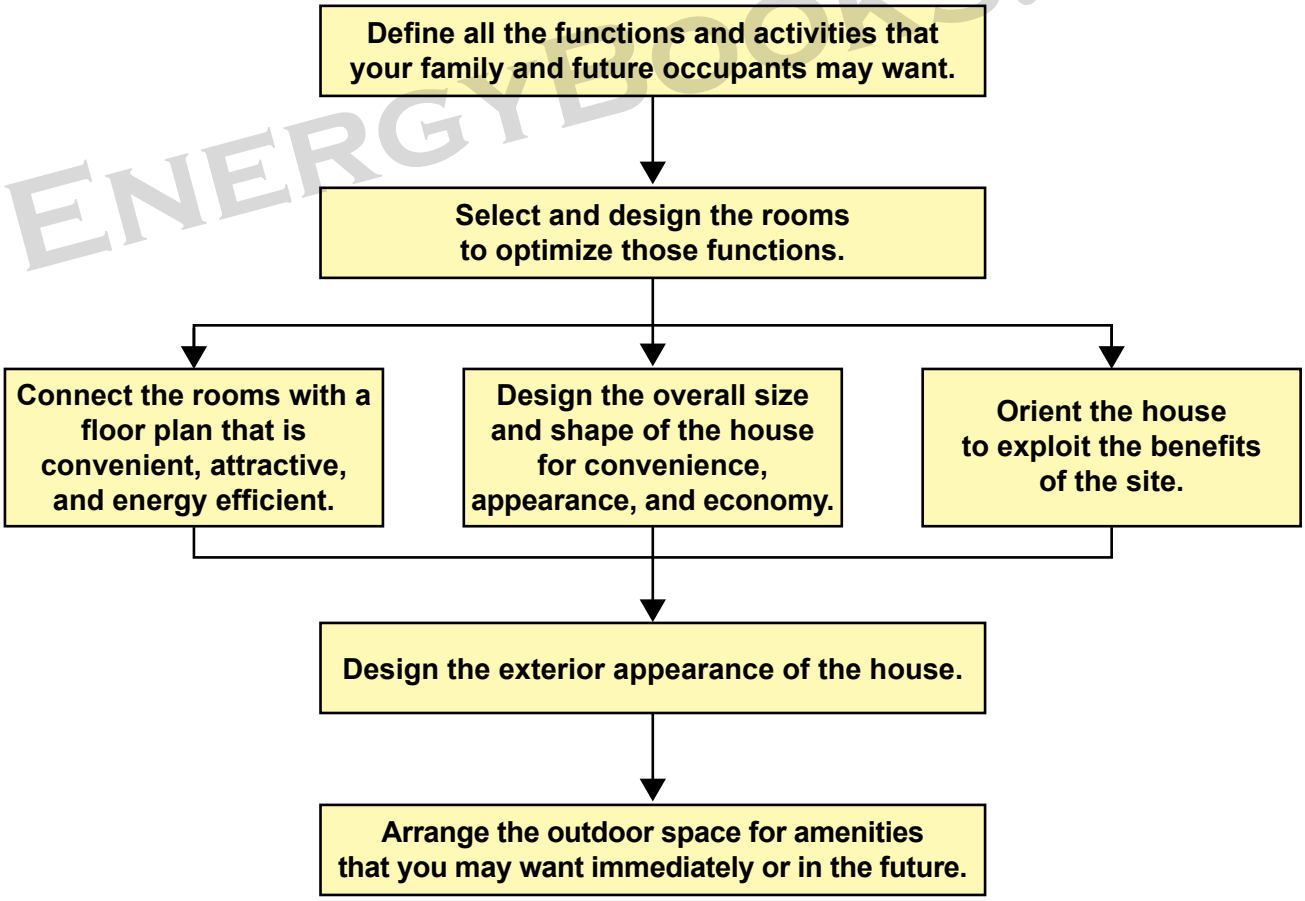
STEP 1

PLAN YOUR HOME'S LAYOUT AND STYLE

Step 1 is the broadest and most creative part of your design. We begin with a blank sheet and a vast range of choices. By the end of Step 1, the main visible features of your house – it's size, shape, room layout, and architectural style – will be complete. Your home will have the rooms and spaces to perform all the functions that you imagine. And, it will have a harmonious relationship to your property, your neighbors, and the surrounding environment. To organize this creative process as efficiently as possible, we will follow this sequence:



Design Your Rooms and Spaces

The room is the basic unit of living space. You live in one room at a time. So focus your first design effort on the individual rooms.

