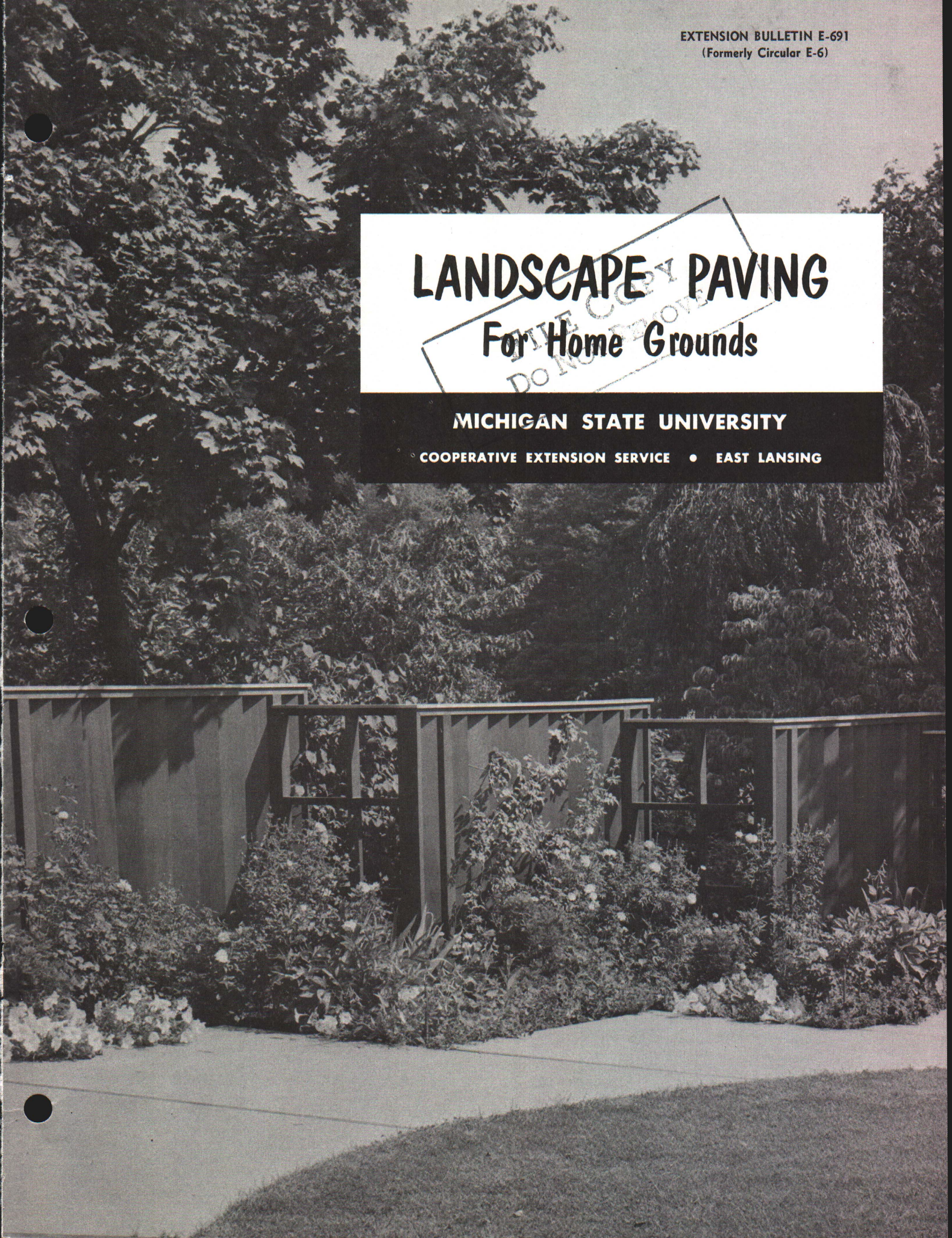


LANDSCAPE PAVING For Home Grounds

MICHIGAN STATE UNIVERSITY

COOPERATIVE EXTENSION SERVICE • EAST LANSING



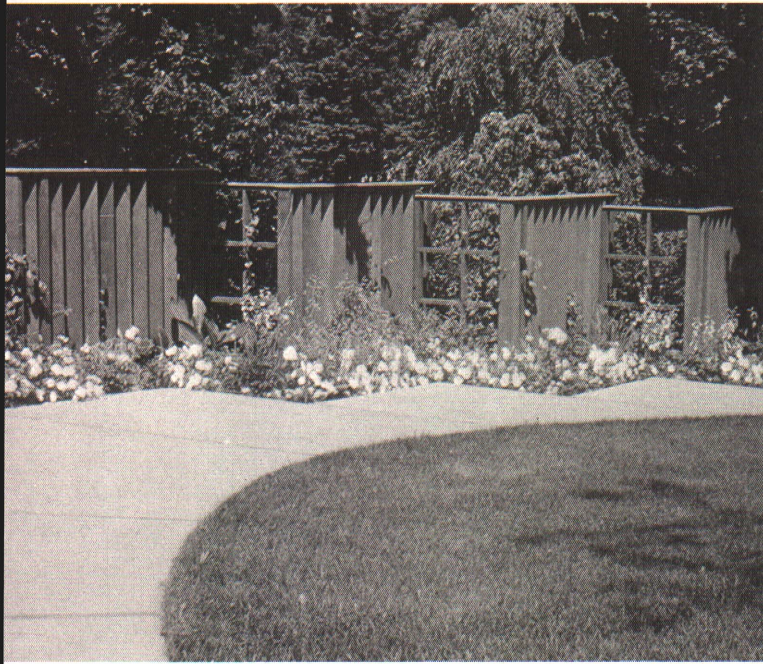


Fig. 1. A walk can complement the beauty of our lawns and gardens.

LANDSCAPE PAVING

For Home Grounds

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TABLE OF CONTENTS

	Page
Foreword	3
General	3
Drainage	4
Grading	4
Asphalt	5
Brick	8
Concrete	11
Flagstone	17
Aggregates	19
Tile	21
Wood	22

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Foreword

Asphalt and concrete are taking over much of the area around us these days, and we long for the sight of an unbroken expanse of turf, highlighted by the color of flowers and shrubs. Our home grounds, parks, and playfields can offer a welcome contrast to our well-paved surroundings.

But even around home, the need for driveways, paved play areas, and sidewalks cuts into the available area for grass, flowers, and other growing things. Because of this, we have a great need for inconspicuous, interesting forms of paving. Even a sidewalk can complement the natural beauty of our lawns and gardens (Fig. 1).

To help the people of Michigan beautify their home grounds, this bulletin presents highlights and construction pointers on some of the more important paving materials.

General

No one type of garden paving will suit your every need. Each has its good and bad points. Low cost or ease of installation, for example, may result in expensive upkeep or rough surface. List the weak and strong points of available materials, then choose one to best fit your needs (Fig. 2).

Guide to Home Paving Materials

WHAT PAVING TO CHOOSE ?
• • • CONSIDER THESE POINTS

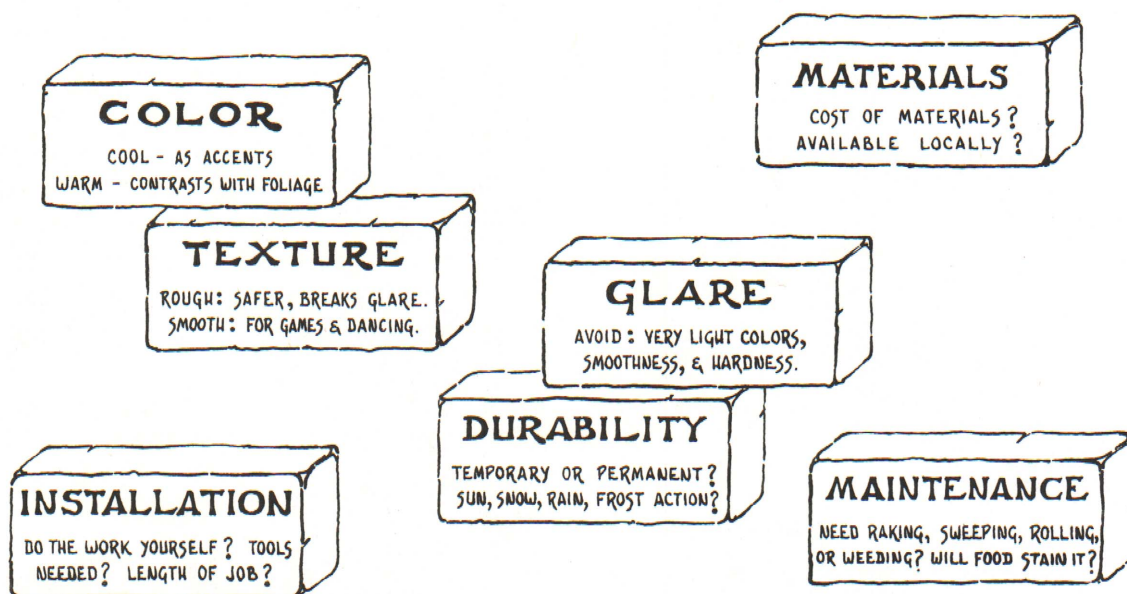


Fig. 2

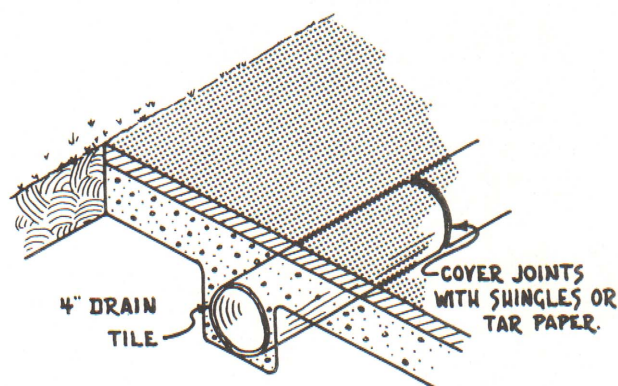
Drainage

Paved surfaces need a firm foundation to keep their original form and slope and to prevent cracking or heaving. A carefully prepared sub-base of stone or gravel and, possibly, tile lines will provide this foundation.

