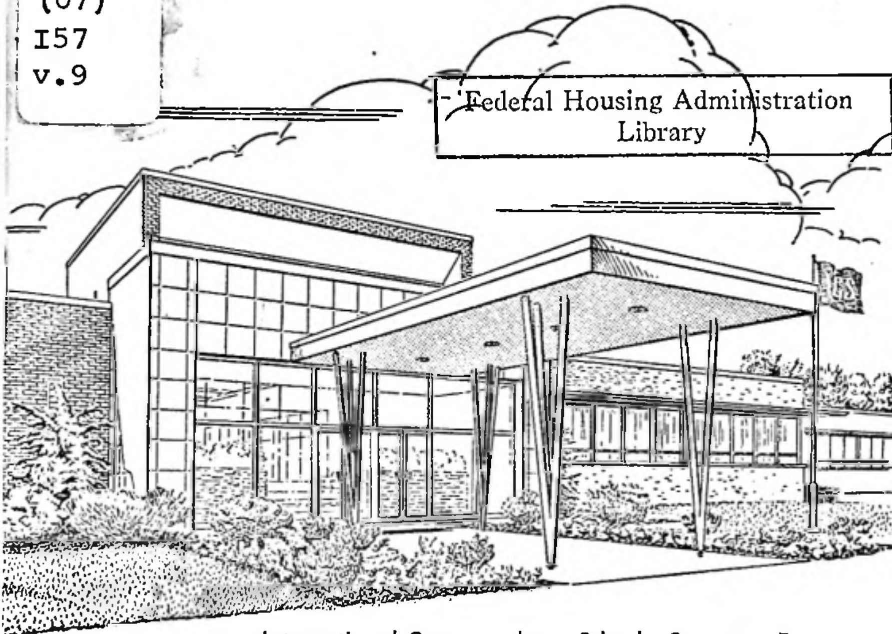

International Correspondence Schools, Scranton, Pa.

Shades and Shadows

Prepared Especially for Home Study

By

I.C.S. STAFF

5533-3

Edition 3

International Correspondence Schools, Scranton, Pennsylvania

International Correspondence Schools, Canadian, Ltd., Montreal, Canada

Most careers are made or marred in the hours after supper.

—C. R. Lawton

* * *

Every time you sit down after supper for your solitary struggle with your assignments, be cheered by the certainty that every hour adds another brick to the solid structure of a successful career.

Architecture home study course v. 9

SHADES AND SHADOWS

By

I.C.S. STAFF

Serial 5533-3

ICS *International Correspondence Schools,*
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Montreal, Canada

What This Text Covers . . .

1. Casting Shadows of Lines and Surfaces .... Pages 1 to 20

Shades and shadows help to give a drawing the impression of reality. This section explains fundamental principles. Some elementary problems are presented and solved.

2. Casting Shadows of Objects .... Pages 21 to 33

This section deals with shadows cast by simple solids and miscellaneous objects on a vertical plane.

3. Shadows on Inclined, Broken, and Curved Surfaces .... Pages 34 to 55

Irregular and curved surfaces present interesting problems in casting shadows. Practical considerations are given.

5533

SHADES AND SHADOWS

CASTING SHADOWS OF LINES AND SURFACES

FUNDAMENTAL EXPLANATIONS

1. **Purpose of Shades and Shadows.**—The purpose of indicating shades and shadows on a drawing is to give to the objects represented an effect of solidity—a realistic quality that they would not have in a plain projection drawing, on which the shades and shadows are not shown. This effect may be seen by comparing Figs. 1 and 2. The plain projection drawing in Fig. 1 includes merely the outlines of the groups of objects represented. In Fig. 2, the same group of objects appears, with the addition of conventional shades and shadows. The parts of the objects in this drawing seem to project one in front of the other and the objects have a solid, realistic appearance.

When an architect prepares sketches or drawings of a building to submit to a client, he includes either a perspective drawing or an elevation of the proposed building, showing the shades and shadows on it. Such a drawing enables a client to visualize the building, or see it mentally as it will actually appear. As a rule, a client cannot obtain a realistic conception of a building from a plain projection drawing, either because he is unable to understand the drawing or because he cannot visualize the completed building. The architect, therefore, presents each design to the best advantage when he uses shades, shadows, and color. The client is helped by such drawings to make an intelligent choice between alternative designs.

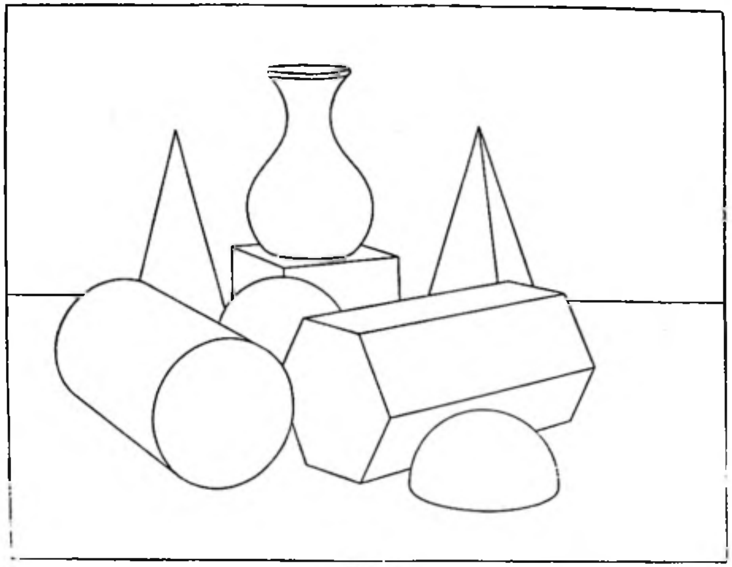


FIG. 1

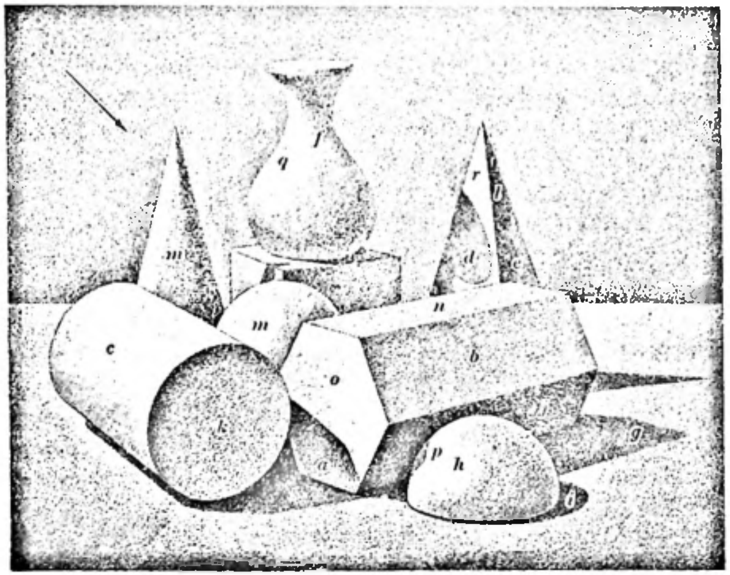


FIG. 2

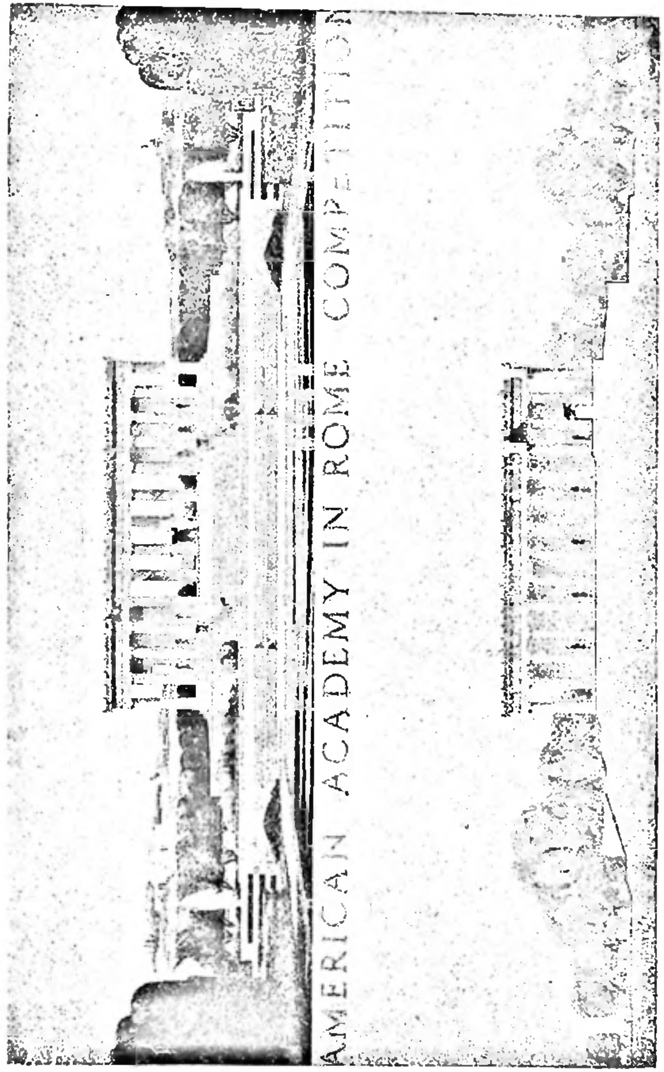


FIG. 3

Drawings of a memorial building are shown in Fig. 3. Here the fine effect brought out by shadows on various parts of the building can be readily seen. A still more natural effect would be produced by the addition of color. A drawing like this is called a rendered drawing or a rendering.

2. Direction of Light Rays.—In showing the effect of light in architectural drawing, the light is considered as consisting of parallel rays, all coming from behind and over the left shoulder of the observer, as he faces the drawing. This

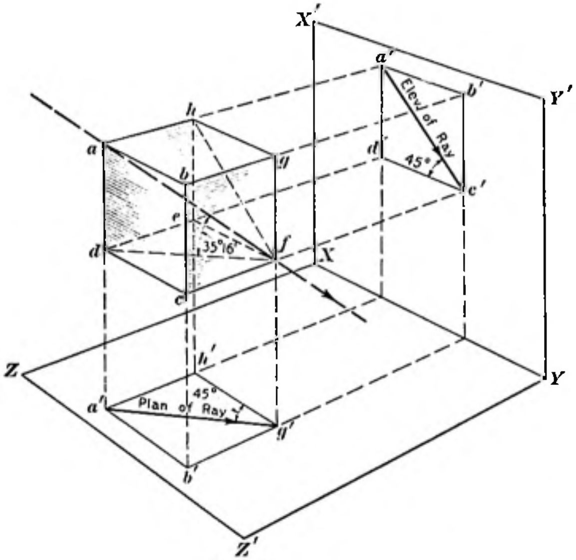


FIG. 4

direction is that of a diagonal of a cube of which the upper and lower surfaces are parallel with a horizontal plane and the front and back surfaces are parallel with a vertical plane, or the surface upon which the picture is drawn.

In Fig. 4, a cube is shown with its upper surface *abgh* and its lower surface *dcfe* parallel with the horizontal plane $XYZ'Z$. The front surface *abcd* and the back surface *hgfe* are parallel with the vertical plane $X'Y'YX$. The direction of the light rays is taken as parallel with the diagonal *af* of the cube.

3. Planes of Projection.—In architectural drawings, shades and shadows are generally shown on vertical planes, or surfaces, such as walls, doors and windows, and occasionally on horizontal planes and on sloping roof surfaces. In every case, the simple principles of projection drawing are all that are required in locating shadows on drawings.

In drawing the light rays, they will appear in the vertical plane $X'Y'YX$, Fig. 4, as parallel with the line $a'c'$, which has an inclination of 45° with the horizontal lines $a'b'$ and $c'd'$ and with the vertical lines $a'd'$ and $b'c'$. The light rays will show in the horizontal plane $XYZ'Z$ as parallel with the line $a'g'$, which has an inclination of 45° with the lines $a'b'$ and $a'h'$. The angle between the ray *af* and the horizontal line *df* is about 35° 16'.

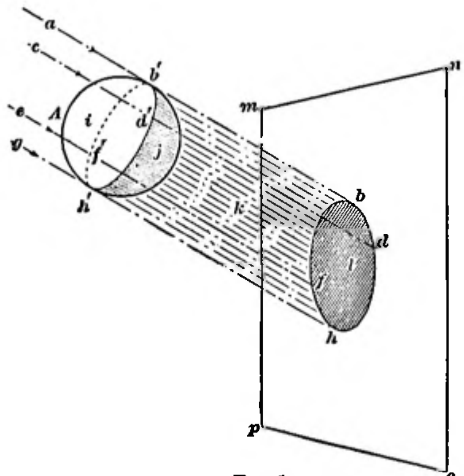


FIG. 5

4. Definitions.—A surface is said to be *in light* when it is illuminated by direct rays of light. The surface *i* of the sphere *A* in Fig. 5 is in light. The lightest surfaces of objects will be those that are at right angles to the light rays, as at *c, m, o, p, q,* and *r* in Fig. 2.

A surface is said to be *in shade* when it cannot be reached by direct rays of light, as in the case of the surface *j* of the sphere in Fig. 5.

A *line of shade* is a line that separates a surface in light from a surface in shade, as line $b'd'h'f'$ in Fig. 5.

An *invisible shadow,* or the *path of a shadow in space,* is a dark space, such as k in Fig. 5, from which direct light is cut off by an opaque object like the sphere A.

A *shadow* is a darkened portion of a surface, as shown in Fig. 5 at l, from which direct light is cut off by an opaque object such as the sphere A.

A surface is said to be *in shadow* when it is in the path of a shadow in space.

A *line of shadow* is a line that separates a surface in light from a surface in shadow, as the line $bdhf$ in Fig. 5.

By the term *total shadow* is meant the entire shadow of an object. A shadow of one part of an object may fall on another part of the same object. A shadow cannot fall on a surface that is in shade. As a rule, shadows appear darkest where they are next to well-lit parts, and surfaces in shadow are generally darker than surfaces in shade.

It is sometimes said that an object casts a shadow. In this text, however, the expression *casting a shadow* will be used to mean the process of locating a shadow on a drawing. The abbreviation VP will be used to indicate the vertical plane upon which shadows are cast.

5. General Principles Relating to Casting of Shadows. Casting shadows is a matter of drawing and this subject should be studied with the aid of drawing materials, such as drawing boards, T-squares, triangles, and drawing instruments. Most of the figures shown in the following pages should be redrawn carefully by the student in order that he may understand them thoroughly. Merely reading the text of this instruction paper will not produce satisfactory results.

The shadows of objects on planes are cast, in most cases, by finding the positions of the shadows of points in these objects. The shadow of a line is cast by locating the shadows of two or more points in the line. The shadow of a solid is cast by locating the shadows of the lines of shade and lines of shadow on the solid.

CASTING SHADOWS OF POINTS ON VERTICAL PLANES

6. Four General Methods.—In casting shadows of points on vertical planes, four methods may be used, as illustrated in Fig. 6 (a), (b), (c), and (d). In each of these diagrams is shown a vertical plane $ABCD$ upon which the shadow of a point a is to be cast. The line EF in (c) represents a plan of the vertical plane, and the line GH in (d) represents a side view of the vertical plane. In all cases in Fig. 6 and also in

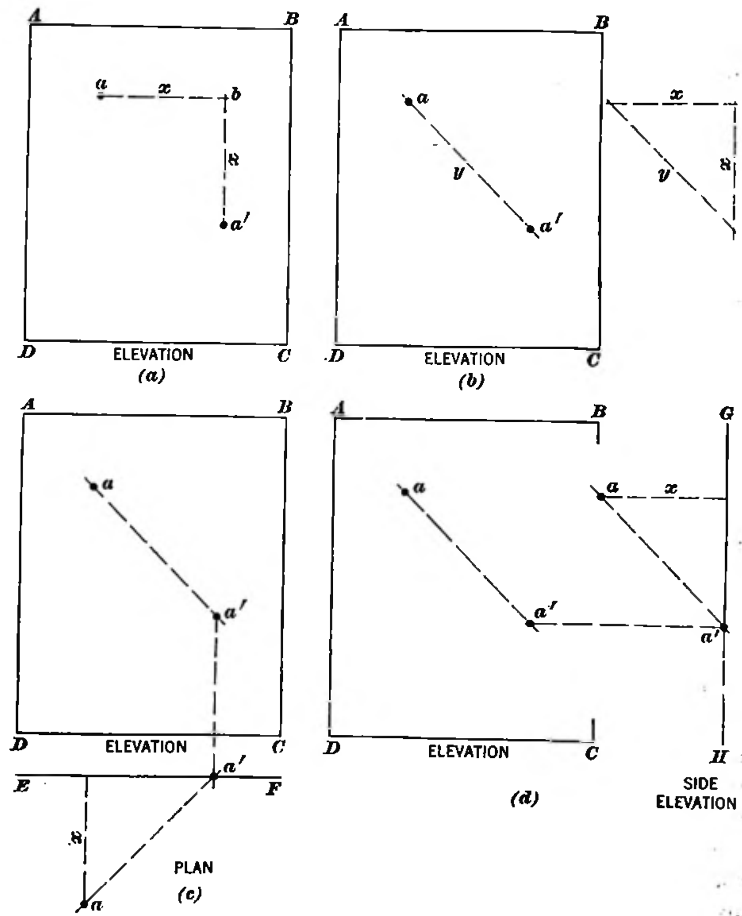


Fig. 6

following cases, x represents the perpendicular distance of a point from the vertical plane. The distance x to the point a in Fig. 6 is known.

