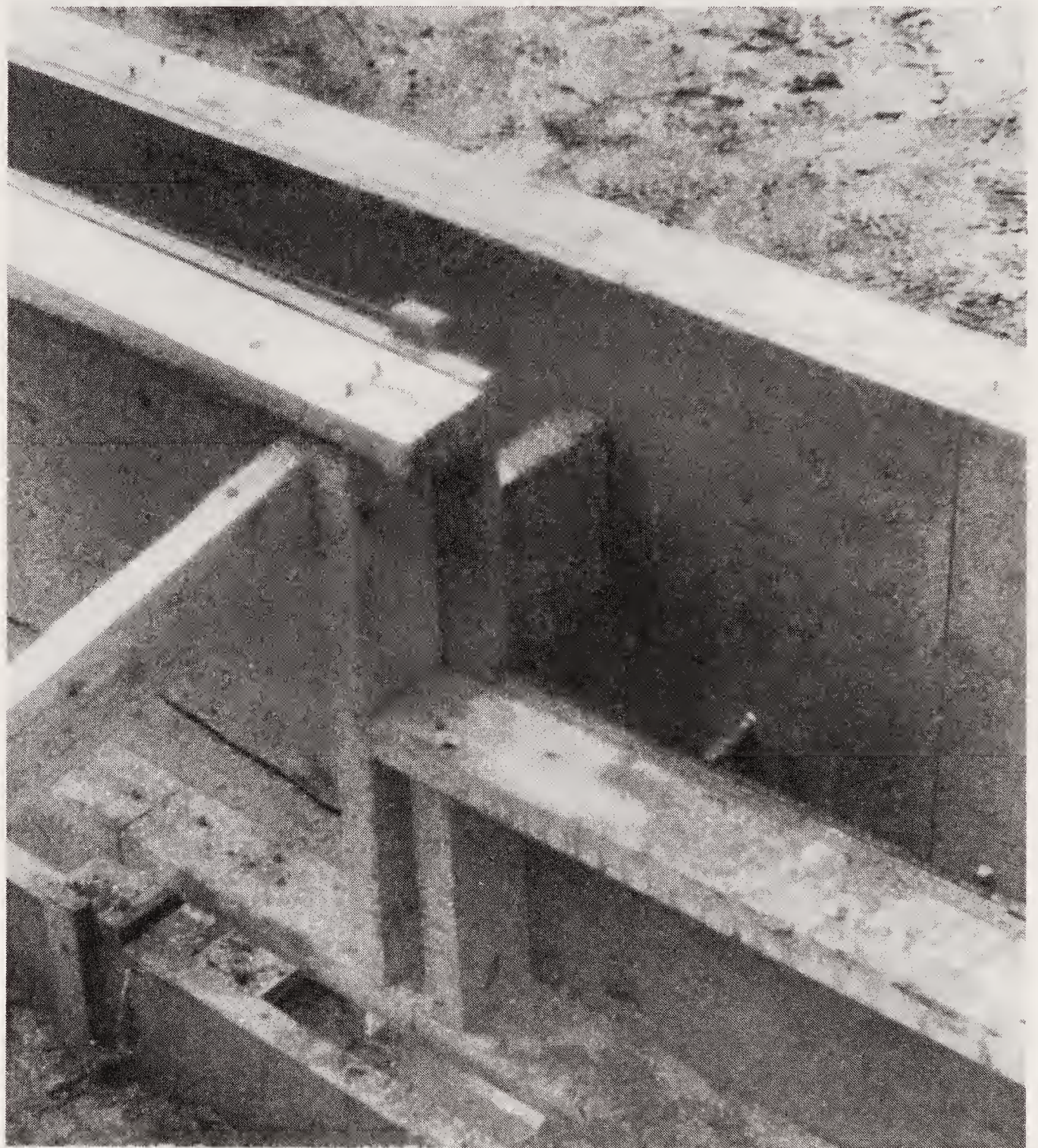


With that chore complete, install a *kicker brace*. The person on the left is pulling the panel in line with a strong guide. Once positioned, the person on the right will nail the kicker to a sturdy stake that has been driven into the ground. The kicker



brace will keep this section of the foundation panel from moving in or out. Plan to install kickers every 4 feet, or so—more often if walls need support to remain straight.

This inside panel was outfitted with 2×4 top and vertical supports. Notice the wedge ties in position. A separate 2×4 was nailed on top of the outside panel's horizontal 2×4 brace to help straighten a section where two 2×4 top braces meet (page 69, bottom).



Foundation forms must account for door openings that might be located below their top level. Here, the inside panel was cut to form an opening for a 36-inch-wide workshop exterior door.

A block was nailed between the panels to serve as a form for the side of the opening. Notice the wedge ties, 2×4 braces, and kicker brace. In addition, a string was attached to the inside face of the inside panel.

A $\frac{3}{4}$ -inch block holds the string $\frac{3}{4}$ inch away from the panel. The string is attached in the same manner at the other end. A separate piece of $\frac{3}{4}$ -inch-wide wood was used to make sure the panel stayed straight. That piece of $\frac{3}{4}$ -inch wood was inserted between the panel and the string. When it fit perfectly between them, the panel was straight. Have a helper secure the kicker braces while you hold the panels in a straight position.

Foundation panels do not have to be set to prescribed heights. The level to which concrete is poured can be below the top of panel edges. Since the concrete foundation walls for our workshop needed to be less than 24 inches, all plywood panels were cut to 2 feet. This reduced plywood waste and will enable them to be used again on another project.

Small blocks of wood, cut exactly 6 inches long, were used to help space panels exactly 6 inches apart, the thickness of this foundation wall. Once this block was placed between these panels, the one on the left pushed out to be in line with the other panel and tightened up against the wedge tie below. Note the rebar suspended inside the formed area. 16d nails were partially driven into the panels and the rebar secured to them with tie wire.



After the foundation panels were straightened, braced, and secured, cleats were nailed to the top as an added measure of support to guarantee the top sections did not move when the heavy concrete was poured.

In addition, long 1×4 boards were nailed on top of the footing forms to cover openings and prevent concrete from spilling out. On the inside face of the outside panel, a piece of wood was nailed just below the top edge. This piece of wood served as a guide to indicate where the top of the concrete should be. Pencil marks, determined by measurements taken with an

engineer's level, were made at each end of the wall and in the middle. A chalk line was then snapped to serve as a guide for the installation of this wooden guide.



This foundation form is set and ready for concrete. The top cleats are in position, as well as the thin piece of wood used as a concrete guide. Concrete was poured to the bottom of the thin board nailed to the inside of the panel. In addition, notice the foundation wall form perpendicular to the panels. This form held the concrete in place next to the house's exposed footing and foundation.

Because our workshop floor is 1 foot lower than the floor of the existing garage, steps were poured to ease access from the shop to the garage. Another small step was formed to ease access into the workshop through a hallway and door opening that will be made next to the garage.

Measurements were taken and pencil marks made on the house's existing foundation wall to indicate the location of a new door opening. A step was formed to include a 1-foot tread (the part your feet step on) and 6-inch rise. Another 6-inch rise from the lower step to the upper one brought the level up to that of the house's first floor.

This long step will be used to access the existing garage; the small step will be used to gain entrance into a basement hallway. The plywood form braced by the horizontal 2×4 that made up the long top step was cut to a 6-inch width. It was braced with more stakes before the concrete was poured.

Plenty of stakes are needed for step forms. Without adequate support, forms will bow or blow out (completely fall away).

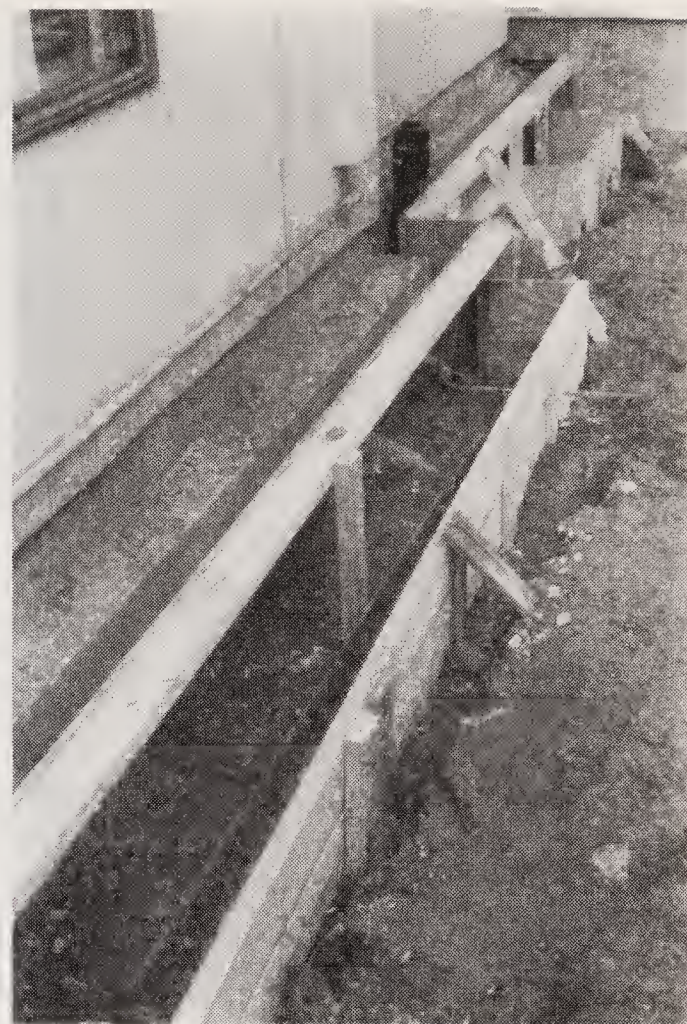
Guides made of 2×4 blocks cut to exactly 1 foot were used to help install these forms. They were placed next to the existing house foundation while forms were held against them. This helped keep the forms positioned 1 foot away from the house while stakes were driven into the ground (see next page).

A 7-foot-tall concrete wall was poured at the same time as the workshop footings and foundation. The wall was formed with plywood panels on top of footings that were formed exactly like those poured for the workshop (see page 75).

In lieu of wedge ties, round snap ties were utilized for this tall wall. Snap ties operate on the same principle as wedge ties. The difference between them rests in their shape and the manner in which their outer ends are secured in place.

For this wall application, snap ties were positioned 16 inches on center horizontally and 18 inches on center vertically. Measurements were marked on the plywood panels and then lines drawn with a pencil to indicate where holes had to be drilled for snap tie placement.

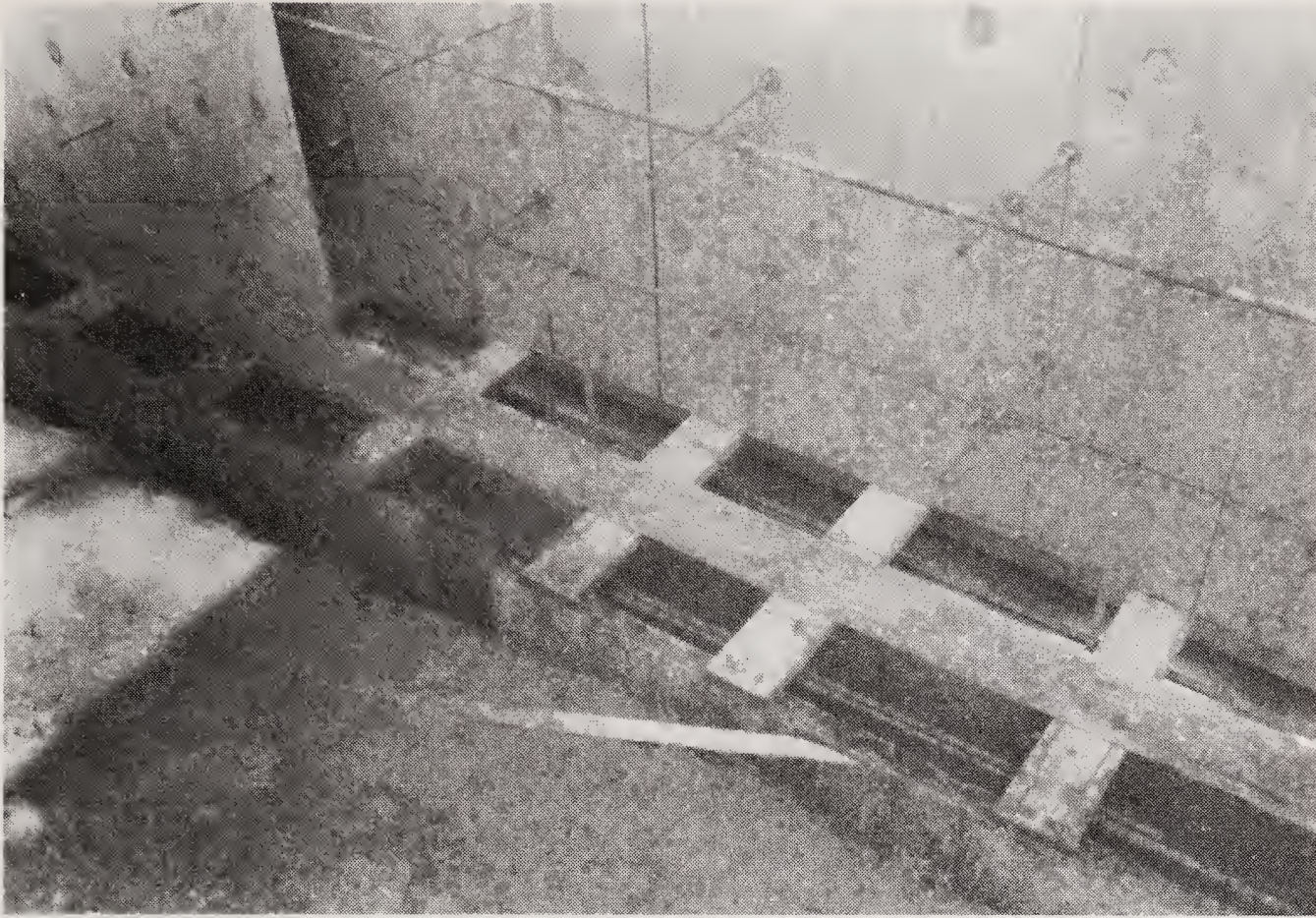
Once the outside panel was positioned and secured, a rebar grid was installed using 16d nails and tie wire. Nail ends that





protruded out of the concrete once the panels were removed were ground off with a grinder.

