

How to Design & Build Decks & Patios

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How to create your own outdoor living areas
with detailed information on design and construction.
Special chart on building and paving materials.



How to Design & Build Decks & Patios

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How to Design & Build Decks & Patios



The Designer's Way

Decks and patios can become outdoor rooms for eating, sleeping, entertaining, bathing or playing. Historically, this is part of a rich design tradition that comes down to us from ancient Egypt, Greece and China. **4**



Design Basics

The basics of designing a deck or patio include considerations of space, visual limits, light, color, textures, form and perspective as well as natural considerations like sound, wind, shade and sun. **20**



The Designer's Workbook

How you design your deck or patio not only means drawing a set of plans, it also means staking out a grid, deciding on your elevations, and creating your concept design. **32**



The How-To's of Deck Construction

How to select lumber and materials. How to pour footings and piers. How to build ledgers and basic substructures. All about blocking and bracing. How to lay decking. **40**



The How-To's of Patio Construction

How to lay and cut bricks. How to mix, pour and finish concrete. How to build steps and paving blocks. Choosing alternative pavings. **70**



The Working Plan

The completed plan includes building permits, balancing load factors, and a variety of special optional features like ramps, gates, benches, planter boxes, even storage spaces. **100**



The Designer's Way

Decks and patios can become outdoor rooms for eating, sleeping, entertaining, bathing or playing. Historically, this is part of a rich design tradition that came down to us from ancient Egypt, Greece and China.

Through the ages, people have created many forms of shelter, inspired by necessity and pleasure. Where mild weather prevails, many of these living areas have been outdoors.

An explosion of designs for outdoor living has now literally turned houses inside out. The new designers are no longer constrained by stiff and traditional forms. People are exuberantly extending their lifestyles to outdoor cooking, eating, sleeping, bathing, playing, partying and working.

If you always thought that living happened in rooms inside, with a roof and all, like a dining room or den, perhaps you haven't yet thought of organizing your outdoor spaces with specific uses in mind. Even avid gardeners and traditional designers recognize the value of solid surfaces in their gardens as spaces for people to walk alone, congregate together, compete in games or work on projects.

Other surfaces in the garden are built as decks or patios and can serve the countless purposes that rooms do. There's nothing that says a room can't be outside. Each outdoor room — spaces on the deck or patio — should be designed for a specific use, as a room inside is, and harmonize those uses with the setting and with each other.

Both decks and patios we define as level spaces that can be put to an almost endless variety of uses. The difference is simply that a deck is a wooden structure built a little or a long way above the ground, while all of a patio rests on the ground and may be surfaced with a variety of materials.

This book itself rests on solid

ground: the firm idea that you can design your own deck or patio and that you can build it. You may never have gone through the design process of the professional landscape architect. And you may rarely have met lumber and concrete in the raw. But with this book in hand, you will learn the procedures, practical information and confidence that will let you conceive, plan and construct outdoor living spaces that are just right for you and your home.

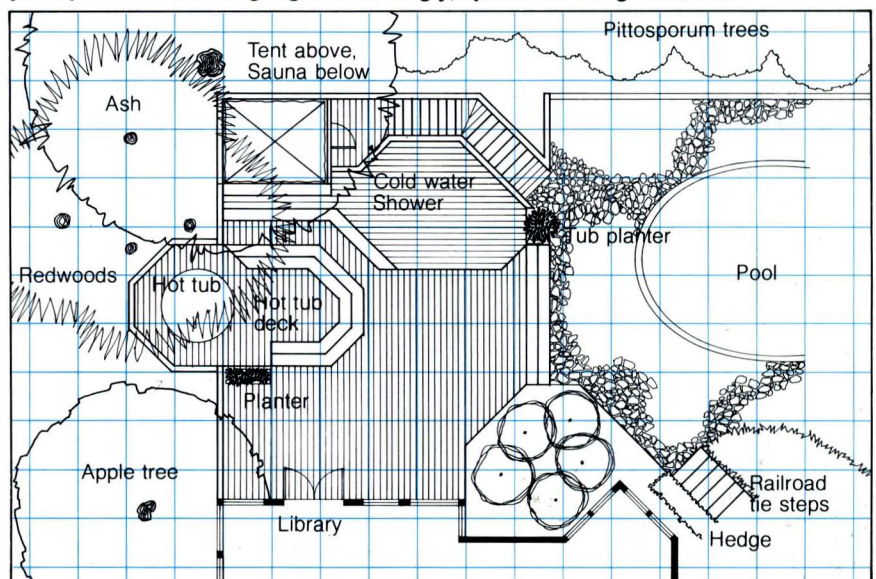
Usual and unusual uses:
Decks and patios are most commonly used as extensions of interior spaces for living, working, eating.
The barbecue replaces the stove and

there may even be built-in kitchen counters with sinks and storage cupboards.

Other decks and patios take on the intimate character of family rooms when furnished comfortably. A deck can be a quiet haven away from children. Or it can be specifically designed for the play of children. Some outdoor rooms have fire pits or niches with cosy mats and subtle lighting for the evenings.

There are a good number of circulation uses for decks and patios. Sunny-morning breakfast nooks can double as entry courts; boardwalks that connect house to deck and garden can be play ramps for kids or fine display areas for collections of perennial flowers. Some patios and decks have several levels, separating functions, age groups and activities. Sets of stairs can be sculptural links between them.

Seen in plan, the deck is divided into room-sized functional spaces, connected yet separate, functioning together or singly; spaces for living outdoors.



On a former hillside void, outdoor rooms spring into use, visually defined by level changes, plantings, tents and furniture groupings.

There are lots of other uses that are less common extensions of the interior. Hot tubs and spas are among the major new features on many decks. They can be put off the master bedroom for private adult use, or for greater family use they might be situated in the direct view of the living room or right near the barbecue. Hot tubs are an outgrowth of the Japanese *o'Furo*, or honorable bath. They are usually at least 3 feet deep and 4 feet in diameter, though there are many sizes and shapes on the market. Filled with water heated to about 110° F, they relax muscles and soothe arthritic pains.

Some designers have enclosed saunas, or Finnish steam baths, in the underpinnings of decks, and showers

to cool off with. Others use their outdoor rooms to entertain with soirées, musicals, children's puppet shows, readings, and outdoor movies projected on foliage.

Outdoor rooms can be furnished seasonally for sleeping under the stars, with hammocks, Hawaiian hakaïi, water beds or gym mats. Where space is limited, decks and patios can house laundry equipment, storage cupboards, garbage cans. And the list goes on. Deck and patio uses as extensions of interior spaces are really limited only by your individual needs, and the site conditions of space, access and weather.

In addition to being outdoor rooms that extend the interior living environment, decks and patios can serve

many normal outdoor functions. Herb and vegetable gardens can be planted in containers or as focal points in patio gardens. Deck space can be set up with a potting shed or greenhouse, and a rear deck may be the ideal place to keep the dog outside but close to the house.

Decks and patios can be good lawn substitutes, reducing the amount of regular maintenance you need to spend time and money on. Adjacent to pools, decks and patios become more like the beach as they are covered with bath towels.

A hot tub "bathroom" rises in rounded layers adjacent to a gazebo covered sitting room. The Victorian picket fence ties old to new, defining the visual and practical extent of the patio room.



Let your imagination run, and make notes of your outdoor needs to consider as you create your deck or patio concept:

- ☐ Fireplace niche
- ☐ Family room
- ☐ Kitchen (barbecue)
- ☐ Dining room
- ☐ Library (contemplation)
- ☐ Foyer (entry court)
- ☐ Hallway (boardwalk)
- ☐ Bathroom (outdoor shower, hot tub)
- ☐ Children's play room
- ☐ Card and game room
- ☐ Music room
- ☐ Theater
- ☐ Laundry
- ☐ Storage
- ☐ Sauna
- ☐ Project room
- ☐ Wood shop
- ☐ Staircase
- ☐ Utility room
- ☐ Garbage enclosure
- ☐ Herb gardeh
- ☐ Vegetable garden
- ☐ Potting shed
- ☐ Greenhouse
- ☐ Bonsai display
- ☐ Beach
- ☐ Poolside
- ☐ Dog run
- ☐ Lawn substitute



Under the eucalyptus boughs, dining room and bedroom function in their special capacities in their own time: meal time, nap time, entertainment time.

Freestanding garden sculpture, a covered deck becomes potting shed, storage closet and sitting area, serving multiple uses.



The feeling of a room: Sometimes a sense of a room enclosed and separated can be created outdoors with the imaginative use of existing surfaces — the boughs of a nearby tree, or a fence, a screen or a wall of the house. Walls of outdoor rooms can also be suggested by columnar trees, potted plants, railings, elevation changes and other interruptions to one's field of vision.

The ceiling of an outdoor room may be the canopy of a large spreading tree, vines on lattice, a canvas covered trellis or other sheltering structure. Or the ceiling may be simply the open sky.

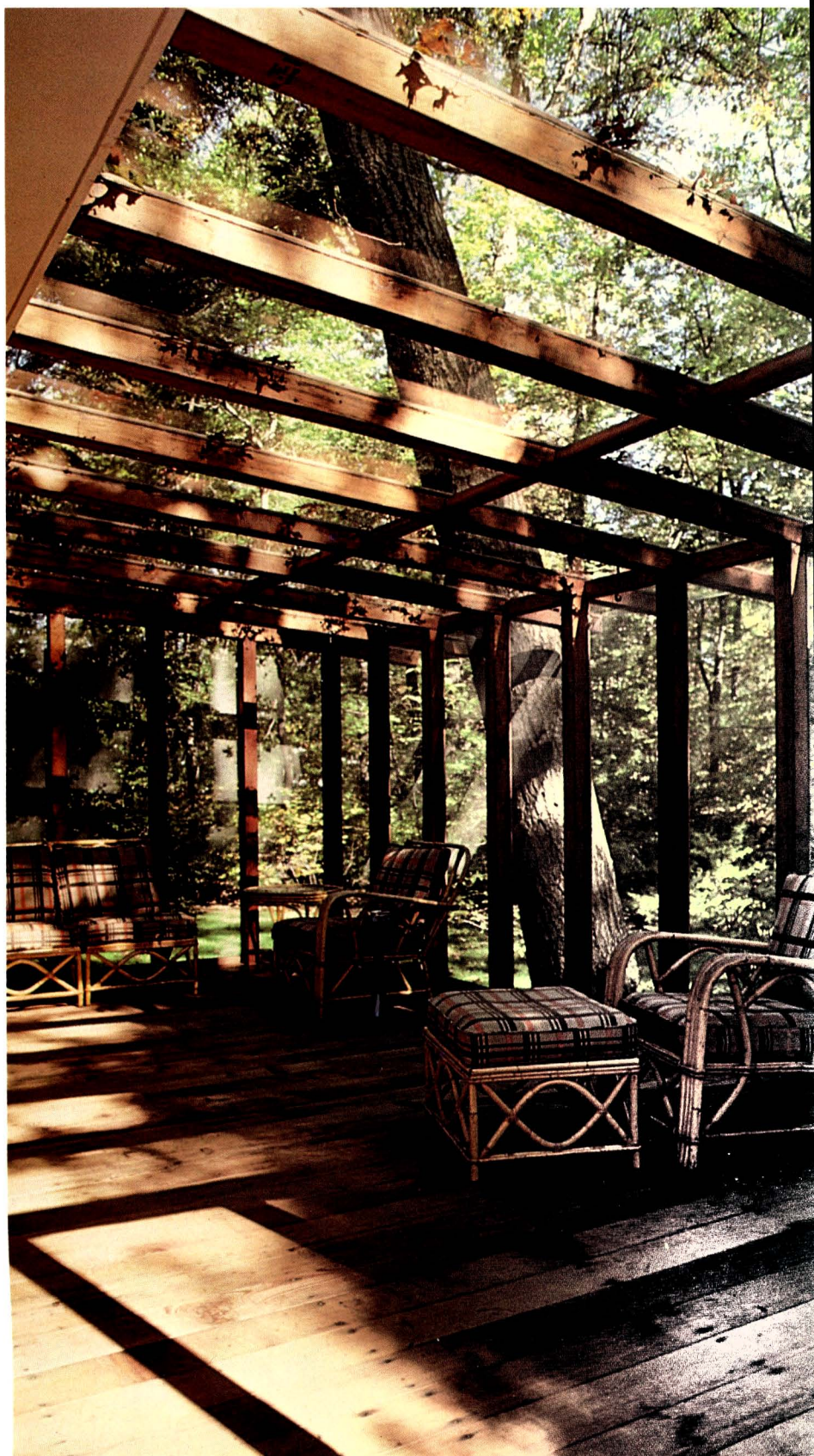
The plane of the floor — wood decking or bricks or any other surface of a patio — can be visually extended by non-walking surfaces such as water or plantings.

The moods of outdoor rooms are influenced by wind, light, temperature, plants and views, and each of these can have a profound effect on how pleasant it is to be in that space.

You the designer and builder: Because you have bought this book, you are probably planning to design and build a deck or patio, and you probably already have a general idea of what you want. Your ideas, though, may still be vague and you may need technical advice about structural elements. So do all of us when we begin a new project. Just take it step by step, starting with the design process and working through the actual construction.

There are no ready-made solutions to creative design. Your site, yourself, and your family are unique. Only you,

The feeling of a room outdoors may result from actual enclosure with fly-screening or it may be merely intoned by plantings, level changes, railings or other interruptions of the field of view.





Food preparation and garbage disposal can be designed into the structure and form of decks and patios.

working with this guided program of design development or a professional designer, can produce *your* ideal creation. To help you do this by yourself, we have outlined the process in workbook fashion so you can design and build your own deck or patio. The process you will follow is an outgrowth of the way many professional designers, architects, and landscape architects come to grips with deck and patio design problems.

You may never have considered yourself a designer. You can be. Creative ideas of balance and form come to some people more easily than others, but that could be because the others have never really given their subconscious abilities a chance to operate.

You can make good design decisions if you study your site and how you want to use it, and then allow your ideas to direct your subconscious understanding of balance and form.

Don't be scared by our discussion of a **design process** because you haven't gone through one before. This book is intended for people who have little or no experience with design and who may not have built many things, either. You should know, however, that a successful creative design will result

only from your actively thinking things through, and some hard work. It can also be lots of fun and very satisfying as you see the fruits of your imagination constructed into reality.

Chapter 4 outlines everything you'll need to know about deck construction, and Chapter 5 does the same for patio construction. Our aim is to be your on-the-spot guide both as designer and builder.

Your private place: William Shakespeare's adage that "the apparel oft proclaims the man" can be aptly extended to the environments people create for themselves — their homes and gardens. To the extent that our homes reflect what we care about, they are open statements of who we are. Our surroundings are often subconscious re-creations of happy and secure childhood places. It is often possible to tell peoples' native regions by the plants and landscape styles they use around their homes.

Different parts of the United States and the world have distinctive design

styles and native plants. These, however, have been diffused over time as immigrants carried their native landscapes to new homes, planting conifers in the desert, for instance, or cacti in lake country, box hedges in New England or lawns in Los Angeles. Designers have long urged respect for every native landscape, warning that too many non-native plants and styles could take away the distinctive beauty of the natural landscape.

Today, many of us find ourselves living in patchwork landscapes that represent wildly different origins. In some newer communities, zoning regulations now limit the homeowner, guiding design choices of plants and house styles to those that will fit the native character.

Although you may not be able to plant some particular tree or have some particular style for your house, you will generally have a great deal of freedom to design your own deck or patio. Make your personal environment reflect your visions, recreating elements of places you've loved in the past or developing other ideas. Be conscious and careful of the native character of the landscape you are working within, and your own design will have that much more charm.

The design process directs deck and patio creation to include the variety of spaces and subtle design elements that make outdoor rooms just right for your family's activities. Such rooms "work."



Cycles of design creation: The design process can really be split into three major creative activities; survey, evaluation and synthesis. In the survey, you get to know all about the site conditions, your needs, desires and objectives, and the resources available to carry the design out. Evaluation is the examination of accumulated information in search of design directions. Synthesis is the creation of actual designed form.

The main objective of all these activities is to free you, the designer, from preconceptions about design forms. Your own intuition, once you have absorbed the site, may be just right for the actual structures. But don't let intuition short-circuit what you discover during your survey and evaluation.

The objective of this book is to lead you through the process of survey, evaluation and synthesis for your deck or patio design. In other words, *we want to show you how to observe, criticize and make design decisions that will really customize your future outdoor rooms.* Follow a cyclical course that repeats and refines the observations, critiques and creations until your design finally develops a satisfying maturity. In the course of several revolutions through these stages, you will refine your observations and ideas well beyond what you could do in one pass at the problem.

Site selection: To begin designing, take some time to observe the potential sites for your deck or patio. You may want to build a combined deck and patio, or just one or the other. It might be close to the house or freestanding out in "the back forty." In any case, start looking over all the sites where it might be.

One way to identify sites is to stroll through the areas you might use and locate several observation places just for sitting and contemplation. Walk a looping trail if you have a very large property, identifying sites and seeing how they look from different angles. If your lot is small, pick two or three places to sit in what may be the only possible site for the deck or patio. Move from one position to another as an observer. You may be surprised how much you will see that you hadn't noticed before.

Think of this observation process as a circling trail where you will find new and exciting details each time you walk it and pause to look anew.

At this early stage in the site selection process, be as open as possible in considering where your outdoor rooms should be. You may have noticed several good places, but there may be an even better one. You don't need to decide on a site now, but if you are familiar with what you have to work with, you will get more out of the exercises that are coming up.



Building a deck around the trees, with hammock in place, is one way to select a site.





To swell the Terras, or to sink
the Grot;
In all, let Nature never be
forgot.
But treat the Goddess like a
modest fair,
Nor over dress, nor leave her
wholly bare;
Let not each beauty ev'ry
where be spy'd,
Where half the skill is
decently to hide.
He gains all points, who
pleasingly confounds,
Surprises, varies and
conceals the bounds.
Consult the Genius of the
Place in all;
That tells the waters to rise,
or fall . . .
Now breaks or now directs,
Th' intending Lines;
Paints as you plant, and,
as you work, designs.

Alexander Pope, c. 1715

As you study the potential sites, imagine what the views to and from them would be with a patio or deck at various elevations off the ground. Can you connect the garden to the house with a deck, and thus make better access between them? How will it look from the inside of the house and from the street? Climb up a ladder to check out views, and lay out hoses or strings to help picture separate areas you might be using.

Remember, though, that this is a preliminary look-see. Shortly you will be doing some design observation exercises that may broaden your understanding of what you can do. The better you know your own sites, the more easily you will see the potential of ideas that will soon be streaming through your imagination.

It might help if you think of these early observations as an effort to see through dark glasses. At first, your prior experience with the site may block out much of the potential that is there. You may think you already know the site, and wonder what you will learn by looking at it in detail. If you can put off the urge to hurry into construction and give yourself time to develop a design, you will create a very different solution. Strain hard to look with fresh attention; don't let your preconceptions limit you.

Use a mirror: A few tricks will help you get around your preconceptions in this initial discovery cycle. What you need are new eyes that see more, and still keep you interested in looking. The more you continue to look (up to a point), the more you will discover about your design possibilities.

A helpful technique is to take along a mirror for studying the sites. Things in reverse look different. All at once you discover that the big tree is blocking a view you never knew existed, or that a connecting deck between the living room and the rose garden would be easier than walking around the house as you do now. Perhaps you will see a flow from one part of the yard to another that you hadn't noticed

before, or a problem with screening that you had just been looking past, not noticing because it is so familiar to you. Using a mirror can help you understand your site.

You might see in the reverse image that there is a sloping surface where you planned to make the patio, but that right near it is a flat place that will be much easier and less expensive to develop. Perhaps you have decided to build a deck because you have a friend who has one and you really like it. But because you have been looking for deck sites, you may have overlooked an area that would make a perfect patio. Maybe there is a tree with a broad-branching canopy where you want your deck. A deck would make a tight fit but a patio would have a fine ceiling of green boughs. If you had gone ahead with a deck, you would have had to prune the tree beyond recognition.

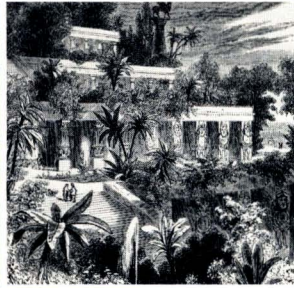
A refinement of the mirror trick is to take slides from different angles and project them backwards.

Both mirrors and slides create the kind of environment of fresh discovery that designers find when consulting with clients. An architect or landscape architect will come to a site without prior ideas about its limitations. For that reason, the professional designer is often able to make suggestions that never occur to the owners. The closer you come to seeing the site without preconceptions, the better you will be able to develop a designer's eye.

There are other ways to see the site with new eyes. Cup your hands to make a sort of telescope, or use rolled paper or a piece of cardboard with a hole cut in it. As you look through, concentrate your attention on details. You can take movies of the potential sites for the deck or patio. They might show areas that need more study.

Walk your observation trail again, trying out your unformed ideas for the spaces you may want to create. Don't worry about making notes or saving your thoughts from this loop. Instead, just observe and understand the site without doing anything else. There will be time later to write down your observations. The important thing to do in this first cycle of your design is to free yourself from preconceived ideas as you go outside in your future rooms.





Greek temples and Babylon's Hanging Gardens became rooms outdoors for another age.

Now that you have been around your design trail several times and have seen the sites with a fresh eye, turn your attention to what other people have done with their outdoor spaces. Look for ideas that might work into the various sites you have been observing. Looking at some great outdoor rooms of history may help you discover your own site and design potential. As you read the following discussion of outdoor spaces, consider yourself a co-author of this book. Indeed, for much of the rest of this book we urge you to interact with it. As creative ideas occur to you, jot them down in the margins. In the pictures, circle details that you like and note why. Work with the book and go beyond it with newspaper, magazine and book pictures of other outdoor spaces that interest you. The greater your exposure to what other people have designed, the more ideas you will have to choose for your own space. You may not be able to build another Hanging Garden of Babylon, but some aspect of that ancient wonder, or something that it reminds you of, could be the cornerstone of your design. Professionals get ideas from classic designs, and you must do so too.

Diverse and curious outdoor rooms: Because so much living occurred outdoors in the Mediterranean area, early mythology often depicted the haunts of gods in pastoral settings. Great temples were built to honor them, but they were thought of as residents of distant mountain perches, overlooking the whole of civilization. The gods frolicked like men and women, and had their passions.

Does your site, like the home of ancient Greek gods, possess commanding views? Like Zeus, the king of gods, you may be able to visually command your world from your terrace or deck. Or perhaps you would prefer to play the part of Dionysus, god of wine and merriment, as you entertain friends in your outdoor space.

Religious writings abound with descriptions of garden-like rooms. The Garden of Eden is, of course, the most celebrated. There was "... made to grow every tree that is pleasant to the sight and good for food ...," a sanctuary from the wilds beyond.

The imagery of Eden has been an inspiration for outdoor rooms through the ages. In designing modern garden



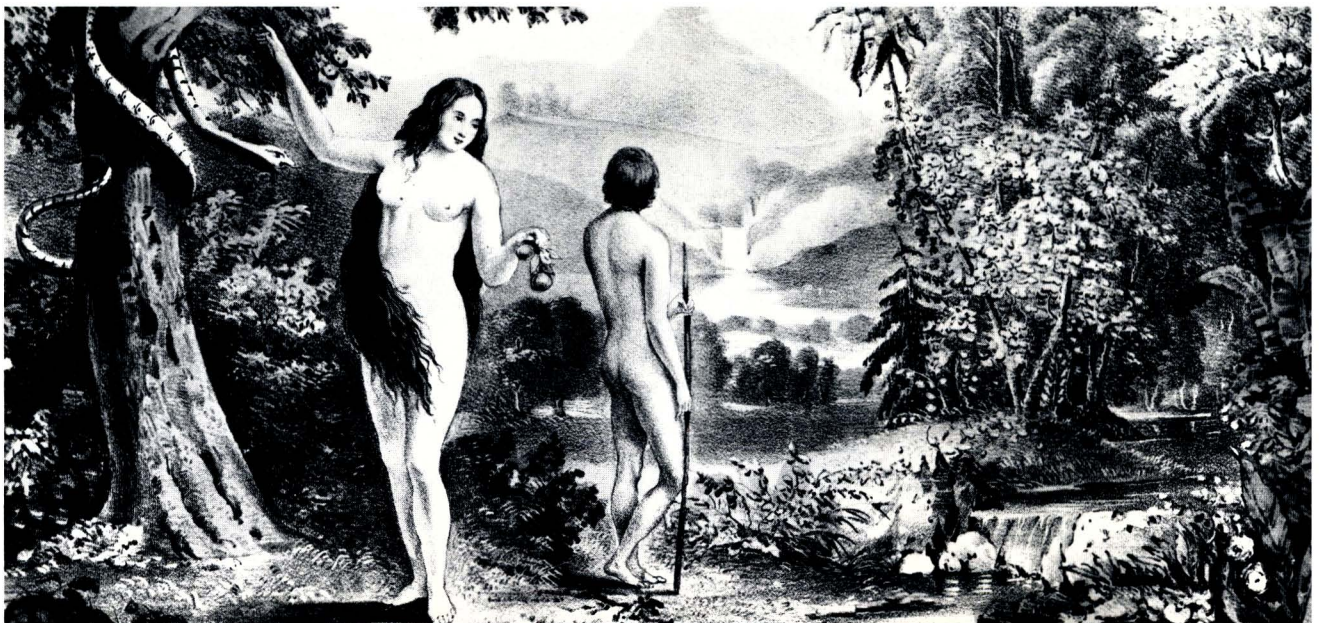
In Athens, Greece, the once lively outdoor market or agora staged other activities in a later memorable time.

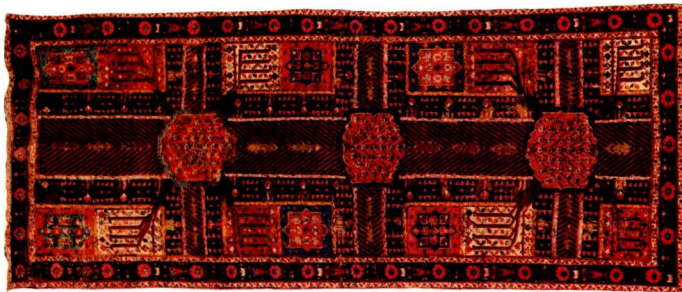
spaces, Eden is still a cultural inspiration for balance and goodness.

Mohammed repeated the notion of paradise gardens and filled them with groves of trees and fountains. Glades of flowers and the splash of water, rare in Islamic countries, came to be the essence of heaven.

In your deck or patio paradise, you may want to incorporate rare elements of your own environment. Perhaps the shaded and stepped character of a creekside can be developed with decks on several levels stepping down to an enclosed canvas canopy. Or if your site is on a craggy mountain, a protected patio simulating a flat rock outcropping might give great pleasure within the natural conditions.

Balance and form, originating in Western thought with Eden, are still inspired by the notion of perfection in creative outdoor room.





Persian rugs preserve the character of ancient glorieta garden rooms, oases in hostile natural environments.

Your own "paradise" will come from your careful use of unusual parts of your environment, so look around you and see what they are.

Among the oldest recorded gardens in the world are the oases of Egypt. They brought together rare shade, water, plants, beauty and food. In form, these gardens were simple rectangles with rows of plants and paths, but they were the beginnings of great outdoor rooms. In Babylon, the celebrated Hanging Gardens were actually oases constructed as roof terraces or decks. The gardens rose to a height of three hundred feet and covered four acres. From the terraced levels, great views opened up and cooling breezes washed the plants and people.

Hanging gardens: Can Babylon be an inspiration as you get ready to design your deck or patio? Think of how you can change your space with structures that alter the direction of views or the character of the topography. Is your site flat and therefore seemingly uninteresting? You might be inspired to make raised planter boxes or to build a multilevel deck stepping down to a patio, simulating the effect of the Hanging Gardens of Babylon.

The paradise garden reached its height of development in the Persian formal designs called glorieta. These rectangular enclosures were filled with elaborate and intricate patterns of flower plantings, gravel paths and water courses. Many of the designs have been preserved in patterns of Persian rugs. As time passed, the glorieta as a design genre migrated to India and Spain, and later to Mexico and California where it developed into the patio.

The detail of the glorieta is its genius, and to study this for inspiration you might visit a Persian rug store and look at the forms and complexities of the designs. Note the regular placement of trees or flowers and the directional quality of some of the de-

signs. Study your own site and think of it richly filled with a variety of textures. If you are going to build a patio, perhaps your pavement pattern should be rich with texture — for example, a herringbone brick or concentric circles of stones.

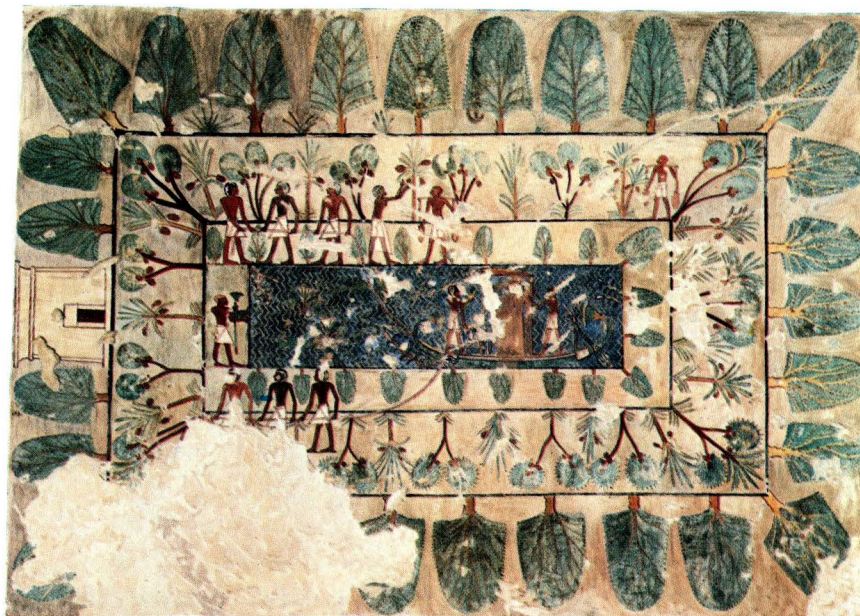
In Greece the golden age of Socrates and Plato centered around largely outdoor spaces. The agora or marketplace, the stadium and amphitheater, and the acropolis or fortified temple were built with outdoor rooms where people lived. These centers of human interaction were typically alive with a multitude of activities. Interest was created by variety, much as we today try to enliven shopping arcades and county fairs.

Give some thought to how you can serve a variety of uses with special built-in facilities in your outdoor rooms. Hobbies and projects, pets and wild animals — if even just the neighborhood hummingbird or gray squirrel — the normal abundance of domestic activities and the facilities needed to serve them can create richness in space.

Throughout the Mediterranean

areas of the Roman Empire, because of the pleasant climate, living continued to happen outdoors in marketplaces, public baths, stadiums and residences. The dominant residential architectural style featured an atrium — a patio or central courtyard garden room — containing fountains, sculpture and plantings. Often the walls of the atrium were covered with paintings of trees, landscapes or heroes. At Pompeii on the Bay of Naples, lava from the volcanic Mt. Vesuvius covered houses with atriums in 79 A.D., preserving them until recent excavations revealed their beauty. With the rise and fall of empires in Asia Minor and the Mediterranean, the Persian garden as a design form migrated to North Africa and then west to Spain with the Moors. There the Roman atrium was combined with the paradise garden in about the 13th century. An early example is the Court of the Lions at the Alhambra, where channels of water not only run through courtyards but into and through some rooms, functioning as a primitive form of air conditioning.

Egyptian garden designs, in rectilinear patterns, are preserved in paintings on the pharaohs' tombs.





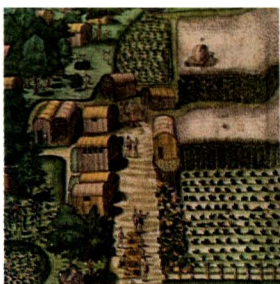
Oriental prints and paintings fancifully demonstrate linked outdoor rooms, borrowing landscapes through manipulated views, framed by shrub masses, trees and architectural features.

Paving or floor surfaces that continue from outdoors to indoors is something to keep in mind as you create your own oasis. They can visually tie exterior and interior spaces together as the Romans did with their atriums, their outdoor garden rooms.

Chinese gardens: In China, gardens evolved as miniature representations of the awesomeness of nature. Symbolic mountain chains and lakes, and miniature trees were viewed from benches and open pavilions. Such an outdoor place became the contemplation center of the home. Developing from this tradition, the Japanese refined the contemplation garden with sand and rock representations of natural balance and form. The great Zen gardens were intended to be seen from prearranged spots where decks and pavilions were sited. Domestic gardens also became very refined, and were the heart and most private part of the home environment. They were places where guests were seldom invited, where deep contemplation of important matters would be uninterrupted.

One trick of ancient Oriental gardens that is good to note is the way neighboring landscapes are used. Contemplation areas on a deck or pavilion were carefully sited to take advantage of views that could be framed and screened with trees or shrubs. Picture, for instance, a site overlooking a great valley and distant mountain range. In the foreground, however, neighboring houses loom up into the view. By siting the deck so that it looks between the house roofs, and then by screening them out of the picture with shrubs and fences — by diverting the eye around them — you are tricked into not noticing them. As you borrow the landscape beyond and overlook intermediate obstructions, the small space you are actually designing opens out into a much larger visual space.

The Japanese can also take credit for developing the art of bonsai, growing miniature trees in pots or on trays. Some of these small trees live to be hundreds of years old and reflect enormous amounts of care over many years.



American Indians developed outdoor rooms for work, play and ceremonial uses.

Until the turn of the century, bonsai trees were confined to Japan but now they have become favorite decorations in outdoor rooms. For some, in fact, their care, cultivation and display is the central interest in the whole garden. Perhaps you like bonsais or some other form of containerized specimen plant and ought to plan for that hobby in your patio or deck design.

European gardens

In Europe during the Middle Ages, the walled towns and castles needed for protection allowed little space for outdoor living. The tiny, crooked streetscapes of medieval enclosures teemed with life and activity, but the small outdoor rooms in these enclosed towns and cloisters had to be used intensively. Herbs were grown in little beds, there were fish breeding ponds, and carefully placed trees gave shade from the summer heat.

If you are building a roof deck or a small city patio, consider the tiny outdoor spaces of Europe's medieval towns. The main problem is to use the space intensively.

Be sure to incorporate the facilities you want into the structure when possible. For instance, if you want a sitting area, you might design it into a raised planter that will provide a backdrop of foliage, vines or espalliered trees. Consider using different paving materials to designate special areas for special purposes — such as the sitting niche or the entry walk as distinct from the general patio or deck area. Look up pictures of medieval courtyards and cloisters for inspiration in designing your small outdoor spaces.

As Europe became safer, people of the Renaissance created an atmosphere reminiscent of the rich outdoor spaces of classical Rome and Greece. Gardens began to imitate classical spaces

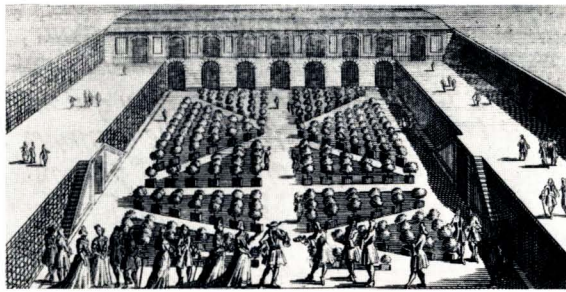
and expand on them. In Italy, the Villa d'Este is a great series of outdoor water-cooled rooms on a geometric plan. In France, some of the world's most grandiose gardens were developed as the countryside was graded level and woods were transplanted to create geometric patterns on the gently sloping landscape. At Versailles, King Louis XIV's masterpiece was a kind of outdoor room. At a scale similar to modern sport arenas, the Versailles gardens provided outdoor rooms for specific activities. Walks and hedged-in spaces at this grandest of gardens were intended to be salons where the royal peers could parade in the height of fashion, seeing and being seen. King Louis wanted to create an image for himself, and with his outdoor rooms, he certainly succeeded.



Fountains at Ville d'Este link spaces with the ephemeral delight of splashing and sparkling water.

Your house as image: Perhaps you are concerned with the image your house projects on visitors or neighbors. There are many reasons why you might want to project an attractive image to passersby and people approaching your front door. How does this image of your house influence what you might build as a patio or deck? Is the street side your sunny area, or the most spacious part of your lot for an outdoor room? Maybe you can make it private with fencing and planting, and create in the newly reclaimed space an image-enhancing deck or patio. Your space might act as a link between the public sidewalk and the more private patio directly adjacent to the house.

It may be that you have only enough room to make a private entryway or court. But at certain times of the day, that little space may have the best climate for an outdoor room. Consider how you can design the space to influence the image you want and also to serve your needs.



The parterre Orangerie becomes a parade ground for the fashion-conscious in Louis XIV's court circles.



Image was not unimportant to the English, and in the early 18th century, great gardens were constructed with formalism borrowed from gardens in France and Italy. There were long vistas down allées lined with hedges, and intricate boxwood hedge parterres that enclosed gaudily colored gravels. The naturally rolling English landscape was graded into flat planes where possible, and the arbitrary geometric designs of other cultures were imposed on a landscape that was ill suited to them.

A revolt developed against the formalism, however, and under the direction of Lancelot Brown (1715–1783), who was also known as Capability Brown, great English estates were regraded and planted in rolling, natural-looking meadows with groves of trees to accent and interrupt the long views. It was Brown who laid out the gardens at Kew and Blenheim. Lakes were formed to simulate romantic natural ponds. Views

were arranged to be seen from pavilions and the great houses. Out in the gardens, careful sequences of views were laid out like stage sets contrived to feature prized elements — rock outcroppings or architectural features.

The eye-catcher: A curious element of many of the great English gardens was the eye-catcher. This was usually a piece of classical ruin or temple set slightly apart to tickle romantic fancy. Often the eye-catcher would distract attention from something the designer didn't want to be noticed, such as a hamlet in the distance.

In planning your outdoor rooms, you may find that an eye-catcher can distract attention from something you don't want to catch the eye. If you don't have a classical ruin at your disposal, you might find a nice piece of driftwood or garden sculpture to do the same thing. Study the views you want to call attention to or away from, and place the eye-catcher where it will be seen from the deck or patio site.

Colonial settlers brought with them the garden styles that prevailed in Europe and England, but on a much smaller scale. In the Carolinas, Middleton Place was an early estate featuring formal arrangements of plants and walks, but set in grounds that resembled Capability Brown's country estates.

In New England, most private gardens were tidy herb plots like English cottage gardens but the town plans for these settlements incorporated commons and squares for public outdoor enjoyment.

Patios evolved from Persian traditions of outdoor living, and came into the United States from Mexico with the Spanish. Courtyards were closely linked to the living space of houses and provided overflow space for living, just as the modern deck or patio does. Some of these Spanish designs were cloisters, with large eaves overhanging broad walks. In the courtyards themselves there were wells, flowers, herbs and trees, as well as pleasant places to sit in the shade. Because interior rooms often opened directly onto the court, access was easy and the court was the center of the house.

◀ **Versailles, grandest collection of Western outdoor rooms, spreads out from a central axis with designer le Notre's intentional cross axes and diagonal axes, punctuated with frequent outdoor sitting rooms.**

Natural-looking meadows and groves create sylvan spaces; grand rooms for hamadryad play in Capability Brown's reordering of the English landscape. Hidden extents and enclaves surprise and delight, contrasting with the formalism of le Notre's Versailles.





Invite outdoors in and indoors out.



As you think of your space, consider how easy it will be to get to and from the house, and think of the links between other "public" rooms — inside and outside. Does the living room open directly onto space you could use for the patio, or will you have to go through the kitchen to get out to it? If access is not direct and easy, and if there is not a good flow between the areas that you will want to use for entertaining or when home alone, consider how you can modify your house access to improve the situation. Perhaps a window can be made into a door, or a new sliding glass door can be put into a solid wall.

If you have a garage out beyond a possible deck or patio site, perhaps its wall can help establish the character of a courtyard. Like the Spanish patio, your space may need deep shade. Can your eaves be extended or a trellis built?

Family tree house catch your fancy? Though you shouldn't attach a deck to the ground *and* a tree, you might have a very big old tree that could support a tree deck by itself.

Perhaps you enjoy busy public spaces. Do you see the sidewalk cafés of Paris or Rome as environments you might want to emulate? There, backwaters of quiet push out into the busy street life where there is lots to look at as people work, play and live. Your patio site might offer these opportunities. If you have a large family, a patio like the sidewalk cafe can provide a place for adults to be out from under children's feet but still within chaperoning distance of pool or play area.

Take ideas from wherever you find them. Maybe the woodland spaces of the Hobbits or gardens that Alice saw in Wonderland attract you. Maybe it's the verandas of the grand antebellum houses in the South or the great

porches of houses in New England.

Your role as designer is to discover the character your outdoor rooms should have. Consider the examples we have mentioned and go through your own memories from childhood and travels, not to mention magazines and movies. Make notes of the spaces that appeal to you, and try to detect what it is about them that interests you. You might find ideas for a hedged patio garden in pictures of Williamsburg, or perhaps a movie about southwestern Indians. As you look at different pictures, try to pick out ones that would work as decks or patios for you.

This development of ideas will be very helpful later when you sit down to design your space. If you don't have idea sources beyond the normal backyard solutions that most of us are familiar with, you will be limited in conceiving imaginative spaces and forms for your patio or deck.

The Alhambra, an important stepping stone on the road to modern outdoor rooms, features courtyard spaces that delight the family or its visitors.

Linking indoors with outdoors: The graceful liaison between house and garden rooms is largely the contribution of western U.S. landscape designers. Certainly, the Spanish court and its predecessors first made these links so important. Until recently, however, most house designers didn't consider access to the garden important, and consequently many houses have no direct access except through the back door. Where there are terraces, they are often poorly sited, not taking advantage of the views and providing neither privacy nor visual extension. Rarely are the tricks of perspective played to give the impression of greater space.

You have seen some patio and deck designs that you really admire. In thinking about them, can you identify elements that you want to incorporate in your own design? Does a Swiss

The graceful union between house and garden derives from careful consideration of how the spaces will be used. Outdoor rooms will function best if the links between them and their sizes are logical.





Design Basics

The basics of designing a deck or patio include considerations of space, visual limits, light, color, textures, form and perspective as well as natural considerations like sound, wind, shade and sun.

After several walks around the planning trail, you've seen your possible deck or patio sites with a new perspective. At the very least, you have seen more and different possibilities for your outdoor rooms than you thought you had before.

Now, consider some basic design elements. Some of our suggestions are very general and some are specific, but they are all things to keep in mind later when you sit down to develop your concept design and plan.

Sensory force: Decks and patios are spaces to do things in and to move through to get somewhere else. There is a visual and sensual aspect of space, however, that greatly influences how we feel about being there. It could be called a sensory force — the completeness of the feeling that grows out of successful integration of the uses for the spaces.

In natural environments, a certain equilibrium usually exists — a balance that creates what we often call "natural beauty." But in man-made environments such as your deck or patio, the balance or integration of elements must result from you, the designer, having strongly carried out your intentions.

A strong "flavor": Your outdoor space will be most successful if you anticipate the "flavor" you want it to have, and then follow through consistently to get it. This is like making a

◀ **The Katsura Imperial Villa, built in three stages during the sixteenth and seventeenth centuries, exemplifies intentioned design, relating interior and exterior living spaces. The additions stand like a flight formation of wild geese, and orient decks and views to avoid the hot summer sun and face the full autumn moon. The sensory force prevailed throughout the creation of this extraordinary house.**

stew. If you add a little amount of every spice on the shelf to the pot, the end result won't be as good as it is when you add only the spices that blend well to create a distinct flavor.

In designing spaces, you want to create a distinct flavor by making clear and intentional design statements. This distinct flavor or character will come from clear and simple forms that are used strongly. An example is the use of textures that contrast (but only a few of them). If you are going to use an unusual angle, repeat it regularly throughout the design — don't suddenly start using an unrelated angle. If, for instance, you are using 45 degree angles on one side of the deck, you should not switch to 30 and 60 degree angles on the other side.

Enclosure and separation: **Outdoor rooms are spaces that have some degree of enclosure**, separating them from surrounding spaces. This enclosure is created by vertical projections from the ground. Shrubs, trees, the wall of a building and a multiple of other vertical things can suggest the closing in of space. Tree boughs or trellised vines overhead can suggest an airy ceiling.