Some soils are stable, well drained, and do not require any advance preparation. However, this is the exception rather than the rule. When in doubt, provide a good sub-base. This will prolong the life of the paved surface and save the extra work of resetting heaved areas or patching cracked portions. In areas of poorly drained soil or where the climate is one of heavy rains, snow, or frost, provide drainage under paved surfaces.

A base of rock, gravel, or sand (or a combination of these) usually allows water to drain off from under the paving and prevents frost heaving of the surface. In most cases, a sub-base of from 3 to 9 inches provides the necessary protection.

If, despite a prepared sub-base, you expect water to collect under a paved surface because of soil conditions or land form, install drain tile lines under the center or around the edge of the paving. Lay drain tiles 3 or 4 inches in diameter with joints unsealed about 1 foot deep. Cover joints loosely with tar paper to keep soil out of the pipe, and backfill the trench around the pipe with gravel (Fig. 3). Run the tile lines



USE DRAIN TILES
FOR SUB-SURFACE DRAINAGE . . .

Fig 3

to a natural swale, a stream, a storm drain, or a nearby dry well. The line should drop at least 1 foot in 100 (1 percent), although a flatter grade is permissible. However, as the grade decreases it becomes harder to lay the tile line at a constant slope.

Grading

Although most paved areas look level, every paved surface must tilt to some extent for surface drainage. ONE PERCENT IS CONSIDERED THE MINIMUM SLOPE FOR UNIFORMLY PAVED SURFACES, although, as with the tile lines above, a flatter grade is allowable. Paving which has a slope up to 3 percent (3-foot drop per 100 feet) looks flat to most people. Beyond 4 or 5 percent, the slope becomes too noticeable for use in terrace, patio, and game court paving. Naturally, walks and drives will exceed these figures in many instances.

Paved surfaces can be drained as a flat sheet so that water runs off all along the low end. Or they can be humped, allowing water to run off to all sides from the middle. In some paving, the middle dips and the water runs off along the low center.

Before the actual paving operation begins, establish grades by setting out stakes at regular intervals in the area to be paved. Using a level and a line, mark out points which are the same elevation on each stake.

From these points, measure down the required number of inches to allow for the surface pitch (Fig. 4). These marks on the stakes represent the finished level of the paving. From them, dig down to the correct depth, allowing for the thickness of the paving material and depth of the sub-base.

If possible, plan and install utility lines before you begin paving. Plan for sanitary sewers, storm drains, tile lines, water pipes, gas lines, and electrical conduits. This will save time and money, and will eliminate the unpleasant task of digging up pavement for a utility line later.

ASPHALT

Most people think of asphalt paving for roads and driveways only. However, it has value as a landscape paving and should be considered along with the other paving materials. Many landscape designers now use asphalt paving effectively in terrace, walk, and service area designs, as well as in driveways. (See Fig. 5.)

Asphalt paving has a smooth, dark surface that is most effective in small areas or broken up by wood dividers, brick, or concrete. The contrast with other paving materials, dividers, turf, plantings, and especially flowers, gives the garden a sharpness of line and combination of colors sometimes lacking in other garden paving. The more recent coloring or painting of asphalt surfaces opens the door even wider to its use in all areas of the garden.

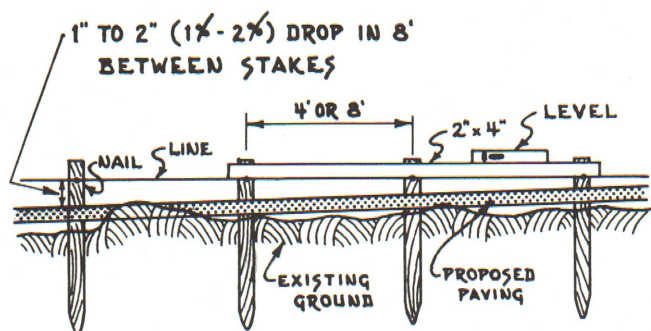
ADVANTAGES AND DISADVANTAGES

The low cost of blacktop or asphalt paving is one of its outstanding virtues. Brick, tile, concrete and flagstone cost more per square foot. For this reason, the homeowner can afford to pave larger areas with it for a given sum of money. It can be placed fairly quickly and

used soon afterward for light traffic. (Concrete would come closer to the same cost if the owner did his own mixing and pouring, because asphalt is usually contracted.)

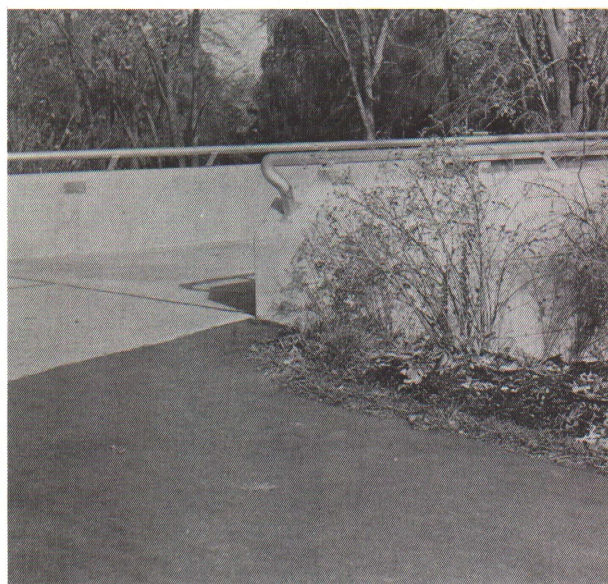
A good, stable base of gravel or stone is necessary because any shifting due to frost or water action will cause "bird bath" sags and cracks. However, these are easily repaired. With a good, firm base and an adequate topping of asphalt, the surface should be as durable as concrete.

In warm weather, asphalt paving may soften and, unless it and the base are properly prepared as mentioned above, garden furniture may leave its mark. Today, asphalt companies have perfected their product to the point that softening is not the problem it used to be. Asphalt paving becomes very hot in the sun and can burn or hurt bare feet. A hosing will quickly bring it back to a usable condition.



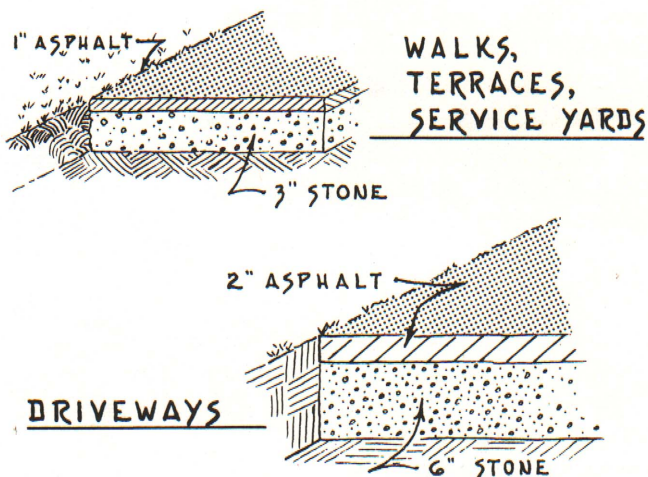
FOR DRAINAGE SET OUT STAKES
TO INDICATE FINISH GRADE . . .

Fig 4



DESIGN: M.S.U. Site Planning Office

Fig. 5. Asphalt paving blends well with adjacent planting border, and in the role of secondary paving, helps emphasize the main concrete walk.



BLACKTOP MINIMUMS . . .

Fig. 6

Asphalt paving does not reflect heat or light as do some of the other paving materials. In winter, the absorption of heat from the sun aids melting of ice and drying of the surface.

Some upkeep will be needed if weeds push their way through. Just covering an area with gravel and asphalt will not prevent the germination of seeds. Sterilize the soil (common rock salt is good) before paving and after removing the existing topsoil. To keep the edges of asphalt paving from crumbling, use header boards, bricks, or some kind of edging to contain the material.

GENERAL DESCRIPTION

Asphalt is used primarily to seal and waterproof the rock and gravel. It is a semi-liquid that is applied either hot or cold. It becomes solid when exposed to the air.

