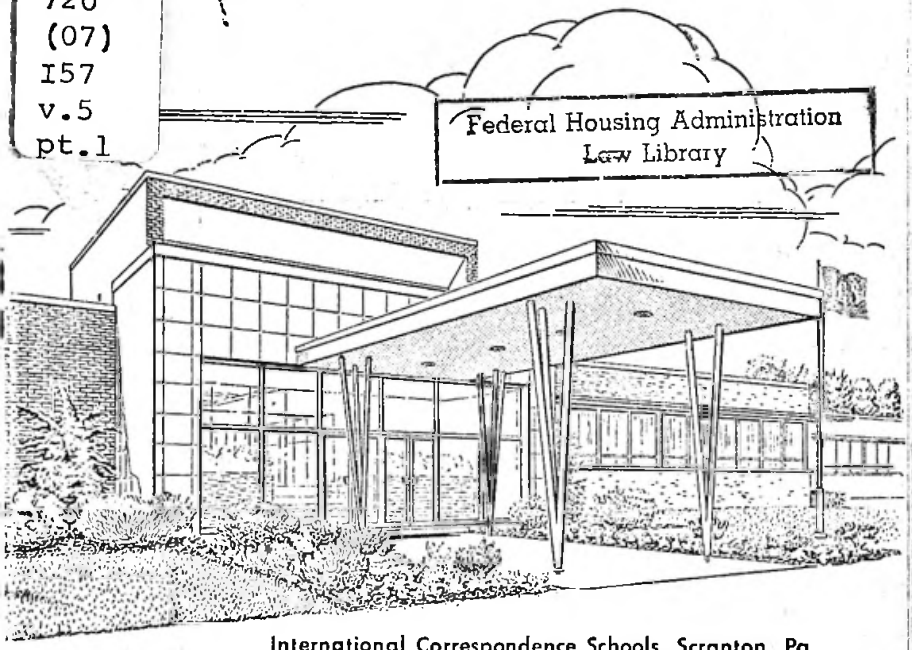

International Correspondence Schools, Scranton, Pa.

Floor, Wall, and Ceiling Coverings

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6239A **Part 1** **Edition 1**

International Correspondence Schools, Scranton, Pennsylvania

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In the City of Bagdad lived Hakeem, the Wise One, and many people went to him for counsel, which he gave freely to all, asking nothing in return.

There came to him a young man, who had spent much but got little, and said: "Tell me, Wise One, what shall I do to receive the most for that which I spend?"

Hakeem answered, "A thing that is bought or sold has no value unless it contains that which cannot be bought or sold. Look for the Priceless Ingredient."

"But what is that Priceless Ingredient?" asked the young man.

Spoke then the Wise One: "My Son, the Priceless Ingredient of every product in the market place is the Honor and Integrity of him who makes it."

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* * *

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Architecture home study course

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PART 1

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What This Text Covers . . .

6239A

Floor, Wall, and Ceiling Coverings

Part 1

General Requirements

Scope of Subject

1. The coverings considered in this text are the exposed finished materials that are used as decorative and wearing surfaces for floors, walls, and ceilings. Such materials are generally applied after the structural portions of the building have been completed. This is especially true in modern fireproof buildings where the skeleton frame is first erected. Therefore, in the following pages, construction will be shown only to the extent necessary to illustrate proper methods of installing and supporting finished coverings. In some cases, the structural material may be the exposed finish also, as, for instance, interior exposed stone or brick walls.

The object of this text series is to give you an understanding of the various materials that are used for floor, wall, and ceiling coverings and the purposes for which each material is best suited. In Part 1 you will study floor coverings, and in Part 2 you will study wall and ceiling coverings. A glossary of technical terms used in Parts 1 and 2 is given at the end of Part 2. A knowledge of floor, wall, and ceiling coverings is essential to the architect, interior decorator, specification writer, draftsman, contractor, and estimator.

Fitness of Materials

2. Many materials that are used for floor, wall, and ceiling coverings have been used since the earliest civilizations. Brick, stone, and wood have been tested by actual use for centuries.

The composition and qualities of such materials are generally understood; information as to their use is readily available. Other newer materials have been tested and improved by laboratory and field experiment until there is no question as to their fitness for certain specified uses.

The varied and exacting uses to which modern buildings are put, and the necessity of reducing maintenance and replacement costs to a minimum, make it essential that you have definite data regarding each material. Such data include the results of chemical and physical tests as well as precise information as to hardness or resistance to wear, absorption of water, resistance to the transmission of heat and cold, absorption of sound, resistance to acids and fumes, and other practical qualities. The successful use of any material depends on proper production, fabrication, and installation, which in turn depend on an understanding of the properties of the material.

3. Fabricated materials—such as brick, tile, resilient flooring, glass, and plaster—are manufactured from natural materials and assembled by various methods into the finished articles. Standard specifications have been adopted for their manufacture. These specifications are the result of laboratory research and of the use of the materials in occupied buildings. Research information for standard specifications and for the properties of materials has been developed by such organizations as the American Society for Testing Materials, the National Bureau of Standards, and some associations of manufacturers.

Selection of Materials

4. In selecting floor, wall, and ceiling coverings, the chief factors that you must consider are wear, design, and cost.

Resistance to wear includes many factors, such as hardness, or resistance to abrasion; softness to provide comfort or acoustic properties; water resistance as required in washrooms; and acid resistance as required in laboratories.

Design in materials is primarily the selection and arrangement of materials to suit the architecture employed or the taste of the owner or occupants. Many materials are of natural growth, such as wood, or of natural formation, such as stones; their sizes, forms, colors, and textures cannot be varied except within their adaptable fixed limits and finishes.

No matter what material is used, it should show itself to be what it is and not pretend to be anything else. If, for instance, the character of a room does not warrant the expense of marble wainscots or mahogany paneling, the desired effect should be obtained with some simpler material but not with imitations of what cannot be afforded. An honest use of materials is an essential of good design.

Cost, which should include installation, is usually a factor in the selection of floor, wall, and ceiling coverings. Too often cost is not considered from the standpoint of the life of the material. A material which has a high first cost, but which will give the best and longest service, is often rejected and an inferior material used to save initial expense. You should always consider carefully the problem of upkeep over a period of years, since any saving obtained by the use of an inferior material may be spent several times over in repairs and replacements, especially in buildings having heavy usage.

5. Often, two or more factors must be considered together. For instance, in a printing plant where there is considerable abrasion due to heavy trucking, there is also considerable walking about. For a floor in such a plant, you should select a material that will give a certain amount of comfort and at the same time be tough. In a restaurant, the problem would be to obtain a floor that would be quiet and still easy to clean.

Installation of Materials

6. To be used to its best advantage, any floor, wall, or ceiling covering must be properly installed. Where industrial associations have developed definite recommendations for in-

stalling various materials, or where custom and past experience have developed proven methods, these recommendations and methods should be followed in actual construction whenever possible.

Many newly developed materials have been in use for a comparatively short time and are the result of experiment and research by individual producers. For each such material, you should secure definite information, directly from the producer, regarding its proper use, characteristics, and methods of installation.

Summary

7. Coverings are used to provide finished decorative and wearing surfaces for floors, walls, and ceilings. They are generally applied after the structural portions of a building have been completed. To be used to their best advantage, they must be applied properly.

The usual factors that you must consider in the selection of floor, wall, and ceiling coverings are wear, cost, and design. The keynote of good design is the honest use of materials.

Perhaps the best way to begin your study of floor coverings is by considering one of the hardest and most permanent floors, the stone floor.

Stone Floors

Uses of Stone

8. In ancient times and during the Renaissance, stone was universally used as flooring in the great houses and government buildings. Today, stone is used for exterior porch floors, steps, walks, and terraces. For interior spaces, it is adaptable to lobbies, stairs, corridors, rooms of monumental design, railroad stations, churches, and similar locations having heavy traffic. Stone flooring may be used alone or in combination with other materials.

Characteristics of Natural Stone

9. Natural stones for finished flooring exist in abundance. Such stones vary greatly in conformation and color. Natural formations govern methods of production. Limitations of finish, hardness, resistance to abrasion, color, and size determine the uses to which each kind of stone may be put.

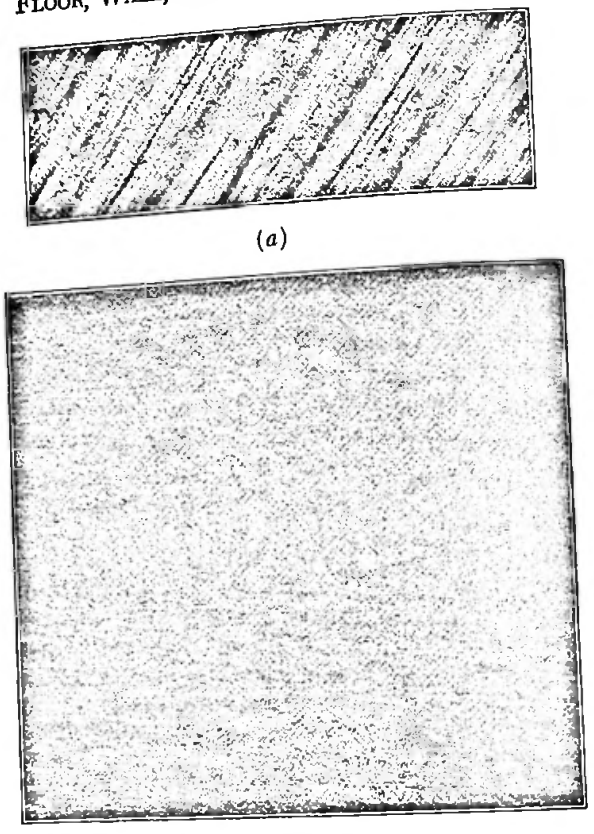
The principal characteristics of stone are permanence and hardness. The hardness of stone is comparative, since there are both hard and soft stones. Soft stones are easy to work and soft to the tread, but do not have as great a resistance to wear as do the harder kinds. For instance, a stone with wearing quality sufficient for a private house may not wear well under the heavy traffic in a railroad station. The degree of hardness of a stone can be established by tests, which make it possible for you to select a stone of the desired density for a specific location.

Because of its hardness, stone does not require refinishing after installation. Generally, the finished surface is permanent and waterproof, and requires little maintenance except for occasional washing and cleaning. Joints in stonework are the vulnerable points that permit the entrance of water. Unless the joints are carefully and thoroughly filled with the proper mortar, trouble may develop.

Finishes for Stone

10. Stones vary in color owing to their chemical composition. Complete uniformity of color is difficult to secure, even when stones are cut from the same block. Lack of color uniformity is one of the advantages of stone, since the variations in color, combined with methods of finishing, lend interest to the finished stone surface, as you can see in Fig. 1, views *(a)* and *(b)*, which shows a sand-rubbed finish on gray and on red granite.

Finishes for marbles and granites are more or less standardized and easily specified. Each finish has an affect upon the

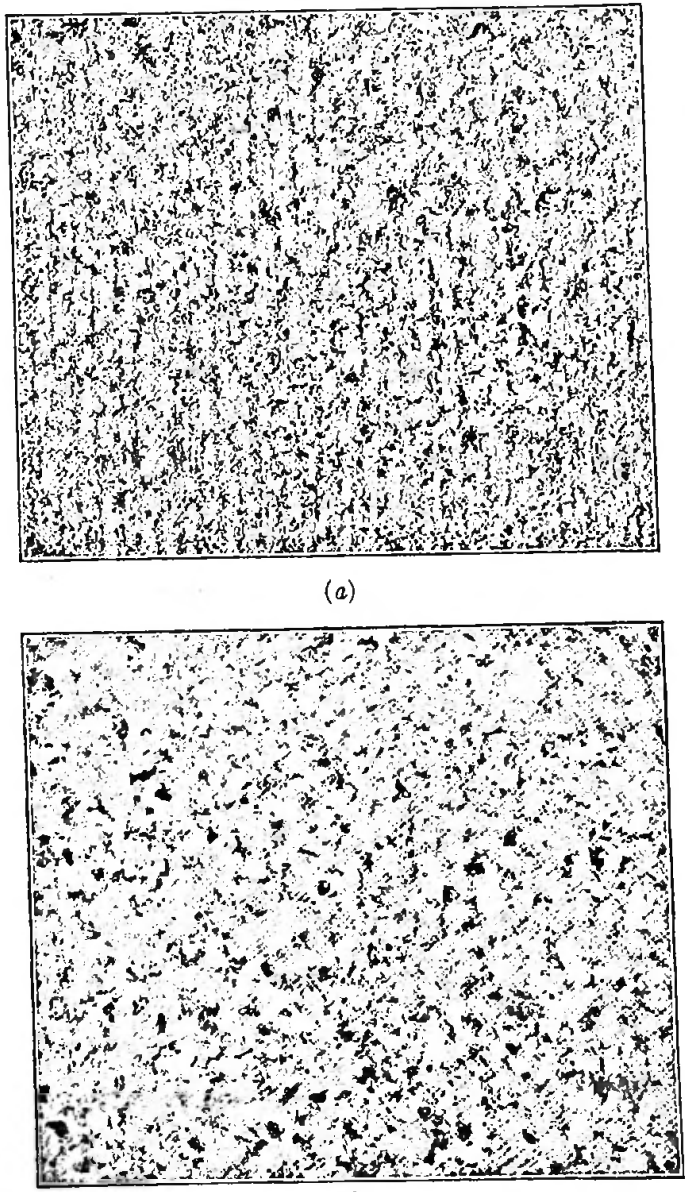


(*a*) Sawed finish (*b*) Split finish

FIG. 2. SAWED AND SPLIT FINISHES ON SLATE

surface and color of the stone. As the quality of the finish becomes finer, the color and variations in marking become more pronounced, until in the polished finish the full beauty of the stone is developed.

Unstratified stones—such as granite, limestone, and marble—are mostly produced in large blocks, which are then sawed into slabs of the desired thickness. The sawing process leaves the surface of the stones roughened slightly by saw marks, as



(*a*) Hammered finish (*b*) Honed finish

FIG. 3 FINISHES ON GRANITE

shown in Fig. 2(*a*). A sawed finish is often used where it is necessary to have a nonslip surface, as on exterior terraces and on porches.

Stratified stones, such as slate or flagstone, are first quarried in large blocks, using compressed-air or electric drills. They are then split with iron wedges into slabs or layers of the thickness desired. This process leaves a natural split, or cleft, surface with a slightly rough and nonslip texture. This finish on slate is shown in Fig. 2(*b*).

11. A planed finished is secured by planing sawed or split slabs of stone with a steel plane. The planed finish shows the marks of the plane in varying degrees, depending on the type of plane used and the number of cuts per inch. This surface, like the sawed and split surfaces, is excellent for nonslip floors and is smoother than either the sawed or the split surface. The planed finish is used mostly on granite, limestone, and flagstone.

Generally applied only to granites, a hammered finish, which you can see in Fig. 3(*a*), is secured by the use of a hand bushhammer. This finish consists of a series of fairly regular, though varied, cuts in the stone, causing corrugated but approximately parallel cut marks. Hammered finishes are generally identified as four-cut, six-cut, or eight-cut, depending upon the number of cuts in an inch of hammer width.

A shot finish is secured by blowing small shot or sand with an air compressor against a sawed, split, or planed surface. This method removes projections and most of the roughness, producing a fairly smooth finish. This finish is excellent for any hard stone floor where extreme smoothness is not required. This finish is not used on marbles.

12. A sand-rubbed finish, some times called machine-rubbed, can be secured on most stones. To produce this surface, stone slabs are placed on flat beds and large circular steel or carborundum wheels are rotated over them. During the rubbing process, the stones are covered with sand, carborundum grains, or small shot, and kept constantly wet. The resulting surface is level and smooth with a slight stipple. It can be used for any purpose for which stone flooring is selected. Examples of sand-rubbed finish on granite are shown in Fig. 1(*a*) and (*b*). A fine sand-rubbed finish is produced by the same process as is used in forming the sand-rubbed surface, but a finer grained rubbing material is used, which results in a smoother surface.

A honed finish is sometimes confused with a sand-rubbed finish, but it is finer and smoother in texture. Fine-grained carborundum wheels or disks are rotated directly on the stone surfaces, which are kept constantly wet, thus producing a smooth, even, and true surface, without stipple, that is velvety to the touch. The honed finish is the finest finish which you can obtain on stone that cannot, owing to its natural structure, take a polish. In Fig. 3(*b*) is shown such a finish on granite. The honed finish is mostly used on vertical surfaces.

13. Stones such as granite, marble, and travertine, which possess a close-grained crystalline formation, can be given a polished finish. This is the highest and most costly finish. It is secured by buffing, or rubbing, the sand-rubbed surfaces of the stone with felt-covered buffers and a polishing powder, such as oxide of tin. The result is a highly polished, smooth finish that displays effectively all the brilliant colors inherent in the stone. This finish is particularly suitable for wall surfaces. It is seldom used on floors, since polished floors become slippery and the polish becomes scratched and eventually wears off.

Granite

14. Each type of stone has its individual characteristics. Granite is a hard igneous rock of granular composition. It is composed chiefly of feldspar and quartz in combination with mica and sometimes other minerals, which give it its color and markings. The texture of granite varies from a coarse

grain with large irregular granules, as shown in Fig. 1(*b*), to a fine grain with small granules, as shown in Fig. 1(*a*).

You will discover that pieces of granite, even from the same quarry, vary in color. Gray is a common color and varies from the almost white, shown in Fig. 1(*a*), to a very dark shade. Some granites are distinguished by a warm buff, brownish-red, or pink color and are named after this color. In Fig. 1(*b*) is shown red granite. Other colors are black, a dark mahogany brown, and a combination of rose and black. Green granites are available in small quantities.

For flooring, granite is sawed into slabs from 1½" (inches) to 2" thick, since thinner slabs cost more to produce. The sizes of the slabs depend on the design and on the facilities for handling and setting the slabs.

Granite flooring is usually given a sand-rubbed, honed, or hammered finish. In the sand-rubbed finish, which is the most commonly used finish, three textures are available: rough, medium, and fine sand-rubbed. Where a nonslip surface is desired, granite is sometimes given a peen-hammered or sawed finish.

Granite should be set on a solid foundation in portland cement mortar. After setting, granite requires no special treatment or care.

Marble

15. Most marbles are composed of natural metamorphic limestone or of carbonate of lime in crystalline form. Marble occurs throughout the world in a wide variety of composition and color. Many domestic marbles, especially those from Tennessee, are noted for their soundness, and you can use them for floors requiring hard wear. The highly colored domestic and foreign marbles are usually more fragile and must be carefully selected for the use intended.