You should be conscious of the exaggerated effect of vertical planes in outdoor space. A slight drop or rise in elevation is far more noticeable than a slight extension or contraction of horizontal distance. For instance, it is easy to tell the difference between a 6-foot and 8-foot wall 20 feet away. On the other hand, it is not easy at all to distinguish between a 6-foot wall

that's 18 feet away and another 20 feet away. This point is important in thinking of outdoor rooms because you will want to create a balance between the planes of walls and floor.

Human scale: **In general, spaces are comfortable if they relate** to the scale of the human form. A good general rule says that external enclosures are most agreeable when their walls are one-half to one-third as high as the space's width. If the walls are less than one-fourth as high as the width, the space won't seem to be enclosed. It will leak out, visually, and though it may still serve its outdoor uses well, it won't have the comfort of the sensory force. When the walls are higher than the width, the space may seem to be a trench or pit, which isn't necessarily bad. A small courtyard completely surrounded by high walls can be a jewel of light.

In thinking about enclosure, keep in mind that the space to be enclosed need not be limited to the actual deck or patio area. You may find that your space is formed by trees at the back of the lot, and that what you want to do is feature the vista toward them. You will still want to create a feeling of space on the deck or patio, but you won't be as concerned about its enclosure because that will be taken care of by the enclosure beyond.

The importance of the sense of enclosure really can't be overstated as a vital part of your design. Look around you as you visit outdoor rooms and try to detect how well space is defined. Chances are that you will like best the places with visual limits that strongly define the space.



Visual limits to deck spaces are suggested by railings. Clear statements of these limits create a comfortable feeling of enclosure while allowing views out.

Visual limits: It is important to make clear statements of visual limits when designing. This is sometimes not done in the design of deck railings or fences around patios. It is generally not a good idea to block the line of sight, that is, the zone between about 3 and 6 feet off the floor. When this zone is blocked, the space is visually neither here nor there. Although the edge of a deck or patio may obviously be its actual limit, if its edge supports a visual barricade 3 to 6 feet tall and open below, the space will leak out under and over the barricade. If the

railing or fence goes all the way to the floor, or even just down to 2 feet from it, the space will close in visually; if the height is raised to 8 feet, the space will close in even if open below 3 feet.

On the other hand, a wall 5 feet tall and solid to the ground may not seem to close in the space — and one 4 feet tall certainly won't.

Railings or other permanent obstructions in or spanning the critical line-of-sight zone create ambiguity by partially hiding the view. They tend to make us feel neither safely enclosed nor free to view the world. It is an uncomfortable sensation to have the normal horizontal plane of vision interrupted, either when sitting or standing. To avoid interrupting this zone of sight, make any solid barrier 2 or 3 feet at

most, or have open framework to the required height. If an obstruction must be solid within the critical 3 to 6 feet, it may be better visually to make it higher, definitely enclosing the space and blocking out the entire view.

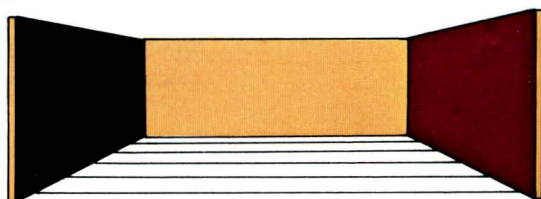
The edges of space — of your deck or patio, or of the earth and the heavens — must be either curved or straight. Usually decks have straight edges because lumber comes in straight pieces. Patios are more often constructed with curves, because paving materials are easily constructed in curving lines. Decks also can be built along curving lines, but when they are, the supporting structure may have to be complex.

When using curves, be careful not to use too many tight circles and loops. They can detract from the strength of the design. An example of this would be a patio with a sharply curved edge that neither increases the size of the space nor strongly suggests its limits. It is better to use curves with the same radii or with regular radial differences — such as 4, 8 and 12-foot circles rather than 6, 8 and 12-foot circles — if you are creating many curved forms. If only a few are being used, sharp differences in radius may be justified.

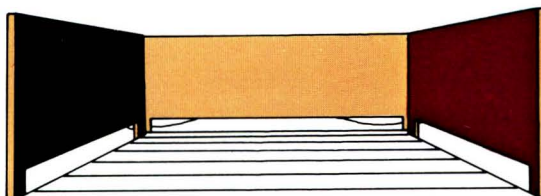
The interface between curves and straight lines can create interest. Blending the two in a repetition of angles and gentle opposing curved lines is pleasing. This form is found in some Japanese gardens, where observation decks have some straight sides and some rock and gravel sides curving in brilliant contrast.

You should be very careful in using curves to be sure that they make a strong design statement. Unrelated curving forms can be as destructive of spatial integrity as meaningless straight-edged forms. Your outdoor rooms can have both straight and curved lines as design elements so long as they are used sparingly and strongly. In considering curved edges for your space, remember that trees with billowy canopies or groundcover plants that grow over the straight edge of the patio pavement are part of the total design. In looking at your site from all angles and without preconceptions, part of what you will have noted are the natural curved forms you can incorporate into the design.

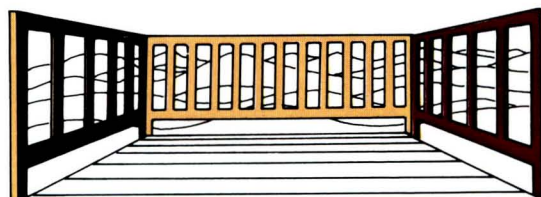
Line of sight



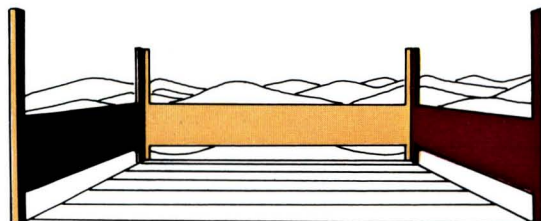
Space completely and comfortably enclosed . . .



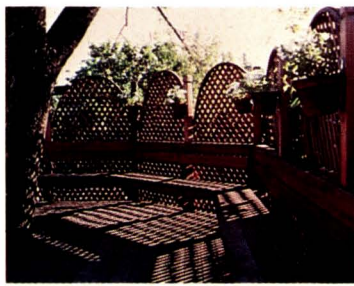
Uncomfortably open only at the bottom . . .



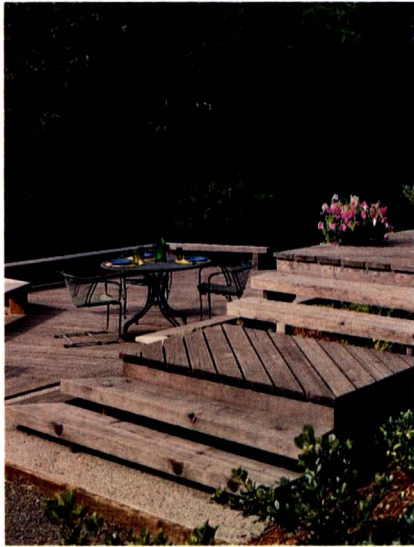
Vision uninterrupted by openwork railing . . .



or solid wall below eye level.



Another way to define visual limits is to block out a view, as with the delicate lattice work in the distant-ground which encloses the space.



Rounded trees and shrubs soften angular designs.



The radiating spokes of a circular design can symbolize solar projections, leading the eye and emotions out beyond, or, like the roads to Rome, drawing to the center.



Curved forms, strengthened by seat-high brick borders, undulate to create a "backwater" dining area out of the circulation pattern, amid the planting.



Boardwalk rises and curves to conceal landforms and highlight images.

Light: Daylight and night lighting, because they reveal space, are basic parts of outdoor design. The quality of daylight varies and is influenced at any particular time by the site location and orientation. During the course of a single day and during the seasons, the effects created by daylight will greatly influence the character of your design. At night, natural light from the stars and moon, and artificial lighting — both from beyond the site and lighting specially designed for it — will vary with condition of foliage, reflectance of night air, and colors of objects placed in the light. Although it is a basic quality of all spaces we live in and move through, light is not easy to understand. Tricks of light and color can have pro-

found effects on the sensual force of space, increasing or decreasing apparent size, giving off warmth or coolness, revealing fine and coarse textures, concealing complexity and creating it with shadows.

Color: Color as a quality of light is usually thought of in terms of **hue** and **value**. Hue is what we see that identifies the color as blue or orange. Value is the quality that makes it seem light or dark, as in a light blue or dark blue. It is rare to find pure hues of color in nature, and when we do in bright autumn leaves or true blue sky or eyes, we take note. Usually the colors we see are hue mixes at various values.

Intense hues may evoke emotional responses, as does a reflectance of high value. It is unpleasant to be in a highly reflective outdoor space on a bright day. Because of this we wear dark glasses to reduce the light or value. Overcast sunlight diminishes value, as do tree canopies, outdoor space covers and big brimmed hats. What might be an objectionable color of chaise mats in full sun might be quite agreeable in the shade of an umbrella.

On earth, where an atmosphere must be looked through, both hue and value are increasingly modified the further one is from an object, by dust or a pollutant in the air. For this reason, a pure hue or high-value color in the distance will not have the same intensity as close at hand.

Light striking surfaces can be identified as front light, back light or side light. If you had a family portrait taken, silhouettes and contrasts were probably heightened by side-lighting. On a spring day you have almost certainly looked up through the pale new leaves of a street tree, and the back-lighting has made them seem to glow. Back-lighting is usually associated with the low sun early in the morning or late in the day, but it is also a popular night-lighting technique. Lights are hidden behind a solid barrier so that only the diffused light away from the source strikes the far side of foliage or objects.

Front light and high intensities of light tend to produce reflected rays that mask the effect of shadows. As you design you may want to manipulate the available light to cast shadows that will strengthen created forms. To do this you must be aware of sun and moon angles and the seasonal effects of light in your latitude. Because shade has a profound effect on the temperature of outdoor spaces, you will want to study the shadow patterns cast by house and trees in siting your deck or patio.

Colors affect the feeling and perspective of space. Blue or gray colors strengthen the atmospheric perspective and thus seem further away. A light-colored space will seem bigger than the same space painted a dark or warm color.



Daylight streaks the forest floor and casts rays and shafts of highlights. At night, the moon and artificial light influence the extent of the deck.

Forcing the perspective: In looking at the horizon, we see into the foreground, middleground and distantground. The complexity of these three spaces — that is, their perceptible texture and form — is simplified as we look from foreground to distantground. This is useful to understand in planning outdoor rooms, because it allows you to play tricks on the senses. In “forcing the perspective,” you can make middleground objects appear to be in the distantground by reducing their scale or by giving them finer texture: by this, we mean leaf size or shadow depth, or any other quality of the object that seems to establish its size or the size of its components. Coarse-textured gravel looks different from coarse-textured plant foliage; although both are coarse, the gravel has a finer texture than the plants.

You can also force the forms to simulate greater perspective than actually exists by changing their size. In the theater, the further upstage a piece of scenery is, the smaller it is painted to make it seem further away.

In laying out your garden rooms, this trick can be useful. If, for instance, you have a space only 10 feet wide at the side of your house, imagine what you could do if you forced the perspective with a lattice work of modules that decreased in size as it focused on a central image.

If you have a space you want to expand to look out onto from the deck or patio, use progressively finer textured plants the further away they are from the patio or deck. If your situation calls for just the opposite (the space being too big for intimacy), force the perspective inward by using larger textured plants in the middleground and distantground and by increasing the size of fence modules or furnishings the further away you go from the main use area.

It is also possible to play tricks by combining texture reduction for forced perspective with a spun-off vanishing

point. Objects in the actual middleground are smaller, as if in the distantground, and also the floor plane is directed around what seems like a natural edge and out of sight. An

instance is a lawn that tongues out of sight behind shrubbery, leaving the impression that it goes on forever, or at least further than it actually does.



Thomas Church, landscape architect master of forced perspective, created expanded space in a narrow side garden with theatrically manipulated lattice and forced textural perspective. Small leaved azaleas in the “distance” contrast with the larger leaved pittosporum in the “foreground” above.

Observer position: In discussing enclosure we noted that differences in vertical elevation have a stronger effect than differences in horizontal distance. With that understanding it is useful to think of what landscape architect Burton Litton defines as "observer position." This is where you are, or where your deck or patio is sited, in relationship to the vertical plane of forms. Litton defines the possible positions as "observer superior," the view from above — from an upper level of a deck, from the roof or down into a valley; "observer normal," the usual horizontal view; and "observer inferior," the view looking up into trees, perhaps, or at a mountain or building above the space.

In choosing your deck or patio site, recognize that the connection or interface between your house and outdoor room will be affected by the observer positions. If the view is mainly up and out of the space, you will have more of a feeling of being enclosed than if the view is mainly down and outward. In the latter case, you may create the exhilaration of an observer superior by exposing grand views. The confines of the space may be extended to the horizon, but a sense of security can still be given by a solid railing 30 inches high. Consider the observer position as your design concept grows in your mind.

Connections and sequence: As you start to create your spaces, keep these ideas in mind.

Remember that the enclosures you design will be centers of activity or relaxation. You will want to plan the connections of the various spaces — the liaisons between house and deck or patio and garden — to facilitate separate uses. You will also want to separate public and private spaces. A hot tub on the deck, for instance,

should be sufficiently screened from the sidewalk to provide privacy but you may want to have it directly adjacent to the living room. What is the logical pattern of connections — kitchen to serving to dining to clean-up? Think of how you will move through the spaces and how their connections should be.

Connection of space is a possible source of excitement if you can plan for it. Concealing and unfolding views — the opening and closing of space as you move — are ephemeral pleasures that can be experienced time after time. A series of small spaces — parts of your deck or patio — can serve the separate uses you identify as necessary and they can undulate, interrupting or accenting the space with sequence. Spaces in a continuous balanced pattern, seen and experienced as they are moved through, heighten their form and strength.

Do not think of your planned spaces as being flat. They will be experienced in three dimensions, and you must plan them with all of their dimensions in mind. You can easily see or imagine the connections between two dimensions, but you will have to work hard at mentally seeing the actual spaces with three dimensions as you are drawing your design plan.

Mystery in space is pleasing as long as we can see the suggestion of a solution. It is never pleasant to be in a maze where there seems no escape. If there are visible objects beyond the maze that give us basic security, however, the mystery can be exciting. In outdoor space design, this idea can be carried out as a baffle wall that doesn't let us quite know

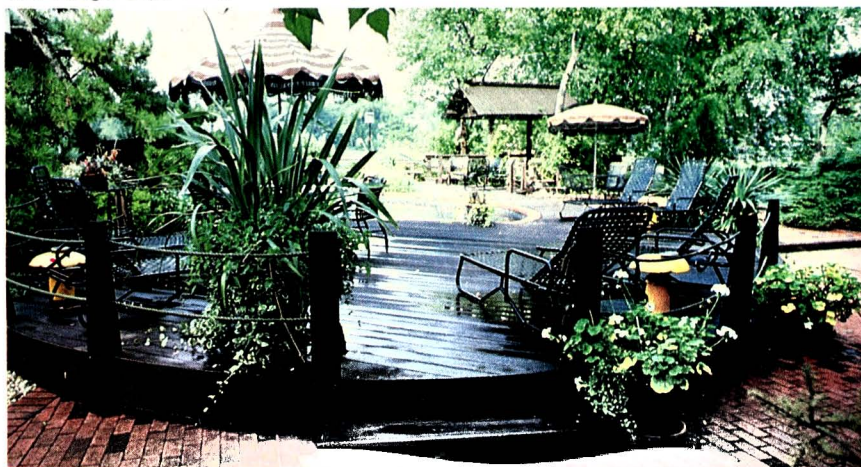
what's beyond. This could be panels 6 or 8 inches wide and about 6 feet high angled to openings. As you walk along, you get just a hint — as in an old-time movie — of actions happening beyond, flashes of what is there. This partial knowledge can create interest.

Another useful space trick is to extend the ground plane out of sight around a solid object, as earlier described. When the lawn disappears around the shrub mass, we are left wondering where the lawn ends. From the deck or patio, it may seem far away, but in actuality it is only just a few feet beyond the shrubs. This disappearing lawn is so interesting to look at precisely because we can't see it all. Paths in the garden and private sections of the deck or patio can take advantage of similar design tricks, disappearing from sight, perhaps to reappear.

Axial orientation: Views can be heightened by opening "windows" in foliage masses or by orienting your deck or patio toward them. If there is a view that you don't want to see, turn the space away from it by screening, by placing an eye-catcher somewhere in the desired view, or by turning the structure itself so it is actually faced in another direction.

Spaces have visual direction when they open toward views. Sometimes they have axial alignments, which are apparent visual lines running perpen-

Connections and sequences highlight the different uses intended for the several parts of a design, separating active from passive use areas and ordering them in sequence.





Axes are by definition straight, but a strong visual leader, like an arc of pavers, creates similar visual effects, guiding the eye to or from a space.

pendicular to each other or in radiating arms. In Washington, D.C., for example, major streets radiate from the Capitol. At Versailles, walks radiate out from cross axes on the main axis that forms the grand canal (see painting of Versailles on page 16). By taking advantage of the human response to look off into the direction that is suggested by design orientation — staircases, seating arrangements, plantings and so on — you can heighten or downplay neighboring views according to their desirability.

Texture: We have made reference to texture as an element of forced perspective. The texture of the floor and walls and the colors chosen for them can unify and set off different areas of your outdoor rooms.

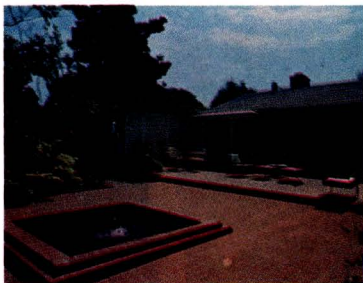
The surfaces of the floor and bench and railings impart sensations of touch

as well as sight, and can have controlling influences on how areas are used. A rough floor surface, for instance, will slow down traffic. Pea gravel adjacent to wood decking will, as a walking surface, create a very different walking pattern. If used consciously, these textural differences can give you, the designer, a means of controlling where people will walk and congregate and where they will sit.

Fine textures such as lawns, moss and large smooth pavements tend to accentuate the mass and shape of the



Different textures, used to separate functions or to highlight the strong character of a design, add to the sensual force. When used spottily, weakly or in odd erratic patterns, however, the result can be reminiscent of a samples display.



A form will relate to adjacent forms to increase or decrease the sensual force. If angles and curves are simple and of a family, strong designed forms will result.

ground form itself and to increase its apparent size. They often act as a neutral screen or background for other textural elements placed on them — furnishings, sculpture and people.

Coarse textures such as cobbles, bricks, tufty grass, herringbone decking and redwood blocks or rounds call attention to the surface itself, not the form or objects on it. For this reason, you should consider what texture range you are going to use to down-play the form of the topography or highlight it.

In dealing with textures, as with all other design criteria, be clear in your intentions. Use coarse or fine textures, and materials of strong color definition sparingly and dynamically. Avoid mixing too many textures in a single pavement area, but do distinguish special intricacies or use areas with textures and textural contrasts.

For example, you can form a giant chess set in a paved patio by contrasting bricks laid out in the chess-board pattern. Concentric circles of cobbles can be used as entrance court pavings. Or a course of bricks along the edge of a curved exposed aggregate patio can define its limits, then run off to define a path away from the patio itself.

In a patio, an area intended for barbecuing might be surfaced with smooth concrete (which is easily cleaned) while the remainder of the patio could have an exposed aggregate surface and thus be less reflective of light or more visually formal in keeping with use as a "living room."

Textures are a detail consideration in your design, and will be chosen at the working drawing phase of the project. But in the early concept phase, you must begin to form ideas about the eventual complexity desired.

There are many other general design considerations to keep in mind as you create your deck or patio plan. Spaces and forms, when consciously designed and intended to do so, can produce satisfaction beyond merely meeting use demands.

Form: Spatial forms sometimes have common symbolic connotations. Vertical forms can bring a sense of awe. Depending upon scale, the vertical could be the north face of Yosemite or a high wall on your neighbor's garage, painted to impress with its height.

Diminutive and intricate forms evoke curiosity and interest. Details of pattern in medieval cobble pavements are an example. The upthrust, heaven-oriented character of tall slender verticals is illustrated in rows of columnar trees and some garden sculpture.

The horizontal line is a static form, passive and apparently permanent, just as water rests in the horizontal.

Circular forms appear to have a closed or static nature. The ring is a symbol of this closure on fingers and in space. In space, circular forms may

be islands out of the traffic, like eddies in a rushing stream. In an entryway, circular forms imply that it is a place to wait, entire of itself. When the door is opened, it is no longer a circle; the opening directs the visitor out of the entry and into the building or into the next space.

Projecting and jagged forms suggest dynamism. Jagged structures may imply speed or strength. They also may look merely sloppy. Projecting forms can imply power. A cantilevered deck, for instance, from which the footings aren't visible, will seem to defy gravity, floating in air, dynamically creating space.

Low, shelflike coverings — caves, canopied walks — imply protection. Like the spatial compression earlier defined as observer inferior, down in a narrow crack looking up and out, the low ceiling accents the horizontal, making vertical expansion strikingly dramatic upon coming out of confinement to open sky.

Similarly, the freedom of the open desert and prairie can be oppressive in its abundance, causing us to yearn for mountains or buildings that confine us. In a very open and level site, the juxtaposition of open and covered spaces makes both independently more interesting. On your deck, a big umbrella or trellis may add the quality of confinement you need.

Space created with an understanding of these basic realities of form and its elements can influence function and the sensual force that creates unconscious comfort.

Enclosures imply protection, and for some deck or patio uses, can be as elemental to sensory force as the walking surface itself.



Shadows contribute their migratory patterns to the collection of textures.



Temperature is a combination of direct sunlight, temperature of still air, the relative humidity and wind. As long as the relative humidity is between 20 and 50 percent, the comfort range for outdoor rooms generally lies between 70° and 80°F. When the relative humidity rises, it becomes increasingly uncomfortable at lower temperatures. If there is a draft, however, the comfort range is increased until the wind velocity reaches about 3½ miles an hour, beyond which it is probably too windy to be comfortable.

Cold air basins: Topography, or the land's form, generally influences the flow of air over it. Just like water, cool air hugs the ground and flows from high to low elevations. This process is dramatically revealed in areas where fog can be seen flowing down

mountains into valleys and canyons. At night, cool air will flow downhill and collect in pockets and reservoirs, held in by hills and buildings. If your patio is on the uphill side of the house situated near the bottom of the hill, you may discover that the temperature on the patio at night is higher than on the other side of the house where cold air is trapped and held. This characteristic of air movement was responsible for the sites chosen for classical Italian villas — far enough below the crest of a hill to be in the lee of prevailing winds, but not near the bottom of the hill. Cool breezes fan such locations on hot days, but cold storms and night air have less impact.

Microclimates: Shadows, wind and sound are environmental conditions that must be considered in creating your design for the enjoyment of outdoor rooms. If any of these influential elements is critical at your site, you should do some additional checking to be sure you understand their influences at different seasons. Even if you live in an area with a gen-

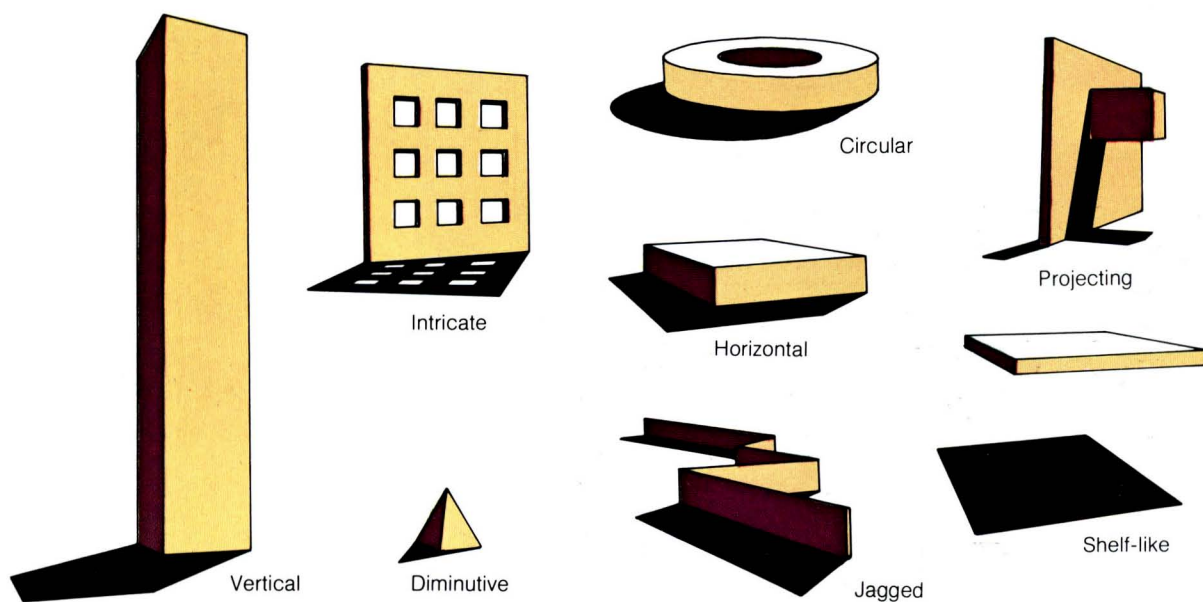
erally good climate, through design you can create microclimates that might be even better. By altering prevailing winds and creating more surfaces that collect and hold or discharge heat, your patio or deck can be a lot warmer or cooler than surrounding areas.

Heat: Surfaces have varying abilities to absorb and reflect radiant energy or heat. A perfect mirror, for instance, reflects back everything that shines on it without holding heat itself. A perfect matte surface, on the other hand, reflects no heat back but soaks it all up. Wet or dark-colored surfaces tend to be more heat absorbent than dry or light-colored ones. Most natural surfaces, such as stone, are relatively heat absorbent.

Conductivity is the speed at which heat or sound will spread through a material. A highly conductive material, such as metal, allows heat to flow rapidly through it and retains just a little. A surface with low conductivity, such as insulation board, will also hold little heat but will release it very slowly over time.

The speed of wind has a great effect on heat retention of objects and of the air mass in a space. The speed and extent that heat and sound spread out depend on wind and its turbulence.

Forms



Sound: Noise is distributed and contained by air movement or winds. In some instances, it is a desirable quality that should be fostered. An example is the splashing sound of a stream. When a pleasing sound is intended in the design, plantings and structure must be designed to limit deflection and absorption. Since noise is carried by air movement, if you want to hear it, be sure not to block the air flow. If, on the other hand, you don't want the noise — street noises or neighbors — or you want to tone it down, you will want to design the space to baffle and obscure the sounds as much as possible. To do this, create solid walls and windbreaks that reflect and deflect the sound away from the site. Where the noise is too loud to be deflected, it can sometimes be masked by adding pleasing sound to it. A good example of this is New York's vest-pocket Pailey Park, where city traffic noises are masked with a waterfall.

Noises can also be disguised by plants that have rustling leaves, such as poplars.

If noise is a problem on your site, perhaps because you overlook a busy road or the neighbors' property dominates yours, consider solid walls for either deck or patio, and the ways you could add the sound of rustling leaves or moving water.

Wind: Wind tends to increase in velocity above ground obstructions that cause turbulence. At different elevations, strikingly varied directions and speeds of wind are shown by the movements of smoke or clouds. Close to the ground, too, there can be substantial wind speed differences. The wind speed at 1 foot above the ground may be only half that at 6 feet. This fact can make a difference if you are designing a quiet-use area on the windy side of the house. Enough shielding to protect someone sitting there could come from a 2-foot barrier. Be-

cause wind close to the ground is slower, the screening requirements for comfort in this zone are reduced.

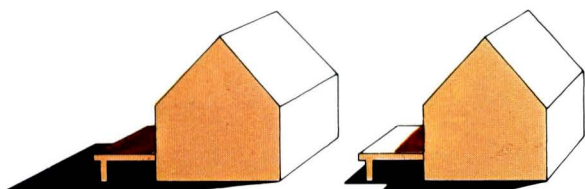
On a cold day, if you can get out of the wind, the cooling effect of the moving air will be greatly reduced, and similarly, on a warm day, exposure to breezes creates a cooling effect.

Windbreaks: The objective of windbreaks is to block and divert winds without creating turbulence or low pressure basins that will draw the wind down and into the protected area.

A solid vertical wall isn't a perfect windbreak because it causes turbulence, lowering the temperature on the protected side. Instead, a windbreak should deflect and guide the air flow over the protected area. Thick belts of shrubs and trees that are progressively higher the closer they come to the protected area can reduce wind speed by as much as 50 percent for a distance downwind on the protected side as much as 10 times their height.

Windbreaks and soundbreaks, coupled with pleasing sound maskers such as moving water and rustling leaves, can modify outdoor rooms and improve their sensory force.





Shadow patterns vary with the time of day and season of the year.

Shade and sun: Shadows and shading are major influences on the temperature of outdoor spaces. In areas of year-round cool weather, you will probably want lots of sunshine and little shade. In areas where hot weather is usual, the reverse will be true.

Earlier you made mental notes of where the shadows were at various times of the day when you walked your loop trail of observation. In some cases this knowledge might be enough to base your design on. If sunshine is critical — either because you want to trap warmth or avoid the heat — you should study shadows on the site to determine and estimate their actual extent at all seasons.

To study the shadow patterns at various seasons, use the tables to calculate the length of shadows cast. Another way to study the site is to make a simple model of it. Tilt it at the angle corresponding to your latitude and make scaled observations of where the shadows will fall.

Orientation is the slope of the ground surface relative to the angle of the sun. In the northern hemisphere, ground surfaces facing north have less sun than those facing south. The further north your site is, the greater the effect of this orientation will be, and the closer to the equator you are, the less effect it will have. Heat from the sun is most intense on surfaces that are perpendicular to the sun, regardless of the orientation of the

ground. The angle needed for this maximum exposure will, of course, depend on the latitude, season and the time of day. As the orientation of any particular site is tilted to the south, the direct heat radiation is increased. For instance, land with a 10 percent slope to the south will get the same direct radiation as a flat site 6 degrees closer to the equator. This is roughly the distance between San Francisco and San Diego, or between New York and Atlanta. Similarly, the orientation of a deck or wall surface will make a great difference in how warm it is. For instance, a wall angled to collect direct sun will be warmer than an adjacent vertical wall. Solar panels are oriented to take advantage of this fact, and in your space, absorbed and reflected heat can, like solar collectors, warm this area.

You may be thinking of using solar collectors to heat the house water or pool. Consider if and how you can incorporate their angled orientation into the general design of patio or deck. Can collectors be built into the windbreak with the south-facing surface serving both collector (heat) and deflector (wind) functions?

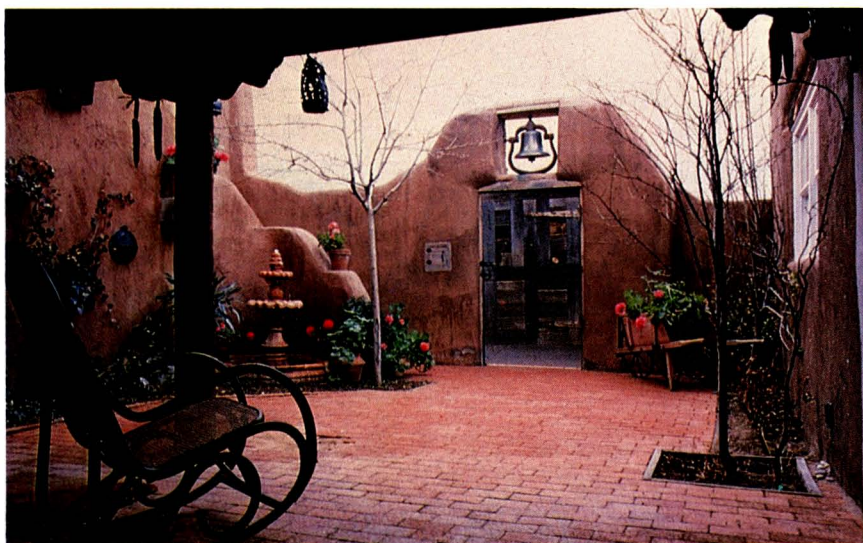
The sensory force — that sum of qualities resulting from conscious design decisions — will make your deck or patio rooms much more than just activity areas. With it, your designs can create beauty, balance and comfort. If you consciously consider all

these qualities in your design, whether they apply to it or not, your spaces will be more defined and successful.

Design testing: As you develop your concept ideas, check them against each of these design parameters:

- ☐ Simple forms
- ☐ Natural beauty
- ☐ Strong repetition of forms
- ☐ Enclosure
- ☐ Human scale
- ☐ Visual ambiguity and clarity
- ☐ Curves
- ☐ Straight lines and edges
- ☐ Light (reflectance and direction)
- ☐ Color (hue and value)
- ☐ Light (daytime, nighttime)
- ☐ Observer positions
- ☐ Connections, liaisons
- ☐ Sequence
- ☐ Mystery
- ☐ Axial orientation
- ☐ Texture
- ☐ Massive surface
- ☐ Diminutive object
- ☐ Forced perspective
- ☐ Vertical projection
- ☐ Horizontal line
- ☐ Circular forms
- ☐ Projecting and jagged forms
- ☐ Horizontal compression
- ☐ Vertical compression
- ☐ Openness
- ☐ Temperature (seasonal, day and evening)
- ☐ Microclimates
- ☐ Heat
- ☐ Noise
- ☐ Wind
- ☐ Shade
- ☐ Sun orientation

Can you now strongly carry out your design intentions?



In hot climates, shade is beloved; deciduous trees are equally revered in cold areas for their bare winter branches which don't block the warming rays of the sun.



The Designer's Workbook

How you design your deck or patio not only means drawing a set of plans, it also means staking out a grid, deciding on your elevations, and creating your concept design.

D

esign is a process, not just an end. Like a piece of written music, it is a notation of how you might later do something. Or you can think of the process as a recipe in which you can try out different ingredients until it suits your taste exactly. Repeating the cycles of observation and evaluation will force you to reexamine the reasons why you are doing something, and either refine or reject it.

You should be able to design and build your deck or patio with the help of this workbook. There may, however, be aspects of the project that will require professional help. If your deck is going to be more than 6 feet above ground, or if you need stout retaining walls or other special improvements for the patio, then consider contacting a licensed landscape architect, architect or civil engineer at least to check your plans. During the actual construction, you may run into special conditions that require the assistance of a skilled carpenter. These experts can be hired on a day-to-day basis.

For most situations, however, you'll find that you can plan your work from the information in this book. The design process may take you almost as long as actual construction. Remember, though, that it is infinitely cheaper and easier to make changes on paper than in wood and stone. That's what the design process is all about: thinking through the changes and getting them down on paper.

Question your requirements: How do you use your garden (or site) now?

How would you prefer to use it?

What do you most like about it?

The objective of a design process is to discover requirements and limitations so that the eventual spaces will accommodate expected uses.

What don't you like about it?

If you have children, what specific uses will they be growing out of and into?

If you have pets, do they have any specific requirements that would influence your design? Do you want to shut them out or let them in?

What specific uses do you want to plan for? Dinner parties, sunning, recitals, to look at, for quiet talks, the kids to play in, as storage? How do other members of your family plan to use it: get them involved if you can, perhaps by having them each do a concept plan for you to get ideas from.

If you were to think of various parts of your garden, or your deck or patio site, as outdoor rooms or extensions of indoor spaces, what would you call them? (Living room, kitchen, den?)

What is the architectural style of your house and should the deck or patio design be consistent stylistically with it?

Do you prefer a particular design style — formal, natural, Japanese?

What other ideas would you most like to include in your design? Perhaps a reading room or aviary? Let it be your own special place.

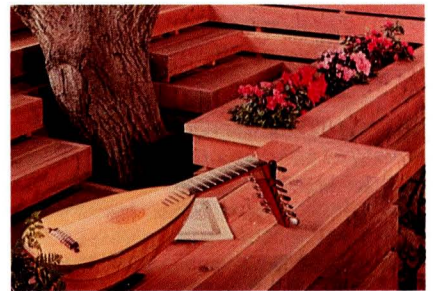
How much can you spend on the improvements? Pick a figure that you can live with comfortably. Remember that the improvement will increase both the property value and your enjoyment of your home.

How much time will you have to build the deck or patio? Remember, it always takes longer than you think.

How much time will you have to maintain it?

How long do you expect it to last? If you are planning to live there for many years, the greater expense for some things you want may be justified.

How available are materials in your area?



Recitals and musical events can be planned for through spatial design.

Where are the underground utility lines in relation to your site? Check with the utility company if you can't discover them yourself.

What local building codes will apply? Check with city hall on this one.

Are there easements, setbacks or other zoning regulations that will influence what you can do?

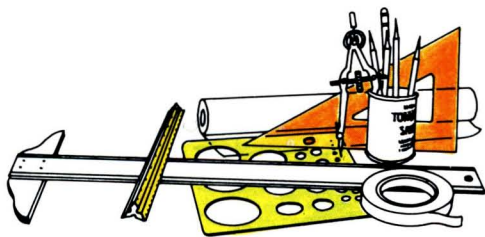
To find out about easements, zoning regulations and setbacks, call city hall or the building department. There, city officials will advise you of current regulations, setbacks in your zone, easements and other special conditions that might affect your plans.

Does what you are planning affect the neighbors' interests?

Do you have a scaled plan of the site, perhaps from the grant deed or from earlier work on the property?

Do you have the tools, skills and patience to complete the project?

You may not be able to answer all of these questions fully, and some of them might not apply to your situation. There may be other questions that you should get the answers to. If there are, jot them down. It is helpful to identify what you don't know about your requirements and needs so that you can be on the lookout for the information. Other answers to the questions will develop as you work into the evaluation and synthesis phases of the design.



For detailed design plans, purchase the following materials: one pad 18 by 24 inches 1000H $\frac{1}{4}$ -inch tracing graph paper; one roll sketching paper/tracing tissue, 14 inches wide; one transparent 6-inch, 45 degree triangle; one transparent 8-inch, 30/60 degree triangle; an architect's flat scale; one roll drafting tape; an eraser; a drafting pencil; soft and hard

lead pencils; a small circle template, a ruler and a compass. Additional equipment for more technical drawings will include a 24 by 36-inch drafting board, a 36-inch T square, an architect's scale, a lead pointer, and an eraser shield. (You can do a good job with some graph tracing paper, ruler and a 50-foot measuring tape for the outside dimensions).

Redefine and refine your concepts: Allow yourself to go back to review your earlier observations and refine your concepts. This is the evaluation or critique phase of the project. Give yourself every opportunity to refine your program because soon you will need to synthesize the information and create your first concept design.

The activity of making plans, verbal and graphic, is essential. The design advances as you record, study and improve upon your thoughts. Making notes, circling ideas that you like in pictures, and drawing out your original ideas are all intermediate steps to a design solution. The more you strip away areas of indecision and replace them with thought-out solutions, the closer you will be to having a design that will work well for you.

Your plan will be as useful as you make it, reminding you what you have decided to do. Working with tracing paper overlays on top of a base plan of existing conditions, you can experiment with a variety of forms for your deck or patio. Lay out rectangles, cir-

cles, angles and freeforms in a variety of sizes and configurations, each on a separate overlay, and try them over your base plan.

After working out several conceptual designs, choose one or a combination of several for a complete concept design. At this point in the concept phase, your attention should be limited to general use and site needs. In Chapter 6, you will refine your plan as you decide on actual materials and methods of attaching them.

Tools for drawing plans:
Designs for decks and patios can be drawn freehand or with the aid of mechanical drawing tools — T square, triangles and templates. For the purpose of accuracy, your final working drawings (see Chapter 6) should be measured with a ruler or architect's scale. This scale is a handy tool because it calibrates dimensions directly into the scale you are using. For example, instead of measuring $1\frac{3}{4}$ inches with a ruler at $\frac{1}{4}$ -inch scale, the architect's scale will show 7 feet.

You can draw most of your plan freehand, then use the triangle and architect's scale to establish angles and dimensions.

With the drafting tape, attach two pieces (one for padding) of the tracing graph paper to a flat table at good working height where there is good light. Use the rolled tracing paper for quick sketch studies as you work through the process. For full overlays, use additional pieces of the graph tracing paper from the pad. The circle template and compass will allow you to measure and draw any circular forms you choose to use in your designs. A soft lead pencil is ideal for making the early freehand sketches. The hard pencils give a finer line, and thus are more suitable for the later, precise drawings.

As you draft your plans, don't get entranced with using the mechanical equipment such as triangles and templates. They are tools to assist you, not to direct you.

If you choose to work with the more technical drafting tools, including drafting board and T square, you may produce more professional looking drawings. But remember that the purpose of mechanical drafting is to make lines that indicate precisely defined thoughts. For this reason, the concept design should be done freehand and the mechanical aids kept for later base drawings of known facts and working drawings that show exact dimensions and conditions.

For most projects, several different scales are used, depending on how detailed the particular plan needs to be. The larger the scale, the more detail can be shown. To choose a scale for any particular plan, keep in mind the information you will need to portray. If you are working with a very small space but one that will have lots of details to note on the plan, choose a large scale such as 1 inch = 1 foot. If your site is very large, you may need to use a scale of 1 inch = 20 feet or even more for the initial layout. You will later need to separate out detail areas for study at a larger scale.

For most patios and decks in residential situations, $\frac{1}{4}$ inch = 1 foot is a good base scale. It's small enough to include the whole project on one sheet but large enough to note details.



Co-author Lin Cotton completes a preliminary plan with simple drafting tools that you can also buy and easily learn to use.



One way to lay out the general plan for your deck configuration would be to lay down nylon cord or, as illustrated, mark your proposed site with garden hose.

B

ase plan: You have tracing graph paper taped to a table (or a drafting board).

If you have a scaled plan of the site or can get one — from the builder, former owner, city building department, perhaps a survey for the original building plan — adjust it for your scale and copy the fixed objects off it to save yourself a lot of measuring. But first check the older plan to make sure it

was correctly drawn and is still accurate — that trees haven't grown or disappeared, for instance.

By this time you should have narrowed down the possible sites for the deck or patio, and although you may not yet know the exact dimension, you can define the general area within a few feet.

If you don't already have a base plan drawn to scale that shows existing conditions, now is the time to make one. It can be very easy and lots of fun. Using a 50 or 100-foot tape measure, go out onto the site and start taking measurements that will be transferred to your plan.

If your site is adjacent to the house, take the house wall as the base or reference line. Orient your plan so that when you draw the first wall line, after measuring it, you leave yourself room to draw the rest of the site on the sheet. Always orient the plan with north at the top or left side. This is standard practice and will make it easier for building inspectors or other people you may call on to orient themselves. Note north somewhere on the plan and the scale you are using (probably $\frac{1}{4}$ inch = 1 foot). If your deck or patio is to be away from the house, you can use the line of a fence or out-building wall as your reference line, and measure subsequent lines off from it. If the deck or patio is to be separate from all other fixed objects, stake off a straight line with nylon string to use as the reference line, and make subsequent measurements from it.

Stake out a grid

With a bundle of nursery or construction stakes (18-inch 1 by 2s are fine), and with nylon string, stake off a grid of squares — perhaps 10-foot squares — covering the extent of the site and based on the reference line. From these grid lines measure other fixed objects that could influence where you build your deck or patio, and draw the objects to scale on your base plan. Include house walls, fences, shrubs, spigots, pools, paths, utility lines overhead and underground, drainage courses, property lines and setbacks.

Check your accuracy occasionally by triangulating on freestanding objects such as trees or fences. To do this, measure back from a known point on the base line and run a right angle out to the object. Check your right angle by marking off 6 feet on one side and 8 feet on the other. A line connecting the two — the hypotenuse of the right angled triangle — should then be 10 feet if your angle is correct. Check the measurements, and on the grid-sheet base plan, make any corrections that are necessary.