7. Method 1.—In the method shown in Fig. 6 (a), lay off the known distance x horizontally to the right from the given point a, as at ab. Lay off the same distance vertically and downward from b to a'. The point a' will be the shadow of the point a. A modification of this method is to lay off x first downward and then to the right.

8. Method 2.—In the method shown in Fig. 6 (b), find the diagonal of a square each side of which is the known distance x. The length of this diagonal will be called y. Draw a 45° line down to the right from a, and lay off on this line the distance y, as at aa'. The point a' will be the shadow of a. By a 45° line is meant the path of the ray of light through any point, as shown in Fig. 6 (b), (c), or (d).

Methods 1 and 2 are extremely simple, but many apparently difficult problems in casting shadows on vertical planes can be easily solved by their use.

9. Method 3.—In the method shown in Fig. 6 (c), a plan EF of the vertical plane and a plan of the point a are also necessary. Draw 45° lines from a in the elevation and in the plan. Such a line in the plan will meet the plan EF of the vertical plane at a'. Draw a vertical line upward from a' in the plan until it intersects the 45° line through a in the elevation. The point a' in the elevation is the shadow of the point a on VP.

10. Method 4.—In the method shown in Fig. 6 (d), the vertical plane and the given point are represented in side elevation at GH and a. Draw 45° lines through the points a as shown. In the side elevation the line will strike the vertical plane at a'. Draw a horizontal line from a' on GH until it meets the 45° line in the elevation at a'. The point a' in the elevation is the shadow of a on VP.

Methods 3 and 4 are used in more complicated cases and should be thoroughly studied and understood. These methods apply, however, only to shadows cast on vertical planes.

CASTING SHADOWS OF LINES PARALLEL WITH VERTICAL PLANE

11. Shadow of a Straight Line Parallel With a Vertical Plane, on the Vertical Plane.—To cast, on a vertical plane, the shadow of a straight line that is parallel with the vertical plane, cast the shadows of the ends of the line and connect these shadows by a straight line. This straight line will be the shadow required.

In Fig. 7 is shown a horizontal straight line ab, which is parallel with the vertical plane $ABCD$, and the shadow of this line is cast on the plane. The shadows of the ends a and b of the line can be cast by any of the four methods described in Arts. 7 to 10.

12. Application of Method 1.—From each end of the line ab in Fig. 7 (a), lay off the known distance x toward the right, as at ac and bd. From the points c and d, lay off the distance x downward, as at ca' and db'. The points a' and b' will be the shadows of the points a and b. Draw the straight line $a'b'$, which will be the shadow of ab.

13. Application of Method 2.—Find the length y of the diagonal of the square of which x is the length of the side, and lay off the distance y along the 45° lines aa' and bb' in Fig. 7 (b), as shown. The points found will be a' and b'. Connect a' and b' by a straight line $a'b'$, which will be the shadow of ab.

14. Application of Method 3.—Lay out the plan EF of the plane $ABCD$ and the plan of the line ab, as in Fig. 7 (c). Draw 45° lines aa' and bb' in the elevation and in the plan. The lines aa and bb in the plan will meet the plane EF at a' and b'. Draw vertical lines from these points until they intersect the 45° lines aa' and bb' in the elevation at a' and b'. The points a' and b' will be the shadows of the ends of the line, and the line $a'b'$ will be the shadows of the line ab on the vertical plane $ABCD$.

15. Application of Method 4.—Lay out a side elevation GH of the vertical plane $ABCD$ and the side elevation of the line ab, as in Fig. 7 (d). The line ab will appear as a point. This point represents both a and b and is marked with both letters. Through ab in the side elevation, draw 45° lines aa' and

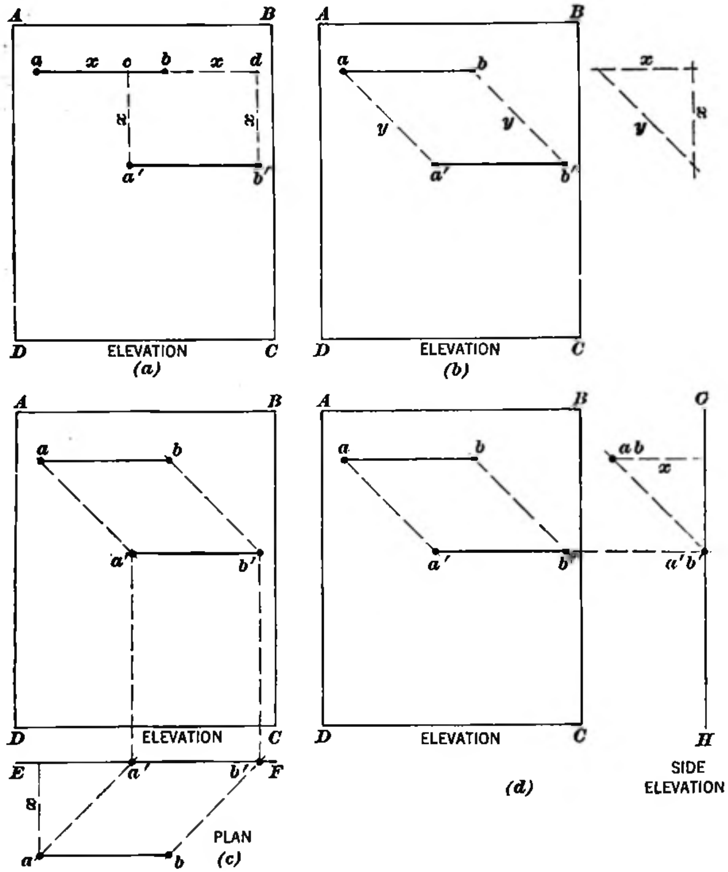


Fig. 7

bb', which will coincide, until the plane GH is intersected at $a'b'$. Draw a horizontal line from $a'b'$ until it meets the 45° lines from a and b in the elevation at a' and b', and draw the line $a'b'$. The line $a'b'$ will be the shadow of the line ab on the vertical plane $ABCD$.

16. Shadow of a Vertical Line on a Vertical Plane.—It will be seen that all four methods just described lead to the same result. The same methods may be applied in casting on a

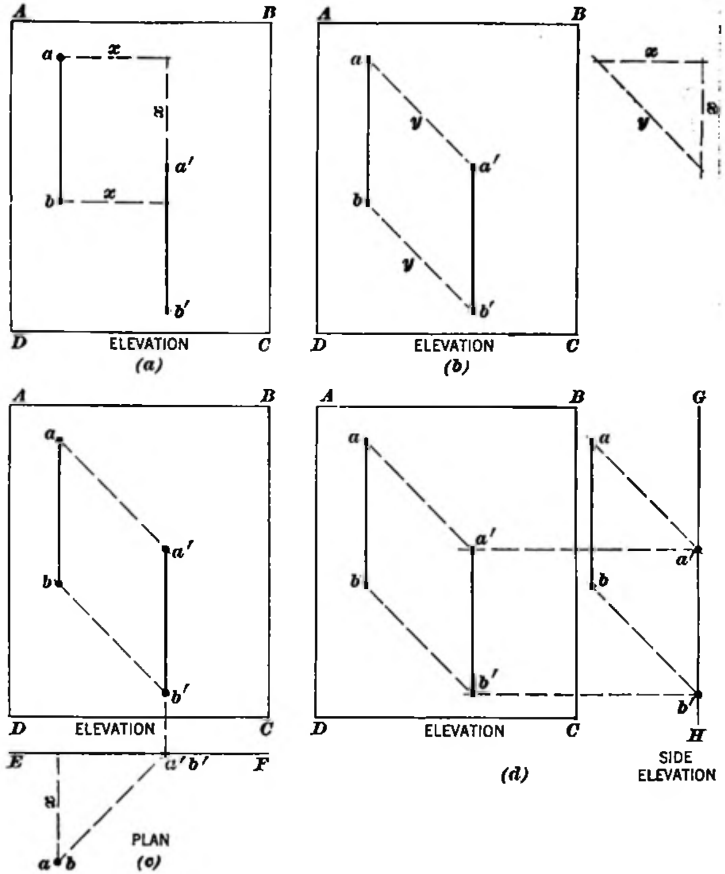


Fig. 8

vertical plane the shadow of any other straight line that is parallel with the plane.

In Fig. 8 are illustrated similar methods of casting the shadow of a vertical line on a vertical plane. Find the shadows a' and b' of the points a and b by any of the four methods already given, and connect the shadows a' and b'. The line $a'b'$ will be the shadow of the line ab. The four methods are illustrated in (a), (b), (c) and (d).

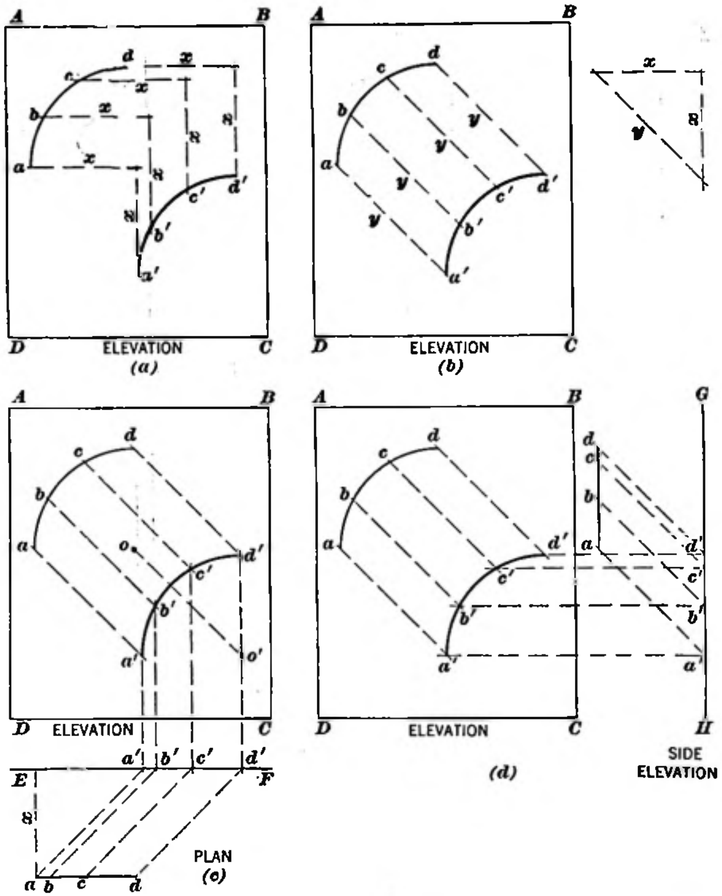


FIG. 9

17. Shadow of a Curved Line on a Vertical Plane.—A line consists theoretically of a series of points. To cast the shadow of a straight line on a plane, the shadows of the ends of the line are found and connected by a straight line. To cast the shadow of a curved line, all points of which are equally distant from

the plane, the shadows of several points must be found and connected by a line having the same shape as the line that casts the shadow.

In Fig. 9 the shadow of a curved line *abcd* is cast by applying each of the four methods already described for casting the shadows of the points *a*, *b*, *c*, and *d*. The shadow of each point is cast separately and the shadows a', b', c', and d' thus found are connected by a line having the same shape as the curve *abcd*. The line $a'b'c'd'$ will be the shadow of the given curved line. Any number of points in the curved line can be used, and their shadows can be cast by any of the methods shown.

The curve considered in Fig. 9 is a quarter-circle, and in view (c) the center of the curve is shown at *o*. The shadow of this quarter-circle may be found by casting the shadow of the center of the circle *o*, as at o', and drawing the quarter-circle $a'd'$ by using o' as the center and the known radius of the given curve as the radius.

18. Shadow of a Broken Line on a Vertical Plane.—To cast the shadow of a broken line, such as *abcd* in Fig. 10, all the points of which are equally distant from a vertical plane, cast on the plane the shadows a', b', c', and d' of the ends of the lines *ab*, *bc*, and *cd*; and connect these shadows by the straight lines $a'b'$, $b'c'$, and $c'd'$, as indicated.

EXAMPLES FOR PRACTICE

NOTE.—All examples for practice are to be included as part of the examination on this instruction paper. The drawings for the following three examples for practice are therefore to be made carefully on sheets of answer paper and are to be sent in for correction and grading as answers to Examination Questions 5, 6, and 7. These drawings should be made now, but should be held by the student until the entire instruction paper has been completed. All drawings called for in the examination questions and also the answers to the other examination questions should then be sent in together.

1. On a vertical plane surface *ABCD*, $1\frac{1}{2}$ inches wide and 2 inches high, draw the shadow of a vertical line $\frac{1}{2}$ inch long and $\frac{1}{2}$ inch in front of the plane. Indicate the four methods of casting the shadow and make a separate sketch for each method, as shown in Fig. 8.

2. Make four drawings, as in Fig. 9, each drawing to show one method of casting the shadow of a quarter-circle *abcd* with the center at

o, as shown in view (*c*). The vertical plane *ABCD* is to be 1½ inches by 2 inches in size, and the radius of the curve *ad* is to be ½ inch. The curve is to be ½ inch in front of the plane, and parallel with it. In each drawing, cast the shadow of each of four points *a*, *b*, *c*, and *d*

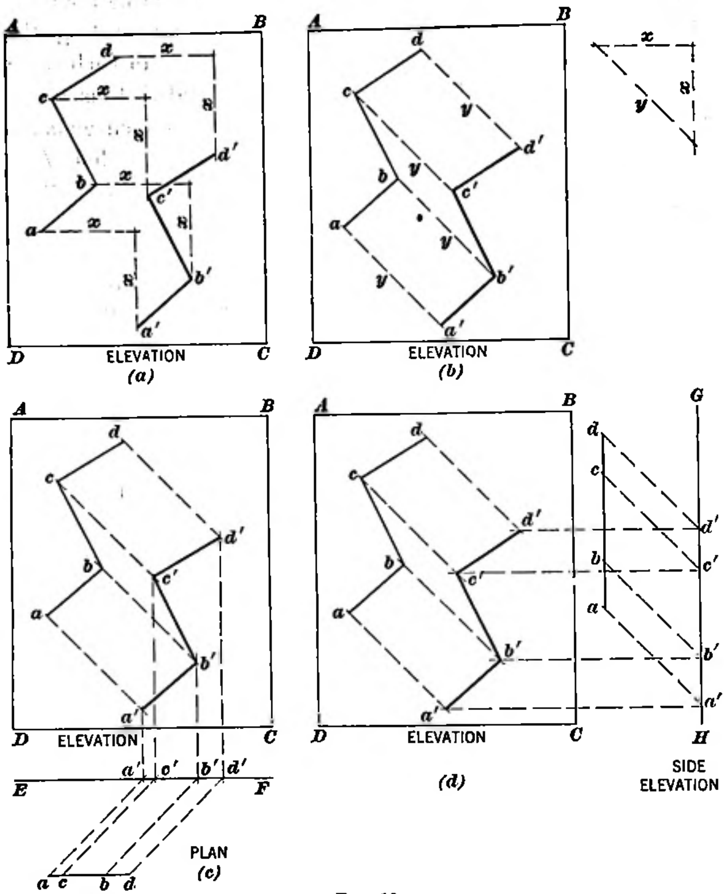


Fig. 10

of the quarter-circle and also of the center *o*. With the compass, using the shadow *o′* of the point *o* as a center, draw a quarter-circle through the points *a′*, *b′*, *c′*, and *d′*.