"Cold-mix" asphalt paving is a mixture of aggregates and liquid asphalt which hardens by drying out. The liquid asphalt is thinned by light, volatile oils (cutback asphalt) or kept in solution in water by means of an emulsifying agent (emulsified asphalt). When the liquid is poured over the aggregate and these liquefying agents evaporate, the asphalt is left to bind together the aggregate.

"Hot-mix" asphalt is heated at the plant, then poured over the aggregate at the job. It is a liquid that penetrates and coats a crushed rock

mixture, binding it all together as it hardens during the cooling process after being put in place.

Hot-mix paving is usually mixed at the plant (plant mix) and placed and compacted at the job. Most cold-mix pavings are mixed at the job.

Apply a general "rule-of-thumb" to the depth of topping and sub-base (Fig. 6). Walks, service yards, and terraces should have a minimum topping of 1 inch of paving. You can save some money by applying it only one-half inch thick, but consider the problems of smoothness, uniform thickness on a stone base, and the extra time required in laying.

Topping for driveways or for any area that will carry heavy weight should be at least 2 inches thick. The sub-base for drives should be at least 6 inches thick, and 3 inches are needed for walks and terraces. This base layer should be composed mainly of crushed stone 1 to 1½ inches in size, with a compacted layer of stone ½ inch in size to fill the empty spaces.

CONSTRUCTION

Usually, the hot-mix asphalt pavings are best left to a contractor who has the equipment and know-how for applying the mixture smoothly and safely. Let the contractor apply both hot- and cold-mix if the areas are large. For small areas where hand tamping can be done or a small power roller used, the cold-mix may prove satisfactory to the home handyman.

The use of a rapid-setting emulsified asphalt might be the first to consider. Apply the emulsion to the compacted sub-base with a portable spray outfit, or pour it from a watering can. Apply at the rate of 1 or 2 gallons per square yard. Follow a day later with a light coating of asphalt emulsion, then cover with sand or pea-gravel and roll. Continue this treatment until you have a smooth surface. Roll repeatedly during the curing process.

Another cold-mix method follows the same steps, but cold plant-mix is used in place of the emulsion asphalt described above. Spread it on the crushed rock base and rake smooth about 1 to 1½ inches deep. Sand or pea-gravel topping, plus repeated rollings, will give a smooth surface.

The cold plant-mix paving is very slow-curing. It can be walked on, but heavy objects will leave marks during the first 4 to 6 months. Apply in the late summer or fall so it will cure over the winter.

MISCELLANEOUS

ASPHALT-CEMENT—Another type of durable asphalt paving is asphalt-cement. It is a combination of asphalt and cement which pours like concrete, dries out to a hard, compact asphalt surface, and is not as heavy to handle as concrete. It is a mixture of 6 parts sand, 9 parts crushed rock, $2\frac{1}{2}$ parts asphalt emulsion, and 1 part cement.

Mix the asphalt-cement by adding water until thin enough to pour. Do not add so much water that it becomes soupy or the asphalt will settle to the bottom of the mix when poured on the sub-base. Use a trowel to finish off the surface after pouring.

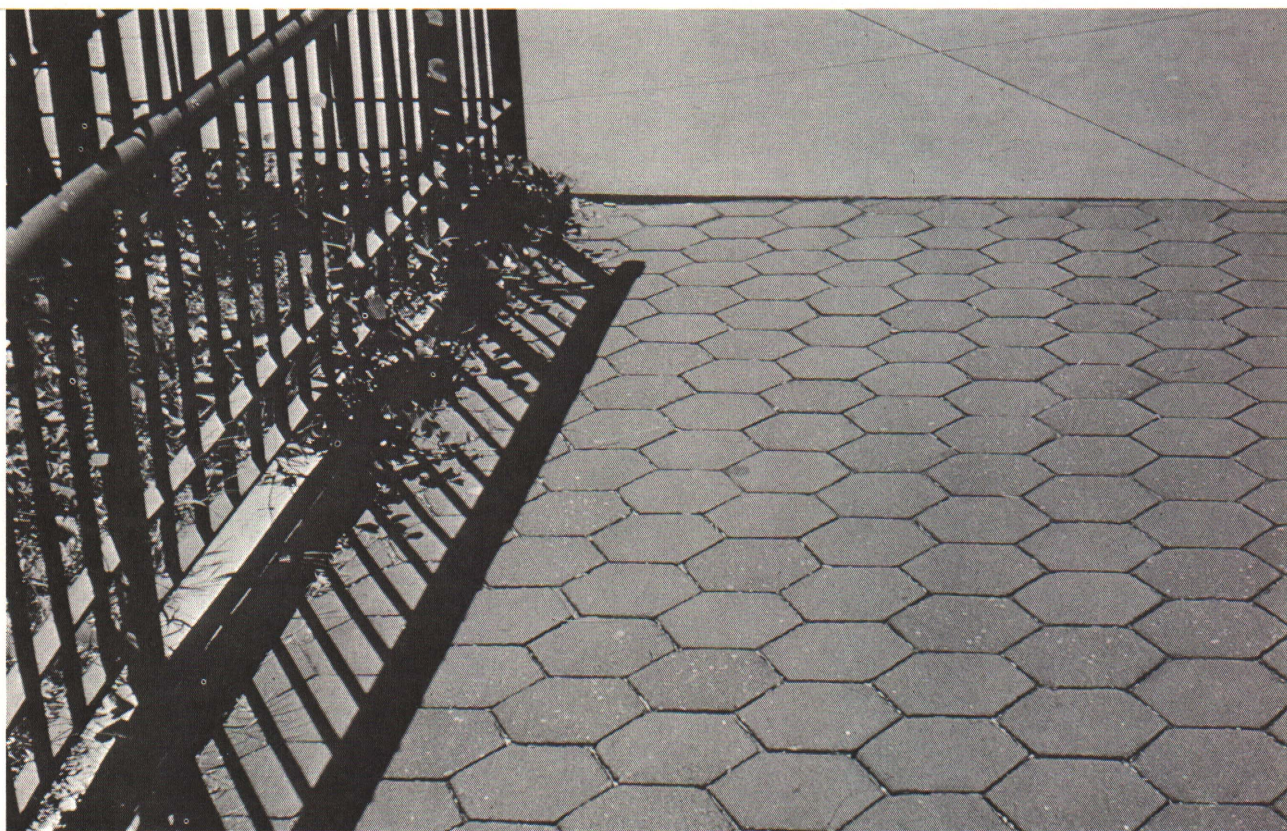
The base should be 4 to 6 inches of crushed rock, with the top portion of sand to fill in the

spaces and give a smooth surface. Divide the area into squares by means of header boards set at the level of the finished grade. This not only adds a pattern to the surface, but it makes it far easier to apply the asphalt-cement in areas of workable size.

Dry-Mix—In some parts of the country, a dry-mix product of gravel and emulsion is on the market. You can add water, or use cement and water if you want an asphalt-cement paving.

Blocks—Asphalt blocks are sold by some paving companies. It is an effective means of paving with asphalt since it gives more pattern and texture than does a smooth blacktop surface (Fig. 7).

Color—Now you can add color to asphalt surfaces so that tennis courts, walks, and terraces no longer have to be black. You can paint it on after the paving is laid, or have a top layer of smooth, colored armor-coat asphalt mix applied. This is done by commercial firms using various trade names for their products; it is most often seen in tennis court paving.



Columbia Heights Park, Brooklyn, N.Y.

Fig. 7. Pre-cast blocks add interesting line pattern to blacktop paving.

BRICK

Brick is perhaps the oldest artificial building material in use today. It is a fairly permanent material, somewhat like stone in its capacity to withstand fire and changing climatic conditions.

As a paving material for residential use, brick is one of the best that the do-it-yourself handyman can choose. The wide range of colors and paving patterns (Figs. 8 and 9), and the ease of installation, plus the fact that mistakes are easily corrected, makes it the favorite of even the most amateur weekend gardener.



DESIGN: M.S.U. Site Planning Office

Fig. 8. Brick paving set in mortar, using a herring-bone pattern.

ADVANTAGES AND DISADVANTAGES

Brick paving is quite easy to install if you lay it on a sand base, but do it in easy stages.

The sand base will often cause an uneven surface after the winter thaw; you can easily correct this by resetting the heaved area. Brick on a concrete base will give a durable and level (though harder to install) surface.

You can buy bricks in a variety of warm colors that blend well with other garden colors. Their texture offers a contrast to smooth paving and architectural features as well as providing a fairly slip-proof surface (poor for dancing). However, some of the smoother type bricks and moss-covered surfaces are quite slippery in a damp location. The texture of the bricks greatly reduces glare.



DESIGN: M.S.U. Site Planning Office

Fig. 9. Shown here is a three-brick basket weave pattern used to edge a concrete walk.

Because bricks hold moisture, they are cool when wet. They absorb oil and grease readily and do not clean easily. The thawing and freezing of a Michigan winter will cause some of the softer type bricks to crumble.

Weeds and grass grow easily in the joints between bricks—ideal if planned that way, but otherwise an upkeep problem.

GENERAL DESCRIPTION

The raw material from which bricks are formed usually comes from surface beds of clay or shale. These beds are found all over the world. The clays of each area are so different that bricks vary considerably in color, even in a single brickyard. For this reason, order all the bricks for one job from one batch at the brickyard. Their next run of bricks may be a bit off the color you have chosen.