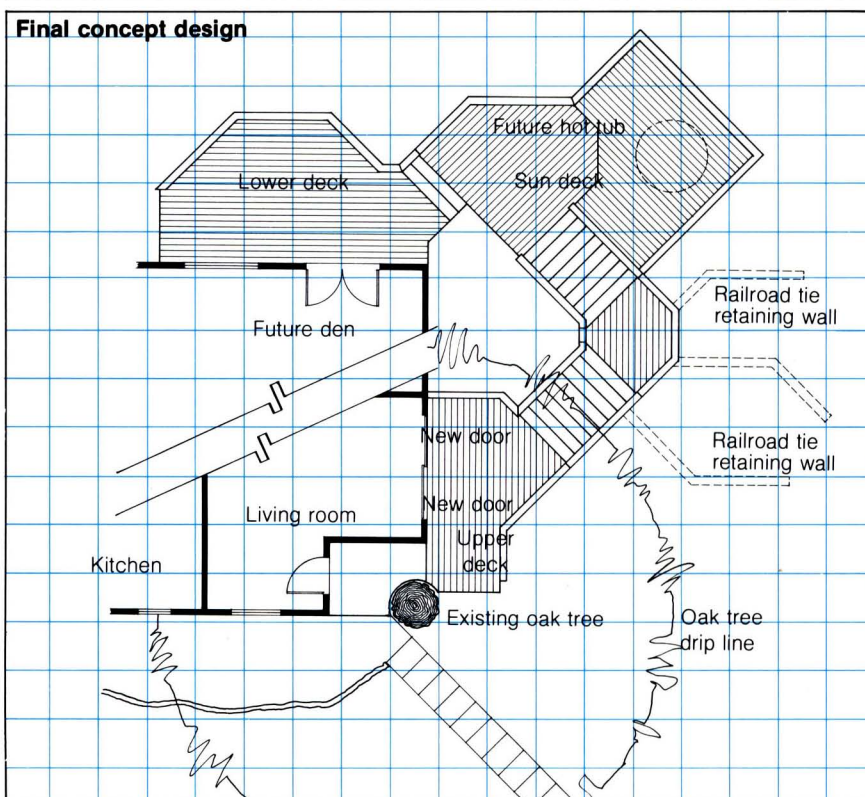
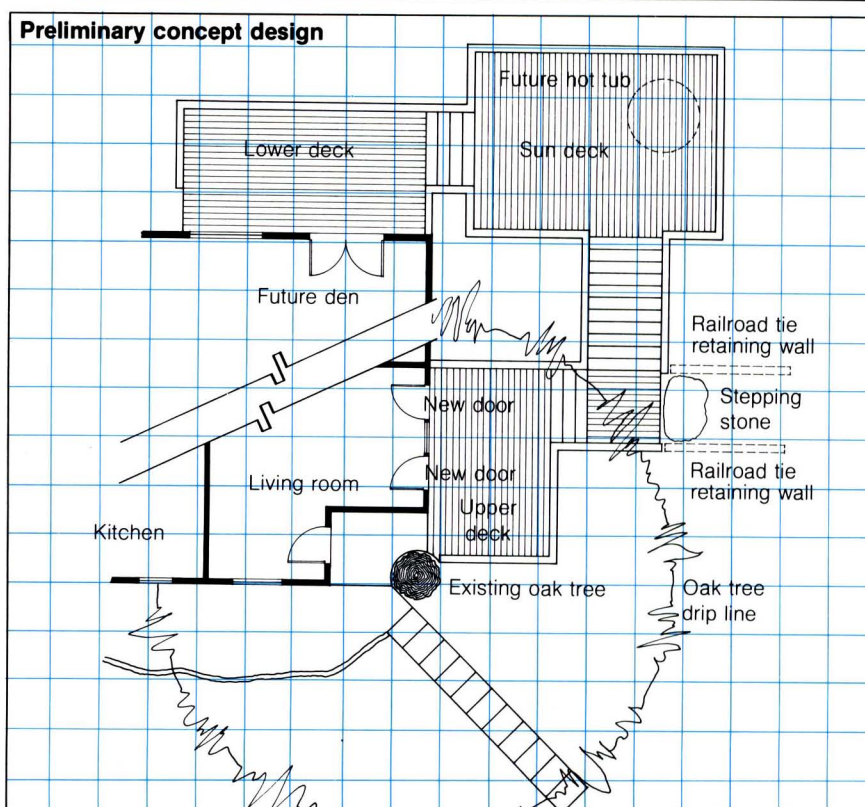
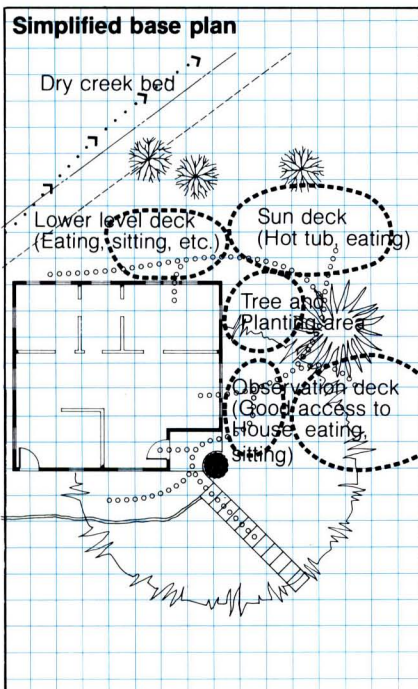
Once you have everything down on the base plan that you can observe and measure, go inside and trace the plan on a new sheet of paper, correcting angles and being as tidy as you can. The standard plan symbols may be useful to you in making notations to tell one line from another.

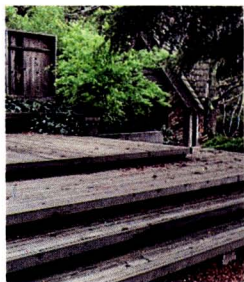
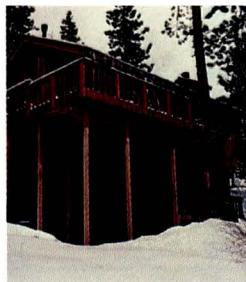


Now go out into the site again and on an overlay of tracing paper, note with arrows, words, magic markers or any other system you like how the following site conditions might influence your plan:

- Views, both good and bad; for instance, mountain range and neighbors' garbage cans.
- Shadows from trees and buildings during various seasons. Some trees lose their leaves, letting sun in with winter but the leaves block its heat in the summer.
- Wind direction and screening needs, sources of sounds, good and bad.
- Snow buildup areas.
- Drainage and runoff problems.
- Present walking-circulation routes.
- Views into the area from the house.
- Privacy screening needs.
- The best access points.

If you find that your base plan by now has a confusing number of notes and arrows, make a tracing of the basic outline of the space and use it for your concept base sheet, keeping the base plan aside for reference. Later you will need to check your concept plan against all the conditions you noted on the base plan, so don't lose it.





Decks may rise from just inches above the ground to many feet in the air.

Elevations for decks: With another overlay of tracing paper, go to the corner of each grid square and estimate its approximate difference from a reference elevation that is convenient to establish — perhaps the floor level of the house. Eyeball these elevation differences at each corner and note them on the plan. For greater accuracy, you can use a hand transit, carpenter's level or a line level. If great accuracy is required, rent a surveyor's transit or have a professional surveyor map existing elevations for you. From these elevation notes, you can calculate how many steps you may need for the deck, what length its posts should be, and how vertically complex the space can be.

Once this is done, you will have all the information you need to begin the concept design. You will have completed the observation phase of designing.

Creating the concept design: Don't expect your first design to be the one you want to develop. The concept design phase is the time just to get general spatial relationships down: the size of the outdoor rooms, circulation and connections between them, views to and from them, and special design considerations such as sequence and separation of public and private spaces. Concentrate on how you will use and move around in the spaces, and on the general physical forms the spaces will assume.

There are many ways to develop a concept design. Every designer probably has an individual technique that helps, and there are no best solutions. There are, however, many good solutions to any design problem. The degree to which your solution will be good will be measured by how well it will serve your requirements, how balanced and consistent it is, and how

flexible it will be to accommodate future changes.

Using the scale you have selected for your base plan, assign rough dimensions to the various spaces or rooms you think you want. For example, if you want a dining and barbecue space, take as a starting point the dimensions of a good sized dining alcove. Think "room size," not "great outdoors," to come up with initial space allocations and to avoid making a patio or deck that is too large for comfort and convenience. There is nothing pleasant about a patio that looks like a parking lot. If you are making a deck to entertain friends, how many people do you normally entertain inside? How much more space will they use outdoors?

Don't spend much energy on assigning these starting dimensions because they may well change as you play with the design.

With your one or more outdoor spaces roughly dimensioned, draw each as a scaled space — squares, circles, rectangles, trapezoids — on separate pieces of tracing paper and cut them out. Move these tracings around on top of one another to form different configurations, and when you find one you like, make a tracing of it. After you have developed several combinations you like, go back over them and study each to see if it really accomplishes your design goals, roughly fits the preliminary measurements of your spaces, and seems practicable in terms of serving the uses you have defined for your outdoor rooms. Save the attempts that have merit.

As you arrange and draw up your preliminary concept designs, be sure to keep in mind that you are creating spaces for activities or contemplation, or both.

Think of the connections that naturally or ideally exist between them, such as easy access from the barbecue to the kitchen or from a hot tub to the bedroom or family room.

Whatever your particular needs are, as you laid them out earlier, be sure that the designs you come up with allow for the uses required.

Be very conscious of circulation — where you will need to walk and where you will want a space to be out of the

walking area. The effective use of any room, indoors or outside, may be reduced if it becomes a corridor from one place to another. An example of this might be a dining room situated between a family room and a pool deck. The dining room would be more successful as such if it were off to one side of the direct route between the other two spaces.

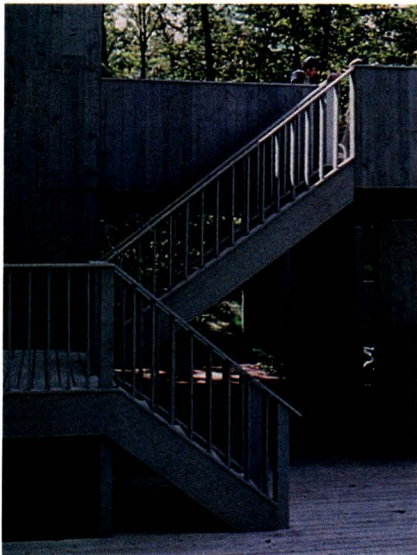
Using the tracing paper, create and discard sketch after sketch, saving only those that seem to have really good points. Work freehand, using the graph paper units to keep your spaces roughly to scale, but being conscious mostly of the basic form and how well various designs create space and answer your use needs. Think of changing levels, raising the use area above ground with a deck, or levelling off a terrace for the patio. Consider how the space will look from interior rooms, how you can incorporate existing conditions, and what the orientation of the space is to sun angle, views, noise and winds.

Consider the following ways of defining or changing spaces by design:

Lowrise	Enclosed
Highrise	Sunken
Multilevel	Tree
Stepped	Belt
Connected	Spectacular
Freestanding	Featuring
Cantilevered	Secluded
Circulatory	Visual extension
Covered	

A T-square and triangle, squared off to a drafting board, make it easy to draw and measure to scale parallel and perpendicular lines.





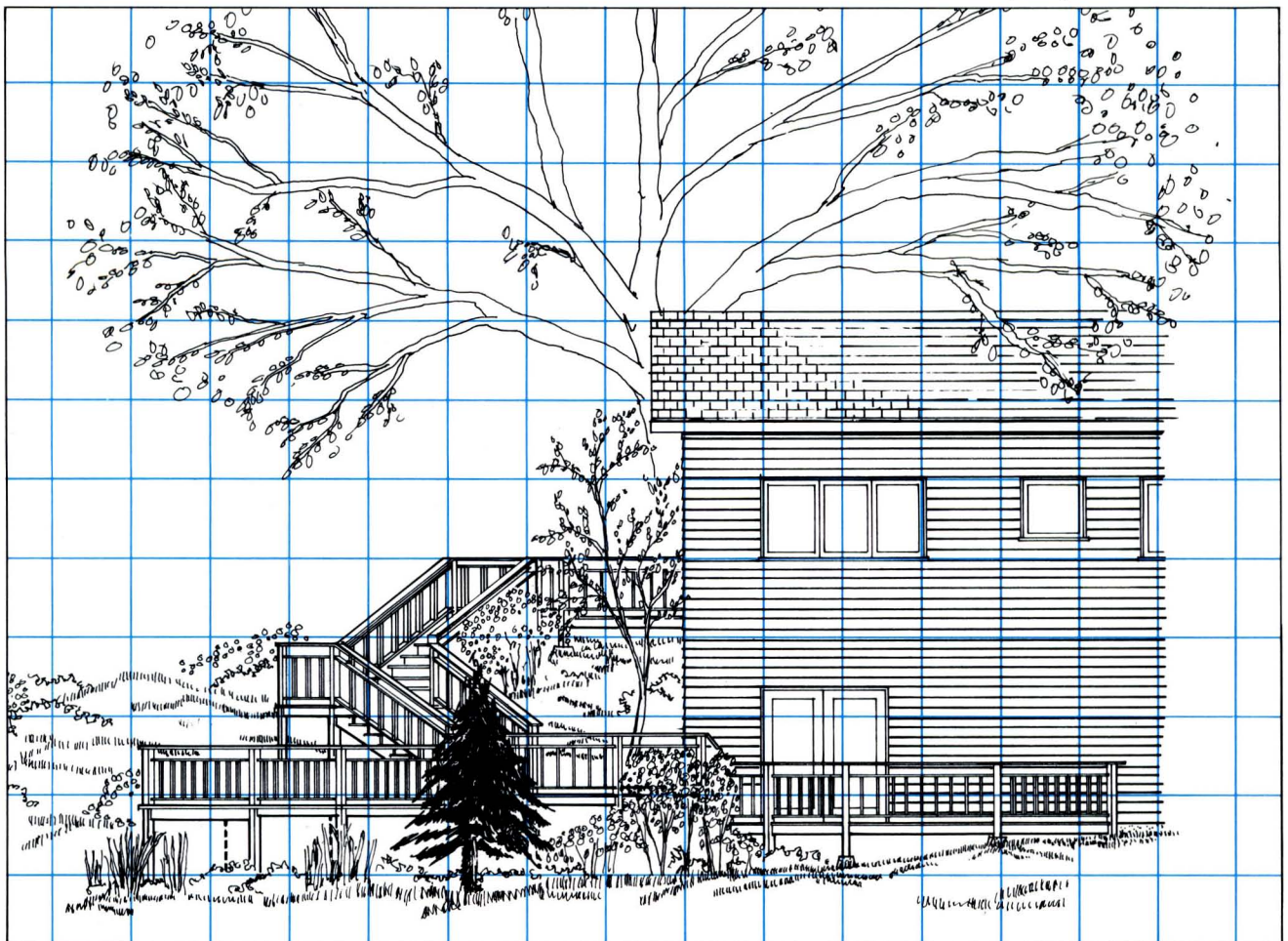
Multi-level decks, as shown above, are best planned using “elevation” drawings like the one for the deck below.

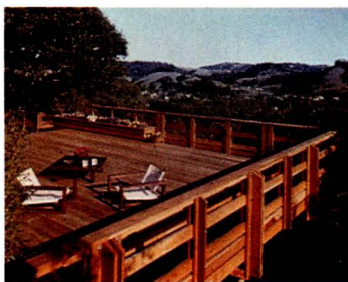
Sketching sections and elevations: Because plans are two dimensional representations of three dimensional space, they only partially note and explain what you may have in mind. To help you understand differences in all three dimensions, occasionally draw **sectional sketches**. These need not be complex because they are really just vertical plans representing certain areas of the whole. Picture a section as what you would see if you were to cut across the plan with a knife. Like a piece of pie cut in half, what you will see for a deck or patio is the surface material and a cut-through view of everything below that surface point.

Elevations are created in a similar manner, but everything you can see from a particular direction is included. Unlike the section, which cuts through the design, an elevation is a view of all the surfaces facing any particular direction.

By using simple sketch elevations and sections as you work through the concept plan, you will know what elevation differences are really possible as you lay out multilevel designs.

From time to time it will be helpful to check your schemes on the ground. Lay out garden hoses, or line off with string, chalk or even baking flour, where the edges of the patio or deck would be. Walk into the spaces you are thinking of and imagine the ways you will use them. Try out the circulation from area to area, confining your walking pattern to the dimensions and directions in your plan.





The elevations of a deck can be breathtaking, as can the view. When planning a deck, sketch the elevations on a side view to see on paper what a photographic view would be.

R

efining the concept design: Once you have three or four concept designs that seem to answer your requirements, select the one or combine several to make the one that best fits your needs. Check its elevations with some simple sketches from different angles, and work through it again with a fresh overlay, checking to be sure that it includes the spaces you intended, handles access and circulation, and is responsive to the screening and view requirements you have made notes about earlier.

Ask yourself as you go through this cycle of reevaluation, "Does it solve my requirements within my budget, time and other limitations?"

After you are sure that it is the best plan you can make, draw a tidy tracing of the final concept design.

If you are dealing with a very difficult site, or there are special conditions you want to study more — such as how well your garden furniture will fit the space — cut out scaled paper or cardboard models of the furniture or whatever, and move them around on the concept plan.

To get a good perspective on the model, put a small hole — just $\frac{1}{8}$ inch in diameter — in another piece of cardboard and look through it into the spaces in the model. Cut out human figures to scale if you have doubts.

Such a detailed evaluation probably won't be necessary, but if you can't imagine the spaces you are laying out, it will be worth the time. Remember, it is a lot easier to make changes on paper than to make them after you start building.

Figuring costs will be difficult until you have completed the final plans showing exact size and placement of all materials. Before making those plans, however, use your concept to estimate roughly the cost per square foot of your deck or patio.

Because of regional differences in prices, we suggest that you contact a local lumber outlet or builders' supply store to get their prices for standard quantities of the construction materials you are planning to use.

Add up the areas of decking, paving, steps and replanting you will need, and multiply them by the local cost figures. If this rough estimate is much higher than you can spend, you should consider doing the project in phases, building some now and some later. If that isn't possible, work through the concept phase again, reduce the scope of the design, and build up your determination to stick within your budget.

After you have completed the working drawing plan (see Chapter 6), you will know the details of sizes and quantities of materials you need and you will be able to make a complete cost estimate.

In this, the concept design phase, you purposefully have avoided considerations of materials and structure. This freed you to pay attention to space relationships, circulation and design qualities that create the sensuous force. You have synthesized what you know about the site, your needs and design principles. Now you

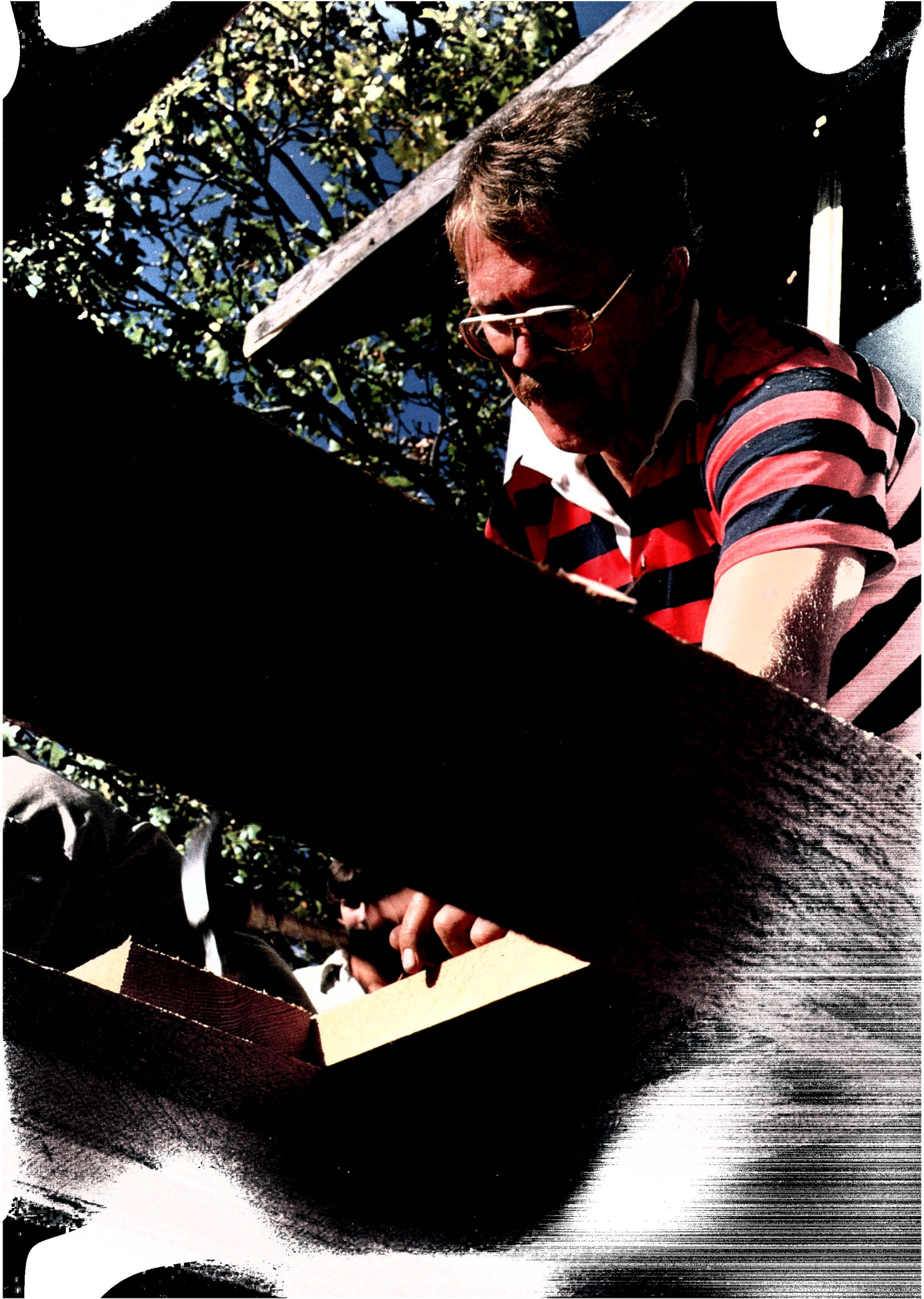
have the basic outlines and forms for your outdoor rooms. The concept design you have created will be largely responsible for the eventual success of these spaces.

But design doesn't stop at concepts. It requires a knowledge of construction principles. Plans are the most convenient means of noting your decisions about how to put something together. Different lines on your plan will represent different elements of the structure. Labels, dimensions and notes will also be useful to record your decisions.

A basic knowledge of construction procedures and possibilities is essential before proceeding with the final drawings from which you will actually be able to build. So our next chapters are devoted to construction. In Chapter 6 you will be able to refer back to these discussions in preparing your working drawing plan. The contents of these chapters will also be a useful reference during the actual construction of your deck or patio.



Decks can be built in phases, as time and money become available, but it is good to work from a plan showing the complete project.



The How-To's of Deck Construction

How to select lumber and materials. How to pour footings and piers. How to build ledgers and basic substructures. All about blocking, bracing, connecting posts, beams and joists. How to lay decking, connect decks and build stairs.

There is something almost irresistible about a deck. Those clean lines seem to draw you outside and into refreshingly new surroundings. It's a chance to put aside the day's cares and let yourself relax.

Like people, decks have their own distinct characteristics that stem from their style and how they are built. There are, for instance, decks for privacy and seclusion, decks open to the world and the sun, multilevel decks for free-wheeling parties, decks for quiet dining and decks that can accommodate half the kids in the neighborhood. And there are decks divided into different sections that give you different living spaces at the same time.

Fortunately, decks are also fairly easy to construct yourself. One very simple deck is made by laying out lengths of 4 by 4 heartwood redwood or other rot-resistant 4 by 4s about 3 feet apart, leveling them, and then nailing on 2 by 6 decking. As simply as that you can convert that barren, dusty section of your backyard where nothing has ever managed to grow into a little area that is both practical and beautiful.

For those more experienced in carpentry, or at least willing to try, we tell in detail here the ways to build sturdy and attractive decks. There are simple and there are complex decks here, and you should find something to meet your needs.

While you are certainly urged to build your own deck, in some cases you may need professional help. It will cost you more money but the job will likely be done faster. Also remember

that the professional doesn't have to do the entire deck. You can call one in just to put in the footings for you, or build a tricky part of the substructure or some elaborate railings. Experienced carpenters who advertise their services in your newspaper can often be hired by the hour or the day for such jobs. Once they finish the part that requires special talent, you can carry on with the rest.

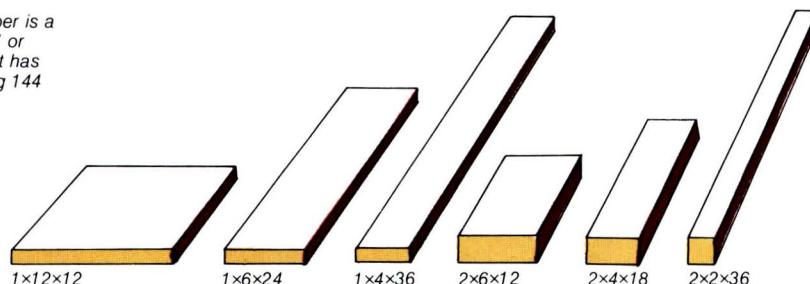
Laying the decking can be a delightful excuse for a party. Make it like an old-fashioned barn raising and invite your neighbors and friends to take part. But try to choose those who will follow *your* design and building procedures. At the day's end, you will find enormous satisfaction in sitting down to a grand buffet with your friends on the deck that you all just completed.



Decks are fairly easy for the average person to build. As co-author T. Jeff Williams suggests, some can be built by people who simply want to have fun at a deck-raising party.

Once you have followed the design process and created a plan, the actual deck or patio construction may be an excuse for a party, like an old fashioned barn raising.

A board foot of lumber is a piece 12" x 12" x 1" or any other shape that has dimensions equalling 144 cubic inches.



The materials of a deck: The bewildering variety of wood species used for building is further complicated because all lumber is classified into a number of different grades. Furthermore, the grading differs with different wood species. But the nice thing about building a wood deck is that you really can't go wrong with almost any type or grade; it's just that some are better than others for specific purposes.

Because of their availability in the West, redwood and cedar are the top choices for decking material. These same woods, along with cypress in the East and South, rank high throughout most of the country because of their natural resistance to decay brought on by moisture. However, other woods such as Douglas fir, hemlock, spruce and pine make excellent decks and usually are considerably less expensive than redwood or cedar. Given proper finishing and care, they can last many, many years.

Your final choice of decking will be considerably influenced by your budget. Don't be concerned if your budget allows only pine instead of redwood for the decking material.

Estimating lumber: After deciding on the species of wood, your next consideration is how much you'll need. In calculating the support structure, there is only one way: draw it all on your working drawing (see Chapter 6) and then count it up piece by piece. If you have some beams that are 8 feet long and some 12 feet long, don't hastily decide to order all 12 foot lengths, because you will have a lot of useless 4-foot pieces left over. Make a detailed list of how many pieces of each length you need. At the same time, count up all the connectors or joist hangers your plan calls for.

In calculating the amount of decking

lumber, first figure the square footage of the deck by multiplying length by width. With this information, almost any lumberyard can quickly calculate how much decking lumber you need. However, you should be aware of how that calculation is done.

Lumber is priced either per linear foot (running foot) or per thousand board feet.

One board foot is a piece of lumber 1 inch thick, 12 inches long and 12 inches wide. In calculating your decking lumber needs, keep this trick in mind: if you cut that piece in half and put one half on top of the other you would have a 2 by 6 that is 12 inches long. That's still 1 board foot. (Therefore, a 1 by 12 by 12 is the same in board feet as a 2 by 6 by 12.)

For more complex calculations, here's the formula:

Thickness times width times length, divided by 12, equals board feet. Thus, a 2 by 4 that is 10 feet long contains $6\frac{2}{3}$ board feet ($2 \times 4 \times 10 = 80 \div 12 = 6.6$).

If your deck is, say, 20 by 25 feet, that's 500 square feet and you need 500 board feet of 1 by 6s to cover it, or 1,000 board feet of 2 by 6s. Allow 5 percent more for breakage and mistakes. And remember that, in fact, the actual size of lumber is less than its nominal size so you need more to make up for this difference.

Count up railings and posts individually.

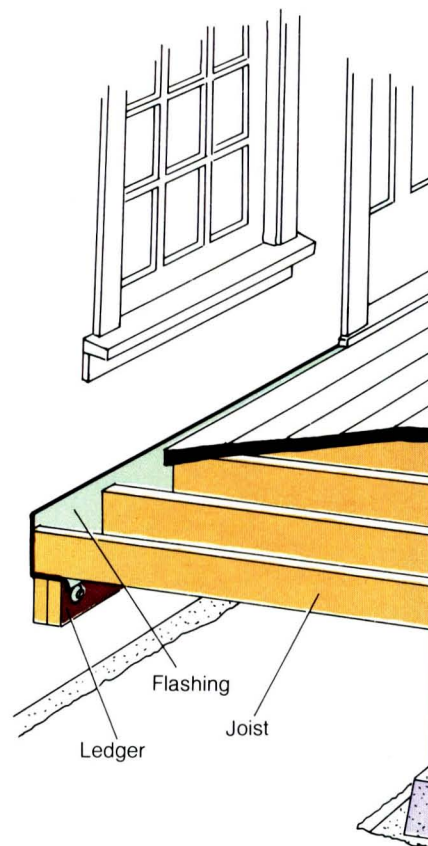
When you set out to buy the lumber, it will be very much worth your while to shop around. Prices of lumber vary considerably and a little comparative shopping can possibly save you hundreds of dollars.

Wood comes in a variety of grades (see charts on page 44) and the higher the grade, the higher the cost. Don't buy lumber that is a higher grade than you need. For instance, decking of clear heartwood redwood would be magnificent but you may need two oil wells in your backyard to pay for it.

All of the major elements of a deck can be found at the right: flashing, joists, ledger, decking, extended post, rail, beam, post, headers (facing boards), braces, piers, blocking, footings, and attached posts. Each element, and how to construct it, is explained in the following pages.

The elements of a deck: Since decks are generally designed to be an extension of the house, they are normally attached to the house. Freestanding decks are built in the same way but of course need that one extra side of substructure.

Although the many variations concerning joist spacings, beam spans and post sizes can be confusing, keep



in mind some basic rules about a good deck: it should have no spring in the flooring and no suggestion of sway. You must also be able to lean against a railing with complete confidence.

Decking terms: Decks are built from the ground up with several key elements joined together to make a firm, lasting structure.

Footings support the entire deck and keep it from shifting or sinking into the ground. A footing is usually poured concrete 12 inches square and 6 inches thick. It must sit on firm, undisturbed soil or at least 6 inches below the freezing level of the ground.

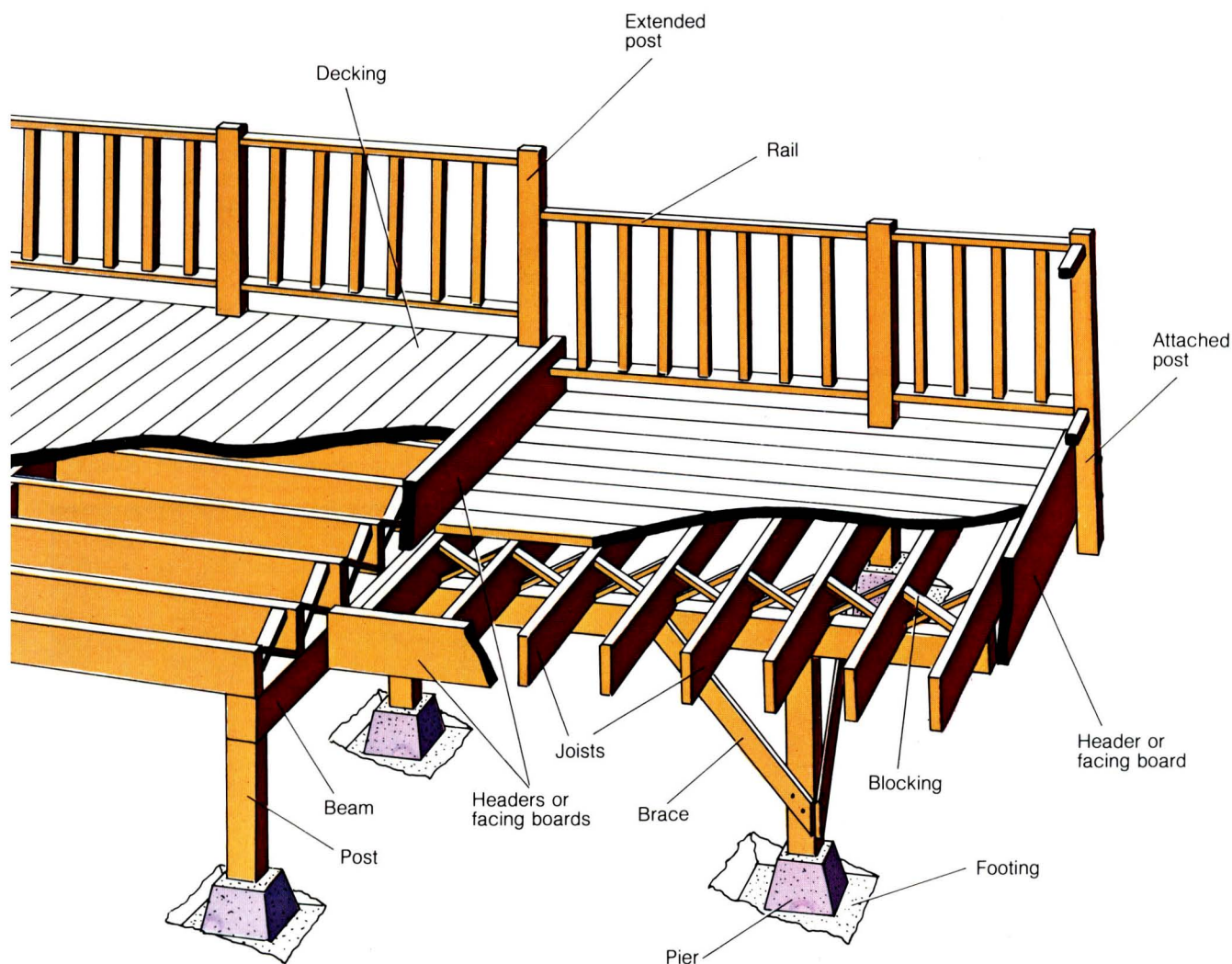
Piers rise from the footing several inches above the ground to keep the posts or beams clear of decay-causing soil. Like the footing, a pier carries and distributes the weight of the deck.

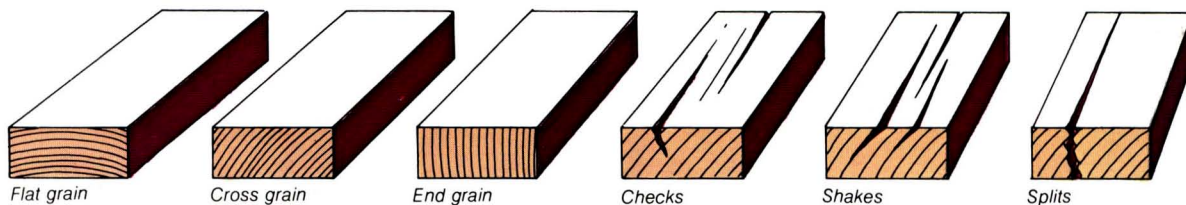
Posts are uprights bearing the weight of the deck and transmitting it evenly to the piers and footings. Posts

are commonly 4 by 4s but can be larger, depending on the structural needs of the deck. And depending on the design, posts can either support a beam or extend past it to form railing posts or other structures such as benches.

Beams rest on top of the posts or are bolted to them. The heavier the beam, the greater distance it can span — which means fewer posts to put up. Also note that if your plan calls for a 4 by 6 beam, you can make this by nailing or bolting two 2 by 6s together.

Joists are commonly 2 by 6s and





are the connection between the beam and the ledger board on the side of the house that supports the decking. Joists are normally spaced 16, 24, 32, or even 48 inches apart, depending on what type of decking will be laid. When using 2-by decking, try not to exceed 32 inches for joist spacing; 24-inch joist spacing makes a much firmer deck. When using 1-by decking lumber, don't exceed 16-inch spacing.

Decking is the show piece of your deck. How you plan to lay it out and pattern it will determine how you build the support structure. Decking material should not exceed 6-inches in width because wider boards have a strong tendency to cup and trap water.

Ledger board. Normally the same width as your joists, it is bolted to the side of the house and supports one end of the joists. Ledgers must be placed so that when the decking is down, there will still be a 1-inch clearance below any existing or planned doorway. This prevents rain from running over the doorsill.

Buying the lumber: In considering your own deck, the best solution is to talk it over with some knowledgeable person at the lumberyard. He probably sells a great deal of lumber for decks and can tell you the best type of wood for your area, considering the climate and the availability of different lumber.

As a footnote here, don't be shy about asking for a contractor's discount when ordering the lumber; it can mean savings of 5 to 10 percent.

Before going to the lumberyard, keep in mind some of these points:

Lumber is sold in 2 foot increments. These lengths usually range from 6 to 20 feet. Boards longer than 20 feet often have to be specially ordered, and you would probably find them too unwieldy for easy handling. If for some reason your deck comes out 15 feet long, you will have to buy 16-foot lengths and trim off that extra foot. So consider changing the design to a 14 or 16-foot deck.

Technically, you should also be able

to buy lumber that is surfaced only on one side (SIS) which would be cheaper. In actuality, wood is generally available in either S4S (surfaced four sides) or rough. Rough wood is cheaper and fine for the support structure unless it is highly visible. Sometimes, of course, it is desirable even for highly visible uses, such as retaining walls.

There are a great many different dimensions of lumber. One combination for a deck would be 4 by 4 posts, 2 by 6 joists and 1 by 6 or 2 by 6 decking. Remember, these are nominal sizes. The actual size of a 2 by 6 is about 1½ by 5½ inches. These actual sizes are important to keep in mind when measuring and cutting during construction.

Selecting the lumber: At the lumberyard you can normally choose all your own wood, particularly if you are hauling it yourself.

Here are some useful things to know about lumber:

Sawmills cut every log in a manner designed to get the maximum amount

of lumber out of it. Some cuts are better than others because they have fewer knots or are less likely to warp.

Boards for construction and decking are generally **flat grain** cuts, where the grain is parallel to the face of the board, or **cross grain**, with a grain angle up to 45 degrees across the face. **End grain** lumber is cut with the grain perpendicular to the width of the wood. This is a higher grade of wood than the others and usually reserved for finishing work.

Note that there is a bark side and pith side to all lumber. In putting down your decking, try to keep the bark side up; otherwise the board tends to "cup" and hold rainwater, speeding its deterioration.

Wood also comes **green** or **dried**. Air or kiln-dried wood is considerably more expensive and normally not worth specifying. Your own deck, once nailed in place, will season itself.

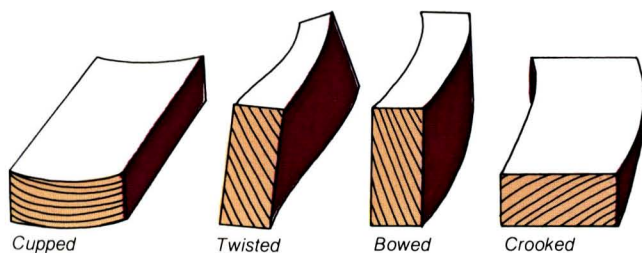
In selecting your lumber, keep an eye out for **checks**, cracks across the grain, and **shakes**, cracks that run with the grain. These not only weaken the board but make it unsightly. They can also cause dangerous splinters.

Also try to avoid lumber that is bowed, cupped, twisted, or crooked at one end.

Lumber shrinkage

The following lumber sizes are those established by the American Lumber Standards Committee.

Nominal (inches)	Dry (inches)	Green (inches)
1	¾	25/32
2	1½	1-9/16
4	3½	3-9/16
6	5½	5%
8	7¼	7½
10	9¼	9½
12	11¼	11½



Wood characteristics¹

Kind of wood	Working and behavior characteristics						Strength properties				
	Hardness	Freedom from warping	Ease of working	Paint holding	Nail holding	Decay resistance of heartwood	Proportion of heartwood	Bending strength	Stiffness	Strength as a post	Freedom from pitch
Ash	A	B	C	C	A	C	C	A	A	A	A
Western red cedar	C	A	A	A	C	A	A	C	C	B	A
Cypress	B	B	B	A	B	A	B	B	B	B	A
Douglas fir, larch	B	B	B-C	C	A	B	A	A	A	A	B
Gum	B	C	B	C	A	B	B	B	A	B	A
Hemlock, white fir ²	B-C	B	B	C	C	C	C	B	A	B	A
Soft pines ³	C	A	A	A	C	C	B	C	C	C	B
Southern pine	B	B	B	C	A	B	C	A	A	A	C
Poplar	C	A	B	A	B	C	B	B	B	B	A
Redwood	B	A	B	A	B	A	A	B	B	A	A
Spruce	C	A-B	B	B	B	C	C	B	B	B	A

¹ A — among the woods relatively high in the particular respect listed; B — among woods intermediate in that respect; C — among woods relatively low in that respect. Letters do not refer to lumber grades.

² Includes West Coast and eastern hemlocks.

³ Includes the western and northeastern pines.

Ash (*Fraxinus excelsior*)

From the earliest times ash has been respected as a hard wood which has served well as tool handles and as weapons of war. These same properties of strength and resistance make it an exceedingly fine wood for construction.

Cedar, Western red (*Thuja plicata*)

Noted for its light weight, strength, straight grain and freedom from knots, the Western red cedar is renowned for its durability and smooth working properties.

Cypress (*Cupressus*)

A fast-growing tree with reddish hue and straight grain, cypress is popular for its ability to resist decay.

Douglas fir (*Pseudotsuga menziesii*)

One of the most magnificent trees in the world, it is also among the best for dependability in heavy construction work. The natural coloring is so strong

that staining is not needed. Fir's good physical properties as well as its availability in large quantities make it a highly desirable wood for home construction purposes.

Gum (*Eucalyptus*)

Although the gum superficially resembles the common oak and the ash, its properties are quite different: it is softer, and tends more toward warping. But like the oak and ash, it is extremely strong.

Hemlock (*Tsuga*)

A fine textured wood, but the hemlock is weak in many properties that one would wish for in deck construction, from decay resistance to hardness.

Pines, soft (*Pinus*)

Grown mostly in the west and north-east, pine is easy to work with, yet strong enough for a wide range of uses. It is not naturally durable, so must be treated for outdoor use.

Southern pine (*Pinus*)

Almost opposite of the other pines in strength (the southern pines are as strong as ash or Douglas fir), these timbers are more difficult to work with and are more easily decayed or warped.

Poplar (*Populus*)

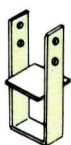
A softwood with surprising strength capabilities, the poplars are also noted for their ability to last and are fairly resistant to decay and warping.

Redwood (*Sequoia*)

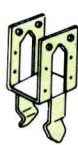
One of the most majestic of trees, the redwood is highly favored as decking material for both its classic grain and color, as well as its outstanding ability to resist decay.

Spruce (*Picea*)

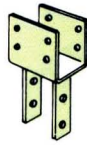
A softwood whose negative qualities include an inability to resist decay, spruce is valued mainly because it is readily available.



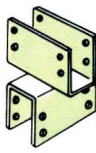
Post anchors



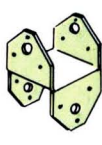
Post cap or anchor



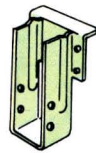
Beam saddle



Post cap



Joist hangers of various styles



Footings: Not all decks, it should be noted here, have to have footings — provided that the ground where you want to build is flat, well drained and never freezes. You can build a deck right on 4 by 4s laid on the ground, if the wood has been

pressure treated with a preservative. Or simply put some piers a few inches into the ground and then place your posts or beams. Check your local codes before you make a move.

Still, a more lasting deck has footings and for a really permanent structure, they are a must.

Footings must be set on undisturbed soil or as far below the surface as required by local codes in frost heave localities. If the area where you want to put the footings is fill dirt (loosely

packed soil left after dirt was excavated to build the house), then it must be compacted first. This is best done by renting a power compactor.

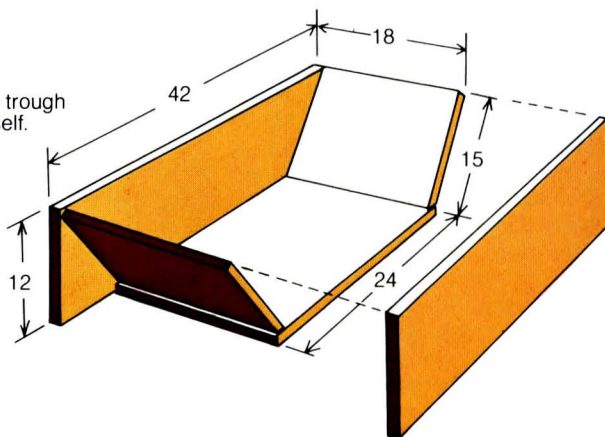
The next consideration is whether to mix your own concrete for the footings or buy ready-mix concrete. First estimate how much concrete you will need for the footings. A footing 12 inches square and 6 inches thick requires half a cubic foot. One 90-pound bag of ready-mix concrete contains $\frac{2}{3}$ cubic foot. Ready-mix is rela-

Mixing concrete in small batches

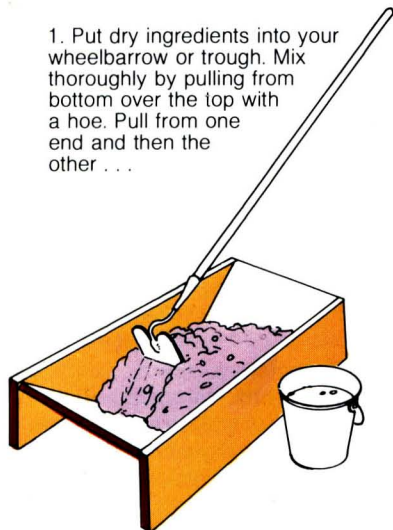
Small batches can be mixed in a sturdy wheelbarrow . . .