3. Lay out the planes as in the preceding examples, and make four simple drawings showing the four methods of casting the shadow of a broken line. Do *not* make the line like the one shown in Fig. 10.

CASTING SHADOWS OF PLANE FIGURES PARALLEL WITH VERTICAL PLANE

19. **General Method of Procedure.**—In order to cast the shadow of a plane figure on a parallel vertical surface, it will be necessary to cast the shadows of the lines that surround the given figure. Thus, in casting the shadow of any polygon, the shadows of the bounding lines are found and they define or surround the shadow of the polygon.

20. **Shadow of a Polygon.**—A method of casting the shadow of a square is illustrated in Fig. 11 (*a*), where the shadow of the square *abcd* is cast on the vertical plane *ABCD*; the plane of the square is parallel to the vertical plane. The shadows of the points *a*, *b*, *c*, and *d* may be cast by any of the methods already described, but they can be found very simply by using method 1 in Art. 7. The shadows *a′*, *b′*, *c′*, and *d′* will be found. These shadows are connected by straight lines, and the shadow of the given square will be the square *a′b′c′d′*. This shadow will have the same shape and size as the given square. The same processes are used to cast the shadow of the triangle in (*b*), and the shadow of the hexagon in (*c*). The same processes can be used for any other plane figure which is parallel to the vertical plane.

21. **Shadow of a Circle.**—In Fig. 11 (*d*) is shown the method of casting the shadow of a circle on a vertical plane. Cast the shadows of various points in the circle and draw a circle through these shadows. A simple and generally used method is to cast the shadow of the center *o* of the given circle, as at *o′*, and to draw a circle with the point *o′* as the center and with a radius equal to the radius of the given circle. This second circle will be the shadow desired.

22. **Shadow of an Arch.**—In Fig. 11 (*e*) are shown a diagram of a simple arch and the shadow of this arch. Only the fourth method of casting the shadows of the various points is indicated here, but any of the four methods can be used. To draw the semicircular portion of the shadow, only the shadows

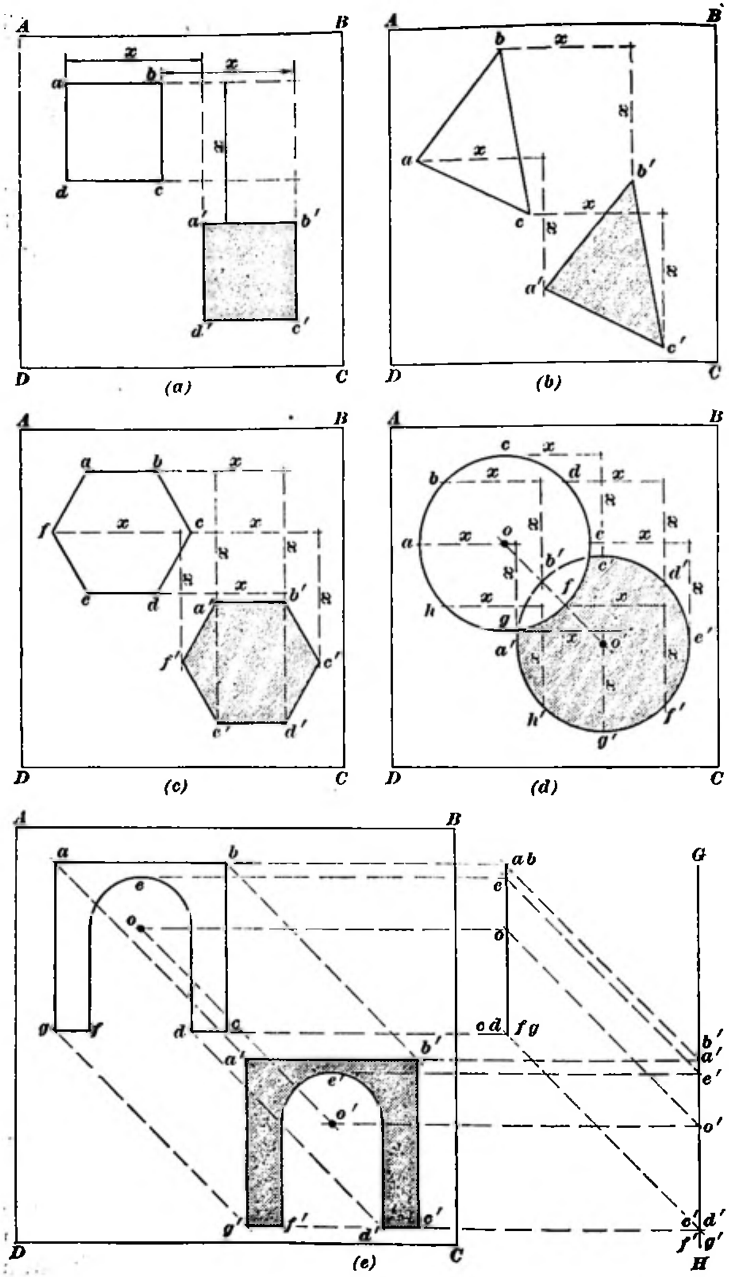


FIG. 11

of the center o and the high point e of the semicircle are cast. The semicircle in the shadow is drawn by using the shadow o' of the center and the radius $o'e'$.

It is apparent from the preceding illustrations that the shadow, cast on a vertical plane, by any plane figure parallel with the vertical plane has the same shape and size as the given plane figure.

CASTING SHADOWS OF HORIZONTAL PLANE FIGURES ON VERTICAL PLANE

23. Shadow of a Line That Is Perpendicular to a Vertical Plane.—The shadow, on a vertical plane, of a straight line that is perpendicular to the vertical plane is cast by locating the shadows of the ends of the line and connecting these shadows by a straight line. In Fig. 12 (a) are shown a front elevation, a plan, and a side elevation of a vertical plane $ABCD$ and a straight line ab perpendicular to the plane. In the front elevation, the line ab will appear as a dot, which is marked ab. This dot will represent both points a and b and is therefore marked by both letters. In the plan and the side elevation, the line ab will have its real length. The shadows of points b and a may be cast in the following manner: In the front elevation, lay off the distance x for b horizontally to the right from b to c and also vertically downward from c to b'. The point b' will be the shadow of the point b. Similarly, lay off the distance x' for a horizontally from a to c' and also vertically downward from c' to a'. The point a' will be the shadow of the point a. Draw the line $a'b'$, which will be the shadow of the line ab. Any of the other three methods can be used instead of method 1 for casting the shadows of points a and b, but method 1 is the simplest.

24. Shadow of a Horizontal Square.—In Fig. 12 (b) are shown the front elevation, plan, and side elevation of a vertical plane $ABCD$ and a horizontal square $abcd$ whose sides are parallel and perpendicular to the plane. The line EF represents the vertical plane in the plan, and the line GH represents that plane in the side elevation. The shadows of the four corners of the square can be cast by any of the four general methods, and

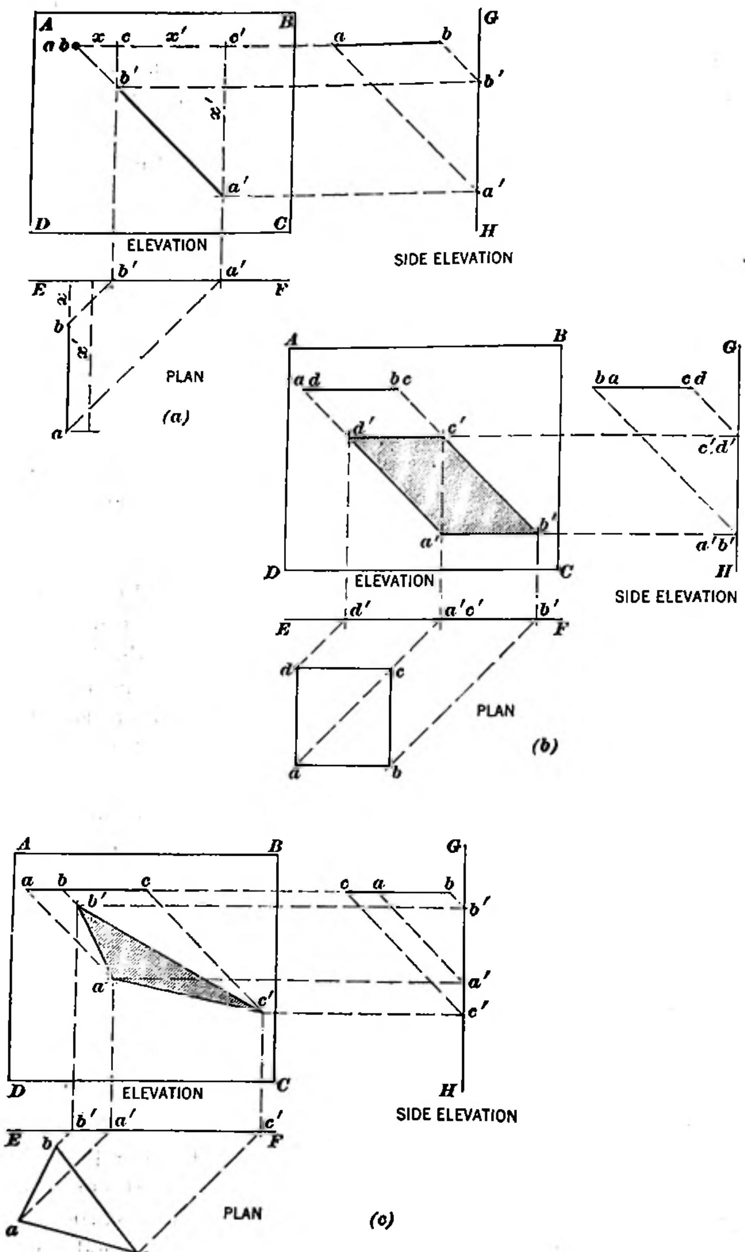

ELEVATION
SIDE ELEVATION
PLAN
(a)
ELEVATION
SIDE ELEVATION
PLAN
(b)
ELEVATION
SIDE ELEVATION
PLAN
(c)

FIG. 12

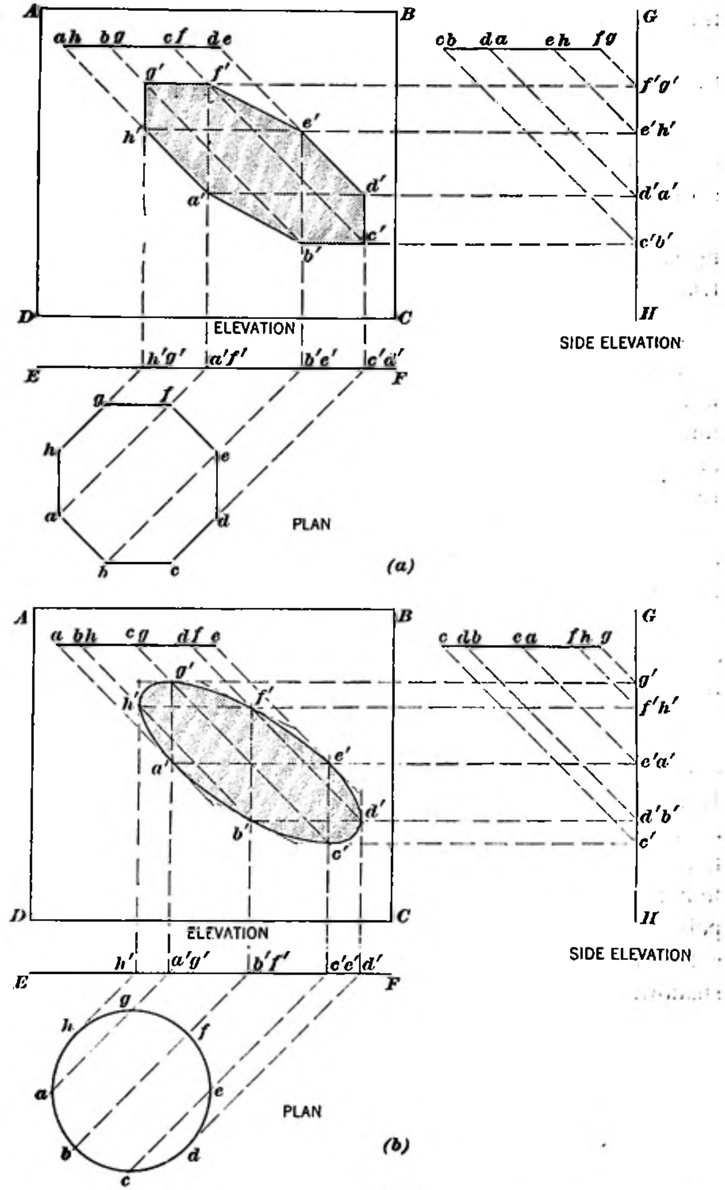

ELEVATION
SIDE ELEVATION
PLAN
(a)
ELEVATION
SIDE ELEVATION
PLAN
(b)

FIG. 13

the shadows a', b', c', and d' of these corners will thus be located in the front elevation. By connecting these shadows as shown, the shadow of the square on the vertical plane will be obtained.

25. Shadow of a Horizontal Triangle.—One method of casting the shadow of a horizontal triangle on a vertical plane is shown in Fig. 12 (c). The shadows of the three vertexes of the triangle should be cast, and these shadows should be connected by straight lines. These lines will enclose the shadow of the triangle, as at $a'b'c'$ in the elevation.

26. Shadow of a Horizontal Polygon.—The shadow, on a vertical plane, of any polygon in a horizontal plane can be cast in the same manner as in the cases of the square and the triangle illustrated in Fig. 12 (b) and (c). By means of a plan of the polygon, the distance x for each vertex of the polygon can be readily found. In Fig. 13 (a) is shown the method of casting the shadow of an octagon. The shadows of the vertexes can be cast on the vertical plane in the elevation most easily by using method 1; but any of the methods can be used, as may be convenient and as indicated in the illustration. Connect the shadows a', b', c', etc. of the vertexes by straight lines, and the outline of the shadow will be obtained.

27. Shadow of a Horizontal Circle.—The shadow of a horizontal circle on a vertical plane is cast as shown in Fig. 13 (b). The shadows of various points, a, b, c, etc., are cast; and a smooth curve is drawn through them, as shown in the elevation. The shadow of a point can be cast by using any of the four methods. The shadow of the circle will be contained in a polygon similar to the shadow obtained in Fig. 13 (a). The sides of such a polygon are tangent to the curve through the shadows a', b', c', etc.

CASTING SHADOWS OF OBJECTS

SHADOWS OF SIMPLE SOLIDS ON VERTICAL PLANES

28. Lines Bounding Shadows.—In casing shadows of solid objects, it must be kept in mind that the shadows of certain lines on an object determine the total shadow of the object. These lines are generally lines of shade, which have been defined. Thus, in Fig. 5, the line of shade $b'd'h'f'$ determines the shadow $bdhf$ of the sphere A on the vertical plane. In case of the cube shown in Fig. 14 (a), the sides $abcd$ and $adhe$ and the top $abfe$ are in light. The other three faces of the cube are in shade. The shadows of the lines of shade dc, cb, bf, fe, eh, and hd will define the shadow of the cube that is cast upon the other planes or objects.

In case it is not obvious which lines of the object determine the bounding lines of the shadow, the shadows of all definite lines may be cast. The shadows of various parts of the object will overlap, but the outside lines of all the shadows will bound the total shadow of the object. Thus, in Fig. 14 (b), the shadows of all the edges of the cube are cast upon the plane $ABCD$. In this case, the shadows of the lines of shade on the cube bound or limit the entire or total shadow. The shadows of the remaining edges of the cube are included within the total shadow and would not be discernible in the actual shadow.

29. Shadow of a Cube.—In Fig. 14 (b), a cube is shown in elevation, in plan, and in side elevation. The sides $abcd$ and $efgh$ are parallel with the vertical plane $ABCD$ on which the shadow of the cube is to be cast. First, cast the shadow of the side $abcd$, as at $a'b'c'd'$. Then, cast the shadow of the side $efgh$, as $e'f'g'h'$. Draw the shadows of the edges bf and hd, as at $b'f'$ and $h'd'$. The total shadow of the cube will then be the polygon $e'f'b'c'd'h'$. The shadows of the edges gh, fg, ad, and ab are lost in the total shadow.