A common mistake of architecture is to begin a home design with the outer shell of the house, and then to use rooms to fill the house. Instead, design each room to contain all the functions that you want it to have. Only then, arrange the rooms into floor plans, and ultimately, enclose the rooms with the house structure.

Some rooms, such as the kitchen and the shower rooms, are defined largely by their special features. For such rooms, we will recommend features to consider.

And, we will learn how to enhance certain rooms to make them more useful and versatile, such as a "strong room" or a "cold weather refuge room."

In addition to the usual room types, we will suggest some less common types that may be valuable assets for your home.

We don't cover hallways or corridors here. We will design them later, when we connect the rooms to create your floor plans.

In the following, related types of rooms are grouped together, including their unusual variations.

Bisse Bowman

Figure 1-10. A classic canopy bed.

BEDROOMS

Let's start with bedrooms, because you will spend more than a third of your life in a bedroom for sleeping, dressing, and more memorable activities. For this reason, I recommend making all your bedrooms commodious. Also, bedrooms are important because they are the most numerous rooms in your home, occupying the largest percentage of floor space.

There's nothing really revolutionary to say about bedrooms. Don't make them too big or too small. Provide adequate space for dressing and for amenities. Provide space for a dresser for each occupant, unless you will have a separate dressing room. Every bedroom should have built-in closets of adequate size, about which we will say more.

Many houses have one or more "spare bedrooms," a term used to describe any room that does not have a specific purpose. A spare bedroom may become an office or a sewing room or a storage room. It is prudent to design each such room as an actual bedroom, including a full sized clothes closet. If a "bedroom" is used for almost any purpose other than sleeping, the closet will provide valuable storage.

Bedrooms that are actually used for sleeping by adults should be furnished with conventional beds. Bunk beds are suitable for children who are old enough to use the top berth safely.

To make large bedrooms cozier during cold weather, recover a technique from days of yore. The beds of prosperous people in cold countries included an insulated canopy and curtains on all sides. Such a bed is called a "canopy bed." Figure 1-10 is an example. This style provides an opulent appearance in any climate. For warm weather, the sides are removed to provide cooling air circulation.

If you have occasional overnight guests who exceed the capacity of your regular beds, you can use the following kinds of temporary or movable beds. However, these alternatives are all inferior to conventional beds.

- ***Sofa beds*** fold into the bottom of a sofa. Because of the compromises needed to make the mattress fold, sofa beds are notoriously uncomfortable. They may even injure persons with sensitive backs.
- ***Rollaway beds*** generally are narrow, with a thin mattress, to minimize storage space. The bed folds in the middle, so back support at the middle of the mattress is poor. Generally, rollaway beds are acceptable only for children and lightweight adults.

- ***Trundle beds*** have a flat mattress that is stowed underneath a taller bed on a low platform. The platform rolls out on casters, so it tends to mar the floor surface. The mattress usually is smaller than the mattress of the main bed. The trundle bed interferes with access to the main bed.
- ***Daybeds*** are small beds, typically with a twin size mattress, that have a back and arms to create the appearance of a deep sofa. A daybed typically is used as an item of furniture for a formal room. It is comfortable as a bed, but it is too deep to be practical for seating. A daybed commonly has a trundle bed or storage drawers underneath.
- ***Futons*** are mattresses that are laid on the floor at night and are rolled up for storage during the daytime. They can be comfortable for sleeping, with good firmness. However, they are difficult for elderly and disabled persons to use. The sleeper is forced to breathe dust and debris that rises from the floor surface. So, futons are best limited to houses where occupants remove their shoes before entering the house.
- ***Murphy beds*** are beds that fold up flat against a wall. Typically, they are built into a piece of furniture that looks like a wardrobe when the bed is stowed. A Murphy bed can use any kind of mattress without deforming it, but the mattress must be strapped to the frame. A balance mechanism typically is installed to ease lifting. Although comfortable when sleeping, a Murphy bed is awkward to use and it limits the layout of the room in which it is located. Murphy beds can be very fancy, costing as much as an additional bedroom. Generally, they are used in apartments that have limited floor space.

