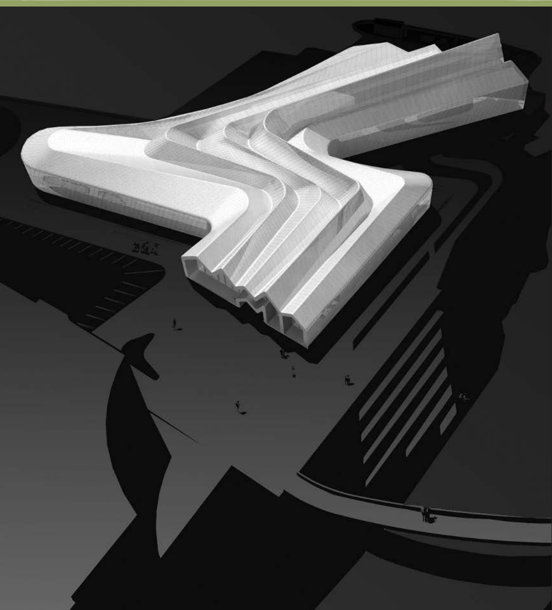
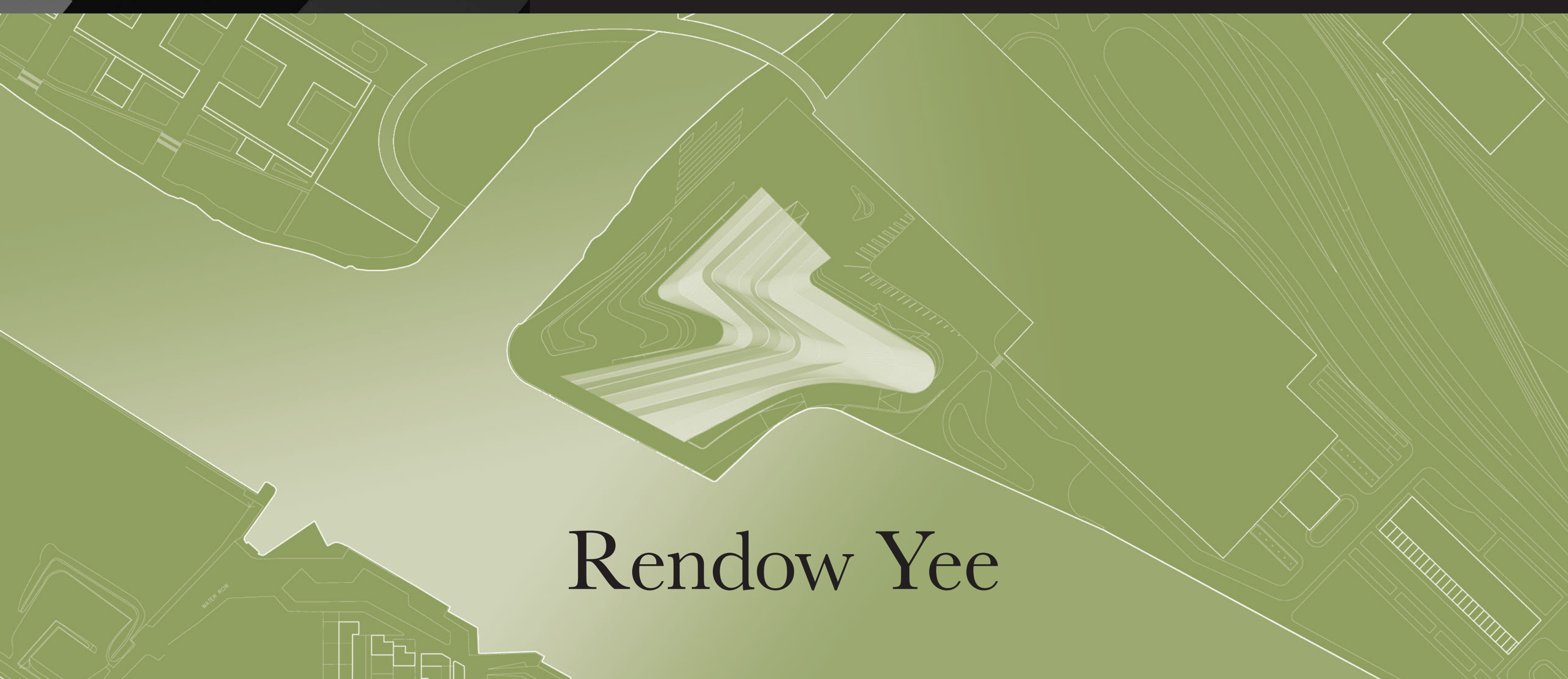
Fourth Edition

Architectural Drawing



A Visual Compendium of Types and Methods



Rendow Yee

ARCHITECTURAL DRAWING

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A Visual Compendium of Types and Methods

Fourth Edition

Rendow Yee

WILEY

This book is printed on acid-free paper. ♾

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Dedicated to each student studying this book

past and present —

Always a source of insightful and innovative ideas.

To my parents —

Always a source for inspiration.

Contents

Preface to the Fourth Edition

The fourth edition adds two important chapters, “Introduction to the Digital/Manual Interface” and “Introduction to Portfolio Building.” The first new chapter is critical for a student’s understanding of how manual drawing and digital modeling play off of each other as partners in design thinking. This partnership is increasingly important, as the simultaneous use of both modes seems to be the most efficacious approach to design drawing. The second new chapter addresses the need for students to formulate portfolios for their work and future careers.

I am deeply grateful for the superlative work of the contributing author for the digital/manual chapter, Professor William W. P. Chan of Morgan State University’s architecture department. He also worked with me as a consultant, shedding light on many other issues in the book. I would also like to express my deep gratitude for the three reviews I received for the portfolio chapter from Professor Mark A. Pearson of the College of DuPage, Professor Hiro Hata of SUNY at Buffalo, and Professor Chan. Special appreciation goes to Guobin Yu, who assisted with the transferring of countless images to CDs. A special thanks to Wiley assistant editor Lauren Poplawski and editorial assistant Danielle Giordano, both of whom patiently worked with me on numerous issues and problems. Finally, I would like to acknowledge the outstanding student projects submitted for inclusion in the book by the schools listed below.

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Professor Stephen Temple, University of Texas at San Antonio
Professor Marissa Tirone, Syracuse University (New York)
Professor Jon Thompson, University of Texas at San Antonio
Dr. M. Saleh Uddin, Southern Polytechnic University (Georgia)

Preface to the Third Edition

The third edition introduces hierarchy to make the book easier to use and its information more accessible. The hierarchical table of contents, for example, allows readers to reference the most salient topics quickly. Structural hierarchy within each chapter is based on two stages: BASICS and BASICS APPLIED. BASICS incorporates fundamental elements such as theory, definitions, principles, and concepts. BASICS APPLIED provides step-by-step how-to applications, along with student and professional examples.

The third edition has also expanded the content in the companion website. In addition to the initial second-edition website chapter titled "Conventional and Computerized Representation in Color," two new chapters—and an appendix—have been added. The chapters are titled "Interfacing Manual with Digital: Professional Office Example" and "Interfacing Manual with Digital: Academic Studio Examples." The interfacing chapters show projects that integrate manual with digital methods. The appendix offers a brief review of geometric definitions and some important principles of descriptive geometry.

I would especially like to thank Professor William Chan of Morgan State University, who was so gracious in donating his time to review most of the chapters as well as the companion website in the second edition. I also appreciate the comments on specific pages by Professors Dick Davison of Texas A&M and Arpad Daniel Ronaszegi of the Savannah College of Art and Design. Finally, I would like to acknowledge the assistance of Tina Chau, Chalina Chen, and Susan Wu.

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Preface to the Second Edition

There are two important new features in the second edition. The first feature is the addition of a drawing and drafting exercises section at the end of the book. This will allow professors of architectural graphics and design communications to glean ideas for formulating fundamental drawing/drafting exercises to suit their own classes.

The second feature is a supplementary website chapter, "Conventional and Computerized Representation in Color," which can be found at www.wiley.com/go/yee. This overview chapter covers traditional color media such as watercolor, gouache, pastels, colored pencil, markers, airbrush, and mixed media. Various aspects of the potential of digital media are also discussed. In addition, typical student and professional solutions for the many drawing exercises in the textbook are shown on the website. These solutions are available to course instructors upon request at www.wiley.com/go/yee or by contacting your local Wiley college representative for details.

Finally, the topics of diagramming and conceptual sketching have been condensed into a single chapter with more explanatory text, and the chapter on presentation formats has been expanded to include professional competition drawings from notable offices.

Acknowledgments

I am very grateful for three insightful critiques of the first edition. All chapters were reviewed by Professors Dick Davison and Stephen Temple; and Professor Owen Cappleman reviewed the chapter on diagramming and conceptual sketching, as well as the website chapter. I would also like to express my gratitude to all of the office professionals who contributed work in a very timely manner. In addition, I am deeply indebted to the strong support team from educational institutions that supplied me with exceptional examples of drawing exercises. A warm thanks to the following architecture schools and professors who contributed projects:

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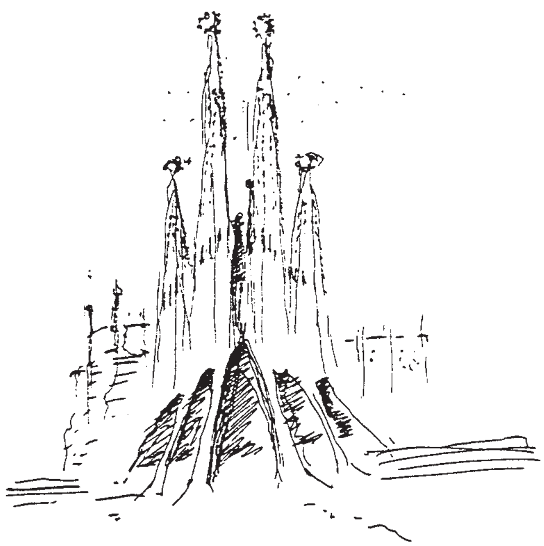

© Charles Yim

Sketch: Student project by Susan Pruchnicki
Church of Sagrada Familia, Barcelona, Spain
10" × 12" (25.4 3 30.5 cm)
Medium: Pen and ink
Antonio Gaudi, Architect
Courtesy of Washington University
School of Architecture, St. Louis, Missouri

Preface to the First Edition

In the visual world of design education and the design professions, message (design) and language (graphics) are so interrelated that they cannot be separated. The design process always includes graphic skills to clarify and communicate the issues in question. This book's goal is to communicate a broad range of design-drawing methods; it is not intended to be a handbook on acquiring design skills.

People learn to communicate through language at an early age. They learn to speak, read, and write. The primary type of communication in any kind of design work, whether fashion or building, is drawing. To communicate our design ideas to others, we must learn how to draw. We must draw with enough facility to make our ideas clear. Furthermore, we need to be able to communicate graphic ideas to ourselves because as we work on any design our ideas are constantly changing and evolving.

The language of graphics requires the use of all aspects of the brain—analytical, intuitive, synthetic, and even emotional. The intent of this primer is to provide students and practitioners with graphic tools essential to visual communication methods in the design process. It will reinforce methods of perceiving existing reality in order to create an awareness of the visual world. It will also develop and build confidence in one's analytical and intuitive graphic skills and abilities.

It is quite common to find students with a wide range of backgrounds in drawing upon entering a beginning course in architectural drawing/graphics; some students may have had numerous courses in mechanical drawing and art in middle school and high school; other students have never used or been exposed to drafting or sketching equipment. There are also students who show a strong potential on aptitude tests related to spatial visualization, but for one reason or another they have never had an opportunity to develop this potential. This book can be used by those who have little knowledge of geometry or basic mathematics. However, it is also designed for intermediate and advanced students in architectural drawing. Students and practitioners with a prior knowledge of pictorial drawing or perspective will find this book to be a convenient reference guide for presentation work.

The first four chapters, including "Representational Sketching," are basic to the study of architectural graphics and provide the necessary framework to pursue the major areas of two- and three-dimensional pictorial drawings. The chapters on paralines, perspectives, and shadows illustrate the most common manual methods in current practice with detailed but simple explanations on the theory behind their use. The use of these procedures will help both the student and the professional in communicating and presenting design ideas. The remainder of the book is devoted to a brief introduction to the topics described by chapter titles "Delineating and Rendering Entourage," "Diagramming and Conceptual Sketching," and "Presentation Formats." The variety of drawings illustrates a large number of diverse styles; and the medium used, the original size, and the scale used (if applicable) are given for each drawing where this information was available. In this sense, the book acts as a springboard to stimulate readers to explore each topic in more detail by investigating the extensive bibliography. Many of the images included are residential building types, but a large variety of other building types are shown as well. In view of today's global culture, many drawing exhibits from outside the United States are also included.

This comprehensive guide attempts to elaborate equally on each of the architectural design-drawing methods in current use. However, the last quarter of the twentieth century has seen an upsurge in the use of paraline drawings. This is due to their ease of construction and their impressive ability to allow the viewer to see and to comprehend the total composition of a design. For this reason, a large number of professional paraline examples are included. Architecture and other design professions have been expanding their expressive vocabulary to include the emerging methods of three-dimensional computer imaging, animation, film, and video. This visual compendium of diverse graphic images done in a variety of both traditional and avant-garde media is rich in its content. Many illustrations are supported by personal commentary from their originators to help shed light on why each type of drawing was chosen to express the design.

Both students and design professionals are continually striving to come up with new ways to represent and express their designs. The graphic image examples that I have chosen are by no means exhaustive. These examples are meant to extend basic techniques that the students learn to a more advanced level as well as to provoke their imagination. They are not meant to dogmatically lead students onto a narrow path of particular styles or "isms"; instead, their goal is to encourage students to start their own journey of discovery and exploration.

As a reference for precise graphic constructions the book is laid out in a simple, easy-to-follow, step-by-step format. Although mechanically constructed pictorials are emphasized, freehand visualization techniques are encouraged. Most architectural schools have courses covering architectural design-drawing in a time frame from one to three semesters. In many cases the material is covered as an adjunct to the design-drawing studio. This book can be used under any kind of flexible time schedule as a student text or a studio reference, or as an office reference for practitioners. The encyclopedic nature of the book encourages browsing and wandering. For ease of reference, design-drawing types have been categorized in such a way that both students and design professionals will find them handy for reviewing design-drawing methods or for obtaining and extrapolating ideas for their own creative presentation compositions.

Plan sketch diagrams: Mica Moriane, official residence of the President of Finland
Mäntyniemi, Helsinki, Finland
Medium: Colored felt pens
Courtesy of Raili and Reima Pietilä, Architects

Acknowledgments

This book on architectural drawing developed from an expression of need over many semesters by the architecture faculty and the students enrolled in the basic architectural drawing course at the City College of San Francisco.

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Initial exposure to drawing and drafting came from my father, the late Rodney Shue Yee. Kindled interest in the field of architectural drawing techniques came from two former professors of mine, the late Professor Emeritus Alexander S. Levens of the University of California at Berkeley and the late Professor Emeritus Roland W. Bockhorst of Washington University. Also, I would like to thank Dr. Wayne D. Barton of the City College of Sacramento for sharing his teaching experiences with me in basic drafting and drawing courses, and I would like to acknowledge Professor Zenryu Shirakawa of Boston University for improving my writing skills during my high school and college years. A special note of gratitude goes to all those who contributed illustrations to this book. The process of contacting everyone was both an arduous and an enjoyable task.

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Toledo, Ohio
12" × 9" (30.5 × 22.9 cm)
Medium: Ink on paper
Courtesy of Frank O. Gehry, Architect

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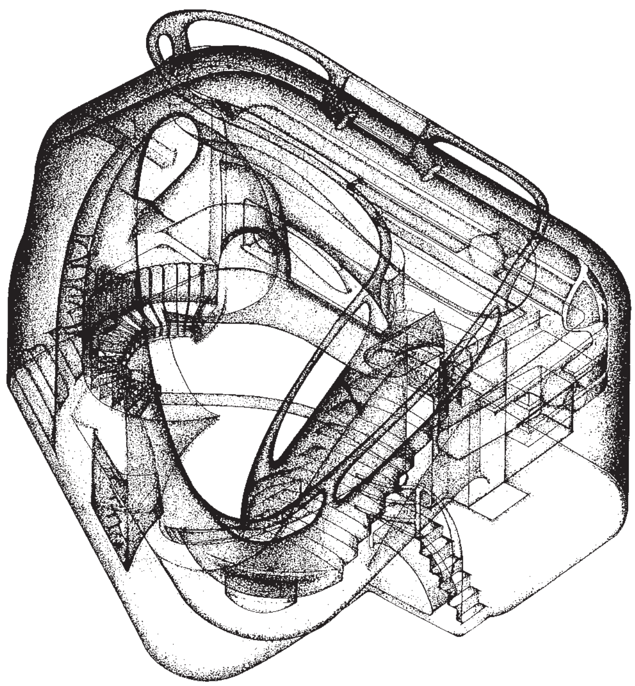

Drawing: Truss-Wall House, Machida, Tokyo, Japan
Transparent isometric
Courtesy of Eisaku Ushida & Katheryn Findlay of the Ushida-Findlay Partnership

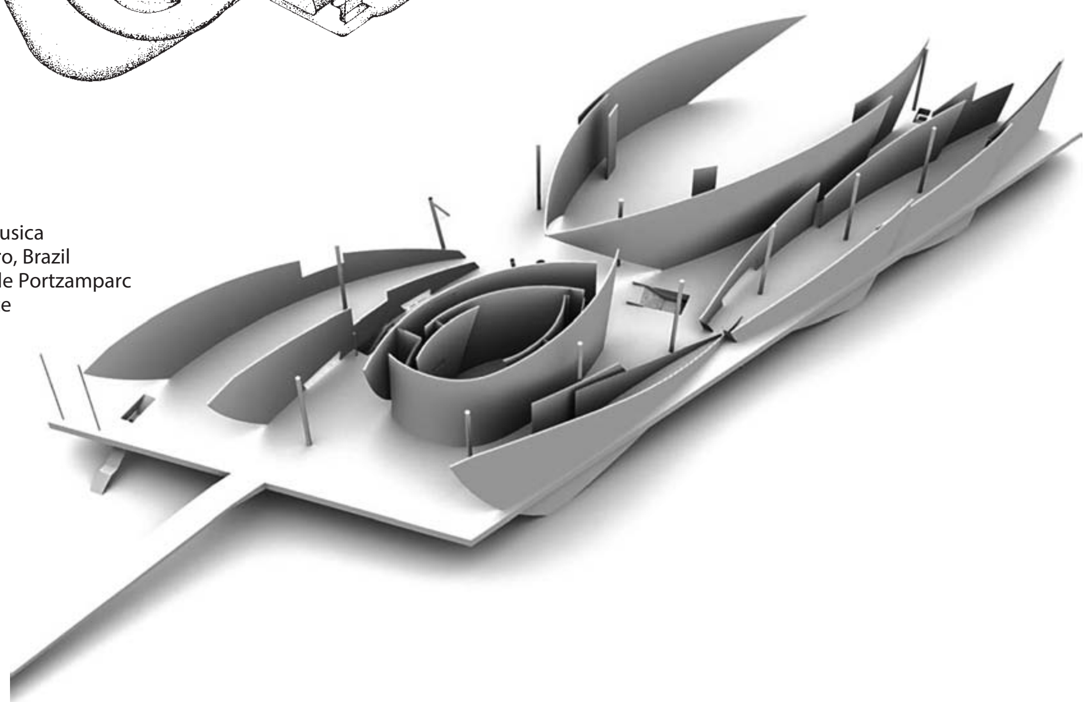

Photo: Cidade de Musica
Rio de Janeiro, Brazil
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Courtesy of Arcspace

1

Representational Drawing

Sketches of the built environment are analytical drawings that generally convey an overall image. We do these drawings to gain a greater understanding of the nature of the man-made and natural landscape. To capture and convey the essence of a place, such drawings must be executed quickly, accurately, and with confidence. These drawings are our pictorial expressions of the spirit and sense of place as we document what we see.

Geometric shapes are the building blocks for all derived forms. Environmental form and composition are an aggregate of simple and complex forms. Whether you draw from life or from your imagination, these forms must be graphically expressed and communicated in a composition within a two-dimensional surface to convey the perception of a third dimension.

The intent of this chapter is to cover the basic aspects of freehand descriptive sketching and delineating, including the types of tools, line, shape, proportion, and values as well as examining, observing, and depicting encountered environmental elements. Another goal is to hone your ability to sketch by using line, volume, texture, and tone—as well as proportional and perspective relationships—to describe various objects.

The following are some of the important skills, terms, and concepts you will learn:

Types of sketching pencils and the strokes they make
Types of sketching pens and the strokes they make
Sketching and delineating architectural elements like trees, cars, and buildings

Sighting	Blocking out	Construction lines
Vignette	Rendering	Focal point
Vantage point	Value	Background
Foreground	Middle ground	Delineating figures
Entourage	Delineating trees	Scribbling
Stippling	Delineating cars	
	Hatching	

Representational Drawing

TOPIC: VEGETATION

Wang 2002.

TOPIC: DRAWING METHODS

Crowe and Laseau 1986.

Mendolwitz and Wakeham 1993.

TOPICS: HUMAN FIGURES, SIGHTING

Wang 2002.

TOPIC: SKETCHING WITH MARKERS

Wang 1993.

TOPIC: BUILDINGS/TRAVEL SKETCHES

Ferriss 1986.

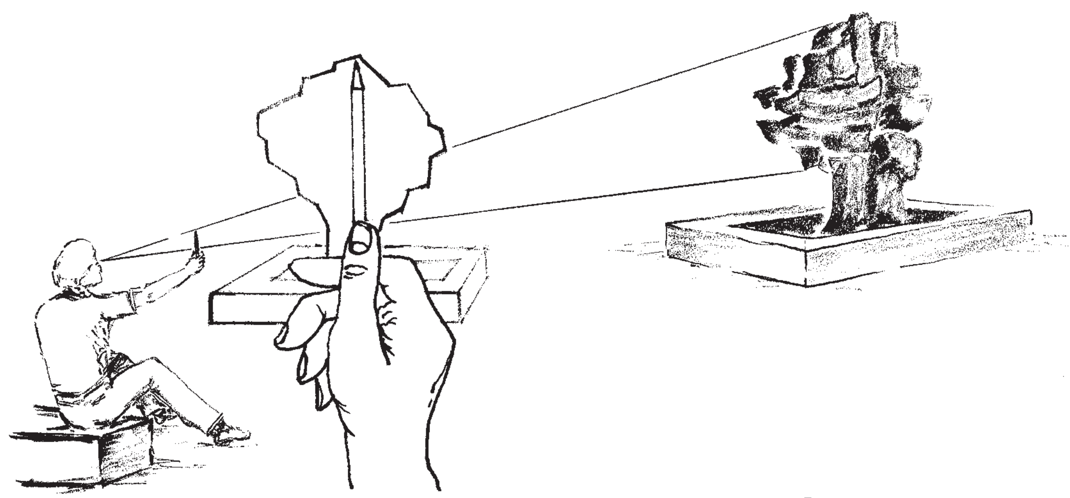
Johnson and Lewis 1999.

Predock 1995.

Chapter Overview
In studying this chapter, you will begin to develop skills in hand representational drawing and delineating. For continued study, refer to Ching 1990 and Wang 2002.

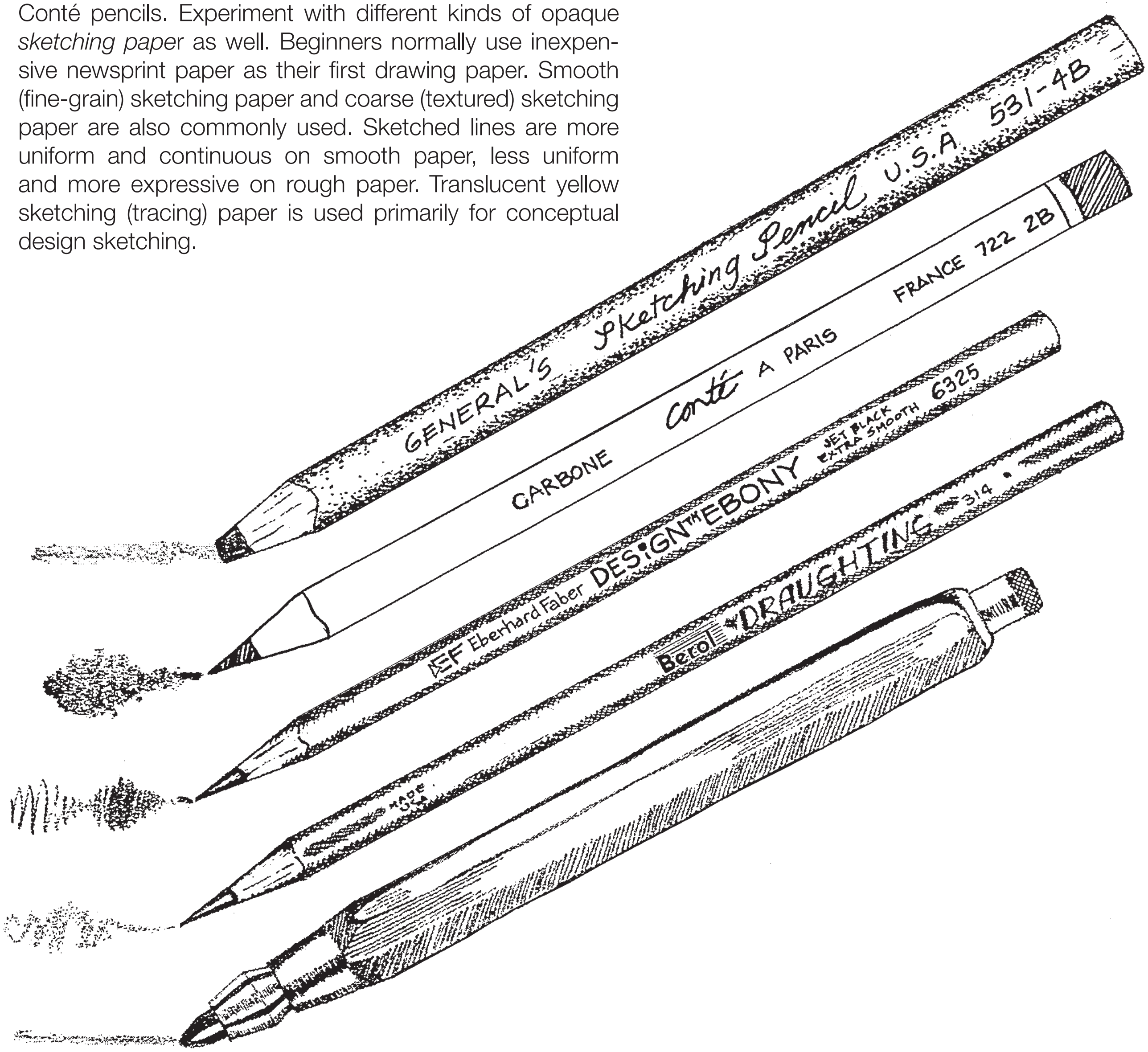
Drawing from life is essential to the development of the hand-eye-brain loop. The more you draw, the more you look at the world around you. As architects, artists, and designers become more aware of their surroundings, their work becomes more formidable. Often, when students begin drawing, their work does not have "the right shape"; in other words, it is not in the correct proportions. One of the most fundamental tools for controlling proportion is called *sighting* (explained on pp. 8 and 9). This method of using a drawing instrument held at arm's or partial arm's length as a measuring device (essentially simulating a picture plane) is highly effective in helping the beginner to make objects in the drawing the right shape, as well as controlling distances and relative sizes in general. Looking and recording reality with the aid of sighting strengthens the visual sense and brings confidence to the drawing process.

Drawing is a process that progresses from seeing to visualizing and, finally, to expressing. The ability to see gives us the raw material for our perceptions and, ultimately, for what we draw. Visual information seen by the eye is processed, manipulated, and filtered by the mind in its active search for structure and meaning. The mind's eye creates the images we see and eventually tries to express them in the form of a drawn image. Our ability to express and communicate relies on our ability to draw.



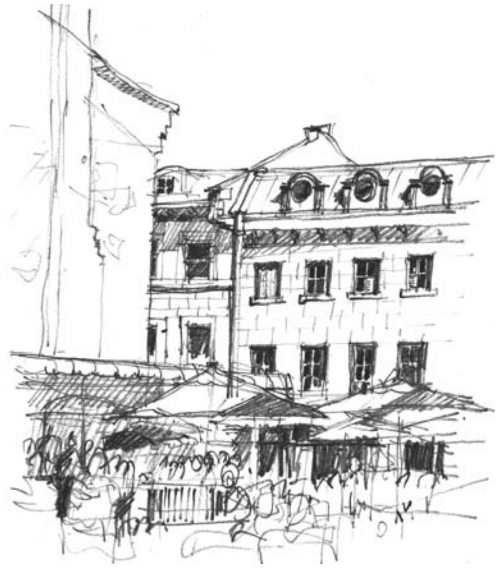
Drawing: Student project by Johanna Rantonnen
Copenhagen, Denmark
Medium: Ink sketch
Courtesy of the University of Virginia School of Architecture

Some of the many quality *sketching pencils* are shown on this page. Other alternatives include charcoal sticks and Conté pencils. Experiment with different kinds of opaque *sketching pape*r as well. Beginners normally use inexpensive newsprint paper as their first drawing paper. Smooth (fine-grain) sketching paper and coarse (textured) sketching paper are also commonly used. Sketched lines are more uniform and continuous on smooth paper, less uniform and more expressive on rough paper. Translucent yellow sketching (tracing) paper is used primarily for conceptual design sketching.



Soft lead sketching pencils can have round or flat leads. A flat sketching pencil can be thick (carpenter's pencil) or medium thick (chisel pencil). Both must be sharpened by hand. Flat sketching pencils are mainly used in three degrees: 2B, 4B, and 6B. They are commonly used for covering large areas quickly, as when creating tonal indications for brick, stone, and wood. Conté pencils or sticks come in three grades of black, in four different colors, and in soft, medium, and hard. Both Conté and Ebony pencils give smooth lines. The Ebony pencil's soft core is slightly wider than that of a typical pencil. Formerly, a good general-purpose sketching pencil with a soft lead was a Berol or Eagle Draughting 314; its successors are Sanford and General's Draughting No. 314. When round leaded pencils become too short from use, add length by using a pencil extender. An all-purpose mechanical leadholder clutch pencil can adapt its lead to almost any shape and is ideal for rapidly sketching over large areas. Excellent brands include Derwent and Mars.

Drawing on-site is always a challenge for me, and I rarely spend more than twenty minutes on a sketch. As an architect my objective is to learn more about the subject, so I focus a lot of attention on form and materials. Ebony pencil allows me to explore shade and shadow quickly, and by keeping at least two pencils with sharp points I can still pick out critical details.
[Architect's statement]

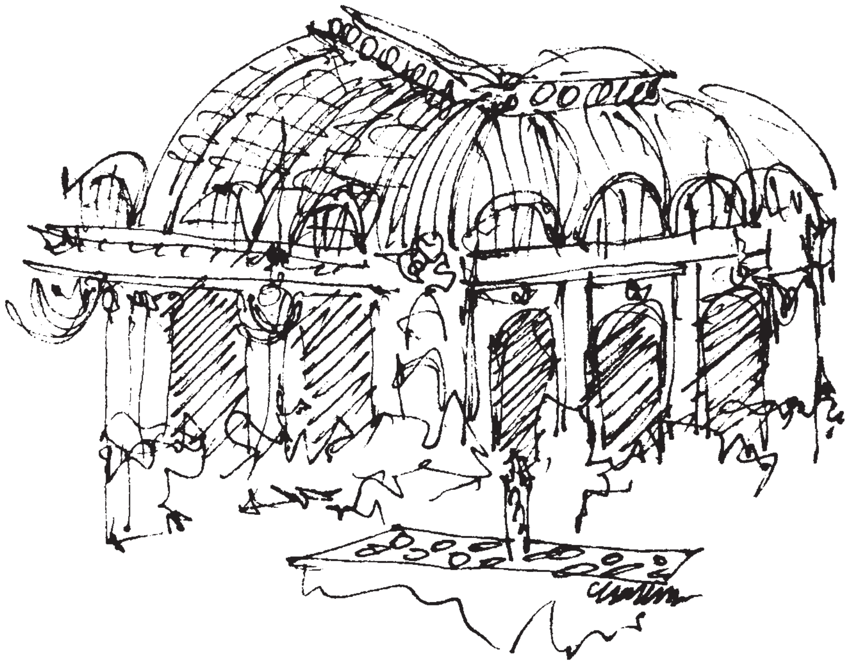


Sketch: Le Jardin Nelson, Montreal, Canada, 1993
9" × 12" (22.9 × 30.5 cm)
Medium: Ebony pencil on paper
Courtesy of David G. Woodcock, FAIA, RIBA,
Professor of Architecture, Texas A & M University,

Sketch: Abbey of San Galgano, Montesiepi, Italy, 1987
12" × 9" (30.5 3 22.9cm)
Medium: Ebony pencil on paper
Courtesy of David G. Woodcock, FAIA, RIBA, Professor of Architecture,
Texas A & M University, Department of Architecture

The quality of a freehand *pencil stroke* is determined by the hardness of the pencil lead, the character of the sharpened point, the amount of pressure applied, and the type of paper used. Softer pencils work better with smoother paper, harder pencils with coarser paper. Architectural pencil sketching is most often done with grades such as HB, B, and 2B, though softer leads are also used. Graphite and charcoal pencils can yield variable line widths and tone. Variable tone and value cannot be achieved when sketching with pens and markers. Lighting conditions resulting in shades and shadows can be most accurately represented by using soft lead pencils, charcoal pencils, square or rectangular graphite sticks, or Conté crayons. To prevent pencil work from smudging, cover completed sections of your drawing with tracing paper or use fixative sprays.

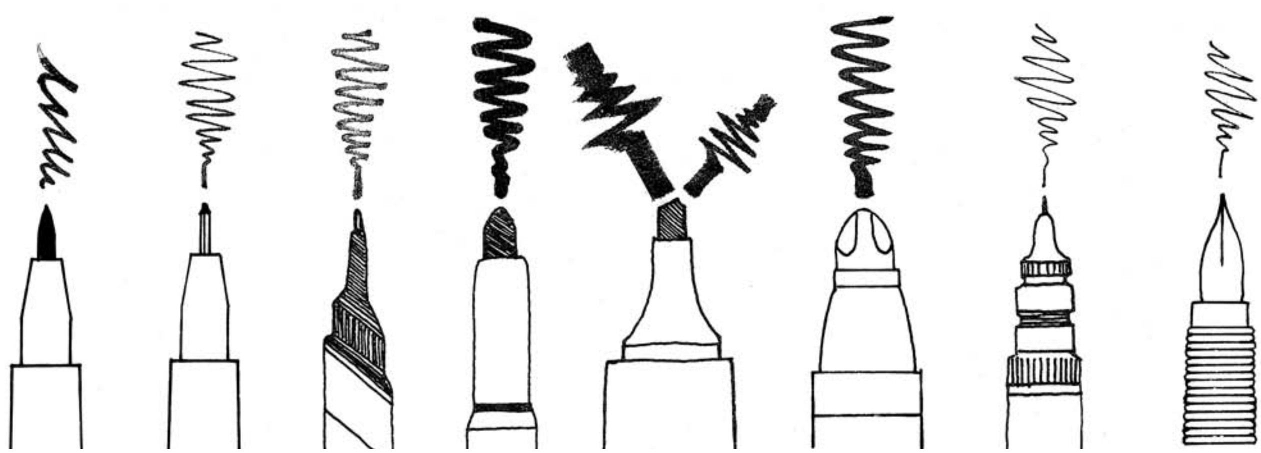
In producing firm, steady strokes, do not rest your hand on the drawing surface as in writing. The pencil should be held in a relaxed position; too tight a grip will cause hand fatigue. A wrist-and-arm movement will produce longer, continuous strokes. Use the wrist, elbow, and shoulders as pivot points. Attempt to master the control of sketching straight lines, curved lines, circular spirals, and circles. When sketching, use the whole page—draw big.



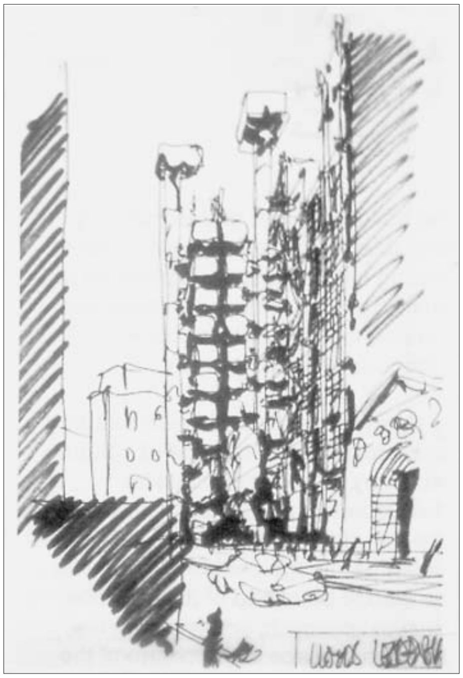
Sketch: The Garden Court of the Palace Hotel
San Francisco, California
Medium: Ink pen
Sketch by Charles Moore, Architect
Courtesy of Saul Weingarten, Executor, Estate of Charles Moore, and the Department of Architecture, UCLA School of Art and Architecture

Using *pens* or *markers* as graphic communication tools allows the architect/designer to express a wide range of images, whether they are representational, like the hotel courtyard and the Austrian street scene, or conceptual, as with the Lloyd's of London sketch. The London thumbnail sketch illustrates the loose, expressive quality that can be achieved with flexible felt-tipped markers. Contrast it with the very uniform, contoured lines *delineated* in the street scene with a fine-point, felt-tipped pen.

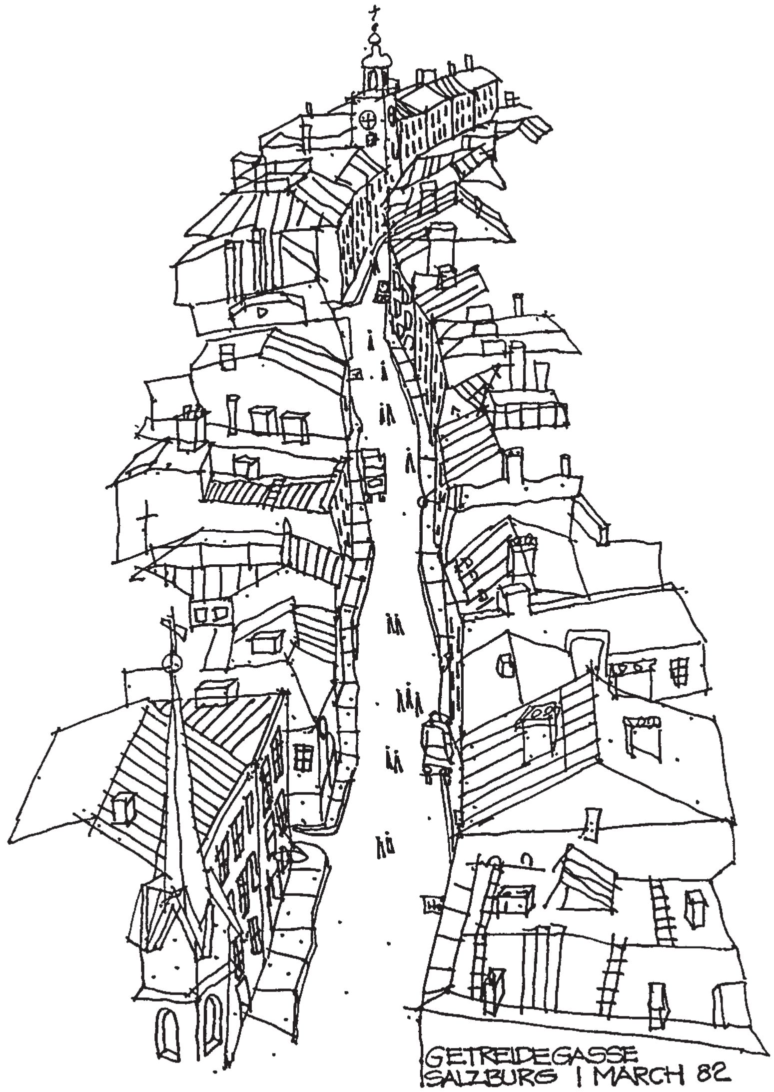
Pens and markers are frequently used to do thumbnail napkin sketches for both conceptual (see p. 68) and representational drawing.



In addition to pencils, line and tone can be produced by a variety of pens and colored markers. Markers are available in a range of halftones, but because they dry quickly, mixing tones is difficult. Marker tips vary in size from fine to broad and in shape from pointed to chisel. Finer tips generate fine lines with more detail, whereas broader tips generate wider lines and solid tones. Technical pens are commonly used for precise mechanical lines. Razor-point pens, cartridge pens, sketch pens, and fountain pens can create loose delineated lines that are permanent. Fountain pens traditionally used for writing become quite versatile in their application of line weight simply by adjusting finger pressure. Excellent for quick sketch studies, fountain pens can also produce much thinner lines when used upside down (i.e., rotated 180º).



Sketch: Lloyd's of London, London, England
11.75" × 16.5" (29.8 × 41.9 cm)
Medium: Brown felt-tipped marker
Sketch by Laurie Abbott
Courtesy of Richard Rogers Partnership, Architects

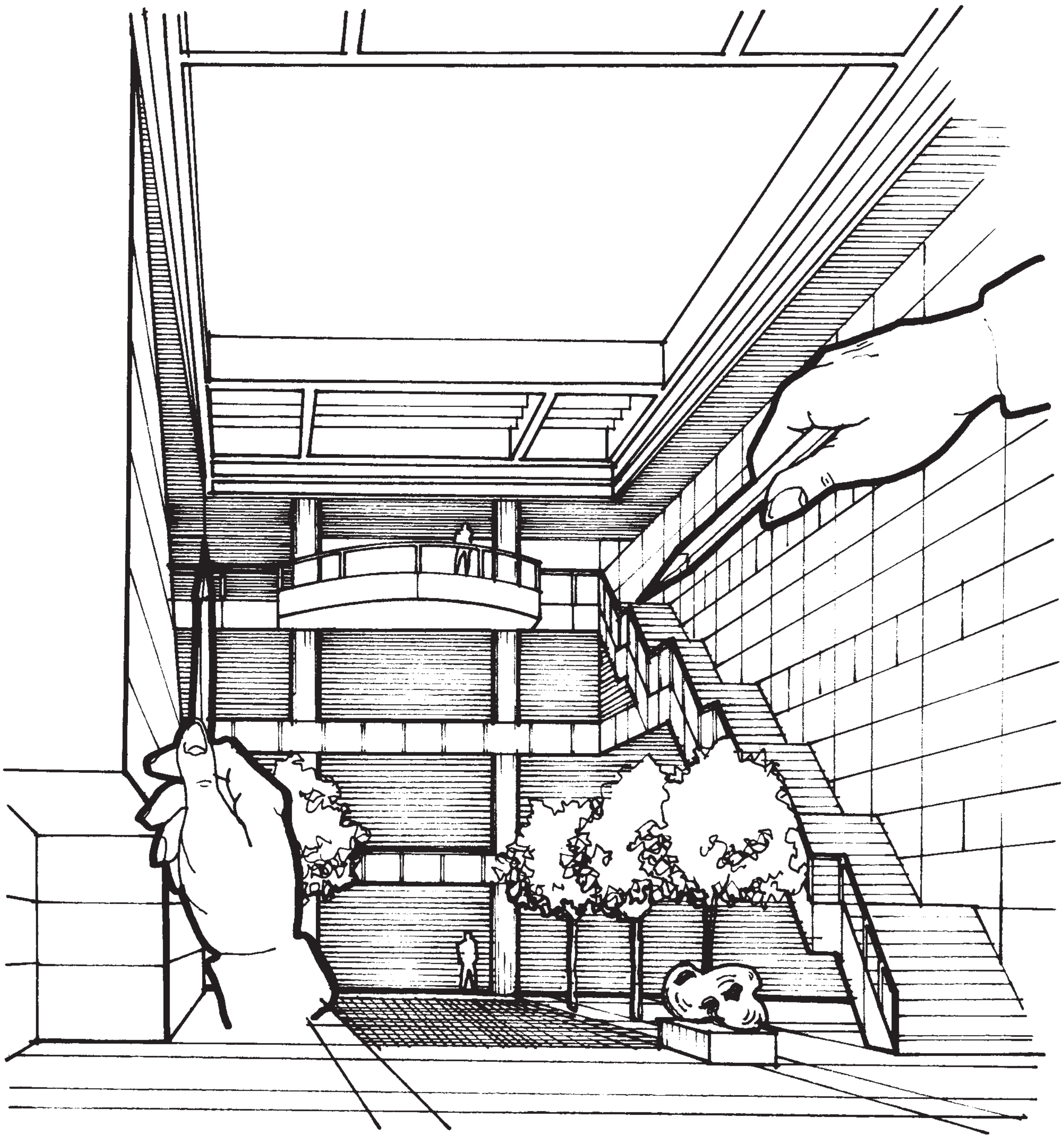


Drawing: Street scene, Salzburg, Austria
7"×10" (17.8 × 25.4 cm)
Medium: Felt-tipped pen on paper
Courtesy of Steven House, Architect, San Francisco

Ballpoint, felt-tipped, fiber-tipped, and roller-tipped pens can also generate a variety of line widths. In general, all types of pens create steady, fluid, smooth-flowing lines—without the need to apply pressure (unlike pencils). Remember that for architectural sketching, the width and type of the tipped nib are of most concern. Nibs can be made of felt, nylon, plastic, foam, etc. New nibs tend to be hard and become flexible after use (keep old ones for soft tones). Try to keep up with the ever-changing technology of newly developed nibs.

Felt-tipped markers are a quick, loose medium (similar to watercolors) for creating transparent presentations; they are quite effective when time is a critical factor. One of markers' advantages is that they very seldom smudge. They come in a large variety of premixed colors in addition to black and shades of gray. Markers are more suitable for smoother, harder, and heavier grades of paper, whereas pencils and colored pencils work best on medium-weight textured paper.

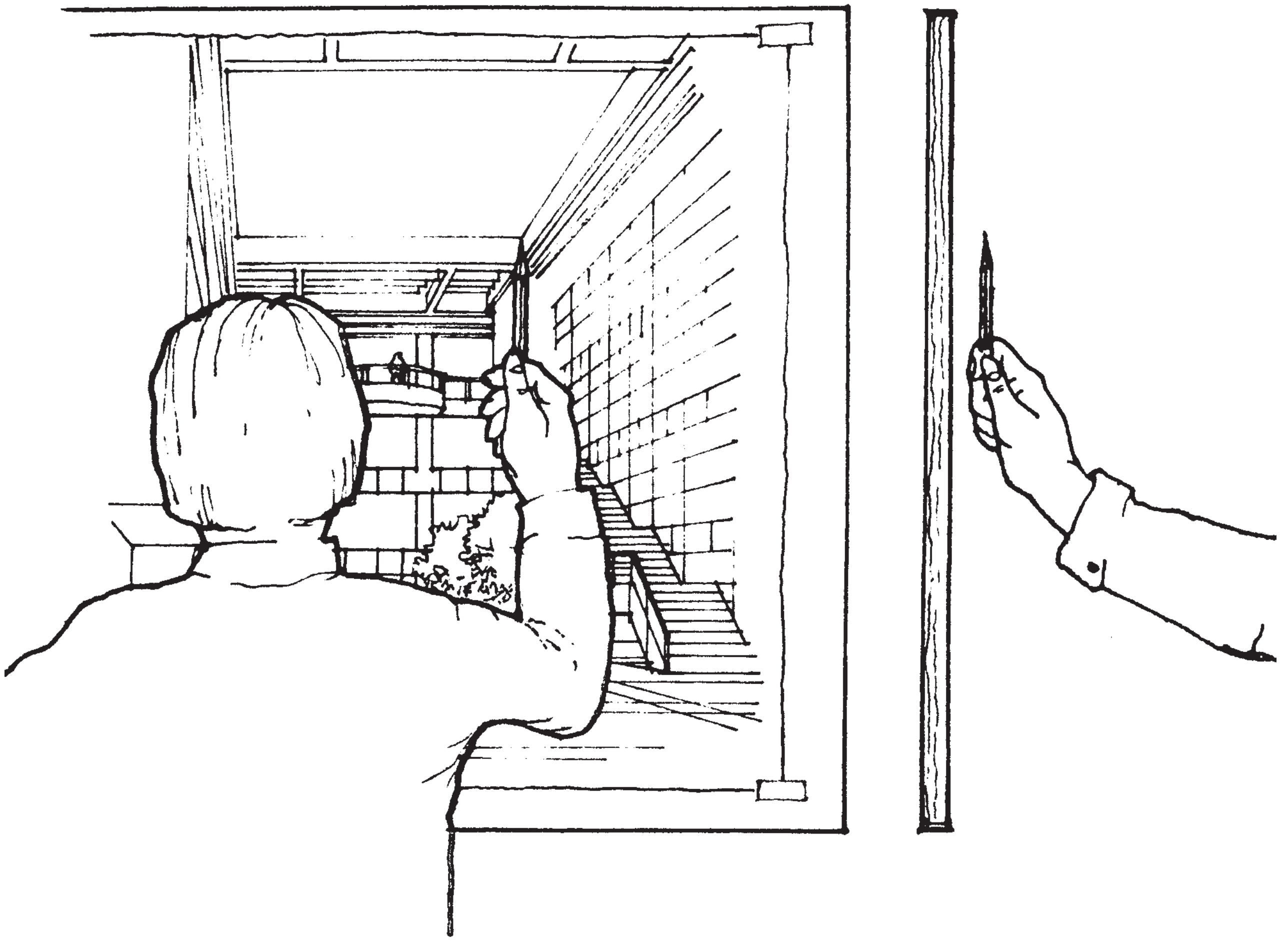
Pens and markers are perhaps best suited for sketching conceptual ideas. These tools give you the ability to loosen up and avoid inhibitions in the design-drawing process.



Drawing: Sacramento State Office Building, Sacramento, California
Fisher–Friedman Associates, San Francisco, California

To properly establish accurate proportions in transferring what you see to your drawing pad, you must accurately compare relative lengths, widths, and angles.

1. Observe the subject/scene that you would like to draw.
2. Close one eye, hold your head still, and extend your arm partially or to arm's length.
3. Holding a pencil or pen, make a basic unit length measurement on any part of the viewed scene, using the distance from your drawing instrument tip to the top of your thumb as a guide to proportion.



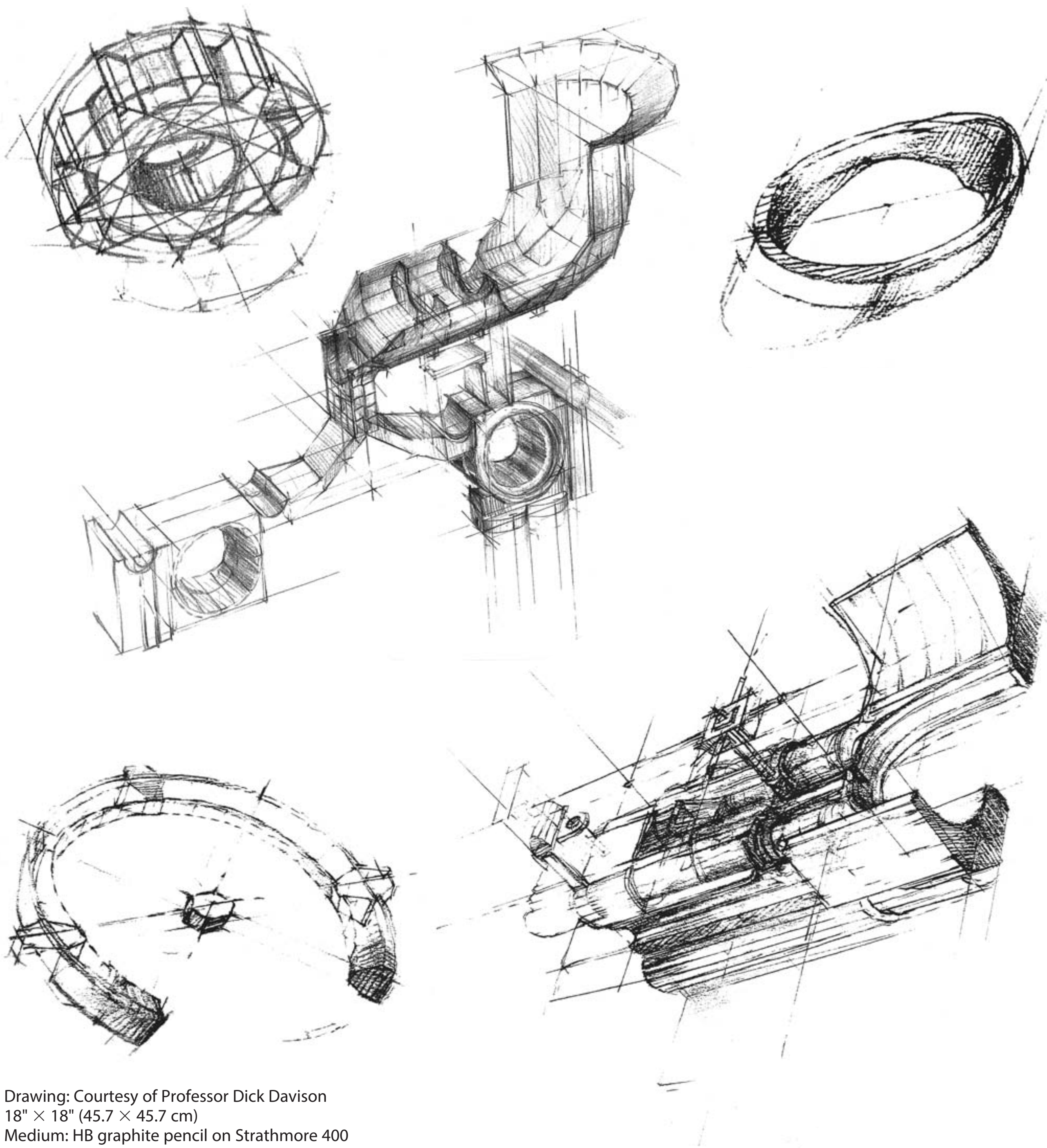
Drawing: Sacramento State Office Building, Sacramento, California
Fisher–Friedman Associates, San Francisco, California

4. Other lengths and widths can now be measured based on the smaller unit length. All of these distances must reference the basic unit in terms of relative size.
5. The drawing instrument must coincide and align with any angled line to properly transfer the same angle to the drawing pad. Measure the angle with respect to a horizontal and vertical reference that corresponds to the edges of your pad.

Remember:

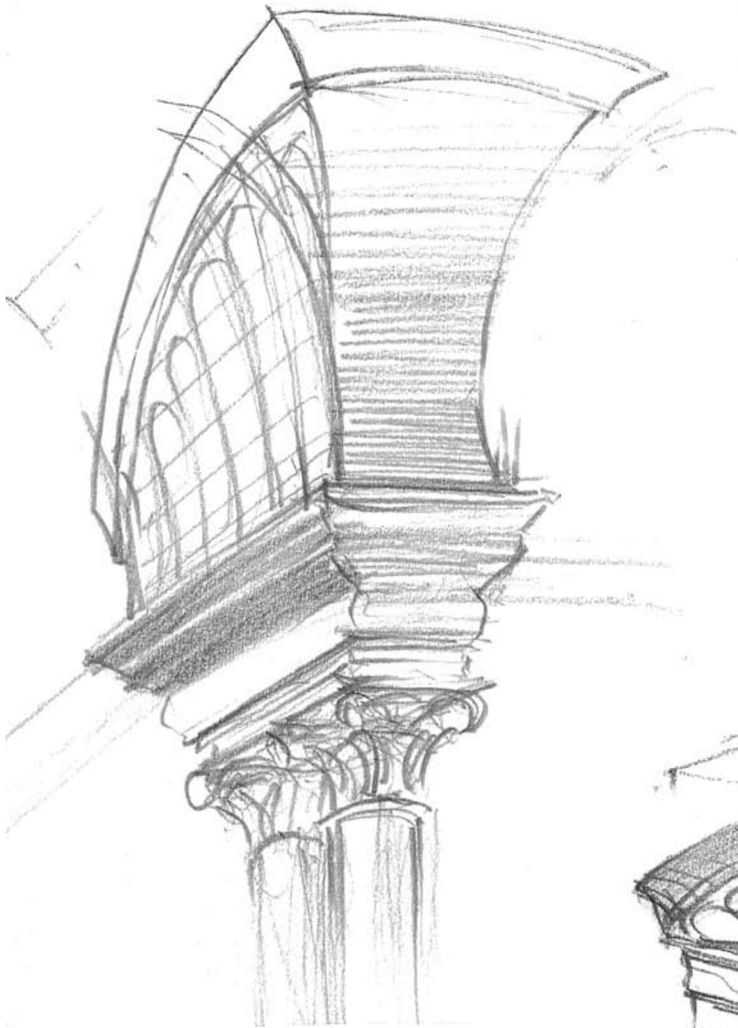
- The plane of your eyes must always be parallel to the plane of your drawing instrument.
- Keep your drawing pad perpendicular to your line of sight so that your drawing instrument can lie in the same plane regardless of its orientation.
- Keep your drawing paper secured to a wood board or hard cardboard pad by using drafting tape, clips, or tacks.

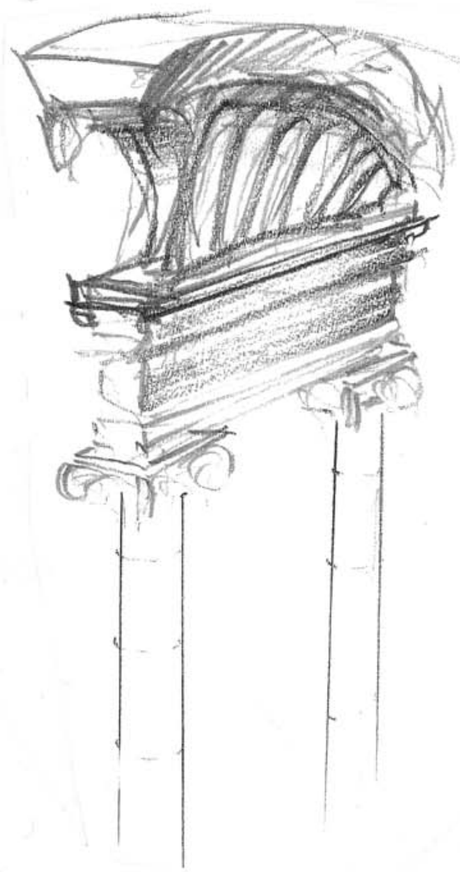
Note: It is best to try to exercise your visualization skills in framing compositions. Various framing devices have been employed over the years, but the most effective, which has been used for centuries, is the use of two small cardboard Ls to frame and crop views. High-tech options are also continually coming out. The ViewCatcher uses a thumb pull to give you an adjustable opening for choice of formats.



Drawing: Courtesy of Professor Dick Davison
18" × 18" (45.7 × 45.7 cm)
Medium: HB graphite pencil on Strathmore 400
Texas A&M University, College of Architecture

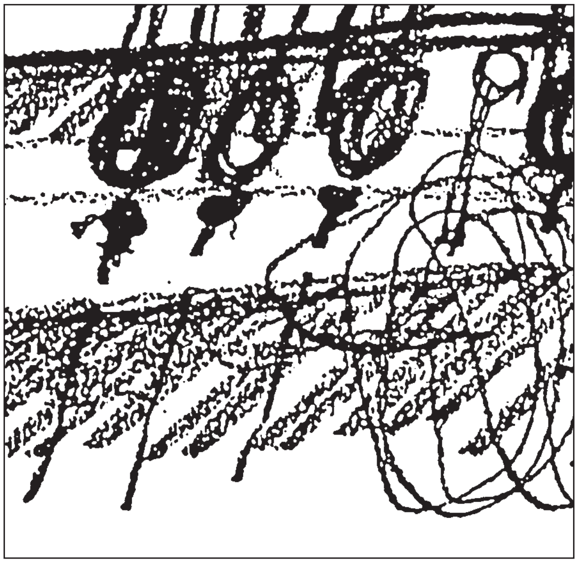
Objects in a composition should always be blocked out within a geometrically configured envelope. Block out a form by using lightly drawn *construction lines* that define the shape and size of the subject. Correct proportional relationships can then be regulated. Two-dimensionally, the shape can be a triangle, a circle, a square, or a 2-D polygon. Three-dimensionally, the basic element can be a cube, a sphere, or a 3-D polygon. *Blocking out* helps you compose a drawing and gives you an idea of what the end product will look like. Once an accurately proportioned composition is drawn, line weights can be adjusted or values applied to complete and finalize the drawing. An HB pencil has a lead that is in the transition zone between hard and soft and can create nice, soft tone values halfway between white and black on a value chart (scale), as shown above.



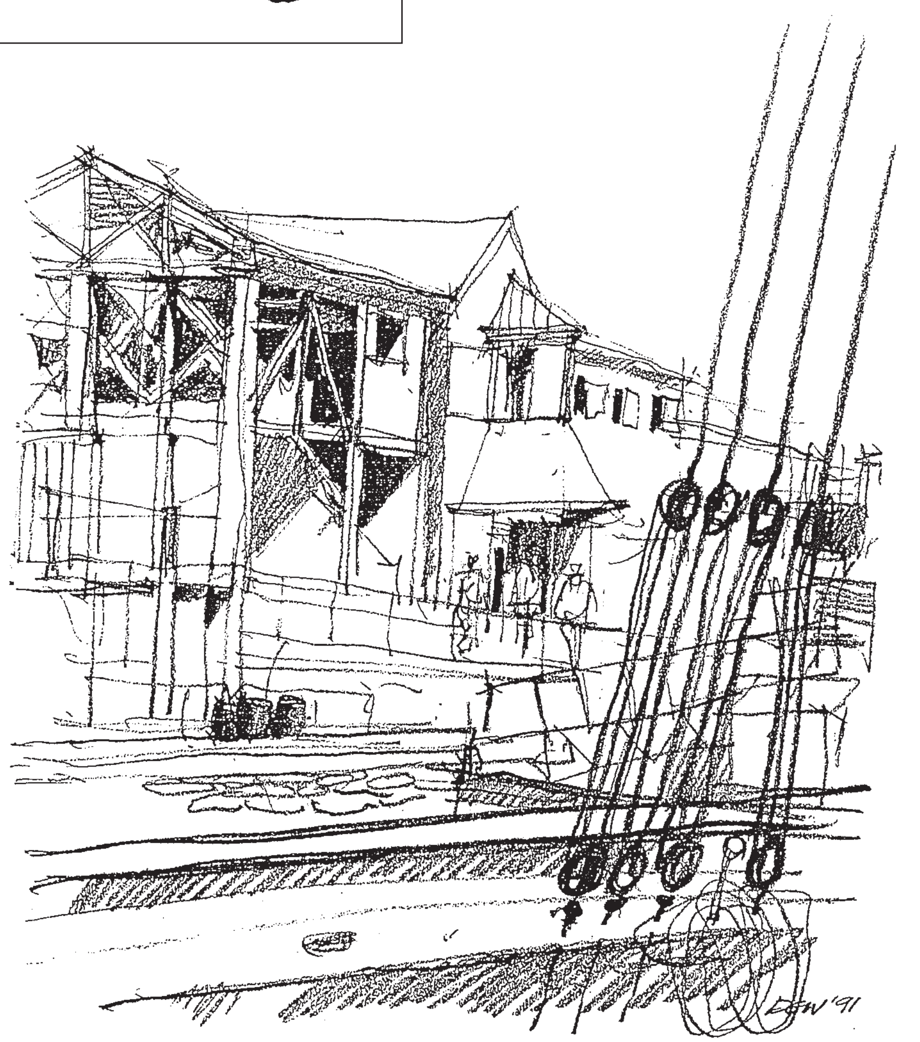


Before attempting to draw an entire building or several buildings in the context of one another, work on particular details of a building or structure. Forcing your mind to isolate interesting building details will improve your focus, concentration, and understanding of architecture. Architectural subjects are treated with the same approach as still lifes. Always set up and regulate proportions using construction lines, which block out and envelop the architectural features of interest.

Drawing: Courtesy of Professor Dick Davison
18" × 18" (45.7 × 45.7 cm)
Medium: HB graphite pencil on Strathmore 400
Texas A&M University, College of Architecture

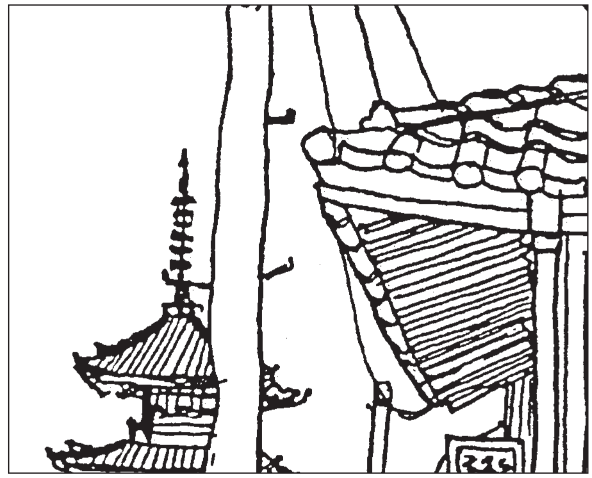


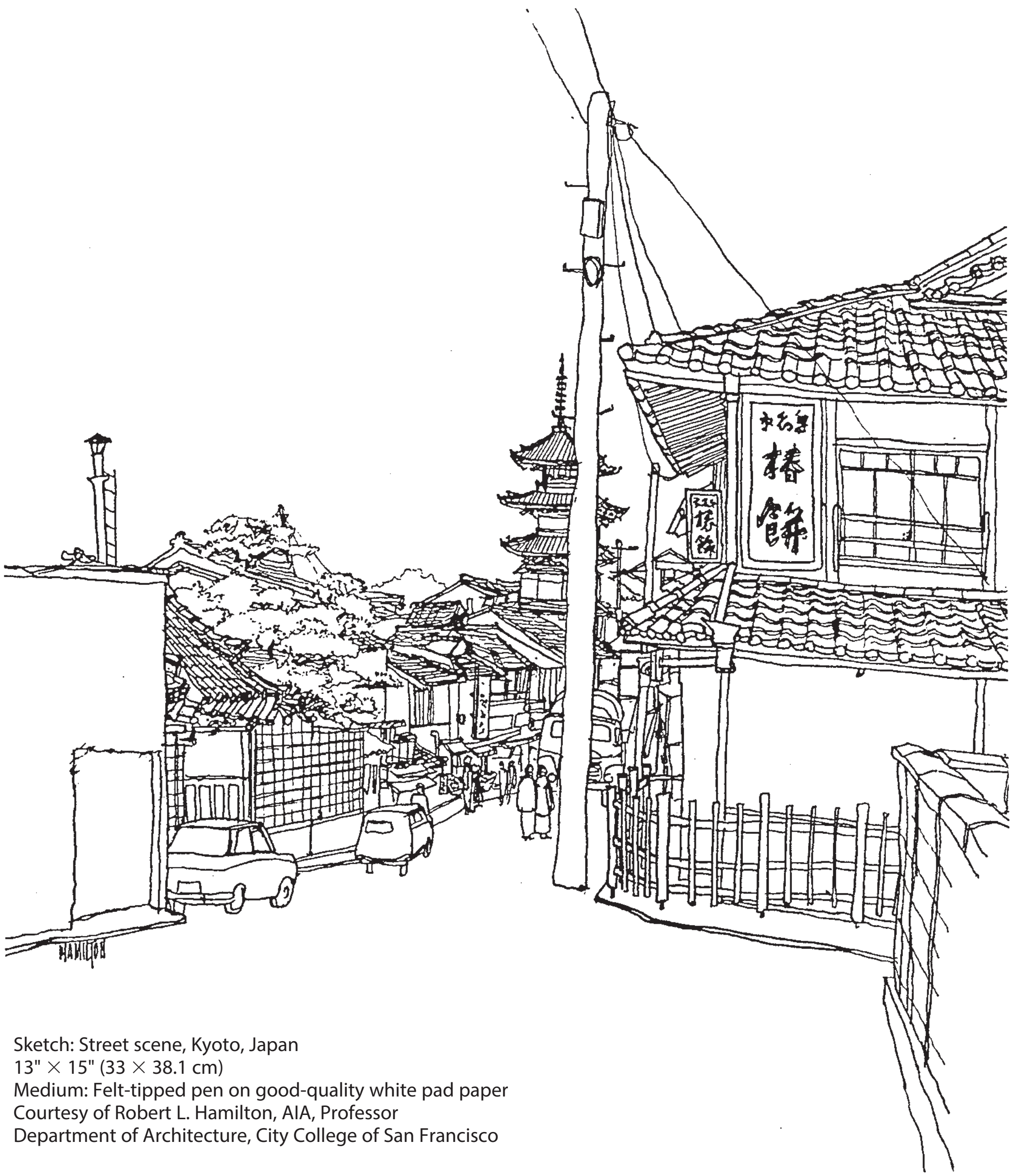
You can produce a wide variety of stroke widths with graphite pencils: from thin, light lines (H series to HB) to denser lines (B series). *Pencil strokes* can vary in direction (vertical, horizontal, angular) and in pressure intensity. The juxtaposition of closely spaced, toned lines (see close-up) creates the effect of a shaded surface. Ebony, carbon, and carpenter pencils are designed for thicker, softer leads. Soft pencil leads are used to sketch wider lines that, when blended together, produce a tonal effect. The darkness of an Ebony pencil means that less applied pressure is needed when rendering denser lines. You can smoothly render any line width with Ebony's soft graphite; you will find it receptive to most slightly toothed paper surfaces. For all pencils, experiment with stroke results based on applied pressure.



Sketch: Texas Seaport Museum, Galveston, Texas, 1991
9" × 12" (22.9 × 30.5 cm)
Medium: Ebony pencil on paper
Courtesy of David G. Woodcock, FAIA, RIBA, Professor of Architecture
Texas A&M University, College of Architecture

You can produce a clear, dark, fluid line with most pens. Unlike pencils, a pen stroke is permanent and opaque. Like pencils, pens are a convenient tool when you are sketching quickly in an unfamiliar place. They do not require extra setup time, as, for example, with watercolors. Every detailed mark and stroke is critical in the development of any drawing done with a pen. *Pen strokes* emphasize uniform line work and the interrelationship of the compositional shapes. Street scenes in the cityscape are always popular travel sketches. Enliven building sketches by adding visible accessories such as vegetation, people, and vehicular traffic in proper scale. Experiment with the wide range of available pens.



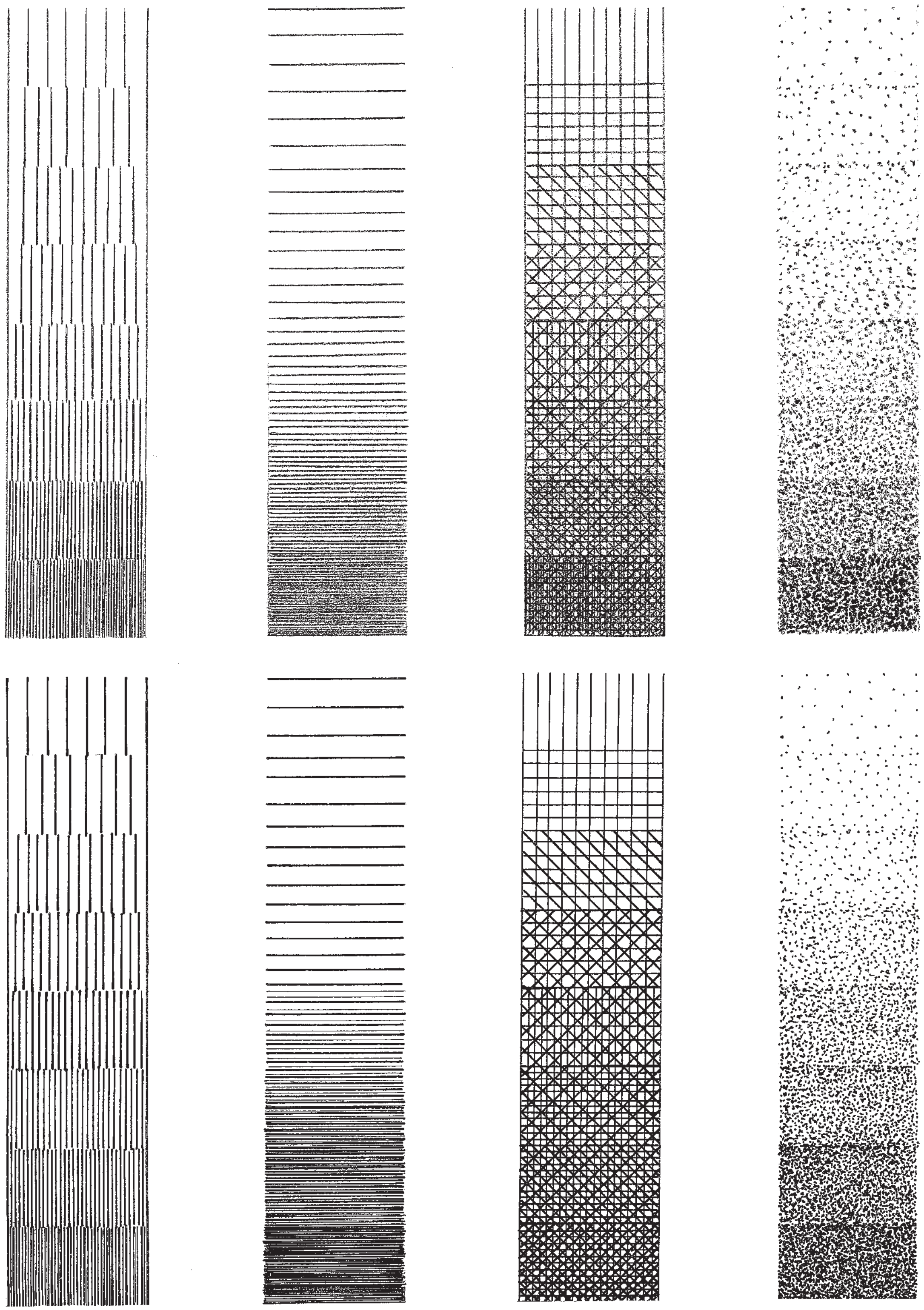


Sketch: Street scene, Kyoto, Japan
13" × 15" (33 × 38.1 cm)
Medium: Felt-tipped pen on good-quality white pad paper
Courtesy of Robert L. Hamilton, AIA, Professor
Department of Architecture, City College of San Francisco

VALUE SCALES USING VALUE-GRADING TECHNIQUES

2H, H, HB, and 4B pencils (left to right)

Ink pen on all four scales



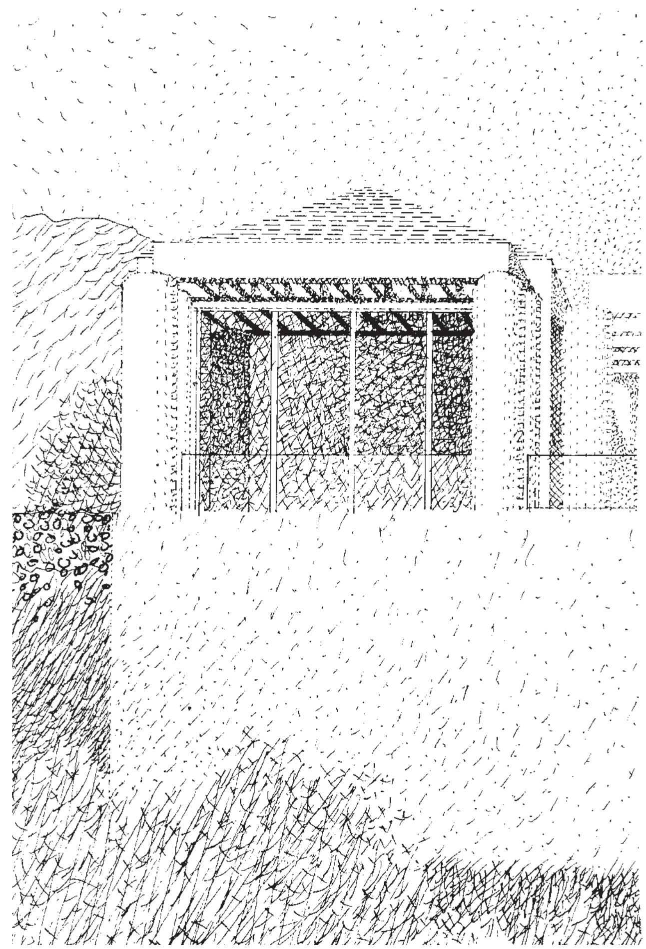
vertical lines | horizontal lines | cross-hatching | dots

The use of dots is also termed "stippling."

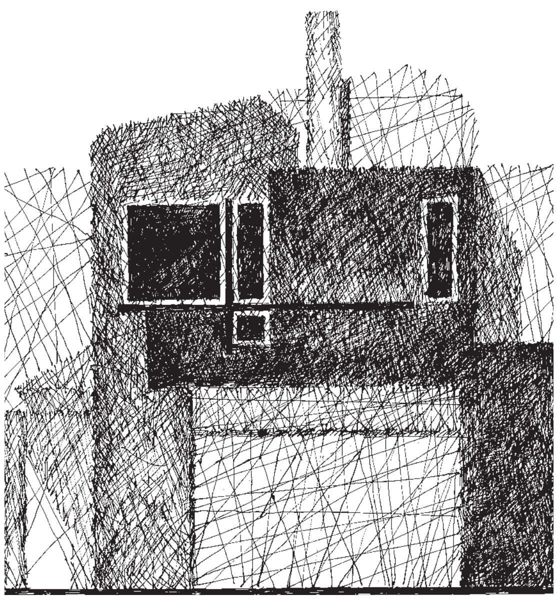
Contrast (playing different shades of dark values against various degrees of light values) in architectural drawings is achieved by *rendering*: the application of artistic delineation to site plans, elevations, paralines, perspectives, and other architectural drawings. The objective of rendering drawings is either to enhance client understanding of the proposed design or for publicity and promotion. The above scales show four methods for rendering value using pencil or ink pen. Other value-producing media are ink wash, watercolor wash, markers, and dry-transfer Zipatone.

Stippling is used to build up shade and value. Its objective—to model form—is the same as that of the linear technique of cross-hatching. By varying the size and spacing of dots, tone values and model form can be created. This dot technique is called "pointillism" and originated with French painters—such as Georges Seurat—who experimented with light and vision in their work. Although quite time-consuming, this method provides excellent control over gradations and produces a copylike quality. Note the stippling for the sky area in the villa rendering.

Hatching is the use of approximately parallel (short or long) lines in a tonal arrangement in order to portray surface or form. It can describe light, space, and material as an abstraction of reality and glass. Adding layers of hatching increases tone density. This is especially effective for nuances in shadow tones.



Rendering: Filothei Villa, Greece
24" × 36" (61 × 91.4 cm), Scale: ⅛" = 1'0"
Courtesy of Hugh Newell Jacobsen, FAIA, Architect, and
Stephen S. Evanusa, Architect



Drawing: Van Kirk House, San Francisco, California, 1991
7.5" × 7.5" (19.1 × 19.1 cm), Scale: ¼" = 1'0"
Medium: Pen and ink
Courtesy of James Shay, FAIA, Architect

This style of rendering communicates visual tonal values very effectively. The high contrast achieved creates a lot of visual "snap."
[Architect's statement]

Scribbling is used to produce a tonal value by applying randomly directed lines that appear haphazard in their arrangement (see foreground, above). Pen and ink is an excellent medium for producing a variety of stroke patterns. These illustrations show the use of straight and curved lines, cross-hatched lines, and dots yielding excellent tonal values. Regardless of the technique, the density of tone produces the needed contrast. Different stroke techniques are often used in combination to depict shape clusters. The number of techniques employed depends on how much detail and precision is desired. Spontaneous loose, imprecise strokes are more suggestive and symbolic. Fine-point felt-tip pens and fountain pens are best suited for hatching and scribbling, whereas pens with a more flexible point are best suited for stippling.

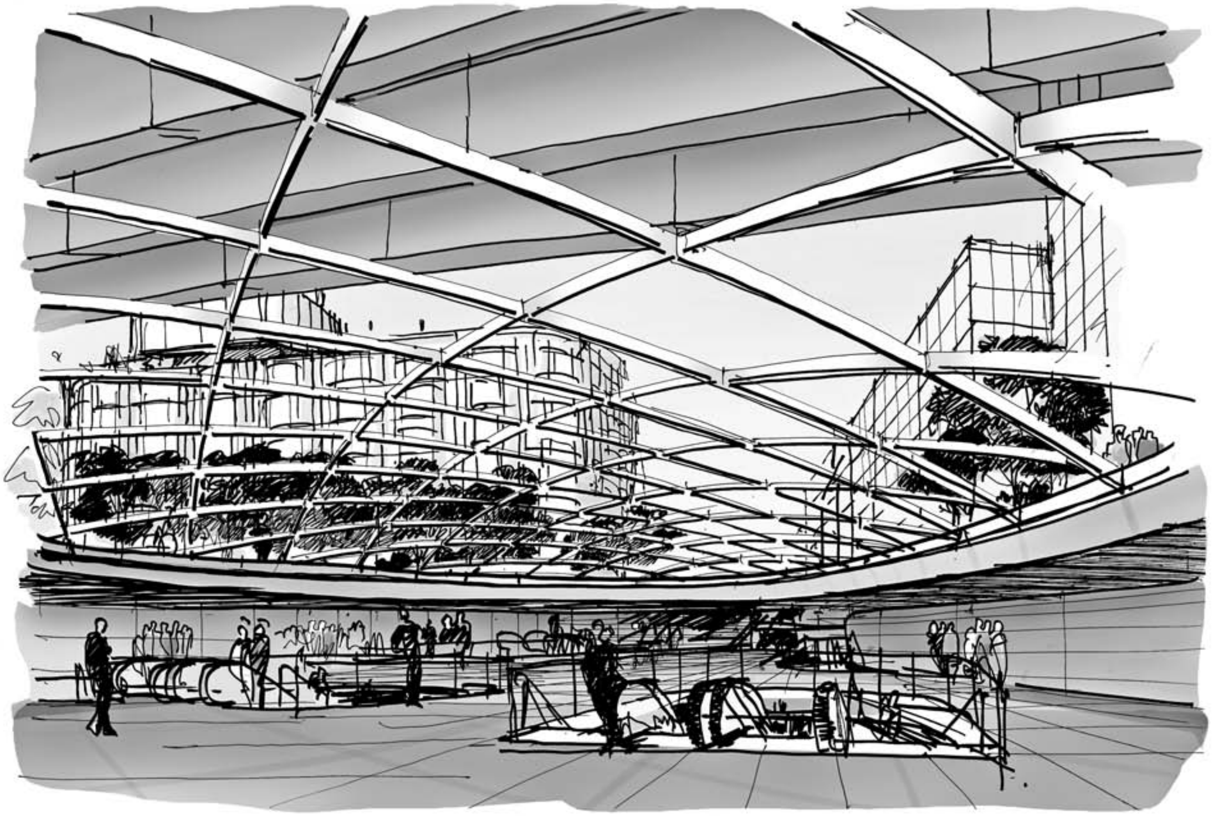
In architectural observation sketching, which activates the hand-eye-brain connection, the first goal is to record exactly what you see. You are sketching for yourself, to understand and analyze what you observed, as well as for your classmates or colleagues, to communicate your observations to them. Be selective in your viewing vantage point, and focus on the architectural features or details that interest you. Describe those elements using what you feel to be an appropriate medium. The sketches on this page consider particular aspects of specific buildings, whereas the sketch on the facing page examines the view from the interior to the exterior.

Drawing (partial): Waterfront Development Plan
Asbury Park, New Jersey
Medium: Ink
Courtesy of Koetter, Kim & Associates, Inc.,
Architects and Urban Designers

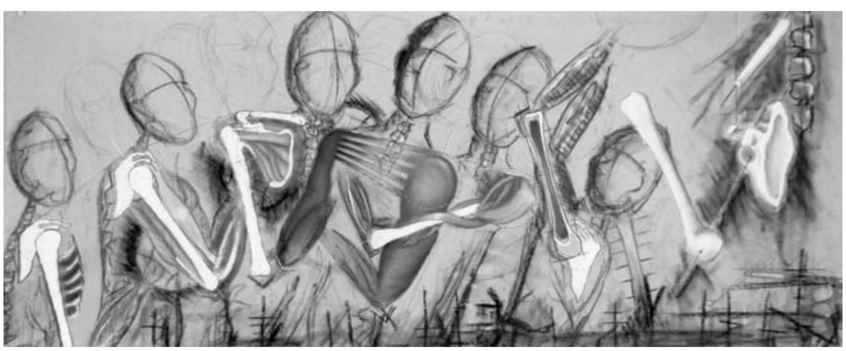
Representational sketching utilizes many basic elements, including line, value, texture, the massing of shapes and volumes, scale, and—sometimes—color. A noncolored pencil or an ink pen will result in a monochromatic sketch. In any medium, you consciously manipulate one or more of these elements. Sketches should exhibit a creative richness regardless of the technique and medium used. Your final composition in representational sketching should go far beyond accurately imitating what you see.

***Drawing** is the essence of description. **Drawing** connects the eye and the hand to define the world, both seen and unseen.*
[ARCHITECT'S STATEMENT—HUGH HARDY]

Sketches: Manhattan, function and form
9" × 10" (22.9 × 25.4 cm)
Medium: Pen and ink
Courtesy of Hugh Hardy, FAIA, Hardy Holzman Pfeiffer Associates



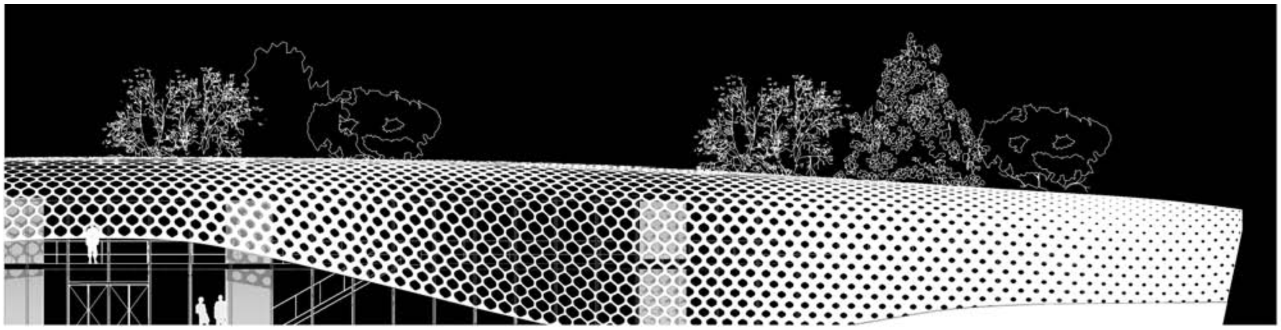
Competition sketch: Rotterdam Central Station
Cambridge, Massachusetts
Medium: Ink on paper and Photoshop
Courtesy of Rafael Vinoly Architects, P.C.



Drawing: Mixed Media Project
Understanding the Medium of Drawing
Medium: graphite, pastel, and charcoal
Student project by Erik Larsen
Course: Design Communication Foundations
Courtesy of Professor Meg Jackson
Texas A & M University

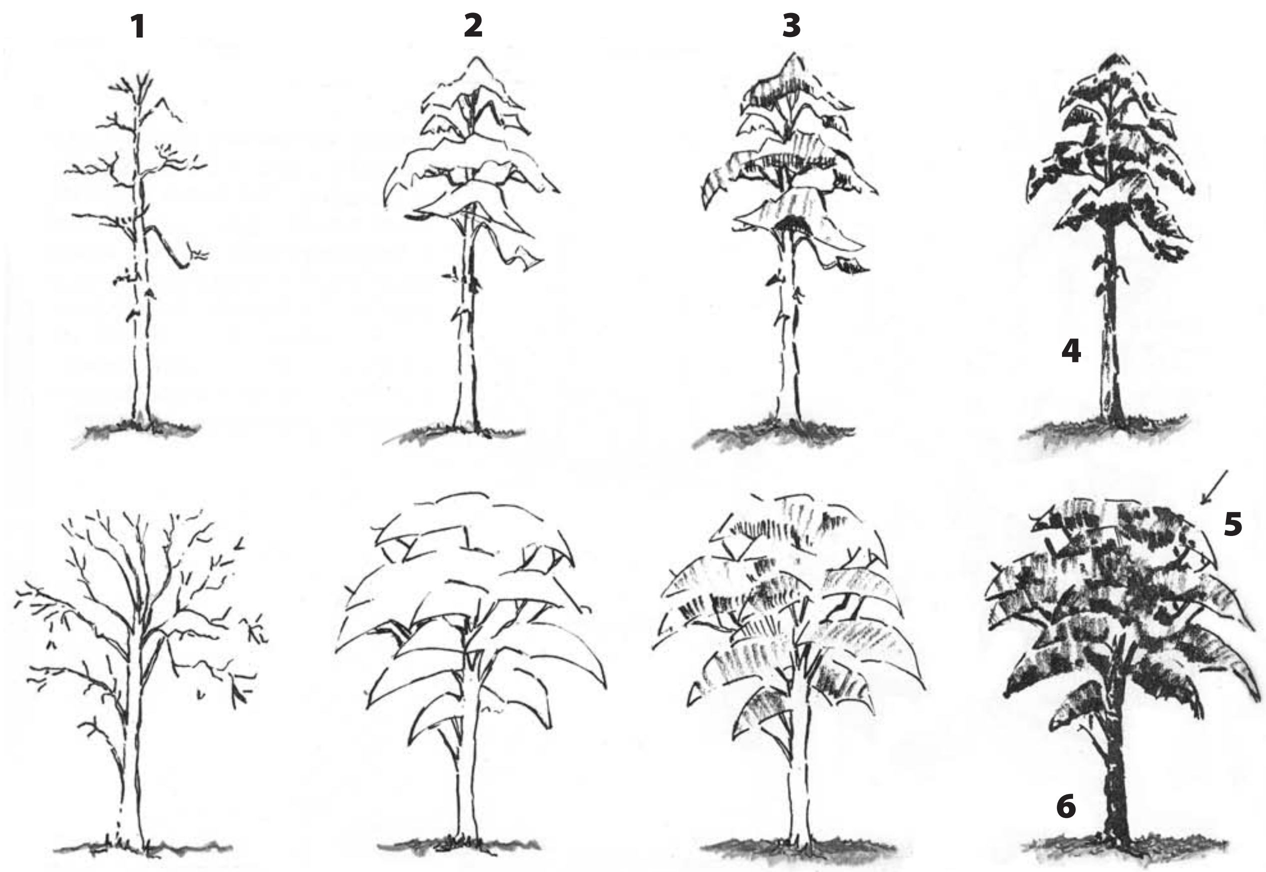
The purpose of this project is media exploration. It is intended to examine a variety of media and methods by exercising their potentials as generative tools for design thinking. The focus is the development of graphic communication, critical drawing skills, and the investigation of mixed media. [PROFESSOR'S STATEMENT]

An artist's choice of medium affects a sketch's character the way an author's choice of words affects the way characters are portrayed in his or her book. Before selecting a medium, try to establish the character or feeling of the sketch by deciding which words would best describe your subject or your design. Will the word or feeling be formal or informal, soft or slick? Graphite, ink, and watercolor are just a few of the possible media for architectural sketches. For color, there are many choices in addition to watercolor, such as colored pencils, colored markers, and oil pastels. Work with the medium (dry or wet) with which you feel most at ease. Be alert to others that evolve, such as digital media that interface with manual methods (mixed media). Mixing media can be an inventive challenge.

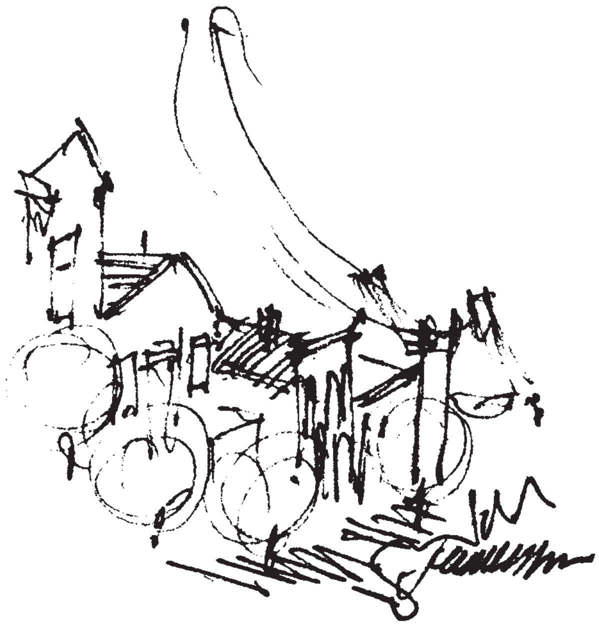


Drawing: Materials Chemistry Development Center
Mourenx, France
Medium: 3D graphic software
Courtesy of Serero Architects

A large massing of trees can be loosely rendered and the foliage made highly suggestive. Groups of trees often create a wall-like effect. Study the foliage's transparency and density. Landscaping vegetation, such as trees, plants, and shrubs, whether hand sketched (below) or digitally drawn (above), should always be complementary and secondary to the architecture to which they are adjacent.

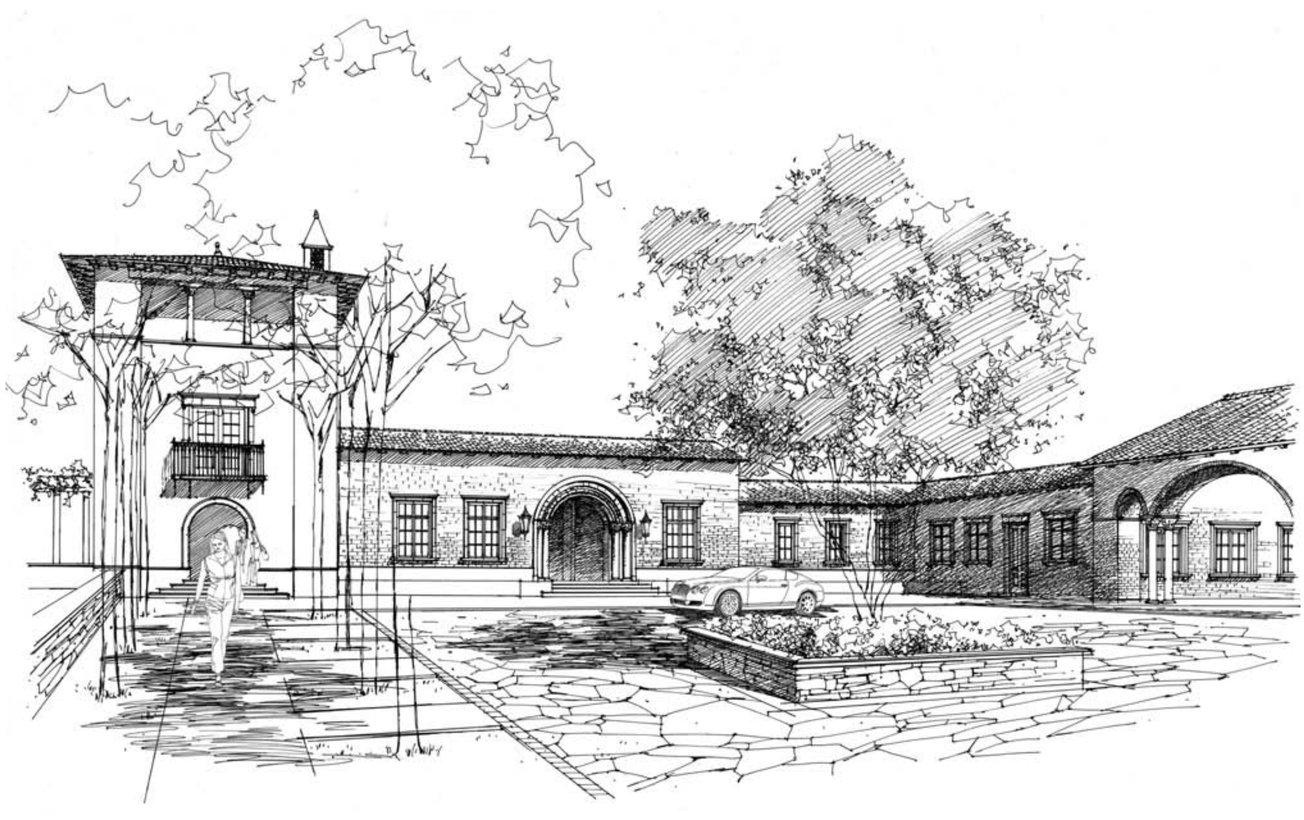


Each tree, with its initial skeletal form, has a character of its own. When sketching or composing trees, one should be aware of (**1**) the direction and pattern of growth on the branches, which is a clue to the tree's form; (**2**) the overall silhouette or shape (tall or short, bulky or thin), which is affected by gravity and wind; (**3**) the massing and pattern of the foliage; (**4**) the texture of the bark; (**5**) how the light hits and penetrates various canopy shapes, producing shades and shadows; (**6**) and the manner in which the trunk flares or tapers off. For pencil work, use 2B and HB for dark values and 2H and 4H for contour lines and light values.

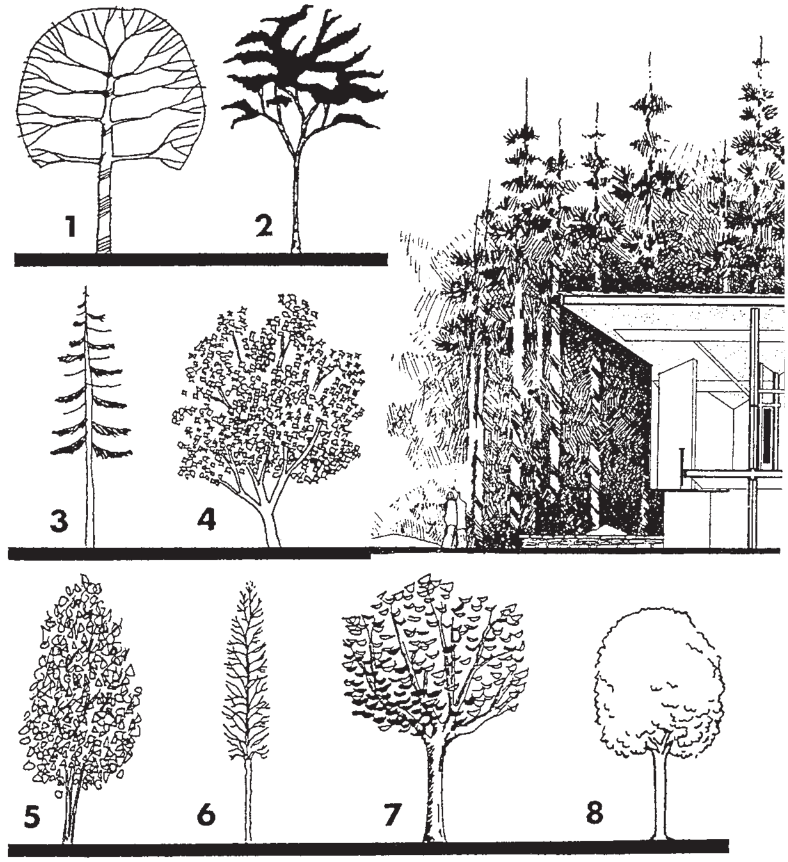


Sketch: Hillside residences, San Francisco, California
Sketch by Charles Moore, Architect
Courtesy of Saul Weingarten, Executor, Estate of Charles Moore, and the Department of Architecture, UCLA School of Art and Architecture

When you are doing rapid sketch studies at a site, you may not have enough time to draw all the tree details (branches, leaves, etc.). In such situations, your objective should be to create a representational feeling of the essence of a tree or other landscape vegetation. Freehand trees can be simple and abstract. These quick sketches suggestive of trees are very effective. Sometimes it is what we leave out rather than what we put in a sketch that makes it highly expressive.



Conceptual sketch: Wuhan Development
Client: Robert Hidey Architects
Medium: Pencil
Courtesy of Wenjie Studio



Drawing: The Moir Building
San Jose, California
36" × 42" (91.4 × 106.7 cm)
Medium: Pentel on vellum
Courtesy of Jerome King, AIA
Renderer: Barney Davidge Associates

Drawing: Rendered trees, Davenport house,
Evergreen, Colorado
18" × 24" (45.7 × 61 cm), Scale: ¼" = 1'0"
Medium: Ink on vellum
Courtesy of Fay Jones + Maurice Jennings, Architects

Rendered trees can show branching (**3** and **6**), branching with outline (**1**), partial texture with outline (**8**), full texture (**2**, **4**, and **5**), or full texture with shade (**7**). Texture with shade is based on directional sunlight. Trees form a parachute shape as they react to gravity.

Drawing: Foliage texture for foreground trees
Medium: Ink on vellum
Herbert Cuevas, AIA, Architect
Courtesy of Brigette Nalley

Symbolic trees can be abstract or representational. They should always complement rather than compete with or overpower the human-built environment they are surrounding. Trees can be made darker (top right) or lighter than the building they are behind to give more contrast. Tracing existing high-quality examples will build your graphic vocabulary of these symbols.

Drawing: Meudon-LaForet Cultural Center
Meudon-LaForet, France
Medium: 3D graphic software
Courtesy of Serero Architects

Trees and other vegetation, human figures, furniture, moving vehicles, and ground textures are defined as *entourage* (French for "surroundings") in an architectural rendering. These supporting elements should always complement the human-built environment, not compete with it. Accurately hand drawn (below) or digitized (above) entourage also helps give scale to the drawing.

The trees in these two illustrations are quite detailed and realistic in appearance. When delineating abstract or realistic trees in perspective, you can create more visual interest by changing the height of the trees; and you can add more depth to the rendering by casting ground shadows.

© McDonough Associates, Inc.

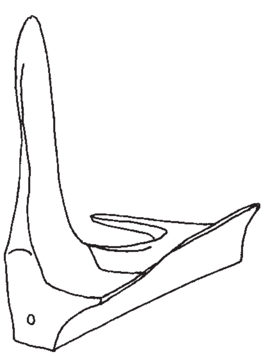
Drawing: Environmental Learning
Center at Camp Sagawau
Camp Sagawau, Illinois
Architect: McDonough Associates, Inc.
Medium: Pen and ink
Courtesy of Manuel Avila, Architectural Illustrator

Drawing: Cairo Expo City
Cairo, Egypt
Medium: Rhino, Maya, and AutoCAD
Courtesy of Zaha Hadid Architects

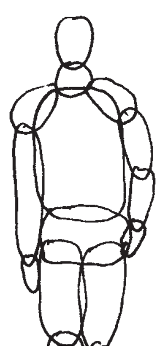
In interior space design, furniture and materiality depiction is the best way to animate a space because these are elements to which users relate. Sofas and chairs are commonly seen in groups of two or more. Become familiar with good furniture design. Outstanding furniture has been designed by many noted architects, including Alvar Aalto, Marcel Breuer, Charles Eames, Frank Gehry, Zaha Hadid, Richard Meier, Eero Saarinen, and Frank Lloyd Wright. As with people and cars, keep a reference photo file.

Drawing: Ivo_03
Client: Phillips de Pury & Co.
Medium: Maxwell Render, VRay, Maya, Rhino, Photoshop
Courtesy of Asymptote: Hani Rashid + Lise Anne Couture

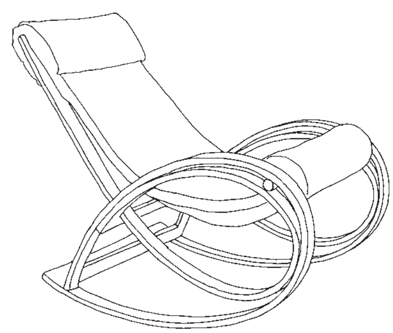
An elegant and unique table that features slumped glass suspended across a contiguous and abstracted surface of diamond-shaped facets. [ARCHITECT'S STATEMENT]



Chair by Zaha Hadid



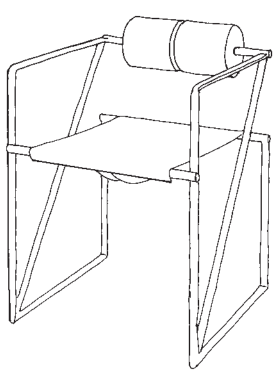
Furniture study by Richard Meier



Chair by Gaetana Aulenti

Drawing: Cairo Expo City
Cairo, Egypt
Medium: Rhino, Maya, and AutoCAD
Courtesy of Zaha Hadid Architects

Furniture accessories, such as lighting elements, chairs, sofas, and tables, should complement the interior architecture and show how interior space is used. The size and scale of an interior space can be indicated when human figures are added with the furniture. Drawing properly scaled people in the interior space will help in drawing properly scaled furniture. It is easier to start by drawing a scaled figure, and then drawing the piece of furniture on which the figure is sitting.

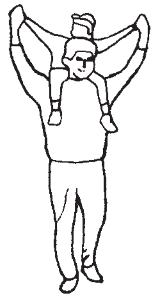


Chair by Mario Botta

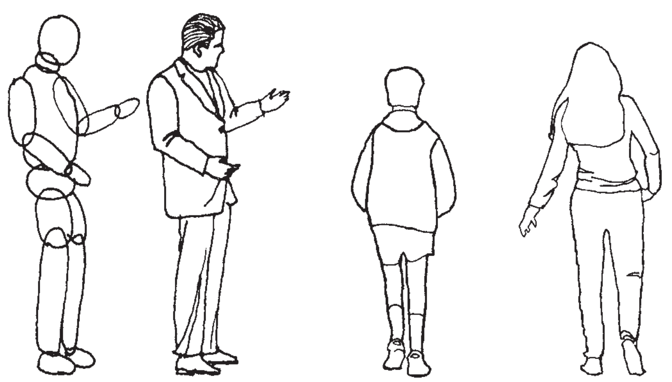
1⁄16"=1'0"

1⁄8"=1'0"

1⁄4"=1'0"



3⁄8"=1'0"



Drawing (partial): Standing figures
Client: Thomas Schoos Design
Medium: Markers on ink
Courtesy of Wenjie Studio

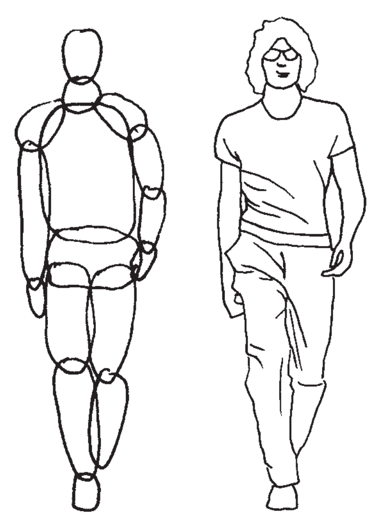
Keep the following in mind when using human figures:

- Figures show the scale of a drawing.
- Figures are secondary to the architecture.
- Figures should not cover space-defining intersections.
- Figures should imply activity yet not be overactive.
- Figures should have simple details for clothes.
- Grouped figures should show overlap.
- Figures should be developed using properly proportioned, contoured bubble forms to depict activity (standing, walking, sitting, etc.).
- Figures should be drawn as an integral part of any rendering (not pasted in, resulting in a cookie-cutter look).

Keep a reference clipping file of photographs and drawings of people in different poses alone as well as in groups. Use a Polaroid camera or a digital camera (with a computer and printer) to freeze figure images for future reference. These photos can be reduced or enlarged to suit the size of your drawing.

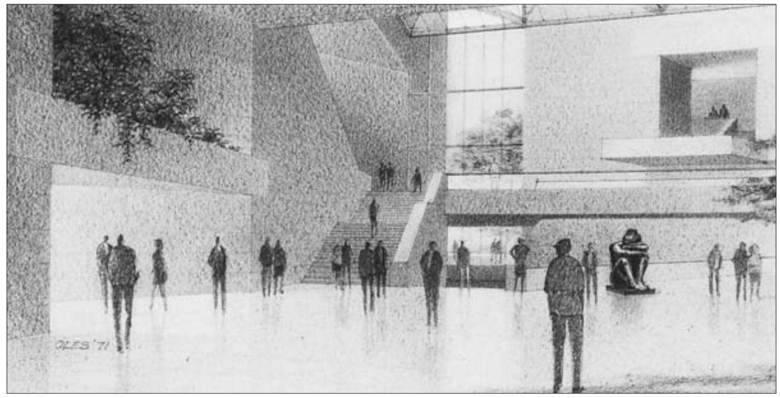
Grouped figures (2nd row left)
Medium: Ink
Courtesy of Martin Liefhebber,
Barton Myers Associates, Architects

Conceptual drawing: Blue Sky
Client: Whitfield Associates, Inc.
Medium: Marker on ink
Courtesy of Wenjie Studio



1⁄2"=1'0"

The people in the drawing at right are abstract, with little or no clothing detail. Abstract figures (either with contour outline or with gray shades) are usually adequate for most drawings. Clothing detail for figures is dependent on the scale, style, and intent of the drawing. As the scale of the human figure increases in size, a simple form without clothing detail is no longer adequate. With clothing detail, keep it minimal to avoid distracting from the architectural subject.



Drawing (partial): East Wing of the National Gallery of Art
Washington, D.C.
Entire original: 21" X 14" (53.3 X 35.6 cm)
Medium: Black Prismacolor on vellum
Pei, Cobb, Freed, and Partners, Architects
Courtesy of Paul Stevenson Oles, FAIA, Renderer

Drawing: Foyer, Music Theater
University of the Arts "Mumut"
Graz, Austria
Medium: Rhino, Maya, Studio Max, and AutoCAD
Courtesy of UNStudio

Drawing: Cairo Expo City Entrance
Cairo, Egypt
Media: Rhino, Maya, and AutoCAD
Courtesy of Zaha Hadid Architects

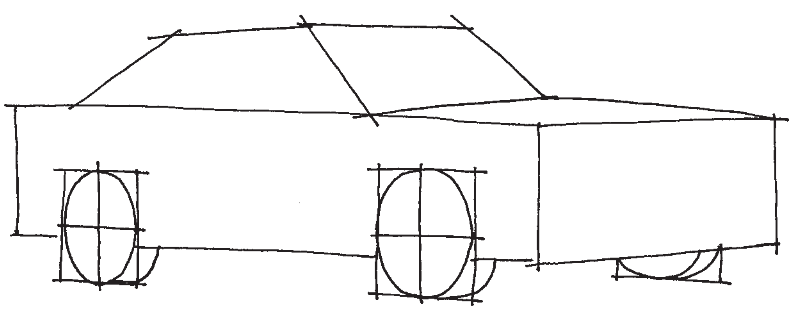
Allow digitally generated people to be transparent so as not to obscure important architectural features.

In the interiors above, almost all of the human heads are on the observer's horizon line—it doesn't matter whether the figure is closer to or farther away from the observer. In such instances, the horizon line tends to be read as the eye level of the observer. If the human figure is taller than the observer, or located above the scene, his or her eyes will be above the horizon line. The same is true for a shorter human figure. Figures on higher elevations such as on escalators and stairs are far above the observer's eye level.

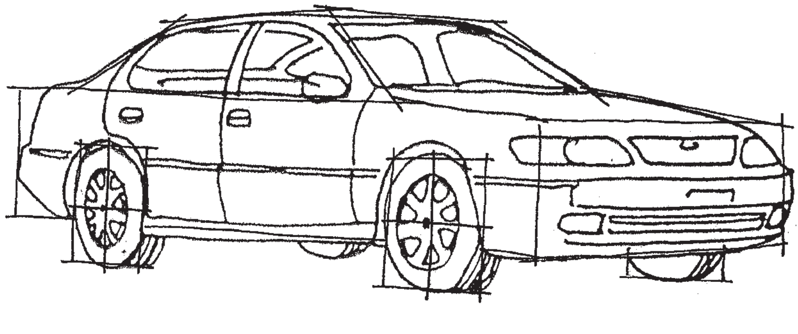
Human figures should be well distributed in a perspective drawing in order to create the proper sense of depth. This distribution should be in three zones: the *foreground,* or the area nearest to the observer; the *middle ground,* or the area that has the observer's attention; and the *background,* or the area farthest from the observer (with smallest figures). When possible, carefully insert figures—whether alone or in a group—into these three distinct areas. The gestures made by figures in a drawing can lend the building a sense of use and occupancy.

Rapid visualization sketch by
Wenjie Chen
Medium: Watercolor
Architects: Ware Malcomb
Courtesy of Wenjie Studio

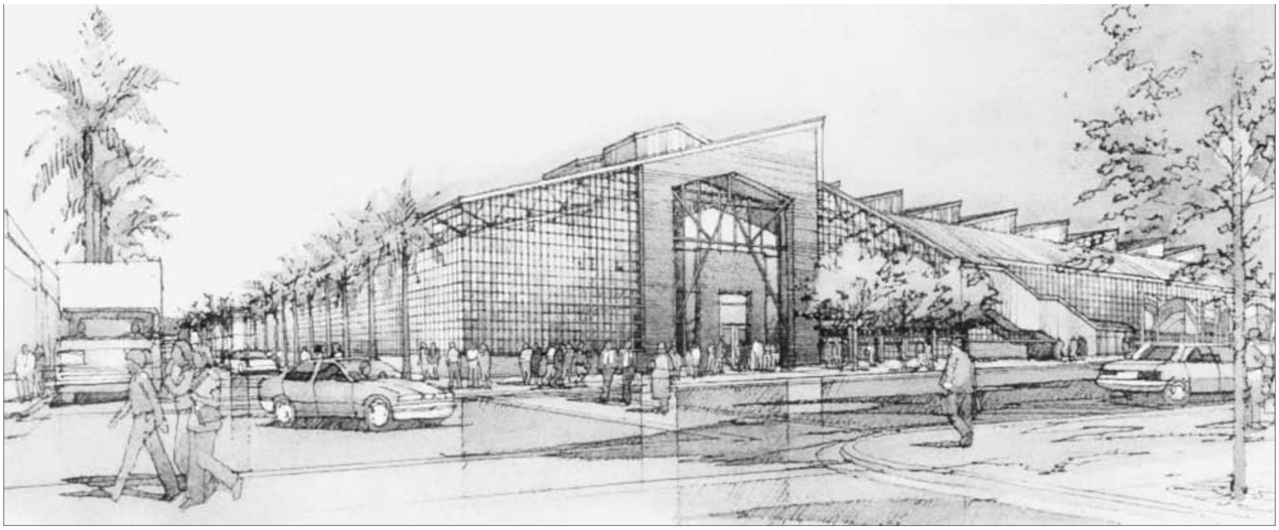
Cars range in length from approximately 14' (4.27 m) to 20' (6.1 m) and in width from 5.8' (1.77 m) to 6.3' (1.92 m). Tires range from 22" (55.9 cm) to 28" (71.12 cm) in diameter.



A car or any type of moving vehicle should be enclosed in an envelope of simple geometric shapes, such as truncated pyramids, rectangular solids, and cylindrical elements. Boats are similar to cars; they can be set up skeletally as a rectilinear box with shaped ends and a specific center line. Graphite is the ideal medium for layout work.



After the basic volume and form are developed with light construction lines, structural details should be sketched with a contour outline technique. To keep it simple, only major details should be added, like headlights and bumpers. The drawing can be finalized with pencil or any other rendering medium.

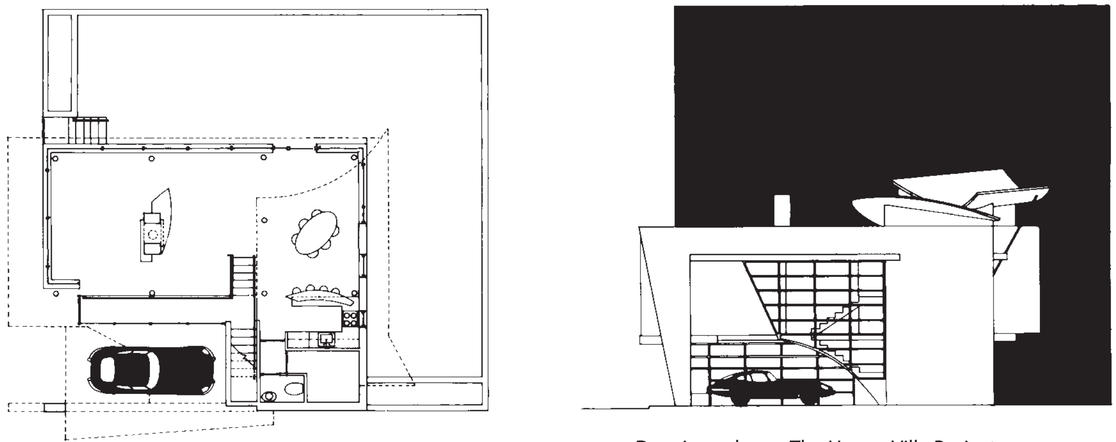


Drawing: Sybase Hollis Street Campus, San Francisco, California
18" × 12" (30.5 × 45.7 cm)
Medium: Sketch watercolor on mounted presentation blackline print of pencil drawing
Robinson Mills & Williams, Architects
Courtesy of Al Forster, Architectural Illustrator

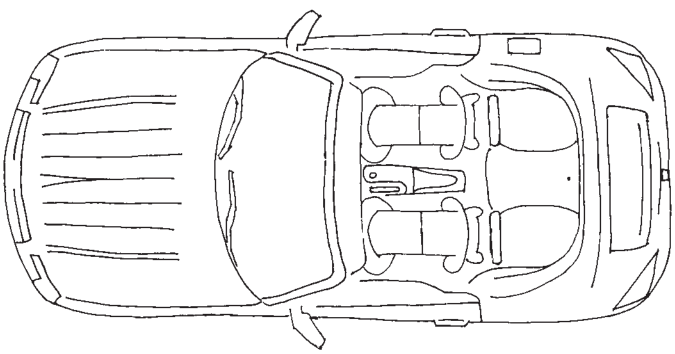
Cars in perspective should always be in scale with the rest of the drawing and secondary to major building elements. Contour outline cars are usually adequate for most architectural drawings. Add details and shaded tones in accordance with the complexity of the rendering. The roofs of cars are slightly below the eye-level line. Add visual interest by showing cars turning as well as moving in both directions.

Drawing: Ponte Vista
Architects: McLarand Vasquez Emsiek & Partners
Medium: Watercolor
Sketch by Wenjie Chen
Courtesy of Wenjie Studio

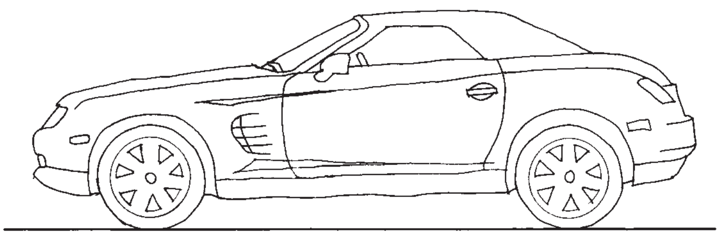
DELINEATING CARS IN PLAN AND IN ELEVATION



Drawings above: The Hague Villa Project
The Hague, The Netherlands
10" × 8" (25.4 × 20.3 cm), Scale: ¼" = 1'0"
Medium: Pen and ink
Courtesy of Hariri & Hariri, Architects

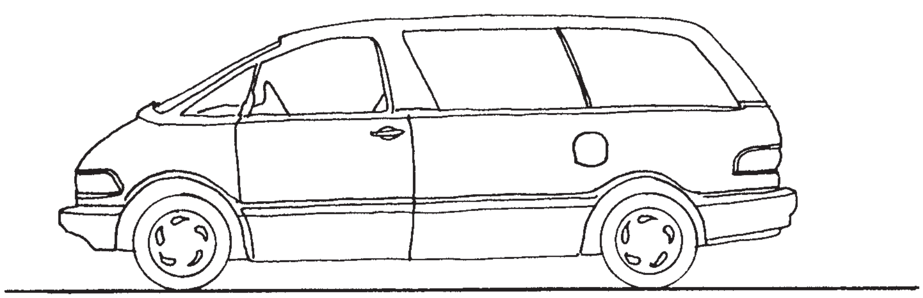


Cars seen in the plan view are good scale indicators when placed on driveways and roadways in site plans. Likewise, cars seen in elevation, as with human figures, are good scale indicators for buildings. They can be symbolic, as shown above, or delineated with more detail.

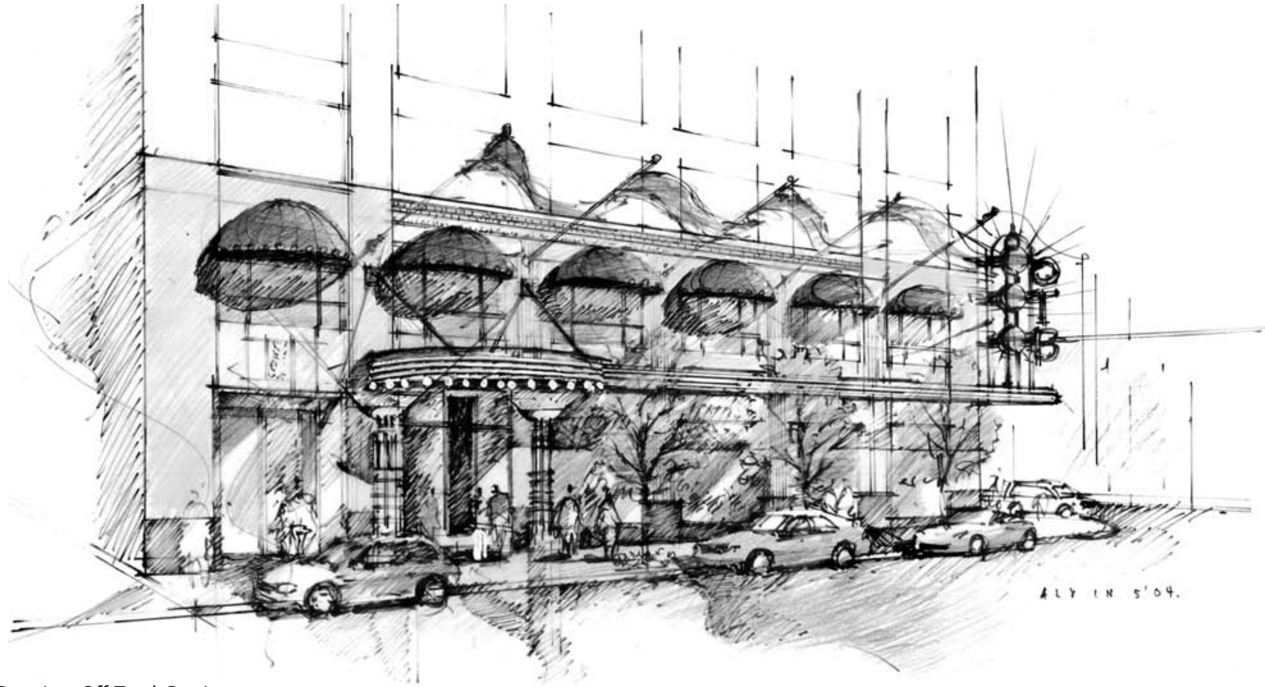


¼" = 1'0"

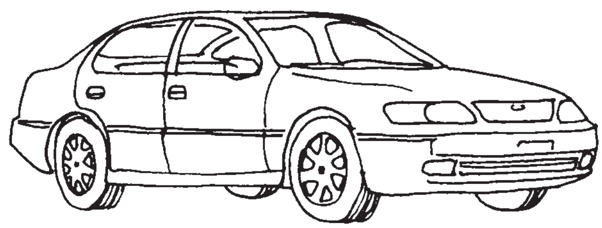
⅛" = 1'0"

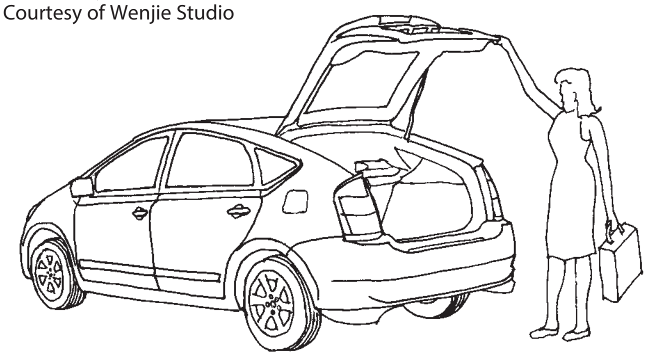


¼" = 1'0"

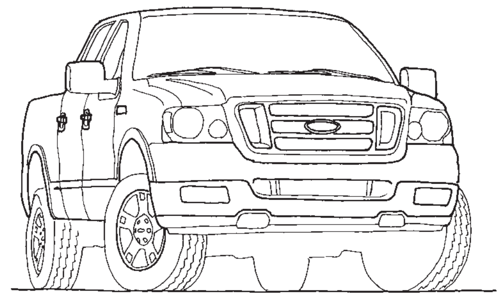


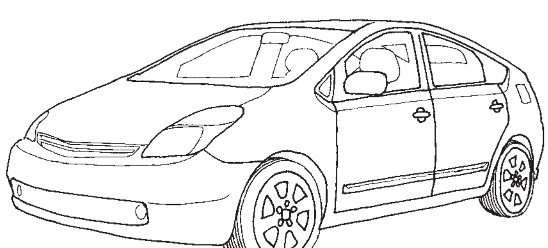
Drawing: Off-Track Betting
Chicago, Illinois
Architects: Ware Malcomb
Medium: Watercolor 11" × 17" (27.9 × 42.2 cm)
Drawing by Wenjie Chen
Courtesy of Wenjie Studio





Car shapes in plan and in elevation are essentially rectangles. Cars in perspective can be simplified into rectangular boxes. Standing human figures are usually drawn in perspective with cars in order to indicate an appropriate scale.



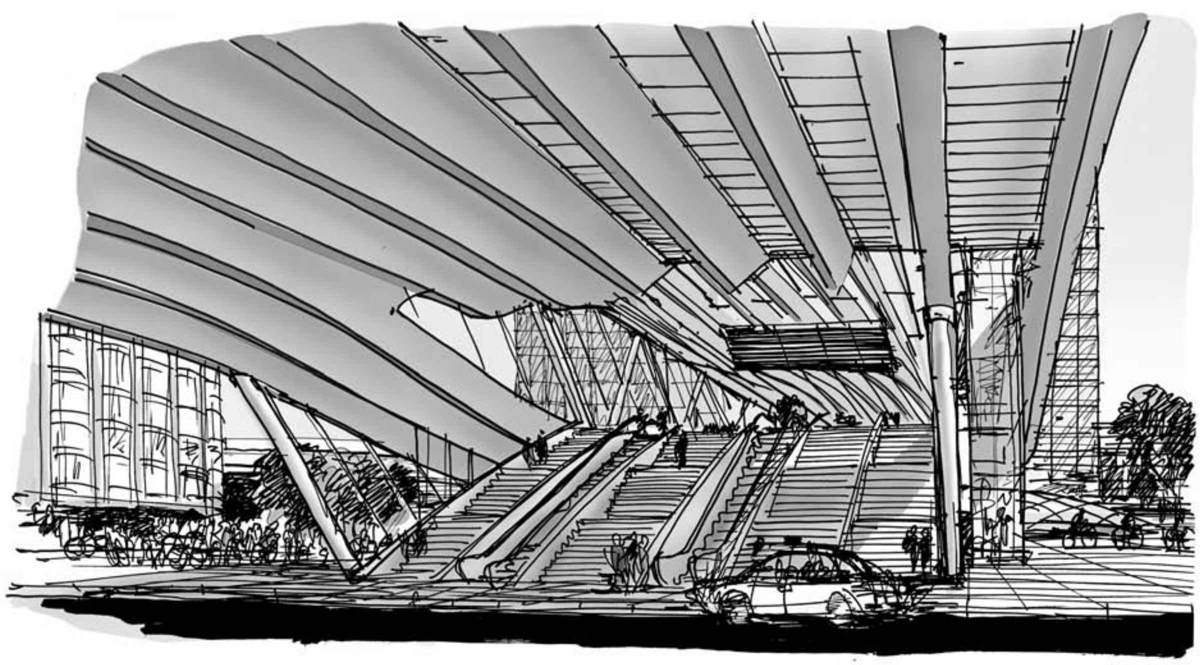


As with people and landscaping entourage, cars should complement the architecture. Keep a reference file of photos and drawings for cars. Periodically update this file with the latest car designs.

Travel sketch: Via Tornabuoni, Frienze, Italy
Medium: Pencil
Courtesy of Professor George S. Loli
University of Louisiana-Lafayette

All objects can be broken down into simple *geometric solids.* For example, trees are basically spheres or cones on cylinders. Buildings are usually a combination of rectangular solids, cylindrical solids, spherical solids, curvilinear elements, and planar elements. In the sketch to the left, the foreground column is defined and created using the background building tone. The column also gives more depth to the perspective view.

Value or tone on buildings refers to the lightness or darkness of a surface. Classic examples of value transitions can be seen in the 1920s and 1930s work of Hugh Ferriss.



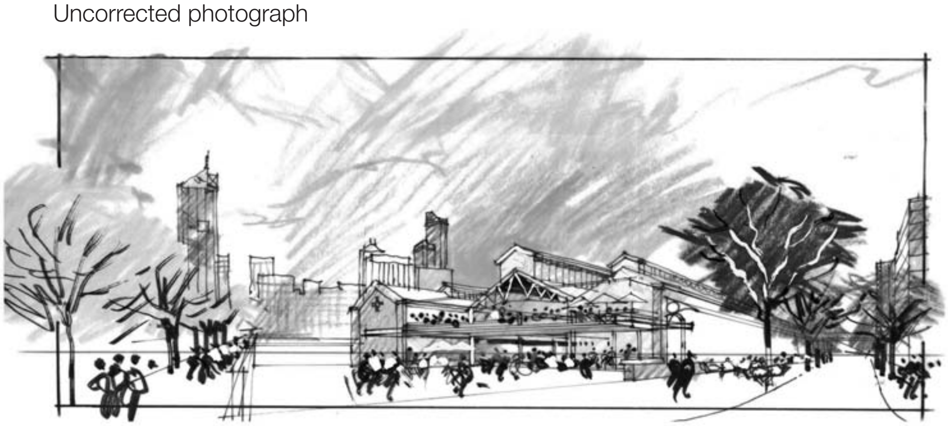
Competition sketch: Rotterdam Central Station
Cambridge, Massachusetts
Media: Ink on paper and Photoshop
Courtesy of Rafael Viñoly Architects, P.C.

Vignette

WORKSHEET No. 89

A study of a drawing technique called "perspective," in conjunction with this chapter, will help you understand why the lines you draw instinctively in your representational sketches appear the way they do. We have seen that sighting skills give you an understanding of proportions in the viewed space. The theories of perspective will accurately verify these proportions. The sketch to the left is another good example of a *vignette.* The continuation of the buildings is left to your imagination.

Existing site
Uncorrected photograph

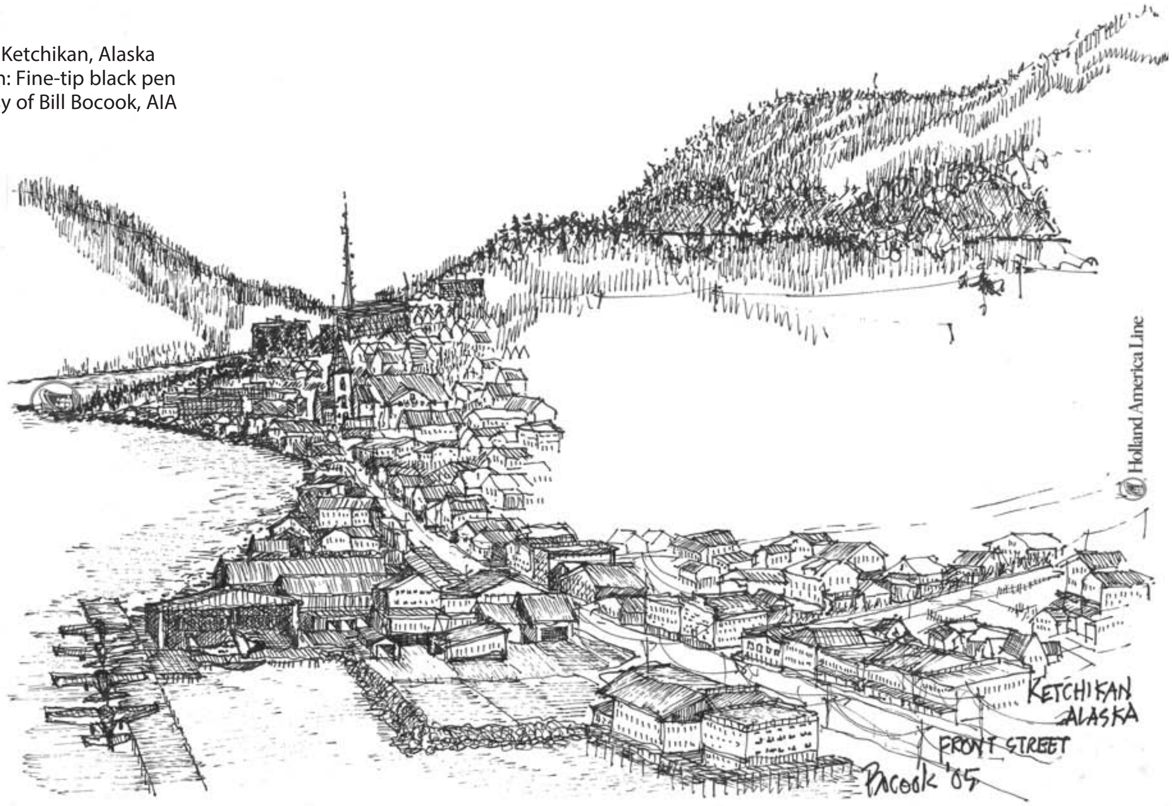


Preliminary sketch
As used during the consultation Process, with client cropping

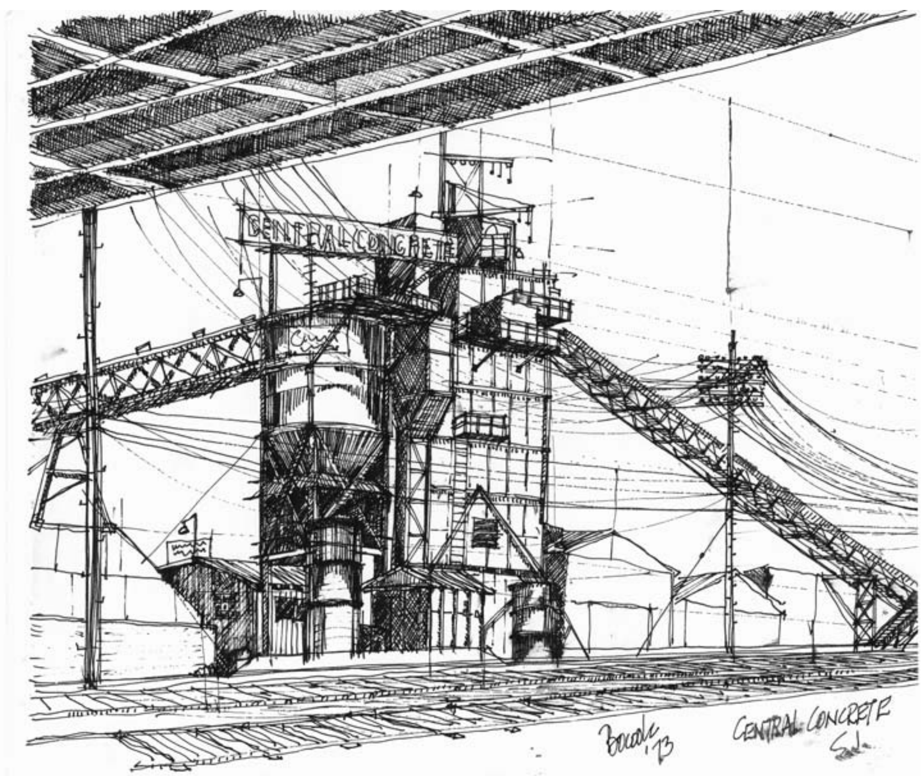
Finished vignette

Images: Docklands2 / Vignette
Medium: Color Pencil
Courtesy of Peter Edgeley, Architectural Illustrator

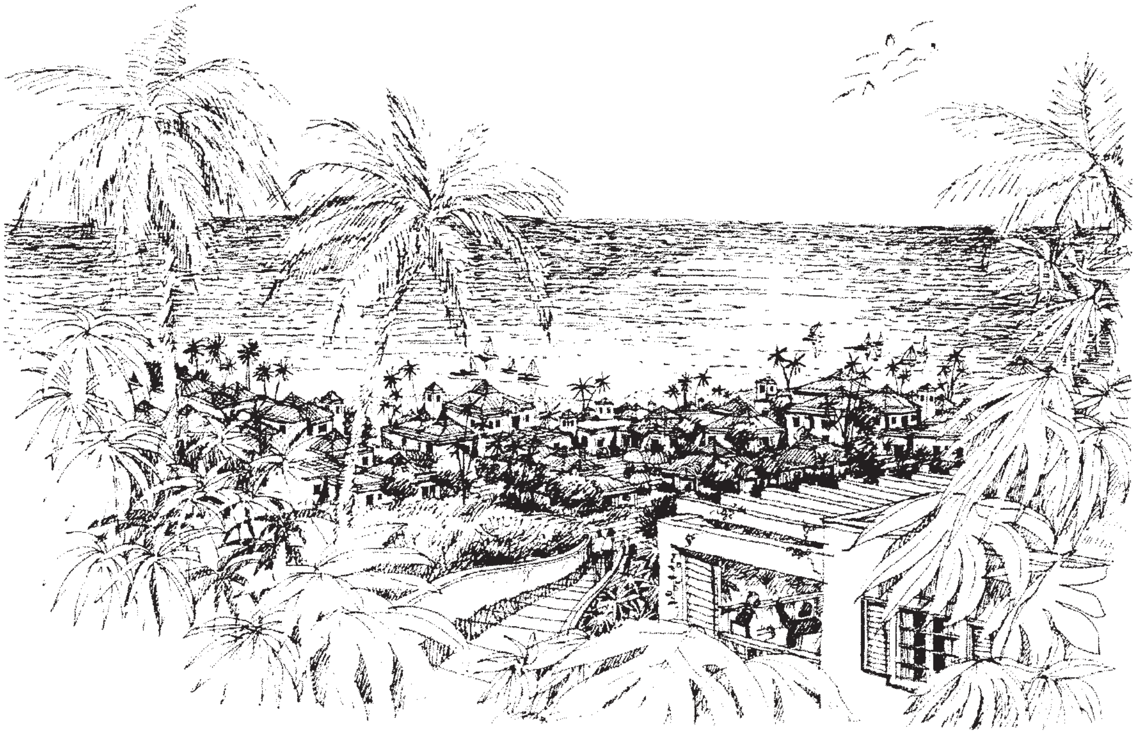
Sketch: Ketchikan, Alaska
Medium: Fine-tip black pen
Courtesy of Bill Bocook, AIA



On-the-spot representational sketching done when traveling gives you a chance to fill your sketchbook with interesting subjects. The landscape is filled with exciting visual surprises—street scenes within a cityscape, mountain roads in a rural village, or panoramic beach views along a waterfront. Your goal may be to capture a sense of place and time at special events. Unusual and interesting views should be sought. Perspective angles can vary from traditional ground eye-level views to bird's-eye and worm's-eye views. Sketchbooks can range in size from 5" × 7" (12.7 × 17.8 cm) to 11" × 14" (27.9 × 35.5 cm). Those with a double-wire binding allow the book to lie flat.



Sketch: Central Concrete, San Jose, California
Medium: Fine-tip black pen
Courtesy of Bill Bocook, AIA



Sketch: Resort Hotel, Mexico
17" × 11" (43.2 × 27.9 cm)
Media: Black Prismacolor and thin Pilot razor-point Pentel
Shading was built up with a single line thickness
Design office: Sandy & Babcock, San Francisco
Courtesy of Lawrence Ko Leong, Architectural Illustrator

Travel sketches can trigger memories of a particular location later on. Form the habit of jotting down notes in your sketchbook or journal about the environment and your experience of the locale. Maybe it's a sound, or a smell, or the weather conditions, or chatter from curious onlookers watching you sketch.

Sketch: Central Park Boat Basin, New York City, 1991
7" × 4" (17.8 × 10.2 cm)
Medium: Pencil
Courtesy of Stephen W. Parker, Architect

2

Diagramming and Conceptual Sketching

Diagrams and conceptual sketches are integral parts of the design-thinking process. They are the means by which the designer generates, organizes, and formalizes options for his or her ideas. These drawings serve to clarify and provide a philosophical anchor to design.

Conceptual diagrams constitute an abstract language that must be understood and used properly within the design community. It is through graphic diagramming that one develops a design strategy and helps convey an understanding of the general design concept. Elements like arrows, nodes, lines, and other symbols help the beginner use graphic techniques to explore ideas.

Conceptual (or design) sketches are quickly drawn syntheses that represent a range of alternative design ideas for an imagined conception. Such visualizations may be crude initial images or somewhat more refined, developed drawings. Although tentative in nature, conceptual sketches are attempts to depict the reality of the design in its idealized and essential state.

This chapter introduces the vocabulary of diagramming and shows a wide range of professional examples of both diagrammatic models and conceptual sketches.

In summary, following are some of the important terms and concepts you will learn:

Graphic diagram	Circulation	Node	Visualization
Thumbnail sketch	Arrowed line	Ideational drawing	Conceptual thinking
Partí diagram	Line	Symbolic language	Site diagram
Programmatic diagram	Formal/spatial diagram	Environmental control diagram	

Diagramming and Conceptual Sketching

TOPIC: DIAGRAMMING

Ching 2009, 230–39.

Clark and Pause 2005.

TOPIC: DESIGN SKETCHING EXAMPLES

Bahamon 2005.

Herbert 1993.

Jeanneret-Gris 1981.

Paulo dos Santos 1994.

Pfeiffer 1996, 7–8, 99, 141.

Portoghesi 2000.

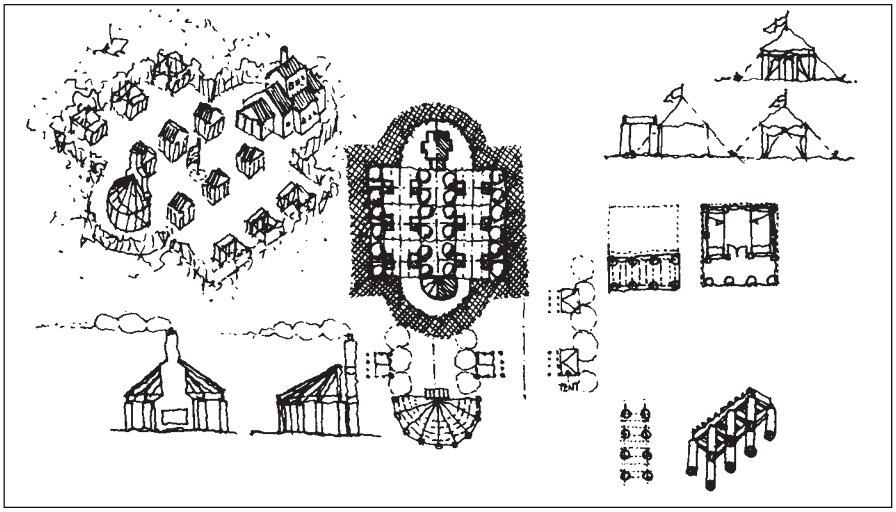
Rappolt and Violette 2004.

Robbins 1997.

Zardini 1996.

Chapter Overview

After studying this chapter, you will have a better understanding of why diagramming and conceptual sketching are important in design communications. For continued study, refer to Laseau 2000.



Preliminary schematic diagrams frequently contain the seeds for the final design and, ultimately, the built project. They can take a two-dimensional or three-dimensional configuration, as shown in the Hoover Center. The diagrams below use a combination of point, line, and two-dimensional zone to explain the design concept.

Diagrams: Hoover Outdoor Education Center, Yorkville, Illinois
Medium: Felt-tipped pen on trace
Courtesy of Tigerman McCurry Architects

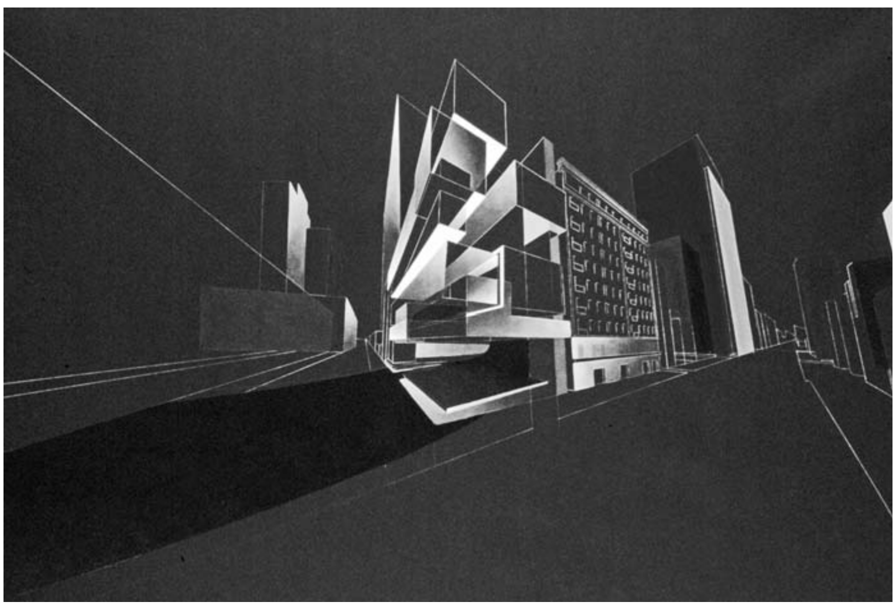
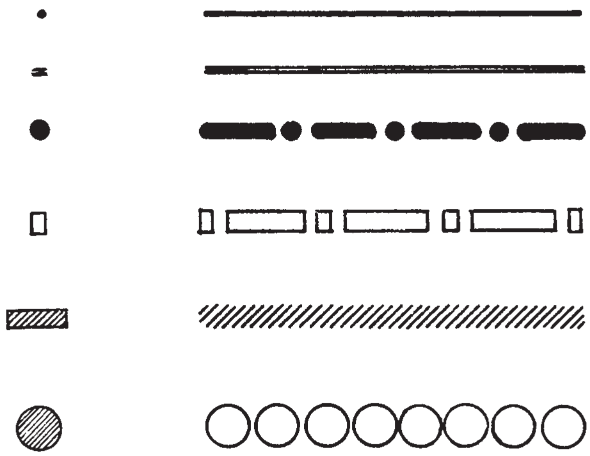


Diagram and conceptual sketch: Rosenthal Center for Contemporary Art
Cincinnati, Ohio
Medium: Acrylic on paper
Photo: © Arcspace Courtesy of Arcspace
Courtesy of Zaha Hadid Architects

Once an architecture student's freehand graphics skills are honed, he or she will begin to appreciate the potential of these skills not only in drawing contextual elements (people, vegetation, cars, etc.) but also in drawing *conceptual diagrams.* Students are immediately confronted with developing sketches on tracing paper (termed yellow trace, flimsy, or bumwad [British]) as part of the design process in a design studio project. Beginning with the first course in architectural design and continuing throughout their academic careers and professional lives, students will face the task of developing numerous alternative ideas or schemes for each design problem. The ability to do quick freehand graphics in the form of scribbles and doodles is essential. These *graphic diagrams* explore alternative solutions and encourage *visualization, visual thinking,* and *transformative understanding.*



point **point becomes line** **line**

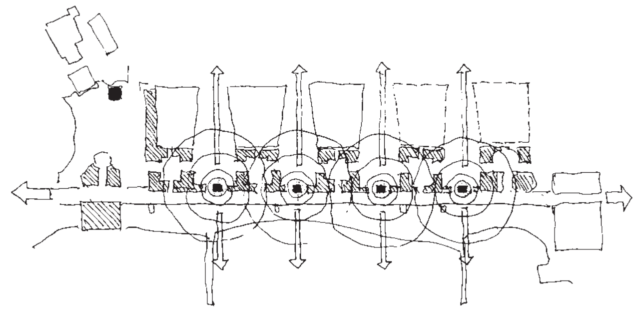
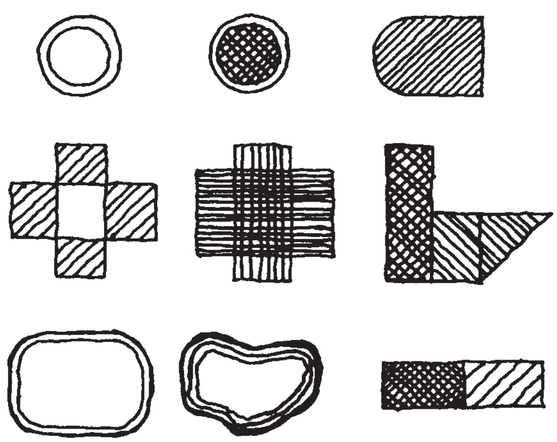


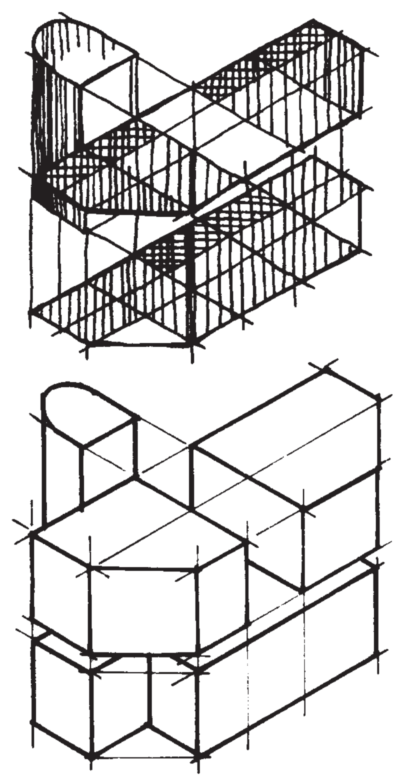
Diagram: Waterfront Development Plan
Asbury Park, New Jersey
6" × 3" (15.2 × 7.6 cm)
Medium: Ink on trace
Courtesy of Koetter, Kim & Associates, Inc.
Architects and Urban Designers

Every drawing type can be used as a conceptual analytical diagram. *Graphic diagrams* can be two-dimensional or three-dimensional in their abstract communication of a design scheme. Through point, line, symbol, and zone diagrams, a building's organization can be represented in terms of user movement (*circulation*), space usage (*zoning*), site plan and site section analysis, structural analysis, and volumetric enclosure (geometric configuration). The use of diagrams early in the design process allows for the creative exploration of an array of alternatives unfettered by rigid programmatic constraints.

Pictorial symbols



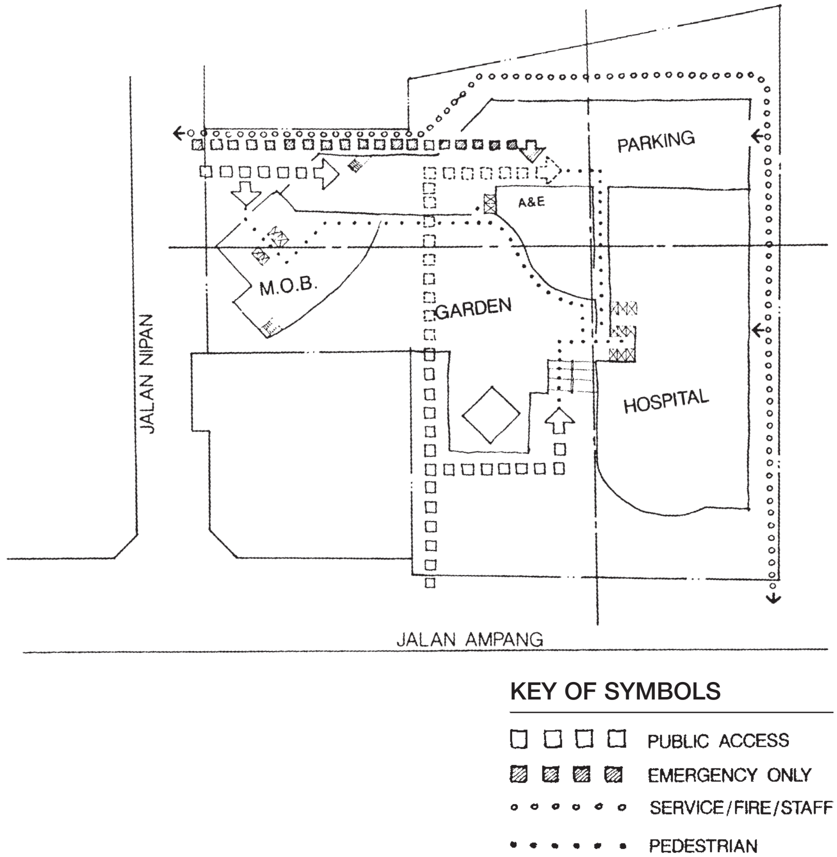
Two-dimensional zone diagrams



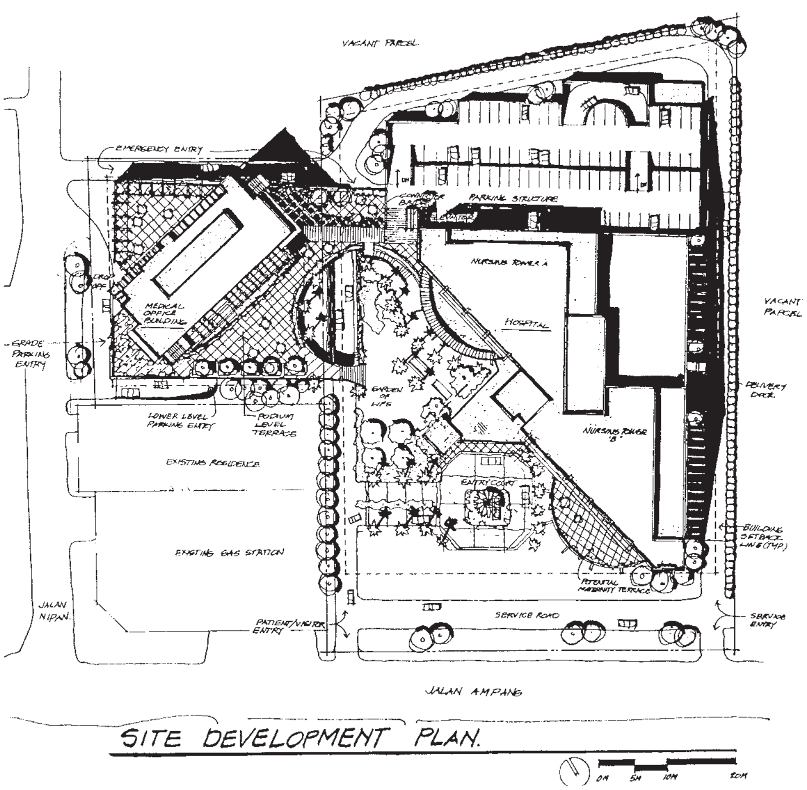
Three-dimensional zone and volume diagrams

Students hear a new vocabulary in the design studio. Terms like "bubble diagram," "schematics," "flow," "circulation," "zoning," "hierarchy," and "metaphor" become commonplace. The many new terms of this studio language, coupled with incessant demands for an abundance of ideas, sometimes overwhelm beginning students. An understanding of the language comes with reading architectural literature.

Diagram: Scheme C
Gleneagles Hospital and Medical
Office Building
Kuala Lumpur, Malaysia
17" × 11" (43.2 × 27.9 cm)
Medium: Ink on bond paper
Courtesy of KMD/PD Architects
Joint venture with the Architectural Network



This is a good example of a circulation analysis in an early schematic stage of the design process. Note that each type of movement has a different symbol. A *symbol* is something that represents something else—in this case, the condition of movement on a site plan. A clear *symbolic language* is essential to communicating graphically important collected data.



Site development plan for scheme C
24" × 36" (61 × 91.4 cm), Scale: 1:300
Medium: Ink on vellum

Photo: Courtesy of KMD © K. L. Ng

Circulation traces the path and flow of user movement two-dimensionally in plan and in section, and three-dimensionally in pictorial diagrams. The movement can be horizontal or vertical. Points where movement begins are called *nodes.* A node is a point of focus for other diagrammatic symbols. On diagrams, nodes—central points or points of concentration—are frequently connected by lines of movement. Nodes can also be the intersection points of lines of movement. The above diagram also shows symbolic lines for the site's property lines and axial arrangement.

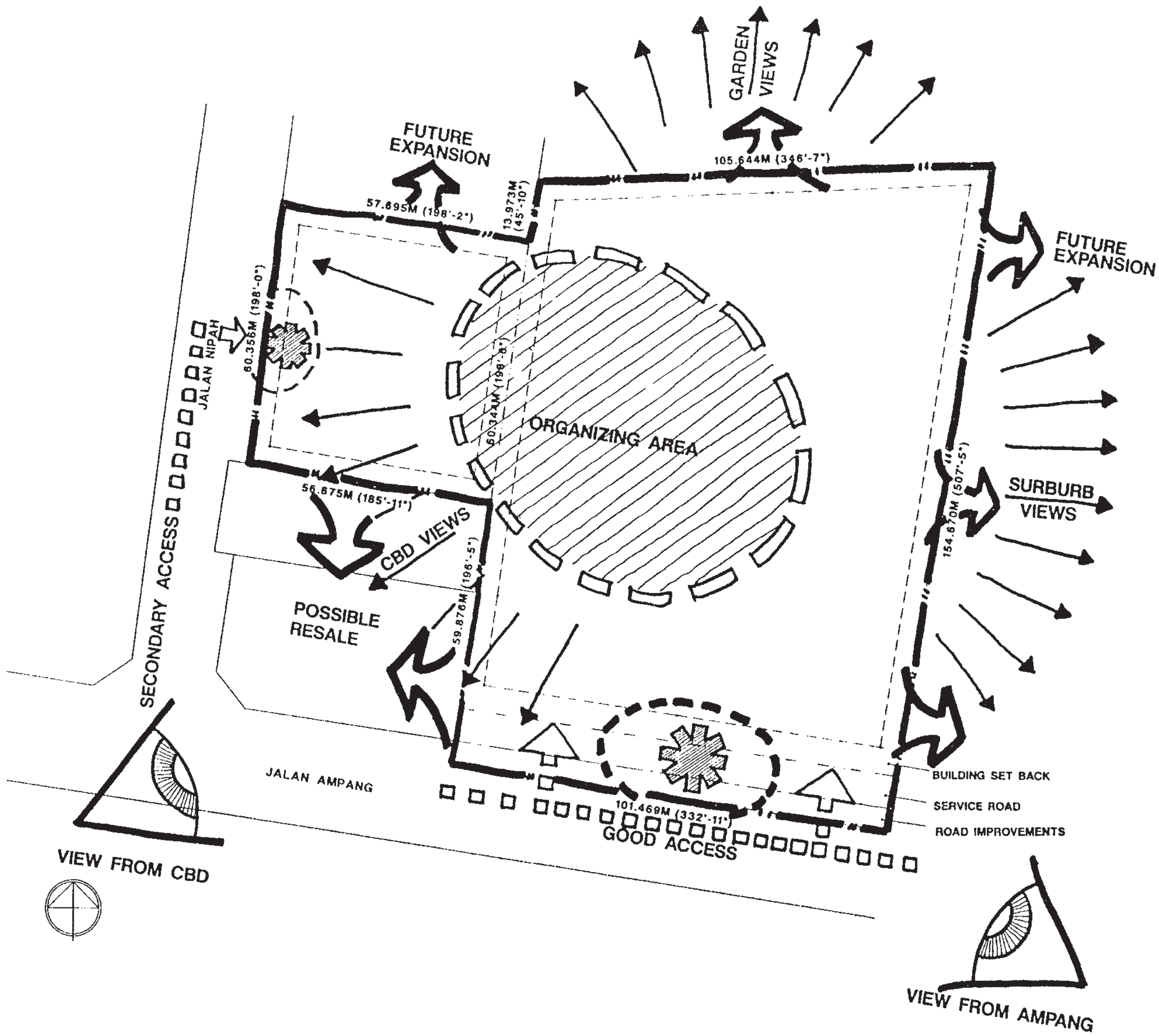
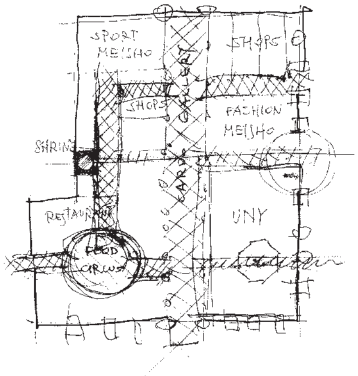


Diagram: Site analysis, Gleneagles Hospital and Medical Office Building, Kuala Lumpur, Malaysia
36" × 24" (91.4 × 61 cm)
Medium: Ink on vellum with Kroy type
Courtesy of KMD/PD Architects
Joint venture with the Architectural Network

Analytical diagrams such as site (see above and pp. 46–47), program, and function (p. 48), and formal/spatial (p. 49) diagrams are generated in the earliest stages of the design process. Diagrammatic study drawings are some of the most important types of drawings for the designer; paradoxically, they are rarely if ever seen by the client. *Diagrams* are abstract: they use symbols to simplify pictorial reality. This abstraction aids in the analysis stage of the design process. Diagrams are a visual means for collecting and sorting information, for testing ideas and exploring alternative solutions—for looking into the very heart of a design problem. They represent that crucial, intimate conversation with oneself, a conversation conducted in a very specific language that has its own vocabulary, grammar, and syntax. They also communicate your ideas to your classmates or professional peers so that their soundness can be tested.

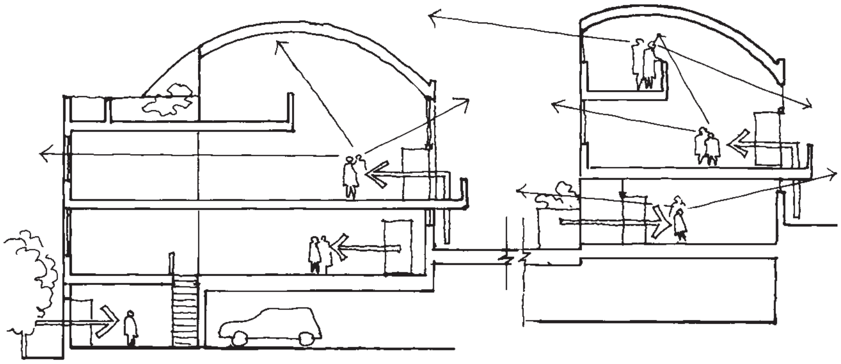


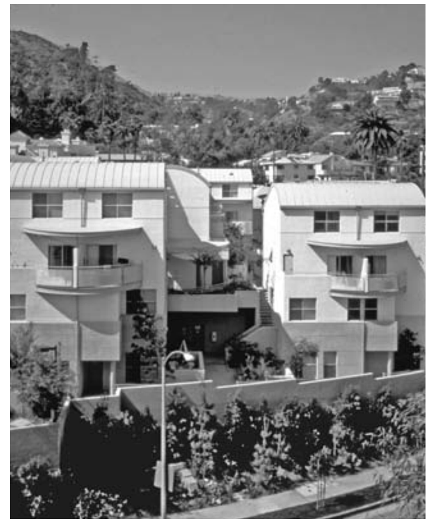
Plan sketch diagram: Shimizu Corporation
Nagoya, Aichi, Japan
Courtesy of Aldo Rossi, SDA, Architect

The drawing at left is a diagrammatic schematic plan sketch showing pedestrian pathways. Note the use of node symbols. The four different schemes sketched below were evaluated with respect to vehicular and pedestrian movement (circulation). Graphic symbols for flow and bubbles are scaleless and are thus ideal for both small- and large-scale projects.

Straight or curved *lines* on diagrams are commonly used as boundaries (see pp. 39 and 46), as axial elements (as seen below), or as organizing elements for conceptual ideas on site, relationship, and circulation diagrams (see p. 43).

Diagrams: Four alternative schemes
Gleneagles Hospital and Medical Office Building, Kuala Lumpur, Malaysia
Each drawing 17" × 11" (43.2 × 27.9 cm), reduced and composed on 36" × 24" (91.4 × 61 cm)
Medium: Ink on bond paper
Courtesy of KMD/PD Architects
Joint Venture with the Architectural Network

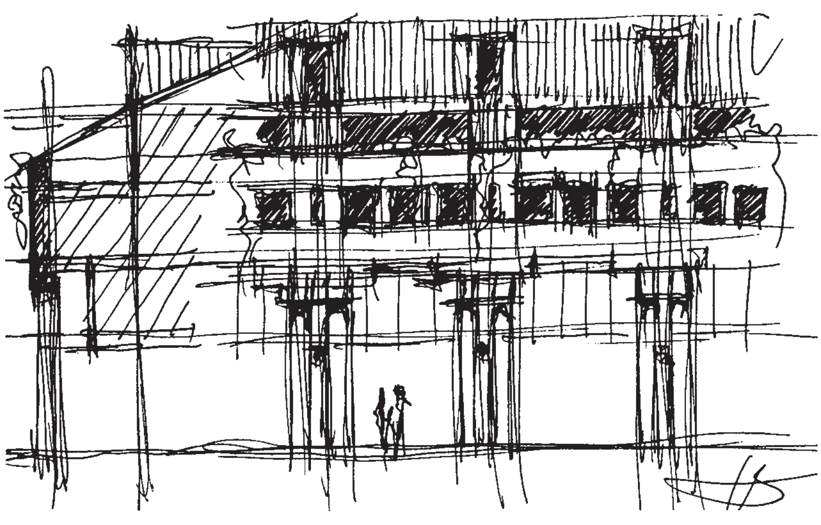




© David Hewitt/Anne Garrison Architectural Photography

Diagram sketch: Franklin/La Brea Family Housing, Los Angeles, California
6" × 6" (15.2 × 15.2 cm), Scale: 1/16" = 1'0"
Medium: Technical pen on Mylar
Courtesy of Adèle Naudé Santos and Associates, Architects

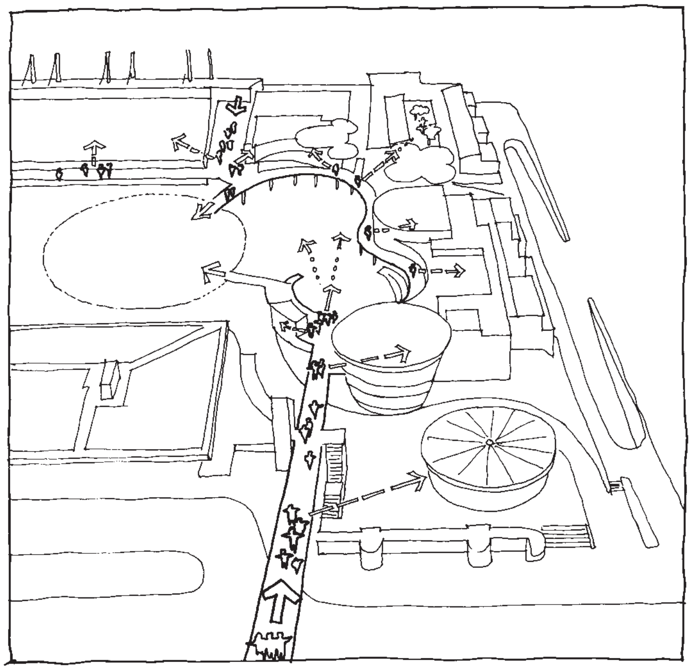
The section diagram clearly shows user view (thin arrowed line) and user movement (thick arrowed line). The *arrowed line* can symbolize the direction of an action or a movement; it can be one-way or two-way.



© Gunnar Birkerts Architect

Diagram sketch: Mixed-Use Center, Turin, Italy
8" × 6.5" (20.3 × 16.5 cm)
Medium: Black marker pen on smooth paper
Courtesy of Gunnar Birkerts and Associates, Inc., Architects

Graphic diagrams should be drawn with loose, fluid line strokes. The looser the line quality, the more evocative the image is to the viewer. Sectional diagrams should include human figures to give scale to the sketches.



Movement diagrams: Yerba Buena Gardens Children Center
San Francisco, California
6" × 6" (15.2 × 15.2 cm)
Medium: Technical pen on vellum
Courtesy of Adèle Naudé Santos and Associates, Architects

These diagrams are part of a series that was used to engage the users of the site and facilities in a public design process. Specifically, the diagrams describe routes through the site and a sequence of visual experiences. They were keyed to vignettes depicting views of the buildings and the activities observed within.
[Architect's statement]

These diagrams make extensive use of a point and an arrow symbol to depict pedestrian movement. Arrowed lines can vary in thickness (see p. 40) and tone intensity depending on what is being depicted (thin arrowed lines for view and thick arrowed lines to depict future expansion).

© Richard Barnes

The bird's-eye view is more descriptive than a site plan in showing user circulation. Three-dimensional diagrams, such as perspectives and plan obliques, are as depictive as two-dimensional diagrams. Sometimes the same diagram can be used to explain different sets of information. These diagrams can be presented individually or as a set using transparent overlays. A composite set should present the information under consideration in a clear hierarchy to avoid information overload.

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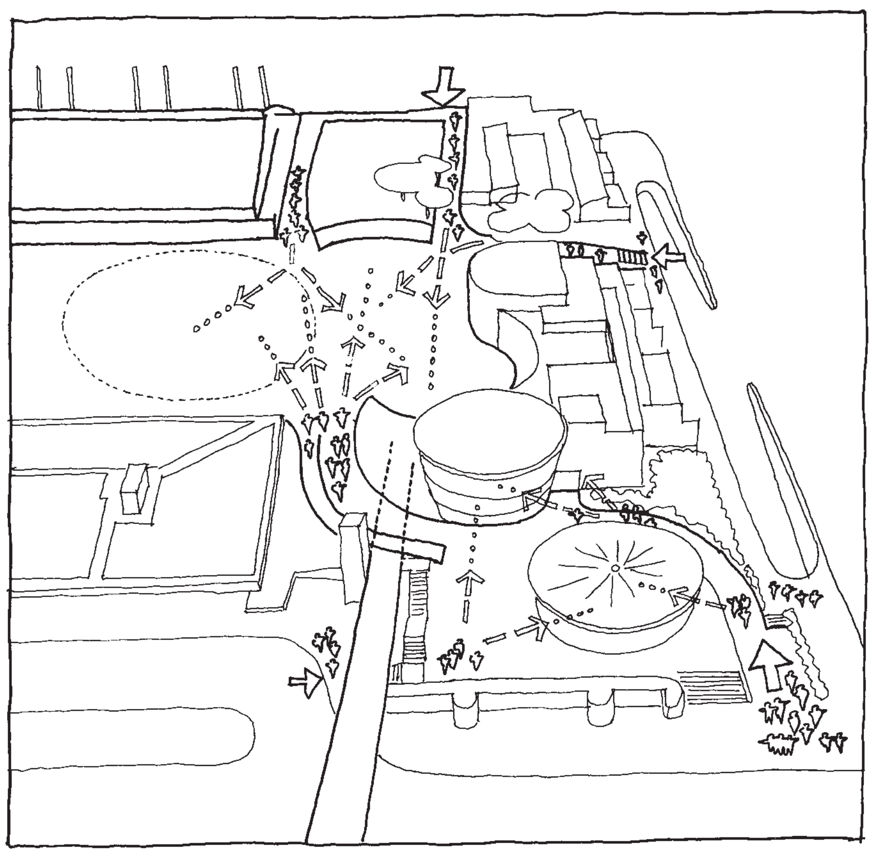
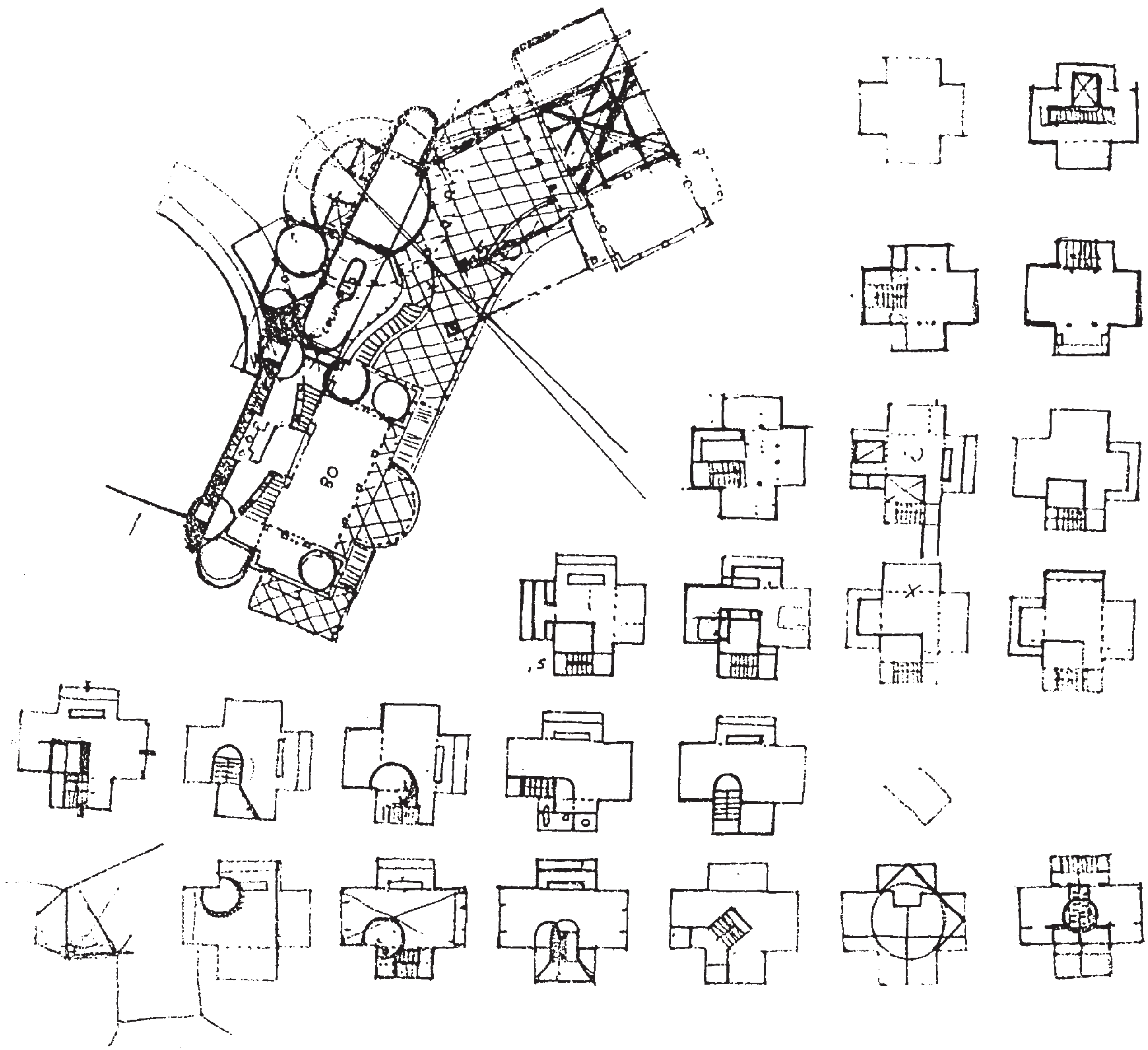


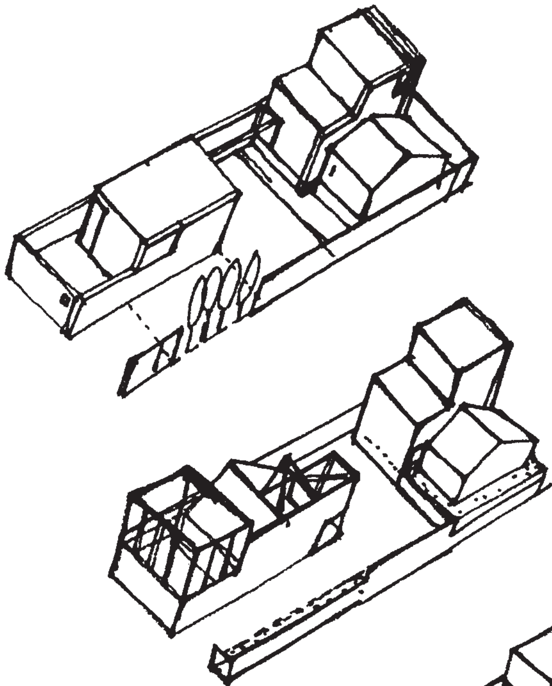
DIAGRAMMING ALTERNATIVES

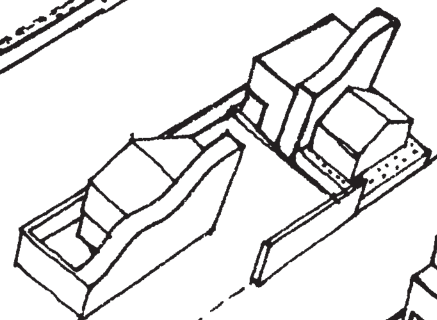


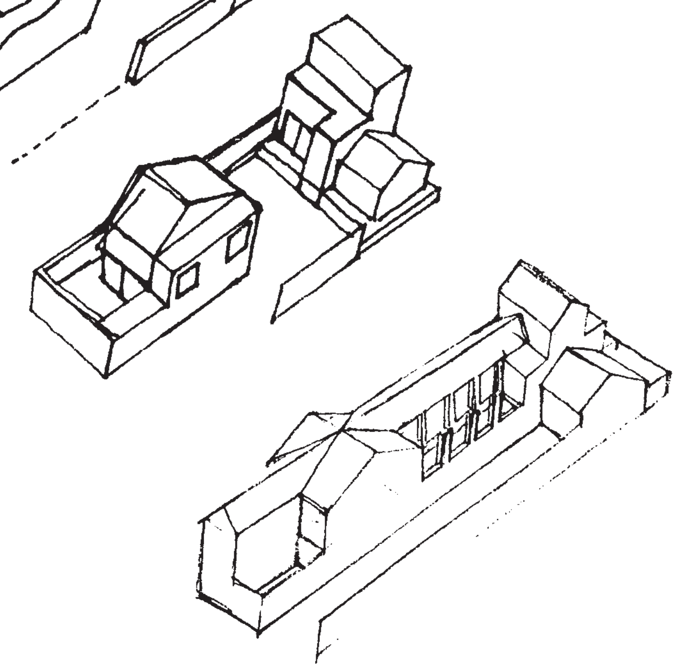
Conceptual diagrams: Villa Linda Flora (unbuilt), Bel Air, California
8½" × 11" (21.6 × 27.9 cm)
Medium: Ink on sketch paper
Courtesy of Hodgetts + Fung Design and Architecture

In any design project, there are numerous alternative solutions to analyze. Seen above is a juxtaposition of diagrams showing potential alternatives. During the design process, *design drawings* (diagrams, design sketches, etc.) are crucial for testing alternative schemes and themes. This project shows the wide range of possible stairway types and locations within the same geometric plan configuration. Diagrams are frequently drawn with a consistent graphic format, as shown above. This allows you to analyze a particular problem or focus on one specific issue (in this case, stairway location) by comparing one alternative with another.

© Tom Bonner

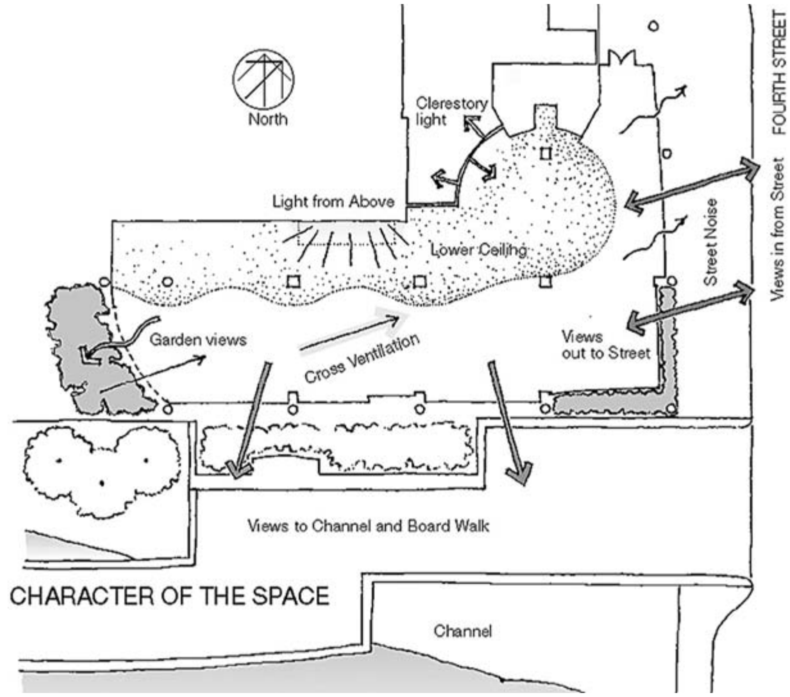






Exploring design issues such as precise shape, proportion, and spatial connections often requires the use of a three-dimensional drawing system. Three-dimensional sketch diagramming can be an exercise in testing alternative geometric layouts until an optimum solution is found that best meets all of the program requirements. These thumbnail concepts, or "napkin diagrams," show five options for the same site area. A conceptual massing sketch should show fairly accurate proportions, but it should not be overly detailed. As with a massing volume, details can be finalized later on. These diagrams help the designer solidify a strong formal strategy from which to move on to more detailed planning.

Alternative diagrams: Click Agency, West Hollywood, California
Medium: Ink on sketch paper
Courtesy of Hodgetts + Fung Design and Architecture



Schematic analytical diagrams for site plans are frequently sketched in the design-drawing process. *Site diagrams* commonly have pictorial *symbols* like those for the plan trees, above, which represent an abstract simplification of physical reality. By using diagramming symbols, influential site factors—such as contours, traffic circulation, view, solar and wind conditions, noise, zoning regulations, property lines, land use, and adjacent landscaping—can be graphically recorded and analyzed quickly. This helps to set the external design constraints.

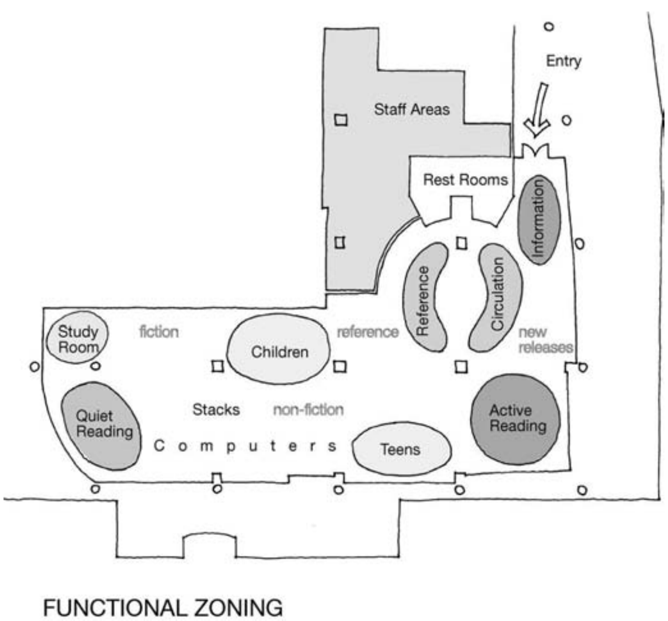


Photo: Sharon Risedorph, Photographer
Courtesy of Santos Prescott and Associates Architects

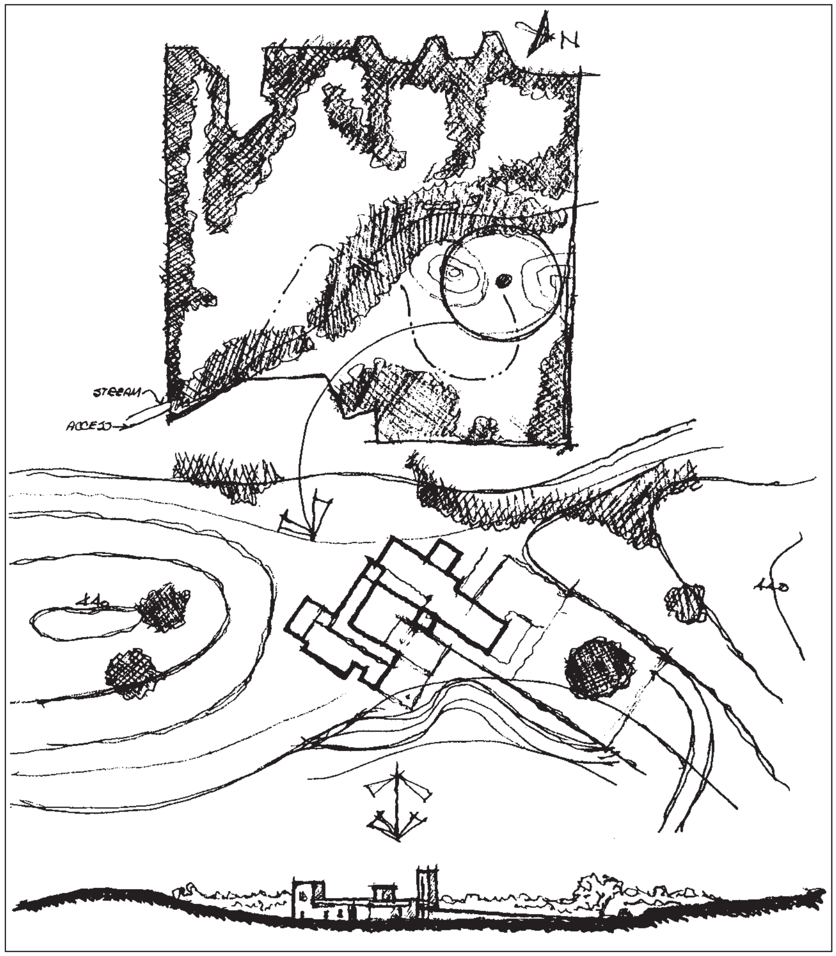
Drawings: Mission Bay Branch Library
San Francisco, California, completed 2006
Medium: Technical pen on tracing paper, with electronic shading and annotations to scanned drawing
Courtesy of Santos Prescott and Associates Architects

The diagrams were made as part of the first presentation of the project to the community to convey the constraints and opportunitites of the site and explain the logic behind the arrangement of the program elements.
[Architect's statement]

Diagrams: House in Northern California
Medium: Pencil on trace
Courtesy of Legorreta Arquitectos, Ricardo Legorreta, Victor Legorreta, Noe Castro

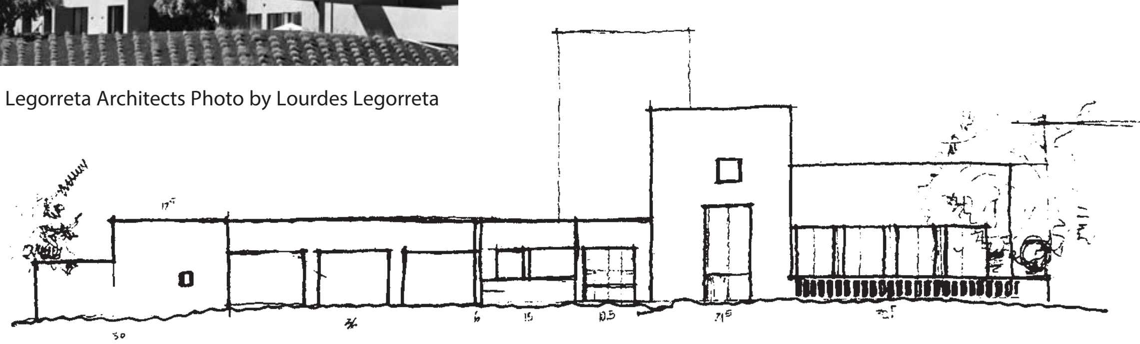
Design drawings document the design process. The initial stages are frequently sketched in black-and-white with the goal of describing only the architectural form and its relation to surrounding conditions. Later stages may incorporate color.

Diagrams simplify reality so specific aspects can be examined. As reality is simplified, it is abstracted. These graphic diagrams of a location plan, a site plan, a site section, and an elevation are precursors for the more three-dimensional diagrams of paraline and perspective sketches. It is important that designers acquire the ability to relate the size and proportion of various architectural elements to buildings and their site conditions. Note the use of various scales in this study.