Marble occurs in a wide range of variegated colors running from almost pure white to black and gold, and including

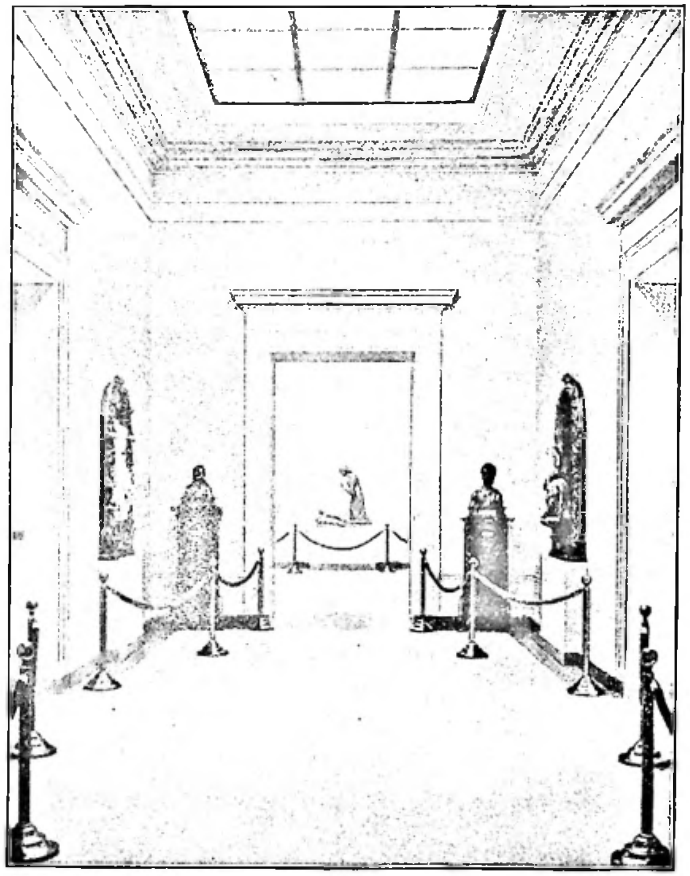


FIG. 4. MARBLE FLOOR IN MUSEUM

shades of gray, pink, red, rose, green, and buff. The color variations which are characteristic of marble are due to the presence of veins, streaks, or patches running in all directions and varying in width, length, and color.

Marble is widely used for floors. In public buildings, such as the one shown in Fig. 4, it is especially useful in entrance lobbies, corridors, and stairs subject to a great deal of traffic. It is also used in operating rooms, bathrooms, dressing rooms,

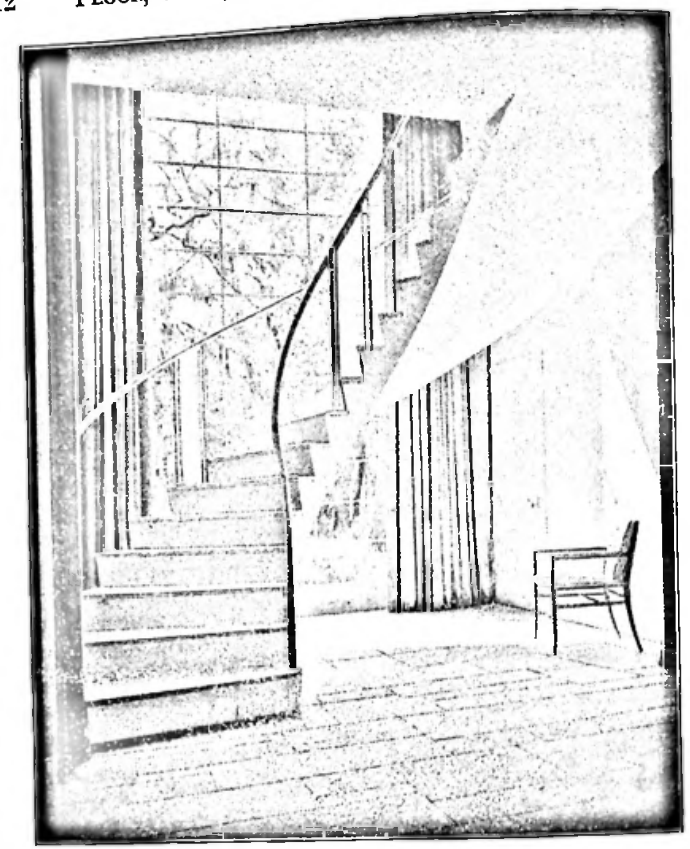
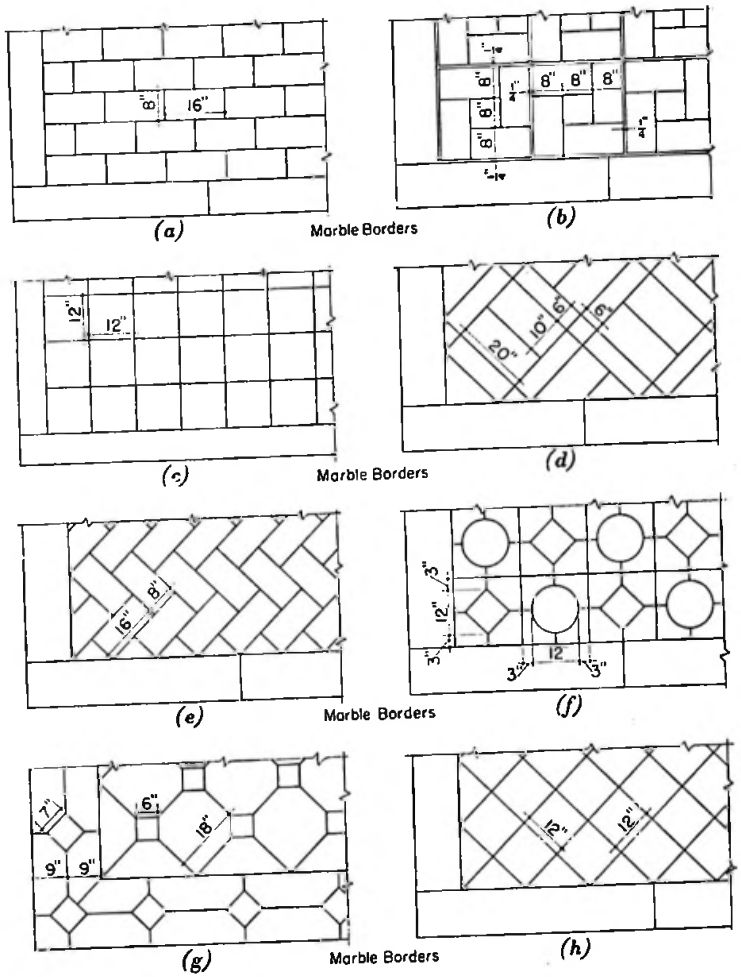


FIG. 5. MARBLE FLOOR AND STAIR TREADS IN RESIDENCE

and toilet rooms, and in houses as shown in Fig. 5. In small chips it is the basic material for terrazzo floors.

The common finish for marble flooring is a fine sand-rubbed finish. This finish wears well and gives some resistance to slipping. A honed or eggshell finish has a dull gloss and is used only where a finer finish is desirable and where traffic is not continuous.

16. The usual thickness of marble flooring is $\frac{7}{8}$". But thicknesses of $1\frac{1}{4}$", $1\frac{1}{2}$", and 2" are sometimes used. The flooring can be cut to fit almost any space or design, but it is customary



(*a*) 8 x 16's in running bond
(*b*) Larger joint used to form 2' squares
(*c*) 12 x 12's in stacked bond
(*d*) 20" squares with 6" borders
(*e*) Herringbone
(*f*) Alternate circles and squares
(*g*) Squares and octagons
(*h*) Squares on diagonal

FIG. 6. MARBLE FLOOR PATTERNS

to employ uniform sizes, such as 4″ x 8″, 8″ x 12″, 12″ x 12″, and 12″ x 16″. Small pieces are easier to lay and are less liable to crack than large ones. Some marble floor patterns are shown in Fig. 6(*a*) to (*h*). Marble lends itself to formal designs, and so the designs shown are regular in pattern.

Marbles vary greatly in their absorption of water and, for the honed finish, it is desirable to use the denser varieties of marble in order to reduce the possibilities of staining.

Marble floors are usually laid in a setting bed consisting of a 1 to 3 ratio of portland cement and sand laid over a concrete slab. The slab should have its top surface at least 2½″ below the finished floor line. To prevent expansion in the slab from causing cracks in the finished floor, a layer of sand covered with tar paper should be placed over the slab. The marble tiles are placed in the setting bed, tamped, and leveled, leaving the joints open. The usual joint is $\frac{1}{16}$″. The tiles are then removed and the backs are parged with neat cement mortar or the bed is given a skim coat of neat cement mortar, in which case the backs of the tiles should be wet. Edges may be buttered as the tiles are laid, or the joints may be filled later with pure nonstaining cement and water. The entire surface should then be wiped off. After the floor has set for at least 6 days, it is finished with a surfacing machine using a fine abrasive.

Selection of Marbles

17. Characteristics of marble vary, due largely to natural formations which give the marbles their color and marking. Therefore, you must exercise care in selecting a marble for a specific use. Color, especially in veins, may be due to natural faults. Such faults may restrict the usefulness of marble for flooring, but, on the other hand, may enhance its value for walls or wainscoting where the color governs its choice and direct abrasive wear is less important. The following four groups, classified according to acceptable characteristics and working qualities, indicate generally accepted trade usage:

Group A includes marbles which require no sticking, waxing, or filling; they are characteristically uniform, with favorable working qualities. You will find that this group is desirable for floors subject to heavy traffic and for stairs and freestanding partitions.

Group B includes marbles similar in character to those in Group A, but possessing somewhat less favorable working qualities. They have occasional natural faults and require a limited amount of waxing and sticking. Most of these marbles can be used for flooring, but care should be exercised in their selection for use other than in rooms where there is little traffic.

Group C includes marbles of wide variation in working qualities. Geological flaws, voids, veins, and lines of separation are of common occurrence. Standard practice is to repair the shortcomings of these marbles by sticking, waxing, and filling; liners and other forms of reinforcement are freely employed when necessary. These marbles are used mostly for wainscot and decorative effects.

Group D includes marbles similar to those in Group C and subject to the same methods of finishing and manufacture. But the marbles embraced contain a larger proportion of natural faults, and maximum variation in working qualities. This group comprises many of the highly colored marbles prized for decorative qualities.

18. In the foregoing divisions, merit, value, and color are not considered, just working qualities. In general, you should remember that Group A is especially desirable for floors, stairs, and freestanding partitions, while marble from any of the four groups can be used for wainscoting, mantels, and decorative bands. In selecting marble for flooring, you will do well to secure a report on the abrasive strength of the types under consideration.

Travertine

19. Travertine is a crystalline limestone. It is found in com-

mercial quantities in Italy and in the United States, where it occurs mostly in Colorado and neighboring states. It is soft, is easily worked when quarried, and hardens on exposure to air. Colors range from light buff to fairly dark brown or rose. You can see the usual color of travertine in Fig. 7.

The distinguishing characteristic of travertine is the series of voids throughout the stone. These voids appear on the finished surface and range in size from pin points to about $\frac{1}{2}''$ in length. They do not affect the usefulness of the stone. When a perfectly smooth floor is desired, the voids are sometimes filled with cement matching the color of the stone.

The texture of travertine produces a soft and resilient surface that is easy to walk on. This quality makes it particularly useful where there is considerable traffic, as in public lobbies, in waiting rooms in railroad stations, and on stairs.

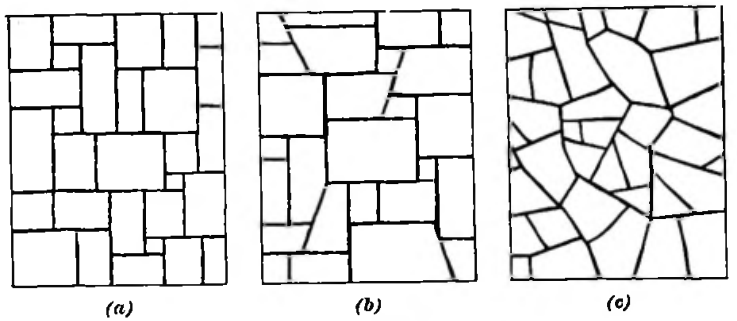
Travertine flooring is produced in the same thicknesses as marble and with the same sand-rubbed and honed finishes. It is generally laid in the same manner as marble, and the same precautions are used in setting and in later care. Since the transverse strength of travertine is low, it should be laid in a full bed of mortar to prevent its cracking.

Limestone

20. Limestone is a fairly hard stone, known for its fine, uniform composition. It ranges in color from a light buff to a silver gray. In the United States, it is found in large quantities in Ohio, Illinois, Indiana, and Alabama. Limestone makes an excellent material for facing exterior and interior walls, but it is seldom used for flooring. It is sometimes used for thresholds, sills, and borders where it can be properly maintained. Limestone flooring is generally installed in slabs from $1\frac{1}{2}''$ to $2''$ thick. Limestone should always be set in nonstaining mortar.

Slate

21. Slate is metamorphic stone formed from sedimentary shale under tremendous heat and pressure. It is found in



(*a*) Rectangular
(*b*) Semi-irregular
(*c*) Irregular

FIG. 8. FLAGSTONE AND SLATE FLOOR PATTERNS

large quantities in the northeastern United States. A characteristic of slate is the presence of ribbons, or hard veins, running irregularly through the material. These ribbons are usually a different color or shade than the rest of the slab. The ribbons do not interfere with the splitting or finishing of the slate and do not detract from its strength. Often they add interest to an otherwise uniform surface. Black slate is divided into two classes, clear stock and ribbon stock. Clear black slate is used for blackboards. Ribbon stock is used for flooring and stair treads.

Common slate colors are black, green, and purple. The black is really a dark bluish-gray which becomes almost jet black when oiled. The green is a light or medium-dark green; the purple is very dark. Green and purple slate are produced generally in the same neighborhood. Often the colors are mixed in the same slate, forming what is known as variegated green-and-purple slate. Red slate can also be secured in limited quantities. Colored slates fade evenly when exposed to the weather.

You can use slate for exterior work, such as porch and terrace floors. You can also use slate in enclosed porches, lobbies, vestibules, lounges, and similar places, and for stair

treads and platforms. In Fig. 8*(a)*, the slate is laid in a random rectangular pattern. Slate can also be used for borders where contrast with a floor of another material is desired.

Slate used as flooring should be not less than 1″ thick for slabs 12″ square or less in size. Usually, it need be no more than 1½″ thick for larger sizes. Slate has considerable tensile strength, and can be used in thinner slabs than can most other stones.

22. Slate is quarried in blocks. The blocks are then split with iron wedges into the thicknesses desired. The natural split surface, shown in Fig. 2*(b)*, which results from this operation provides a fine nonslip surface for floors, and is widely used for porches and terraces The sand-rubbed and honed finishes are more used in interior work.

Slate floors are set in the same manner as marble floors, and care is taken to secure a substantial base and to bed the slate well in cement. You need not use a nonstaining cement for slate. The joints should be filled with mortar as the slate is laid and wiped smooth. After the slate is cleaned, it should be wiped with a thin coat of boiled linseed oil to bring out the color and and protect the surface.

Bluestone

23. Bluestone is a light-blue-gray even-grained sandstone. As it is extremely dense and resistant to wear, it is especially useful for thresholds, exterior stairs, walks, borders, terraces, and places subject to considerable traffic.

Bluestone is quarried in blocks, which are sawed into slabs of the required thicknesses. It is available in sawed, shot, and sand-rubbed finishes. Some types of bluestone are laminated; slabs are available with split surfaces, and are used as flagging.

The usual thickness of bluestone flooring is from 1½″ to 2″. When used in blocks 12″ square or smaller, bluestone can be as thin as 1″. It is laid in the same manner as other natural

stones, such as slate, using a mortar containing normal portland cement.

Flagstones

24. Flagstones are sandstones. They are of two types: one has a solid formation, while the other is laminated like slate. They are found in widely distributed localities. The flagstone in each locality generally has its own peculiarities of surface and color.

Flagstones are usually blue, gray, brown, or buff, although some other shades may be found. They are generally variegated in shades of the same color, a feature which adds interest to their appearance. The blue and grays are usually soft in tone, but some browns and buffs are almost brilliant.

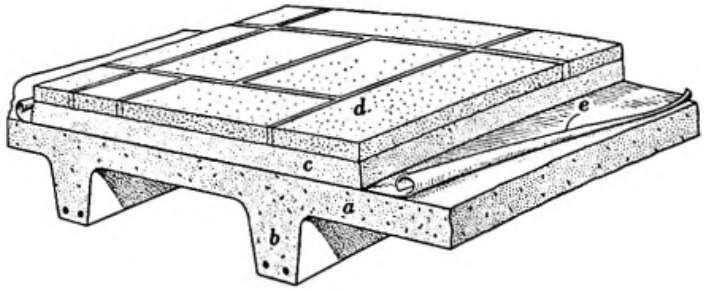
Flagstones are desirable for informal garden walks. They also form excellent sills, thresholds, and exterior stairs. In interiors they are used in such places as vestibules, garden and flower rooms, porches, halls, living rooms, and church floors. You may also use flagstones as borders with fields of other materials. Commonly used floor patterns are shown in Fig. 8.

Flagstone is finished with sawed and sand-rubbed surfaces, and occasionally with a honed surface. The laminated type can be obtained with split, or cleft, surfaces and, in this respect, is similar to slate. Flagstones for exterior use are not less than 1¼″ thick; for interior use a thickness of 1″ is sufficient. Flagstone may be cut into sizes and shapes to fit any design.

Soapstone

25. Soapstone is of mineral composition with a large proportion of talc, which gives a somewhat smooth, oily feel to the surface of the stone. It can be accurately worked, due to its fine, homogeneous structure, and has high resistance to abrasion and to heat.

Normally, soapstone is a light-to-dark bluish-gray, some-



a. concrete slab
b. reinforced-concrete beam
c. setting bed
d. stone floor
e. waterproofing

FIG. 9. STONE FLOOR ON CONCRETE SLAB

times with irregular white veins. You can obtain it in green, mottled blue, and blue and black also, depending on the lesser amount of talc in the stone and the greater proportion of various minerals.

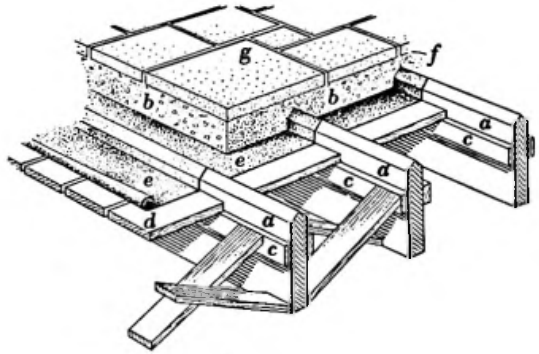
For flooring, soapstone is generally $\frac{3}{8}$" to 1" thick, although thicker slabs can be secured for thresholds, sills, and stairs. Soapstone floors are usually given a sand-rubbed or honed finish. Some of the harder varieties will take an excellent polished finish, and are used for such areas as the outer hearths of fireplaces.

Setting Stone Floors

26. Certain general considerations govern the setting of stone floors.

The base under a stone floor should be firm and level to provide a solid bearing. Granite, for instance, is extremely heavy and requires a substantial foundation to prevent the stone from settling and the joints from opening.

Two common types of bases for supporting stone floors in buildings are shown in Figs. 9 and 10. The first type, which is used for most new buildings, is shown in Fig. 9. In this type a slab of concrete *a* is supported on reinforced-concrete



a. wood joists
b. concrete slab
c. wood strips
d. rough floor
e. waterproof paper
f. setting bed
g. stone floor

FIG. 10. STONE FLOOR ON WOOD JOISTS

beams, *b*. On the slab *a* is laid a setting bed *c*. The stone-floor covering *d* is laid in this setting bed. A layer of felt or membrane waterproofing *e* may be laid over the concrete slab under a bathroom or washroom floor to prevent penetration of water.

In existing buildings where a concrete base must be prepared over wood construction, the wood joists *a* in Fig. 10 are chamfered at the top. The tops of the joists should be at least $\frac{3}{4}$" below the top of the concrete slab *b*. Wood strips *c* are then nailed to the sides of the joists, and a rough wood floor *d* is placed on the strips. Over this wooden construction, a layer of waterproof paper *e* is laid, and the concrete *b* is placed. This concrete should be a fairly dry mixture, and may contain either stone or cinder aggregate. In new work, the wood joists usually can be set lower, allowing the floor *d* to be placed without chamfering the tops of the joists, and thus providing a stronger and better construction.