The two types most commonly used for outdoor paving are rough-textured “common” brick and smooth “face” brick. (Some common brick is fairly soft and does not stand much freezing.) Another face type, “Roman” brick, is used by some people because of the difference in size and shape (Fig. 10).

“Paving” bricks are sometimes used for residential purposes. These are very hard and durable, being made under pressure, and come in regular lengths. This brick was used widely in the street paving of some of our older cities and towns. Because of their higher cost, plus their association as a street material, they are not recommended very highly for residential paving.

CONSTRUCTION

If you are a beginner, a sand base is the best foundation material. You can correct mistakes in grade, brick alignment, and pattern quite easily. Brick-on-sand is used by many experts as well as by amateurs. Brick on a concrete

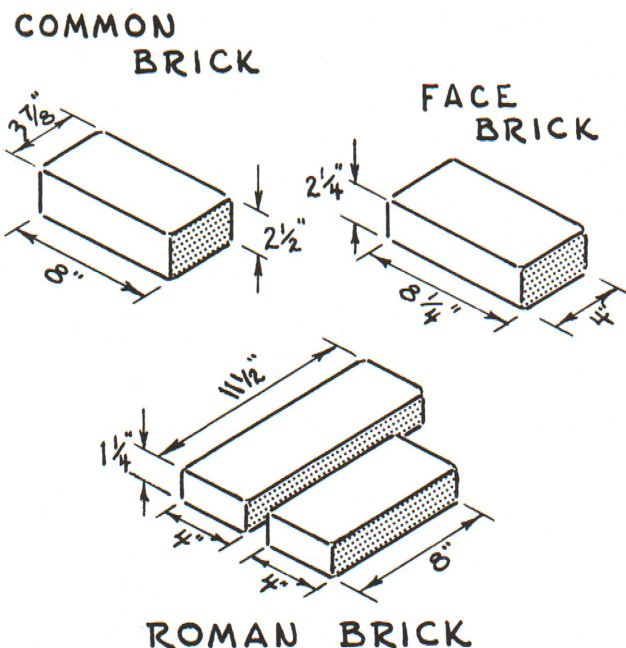
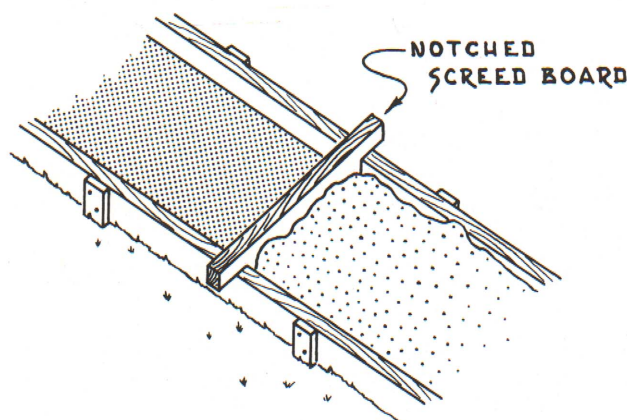


Fig. 10

or mortar base requires more care in laying and costs more, but it does give a stable, permanent job.

Grade the soil to the desired slope; put down a 1- or 2-inch layer of sand, and place the bricks in the desired pattern on the sand. If an unstable soil condition exists, use a 3-inch base of crushed stone with the sand on top. However, most brickwork is laid on a thin layer of sand only.



LEVELING THE SAND BASE . . .

Fig. 11

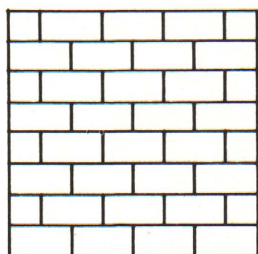
For walks and terraces, set up header boards to the desired finished grade. If the area is large, use stakes or dividers as well as header boards to set the grade. Then use a notched screed board to smooth the sand base to the desired level (Fig. 11). Cut the notch to the depth or width of the bricks, depending on whether you are going to lay the bricks flat or on edge. Place the bricks on this leveled sand. After the brick paving is laid, spread sand on it and sweep into the joints between the bricks.

If you want a more stable brick paving, use a concrete sub-base. Pour 2 to 3 inches of concrete on a 6-inch gravel base. After the concrete hardens, this provides a permanent base on which to lay the bricks in mortar.

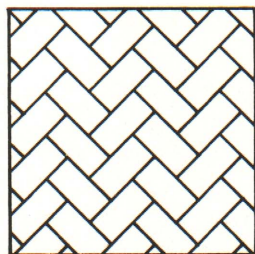
Bricks on a mortar bed with mortar-filled joints require great care in laying. Practice on a small area, such as a walk, before undertaking a terrace or drive. Mistakes are not as easily corrected as when a sand bed is used.

MISCELLANEOUS

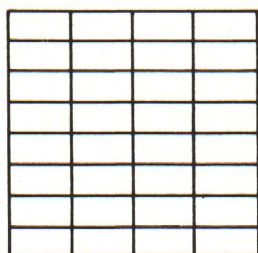
Pattern—You can work out many patterns to give interest to a paving job. It is best not to use too complicated a pattern. A simple basic pattern used throughout has a repetition of line that can tie the area together. Fig. 12 shows the four paving patterns most commonly used by landscape designers.



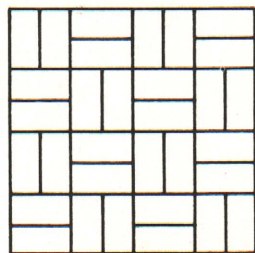
RUNNING BOND



HERRINGBONE



IN-LINE (JACK-ON-JACK)



BASKET WEAVE

Fig. 12

Joints—You can lay bricks tight against each other or with a joint of about $\frac{1}{2}$ inch. The joints allow for any differences in the size of individual bricks, thus making a more professional-looking pattern. The spaces allow you to use a variety of joint materials.

Sand, grass, and mortar are the most common joints seen in brick terraces and walks. You can mix 1 part cement with 3 parts sand, sweep the dry mix into the joints, and sprinkle the whole area with a hose to combine the advantages of using all sand with those of mortar binders.

Edging—set the bricks on the outside edge of a walk or terrace in concrete. This gives a stable edge to the area of paving and, if the base is sand, helps keep the whole job in place. Or you can set header boards flush with the paving to act as the outside retainers (Fig. 13). You can use wood dividers throughout a terrace area to give added interest to the brick pattern. Divider strips of concrete with bricks set in the spaces between make another interesting paving combination.

More and more people are finding concrete the answer to their garden-paving problems. (See Figs. 14 and 15.) Because of its wide range of colors and textures, it has the greatest variety of uses of the residential paving materials.

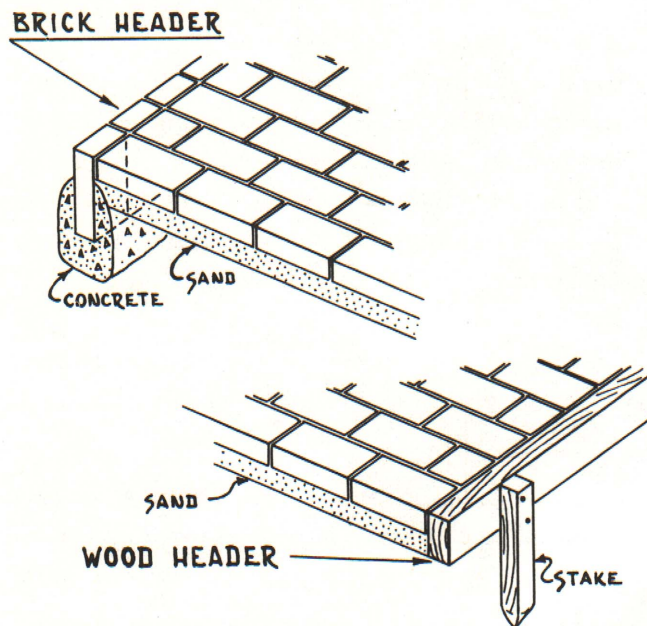


Fig. 13

CONCRETE

Being a plastic material, concrete can be made to take almost any form. Add to this its fairly low cost and ease of handling in small batches by the amateur, and you can see why it is being used so widely in residential work.

ADVANTAGES AND DISADVANTAGES

Concrete is a durable material. However, if not properly mixed and handled, it will crack. It sometimes buckles on a poor foundation. Some people consider it an easy material with which to work, while others consider it difficult due to its weight, the special equipment needed, and the speed with which it must be handled before it sets.

This necessary speed means that many jobs must be done quickly, not stretched over many weekends, as is possible with brick surfacing. The material is not too expensive, although header boards and wood forms bring up the cost. Concrete may develop "bird bath" sags and is hard to patch.

You can finish concrete in a smooth or rough texture. The smooth surface is easy to clean

and polish, and it is good for games as well as dancing. It has quite a bit of glare. The rough-textured surfaces provide more traction and less glare. However, they are harder to keep clean, showing food and oil stains quite easily.

Concrete gets hot in the summer, but it is porous and will remain cool for a while after hosing. You can add a variety of colors before or after the mix is laid. Special treatment is necessary if you want a broom finish, exposed aggregate, or other texture.