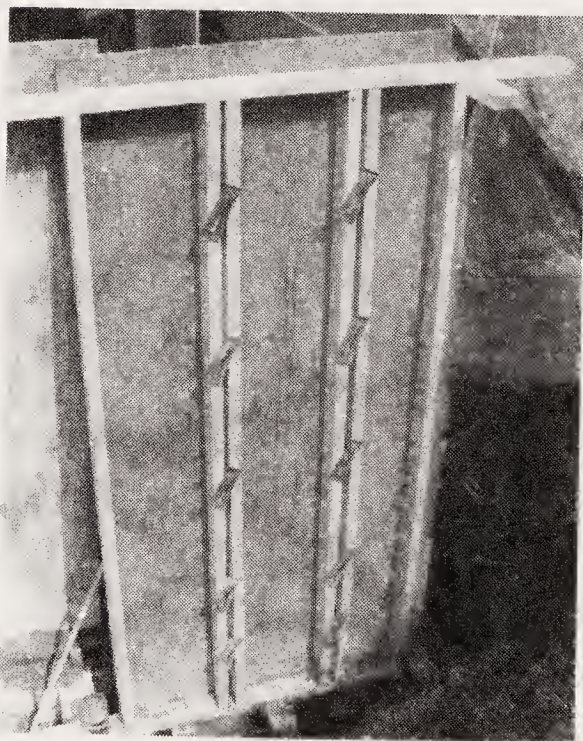
Rebar was positioned horizontally on 1-foot centers up to 3 feet high, then on 2-foot centers to the top. See photo, top of page 76. At the 7-foot level, a piece of chamfering strip was attached using small finishing nails. This strip had a 45-degree angle cut along its length and that angle rested inward toward the concrete. The strip indicated the top of the concrete. The 45-degree angle caused the top outer edge of the concrete wall to form at a 45-degree angle—a nice custom touch.



A 2×4 board resting vertically at the end of the inside panel and next to an existing concrete foundation wall was anchored to the house wall and served as support for that end of the new wall.

Outer ends of the snap ties were secured with metal shoes designed especially for this application. Then 2×4s were nailed to top and bottom horizontal 2×4 braces on each side of all the snap ties. Shoes were placed over the snap-tie ends and across the 2×4 braces. See photo, bottom left, page 76.

Shoes incorporate a hole at the base of an angled projection and slot that runs up that projection. Holes are lined up with buttons on the ends of snap ties. Once buttons are inserted through the holes in the shoes, hammer blows force the shoes across the snap ties. Snap-tie buttons are then forced along the slots and upward along shoe projections to essentially wedge the shoes in place. This causes a great deal of pressure to be exerted on the ties, as they are stretched between plywood panels and the 2×4s supporting the shoes. Large washers on the inside portions of snap ties keep them from pulling out of the plywood.



Snap-tie washers are visible on the outside plywood panel. This inside panel was outfitted with 2×4 braces and shoes after all of the rebar work was complete. See photo opposite, bottom right.

A roto hammer and hand tools were used to insert anchor bolts through a 2×4 brace and into the existing concrete foundation wall. Anchor bolts used for this application featured a wedge ring at their base that expanded as the bolts were tightened.



After the snap ties and shoes were secured, the 7-foot-tall wall was braced with other lumber to keep it straight and help secure it during the concrete pour. The upright 2×4 in the middle was a brace for the 2×10 catwalk. Notice the uniformity in which snap ties were installed.

Do not forget to cover openings on the tops of footing forms before you pour concrete. If you do, expect lots of concrete to spill out as it is forced toward the openings by pressure from concrete above it.

**Footing and
foundation
concrete pouring**

Small trowels are perfect for smoothing concrete inside confined foundation wall panels. A small-size trowel measures about 10 inches long by 3 inches wide. It is easy to maneuver inside panels and next to mudsill anchors.

Concrete pumps make getting concrete into tall foundation forms easy. Concrete is poured into a pump's hopper directly from a concrete delivery truck. Mud is then pumped through heavy-duty hoses to the job site. For this job, we used a boom pump. A large boom was raised up and over the existing house and then maneuvered by the operator through a remote-control device.



A flexible hose located at the end of the concrete pump boom was maneuvered along the foundation walls. After filling footing spaces, plan to pour only 1 to 2 feet of concrete into the foundation walls before you move on. Come back later and add more concrete after the first couple of feet have settled. If you pour the foundation walls full of concrete on the first pass, the weight of the concrete might cause the panels to bow or blow out.

Just behind the pump hose, helpers should operate a concrete vibrator. This tool consists of an electric motor and long hose with a heavy, metal cylinder attached to the end. As the hose and cylinder operate, the concrete vibrates, which causes rocks to settle and creamy mud to work its way toward panel faces. This helps to ensure that the concrete walls turn out smooth.

Another way to help smooth concrete wall surfaces is to apply concrete form oil on the panel faces before you pour. This oil helps to prevent concrete from adhering to the wood, so when the panels are removed surfaces remain undisturbed.

Notice that just a little concrete was poured initially into this wall space. Two helpers maneuvered a concrete vibrator along a foundation wall. One held the motor while the other moved the hose around.

Concrete vibrators are exceptionally powerful. Their movement inside foundation wall forms is incredible. You must use them on every section of concrete to avoid rock pockets and help smooth out concrete surfaces, but only allow the machines to vibrate for a second at a time. Use the on and off switch for short spurts of vibration. *If you turn on a vibrator and leave it on, you stand an excellent chance of blowing out all your forms!*

Although one person can operate the end of a concrete-boom pump hose, it really helps to have more than one person when you try to get concrete into a narrow, 6-inch space. Concrete exits the hose with a great deal of force. After all, along with pressure from a pump, the material falls from a boom perched 25 feet or more above.

As the concrete fills open form spaces, make sure the vibrator is working right behind. Especially on big jobs, the vibrator hose can get heavy. Find a comfortable position from which to work, like resting the hose over your shoulder.



As concrete is poured at the level of your inside form guides (thin strips of wood nailed inside), use a small block of wood to screed concrete at the proper level.

Whenever you work with concrete, plan to wear heavy-duty latex gloves. The pair I wore were from Stanley Goldblatt. They have held up under numerous concrete jobs and have prevented the skin on my hands from becoming super dry and cracking.

Once concrete starts to set up a little bit and isn't quite so soupy, install mudsill anchors or anchor bolts. These accessories hold the wall's bottom plates tight against the top of the foundation walls. Simpson Strong-Tie mudsill anchors should be spaced about 3 feet apart.



Use hand trowels to finish the surface of foundation walls to a smooth texture. The walls do not have to be perfectly smooth, but should offer an even surface to aid in the installation of walls on top of them.

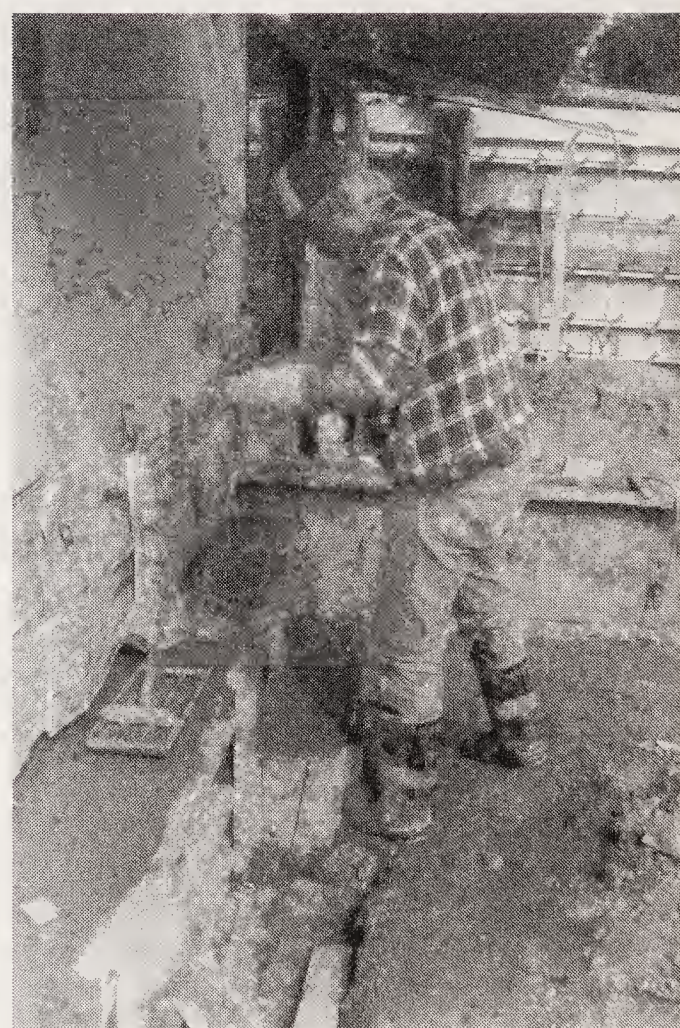
A hand float works well to level out and initially smooth concrete inside narrow forms. When existing walls are located adjacent to concrete pour areas, use chalk lines as guides to show the top of the concrete.



Newspapers taped to the adjacent house wall prevented the siding from being splattered with concrete during the pour. It also prevented concrete splatters when rocks were forced down with the *tamp* (jitterbug).

Tamping helps to level concrete, force rocks down, and bring up cream. Plan to tamp every concrete job, with the exception of narrow foundation walls and jobs poured with *pea gravel*. Pea gravel is small enough to be forced down with a wooden or magnesium float. While tamping, wear safety glasses or goggles to prevent concrete splatter from getting in your eyes. After an area has been tamped, smooth it with a float and then steel trowels for a smooth finish.

Once all mudsill anchors or anchor bolts are installed and the concrete smoothed to satisfaction, let the foundation walls sit for a few days to dry out (*cure*). Inside panels can



be pulled one or two days after a pour, but wait a day or two longer to pull outer forms. This will give the concrete a chance to cure slowly and, thus help prevent cracks. As long as concrete remains a dark color, it is susceptible to scratches and chips. After it has turned a uniform, light-gray color, the concrete should be almost fully cured. This will take a week or two depending on the humidity and temperature.

After the pour

Removing forms entails a great deal of nail pulling; hence the use of duplex nails during form construction. Light hammer blows might be needed to break the forms loose from the concrete. Always pull forms horizontally away from concrete, not vertically. This reduces the chance of pulling off chips of concrete.

Exposed ends of Simpson wedge ties were simply bent back and forth until they broke off. Snap ties required back and forth hammer blows to break them. Be cautious of sharp broken ends.



Apply a concrete sealer to the foundation walls to prevent moisture penetration into interior structure areas. Paint on the sealer to a height equal to the eventual level of landscaping soils. Allow the concrete sealer to dry according to label instructions before shovelling dirt next to it.

After all the footing and foundation forms are removed, work on the footing drain installations. Footing drains consist of plastic pipes outfitted with holes on two sides. Water seeping down along foundations will eventually run into and then out

of these drains, which prevents water from penetrating inside structures.

A Structron trench shovel is perfect for cleaning out and digging footing drain trenches. The long, cushioned handle is comfortable to maneuver and the long, narrow shovel blade is bent at a convenient angle. Be sure the trenches reach down to the bottom of footings and no more. The trench should also run at a slight downward angle to facilitate water flow.

The 1×4 wooden braces, which were nailed to the tops of the footing forms, were exposed after the forms were removed. Embedded in concrete, their ends stuck out past the footings by at least 1½ inches. We cut them off with a saw or axe, or left them in place. They were buried when the footing drains were installed.

Position footing drain pipes so that their holes face outward—one line of holes should face almost straight down, the other not quite straight up. This way water that seeps upward will enter the lower holes and water that filters down will flow into the upper holes. This footing drain pipe was located behind the 7-foot wall. A few connections were used to get the pipe into position along the wall. It connects with another pipe at the front of the wall.



After the pipe was put in the trench and the pipe ends were secured with glue, the drain pipe was covered with a sheet of perforated material to help prevent dirt from filtering through and clogging the pipe. Available at most home-improvement centers, this perforated material is used commonly on flower beds because it allows water and air to penetrate. Then the trench was filled with about 5 inches of round rock gravel, which allows water to filter into the drain pipe. Dirt was placed on top of the gravel to landscaping level.

Once footing drains run past footings and into open areas, they can be connected to flexible pipe. Flexible pipe works well,

especially when you are forced to dig trenches around trees and other obstacles.

Run footing drain pipe away from foundations and walls to an approved runoff spot. This might be a natural water-runoff location or a specified groundwater sewer. Runoff locations will have to be included in your building plans.

Floors

WORKSHOPS AND OUTBUILDINGS MUST HAVE SOLID floors. Without a floor, everything stored inside is susceptible to moisture contact, to say nothing about the dusty and dirty conditions in which you will work. Floors for workshops and outbuildings are generally constructed with wood or concrete after footings and foundations have cured.

An entire workshop floor could be made out of wood. The endeavor would require post and beam construction, which utilizes heavy timbers as main supports and large dimensional lumber for joists. The framework would then be covered with a subfloor made of tongue-and-groove, $\frac{3}{4}$ -inch plywood with another layer of plywood over that for added strength. For special applications that require heavy-duty floors, use *car decking*—2×6 tongue-and-groove lumber.

Although an outbuilding can be built on top of a concrete slab floor, a typical style features 2×4 floor framing covered with $\frac{3}{4}$ -inch plywood. A wooden floor like this is easier and generally less expensive than a concrete slab floor. Unless you expect to store a great deal of heavy material inside small outbuildings, space the 2×4 floor joists on 2-foot centers. Those with heavier loads should have joists spaced on 12- or 16-inch centers.

Ground-level wooden floors are constructed exactly like second-level wooden floors with foundation walls around the perimeter, structural support walls in the center, joists, and a covering.

Floor joists for structures other than small storage sheds should be spaced on 16-inch centers and run true to square. If they are not square, there will be nothing to which some plywood edges can be nailed. Along with the 3-4-5 rule and full-size squares, use string guides to properly position joists straight and square.

Wooden floors

Joists spaced on 16-inch centers will provide a full 1½-inch-wide nailing surface onto which two plywood edges can be nailed every 4 or 8 feet where two sheets of plywood meet.

Floor joists must rest on top of lower support walls. If the joists sit even slightly higher, your floor will squeak and be weak in spots. Once joists have been put into position, check their relative position to lower support walls and fill voids with *shims* (pieces of wood).



In addition to shims, install *blocks* between joists to add support and prevent squeaks. Blocks are pieces of wood the same size as the joists. The blocks are cut to fit between joists on top of support walls or in the middle of spans. Blocks are usually positioned in a staggered pattern; the first one just left of center, second one right of center, and so on.

After joists were installed and secured, plywood was laid on top in a staggered pattern. Plywood widths should be positioned in line with joists and then staggered so that a solid seam is *not* created along the 4-foot plywood edges. Each 4-foot plywood edge is offset from the next by at least 2 feet. This pattern provides maximum floor support.

Apply subfloor adhesive (glue) to the top of the joists just prior to installing the plywood. Then nail or staple the plywood in place. When an entire floor will be covered with plywood, install deck screws through the plywood and into joists on about 6-inch centers. The addition of deck screws, along with nails or staples, might seem excessive until you realize that without screws your floor will develop squeaks.



