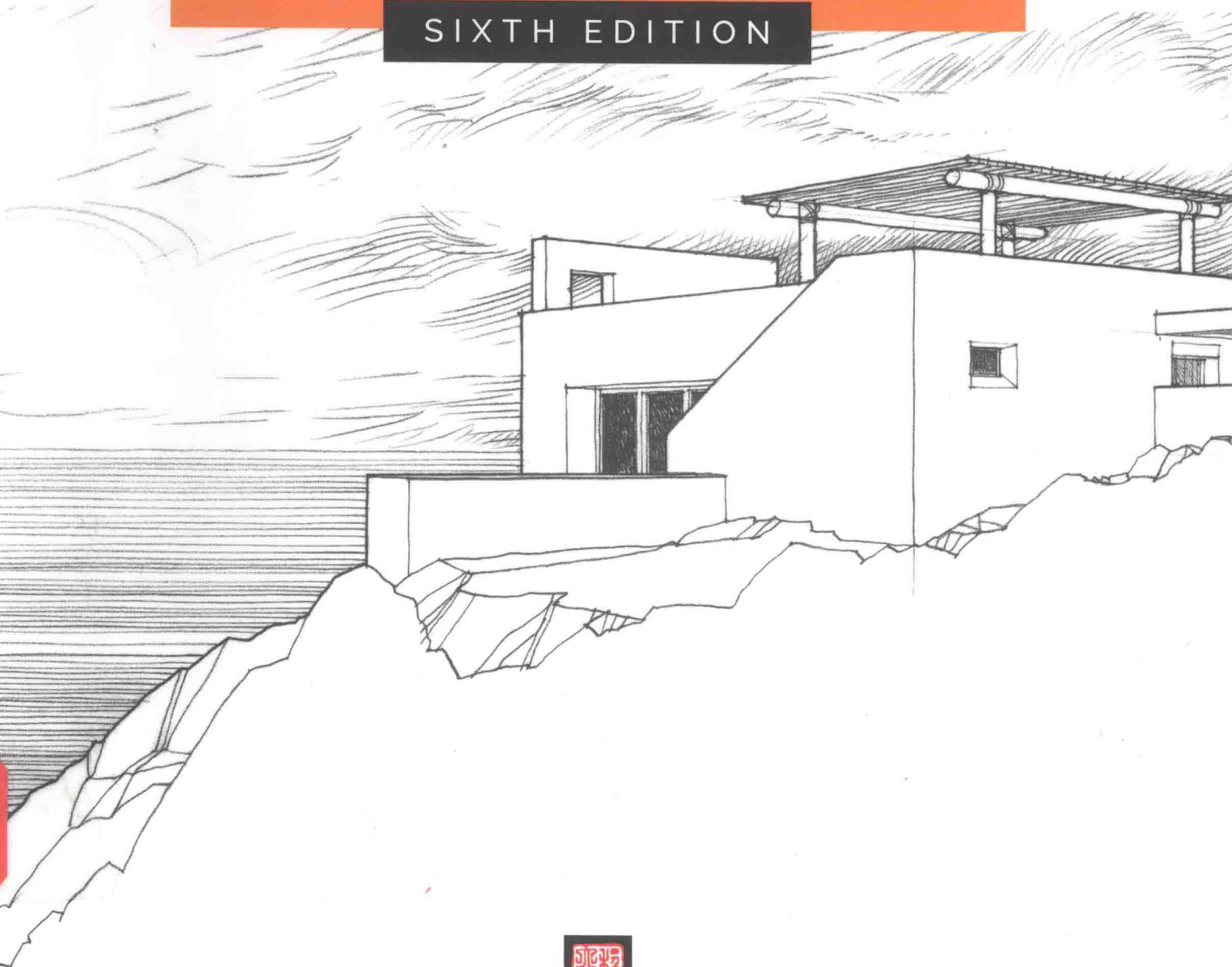
FRANCIS D.K. CHING

ARCHITECTURAL GRAPHICS

SIXTH EDITION



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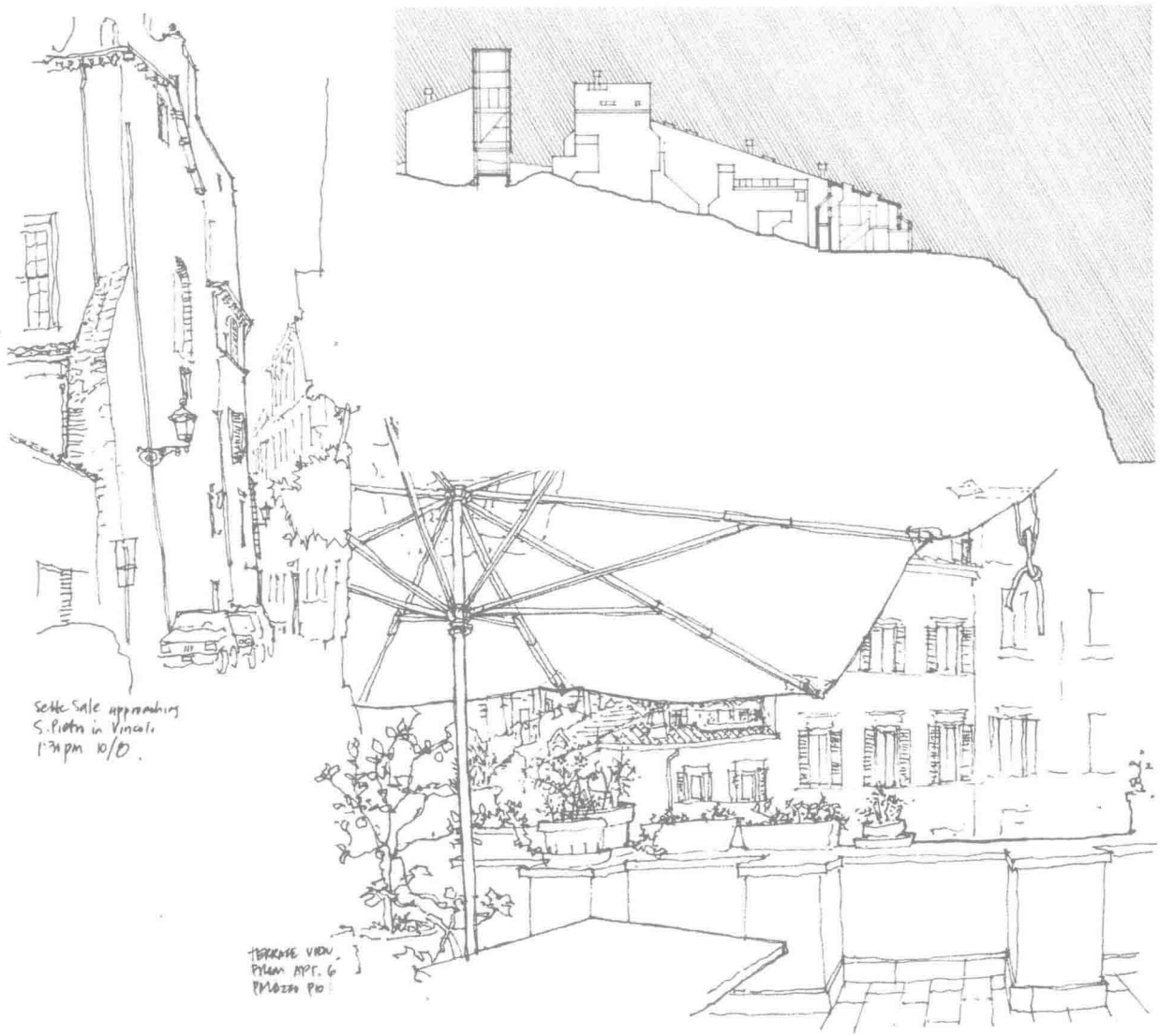