Site plan, location plan, and site section diagrams

© Legorreta + Legorreta Architects Photo by Lourdes Legorreta



Elevation study, Scale: ⅛"=1'0"

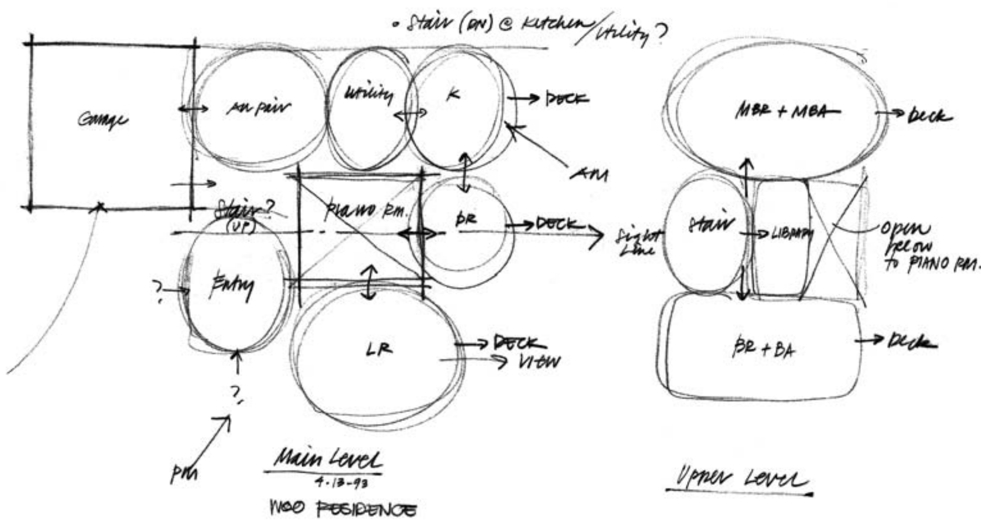
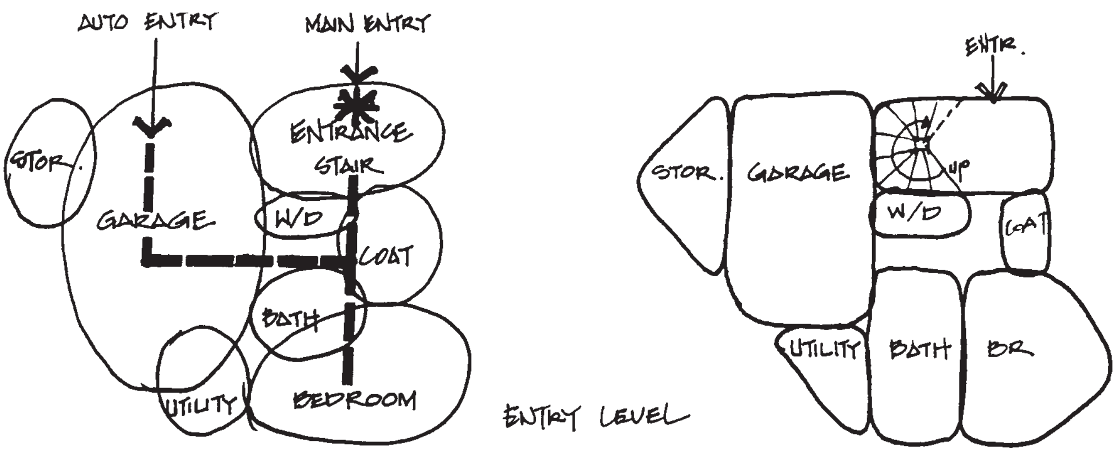
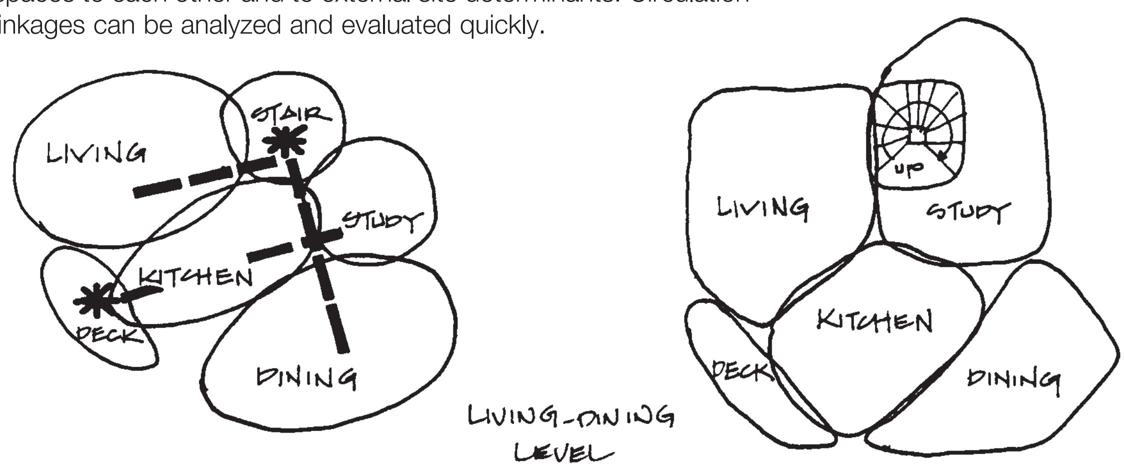


Diagram: Woo residence, Oakland, California
Medium: HB pencil
Courtesy of Kenzo Handa, Architect

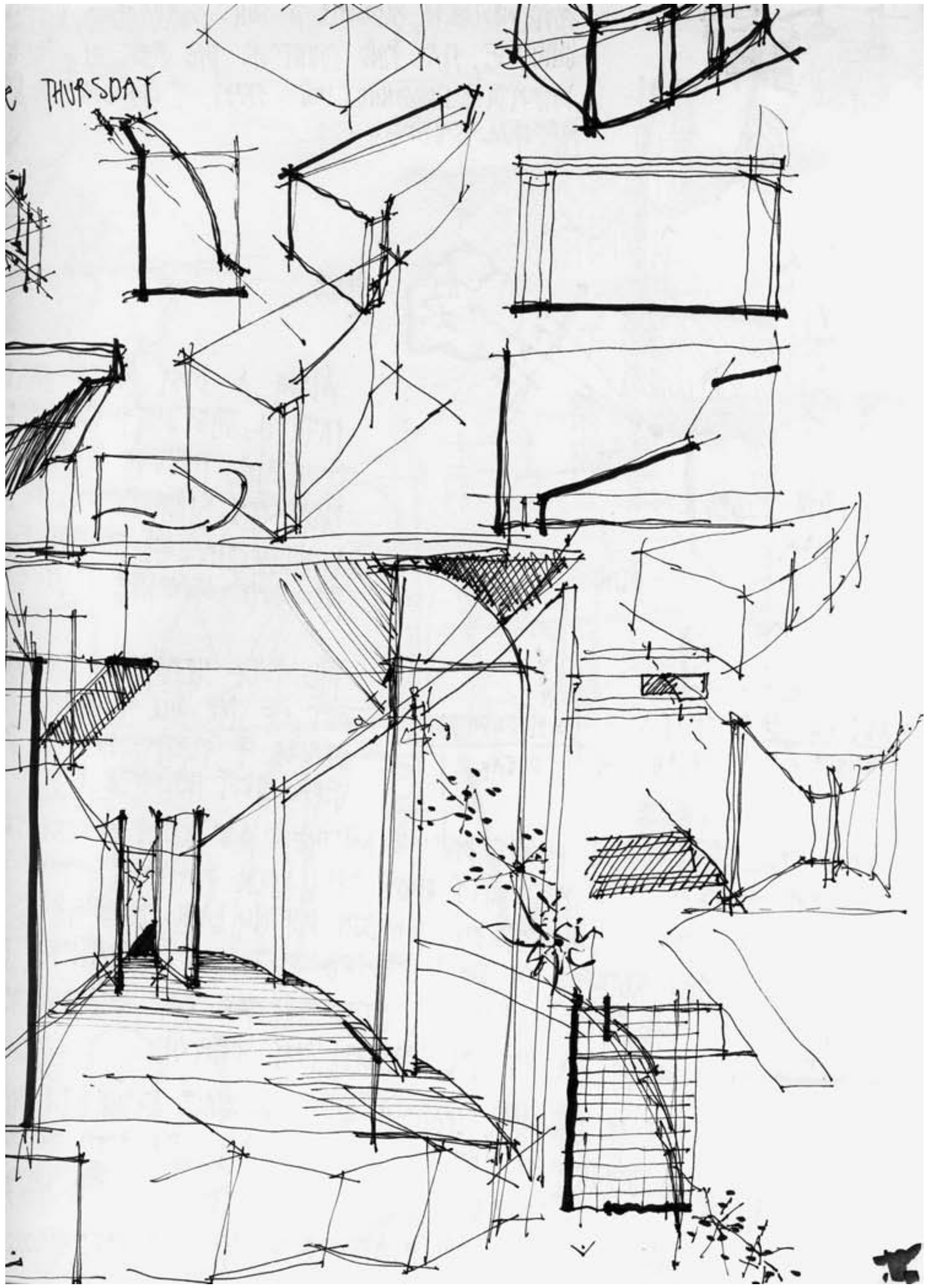


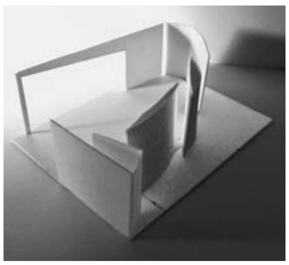
Bubble diagrams relate the program functions and relative sizes of spaces to each other and to external site determinants. Circulation linkages can be analyzed and evaluated quickly.

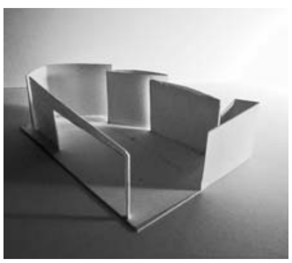


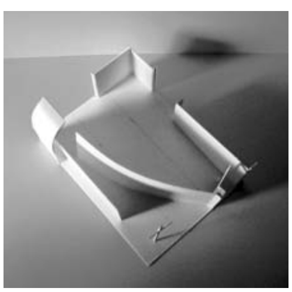
With an area program (square footage or square meters), it is important to set up functional zone adjacencies. These diagrams hint at the proximity relationships and the possible arrangements for a final solution.

Sketches: Student project by Charles Roberts
Courtesy of studio professor William W. P. Chan
Institute of Architecture and Planning
Morgan State University







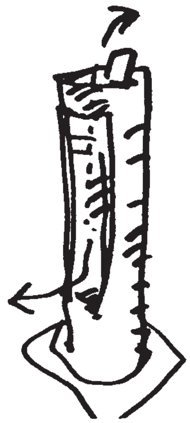


All photos: © Charles Roberts

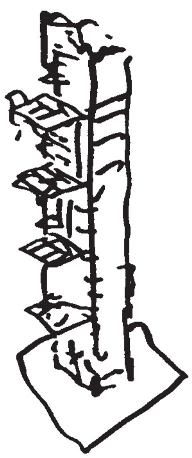
Formal/spatial diagrams delve into the analysis of a design's scheme. The elements for the analysis and diagramming examine numerous characteristics. Some of these elements include natural daylighting, structure (the support system of a building), axial arrangement (and thus symmetry and balance), spatial usage and circulation (entry and path), geometric configuration (proportion) and massing, plan and its relationship to vertical configurations (section/elevation), and hierarchy (a rank order such as major–minor relationships). These diagrams/conceptual sketches do not have to be at a particular scale (such as ¼" = 1'0"). "Not to scale" (NTS) is also often seen with conceptual study models.

ENVIRONMENTAL CONTROL DIAGRAMS

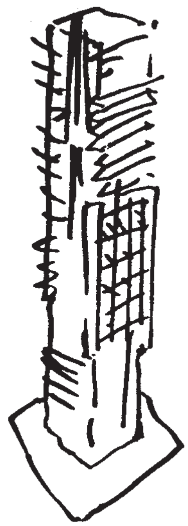
vertical landscaping



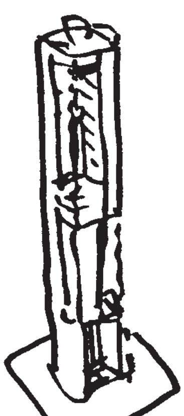
wind scoops



balconies & terraces



solar-collector wall



sky courts

shading devices

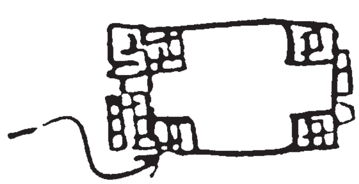


Photo: Menara Mesiniaga (IBM Tower)
Selangor, Malaysia
Courtesy of T. R. Hamzah & Yeang, Architect

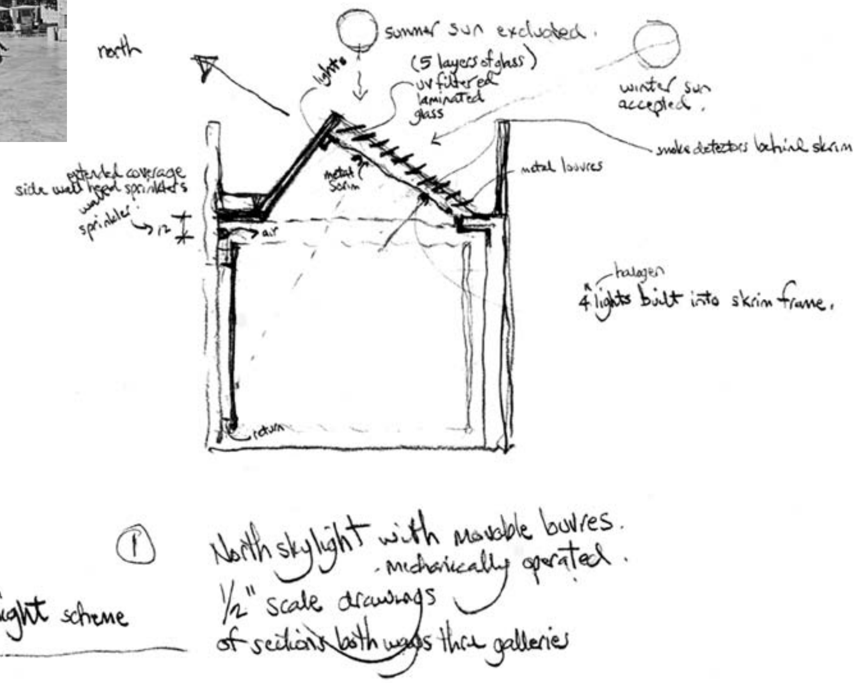
Structure, elements of enclosure, and the control of sunlight are vital issues in an environmental control diagram. These issues are clearly seen in the diagrams for the IBM Tower design, which responds to regional bioclimatic principles through low energy consumption. These diagrams relate to an agenda for high-rise buildings that alters highly industrialized societies' relationships to artificial mechanical systems such as air-conditioning.

Diagrams: Design principles and agenda
Courtesy of T. R. Hamzah & Yeang, Architect
Tengku Robert Hamzah and Dr. Kenneth Yeang, Partners

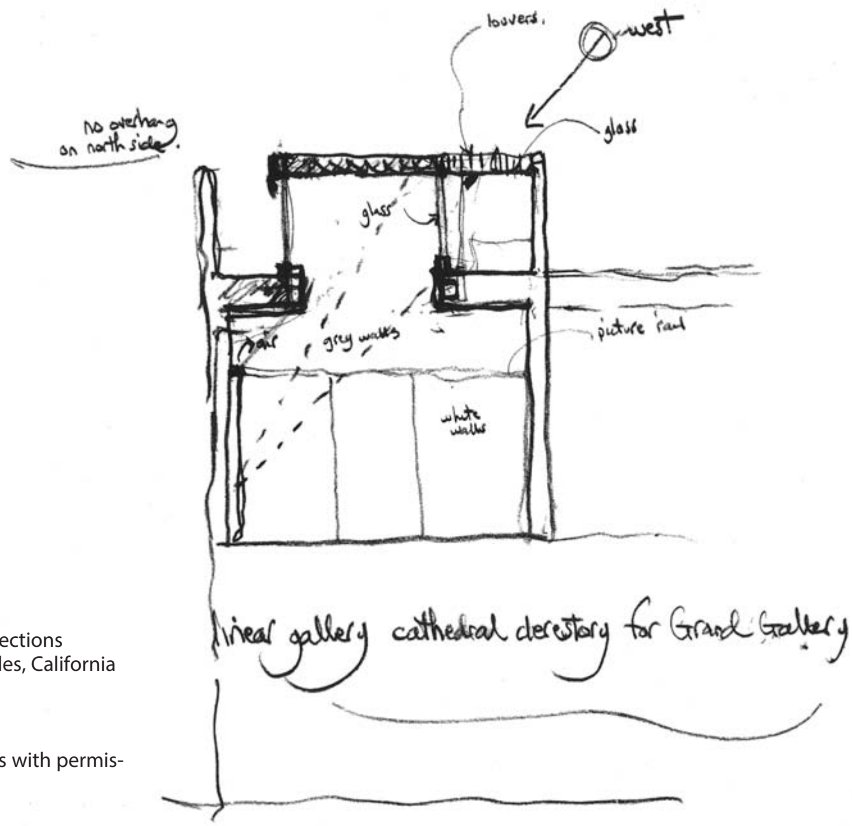
© Wikipedia

Photo: Terrace between pavilions

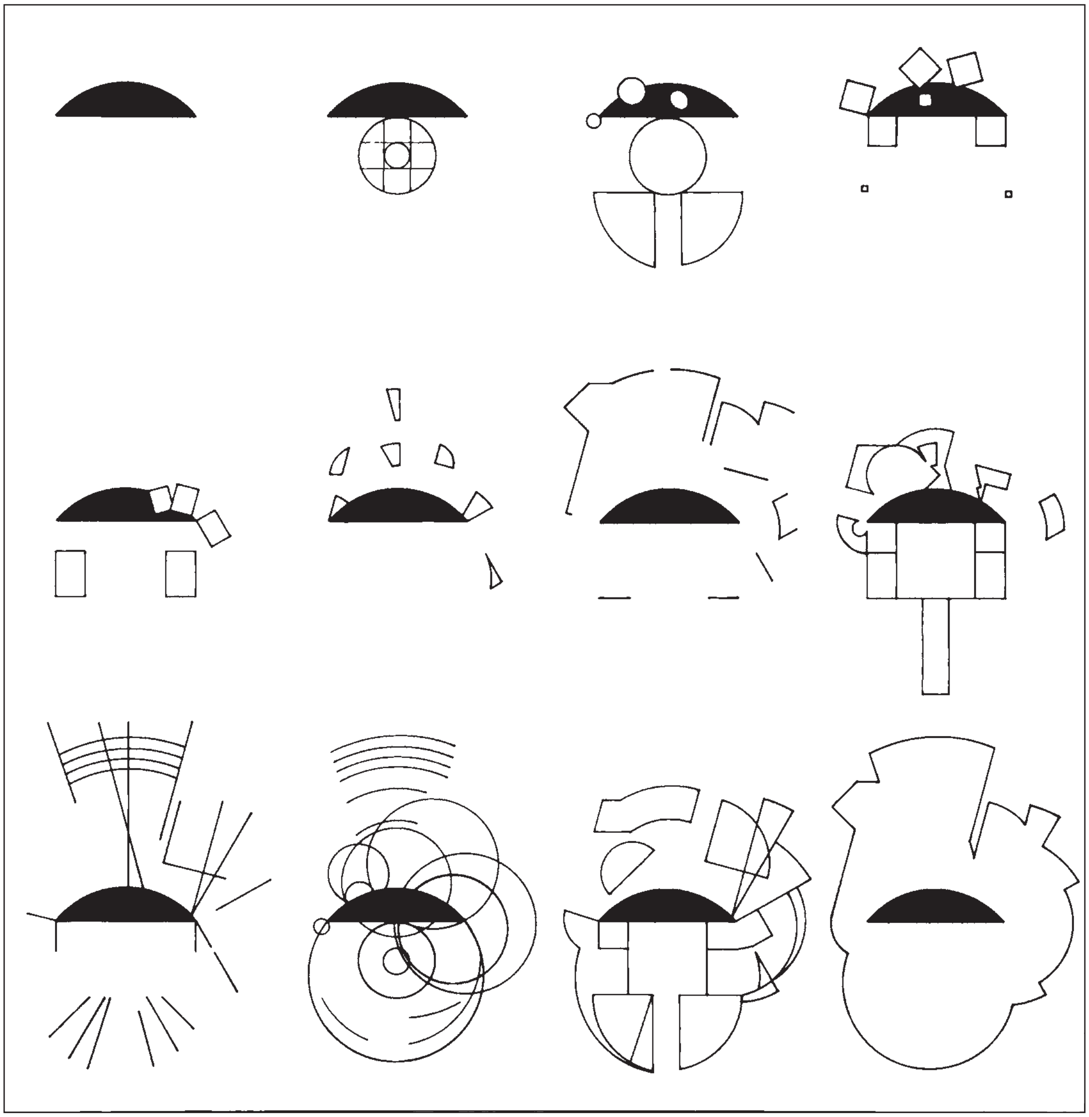
The use of light, both natural and artificial, is central to the conception of the Getty Museum and is therefore the focus of these sketches. These drawings explore the uses of light and its ability to mediate between the building's exterior and interior. [ARCHITECT'S STATEMENT]



The environmental control diagram at the top uses a sun symbol with directional arrows to show the effect of winter and summer solar angles. Arrow symbols are frequently used in diagrams, especially in plan and section diagrams. Light direction is represented by a directional arrow to enhance the viewer's understanding of how light enters the museum's space. Note also the integration of an architectural design concept with structural section/environmental control diagrams.



Drawings: Diagram sketch studies of museum sections
The Getty Center Museum, Los Angeles, California
Both 18" × 18" (45.7 × 45.7 cm)
Medium: Graphite pencil on yellow trace
Courtesy of Richard Meier & Partners, Architects
Reprinted from The Getty Center Design Process with permission of The J. Paul Getty Trust

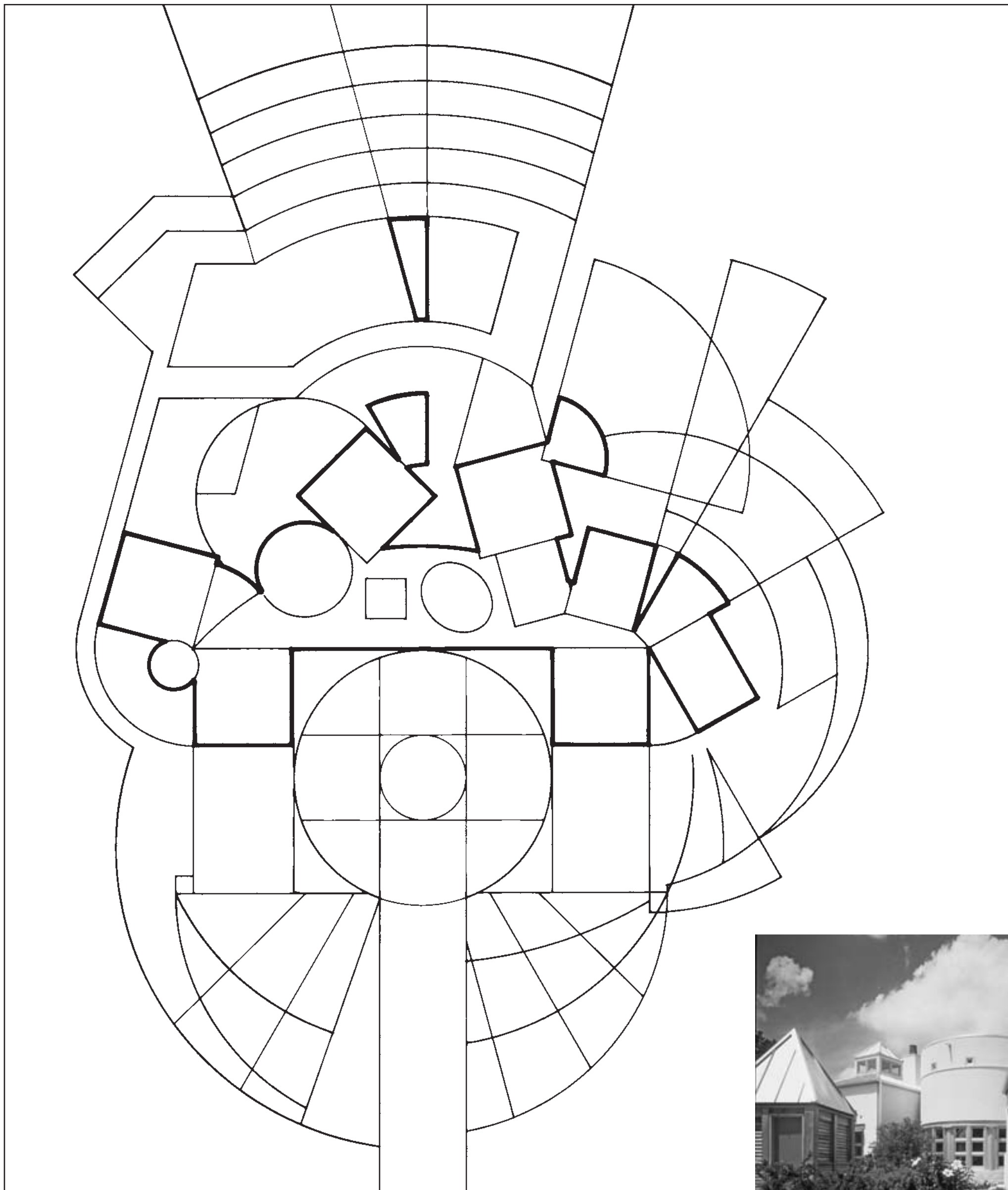


ELEMENTS **DEVELOPMENT**

Diagrams: Private residence, Illinois (1988–1990)
Medium: Ink
Courtesy of Stanley Tigerman, Architect

Storyboard showing the evolution of elements. The house begins with a wedge, generating other forms that tumble off of it.
[Architect's statement]

In addition to the site analysis and site synthesis diagrams shown on the preceding pages, the plan diagrams, section diagrams, and elevation diagrams shown on the following pages are most often used during the initial phase of the design process. These diagrams attempt to effectively understand the organizing idea of the design concept by addressing a variety of issues. As the design continues, layers of tracing paper are used to refine the development of ideas.



PARTÍ DIAGRAM

Diagram: Private residence, Illinois (1988–1990)
Medium: Ink
Courtesy of Stanley Tigerman, Architect

Photograph by Bruce Van Inwegan
Courtesy of Stanley Tigerman, Tigerman McCurry Architects, Ltd.

In the partí diagram, the house expands into the site, and geometric repetitions radiating from the home into the landscape are indicated.
[Architect's statement]

A *partí diagram* shows the basic schematic assumption of a plan. It is the fundamental overarching or big idea (scheme) of a plan. A strong *partí* can withstand design transformations. The elements in Tigerman's design are the determinants that shape the final resolved form. The ongoing refinement process allows for the evolution of a mature solution that satisfies the restrictions and requirements of the program.

Diagrams: A study of the Central Glade
University of California at Berkeley
Courtesy of Philip Enquist, Architect
with Skidmore Owings and Merrill

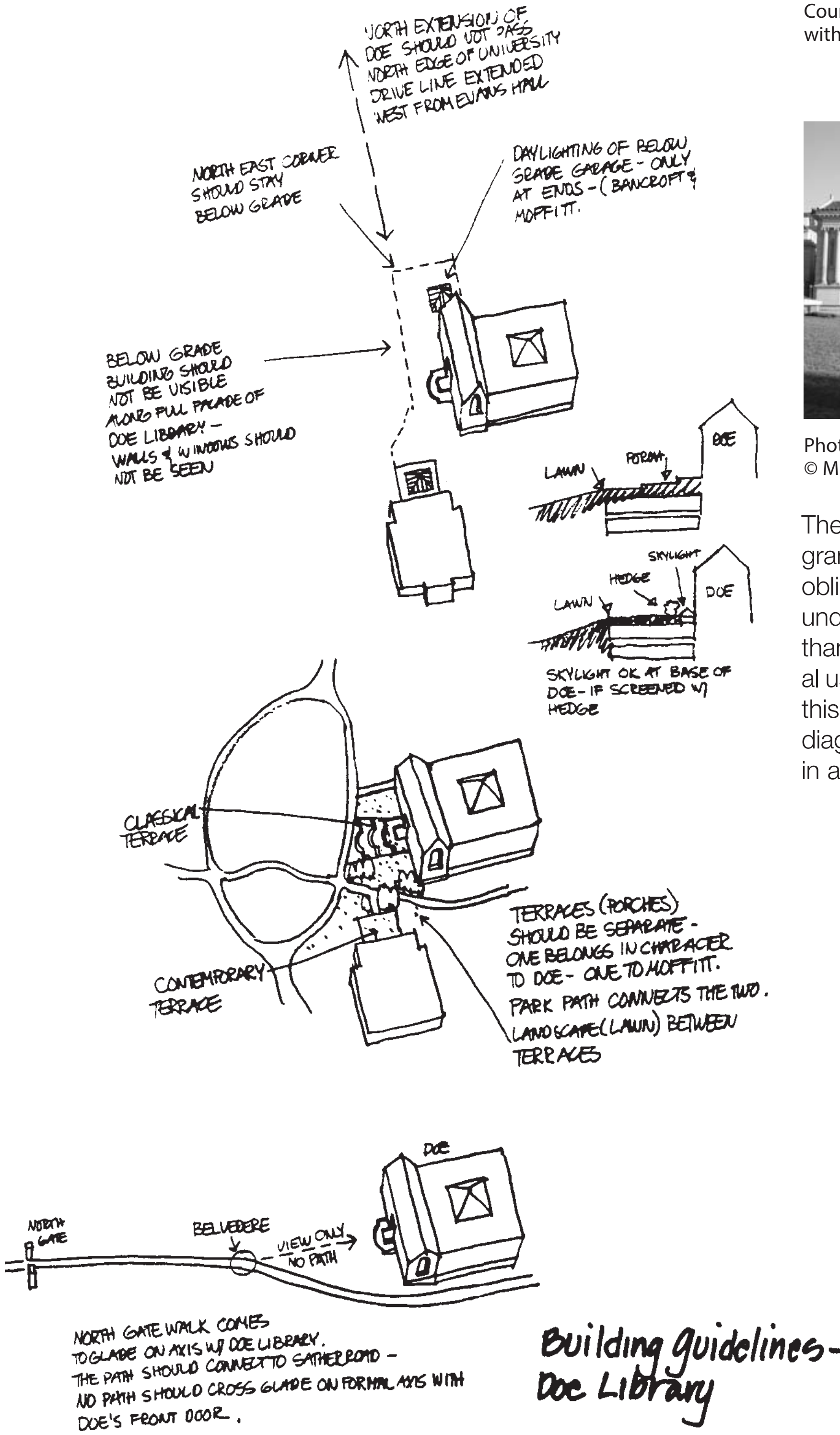


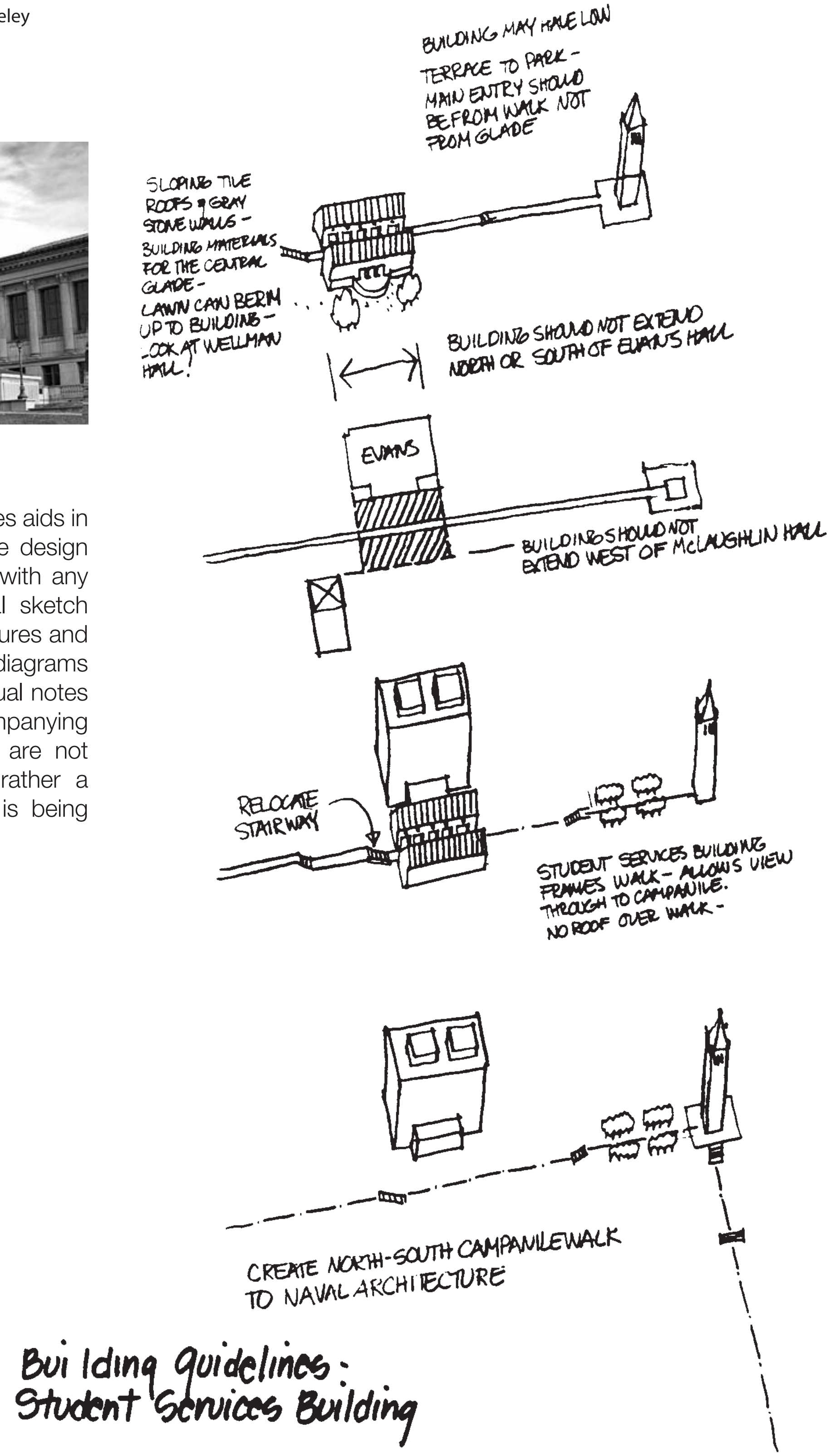
Photo: Courtesy of Wikipedia
© Minesweeper at en.Wikipedia

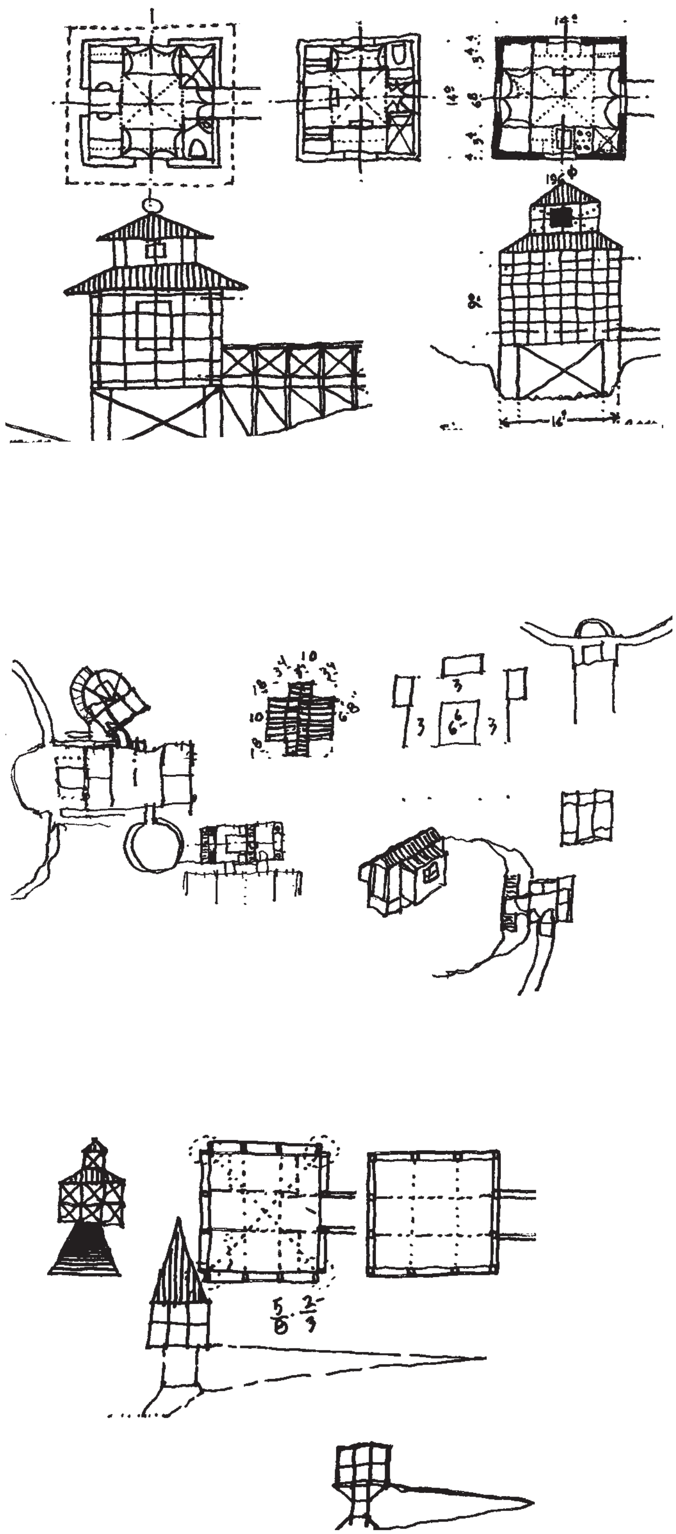
These quick thumbnail sketch diagrams were done primarily as plan obliques, which can be more easily understood, especially by a layperson, than plan diagrams. Note the additional use of a two-dimensional diagram on this page. Two- and three-dimensional diagrams are frequently used together in analytical studies.

Diagrams: A study of the Central Glade
University of California at Berkeley
Courtesy of Philip Enquist, Architect
with Skidmore Owings and Merrill

Photo: Courtesy of Wikipedia
© brainchildvn

The use of abundant written notes aids in design communications and the design process. Analytical note-taking with any type of diagram or conceptual sketch prompts the recall of salient features and important objectives. Think of diagrams and conceptual sketches as visual notes that are reinforced by accompanying written notes. These drawings are not accurate representations, but rather a descriptive dissection of what is being observed.





Sometimes travel sketches may not be representational. Some architects, such as Stanley Tigerman, often translate what they observe into many architectural graphic conventions. They may see a perspective view of a building, but in recording visual notes, they recode what they see into plan, elevation, section, or paraline diagrams.

Tigerman, like many architects and designers, has a habit of drawing and sketching as a way of getting warmed up, like a boxer before getting in the ring. Sketching acts as a warm-up exercise for his hand-eye-brain faculty, to get the "design engine" started and in preparation for ideas to flow. This random display of visual images in his ongoing visual diary shows recorded sparks and flashes relating to subject matter that is sometimes seemingly disconnected.

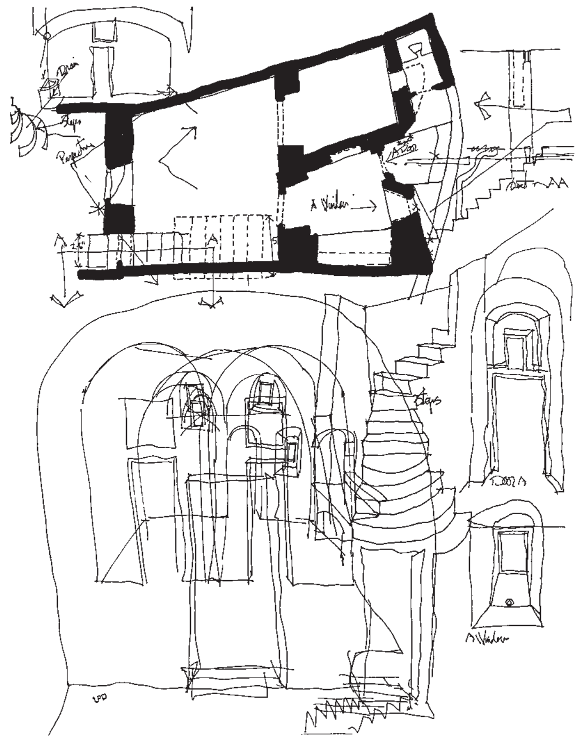
My first thoughts are always recorded in my "Daler" sketchbook. I may draw anywhere from two or three to up to twenty little sketches before they move to the next level
[Architect's statement]

Travel sketches: Study for one-room house
Boardwalk, Michigan
$3\frac{5}{8}$" × $5\frac{13}{16}$" (9.22 × 14.76 cm)
Medium: Ink on paper
© Stanley Tigerman, Tigerman McCurry Architects
Sketches by Stanley Tigerman

Multiple interior or exterior vantage points are common in study sketches. These superimposed sketches show a variety of perspective views taken inside a house, with the direction of views indicated on the sketched plan. Travel sketches can sometimes be analytical studies.

Travel sketching can offer spontaneous opportunities to document the environment. By drawing a plan view along with a series of corresponding vignettes, one can begin to caxpture the true essence of architectural space. These analytical studies can provide thoughtful insights into form and movement.
[Architect's statement]

© Cathi House

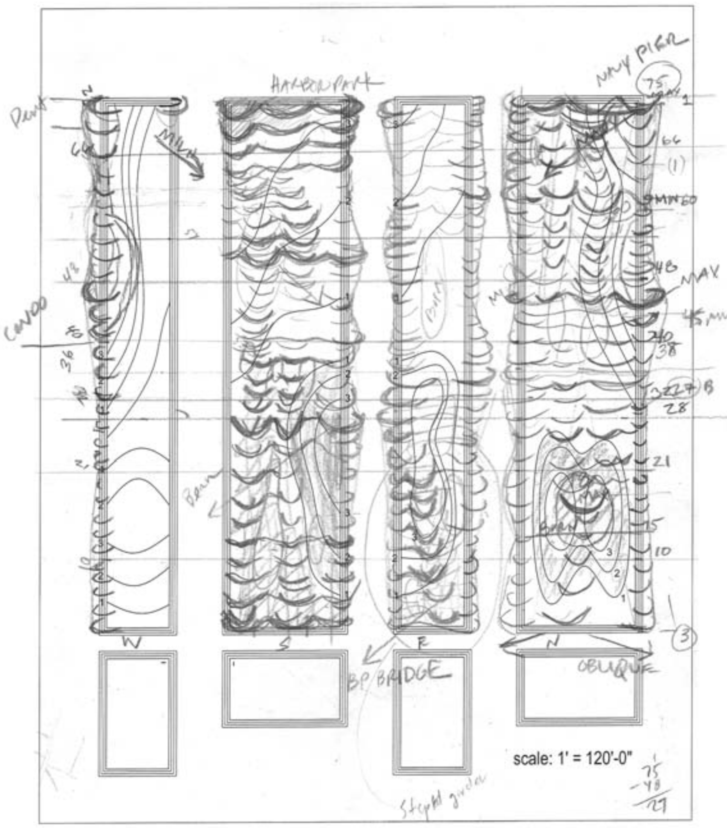


Drawing: House, Santorini, Greece
8" × 10" (20.3 × 25.4 cm)
Medium: Pen and ink on paper
Courtesy of Steven House, Architect, San Francisco

© Matt Wargo for VSBA

…]n early study for an axis of the interior of the Sainsbury Wing at the National Gallery in London, emphasizing abstracted representations of Classical elements, false perspective in the Renaissance way, and a scenographic effect in a Baroque manner, exposing lots of paintings as fragments.
[Architect's statement]

Study sketch: National Gallery, Sainsbury Wing, London, England
Medium: Felt-tipped pen
Courtesy of Venturi, Scott Brown and Associates, Inc., Architects
Sketch by Robert Venturi



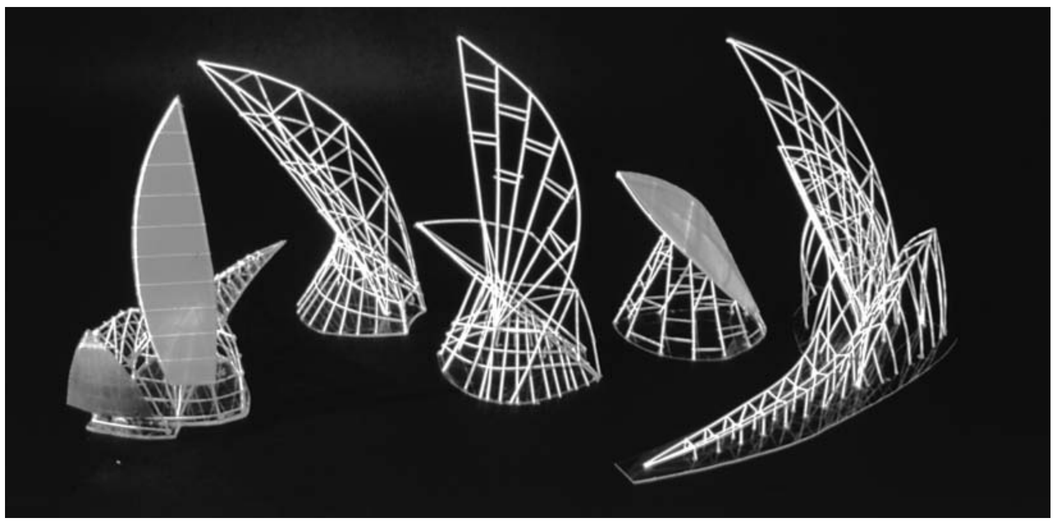
Conceptual sketch diagram: Aqua Tower
Chicago, Illinois
Medium: Colored pencil
Courtesy of Studio Gang Architects

This drawing shows an exemplary combination of the visual/intuitive eyes of the architect/sculptor and the use of a digital medium as a printed base for design exploration, as noted in the architect's statement. Having a digitally plotted three-dimensional display of the varying floor slabs using the cantilever benefit of a concrete slab system rising uniformly upward is a very effective way to design the tower in three dimensions. By manipulating the shadow effect on the tower's elevation, one floor at a time, it is conceivable to work back and forth between the sculptural effect of the tower and the extent of the projection from the basic box. It is a very efficient way to work interactively between 2-D and 3-D media. The architect's hand on the tracing overlays guided the design decisions.

Overlay drawing studying the convergence of Aqua Tower's view targets with its slab delineation.

The pure diagram on white paper is invaluable, but perhaps more frequently, we use a mixed-media approach to communicate ideas through sketching. These include combinations of digitally drawn 3-D views, digitally drawn sections, and model photos used as underlays for the sketch. For Aqua, sketching on top of digital model photos and drawings allowed us to tailor the "hills" on the facade, and to understand how the hills transformed over the entire height of the building.
[Architect's statement]

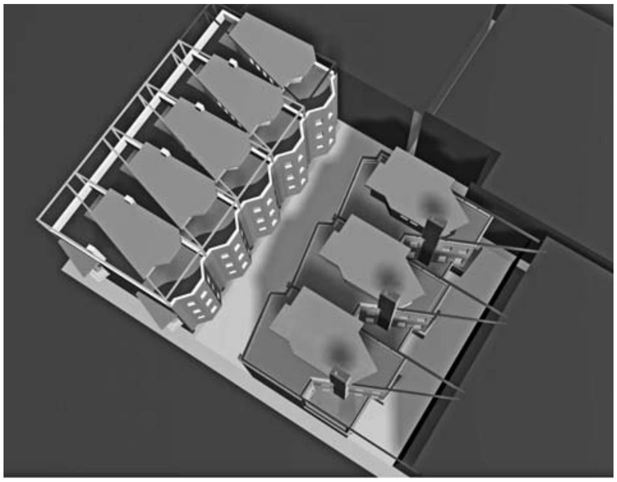
Computer-generated wireframes, like manually executed contour and cross-contour drawings, describe the form of an object. In cross-contour drawings, parallel lines are typically used to traverse the surface of an object. With wireframe drawings it is possible to visualize the overall shape of a building in a pure sense, without the distractions of nonarchitectural features.

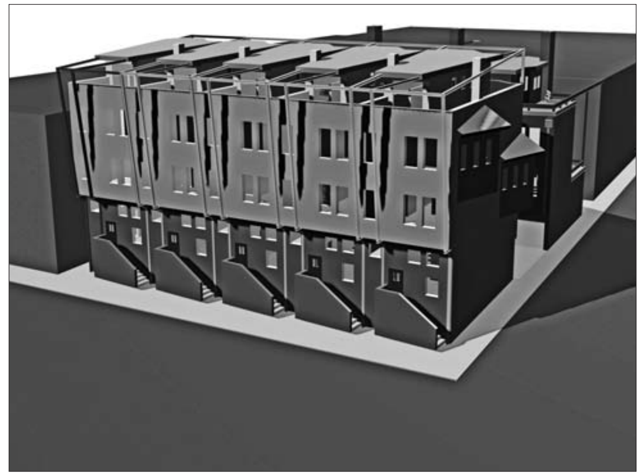


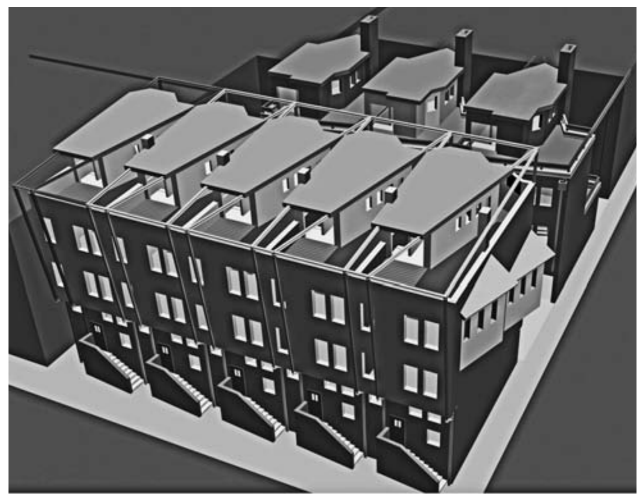
Computer wireframe studies: National Museum of Contemporary Art
Osaka, Japan
Courtesy of Cesar Pelli & Associates Architects
Photo credit: M. LaFoe with Cesar Pelli and Associates

These wireframe computer diagrams have geometric properties within various planes, which are hard to visualize without additional contours traversing those surfaces. This technique requires a minimum input of data without rendering the planes. Hence, one could rotate images rapidly for the quick assessment of forms. This rapid imaging seems to allow a synchronization of the mind and the eyes without the need to wait for a detailed display, as a slow display might disrupt the flow of intuitive design decisions.

Digital photo rendering of aerial view
The National Museum is in the central foreground.
Courtesy of Jun Mitsui Associates



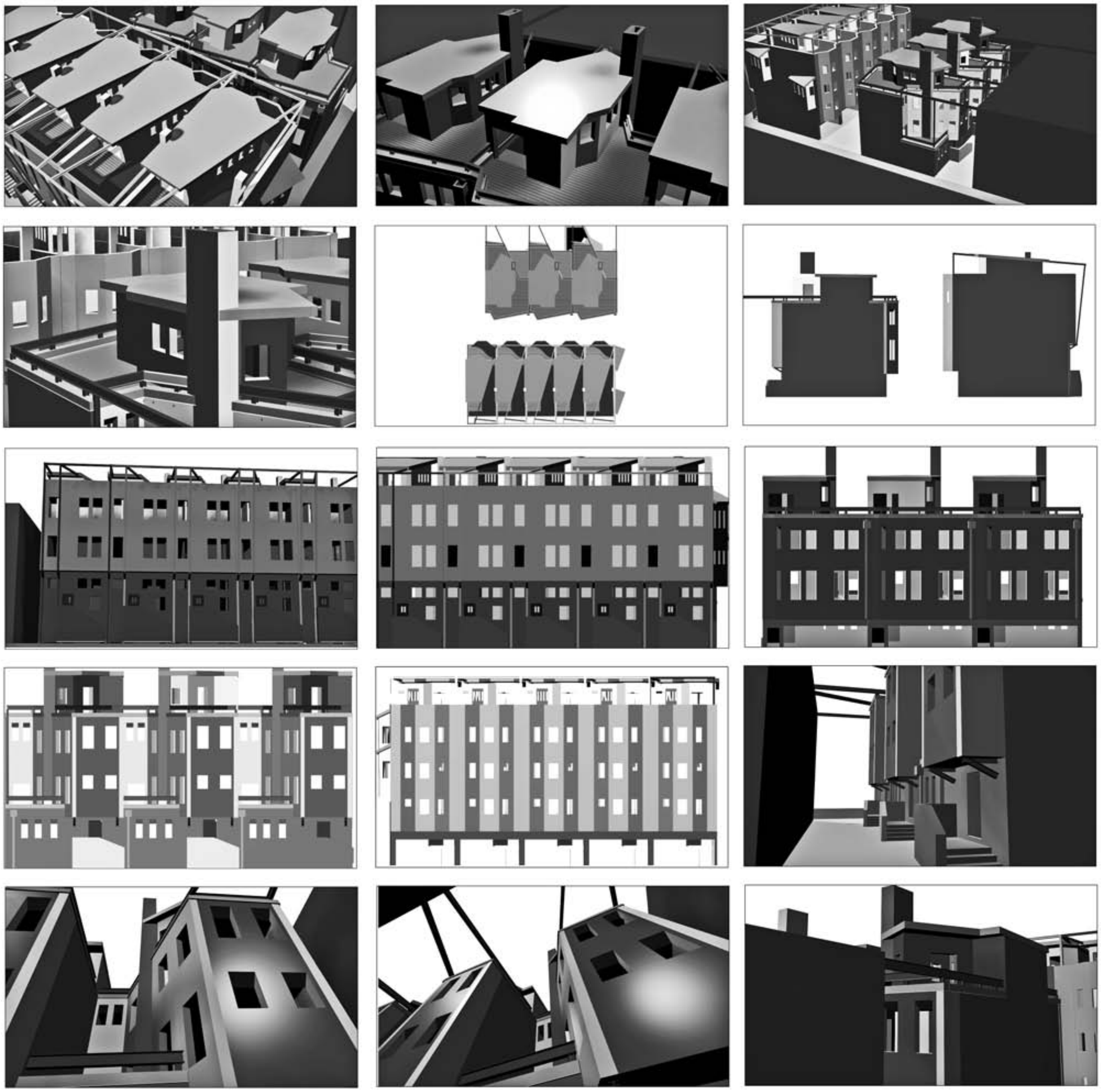




This and facing page: Student project by Robert Reichel
Baltimore townhouses
Software: IronCAD
Courtesy of studio professor William W. P. Chan
Institute of Architecture and Planning
Morgan State University

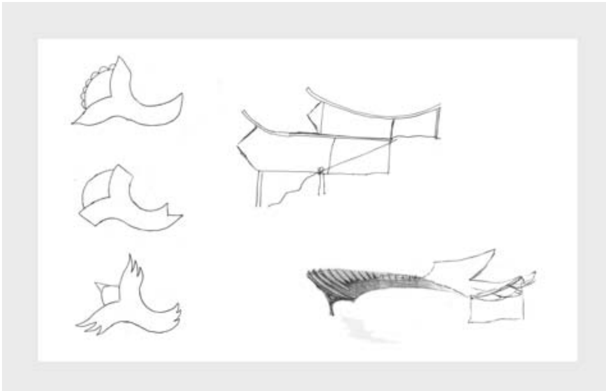
The first semester of the first-year graduate program began with simple projects involving problems in descriptive geometry, orthographic drawing, and constructing models with foam board, chipboard, and basswood. The objective is to open up the hand-eye-brain coordination in three-dimensional thinking.

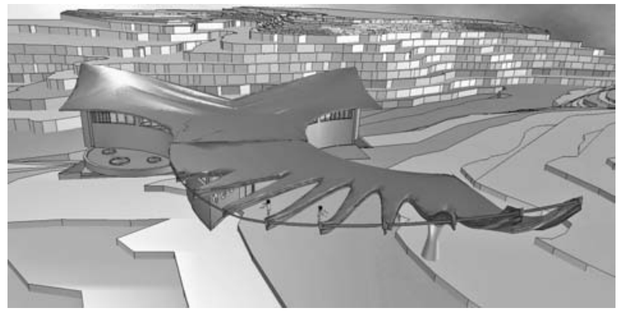
After a survey of a lot of 3-D software, IronCAD was selected because it is user-friendly, and its maneuverability is similar to constructing real models. Shapes and forms are created onscreen, positioned, copied, modified, and rotated; this is all done in real time and allows the user to work intuitively in designing in three dimensions. The onscreen assemblage can be printed out and sketched over with new ideas. The components can be reconfigured instantly, with no interruption of the creative process. Every model part put into the assemblage is automatically registered and, with a click of the mouse, activated for modification. A small object inside a very tight enclosure can be worked on without disturbing the layers of enclosures that house the object. Colors, textures, lighting, and materials are available for a more detailed rendition of the scene. It is also possible to move back and forth between 3-D and 2-D drawings. For all these reasons, IronCAD is ideal for training beginners in architectural design.
[Professor's statement]

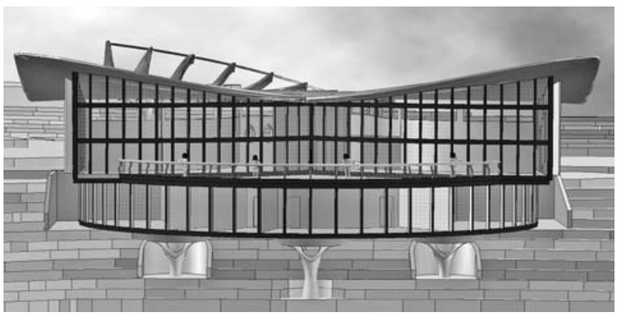


Design through Digital Imaging

With a background in sculpture and furniture design, my visualization and design process has always been three-dimensional. I am used to being able to walk around my work and consider it from any angle. Designing with 3-D modeling software was a natural transition for me. It allows me to mass out buildings using techniques that are conceptually similar to working in wood, metal, or clay. Computer modeling also gives me the opportunity to evaluate my design from any angle or perspective that I want. The program for the townhouses had extreme real-world limitations, such as tightly surrounding existing buildings, limited southern light, and difficult parking requirements. Using IronCAD software allowed me to design by modeling within this space. I then used the program to generate plans, elevations, sections, and drawings based on the model. I could then reassess my design using both the drawings and the model.
[Architecture student's statement]

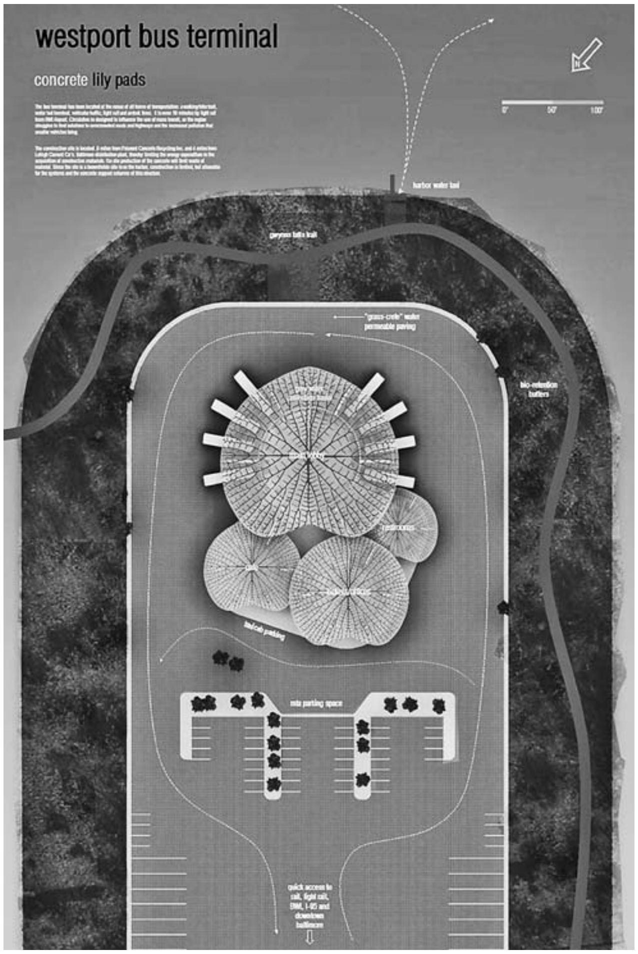


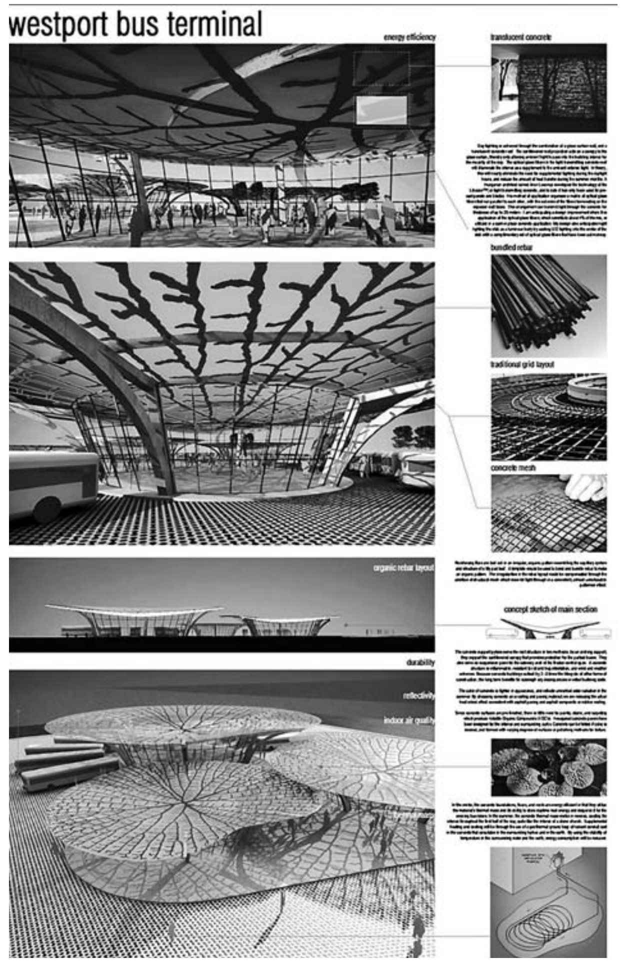




Student project by Matthew Richardson
Herring Run Nature Center
Baltimore, Maryland
Courtesy of Studio Professor William W. P. Chan
Institute of Architecture and Planning
Morgan State University

The design objective was to produce a nature research center in an urban park with diverse topography, allowing access to different research plots on the site. Initially, organic shapes and themes were sketched out on paper. Then, in IronCAD software, a massing was created that rose from a ridgeline in the topography and projected out over the stream valley. The idea was to create a building that looked as if it were taking off in flight as the wind swept up the valley walls. The building would be easily approached from the ridgeline but have a dramatic view over the stream valley. The massing was printed onto paper and sketched over on tracing paper to define the wing shapes and tail of the building. Once these changes were visualized with hand drawing on tracing paper, they were further developed with the 3-D software. The designs of the window facade and promenade railing were altered similarly. Going back and forth between the two media and utilizing the software's ability to view the model from all angles allowed for quick advances in the 3-D design. If relegated to only working with a physical model, there would have been little room for design changes throughout the process; working with a computer model accommodated the design's mutating form more quickly.
[Architecture student's statement]

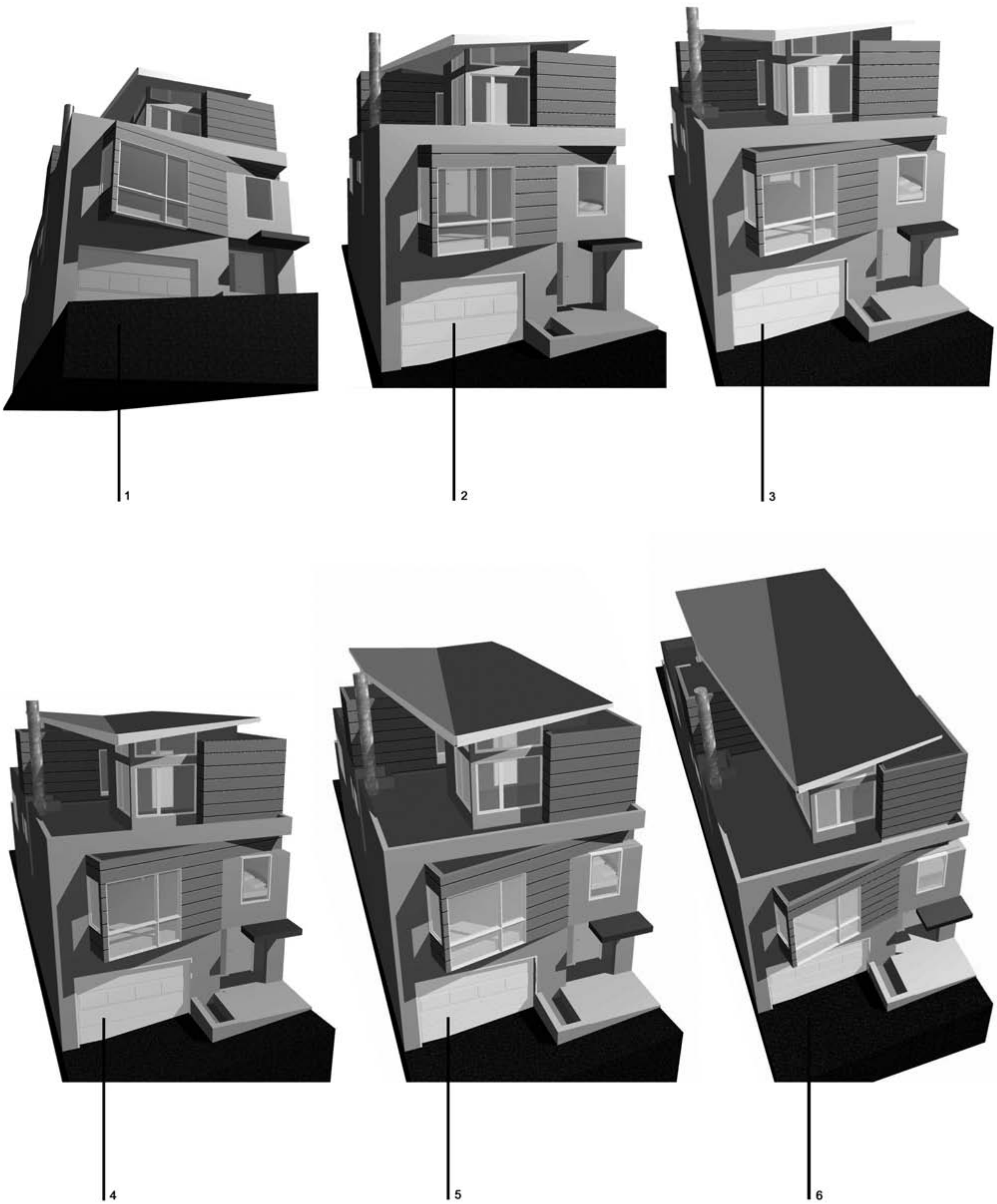


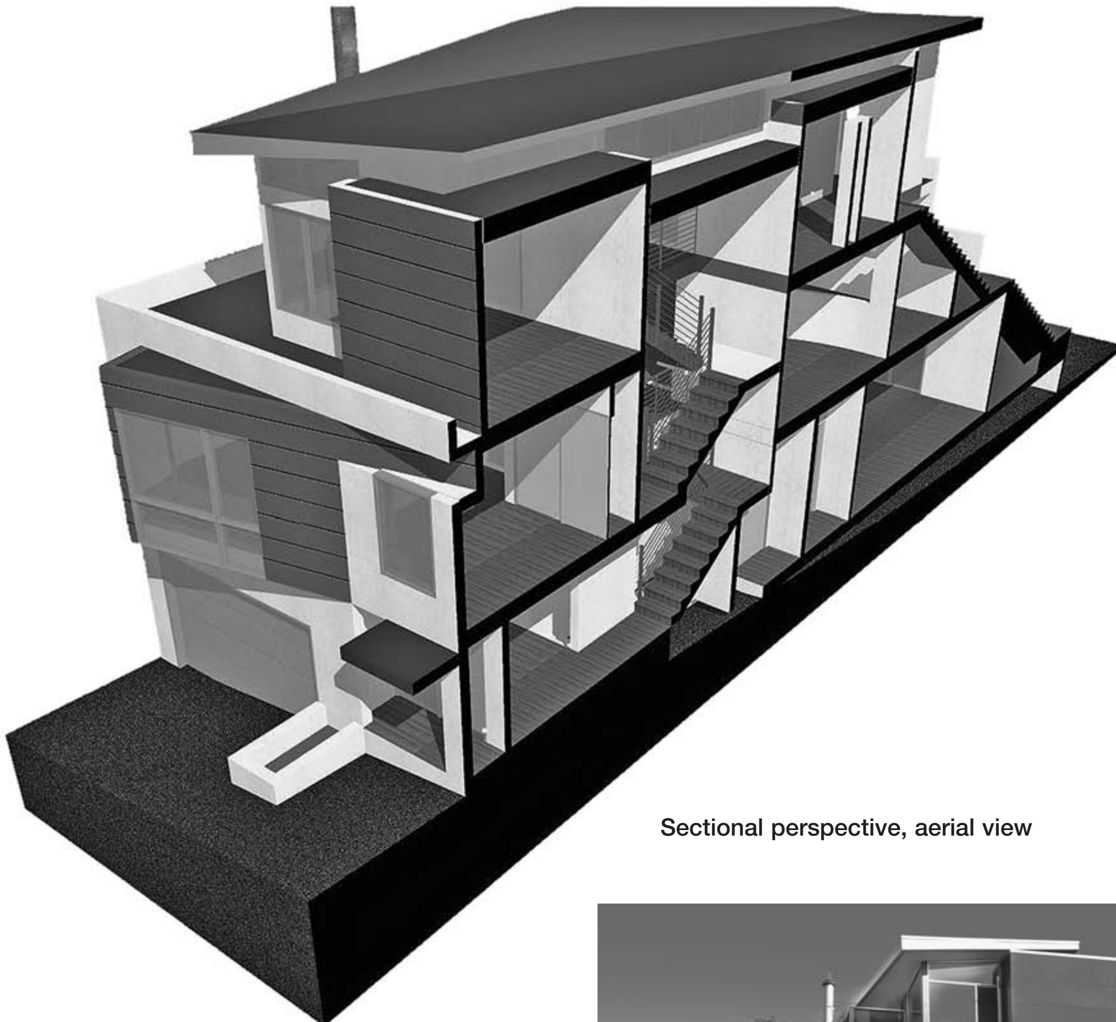


Student project by Matthew Richardson (May 2006)
Westport Bus Terminal, Westport, Maryland
Third place in Association of the Collegiate Schools of Architecture and Portland Cement Association's International Competition: Concrete Thinking for a Sustainable World
Courtesy of Matthew Richardson, Morgan State University, Baltimore, Maryland

Entrants were encouraged to come up with a design that used concrete as a sustainable building material. Students were limited to two 20″ X 30″ presentation panels and were encouraged to limit the presentations to those aspects of the design that showcased concrete as an innovative structural element. Because sustainable design is clearly evident in the layout of this site, an entire presentation panel was dedicated to the whole site plan, detailing all aspects of the design through a series of leader lines and labels. The second presentation panel displayed section and perspective renderings generated from the 3-D Studio Max model, which were subsequently enhanced slightly in Adobe Photoshop. These four renderings were organized at the fullest size that would fit on the presentation panel, leaving room on the right-hand border for details and descriptions of the design. This simple organization process allowed for large renderings while permitting text and details to fully explain the design. The design began as a notebook sketch, and developed through repeated interfacings between computer models and tracing overlays on top of a computer printout. As a nice balance to the beautifully rendered computer images, the initial ink concept sketch was used as one of the details in the right-hand border.
[Architecture student's statement]

SEQUENTIAL AERIAL VIEWS





Sectional perspective, aerial view

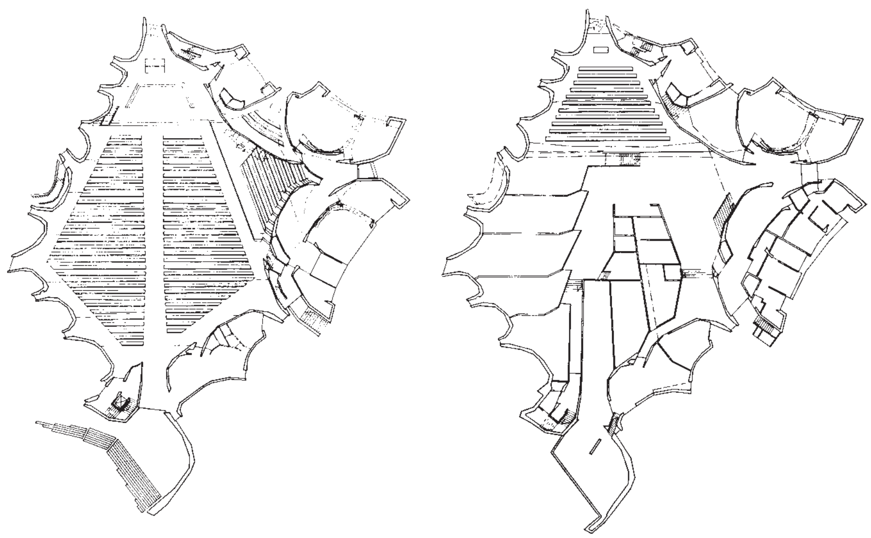
© Norma Lopez Molina

Images (this and facing page): Douglass Street Residence
San Francisco, California
Medium: ArchiCAD 8 software
Principal in Charge: Mark English
Architectural Illustrations: Masha Barmina
Courtesy of Mark English Architects

The use of a sequence of computer 3-D views helps architects review and explain the relationships among all of the major components in a building at the same time. In this case, the model allowed us to quickly review how changes to any of the roof or facade elements might impact the overall project. The sketches suggested further adjustments to the computer model, which in turn inspired more finished sketches.
[Architect's statement]

very abstract initial doodle

less abstract



refinement from the abstract

Sketches and drawings: Kaleva Church, Tampere, Finland
Scales: Upper left and bottom 1:50; upper right 1:100
Medium: Charcoal
Courtesy of Raili and Reima Pietilä, Architects

Images in the mind are first visualized (a mental act) and then sketched (a physical act). Sketching ideas on paper helps to evolve other ideas; these concepts are constantly evaluated and reevaluated. The examples here show a progression from creative abstract sketches to more refined drawings.

The ability to formulate mental images comes with practice. Visualizing everyday objects will form the basis for sharpening the conceptual imagination. As ideas occur, they are put on paper. This is an *ideational* drawing. An idea on paper is a visual representation of what something may look like conceptually. Some ideas will be discarded; others will be changed, modified, refined, and expanded.

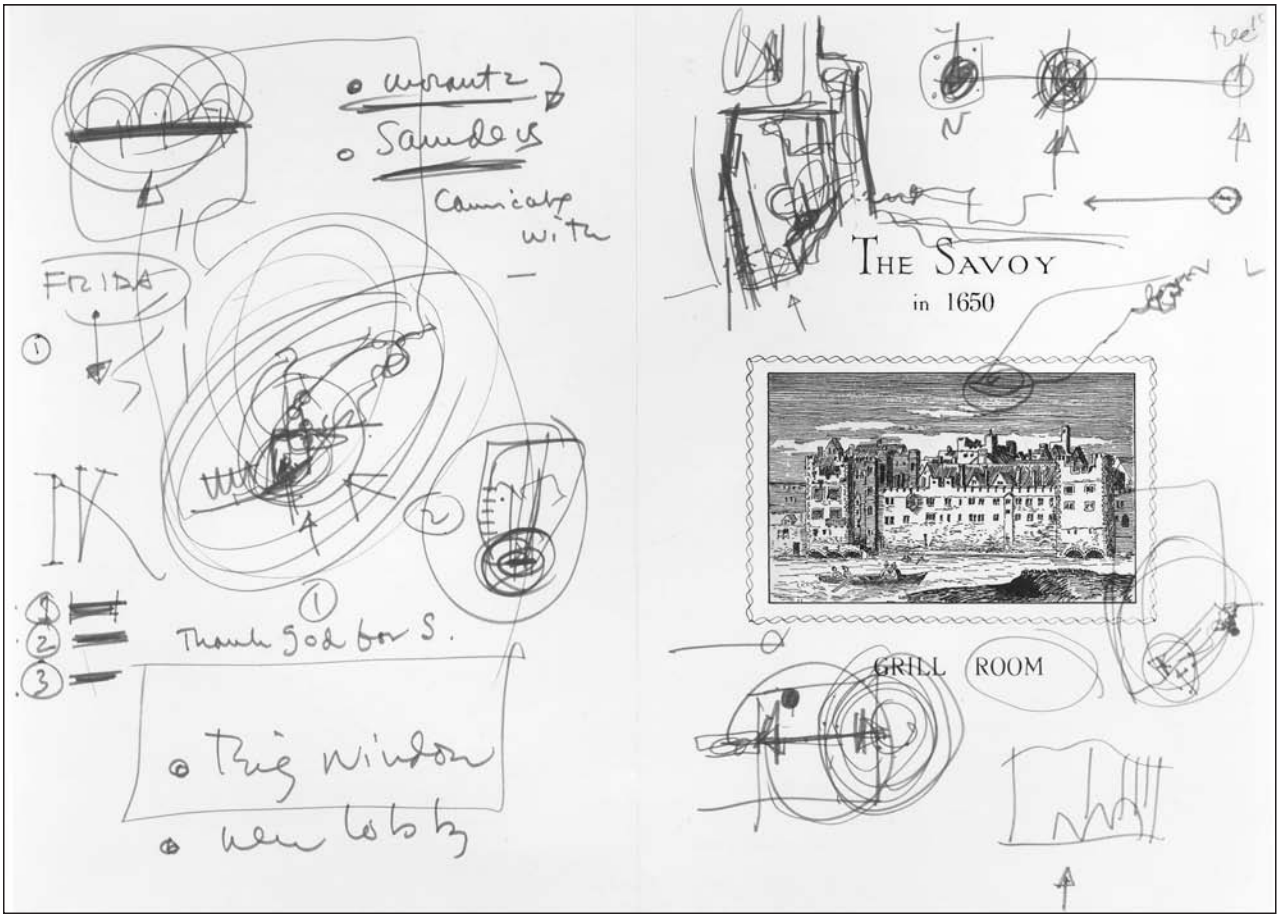
Sketches: Kaleva Church, ground floor
Tampere, Finland
45" × 29" (114.3 × 73.7 cm)
Media: Charcoal and crayon on sketch paper
Sketches by Reima Pietilä
Courtesy of the Pietilä Archive, Helsinki

Photo: Kaleva Church interior, 1966
Courtesy of Raili Pietilä

A diagram with a photograph is very telling, because it shows whether the character of the sketch is evident in the actual building.

Perhaps many modernistic designs should be grateful for this thin, unqualified sketch paper. The aesthetic expression of architectural integrity or totality can also be seen to derive from the skillful techniques of transparent designing. These sketches here are merely a sample from hundreds, but it is still possible to note how through these sketches the building grows on the drafting table. These sketches are conceptual tools on the way to becoming objects, and not in themselves detached objects like an artist's graphics. I would advise everyone not to break this vital growth link between these sketches and the actual building they become.

Creating architecture is a multimedia process. It involves verbal programming and directing; visualization by sketching floor plans, sections, and elevations; spatialization with the help of a scale model; and materialization by building. Both words and pictures are used to explain architectural form. Neither one nor the other alone is enough to make architecture as a phenomenon sufficiently comprehensible.
[Architect's statement]



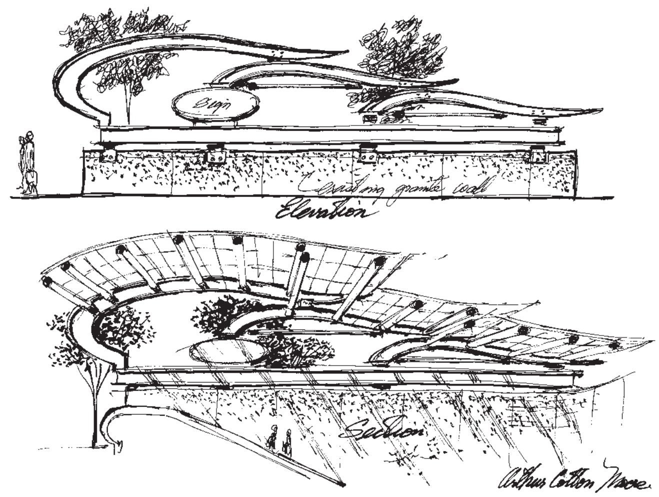
Diagrammatical sketches (both pages): National Gallery, Sainsbury Wing
London, England
Medium: Red felt-tipped pen
Courtesy of Venturi, Scott Brown and Associates, Inc., Architects

For background on the architecture and ideas of Robert Venturi and Denise Scott Brown, see James Venturi's documentary film *Learning from Bob & Denise.*

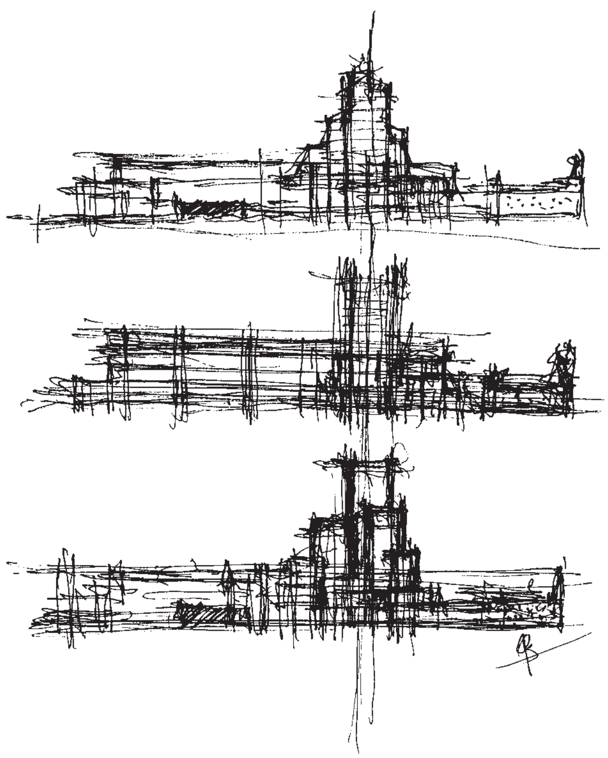
The ideal sketches are those that evolve from intuition indirectly guiding the hand, more than the mind directly guiding the hand. Also, combinations of images and words enrich the process.
[Architect's statement]

These two-dimensional "napkin sketches" (in this case done on a dinner menu) were made by architect Robert Venturi. Designers and architects usually sketch at a minute size, as shown above, thus giving us the term "thumbnail sketches," which are about the size of Venturi's small doodles. Sketching at a small scale allows you to explore more ideas and thus consider more possibilities and choices for a design problem. The mind can generate creative thoughts not only at work but also while playing, eating, or answering nature's call. In other words, creative thinking is not altogether controllable, and it is important for the designer to be on alert for creative insights.

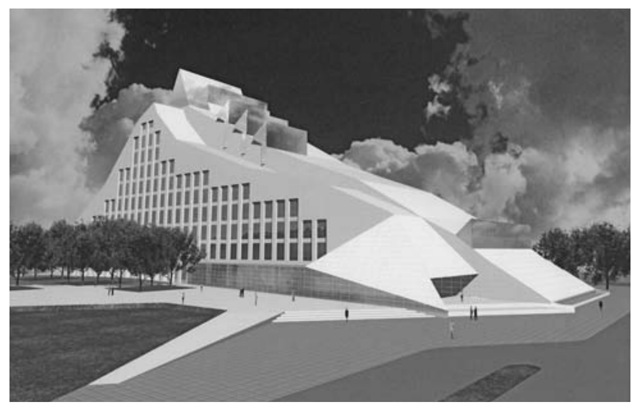
Color or black ink is usually a better medium for thumbnail sketches than colored or toned pencil values, especially if you plan to do a percentage reduction of the thumbnails to accommodate a certain page or panel size in a presentation.



Sketch: Canopies over metro entrances
Washington, D.C.
8.5" × 11" (21.6 × 27.9 cm)
Medium: Ink on vellum
Courtesy of Arthur Cotton Moore/Associates, Washington, D.C.
Drawn by Arthur Cotton Moore, FAIA



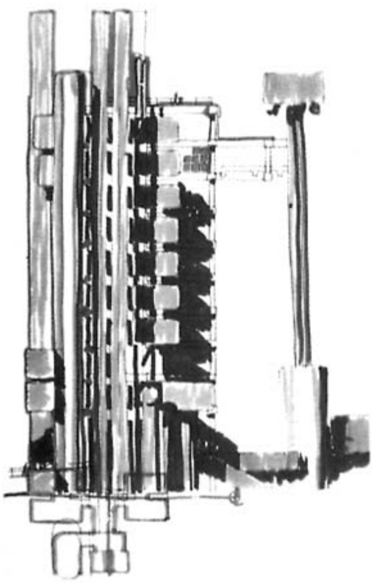
© Gunnar Birkerts Architect



Sketch diagrams: National Library
Riga, Latvia
Medium: Black marker pen on smooth paper
Courtesy of Gunnar Birkerts and Associates, Inc. Architects

Sketch (top right) of proposed canopies over the existing metro entrances for the metropolitan Washington, D.C., transit system. The curved beams are bent or cut out of stainless steel sheets and are designed to expand or contract laterally in order to adapt to the wide variety of existing entrances. The curved beams support pipe purlin and glass roofs. The canopies are shaped to have natural ventilation and to be evocative of a rapid-transit system. The intent is to provide a light, airy signature structure that will quickly become identified with the system.
[Architect's statement]

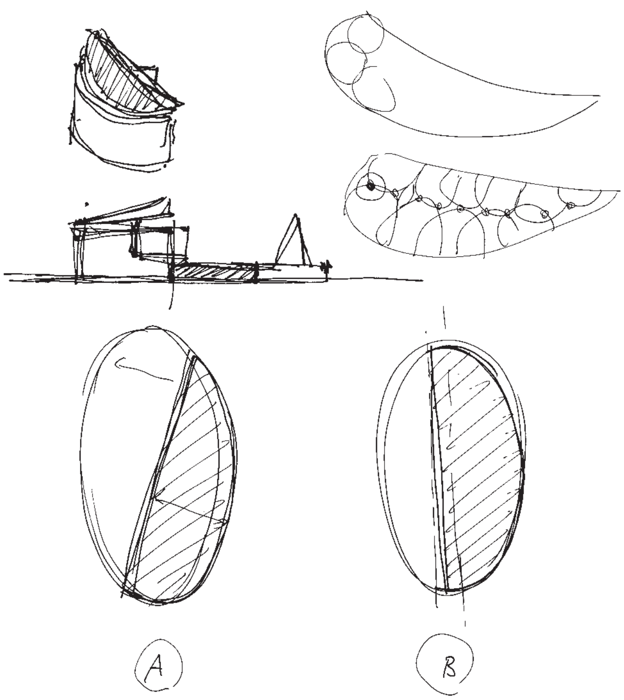
Diagrammatic exploration is an evocative way of design sketching. Hand-generated diagrams and computer-modeled diagrams are both forms of conceptual sketching. Likewise, conceptual modeling by fabricating "hands-on" models or study models (see model photo above) using any kind of found material is also a form of conceptual "sketching" in three dimensions. The Birkerts' thumbnail sketch is a case in point that the final building deviates substantially from the sketch. It illustrates the nonlinear development of the design process for a particular designer/architect.



© Wikipedia

A very early study showing plan and elevation of a satellite tower for Lloyd's of London. At this stage of the project, the provision of services was considerably underestimated. In particular, the plant room was eventually more than twice the size of that shown. This freestanding tower is one of six servant satellite towers that surround the main atrium of the building.
[Architect's statement]

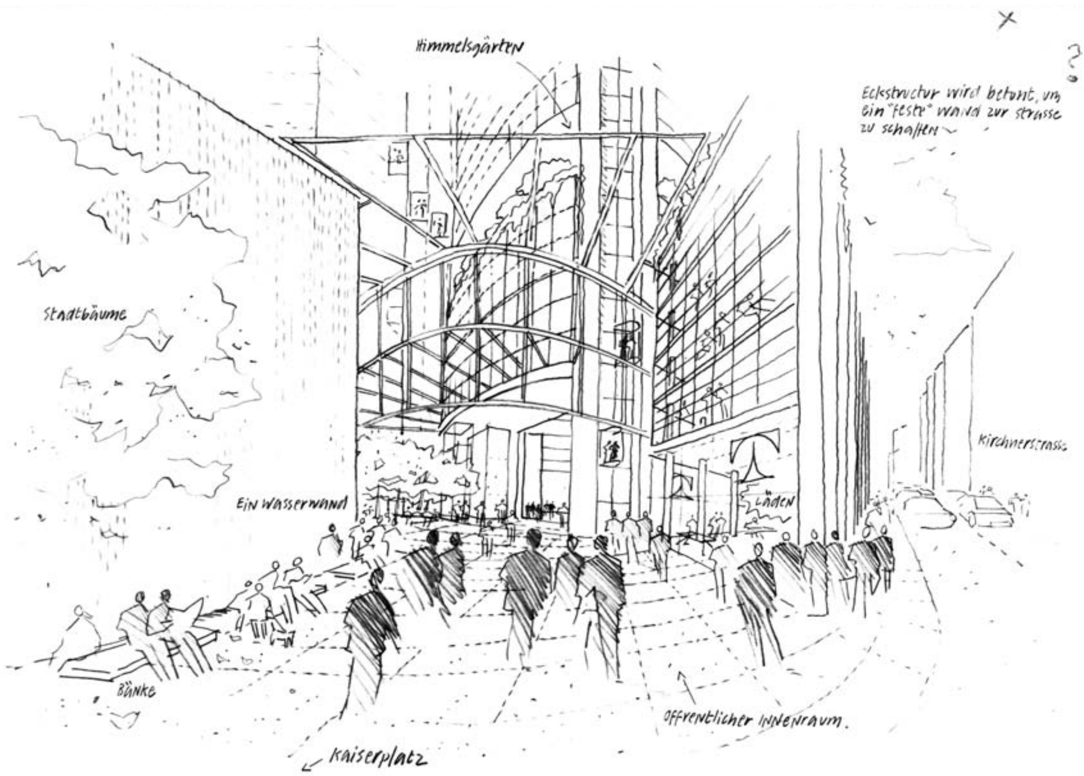
Sketch: Lloyd's of London, London, England
33" × 45.5" (83.8 × 115.6 cm)
Medium: Pen and ink on tracing paper
Courtesy of the Richard Rogers Partnership, Architects



Sketches: New wing of the Van Gogh Museum
Amsterdam, The Netherlands
Medium: Ink on paper
Courtesy of Kisho Kurokawa Architect

Design concept: The new wing was built in the open space adjacent to the main building of the museum, which was the last work of the Dutch modernist architect Gerrit Rietveld. After the whole landscape had been considered, 75 percent of the building's area (excluding the main exhibition hall) was constructed underground to minimize the space it would have taken aboveground. The new wing connects to the main building through an underground passage. Although Rietveld and Kurokawa share the modernist idea of geometric abstraction, Kurokawa's new wing departs from Rietveld's linear style with curvilinear shapes and lines, employing the traditional Japanese idea of abstraction.
[Architect's statement]

The design-drawing process typically begins with freehand sketches. The sketched design drawings should be artful even though they will rarely be considered art. The artist usually creates permanent artifacts, whereas the designer creates sketches that are referential but are not ends in themselves. These documents give rise to built form and are afterward largely forgotten. The sketches on this page resulted in outstanding completed works by the architects noted. Develop the good habit of carrying a *sketchpad* with you as you travel within the urban landscape; observe and record what you see with quick sketches. Fostering this habit will eventually strengthen your ability to visualize and conceptualize. *Conceptual thinking* is the crucial initial step in the design-drawing process that helps you communicate your ideas.

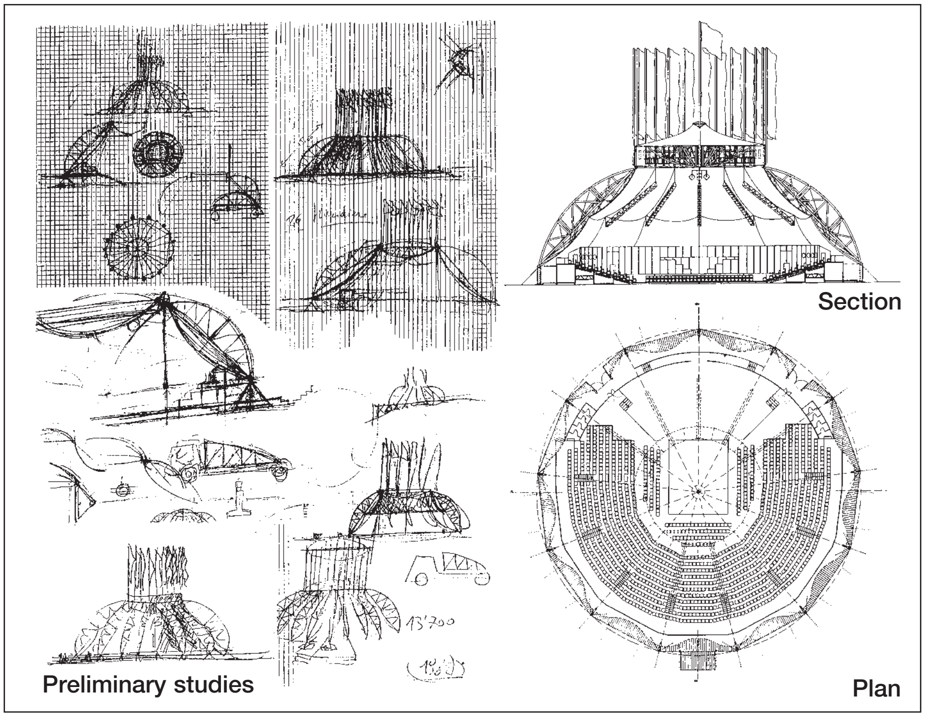


Conceptual sketch: Commerzbank, Frankfurt, Germany
11.7" × 8.23" (297 × 209 mm)
Medium: Pencil on paper
Courtesy of Foster and Partners
Sketch by Lord Foster of Thames Bank

The sketch explores the three-dimensional geometrics that meet at this critical junction—the entrance to the public spaces. It is also mindful of the role that it can play to communicate ideas to others.
[Architect's statement]

Freehand *conceptual sketching* is the most potent means of generating ideas for any type of design. It is unlikely that any medium will fully supplant the immediacy and directness of freehand drawing. In architectural design, recording and evolving ideas as they occur is of utmost importance, and this oldest and most primal method of recording ideas is still essential. The designer should always record exploratory ideas with any accompanying notes (those on the sketch above are in German) on a sketchpad or in a *sketchbook* (logbook) with bond paper that takes any kind of medium. Many architects keep sketchpads or sketchbooks on hand at all times for the express purpose of recording their design ideas. A sketch journal or visual diary can be an invaluable reference source during the design process.

© Ian Lambot



Design sketches:Tent for the 700th anniversary of Switzerland
Medium: Pencil
Courtesy of Mario Botta, Architect, Lugano, Switzerland

Envisioning and exploring a design concept in the conceptual design stages is a time-consuming, gradual process. Quick freehand doodles and speculative thumbnail sketches are the vital images that make the process work. The preliminary sketch studies in this example typify an analysis and exploratory stage, whereas the hardline drawings typify and represent a synthesis stage.

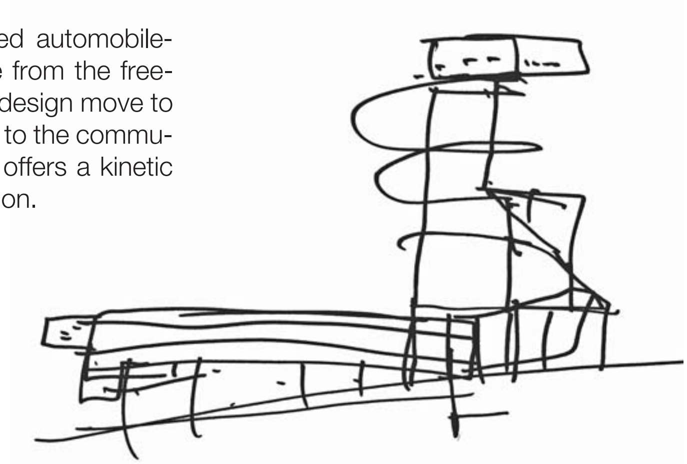
© Alo Zanetta

© Alo Zanetta

Project by Mario Botta, Architect, Lugano, Switzerland
Photographs © Alo Zanetta

Note that Botta used gridded graph paper (top left) to give more scale to his freehand conceptual sketches. The lesson here is that designers must always have a sense of scale when sketching ideas. That the design exploration stage should not be scaleless needs to be inculcated early in a student's education. Otherwise, the student may find his or her design concept not fitting the scale of the site.

Taking into consideration the prominent high-speed automobile-oriented context of the building, which is so visible from the free-way, the architect applied the "building as signage" design move to effectively create a "billboard" advertising the school to the community. The ramp's subtle ideogram of the number 9 offers a kinetic addition to the otherwise static rectilinear composition.

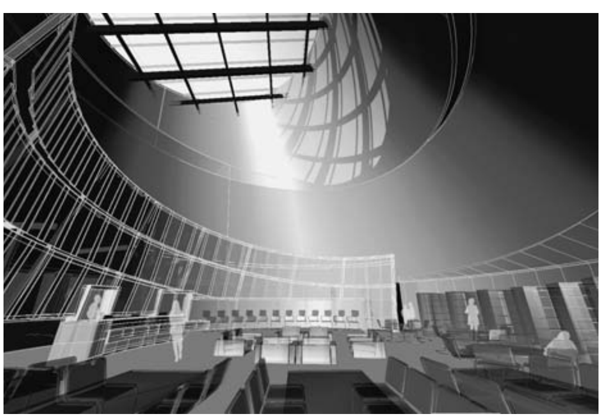


Conceptual sketch: Central Los Angeles High School #9
for the Visual and Performing Arts
Los Angeles, California, USA (2002–2008)
Medium: Marker on tracing paper
Courtesy of COOP HIMMELB(L)AU

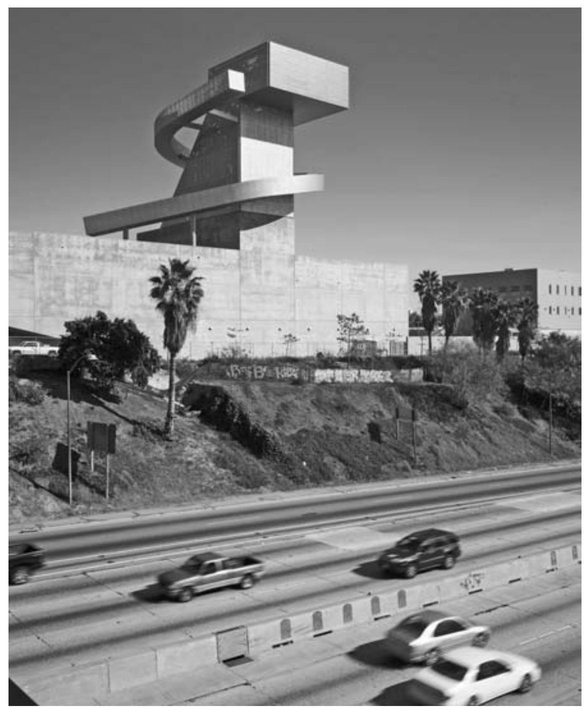
© Duccio Malagamba

Photo of library interior

© Roland Halbe

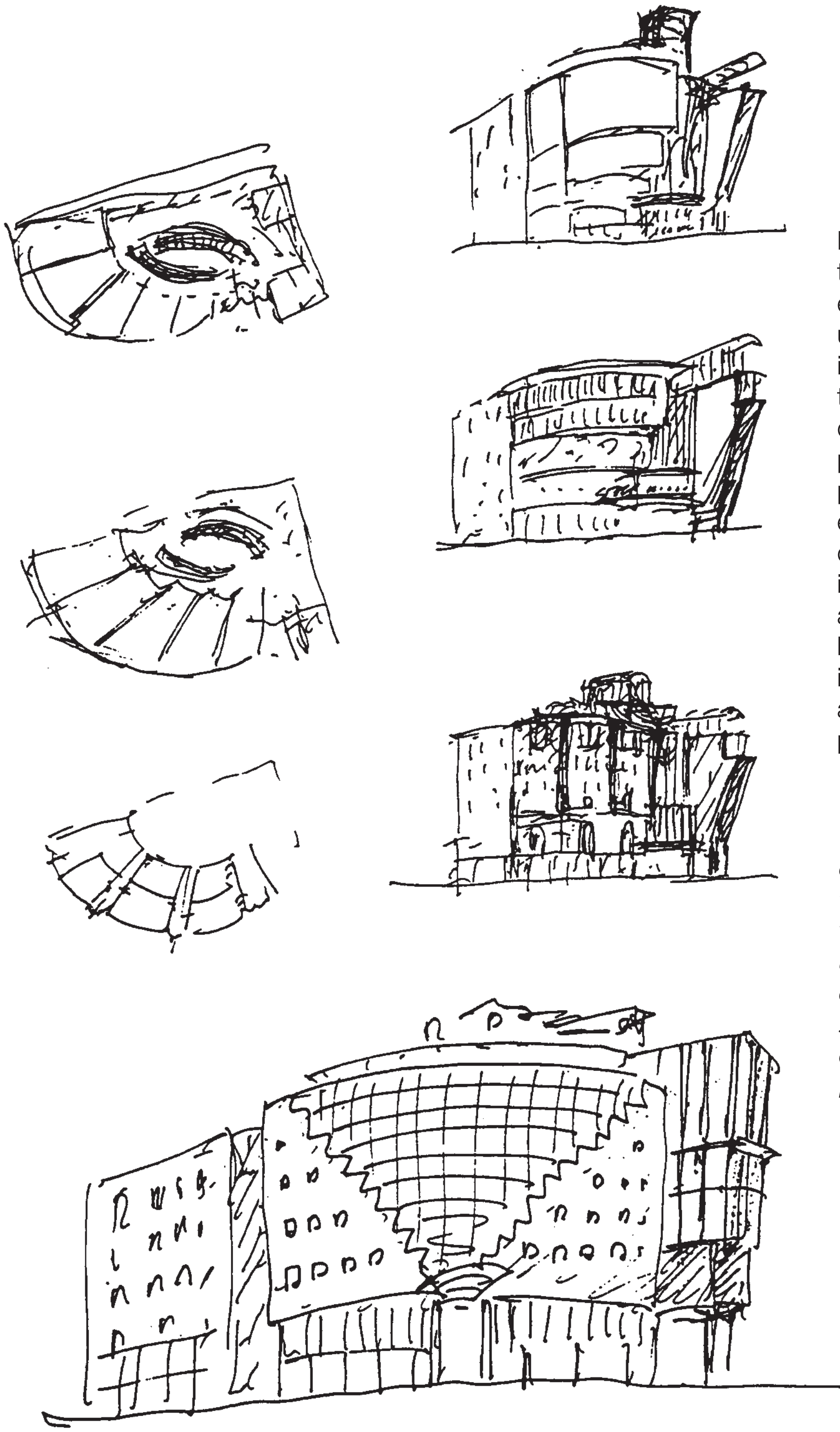


Drawing: Interior view
Courtesy of COOP HIMMELB(L)AU



© Roland Halbe

COOP HIMMELB(L)AU'S design concept is to use architectural signs as symbols to communicate the commitment of the Los Angeles community to Art. Like chess figures, three sculptural buildings—which relate to the context of downtown Los Angeles and the program—redefine spatially and energetically the otherwise orthogonal arrangement of the master plan. A tower figure with a spiraling ramp in the shape of the number 9 located on top of the theater's fly-loft serves as a widely visible sign for the arts in the city, and a point of identification for the students.
[Architect's statement]



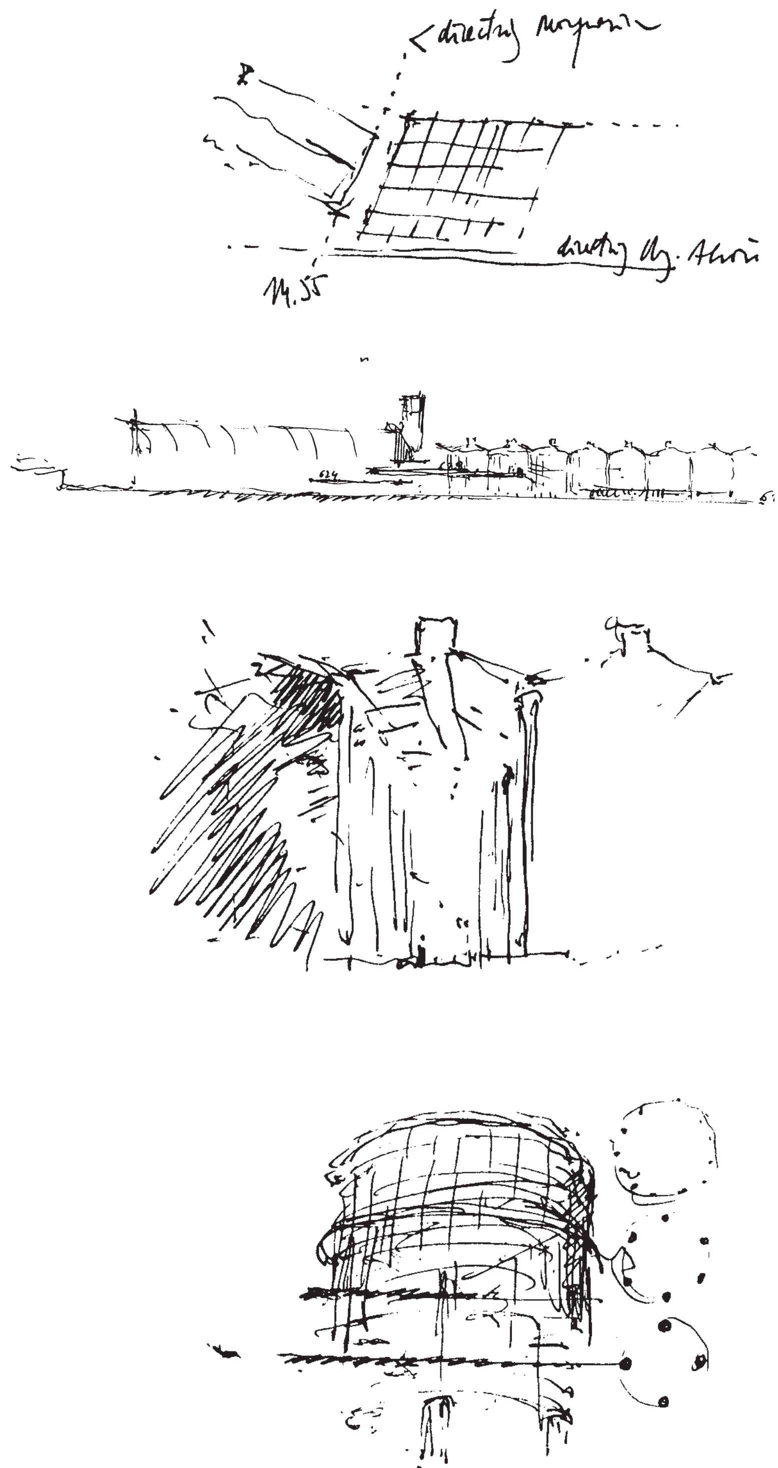
Much like nondirected research in the sciences, sketches can be generated for the purposes of speculation and reflection without any immediate goal in mind. Sometimes these highly imaginative doodles are developed without regard for the pragmatic constraints found in the physical world (e.g., gravity, climate, etc.). Every design professional develops his or her own language in expressing concepts graphically as a way of seeing. Concepts can be approached by thinking in plan, in elevation, in section, in paraline axonometric/oblique images, or in perspective images.

These sketches investigate two different approaches. The top three perspective sketches show stone facades as a veneer and a cantilevering part of the building to separate two urban spaces. The bottom sketch investigates a symmetrical approach with a central entrance, which was not followed up.
[Architect's statement]

Early conceptual sketches:Haas–Haus, Stephansplatz, Vienna, Austria
Medium: Ink
Courtesy of Hans Hollein, Architect

© Hans Hollein

As you examine the design sketches in this chapter, be aware that different types of media directly affect the feeling of space that is perceived. Architects and design professionals have adopted many traditional artistic media (graphite, ink wash, watercolor, pastel, gouache, etc.) to express their ideas; now they are beginning to exploit the medium of digital technology.

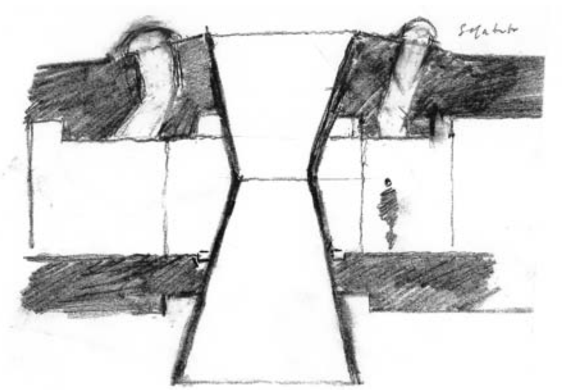


Several sketches of the Atocha Railway Station. One of them speaks about the plan and shows the importance of the existing axes in defining the project. Another two are more related to the description of what a space atmosphere should be: One is related to the lantern, the other to the big hall. The sketch in the middle shows a section. Sketches help to fix the ideas floating in an architect's mind. They often record this early moment when an architect foresees the space to come.
[Architect's statement]

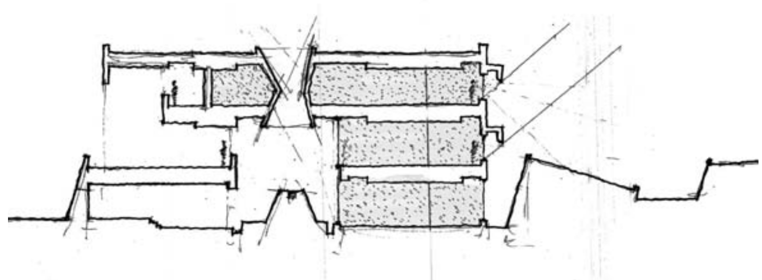
© José Rafael Moneo

Conceptual sketches: Atocha Station
Madrid, Spain
31.5 × 21.5 cm (12.4" × 8.5")
Medium: Ink
Courtesy of José Rafael Moneo, Architect

The partial section, the overall cross section showing the context (see also pages 551–565), and the oculus mock-up reveal the simultaneous testing of a design idea of bringing natural light into the interior of a building. Notice the insertion of a scale figure to enable the designer to imagine himself or herself in the space; this is more useful than putting a dimensional scale on the sketch. When drawings are not sufficient, building a mock-up on the site would give the designer a sense of assurance and confidence that drawings cannot provide. This is an excellent example of a thorough methodology in design.



We always believe in sketching by hand—especially at the early stages of design. The hand is more connected to intuitive thinking.
[Architect's statement]



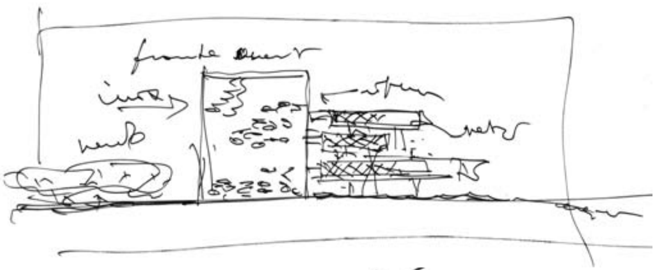
Conceptual sketch: TATA Consultancy Services (top)
Bunyan Park, Mumbai, India
Medium: Graphite sketch on trace paper
Courtesy of Tod Williams Billie Tsien Architects

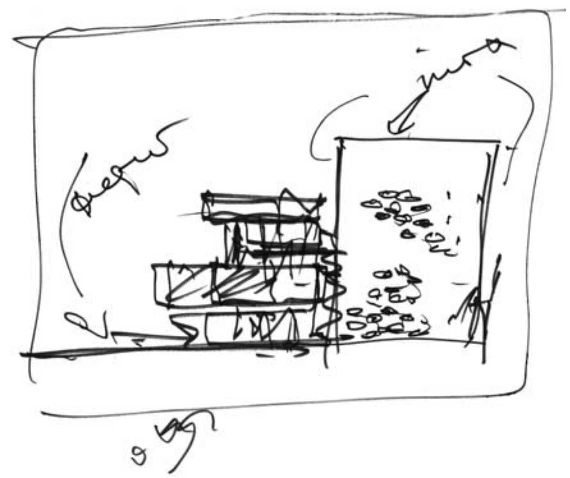
Workstation section sketch (middle):
Medium: Ink on paper
Courtesy of Tod Williams Billie Tsien Architects

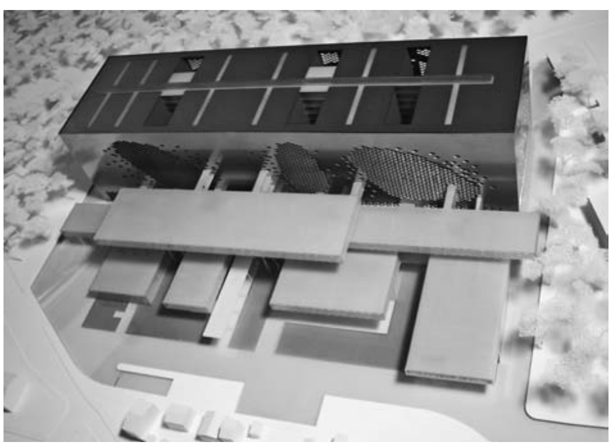
Photo: Oculus mock-up
Courtesy of Tod Williams Billie Tsien Architects

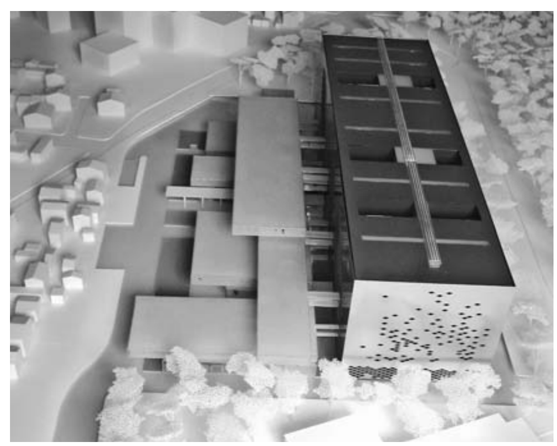
Photo: Workstation courtyard with oculus and fountain
Courtesy of Tod Williams Billie Tsien Architects

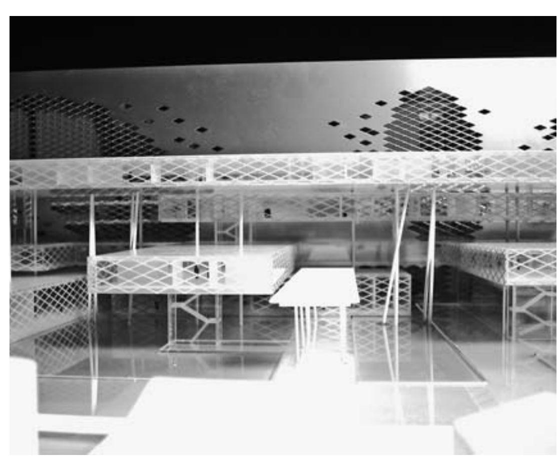
These are thumbnail conceptual sketches and model photos of architect Massimiliano Fuksas's competition-winning project for the State Archives Centre in France. Note to what degree the initial hand-sketched ideas contain the essence of the final model. Thumbnails serve as a visual diary, tracing the designer's thought process as the design evolves. This exciting building, scheduled to open in 2013, has one of the largest storage capacities in the world, with 200 miles of shelves for state archives dating to 1790.



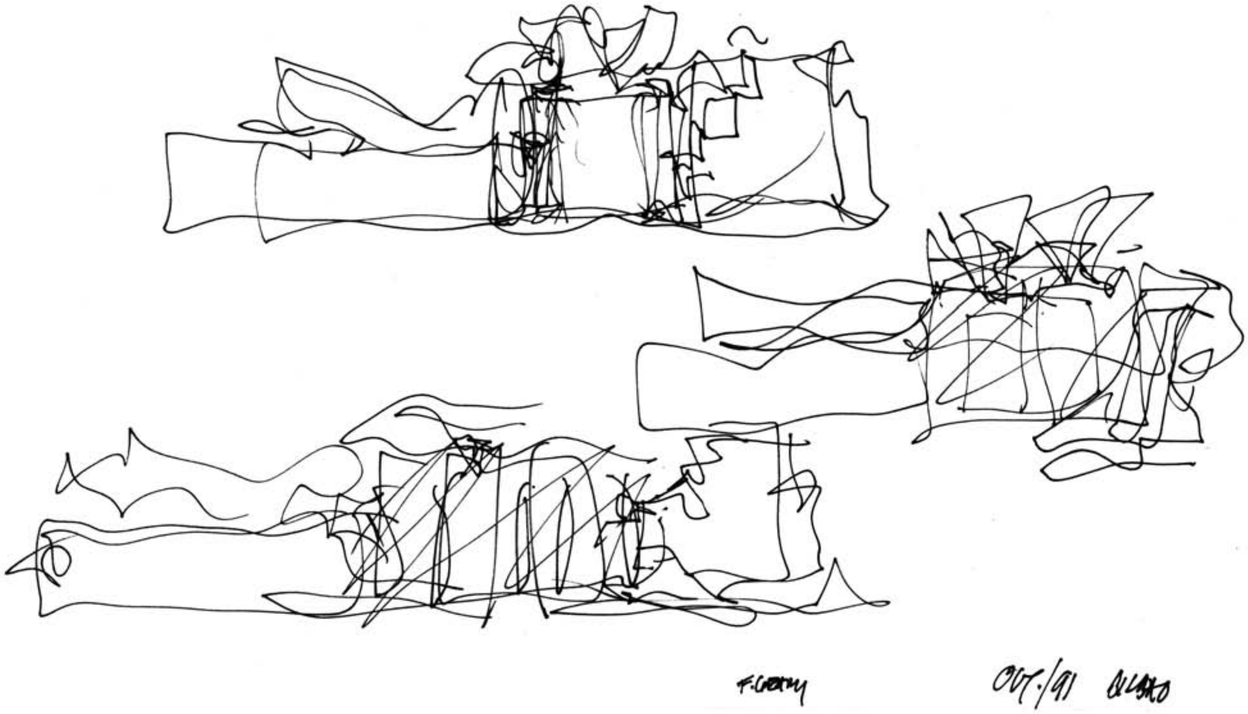








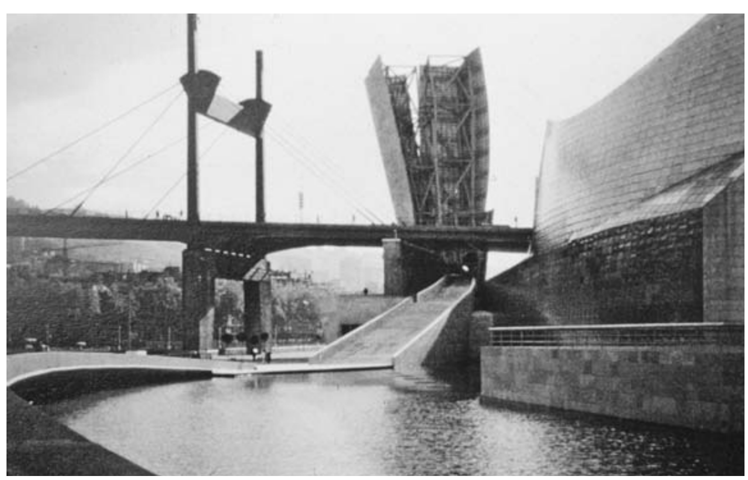
Conceptual sketches and model photos: State Archives Centre
Pierrefitte-sur-Seine, France
Courtesy of Massimiliano Fuksas, Architect



Conceptual sketches: Bilbao Museum
Bilbao, Spain
Medium: Ink on paper
Sketch by Frank Gehry
Image provided by Gehry Partners, LLP
Courtesy of Gehry Partners, Architects

© Sydney Pollack

The Bilbao Museum in Spain, with its titanium panels, is one of the great signature buildings in the world today. One should not view it only as an isolated piece of sculpture, but rather as a building that blends well into the urban fabric of the city. Furthermore, it addresses an existing nearby bridge by having a related sculptural element on the other side of the bridge (photo right).

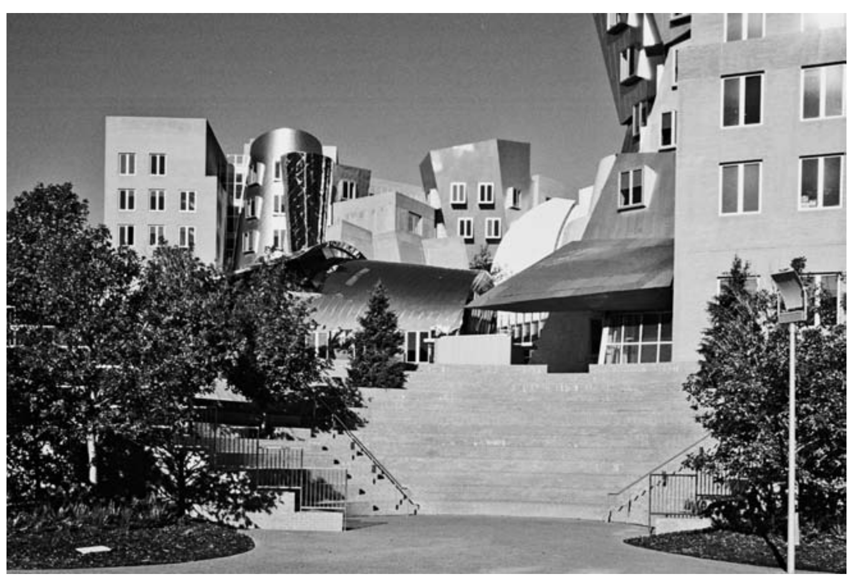


© Sydney Pollack

In classic examples of conceptual sketching such as Erich Mendelsohn's drawing for the Einstein Tower (left) at Potsdam, Germany (ca. 1920) or Ludwig Mies van der Rohe's sketches for the Barcelona Pavilion (ca. 1929), we again see how initial impressions are often precursors to or contain the essence of the subsequent, more developed design. The same connection is seen between Frank Gehry's conceptual sketch for his Stata Center at the Massachusetts Institute of Technology and the completed building complex.

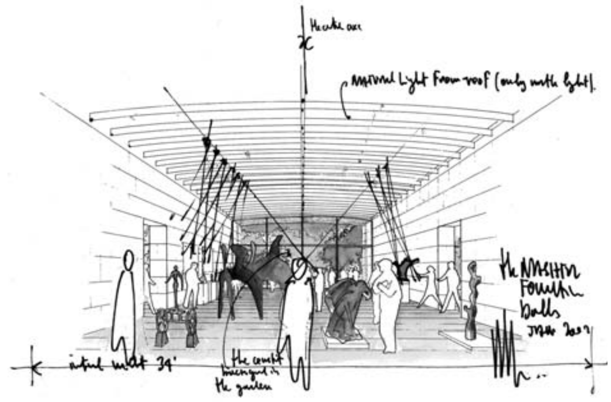
In addition to ink-on-paper conceptual sketches, Gehry works extensively with study models. His office is filled with models—each project done at different scales—and looks like a sculptor's studio. Because of the complexity of his designs, the real-space models are quickly digitized so that design modifications can be made on computers.

For background on the architecture and ideas of Frank Gehry, see Sydney Pollack's documentary film *Sketches of Frank Gehry (2006).* It is well documented that Gehry's team uses physical models extensively in design exploration at all stages of developing the design in iterations between manual sketching and the computer. His models and sketches may be his very personal way of talking to himself.



© William W. P. Chan

Sketch and photo: The Ray and Maria Stata Center for Computer, Information, and Intelligence Sciences
Cambridge, Massachusetts
Medium: Ink on paper
Sketch by Frank Gehry
Courtesy of Gehry Partners, Architects



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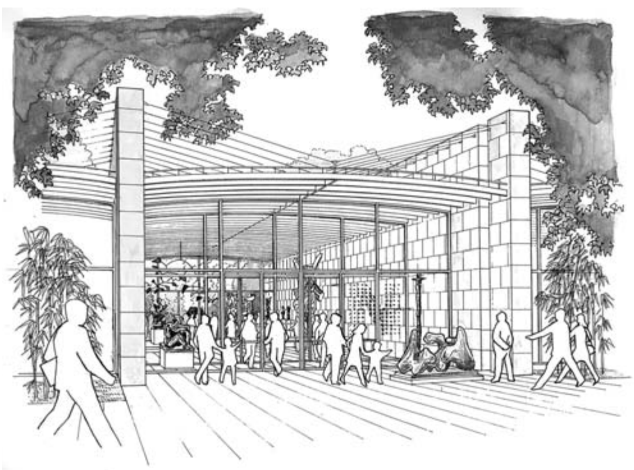

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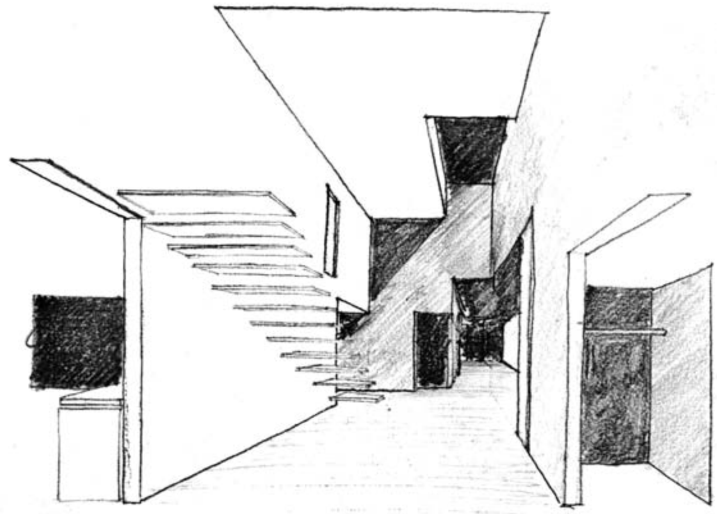
These drawings illustrate the method of working out the details of the architectural elements after the volume and materials for the wall and structure were decided. The notes on the base drawing clearly show us that the designer was trying to organize and resolve issues of lighting—both natural and artificial—and the visual coordination of fixtures to the exterior glazing. These eye-level drawings, which are not abstract, reveal an excellent method in achieving accuracy. Hence, the final built design is very close to the design intention.

Conceptual perspectives: The Nasher Sculpture Center (1999–2003)
Gallery Pavilion and Gallery Space, Dallas, Texas
Medium: Watercolor
Courtesy of the Renzo Piano Building Workshop, Architects; E. Baglietto, Partner in Charge
Client: The Nasher Foundation Consultants: Peter Walker & Partners; Ove Arup & Partners; Interloop A/D; Beck Architecture
General Contractor: HCBeck

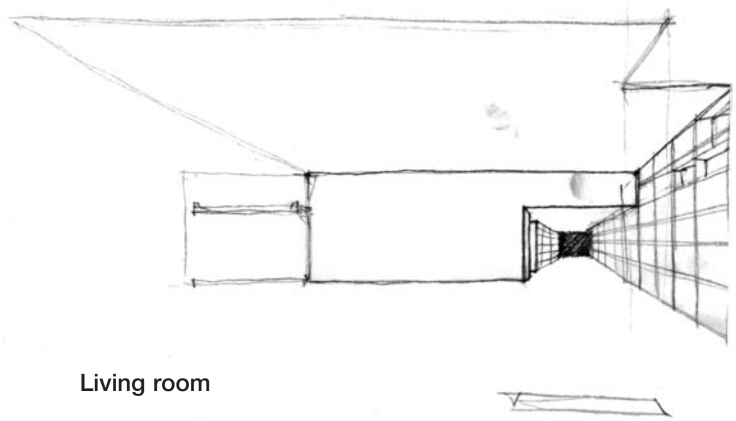
These quick conceptual sketches were done to convey the spatial quality of the interior of this sculpture center. Quick visualization studies using one-point perspectives are particularly good for capturing the feeling and essence of a space. Handwritten notes were used on the interior sketch to clarify design issues. Note the use of simplified human figures: For rapid visualization studies, details on people are not necessary.

© Christian Richters



Entrance hall

© Christian Richters



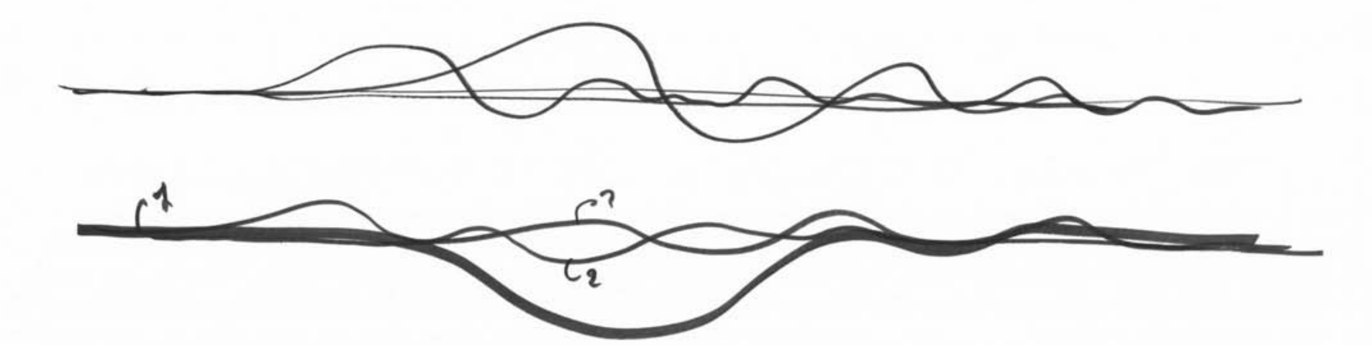
Living room

Conceptual perspectives: Lubbering residence
Herzebrock, Germany
Medium: Pencil with colored pencil
Courtesy of Drewes + Strengearchitekten

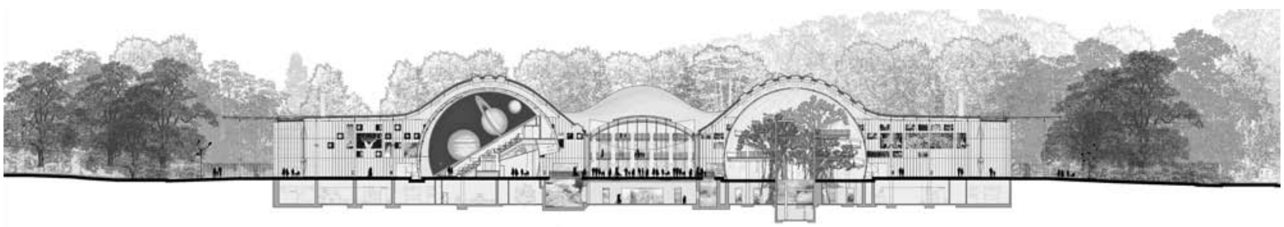
© Christian Richters

This quick manual pencil drawing (top right) was accentuated and highlighted with colored pencil. Instead of a rectangular frame, an endless outline was used to show the openness of this porous entrance hall. The space is perforated in all directions in order to keep the space flowing.
[Architect's statement]

Design sketches of interiors attempt to show the volumetric spatial quality of the conceived form in the most descriptive way. Freehand drawn perspectives, especially frontal one-point perspectives that emphasize depth of space, are commonly an architect's first choice for speculative representation.



The sketches show curved lines as a series of loci of design counterpoints moving up and down a horizontal axis. The idea conveyed by this sketch is that there is a powerful driving force keeping the momentum of the design intact. The section and the photographs attest to the use of available lightweight technology to realize this "flying carpet" metaphor. They demonstrate the importance of having the technology in one's mind when conceptualization begins.



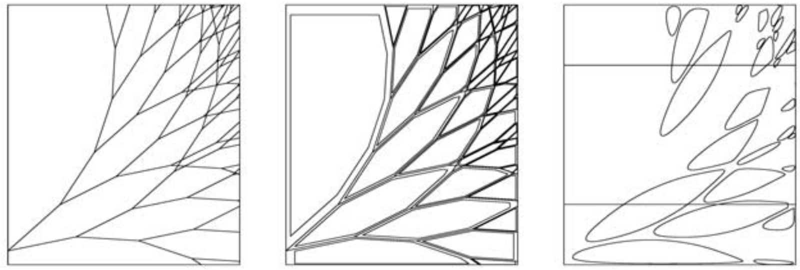
Conceptual sketch and building section: 2000–2008 California Academy of Sciences
San Francisco, California, USA
Medium: Black ink Pentel for sketch and AutoCAD for building section
Courtesy of Renzo Piano Building Workshop, Architects
In collaboration with Stantec Architecture (San Francisco)

© Rendow Yee

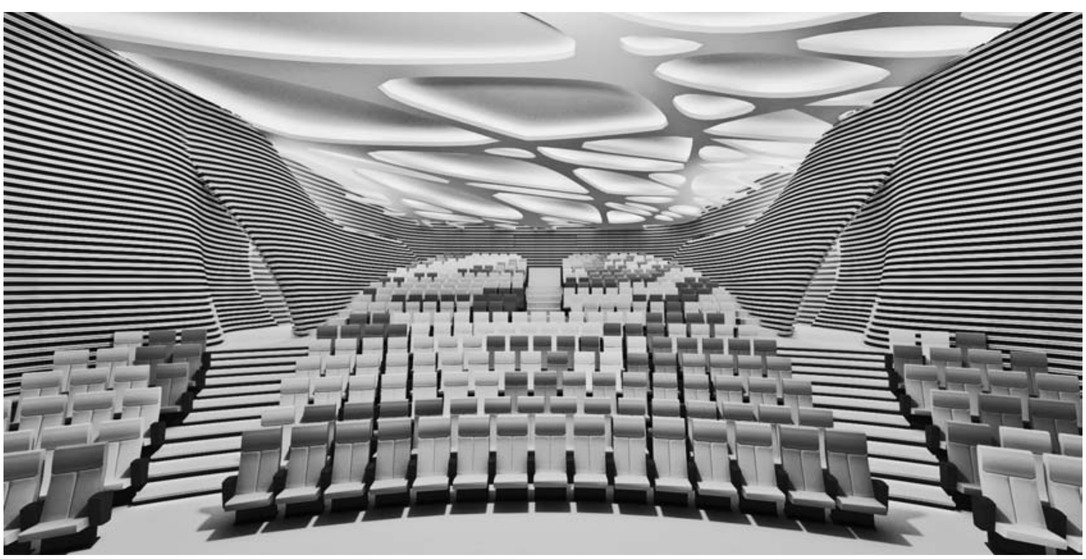
© Rendow Yee

The idea came to me to make a flat roof, like a flying carpet, and in the places where you need to put the planetarium and the rainforest, it could curve up and curve down. It makes it more organic, a bit like it's growing.
[ARCHITECT'S STATEMENT]

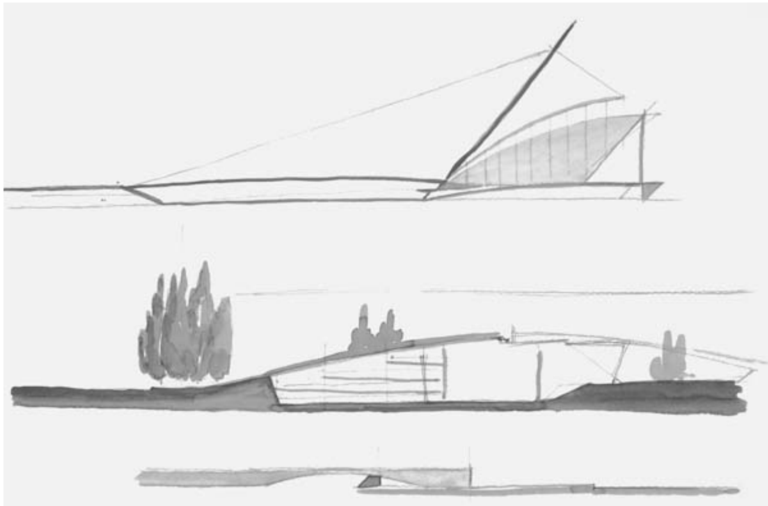
Trees are often the source of inspiration to me: they are complex structures elaborated from simple rules, growing coherently and continuously in time and space. The efficiency of those structures is based on the notions of redundancy and differentiation in opposition to the concepts of modern engineering, such as modern optimization and repetition.
[Architect's statement]

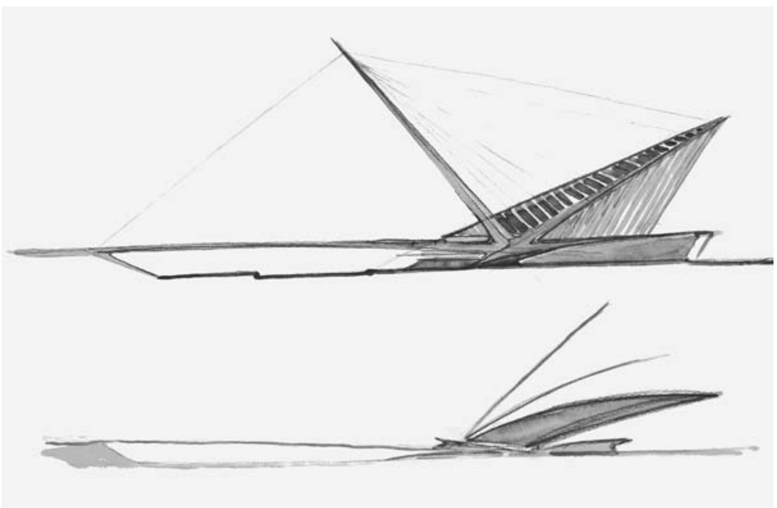


In this instance one can see the inspirational theme of a form narrative, as in the first three panels. There is a metamorphosis of abstraction from the plant/tree form to the pure geometric form. A unique aesthetic was designed for the ceiling by bending the plane and duplicating the abstracted form.

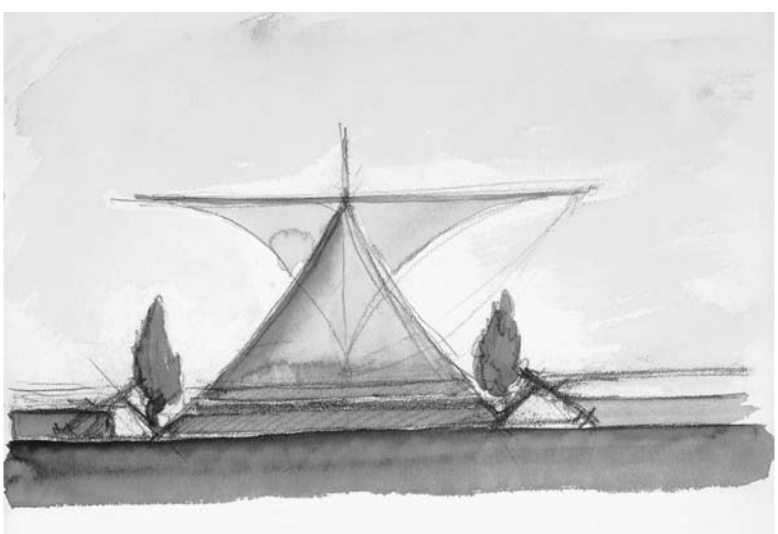


Drawings: CANOPY: Competititon for the new auditorium and movie theater (VTHR)
Saint Cyprien, France
First-prize winner, Schematic Design Phase
Medium: 3-D graphic software
Courtesy of Serero Architects





Santiago Calatrava, like architect Steven Holl, uses watercolors for his conceptual sketches. Watercolors usually show volumes and planes better than other media. When analyzing the architecture of Calatrava, one notices a sense of motion—real or perceived—in addition to the organic and complex formal resolution. Emerging plans, sections, and/or elevations are snapshots of aspects of the yet-to-happen design. These partial and static renditions of an architecture of such fluidity are inadequate to capture the spirit of a project in the design stage. Nevertheless, brushes with watercolor tend to stimulate and communicate many ideas to the imagination of the designer, as well as to the intended audience. Calatrava's *brushstrokes* express a kinetic quality in depicting form and movement. *Watercolor,* with its minimal and subtractive quality, seems to be the perfect medium for recording a designer's goal in the beginning stages of conceptualization.



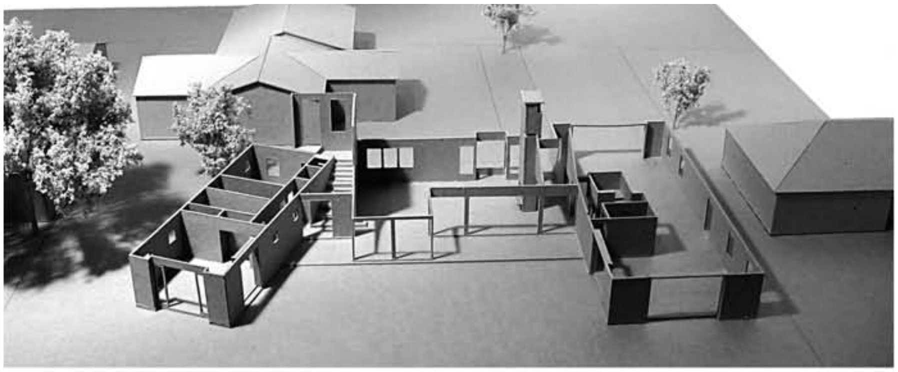
Conceptual sketches: Milwaukee Art Museum
Milwaukee, Wisconsin
Medium: Watercolor
Courtesy of Santiago Calatrava, Architect & Engineer

Calatrava's sketches helped communicate his design to clients, users, and design team members. They also aided in conceiving, developing, and confirming ideas prior to the building process. Note how well all three photos represent the three watercolor sketches.

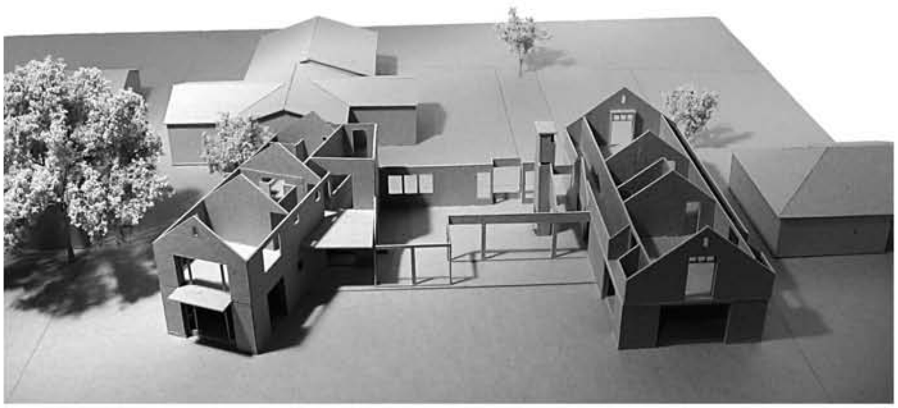
Calatrava is that rare hybrid—both architect and structural engineer. His buildings are usually kinetic, in that they have components that move. Other prominent twentieth-century architect-engineers are Pier Luigi Nervi (1891–1979) and Felix Candela (1910–97). (See page 97.)

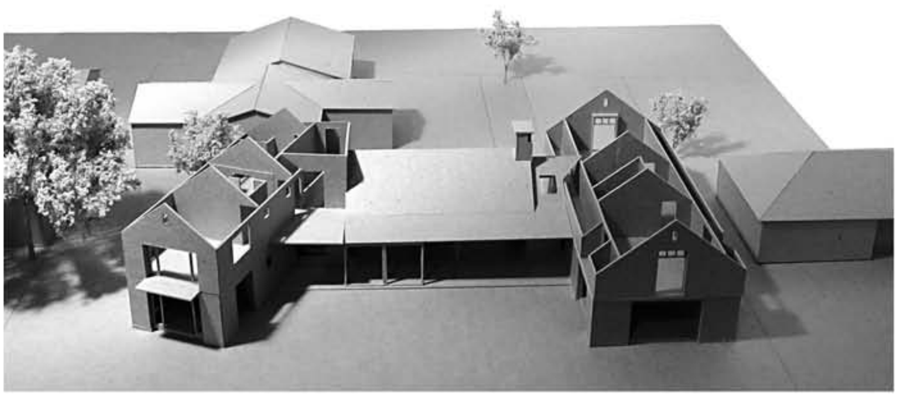
Architects define the building's appearance, feeling, and style, the arrangement and sequence of spaces, and the materials used for construction. Structural engineers make sure the building stands up by satisfying codes for structural connections and designing exact load bearings for every part of the structure.

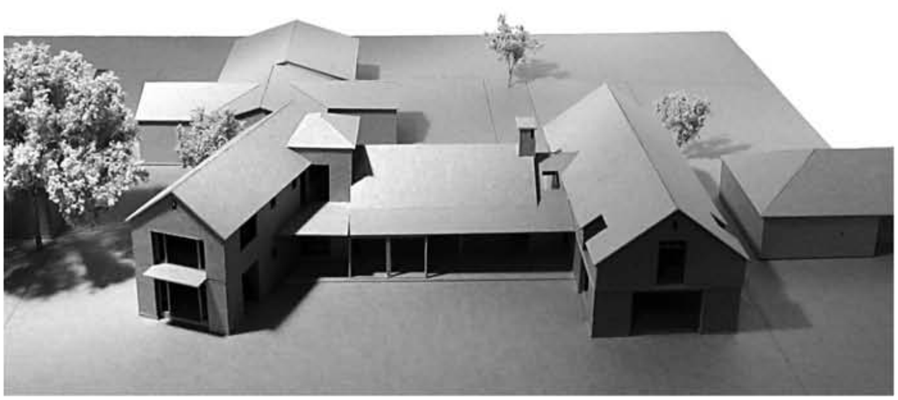
Photos: Milwaukee Art Museum
Milwaukee, Wisconsin
Courtesy of Alan Karchmer Photography



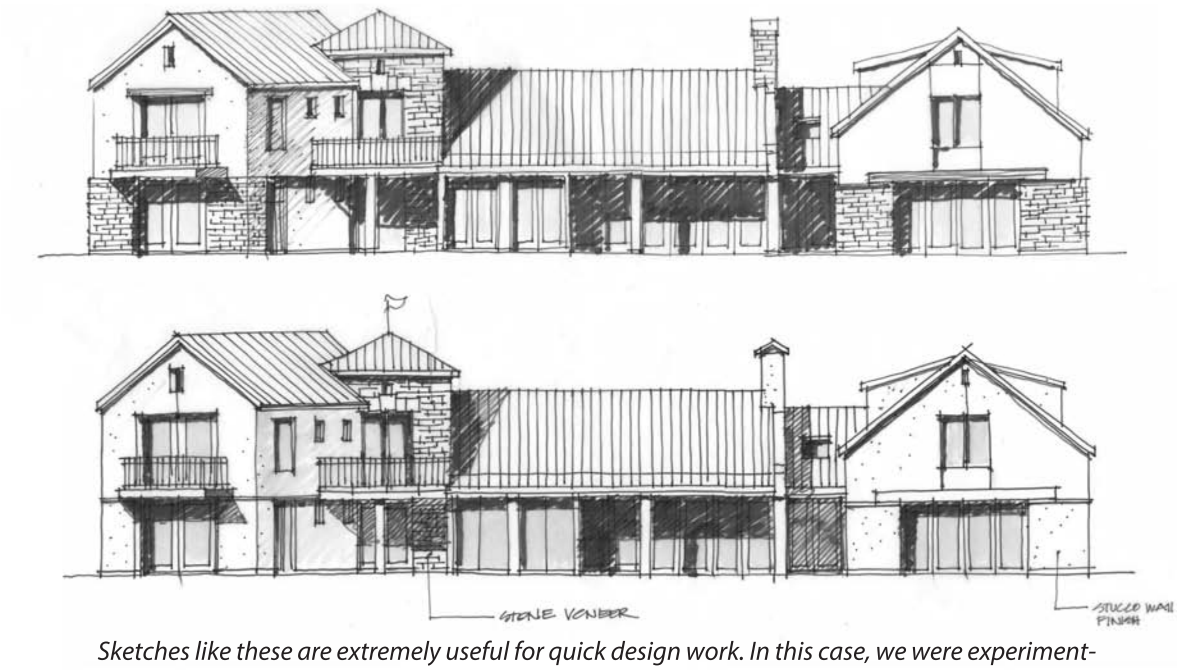
Residence (this and facing page): Half Moon Bay, California
Cardboard model: Walter Evonuk
Computer illustrations: Walter Evonuk and Masha Barmina
Media for model materials: Chipboard, wire, and foam
Medium for drawings: Ink on tracing paper
Medium for digital illustrations: ArchiCAD 8
Principal in charge: Mark English
Courtesy of Mark English Architects





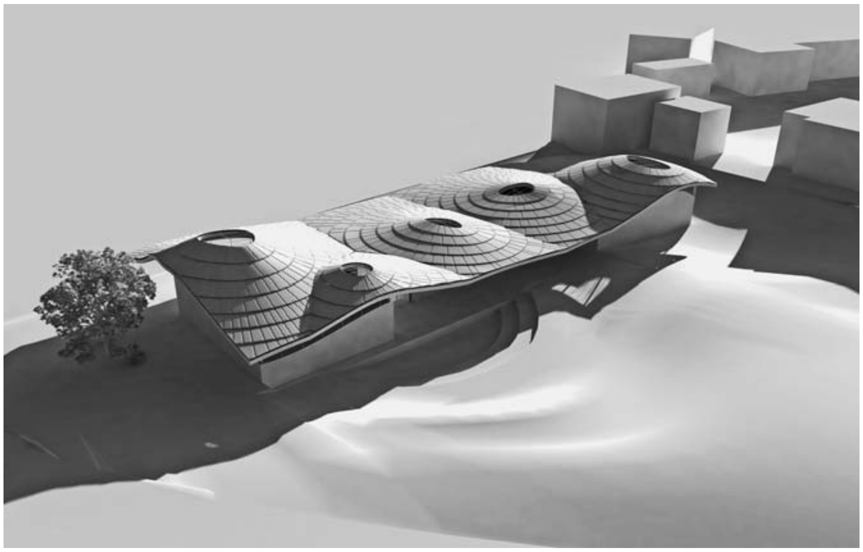


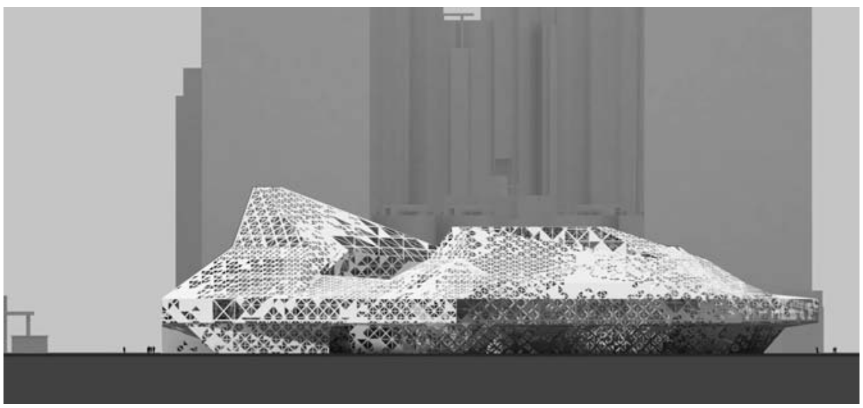
To design and communicate with clients, we often employ several different methods of visual representation. Physical models are helpful in refining the massing and proportion of a building. Their tactile nature often makes them an essential tool when communicating the big picture to our clients. When a model can be dissected to reveal an interior layout, its usefulness is compounded.
[Architect's statement]



Sketches like these are extremely useful for quick design work. In this case, we were experimenting with various finish materials. Several options were represented while expending relatively few resources in time or materials.
[Architect's statement]

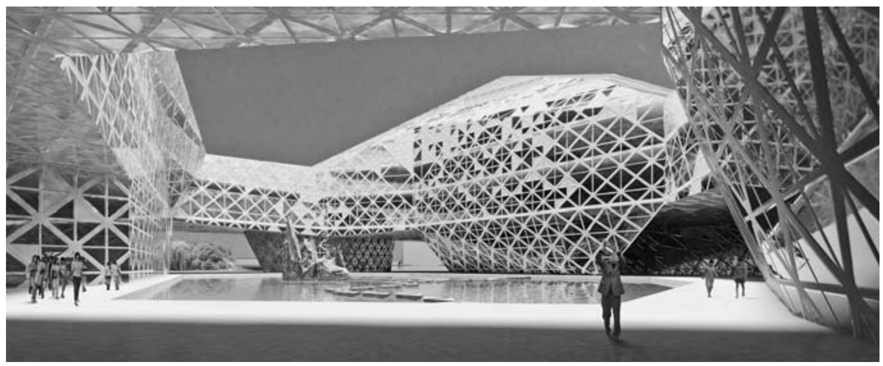
Computer modeling is a vital design tool in our office. These models are useful in the ways physical models are, but can be made much more precise and offer more options for detail, including realistic coloring and textures. While often time-consuming, 3-D modeling can be made affordable by using a program like ArchiCAD 8. Floor plans, sections, and elevations can be extracted from the model and used to speed the production of construction documents.
[Architect's statement]

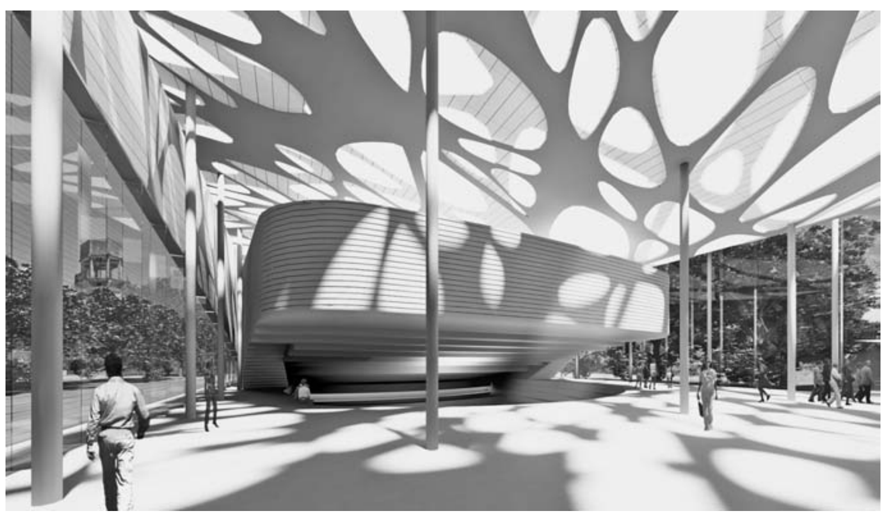




In order to explore design alternatives, quick conceptual modeling with rough study models that are always subject to modifications is a normal part of the design process. The models shown (top made of white paper, middle and bottom of styrene) resulted in the digitally designed interior images on the facing page. The photograph of the study model of Serero Architect's design of the Orcines Cultural Center (top) is a good example of a design model constructed to explore and explain exterior massing and interior design of a nonrectilinear volume. First, the exterior massing illustrates a series of hilly roof terrains with oculus skylights at the apex of each hill. This model can be easily constructed to express the formal design framework. Without resort to sophisticated computer plotting, the model was constructed as topographic contours.

Once the exterior volume has been set conceptually, digital coordinates of the curved form can then be entered using a computer program to give a more detailed configuration to the interior, which allows the designers to experience the virtual excitement and potential of such an *organic design.* The initial study models were simple and conceptual and permitted the designers to do elaborate data entry to proceed beyond the conceptual stage. More data leads to more details of both the interior and exterior resolution of the design. The subsequent chapter will discuss this area of modeling with organic forms.





Top: Study model, interior view: Orcines Cultural Center
Orcines, France
Medium: 3-D graphic software

Middle: Study model, interior courtyard view: Mocape Shenzhen
Shenzhen, China
Medium: 3-D graphic software

Bottom: Study model, interior view: Competition for a new auditorium and movie theater,
Saint Cyprien, France
First-prize winner, Schematic Design Phase
Medium: 3-D graphic software
Courtesy of Serero Architects

3

Introduction to the Digital-Manual Interface

BIM (building information modeling) and drafting software such as Revit, ArchiCAD, AutoCAD, and Bentley have become not only effective drawing tools but also precision facilitators of the construction process. It is not unusual for construction documents to number hundreds of pages of detailed information on all aspects of a building. BIM software has proved itself indispensable in professional practice now because of its ability to store or encode all such information in one digital model. In the drawing phase, BIM enables professionals to automatically update an entire set of drawings when design changes are made. And BIM's utility, in terms of engineering and data management, extends well beyond initial design and construction into the postoccupancy phase.

Before BIM, drafted lines were just two-dimensional graphic symbols, and every sheet of a drawing was a flat surface displaying one layer of information. To maintain a coordinated document, every design change had to be manually updated across numerous sheets. With BIM, in a document a wall is no longer defined simply by lines; it has specified material properties. Because of such attributes, engineers have ready access to the information they need to communicate with architects and to compute engineering feasibilities.

Marketing and conceptual software such 3D Studio Max, Maya, Rhino, and SketchUp is used to give architects and clients a preview of the design. Because some of these programs were originally developed for the entertainment industry, they are wonderful tools for adding realistic detail to a still-evolving diagrammatic design.

The free-flowing modeling capabilities of these rendering programs make it much easier for the designer to follow a design into whatever conceptual shape the exploration leads. Thus, commonly such software is used either in the beginning stages of a design, for nonrectilinear form-making, or in the end stages, to produce photorealistic renderings for marketing. In any digital design workflow, it is important to keep in mind that modeling need not be restricted to one software program. When the designer understands how to transfer models from one program to the next efficiently, without losing information, he or she can begin to take advantage of the individual strengths of each program.

If the digital revolution has brought remarkable gains in efficiency it has not supplanted the urge to be creative, in whatever medium is most congenial. Art and human dexterity still often take the lead. For some, design exploration, especially, goes hand in hand with traditional drawing skills. The strengths of manual drawing and modeling lie in the intuitive manipulation of the pencil or other physical media in making fluid, conceptual sketches and models. Nevertheless, as a design team confronts deadlines, the move is often made toward the assumed greater efficiency of computer graphics

The two kinds of approach to practice has led also to a pedagogical divide in architectural education. The intent of this chapter is to suggest a rapprochement, based on the recognition and appreciation of two unavoidable facts: that there has always been a strong manual component to architecture, both in representational drawing and in conceptual sketching; and that in contemporary practice a transition from manual to digital design processes continues at an ever quickening pace.

Introduction to the Digital-Manual Interface

Topic: Sketching and Design

Sullivan 2004.

Wright 1984.

Fraser & Henmi 1997.

Mills 2010.

Robbins 1997.

Topic: Study Models/Drawing as Tools of Design

Saarinen 1968.

Oles 1987.

Topic: Digital Application to Form Making

Mitchell 1990.

Hadid & Betsky 2009.

Iwamoto 2009.

Zellner 2000.

Schumacher, Patrik. "The Parametricist Epoch: Let the Style Wars Begin." *Architects' Journal* (May 2010).

Chapter Overview

After studying this chapter and browsing some reference books, you will understand the importance of designing in three dimensions. You will be aware of the options available to you when you design. Hand, eye, and brain are built-in personal resources that you develop as you engage in problem-solving with the computer and various other tools at your disposal. You should be open to options in using those tools to serve your intuition in design.

Historically, architectural design had a strong connection to the visual arts—sculptures and paintings. There is a hand-eye-brain dialogue, of varying degrees of intensity, that produces a sequence of formal ideas. It is a nonlinear process and is often described as "flashes" of evidence, which eventually bring forth solutions that constitute part of a creative process. Popular one-line statements such as "form follows function" or "form follows form" are philosophical, rhetorical judgments on a finished product that remain inadequate to describe a very complex creative process.

A simple three-dimensional object has many surfaces (planes), which can be flat or curved. Each surface consists of a series of points with coordinates in space (x, y, and z). It is the job of the designer to set these points such that they manifest themselves in three-dimensional spaces. Therefore, geometry as a tool provides the foundation of form-making.

A rectangular block has a very simple geometry with six flat surfaces. If one draws the plan view of the rectangular block, one can easily create the form by extruding the plan upward. The other end of the formal spectrum would be a piece of bone, which is curvilinear—that is, the surfaces are not flat. There is no one plan, but rather slices of plans that together describe the bone. The only way to design the bone is to make a real model with a series of abstracted planes representing the nonplanar surfaces of the bone.

1

(Left): Maya 3-D of a bone, with sections cut at different parts of the bone
Courtesy of Samir Taylor

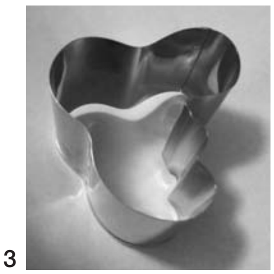
(Right): Hand sketch of a bone
Courtesy of Sara Swecker

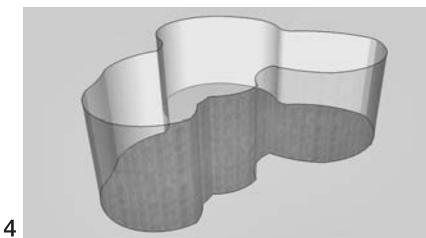
2

(Above): Photo of Aalto-designed glass vase
Courtesy of Carmen Potter

(Above): Google SketchUp 3-D model of Aalto-designed glass vase
Courtesy of Carmen Potter

3





4

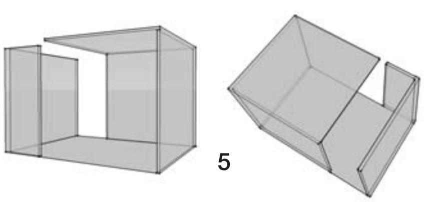
Basic Conceptual Form-Making in the Beginning (Modeling)

If one conceptualizes an object, this object possesses attributes of three-dimensionality, with lines defining planes and points defining lines. When this object is being conceptualized, the designer begins to give the shape some dimensions. With enough data, the designer would be able to create a real model, hold it in his or her hands, and look at it from any viewpoint. Small objects can easily be designed this way.

Intermediate Form-Making: Beyond Basics

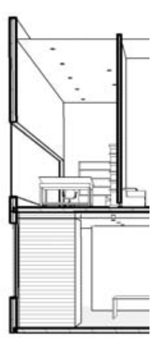
What if this object is a small building with certain habitable features—walls, roofs, ceiling, windows, and doors? The abstract box form with these tectonic elements must then be embellished with materials and constructed elements reflecting the reality of the circumstances. One method is to sketch over photographs of the simple model with detailed design elements to proceed to higher levels of design decisions. The design is no longer abstract and becomes imbued with different levels of interpretation as details are added.

Early on, much has to be resolved in structure and materiality. With the advent of digital 3-D modeling and computer-aided drafting tools, it is more efficient to switch from physical to virtual model-making.



5

(Above): Two Google SketchUp-generated views of a conceptual box
Courtesy of Carmen Potter



6

(Left): Revit 3D partial section
Courtesy of Carmen Potter

7

(Right): Revit 3D exterior perspective of exterior of room
Courtesy of Carmen Potter

As we move the design away from diagramming, each building type takes on certain inherent formal/architectural characteristics of its typology: a place for worship and assembly is very different from a typical place to live; a train station is designed for efficient movement of people; a classroom is programmed for tutoring and learning. The Industrial Revolution provided the background environment for many new building types to emerge. As many new structures began to adorn the urban landscape with new technological inventions, architects were confronted with new paradigms to test the methods they were used to, and the new ideas they had developed. While historic building icons of the past centuries were documented and viewed firsthand, designers of modern architecture often relied on physical models to do the approximation and forecasting for them. Hence, the steps from drawings to models were already laid as design methodology in prediction and forecast. Complexity of the technology in design and building also began to shift from rectilinear form-making to a more organic and dynamic vocabulary, consistent with the modern age.

For decades, designers relied on descriptive geometry to determine the geometric relationship of lines and planes and their projective views for constructability. Now with nonplanar and curvilinear forms conceived by the nontraditional designers, digital modeling has arrived at a very timely period to facilitate in producing these designs. The availability of the new software now allows designers to perform interactive assessments of their design actions and design choices.

8

(Left): Computer-generated 3-D view of Mies van der Rohe's Farnsworth House Courtesy of Student Bojana Martinich, College of DuPage, Department of Architecture

9

(Left): Photo of interior of Calatrava-designed Milwaukee Museum Courtesy of Richard Weatherby

(Right): Photo of BP Theater at the Gehry-designed Walt Disney Concert Hall in Los Angeles Courtesy of Carmen Potter

10

Investigation and Testing of Options

Advancement in computer-aided engineering has also made possible a fruitful collaboration between the artistic side of form-making and the implementation side of constructability. What once took weeks and months of structural analysis and engineering has now become a conceivable routine in a much shorter period. This permits designers to act with speed and assurance in reconciling the aesthetic with the engineering.

Rendering and Illustrations as Products of Communication

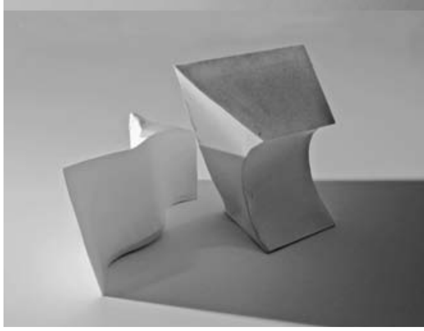
The primary tools available for designers to communicate their design are (1) drawings, (2) models, and (3) renderings—and, ultimately, the built product at the conclusion of design. Who are the audiences of the communication? Of course, first and foremost is the designer (the author of the object), not unlike an author makes notes in working out the drafts and sketch outline of the narrative. In architectural design, the sketches are mementos and a dialogue with oneself. It is not necessary to be organized and obvious. Sketches may be abstract and self-referential, with few notes—hardly communicative outside the designer's mind. When occasion arises to contact team members and/or clients/users, a designer usually creates more elaborate drawings and models to capture the spirit of the design. How elaborate and detailed the forms of communication need to be is an open question, depending on where the design is in the timeline of delivery and how open the study of options is. Often, the role of graphic media requires written and verbal supplements to focus the discussions on critical issues in order to move forward. The goal is to communicate the spirit of the design while allowing room for consensus on methodology and on the direction in which to move forward.

An experienced designer has the advantage of using prior knowledge as a foundation for improvement and efficiency in delivery. With prior experience comes maturity and the ability to refine one's designs. "Creation is a patient search"; seasoned designers attain an intuitive level of decision-making, making it appear that a few rough sketches sparked the genesis of form. Decades of experience in analyzing and synthesizing form pay off.

Modeling a Deformed Form

Consider making a rectangular block with chipboard. It is quite easy to build simply by cutting chipboard with a sharp cardboard cutting blade. Next, deform two surfaces into curved planes. How the model will appear depends on the degree of curvature and how smooth the surfaces appear.

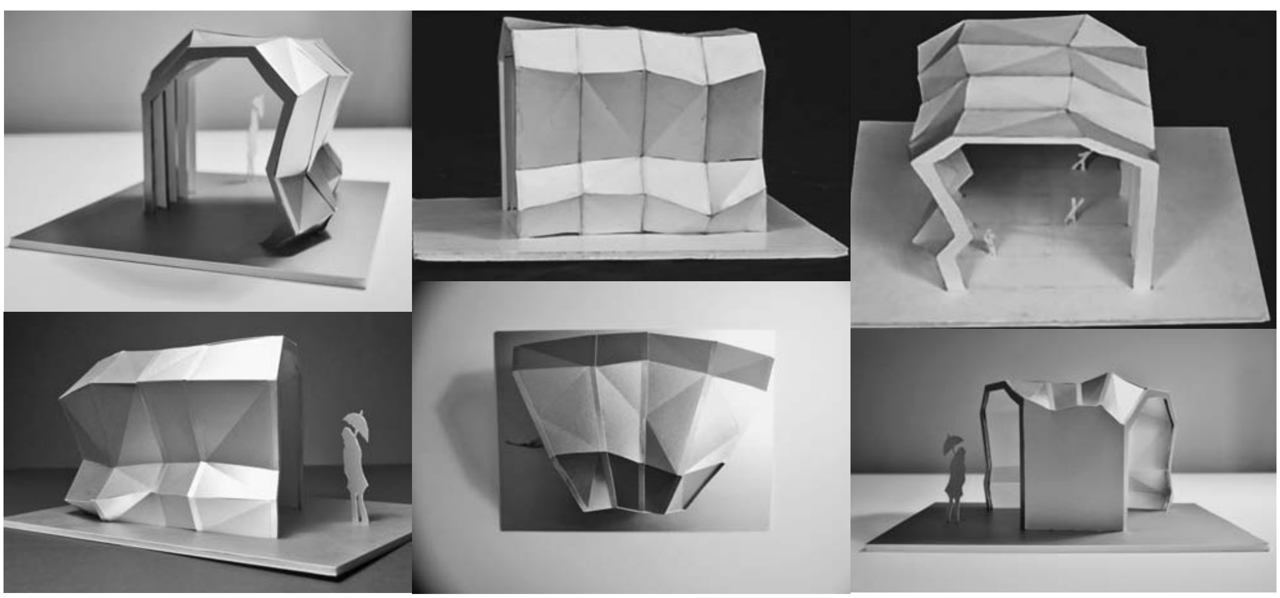
Note the resultant image appearance in the photo sequence below.



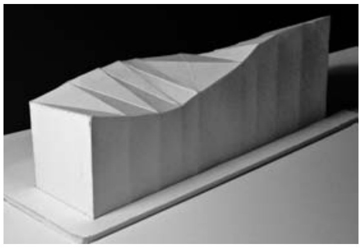
Student projects on Deformation (this and next page):
Courtesy of studio professor William W. P. Chan School of Architecture & Planning, Morgan State University

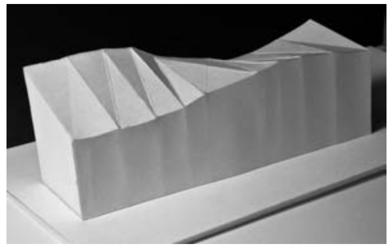
In the first year of graduate studio, we have a project exercise assignment on deforming a 2" × 2" × 4" volume. In general, it is easier to deform one or two surfaces while keeping the other four surfaces flat. The students found out that as the shapes became more complex, they ran into difficulty fabricating the model.

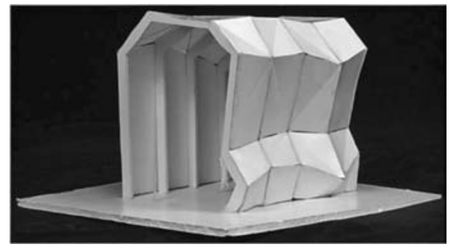
In the subsequent year, students used sections of the model and deformed the supporting skeleton. The result is the precursor for digital fabrication, which opens opportunities to make nonrectilinear forms in physical modeling. [PROFESSOR'S STATEMENT]



Student projects on Deformation—Multiple Planes Warping (above): Evenly spaced frame: Babajide Tenabe; Fan-out frame: Karolina Tittel
Courtesy of studio professor William W. P. Chan, School of Architecture & Planning, Morgan State University







Student projects on Deformation: One plane warping (left) and two planes warping (right)
Courtesy of studio professor William W. P. Chan, School of Architecture & Planning, Morgan State University

Object Design versus Space Design

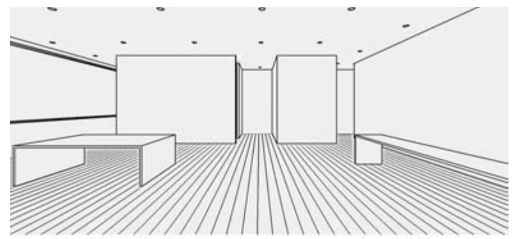
To design a solid object, one relies mainly on externally visualizing and looking from the outside. However, architectural design consists of both object design and space design. A building invites the user to enter the building and move around in all directions. In a sense, the designer is creating a future environment not yet built. The tools (sketching and modeling) in design are to help the designer predict the future as he or she goes about making plans, sections, and elevations in the third dimension. One can do partial problem-solving much like one would on a movie set—by focusing on the visual path of the viewer to choreograph a design experience. It is a circumstantial design strategy that is site- and user-specific, akin to making a product design with numerous design constraints. By this definition of tightly orchestrated form- and space-making, the designer is inventing a prototype that, upon completion, can be manufactured if he or she chooses.

When a design is at the early stage of inception and when all the design decisions are in flux during the conceptualization stage, study models are often used to ascertain the formal outcome. However, conceptual models are lacking in details; this may make these highly abstracted forms not readily comprehensible to a layperson. Perspectives are most useful at this early conceptual stage, when an illustrator's artistic rendering is most effective in communicating the intended character of the design without being required to have solved all the problems.

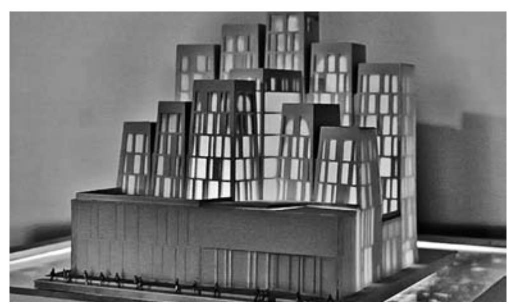
Digital Manufacturing

The technology of physically constructed 3-D geometries directly from 3-D CAD data began in the 1980s as a way to make prototypes of parts for analysis before investing time and money in the mass manufacturing of products with industrial state-of-the-art material and quality control. This faster and more conceptual product manufacturing, though lacking in machine quality control, has the advantage of speed and cost savings when used at the initial stages of product design. It can be referred to as additive manufacturing, *rapid prototyping,* layered manufacturing, or simply *3-D printing.* Complex forms can be fabricated by a simple machine using a broad range of plastics or metals without any sophisticated hardware or casting.

(Below): Two 3-D views from the same room
Courtesy of Carmen Potter



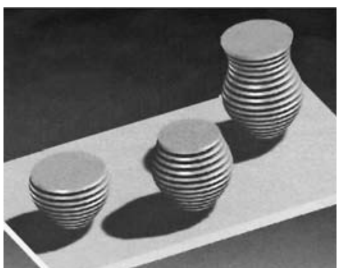
(Below): Morgan State University thesis project
3-D printed model of mixed-use residential development
Courtesy of Matthew Richardson
Professor Paul Walker Clarke

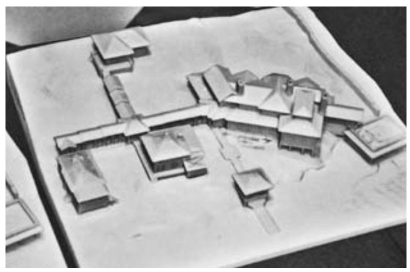


(Below): George Washington Bridge Bus Station
3-D printed study model
Scale: ¼" = 1'0"
Courtesy of NY Port Authority

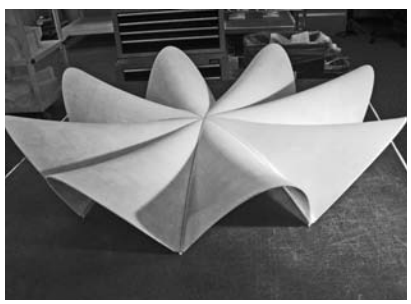
To understand how *3-D printing* works, consider a nonplanar solid cup form with a curved shape design. If a machine slices up the form into layers thinner than paper-thin and stacks these layers in a proper sequence, the layers can be fused. This depositing of micro-thin layers of powders upward in the Z direction is an additive approach to printing on a flat surface, versus a chiseling-off from a solid piece of material (subtractive approach), as with producing sculpture. At the end we would get a form that is exactly the one conceived in the digital model. Of course, if we are looking for smoother surfaces, the data increases, and so does the manufacturing time for each cup. Over the first decade of the twenty-first century, there has been an explosion on the market of available hardware to bring the efficiency up and the price down (see project at USC using 3-D printing in "Drawing Approaches" on the companion website). A form may be designed as a BIM model and the data sent through a 3-D printing machine to make the design, *or* we could scan an object with a hand-held 3-D scanner, enter the data into the computer, and have the same object duplicated by the 3-D printer. Colors may be added during data entry to print a color object in 3-D.

There are now quite a few products in the market to be purchased and installed. These machines are not big and affordable to many offices. A small-scaled study model of a building can be printed in a few hours, and if a larger model is required, the file may be easily broken down into parts and, after printing, the parts reassembled into a larger piece. This rapid production of study models or machine parts can be stronger than some metals; thus, machine parts are now manufactured this way to take advantage of both speed and strength.





(Above): Princeton University Felix Candela Exhibit-—3-D printed model of restaurant roof
Courtesy of NY Port Authority



(Above): Princeton University Felix Candela Exhibit-—3-D printed model of restaurant roof
Courtesy of NY Port Authority

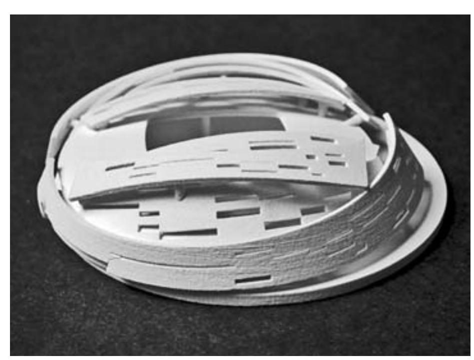
(Top left): Computer-generated rendering showing principles of 3-D printing
Courtesy of William Chan

(Top middle): Study model of a residential project
Courtesy of Andrew Chary Architect, PLLC

(Top right): Boston Society of Architects building (52 Broad St., Boston)
Courtesy of Munson3d

(Below): Stadium study model (3-D printed)
Model photo courtesy of Wesley Wright
Pelli Clarke Pelli Architects

The following pages show some of the most creative uses of study models before the advent of 3-D printing and digital application in drawings. With a selection from a range of projects in the latter part of this chapter as case studies, it is evident that drawings, real models, and virtual models continue to be instrumental in making architecture. Advanced computation in engineering also facilitates the construction of some of the most imaginative forms, which previously had eluded reality. Now 3-D printing is taking design to a level previously limited by the drawing stage. The case studies on the following pages also reflect personal choices designers made in the use of manual versus digital tools.



TWA AIR TERMINAL—NEW YORK

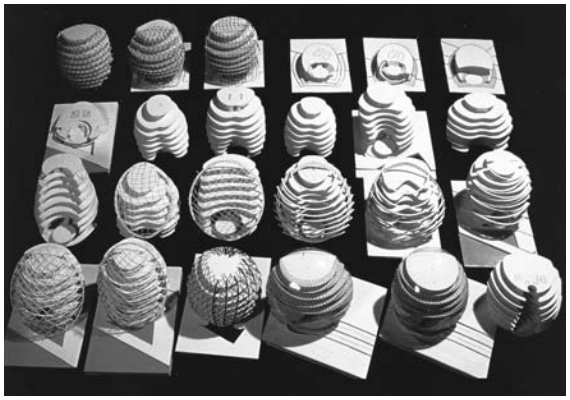
The design of the TWA terminal in New York by Eero Saarinen exemplifies a groundbreaking approach to the design of a nonrectilinear building in the mid-twentieth century, when computer-generated 3-D modeling had not yet been invented for professional use.

With a symmetrical plan, the organic formal volume—both inside and out—posed challenging engineering and architectural objectives for any designer to meet.

The pictures of the recently renovated interior at left and bottom shows the built solution. Saarinen was attempting to make the form of the small interior elements consistent with the formal language of the building in expressing a metaphor of flight.

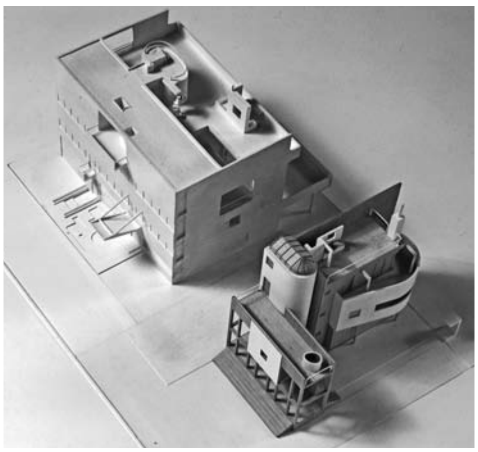
The building design method is a precursor to the CAD/CAM works that followed decades later, as in the works of Frank Gehry and many others. Considering that the design was conceived and built more than half a century ago, with tools consisting of large-scale models and drawings, it was way ahead of its time in setting the direction of futuristic formalism.

Photos: TWA Terminal
New York, New York
Courtesy of David Leventi, photographer
David Leventi, New York
www.davidleventi.com



STUDY MODELS OF LONDON CITY HALL

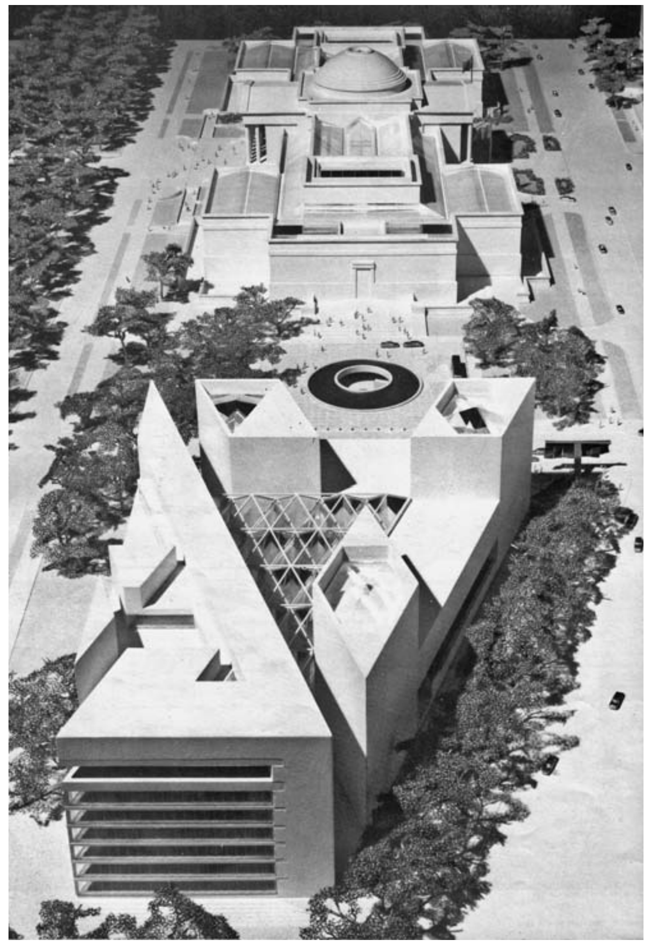
(Courtesy of Norman Foster Architects, London)



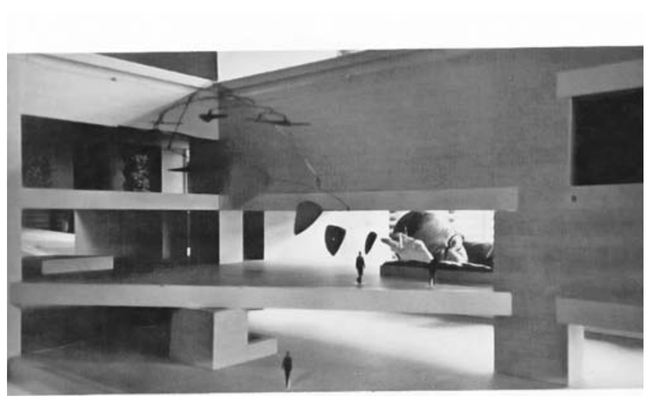
The study model above of a house by Anthony Ames is still an important tool for architects in assessing the formal outcomes of the design moves.

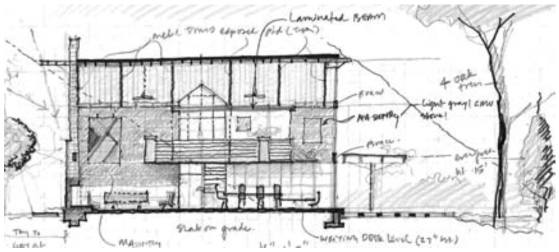
This model of I. M. Pei's design icon, the East Wing of the National Gallery in Washington, D.C., shows the care invested in a definitive method of studying design in great detail on a scale at which Pei could immerse himself to view the space at a personal level.

In London, architect Sir Norman Foster used dozens of study models to understand the formal possibilities of the London City Hall (page 472) as a sustainable design. Now his office uses in-house rapid prototypes to manufacture 3-D printed models at a much faster pace, thus increasing both efficiency and precision in design.



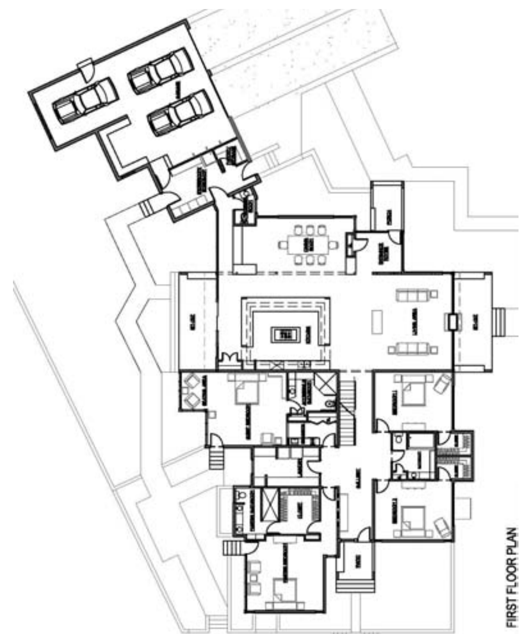
Presentation model of the East Wing of the National Gallery of Art, Washington, D.C. (above) and large-scale study model (below)
Courtesy of I. M. Pei & Partners



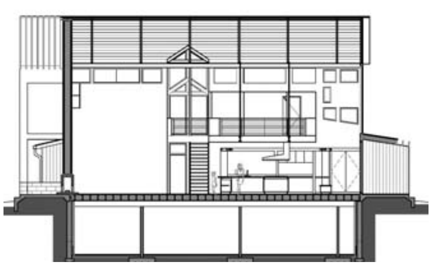


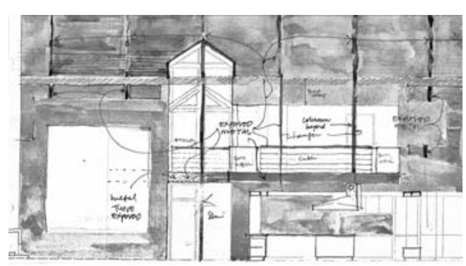
The architect/educator used rapid and accurate sketches as a primary tool in arriving at his very detailed design decisions without building any models. When all the plans/sections and elevations were synchronized, CADD drawings were then introduced during the construction documentation phase.

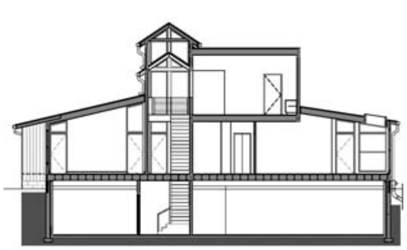
On the design of the Gandhi residence, everything was conceived in hand drawings first, and also sketched-on during the development of CADD drawings. [ARCHITECT'S STATEMENT]



AUTOCAD FLOOR PLAN



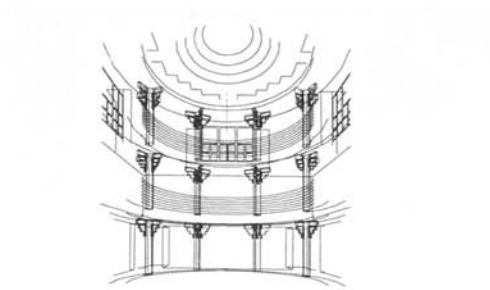


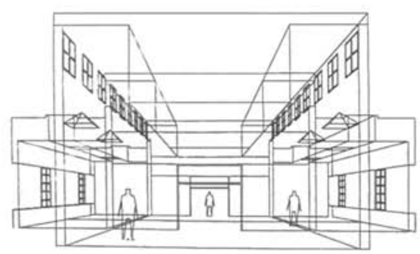


CADD SECTIONS

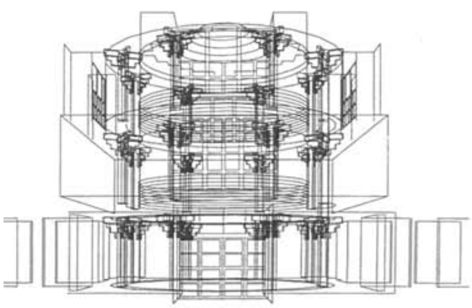
Drawings and photos: Gandhi Residence, Illinois
Courtesy of Mahendra Parekh, Architect
SP Arch, Inc.