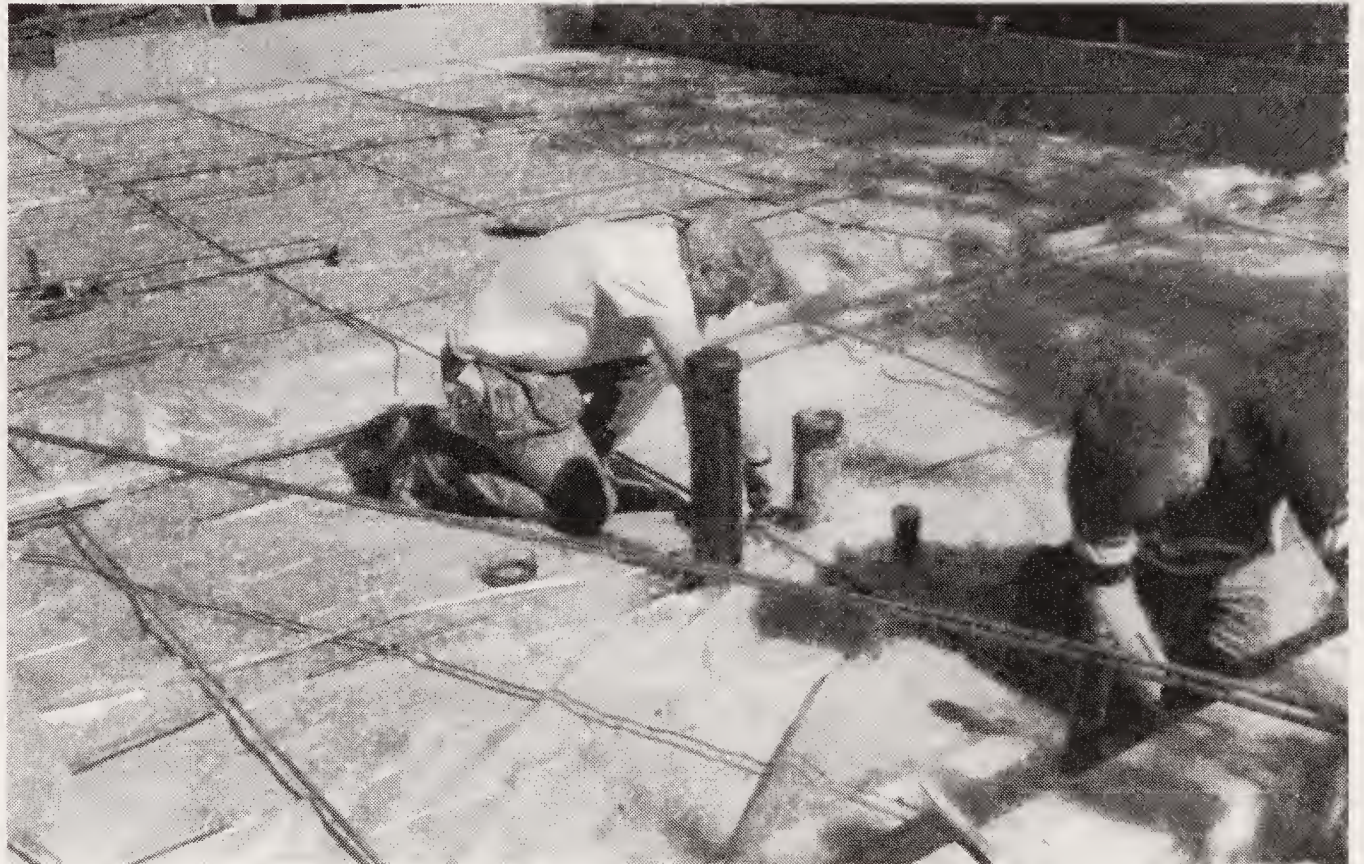
From floor level, this is a view of a cantilevered deck through a first-floor window opening. Cantilevered decks that won't have post support underneath should not exceed 3 feet in width. At that, joists should extend inside the structure at least an equal distance of 3 feet.

The 2×10 joists cut at 6-foot lengths were first nailed to a long 2×10 on top of the second floor, which was covered with plywood. The unit was then lowered into position on top of the wall with the long 2×10 butted up next to a wooden I-beam. The long 2×10 was then nailed securely to the wooden I-beam and blocks were placed between the 6-foot joists on top and along the outer edge of the exterior wall.

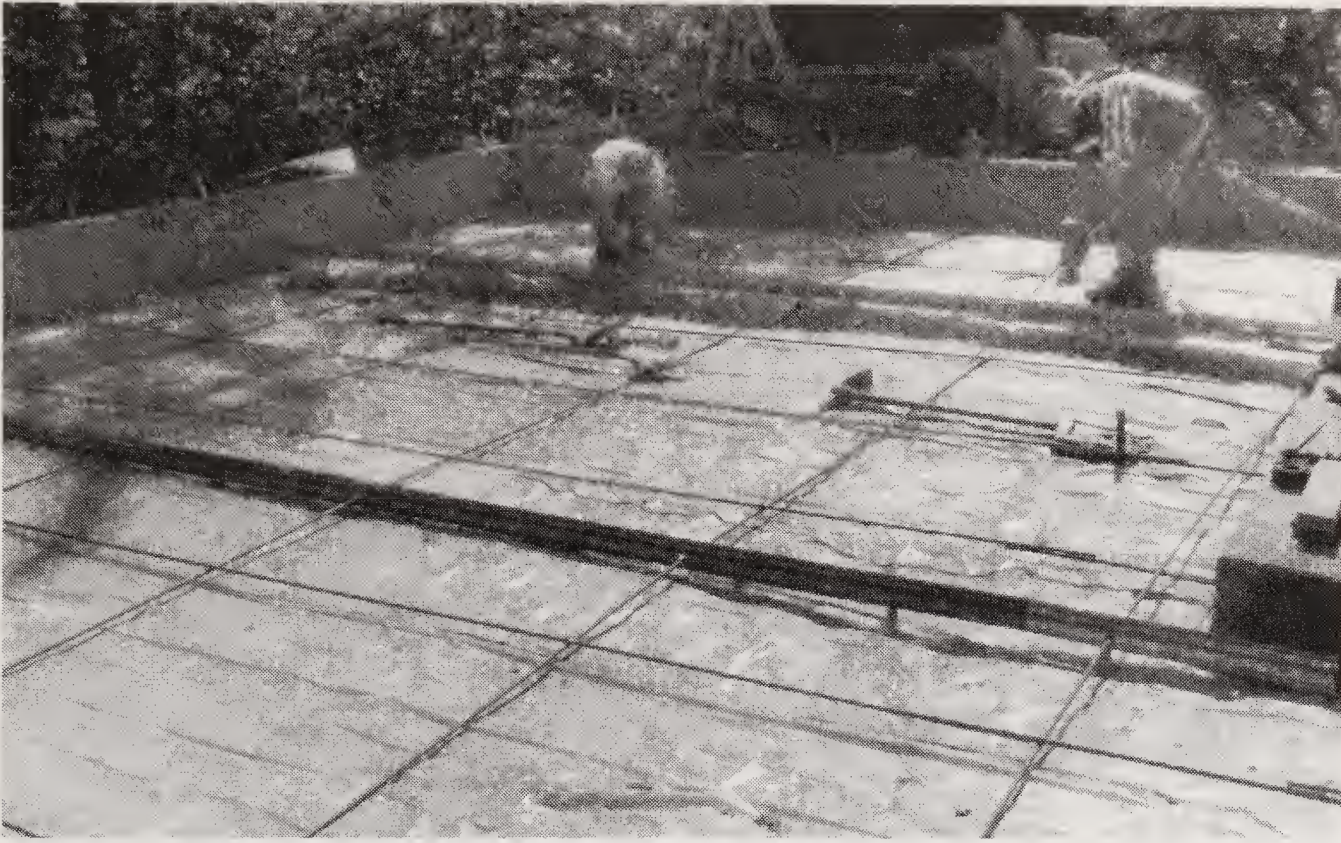
Be alert to your every move when you work on the second floor. Keep tools and wood out of the way so they do not present tripping hazards.

Concrete floors

Concrete pads for small outbuildings do not require extensive rebar reinforcement, although a few rods spaced 4 feet apart will help prevent cracks from separating. All concrete slabs should be poured a minimum of 4 inches thick. Some homeowners who expect to drive cars and other heavy vehicles into their shops on a regular basis or who install heavy pieces of machinery, might consider concrete floors 6 inches thick with rebar spaced in a grid on 2-foot centers. Concrete is sold by the square yard. One yard will cover 80 square feet at a depth of 4 inches.



A Makita roto hammer was used to bore $\frac{1}{2}$ -inch holes along the foundation, on 4-foot centers at a height that was in the middle of the concrete slab. Two-foot sections of rebar were then driven into those holes. Long sections of rebar were then secured to them with tie wire. This resulted in a 4x4-foot rebar grid across the entire floor area. Note the plumbing drain pipes protruding from the ground.



Metal screed/expansion-joint strips were installed in two places to divide the slab into three separate sections. In addition to absorbing the expansion or contraction of the concrete, these strips served as guides for screed boards when the concrete was poured. Knock-out holes in these strips allowed room for the rebar. These strips required special stakes that snapped into place along one of their sides.

The 6-mil, plastic moisture barrier will help prevent moisture from penetrating through the slab and into the workshop. Most building departments require moisture barriers under slabs.

Before you pour the concrete, snap two chalk lines along the foundation wall. The first one should be set at exactly the height to which concrete will be poured. The other line should be chalked $3\frac{1}{2}$ inches above it. This top line will serve as a guide for the top edge of a 2×4 screed board. The top line is very important because the bottom line will be covered with concrete before the area can be screeded off. Without any lines, screed-board operators have to guess the screed level.

Long chalk lines should be snapped by three people. Make pencil marks at both ends and in the middle. The person in the center should hold the line taut on the center pencil mark

while the others hold their ends tight on their pencil marks. Snap the line twice: on one side and then the other.

An hour or two before the concrete is scheduled to be delivered, completely check your worksite to determine that screeds are level, rebar is secure, the plastic moisture barrier is laying flat, and all concrete pouring and finishing tools are on hand. Be certain you have plenty of helpers available, too.



As with the footings and foundation, a concrete boom pump was employed to deliver concrete right to our job site. Since maneuvering the hose was not confined to a narrow, 6-inch opening, only one person was needed to handle it. Three people worked with a screed board, a couple with shovels, a person with a come along assisted the screeders, and two more people pitched in as needed.

When you get close to the end of the pour, stop the delivery of concrete until the screeders have completely caught up. Then pour in only enough concrete to fill the forms. Do this slowly. Excessive mud inside the forms will have to be shoveled out.



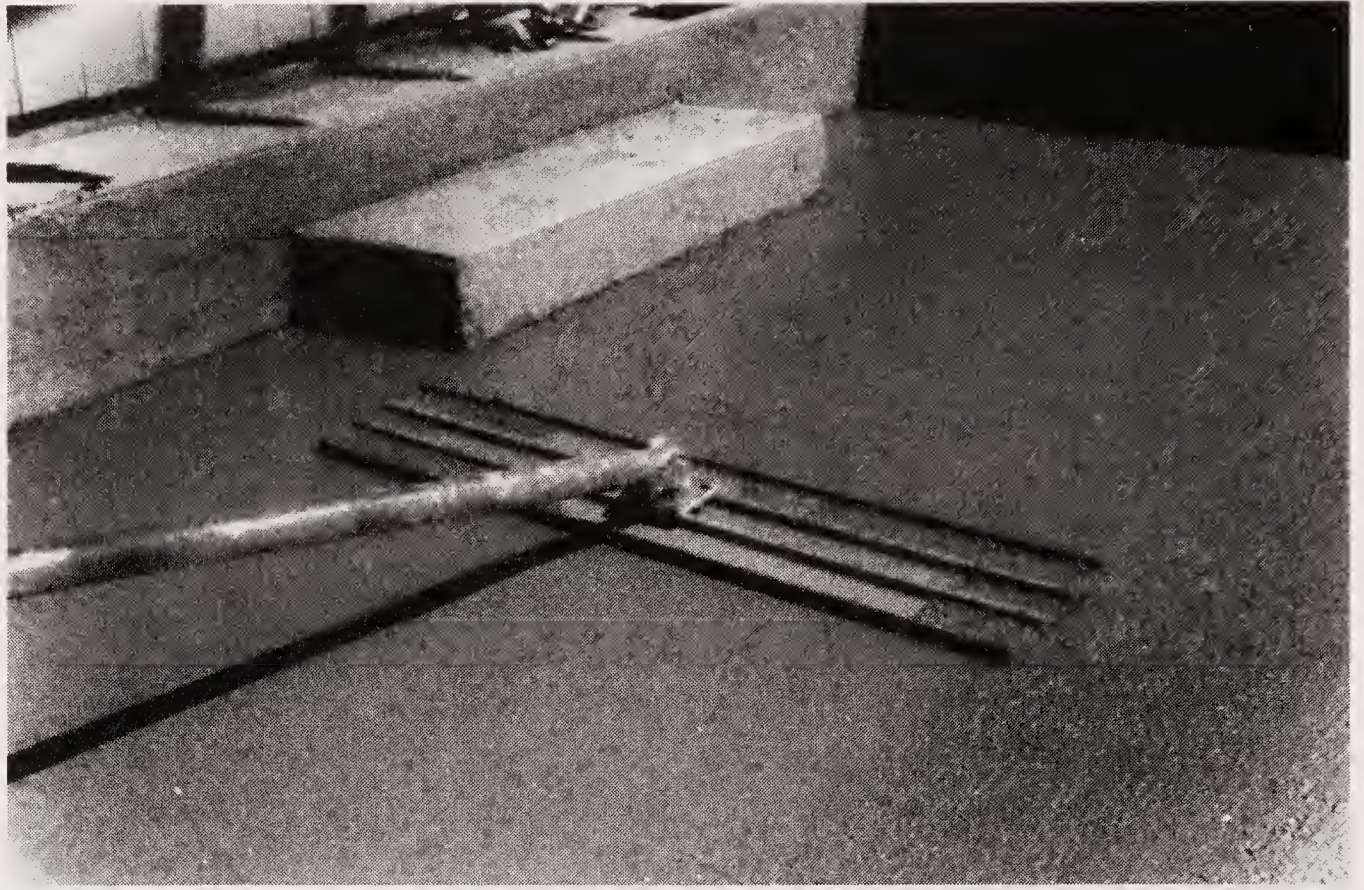
If you have never finished concrete, plan to have someone on site with this kind of experience. Except for very small jobs of maybe $\frac{1}{2}$ -yard (40 square feet) or less, the concrete might get away from you, which will result in a very coarse, uneven, lumpy, and unattractive surface finish.

Concrete slab finishing

After the concrete is screeded, tamp slabs that contain rocks larger than pea gravel. This exercise forces down the rocks and brings up cream. Cream is the material that finishes smoothly. Right after tamping, smooth the concrete with a float.