Perhaps concrete's biggest drawback is its hard, commercial look. Despite its many possibilities of color, form, and texture, some people steer clear of concrete for that reason. But the continued appearance of concrete in the designs of some of our leading landscape architects is doing much to overcome this objection.



DESIGN: D. Newton Glick

Fig. 14. Wood dividers and planters give added interest to this concrete terrace.



DESIGN: Thomas D. Church

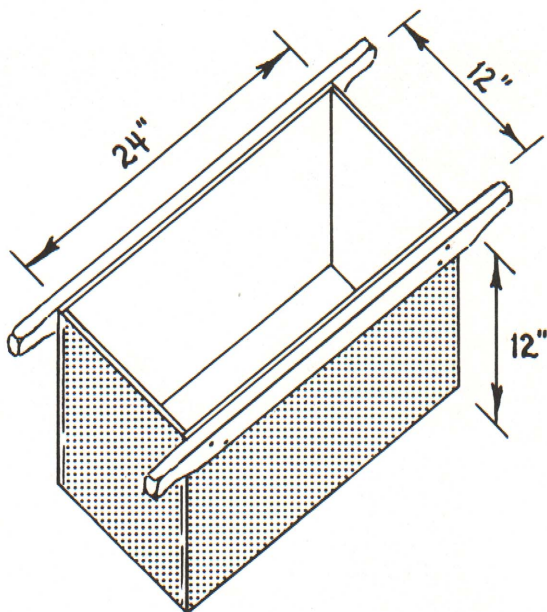
Fig. 15. Concrete terrace and garden paving effectively join the house and garden areas.

GENERAL DESCRIPTION

Concrete is composed of cement and rock particles which, when mixed together with water, harden into a rocklike mass. The process of hardening is a chemical reaction between the cement and water known as "hydration." A considerable amount of heat is released during this process. You can do a better job of curing concrete if you remember that the hardening is not a "drying" process. (See Curing, page 15.)

Concrete is mainly made up of coarse aggregates, fine aggregates, cement, and water. The coarse aggregates are the pebbles and stone which give concrete its strength; they form the biggest part of the mix. They can range from 6 inches in size down to $\frac{1}{4}$ inch, depending on the particular job in which they are being used. Use hard stones, such as granite, rather than soft, flaky stones. Gravel up to $1\frac{1}{2}$ inches in size is sufficient for most home uses.

Some of the aggregate sold in certain areas of Michigan is quite porous. It absorbs moisture and freezes in winter weather. Freezing cracks the aggregate, leaving the concrete with an undesirable pitted surface.



MEASURING BOX . . .

Fig. 16

The fine aggregate fills the spaces between the coarse aggregates to form a solid mix. It is graded down from one-quarter inch in size to tiny particles. Most commercial concerns sell only one or two grades of concrete sand recommended for home projects. All aggregates should be clean and free of soil and organic matter.

Portland cement is the active ingredient in concrete. It serves as the glue that coats the surfaces of the aggregates and binds them together. The standard cement sack contains 1 cubic foot.

For a concrete mix, use any water pure enough to drink. It combines with the cement to form the gluelike mixture and makes the whole mix workable. Add water carefully because too much will weaken the concrete.

CONSTRUCTION

Tools and Equipment—For hand mixing, you will need a smooth, hard, watertight surface. A mortar box or old oil drum cut in half lengthwise will do. A square-pointed shovel or hoe and a measuring box fill out the basic mixing equipment.

The measuring box is for the aggregate. It should be without a bottom, the measuring being done right on the mixing surface, and should have a capacity of 1 or 2 cubic feet. A box 1 foot square holds 1 cubic foot of material, while the box shown in Fig. 16 holds 2 cubic feet. A wheelbarrow is handy for moving concrete to where it is to be used. You can mix small amounts of concrete right in the wheelbarrow.

You can rent powered mixing machines in most areas. The saving in labor is well worth the rental cost.

Transit-mix concrete is available within reasonable distance of concrete plants. This is the concrete that is delivered by truck to the site ready for placing. You need only finishing tools. This service saves much of the labor of mixing and carrying, and it usually results in a more even, better grade concrete finish.

Mixing and Placing—You can get concrete in several ways. You can buy the cement, sand, and gravel separately and mix them at the job by hand or machine. Some companies sell sand

Fig. 17. The terrace of this residence is of concrete with a grid pattern of flush 2 x 4 inch dividers.



DESIGN: D. Newton Glick

and gravel mixed; the cement and water are added at the site. Another method is to buy dry-mix concrete, a mixture of aggregate and cement, sold in 98- to 100-pound bags by most building supply yards. Water is added on the job. Lastly, the transit-mix concrete delivered by truck is premixed and comes ready to pour.

In mixing, be careful to completely cover the aggregate with the cement-water paste. Machine mixing gives the most uniform batch. For hand mixing, work the dry cement and aggregate until it has a uniform color, then gradually add water until the mix has the desired thickness. Place concrete as soon after mixing as possible. It begins to set in about 45 minutes; never let it stand that long before placing it in the forms.

The thickness of garden paving varies from a minimum of 2½ inches up to 4 inches. Areas that will carry a load (such as driveways) should be 6 inches thick. A foundation of 3 to 6 inches of crushed stone is needed unless a stable soil condition exists.

Mixes—The proportions of a mix vary according to the type of construction. The ratio of water to cement is very important in making durable concrete. The formula recommended for garden paving, driveways, and pools is:

- 1 100-pound bag cement
- 2¼ cubic feet sand
- 3 cubic feet of stone (1½ inches maximum size)
- 5 gallons water (approximate)

If some part of your garden work requires a mortar bed or joints (as in brick paving), the mix is one part cement to three parts fine sand

and two parts hydrated lime. There are no coarse aggregates in mortar.

You may want a smooth surface finish. Apply "finishing concrete" with a trowel before the regular concrete sets. It is a mixture of one part cement to two parts sand with only enough water to make the mix workable.

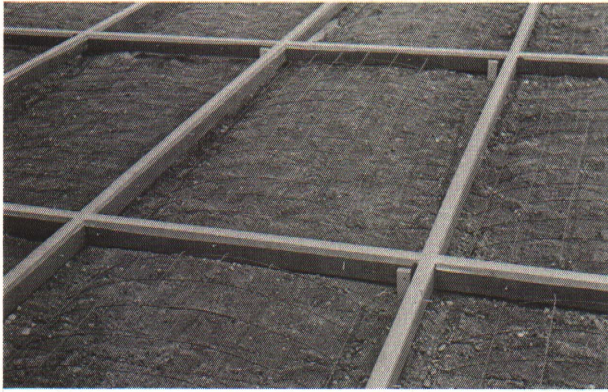
In figuring the materials needed, remember that a given amount of concrete is **not** equal to the volumes of the dry materials added together. The mix usually amounts to slightly more than the amount of coarse aggregate. The fine aggregate, cement, and water fill the spaces between the coarse aggregate. To obtain 1 cubic yard of concrete (3 feet by 3 feet by 3 feet), following the formula given above, use these amounts:

- 1:2¼:3 mix 6¼ bags cement
- 14 cubic feet sand
- 19 cubic feet stone

A cubic yard of finishing concrete, at a 1:2 proportion of cement and sand, requires 12 bags of cement and 24 cubic feet of sand.

Grading and Forms—Grade the ground to the desired subgrade level. Remove all roots, stones, and debris. Place wooden header boards with their tops level to the finished grade. Brace them well with stakes so the liquid concrete doesn't push them out of place.

If the area is large, make work easier by blocking it off into smaller squares with wood dividers. Remove them after the concrete has set, or leave them in place to provide some interest and pattern to the paving (Fig. 17). Oil the temporary header and divider boards with light lubricating oil to prevent the concrete



DESIGN: D. Newton Glick

Fig. 18. The wood dividers are covered with masking tape to prevent staining by the moist concrete. Note the galvanized nails used to hold the wood in place after the concrete sets.

from sticking to the forms. If these boards are going to be left in place, use redwood, cedar, or some other rot-resistant wood.

Keep the permanent dividers and headers from being stained by the wet concrete during pouring and finishing by placing masking tape along the top wearing surface (Fig. 18).

To help keep boards in place you can drive nails into the sides of the divider boards and let them protrude. When the concrete sets around the nails, it holds the boards in place. Some people leave out the nails so they can replace the wood if it decays. However, the concrete shrinks away from the wood when it sets and, in a cold climate, the loose boards are likely to work their way above the surface.



Fig. 20. Too much trowelling to obtain the finish can weaken the surface and cause flaking or spalling.

Place the gravel sub-base in the squares between the forms, press it down, and pour the concrete mix on top. Doing the paving in squares allows you to take on only enough area for the amount of concrete you can mix in one batch.

Finishing—You can finish the surface of the concrete in a number of ways. Some of the special finishes will be mentioned later. The basic finish, called **screeding** or leveling, is the striking off of the excess concrete above the forms (Fig. 19). Use a flat piece of lumber, moving the board with a sawing motion while pushing it forward.

Do nothing more until the concrete has begun to set. Apply the final or special finish after the set begins but while the concrete is still workable.