The conceptual design stage of the Tibet Center, which consists of exhibition spaces, visitors' sleeping quarters, gift shop, dining room, and offices, involves many tools. Initially there were hand drawings, computer modeling, and eventually a large-scale study model with demountable components for the study of the building's interiors. The study model also functioned as a presentation model. [ARCHITECT'S STATEMENT]

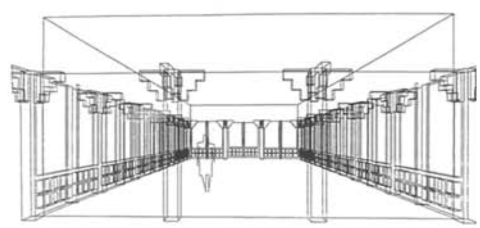


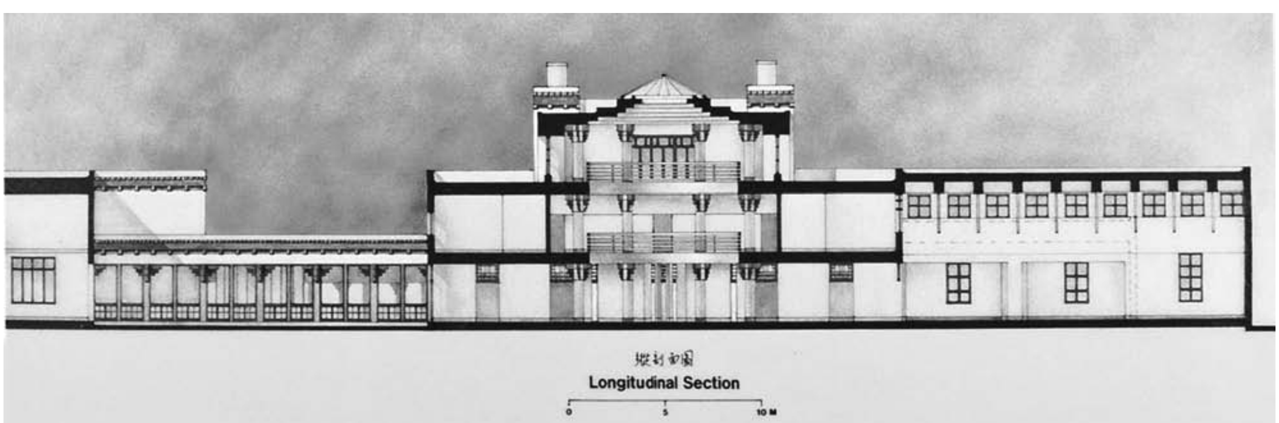


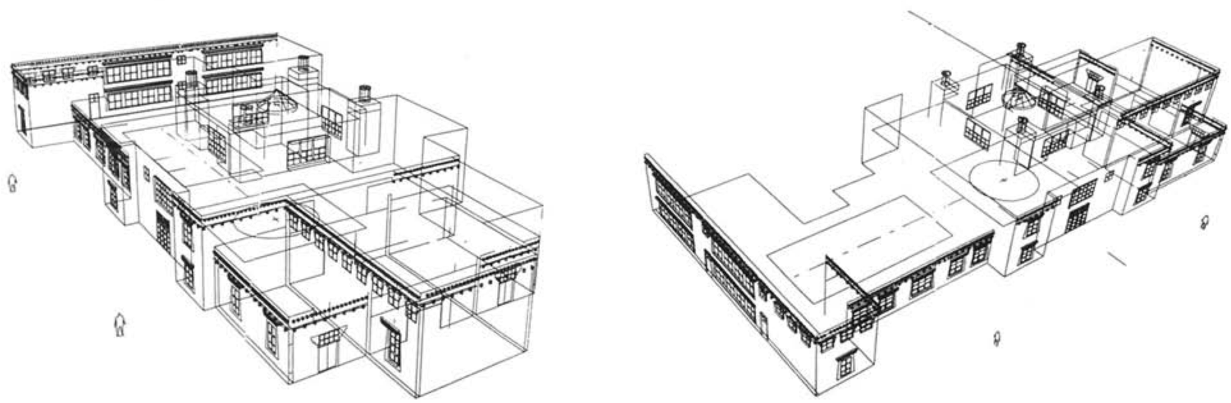
COMPUTER-GENERATED WIREFRAME OF INTERIOR SPACE



(This and next page): Tibet Center, Tibet
Courtesy of William W. P. Chan, Architect
Team: William Chan, Don Duncan, Chris Rice, Nicholas Linehan (Landscape Architect)
Client: Future Generation, U.S.A.

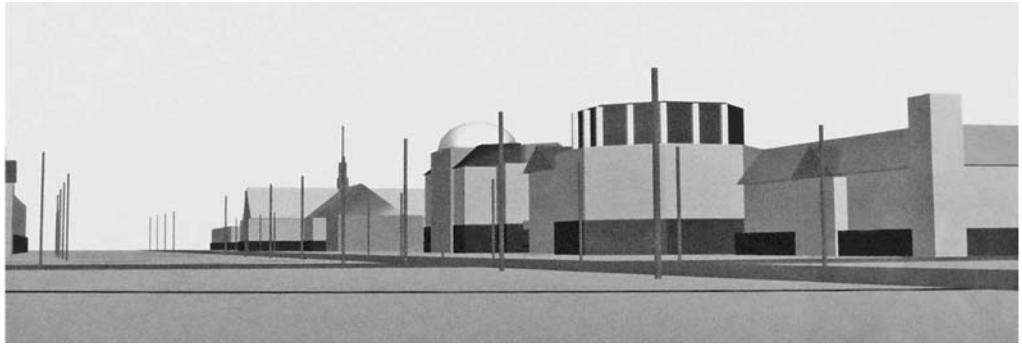






COMPUTER-GENERATED WIREFRAME STUDIES OF BUILDING MASSING

The 300-acre urban design development proposal involved land-use and circulation layouts with illustrative views of the overall character of the proposal. We used 3-D computer modeling printouts (AutoCAD) as a base for overlaying the hand drawing for final presentation. This is a very effective means of visual communication without really designing the many buildings.
[Architect's statement]



(This and facing page): Plainsfield Town Center, Illinois

Courtesy of William W. P. Chan, Architect

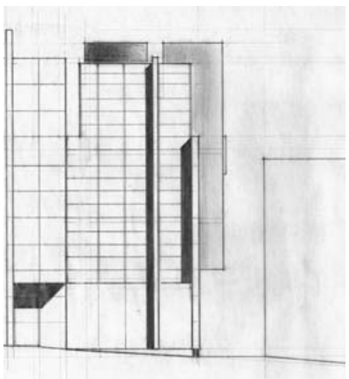
Team: William Chan, Don Duncan, Chris Rice, Nicholas Linehan (Landscape Architect)

Honorable Mention in National Competition

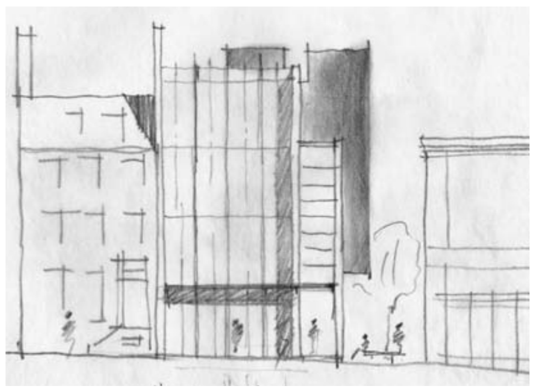
LIBRARY OF FORBIDDEN BOOKS

Project derives its form from two major considerations: the site and the program. The site is an urban lot in the historic district of downtown Baltimore, Maryland. The building responds to its urban context by presenting a facade that holds the edge of the street and maintains the continuity of the urban fabric of buildings and streets, and by maintaining the scale and proportions of the adjacent buildings.

Programmatically, the library holds a collection of rare and previously banned books. There was a desire to put these books on display but in an unattainable way, and from this the concept of the book vault emerged. The cylindrical vault floats above the ground with solid walls and a glass top and bottom. Views into this banned vault are possible only obliquely from below and from a gangplank that extends to an opening in the vault, where a robotic arm that rotates inside the vault delivers requested volumes to the hands of the readers. The vault becomes the centerpiece of the project where the building program continuously references it and the circulation wraps around it, reinforcing the sense of a powerful yet elusive presence. [Architect's statement]

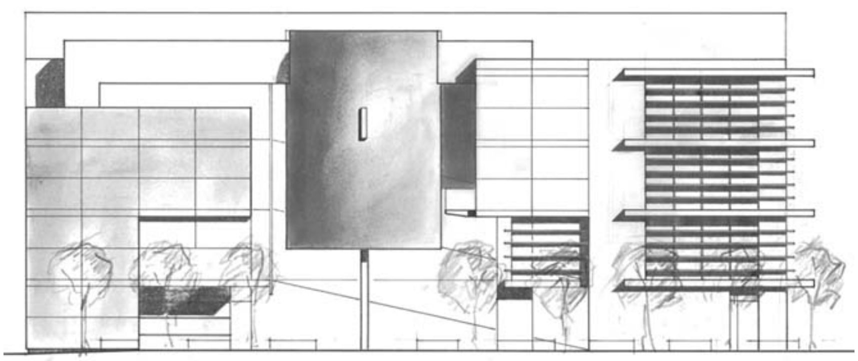


NORTH ELEVATION—EARLY CONCEPT

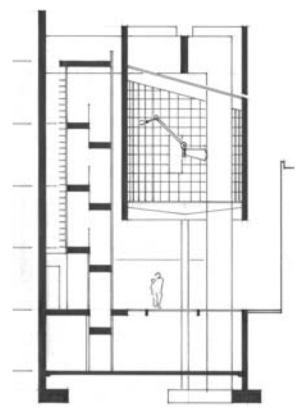


NORTH ELEVATION—INITIAL CONCEPT STUDY

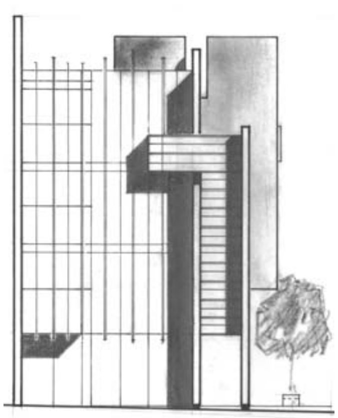
NORTH ELEVATION—INITIAL CONCEPT



WEST ELEVATION



TRANSVERSED SECTION



NORTH ELEVATION

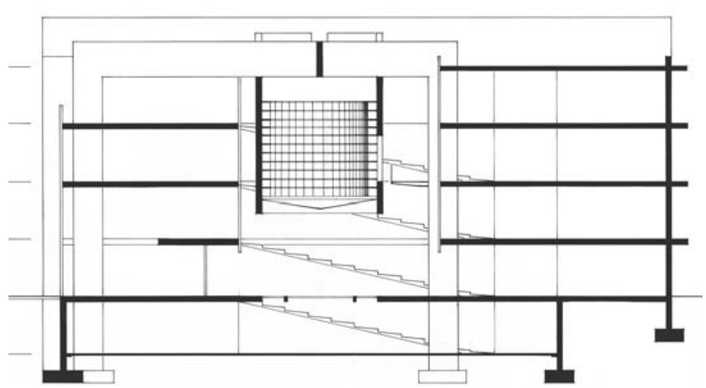
(This and facing page): Student project

Media: Pencil and black India ink on 16-lb vellum; chipboard and cardboard models

Courtesy of Sami Basuhail, architect/student, and Studio professor Jeremy Kargon

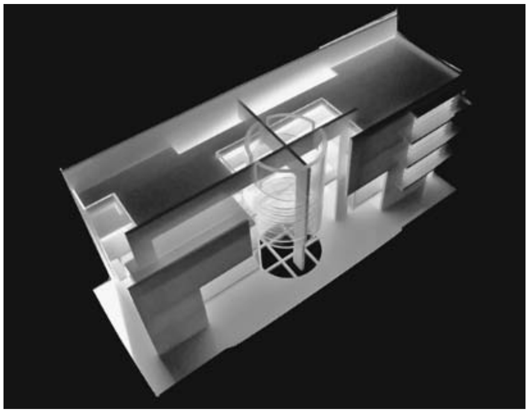
School of Architecture & Planning

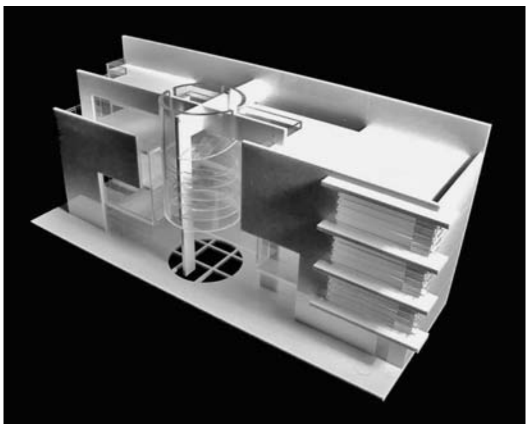
Morgan State University

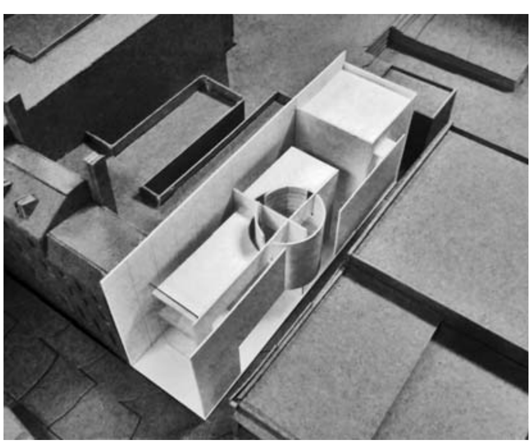


LONGITUDINAL SECTION

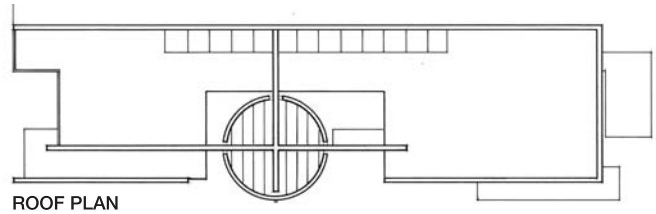
CASE STUDY—COMMUNITY BUILDING



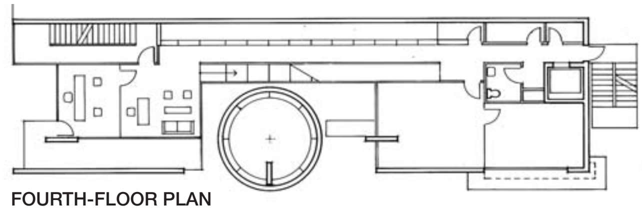




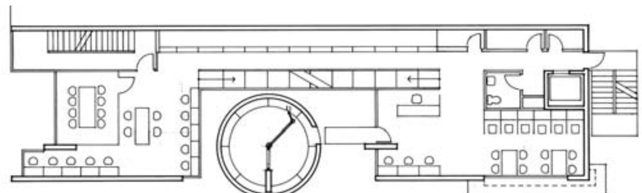
FINAL SITE MASSING MODEL



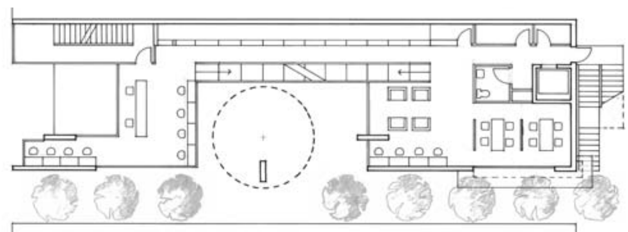
ROOF PLAN



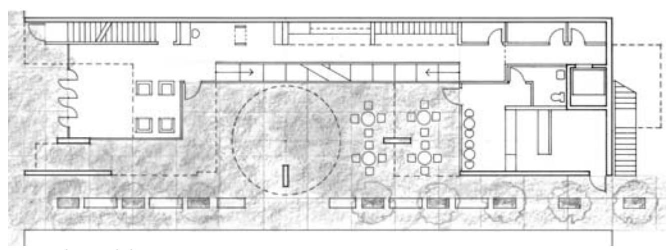
FOURTH-FLOOR PLAN



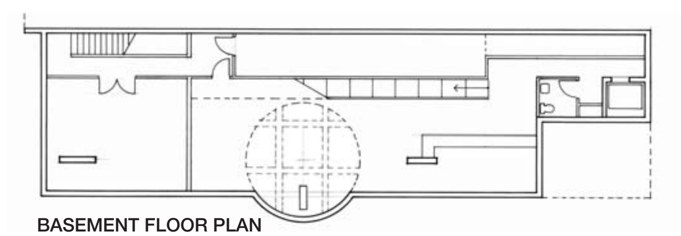
THIRD-FLOOR PLAN



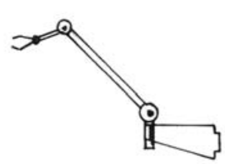
SECOND-FLOOR PLAN



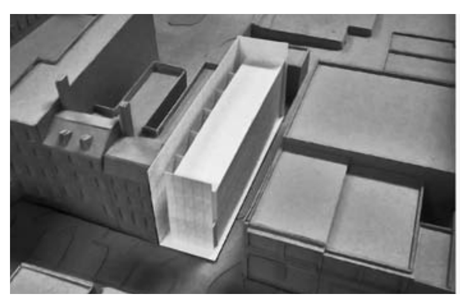
FIRST-FLOOR PLAN



BASEMENT FLOOR PLAN



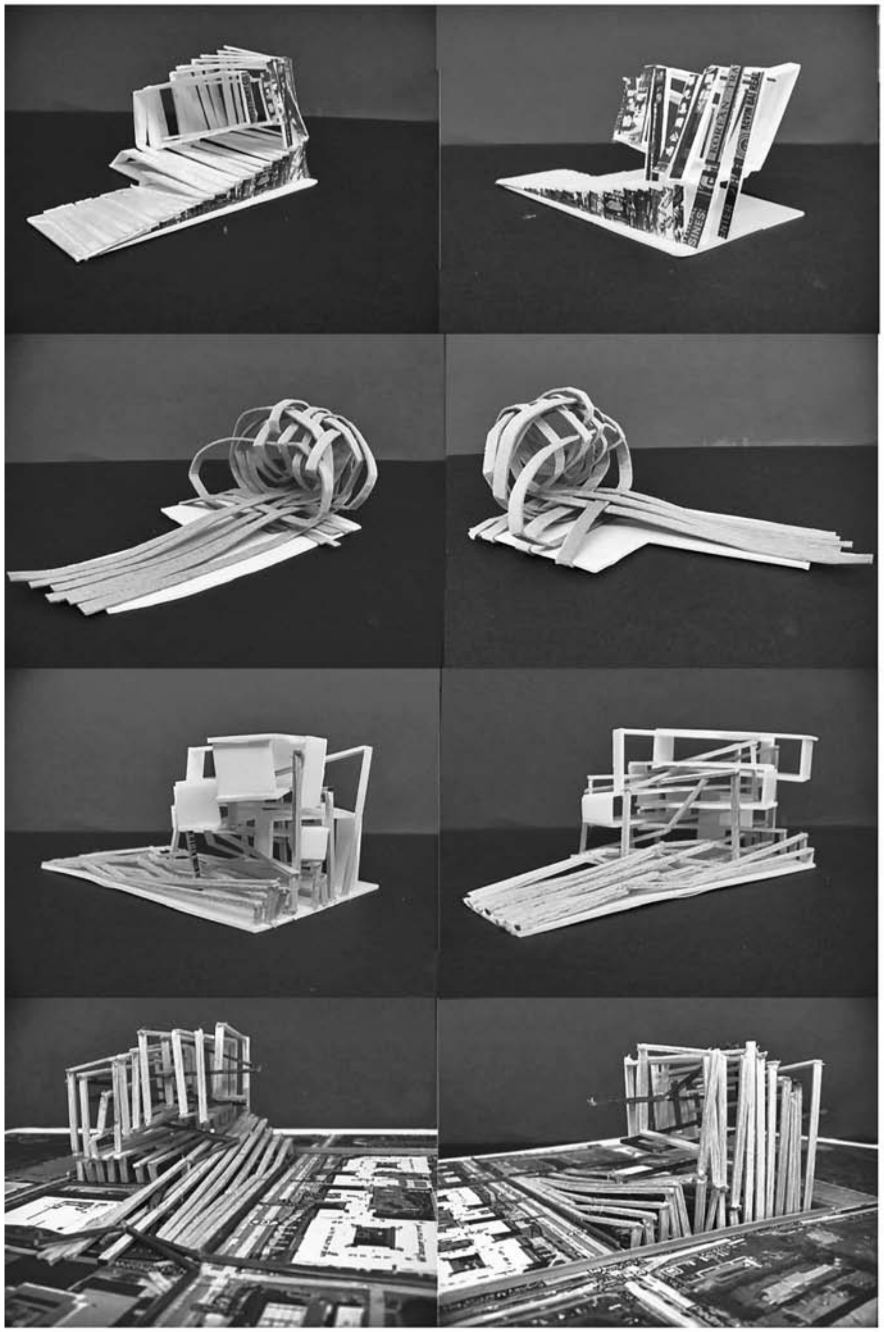
RARE BOOK ROBOT
ARM SECTION

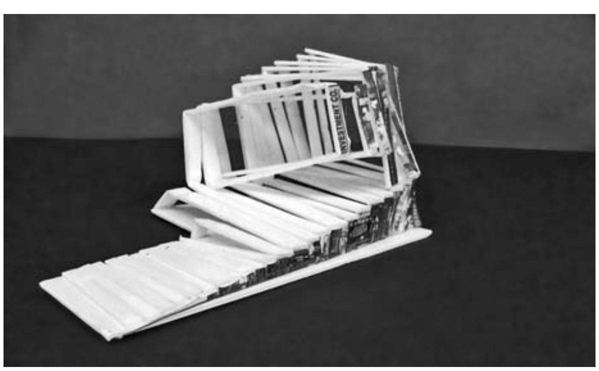


EARLY SITE MASSING MODEL

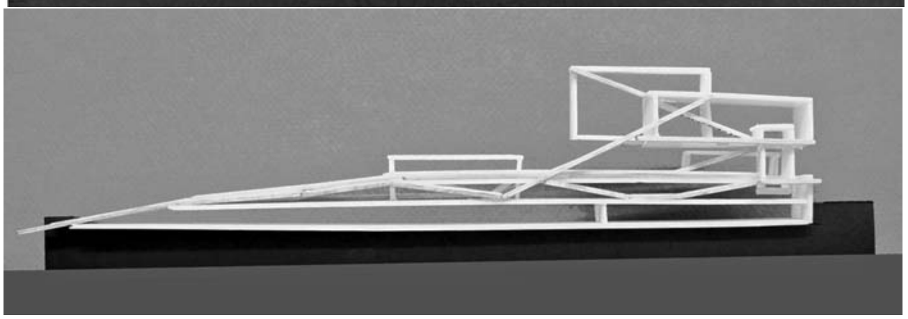
Design-drawing process explored through freehand sketches, 3-D sectional studies, and schematic volume models. This process investigates the design concept of overlapping spaces. The convergence of spaces is investigated through a series of sections—by taking a simple sectional sketch of schematic programs and extruding it into a three-dimensional sectional model.
[Professor's statement]

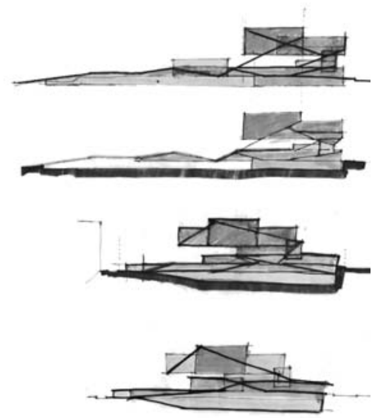
(This and facing page): Student project by Kathrine Gella
Cultural Emporium
Courtesy of Professors M. Saleh Uddin and Ameen Farooq
Department of Architecture
Southern Polytechnic State University, Georgia

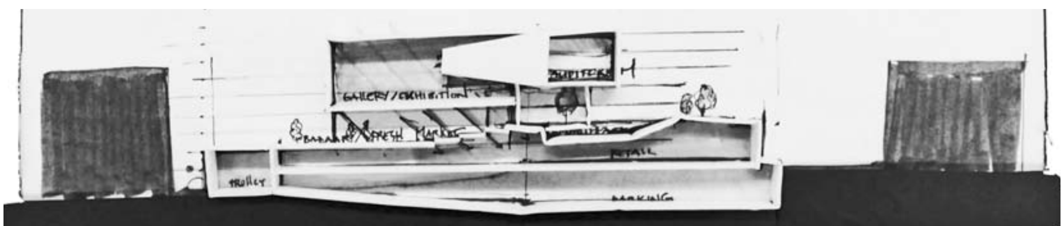


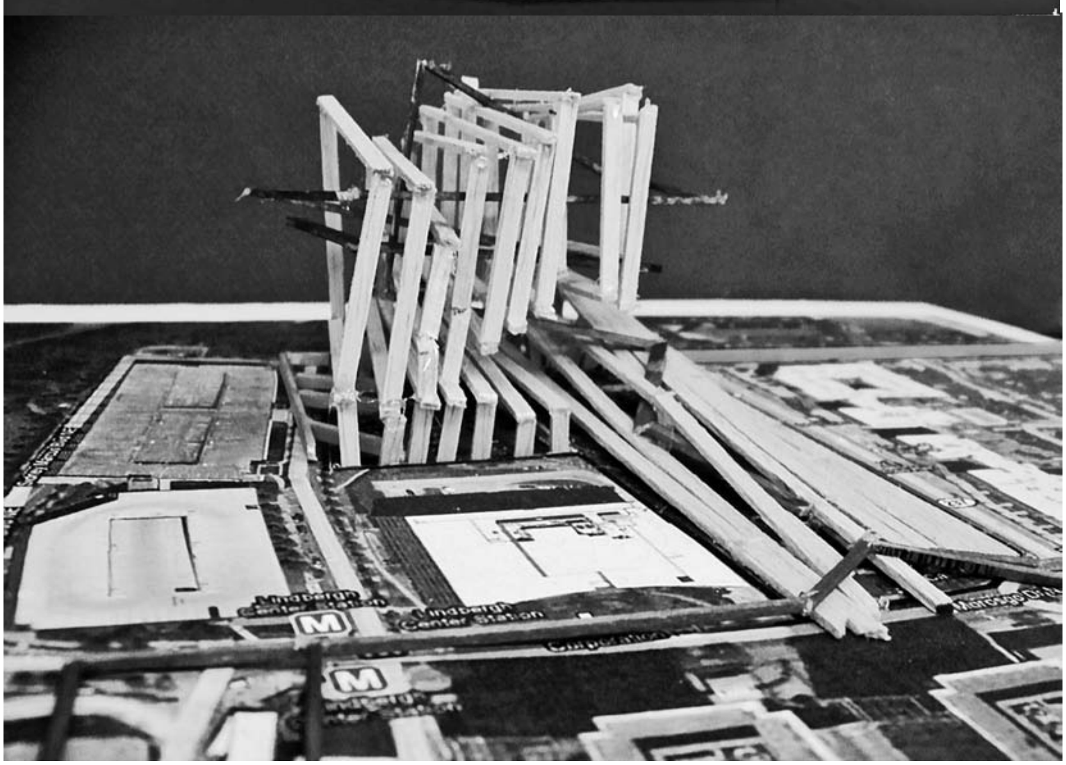



RETAIL

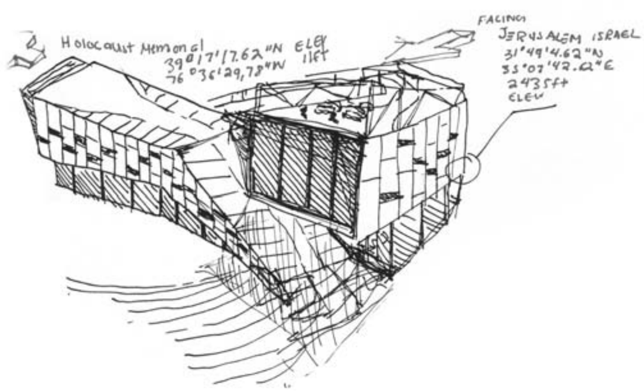





GALLERY / EXHIBITION
FRESH MARKET
RETAIL
TROLLEY
PARKING


Lindbergh Center Station

ORTHODOX SYNAGOGUE

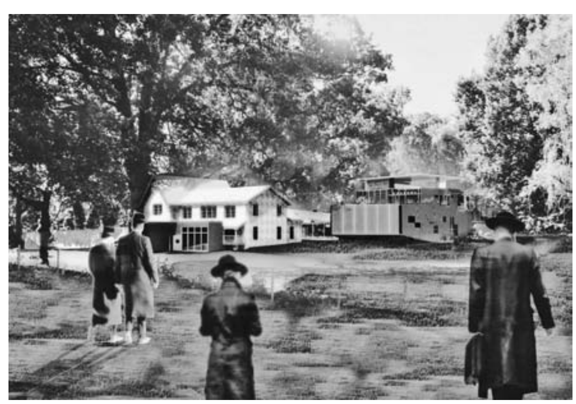


CONCEPTUAL SKETCH

(This and facing page): Student project by Kordae Henry
Urban synagogue
Medium: Revit
Courtesy of studio professor Leon Bridges
School of Architecture and Planning
Morgan State University

Senior project of the fall semester required students to design a religious structure that demonstrated an ability to work with the site, existing building context, and conceptual client-based criteria.

PARKING LOT/ EAST PERSPECTIVE



APPROACH FROM LIBERTY HEIGHTS AVENUE

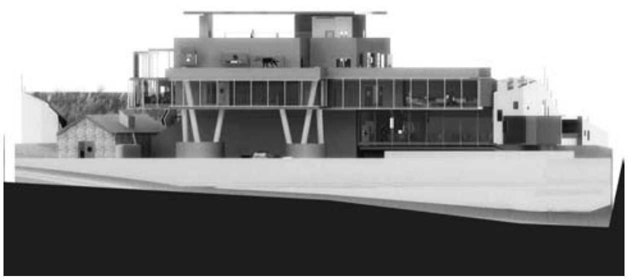
GREEN ROOF CORRIDOR (WALKING FROM SYNAGOGUE)

GREEN ROOF CORRIDOR (WALKING TO SYNAGOGUE)

INTERIOR LIBRARY CORRIDOR

ORTHODOX SYNAGOGUE SYNOPSIS

This design takes important artifacts from Jewish history to form and create a contemporary Jewish Orthodox synagogue. By traveling through the site you will see that the building rises from the ground as they, too, have risen—through slavery, tragedy, and nomadic despair. I used the the Ner Tamid and Shofar and an artist named Matisyahu as a concept to transform and challenge previous ideas of traditional Jewish architecture.
[Architecture student's statement]



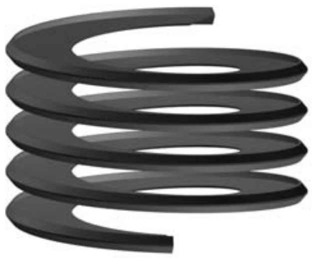
SOUTH ELEVATION

EAST ELEVATION

PHYSICAL STUDY MODEL

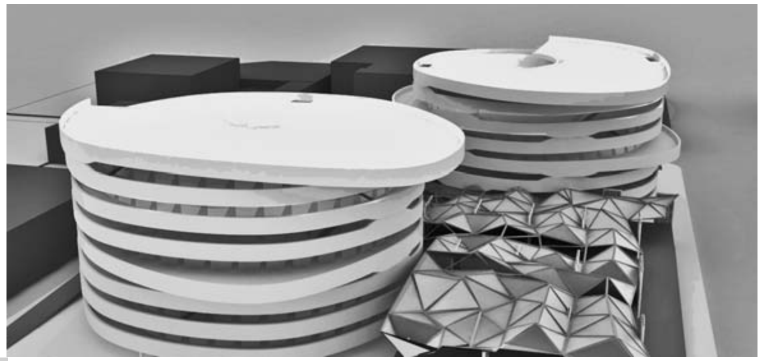
NORTH ELEVATION

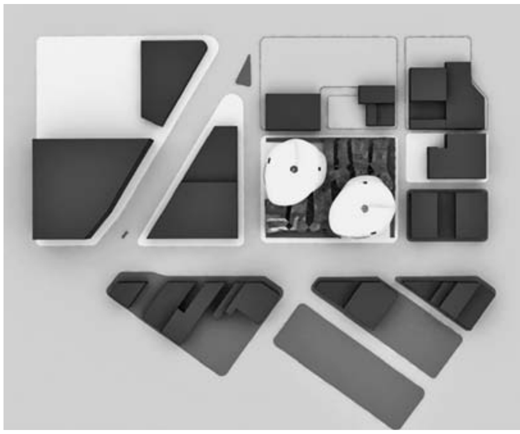
WEST ELEVATION



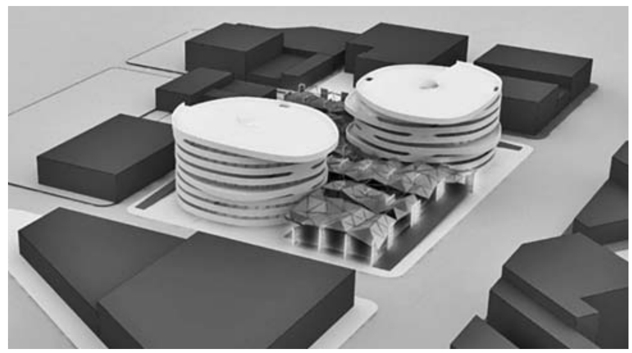
CONCEPT DIAGRAM

Studio Project: Urban Parking Garage

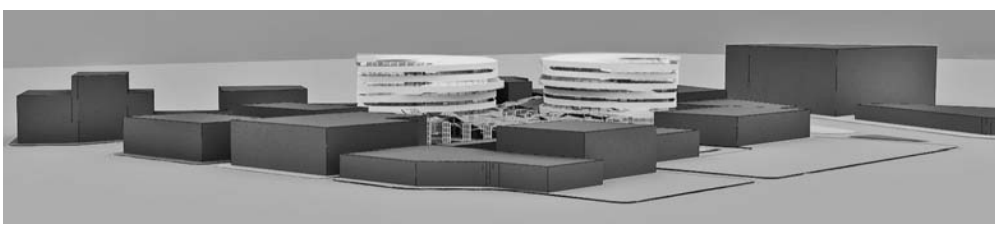




SITE PLAN

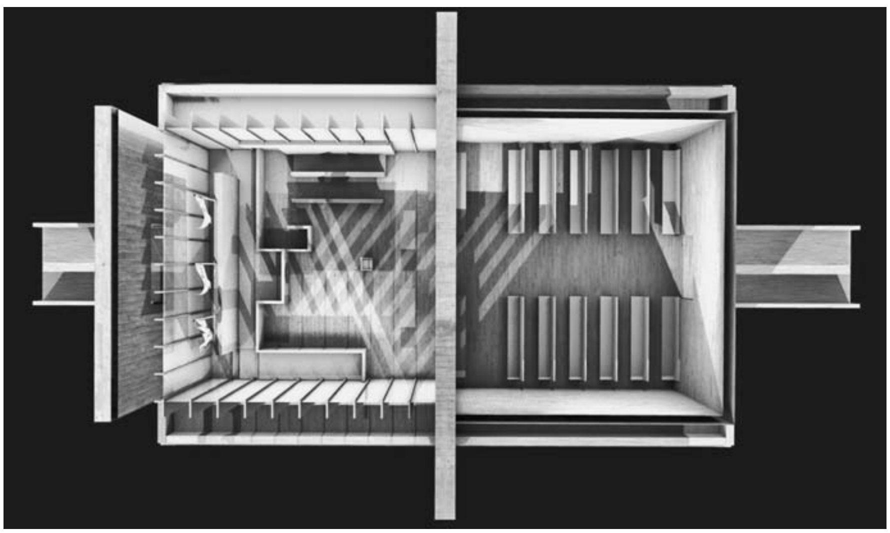


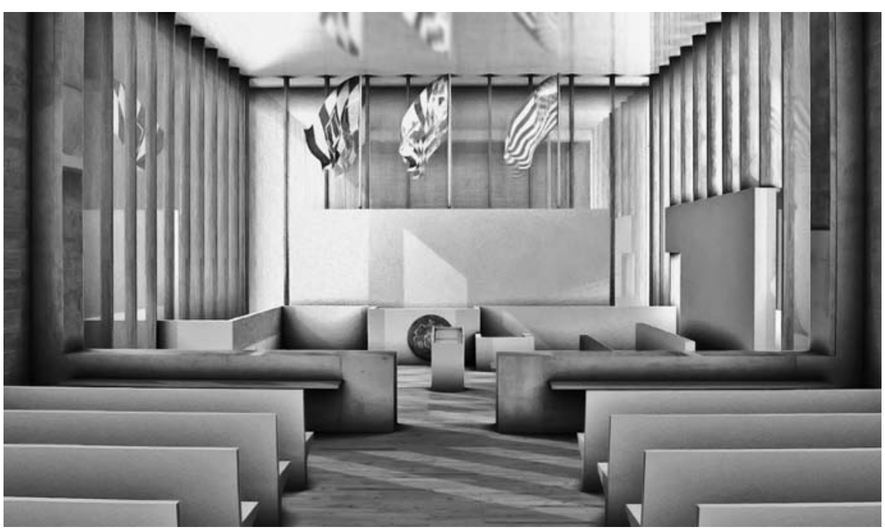
The design of this building was conceived and executed without any hand drawings. It exemplifies a common pedagogy of young students' digital skills.



Project: Parking garage
Location: West Market Street, San Francisco
Courtesy of Godwin Obami
Academy of Art University, San Francisco
Instructor: Paul Allen
Theme: Weaving a new urban fabric

The building, aside from its primary function, will help create a new urban fabric for West Market Street of San Francisco. This will mark the start of a new architecture—one that's expressive, creating a cluster of gestures within the built environment. The form sits on the site in a dramatic way, expressing a paradox of detachment and interaction. The light emanating from the structure initiates a rather romantic feel, adding to the dramatic nature of the design—a "Romeo and Juliet" character; purple and pink lights. This creates a new reaction to parking garages, seeing them as an expressive structure rather than a cold concrete structure.
[Designer's statement]





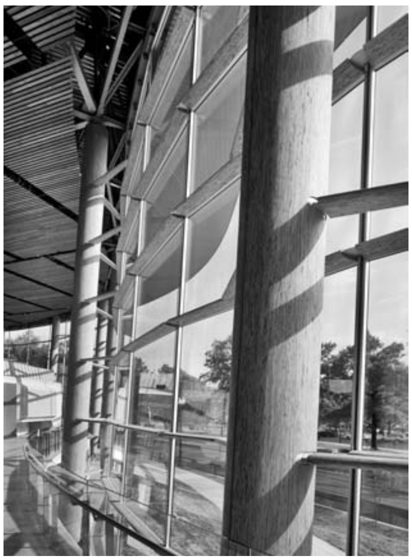
When designing architectural projects while utilizing 3-D programs, it is important to have a thorough pipeline established. Throughout the entire process the pencil is an important tool for sketching quick ideas and diagrams; however, the final result is always a product of the kind of software you use. I have chosen to use Autodesk's Revit architecture for construction documents and Maya for 3-D renderings. These two programs are made by the same company, which helps when transferring computer models from one software to the next. I first use Revit architecture because it is a well-proven BIM program that allows for efficient construction document production as well as the ability to simulate engineering tests, such as mechanical and electrical loads. I then transfer my computer model to Maya, an entertainment software best suited for quick and photorealistic images. In the end, depending on whether I am making a movie or a static image, I use Adobe's Photoshop or After Effects to do touch-ups and bring it all together for the final composition.

[Architecture student's statement]

Images: Student project by Samir Taylor
Conceptual courtroom
Courtesy of studio professors Paul Walker Clarke and William W. P. Chan
School of Architecture & Planning, Morgan State University

View from lobby looking southwest

View from lobby looking southeast



Parallel columns

View of lobby looking west

View of lobby from upper lobby

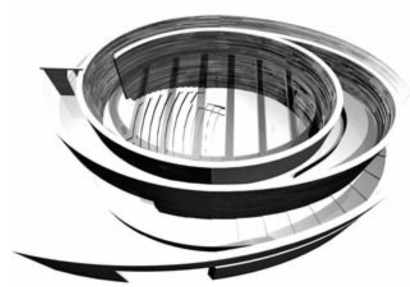
Close-up of wood curtain wall

Arena Stage at the Mead Center for American Theater

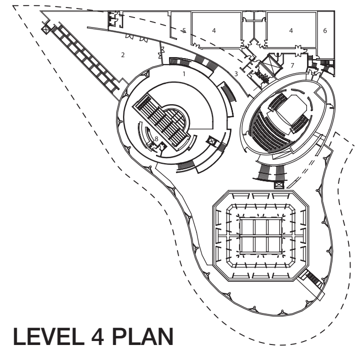
The design of the new Arena Stage at the Mead Center for American Theater was inspired by the vision of Molly Smith, Arena's artistic director, for "a theater for all that is passionate, exuberant, profound, deep, and dangerous in the American spirit." Building on Arena's illustrious history and close relationship with the Southwest Washington community, the reinvented Arena Stage effectively doubles the facility, allowing for state-of-the-art technology and modern amenities, including spacious workspaces for rehearsals, set design, and construction; classrooms for education programs; office space; community gathering spaces; a centralized lobby, box office, and concessions; and underground parking. The project included restoration of two existing theaters—the Arena's original theater-in-the-round and the Kreeger. In addition, a new 200-seat experimental theater, the Kogod Cradle, supports production of new American plays.

A dramatic roof and wood/glass curtain wall encompass the three theaters and offer views of the adjacent Washington Channel and Washington Monument. Through careful site design and bold sculpting of the structures, a renewed image for the neighborhood has been created that fosters public activities in and around the buildings. The project has been a catalyst in the community, spurring redevelopment of the surrounding area. [Architect's statement]

Rendering of Cradle Theater



Rendering of Cradle Theater



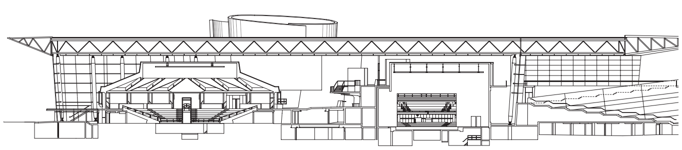
LEVEL 4 PLAN

View of lower lobby entrance—looking north

View of front entrance—looking north

View of front entrance—looking south

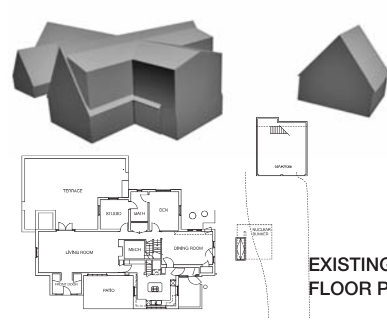
View of lobby looking east from upper lobby



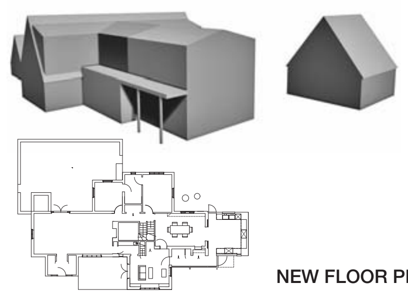
TRANSVERSED SECTION

Images (this and facing page): Arena at the Mead Center for American Theater Washington, D.C.
Medium: Rhino 3D, AutoCAD 2004
Photos by Nicole Lehoux
Courtesy of Bing Thom Architects, Vancouver, British Columbia

For a more in-depth coverage of this architect and other architects (interviews, etc.) in this chapter, see the book's companion Web Resources guide.



EXISTING
FLOOR PLAN



NEW FLOOR PLAN

This addition exemplifies a masterful integration of an addition to an existing house by working the design from the inside out and the outside in. The massing diagrams show a simple idea worked through all of the details in their finality.



The existing house is a picturesque 1920s suburban house set on a leafy knoll next to a pond; its high gables and leaded windows further enhance the Grimes fairy tale image. As in most fairy tales, there was a downside: the kitchen was a cramped dark space with failing fixtures, ugly cabinetry, and cracked floor tiles. Initially the client had imagined renovating the kitchen and adding a sunroom. This option proved to be impractical, as the only sympathetic site to add on to the house was on the north facade, so we suggested that the existing kitchen should be converted into a den and a new addition on the north facade should contain the kitchen.

The gable end of the house contained the dining room with the master bedroom above. The concept was to extend the house with a volume that corresponded exactly with the gable; this maintained the scale and form of the house. A band of glass was introduced to separate the existing structure from the new and further abstract the connection between the two. The resulting double-height space is flooded with natural light and is the antithesis of the cozy cottage interior aesthetic of the rest of the house; however, together they complement each other. A single-story glass corridor links the addition back to the new den and provides a new entry point for the back door.

The intention was to complement the existing house in volume and material, but not to copy it, thereby allowing both the old and new to have their own integrity. In keeping with the simple design concept for the exterior of the new addition, we choose cedar siding. This matches the existing cedar roof shingles but contrasts with the white stucco of the house. Sliding glass-panel doors replace the French windows at the north end of the dining room, opening that space up to the kitchen.

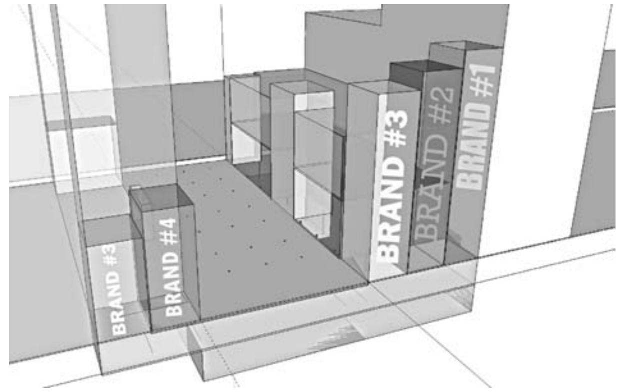
The interior of the kitchen is simple and abstract. A wall of cabinetry containing the refrigerator is flanked by two marble counters—one containing double sinks in front of a ten-foot-tall window, the other the range oven. The wall cabinetry opens and folds back to reveal additional counter space. The kitchen opens onto a small breakfast patio on one side and the new glass corridor on the other. It is an extremely light and airy space, shaded in the summer by overhanging mature deciduous trees and warmed in winter by radiant-heated limestone floors. The floor extends into the glass entry hall, in which a white lacquered panel wall contains the coat closet and laundry. [Architect's statement]

Images: Shorthills remodeling
Shorthills, New Jersey
Medium: Vectorworks
Courtesy of Architect Messana O'Rorke.
New York City
© Photographer—Elizabeth Felicella

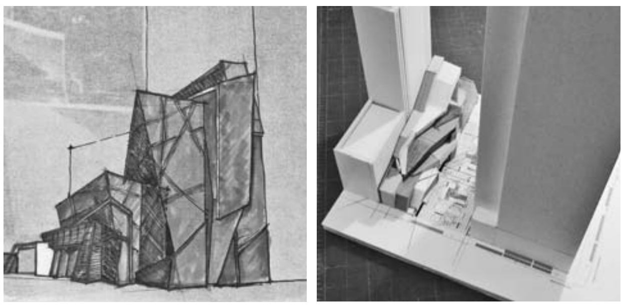
CASE STUDY—RESIDENTIAL

PROJECT CRYSTAL

CRYSTAL LATTICE SYSTEM
(Courtesy: Wikipedia)

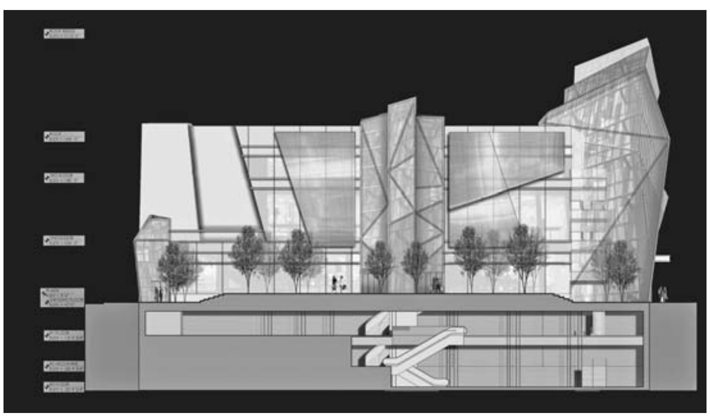


MASSING DIAGRAM

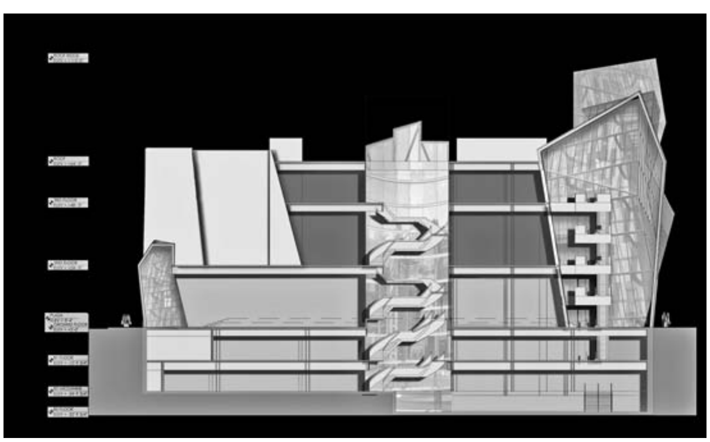


CONCEPTUAL SKETCH

PHYSICAL STUDY MODELS



PLAZA ELEVATION



LONGITUDINAL SECTION

Inspired by the lattice structure of crystals, this retail building provides individual brand identities for multiple tenants.

Located in the Times Square District of New York City, the architecture of the building captures the excitement of the neighborhood.

The process began by identifying the program massing and locating the various components on site.

Program volumes were created in a 3-D application, then manipulated to conform to zoning and building code requirements. The resultant massing is shown above in the massing diagram.

Moving between hand sketches, physical study models, computer modeling, and digital graphics, the architecture of the building gradually emerged. Throughout the conceptual design stage, the image of crystallized forms guided design and aesthetic decisions. This required balancing the manifest implications of practicality with the artistry of design.

As the design and program became more finalized, additional layers of detail were built into the computer model, while being very aware to minimize the number of surfaces. A series of test renderings were done to control lights and shadows, as well as material behavior in the program. Simultaneously, site photos were manipulated and rendering views were finalized, allowing for the model to be placed in context.

Once final renderings were completed, postproduction work took place. To cut down on rendering time and as a way to control anomalies such as unintentional reflections, material textures and surface conditions such as construction joints, grilles, and louvers were done in postproduction.

Multiple layers were created to bring about the impression of foreground and background. The layers also help in enhancing the perceptual quality of realism in light, colors, brightness, and contrast.

Once completed, copies of varying resolutions and sizes were generated for appropriate final presentation uses.
[Architect's statement]

PLAZA PERSPECTIVE

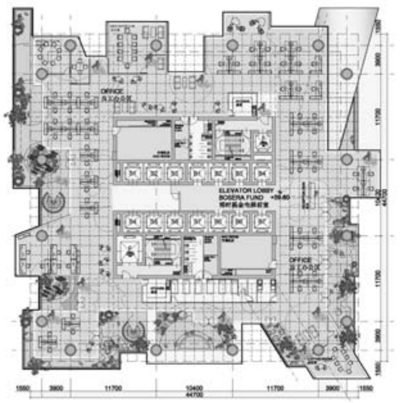
APPROACH ON WEST 42ND STREET

Courtesy of Kenneth Park Architects, N.Y., N.Y.

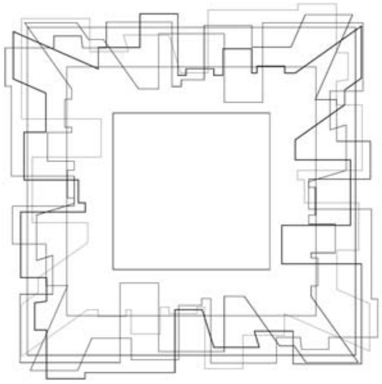
PROJECT TEAM:
Kenneth Park
Paul Madden
Owen B. McEvoy
Robert Holub
Stephen Kandora

PROGRAMS USED:
SketchUp
form•Z renderer
AutoCAD
Photoshop

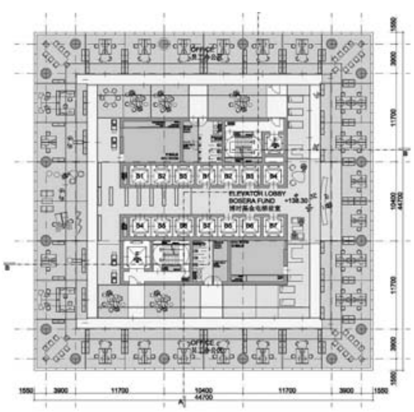
WEST 42ND STREET FACADE



SKYGARDEN FLOOR D 13
花园层D



Five floors of irregular plans forming terraces

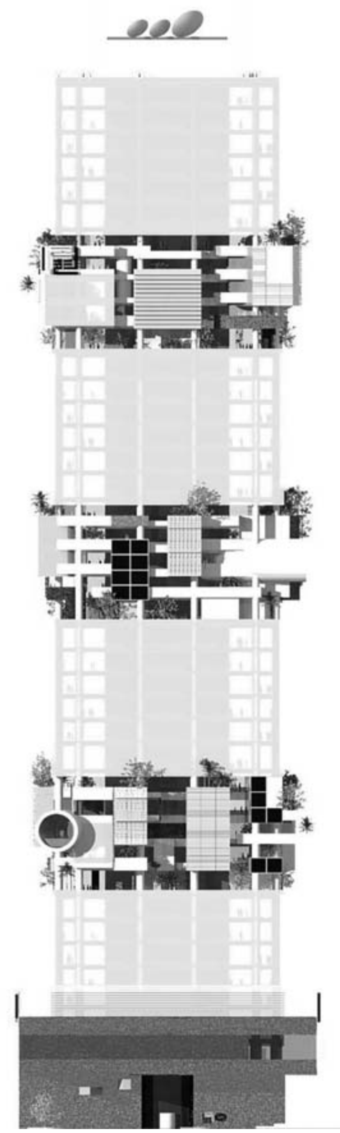


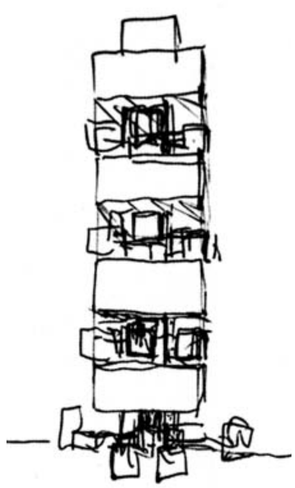
BOXLEVEL 30
標準楼层

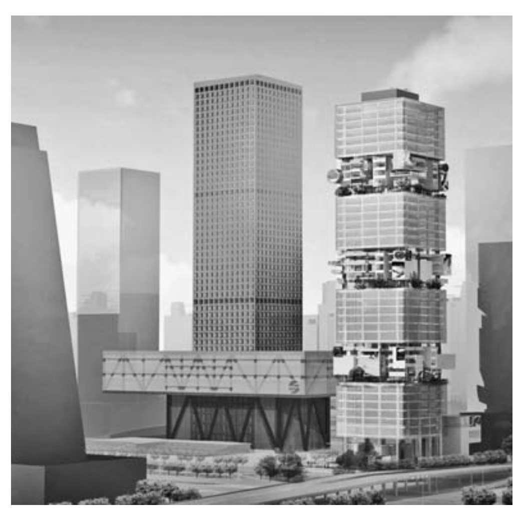
Six floors of identical plans

The tower building in plan is a simple square of 45 m x 45 m, with 42 floors and an overall height of 200 m; and it features a total aboveground floor area of 80.500 m². A skirt building partially frames the tower in the base zone, where the entrance area, the public business hall, and a high-class restaurant are located. [ARCHITECT'S STATEMENT]

Vertically in section, the tower is a layered structure featuring two different zones of five to six floors, each of which repeat and alternate three and four times. One such zone has six identical floors with a square outer perimeter. [ARCHITECT'S STATEMENT]

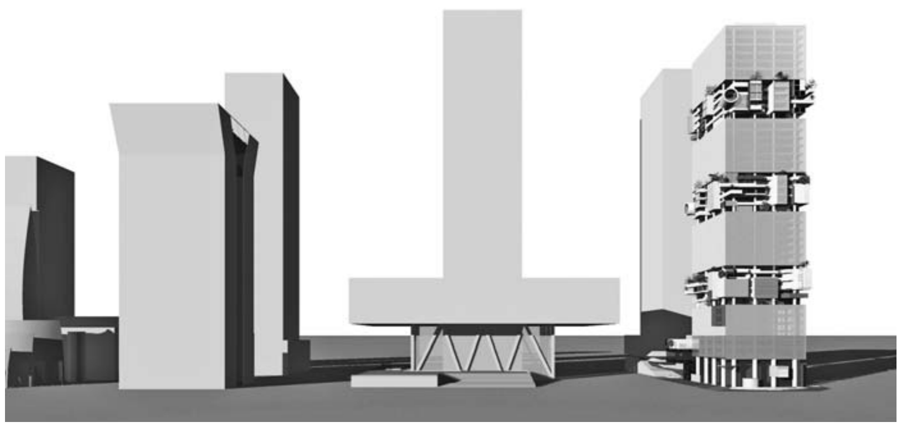




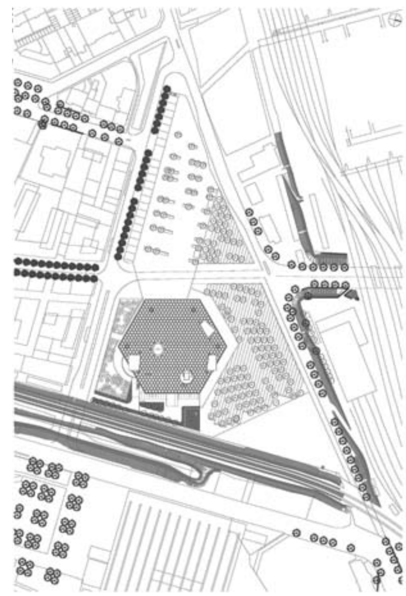


The SFB Tower building contrasts with the stock exchange building. In actual fact, it contrasts with any high-rise in the vicinity, because it is different. With its memorable design in an exposed corner position of the cluster, it becomes a dominant statement within the high-rises. [ARCHITECT'S STATEMENT]

The design of this office tower in the rapidly expanding downtown area of Shenzhen, China, incorporates terraced gardens in the vertical section of a high-rise building.

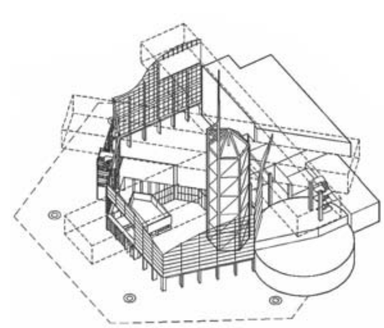


Images (this and facing page): SFB Tower, Shenzen, China
Medium: Computer generated
Courtesy of Hans Hollein, Architect, Vienna, Austria



My first thoughts when beginning the design were two recent phenomena concerning art museums throughout the world today. The first trend, which has become widely known as the "Bilbao Effect," was born from the Guggenheim Museum in Bilbao, Spain, designed by Frank O. Gehry and completed in 1998. The strategy was to create sculptural architecture in an internationally unknown city to draw tourism, and it was ultimately a success. But there is an opinion that this kind of architecture spoils its functionality by disregarding the concerns of artists and staff, to produce a personal monument resulting in poor conditions for displaying and viewing art.

As an example at the other extreme, there is a method of renovating old industrial architecture to produce an optimal space for the exhibition of works, however neutral the architecture may be. The Tate Modern in London and the Dia:Beacon, completed in 2003 in upstate New York for the Dia Art Foundation, are successful examples of such. Rather than choosing either extreme, I thought to create a design concept that considered the ease of displaying and viewing art, while architecturally leaving a deep impression with visitors.



In order to create functional spaces, I articulated the program into simple volumes with a clear circulation amongst them. They were arranged three-dimensionally in order to simplify their functional interrelationship.

The general galleries, with varying requirements for lengths, were based on a 15-meter-wide module to create three simple square tubes with long, 90-meter-deep rectangular volumes inside. The three tubes are stacked vertically and arranged around a hexagonal steel frame tower that contains the stairs and elevators. The space created beneath the tiered ceilings of the three shifted gallery tubes makes up the Grand Nef Gallery.

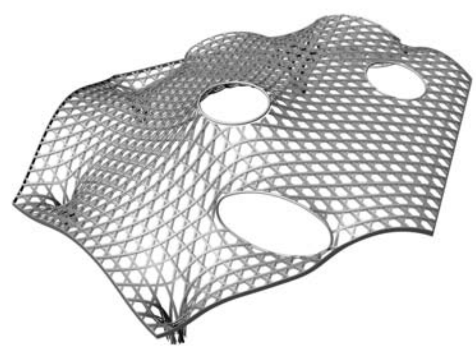
The main purpose for this annex to the Centre Pompidou was to be able to show more works to the public—only about 20 percent of the entire collection is exhibited in Paris—and to be able to display the very large works that cannot be shown in the Paris museum due to the 5.5-meter ceiling height under the beams. To accommodate this requirement, 18 meters was maintained as the highest ceiling height under the Grand Nef Gallery.

The site is the location of the original switchyard south of the current station, and is isolated from the urban center of the city to the north. To establish contextual continuation with the city, the large picture windows at the ends of the three gallery tubes frame views to the city's monuments.

Aside from the three gallery tubes, there is a round volume containing the Creation Studio, with a restaurant on top, and a square-shaped volume containing an auditorium, offices, and other back-of-house program spaces. A timber roof structure in the form of a hexagon hovers over all of the separate volumes in order to unify them into a cohesive whole. To the French, the hexagon is a symbol of their country, as it is similar to the geographical shape of France. Furthermore, the hexagonal is composed of a pattern of hexagons and equilateral triangles inspired by traditional woven bamboo hats and baskets of Asia. Although it is preferred to form triangles to create in-plane stiffness, by dividing up the whole surface into triangles, six wood elements would converge at each intersection, producing extremely complex joints. By creating a pattern of hexagons and triangles, only four wood elements ever intersect. The intersections do not use mechanical metal joints, because if these were used, the surface would become voluminous and the lengths of the elements would all become unique, increasing the complexity and also the cost of the joints. Instead, each member overlaps one another in a manner similar to bamboo wickerwork. This idea came from a traditional woven Chinese hat I found in an antiques shop in Paris in 1999 while designing the Japan Pavilion for the Hanover Expo. I was collaborating with Frei Otto to design the pavilion as a paper tube grid-shell structure, and since first seeing his design of the Institute for Lightweight Structures and Conceptual Design at the University of Stuttgart, I had been fascinated with the tensile wire-mesh structure while also being left with some doubts.

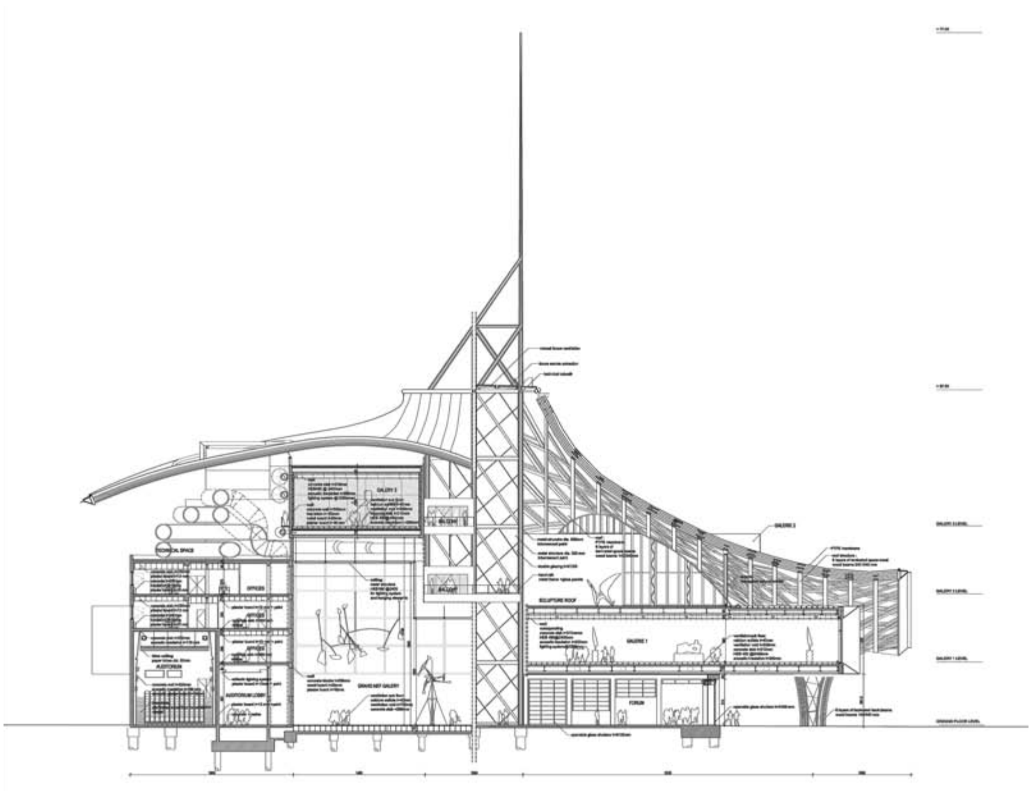
Images: Centre Pompidou-Metz
Metz, France
Medium: Computer-generated
Ove Arup, London – Cecil Balmond
Structural Engineers
Courtesy of Shigeru Ban Architects

© Photos: Didier Boy de la Tour



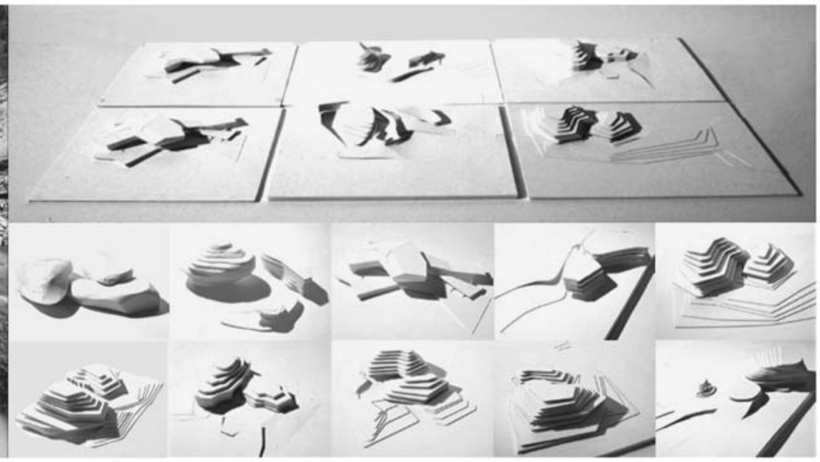
CASE STUDY—CULTURAL

When I saw the Chinese hat, these doubts were cleared. Frei Otto's wire-mesh allowed the formation of an interesting three-dimensional interior space using the minimum amount of materials, but in the end the wire was only a linear member; and in order to build a normal roof, a timber shell had to be formed over the wire-mesh. When I saw this, I wondered about the possibility of making a grid structure using wood (laminated timber) that can be easily bent two-dimensionally, where the roof can be placed directly on top. Since timber can be used as both a tensile member and compressive member, I thought it could be realized as a compressive shell structure, in addition to being a tensile mesh structure. Since then, I have continued to develop timber structures, such as Uno Chiyo Memorial Museum Proposal (Iwakuni City, 2000), Imai Hospital Daycare Center (Oita, 2001), Atsushi Imai Memorial Gymnasium (Oita, 2002), Bamboo Roof (Houston, Texas, 2002), and Frei Otto Laboratory Proposal (Cologne, Germany, 2004); and this work has culminated in the now completed roof of the Centre Pompidou-Metz. During the competition phase, through ties from Bamboo Roof, Cecil Balmond of Arup was in charge of the structure for the roof, and a timber and steel hybrid structure was proposed; but after winning the competition, as stated above, a completely timber roof structure was developed.

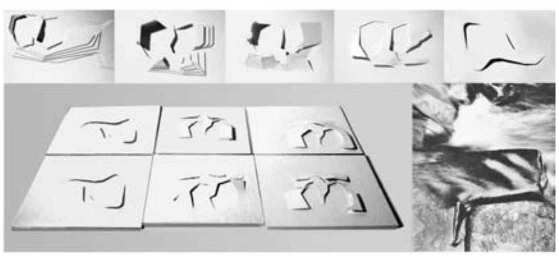


Another important aspect of the concept is the continuation of interior to exterior spaces, and the sequence of spaces born from these relationships. Buildings are generally boxes that begin only when the interior and exterior are separated by walls. However, a space can be created with the presence of just a roof. In recent years art has become more and more conceptual, to the extent that it is distancing the general public. An increasing number of people are not willing to pay money to enter a box to view works that they may not even comprehend. Instead of a box, the museum is a gathering place under a large roof that is an extension of the surrounding park. As it is easier to enter without the presence of walls, the facade was composed of glass shutters that can be easily removed. Mies van der Rohe's New National Gallery in Berlin has walls that are all in glass; but it is only visually transparent, and cannot be called physically transparent. The large volume of the forum can be accessed free of charge, where people can have tea and freely enjoy the sculptures and installations there while they are drawn by glimpses of the artwork in the galleries, and gradually experience the sequences of spaces as they proceed further. The interstitial areas between the large roof and each volume have various functions. First, it is a forum space for gathering. Second, on top of Gallery Tubes 1 and 2, it is an exhibition space for displaying sculptures, taking advantage of the natural light filtering in through the roof. The 840 square meters of these two exhibition spaces were extra spaces not originally requested in the program. Unfortunately, the restaurant atop Gallery Tube 3 that was originally proposed during the competition had to be cancelled for budgetary reasons (according to French building code, general-purpose floor use higher than 28 meters above the ground is considered a high-rise building, which makes emergency evacuation and safety precautions very complex). These are the concepts of this architecture. [ARCHITECT'S STATEMENT]

2 PEBBLES METAPHOR

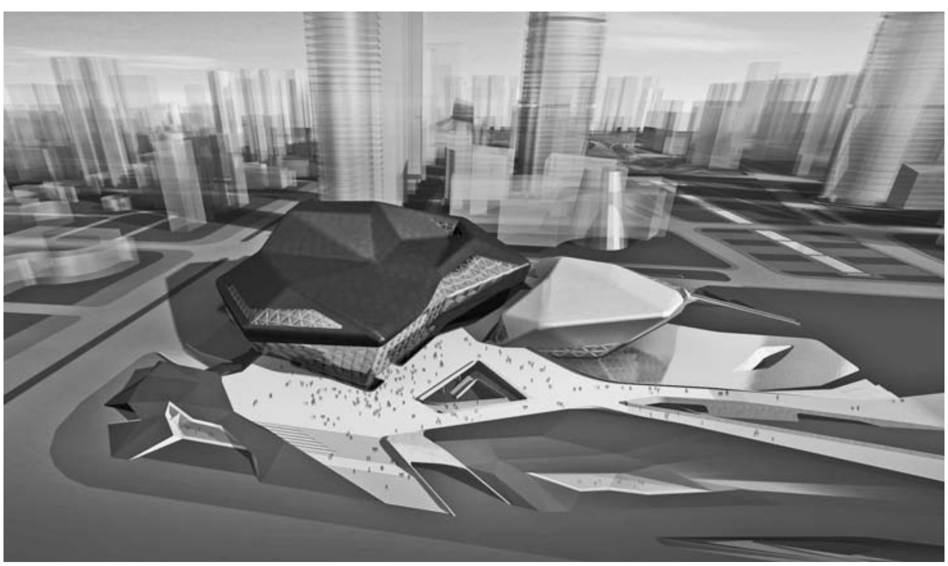


STUDY MODELS OF MASSING CONCEPTS—COMPETITION STAGE



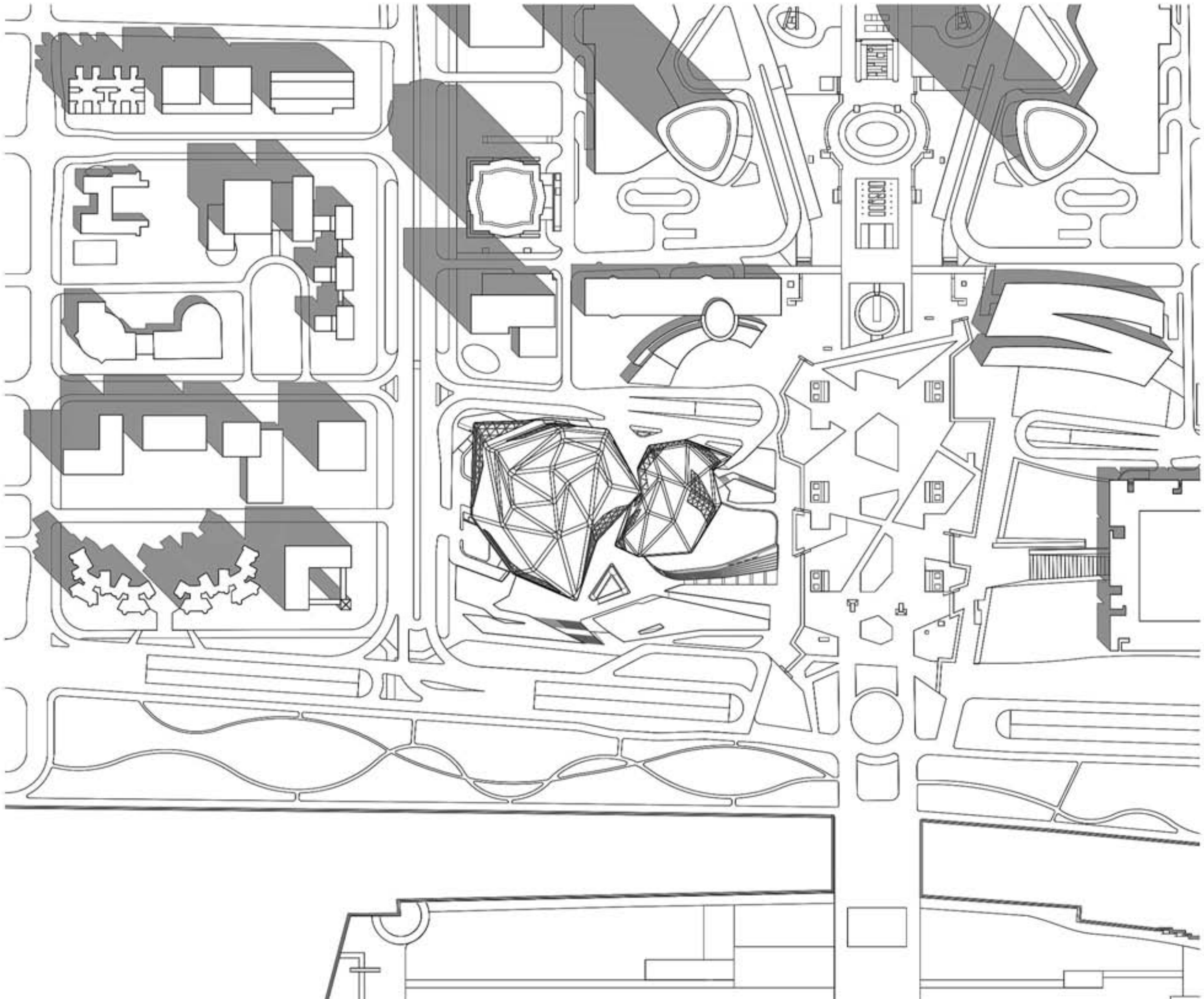
CALLIGRAPHIC CONCEPT

COMPLETED BUILDINGS



3-D AERIAL VIEW—COMPETITION STAGE

Images (9 pages): Guangzhou Opera House
Guangzhou, China
Courtesy of Zaha Hadid Architects

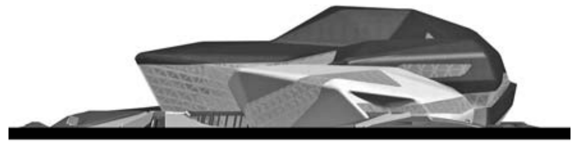


MASTER SITE PLAN

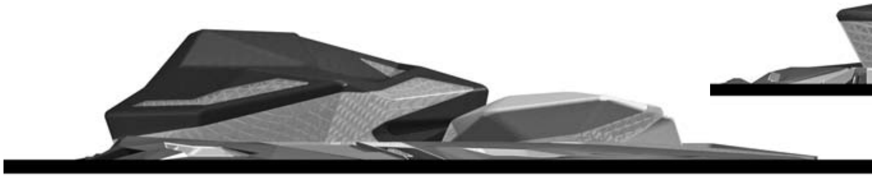
The dynamism of China's development is breathtaking; throughout the entire country, you can sense the enthusiasm, ambition, and boundless energy of the upcoming generation. It is a very rewarding experience to see the completed Opera House, and I am very grateful to the city of Guangzhou. There are very few places in the world today where architects can find such forward-looking, enthusiastic clients with such passion for innovation. I first travelled to Guangzhou in 1981—at the beginning of my career—and the contrast to the Guangzhou we see today could not be greater. The design of the Opera House reflects China's rich cultural history, but also the remarkable future China will play on a worldwide stage.

The Opera House design has to play a role in its cultural context and immediate settings. We knew the opera house would be set within a new master plan of civic and commercial projects, so our concept of gradually lifting the landscape to draw in visitors, and the interplay of the two sculptured volumes on this public arena, gave us an opportunity to propose this scheme in China with a poetic analogy.

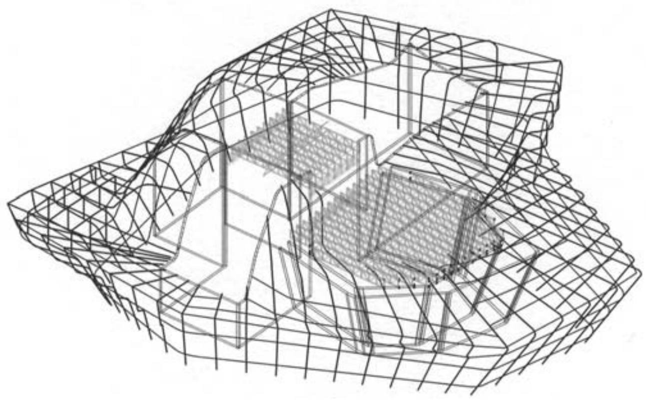
In Chinese culture, certain analogical thinking makes sense, and the idea of pebbles and rocks on the banks of a stream is actually very meaningful for a project located next to the Pearl River. As designers, this is more of a technique for us to articulate the relationship of an object within a landscape, describing how the design is informed by its context. So, when designing the building we were not thinking so much of metaphor, but more in terms of analogy—the landscape analogy—where features of a natural landscape are expressed within the architecture. For example, the smooth transitions between territories and zones, and smooth transitions between levels.



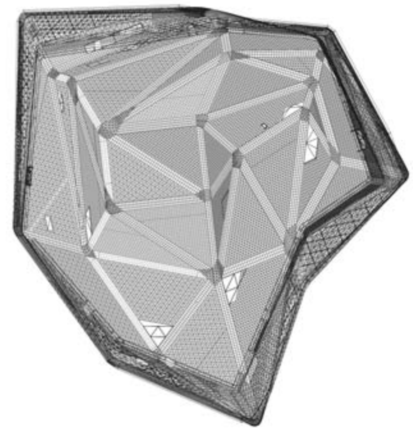
EAST ELEVATION



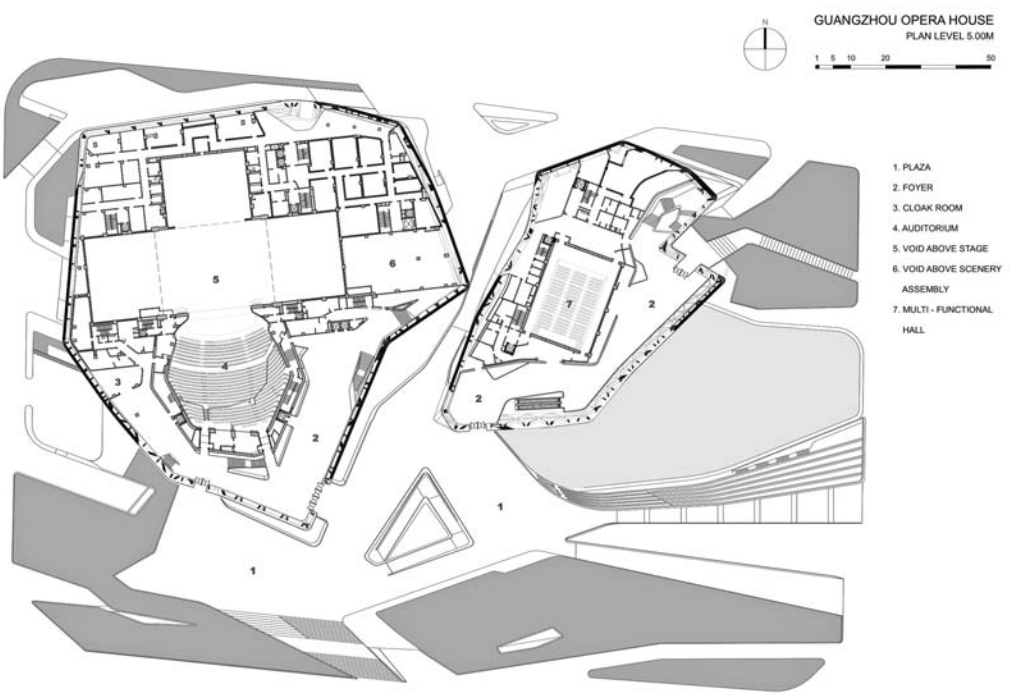
SOUTH ELEVATION



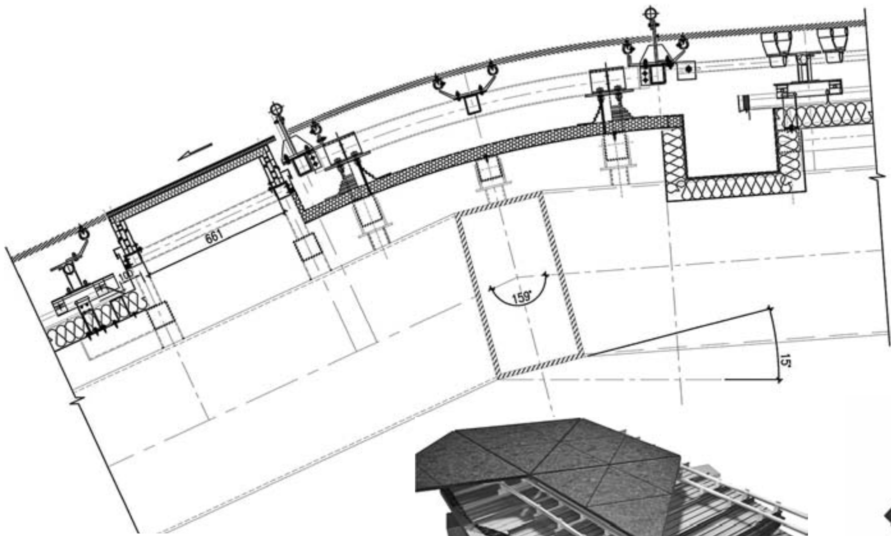
STRUCTURAL PROPOSAL—COMPETITION STAGE



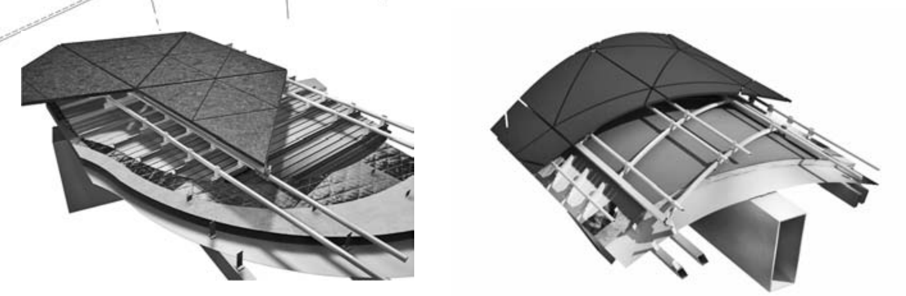
ROOF-FRAMING DIAGRAM OF OPERA HOUSE BUILDING



"Spatial folded-plate triangular lattice structure" is used for the first time in the design of the structure of this building. As a steel structural system, it is most applicable to the design of enclosures of irregular-shaped buildings. The ingenious solution takes into consideration of resistance to earthquake, efficient constructability, and elegant detailing with architectural materials. The built result is a testimony of complete integration of engineering and visual appearance. The organic appearance on the exterior is reflected on the fluidity of the interior. As presented by Huang Tai Yun, Senior Structural Engineer, the design is exemplary of a world-class iconic collaboration of artistic and scientific disciplines.



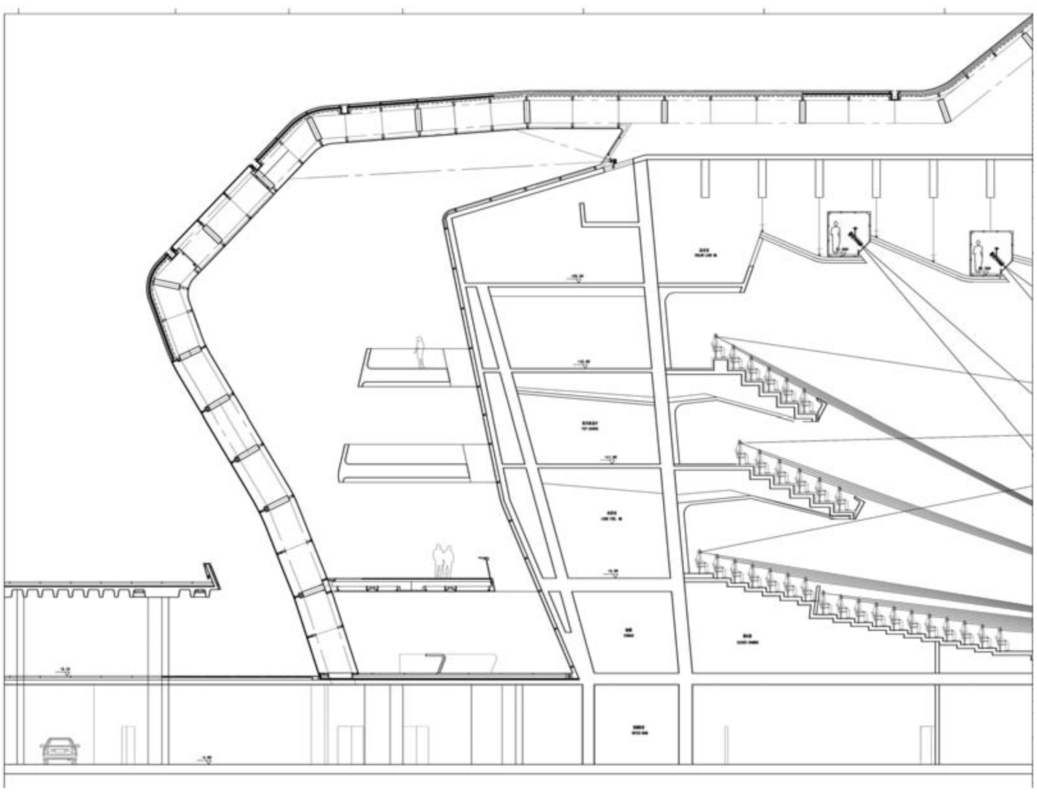
WALL PANEL DETAILS



3-D ILLUSTRATION OF WALL PANEL DETAILS

NORTH ELEVATION

WEST ELEVATION



PARTIAL SECTION
OF OPERA HOUSE

It is always exciting when architectural concepts can be delivered through a new construction technique, and some examples of this can be seen in the Opera House project. For example, the main steel structure is entirely asymmetrical, and, though complex, embodies an innovative combination of age-old methods and new technologies. To ensure rigidity, the 59 steel joints of the main structure all differ from one another and are sand-cast (as in a medieval bell foundry) and assembled accurately using laser and GPS positioning systems.

The requirements in an auditorium for Western and Chinese operatic performances differ significantly. It was important, therefore, that the layouts and interiors for this space were established early on, with the support of the acousticians (Marshall Day Acoustics) and theater consultants.

The two traditions of Chinese and Western opera are mutually exclusive. With Western opera the focus is on natural acoustics, whereas in Chinese opera the drama and story have priority and audio equipment is used on almost every occasion. Our research into opera house and auditorium design over the past twenty years has shown us the many benefits of asymmetrical auditoriums—they can give a real depth to the natural acoustics. All three acoustic parameters—reverberation, sound pressure (volume), and clarity—need to be balanced, and we worked very closely with Marshall Day to optimize the performance of the space. To take one example, we molded dips into the glass-fiber-reinforced gypsum (GFRG) panels toward the front of the auditorium, where the sound pressure was required to be toned down. The deeper and closer together these dips are, the more effective they are at toning down the pressure. For Western productions, the space is designed to ensure perfectly balanced acoustics with concealed lighting and audio equipment that can be revealed as needed.

The day and night photographs are expressive of a civic and cultural icon reflecting its futuristic role in a dynamic and ever-expanding city.

The form of the building composition offers a kinetic quality of two buildings in motion. The plaza side of the building shows a dialogue of solid and void, layering and transparency, with a simple paved ground contrasting with an open sky.

The facade side of the building touching the pool is sculptural and Baroque-looking, with a doubling of the image through reflection (see pp. 320–23).

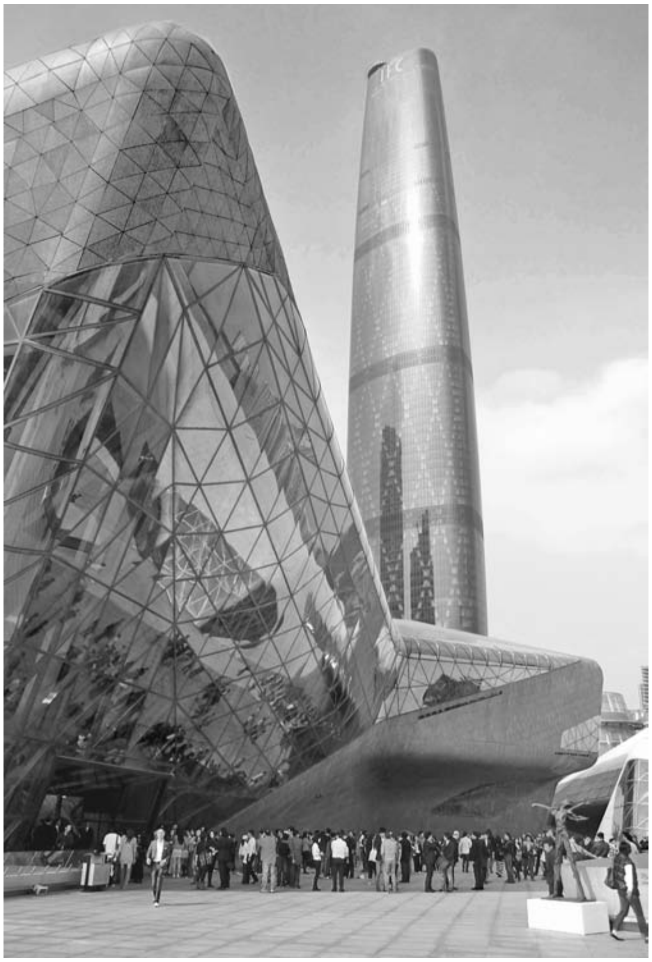
The interior of the Opera House's main auditorium space is a champagne-colored gold space with a gloss finish—similar to the appearance of luxurious silk. This is continued into the seating, which is also copper-toned. The overhead lighting is a constellation of very small white LED lights. As with all our work of the past ten years, we wanted to achieve the ultimate fluid space to deal with the complexities of the demanding acoustic engineering, as well as with the complicated programming requirements that allow for a variety of events and performances in the building. Therefore, we have continued the seamless organic architectural language in the asymmetrical auditorium space. Glass-fiber-reinforced gypsum (GFRG) panels have been used to create one single surface with many pleats and folds that house a variety of acoustic panels and extend into the space to accommodate seating areas.

Computing was essential in all aspects of the design and construction of the Opera House, but most especially the interior of the auditorium. The contractors made bespoke wax molds to create the GFRG panels, allowing for seamlessness of the auditorium's complex geometries. These molds were fabricated directly from the 3-D computer files we supplied, allowing for an almost perfect precision—making the interior a truly uplifting and transformative space.

The exterior is clad in triangular granite sections that correspond with the structure. A charcoal-colored granite with a rough texture is used on the larger of the two "twin boulders" that house the main auditorium, and a lighter white color is used on the smaller structure that houses the multifunction hall. These textured finishes reinforce the overall design concept of the project as boulders, eroded by water, on the banks of a stream—a continuation of our architectural language of landscape formations and natural systems. Tessellated triangular glass sections emphasize the crystalline nature of the design and open up the public areas of the Opera House.
[Architect's statement]

Images: Guangzhou Opera House
Guangzhou, China
Media: Rhino, Maya, and AutoCAD
Courtesy of Zaha Hadid Architects

©Iwan Baan



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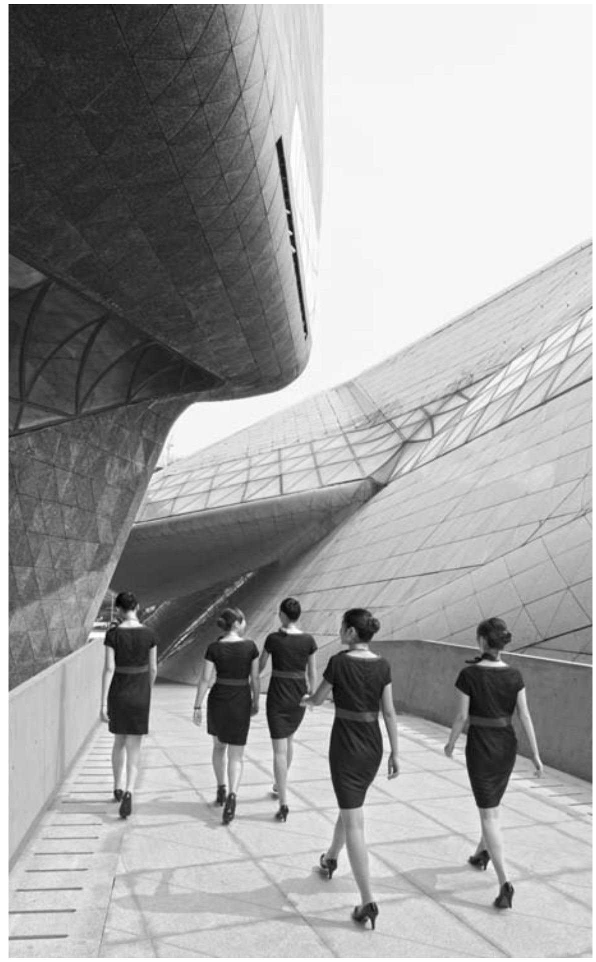

© Iwan Baan

Dynamic view of exterior space between two building masses and glass tower beyond

A sense of motion looking at structural supports in parking structure

© Matthew Richardson

Longitudinal section through the Opera House (left) and the multipurpose hall (right)

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View of Opera House beyond from underground parking structure with integration of triangular lighting above

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Views of public areas and lobby of Opera House—the interior volumes of a dynamic spatial experience, with a sense of juxtapositioning of structural expression and sculptural interplay of geometric and organic shapes, both smooth and textural

© Matthew Richardson

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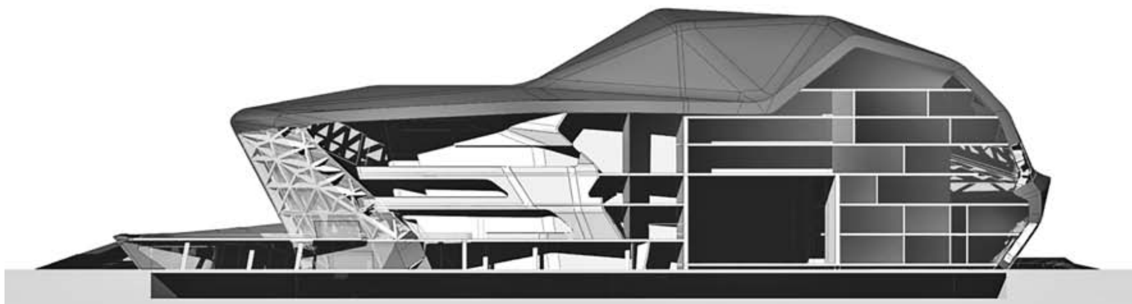
View of lobby showing complexity of massing volumes in public area

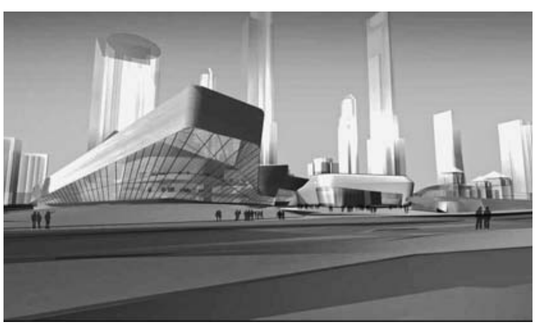
View of lobby at entrance to Opera House

COMPUTER RENDERINGS (LEFT & RIGHT): COMPETITION STAGE



SECTION THROUGH THE OPERA HOUSE

Competition stage renderings are by necessity conceptual.



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OPERA HOUSE INTERIOR—COMPLETED BUILDING

4

Conventional Orthogonal Terminology

Scaled plans, elevations, and sections are architectural drawing conventions that permit the representation of three dimensions at a smaller scale. These multiview drawings are the result of projecting orthographically and help to depict a three-dimensional form—like a building—in various, related two-dimensional views. With these projections, design aspects related to space, scale, and configuration can be studied.

In the previous chapter on digital/manual interfacing, you got a preview of the current diversity of forms in building design that manifest a variety of shapes, some of which are nonrectilinear. The advent of sophisticated digital design methods coupled with cutting-edge engineering technology made it possible to design and build these structures. One might raise questions regarding the extent and limitations of orthographic projections of plans, sections, and elevations if a designed object does not lend itself to this type of proven geometric analysis. However, a majority of built forms consists of a right-angled assemblage of parts, and it is therefore critical to understand the fundamental procedures of manual technical drawing shown in this chapter.

The intent of this chapter is to introduce the potential and capabilities of multiview drawings and graphic symbols, and the kinds of information they can communicate.

The following are some of the important terms and concepts you will learn:

Orthogonal	Orthographic projection	Plan
Section	Reflected ceiling plan	Elevation
Roof plan	North arrows	Graphic scales
Stairways/ramps	Doors	Windows

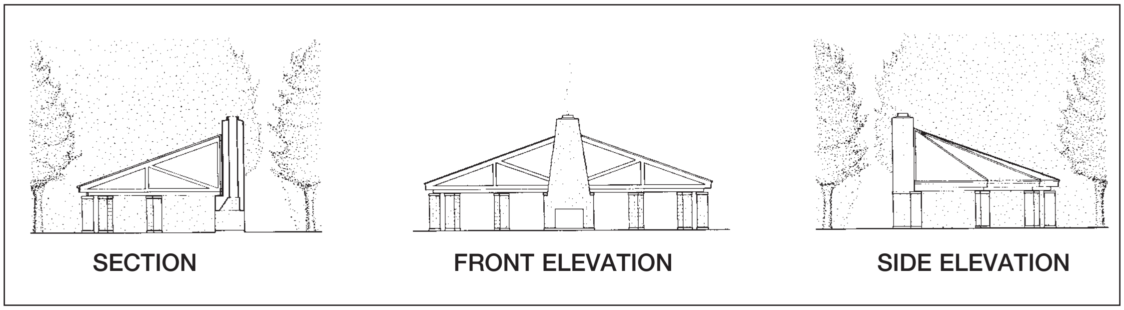
Conventional Orthogonal Terminology

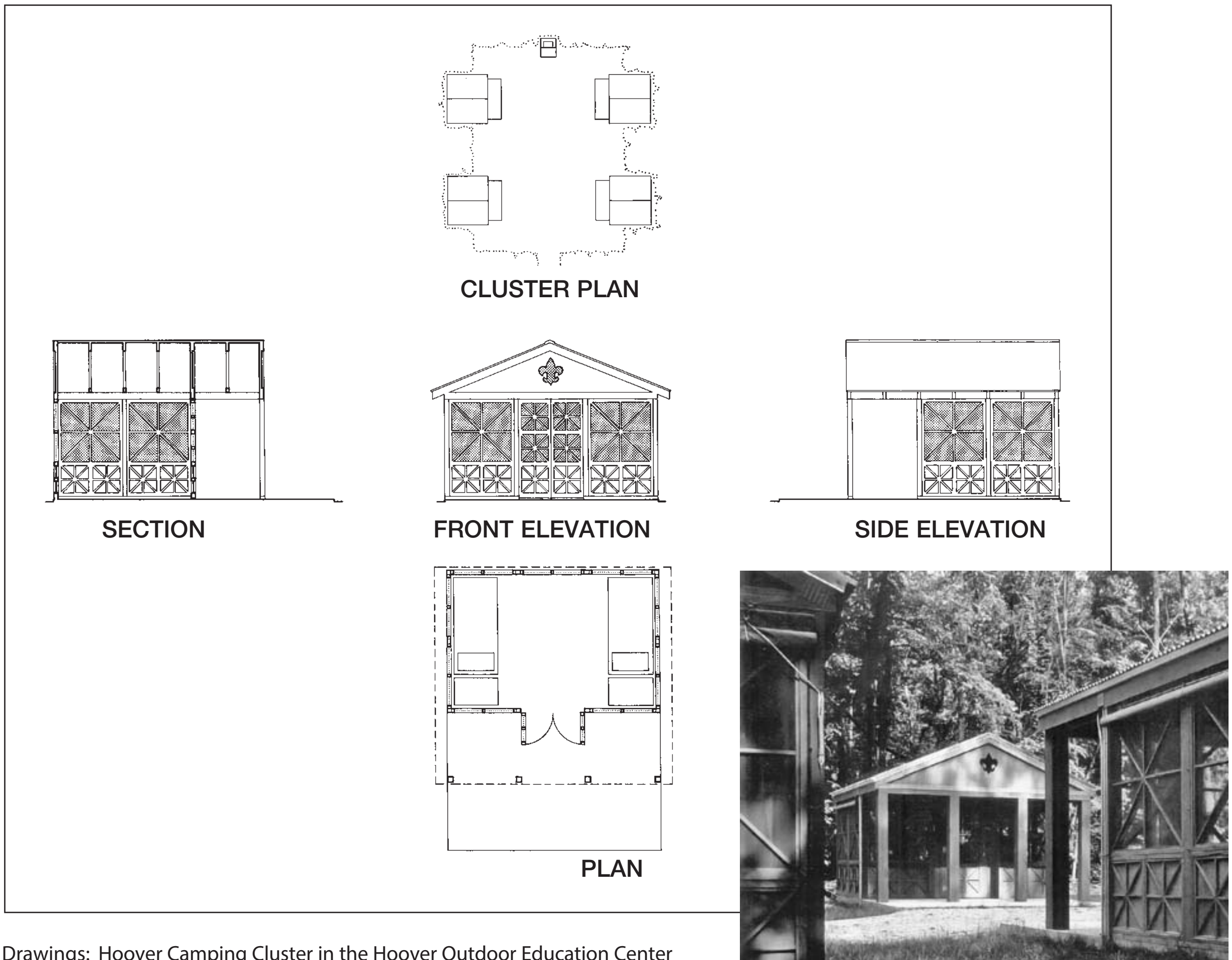
TOPIC: CONVENTIONAL ORTHOGONAL TERMINOLOGY

Forseth 1980, 66–75.

Chapter Overview

After studying this chapter, you will have a detailed understanding of drawing conventions such as plan, elevation, and section, as well as north arrows and graphic scales. For continued study, refer to Forseth 1980.





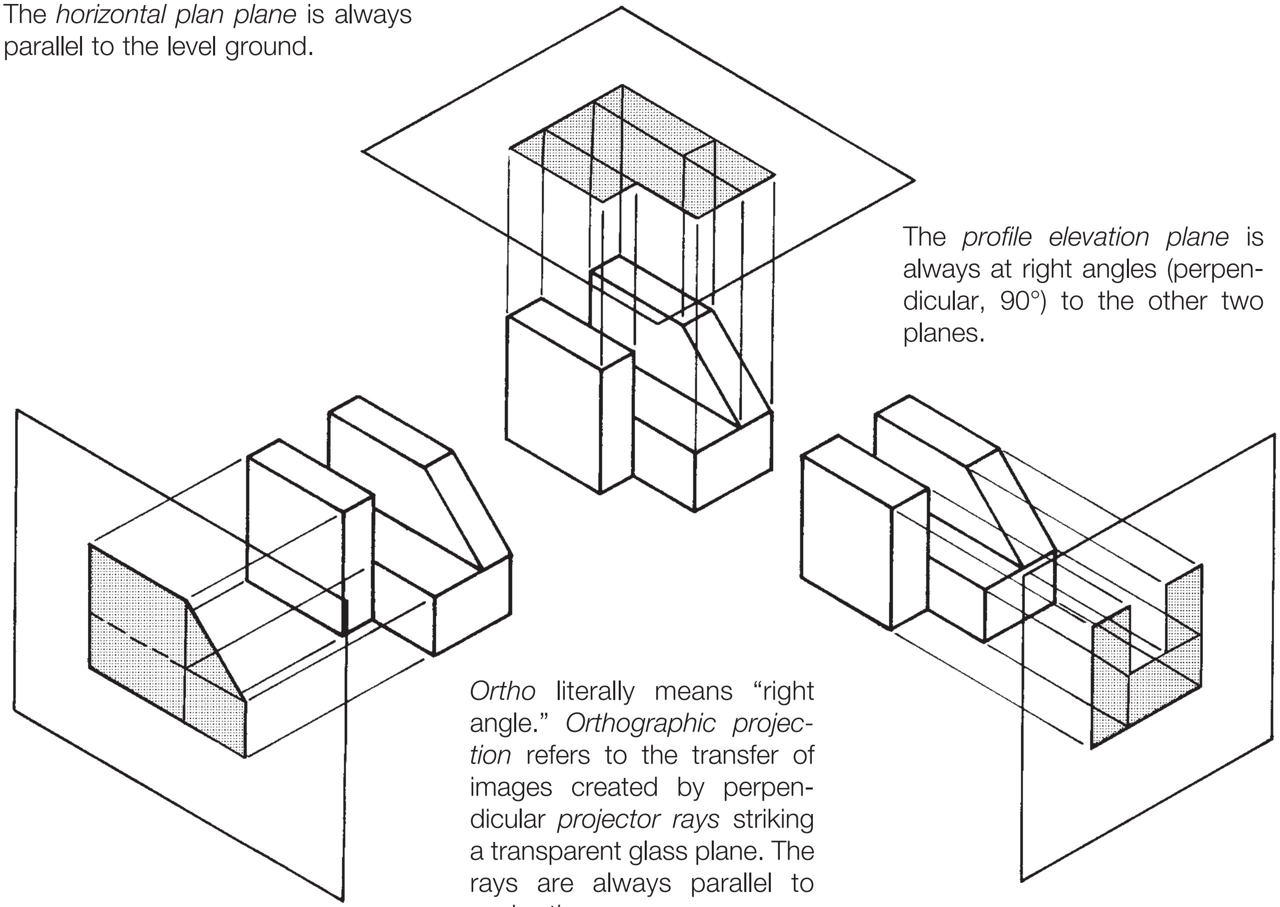
Drawings: Hoover Camping Cluster in the Hoover Outdoor Education Center
Yorkville, Illinois
Medium: Ink on Mylar
Courtesy of Tigerman McCurry Architects, Ltd.

Photograph by Bruce Van Inwegan
Courtesy of Tigerman McCurry Architects, Ltd.

Historically, buildings have been described using an *orthogonal* (right-angled) two-dimensional drawing system. The nomenclature used for the various orthogonal views is shown here. Popular architectural terminology such as “floor plan” is common knowledge for the layperson.

Small building types like residences are usually drawn orthogonally at a scale of ⅛" = 1'0" or ¼" = 1'0". A smaller scale (1⁄16" = 1'0") can be used for larger building types such as hospitals and schools. A knowledge of orthogonal conventions and graphic symbols is necessary for architectural drawings and presentations. This chapter isolates and explores these topics in detail.

The *horizontal plan plane* is always parallel to the level ground.

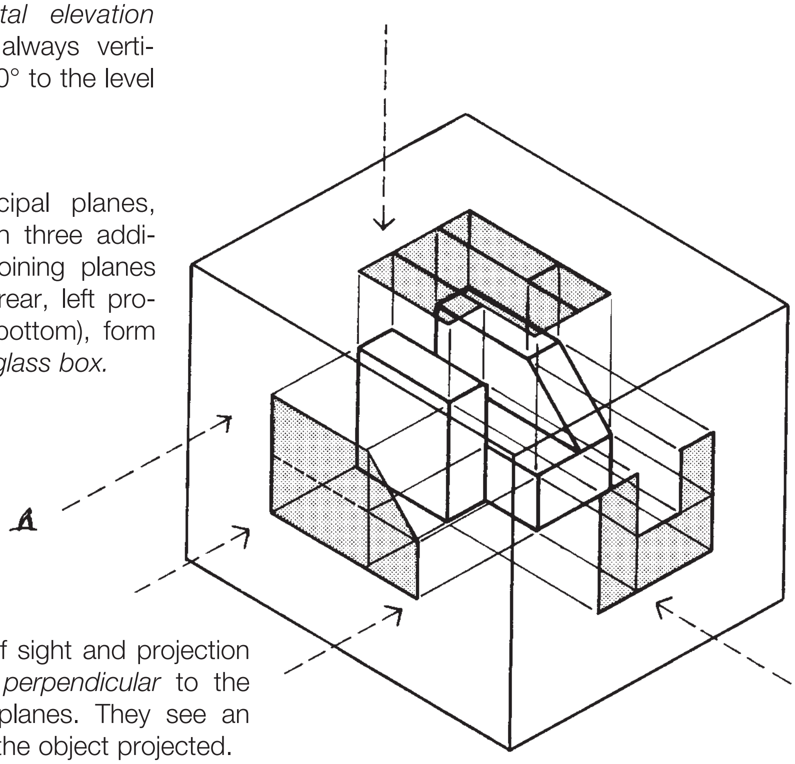


The *profile elevation plane* is always at right angles (perpendicular, 90°) to the other two planes.

Ortho literally means "right angle." *Orthographic projection* refers to the transfer of images created by perpendicular *projector rays* striking a transparent glass plane. The rays are always parallel to each other.

The *frontal elevation plane* is always vertical and 90° to the level ground.

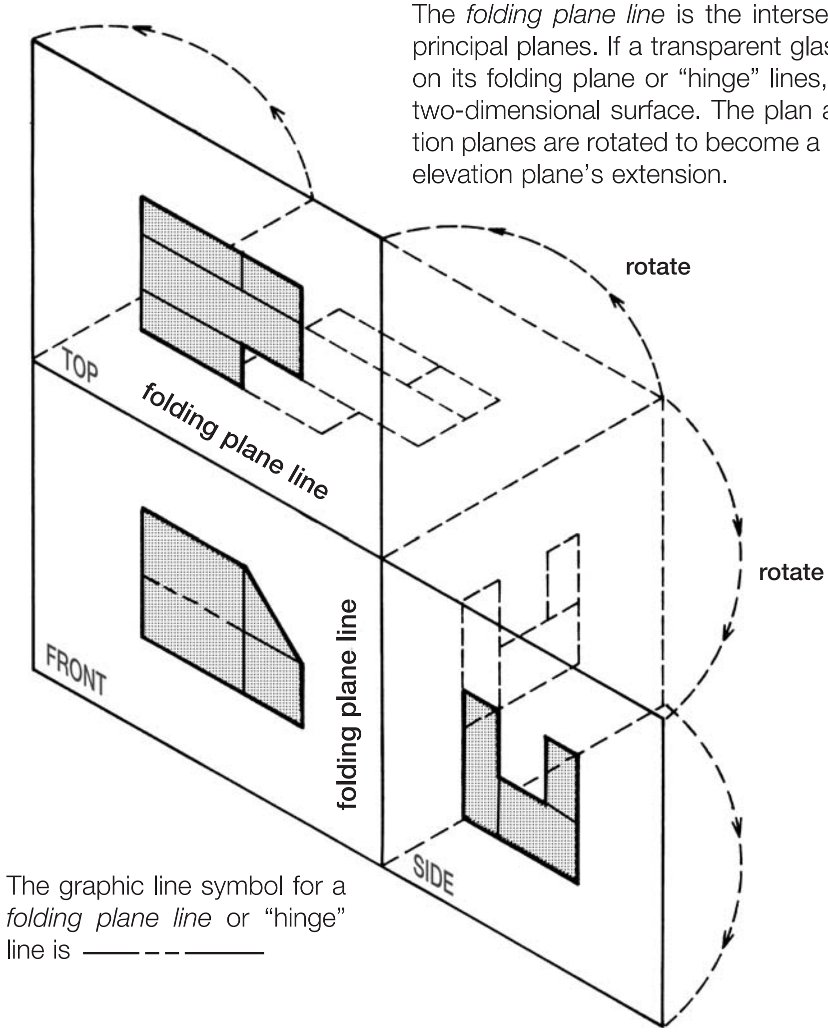
The principal planes, along with three additional adjoining planes (back or rear, left profile, and bottom), form a closed *glass box.*



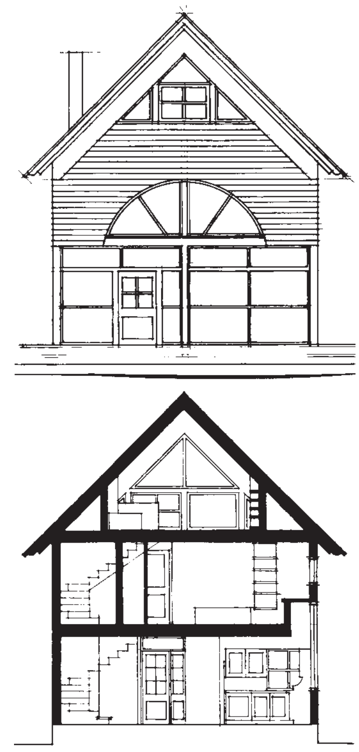
All three principal planes are perpendicular to one another. Each two-dimensional principal plane can be classified as a *picture plane* because it records a picture image of the object.

All lines of sight and projection lines are *perpendicular* to the principal planes. They see an *image* of the object projected.

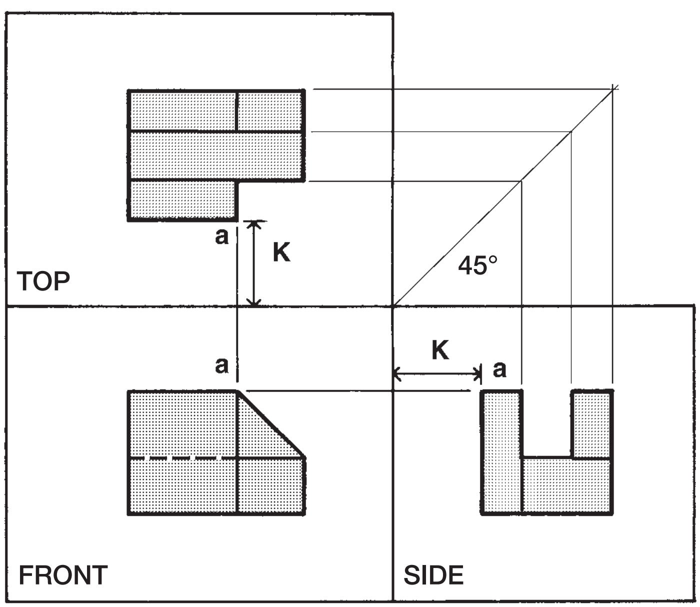
The *folding plane line* is the intersection of any two principal planes. If a transparent glass box is opened on its folding plane or "hinge" lines, it will become a two-dimensional surface. The plan and profile elevation planes are rotated to become a part of the frontal elevation plane's extension.



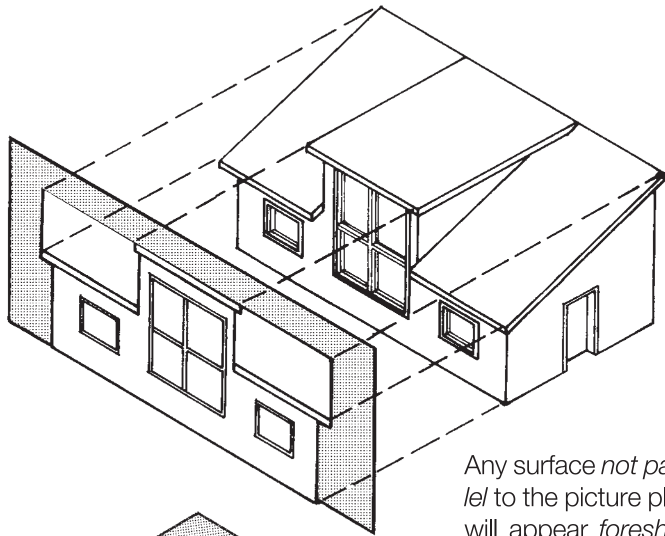
The graphic line symbol for a *folding plane line* or "hinge" line is ——— – – ———



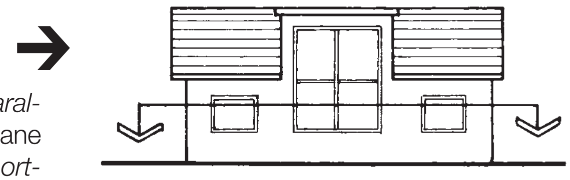
Drawing: The Coxe Studio
Block Island, Rhode Island
18" × 24" (45.7 × 61 cm), Scale: 1/4" = 1'0"
Medium: Pencil on vellum
Courtesy of Venturi, Scott Brown and Associates, Inc., Architects



The above example shows two true-size profile views (elevation and section). *Orthographic drawings* are true-size and true-shape views that are related on a two-dimensional surface. When two planes are perpendicular to a third plane, any point in space (such as **a**) will be seen twice an equal distance **K** behind the third plane, where **K** can be any distance. In constructing related orthographic views, use a *45° diagonal line* from the intersection of the folding plane lines. Proper distances can then be transferred with projector lines from the top or horizontal view to the side or profile view.

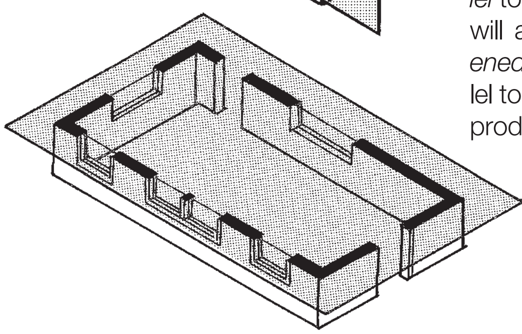


In an *elevation,* the image is projected onto a vertical picture plane. A building elevation shows vertical-dimension relationships, the organizational massing, and the scale of the fenestration. It also shows the location of doors and windows, as well as the pattern and textures of the construction materials. Only the ground plane outside of the building will be shown as a solid cut line or a solid mass.



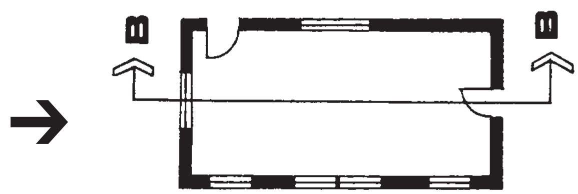
elevation

Any surface *not parallel* to the picture plane will appear *foreshortened.* Surfaces parallel to the picture plane produce *true shapes.*



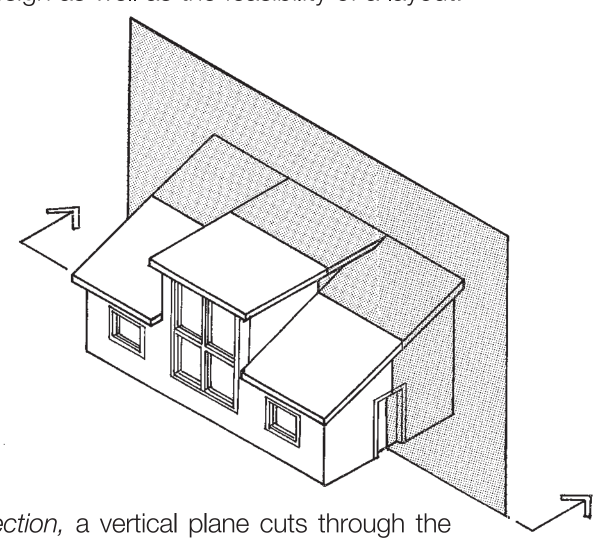
To facilitate understanding of the viewer direction and location on sectional cuts, a line with labeled direction arrows (in this case [below], **B-B**) should always be shown in the plan view.

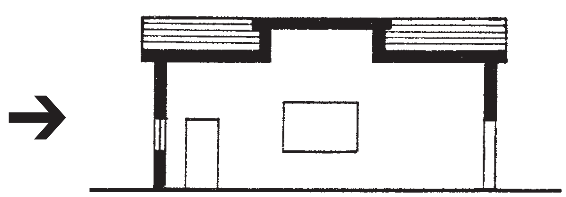
In a *plan,* a horizontal plane cuts through the building so as to remove that part of the building above the cutting plane. Floor plans express and communicate the intent of a design as well as the feasibility of a layout.



floor plan

Design sections normally do not show the foundation piers to reference the datum line, but rather show a toned or solid cut ground mass, or an edge line between sky and ground.

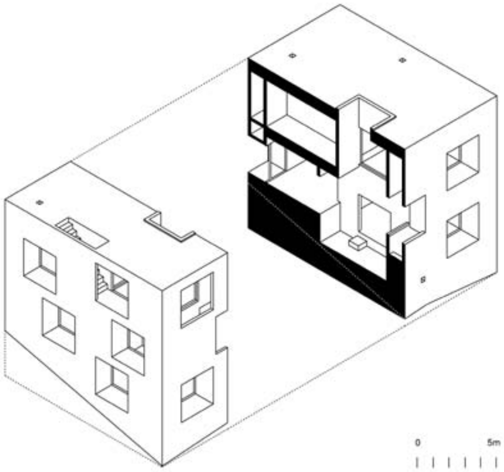




longitudinal section

In a *section,* a vertical plane cuts through the building lengthwise (longitudinally) or crosswise (transversely) so as to remove that part of the building in front of the cutting plane.

In essence, plans, sections, and elevations are measurable aspects of a project to assist the designer and/or professional in comprehending the true scale of a design. These fragmentary two-dimensional projections are often collaged into the presentation page to heighten the visual sense of graphic communication. The cognitive experience of an object is three-dimensional and dynamic.

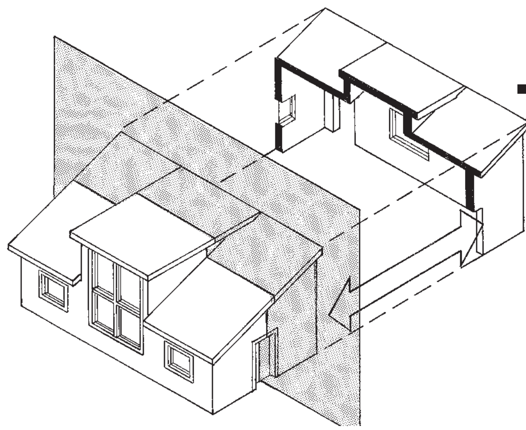


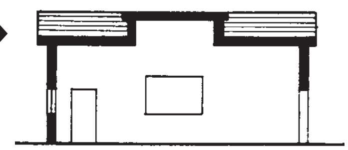
Drawing: Casa Poli
Collumo, Chile
Medium: Pen and ink
Courtesy of Pezo von
Ellrichshausen Architects

Perched high on a cliff at the world's edge with commanding views of the ocean, this economically built comfortable weekend retreat provides an ideal location to stimulate the creative mind of artists. This firm's hand-drawn sliced sectional axonometrics are always superb.

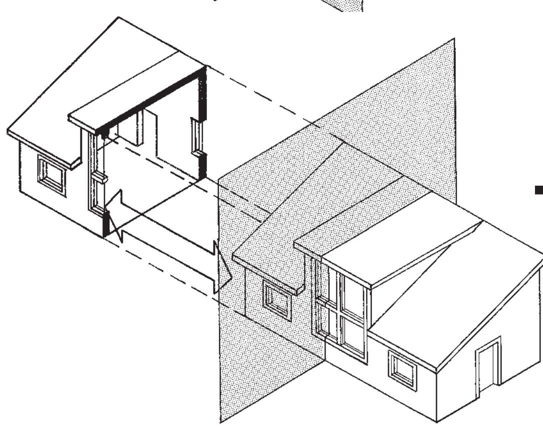
© Cristobal Palma

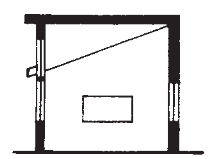
These two *building sections* reveal the roof structure, the supporting walls, and the ground line cut (which can be a heavy solid profile line or a toned area). Section cuts can be solid black, profiled with a heavy line, or rendered with a shade of gray. Lines seen beyond the cut are elements of the interior elevation (doors, windows, interior roof structure, etc).





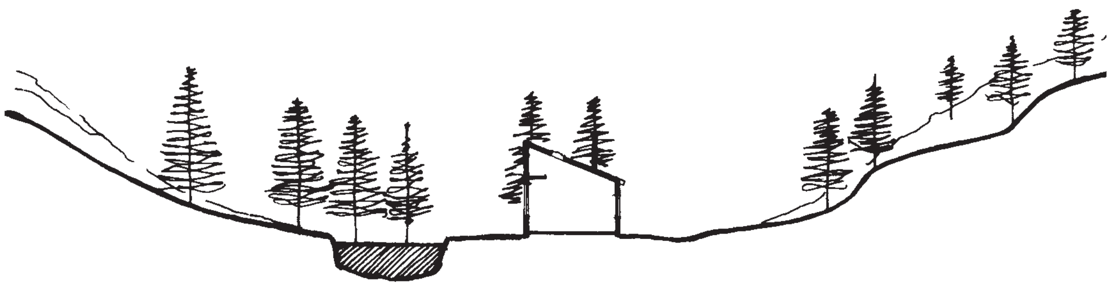
building section



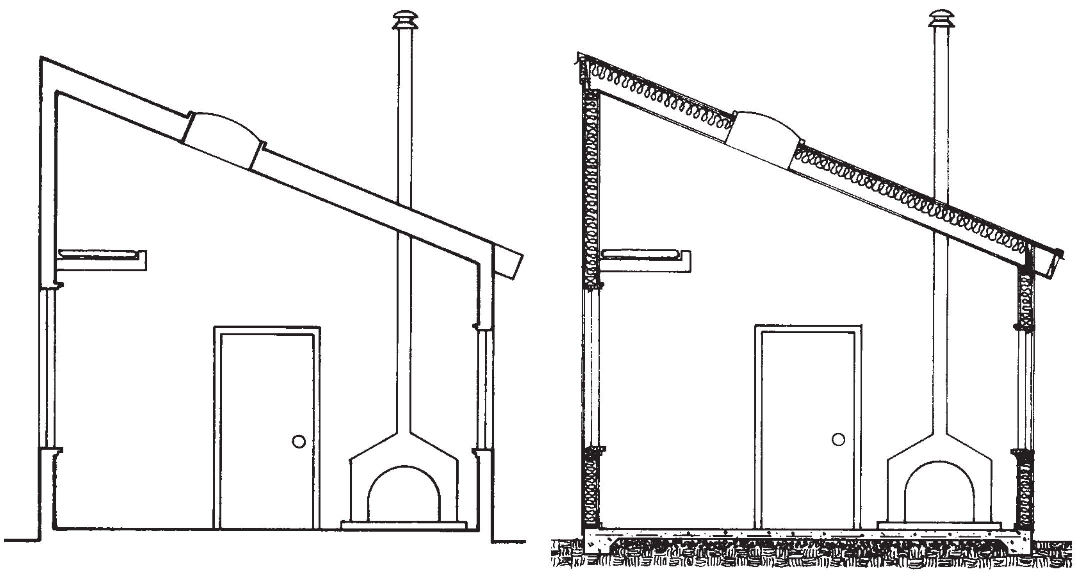


building section

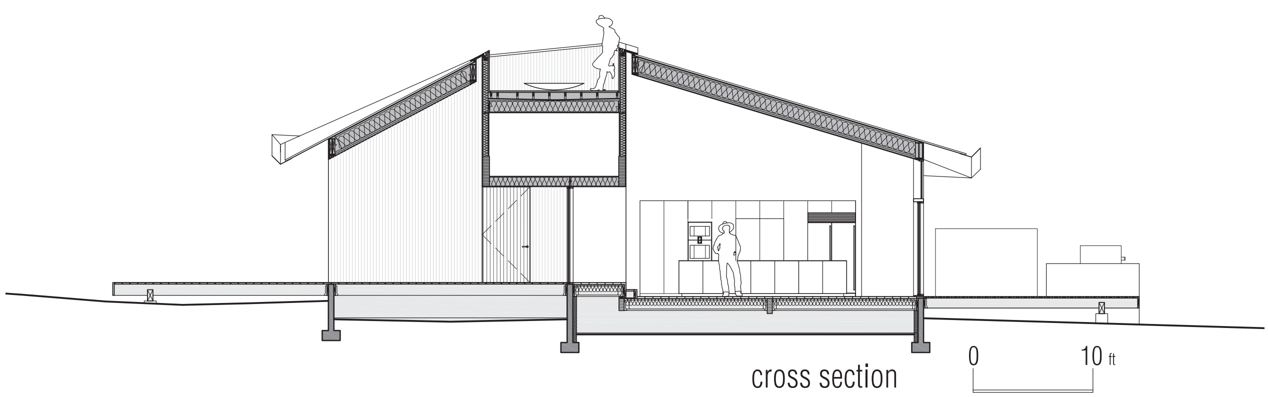
A *building section* is analogous to the plan (horizontally cut section) except that the continuous cutting plane is *vertical.* Removing that part of the building in front of the plane reveals a cut section of the interior space. Logically, sectional cuts in architectural drawings are most often done parallel to walls in either the front or the side elevation. These sections are then properly annotated, as explained on the previous page. Other types of sectional cuts (such as offset cuts) tend to be more complex. The location of the sectional cut and the direction of view is left to the discretion of the architect/designer. Try to be very descriptive in showing the configuration and scale of the contained spatial relationships.



The contour that defines where the sky (or space above) meets the building mass and the ground line determines the configuration of any *site section.* The primary function of a site section is to relate any building design to its *contextual environment.* It is quite common to see large site sections that show multiple cut sections of the building complex in combination with elevations of the same complex.

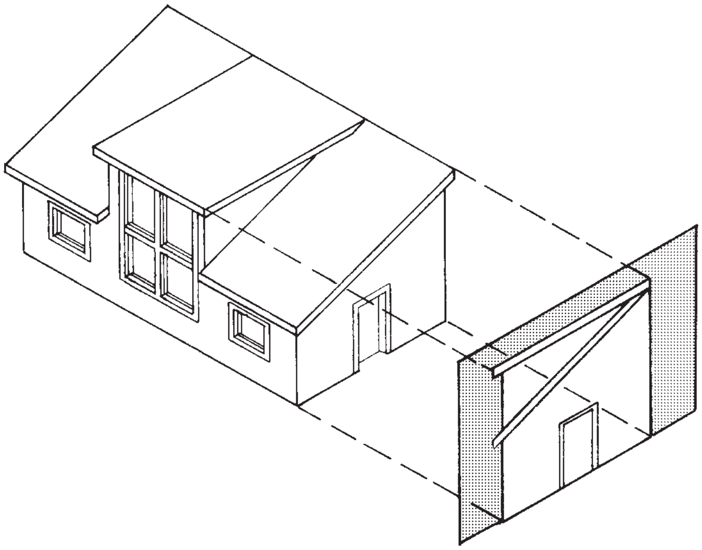


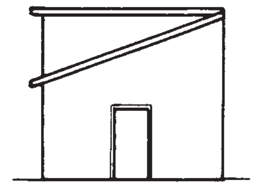
A *design section* shows no structural or construction details in the section area that is cut. The section is profiled with a heavy line to help define the interior spaces and overall form of the building. A *construction section* (above right and below) shows the details required to fabricate the building.



This six-bedroom desert retreat has a twisted hip roof with a perimeter gutter that channels water to water-harvesting cisterns at two opposing corner points of the house. It also has a secret roof deck for stargazing.

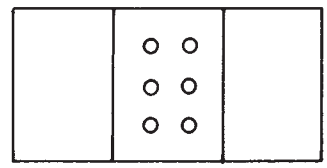
Drawing: Lone Mountain Ranch House
Golden, New Mexico
Medium: AutoCAD 2006
Courtesy of Rick Joy Architects





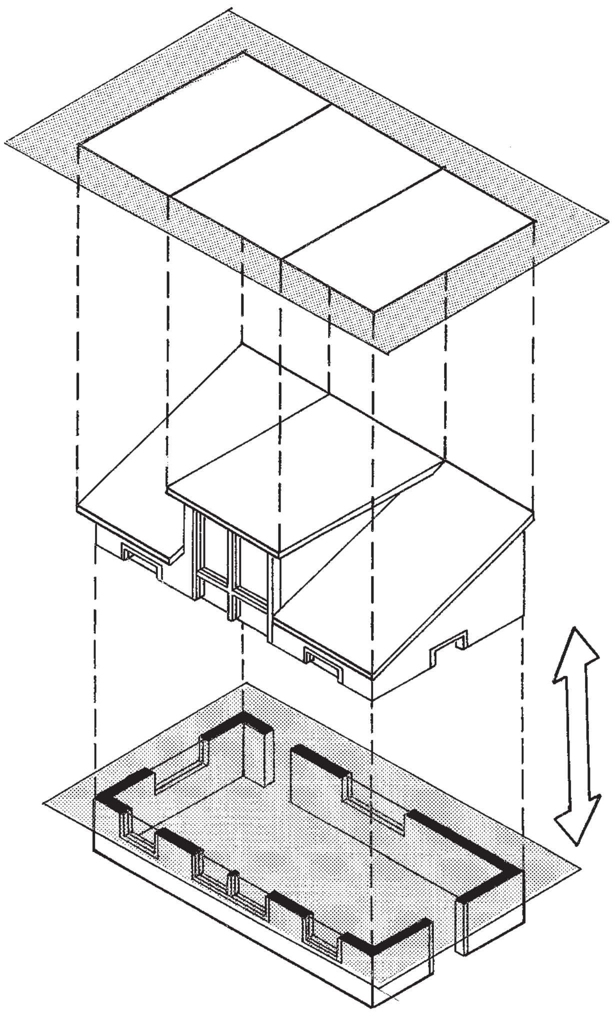
elevation

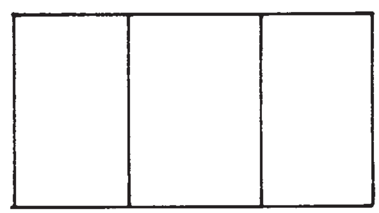
Elevation views are identified by the compass directions (e.g., North Elevation, Southwest Elevation). An elevation shows the relationship of a building's mass to the ground plane, as well as its scale and exterior material texture.



reflected ceiling plan

A *reflected ceiling plan* is the image reflected into an imaginary mirror placed on the floor plan below. It primarily shows the placement and type of lighting fixtures as well as the ceiling configuration.





roof plan

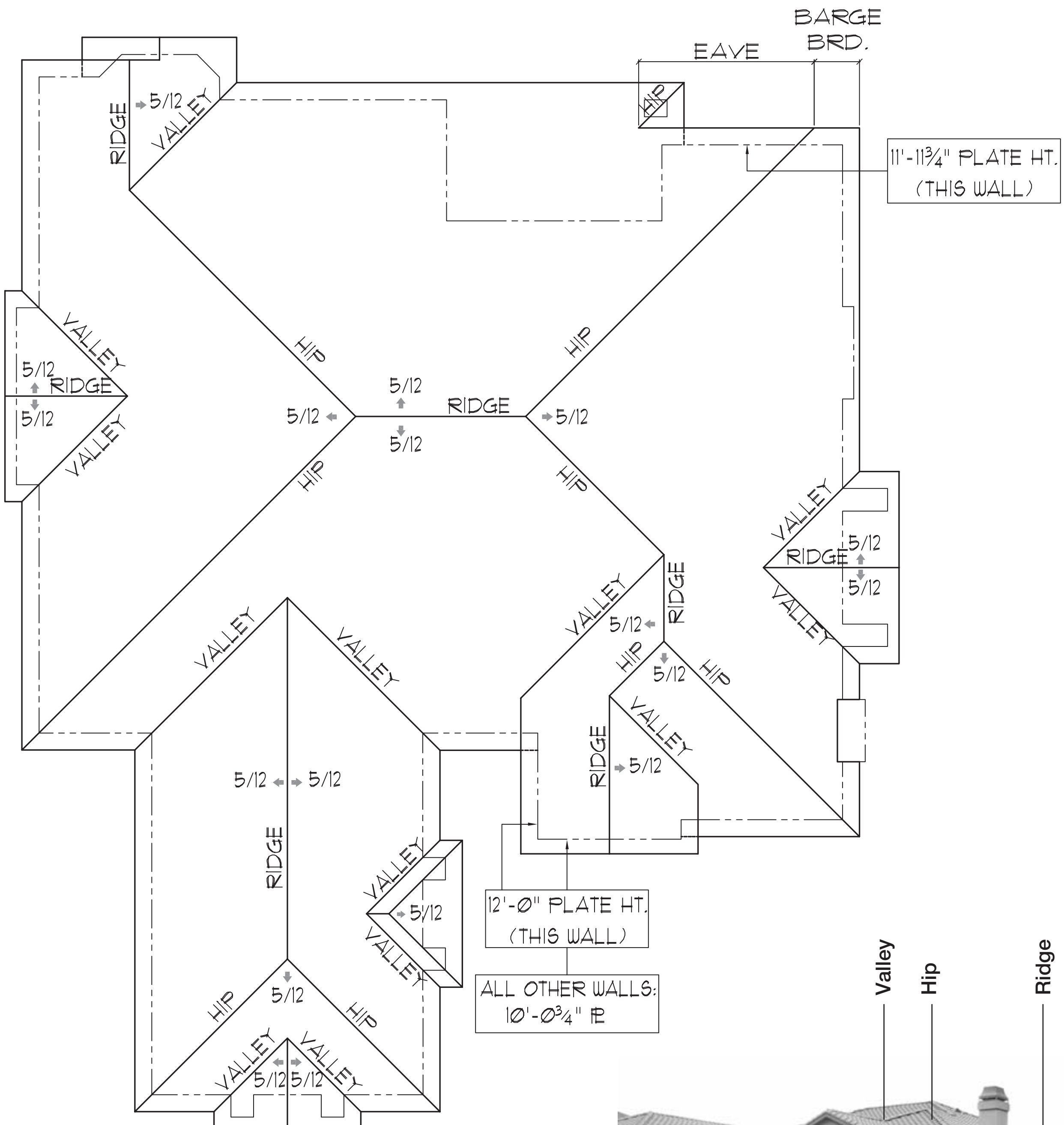
A *roof plan* shows the roof configuration projected on a horizontal plane (see page 366).

A *floor plan* is represented best if the horizontal cut is taken through all openings (such as doors and windows) as well as important vertical elements (such as columns). The location of the cutting plane can vary, but normally ranges from 4' to 6' above the floor plane.

floor plan

Section arrows indicate the observer's direction of sight when viewing a building section.

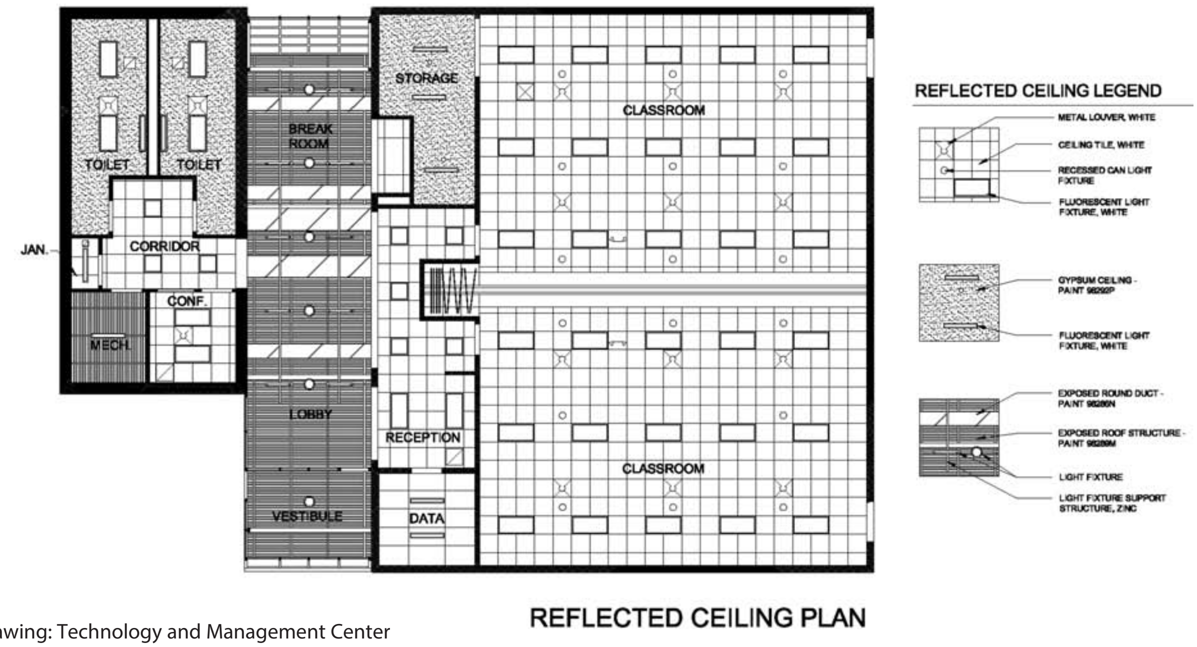
ROOF PLAN



Drawing: Johnson Residence
Folsom, California
Medium: AutoCAD 2004
Courtesy of Tamano & Chaw Residential Design

© Marcus Chaw

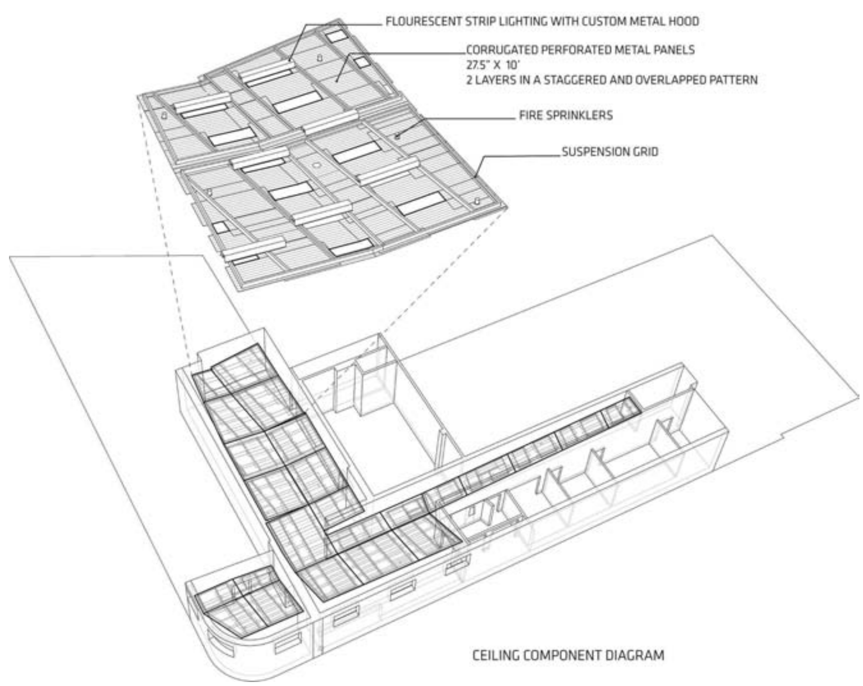
A *roof plan* shows the overall shape and detailed configuration of the roof structure. In residential construction roof plans, lines are typically defined as hip, valley, or ridge. The roof's slope and the wall outline beneath the roof are also indicated. In design drawings, the material texture is indicated by symbol.



Drawing: Technology and Management Center
Edwardsville, Illinois
Medium: AutoCAD
Wight & Company/Fitch-Fitzgerald, Inc.
Architects/Engineers
Courtesy of Richard Klein, SIUE

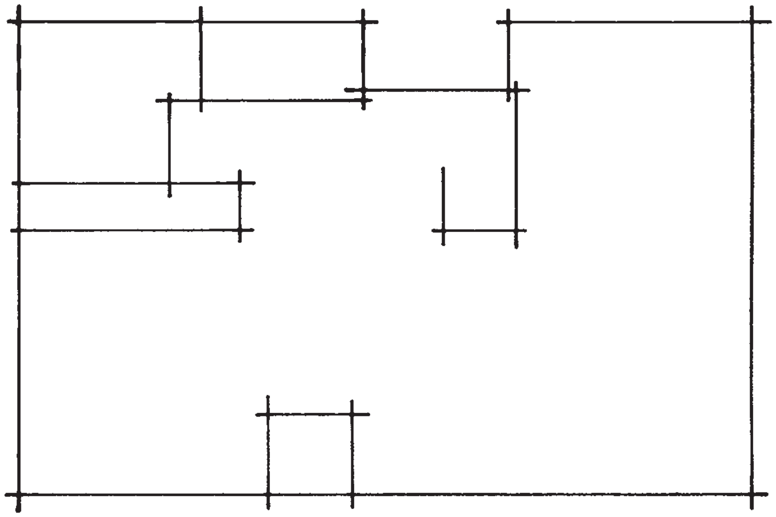
Imagine placing a huge mirror on the floor configuration shown above that matches the roof configuration. You would see the white fluorescent light fixtures, the white metal louvers, the recessed can light fixtures, and the white ceiling tiles all reflected in this mirror in their exact ceiling positions in the classrooms. The gypsum ceilings in both bathrooms and the storage area would be similarly reflected. A *reflected ceiling plan* commonly shows ceiling elements like light panels and ceiling-mounted heat registers in the same orientation as the floor plan.

The *ceiling component diagram* drawn to the right is an excellent variation to the reflected ceiling plan. More three-dimensional than the flat reflected ceiling plan, it clearly illustrates the ceiling elements.

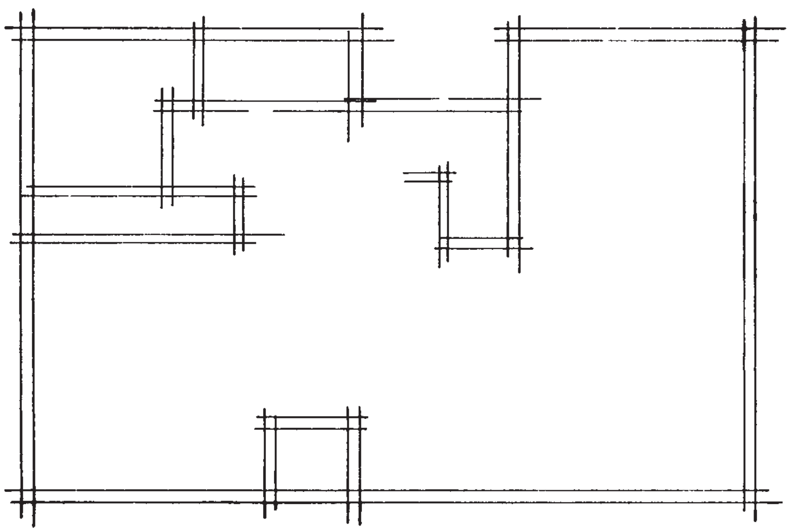


Drawing: Harvard College's Fine Arts Library
Cambridge, Massachusetts
Medium: Rhino
Courtesy of Daly Genik Architects

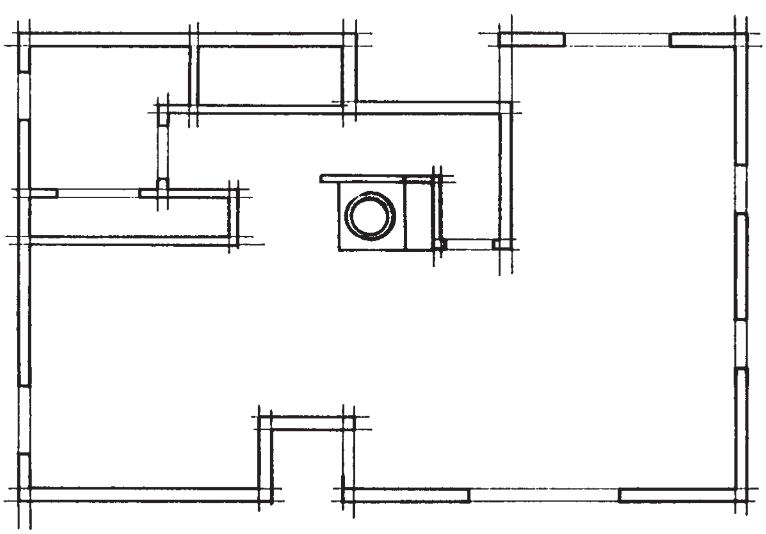
This and the next page give a step-by-step process for drawing a plan. In general, the best procedure is to draw the building shell first, then all of the elements contained within the shell. Be sure to locate the center lines of all windows and doors.



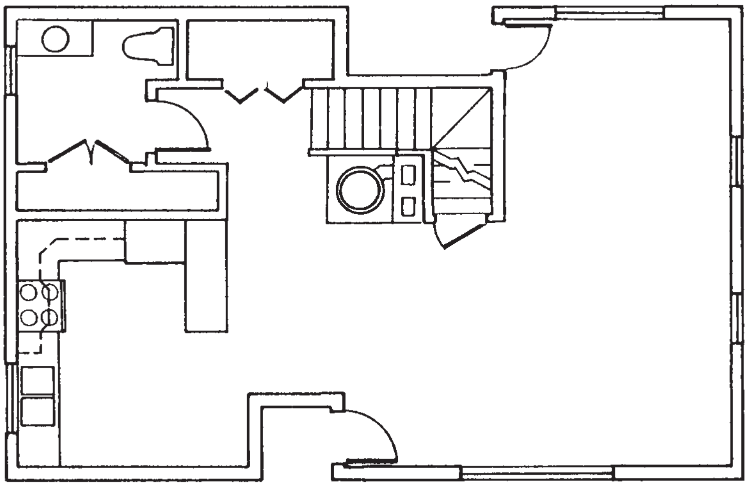
1. Lightly draw the building outline with a single line. Again using a single line, lightly draw the center lines for interior walls.



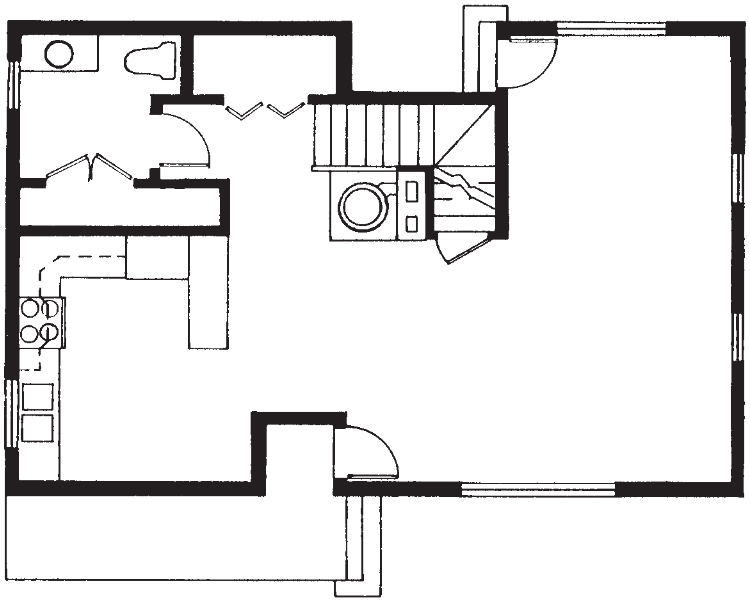
2. Add wall thickness for both exterior and interior walls.



3. Locate and draw wall openings such as windows, doors, fireplaces, and stairs.

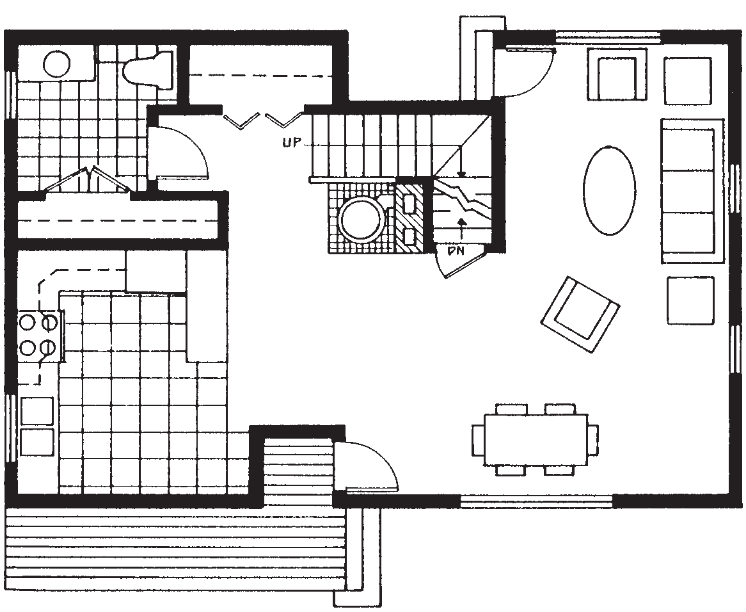


4. Locate and draw bathroom and kitchen fixtures, as well as plan details for doors and windows.



5. Draw any plan view wall indications with proper tone value (see next page). In this case the wall is toned solid black. If it were left white, the wall outline could be made heavier to make it read better.

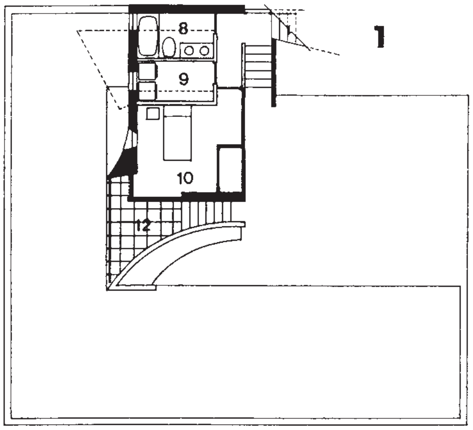
Floor plans illustrate the location of walls, doors, windows, and stairs, as well as other elements below the cutting plane (countertops, toilets, etc.). Plan drawings are abstract views; at ground level, we cannot see the things they represent.



6. Draw the proper material symbol (tone and texture) for the floors in each room.

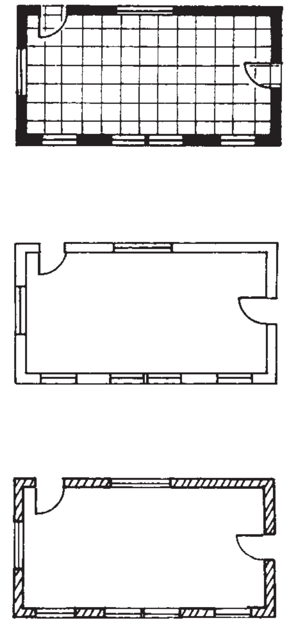
This step-by-step procedure applies to plans drawn both freehand and mechanically.

Nonrectilinear plans, such as angular plans (p. 147) can also be generated this way; however, nonfreehand curvilinear plans should be done digitally. The main purpose of including furniture and built-in elements (stoves, sinks, etc.) in the plan view is to show function and scale. For an accurate interpretation, the plan view, as with all orthogonal views, must have a constant scale.



© Hariri & Hariri, Architects

Drawing: The Hague Villa Project
The Hague, The Netherlands
8" × 10" (20.3 × 25.4 cm), Scale ¼" = 1'0"
Medium: Pen and ink
Courtesy of Hariri & Hariri, Architects

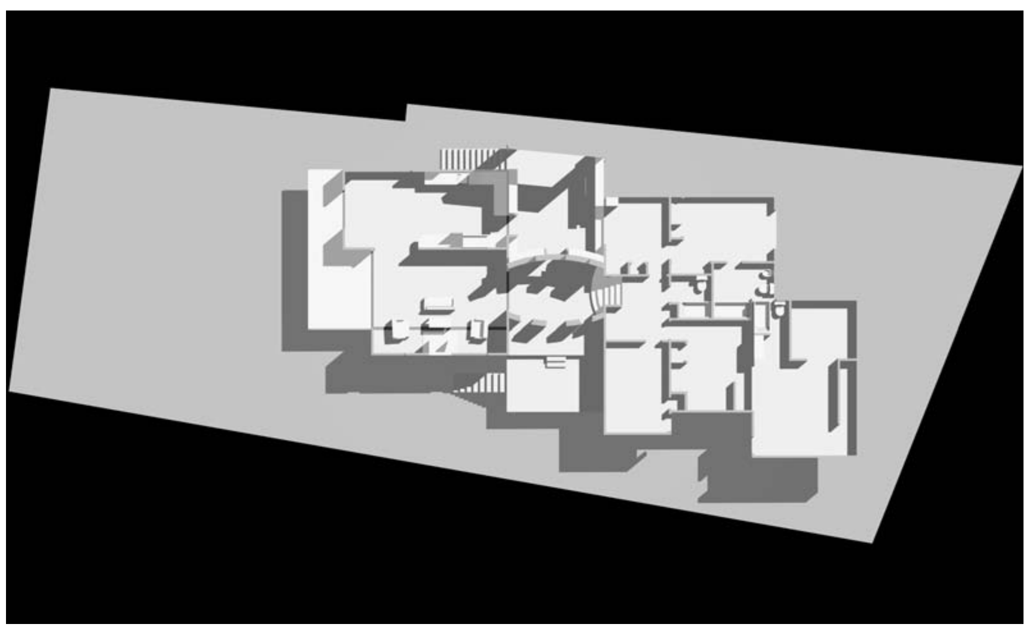


1

2

3

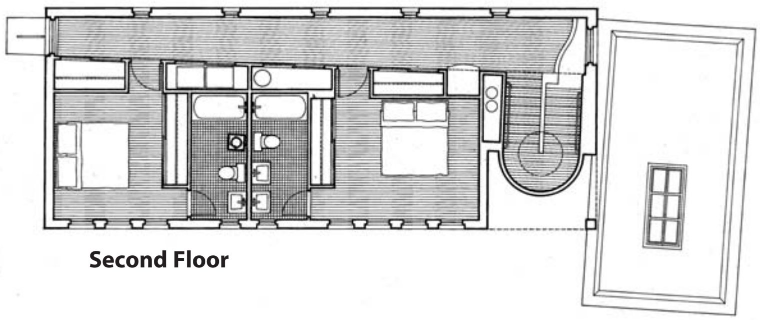
4



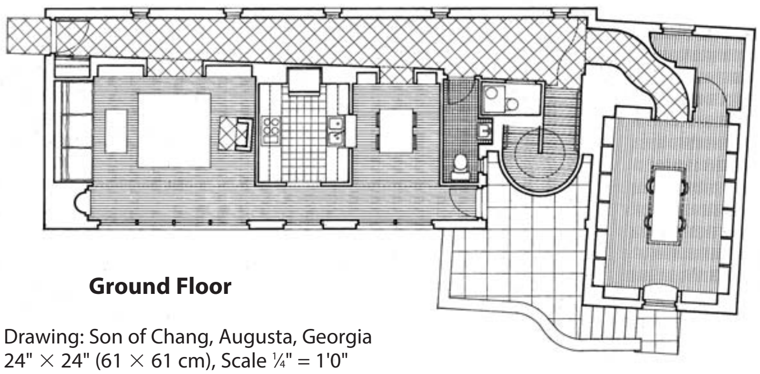
Plan study image: Nomikos residence, Berkeley, California
Courtesy of Mark English Architects

This project involved connecting two existing building elements and changing the entry location. The entrance has a distinct geometry with a curving wall form, to emphasize its fluid role in linking the two previously unconnected spaces. [Architect's statement]

Floor plan wall indications can be given different tonal values. In **1**, more contrast with the floorscape is desired; thus, the walls are toned solid black. In **2**, minimal contrast is needed; thus, the walls are left with no tone and a profile line. In **3**, a hatched tone is used for intermediate contrast (this can also indicate the building material). In **4**, shadows are cast within the plan view to accentuate the walls and give added contrast. The shadows also give hints as to the heights of walls and other vertical elements.



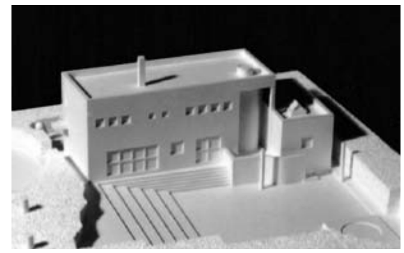
Second Floor



Ground Floor

Drawing: Son of Chang, Augusta, Georgia
24" × 24" (61 × 61 cm), Scale ¼" = 1'0"
Medium: Ink
Courtesy of Anthony Ames, Architect

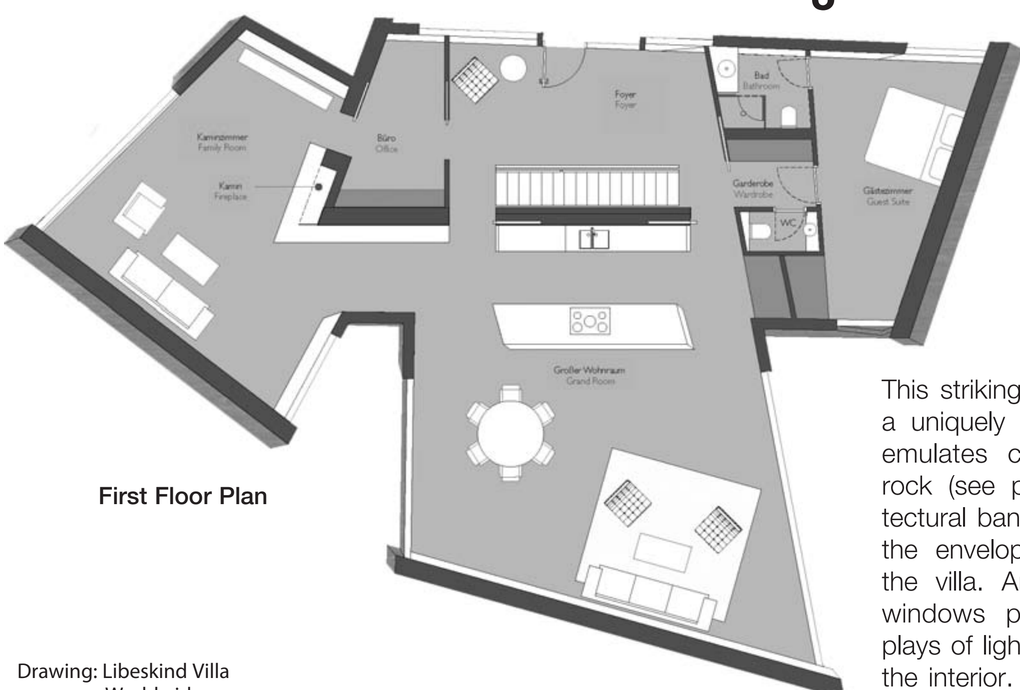
2 The *indication* patterns, values, and colors of floor finishes are equally as important as plan wall indications. In Condition **2,** the outline of the plan cut is darkened to differentiate it from the floorscape texture. In Condition **3,** a solid black wall easily contrasts with the toned floorscape.



© Anthony Ames Architect

In multistory buildings, floor plans are commonly drawn in a vertical *alignment* with the lowest floor at the bottom. Plans can also be drawn in a horizontally related alignment with the lowest floor plan farthest to the left.

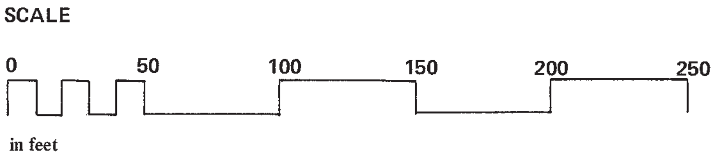
3

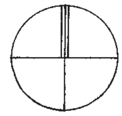


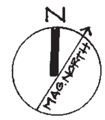
First Floor Plan

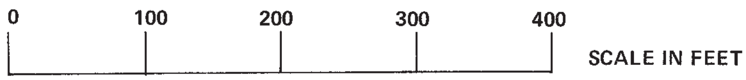
Drawing: Libeskind Villa
Worldwide
Medium: AutoCAD
Courtesy of Studio Daniel Libeskind

This striking angular plan is from a uniquely designed house that emulates crystal growing from rock (see p. 158). Three architectural bands interlock to create the enveloping angular form of the villa. Angular floor-to-ceiling windows produce breathtaking plays of light and transparency in the interior. Built with sustainable materials such as wood and aluminum, the facade offers excellent thermal insulation, weather resistance, and noise reduction.

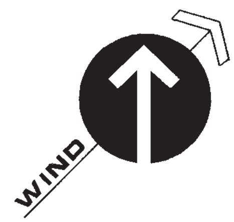


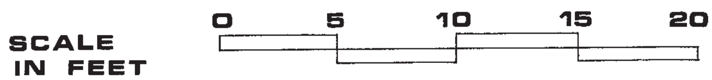


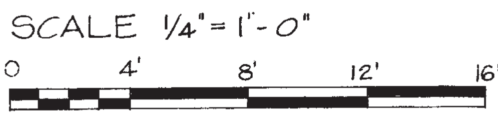


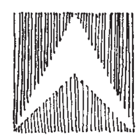


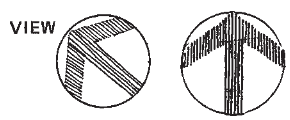
North arrows and *graphic scales* are graphic symbols that facilitate the understanding of the *orientation* and the *scale* of a building and the site it sits on. They should be placed adjacent to each other and next to the drawing they refer to in a presentation. They should be clean, simple, and legible, and must never have fancy detail or distract from the drawing itself. Graphic scales are also frequently used with sections and elevations.



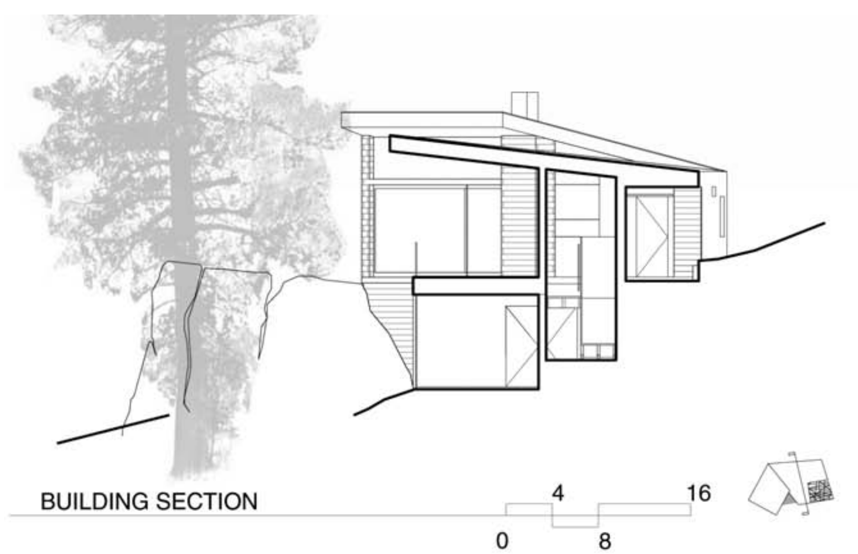






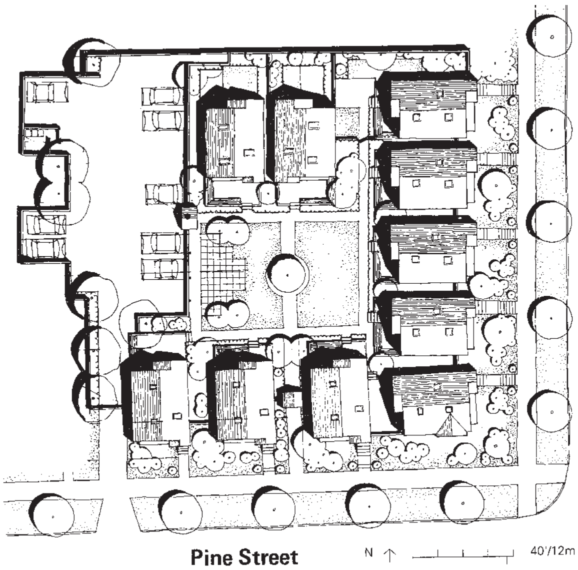


Graphic scales are lines or rectangular bars with graduations. The choice of a graphic scale size is dependent on the size and complexity of the drawing as well as its distance from the viewer. The decision as to how many feet one inch represents is yours (i.e., 1" can be equal to 4', 5', 50', etc.).

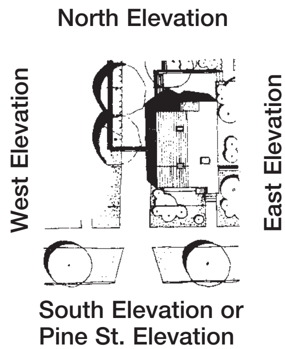


Drawing: Basalt Cabin
Brazos, New Mexico
Courtesy of Antoine Predock Architect, PC

This sectional elevation shows a simple but effective graphic scale.



Drawing: Pine Street Cottages, Seattle, Washington
Kucher/Rutherford, Inc., Developer and Contractor
Courtesy of Marcia Gamble Hadley, Designer

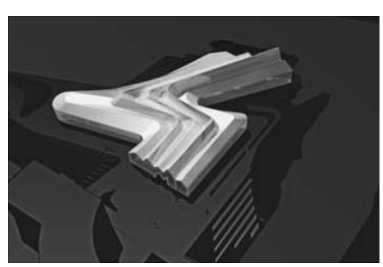


If the front of a building faces north, then the proper notation is North Elevation, and likewise for any direction the various sides of the building may face (e.g., Southwest Elevation). An important site feature, such as a major street or a body of water, can be used in place of the direction.

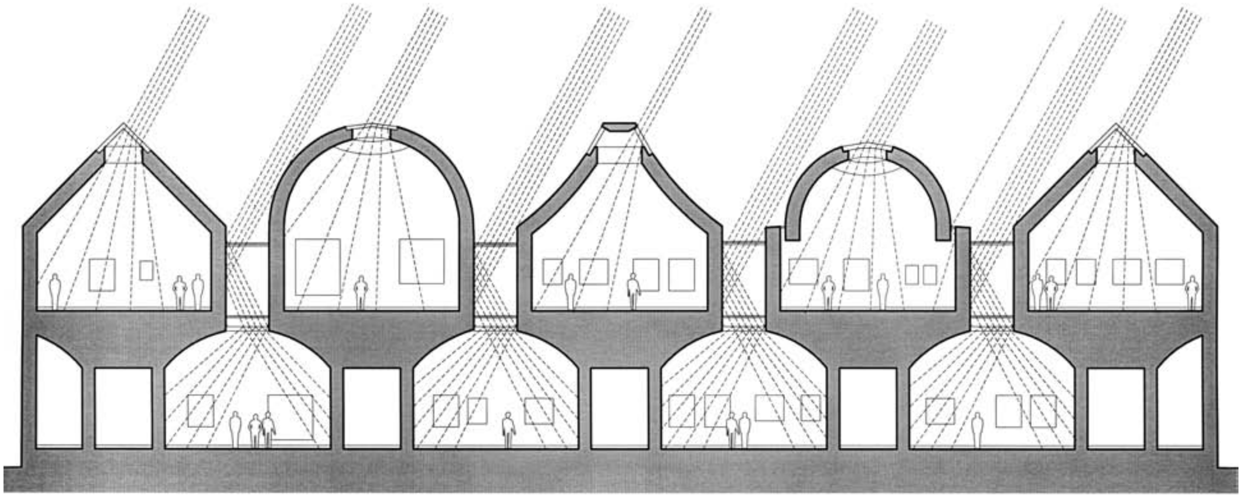
Site plans show the orientation and the location of a building (below) or many buildings (above). They can be precise pictorial drawings as shown on this page or schematic drawings. They are commonly drawn at $\frac{1}{16}$" = 1'0" or at engineering scales such as 1" = 20', 1" = 40', or 1" = 50'. The boundaries of the site enclose all site elements as well as the building complex. Site elements (see pp. 361 and 366) include topographic lines and landscaping elements such as trees and walkways (above). Shadows help to reveal the building's height and its overall configuration.

Drawing: Four Towers in One
Shenzhen, China
Media: Custom software, BIM, and other platforms
Courtesy of Morphosis Architects

A location plan is a variation of the site plan that extends to include a broader, regional context. Important site features, such as transportation arteries, surrounding buildings, and the physical topography are commonly drawn. These environmental elements usually play a significant role in influencing the design of the proposed building.



Drawings: Riverside Glasgow Museum
Glasgow, Scotland
Media: Rhino, Maya, and AutoCAD
Courtesy of Zaha Hadid Architects



Drawing: Peabody Essex Museum, Salem, Massachusetts
Medium: AutoCAD
Courtesy of Moshe Safdie and Associates, Inc., Architects

Section through upper and lower house galleries

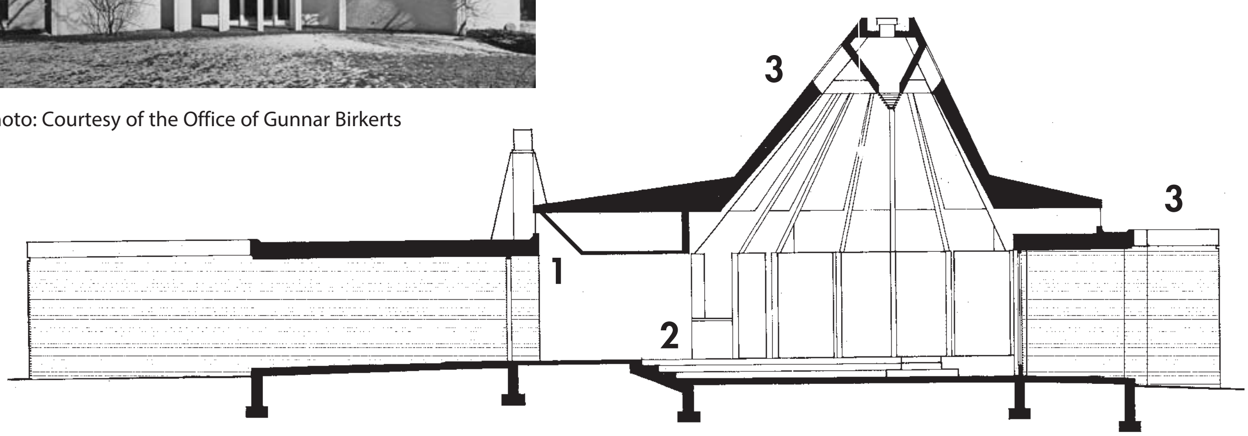
See companion Web site (Chapter 10) for additional drawings for this building.

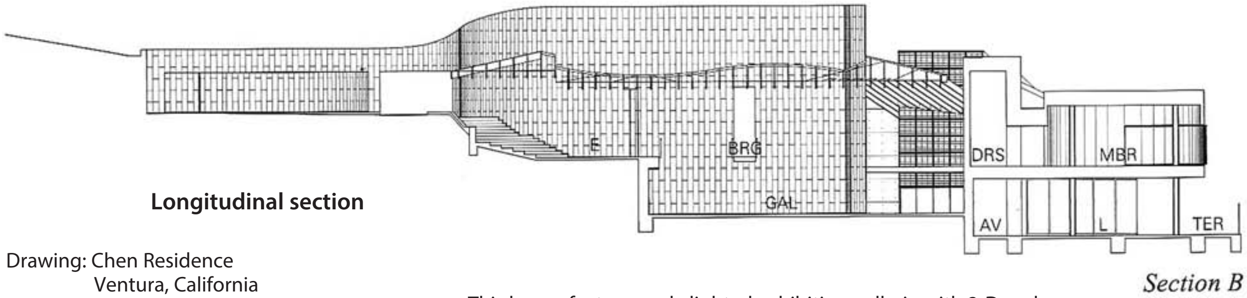
Sections are normally cut through (**1**) door and window openings, (**2**) circulation change of level elements (e.g., stairs and ramps), and (**3**) ceiling or roof openings such as skylights. Foundation elements may or may not be shown, depending on their significance in the overall design. Section cuts should never be made through columns.

A *building design section* must reveal design objectives as much as possible. To this end, slices are taken through important solids and voids. Light studies are frequently done to determine how directional sunlight comes through window or skylight openings. Architects play with how light enters an interior space and how we feel about an architectural structure's spatial quality and textural appearance. Human figures are also added to give the drawing human scale.

Photo: Courtesy of the Office of Gunnar Birkerts

Drawing: Freeman residence, Grand Rapids, Michigan
30" × 20" (76.2 × 50.8 cm), Scale: ⅛" = 1'0"
Medium: Ink on vellum
Courtesy of Gunnar Birkerts and Associates, Inc., Architects





Longitudinal section

Drawing: Chen Residence
Ventura, California
Medium: Ink on vellum
Courtesy of Edward R. Niles, FAIA

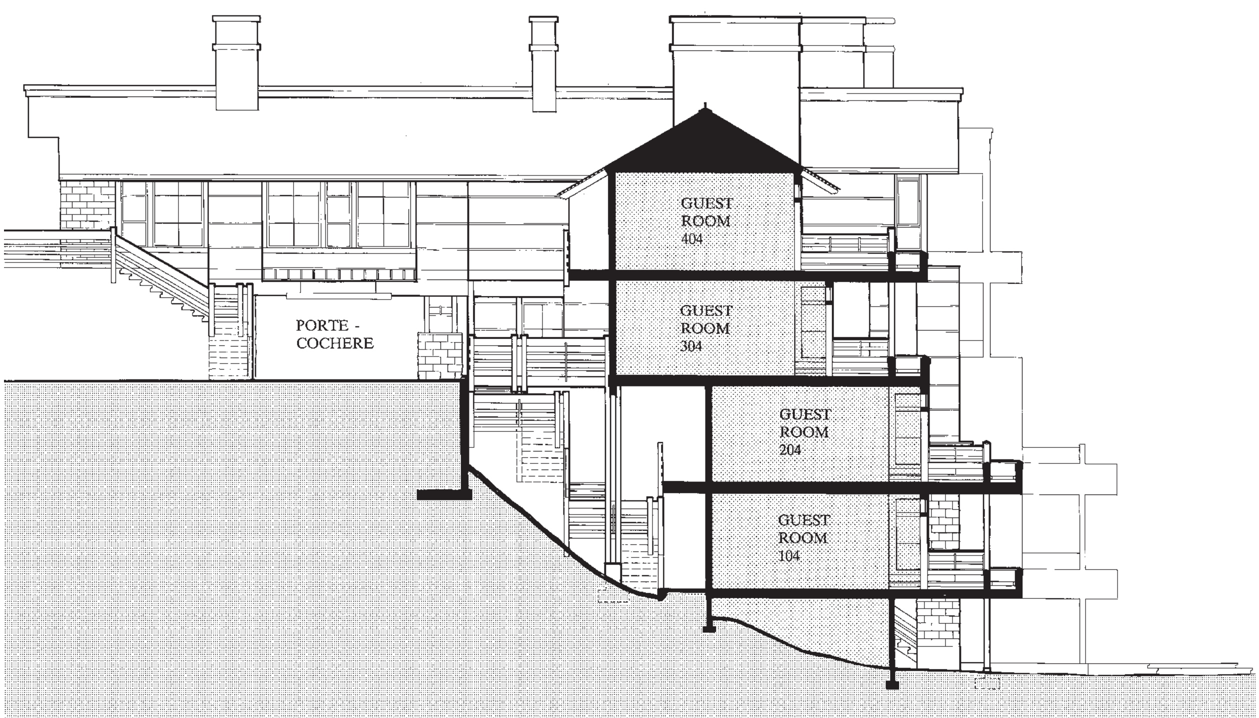
This house features a skylighted exhibition galleria with 2-D and 3-D Chinese sculpture.

A *sectional elevation* shows elevation lines beyond the cut section. Lines within the longitudinal section showing the interior elevation, above, have slightly different line-weight intensities in order to provide a greater sense of depth. The unequal spacing of fine lines in the interior elevation implies a foreshortened curved surface.

It is common to see a hierarchy of elevation lines in a design section. The elevation line weights diminish in intensity as the distance from the observer increases. This contrast in line weights is an excellent depth cue.

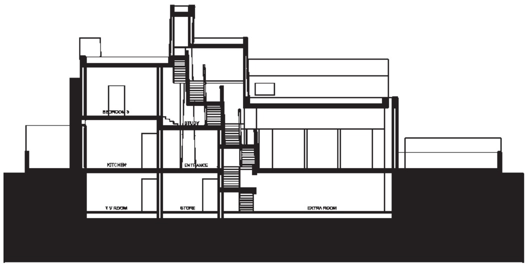
© Roberto Pisano Studio

SECTIONAL ELEVATION

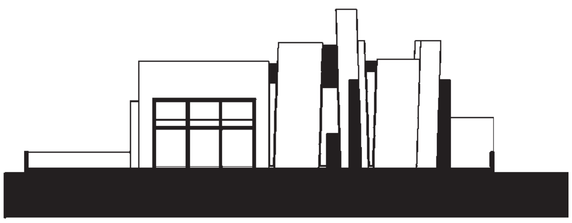


Drawing: The Inn at Langley, Whidbey Island, Washington
Courtesy of GGLO Architecture and Interior Design

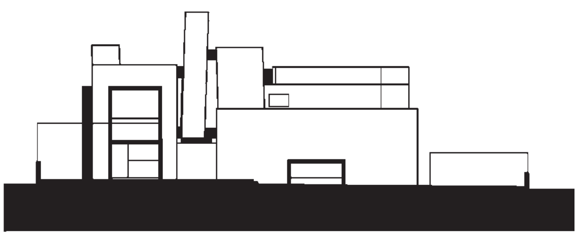
Drawings: Marbled House
Ahmedabad, India
Media: AutoCAD for drawings and Google SketchUp for perspective
Courtesy of Matharoo Associates Architects



Section A



South Elevation



West Elevation

In the Marbled House presentation of section and elevations, the sectional cut is toned solid black, which allows the viewer to see a clear relationship between the building design and the ground plane. Section cut spatial volumes can be shown from above the ground plane or from below it (i.e., from underground). Drawings may be conveniently labeled and identified within or adjacent to the toned area of the ground mass. Elevations are labeled based on the direction they are facing; in the south elevation, the facade of the building is facing south. The facade faces west in the west elevation. As with the Chen Residence on the previous page, the roof area in the Botta House is shown foreshortened using the unequal spacing of lines due to its curvature.