To reach areas in the middle of the slab, I recommend using a bull float, available in wood or metal. The Stanley Goldblatt magnesium bull float does an excellent job of initially smoothing six-sack pea-gravel concrete right after screeders have completed their job. When possible, operate bull floats in the opposite direction of screeding. This will help to further level concrete surfaces. See next page.

Smooth lines left by bull float outer corners as the concrete begins to set up. You can usually wait 20 to 30 minutes between bull float applications. In warm weather, don't wait much



longer than 15. In hot weather, you might have to start subsequent bull float applications immediately after completing previous ones. Normal concrete finishing projects seldom require more than three magnesium bull float applications.

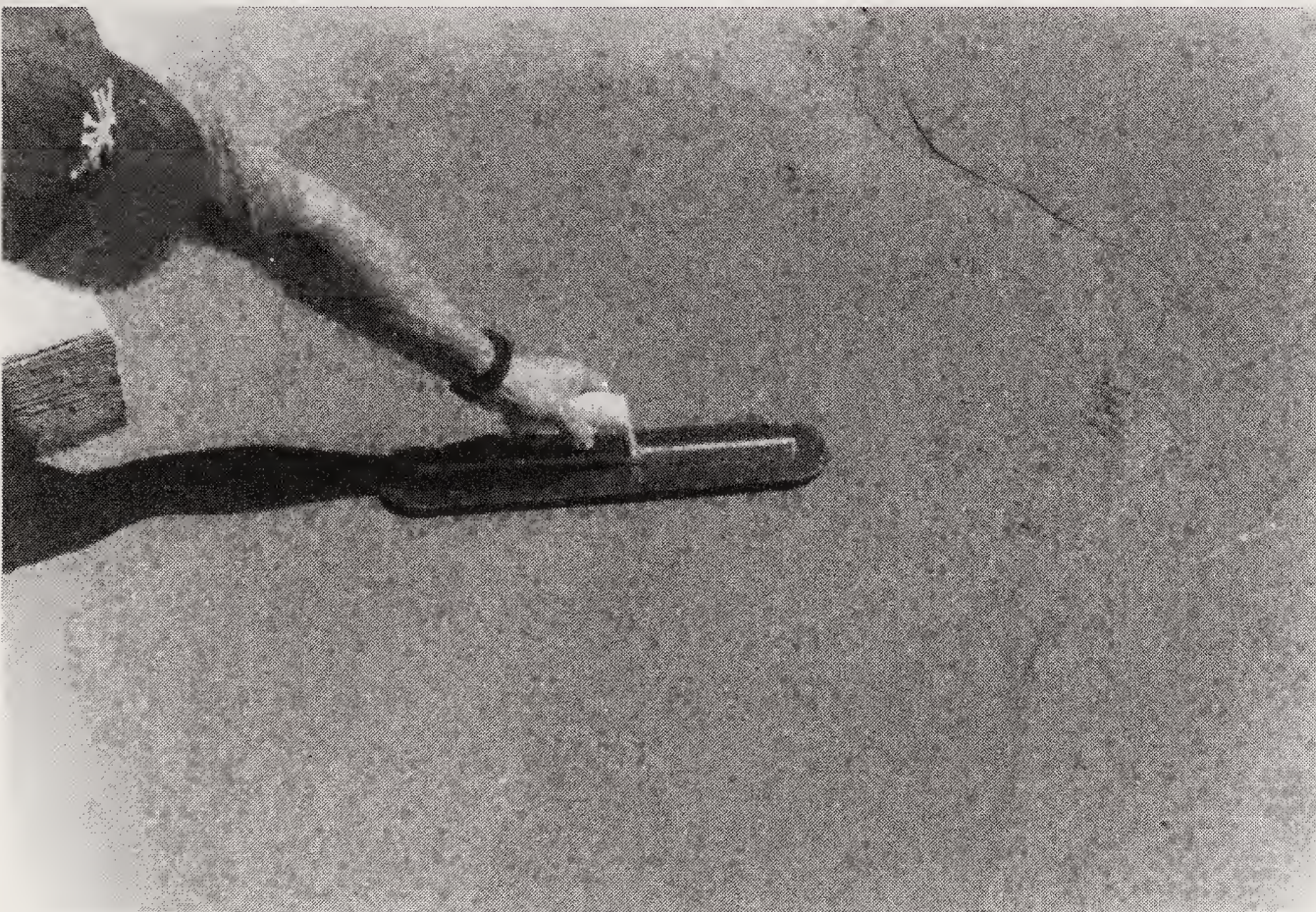
A wooden bull float is normally only applied once. After that, finishers use a steel *fresno*. This tool is very similar to a steel trowel except that it is 3 feet wide and is operated off an extension pole.

The rounded edges of the Stanley Goldblatt fresno help prevent ridges from forming. Just like the bull float, you push it across the slab with the front edge raised and then pull it back toward you with the back edge raised. Use a fresno to smooth concrete as it starts to harden. Apply downward pressure to the pole in order to make it better finish tough spots.

Notice the concrete is a darker color each time the fresno passes over it. The spots that do not change color are low spots. Maneuver the fresno over them from different directions to push cream into them.

As concrete hardens, you will notice that a fresno has little effect on the slab surface and that you hear a distinctive ringing sound each time the tool is operated. These are signals that it is time to get out on the slab and finish it by hand with a steel trowel.

Hand trowels are generally operated in an arced motion. However, next to and out from obstructions, like foundation walls, set the trowel next to the obstruction and then work out in a straight line. As you move the tool, be sure the leading edge is raised off the surface, just like a bull float or fresno. Like the rounded-edge fresno, trowels with round corners finish concrete without leaving behind noticeable ridges.



In open areas, make wide passes in long, definitive arc motions with the trowel. Adjust leading edges up or down to accomplish the smoothest results. Practice with a trowel to become proficient.

Getting out in the middle of a slab to finish concrete requires the use of two knee boards, which are used in a leap frog fashion—step on one, move the other, then kneel down on the finished concrete; then pick up the one you were kneeling on and move it behind; and so on. This method will get you to the middle of the slab.

In lieu of plywood knee boards, try out the plastic models offered by Stanley Goldblatt. A smooth bottom surface, curved edges, built-in knee pads, and foot brackets make these tools easy to use and maneuver. Instead of having to stand up and leap frog around slabs, these knee boards slide from place to place. Work backwards so that you can finish those areas marred by the knee boards and leave them perfectly finished. Bring two trowels with you—lean on one and work with the other.



Outdoor slabs

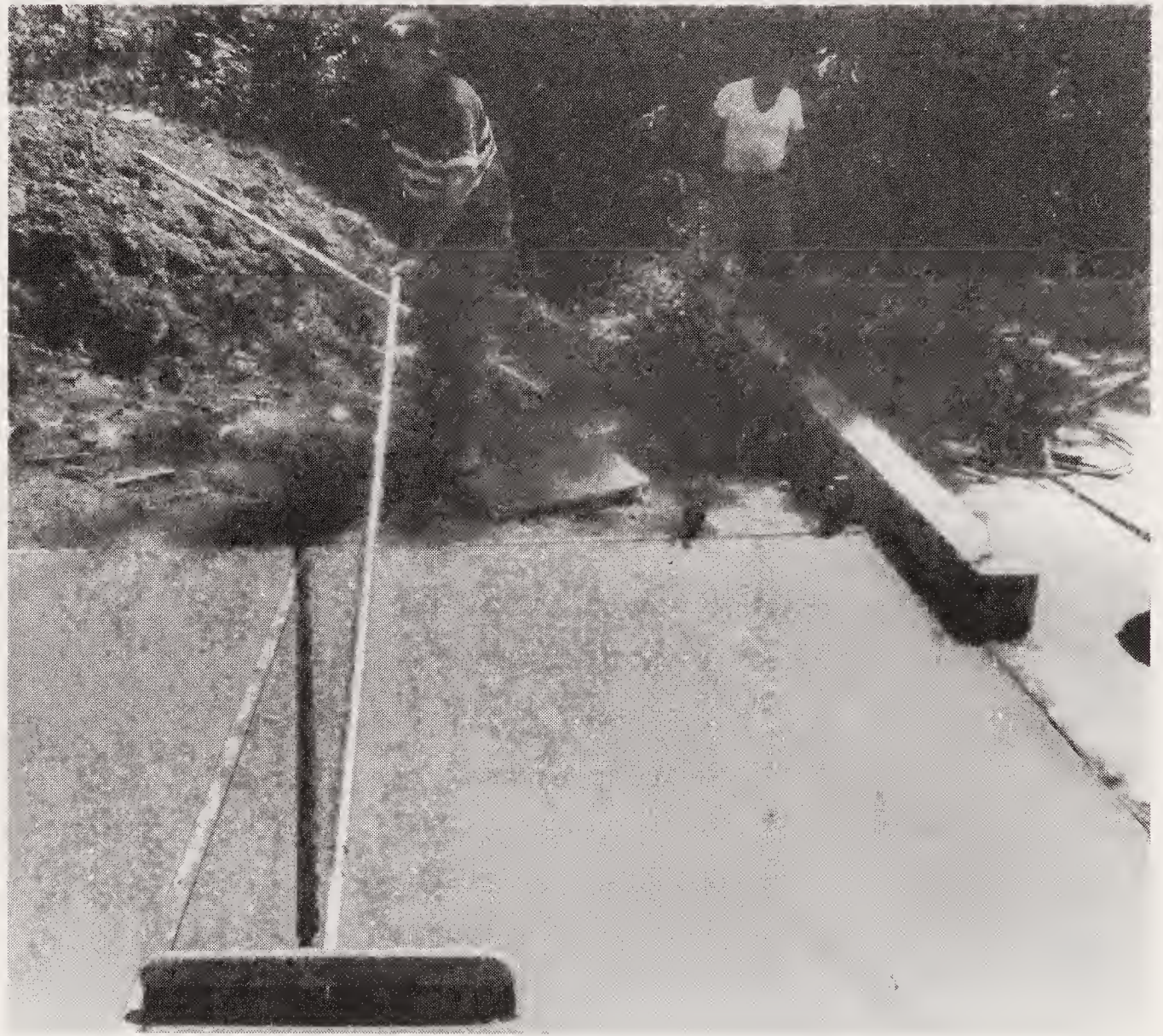
Concrete poured for outdoor use must have a finish that is not as smooth as that for indoors. Smooth concrete will be as slippery as ice when wet. Therefore, run a soft-bristled broom over freshly finished outdoor slabs to make tiny lines on the surface. This will greatly increase the traction on the slab when it is wet.

This area was prepared for a concrete slab. An outdoor storage unit will eventually be built next to the 7-foot wall. The rest was designed as a simple patio area. Pressure-treated 2×4s were positioned inside the forms for both expansion joint and decorative purposes. These stringers will come in handy for screeding, too. Notice that holes were drilled in the stringers so that rebar rods could pass through them. Rebar will add strength to the slab and prevent both the concrete sections and stringers from lifting up.



Concrete was poured and finished the same for both indoor and outdoor slabs. In the case of stringers, extra work was required to form edges on the concrete that rests next to them.

To make rounded edges along the top corners of concrete, use a special trowel called an *edger*. Stanley Goldblatt offers a number of different sizes with various radius curved edges. It is the arc of this curved edge that forms rounded concrete corners. Operate the edger back and forth on concrete with the curved edge placed between concrete and the wooden stringers or forms. Continue working the tool back and forth until the concrete is smooth. Then use a steel trowel to smooth out any imperfections left behind on the flat part of the surface. All concrete corners resting next to stringers and forms should be edged.



After finishing an outdoor slab and edging all top corners around stringers and forms, it is time to put on the broom finish. Pull a Stanley Goldblatt concrete broom, with soft bristles and an extension pole, across the slab to effect tiny lines. These lines will increase the traction on the slab whenever it is wet. Indoor slabs are not generally broom

finished because they seldom get wet. Smooth workshop floors are easier to sweep and mop.

Spray concrete slabs, especially those for indoor use, with a clear, liquid concrete sealer once they are hard enough to walk on without leaving marks. Sealers are available from concrete tool-supply stores. The sealer will make the concrete floor easier to sweep and clean with wet mops. Sealers will also prevent oil and other liquids from penetrating or staining concrete.

Wall framing

OF ALL THE TASKS REQUIRED TO CONSTRUCT WORKSHOPS or outbuildings, wall framing is perhaps the most fun and rewarding. Cutting and then nailing studs, plates, headers, and cripples together does not take much time. Once walls are stood up you can really see your building take shape.

To make wall framing fun and rewarding, follow recommended and common-sense safety practices. Wear safety goggles when cutting and nailing; position electrical extension cords away from active framing areas; situate your air compressor in a remote corner and string air lines away from sawing operations; measure twice and cut once; keep your free hand away from driving hammer heads; and so on.

Setting up

Wood-framed walls are put together on the floor next to the foundation wall on which they will be placed. This way, they can be tilted up and jockeyed into position. Therefore, stack framing lumber away from foundations so there is enough open floor room to work around.

If your workshop or outbuilding project requires numerous studs to be cut to prescribed lengths, seriously consider setting up a chop saw on a cutting table. Such a work stand makes the job of cutting boards to equal lengths easier and quicker.

Position 2×4 or 2×6 studs on 16-inch centers for wood-framed walls. This is standard. In lieu of measuring each stud that will be nailed to top and bottom plates, lay out the top and



bottom plates along the walls and make pencil marks at each point a stud is required.

A pressure-treated bottom plate rests on top of the foundation wall on which it will be built. A tape rule was stretched from one end to the other and pencil marks made at each 16-inch interval. Stanley tape rules include special markings their entire length that point out each 16-inch interval. Notice the Simpson mudsill anchors spread out beneath the bottom plate.