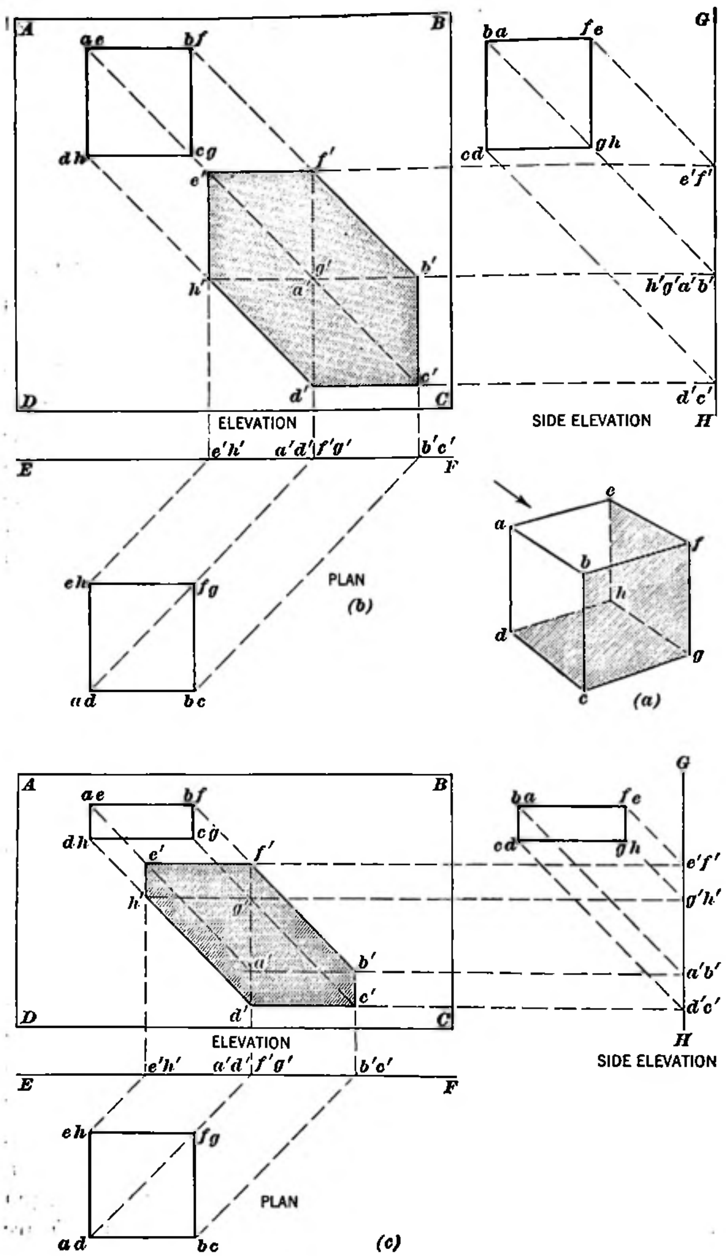


FIG. 14

It will be noted that in many cases points are marked by two letters. This means that the point so lettered indicates the position of two points, one in front of or above the other.

30. Shadow of a Rectangular Prism.—The shadow of the rectangular prism shown in Fig. 14 (*c*) is cast in the same manner as that of the cube in (*b*). The vertical faces of the prism are, however, smaller than those of the cube. The lines of shade on the prism are the edges *dc*, *cb*, *bf*, *fe*, *eh*, and *hd*, and the total shadow is the polygon $c'f'b'c'd'h'$. The shadows of the various points can be easily cast by any of the four general methods already described, and the shadows of the sides *abcd* and *efgh* and the edges *bf* and *hd* can be cast as in (*b*).

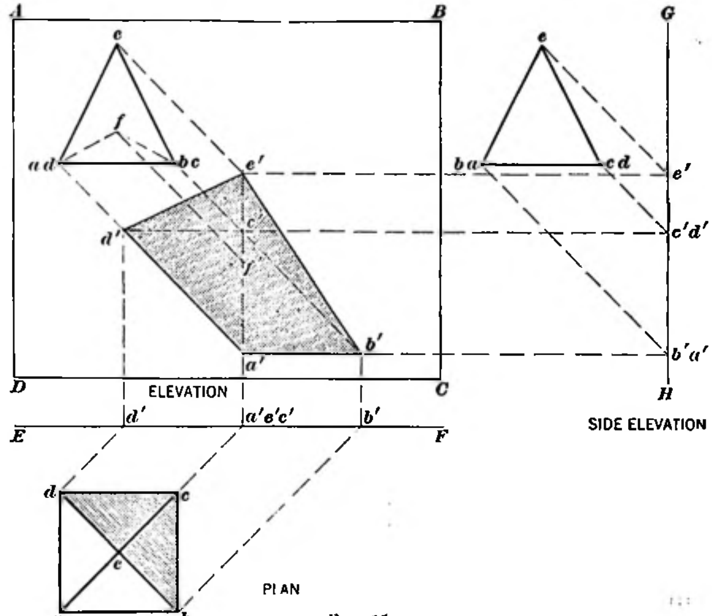


FIG. 15

31. Shadow of a High Square Pyramid.—The pyramid shown in Fig. 15 has a square horizontal base *abcd*, and the edges *ab* and *cd* are parallel to the vertical plane *ABCD*. Cast the shadow, $a'b'c'd'$, of this square by applying the method indicated in Fig. 12 (*b*). Then, cast the shadow of the apex *e*,

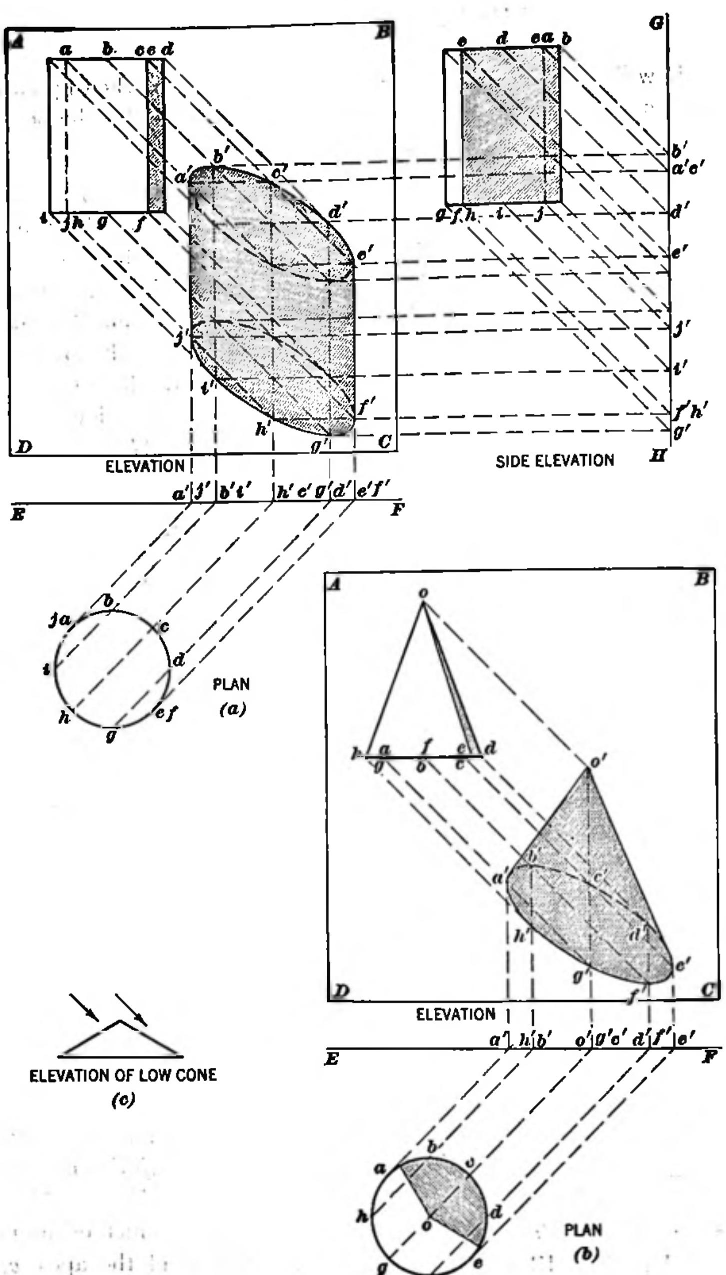


Fig. 16

Fig. 15, and connect the shadow e' with the points a', b', c' and d'. The total shadow of the pyramid will be the polygon $a'b'e'd'$. In the total shadow, the shadows of the edges *dc, cb, ce,* and *ae* are lost.

32. Shadow of a Low Pyramid.—If the pyramid is low, as indicated by the triangle *abf* in the elevation in Fig. 15, the shadow of the apex *f* will fall within the shadow of the base, and the total shadow of the pyramid will be the parallelogram $a'b'c'd'$.

33. Shadow of a Vertical Cylinder.—The illuminated parts of a cylinder with its axis vertical are the upper circular surface and the half of the cylindrical surface that faces the light. The lines of shade on the cylinder shown in Fig. 16 (*a*) are the half *abcde* of the upper circle, the half *fghij* of the lower circle, and the vertical lines *aj* and *ef*.

Cast the shadows of the entire upper and lower circles in Fig. 16 (*a*) as directed for the circle in Fig. 13 (*b*); and draw the shadows $a'j'$ and $e'f'$ of the vertical lines *aj* and *ef* in Fig. 16 (*a*). The shadow of the cylinder will thus be found. The shadows of parts of the circles will be included or lost in the total shadow. The shadows of the various points can be cast by any of the four general methods given in Arts. 7 to 10.

34. Shadow of a Cone.—The shadow of a cone with its axis vertical may be found by casting the shadow of the base and the shadow of the apex of the cone, and drawing tangents from the shadow of the apex to the shadow of the base. Thus, in Fig. 16 (*b*), the shadows of several points on the base of the cone are cast, as at a', h', g', f', etc., and the shadow of the apex is cast, as at o'. Tangent lines are drawn from o' to the shadow of the base, as shown.

A cone may be very flat, as shown in (*c*), so that the shadow of the apex is within the shadow of the base. In that case, the shadow of the cone will be merely the shadow of the base.

SHADOWS OF MISCELLANEOUS OBJECTS ON VERTICAL PLANE

35. Single Prism With One Side in Vertical Plane.—In Fig. 17 are shown plans and elevations of several prisms attached

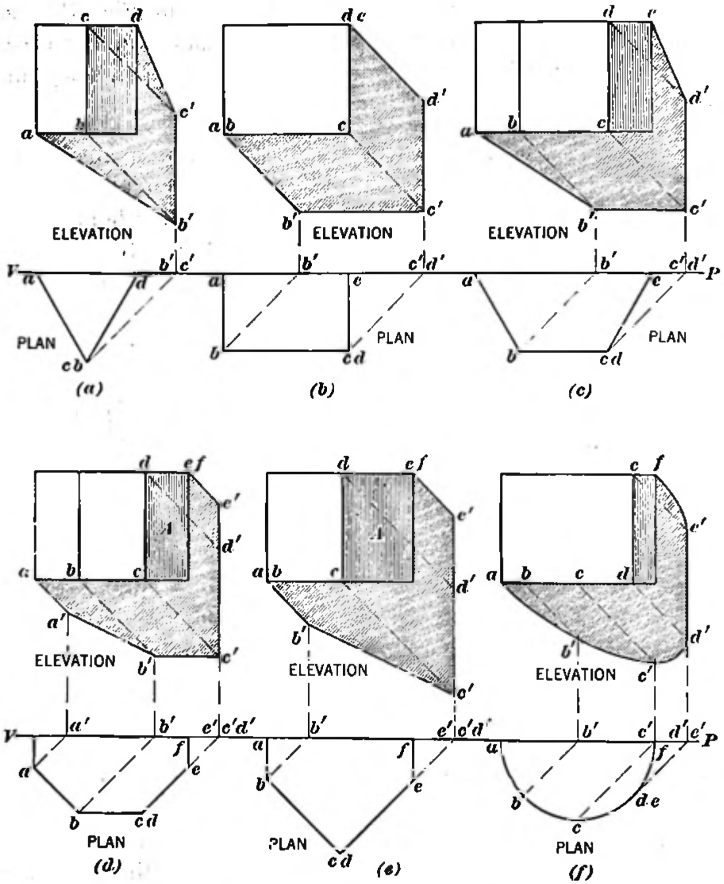


FIG. 17

to a wall surface *VP*. The elevations of the prisms and the shadows cast on the wall are shown above the plans. All the shadows in this illustration can be cast by determining the

perpendicular distances, *x*, of the various points from *VP* and using method 1 in Art. 7. The distances of all points in the prisms from the vertical plane are shown in the plans. The lines whose shadows are cast are *ab*, *bc*, *cd*, etc., as lettered in the elevations.

The shadows of lines of shade, as *ab*, *bc*, and *cd*, are cast, as at *ab'*, *b'c'*, and *c'd'*; and the outlines of the total shadow are found. The surfaces in shade are lightly shaded, and the shadows are in darker shading. The surfaces marked *A* in (*d*) and (*e*) are at an angle of 45° with the vertical plane. The rays of light would therefore be tangent to those surfaces, and the surfaces are in the position of being neither in light nor in shade. In practice, however, they are considered as being in shade.

EXAMPLE FOR PRACTICE

Make a drawing of each of the objects included in Fig. 17, and cast the shadows. Make the dimensions of the various figures twice the size shown in the text, and show the method used in casting the shadows. This drawing is to be sent in as answer to Question 8 of the examination on this instruction paper.

36. Combinations of Prisms.—In Figs. 18 (*a*) and (*b*) and 19 (*a*) and (*b*) are illustrated combinations of prisms that resemble piers and caps. These prisms are attached to walls or vertical surfaces *VP*, as shown in the plans. The elevations are above the plans and show the shadows that are cast on the wall and upon the objects themselves.

The boundaries of the shadows are determined by lines of shade such as *c'h* in Fig. 18 (*a*) and *bd* in (*b*). Thus, the shadow of the cap in (*a*) is formed by shadows of the lines *ab*, *bd*, *de*, and *cf*. The parts of the shadow of the cap that are visible on the wall are *c''d'e'f* and the small triangle at *ab*, and these parts are marked *A* in the elevation. The shadow of the pier on the wall will be bounded by the shadows of the lines *ih* and *hc'*, and it will show at *ih'c''*, which is marked *B* in the elevation. The shadows of the cap and the pier lap over the space *C*. There is a shadow on the pier *D* that is produced by the cap.

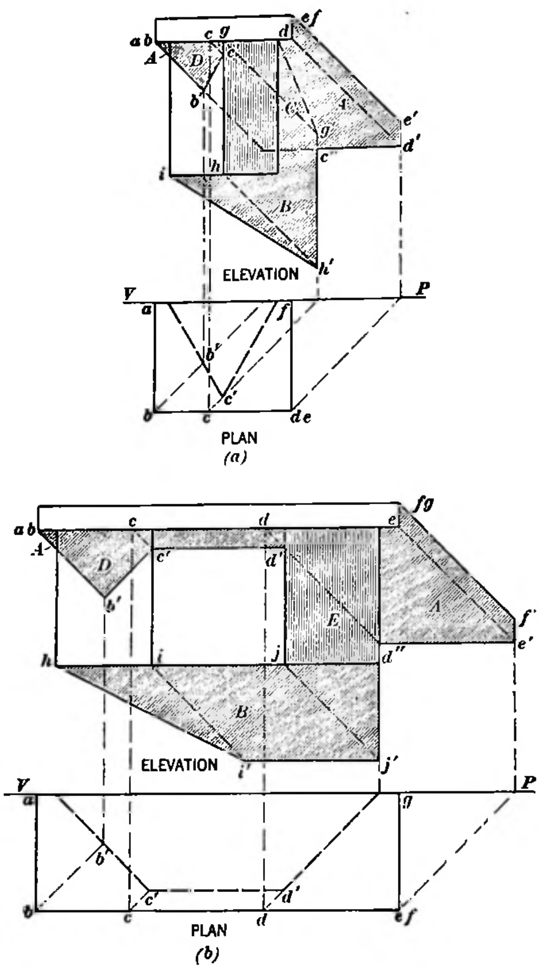


FIG. 18

To find the shadow of b in the elevation, draw the 45° line bb' in the plan. Project a line vertically up from b' until it meets the 45° line bb' in the elevation. The point b' is the shadow of the point b.