27. The concrete base should be dry and thoroughly clean. After it is sprinkled with clean water, the setting bed of mortar is laid. The setting bed is usually a mixture of portland cement

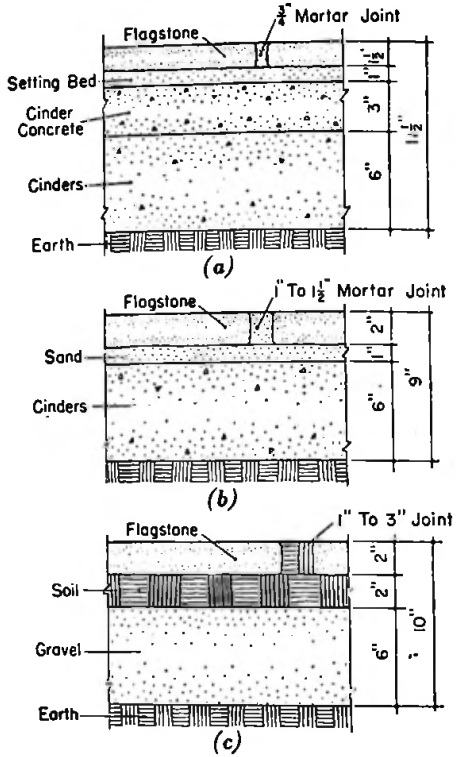


FIG. 11. STONE FLOORS INSTALLED ON GROUND

and sand. After the setting bed is laid, it is screeded level with a long straightedge, and troweled to a proper distance below the finished floor level to receive the stone slabs *g*. In Fig. 10 the setting bed is shown as being integral with the concrete base.

The undersides of the stone slabs are first covered with mortar; then the slabs are shoved into place and tapped down. A wooden mallet is used for tapping to avoid injury to the surface of the slabs.

Where light-colored marble and limestone are used and there is a possibility of the mortar staining the stone, nonstaining portland cement should be used. For other kinds of

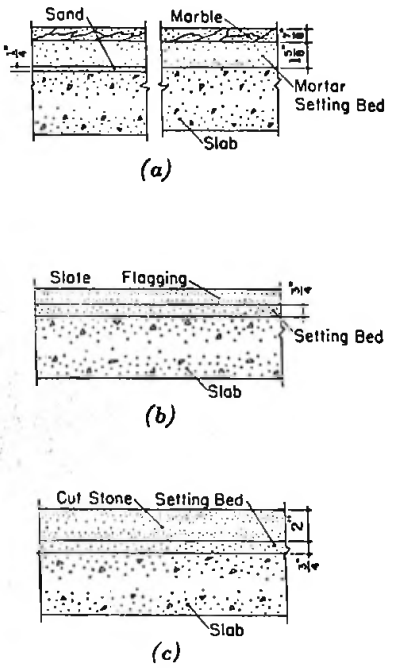


FIG. 12. STONE, SLATE, AND MARBLE FLOORS ON CONCRETE SLAB

stones—such as granite, slate, and flagstone—standard portland-cement mortar is satisfactory.

Where the joints are narrow and the stones are laid close together, the edges of the stones are sometimes buttered with mortar before the stones are set in place, to avoid grouting and thus the possibility of staining or spoiling the finished surface of the stone. Generally, however, as with marble, the slabs are set in portland-cement mortar and the joints are later grouted full, using nonstaining mortar.

Where wide joints are used, as in flagstone and slate floors, buttering is not necessary, since the mortar can be filled in after the stones are set and leveled. The surplus mortar is then wiped off.

For exterior walks, stone flooring is often laid on sand or

on earth. Details of methods of installing stone floors on the ground and on concrete slabs are shown in Figs. 11 and 12.

In all cases, after setting, the floor slabs should be carefully wiped and washed clean before any mortar has a chance to dry and harden on the surface. The final cleaning and surfacing should be completed as required for the type of material and finish.

Maintenance of Stone Floors

28. After a stone floor is installed, it should receive periodic care and cleaning if it is to retain its original appearance. Generally, it is sufficient to use clean water for wetting the floor, a detergent for washing it, and then clean water for rinsing it.

Oiled mops or any material containing grease or oil, which will stain marble, should not be used on marble floors. Acids and wire brushes should not be used on stone floors, as they will eventually spoil the finish of the floors. Slate floors may be given a thin coat of linseed oil to maintain the surface.

Summary

29. The chief characteristics of stone floors are hardness and permanence. Stones that are used for flooring—such as granite, marble, slate, and flagstone—differ in hardness and in their natural formations and colors. Variations in color and surface add to the interest of stone floors. Floors of stone, marble, and travertine are unequalled for richness and dignity. They are commonly used in banks, churches, and lobbies in monumental buildings.

Stone floors are usually laid in a mortar setting bed on a concrete slab. For marbles and limestones, nonstaining cement mortar should be used. You may give a stone floor a variety of finishes, ranging from split or sawed surfaces to a smooth honed finish. The polished finish is rarely used for stone floors, since it is slippery and will become scratched and wear off.

Cement Floors

Composition and Use

30. The term "cement floor" refers to a floor having a concrete base and a finished surface of cement and aggregates. The top surface may be an integral part of the concrete base or it may be obtained by applying a separate top coat to the base after the concrete has set and become dry. You should keep in mind that mixtures of cement and sand dust off and that, to afford a hard-wearing surface, the top coat should contain grit or pea-sized aggregate. The best methods of installing poured-in-place cement floors are explained in the text *Concrete Construction.*

Sometimes a cement floor is in the form of precast floor tiles. In this case, the installation is the same as that for a tile or stone floor.

Color may be given to a cement floor, either as an integral part of the floor, or in the form of paint. Various designs may be obtained by dividing the floor into different shapes.

Cement floors are commonly used in utilitarian areas, such as laundries, storage areas, factories, basements, boiler rooms, and garages. Cement floors are often colored and waxed and used for such areas as living rooms, offices, and recreation rooms.

Color in Cement Top Coats

31. Normally, a finished cement floor is the same shade of gray as the cement used. Other colors may be obtained by adding them directly to the top coat. The colors most used are red, brown, and green.

When the color is to be mixed in the top coat, you will usually secure the best results by using mineral pigments. The pigments should be added and thoroughly mixed with the cement before either the aggregate or the water is added.

Patterns

32. Cement floors can be laid in almost any pattern; only proper spacing of individual joints and a pleasing arrangement of colors are required. Color separation is generally secured by placing thin wood or metal strips on the base and then pouring the proper colored top mixture into the spaces formed by these strips. The entire floor should then be leveled off and troweled, with care being taken to avoid running the colors together. The strips are then removed and the joints filled. Or the metal strips may be allowed to remain and form permanent joints, as for terrazzo floors. Or one section may be poured at a time and allowed to dry before other sections are poured. This does away with joints.

Various effects can be obtained by using colored or large aggregate. The troweling brings the granules to the top where they give color or texture to the floor. This is useful in providing nonslip finishes.

You can secure tile effects in a cement floor by cutting false joints in the top coat of cement as it is being troweled. The joints may be thin, requiring no filling mortar, or they may be cut wide enough so that they can be filled with mortar after the floor is dry, producing the effect of mortar joints in tile work.

Cement Tile

33. Precast cement tile are formed in metal or wood forms and can be cast in different sizes, shapes, and designs. They are made in gray, which is the normal cement color, or in different colors.

Cement tile have a fairly smooth surface and texture, depending upon the surface of the material in which they are cast. They are used for exterior floors and porches, and in vestibules and stair halls.

Cement tile are usually laid on a concrete base, in a mortar setting bed similar to that used for stone floors. As a rule,

joints are fairly wide and are often filled with a contrasting mortar to bring out the pattern.

Concrete Slab Floors

34. Precast concrete slabs are available which can be set over a structural frame of concrete or steel, or on sand or cinder fill on earth. Such slabs can be used to form a finished floor. They are much used in buildings that have no cellars. The slab units are generally 24″ to 30″ square and 2″ thick. They can be produced with or without color and in different surfaces. The surface depends upon the material used in the casting forms and upon whether or not the surface is ground after the slab is cast. Usually, precast concrete slabs are waxed upon completion and after installation.

Floor Hardeners

35. Cement floors are often treated with hardeners. Manufacturers claim that hardeners make the mixture more dense, and, therefore, more resistant to wear. They also claim that hardeners eliminate some of the sanding or dusting usual in a finished cement floor. You may secure hardeners in liquid or powder form. They may be mixed with the finish coat, or applied after the floor is laid and dry. You should carefully follow the directions of the manufacturers producing the hardeners.

Painting Cement Floors

36. If you intend to use either paint or stain on a cement floor to produce the desired color, the floor surface should be clean, dry, and free of oil, plaster, lime, or other stains. Your best procedure is to wait for several months after the floor has been laid before you paint or stain, to assure its being completely dry.

For staining cement floors, stains made from inorganic dyes are generally used, and interesting mottled effects can be obtained. Usually, several applications are necessary to produce

the desired effect. The paint used on cement floors generally has an oil or rubber base or is of a synthetic-resin composition.

Before applying paint, you should give the floor a priming coat of zinc sulphate dissolved in water; this coat should be allowed to dry thoroughly. The surface is then cleaned with water to remove all crystals. For best results, the paint is applied in not less than two coats, and preferably in three. The first coat should be mixed with a thinner to secure good penetration. In applying a manufactured paint, you should follow the directions of the paint manufacturer. As a rule, painted cement floors should not be used where there is heavy traffic.

Finished Waxing

37. In living areas, a cement floor, whether colored or not, is generally given one or two coats of standard floor wax and is well rubbed and polished. The dull polish makes the surface easier to clean and less liable to dusting or sanding.

Summary

38. A cement floor may be applied as part of the base slab, as a top coat, or in the form of precast tiles or slabs. In coloring cement floors, the most permanent results are secured by using mineral pigments.

Attractive results can be obtained in cement floors that that been carefuly installed, colored, and waxed.

Brick, Tile, and Mosaic Floors

Composition and Use of Brick

39. The term "brick" commonly refers to a building unit of solid burned clay or slate. Brick may be classified as either facing or building brick. Building brick are made especially for building purposes and are untreated for texture or color. Facing brick are made for facing purposes and are treated for texture and color. You may use both types of brick for flooring.

Brick is used for flooring both because of its beauty and its utilitarian characteristics. In the home, brick is used for walks, terraces, porch floors, fireplace hearths, entryways, kitchens, and laundry rooms. In industry, brick fillers are used to withstand heavy wear in steel mills, chemical plants, foundries, breweries, packing houses, and food-processing plants.

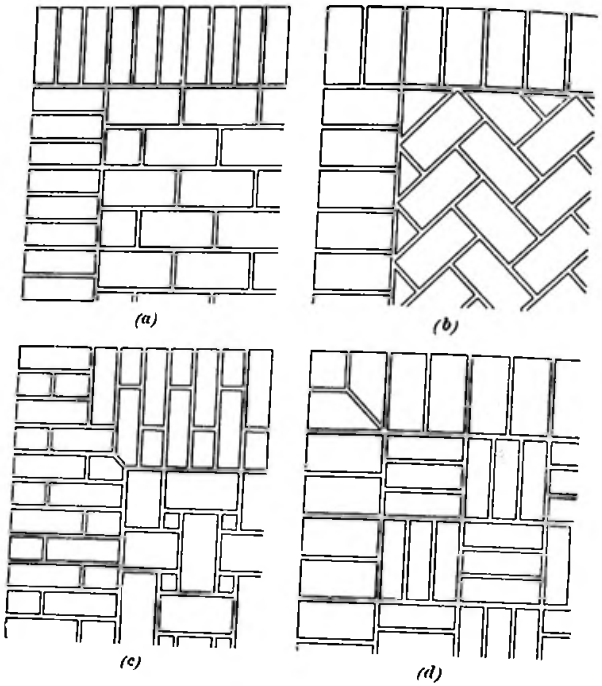
The type of brick that you select for flooring will depend upon the use to which the floor will be subjected. In all cases, the brick that you select should be a solid unit.

Types of Brick

40. For residential work, or for floors not subjected to extreme wear, a dense, low-absorption brick meeting the requirements of Grade SM of ASTM (American Society for Testing Materials) Specifications for Building Brick will usually be satisfactory for floors and pavements. This is true of exterior walks and terraces and the like where the brick are laid in contact with the earth and are often subjected to alternate cycles of freezing and thawing. Here, the lower the absorption of the brick, the more resistant they will be to staining or discoloration and, consequently, the easier they will be to clean.

For locations where appearance is the deciding factor, you can select from the whole range of colors and textures available in face brick. But keep in mind that floors that are to be easy to walk on and to clean should have fairly smooth surfaces. Smooth brick, except that which is glazed, will still provide a nonslip surface.

For industrial floor construction, vitrified paving brick are recommended. Vitrification is that stage in the burning of brick at which the temperature is sufficient to fuse all the grains, close all pores, and render the mass of clay impervious. Usually, only paving brick are burned to complete vitrification. Most paving brick can also be classed as acidproof brick. Paving brick and acidproof brick should comply with the ASTM specifications for these types of brick.



(*a*) Running bond
(*b*) Herringbone
(*c*) Brick and tile
(*d*) Basket weave

FIG. 13. PATTERNS FOR BRICK FLOORS

41. Paving brick are generally the same size as standard building brick, 8″ x 2¼″ x 3⅝″, but they are also made in 1¾″ thicknesses. There is also available a larger size, 8″ x 3″ x 3⅞″. Paving brick have straight edges and faces, so that close joints are possible. In some cases, the edges are slightly rounded to prevent chipping.

For heavy-duty floors where there is much traffic, you may obtain paving blocks 12″ x 12″ x 4″ thick.

Design Patterns

42. You can use brick flooring in any number of patterns. Four common patterns are shown in Fig. 13. Other patterns

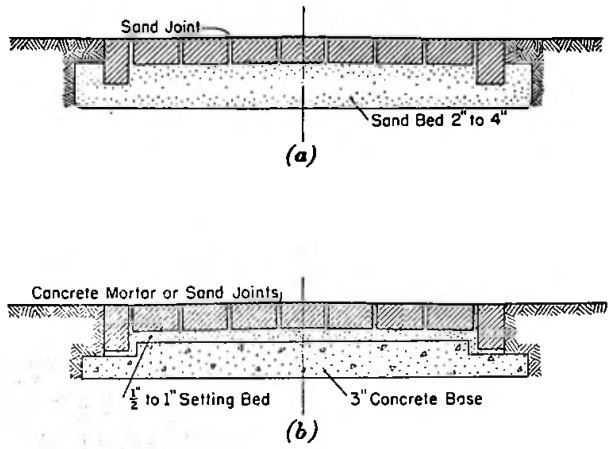


FIG. 14. SECTIONS AT BRICK WALKS

are also used. Brick flooring is often used in combination with other materials to form borders, bonds, and patterns. Most of the brick used for flooring are of a reddish shade.

The Base

43. The base for a brick floor is usually a concrete slab or well-compacted earth. Some exterior brick floors and most interior brick floors are installed over a concrete slab. Residential walks and terraces are often laid over firm ground. Whichever type of base you use, you should install the brick over a cushion or setting bed.

Where no concrete base is required, the cushion may be ¾″ to 4″ of sand rolled and tamped to a uniform thickness. Where the brick floor is laid over a concrete base, cement-sand mortar, bituminous sand, or other types of cushions or setting beds may be used. A brick walk installed on a sand cushion is shown in Fig. 14(*a*). A brick walk on a mortar setting bed is shown in Fig. 14 (*b*).

The mortar setting bed usually consists of 1 part portland cement and 2 parts sand. In chemical or alkali plants, the

cushion may be a mixture of cutback asphalt and sand. In the usual asphalt-sand mixture, 3 to 5 per cent of asphalt is used.

Brick Joints

44. The average paving joint is from $\frac{3}{8}$" to $\frac{1}{2}$" thick. In chemical-resistant brick floor construction, using acidproof brick, the joint should be kept as thin as possible and is generally not over $\frac{1}{4}$".

Where brick are laid on a sand cushion, as in outside walks, you may fill the joints between the brick with fine sand. This gives a certain resilience to the paving, permits rain water to percolate through the joints, and keeps the walk dry. It is not possible by this method to maintain an even, true surface, but the irregular surface is interesting.

Laying Brick Floors

45. In laying brick floors in a setting bed of portland-cement-and-sand mortar on top of a concrete fill or slab, your first step is to level the bed to receive the brick. After mortar has been spread on the edges or faces of the brick forming the joints, the brick are placed on the setting bed and tapped into place. The joints should then be scraped off, using a trowel, in order to secure flush, level joints.

The jointing mortar is usually prepared in the same proportions as the setting bed, with a small percentage of lime added. The lime makes the mortar easier to work and more likely to fill all voids. After the joints are filled and before the mortar is set, all excess should be wiped off. After the mortar is thoroughly dry, the brick should be cleaned with water; at this time the brick can be scrubbed to remove any dirt.

Portland cement grout should consist of 1 part cement and 2 parts sand, by volume, with sufficient water added to permit the grout to be poured between the brick. Before the grout is poured, the brick should be thoroughly wet. After the grout is poured, you should keep the whole assembly damp for at least five days to permit proper curing.

It is often difficult to keep the brick clean during the grouting operation. If portland-cement-and-sand grout is used for the joints, mortar staining can be minimized by brushing the exposed portions of the brick with melted paraffin before the joints are poured. If this is not done and mortar stains result, they may be removed by brushing the brick with a 10 per cent solution of muriatic acid and water.

46. A simple method of applying cement joints is to brush a dry mixture of portland cement and sand—1 part cement to 2 parts sand—into the joints. After the joints are filled, the surplus mixture should be swept off. The brick floor is then sprayed with water at frequent intervals for several days to insure penetration and to aid curing.

There are few chemicals which do not attack regular portland-cement mortar. However, you can render such mortar chemical resistant by means of admixtures. Bituminous mortars and asphaltic mixtures are usually resistant to acids, but do not resist oils, fats, greases, and some organic solvents. Chemical-resistant masonry is a highly specialized field and outside the scope of this text.

When a bituminous filler is poured into the joints, a "separating" agent should be applied first to the brick surface. One such separating agent is composed of 35 per cent calcium chloride, 2 per cent laundry starch, and 65 per cent water, by weight, and is applied in the form of a fine mist. After the joints have been filled and the bituminous filler has cooled sufficiently, the surplus filler can then be easily cut off by means of a flat-bladed tool.

Finish and Care of Brick Floors

47. For industrial floors, no further finishing of the brick surface is required. In residences, or other installations where an extremely smooth surface is desired, the brick floor may be ground to a uniform smoothness by using a grinding machine. The surface may then be given one or more coats of a suitable

floor wax. Special sealing compounds may also be supplied to such a floor. You should not use shellac or varnish.

Brick floors can be cleaned by scrubbing with soap and water. They may be maintained by occasional coats of floor wax.

Composition and Use of Tile

48. The word "tile" when used alone has come to mean, in terms of floor and wall coverings, nonstructural units having a clay or ceramic base. Other types of tile are distinguished by qualifying adjectives; thus there is concrete tile, asphalt tile, plastic tile, rubber tile.

The small units of clay and other ceramic materials in different shapes and sizes are fired in the ovens in the course of manufacture and are produced in glazed or unglazed surfaces and in a variety of colors and finishes.

Tile floors can be used in many different applications, especially where sanitation and resistance to wear are essential. In the home, tile floors are used for vestibules, living rooms, kitchens, laundries, bathrooms, porches, and terraces. In larger buildings, tile floors are used for corridors, washrooms, toilet rooms, lobbies, laboratories, industrial areas, and general working areas.

Methods of Production

49. Both floor and wall tile are produced in the same general manner by either the plastic or the dry-press method. A brief description of how tile are made should help you in selecting the correct type for a required use.