The drawings are aided with study models and SketchUp 3D to facilitate understanding and further detailing. The house is for a stone trader and is inspired by the various stone slabs that are stacked in their warehouses. The stone walls make use of the myriad wastage in a no-maintenance cladding. [ARCHITECT'S STATEMENT]

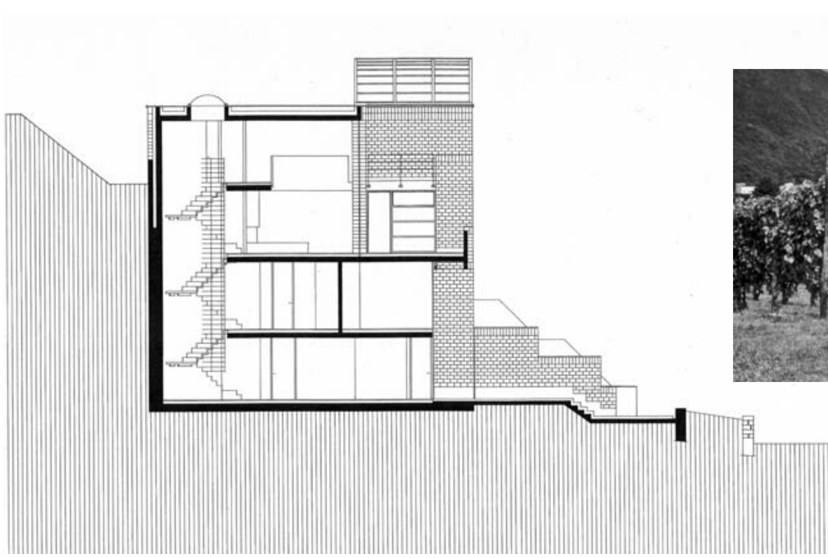
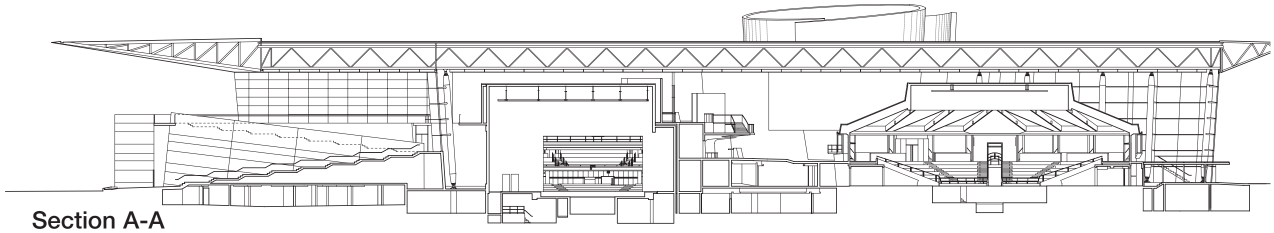
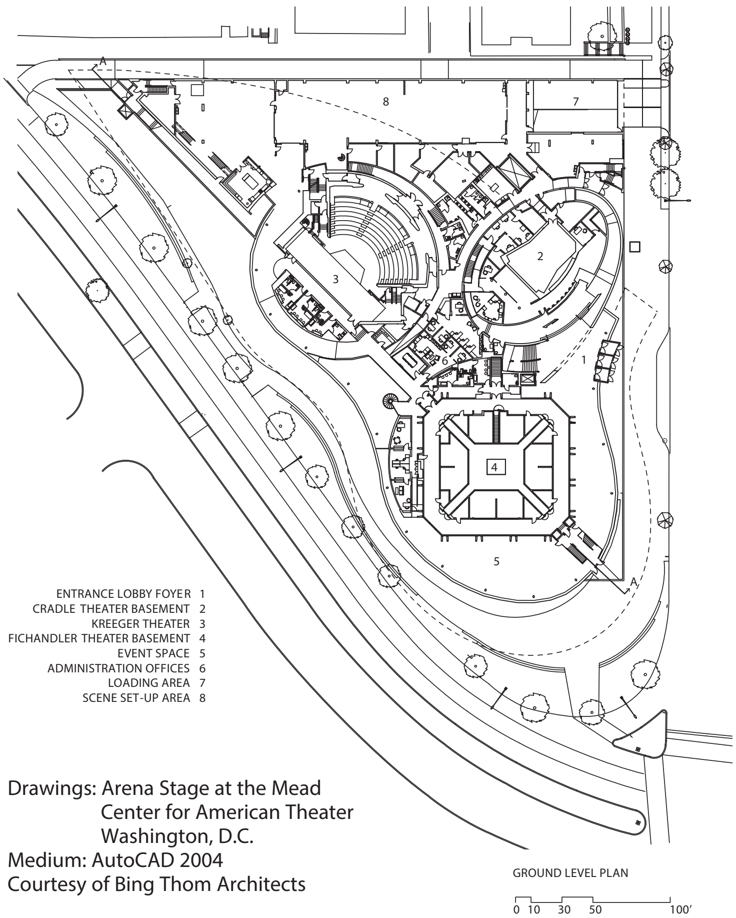


Photo by Pino Musi

Drawing: Single-family house, Daro, Bellinzona, Switzerland
Drawing by Studio Architetto Mario Botta
Courtesy of Mario Botta, Architect, Lugano, Switzerland



Section A-A

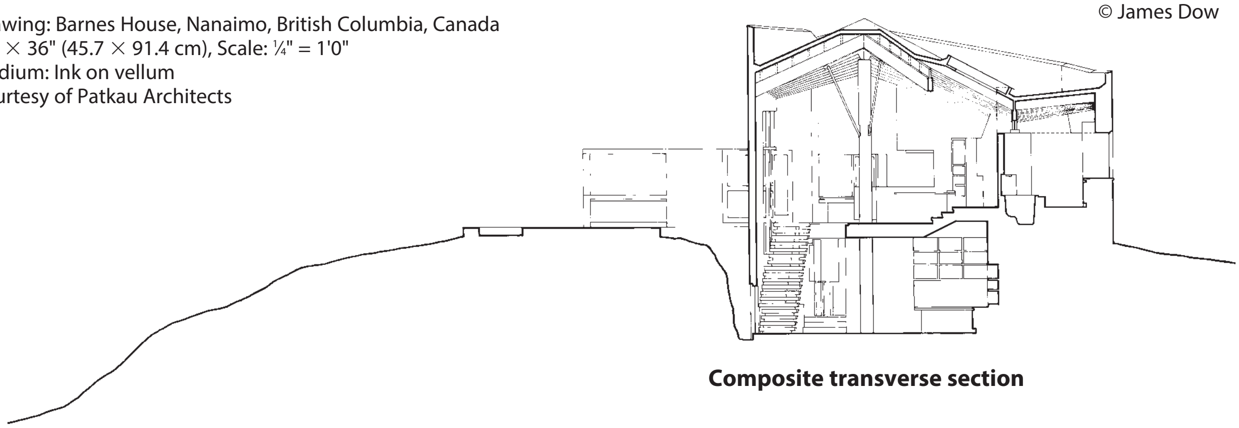


Drawings: Arena Stage at the Mead Center for American Theater Washington, D.C.
Medium: AutoCAD 2004
Courtesy of Bing Thom Architects

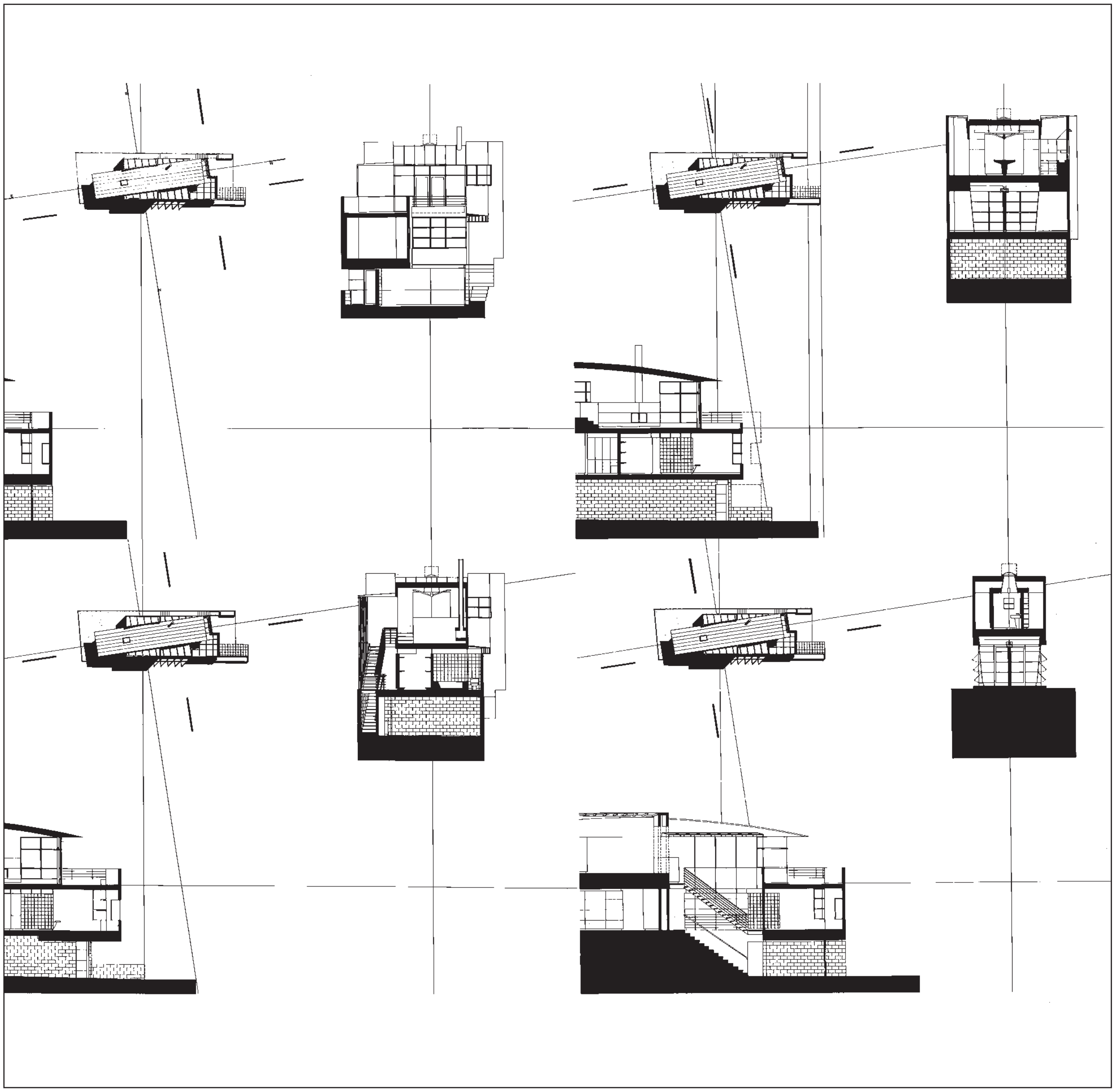
Arena Stage (pp.112–13) has its section cut identified based on the notation indicated in the plan view. SECTION A-A indicates the viewer's direction looking at the section. Note the use of a graphic scale with the arena plan view. The Barnes House, below, uses a contour line to delineate the ground line section cut through the surrounding site and house. See (pp. 551–65).

© James Dow

Drawing: Barnes House, Nanaimo, British Columbia, Canada
18" × 36" (45.7 × 91.4 cm), Scale: ¼" = 1'0"
Medium: Ink on vellum
Courtesy of Patkau Architects



Composite transverse section



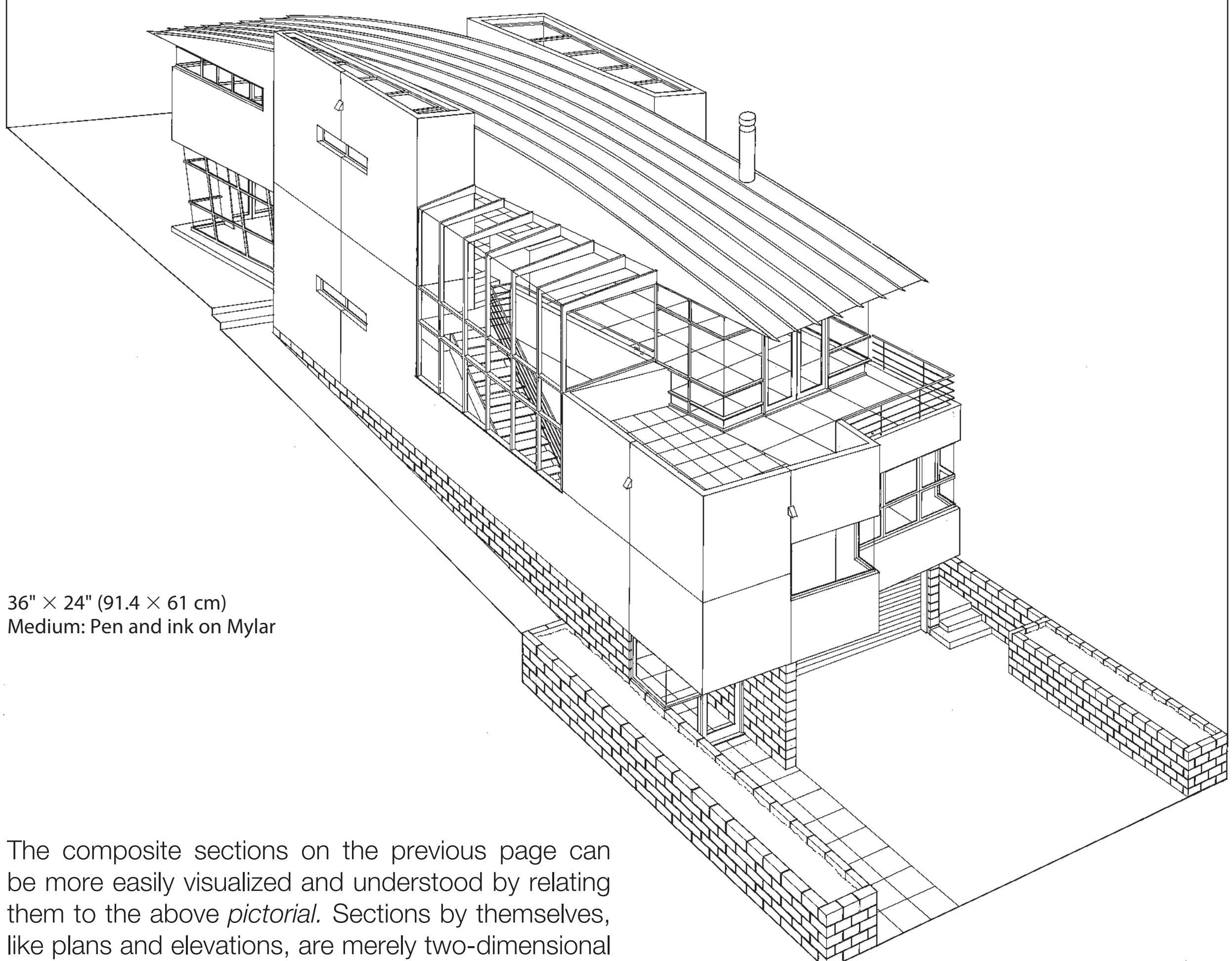
Drawings (this and facing pages): Elliott residence, Hermosa Beach, California
Scale: ⅜" = 1'0"
Medium: Pen and ink on Mylar
Courtesy of Dean Nota Architect

Webster's Dictionary defines "composite" as something comprising a number of distinct parts or elements (see pp. 382–401).

As shown above, the use of *composite sections* allows the viewer to examine a multitude of sections for a building. The cut sections are taken at selected intervals indicated in roof plan views. With the advent of computer-generated drawings, sectional cuts can be immediately examined at an infinite number of locations. This instantaneous imaging is especially beneficial in the design and fabrication of curvilinear structures. The process is analogous to a computed tomography (CT) scan in medical technology.

This small house composed of stucco, glass, and concrete bloc is located in a densely populated neighborhood on the edge of transformation—a beachfront community on the edge of Los Angeles. Of primary concern was a desire to open the house up to views, while maintaining a degree of privacy from adjacent buildings. Dramatic views are available to the west and southwest. The plan geometry and formal massing evolve from a rotation of the axis of the view-oriented spaces along a view corridor defined by nearby buildings that have been or will soon be built-up to maximum height limits. The rotated piece is further articulated by a vaulted roof that emulates the hilltop site. Wedges of interstitial space become skylighted interior service and circulation spaces.
[Architect's statement]

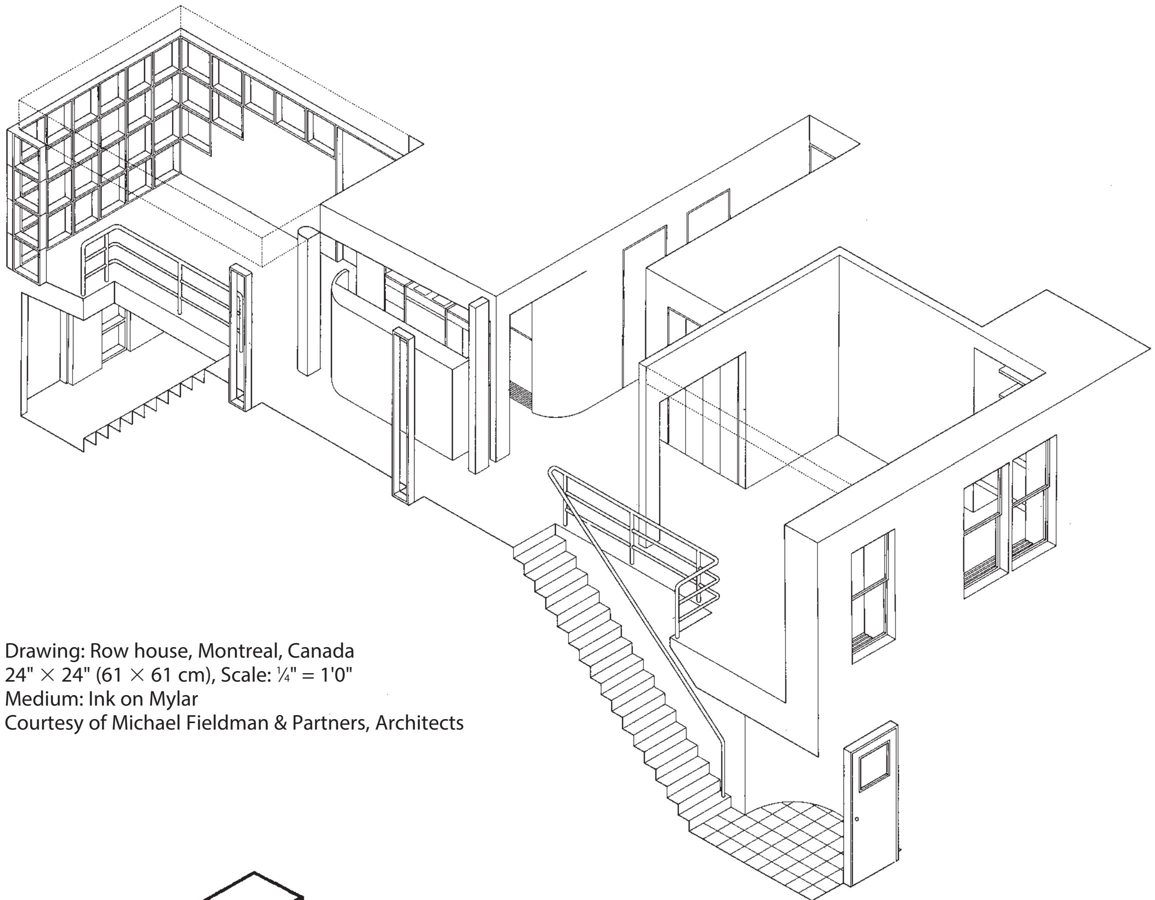
© 1993 Samuel Nugroho, Photographer



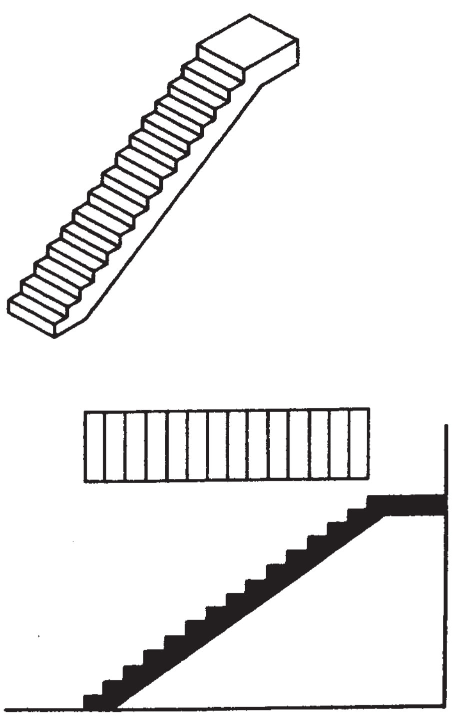
36" × 24" (91.4 × 61 cm)
Medium: Pen and ink on Mylar

The composite sections on the previous page can be more easily visualized and understood by relating them to the above *pictorial.* Sections by themselves, like plans and elevations, are merely two-dimensional fragments of a whole. The design process always involves visualizing how these fragmentary parts compose the three-dimensional whole and vice versa.

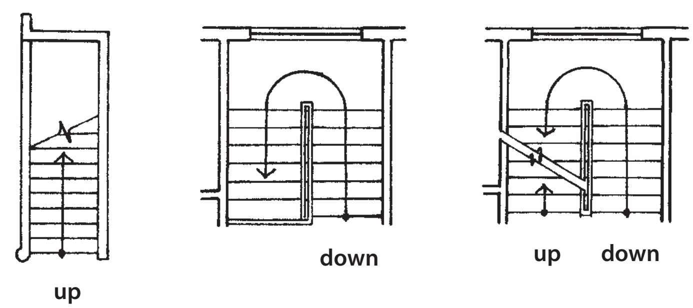
STAIRWAYS



Drawing: Row house, Montreal, Canada
24" × 24" (61 × 61 cm), Scale: ¼" = 1'0"
Medium: Ink on Mylar
Courtesy of Michael Fieldman & Partners, Architects



Straight run



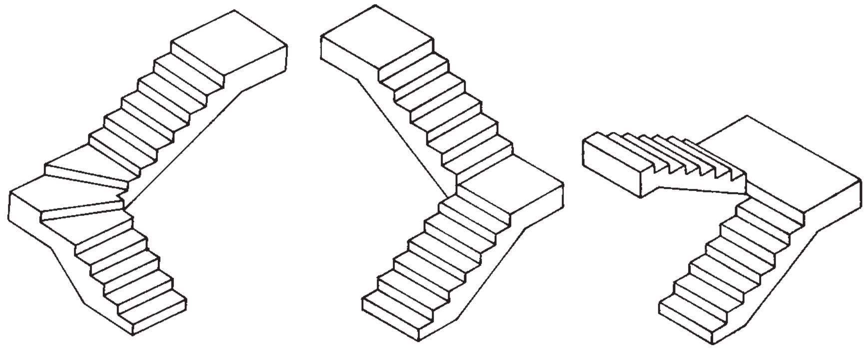
From 1st floor

From 2nd floor (two stories)

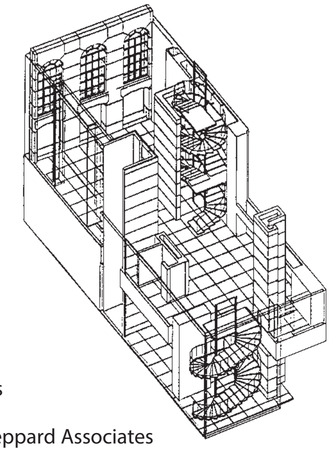
From 3rd floor (three stories)

A *stair* can be defined as steps with treads (horizontal surfaces) and risers (vertical surfaces) connecting different levels. Use a thin arrowed line to denote the circulation movement—up or down—from the designated floor plan. A thin diagonal cut line is where the plan cut is taken.

The use of glass staircases as a design element can be quite exciting; see book's companion Web Resources guide link for this page.



Stairs shown in pictorial
For simplicity, the handrails have been removed.

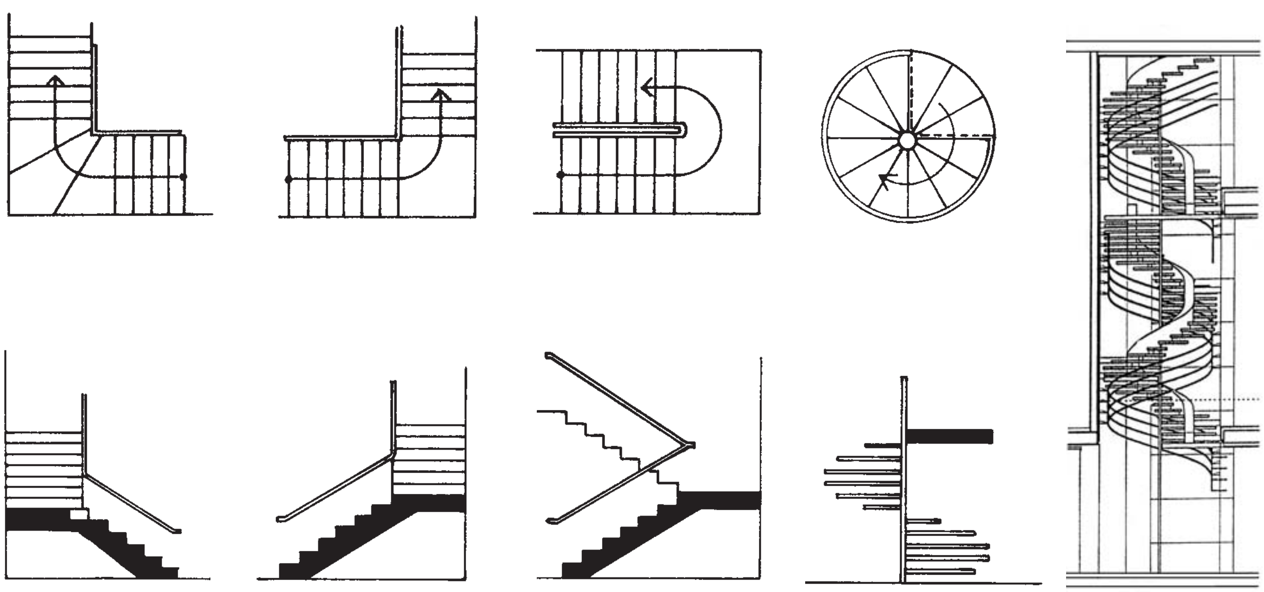


Drawings: Jil SanderParis
Paris, France
Courtesy of Gabellini Sheppard Associates

This three-floor podium building (left), silent in its forms, includes two levels below ground. The three levels are connected by circular ramps within an elliptical central courtyard.

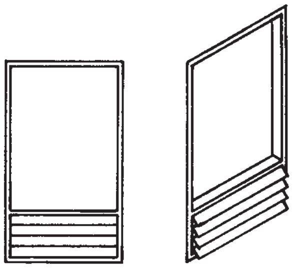
Photo: Andalusia's Museum of Memory
Granada, Spain
Courtesy of Alberto Campo Baeza, Architect

© Paul Warchol

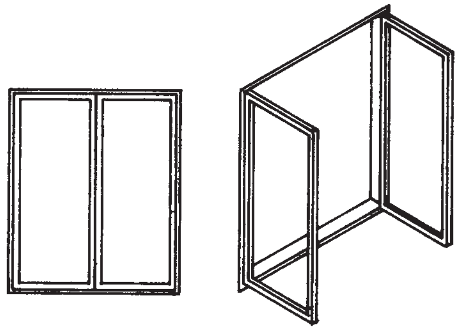


90° winding **"L" landing** **180° "U" landing** **Spiral or spiral type**

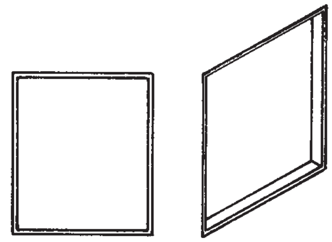
Stairways are the sequences of steps that connect two or more floors in a building. The four examples above are typical stairway situations seen in plan and in section. Straight stairs are also common. A ramp, as shown in the middle left image, is a sloping or inclined surface that connects two or more levels. Note that the U.S. American Disability Act allows for a maximum slope for a pedestrian ramp of 1:12; if a ramp exceeds 30', it must have an intermediate platform.



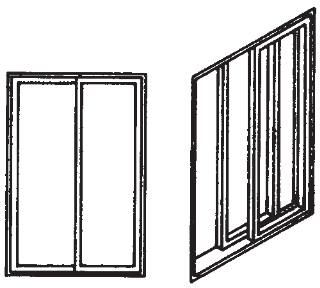
window with louvres



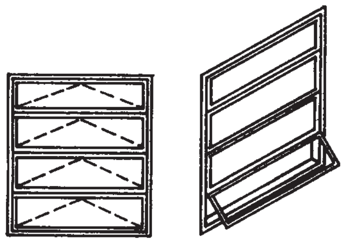
casement window



picture window



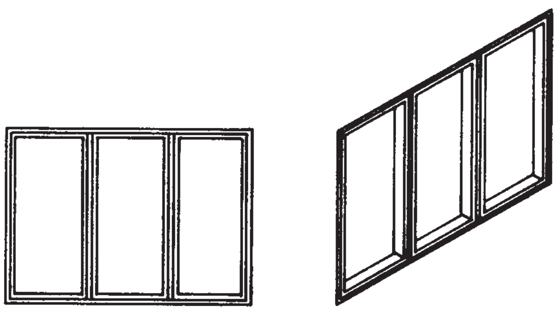
sliding window



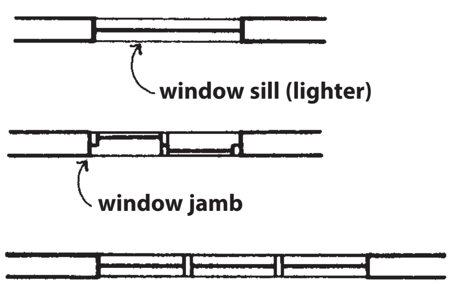
awning windows

Many high-tech buildings use atypical shapes for windows (see p. 147 for plan view).

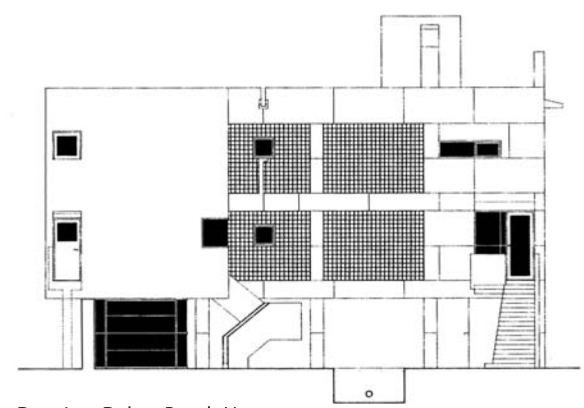
Photo: Libeskind Villa
Worldwide
Courtesy of Studio Daniel Libeskind
© Studio Daniel Libeskind



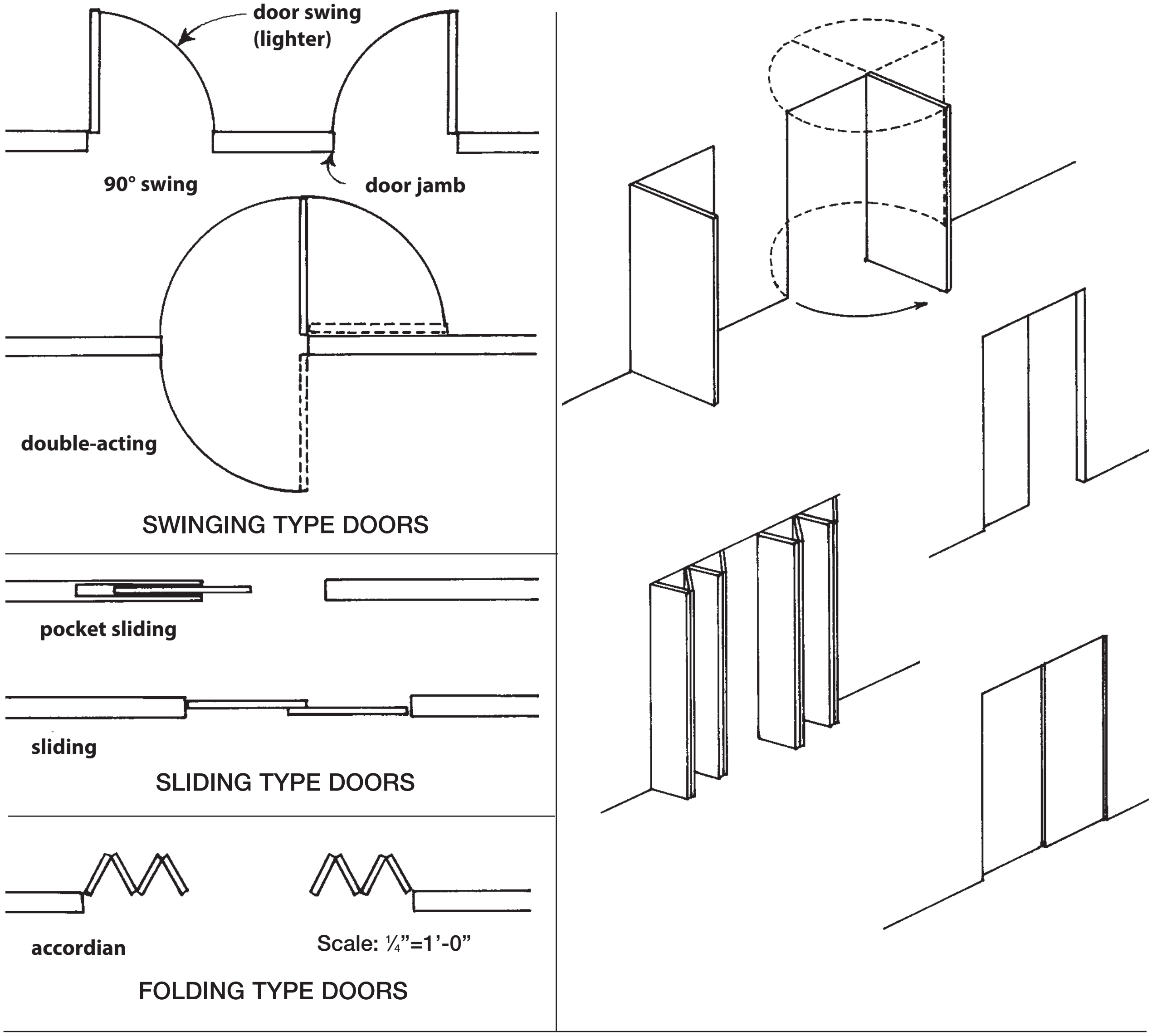
window wall

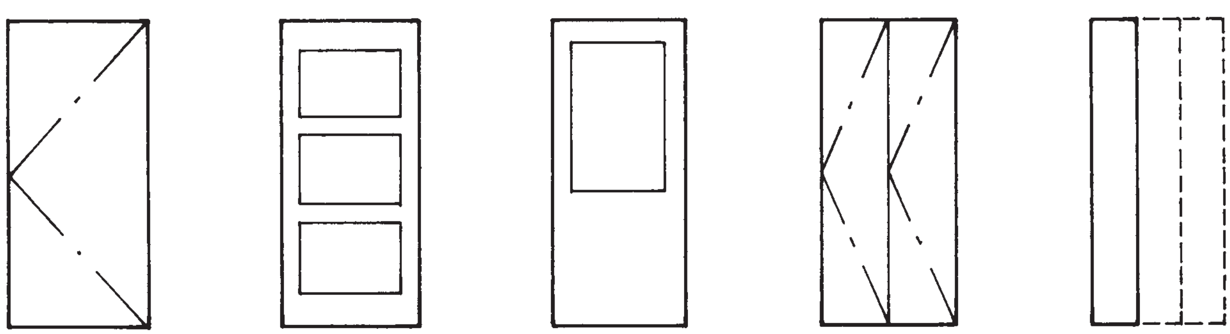


A plan window showing the width of the opening is the result of a horizontal cut through the window glass, its frame (jamb), and the wall on both sides. The cut is always above the windowsill, which is drawn lighter than the section cut. When designing, consider other nonrectilinear shapes (see pp. 508–509).



Drawing: Delray Beach House
Delray Beach, Florida
Medium: Ink on vellum
Courtesy of Anthony Ames Architect





STANDARD DOOR TYPES

Six standard window types (p. 158) and five standard door types are shown in elevation and in pictorial. Doors in plan show the width of the opening. Convention has any swinging doors drawn perpendicular to the wall plane.

5

Orthographic and Paraline Drawing

Developing the ability to visualize and graphically express forms and spaces in three dimensions is important for environmental design students. With the exception of the case studies in Chapter 3, which might be inspired by different kinds of narratives and conceived with the help of advanced digital software, the design-drawing process usually begins with two-dimensional expressions in the form of orthographic sketches and drawings. These multiview drawings are the plan, elevation, and section vocabulary that an architect/designer uses. Multiviews help us accurately examine geometric configurations, spatial relationships, and the scale and proportion of a design. Multiviews by themselves cannot, however, reveal the three-dimensional pictorial configuration of an object or building, according to orthographic projection theory. For pictorial depth expression, the closely related three-dimensional, single-view drawings termed "paralines" and "perspectives" are needed. Paralines, as the name implies, are characterized by parallel lines, whereas perspectives are characterized by converging lines. Paraline drawings depict volumetric forms by combining the parameters of length, width, and depth, while simultaneously uniting plan, elevation, and section into one illustration.

The intent of this chapter is to develop your ability to visualize and communicate form and space by relating two-dimensional orthographic drawings to three-dimensional paraline drawings such as axonometrics and obliques.

The following are some of the important terms and concepts you will learn:

Orthographic drawings	Axonometric drawings	Plan oblique drawings
Paraline drawings	Isometric drawings	Elevation oblique drawings
Auxiliary views	Up views	Down views
Exploded views	Expanded views	Multioblique combinations

Orthographic and Paraline Drawing

TOPIC: ORTHOGRAPHICS

Ching 2009, 28–31, 74–84.

Forseth 1980, 21–75.

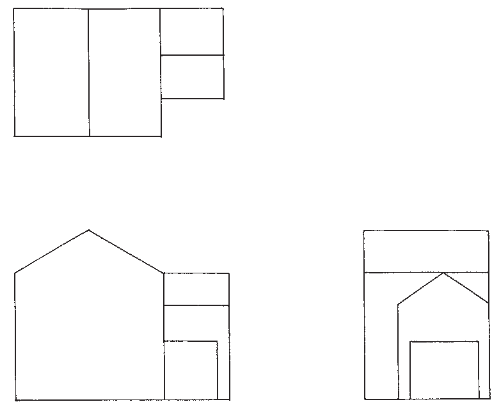
TOPIC: PARALINES (AXONOMETRICS AND OBLIQUES)

Ching 2009, 86–100.

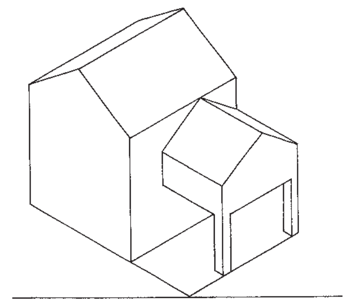
Forseth 1980, 77–97.

Chapter Overview

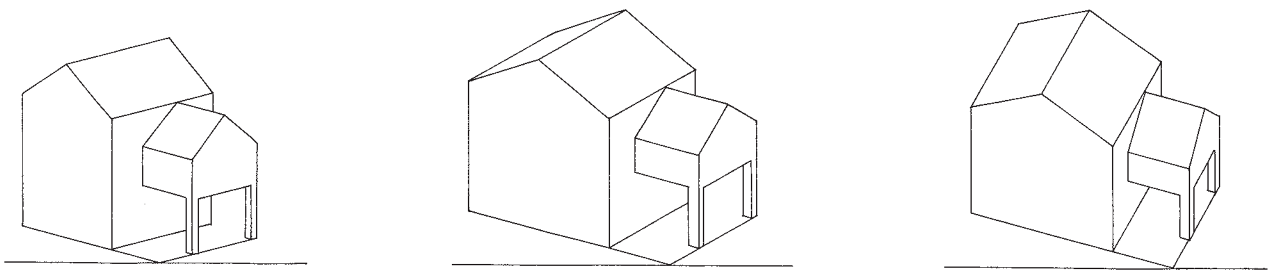
After studying this chapter and doing the related exercises in the book's final section, you will understand how to construct orthographic views, axonometric drawings, and oblique drawings. For continued study of the principles discussed in this chapter, refer to Uddin 1996.



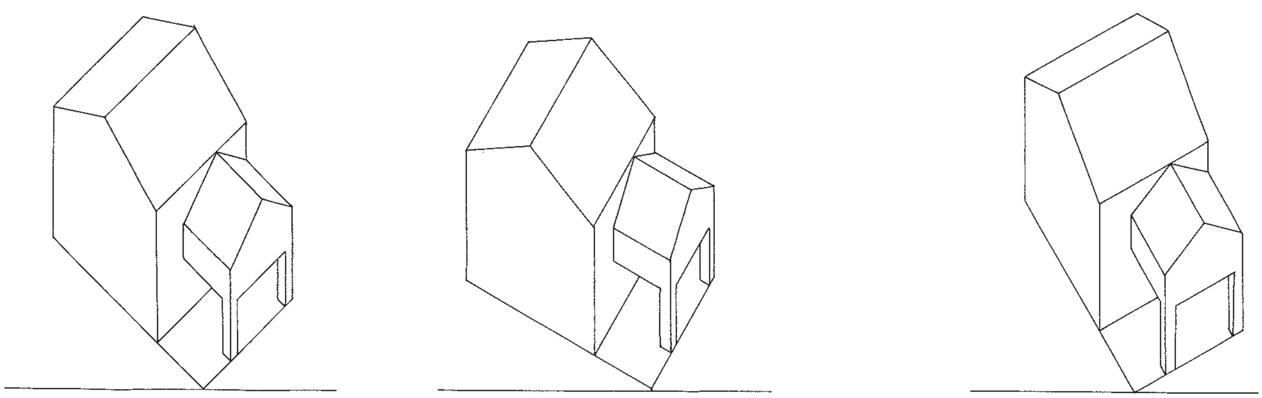
ORTHOGRAPHIC DRAWINGS



ISOMETRIC



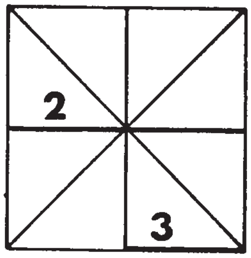
PARALINE AXONOMETRICS



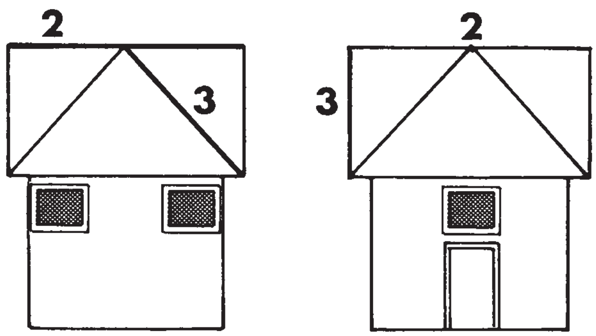
PARALINE OBLIQUES

Plans, elevations, and sections are *orthographic* drawings (two-dimensional). In *paraline* (single-view) drawings, sets of lines are infinitely parallel to each other, giving a three-dimensional character to the pictorial. The proper preparation for the study of *orthographic–paraline drawings* consists of a proven proficiency in lettering, line quality, and handling drafting tools. This, coupled with a brief introduction to drawing conventions, provides the essential background for a survey of these types of pictorial drawings. The family of *axonometric* and *oblique* drawings, which includes *isometric* drawings, can all be classified as *paraline* drawings. Paraline axonometrics are also termed *dimetrics* and *trimetrics*.

TRUE-LENGTH AND FORESHORTENED LINES



ROOF PLAN

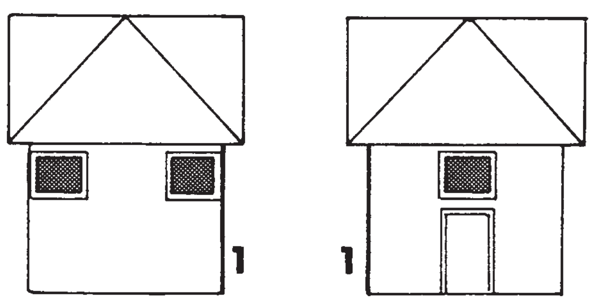


FRONT ELEVATION

SIDE ELEVATION

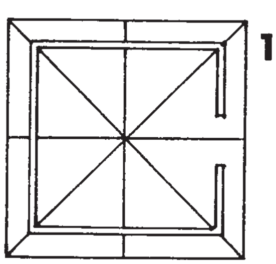
Any building form is composed of the basic elements of points, lines, and planes. We sometimes grasp intuitively why a shape appears the way it does. However, it is only through an understanding of how these geometric elements interact in orthographic projection that we can fully understand what we see. The study of this interaction is called *descriptive geometry.*

In elevation, the building form displays true-length vertical lines (**1**), which can appear as either a point or a true-length line in the adjacent views. Likewise, true-length horizontal lines (**2**) also appear as either a true-length line or a point in adjacent views. True-length inclined lines (**3**) appear foreshortened in the adjacent views.



FRONT ELEVATION

SIDE ELEVATION



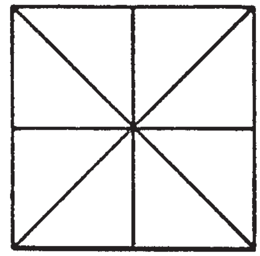
WORM'S-EYE PLAN

© Rendow Yee

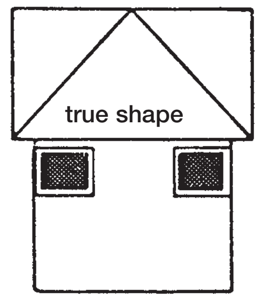
Photo: Sundial Bridge, Redding, California
Architect: Santiago Calatrava

The 217' (66 m) structural support pylon for this pedestrian bridge appears vertical from this vantage point, when in actuality it is about 60º to the horizontal plane of the walkway (when seen from a viewpoint rotated 90º). Its true length is actually seen foreshortened from the photo view. See side elevation condition (**3**).

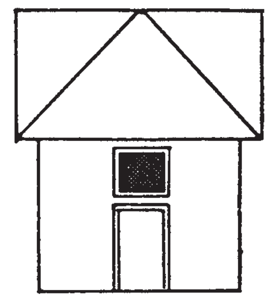
In the drawing at bottom right, note that the edge view contains a true-length line (outer soffit line) that appears as a point. A soffit is the exposed underside feature of any overhead component of a building. Edge views of this plane show the plane as true shape in the adjacent view. The concepts of point view from a true-length line, edge view (true-length as a point), and true shape (true size) become readily apparent as you visualize the roof structure of this house. Correlate the orthographic views with the pictorial (true shape is the toned area).



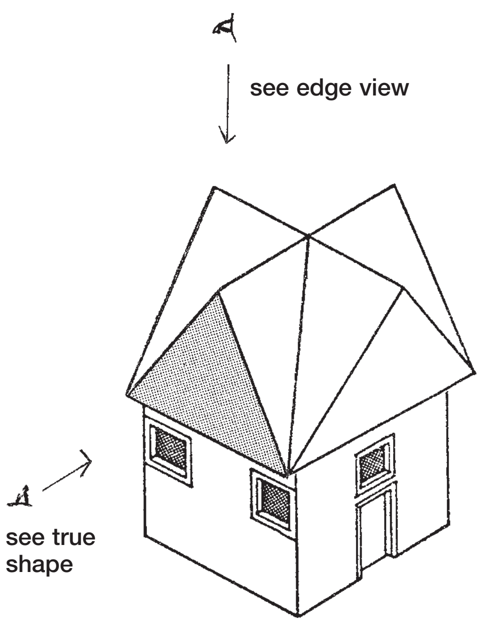
ROOF PLAN EDGE VIEW

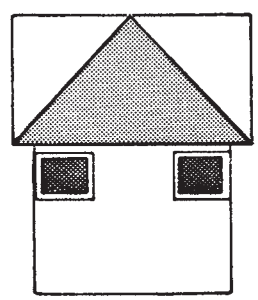


FRONT ELEVATION



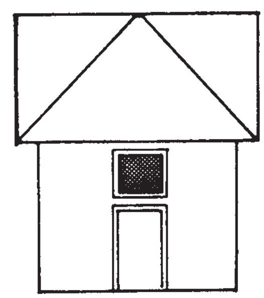
SIDE ELEVATION



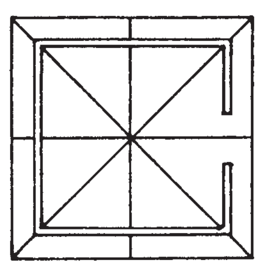


FRONT ELEVATION

edge view (true-length as a point)

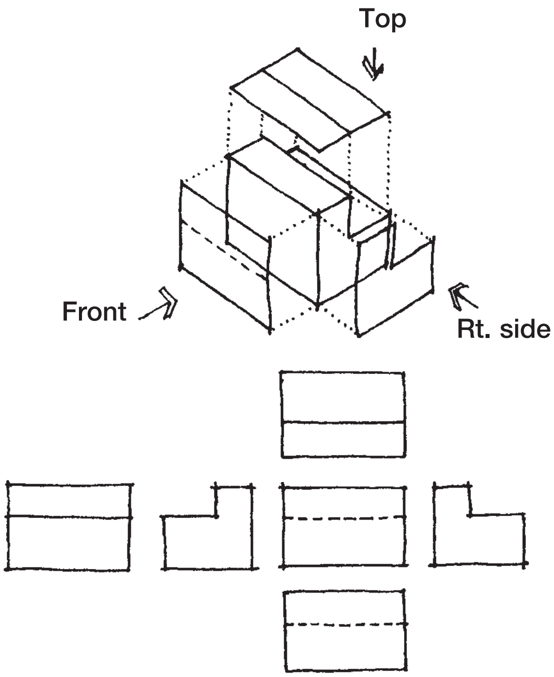


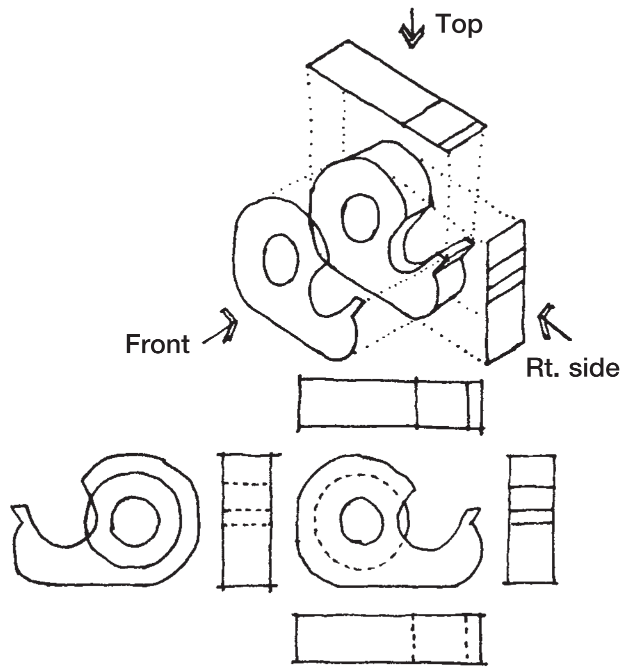
SIDE ELEVATION



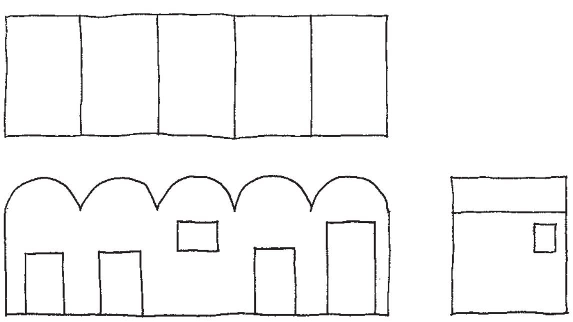
WORM'S-EYE PLAN

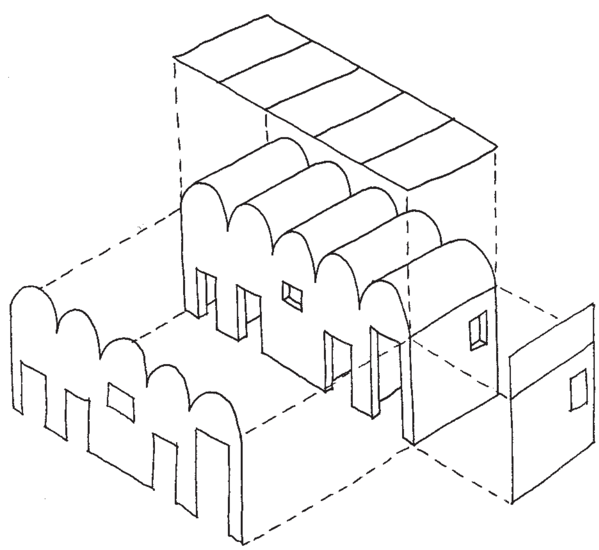
Refer to the sections on basic geometric forms and the basic principles of descriptive geometry in the companion Web site's appendix.

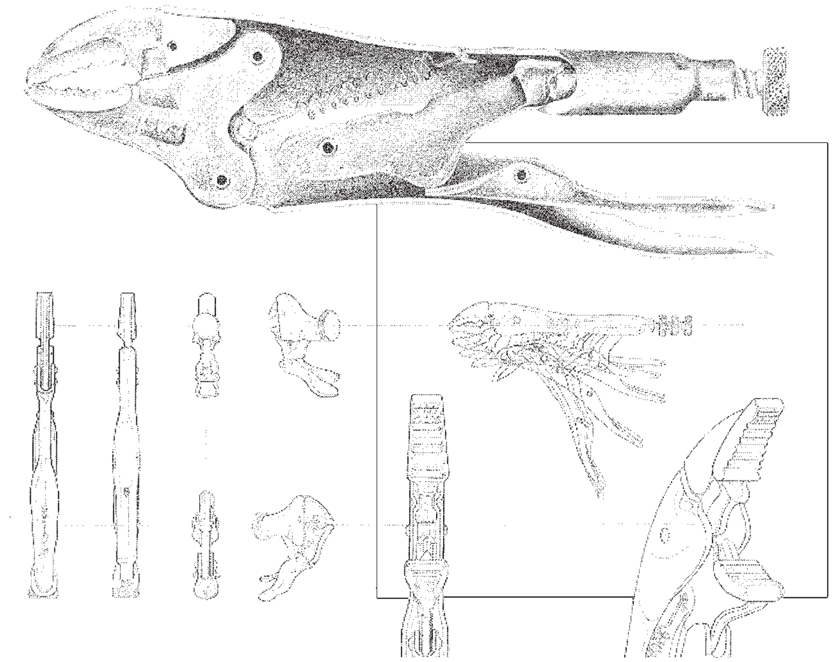




As we saw in Chapter 4, architects and designers represent a three-dimensional building by utilizing right-angled or orthogonal views. Multiview orthogonal (orthographic) images allow us to comprehend the totality of a design. These images are produced by *visualizing* the design and then sketching the visualized shapes. The freehand graphic process begins with sketching a three-dimensional pictorial image, pulling the two-dimensional orthographic images away from the various surfaces of the object (or building form) being studied, and transferring these images to a two-dimensional orthographic drawing.



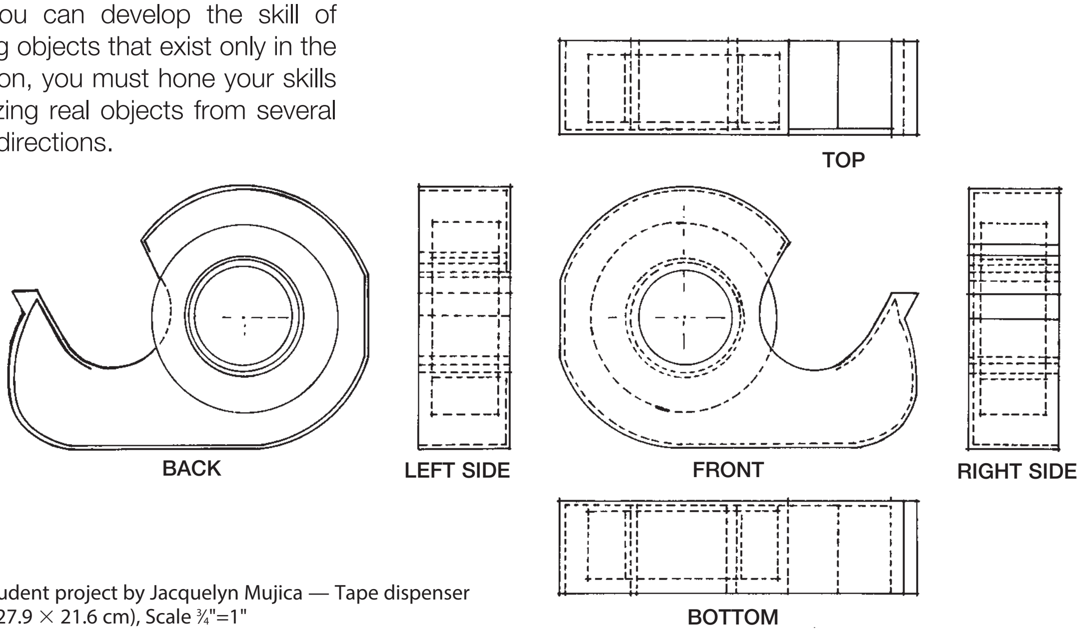




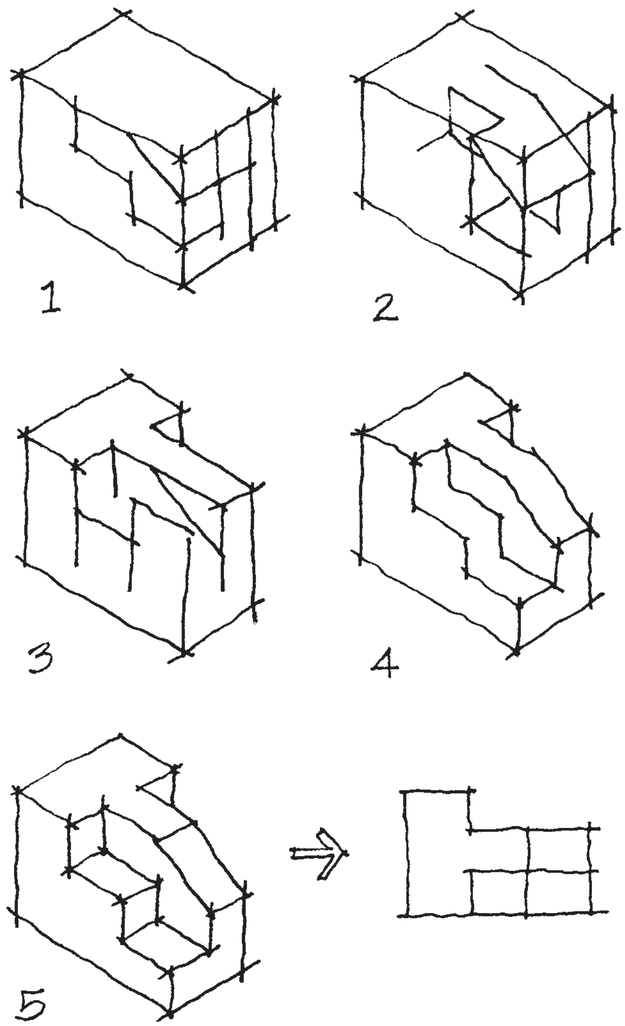
Drawing: Student project by Chris Ernst —Vise grip
Medium: Pencil
Courtesy of the University of Texas at Austin
School of Architecture

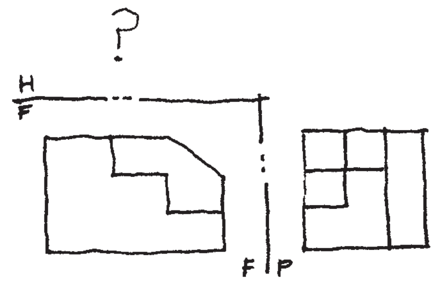
Being confident and competent in this *visualization* sketching process requires a lot of practice. The mental visualization process can begin with objects that you can hold in your hand and rotate. An orthographic image by itself cannot be descriptive enough to give us clues as to the spatial composition of the three-dimensional form, but when many orthographic views are related to each other, they become a powerful tool in describing and deciphering the object in question.

Before you can develop the skill of visualizing objects that exist only in the imagination, you must hone your skills in visualizing real objects from several different directions.



Drawing: Student project by Jacquelyn Mujica — Tape dispenser
11" × 8.5" (27.9 × 21.6 cm), Scale ¾"=1"
Medium: Pencil
Courtesy of the City College of San Francisco
Department of Architecture

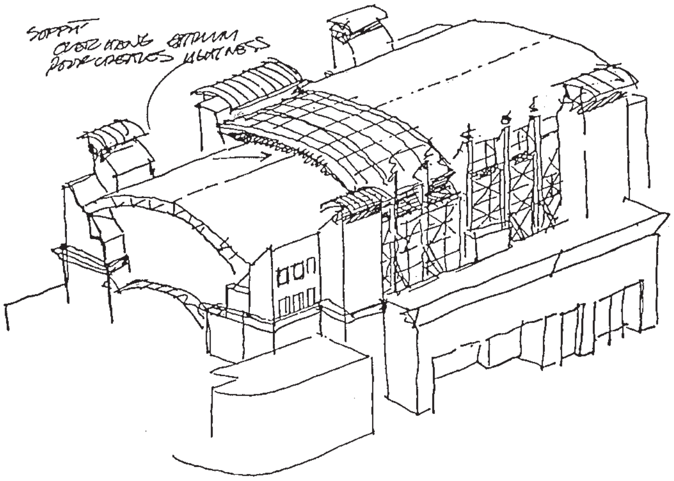




Design professionals often use paraline sketches, as well as other types of sketches, to help them visualize their designs. The best way to develop your *visualization* skills is to practice seeing the relationship between orthographic and paraline drawings.

This example shows a missing horizontal (top) view. To resolve the missing view, sketch the front and profile planes as shown in sketch **1**. Project related points toward the interior of the rectilinear box. Start with the basic or rough forms as shown in sketch **2**. Proceed with more detailed parts of the object as shown in sketches **3**, **4**, and **5**.

The ability to develop *rough freehand sketches* in the orthographic-paraline conversion process will enhance visualization. When an impasse is reached in the resolution of the problem, it is much better to be loose than stiff; this helps to avoid communicative inhibitions that may develop later on in the design-drawing process.



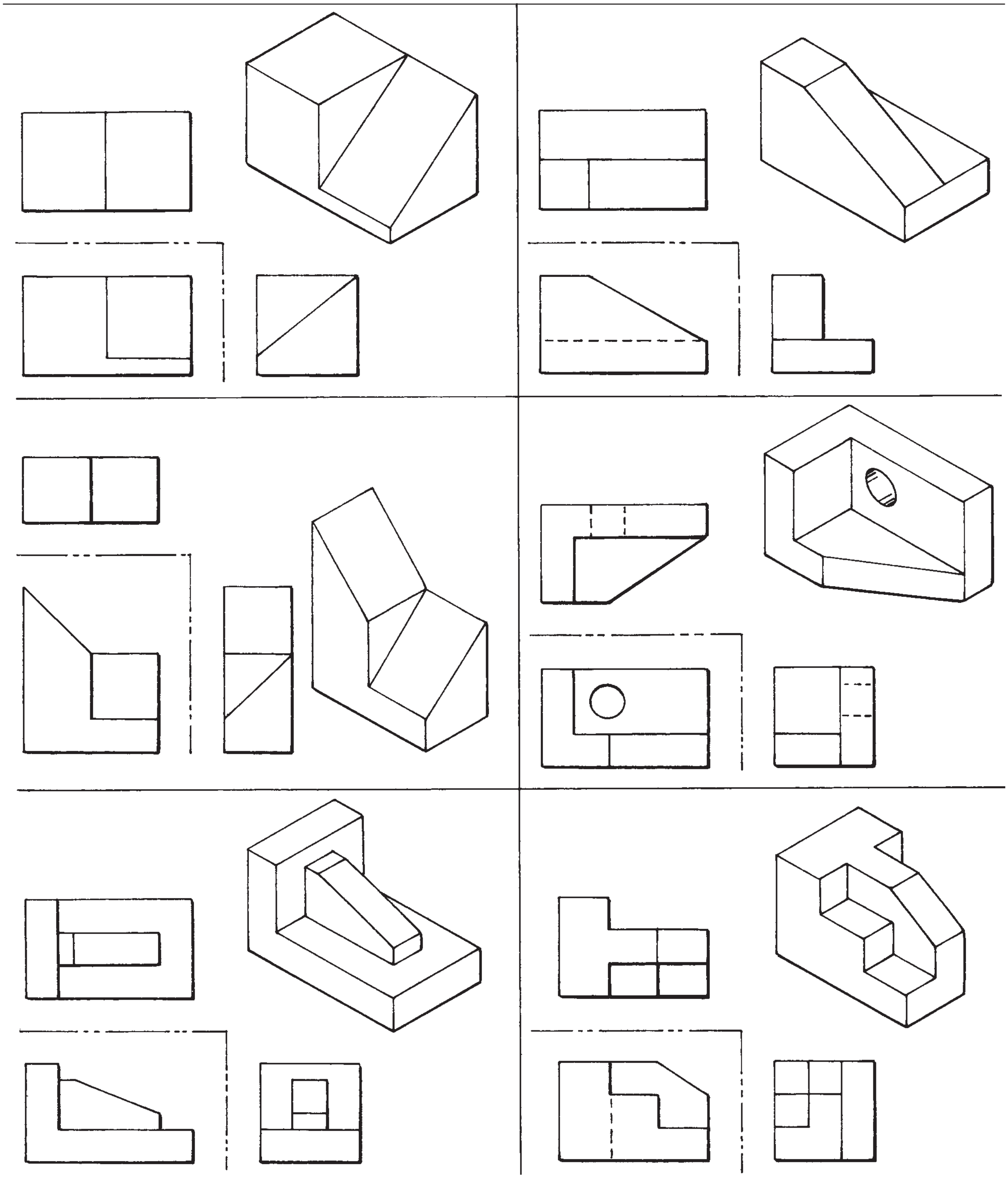
Sketch: The redevelopment of Charing Cross Station
London, England
Medium: Black ink line with colored pencil
Courtesy of Terry Farrell & Partners

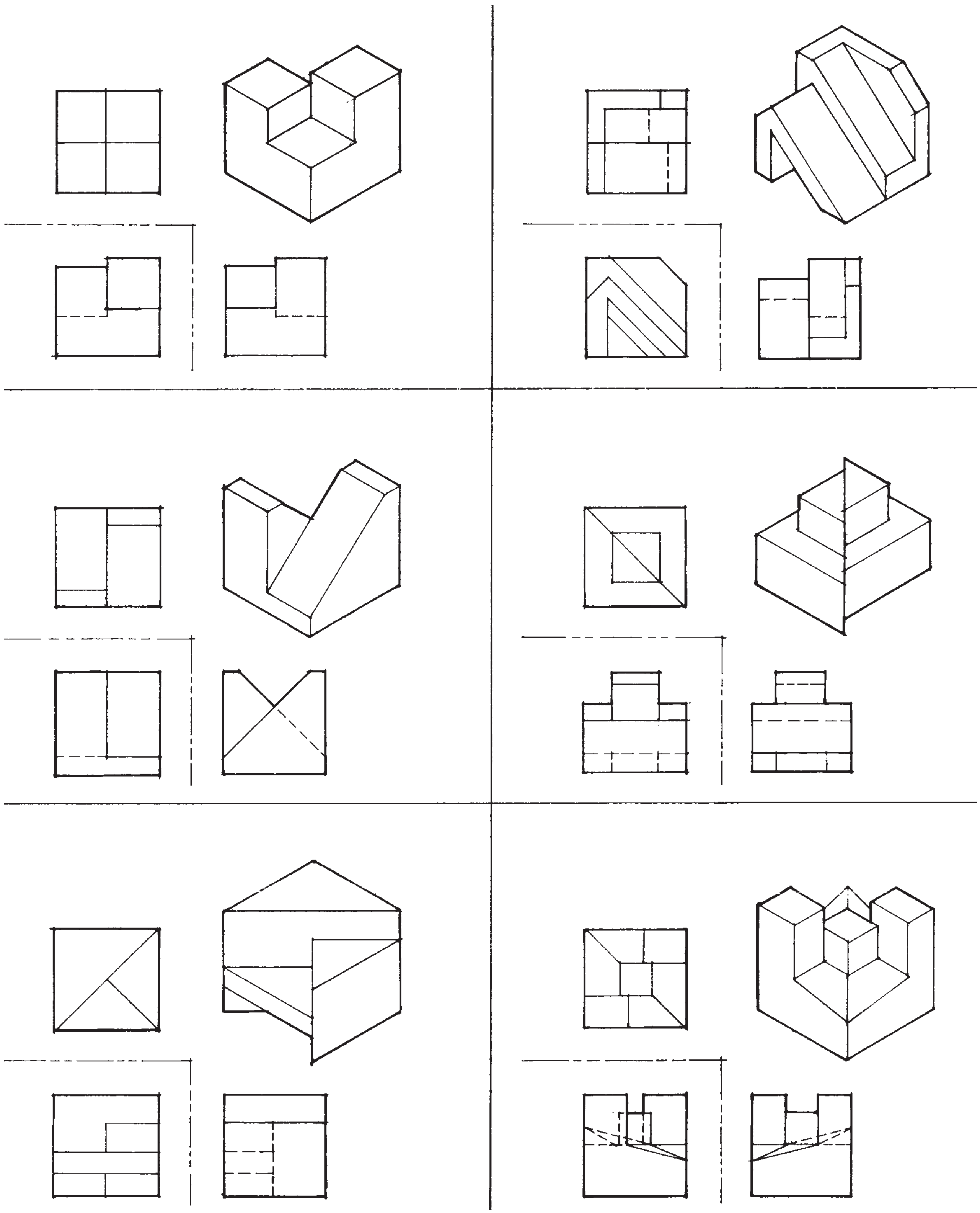
© Penn Station

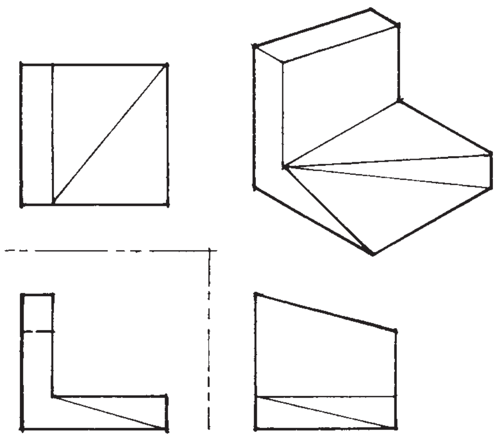
Photo: Charing Cross Station
Courtesy of Wikipedia

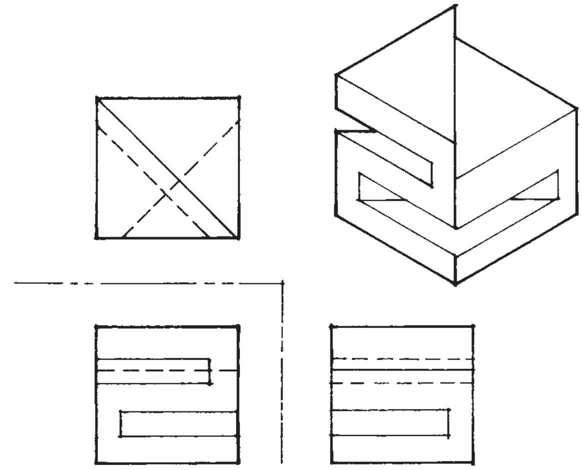
Siting a large scale mixed-use project using a "contextual approach," this project demonstrated Farrell's facility in integrating engineering and infrastructure projects in difficult and prominent urban settings.

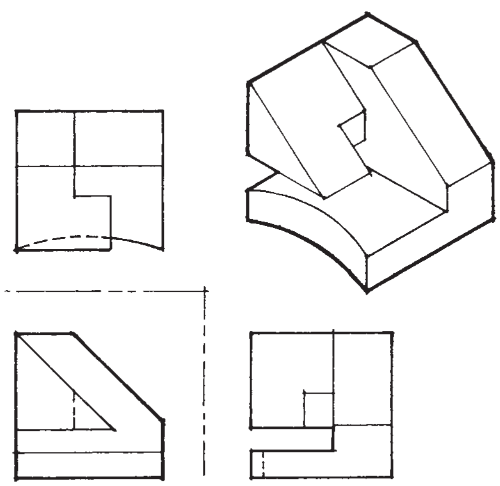
Honing your skills in the visualization of simple block forms will enhance your ability to understand the building forms shown in the latter part of this chapter.

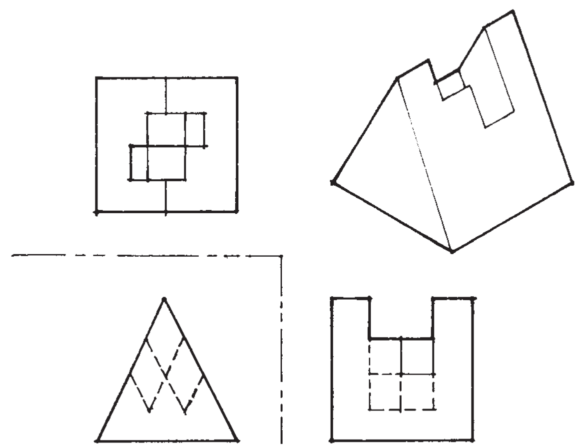


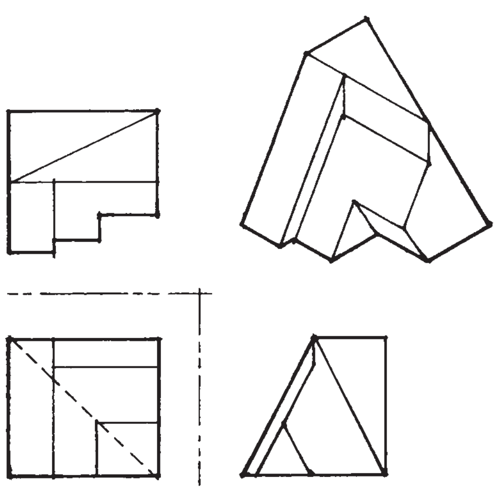


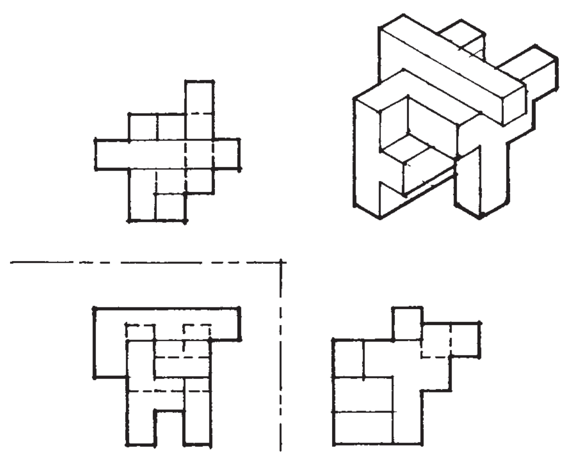


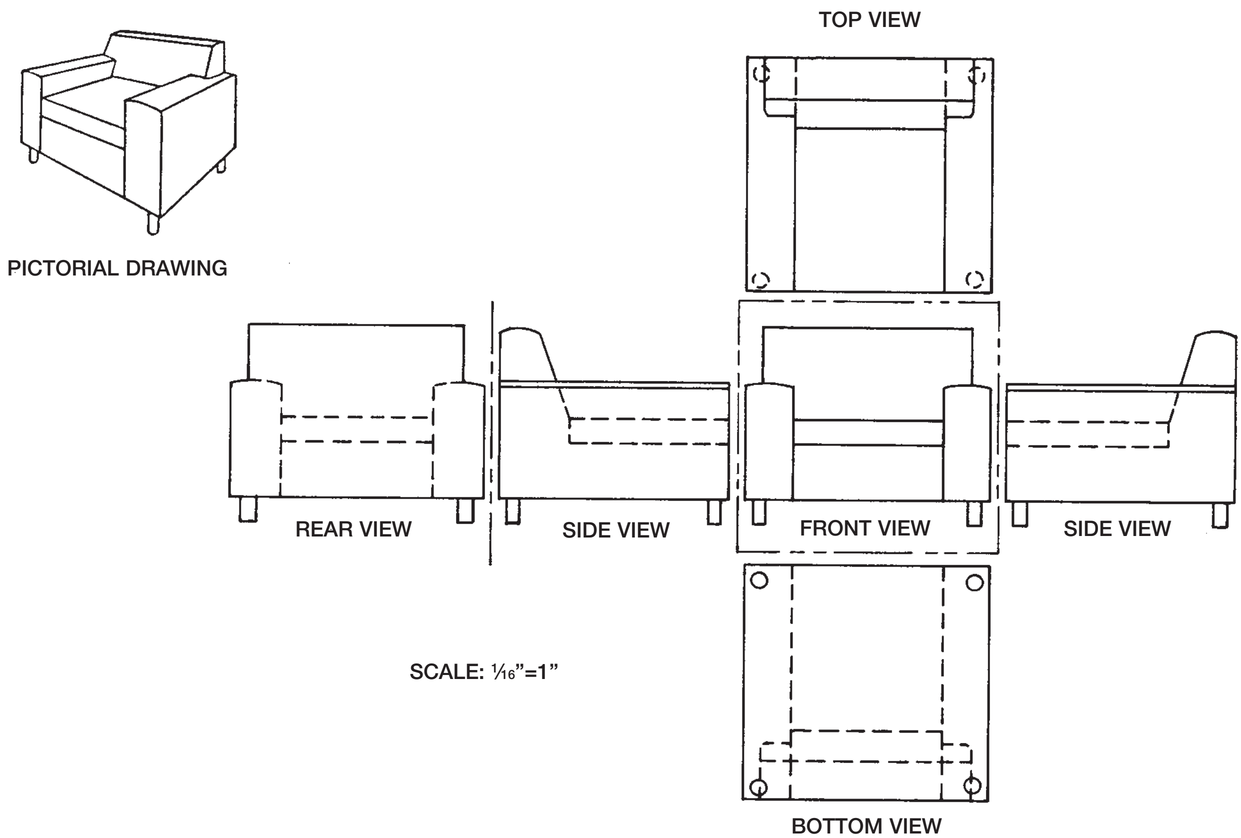




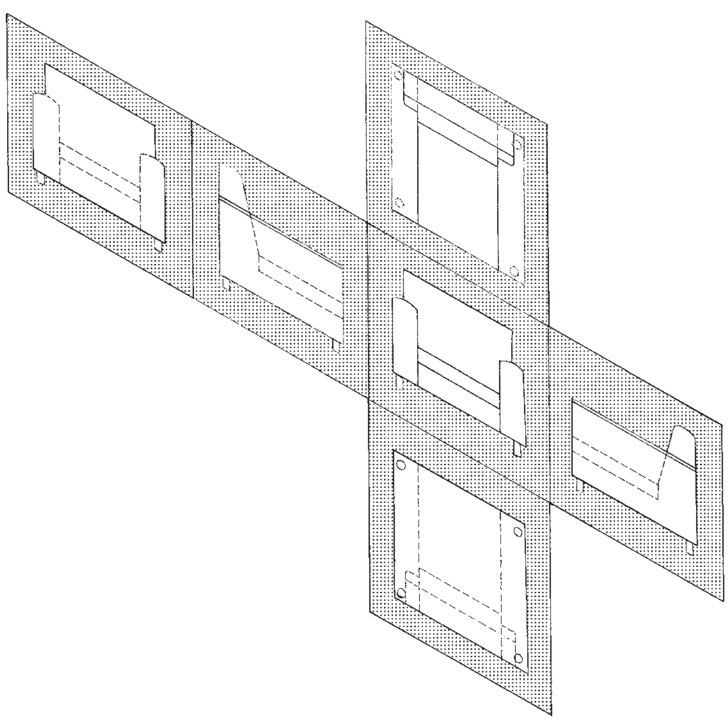






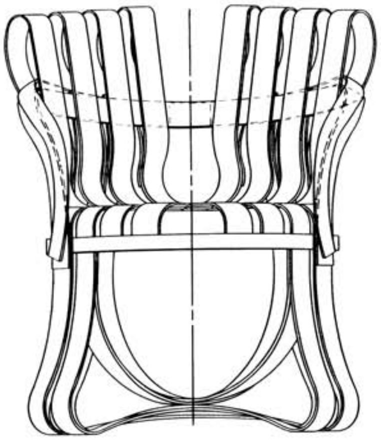


ORTHOGRAPHIC DRAWINGS

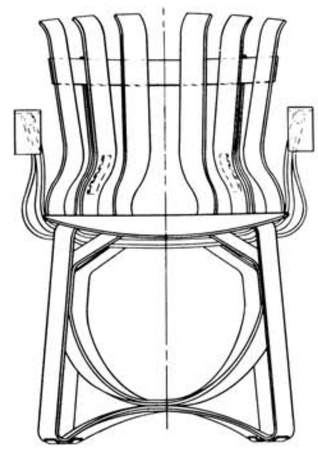


Pictorial and orthographic drawings:
Student project by Ellen Lew
Medium: Pencil on vellum
Courtesy of the City College of San Francisco
Department of Architecture

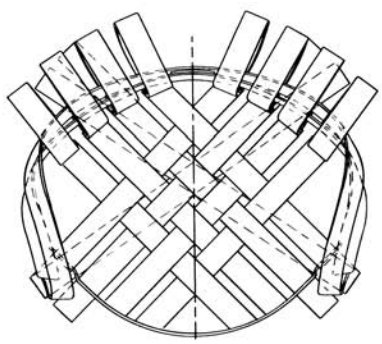
After drawing handheld-size objects, examine larger objects like furniture and small buildings and draw them with six or fewer views, as needed. The drawing at left shows six views of a chair projected on the surfaces (picture planes) of an opened glass box. In orthographic projection, a folding plane line is used to help understand how the six views are positioned in relation to each other. Henceforth, this line will not be shown between views because in actual architectural practice the line is not drawn.



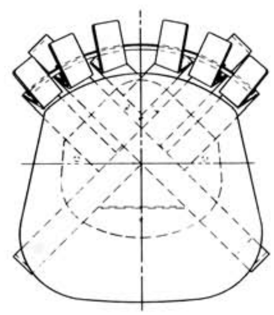
FRONT VIEW



FRONT VIEW



TOP VIEW



TOP VIEW

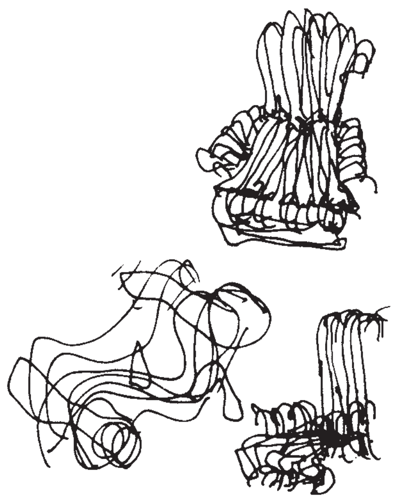
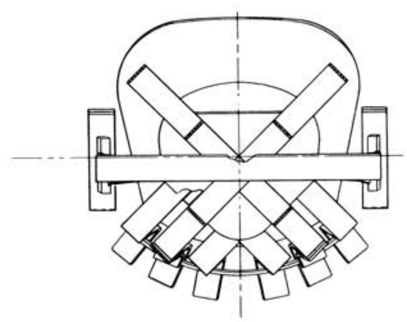


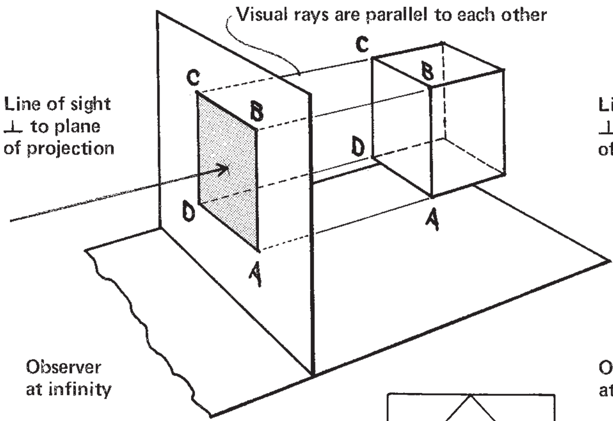
Photo: Bentwood Chair
Courtesy of Arcspace



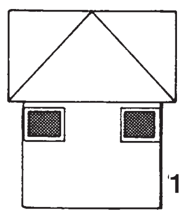
BOTTOM VIEW

With just a front view and a top view, you can visualize the shape of most chairs and other pieces of furniture. With small objects like chairs, two or three views (top, front, and side) are adequate. With buildings, it is customary to use four or more views. Architect Frank Gehry played with bushel baskets as a child. This inspired him to create lightweight wood furniture. His line of chairs was introduced in 1992.

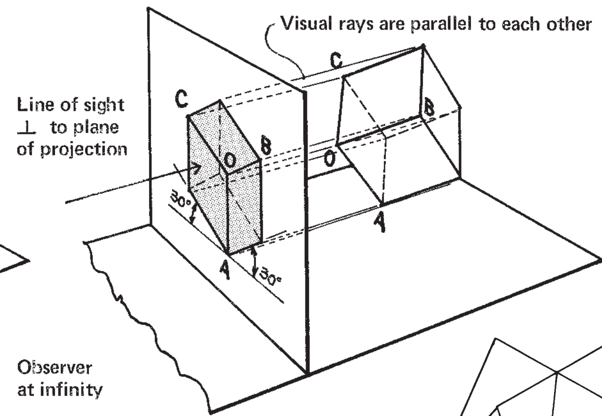
Concept sketches and drawings:
The Frank Gehry Bentwood Collection
Crosscheck armchair (*left*)
28" × 33.5" (72.4 × 85.1 cm), Scale: 1" = 1'0"
Hat trick armchair (*right*)
23.4" × 33.5" (59.4 × 85.1 cm), Scale: 1" = 1'0"
Medium: Ink on paper
Courtesy of Knoll and the Frank Gehry Bentwood Collection



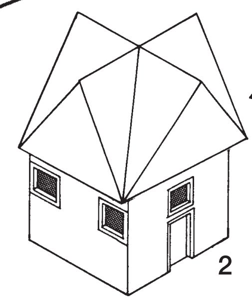
1 ORTHOGRAPHIC PROJECTION



1

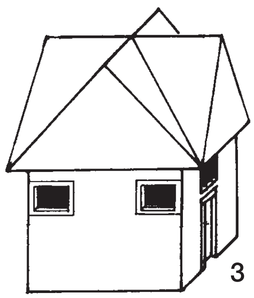


2 AXONOMETRIC PROJECTION



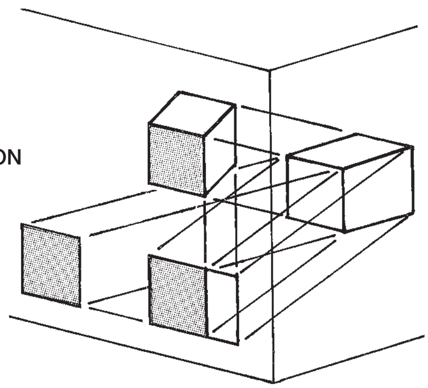
2

ISOMETRIC study shown
for axonometric projection

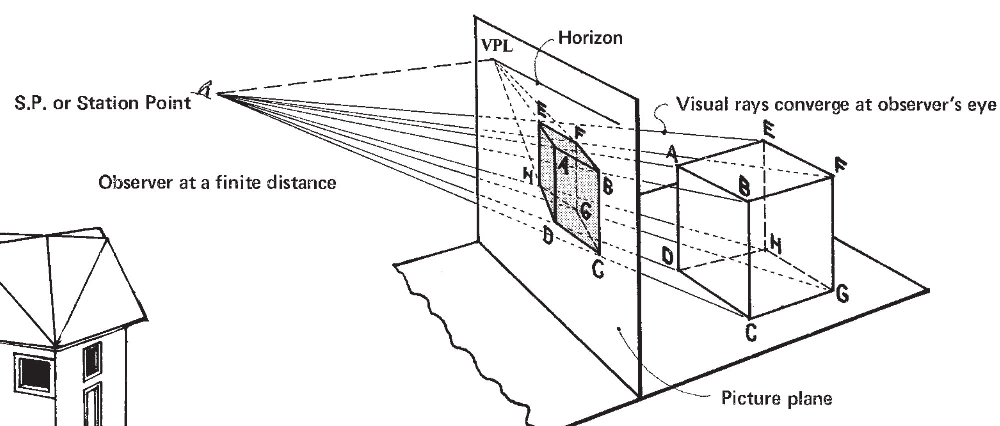


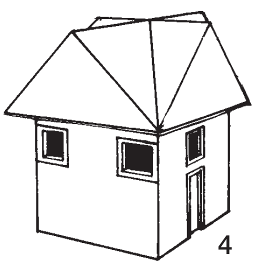
3

3 OBLIQUE PROJECTION



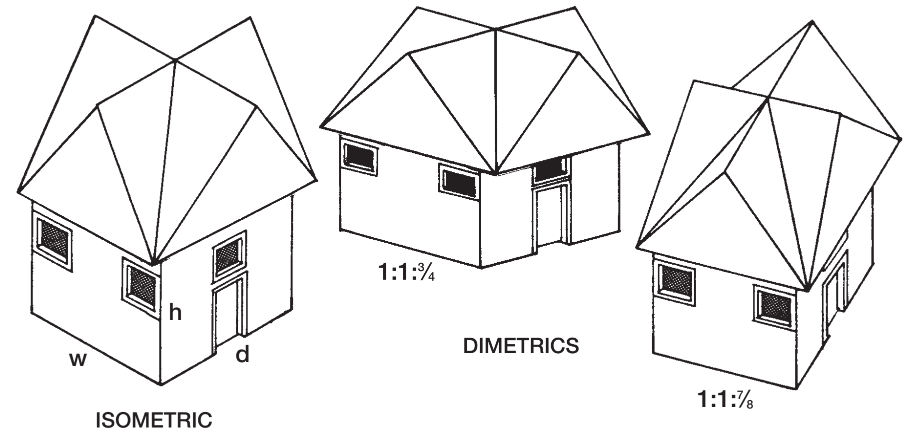
Four projection systems are commonly used on architectural drawings. They all produce single-view drawings, with the exception of orthographic projection, which produces plans and elevations (multiviews). Only perspective projection is characterized by nonparallel lines. All *projection systems* have four elements: an object, a picture plane, a viewer, and projected visual rays. *Visual rays* are the projection lines from the observer's eyes to various points on the viewed object or scene. For convenience and to save time, slightly foreshortened axonometric projection lengths are drawn true-length in an axonometric drawing. Note that the symbol for perpendicular is ⊥.





4

4 PERSPECTIVE PROJECTION



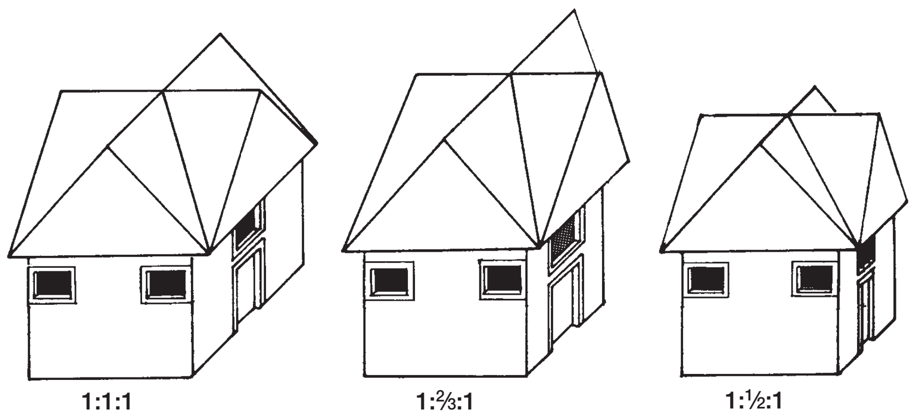
Paraline axonometrics (from Greek) or *axiometrics* (from English) exhibit projectors that are *perpendicular* to the picture plane and *parallel* to each other. They exhibit a vertical front edge and nonconverging side planes

Isometric: All three primary axes are set at the same scale: 1:1:1.*

Dimetric: Any two of the three primary axes are set at the same scale. Isometric is a special case of dimetric drawing.

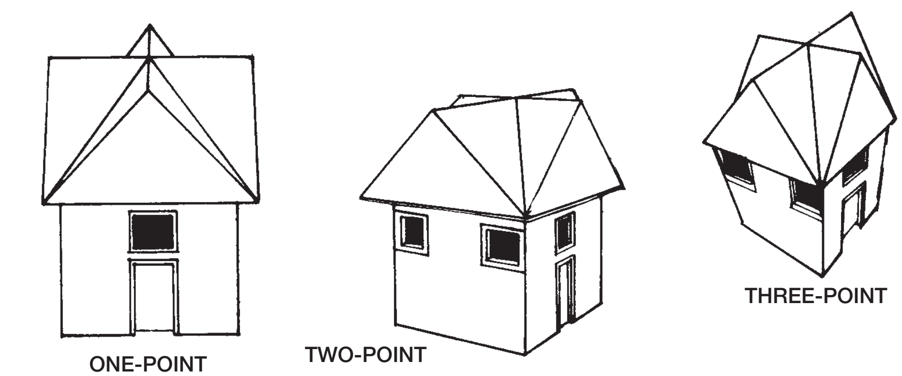
Trimetric: All three primary axes are set at different scales. Two viewed sides are at unequal angles to the horizontal.

*Scale ratios for the width (w), depth (d), and height (h) of the building.



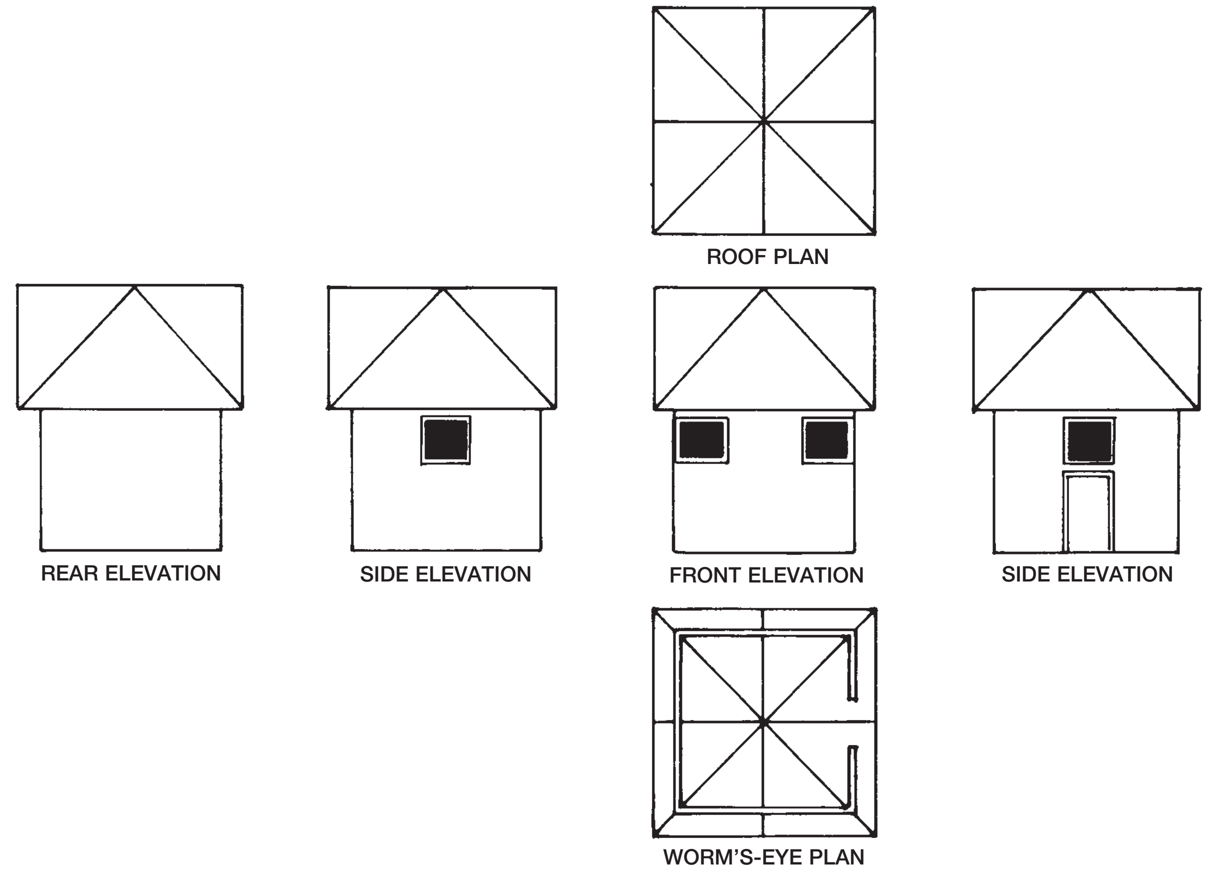
Paraline obliques (here in the form of elevation obliques) exhibit projectors that are *oblique* to the picture plane and *parallel.* They exhibit a flat, true-size frontal shape and non-converging side planes. Historically, they derive from drawings of ancient European fortifications.

These are *elevation obliques*: one elevation is parallel to the picture plane and seen in true size and true shape. Often the receding planes seem too elongated in their true length. In practice they are usually shortened by as much as one-third to one-half to give visual comfort.

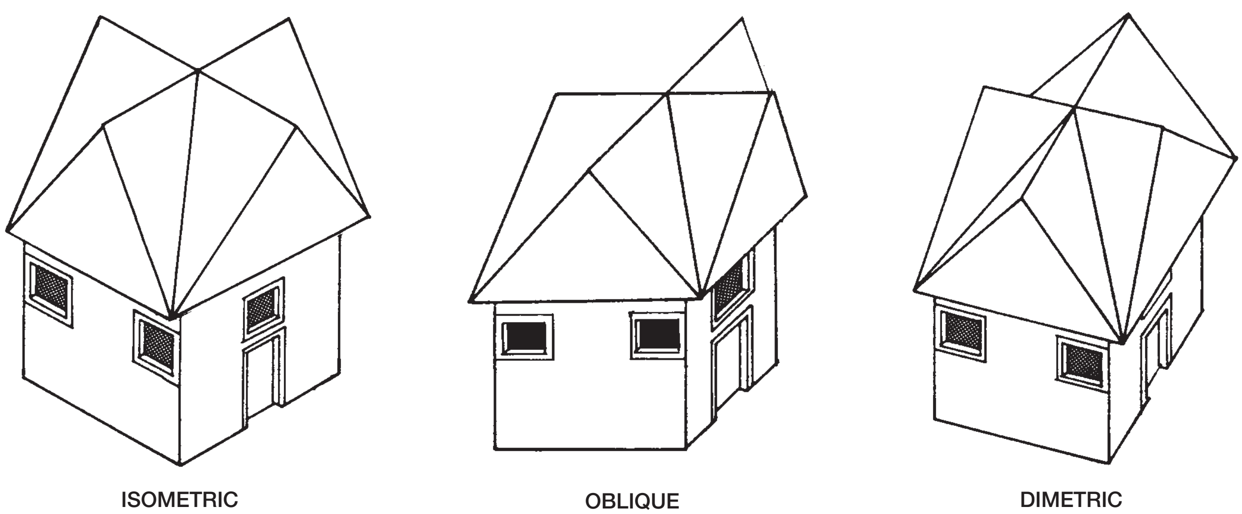


Perspectives exhibit projections that are at a variety of angles to the picture plane and display the characteristics of *point convergence.* They show converging side planes. Historically, they derive from drawings of the Renaissance.

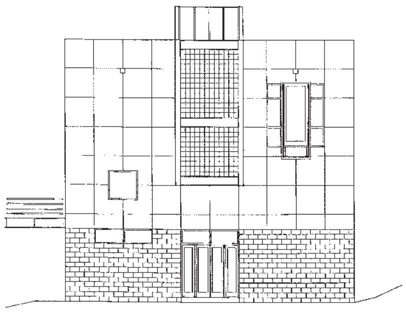
Perspectives, which will be covered in detail in Chapter 6, are single-view drawings that approach a person's optical perception. For two-point and three-point perspectives, the various surfaces are at a variety of angles to the picture plane, whereas one surface is parallel to the picture plane for a one-point perspective.



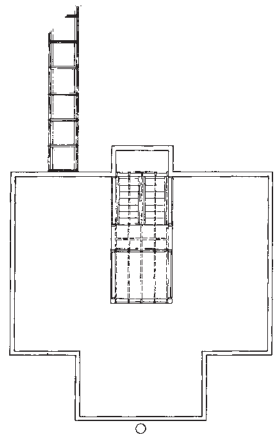
The drawing above shows six orthographic views of a building shape. This is a *multiview* drawing. In the design process, two-dimensional multiviews help us envision and communicate what the composite three-dimensional form will look like. Similarly, knowing the three-dimensional pictorial (see below) makes it easier to visualize how the multiviews lay out and relate to each other.



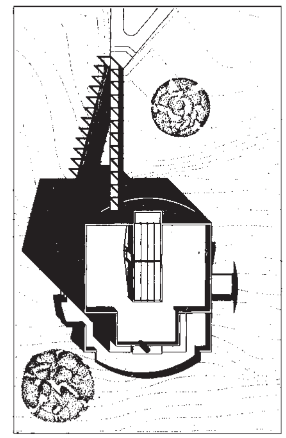
Isometric, oblique, and dimetric are three types of *single-view paraline* drawings. Unlike an isometric drawing, a *dimetric* drawing has the flexibility of being able to emphasize one or two of its primary planes. Seen at the bottom on the facing page is a fourth type of single-view drawing: a perspective.



EAST ELEVATION

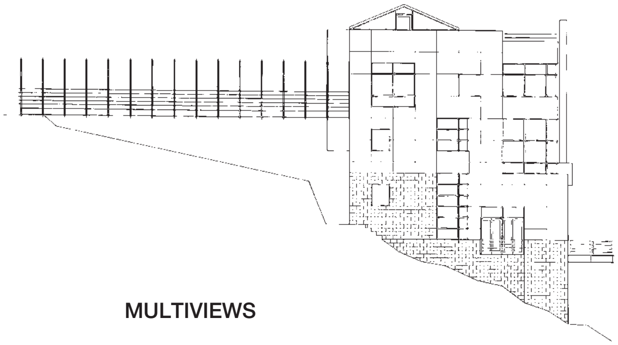


ROOF PLAN

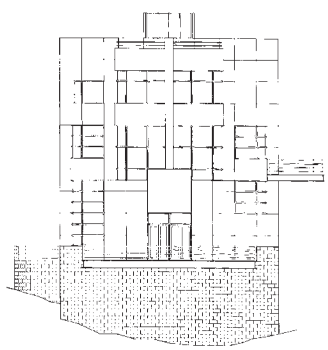


SITE PLAN

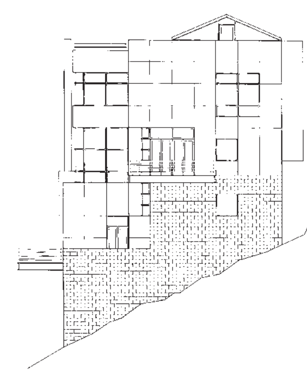
MULTIVIEWS



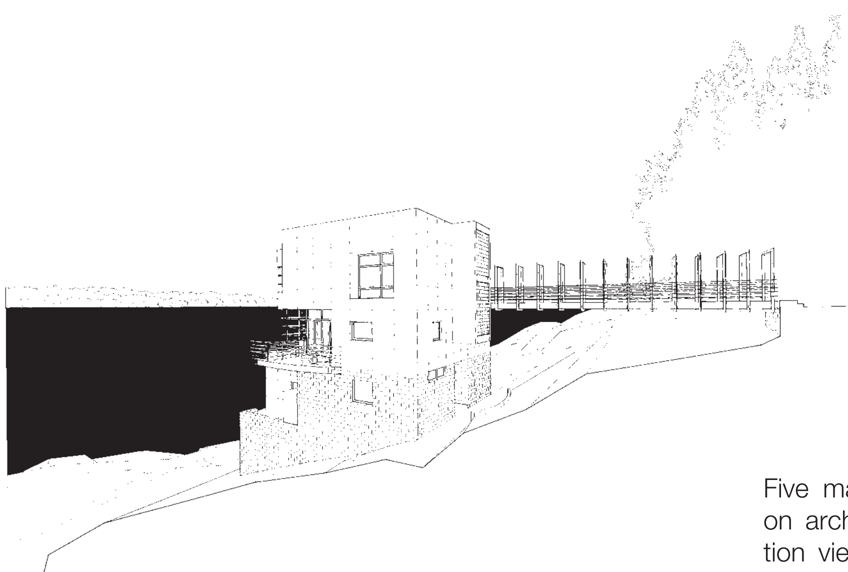
NORTH ELEVATION



WEST ELEVATION



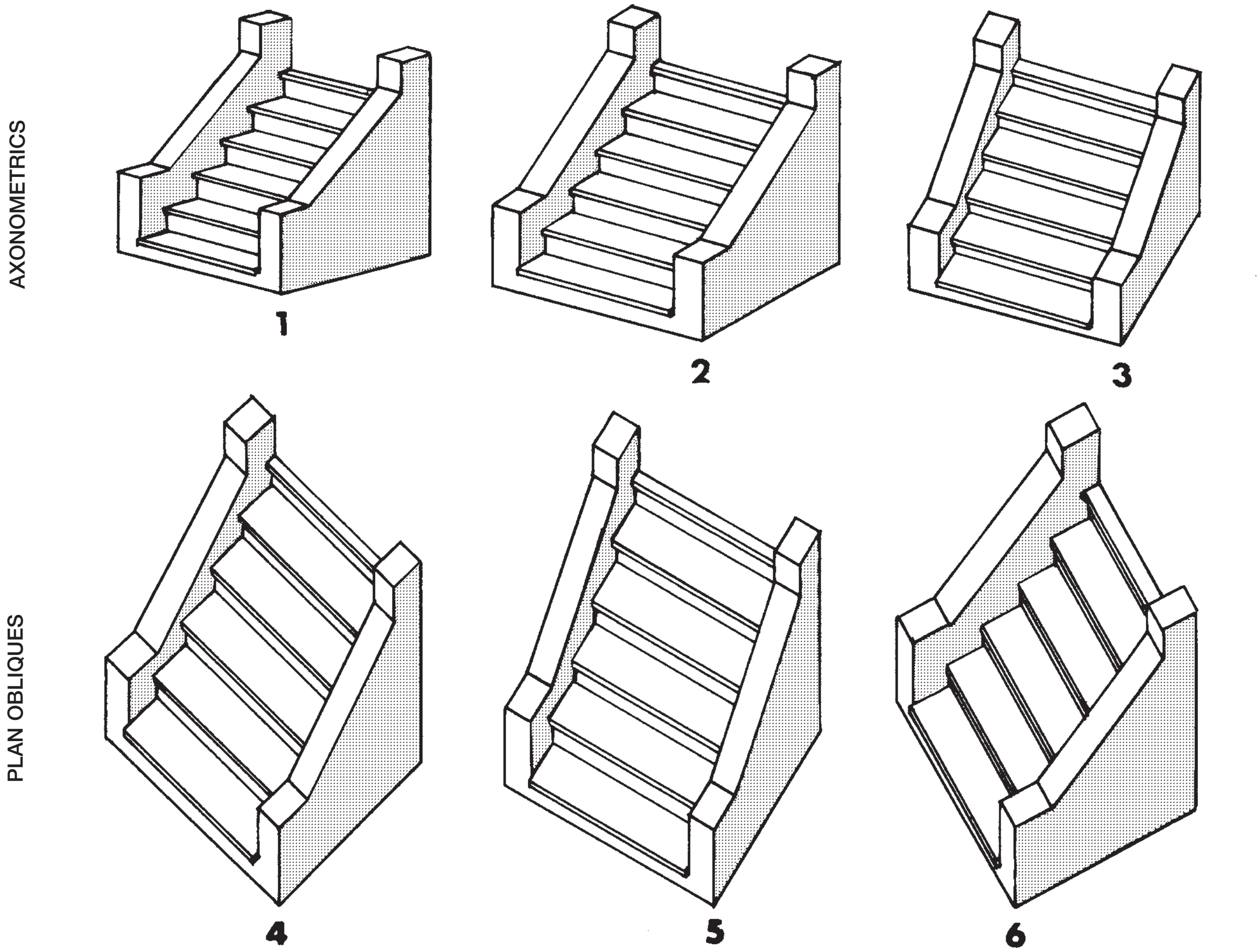
SOUTH ELEVATION



SINGLE-VIEW DRAWING

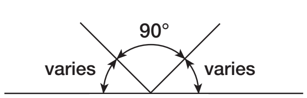
Drawings: Robertson residence
Flathead Lake, Montana
Original size of perspective: 32" × 32" (81.3 × 81.3 cm)
Scale for multiviews: ¼" = 1'0"
Medium: Pen and ink on Mylar
Courtesy of Dean Nota Architect

Five major *orthographic views* are shown on architectural drawings. Four are elevation views, which are parallel to the walls of the building, and one is a site plan/floor plan view, which is parallel to the ground. Any views that are not parallel to the primary walls of the building are classified as *auxiliary views.*

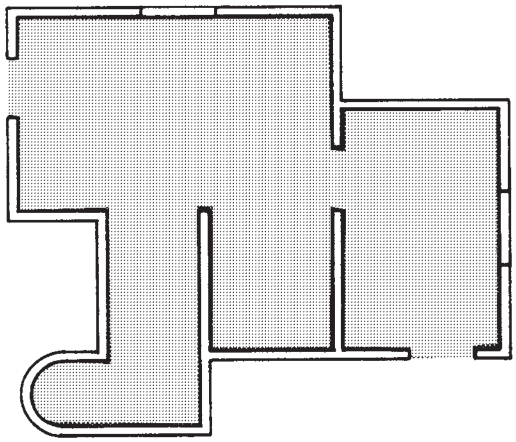


1. 15°–15° ¾:¾:1
2. 15°–30° 1:¾:1
3. 15°–60° 1:¾:¾
4. 45°–45° 1:1:1
5. 30°–60° 1:1:1
6. 60°–30° 1:1:1

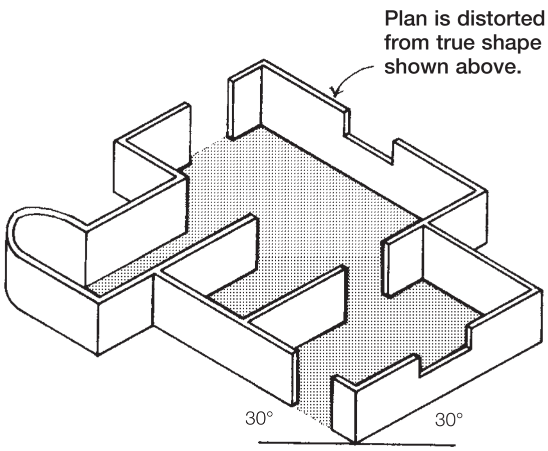
Paraline *axonometrics* (axis measure) and paraline *plan obliques* allow for a great variety of choices in deciding which viewpoints are best relative to the type of object being depicted. The six alternatives shown are some of the more common angle and axes scale combinations that are used. In the oblique views of the staircase, all horizontal surfaces, such as the tread areas (horizontal part of the step), are shown in their *true shape* and *true size* (actual plan dimensions). A small percentage of the actual riser (vertical part of the step) area is visible in the oblique situations. In contrast, note that in all of the axonometric views, the percentage of actual tread area decreases as more riser area becomes visible. You must first decide what is most important to show or emphasize before selecting the desired angle and axes scale combinations. This decision process will seem more straightforward as you study the various examples shown toward the end of this chapter. Through many years of professional usage it has become popular to classify "plan obliques" as "axonometrics." Loosely defined, the terms are interchangeable, even though they are technically two separate terms with distinct definitions.



Plan obliques are quite flexible—the axes' angles can have any angular combination that you desire. An axonometric like an isometric (30°–30°) has fixed angles.

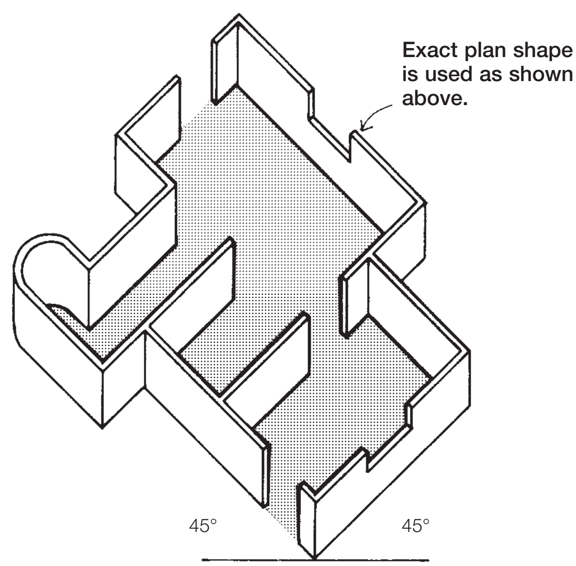


The *plan* view is essential for creating both *isometric* and *plan oblique* drawings for interior spaces. In professional practice, the plan is always available at common scales such as ¼"=1'0". This same scale would be used for plan obliques. A plan view is a two-dimensional view of that space. The plan becomes a three-dimensional drawing when the vertical dimension is added. Because a plan view can be drawn quickly and easily by hand, it is especially useful for paraline oblique interiors.



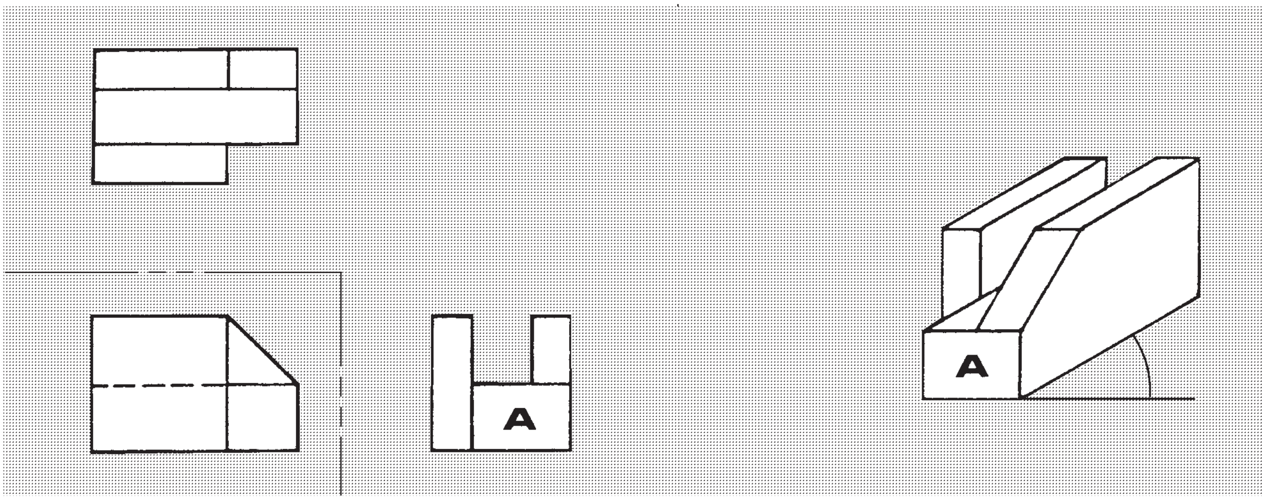
In a 30°–30° isometric, the interior partitions conceal large parts of the rooms, making it difficult to see the interior furniture, plants, people, etc. *Isometrics* are more commonly used for building *exteriors,* whereas *interiors* are best displayed with *plan obliques,* as shown below. An exception is the use of interior isometric drawings with transparent partitions (see p. xix). Note also that the walls are more visible in the isometric than in the 45°–45° drawing below. In plan obliques, the cut is usually taken in the range of ½ to ⅞ of the full floor-to-ceiling height.

Axes angles such as 45°–45° (see example at right), 60°–30°, and 75°–15° allow the observer to obtain a higher vantage point than the 30°–30° isometric. The partitions conceal less of the rooms in the 45° axes, and the plan becomes a *true shape***.** These drawings can be termed *true-shape plan obliques;* they are simply a variation of the general oblique. As a drawing type, plan obliques give the best simultaneous representation of plan and elevation. They also give an excellent analytical view of the spatial organization of the plan. All paralines are excellent tools for verifying three-dimensional relationships.



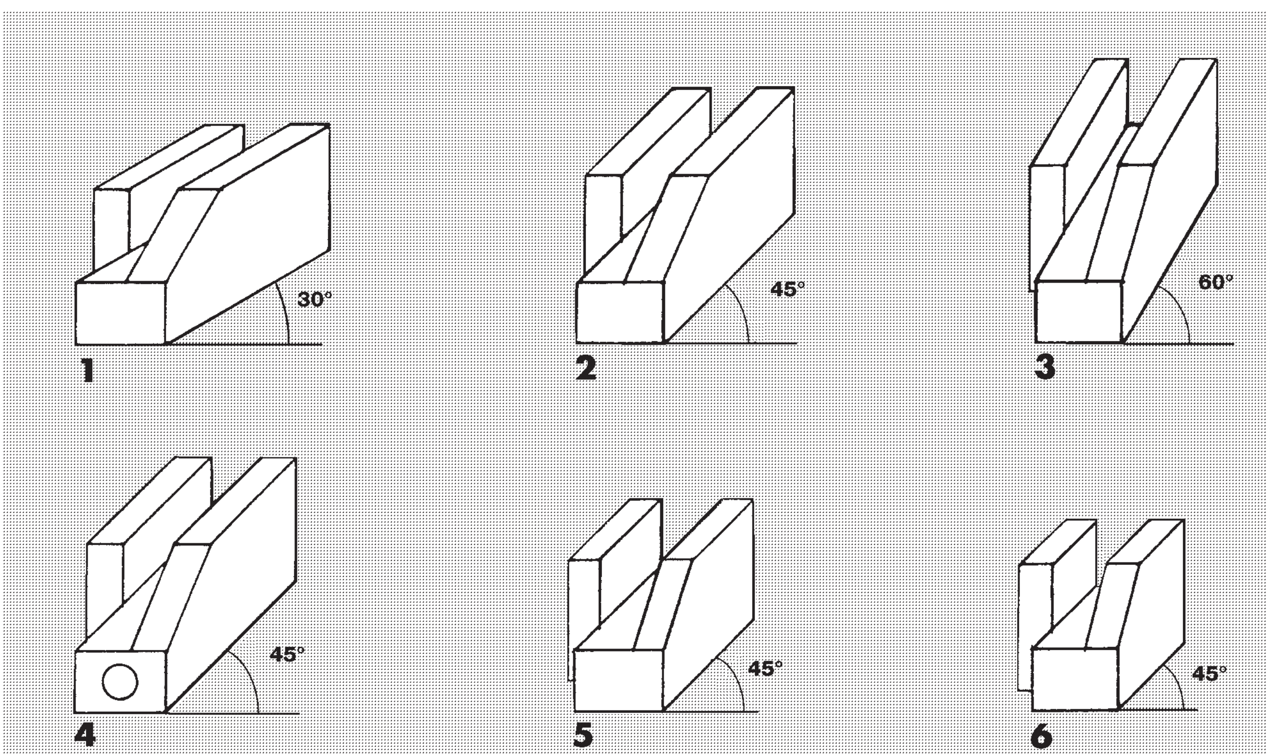
Plan obliques have been a popular technique for illustrating architecture for decades, and remain so. An oblique view from the top shows the space in three dimensions. One can measure the space because it is the plan rotated, with information about the other dimensions added. The plan oblique shows a lot of details without having to build a physical model. The walls can be removed graphically, and the plan rotated to illustrate the design. This kind of drawing can be sketchy or accurate. The only limitation is that it is not digitally produced as in *building information modeling* (BIM), which is like a physical model that can be viewed as one rotates the design model in any preset viewports.

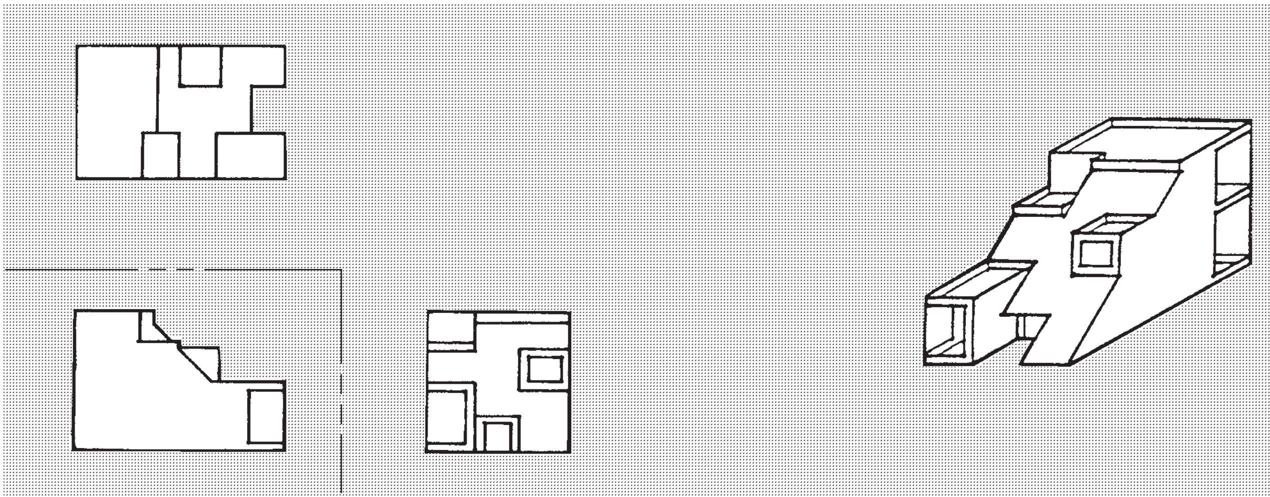
ELEVATION OBLIQUES: A COMPARISON



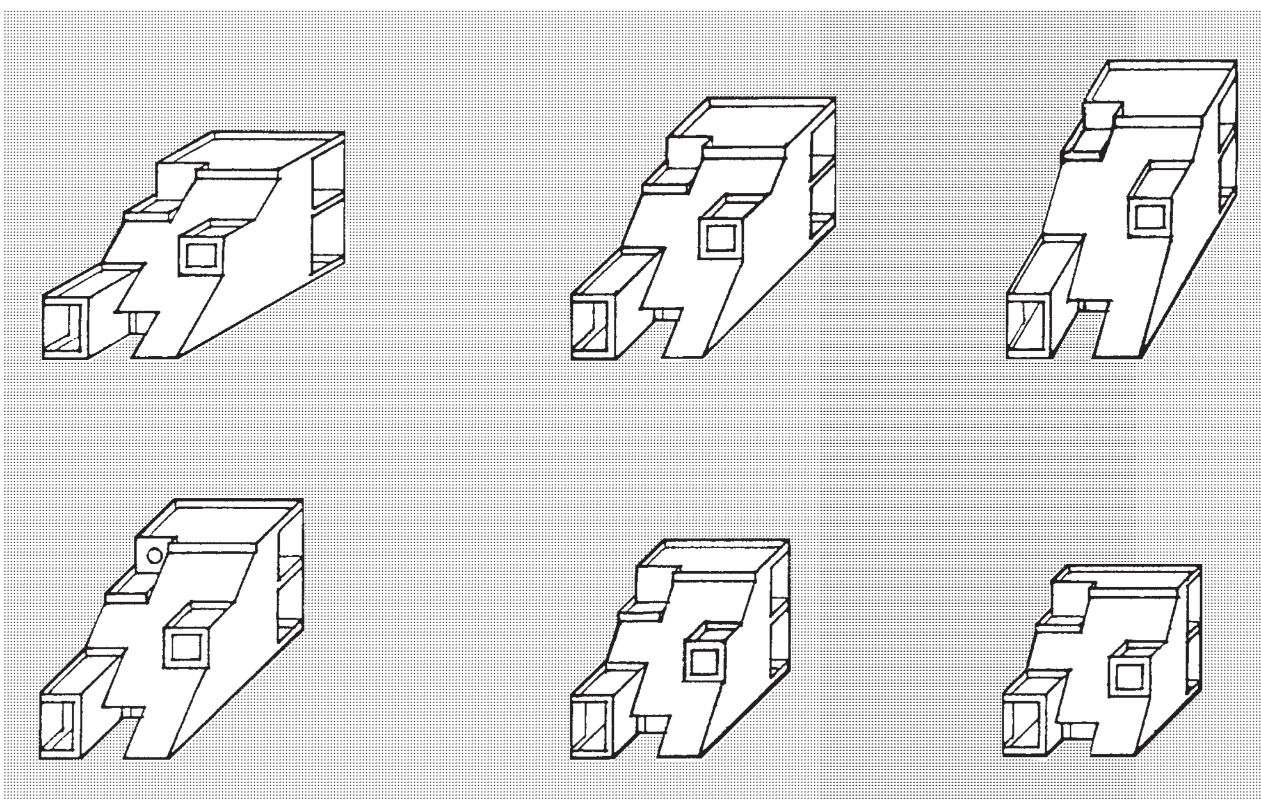
In an *elevation oblique,* a chosen elevation view is seen as *true size* and *true shape.* Elevation surface **A** is used in this example. It is easy to draw elements like true-shape circles or curves on true-shape surfaces (**4** is **2** with a surface modification). The receding lines are usually drawn at 30°, 45°, or 60° angles from the horizontal. Measure the "notated" oblique angle from due north. For example **1**, this would be 90° minus 30° = 60°. The next two notations are the elevation scale and the receding line scale. For example **1**, this would be 1:1.

1. 60° — 1:1 **2.** 45° — 1:1 **3.** 30° — 1:1 **4.** 45° — 1:1 **5.** 45° — 1:⅔ **6.** 45° — 1:½

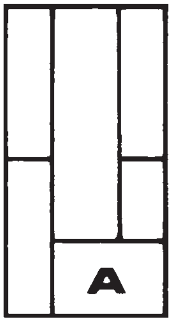




The building form shown in this example has a geometric configuration similar to that of the example shown on the opposite page. Note that all surfaces parallel to the vertical front elevation plane retain their true size and true shape and are perpendicular to the line of sight. It is common practice to show the elevation with the most irregular form as the frontal elevation. The direction of the receding lines and the scale ratio of each drawing correspond to the six drawings on the previous page. Receding lines can be set at any oblique angle.

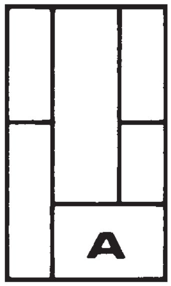


FRONTAL ELEVATION OBLIQUE 0°—1:1



1

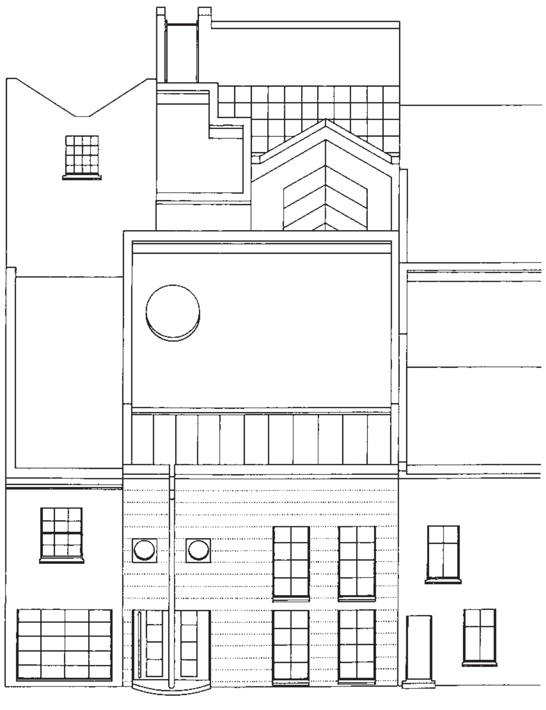
0°-1:1



2

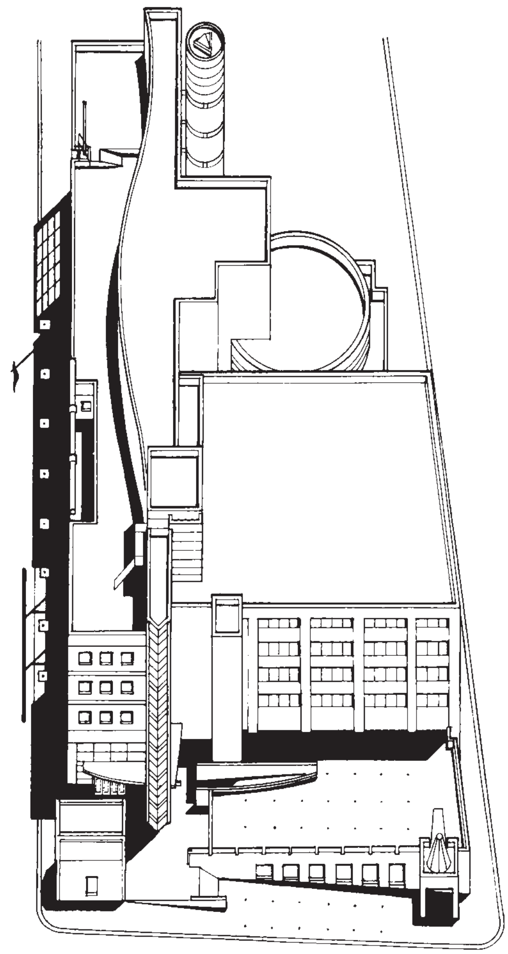
0°-1:¾

In examples **1** and **2**, the front elevation remains true size. Example **2** shows that the plan dimension is sometimes reduced from true length to generate a more realistic (foreshortened) view. This reduction can range from very little to as much as 25%. Most architects and designers, however, tend to maintain a true-size plan. Both examples below, as well as the drawings at left, show their elevations and roof plans true size and true shape. This unusual variation of an elevation oblique results when either the roof plan or floor plan (see facing page) has one of its sides parallel to the picture plane.



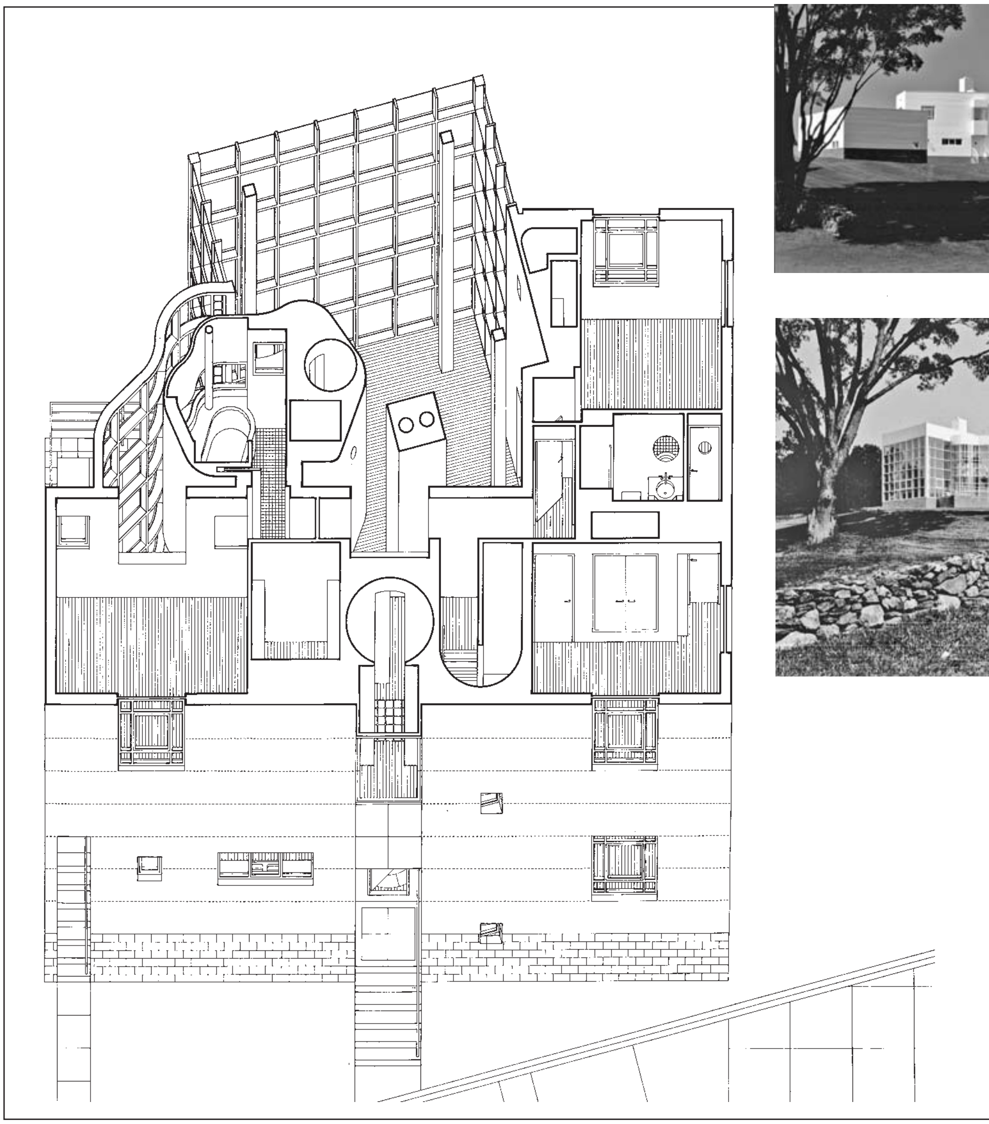
Drawing: Pond Place, London, England
Medium: Ink
Courtesy of Troughton McAslan Architects

©Troughton McAslan Architects



Drawing: Eugenio Maria de Hostos Community College, New York City
20" × 30" (50.8 × 76.2 cm), Scale: ⅛" = 1'0"
Medium: Ink on Mylar
Courtesy of Bartholomew Voorsanger, FAIA

The three-story concrete framed and polychromatic brick-fronted studio building completed in 1989 is set in a conservation area in West London. Despite its modest size of 300 square meters, it became a controversial scheme given its modernist design within a traditional setting.
[Architect's statement]



© Anthony Ames, Architect

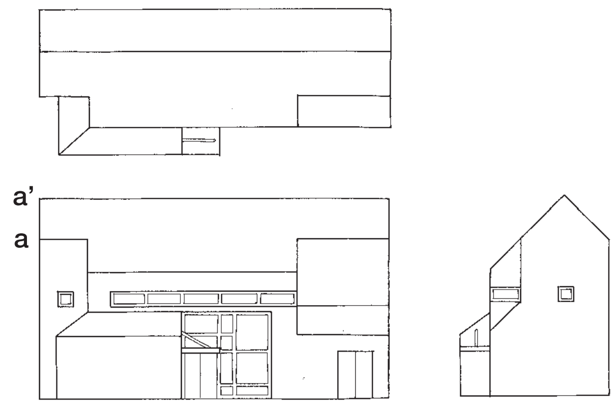
© Anthony Ames, Architect

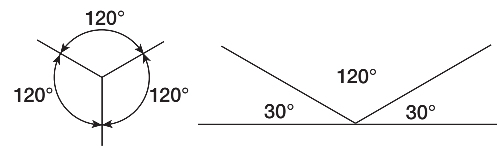
Drawing: Martinelli residence, Roxbury, Connecticut, 1989
22.5" × 22.5" (57.2 × 57.2 cm), Scale: ¼" = 1'0"
Medium: Ink
Courtesy of Anthony Ames, Architect

The Martinelli House is based on a conflicting coexistence of front and rear, passive and active, modern and premodern. The front of the house has a formal, passive, closed relationship with the road; while the rear, in the form of a rotated glazed cube, has an informal, active, open relationship to the expansive view beyond. The roof is removed from the building in this frontal axonometric drawing to illustrate the room locations on the second floor and their relationship to the double-height living and dining space, with the cloudlike element that encloses the master bathroom.
[Architect's statement]

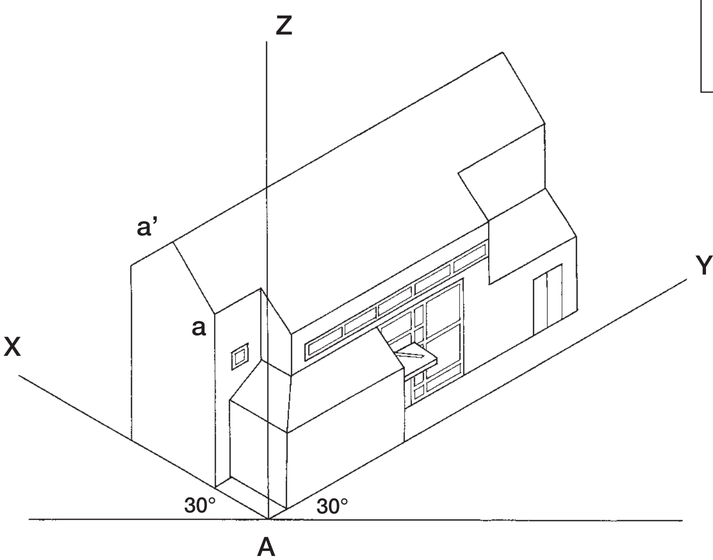
As with the drawings on the previous page, this frontal elevation oblique (also termed a 0° planometric) does not create the illusion of the third dimension. This type of drawing allows us to see vertical dimensions, fenestration patterns, and the roof structure configuration or plan layout simultaneously.

Isometric, when literally translated, means "equality of measurement." True lengths parallel to any of the orthographic axes will be the same as in the isometric drawing. An isometric drawing is not composed of true angles, whereas plan oblique drawings do have true angles. Isometric bird's-eye views create the illusion of parallel lines, when in reality the lines are converging. Your eyes tend to lead you to the corner of the building mass.



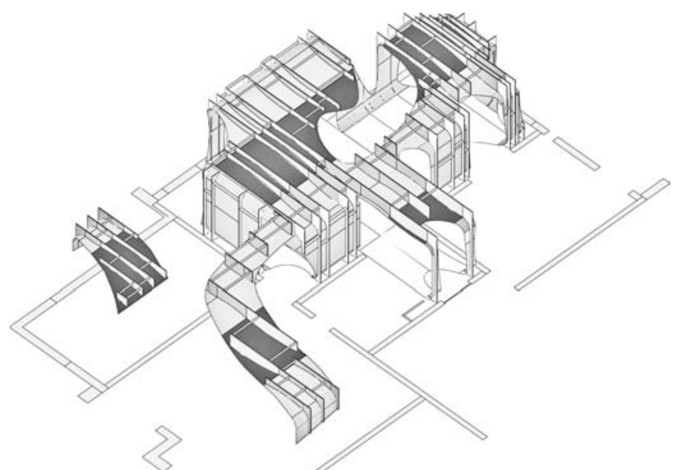


When projected on the picture plane, the three axes are always 120° apart. Conventionally and for simplicity, the two non-vertical axes are constructed 30° to a horizontally drawn line.



The *isometric drawing* is one of the most important types of *axonometric drawings.* Principles for its construction are as follows:

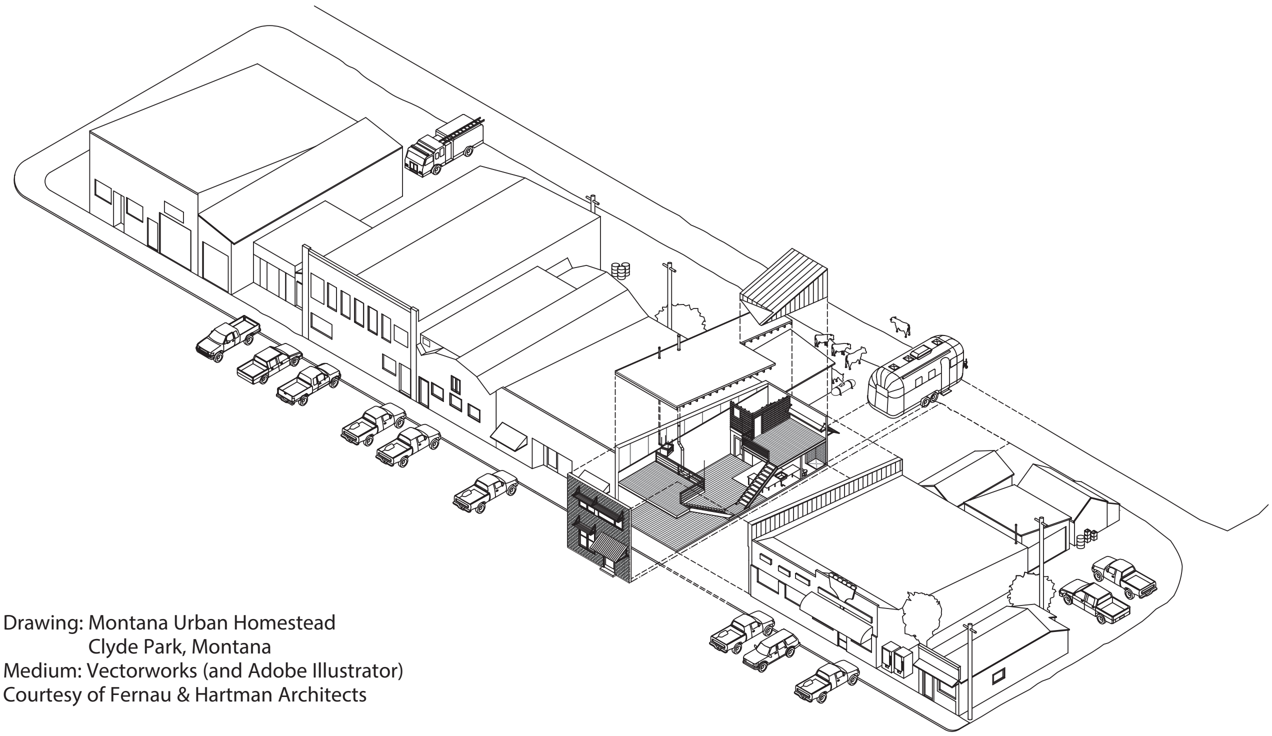
- The axes (*AX* and *AY*) on the ground plane are always drawn 30° from the horizontal.
- Measure all orthographic distances along the three axes *AX, AY,* and *AZ,* and only along these axes.
- Any lines that are not along the isometric axes (inclined or nonaxial lines) should be located and measured by locating the end points of the line (see ***a'-a*** above). These lengths will not be the same in the isometric view and the orthographic views.
- Parallel lines in an orthographic drawing remain parallel in the corresponding isometric drawing.
- Vertical lines in an orthographic drawing remain vertical in an isometric drawing.
- Hidden lines are normally not drawn in an isometric, but they can be used to help visualization.
- Corner points may be labeled in each orthographic view and in the isometric view to help visualize the isometric drawing.
- One disadvantage of the isometric is that it cannot use the orthographic view in the actual orthographic (plan/elevation) layout.



Drawing: Template House
Beijing, China
Medium: AutoCAD
Courtesy of Michele Saee, Architect

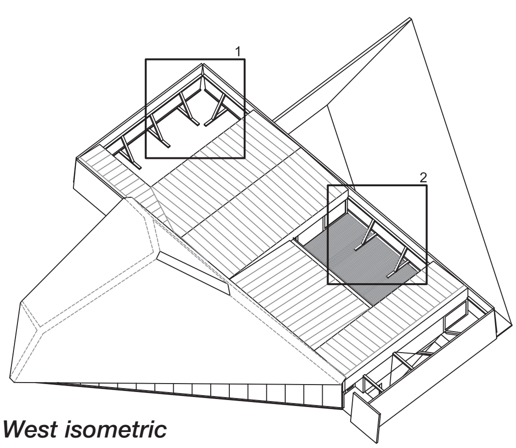
The idea was to insert a protective layer—like a cocoon or set of clothes—within the existing building's hard shell. [ARCHITECT'S STATEMENT]

See image in color at Web p. A-8.

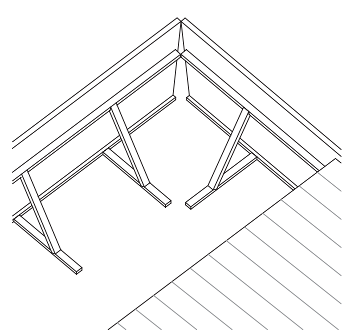


Drawing: Montana Urban Homestead
Clyde Park, Montana
Medium: Vectorworks (and Adobe Illustrator)
Courtesy of Fernau & Hartman Architects

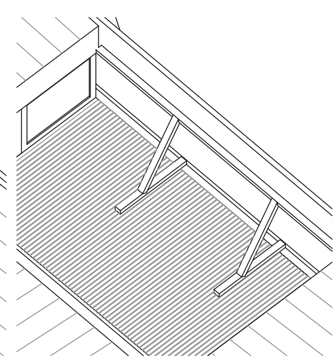
An *isometric drawing* shows a more mechanistic type of perception. Perspective drawing, which will be studied in a later chapter, is much closer to natural human perception. Nevertheless, isometrics are used because seeing three nonconverging faces of an object is still quite beneficial in understanding its form. The observer is limited to viewing only bird's-eye views in an isometric. Due to its low angle of view (lower than plan obliques), an isometric drawing does not permit the viewer to see interior spaces unless the roof and side walls are removed. All three of these elements are absent in the example above. The example below shows isometric blowups of salient details.



West isometric

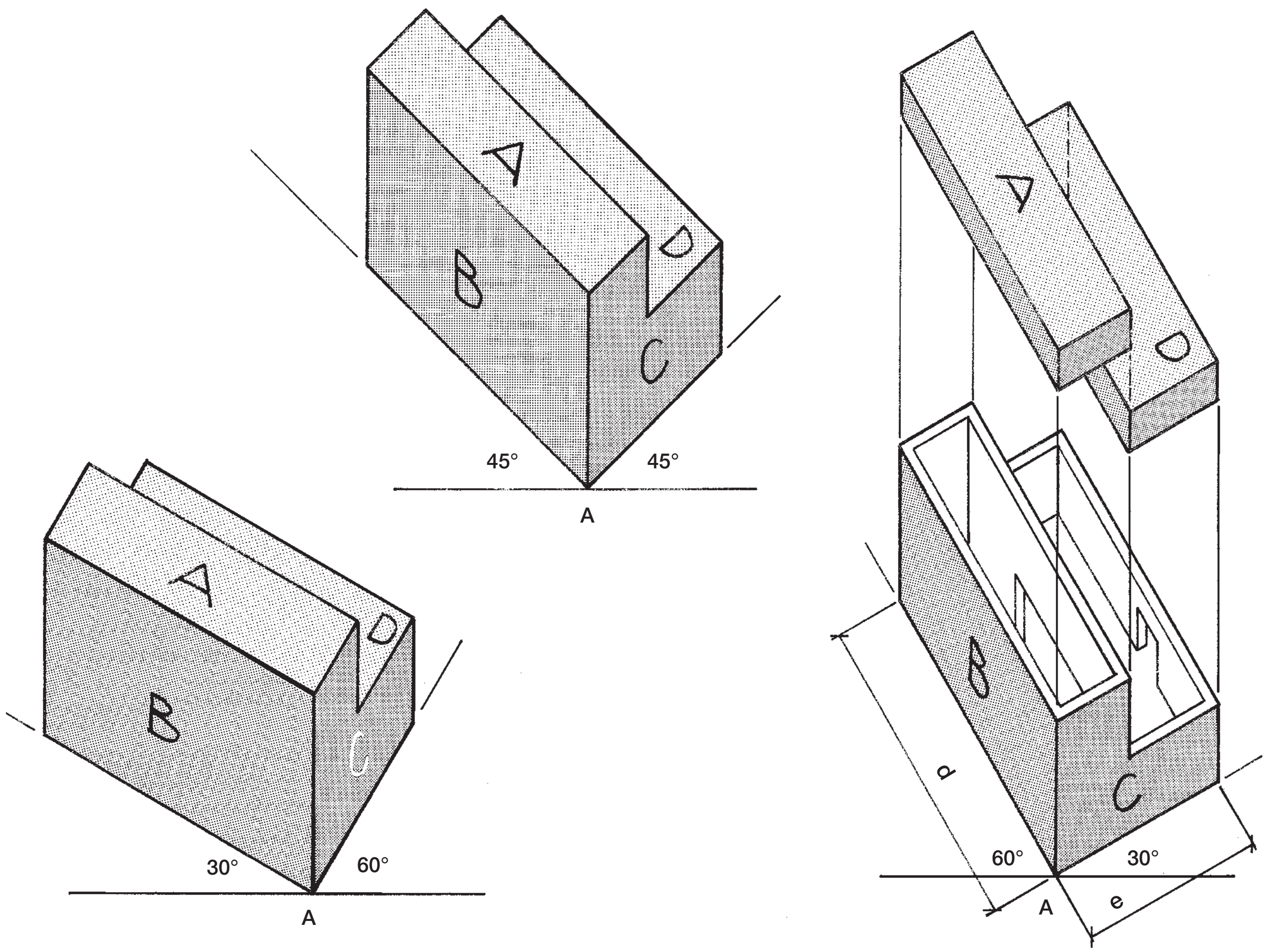


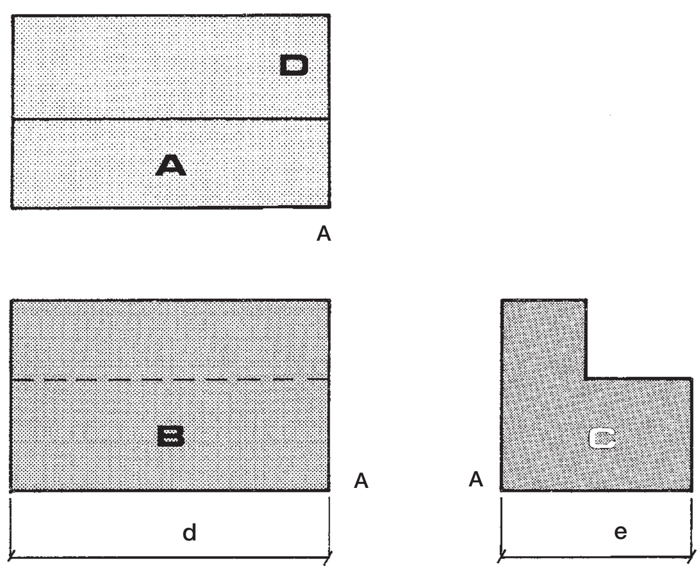
Detail 1



Detail 2

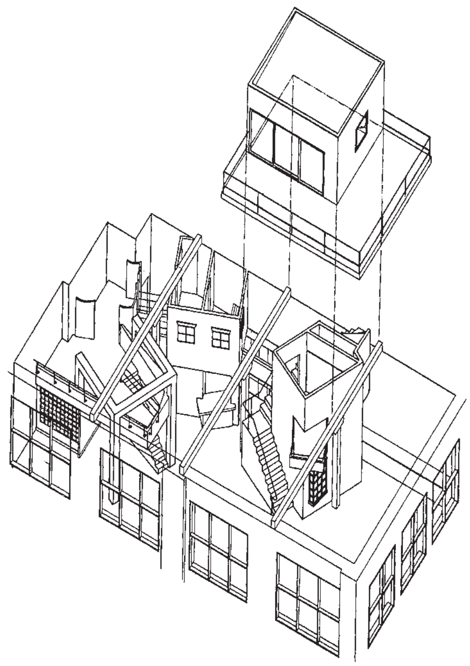
Drawings: Vitra Children Workshop
Weil am Rhein, Germany
Media: SketchUp, Kerkythea, and Photoshop
Courtesy of Alejandro Aravena Architect





The principles for constructing *plan obliques* are the same as those for isometrics. Orthographic lengths are measured along the selected plan oblique axes angles. All vertical lines in the orthographic drawings (elevations) remain vertical and parallel to the z-axis in the plan oblique. The vertical scale (which can be foreshortened if it appears too elongated) and the plan scale are kept the same. The selection of a set of appropriate plan oblique or axonometric angles depends on how the object will be emphasized. At appropriate angles, these drawings become a powerful tool for showing the scale, mass, and bulk of a design.

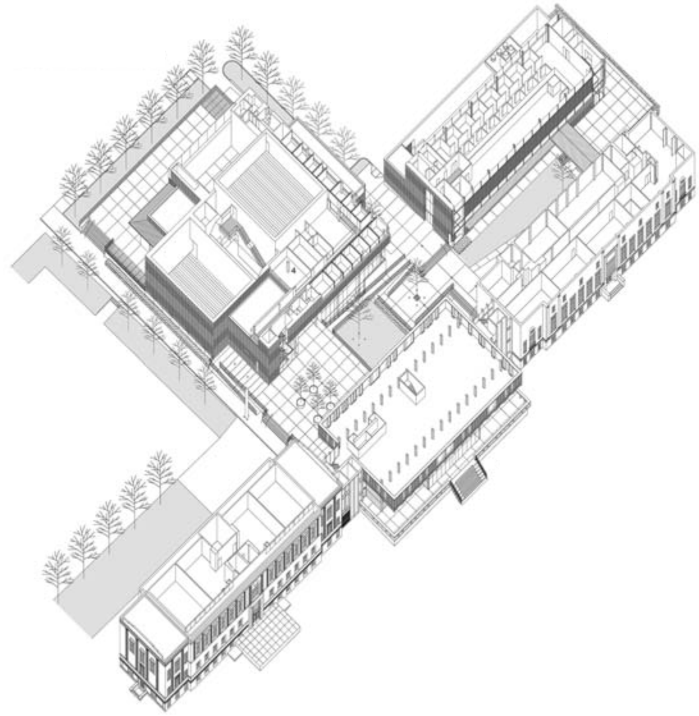
With a multitude of vertical and horizontal elements, it is most efficient to construct each element separately. No matter how complex the building, follow the basic principle of projecting the plan configuration upward to the exact elevation heights. This will result in a volumetric solid based on the plan view.



©Pappageorge Haymes Partner

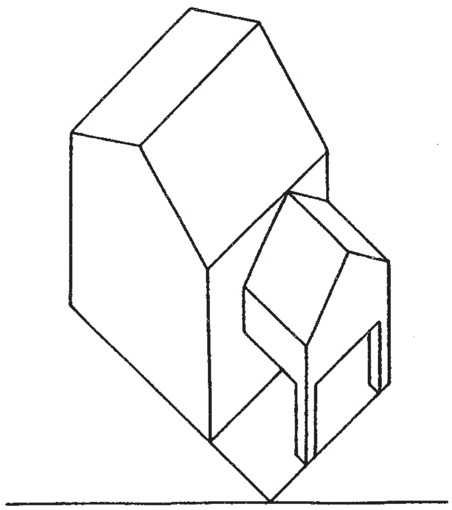
Drawing: Clybourne Lofts
Chicago, Illinois
30" × 40", (76.2 × 101.6 cm), Scale: ¼" = 1'0"
Medium: Ink on Mylar
Courtesy of Pappageorge Haymes Ltd., Chicago, Architects

Removing the roof from a building form helps to reveal the interior spaces drawn at plan oblique axes angles. Plan obliques (either looking down or looking up) provide an unnatural but informative way of observing architecture. They make height changes and volumetric characteristics easy to understand. As a procedural rule, always construct the wall or roof outline first. The two projects shown have slightly different axes angles. Internal elements in the Clybourne Lofts project are skewed at different sets of angles from the exterior walls, but they can clearly be seen along with the stairs. And the Sam Fox School of Design and Visual Arts project clearly spatially delineates all of the rooms in the building, which can be numbered for identification purposes.



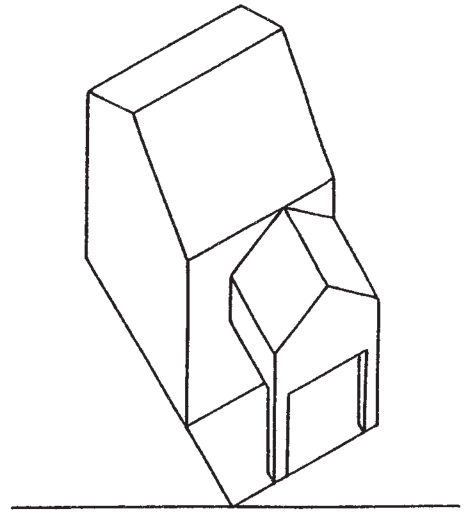
Architect: Fumihiko Maki + Maki and Associates

Drawing: Sam Fox School of Design and Visual Arts
Washington University in St. Louis
Medium: AutoCAD
Courtesy of Maki and Associates Architects



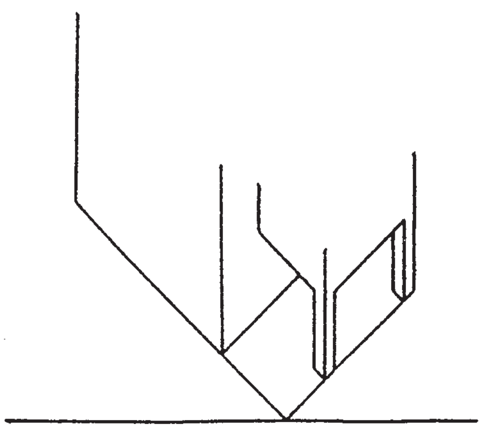
45°–45°

Step 4

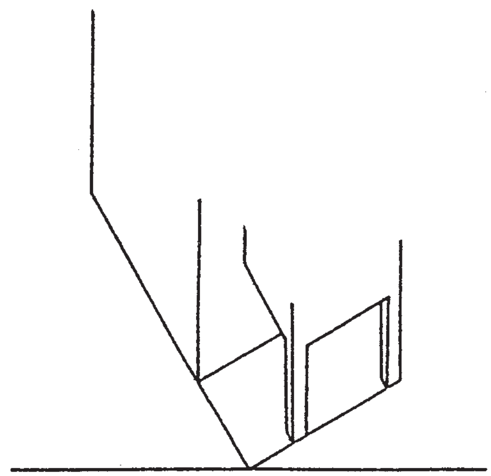


60°–30°

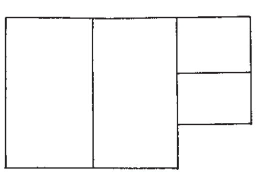
Step 4



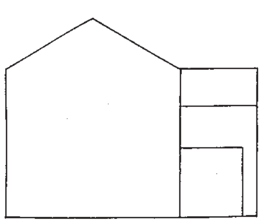
Steps 1, 2, and 3



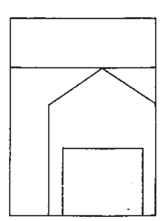
Steps 1, 2, and 3



roof plan



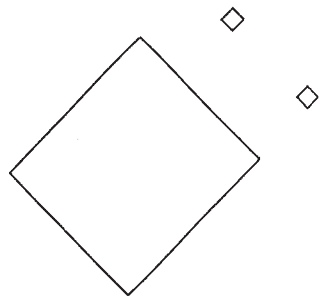
elevation



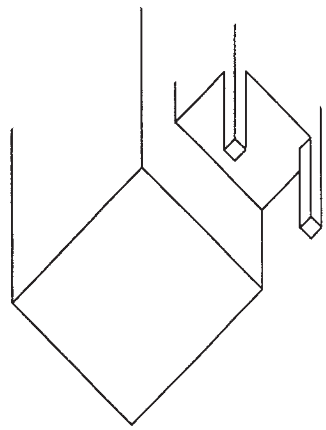
elevation

For exterior forms:

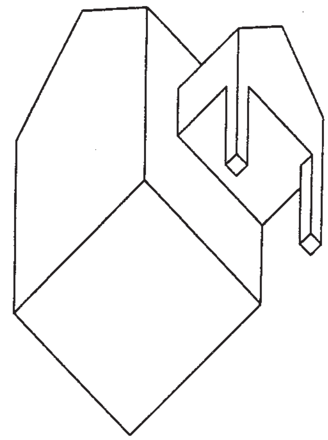
1. Access the plan configuration (roof or floor plan) and one or two elevations, all drawn to the same scale.
2. Place and rotate the plan to any axes angle combination. Construct the true-shape plan view (examples shown are 45°–45° and 60°–30°). For exteriors, some of the sides may not be visible.
3. From the elevations, scale and construct all vertical lines.
4. Complete other true-length horizontal and non-true-length lines (determined by finding their end points, as with isometric drawings).



Draw the overall plan configuration (footprint) of the up view.

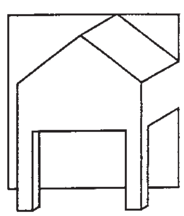


Then draw verticals and true-length horizontals.

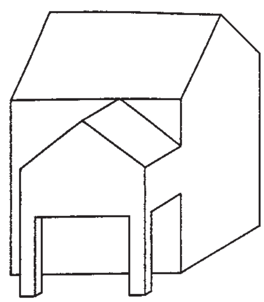


oblique up view

Then draw other non-true-length lines.

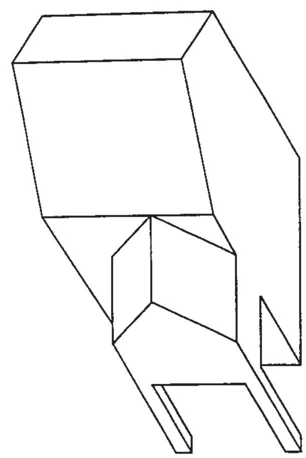


Draw the true-shape elevation view.



elevation oblique

Then draw all parallel receding lines and other nonparallel lines.

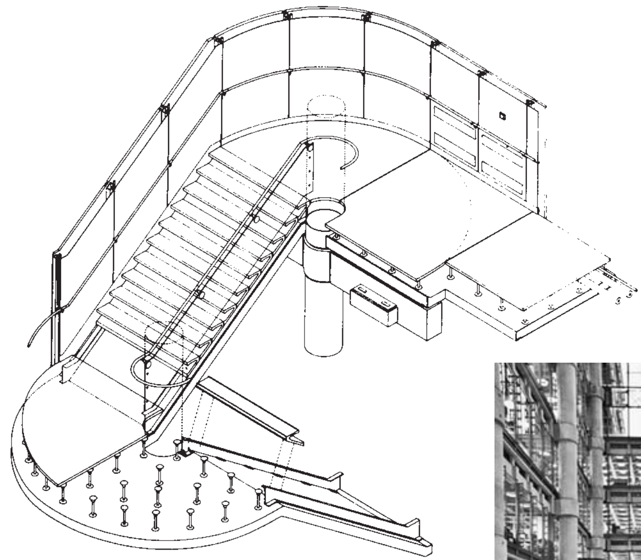


nonvertical z-axis oblique

The procedure is the same as that for other obliques; the vertical axis is swung and drawn left or right of the actual vertical.

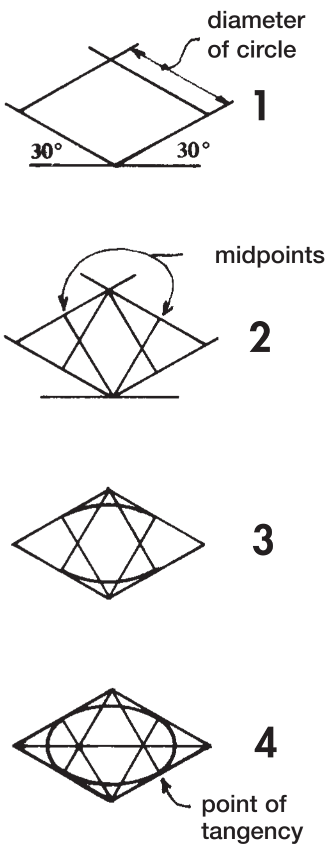
The latter part of this chapter will introduce you to three other types of drawings that are related to the plan oblique. The construction procedure is shown above for these three types, identified as oblique up views, elevation obliques, and non-vertical z-axis obliques.

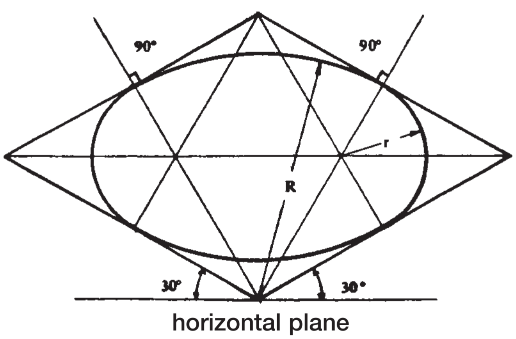
In paraline drawings, all circles appear as ellipses except true circles—those that appear in planes parallel to the picture plane. The four-center ellipse procedure, below, is the most precise method for approximating true ellipses.

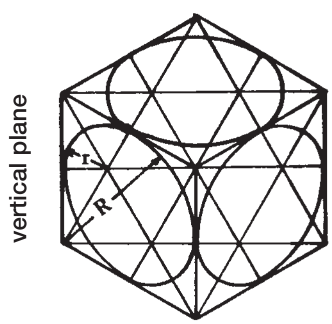


Drawing: Staircase isometric, Lloyd's of London London, England
33" × 45.5" (83.8 × 115.6 cm)
Medium: Rottering pen on tracing
Courtesy of the Richard Rogers Partnership, Architects

Note the numerous escalators in the main central atrium space. See page 70.



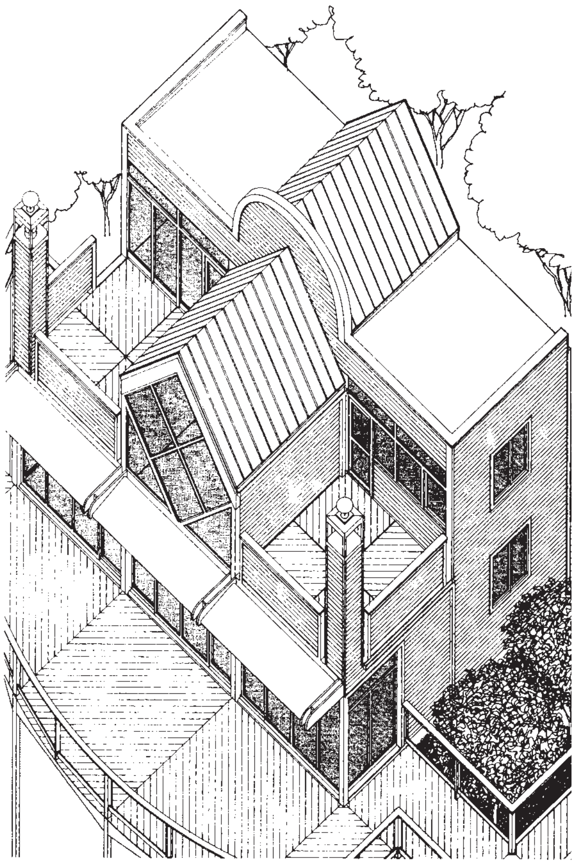




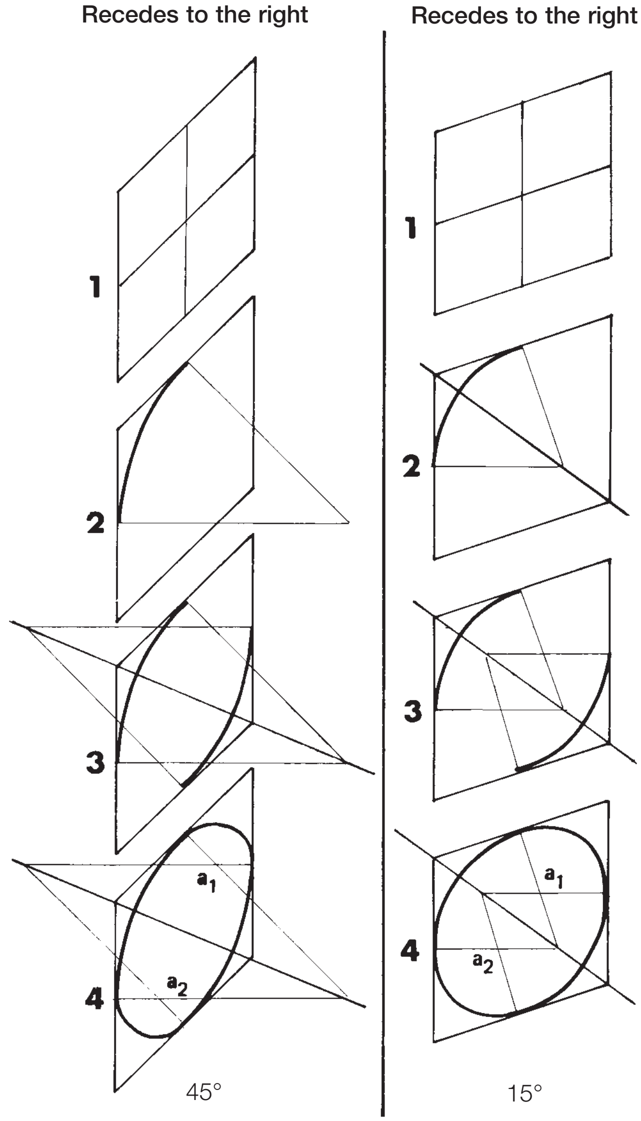
Procedure for the Four-Center Ellipse

1. Draw an isometric square using the desired circle's diameter.
2. Find adjacent side midpoints. Large radius **R** has two centers at the closest corners of the parallelogram. The intersections of the perpendiculars to both opposite sides determine the terminal points of the arc.
3. Construct the arcs.
4. Small radius **r** has two centers at the intersections of the perpendiculars within the parallelogram. These small arcs meet the large arcs to complete the ellipse.

The entire construction can be made with a T-square and 30° × 60° triangle. The same procedure applies for circles in both vertical planes and horizontal planes.



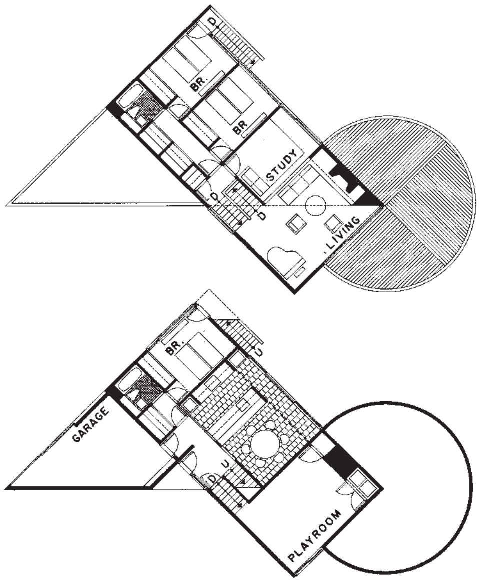
The above semicircle recedes to the left.

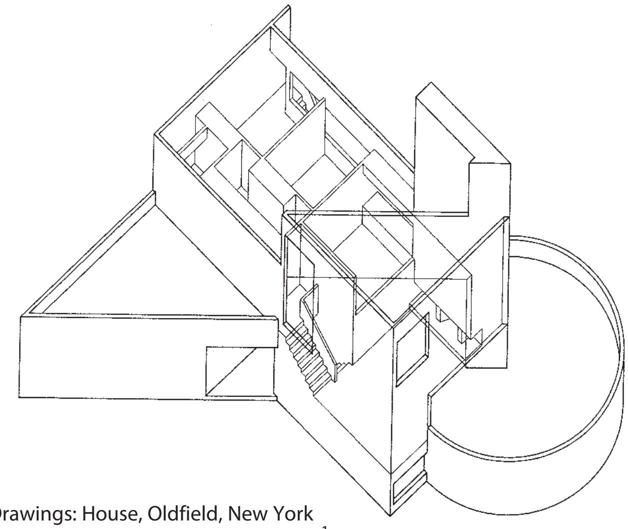


Drawing: Compact House,
Bayview, Lake Pend Oreille, Idaho
18" 3 24" (45.7 3 61 cm), Scale: ¼" = 1'0"
Medium: Ink on vellum
Courtesy of David A. Harris, DHT² Architects & Planners
Reprinted from New Compact House Designs, edited by Don Metz, with permission of Storey Communications/Garden Way Publishing, Pownal, Vermont.

The four-center ellipse method shown on the previous page applies to non-30°–30° axonometric circles in left and right receding vertical planes only. Note that in the horizontal plane, circles are seen in true shape.

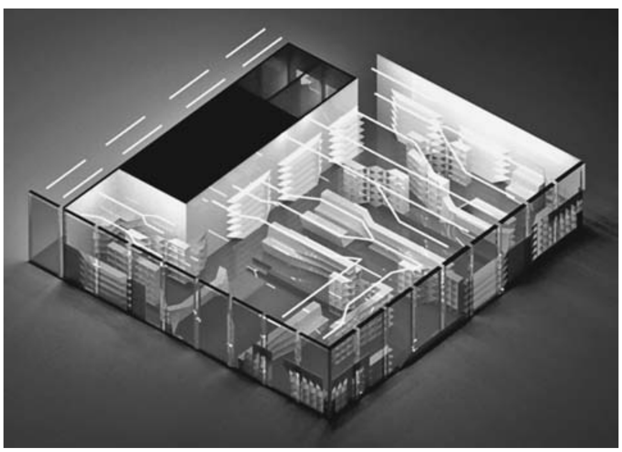
1. Draw a paraline square.
2. Find adjacent side midpoints and construct intersecting perpendiculars. The intersection becomes an arc center.
3. Repeat the process for a symmetrical mirror-image arc on the opposite side.
4. Using points $\mathbf{a_1}$ and $\mathbf{a_2}$, complete smaller arcs to accomplish the total axonometric circle.





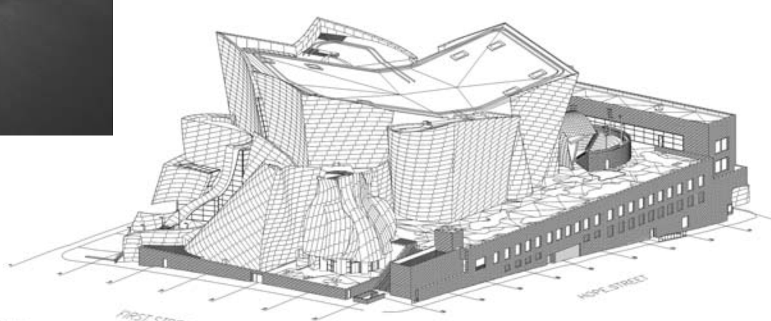
Drawings: House, Oldfield, New York
13.5" × 15.5" (34.3 × 39.4 cm), Scale: 1/4" = 1'0"
Medium: Ink
Courtesy of Hobart D. Betts, Architect

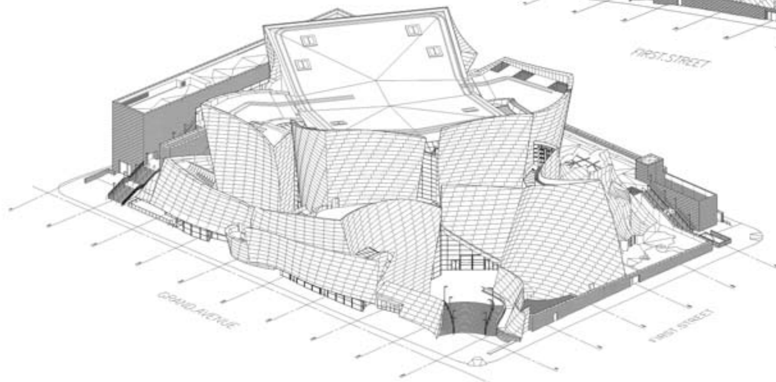
The popularity of plan obliques (interchangeably termed axonometrics) is due to their ease of construction. All geometric shapes are transferred at true size (note triangle, rectangle, and circle above).



A current trend in competition presentations is to show digital drawings approximating an isometric or dimetric view with an interior lighting effect to enhance the definition of interior elements and spaces.

Drawing: Yin Yang Lounge Prototype, New York City
Media: Rhino for modeling; Maxwell for rendering
Courtesy of Enrique Limon of LimonLab

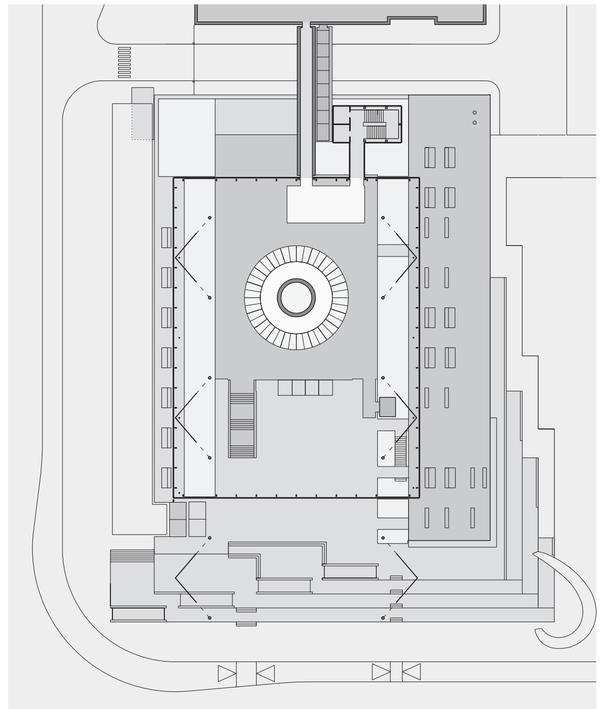


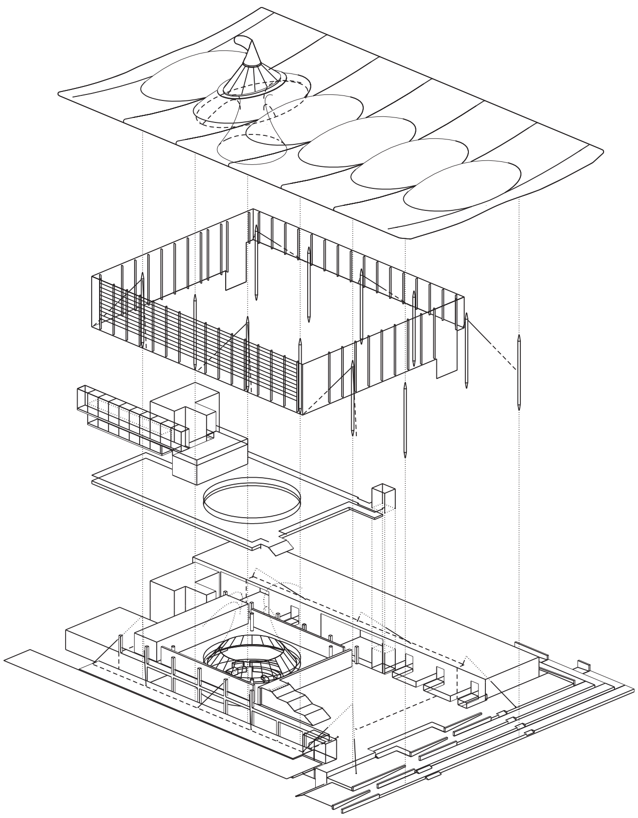


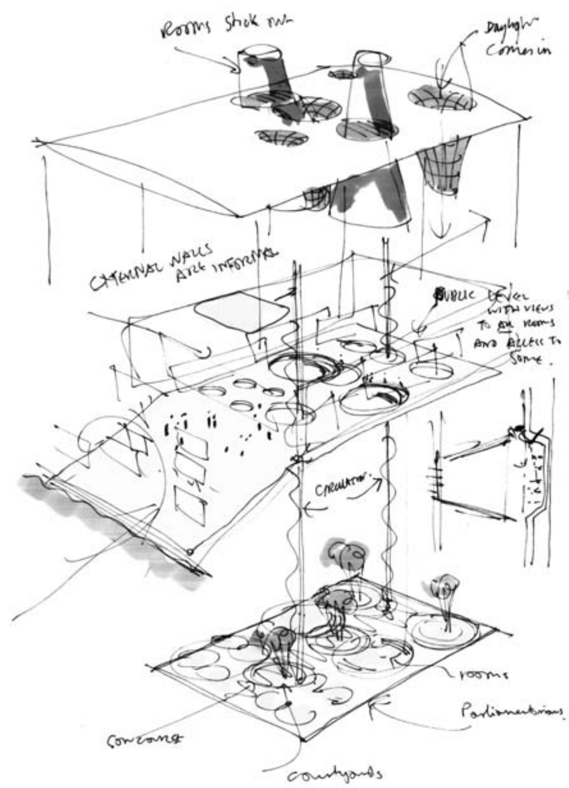
The low angle of these two dimetrics allows one to see the intricate details of the complex roof form. See photo of building at Web p. A-2.

Drawings: Walt Disney Concert Hall,
Los Angeles, California
Medium: CATIA software
Courtesy of Gehry Partners, LLP

The concept of this highly sustainable building was to design a “transparent envelope” looking toward Cardiff Bay and beyond. Natural ventilation is driven by the use of a roof cowl that rotates to the direction of the wind. Steel columns collect rainwater to supply the toilets and wash the windows. Also, the ground is used as a heat source. This building received the 2006 award for sustainability by the BRE (Building Research Establishment).

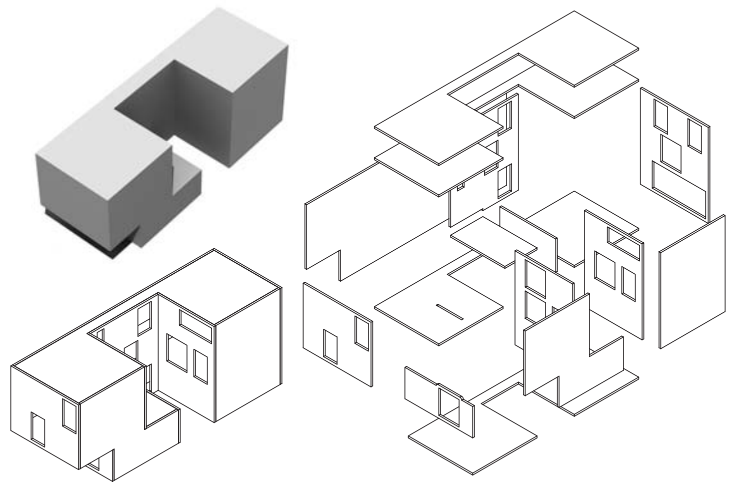






Images: National Assembly for Wales
Cardiff, Wales
Upper left: Bridge Link Level Plan @1:500
Upper right: Exploded axonometric
Medium: Microstation 3-D model “hidden line” render
Lower left: Concept drawing—architectural sketch to explain ideas
Medium: Fiber-tipped colored markers
Courtesy of Rogers Stirk Harbour + Partners

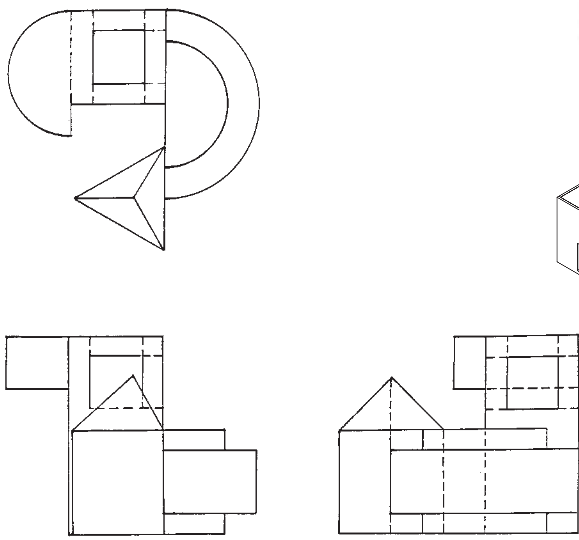
Axonometric drawings, whether they are isometrics or dimetrics, are quite descriptive and popular in their usage. The National Assembly building shows numerous axonometric circles in the conceptual sketch. Note that the refined and sketched circles all appear as elliptical forms.

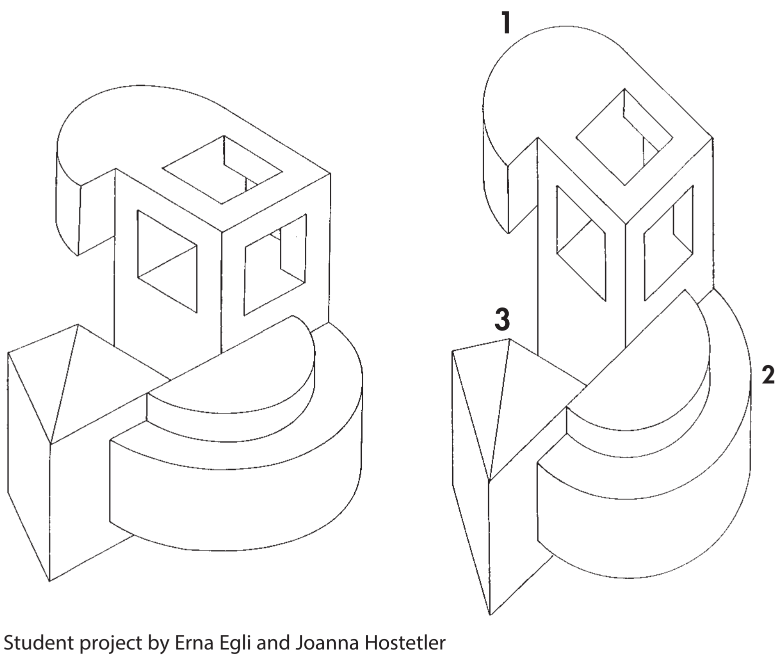


Drawings: Triangle Oval Townhouses
West Sacramento, California
Medium: Adobe Illustrator
Courtesy of Stanley Saitowitz/Natoma Architects

This is a linear *axial* paraline drawing. It has been exploded to reveal more details, such as the nature of the facades we cannot see.

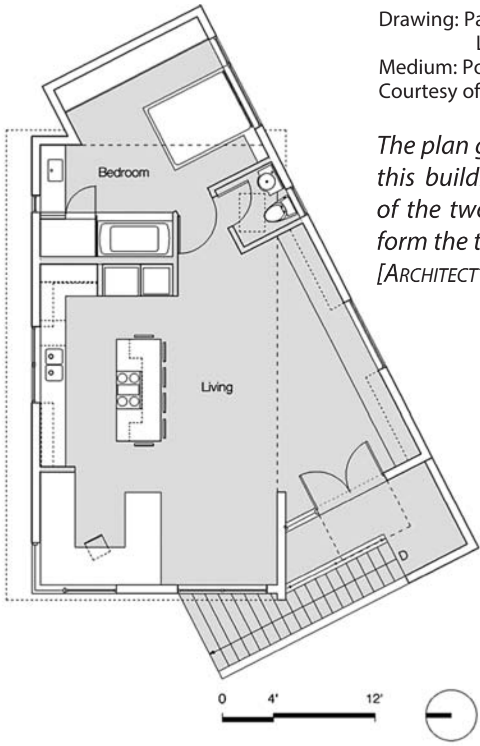
Four type models of 40 brick townhouses are located around a grassy oval. In the tradition of the courtyard house, these townhouses are of subtractive form that are intricately woven vertically. The entire site volume block is sculpted to produce voids of light and air through a subtractive process. In this warm climate, exciting interior voids are created, along with well-lit and shaded exteriors.





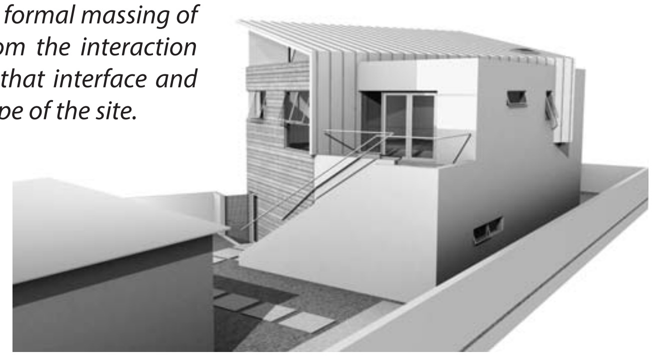
Student project by Erna Egli and Joanna Hostetler
Courtesy of the City College of San Francisco
Department of Architecture

In complex paraline drawings the order of construction can vary, but in general subordinate forms like **1** and **2** are commonly constructed as an addition to the primary form (square-shaped element). Note that the pyramid form **3** shown in this design has three non-axial lines. See if you can identify them. Linear lines in paraline drawings must either be *axial* (parallel to one of the three main axes) or *non-axial* (not parallel to any of the three main axes). When there are nonlinear elements in a design, such as circular and curvilinear shapes, these elements are frequently constructed last. Plan oblique circles, as well as plan oblique curvilinear forms, are always projected upward to their true elevation heights.

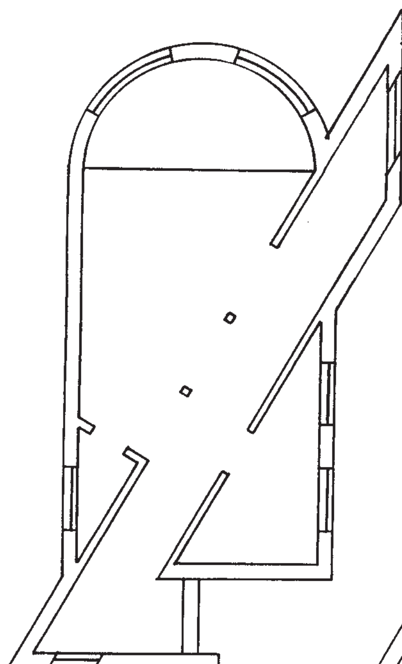


Drawing: Palms Boulevard studio, residence
Los Angeles (Venice), California
Medium: PowerCADD
Courtesy of Dean Nota Architect

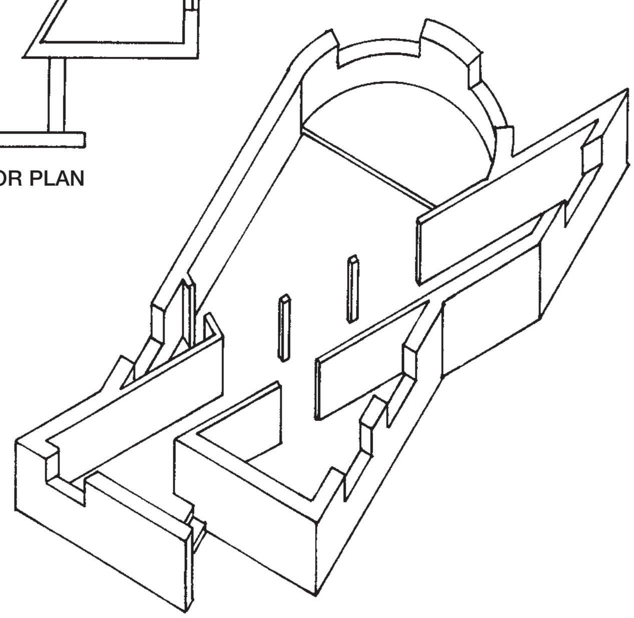
The plan geometry and formal massing of this building evolve from the interaction of the two street grids that interface and form the triangular shape of the site.
[Architect's statement]



Drawings: House, Austin, Texas
Medium: Graphite
Courtesy of Kwok Tsui, an architecture graduate of the University of Texas at Austin



FLOOR PLAN



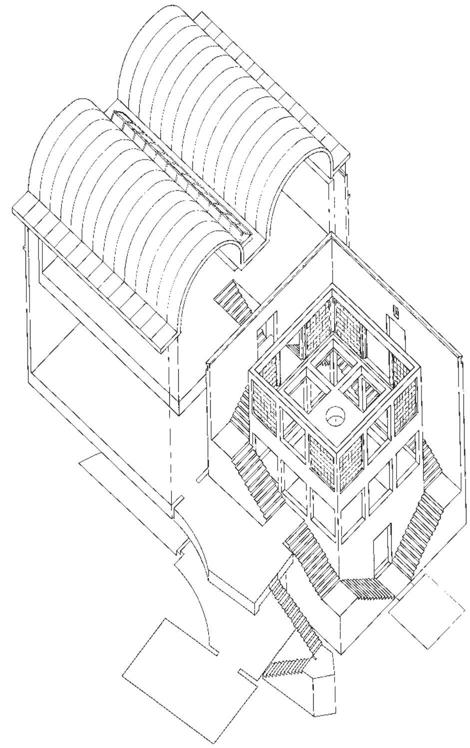
For interior spaces:

1. Access the scaled plan view.
2. Choose desired axes angles.
3. Construct scaled vertical lines to a desired height that best reveals the interior spaces.
4. Construct the true-length horizontal lines.
5. Construct any nonlinear forms.
6. Complete the same procedure for additional axes angles.

When solid elements in a building form intersect at other than 90°, it results in more than one set of plan-oblique axes angles. Construct the primary volume with its one set of axes angles first, then construct secondary volumes.