Francis D.K. Ching

JOHN WILEY & SONS, INC.

Cover design: C. Wallace
Cover image: Courtesy of Francis D.K. Ching

This book is printed on acid-free paper.

Published by John Wiley & Sons, Inc., Hoboken, New Jersey
Published simultaneously in Canada

Library of Congress Cataloging-in-Publication Data:

Ching, Frank, 1943-
Architectural graphics / Francis D.K. Ching. -- 6th ed.
ISBN 978-1-119-03566-4 (paperback); ISBN 978-1-119-07338-3 (ebk);
ISBN 978-1-119-07350-5 (ebk); ISBN 978-1-119-09099-1 (ebk)

Printed in the United States of America.

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About the Companion Website

This book has a companion website, which can be found at:

www.wiley.com/go/archgraphics6e

Enter the password: 111903566

The companion website contains over 100 interactive animations that support additional learning by expanding on key concepts covered throughout Architectural Graphics, Sixth Edition.

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PREFACE

Forty years ago, the first edition of this text introduced students to the range of graphic tools, techniques, and conventions designers use to communicate architectural ideas. The prime objective behind its original formation and subsequent revisions was to provide a clear, concise, and illustrative guide to the creation and use of architectural graphics. While retaining the clarity and visual approach of the earlier editions, this sixth edition of *Architectural Graphics* is unique in its use of digital media to convey and clarify the essential principles of graphic communication.

Advances in computer technology have significantly altered the process of architectural drawing and design. Current graphics applications range from 2D drawing programs to 3D modelers and Building Information Modeling (BIM) software that aid in the design and representation of buildings, from small houses to large and complex structures. It is therefore important to acknowledge the unique opportunities and challenges digital tools offer in the production of architectural graphics. Whether a drawing is executed by hand or developed with the aid of a computer, however, the standards and judgments governing the effective communication of design ideas in architecture remain the same.

The overall chapter organization remains the same as in the fifth edition. Chapters 1 and 2 introduce the essential tools and techniques of drawing and drafting. While digital tools can augment traditional techniques, the tactile, kinesthetic process of crafting lines on a sheet of paper with a pen or pencil remains the most sensible medium for learning the graphic language of drawing.

Chapter 3 introduces the three principal systems of pictorial representation—multiview, paraline, and perspective drawings—and analyzes in a comparative manner the unique viewpoints afforded by each system. Chapters 4 through 6 then focus on the principles and standards governing the conventions and uses of each of the three drawing systems, concepts that apply whether an architectural graphic is created manually or digitally.

The language of architectural graphics relies on the power of a composition of lines to convey the illusion of a three-dimensional construction or spatial environment on a two-dimensional surface, be it a sheet of paper or a computer screen. While digital technology may have altered the way we input information and create perspective, paraline, and orthographic projections, a fundamental understanding of what each of the three drawing systems conveys is required of all designers. Each drawing system provides a limited view of what we are designing and representing. And an appreciation for what these viewpoints reveal—and conceal—remains indispensable in the design process.

Although the line is the quintessential element of all drawing, Chapter 7 demonstrates techniques for creating tonal values and develops strategies for enhancing the pictorial depth of architectural drawings and conveying the illumination of spatial environments. Special thanks go to Nan-Ching Tai, who offered his invaluable expertise and assistance in preparing the examples of digital lighting.

Because we design and evaluate architecture in relation to its environment, Chapter 8 extends the role of rendering to establishing context in the drawing of design proposals and indicating the scale and intended use of spaces.

Chapter 9 examines the fundamental principles of graphic communication and illustrates the strategic choices available in the planning and layout of architectural presentations. Incorporated into this discussion is the original chapter on lettering and graphic symbols, which are informative and essential elements to be considered in preparing any presentation.

Drawing with a free hand holding a pen or pencil remains the most direct and intuitive means we have for recording our observations and experiences, thinking through ideas, and diagramming design concepts. Chapter 10 therefore includes additional instruction on freehand sketching and diagramming. This terminal position reflects the importance of freehand drawing as a graphic skill and a critical tool for design thinking.

Other than the early phases of the design process, during which we initiate ideas, there is no other area of design drawing that is better suited for freehand drawing than drawing on location—from direct observation. For this reason, the section on drawing from observation has been expanded to demonstrate how the act of seeing, responding to, and sketching spatial environments invigorates seeing, enables understanding, and creates memories.

Despite substantial changes in technology over the past forty years, the fundamental premise of this text endures—drawing has the power to overcome the flatness of a two-dimensional surface and represent three-dimensional ideas in architecture in a clear, legible, and convincing manner. To unlock this power requires the ability both to execute and to read the graphic language of drawing. Drawing is not simply a matter of technique; it is also a cognitive act that involves visual perception, judgment, and reasoning of spatial dimensions and relationships.

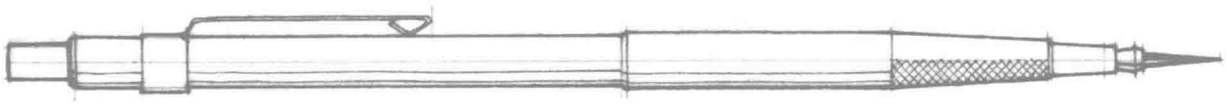
CONTENTS

1

Drawing Tools and Materials

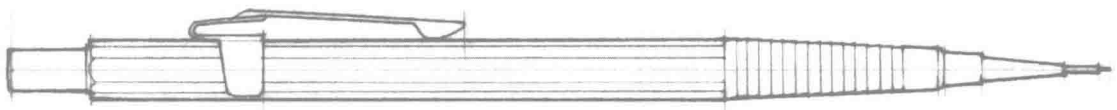
This chapter introduces the pencils and pens necessary for inscribing lines, the instruments available for guiding the eye and hand while drawing, and the surfaces suitable for receiving the drawn lines. While digital technology continues to further augment and enhance this traditional drawing toolkit, the kinesthetic act of drawing with a hand-held pencil or pen remains the most direct and versatile means of learning the language of architectural graphics.