Plastic Method. In the plastic method of production, the clays are ground, mixed with water, and then formed in molds either by hand or by pressing through machines. When dry, the tile are placed in kilns and fired under high temperatures. Owing to the effect of the heat on the clay, a slight warping in surface and shape is usual, resulting in a handmade appearance. Tile is produced by this method in glazed faience tile, and in both glazed and unglazed quarry tile, natural-clay-type ceramic-mosaic tile, and pavers. When the tile are formed by hand, they are more irregular, and are generally known as faience tiles.

Dry-Press Method. In the dry-press method, the clays are first ground to dust and mixed with water. The water is then extracted until the clay contains only about 10 per cent moisture. This mass is then pulverized and mechanically pressed into shapes in metal forms, which are placed in the kilns and fired. The result is tile with an even, uniform surface, and but little irregularity in form. The dry-press method is generally used to produce the body, or biscuit, for glazed tile and ceramic-mosaic tile.

The product of the first firing by either the plastic or the dry-press method is unglazed tile.

Surface Finishes and Colors

50. Tile come in glazed and unglazed surface finishes. In unglazed tile, the normal color results from the color of the natural ingredients in the mixture. To secure other colors, chemicals or coloring matter are added to the clay during the process of manufacture and before firing.

In glazed tile, you will find a much wider range of colors than in unglazed tile. The color is applied to the unglazed body, or biscuit, as part of a liquid glaze. The tile is then fired again. This second firing causes the glaze to fuse with the body. Usually, it takes several coatings and firings to produce the desired effect. There is almost no limit to the variety and shades of color obtainable. The tile can have a dull or mat glaze, a satin finish, or a highly polished surface.

Density and Vitrification

51. The density of tile is due to the composition of the materials used to make the tile and to the method of firing, or

TABLE 1

PER CENT OF WEIGHT OF WATER ABSORBED BY TILE

Degree of Hardness	Per Cent of Weight Absorbed
Impervious	Less than 0.5
Vitreous	From 0.5 to 3.0
Semivitreous	From 3.0 to 7.0
Nonvitreous	From 7.0 to 15.0

burning. As shown in Table 1, tile are usually classified according to degree of vitrification, or hardness, depending upon the amount of water the tile will absorb under test. Tile falling within the first three degrees of hardness in Table 1 are considered as best adapted to floor surfaces. From this you should not conclude that nonvitreous tile is weak tile. Its greater absorption gives it greater adherence to mortar, and makes it more readily laid than vitreous tile. However, where resistance to heavy wear, moisture, grease, or liquids is required, you should use the vitreous or impervious types of tile.

Weather Test

52. Not only must tile for exterior work meet hardness requirements, but they should pass a test showing their resistance to severe weathering conditions or freezing. This test, recommended by the tile industry, consists of immersing tile in water, then freezing them, and finally dipping them into lukewarm water. If, after passing these tests, the tile are generally free of crazing, cracking, or spalling of either body or glaze, you may consider them suitable for use in exposed places.

Basis of Sizes of Tile

53. Tile come in various sizes and shapes, but the basis of nearly all shapes and sizes is a geometric retrogression from a 6″ square, as shown in Fig. 15. All subdivisions are made from the diagonal and parallel spaces resulting from dividing this

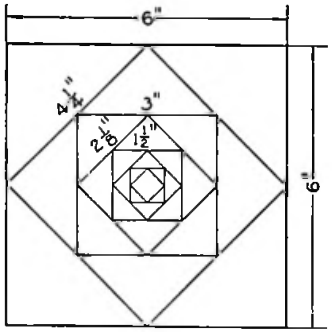


FIG. 15. BASIC SHAPE AND CUTS OF TILE

square. As a result of this system, standard sizes have been developed which fit together with uniform joints in any desired pattern.

Unglazed Tile

54. Unglazed tile are composed of a homogeneous mixture, having the same ingredients throughout the body. The surface may be plain, mottled, textured, or variegated, depending upon the method of production and firing.

Unglazed tile are of several types and are generally distinguished as ceramic-mosaic tile, pavers, quarry tile, or unglazed faience. While used to some extent for wall covering, unglazed tile are mostly used for floors.

Unglazed Quarry Tile

55. Quarry tile are made principally from a combination of clay and shale by the plastic method, either by mechanical extrusion or by hand pressing. The body of these tile is very dense and the tile have irregular edges with a rugged, handmade appearance. Color is obtained by using certain combinations of clay, and is restricted mostly to red, buff, brown, black, and gray The faces are either a plain uniform shade, or are burned in such a way that the edges become harder and darker. This burning process is called fire flashing. Quarry tile are

TABLE 2

COMMON SIZES OF QUARRY TILE

Shape of Tile	Sizes Inches	Thicknesses Inch
Square	$2\frac{3}{4}$	$\frac{1}{2}$
	4, 6	$\frac{1}{2}$, $\frac{3}{4}$
	8, 9	$\frac{3}{4}$
Oblong	$6 \times 2\frac{3}{4}$	$\frac{3}{4}$
	$8 \times 3\frac{3}{4}$	$\frac{3}{4}$
	6×9	$\frac{3}{4}$
	8×4	$1\frac{1}{2}$

made in various thicknesses, depending upon the sizes of the tile. Some common sizes are given in Table 2.

You will find quarry tile suitable for exterior and interior flooring. A quarry tile floor used for the interior of a store is shown in Fig. 16.

Unglazed Ceramic-Mosaic Tile

56. Unglazed ceramic-mosaic tile are made of natural clay and porcelain and are used mostly for floors. The surface of the tile is flat and dull and only slightly granular in texture. The surface is generally uniform with sharp edges. The tile come in various colors from white to black. For ease in laying, unglazed ceramic-mosaic tile are generally mounted on paper in 2′ (foot) squares. These tile are usually made in thicknesses of $\frac{1}{4}$″ and $\frac{3}{8}$″ and in the sizes and shapes given in Table 3.

TABLE 3

COMMON SIZES OF UNGLAZED CERAMIC-MOSAIC TILE

(In Thicknesses of $\frac{1}{4}$″ and $\frac{3}{8}$″)

Shape of Tile	Sizes Inches	Shape of Tile	Sizes Inches
Square	1, $\frac{3}{4}$, $1\frac{9}{16}$, 2, $2\frac{3}{16}$	Hexagon	1, $1\frac{1}{4}$, 2
Oblong	$1\frac{1}{16} \times \frac{1}{2}$	Pentagon	$1\frac{9}{16}$, $2\frac{3}{16}$
	$1\frac{9}{16} \times \frac{3}{4}$	Octagon	$2\frac{3}{16}$
	$2\frac{3}{16} \times 1\frac{1}{16}$		

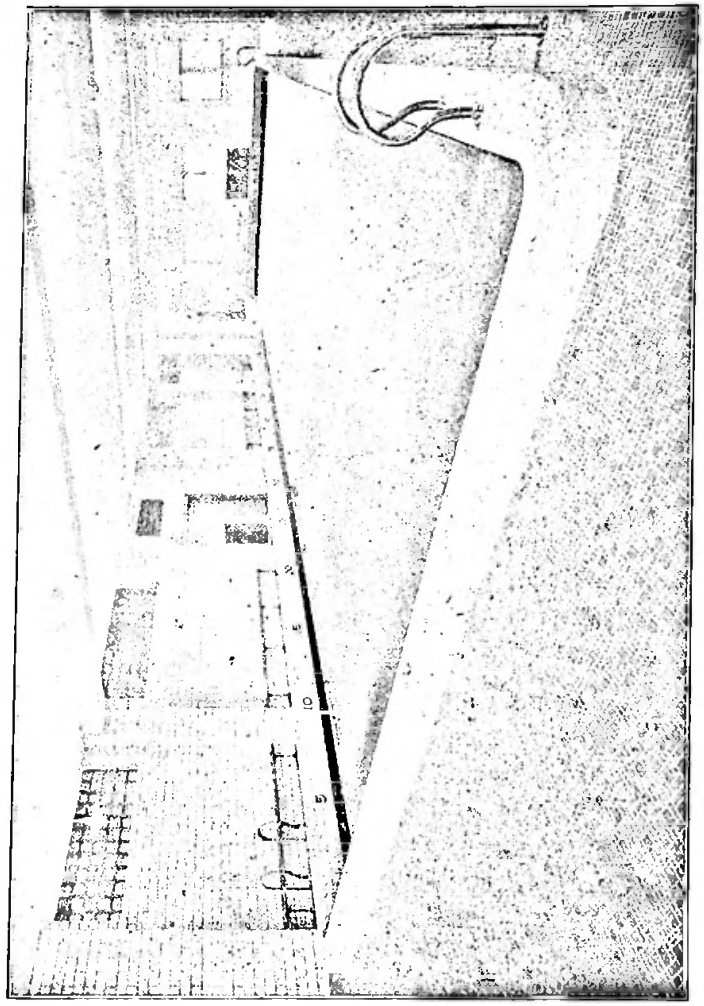


FIG. 18. CERAMIC-MOSAIC FLOOR IN NATATORIUM

Unglazed ceramic-mosaic tile are used for the floor and end wall of the bathroom in Fig. 17 and for the natatorium floor in Fig. 18. The numerous joints are an advantage in reducing the slipperiness of the floor when wet. An infinite number of patterns is available in ceramic-mosaic tile.

A special-purpose ceramic tile used for floors of hospital operating and anesthetizing areas is made electrically conductive to prevent sparks or shock. This conductive tile is an unglazed tile made by either the dry-press or plastic method. Materials are added to the clay to give electrical conductivity to the tile while retaining other normal physical properties.

Unglazed Faience Tile

57. Unglazed faience tile are generally fairly thick and solid tile, used mostly for floors but sometimes on walls. The usual sizes of this tile are 6″x6″, 6″x3″, 3″x3″, and 4¼″x4¼″, although you can obtain other sizes upon request. The surface of this tile has slight irregularities and shadings of color; thus this tile make an interesting installation.

Unglazed Pavers

58. Unglazed pavers are made of natural clay and porcelain and are sometimes known as flints or hydraulics. They are usually ½″ or more in thickness and are made in units larger than 6 sq. in. (square inches). They come in a variety of colors and are used for heavy-duty flooring.

Nonslip Abrasive Tile

59. Abrasive tile are made from either natural clay or porcelain bodies. Into the body mix is introduced an abrasive grain, such as carborundum or alundum. This grain gives the tile, after burning, a nonslip surface, useful on steps and where nonslip floors are needed.

Glazed Tile

60. Glazed tile are made by fusing a glassy surface of ceramic materials upon the unglazed body. The glazed surface

is hard, impervious, and resistant to most acids and stains. Glazes are generally mat glazes, which have a dull finish with no reflective surface. Glazed tile is made in several degrees of hardness. For a glazed tile flooring, you should select one of the hard glazes with a mat finish to withstand wear.

The more common types of glazed tile are glazed interior tile, glazed exterior, or weatherproof, tile, glazed faience tile, and glazed ceramic tile.

Glazed tile for interior use are about ¼″ to ⅝″ thick, depending on the method of manufacture. They form a durable wall surface, but are never recommended for floors. They are usually made in 6″ x 6″, 3″ x 3″, and 4¼″ x 4¼″ sizes. Glazed 4¼″ x 4¼″ tile are used for the side wall in Fig. 17.

Glazed exterior tile pass the weather test and have very durable surfaces. They can be used inside or outside, and will resist heavy wear. Included among them are glazed vitreous and semivitreous tile, glazed quarry tile, glazed faience tile, and glazed ceramic-mosaic tile. They are generally made in the same sizes as interior tile and can be used for light-traffic floors as well as for wall finishes. Special glazed tile are made for use in industrial rooms, swimming pools, and tunnels, or where there is heavy usage.

Glazed ceramic-mosaic tile are generally from ¼″ to ½″ thick and of the same sizes as the unglazed types. They are used mostly on floors, but sometimes for walls. You can obtain them in many colors.

Grading of Tile

61. The National Bureau of Standards recommends certain requirements for the physical grading of tile. These standards vary for different classes of tile.

For most tile there are two grades: "standard grade" and "seconds." Grades are generally marked by the manufacturer on the sealed containers in which the tile are shipped. You can also secure certificates of quality from the tile contractor

TABLE 4

SIZES OF JOINTS FOR TILE FLOORS

Kind of Tile	Width of Joint Inch
Ceramic tile, mounted, in small pattern	$\frac{1}{16}$ to $\frac{1}{4}$
Ceramic tile, unmounted, in small pattern	$\frac{1}{8}$ to $\frac{1}{4}$
Flint and paving tile	$\frac{3}{16}$ to $\frac{1}{2}$
Faience and handmade types	$\frac{1}{4}$ to $\frac{1}{2}$
Quarry tile	$\frac{3}{8}$ to $\frac{1}{2}$

on request. Faience tile, since they are handmade, are difficult to classify, but tile obviously damaged during manufacture are graded as "seconds." Grades for quarry tile are "perfected," "standards," and "seconds." "Perfected" includes selected standard tile which have had the edges ground to size so that they may be laid with a close joint.

Installation of Tile Floors

62. In most cases, floor tile are laid on a concrete foundation or base. Where there is a structural floor slab, a setting bed is placed over the slab. Depending on the roughness of the slab, this setting bed should be from $\frac{3}{4}$" to $1\frac{1}{2}$" thick.

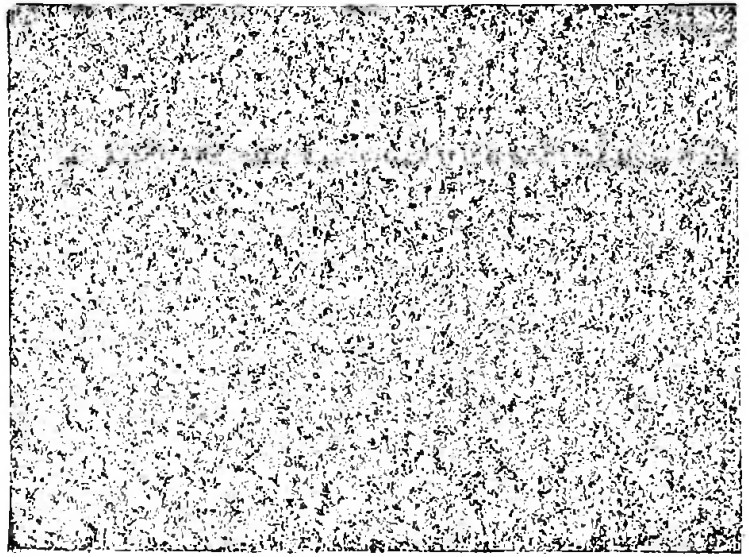
The setting bed, composed generally of 1 part cement and 3 parts sand, is spread evenly to the level required to bring the tile to the correct floor level. The thickness of the tile governs the thickness of the setting bed.

The top of the setting bed is dusted while wet with neat portland cement. The tile are then positioned, pressed firmly into place, and tamped level before the initial set has taken place in the setting bed. All types of tile, except the nonabsorbent types and those mounted on paper at the factory, must be thoroughly soaked in water before they are set. This soaking prevents the tile from absorbing water from the mortar setting bed. Such absorption of water would weaken the mortar so that the tile would not adhere properly to the bed.

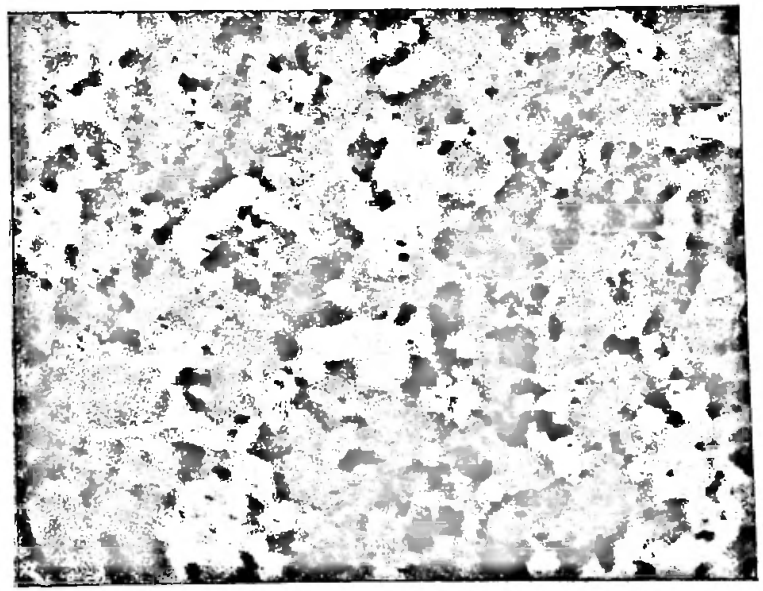
Floor, Wall, and Ceiling Coverings

Serial 6239A Part 1 Edition 1

Illustrations in Color that are referred to by figure numbers throughout the text.