CLOTHES CLOSETS

Clothes closets typically are installed in bedrooms or dressing rooms. They can also be located elsewhere, primarily for seasonal storage of clothing. Each bedroom should have a closet of ample size. Maximize the width of the closet by having it span the entire inside wall, rather than sharing the wall with another closet for the room on the other side of the wall. *You can never have too much closet space*. A closet that is built into a bedroom is the least expensive type of storage space, and it is the most convenient.

Aside from size, the other important design issue for closets is avoiding mildew. (See the sidebar, *Defeat Mildew,* under the heading, *Limiting Humidity,* in Step 4.) Closets typically are cooler than the rest of a house because they have no heat sources, such as light fixtures or sunlight. This makes them vulnerable to condensation, which promotes mildew. Locate closets where they will remain as warm and dry as possible. Don't install closets in any rooms that generate moisture, including shower rooms, toilet rooms, the kitchen, and the laundry area. And, keep the doors of closets away from those rooms.

Try to arrange closets so that they have little or no contact with outside walls. Clothing that presses against an exterior wall acts as insulation, making that wall of the closet colder than the inside of the house. Moisture will condense on this cold surface and on the clothing.

It is common practice to build bedroom closets into interior walls between rooms. This arrangement works well. It locates most of the closet surface inside the heated portion of the house, with perhaps only a narrow end against an exterior wall. To prevent mildew at that end, build a ventilated barrier there so that clothing cannot press against the outer wall. For example, you could place a shoe rack at that end. Closet doors should fit loosely or they should have louvers, to allow the closet interior to be warmed by the room it serves.

If your floor plan requires a wide closet against an exterior wall, install the hanger rods far enough away from the wall so that clothing will not contact the wall. Install louver doors, as in Figure 1-20, to keep the interior of the closet as close to room temperature as possible. The idea is to allow air from the inside of the house to circulate between the clothing and the exterior wall.

However, do not install louvered closet doors if you install a closet heater as a defense against mildew. In a humid climate, all closets may need additional steps to avoid mildew. See *Keeping Closets Dry*, in Step 4.

DRESSING ROOMS

A dressing room is a wonderful adjunct for a large bedroom in which adults sleep together. The dressing room maintains privacy and darkness in the bedroom, while allowing light for dressing. It provides for intimate preparations. The dressing room can serve as a passage to the toilet and shower room, isolating their light and noises.

A dressing room can provide a lot of convenient clothing storage. For example, the dressing room in Figure 1-20 has an entire wall of closets. A dressing room typically is furnished with a dresser or two, one or two chairs that are comfortable for dressing, a valet, and a large mirror. An elegant carpet is appropriate.

Dressing rooms were a feature of opulent architecture in the past, and they deserve to be revived. The walk-in closet is paltry in comparison. Unlike a closet, a dressing room has the size, lighting, convenience, and beauty of a primary room.

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Figure 1-78. A patio that blends well with an existing porch and a newly built deck.

A wooden deck needs periodic rebuilding, which is expensive. Figure the life of a deck as about ten years in a wet or snowy climate, and thirty years or more in a dry climate. Because of environmental concerns, the preservatives presently used for deck lumber are not as effective as earlier kinds.

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Figure 1-79. An attractive deck that adds a large amount of outdoor living space.

To maximize the life of a deck, build it to drain water quickly. In particular, lay the floor boards so that they dome upward as they warp with age. To do this, lay the boards ***with the end grain cupped upward, not downward.*** This seems contrary to intuition, so a majority of carpenters get it wrong.

A fancy deck is an expense that you can defer into the future. Just make provision for it in your home design.

EMERGENCY SHELTER

Your house may experience a variety of calamities during its life. Hurricanes threaten coastal areas. Tornadoes are a major peril in the central United States, and changing weather patterns may expand the range of tornadoes considerably. Earthquakes are common in many of the earth's most populated areas. Homes that are surrounded by forests or dry vegetation are vulnerable to forest fires. Volcanoes may erupt, releasing toxic gases over a wide area. A nuclear reactor meltdown may spread radiation over a wide area. And that's not all.