To find the point c' in the elevation, draw the 45° line $c'c$ in the plan. Project a line vertically up from c until it strikes

the line bd at c in the elevation. Draw the 45° line from c until it strikes the line $c'h$ at c'. Draw the lines bb' and $b'c'$, which will define the shadow of the cap on the pier. The line of shade gh will produce the shadow $g'h'$, but only the part $c''h'$ will show on the wall.

The same processes are followed in casting the shadows in Fig. 18 (b). The lines whose shadows are the limiting lines of the total shadow are ab, be, ef, and fg on the cap, and hi, ij, and jd' on the pier.

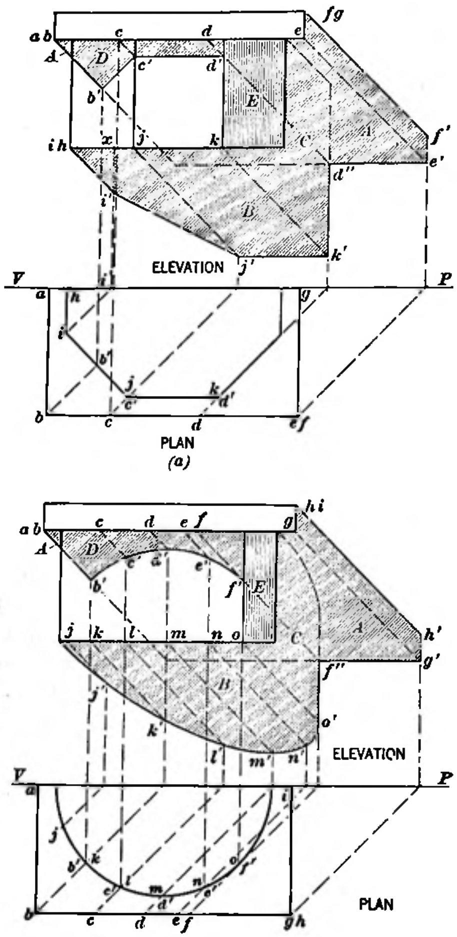
The shadows in Fig. 19 (a) and (b) are much the same as those shown in Fig. 18. The shadows in Fig. 19 (a) can easily be found by method 1. The distance x of every point in (a) from VP is shown in the plan and can be used in casting the shadows.

Methods 2 and 3 are illustrated in (a), and method 4 can be used if a side elevation is drawn.

In (b), method 1 can be used where the shadows are cast on the vertical plane, as for the parts of the shadow marked A, B, and C. Where the shadow falls on the curved surface of the shaft, method 3 is most convenient and is used as follows:

The shadow of the line ab will be at ab' in the elevation. The shadow of b on the cylindrical surface in the elevation is found by drawing in the plan the 45° line bb', which will strike the surface of the cylinder at b'. Draw a vertical line up from b' in the plan to intersect the 45° line bb' in the elevation. The point of intersection will be at b', which is the shadow of b. Through any points c, d, e, and f in the elevation and the plan, draw 45° lines as shown. In the plan, the 45° lines will strike the curved surface at c', d', e', and f'. From these points, draw vertical lines to intersect the 45° lines in the elevation at c', d', e', and f'. These points will be the shadows of the points c, d, e, and f. Draw a curved line through these shadows and point b' and the shadow of the cap on the cylinder will be obtained. The line $f'o$ will cast the shadow on VP at $f''o'$. All the other shadows will be on the vertical plane and can easily be determined by method 1.

In Fig. 19 (a) or (b), A indicates the shadow of the cap on VP; B represents the shadow of the pier on VP; C shows where the shadows A and B lap over each other; D is the shadow of the cap on the pier; and E is the part of the pier in shade.

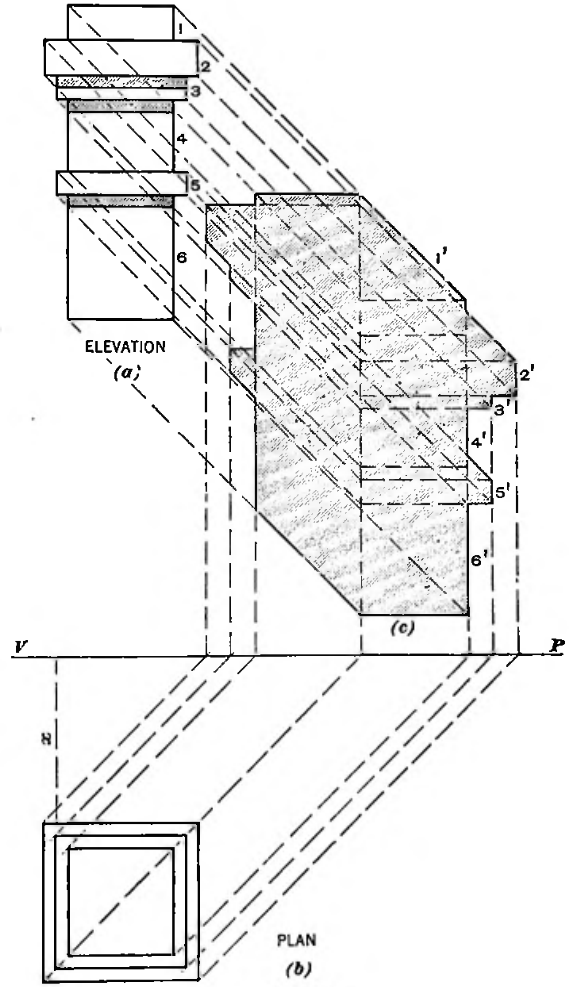


(b)

FIG. 19

37. Shadow of a Chimney on a Vertical Wall.—In Fig. 20 are shown an elevation in (a) and a plan in (b) of a simple chimney cap. The shadow of the cap on the vertical plane is

shown in (c). In the plan are shown the distances x of the various parts of the cap from the vertical wall VP, upon which



(b)

FIG. 20

the shadow is cast. The entire shadow can be easily cast by using method 1. The shadows of the prisms 1, 2, 3, 4, 5, and 6 in (a) can be cast as shown in previous articles. The

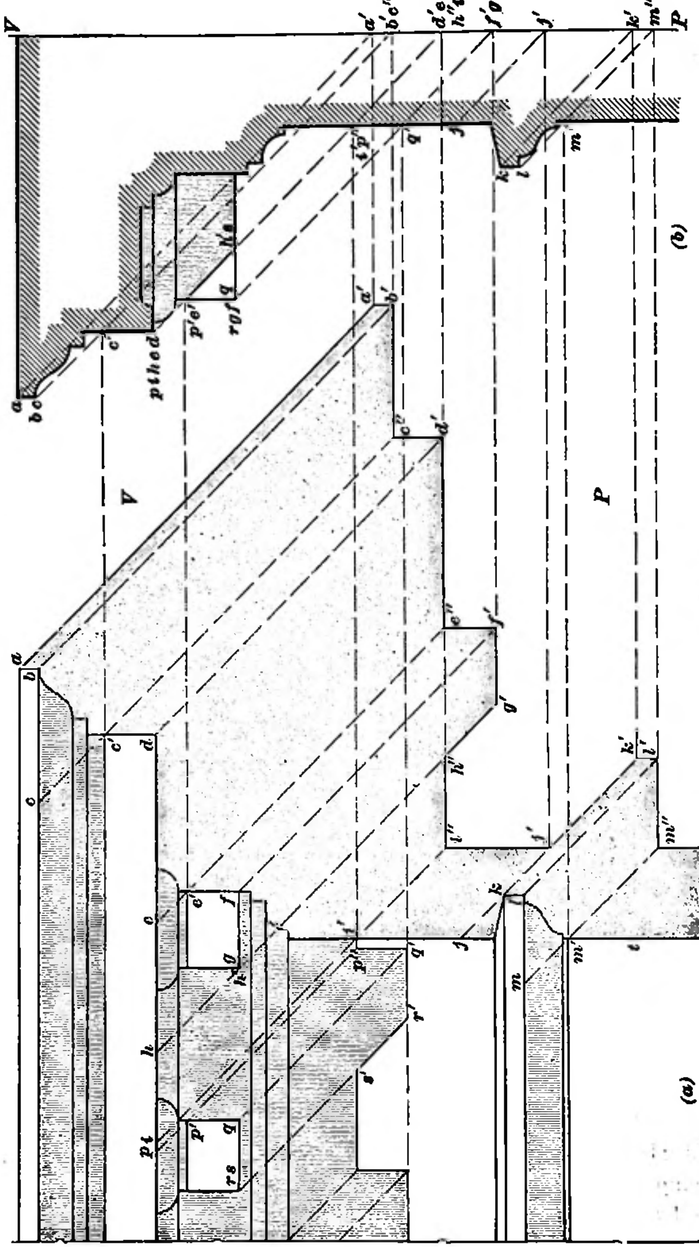
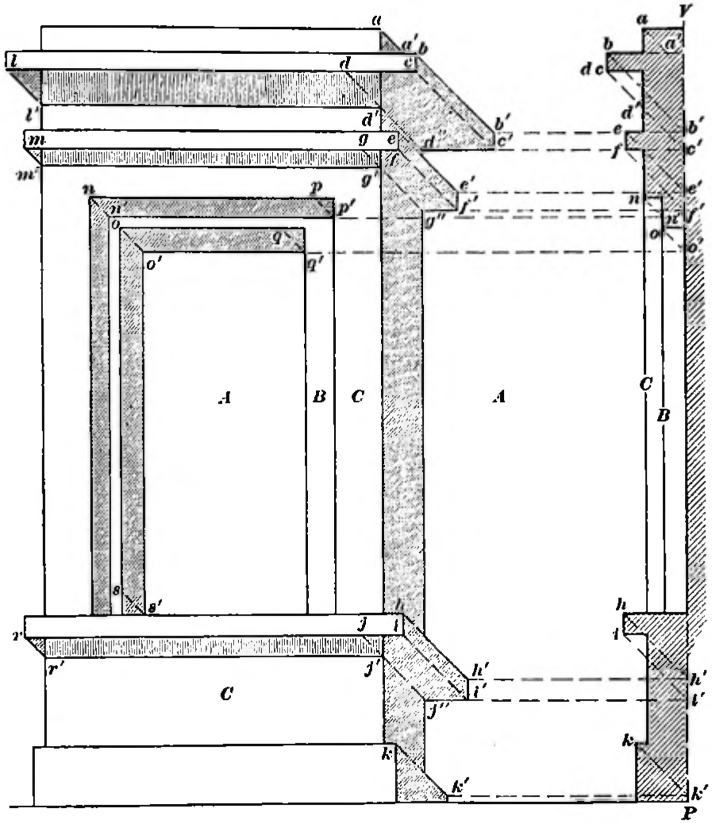


Fig. 21

shadows of these prisms are shown at 1′, 2′, 3′, etc. in (*c*). The total shadow of the chimney will show as indicated by the heavy lines and the shadows of the remaining lines will be lost in the total shadow, as indicated by the dashed lines within the heavy outline.



ELEVATION
(*a*)

SECTION
(*b*)

Fig. 22

38. Shadow of an Entablature Projecting From a Wall. In Fig. 21 are shown an elevation in (*a*) and a vertical section in (*b*) of an entablature projecting from a wall *VP*. The section shows the face of the wall *VP*, and the projections of the various members of the entablature in front of the face of the wall. With these projections shown, the shadow of the entablature on the wall VP can be easily cast by methods 1, 2, 3, or 4.

The lines in (a) whose shadows form the outline of the total shadow are ab, bc, $c'd$, de, $e'f$, fg, gh', hi, $i'j$, kl, and lm. The shadows of these lines on the wall are shown at $a'b'$, $b'c''$, etc. The shadow of the left-hand bracket $p'qrs$ in the cornice is formed at $p''q'r's'$ on the frieze, as shown. It will be seen upon inspection of the section that the lines ab, $c'd$, $i'j$, etc. are in surfaces receiving light.

EXAMPLE FOR PRACTICE

Redraw the entablature shown in Fig. 21 on a sheet of answer paper and cast the shadows, using method 1. Send in your work as answer to Question 9 of the examination on this instruction paper.

39. Shadow of Window Trim.—A diagram of a window trim is shown in Fig. 22, where (a) is the elevation and (b) is the section. The elevation shows the design of the window trim and the shadows cast upon the vertical plane and upon parts of the window trim. In the elevation, the parts of the vertical plane VP are marked A. Corresponding parts of other vertical planes are marked in the elevation and section by the letters B and C.

The points whose shadows are cast on the surface A are a, b, c, d, e, f, g, h, i, j, k, o, q, and s. The shadows of these points which are at a', b', c', etc., can easily be cast by the methods used in the preceding problems. The shadows on the frame itself are those of the lines ld, mg, np, and rj, which are at $l'd'$, $m'g'$, $n'p'$, and $r'j'$, respectively.

SHADOWS ON INCLINED PLANES

40. Shadow of a Dormer Window.—In Fig. 23 are shown a front elevation in (a) and a side elevation in (b) of a dormer window. The slope of the roof IP is an inclined plane upon which the shadow of the dormer is cast. The points of the dormer whose shadows are cast on the roof are a, b, c, d, e, f, and g, and the shadows of these points are shown at a', b', c', etc. The method of casting the shadow of the point a in (a) is

to draw, from the corresponding point a in (b), a 45° line aa' which meets the roof line at a'. From this point, draw a horizontal line until it intersects the 45° line aa' in (a) at a'. The point a' will be the shadow on the roof of the point a. The shadow of the point h will be at h. The shadow of the ridge of the dormer ha will therefore be ha' in (a).

In a similar manner, draw a 45° line bb' in (b) until it meets the slope IP at b'. From b', draw a horizontal line until it meets the 45° line bb' in (a), and b' will be the shadow of b. Join a' and b'. The line $a'b'$ will be the shadow of ab on the roof surface.

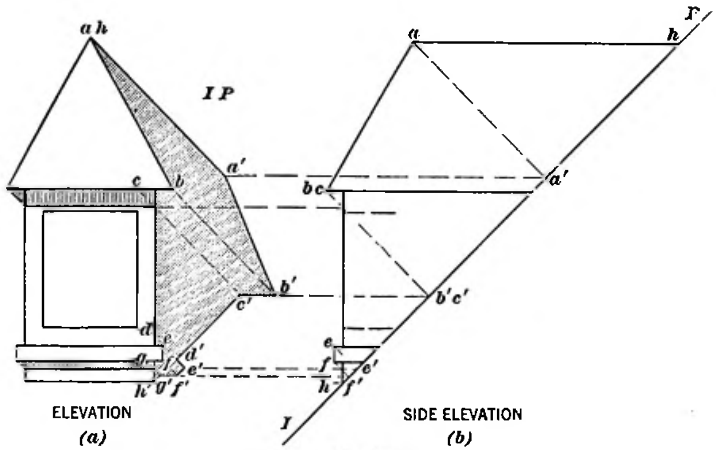


Fig. 23

Proceed in the same manner to cast the shadows of all the points that determine the outline of the shadow, and join them as indicated in Fig. 23. Methods 1 and 2 cannot be used on inclined surfaces, and plans or side elevations are required.

41. Shadow of a Chimney on an Inclined Roof.—A chimney whose shadow falls on a sloping roof is shown in Fig. 24 (a), (b), and (c). In (a) are shown an elevation of the chimney and the shadow that will be cast on the roof. The same processes are used in casting the shadow of each point as in the case of the dormer in Fig. 23. Thus, to cast the shadow of the point b

in Fig. 24 (a), draw a 45° line bb' in (b) until it meets the slope IP at b'. Draw a horizontal line $b'b'$ until it meets the line bb' in (a) at b'. The point b' will be the shadow on the roof of the

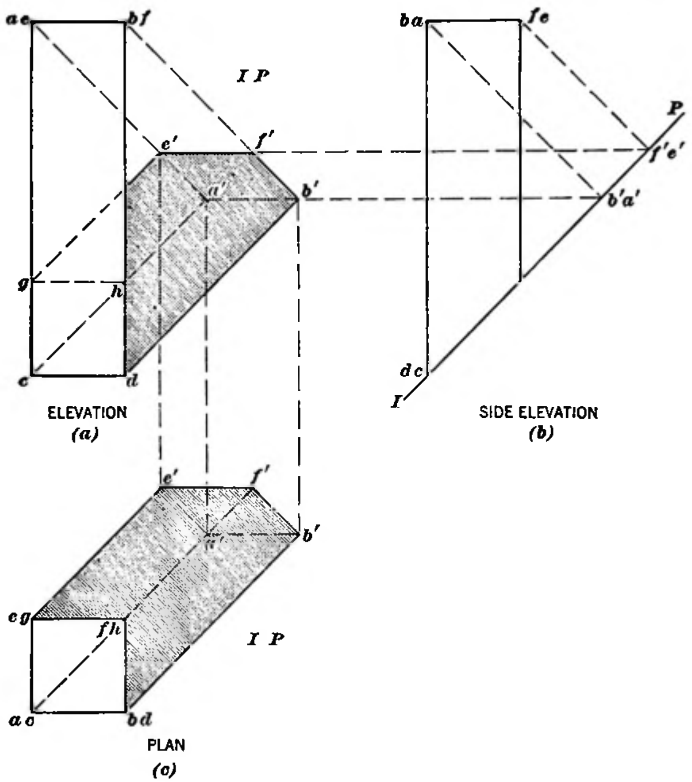


Fig. 24

point b. Each point can be treated in the same manner, and the total shadow will be obtained. The shadow of the chimney on the roof is shown also in the plan in (c).