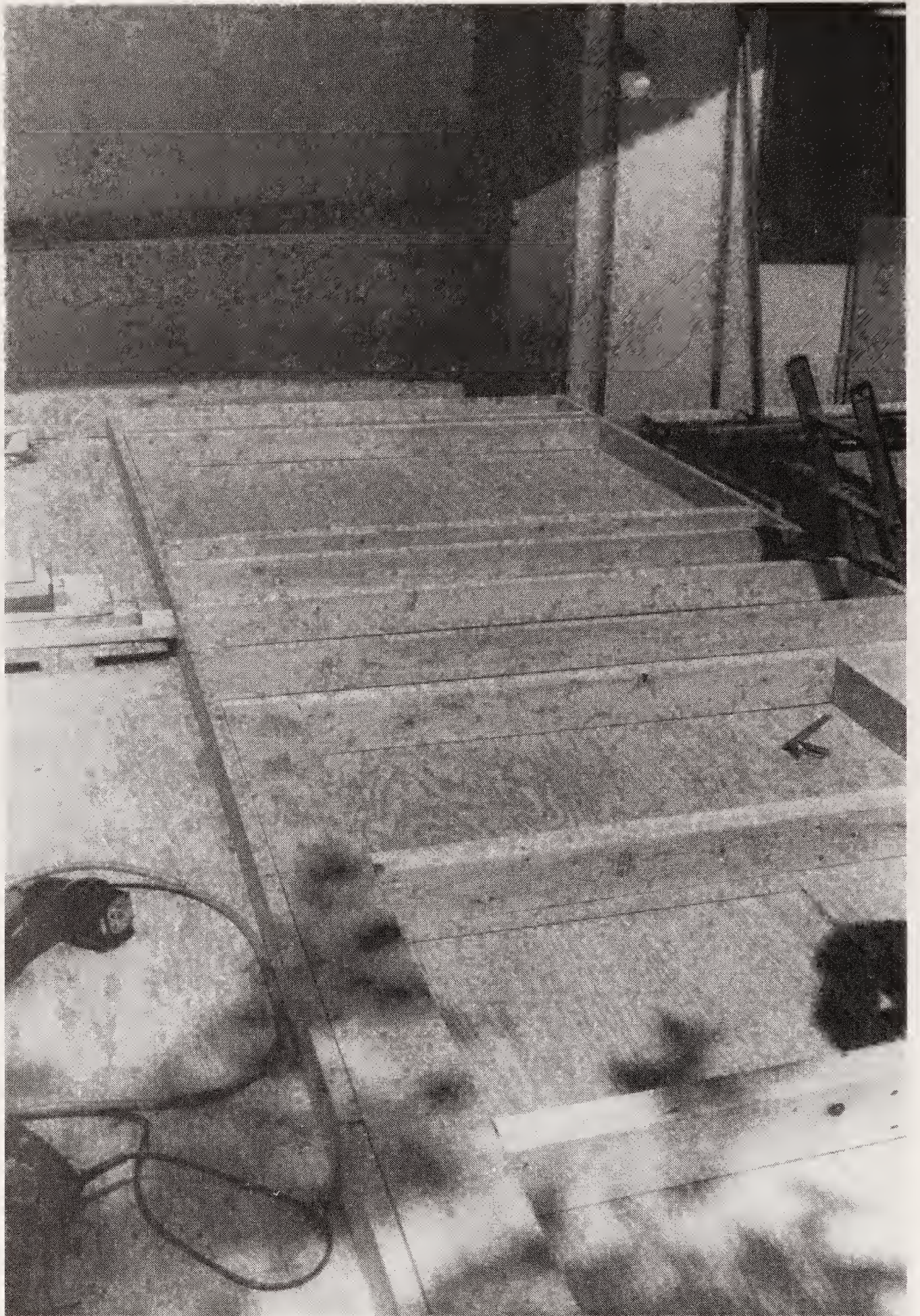
Once the bottom plate is marked, use a hand square to copy those indicators onto the top plate.

In addition to marking stud locations, you must also mark for windows and doors. Naturally, full studs cannot occupy spaces reserved for window and door openings. You will have to install headers across these openings, which must be supported on both sides by regular studs and under each end by their own studs, called *cripples*. Since you will be installing two cripples under headers—one at each end—account for cripple width (1½ inch plus 1½ inch) when you determine header length. See next page.

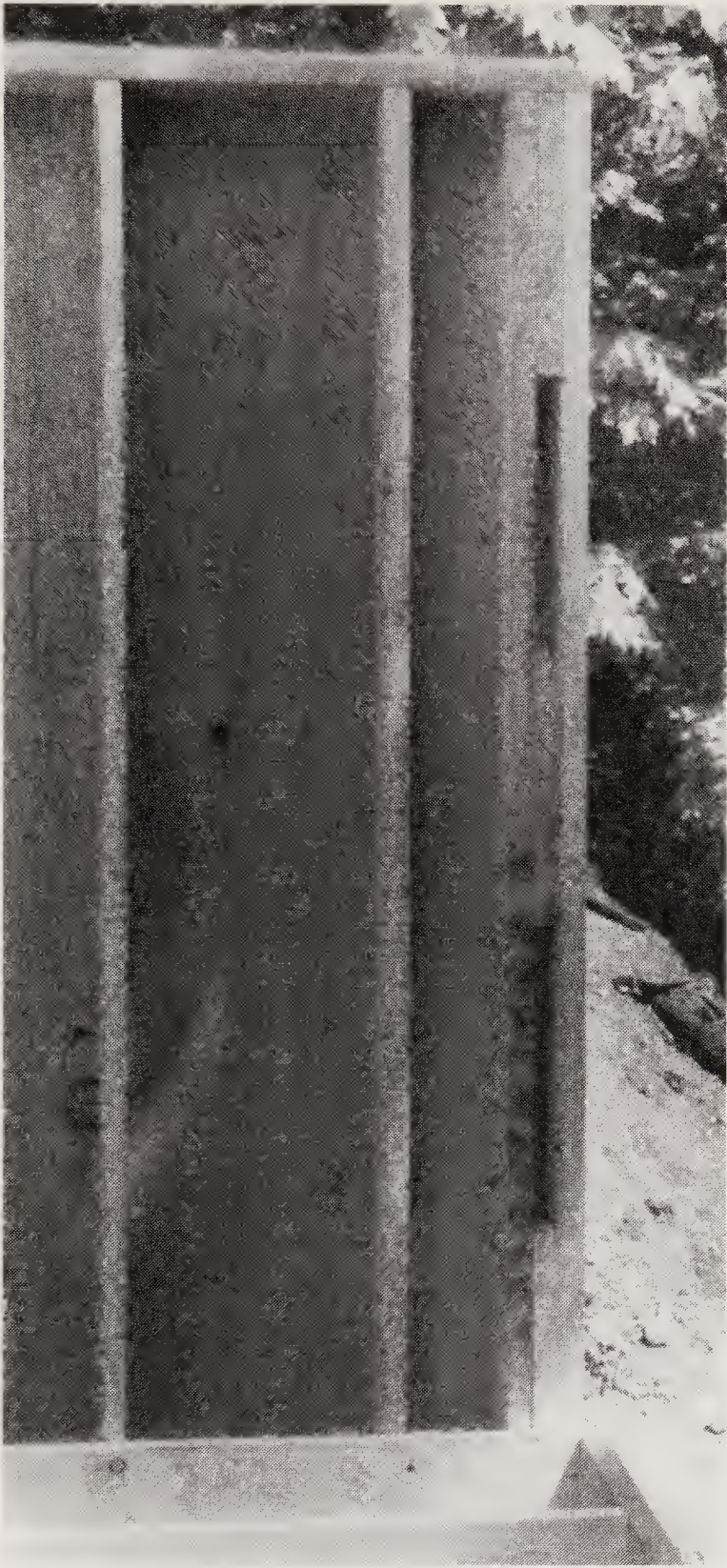
In other words, if you want your door opening to be 36 inches, cut its header to 39 inches. This way, once cripples have been placed under each end of the header, the opening will be 36 inches. Always account for cripple width when you lay out walls with scheduled window and door openings.

Along with studs placed on 16-inch centers and openings made for windows and doors, plan for the installation of additional studs at wall ends and spots where other walls will connect. See left illustration on page 101.

Made to be used as a nailing base, the extra stud and three shorter 2×6 boards fastened at this upright corner offer a wide, solid surface to which a perpendicular wall end was nailed. Once the perpendicular wall was stood up, the end stud was nailed to the thick corner at the end of the upright wall. See right illustration on page 101.



Similar stud placements are required for interior walls that will connect to exterior walls. An interior wall was built to connect at this junction. Since the interior wall was made of 2x4s, a single 2x4 stud was positioned flat at the inside edges of two



regular 2×6 studs. All three studs were nailed together and then inserted in this wall as it was framed on the floor. The extra stud surface provided on each side of the flat 2×4 served as nailers for the drywall. Drywall and other structural wall coverings must have solid bases at all corners in order for their edges to be nailed or screwed securely in place.

After studs, headers, and cripples are nailed and secured between top and bottom plates, it is time to square the entire wall and prepare for *sheathing*. Generally, ½-inch CDX plywood,

Wall sheathing

oriented strand board (OSB), or 5/8-inch T1-11 is used for small outbuildings. Although walls will be heavier to raise with sheathing installed, it is much easier to square walls while they are on the floor. Walls will stay square once sheathing is attached.

Use a string guide along the length of one plate to see where the framed wall might be misaligned. Use a sledge hammer, if need be, to pound plate sections into a straight line.

Check the alignment using the 3-4-5 rule at corners to ensure the wall is perfectly square. Another way to check for square is to measure diagonally across the wall. Measure from one end of the top plate to the far end of the bottom plate. Note that measurement. Then measure from opposite top and bottom plate ends. If the measurement is the same, the wall should be square.

Plywood on walls that are out of square will rest at angles to studs. You might also find that there is no stud surface available to support plywood edges. Wood-framed walls must be square before sheathing work commences.

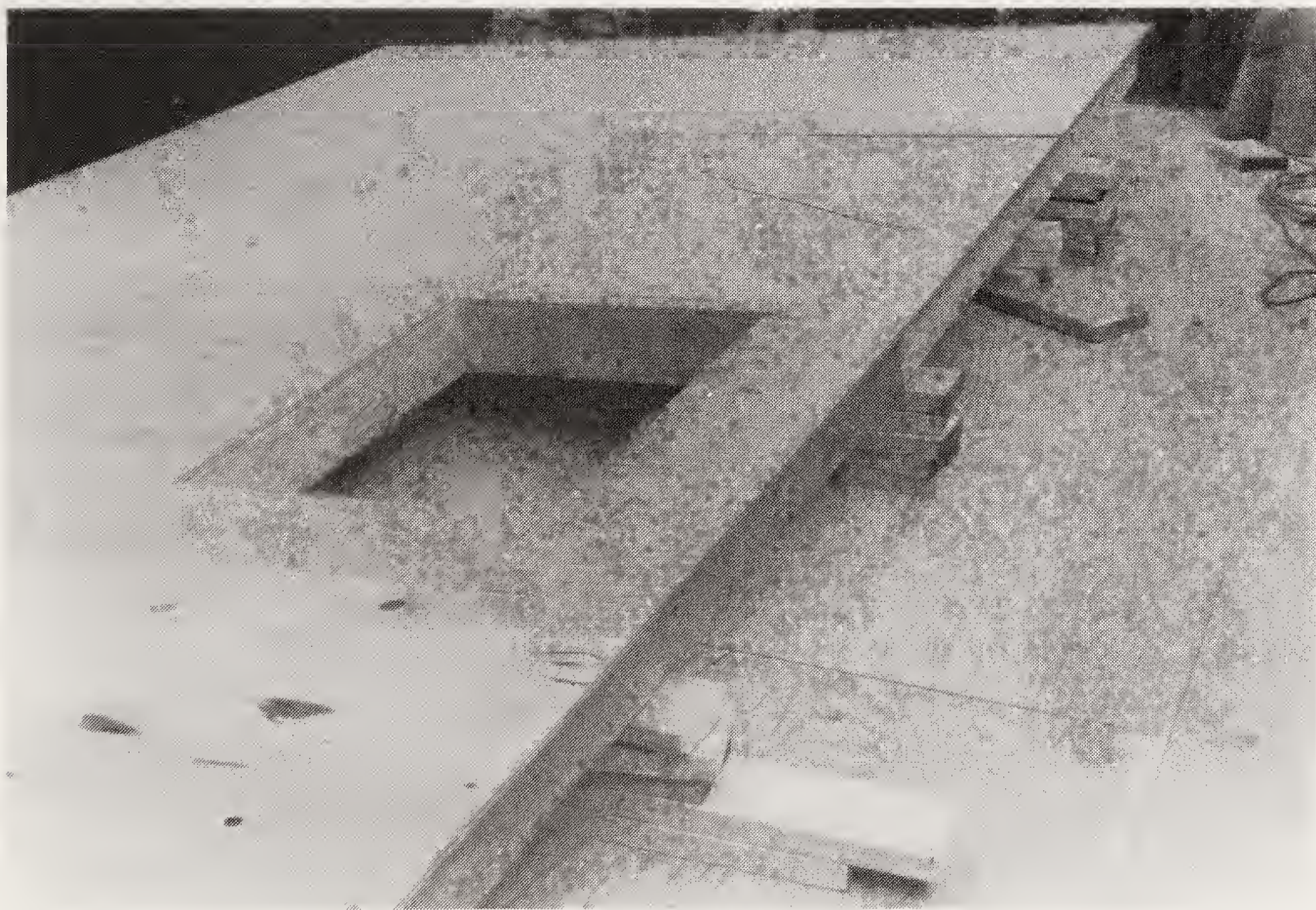
Fasten sheathing to studs with 8d nails or staples. Our Stanley Bostitch pneumatic stapler quickly secured sheathing, cutting nailing time by at least 80 percent. Be sure to read, comprehend, and follow all power-tool operating instructions.

Instead of trying to measure for and cut out sheathing sections that cover window openings, install sheathing first and then cut out those sections while the wall rests on the floor.

Insert your tape rule under the sheathing until it makes contact with a cripple. Note the measurement and mark it on the outside. Use a straight guide and pencil to mark straight lines that depict where cuts need to be made. Precise cutting is not mandatory for this exercise. You can trim away excess sheathing later with a small cordless saw.

Raising walls

Raising wood-framed walls involves more than brute strength. More than once, people (even professionals) have lifted a bit too



hard, which caused the wall to fall over on the opposite side of the foundation.

A large pry bar was used initially to raise up this wall so blocks could be placed under the edge. Blocking walls like this makes room for people's hands to reach under and gain satisfactory grips. See bottom of previous page.

If a new-construction wall will be attached to an existing house wall, properly prepare the section of the existing wall. In many cases, this entails cutting away eave sections and sheathing.

Before you cut the sheathing, check for possible electrical outlets, wiring, or pipes that might be located behind the sheathing. Check for and remove nails or staples in the path of your saw blade. Adjust the blade depth of your saw so that it cuts the sheathing and nothing behind it.



One of the handiest tools for this type of procedure is a Makita reciprocating saw. Tough steel cutting blades are capable of cutting through wood as well as some nails. Notice the nailing block installed at the corner of this existing wall. A new wall end was secured to it.

Plan to have plenty of helpers available for wall raising activities—the more, the better. Expect to need one person for every 5 feet of wall: six folks for a 30-foot wall, five for a 25-foot wall, and so on.

Once a wall is up, maintain a firm grasp on it so it doesn't lean in or out. Once it starts to fall over, it is difficult to regain control.



Have helpers nail 2×4 braces between the wall and stakes, which have been securely driven into the ground outside of the foundation. For new walls raised on wooden subfloors, nail small blocks to the floor and then secure wall braces to them.