If your home site is vulnerable to one or more of these perils, consider building an emergency shelter into your house. An older example is the "storm cellar," widely adopted in tornado regions of the United States from the 19th century onward. These consist of a small underground space, with its own structural walls and with a door that exits directly to the outside.

The first point to make is that you should ***build your entire house strongly enough to serve as an emergency shelter***. By exploiting the construction methods and materials that we recommend, you can build a house that is so strong that it will protect you against most of the previous terrors. The construction techniques recommended in Step 3 provide a host of benefits, all of which reinforce each other. Exceptional strength is one of these benefits.

Some hazards are so powerful that no home can protect against them. To avoid those, build your home in a safer location. It is folly to build a home near an active volcano, or to build in a low coastal area that is vulnerable to hurricanes or tsunamis. Millions of people do so, but think hard before joining them. (See the sidebar in Step 3, *Some Places You Just Don't Build*.)

Basement Shelter

A basement shelter provides the strongest defense against forces that may collapse a house or blow it away, especially tornadoes and hurricanes. Basement walls cannot be crushed or blown over.

A basement shelter is less reliable as a shelter against fire. It provides protection from the high temperatures of a surrounding fire, such as a forest fire. It also provides refuge from smoke because smoke tends to rise during a fire. However, if the house itself is burning, a basement shelter would be deadly. It would not block the high temperature of the fire, and it would accumulate deadly gases, such as carbon monoxide. The only safe response to a burning house is to get out of it. For protection from a fire that surrounds the house, equip the shelter with respirators.

A basement shelter is not desirable if the basement can be flooded.

If you are building a new house with a basement, Step 3 recommends reinforced concrete basement walls. It is a simple matter to create a strong emergency shelter by extending the foundation walls into the basement to create a refuge space, as in Figures 1-82 and 1-83. To add an emergency shelter in the basement of an existing house, create a shelter space with a concrete block wall that is tied together with steel reinforcing bars ("rebar"). The wall should enclose a portion of the basement that includes an exterior exit.

The floor above the shelter acts as its ceiling. It can be strong enough if the joists span a relatively short distance across the shelter walls. Secure the floor joists to the shelter walls with anchor bolts that are embedded into the tops of the shelter walls.

To protect against fire, install a thick fireproof layer, such as gypsum board, between the floor joists and the shelter.

The exits from a shelter are critical. You don't want to be trapped inside. Also, it is important to have a quick escape from the poisonous gases that are generated in a house fire. Locate the shelter so that it has direct access to the outside, along with an interior entrance from the basement. The exit door should open inward, so that it cannot be obstructed by wreckage. The door opening should be very strong to avoid jamming the door. Select doors that are fire resistant.

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Figure 1-82. A basement emergency shelter that is completely surrounded by reinforced concrete walls. The walls provide strong support for the joists that form the ceiling. The shelter has direct access to the outside.

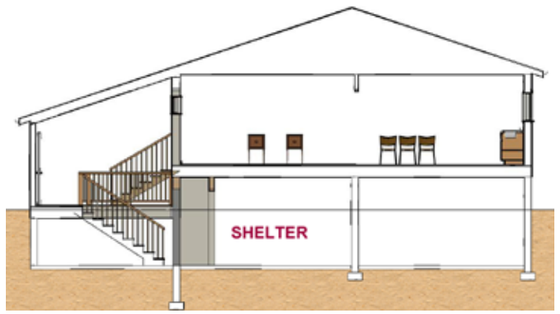

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Figure 1-83. The same shelter as in the previous figure, showing how the stairs to the outside share an entry vestibule with the stairs leading to the main floor.

To enhance escape from a collapsed house and surrounding wreckage, place the exit above grade. This means that you will need a strongly protected stairway from the basement shelter to grade level.

Shelter on a Slab Foundation

If a house is built on a slab foundation, you can create a strong shelter by creating a space with interior concrete walls, as in a basement. Reinforce the ceiling and make it fireproof, as for a basement shelter. Include a strong exterior exit.

If the house has a single floor, the roof structure forms the shelter ceiling. Therefore, it is especially important to attach the roof strongly, as we explain in Step 3. Severe windstorms commonly lift the roofs off houses that are not designed and built specifically to resist wind damage.