Pencils are relatively inexpensive, quite versatile, and uniquely responsive to pressure while drawing.



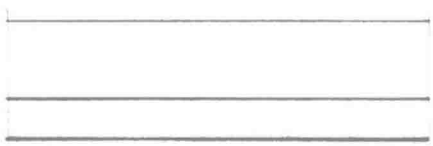
Lead Holders

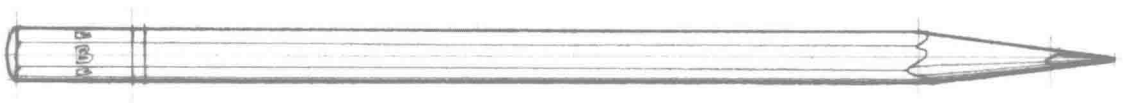
- Lead holders employ standard 2 mm leads.
- The push-button action of a clutch mechanism allows the exposed length of the lead shaft to be adjusted or withdrawn when the pencil is not in use.
- The lead point, which is capable of a variety of line weights, must be kept well sharpened with a lead pointer.



Mechanical Pencils

- Mechanical pencils use 0.3 mm, 0.5 mm, 0.7 mm, and 0.9 mm leads.
- A push-button mechanism advances the lead automatically through a metal sleeve. This sleeve should be long enough to clear the edges of drafting triangles and straightedges.
- The relatively thin leads of mechanical pencils do not require sharpening.
- 0.3 mm pencils yield very fine lines, but the thin leads are susceptible to breaking if applied with too much pressure.
- 0.5 mm pencils are the most practical for general drawing purposes.
- 0.7 mm and 0.9 mm pencils are useful for sketching and writing; avoid using these pencils to produce heavy line weights.





Wood-Encased Pencils

- Wooden drawing pencils are typically used for freehand drawing and sketching. If used for drafting, the wood must be shaved back to expose 3/4" of the lead shaft so that it can be sharpened with sandpaper or a lead pointer.

All three styles of pencils are capable of producing quality line drawings. As you try each type out, you will gradually develop a preference for the characteristic feel, weight, and balance of a particular instrument as you draw.

Graphite Leads

Grades of graphite lead for drawing on paper surfaces range from 9H (extremely hard) to 6B (extremely soft). Given equal hand pressure, harder leads produce lighter and thinner lines, whereas softer leads produce denser, wider lines.

Nonphoto Blue Leads

Nonphoto blue leads are used for construction lines because their shade of blue tends not to be detected by photocopiers. However, digital scanners can detect the light blue lines, which can be removed by image editing software.

Plastic Leads

Specially formulated plastic polymer leads are available for drawing on drafting film. Grades of plastic lead range from E0, N0, or P0 (soft) to E5, N5, or P5 (hard). The letters E, N, and P are manufacturers' designations; the numbers 0 through 5 refer to degrees of hardness.

Recommendations for Grades of Graphite Lead

4H

- This dense grade of lead is best suited for accurately marking and laying out light construction lines.
- The thin, light lines are difficult to read and reproduce and should therefore not be used for finish drawings.
- When applied with too much pressure, the dense lead can engrave paper and board surfaces, leaving grooves that are difficult to remove.

2H

- This medium-hard lead is also used for laying out drawings and is the densest grade of lead suitable for finish drawings.
- 2H lines do not erase easily if drawn with a heavy hand.

F and H

- These are general-purpose grades of lead suitable for layouts, finish drawings, and handlettering.

HB

- This relatively soft grade of lead is capable of dense linework and handlettering.
- HB lines erase and print well but tend to smear easily.
- Experience and good technique are required to control the quality of HB linework.

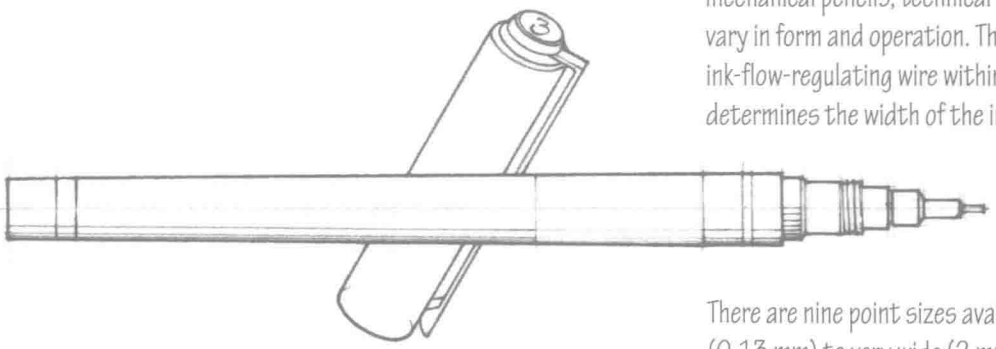
B

- This soft grade of lead is used for very dense linework and handlettering.

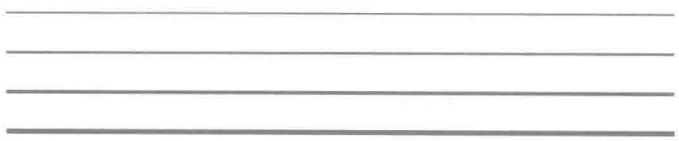
The texture and density of a drawing surface affect how hard or soft a pencil lead feels. The more tooth or roughness a surface has, the harder the lead you should use; the more dense a surface is, the softer a lead feels.

Technical Pens

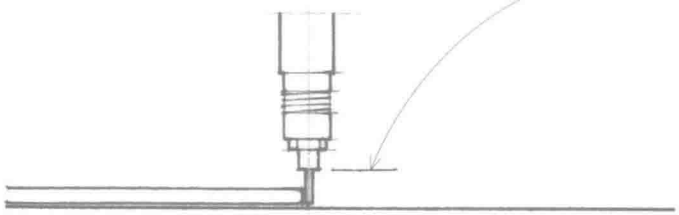
Technical pens are capable of producing precise, consistent ink lines without the application of pressure. As with lead holders and mechanical pencils, technical pens from different manufacturers vary in form and operation. The traditional technical pen uses an ink-flow-regulating wire within a tubular point, the size of which determines the width of the ink line.



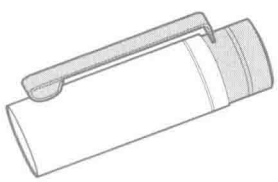
There are nine point sizes available, from extremely fine (0.13 mm) to very wide (2 mm). A starting pen set should include the four standard line widths— 0.25 mm, 0.35 mm, 0.5 mm, and 0.70 mm—specified by the International Organization for Standardization (ISO).