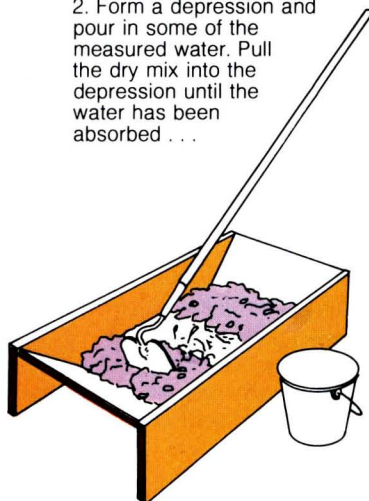
or in a wooden trough you build yourself.



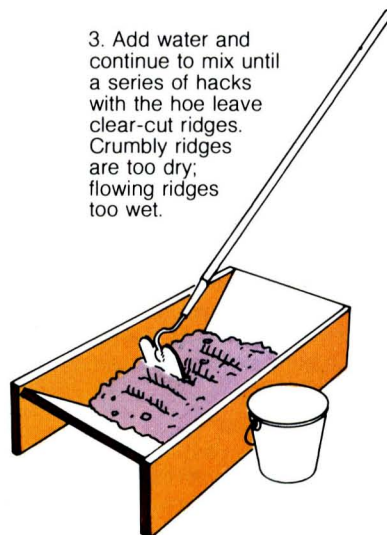
1. Put dry ingredients into your wheelbarrow or trough. Mix thoroughly by pulling from bottom over the top with a hoe. Pull from one end and then the other . . .

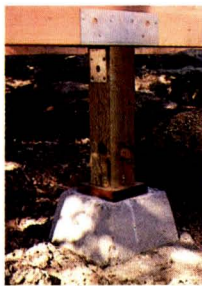


2. Form a depression and pour in some of the measured water. Pull the dry mix into the depression until the water has been absorbed . . .



3. Add water and continue to mix until a series of hacks with the hoe leave clear-cut ridges. Crumbly ridges are too dry; flowing ridges too wet.





Saddle fittings or pre-cast piers provide alternate supports for decks.

tively expensive if you are doing many footings. However, you only have to add water, mix and pour.

In many areas, suppliers will sell you ready-mix concrete and lend you a trailer to haul it yourself. That's also fairly expensive and you must do a lot of hauling and driving.

You can order a ready-mix truck to deliver the concrete but then you may have to order at least 1 cubic yard (27 cubic feet). In addition, the delivery truck must be able to back up near the site. Many suppliers allow only about five minutes to unload a cubic yard, after which you are charged overtime and that can cost upwards of 50 cents a minute.

Probably you will want to mix the concrete for the footings right in your own yard, either with a rented cement mixer or in a wheelbarrow.

To estimate how much cement, sand and gravel you need to order, use this formula:

	Cubic feet of concrete			
	4	6	12	18
Cement (90 lb. sacks)	1	1½	3	4½
Sand (100 pounds)	2	3	6	9
Gravel (100 pounds)	3	4½	9	13½
Water (gallons)	5	7½	15	22½

Details on how to mix and pour concrete footings are on page 55.

Piers: You can either make your own piers or buy them precast. The cost will be about the same so it's generally easier to buy them unless you are pouring a lot of concrete, in which case you can make up some forms and pour your own.

Precast piers come with a redwood block already set into the top, which allows you either to toenail the post to it, as is commonly done, or bolt a metal post connector to the top, which is a preferred practice because the connection is stronger.

Piers can also be made from hollow-core concrete building blocks. They can be set in place while the footing is still pliable, filled with concrete and topped with a metal post or connector. For strength, be sure to use standard aggregate blocks and not cinder blocks.

Pouring your own piers allows you to use a drift pin, which provides a secure fitting for the post. The drift pin — either a foundation bolt or length of re-bar — extends about 6 inches above the top of the pier.

The post is drilled in the center of its base and then set in place over the pin.

A type of pier form useful where greater height is needed is the fiber tube. Tubes come in various lengths and diameters, and can be cut with a handsaw. If footings are sunk several feet in the ground, use the tubes to form piers that rise above ground level. Set the tube on the newly poured footing and square with a level before filling with concrete. Top with either a redwood nailing block or a metal connector. For piers higher than 3 feet, use a length of reinforcing rod up the center.

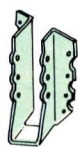
Joining post and beams: In most decks, particularly those just a foot or two off the ground, posts are toenailed to the piers and the beams toenailed to the posts. This is an easier construction method because the weight of the deck will keep everything firmly in place, but you have to worry more about the possibility of wood rot.

However, stronger and more rot resistant joints can be made with metal connectors. They come in a great variety of sizes and styles.

One type of post support is particularly noteworthy. It has a removable steel saddle fitting inset that keeps the base of the post clear of the pier where it could sit in water and eventually decay.



Tools and supplies for the do-it-yourself cement mixer include: wheelbarrow, shovel, hose and water, bucket, redwood nailing blocks, pre-cast piers and hollow-core concrete blocks.



Skewed hanger



Double hanger



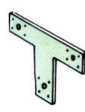
Framing anchor



Hurricane anchor



L-tie Strap



T-tie strap

Basic substructures: In the framework of a deck, joists are normally attached to the beams in one of the three ways illustrated.

The best method, with joist hangers, gives by far the sturdiest structure. Bolts or nails are driven through predrilled holes in the joist hanger into the joist to hold it firmly in place.

A joist placed on top of the ledger

provides firm support and has the advantage of saving you the price of a joist hanger. One risk here is that if the deck shifts outward with unanticipated heavy weight — such as a heavy snow pack that is rained upon — it could pull the joist free of the ledger, and down goes the whole deck.

The least desirable method is using a cleat, as illustrated. There is the risk of the joist separating from the ledger. However, this method allows you to mount joists flush with the ledger without using joist hangers, and it is satisfactory for low decks.

If the other end of the joists rests on

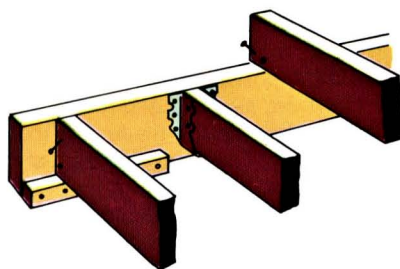
top of the beam, toenail each one in place with 16-penny nails on both sides. More rigidity is gained by placing a facing board across the joist ends.

You may wish to extend some joists to hold rail posts (see page 64 for details on posts and rails).

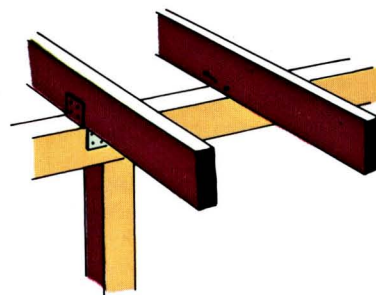
In designing your deck, decide whether you want a post and beam style or extended posts. The advantage of the extended post system is that it provides a ready-made and firm railing post. If extended far enough, it can support a shade cover for the deck.

There are two basic extended post systems.

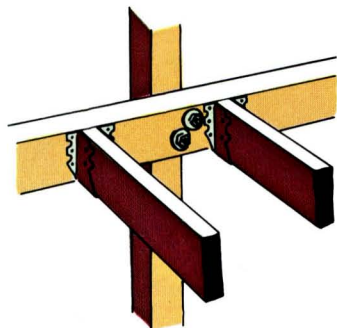
Basic attachments



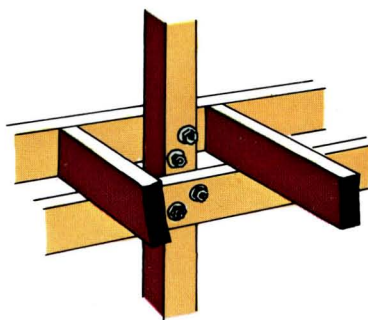
Joists to ledger with a cleat, joist hanger, or toe-nailed on top.



Joists to beam with saddle or toe-nailed.

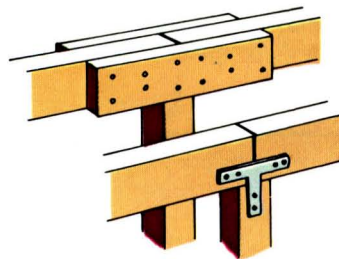


Joists to an extended post using a single beam.

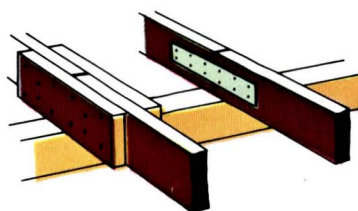


Joists to an extended post using two narrower beams (see text).

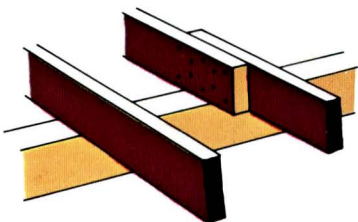
Splices



Splicing beams on top of posts with wooden gussets or metal tie straps.



Splicing joists with wooden gussets, metal straps . . .



or by overlapping (see text).



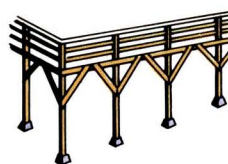
"X" bracing



"W" bracing



"K" bracing



"Y" bracing

In the first example, the beam is bolted to the inside of the posts and joists are placed or hung on it. Generally, if you have a 6 foot span for the beam, use a 4 by 6; if you have an 8 foot span, use a 4 by 8. (See table, page 104.)

In the second example shown, a narrower beam is placed on the outside of the post and joists are then attached. This beam can be a 2 by 6, the same as the joists, for a 6 foot span. Additional support is gained by nailing a second 2 by 6 along the inside of the posts directly under the joists. The end result is the same as a 4 by 6. The advantage here is that two 2 by 6s are easier to handle than a 4 by 6, and they can be nailed in place. This is a proven but unorthodox method and should be first approved by local codes.

Splices: Since it is impractical to buy all the deck elements in one piece, two or more pieces must often be joined in a splice.

Beams meeting on top of posts should be toenailed in place with 16-penny nails and then spliced with gussets. The gussets should be 2-by wood the same width as the beam and overlap each side by 12 inches. Hold in place with 16-penny nails or 1/2 by 4-inch lag-screws.

Joists meeting on top of beams should be spliced in the same manner. This prevents unexpected weight from separating them and possibly pulling them free of the beam. (See bracing and blocking, this page.)

Joists can also be overlapped as illustrated. Toenail each in place with 16-penny nails.

If many splices are required in joists, stagger them so they don't all land on the same beam. Otherwise that beam would be a weak joint in the whole deck structure.

Beams can also be built up by splicing boards together, a common practice in deck construction. A 4 by 6 is quickly formed for a beam by nailing together two 2 by 6s with 16-penny nails.

Joist bracing: Joists that span 8 feet or less do not normally need cross-bracing, although it will add strength. Usually, a facing board on the outer end of the joists is more than sufficient.

Joists spanning more than 8 feet, however, should be crossed-braced to help minimize any tendency to wobble.

Cross-bracing is most easily done by nailing in spacers cut from the same stock as the joists. Snap a chalk line down the center of the joist span and then, for ease of nailing, stagger each spacer.

An alternate method is to use X-bridging. It requires considerably more cutting, fitting and nailing. However, there are metal X-bridges available if you want this style of support, but they have an esthetic drawback if the deck is to be seen from below.

Proper bracing and bolting: A deck more than 6 feet above the ground should have some form of bracing to minimize any sway which could loosen and ultimately bring down the entire deck. Any deck that will carry heavy snow loads or face high winds should also be braced.

Braces that will reach 8 feet or less

can be cut from 2 by 4s; for longer spans use 2 by 6s.

All of the illustrated bracing methods are acceptable. Which one you choose will depend in part on how much bracing you need and whether you want easy access under the deck. As an example, the Y-brace can be used where some headroom is needed for walking under the deck, but this is not as strong as the K-brace.

To put up braces, hold or temporarily nail one in place and mark it. After cutting it, make sure it fits, then use it as a pattern to cut the others.

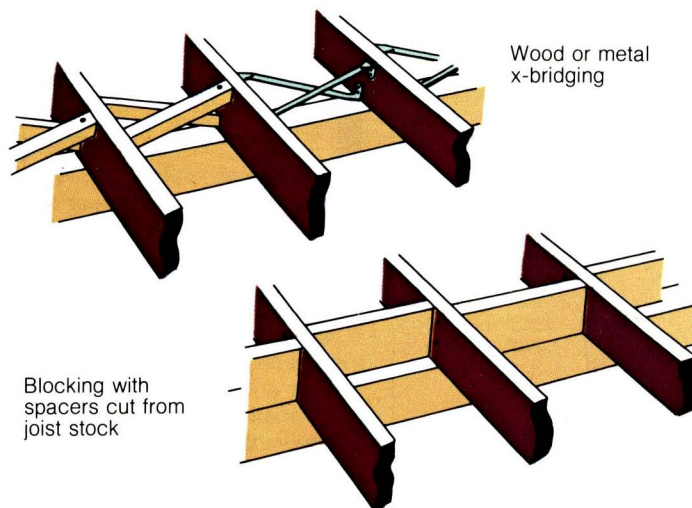
As shown on page 50, cut the brace ends flush with the side of the post rather than in a V angle in order to get more wood on the post. Braces should be attached with lag-screws or bolts rather than nails.

Using bolts: Deck loads are carried in two different ways: on the cross-grain as in ledgers, beams and joists, or on the vertical grain as in posts.

Bolts on bearers of cross-grain load should normally be spaced no closer to the top of the board than four times the bolt's diameter. They should be equally spaced along the board.

When bolting in vertical grain, do not place a bolt nearer the end than four times its diameter. This prevents a compression fracture in the end of the board. You can go as close as one and a half diameters to the side of the board or post.

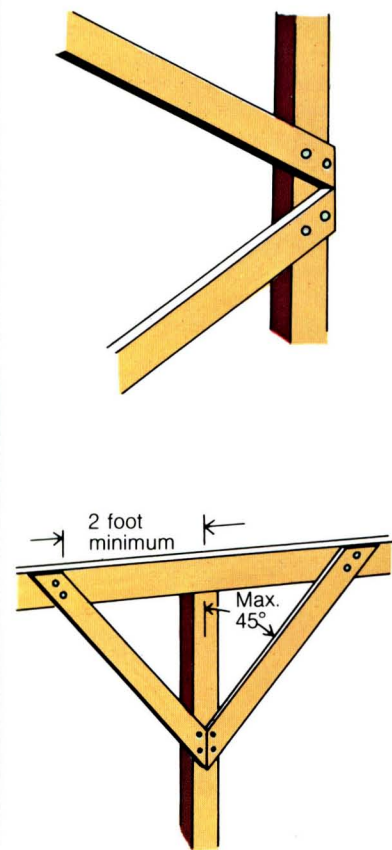
Blocking



The best size of bolt to use depends on the load and on the frequency of bolting. As a rule of thumb, use one $\frac{1}{4}$ -inch bolt for 2-inch boards, two $\frac{1}{4}$ -inch bolts for 3 and 4-inch boards, and three to eight bolts for 6-inch and larger boards. Bolts $\frac{3}{8}$ -inch in diameter should be used with timbers 6 inches thick, and $\frac{1}{2}$ -inch diameter bolts with timbers more than 8 inches thick.

Except for carriage bolts, always use washers on the head and nut ends of the bolts. Drill the hole just large enough to accommodate the bolt, so you have to tap it through with a hammer.

Proper bracing



Carriage bolts are usually the best for decks because of their smooth heads and self-clinching traits. With these, washers are needed only on the nut end.

Attaching ledger boards: The first step in building an attached deck is to put up the ledger board.

That's a rather simple process but it must be done right because your entire deck will grow from here.

The ledger must be placed so that the decking, when installed, will be about 1 inch below the floor level and any existing or planned door to prevent rainwater from running into the house.

You can find the floor level on the outside of a house where there is no door opening by measuring from a window sill to the floor inside and transferring the measurement outside.

The ledger must be level and should be bolted to the floor joist header with $\frac{3}{8}$ -inch bolts or $\frac{3}{8}$ by 4-inch lag-screws spaced every 2 feet. Alternate them, one up and one down, as you work across the board.

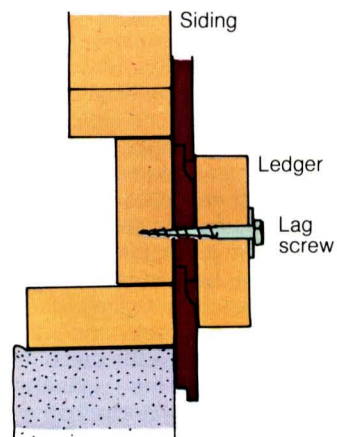
It's advisable to use flashing — aluminum or galvanized tin — over the ledger to keep water from soaking in between the house and ledger, which could lead to decay.

Length of ledger: The ledger will be cut either a little longer or shorter than the actual deck dimensions. Here's why:

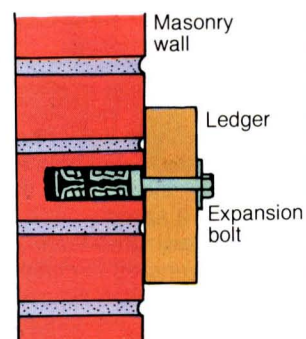
If you use joist hangers, the ledger must be longer than the deck by about 2 inches on each end to provide nailing space for the outer sides of the hanger on each end.

Alternatively, cut the ledger shorter by the width of the joists on each end and then butt the first and last joist against the end of the ledger and bolt in place. Joists in between can be placed in hangers.

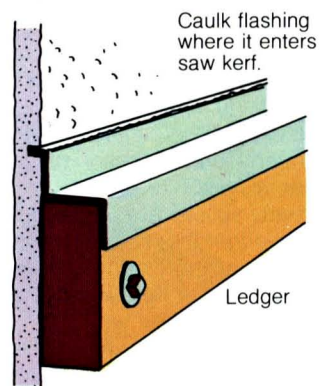
Attaching ledger board to wood



Attaching to masonry



Attaching to stucco



Ledgers on brick houses: These must be held in place with expansion bolts. For added security, place 2 by 6 supports against the house under the ledger every 4 feet, particularly if you live in snow country.

Hold the ledger in place and mark drilling points every 16 inches, or 24 inches at most. Drill the holes in the ledger, while holding it in place on the

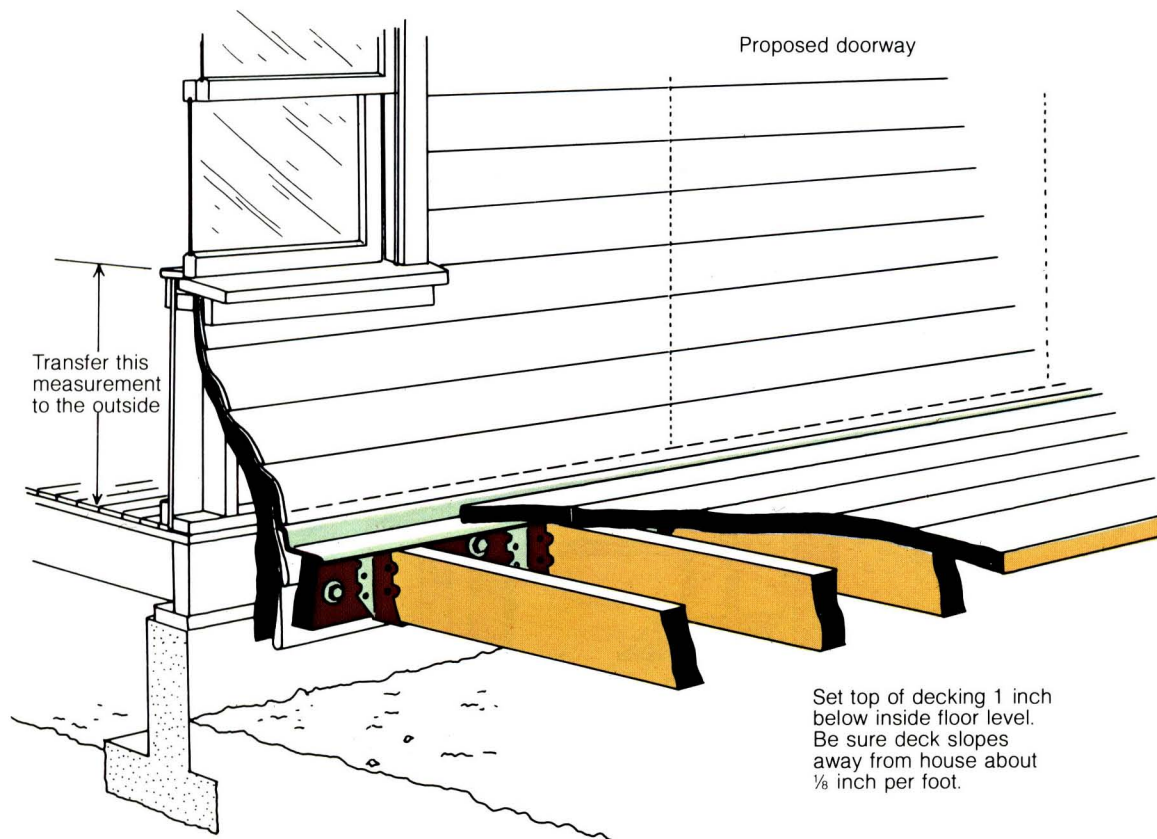
house and mark where the bricks must be drilled. Use a nail punch to make a guide hole in each spot. The drilled holes should be large enough to accommodate $\frac{3}{8}$ by $4\frac{1}{2}$ -inch expansion bolts.

Ledgers on stucco houses: These are put up essentially as on a frame house: tack in place with 16-penny nails and then bolt or lag-screw in

place.

Flashing can be installed by snapping a chalk line a few inches above the ledger and then using a power saw with a carborundum blade to cut a groove $\frac{3}{8}$ inches deep in the stucco. Bend the top of the flashing to fit into the groove and seal it with butyl rubber caulking — the best type for joining metal to masonry.

Measuring ledger height



Locating the footings: With the ledger in place, the next step is the most critical part of building a deck: locating the footings. After studying the basic load factors (page 102) and the required post spacing (page 104), you know how far each footing is to be spaced and how far out from the house they must be.

Transferring these measurements from plan to reality requires patience

and careful work to ensure that the deck goes up square. There are two primary ways to do this: with a stake and simple triangulation, or with batter boards.

Stakes: If you are building a low deck over fairly level ground, this method is faster and simpler.

Start by attaching a length of twine to the end of the ledger board right in the center of where the first joist will fit. Measure from the house out to where the first footing will go and drive a stake temporarily in place there.

Now, using a framing square as a guide, with the tongue against the house and the blade extending toward

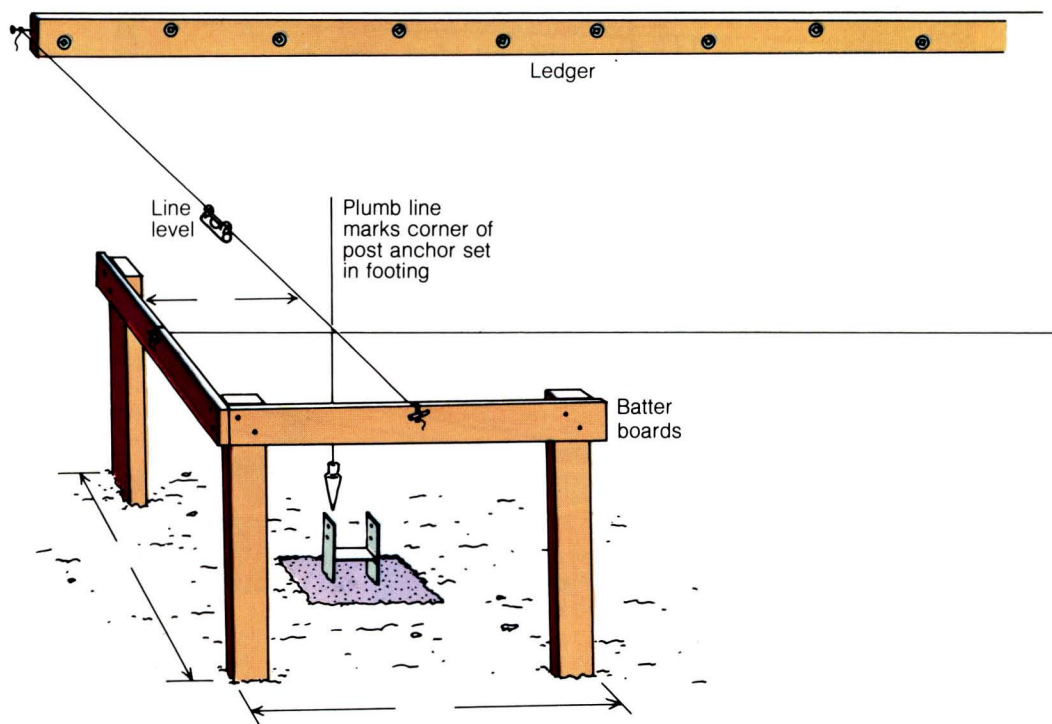
the stake, pull the string tight and shift the stake until the string is at right angles to the house. Drive a nail in the top of the stake and tie the string off.

To check whether you are square or not, measure out 4 feet from the house and mark that with a felt tip pen or paper clip on the string. Measure off 3 feet along the ledger board from the string. The distance between this mark and that on the string must be 5 feet if your angle is square. Adjust the stake and string until it is.

Do the same at the other end of the future deck, then draw a string between the two stakes and measure off your other footings in between.

Locating footings

NOTE: String marking the edge of the deck will be either a little outside or inside the end of the ledger (see text on "Length of ledger," page 50).



Batter boards: These provide very accurate locations and are essential when working on sloped or irregular ground, or building a free-standing deck.

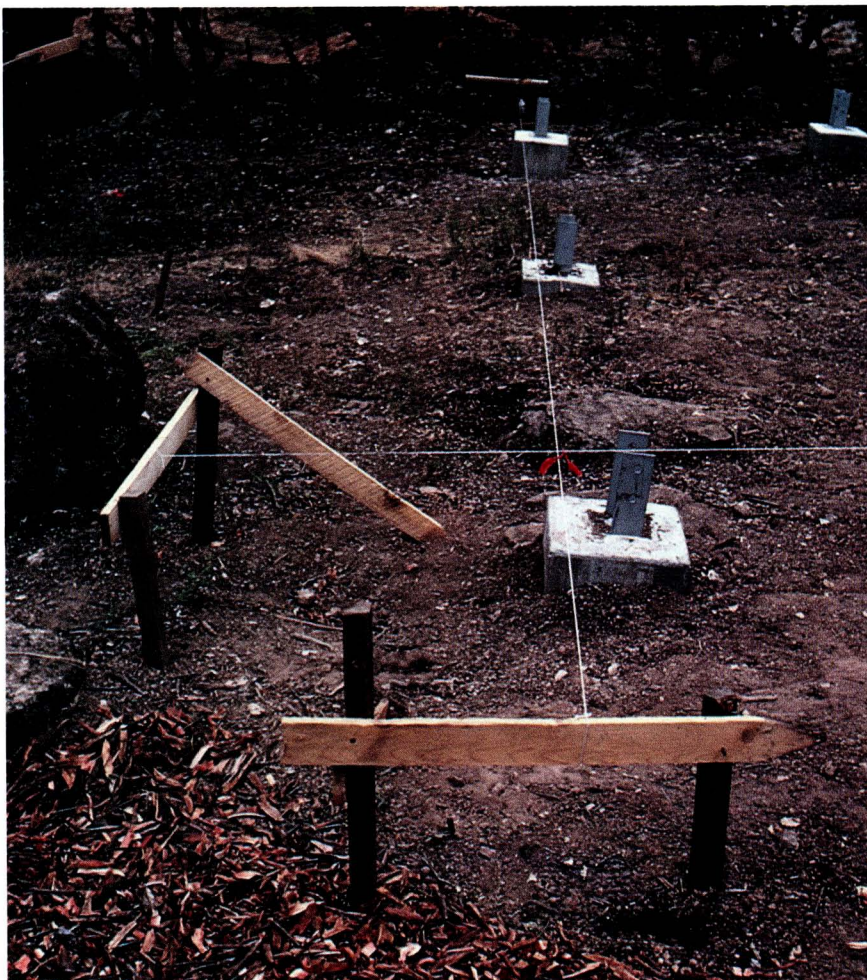
Place the string on the end of the ledger as previously described, measure out the required distance and use a square to approximately locate the first footing.

Build batter boards with 2 by 4 stakes and 4-foot long cross-pieces of 1 by 4. Locate them 2 feet back from the stake. Each cross-piece should be level, and the string running out from the house to the boards should also be as level as possible.

Mark the string 4 feet out from the house and 3 feet along the ledger board, then move the string back and forth along the board until the long side of the triangle is exactly 5 feet.

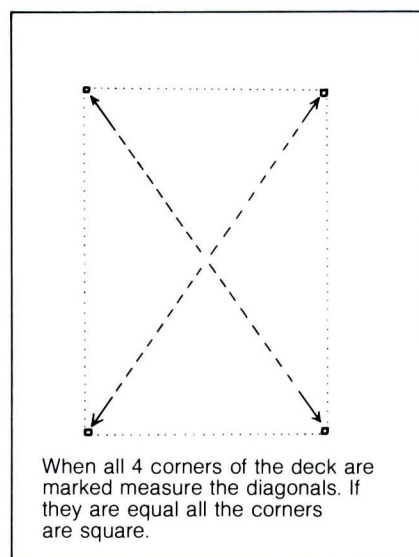
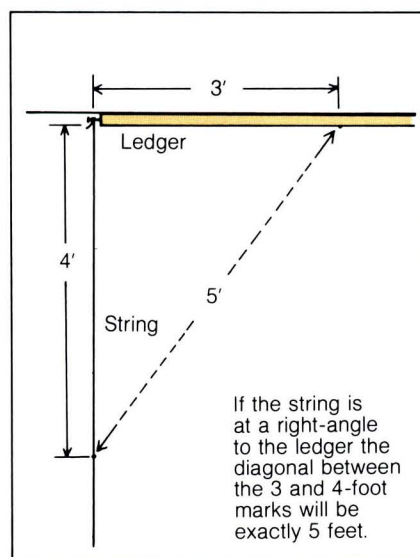
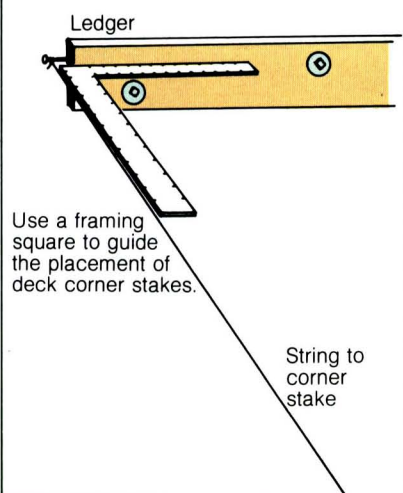
Repeat the process at the other end of the deck, or at all four corners for a freestanding deck. Pull a string between the batter boards directly over the intervening footings and mark them with stakes.

If your batter boards are all on the same level, you can double-check your work by measuring the two diagonals. If they are the same length, your deck will be square.



String lines run between batter boards allow for exact footing location, even on rough or sloping ground.

Squaring the site



Installing footings and piers:
Before digging the holes for your concrete footings, check your local codes for the exact size and depth required.

Generally, footings should be 12 inches square and 6 inches thick. They must also be placed in undisturbed soil.

If your house is newly built and on a slope, the dirt around it may be loose fill, pushed in there when the house site was leveled. In that case, you will have to dig through the fill to reach undisturbed soil. A footing placed on fill dirt will slowly settle in the loose earth and cause the deck to shift.

If the fill dirt is too deep to get through, rent a power compactor and compact the earth around the footing locations to 90 percent of the original soil volume.

If you live in an area of severe winters, be sure to sink the footings at least 6 inches below the frost line. Otherwise, freezing soil will heave and shift your deck. Again, check local code requirements by calling your local building permit office.

With a post hole digger or shovel, dig the footing holes, keeping the sides as straight as possible.

Pouring footings: Footings are made with a 1:2:3 mix, that is, one part portland cement, two parts sand and three parts gravel that is $\frac{3}{4}$ to 1½ inches in diameter. Your measure can be a shovel.

When mixing concrete in a wheelbarrow, first shovel in the sand and

cement and mix until a uniform gray. Next add the gravel and then about half the estimated amount of water. Keep mixing by turning with your shovel until everything is damp, then slowly add more water while you keep mixing. The amount of water is important to make the final strength of the concrete. The mix should not be so dry that it appears flaky or so wet it is soupy; it should appear almost plastic.

If you have only a few piers, consider buying ready-mix concrete in a bag. You just add water and mix with a shovel. One bag will make two footings that are 12 inches square and 6 inches deep.

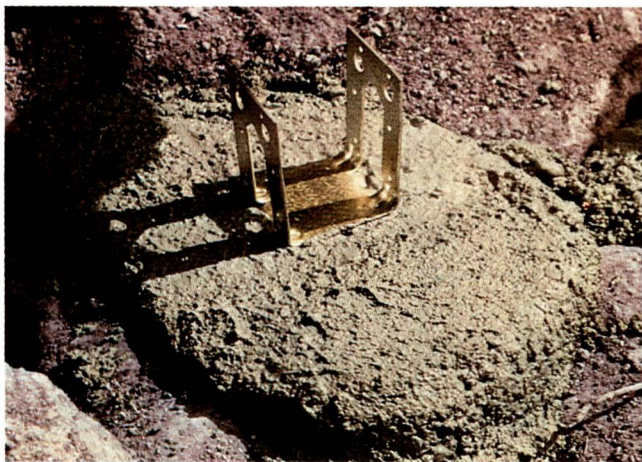
After the concrete is placed in the hole, tamp it a few times to remove any air pockets. But do not overdo the tamping since agitation makes the gravel settle.



Prepare the site and pour concrete. Have fittings handy.



Be sure depth of concrete is at least 6".



Tamp in the metal fitting or the footing.



Position and level footing.

Piers: In making your footings, keep in mind that the pier must rise about 6 inches above them to keep posts and joists clear of the soil. If you are using precast piers, the footing should rise about 6 inches above the ground surface.

However, if you had to dig deep footing holes, they will require a great amount of concrete. A good alternative is to pour a standard footing and then make long cylindrical piers by using fiber tubes. Cut the tube to length, place on the footing and plumb with a carpenter's level, then fill with concrete. For a tube longer than 3 feet, cut a length of reinforcing rod to extend from inside the footing to about 6 inches below the top of the tube.

After filling the tube, place the type of post support you want on top. If metal, just set it into the concrete. For a wood nailing block, use a rot-resistant wood and drive three 16-penny nails into one side. Bend the tops of the nails over to hold in the concrete and then push into the tube until nearly flush.

The advantage of a nailing board over a metal fitting is that it allows you to adjust your post an inch or two for precise alignment. With metal connectors already in place, a post can only go exactly where the connector is. But they provide an air gap at the bottom of the post, which is therefore less likely to rot.

If you are using precast piers, put them in place while the concrete is still moist. Work the pier into the footing about ½-inch and then check that it is level.

Double-check that the piers are laid out square and in line. Stretch a string between the two end piers as a guide for the middle ones. Make sure that this is done *before* you start pouring.

If a footing has hardened before you can lay the pier, wet the top and then coat it with a rich paste of one part cement and two parts sand. (The pier has to be wetted to prevent it from drawing out moisture from the mix.) Press the pier into place.

Making piers: If you plan to be mixing a great deal of concrete yourself or are having it delivered by truck, it might be worth your while to make your own piers.

Forms can be made from wood, 5-gallon cans with both ends cut out, or two No. 10 cans soldered together.

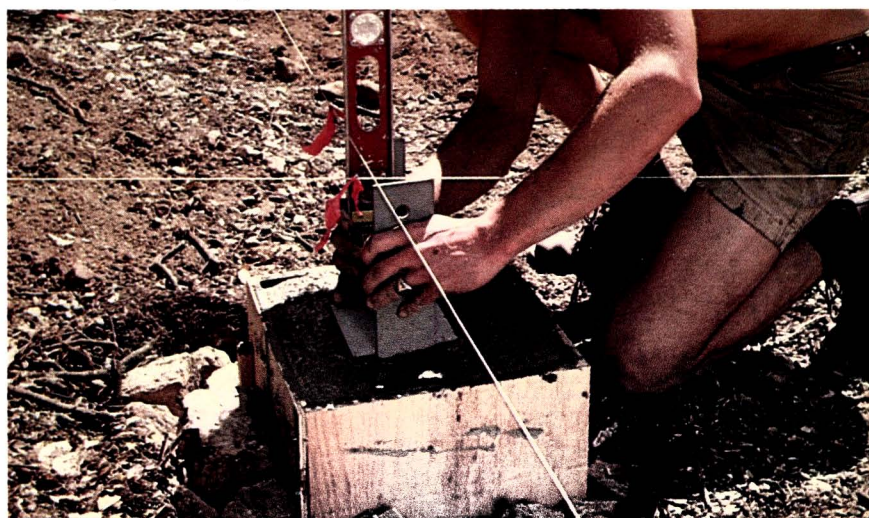


Build and brace form.



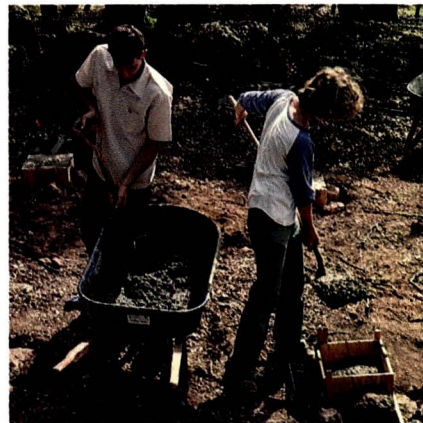
Keep forms and concrete moist.

Level and plumb footings.



In all cases, coat the insides with car oil before pouring to prevent the concrete from clinging to the form.

Place nailing blocks or metal connectors immediately after pouring the piers. Then cure the piers for 24 hours under a sheet of plastic before placing them on the footings.



Fill form with concrete.



Position footing along batter boards.



Toenailing a post on all four sides may be the weakest connection, but it is certainly the easiest, since measurements are not required to be exactly precise. Joist hangers, however, are strong easy methods for constructing a decking substructure.

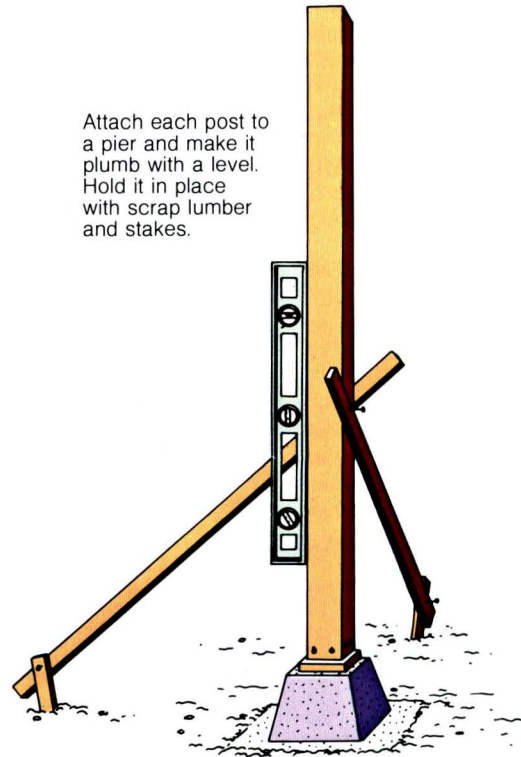
Connectors: There are many ways of connecting beams to joists and posts. Toenailing, or spiking at an angle on all four sides, is perhaps the easiest, but it is also the weakest shear connection: that is, it is least able to resist side forces that might exert pressure on the joint. There are numerous metal connectors that have great application in building decks, particularly where they won't show. In visible situations, however, some of these connectors might detract from the esthetic character, and this should be considered in their selection. For instance, a joist hanger on a lower level hanging from a beam might be visible from the side of the deck. It can be covered with a trim board, or some other form of joining can be used for this outermost joist. A wood cleat or simple metal strap can be a good joist holder. A T-plate or an angle iron are also easily used connectors. Specially fitted metal flanges are also available. To attach joists to beams or ledgers, joist and beam hangers are fabricated in many different forms and angles, and for irregular angles. Your supplier can order special custom angled hangers if you need them. Hangers are most useful when joists butt end into beams or ledgers. When they run along the top of beams, metal framing anchors are useful, or the joists can be toenailed in or attached with simple metal straps twisted to nail into beam and joist faces.

As earlier noted, ledgers are like beams, only attached directly to house.

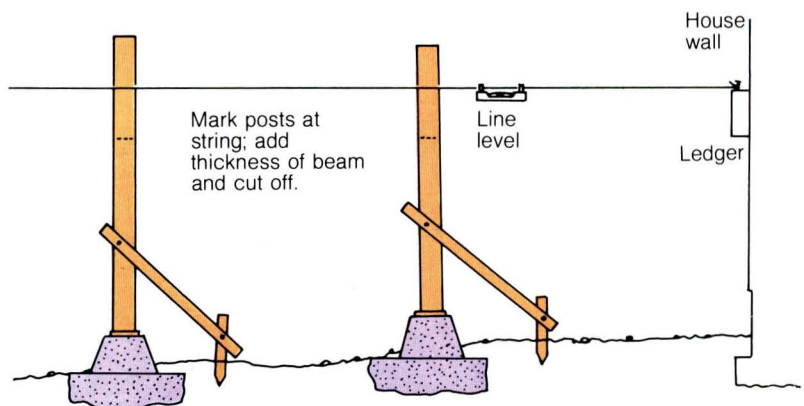
This connection is usually made by bolting the ledger to the house joist system with lag-screws or bolts. Leave the external finish of the building intact whenever possible. Where you must remove it, however — shingles, stucco or siding — the ledger can be bolted directly to the structure itself. On brick or concrete walls, connections can be made by drilling and placing expandable lead masonry connectors that give purchase for lag bolts.

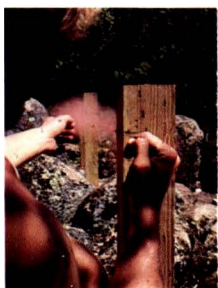
Whenever you connect a deck

How to plumb a post



Attach each post to a pier and make it plumb with a level. Hold it in place with scrap lumber and stakes.





You can also snap a chalk line horizontally. In this case, the chalk line was leveled with a line level, then snapped so the builder could saw off both posts at an equal height.

directly to the house, you must flash the exterior wall. This is the sheet metal or other water-tight membrane used to protect joints from wind-driven rain water. A stucco surface of a ledger wall undisturbed except for the bolt holes need not be flashed. Merely caulk the holes. If, however, you have a wood or shingle sided house, flash from above the finished deck level to below the bottom of the ledger, that is behind the ledger, or from above the future deck level, over the top of the ledger and down its face. The purpose of flashing is to prevent rain water from making its way into the house

structure where it could cause decay.

As we stated above, ledgers are bolted to the house. Once they have been nailed in place with 16 or 20-penny nails, drill and place four $\frac{1}{4}$ or $\frac{3}{8}$ -inch lag-bolts every six or eight feet. Generally, loads carried by bolts across the grain — that is, perpendicular to the grain — will be best supported if the bolts are spaced at least four times their diameter from the top of the member and an equal distance apart. When the load is parallel to the grain, as in a vertical post, you should drill bolt holes four bolt diameters apart and at least one and a half bolt dia-

eters from the post's sides. This spacing will prevent splitting and compression failure. The size of bolt you should use will depend on load and frequency of bolting, but generally, you should use one $\frac{1}{4}$ -inch bolt for 2-inch thick boards, two $\frac{1}{4}$ -inch bolts for 3-inch and 4-inch boards, and three to eight bolts for 6-inch thick and larger boards. As noted earlier, the size of the bolt should increase to $\frac{3}{8}$ or $\frac{1}{2}$ -inch diameter with 6-inch or thicker boards. Where you use bolts, be sure to use washers on the head and nut sides. When pre-drilling, use a bit just large enough to accommodate the bolt.



The ledger board, bolted to the house, creates a base elevation for the rest of the deck. Be sure to allow a $\frac{1}{8}$ " per foot slope away from the house for drainage.