The interior space of the museum is formed around an eight-meter cubic space, located below an exterior courtyard plaza. Each exhibition space is connected by staircases that surround this plaza. The exterior walls of these staircases are washed by daylight to relieve the confined feeling of being underground.
[Architect's statement]

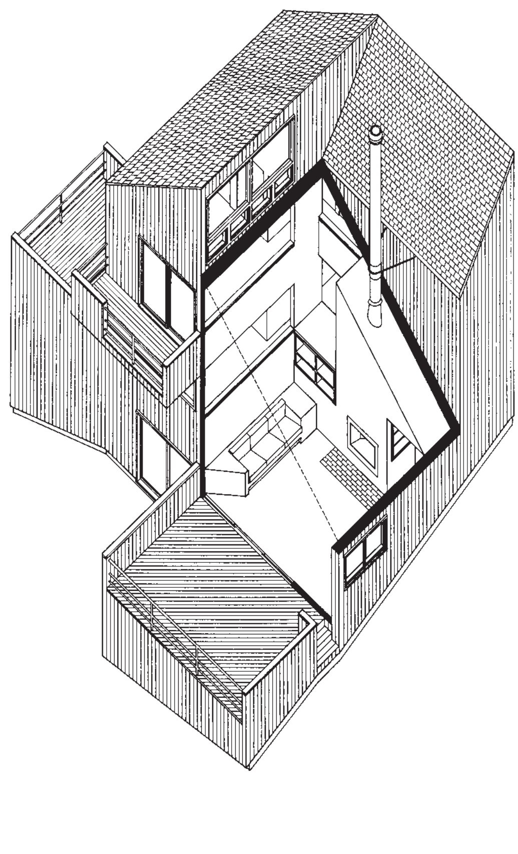
The formal and geometric echoes and counter-points are precise-vault and mountain, glass and stone, circle and square, ground and sky. They lend an almost metaphysical quality to this empty, ordered space, contrasting powerfully with the landscape and the lyrical play of light, form, and art that distinguishes the museum's interiors.
[Statement from "Museum Architecture"]



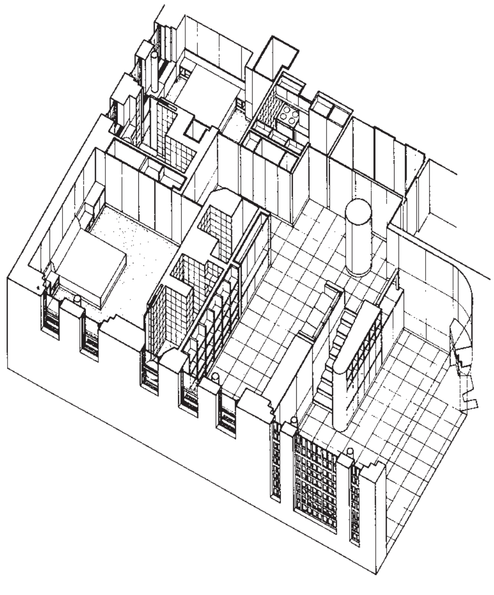
Drawing: Whanki Museum, Seoul, Korea
18" × 24" (45.7 × 61 cm), Scale 1:500
Medium: Ink on vellum
Courtesy of Kyu Sung Woo, Architect

Plan obliques are commonly drawn with axes angles of 30°–60°, 60°–30°, and 45°–45°. The plan in its true shape can be quickly transferred to construct the oblique drawings. The observer's vantage point appears higher than in an isometric drawing. These plan obliques use axes angles of *45°–45°.* Facade details show equally well on either receding axis. Roof configurations and interior spaces are also clearly seen. Partial roof cutaways help to focus on the interior spaces. Obliques lack the size diminishment characteristic of perspectives and thus have the advantage of retaining size, detail, and information.

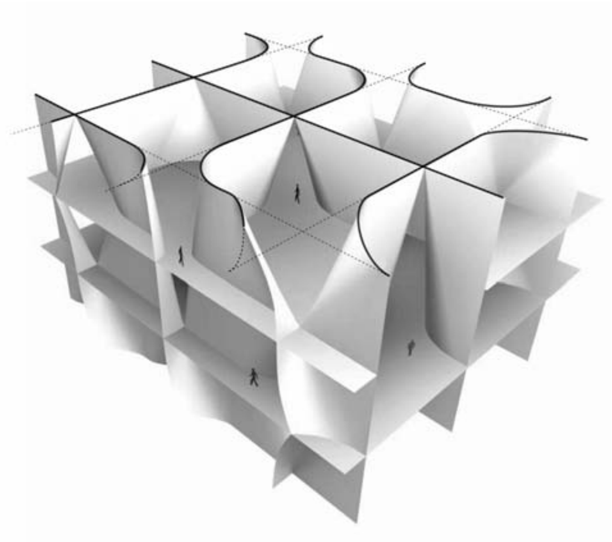
A dashed line indicates the volume removed in the Dattelbaum house. A line with short dashes or a very thin line is the accepted way of showing the *cutaway* portion that is removed.



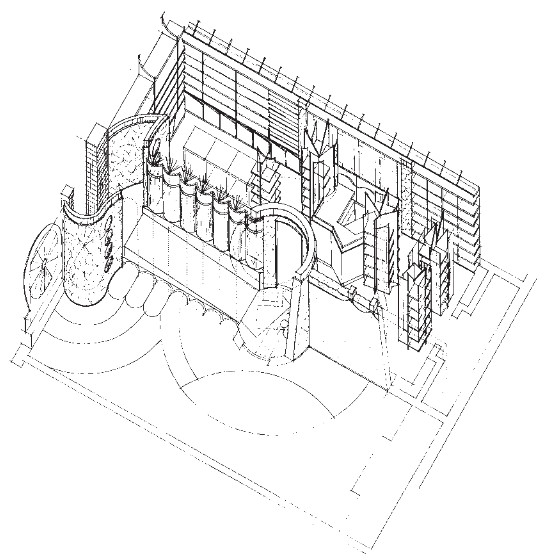
Drawing: Dattelbaum house
Kezar Lake, Center Lovell, Maine
18" × 23" (45.7 × 58.4 cm), Scale: ¼" = 1'0"
Medium: Ink on Mylar
Courtesy of Solomon & Bauer Architects Inc.



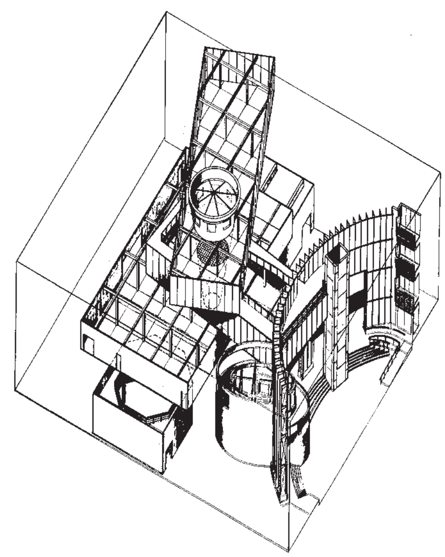
Drawing: Manhattan pied-à-terre, New York City
24" × 36" (61 × 91.4 cm), Scale: ¼" = 1'0"
Medium: Ink on Mylar
Courtesy of Gwathmey Siegel & Associates, Architects



Drawing: University of California, Berkeley Art Museum and Pacific Film Archive
Berkeley, California
Medium: Maya
Courtesy of Toyo Ito & Associates, Architects



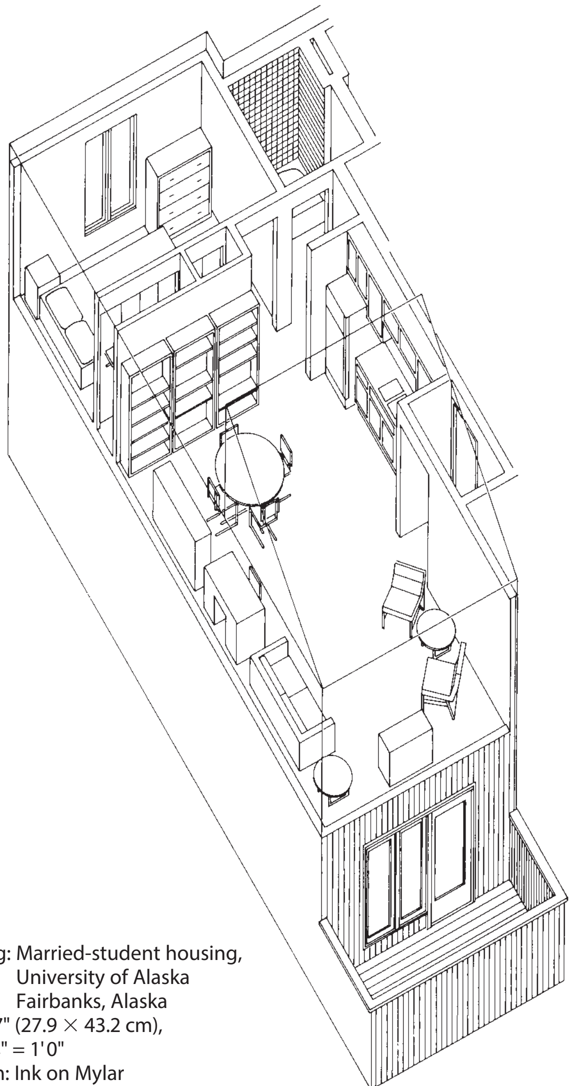
Drawing: Contemporary Arts Center Bookstore and Artware
Cincinnati, Ohio
24" × 36" (61 × 91.4 cm), Scale ½" = 1'0"
Medium: Penal on vellum
Courtesy of Terry Brown Architect



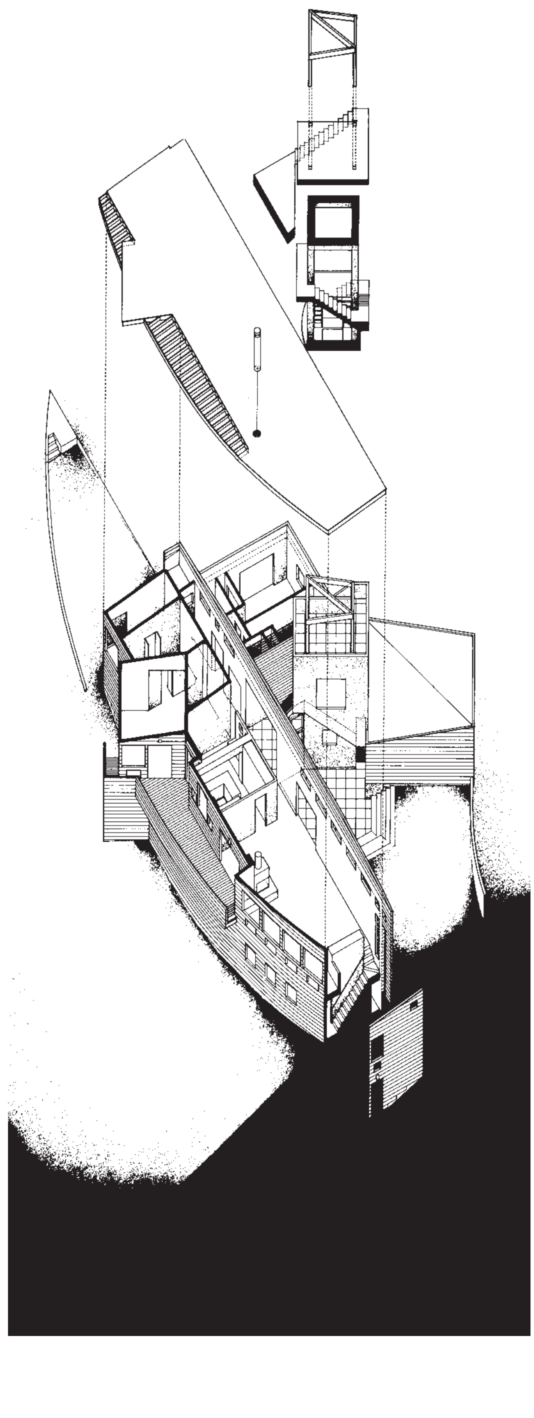
Drawing: Contemporary Arts Center New Orleans, Louisiana
30" × 40" (76 2 × 101.6 cm), Scale: 1⁄16" = 1'0"
Medium: Plastic lead on Mylar
Courtesy of Concordia Architects, New Orleans, Louisiana

With the exception of the interior three-point perspective in the upper right, these plan obliques use axes angles of *30°–60°.* This orientation allows the observer to clearly see interior spaces or roof configurations. Usually the 30° receding facade receives the most emphasis. However, if the facade is not linear, as with the New Orleans Arts Center, then a 60° receding axis can show the more detailed facade. The Cincinnati Arts Center, above, and the Whanki Museum on the facing page show how the interior anatomy of a building can be further revealed by dissecting it both horizontally and vertically—combining two or more section cuts. The Cincinnati building, as with previous cutaway isometric examples, shows how cutaway plan obliques can also reveal a partial footprint (plan view). Note that the Toyo Ito design shows less interior detail but more facade structure compared to plan obliques.

These plan obliques use axes angles of *60°–30°.* Normally the 30° receding facade is emphasized. However, a lot of detail can be shown on the 60° receding facade if part of it is nonlinear. All built-in and movable furniture pieces retain their verticality and true heights. The 60°–30° axes angles allow the observer to see the interior spaces clearly when the roof and parts of both side elevations are removed.



Drawing: Married-student housing,
University of Alaska
Fairbanks, Alaska
11" × 17" (27.9 × 43.2 cm),
Scale: ¼" = 1'0"
Medium: Ink on Mylar
Courtesy of Hellmuth, Obata,
and Kassabaum, Architects



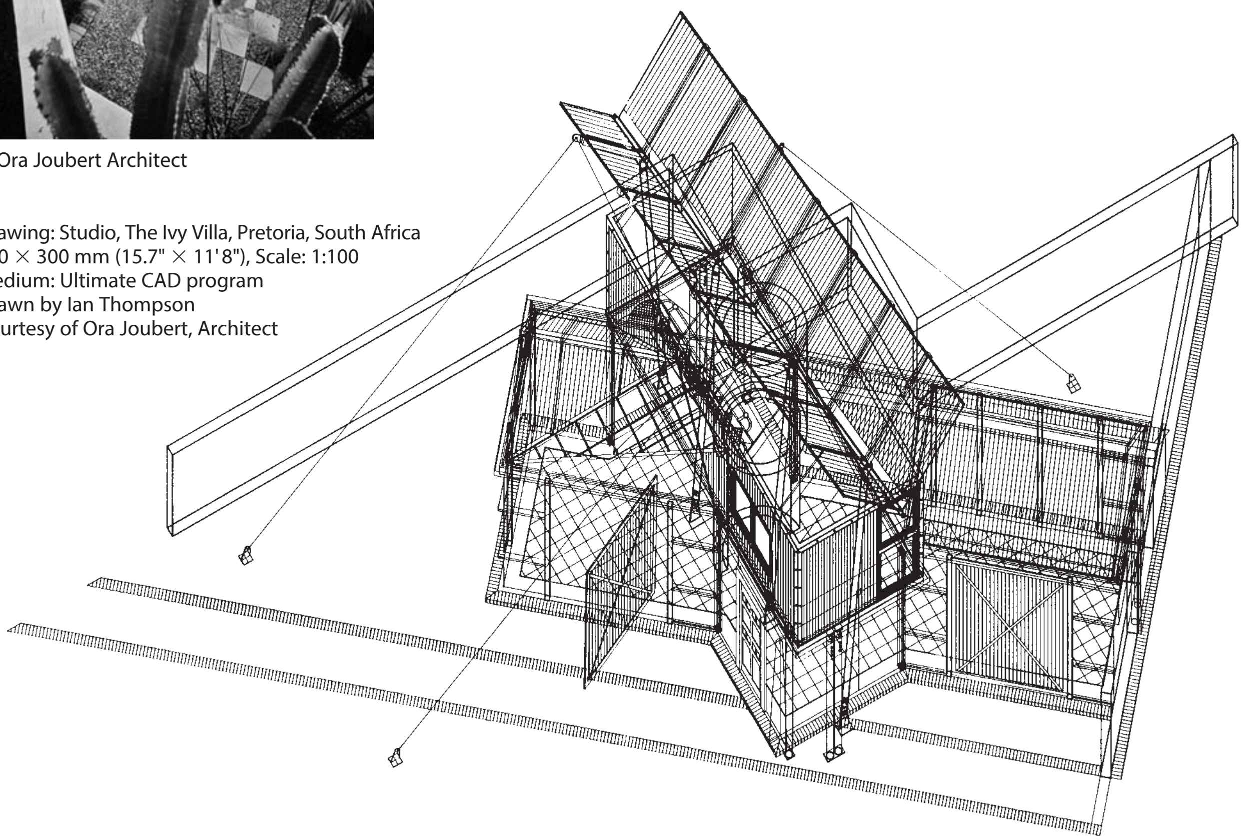
Drawing: Waldhauer residence, Woodside, California
20" × 48" (50.8 × 121.9 cm), Scale: ½" = 1'0"
Media: India ink and airbrush on Mylar
Courtesy of House + House, Architects Mark David English,
Architectural Illustrator

© Alan Weintraub, photographer

© Ora Joubert Architect

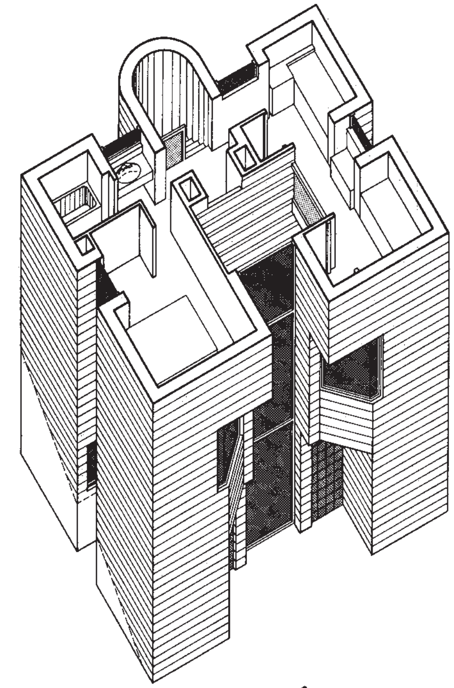
© Ora Joubert Architect

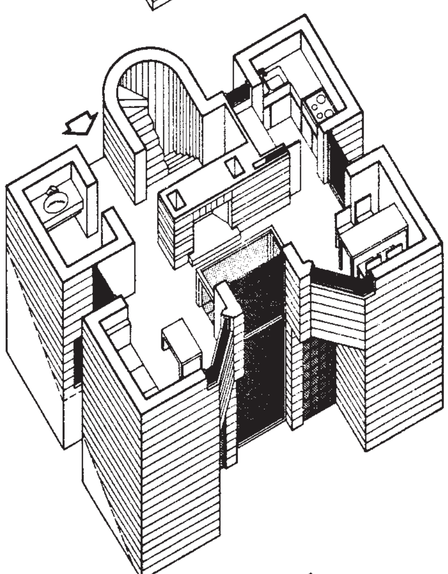
Drawing: Studio, The Ivy Villa, Pretoria, South Africa
400 × 300 mm (15.7" × 11'8"), Scale: 1:100
Medium: Ultimate CAD program
Drawn by Ian Thompson
Courtesy of Ora Joubert, Architect

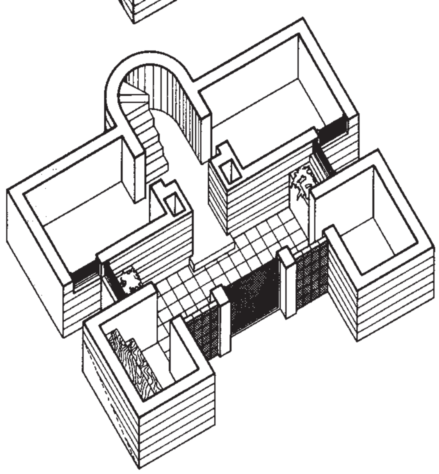


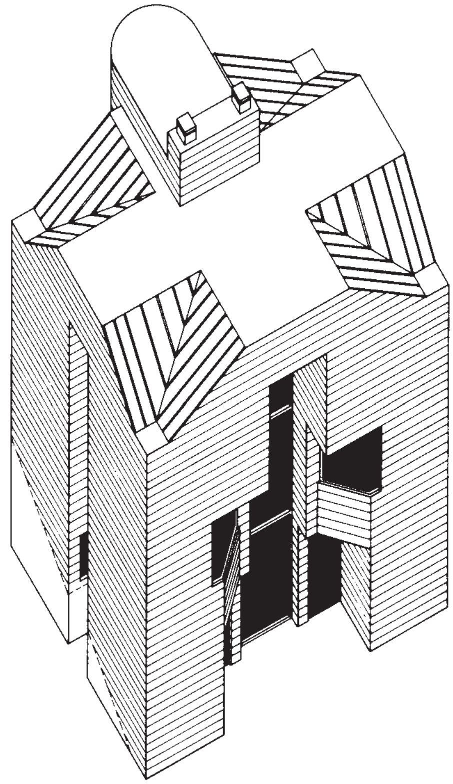
This drawing has one structure with axes angles of 9°–81° and another structure with axes angles of 60°–30°, The intersection of solid elements will always require two (dual) or more sets of plan oblique axes angles. Note that the structure with the 9°–81° orientation shows details on its 9° facade extremely well, whereas its 81° facade is barely visible. Also shown above are structural cables, which are not true length in the plan oblique. All drawn elements are relatively transparent. With the design of more high-tech buildings, the drawing of dual-axes and tri-axes plan oblique angles has become commonplace.

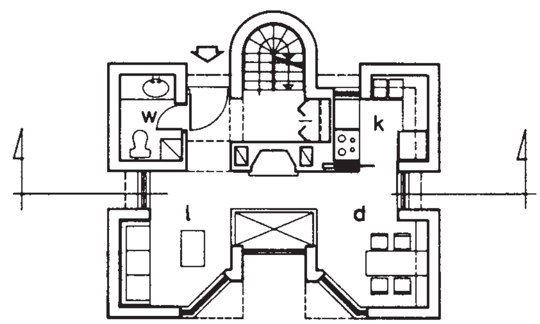
The original house, an eclectic villa built shortly before the Anglo-Boer War (ca. 1910), is a well-preserved example of its type. The stables is a balloon structure of timber and corrugated iron, a worthy example of late-nineteenth-century industrial building technology. The new studio (1995) is a careful recycling of the century-old stables. The studio has a butterfly roof inverting the pitch roof of the stables. This inverted roof accentuates its structural independence from walls through slanted steel columns (held in check by cables), amplifying the differing means of support and construction.
[Architect's statement]







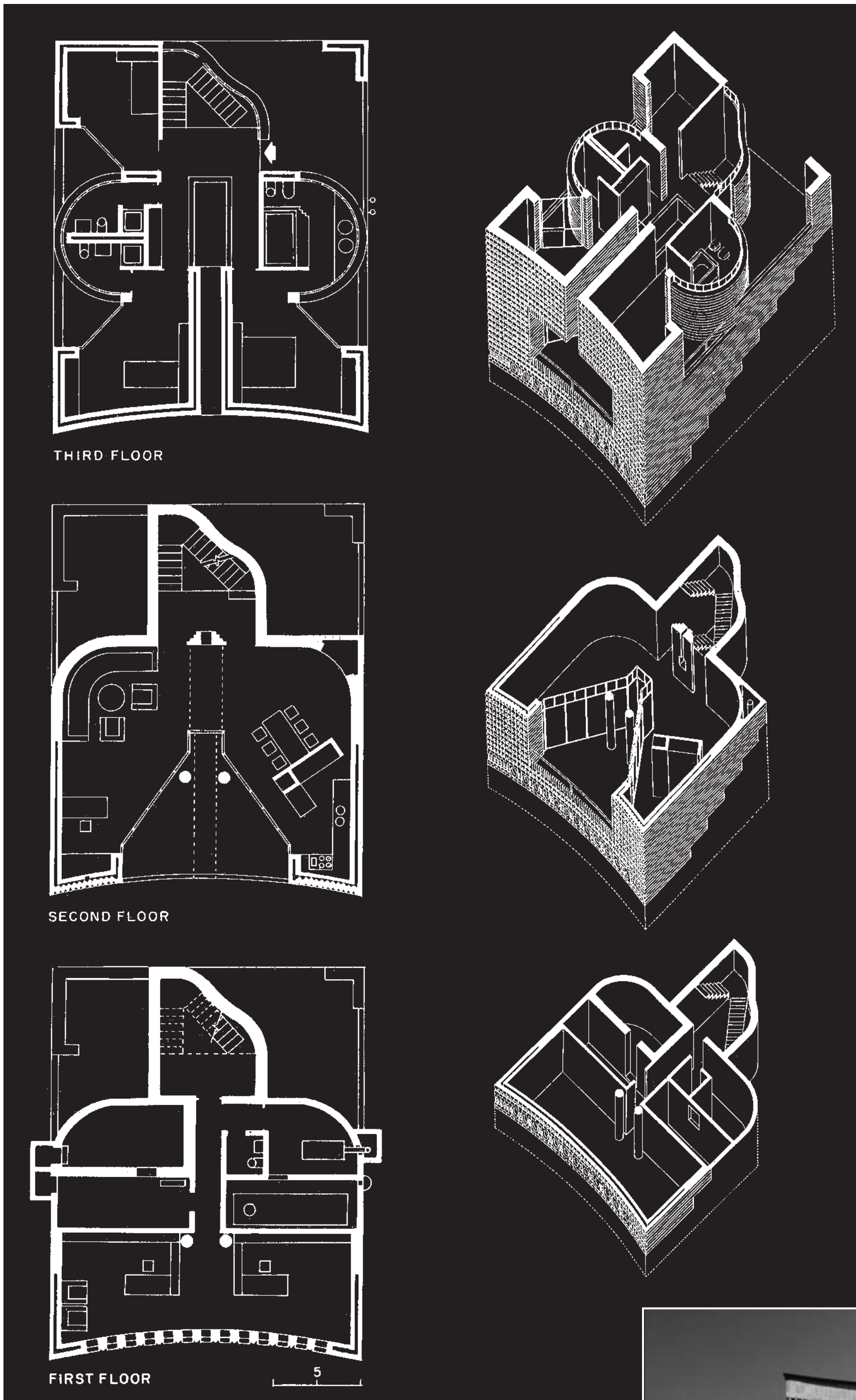




For multistory building types, the plan oblique can be effectively used for showing an *incremental growth* (layering) sequence of floor levels. Growth can begin with the first-floor plan shown at the ground plane or it can begin a few feet or meters above the ground plane, as in this example and the one on the following page. These drawings become an efficacious visual means of conveying how the entire building shell relates to the interior spaces.

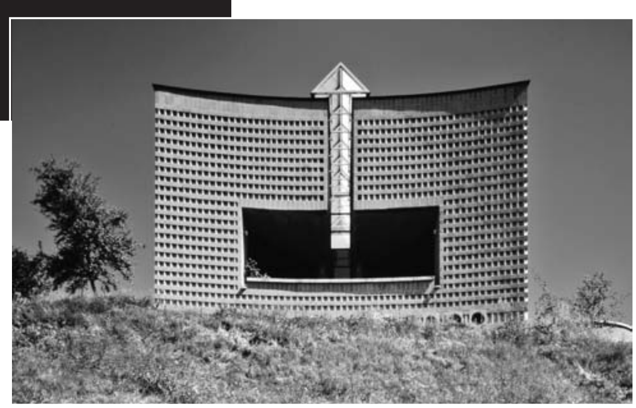
Drawings: One-family prototype house, Toronto, Ontario, Canada
Courtesy of G. Nino Rico and Giancarlo Garofalo
Reprinted from *The Compact House Book,* edited by Don Metz, with permission of Storey Communications/Garden Way Publishing, Pownal, Vermont

Plan obliques illustrating incremental growth can clarify details in plan view cuts taken at different locations. Axes angles of 45°–45° were used in the example to the left, whereas 60°–30° angles were used in the example on the facing page.

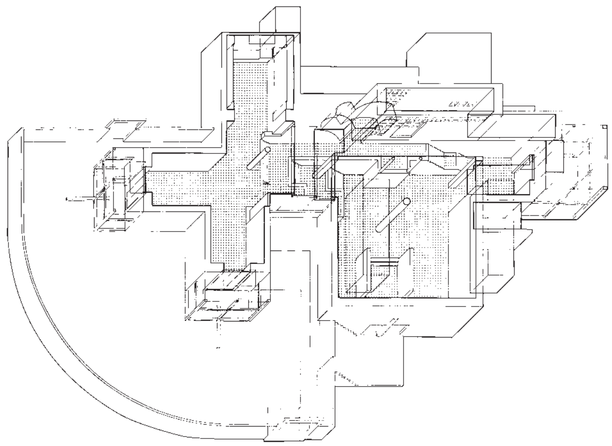


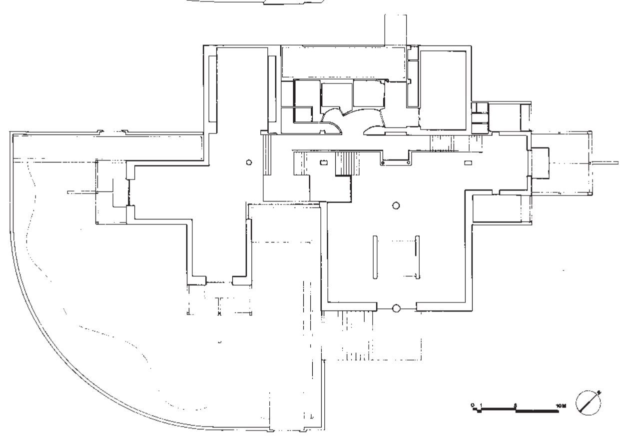
This house is characterized by an overall simple geometric form constructed with local concrete blocks, the openings of which have been detailed in glass and steel. There is a feel of the monumentality of the man-made with respect to the natural landscape; the building is very site-specific. It is a well-crafted spatial volume for modern living that was carved out within a very disciplined exterior.

Drawings: Single-family house in Morbio Superiore, Switzerland (1982–1983)
Photographer: Alo Zanetta, Chiasso, Switzerland
Architect: Mario Botta, Lugano, Switzerland



© Alo Zanetta

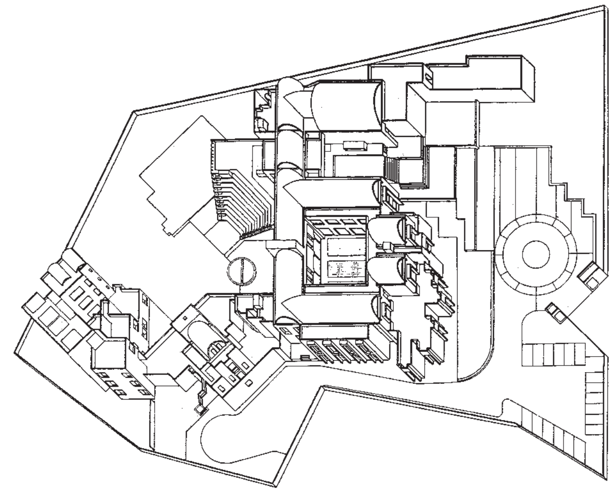


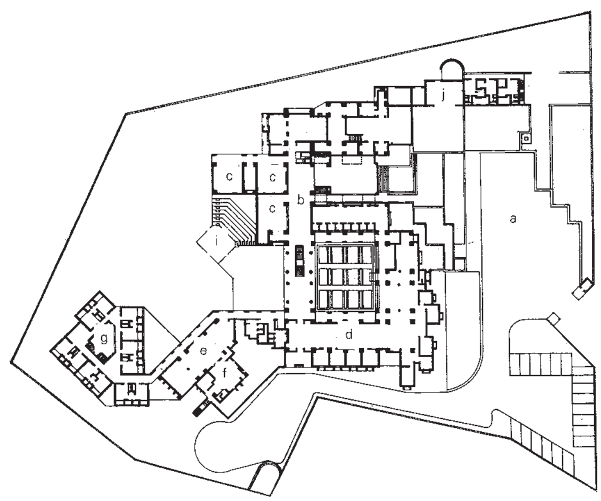


Architect: Fumihiko Maki +
Maki and Associates

Drawings: Iwasaki Art Museum, Kagoshima Prefecture, Kyushu, Japan
Axon: 23.2" × 16.9" (59 × 43 cm)
Plan: 28.3" × 197" (72 × 50 cm), Scale: 1:100
Medium: Ink on vellum
Courtesy of Fumihiko Maki and Associates, Architects

Set in a garden of a resort hotel, this building composed of three structures is conceived as a villa-like complex with each structure forming a common language and a comparable spatial expression of late-modern architecture incorporating light and dark as well as Mediterranean and traditional Japanese regional images. It houses a succession of pavilion-like exhibit spaces, which are articulated by skylights. [Statement by Professor Hiro Hata]

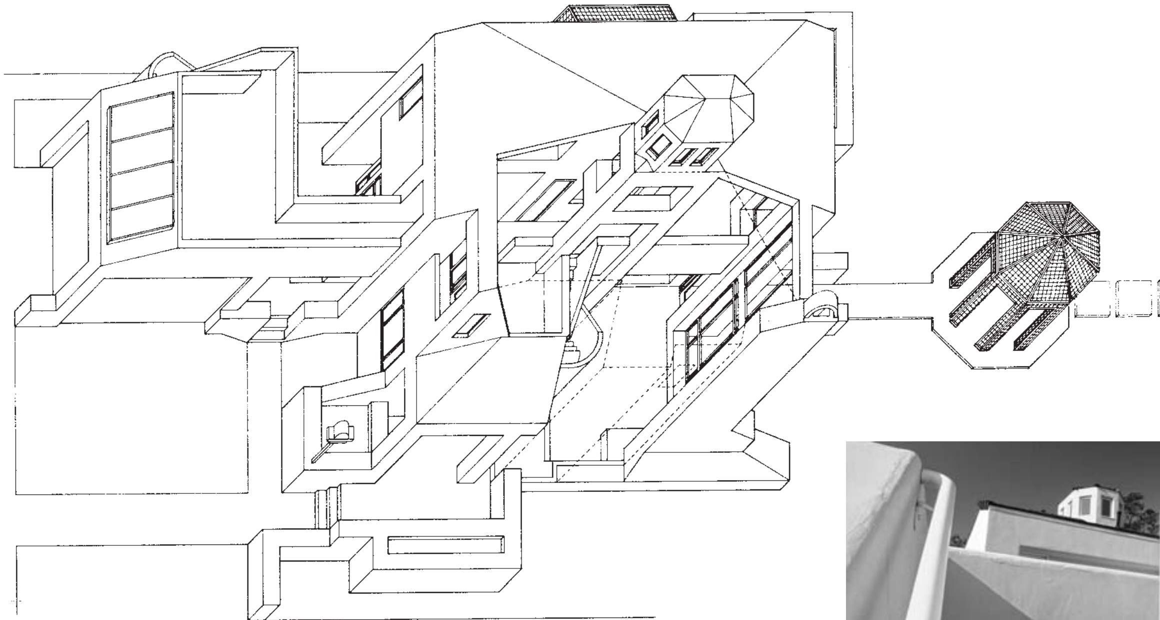




ground-floor plan

Drawing: Gandhi Labour Institute, Ahmedabad, Gujarat, India
26" × 39" (66 × 99 cm), Scale: 1:200
Medium: Ink on Gateway (tracing paper)
Courtesy of B. V. Doshi, Architect

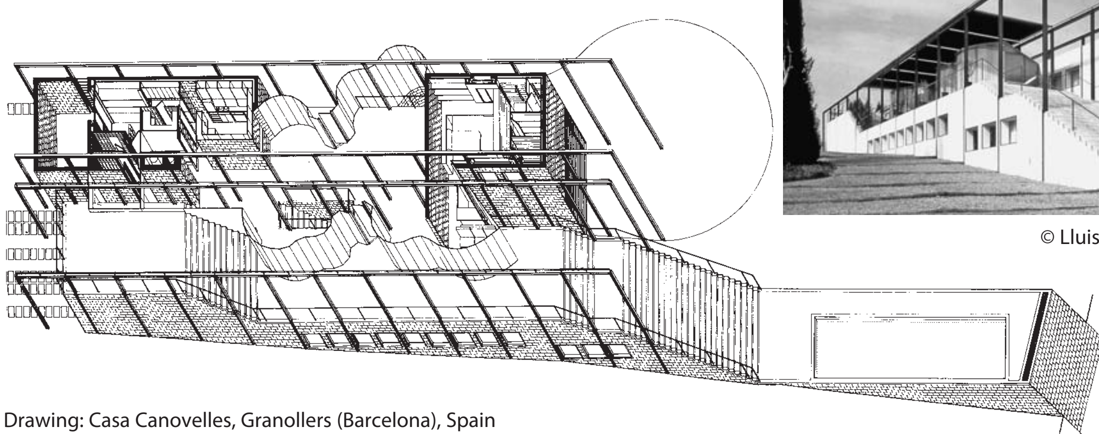
A variation to the typical plan oblique is one in which the z-axis thrusts the vertical planes upward (most commonly at 45° or 60°) from the horizontal. This gives the observer a vantage point that is almost directly overhead. This method has the advantage of revealing more of the important horizontal planes. However, distortion appears greater than in the typical plan oblique. The plan oblique with a plan sectional cut (above left) retains the plan geometric configuration better than does the plan oblique (above), which shows a site plan view of the roof configuration.



Drawing: Karlstad residence, Orange Park Acres, California
36" × 24" (191.4 × 61 cm). Scale: 1/16" = 1'0"
Medium: Ink on vellum
Courtesy of Dougherty & Dougherty Architects LLP

© Dougherty & Dougherty Architects LLP

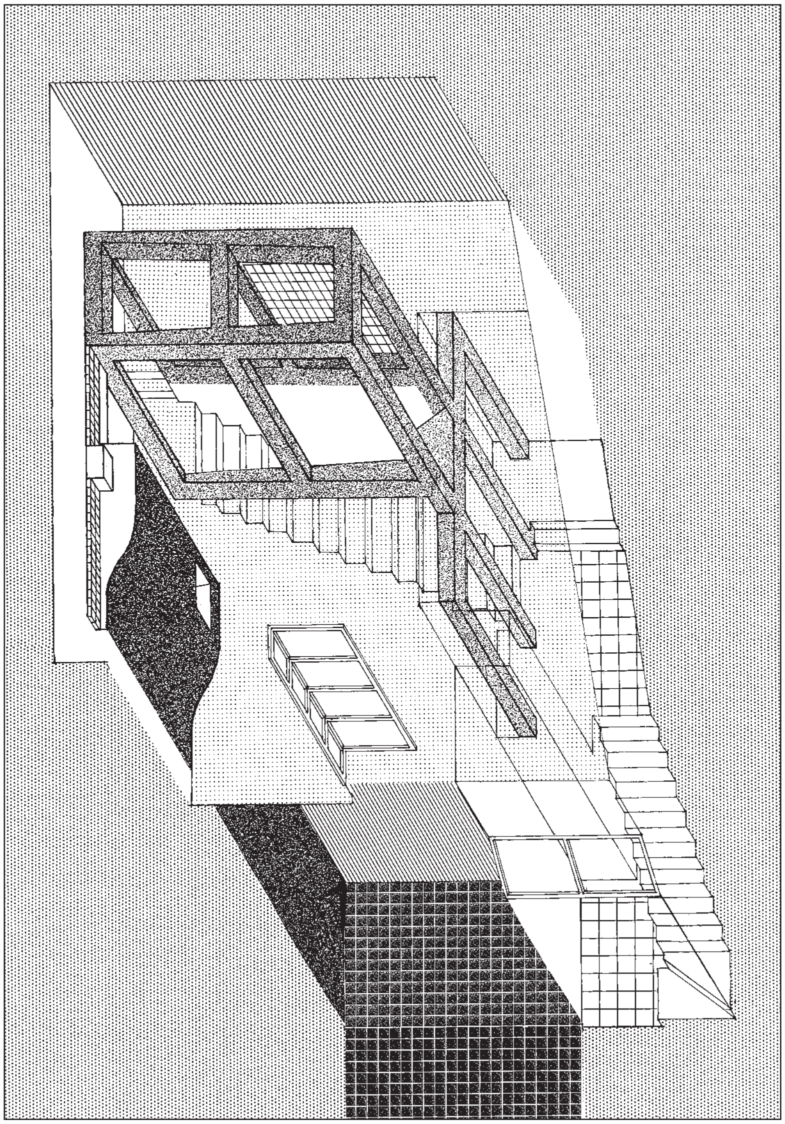
Grounded in a strong axial plan that reaches out into the surrounding landscape, the design imagines a series of interior and exterior rooms linked to the central vertical circulation element. Layered public and private spaces provide open access to light, air, and the wooded grounds while providing privacy and a feeling of retreat. Volume and framed views are utilized to expand the compact plan. [Architect's statement]



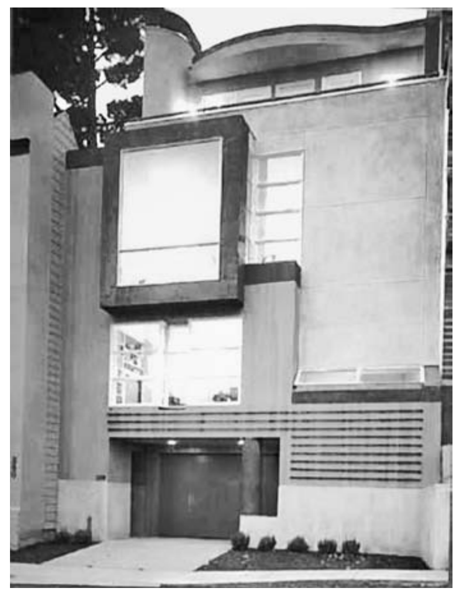
Drawing: Casa Canovelles, Granollers (Barcelona), Spain
26.4" × 54.3" (67 × 138 cm)
Medium: Ink on vellum paper
Courtesy of MBM Arquitectes
Josep Martorell, Oriol Bohigas, and David MacKay

© Lluis Casals Fotografia

The nonvertical z-axis can be swung either left or right of the vertical direction. These examples show that vantage points from either direction are equally effective: the choice is based on the viewing information to be conveyed.



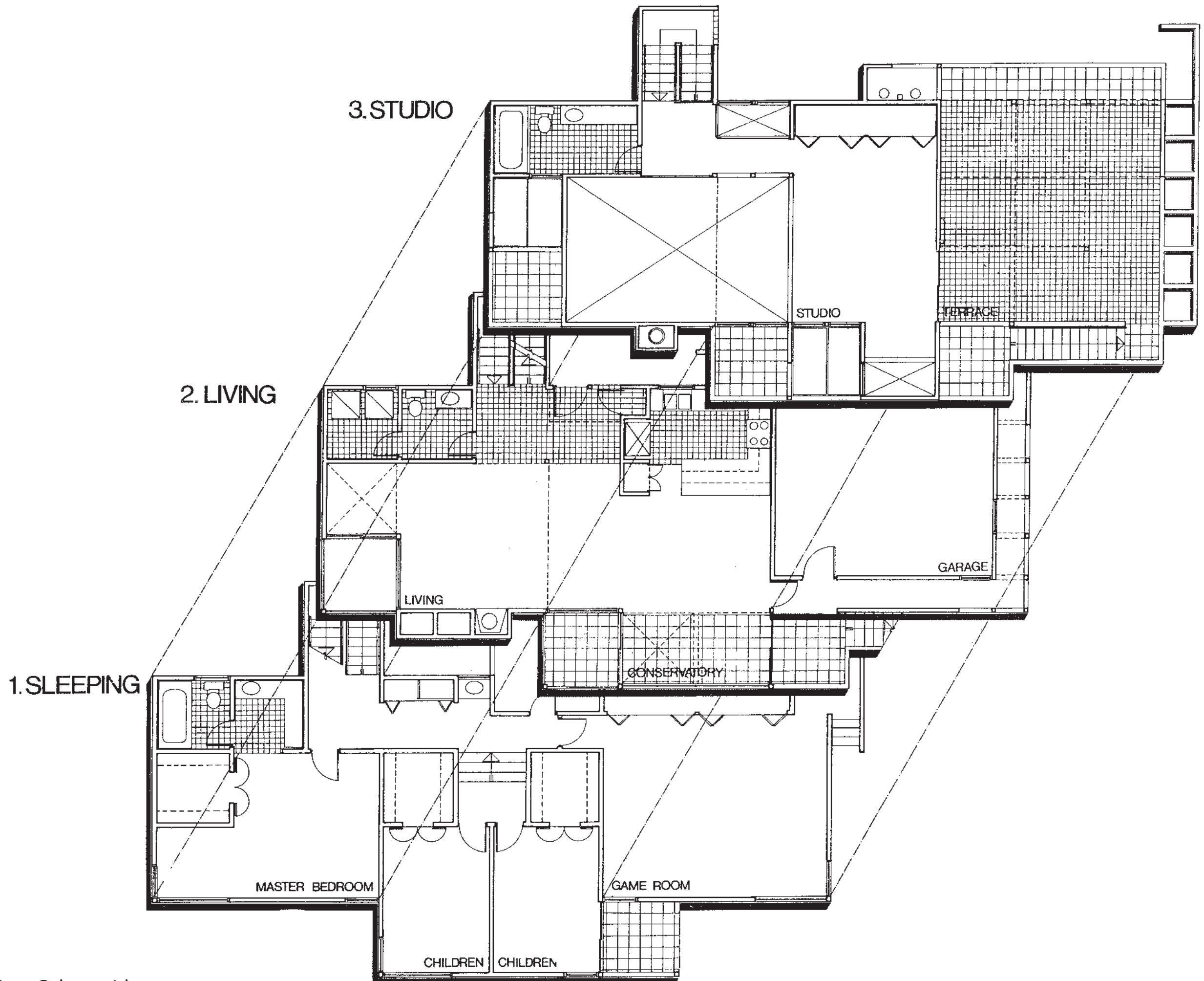
Drawing: Curtis House (1988)
San Francisco, California
$10\frac{5}{8}$" × 15" (27 × 38.1 cm), Scale: ¼" = 1'0"
Medium: Pen, Rapidograph ink, and shading films
Courtesy of James Shay, FAIA Architect



The primary spatial organization device in this house is the dark framework indicated in the drawing by line and shade. Secondary building elements, such as planes and shaded stairs, are indicated by line and film to establish context. The drawing speaks to interior and exterior relationships. The exterior forms of the Curtis house serve as a stepped introduction to a row of simplified, semi-modern townhouses on Upper Terrace. Behind them, the interior layout responds to the desire to create interesting circulation spaces, retains the building's two-unit zoning in case the owners wish to have a second unit in the future, and orientates spaces hierarchically with regard to the great views from the house. As the drawing indicates, spaces are delineated in a modernist manner, with parallel planes and column patterns. The drawing clarifies relationships for architects. Unfortunately, it was a long time before the client could make heads or tails of it. So, during the design process, the architect used more conventional interior perspectives and a model to show the client something of what the building would become.
[Architect's statement]

Paraline drawings, more than any other type of drawing, can be utilized to explore a large number of viewpoints. Perspective drawing, although quite descriptive of pictorial depth, does not provide as many options. This page and the facing page, which shows stacked layers of floor plans, display just two of the many options and variations available for expressing a design with paraline oblique views.

NON-VERTICAL Z-AXIS STEPPED PLAN

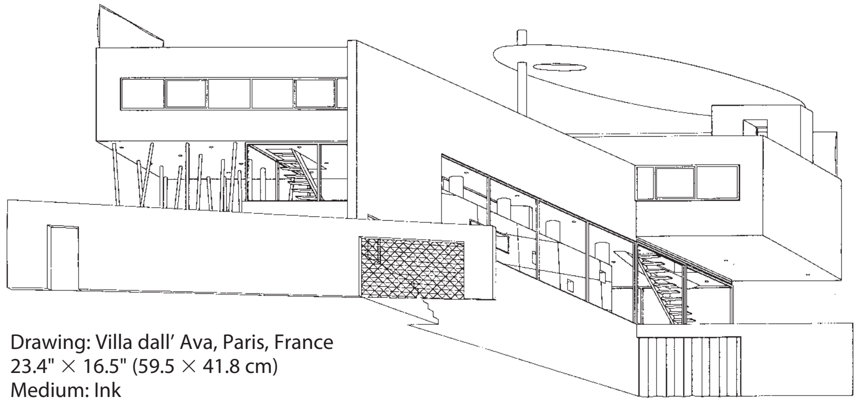


Drawing: Galor residence,
Los Angeles, California
28" × 28" (71.1 × 71.1 cm), Scale: ¼" = 1'0"
Medium: Ink
Courtesy of John V. Mutlow, FAIA, Architects

This hillside residence is designed on a 20' x 20' grid of caissons with a 6'8" x 6'8" sub-grid/module. The stepped and overlapping plans articulate the vertical relationship between the residence, the connective vertical volumes, and the third-floor artist's studio and rooftop terrace. The shaded edge of the floors simultaneously reinforces the plan edge whilst creating a three-dimensional image.
[Architect's statement]

© John V. Mutlow FAIA

This elevation oblique of a house recedes down to the right. The result is a worm's-eye view looking up. Note that interior details can easily be seen through the receding facade. This house high up on a hill was conceived as a glass pavilion with two hovering perpendicular apartments shifted in opposite directions to exploit the panoramic view of Paris. A swimming pool on the roof joins the two apartments.

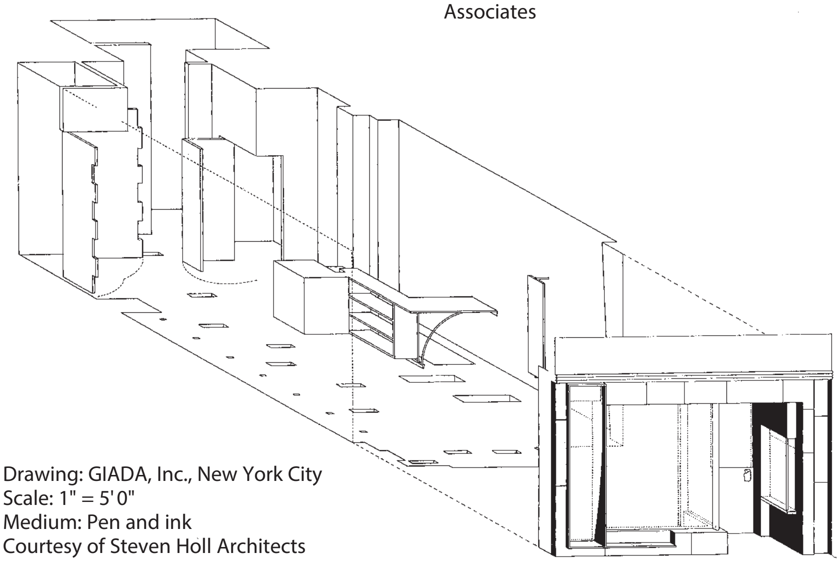


Drawing: Villa dall' Ava, Paris, France
23.4" × 16.5" (59.5 × 41.8 cm)
Medium: Ink
Courtesy of Office for Metropolitan Architecture (OMA)

The drawing to the right is a variation of the elevation oblique in that the receding lines are not parallel. Converging lines are seen in perspective drawing, which will be discussed in Chapter 6. This kind of drawing, like the elevation obliques, shows much more information than does a pure elevation or plan. Some architects, like Tadao Ando, favor this type of drawing. This triangular studio is part of a beach house, a guest house, and an artist's studio facing the Mexican Pacific Ocean. Ando wanted to create a village atmosphere with terraced sea views.

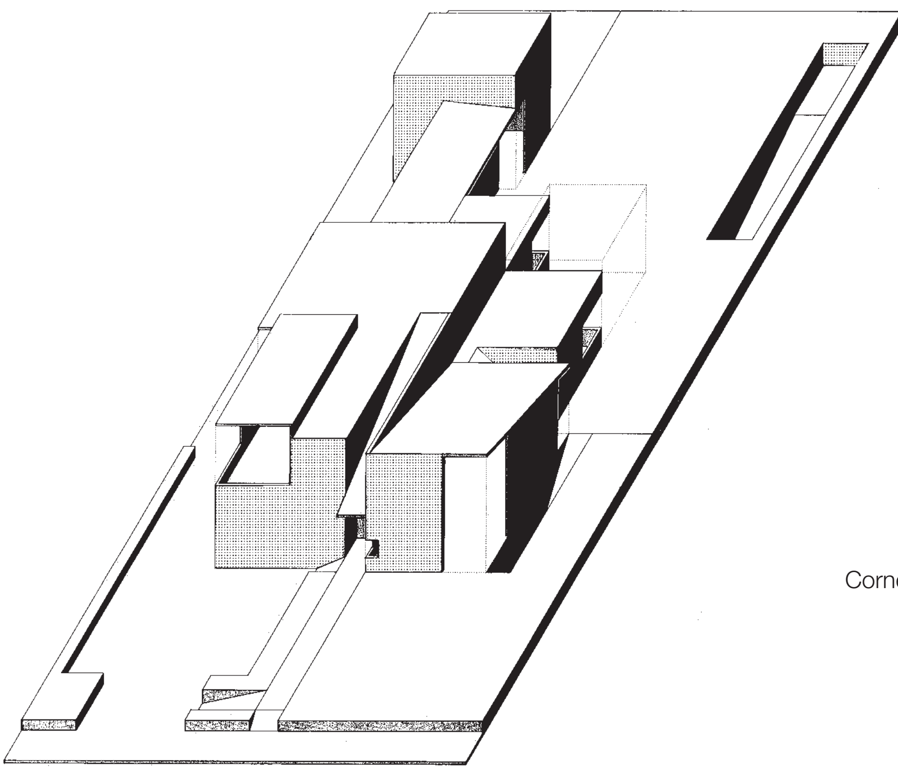
Drawing: Studio in Mexico
Media: Computer graphics, photo montage
Courtesy of Tadao Ando Architect and Associates

In most cases, elevation obliques recede up to the right or up to the left at a selected angle. Regular or irregular curvilinear forms are commonly seen in the true-size elevation, It is sometimes necessary to use a cutaway wall or a transparent oblique to reveal interior spaces.

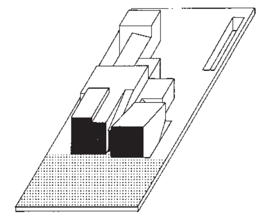


Drawing: GIADA, Inc., New York City
Scale: 1" = 5'0"
Medium: Pen and ink
Courtesy of Steven Holl Architects

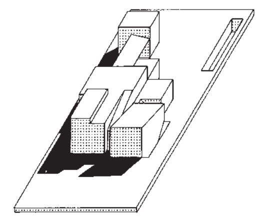
Elevation obliques can be very effective in showing how the building design responds to various design parameters. This example shows a simple form repeated five times with an upward receding angle of 60° for the purpose of diagramming design concepts. Note the use of gray tone and black to express the parameters. The largest diagram expresses rooms as volume: in this drawing, vertical planes were toned black or gray to accentuate building components. Artificial toning can give the needed planar contrast to help enhance the understanding of a design, especially in cases where material texture is absent or not shown. An elevation oblique may be foreshortened to avoid distortion, but a plan oblique is never foreshortened.



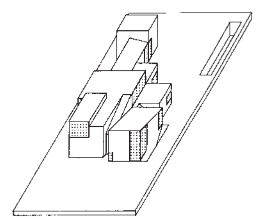
Drawing: Adelman/Lianos residence, Santa Monica, California
Medium: Ink
Courtesy of Mack Architects; Mark Mack, principal



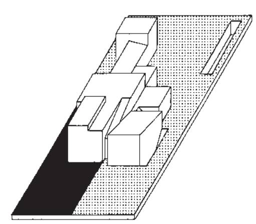
Fronting the street



Opening up the rear to the sun

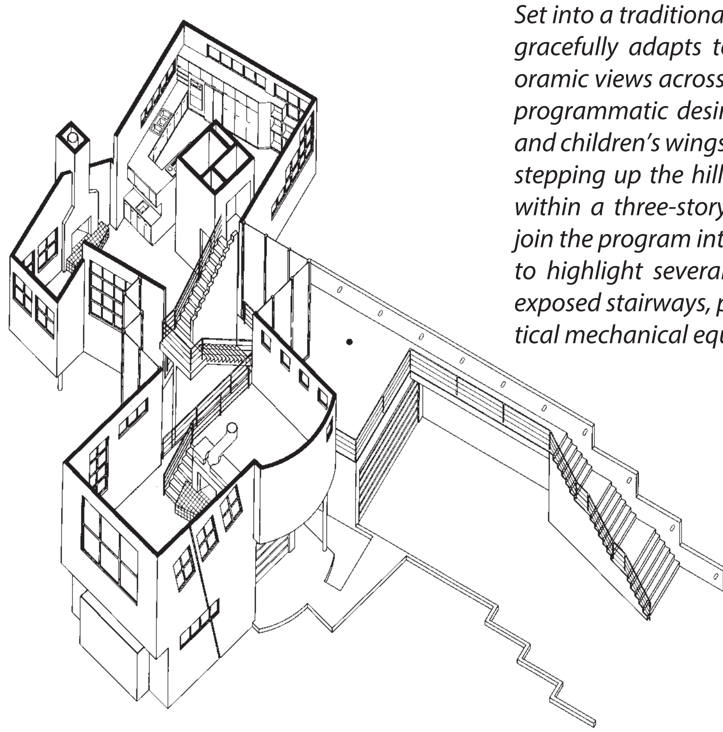


Corner windows to catch light and views



People space vs. auto space

Elevation oblique diagrams



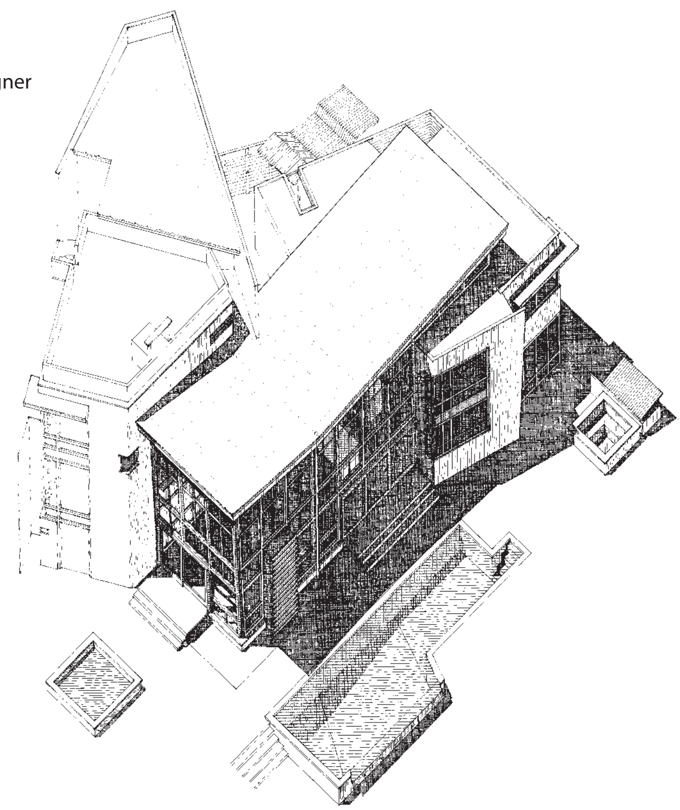
Set into a traditional hillside neighborhood, the 4,500-square-foot home gracefully adapts to the sloping site and orients to spectacular panoramic views across Orange County to the Pacific Ocean. Expressing the programmatic desire for public and private spaces as well as parents' and children's wings, the building form is split into two separate volumes, stepping up the hill and skewed at 15 degrees. Bridges and a stairway within a three-story circulation core clad in translucent acrylic panels join the program into a cohesive home. The exterior forms are composed to highlight several interior functions and are further animated with exposed stairways, pipe railings, window patterns, and an expressed vertical mechanical equipment core. [ARCHITECT & DESIGNER'S STATEMENT]

© David Lee VanHoy and George P. Elian

Drawing: Springwood Drive residence, Cowan Heights, California
36" × 36" (91.4 × 91.4 cm), Scale: ¼" = 1'0"
Medium: Ink on Mylar
Courtesy of David Lee VanHoy, Architect and George P. Elian, Designer

Building configurations that exhibit *multi-oblique* combinations are quite common. The addition of shades and shadows gives depth to a multioblique drawing. The example above with the roof removed combines two axes of 45°–45° and 30°–60°.

© Paul Warchol

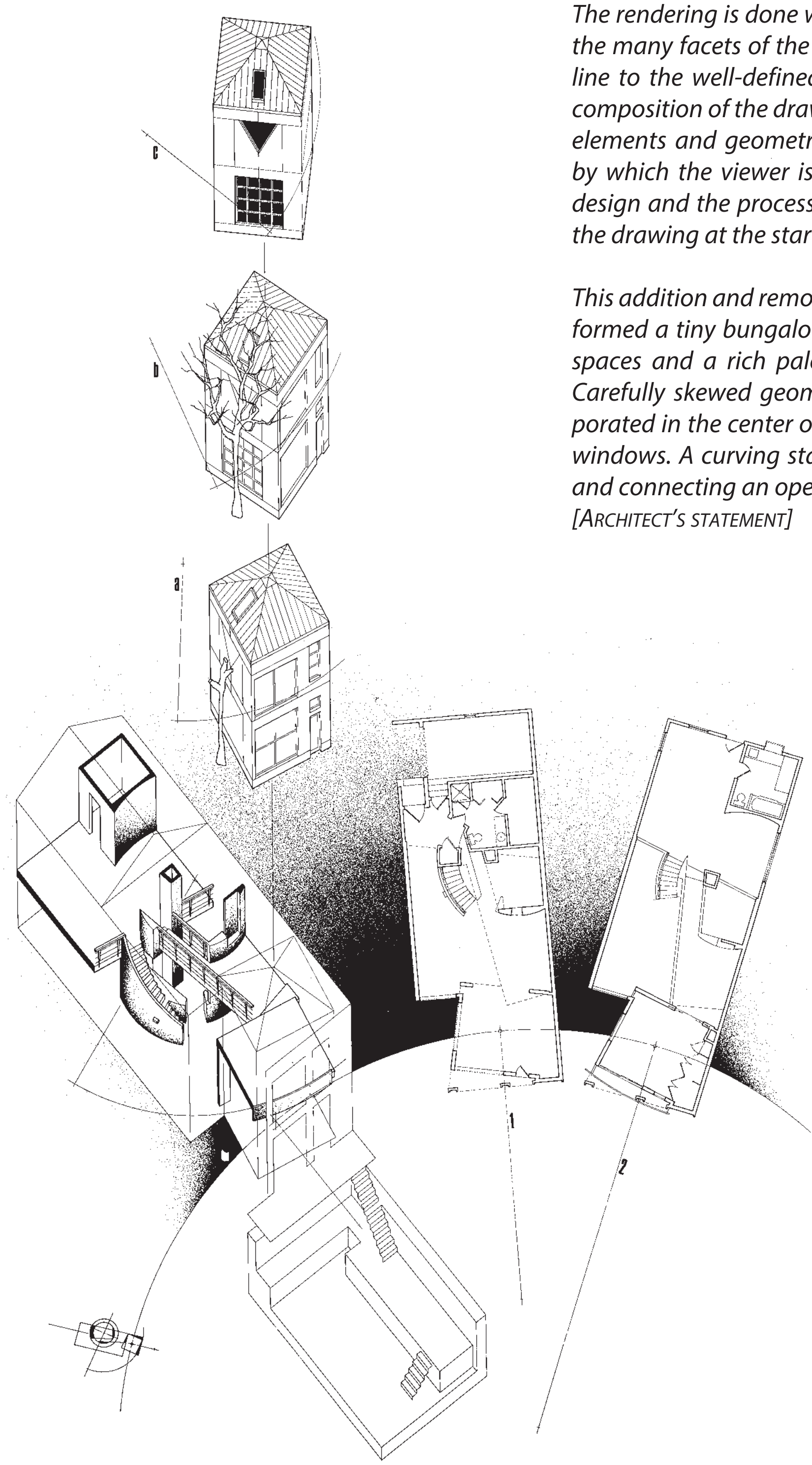


Drawing: Summer compound,
Barnegat Light, New Jersey
42" × 48" (106.7 × 121.9 cm), Scale: ¼" = 1'0"
Medium: Ink on Mylar
Courtesy of Brian Healy Architects

The design was for three generations of one family. Three separate structures share a common living area. Each family is given their own dwelling that can operate autonomously, so a communal village-like arrangement was used to organize the site. A shared open glass pavilion of 760 square feet is aligned with Barnegat Lighthouse in the distance. [ARCHITECT'S STATEMENT]

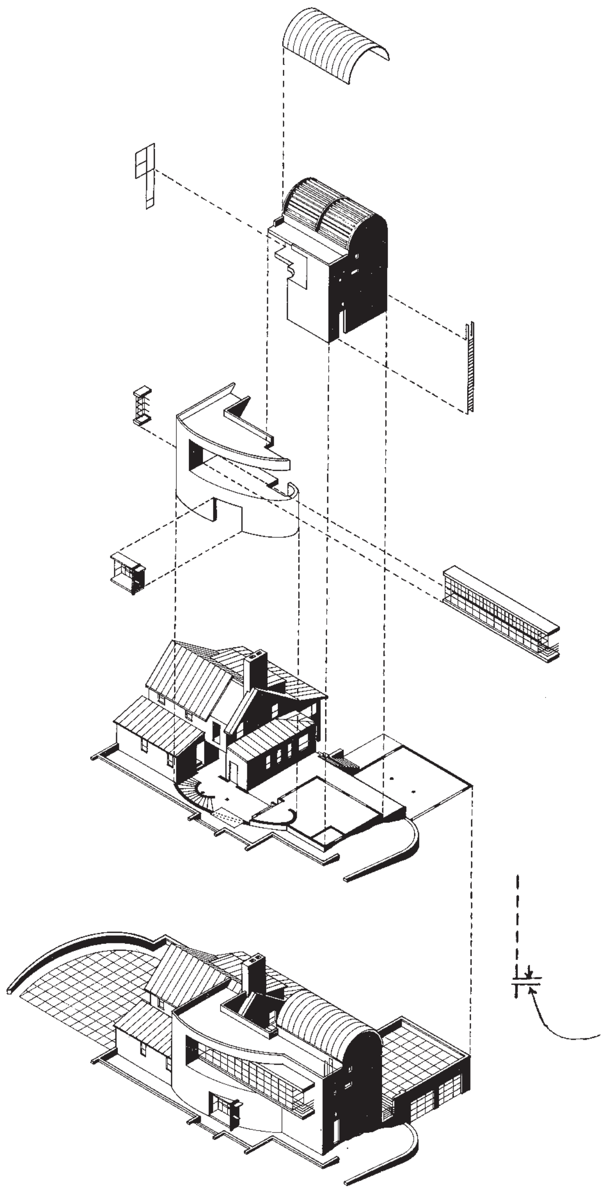
The rendering is done with ink on Mylar and is a representation of the many facets of the actual design. The use of ink lends a clean line to the well-defined edges and angles within the house. The composition of the drawing itself is first a vehicle to view the many elements and geometries of the house, and is secondly a device by which the viewer is given a sense of process—the process of design and the process of experience. Airbrush is added to center the drawing at the starting point of this process.

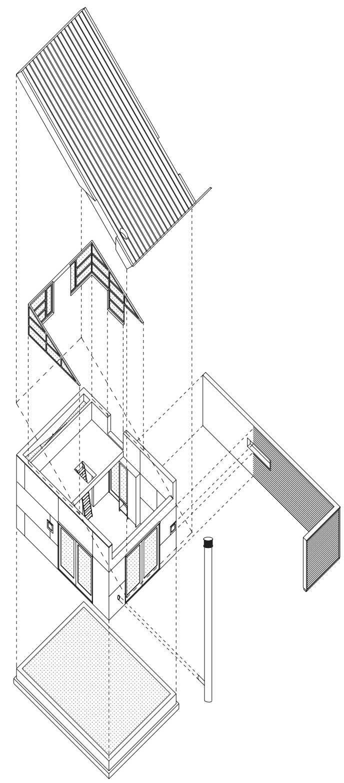
This addition and remodel of a 1906 earthquake relief house transformed a tiny bungalow into a dramatic new home with soaring spaces and a rich palette of materials bathed by natural light. Carefully skewed geometry allowed an existing tree to be incorporated in the center of the home, framed through a large grid of windows. A curving staircase wraps the bar, defining the kitchen and connecting an open bridge flying above the master bedroom. [Architect's statement]



Drawing: Exploded axonometric and plan composite
Chasen residence, San Francisco, California
30" × 52" (76.2 × 132.1 cm), Scale: 3/16" = 1'0"
Medium: India ink on Mylar
Courtesy of House + House Architects, San Francisco
Michael Baushke, Architectural Illustrator

© Alan Geller, Photographer





EXPLODED AXONOMETRIC VIEW

0 5 10

Drawing: C3 cabin,
Camano Island, Washington
Medium: ArchiCAD
Courtesy of Vandeventer + Carlander Architects

Draw with a small space
between dashed projection lines

© Photographer: John M. Hall

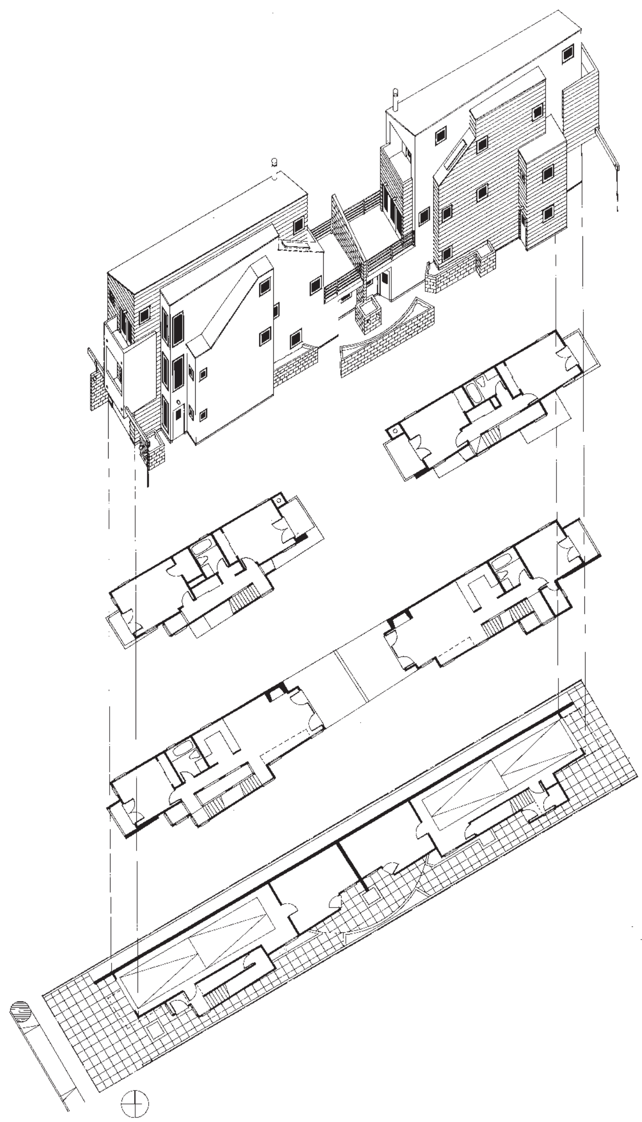
Drawing: Gorman residence, New Canaan, Connecticut
24" × 36" (61 × 91.4 cm), Scale: 1/16" = 1'0"
Medium: Pen and ink
Courtesy of Hariri & Hariri-Architecture

Plan obliques and isometrics can be quite powerful and revealing when the vertical and horizontal dimensions are expanded by the use of either dashed lines or light solid projection lines. These *exploded views* illustrate how structural components relate to one another. If possible, horizontally or vertically exploded elements should not overlap. *Expanded views* (opposite page) are exploded in one direction only, as shown with the numerous roof removals on the previous pages.

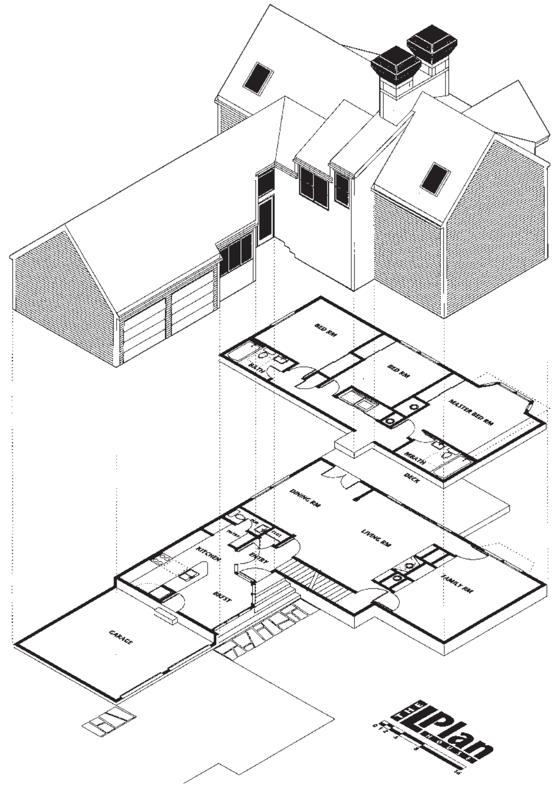
The amount that the building parts are displaced (movement axes are usually parallel or perpendicular to the building axes) depends on finding the most explanatory positional relationship of the parts to each other and to the whole. Note in the Gorman residence (left) how easily the disparate elements seem to come together to make a coherent whole.

© Rebecca L. Binder

© Rebecca L. Binder



Drawing and photos: Armacost duplex, Los Angeles, California
24" × 36" (61 × 91.4 cm), Scale: 1/8" = 1'0"
Medium: Pencil
Courtesy of Rebecca L. Binder, FAIA, Architect



Drawing: House, Connecticut
8 5" × 11" (21.6 × 27.9 cm)
Scale: 1/16" = 1'0"; originally drawn at ¼" = 1'0"
Medium: Macintosh computer in PowerDraw
Courtesy of Robert T. Coolidge, AIA, Architect

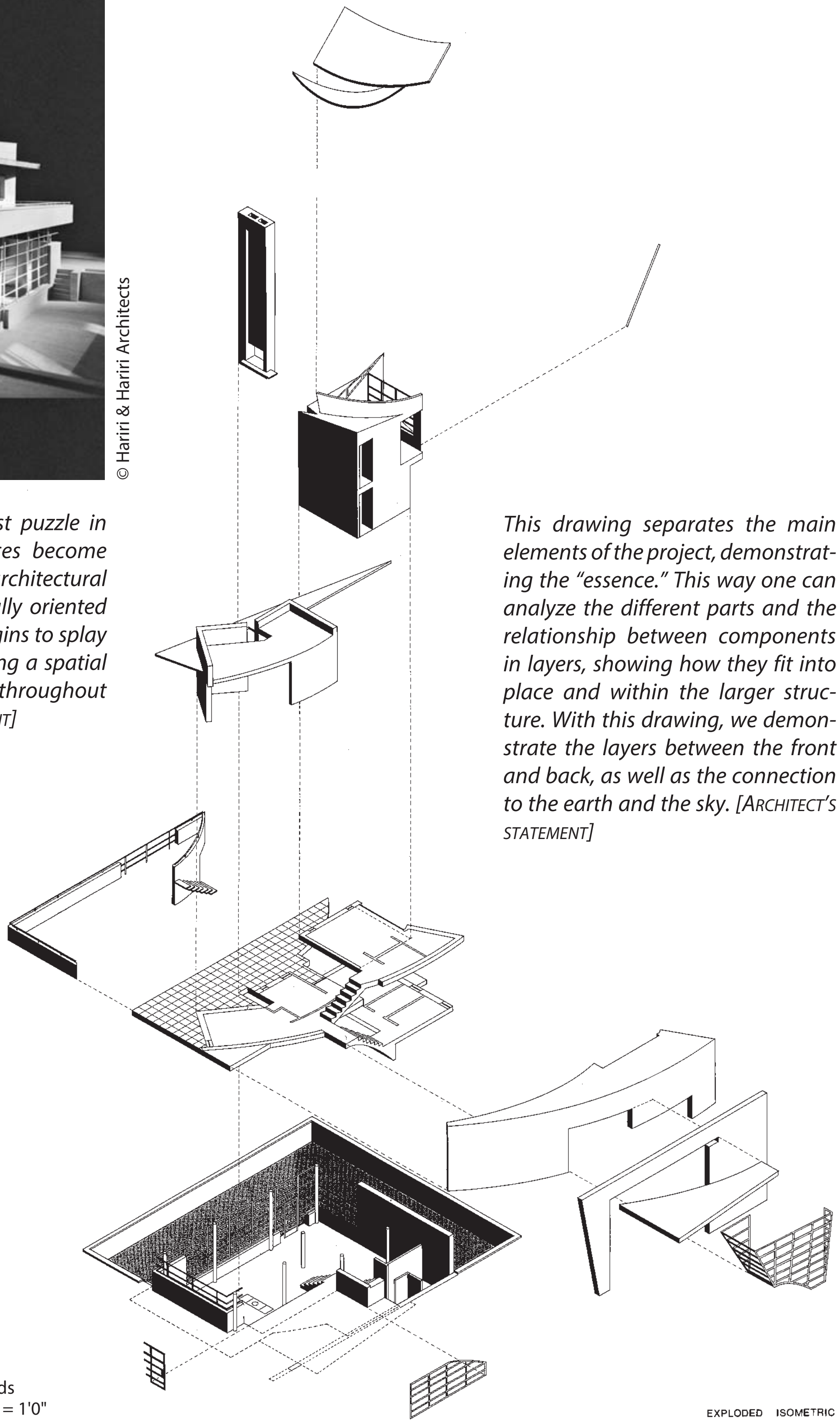
This house was designed for the 1990 Innovations in Housing competition and was an exercise in design for construction with relatively new (at the time) I-joist framing. It explored what could be done within a single span of 20 feet and was an exercise in isometric drawing with PowerDraw software (now PowerCADD). Adobe Illustrator was used to finish the drawing by shearing text to match the isometric. It appeared in the AIA New England Regional Council Design Awards 1990 as well as Progressive Architecture *magazine.* *[Architect's statement]*

The concept of the expanded view in both plan obliques and isometrics is frequently applied to buildings with two or more floors. Stacked floors usually exhibit similar geometric configurations. These examples illustrate how the floor plans can be removed from the building shell to help visualize the vertical relationship of all levels in conjunction with the exterior form. Both expanded and exploded views allow us to see the internal makeup of a building. In this sense, they are quite similar to cutaway views.

EXPLODED ISOMETRIC

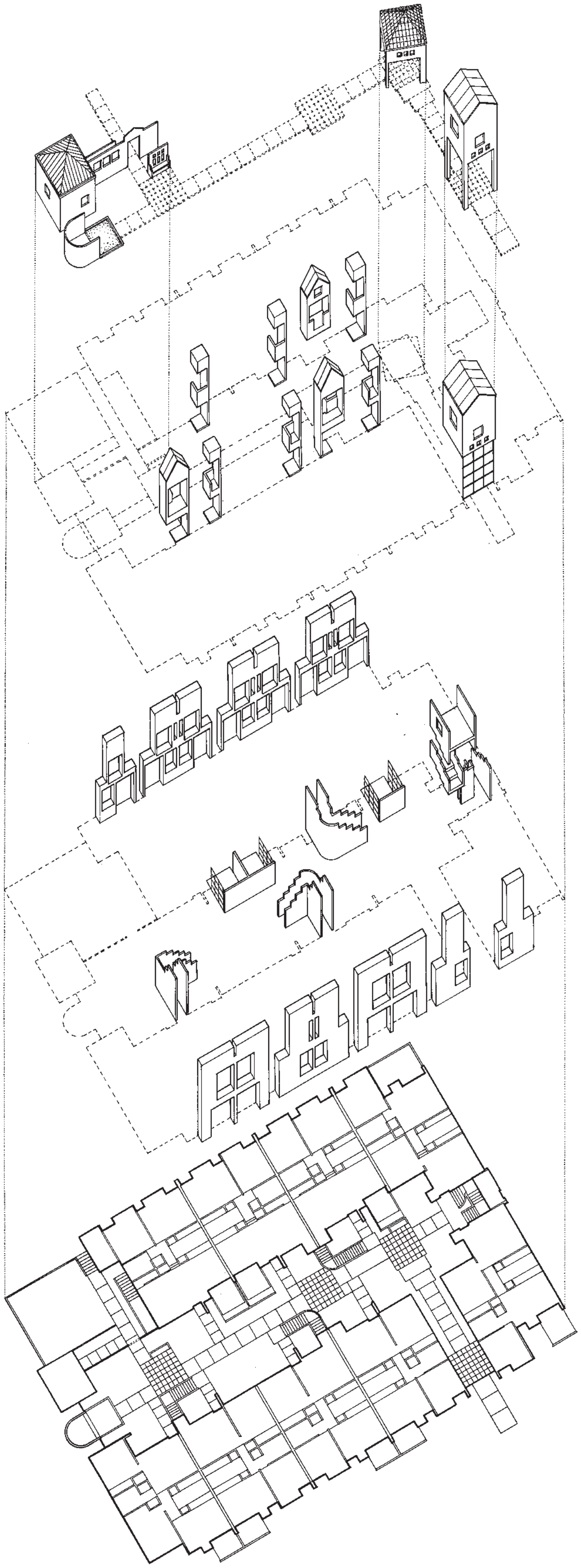
© Hariri & Hariri Architects

The villa becomes a gestaltist puzzle in which the overlapping spaces become contiguous parts of a greater architectural whole. Behind the orthogonally oriented street facade, the building begins to splay away from its origins, revealing a spatial momentum that continues throughout the house. [ARCHITECT'S STATEMENT]



This drawing separates the main elements of the project, demonstrating the "essence." This way one can analyze the different parts and the relationship between components in layers, showing how they fit into place and within the larger structure. With this drawing, we demonstrate the layers between the front and back, as well as the connection to the earth and the sky. [ARCHITECT'S STATEMENT]

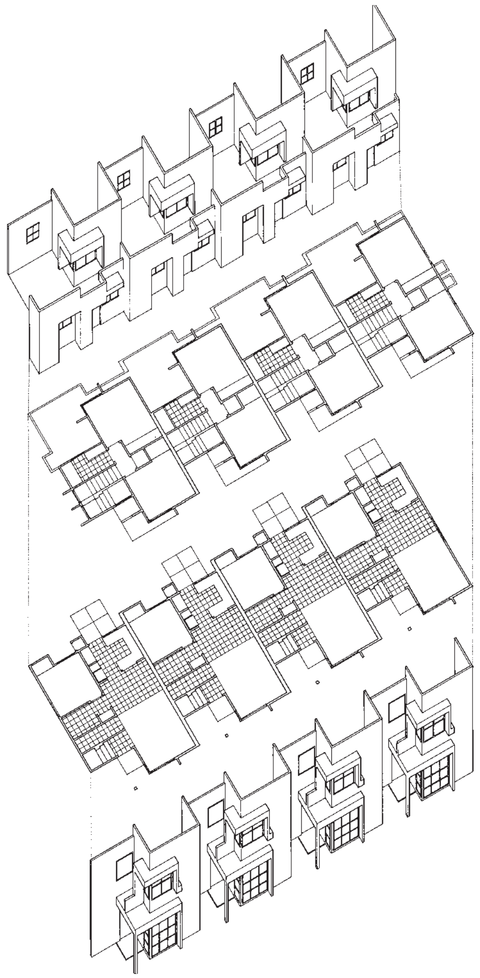
Drawing: The Hague Villa Project
The Hague, The Netherlands
24" × 36" (61 × 91.4 cm), Scale: 1/16" = 1'0"
Medium: Pen and ink
Courtesy of Hariri & Hariri, Architects

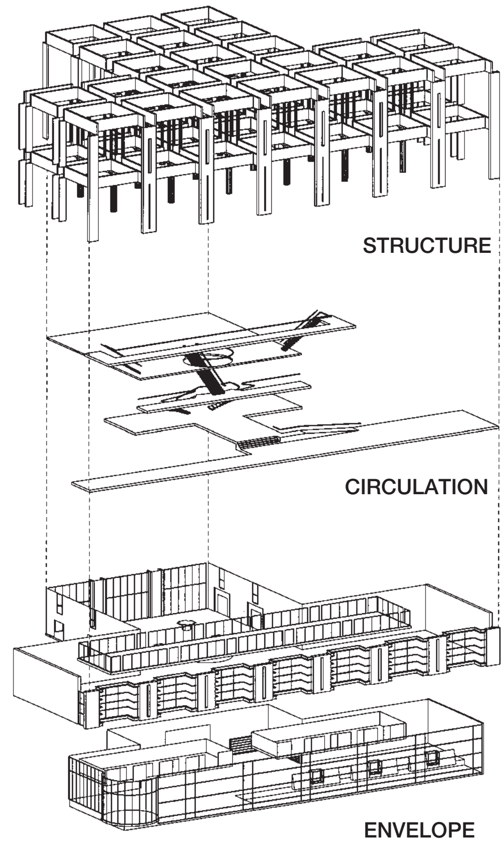


The element axonometric drawing is a composition of design elements: public street facade, private courtyard facade, axes, focal point, and circulation elements. The drawing visually analyzes the different design approaches to and the relationship between the public street and the private courtyard, and the sequence of circulation spaces that connect the major street to the inner courtyard with the linkage of the street entry porch to the rotated courtyard gazebo, the axis, and the focal point. The floor plan anchors the drawing as a basic reference. The identity of the courtyard project's front and rear public facades is developed within a narrow 2-foot-deep storage volume, with clip-on staircase elements providing the identity to the private courtyard facades. The communal elements are then articulated and differentiated as complete forms. [ARCHITECT'S STATEMENT]

Note the orderly manner in which the four expanded design elements fit together. Displaced vertically in a consistent direction, the way the elements would come back together into a cohesive whole can be visualized easily.

Drawing: Yorkshire Terrace, Los Angeles, California
34" × 42" (86.4 × 106.7 cm), Scale: 1/8" = 1'0"
Medium: Ink
Courtesy of John V. Mutlow, FAIA, Architect

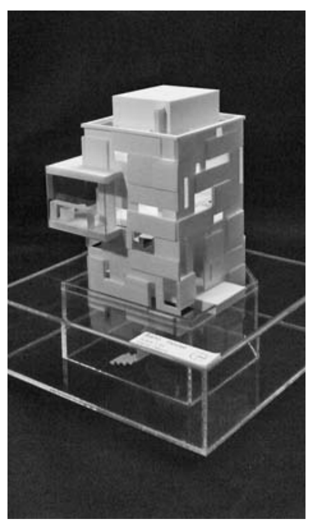




Drawing: Library, Toronto, Canada
Medium: Ink
Courtesy of A. J. Diamond, Donald Schmitt, Architects

The front and rear elevations below and above the floor plans help to project the three-dimensional richness of the facade from the two-dimensional floor plans. Geometry of squares is the principle design element, with the double-square main meeting hall sized so that all the farmworker families can meet in one room. This forms an axis for a series of smaller square and double-square spaces ordered in a symmetrical format. [Architect's statement]

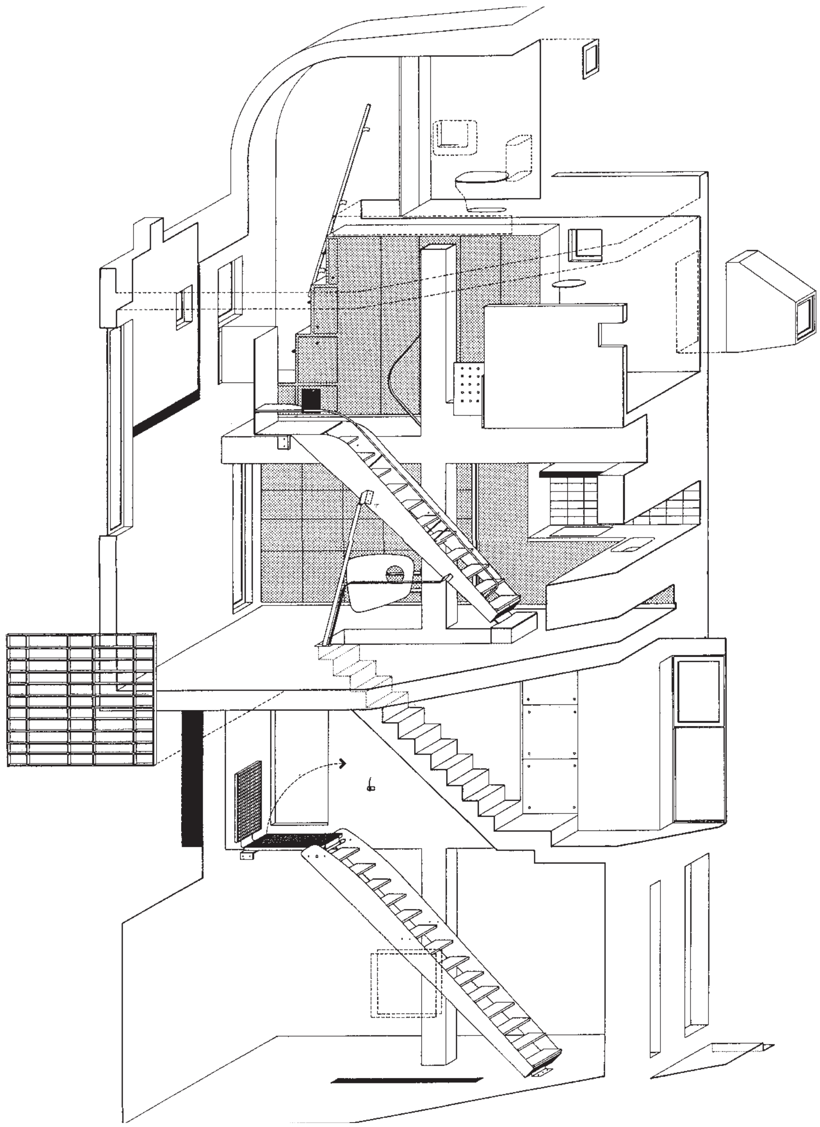
Drawing: Cabrillo Village, Saticoy, California
24" × 36" (61 × 91.4 cm), Scale: 1/8" = 1'0"
Medium: Ink
Courtesy of John V. Mutlow, FAIA, Architects



This expanded view uses a paraline axonometric in the form of a dimetric. The lower angle of view permits one to see the linking circulation elements between floors. Dimetrics are more flexible than isometrics because a variety of viewing positions are possible.

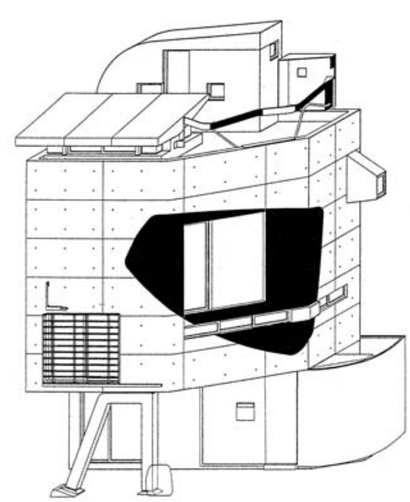
Model photo: Anti-Gravity Atelier and House Meguro, Tokyo, Japan
© Atelier Tekuto
Courtesy of ATELIER·TEKUTO

Using a lamp inside the model and adjusting contrast and brightness with Photoshop, a strong interior lighting effect was created. This has become a fashionable approach in competition models, especially with dimetric, isometric, and perspective views.



© BOLLES+WILSON

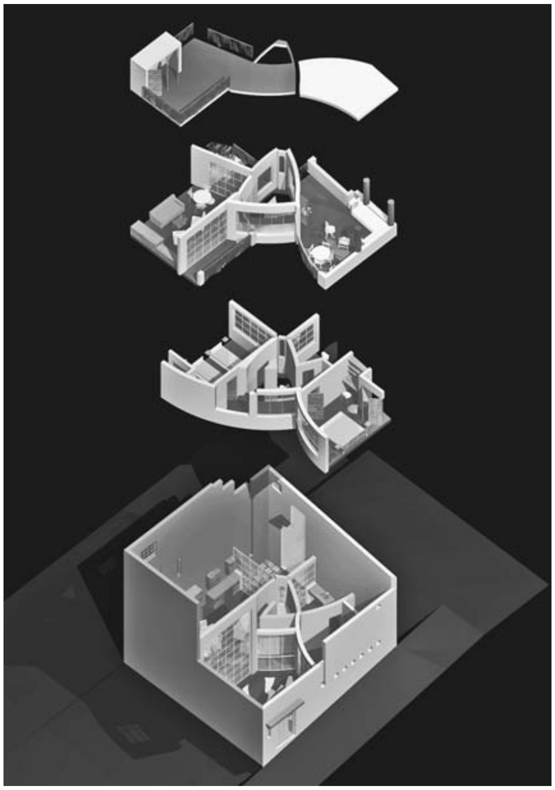
© BOLLES+WILSON



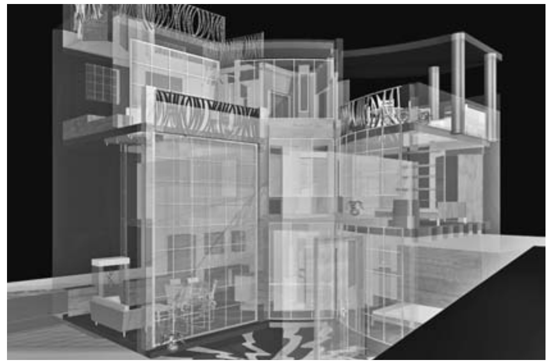
Drawings: Suzuki house, Tokyo, Japan
8.7" × 11" (22 × 28 cm), Scale: 1:30 (Japanese scale)
Medium: Ink on trace
Courtesy of BOLLES+WILSON

The space of the house at all levels is visible on one projection. The central stair is understood as the connecting sequence…as in Japanese painting, what is not shown is as important as what is shown.
[Architect's statement]

Both exploded and expanded views are excellent tools for examining the way details are put together, whether they are small structural components or large building elements. This is an interior elevation oblique with exploded parts. Overlapping exploded or expanded parts is permissible, provided they do not cover important information. Within a very small space of a house, this design manages to pack in a lot of action through a well-positioned stairwell vertically connecting the volumes of the floors.



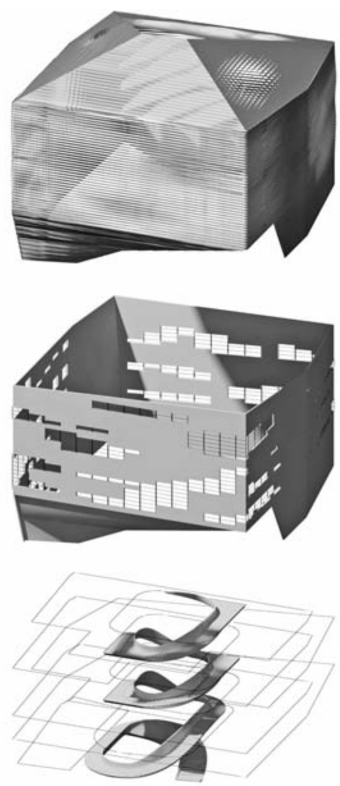
Drawing: Casa Joya, San Miguel de Allende, Mexico
8½" × 11" ArchiCAD exploded axonometric
Courtesy of House + House Architects
Rafael de le Lama, Architectural Illustrator



Drawing and photos: Casa Joya, San Miguel de Allende, Mexico
7" × 7" ArchiCAD transparent perspective
Courtesy of House + House Architects
Rafael de le Lama, Architectural Illustrator
Steven & Cathi House, photographers

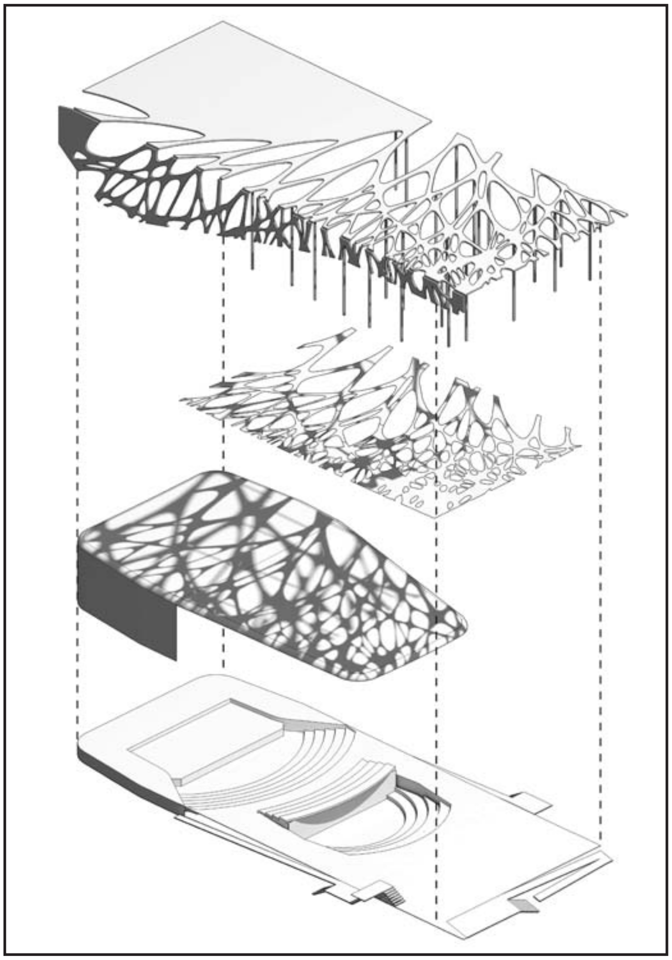
This exploded axonometric drawing was chosen to describe the form and volume of this unique 10 × 10-meter cube-shaped house located at the end of a pedestrian street in Mexico. The rooms are defined by a series of curving walls, courtyard spaces, floor-to-ceiling windows, and private terraces. An extensive color palette and a rigid geometry are clearly shown as the upper floors are pulled up and away to reveal the lower floor plan.

The strong geometric form is clearly shown in the transparent rendering. The exterior property line walls disappear and allow the viewer to see inside to a layering of colorful walls, decorative courtyard paving, cylindrical columns, and floor-to-ceiling windows. [Architect's statement]



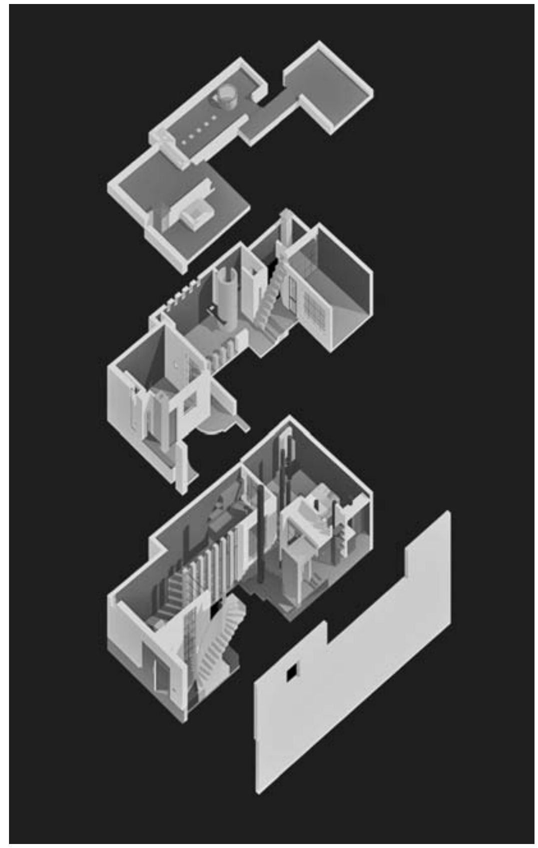
This school has no corridors, but is organized around a large atrium bathed in natural light. The interior environment changes with the sun's course and the year's seasons. The large central staircase connects all majors and disciplines. [Architect's statement]

Expanded dimetric: New School of Music of Paris
Paris, France
Medium: 3-D graphic software
Courtesy of Serero Architects



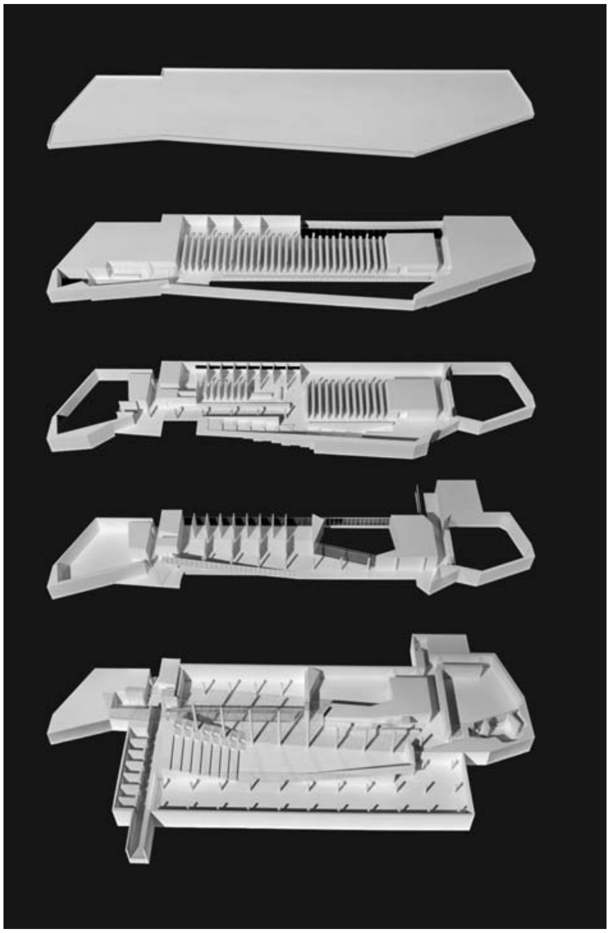
Expanded axonometric: CANOPY: Competititon for the new auditorium
and movie theater (VTHR)
Saint Cyprien, France
First-prize winner, Schematic Design Phase
Medium: 3-D graphic software
Courtesy of Serero Architects

The natural environment inspired my auditorium design. The large sun umbrella with egg-shaped perforations protects the interior from the sun. The internal shell of glass and concrete regulates heat and ventilation.
[Architect's statement]

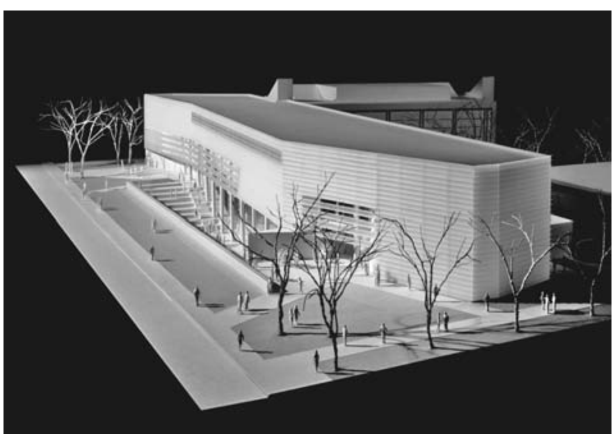


Drawings and photo: Casa de las Estrellas
San Miguel de Allende, Mexico
12" × 20" ArchiCAD exploded axonometric
Courtesy of House + House Architects
Kelly Condon, Architectural Illustrator
Steven & Cathi House, photographers

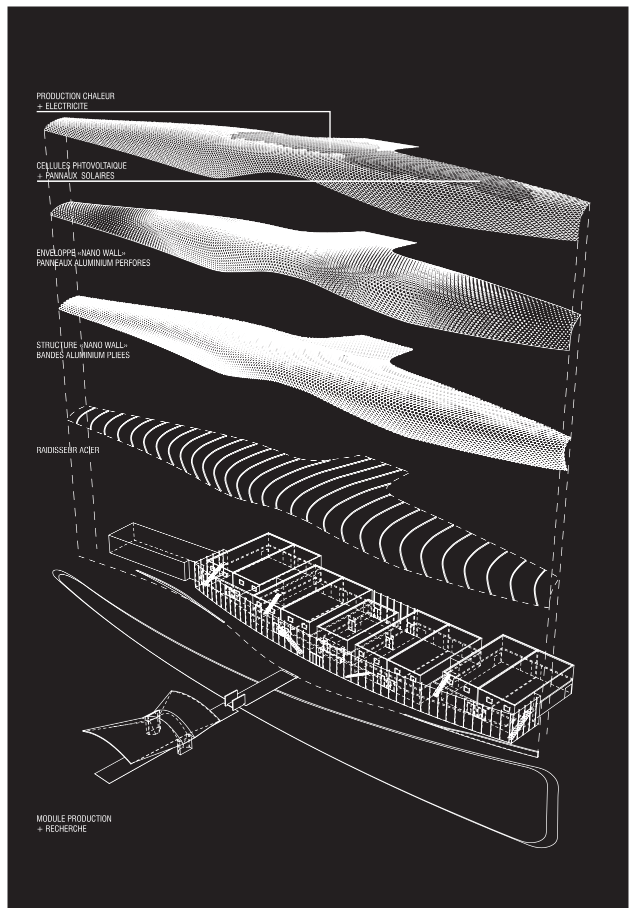
The purpose of this drawing is to illustrate the openness and geometric rigor of this modern courtyard house. The two-story house is presented as an exploded axonometric to clearly define the colorful geometric elements that distinctly delineate the mass and form. The property line wall and the roof are pulled away to show the interior spaces that are articulated by curving stairs, columns, floor-to-ceiling windows, fireplaces, and walls.
[Architect's statement]



The Centre for Music, Art, and Design is an interdisciplinary facility. The project was conceived to achieve functional objectives and interdisciplinary ambitions with economy, and consists of six "big rooms" (plus associated support spaces) that accommodate multiple activities.
[Architect's statement]



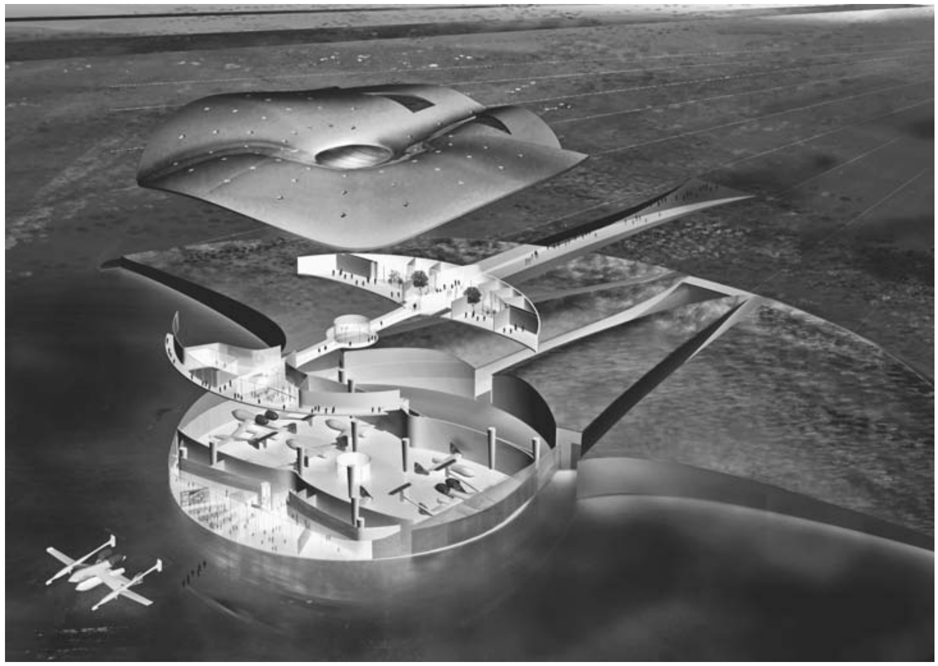
Model photos: Center for Music, Art, and Design
University of Manitoba, Canada
Courtesy of Patkau Architects



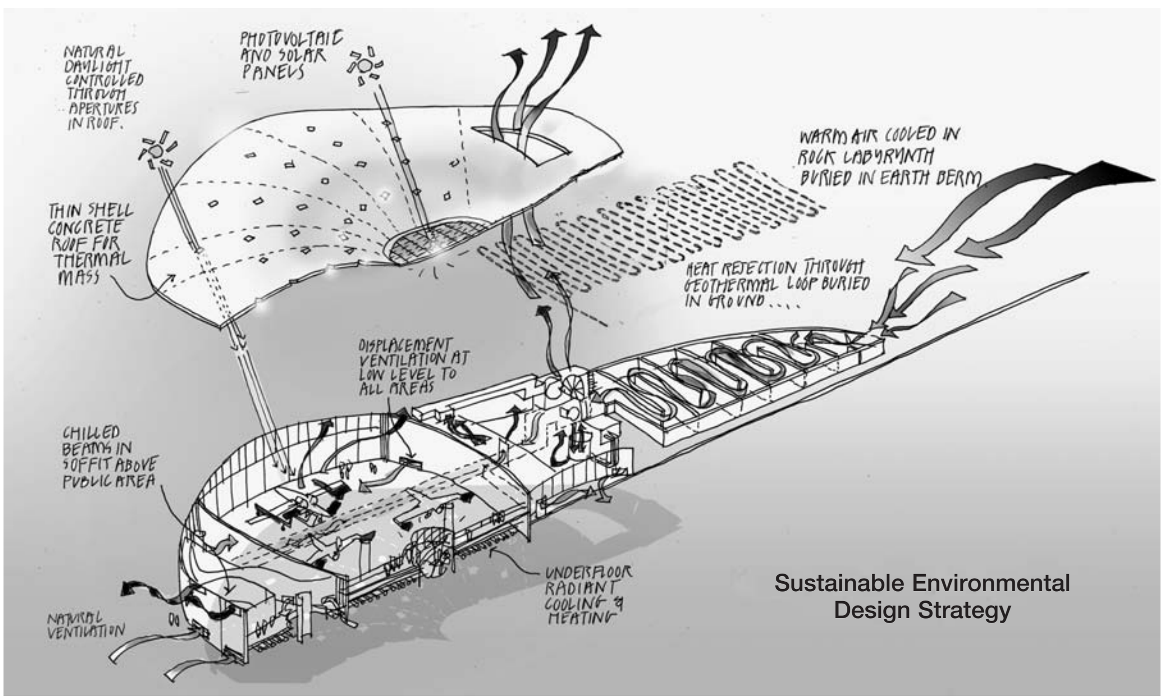
Drawing: Materials Chemistry Development Center
Mourenx, France
Medium: 3-D graphic software
Courtesy of Serero Architects

These two buildings are effectively presented using variations of the expanded view. The Patkau building uses a pictorial effect characterized by a variable station-point height and horizon line. The horizon line and station point move up and down. As they move up, we see more of a bird's-eye perspective, as shown in the bottom of the upper left images. The Serero building is essentially an expanded view with an element of perspective showing slight convergence to a vanishing point below.

Designed to obtain the prestigious LEED Platinum accreditation, this unique one-of-a-kind spaceport strives to be both sensitive to its immediate surroundings and sustainable. The thin concrete shell roof structure captures westerly winds for ventilation and provides protection from the harsh extremes of the New Mexico climate.



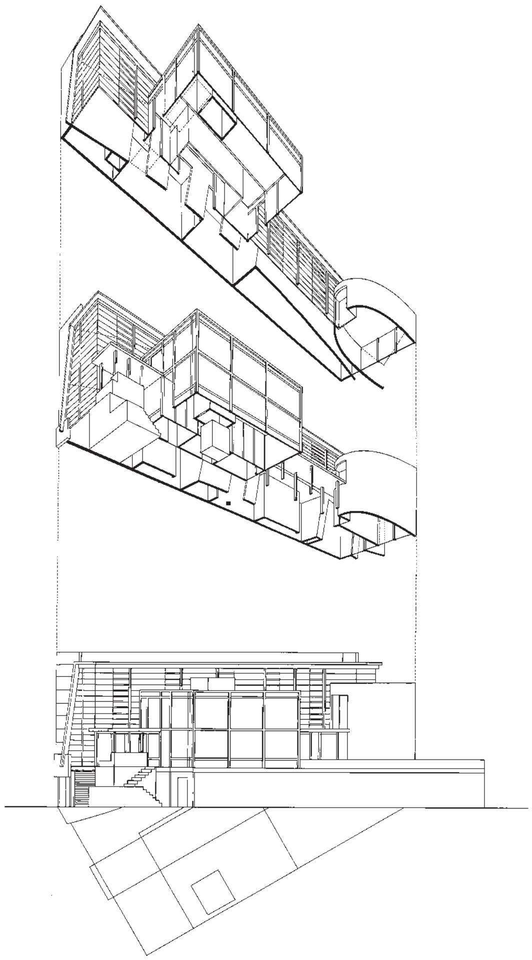
Axonometric View



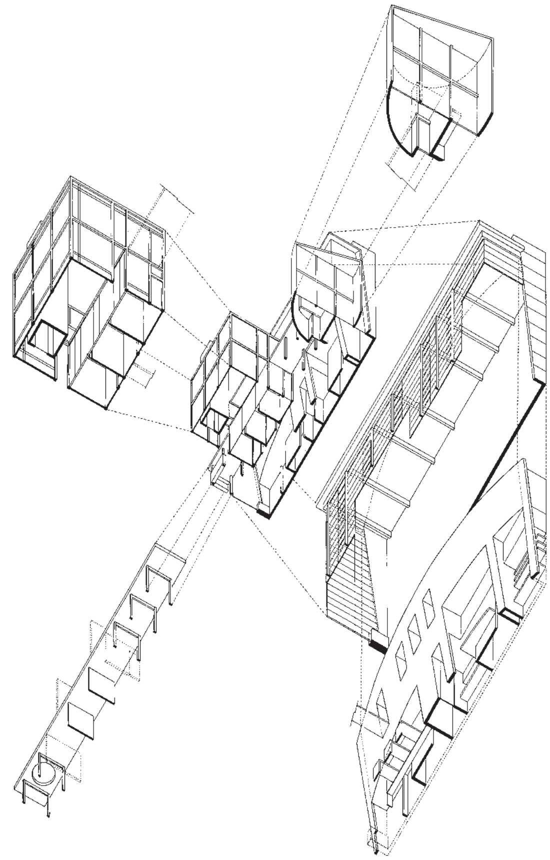
Sustainable Environmental Design Strategy

Drawing and diagram: Spaceport America
Upham, New Mexico
Medium for drawing: Autodesk
Medium for diagram: Autodesk
Courtesy of Foster + Partners, Grant Brooker, Senior Partner

In these drawings, neither the expanded view axonometric nor the expanded environmental design strategy freehand sketch have the usual expanded dashed lines that accompany this type of drawing. Note the overlapping of layers in the view above.

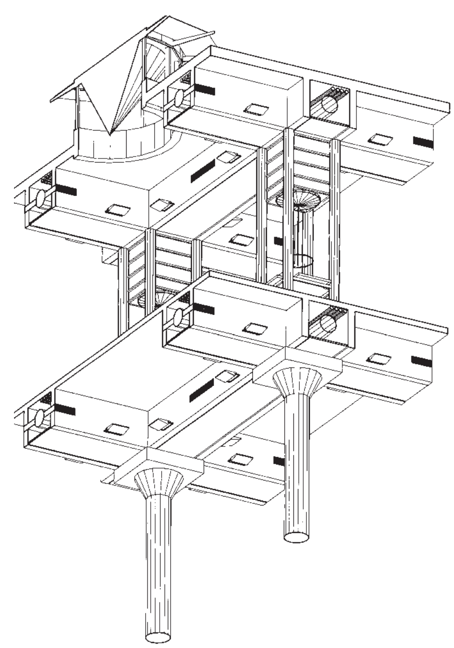


PERSPECTIVE DIAGRAM



EXPLODED AXONOMETRIC

Drawings: Click & Flick Agency, West Hollywood, California
Perspective: 20" × 30" (50.8 X 76.2 cm), Scale: 1/8" = 1'0"
Axonometric: 24" × 30" (61 X 76.2 cm), Scale: 1/8" = 1'0"
Courtesy of Hodgetts + Fung Design and Architecture

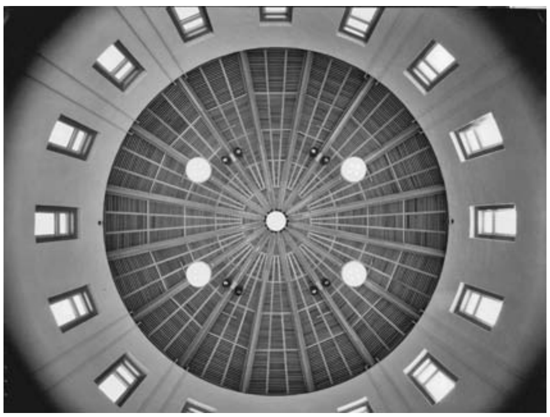


Drawing: Richmond Hill Library, Toronto, Canada
Courtesy of A. J. Diamond, Donald Schmitt, Architects

These dramatic worm's-eye views permit the viewer to peer upward into the buildings. This method was first developed and utilized by August Choisy in the nineteenth century. In design drawings, it is sometimes necessary to show the relationship between the ceiling or the soffit and the walls (see Cabrillo Village drawing on p. 222). The upper right exploded axonometric shows that exploded or expanded elements can in turn have their own exploded or expanded parts. Axonometric up views in the form of dimetrics or isometrics show excellent detail. Note the clarity of detail in the Richmond Hill Library.

This drawing allows one to understand the building's form and organization while simultaneously giving clues as to how the designers conceived the building: a modest shell that bends to accommodate and encourage movement and circulation; a pure cylinder at the center of the mass as a primal gathering place; and a peaked, conical roof capping the cylinder as a distinguishing image at the center of a four-building residential village.
[ARCHITECT'S STATEMENT]

This drawing combines a plan oblique down view with plan oblique up views. Its advantage is that It allows us to simultaneously understand the total geometric configuration of a design.



© Steve Rosenthal

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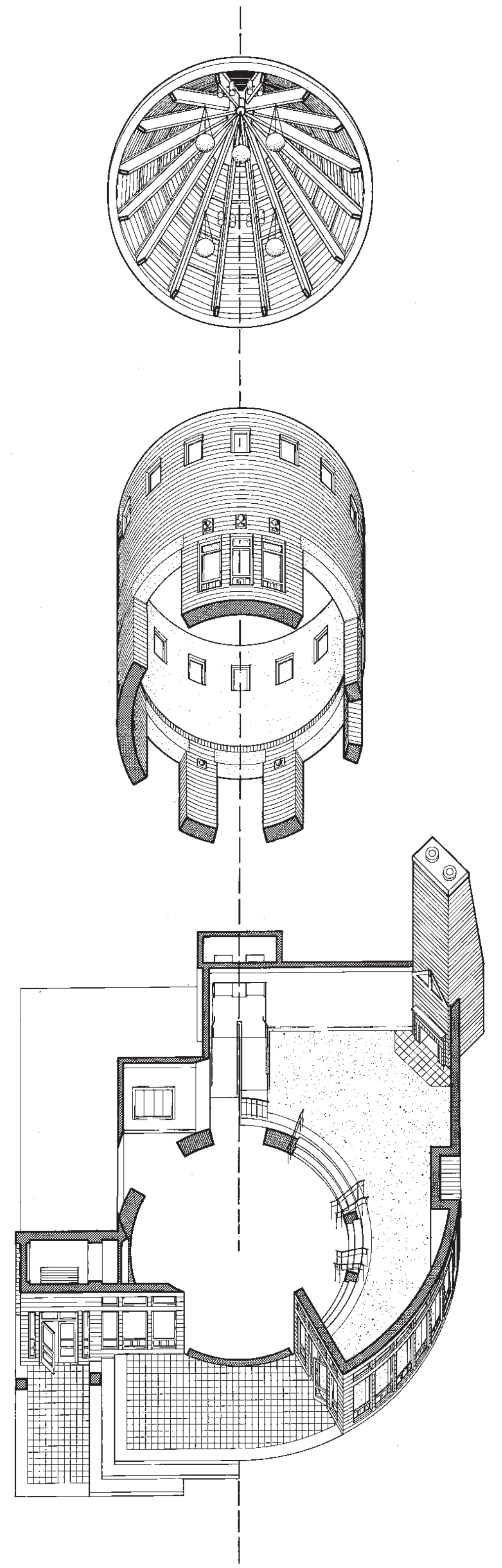
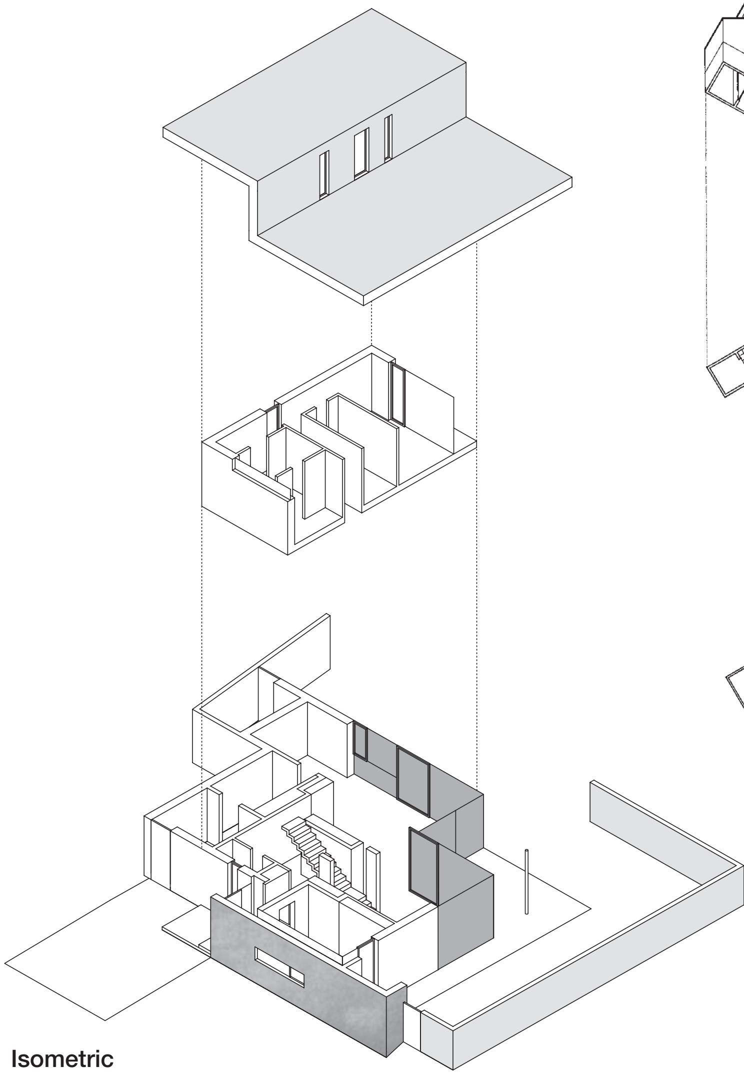
Photos: Courtesy of William Rawn Associates



Drawing: Bates College Social/Study Center
(Residential Halls project), Lewiston, Maine
12" × 30" (30.5 × 76.2 cm), Scale: ¼" = 1'0"
Medium: Ink on Mylar
Courtesy of William Rawn Associates, Architects, Inc., Boston, Massachusetts

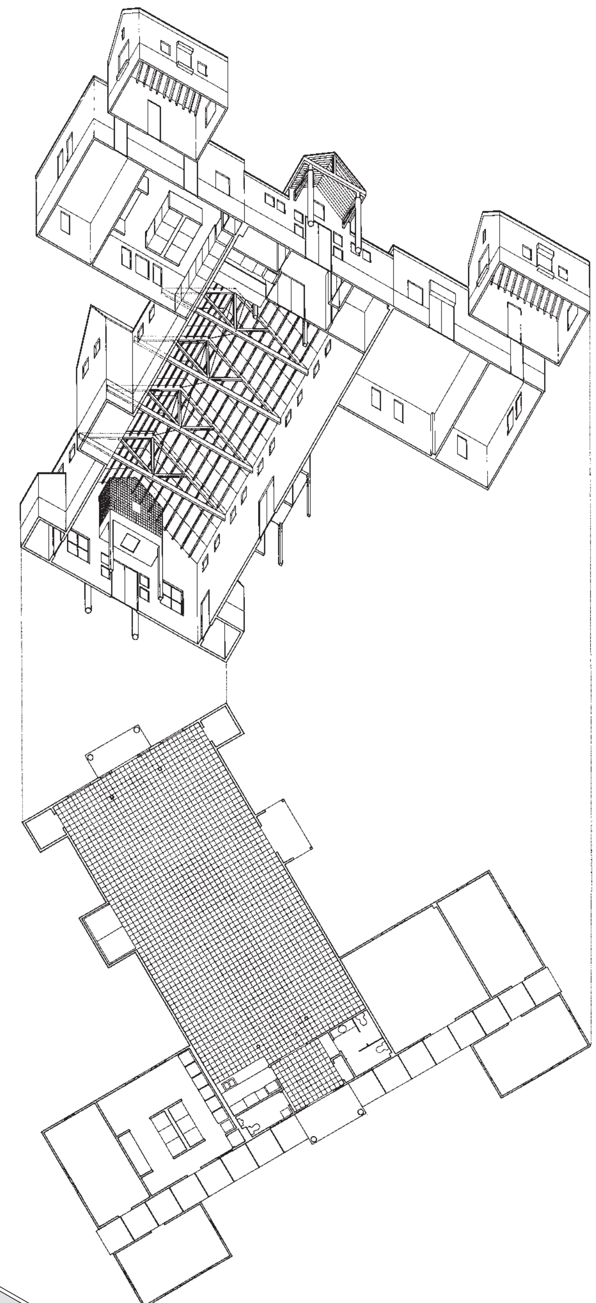
Axonometric up and down views can provide great detail for visualizing interior spaces. Note the intricate structural details in the Cabrillo Village drawing as well as the spatial detail in the expanded view of the Rettig House.

The Rettig House offers a complex yet compact space for one person on a small corner lot. The folded roof unifies the two stories and offers a generous gesture to the public. The first floor evolves around the central staircase, which is the "heart" of the house. [ARCHITECT'S STATEMENT]



Isometric

Drawing: Rettig House
Rheda, Germany
Medium: Adobe Illustrator
Courtesy of Drewes + Strenge Architekten



Drawing: Axonometric/floor plan
Cabrillo Village, Saticoy, California
Medium: Ink
Courtesy of John V. Mutlow, FAIA, Architects

The ink axonometric drawing takes the view from below to accentuate the roof structure and to visualize the quality of the spaces below. The floor plan provides an understanding of the relationship between the spaces. [ARCHITECT'S STATEMENT]

Relating to and radiating out from the floor plan, these sequentially rotated views allow the observer to simultaneously experience different viewpoints. Sequentially rotated simultaneous views are also frequently seen as plan obliques radiating out from a centrally drawn floor plan. Seeing many views from different vantage points (same altitude) at one time gives a quick comprehensive overview of any structure.

This shows the use of sequentially rotated simultaneous views to hone in on a given detail to explain its relationship to the building element. All new and renovated components were integrated into the general color and material palette of the existing 1970 campus, while updating the campus programmatically, technologically, visually, and seismically. Our design team actively engaged the users and the school district to provide a product that will serve the community for decades.
[Architect's statement]

Image: Administration Building,
Kennedy Senior High School
Granada Hills, California
Courtesy of Rebecca L. Binder, FAIA, Architecture & Planning
Hardware: PC
Software: AutoCAD 14 (2000); 3D Studio

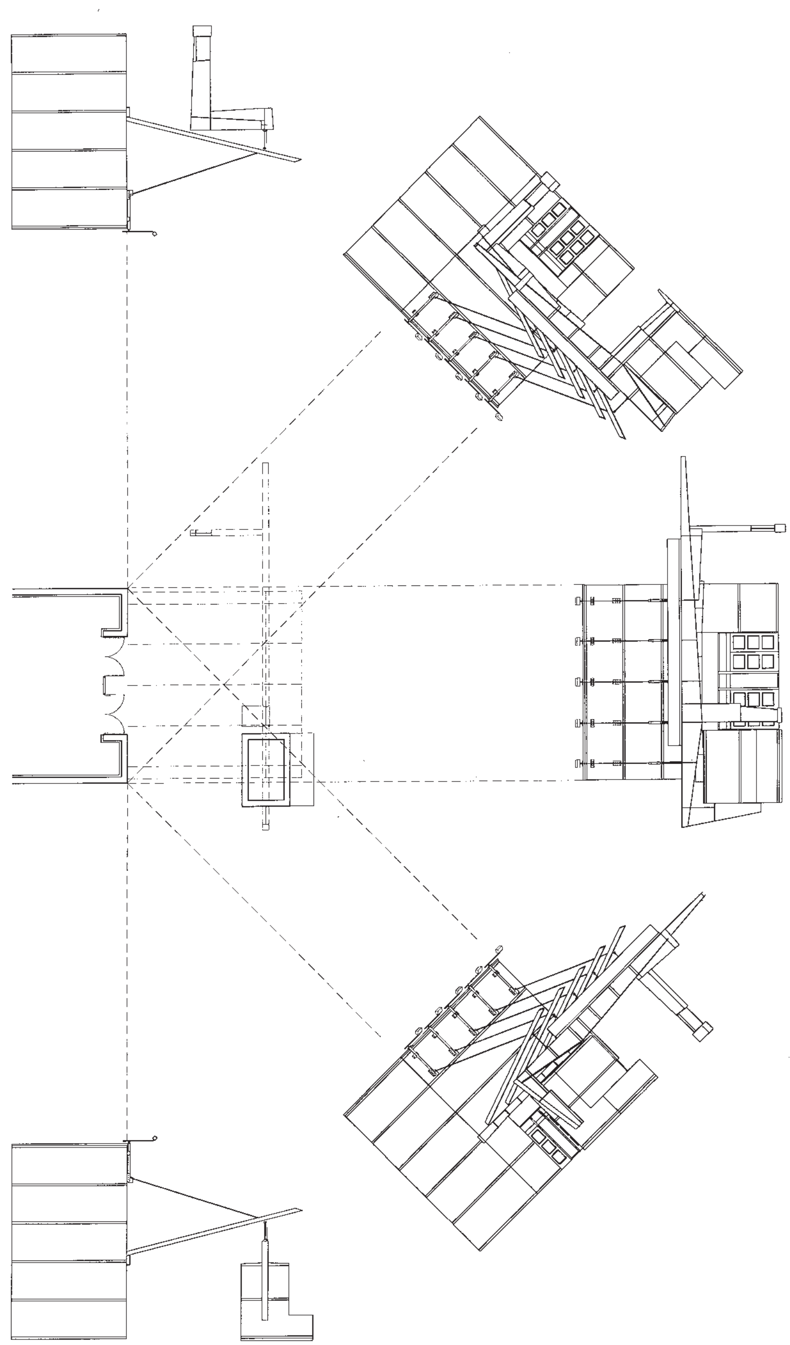


Photo by Timothy Young

6

Linear Perspective Drawing

Perspective drawings seen from a fixed vantage point create the most realistic, life-like views of the built environment and the urban landscape. On a two-dimensional surface, pictorial views of three-dimensional forms can be represented in a believable manner using methods characterized by diminishing sizes and defined by converging lines. Preliminary perspective design drawings or sketches show form, scale, texture, light, shapes, shadows, and spatial order. Presentation perspective design drawings take on a more precise character from these and related components. As a final step, they may be refined into perspective renderings to complement and enhance a presentation.

During the early conceptualization stages of design, when all decisions are in flux, study models are often used to ascertain the formal outcome. However, conceptual models are lacking in details; these highly abstract objects are not readily comprehensible to the layperson or client. It is at this stage that perspectives are most useful.

As I. M. Pei once wrote, in the foreword to Paul Stevenson Oles's (1987) acclaimed book on rendering, "Working models are useful tools in the study of form and the juxtaposition of forms, but only drawings can animate." Most recently, "rapid prototyping" in 3-D printing has begun to be a valuable tool in allowing designers to see their designs as hand-held objects at the early stages of design. Perhaps in the near future a combination of hand drawing and 3-D printing will compress design time.

The intent of this chapter is to introduce the theory of and methods for constructed architectural perspectives. It stresses the importance of visualizing in parallel (one-point) or angular (two-point) perspective from the plan and the elevation of an object. This, of course, comes with patience, perseverance, and most of all, practice.

The following are some of the important skills, terms, and concepts you will learn:

How to use one-, two-, and three-point perspectives
How to change the pictorial effect by changing the perspective variables

Station point	Picture plane	Horizon line	Ground line
Vanishing point	Line of sight	Cone of vision	Distortion
Office method	Oblique lines	Perspective circles	Measurement systems

Linear Perspective Drawing

TOPICS: CONE OF VISION

Ching 2009, 105.

TOPICS: DIAGONALS, X-, Y-, Z-AXIS, STATION POINT, PICTURE PLANE, HORIZON LINE, VANISHING POINTS, CENTER OF VISION, VERTICAL MEASURING LINE, MIDPOINT, PERSPECTIVE FIELD, PERSPECTIVE VIEWPOINT, PERSPECTIVE SETUP

Hanks and Belliston 1992, 16–19, 21–23.

TOPIC: ONE-POINT PERSPECTIVE USING DIAGONAL LINES

Ching 2009, 117–121.

TOPICS: VERTICAL VANISHING LINES, DIAGONAL LINES, OBLIQUE LINES, OBLIQUE VANISHING POINTS, DIAGONAL VANISHING POINTS, 45° VANISHING POINTS.

Forseth 1980,154–158.

TOPICS: ONE-POINT OFFICE METHOD, SECTION PERSPECTIVE, PLAN PERSPECTIVE

Ching 2009,116,122.

Lin 1993, 116–120,124–134.

TOPICS: CIRCLES, CIRCLES AND ELLIPSES

Ching 2009, 137.

Forseth 1980, 168–169,170.

Hanks and Belliston 1980,122–123.

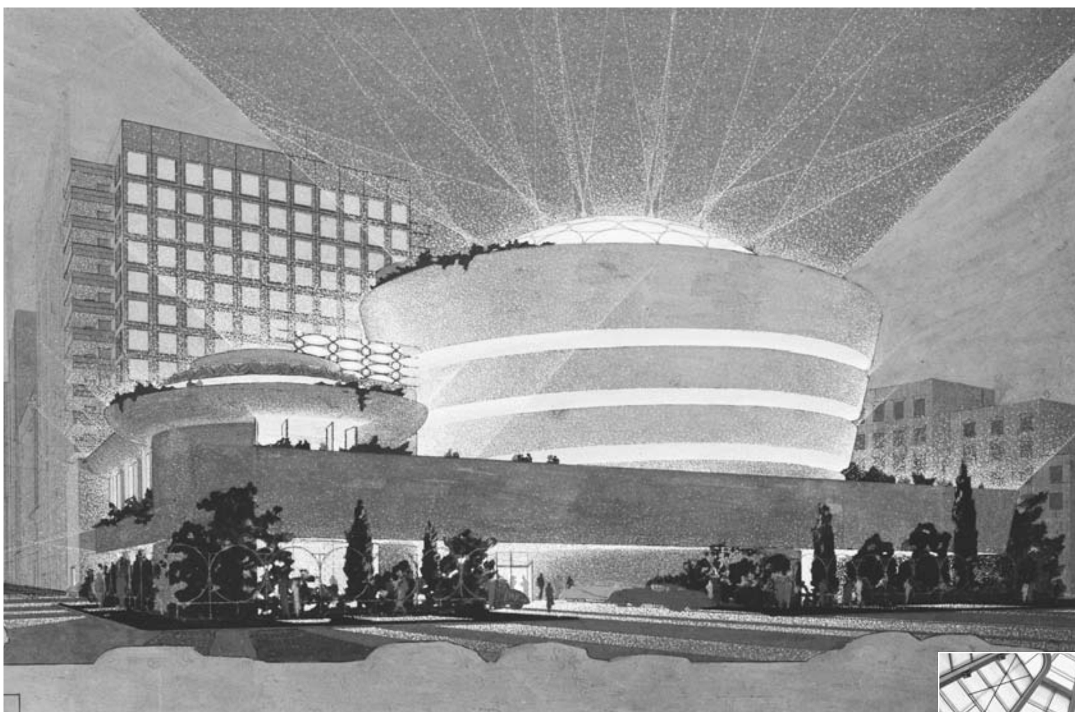
Chapter Overview

After studying this chapter and doing the related exercises in the book's final section, you will understand important perspective terms, as well as how to construct one- and two-point perspectives. For continued study of the principles discussed in this chapter, refer to Forseth 1980 and Ching 2009.

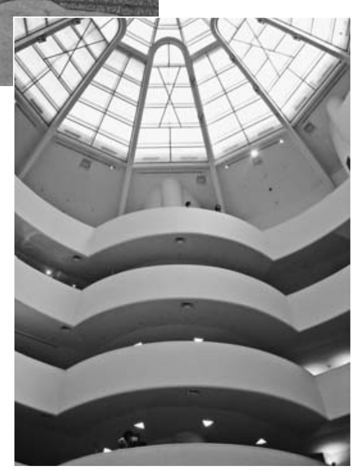
Perspective is a method of depicting the manner in which objects appear to the human eye with respect to their relative positions and distance. The optic mechanism of seeing the urban landscape is done simultaneously with both eyes, and as a result we visually experience things three-dimensionally or spatially. The term “perspective” comes from the Latin *perspectare,* which means “to view through.” The origin of linear perspective theory comes from the Renaissance. The perceptual schema of Western philosophy and civilization values a drawing system that logically duplicates an individual’s visual experience. Thus, linear perspective is considered “correct” in the sense that it values representation.

Architects use perspectives in both preliminary and final design stages. They utilize both drafting’s traditional manual methods and computer programs to generate desired perspective views to aid in the design process. To fully appreciate perspective drawing, it is important to understand the time-consuming hand-drawing procedures before embarking on quicker computer methods. Manually constructed methods form the basis for the computer programs used today.

In the preliminary design stages, rough freehand perspective drawings are the norm. In the final presentation stages, perspectives are accurately constructed for the purpose of rendering them. In 1949, Frank Lloyd Wright did a rendered conceptual drawing for his famous Guggenheim Museum in New York City showing a tower in the background that at the time was not built. The complete dream in the perspective rendering finally came to fruition with the completion of the tower addition done by Gwathmey Siegel & Associates in 1992.



Frank Lloyd Wright
Solomon R. Guggenheim Museum (night rendering), ca. 1950–1951
37" × 26" (94 × 66 cm)
Medium: Tempera and black ink on composition board
Collection Peter Lawson-Johnston
Photograph by David Heald © The Solomon R. Guggenheim Foundation, New York



© Marcus Chaw

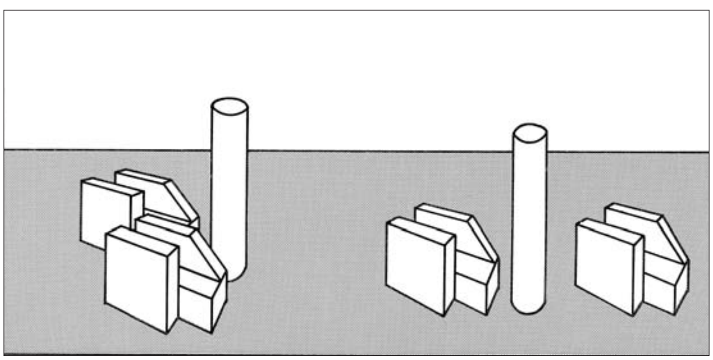
Bear in mind that perspective drawing is the primary tool to present a point of view in three dimensions from a position where you would find an informative and interesting vantage point experience before it materializes. It is a form of drawing the future.

INTRODUCTION

Photo: Waterfront pier
San Francisco, California

© Albert Lee

Whether we are viewing the environment or attempting to realistically depict what we see on a two-dimensional, flat drawing surface, we experience four major phenomena: (1) diminution, (2) overlapping, (3) convergence, and (4) foreshortening. *Diminution* occurs when equal-sized objects, such as the lampposts above, appear to diminish in size with distance. This can be seen on the opposite page, where a fixed observer notices that columns and arches of equal size appear to diminish with distance. Photographs require the cameraperson to view from a frozen position, much like the single vantage point of any perspective drawing. Thus, perspectives have a photolike quality.



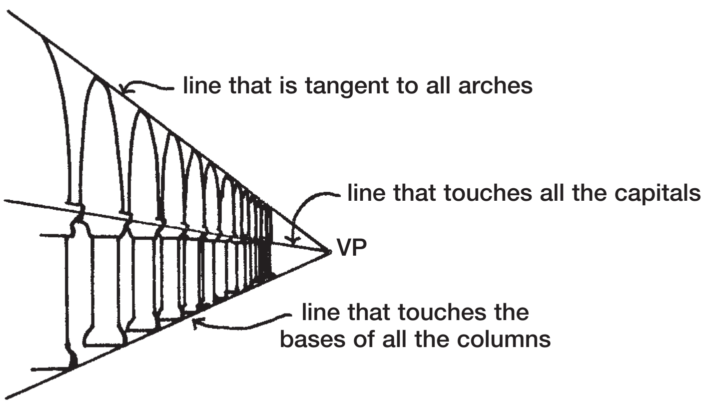
Two of the three towers in the upper-right photo show an overlapping condition with a visual depth of field, whereas the tower on the far right is isolated and gives less feeling of depth in space. When we see objects *overlapping,* a sense of depth and space is achieved. Isolated objects provide very little sense of spatial depth—if any. These towers, which have a combined weight of 350 tons, symbolize power and freedom. They are giant visible signs by day and vivacious sound and light sculptures at night. The night view evokes a sense of motion due to the lighting effects that animate the spaces they occupy.

Photos: The Towers of Biel and Open Architecture
Forum Arteplage Biel, Switzerland
Architect: Coop Himmelb(l)au
© Arcspace
Photos: © Gerald Zugmann

© Rendow Yee

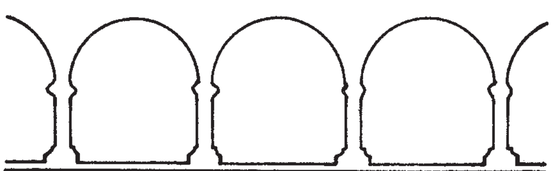
Stanford University quadrangle, Palo Alto, California
Shepley, Rutan and Coolidge, Architects

These two photographs of a series of arches were taken from two different vantage points. The oblique angle at left is the frontal exterior side of the series of arches, whereas below the angle is from behind the series of arches. In both cases a *convergence* of parallel lines occurs: the line tangent to all the arches vanishes to the same point as the line that touches the bases of all the columns.

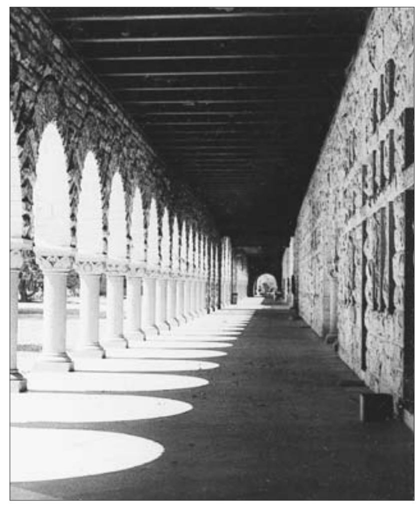


FORESHORTENED ARCHES

The three lines that converge above would be parallel if drawn in the true-size view below.



TRUE-SIZE ARCHES



© Rendow Yee

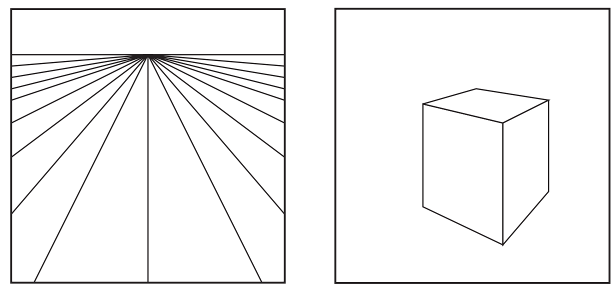
Photo: Macao Science Center
Macao, China
Photographer: L. C. Pei
© Pei Partnership Architects LLP

In a head-on view, there would be no illusion of perspective space because no convergence would be evident. The arches would be seen in their maximum or true size. At an oblique angle the arch size becomes *foreshortened* since it is no longer in its true size. The semicircular arch becomes elliptical in all oblique-angle positions. In the photo at right, the vertical structural elements on this pedestrian bridge show significant foreshortening as the horizontal elements converge to a distant vanishing point.

Webster's Dictionary defines "cue" as a hint or intimation. We pick up visual cues all the time. The cues may not always be exactly how we see the physical environment. In general, what we see can be called "perspective" cues. The most fundamental and efficient types of drawing cues are those that employ lines to record the edges of surfaces as we experience them in reality. These are called perspective cues because they represent the relationships between the edges of surfaces at a particular point in time and space—a particular perspective on the world. Perspective cues have been codified into three drawing systems: *linear perspective, paraline perspective* (used here to include axonometric and oblique systems), and *orthographic perspective* (multiview drawings). None of these is exactly how we see the world all the time. Each represents certain perceptual and cognitive realities—some combination of what we see and what we know about things.

Linear Perspective Cues

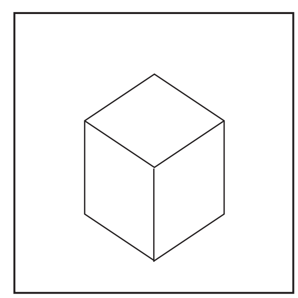
Linear perspective is most acutely experienced in places where long rectangular surfaces begin near the observer and recede into the distance, such as long, straight roads. The essential experience is that the parallel lines seem to come together in the distance. The edges of surfaces are represented by lines that follow the rules of linear perspective, and each has a line grammar. One-point perspectives have vertical lines, horizontal lines, and perspective lines (lines that go to vanishing points). Two-point perspectives have vertical lines and perspective lines. Three-point perspectives have only perspective lines.



Diagrams and text: Courtesy of William R. Benedict, Assistant Professor
California Polytechnic State University
College of Architecture & Environmental Design
San Luis Obispo, California

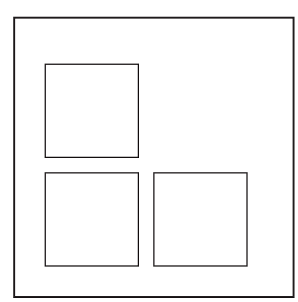
Paraline Perspective Cues

The Western perceptual schema is culturally biased toward linear perspective. To other cultures and in other times, a paraline drawing looked more "correct" than one using linear perspective. When things are small relative to our visual field, their edges and surfaces tend to retain their dimensions. The degree to which the edges vanish is so slight that our knowledge of their equality in length and angle can easily be more important than their adherence to the linear perspective. Paraline systems codify this view of reality. The edges of surfaces are represented by lines that follow the rules of paraline drawing conventions. The edges of parallel surfaces remain parallel and retain direct measured relationships to each other and the thing being represented. Verticals remain vertical and the other axes slope at specified angles.



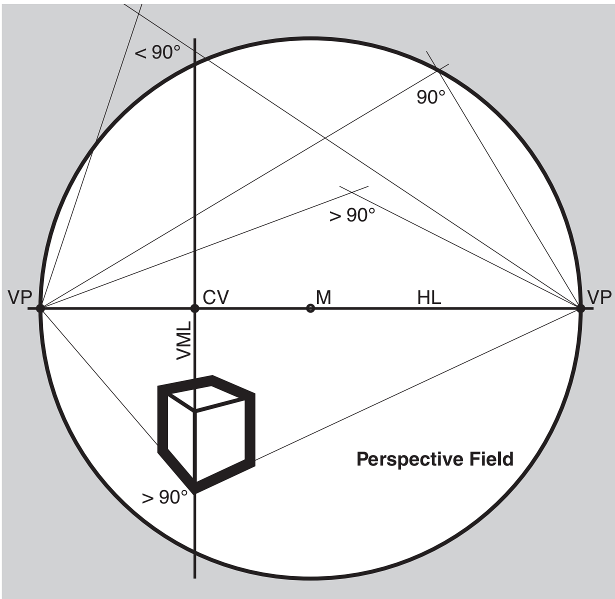
Orthographic Perspective Cues

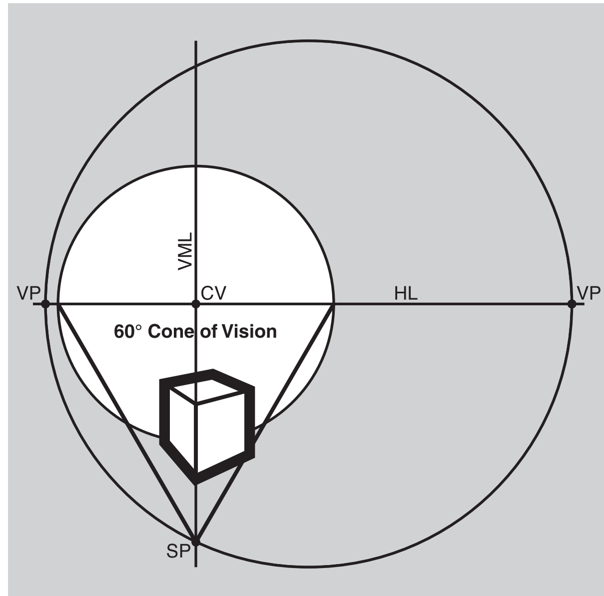
Orthographic perspective is less acceptable to our eyes and requires experience with its conventions to be able to read it. It represents a single object with multiple drawings and requires the ability to assemble the drawings in your mind. We experience things in orthographic perspective when their surfaces are relatively flat and we are standing directly in front of and facing them. As we move away from an object, our experience more closely corresponds to an orthographic drawing. The edges of surfaces are represented by lines that follow the rules of orthoghraphic drawing. Parallel edges remain parallel and retain direct measured relationships to each other and to the thing being represented. Verticals remain vertical, horizontals remain horizontal, and the depth axis is represented by a point.



Linear perspective drawing is a tool used by the designer or delineator to make a reasonably accurate representation of a three-dimensional object on a two-dimensional surface (the drawing sheet). A linear perspective drawing is an image of an object projected upon an assumed plane (the picture plane, or PP) that is parallel to the observer's face or eyes. When used as a representational tool for the design-drawing process, it is of utmost importance not to misrepresent the physical appearance of buildings with inaccurate perspective representations. The following are the most commonly used terms in the vocabulary of perspective drawing techniques.

TERM	ABBREVIATION	DEFINITION
Station Point	SP	• A vantage point location to view an object or group of objects; the location of the observer's eye. Object projection lines (also termed *visual ray* or *sightlines*) converge to this point.
Picture Plane	PP	• A stationary, transparent, two-dimensional vertical plane or "window." This window receives a true-size image from the projection lines that converge to the station point. It is perpendicular to the ground plane and parallel to the observer.
Line of Sight	LS	• An imaginary central axis line projected from the observer's eye (station point) that intersects the vertical picture plane perpendicularly. It is perpendicular to the observer.
Horizon Line or Eye-Level Line	HL	• The horizon line represents the observer's eye level and is recorded on the picture plane. It is the vanishing line for all horizontal lines and planes.
Ground Line	GL	• The line where the picture plane and the ground meet. The ground line lies within a ground plane from which vertical measurements are made.
Ground Plane	GP	• The reference plane where the observer is situated. It can be at any level (real or imaginary), depending on the vantage point of the perspective view.
Vanishing Point	VPL, VPR, and VP_o	• A point on the horizon line where any group of parallel horizontal lines converge in perspective. Groups of oblique (inclined) parallel lines vanish either above (sloping upward) or below (sloping downward) the horizon line. Parallel lines that are parallel to the picture plane do not converge.
Vertical Measuring Line	VML	• A vertical line within the picture plane. Vertical height dimensions are transferred from an elevation to this vertical true-length line in order to be projected into the perspective drawing.
Midpoint	M	• A point located on the horizon line that lies halfway between the vanishing points in a two-point perspective.
Horizontal Measuring Line	HML	• A horizontal line lying in the picture plane; it is therefore a true-length line.





Acceptable Distortion

Linear perspective formalizes through geometry a system that attempts to represent three-dimensional reality on a two-dimensional surface—that is, it attempts to place a portion of the visual field on a page. Because it is a closed system assuming a fixed, one-eyed observer, it has limitations that must be respected if the goal is to accurately represent perceived visual reality—for the drawing to "look right." The cube that is drawn with its lead edge coinciding with the vertical measuring line (VML—the line drawn through the center of vision) and centered vertically on the horizon line is the most accurate cube in the perspective. As the cubes move away from this location, they become progressively more distorted. The question, therefore, is how far from this location does a perspective retain sufficient accuracy so as not to be visually disturbing—what are the limits within which the perspective looks right?

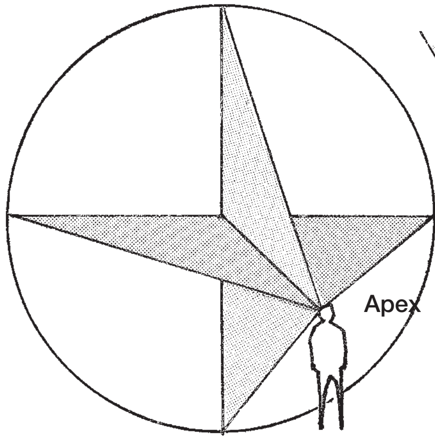
Cone of Vision

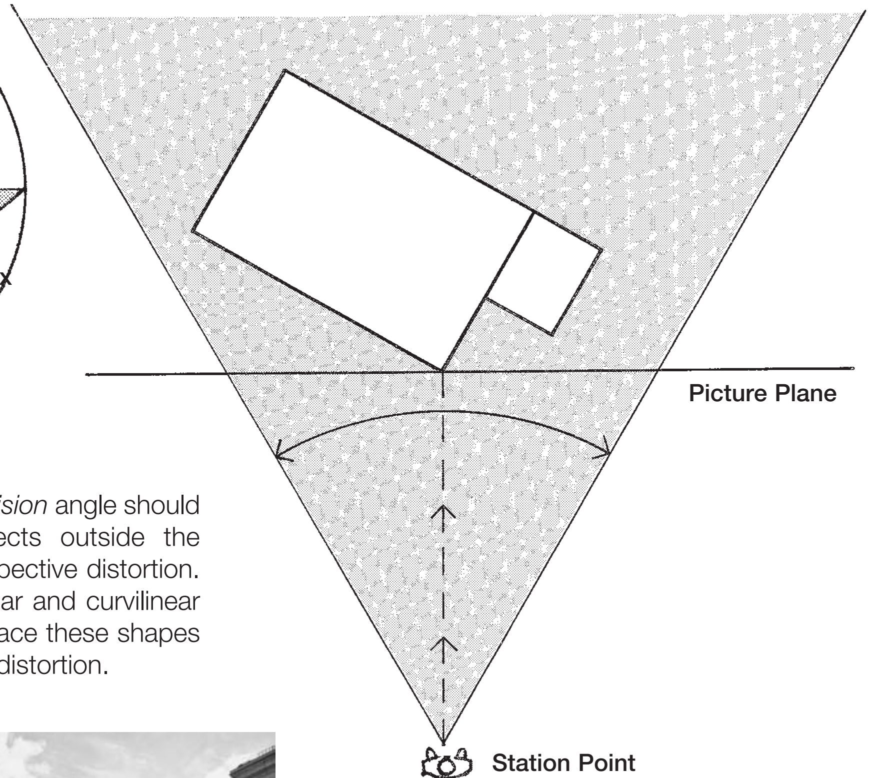
For any given perspective setup, there is a finite area surrounding the center of vision (CV) within which the perspective will look normal. The limits of this area are defined by a *cone of vision* (COV), which starts at the station point. The cone of vision links the way our eyes work and controls *distortion* within the perspective system. A 60° cone is one that extends 30° to either side of our line of sight. This illustration simultaneously shows a 60° cone of vision in both plan and perspective. For any measuring point perspective setup, the cone of vision can be constructed to establish the area within which a perspective will look "most correct."

Diagrams and text: Courtesy of William R. Benedict,
Assistant Professor
California Polytechnic State University
College of Architecture & Environmental Design
San Luis Obispo, California

Perspective Field/90° Horizontal Corner

The *perspective field* is the area defined by a circle whose center is located at the midpoint (M) and whose circumference intersects the two horizontal vanishing points in a two-point perspective. The perspective field can be used to control the near internal angle of horizontal rectangles to 90° or greater. When the angle becomes less than 90°, it does not look right. Any two lines intersecting at the circumference of the perspective field will create a 90° angle. Those intersecting beyond the circumference will create an angle of less than 90°, while those intersecting within the perspective field will create an angle of more than 90°. Therefore, the perspective field provides a guideline for establishing some limits within the linear perspective system.





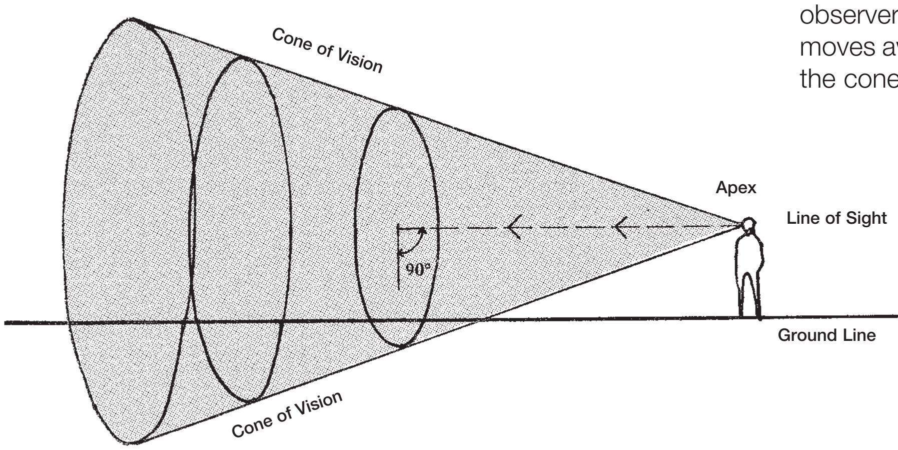
Cone of Vision

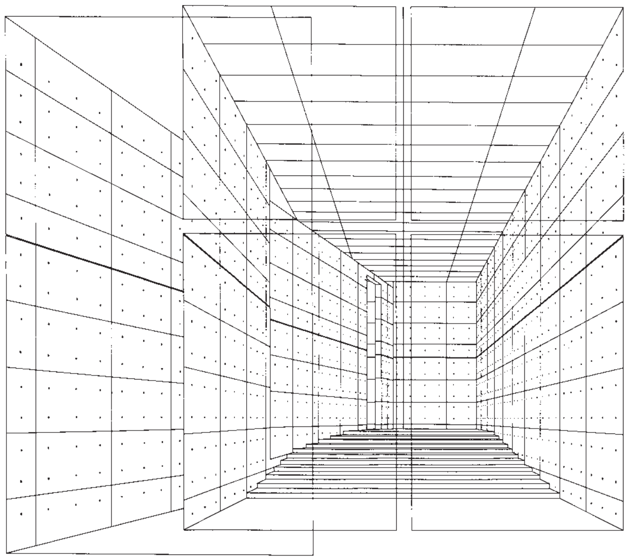
To prevent distortion, the *cone of vision* angle should not exceed 60°. Peripheral objects outside the cone of vision will suffer from perspective distortion. Minimal distortion occurs for circular and curvilinear shapes within a 60° cone; try to place these shapes within a 30° cone to eliminate any distortion.

Photo: Labels 2 Fashion Center
Berlin, Germany
Courtesy of HHF Architects

This building's facade features two differently cut mathematical sine curves.

Think of the three-dimensional *cone of vision* as what you can see without moving your eyes (see photo). The boundary of this view is the cone's surface. The area of nondistorted vision is the area of the base of the cone (a true circle) that is perpendicular to the observer's central axis line of sight. This circular area on the vertical picture plane can be seen in clear focus when the apex angle is 60° or less. The area viewed increases in size as the picture plane moves away from the observer's eyes. However, if the observer moves away from an area of constant size, the cone of vision angle becomes smaller.



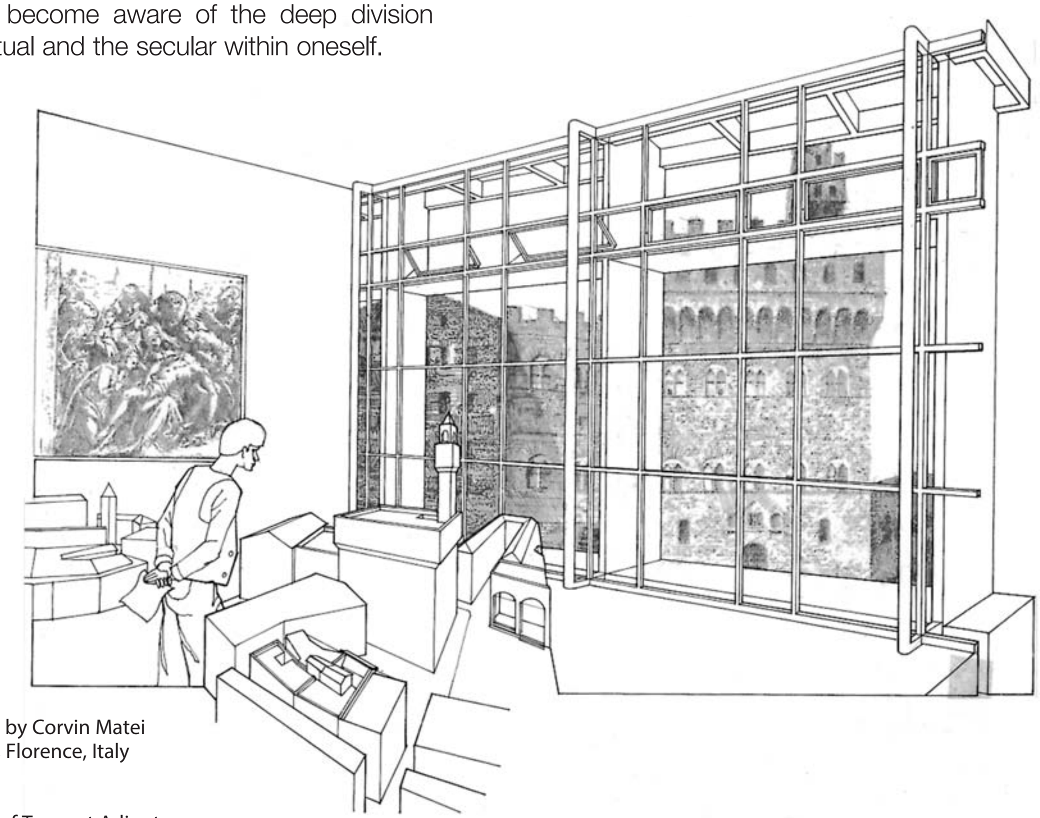


Drawing: Church of the Light, Ibaraki, Japan
23.3" × 16.5" (59.2 × 41.9 cm)
Medium: Ink
Courtesy of Tadao Ando, Architect

Light enters the chapel through the cross cut in the concrete. At this intersection of light and solid, Ando wants the occupant to become aware of the deep division between the spiritual and the secular within oneself.

The Picture Plane

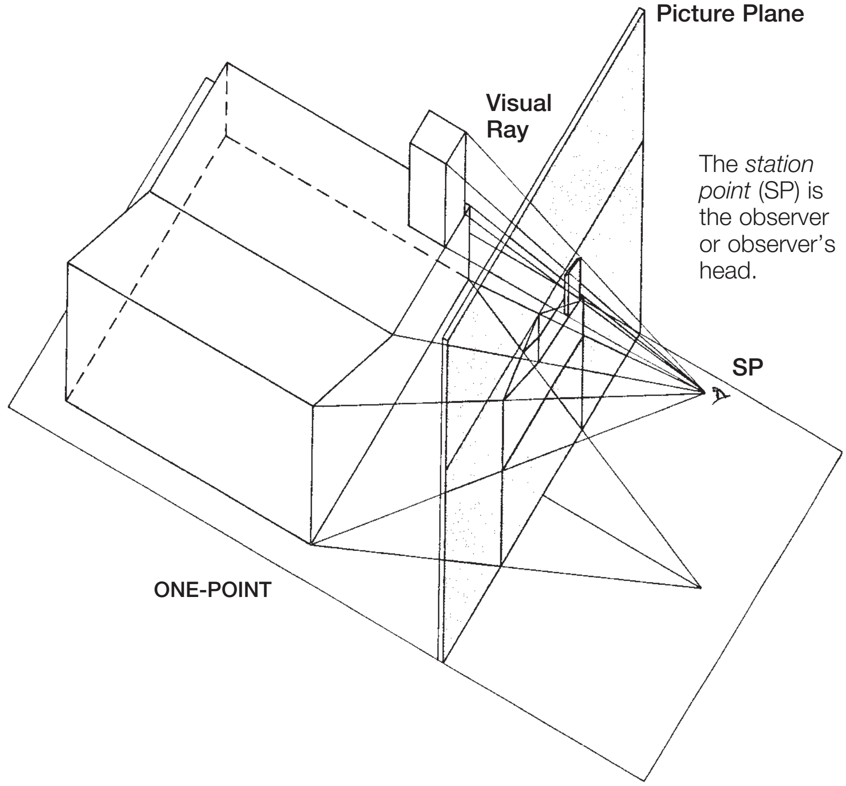
This transparent interior perspective shows the wall with a cross slit behind the church's altar. The wall simulates a vertical picture plane through which one can capture the perspective view. An exception to the flat, two-dimensional picture plane is the spheroidal (similar to a sphere but not completely round) picture plane used with a fish-eye lens view.

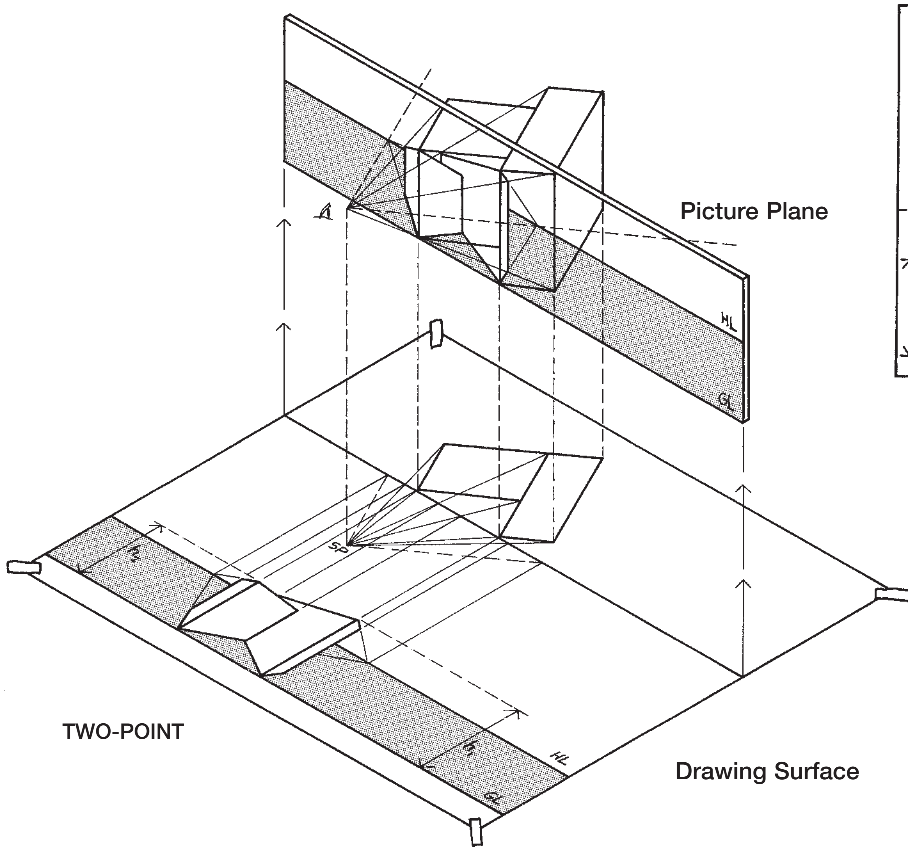


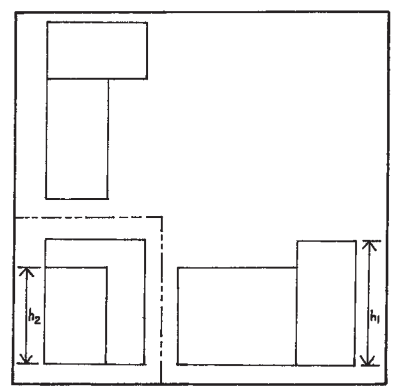
Drawing: Student project by Corvin Matei
Vasari Museum, Florence, Italy
10" × 8" (25.4 × 20.3 cm)
Medium: Ink on Mylar
Courtesy of the University of Texas at Arlington
School of Architecture

A window is a fixed transparent vertical plane. When we look through a window, our eyes receive images of the three-dimensional objects we see. These images are translated onto a two-dimensional plane (the window) at an infinite number of points when our lines of sight intersect the window. Thus, the window becomes the *picture plane.* This drawing shows the viewpoint of an observer looking through a window. Note that the observer's side with the widest upper-body dimension is always parallel to the picture plane (window).

To the right is an example of parallel one-point perspective. The image of the building form is projected on the picture plane by sight lines that intersect the picture plane. Vertical and horizontal lines in the building retain verticality and horizontality in the image. Lines in the building not parallel to the picture plane will converge to a vanishing point. Because the building form is behind the picture plane, it is projected smaller than true size on the picture plane. If it were in front, it would be projected larger than true size. A one-point perspective always has a plane parallel to the picture plane. Any planes perpendicular to the picture plane vanish to one point. A two-point perspective (below) has angled planes (not parallel) to the picture plane.







The *picture plane* is always perpendicular to the drawing surface and the central line of sight. It is represented by a *line* on the drawing. Also on the drawing, the observer reduces to a dot and the building form to a two-dimensional plan view. True heights (**h_1** and **h_2**) are always obtained from a set of orthographic drawings (plans and elevations). They are measured vertically from the ground line.

You can manipulate a perspective image by changing certain variables. These include moving the picture plane, changing the orientation, changing the station point location with respect to the object, and moving the horizon line up and down.

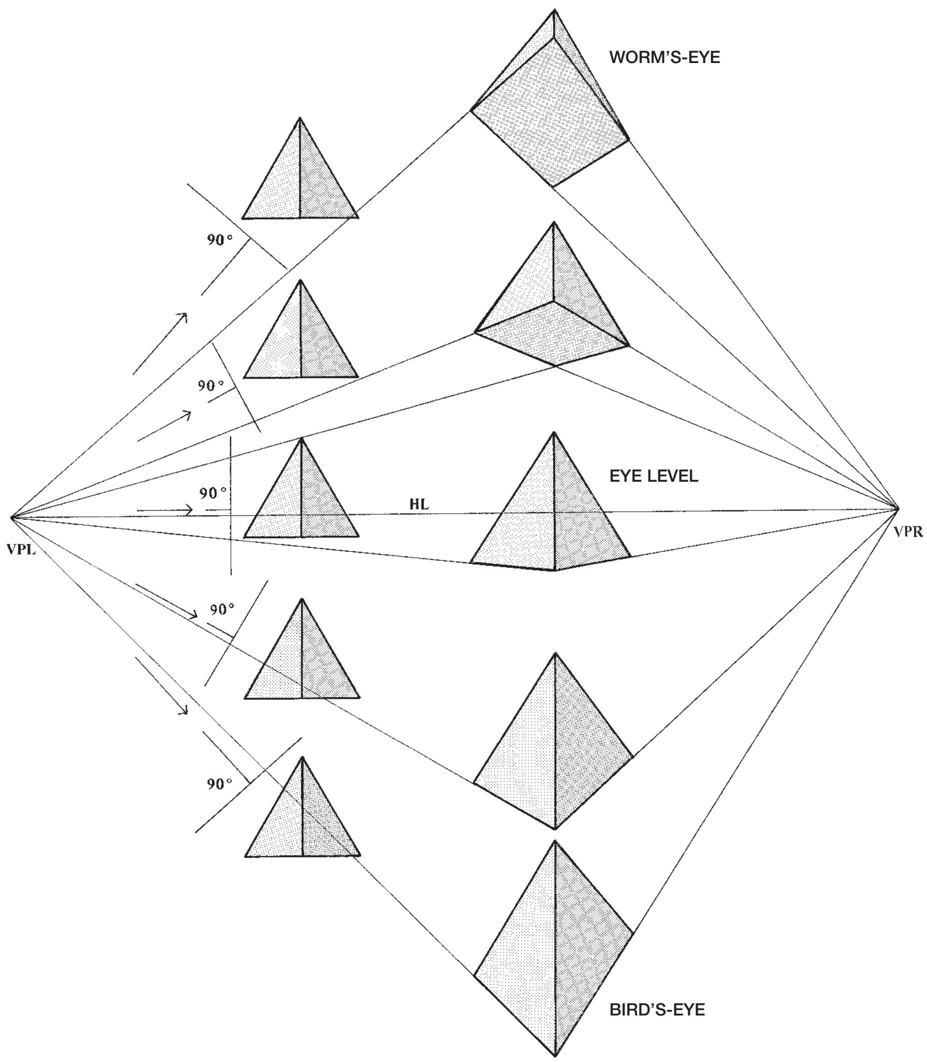


Photo: Shanghai World Financial Center
Park Hyatt, Shanghai, China
Courtesy of Kohn Pedersen Fox Associates / H. G. Esch

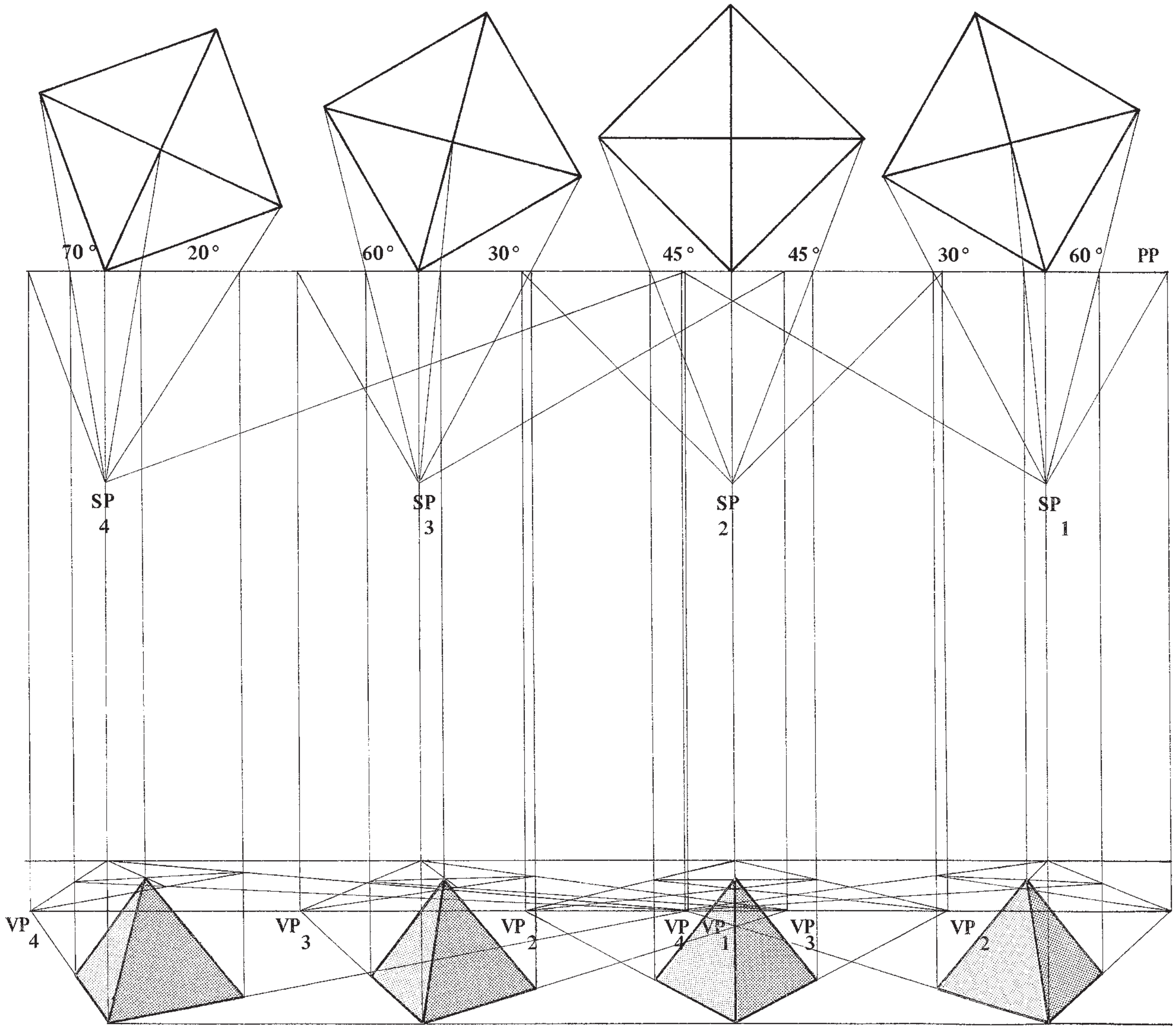
This is a square prism (representing the earth) intersected by two cosmic arcs (representing the heavens). A square sky portal is carved at the top. Best tall building worldwide in 2008 (Council on Tall Buildings and Urban Habitat).

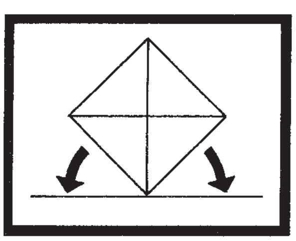
Photo: Northeast Asia Trade Tower
Songdo IBD, Incheon, Korea
Courtesy of Kohn Pedersen Fox Associates

This 68-story tower has high-performance glazing with exterior shading devices. Limiting solar heat gain and reducing cooling loads, it is a model of sustainable design strategies.

Pictorial Effect

In this example, the picture plane and the orientation remain fixed. The horizon line and station point with respect to the ground plane moves up and down. As they move up, an aerial view of the pyramid becomes apparent. As they move down, a greater amount of underside view becomes apparent.





Each *orientation* change produces a new set of angles with respect to the picture plane.

In this example, the picture plane, the station point location, and the horizon line remain fixed. The orientation changes. As the plane of the pyramid sides turn away from the picture plane, you see less of its surface. In other words, it is foreshortened more.

This photo is a more static view of an otherwise very dynamic assemblage of mostly primary forms. This is not a formal pyramid at all; nevertheless, the view gives one the illusion of a pyramid colliding into a rectangular block.

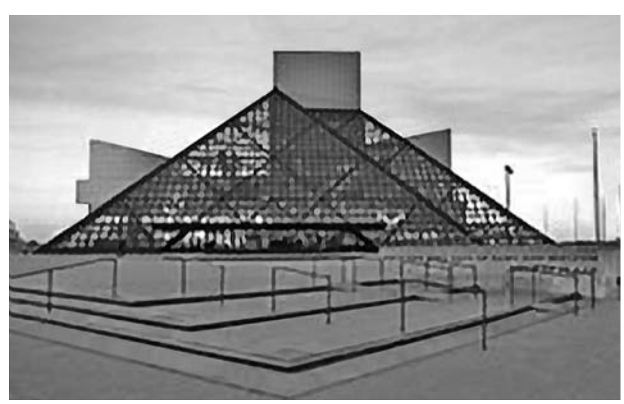
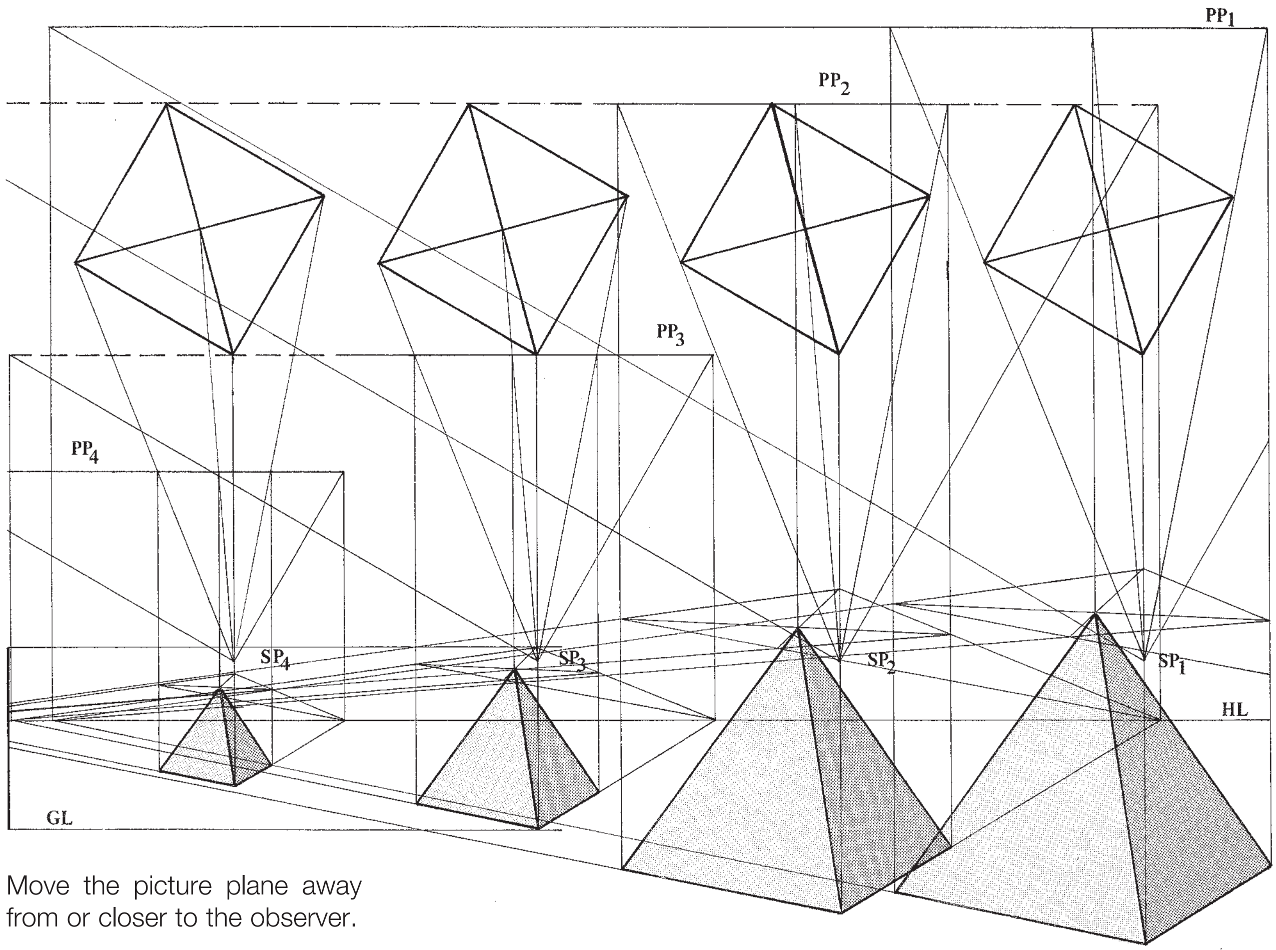
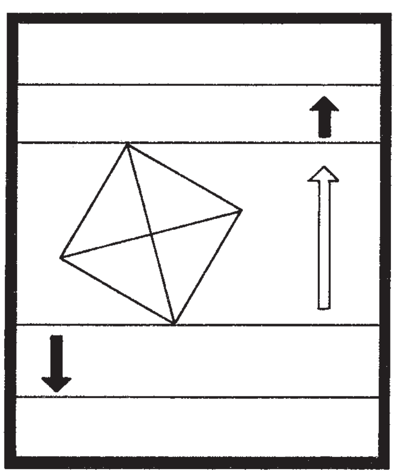


Photo: Rock and Roll Hall of Fame
Cleveland, Ohio
Architect: I. M. Pei & Partners
Courtesy of Wikipedia

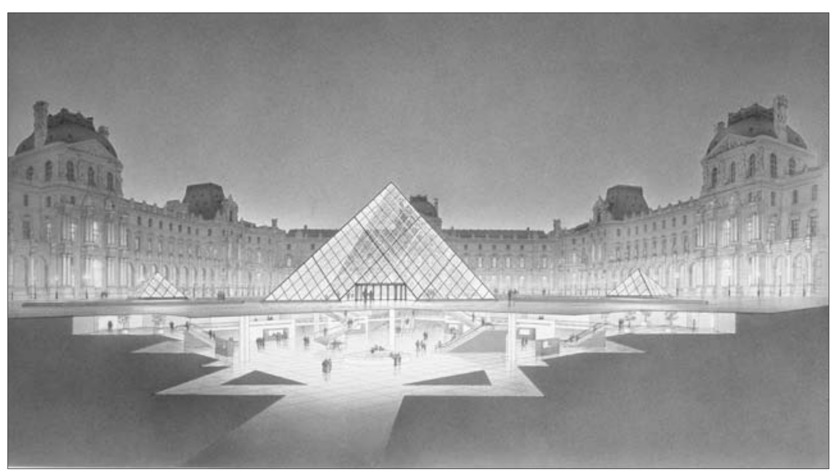
Note that increasing the distance from the picture plane to the station point (**PP_4** to **PP_1**) causes a progressive enlargement of the perspective images that have a similar projection.



Move the picture plane away from or closer to the observer.

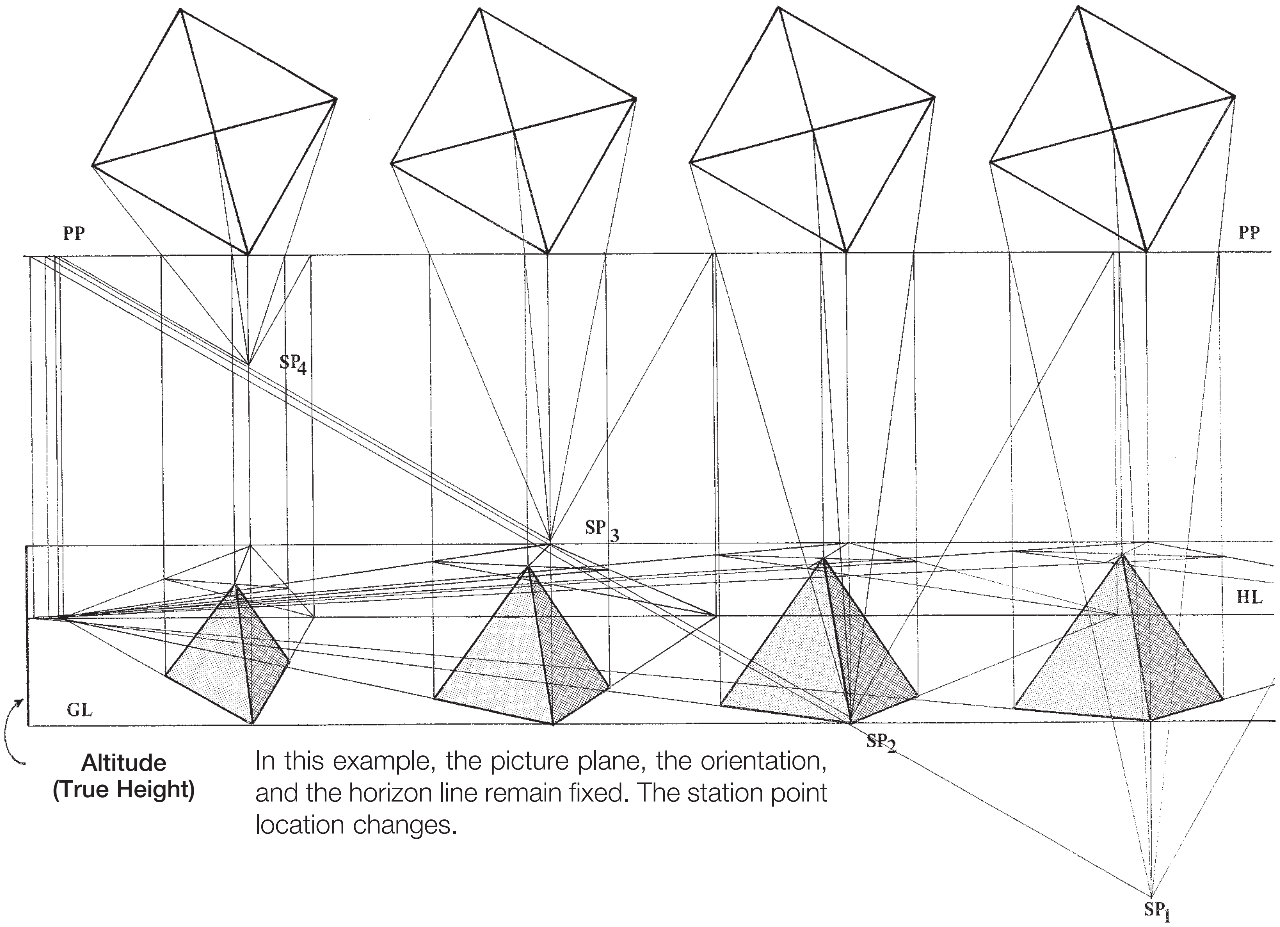


In this example, the station point location, the horizon line, and the orientation remain fixed. The *picture plane* location changes.