(*a*)



(*b*)

(*b*) Red granite (*a*) Gray granite

FIG. 1. SAND-RUBBED FINISH ON GRANITES

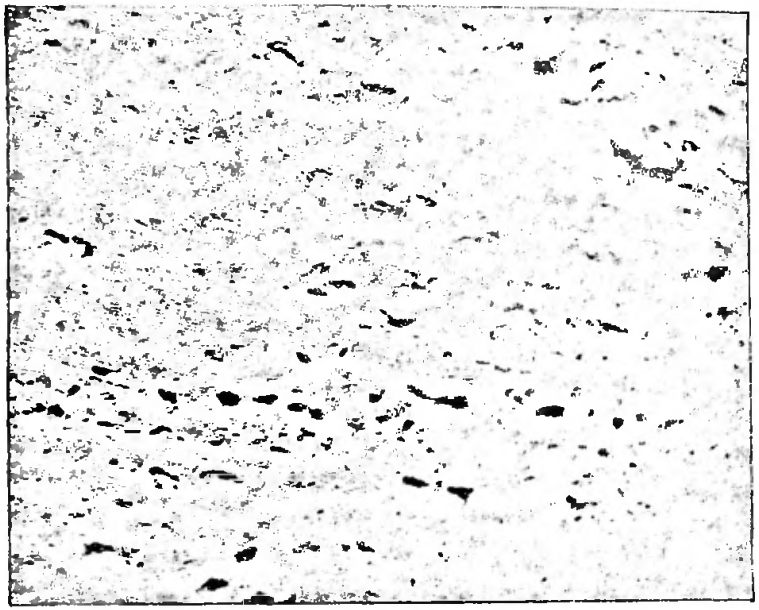


FIG. 7. TRAVERTINE

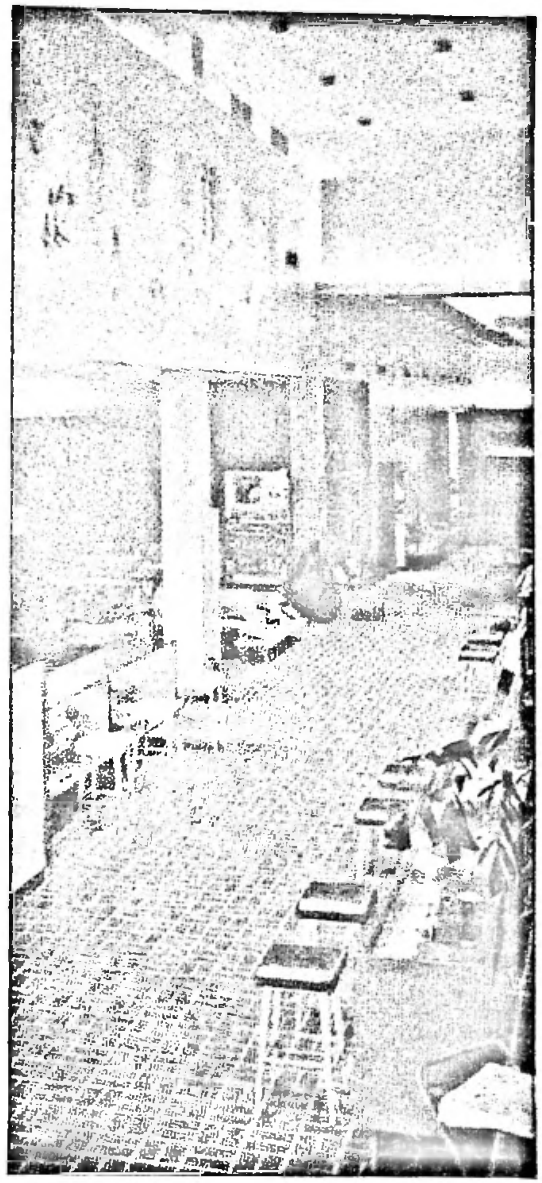


FIG. 16. QUARRY-TILE FLOOR IN STORE

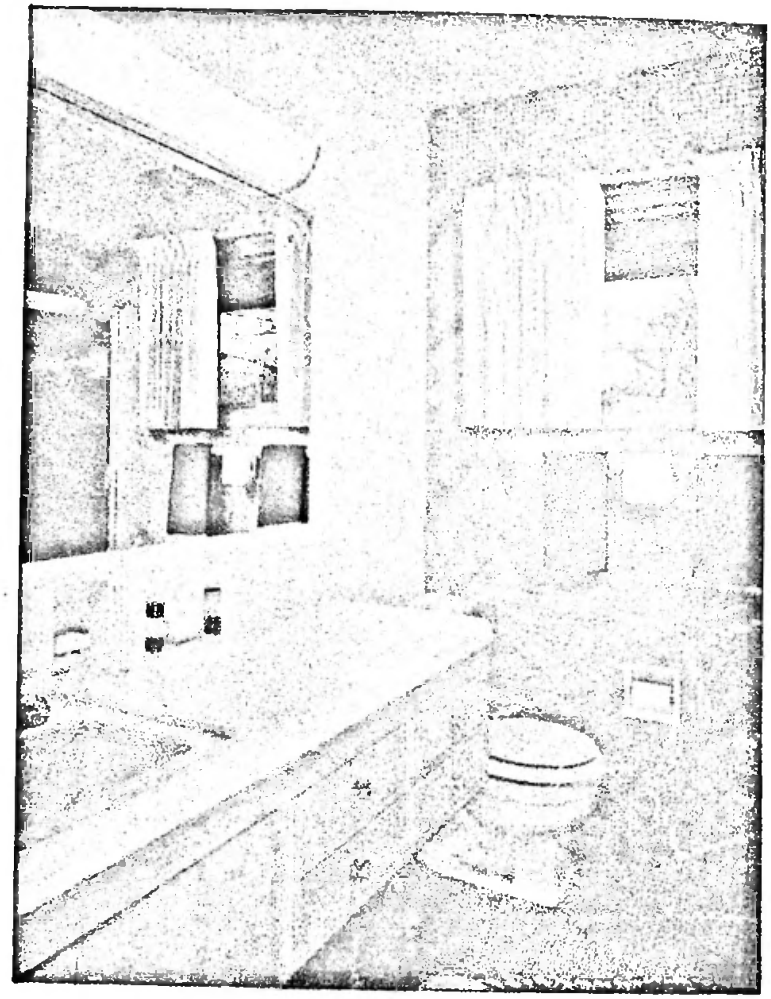


FIG. 17. CERAMIC-MOSAIC FLOOR IN BATHROOM

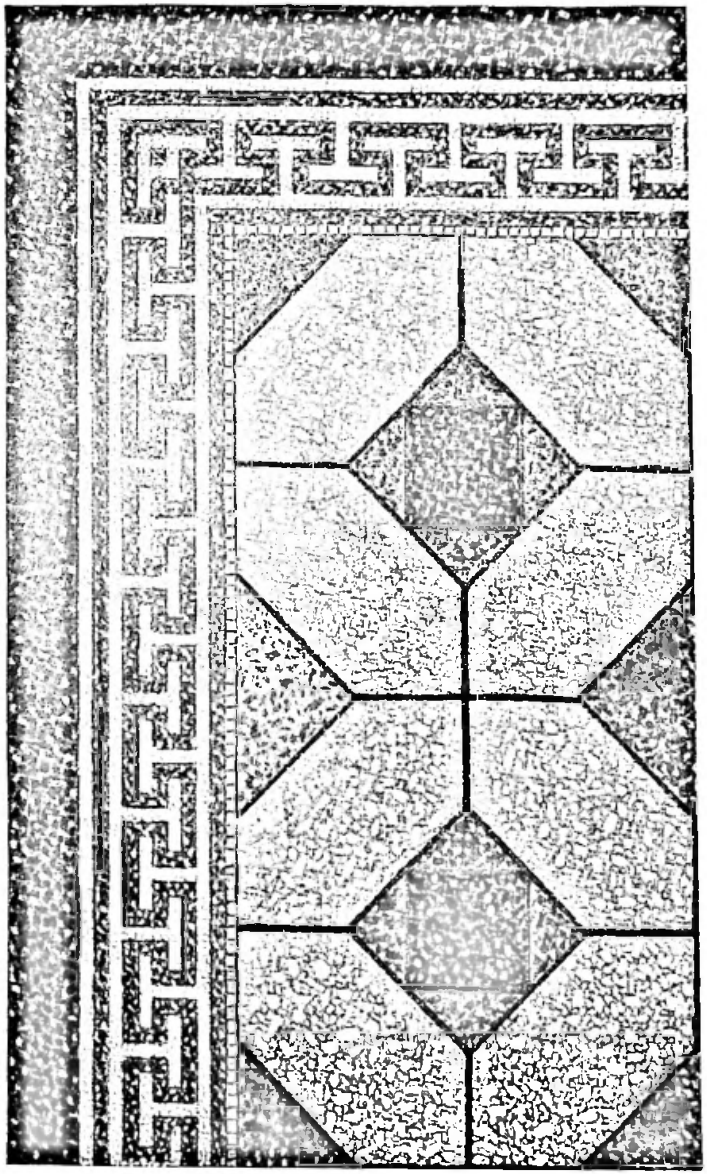


FIG. 21. DESIGN IN TERRAZZO FLOOR

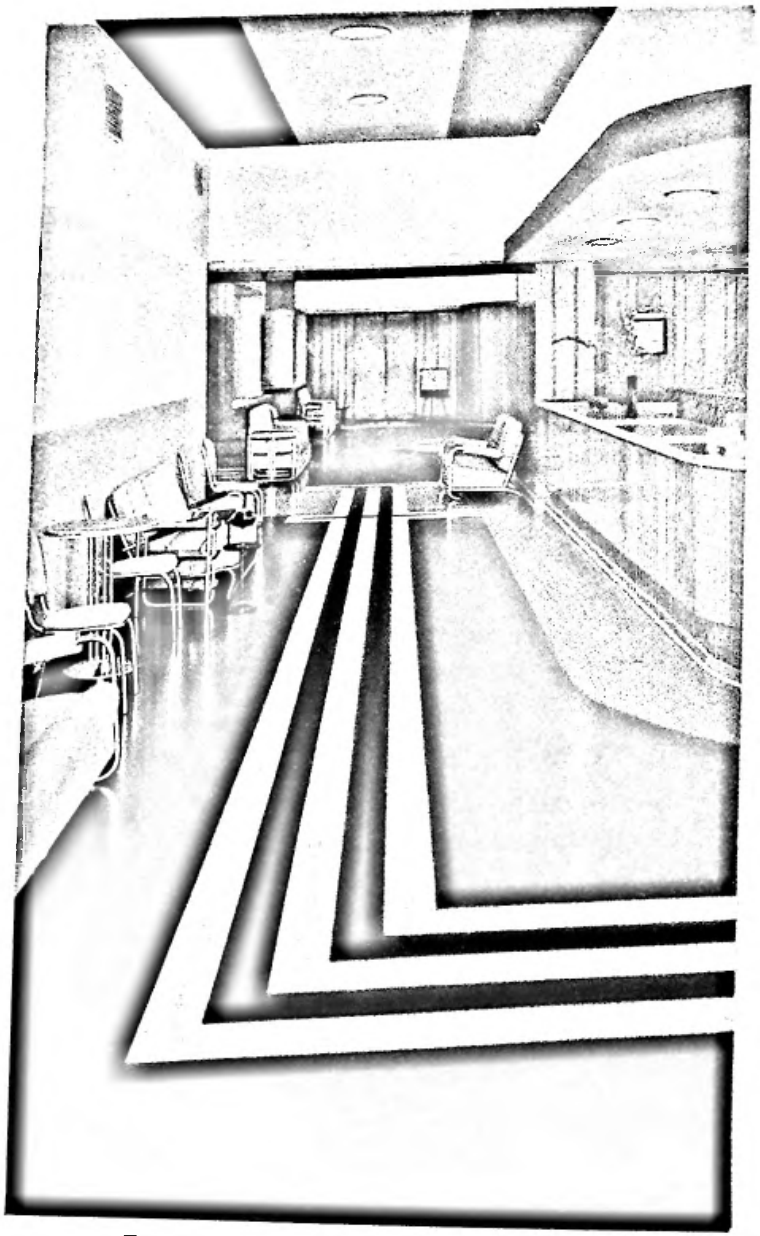


FIG. 26. LINOLEUM FLOOR OF SPECIAL DESIGN

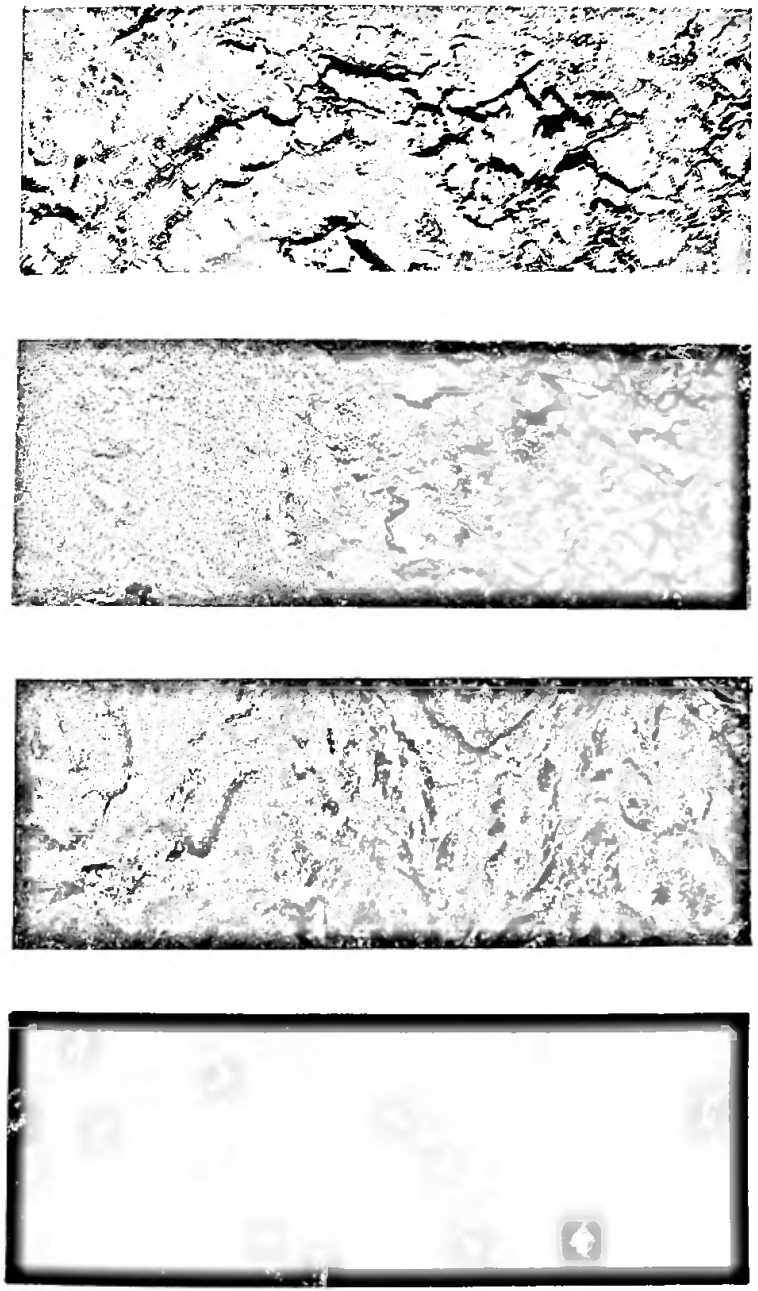


FIG. 28. PATTERNS OF MARBLEIZED LINOLEUM

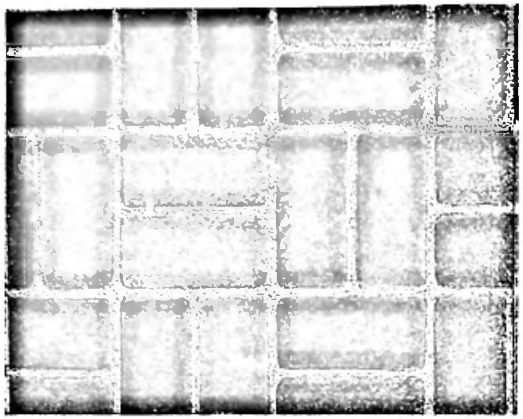


FIG. 29. EMBOSSED INLAID LINOLEUM

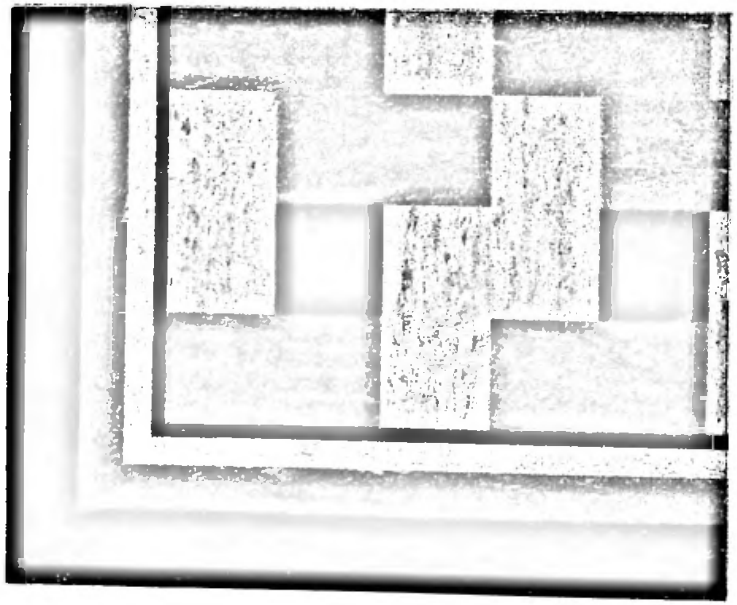


FIG. 30. CORK TILE

FIG. 34. PLANK FLOORING IN LIVING ROOM

Fig. 37. Wall-to-Wall Carpeting

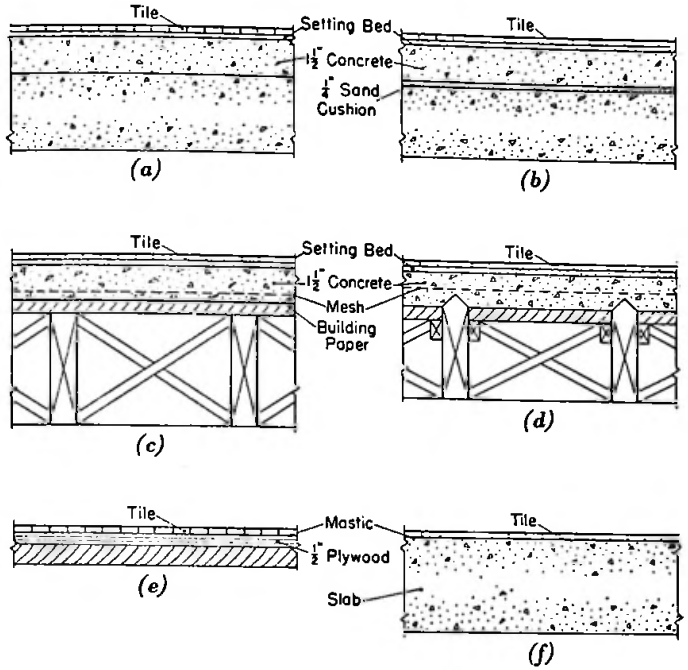


Fig. 19. Details of Tile Floors

Ceramic-mosaic tile are generally laid with close joints. Quarry and faience tile usually have wider joints, as determined by the floor design. In Table 4 you will find the customary widths of joints for various types of tile floors.

63. When the mortar bed has set firmly, the paper backing in the ceramic-mosaic types of tile, or the excess mortar in all individually set types, is removed. The joints between the tile are then filled, either by grouting or by placing mortar with a trowel, depending on the width of the joints. Next, the joints are rubbed or troweled smooth and level and sprinkled with dry cement while wet, to take up any voids on the surface. Before the jointing mortar has completely hardened, you should see that all excess cement is washed off, leaving the floor clean.

64. In existing wood construction, a concrete slab may be formed between the wood joists or on them, as shown for stone floors in Fig. 10 *(b)*. The setting bed and the tile are then laid in the usual manner.

If the tile floor is laid in mastic, no setting bed is needed, but a firm, level surface is required. In wood construction, a firm, level surface may be provided by plywood. In concrete construction, a troweled finish may be given to the concrete slab. You can see the different types of construction in Fig. 19, views *(a)* to *(f)*.

Cleaning

65. After the mortar in the joints has set thoroughly, the tile should again be washed. Unglazed-tile and quarry-tile types are sometimes given a light coat of linseed oil, applied with a rag, to bring out the color and texture.

Composition and Use of Mosaic

66. Mosaic floors consist of small cubelike pieces called tesserae, which are laid in patterns. The patterns are formed by the colors of the various cubes. In most cases, these cubes are of marble, but glass and small ceramic tile are also used. The distinctive feature of mosaic flooring is the effect secured by laying the cubes individually by hand, so that there is an absence of a mechanical appearance. In Fig. 20 is shown a design in a mosaic floor.

A mosaic floor is a hard, long-wearing floor, and the many joints give it a nonslip character. Due to the labor involved, mosaic floors are usually expensive. Mosaic floors occur principally in locations requiring special architectural treatment, as in the lobbies of public buildings and in church sanctuaries.

Installation of Mosaic Flooring

67. The sides of the cubes used for mosaic flooring vary in size from $\frac{5}{8}$″ to $\frac{3}{4}$″ square. They are cut mostly by hand. For special designs, the pieces are cut into the shapes required to

FIG. 20. DESIGN IN MOSAIC FLOOR

carry out the pattern The human figure, trees, flowers, and paintings can be imitated in mosaic flooring.

To make certain that the design will be accurately carried out, the cubes, or tesserae, before setting, are usually assembled and individually pasted to a paper backing in the same manner as ceramic mosaic. The paper is attached to the exposed surface of the mosaic and must be washed off after the mosaic has been embedded in and tamped into an underbed of cement mortar. After the paper is removed, the joints are grouted with cement. If marble tesserae are used, the floor is machine rubbed. The joints are then grouted again, and the floor is reground so that the marble will have a smooth, honed

finish. If glass and ceramic cubes are used, they are tamped level, the joints grouted, and the floor cleaned.