BASIC ROOF STRUCTURES

There are many ways to build a roof. We cover most structural issues in Step 3, but we need to make a short detour into the basics of roof construction at this point so that you can select the type of roof that is best for your home.

This sidebar looks under the skin of the various roof types to see how they are built. The later sidebar, *Roof Styles*, shows how different styles of roofs look from the outside.

The following are the fundamental types of roof structures that are used for contemporary houses. These structures can be modified or combined to yield a variety of shapes and styles. They can be supplemented with auxiliary structures and accessories, such as dormers, side gables, and skylights.

Truss Roofs

A truss is a lightweight framework of timbers that uses many triangular connections to achieve strength and rigidity. The roof is supported by closely spaced trusses. The roof surface is supported by the top members of the trusses. The bottoms of the trusses act as the ceiling joists for the top floor. Figure 1-106 shows a truss roof being built.

Truss roofs offer these benefits:

- ***strength with economy.*** Trusses can provide great load carrying capacity with minimum use of materials.
- ***clear span.*** Trusses can be made to span any desired width. They can provide a clear span from one outside wall to the opposite wall. This allows you to build the uppermost floor of the house without interior load-bearing walls to support the roof. By the same token, the clear span provides unlimited flexibility in locating the interior walls.
- ***access for installation and inspection.*** The space inside a truss roof remains accessible for installation of wiring, fixtures, and insulation. It allows inspection for damage from moisture and insects.
- ***virtually unlimited super-insulation.*** The attic space can be designed to accommodates almost any thickness of insulation, allowing a truss roof to have a higher insulation value than other roof types.
- ***adaptability to loose fill insulation.*** If the floor of the attic space is flat, a truss roof allows the use of loose fill insulation as an alternative to batt insulation.
- ***ample space for ventilation cooling.*** The large air space above the insulation can be a path for effective cooling ventilation. During warm weather, this reduces heat penetration into the house and extends the life of roofing materials, especially shingles.
- ***versatility of shape.*** Trusses can be used to produce a roof of almost any shape and complexity, suitable for any style and climate. Figure 1-107 gives examples of various truss designs.

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Figure 1-106. A truss roof being built. It is about to be covered with the sheathing panels that are stacked along the wall. Note the variety of truss shapes needed to create a "hip roof" shape.

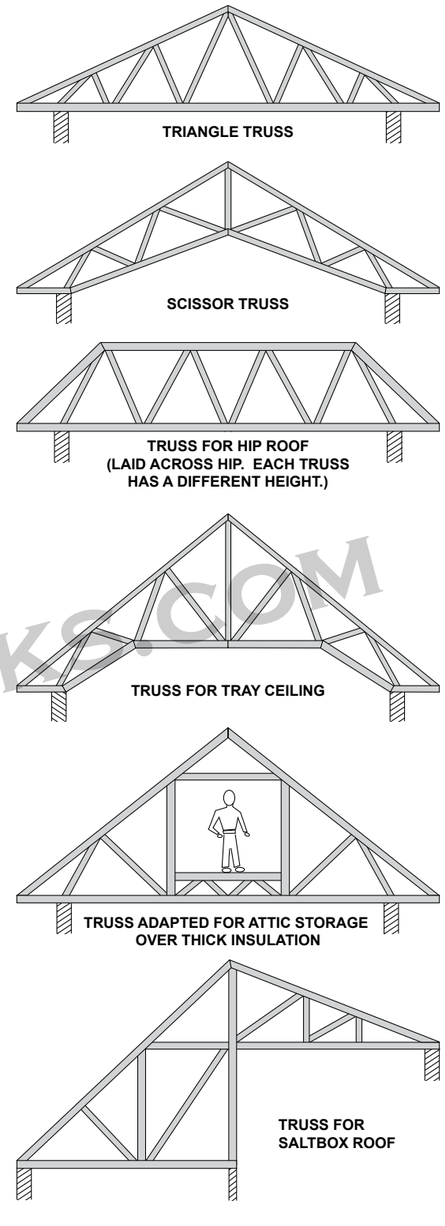

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Figure 1-107. A variety of truss designs illustrate the versatility of truss roof construction.