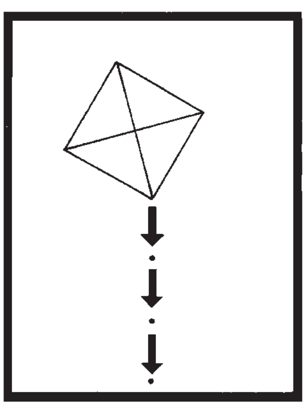


Drawing: The Pyramid at Le Grand Louvre, Paris, France
30" × 16" (76 × 41 cm)
Medium: Acrylic
Pei Cobb Freed & Partners / Michel Macary Architects
Courtesy of Lee Dunnette, Architectural Illustrator

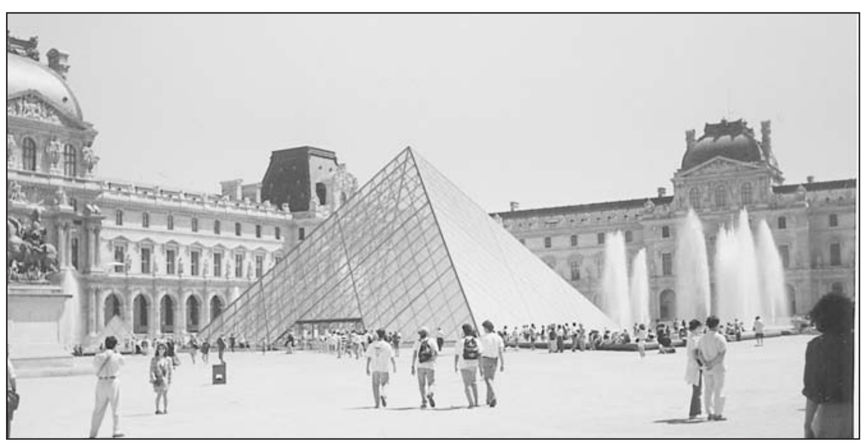
Note that increasing the station point distance to the object (**SP$_4$** to **SP$_1$**) causes a decrease in foreshortening due to the two vanishing points progressively moving away from each other.



In this example, the picture plane, the orientation, and the horizon line remain fixed. The station point location changes.

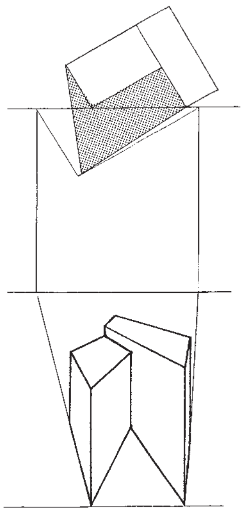


The observer moves away from the viewed object.



© Olallo L. Fernandez

The large expansion of this historic museum was conceived as a subterranean structure to maximize exhibition space with controlled lighting and indoor connections to several visitors' entrances. With only the glass pyramid exposed to let in natural light at the grand concourse, the architect masterfully created a dialogue between an old ornate building and a modern version of the pyramid, which is one of the oldest structures in history. Supporting glass with a set of thin metal truss systems testified to Pei's attention to detail.



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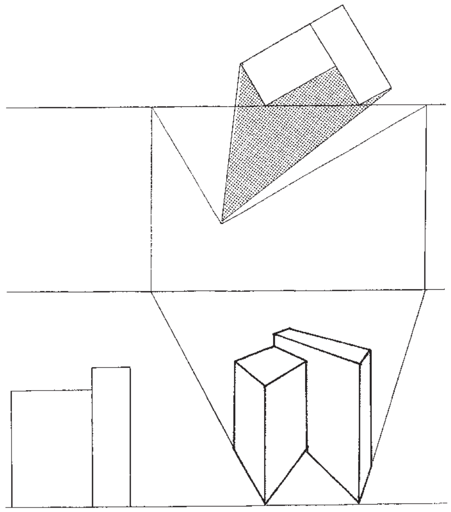

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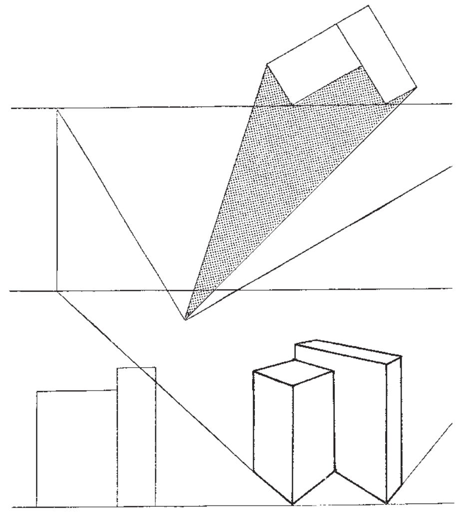

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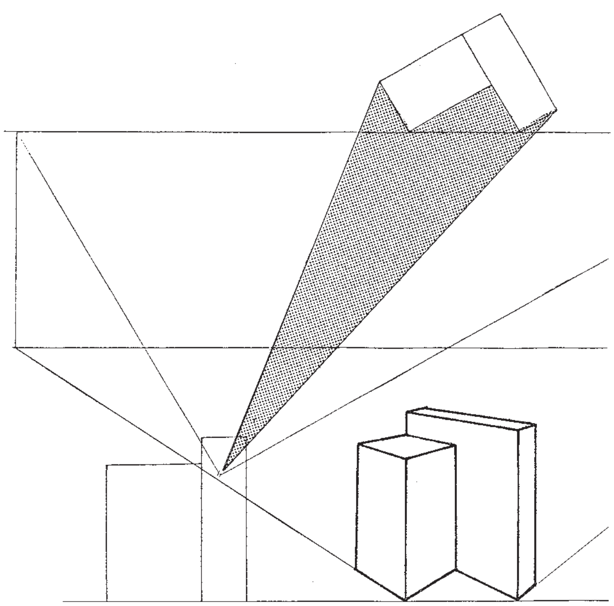

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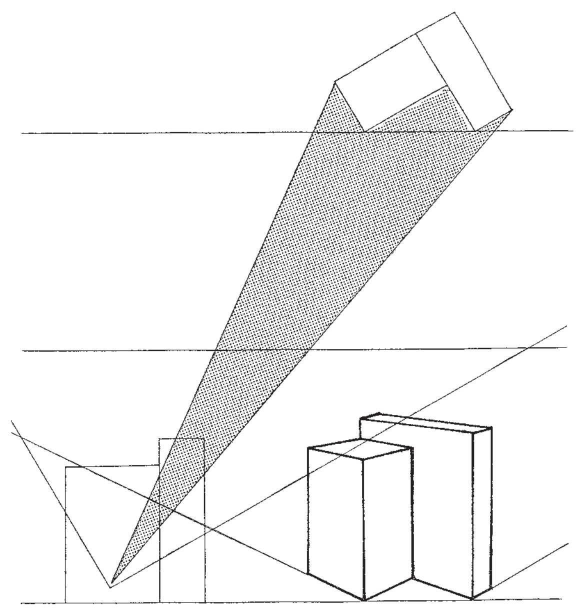
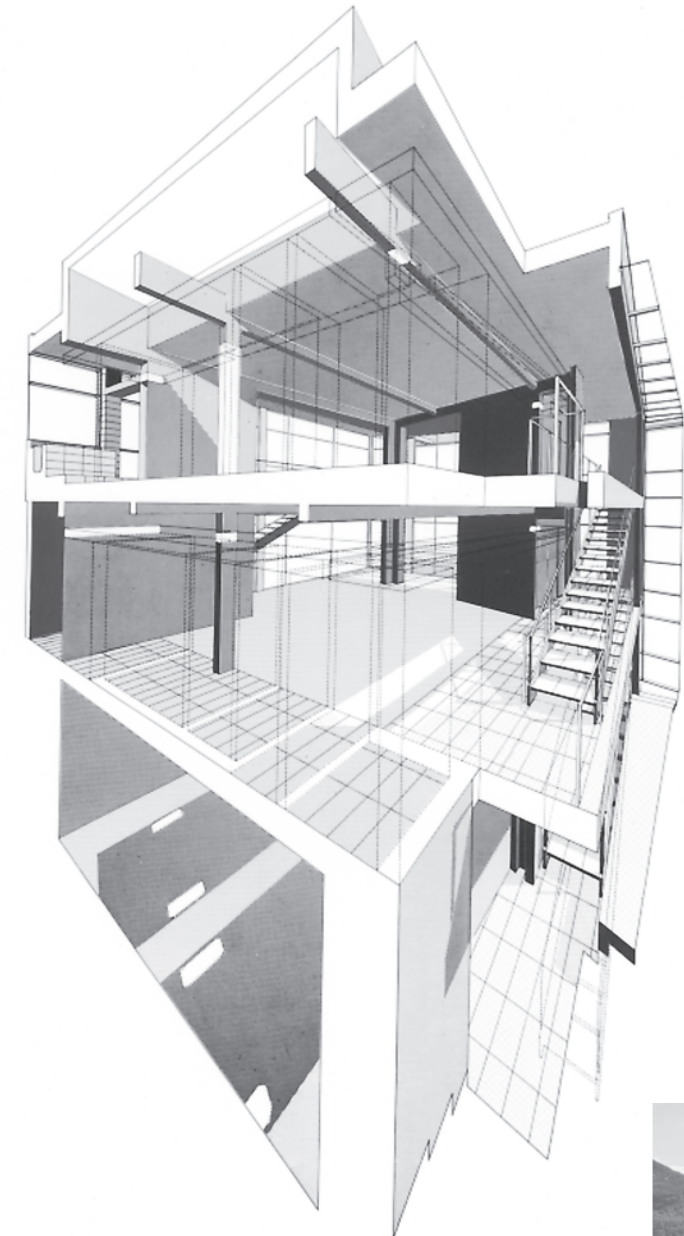


5

Distortion

Distortion, shown here in two-point perspective, is dependent on the spacing of vanishing points. A very close station point location with close vanishing points results in extreme convergence with a great amount of foreshortening (see **1** and **2**). A very distant station point results in minimal convergence with very little foreshortening. A more natural pictorial view is obtained by spreading the vanishing points apart (see **4** and **5**). However, try not to spread them too far apart or a distorted flatness will occur. A good distance from the SP to the PP is three times the object height, or 1.80 to 2.40 times the width of the scene or object.



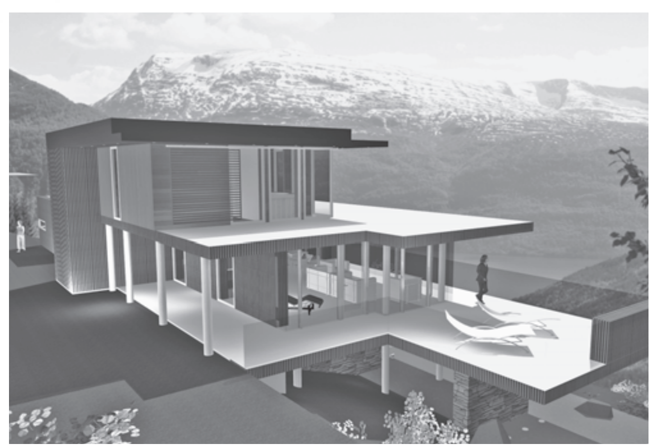
Drawing: Burnett House addition
Lake Oswego, Oregon
24" × 36" (61 × 91.4 cm)
Medium: Ink on Mylar with Zipatone
Courtesy of David Rockwood Architects & Associates

The project was an addition to an existing house having a program that duplicated existing spaces. The addition design was based on first duplicating the house in a slightly altered form, and then duplicating the addition by adding one form against the other.
[Architect's statement]

Distortion

This interior perspective shows a large amount of foreshortening with conditions similar to example **1** (opposite page). There is a point at which the vanishing points become too close with respect to the height (which relates to the cone of vision). This results in a distorted view.

Example of extreme convergence

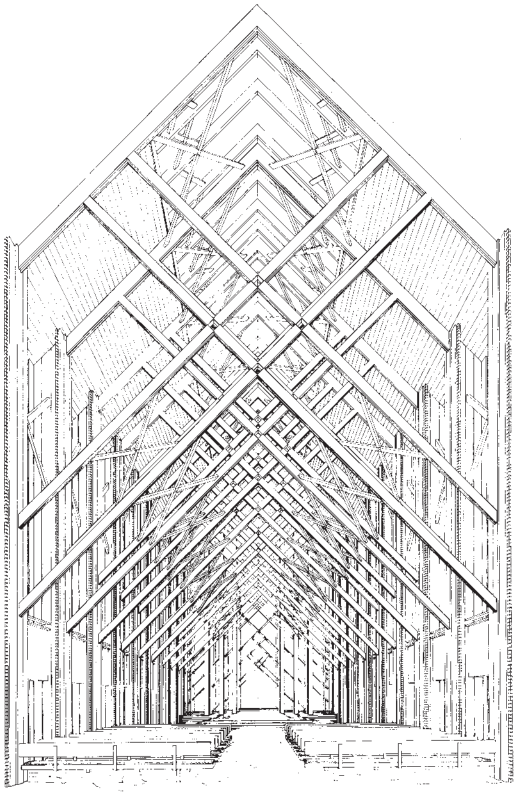


This exterior perspective shows a small amount of foreshortening with conditions similar to example **5** on the opposite page. The vanishing points are more spread apart.

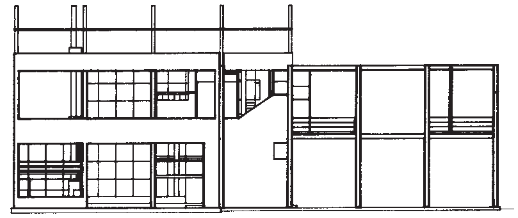
Example of a closer to natural pictorial view

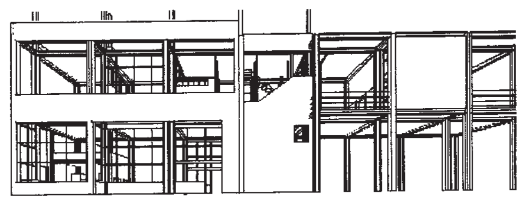
Drawing: Single House
Stryn, Norway
Medium: ArchiCad and Artlantis
Courtesy of Gudmundur Jonsson, Architect

The magnificent view toward the Stryn Valley is captured with the building front acting as a wide panoramic lens absorbing the beauty of nature. The house is essentially a balcony in the theater of mother nature.
[Architect's statement]



Drawing: Chapel for Rose Hills Memorial Park
Whittier, California
24" × 36" (61 × 91.4 cm), Scale: ¼" = 1'0"
Medium: Pencil and ink
Courtesy of Fay Jones & Maurice Jennings, Architects
Drawn by Barry McNeill/Jones & Jennings





Drawings: Student project by Lois McGinnis and Michael Patrick
Shelby's Lake House — A project in CAD
Courtesy of the University of Texas at Arlington
School of Architecture

One-Point Perspective

The above one-point perspective seen at ground level is much more descriptive than its flat two-dimensional elevation.

The three main types of perspectives are classified based on the drawing's primary vanishing points. Many drawings have secondary minor vanishing points. These building examples show that all horizontal lines that recede away from the observer's eye converge to *one* vanishing point. Therefore, they can be classified as *one-point* perspectives. Note that in all three cases, one face of the building is parallel to the picture plane.

The Aga Khan is a one-point in the most traditional sense, with the picture plane parallel to the end wall. It clearly follows the rules of a one-point perspective, with the spacing of columns getting uniformly closer as we move away from the viewer. The space expresses a sense of stationary tranquility by using perceptual transparency of marble's various materiality.

Drawing: Aga Khan Museum
Toronto, Canada
Medium: V-Ray for rendering and SketchUp for modeling
Courtesy of Maki and Associates Architects

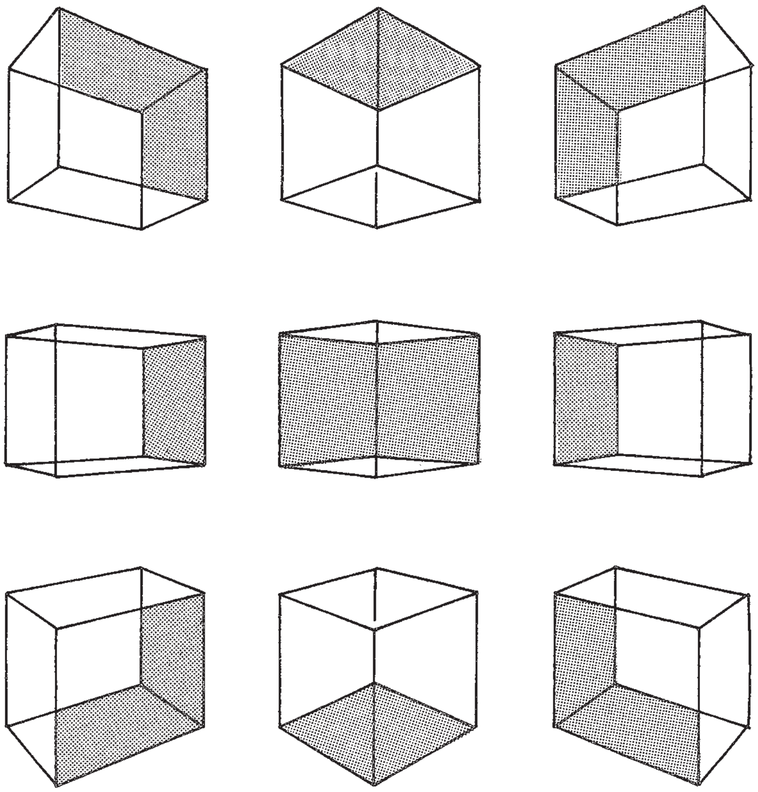
Two-Point Perspective

These building examples show their dominant facades converging on left and right sides to *two* vanishing points on their respective horizon lines. Therefore, they can be classified as *two-point* perspectives. Two-point perspectives, as in these examples, have parallel lines and edges in their dominant facades not parallel to the picture plane. With *three-point* perspectives (discussed at the end of this chapter), there is a characteristic upward or downward convergence of those same two sides to a third vanishing point.

Drawing: Student project by Ben Fasano
Medium: Pencil
Courtesy of Lauren Karwoski Magee
Director of Instruction in Representation
Department of Architecture + Interiors
Architecture Program, Drexel University, Philadelphia, PA

This "modern castle" of interwoven spaces in white concrete and glass is on a beautiful site that demands utmost contact with mother nature and the view. The upper "bridge" is stretching out in order to reach for the view toward the mountains in the east. The design approach was based on simplicity in design giving complexity in spatial experiences.
[Architect's statement]

Drawing: Single House
Volda, Norway
Medium: ArchiCad and Artlantis
Courtesy of Gudmundur Jonsson, Architect



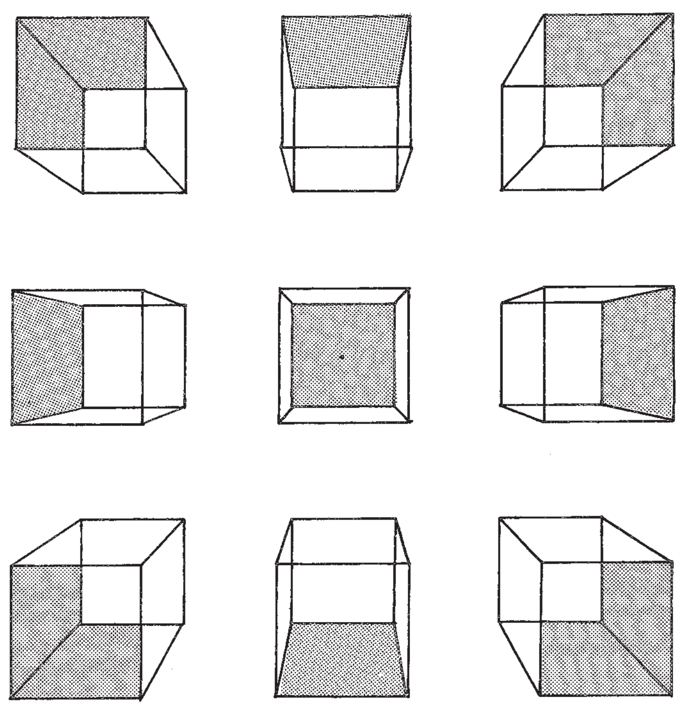
Comparing Two-Point and One-Point Perspectives

In the *two-point perspective* views shown at left, note how two sets of parallel horizontal lines converge to the left and to the right. In reality, vertical lines remain vertical only in the middle row, where the line of sight is horizontal. Looking up or down from the horizon line results in the appearance of upward or downward convergence of the vertical lines.

Look at cardboard cartons (boxes) and try to visualize them moving around in space. Visualizing and drawing a cube anywhere in space in any orientation and noticing the emphasis on different planes as the cube moves around will enhance your perspective drawing skills. Other geometric forms can be drawn and derived from a rectilinear or cubic form: the human senses of sight and touch allow us to experientially model all kinds of shapes.

© D. Finnen/American Museum of Natural History

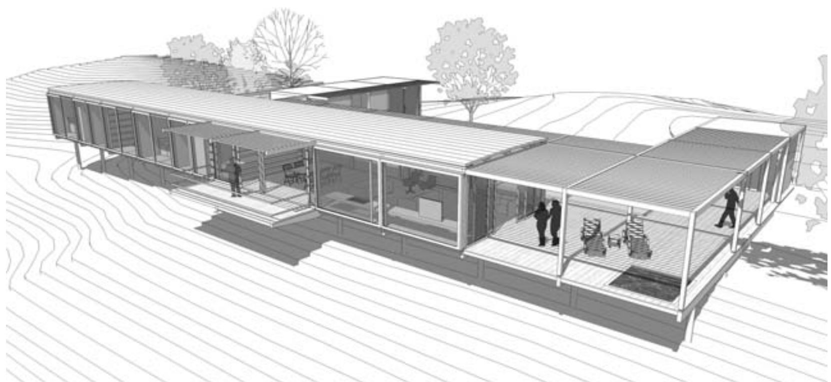
Photo: Rose Center for Earth and Space at the American Museum of Natural History (New York) by Polshek Partnership Architects

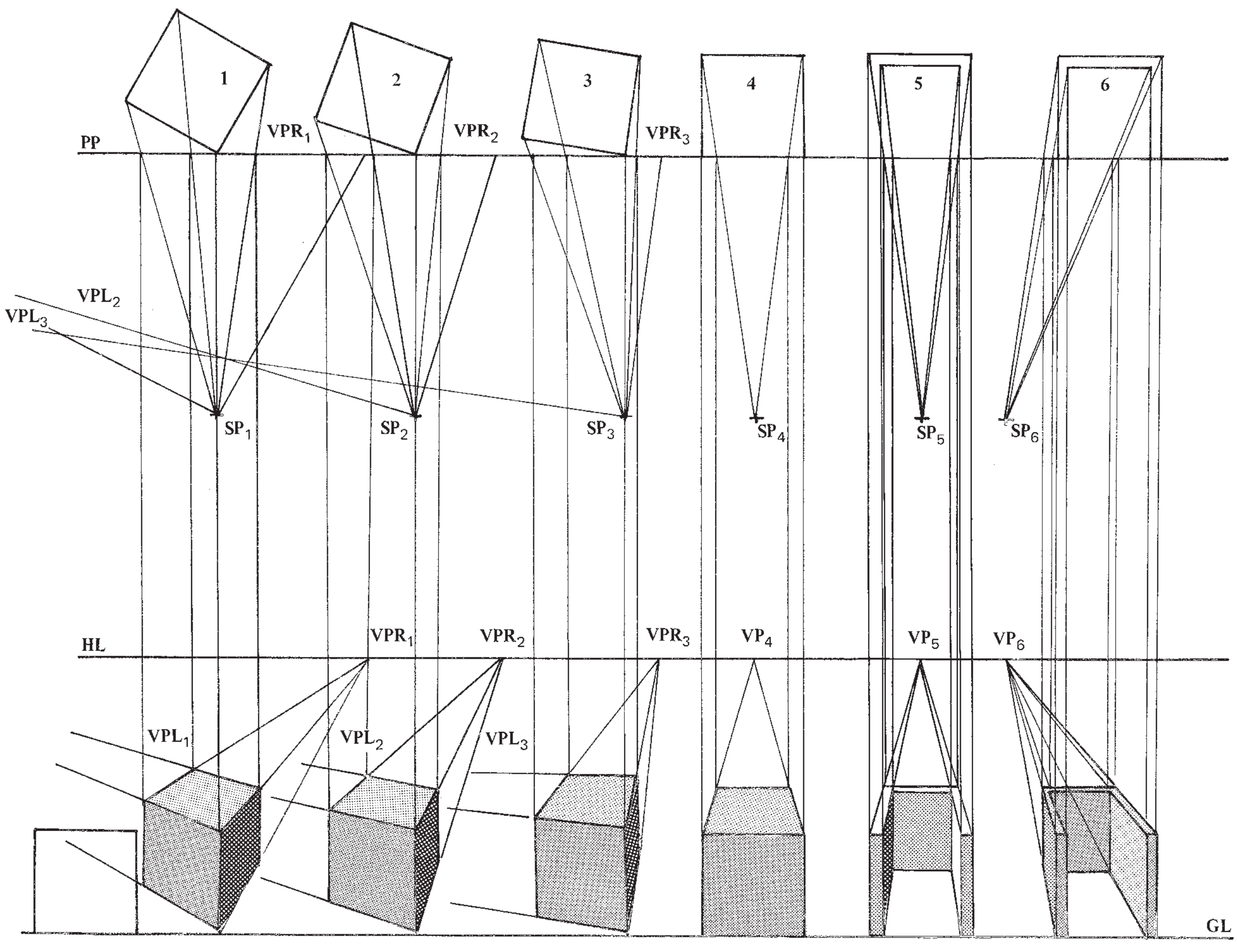


In a *one-point perspective,* the vanishing point is on a line that is perpendicular to the picture plane and intersects the observer's eyes (station point). The Rose Center's 95' high cube of suspended glass contains a 2,000-ton sphere, which is the planetarium structure. The large-magnitude glass curtain wall is among the first to be constructed in the United States.

This isolated house within a sea of mountains has two distinct spaces defined by the edge of the hill, a main volume with a glassy facade facing a view and a meeting space, protected and delimited, facing the interior of the terrain.
[Architect's statement]

Drawing: SFX HOUSE
São Francisco Xavier, SP, Brazil
Medium: SketchUp
Courtesy of Nitsche Arquitetos

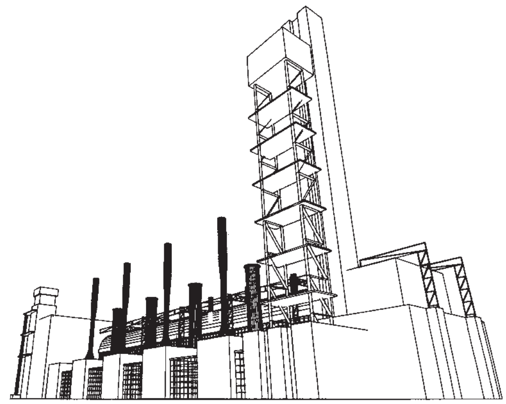




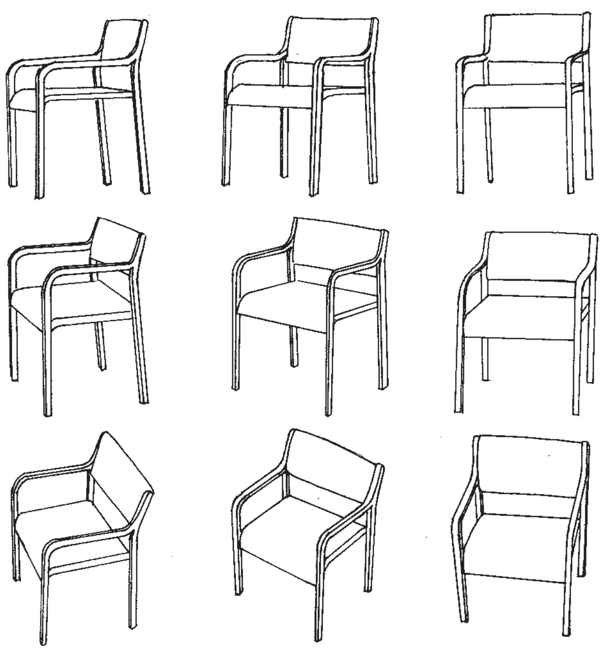
Understanding the concepts of *one-point parallel* perspective will facilitate your understanding of the construction of *two-point angular* perspective. The construction methods of one-point perspectives are therefore presented prior to those for two-point perspectives. All horizontal and vertical lines in a one-point are parallel to the picture plane—hence the term "parallel perspective." However, all lines perpendicular to the picture plane converge to the one vanishing point (**4, 5,** and **6**). Note how the cube transforms from a two-point (**1–3**) to a one-point (**4**). The illustration at the top shows characteristics of a two-point perspective. For both one- and two-point perspectives, construction methods using orthographic views (plans, elevations, and sections) will be shown first; this will be followed by methods employed without orthographic views that use measuring points.

Bird's-Eye, Eye-Level, and Worm's-Eye Views

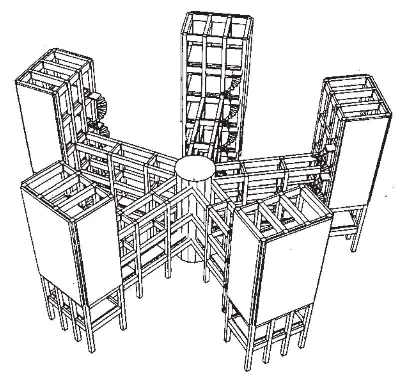
Because several people can't occupy the same physical space simultaneously, people will see the same object from different angles if they all look at it at the same time. Once we vacate a physical space, another person can experience the same viewpoint. The eye-level line would change as an observer sits down, stands up, or stands on top of an object to view the chair illustrated below. Notice the foreshortening of the legs of the chair below as an observer moves higher and higher. The eye-level line is always at right angles to an observer's line of sight and is theoretically located at an infinite distance from the observer's eyes. In the design-drawing process, it is important to study a design from every conceivable vantage point.



Worm's-eye view at ground level with upward convergence



CAD drawings (above and below):
Student projects by Bradford Winkeljohn
and Jordan Parnass
Excerpted from abstract, Columbia School of
Architecture Planning and Preservation (CSAPP)



Bird's-eye view at a high angle with downward convergence

Eye-level view with upward convergence

Bird's-eye view taking in the surrounding landscape

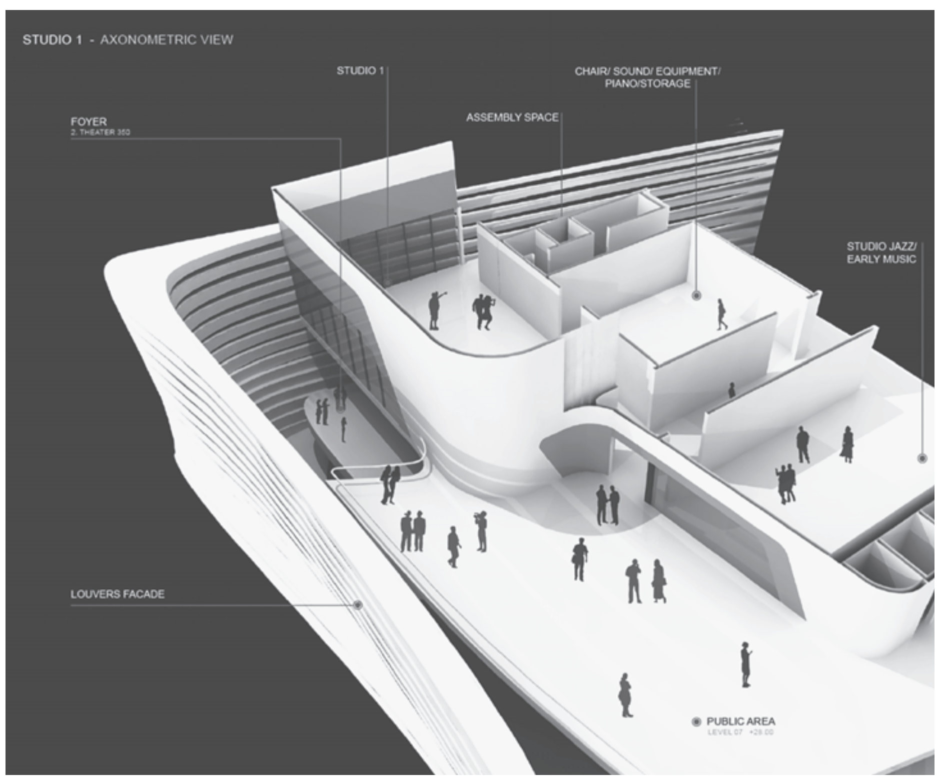
Drawings: Khanty Mansiysk
Siberia, Russia
Medium: Autodesk
Courtesy of Foster + Partners

This development, high on a hill in a densely wooded area with a tower above two podium buildings cut like diamonds, will take advantage of numerous sustainable energy strategies. Natural solar light is efficiently reflected and refracted into the interior atria.

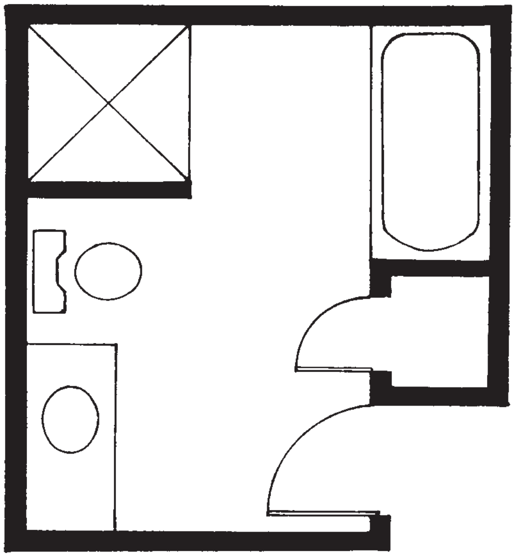
Photos: Freshwater House
Sydney, Australia
Architect: Chenchow Little
Photographer: John Gollings

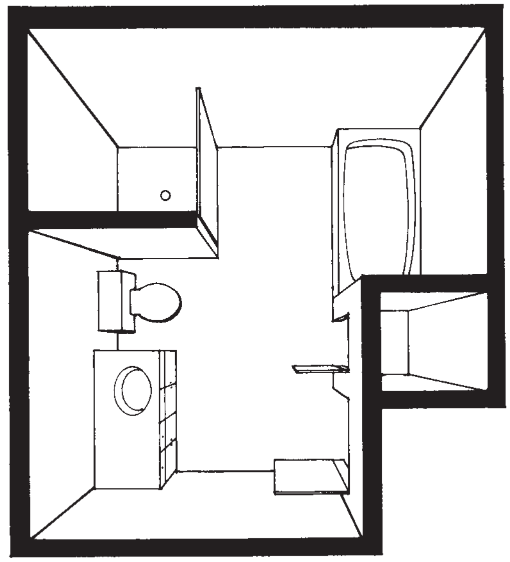
The two pictures of the Freshwater House are views of well-thought-out solar control options of windows from the same position. It happens that the living and dining spaces are on the second level above a ground-level garage. Relative to the main living spaces on the second level, we are looking at the house from a "worm's-eye" view. The significance of this view position is to display the dramatic exterior of the building form from the street level.

Drawing: Dance and Music Center
The Hague,
The Netherlands
Medium: Rhino, Maya, and AutoCAD
Courtesy of Zaha Hadid Architects



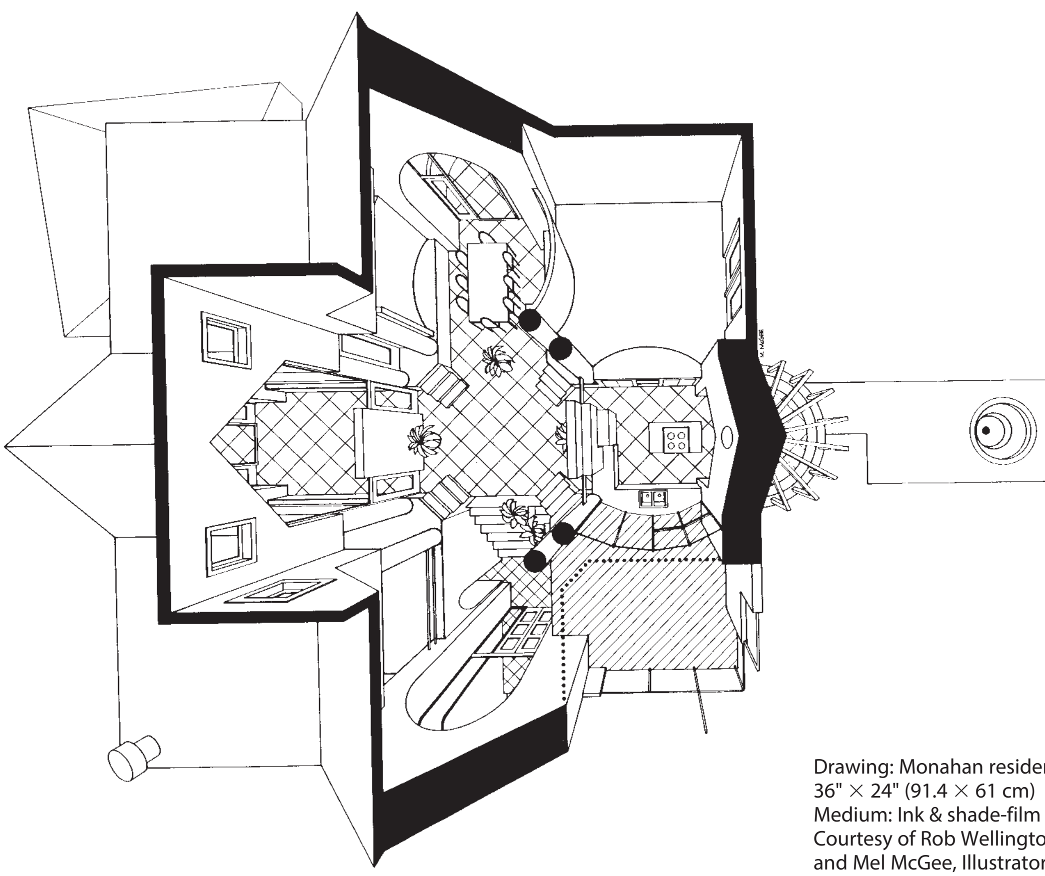
The picture of the Dance and Music Center presents a view from above eye-level, hence a "bird's-eye" view with the roof taken off to give a three-dimensional perspective of a partial floor layout. This could just as easily be a snapshot of a hand-held model, communicating very effectively the functional layout of the building plan.



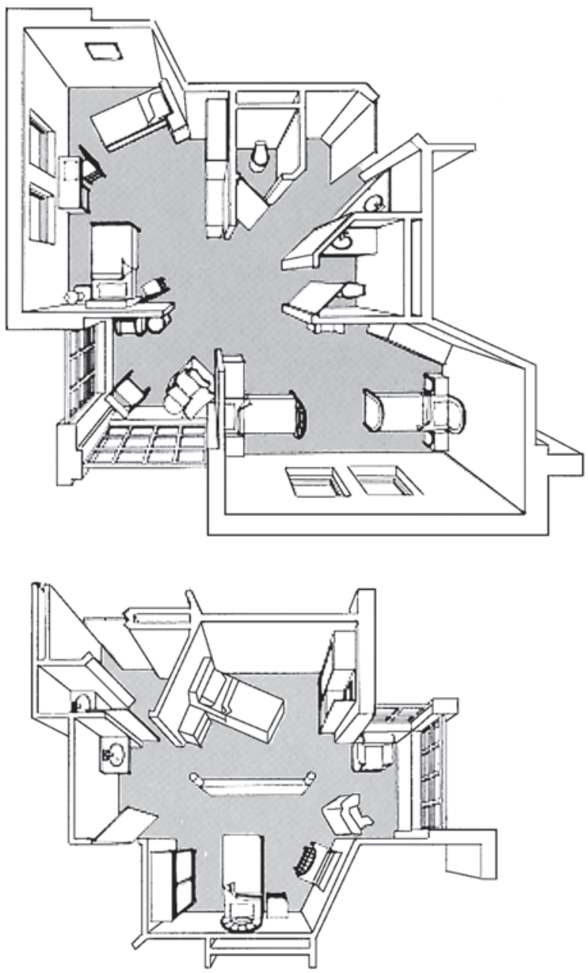


One-Point from Above

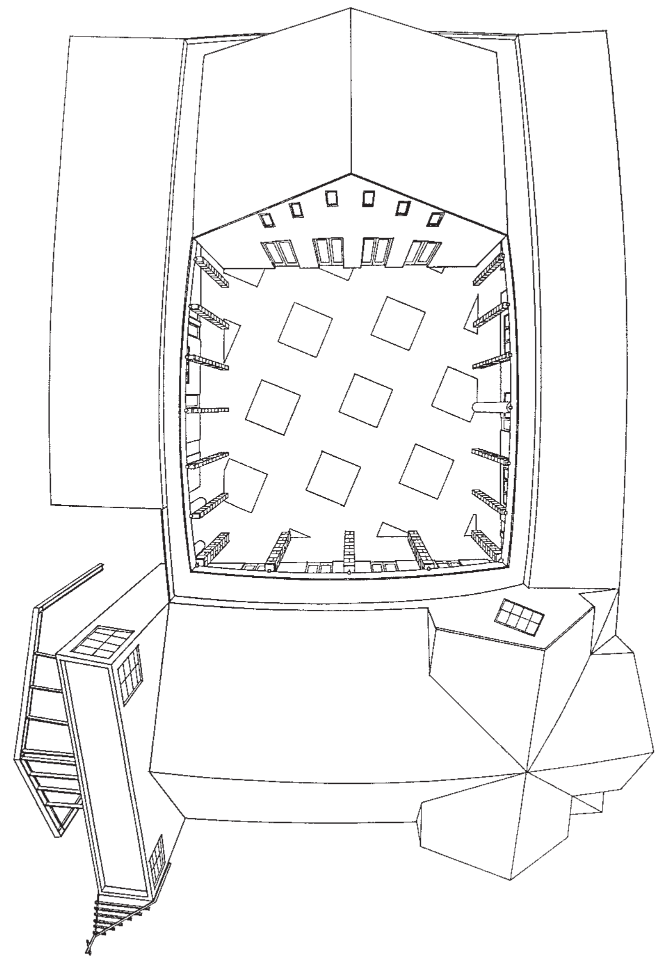
An unusual variation of the *one-point perspective* is a bird's-eye view with the line of sight perpendicular to the ground plane. This variation, which is achieved by transposing the positions of plan and elevation, is commonly used for small interior spaces and interior or exterior courtyard areas.



Drawing: Monahan residence, La Jolla, California
36" × 24" (91.4 × 61 cm)
Medium: Ink & shade-film on Mylar
Courtesy of Rob Wellington Quigley, FAIA
and Mel McGee, Illustrator



Drawings: Freeport Hospital Health Care Village, Kitchener, Ontario, Canada
Courtesy of NORR Partnership Ltd./
NORR Health Care Design Group



Drawing: New Hope Church, Duarte, California
24" × 36" (61 × 91.4 cm)
Medium: Ink on vellum
Courtesy of Rebecca L. Binder, FAIA

© Marcus Chaw

Photo: The Dueling Stairs of the Vatican Museum

One-Point from Above

Interior views from above are very descriptive and hence quite informative, especially to a person (client) who does not completely understand an architectural plan. In most cases, they simulate a one-point perspective view that one would have if the roof or ceiling of a scale model were removed. The view can be constructed quickly by placing the plan view so that it coincides with the picture plane. Vertical height lines through all corners of the plan are then drawn converging to one vanishing point in a relatively central location. Height lines are terminated where descriptively appropriate—typically where the plan section cut is taken. With the church at right above, there is no plan section cut, and the curving of the roof elements creates a fish-eye lens effect.

Drawing: Star Place, Kaohsiung, Taiwan
Medium: CAD software: AutoCAD; 3-D modeling: Rhino, 3D Studio Max, Alias Maya Complete, Top Solid, V-Ray, and T-Splines
Courtesy of UNStudio

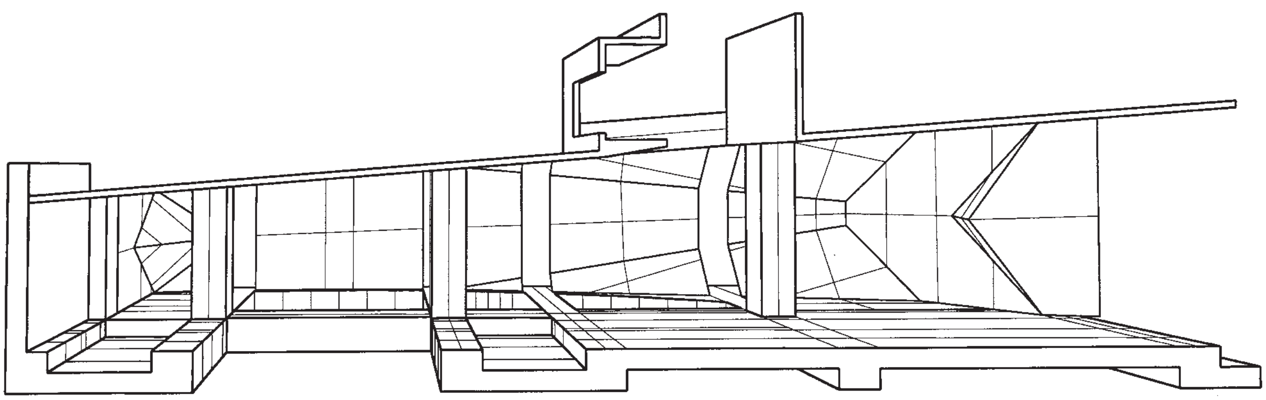
One-Point from Below

A unique design aspect of this building is the spiraling escalators, which give the users a constantly changing visual field due to the curved concave facade and twisted frame system. Digitally controlled lighting and color effects add another layer of fluidity to the building's envelope.

The Star Place, the Oculus, and the Ackerman Student Union all display characteristics of a one-point perspective as seen from below. The Star Place design features rotating escalators over a central axis.

© Marcus Chaw

Oculus in Michelangelo's Petersdom in the Vatican



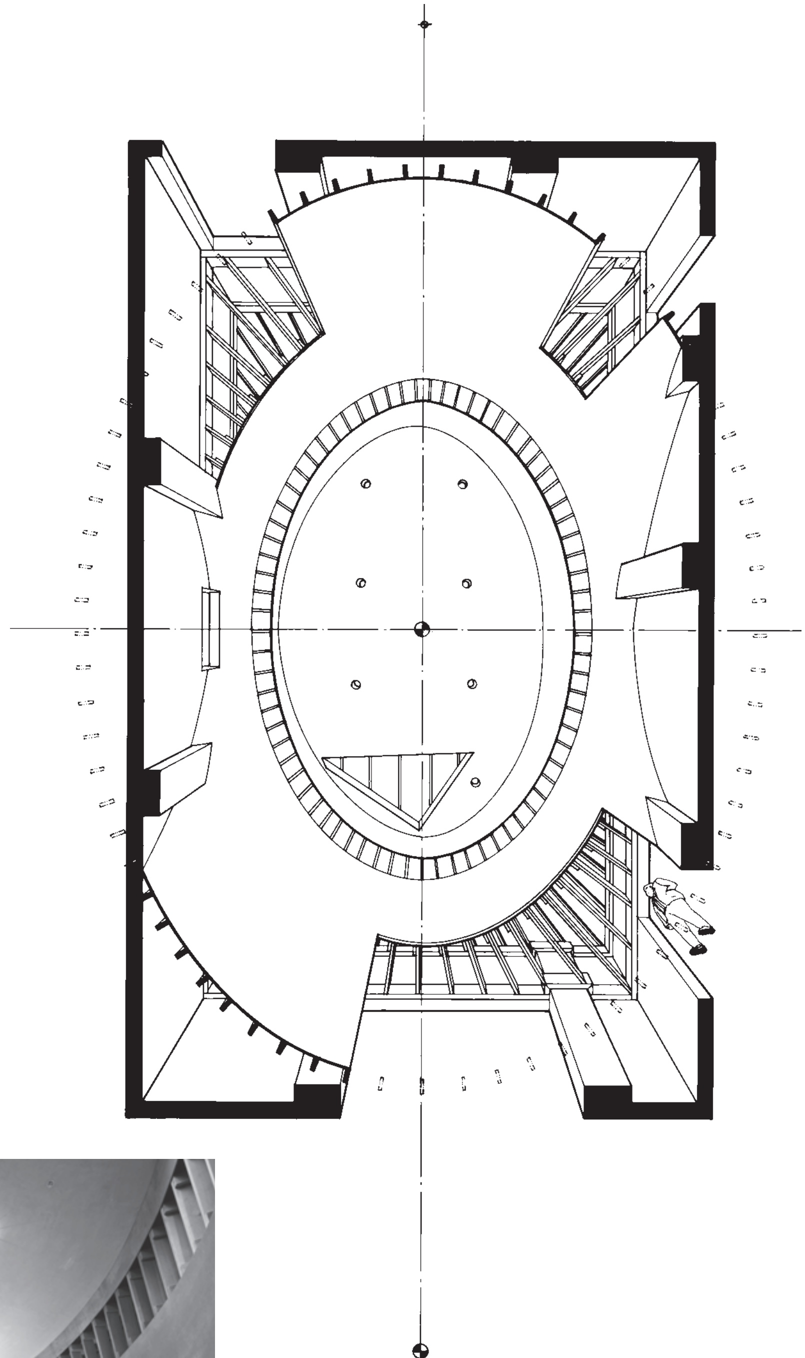
Drawing: Ackerman Student Union, University of California/Los Angeles
Medium: AutoCAD release 12
Courtesy of Rebecca L. Binder, FAIA Architecture & Planning

The entry elements and circulation in this remodel/addition project are key to the establishment of a "new" whole. The ceilings are integral to the design, articulated in finished plywood. This floor-view perspective offers a clear description of this northeast entry element.
[Architect's statment]

One-Point from Below

This is a worm's-eye, one-point, dead-center view looking up.

This drawing illustrates the fact that symmetry is a moment in time and not a place. This is symmetrical asymmetry from the ground up.
[Architect's statement]



Five dilapidated warehouses with different structural systems adjoin to form one building. In the unification, beautiful rich interior spaces with great clarity and variety were created, one of which is this conference room. The working spaces developed for innovative clients are truly unique. This building received a National Interior Design Award by the AIA.

Drawing: Conference Room, 8522 National Boulevard
Culver City, California
Medium: Ink on Mylar
Courtesy of Eric Owen Moss, Architect

Looking Down, Across, and Up/Downhill and Uphill

In the right photo, our vantage point results in simultaneous down, across (horizontal), and up views. In the other three images below, we see downhill and uphill perspective views outside or inside a building, which can be seen in stairs, ramps, or escalators. On the facing page, we see downhill and uphill views as street scenes in the cityscape.

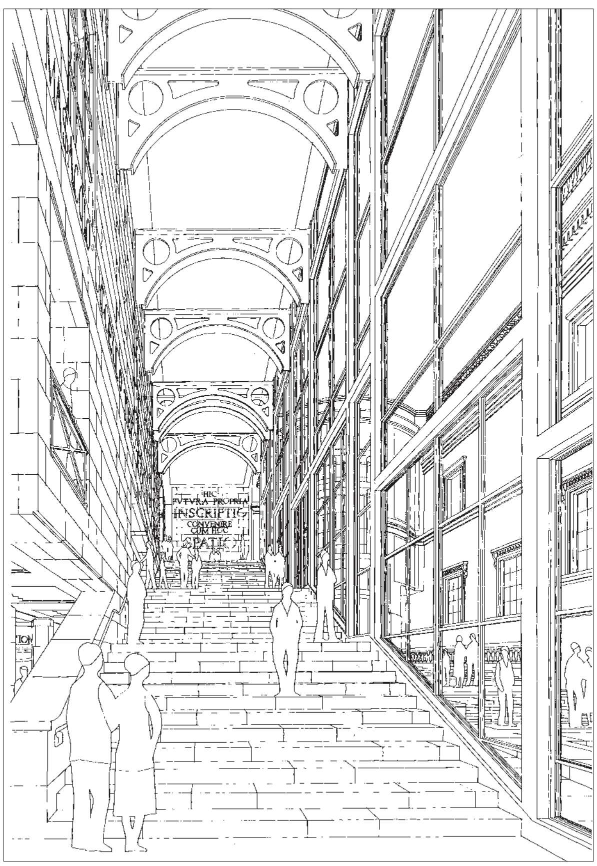
Photo © Thomas Mayer

Photo: De Young Museum, San Francisco, California
Architect: Herzog & DeMueron
Courtesy of Arcspace

Image courtesy Polshek Partnership Architects/
Ralph Appelbaum Associates

Drawing: Newseum
Washington, D.C.
Architects: Polshek Partnership Architects/
Ralph Appelbaum Associates
Courtesy of Arcspace

The building's transparent design and place in the heart of the news capital of the world constantly invite the visitor to relate the exhibition experience inside to the historic locale and news-making world outside.
[Architect's statement—Ralph Appelbaum]

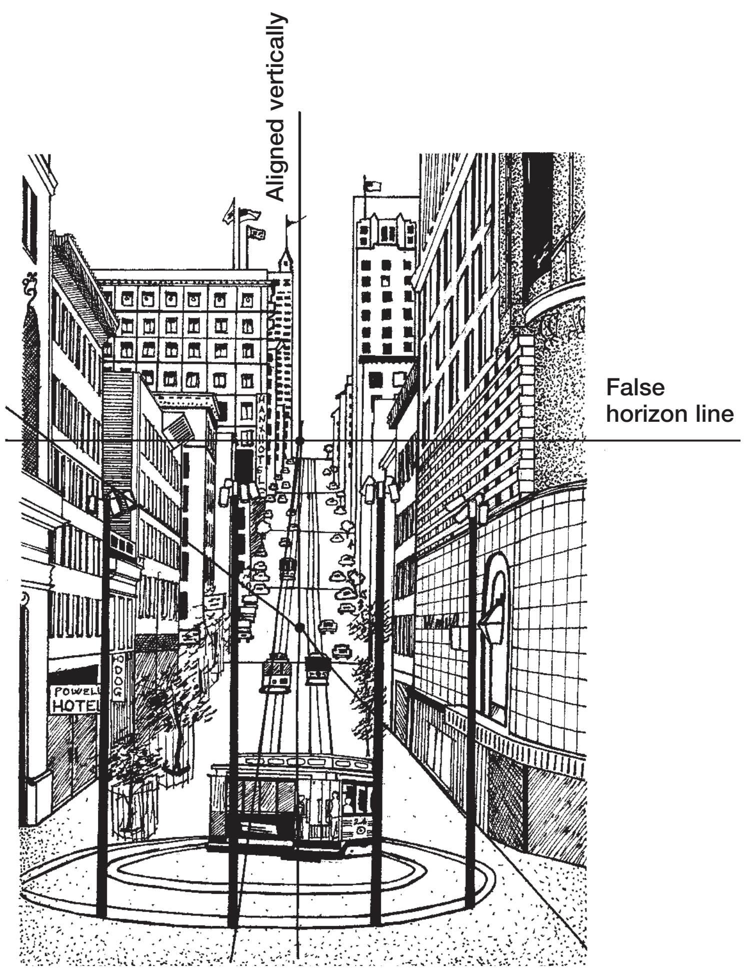


Drawing: The Sainsbury Wing: An extension to the National Gallery
London, England
28" × 40" (71.1 × 101.6 cm)
Medium: Pencil on vellum
Courtesy of Venturi, Scott Brown and Associates, Inc., Architects

© Marcus Chaw

Photo: The Spanish Steps leading to the Church of Trinità dei Monti
Rome, Italy

Drawings: Student project by Thanh Do
San Francisco downhill and uphill views
4" × 6" (10.2 × 15.2 cm)
Medium: Ink on vellum
Courtesy of the City College of San Francisco
Department of Architecture



Looking Downhill and Uphill

Downhill and uphill views produce false horizon lines. The observer's view is parallel to the sloping hills. The true horizon lines (straight-ahead, eye-level lines) are where the vanishing point of all the horizontal lines on the building facade rests. Horizontal lines on the streetcar in the downhill view (top) vanish at a point on a false horizon line below the true horizon line. Likewise, in the uphill view (left), there is a false horizon line above the true horizon line. In both the downhill and the uphill situations, the different vanishing points align themselves vertically above and below each other.

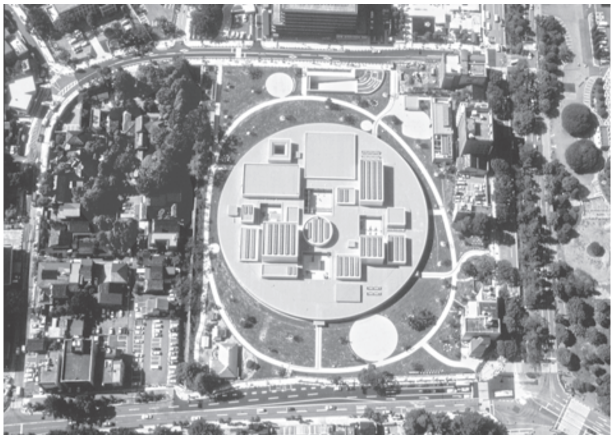


Photo: 21st Century Museum of Contemporary Art
Kanazawa, Japan
Courtesy of SANAA
Kazuyo Sejima + Ryue Nishizawa

Photo: 21st Century Museum of Contemporary Art
Kanazawa, Japan
Courtesy of SANAA
Kazuyo Sejima + Ryue Nishizawa

Perspective Circles

Circles in perspective take the form of *ellipses.* We see this form not only in architectural subjects but also in everyday things, such as tables (see below), bottles, dishware, pots, waste containers, coins, and wheels for transportation.

Drawing: Developer's Center
Oslo, Norway
Medium: ArchiCAD and Artlantis
Courtesy of Gudmundur Jonsson, Architects

Photo: Macao Science Center
Macao, China
Photographer: Kerun Ip
© Pei Partnership Architects LLP

Architecturally, *horizontal circles* are commonly part of semicircular or circular skylights and semicircular or circular horizontal cylindrical forms (e.g., rotundas). They are also integral parts of cones and cylinders as seen in the Macao Science Center. *Vertical circles* are commonly part of arches, semicircular windows, and circular vertical cylindrical forms.

The science center is composed of a rhomboid, a dome, and a tilted cone. Toward the top of this shimmering aluminum-clad building is a 360° observation deck with spectacular views of the city. The 21st Century Museum of Contemporary Art is a circular building complex without front or back and is capable of being entered and explored in all directions.

Visualize a circle, such as a bicycle wheel. The wheel below can take the form of a *horizontal* circle as it rotates about its horizontal diameter. This diameter can be described as major (longest true length). The minor diameter (axis) is perpendicular and foreshortened and becomes progressively smaller. Or, the wheel can take the form of a *vertical* circle as it rotates about its vertical diameter. The minor diameter (axis) is perpendicular and becomes progressively smaller, as in the first case.

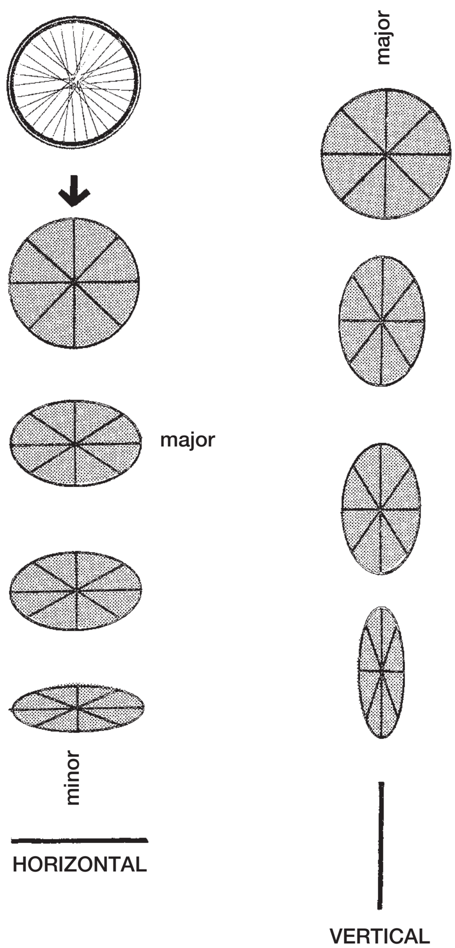
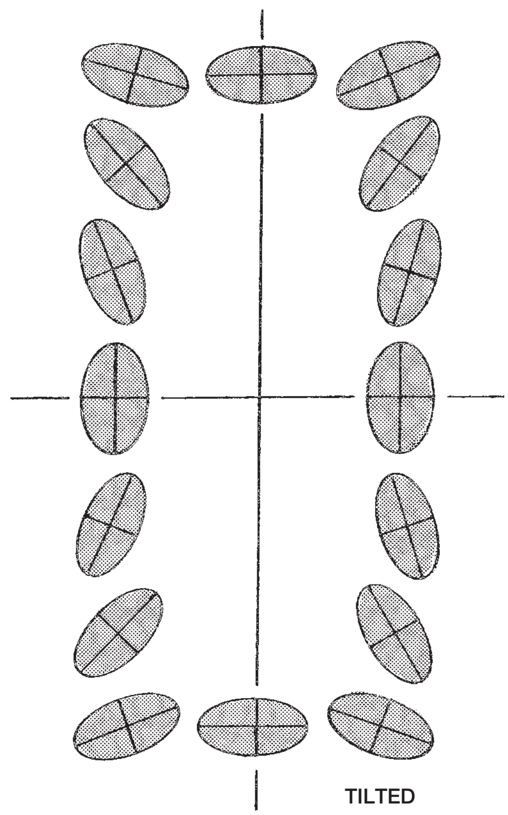


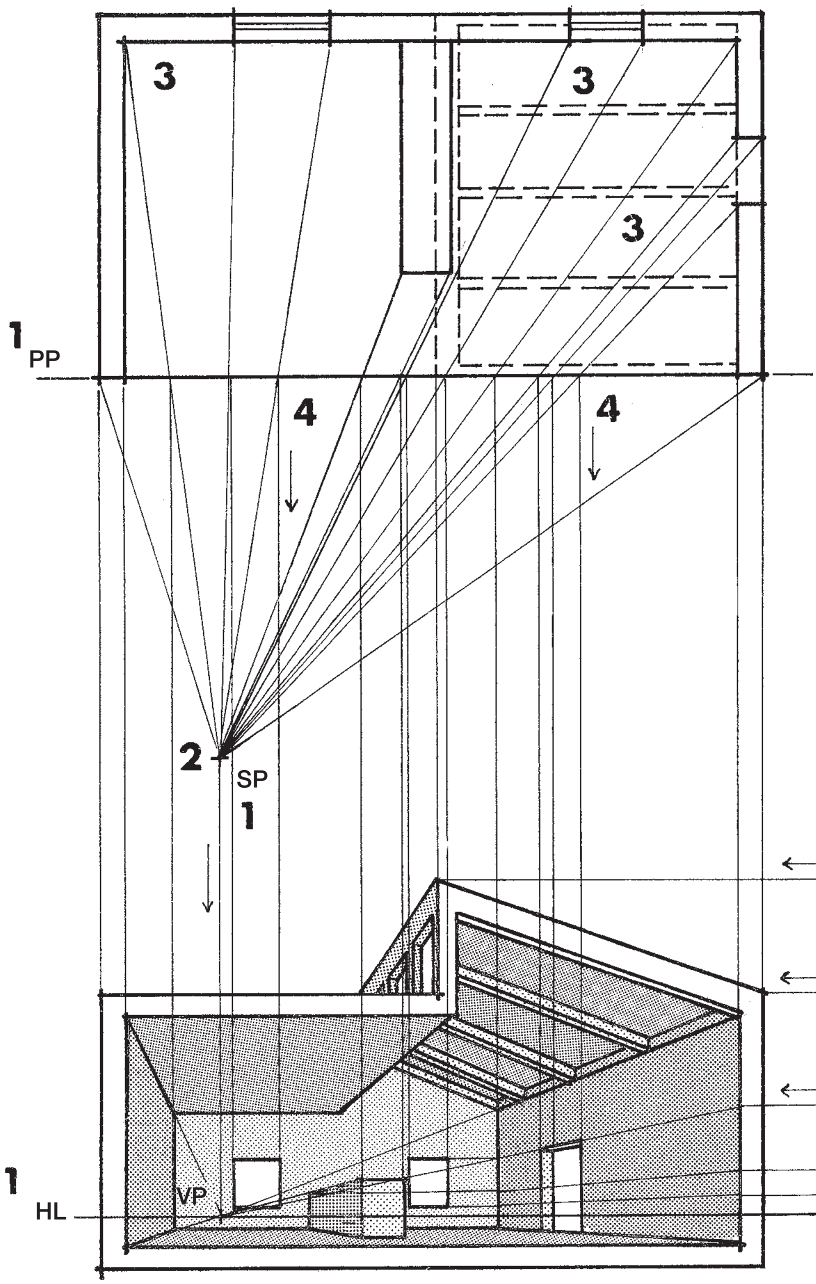
Photo: Niteroi Contemporary Art Museum, Niteroi, Brazil
Architect: Oscar Niemeyer
Photo: Courtesy of Wikipedia, © Wikipedia

Photo: Macao Science Center
Macao, China
Photographer: Kerun Ip
© Pei Partnership Architects LLP

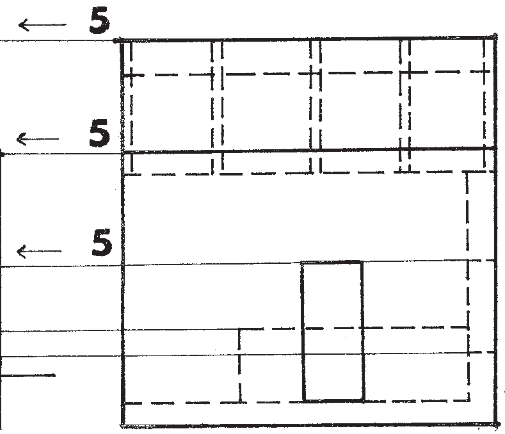


The above diagram illustrates how a circle seen in perspective as an ellipse will change in orientation from a horizontal to a vertical condition for the major axis. The intermediate conditions result in *tilted ellipses,* the degree of which depends on the inclination of the axes relative to the observer's position. Note the slightly tilted ellipse in the above photo.

In a one-point perspective, a group of lines will vanish to one point, and this group will not be parallel to the picture plane. All vertical lines remain vertical, and all horizontal lines remain horizontal in the constructed perspective. The plan and the elevation of the room should always be traced to obtain exact dimensions.

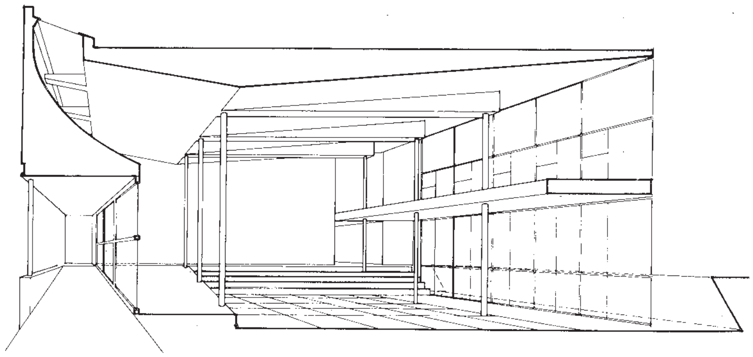


1. The picture plane, the station point, and the horizon line locations are arbitrarily selected.
2. Locations are based on creating the desired pictorial effects. A horizon line below eye level was selected to reveal more of the ceiling detail.
3. From the station point, sight major elements in the interior, such as wall intersections, doors, and windows.
4. Where the lines of sight intersect the picture plane, drop vertical projection lines into the area of the perspective drawing.
5. Transfer true heights from the elevation to a vertical reference line in the picture plane. From these points, project back to the vanishing point. Connect proper projection lines, which will define wall, floor, and ceiling intersections.



Interior One-Point

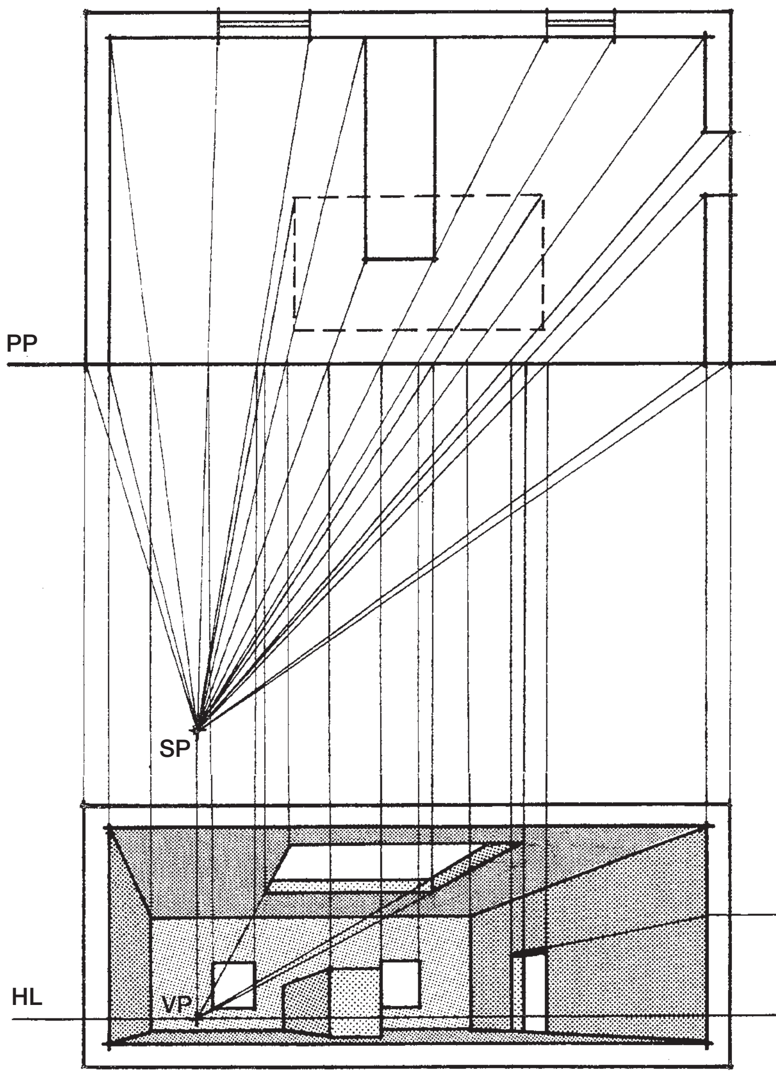
As with two-point perspectives (discussed later), the *office* or *common method* is frequently used for one-point perspectives. At least one plane of the object in a one-point is always parallel to the picture plane. This plane is always perpendicular to the observer's line of sight. For interiors, the picture plane makes a sectional cut through the building or object where the interior space to be viewed begins.

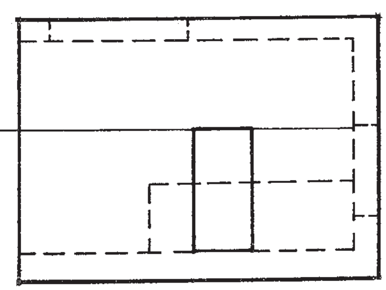


Drawing: Student project by Richard Bacino
Housing for the elderly/day care
Medium: Ink on Mylar
Courtesy of Washington University
School of Architecture, St. Louis, Missouri

One-point perspectives are mostly used to depict interior spaces. They can also be effective for urban landscape situations where a central axis may be involved (streets, large courtyards, etc.).

These two facing pages display examples of *perspective sections* (also termed *section perspectives*). As the name implies, it is the fusion of a two-dimensional sectional cut (building section drawn to scale) with a three-dimensional linear perspective view. Section perspectives can be constructed using the method with a measuring point (diagonal vanishing point). Using a similar procedure, one can construct *plan perspectives* or worm's-eye perspectives looking directly down or up. The plan perspective uses a sectional cut, which is taken at or just below ceiling level.





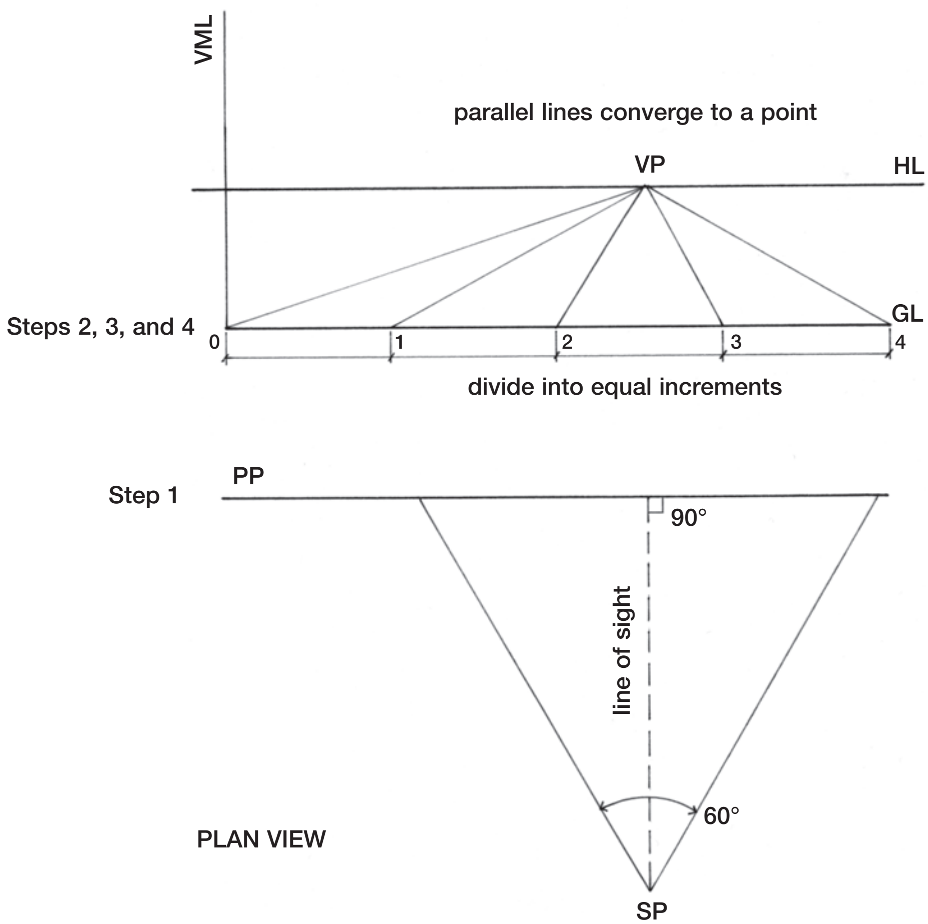
The placement of the vanishing point will govern what one sees in the interior space. If the vanishing point is high, very little ceiling will show, but much of the floor will show. If the vanishing point is near the center, an equal amount of ceiling and floor will show. If the vanishing point is low, much of the ceiling and very little of the floor will show. Moving the vanishing point to the right or to the left on the back wall has a similar effect on the side walls—that is, if near the left, more of the right wall will show, and if near the right, more of the left wall will show.

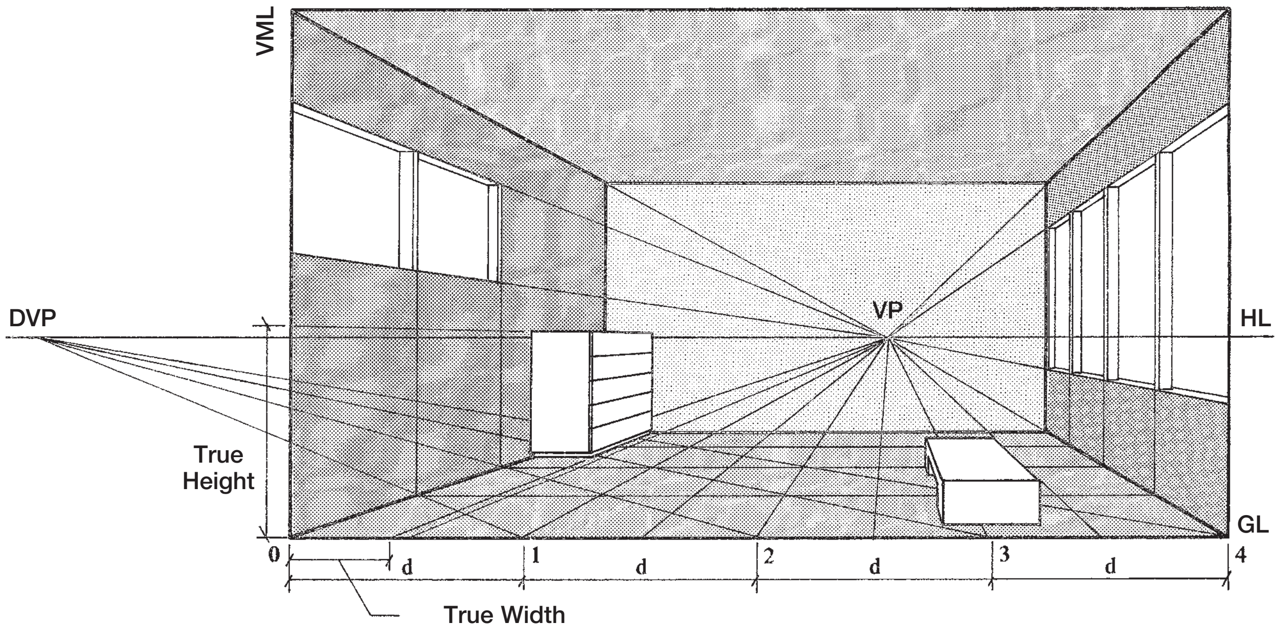
The *New York Times* cited the main concert hall at left as having "near-perfect acoustics."

Photo: Main Concert Hall, San Francisco Conservatory of Music
San Francisco, California
Courtesy of Perkins + Will, Architects
Photo by Tim Griffith

One-Point Grid

Design professionals study interior space usage. The *diagonal vanishing point* (or *measuring point*) *method* accurately locates interior elements within a plan grid layout. Unlike the office method, it doesn't require a plan and elevation; it also allows you to start with whatever perspective size you desire. The primary goal of this method is to divide a line in perspective into either equal or unequal parts. True heights are measured in the picture plane and projected back along the walls. True widths are similarly projected on the floor. Furniture and lighting elements can be positioned quickly (see above and opposite page).





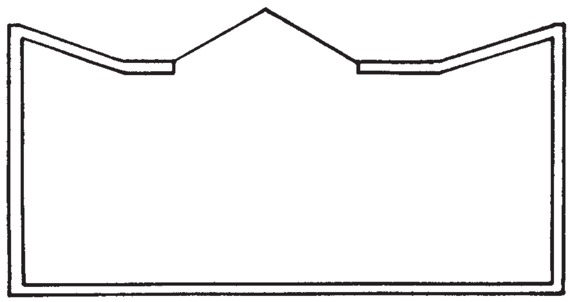
Diagonal Vanishing Point Method

These steps explain how to generate a grid in parallel perspective using a logically placed *diagonal vanishing point.* Acute perspective foreshortening will occur if you move the diagonal vanishing point too close to the vanishing point along the horizon line. A general rule is to keep the width of the drawing smaller than the distance between the diagonal vanishing point and the vanishing point. The drawing above violates this rule slightly but is still within the limits of a correctly foreshortened perspective.

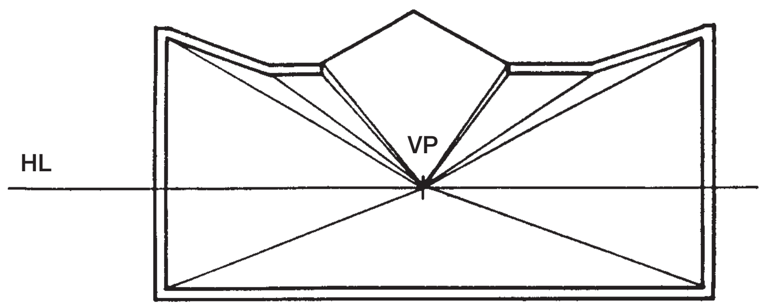
1. Decide where your vantage point will be in order to establish a station point in plan view and, subsequently, a vanishing point (**VP**) in perspective. The ground line (**GL**) and horizon line (**HL**) are consequently established.
2. Draw the horizontal ground line through point **0.** The horizon line (observer's eye level) is located a true height distance along a vertical measuring line (**VML**) in the picture plane, intersecting point **0.**
3. Divide the measuring line at the **GL** where the section cut is taken into *n* equal increments (**d**), *n* being how many mullions or other interior elements must be spaced in perspective (in this case, four).
4. Generate vanishing lines (parallel in the plan view) from points **1, 2, 3,** and **4** to the vanishing point.
5. Decide on the relative depth locations of elements like mullions in the perspective. Select a diagonal vanishing point (**DVP**) location on the horizon line and draw a line to point **4.**
6. Horizontal grid lines can be located at the intersection of the diagonal vanishing lines and the line from **0** to the **VP.**
7. The diagonal line from **0** to the **VP** can also be divided unequally using the same procedures in order to locate furniture or other interior elements.

Note: For establishing depths in front of the picture plane, draw a diagonal line from the **DVP** through point **0** and proceed in the same manner.

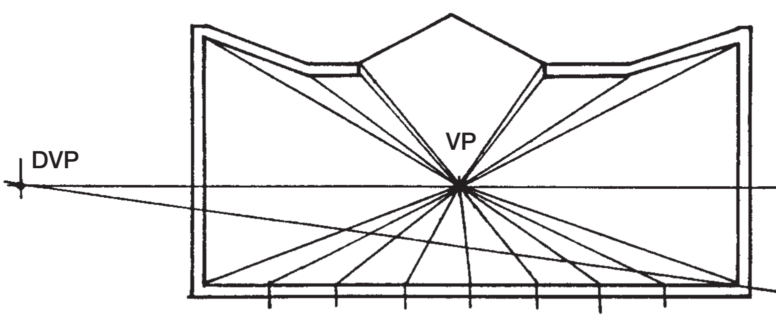
The addition of wall, floor, and ceiling thicknesses to the plan grid measuring point method creates a section cut. The cut coincides with the picture plane, and this plane frames a three-dimensional view of pictorial space that communicates an interior design. Construction of the *section perspective* saves time and space because, as with measuring point methods, no projection from a plan view is needed, and thus excess drawing space is not needed.



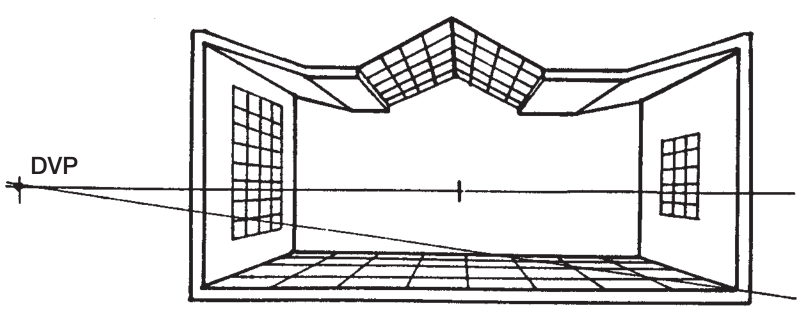
1. Determine where the section will be taken.



2. Establish the locations of the horizon line and the vanishing point. Project vanishing corner lines from the sectional corners.

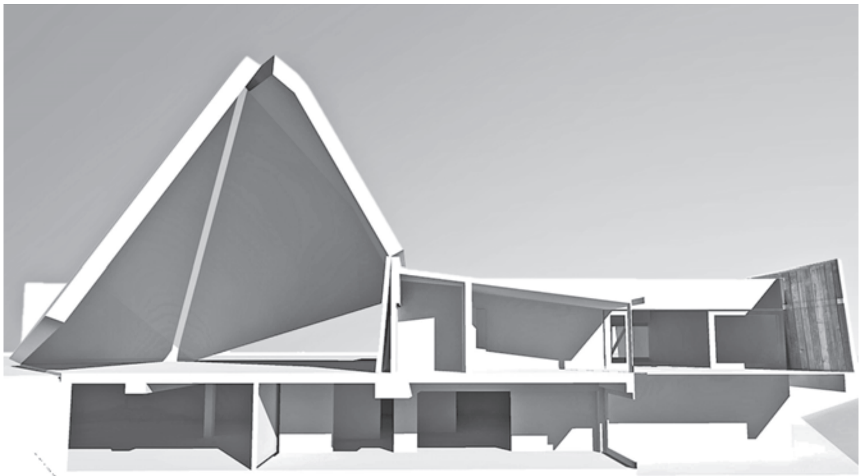


3. Mark equal increments along the sectional floor line. Select an arbitrary diagonal vanishing point (**DVP**). The farther away the diagonal vanishing point is placed from the vanishing point on the horizon line, the less the distortion. Draw a diagonal line from the diagonal vanishing point to the farthest lower corner.



4. At the intersections of the diagonal line and the receding floor plane lines, construct horizontal lines that divide the floor, wall, and ceiling in perspective.

Generating a perspective from a building section sometimes has the drawback of exaggerating the apparent length of spaces.

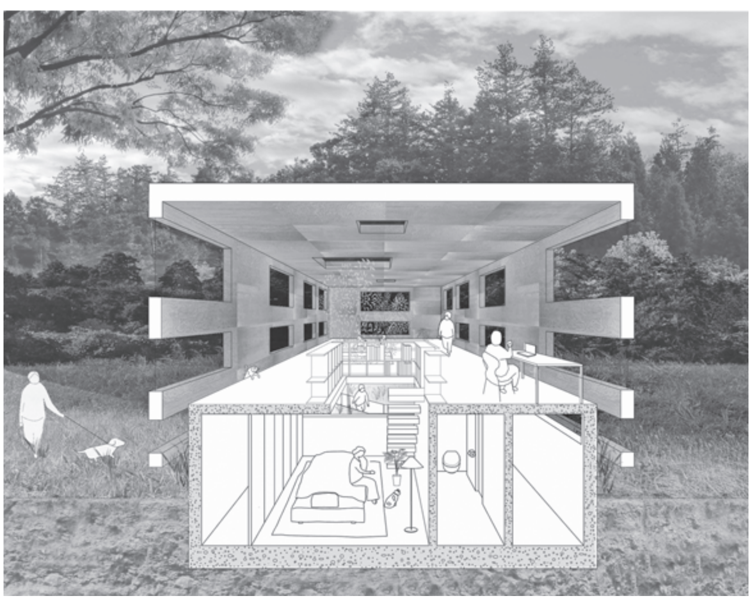


Drawing: Vitra Children Workshop
Weil am Rhein, Germany
Medium: SketchUp, Kerkythea, and Photoshop
Courtesy of Alejandro Aravena, Architect

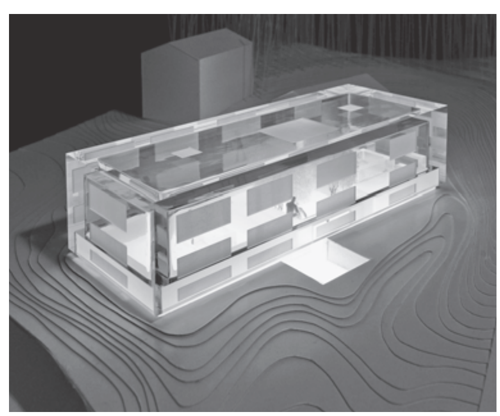
In designing this building, we decided to integrate as many layers of accumulated knowledge as possible, replacing experimentation by synthesis. Very clear, common sense, pragmatic options were evaluated. It was an exchange of facts, not ideas. Ideas are overrated. [ARCHITECT'S STATEMENT]

Section Perspective Views

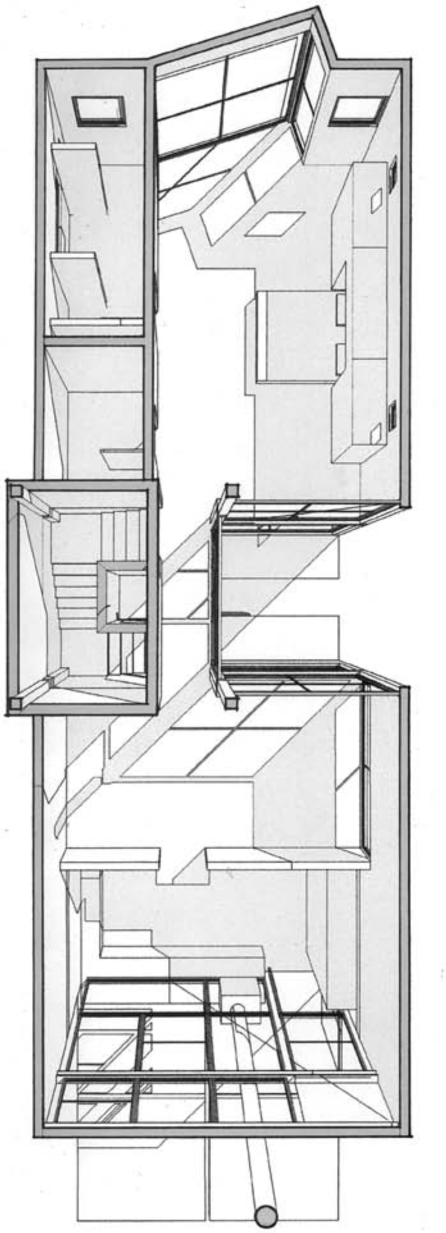
The perspective view above has a shallow depth of field; the one below has a deep depth of field. Section perspectives delineate the structural profile of a building. If the purpose of the section is to show spatial relationships, then keep accessories (people, furniture, etc.) to a minimum. Perspective sections are useful in making the often difficult-to-read section more communicative. Note that the vanishing point is placed within the major space. Avoid placing the vanishing point in smaller secondary spaces like the lower level shown below. A perspective section adds a dramatic effect to the two-dimensional section. The receding third dimension reveals the pictorial quality of the interior spaces. Simultaneously viewing all the interior spaces allows for quick appraisal of spatial qualities. The pictorial or "real" view quality is a perspective section's strength; its weakness is that it does not convey the overall organization of spaces as well as a plan oblique (axonometric).



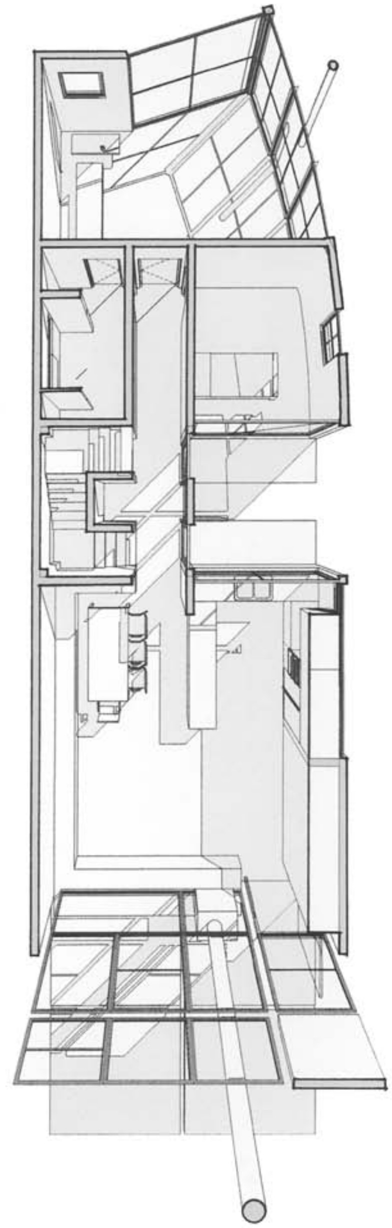
This is a single-space small house surrounded by a rich forest for a family of three women. I wanted to seize the nondividable environment, similar to nature's creatures that generate their nest under elements that cover the forest's ground. [ARCHITECT'S STATEMENT]



Drawings: NEST
Onomichi, Hiroshima, Japan
Medium: Vectorworks, Illustrator, Photoshop
Courtesy of Keisuke Maeda, Architect



Second-Story Plan



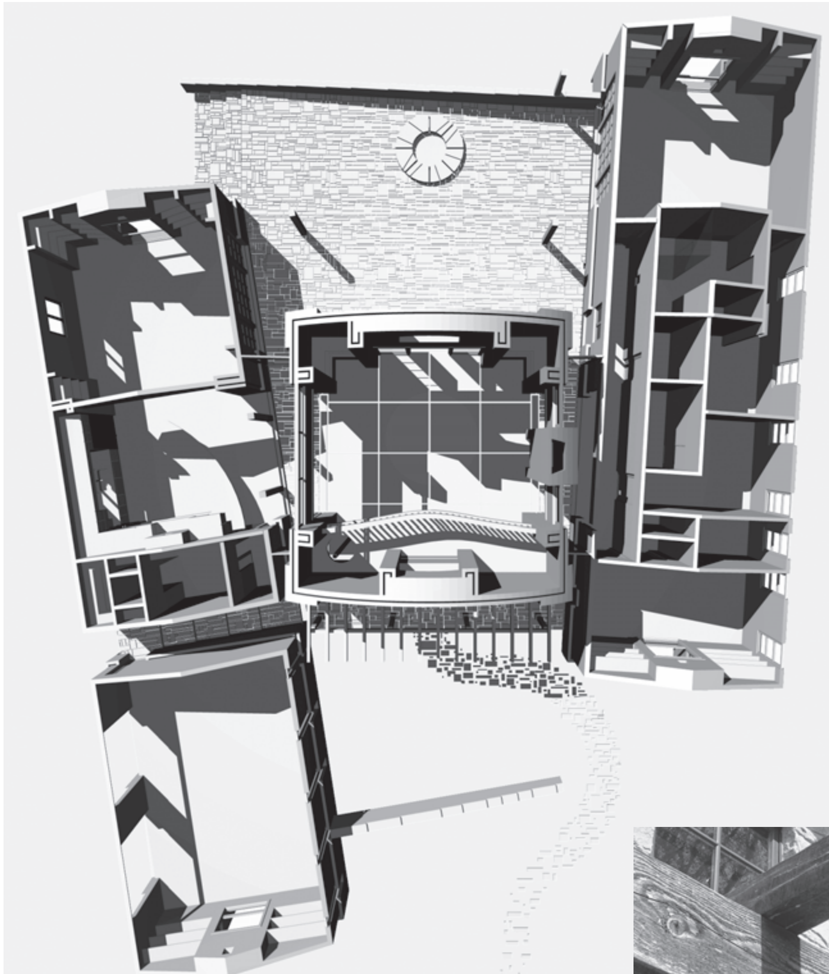
Ground-Level Plan

Images: Bernal Heights residence
San Francisco, California
Medium: Computer-generated
Principal in charge: Mark English
Architectural illustrations: Star Jennings
Courtesy of Mark English Architects

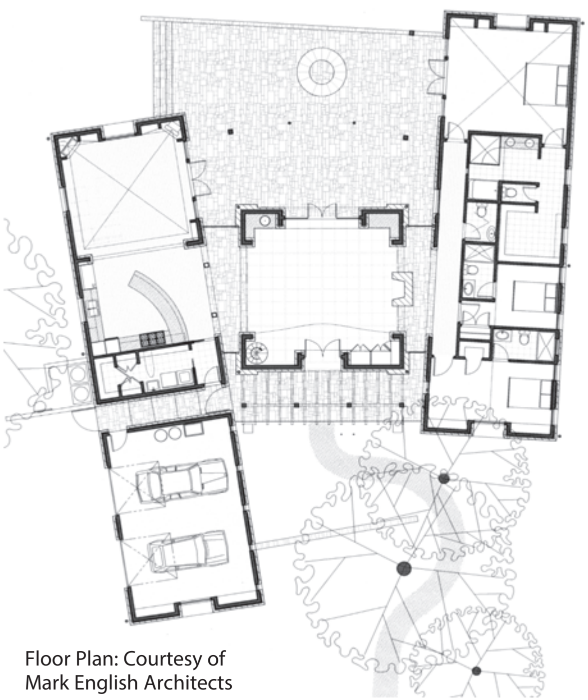
Images (facing page): The Devitt residence
Austin,Texas
Medium: Computer-generated
Principal in charge: Mark English
Architectural illustrations: Star Jennings
Courtesy of Mark English Architects

Plan Perspective Views

One-point perspective plan views are used to show the floor layout with additional volumetric information. In this case, the observer is close enough to see some window and facade details.
[Architect's statement]



© Mark English Architects



Floor Plan: Courtesy of
Mark English Architects

Plan Perspective Views

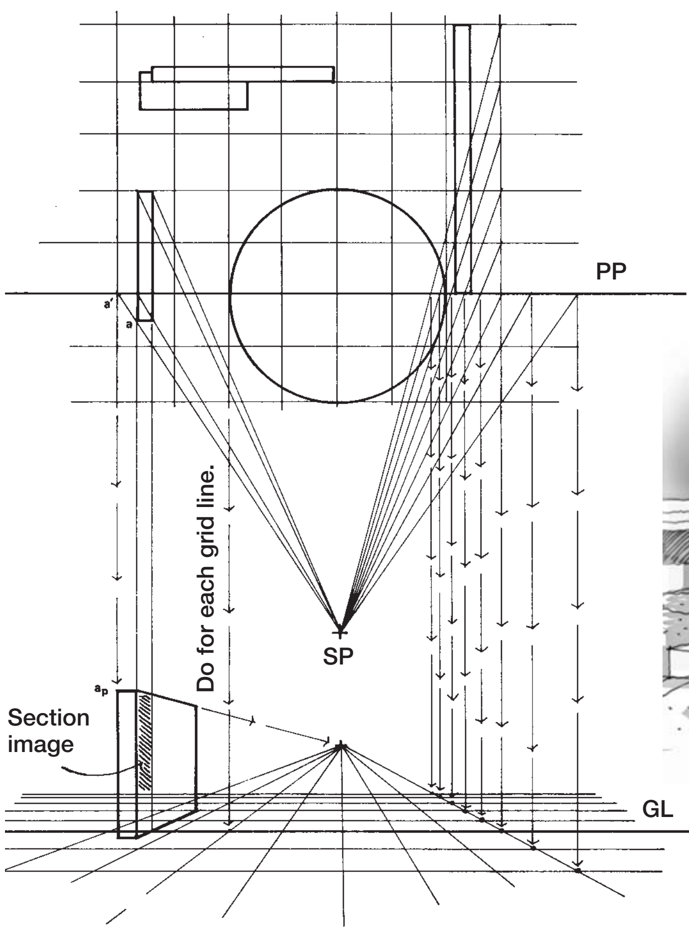
In keeping with the vernacular architectural traditions, the two wings of this residence are simple rectangles with gable roofs. The arrangement of building elements is anchored by a paved north-facing patio. This image is a one-point perspective showing the building and some adjacent landscape features. Our intent is to describe the floor layout as well as capture volumetric characteristics. Indications of floor pattern and material are given where clarity is required.
[Architect's statement]

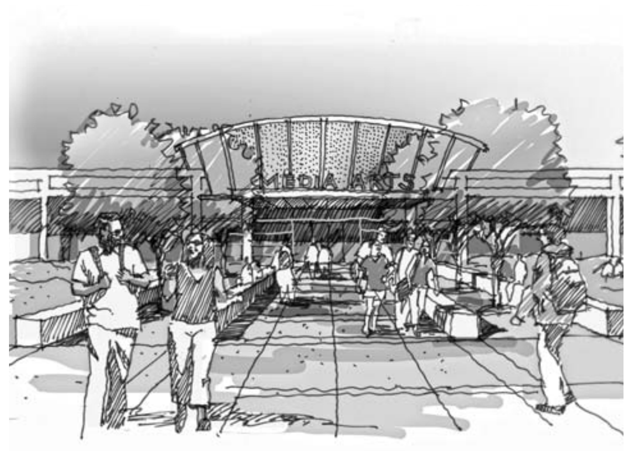
Conceptual drawing: Black n Bleu Restaurant
Medium: Markers on ink
Courtesy of Wenjie Studio

One-Point Grid

As we have seen with interiors, a grid in parallel or one-point perspective is constructed using a *plan* with an *elevation* or elevation heights. In this exterior-view example, you are given standing rectilinear slabs and a circular pond drawn to a specific scale (scale and heights not shown).

1. Draw both the plan grid and the perspective grid. Construct lines to the vanishing point to see how grid lines in plan converge in perspective.
2. Find where the objects in plan intersect the picture plane.
3. Establish a section image and project through the critical points to the vanishing points. Find corner points of objects by sighting corresponding plan points **(a).**
4. Draw the completed perspective image of the first plan object selected (in this case a rectilinear slab).





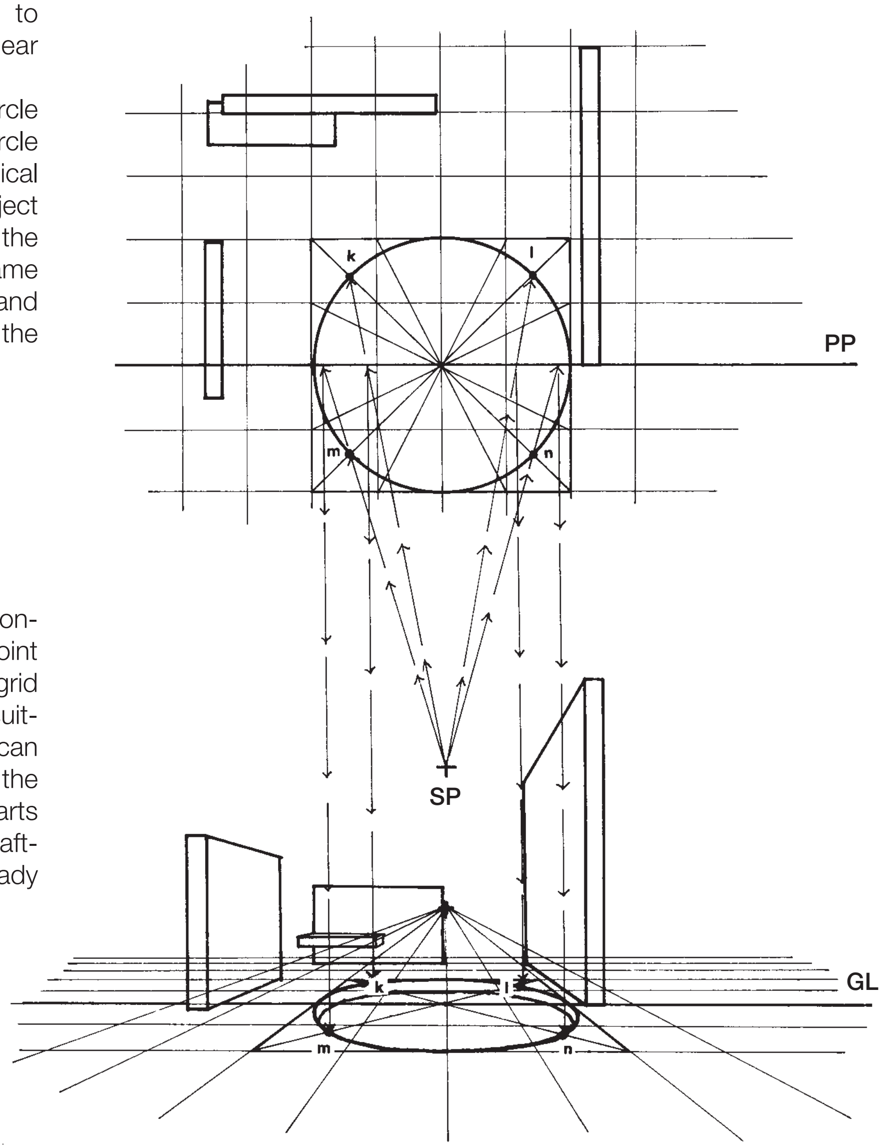
Conceptual sketch: San Diego City College Proposal
San Diego, California
Client: MVE Institutional
Medium: Watercolor
Courtesy of Wenjie Studio

Drawing: SPA Center
Vikna Community, Norway
Medium: ArchiCAD and Artlantis
Courtesy of Gudmundur Jonsson, Architect

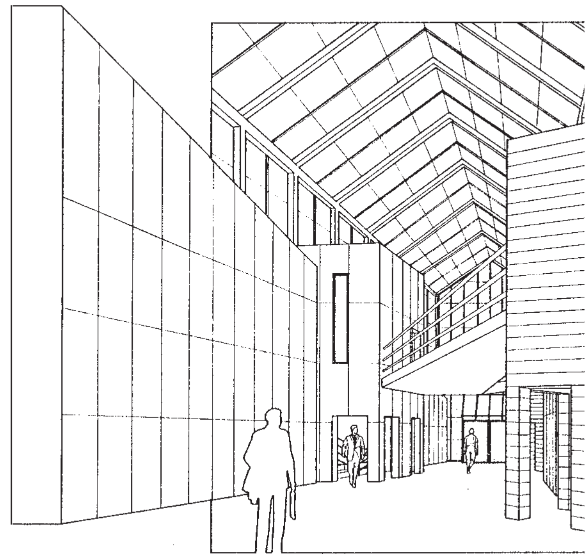
A search for expression of tranquility and silence in architecture. The mountain playing an important inspiration in the creation of volumes and spaces together with the importance of never touching the ground, "mother nature" being praised.
[Architect's statement]

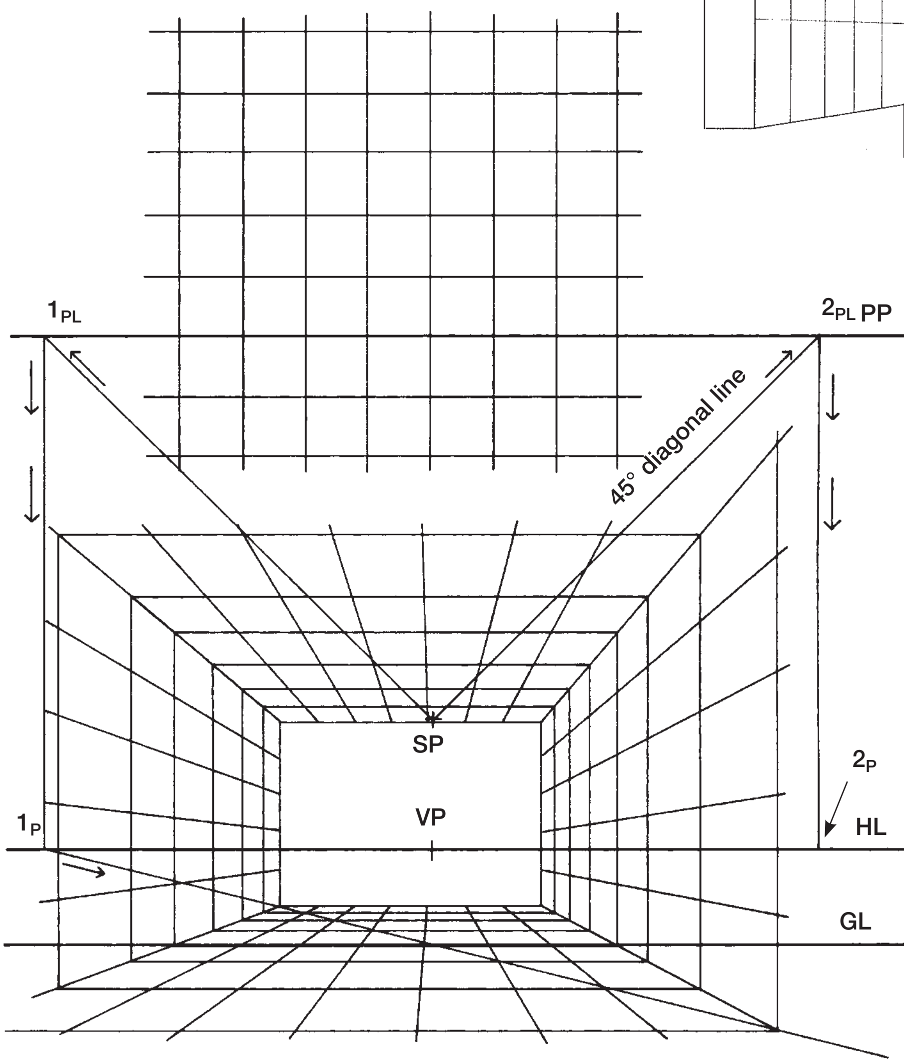
5. Follow the same procedure to complete the other rectilinear objects in the perspective.
6. For the pond, enclose the circle within a square. Divide the circle into quarter-circles. Sight critical points **k, l, m,** and **n,** and project picture plane intersections into the perspective image of these same points. Use a french curve and construct the pond (it takes the form of an ellipse).

Hand-drafted grids are useful for constructing both one- and two-point perspectives. The hand-drawn grid can be blown up or reduced to a suitable scale, and design sketches can be done on trace overlays. With the development of perspective charts and especially computer-aided drafting, grids can be ready or made ready for immediate use.



Drawing: Student project by Howard Fineman
Augusta City Hall
Medium: Ink on Mylar
Courtesy of Washington University School of Architecture,
St. Louis, Missouri





Station Point Placement

The above interior one-point places a strong visual emphasis on the left wall and the ceiling. This is because the observer is closer to the right wall. The location of the horizon line can be manipulated to emphasize either the ceiling or the floor. The manipulation zone ranges approximately from 4' to 6' above the ground. Depth enhancement is achieved by adding scaled figures.

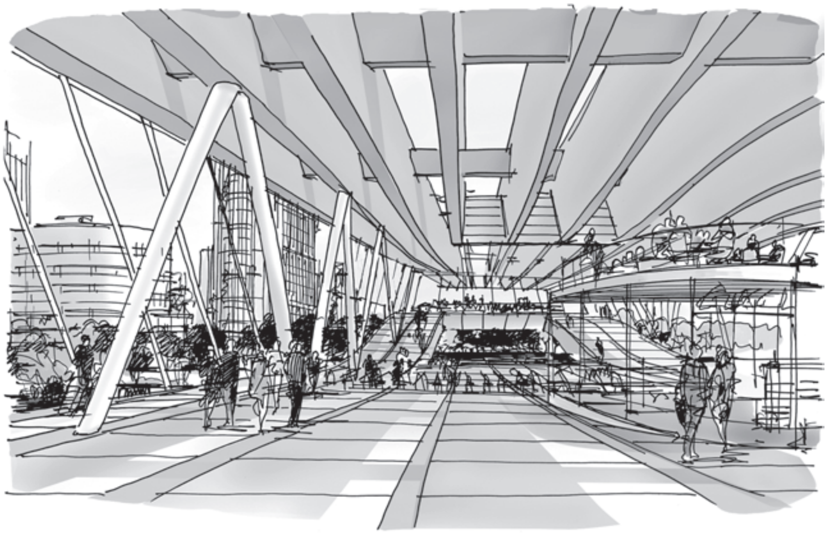
Notation for diagram (left):

1_{PL}: plan view point 1
2_{PL}: plan view point 2
1_P: perspective view point 1
2_P: perspective view point 2

These points (**1_P** and **2_P**) are the *measuring points*, or *diagonal vanishing points (DVP).*

45° Diagonal Plan Lines

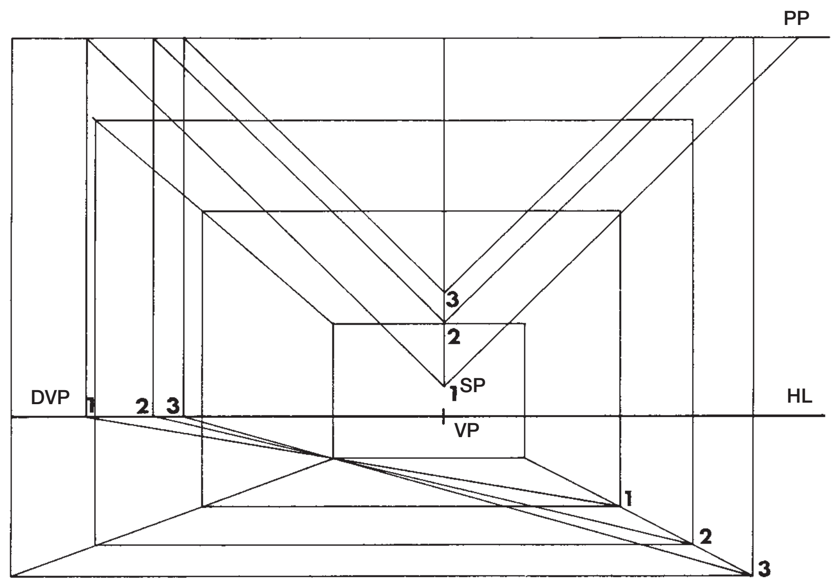
This quick procedure simply utilizes 45° diagonal plan lines from the station point. This results in an equilateral (45°) triangle. The length of the bisector from the station point will always be equal to the distance from points **1** or **2** to the picture plane intersection point. The diagonal line in perspective passes through the lower left or right corners of the picture plane. Its intersection with converging vanishing lines on the ground plane produces all the needed horizontal grid lines in perspective.



Competition sketch: Rotterdam Central Station
Cambridge, Massachusetts
Medium: Ink on paper and Photoshop
Courtesy of Rafael Viñoly Architects, P.C.

This one-point has an excellent field of view. Don't be afraid to step back when attempting to depict an interior space; most problems in distortion come from being too close to the picture plane. With interior one-points it is essential to create the feeling that you are part of the viewed space. This requires good judgment in cropping interior features on the ground plane. Cropping is permitting part of the subject to be removed from within the frame of the picture.

The Freelon Group Architects
© Mark Herboth Photography
Photo: International Civil Rights Center and Museum
Greensboro, North Carolina
Courtesy of Mark Herboth, Photographer



Station Point Movement

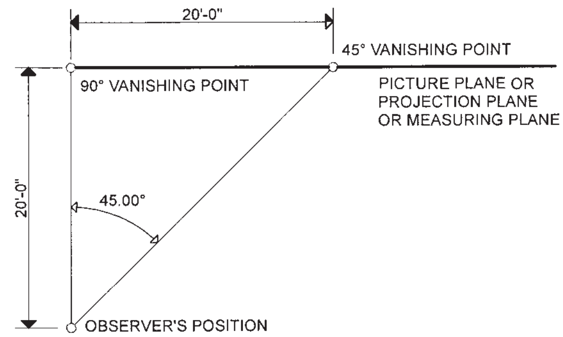
Using 45° diagonal plan lines, what will happen when the station point **(SP)** is moved along the line of sight? The station point location will affect the corresponding point location on the horizon line (and thus the picture plane). The placement of the points **1, 2,** and **3** along the horizon line controls perspective distortion of the grid. The farther the point is moved away from the vanishing point (and thus, the picture plane), the less distortion there will be. The field of view also changes as the observer moves farther away. The view is of a much larger area, and thus the cone of vision is much greater. Even though the 45° VP is a direct function of the station point distance from the picture plane, it is nevertheless variable in a one-point perspective. Note the deep elongated field of view, which is accentuated by a slate wall with inset horizontal lighting in the museum image above.

This is a *simplified* method that allows the construction of an accurate but quick *one-point perspective*. It is based on the principles of the projected perspective method but takes advantage of the fact that depth can be defined from a width by using a diagonal or 45° angle. In this method, elements or objects can be constructed or placed directly in the perspective view without projecting from a floor plan.

You will construct an object with a 4' X 5' base and 4' and 10' heights on its opposite sides. You will place the object 6' to the right from the observer and 8' from the back or projection plane. Call the points on the base of this object points (**a**), (**b**), (**c**), and (**d**).

In projected perspective, images are projected onto a picture (measuring or projection) plane. Any line that lies on this plane is true length since it is on the plane itself. In this method, therefore, all measurements will be done on this picture plane, which can be placed anywhere it best suits its intended purpose. For example, it can be a wall in a space, a line defining a plane for several objects, or a street facade in an urban setting.

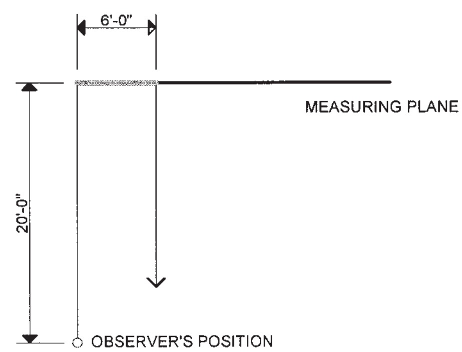
CONCEPT



1. PERSPECTIVE SETUP AND MEASURING DISTANCE

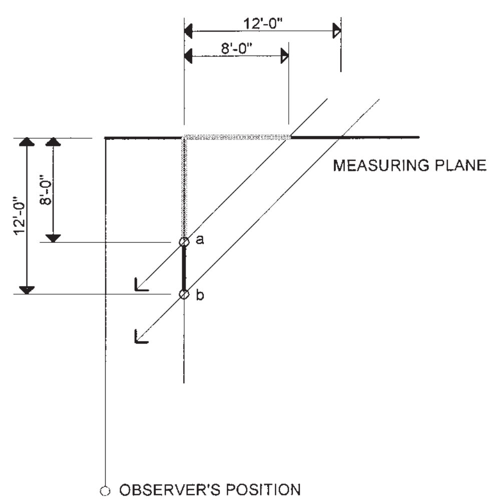
The HORIZON LINE is a line at eye level. The BASE LINE (ground line) is the line where the picture plane intersects with the base (ground) plane.

Define the location of a line that is 6' to the right of where the observer stands. Points (**a**) and (**b**) will be on this line.



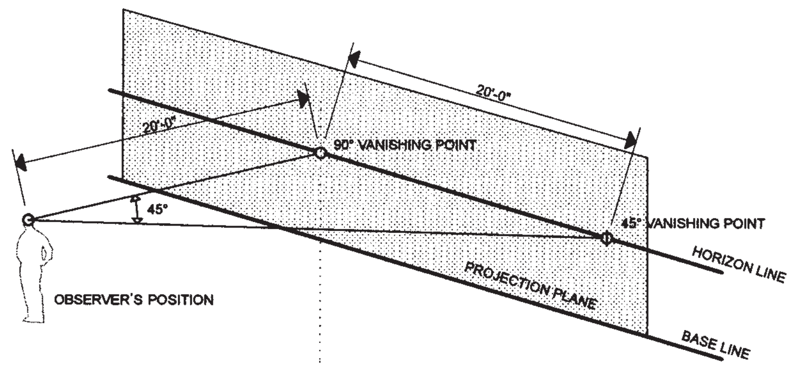
2. MEASURING DEPTH

Locate (**a**) at 8' from the back plane and (**b**) at 12'.



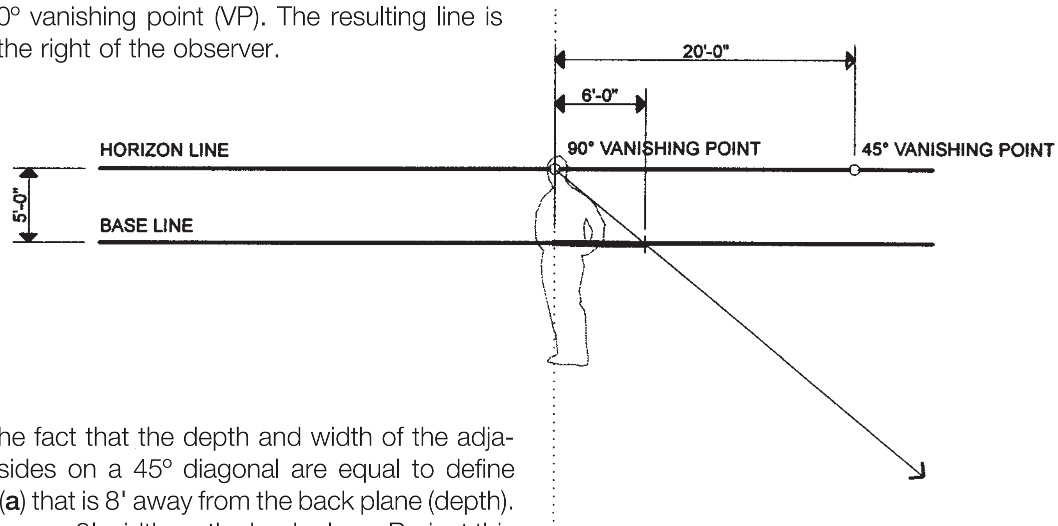
Diagrams and text (both pages):
Courtesy of Professor Arpad Daniel Ronaszegi
Savannah College of Art and Design

CONCEPT SKETCH

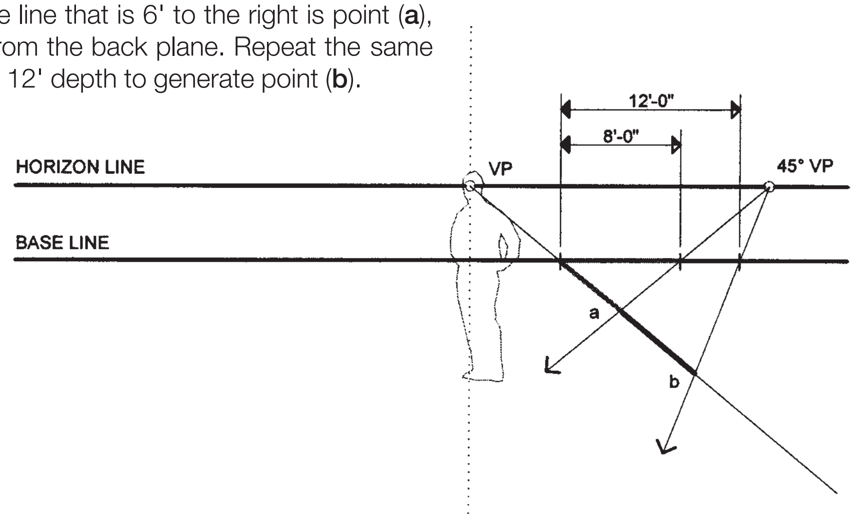


Perspective Drawings

Define the location of the HORIZON LINE and BASE LINE. The 6' distance will be measured on the back of the projection plane, where measurements are true dimensions. This distance will be projected out to the perspective space through the 90° vanishing point (VP). The resulting line is 6' to the right of the observer.



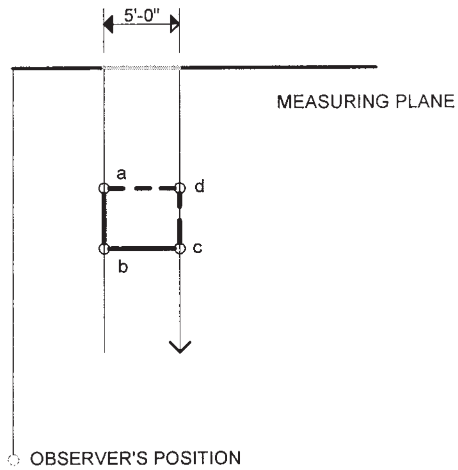
Use the fact that the depth and width of the adjacent sides on a 45° diagonal are equal to define point (**a**) that is 8' away from the back plane (depth). Measure an 8' width on the back plane. Project this point through the 45° VP. The intersection of this point with the line that is 6' to the right is point (**a**), which is 8' from the back plane. Repeat the same process with 12' depth to generate point (**b**).



Diagrams and text (both pages):
Courtesy of Professor Arpad Daniel Ronaszegi
Savannah College of Art and Design

3. MEASURING WIDTH

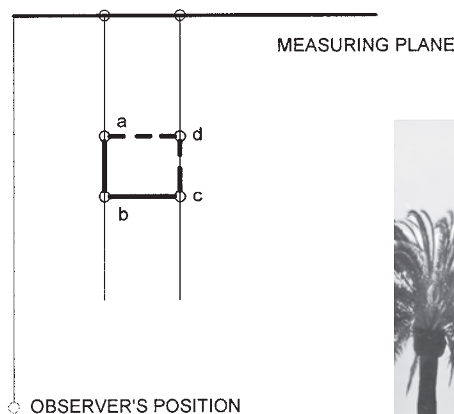
Locate points (**c**) and (**d**) 5' to the right of line (**ab**).



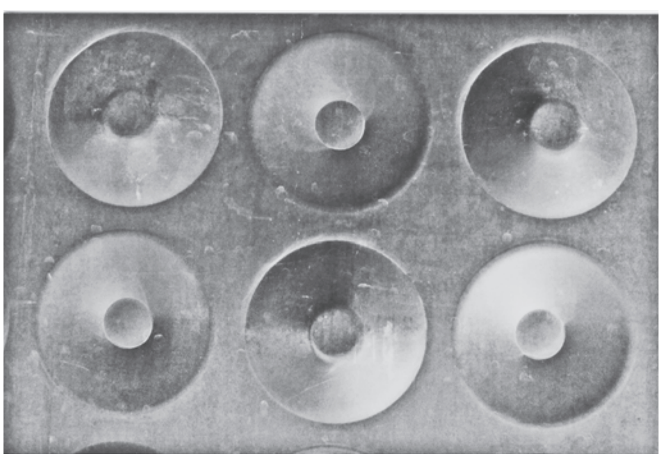
4. MEASURING HEIGHT

Define a 4' height on the line (**ab**) and a 10' height on line (**cd**).

The heights will be measured vertically on the back plane and then projected to the proper points.



© Rendow Yee



© Charles Yim

© Charles Yim

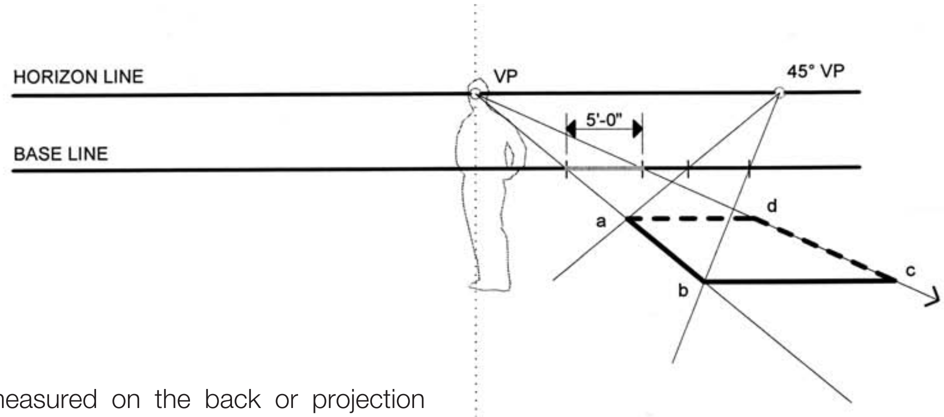
Photos: Facade detail, facade, and tower
De Young Museum, San Francisco, California
Architect: Herzog & DeMueron

Similar to the perspective on the facing page, this building has lines that recede to one vanishing point.

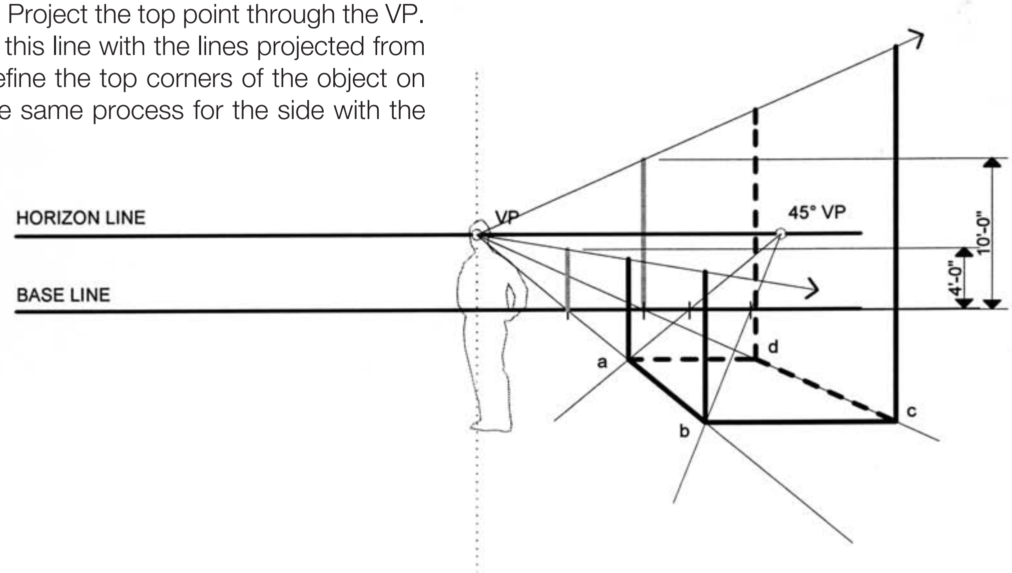
The use of a perforated and textured copper sheathing that replicates the "pixilated" photograph of light filtering through the surrounding tree canopy creates a dramatic facade with indentations. When the copper turns green from oxidation in later years, the color of the building will blend into the landscape of the surrounding vegetation.

5. FINISH OBJECT

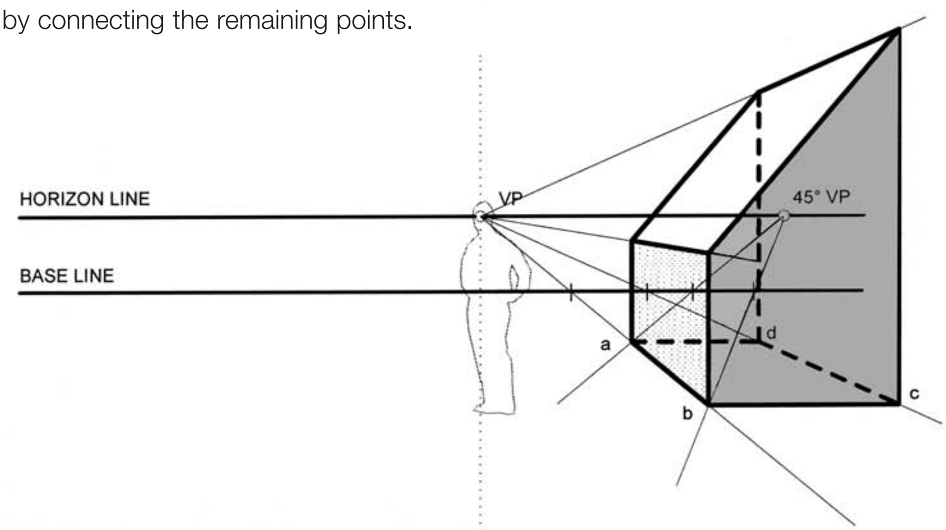
To define points (**c**) and (**d**), which are 5' from line (**ab**), measure a 5' width on the back plane. Project a line through the VP. The intersection of this line with lines projected horizontally from points (**a**) and (**b**) will define points (**c**) and (**d**).



Heights are also measured on the back or projection plane. Measure the 4' height where the (**ab**) line intersects with the back plane. Project the top point through the VP. The intersections of this line with the lines projected from points (**a**) and (**b**) define the top corners of the object on this side. Repeat the same process for the side with the 10' height.



Complete the object by connecting the remaining points.

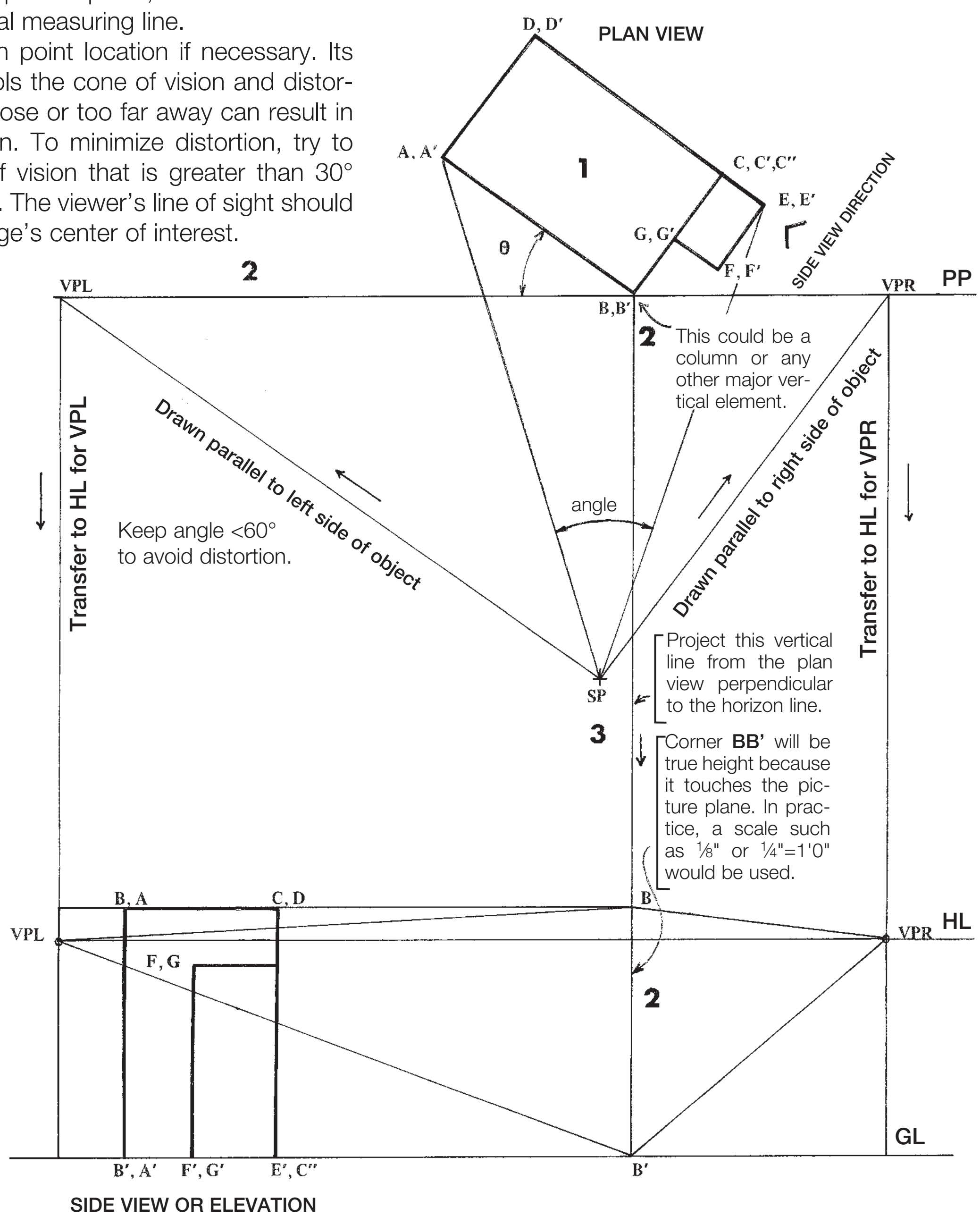


The Office Method

The *office* or *common* or *plan projection* method for constructing an accurate *two-point* perspective is a traditional one. Both sets of horizontal lines are turned at an angle to the picture plane (thus the term "angular" for the two-point system). It is dependent on both the scale of the *plan* and the scale of the *elevation.*

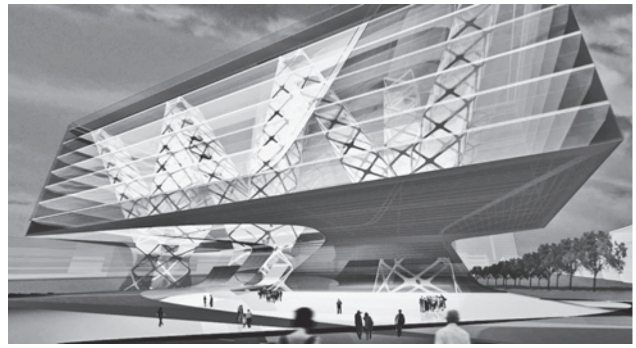
1. In the top or plan view, place the outline of the object or objects (buildings) with an arbitrary orientation angle **θ** (based on the view desired).
2. Arbitrarily locate the picture plane and the station point in the plan view to create a distortion-free view. It is advantageous to have the corner of the object touch the picture plane; this establishes a convenient vertical measuring line.
3. Adjust the station point location if necessary. Its placement controls the cone of vision and distortion. Being too close or too far away can result in extreme distortion. To minimize distortion, try to set up a cone of vision that is greater than 30° but less than 60°. The viewer's line of sight should focus on the image's center of interest.

Note: In a preliminary design drawing, an overlay of the floor plan or roof plan and elevation would be made on tracing paper. Position the plan and elevation to allow adequate space for the perspective view. When space is at a premium, place the plan and elevation closer together, keeping horizontal and vertical lines in alignment.

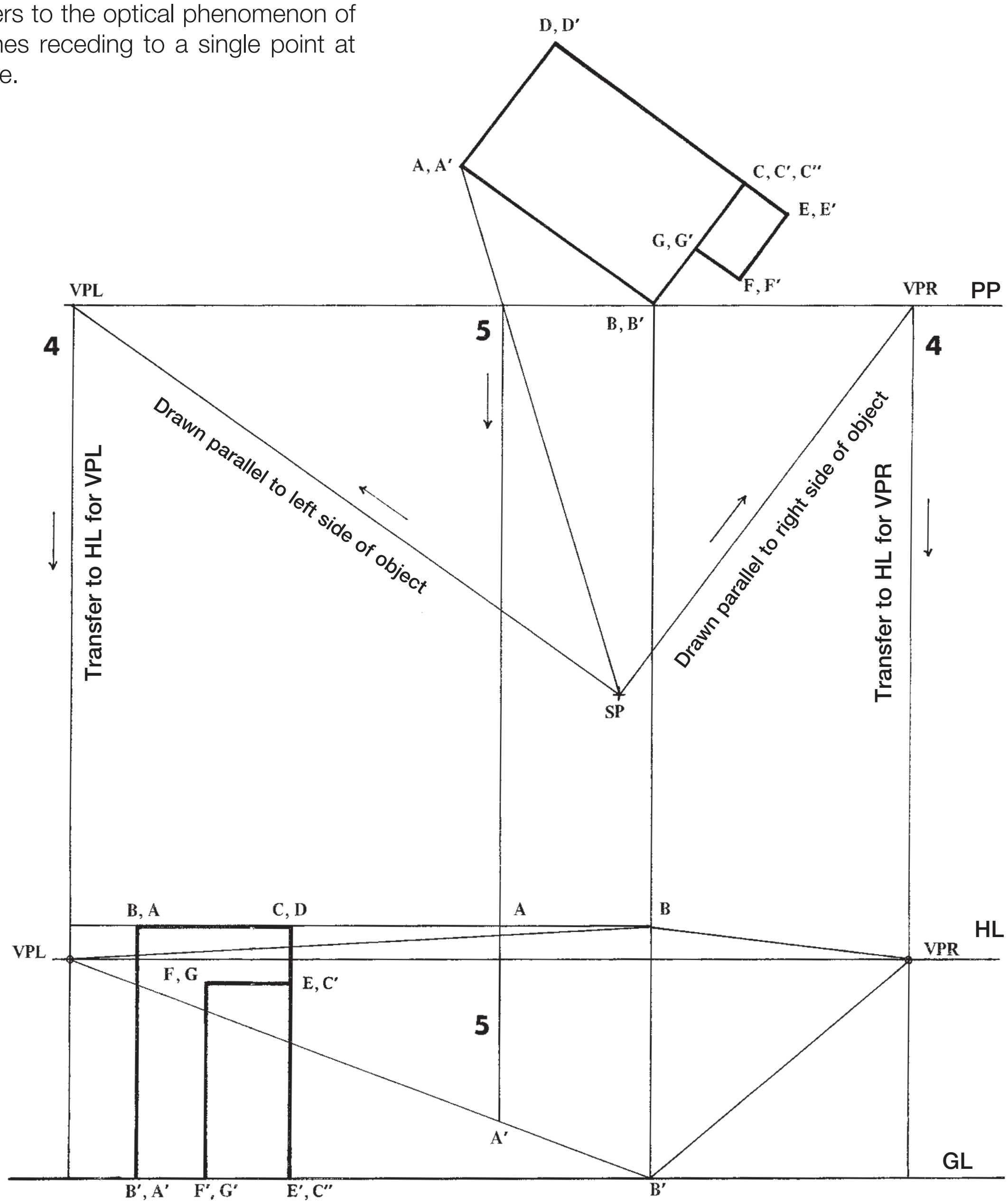


4. Draw lines parallel to the sides of the object from the station point until they intersect the picture plane. At these points, drop vertical tracer lines until they intersect the horizon line established for the perspective. The intersection points become the vanishing points for the perspective.
5. From the station point, sight all corner points, such as **A, A,** and note where the line of sight intersects the picture plane. At this point, project a vertical line into the perspective to locate foreshortened length **A, A.**

Note: Look for sets of parallel lines in your building or object and note where these sets will converge. *Convergence* refers to the optical phenomenon of sets of parallel lines receding to a single point at an infinite distance.

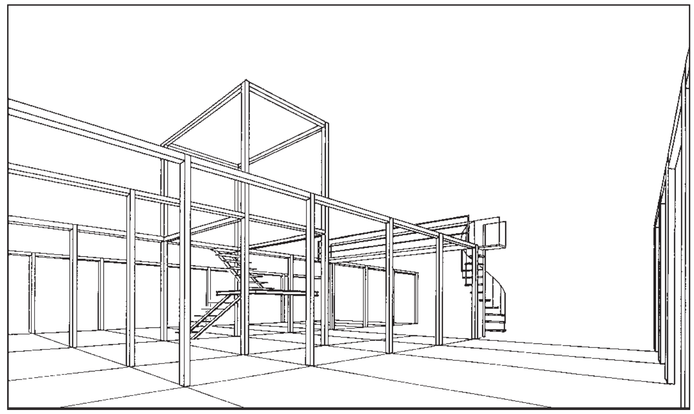


Drawing: Jalisco State Public Library, Guadalajara, Mexico
Medium: Maxwell Render, VRay, Maya, Rhino, Photoshop
Courtesy of Asymptote: Hani Rashid + Lise Anne Couture



6. Project all sighting intersection points on the picture plane into the perspective in order to complete the perspective of the object. Hidden lines are optional.

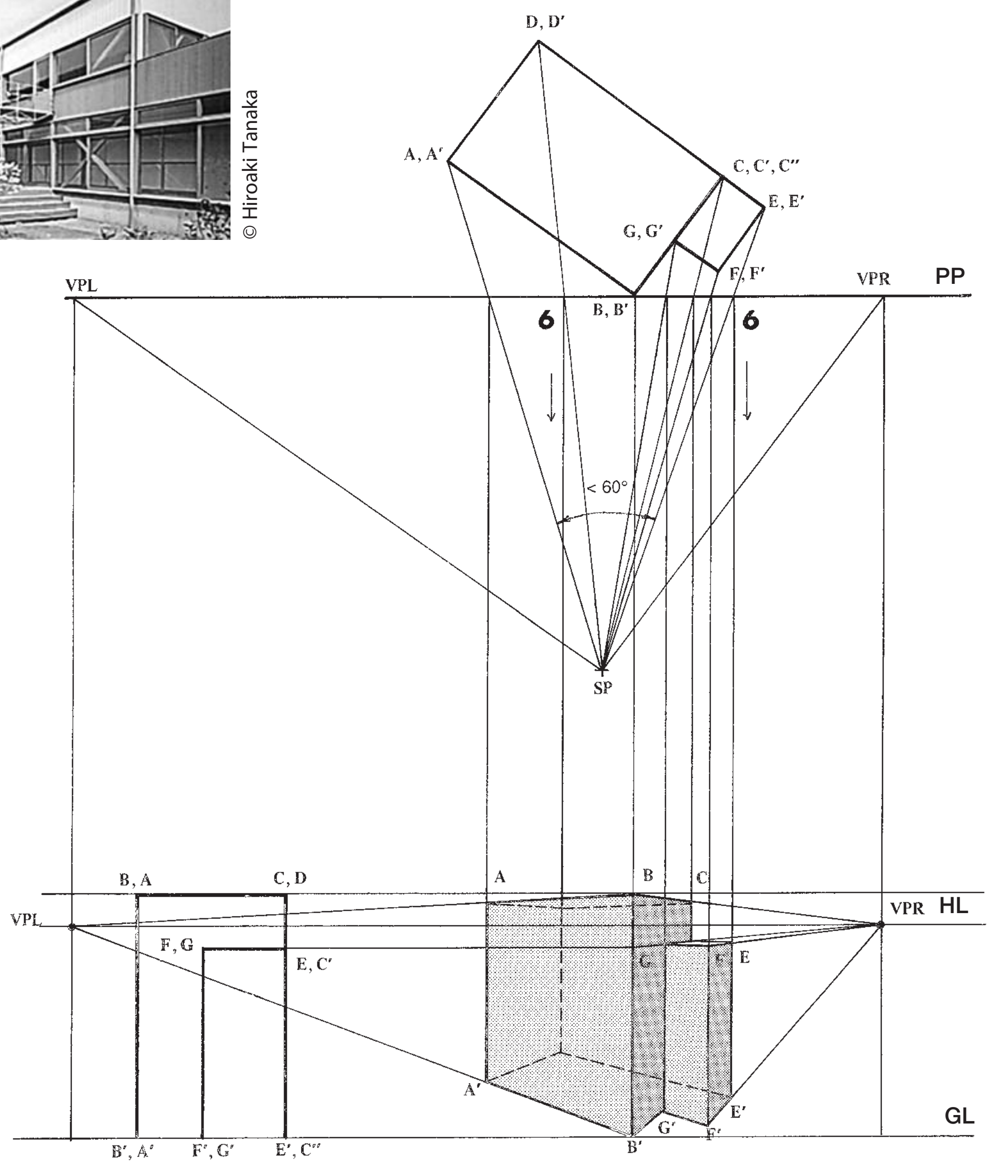
This and the previous two pages show the step-by-step sequence for constructing a two-point perspective when both the building plan and the elevation are drawn at the same scale. Angular (two-point) perspective is characterized by angular planes (inclined to the picture plane) having their own separate vanishing points. All vertical lines remain vertical.



Drawing: T residence, Hayama, Kanagawa, Japan
Courtesy of Iida Archiship Studio

© Hiroaki Tanaka

Photo: T residence
Courtesy of Iida Archiship Studio



© Mark Mack Architect

© Mark Mack Architect

Drawing: Bogner Fashion House, Munich, Germany
Medium: Ink
Courtesy of MACK — Mark Mack, Architect
Heino Stamm Planungsbüro; Bruckner & Partner, Associated Architects

Two-Point Perspective Application

This unique, two-point cutaway sectional perspective has lines going to two vanishing points on a horizon line. Note that the basement level shows a partial perspective plan view. The two vanishing points on the previous page are more evenly spread apart from the observer's line of sight and the cone of vision than are the vanishing points shown above. This is because the observer's line of sight is almost exactly at the corner of the object. In the above drawing, the vanishing points are quite unevenly spread apart because the front facade is almost parallel to the observer's face, and the sectional cut surface is almost perpendicular to the observer's face (foreshortening).

Multiple Vanishing Points

1. Label each block element and find the vanishing points for each. This particular example has six vanishing points.
2. Drop true-height tracer lines (circled points) from where the object touches the picture plane. Transfer corresponding true heights from the elevation.
3. Draw lines from the top and the bottom of the true-height lines to the appropriate vanishing points.
4. From the station point, sight all object corners and follow appropriate procedures to complete the perspective view.

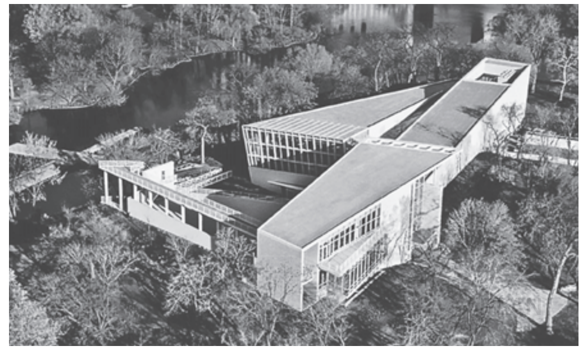
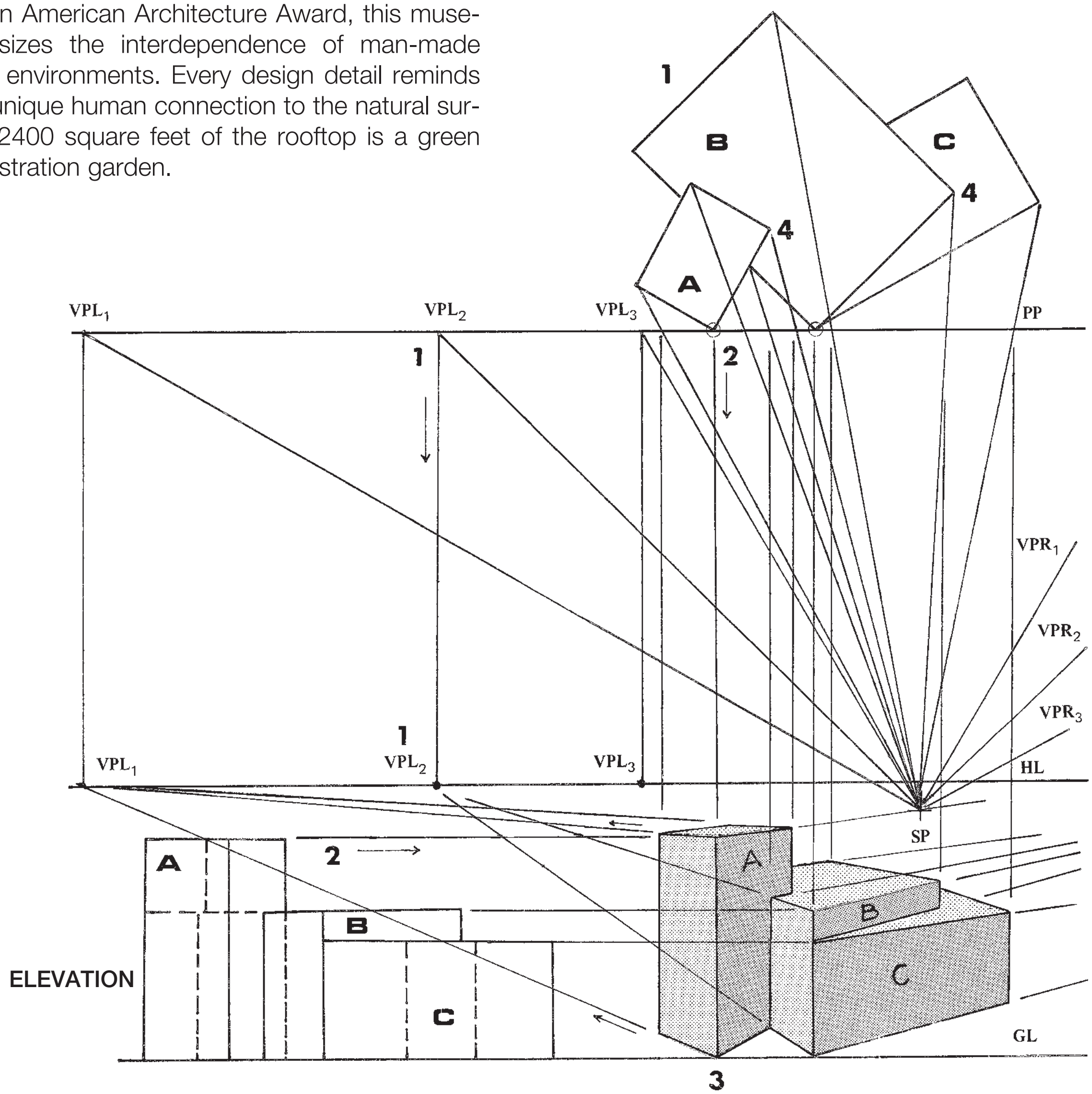
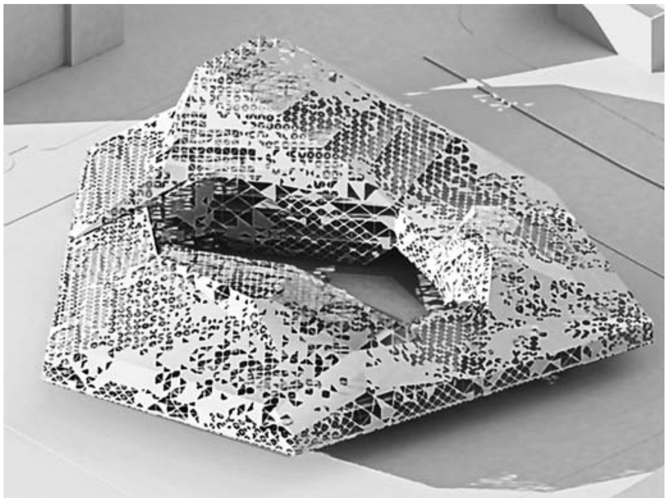


Photo: Peggy Notebaert Nature Museum, Chicago, Illinois
Courtesy of Perkins + Will Architects
© James Steinkamp, Steinkamp Photography

Winner of an American Architecture Award, this museum emphasizes the interdependence of man-made and natural environments. Every design detail reminds one of the unique human connection to the natural surroundings. 2400 square feet of the rooftop is a green roof demonstration garden.

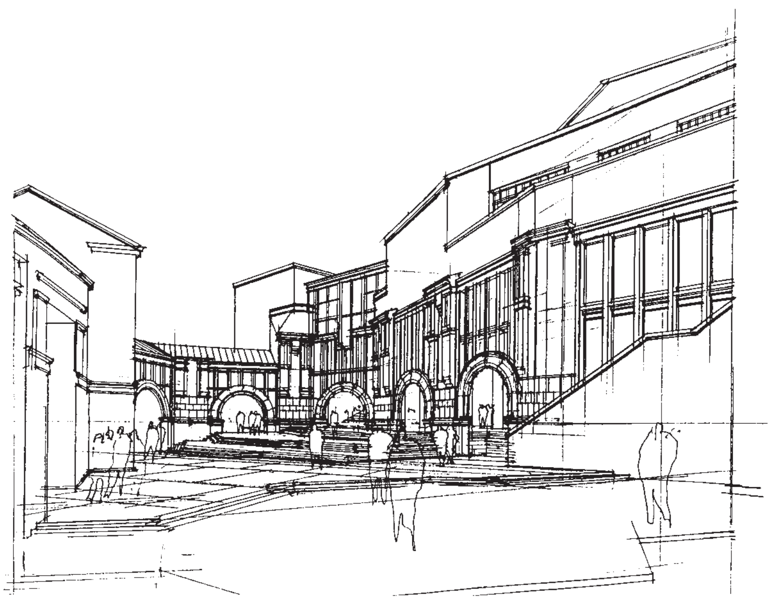


The total number of vanishing points depends on how many sets of parallel lines there are.



Drawing: Mocape Shenzhen, Shenzhen, China
Medium: 3-D graphic software
Courtesy of Serero Architects

Drawing: Mocape Shenzhen: interior courtyard view
Shenzhen, China
Medium: 3-D graphic software
Courtesy of Serero Architects



Drawing: California Center for the Arts, Escondido, California
Moore Ruble Yudell Architects
17" × 14" (43 × 36 cm)
Rough layout before a final line sketch and the use of watercolor as the medium
Courtesy of Al Forster, Architectural Illustrator

The California Center for the Arts entry plaza is partially enclosed by wall planes that have multiple vanishing points on the horizon line. Likewise, the Mocape Shenzhen courtyard displays planes with multiple vanishing points.

Mocape is conceived as a rock and not a building, shaped and sculpted by the program and by the surrounding environment. The facade is wrapped by a continuous surface of glass and steel cladding composed of triangular and square panels similar to the ancient Chinese puzzle, the Tangram. The amount of light penetrating the museum spaces and filtering the views to the interior courtyard is constantly changing.

Multiple Vanishing Points

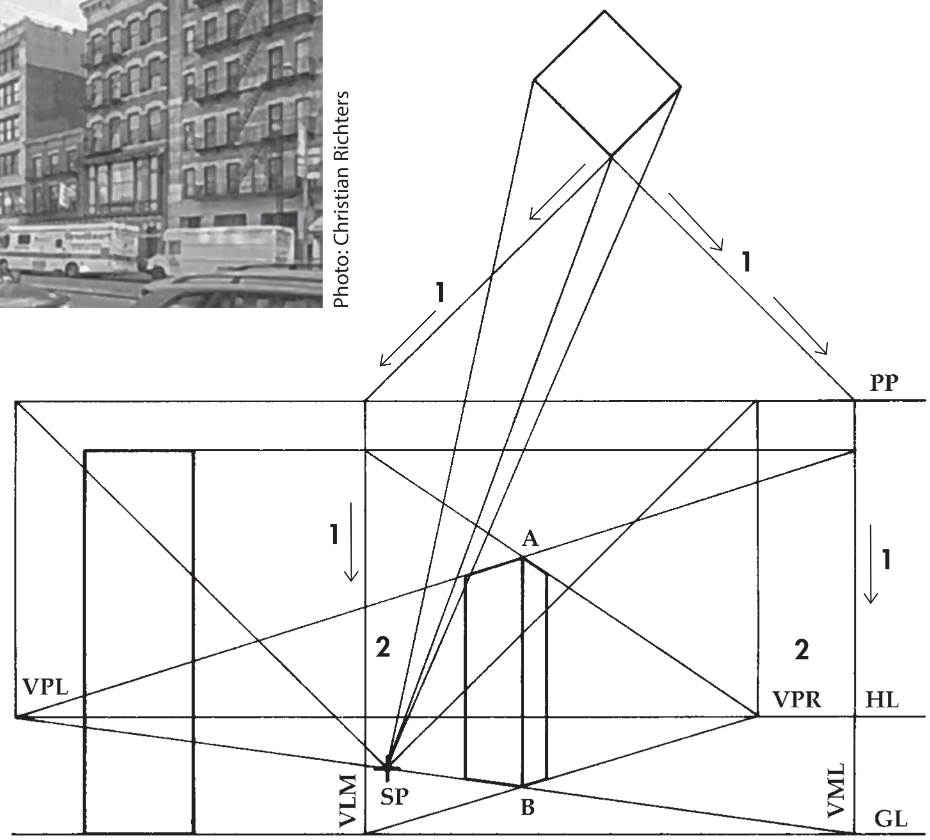
The blockout began as if there were just one ground plane. Plaza levels were added or (as in the foreground) subtracted from the ground plane, and the figures in the final drawing were placed below or above the horizon line on their proper plaza levels. In a complicated drawing like this one, with multiple levels, vanishing points, and detail, it is easier to disguise certain inevitable errors than it is in a very simple drawing.
[Architectural Illustrator's statement]

1. Project extension lines from the left and right sides of the object to the picture plane and drop them vertically to the ground line.

Photo: Christian Richters

Photo: New Museum of Contemporary Art
New York, New York
Architect: SANAA
© Arcspace

This transparent building completed in 2007 is composed of a stack of rectangular boxes shifted off axis in various directions. Designed from the inside out, the column-free exhibition space is encased in a silvery galvanized zinc-plated envelope that is punctuated with skylights and windows for sweeping vistas and great views.



ELEVATION

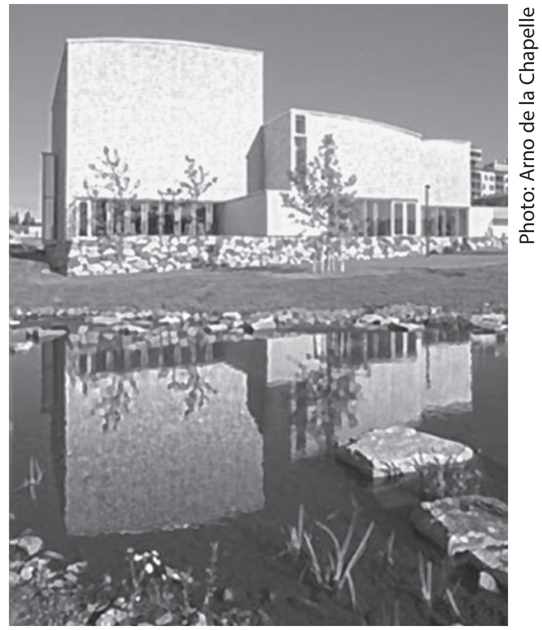
Building corner height AB is defined by the intersecting perspective planes.

2. Project the perspective planes back to VPR and VPL for both sides.

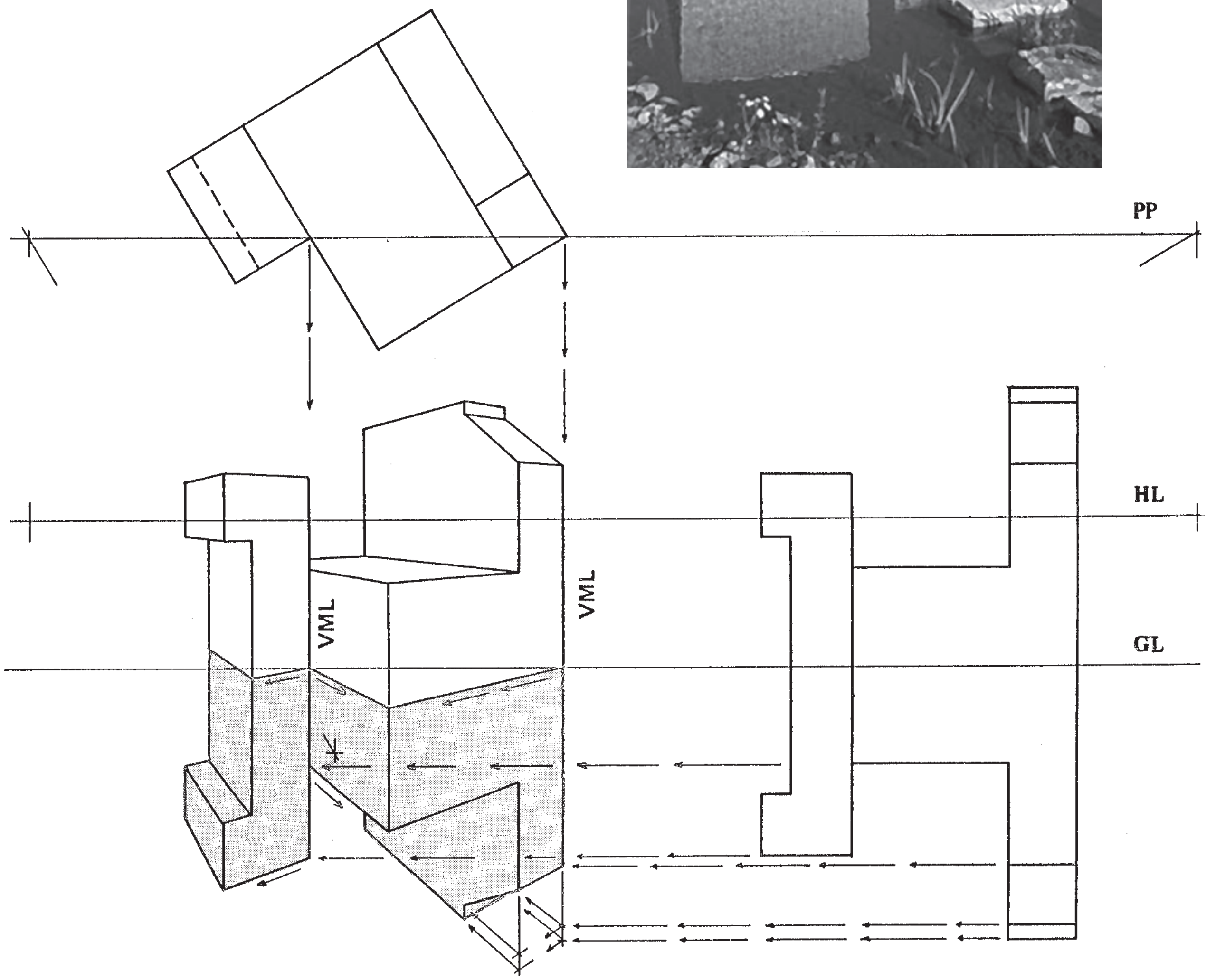
Object–Picture Plane Relationship

Objects that are behind the picture plane usually fall well within the cone of vision and show no distortion. The high-rise illustration was drawn with a greater degree of convergence to the left vanishing point than the example diagram to the right. Nevertheless, the view is well within the cone of vision. To find all the vanishing points when an object does not touch the picture plane, always construct (or trace) the plan view and note all the planar elements and their angles relative to the picture plane. Draw light construction lines parallel to all these planar elements, regardless of whether they are on the left or right side of the building. Drop these projection lines vertically from the picture plane to the horizon line. Relative to the station point, all left-side planar elements go to left vanishing points, and all right-side planar elements go to right vanishing points.

Photo: Viikki Church
Helsinki, Finland
Architects: JKMM Architects
© Arcspace



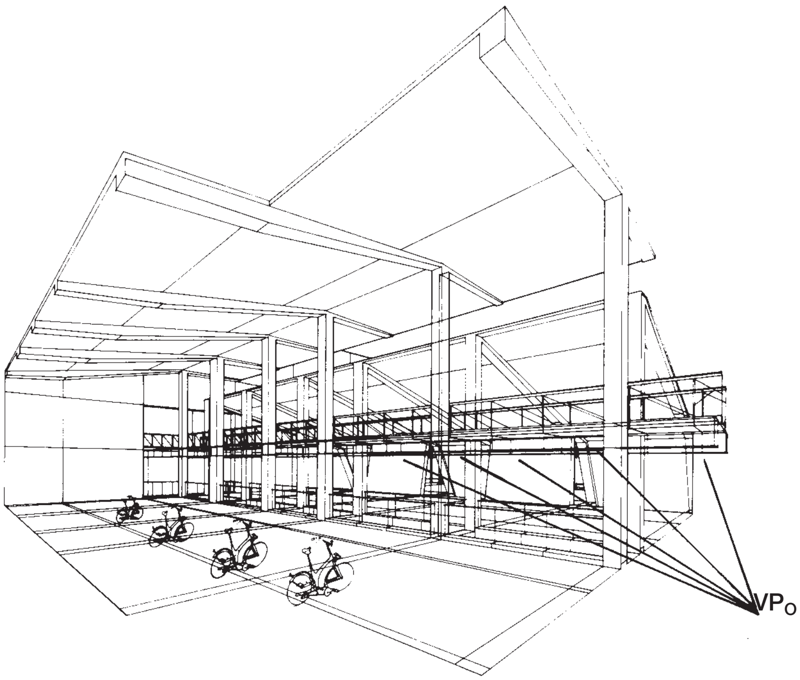
This prefabricated church built of factory-made components combines modern and ancient building methods. The idea was to create a modern successor to the traditional wooden Finnish churches. It respects and accounts for the ecological ideas and criteria of sustainability in the entire Vikki area.

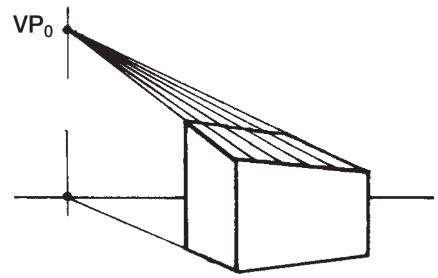


Object–Picture Plane Relationship

Objects completely in front of the picture plane will have a distorted perspective image because they begin to fall outside the cone of vision. However, partial penetration of the picture plane by an object is usually visually acceptable, as shown above. Use all *vertical measuring lines (VML)* that touch the picture plane to project construction lines into the volume in front of the picture plane. When partial penetration is minimized, the image result shows minimal or no distortion, as in the photo above.

Drawing: Student project by Jennifer Kinkead
Bicycle factory, Mexico
Excerpted from abstract
Medium: Ink on Mylar
Columbia School of Architecture Planning and Preservation (CSAPP)

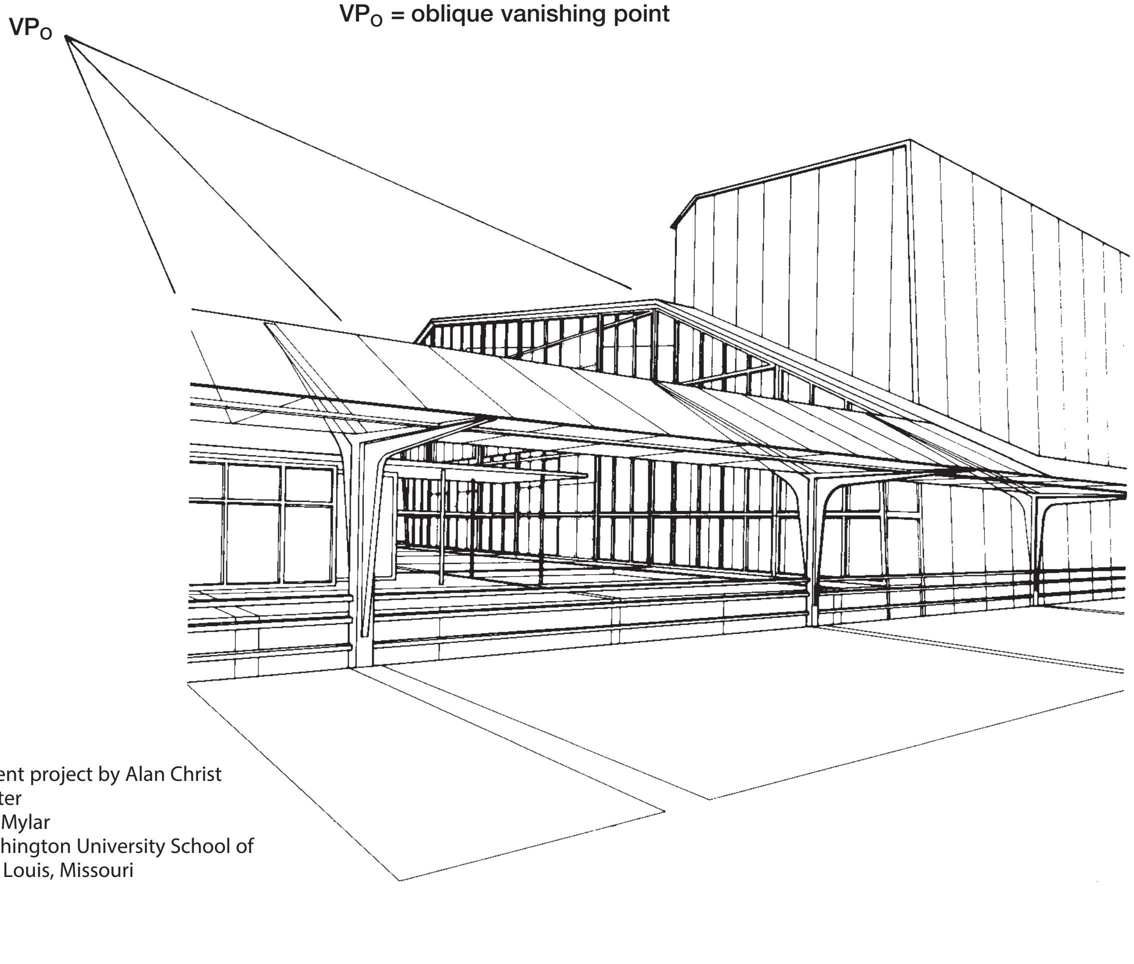




Oblique Vanishing Point

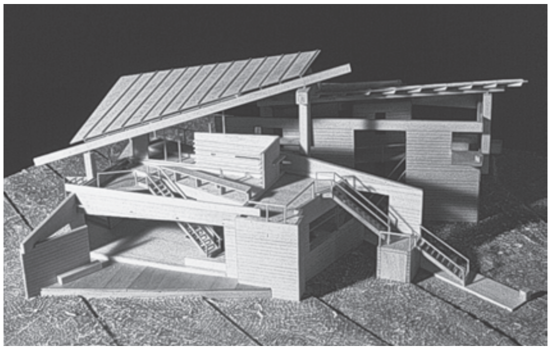
It is quite common to find a series of *oblique* (also termed "sloping" and "inclined") edges that are parallel in building forms. In such cases an oblique vanishing point (**VP_O**) expedites perspective construction.

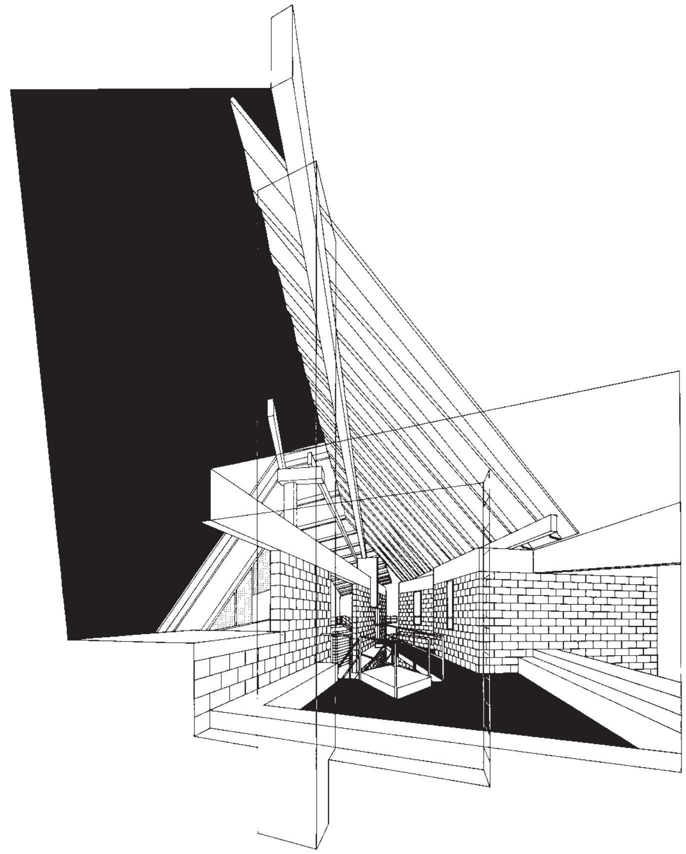
VP_O = oblique vanishing point



Drawing: Student project by Alan Christ
Theater
Medium: Ink on Mylar
Courtesy of Washington University School of Architecture, St. Louis, Missouri

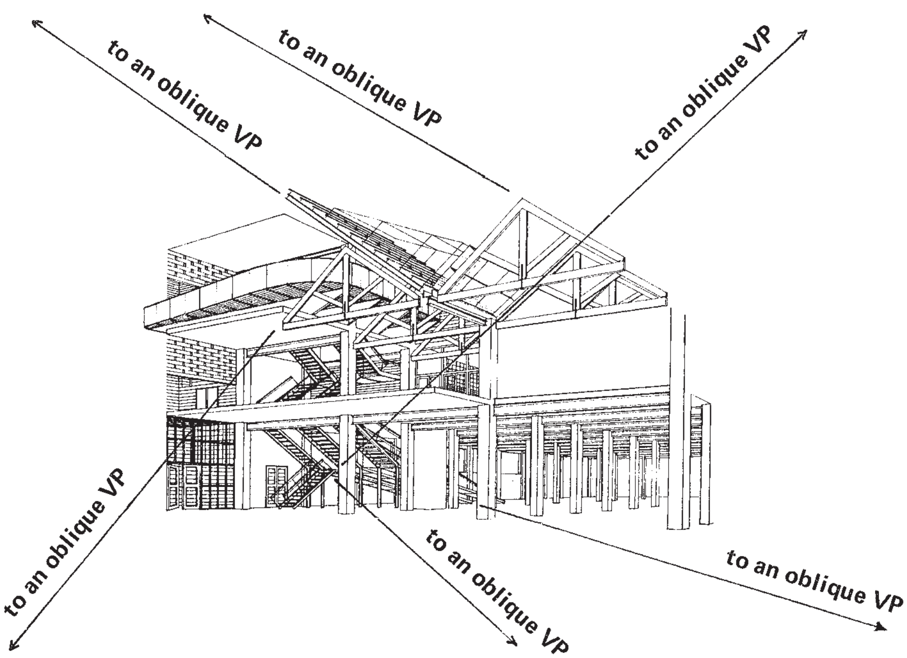
Drawing: Glass-Kline residence, New Paltz, New York
14" x 17" (35.6 x 43.2 cm)
Medium: Ink on vellum
Courtesy of Taeg Nishimoto & Allied Architects





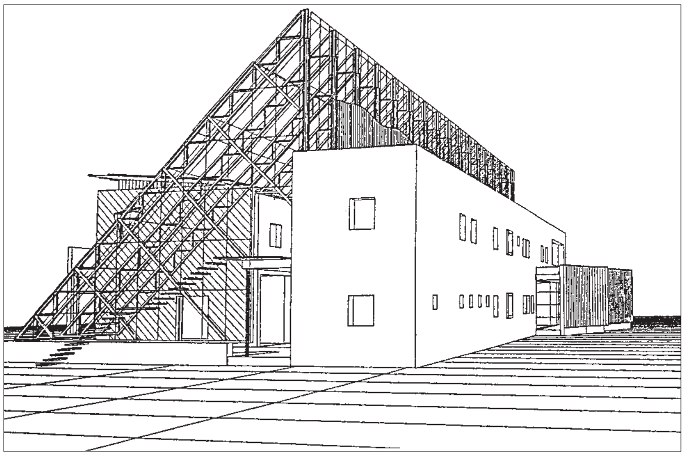
Oblique Vanishing Points

This interior perspective has structural ceiling elements that have oblique vanishing points both down to the right and down to the left.



Drawing: La Llauna School, Badalona, Spain
Medium: Ink on Mylar
Courtesy of Enric Miralles & Carme Pinós, Architects

Edges that are *parallel* in an inclined plane converge to a *common* vanishing point. This vanishing point is not on the eye-level line. The vanishing points for a building's *oblique* lines fall either above or below its eye-level vanishing points. The process of determining the proper direction is discussed on the next two pages. The perspective of this building has numerous inclined lines and planes and, consequently, many oblique vanishing points. Sloping lines in perspective are a common occurrence with staircases and ramps.

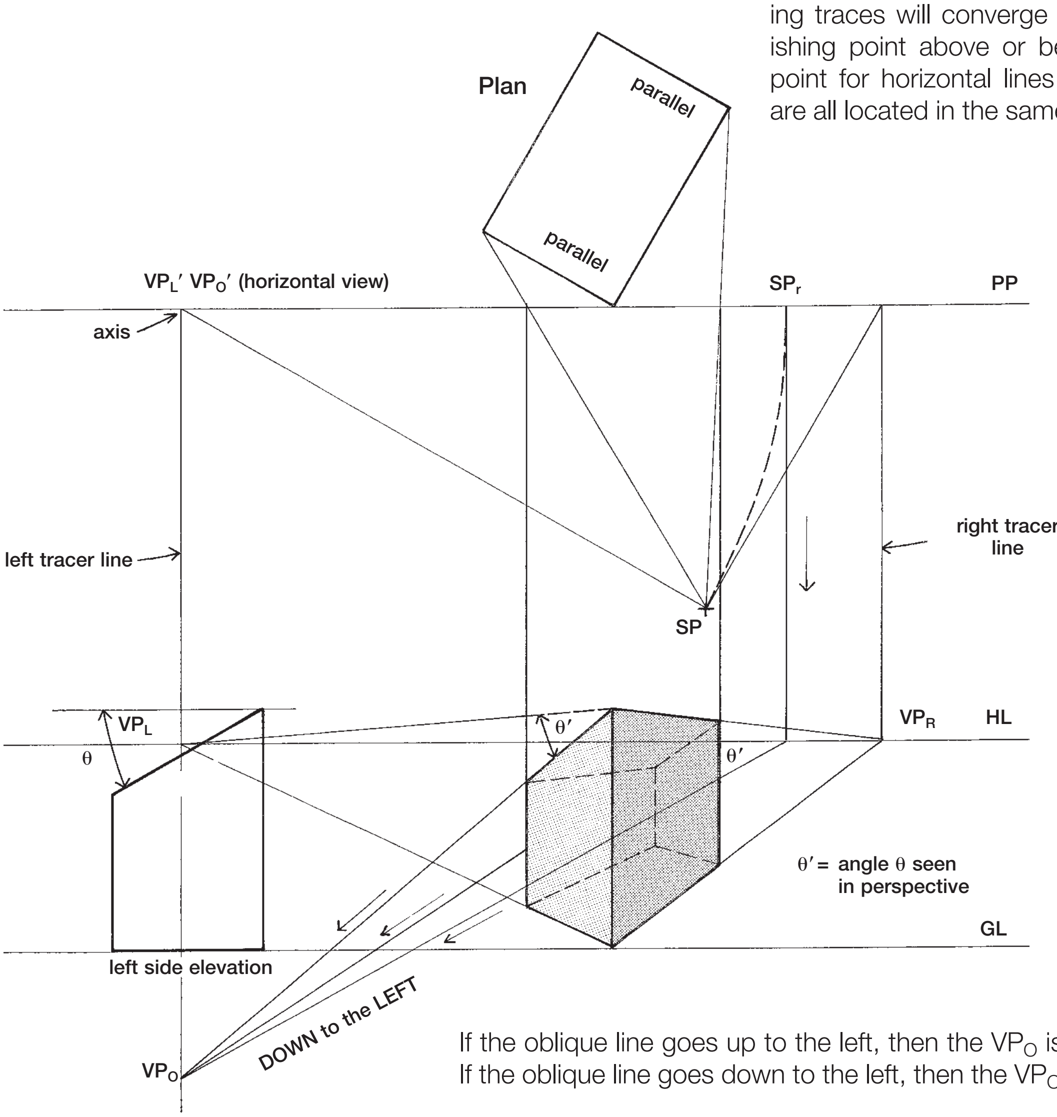


Drawing: Kindergarten Griesheim
Frankfurt–Griesheim, Germany
16.5" × 11.7" (41.8 × 29.7 cm)
Medium: CAD
Courtesy of fs-architekten Paul Schroder Architekt BDA

Photo: Kindergarten Griesheim
Frankfurt am Main, Germany
Courtesy of fs-architekten, Paul Schroder Architekt BDA

Oblique Vanishing Points

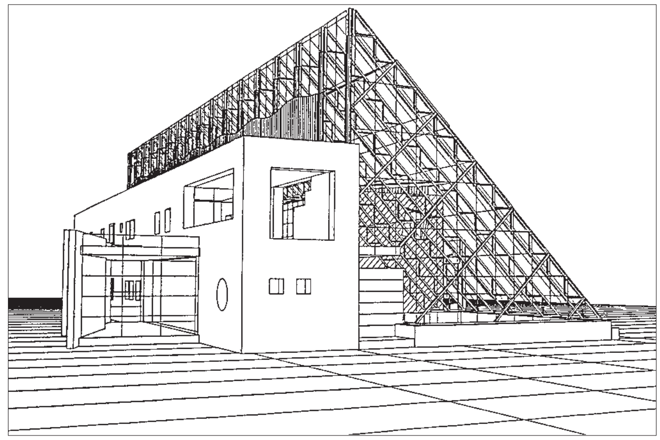
If a building has parallel inclined (slanted) edges that are neither horizontal nor vertical, as seen in the plan view below, their vanishing traces will converge to an oblique vanishing point above or below the vanishing point for horizontal lines. These trace lines are all located in the same or parallel planes.



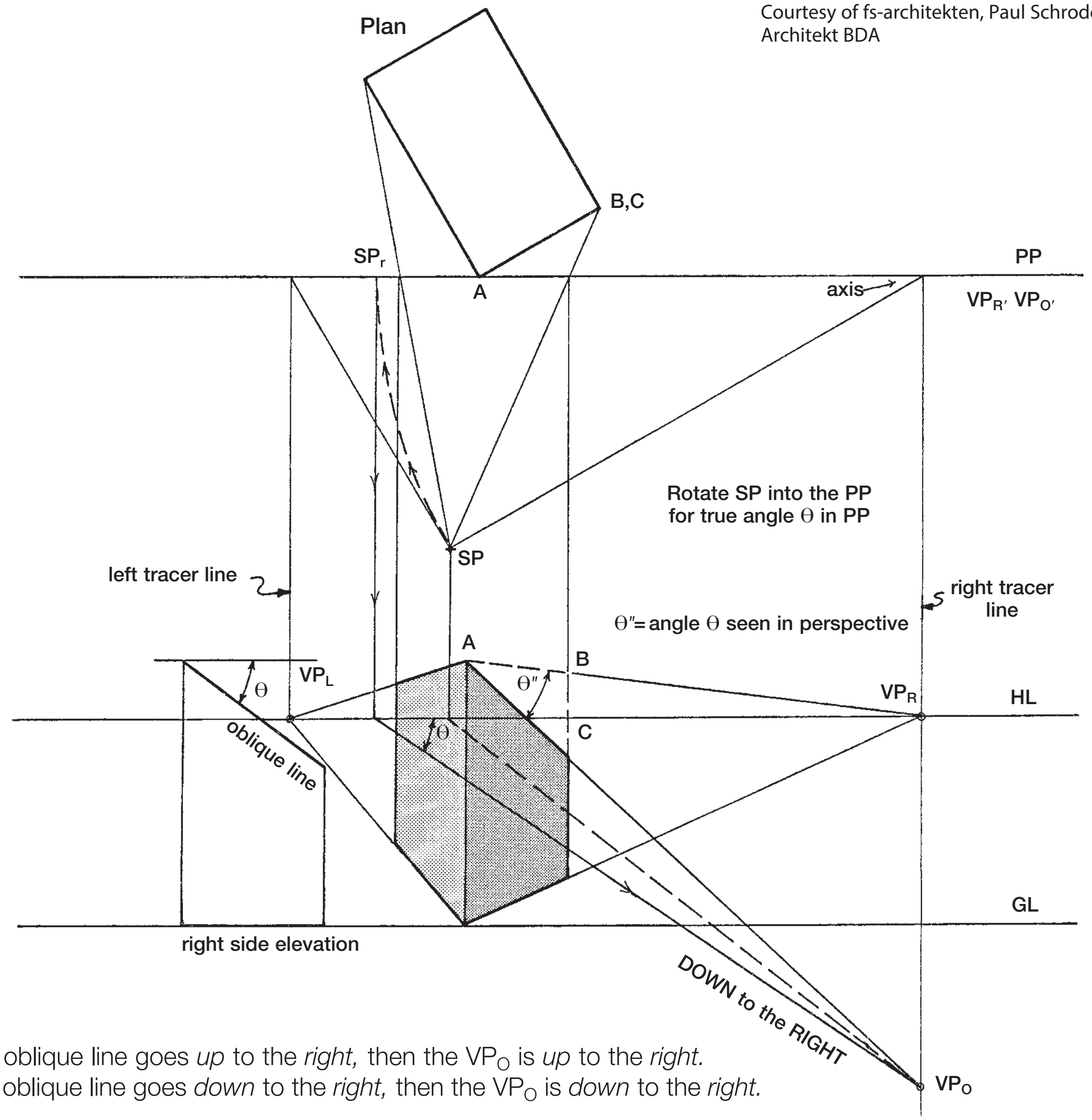
If the oblique line goes up to the left, then the VP_O is up to the left.
If the oblique line goes down to the left, then the VP_O is down to the left.

Δ**ABC** is proportional to $\mathbf{\Delta SP_r\ VP_{R'}\ VP_{O'}}$ where **r** means rotated.

Photo: Kindergarten Griesheim
Frankfurt am Main, Germany
Courtesy of fs-architekten,
Paul Schroder Architekt BDA



Drawing: Stadt Frankfurt
Frankfurt–Griesheim, Germany
16.5" × 11.7" (41.8 × 29.7 cm)
Medium: CAD
Courtesy of fs-architekten, Paul Schroder Architekt BDA



If the oblique line goes *up* to the *right*, then the VP_O is *up* to the *right*.
If the oblique line goes *down* to the *right*, then the VP_O is *down* to the *right*.

Photos: August Wilson Center for African American Culture Pittsburgh, Pennsylvania

Courtesy of Perkins + Will Architects

The colliding of two forms—one rectilinear and one partial cylindrical—is a powerful use of contrast to draw attention to the street-front elevation. There is no question that where the two forms meet, something special happens at the intersection. This building won an AIA Pittsburgh Design Honor Award.

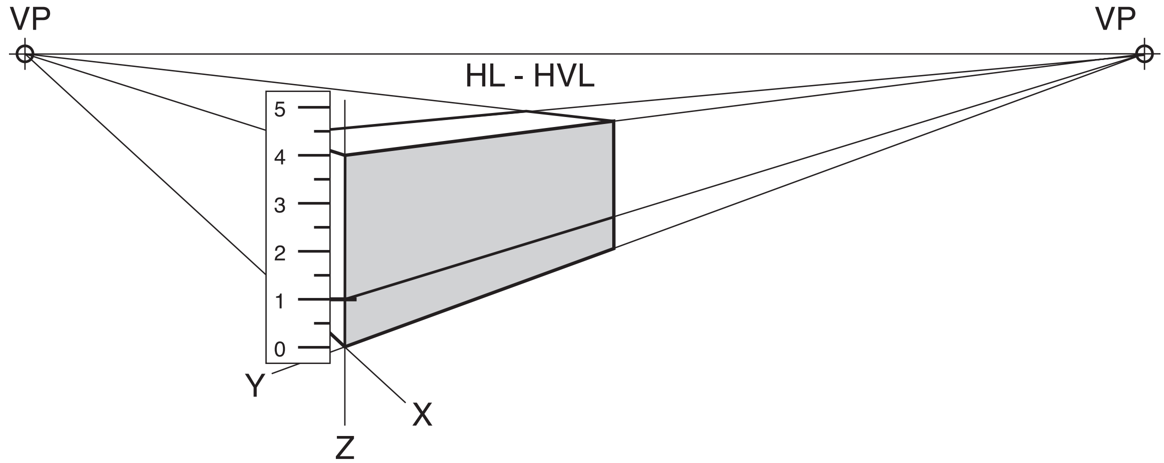
Multiplying, Dividing, and Transferring

The plan/elevation method (for both two- and one-point) is just one of many ways to generate mechanical perspective drawings. In the future, new methods may emerge, and it is important not to be afraid to experiment with them. The balance of this chapter will, for the most part, discuss other methods.