SHADOWS ON BROKEN AND CURVED SURFACES

42. Shadows on the Entrance to a Motion-Picture Theater. In Fig. 25 are shown outline drawings of the entrance to a motion-picture theater, including an elevation in (a), a plan

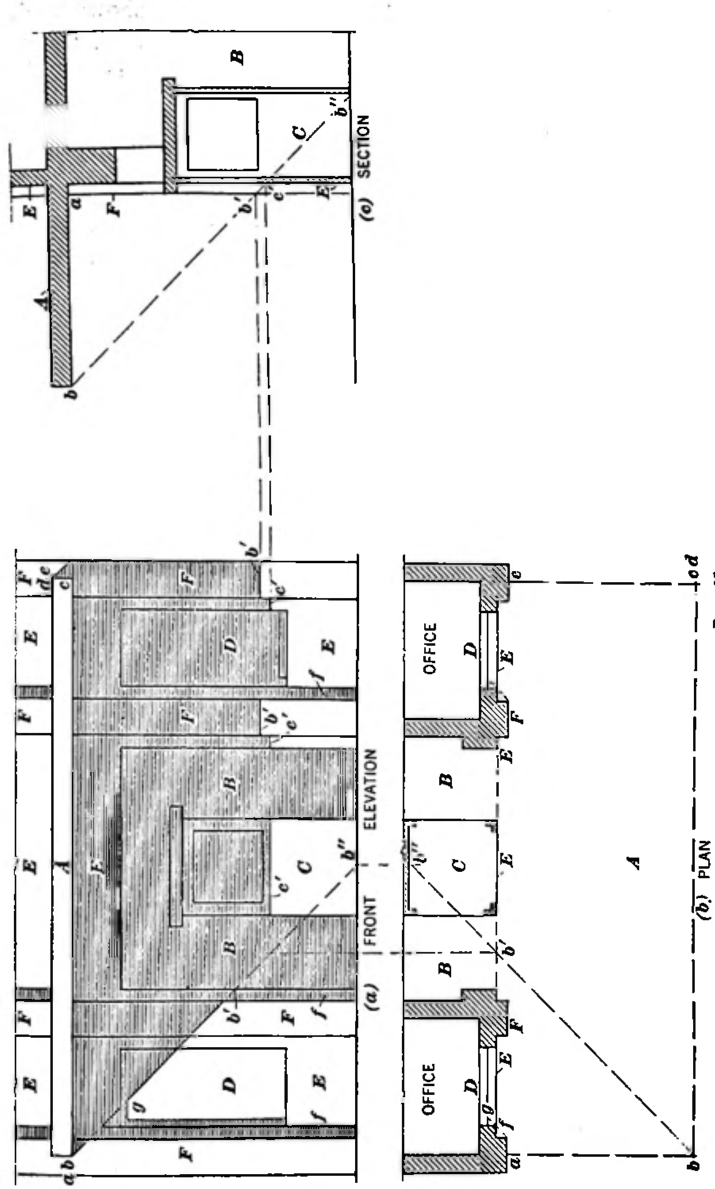


Fig. 25

in (b), and a section in (c). A marquise or hood is shown at A, entrances to the theater are shown at B, a ticket booth is shown at C, windows to the offices are shown at D, the face of the building is at E, and the faces of pilasters projecting in front of the wall are at F.

The shadow of the marquise A is the most important shadow to be cast. The lines on the marquise whose shadows bound the limiting shadow are ab, bc, cd, and de. In the elevation in (a), the shadow of the line ab will cut across in a 45° line from a to b'. The point a will cast a shadow at a, and the point b will cast a shadow that would strike the floor at b'' in (a). The part of the shadow of the line ab that would appear in the elevation is ab'. The rest of the shadow is lost in the shadow of the entrance.

Also, in (a) the shadow of the line bc of the marquise will be a horizontal line crossing each of the two pilasters F at the right at b'. This line is obtained by drawing a 45° line bb' in (c). Where it intersects the face of a pilaster F at b', a horizontal line is projected to (a), where it will cut the faces of the pilasters F at b'.

To cast the shadow of line bc of the marquise on the wall E, draw the 45° line bb'' in (c) until it hits the surface E at e'. Project the horizontal line from e' to the elevation in (a). The lines e' are the shadow of bc on the wall E.

The face of the ticket booth C is in the same plane as the face of the wall at E, and the line e' will also appear on the booth.

The pilasters F will cast shadows on the wall at f and on the left-hand window D at g. These shadows can be determined from the plan in (b). A careful study of this problem will be of great service in casting shadows in many similar ones.

43. Shadow in a Niche.—A niche is shown in elevation in Fig. 26 (a) and in plan in (b). The niche is semicircular in plan, and its head is a quarter-sphere. The shadow will be cast practically by one part of the niche upon another. The main shadow in (a) will be bounded by the shadows of the straight line na and the curve from a to i upon the wall and head of the niche.

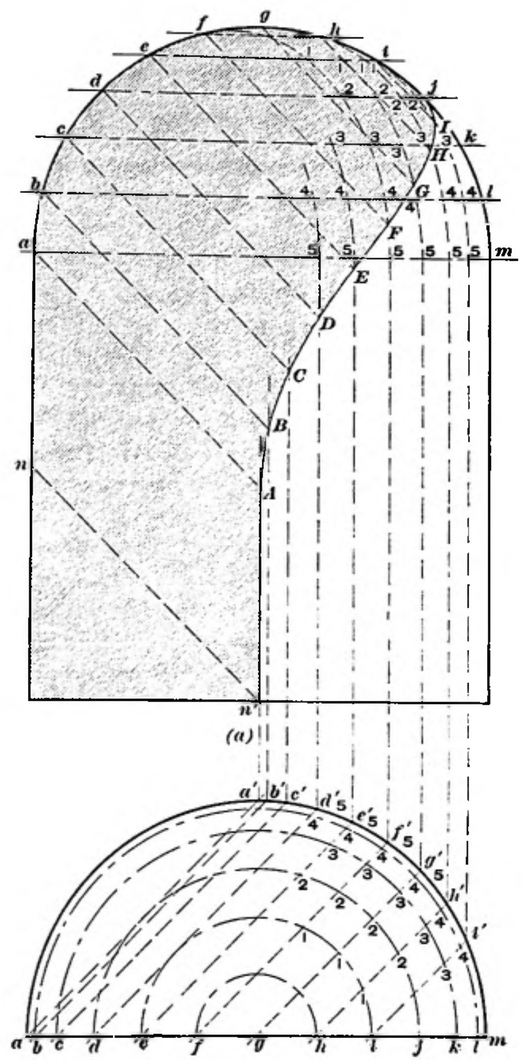


FIG. 26

In order to determine the shape of the shadow through the points A, B, C, etc., cuts or slices are taken through the niche, as indicated in (b) at aa', bb', cc', etc. These cuts are taken in the direction of the rays of light, and one point of the shadow is obtained from each cut. These points are marked *A*, *B*, *C*, and so on to *I* in (*a*). After these points have been located, a curved line is drawn through them, with the aid of a French curve, and there is obtained a graceful, flowing line which is the desired shadow line.

The method of showing the cuts or slices through the niche is as follows: Draw the line *ff'* in (*b*) at 45° with *am*; this line will represent one cut or slice in the plan. Cut the dome over the niche in (*a*) into several horizontal slices by drawing the lines *bl*, *ck*, etc. Draw plans of these horizontal cuts in (*b*), as shown at *bl*, *ck*, etc.; the plans of the horizontal cuts will be semicircles. Where the line *ff'* intersects the semicircles on the plan, mark the intersections 1, 2, 3, 4, and 5. From the point 1 on *ff'* in (*b*), draw a vertical line until it meets the horizontal cut *ei* in (*a*) and mark the point of intersection 1. From the point 2 on *ff'* in (*b*), draw a vertical line until it meets the horizontal slice *dj* in (*a*) and mark this point 2. The points 3, 4, and 5 can be obtained in the same manner. The line through the shadows of *f*, 1, 2, 3, 4, and 5 in (*a*) will show where the plane *ff'* in (*b*) cuts the dome in (*a*). Draw a 45° line *fF* in (*a*) to intersect the curve through *f*, 1, 2, 3, 4, and 5. The point *F* will be one point in the line of shadow from *A* to *I*.

Repeat the same process for each of the cuts *aa'*, *bb'*, etc. in (*b*), and one point will be found in the line *A-I* for each cut. When a sufficient number of points have been found, draw the curved line through the points. The line *ABC-I* thus obtained will represent the shadow of the line *abc-i* in (*a*). The shadow of the edge *an* in (*a*) will be the line *An'*.

44. Shadow of a Column on a String-Course.—In Fig. 27 (*a*) is shown an elevation, and in (*b*) a plan, of a column whose shadow is cast on a string-course. The column is at *A*, the string-course is at *B*, and the wall or vertical plane is at *C*, in both (*a*) and (*b*).

The lines on the column that limit the shadow on *B* are *aa* and *bb* in (*a*). These are shown in plan at the points *a* and *b*. There will be two vertical planes of light that touch the column

at *a* and *b* in (*b*) and that intersect the wall at *a'* and *b'* and cut the molding at *cdea'* and *c'd'e'b'*.

Where the rays through *a* in (*b*) strike the string-course at *c*, *d*, *e*, and *a'*, project vertical lines up from those points to the corresponding vertical surfaces *c*, *d*, *e*, and *a'* in (*a*). Similarly, where the rays through *b* in (*b*) strike the string-course at

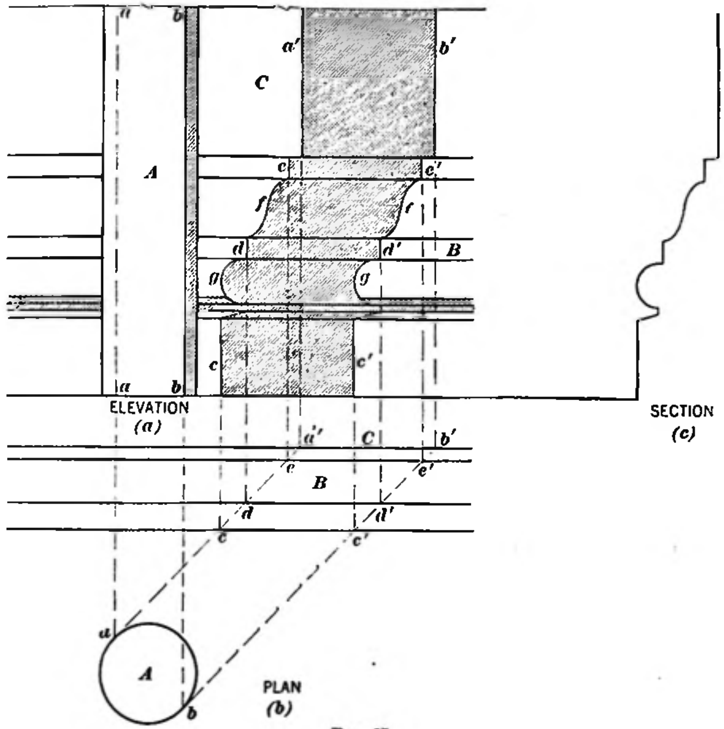


Fig. 27

c', *d'*, *e'*, and *b'*, project vertical lines up to the corresponding vertical surfaces *c'*, *d'*, *e'*, and *b'* in (*a*). The shadows on all the vertical parts of the molding will thus be determined.

The curved outlines of the shadow will be obtained by drawing the correct profiles of the curved parts of the molding as at *f* and *g* in (*a*). In casting shadows under the conditions shown, the shadows *c-e* and *c'-e'* on the string-course will be exactly like the true profile of the molding shown in (*c*).

45. Shadows on Steps.—Diagrams of a short flight of steps are shown in Fig. 28. In (*a*) is a plan of the steps, in (*b*) an elevation, in (*c*) a section through the steps, and in (*d*) an isometric view. At *A* are shown cheek-walls and at *B* is shown a platform.

The limits of the shadows on the steps and platform will be the shadows of the edges *ad* and *di* of the cheek wall *A* at the left. The shadows of these lines will fall on the platform *B* and also on the treads and the risers of the steps, as shown clearly in (*d*). The directions of the light rays are shown by broken lines in all the diagrams.

The shadow of the line *ad* on the various surfaces will be a broken line, as shown in (*d*). The shadow of the part *ab* will be *a'b'*; that of the part *bc* will be *b'c'*; and that of the part *cd* will be *c'd'*. To locate the points *b* and *c* in (*c*), draw 45° lines from *b'* and *c'* until they meet the line *ad*. Lay off points *b* and *c* on *ad* in (*a*) in corresponding positions.

Draw a 45° line from *a* in (*b*) until it strikes the platform *B* at *b'*. Project a vertical line from *b'* down to (*a*) until it strikes the 45° lines *aa'* and *bb'*. The line *a'b'* in (*a*) will be the shadow of *ab* on the horizontal platform *B*, as it would appear in plan.

Draw a 45° line from *a* to *c'* in (*b*). Project a vertical line *c'c'* down until it meets *cc'* in (*a*) at *c'*. The line *b'c'* in (*b*) will be the shadow of *bc* on the top riser. This line will show at *b'c'* in (*b*) and (*d*) as a 45° line across the face of the riser.

Draw the 45° line *dd'* in (*b*) until it strikes *d'*. Project a vertical line *d'd'* down to (*a*) until it meets the 45° line *dd'*. The point *d'* will be the shadow of *d*, in plan.