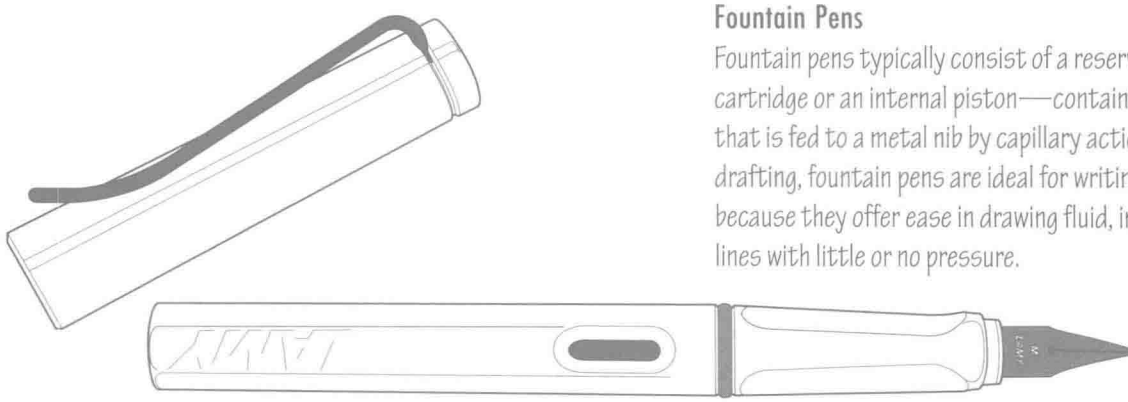
- 0.25 mm line width
- 0.35 mm line width
- 0.50 mm line width
- 0.70 mm line width



- The tubular point should be long enough to clear the thickness of drafting triangles and straightedges.
- Use waterproof, nonclogging, fast-drying black drawing ink.
- Keep points screwed in securely to prevent ink from leaking.
- After each use, replace the pen cap firmly to prevent the ink from drying.
- When pens are not in use, store them horizontally.



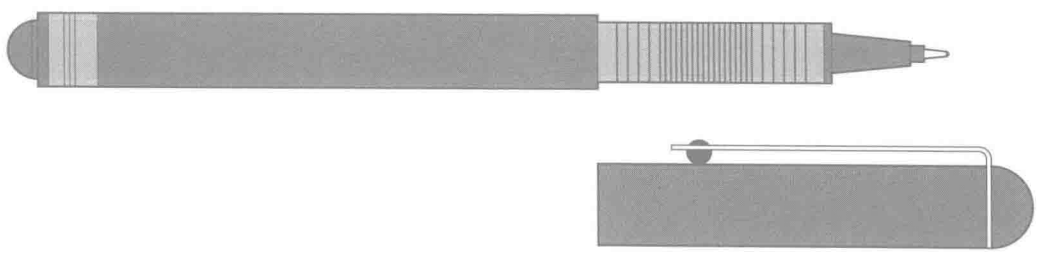
Since digital tools have reduced the need for manual drafting, a variety of less expensive, low-maintenance technical pens have been developed. Equipped with tubular tips and waterproof, pigment-based ink, these pens are suitable for writing, freehand drawing, as well as drafting with straightedges. They are available in point sizes that range from 0.03 mm to 1.0 mm. Some are refillable and have replaceable nibs.



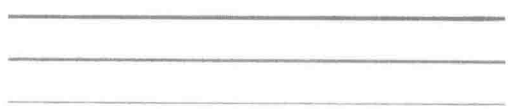
Fountain Pens

Fountain pens typically consist of a reservoir—either a disposable cartridge or an internal piston—containing a water-based ink that is fed to a metal nib by capillary action. While not suitable for drafting, fountain pens are ideal for writing and freehand sketching because they offer ease in drawing fluid, incisive, often expressive lines with little or no pressure.

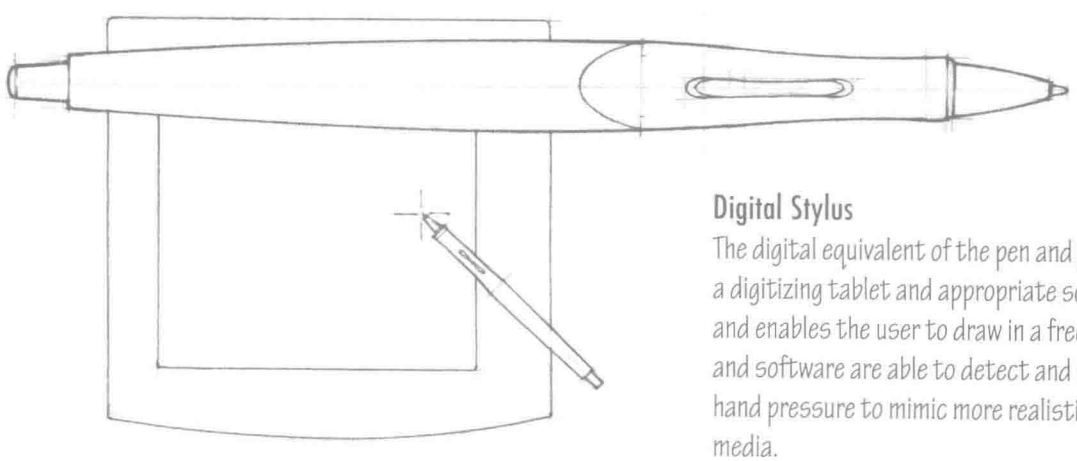
Fountain pen nibs come in extra-fine, fine, medium, and broad sizes; flat tipped nibs are also available for italic and oblique strokes. Some nibs are flexible enough that they respond to individual stroke direction and pressure.



Other Drawing Pens



Gel pens use a thick, opaque ink consisting of pigment suspended in a water-based gel while rollerball pens use a water-based liquid ink. Both offer similar qualities to fountain pens—they are capable of a consistent ink flow and laying down lines with less pressure than that required by regular ballpoint pens.