Once an initial cube has been constructed, concepts and techniques for *multiplying, dividing,* and *transferring* dimensions in perspective space can be employed. These techniques support the development of a perspective without adding to its constructional framework. They build and reinforce an understanding of the perspective structure and the relationships among things within it regardless of the generated perspective method used. They do not require drawing space beyond the perspective itself, and they can be applied to any part of any existing perspective. Armed with this set of concepts and strategies for their employment, anything can be accurately drawn in perspective.

The application of the multiplying, dividing, and transferring techniques is of particular importance because it provides the means for linking sketching with the computer. The ability to quickly and accurately sketch within and extend a computer-generated perspective supports the exploration of alternatives and the development of presentation drawings. It allows three-dimensional modeling programs to be used to create simpler and more efficient mass models for generated perspective frameworks that can also be elaborated on by hand.

Diagram (facing page) and text:
Courtesy of William R. Benedict, Assistant Professor
California Polytechnic State University
School of Architecture, San Luis Obispo, California



X-, Y-, and Z-Axes

The x-, y-, and z-axes are the axes of the Cartesian coordinate system that are parallel to the three sets of parallel edges of a cube or any rectangular object or rectangular space. Moving through perspective space can be visualized as moving successively along the axes to arrive at the desired location. The z-axis is parallel to the picture plane; therefore, all lines parallel to it will retain their true orientation—that is, they will be drawn as vertical lines.

Dividing by Measuring

A common need in drawing is to give a line some scale and establish dimensions along it. You may have a line of some length that you wish to call a specific dimension (give a specific scale), say 4', and then establish a point on the line that is one foot from one end.

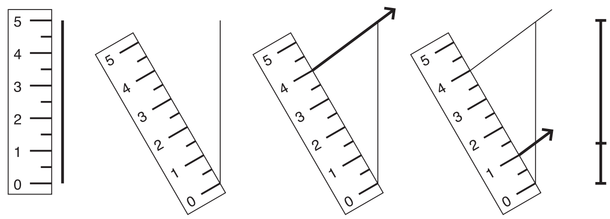
Three techniques can be used: direct measurement, vanished transfer, and parallel transfer. All three techniques are intended to give a line scale and locate specific dimensions. Once this has been done, other techniques must be used to move the dimensions within the drawing. Direct measurement, parallel transfer, and a variation of parallel transfer with vertical and horizontal lines will be discussed.

Direct Measurement

This technique involves directly measuring the line. It is used when establishing dimensions through visual judgment or direct measurement with a scale. Direct measurement with the eye involves making visual judgments that proportionally divide the line. For example, if the line is assumed to be 4' long and a 1' increment is needed, you can visually divide the line in half and then in half again to demarcate 1'. This works very well because we can accurately judge the middle of things. With practice you can also divide a line into thirds or fifths. By combining judgments of halves, thirds, and fifths, you can easily and accurately use your eye to establish dimensions in a drawing.

Photo: Extension to the Denver Art Museum
Frederic C. Hamilton Building
Denver, Colorado
© Studio Daniel Libeskind
Photograph by Bitter Bredt

This building, which has multiple vanishing points and many nonparallel planes, is the antithesis of the Cartesian coordinate system developed in the Renaissance by Brunelleschi. Libeskind's idea was two lines not touching that fold onto each other in a spatial dance, resulting in many sloped roofs toward the sky.

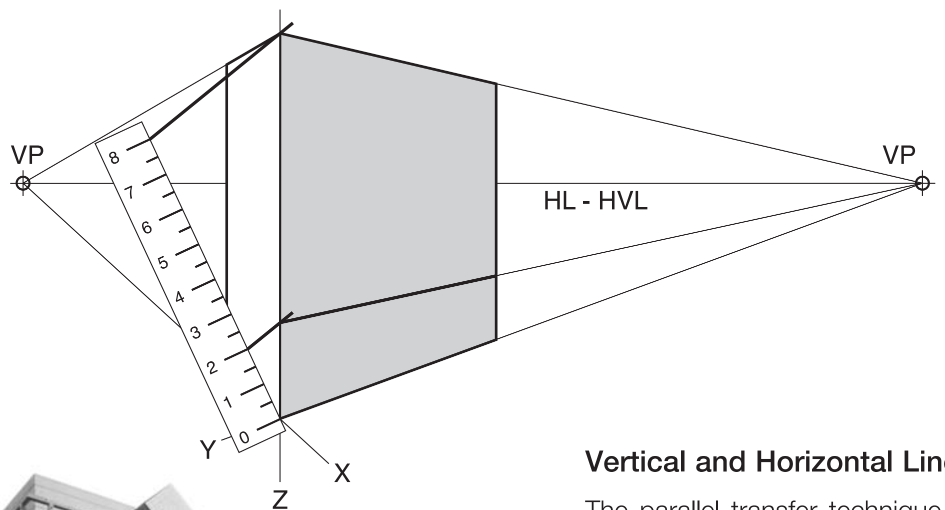


Parallel Transfer

Suppose the existing line is of a dimension not readily divisible by four. Identify the line parallel to the picture plane that you want to make equal to that dimension.

Choose a scale reasonably close to the actual length of the line. Align the zero mark on the scale to one end of the line to be dimensioned. Angle the scale away from the line. Mark the desired dimensions along the edge of the scale, including the one that designates the full length of the line.

Draw a line from the full-length dimension along the scale to the end of the line you want to dimension. The angle of this line will be used to transfer all other dimensions from the scale to the line. Draw lines that are parallel to the line created in the preceding step between all dimensions along the scale and the line you are dimensioning (i.e., 1'). You have now proportionally dimensioned the base line and can proceed with the drawing construction using other techniques.



© Marcus Chaw

Photo:Reforma 164 Building, Mexico City, Mexico

Vertical and Horizontal Lines

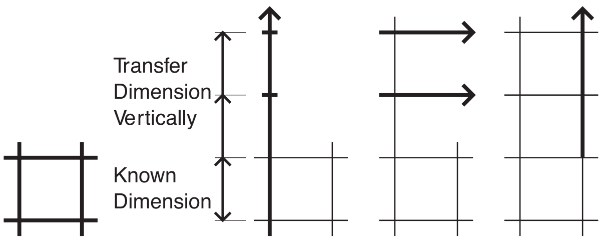
The parallel transfer technique translates directly to any line that is parallel to the picture plane, such as those that are vertical and horizontal. The perspective example above shows the technique being used for a vertical edge—a condition that occurs in both one- and two-point perspectives.

Note: The photo of this eighteen-story high-rise building shows that the parallel vertical lines appear to converge upward when seen by an observer at ground level. This photograph was taken without a perspective corrector lens; with a perspective corrector, all lines would be vertical and nonconvergent.

Diagrams and text (pp. 285–287):
Courtesy of William R. Benedict, Assistant Professor
California Polytechnic State University
School of Architecture, San Luis Obispo, California

Multiplying by Measuring

The assumption is that you have a visually and proportionally correct square and wish to generate additional squares above or below.

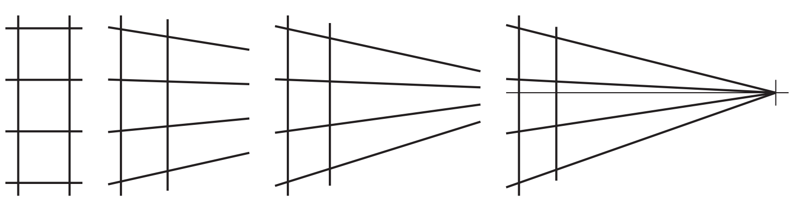


Draw or identify the base square whose vertical edges are parallel to the picture plane. All edges are parallel in orthographic drawings.

Extend a vertical edge of the base square to function as a measuring line. Transfer the height of the base square (the known dimension) along this edge. You can transfer dimensions above and/or below the base square as many times as needed.

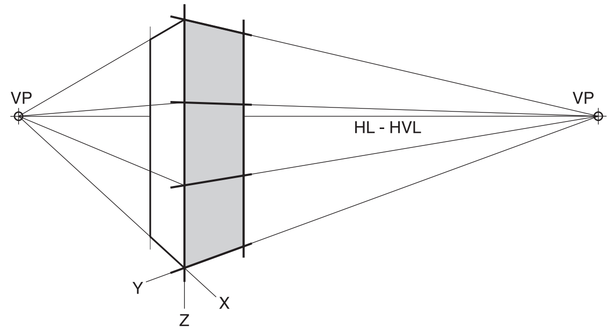
Principle: Vertical lines in both one- and two-point perspectives represent edges that are parallel to the picture plane—they do not vanish. This means that a dimension or portion of the dimension (½, ¼, etc.) established on any vertical line within a perspective can be transferred vertically along that line.

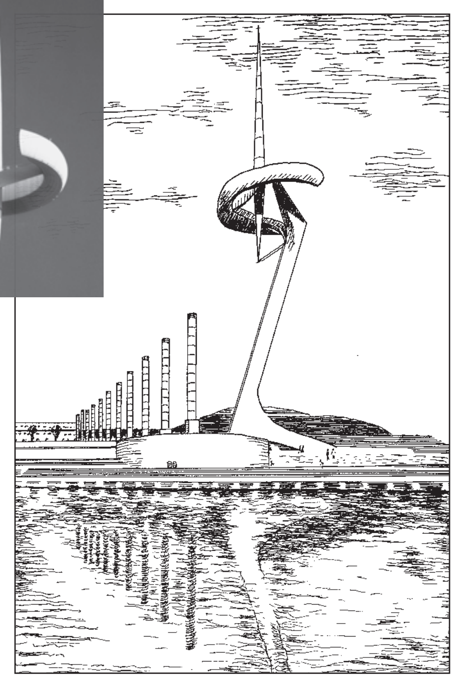
Draw horizontal lines through these points (orthographic) or lines that go to the vanishing point for the plane (perspective).



Principle: In both one- and two-point perspectives, sets of parallel horizontal lines not parallel to the picture plane vanish to a common vanishing point on the horizon line. This means that dimensions can be transferred horizontally between vertical lines on the same plane by using the vanishing point for horizontal lines for that plane.

Extend the remaining vertical edge to complete the additional squares.

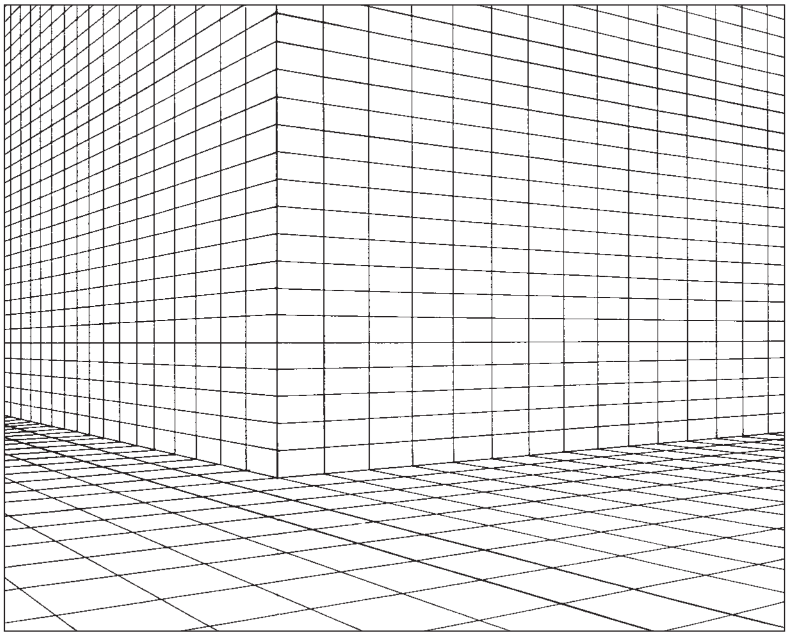




This tower, popularly known as “Torre Calatrava,” can work as a giant sundial because of its orientation. To set up a balanced composition and to expand the impact of the sculptural form, Calatrava created a linear set of vertical columns into the distance.

Drawing: Torre de Telecomunicacions de Montjuïc
Barcelona, Spain, 1992
Santiago Calatrava, Architect & Engineer
4.5" × 7" (11.4 × 17.8 cm)
Medium: Ink on vellum
Drawn by Kwok Tsui, architecture graduate, University of Texas at Austin

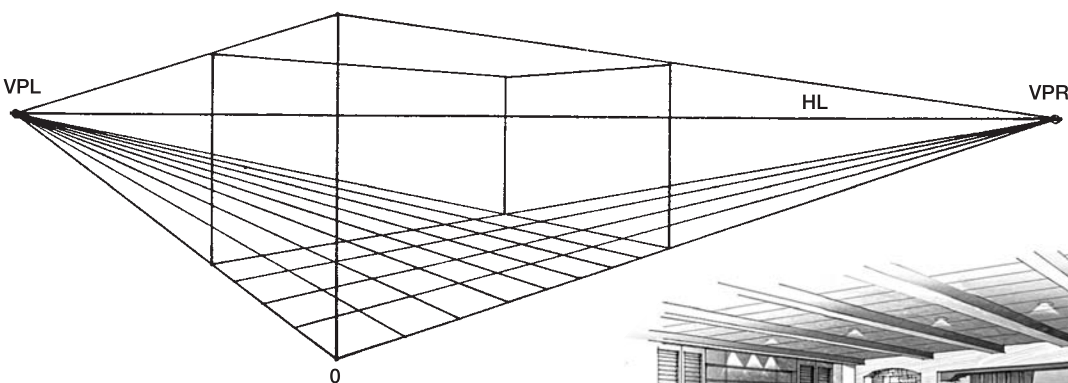
Photo: © Palladium Photodesign-Oliver Schuh/ Barbara Burg

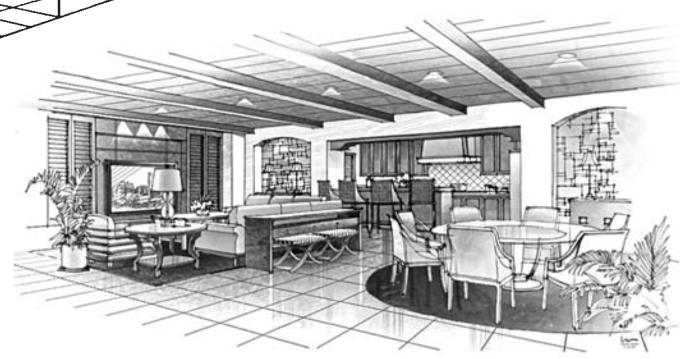


This is part of a typical two-point perspective grid chart. Grids for exteriors and interiors are rotated at specific angles (30º, 45º, etc.) from the picture plane to allow various views. Using manual methods, a perspective plan can be constructed to simulate a grid chart (see below). Constructed grids should be saved for future use. Grids are ideal for plotting points on axial lines or within axial planes to facilitate drawing exterior or interior views. The selected scale can be any unit of length.

Perspective Grid Charts (Pros and Cons and View Development)

Perspective charts (such as Lawson charts, which include metric applications) are commercially available. They save time when you need to generate many similar images; they are also space savers, especially when a large layout is required (residential layouts, for example, may need 5' or more). The scale of the grid lines on perspective charts is flexible, and the observer's relationship to the horizon line (bird's-eye, worm's-eye, eye-level, etc.) can always be adjusted. Perspective charts restrict the placement of the SP and PP, however, and have limited viewing angles. Charts that are made for both one- and two-point perspectives are divided into two categories: those with a relatively high HL and those with a relatively low HL. Although they are handy for quick studies, perspective charts are becoming dated by digital technology.



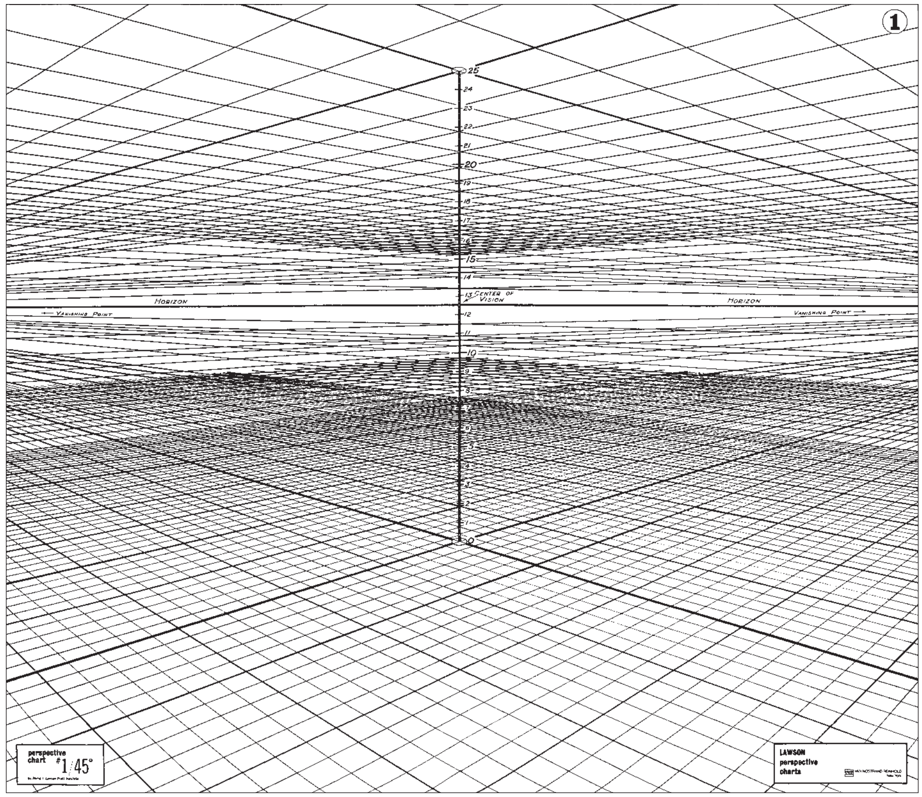


Drawing: Marrasi-Villa 4
Client: Creative Design Consultants, LLC
Medium: Markers on ink
Courtesy of Wenjie Studio

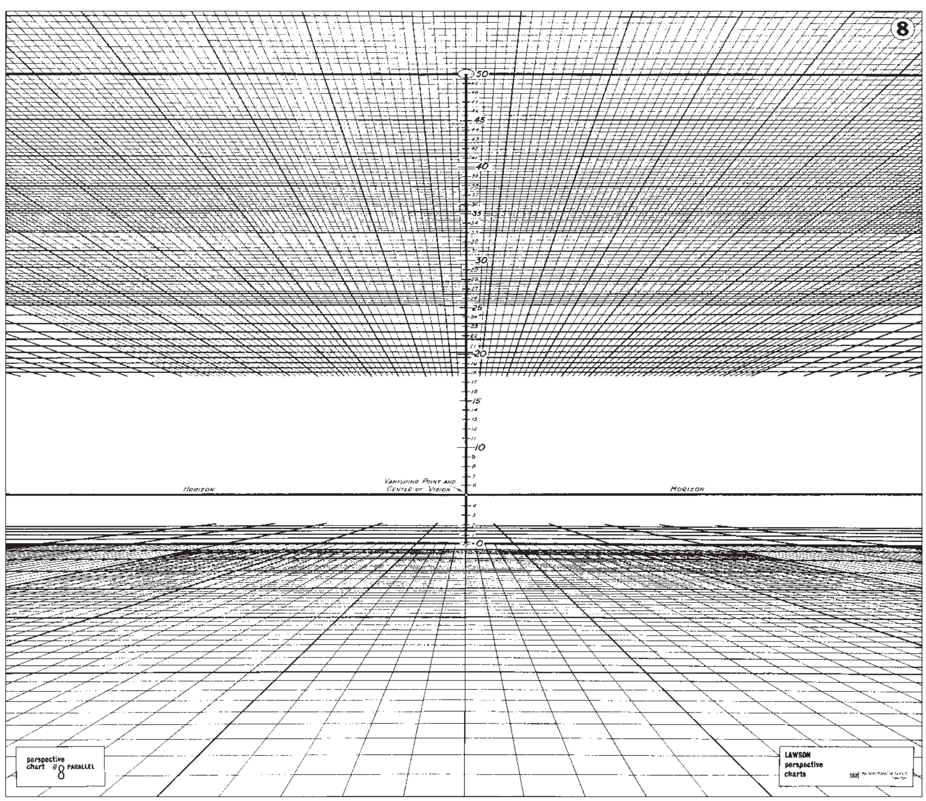
Briefly, the sequential process for developing a view begins with (**1**) determining the SP location; (**2**) choosing an angle of view; (**3**) selecting an appropriate chart; (**4**) locating architectural elements such as ceilings, doors, and windows from major vertical dimensions (heights) using elevations, etc.; and (**5**) adding accessories such as human figures and furniture (if drawing an interior scene) in their accurate relative positions.

Sample Perspective Charts

Perspective charts are excellent for developing quick sketches. Eight easy-to-use charts comprise the set of Lawson perspective charts. Charts 1 through 4 are more suitable for drawing interiors and elements within the interior space, such as furniture. Charts 5 through 8 are usually used for exterior views or large-size subjects. The 45° two-point chart shown here lends itself to views showing two interior walls with equal emphasis. The one-point perspective chart shown below emphasizes one important (parallel) side, with two other sides of secondary interest.



Use the bold vertical measuring lines given on all charts to measure and project true heights. The true heights are then projected on axial lines along true-height vertical grid planes and eventually into the perspective view. Circles and noncircular curves can be constructed using plotted points on the grid. The recommended value for general work in the metric system is 15 cm (6") per unit; for drawing interiors, it is 12.5 cm (5") per unit. Use smaller units (5 cm or 3" per unit, etc.) for small furniture objects.



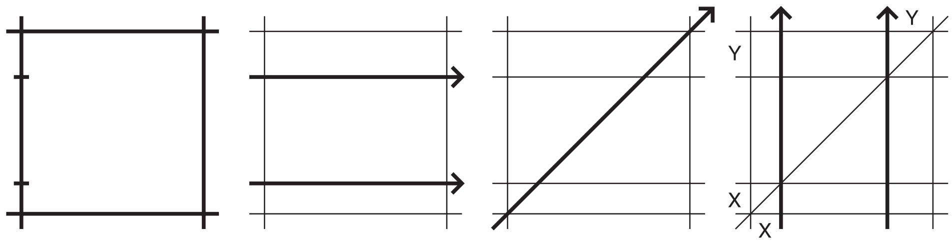
Lawson Perspective Charts:
Courtesy of John Wiley & Sons, Inc.

TRANSFERRING WITH THE DIAGONAL

Transferring with the Diagonal

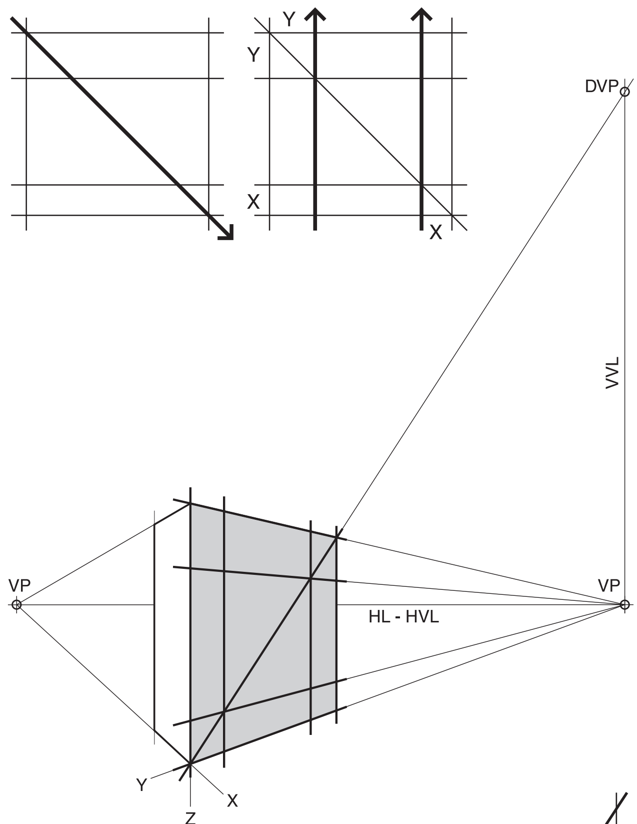
Diagrams and text (both pages): Courtesy of William R. Benedict, Assistant Professor California Polytechnic State University College of Architecture & Environmental Design San Luis Obispo, California

Suppose that you have a visually and proportionally correct square with dimensions located on one side that you want to transfer to an adjacent side.

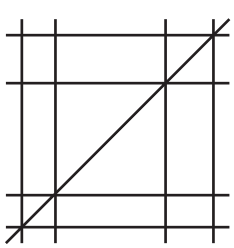


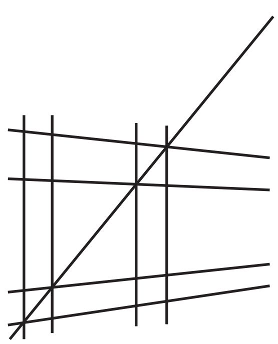
Draw or identify the base square and the dimensions. The vertical edges are parallel to the picture plane. All edges are parallel in orthographic drawings. Extend the dimensions across the square. Draw one of the diagonals of the square. Draw lines that intersect with the sides of the square through the intersections of the diagonal and dimension lines.

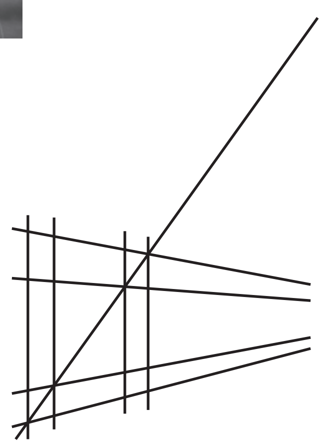
Principle: A 45° line drawn through the intersection of two perpendicular lines will transfer dimensions from one line to the other. The diagonal you choose to draw will control the side to which a dimension is transferred. This technique has slightly different results when used in a square, as illustrated, than when used in other rectangles. The diagonal of a square will transfer the exact dimensions (2' to 2'), while the diagonal of a rectangle will transfer only proportions (¼ to ¼).

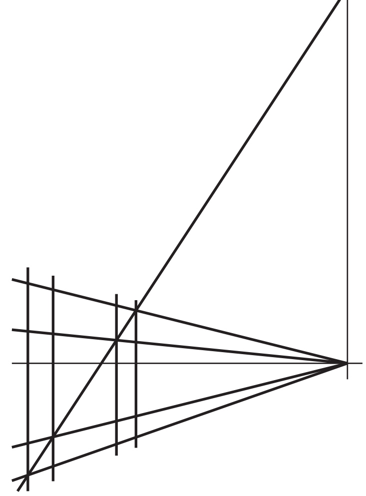


Drawing: Goldring Center for High Performance Sport
Toronto, Canada
Medium: Photoshop
Rendered by LUXIGON
Courtesy of Patkau Architects





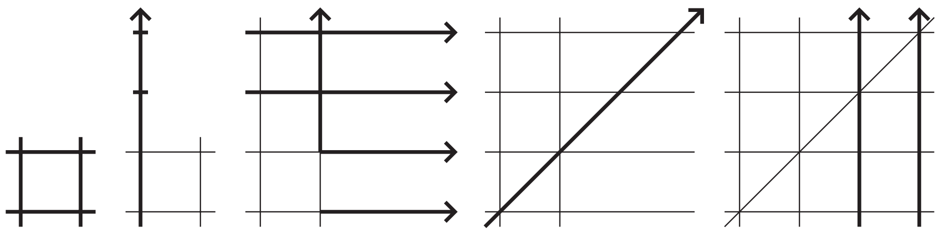


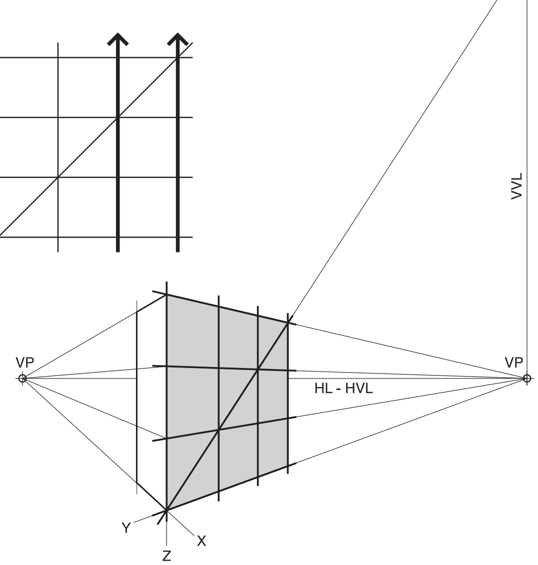


Multiplying by Measuring Plus the Diagonal

Suppose that you have a visually and proportionally correct square and wish to generate additional squares to one or more sides. The strategy combines the vertical transfer of dimensions introduced in Multiplying by Measuring, with transferring the diagonal of a square.

As the illustrations show, the diagonal can be further extended to intersect a vertical line **(VVL)** drawn through the vanishing point **(VP)** for the horizontal lines. This creates a diagonal vanishing point **(DVP)** to which all parallel diagonals will converge. You do not need to create the diagonal vanishing point to use this technique. The diagonal vanishing points may be above or below or to either side of a VP.



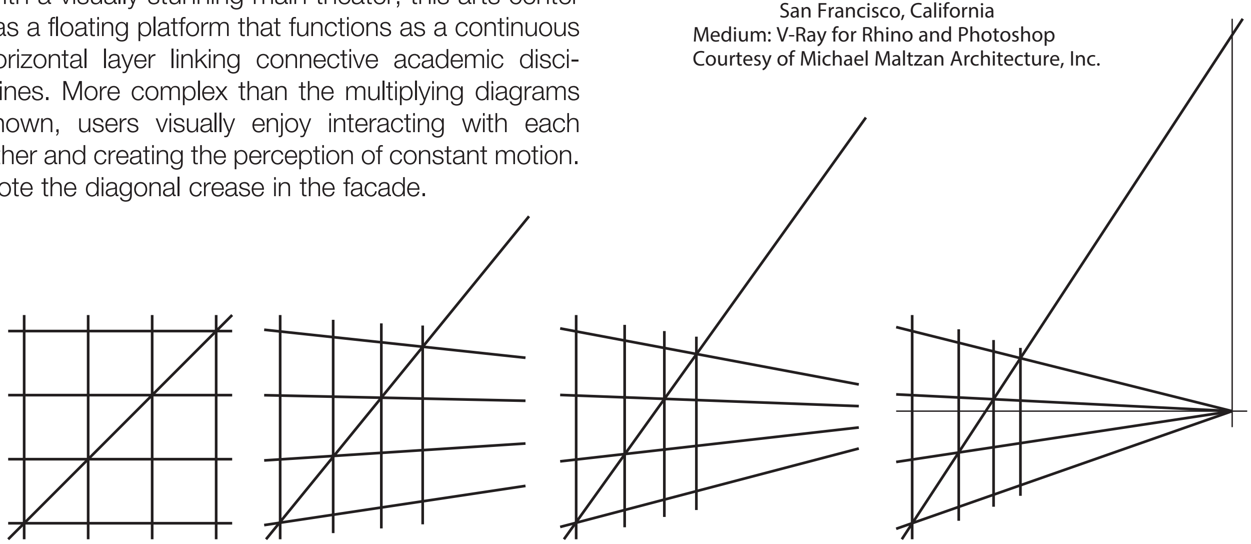


Draw or identify the base square whose vertical edges are parallel to the picture plane. All edges are parallel in orthographic drawings. Extend a vertical edge and transfer dimensions along it. Draw horizontal lines through these points (orthographic) or lines that go to the vanishing point for the plane (perspective). Extend the remaining vertical edge. Draw the diagonal of the original square and extend it to cross all horizontal or vanished lines.

Principle: A diagonal line crossing a set of equally spaced parallel lines produces intersections that can be used to define another equally spaced set of parallel lines. If the diagonal is at 45°, and the sets of lines are perpendicular to each other, a square grid is produced as shown in the illustrations. Draw vertical lines through each intersection of the diagonal with a horizontal or vanished line to complete the additional squares.

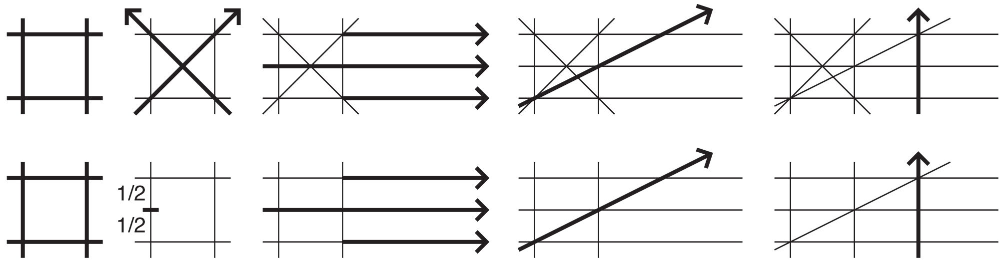
Drawing: Mashouf Performing Arts Center
San Francisco State University
San Francisco, California
Medium: V-Ray for Rhino and Photoshop
Courtesy of Michael Maltzan Architecture, Inc.

With a visually stunning main theater, this arts center has a floating platform that functions as a continuous horizontal layer linking connective academic disciplines. More complex than the multiplying diagrams shown, users visually enjoy interacting with each other and creating the perception of constant motion. Note the diagonal crease in the facade.



Multiplying with the Diagonal

Suppose that you have a visually and proportionally correct square and wish to generate additional squares to either adjacent side, or above, or below.



Draw or identify the base square whose vertical edges are parallel to the picture plane. All edges are parallel in orthographic drawings. Draw the square's diagonals (top illustration).

Principle: The intersection of the diagonals of a square locates its center.

Extend the appropriate edges of the base square.

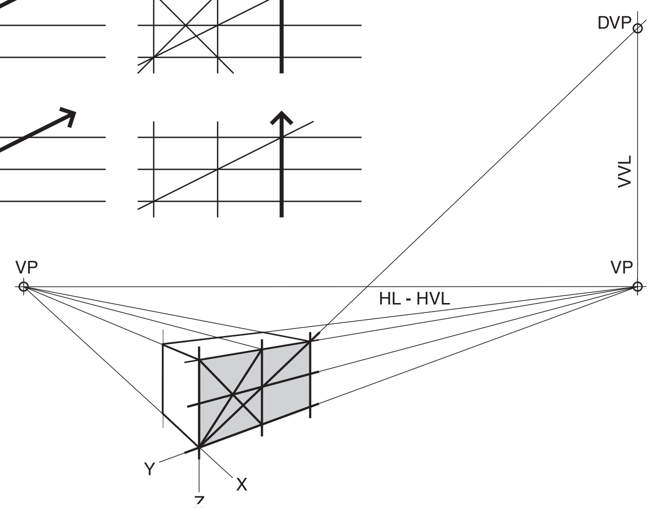
Draw a line through the center of the square (the intersection of the diagonals) that is parallel to the extended sides.

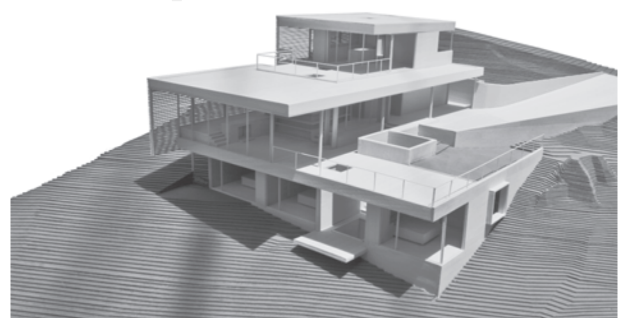
Principle: A line drawn through the center of a square that is parallel to two of its sides will bisect the other two sides.

Alternative (bottom illustration): Sometimes it is faster to divide a vertical edge with a scale or by visual judgment. In this case, draw a line through the center of the side that is parallel to the extended sides.

Draw a line from one corner of the square through the center of an opposite side. Extend this line until it intersects one of the extended sides. This line is now the diagonal of a rectangle that is twice as wide as the original square.

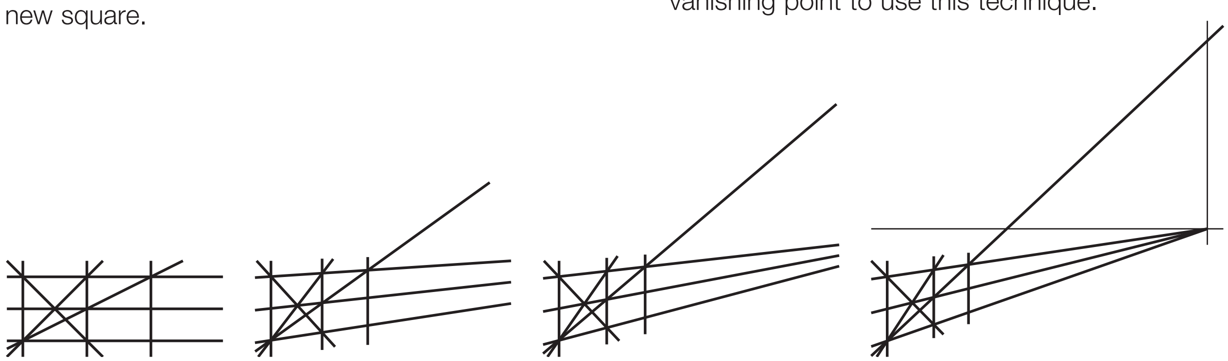
Draw a line through the intersection of the line just completed and the side of the square to define the new square.





Model photo: Dillon Beach Residence, Marin County, California
Media: Basswood and painted chipboard
Courtesy of Brian Healy Architects

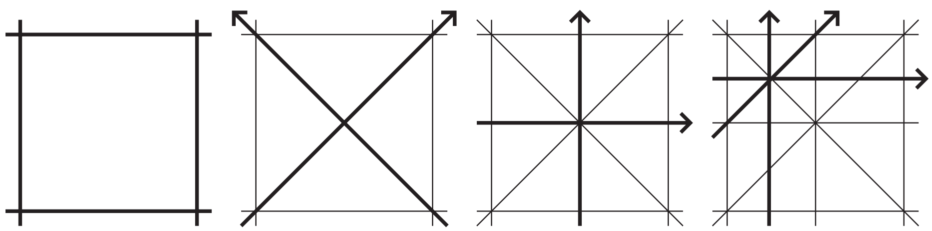
As the illlustrations show, the diagonal of the double-wide rectangle can be further extended to intersect a vertical line **(VVL)** drawn through the vanishing point for the horizontal lines. This creates a diagonal vanishing point **(DVP)** to which all similar diagonals will converge. You do not need to create the diagonal vanishing point to use this technique.



Dividing with the Diagonal

It is a good strategy to draw the largest inclusive form possible as a first step in constructing a perspective and then to subdivide that form to locate smaller elements. This technique assumes that you have a visually and proportionally correct square and wish to divide it into halves, quarters, eighths, etc.

As the illustrations show, the diagonals can be further extended to intersect a vertical line **(VVL)** drawn through the vanishing point **(VP)** for the horizontal lines. This creates a diagonal vanishing point **(DVP)**. You do not need to create the diagonal vanishing point to use this technique. The diagonal vanishing points may be above or below or to either side of a VP.



Draw or identify the base square whose vertical edges are parallel to the picture plane. All edges are parallel in orthographic drawings. Draw the square's diagonals.

Principle: The intersection of the diagonals of a square locate its center.

Draw a vertical and a horizontal line through the intersection of the diagonals. In perspective, the horizontal line vanishes to the vanishing point for horizontal lines on that surface.

Principle: A line drawn through the center of a square that is parallel to two of its sides will bisect the other two sides.

The vertical and horizontal lines have defined four smaller squares that have the same proportions as the original but are one-quarter the size. This process can be repeated within each progressively smaller square until the desired subdivision is produced. Each subdivdsion halves the square (e.g., a 12' square becomes four 6' squares.

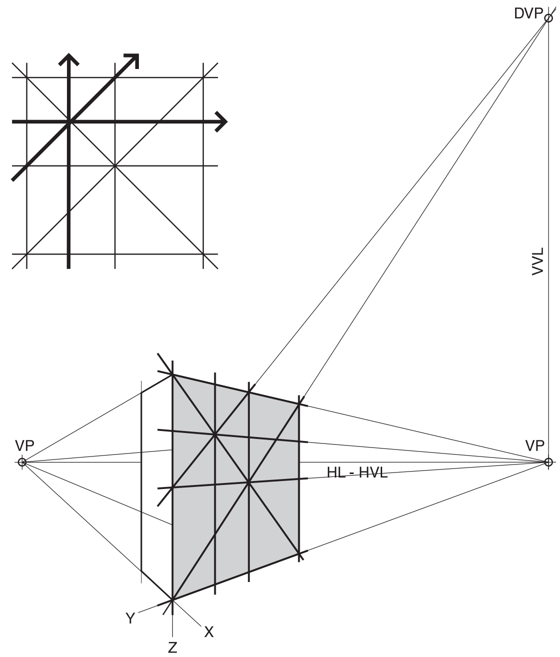
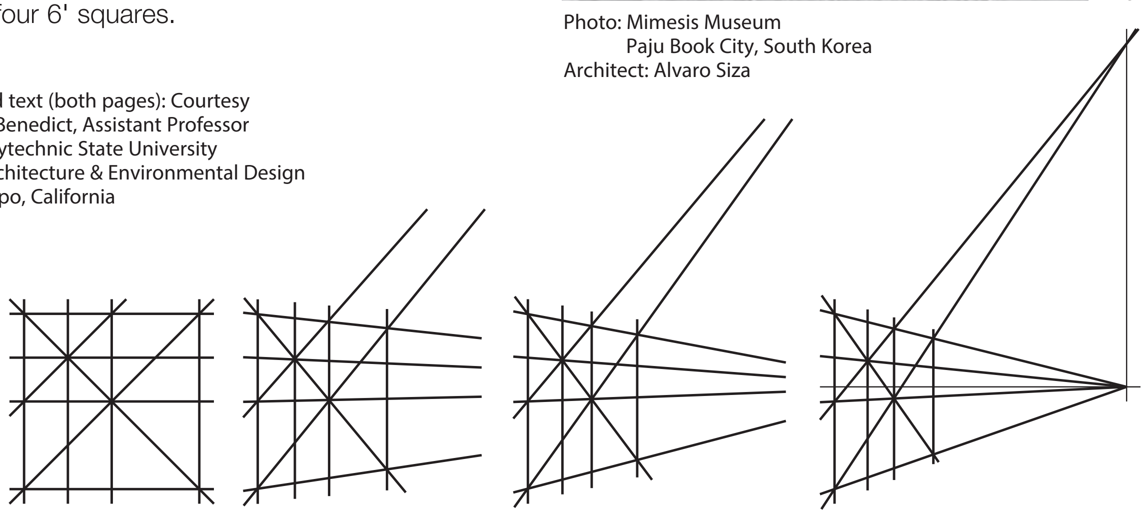


Photo: Duccio Malagamba © Arcspace

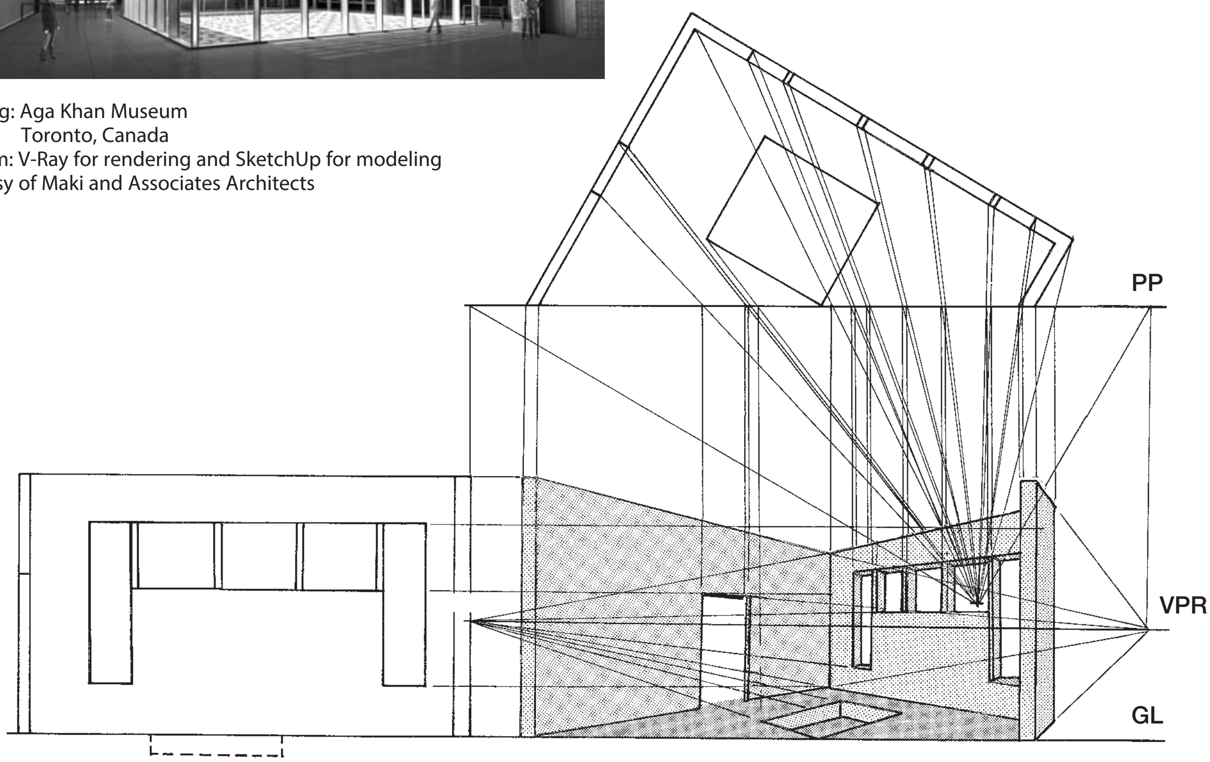
Photo: Mimesis Museum
Paju Book City, South Korea
Architect: Alvaro Siza

Diagrams and text (both pages): Courtesy of William R. Benedict, Assistant Professor California Polytechnic State University College of Architecture & Environmental Design San Luis Obispo, California



Drawing: Aga Khan Museum
Toronto, Canada
Medium: V-Ray for rendering and SketchUp for modeling
Courtesy of Maki and Associates Architects

Try to count the number of wall planes vanishing to the same horizon line in this nice interior illustration. The view is more dynamic than the static one-point of the same building seen earlier. Drawings and models normally require us to have walls removed to truly have a "real space" experience.



Interior Two-Point

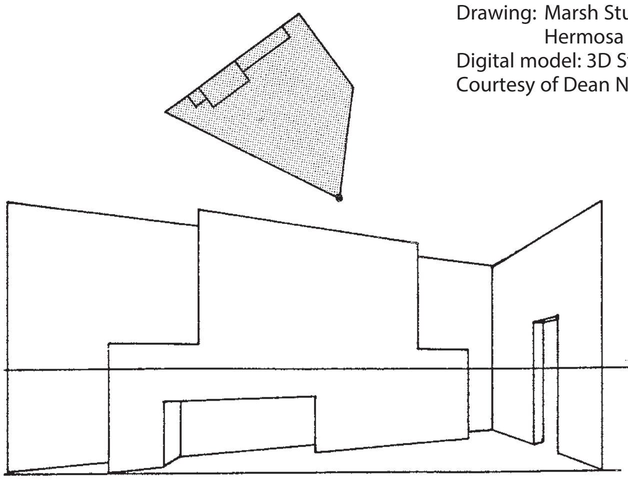
Let's examine the two-point *plan-elevation* office method again. These perspectives are commonly constructed for both exterior and interior two-point perspectives. The method is basically the same in both cases. This method can also be applied to exterior and interior one-point perspectives. Choose a station point that best describes the important interior elements and the feeling you would like to convey. Frank Lloyd Wright favored the two-point interior view, which is essentially a one-point made slightly oblique to the picture plane, resulting in a very long second vanishing point. Avoid placing the eye-level horizon line in a position where it coincides with any horizontal structural element (e.g., the windowsill shown above).

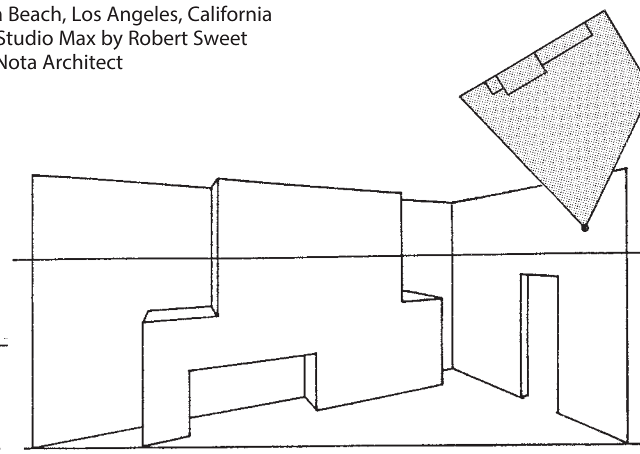
1. Select locations of the **SP**, **HL**, and **PP** based on the perspective desired.
2. Select a **PP** that will cut both walls of an interior space and will intersect the corners of important or major interior elements.
3. Construct the appropriate parallel lines to find the vanishing points.
4. Transfer the true heights from the elevation view to the vertical tracers from the interior wall intersections.
5. Converge the wall planes to their appropriate vanishing points and then construct the details of the interior space.

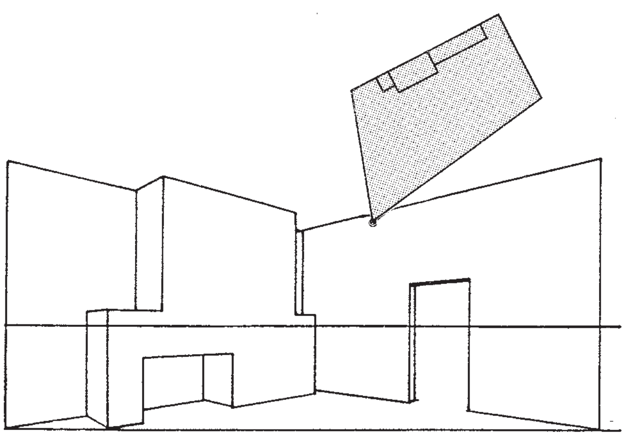
Compare this method to the one-point office procedure.

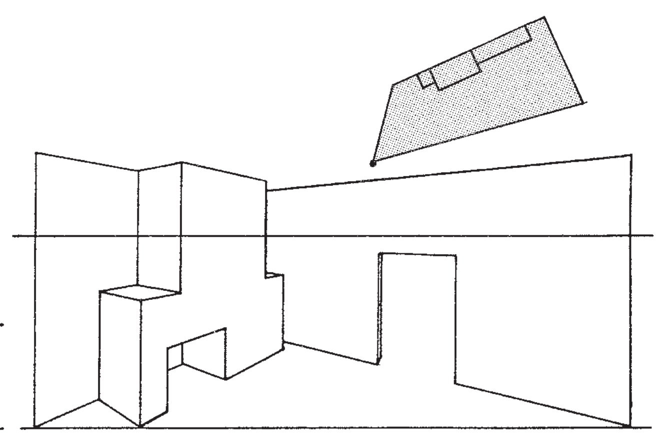
Recognizing the dense, public nature of the site, an inwardly focused courtyard solution evolved. The street and alley elevations are asymmetrical compositions of stucco, glass, metal, and concrete block, while the primary glazed openings are oriented inward to the courtyard. From the courtyard, access is possible to any of the interior, public, or private spaces within the building.
[Architect's statement]

Drawing: Marsh Studio—Residence 2
Hermosa Beach, Los Angeles, California
Digital model: 3D Studio Max by Robert Sweet
Courtesy of Dean Nota Architect









In any interior perspective, visual emphasis on the left or right wall is governed by the *variable station point.* The station point also dictates whether the wall vanishing points fall within or out of the drawing. Note how the images of the fireplace and the door change as one moves from being close to the wall with the door **(1)** to being close to the fireplace wall **(4).** Also note that the higher horizon line in **2** and **4** allows the viewer to see more floor and less ceiling (above normal eye level).

Drawings: Canadian Museum of Human Rights
Winnipeg, Manitoba, Canada
Medium: Vectorworks, form-Z, InDesign, and Photoshop
Area: 23,200 sq. m
Courtesy of Antoine Predock, Architect

These beautiful interior perspectives, which are part of a set of winning competition drawing panels (see companion website), have a greater sense of enclosure than the interior diagrams on the previous page simply because a third wall or third side is included. This third element has its own vanishing point.

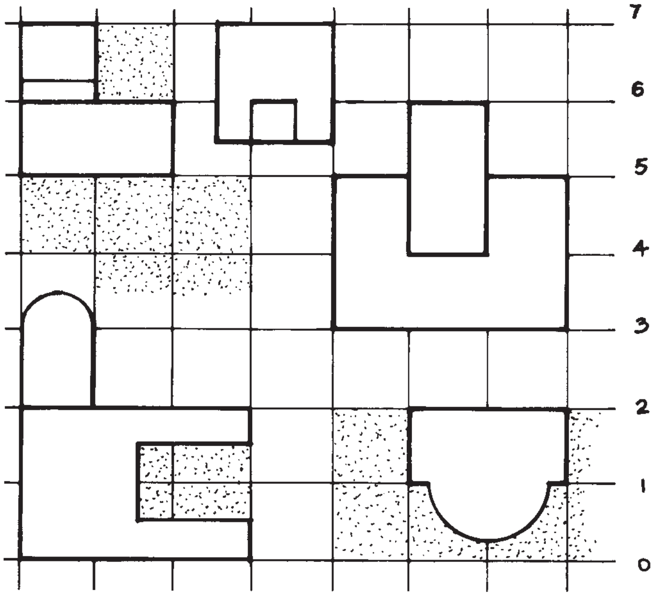
This museum is rooted in humanity, making visible in the architecture the fundamental commonality of humankind—a symbolic apparition of ice, clouds, and stone set in a field of sweet grass. Carved into the earth and dissolving into the sky, the abstract ephemeral wings of a white dove embrace a mythic stone mountain of limestone in the creation of a unifying and timeless landmark for all nations and cultures of the world. [Architect's statement]

The interior at left is primarily a two-point perspective with a long vanishing point to the left. The curving staircase has its own series of oblique vanishing points. The library below has essentially only one vanishing point with an additional wall element that has its own vanishing point. This can be called a *modified one-point* in the sense that it has one vanishing point in the picture area, even though the total drawing is a multipoint perspective.

Drawing: New School of Music of Paris
Paris, France
Medium: 3-D graphic software
Courtesy of Serero Architects

This elegant design is a minimal architectural volume suspended above a vibrant new entrance plaza. The building is supported by luminescent, glass-enclosed structural "trees" that join the north and south wings, the two main components of the library. [ARCHITECT'S STATEMENT]

Drawing: Jalisco State Public Library
Guadalajara, Mexico
Medium: Maxwell Render, V-Ray, Maya, Rhino, Photoshop
Courtesy of Asymptote: Hani Rashid + Lise Anne Couture

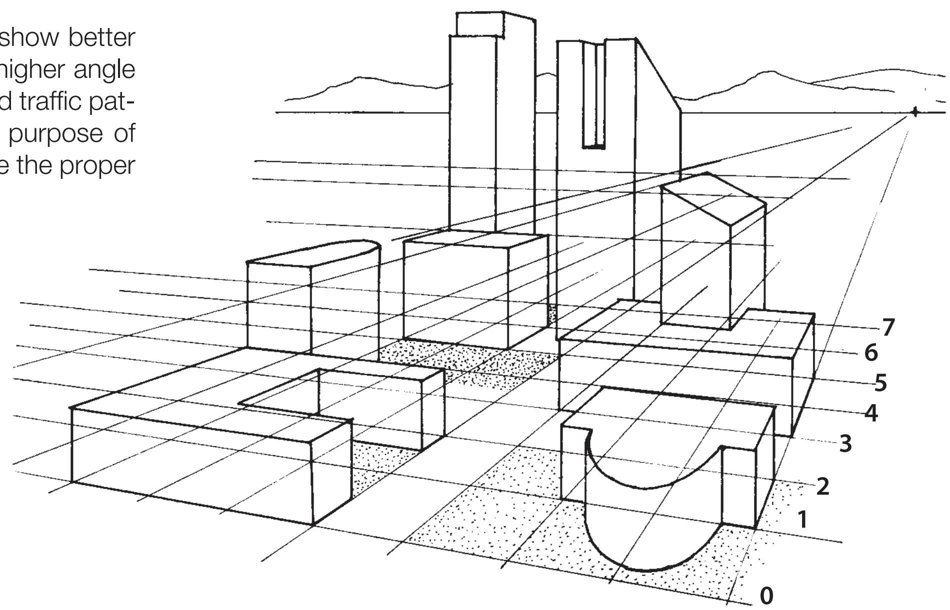


Bird's-Eye View

Technically, the terms bird's-eye and aerial are synonymous.

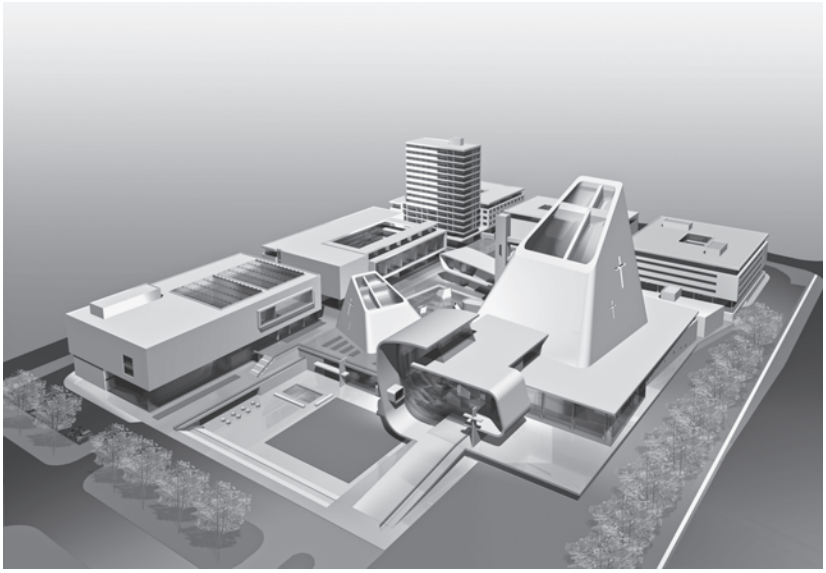
A grid procedure for bird's-eye perspectives is advantageous when the building complex or urban landscape is in a predominantly regular arrangement. After transposing the elements from plan grid to perspective grid, structural forms can be eyeballed and sketched using appropriate heights. The plan grid and perspective grid can be at different scales, but the total number of grid lines must correspond. Relate the plan shown at the left to the selected aerial perspective view shown below. Note that the eight (**0** to **7**) grid lines correspond.

Foreground building details show better with a low angle of view. A higher angle of view shows orientation and traffic patterns better. The goals and purpose of your illustration will determine the proper station point location.



This design comprises new green spaces that provide a linkage system through the Colegio Civil District and three new towers that create a connection between the area's institutional and government buildings.
[Architect's statement]

Drawing: Monterrey City Center Master Plan
Monterrey, Mexico
Medium: Maxwell Render, V-Ray, Maya, Rhino, Photoshop
Courtesy of Asymptote: Hani Rashid + Lise Anne Couture



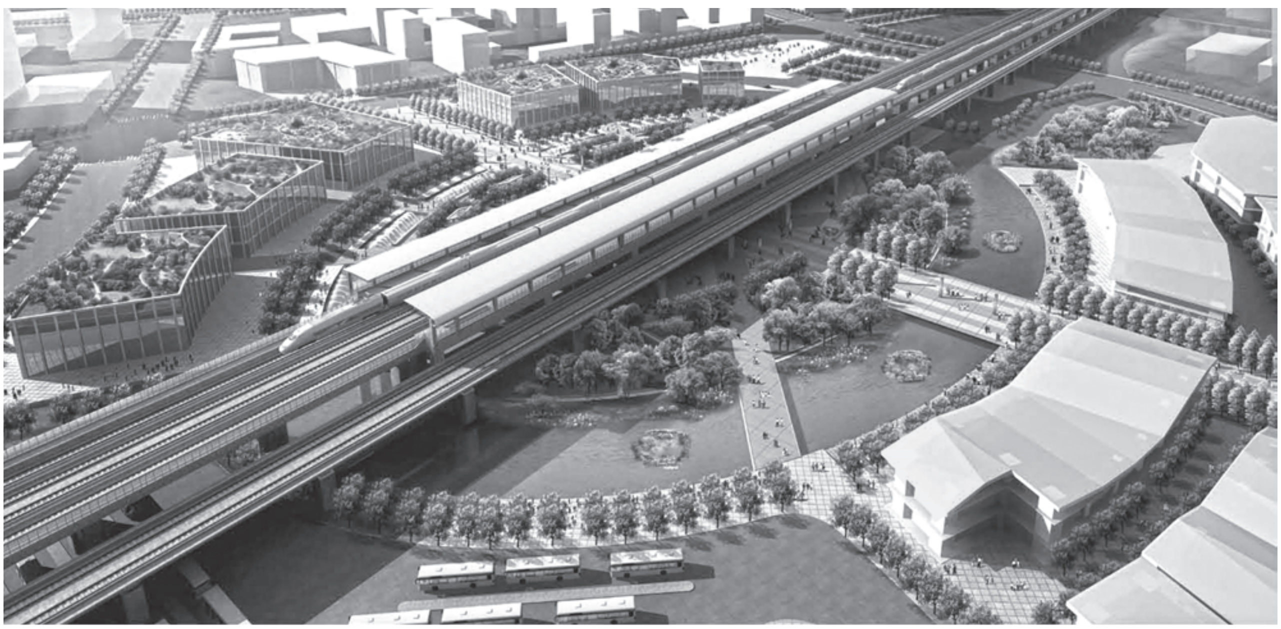
Drawing: St Mark's Coptic Canadian Village
Ontario, Canada
Medium: Vectorworks
Courtesy of Hariri & Hariri Architecture

Most bird's-eye view perspectives that are slightly above roof level are characterized by a horizon line that is in the range of 50' to 200' above the ground plane. Unlike an eye-level perspective, a bird's-eye perspective reveals the surrounding landscape (trees, group of buildings, townscape, etc.) as well as unexpected roof line details.

Drawing: Dance and Music Center, The Hague, The Netherlands
Medium: Rhino, Maya, and AutoCAD
Courtesy of Zaha Hadid Architects

Most notable about the Dance and Music Center are the fluid dynamic facades that are basically composed of undulating horizontal bands. Some bands allow for endless vistas and great visual interactions with the environment. Other, more solid opaque bands allow for more internal privacy.

Drawing: Dongtan New City, Dongtan, China
Medium: 100% digitally created by SWA and Chrystal Stone (Chinese 3-D Studio)
Courtesy of the SWA Group

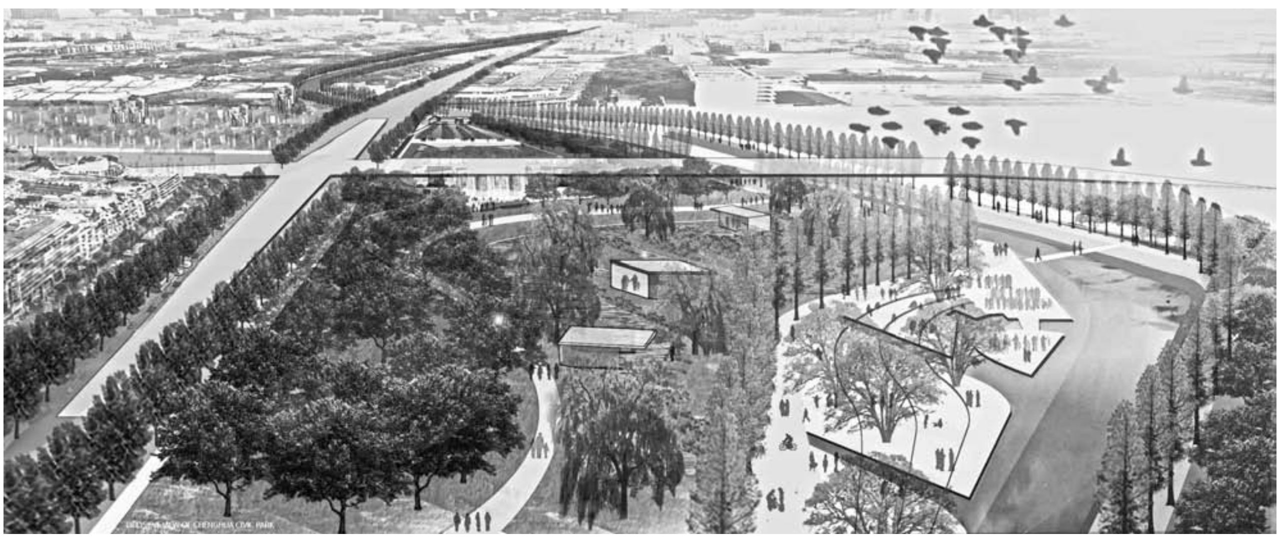


Drawing: Huaqiao Intercity Railroad Station, Huaqiao, China
Medium: 100% digitally created using 3-D software to build the model and then using Photoshop to add trees and people
Courtesy of the SWA Group

Bird's-Eye Perspective

Large-scale bird's-eye views are used frequently, not only by architects but also by city planners, urban designers, environmental analysts, landscape architects, and site engineers. These design professionals need precise renderings as well as conceptual visualization studies of aerial cityscape views. Cityscape views are most informative when the angled vantage point is approximately 60º to 75º from the horizontal ground plane. These professionals are envisioning a global goal for planet earth in the twenty-first century in which cities will be designed for people and not for cars. More emphasis should be placed on high-speed intercity rail systems. Cities should be planned for environmental conservation and economic restructuring in such a way that they will use renewable energy on a large scale, such as solar, wind, and geothermal energy sources.

Drawing: Hengqin Island, Hengqin, China
Media: 3-D digital model with hand-drawn watercolor overlay; 3-D digital model by SWA; watercolor by Ronghue Li
Courtesy of The SWA Group

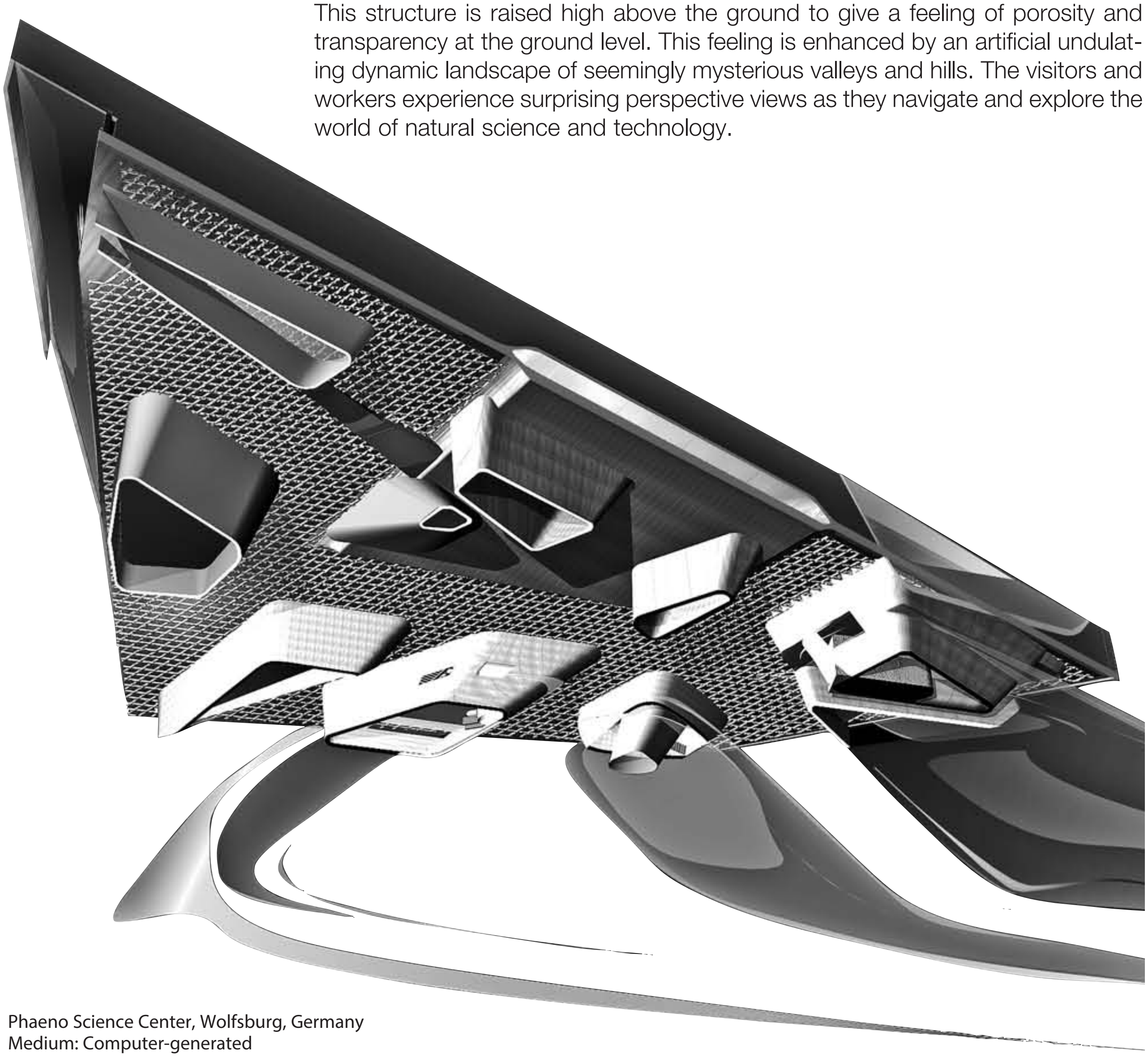


Drawing: Chenghua Civic Park, Chenghua, China
Medium: 100% digitally created by SWA
Courtesy of The SWA Group

Illustrating 3-D drawings using digitally created tools is easy, and programs are readily available. With the additional techniques in Photoshop and color rendering, the finished drawings can be shown in many different styles, in any selected view angles, and with a quick turnaround time. At SWA, many of our designers use these available tools to develop the design; and at times, we still continue to maintain the traditional sketch method to search, explore, and test the refinement of an idea.

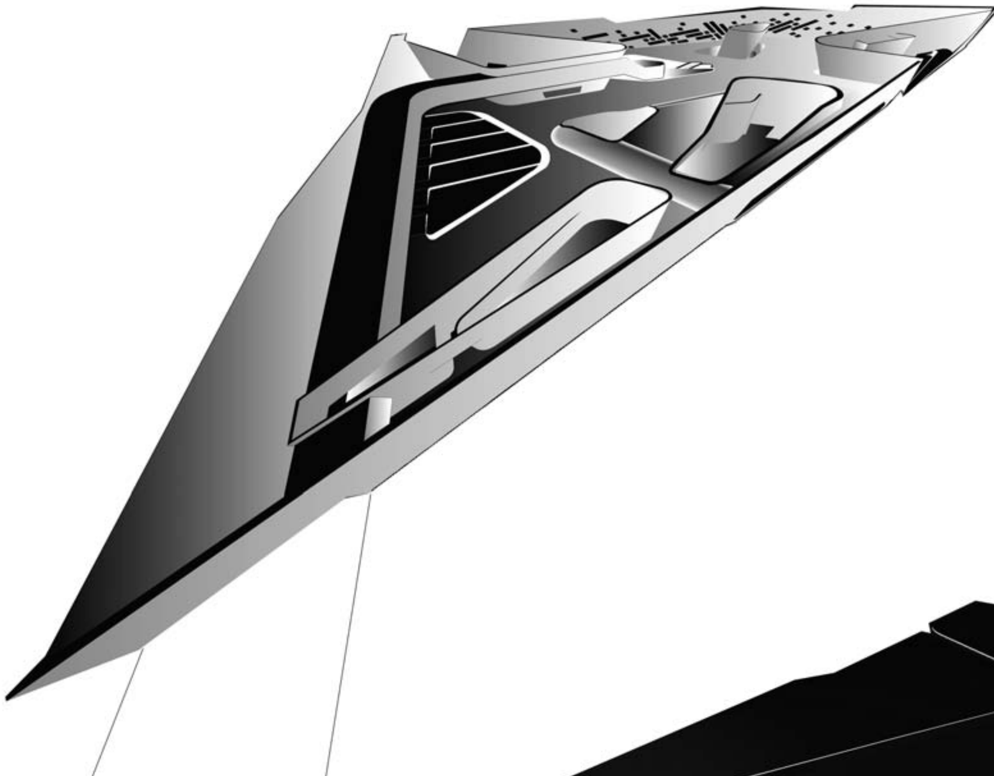
[Landscape architect's statement]

This structure is raised high above the ground to give a feeling of porosity and transparency at the ground level. This feeling is enhanced by an artificial undulating dynamic landscape of seemingly mysterious valleys and hills. The visitors and workers experience surprising perspective views as they navigate and explore the world of natural science and technology.



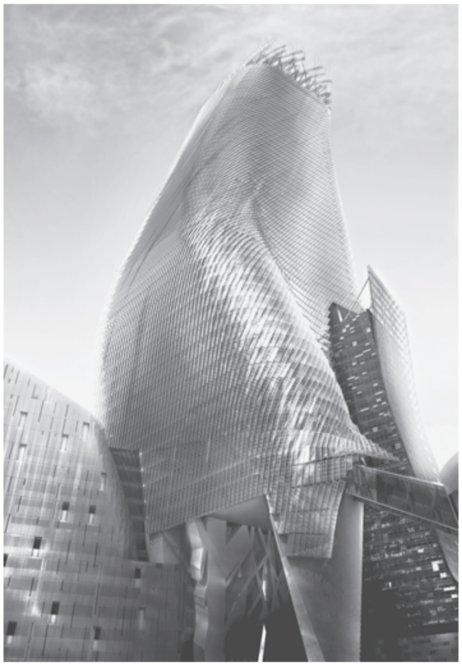
Phaeno Science Center, Wolfsburg, Germany
Medium: Computer-generated
Courtesy of Zaha M. Hadid Architects

In the perspective *underside view*, the observer looks up; his or her station point is subterranean. This creates an effect similar to that of the paraline up view.

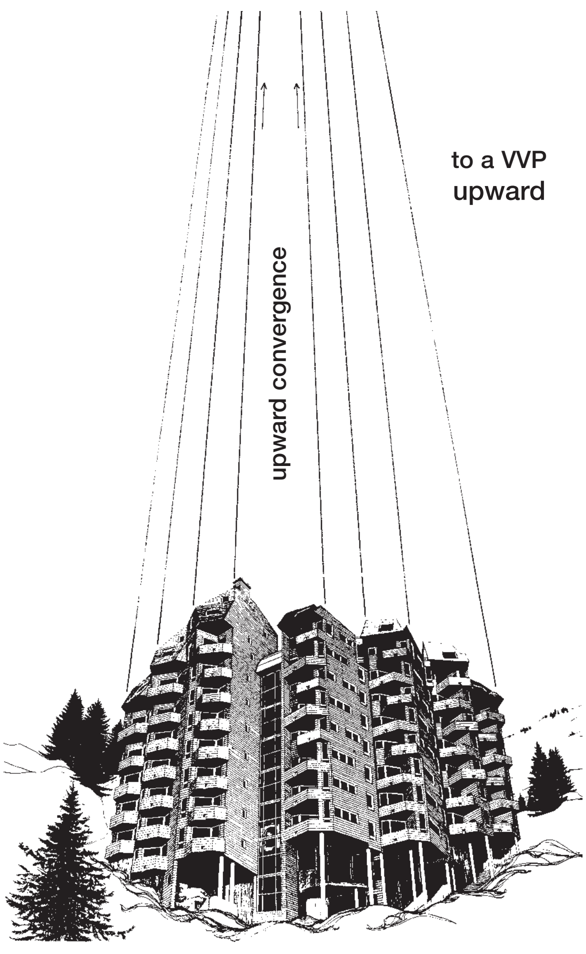


Phaeno Science Center, Wolfsburg, Germany
Medium: Computer-generated
Courtesy of Zaha M. Hadid Architects

As with the underside view, this section perspective underside view renders this building interior quite dramatically. The low-angle bird's-eye view of the building interior creates a similar feeling.



Drawings: Phare Tower
Paris, France
Medium: Custom software, BIM, and other platforms
Courtesy of Morphosis Architects



Drawing: Ski resort
Avoriaz, France
Courtesy of Jacques Labro et Jean-Jacques Orzoni, Architectes

© Marcus Chaw

Photo: Duomo Cathedral and Campanile Tower
Florence, Italy

Upward Convergence

Looking up results in an *upward convergence* of vertical lines. The ski resort and Duomo Cathedral are characterized by projection lines, which are extensions of vertical lines in the buildings converging upward to a vertical vanishing point (VVP) (see p. 58). The 21st Century Phare Tower also has this feeling of upward convergence with its nonlinear organic structure. The 40-meter lobby functions as a large grand plaza for the public.

This tower captures wind for the production of energy and minimizes solar gain while providing glare-free daylight. The building skin is transformative in that it can be opaque, transparent, or translucent from multiple vantage point angles.

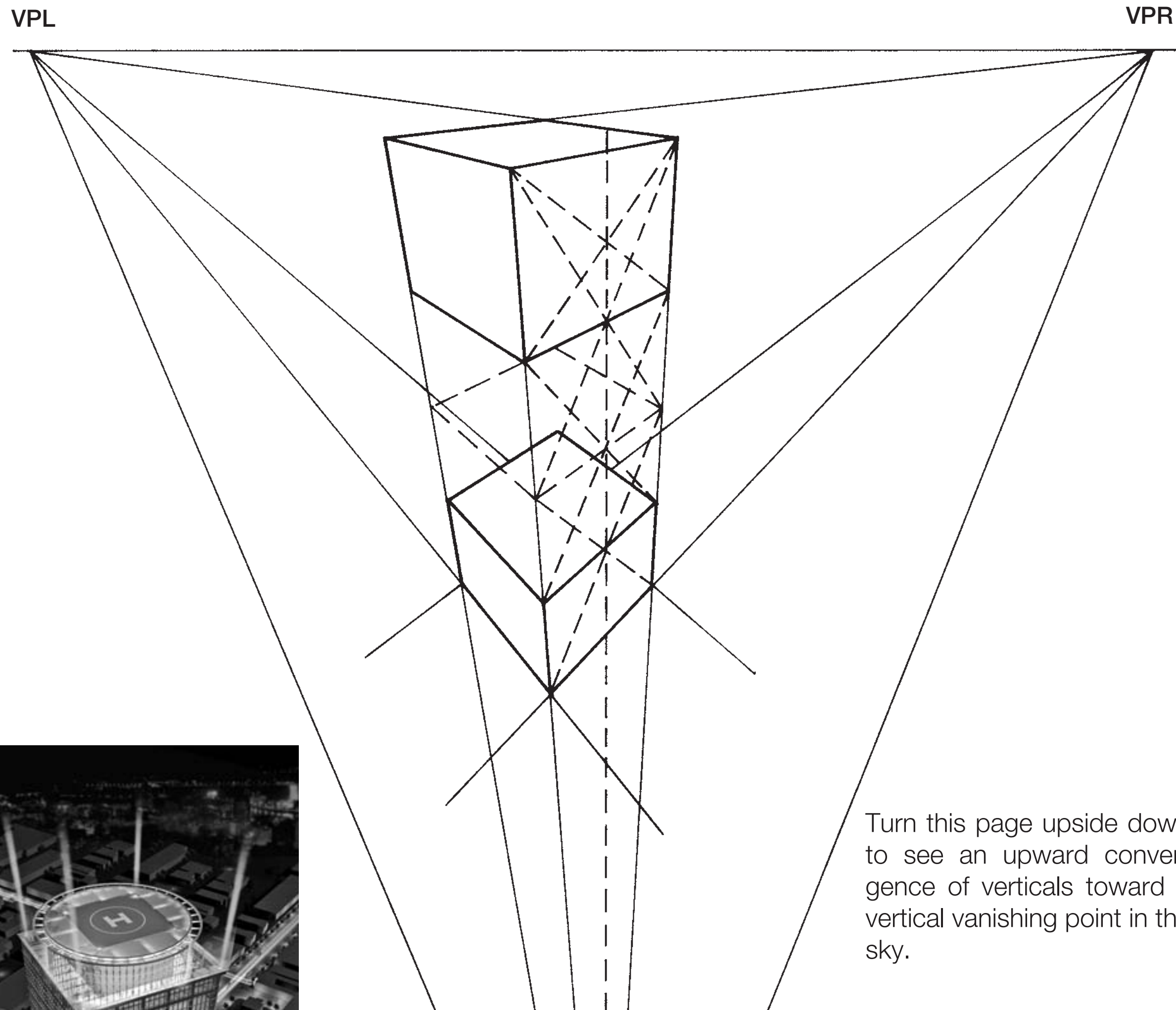
The drawing and the photo are from slightly different vantage points from the same Victoria peak. They show that the illustrator took the liberty to exaggerate the lines of downward convergence from what is actually seen.

Drawing: Victoria peak vantage point
Hong Kong aerial, Hong Kong, China
A3-size tracing paper 16.5" × 11.5" (41.9 × 29.2 cm)
Media: Colored pencil with black marker and overlaid paint highlights (spirit-based)
Courtesy of Peter Edgeley, Architectural Illustrator

Downward Convergence

Looking down results in a *downward convergence* of vertical lines. A view with upward or downward convergence has the characteristic of a tipped or tilted picture plane. The picture plane is inclined at an angle to the ground plane—not perpendicular to it, as with one- and two-point perspectives. Therefore, the three typical planes (horizontal, frontal, and profile) are not parallel to the picture plane. The vertical vanishing points above and below are usually placed closer to the ground plane than they normally would be in order to exaggerate the soaring or plunging effect.

This is an example of a very high vantage point view looking down, with a lot of downward convergence. Architects and architectural illustrators use such vantage points to increase the dramatic effect of a rendering. They can use three-point perspective grid charts where the third vanishing point has already been set to quickly add detail and create downward or upward views. Similar to rough digital wire-frame methods, charts are much faster than the rigorous plan-elevation projection method for constructing a three-point perspective.



Turn this page upside down to see an upward convergence of verticals toward a vertical vanishing point in the sky.

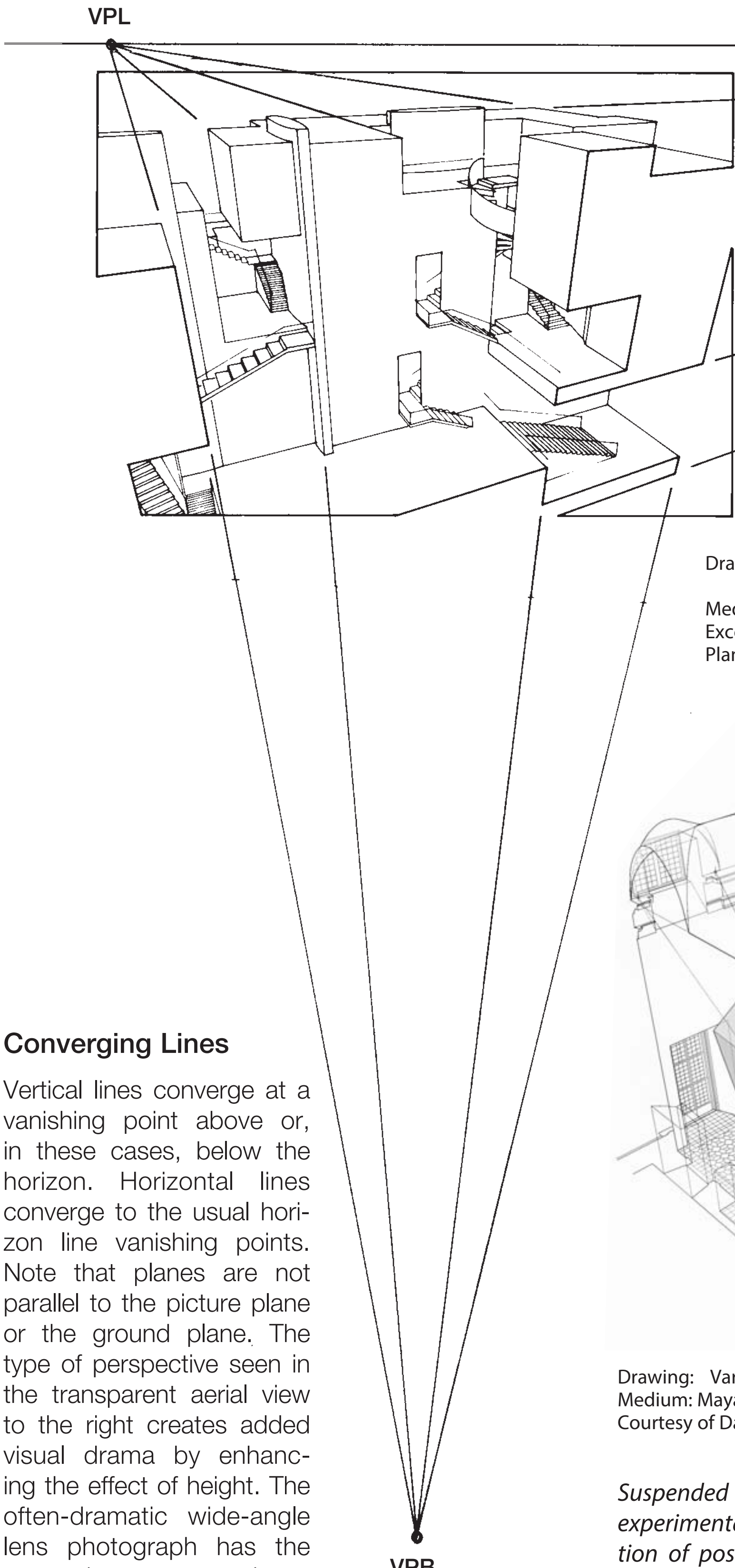
Digital drawing: One Broadway Plaza
Santa Ana, California
Architects: carrierjohnson
Medium: 3DStudio Max and Photoshop
Courtesy of Wenjie Studio

Diagram and text: Courtesy of Dik Vrooman, Professor
Texas A&M University
Department of Architecture

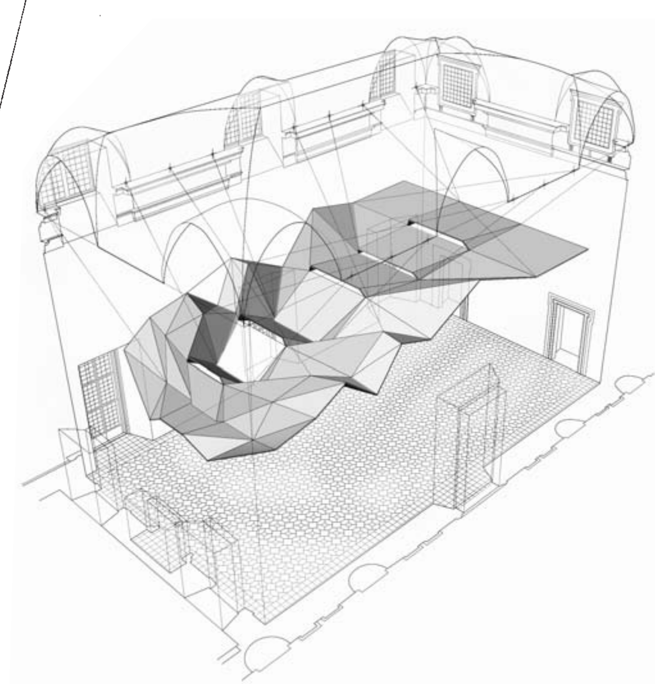
The Cube-Judgment System for Three-Point Perspectives

This method is not as laborious as the plan-elevation mechanical procedure for three-point perspectives. To draw a *three-point perspective* of a cube form that is far below (bird's-eye view):

1. Draw a cube near the horizon line, where it is easier to judge the foreshortening of all three visible faces.
2. Using diagonals, extend the cube module system downward to draw the correct perspective of the cube on the ground.
3. Also using diagonals, extend this system laterally.
4. Building design shapes other than cubes are then measured from these cubes.



Drawing: Student project by Paul Audrain
Housing in Greenwich Village, New York City
Medium: Ink on Mylar
Excerpted from abstract, Columbia School of Architecture Planning and Preservation (CSAPP)



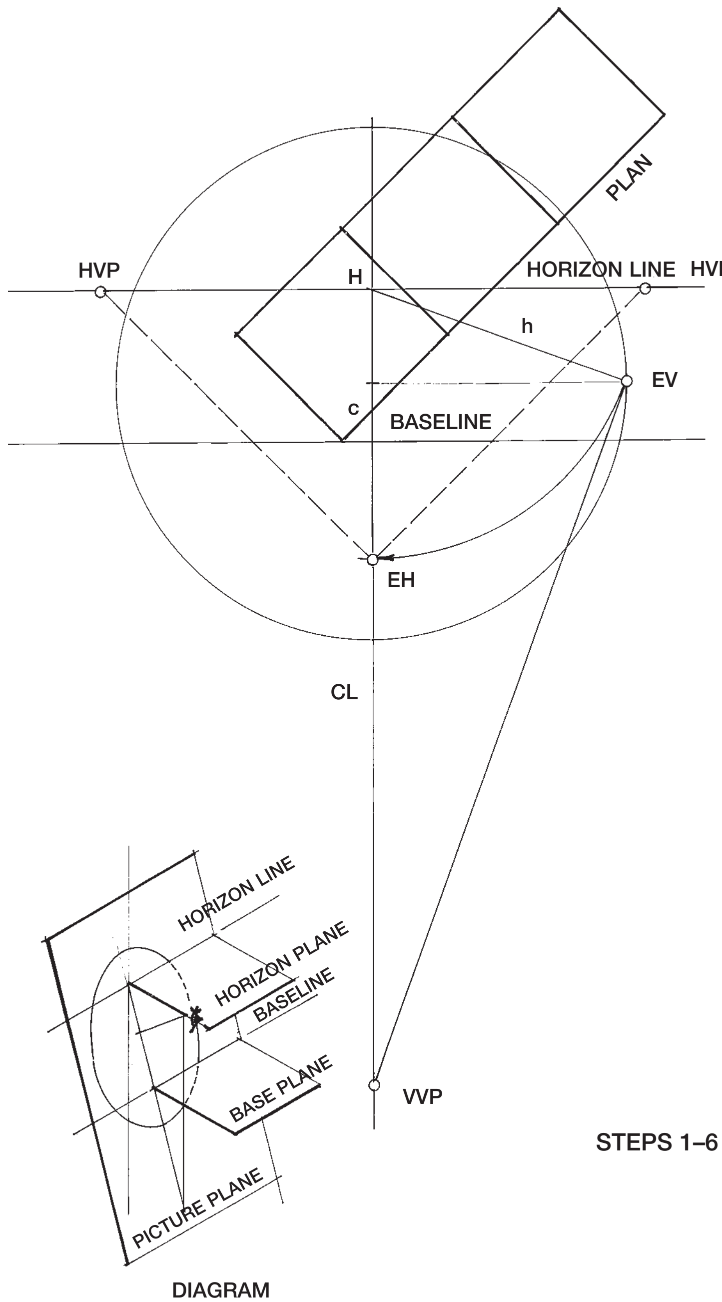
Drawing: Variable Geometry Acoustical Dome, Rome, Italy
Medium: Maya, Rhinoceros, Illustrator, and Photoshop
Courtesy of David Serero Architects

Suspended from the ceiling, the Acoustical Dome is an experimental device in which geometry allows for a variation of position in space and an adjustment of form to modify the acoustical behavior within the space.
[Architect's statement]

Converging Lines

Vertical lines converge at a vanishing point above or, in these cases, below the horizon. Horizontal lines converge to the usual horizon line vanishing points. Note that planes are not parallel to the picture plane or the ground plane. The type of perspective seen in the transparent aerial view to the right creates added visual drama by enhancing the effect of height. The often-dramatic wide-angle lens photograph has the same character as a three-point perspective.

This method of construction produces an accurately measured *three-point perspective* drawing. The principle is based on the measured two-point perspective method: The image is generated on a picture plane by projecting lines from the object to a single eye point. In three-point perspective, the picture plane will be tilted at an angle, as one would tilt a camera to photograph a tall object. When the picture plane (and the camera) are tilted, the lines in the vertical direction will converge as well. The principle is illustrated in the diagram at right. Using a scale for the perspective layout allows control of the image. In the example, a scale of 1" = 50' was used.

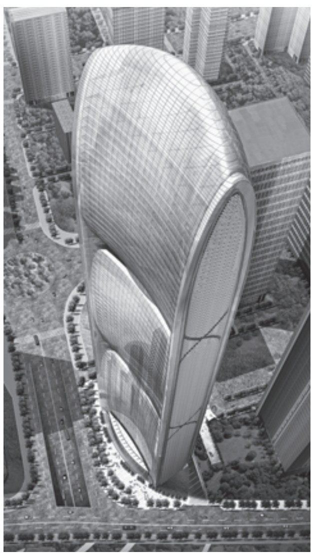


STEPS 1–6

Text and diagram:
Courtesy of Arpad Daniel Ronaszegi,
Assistant Professor,
Andrews University Division of Architecture

1. Determine the distance of the observer (the eye point E) from the picture plane. A larger distance will produce a smaller but less distorted image. This distance is the radius of the circle drawn.
2. To generate the vanishing point for the vertical lines **(VVP)**, the eye point (E) must be rotated around the centerline **(CL)** from the center of the circle **(c)** into the surface of the picture plane. The point received **(EV)** will be used for generating measurements in the vertical direction.
3. Determine the tilt of the picture plane. A larger angle produces a closer vanishing point. In the example, the angle is 20°. Draw a line **(h)** with the angle from **EV**. The intersection with the centerline **(CL)** gives the location of the horizon line. Perpendicular to the line **(h)**, draw a line **(v)**. The intersection with the center line **(CL)** will give the vanishing point **(VVP)** for the vertical lines. Note that the tilted picture plane is the surface of the paper; thus, the horizontal and vertical lines (**h** and **v**) must be drawn tilted instead.
4. Rotate the **EV** eyepoint around point **H** into the centerline **(CL)** to generate the eye point **(EH)**. This point will be used to construct the perspective in the horizontal direction.
5. Determine the distance of the base plane from the horizontal plane. In the example it is 60'. In this perspective, the base plane was selected at the top of the object to reduce the drawing size. The *baseline* **(BL)**—the intersection of the base plane and the picture plane—is drawn in scale 60' below the *horizon line* **(HL)**.
6. Position the plan on the base plane. Here, the object was placed behind the picture plane with one corner touching it. From **EH** you can construct the vanishing point **(HVP)** by drawing parallel lines with corresponding sides and intersecting with the horizon line **(HL)**.

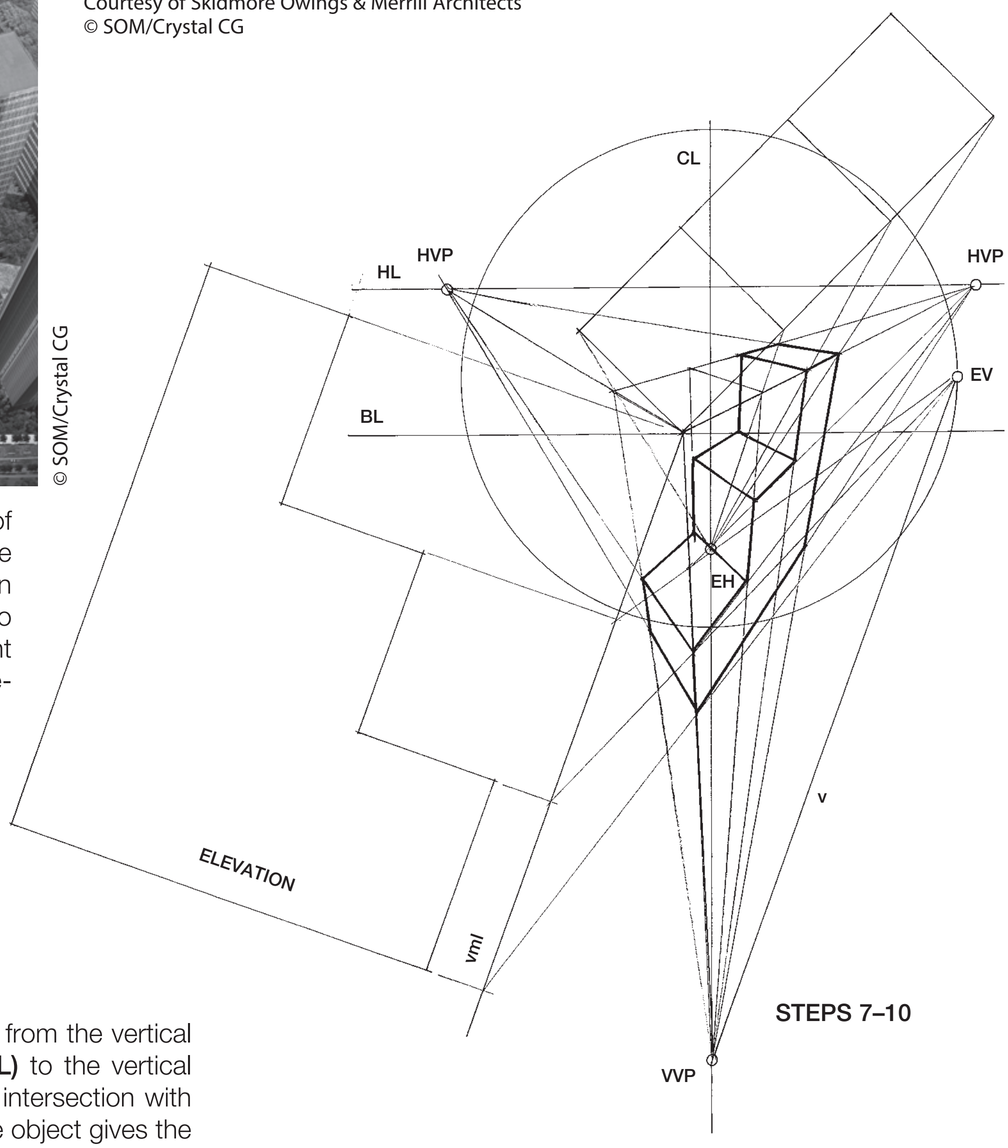
7. Construct the perspective image of the plan by connecting lines to the appropriate horizontal vanishing points **(HVP)**. The lengths of the lines will be measured by connecting points to the eye point **(EH)** and intersecting them with the corresponding lines.
8. The image of vertical lines can be constructed by connecting points from the plan image to the vertical vanishing point **(VVP)**.
9. The heights in the vertical direction will be generated from the vertical measuring line **(VML)**. Draw a line parallel to line **v**, starting from the point where the plan touches the picture plane (**BL** on the drawing). On the line generated **(vml),** the actual heights can be measured out. In this example, the elevation is drawn orthogonal to the **VML** and then projected onto it.



© SOM/Crystal CG

This beautiful drawing of a high-rise shows the structural elements on the sides converging to a vertical vanishing point in the context of a three-point perspective.

Drawing: Pearl River Tower, Guangzhou, China
Medium: Computer-generated
Courtesy of Skidmore Owings & Merrill Architects
© SOM/Crystal CG



STEPS 7–10

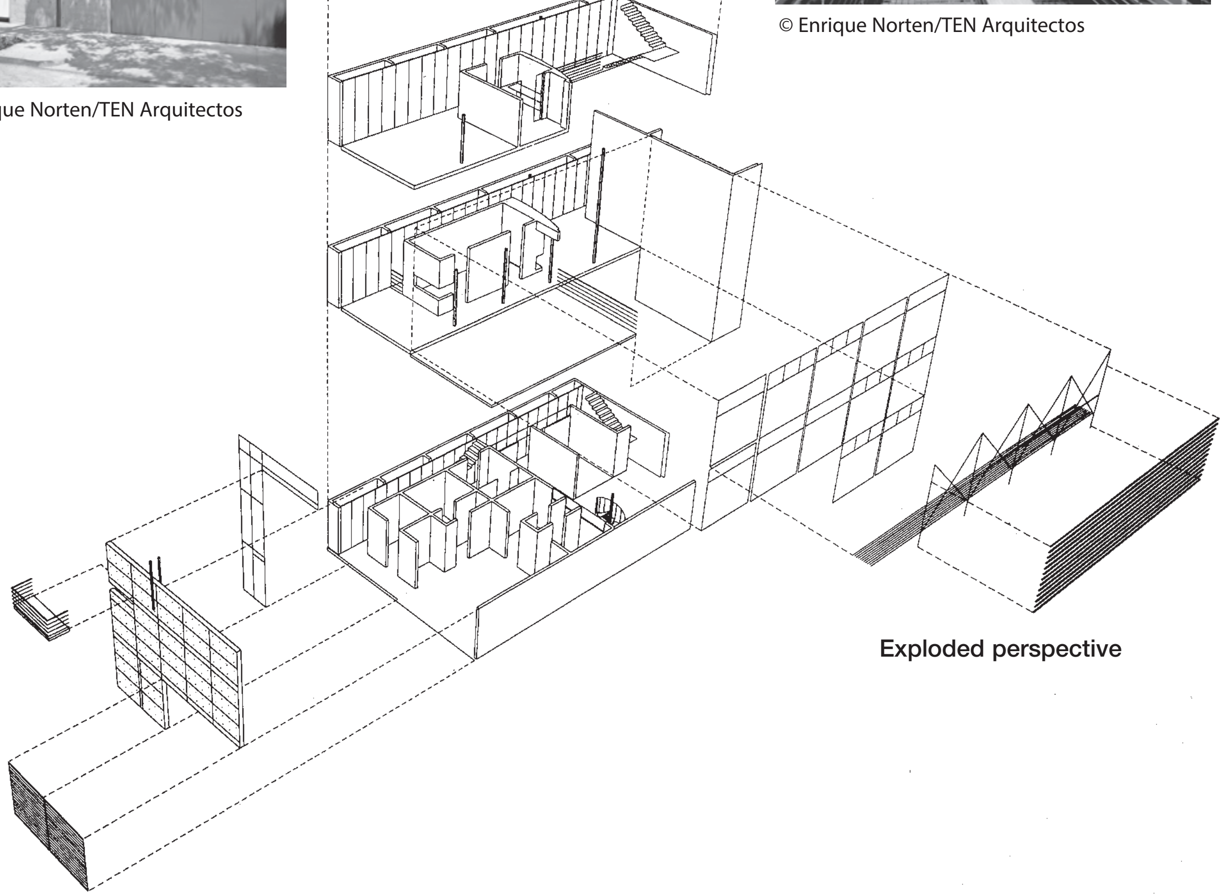
10. Connect each point from the vertical measuring line **(VML)** to the vertical eye point **(EV)**. The intersection with the corner line of the object gives the points for the heights in perspective. These points can be connected to the appropriate **HVP** points to finish the construction of the image.

Text and diagram: Courtesy of Arpad Daniel Ronaszegi, Assistant Professor
Andrews University Division of Architecture

THREE-POINT PERSPECTIVE

© Enrique Norten/TEN Arquitectos

© Enrique Norten/TEN Arquitectos



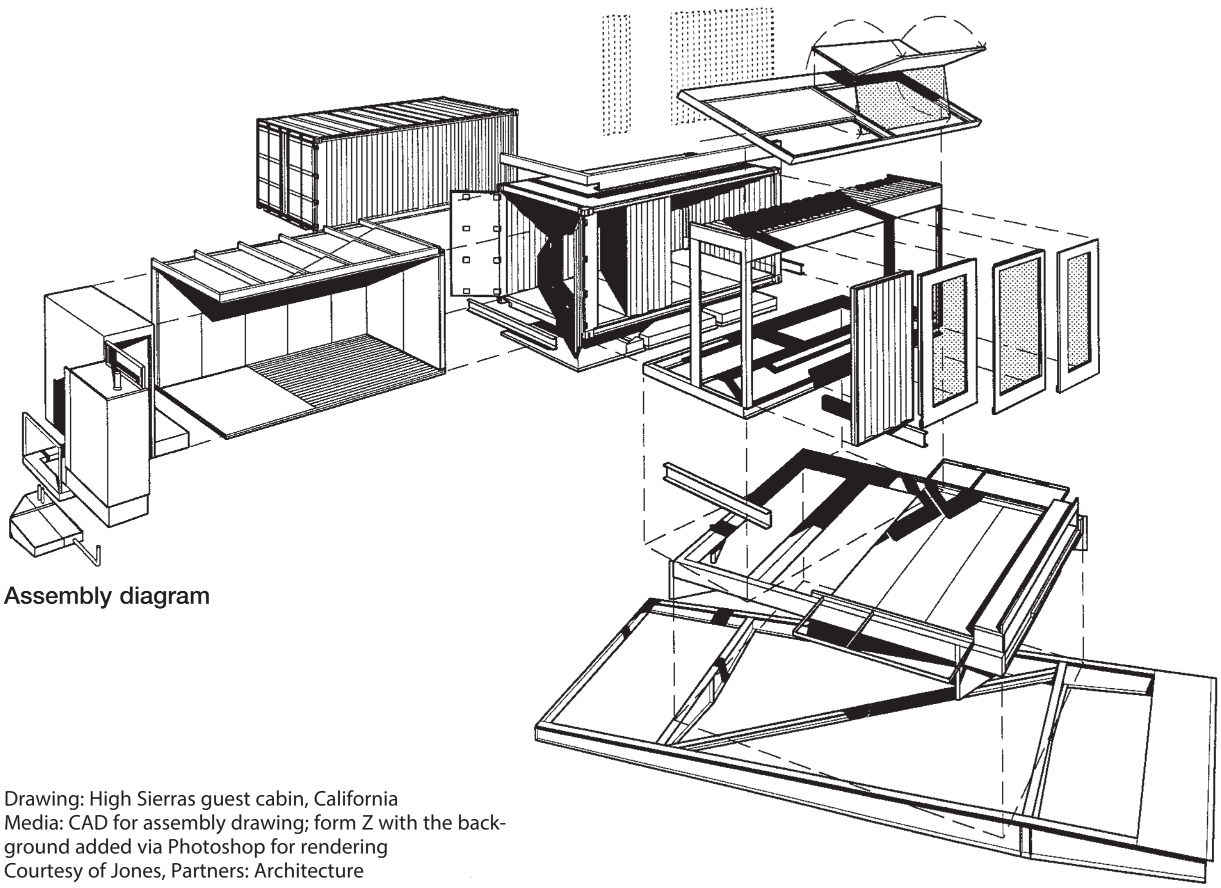
Exploded perspective

Drawing: HOUSE LE, Colonia Condesa, Mexico City, Mexico
Courtesy of Enrique Norten/TEN Arquitectos
Bernardo Gomez-Pimienta, Carlos Ordoñez, project coordinators

Exploded Perspective

Each layer in this exploded perspective gives an unimpeded view of the interior and exterior details of the house. The individual layers must be far enough apart to distinguish each layer (horizontal and vertical), yet be close enough so that they read as a coherent whole. The exploded view is successfully used to illustrate the off-the-shelf building components of a possible mass-produced house. The boxy interiors displayed by both this dwelling and the one on the facing page have a similar discipline and feeling to the post–World War II houses built in Los Angeles. The goal at that time was to build efficient and inexpensive model homes.

© Jones, Partners: Architecture

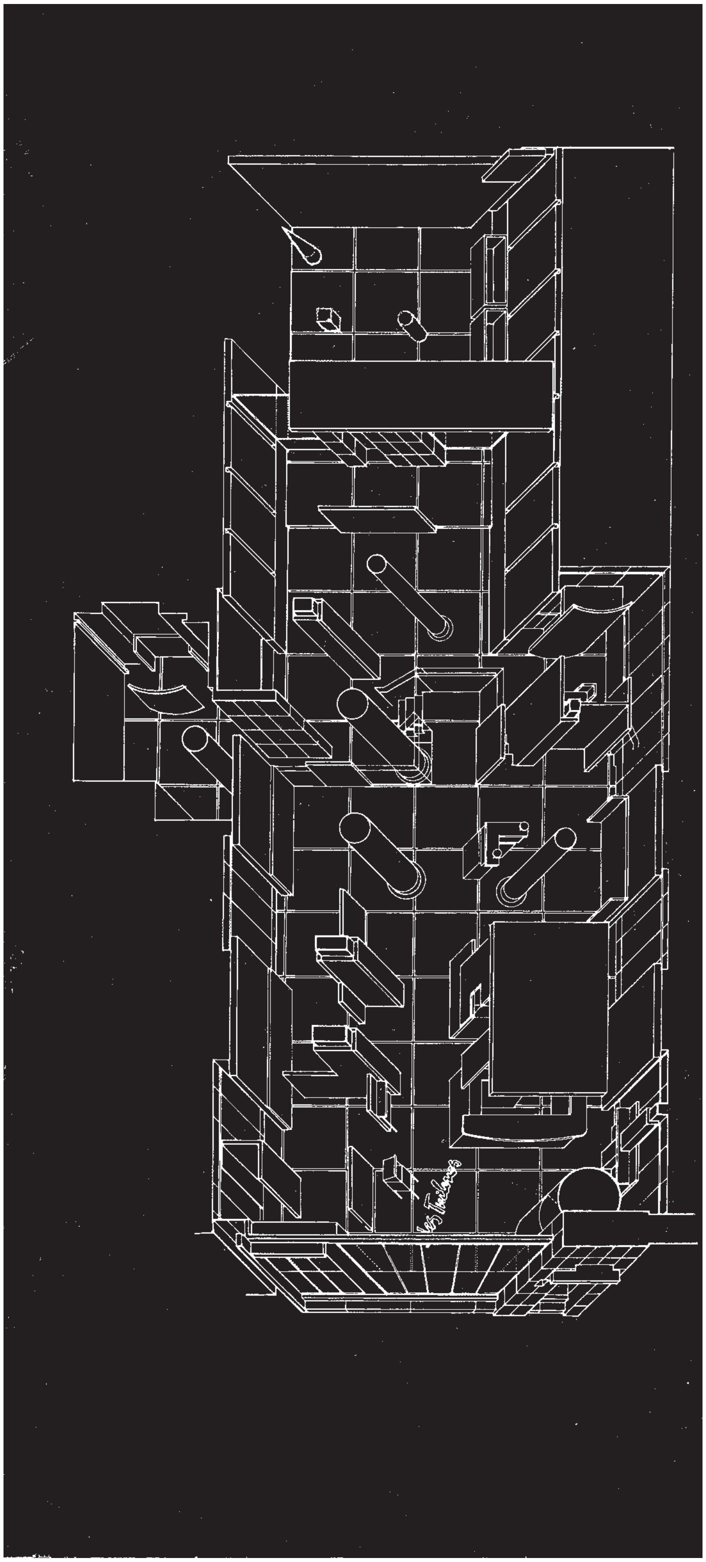


Assembly diagram

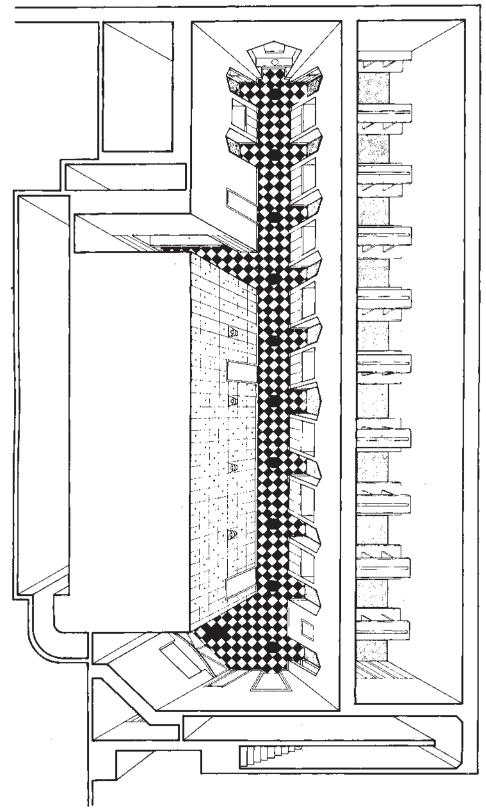
Drawing: High Sierras guest cabin, California
Media: CAD for assembly drawing; form Z with the background added via Photoshop for rendering
Courtesy of Jones, Partners: Architecture

Exploded Assembly Drawing

The use of the exploded view highlights the nature of this structure as an assemblage of standardized parts and shows the genesis of the primary building module in the standard 20′ shipping container. The primary modular assembly occupies the horizontal plane established by the existing container in the background, while accessory elements are, where possible, exploded along the vertical axis. Corrugated steel removed from the existing container is shown dotted in.
[Architect's statement]



Drawing: The WEB (Workstations in Evans Basement)
University of California, Berkeley
12" × 18" (30.5 × 45.7 cm), Scale: ⅛" = 1'0"
Medium: Ink on Mylar
Courtesy of Sam Davis, FAIA, of Davis & Joyce Architects

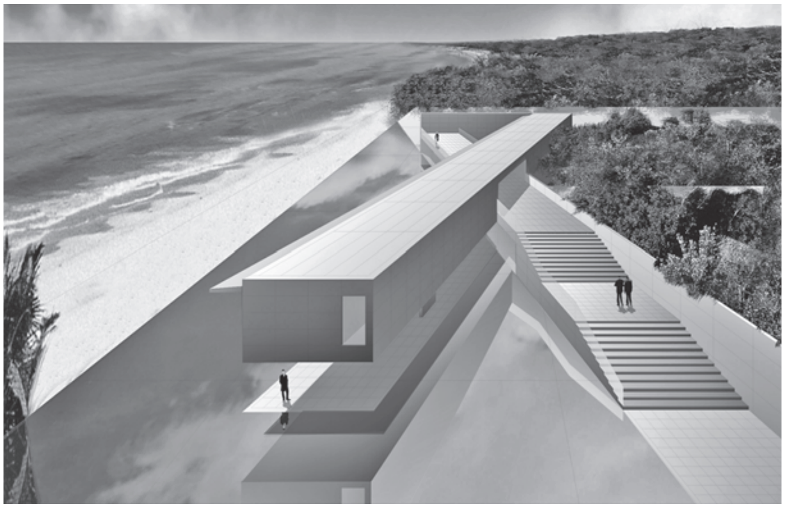


Drawing: Les Tuileries Restaurant, New York City
20" × 30" (50.8 × 76.2 cm), Scale: ¼" = 1'0"
Medium: Ink and Mylar
Courtesy of Diane Lewis, Peter Mickle, and Christopher Compton, R.A., Designers

An aerial one-point perspective shows the organization of the various rooms as would a simple plan, while also showing the volumetric relationships of the spaces. Certain liberties are necessary in the construction of such a drawing, but revealing so much conceptual information at a single glance is often valuable.
[Architect's statement]

Hybrid Drawings

When drawing types are superimposed, the result is a *hybrid* drawing. These two hybrid drawings with unusual overhead views combine the principles of paraline and perspective drawing. At first glance, they appear to be overhead one-point perspectives. On closer examination, however, one notices many internal structural elements having infinitely parallel lines. Today, it is very common to see the interfacing of manual and digital methods to produce hybrid drawings.



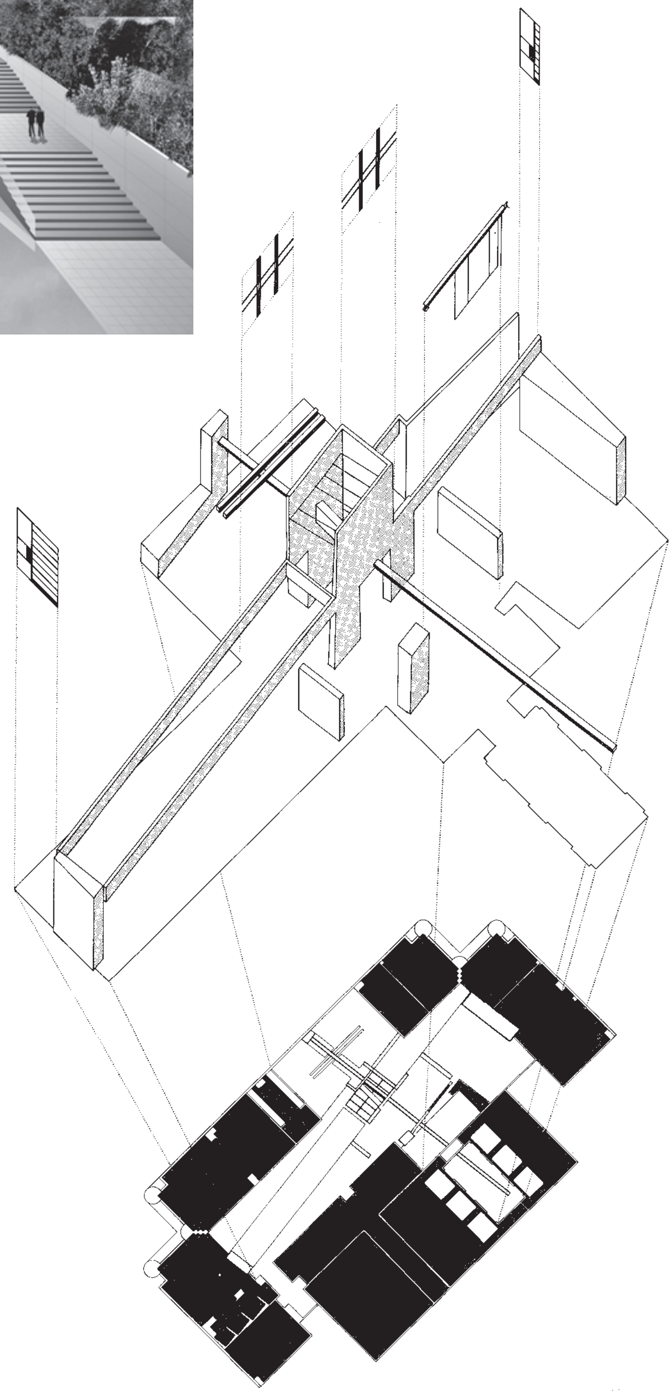
Drawing: Studio in Mexico
Media: Computer graphics, photo montage
Courtesy of Tadao Ando Architect and Associates

Hybrid Drawings

The above drawing is a hybrid in the sense that it has converging perspective lines from a flat picture plane elevation that is parallel to the picture plane. This is a favorite approach by some architects, such as Tadao Ando.

This hybrid drawing (right) combines a one-point persective with a vertically expanded plan oblique. Note that the perspective convergence results in the plan being enlarged, allowing for a clearer view of many details.

This drawing was made to illustrate a relation between a plan (in this case a floor plan) and certain three-dimensional elements contained within that plan. The plan is made as a figure/ground drawing in which the central void space of the office is highlighted. It is out of that void space that the three-dimensional parts are drawn as an axonometric projection.
[Architect's statement]



Drawing: World Savings Center Executive Suite, Oakland, California
14" × 26" (35.6 × 66 cm), Scale: $\frac{1}{8}$" = 1'0"
Medium: Ink on vellum
Courtesy of Jim Jennings, Architect, of Jennings + Stout, Architects
Drawn by Jim Jennings

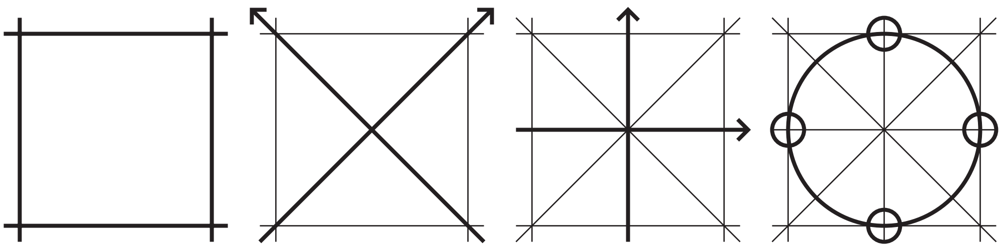
Drawing Perspective Circles

To draw a circle or a portion of a circle accurately in perspective requires that you first draw its circumscribing square. With experience and practice, you will be able to derive from the square all the reference that is needed for quick sketches. However, as accuracy requirements and circle size increase, so does the need to construct additional points of reference to assist in constructing the circle. The following sections describe the four-, eight-, and twelve-point techniques for constructing circles.

Photo: St Mark's Cathedral Venice, Italy

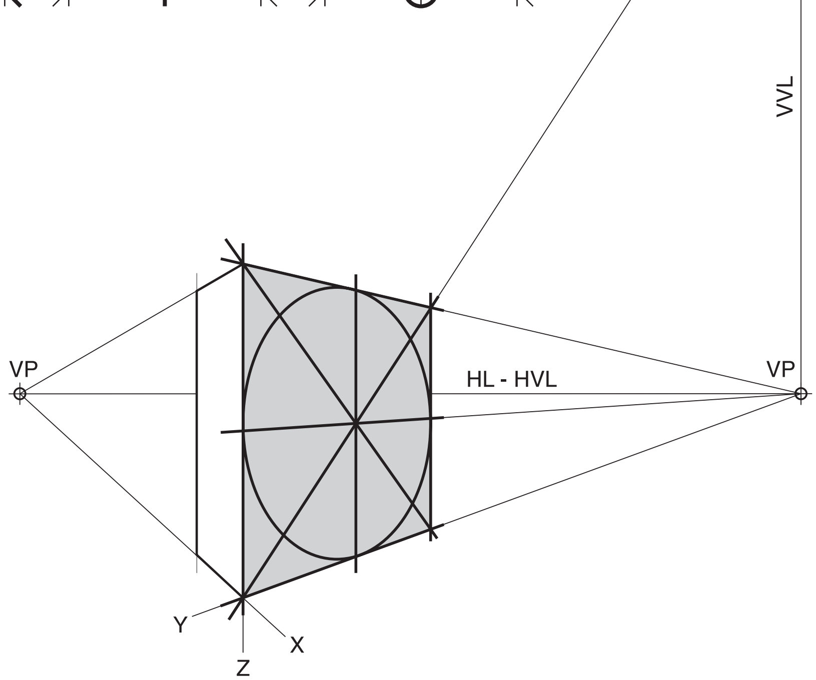
The Four-Point Perspective Circle

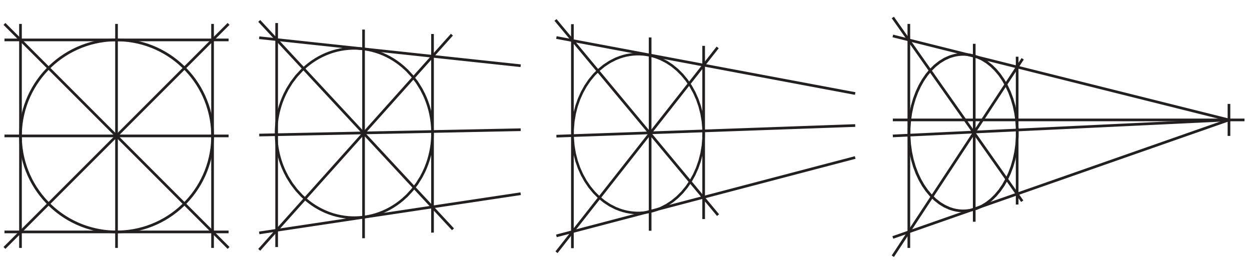
The four-point technique locates the points of tangency between the circle and square.



Draw or identify the square that circumscribes the circle. Draw the diagonals of the square to locate its center. Draw vertical and horizontal lines through the center point of the square. The intersection of these lines with the sides of the square will locate the midpoints of the respective sides, which are also the tangent points for the circle and square. Draw a smooth curve that connects the four points to create a circle in perspective. Visually adjust the circle until it looks correct.

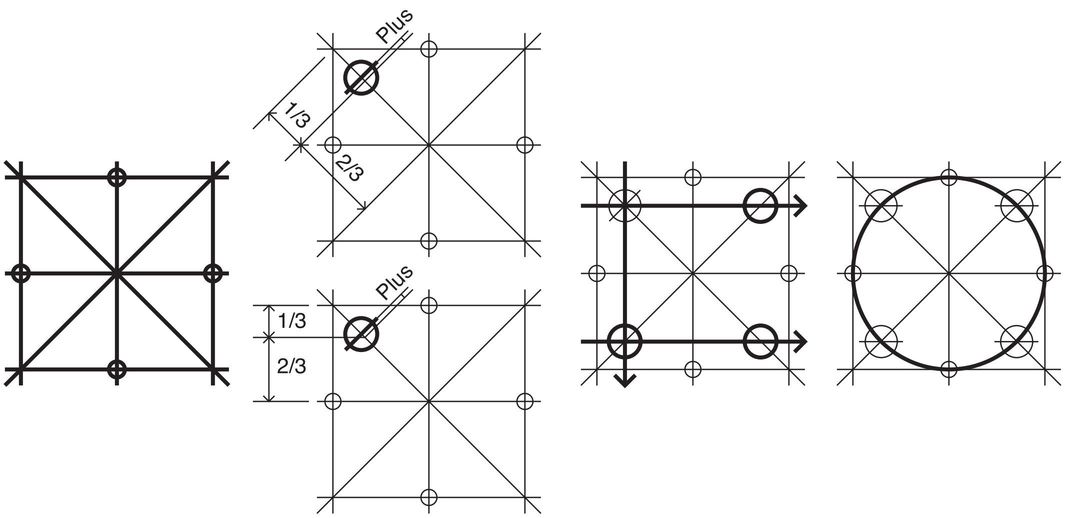
Note that the highest and lowest points of the circle are to the near side of their respective tangent points.





The Eight-Point Perspective Circle

The eight-point technique builds directly on the four-point system with a visual approximation that provides four more points.



Follow the four-point procedure to locate the first four points. The diagonals used in this process are now divided to locate the additional points.

Divide the near half of one of the diagonals into thirds to locate the two-thirds point as shown. This can be done either directly along the diagonal or along the corresponding half of the square's side. If you use the square's side, you must transfer the two-thirds mark to the diagonal.

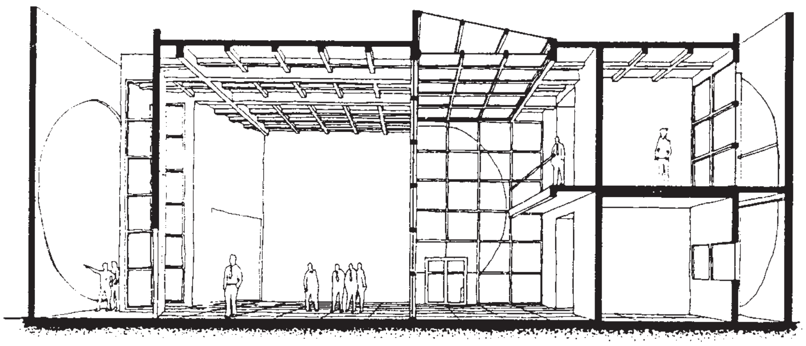
Mark a point just beyond the two-thirds point of the diagonal. This locates the point at which the circle will intersect the diagonal.

Transfer this point to the other diagonals with lines that are parallel to the respective sides. This locates the other three points, giving you eight points to guide your circle construction.

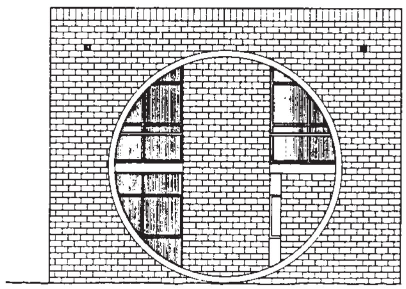
Draw a smooth curve that connects the eight points to create a circle. Visually adjust the circle until it looks correct.

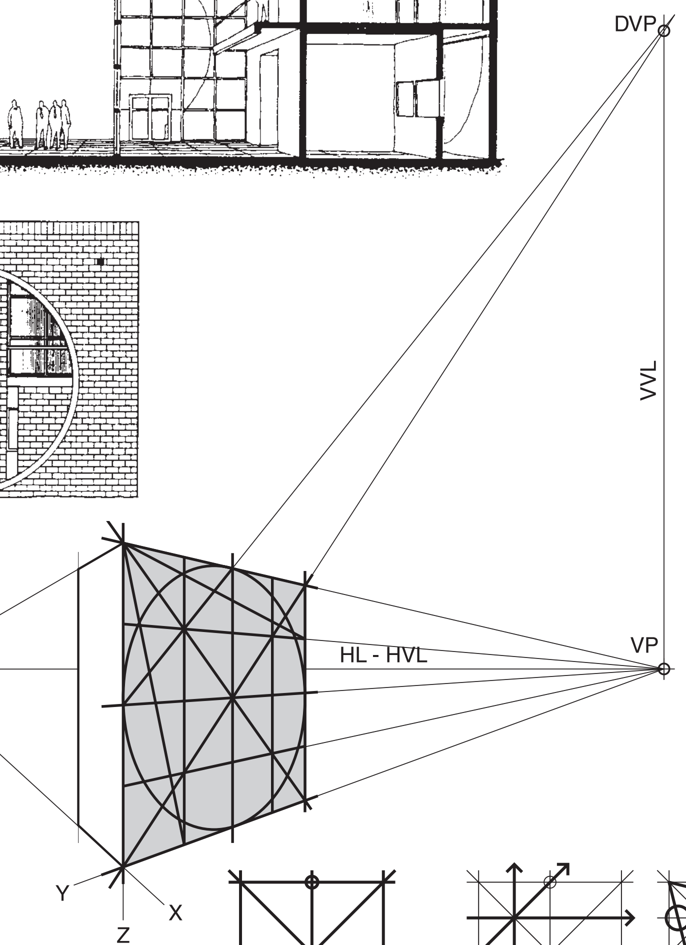
This is the largest Victorian glasshouse in the United States. It was restored in 1997.

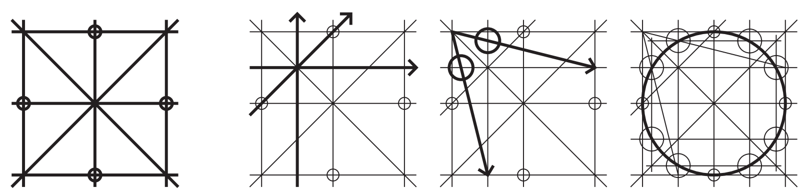
Photo: Enid A. Haupt Conservatory
New York Botanical Garden
New York, New York
Architect: Beyer Blinder Belle
© Arcspace



Drawing: Student project by Duke Wilford
Wine Growers Association
30" × 30" (76.2 × 76.2 cm)
Medium: Technical pen (latex ink) on Mylar
Courtesy of Washington University
School of Architecture, St. Louis, Missouri







The Twelve-Point Perspective Circle

Follow the four-point procedure to locate the first four points.

Draw a diagonal through a near quarter of the original square to find its center. Draw vertical and horizontal lines through this point.

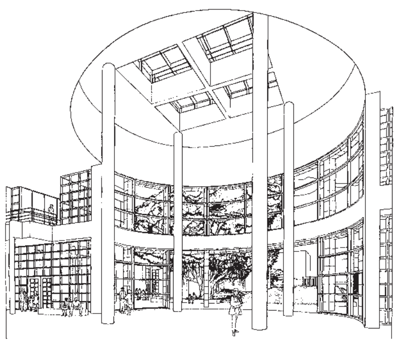
Draw lines from the corner of the original square to the one-quarter points on the opposite sides as shown. The intersection of these lines with the nearest horizontal or vertical one-quarter line defines two new points on the circle.

Use transfer techniques to create the other vertical and horizontal lines, and then transfer the location of the two new points on the circle to the appropriate lines. This locates the other six new points and provides twelve points to guide circle construction. Draw a smooth curve that connects the twelve points to create a circle. Visually adjust the circle until it looks correct.

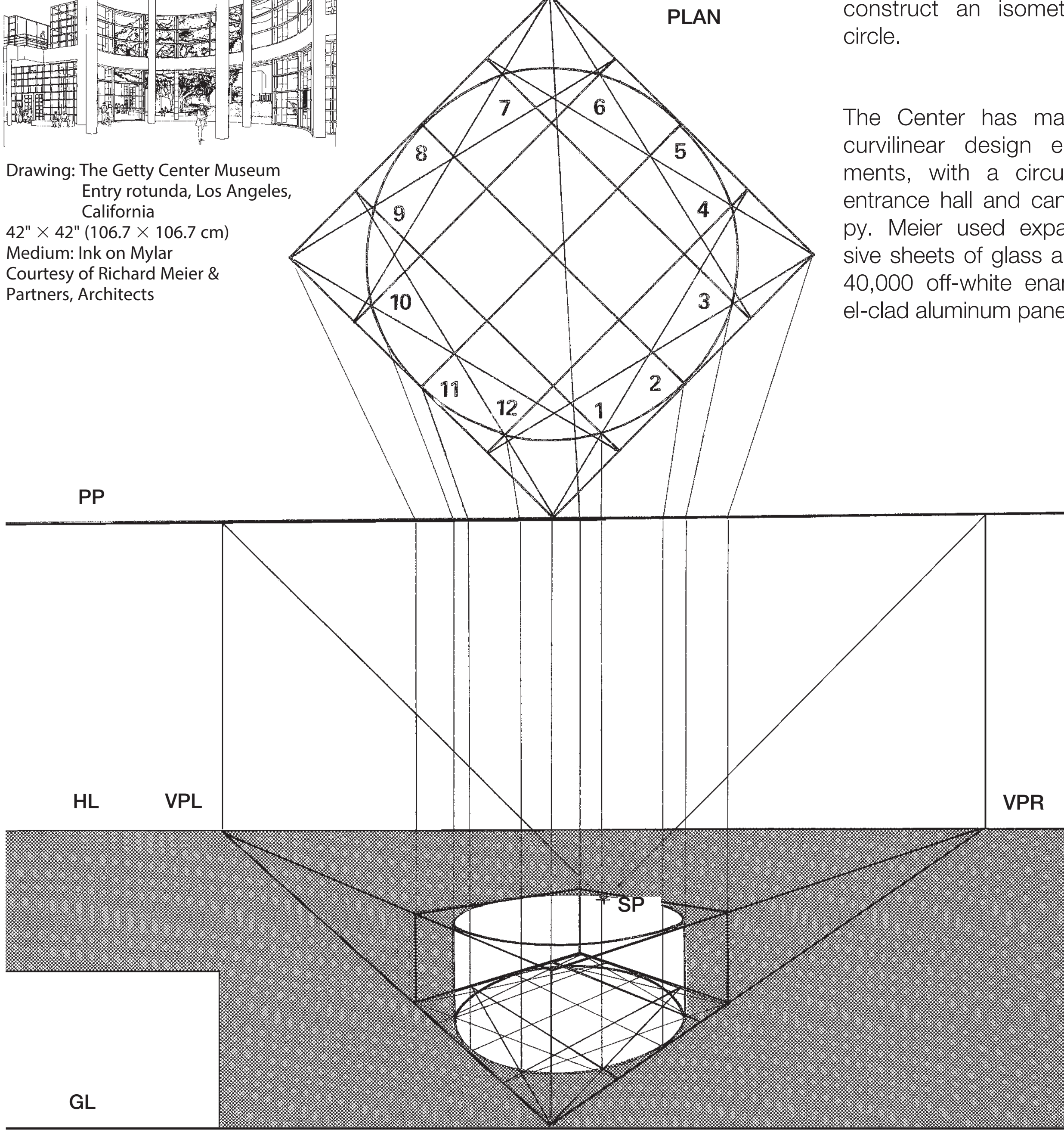
Diagrams and text: Courtesy of William R. Benedict, Assistant Professor,
California Polytechnic State University School of Architecture
San Luis Obispo, California

The *twelve-point* procedure is equally effective in constructing a horizontal perspective circle. It can also be used to construct an isometric circle.

The Center has many curvilinear design elements, with a circular entrance hall and canopy. Meier used expansive sheets of glass and 40,000 off-white enamel-clad aluminum panels.



Drawing: The Getty Center Museum Entry rotunda, Los Angeles, California
42" × 42" (106.7 × 106.7 cm)
Medium: Ink on Mylar
Courtesy of Richard Meier & Partners, Architects

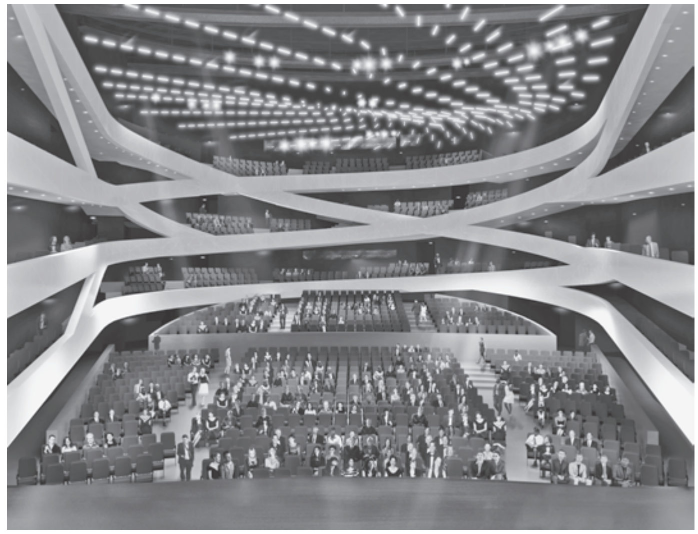


The Twelve-Point Perspective Circle

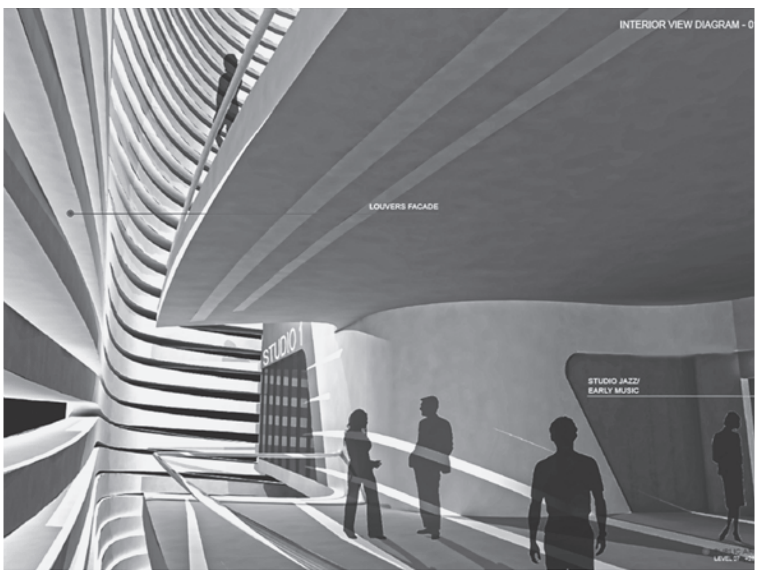
1. Divide the encompassing square into sixteen squares of equal size.
2. Project lines from the four major corners to the farthest corner of each smaller corner square.
3. Intersection points (8) for the circle occur at the intersection of the major corner line and the opposite side of the first smaller square.
4. The other four points are the tangent points. Carefully draw the elliptical curve connecting the twelve points.

The 1,200-seat theater supports a range of performances, including music, theater, opera, and dance, as well as serving as a space for public debates and panel discussions. The dynamic form of the theatre's balconies fosters a sense of individual intimacy while knitting together audience and performer. [ARCHITECT'S STATEMENT]

Model Photo Courtesy of Marsel Loermans Foto graphic.pdf



Drawing: 1,200-seat theater, view from stage
San Francisco State University
San Francisco, California
Medium: V-Ray for Rhino + Photoshop
Courtesy of Michael Maltzan Architecture, Inc.



Drawing and Model Photo: Dance and Music Center
The Hague, The Netherlands
Medium: Rhino, Maya, and AutoCAD
Courtesy of Zaha Hadid Architects

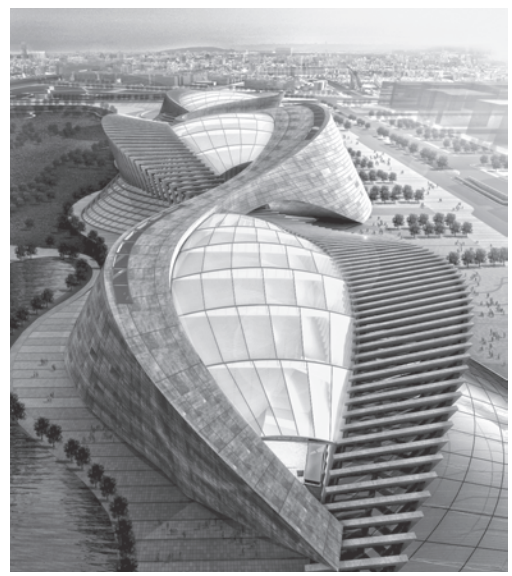


Photo: Weiwuying Performing Arts Center
Kaohsiung, Taiwan
Courtesy of Kris Yao/ARTECH Architects
Council for Cultural Affairs, Republic of China (Taiwan)

Noncircular curvilinear forms in architecture can be elliptical or even undulating (a wavelike continuum), as seen in the work of Alvar Aalto. *Noncircular curvilinear* horizontal or vertical forms can be plotted by using a similar point-by-point technique, as shown with perspective circles. Contemporary graphic strategies dictate that its expeditious accurate plotting be computer-generated or approximated by eye using freehand techniques. Note the beautiful noncircular curves in these four images. Hadid's Dance and Music Centre has horizontal louvers that visually move when struck by light and shadow. It reminds one of a fluid force field that is undulating and dynamic. The building culminates with a beautiful curving roofline. The curvilinear Taiwan arts center was designed with the seamless integration of the surrounding landscape in mind. The great roof provides protection from the tropical climate and allows visitors to stroll, relax, meditate, and practice Tai Chi.

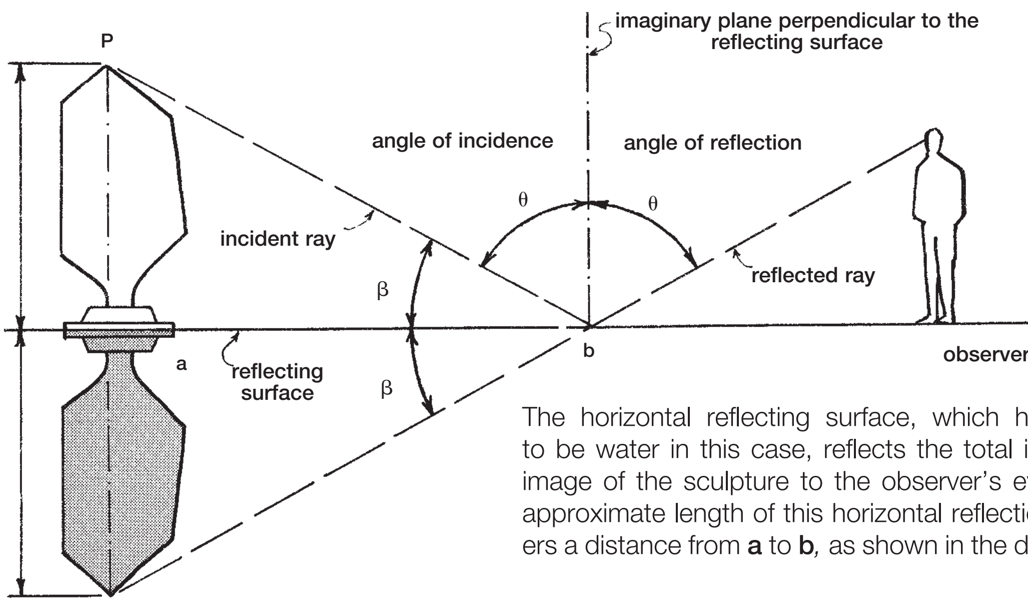
Drawings: Developer's Center
Oslo, Norway
Medium: ArchiCAD and Artlantis
Courtesy of Gudmundur Jonsson, Architect

My drawing method is simple. I make the original architectural drawings in the 3-D-based program ArchiCad. I then make a 3-D perspective in ArchiCad and convert it into an Artlantis Studio 3 render file. This step is followed by using the Artlantis file to continue improving the image by adding light, changing views, adding textures and colors as well as modifying them. When finished, the actual image is rendered. [ARCHITECT'S STATEMENT]

Oakland Museum pool structure, Oakland, California
Oakland Museum
Kevin Roche, John Dinkeloo, and Associates, Architects

Reflections

In most cases, a reflecting surface causes a visually interesting and appealing phenomenon. Reflections in architecture are associated with water, glass window panes, glass mirrors, wet pavement, and materials with a shiny surface, such as polished granite. Light causes the phenomenon of reflections. A *reflecting surface* results in an *extension* of any viewed perspective. The rendering of reflections furthers the understanding of a building within its contextual setting. The analytical drawing of the sculpture and its reflection is the optimal case of a reflected inverted object identical in size to the object itself. In reality, a horizontally reflected object does not create an exact mirror image in its reflected perspective, because the observer's eye level is always above the ground (reflecting surface) line. This results in different distances between the eye and any point, and its corresponding reflected point on the inverted image.



The horizontal reflecting surface, which happens to be water in this case, reflects the total inverted image of the sculpture to the observer's eye. The approximate length of this horizontal reflection covers a distance from **a** to **b**, as shown in the diagram.

Photo: Xixi Wetland Art Museum
Hangzhou, China
© Studio Pei-Zhu Architects
Courtesy of Arcspace

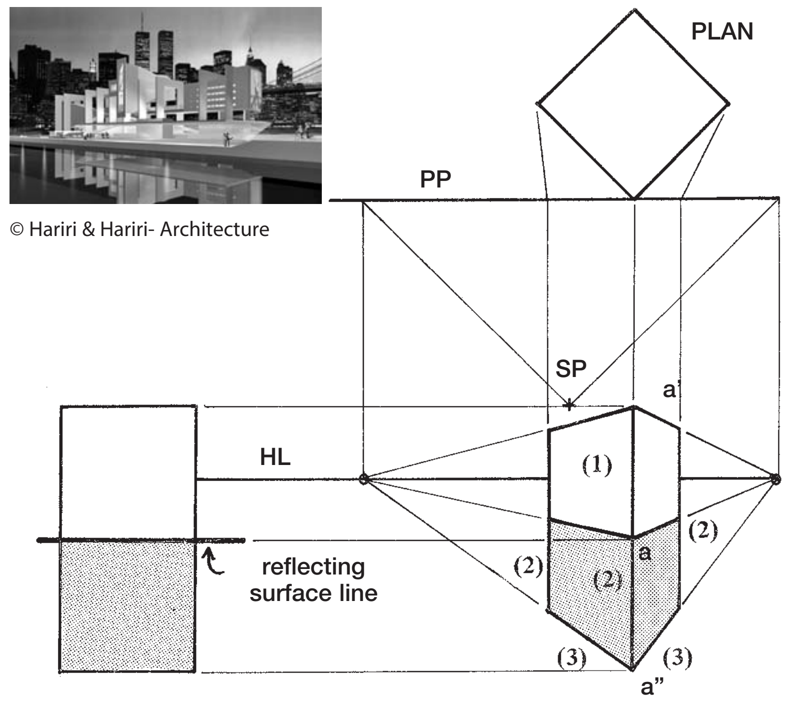
The design concept stems from the interaction between building and nature. As leaves fall from the trees, they arrive naturally on the ground, creating a shelter against the earth. [ARCHITECT'S STATEMENT FROM ARCSPACE]

Building Touching the Reflective Surface

1. Construct the perspective of the building.
2. Extend all vertical lines into the reflection. The reflected lengths will be equal to the existing building verticals (aa'= aa").
3. Horizontal lines in the reflection vanish to the same vanishing points as their corresponding horizontal lines in the existing building.

Drawing: The Cine, New York, New York
Medium: Vectorworks
Courtesy of Hariri & Hariri Architecture

This project proposal will be located on a pier beneath the Brooklyn Bridge that has a commanding view of the Manhattan skyline. The projected completion date is 2020.



© Hariri & Hariri- Architecture

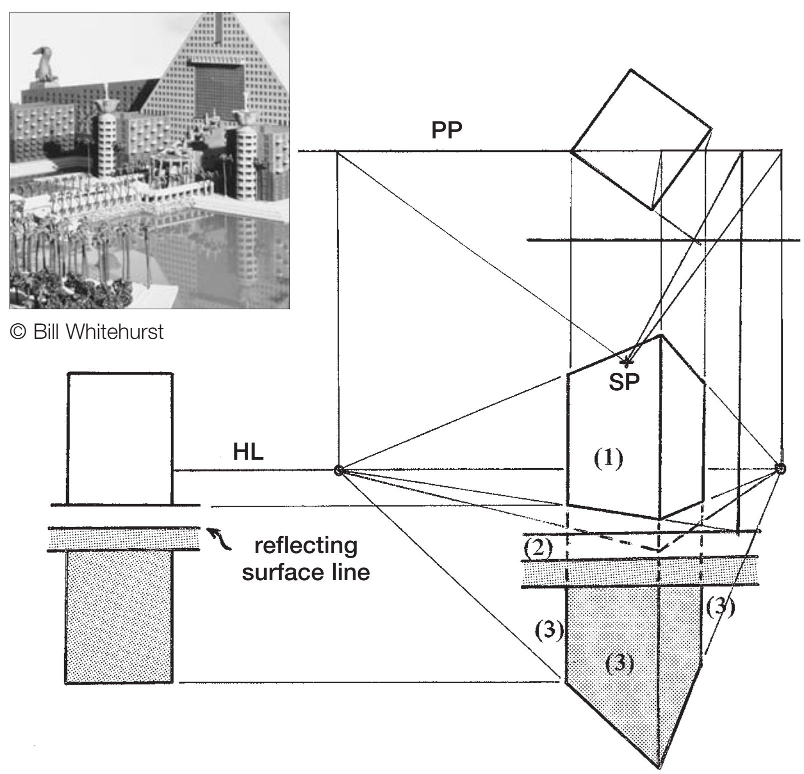
ELEVATION AND INVERTED ELEVATION (ALWAYS CONSTRUCT)

Building Not Touching the Reflective Surface

1. Construct the perspective of the building.
2. The reflecting surface does not extend under the building; therefore, parts of the reflection will be concealed. Construct the projection of the building onto the plane of the reflecting surface. The verticals are measured to the plane of the reflecting surface.
3. These vertical distances are duplicated to construct the reflection.

Photo: Dolphin and Swan Convention Hotels
Orlando, Florida
Photo by Bill Whitehurst
Courtesy of Michael Graves, Architect, and
Courtesy of Tishman Realty & Construction Company

A very playful design, the fish and swan sculptures represent classical and contemporary symbols of water. The concept was to bring a personality and a sense of fun to the hotels.



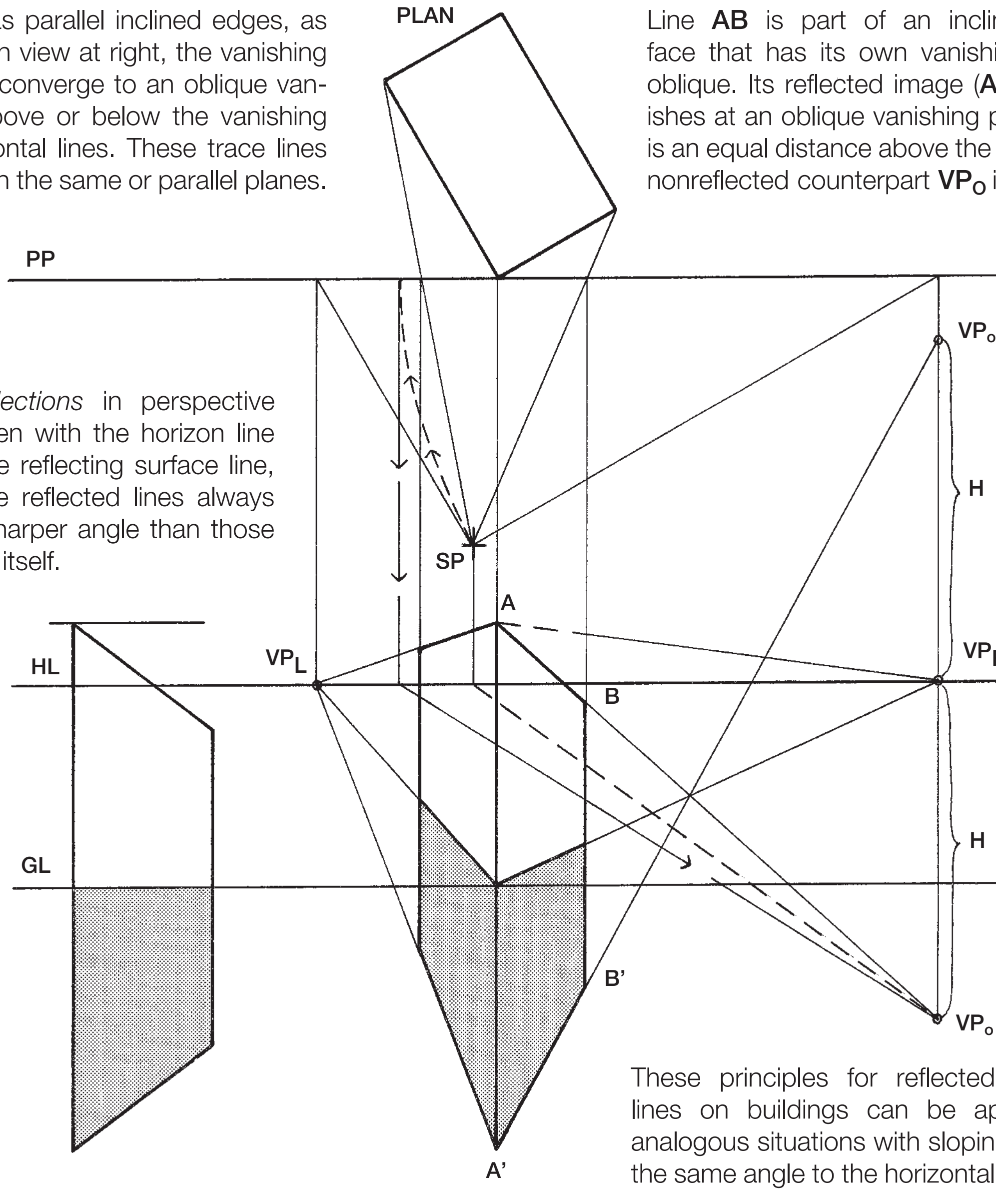
© Bill Whitehurst

ELEVATION AND INVERTED ELEVATION

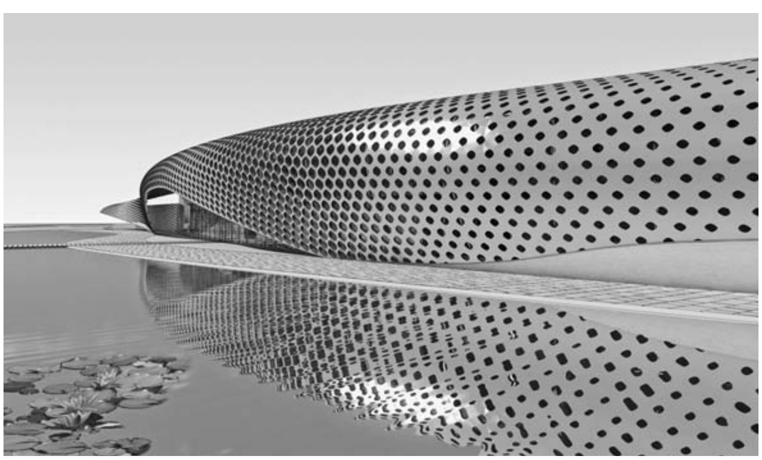
If a building has parallel inclined edges, as seen in the plan view at right, the vanishing trace lines will converge to an oblique vanishing point above or below the vanishing point for horizontal lines. These trace lines are all located in the same or parallel planes.

Line **AB** is part of an inclined surface that has its own vanishing point oblique. Its reflected image (**A'B'**) vanishes at an oblique vanishing point that is an equal distance above the **HL** as its nonreflected counterpart **VP$_O$** is below.

Horizontal reflections in perspective are always seen with the horizon line higher than the reflecting surface line, resulting in the reflected lines always sloping at a sharper angle than those of the building itself.



These principles for reflected oblique lines on buildings can be applied to analogous situations with sloping lines at the same angle to the horizontal, such as stair railings.



Drawings: Materials Chemistry Development Center
Mourenx, France
Medium: 3-D graphic software
Courtesy of Serero Architects

HORIZONTAL REFLECTING SURFACE

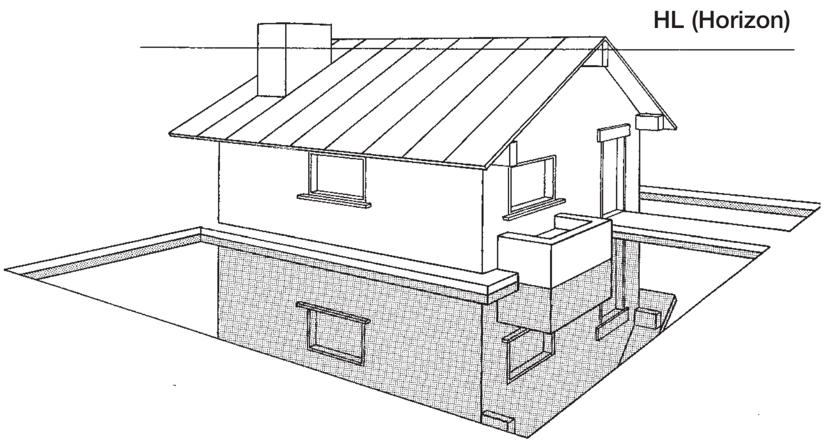
Photo: Andy Ryan © Arcspace

Photo: Nelson-Atkins Museum of Art
Kansas City, Missouri
Architect: Steven Holl Architects
Courtesy of Arcspace

© Arcspace

Photo: De Young Museum
San Francisco, California
Architect: Herzog & DeMueron
Courtesy of Arcspace

Holl's building (above and below ground), with a reflecting pool like the De Young, is a series of simple "lanterns" cascading down the landscape with ramps, circulation spaces, and galleries linking with each other to establish a contemporary dialogue with the existing masonry classical building and the natural landscape.



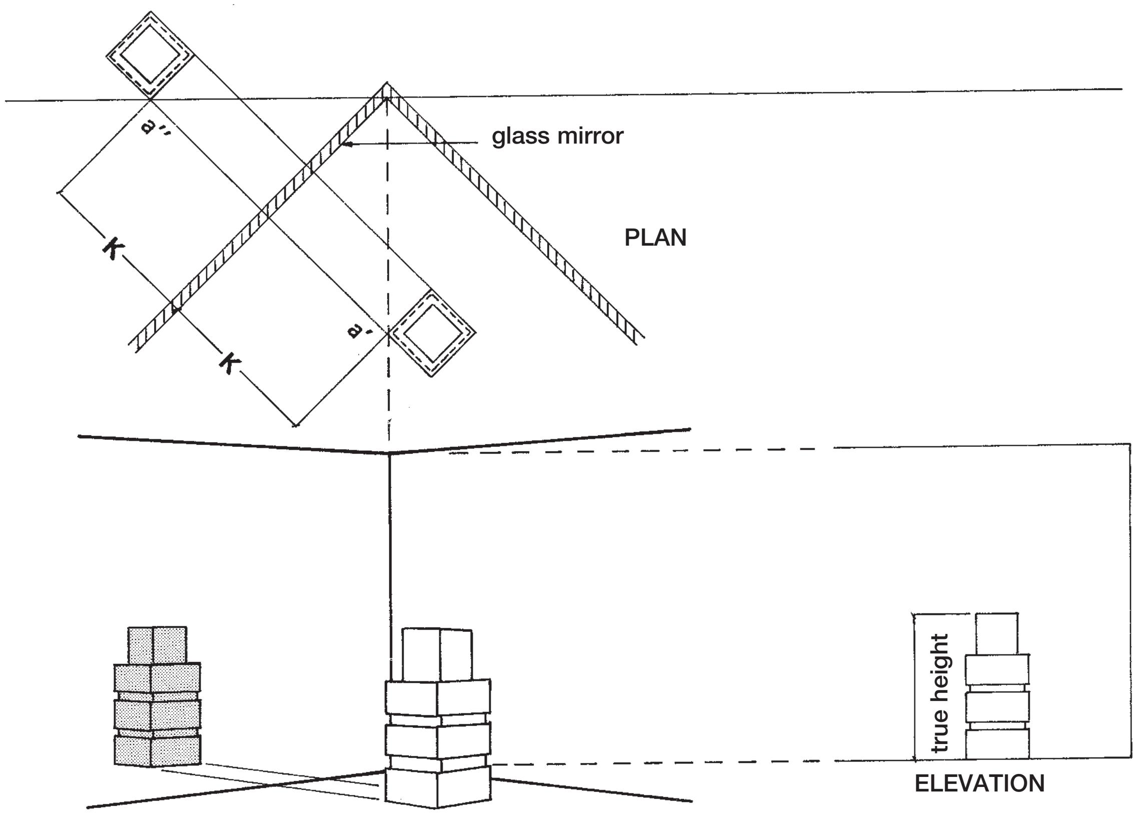
The horizontal reflecting plane is defined by the waterline. Horizontal lines in both the object and its reflection converge to the same vanishing point. Vertical lines of the object continue and remain vertical in the reflection.

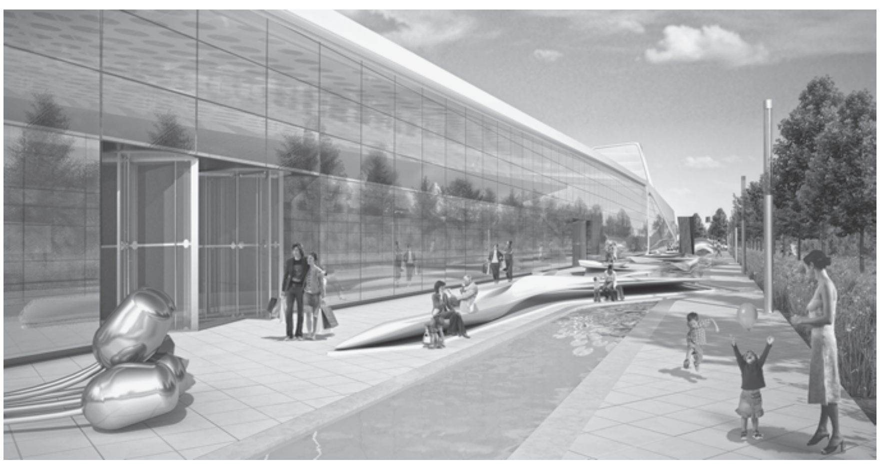
Artificial reflecting pools commonly display partial reflections because of the pool's enclosing elements. Natural bodies of water display almost total reflections. The edge of the reflecting pool in Holl's building and the diagram left cut off the top of the reflected images of the buildings.

The soft light of a late fall day established the mood of this photograph. The selection of a low viewpoint captures an almost complete reflection of the house and emphasizes the strong geometry of the design. A conscious effort was made to establish the sympathetic relationship of the house setting with freshly fallen leaves around and on the pool's surface. Some photographers might have cleaned it up, producing a stiffer, more formal result. Recognizing and taking advantage of unpredictable circumstances such as those shown here can produce images that are both aesthetic and informative. A 4" × 5" view camera with a wide-angle lens was used to produce this photograph.
[ARCHITECTURAL PHOTOGRAPHER'S STATEMENT]

© Norman McGrath, Photographer

Photo: Sklar House, Westchester County, New York
Courtesy of Christopher H. L. Owen, Architect,
and Norman McGrath, Photographer





Drawing: The Azzano: San Paolo Complex
Bergamo, Italy
Medium: Maxwell Render, VRay, Maya, Rhino, Photoshop
Courtesy of Asymptote: Hani Rashid + Lise Anne Couture

The design scheme calls for powerful and subtle architectural works placed on an urban plinth. It pursues a quasi-urban notion of occupancy where the interior and exterior spaces are fluid and transitional from one another.
[Architect's statement]

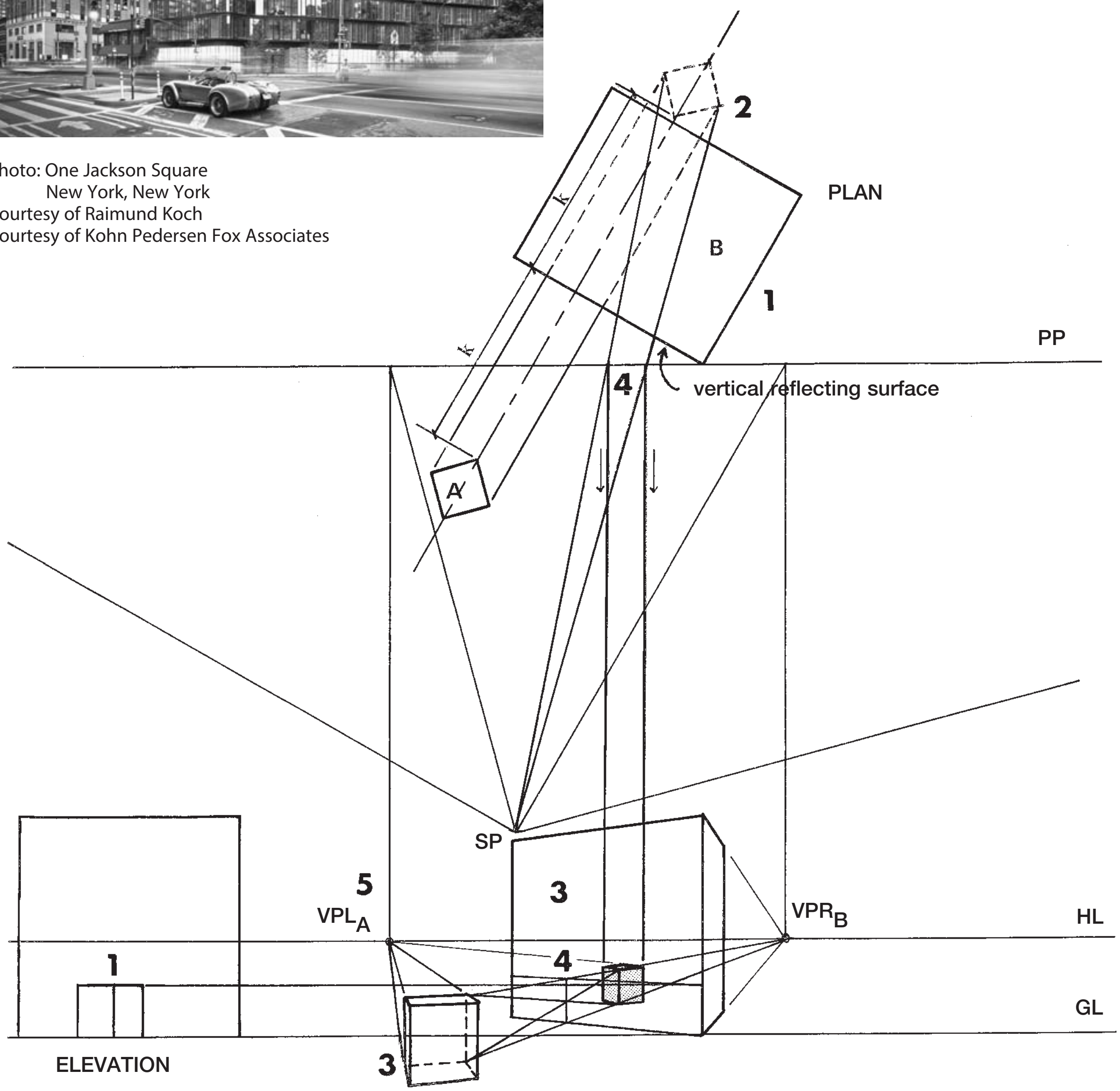
It is common to have either *interior* perspective views (top) or *urban landscape* perspective views (bottom and facing page) where *vertical reflecting surfaces* give an added dimension to the perspective. The added dimension for a mirror is the optic expansion of a small interior space. This extension seen in the mirror usually shows parts of the room not seen from the perspective vantage point. For vertical reflections, the most important principles to remember are:

- A point such as **a'** in front of a reflecting surface is reflected back an *equal distance* **(K)** to its reflected image **a"**.
- A point **a'** and its corresponding reflected image **a"** always lie on a line *perpendicular* to the reflecting surface.
- The object and its reflected image follow the same rules for perspective construction.

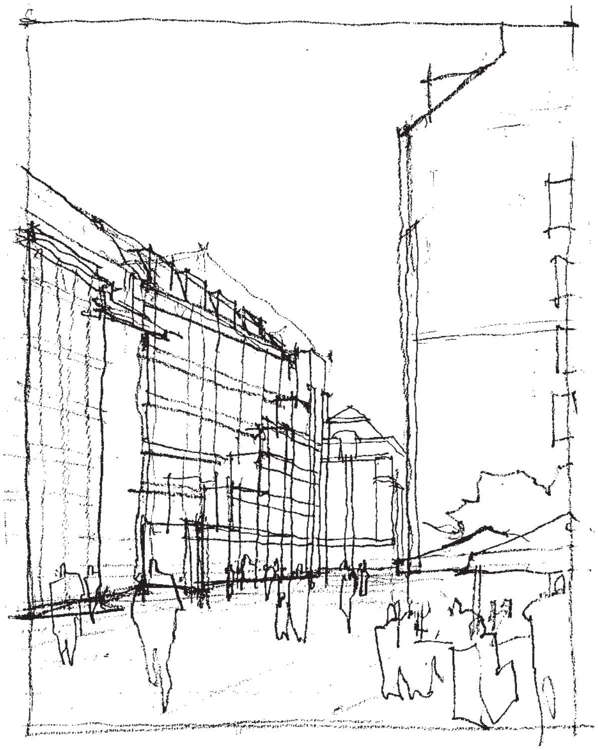
This photo shows an excellent example of modulating the reflecting surface to give a unique reflective character to the design.

Because of all its facets, the glass wall becomes a kaleidoscopic playback of everything that surrounds it. An ordinary glass wall just reflects its context pretty much as you see it. This wall transforms it. [ARCHITECT'S STATEMENT]

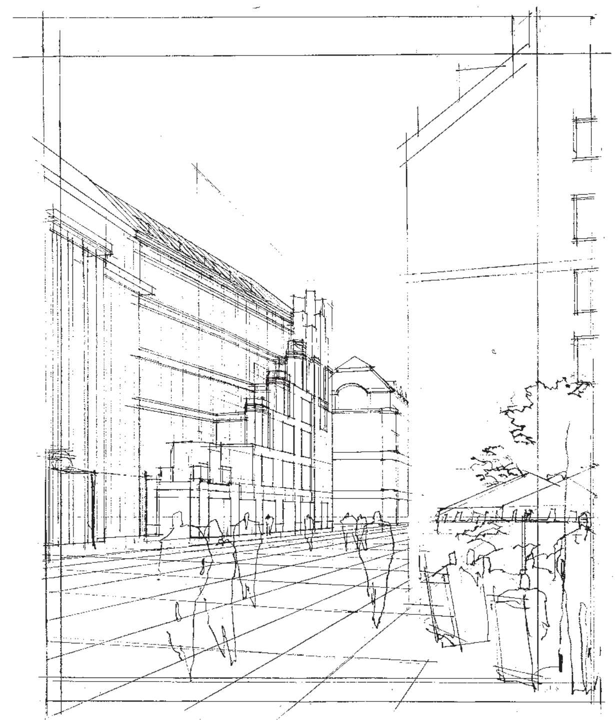
Photo: One Jackson Square
New York, New York
Courtesy of Raimund Koch
Courtesy of Kohn Pedersen Fox Associates



1. Construct plan and elevation views of the buildings (**A** and **B**) involved.
2. Construct the plan view of the building (**A**) reflected in a reverse image, an equal distance (**k**) beyond the reflecting surface.
3. Construct a two-point perspective of the reflecting surface and the building (**B**) being reflected.
4. Construct the reflected reverse image by first finding an image height on the reflecting surface and then projecting rays from the **SP** through the **PP** and down into the perspective view.
5. The reflected reverse image of the building uses the same set of vanishing points as the building itself.



Step 1



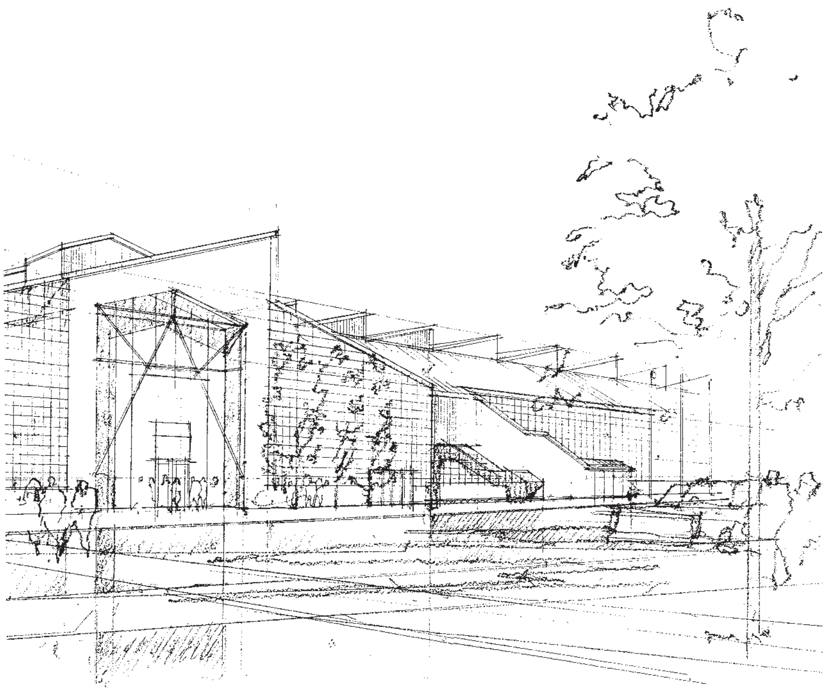
Step 2

Once you understand linear perspective drawing, you can develop perspective views—from the rough to the finished form. In the profession of architectural illustration, this requires an understanding of the design of the project being illustrated, as well as skills in managing the balance, composition, and arrangement of a drawing's many elements. These drawings depict the process, from a rough layout to a line transfer to a detailed line drawing. The architectural illustrator must decide which way of representing a project will be most likely to lead the client to accept the design concept.

The project site was a narrow street/mall. The rough layout was done to determine the view and the relationship to the background building. The view of the final line transfer was done from a photograph supplied by the client to each competitor so that each scheme could be compared from the same fixed station point. Note the actual amount of background building that shows versus the perceived amount of the building that shows in the rough layout.
[Architectural illustrator's statement]

Drawings: Peek & Cloppenburg Department Store competition winner
Leipzig, Germany
14" × 17" (35.6 × 43.2 cm)
Media: Full watercolor over pencil line transfer
Moore Ruble Yudell, Architects
Courtesy of Al Forster, Architectural Illustrator

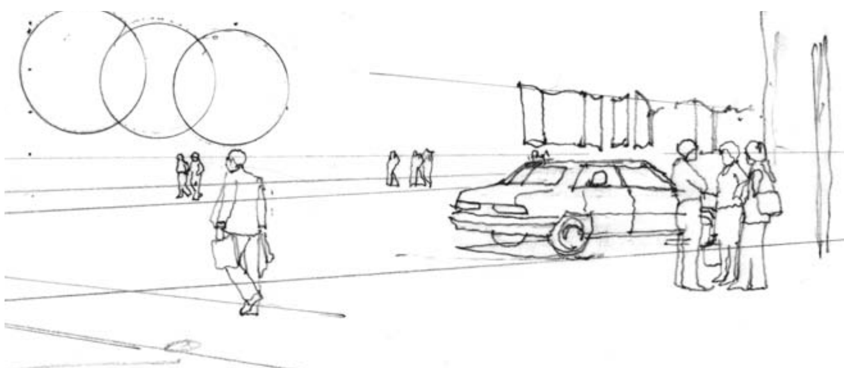
Step 3



Step 1

View Development

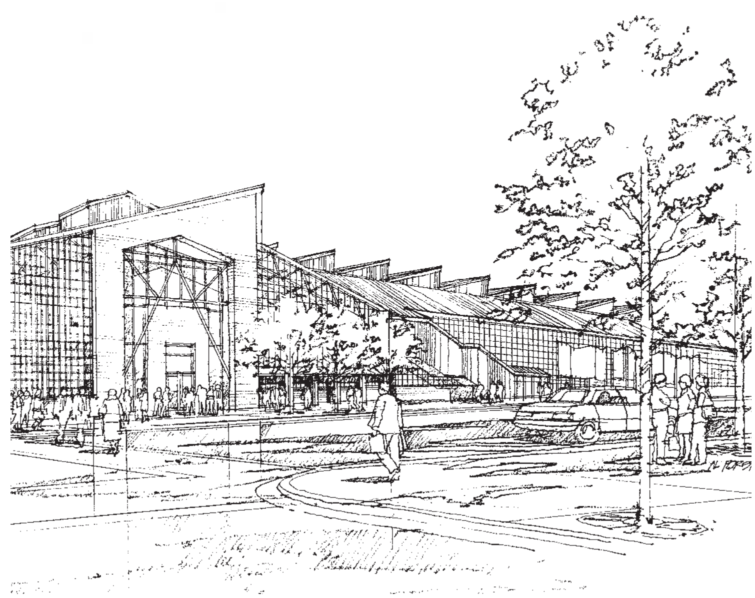
Step 1: For the rough block-out, human figures, cars, and tree forms are sketched in for scale, depth, and possible (or actual) placement.
Step 2: An entourage tracing paper overlay is used for clean figures, cars, etc. This can be done directly onto the rough block-out from Step 1.
Step 3: A final line sketch or pencil transfer incorporates building and entourage together. More tree detail is now added, as well as small, distant hand-drawn figures not necessarily on the entourage overlay.
[Architectural illustrator's statement]



Step 2

Drawings: Sybase Hollis Street Campus
San Francisco, California
18" × 12" (45.7 × 30.5 cm)
Media: Sketch watercolor on mounted presentation blackline print of pencil drawing
Robinson Mills & Williams, Architects
Courtesy of Al Forster, Architectural Illustrator

The advantage of a constructed perspective layout is that before the tone and values are finalized, the renderer can experiment with additions, deletions, and corrections to apparent distortions. Using overlays, tonal values, and color can also be applied in varying degrees to help determine how to finalize the rendering.



Step 3

7

Light, Shade, and Shadow

Light allows us to have vision. With light we can structure and put order into the environment. It enhances our senses for experiencing architecture as we move through space over a period of time. The experience of the three-dimensional or sculptural quality of a building depends largely on the direction of sunlight hitting its surfaces. A building or space becomes alive when natural light illuminates its architecture, in its responses to the ever-changing qualities of sunlight. Your awareness of this aids in your design decisions. A thorough knowledge and understanding of light and the application of shades and shadows to presentations of the built environment helps to further client–architect understanding during the design process. Shadows accent orthographic (particularly elevations and site plans), paraline, and perspective drawings, adding a sense of clarity and substance to the represented forms.

The intent of this chapter is to develop your ability to draw and construct shades and shadows in plan, elevation, and paraline drawings. During your journey to attain the mastery of this ability through constant exercise, practice, and observation, you will ultimately gain the wisdom of, as architect Louis Kahn referred to it, the "gift of light" in architecture.

Following are some of the important terms and concepts you will learn:

How to construct shades and shadows in plans, elevations, axonometrics, and obliques

Light	Shade	Shadow	Casting edge
Altitude	Azimuth	Plan shadows	Paraline shadows

Light, Shade, and Shadow

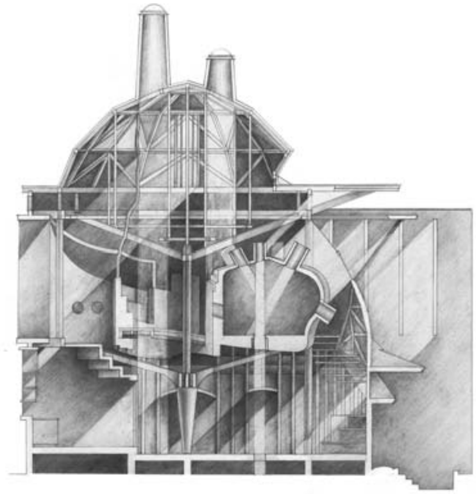
TOPICS: CASTING EDGE, VERTICAL CASTING EDGE, ALTITUDE AND AZIMUTH, SUN RAY TRIANGLE, HORIZONTAL CASTING EDGE, SHADOWS IN PLAN, SHADOWS IN ELEVATION, SHADOWS IN PARALINE

Ching 2009, 164–178.

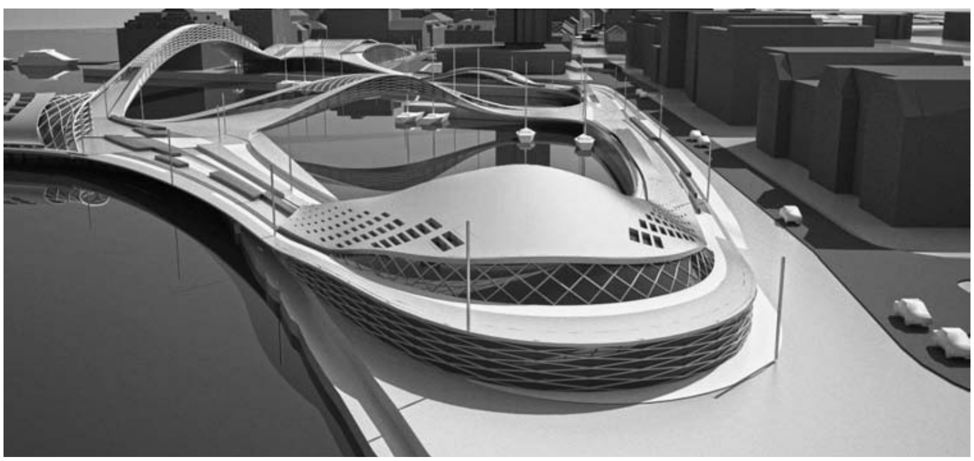
Chapter Overview

After studying this chapter and doing the related exercises in the book's drawing exercises section, you will learn how to cast shadows in plan, in elevation, and in paralines. For continued study, refer to Forseth's *Graphics for Architecture* and Lockard's *Design Drawing.*

Photo: Gateway Center & Plaza
University of Minnesota
Architect: Antoine Predock Architect PC
Courtesy of Timothy Hursley, Photographer



Drawing: House Tenchi
Nagoya, Japan
Medium: H pencil
Courtesy of Takasaki Architects



Drawing: Elastic Urbanism
Bodo, Norway
Medium: Rhino and rendered in VRay
Courtesy of Enrique Limon of LimonLAB

Elastic urbanism is a synthesizing surface that enhances the civic nodes of Bodo's cultural foundation by developing a single surface incorporating program as the main generator, creating a formal urban strategy. A set of axes existing on the macro scale of the site yielded spatial connectivity and placement of the three cultural institutions—a library, theater, and Slooping Museum.
[Architect's statement]

© Winnie T. Leong

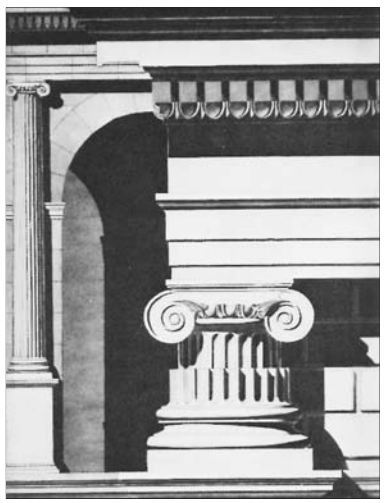
Photo: Great Wall of China near Beijing, China

During the day our shadow is our constant companion, whether or not we are aware of it. There is also constantly shade on those parts of our bodies not in direct light. We perceive shades and shadows on both animate and inanimate objects. From experience, most of us can sense why an object's shadow takes on a certain geometric configuration. However, design professionals must carefully study how light penetrates into interior spaces, as in the Gateway Center and House Tenchi above, and how light produces shades and shadows on all shapes and forms during the design process.

Four terms can appropriately describe our timeless response to and interpretation of shadows: (1) mysterious, (2) vague, (3) dramatic, and (4) dimensional. "Dimensional" refers to a shadow's unique property of delineating form and scale in the urban landscape. During the early periods of architecture, shades and shadows were of utmost importance in providing depth to the facades for front elevations. The added illusion of depth was aesthetically pleasing. It clarified overlapping elements on the facade to the layperson. Knowing how to delineate and draw shades and shadows helps us to better understand spatial concepts in our designs. *Sciagraphy* is the science of shade and shadow graphics and is an indispensable tool for architects, designers, and delineators. Sciagraphy provides a tool for obtaining a finished and realistic appearance to any drawing.

The illustration below left emulates the work of the late professional renderer Hugh Ferriss. It is rendered to give form to a lighting quality that has mystery and drama. The other illustration typifies the meticulous delineation techniques that were instilled by the nineteenth-century École des Beaux Arts. Light, shade, and shadow are purposely articulated to create artificial lighting effects for compositions of classical details. Shadows play an important role in the conceptual design stages of contemporary graphic strategies. Fenestration patterns on conceptual elevations are visually articulated and enhanced by the use of shadows. These studies of the interplay of solids, voids, and inclined planes give a surface modulation to make interrelated parts understandable.

Drawing: Student project by Ed Yeomans
Rudder Tower
18" × 24" (45.7 × 61 cm)
Medium: Charcoal
Courtesy of Texas A&M University
Department of Architecture



Drawing: Student project by Eberhard Lenz
Classical details
18.5" × 25.5" (47 × 64.8 cm)
Medium: Ink wash
Courtesy of Washington University
School of Architecture, St. Louis, Missouri

Drawing: Lotte Super Tower
Seoul, Korea
Medium: Computer-generated
Courtesy of Kohn Pedersen Fox Associates

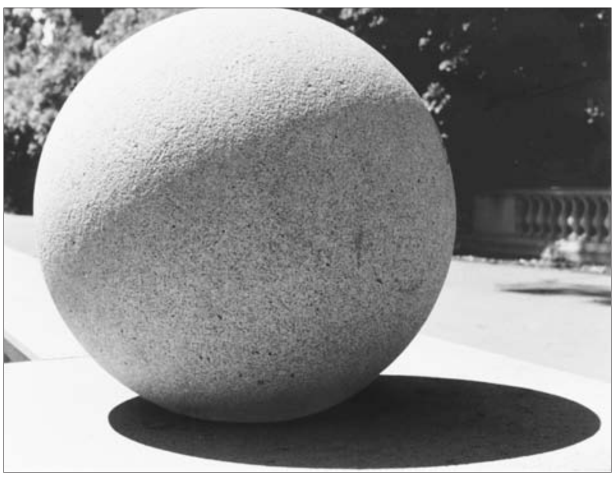
Drawing: United States National Slavery Museum
Fredericksburg, Virginia
Medium: Computer-generated
Courtesy of the Pei Partnership LLP

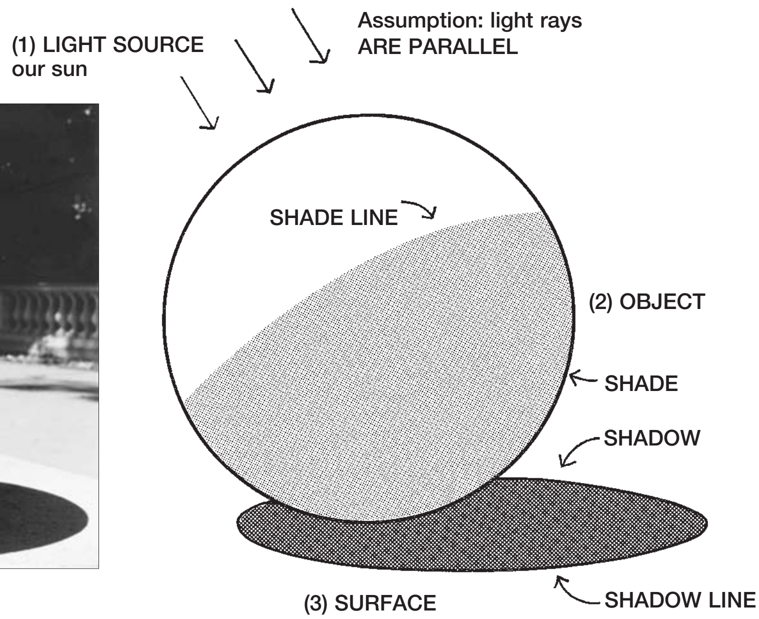
Today, light, shade, and shadow play a vital role not only in designing exterior shapes but also in creating wonderful and exciting interior spaces, as seen in these two examples of a lobby and an atrium space. It is interesting to see in both buildings the shadow patterns of a regular window grid cast onto wall planes that are diametrically opposite to the glass walls (curved glass on straight wall and straight glass on curved walls).