Before you secure a new wall to mudsill anchors or nail it to the wooden floor, adjust it into position. Use a sledge hammer to persuade the wall into position. Place a piece of scrap 2×4 or 2×6 next to the wall and hit it with a sledge hammer as opposed to smacking parts of the new wall directly. When the new wall is positioned perfectly, secure the bottom plates to anchors with strong-drive metal screws.

If you chose to use mudsill anchor bolts, drill holes in the bottom plates before the wall is raised. Lift the wall over them for positioning. To make this job easier, place long scraps of 2× material next to the anchor bolts and lift the bottom plate edge of the wall on top of them first. After the wall is raised, use pry bars and a sledge hammer to knock the blocks out of the way so the wall lowers over the bolts.

Getting two wall corners to meet flush against each other sometimes requires more than simple pulling or pushing. These Quick-Grips did an outstanding job of pulling these two wall corners together for adjusting and nailing.



With Quick-Grips holding this corner together, just slight hammer taps were needed to complete final plumb adjustments. Once the level read plumb, the corners were securely nailed together with 16d nails.

Making walls straight

Even with wall ends secured plumb and square, inner wall sections might remain crooked. Straighten them with 2x4 braces and install a second top plate.



A second top plate will not hold the wall straight by itself, you need 2x4 braces, too. Notice that a Quick-Grip was used to help a top plate line up with the wall, and that wall braces are visible at the door and window openings. Be sure your Keller ladder is positioned properly and securely before you climb up and work off it.

After the second top plate is nailed in line over the first top plate, string a line across the top of your new wall. Nail pieces



of scrap 2× material at each end to hold the string 1½ inches away from the wall.

Use another short piece of 2× material as a guide to check if the wall is straight. As need be, adjust wall braces to push or pull

the wall into a straight position. After all braces are nailed to the wall and opposite end supports, check for wall straightness one last time to be sure the entire length is totally straight. Once walls are straight and securely braced, proceed to roof or second-floor construction projects.

Although prefabricated roof trusses are capable of spanning great distances without middle support, there are times when extra support is required, such as stick-framed roofs designed to accommodate attic storage space or the addition of second-level working or living space.

Extra support for upper structures commonly calls for post installations at bottom-floor levels. Although structurally strong, posts in the middle of a large workshop are not always regarded as assets. In lieu of post support for medium-size beams, consider installing a glue-laminated beam. *Glu-Lams* are heavy-duty beams made from numerous dimensional lumber sections that have been milled perfectly flat and then glued together. Lumberyards are equipped with charts that describe which size Glu-Lams are appropriate for specific open spans.

This Glu-Lam spans an opening in the middle of our new first-floor workshop. Numerous 2×6 studs were positioned below to support this Glu-Lam end. In addition, a Simpson Strong-Tie metal connector was screwed to the Glu-Lam and existing house wall. Metal connectors run the full width of the Glu-Lam on both sides and two more 2×6s were used to fill the void between those 2×6s already supporting the beam.

Supporting units for Glu-Lams generally are required to be fully filled with stud material to maximize support.

Glu-Lams are very heavy. You will need lots of helpers to install them. The opposite end of this Glu-Lam was first raised into position and secured with blocks. Then the end was lifted onto the adjacent window sill. It stayed there until sufficient ladders were positioned so that helpers could raise it up to the top of

Glue-laminated beams





the wall at an angle to its resting place. It had to be raised at an angle because the end of it fit flush with the outside part of the wall.

Once the Glu-Lam was on top of the wall, it was scooted over until it fell into the support notch. After we checked this wall for overall straightness again, the Glu-Lam was secured in position with 16d nails from a Campbell Hausfeld power nailer and then Simpson connectors. Building codes generally require such strong Glu-Lam support.

Second-level floor framing

Floor joists are placed on top of walls and then run to other supports to form a framed-floor area. Joist sizes are determined by how far they span. Lumberyards generally have charts that specify the required sizes according to the building code. Builders

use 2× dimensional lumber for joists or newly developed I-joists that consist of solid wood top and bottom plates connected in the middle by upright strips of plywood or OSB.

Extra-wide I-joists could have spanned our entire workshop, without the need for a Glu-Lam. However, it was important to maintain an 8-foot-3-inch ceiling for this workshop and the only way to do that was with 9½-inch-wide I-joists, which were too small to make that long of a span without a Glu-Lam support. Therefore, a Glu-Lam was installed in the middle of the space and outfitted with Simpson Strong-Tie hangers placed on 16-inch centers. The I-joists sat on and were secured to these hangers on one end and then rested on top of the wall at the other.



These Simpson hangers were made specifically for I-joists. Other types are available for all sorts of applications. A flange at the top of the hanger rests on top of the Glu-Lam. Each unit is outfitted with holes for nails or screws.

A rim joist must be installed along the outer edges of exterior walls to which the ends of joists are nailed. Rim joists are toe nailed initially to top plates and then nailed to joists as they are placed in position.



Toe nailing refers to the installation of nails at an angle as opposed to straight into wood. A block placed on the opposite side of a toe nail operation helps keep the wood in place as it is nailed. You can also start the nailing process with a board off its mark toward the nail, so as hammer hits continue to drive nails, the board is moved into position.

Should a toe-nailed board be forced away from its intended mark, simply drive another toe nail in from the other side to beat the board back into position.

Connecting walls

Interior walls are connected to exterior walls by way of nailing blocks. In addition, a section of the second top plate on the interior wall should extend out and onto the first top plate of the exterior wall.



A section of the exterior wall's second top plate was cut out to accommodate the interior wall's second top plate extension. This element adds stability to interior walls and corners. The same thing was done for exterior wall corners. One of the second top plates extended over and on top of the other wall's first top plate.

If an interior wall is built to support roof structures before connecting walls are built, leave a section of the second top plate sticking out so it will be able to rest on top of the new wall's first top plate.

An intersecting interior wall will be built later. Its first top plate will fit under the extension of this wall's second top plate. See next page.

All walls must be adjusted plumb before being nailed into position. An easy way to accomplish this without a second pair of hands is with Quick-Grips. Use Quick-Grips to hold your long level in place while you move the wall back and forth into a plumb position. Once plumb, securely nail the wall to top and bottom supports with 16d nails.



Roof, window, & door framing

TO AVOID WOOD-FRAMING MISTAKES AND THE NEED TO tear apart sections incorrectly put together, you must understand just what it is you are trying to accomplish. Grab a scrap of wood and start making drawings on it. Carpenters often pencil out drawings or dimensions on pieces of wood or rough-framing components to use for reference.

Remember, measure twice and cut once. This is as true for professionals as it is for do-it-yourselfers. When it comes to laying out plates for the inclusion of door and window openings, make sure rough openings are made according to window and door specifications. Rough openings will generally be $\frac{1}{2}$ to 1 inch wider than finished window and door sizes. These specifications differ from company to company. You must know ahead of time which window and door products will be installed to ensure the rough opening specifications are correct.

The top parts of all window and door openings must be outfitted with a header. These small beams range in size from 4×6 to 6×12, depending on the span they will support. Charts and tables are available at lumberyards, from books at the library, and in all building codes.

Our exterior walls were framed with 2×6s. Window and door headers were 4×8s. In order to make headers thick enough to fill spaces between 2×6 studs, each was outfitted with a piece of $\frac{1}{2}$ -inch plywood and a 2×8 nailed to one side. Since 2×6s measure $5\frac{1}{2}$ inches thick, our header designs resulted in identical widths: $3\frac{1}{2}$ -inch header thickness plus $\frac{1}{2}$ -inch plywood plus $1\frac{1}{2}$ -inch-thick 2×8 equals $5\frac{1}{2}$ inches.

Windows

At window bottoms, plates were installed to serve as window supports. Although many installations might require only single plates, we opted for doubles for additional strength. Our plates were made from 2×6-stud stock. They each have three nails driven in from the side and are supported underneath by *cripples* (short studs) on 16-inch centers.

Full studs were placed on each side of the headers. These were in addition to those studs placed on 16-inch centers. Once headers were nailed in place, side support cripples were cut to the length called for in the rough opening specifications. The header length (plus 3 inches for cripples) made up rough opening horizontal spans; side cripple lengths determined vertical, rough opening dimensions.



Bottom window plates are positioned under header cripples, as seen here. Note that both the header and window plates were cut to the same length and that the header extends over the top of this side's cripple. Cripple studs under the window plates were installed on 16-inch centers in line with the rest of the studs for this wall.

Framing windows is no different than framing solid walls. You just have to know and understand that rough opening window sizes are crucial. Made too small, windows will not fit. Too big an opening will require extra shim and trim work during the window installation. Make all necessary measurements on plates before you nail together studs, headers, cripples, and plates. Be certain the pencil marks you make on these pieces of wood are accurate and understood by everyone involved in the framing project.

During wall-sheathing work, take time to cut away sheathing from window openings. It is much easier and safer to accomplish this task while walls are flat on the floor.

Should you make a slight error when cutting away sheathing over window openings, don't worry. Excess sheathing material is easy to trim later, after walls have been raised and secured.

Workshops and outbuildings must be weatherproof before windows are installed, especially beautiful Eagle wooden windows. If not, water will stain window wood and ruin an otherwise perfect finish. Once your roof is covered with shakes or shingles and all walls are sheathed, windows can be installed.



Building paper was applied around this window opening in preparation for the window installation. All window openings must be covered with building paper or another moisture barrier before windows are installed. Staple building paper in place and wrap around inside cripple faces.

Windows are equipped with *nail fins*—metal or plastic flanges through which nails are driven to secure windows to their opening frames.

Most professional carpenters and window people recommend that you don't nail top nail fins to headers. This is because headers tend to sag a little as time goes by. Should windows be nailed to sagging headers, pressure would be applied to the window glass by the nail fins.

Nail fins are attached to window units in different ways. Some feature fins as part of metal window frames. Others, like Eagle, rely on vinyl nail fins that snap solidly into place.

Every window should come packaged with installation instructions. Read them. Follow recommendations as they relate to installation adjustments, fastening, and sealing for best all around results.

Doors

Outbuilding doors generally should be wide enough for easy access with wide objects, like summertime outdoor furniture, bicycles, wheelbarrows, and so on. Door designs might be made to reflect barn-like features, or can simply be made with 2×4s and T1-11.

Larger outbuildings expected to hold more and bigger things might be best served with double doors.

For maximum security, you might even consider metal roll-up doors. Metal doors are available through some lumberyards, home-improvement centers, and regular door manufacturers. As opposed to simple hinges, roll-up doors have special tracks attached to inside door frames. Door tracks continue along the ceiling for a distance equal to door height. This might hinder some upper storage areas and block ceiling lights, so be sure to plan for this feature when you design your structure.

Large wooden sliding doors do not require open room in front of them as do hinged doors, nor will they hinder ceiling space when opened like roll-ups. Workshops can be set up with one or more sliding doors to accommodate different working bays.

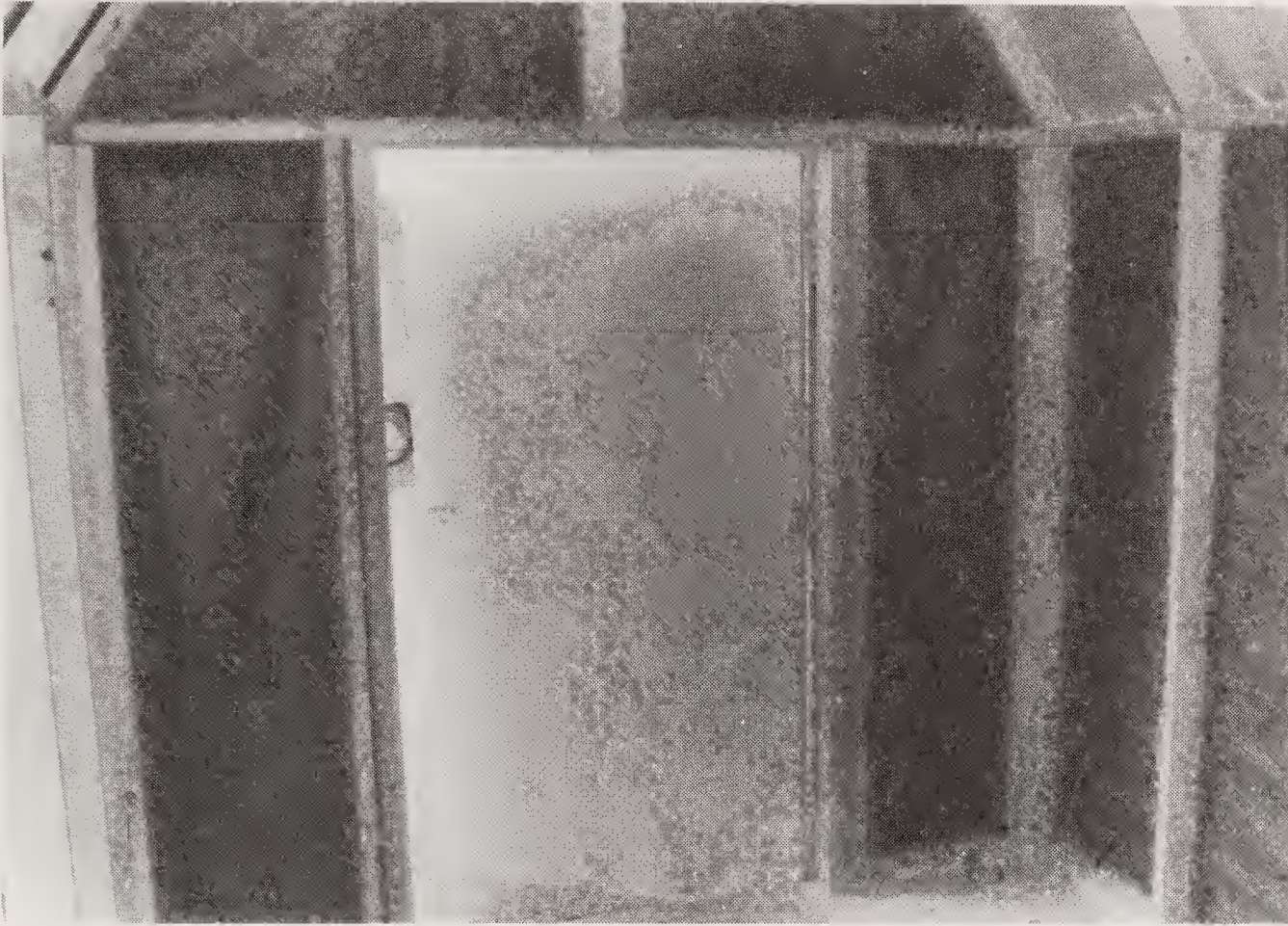


Sliding-door hardware is mounted to the top of the doors with a system of guides at the bottom to keep the lower ends from swaying in and out of position. The workshop featured on page 120 has two sliding doors with a support built between them. Hardware on the outside is for the door on the right. The left-hand door's hardware is mounted inside.