The big disadvantage of a truss roof is that it does not make efficient use of the attic space. For strength, trusses must be fairly tall in relation to their width. The large volume of space within the trusses creates an attic in the finished house, which may or may not be useful. (In this book, we usually limit the term "attic" to mean the space inside a truss roof structure.)

A truss roof must be vented to the outside to protect the structure against moisture damage. Venting exposes the attic to extremes of temperature and humidity. Subject to this limitation, the attic may be adapted to provide a useful amount of storage space, as discussed under *The Attic as Storage Space.*

These days, roof trusses typically are prefabricated in specialized factories. This lowers cost and helps to ensure that the trusses are designed properly. Usually, the home designer tells the truss manufacturer the outer shape of the truss, and an engineer who works for the truss manufacturer designs the size and placement of the truss members.

The truss manufacturer will deliver trusses to the home site using a truck that has a crane to lift the trusses into place. Experienced builders know how to work with truss manufacturers to make this part of the job go smoothly.

Most trusses are spaced at intervals of 16" (40 cm) or 24" (60 cm). If the building will have a sheetmetal or tile roof, the trusses may be spaced at longer intervals, typically 4 feet (120 cm). In this case, the sheetmetal panels are supported by "purlins," which span horizontally across the trusses, as in Figure 1-108.

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Figure 1-108. This truss roof uses purlins to support a sheetmetal surface, increasing the distance between the trusses.

ADDING UPPER FLOORS

It is becoming popular to increase the size of existing single-story houses by tearing off the roof and building upward on the existing walls. The previous heading, *Single- or Multi-Story?*, presents the pros and cons of having a multi-story house.

If the original house has an attic, you may leave the original ceiling in place or you may remove it. Experience seems to teach that you will get better results by tearing off the ceiling along with the roof. This avoids the need to work around the original ceiling joists and the clutter in the original attic. Also, it is easier to install new electrical wiring, thermostat wiring, plumbing connections, etc.

While the roof is removed, it is almost impossible to protect the interior of the house from rain and snow. Therefore, the new structure and roof must be installed quickly. While this is happening, it is best to vacate the house entirely, put vulnerable furnishings into storage, cover everything else, and be prepared to remove any rainwater that accumulates.

Usually, the new upper floor is a frame structure, even if the original walls are masonry. Figure 1-104 shows a typical example of an upper floor addition, flanked by houses of the original height. Figures 1-124 and 1-125 show fancier additions of this kind.

Adding a second story approximately doubles the living space. Often, the floor joists of the new upper floor overhang the original walls by about two feet (60 cm) on one or both sides. This is an easy and inexpensive way to increase the area of the upper floor. However, a stairway must be added, which deducts from the total living space.

The resulting floor plan is typical of most two-story houses. The rooms that are occupied mainly during the daytime remain on the ground floor. Most of the upper floor is occupied by "bedrooms," along with their associated toilet and shower rooms.

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Figure 1-125. Another attractive second story addition.

Another option is to remove the original roof and replace it with a roof that has a steeper slope, thereby adding living space under the roof. Figure 1-126 shows an example. This approach provides less space than adding an entire floor, and the cost per unit of additional space is higher.

You are not limited to adding one floor level to a house. You could add two or more, provided that you are certain that the foundation and the load-bearing walls can support the additional weight. Building codes may impose additional requirements if a house is taller than two stories, so check that issue if you want to add more than one level.

Usually, it is easiest to expand upward if the original house has *structural* masonry walls, such as concrete block or brick-and-block. When you remove the existing roof, you are unlikely to find nasty surprises that you can't overcome.

If the original walls are frame construction, you may not be able to tell whether they are built strongly enough to support the additional floor and walls. However, it is usually possible to reinforce

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Figure 1-124. An attractive second story addition. The result matches the original style well. The house was originally identical to the one at its left.

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Figure 1-126. Increasing the roof slope to convert a low attic into living space. The house to the right shows the original slope.

the original walls, if needed. To inspect and reinforce the original walls, remove the outer sheathing, one wall at a time. Strengthen the walls, if necessary, by inserting additional structural members. At the same time, maximize the insulation in the wall, as we explain in Step 3.

The exterior sheathing is an important structural component of the wall. If necessary, replace the original sheathing with strong plywood. Figure 1-127 shows an example of such an addition. Step 3 explains how to install exterior sheathing to create a strong wall.