DESIGN: M.S.U. Site Planning Office

Fig. 19. Screeding the concrete is the first step after it is poured in the forms.



DESIGN: M.S.U. Site Planning Office

Fig. 21. Floating the surface smooths the concrete.

Curing—The important point about curing concrete is keeping the surface moist. The hardening process is **not** a drying process. Moist-curing for about 7 days is best. Spread burlap, canvas, straw, shavings, or sand in a layer over the concrete and sprinkle at intervals to hold the moisture. In freezing weather, protect the concrete with heavy paper covered by 1 foot of straw to prevent freezing.

MISCELLANEOUS

Special Finishes—Concrete surface finishes cover a wide range of textures. They vary from the smooth, slick finish to the rough, pebbly surface.

(1) **Smooth**—Use a steel trowel to smooth the surface. The best time is when the concrete begins to set and the water sheen has left the surface. If done earlier or trowelled too much, the top part of the concrete will be weakened; it will tend to flake and chip off (Fig. 20).

(2) **Wood Float**—A mason's wooden trowel provides a slightly rougher "smooth" finish (Fig. 21). The concrete is finished the same way as with a steel trowel, but the surface has a bit more grain or texture and is not slick.

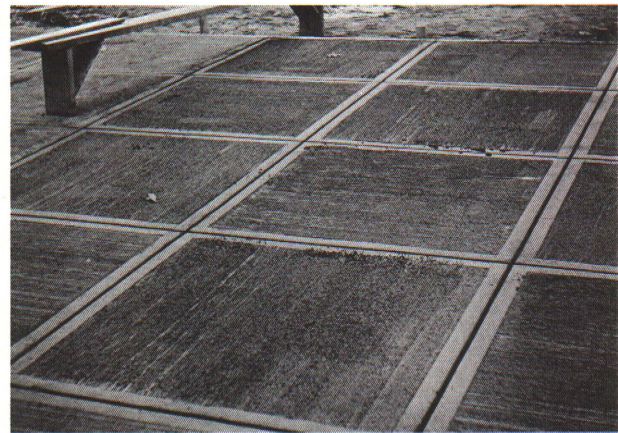
(3) **Broom**—A straw, steel, or hair broom will give a variety of textures if pushed over the still-soft concrete surface. (See Figs. 22 to 24.) The ribbed finish provides good traction and cuts glare considerably.

(4) **Exposed Aggregate**—A pebbly surface will fit in better with a natural setting than any of the other concrete finishes. Expose the aggregate near the surface of the concrete by



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Fig. 22. The man with the broom puts the brushed texture on the surface, while the other is using a jointer tool to smooth the joint edges.



DESIGN: M.S.U. Site Planning Office

Fig. 23. Surface finish applied with broom and jointer tool.



DESIGN: Harold Breen

Fig. 24. This walk is made of pre-cast concrete blocks, with a broomed surface finish.

brushing the surface with a stiff broom or wire brush while you wash the surface with a gentle stream of water. This removes the cement and sand mortar, exposing the large aggregate. Do



At Lincoln Memorial, Washington, D. C.

Fig. 25. Shown here is a pebble finish; flat stones pressed in the moist concrete.

only small areas at a time so that the concrete does not set up before you brush the whole surface. If done too soon, the pebble aggregates may come loose during the brushing or hosing.

(5) **Pebble Mosaic**—This is a variation on the exposed aggregate; patterns are formed with pebbles and stones. Press them into mortar on a concrete slab (Fig. 25). Then hose the surface to remove excess mortar from the stones. Some people prefer to work out a pebble mosaic in soft earth or mud rather than in mortar.

Color—Color helps soften the commercial look and glare of most concrete mixes. The color is hard to apply, and the results are not always predictable. But it usually fades a bit so that any color variation is not too noticeable or harsh.

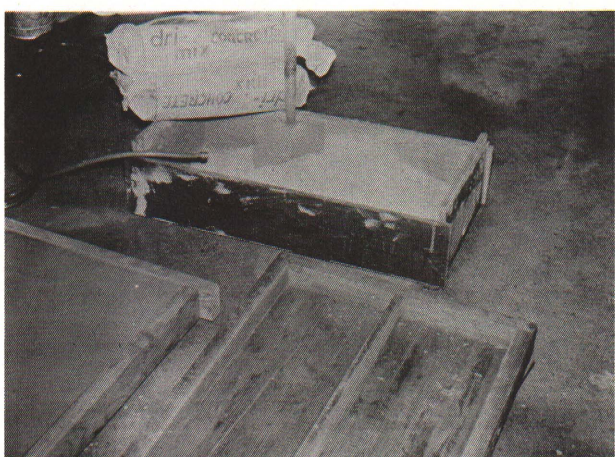


Fig. 26. Simple wood forms and a mixing box are the basic items needed for casting concrete blocks at home in your spare time.

There are three ways to color concrete:

(1) **Pigment**—Before the concrete has hardened, mix a colored pigment with a topping layer of concrete; or dust it on the surface as a dry-mix of sand, gray or white cement, and pigment. You can buy these pigments from most builder's supply yards; the manufacturers give complete instructions on how to use it.

(2) **Stain**—After concrete has hardened for about 6 weeks, you can stain it with one of a number of commercial concrete stains on the market.

(3) **Paint**—Special rubber-base concrete paints are made in a variety of colors. They are made to withstand the rise of moisture and alkali through the concrete.

Cast Blocks—You can save much time and form work by building a set of forms on a flat surface with hinged joints to precast paving blocks. (See Fig. 26.) Oil the forms to prevent sticking. Mix a small batch of concrete to fill the forms. When the concrete has set, put the blocks in a corner of the garage or cellar and keep them damp. This is a slow process, but it is a good way to make paving blocks during the week for placing over the weekend. You can make pebble mosaic blocks by using small stones on the surface.

Reinforcing—Most concrete garden paving does not require reinforcing. But if you expect heavy loads, or if the area is large, reinforcing is a good idea (Fig. 27). Use steel rods one-quarter



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Fig. 27. Reinforcing wire mesh is used where large areas are to be paved with concrete.

to three-eighths inch in size, spaced 6 inches apart, or use wire mesh. The mesh is much easier to place than the rods. Hold either one up off the fill by placing stones under it. Pour the concrete around the reinforcing; the steel gives the needed tensile strength.

Soil-Cement—You can mix Portland cement right into the garden soil for a hard, dry surface suitable for secondary paths, service areas, and even driveways. It will not hold up under as heavy loads as will concrete, however. Use headers to prevent the edges from crumbling.

Loam and sandy soils are the best soils for

hardening by this method. Clay soils do not make a good soil-cement mixture. Make sure the soil is fairly free of grass, twigs, and trash before you add the cement.

Loosen the soil to a depth of 6 inches by hand or with a garden tractor. Mix cement evenly into the soil at the rate of 1 cubic foot of cement to every 9 cubic feet of soil (a path 5 feet wide, 18 feet long, and 6 inches deep contains 45 cubic feet of soil; you will need five bags of cement). Spray the soil surface lightly until it no longer absorbs water. When dry, roll to compact the soil. Repeat sprinklings and rolling for 2 or 3 days afterward.

FLAGSTONE

Flagstone is perhaps the best-known garden paving material (Fig. 28). It is usually the first material people think of when a garden terrace or walk is mentioned. If you are willing to pay a good bit more for flags than for the other landscape pavings, flagstone will give a high-quality, very durable form of surfacing.

ADVANTAGES AND DISADVANTAGES

Flagstone costs five or more times as much as many of the other pavings, although the softer, thinner types are not much higher in cost (material only) than contractor-laid concrete. However, the labor cost of placing flagging is high; unless you have a good sense of color and pattern, the result can be disappointing. You must lay flagstone carefully to keep from getting a patchwork of colors or too irregular patterns.

Although some people feel that flagstone is too hard and cold-looking, many like it for its subdued, mellow tones that blend well with garden colors. It is quite durable, and the ir-



DESIGN: Beatrice Zion

Fig. 28. These cut flagstone squares, laid open-joint, give a pleasing, informal look to this terrace.

regular pattern and texture add much to the garden plan. You can change the size of the flags to suit the scale of a small or large garden.

Because of its hard, permanent surface, flagstone does not absorb moisture or break down easily from frost action. It can be slippery in wet weather or in moist, shady conditions.

GENERAL DESCRIPTION

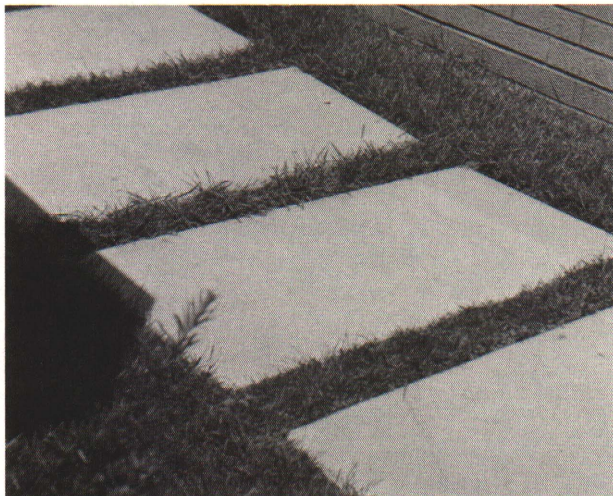
Most flagstone comes from stratified layers of stone in the form of slate, cut from quarries throughout the country. Some of it is cut by machine so that it is fairly regular in shape.