Summary

68. Brick floors provide a pleasing, nonslip, durable surface that is low in maintenance cost. You can arrange brick flooring in many patterns, and use it in such areas as porches, terraces, living rooms, and recreation rooms. Brick floors should have comparatively smooth surfaces for easy cleaning and safe walking. Vitrified paving brick are recommended for industrial floors.

Tile can be obtained in a wide range of colors and in glazed or unglazed finishes to produce durable and colorful floors. Vitreous tile are more resistant to moisture, wear, and grease than are nonvitreous tile. Most floor tile are laid in a mortar setting bed on a concrete base.

Original designs may be executed in mosaic floors. Because of the small size of the individual pieces and the labor involved, mosaic floors are expensive. You will find that use of such floors is usually restricted to important areas in public buildings and to church sanctuaries.

Terrazzo Floors

Composition of Terrazzo

69. A terrazzo floor is similar to a cement floor in that it is composed of cement, water, and aggregates. Usually, the aggregates consist of small chips of marble, but sometimes chips of granite or other hard stones are used. The chips are mixed with portland cement and water, and the mixture is usually applied as a top coat over a concrete base. Sometimes the terrazzo is precast in the form of slabs and is then installed in the same manner as marble. When the terrazzo is poured in place, metal divider strips are used to control and localize the shrinkage that accompanies setting.

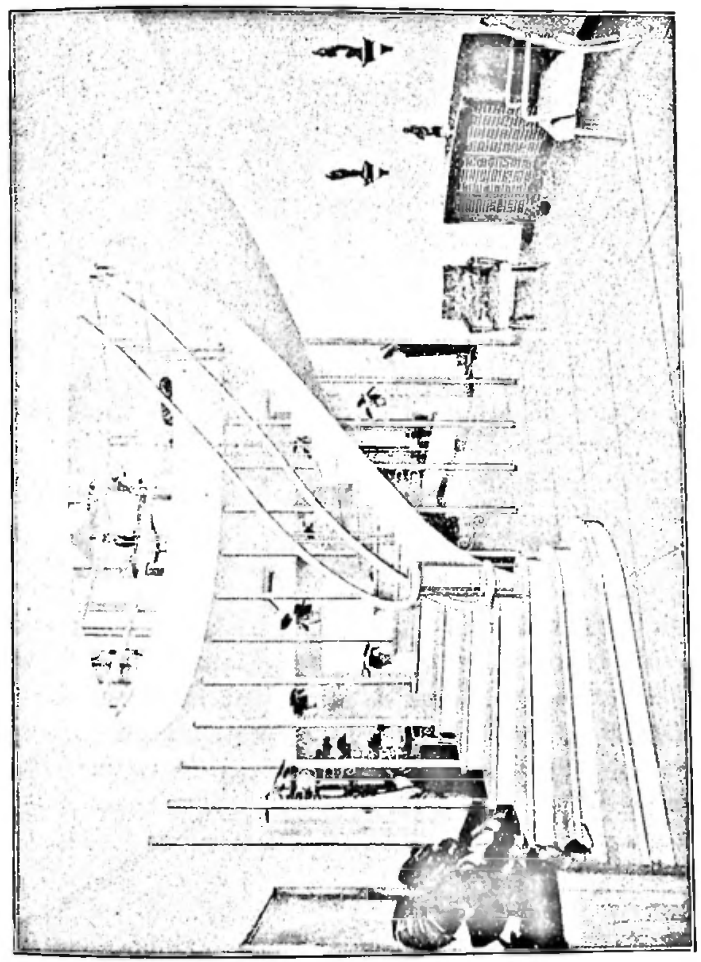


FIG. 22. TERRAZZO FLOOR IN RESIDENCE

The color of a terrazzo floor is determined by the color of the cement and aggregates used. Terrazzo floors may be installed in a wide variety of colors.

A terrazzo floor may be laid out in interesting designs with the divider strips separating the various colors. Fig. 21 shows the use of different colors in a patterned terrazzo floor, and the method of outlining the components of the pattern and separating the colors by means of divider strips. Notice that the strips are indicated on the illustration by dark lines. Notice also the mosaic tile border.

Uses

70. Terrazzo floors are suitable for locations where the floors must be sanitary, resistant to wear, and easy to clean. Corridors, lobbies, washrooms, public waiting rooms, toilet rooms, hospital operating rooms, and laboratories are typical of such locations. In Fig. 22 is shown a terrazzo floor used in the stair hall of a home.

Aggregates

71. The sizes of aggregates generally used for terrazzo are given in Table 5, Sizes Nos. 1, 2, and 3, mixed in proportions as desired, are commonly used. These small sizes are available in marble from the waste that results from cutting marble slabs. They may be had in most types and colors of marble.

For a nonslip surface, you may add powdered grains of

TABLE 5

SIZES OF AGGREGATES FOR TERRAZZO FLOORS

Size No.	Passed by Screen, Opening Size in Inches	Retained on Screen, Opening Size in Inches
0	$\frac{1}{8}$	$\frac{1}{16}$
1	$\frac{1}{4}$	$\frac{1}{8}$
2	$\frac{3}{8}$	$\frac{1}{4}$
3	$\frac{1}{2}$	$\frac{3}{8}$

minerals such as carborundum, alundum, or bronzalum to the top mixture.

Matrix

72. The mortar of cement and water in which the aggregates are mixed to produce a terrazzo floor is called the matrix. In some cases a close, firm pattern with a larger percentage of chips is desired, and so little of the matrix is visible. In other cases the proportion of chips is less, and more of the matrix appears on the surface. A white portland cement is generally used in the matrix; this can be colored as desired. Where a dark-gray color is wanted, you will find that standard or normal portland cement is usually satisfactory.

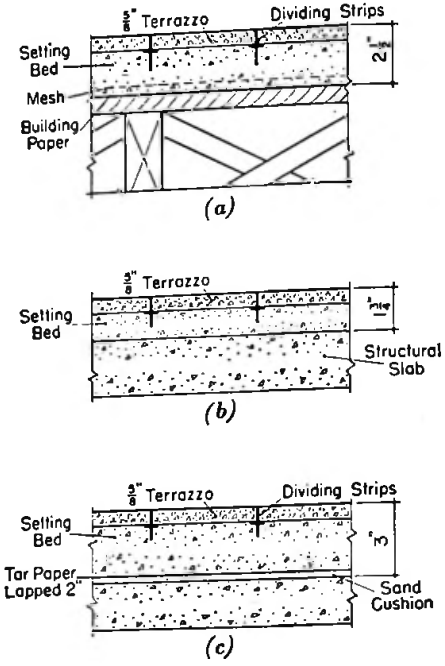
A matrix that employs gypsum cement instead of portland cement is sometimes used, and is satisfactory in places where the traffic is not too heavy.

Preparation of Base

73. If cracks in the finished terrazzo floor are to be avoided, you will need a substantial structural base. The usual base for terrazzo work is a concrete slab.

There are two methods of installing the finished terrazzo floor. One method is to bond the underbed directly to the floor construction. The other method is to place on the floor slab a sand cushion which will prevent any shrinkage cracks in the structural slab from coming through the terrazzo. In both methods, the surface of the slab should be entirely free of all plaster droppings, wood chips, and other debris.

In the second method, a $\frac{1}{4}$″ layer of fine sand is first placed on the floor slab; over this layer of sand, layers of tar paper are laid. On them is placed the underbed, which is composed of 1 part portland cement and 4 parts coarse screened sand. This underbed should be reinforced with a thin wire mesh. As soon as the underbed is laid and leveled, the divider strips should be placed so that the tops of the strips will be at the level of the finished floor.



(*a*) Over new wood construction
(*b*) Over concrete slab
(*c*) Over concrete slab with sand cushion

FIG. 23. DETAILS OF TERRAZZO FLOORS

Terrazzo Dividing Strips

74. The divider strips, used for separating colors and for overcoming shrinkage in the terrazzo top coat, are usually of brass. Strips of other nonferrous metals—such as aluminum, bronze, or nickel-bronze—are also used, as well as plastic composition strips in various colors. In all cases, the strips should be 1¼" deep and should be well anchored in the underbed.

When the strips are placed and leveled, the terrazzo top coat is mixed. The top coat is mixed dry, usually in the proportions of 200 lb (pounds) of marble granules to 100 lb of portland cement Water is added after the mixing to make the mix plastic but not flowing.

The top coat is then placed. This coat should be not less than ⅝" thick. To carry out the desired pattern, the terrazzo top coat is placed carefully between the strips, which separate the colors. Next, it is rolled level with a heavy hand roller until all surplus cement and water are extracted, with care being taken to avoid running one color into another. It is then hand troweled to an even surface, disclosing the lines of the strips on a level with the terrazzo filling. The finished surface should show a minimum of 70 per cent of marble granules. The floor is kept moist for at least 6 days by covering it with sand, paper, or curing mats.

This type of construction with a sand cushion requires a minimum thickness of 3" over the structural concrete slab. If the underbed is bonded directly to the concrete slab, only 1¾" is needed. Over a wood floor on wood joists, allow 2½". These various constructions are shown in Fig. 23, views *(a)*, *(b)*, and *(c)*.

Finishing Terrazzo Flooring

75. When a terrazzo floor has cured and is sufficiently hard to prevent defacement, it is machine rubbed, generally with an electric-powered machine operating with a rotary motion and using No. 24 grit or finer abrasive stones. This first operation grinds the marble and cement to a true, level surface. The surface is then reground, using a No. 80 grit or finer abrasive stone. The grinding produces a thick mud which is washed off before the next operation.

Next, a thin coat of cement grout of the same color as the matrix is put over the flooring and allowed to set until the final grinding and not less than 72 hr (hours). This grout fills all of the pores and voids, and makes the flooring solid. The flooring is then thoroughly wet again and ground, using a stone not coarser than No. 80 grit, until a fine, semipolished surface is obtained. At the corners of the wall and the flooring, and in any coved or vertical work—for instance, a terrazzo base—

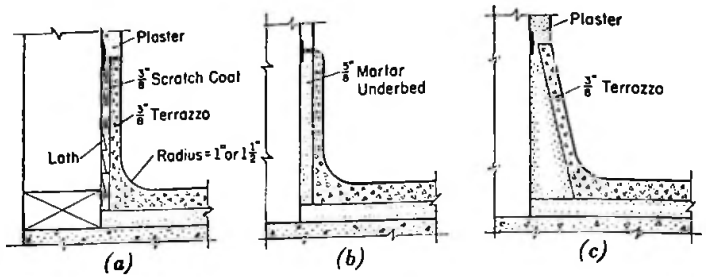


FIG. 24. DETAILS OF TERRAZZO BASES

the grinding must be done by hand. Sections through terrazzo bases are shown in Fig. 24. A base for a shower stall is shown in Fig. 25. When the grinding is completed, the terrazzo is thoroughly washed; it requires no maintenance other than occasional cleaning.

Terrazzo floors may be washed frequently. A neutral soap should be used; you should avoid soaps containing alkalies, acids, oils, or other strong ingredients which will cause stains or otherwise harm the finished floor. After every washing, the floor should be rinsed with clean water.

Precast Terrazzo

76. Terrazzo is sometimes precast, especially when it is to be used as floor tiles, door thresholds, stair treads and risers, coves, and bases. You may also use it for wainscoting.

Precast terrazzo is made by the same general method as terrazzo that is finished in place, except that the material is poured into molds and finished in the shop. At the building, precast terrazzo is set in mortar in the same manner as marble.

Art Marble Flooring

77. Art marble flooring is similar in composition to terrazzo, but instead of small marble chips being mixed with a matrix layer, larger pieces of marble of odd and irregular sizes are used. The pieces of marble are individually set in mortar, and are then ground or rubbed smooth after the mortar has set.

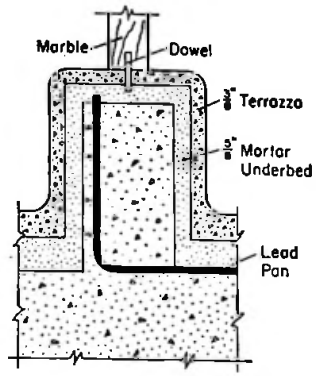


FIG. 25. TERRAZZO BASE IN SHOWER STALL

Sometimes the pieces of marble are set and the mortar is poured around as a grout. Like terrazzo, art marble flooring may be precast at the shop as floor tile. The flooring is used for such locations as sunrooms, porches, and patios, where colorful effects are desired.

Summary

78. Terrazzo floors are made of cement, water, and aggregate. A terrazzo floor that uses marble chips as the aggregate may be compared to a monolithic marble floor. Its freedom from joints makes the terrazzo floor sanitary and easy to clean. The terrazzo floor, since it is sanitary, beautiful, and available in a wide selection of colors, has many uses.

The extremely durable floors that you have studied thus far—stone, cement, brick, tile, mosaic, and terrazzo—have hard surfaces. Next you will study some of the softer and more resilient floors.

Resilient Floors

Composition

79. The term "resilience" as it applies to a floor refers to the underfoot comfort of the floor, its deadening of the noise due to foot traffic, and its resistance to or recovery from indentation from foot traffic and other short-term loads.

The base in most resilient floors is a resilient material such as cork, asphalt, or rubber. The resilient materials in combination with binding cements are manufactured by various methods.

Composition varies with each type of resilient flooring. The basic materials and binders determine the characteristics of a floor and areas in which it can be used.

Areas of Use

80. The first general use of resilient flooring was in kitchens and bathrooms, where sanitation and ease of cleaning are definite requirements. Today you will find resilient flooring used in almost every kind of interior space. They are particularly adaptable for use over old floors in existing buildings.

Recent developments have resulted in improved floorings and in many different types of flooring which are known by their trade names. Some floorings are especially made for spaces where a quiet floor with resilient qualities is desirable. Others are produced for industrial areas. As a general rule, resilient floors are not used where heavy trucking, acids, or excessive dampness are encountered.

Types and Characteristics

81. Resilient floors are of two types. The first type and the one most commonly used consists of a finished material applied in thin sheets, strips, or small units. Included in this type are asphalt tile, rubber tile, linoleum, plastic tile, and cork tile.

Floors of the second type provide a homogeneous surface

TABLE 6

PROPERTIES AND USES OF RESILIENT TILE AND SHEET FLOORINGS

Type of Flooring	Gage Inch	Basic Materials	Subfloor	Resilience and Quietness	Light Reflectivity Per Cent	Surface Resistance		Durability	Suggested Use
						Grease	Alkali		
Asphalt tile		Asphaltic compounds	All subfloors	Poor	0 to 40	Poor to fair	Excellent	Excellent	
Standard	3/16								Severe commercial
	1/8								Residential, commercial
Conductive (not for use in hospital operating rooms)	1/16		Suspended and on-grade					Good	Heavy industrial for static control
	1/8								Industrial for static control
Cork tile	5/16	Raw cork and resins	Suspended	Excellent	20 to 25	Fair	Fair	Good	Severe commercial
	1/8								Residential, commercial
	1/8								Residential
Linotile	1/8	Oleoresinous compound	Suspended	Fair	0 to 50	Excellent	Poor	Excellent	Residential, commercial, severe commercial
Rubber tile	3/16	Rubber compound	Below, on-grade, suspended	Good	0 to 50	Good	Good	Good	Commercial, severe commercial
	1/8								Residential, commercial
Homogenous vinyl tile	1/8	Vinyl resins	Below, on-grade suspended	Good	0 to 55	Excellent	Excellent	Excellent	Residential, commercial, severe commercial
	3/32								Residential, commercial
Sheet vinyl with backing	0.070	Vinyl resins	Suspended	Fair	0 to 55	Excellent	Excellent	Excellent	Residential, light commercial
Vinyl plastic and asbestos		Vinyl plastic and asbestos	All subfloors	Poor	5 to 50	Excellent	Excellent	Excellent	
Standard	1/8								Residential, commercial, severe commercial
Service gage	1/16								Residential, light commercial
Linoleum tile	3/32	Oleoresinous compound	Suspended	Fair	0 to 45	Excellent	Poor	Good	Residential, light commercial
	1/16								Light residential
Linoleum		Oleoresinous compound	Suspended	Fair to good		Excellent	Poor	Good	
Battleship, heavy	1/4				0 to 55				Residential, commercial, severe commercial
Plain					0 to 55				
Heavy	1/8								Residential, commercial, severe commercial
Standard	0.090								Residential, light commercial
Jaspé					0 to 45				
Heavy	1/8								Residential, light commercial
Standard	0.090								Residential, light commercial
Marbleized					0 to 55				
Heavy	1/8								Residential, commercial, severe commercial
Standard	0.090								Residential, light commercial
Light	0.070								Light residential
Felt-backed					0 to 45				
Standard	0.090								Residential, light commercial
Light	0.070								Light residential
Inlaid, standard	0.090				0 to 35				Residential, light commercial
Embossed inlaid, standard	0.090				5 to 45				Residential, light commercial
Mastic composition	1/4 to 3/4	Asphaltic or special compounds	All subfloors	Depends on composition and type of aggregate		Depends on composition			

and include floors of a mastic type which are applied as mix and troweled to a finish. Properties and uses of this type of flooring are given in Table 6.

Most of the resilient floorings can be produced in a wide variety of colors and patterns. In such floorings as linoleum, rubber tile, and asphalt tile, inserts with multicolored designs are available.

The most useful characteristics of resilient flooring are cleanliness and comfort. The degree of resilience and quietness varies with the thickness of the flooring, the top surface, and the base on which the surface is applied. Generally, resilient floors are not resistant to acids, but ordinary stains, grease, and dirt can be readily cleaned off without damage to the surface. Some resilient floorings are acidproof and greaseproof.

Selecting Resilient Flooring

82. In selecting resilient flooring, you should keep in mind the service conditions under which the floor will be used. The wear that a floor receives has a great bearing on how long it will retain its utility and beauty. Resilient floorings vary in ability to withstand harsh treatment.

In residential installations, most resilient floorings are satisfactory from the standpoint of wear. But in commercial installations, wear is frequently the limiting factor, often requiring the use of heavy-gage products.

If resilience is the prime factor in selecting a floor covering, you should keep in mind that resilient floors have varying degrees of resilience; cork and then rubber tile are the most resilient, and asphalt tile is the least resilient.

Closely related to resilience and wear is the gage of the flooring material. Today, gages which were once considered too light for satisfactory performance now appear more than adequate for most areas. However, the thicker the gage, the more attractive the appearance of the floor, and the better it hides minor subfloor irregularities. And comfort, value, and

quietness increase with increases in gage for each type of flooring. In considering resilience and wear, keep in mind the gage of the material.

Your choice of resilient flooring will often be based ultimately on price, preference for a design or pattern, or other considerations, such as grease resistance, light reflectivity, and ease of maintenance. Of the resilient floor coverings, linoleum is one of the oldest and perhaps the most commonly used.

Kinds of Linoleum

83. There are different kinds of linoleum, and each kind is produced in various gages. Linoleum is composed of an oxidized oleoresinous compound, pigments, and fillers with a supporting backing. The mixture is compressed under rollers and then placed in an oven, where it is baked, or matured, until oxidation is complete. The product is dense, resilient, and highly resistant to abrasion.

Each kind of linoleum has its own name, which you should use in describing it, together with the proper gage. The kinds of linoleum most commonly produced are battleship linoleum, plain linoleum, jaspé linoleum, marbleized linoleum, inlaid linoleum, linoleum tile, and felt-base floor covering.

With the exception of linoleum tile, linoleum comes in sheet form, usually in roll width that can be cut to size. Linoleums are available in a wide range of colors and patterns. They are widely used in residential, institutional, and commercial buildings. Linoleums should not be used on floors below or on grade. You should install linoleums only on suspended subfloors.