The points *e*, *f*, *g*, and *h* in (*c*) are found by drawing 45° lines from the points *e'*, *f'*, *g'*, and *h'* where the surfaces of the treads and risers join. Project horizontal lines from *e*, *f*, *g* and *h* in (*c*) until they meet the line *di* in (*b*). Draw 45° lines from *e*, *f*, *g*, and *h* in (*b*) to the points *e'*, *f'*, *g'*, and *h'*. The shadow of the line *ef* will be at *e'f'*; the shadow of *fg* at *f'g'*, the shadow of *gh* at *g'h'*, and the shadow of *hi* at *h'i*. The shadows on the treads of the steps and on the platform will be as shown in the plan in (*a*). The shadows on the risers are shown

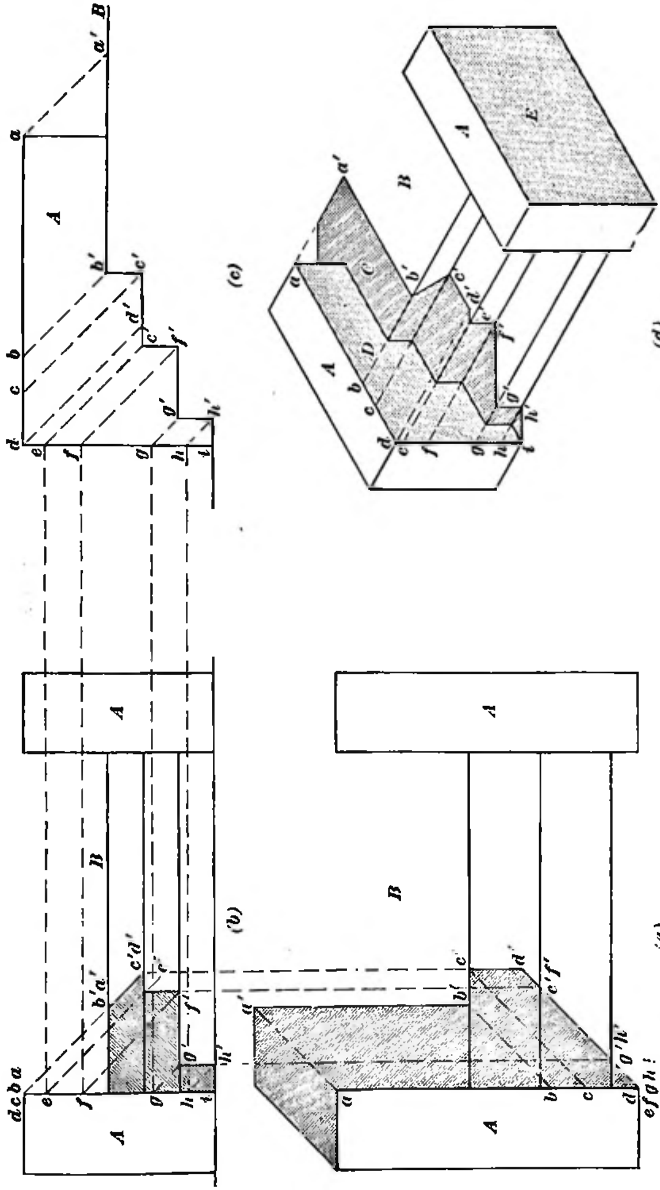


FIG. 28

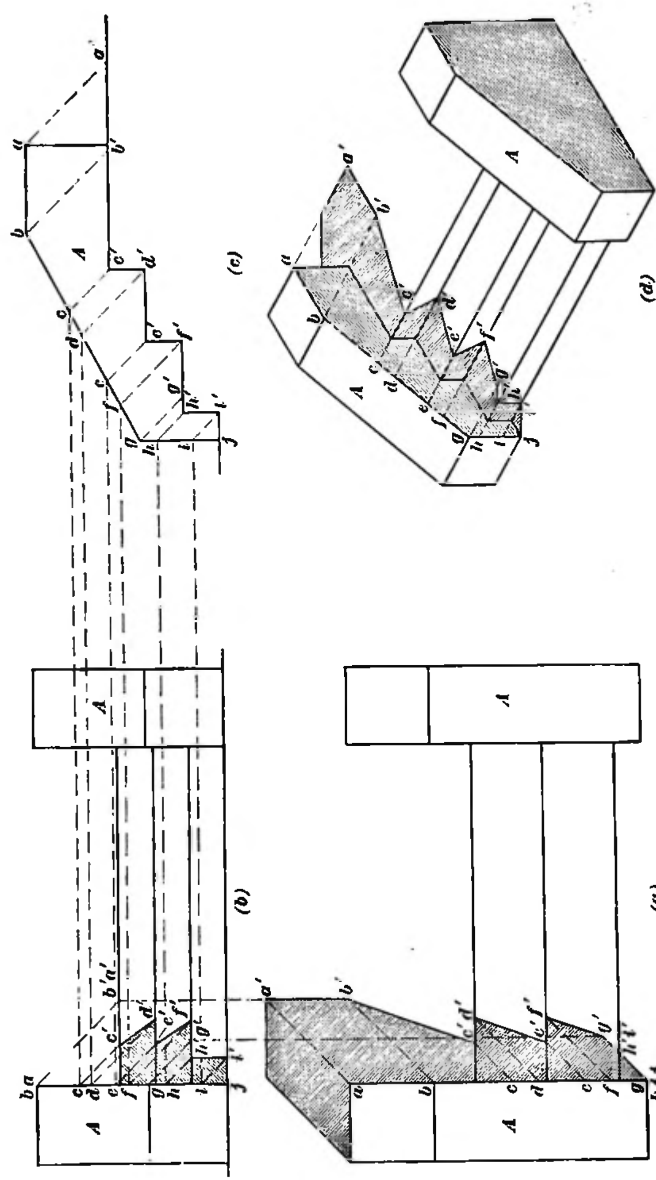


Fig. 29

in (*b*). The isometric view (*d*) shows the entire shadow *c* in a single view. The surfaces *D* and *E* are in shade.

46. In Fig. 29 is shown a flight of steps having slanting cheek walls *A*. The method of finding the shadow of the cheek wall on the steps is similar to that given in the preceding article. The points whose shadows fall at the intersections of the steps and risers are found in (*c*) by drawing 45° lines from the points c', d', e', f', h', and i' to the lines *bg* and *gi*. The lines aa', bb', and gg' in (*c*) should also be drawn. Project horizontal lines from *c*, *d*, *e*, *f*, *h*, and *i* to (*b*) to meet the line *aj*. Also, lay off the same points in the plan in (*a*) in their corresponding positions. In (*b*), draw 45° lines to the points where the rays strike the steps. Project vertical lines down from these points, until they meet the corresponding ray lines in (*a*).

47. Shadows of an Arcade.—In Fig. 30 is shown a diagram of a porch in front of a building. The front of the porch consists of an arcade of three arches, as shown in elevation in (*a*). In (*b*) is a plan of the porch, showing the piers and the spaces between them. In (*c*) is a section taken through the middle of the doorway which is indicated in (*a*) in the wall of the building back of the middle arch. An arched recess is shown above the door.

The total shadow will be bounded by the combined shadows of the outer and inner edges of the three arches and the piers. The shadow will be cast on the wall of the building shown at *VP* in the section and the plan. The shadow of one pier will be cast on the door.

The shadows of all points can be cast simply by the use of method 1. The distance *x* of any point from the wall *VP* can be found from the section or the plan. For example, to cast the shadow of point *a* in (*a*), lay off the distance *x* (determined from the plan) horizontally from *a* to *e* and vertically from *e* to a'. The point a' thus located will be the shadow of *a* on *VP*. The same processes will locate the shadows of *b* and *c* in (*a*) at b' and c'. The method actually used is similar to that illustrated in Fig. 6 (*a*).

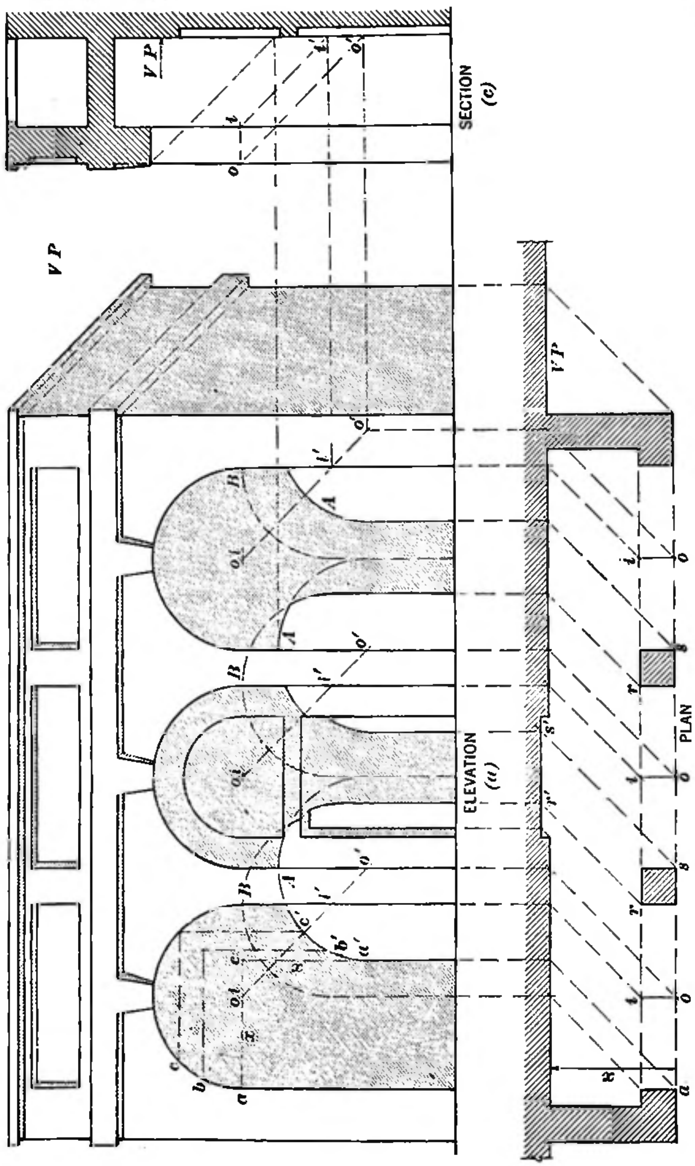


Fig. 30

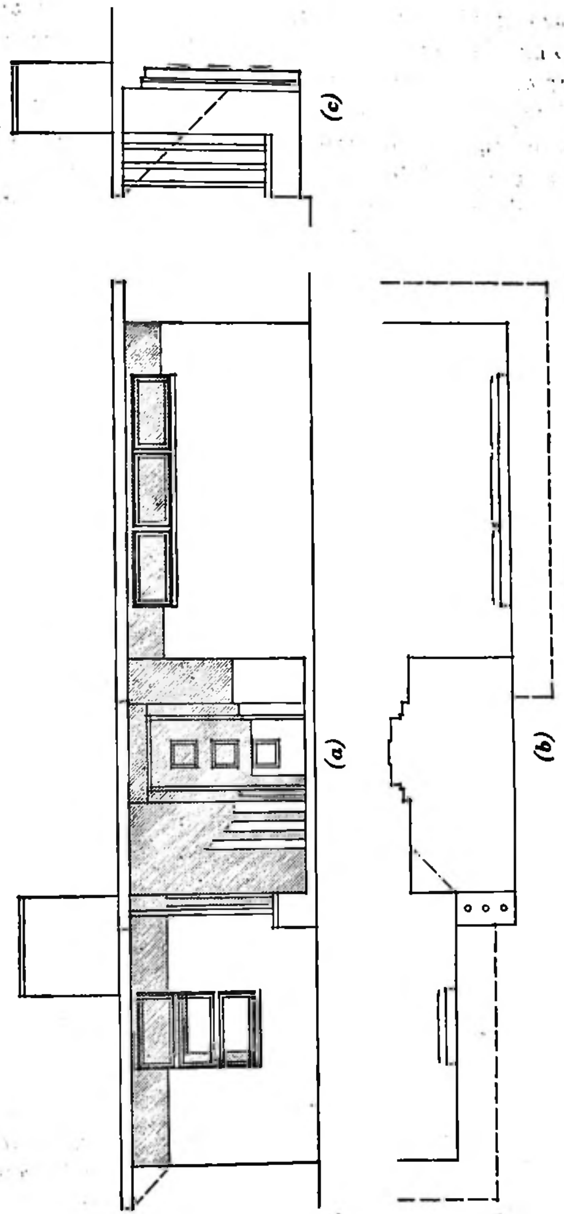


Fig. 31

The shadows of the semicircles on the outside of the arcade in Fig. 30 may be located most easily by casting the shadows of the centers *o*, as at *o′*, and drawing the semicircles *A*, as shown in Fig. 11 (*e*). The shadows of the semicircles of the inside of the arcade in Fig. 30 are located by casting the shadows of the centers *i*, as at *i′*, and drawing the semicircles *B*. In the elevation, the shadows of the pier edges designated *r* and *s* in the plan will be vertical lines from the shadows of the arches to the ground.

The shadow of the pier on the door is found by method 3, Art. 9, or by drawing 45° lines *rr′* and *ss′* in the plan and projecting vertical lines from *r′* and *s′* to the door in (*a*), as shown. Lay out this drawing carefully in order to make sure that the solution is understood.

48. **Shadows of a Small House.**—In Fig. 31 is shown a drawing of a small ranch-type house. In (*a*) is the elevation, in (*b*) is a plan of the outline of the face of the wall, and in (*c*) is a section through the center of the entrance door with the observer looking toward the chimney. In the plan view, the broken line shows the outline of the cornice; at the porch the outline of the cornice coincides with the outside line of the entrance platform.

The shadows on the face of the main wall and on the windows are self-explanatory as is also the shadow of the lower right-hand edge of the chimney on the wall adjoining the entrance. The main problem encountered in casting the shadows for this house involves the entrance porch and the screen that adjoins the entrance porch.

The shadows of the small round columns that screen the porch are found first on the plan (*b*) and are then projected to the elevation. Notice that the shadow of the column is wider than the column itself. The left-hand edge of the cornice casts a shadow line at 45° across the back wall of the porch.

This shadow line at 45° does not break regardless of how complicated the receiving surface may be. The shadow line for the cornice is found on the back wall of the porch from the section drawing and is then projected to the elevation.

The shadows on the house in Fig. 31 while they involve some work are not difficult to cast and are the kind that are met with in every day practice.

SHADOWS OF CLASSIC ORDERS

49. It is occasionally necessary to cast the shadows of the classic orders. The shadows of the capitals of the columns and of other features of the orders are rather complicated, and considerable time and effort are required in casting them. In order to illustrate the process of casting shadows of the classic orders on vertical surfaces, Figs. 32, 33, 34, and 35 are given.

The orders as customarily shown on rendered drawings are small in size, and the shadows are correspondingly small. The shadows are very similar for all Tuscan orders, Doric orders, etc., and can be shown in the manner indicated in the illustrations.

In Fig. 32, the distance *ab* of the face of the frieze *A* from the vertical wall *B* upon which the shadow is cast will determine the position of the shadow with relation to the order. The distance *ab* being known, the shadow of the frieze will be at *c*. If the distance *ab* is greater, the boundary of the entire shadow will be farther to the right and lower than that of the shadow shown in the figure. The profile of the shadow of the entire order will, however, have exactly the same shape as that shown in the figure, provided the shadow is cast on a vertical plane, such as *B*, which is parallel with the face *A*.

If the draftsman wishes to save time in casting the shadows of the orders, he may use the shadows shown in Figs. 32 to 35 as models, varying them according to the distance *ab*.

The purpose of Fig. 36 is to illustrate the shadows in the fluting of the shaft and applies to any style of column. This figure shows also the shades and shadows on an Ionic base.

PRACTICAL CONSIDERATIONS

50. **Shadows on Perspective Drawings.**—It is a very complicated matter to cast shadows directly on perspective or isometric drawings. The simplest way to show shadows on a