Many workshop and outbuilding doors are constructed with 2x4s and plywood. A 2x4 frame is built and secured with plywood attached either inside or outside, depending on the design. See photo at top of page 121.



Plywood covers the inside portion of this door so that 2x4s on the outside could be patterned like those on barns. Three sturdy hinges keep the door in place.



Hinges must be secured to solid studs in order to hold up under continuous use. This outbuilding door features two 2×4 studs close together next to the door opening. They add support to the top plate, which will be strained by door movement because the hinged stud is nailed to it.

Swinging doors require stops on frames so that doors have something solid to close against. Without stops, doors will be forced too far into structures, eventually damaging hinges and/or their supports.

Wall framing for door openings must take into account door width and height. As with windows, rough openings are provided with door models. Be sure to have doors selected before framing begins to ensure the openings made for them are dimensionally correct.

Bottom plates in door openings are left in place during the framing process. To cut them out before walls are stood up would greatly reduce an entire wall's stability. Cut out the bottom plate sections after walls are raised and completely secured in position. You can, however, make small *back cuts*

along the bottom sides of the plates to facilitate later cutting and removal.

Back cuts only need to go into the wood a short way. They are installed so that a saw will not have to be operated down to a concrete foundation or floor surface to cut out the section.

Framing for doors and windows is basically a standard operation. The only difference between one structure and the next are the rough openings for various styles of window and door products.

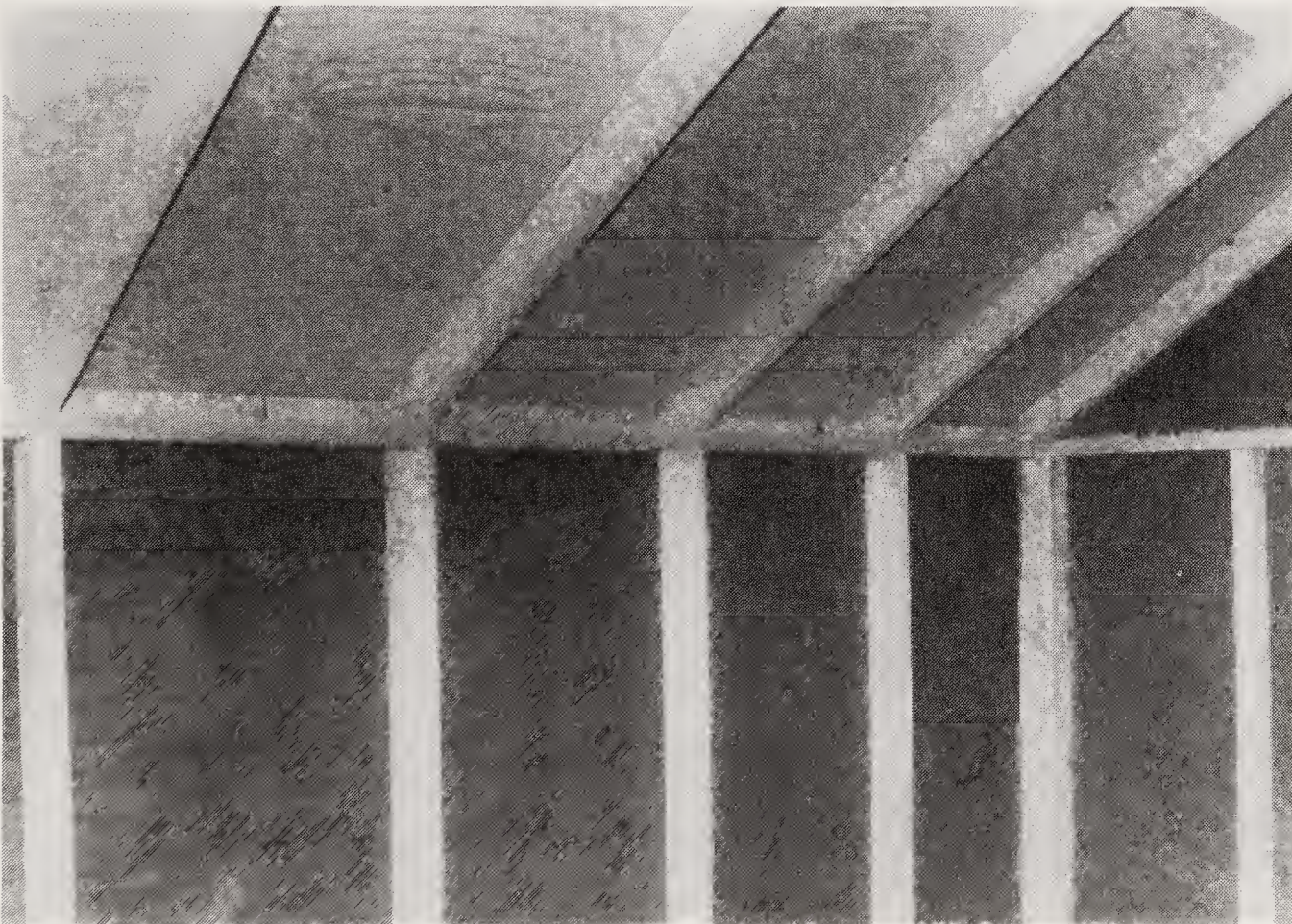
Roofs

Workshops and outbuildings generally feature simple roof designs. Although intricate variations of various peaks and valleys might look good for some applications, trim pieces painted different but complementary colors can make simplicity stylish.

Gable roofs are very common. A peak in the middle supports rafters that run down and rest on top of the outer walls. This outbuilding features a gable roof with rafters that were secured together at the top with plywood *gussets*—pieces of plywood nailed to both sides of the joint (see top photo, opposite). *Roof pitch*, or *slope*, is described as how much a roof falls per 1 foot of horizontal run. A 5/12 pitch means that in 12 inches of horizontal space the roof drops 5 inches. A 4/12 means the roof drops 4 inches per 12 inches of horizontal run.

It is the angle at which a rafter end is cut that determines how much pitch a roof will have. To determine that, you will have to study the instruction booklet that accompanies your speed or roofing square.

Rafters can run free past the tops of outer walls to form eaves, or they can be cut flush with walls. The rafters for this small outbuilding were cut flush with the outer walls and a small section of plywood roof sheathing was allowed to extend past the wall to form small eaves. Plywood siding extended up past the top of this exterior wall to butt against the roof sheathing. This prevents entry by birds and other small animals. On larger structures, 2×4 blocks should be installed between rafters on top of exterior walls (see bottom photo, opposite).



Roof-peak ends naturally sit higher than eave ends. Most of the time they sit higher than 8 feet. Since the vertical distance from wall bottom to top at those ends will exceed plywood lengths, install an additional piece of plywood. At the point where both

the top and bottom plywood sheets meet, install a 2×4 to serve as a nailer. On the outside, install a 1×4 to cover the seam. Caulk the gap between the top of the 1×4 and plywood to keep rainwater from seeping inside the plywood siding.



Mansard roof rafters require more work to cut and place. You have to decide at which angles rafter ends will be cut in order to end up with specific pitch as it relates to actual building size. Again, read the booklets that come with your speed or rafter squares.

In lieu of trying to figure out rafter end cuts for mansard and other styles of roofs by yourself, consider using any number of outbuilding plans available through the Western Wood Products Association (WWPA) and American Plywood Association (APA).

Skylights

Installing skylights or roof windows on a new roof is easy because the rafters can be cut and braced before installation.

NOTE: Roof truss manufacturers recommend that prefabricated trusses not be cut unless a truss engineer



has designed a specific blocking plan to accommodate the loss of structural strength developed when members are severed.

Regular stick-framed rafters that are installed individually may be blocked according to skylight and roof-window directions because rafters are almost always made of larger material than trusses. If you are in doubt as to whether your roof is trussed or stick-framed, simply look for familiar nailing plates. All wood trusses are equipped with nailing plates at every point where two boards intersect. Stick-framed rafters will not be outfitted with such nailing plates.

Prefabricated roof trusses are quick and easy to install. All you need to do is give a truss company the dimensions of your structure (spanning width from outside wall to outside wall) and the pitch desired. Their engineers will design a truss system for you and deliver the trusses to your job site. Trusses cost around \$100 each, depending on size.

Prefabricated roof trusses



Trusses are characterized by the familiar nailing plates attached at each point where two or more framing pieces meet. Units like these offer a great deal of roof support, but very little room for attic storage. If you want a great deal of attic storage, be sure to tell the truss company. For an extra fee, they will

design trusses that feature attic storage. These trusses will cost more because larger dimensional lumber will be required.

Numerous framing members cut at different angles and positioned according to an engineer's specifications work together to form a solid roof structure.

Since trusses are designed to span wide distances without support in their middle sections, interior walls constructed under them are not required to be of the bearing type. Therefore, footings do not have to be poured under them.



Interior walls are nailed to trusses to help walls stay straight and securely anchored. Be sure lower truss members are maintained on 2-foot centers in line with their other parts when you nail them to the tops of interior walls.

Be alert to the nailing plates located on trusses. These pieces of metal feature lots of pointed projections on the opposite sides of noted slots. Some plates might have exposed edges and points.

Nailing plates are pressed on with machines. Since pointed projections only penetrate a short distance, nails are also inserted to bolster holding power.

Trusses are delivered to job sites on large trucks equipped with booms. On delivery day, be sure you provide plenty of room for the truss truck to maneuver. Optimally, trusses should be lifted and placed on top of new-construction walls. Lifting each one by hand is labor intensive work, especially when you realize that trusses are very weak in any position other than vertical.

Stay out from under trusses as they are lifted and moved into place. Have someone direct the boom operator to gently lower the trusses onto the walls if the job site is out of his or her view. Hold your hands vertically apart equal to the distance from wall tops to trusses to give the operator an idea of the remaining distance.

Once trusses are set on top of walls, loosen the chain around the load. Do this cautiously to avoid mishap. Once free from the chain, secure the truss bundles with a few pieces of wood. Nails should be partially driven through wooden pieces into each and every truss.



Trusses must be secured in a bundle by way of wood and nails before the metal bands that secure them together are cut. In addition, long 2×4s should be positioned as braces to help keep trusses upright and secure.

Boards both in front and back will help keep the trusses upright. Move the board in front each time a truss is walked out to its position. As one worker on top of each wall carefully walks trusses out to position, another should stabilize each truss by nailing a long board to it.



The truss shown here is a *gable end*. It sits at the outer end of the roof and is designed to support sheathing and siding. Gable-end trusses are toe nailed into the top of the wall with their outside edges in line with the outside edge of the wall.

Notice that Quick-Grips help to snug the bottom end of this gable truss to plywood sheathing that extends up and over the top of the wall. Truss ends that rest on top of side walls are toe nailed into place. Drive nails through openings in nailing plates.

Once a gable-end truss is set in its prescribed position, other trusses are set away from it on 2-foot centers. To help determine those spots, trusses are placed against blocks.



Truss blocks can be solid or have ventilation holes. Building codes require minimum amounts of ventilated blocks, although some people believe all blocks should be of the ventilated type. Wire screens cover vent holes to prevent access by birds and other small animals.

Trusses are toe nailed to the tops of walls; blocking is toe nailed to the trusses. In addition to nailing with 16d nails, many local building codes also require metal hangers for additional support. Simpson Strong-Tie Company offers truss hangers for every application. Determine the types and numbers of hangers required for your job by consulting your local building department or the truss manufacturer.

Eaves are the extension of roof rafters or truss ends. They can be covered with plywood on the top and by a *facia* board over the ends.

Eaves



Many folks prefer to box-in eaves—install wood underneath so the projection features a flat surface with no visible rafters. On this tall workshop structure, in addition to the eaves, notice the strip of flashing inserted horizontally a few feet below the eaves. The strip was installed at the point where plywood ends meet. It is employed as a sealer to keep water from seeping inside the wall.

At the peak end of roofs, a different set of eave projections must be installed. The assembly is called a *barge rafter*.



The 2x4s were nailed from the inside through the gable-end truss or rafter. Plywood placed on top also extends 2 feet in and is nailed to the first truss or rafter just inside the gable end. It is the plywood that gives strength and support to the 2x4s that extend out.

Other designs call for 2x4s to be laid flat. Gable-end rafters are notched so that 2x4s can be nestled inside them. The 2x4s are nailed to the first rafter in from the gable end, and also the gable-end rafter.

Boxing in eaves looks nice and also reduces the amount of paint work that will be needed on them because rafter ends do not have to be painted on three sides. If you decide to box in the eaves on your workshop or other large outbuilding that is equipped with ventilation blocks, be sure to install vents along the bottom of the eaves.

Roofing & siding

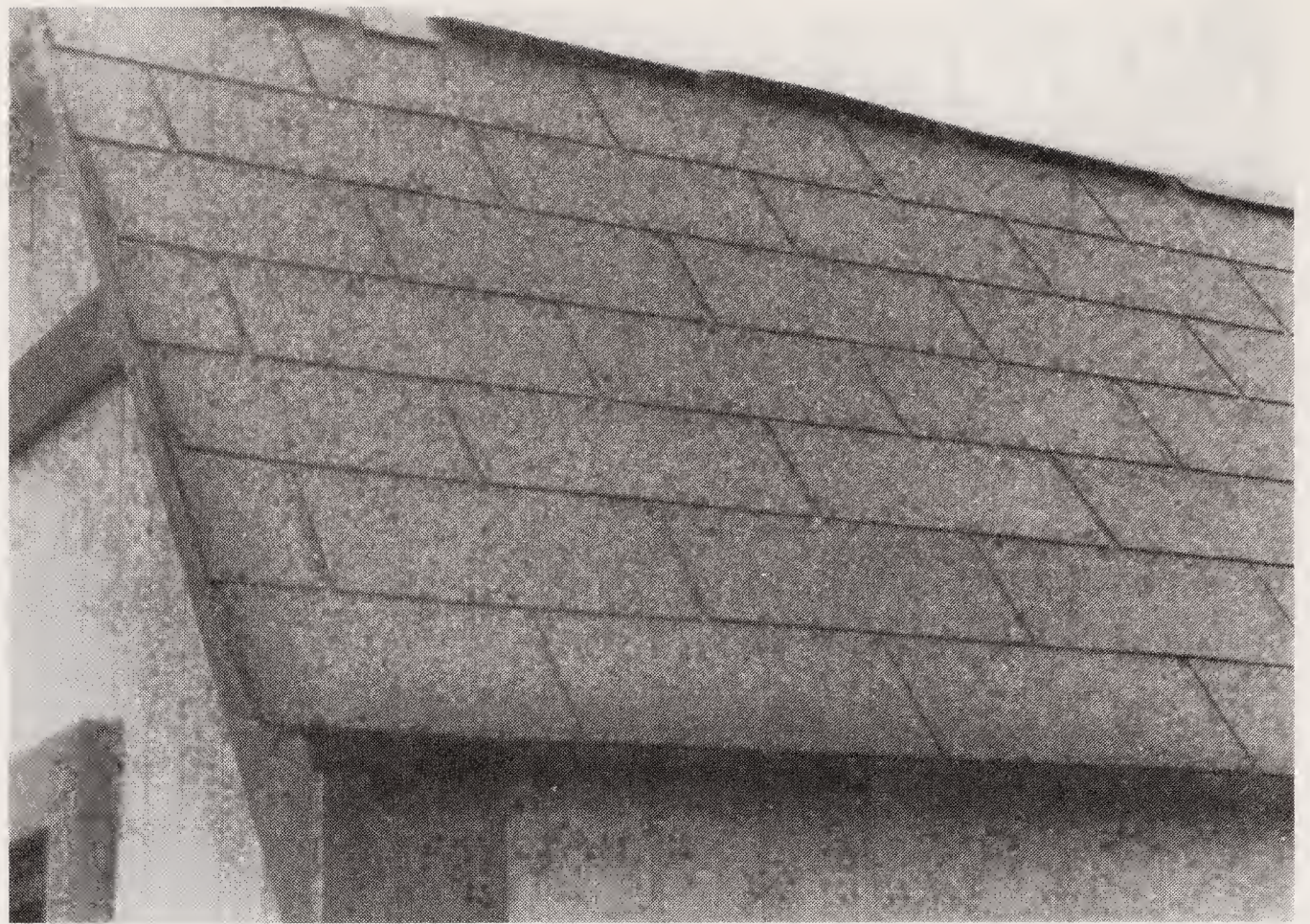
A LARGE VARIETY OF ROOFING AND SIDING MATERIALS ARE readily available from lumberyards, home-improvement centers, roofing companies, and other outlets. You are encouraged to visit one or more of these retailers to learn about all that is available to you. For the most part, new-construction projects built near or added onto existing structures should be outfitted with materials that match. Unless, of course, you plan to remodel the existing structure.