Battleship and Plain Linoleum

84. Battleship linoleum was first made in large quantities to meet United States Navy specifications for warship flooring. Normally, it is produced in $\frac{1}{8}$" thickness. It is made in rolls of varying widths, generally 6', and is laid in strips as wide as

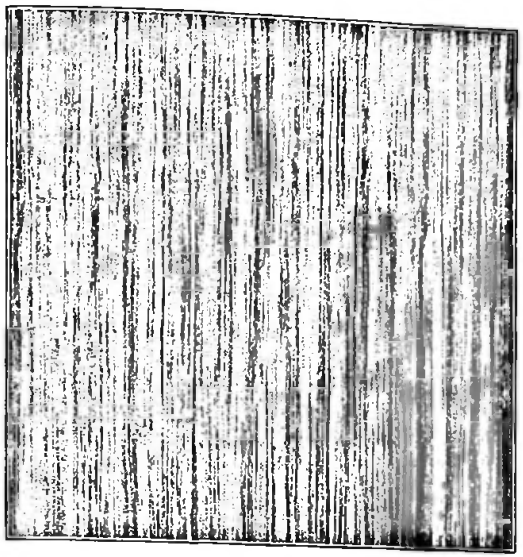


FIG. 27. JASPÉ LINOLEUM

possible, except where joints are required for design. It is often made in special designs with borders and strips, as shown in Fig. 26.

Battleship linoleum is especially useful for locations where there is heavy wear, such as school corridors, laboratories, offices, ship decks, and working areas in light-manufacturing buildings. You may also use battleship linoleum in kitchens, bathrooms, and living rooms in dwellings.

Plain linoleum has the same composition and uses as battleship linoleum, but it comes in two gages, heavy gage, $\frac{1}{8}$", and standard gage, $\frac{3}{32}$".

Jaspé Linoleum

85. Jaspé linoleum has the same composition and gages as plain linoleum. An example of jaspé linoleum is given in Fig. 27.

The surface effect of jaspé linoleum was developed so that the discoloration caused by dirt, slight irregularities in laying,

and the monotony of a single tone would not be noticeable. Likewise, parts subject to constant wear would not show wear as distinctly as they would on a single color. Jaspé linoleum is much used in solid colors with plain borders.

Marbleized Linoleums

86. Marbleized linoleum is so called because it reproduces the colors, distinctive veinings, and effects of marble. Four of these effects are shown in Fig. 28.

Marbleized linoleums have the same composition as battleship and jaspé linoleums and are available in gages of $\frac{1}{8}$", $\frac{3}{32}$", and $\frac{1}{16}$". Linoleums that resemble terrazzo, in what is known as a spatter pattern, are available in a standard gage of $\frac{3}{32}$".

Inlaid Linoleums

87. In the linoleums that carry a surface design, the design may extend through to the backing, so that the linoleum, no mater how much worn, still carries the same color and effect. This group of linoleums is sometimes referred to as inlaid linoleum.

Embossed inlaid linoleum has the same composition as inlaid linoleum; the difference is that the joints between the design units are actually depressed, making the blocks stand out in relief. Embossed inlaid linoleums are used to imitate such floors as slate, tile, and wood planking. An example of embossed inlaid linoleum flooring is shown in Fig. 29.

Most embossed inlaid linoleums are available in standard gages.

Felt-Base Floor Covering

88. Felt-base floor covering, sometimes referred to as printed linoleum flooring, is backed with asphalt-impregnated felt and is produced only in the very thin gages. The design is printed on the surface only. Felt-base floor covering is used in locations where economy is the prime factor. This type of linoleum is used in the production of linoleum rugs.

Linoleum Tile

89. The body and surface of individual linoleum tiles are the same as those of the roll-type linoleums. Linoleum tile can be better adjusted to any irregularities in the floor than can the roll-type linoleums. And if repairs are required, you can easily replace a few tile.

Linoleum tile are available in various colors in plain, jaspé, or marbleized surfaces, and in thicknesses of $\frac{3}{32}$" and $\frac{1}{16}$". The usual sizes are 9" x 9" and 6" x 12". Linoleum tile cost less than most of the resilient tiles.

Cork Tile

90. Cork tile are made of first-quality pure cork. They are homogeneous from face to back, and are thoroughly and evenly bonded with a heat-processed resinous binder. The tile are accurately cut in 6" x 6", 6" x 12", 9" x 9", 12" x 12", and 12" x 24" sizes and in thicknesses of $\frac{1}{8}$", $\frac{3}{16}$", and $\frac{5}{16}$". Other sizes can be produced when necessary. Several shades of cork tile are available, varying from light to dark brown. The different shades may be used to advantage to produce interesting designs. A cork floor is shown in Fig. 30.

Cork tile may be laid on any type of suspended subfloor. They may be laid over concrete on grade if the top of the slab is at least 12" above grade level, and if the grade slopes away from the foundation and the tile are laid with waterproof adhesive.

91. Cork tile are the most resilient of the floor tiles. Owing to their close texture, they can be readily washed. They are used in corridors, assembly rooms, libraries, churches, restaurants, lobbies, and similar places where people congregate. You should not use cork in entrance vestibules where there may be sand and grit, as they would spoil the surface. Neither should you select it for exterior use. Waxing cork flooring after it is laid will increase the life of the flooring, and will bring out

FIG. 31. INLAID RUBBER TILE WITH INSERTS

the full beauty of the natural cork color. Nearly all cork tile are now finished with an initial coat of wax at the factory.

Rubber Tile

92. Rubber tile are of a homogeneous rubber composition that is free of objectionable odors and contains thoroughly dispersed reinforcing fibers and fillers. The color and design

effects extend through to the back of the tile, except for those tiles mounted on a special sponge-rubber backing. In Fig. 31 is shown an example of rubber tile flooring.

Colors are obtained by adding mineral pigments to the rubber. The tile are made in plain and in marbleized colors and in two or more tones. In rubber tile, you have a choice in colors almost as extensive as that in linoleums.

The usual thicknesses of rubber tile are $\frac{1}{8}''$ and $\frac{3}{16}''$, although tile in $\frac{1}{4}''$, $\frac{3}{8}''$, and $\frac{1}{2}''$ thicknesses can be obtained for use where the heaviest type of wear occurs. The tile are usually available in 6″ x 6″, 9″ x 9″, 12″ x 12″, and 18″ x 36″ sizes. Special shapes for various designs can be obtained from the manufacturer upon request.

Because of its durability, its resistance to ordinary stains, such as ink and grease, and its high degree of resilience, you will find rubber tile particularly adaptable to use in banks, churches, stores, offices, and reception rooms in large buildings.

Rubber tile can be used for suspended floors and, with the proper cements, can be installed on floors on grade and floors below grade.

Asphalt Tile

93. Asphalt tile are generally composed of inert materials such as asbestos fiber, with a natural asphalt binder and mineral pigment. The mineral pigments provide the color. The color extends through the thickness of the tile, which is usually $\frac{1}{8}''$ or $\frac{3}{16}''$. Greater thicknesses are available, but in fewer colors. Some manufacturers use a resinous compound as a part binder, while other manufacturers use different binders. The materials are mixed thoroughly under heat, compressed under heavy pressure while hot, and cut to size with square, true edges. The usual size is 9″ x 9″, although tile are available in 18″ x 24″ sizes. A wax coat is usually applied at the factory before shipping.

The range of colors in asphalt tile is considerable, and in-

cludes many of the marbleized effects that are available in linoleum and rubber tile.

Asphalt tile are not affected by dampness, and there is nothing in their composition to encourage rotting or deterioration. They are recommended for use in basements and on grade-level concrete floors. They are resistant to fire and to heavy wear, and will withstand the action of mild acids and alkalies. For resistance to grease, oils, or fats, you should select one of the greaseproof types.

Asphalt tiles are used in wide variety of designs and colors for such locations as classrooms, corridors, lobbies, kitchens, bathrooms, recreation rooms, and social halls.

For many locations where static electricity presents an explosion hazard, you should select conductive asphalt tile. However, this tile should not be used in hospital operating rooms or in paint-spray rooms, where frequent cleaning with strong detergents is necessary. Conductive tile may be installed on suspended or grade-level floors, but not on floors below grade. Where both grease and static electricity present problems, greaseproof conductive tile should be employed. Both types of tile are manufactured in 9″ x 9″ and 18″ x 24″ sizes, and in $\frac{1}{8}$″ and $\frac{3}{16}$″ gages.

Linotile

94. Linotile is the manufacturer's name for a tile that is composed of oxidized linseed oil—or an equivalent thoroughly oxidized oleoresinous binder—resins, fillers, and pigments. It is rolled or pressed into sheet form, seasoned, and finally cut to size. Linotile is dense but still resilient, highly resistant to abrasion, and capable of withstanding heavy furniture loads without permanent indentation. It is made especially for areas such as stores and offices that are subject to hard wear and heavy furniture loads. Linotile is made in one grade only, in $\frac{1}{8}$″ thickness, and in 6″ x 6″, 9″ x 9″, 12″ x 12″, and 18″ x 36″ sizes.

You should not install linotile on subfloors of concrete or other materials in direct contact with the ground. Linotile should be installed only over suspended subfloors.

Plastic Floorings

95. A flexible plastic flooring that is composed of vinyl resins, alkali-resisting color pigments, and other plastic compounds is available in sheet or tile form. The material is dense, resilient, and highly resistant to abrasion, grease, and solvents. The sheet-type material has a supporting backing of resin-saturated felt and is 0.070″ thick. Plastic tile are homogeneous throughout, without a backing, are accurately cut with square edges, and are available in thicknesses of $\frac{1}{8}$″ and $\frac{3}{32}$″. There is also a type of plastic tile with a backing. It is made by cutting the sheet plastic into tile sizes. Vinyl plastic tile are capable of withstanding a furniture load of 200 psi (pounds per square inch) without deformation. As a general rule, you should install this type of flooring only on suspended subfloors, although the better quality flooring can be installed on grade or below grade.

A tile formed of a thoroughly blended composition of vinyl plastic resins, asbestos fibers, and alkali-resisting pigments and fillers is suitable for use on any type of subfloor. This vinyl asbestos tile is available in gages of $\frac{1}{8}$″ and $\frac{1}{16}$″. It is extremely durable and is highly resistant to alkaline moisture, oil, grease, and household chemicals. The tile is suitable for use in kitchens.

Plastic floorings are usually identified by the manufacturer's trade names. These floorings are of first quality and fine appearance, and are extremely durable. They are suited to residential or commercial use.

Cove Base

96. A rubber cove base is widely used, not only for rubber flooring but also for floors of linoleum, asphalt tile, and plastic. This base comes in standard heights of 4″ and 6″, and provides

a sanitary finish at floor and wall. A similar cove base is available in linoleum, but the rubber cove base is more widely used, since it is more flexible and thus more easily adjusted to surface irregularities. An asphalt cove base is also available.

Preparation of the Subfloor

97. Resilient floors, except those designed for heavy wear, and mastic floorings are generally thin and are laid after all construction work has been finished. The subfloor or base on which they are laid must be firm and level, since any irregularities in the base will show through the thin materials. Most resilient floor coverings in sheet and tile form require similar preparation of the base.

The base for such resilient floors should be dry. Moisture is the great destroyer of building materials, and resilient floorings are no exception.

The moisture content of a recently poured concrete floor, even when suspended above grade, may cause serious deterioration of resilient flooring materials. Wood floors over poorly ventilated crawl spaces are apt to pick up moisture. Wood floors on sleepers on concrete at grade or below grade are also apt to pick up moisture, with subsequent warping of the wood floor and damage to the resilient floor. Construction should be designed to prevent such accumulation of moisture.

Around drinking fountains, soda fountains, and in other areas where excessive water is apt to be spilled on the floor, moisture may find its way through the seams in the flooring and attack the adhesive. In the case of cork tile, excessive surface moisture may attack the tile itself. Where excessive moisture exists, you may find it advisable to use a flooring such as terrazzo rather than one of the resilent floorings.

98. Where resilient floorings in sheet or tile form are to be laid on wood floorings, the floor boards should be no more than 3″ wide, and they should be tongued and grooved and

thoroughly nailed. The wood floor should be planed and sanded if necessary so that there will be no projections; the entire base should be level.

Never install a resilient floor over a single wood floor. If the wood floor is a single floor or if it is comprised of wide boards, an underfloor of plywood or hardboard should be applied to give a smooth surface and to prevent any movement of the floor boards from showing through the floor covering. When a resilient floor is laid on a concrete slab, the slab, if rough, should be prepared by placing a topping on the slab. This topping should be screeded and troweled to a level surface by means of a darby float.

Except over thoroughly dry cement floors or similar nonabsorbent surfaces, a layer of lining felt should be applied before the resilient flooring. This provides protection against moisture below, acts as a level base to receive the flooring, and allows for expansion and contraction in the subfloor. The lining felt should be laid in a specially prepared paste as recommended by the manufacturer of the flooring, rolled flat with a heavy roller, and allowed to dry.

Before the resilient flooring is laid, you should test the floor to make sure that it is dry. Concrete floors are generally tested by placing calcium chloride on the floor and tightly covering it with a glass dish. If the calcium chloride dissolves, the floor is still too wet to receive the linoleum. You should not allow linoleum or cork to be laid on a cement floor which is directly on the ground unless there is a layer of waterproofing and concrete base not less than 2″ thick over the slab.

Adhesives

99. The selection of the proper adhesive for a resilient floor is frequently as important as the selection of the correct flooring. The life and serviceability of any installation of resilient flooring depend greatly upon the proper application of the correct adhesive.

The adhesive must hold the flooring material to the subfloor by surface attachment This attachment, or bond, must be great enough to prevent the separation of the flooring material from the subfloor under slightly greater than normal stresses. However, the bond must not be so strong that it will prevent removal of the resilient flooring at a later date if desired.

Different subfloors and different floorings require different adhesives. Asphalt tile, for instance, requires a different adhesive than linoleum does. In selecting from among the many cements, pastes, emulsions, and primers that are available, your safest procedure is to choose the type recommended by the manufacturer for the installation of a particular floor.

Laying Resilient Tile and Sheet Flooring

100. Similar procedures are used for laying the various resilient floorings that are available in sheet and tile form. As a general rule, to secure satisfactory results, you should not lay resilient floorings in temperatures of less than 70 F.

Before laying any resilient flooring, you should thoroughly inspect the subfloor. You should not install flooring on a subfloor that is not in first-class condition. The subfloor should be true, level, broom clean, free of foreign matter, and thoroughly dry.

The first step is to coat the subfloor with the proper adhesive. The flooring is then placed with true and tight joints. If asphalt cement is the adhesive used, it is usually allowed to set for about 30 min (minutes). Resilient tile should be pushed into place. On wood floors, resilient sheet flooring is laid at right angles to the floor boards. Resilient tile should be laid diagonally to the floor boards. If an underfloor of plywood or hardboard is used, the tile may be laid in any direction in relation to the floor boards. After laying, the floor should be rolled in two directions, using rollers weighing not less than 100 lb. The rolling and subsequent wear causes the floor to adhere at the joints, making a homogeneous floor.

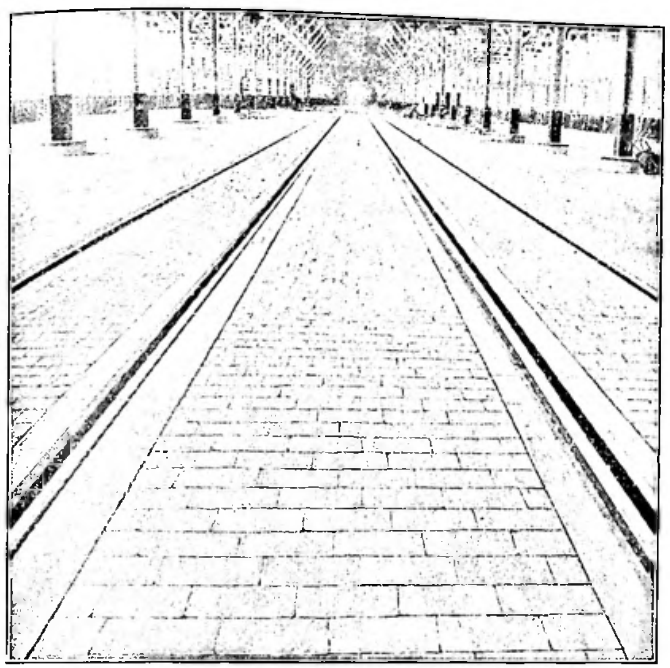


FIG. 32 ASPHALT BLOCK FLOORING

All excessive adhesive should be removed. When the cement is thoroughly set and dried, which in some cases requires 5 days, the floor can be washed. Avoid solutions containing naphtha or turpentine, which act as solvents for asphalt compositions. For a final finish, the floor should be given at least one coat of wax and buffed. This wax coat should not be applied until several days after the installation of the flooring so as not to interfere with an effective adhesive bond.

In all cases, the resilient floor should be installed in accordance with the manufacturer's specifications for that type of floor.

Plank and Block Flooring

101. For industrial floors where the traffic is heavy and where color is not important, you may use planks and blocks

of asphalt composition. Plank and block floors are resilient and noise deadening.

Asphalt planks can be secured from ½″ to 2″ thick, in lengths from 2′ to 10′. These planks have the natural black color of asphalt and are used in industrial spaces where there is continuous traffic. They can be nailed to wood flooring or cemented to concrete.

Asphalt block floors have been developed for locations where there is exceptional wear, such as warehouses, baggage rooms, piers and docks, parking spaces, and ramps. This flooring is also used on decks, streets, and bridges, since it will withstand the wear caused by heavy trucks. An asphalt block floor in an army supply-base building is shown in Fig. 32.

Asphalt blocks are available in 4″ x 8″, 5″ x 12″, 8″ x 8″, and 8″ x 16″ sizes, and in 1½″ to 3″ thicknesses. These blocks can also be secured in hexagonal form. The blocks consist of asphalt cement, crushed rock, and mineral fiber, heated and compressed. The color is usually a dull gray-black.

Asphalt blocks are set either in a ½″ bed of 1 part portland cement and 3 parts sand or over an asphalt primer which is allowed to set. In either case, the blocks are set as tight as possible, the surface is swept clean, and the joints are filled with a joint filler. On the finished floor should be spread a thin layer of clean, dry, fine sand which is allowed to remain until it disappears through usage

Composition of Mastic Flooring

102. The composition of mastic flooring varies according to formulas developed by different manufacturers. The base may be of wood fiber, cork shavings, asphalt, magnesite, cement, gypsum, or similar materials that lend themselves to mixing in such a way that they will harden into a finished floor covering. Resistance to wear may be increased by the addition of aggregates and abrasives.

Color pigments are used when color is desired, and are

usually added at the factory during production. In some types of mastic flooring, you can add the color at the building when the flooring is laid. In the heavy industrial types, color is usually restricted to a few basic tones. Mastic flooring can be laid in combinations of colors, either by laying each color separately to keep the colors from running together, or by using metal divider strips as in terrazzo work.

Use of Mastic Flooring

103. An advantage of mastic flooring is its flexibility. This flexibility is especially important where the finished floor must take care of irregularities in the subfloor. Since mastic flooring is plastic, it will fill any hollows. Other advantages of mastic flooring are that it is monolithic, resilient, slipproof wet or dry, resistant to acids and alkalies when so formulated, and economical to install and maintain.

Some types of mastic flooring have soft surfaces and are highly resilient, but will not resist hard usage. They are sometimes used where noise reduction is an important factor. Other types are sufficiently hard to withstand heavy industrial trucking and can be made as hard as concrete by the addition of aggregates and abrasives.

Mastic floors are used for offices, corridors, classrooms, basements in general, and industrial areas. Since they do not have the finish that is possessed by resilient floors in tile or sheet form, they are seldom used for lobbies, restaurants, and other locations where appearance is a prime factor.