Blocking: You can stiffen your deck structure and distribute its live load by blocking between the joists every six to eight feet. Cut out of the joist material or smaller lumber, blocks should have their top elevation level with the top of the joists. You can precut blocks to their exact size and as you assemble the joists, if you have long spans, they will help keep the joists upright and plumb. Blocking can also be used to connect different sections of decking patterns, carrying loads to the normal joist system. When blocks function as load bearing members, they should be fitted with joist hangers and not just toenailed in. Draw in blocking lines every 8 feet along joist lines on large decks.

Bracing: Bracing is used to strengthen against lateral or sideways movement like earthquakes, strong winds, or motion caused by people or objects moving on the deck surface. An example of this is the rocking movement of a chaise swing. To prevent a wiggle from developing and eventually weakening the deck, brace it with simple cross members in one of a number of patterns. It is generally not necessary to brace all of the posts in a deck. Usually a single line of braces in each direction is sufficient so long as the whole length of the side you choose is braced. Placement of braces may be dictated by under-deck uses like wood storage, pool pump or play house. Be sure not

to put braces across an access point. If a brace is to be longer than eight feet, use 2 by 6 lumber. If less than eight feet, 2 by 4 lumber will work. Other forms of bracing are Ks, Ys, parallels, Ws and the tension braces of cable and turnbuckle.

Connecting the posts, beams and joists: With the footings and piers in place, you are now ready to put up the deck itself.

The first task — and one that can be tricky if your deck is several feet high — is to put up the posts.

Of course, if you are lucky enough to have very level ground and the tops of your piers are all on exactly the same level, you don't necessarily need posts; just lay beams across the tops of the piers. Such perfect piers can be accomplished by pouring them in tubes already cut to the same level.

There are two basic types of deck construction considered here: post and beam, and extended post.

Post and beam: This style is excellent for low decks where no railing is required, although railing posts can be attached.

You will need a helper to determine where to cut the post. One person holds the end post in position on the pier while another extends the first joist. Place a level on the joist to make sure it is exactly level and then mark the post along the bottom of the joist.

This line represents the top of the beam, so subtract the actual thick-

ness of the beam, mark the post with a square, then cut the post.

Repeat this process at the farthest point the beam will reach.

When the two posts are cut, fasten the bases of each post to the piers and then carefully place the beam on top. Toenail the beam down to the posts.

While one person holds this framework in place — or builds a brace for it — the other person connects joists at each end. Check that the posts are plumb (exactly vertical) and that the beam is level, then nail all parts firmly in place.

You now have the skeleton of the support structure up and supporting itself.

Measure from pier to beam for each post required in between and put the posts in place. If you cut one a little short, shim it up with pieces of shingle between the post and beam. Don't be like the novice builder who complained that he had cut the post four times "and it's still too short."

Instead of using a joist to mark the beam location on the post, you can use twine or nylon string and a line level. Fasten the string so it is exactly flush with the top of the ledger and pull it tight against the temporarily upright post. Use a line level to check your accuracy and mark the post. Subtract the thickness of joist plus beam, double-check the measurement, then cut the post.

Extended post: The advantage of extended post construction is that it provides a particularly secure upright for either a railing or an overhead shade support.

These posts should reach a little further above the decking than the anticipated railing top so that you can cut them as necessary to make a level railing. Remember that where the deck is going to be 36 inches or more above ground level, most local codes (and common sense) require railings at least 36 inches high.

To find where the beam must be attached to the posts, raise the first post on the pier, check that it is plumb by using a level on two sides, then stretch twine from the bottom of the ledger to the post. Use a line level on the twine and then mark the post. Repeat this with the second post,



Cross-bracing strengthens a deck against lateral (sideways) movement.

then lay both on the ground and fasten the beam on the inside. Check that everything is square and remember to carry the beam across only half the face of the second post so there will be room to attach the next one if necessary.

Now raise the posts and beams back into position on the piers. Hold or brace them in a plumb position while the joists are fastened at each end to stabilize this initial framework.

Save yourself time and effort when using joist hangers: have them all nailed in place on the ledger and beam before raising it.

Install all the joists in this initial framework and then cross-brace it.

You now have a firm framework to support the rest of the deck.

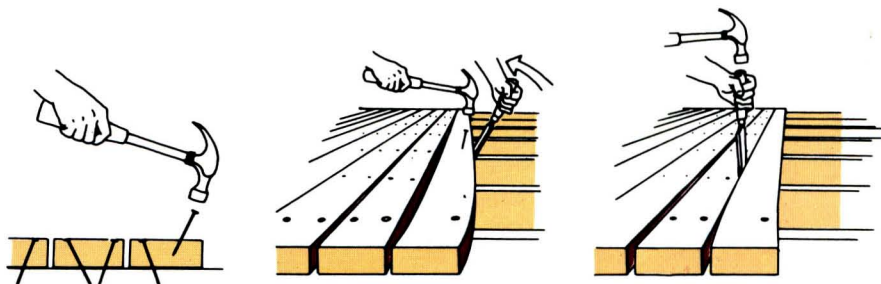
Pre-measuring post heights: Instead of raising posts and using a line level, you can calculate the height for the posts while they remain on the ground. Measure from the top of the ledger board down to a point a couple of inches above the ground. Make a note of this distance. Now run a line out to the pier, check that is level, and measure the distance between that and the top of the pier. Combine that distance with the measurement marked on the house and you have the distance from the top of the pier to the top of the ledger. Fasten the beams to the posts accordingly.

Cantilevered decks: Cantilevers and the sensation of floating decks can result from placing the posts well in from the edge of the joist system. To do this, cantilever the beams one half of the allowed span (see page 103) and do the same with the joists. Along the end of the joists, place a face board with the same vertical dimension as the joists. If you want to strengthen the visual effect of the cantilever, make the face board wider than the joist and face the joists along all edges with the same material. This broad band of joist-facing material (1 by 8s or 1 by 12s) will make the deck seem substantial enough to defy gravity and "float" on its own.



A builder sometimes finds it necessary to work in awkward spaces, especially when joining joists to beams.

Driving nails at opposite angles helps hold the decking down. Warped boards can be straightened by the use of a wood chisel. See details in text below.



Laying the decking: If the deck is too high to work on from the ground, start by pushing a dozen or more decking boards over the joists to provide footing. Never step on the end of a plank, since there will probably be no support under it and you could fall.

Begin by laying a straight board alongside the house. Leave a space of at least $\frac{3}{16}$ inch to allow rain water to drain past the decking.

Position the first board along the house and either flush with the end of the deck or overhanging if you have designed a cantilever. Mark where this first plank crosses the center of the farthest joist it will reach. Use a square to draw the line across the board, cut it and nail in place. Make this first board as true as possible since it is the guide for the rest of the

decking. Although you can adjust as you go, it's best to have the truest start possible.

Nailing: It is preferable to use stainless steel or aluminum nails for the decking, but they are difficult to locate as few stores carry them. They are also very expensive. Galvanized nails will stain woods, showing stains on redwood, cedar or cypress. You may, in the end, have to learn to be happy with galvanized nails.

The diameter of a 16-penny nail is the standard spacer for decking boards.

A nail driven straight down through the decking can soon work its way back out. To counteract this tendency, drive the nails at about a 30 degree angle. Two 16-penny nails driven at opposing angles are sufficient for 2 by 6 deck boards except at the joints, where three nails should be used. Before starting a nail in at a joint, flatten its tip slightly by tapping it on the head of a nail already driven in. This will reduce the chance of splitting

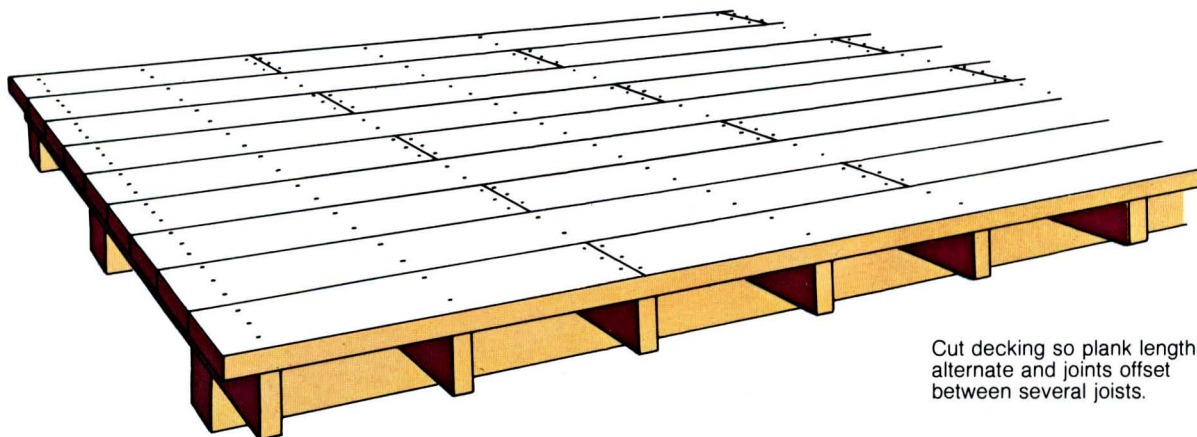
the end of the board.

Alternating the planks: After the first line of the deck boards has been laid, the second row must be offset so all the joints do not end up on the same joist, which would weaken the deck significantly. If, for instance, you are laying 12-foot boards, cut a number of them in half and start every other row with a 6-foot plank. This keeps the joints alternated.

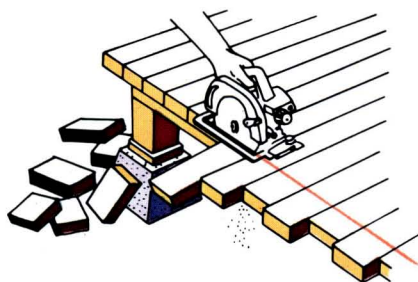
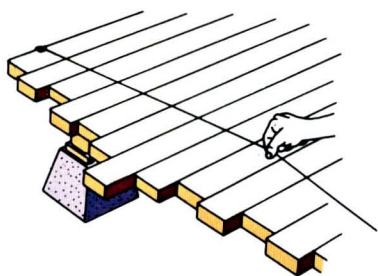
Straightening boards: It seems inevitable that you will have a number of crooked boards, but you can make them lie straight. Here are two tricks to help you convert those stubborn boards.

If the board is bending out and away from you in the middle, first attach it to the joists with just one nail in each end. (Remember to space each plank with a 16-penny nail.) To get the board back into line, pull it as far as you can with one hand then jam a chisel between the board and the joist behind it. Now pull the chisel handle toward you. It will give you a

Cutting decking planks



Cut decking so plank lengths alternate and joints offset between several joists.



Trim irregular decking boards by snapping a chalk line and cut along it with a portable circular saw.

surprising amount of leverage. If you have already started the nails, you can hold the board with one hand while driving the nails with the other.

If the board is curved in too tightly against the plank already in place, nail the ends and then drive the chisel between the two boards until you have forced it out the required amount before nailing to the middle joist.

Keeping the decking straight: As you work, stop after every four or five rows and eyeball your progress. Further check it by measuring each end out from the house.

Usually you are going to have to make adjustments as you go. But several small adjustments rather than one large one at the last row will make changes practically invisible. Measuring repeatedly as you go will keep the deck progressing smoothly.

Odds and ends: As you finish each course, don't worry about irregular overhangs at the end of the deck. When you are all done, snap a chalk line or use a straight board to mark, then use a power saw to trim all the boards at once.

A bigger problem is getting the last piece of decking to fit properly around extended posts. With precise planning and measurements during construction, you might make the last piece fit exactly. If you don't, you will just have to notch the last board to fit around the posts.

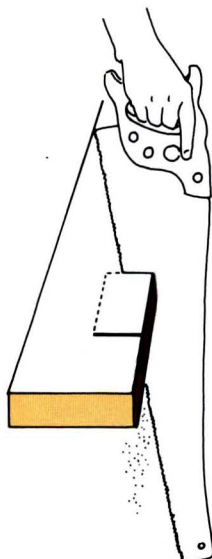
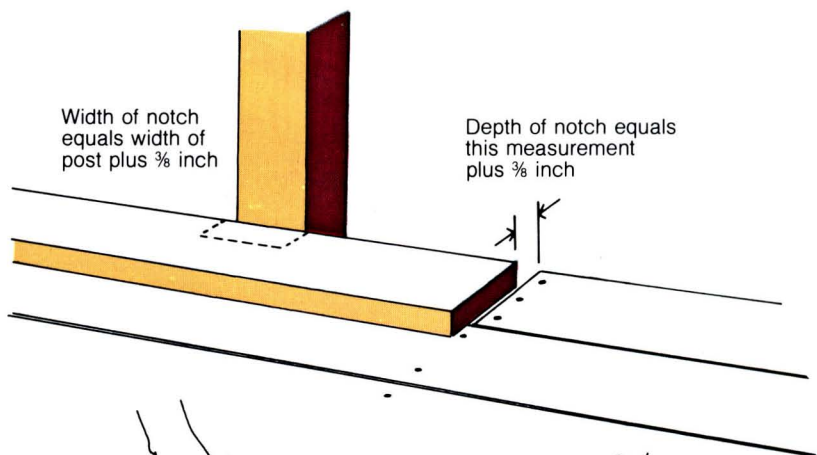
To determine how deep your notch should be, lay the board in position alongside the posts. Mark each side of the post and add $\frac{3}{16}$ -inch for clearance on both sides to allow water runoff.

Now measure how much this board overlaps the one underneath already in place. To that distance add $\frac{3}{16}$ -inch for spacing between the boards plus $\frac{3}{16}$ -inch for clearance around the post. This last measurement is important to remember.

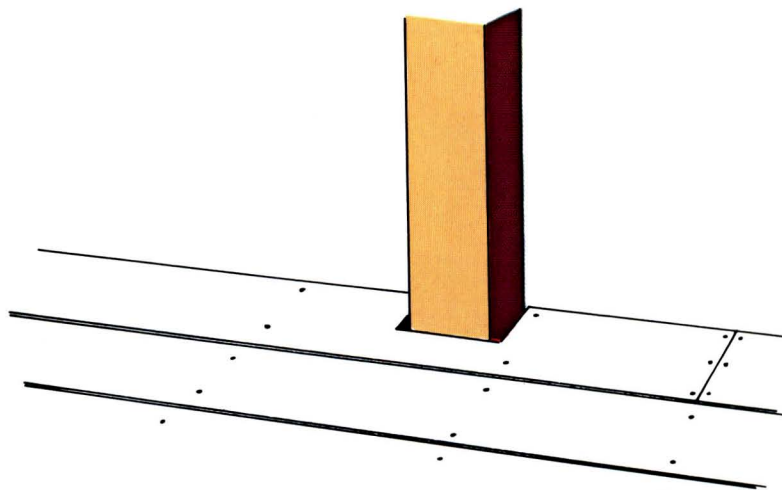
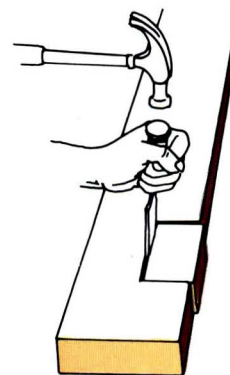
With a square, transfer all these measurements around each post and cut. Most of the inside edge can be cut with a power saw by carefully lowering the blade into the wood. Finish the cut with a handsaw.

In making these and all other cuts, remember the carpenter's maxim: "Always save the line." Otherwise your measurements will be off by the width of the saw blade.

Fitting around posts



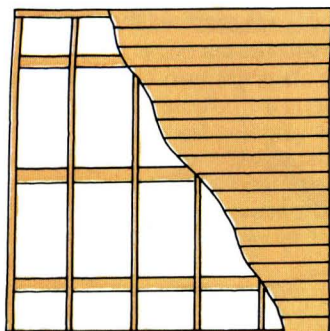
Cut sides of notch with a hand saw and split it out with a chisel





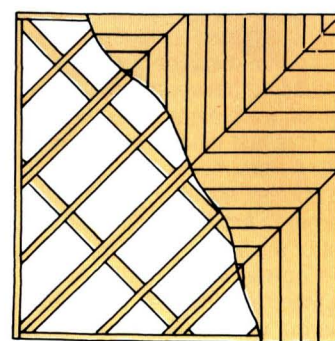
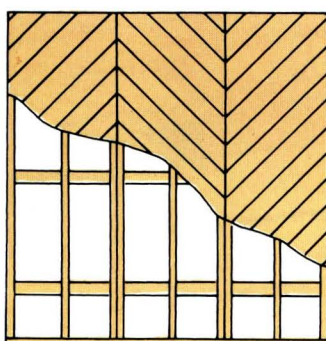
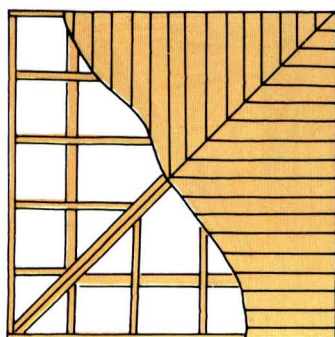
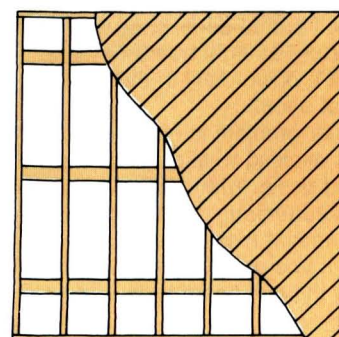
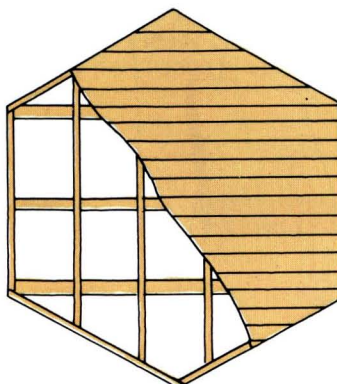
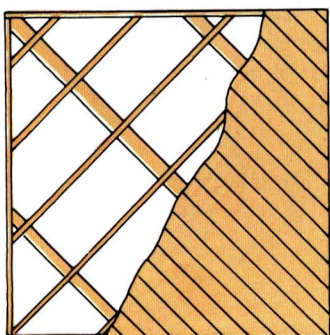
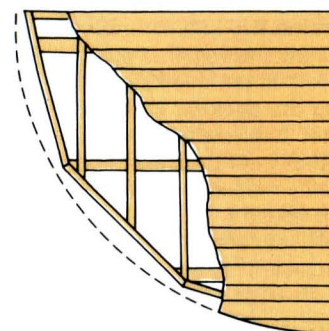
Deck patterns require structural support to fit their complexity.

Various deck patterns and their supports



Decking patterns: The size and shape of the deck and the plank size and pattern of the decking determine the framing plan of the deck.

In diagonal patterns, the decking may be laid at any angle greater than 45° or less than 90° to the joists. Standard framing may be used for diagonal decking as long as you note that the span between joists, must be measured at the same angle as the decking. The joists must be set closer together than for standard decking.



Fitting around a tree: A handsome tree coming through your deck can be both attractive and practical: beauty and summer shade. However, you can never tie part of a deck to a tree since its movement in the wind will destroy the deck. Similarly, in building around a tree remember to leave room for it to sway and grow.

Build a block around a tree as illustrated.

If a tree is directly in line with where a joist should go, first put in the joists on either side and then cross-brace the two as illustrated. Finally, add the two short sections of joists.

Decking on edge: An attractive deck is made by placing 2 by 4s on edge. It requires considerably more wood and time, but you'll have a deck that is both strong and unusually attractive. Wood spacers are normally required at the ends and over each joist. As each 2 by 4 is put in place, toenail through the side into the joist.

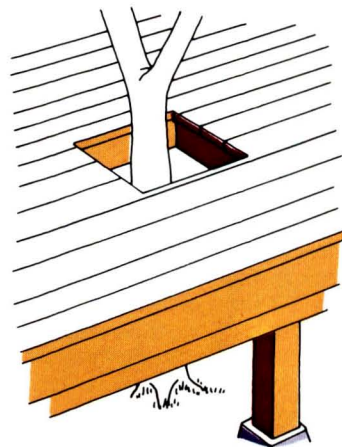
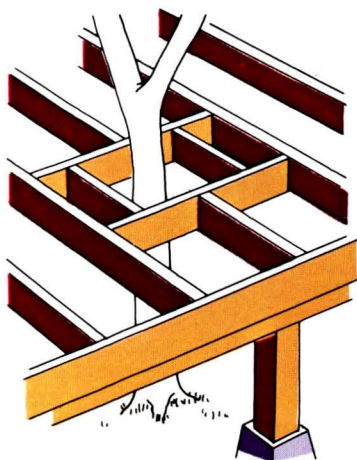
To calculate the number of 2 by 4s needed for an on-edge deck, multiply the deck's width by 6.9. This allows for $\frac{3}{16}$ -inch spacing. Round up to the next whole number and add 5 percent for breakage and mistakes.

Parquet decks: These are generally laid out in 3-foot grids so the size of the deck should be a multiple of 3. If this is not possible, you can carry the 3-foot grids as far as possible each way and then finish the outer edges with a contrasting design that will appear as a border or trim.

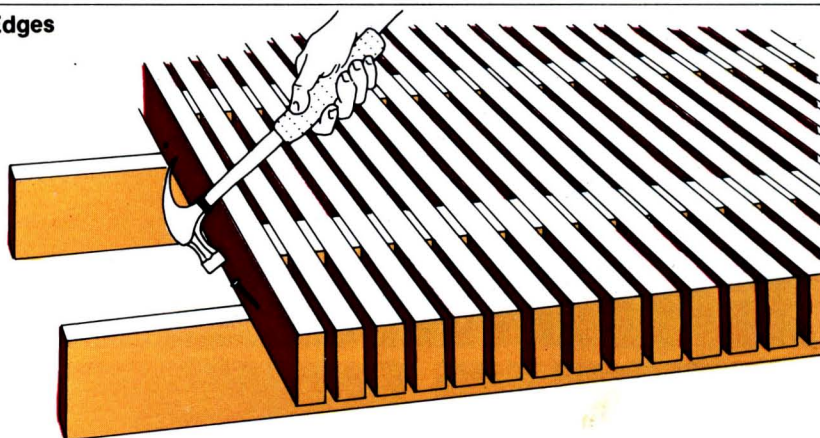
Use a framing jig as illustrated to speed the process of making the parquets and to ensure uniformity. In making these decks, the narrow 2 by 4s rather than 2 by 6s lend the appearance of more detailed work.

Parquet decks are often laid directly on the ground. Mark out and square the area, then dig it down deep enough to allow for 2 inches of pea gravel for drainage and 2 inches of sand to firmly seat the deck. The finished deck should be level with the turf surface.

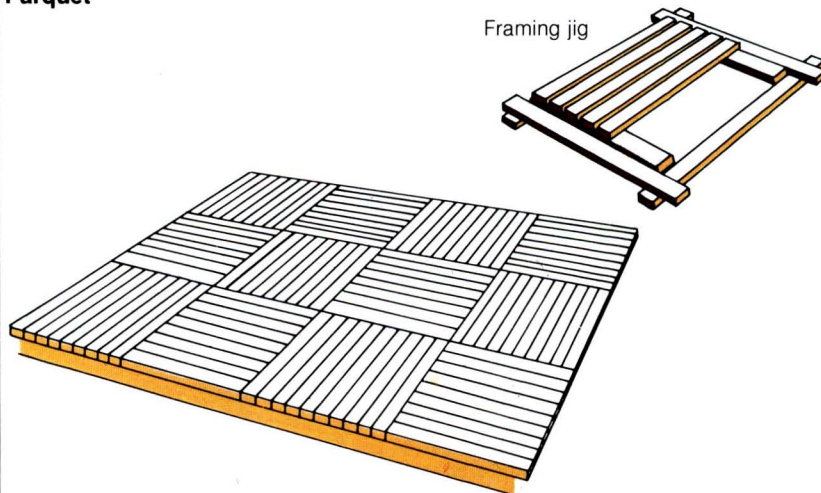
Trees

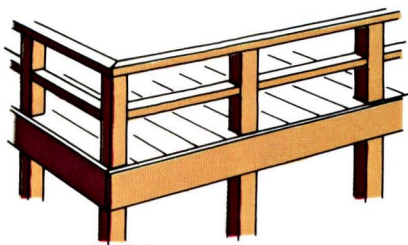


Edges

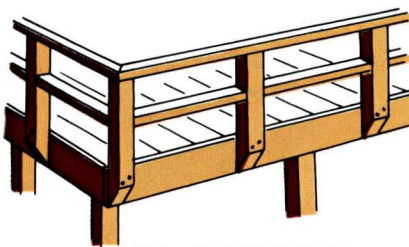


Parquet





Extended post rail supports



Rail posts bolted to facing board

Constructing railings: There is almost no limit to the variety of attractive railing designs, but there are a few basic rules. First, railings must be sturdy enough to support people leaning or even sitting on them. If the deck is more than 3 feet off the ground and if small children will ever be on the deck, it should be designed to prevent them from falling through. Your local codes will usually specify

the minimum opening.

Attaching posts to the deck: If you have an extended post deck, this will not be one of your problems.

One of the most common methods of attaching posts is simply to bolt them to the facing board around the deck. Use carriage bolts — a minimum of 2 per post. You gain additional stability by cutting out a section of the post so it locks into the deck and adds strength.

Posts can also be set on top of a beam and next to a joist before the final decking boards are put in place. Toenail the post to the beam on three sides and then cinch it tightly against

the joist with two $\frac{3}{8}$ by $3\frac{1}{2}$ -inch lag-screws. Put a cleat on the post opposite the joist to provide a nailing base for the decking.

A more secure post is made by clasping a joist between two 2 by 4 or 2 by 6 uprights. In this case, use 2 carriage bolts through the joist and both uprights. This system works well on decks where benches are to be built in (see page 68). The uprights can be angled out to provide a comfortable backrest.

The railings: For most decks, imagination and money are the only limits on the choice of railing. Here are some of the basic elements:

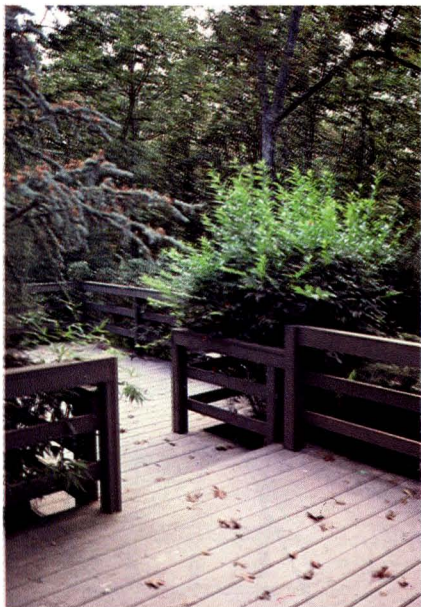
Cap board: Although not necessary and not used on many decks, a cap board lends a finished look and provides a handy place for people to lean comfortably, put drinks and plates, or perch upon. If you have 4 by 4 posts, use a 2 by 6 cap which gives you a $1\frac{1}{2}$ -inch overhang. The cap can be either centered on the post or offset to cover the top railing that fits directly under the offset.

Once in place, the cap can be given a particularly finished appearance by routing the edges, which also minimizes the chances of splinters.

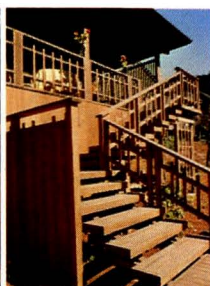
At corners, cut the caps at 45 degree angles for a strong and finished joint.

Rails: These can be attached in any of the illustrated ways. Although some sources suggest you shouldn't have rails inset into posts because that increases the chance for decay, this does not appear to be a common problem. Besides, inset joints are strong and give a handsome and finished appearance. Before setting the railings in this manner, soak the ends of the rails and the notches with a preservative. (See comments on preservatives on page 67.) When they are thoroughly dry, add a thin coat of waterproof glue to both parts and toenail in place with 8-penny finishing nails.

To stir your imagination, here's a sampling of different deck rails.



Railings for residential decks should be 36" high and should have no opening greater than 9" in one direction. A small gap at the base — 3" or 4" — can be useful in sweeping or hosing leaves off. All railings should be strong enough to support 15 pounds of horizontal pressure.



Stair railings are necessary if more than three steps are used. When possible, the railing should create a visual link between the levels connected.

Connecting decks: Decks are usually connected to each other or to the ground by stairs. But there are stairs, and then there are stairs. They can be the practical everyday variety, or a series of descending decks.

Stairs are comprised of a riser, the vertical part, a tread where you step and stringers to support the steps.

Stairs must always have a constant ratio between riser and tread so there is no guesswork about where to put your foot down.

There are several ways of working out a comfortable riser-to-tread ratio (see page 106). Household stairs commonly have a 7:11 ratio, that is, a 7-inch riser and an 11-inch tread. Stairs on decks, however, are usually cut broader for more stability and may have a 6:12 ratio, for example. This type of stair is readily made by using two 2 by 6s as the tread and a 2 by 6 as the riser.

As a general rule, the lower the riser the wider the tread.

It is also important that different sets of stairs around decks be laid out in the same fashion. It is confusing if not dangerous to proceed from stairs with a 4-inch riser to stairs with a 6-inch riser.

Stairs are normally supported by stringers made of 2 by 12s. They provide enough depth for the step notches to be cut out and still carry the weight.

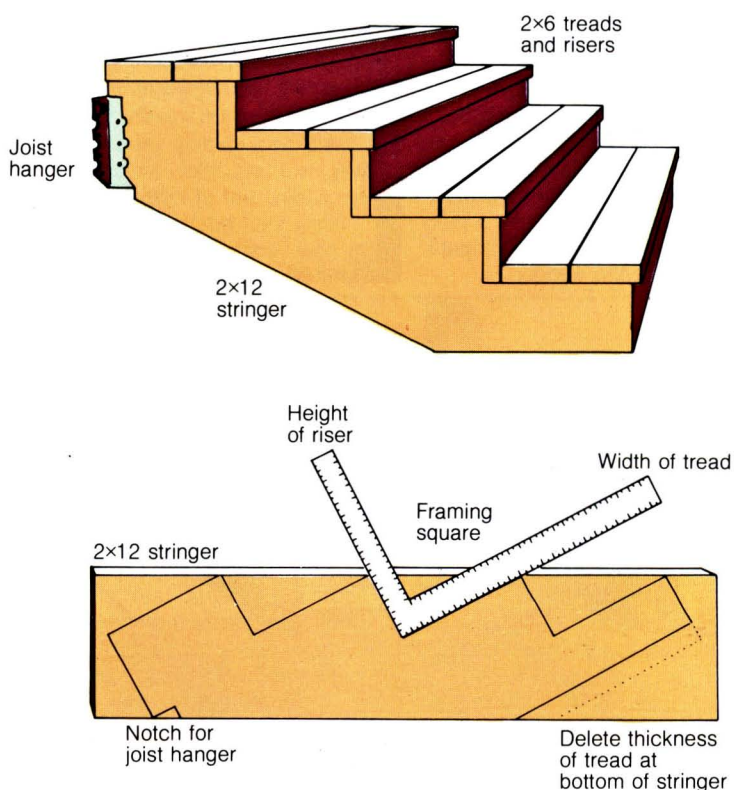
Stairs can also be placed between the stringers by using 2 by 4 cleats or angle irons.

Unless you make a conscious design decision to do otherwise, you should cut the stair treads from the same size lumber used for the decking to provide uniformity.

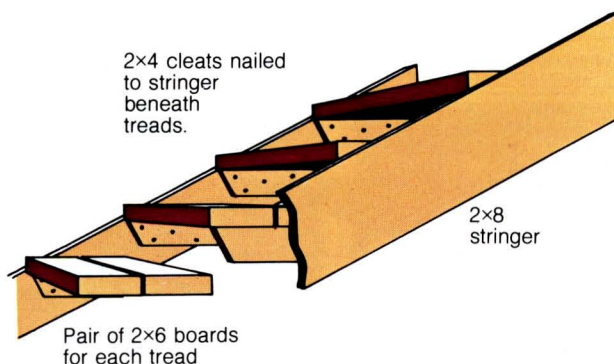
The riser space can be left open to speed the drainage of water or it can be closed to block the support structure from view and to provide the appearance of more stability.

Cutting stair stringers: The top of the stringers should be bolted to the deck joists and the bottom should rest on a

Steps with notched stringers



Steps with cleats holding treads



brick or concrete pad — never on bare ground, where it would soon decay.

Measure the distance from the deck to the landing pad and then, using the

height of riser you prefer, estimate how many steps it will require. Depending on space and height, you may have to compromise your ideal steps.



Little stepped decks make easy elevation changes, but can be dangerous if the steps are not carefully placed. Single risers are hard to notice, and can become tripping blocks for the unwary.

Mark the stringer with the framing square (see page 65). In this case, the blade of the square is placed at 12 inches and the tongue at 6 inches for the riser.

The top step should either be the exact riser height below the decking or flush with it. The riser distance between the last step and the landing pad can be a little less than the others to make the other steps come out evenly.

After marking the first stringer, cut it with a power saw and check your work by putting it in place. If it fits, use it as a pattern to cut the second

stringer.

For stairs 4 feet or wider, use a third stringer down the center.

If you are building ramps, keep in mind that no ramp should exceed 1:5 slope, that is, a 1 foot rise for every 5 feet horizontally. The stringers for a ramp, of course, will have a smooth slope along the top edge.



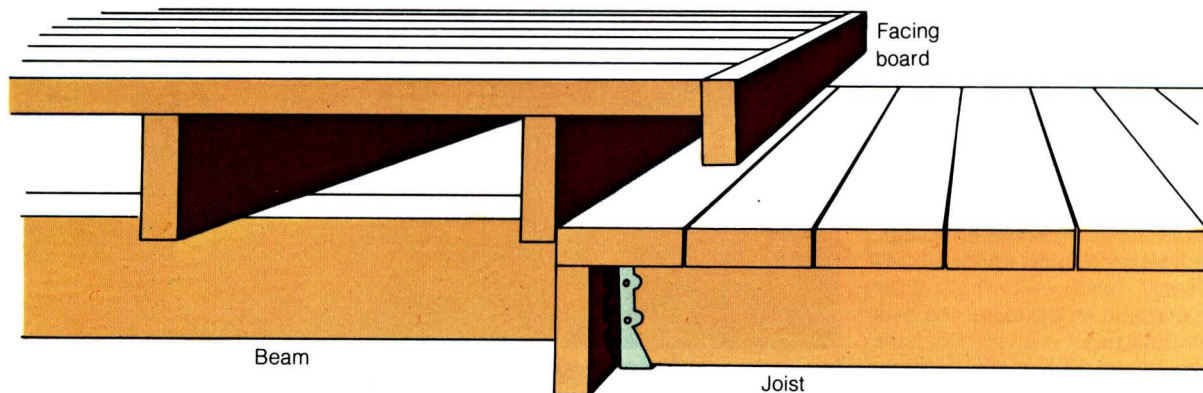
linked decks: Instead of plain

stairs, a series of little stepped decks can be useful and attractive.

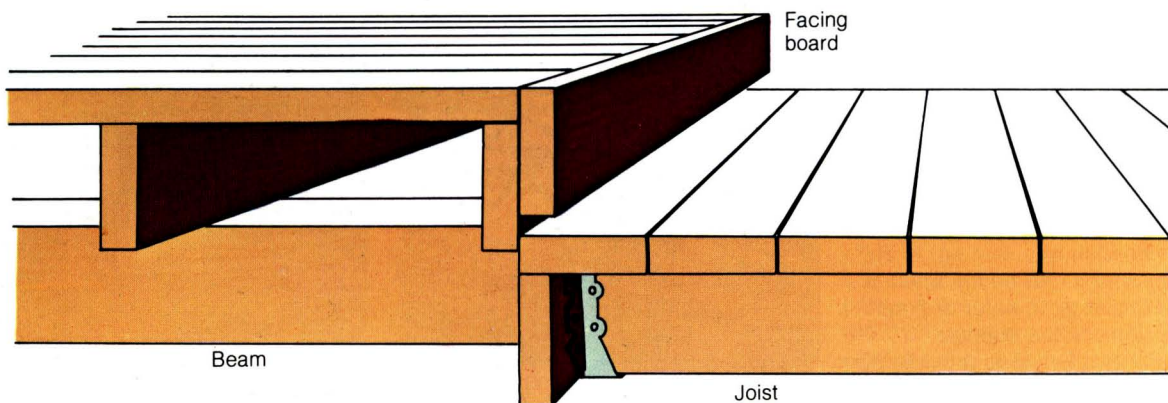
This is done by attaching joists either to the existing beam on the upper deck or by bolting on another beam to support the joists. The choice depends on how much of a step down you want. Two steps can be added between decks for an even greater drop.

A floating effect is achieved by having the decking on the upper level extend out 6 to 12 inches beyond the next level down and covering the extended joists or decking with a facing board.

Faced overhang



Faced flush





Application of Danish oil to decking is costly, but yields rich wood tones and good protection.

Protective finishes: All decking, regardless of the kind of wood, will benefit from some form of protective finish. What type you use is determined by what effect you want to achieve.

Decks can be bleached for instant weathering; they can be stained for more subtle coloring; or they can be painted to match or contrast with the house.

Whatever the finish you choose, the decking and substructure should be treated with a water repellent as described later. For continuing good results, it should be reapplied every two years.

Paint: Painting a deck requires careful preparation to ensure a smooth and lasting finish. All work should be done on cool and windless days so the paint won't dry too quickly and blowing dirt won't mar the finish.

Select a high-quality paint specifically designed for heavy use outdoors. A good choice is an alkyd paint that is quick-drying and self-priming. Oil base paints are slower drying and must be applied over a zinc-free primer. Although very expensive, certain marine enamels can give a hard wearing, non-slip surface.

For best result, paint the deck and all exposed wood ends with a water repellent and let dry. Apply a primer coat and allow that to dry before finally applying the finish paint. Two coats are recommended for long-lasting results.

Stains: You can select a heavy-bodied stain that obscures the texture of the wood but not the grain, or a light-bodied penetrating stain that leaves the wood texture visible.

In either case, be sure to specify a sealer type of stain that is "non-chalking," which means it will not rub off on clothes or feet and be tracked into the house.

Before applying a stain, let the newly constructed deck stand in hot dry weather for at least a month. This allows the decking wood to dry enough to absorb the stain.

For best results, mix the stain with an equal amount of water repellent. In applying it, be careful not to leave marks from overlapping brush or roller strokes.

Stain will weather away and usually needs a replacement coat every two or three years.

Bleaching: Unless you use a special wood sealant, decks made from redwood or cedar quickly lose the original distinctive color and turn dark when first subjected to the weather. Within a year or two, the dark color changes to a soft silvery gray with the natural bleaching brought on by the combination of sun and water.

You can effect this change nearly overnight by applying decking bleach available in many hardware stores. Check that it contains an anti-mildew substance to protect your deck. If the wood begins to darken again after a few months, one more coat should make the bleach job permanent.

Water repellents: A wood preservative should be applied to all decks, even redwood and cedar. It's a small investment for the added protection.

The best type of preservative for decking is pentachlorophenol, called "penta" for short. It is clear and odorless, and quickly soaks into the wood. It should be applied liberally to all exposed wood, with extra coats being given to the ends of the boards.

Since it is film-free and penetrating, penta should be applied as a primer for all decks to be painted, stained or bleached. It can be mixed directly with the stains or bleaches, or it can be

colored by adding pigments available at the paint or hardware store.

A second choice as a preservative is copper naphthenate. It is about equally effective but leaves the wood stained lightly green. However, it can be painted over.

One of its chief benefits is that it is non-toxic to plants, while penta is toxic. Copper naphthenate is the best choice for protecting the inside of wood planters.

Creosote should not be used around decks because of its dark coloration, sticky surface and distinctive odor.

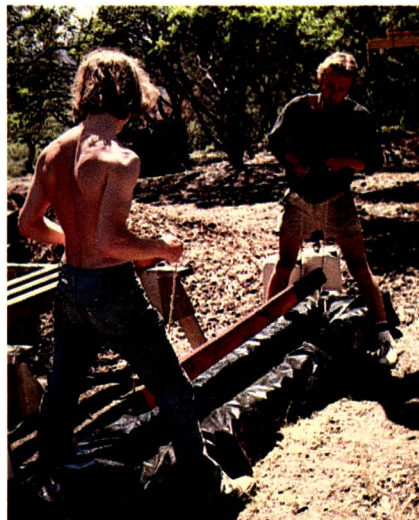
Preservative treatments: Except for heartwood redwood, any wood that will be placed directly in the ground must be pressure treated. Heartwood cedar will hold up nearly as well as heartwood redwood. Wood that is just painted or soaked in a preservative will not last.

For substructure wood exposed only to the weather, the best way to treat with a water repellent is to soak it. The whole board or timber can be soaked effectively in a make-shift tub made out of heavy plastic sheeting draped over stacked wood or concrete blocks.

The ends of boards can be soaked by standing several pieces in a partially filled 55-gallon drum.

Allow wood to soak 24 hours.

A temporary trough made from timbers and plastic sheeting makes efficient use of wood preservative as posts are soaked.





Benches can be an integral part of the structure.

Benches for decks: Benches around a deck, either freestanding or built in, are invitations for people to sit, converse and relax. Benches can have backs that form a railing or — if the deck is near the ground — they can be low, wide areas that in effect are railings you sit upon.

Benches can be built easily if you have used the extended post style of construction (see page 58). Bolt two 2 by 4s to each post about 14 inches above the deck and extend them out 15 to 18 inches. A 4 by 4 clasped at the end provides the outer support. Top these supports with 2 by 4s spaced to allow rain to run off. The ends of the 2 by 4 supports can be faced with a 1 by 6 for a finished



A high bench can double as a table.



Tables and benches in dining areas can be moved about to accommodate a variety of uses.

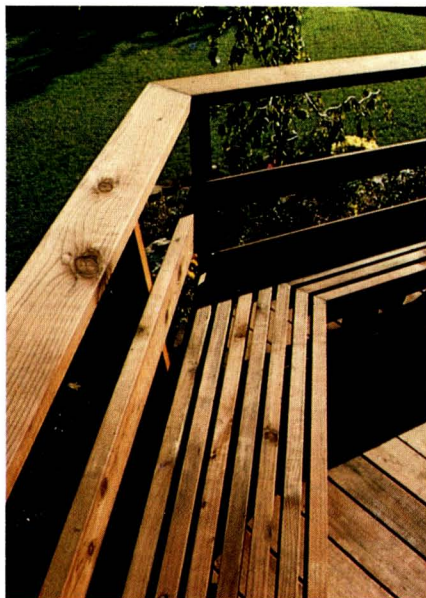
appearance.

If you are installing railing posts on your deck and you want benches around the edges, bolt 2 by 6s to joists every 4 feet and tilt them out at about a 30 degree angle. This provides a comfortable backrest.

Make the bench supports from 2 by 4s clasp the posts, as described above.

Low benches without backs can be made by bolting 2 by 4s to the joists. These in turn clasp a support at the top and 2 by 4s are nailed on top. For a more unusual appearance, nail them on edge with spacers over each support.

A simple but elegant low bench is made by bolting a 2 by 6 to joists every 4 feet and then bolting a 2 by 6 to the top. Cut the ends back at a 45 degree angle so they won't interfere with legs. Top with 2 by 4s or 2 by 2s.



A bench can double as railing.



A curved bench produces little comfortable group seating.



A free standing bench eases maintenance by eliminating feet to be swept around.



Benches create a cozy corner seating nook.



The How-To's of Patio Construction

How to lay and cut bricks. How to mix, pour and finish concrete. How to build steps and paving blocks.

Choosing alternative pavings: flagstone, planks, log rounds, wood blocks, wood beams, bark chips. How to build edgings, retaining walls and plank walls.

A guide to garden paving materials.

All too often, homes simply have backyards and nothing resembling a patio. Or at best, the so-called patio may be a big square of concrete just beyond the back door.

But the yard — behind the house or in front, for that matter — can be turned into an attractive patio garden that can change the whole feeling of your house and how you use it. A patio, like a deck, should be an extension of the house, a smooth transition that adds to your living spaces. Then in the patio itself there should be more transitions in the form of walkways, open spaces and shrubs that please the eye.

The patio should be planned around the uses you have in mind for it, how much activity will go on there, how much openness and how much privacy is desired.

It would be nice to say that changing an ordinary backyard into a delightful patio garden is a fairly easy task. Unfortunately, it requires work and sometimes lots of it, depending on your own expectations and how difficult an area you have to work with. But in the end it will be worth it, not only for your satisfaction but because you will have significantly raised the value of your property.

In planning the patio, you'll want to study several basic questions.