Some available roof coverings are asphalt shingles, asphalt with fiberglass shingles, rolled roofing made of the same material, a combination of cement and wood fibers, cedar shakes, cedar shingles, concrete tiles, and more. Concrete tile roofs require extra support because of their weight. Other roof coverings are generally acceptable on most normal roofs. For definitive information, talk to professionals at your local lumberyard, home-improvement center, or roofing supply outlet.

Shingles are installed on roofs from the bottom up. This is so rainwater and melting snow will flow down over the shingle edges onto the next course. A course of shingles is installed along the edge of the roof perimeter before the regular courses are started. This layer protects the ends of roofs that might not receive full coverage from horizontal courses.

The slots on these shingles (see next page) were lined up with each other all the way up this roof. Many experienced roofers believe these gaps should be offset to alter the course of the water that will run down them. This is a minor issue and one that frequently meets with disagreement. In areas that experience heavy rainfall, some believe that having gaps lined up like this helps to promote the growth of moss and mildew. On the other hand, the uniformity looks nice.

Roofing



Asphalt shingles are somewhat pliable, especially during warm weather. You can maneuver them into position on top of carport awnings and other roof features.

Asphalt shingles frequently feature marked lines that indicate where the next course should be placed. Rolled roofing offers this same sort of guide. For appearance and service, shingles should be installed straight across. Secure asphalt shingles to the roof with short galvanized roofing nails. The nails are galvanized to help guard against rusting, and short so that they do not protrude too far out under the sheathing. It will take practice to get these short nails started, so watch out for your fingers.

There is a difference between cedar shakes and cedar shingles. Basically, shakes are split to offer a rough texture, while shingles are sawn to appear smooth. Different installation techniques are required for various sizes and types of cedar shakes or shingles.

Place tar paper under or between layers of cedar roof coverings depending on the type of application. Regardless, courses are first

installed at the bottom and progress up toward the roof peak. Peaks are covered with *ridge caps*—special units that angle down on both sides to ensure a gap is not presented at the very peak.

Cedar shakes or shingles can be nailed in place or attached with a pneumatic stapler. The stapler works a lot faster. Some cedar shakes or shingles will have to be cut to fit around vent pipes, vents, skylights, and other projections. About the handiest tool around for those chores is the Makita cordless circular trim saw. Its small blade is powered with plenty of torque to cut effortlessly through the cedar material.

The Cedar Shake and Shingle Bureau has volumes of material available about the benefits and installation of such products. If you are contemplating the installation of a cedar shake or shingle roof, seriously consider requesting additional information.

Siding selections for your workshop or outbuilding are as varied as your roofing options. Among your choices are plain plywood, T1-11 plywood in various designs, beveled siding, vertical tongue-and-groove, vinyl, aluminum, shingles, cedar panels, and so on. Visit your local lumberyard or home-improvement center to see firsthand what is available.

Siding

This outbuilding (see next page) is adorned with T1-11 5/8-inch-thick plywood siding. Its particular groove pattern is typical of most, although there are other groove patterns from which to choose. T1-11 is very popular and because sheets come in full 4×8-foot dimensions, they are quick and easy to install.

Numerous styles of siding are available in cedar. Boards generally are installed horizontally, though some are designed for vertical installations. Be sure to follow recommended installation instructions for best siding results. Galvanized siding nails are used because the heads are small and the galvanized feature helps prevent rusting.

Cedar siding is most often delivered in bundles. Pay strict attention when handling these boards because they are rather



thin and can split easily if dropped or twisted, especially when they are dry and the weather is hot and dry.

One end is slimmer than the other on beveled siding. Different types of beveled siding present variations of that characteristic. Again, the type of siding you select will determine the actual shape of the boards.

Wall sections located just below roof peaks are frequently sided with horizontal boards, even when the rest of the siding is T1-11 or of a vertical design. Boards running horizontally at this location are easier to cut and install.

The addition of 1×4 trim pieces on wall corners and around doors gives a flair to otherwise plain workshops or outbuildings. For plywood- and T1-11-siding jobs, trim pieces like these might help prevent wind-driven rain from creeping into corner spaces.

Paint these trim pieces a color different, but compatible with the rest of the building to accent their custom installation. See photo on next page.

For outbuildings, a simple 2×4 nailed to the bottom edge of the roof plywood and extending out from exterior walls will serve as a nailer for a fascia board. Consider filling nail holes with wood putty before you paint to put a perfect finish on your job.

Horizontal siding is normally butted up against 1×4 or larger, corner trim pieces. This alleviates problems associated with matching horizontal wood ends with each other and also makes for a more attractive siding job.

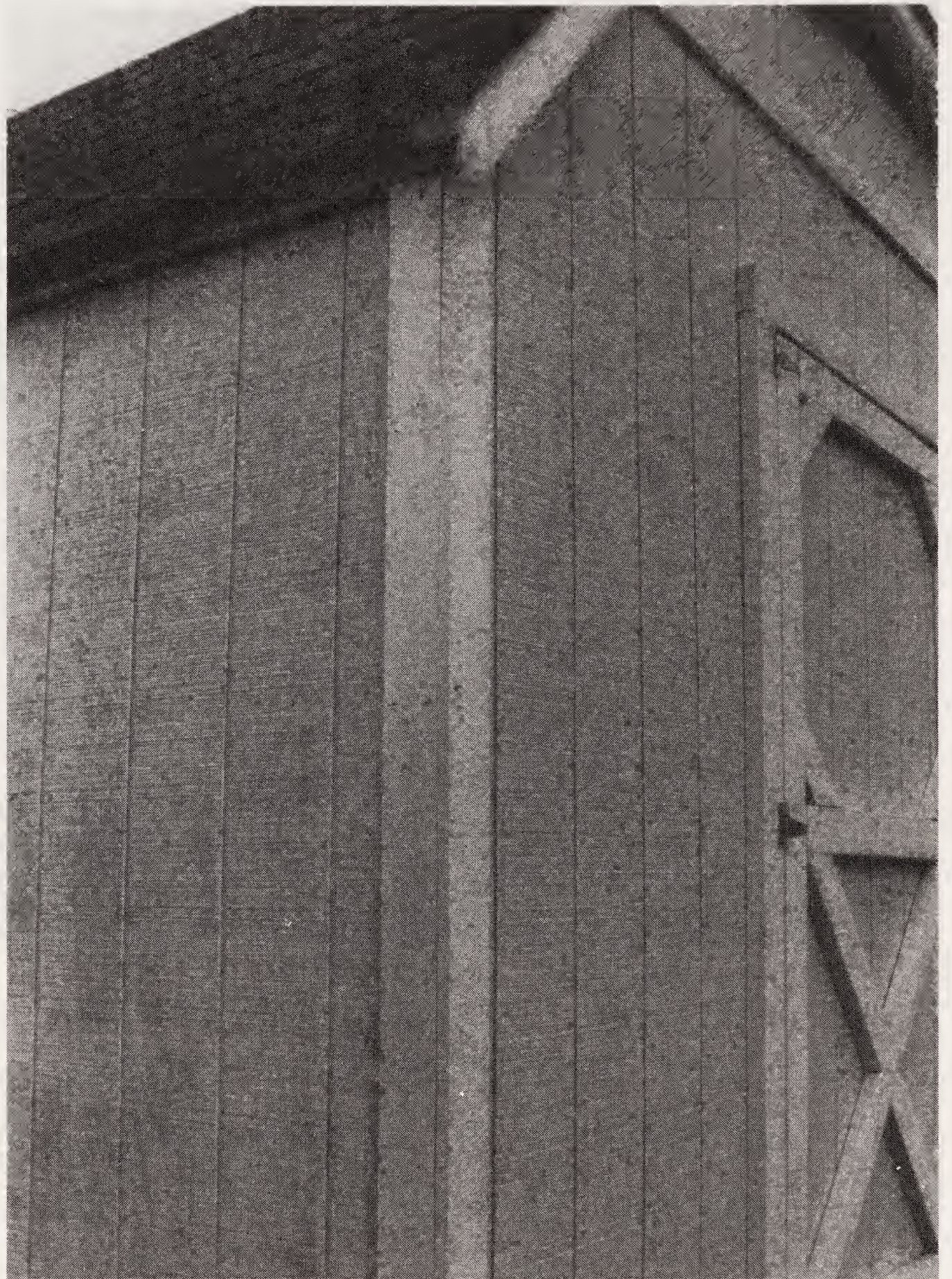
Once the job is complete, spread caulking in the gaps between horizontal siding boards and trim pieces to seal the area and prevent rainwater seepage.

Install all siding over building paper or another moisture/vapor barrier. Building paper generally features sets of lines that can be used as guides to position siding boards at a perfect horizontal level. Continue to gauge your work with a long level to ensure boards are installed symmetrically.

The type of nails used for siding jobs is important. Nails that are too big will split wood. If they are too small, their holding power might be less than adequate. The spots where nails are set is also important. Optimally, no nails—or at least very few—should be visible once the job is complete.



Clear, vertical-grain tongue-and-groove cedar siding calls for nails to be installed at an angle through the tongues, so that they are not visible nor interfere with the next board's groove. Once again, use galvanized siding nails with small heads. Non-galvanized finishing nails will eventually rust and large headed nails will damage tongues. Use galvanized 8d or 6d nails with regular heads to secure plywood or T1-11.



Sources

The following companies and organizations were selected to participate in this project because of the quality of their products and information, superior customer service, and proven performance. I have used or installed products from these companies and highly recommend them as a result of first-hand experience. You are encouraged to contact the following companies for further information and product catalogs.

Alta Industries
P.O. Box 2764
Santa Rosa, CA 95405
(707) 544-5009

American Plywood Association
P.O. Box 11700
Tacoma, WA 98411
(206) 565-6600

American Tool Companies, Inc.
P.O. Box 337
DeWitt, NE 68341
(402) 683-2315

Autodesk Retail Products
11911 North Creek Parkway South
Bothell, WA 98011
(800) 228-3601

Behr Process Corporation
3400 West Segerstrom Avenue
Santa Ana, CA 92704
(800) 854-0133

Campbell Hausfeld
100 Production Drive
Harrison, OH 45030
(513) 367-4811

Cedar Shake and Shingle Bureau
515 - 116th Avenue NE, Suite 275
Bellevue, WA 98004-5294
(206) 453-1323

DAP, Inc.
P.O. Box 277
Dayton, OH 45401
(800) 568-4554

DuPont Tyvek
Wilmington, DE 19880
(800) 44-Tyvek (448-9835)

Eagle Windows and Doors
375 East Ninth Street
Dubuque, IA 52004
(319) 556-2270

The Eastwood Company
580 Lancaster Avenue
Box 296
Malvern, PA 19355
(800) 345-1178

Empire Brushes, Inc.
U.S. 13 North
P.O. Box 1606
Greenville, NC 27835-1606
(919) 758-4111

Freud
P.O. Box 7187
High Point, NC 27264
(800) 472-7307

General Cable Company (Romex®)
4 Tesseneer Drive
Highland Heights, KY 41076
(606) 572-8000
Fax: (606) 572-9634

Harbor Freight Tools
3491 Mission Oaks Boulevard
Camarillo, CA 95008
(800) 423-2567

Keller Ladders
18000 State Road Nine
Miami, FL 33162
(800) 222-2600

Kohler Company
444 Highland Drive
Kohler, WI 53044
(414) 457-4441

Leslie-Locke, Inc.
4501 Circle 75 Parkway, Suite F-6300
Atlanta, GA 30339

Leviton Manufacturing Company, Inc.
59-25 Little Neck Parkway
Little Neck, NY 11362-2591
(718) 229-4040

Makita U.S.A., Inc.
14930 Northam Street
La Mirada, CA 90638-5753
(714) 522-8088

McGuire-Nicholas Co., Inc.
2331 Tubeway Avenue
City of Commerce, CA 90040
(213) 722-6961

NuTone
Madison and Red Bank Roads
Cincinnati, OH 45227-1599
(513) 527-5100

PanelLift Telpro, Inc.
Route 1, Box 138
Grand Forks, ND 58201
(800) 441-0551

Plano Molding Company
431 East South Street
Plano, IL 60545-1061
(800) 874-6905

Plumb Shop
A Division of Brass Craft
100 Galleria Officentre
Southfield, MI 48034
(313) 827-1100

Power Products Company (SIMKAR)
Cayuqa and Ramona Streets
Philadelphia, PA 19120

Simpson Strong-Tie Company, Inc.
1450 Doolittle Drive
San Leandro, CA 94577
(800) 227-1562

The Stanley Works
1000 Stanley Drive
New Britain, CT 06053
(800) 551-5936

Sta-Put-Color Pegs
23504 - 29th Avenue West
Lynnwood, WA 98036

Structron Corporation
1980 Diamond Street
San Marcos, CA 92069
(619) 744-6371

Weiser Lock
6660 South Broadmoor Road
Tucson, AZ 85746

Western Wood Products Association
522 SW Fifth Avenue
Portland, OR 97204-2122
(503) 224-3930

Zircon Corporation
1580 Dell Avenue
Campbell, CA 95008
(800) 245-9265

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