Adding an upper floor is most difficult if the original house has brick veneer walls. The brick veneer makes it difficult to inspect the original walls, and makes it impossible to replace the exterior sheathing. The brick itself should not carry any load in a veneer wall. Unless you are sure that the wall construction is adequate, you would have to remove the brick veneer. It's not impossible, but it is a big deal. Certain kinds of brick can be salvaged and reused, while others can't be. The original windows and doors probably would not survive, making it prudent to replace them with better models at the same time you build the addition.

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Figure 1-127. Adding a second story to a house that has frame walls. The original board sheathing of the exterior walls is being replaced with plywood sheathing for additional strength. This modification is in the wrong sequence. The lower walls should have been strongly reinforced before adding the second story.

Adding Stairs to an Existing House

You will need a stairway to reach the new upper floor(s). Design the stairway to satisfy the requirements that we explained previously, under the heading *Moving Between Floors*.

Adding a stairway within the original floor plan of an existing house is likely to be awkward. For example, one expansion that I witnessed placed the stairway in the middle of the original living room. Don't do anything like that.

Instead, it is usually best to build a stairway enclosure outside the original footprint of the house, as in Figure 1-128. On the original ground floor, the stairway can connect through an existing door, or a window can be converted into a door.

The stairway structure needs its own foundation. In addition, attach the stairway enclosure securely to the house wall.

EXPANDING HORIZONTALLY

In the past, most additions were attached to a side of the house. This can be done with any kind of original structure. Also, if you are starting with a single-story house, this approach avoids the disadvantages of multiple stories.

Figure 1-129 shows a typical horizontal addition. Figure 1-130 is the addition that I made to my house, in which both the main floor and the basement level were extended horizontally.

The biggest challenge in extending a house horizontally is creating a secure structural connection between the old and new portions of the house. Without this, the addition may settle independently of the house, creating a gap between the two that looks bad, leaks heat, and is an entrance for vermin.

The key to minimizing such future trouble is to build the addition on a firm foundation, going as deep as necessary to rest on solid soil or bedrock. Step 3 explains how to build a good foundation.

If conditions permit, the foundation of the addition should be joined to the foundation of the original house with steel reinforcing rods (called "rebar"). The rebar is drilled and cemented into the original

ROOF STYLES

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Figure 1-190. ***Gable roof.*** This is the basic shape for most roofs because it is strong and easy to build. Usually, the sides are symmetrical. The eaves can be extended easily to provide wide overhangs.

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Figure 1-191. ***Inline staggered gables***.

Separate gables are attached end to end, but offset laterally or in height. The design accommodates spaces of different sizes, such as a garage attached to a house. This style is commonly used to break up a long roof line for the sake of appearance.

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Figure 1-192. ***Side gables*** provide daylight, view, and additional living space, usually in roofs with triangle-frame construction. The side gables may have the same height as the main gable or they may be shorter. Shorter gables tend to weaken the portion of the roof where they are attached.

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Figure 1-193. ***Cross gable roof***. Gables of equal height meet in a cross pattern.

ROOF STYLES

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Figure 1-194. ***Dormers*** provide increased daylight and view through the sides of a triangle-frame roof. They can serve as clerestories for a beam roof. The width of dormers is limited, to avoid weakening the roof. Dormers can be effective appearance enhancements to break up a large roof surface.

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Figure 1-195. ***Gable roof with end wall overhang***, commonly used to provide coverage for an outdoor balcony or deck. Typically yields a "Swiss chalet" appearance. If the overhang is oriented toward the south, it can provide sun shading that adapts to the seasons (as explained in Step 2).

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Figure 1-196. ***A-frame roof***. This roof structure encloses the entire house. It may have one or more floors of living space. The rafters function as wall studs, usually resting on a short foundation. Dormers may be added to provide daylighting and view through the roof surfaces.

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Figure 1-197. ***Hip roof***. A gable roof that has hips, which are sloped ends, instead of gable end walls. Primarily an appearance feature. For good appearance, the hips generally have the same slope as the main gable. Can be built with truss or triangle-frame construction. Sacrifices valuable attic space. Complicates the carpentry somewhat. Considered to be less vulnerable to wind damage than a simple gable shape, although both styles resist wind damage if they are built strongly.