What type of paving materials you want in the garden will be one of the first considerations, for that will help set the tone of the whole area. It may be brick laid on sand, irregular patterns of textured concrete, or blocks of redwood laid like bricks on sand.

The surface you choose will be de-

termined in part by what activities you plan there. A family with young and active children may want a combination of concrete and grass as play areas year round. Others may want small nooks where they can relax in peace and quiet.

Another consideration is ease of maintenance. That will be partially determined by how much time you have to work in and around the patio, and how much work you want to do. A patterned concrete patio, while difficult to install, is virtually maintenance free. Bricks on sand, however, require occasional repair as bricks crack or sink out of line in the sand.

Apart from regular maintenance, there is the question of just how much work you can do initially to alter your property. It's wisest to build the patio to harmonize with the existing terrain. If you have a steep slope in your yard, plan on altering that with terraces — see page 90 — which will give you level spaces to walk or garden, rather than trying to grade all the ground absolutely flat. Conversely, an uninteresting flat yard can be altered by raising the ground one or two levels with fill dirt.

Also, keep in mind the location of your planned patio in relation to the sun and prevailing winds. If you are going to need lots of shade in the summer, include existing shade trees in your layout, or plan on planting shade trees. If wind is a problem, design the patio so there will be areas of calm.

Privacy is another consideration. You don't want to have a patio where everyone walking or driving past the house will be able to watch your activities. If this seems unavoidable at your house, screen the street with a fast-growing hedge, or a fence just high enough to block the view in without hemming you in.

The cost of your patio is a final consideration, but don't let it deter you from having what you want. A poor compromise on your part will leave you with a patio that you find less than pleasant and therefore won't use much.

If you can do most of the work yourself — and that is what this section is aimed at — consider all you save in labor costs, and put that toward buying exactly the type of materials you want.

You can do it. It's just a matter of making the decision and the first move.



Different brick patterns delineate areas, separating circulation from use spaces.

A circular brick pattern with a tree at the eye of the hurricane, creates dynamic motion within an enclosed space.



The earthy quality of brick patterns provides an esthetic counterpoint to the flowers, trees and bedding plants on any patio.

The wonders of brick: In planning a patio, many people find that brick is the best solution. Bricks come in a variety of rich, warm colors, are relatively inexpensive and not difficult to put down for terraces or walks. They can be placed flat or on edge, can be set in dry sand or mortared in place, and they can be laid in a great variety of eye-catching patterns.

There is also a wide variety of styles to choose from.

The common brick, also called the building brick, can be found virtually everywhere throughout the country.

The common bricks often found in garden construction are divided into three main categories. The most common are wire-cut bricks with straight, rough sides. Sand mold bricks are smoother, with tapered sides that make them easier to remove from the molds. Clinker bricks are hard-baked, tough and smooth, and often show patches of black oven burns.

Bricks are also available in a variety of textures that should be carefully considered in planning your patio.

A very smoothly finished brick may be slippery when wet and reflect too much glare in the summer. Particularly irregular bricks — such as stippled or water-struck bricks — are sometimes considered too rough for comfortable walking in the patio, par-

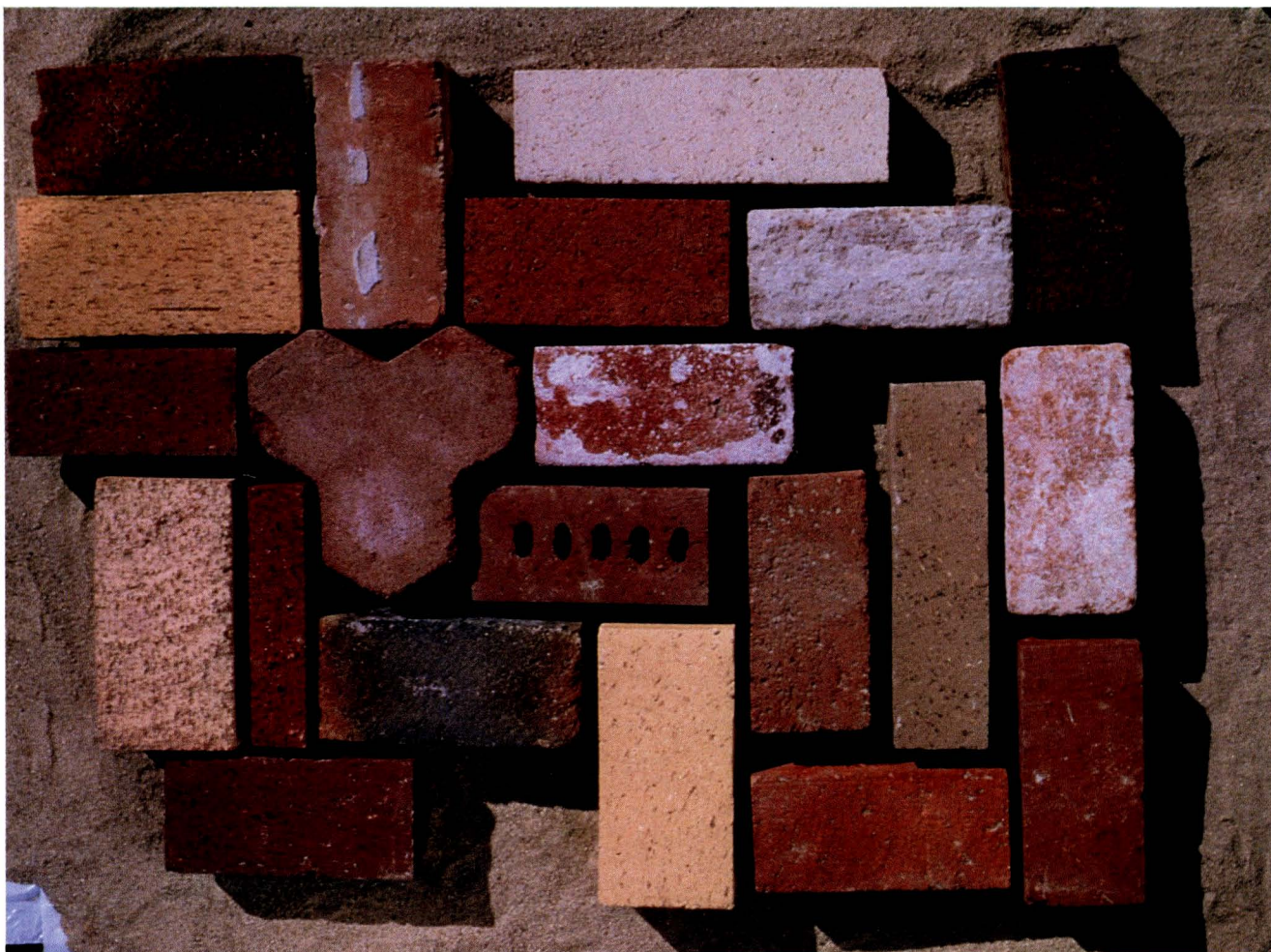
ticularly for women in high-heeled shoes.

A good choice are the sand-finished bricks; they provide good traction with a minimum of glare.

Some of the different styles of bricks include the standard, engineer, economy, Roman, and utility.

In addition, bricks are also rated for durability. "NW" stands for no weather resistance. "MW" bricks have moderate weather resistance and "SW" bricks can stand severe weather. SW should be the first choice for patio bricks, particularly if you live in an area with harsh winters.

And finally, there are fire bricks that are able to withstand very high temperatures. These, along with fire clay in your mortar mix, should be used to line a fire pit or barbecue.



Patio bricks can be purchased in a variety of textures, from smoothly finished types (which can be slippery when wet) to coarser kinds. Bricks also come in more than one size and shape.

Brick patterns: Bricks can be laid in several basic patterns which can in turn be altered and combined to produce an almost infinite variety of patterns.

The eight patterns shown here are among the most widely used, and all except the herringbone are simple to install. Herringbone requires a great deal of cutting to fit along the edges.

From the illustrations you can see how the basic styles have been combined into a great variety of patterns. However, such combinations should be consistent and not so complicated that they bewilder the onlooker.

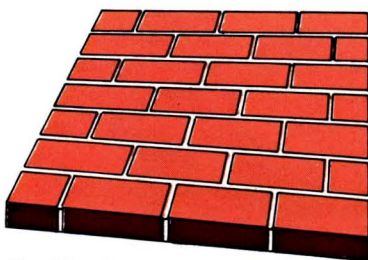
Cutting a brick: The type of pattern you choose will determine how many bricks you have to cut. But even on the simplest arrangement, you sometimes have to cut bricks to make the last row fit.

A special broad cold chisel, called a brick set, is used to cut bricks. For the cleanest cut, first score the brick on both sides with moderate taps, then make the final cut with one sharp blow. If your brick set has a beveled edge, face that away from you.

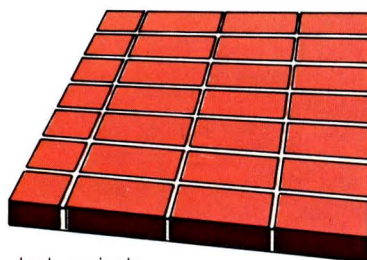
It's nearly impossible to get a smooth, clean cut with a brick set. The edges must be smoothed afterwards with a chipping action. If a great many bricks are to be cut, it will save time to rent a power cutter that gives smooth, exact cuts.

Estimating needs: Standard bricks are 8 inches long, 3¾ inches wide and 2¼ inches thick. In making your estimate, allow 5 bricks per square foot for bricks laid flat. The extra bricks will allow for some breakage, which is almost inevitable. Calculate the square footage in your planned patio by multiplying the width times the length in feet. For patios with triangular, circular, or irregular outlines, see the illustrated graph on page 77 to aid you in calculating the area.

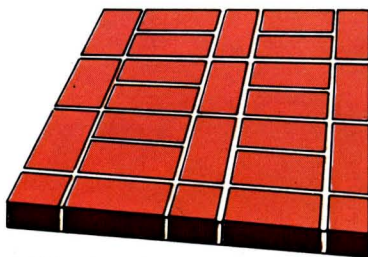
Common brick patterns



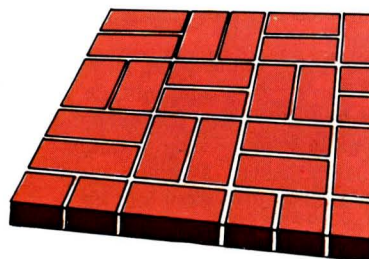
Traditional



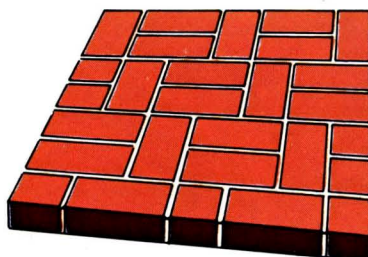
Jack-on-jack



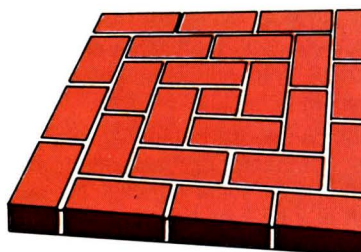
Ladder weave



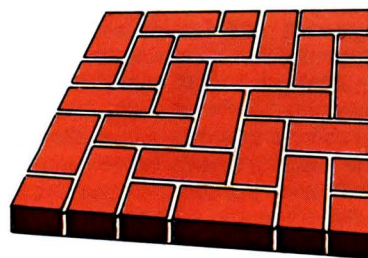
Basket weave



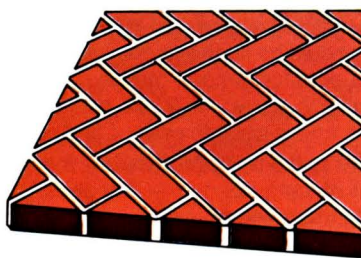
Half-basket weave



Whorling square



Herringbone



Diagonal herringbone



Screed

Laying the brick: One of the great advantages of laying brick in sand is that you can do as much in a day as you feel like without worrying about mortar setting up too fast.

The first step is to outline the area to be bricked. Drive stakes at each corner and then connect them with string. Remove any sod or weeds in the area with a straight-edged shovel. Cut the edges under the outline straight up and down. Remove the sod and dirt to a depth equal to the thickness of the brick plus two more inches for the sand base.

Before laying in the sand, spray the ground with a grass retardant. Or you can cover it with black polyethylene to keep weeds from growing through. When using plastic, cut holes about an inch in diameter every foot for drainage.

If the ground is clay and doesn't drain well, first put down a 2-inch layer of pea gravel to handle the runoff. If the ground is soft and spongy, perhaps because of loose fill dirt, it must be compacted before putting down the sand. If you don't, the ground will settle unevenly under the weight of bricks and people, and you will be constantly re-setting loose bricks.

To compact loose dirt, either rent a power compactor or make one from a length of 4 by 4. For handles, screw a length of 2 by 2 on top, or shove a length of pipe through a hole drilled near the top, or screw on some large handles.

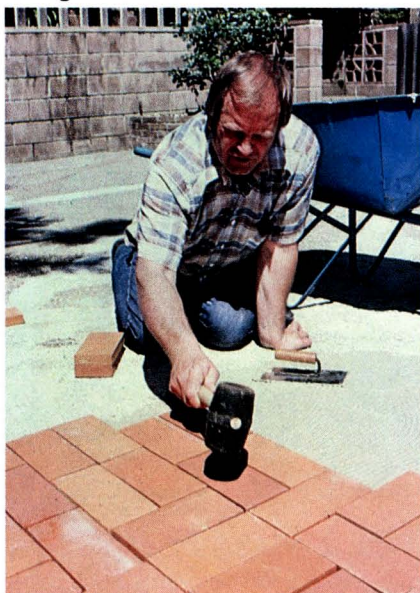
Once the area is cleared and compacted, place redwood or cedar 2 by 4s around the edges (other kinds of 2 by 4 should be pressure-treated). These should be flush with the lawn, if there is one, for ease in mowing. Hold the edging in place with 2 by 4 or 2 by 2 stakes on the outside every 4 feet.

Fill the bed with approximately the amount of sand needed — 2 inches is a good base — and spread it with a shovel. Spray the sand until thoroughly damp.

The sand is now smoothed and leveled to the precise depth with a



Mixing



Tapping

screed. It can be cut from any straight length of 2 by 4. The desired depth is achieved either by nailing on "ears" or notching the ends to fit over the edging.

In screeding large areas, make temporary edging boards in the middle with 2 by 4s set into the sand and leveled.

Starting from one corner, begin laying the rows of bricks. Press them tightly together; the sand later spread on top will work its way into these



Troweling



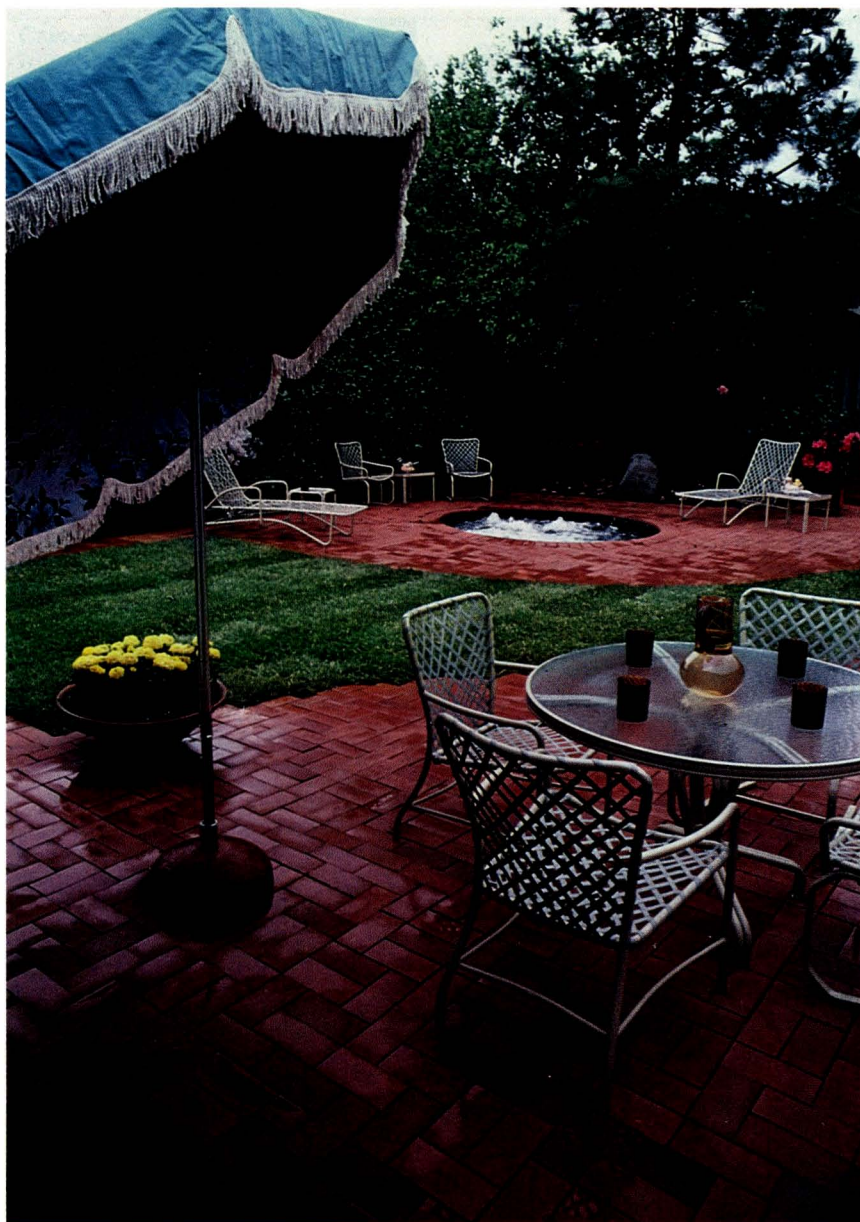
Cutting

joints and bind the brick firmly in place.

As you progress, work in the sand, screeding as you go. Don't kneel on the bricks for that will dislodge them.

After each row is finished, lay a short length of 2 by 4 across the bricks and tap it to level them. For any stubborn bricks, use a rubber mallet. Check your work with a level after each row.

When all bricks are in place, spread a layer of fine, dry sand over them. With a long-handled push broom, sweep the sand back and forth across



The contrast between red brick and green lawn is dramatic and pleasing.

the bricks to fill the cracks. Sweep at an angle so you don't sweep sand back out of some cracks.

Bricks in mortar: Although bricks set in sand provide a firm patio, some people prefer them set in mortar for a more finished appearance and more stability.

An easy way of binding brick with mortar uses dry concrete mix. With this method, lay the bricks out on sand as previously described but space each one $\frac{1}{4}$ inch — use a $\frac{1}{4}$ -inch

piece of plywood as your guide.

Thoroughly mix one part portland cement to three parts completely dry fine sand. Spread the mix over the bricks and gently sweep it back and forth until spaces between are filled.

Now, using a fine spray attachment on a hose, soak the entire area. Wait 15 minutes and then repeat the process to make sure that the water has penetrated to the bottom of the mix.

After the bricks have dried, sweep in another layer of the mix if necessary

to fill any settled areas. Give a final soaking to the new mix.

Mortaring bricks: Bricks individually mortared in place are more permanent — and more difficult — than bricks on sand. They must also be laid on a concrete base.

If you already have a concrete pad or sidewalk you want to cover with brick, you can do it with bricks cut as thin as $\frac{1}{2}$ inch. These can be put down with a special epoxy that is available at hardware stores or perhaps where you buy the bricks. The epoxy is spread in a thin layer with a trowel and each brick pressed into place like tiles. Be careful that the epoxy does not become stuck to the top of the brick; it's difficult and time-consuming to clean off.

If you don't want to use the epoxy method, full-size bricks are needed. Work only a medium-size area at a time so the mortar doesn't harden too rapidly on you. Wet the concrete slab so it doesn't draw too much moisture from the mortar, then spread a $\frac{3}{4}$ -inch layer of mortar over the slab. Then press the bricks — which also should be dampened — into place. Space each one $\frac{1}{2}$ inch, using a piece of $\frac{1}{2}$ -inch plywood as a guide.

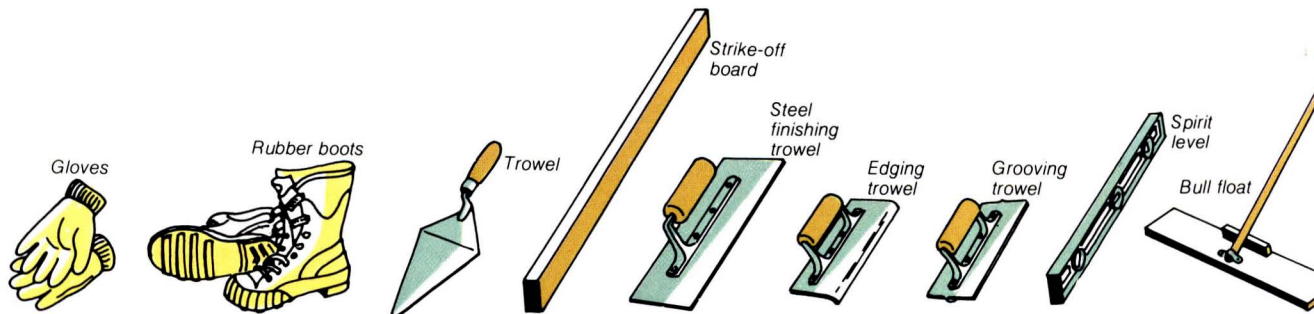
As each brick is placed, give it a light rap in the center to settle it into the mortar. As each row is completed, place a level across it and adjust any brick that's out of line. For wide areas, place the level on top of a straight 2 by 4.

When all the bricks have been placed, let them firm up overnight before filling the spaces with mortar. If you must kneel on the bricks, put a sheet of $\frac{1}{4}$ -inch plywood over them so your weight is distributed.

Fill the spaces with a mortar made from 1 part masonry cement and $3\frac{1}{2}$ parts fine sand. Color can be added to the mortar, to blend or to contrast with the brick color.

The mix is most easily placed by using a grout bag, available at most hardware stores. Squeeze the mix into the joints and then finish with a jointing tool.

After 24 hours the brick surface can be cleaned of mortar stains with a mixture of 1 part muriatic acid to 10 parts water. Scrub the bricks with a large, heavy-duty sponge or a burlap sack.



Concrete — multi-textured surprise: A concrete patio need not be a massive, unadorned slab that dominates your backyard. Concrete can be worked in a great variety of ways that are both practical and attractive. It is relatively cheap and it goes in place quickly. One disadvantage is that it is heavy work to mix and finish your own, but that can be reduced if you have a ready-mix truck deliver it for you.

Concrete can be colored, curved to any shape, inlaid with stones, stamped to resemble cobblestones or finished for a smooth shuffleboard court. It makes a fine, lasting patio surface.

Making good concrete: Good concrete comes from a proper mixture of cement, sand and gravel, plus water. When cement combines with water, a chemical change starts that binds the sand and gravel into the familiar concrete.

Portland cement — which is a type of cement and not a trade name — is the most common cement used in construction. There are several different grades but for quality assurance, the bag should be marked with the letters ASTM (American Society for Testing Materials). When storing cement, always keep it off the floor and dry. If it gets damp, solid lumps will form and it will no longer be usable.

Masonry cement is even finer than portland and is commonly used when making mortar alone.

Sand is considered a fine aggregate and is essential to a concrete mix. Sand must be clean and free of dirt or vegetation. If you are digging your own sand, test for silt content by putting 2 inches of sand in a quart jar and filling $\frac{3}{4}$ full with water. Shake for one minute and let settle. If more than a $\frac{3}{16}$ -inch layer of silt lies on top of the sand, it is too dirty to use.

A reminder: never use sand from

the seashore since the salts therein will prevent the concrete from curing properly.

Gravel, or coarse aggregate, usually ranges from $\frac{1}{4}$ to $1\frac{1}{2}$ inches in size. Generally, no gravel should be greater in diameter than $\frac{1}{3}$ the thickness of the concrete slab.

Water is a particularly critical element in good concrete. It must be clean, free of any salts, oils or acids. As a rule of thumb, it should be clean enough to drink. The amount of water used makes the difference between weak and strong concrete.

Useful tools: A lot of good concrete work can be done with just a trowel and strikeoff board, but a few more tools make life easier.

Gloves: Working in concrete quickly wears away the skin and leaves it cracked and bleeding. Protect your hands with good work gloves.

Rubber boots: You need these because on many projects you are forced to work in the middle of the concrete.

Trowel: Buy the best you can afford since it takes a beating in smoothing, cutting, scraping and chipping concrete.

Strikeoff board: This is usually just a straight 2 by 4 used to level off the concrete after it's been poured.

Steel finishing trowel: This gives a smooth, almost glassy finish to concrete.

Edger: Similar to a finishing trowel but has one curved side to cut a rounded edge between the concrete and form.

Groover: This is necessary to cut smooth, straight control joints in concrete to prevent cracking.

Level: This is a must tool to check your poured forms, both vertical and horizontal. When longer reaches are necessary, place it on a straight 2 by 4.

Bull float: This long-handled float smooths out any depressions or ridges after the concrete has been roughly leveled with a strikeoff board.

Wood float: This gives a rougher finish to concrete than the steel trowel, but that is often desired on driveways or walkways where traction is needed.

Darby: This is used over smaller areas in the same manner as a bull float.

Square-edged shovel: This shovel is essential for being able to cleanly pick up the concrete mix or smooth out the work site.

Estimating concrete needs: You want to estimate the amount of concrete needed before you begin a project. A correct estimate will save you time and money.

If you are having the concrete delivered or are using bags of ready-mix, you need only calculate the cubic feet or yards involved. If you are mixing your own, you need to estimate how much cement, sand and gravel to order.

To find cubic feet, multiply the length by the width in feet, multiply that by the thickness in inches, and divide that by 12. For instance, a patio 12 feet wide, 20 feet long and 4 inches thick requires 80 cubic feet of concrete ($20 \times 12 \times 4 = 960$, divided by 12 = 80 cubic feet).

Concrete ready-mix in a 90 lb. bag contains $\frac{2}{3}$ of a cubic foot. The job above would therefore require 121 bags (80 divided by 0.66 = 121.2).

In this case, it would be better to order it by the truck, if possible. Since truck-delivered concrete is always sold by the cubic yard (usually the minimum delivery), you must turn cubic feet into cubic yards. Since there are 27 cubic feet in a cubic yard, you need 2.96 cubic yards of concrete (80 divided by 27 = 2.96).

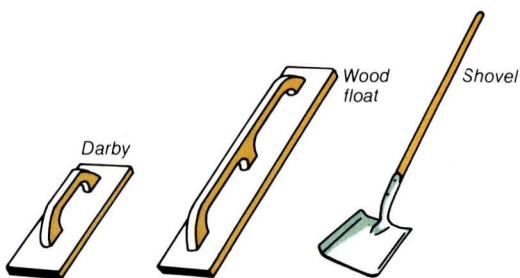
Here's a ready-reference guide on mixing your own concrete in a proportion of 1 part cement, $2\frac{1}{4}$ parts sand and 3 parts gravel ($1\frac{1}{2}$ inch diameter), which is excellent for a patio surface.

For 100 square feet of concrete of varying thicknesses:

Ingredients	Concrete thickness (in.)		
	3	4	5
Cement (sacks)	5.8	7.8	9.8
Sand (cu. ft.)	12.9	17.3	21.7
Gravel (cu. ft.)	17.5	23.6	29.6

For each sack of cement, use 5 gallons of water.

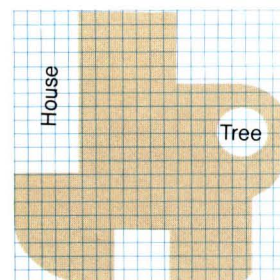
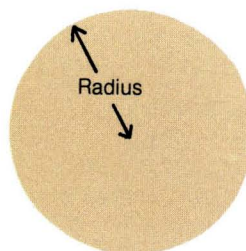
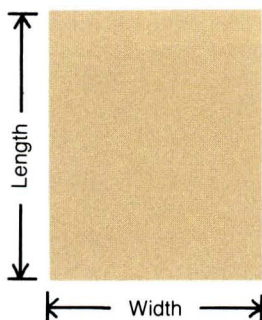
Aggregates are sold by the ton or by the cubic yard. Convert from pounds to cubic yards, by assuming a weight per cubic foot of 90 pounds for sand and 100 pounds for gravel.



Calculating concrete areas

To estimate how much concrete to buy, you need to know two things: the area of the patio in square feet and the thickness you want the concrete in inches.

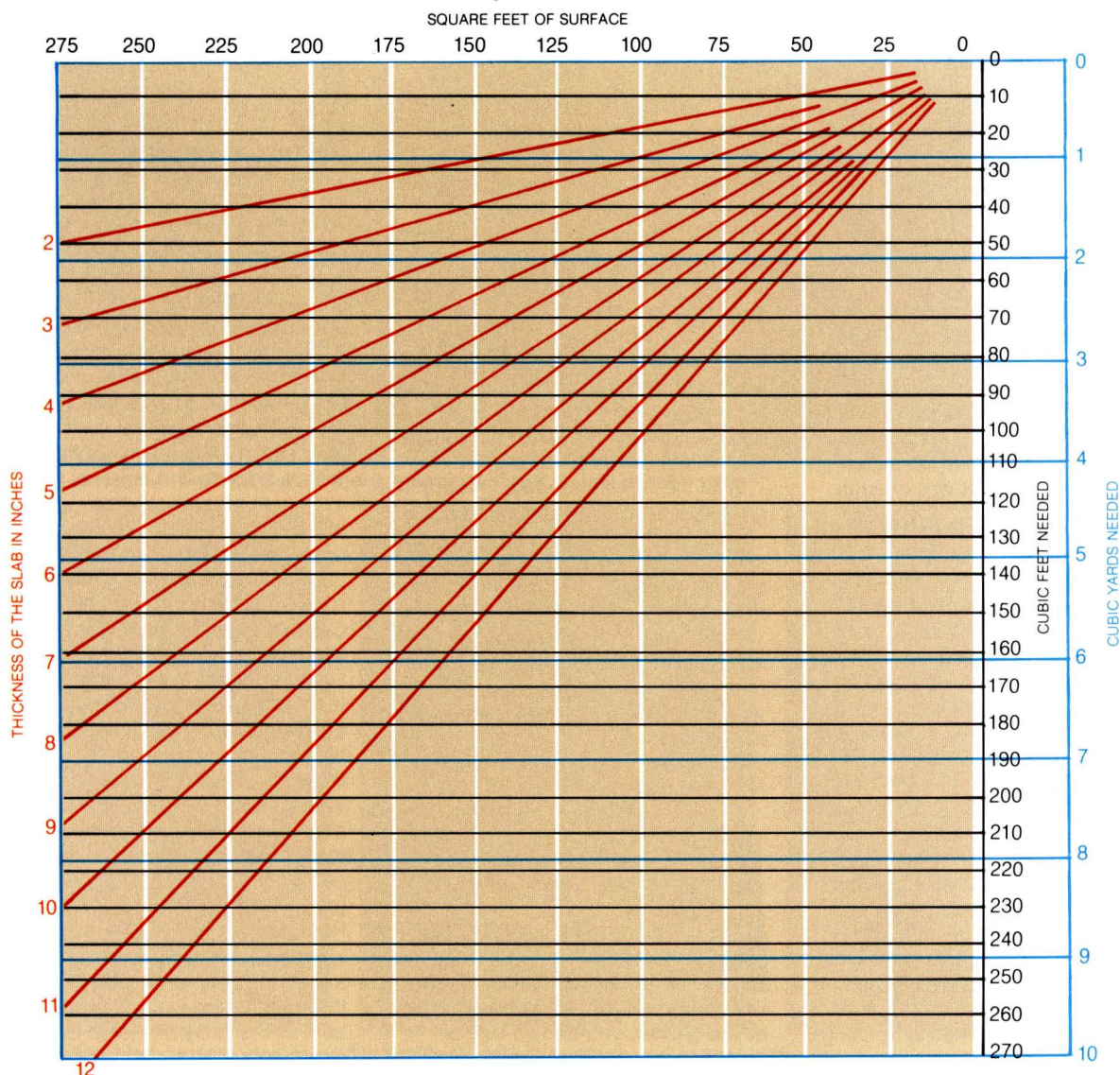
To figure the square feet of rectangular or circular areas use the formulas you learned in the 7th grade: length multiplied by width; or 3.14 multiplied by the radius squared. Complex shapes can be figured by drawing them on graph paper with each square equaling one square foot — count all the squares that are over half within the area.



Graph paper

Calculating volume of concrete

Find where a vertical line from the number of square feet you have crosses the red line for the thickness you want. From that point, follow a horizontal line to the scale at the right for the amount of concrete.



A proper mix: Good concrete is the proper combination of cement, sand, gravel and water.

A proven mixture for patios, walkways or driveways is 1 part cement, 2¼ parts sand, and 3 parts gravel.

For each sack of cement, allow 5 gallons of water. This works out to about ½ part of water to 1 part sand, or roughly 3 quarts to 1 shovelful of sand.

Before you start, however, make a test batch. How much water you use will be influenced by the water content in your sand.

Sand is always sold wet. Pick up a handful and squeeze it. If it tends to crumble, it is only damp and relatively more water will be needed in the mix; if it compacts smoothly without visible water in your hand, it is wet, or average, sand; if it forms a ball and leaves your hand soaked, it is very wet and less water will be used.

The key thing to remember is that the mixture should be plastic, almost smooth and creamy. It should not be soupy and it should not be crumbly and dry in appearance. To avoid soupy mixes, which weaken the concrete, add water very carefully when you think the mix is almost wet enough.

Mixing in a wheelbarrow: When mixing by hand, a deep contractor's wheelbarrow is best. It holds about 1 cubic foot and the mix is then easily moved to the dumping site.

After you have made a successful test batch, you can double or triple your proportions depending on the size of the wheelbarrow and your own strength.

Start by shoveling in the sand and cement and mixing with a flat bottomed shovel until the color is uniform. Add the gravel and turn the mix a few more times before adding about half the required water. Mix thoroughly. Be careful to scrape the sides and bottom of the wheelbarrow in order not to leave pockets of cement out of the mix.

As the mixture becomes increasingly wet, be careful how much water you

add near the end. It now takes only a little to turn the mixture soupy. If you go too far, add a little more sand and gravel, but never add more cement for it will drastically alter the combination.

Mixing in a wheelbarrow is facilitated by a large hoe, or better, a cement hoe with holes in it.

Mixing on the ground: For small jobs, you can mix concrete on a sheet of plywood or heavy plastic near the work site.

Start by placing the sand in the middle of the board and then add the cement. Mix these until a uniform color. Flatten out the pile and add the gravel on top. Turn all three elements over at least three times and then spread into a mound with a depression in the center.

Begin adding the water here, mixing all the while from the outer edge toward the middle. Continue mixing until all the ingredients have been thoroughly combined. When about right, smooth the top and then jab it a few times with the shovel. A proper mix will leave clearly defined cuts, neither soupy nor crumbling.

Machine mixing: When doing a concrete job of any size, save your back and time by renting a mixer. Set it up beside the piles of sand, gravel and bags of cement with a hose nearby. Mixers range from ½ to 6 cubic feet in capacity but never put in more than ¾ the capacity for a good mix.

With the mixer stopped, first add the gravel and half the amount of water.

Start the mixer and then add the sand, cement and the remaining amount of water. Mix at least 2 or 3 minutes before pouring.

If the mix must sit an hour or more in the mixer and grows stiff, turning it over a few more times may restore its workability. However, never add water to loosen it up.

At the end of the day, be sure to hose out the mixer carefully.

Air-entrained concrete: If you live in an area subject to freezing in the winter, you should use air-entrained concrete. It contains billions

of tiny air pockets that contract and expand with severe temperature fluctuations and prevent the concrete from cracking. It also protects concrete that is subjected to de-icing salts in the winter.

Air-entrained concrete can be made either by buying portland cement or by purchasing an air-entraining agent and adding it to your mix. Since there are different air-entraining agents, follow the instructions on the bag.

Mixing by hand is not vigorous enough to make air-entrained concrete. It must be done in a power mixer. Once poured, however, the mix should be worked as little as possible.

Concrete finishes: The plasticity of wet concrete has long been utilized for a wide range of finishes, both mechanical (broom, brush, trowel) and chemical (salt, dyes). Recent technological developments have expanded this versatility to a dazzling array of possibilities. Some of the more sophisticated techniques are as yet available only through franchised contractors. One example is Bowmanite, a patented process in which a cast-in-place concrete slab is colored and imprinted with a pattern. The finished appearance can closely resemble a wide variety of surfaces, including many brick and tile patterns, cobblestone, quarried limestone, flagstone, and river rock—all offered in a range of colors. Custom patterns and colors are also available. While most often a monolithic structural slab on grade, 4 inches thick or more, thinset capabilities allow a Bowmanite topping as thin as one-half inch to be bonded to most existing slabs. Cost is midway between standard concrete surfacing and masonry work. While the specific Bowmanite process is not something you can do yourself, it is a testament to the increasing versatility of concrete. Perhaps you wish to experiment with impressed patterns in concrete, constructing your own molds. If so, keep the pattern simple and the area limited. For the creative home craftsman, Bowmanite can be an inspiration.



A broomed finish on concrete provides an easy maintenance surface.



The interplay of concrete and wood patio forms provides a visual delight in large areas.



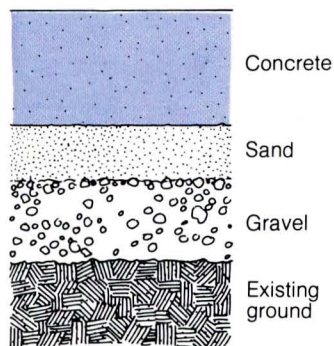
Bowmanite, a patented process, can resemble a wide variety of surfaces, colors and textures.

Preparing the site and installing the forms: Unless you have a very good design reason for doing otherwise, it is good to make patios and walkways flush with the ground to prevent people from tripping over raised edges and to facilitate mowing and edging. This generally means you are going to have to do some excavating.

Start by driving stakes at each corner of the area and pull string taut around them. Divide large areas into smaller and more manageable sections.

Remove any grass or vegetation with a straight-edge shovel. If your ground is firm — not boggy or heavy clay that will not drain well — you can put the concrete directly on it. Otherwise, put down 2 inches of sand and tamp it firm. For real problem areas,

Base for concrete



first put down 3 inches of pea gravel topped by 2 inches of sand as a drainage base under the concrete. A sand and gravel base is also advisable in severe winter areas.

Patios adjoining the house should be graded so water runs away from the building. A slope of $\frac{1}{8}$ inch per foot (1 inch per 8 feet) is recommended for smooth, hard surfaces, $\frac{1}{4}$ inch for rough surfaces.

Forms: Concrete is extremely heavy and must be contained by well-braced forms. For patios and walks, excellent forms can be made of 2 by 4s. If these are to remain in the concrete, use redwood or cedar. Before starting to pour, cover the top edges of the wood with masking tape to prevent concrete stains.

Hold the forms with 2 by 4 stakes driven every 4 feet or less. If leaving the forms in place, use redwood or cedar stakes and drive them about 1 inch below the surface so they can be covered with sod later.

As the forms are placed, check them with a level to make sure the proper grade is maintained.

To curve your forms, cut saw kerfs about every inch halfway through 2 by 4s and then bend them so the kerfs close. For gentle curves, you can also use 1 by 4s and stake them every 2 feet to hold firmly in place.

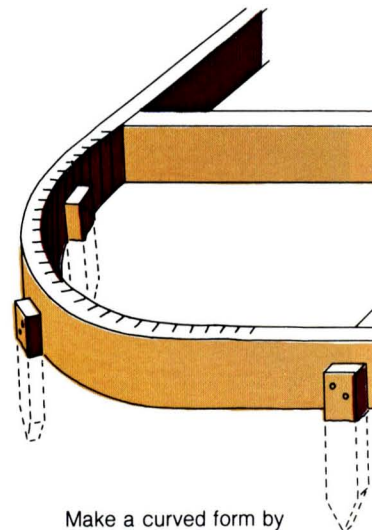
For tight curves, use $\frac{3}{8}$ -inch plywood or redwood bender boards. Put 2 or 3 bender boards together against the stakes and nail in place.

In building walkways or patios, remember that concrete expands and contracts with the temperature. Unless there is room for this movement, the concrete will crack. In walks, place control joints (or crack lines) every 4 to 5 feet; in patios, every 8 or 10 feet. Use either lengths of redwood or cedar left in place, or cut expansion joints with a groover after the concrete has begun to set up.

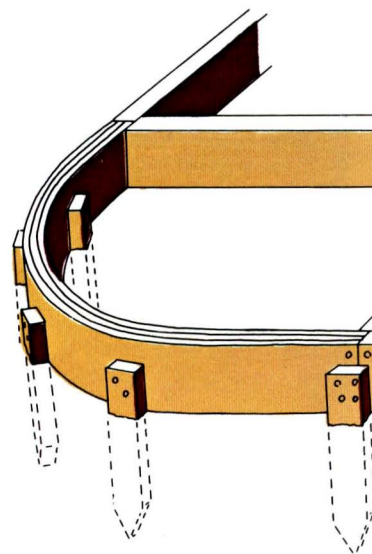
In building a patio, keep in mind also that once you start to pour concrete, you cannot stop until that section is completed. This means leveling, floating, edging, grooving and finishing. Thus, when working alone, divide your project into easily manageable sections, preferably in accord with your design for parts of the patio.

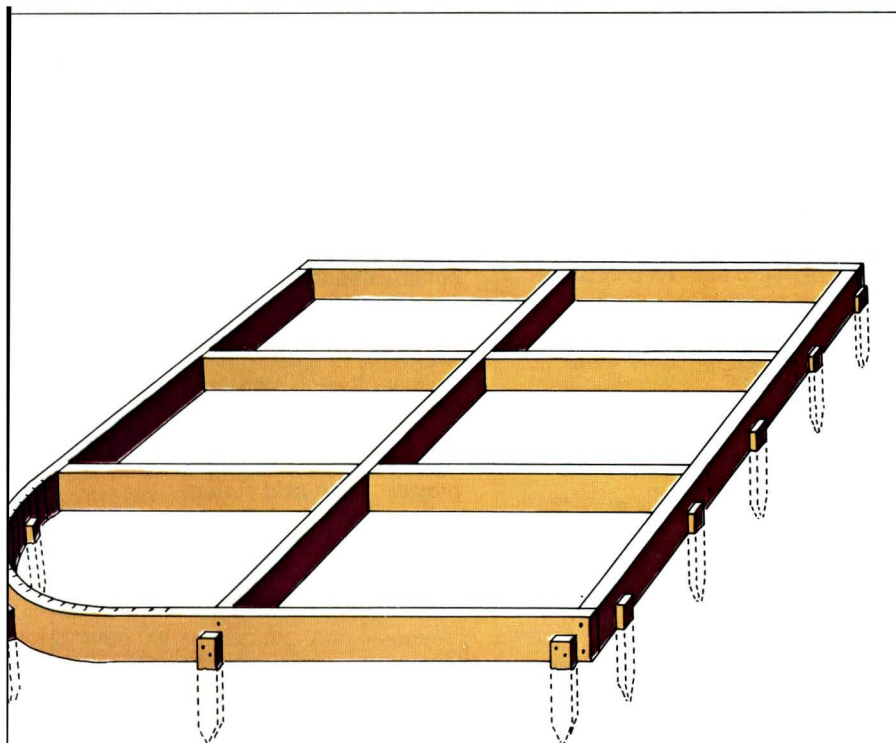
In working alongside a wall or the edge of a house where you can only work from one side, break your forms into sections and fill every other one first. When these are firm, you can walk on them while filling and finishing the other areas.

Concrete patio forms

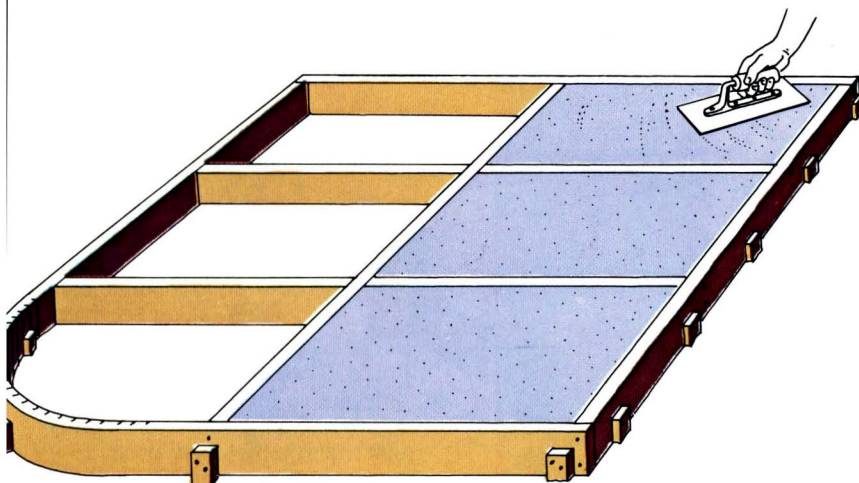


Make a curved form by cutting saw kerfs halfway through a 2 x 4 or using a sandwich of bender boards or $\frac{3}{8}$ " plywood.