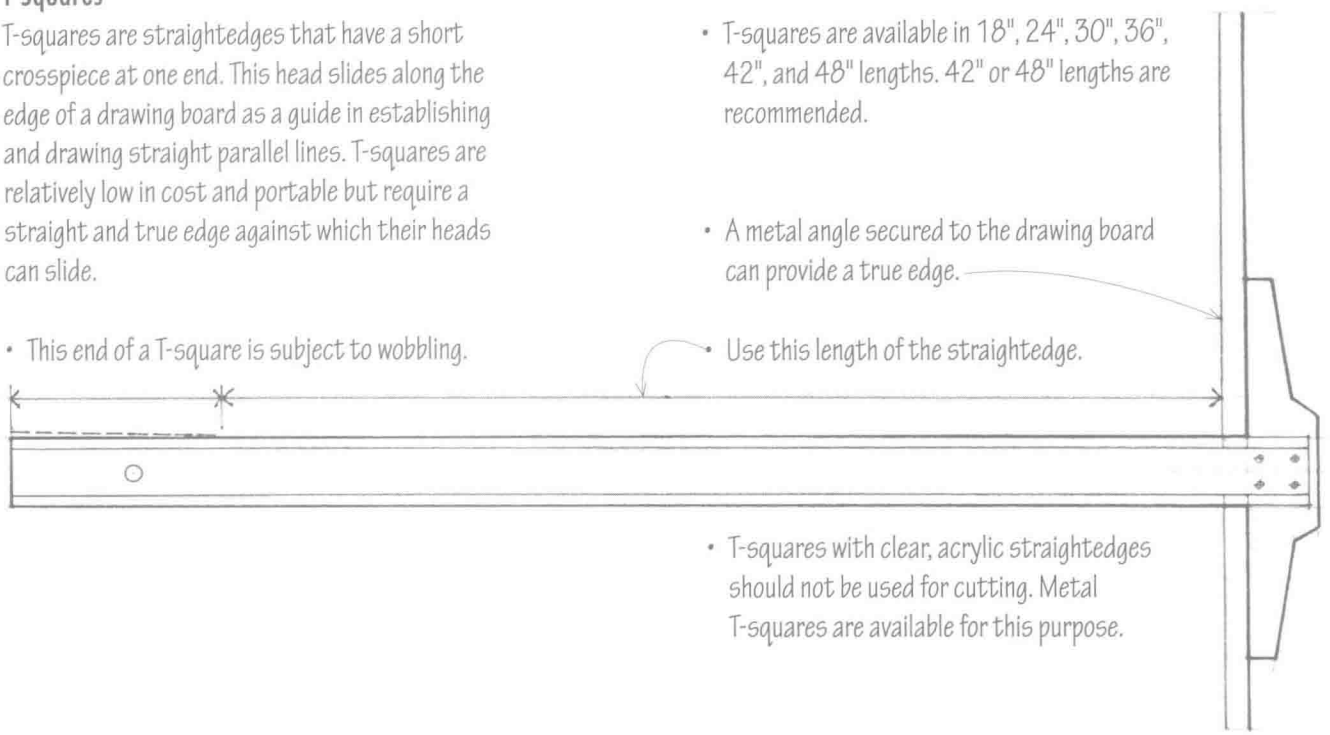
Digital Stylus

The digital equivalent of the pen and pencil is the stylus. Used with a digitizing tablet and appropriate software, it replaces the mouse and enables the user to draw in a freehand manner. Some models and software are able to detect and respond to the amount of hand pressure to mimic more realistically the effects of traditional media.

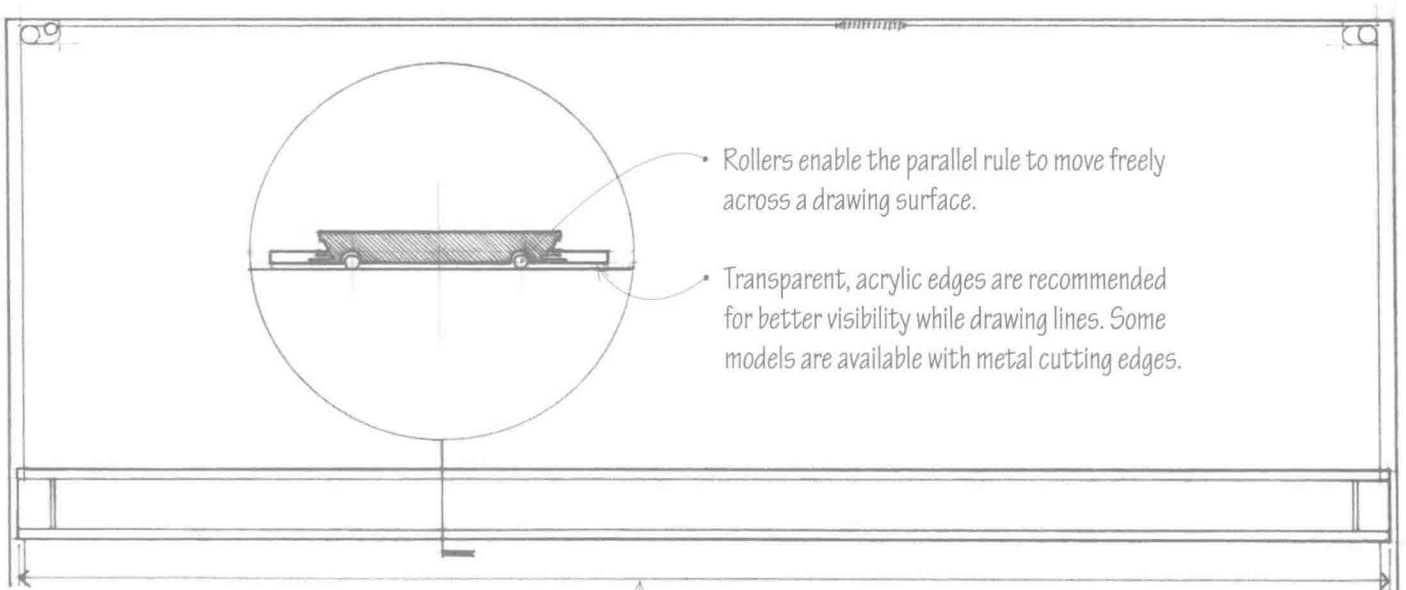
T-Squares

T-squares are straightedges that have a short crosspiece at one end. This head slides along the edge of a drawing board as a guide in establishing and drawing straight parallel lines. T-squares are relatively low in cost and portable but require a straight and true edge against which their heads can slide.

- T-squares are available in 18", 24", 30", 36", 42", and 48" lengths. 42" or 48" lengths are recommended.
- A metal angle secured to the drawing board can provide a true edge.
- This end of a T-square is subject to wobbling.
- Use this length of the straightedge.



- T-squares with clear, acrylic straightedges should not be used for cutting. Metal T-squares are available for this purpose.