The individual pieces vary both in size and in thickness. The usual width is from 1 to 2 inches, although some flagstone goes up to 6 inches in thickness. The shapes can be changed with a brick set or some other cutting tool.

The colors range from the common blue-gray through yellow, brown, red, and in some areas, green and even purple. The variety gives you a wide selection from which to choose. Check with your local stoneyard for available colors.

CONSTRUCTION

To keep from getting too "busy" a pattern, lay out all the stones on the ground beforehand. You can then move them around to get the best color arrangement and pattern. The irregular shapes give a variety of joint spaces between the stones. This is desirable, especially if you want grass to grow between them, but don't let the spaces get too large.



DESIGN: D. Newton Glick

Fig. 29. The effect of flagstone paving may be achieved at lower cost by using concrete flags.

There are three ways to lay flagstone:

(1) In soil

This is the simplest method if your soil is stable and well drained. Dig out the soil to the shape of the flags, with the joints left open for planting. This method is good for walks, but do not use it for large terrace areas. In wet or frosty weather, the flagstones are apt to shift and heave.

(2) In sand

A 1- to 2-inch sand bed on a stable soil will give the paving a better footing. Soil for planting can be placed in the joints.

(3) On concrete

For a permanent, more true-to-level surface, put in a concrete bed 2 to 4 inches thick. Lay the stones on a mortar bed (1:2 or 1:3 cement: sand mix) with mortar joints. Smooth the concrete to a pavement finish in the joint spaces. This gives a permanent, professional finish of high quality.

If your soil is unstable or poorly drained, a sub-base of from 6 to 9 inches of crushed stone will give it the necessary firmness for the flagstone paving.

MISCELLANEOUS

Joints—Grass and mortar are the most commonly used joint materials. If the space (joint) between stones is too wide, sand may get out.



DESIGN: D. Newton Glick

Fig. 30. Broken concrete sidewalk is used for random flagstone paving.

When preparing a grass joint, keep the soil level one-half to 1 inch below the level of the flagstone surface. This will keep the mower from cutting the grass too low. Also, if the grass is planted level with the stone, the raised joints of grass are apt to trip people.

Cast Concrete—Many people prefer to use cast-in-place or precast concrete stones because they give a more controllable, regular pattern. The

cost is lower, too; yet, you still get the effect of flagstone paving (Fig. 29). Set up a form for precast stones as described in the section on concrete.

In areas where construction work is going on, you might be able to buy broken sections of concrete paving from old sidewalks that have been removed—they are sold at low cost. Properly placed with grass joints, they make a very effective random concrete flag paving (Fig. 30).

AGGREGATE

These materials might be classed as temporary paving when compared with the more permanent materials covered in other sections. Some people will use one of the loose aggregates mentioned below to get paving at low cost until they can afford more permanent paving. Others will use a loose aggregate surface for a service yard and secondary walks in addition to their hard main terrace areas. Some will consider it part of their permanent plan because they want the rough, natural texture given by loose aggregates.

Whether you think of the aggregate pavings

as a temporary economy measure or a permanent surfacing, there are certain advantages to their color and texture.

ADVANTAGES AND DISADVANTAGES

The term "loose aggregates" can cover many materials. Almost everyone will have his own ideas as to what can be used in this classification. Only the more commonly used loose aggregates are discussed below.

Gravel—Either river-run gravel or crushed rock provides a durable surface if placed over a stable base. Properly compacted, it serves very well as a surfacing for walks, drives, and service areas.

The small stones stick to the soles of shoes and are apt to be tracked into the house (keep gravel areas away from house entrances). They also get into open-toed shoes. The large sizes make walking uncomfortable, especially in high-heeled shoes.

Gravel surfaces need refilling occasionally and they are a menace to lawn mowers on nearby grass. A gravel walk is very hard to shovel clear of snow in the winter without scooping up the gravel. Weeds are a constant problem.

Limestone chips—These add color to a path or service area (Fig. 31). They have about the same advantages and disadvantages that are listed for gravel.



DESIGN: M.S.U. Site Planning Office

Fig. 31. Limestone chips give added color to a garden path. Note header board to keep stones out of shrub border.



Fig. 32. Crushed brick combines color and utility in this heavily travelled area between walk and curb.

Crushed brick—This material contrasts very well with plants. Use crushed brick in small areas; the color is too strong for use in large-area surfacing. It breaks down easily, may be tracked into the house, and costs more than the other loose aggregates. (See Fig. 32.)

Tanbark—It gives a natural setting as well as a cushiony effect in play areas. Soft and springy, it is not harmed by moisture. It can stain clothing. Tanbark is not always available.

Sawdust—This provides soft, springy, colorful temporary surfacing. Sawdust sticks to shoes, especially when it is wet. You can use it in the garden as a mulch after replacing it with permanent paving.

GENERAL DESCRIPTION

Gravel—You can get gravel in many different sizes. Buy only one size, rather than mixed sizes—with mixed gravel, the large stones will stay on the surface and small ones work down. Best size is around one-half inch. Natural gravel is smooth, while crushed gravel has sharp edges.

Limestone chips—From one-quarter to one-half inch is best size. It compacts easily, and is light in color.

Crushed brick—Actually a roofing material, it is obtained from building supply dealers. Sometimes defective clay pipe is crushed and sold for the same purpose. If used for heavy traffic, crushed brick breaks down into dust.

Tanbark—This is made up of oak bark chips that have been used in leather tanning. Some nurseries or local tanneries sell it.

Sawdust—You can usually get small amounts from nearby sawmills for a small amount; if you do the hauling, it may be free. You can order it through some nurseries. It is more usable as a mulch than as path surfacing.

CONSTRUCTION

All loose aggregates will hold up best if you place them on a compacted sub-base of stone or stable soil. Spread gravel 1 to 2 inches thick. More than 2 inches makes walking and upkeep difficult.

You can put limestone chips on in a single layer or up to 2 inches thick. They break down and their particles help bind the sub-base to a concretelike hardness. Spread crushed brick to about a 1 inch depth. Tanbark is best spread from 2 to 3 inches thick. Use a very thin covering of sawdust over a base to give color to a path, or spread it up to 1½ inches thick if desired.

MISCELLANEOUS

Rake loose aggregates on in thin layers, dampen, and roll repeatedly. This will compact the area and make it more usable. Re-roll it from time to time.

Use wood headers, stones, brick, or concrete on the outer edges of loose aggregate areas to keep them from spreading into flowerbeds and lawn areas. Loose aggregate walks and service areas near the house will result in stones being tracked indoors.

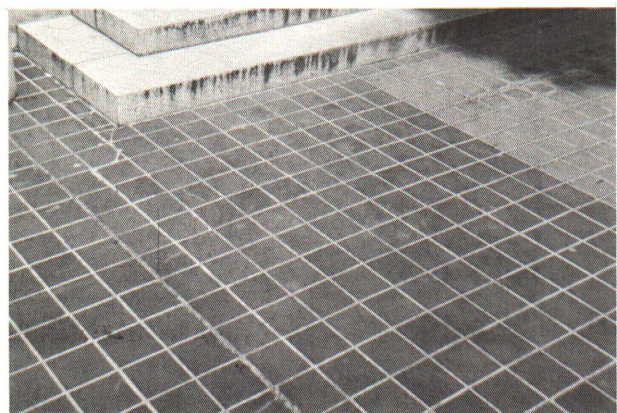


Fig. 33. Tile gives a more formal, finished look to an entrance.

TILE

Tile is a paving material that gives the garden area a dressy, finished feeling. (See Fig. 33.) Its smooth, hard surface has long been used indoors. Not too many people are familiar with it as a garden paving material. Yet, more and more, it is being used to give a professional, glossy finish to small areas of the garden. Use it in walks, combined in patterns with brick or concrete, or around swimming pools. It serves very nicely in a terrace and it often serves as an extension of the living room flooring.

ADVANTAGES AND DISADVANTAGES

The tile itself is rather expensive. Because of the quality of the workmanship needed for a good tile job, the installation cost is high. As with other paving materials, you can keep tile costs down by placing it yourself. It looks best in small areas or blended with brick or concrete (Fig. 34). This provides a change in color, pattern, and texture. Its colors blend well with garden colors.

Tile is smooth and hard, does not absorb grease and dirt as do bricks and concrete, cleans and waxes easily, and is good for dancing.

GENERAL DESCRIPTION

Colors range from brick-red through orange and brown into the grays. They are available in tile of various shapes and sizes. The standard size is 6 inches by 6 inches, although 9 inches by 9 inches is popular, and 12 inches by 12 inches is sometimes used. You can also get rectangular forms.

"Quarry tile" is the name used in the Lansing area to describe all outdoor tile. "Patio tile," a slightly cheaper, rougher tile, is another outdoor tile used in some parts of the country.

Outdoor tile is rough on the surface, compared to the glazed bathroom tile used in homes.

Most tiles are three-quarters of an inch thick. Some companies report that hearth tile is usable for outdoor paving.