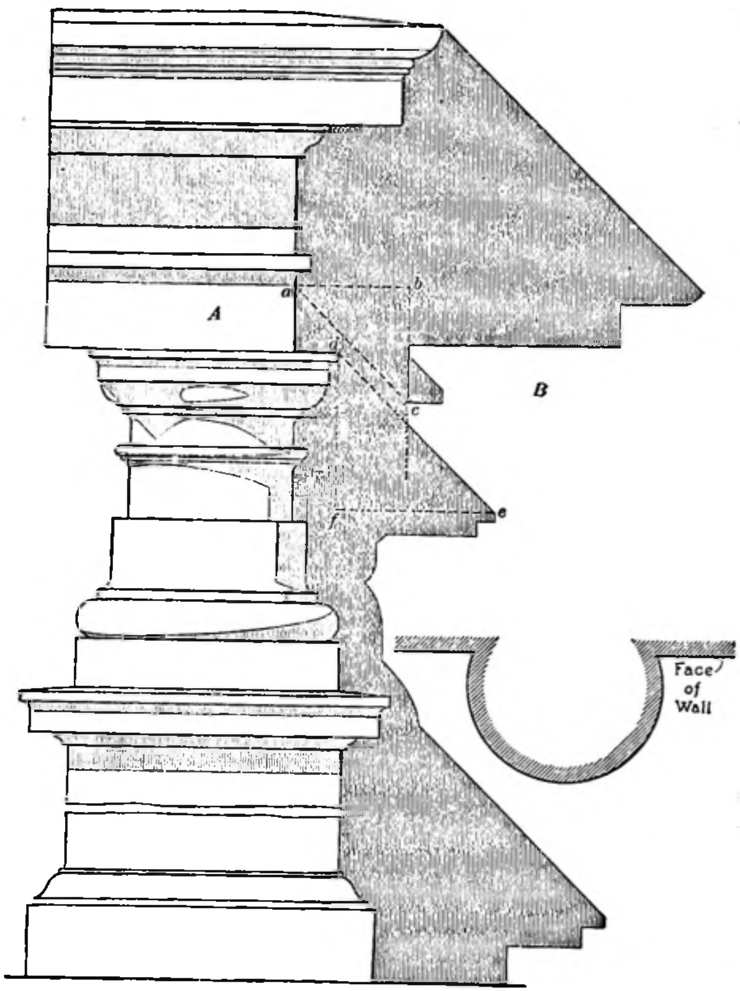


FIG. 32

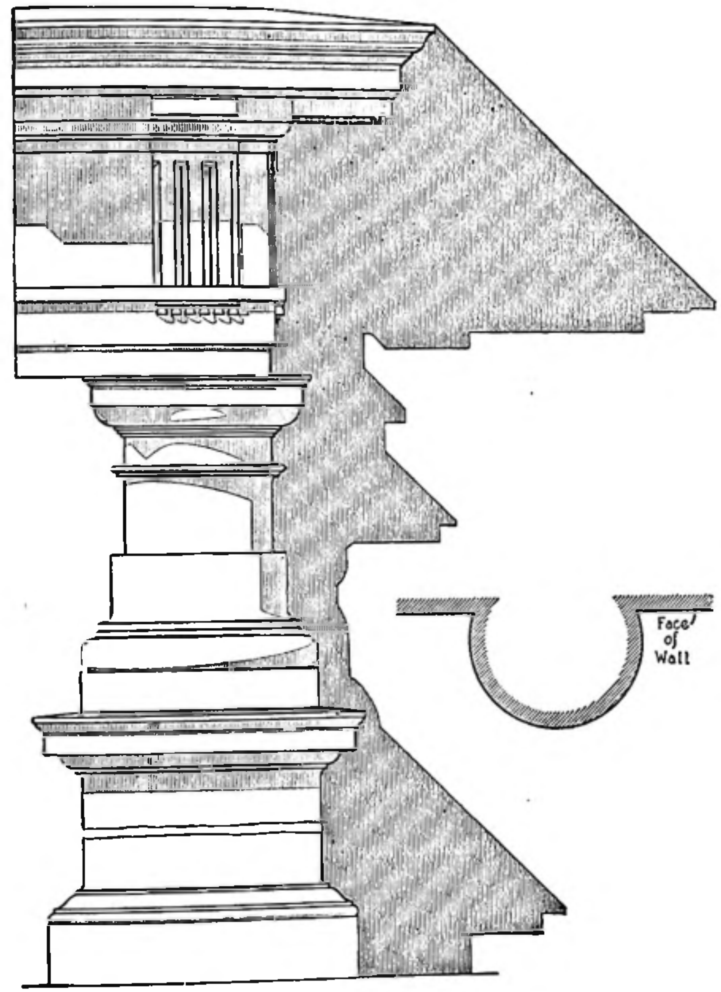


FIG. 33

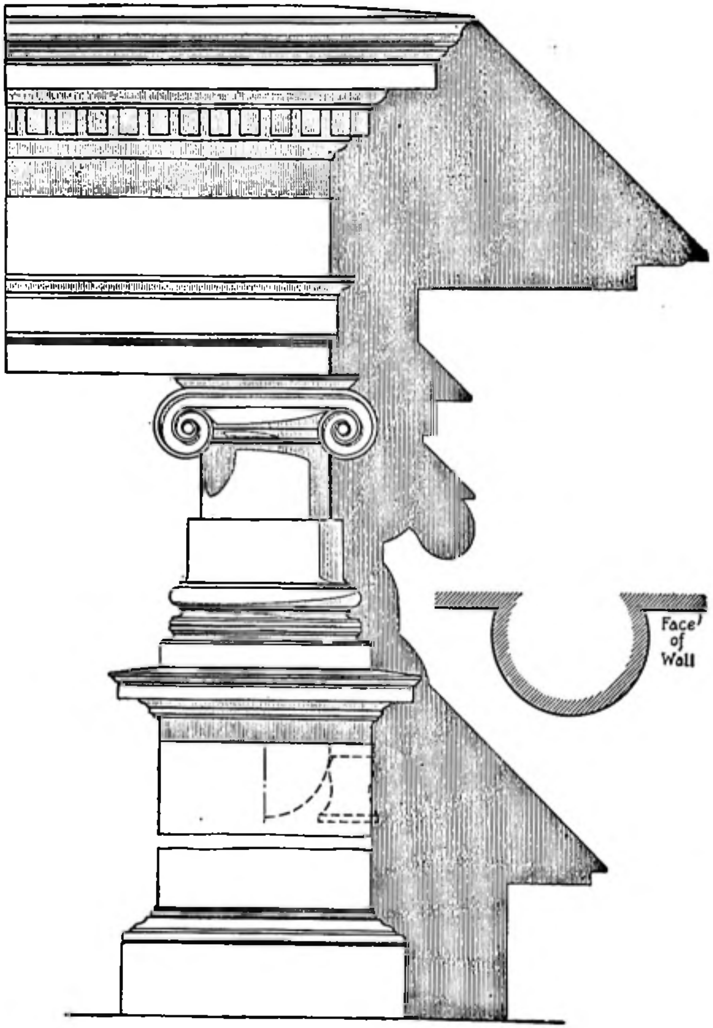


Fig. 34

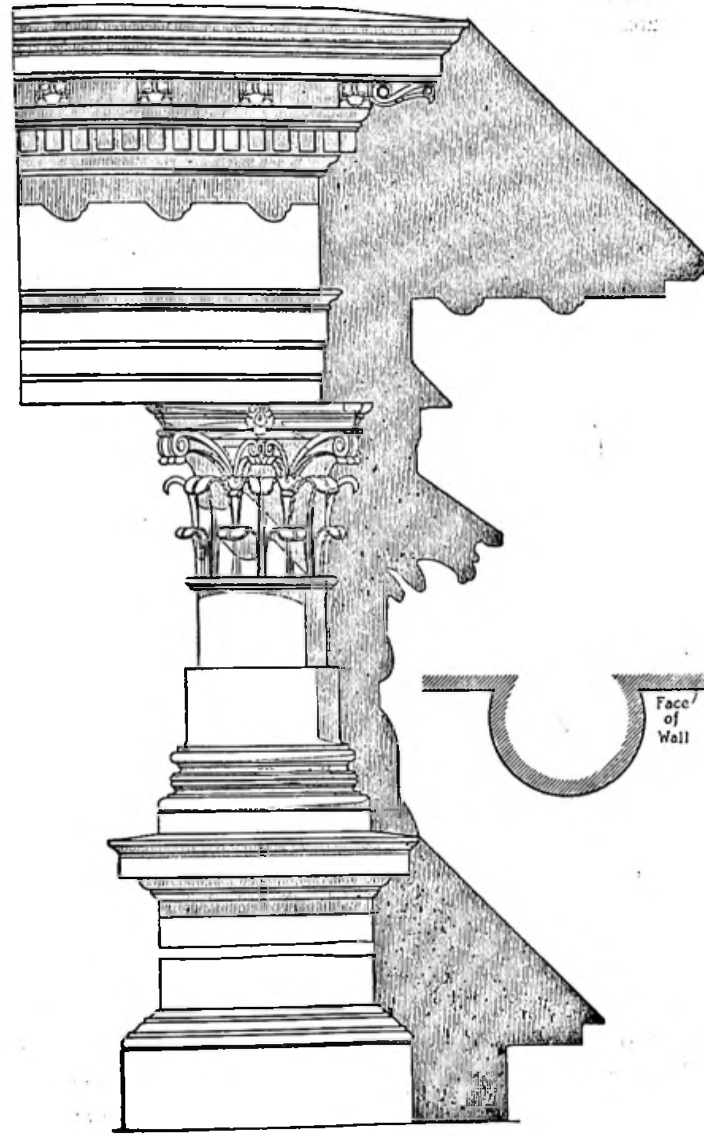


Fig. 35

perspective drawing is to cast the shadows on an elevation and to transfer them point for point from the elevation to the perspective drawing.

51. Summary.—The representation of shades and shadows gives the readiest means of presenting the solidity of a building or an object on a two-dimensional plane such as a sheet of paper. A knowledge of shades and shadows is necessary in the design of form and in the preparation of rendered drawings. The subject is, therefore, important in the development of the draftsman, designer, illustrator, and architect.

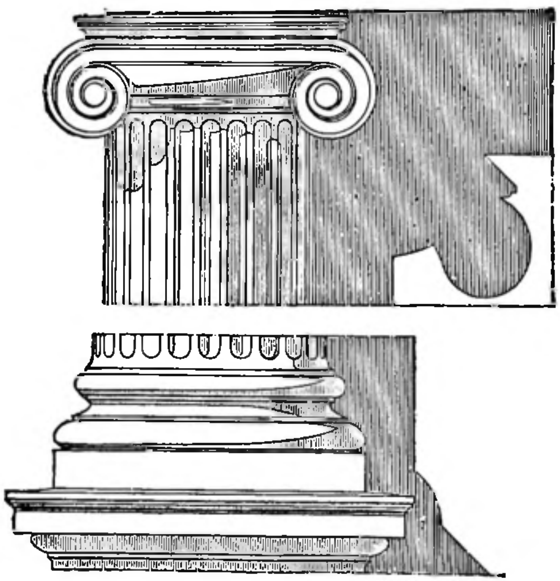


Fig. 36

The foregoing pages contain solutions for most of the problems in shades and shadows encountered in architectural drawing. The problems presented have been based on the common assemblage of simple forms; the solutions chosen for these problems have been based on the simplest procedures.

Best results will be obtained by the student solving the various problems, especially Figs. 6, 7, 9, 10, 13, 15, 18, and 25, at a drawing board. If he proceeds carefully, plotting one point at a time, the student should not experience any difficulty but should find *Shades and Shadows* a fascinating subject.

Shades and Shadows

Serial 5533-3 Edition 3

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. You will profit most if you answer the questions in your own words. 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. Define briefly the following terms: (*a*) line of shade, (*b*) shadow, (*c*) line of shadow, and (*d*) invisible shadow.

2. *a*. When is a surface said to be in shade?
   b. When is a surface said to be in light?

3. What is meant by the term "casting the shadows"?

4. Redraw Fig. 19 (*b*) at twice the given size.

5. Solve Example for Practice No. 3 on page 14 of the text.

6. Solve Example for Practice on Page 26 of the text.

7. Solve Example for Practice on Page 34 of the text.

8. Make a drawing of the building shown in Fig. I on the page following, at twice the given size and cast the shadows on the elevation.

9. The drawing in Fig. II shows a court enclosed on three sides by the exterior walls of a building and on the remaining side by an open colonnade. In the center of the court is a monument.

   Make your drawing at four times the given size and cast the shadows in plan and elevation.

10. The drawing in Fig. III shows a V-shaped prism, one beam resting against the prism and another beam on top of the prism. Make your drawing at twice the given size and cast the shadows in plan and elevation.

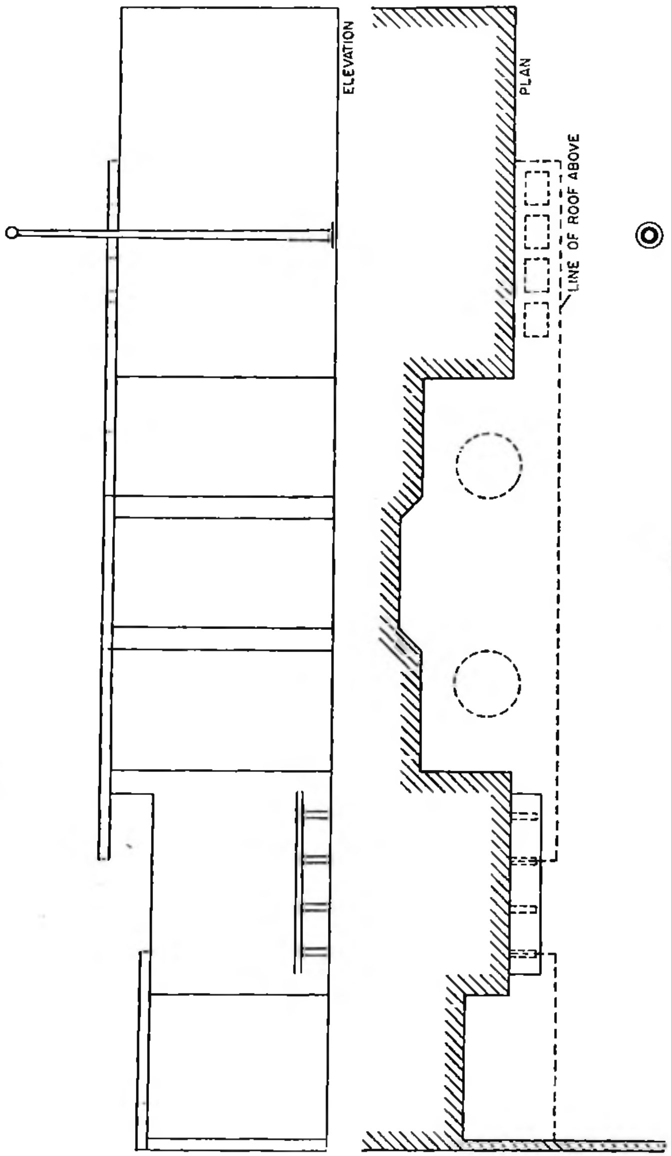


Fig. I

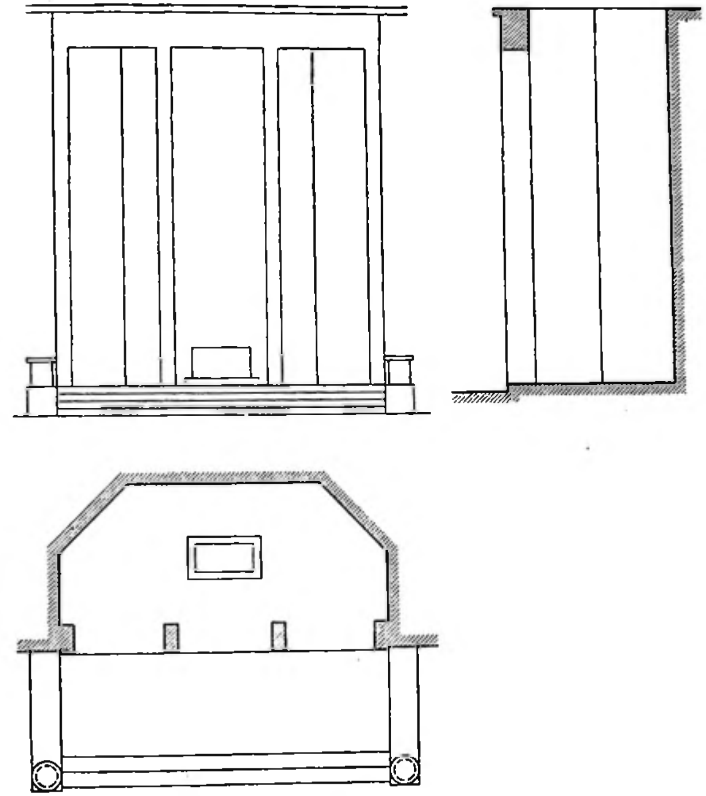


Fig. II

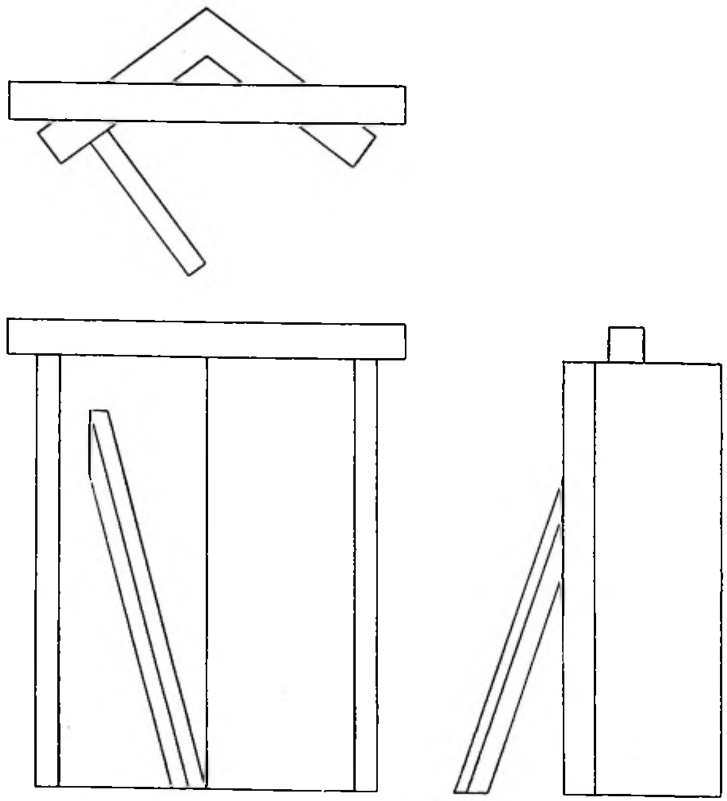


FIG. III

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