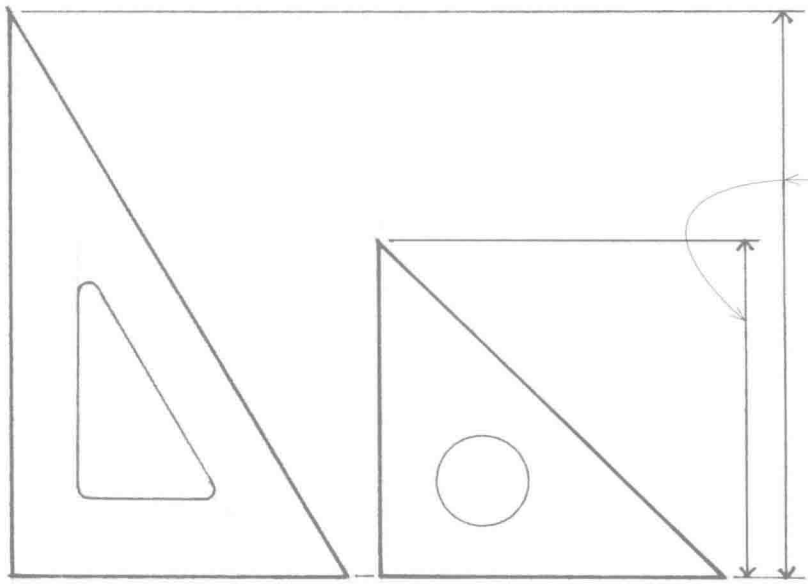


- Rollers enable the parallel rule to move freely across a drawing surface.
- Transparent, acrylic edges are recommended for better visibility while drawing lines. Some models are available with metal cutting edges.

Parallel Rules

Parallel rules are equipped with a system of cables and pulleys that allows their straightedges to move across a drawing board only in a parallel manner. Parallel rules are more expensive and less portable than T-squares but enable one to draft with greater speed and accuracy.

- Parallel rules are available in 30", 36", 42", 48", 54", and 60" lengths. The 42" or 48" length is recommended.



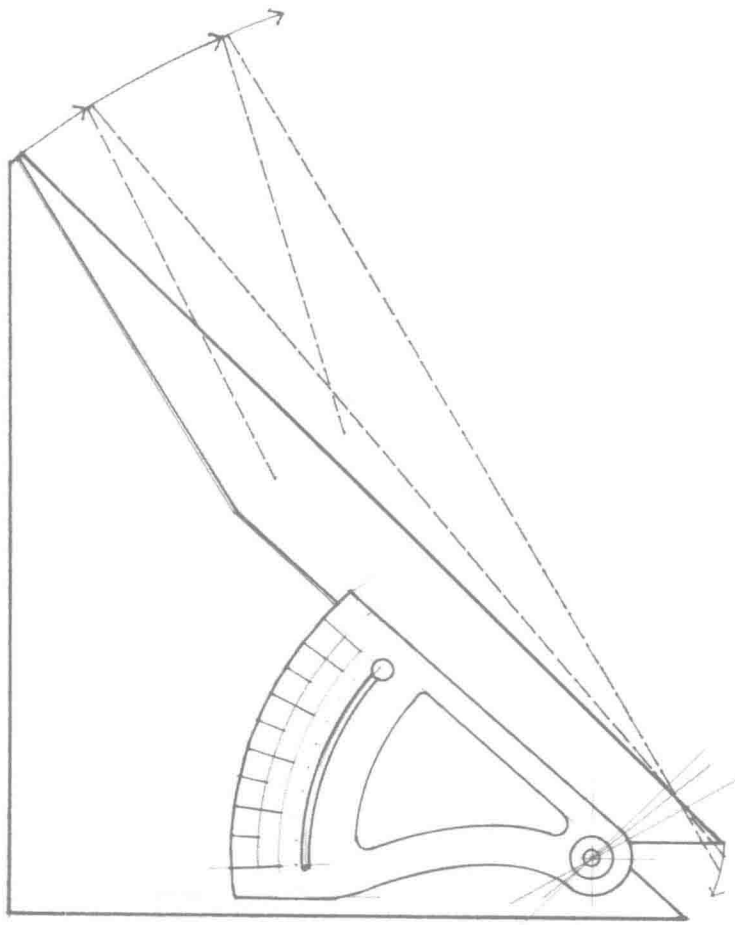
Triangles

Triangles are drafting aids used to guide the drawing of vertical lines and lines at specified angles. They have a right angle and either two 45° angles or one 30° and one 60° angle.

- 4" to 24" lengths are available.
- 8" to 10" lengths are recommended.

- Small triangles are useful for crosshatching small areas and as a guide in handlettering. See page 210.
- Larger triangles are useful in constructing perspectives.

- The 45°–45° and 30°–60° triangles can be used in combination to produce angular increments of 15°. See page 26.

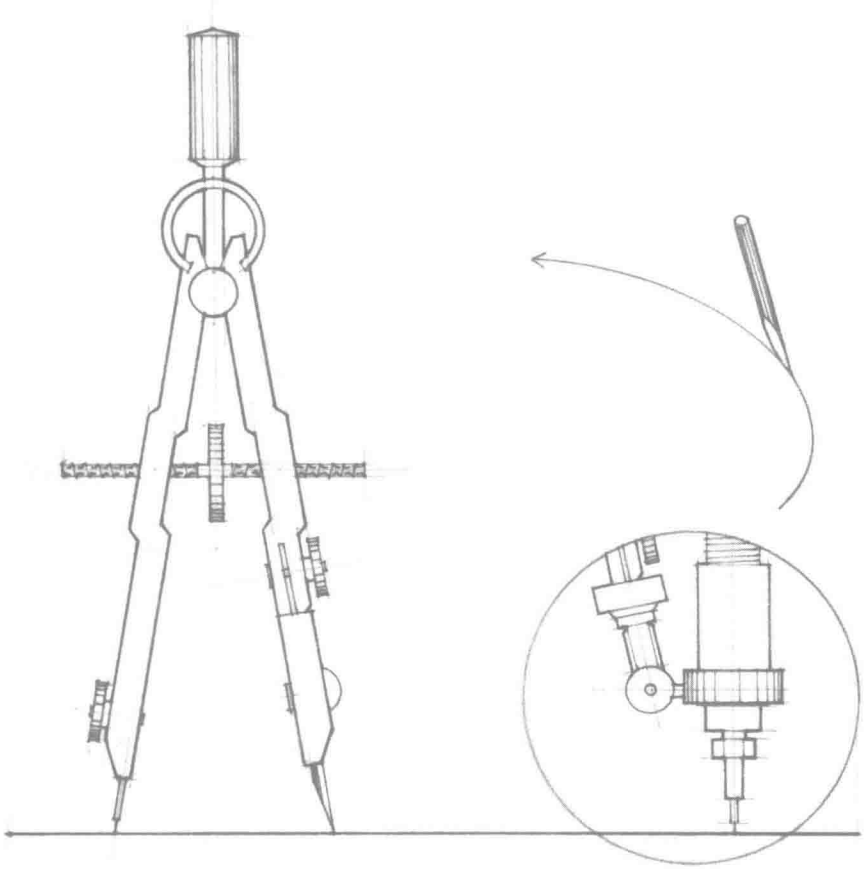


- Triangles are made of clear, scratch-resistant, non-yellowing acrylic to allow a transparent, undistorted view through to the work below. Fluorescent orange acrylic triangles are also available for greater visibility on the drafting surface.
- Machined edges should be polished for precision and to facilitate drawing. Some triangles have raised edges for inking with technical pens.
- Inner edges may be beveled to serve as finger lifts.