CONSTRUCTION

If you are a beginner, you want to lay your tile directly on a soil base or thin layer of sand. This will let you practice tile laying without permanent results, and it will give a quick, temporary effect. The soil should be stable and graded smoothly. If you use sand, it should be 1 inch deep; any deeper will allow the tiles to move when stepped on in the corners. Screed the sand carefully to get a smooth base. Set the tiles tightly against each other or leave a half-inch joint which you can fill with sand later.

The method of laying tile most often seen is that of putting it on a mortar base with smooth mortar joints. A 3-inch concrete slab underneath provides the necessary base. Place the tile on a 1-inch mortar bed (one part cement, three parts sand).

Joint should be one-half to three quarters of an inch wide. Fill the joints with mortar within 24 hours, and finish smooth with the surface of



DESIGN: M.S.U. Site Planning Office

Fig. 34. Tile forms are used in this concrete terrace for color and interest.

tile. Soak tile in water a short while before you place it on the mortar bed so the tile will not draw water from the mortar and weaken the mix. Wipe the surface of the tiles clean of any excess mortar before it sets.

MISCELLANEOUS

You can lay tile on a 1-inch mortar bed directly on a stable soil without a concrete sub-base. This is an economy measure; some cracking and heaving may result.

Try to plan the tile area to fit to the tile sizes available. If this is not possible and a curved edge of terrace or some other form requires that the tile be cut, you can chip away slowly with cutting tools. This is a slow process—you can save time by having the tile cut with a special saw at a stoneyard.

Wood for outdoor paving is the least used of the materials mentioned in this bulletin. Its soft color and texture can add much to a natural garden setting, however (Fig. 35). It does require continued care and replacement, though.

WOOD

ADVANTAGES AND DISADVANTAGES

Wood is subject to decay, insect invasion, and splitting from sun or frost action. However, properly treated with preservative, it can last a number of years.

Wood should be considered a temporary paving. Every so often, you will have to replace pieces and, eventually, you may have to remove the whole wood area.

You can use many different forms of wood. The paving block or brick shape are most popular, followed by round pieces sliced from a tree trunk.

Wood gives a nice texture and color to a paving area. In a damp place, it can be quite slippery.

GENERAL DESCRIPTION

Redwood, cedar, and cypress are the most rot-resistant of the woods in this country. Even though it is treated with chemicals, you can't expect other wood to stand up as well to weather, insects, and decay.

The rounds are cut from tree trunks, either as one solid slice or broken into smaller pieces

to fit into the paving spaces between the rounds. The bricklike blocks are cut from railroad ties (Fig. 36).

Lumber is sometimes used to create a deck-board type of paving over a muddy or wet spot. It is also used quite a bit outside summer houses, near swimming areas, or as raised decking to provide a terrace area on a steep hillside site.



DESIGN: Eckbo, Royston, & Williams

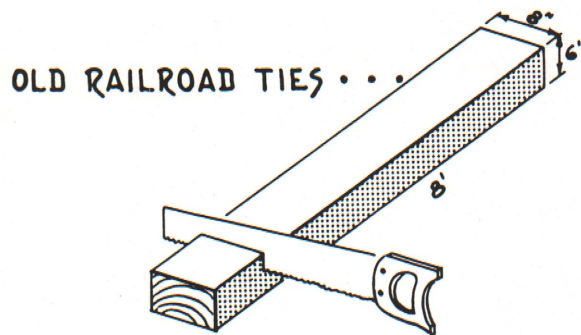
Fig. 35. Wood rounds give a more natural setting than do most of the other paving materials.

CONSTRUCTION

You can put down wood blocks and rounds on level, stable soil or set them on 1 inch of screeded sand. Plant the joints with grass or some low plant for a natural effect. Use headers around the outside edge to keep the wood in place. Wood set in a 1-inch layer of mortar can be used on levelled soil. Do not use anything more permanent than the mortar bed, because replacing the wood blocks or rounds will be too difficult.

MISCELLANEOUS

Apply a toxic wood preservative to all wood used for paving, even redwood, cedar, and cypress. Railroad ties, if available, are excellent for outdoor use because they usually have been pressure-treated with a preservative. The preservatives are often poisonous to plants, so it may be hard to grow anything in the joints.



MAKE GOOD BLOCK PAVING

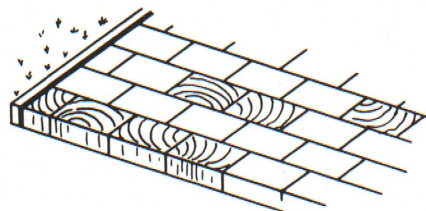


Fig. 36

See Comparison Table for Landscape Pavings on page 24.

COMPARISON TABLE FOR LANDSCAPE PAVING

	GENERAL COMMENT	COST*	ADVANTAGES	DISADVANTAGES	INSTALLATION
ASPHALT	Easy to handle in small batches. Break up area with dividers; contrast color and texture with nearby plants, brick, concrete, or wood. Use asphalt paints for color. Asphalt-cement combination is light and inexpensive.	Less per square foot than brick or concrete. Hot-mix: about 17 to 23 cents per square foot by a contractor. Cold-mix: about half the above cost if you do it yourself.	One of the cheapest of the pavings. Fairly easy to apply. No glare or reflected heat. Can be colored.	If the base moves, it is liable to have "bird baths" and cracks. Gets soft and quite hot in full sun; some metal lawn furniture leaves marks.	Treat soil with weed killer. Very important that base is well prepared. Use forms around edge to prevent crumbling.
BRICK	Adds year-round warm colors to garden. Combines well with other paving materials. Easy to handle, easy to install.	Between 25 and 32 cents per square foot, depending on quantity and quality of the bricks (labor and base materials not included).	Simple to install in sand. Has warm colors; nonslip; very little glare. Variety of patterns, colors, and joint materials possible.	May crack, crumble, and heave in freezing weather. Absorbs food stains. Weeds grow through joints. Not recommended for game areas.	Few tools needed. Laid most easily in sand. Mortar bed, mortar joints, concrete slab bed are other possibilities.
CONCRETE	Use wide range of textural effects and colors to eliminate commercial look. Use dividers to break up large areas. Combines well with other paving materials and plantings.	From 20 to 30 cents per square foot, 4 inches deep, contractor-laid, if you do form work and grading beforehand; otherwise 40 to 50 cents a foot. Special finishes and colors are extra.	Can be applied quickly to large areas. Easy to handle in small batches. Good for outdoor games and dancing. Permanent, durable.	Hot in summer; glaring; shows stains; commercial-looking. Cracks and buckles; hard to patch.	Sometimes laid on stable soil, but gravel sub-base is better. Use headers and dividers to keep areas small and workable.
FLAGSTONE	Permanent, high quality type of paving. Blends well with garden colors, but requires experience to get good color combinations and patterns.	Thickness of stone affects cost; ranges from 1/2 to 4 inches thick. In Lansing area, 1 inch starts at 55 cents per square foot. Some of the thicker and harder-grade flags go up to \$3.00 per square foot (labor extra).	Wide range of subdued, mel-low colors. Permanent. Withstands winter freezing action.	High cost of material. Irregular shapes and colors. Hard and cold-looking. Slippery when wet.	Can be set on stable soil, 1 to 2 inch sand base, or on a concrete base with mortar joints. Precast concrete flags are very popular.
LOOSE AGGREGATES	Use for temporary effect or to supplement main paved areas. Offer a variety of color and textures at low cost.	Gravel 12 to 20 cents per square foot in place, 1/2 inch deep. Cost varies with size. Tanbark costs about 10 to 12 cents per square foot.	Low cost. Easy to put in place. Adds color to the garden plan. Variety of textures available.	Gets kicked into flower beds and onto lawns. Tracks on shoes. Hard to walk on in high-heeled and open-toed shoes. Requires constant upkeep because of weeds.	Use stable soil or rock base for best results. Gravel, limestone chips, and crushed brick should be up to 2 inches thick. Tanbark: spread 2 to 3 inches thick. Sawdust: thin layer for color.
TILE	Gives garden a dressy, finished look. Combines well with brick and concrete. Has warm range of colors.	Quarry tile costs about 90 cents per square foot, material only. If available, patio tile is half that cost. Exacting craftsmanship required; labor costs run high.	Colors blend well with garden plantings. Smooth, hard; does not absorb grease; good for dancing and games.	Formal-looking; not good for natural setting. Expensive. Requires careful craftsmanship.	Set in soil or 1-inch sand layer, with 1/2-inch joint. For a permanent job, use 1 inch mortar bed on 3 inch concrete slab with 1/2- to 1/4-inch joints.
WOOD	Most natural effect of all pavings. Soft wood colors and textures blend well with plantings.	Large rounds up to \$1.00 per square foot. Wood blocks from railroad ties about \$1.25 per square foot in place.	Color and texture of wood form a natural background for rest of garden plan. Lasts several years if treated with preservative. Redwood, cedar, or cypress recommended.	Temporary paving. Subject to decay, insects, and splitting. Slippery when wet.	Place on stable, level soil or on 1 inch of sand, with grass joints. Can be set in mortar bed, but not recommended.

*Comparative costs rather than actual. Vary with locality.