Because of wide variations in mastic floorings, your selection of a mastic flooring should be made only after careful consideration of the proposed use of the floor.

Laying Mastic Flooring

104. Except for the asphalt mixes, which are plastic, most mastic floorings are delivered to the building as dry, powdered, premixed compounds. The dry compounds are thor-

oughly mixed in batches with the proper proportions of water, and are then spread in a plastic state on the subfloor. Some floorings are applied in two coats. In such a case, the final color is incorporated in the top coat only, which should be at least $\frac{1}{4}$" thick.

When the flooring has an asphalt base, the mixture is sometimes applied after being heated at the building, but you can secure asphalt materials that may be applied without being heated.

The thickness of the finished flooring varies according to the type of flooring and the intended use. No flooring should be less than $\frac{1}{4}$" thick, and this minimum thickness is used only when the flooring is laid over a substantial, level concrete base. Any projection above the general level of the base should be avoided, since it may cause a crack after the flooring has dried. Most floorings are installed to a thickness of $\frac{1}{2}$" to 2". Care should be taken so that the thickness is at no point less than that recommended by the manufacturer.

If a wood floor forms the base on which the mastic is to be laid, the wood must be thoroughly top-nailed as well as blind-nailed. Some manufacturers advocate nailing wire-mesh reinforcing to the wood floor before any mastic is applied. This reinforcing helps to prevent shrinkage and to hold the finished flooring firmly to the base. Over concrete or a similar dense floor, reinforcing is not necessary, but the concrete should be without any projecting aggregates, and should be troweled or floated to a smooth, level surface.

The mastic floor should be leveled, troweled, and surfaced with a float or rubbed until it is smooth and even. In every case, you should carefully follow the manufacturer's recommendations for the installation of the type of floor selected.

Maintenance

105. Normally, the maintenance of a resilient floor consists of only an occasional washing and waxing along with regular

sweeping. Daily sweeping with a soft broom or dry mop will keep a resilient floor clean for long periods. Oil mops or oil-type sweeping compounds are not recommended.

"More floors are washed away than worn away" is an old saying in the flooring industry. Unless resilient tile or sheet flooring is subjected to unusual amounts of dirt, it should be washed infrequently. You should not wash floors of this type until the adhesive has set at least 4 or 5 days.

As soon as the resilient floor is dry after washing, it should be waxed, although on mastic floors the wax is often omitted. A common fault is to use too much wax. Dirt lodges in a thick coating of wax, making the floor appear dirty and gray. It is better to use two thin coats of wax than one thick coat. Waxing helps to seal the pores and joints in a floor and makes it easier to keep clean.

Waxes which contain solvents such as naphtha or turpentine should not be used on asphalt or rubber tile floors. The water-emulsion type of wax which dries in less than 20 min to a hard, colorless finish that is lustrous but not shiny is suitable for resilient floors. A safe rule for you to follow is to use the wax recommended by the manufacturer.

Summary

106. Resilient floorings are used for almost every kind of interior space. These floorings are of two types. One type consists of finished materials applied in sheets, strips, or small units and set in mastic cement. The other is a mastic type that is applied as a mix and brought to a smooth finish, forming a homogeneous floor without joints.

Asphalt tile, linoleum, rubber tile, vinyl plastic tile, cork tile, and mastic flooring are among the common types of resilient flooring. These floorings provide, in varying degrees, cleanliness, quiet, resilience, comfort, resistance to wear, and ease in maintenance. You will find that these floorings are available in various colors and thicknesses, and in a wide

variety of designs. Inserts for special designs can usually be obtained from the manufacturer upon request.

In the installation of each type of flooring, you should carefully follow the manufacturer's instructions.

Daily sweeping with a soft broom or dry mop will keep most resilient floors clean for long periods. Resilient tile and sheet floors should not be washed any oftener than necessary. After washing, they should be waxed. Waxing helps to seal the pores and joints in a floor and makes it easier to keep clean.

Miscellaneous Floor Coverings

Special Wood Floors

107. Wood is the traditional material for flooring in this country. The common types of wood floorings are described in the texts devoted to carpentry. There are, in addition, special types of wood flooring.

Many of these special types of flooring are prefabricated at the factory to reduce field installation time. These special floorings are sometimes made up of woods—such as maple, oak, and pine—that are used for common floorings. Besides these, such woods as teak, walnut, gum, cherry, ash, and pecan are used to obtain special colors or effects. The floorings may be laid in short strips or squares, in herringbone or many other patterns.

Normally, wood floors are applied in long strips and are nailed to the joists, underflooring, or wood sleeper strips provided to receive them. Many special types of wood flooring are laid in mastic on concrete slabs.

Underflooring

108. The base that receives any type of wood flooring should be properly prepared. Underflooring should be solidly nailed and sleepers or joists should be planed level. Otherwise, squeaking, buckling, and other irregularities will result. Where

wood floors are to be laid in mastic on concrete floors, you should have a top surface that is level and fairly smooth, with no projections.

Laying in Mastic

109. Mastic is used when the wood flooring is laid directly over concrete without any wood underfloor or sleepers. The concrete must be thoroughly dry before the wood flooring is laid.

Mastic consists of a thick liquid, generally of an asphaltic nature, and is used either hot or cold, depending on the kind selected. The mastic is spread over the floor and then on the back of the wood strips or blocks, which are set level, tamped into place, and driven together to form close joints.

The mastic does not completely harden, and there is always a high percentage of adhesion both to the concrete and to the wood. Generally, only short-strip flooring is used in this method of laying the finished flooring, although long strips can be laid if required.

Wide Plank Flooring

110. You may use wide plank flooring where it is desirable to carry out the design of a period, such as early Colonial or baronial English. In colonial design, the boards vary in width from 4″ to 12″, and often are of pine; in English design, the wood selected is usually oak in the same widths.

The first wide plankings were produced by hand and were laid as plain boards without the tongue and groove. In most cases, they were top-nailed. Modern flooring of this type comes tongue-and-grooved, and can be either blind-nailed or top-nailed, or both.

Plank flooring is generally not less than 1″ thick; the usual thickness is $1\frac{1}{8}$″. The widths are often varied to enhance the informal effect of the finished floor. White and yellow pine, oak, teak, and mahogany are the woods most often used for this type of floor.

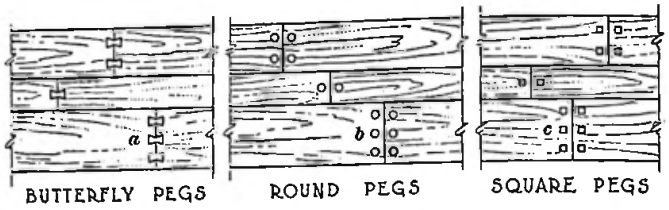


FIG. 33. PEGGED PLANK FLOORS

For plank flooring, top nailing is used in addition to the blind nailing along the side; the nailing, combined with the tongue and groove, holds the flooring firmly. When the boards are very wide, it is necessary to top-nail along the center of the board.

Where the floor is screwed or nailed through the top, wood insets, or pegs, are fitted over the nails or screws. These give an interesting effect and imitate the wooden pegs which were commonly used in the early days of wood flooring. In Fig. 33, pegs known as butterfly pegs are shown at *a*, round pegs at *b*, and square pegs at *c*. An installation of plank flooring in a living room is shown in Fig. 34.

Unit Wood-Block Flooring

111. The type of flooring known as unit wood-block flooring is usually finished in the same manner as flooring in fine rooms and is used for the same general purposes.

The blocks, if thick, are made up of strips of tongue-and-grooved flooring glued together, or, if thinner, of grooved strips reinforced with splines. The strips usually are made in widths from $1\frac{1}{2}$″ to $3\frac{1}{4}$″. The thickness is generally $\frac{1}{2}$″, $\frac{3}{8}$″, or $\frac{25}{32}$″. These blocks are generally about 9″ square, although they may be made in other sizes to fit special designs. They can be either top-nailed, blind-nailed in the thicker types, or laid in mastic.

You can obtain some types of flooring with the finish applied at the factory. Such flooring requires only the final coat of wax for completion. In most cases, the blocks come only in

FIG. 35. LAYING UNIT WOOD-BLOCK FLOORING

the hardwoods and can be factory selected for matching grain and color.

In Fig. 35 are shown wood blocks being laid in mastic. Wood block flooring is mostly used in living rooms, libraries, reception rooms, and offices, to give a parquet effect.

Industrial Wood Flooring

112. Industrial wood floorings are used in factories where there is heavy trucking, especially when the trucks used have steel wheels. These floorings are generally of maple, yellow pine, or fir. The wood is mostly cut to give an end-grain face for better wear.

Industrial wood floors come in thicknesses of from $\frac{3}{32}''$ to 3", and are generally laid in mastic over concrete and joined together with steel or wood splines.

Some industrial wood flooring is in strips, either short or long as desired. Some consists of a series of small blocks joined together with splines to form strips. The thickness and type of flooring that you select should be determined by the use to which the floor is to be put.

Scraping and Planing Wood Floors

113. Wood flooring is scraped and planed in order to secure a smooth, even surface to receive the finish.

Softwoods are generally planed, and the edges against the wall must be scraped where the plane cannot reach. Plane marks will not show if the work is well done.

For hardwood flooring, the usual methods are to scrape the surface by hand, or to sand it with a machine. When scraped by hand, the floor is first wet. Then a flat metal scraper is pulled across, taking off all the roughness and raised grain, until the floor has a fine, smooth surface without tool or other marks.

For large areas, the smoothing is usually done by sanding with an electrically operated machine. Sandpaper is mounted on a large roller that revolves as the machine crosses the floor. The sanding is first done diagonally and then in the direction parallel to the length of the flooring boards. A coarse sandpaper is first used, followed by a fine sandpaper. Be careful to avoid too much pressure at any one point, as excessive pressure will create hollows. The resulting surface should be fine, level, and smooth.

Finishing Wood Flooring

114. After wood flooring is prepared by sanding, scraping, or planing, the finishing protective coats are applied. For an inexpensive finish, a stained filler, used to close the grain and give color, is followed by one or two coats of varnish. This finish, while resistant to wear, does show scratches and is difficult to refinish without going down to the bare wood. It can be protected by a coat of wax.

You can obtain a better finish by applying a coat of filler, one coat of shellac, and two coats of wax, well rubbed and polished.

A very satisfactory finish is obtained by applying two coats of a penetrating sealer, which can be rubbed and polished to a dull gloss. This type of finish is resistant to wear and has a long life.

For factory floors, the wood flooring is given one or two coats of protective penetrating oil stain, which serve to preserve the wood and make the maintenance easier.

Metal Floors

115. At times, you may find that metal flooring is best for a specific purpose. In industrial buildings, around printing presses or heavy machinery, for stair treads, thresholds, and suspended walkways, metal flooring should be used.

Standard metal floors come in solid types and in open types, usually called gratings.

Solid types generally have a deformed face and often an

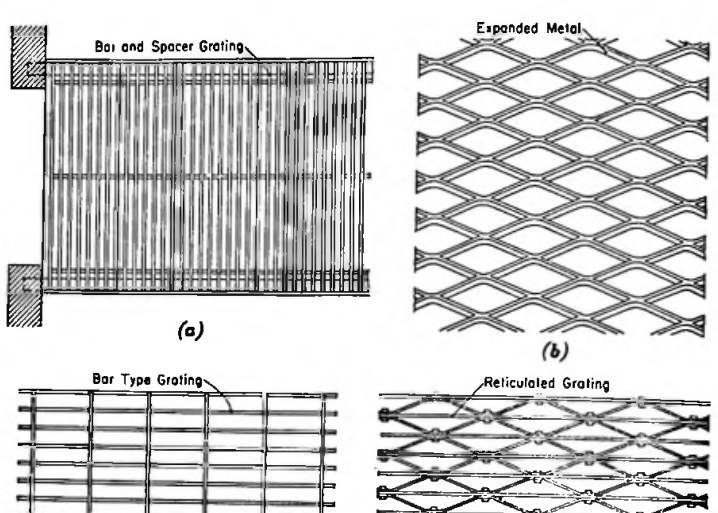


FIG. 36. FLOOR GRATINGS

applied surface of grit, either ground cast iron, aluminum, bronze, or nickel. This makes an excellent nonslip surface and will withstand heavy wear.

Gratings are usually of the reticulated, rectangular, or bar-and-spacer types They are made to cover open spaces and to permit light and air to pass through. The requirements of use should determine the type selected. In Fig. 36 *(a)* to *(d)*, you can see several examples of stock designs for gratings.

Gratings are sometimes embedded in the concrete or mastic top coat to form an armored surface which will resist heavy wear. The top of the steel is placed flush with the top of the floor.

Types and Uses of Carpets

116. Carpets and rugs are made in the same way, but carpets are usually of plainer colors or patterns and are laid over an entire floor from wall to wall, as shown in Fig. 37.

Rugs are of limited size, are woven all around, and are generally arranged so as to have an area of bare floor exposed around the edges.

Most carpets are made of wool, but you may obtain rugs made of wool, cotton, nylon, linen, jute, or sisal fibers. The popular types of wool carpets in the order of decreasing cost are chenille, Wilton, Axminster, velvets, Brussels, tapestry, and ingrain. Most of these are "cut pile," in which the separate strands of yarn literally stand on end, either as the result of shearing or of inserting tufts of wool into the backing. The ability of the pile to stand up is principally the result of a dense weave and a strong wool.

Chenille carpets have a wide range of quality and price. They are sometimes woven in imitation of some of the finest and rarest Oriental creations.

In worsted Wilton carpets or rugs, the best grades of worsted yarns and a close weave provide a sturdy construction which permits frequent and comparatively harsh cleaning. Because of the heavier and coarser woolen yarns used in woolen Wiltons, these rugs feel luxurious underfoot. Because of their fine wearing qualities under continuous traffic, expensive Wilton carpets are often installed in large lobbies, foyers, and other public places. Brussels carpets are similar to Wiltons except that the pile consists of uncut loops of yarn.

Axminster carpeting has the largest yardage production in the United States. It meets the requirements of medium-cost floor covering for public and residential use. Because of their construction, Axminster carpets can be rolled lengthwise, but not crosswise. The better grades possess a deep pile and a close weave.

The velvet weave is the simplest form of carpet construction. The usual design produces a tightly woven pile of comparatively short length.

Tapestry weave in rugs forms uncut loops of surface yarn that assure unusual wear. The use of heavy yarn furnishes a

depth of pile and allows variety in the height of the loops to form special textural effects.

Ingrain carpet has a flat weave and is made in simpler patterns than tapestry carpet. It is the lowest priced carpet, and is not much used in modern buildings.

Cotton rugs are made in flat weaves, using bulky, soft yarns, or in pile weaves having a soft, wooly effect or a long, uncut pile of loosely twisted yarns. Cotton rugs are washable, but they do not have the durability or rich appearance of wool rugs. They are used mainly in areas of light traffic, such as bedrooms.

Flax, linen, jute, and sisal fibers are used in the manufacture of rugs for use in areas which require economical coverings that will take hard wear. Other types of rugs are braided rugs, rag rugs and carpets, and hooked rugs.

Oriental rugs are woven on hand looms in a number of Eastern countries. They vary considerably in quality and design. Oriental rugs are expensive, and you should select them for their ornamental value rather than for their utility. They should not be exposed to excessive traffic.

Carpets and rugs are soft floorings. They provide a feeling of comfort, warmth, and luxury. They assist in reducing noise and are an important element in decoration. Carpets and rugs are widely used in such locations as homes, offices, restaurants and hotels. In hotels and other public places, overall patterns are desirable, since they show wear less.

Laying Carpets

117. Carpets and rugs should be laid over a layer of heavy prepared paper, sponge rubber, or one of the many types of mothproof, nonskid mats now available. The use of such mats adds considerably to the life of the carpet. On wood floors, carpets are sometimes fastened to the floor with tacks, but heavy carpets will stay in place by virtue of their own weight. For carpets laid over cement floors, a type of fastening called a grommet is used. The socket of the grommet is secured to the floor, while the upper part of the grommet is sewed to the carpet and then pushed into the socket.

Summary

118. Special wood floorings are available and include strips, plank floorings, and factory-assembled squares. Unit wood-block flooring consists of blocks about 9″ square made up of strips of wood glued together. Many of these special floors are laid in mastic over a concrete slab.

Wide plank flooring is generally 1⅛″ thick and comes in varying widths. It is usually tongued-and-grooved, and is either blind-nailed, top-nailed, or both.

Metal floors are used for such locations as stair platforms, and walkways in boiler rooms.

119. This brings you to the end of Part 1 of *Floor, Wall, and Ceiling Coverings*. You are now familiar with a wide variety of floor coverings. Some of the same materials that are used for floor coverings are also used for wall and ceiling coverings. In Part 2, you will study the many materials that are used for wall and ceiling coverings.

Pronunciation Hints

Sometimes it is very difficult to indicate exactly how a letter or a combination of letters in a certain word in the English language should be pronounced. Moreover, some of the words are pronounced somewhat differently in different localities. To help you pronounce correctly several words used in this text, we have respelled the words here. Also we have underlined the accented syllable of the word.

CORRECT SPELLING	RESPELLED FOR PRONUNCIATION
ceramic	suh-ram-ik
chenille	shuh-neel
faience	fay-ahns

jaspé	zhas-pay
marbleized	mar-bl-ized
mosaic	moh-zay-ik
resilient	re-zill-yunt
shellac	shuh-lack
terrazzo	terr-rat-so
tesserae	tess-ur-ee
travertine	trav-ur-teen
vitrification	vit-ruh-fi-kay-shun
vitrified	vit-ruh-fide

Floor, Wall, and Ceiling Coverings

Serial 6239A PART 1 Edition 1

Examination Questions

Notice to Students.—Study this instruction text thoroughly before you answer the following questions. Read each question carefully and be sure you understand it; then write the best answer you can. When you complete your work, examine it closely, correct all the errors you can find, and see that every question is answered; then mail your work to us. DO NOT HOLD IT until another examination is ready.

1. Give the finish you would specify for the following:
   a) A slate floor for an exterior porch.
   b) A marble floor in a public library.
   c) A cement floor for a basement rumpus room.
   d) Exterior granite steps.

2. Identify the following:
   a) A hard igneous rock of granular composition.
   b) A sedimentary stone formed in layers.
   c) A combination of clay and shale by the plastic method.
   d) An asphalt binder and mineral pigments.
   e) Pigments and a filler mixed with an oxidized oleoresinous compound and applied to a backing.

3. *a)* When installing a terrazzo floor over a concrete slab, what provision would you make to ensure that any movement in the concrete slab will not cause cracks in the terrazzo finish?
   b) What is the purpose of the dividing strips in a terrazzo floor?

4. *a)* What is the normal composition of a terrazzo top coat?
   b) What is the minimum thickness of a terrazzo top coat?
   c) Explain briefly how terrazzo floors are finished.
   d) How may terrazzo floors be made nonslip?

5. Explain the following terms: *a)* ribbon stock, *b)* biscuit, *c)* butterfly peg, *d)* faience, *e)* pavers, *f)* tesserae.

6. *a)* List two materials that would be highly suitable for the floor in the work space of a bank where quiet is essential.
   b) What material would you select for the floor in the lounge room of a home of early Colonial or baronial English design?
   c) What type of flooring would you select for the catwalk in a boiler room?

7. Compare briefly the characteristics of asphalt tile flooring, rubber tile flooring, and mastic flooring.

8. What type of portland cement would you use in a setting bed for a slate or bluestone floor? Explain.

9. A finished concrete floor on a loading platform is giving unsatisfactory service under the wear of hand trucks, and is dusting off. If conditions are such that the floor may be raised 1″, how would you correct this floor?

10. Compare a honed finish and a sand-rubbed finish.