- Keep triangles clean by washing with a mild soap and water.
- Triangles should not be used as a straightedge for cutting materials.

Adjustable Triangles

Adjustable triangles have a movable leg that is held in place with a thumbscrew and a scale for measuring angles. These instruments are useful for drawing such inclined lines as the slope of a stair or the pitch of a roof.

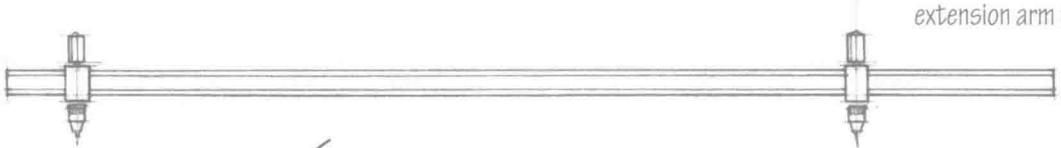


Compasses

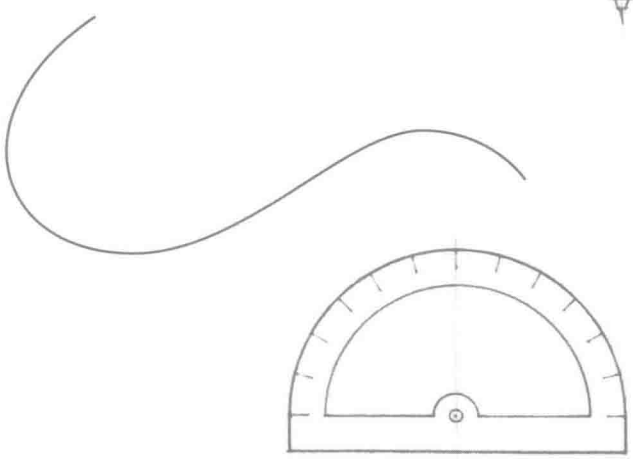
The compass is essential for drawing large circles as well as circles of indeterminate radii.

- It is difficult to apply pressure when using a compass. Using too hard a grade of lead can therefore result in too light of a line. A softer grade of lead, sharpened to a chisel point, will usually produce the sharpest line without undue pressure. A chisel point dulls easily, however, and must be sharpened often.

- An attachment allows technical pens to be used with a compass.



- Even larger circles can be drawn by appending an extension arm or using a beam compass.

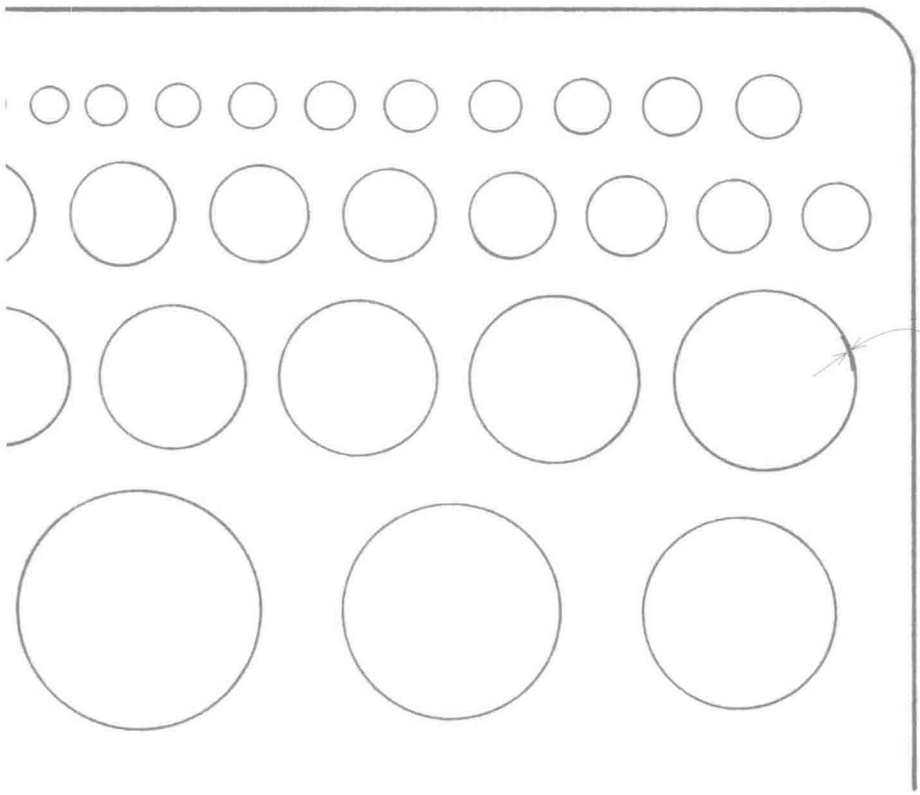


French Curves

- A variety of French curves are manufactured to guide the drawing of irregular curves.
- Adjustable curves are shaped by hand and held in position to draw a fair curve through a series of points.

Protractors

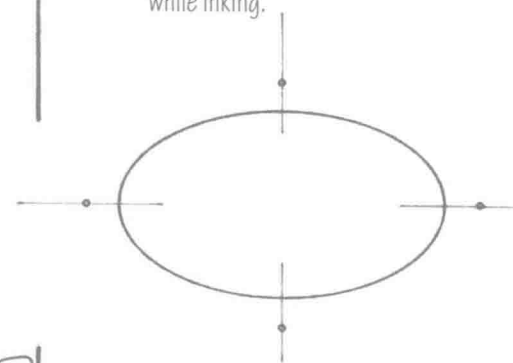
- Protractors are semicircular instruments for measuring and plotting angles.