Use redwood or cedar for forms that will remain in the concrete. Cover the top edges with masking tape to prevent staining.



These easily manageable sections can be poured and finished one or two at a time if you are working alone.

Pouring and finishing: If you are having the concrete delivered, it is essential that you have two or three helpers to speed the process and save you expensive overtime charges.

1. As the concrete is poured, shovel and rake it evenly throughout the form area. Do this with as little agitation as possible, which causes the gravel to sink. Bring the concrete up about $\frac{1}{2}$ inch above the forms to allow for settling.

2. Smooth and level the concrete by pulling a strikeoff board across the top in a sawing motion. If working alone, stand in the mix and pull the board toward you, sawing back and forth as you move.

3. Immediately after the strikeoff, use the bull float (or darby for small areas) to further level and fill in any depressions. Push the bull float away from you with the front edge slightly raised, then draw it back to you in a sawing motion.

4. Run the tip of a trowel around the edges between the form and concrete to cut the spill over. Make the cut about 1 inch deep and scrape clean the form tops.

5. With bull floating completed, you are ready to start finish work but you must wait until the water sheen on top of the concrete has evaporated. Depending on temperature, that may take a few minutes to several hours.

6. Once the water sheen is gone and the mix has stiffened, work your way around the forms with the edger. Be careful not to push concrete ahead of you. A final edging can be done after the final texturing is completed.

7. Cut grooves, or control joints, with a groover every 4 to 5 feet in walks and every 8 to 10 feet in patios, or as designed. Place a 1 by 10 board on the concrete to serve as a guide and to distribute your weight so you won't mar the concrete.

8. Floating further pushes down the aggregate and adds to the finish of concrete. A wood float gives it a rather rough finish. Moving it in sweeping



Exposed aggregate finish, broken by expansion joints, allows freeform.

curves will give a distinct pattern. For air-entrained concrete, use an aluminum or magnesium float.

9. For a smooth, almost polished finish, use a steel float. Keep the leading edge up and move in long sweeping strokes. Do the troweling immediately after the floating. Additional troweling will provide a harder, smoother surface.

Exposed aggregate:

10. In spreading the concrete, disturb it as little as possible to keep the gravel near the top. When the sheen has left the concrete, brush away the top layer of concrete with a soft bristled broom to just expose the gravel.

11. After the concrete has firmed up a little more, continue the brooming. If stones are dislodged, the concrete has not hardened enough.

12. In final sweeping, combine the brooming with a fine spray of water. Sweep away enough concrete to expose nearly half the large stones on top. Timing is critical in this procedure. If you wait too long, you will not be able to broom away the concrete.

Curing concrete: All your work in building a concrete patio or walkway may be for naught if the concrete isn't cured properly. During this period, concrete must be kept warm and damp to gain its strength. In warm weather, allow 5 days for curing; in cold weather, allow 7 days.

The following are good methods for curing. The key is constant dampness.

1. Cover the top and the edges with plastic sheeting. This traps the moisture inside and permits a slow, steady curing rate. Weight the edges of the plastic so dry air can't blow in.

2. Cover the area with wet burlap. New burlap should be washed first and old burlap should not have stains that will transfer to the concrete. Burlap must be kept constantly wet.

3. Ponding is recommended for areas small enough to be flooded and where the water can be held on top of the concrete. Alternatively, a sprinkler can be left on during the day while burlap holds the moisture at night.

4. There are curing agents you can spray on, but coverage must be complete and they are not considered as effective as the above methods.

Building steps: Concrete steps are often made half again as wide as the walkway leading up to them. Footings are required for steps and should be 2 feet deep in undisturbed soil, and 6 inches thick — or more to reach below the frost line.

Build the form from 2 by 6s as shown. The sides and risers in front must be braced with great care. Enormous pressure is exerted here.

The risers can be angled back to provide more tread room.

The forms should be coated with engine oil so they will easily separate from the concrete.

After the forms are built, fill the inside with large rocks, broken concrete or bricks so you will not have so much concrete to pour. Keep the fill away from the top and edges so it won't be exposed.

Make the concrete with a 1:2¼:3 mix and use gravel no larger than 1 inch in diameter.

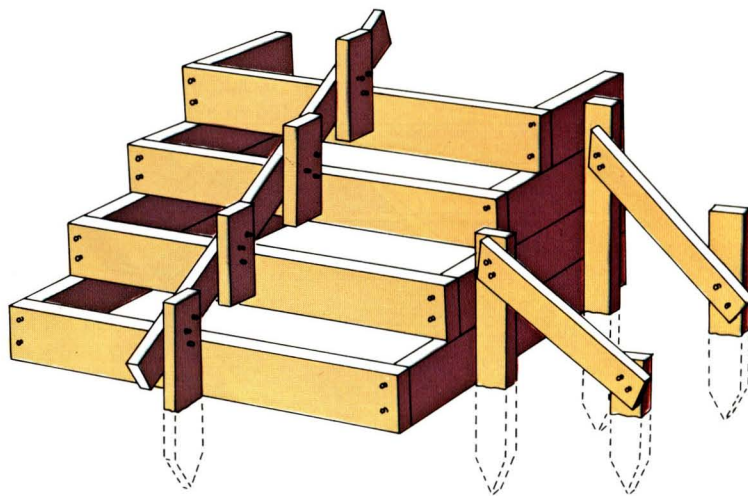
Begin placing the concrete in the bottom step and work your way up. Trowel the mix down along the edges of the form so no air pockets will be left there.

Float off each step as it is filled. When the top step is filled, strike it off and then darby it.

Texture the steps with a broom to provide a non-skid surface.

Forms can be removed in not less than two hours, and then the steps wrapped in plastic to cure.

Concrete step forms



Forms for concrete steps must be very sturdy. Build them with 2x6s and brace them securely with 2x4s.



Interesting patterns can be created when paving blocks draw attention to the floor.

P

aving block construction: Paving blocks can be made in almost any design and make excellent walkways or patios. Precast concrete pavers are available in many sizes, shapes and finishes. But you may want to make your own.

To do so, lay out forms to your design, made from 2 by 4s. The paving blocks need be only 2 inches thick, so the forms may be either embedded in sand to the proper level or marked on the sides. Check them with a level after they're in place.

Forms can be constructed in several ways. For large projects, build a form with 2 by 4s and stake it every 4 feet. Screed the sand in the form smooth and to the proper level, then pour the concrete.

Strikeoff the mix and float as previously described. After the water sheen has left the surface, lay a 12-inch wide board across the surface to disperse your weight, and cut the concrete into squares with a trowel. Finish the concrete in whatever style you wish.

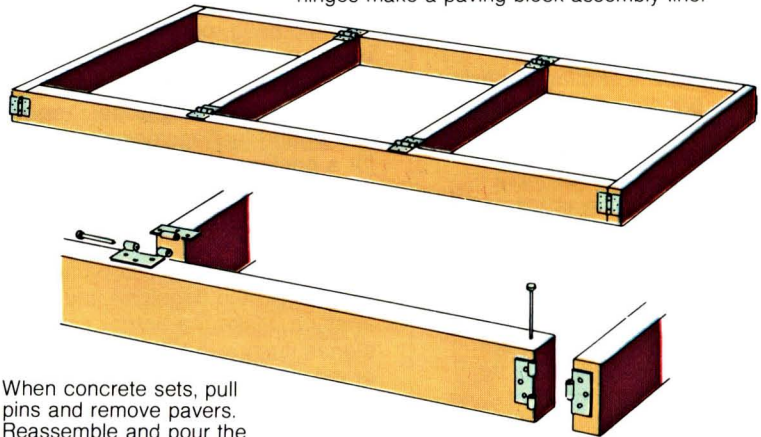
Alternatively you can make smaller forms with a variety of patterns built in. Oil the sides of the form with engine oil and after the concrete has firmed up, lift away the form and proceed with the next batch. Repeat this procedure until you've completed the total amount of pavers required to pave the entire area.

Another simple and efficient way to make stepping stones in frost-free areas is to cast them directly into the ground. Dig out the pattern you desire — making them larger rather than smaller — and space them 8 to 15 inches apart. Dig the holes about 2 inches deep and fill with a 1:2½:3 mix of concrete. Finish by brooming the top for a non-skid surface or, more attractively, expose the aggregate.

Precast slabs can be very effectively laid in sand. Follow the same procedure as detailed for bricks on page 74.

Paving block forms

Forms built with 2×4s and loose-pin hinges make a paving block assembly line.



When concrete sets, pull pins and remove pavers. Reassemble and pour the next batch.



Tile pavers make a good patio surface. Be careful of glazed tiles, however, for they may be slippery and dangerous if wet.

Flagstone paving: Paving with flagstones is similar to paving with brick but they go down faster, are usually durable and their natural rock look will highlight any patio.

One key difference between flagstone and brick is that flagstone must be either mortared in place or the cracks between filled with sod.

Because of the greater spacing, sand alone will not hold the stones in place.

Because flagstone is irregular in shape and thickness, it must be seated in at least 2 inches of sand.

Cutting flagstone: Flagstone is cut in a manner similar to brick. Use a broad chisel or a brick set and hammer. Wear protective goggles because small chips of stone will almost certainly fly at you.

Mark where you're going to cut by scratching a line with the chisel and then score it deeply. Repeat on the opposite side.

Now place the stone with the scored line just over the edge of a 2 by 4. Place the brick set on the line and give it a sharp rap. Use the chisel to trim up the cut.

If you need more precise cuts, stone yards have special saws and will do the cutting for a price.

Putting down flagstone: Prepare the ground for flagstone as you would for a brick or concrete patio by marking out the area with stakes and string, and then clearing and leveling the site. Lay in 2 inches of sand.

A border must be placed around the site to hold the flagstone and mortar in place. Make the border and flagstones flush with the ground for ease of mowing.

After screeding the sand level, lay all the flagstones out in order to judge their final appearance. Stones should be placed 2 to 3 inches apart for mortar, further apart if you are going to fill with soil and grass.

Flagstones can be most conveniently cemented in place with a dry mortar mix of 1 part portland cement and 3 parts sand. Mix this in a wheelbarrow until a uniform color.

Spray the site until the flagstones and sand base are thoroughly wetted. Let the stones dry and then spread the dry mix over the area, filling all the spaces. Sweep with a broom to smooth and level the dry mix.

Spray with a fine nozzle from the hose until completely soaked. After 15 minutes, repeat the process to ensure the water has penetrated the dry mix. Add more dry mix in areas that have settled.

After 24 hours, the stones can be cleaned of any mortar stains with a mixture of 1 part muriatic acid to 10 parts water. Keep the area constantly damp to cure properly for at least 5 days.

If you prefer to fill the spaces with soil, tamp in the fill with the end of a 1 by 4 to pack it tightly around the stones. Then you can lightly rake in grass seed or encourage moss to grow between the stones.

Flagstones can also be placed directly in the ground by cutting around their outline with a trowel and digging out the soil beneath. Even then, the flagstones must be placed on a bed of sand to stabilize them in the ground.



Stone paving and flagstone paving can add textural complexity and durability. Watch out, though, for rough surfaces where bare feet or bodies are apt to be, as at pool side. Large rocks, in such instances, can blend well with smaller ones to soften edges.



Paving patterns can become too busy, with a visual overload of materials and textures. Simple textural contrasts are often stronger than complex ones and demonstrate that less is often better.

Alternative pavings: although brick, concrete and flagstone are widely favored as surfaces for patios and walkways, a host of other materials can work well and look good.

Here are a few choices for you to consider.

Planks on stringers: For an informal, woodsy effect, simply lay out 4 by 4 redwood heartwood or pressure treated wood on the ground. Place them 3 feet apart and then cover with 2 by 6s. These sections can be combined to make either walkways or patio—or a kind of deck. For best results, the 4 by 4s should be laid on a 2-inch gravel bed so they will seat themselves firmly and there will be drainage underneath. Space the decking boards the width of a 16-penny nail, the size they should be nailed in place with.

To keep grass and weeds from growing through the boards, spray the area with a non-selective weed killer, and then cover the ground underneath with a sheet of black polyethylene. This can be hidden by covering the exposed edges with bark chips or gravel.

Log rounds: If you can cut your own log ends, you can make walkways or small patio areas yourself quite cheaply. Otherwise, these rounds are sometimes difficult to find and often expensive.

Like bricks, they can be laid on a sand base and the spaces filled with sand, which provides good drainage, or with bark chips.

While these rounds have a warm and natural character, they cannot be considered permanent, even if you are able to use redwood or cedar. However, even pine or fir should last several years. They are easy to replace if they split or break.

Wood blocks: These lend an inviting and natural appearance to a patio and work well because they fit snugly together.

Cut the blocks from 4 by 4s or larger timber about 3 inches or perhaps longer. Soak them in wood preservative. When dry, place them on a 2-inch bed of sand close together. They must be

held in by a border frame. When in place, sweep dry sand back and forth over them until all the spaces are filled, as you would on a brick patio.

Wood beams: These larger pieces of lumber make attractive and effective walkways or small patios. Railroad ties are particularly effective. Lay them on sand and space just an inch or so apart. Fill the gaps with sand, white gravel or bark chips to accent the beams. Remember that the creosote on railroad ties can be toxic to nearby plants.

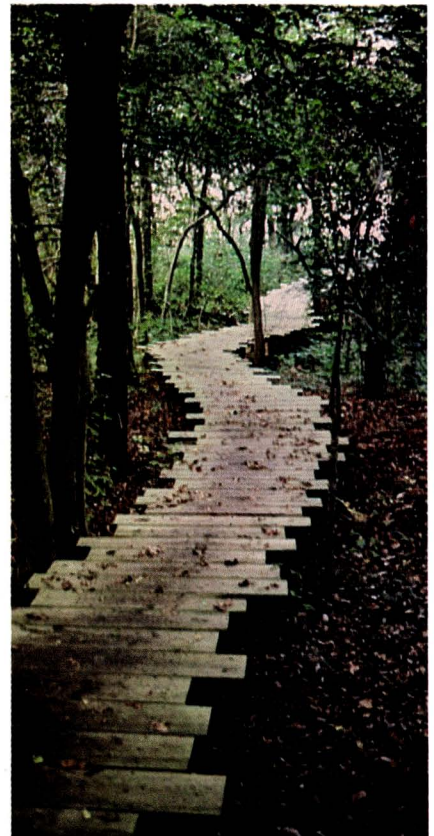
Bark chips: Generally russet in color, they provide a pleasing contrast to surrounding green grass or shrubbery. Bark chips must be laid between borders to keep them from being scattered. As they decompose, just add more.

One problem: if bark chips are put where lots of small leaves fall in the winter, it is very difficult to remove the leaves without removing half the bark at the same time.

Wooden walk



2 x 6 planks on 4 x 4 stringers make a simple, woodsy path



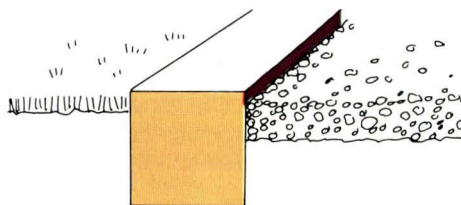
Boardwalks reflect the structural support system of joists, and can create fanciful routes from here to there and lead the eye beyond.

Constructing edgings:
Edgings are essential to defining a flush-with-the-ground patio and to hold in place any loose material. They can range from functional concrete to bold brick and wood beams.

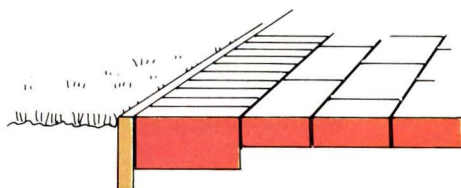
Here's a step-by-step process for putting in basic edgings.

1. With stakes and string, lay out the precise outline of the patio, where the edging will be located.
2. With a straight-edge shovel, cut the sod on each side of the string. Keep the cuts vertical. Make the trench the width of the shovel and the depth of the form — in this case, a redwood 2 by 4.
3. Place the form in the trench, check that it is level, and support it with 2 by 4 stakes every 4 feet along the outside. Use 2 stakes on each side of connecting boards.
4. Nail the form into the stakes with a 16-penny nail. Steady the stake with a crowbar or a length of 2 by 4 behind it while you hammer.
5. Stakes should be driven well below the top of a form so they will not interfere with resodding. Fill in the back side of the trench flush with the top of the form and reseed if necessary.
6. Against this form, stand the first row of bricks on end as the visible edging. The 2 by 4 form is essential to keep the brick edging from working loose and falling over. Against the edging, begin laying bricks on sand.
7. Alternatively, a ditch is dug and leveled, and the concrete poured directly into it. After the concrete has cured, remove the soil to the proper level in the patio site.
8. For a raised concrete edging, dig the ditch the desired width. Along the top edge, stake 2 by 4 forms in place with support stakes every 3 feet. Pour concrete to the top of the forms, strike-off and float, and let cure a week.
9. If an unadorned concrete edging is unattractive to you, cap it with a layer of bricks after the patio is in place.

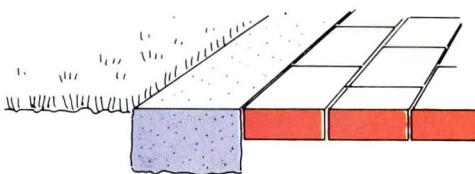
Edgings



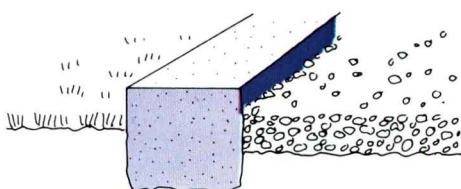
Wood beam or railroad ties edge gravel patio



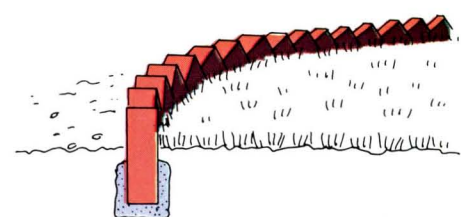
Staked wood form edges brick patio



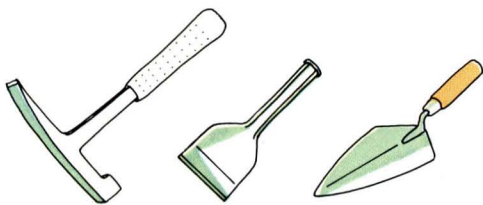
Flush concrete edges brick patio



Raised concrete edging retains gravel patio



Angled bricks set in mortar edge a lawn



Brick tools: hammer, chisel, trowel

Bricks on edge: Bricks placed in the ground make attractive edgings along lawns. But to keep them from working loose, they must be placed in mortar.

After outlining the area for the brick edging with stakes and string, dig a narrow trench about half the length of the brick deep. Keep the trench as wide as the brick.

Sod and dirt removed from the ditch should be loaded directly into a wheelbarrow.

Replace the string on the stakes to use as a guide when you begin placing the brick. Place the bricks either upright or angled for a different effect.

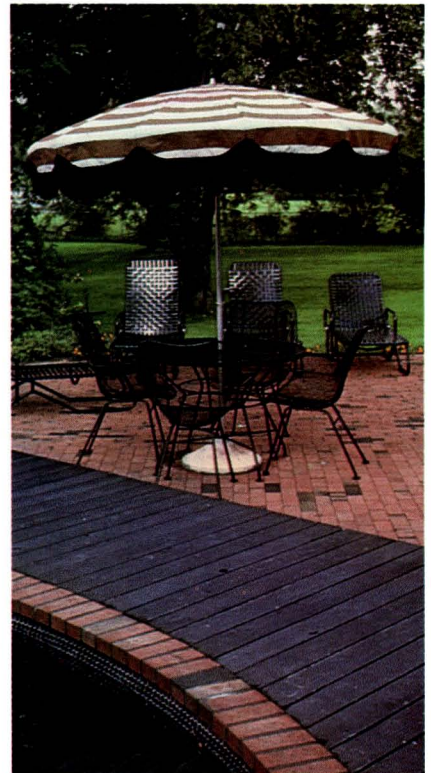
Bricks are set in a mortar made from 1 part cement to 3 parts sand. Fill the ditch on both sides of the brick to within $\frac{1}{2}$ inch of the top — to leave room for resodding flush with the bricks.



Bricks can create a strong sense of perimeter.

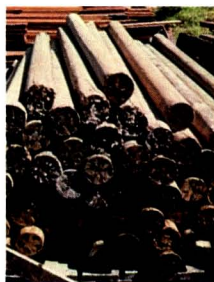


Turned on their sides, coarse, rough bricks or cobbles accent level changes in patio stairs and give them a strong, natural edging.



Bricks laid in various patterns present pleasing contrasts.

Bold wood edgings can be constructed from railroad ties, telephone poles, 4 by 4's, round logs or other heavy timbers.



Bold wood edgings: If you want strong and clearly defined edgings, consider using heavy timbers. Railroad ties are excellent but increasingly difficult to find. Alternatives include sections of old telephone poles or small pressure treated poles. Any wood laid on the ground should be treated with

preservatives. Painting on a preservative is not particularly effective; soaking is better (see page 67).

Where timbers are butted together as edgings, cut the corners at a 45 degree angle for a more finished appearance and better drainage. Use a big crosscut or chain saw for railroad ties.

Round logs used as edgings can be kept from rocking and moving about by drilling a hole near each end and driving a 2 foot length of 1/2-inch galvanized pipe through it and into the

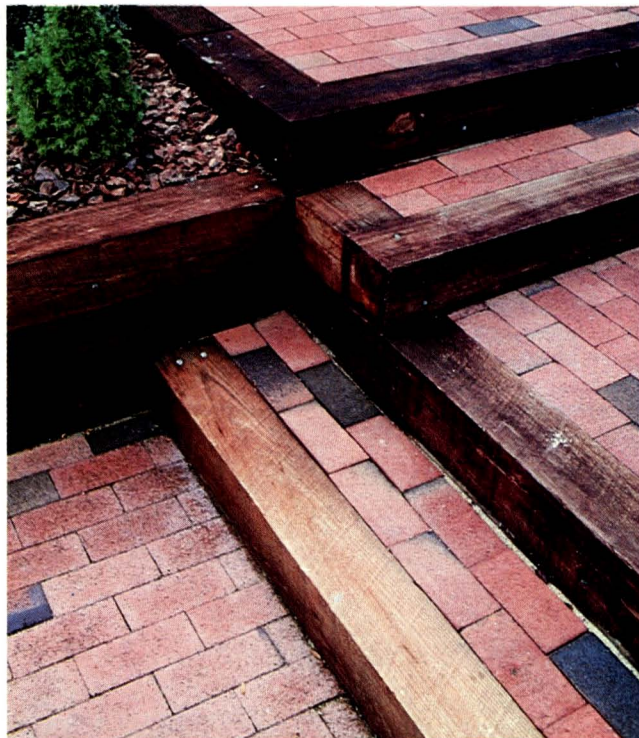
ground. Hide the pipe tops with plastic wood.

For curved effects with wood borders, 2 by 4s or 2 by 6s can be kerfed — cut with a saw — to give them flexibility. Make the kerfs about 2 inches apart for gentle curves, closer for tighter curves. Cut no more than halfway through the board.

Easier to shape are redwood bender boards that can be laminated by nailing them together for greater strength after they are in place. Supporting stakes can be hidden with soil.



Bold wooden edges set off other materials, accenting circulation corridors.



Railroad ties make excellent stair treads, with bricks, gravel or other contrasting paving materials.



Telephone pole rounds create a solid and exciting edge.

Tree wells: If you are planning on raising the level of your patio with fill dirt, but there is a lovely tree there, you cannot simply bring the dirt up around the tree without killing it. To circumvent this, build a tree well.

One simple solution is to bring the fill up to grade around the tree and

then sculpt it back away in a sweeping "cup." The bottom should be level with the original grade.

The interior can now be filled with large boulders. This brings the interior up to grade but still allows the tree to breathe and not be choked off by the surrounding dirt. (But you should know that some trees can't take this weight of fill over their root zones. Check this in regard to your own tree.)

For a more elaborate well, the cup could be lined with bricks on sand. This would be porous enough to let

water drain through.

For deeper wells, construct a redwood box around the tree — something like a planter box set in the ground. Be sure to leave lots of room for the tree to move in the wind, and to grow. Use heartwood redwood for best resistance against decay. Topped with a 2 by 6 cap, it makes a comfortable garden seat.

Be careful to construct a tree well that will drain well. Otherwise the tree will stand in a pool of water most of the winter, and soon drown.

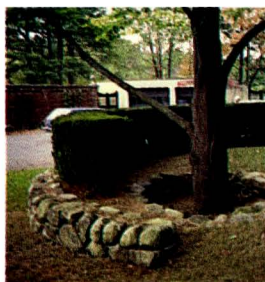


Raised bricks circle a tree, separating planting from patio surface.



Cutouts in the decking allow trees to grow through and cover part of the deck. Care must be taken to allow a big enough hole for growth and wind sway. Never attach a deck directly to a tree, unless it's a tree house deck and is unattached to anything else.





Non-mortared drywall and concrete formwork wall enclose planting and define spaces.

Retaining walls: If you live with sloping ground around your house, you can transform it from just a hill — often unused — into an attractive series of terraces with retaining walls. The walls can be made largely from whatever is at hand: rocks, broken pieces of concrete, 4 by 4s, lengths of telephone poles or railroad ties: whatever your imagination allows.

Most retaining walls are built with open construction, which means water from the banked earth will easily drain through and you do not have to install drain pipes or "weep holes."

Because of loose construction, the walls will shift slightly without cracking or breaking. If some part of it does come loose, it can be replaced without much trouble. In this same vein, deep footings do not have to be prepared even in areas with severe ground frost because a little movement of an un-mortared wall will not harm it.

Rock walls: Perhaps the most attractive and rugged retaining wall is one built from large rocks. If your property is plagued with rocks, put them to good use in retaining walls. Nearby rivers or streams are other good sources of rocks. As a last resort, buy them.

Start the construction by outlining the base of the wall with string stretched over stakes. Remove any sod and set the largest boulders you have about half their depth into the ground. These are the "footings" for the rest of the wall.

Fill in the space behind this first row with dirt and add more soil along the top to cushion the next row. The soil, acting as a type of mortar, can also be planted with flowers or ivy. The roots will further bind the wall in place.

As the wall proceeds, check your work with a simple angle guide you can make for yourself to keep your wall

tilted, or battered, back at least 1 inch for every 24 inches of rise. A 1 inch batter for every 12 inches makes an even more secure wall. Do not let an un-mortared wall exceed 3 feet in height — 4 feet at most. Rocks coming loose from that could hurt someone. Besides, it may not be allowed under local codes.

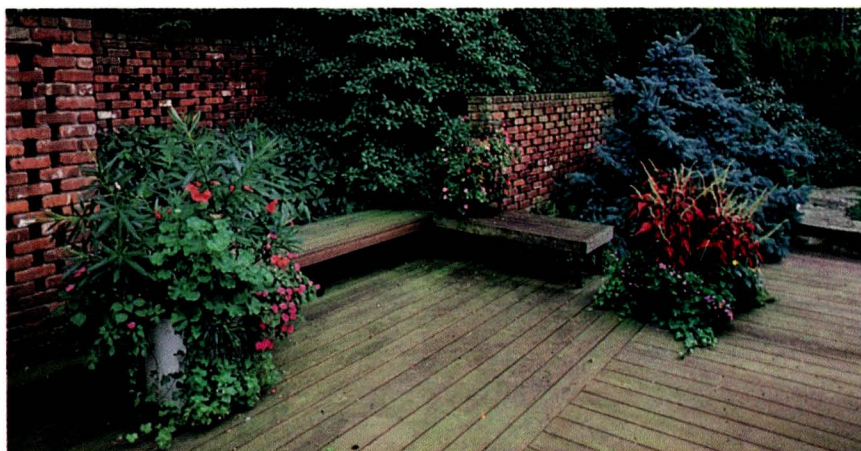
With each layer of rock on the wall, move more dirt down from the hill and tamp it firmly in place. By the time you reach the desired height of the wall, you will have flattened a patio area ranging from several feet to several yards wide into the slope. If terracing, start another wall on the next level down.

Broken concrete walls: This initially sounds unattractive but it's not. The only concrete exposed generally

is the rough, pebble-filled broken ends which give the wall an attractive, rough-hewn appearance. Moreover, broken concrete is one of the few building materials around that is still free. Check construction or demolition sites. Contractors will normally be glad to have you haul it away.

Broken concrete walls go up just as rock walls, with the biggest pieces laid down first as footings, and dirt tamped between each layer. The layers of soil are particularly useful in these walls because plants and flowers will soften the appearance.

Because the flat pieces fit together better than do rocks, they can be raised vertically if only going up two or three feet. Higher than that, however, they should be battered back 1 inch every 24 inches of height, for safety.



Brick walls come in many forms including basket weave. A famous brick wall design which curves back and forth, serpentine, was designed by Thomas Jefferson for the University of Virginia.



A low wall defines patio area without restricting the view.



Railroad tie walls create raised planters as sculptural elements in patios and gardens.

Plank walls: Walls made from wood must be decay resistant — such as redwood, cedar, cypress or black locust planks, or other wood pressure-treated with preservative. The supports are 4 by 4 posts set every 4 feet and sunk about 30 inches into the ground. Build the retaining wall with 2-inch thick planks 6 to 12 inches wide. Place them inside the posts and begin backfilling from the hill above to create the terrace. Space each plank $\frac{3}{16}$ inch or the width of a 16-penny nail to allow seepage. Before you start to fill, you can give

this wall considerable support with a "deadman." This is an anchor buried in the hill and attached to the wall. One way is to bolt a length of redwood from the inside of the wall to a stake driven deep in the soil some 3 to 5 feet back in the bank. The stakes and supports will be covered by the fill.

For a finished look and a garden perch, top the wall with a 2 by 6 cap.

Walls with timbers: Heavy timbers or pressure treated poles also make attractive retaining walls.

With timbers, such as railroad ties, put the bottom layer three to four inches in the ground to prevent any slippage.

When stacking timbers, and at corners, be sure to offset them as you would bricks so one holds the other in place.

For a wall that will rise more than 3 or 4 feet, the timbers must be firmly braced.

The bottom one should be drilled so you can drive a $\frac{1}{2}$ -inch pipe through it and 2 feet into the ground.

Each successive layer then must be drilled and joined to the one below with a length of pipe or reinforcing rod.

Round logs can be drilled and stacked in the same manner, or held with a "deadman." For a log deadman, notch the retaining-wall logs every 4 feet in height and about 10 feet apart and fit in another log that extends at right angles some 4 feet back into the slope. Angle the deadman down and bolt on a 4 by 4 length at the end to key into the dirt when the fill is packed around and over it.



Railroad tie walls, joined to stairs, create substantial elements in garden designs.

Mortaring a rock wall: Unlike a wall made from loose stone, a mortared rock wall requires a footing and a drain system, since any earth movement can crack the mortar and loosen the rocks.

Mark off the base of the wall location with stake and string, and dig a straight-sided trench at least 12 inches wide and down several inches below the frost level. Using a 1:2:3 mix of

concrete, fill the ditch to within 3 inches of the ground level. If the ditch is quite deep, you can partially fill it with rocks so you use less concrete.

While the footing is still wet, place the largest rocks as the first layer. For the mortar between layers, use a mixture of 2 parts portland cement, 6 parts sand and 1 part fireclay to make the concrete more flexible and more adherent to the rocks.

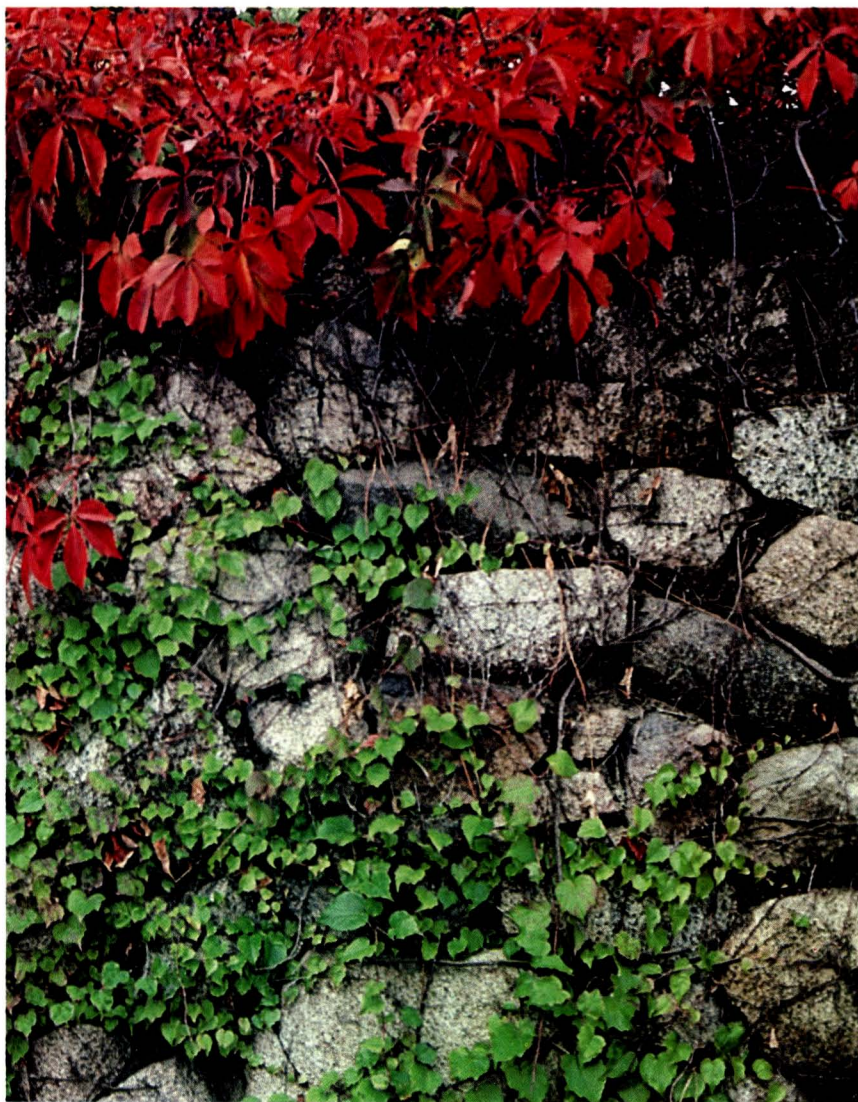
Mortaring a rock wall takes a great deal of cement and it is quite difficult to estimate how much you will need for the job. You can see how much is used for the first layer or two and then make a rough guess based on how

many layers you will have.

If you live in an area of heavy rainfall or if there will be seepage from the hill behind the wall, put in a drain system behind the wall after the first row or two (see page 93).

The wall, if going up 3 to 4 feet high, should be battered 1 inch for every 24 inches. A wall 2 feet or less need not be battered.

At the bottom and every 12 inches up the wall, about 4 feet apart, place small drain holes. These can be short lengths of PVC pipe or small tin cans embedded in the mortar and set back deeply so they won't be visible.



A rock retaining wall, when whitewashed, visually enlarges the patio. When covered with vines, it encloses the space.



Formwork for a concrete wall must be sturdy and can be three-dimensional.

A living wall: A wall that seems alive with flowers or vegetables can be made with hollow-core pumice blocks normally used in buildings.

After putting down a footing as described for mortared rock walls, mortar the pumice blocks in place on their sides with the openings facing out.

Lay the first row of blocks so the openings are slightly tipped up, and then continue with the wall. The slight upward angle will not only better hold the dirt fill behind but will better hold the soil in the openings. Plant your choice of flowers or such trailing vegetables as snow peas or string beans.

Drainage problems: In building a retaining wall, water that collects in the soil behind the wall during the rainy months must go somewhere. If it can't move through or around the wall, it will move the wall.

To be safe, you should build in a drainage system when putting up more than a foot or two of retaining wall.

Place a few layers of newspaper or some straw between the drain and the dirt fill. This keeps dirt from washing in and plugging the drain system.

Rubble fill: An effective drain can be made simply by filling an area 3 or 4 inches wide directly behind the wall, down to the base of the footing, with gravel. This allows the water to flow freely toward the ends rather than building up against the wall.

Drain pipes: Water can be directed more efficiently by placing leach line pipes along the base of the wall. These are inexpensive 10 foot sections of pipe with a perforated top.

Place them at the base of the wall and slope them down 1 inch for every 10 feet. Cover with four inches of gravel topped with newspaper before covering with fill dirt.

Dry wells: At the end of the drains, if there is no place for the runoff to go, install dry wells. These are holes dug 3 to 6 feet deep, usually 3 feet in diameter, and filled with rocks or large gravel.

Excellent retainers for the dry wells can be made from 55-gallon drums with both ends cut out with a cold chisel. If necessary, install 2 or 3 dry wells.

Buying stone: It is not always possible to collect your own stone for a retaining wall and you must, alas, buy it.

Stoneyards sell rock in three different grades:

Dressed stone: This has been cut

with nearly square sides, often to your specifications. It is easy to work with because of its regular form, but it's the most expensive.

Semidressed stone: Here the stone has only been chiseled away into a generally regular outline. It is cheaper than dressed stone and still easy to work with because of its generally uniform size.

Undressed stone: This is the cheapest and is simply stone with no work done to it. It is sometimes also called rubble.

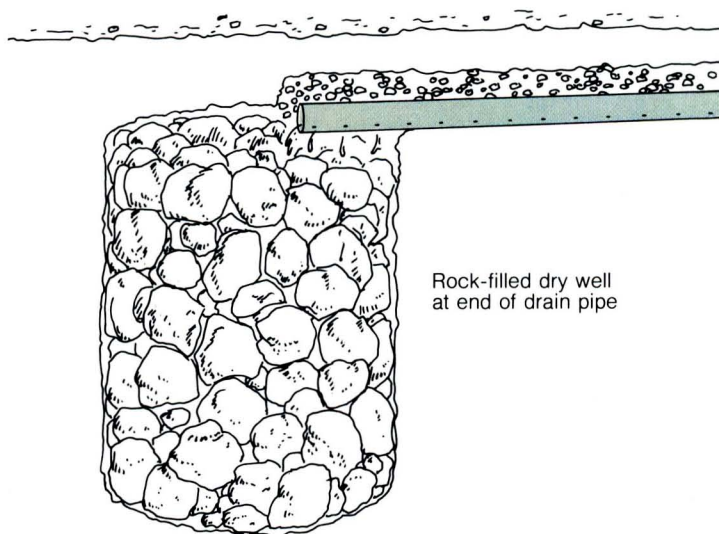
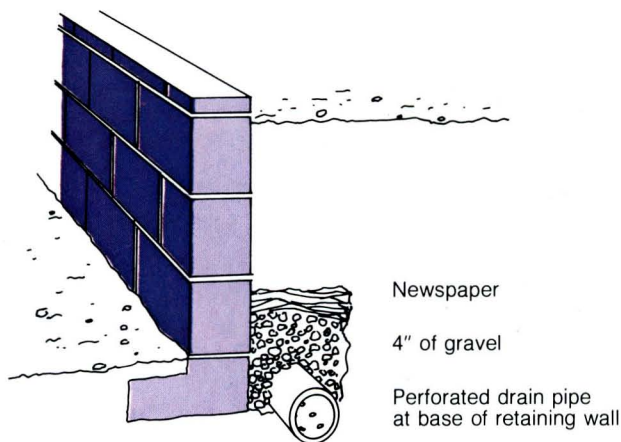
Also available in most stoneyards is rock irregular in outline but cut flat on

top and bottom. This is easily done because it is taken from stratified layers of stone. It is known as ashlar and makes particularly handsome walls.

And finally, there is artificial stone that is made in a wide variety of sizes and colors. It is light and therefore easy to handle. It is commonly seen in "rock" fireplaces.

Stone is sold either by the ton or by the cubic yard. To estimate how much you need, give the stonemason the cubic dimensions of your wall (height, length and width) and he will estimate your needs based on the type of stone you buy.

Drainage





Steps linking patios and formed to the topography are pleasing.

Patio steps: In a raised or terraced patio, steps are not simply a means to get from one level to another. Their style should be clearly defined and dramatic. They should be broad and inviting for those strolling through the garden, and they should lead the eye smoothly between the separate but related levels in the patio or garden. They can also serve as seats, planter areas, or small terraces.

At the same time, steps must be comfortable and safe for walking. The tread areas must be wide and stable underfoot, and the risers not so high that it is an effort to move up or down. Risers must also be of equal height to prevent tripping. Risers should not be less than 4 inches or more than 7 inches in height for safety and comfort.

As described further in Chapter 6, one way to calculate the riser-tread relationship is to follow this formula: twice the riser height plus the tread width equals about 26. Thus, a step with a 6-inch riser would have a 14-inch tread ($2 \times 6 + 14 = 26$).

Another rule is: the lower the riser the wider the tread, both for the sake of comfort in walking and appeal to the eye.

In planning the number of steps required down an embankment, you should first calculate the angle of the slope.

Start by driving a stake where the top step will be and directly below that another stake where the bottom step will be. From the top stake, stretch a length of string held perfectly level (check with a line level) over the bottom stake. Measure the distance from the ground up to the string and measure the length of the string. This



Patio and deck steps should have uniform treads and risers, and be grouped at least two per set. Single steps are hard to see and may be dangerous whether or not they are shallow or deep.

gives you the change in grade.

If, for instance, the vertical rise is 3 feet and the horizontal distance is 12 feet, you know your steps must rise 3 feet within the space of 12 feet.

Draw these calculations on graph paper, showing 1 foot or 6 inches per square. Work out the tread-riser relationship you want in your patio and draw it in.

If your particular embankment is so steep that you must have risers more than 7 inches high, then study the possibility of turning the steps so they run up the slope at a long, low angle, or zig-zag from one landing to the other.

For building wooden stairs with stringers, see page 65.

It will depend on your own design and your particular site, but many people feel that outdoor steps should be a minimum of 4 feet wide for comfort and safety. Some people consider even that too narrow. Stairs 5 feet wide allow a pair of people to walk together, and stairs 8 feet wide lend a sense of spaciousness and graciousness to the entire patio or garden area.

Step materials: Steps should be a part of the whole patio design and not clash with the mood you have created. Thus, if you have a rustic or sylvan patio area, you would not want a broad run of smoothly finished concrete steps. Instead, use cedar logs, railroad ties or flagstone to maintain the rustic sense.

Here are some ideas to adapt to your own patio.

1. Railroad ties
2. Logs
3. Flagstone
4. Redwood and brick
5. Concrete rounds
6. Exposed aggregate
7. Patterned brick
8. Railroad tie risers and brick-on-sand treads
9. Decomposed granite contained in 2 by 10 risers
10. Paving tiles and 6 by 6 redwood beams



Some patterns blend in well; some do not. Mixing patterns, materials and forms in too small an area can lead nowhere.



Brick and railroad tie stairs. The retaining wall blends well with the ties, and adds a rustic wooden touch to the garden.

Patio benches: Finishing touches that are both practical and attractive for patios are the benches. They can range from the very simple to the complex, but they should remain in character with your entire design. Some may be set permanently in place while others can be moved about, depending on your patio.

Outdoor benches are usually made from wood because it is the easiest material to work with. It also doesn't rust. Redwood and cedar are commonly used because of their natural weather resistant properties, but Douglas fir and pine or cypress will also work well, especially if soaked in a water repellent before construction.

Portable bench: Cut the end pieces from 2 by 12 stock 14 inches long. Use a waterproof glue, such

as epoxy resin, and clamp overnight.

Put the 6-foot center brace in position flush with the top of the legs and centered. Fasten it with epoxy resin and three No. 16 4-inch long screws in each end. Countersink the screws and cap holes with wooden "buttons."

Build the top from four pieces of 2 by 6 of 8-foot length, which allows a 1 foot overhang at each end. Hold each 2 by 6 in place with two No. 10 screws 4 inches long. Countersink and fill the holes with plastic wood.

Curved bench: Curved benches are normally permanently fixed in the ground because of the considerable stress exerted on the wood.

How much curve you can get will be determined by what lumber you use. A 2 by 2 will bend more easily than a 2 by 4 on edge, but will not be quite as strong.

The wood selected for this must be clear of knots, which create weak points in the structures.

Put the supports in place in the ground, using clear heartwood red-

wood or pressure-treated wood. Make sure all posts are the same height. Put the cross-supports on with two $\frac{3}{8}$ by 4-inch lag-screws.