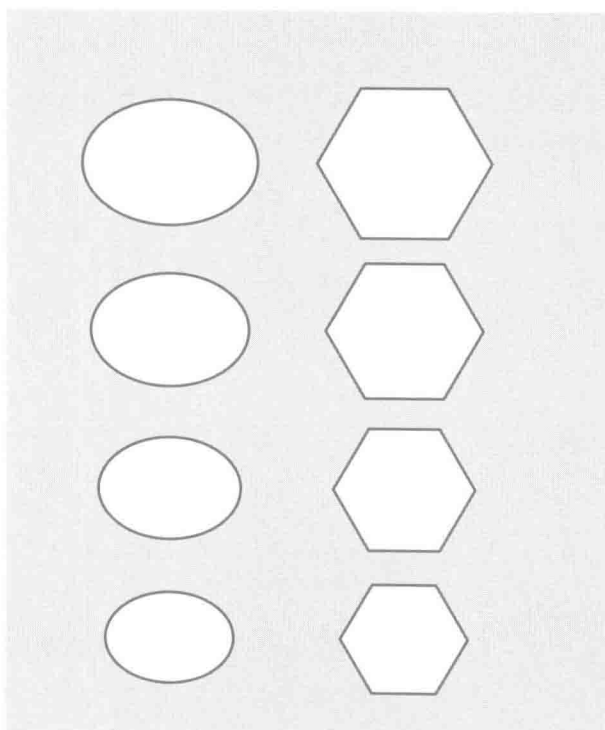


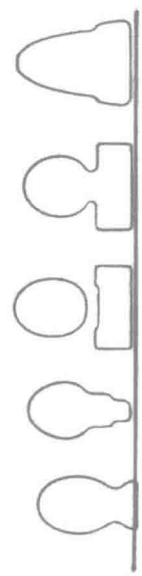
Templates

Templates have cutouts to guide the drawing of predetermined shapes.

- Circle templates provide a graduated series of circles commonly based on fractions and multiples of an inch. Metric sizes are also available.
- The actual size of a cutout differs from the drawn size due to the thickness of the lead shaft or pen tip.
- Some templates have dimples to raise them off of the drawing surface while inking.



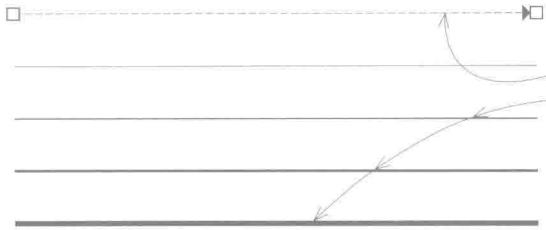




- Templates are available for drawing other geometric shapes, such as ellipses and polygons, as well as symbols for plumbing fixtures and furnishings at various scales.

Digital Drawing

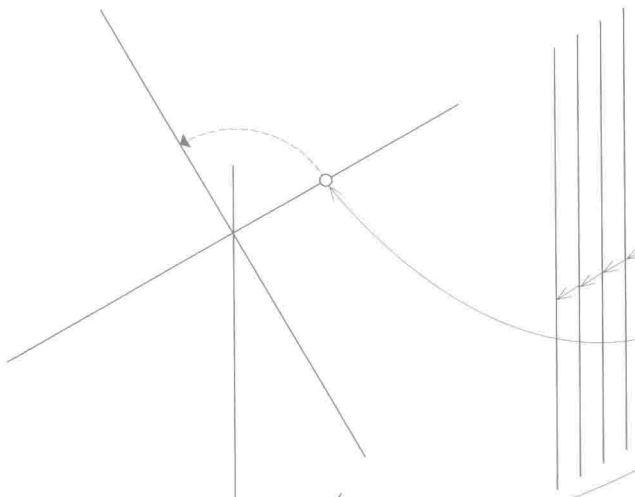
Analogous to traditional hand-drafting tools are the software capabilities of a 2D vector-based drawing program, which define lines—the quintessential element of architectural drawing—as mathematical vectors.



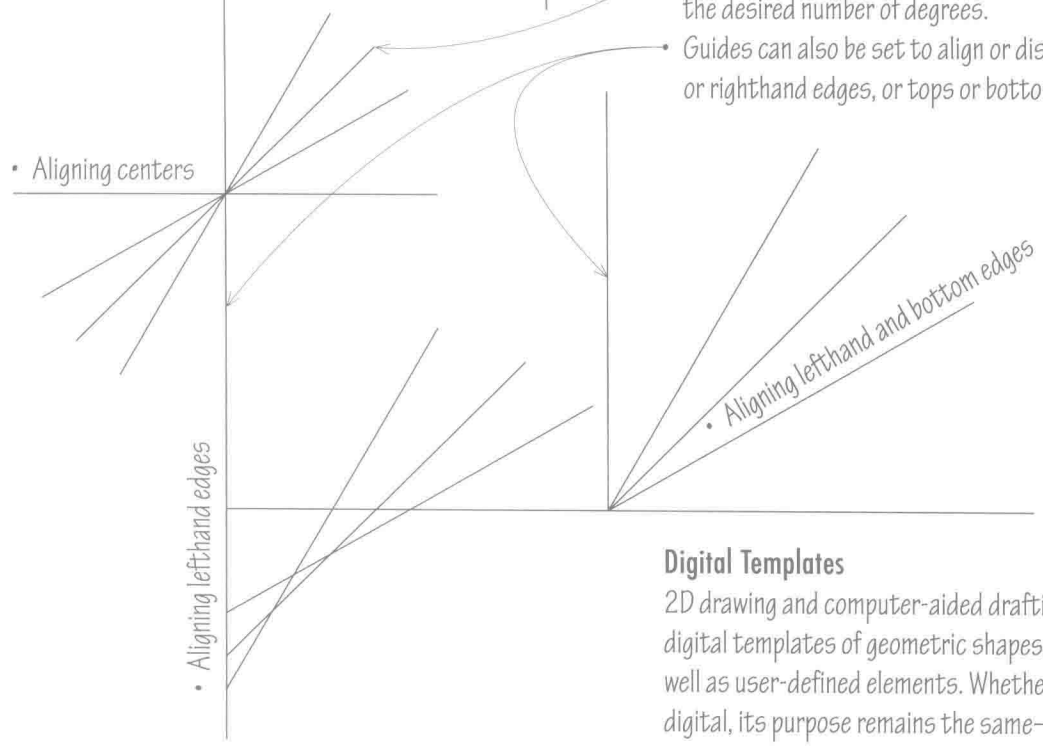
- A straight line segment can be created by clicking two endpoints.
- The weight of the stroke can be selected from a menu or by specifying its width in absolute terms (millimeters, fractions of an inch, or number of points, where 1 point = $^1/_{72}$").

Digital Guides

Drawing programs typically have commands to constrain the movement of points and lines to a precise horizontal, vertical, or diagonal direction. Grids and guidelines, along with snap-to commands, further aid the precise drawing of lines and shapes.



- Parallel lines can be drawn by moving a copy of an existing line a specified dimension and direction.
- Perpendicular lines can be drawn by rotating an existing line 90°.
- Smart guides can be set to draw lines at 30°, 45°, 60°, or any specified angle.
- Sloping or inclined lines can be drawn by rotating an existing line the desired number of degrees.
- Guides can also be set to align or distribute the centers, lefthand or righthand edges, or tops or bottoms of line segments.



Digital Templates

2D drawing and computer-aided drafting (CAD) programs include digital templates of geometric shapes, furnishings, fixtures, as well as user-defined elements. Whether a template is physical or digital, its purpose remains the same—to save time when drawing repetitive elements.