Now, toenail one end of the top rails in place and, while someone holds and bends the wood, work your way around and nail each rail to a support. Use $\frac{1}{2}$ -inch spacers between the top pieces, toenailing them in place.

Bench around a tree: This bench requires inner and outer rings of support. These support forms are made from three 2 by 6s held together with cleats on the inside. Cut them to your required lengths.

The outer ring of supports should be spaced 2 feet from the inner ring. Top them with 2 by 4s spaced the width of a 16-penny nail for drainage. Trim the ends to conform with the base, allowing a 2-inch overhang.

Low tree bench: Cut all the supports in this case from rough 2 by 12 redwood. Note the cross-supports needed for any patterned decking. Cover with 2 by 4s or 2 by 6s.

Unusual benches, when the materials and design are carefully chosen, can provide a special atmosphere, as in this stone bench.





Curved benches enforce table design in coordinated furnishing scheme.



Built-in wooden benches can complement brick paving and shingled house wall.

Bench supports which are anchored to rear wall leave the floor open for easy maintenance and activities that need space.





Stones, cobbles and paving tiles make interesting patio surfaces when used in strong, simple patterns.

A guide to garden paving materials

Type	Description and Comments
Concrete	Practical, durable, many surface treatments.
Natural	Gray tends to be cold-appearing and glaring. Steel trowel finish is slippery when wet. "Sweat" or "swirl" and broom finishes are non-skid and texture helps break glare.
Color	Earth tones harmonize with plants. Use others with caution. Integral color mixed throughout concrete is easier than sprinkle-on which can be splotchy.
Salt-Finish	Travertine-like pitted surface derived from rock salt. Coarseness of salt determines the size of the pits. Can be used with colored concrete.
Exposed Aggregate	Pebbly texture goes well with plants and wood, and softens glare. Uneven surface collects dirt and makes furniture wobble. Rounded stones best.
Impressed	Patented process impresses brick, cobblestone and tile patterns into soft concrete. Mortar can be used to fill the joints for a smoother surface.
Light-weight Topping	Troweled-on concrete topping that stays cool, even when in direct sun. Can be textured for added interest.
Fine Aggregate Coating	Franchised method consists of a thin layer of tiny pebbles in an epoxy mix applied over existing concrete.
Acid Stain	Can be applied to new or old concrete, after thoroughly cured. Will not rub off.
Latex Coating	Another way to salvage a drab appearing slab of concrete. Tough enough for normal wear.
Paint	High quality concrete paints hold quite well under proper conditions. Periodic repainting is necessary.
2" to 6" Sub-base	To minimize cracking in expansive soil or where soil freezes.
Steel Reinforcing	Wire mesh or steel rods as an added protection against cracking where soil conditions are unstable or heavy loads are anticipated.
2x4 Dividers	Permanent strips of redwood or other decay-resistant wood serve as expansion joints and add interest to large areas. Helpful for amateur in setting up grades and leveling concrete when pouring.
Vinyl Strips	Attractive expansion joints available in white, black, gray and tan.
Brick	Old favorite for garden surfacing. Excellent for homeowner to install. Available in reds, buffs, yellows and other colors. Soft types less expensive, but use harder pavers for heavy traffic and cold winter areas.
Laid on Sand	Easy to do, casual appearance, mistakes or movement easily repaired. Outside edge should be set in mortar or lined with a permanent border. Sweep sand into tight joints.
Laid on Concrete	Less subject to movement, can be kept cleaner. Joints are usually mortared. Laying over existing concrete saves cost of a new slab.
Used Bricks	Informal effect with rougher surface than new bricks. Joints are usually mortared to fill in irregularities. Inexpensive salvage source can reduce cost.
Hot-Mixed Asphaltic Concrete	Best use is for driveways and parking. Because of heavy equipment needed, minimum installation is for 1000 square feet with good access. Cost increases for walks and small areas. Contractor normally includes 2" base with 2" mix over, weed killer and permanent wood borders.
Seal Coat	Bituminous or epoxy solutions applied over existing asphalt to seal pores and enhance appearance.
Paint	Must be specifically manufactured for application over asphalt. Follow directions carefully.
Soil Cement	Mixture of cement and existing granular soil for a casual appearing, reasonably durable surfacing. Good do-it-yourself method.
Flagstone	Natural sandstones, granites and slates in ½" to 4" thick slabs. Source of stone determines cost. Thin types excellent for laying over existing concrete.
Laid on Sand or Soil	Best for natural setting with lawn or groundcover grown in open joints.
Laid on Concrete	Better surface for furniture, easier to keep clean, when joints are mortared.
Tile	Informal appearing types best for garden use. Available in squares, rectangles and geometric shapes, and several sizes.
Laid on Sand	Use only strong tiles and make sure base is firm and level, or cracking will occur. Sweep sand into tight joints. Needs a permanent edge to hold in place.
Laid on Concrete	Preferred method, with mortar joints. Good material to dress up an existing concrete entrance.
Adobe Blocks	Appropriate with southwestern architecture. Laid on a sand base with mortared or planted joints. Availability is limited to certain regions.

Pre-Cast Concrete Pavers	Wide choice of colors, sizes, shapes and surfaces. Can be laid on sand base with sand joints or over concrete with mortar joints. Patterned types are good substitute for more expensive clay and stone products.
Soft Pavings	Materials that can be walked on and cost less than solid surfaces, yet don't have to be cared for like a lawn or groundcover. A permanent edging of some type is optional. Buying in bulk is much less expensive than sacks.
Decomposed Granite	Granular material that looks a little like coarse sand. Packs well, and easy to rake leaves off. Usually tan or brown. Good for garden paths, can be used for driveways and parking.
Brick Dust	Similar to decomposed granite except red.
Crushed Gravel	Includes roofing gravel of various sizes and colors. Displaces easily and not comfortable to walk on.
Rounded Stone	$\frac{3}{4}$ " mixed stays in place fairly well and is walkable. Brownish tones are attractive, but not always available.
Bark Products	Looks well and also serves as a mulch for plants. Shredded types form a safety cushion under play equipment. Chips can float away in a rainstorm. Eventually decomposes.
Pecan and Walnut Shells	Lasts longer than bark. Limited availability.



Paving materials can be used to separate areas within the designed space.



The Working Plan

The completed plan includes building permits, balancing load factors, and a variety of special optional features like ramps, gates, benches, planter boxes, even storage spaces.

The plans you will now make can be called **working drawings** because you will be able to work directly from them when you come to build your deck or patio. They will graphically indicate what kind, what size and how many of each item of material you will need. They will also show how you intend to put the materials together to make the deck or patio level and solid.

With your tracing overlay on your final concept plan, you are now ready to begin the working drawing. Measure and write on the edge of the overlay the dimensions of the spaces. Be

exact in your drawing. Whenever possible, incorporate standard sizes of the materials you plan to use. Although this may mean slightly different dimensions from those in your concept plan, using standard sizes of building materials will save you money by reducing waste.

For instance, if you conceived of a rectangular deck 9 feet wide, change it to 8 feet if possible, because that is a standard lumber length. These minor adjustments as you start the working drawing will save you lots of time when you actually build the structure.

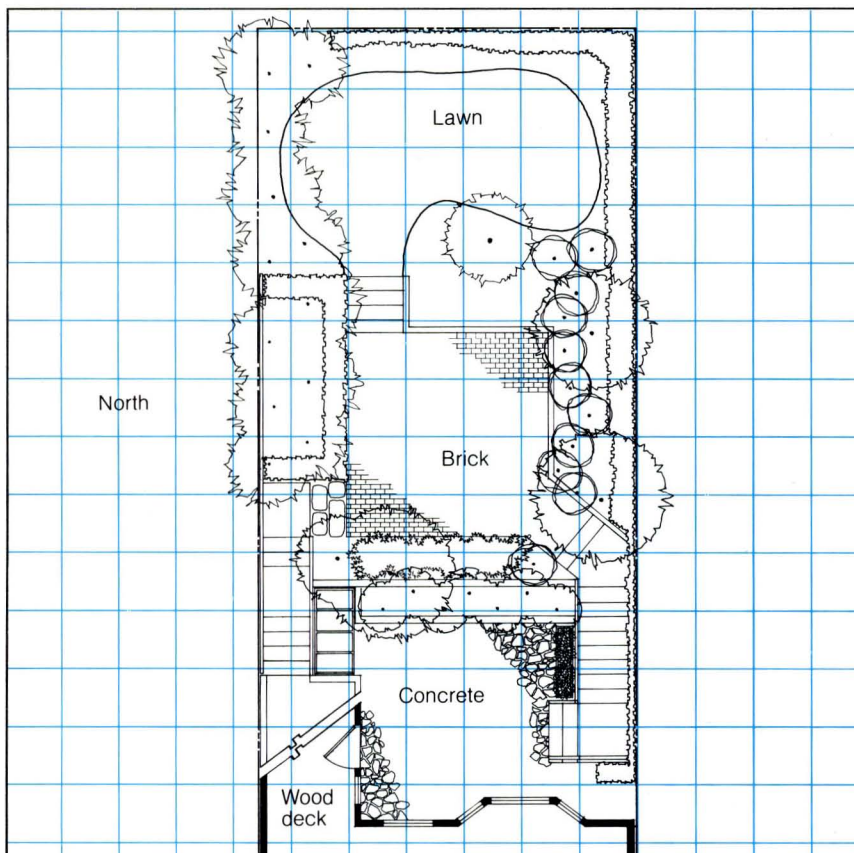
Zoning variances: Most local planning agencies have zoning regulations that require setbacks (areas a certain number of feet from the property line that can't be built upon), lot coverage limitations (a set percentage of the lot to be open space or planting), height limitations (no building above certain heights, to keep views open), and lots of other specifics. If your concept design proposes improvements that turn out to be in conflict with an existing zoning requirement, you may request a zoning variance.

Variances are intended to provide flexibility to hard-and-fast rules. If your proposal is reasonable and does not interfere with the neighbors' interests, the local planning board will probably give you approval to go ahead. In order to apply for approval, however, you will need a plan that shows clearly what you propose, and thus how it may conflict with a zoning regulation.

The authorities will probably need two copies of your final working drawing plan. However, the concept plan which you have just finished may be enough to obtain a building permit and indicate any potential need for a zoning variance.

Check on procedures with your local building department.

The plan (left) of the photo patio (opposite) illustrates the relationship between plan-drawn spaces and built reality. Working drawings are the ultimate refinement and notation of how you plan to build something, based upon your concept design.





Dead load is the weight of the structure and its permanent fittings. Live load is you, the wind, snow and all other temporary pressures upon the structure.

Balancing loads: Everything on earth is subject to the pull of gravity. People, trees and even decks fall to the ground when gravity sufficiently overpowers forces that resist it. Every part of every structure must be built out of materials strong enough to support one another.

Downward forces are divided into **live** and **dead loads**. Dead load is the weight of the components of the structure. Live load is a non-permanent weight which is added to this dead load. Typical live loads are furnishings, snow, rain water and even wind.

The building materials industry has established load allowances for different sizes and types of lumber, bolts, nails, metal fasteners, bricks, and so on. These are based on tests that determine their actual breaking point.

Most building codes set the residential live load at 40 pounds per square foot for normal usage. If you are building a structure that will have heavier than usual loads — for instance, a waterbed, or a meeting area where people will congregate — it's wise to increase the live load allowance in choosing materials.

Heating and water: Before getting into the detail design of your deck or patio, you may want to consider also whether you'll need heat or water there.

Nighttime heating on decks and patios is often taken care of by heat that is naturally stored and radiates from the building materials themselves. When the nights get colder, though, there are a number of artificial means of heating the space.

From a Franklin stove mounted outside to elaborate concrete and

stone fire wells, the enclosure of fire adds cheery warmth to outdoor decks and patios and can extend the useful season for the spaces.

A fire pit is the most primitive but enduringly popular source of heat in outdoor rooms, and if firewood is reasonably available, it will probably be the most economical. Fire pits can be designed into the space to serve other functions when not supplying heat, and there are numerous forms and materials that can be used.

It is important in designing fire pits to be sure that smoke is vented out of the use area or that the pit is placed downwind from the areas you want to be in. Consider groupings of furniture in designing the pit, and remember fire safety by being sure flammables and wood decking and structures will be placed at least 3 feet from the open flame. Design the fire pit out of brick or stone as you would a brick or paved surface, as described in Chapter 5. Be sure that it slopes to drain and will not puddle. And, of course, use only materials guaranteed fire-resistant when you build it.

A freestanding or hanging gas or propane reflecting heater can be fueled from tanks for permanent installation. Because of the complexity and potential hazards of these systems, we recommend that you contact an architect if you think you want to use such a heater.

If you want to have planters on your deck or patio, you may want to consider running a water pipe to provide them with either sprinkler or drip irrigation. PVC pipe is very easy to install, and when tied into one of the many automatic timers available on the market today, a simple system can supply your plants with the correct amount of water on a regular schedule.

Even if you are planning just to use the garden hose, a cold water tap on or near the deck or patio may be a great convenience and should be included in your working drawing.



An important consideration when designing a deck is balancing loads. This is especially true in areas of heavy snowfall.

Decks: In designing the structure of a deck, the objective is

to choose the correct size (and, accordingly, strength) of lumber for the various components to be safely within the load allowances. For any particular part of the deck, you want to use a piece of lumber that will be strong enough to withstand both the expected live and the dead load requirements, but not one that will be needlessly bigger and more expensive than required.

As you choose the lumber in the design process and put it together in the building process, the objective is to create a structure that will not only be able to withstand the loads exerted upon it, but will also be firm. You don't

want it to wiggle or seem cushiony as people walk and move around on it. It should be as solid as the ground you are building on.

The beginnings of a solid deck are **concrete footings** dug into solid undisturbed soil.

Rising from the footings will be **posts** fastened to **beams** which, in turn, will be fastened to **joists** which, in turn, will be overlaid with the actual **decking** material. If the posts are more than a few feet high, they will be tied together with **diagonal braces**. Railings, benches, stairs and walls will be fastened by various means to the structure. If part of the deck is along a

house wall, a joist or beam may become a **ledger** — a member bolted directly into the house structure. Posts are thus not required on that side.

With the information about construction from Chapter 4, you are ready to work through the structural design of the deck. On the tracing overlay of your concept plan, sketch in the pattern of decking you'd like to use. You may think the deck will look best with boards placed parallel to the house wall, or you may prefer them running the other direction or in a herringbone or checkerboard pattern. Because the surface is what you will see, determine this pattern before

Beam sizes (joist spans)¹

Species group ²	Beam size (in.)	Beam spacing ³ (ft.) (Joist span)									
		4	5	6	7	8	9	10	11	12	
1	4 × 6	Up to 6-ft. spans									
	3 × 8	Up to 8-ft.	Up to 7'	Up to 6-ft. spans							
	4 × 8	Up to 10'	Up to 9'	Up to 8'	Up to 7-ft.	Up to 6-ft. spans					
	3 × 10	Up to 11'	Up to 10'	Up to 9'	Up to 8-ft.	Up to 7-ft.	Up to 6-ft.				
	4 × 10	Up to 12'	Up to 11'	Up to 10'	Up to 9-ft.	Up to 8-ft.	Up to 7-ft.				
	3 × 12		Up to 12'	Up to 11'	Up to 10'	Up to 9-ft.	Up to 8-ft. spans				
	4 × 12			Up to 12-ft.	Up to 11'	Up to 10-ft.	Up to 9-ft.				
	6 × 10					Up to 12'	Up to 11'	Up to 10-ft. spans			
2	4 × 6	Up to 6-ft.									
	3 × 8	Up to 7-ft.	Up to 6-ft.								
	4 × 8	Up to 9'	Up to 8'	Up to 7-ft.	Up to 6-ft.						
	3 × 10	Up to 10'	Up to 9'	Up to 8'	Up to 7-ft.	Up to 6-ft. spans					
	4 × 10	Up to 11'	Up to 10'	Up to 9'	Up to 8-ft.	Up to 7-ft. spans	Up to 6'				
	3 × 12	Up to 12'	Up to 11'	Up to 10'	Up to 9'	Up to 8-ft.	Up to 7-ft. spans				
	4 × 12		Up to 12'	Up to 11'	Up to 10'	Up to 9-ft.	Up to 8-ft.				
	6 × 10			Up to 12'	Up to 11'	Up to 10-ft.	Up to 9-ft. spans				
3	4 × 6	Up to 6'									
	3 × 8	Up to 7'	Up to 6'								
	4 × 8	Up to 8'	Up to 7'	Up to 6-ft.							
	3 × 10	Up to 9'	Up to 8'	Up to 7'	Up to 6-ft. spans						
	4 × 10	Up to 10'	Up to 9'	Up to 8-ft.	Up to 7-ft.	Up to 6-ft. spans					
	3 × 12	Up to 11'	Up to 10'	Up to 9'	Up to 8'	Up to 7-ft. spans	Up to 6-ft.				
	4 × 12	Up to 12'	Up to 11'	Up to 10'	Up to 9-ft.	Up to 8-ft.	Up to 7-ft.				
	6 × 10		Up to 12'	Up to 11'	Up to 10'	Up to 9-ft.	Up to 8-ft. spans				

¹ Beams are on edge. Spans are center to center distances between posts or supports. (Based on 40 p.s.f. deck live load plus 10 p.s.f. dead load. Grade is No. 2 or Better; No. 2, medium grain southern pine.)

² Group 1 — Douglas fir-larch and southern pine; Group 2 — Hem-fir and Douglas-fir south; Group 3 — Western pines and cedars, redwood, and spruces.

³ Example: If the beams are 9' 8" apart and the species is Group 2, use the 10-ft. column; 3 × 10 up to 6-ft. spans, 4 × 10 up to 7-ft., etc.

selecting joists, beams, posts and connection designs. The surface pattern may influence the placement of all of them. Another influence on wood selection is the effect of available preservatives, stains and paints.

Remember our earlier comments about textures and design simplicity. Also, remember that decking patterns can separate parts of the deck for specific uses. Consider how the patterns will look from the interior rooms of your house. Note that decking parallel to doors and windows can make a deck seem larger with the receding patterns of crack lines making a statement of perspective. Decking at right angles to a door or window may guide the eye out along the decking boards, making the expanse seem smaller. But if there is a view it may be better featured if the crack lines run toward it rather than across it.

Avoid wild and irregular changes in the decking pattern. Unless there is a specific reason, keep it uniform. Remember that when the decking changes from one pattern or direction to another, the support system underneath will have to be that much more complex.

After you have laid out the pattern and direction of the decking boards on an overlay of your concept plan, select the type of wood and size of lumber you will use for this decking and the structure.

Decisions about lumber require give and take, trading off longer spans for larger and more costly sizes of lumber. For instance, a 4 by 8 Douglas fir beam may require posts every 10 feet to support the load of joists and decking if there are beams every 4 feet under the joists. The same 4 by 8 Douglas fir beam, however, placed 10 feet on center under the joists may require post supports every 6 feet. Where beams are less frequently placed and are therefore carrying more load per linear foot, the posts that hold them up have to be closer together and thus steal potentially useful space from under the deck.

Thus the selection of beams and joists is a trade-off between smaller and less expensive lumber (more frequent spacings and thus more of them) and larger and more expensive



lumber (more widely spaced and thus fewer of them). In situations where the beam and joist structure will be seen under the finished deck, you may choose to use larger lumber with less frequent spacing for esthetic reasons. On sites where it is difficult to install footings — such as steep slopes or in water — it may be an advantage to choose larger lumber and long spans to reduce the number of footings.

Another factor to consider is the headroom. If, for instance, you want the finished elevation of the deck to be just below the door sill and there is limited space above ground, you will have to size the joists and beams to fit it, using thicker lumber. Otherwise, you would have to excavate.

Similarly, if the planned deck has a change of level, you may want to choose a long and narrow beam, perhaps even a bigger one than you need for load and span, in order to avoid running a second beam for the lower elevation joists. A single beam can support more than one level of deck connected with metal joist hangers on its face. In instances where vertical space is tight, all of the joists can be hung from metal hangers on the beam face. You may, in fact, want to use joist hangers throughout because of the easy connections they make possible.

Mimimum post sizes¹ (wood beam supports)

Species group ²	Post size (inches)	Load area ³ beam spacing × post spacing (sq. ft.)									
		36	48	60	72	84	96	108	120	132	144
1	4 × 4	Up to 12-ft. heights →				Up to 10-ft. heights			Up to 8-ft. heights		
	4 × 6					Up to 12-ft. heights →				Up to 10-ft.	
	6 × 6									Up to 12-ft.	
2	4 × 4	Up to 12-ft.	Up to 10-ft. hts. →		Up to 8-ft. heights →						
	4 × 6		Up to 12-ft. hts. →		Up to 10-ft. heights →						
	6 × 6					Up to 12-ft. heights →					
3	4 × 4	Up to 12'	Up to 10' →	Up to 8-ft. hts. →			Up to 6-ft. heights →				
	4 × 6		Up to 12' →	Up to 10-ft. hts. →			Up to 8-ft. heights →				
	6 × 6				Up to 12-ft. heights →						

¹ Based on 40 p.s.f. deck live load plus 10 p.s.f. dead load. Grade is Standard and Better for 4 × 4 inch posts and No. 1 and Better for larger sizes.
² Group 1 — Douglas-fir-larch and southern pine; Group 2 — Hem-fir and Douglas-fir south; Group 3 — Western pines and cedars, redwood, and spruces.
³ Example: If the beam supports are spaced 8 feet, 6 inches, on center and the posts are 11 feet, 6 inches, on center, then the load area is 98. Use next larger area 108.



Deck structures under construction.

Joist, beam and post layout: After consulting the tables, note your joist spacing on your plan overlay. This measurement, looked at another way, is the decking span — the distance along each decking board between the points where it is supported by a joist. Because decks should be designed for parties where many people congregate, we recommend greatly reducing the standard allowances for joist spacing to a maximum decking span of, for example, 32 inches for 2 by 4s laid on edge or 24 inches for 2 by 4s or 2 by 6s laid flat. For 1 by 2, 1 by 3, and 1 by 4 decking, we recommend 12 inches, although you can often get away with 16 inches. The psychological importance of rocklike firmness on decks, particularly when they are more than about 4 feet above ground, makes it a poor bet to scrimp on joists. The few extra joists needed to reduce the decking span to 24 or 16 inches are well worth it.

At the edge of the deck, you may have designed a cantilever on your concept plan. In order to get this effect of a floating platform, the posts and footings must be inset from the edge of the actual decking. Depending on the use intended for the cantilevered part, the decking can extend from 6 to 24 inches beyond the joist ends. If, for instance, the cantilevered portion is beyond a railing so that it can't be walked upon, it can have a greater span because it won't be asked to carry a load. On the other hand, a cantilever in a traffic area would be noticeably springy. In general, it is best not to exceed the length of one-half the decking span on a cantilever unsupported by joists.

On a separate piece of tracing paper, copy the joist spacing you have chosen at an appropriate scale from our tables and overlay it on your decking pattern drawing, perpendicular to the direction of the decking boards. If you have an irregular shape that divides the decking direction, you must orient the joists for each sec-

tion perpendicular or at not less than a 45 degree angle to the decking.

Copy the whole joist system off on a fresh overlay, and from our table of information, make a tentative selection of lumber size for the joists. Now note the span allowed for that size and type of joist — that is, the spacings of the beams.

Because the joists divide up the load of the accumulated decking above, they must be supported as regularly as required by this span allowance. If, for instance, your joist has an allowable span of 8 feet, you *may* have beams every 6 feet but you *must* have them at least every 8 feet. Don't stretch the span allowance because, if you do, the deck structure won't pass code, will not be solid, and may even fall down.

The woods most frequently used for decking in the western states are redwood and cedar. In other areas, cedar

and pine are common. As prices of redwood and other preferred woods rise, formerly unavailable woods are coming on the market. Malay mahogany and Alaska cedar are both available in some areas at prices comparable to redwood, and in decking dimensions (2 by 4 and 2 by 6). Until recently, both of these were considered specialty woods and were far more expensive than redwood. In your area there may be woods with special qualities at prices that beat the commonly available woods. Check out availability before finally selecting the wood you want to use.

It is often desirable to use different woods for deck surface and structure. Combinations of Douglas fir and redwood are frequent. The fir, which is stronger, is used for the joist, beam and post structure; the redwood is the decking. An additional advantage of Douglas fir joists is that they can be

Joist spacing¹ (Decking span)

Species group ²	Joist size (inches)	Joist spacing (inches)		
		16	24	32
1	2 × 6	9' 9"	7' 11"	6' 2"
	2 × 8	12' 10"	10' 6"	8' 1"
	2 × 10	16' 5"	13' 4"	10' 4"
2	2 × 6	8' 7"	7' 0"	5' 8"
	2 × 8	11' 4"	9' 3"	7' 6"
	2 × 10	14' 6"	11' 10"	9' 6"
3	2 × 6	7' 9"	6' 2"	5' 0"
	2 × 8	10' 2"	8' 1"	6' 8"
	2 × 10	13' 0"	10' 4"	8' 6"

¹ Joists are on edge. Spans are center to center distances between beams or supports. Based on 40 p.s.f. deck live loads plus 10 p.s.f. dead load. Grade is No. 2 or Better; No. 2 medium grain southern pine.

² Group 1 — Douglas-fir-larch and southern pine; Group 2 — Hem-fir and Douglas-fir south; Group 3 — Western pines and cedars, redwood, and spruces.

Maximum allowable spans for spaced deck boards¹

Species group ²	Maximum allowable span ³ (inches)					
	Laid flat				Laid on edge	
	1 × 4	2 × 2	2 × 3	2 × 4	2 × 3	2 × 4
1	16	60	60	60	90	144
2	14	48	48	48	78	120
3	12	42	42	42	66	108

¹ These spans are based on the assumption that more than one floor board carries normal loads. If concentrated loads are a rule, spans should be reduced accordingly.

² Group 1 — Douglas-fir-larch and southern pine; Group 2 — Hem-fir and Douglas-fir south; Group 3 — Western pines and cedars, redwood, and spruces.

³ Based on Construction grade or Better (Select Structural, Appearance, No. 1 or No. 2).



Blocking is necessary to stiffen many deck structures. Design for rock solidness as you work back and forth on the lumber sizing tables. Don't cut down lumber sizes if you want to have a solid deck.

smaller for a given load, which in some instances is important in fitting a deck into a specific gap.

Play back and forth with the load and span information in the tables, finding the combinations of joists and beams that will work safely and most closely fit your needs. Remember that the larger the joist or beam, the more expensive it will be and the harder it will be to lift as you work with it. If you use large joists and beams, though, there will be fewer of them to buy and fasten into the structure. Structural design of decks is a matter of trying out various solutions and then choosing the best, considering the particular conditions of the job.

After you have selected the joists and beams size and draw them onto your working plan in complete detail to guide the later construction. If you are using full allowable spans, your deck will be designed for a maximum load of 50 pounds per square foot — 40 pounds live load and 10 pounds dead load. If you expect to give parties with lots of guests, or if you plan to use container trees or other heavy objects on the deck, stay well within the span allowances in selecting joist, beam and post lumber. The extra expense will be worth it to insure a sturdy and strong deck. This is the place to over-design for strength — and for the esthetic appeal of large timbers.

You may be planning a hot tub, spa or other especially heavy item for part of your deck. It should have a separate structure with its own beams, posts and footings because of the extra weight. To handle this problem, separate out the special use area and design the separate structure with significantly oversized lumber. It is a good idea to consult with a professional engineer if the load is great or high off the ground.

Be sure to label everything you have made a decision about, because you will forget details as you move on. The working drawing must have all your directions to whomever will order the materials and build the deck, most likely you.

The next part of the structure to design is the footings connection to posts or beams. There are a number of different systems for connecting wood posts to concrete footings, but they all have the basic purpose of

making sturdy joints above flood water and soil levels, preferably with an air gap at the bottom of the post to reduce the chance of rot. Different ways of making these connections are discussed on page 47. Select the type of footing and size hole you will need and draw this on your plan with a small circle template, choosing the correct diameter. Label the dimensions of the footings and make a note about any special conditions that apply to them.

Note the type and number of metal connector you are using — if you are — the bolts, and where you will need flashing. This information will be helpful for cost estimating and ordering.

Blocking and bracing: You can stiffen your deck structure and distribute its live load by blocking between the joists. On your plan, draw in this blocking and label.

Bracing is used to strengthen a deck against lateral (sideways) movement caused by strong winds or people or objects moving on the deck surface: an example is the swinging of a hammock. To prevent the deck from wiggling and eventually weakening, it should be braced with cross-members in one of a number of patterns (see page 49).

On your plan overlay, draw in the braces using a dashed line. Then consider the detail connection of the braces. Some can be shown on your ¼-inch scale plan but others may need a larger scale that will show the proportions of the lumber and hardware.

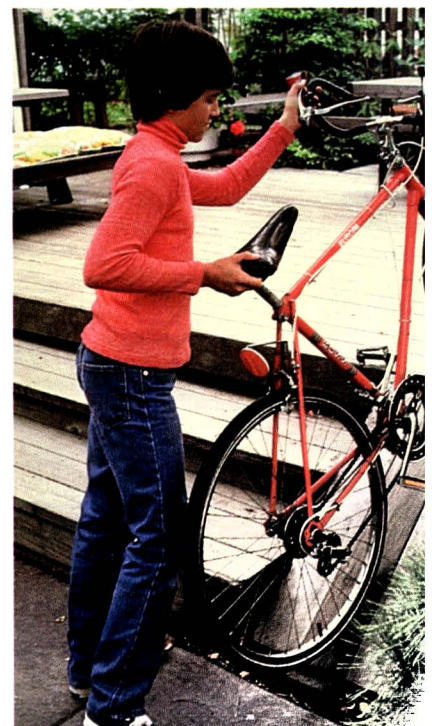
Special features: Stairs, ramps, walls, railings, gates, fences, planter boxes, benches and any other special features you want to explore can be drawn as detail studies on separate sheets of tracing paper and later

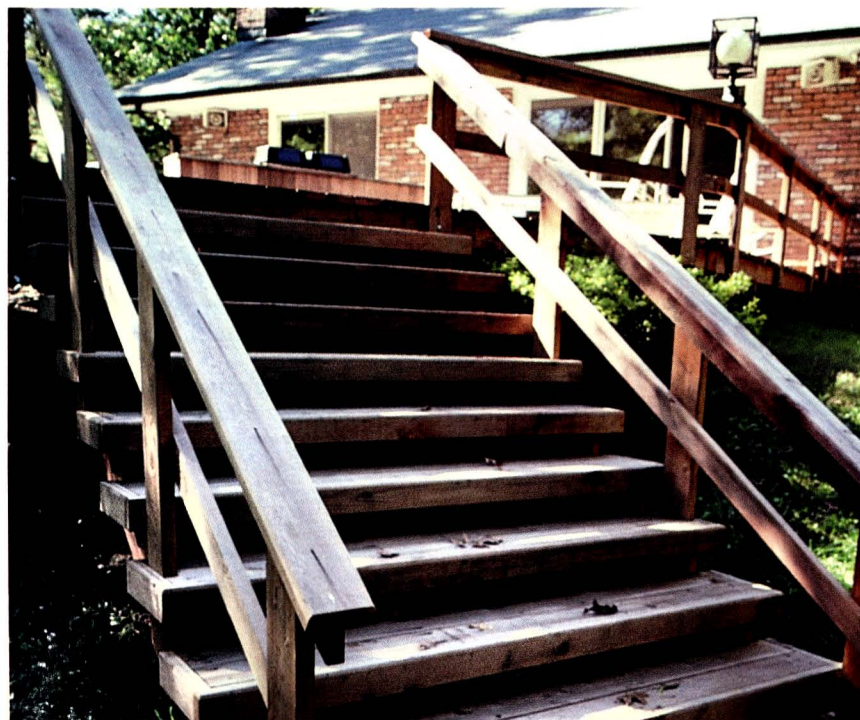
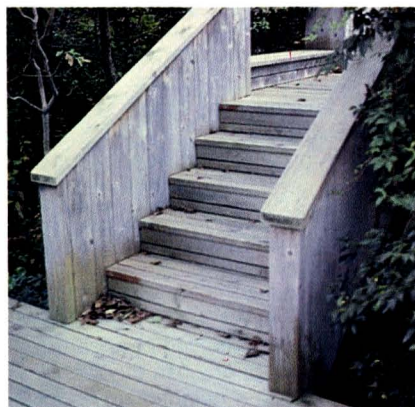
combined onto a single 24 by 36-inch sheet. You may want to draw them all on tracing paper to make it easier to refer to the large number of details. You can make lots of notes on 8½ by 11-inch paper and keep them with the detail drawings as part of your working drawing plan.

Stairs and ramps: Connections between deck levels, house and garden are usually made with stairs. If on your concept plan you have designed their location, you can now design their actual structure.

All steps have a riser and a tread. The riser is the height — the elevation difference from step to step — and the tread is the horizontal length or run. Stairs with a constant tread-to-riser ratio are comfortable to climb if the ratio is correct. Generally, the lower a riser, the wider the tread must be. A standard arrangement is 6-inch risers with 12-inch treads, but different formulas have been developed to calculate tread-riser relationships. One says two times the riser height plus the tread width equals about 26 inches. Using this system, a stair with a 6-inch riser would have a 14-inch tread [$(2 \times 6) + 14 = 26$]. A stair with a 4-inch riser would have an 18-inch tread [$(2 \times 4) + 18 = 26$]. Another

A steep little ramp can be very useful to the family that bicycles a lot.





system of calculating riser-run relationships says a tread times a riser should equal 72 to 75 inches. With this system, a 6-inch riser would have a tread of 12 to 12½ inches, and a 4-inch riser would have a tread of 18 to 18½ inches.

As you can see, there is a bit of flexibility in choosing riser-to-run ratios, but it is important to be constant. If you have several sets of stairs on your deck, keep them all uniform. Try not to have any risers less than 3 inches tall as they may become tripping blocks.

On your plan, calculate the elevation difference between levels. You may need to draw a scaled section as described earlier, based on your first elevation measurements, to figure out how big the drop is. You may even need to plan and design higher or lower levels for the deck to reduce or increase the number of stairs or the distance they need to cover.

If you have included a ramp in your concept design, draw in a stringer plan as you would for steps, but you won't need to show the risers or fasteners. No ramp should exceed a slope of 1:5 — that is, 1 foot of rise every 5 feet of horizontal distance. If you are planning access for wheelchairs or wheeled carts, you will want to make the slope as gentle as space allows.

Battered walls: You may be planning a series of battered walls between deck levels or fences. These are very steeply inclined walls or railings, and they can be handsome if handled with uniformity. Be sure, however, that your battered angle is great enough to be obviously intentional. A slightly battered wall can look disconcertingly like one that is falling over.

A battered wall can be cleated like a ramp stringer or built out of 2 by 4s and fence or siding lumber. If you are planning such walls, show them on your plan in detail. But first, develop an actual design on another piece of tracing paper and at a large scale — perhaps 1 inch = 1 foot. Draw the lumber to scale and detail how it will fit together. This will allow you to discover how much you will need as well as how to put it together. Study some already-built examples, if possible.

Stimulate your own ideas for stair, railing and bench design from this random selection of designs.



Railings and benches: If a deck is more than 36 inches above ground, railings 36 inches high are required by building codes in most areas. Railings are required only where the deck is that far above ground, but your design might be better if you continue a railing system to a corner or other logical stopping point. For residential decks, that part of the railing below 3 feet can have no opening larger than 9 inches. This allows considerable flexibility, for there are many combinations of boards and metal work that can meet this requirement. If you are not regulated by codes, you have greater flexibility and may decide to have a low bench as the railing, or an open framework with just a top rail at 3 or 3½ feet. Remember that a railing which cuts across the zone of sight may be less pleasing than one that leaves that area open.

Decide on your plan where you want and need railings, then with detail studies and by examining our examples on page 64 draw up your railing design.

Railings can combine with benches and walls to reinforce the planned use of space and the feeling of enclosure. You may want to enclose the side of a deck that faces a neighboring house with a 6-foot solid wall, and then drop the height down to railing level at a corner or other satisfactory point. If you want to fill in the space between deck and railing, leave a 3-inch gap at floor level every 10 or 12 feet for drainage and to sweep leaves through.

Your concept design may have called for benches that can be built into the railing. There are innumerable bench designs for decks, as illustrated here. Benches can be freestanding, bolted with vertical braces from the joists below, or hung off the railing supports with brackets or angle bars. An advantage of hanging benches from the railings is that there are no legs to impede deck cleaning.

Spaces under decks: If you are designing a deck that is sufficiently far off the ground to walk under, you may have some uses in mind for the underside space. Obviously, it may be fine to store pool and sports equipment, firewood, garden implements, deck furniture or perhaps the garbage cans. But what about a light well to



Railings and benches should be detailed on your working drawings — work out what they will look like and how they will fit together *before* you begin to build them.

the basement, a sauna, a fort for the children, heater and filter system for the hot tub or pool, or a laundry area?

On your layout plan, see if you can allow for this kind of upgraded use, surfacing the area as a lower deck or with a patio paving material.

Review your drawings and study again the ideas for detail components of your design — the stairs, railings, walls and benches — and other special requirements such as lighting, electrical outlets, sprinkler irrigation lines, outdoor heating, treatment of space below deck level, and connections to existing decks or patios. Draw details and make notes of them on your plan sheet, being sure that you have allowed for bracings, footings or other supports that the special features may require.

Recheck your joist, beam and post system, and once you have determined it is correct, trace the lines onto a clean overlay, label them and make notes as necessary.

Blueprinting your plans: If you have drawn the plan on good quality tracing paper, you can now have a blueprint copy made of it. It is useful to have 5 or 6 copies for purposes of applying for a variance, cost estimating and actual construction. To locate a blueprint company in your area, look in the yellow pages or call a local architect's office and ask them.

Patios: If your concept design called only for a patio, you can disregard much of the information about decks and structures just given. However, you'll still want to adjust your concept plan to use standard sizes and components of materials. You will need to select the materials, specify their color and work out their detail design on your working plan.

Making a dimensional plan: To start, make a dimensional plan of your concept drawing. Write in the lengths of each of the edges around the patio. You may have a wide choice of surface materials, as illustrated in the previous chapter. You can have patterns of brick, exposed aggregate, smooth concrete, stone, tile, wooden blocks, redwood rounds, asphalt, gravels, indoor/outdoor carpet or other materials. You may have located stairs or level changes in the design, and you may have raised planters as well as retaining walls as elements that define your space.

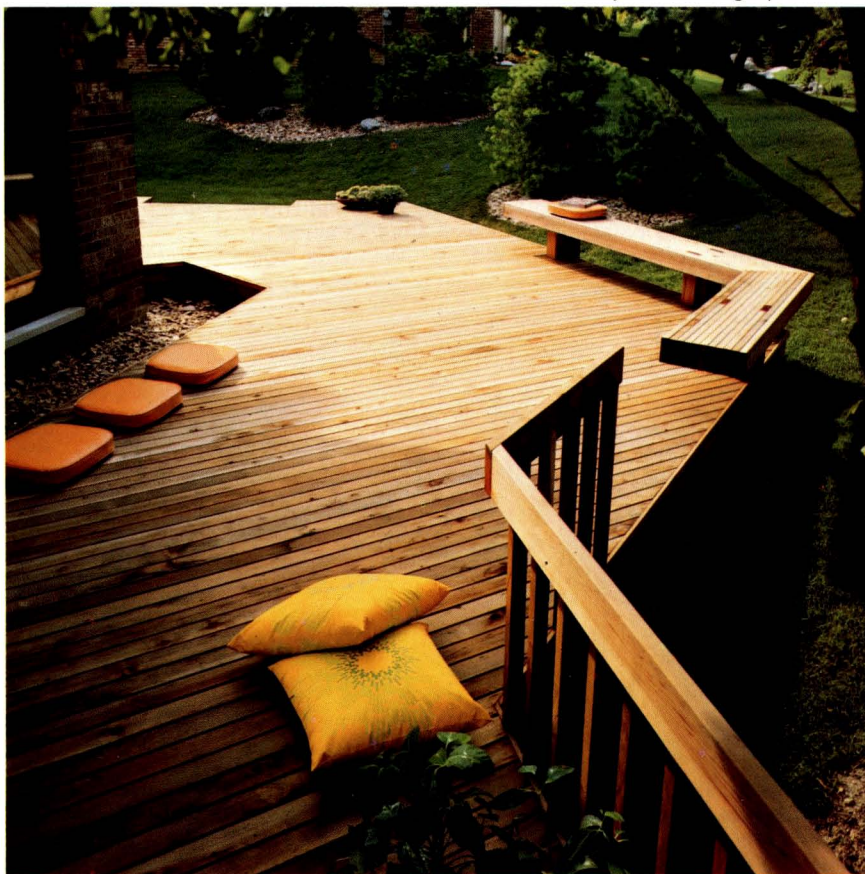
Complexities of angles and elevations are much easier to decide on paper than after you have invested in the materials.

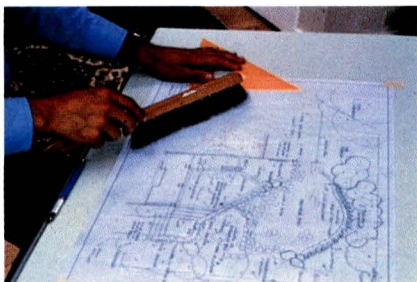
Drainage: Because part or all of a patio rests directly on the ground, you have to be more conscious of drainage and settlement of base materials than the deck builder. You don't want your patio to be flooded every time you hose it down or when it rains or if it settles irregularly.

On your concept plan you noted where natural drainage occurs. You should also have noted any low points on the site that need to be raised to drain well. As you do your working drawing, decide how you will draw the flat surface of the patio. Actually, the surface should slope slightly away from the house — $\frac{1}{4}$ inch per foot — toward a planting area or a drain outlet.

If drainage is a great problem, see page 93 for possible solutions.

Draw drainage details on an overlay, and label it as your drainage plan.





Co-author Lin Cotton finishes his final working plan for a deck design.

Checking your patio plan: Trace your patio working drawing onto a clean overlay, labeling and detailing with close care. Try to outdo us in anticipating as many of the problems you will encounter during construction as possible, and note your decisions on the plan and details.

Adding on to old decks and patios: If you are making an addition to an existing deck or patio, there are several things you should check out as you create your design.

Be sure that the old structure will last long enough to warrant being left. In some cases, decks may not show signs of rot on the surface but when you look at the footings, posts or joists, you will find advanced rot. Be careful not to limit your new design by an older structure that will need to be replaced in a year or two.

Another problem is blending the textures of new and old materials. If you have a patio surfaced with exposed aggregate slab, try to copy the

aggregate color and size in the new paving. If you are adding on to a deck, consider staining all of the decking, new and old, to blend. You may need to sand the old deck before staining, or match its new color with a specially mixed stain.

Most important, though, be sure that you aren't limiting your design directions in order to save a bit of old patio, and by doing so, precluding the development of outdoor rooms you really want. In some cases it is better to tear down the old structure.

Critical path: Before you begin construction on your now designed deck or patio, map out the critical order of events that you will have to follow in the construction. Often called the **critical path**, this organization of the project will be a list of every task and the order in which each should be started and finished. For instance, if you are building a deck, you will need to order the lumber before you start to dig the footings if you want it to be delivered when you need it.

Anticipate the construction process and problems and map it out for the smoothest job.

With your thoughts and plans fully

worked out on your drawings, you are nearly ready to begin construction, following your critical path of activities, ordering materials in time for them to be delivered when you need them, and phasing this work to avoid stalling one aspect of the project because of something you should have done before.

But there are still lots of decisions to be made in the actual selection of materials. Your plans like a road map, will guide you along, but at many a juncture, you will have to find solutions to problems that arise which you didn't consider in the planning phase. You will have to put on many hats for the construction phase, being not only carpenter, but also laborer, electrician, plumber, surveyor, bricklayer, stonemason, and gardener.

As you go to the suppliers, look out for quality materials, and be careful to specify exactly the materials you want. For both decks and patios, you will want to select the lumber. For a patio you will need relatively little, but even redwood benders can be good or bad. It is best to hand select what you need so that you don't get split or knotty pieces. For decks, of course, lumber selection will be very important since lumber is the main material and the quality you use will greatly influence the look and strength of the final structure.



Decks can give you access to formerly unusable sites, improving your enjoyment of your property. When combined with patios, you can develop a series of outdoor rooms with great potential for spacious living.

List of events for designing and building a deck or patio

- Observe all sites
- Select the site
- Consider texture, color, perspective, connections, and forms
- Consider temperature, noise, wind, sun, shade and human scale
- Draw and refine the base plan and concept design
- Draw the working plan
- Estimate material needs
- Select materials
- Construct the deck or patio
- Enjoy the deck or patio

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