The application of sciagraphy is of great importance to the design professional. Light, shade, and shadow define form and space. A *shadow* indicates the shape of the object casting the shadow and can in many ways indicate the texture of the surface receiving the shadow. When *light rays* are intercepted by an object, the portion of the object on the light side will be illuminated, while the portion opposite the light side will be protected from the light rays. This shielded portion can be defined as *shade.* The boundary line that separates light from shade determines the *shadow line* on a receiving surface. The boundary of the shadow line determines the dark area cast onto the surface on which the object rests and which receives the cast *shadow.* To produce a shadow, three conditions are required:

1. A *light source*
2. An *object* to cast the shadow line, or to intercept the light ray
3. A *surface* to receive the shadow line and shadow

© Rendow Yee





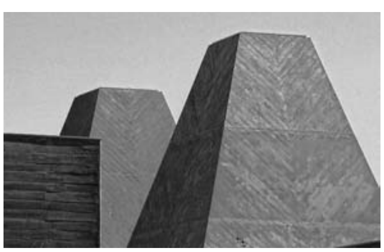


Photo: Paula Rego Museum
Cascais, Portugal
Architect: Eduardo Souto de Moura
Courtesy of Wikipedia

This prismatic roof structure shows a clear demarcation between the lighted side and the shaded side. Rather than the gradual transition seen in a spherical shape, one sees an edge or line as the boundary. Souto de Moura has been praised for his use of natural materials in his buildings.

© Charles Yim

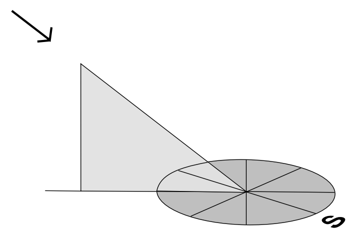
If the light source is behind the observer, one sees very little shade on the object.

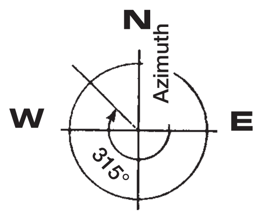
Basic Shadow Concepts

Due to the enormous distance of the earth from the sun, the light rays from the sun are considered to be parallel (in reality, the rays are divergent). This condition can be contrasted with artificial light, which produces radiating rays of light because of the proximity of the light source. The photograph of the spherical solid above shows that humans see shade and shadow at approximately the same value intensity or darkness. When sketching, the gradual transition in tone from shade to light seen in the photo is described as a “soft-edge” area. A sharply defined border such as the edge of the shade area is described as “hard edge.” In architectural drawings, shadow is usually shown darker than shade, regardless of the sketching or rendering medium.

The direction of solar rays is identifed by two angles described as *bearing* and *azimuth.* Both bearing and azimuth are measured only in the plan view. The bearing acute angle of an inclined line is always measured in degrees.

Altitude is the angle between the sun's position in the sky vault and the earth's horizontal plane for a given latitude.





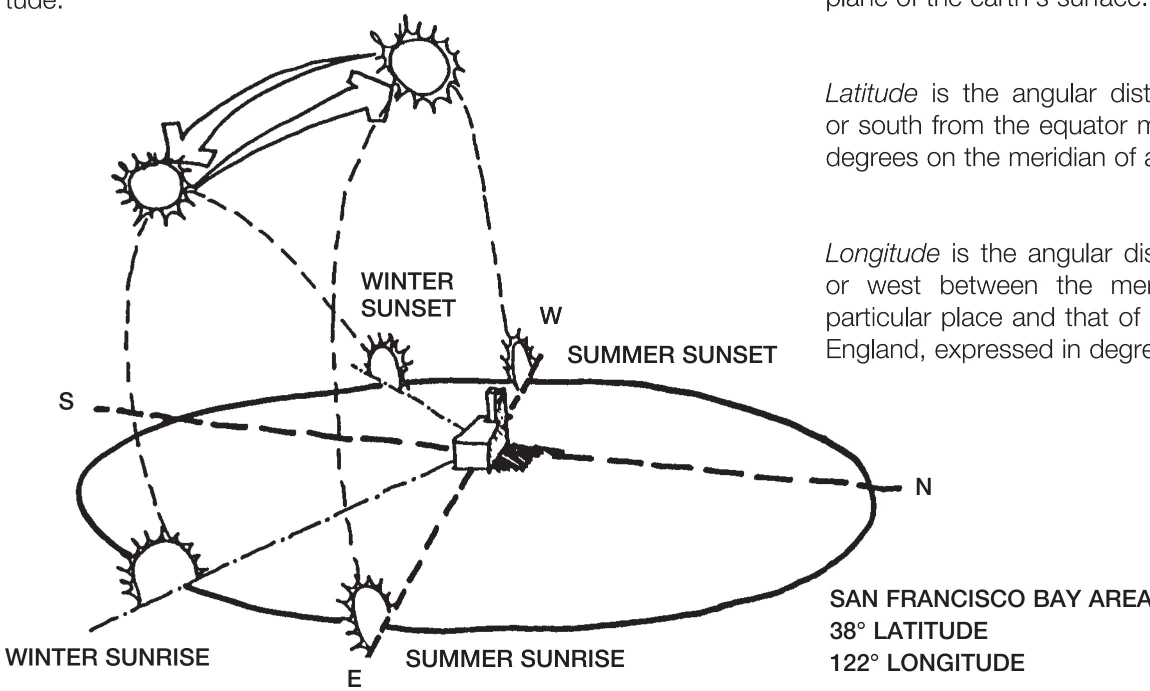
Example
N 45° W is a bearing
or
315° azimuth

Light rays are notated by their *bearing* relative to due north or south, and their *azimuth* is measured clockwise from due north.

Azimuth is the angle between the sun's bearing and a horizontal line that is in a plane perpendicular to the horizontal plane of the earth's surface.

Latitude is the angular distance north or south from the equator measured in degrees on the meridian of a point.

Longitude is the angular distance east or west between the meridian of a particular place and that of Greenwich, England, expressed in degrees.



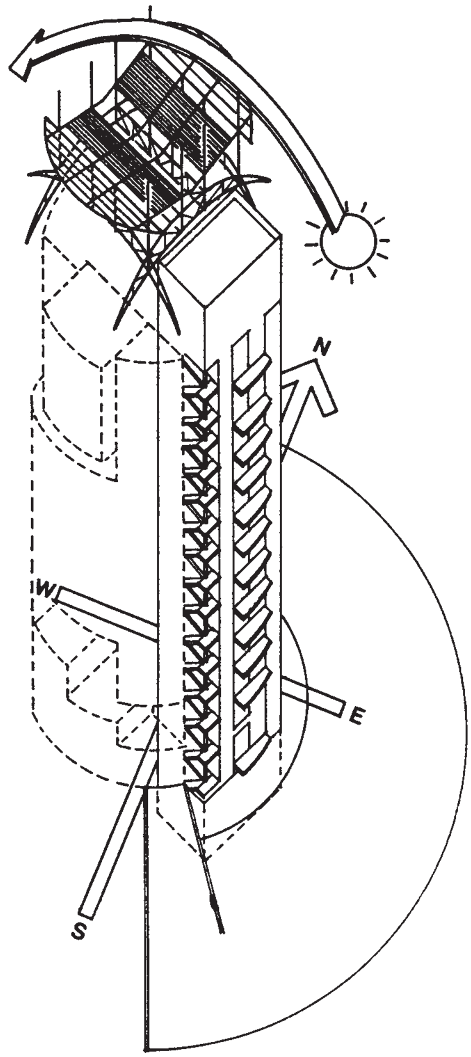
Sun path diagram: Courtesy of Thomas L. Turman, Professor
11" × 8½ " (27.9 × 21.6 cm)
Medium: Ink (freehand)
Laney College Department of Architecture

Solar Angle Diagrams/Definitions

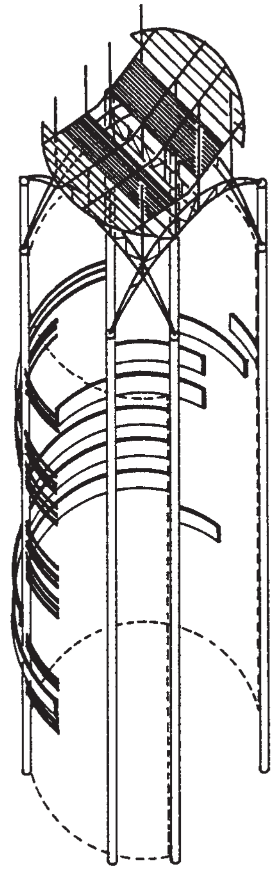
One of the most important factors in architectural design is natural sunlight. How the sun moves across the sky in different geographic locations affects how architects design for each place, because architects are concerned about radiant heat energy and the design of shading devices for buildings.

Solstice is defined as either of the two times a year when the sun is at its greatest distance from the celestial equator. The summer solstice occurs about June 21, and the winter solstice occurs about December 21. In North America, June 21 marks the sun's highest point in the sky and thus the longest solar day, whereas December 21 marks the sun's lowest point in the sky and thus the shortest solar day. A solar day is from 12 o'clock noon to 12 o'clock noon. The simple diagram above is for the San Francisco Bay Area in the United States. Refer to page 559 to see interior lighting effects on June 21 and December 21.

An interesting feature is the filtering effect of the sieve-like building skin, as opposed to having a sealed facade. The orientation of the building dictates the glazing and shading provided by louvers and shades. This allows for reduction or increase in solar gain. Full-height curtain walls are provided for deep garden insets on the north and south sides for protection from the tropical sun path overhead.



ORIENTATION



GLAZING AND SHADING

Drawing: Menara Mesiniaga (IBM Tower)
Selangor, Malaysia
T. R. Hamzah & Yeang, Architects

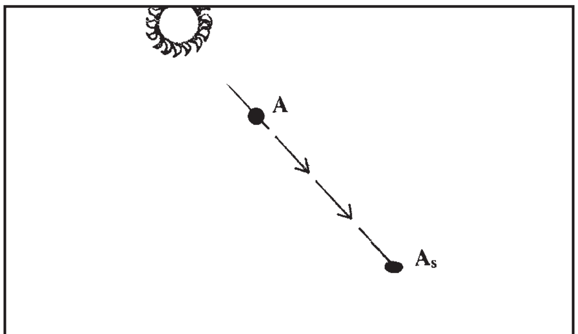
Solar Angle Diagrams

Tall buildings are more exposed to the full impact of the sun and heat than low-rise structures. Office towers throughout the world do not adapt to their local climates; they fight them, using the twentieth century's arsenal of mechanical systems such as air conditioning, artificial light, and heating.
[Architect's statement]

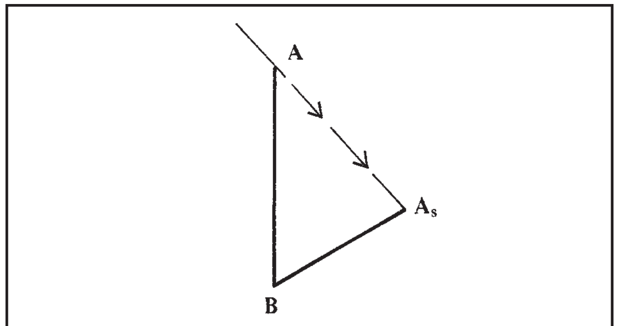
Perspective solar angle diagrams are the most difficult and most complex of all shadow diagrams for the beginner. For this reason, this chapter examines shadow constructions progressively, starting with prismatic forms in orthographic views. It then focuses on common construction situations in elevations, such as overhangs, canopies, colonnades, arcades, stairs, niches, dormers, and inclines. This is followed by a study of paraline shadow constructions.

As an alternative to towering blocks of faceless units, this project explores a radically different social model that integrates landscape and village topologies. This idyllic design brings open green space to a dense urban milieu. The idiosyncratic topology creates a community-oriented social fabric and challenges the prevalent urban social order.
[Architect's statement]

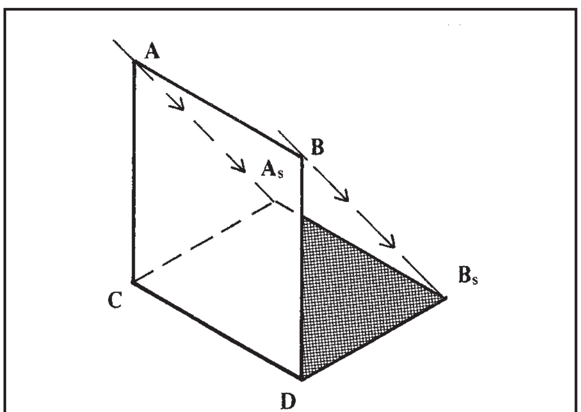
Photos: Madrid Housing
Madrid, Spain
Architect: Morphosis Architects
Courtesy of Nic Lehoux, Photographer



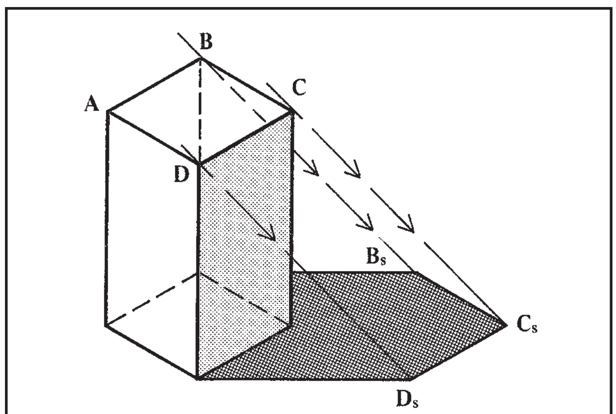
Shadow of a POINT



Shadow of a LINE



Shadow of a PLANE



Shadow of a SOLID

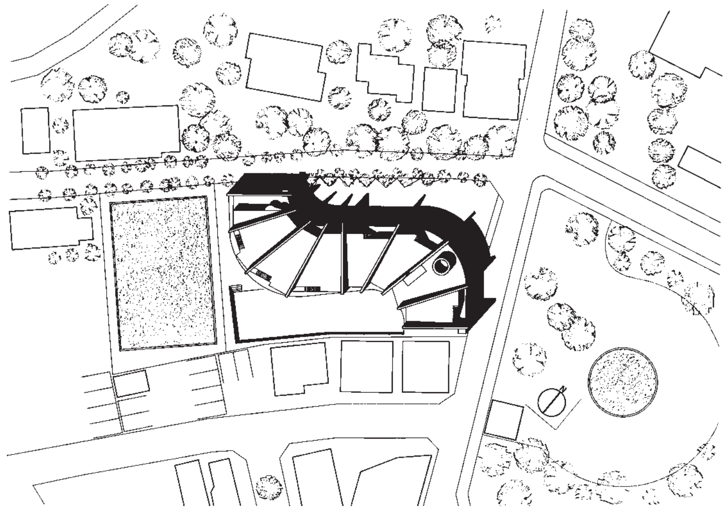
Shadow development can be analyzed by studying shadow progressions from points to lines to planes and finally to solids. Begin by studying point shadows, since a finite series of points will ultimately:

1. Determine shadows of *lines* (lines being composed of points)
2. Determine shadows of *planes* (planes being composed of lines)
3. Determine shadows of *solids* (solids being composed of planes)

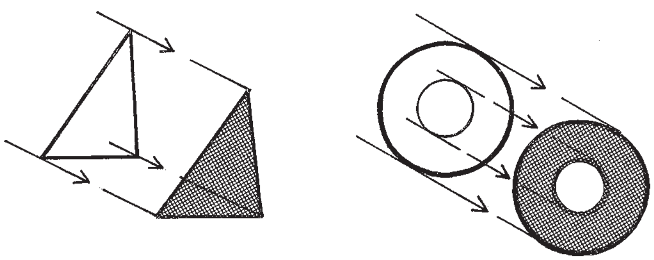
The shadow of a line, a plane, or a solid is most efficiently determined by locating the shadows of the *critical* points of the line, plane, or solid.

Drawing: Site plan of housing at Shakujii Park
Tokyo, Japan
Medium: Ink on Mylar
Courtesy of Shigeru Ban Architects

© Hiroyuki Hirai

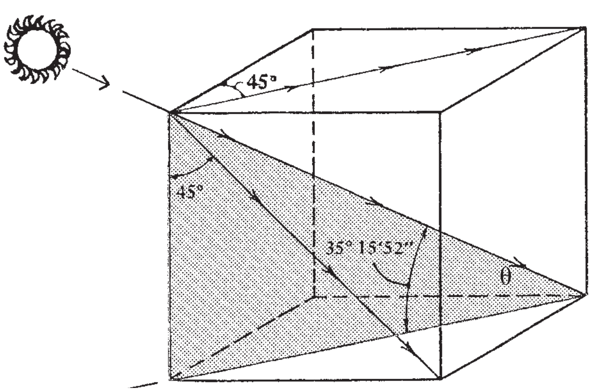


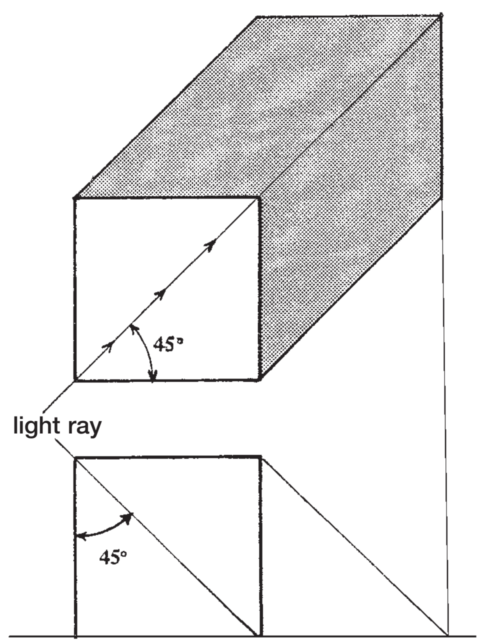
Shadow Principles



The shadow of a plane figure on a parallel plane is identical in size, shape, and orientation to the figure. The more distant the parallel plane (triangle and donut), the more shadow will show.

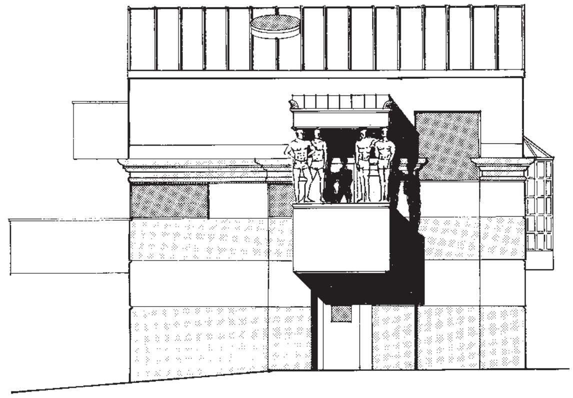
For architectural graphics, a 45° angle light ray direction from the left in plan and in elevation is conventionally used. In cubic form this can be represented by the diagonal of a cube with a slope of 35°15’52” (θ). Also commonly used is a 45° angle light ray direction from the right. Note that the *slope* angle of the light ray is the inclination relative to the horizontal plane.

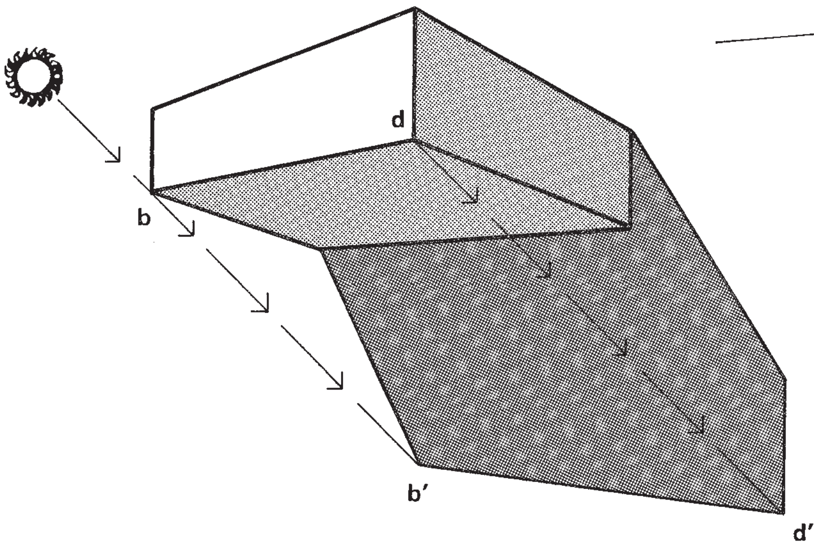




Drawing: Erectheum house, San Francisco, California
12" × 20" (30.5 × 50.8 cm), Scale: ¼" = 1'0"
Media: Pencil, Prismacolor, pastel, Zipatone
Courtesy of Kotas/Pantaleoni, Architects
Jeremy Kotas

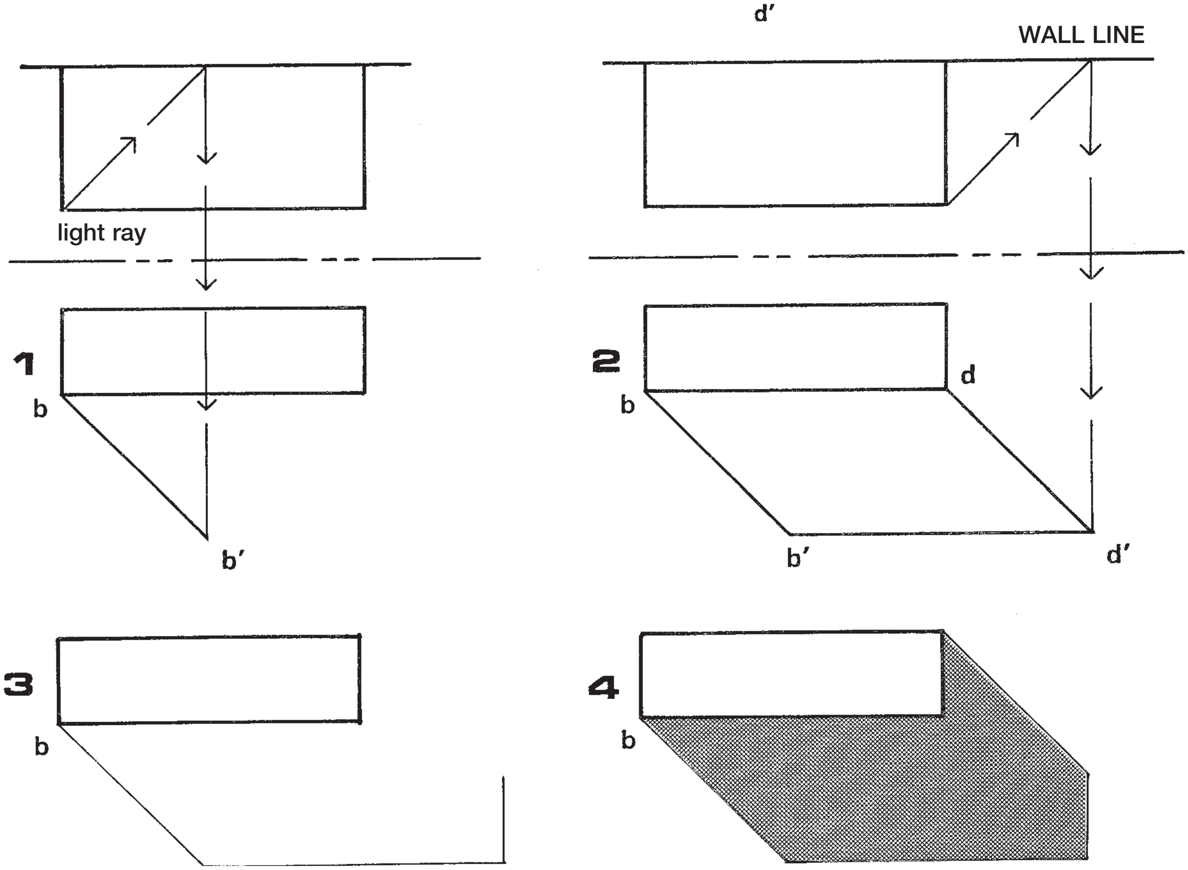
This building is essentially a simple box punctuated by traditional balcony and bay window projections. The treatments of both the balcony support and the multiple divided lights of the bay window are often used in conjunction with the introduction of color banding on the surface of the box.



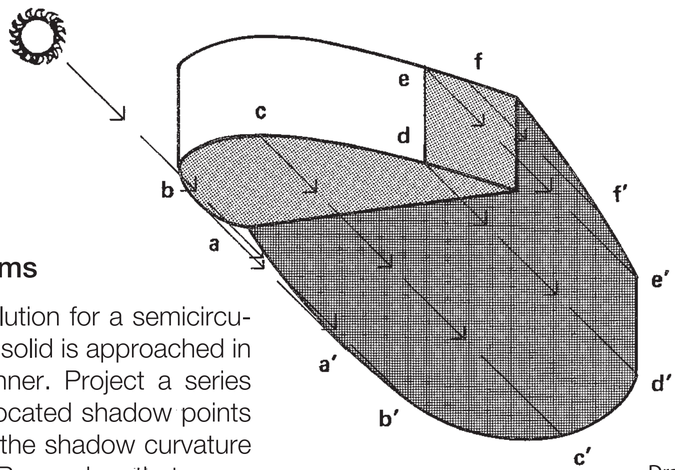


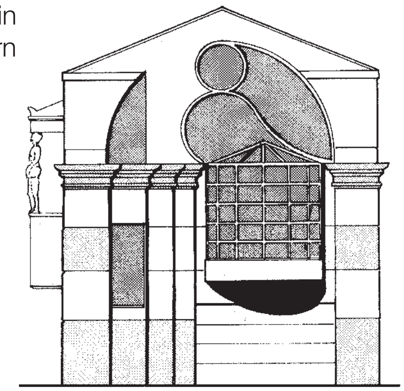
Rectilinear Forms

The perspective diagram is related to—and the corresponding letters keyed to—the step-by-step orthographic sequence shown below. The top or horizontal view determines where the light ray hits the wall; this location is then transferred to the front or frontal view.



This postmodern design strategy has been employed in the past to give scale to the formal severity of a modern building very much demanded by the human psyche.



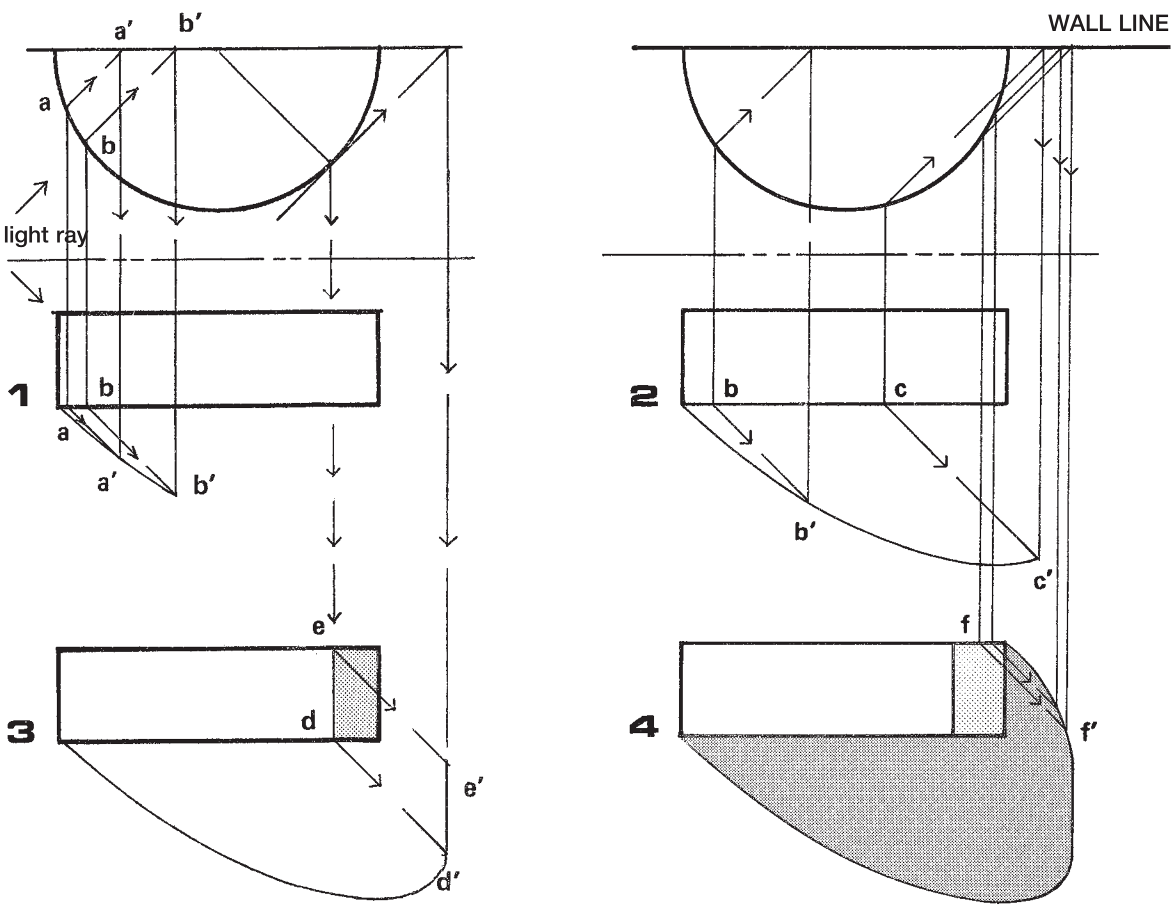


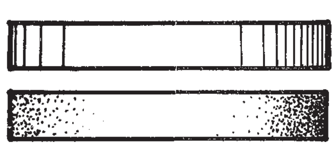
This protruding bay window casts a *curvilinear* shadow on a flat surface.

Drawing: Erectheum house, San Francisco, California
12" × 20" (30.5 × 50.8 cm), Scale: ¼" = 1'0"
Media: Pencil, Prismacolor, pastel, Zipatone
Courtesy of Kotas/Pantaleoni, Architects
Jeremy Kotas

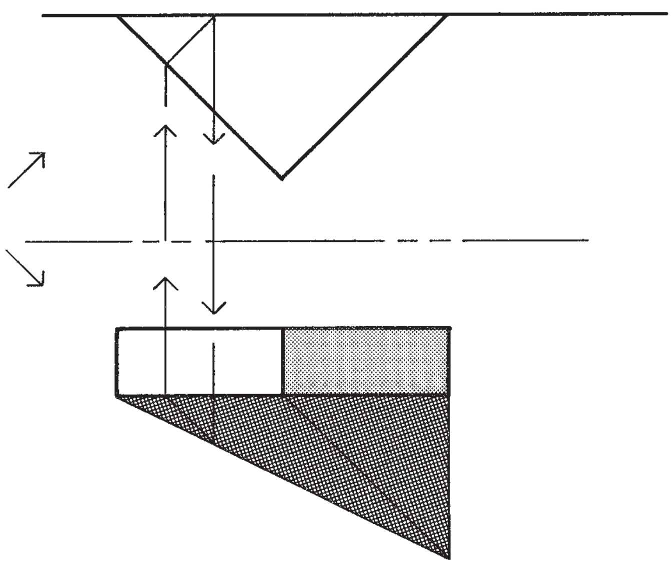
Curved Forms

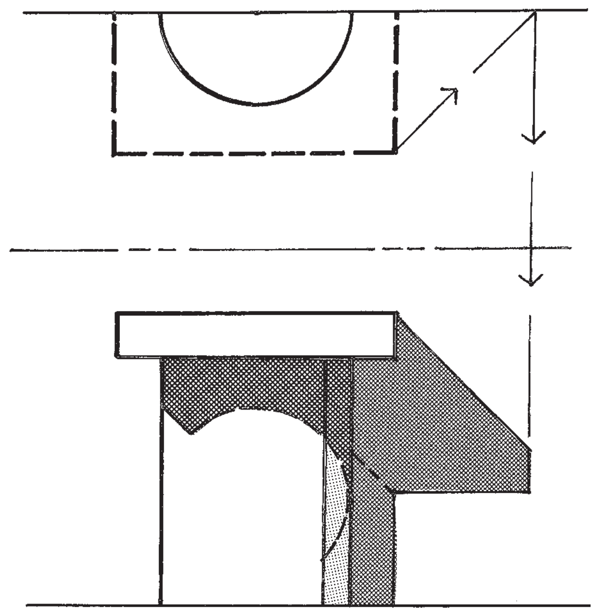
Shadow resolution for a semicircular curvilinear solid is approached in a similar manner. Project a series of arbitrarily located shadow points to determine the shadow curvature on the wall. Remember that every point on the line that separates light from shade (*shade line*) will cast a shadow point on the *shadow line.*





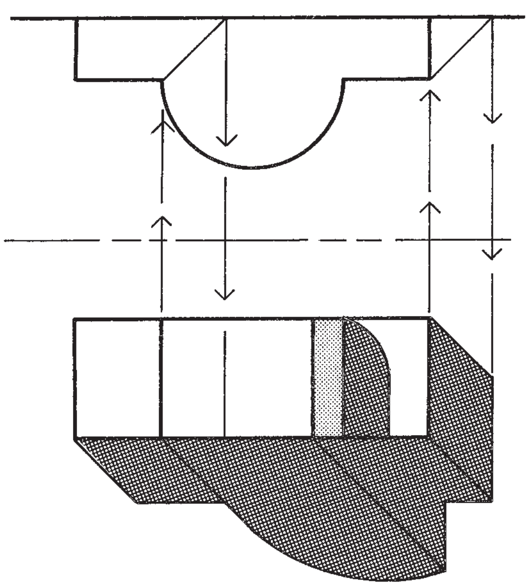
A cylindrical or curvilinear surface always appears flat in the front elevation. Use a series of unequally spaced fine lines or increasing dot density instead of a uniform shade density to create a feeling of depth.

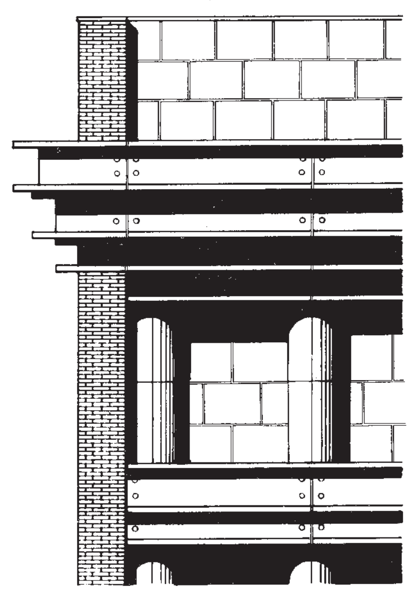




Elevation View Shadows

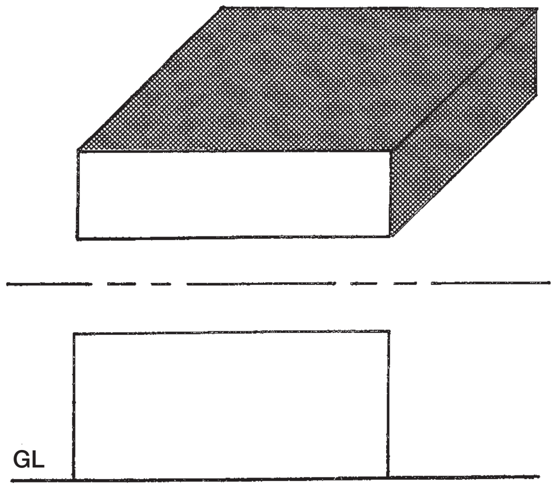
The study of wall condition shadows for various geometric forms, such as the previously described rectilinear and curvilinear forms and the variety shown on this page, provides the necessary framework for the analogous situations encountered in site plan and roof plan shadows. This analogy becomes apparent by turning any wall condition drawing upside down: the "wall line" then becomes the "ground line," and the "wall object" becomes the object seen in the plan view.

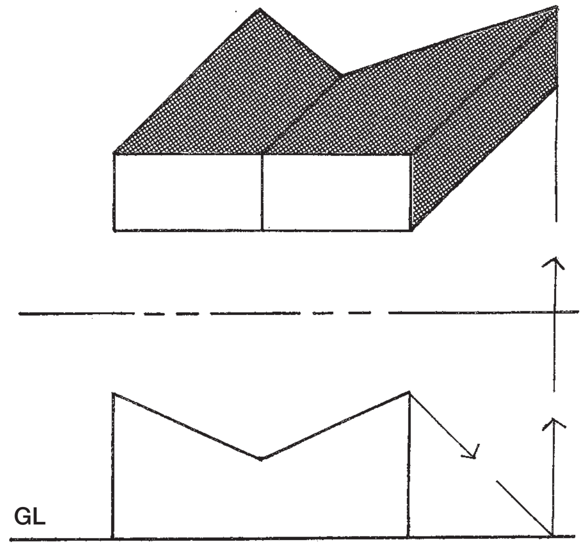




Aldo Rossi designed this 1989 postmodern building to show a reinterpretation of classical orders with the use of strongly expressed steel lintels that cast sharp, crisp shadows on the brick masonry facade. The striking cedar-red facade is windowless and accented by its pink marble columns.

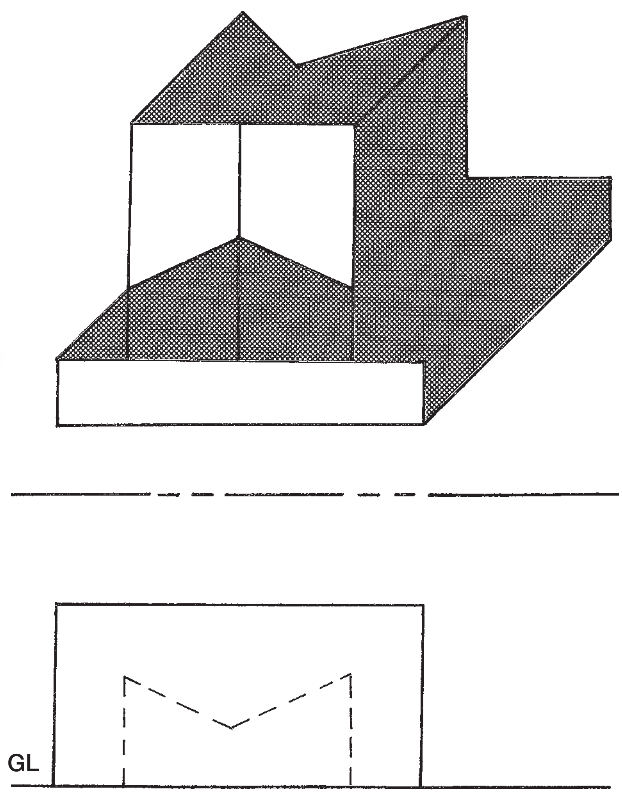
Partial elevation: Hotel Il Palazzo
Fukuoka, Japan
18" × 24" (45.7 × 61 cm), Scale: 1:50 m
Medium: Black ink on Mylar
Courtesy of Aldo Rossi, Studio di Architettura
New York, Architect

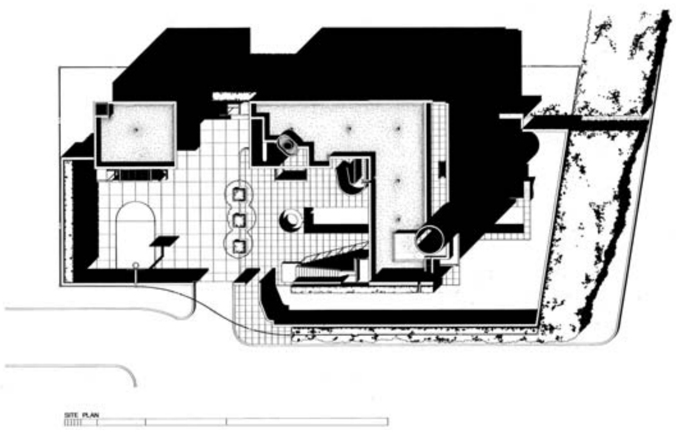




Plan View Shadows

These drawings illustrate the analogy between wall elevation shadows and site/roof plan shadows. The height of the solid forms above the “ground line” determines the length of the shadow cast in the plan view. Note that by simply turning the drawing upside down and switching the plan and elevation views, wall elevation conditions result.



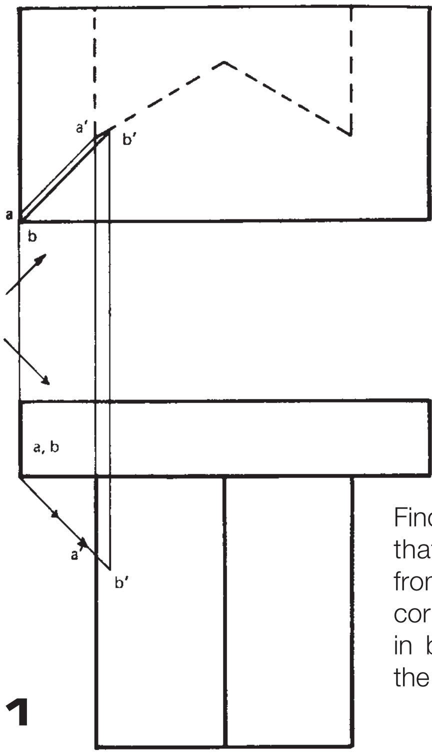


© Anthony Ames, Architect

Drawing: House in Delray Beach
Delray Beach, Florida
Medium: Ink on vellum
Courtesy of Anthony Ames, Architect

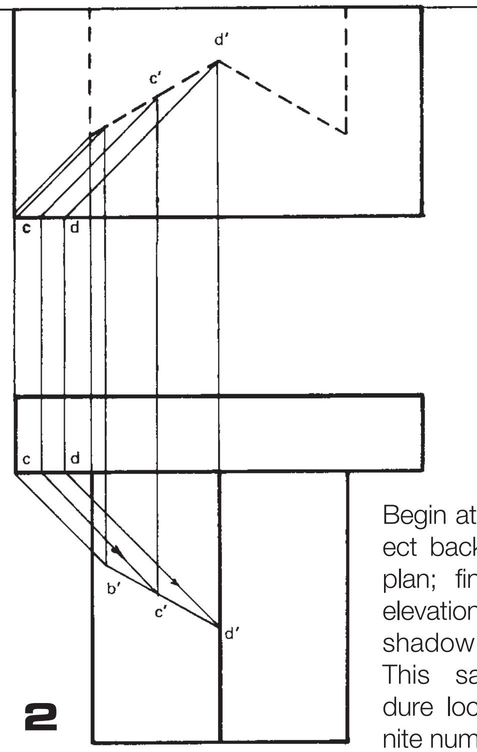
The House in Delray Beach is a volume containing the major formal spaces raised on pilotis over a lap pool addressing the road and the view to the Atlantic Ocean beyond. [ARCHITECT’S STATEMENT]

Singular Forms Combined



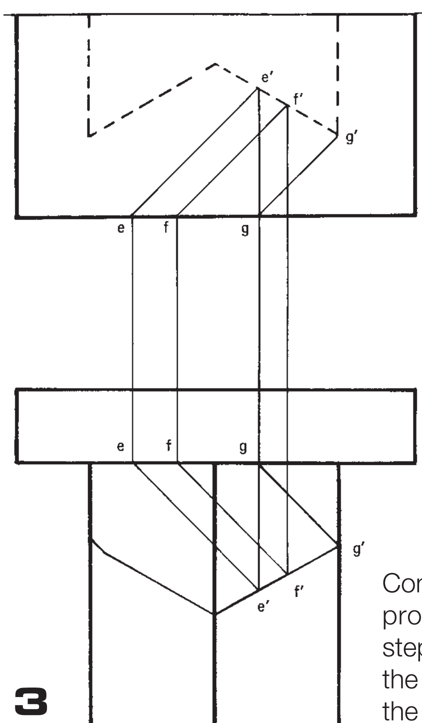
Find the line or lines that separate light from shade. Project corresponding points in both the plan and the elevation.

1



2

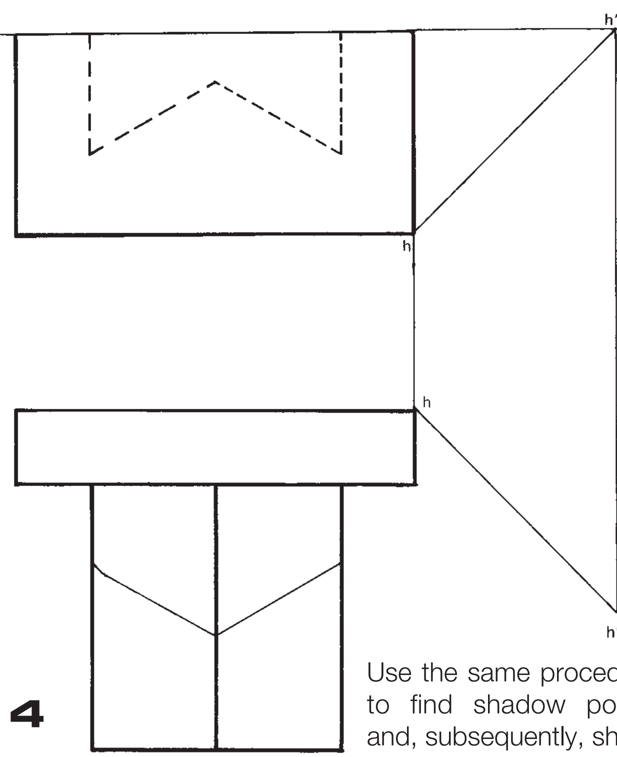
Begin at **d’** and project back up to **d** in plan; find **d** in the elevation and locate shadow point **d’**. This same procedure locates an infinite number of points between **b’** and **d’**. A straight line results.



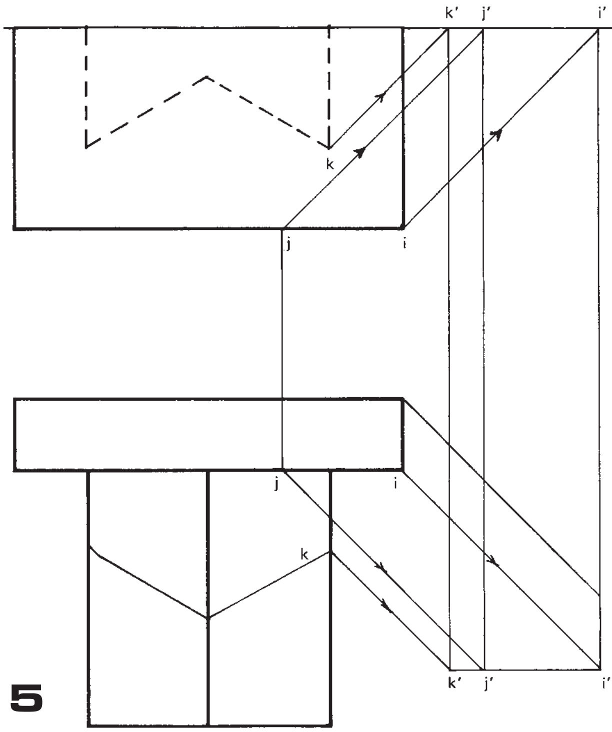
Continue the same procedure as in step **2** and locate the shadow line on the remainder of the object.

3

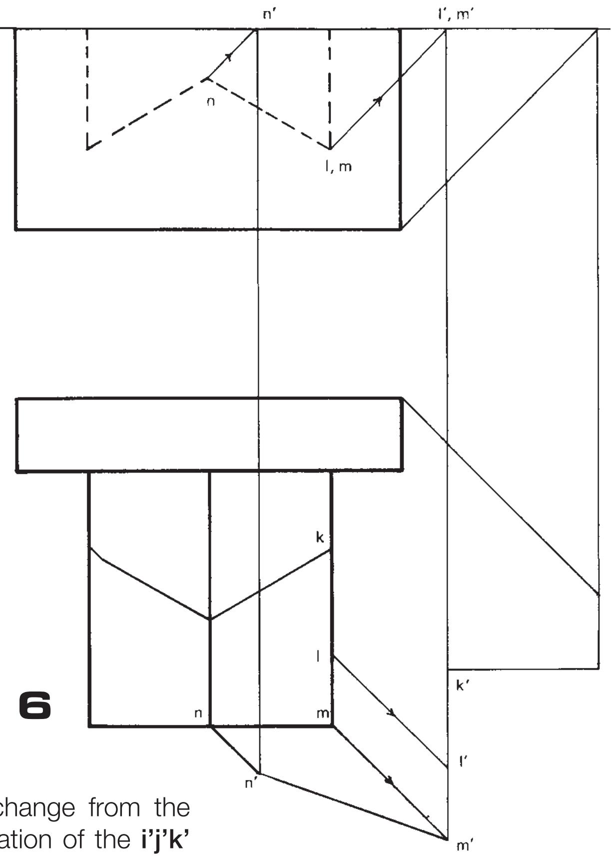
4



Use the same procedure to find shadow points and, subsequently, shadow lines on the wall.

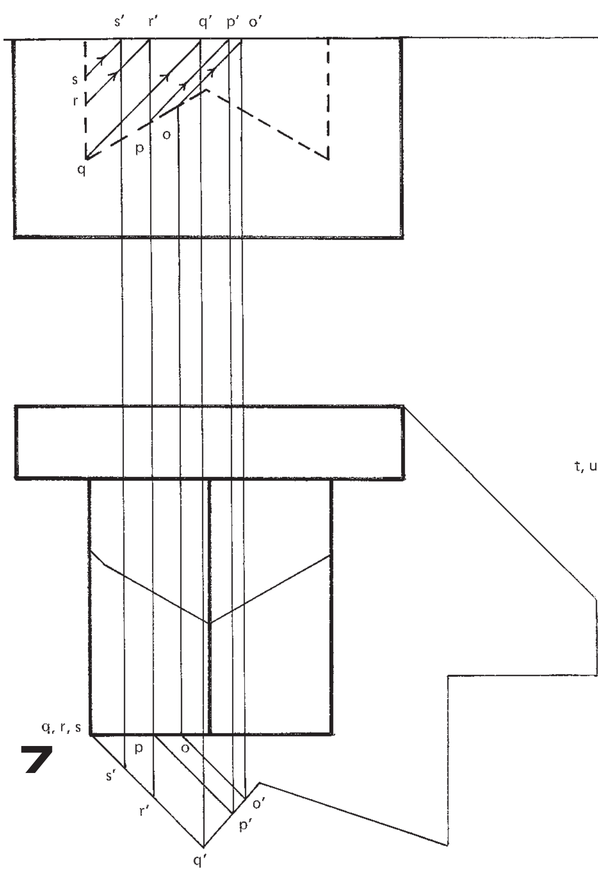


5

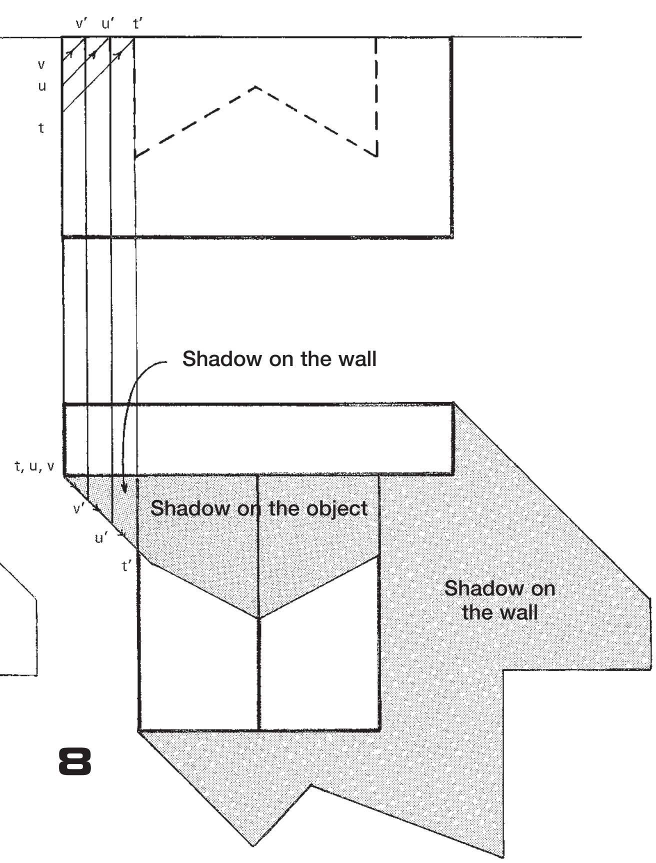


6

Continue the same procedure. Note the sudden change from the light/shade separation lines **ij** and **klm**. The continuation of the **i'j'k'** shadow line in the horizontal direction is covered by the shadow cast by the bottom part of the object (defined by **k'l'm'n'**).

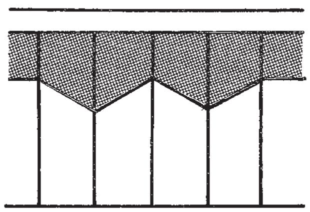


7

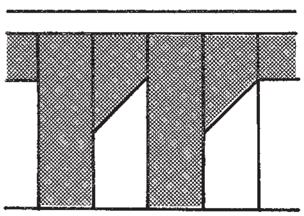


8

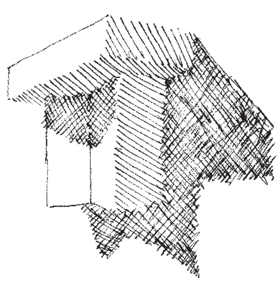
wall treatments

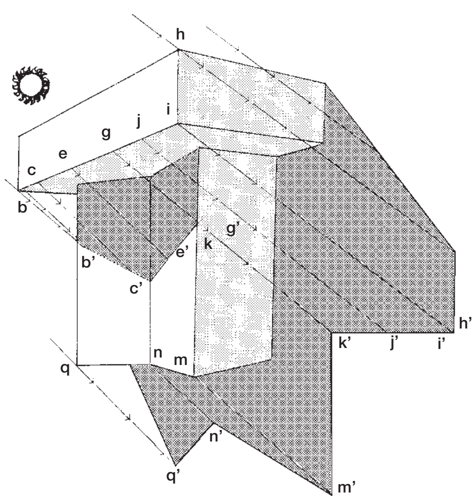


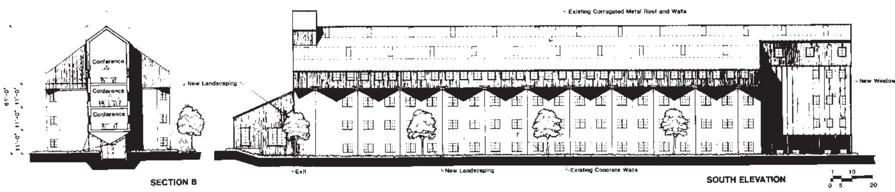
30° zigzag



45° zigzag

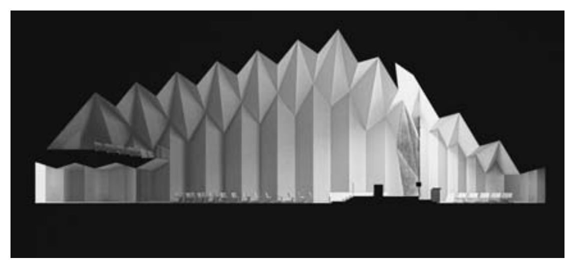






Drawing: Old Town Granary Motel
Irvine, California
Medium: Ink
Courtesy of Thirtieth Street Architects, Inc.

Drawings: Our Lady of the Assumption Parish Church
Port Coquitlam, British Columbia, Canada
Media: Maxwell Render, Google SketchUp
Rendered by LUXIGON
Courtesy of Patkau Architects



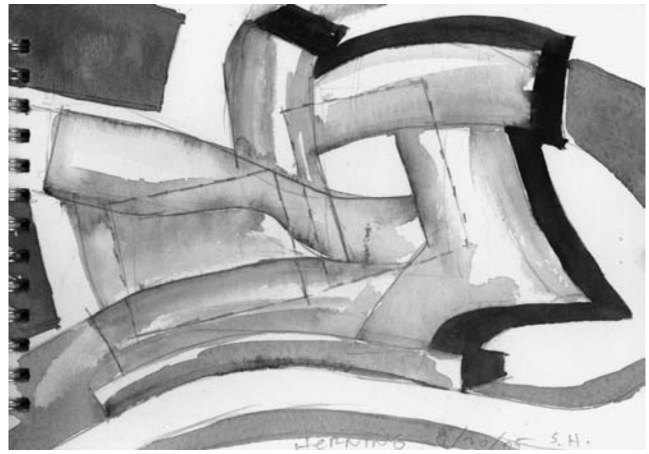
This church shows a complex beautiful structural variation on the standard zigzag pattern in the motel above.

The folded geometry enlivens the exterior and interior, evoking the depth and rhythm of a traditional arcaded and columnar nave. Interior volumes are low at both church and chapel entrances. The volume rises slowly, releasing space into light over the sanctuary. Light from the skylight over the sanctuary gives way to shadows and dimness as it models the interior to reveal the order, space, and form of the church.
[ARCHITECT'S STATEMENT]

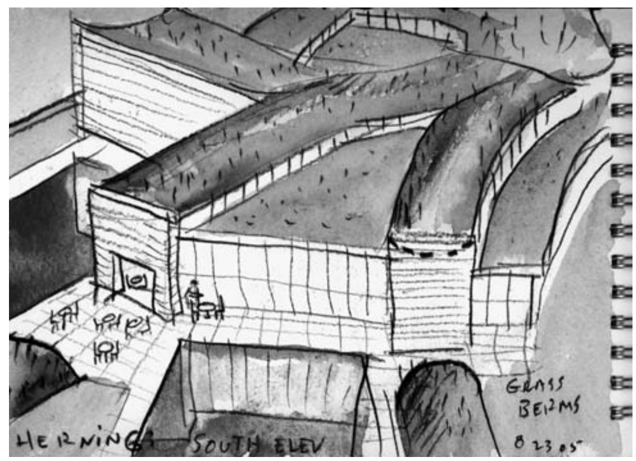
Visualizing Shadows/Zigzag Shadows

To visualize problems with shades and shadows, quickly sketch the object in a three-dimensional perspective setting. It may take many such preliminary sketches to resolve a problem with shadows. The sequential drawings on the previous pages can be more easily understood with the aid of a typical sketch (above left) and verified by point analysis. Labeling corresponding points in a perspective diagram will enhance your understanding of any shadow configuration.


© Iwan Baan

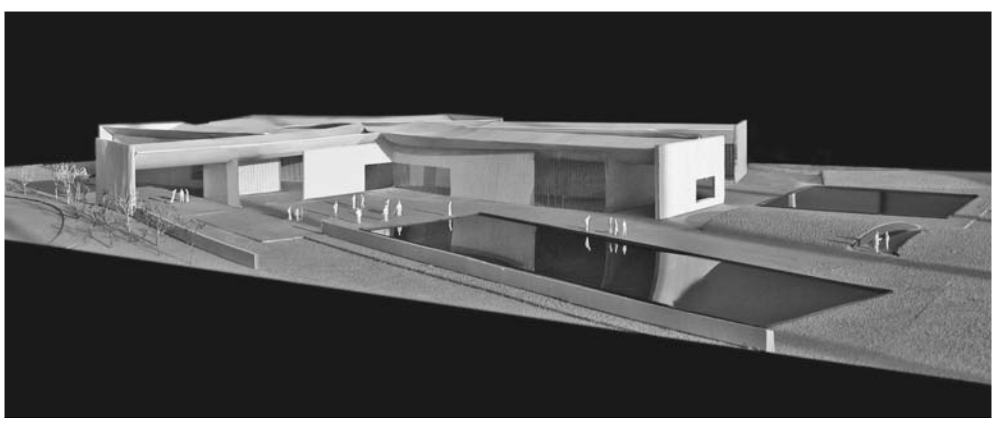

Concept Sketch


© Iwan Baan



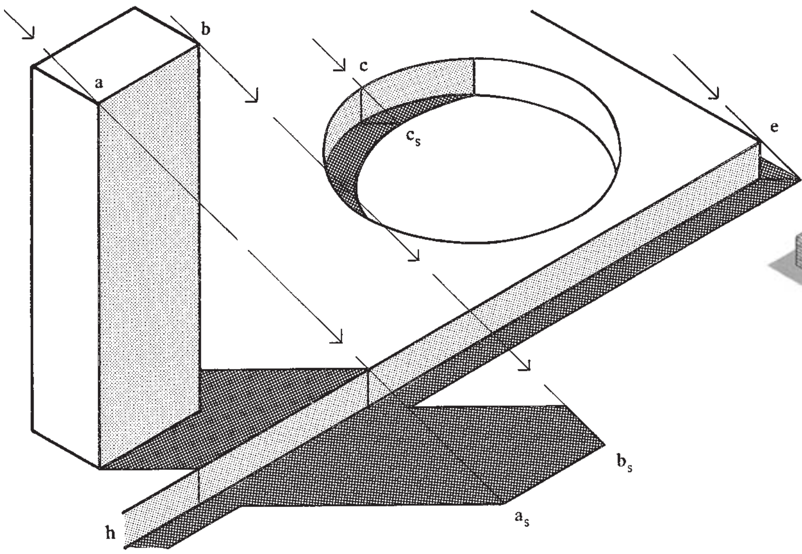
Sketch Exterior View

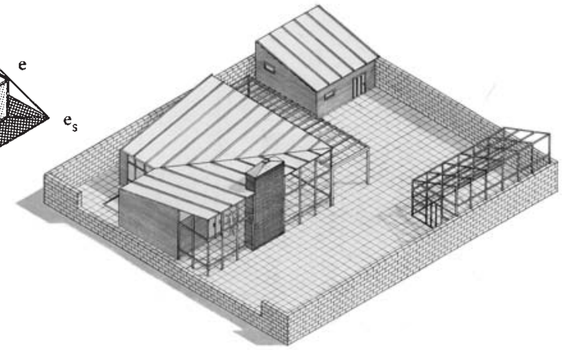
Images: Herning Museum of Contemporary Art Herning, Denmark
Medium: Sketches—watercolor
Courtesy of Steven Holl, Architect


View from southwest

Architect Steven Holl, like Santiago Calatrava, works with watercolor as the medium for his conceptual sketches. The building consists of a few subtly differentiated curved volumes within a larger organic footprint. These volumes express themselves linearly in three dimensions. Holl uses light watercolor washes very effectively to show the volumetric strips in the roof plan sketch. The companion perspective drawing and the study model take the concept to a more developed rendition. See more of Holl's watercolor sketches in Web site Chapter 10.

45° light ray condition: Paraline conditions exhibit light rays parallel to the picture plane.



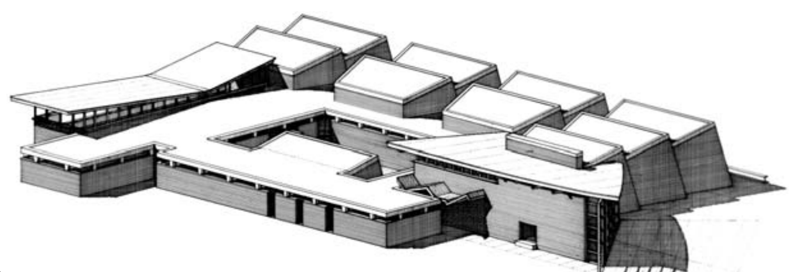


Drawing: Student project by Kate Rodgers
Medium: Graphic pencil
Courtesy of Professor Jon Thompson
College of Architecture
University of Texas at San Antonio

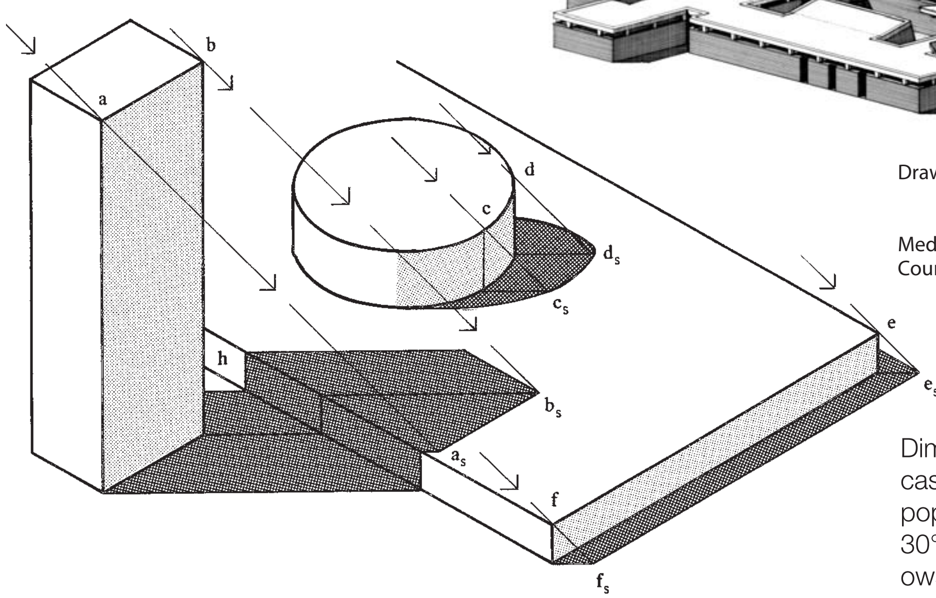
Isometric Paraline Shadows

Critical paraline shadow points are determined by constructing triangular planes parallel to the picture plane. A vertical drop or rise (**h**) in the horizontal surface connects paraline shadows on different horizontal surfaces. A drop in a horizontal receiving surface always results in a longer shadow. A rise in a horizontal receiving surface always results in a shorter shadow.

Paraline shadows of cylindrical forms can be determined by finding and plotting a series of arbitrary points (**c** and **d**) on the light/shade boundary.

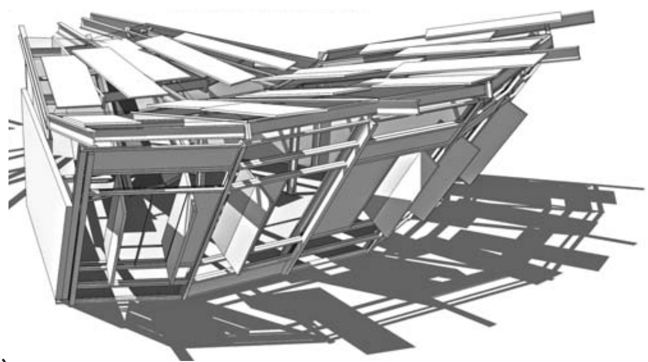


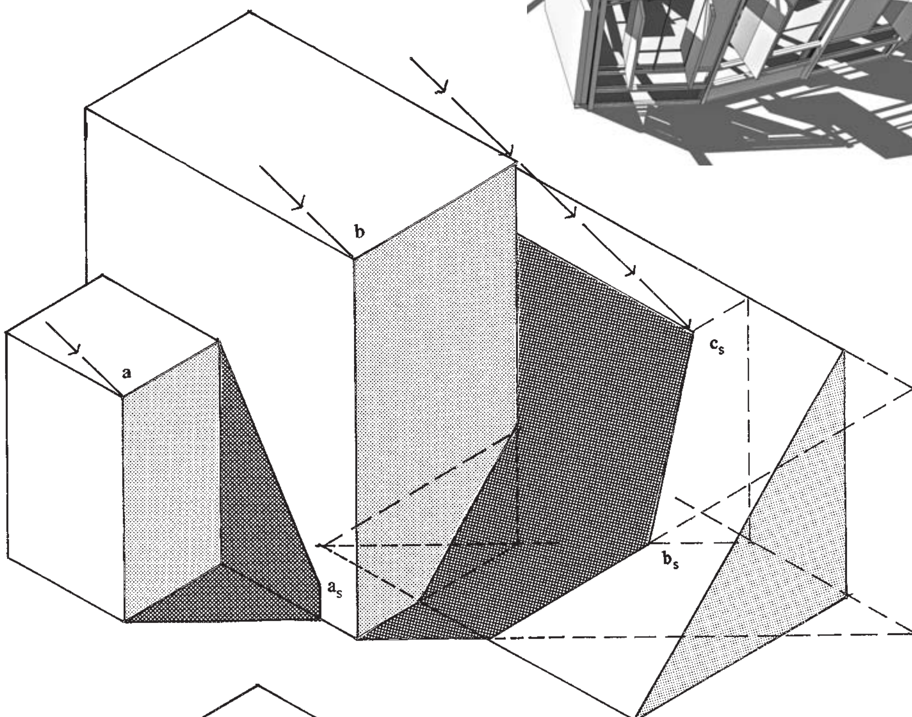
Drawing: Brandeis University
Additions to the Fine Arts Building
Waltham, Massachusetts
Medium: Ink on vellum
Courtesy of Brian Healy Architects

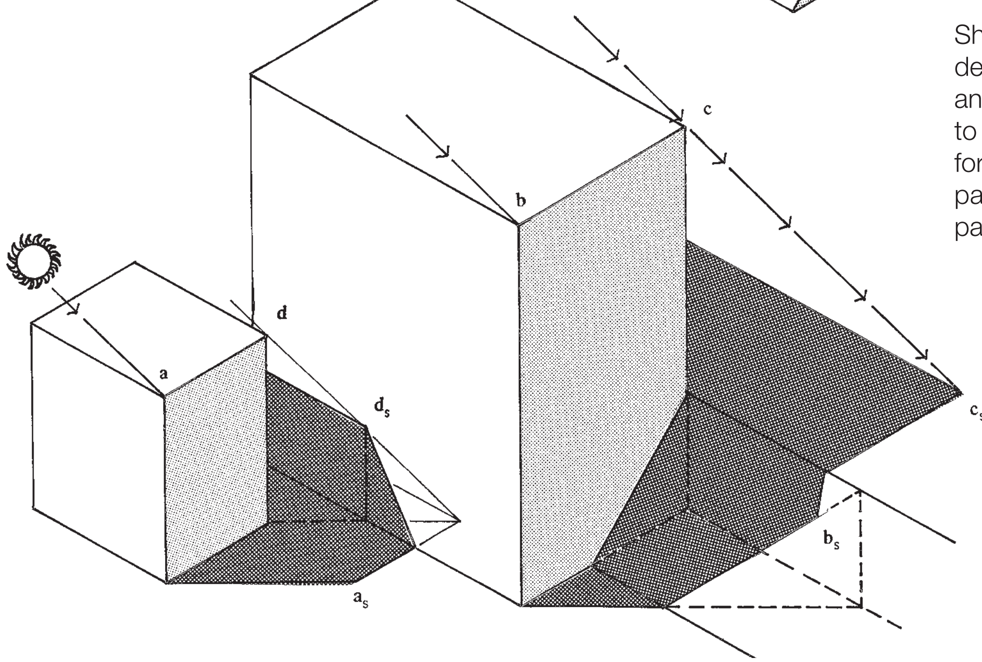


Dimetric paraline shadows were cast at a 15°–15° angle in this popular variation to the standard 30°–30° isometric paraline shadows. Note the different tilt to the ground plane.

Drawing: Chicago Music Pavilion
Medium: Google SketchUp
Courtesy of student Damian Rozkuszka
College of DuPage
Department of Architecture

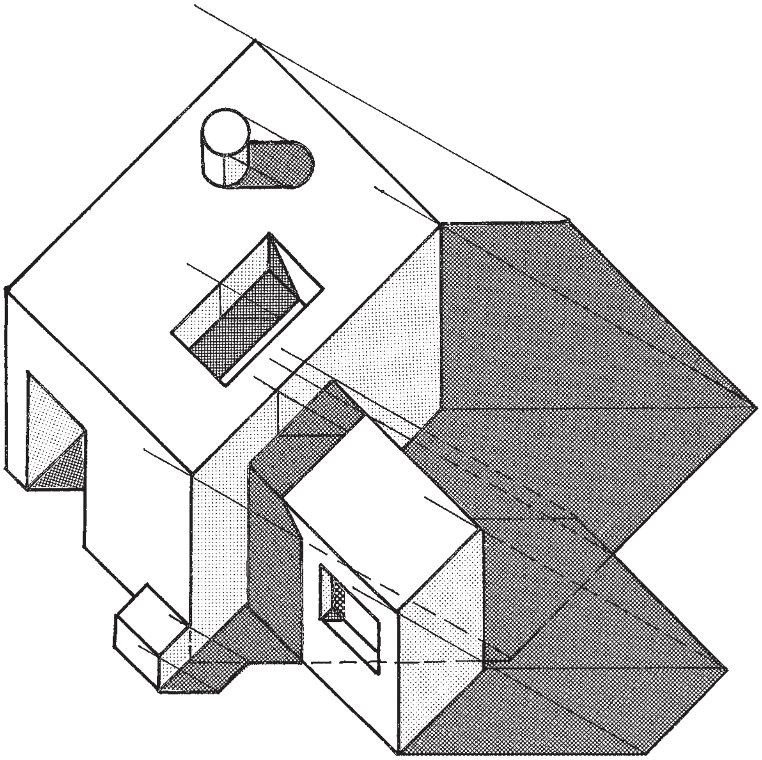


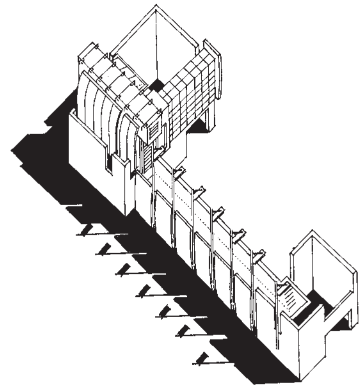


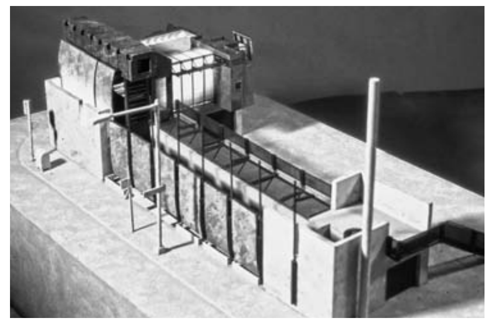


Shadow points $\mathbf{b_s}$ and $\mathbf{c_s}$ are determined by the use of triangular slices that are parallel to the picture plane. Note that for the 45° light ray condition, paralines exhibit light rays parallel to the picture plane.

To determine the shadow on the vertical wall above, cast a shadow on the ground as if there were no wall. Next, project horizontal and vertical trace lines until they intersect the light-bearing rays. In your design-drawing projects, always weigh alternative methods for displaying shadows. For example, a bird's-eye perspective view (top right) is similar to an isometric view, but the shadows cast may lend a different feeling to your design.



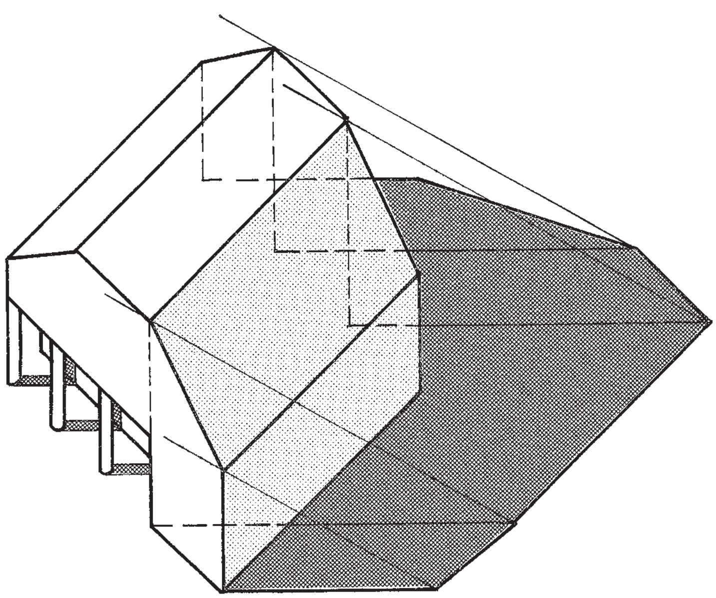


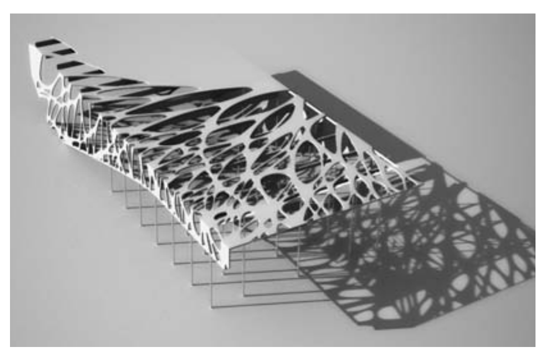


Drawing and model photo: Private studio
Venice, California
18" × 24" (45.7 × 61 cm), Scale: ⅛" = 1'0"
Medium: Ink on velium
Courtesy of William Adams Architects

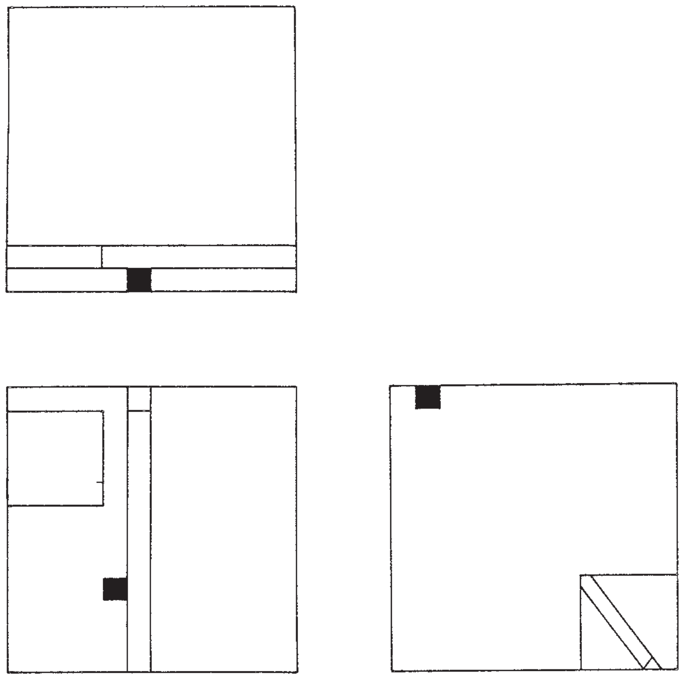
Plan Oblique Paraline Shadows

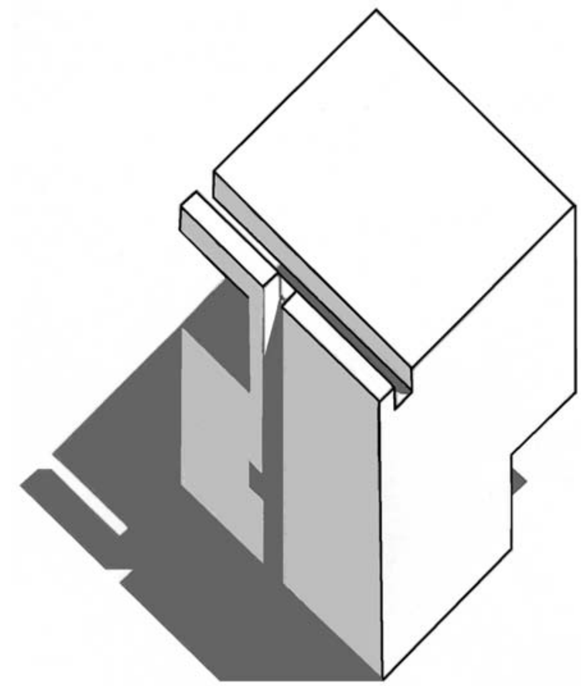
These plan oblique (45°–45°) drawings exhibit shadows cast from light rays that are parallel to the picture plane. Critical shadow points on the ground are determined by the intersection of sloping light rays from a casting edge (height or altitude) and the bearing line on the ground. In the above example, the small building elements intercept the light rays cast by vertical and horizontal casting edges of the large building element. This results in a shadow line that climbs across the small element. The bird's-eye perspective (below right) shows shadows cast that approximate paraline conditions.





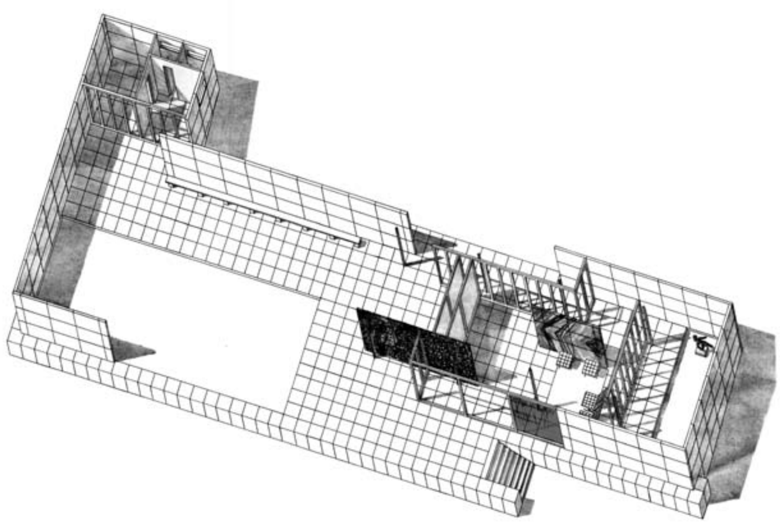
Drawing: CANOPY: Competition for the new auditorium and movie theater (VTHR)
Saint Cyprien, France
Medium: 3-D graphic software
Courtesy of Serero Architects



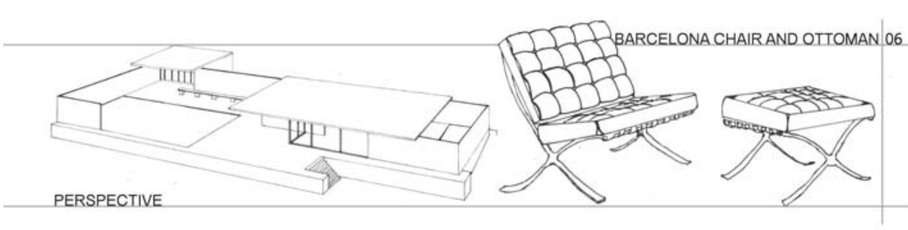


Drawing: Student project by Andrew Von Mauer
Solid-void relationship investigation
17" × 11" (43.2 × 27.9 cm), Scale: Full-size after model
Medium: Ink on Mylar
Courtesy of Andrews University, Division of Architecture, first-year Graphics Studio

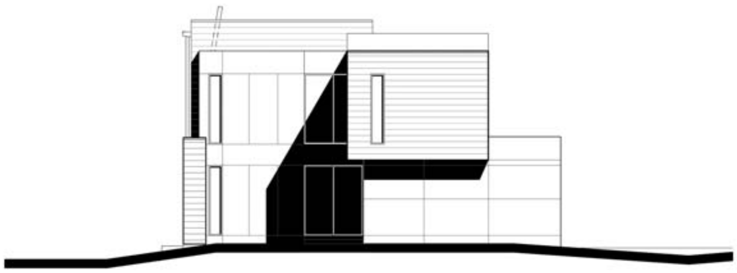
These two plan obliques are drawn at different axes angles, but the nice use of paraline shadows helps to clearly define the object above and the building below. Always chose a shadow direction that will help to articulate the volume.



The Barcelona Pavilion (ca. 1929) and Barcelona Chair were masterpieces of the modern movement in architecture (see also p. 369). Current proponents of this type of minimalist architecture are Fumihiko Maki and SANAA.



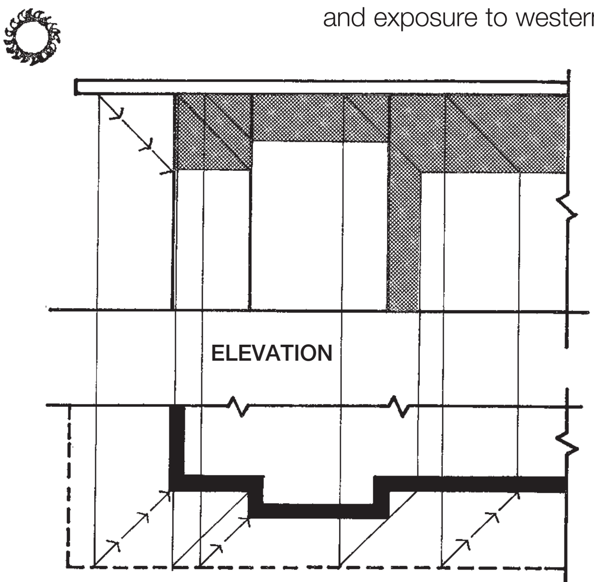
Drawings: Barcelona Pavilion
Barcelona, Spain
Media: Ink and pencil on vellum
Architect: Ludwig Mies Van der Rohe
Courtesy of student Geunho Song
College of DuPage
Department of Architecture



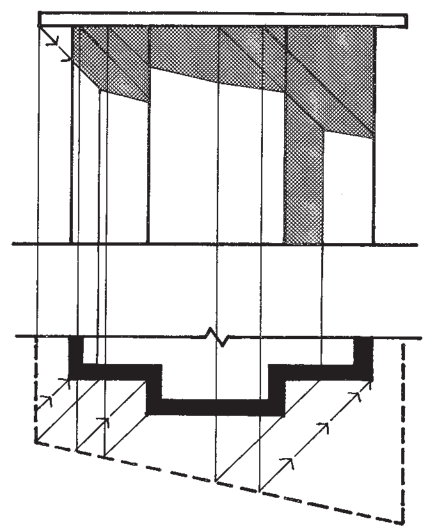
East elevation

Drawing: Optic House (see page 364)
Bennington, Nebraska
Medium: Adobe Illustrator and AutoCAD
Courtesy of Randy Brown Architect

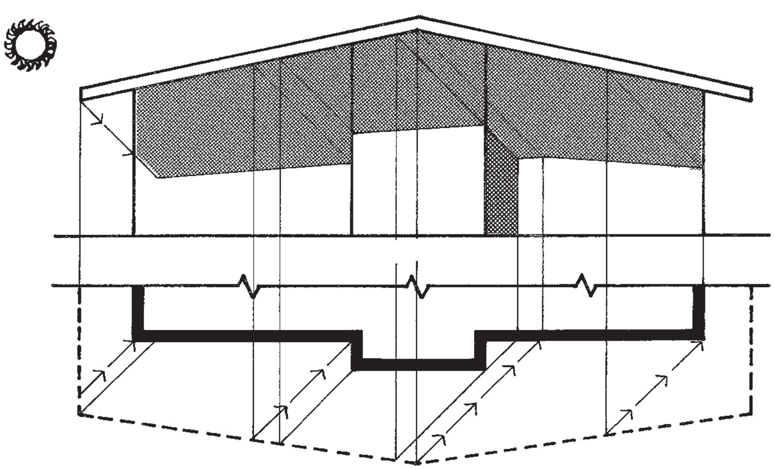
This house was designed to be a viewing device toward a beautiful lake and its surrounding environment. The client, an eyeware designer, wanted to have a solution that used the tectonic language of folding, framing, and transparency. The design had to balance the creation of breathtaking views against lake glare and exposure to western sunlight.



Flat overhang parallel to wall



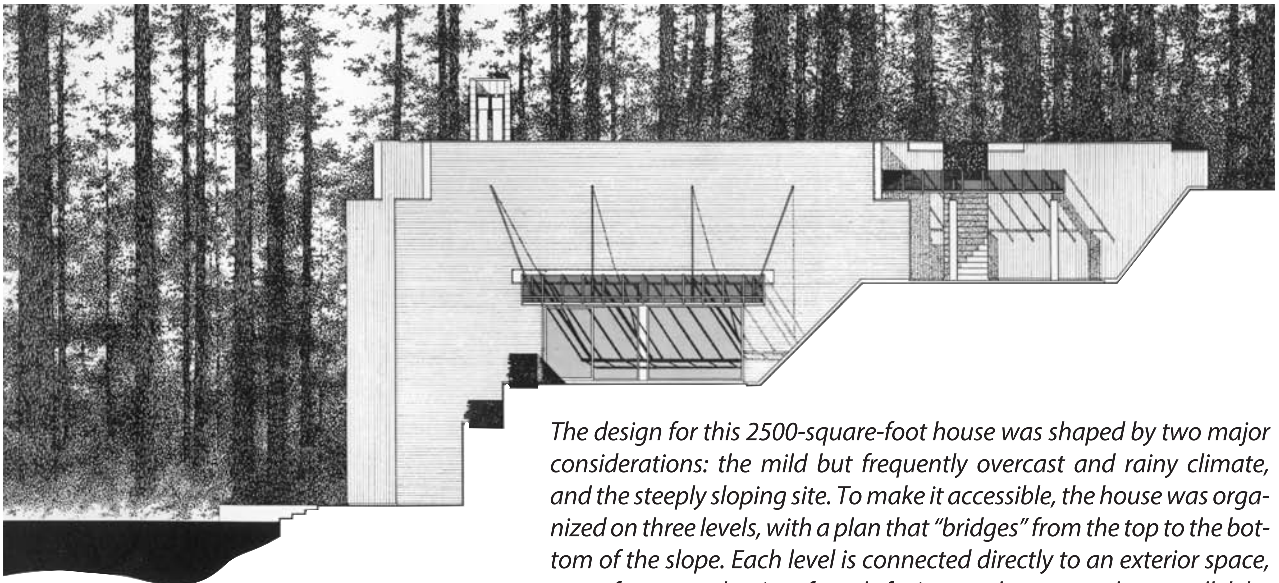
Flat overhang oblique to wall



Inclined overhang oblique to wall

Solid Overhang Shadows

It is common to encounter buildings that have either flat or inclined solid overhangs. The edge casting the shadow line on the vertical wall can be either parallel or oblique to the wall. The previously explained shadow-casting principles for objects on a vertical wall also apply to overhangs. Use the plan view to transfer critical points into the elevation. As the angle of the light ray with respect to the ground line becomes steeper, the length of the resulting shadow will become longer.

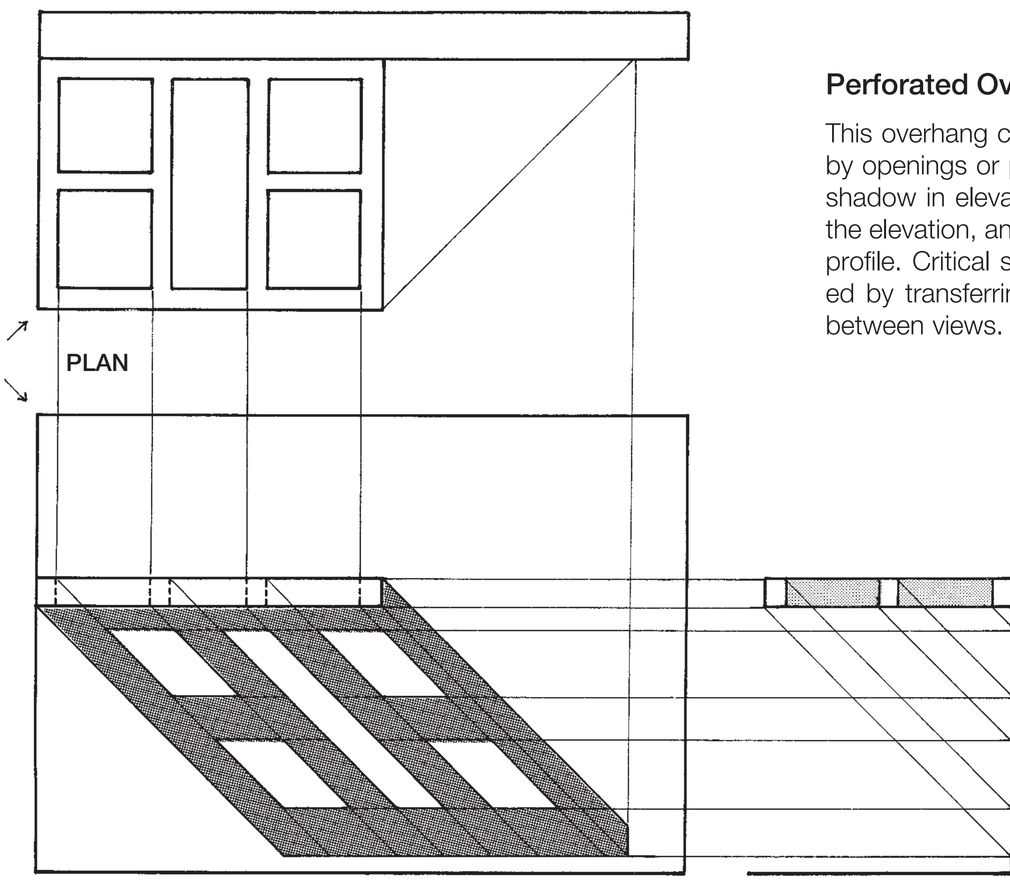


Drawing: House, Vancouver, Canada
Scale: ¼" = 1'0"
Medium: Ink on vellum
Courtesy of Patkau, Architects

The design for this 2500-square-foot house was shaped by two major considerations: the mild but frequently overcast and rainy climate, and the steeply sloping site. To make it accessible, the house was organized on three levels, with a plan that "bridges" from the top to the bottom of the slope. Each level is connected directly to an exterior space, part of a terraced series of south-facing garden spaces that parallel the interior spaces of the house. A large canopy over the south-facing terrace adjacent to this level is glazed to avoid shading the large window openings below it. Also, a large pond has been created at the bottom of the site to reflect the light of the sky above back up into the interior of the house. [ARCHITECT'S STATEMENT]

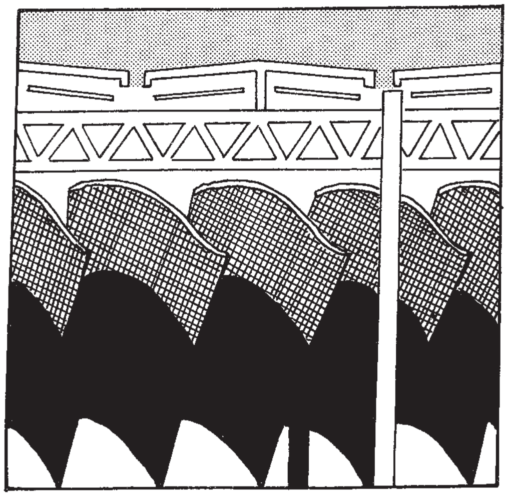
Perforated Overhang Shadows

This overhang condition is characterized by openings or perforations. To cast the shadow in elevation, construct the plan, the elevation, and a sectional elevation in profile. Critical shadow points are located by transferring corresponding points between views.



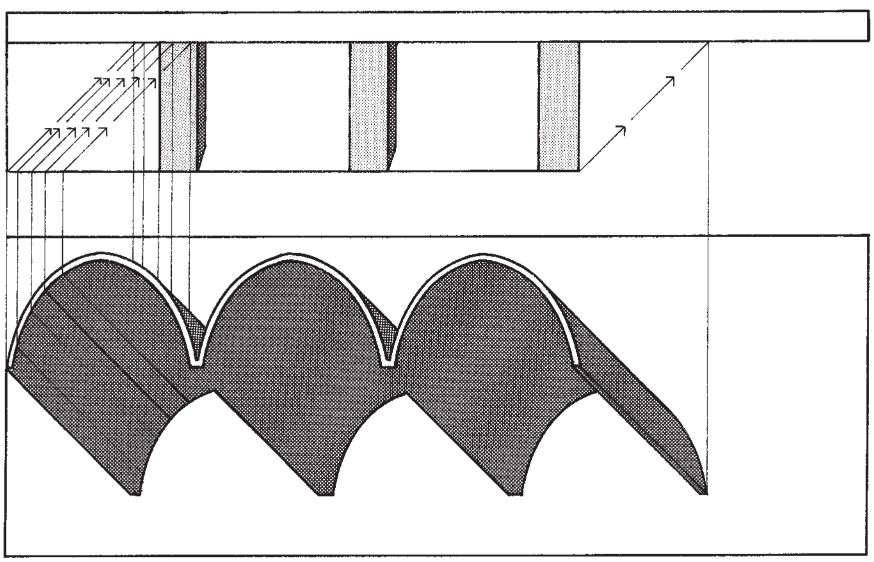
ELEVATION

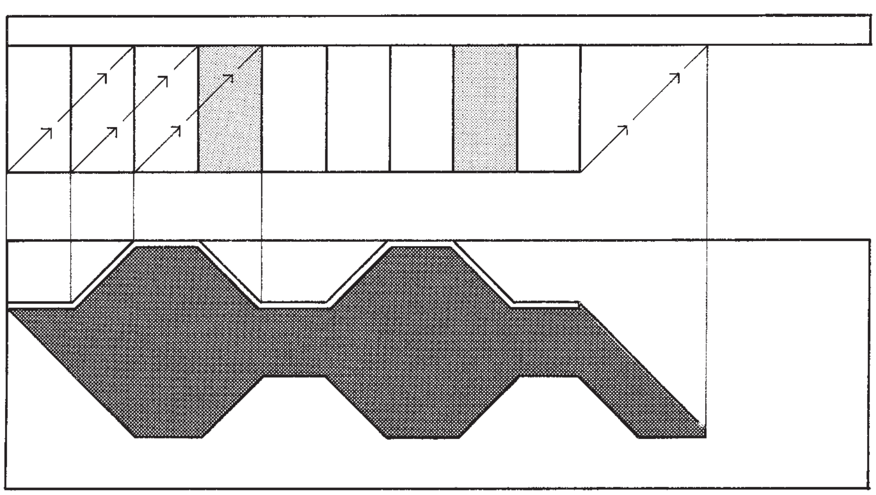
This high-tech modern building uses sensuous and elegant sun shade louvers to entirely shade the glass-roofed galleries. A feeling of motion and lightness gives the galleries a larger-than-actual-size feeling. Piano starts with initial "napkin" sketches of details that he takes with him everywhere. With sketches in hand, he always attempts to understand the ideological reasons for a project, such as its formal and social innovative aspects. Piano was awarded the Pritzker Prize in 1998.



© Kwok Tsui

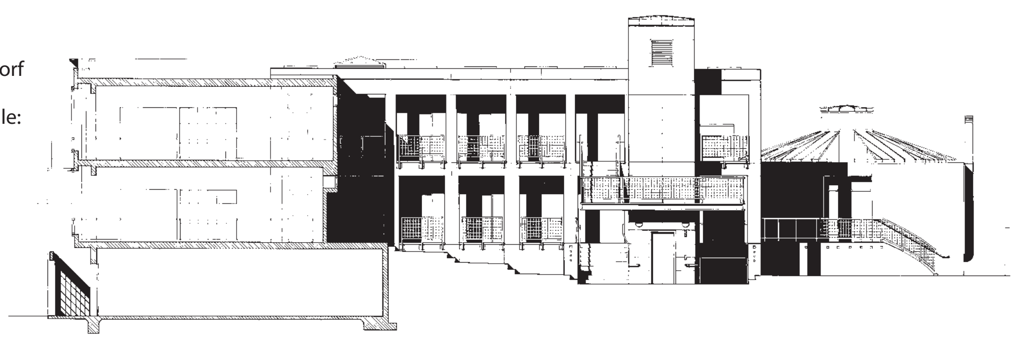
Drawing: Student project by Kwok Tsui
2.5" × 2.5" (6.4 × 6.4 cm)
Media: Ink and Zipatone on vellum
The Menil Collection Museum,
Houston, Texas
Courtesy of Renzo Piano Architect,
Piano & Fitzgerald, Houston,
and the City College of San Francisco
Department of Architecture
Structural Consultant: Ove Arup





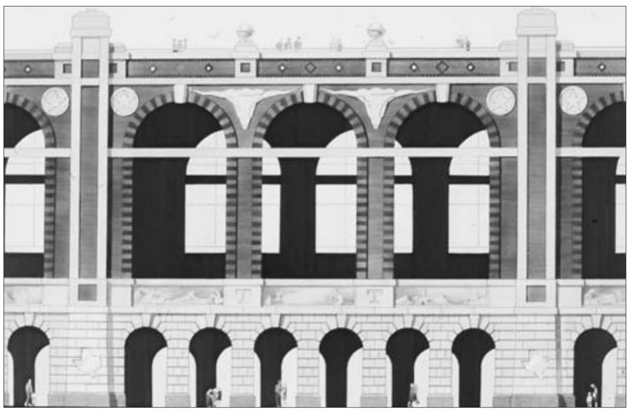
Canopy, Colonnade, and Arcade Shadows

The ways a plane figure casts a shadow on a parallel plane is demonstrated on these two facing pages. The bottom edges of the canopies cause a wall shadow line that has the same orientation and configuration as the canopy forms. Likewise, the geometric shapes of the arcade and the colonnade are cast on the recessed wall shadows. The repetition of geometric forms in all cases creates a shadow rhythm on the receiving surfaces. Note the shade on the underside of the sinuously curved roof canopy (upper left).



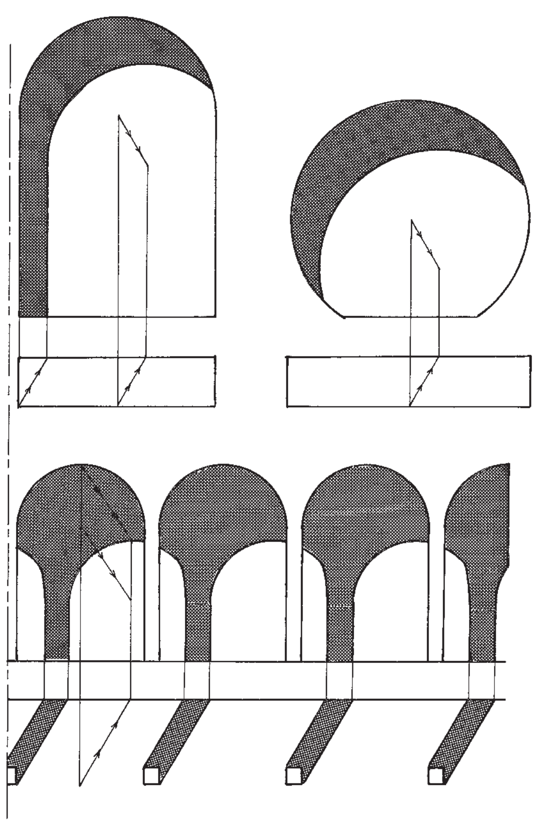
Drawing: San Francisco Waldorf School
36" × 24" (91.4 × 61 cm) Scale: ¼" = 1'0"
Medium: Ink on Mylar
Courtesy of Tanner Leddy Maytum Stacy, Architects

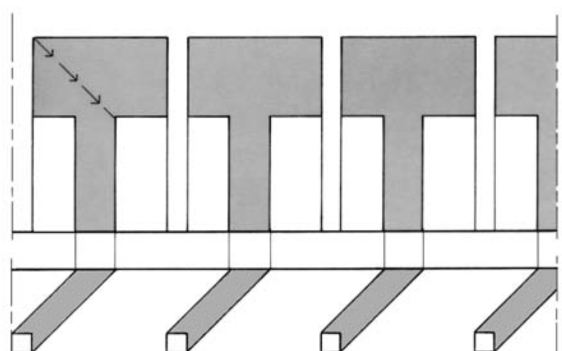
The internal spaces of this addition and renovation of an existing school were designed to resemble a medieval village, with overlooks, bridges, campanile, and plaza.



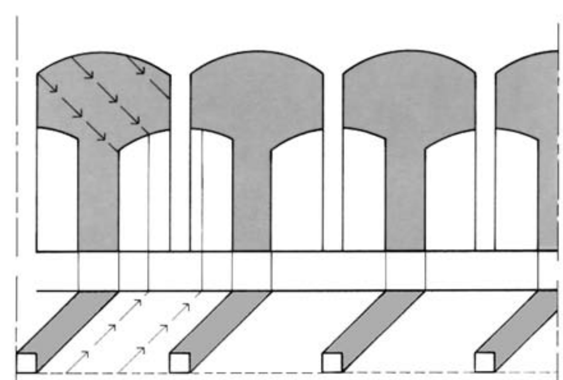
Drawing: Texas Rangers Ballpark, Arlington, Texas
24" × 18" (61 × 45.7 cm), Scale: ¼" = 1'0"
Media: Watercolor and pencil on mounted Bristol paper
Courtesy of David M. Schwarz/Architectural Services

The clients wanted a nostalgic feeling that recalled a stadium style of earlier years. The decorative band around the upper deck is of white steel and a copy of pre-1973 Yankee Stadium in New York. Also unique is a centerfield four-story office building, which helps enclose the ballpark.





CONTINUOUS COLONNADE



CONTINUOUS ARCADE

Drawing: Museum of Contemporary Art, Barcelona, Spain
36" × 48" (91.4 × 121.9 cm)
Medium: Ink on Mylar
Courtesy of Richard Meier & Partners, Architects

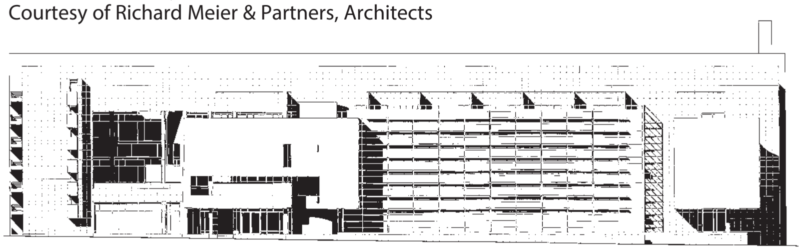
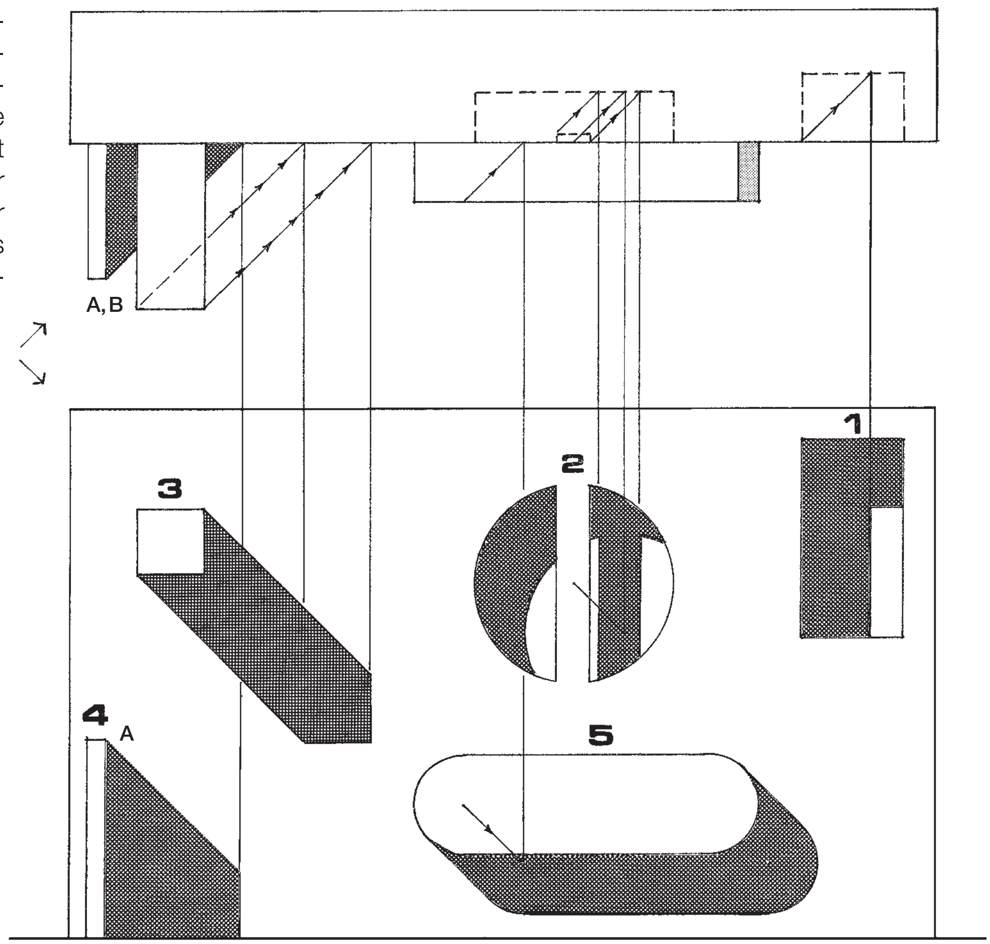


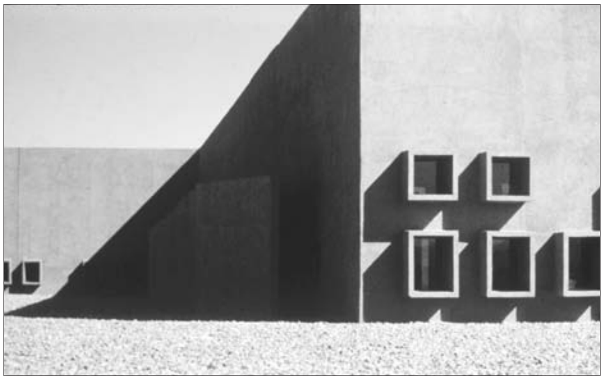
Photo: arcspace

Meier animated this museum's ramp-hall with horizontal louvers and the filtering-in of natural light. The building respects the fact that works of art, whether small or large and whether needing light or not, always have different scales at different times.



Non-overlapping Shadows

In the wall of shadows shown above, the light source is coming from the left at 45° (see direction arrows in the elevation and the plan views). When the general rule that shadows of plane figures on parallel planes cause shadows of the same size, shape, and orientation is applied, the shadow configurations seen in conditions **1** and **2** become readily apparent and are easily understood. When edges are perpendicular to a vertical wall, as in condition **3** and the top edge of condition **4**, the shadow line produced is in the sunlight-bearing direction. Likewise, edge **AB** is perpendicular to the horizontal ground surface, and the shadow line produced on the ground is in the sunlight-bearing direction (plan view) as well as parallel to edge **AB** when it is intercepted by the vertical wall (elevation view). Condition **5** follows the aforementioned rules.

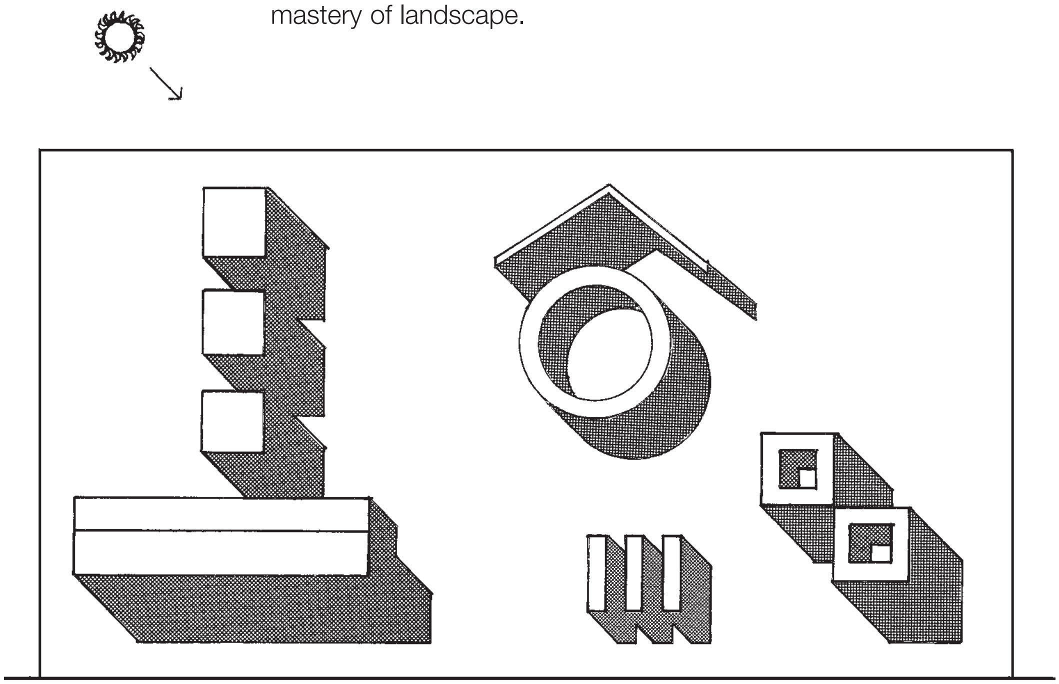


© Markova Nadine, photographer

Photo: Renault Factory (partial elevation)
Gómez Palacio, Durango, Mexico
Courtesy of Legorreta Arquitectos: Ricardo Legorreta, Victor Legorreta, Noé Castro

This photograph was taken early in the morning in order to obtain hard shadows. Facade details were taken with a 200mm telephoto lens. I used a Minolta camera with a polarizing filter. [Architectural photographer's statement]

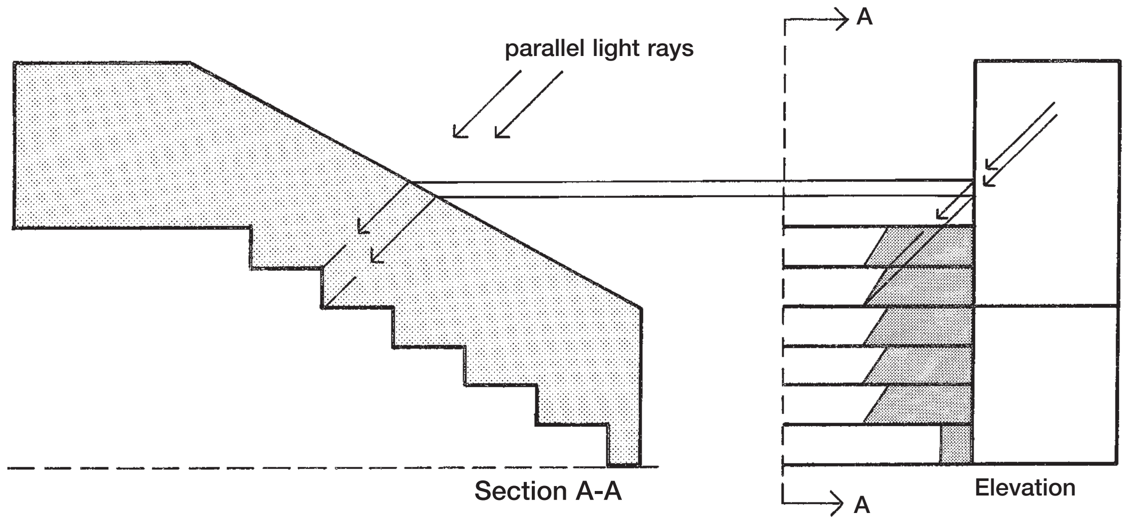
Ricardo Legorreta, a disciple of the noted Mexican architect Luis Barragan, is known for his use of bright primary colors, the play of light and shadow, and the play of solid Platonic geometric shapes. The Renault Factory is one of his best examples of his use of a wall plane. This building is dominated by the terra-cotta red exterior stone wall. His use of a stone lawn to transition between building and enormous desert also demonstrates his mastery of landscape.



Drawing: Student project by William Xie and Daniel Orona
Design of a sculptural wall of shadows
Studio professor: Pershing C. Lin
Courtesy of the City College of San Francisco
Department of Architecture

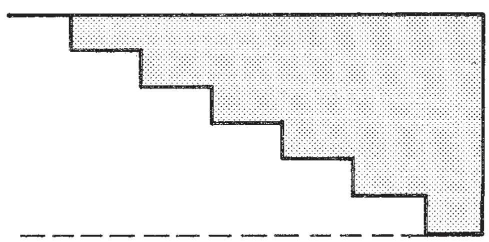
Overlapping Shadows

When casting shadows of protruding elements that are in close proximity to each other, it is common to find shadows that are interrupted before they hit the major receiving surface. The shadow lines that we do not see sneak across the lighted surface closest to their neighbor.

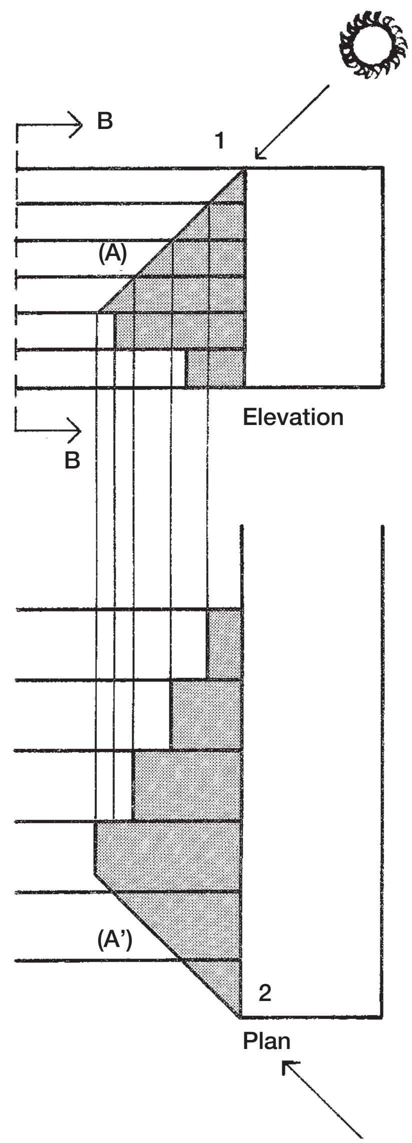


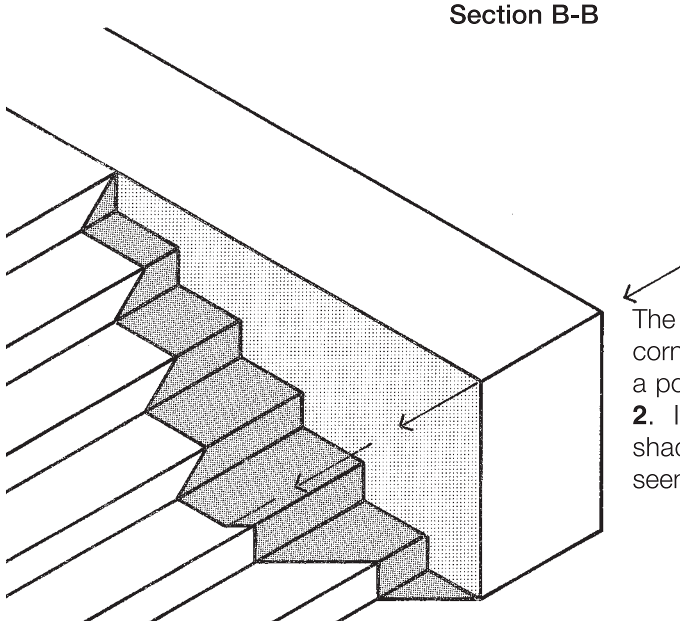
Stairway Shadows

Project corresponding points to find the shadow line of an oblique line on the steps above. Light rays maintain a parallel condition regardless of the geometric configuration of the receiving surface. See condition **A** in both elevation and plan below. A horizontal edge is seen as a point in the elevation **1**. It causes shadow line **A** seen in elevation.



Section B-B

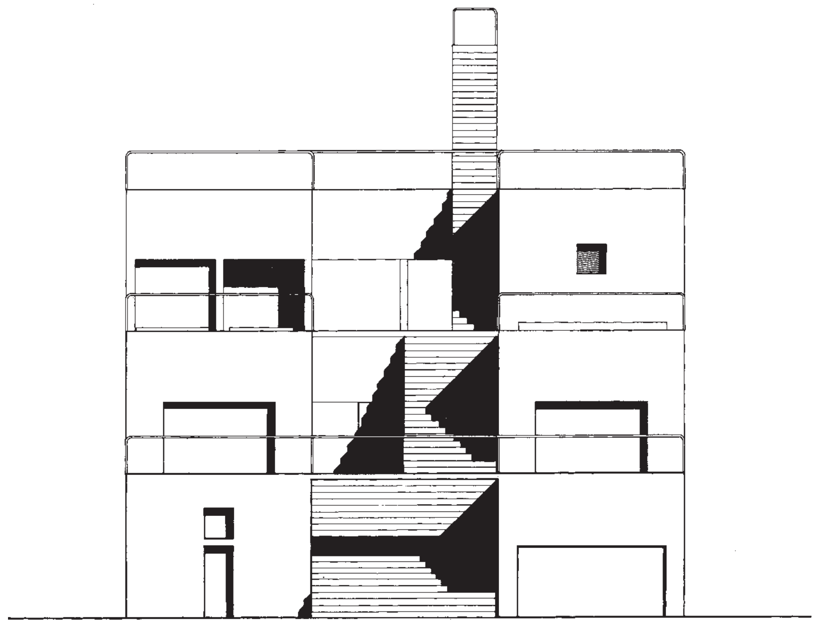




The inside vertical corner is seen as a point in the plan **2**. It causes the shadow line (**A'**) seen in plan.

Isometric

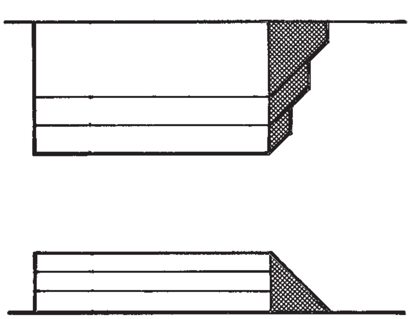
On a 30° hillside slope, this house's interesting facade, characterized by order and symmetry, is oriented to the southwest and the Mediterranean Sea. It is simultaneously both a public and private space. Bright daylight casts clear crisp shadows on its facade, whereas a reversal of light is seen emanating at night as musicians practice. As musicians articulate a specific mood with their musical pieces, in the same way, this house displays a strong individualism in its character. It is well known that musicians enjoy both public acclaim and private seclusion. Here, when playing for others, they project their music to the hillside and the sea; when practicing, they enjoy contemplation and retreat. Likewise, some views are open and expansive, while others are quite limited and minimized.

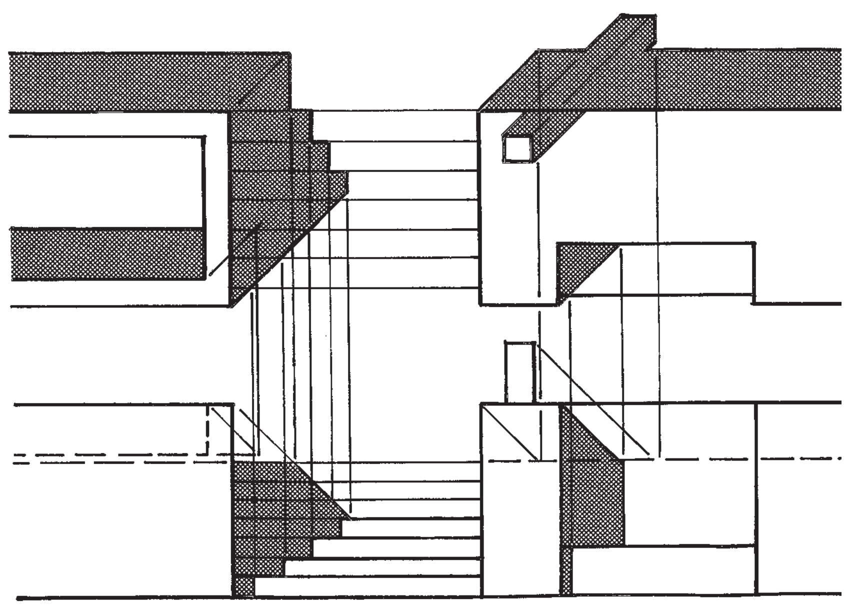


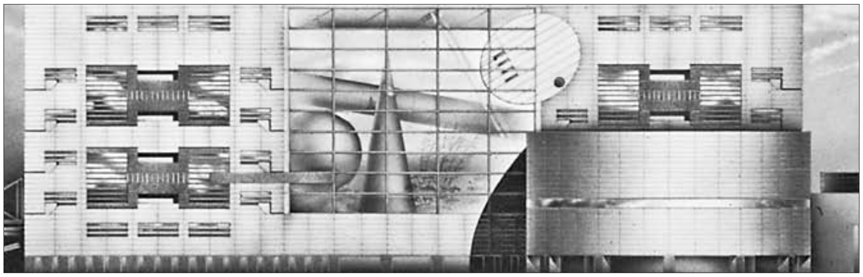
Drawing: Les Echelles
House for a musician
Mallorca, Spain
12" × 12" (30.5 × 30.5 cm)
Medium: Ink on Mylar
Courtesy of Diana Agrest, Architect

Stairway Shadows

Three parallel angled shadow lines are cast on the building elements above. The three horizontal edges casting these lines all appear as points (see **1** on the facing page). This fact helps us understand that each floor level must step back and that we are not seeing a continuous vertical facade. Shadows model a building form and give us clues to its shape and disposition. Note that the elevation shadows on the stairway take the same configuration (see facing page) regardless of the direction of the sun's rays. Sometimes stairway configurations protrude from a vertical surface (see below left).



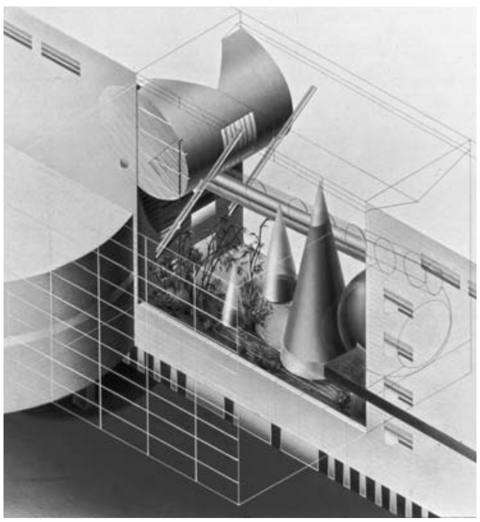




Drawing: Kunibiki Messe, Matsue, Shimane, Japan
48.6" × 33.1" (118.9 × 84.1 cm)
Medium: Airbrush
Courtesy of Shin Takamatsu Architect & Associates, Kyoto

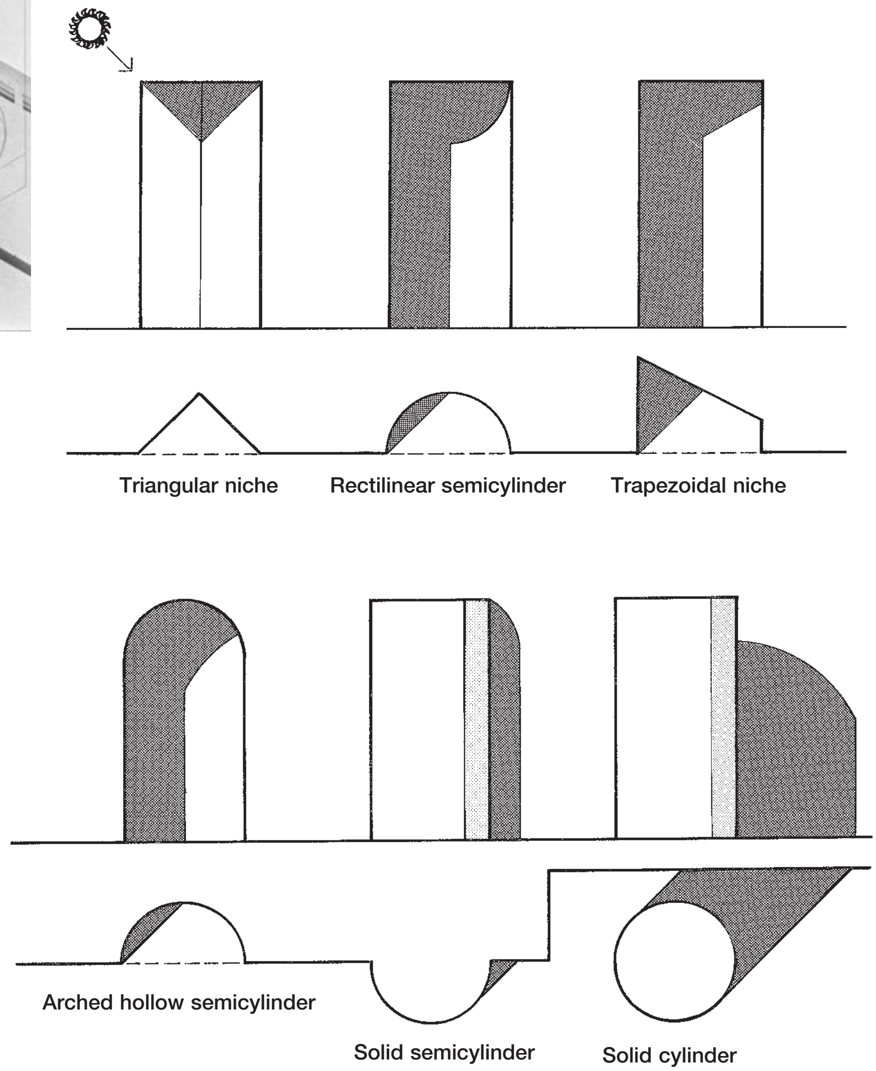
Shadows on Cylindrical Forms and Niches

Triangular and trapezoidal niches and cylindrical forms produce interesting shadows. The protruding element on this facade is slightly larger than a semicylinder, producing a shadow that begins in a hidden position, as seen in the frontal elevation.



Shadow designs (this and facing page):
Courtesy of Ann Cederna, Associate Professor
8½" × 11" (21.6 × 27.9 cm)
Original medium: Pencil
The Catholic University of America School of Architecture & Planning

Many of Takamatsu's designs, like this convention center, feature platonic geometric forms like cones, cylinders, and spheres. His designs are well known for the mechanical and anthropomorphic (ascribing human forms or attributes to a thing) imagery that gives a futuristic look to his buildings.

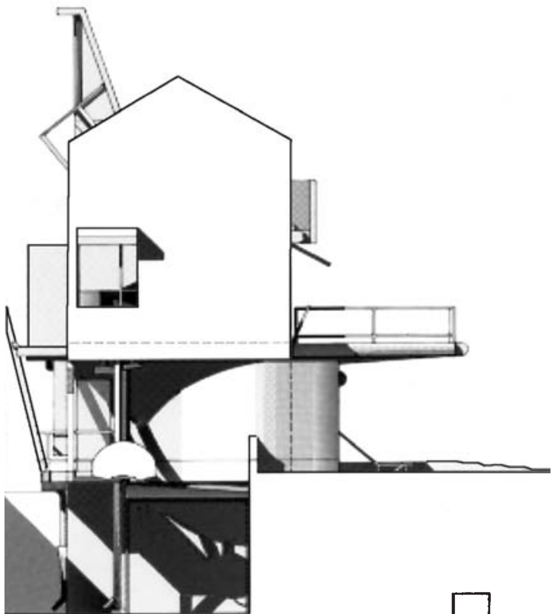


Shadows on Niches, Recessions, and Protrusions

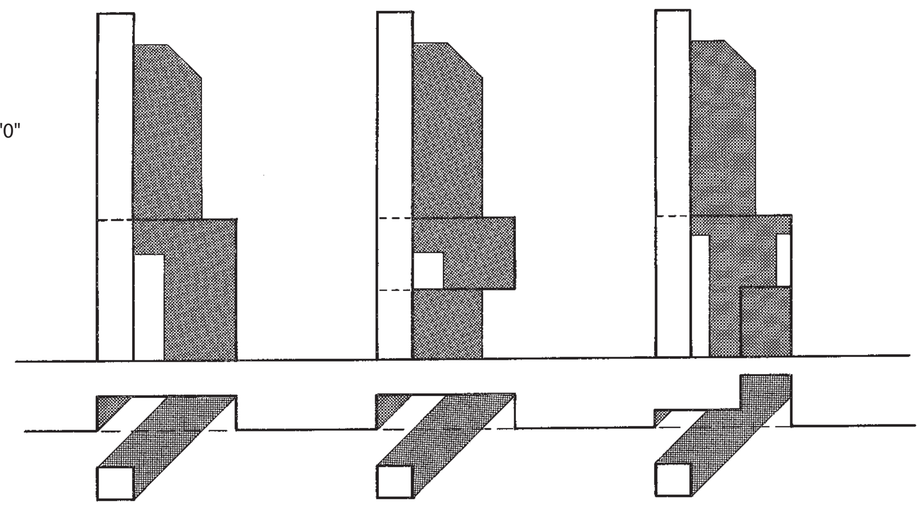
We see overhangs and niches primarily as elevation views. The shadows they cast give us hints as to the depth of overhangs and the amount of recessions.

Rectilinear niches and overhangs also produce interesting shadows. Overhangs in this example cast shadows on both flat and curvilinear surfaces. The curvilinear shape beneath the flat facade results in a curvilinear shadow line.

The tract house was designed as a flexible prototype for duplication in an area of undifferentiated tracts. It was meant to be a new tract example that criticized the old housing tract trend that fostered the concept of maximum value equating to maximum volume.



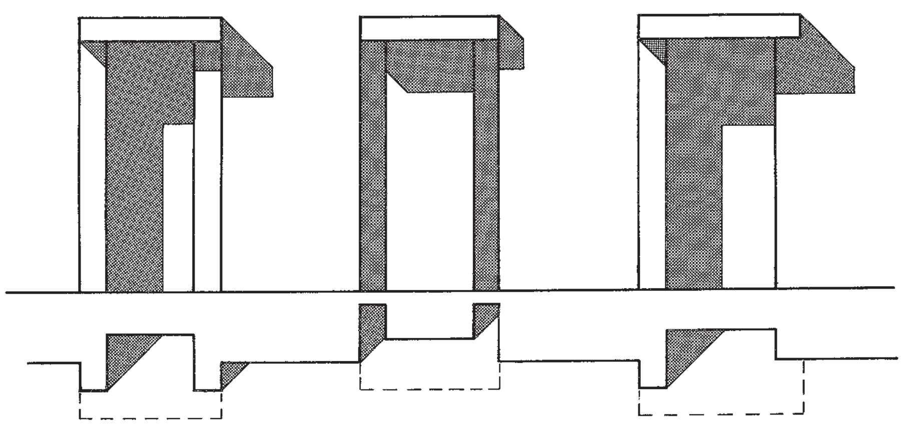
Drawing: Tract House
Manhattan Beach, California
11" × 11" (43.2 × 27.9 cm), Scale: ¼" = 1'0"
Medium: Ink on Mylar with Zipatone
Courtesy of Holt Hinshaw Pfau Jones, Architecture



Rectilinear columns casting shadows on rectilinear niches

© Charles Yim

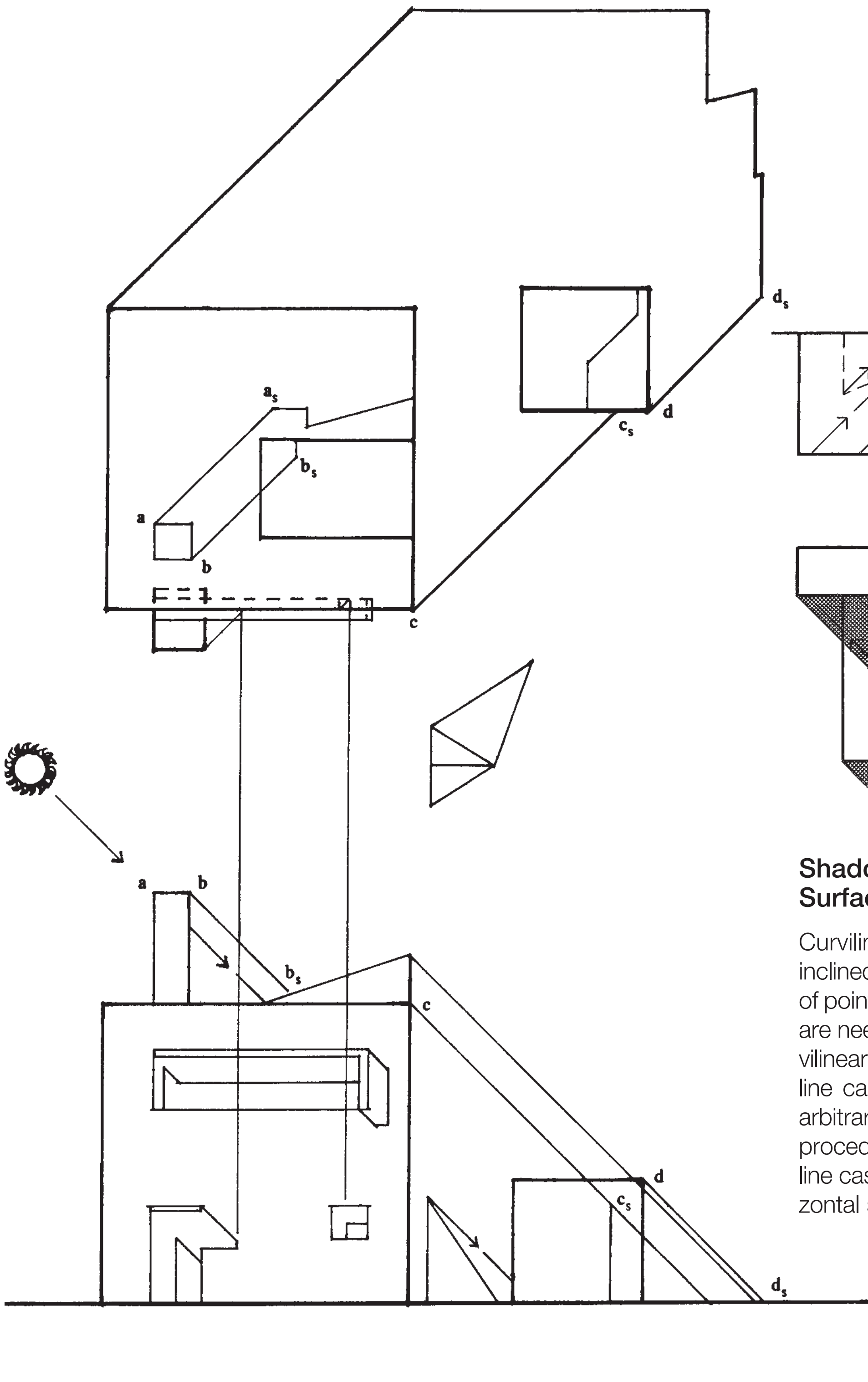
The shadow conditions on the buildings on these facing pages are combined in this photo and are shown as crisscrossing shadows.

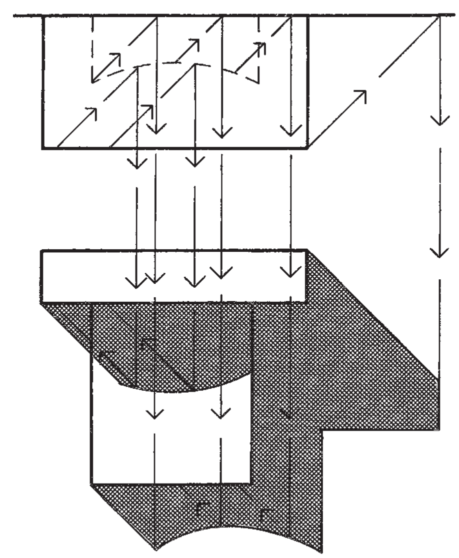


Overhangs casting shadows on rectilinear wall recessions and protrusions

Projection Using Corresponding Points

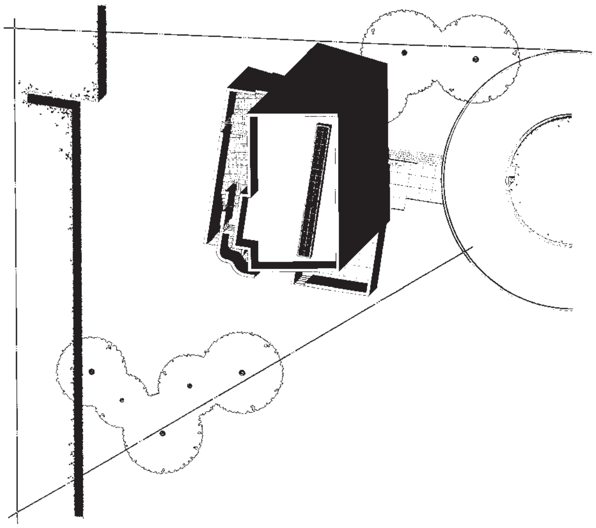
Once you understand the basic principles for casting shadows in both plan and elevation using precise corresponding point-by-point methods, it becomes simple to construct shadow lines for any complex building form for plan or elevation studies. The overall shadow configuration is nothing more than the composite of shadow forms from the simple geometric shapes that make up the complex shape (see facing page).



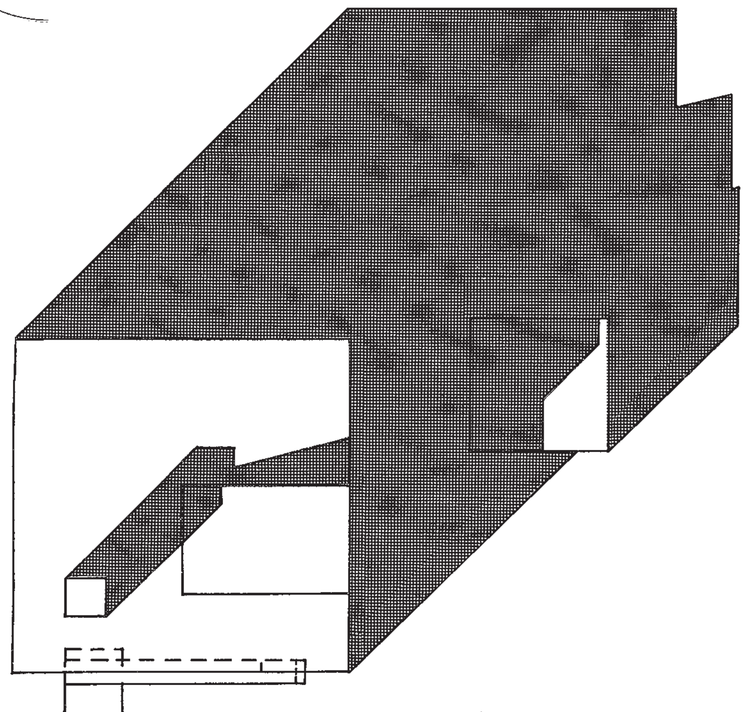


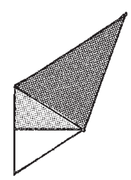
Shadows on Curvilinear Surfaces

Curvilinear surfaces differ from inclined surfaces because a series of points, rather than just endpoints, are needed. Shadow lines on a curvilinear surface cast by a horizontal line can be determined by plotting arbitrary points. Likewise, the same procedure applies for a curvilinear line casting a shadow line on a horizontal surface.

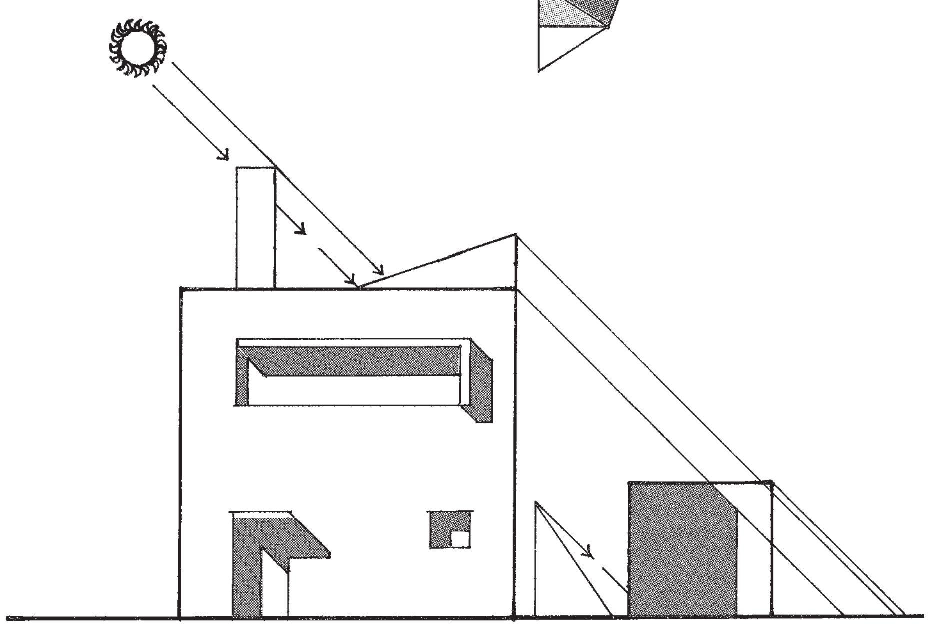


Drawing: House in Mississippi, Laurel, Mississippi
24" × 24" (61 × 61 cm), Scale: ¼" = 1'0"
Medium: Ink on vellum
Courtesy of Anthony Ames, Architect

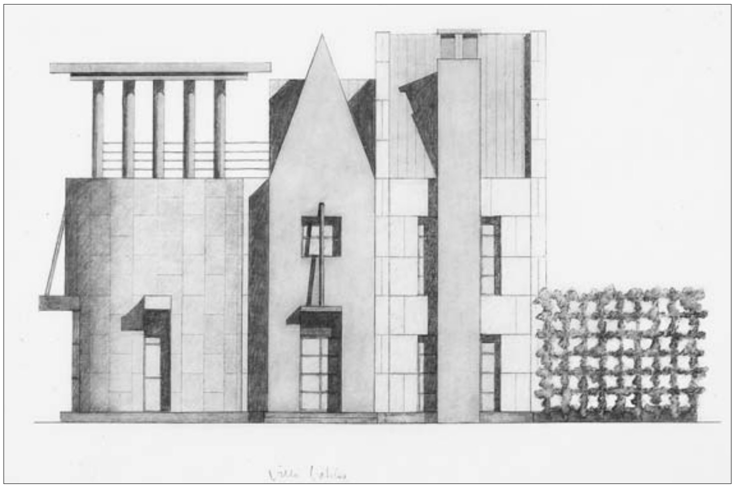




The design for the House in Mississippi is based on the superimposition of two dimensionally identical rectangular volumes, creating a spatial dynamic that emphasizes and accentuates the dichotomy between two distinctive spatial types.
[Architect's statement]

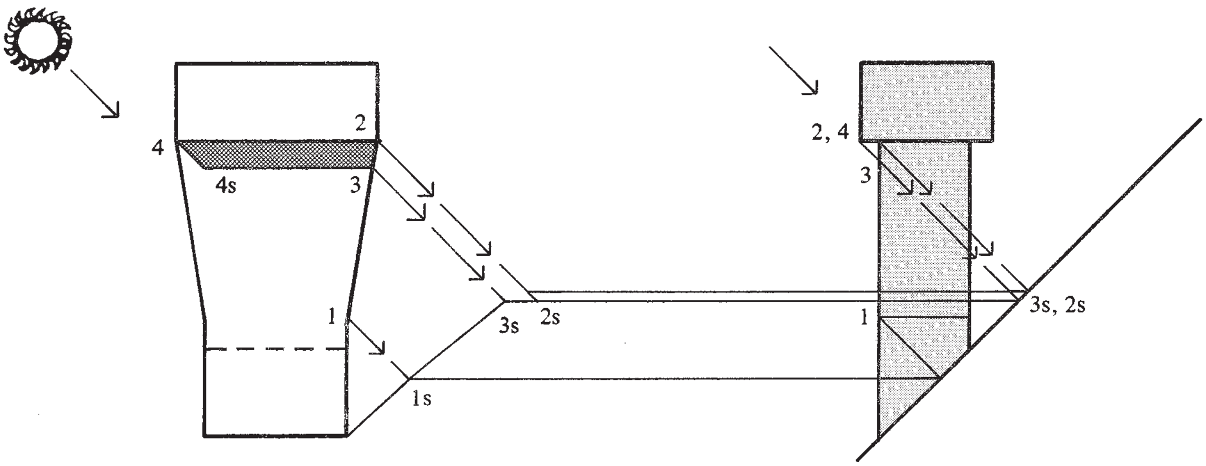


Shadows in Plan and in Elevation



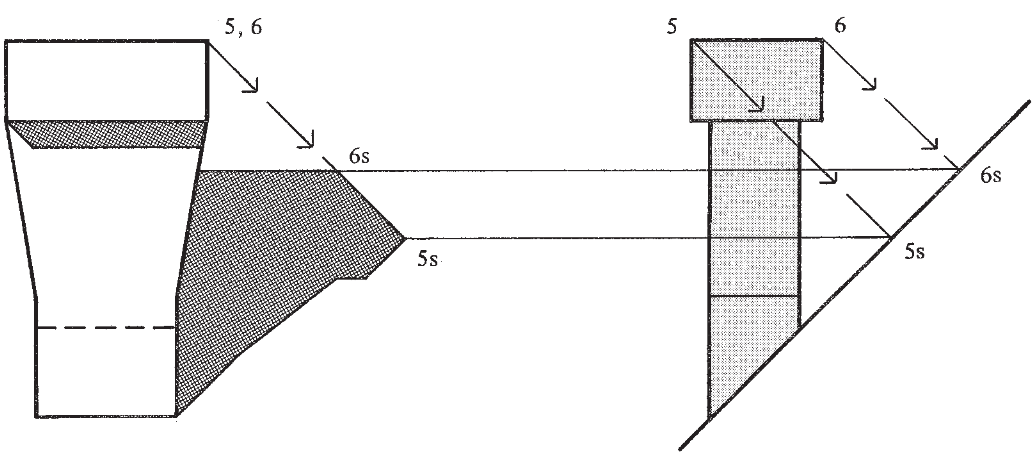
Drawing: Villa Gables
Meersbusch, near Dusseldorf, Germany
Southwest facade
15" × 9" (38.1 × 22.9 cm), Scale: 1:50
Medium: Colored pencil on yellow tracing paper
Courtesy of Michael Graves, Architect
Photo credit: Marek Bulaj

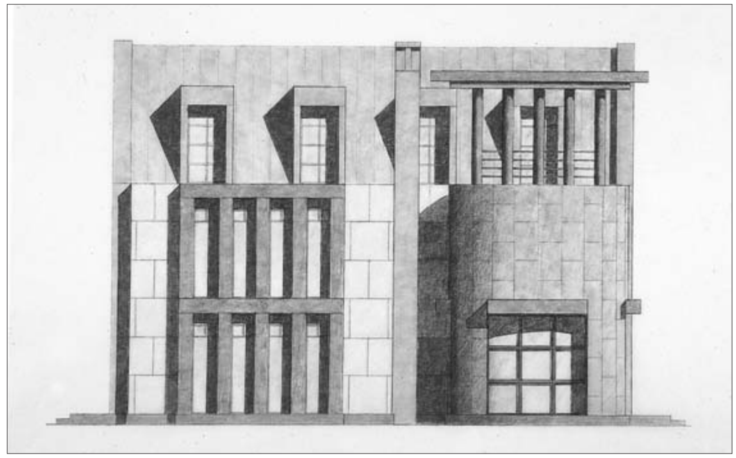
The representational style that Graves uses in his soft colored-pencil drawings is characterized by predominantly frontal views such as elevations. In his works, he uses colors derived from nature, such as terracotta, which represents the earth, and blue, which is frequently used as a metaphor for sky, especially in his ceilings. His sketches view architectural drawings as works of art.



Shadows on Inclined Surfaces

Chimneys are commonly seen casting shadows on a roof plane that is inclined. Most chimney shapes are rectilinear; this example shows a slight variation. With two or more elevations, you can project shadow construction lines from one to the other to determine the proper shadow configuration. Always label the critical points in all views and be systematic in your convention.





Drawing: Villa Gables
Meerbusch, near Dusseldorf, Germany
Northwest facade
14" × 9" (35.6 × 22.9 cm), Scale: 1:50
Medium: Colored penal on yellow tracing paper
Courtesy of Michael Graves, Architect
Photo credit: Marek Bulaj

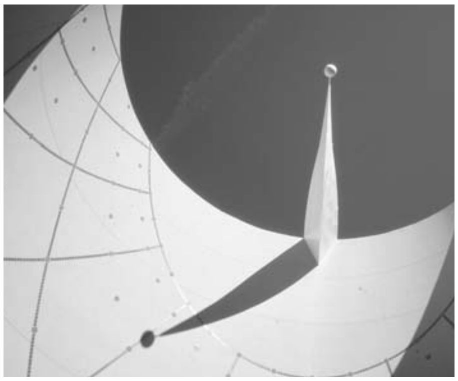
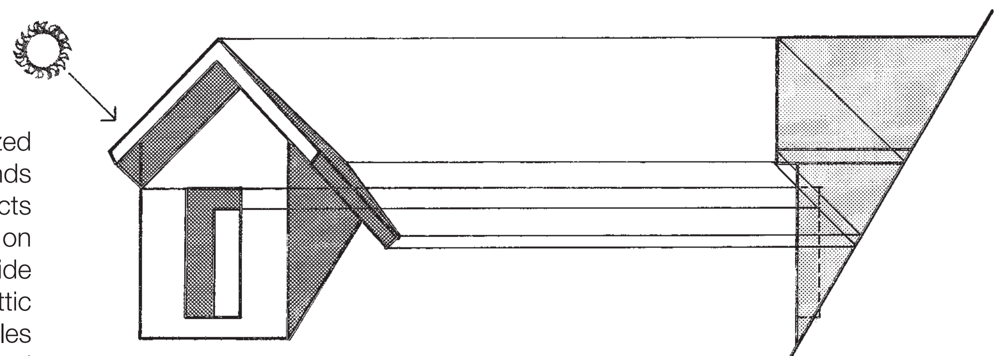


Photo: Stylus in sundial courtyard
Team Disney Building
Lake Buena Vista, Florida
Courtesy of Arata Isozaki and Associates, Architects
© Yasuhiro Ishimoto, photographer

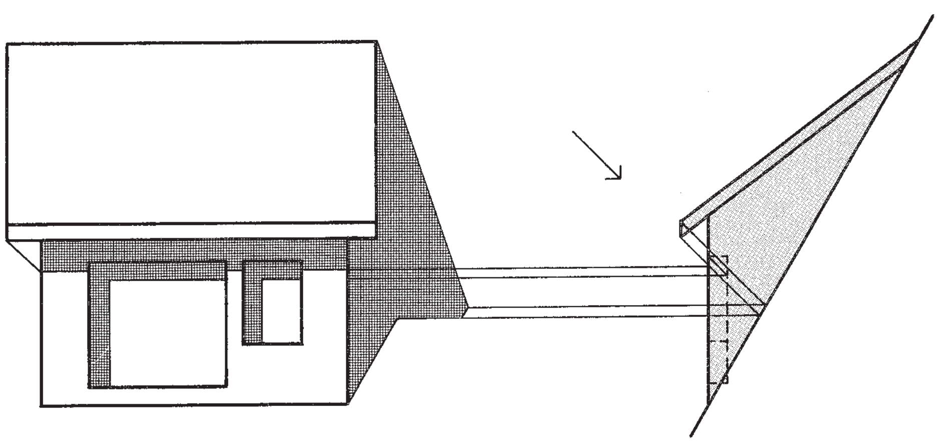
With an inclined curvilinear surface, as seen in the shadow of the stylus, it is much more expeditious to generate the cast shadow using digital methods.

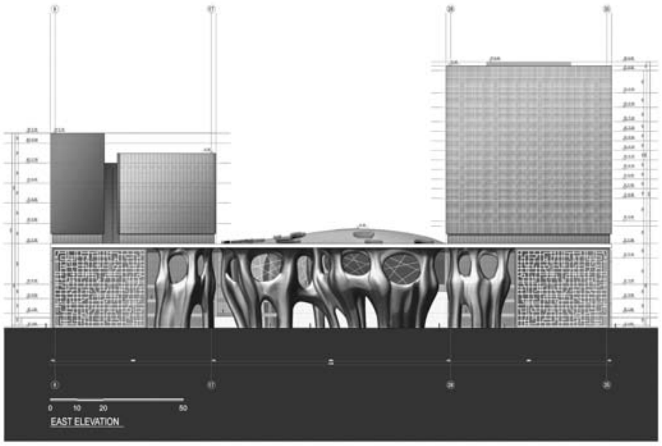
Shadows on Inclined Surfaces

A dormer is characterized by a projection that extends above a wall and intersects a sloping roof. Windows on its front vertical face provide light, ventilation, and attic space. These two examples show typical shade and shadow conditions.



Dormers exhibit a combination of shadows on vertical and inclined surfaces seen in elevation. The profile of the side elevation of the dormer that is seen in shade will cast critical points on the sloping roof. These points are horizontally projected back into the front elevation in order to locate the same critical points seen in the front elevation view.



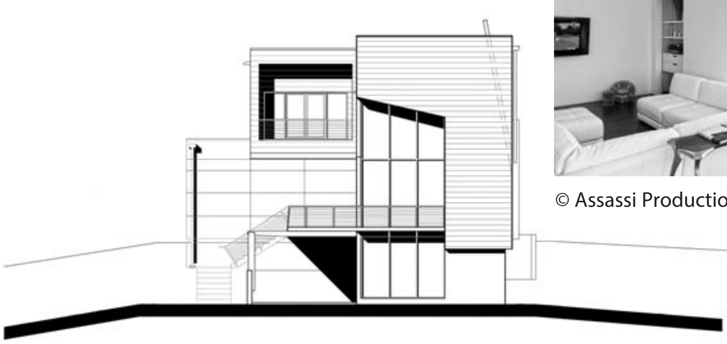


East elevation

Drawings: Shanghai Zendai Himalayas Art Center
Pudong, Shanghai, China
Medium: 3-D digital rendering
Courtesy of Arata Isozaki & Associates

Conceptual Elevation: Bedrosian
Client: Ware Malcomb
Medium: Markers on ink
Courtesy of Wenjie Studio

© Assassi Productions



West elevation

Drawing: Optic House (see p. 350)
Bennington, Nebraska
Media: Adobe Illustrator and AutoCAD
Courtesy of Randy Brown, Architect

Shadows in Elevation

The form displacement and composition of the fenestration on building facades, whether linear or curvilinear (see above), cannot be rendered without shadows. Whether an elevation is precise or conceptual (left), shadows will accentuate the facade.

Shadows provide clues as to how a facade articulates. For example, the wider the shadow on a receiving surface, the more the protruding element casting that shadow will extend outward. Shadows on elevations are an effective means of showing the massing and character of protruding and recessed elements. All of these examples illustrate how two-dimensional elevations can be given a three-dimensional feeling and quality.

The purpose of elevation shadows in presentation drawings is to provide contrast in order to suggest a third dimension. In practice, the designer or delineator is free to choose the sunlight's direction and is not required to hew to the convention of a light ray from behind the left shoulder of the viewer at a 45° angle. Whether working manually or digitally, select a position for the sun that accentuates the architectural design.

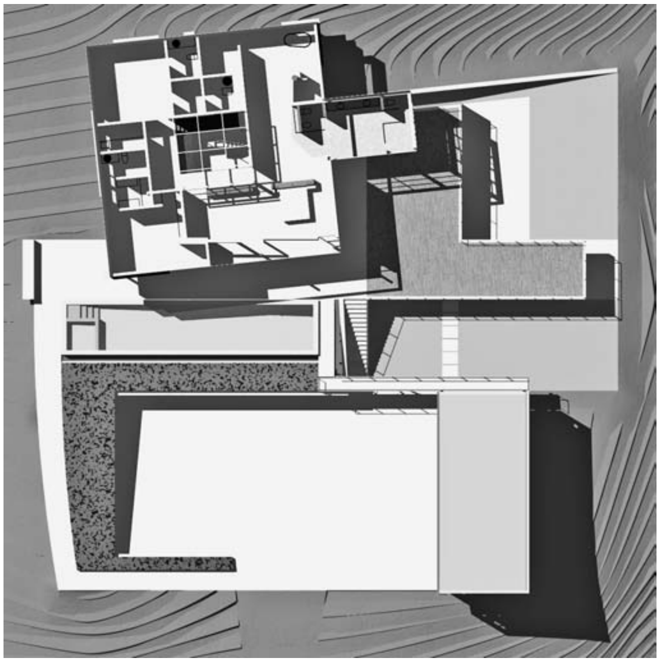
Northwest elevation

Southeast elevation

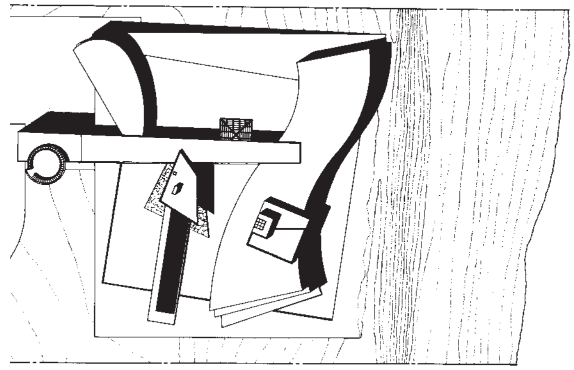
Drawing: Nuragic and Contemporary Art Museum
Cagliari, Italy
Media: Rhino, Maya, and AutoCAD
Courtesy of Zaha Hadid Architects

This museum assimilates to the ground, creating a new landscape. It also acquires a strong mass that defines the new skyline. The open and dynamic quality of the shape is also pursued inside the building, where the circulation of visitors determines the geometry of the spaces.
[Architect's statement]

The biomorphic formalism of Hadid's design can only be created with a computer. With the versatile software available in the marketplace, the designer and client can observe the realism of the daylight casting of shades and shadows for any time of the year. The above four images at the top show that digital software also allows us to create a simulated flyover or to "walk through" a building.



Drawing: TR + 2 STUDIOHOUSE
Pacific Palisades, California
Medium: Digital rendering
Courtesy of Cigolle & Coleman Architects

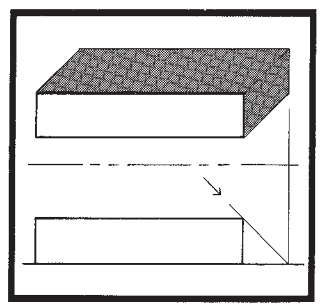


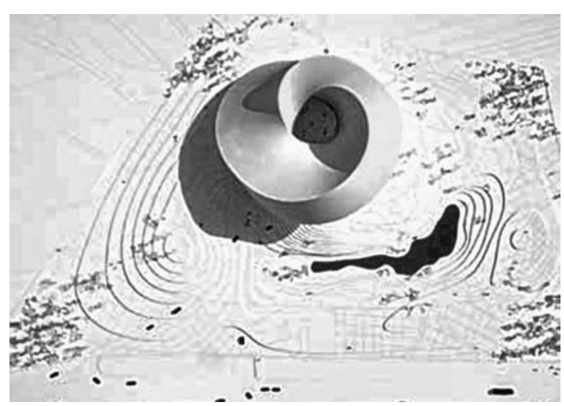
Drawing: Worrel residence, Hillsborough, Florida
36" × 24" (91.4 × 61 cm)
Medium: Ink on vellum
Courtesy of Arquitectonica International Corporation

Shadows on Roof and Site Plans

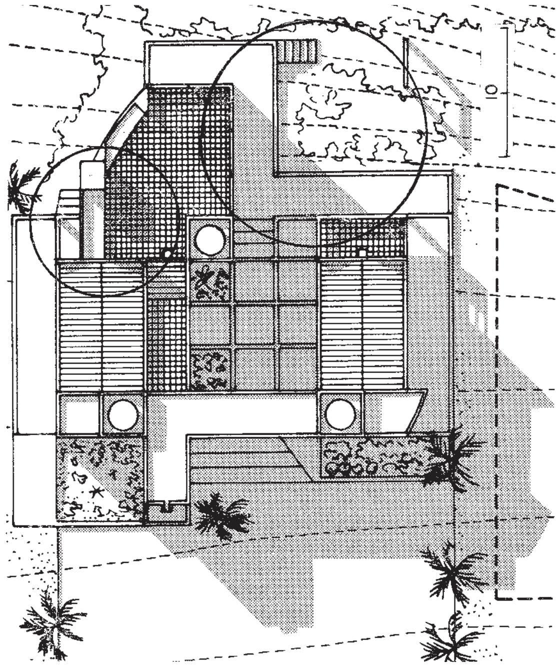
When a site plan contains many elements, as in these examples, the resolution of their proper shadow lengths will require both the plan and the elevation (height) of each element. The procedure is analogous to resolving shadow lengths for wall elements seen in elevation. Note that the shadows cast by the structures shown mimic the size, shape, and orientation of the structures.

Drawing: St. Marks Coptic Canadian Village
City of Markham (North of Toronto), Canada
Medium: Vectorworks
Courtesy of Hariri & Hariri Architects





Drawing: National Library
Astana, Kazakhstan
Architect: Bjarke Ingels Group (BIG)
Courtesy of Arcspace

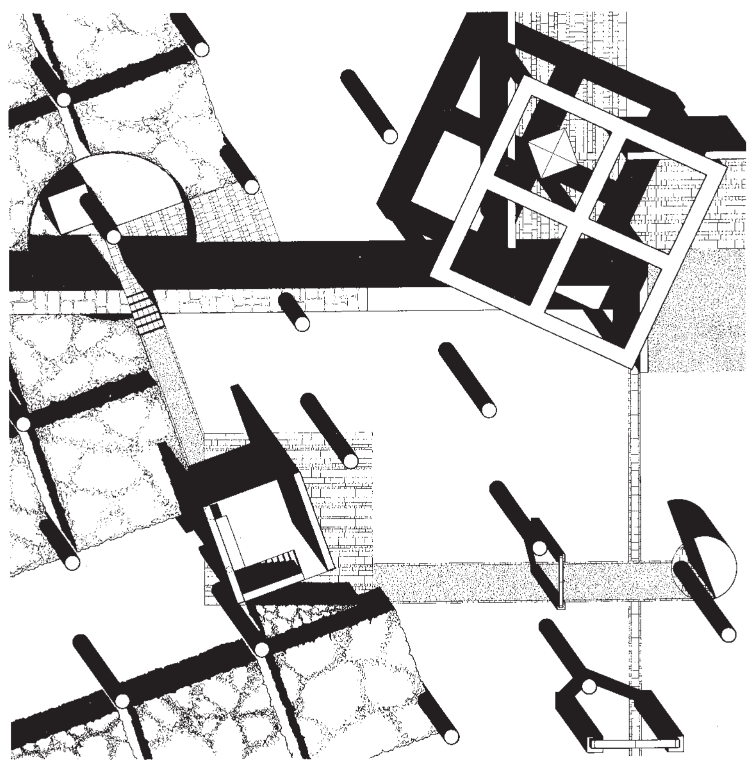


Drawing: Lohmann House
Akumal, Yucatan, Mexico
16" × 24" (40.6 × 61 cm), Scale: 1:100
Medium: Ink and Zipatone
Courtesy of George C. T. Woo, Architect, FAIA

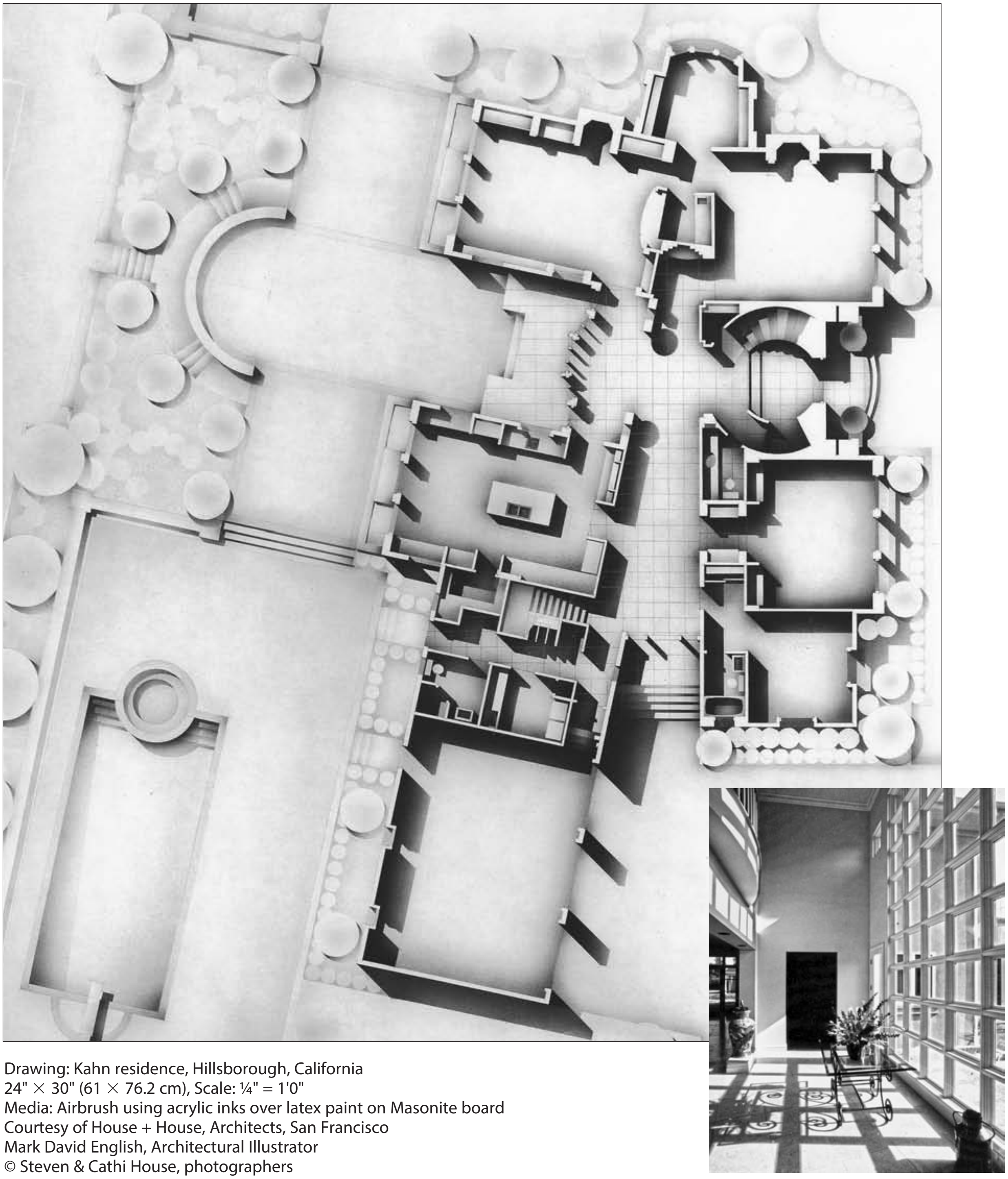
Drawing: Nuragic and Contemporary Art Museum
Cagliari, Italy
Media: Rhino, Maya, and AutoCAD
Courtesy of Zaha Hadid Architects

With curvilinear shadow forms, which should be computer-generated, look for their shapes to give you clues as to the shape of the building. See the curvilinear elevations of this building on page 365.

Circled situations in the above left site plan adhere to the following principles: in the plan view, light rays and shadow lines cast by *vertical* light/shade lines remain *parallel* regardless of the receiving surfaces' geometric configuration. The shadow line retains continuity in a straight line when it strikes the receiving geometric forms. The shadows of all the posts in the drawing at right are parallel to each other as well as to the shadows of the other vertical structural elements (posts, vertical edges of walls, etc.), following the same principle.



Drawing: Student project by Stephen Roberts
and Doug Lincer
Garden intervention
Medium: Ink on Mylar
Courtesy of the University of Texas at Arlington
School of Architecture



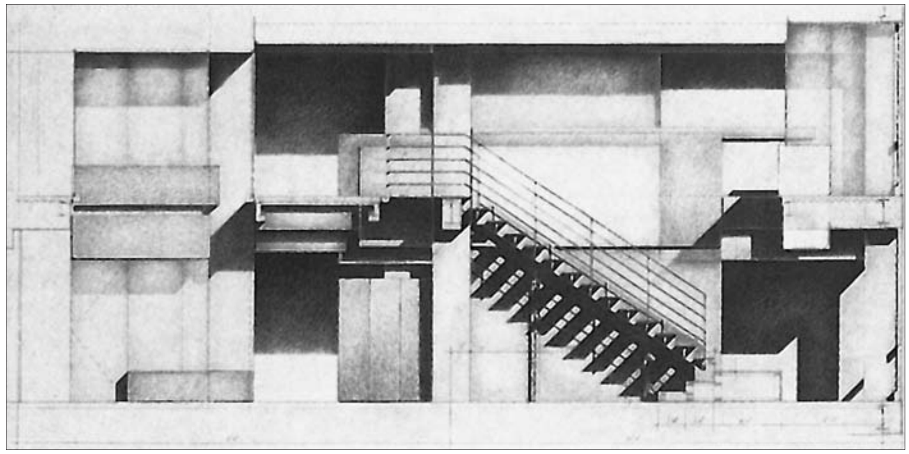
Drawing: Kahn residence, Hillsborough, California
24" × 30" (61 × 76.2 cm), Scale: ¼" = 1'0"
Media: Airbrush using acrylic inks over latex paint on Masonite board
Courtesy of House + House, Architects, San Francisco
Mark David English, Architectural Illustrator
© Steven & Cathi House, photographers

In an affluent neighborhood south of San Francisco, this stately home provides a formal, articulated facade to the street. Incorporating elements of symmetry, order, geometry, and axiality, this home was designed as an interpretation of the traditional classic villa with a strong relationship to the outdoors. [ARCHITECT'S STATEMENT]

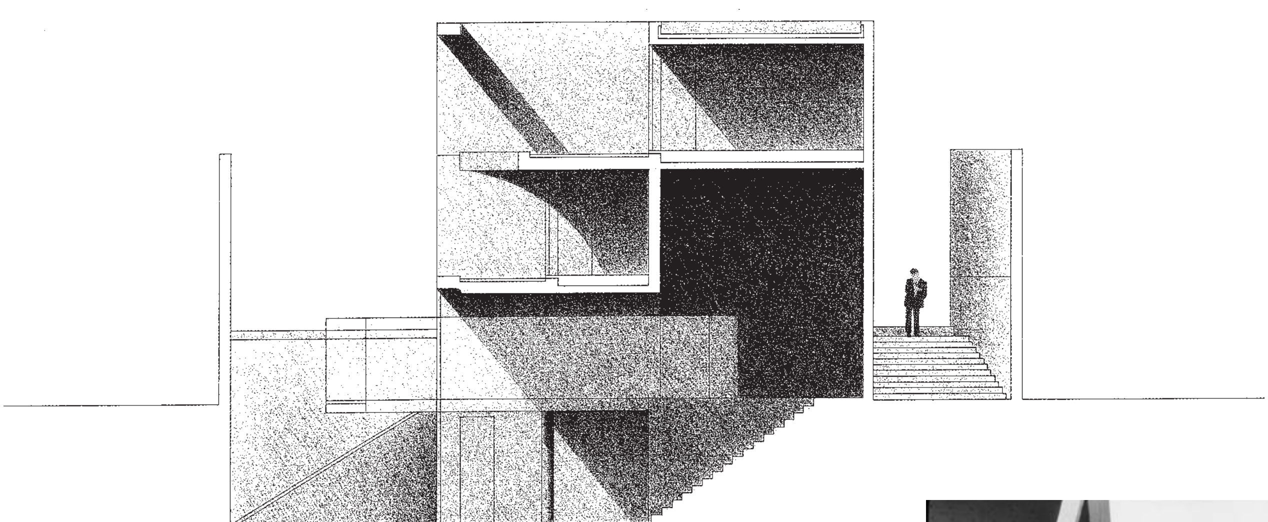
Shadows Cast within the Plan

This drawing shows shadows cast in the plan view by vertical elements cut in plan. The purpose is to make the drawing read better by accentuating the heights of the elements (walls, columns, etc.). This creates a greater feeling of depth and eliminates the flatness of the plan view.

A 1992 interior design of an apartment within and on top of Mies's classic 1951 landmark steel-and-glass high-rise overlooking Lake Michigan and Chicago, with breathtaking descending staircase views. The client wanted dynamically detailed spaces that would reflect and extend the classic building's design. Mies's high-rises were an example of light, delicate, and bony "less is more" architecture that had a profound impact on his American contemporaries.



Drawing: The Stainless Steel Apartment, Chicago, Illinois
36" × 24" (91.4 × 61 cm), Scale: ½" = 1'0"
Medium: Colored pencil
Courtesy of Krueck & Sexton, Architects, and
Ludwig Mies Van der Rohe, Building Architect

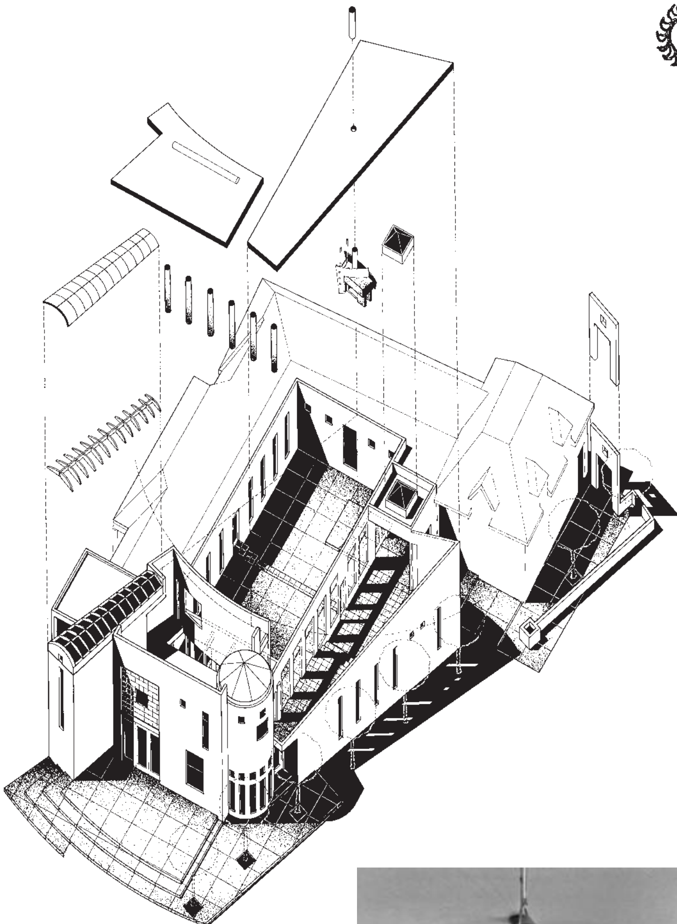


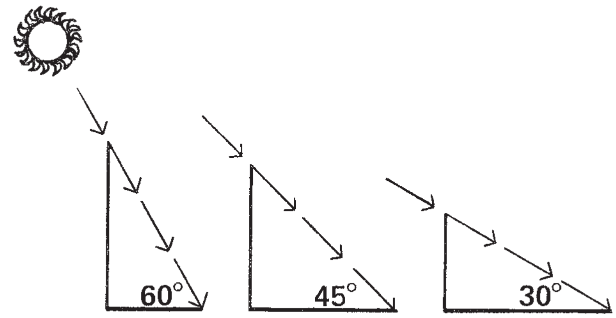
Drawing: I Gallery, Tokyo, Japan
429 × 297 mm (16.9" × 11.7"), Scale: 1:100
Medium: Colored pencil on the copy of the inked drawing
Courtesy of Tadao Ando, Architect

Shadows Cast within the Section

These drawings show shadows cast in a cut section. All elements that protrude (wall, floor, roof, stairs, built-in furniture, etc.) cast a shadow. This allows a normally flat two-dimensional section to "punch out." In the gallery drawing, note the gradual change in the tonal value of the shadows cast. This rendering technique helps to more clearly define the interior spaces. Architects and designers use shadows to help accentuate and articulate their design ideas and goals.

© Tadao Ando, Architect



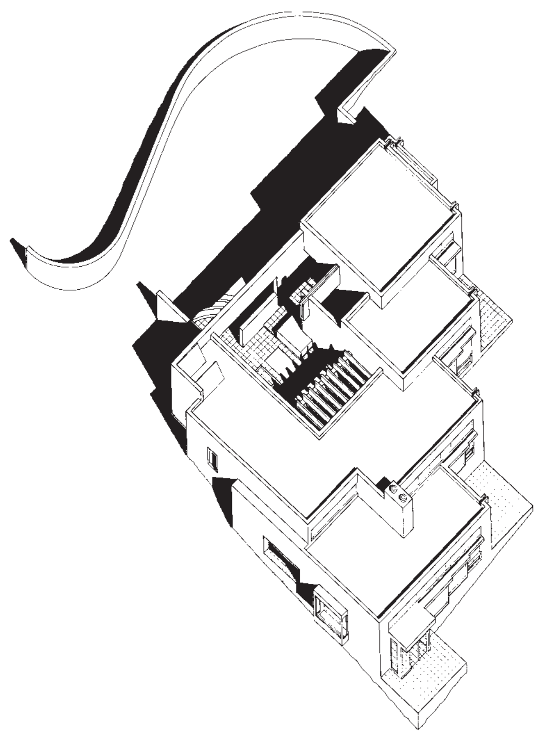


The quickest way to construct shadows for a paraline drawing is to utilize true-shape light ray triangles that are parallel to the picture plane and perpendicular to the line of sight. Use the convenient triangle angles of 60°, 45°, and 30°.

Sometimes it is advantageous not to have a true-shape light ray triangle, as in the paraline drawing below. In this case, the bearing direction of the light ray is not parallel to the picture plane.

Drawing: Shamash residence, Hillsborough, California
20" × 28" (50.8 × 71.1 cm), Scale: ⅛" = 1'0"
Medium: Pen and ink and airbrush on Mylar
Courtesy of Steven House, Architect

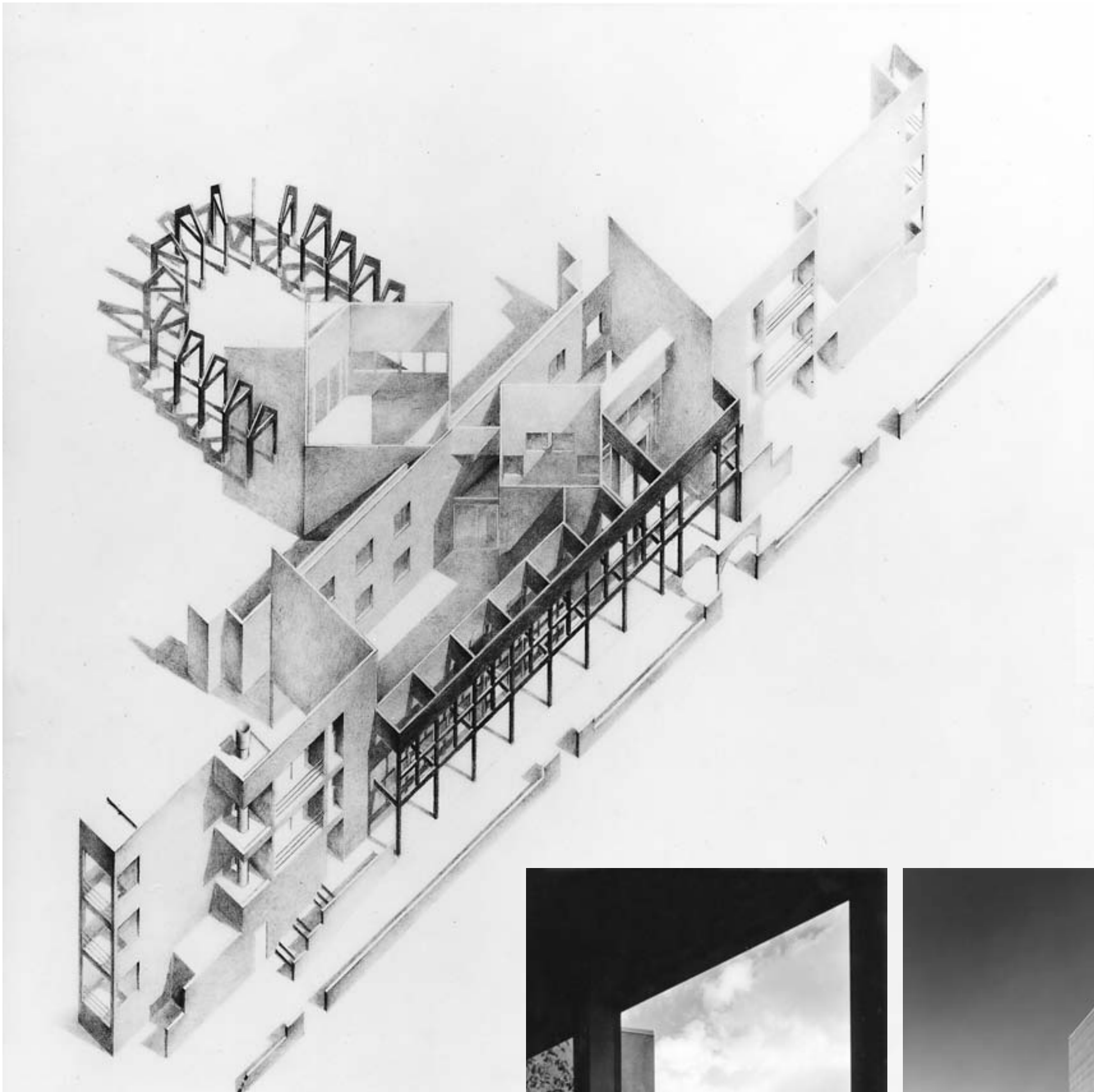
© Christopher Irion, photographer



Shadows Cast in Paraline Drawings

Shadows on buildings in paraline drawings create a strong three-dimensional feeling, as shown in these examples. A paraline drawing without shadows is relatively flat. Absent or just lightly rendered shade on planes is permissible when fenestration detail must be clear (see above). Always choose a convenient angle (45° or 60°) and direction for the slope of the light rays. Complex configurations can best be resolved by a series of shadow-point-casting triangles.

Drawing: Kress residence, Albuquerque, New Mexico
20" × 30" (50.8 × 76.2 cm), Scale: ¼" = 1'0"
Medium: Ink on vellum
Courtesy of Robert W. Peters FAIA, Alianza Arquitectos/An Architect's Alliance

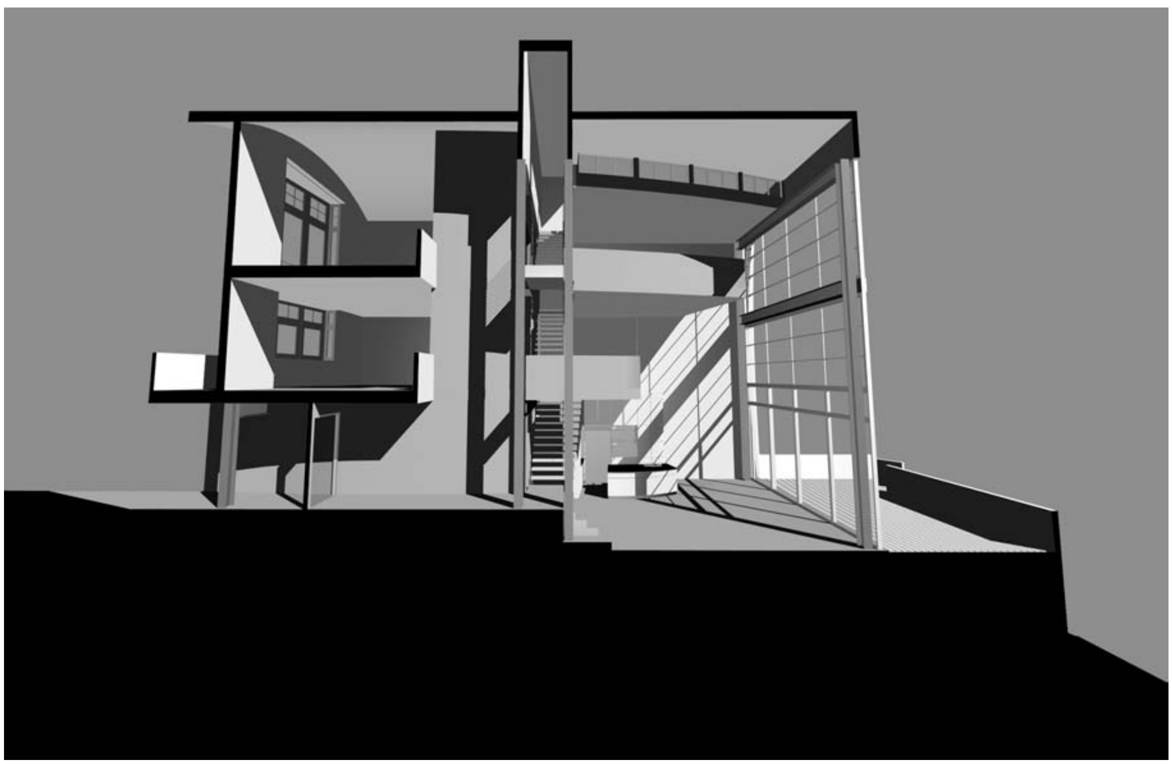


Drawing: Verdugo Hacienda Housing for the Elderly,
Sunland-Tujunga, California
24" × 24" (61 × 61 cm), Scale: ⅛" = 1'0"
Media: Ink and colored pencil
Courtesy of John V. Mutlow FAIA, Architects

© John V. Mutlow FAIA

The base premise of this illustration was to delineate a series of interconnected elements—the symmetrical front/street facade, the building's communal spaces, the brise soleil, and the lanai in the center of the courtyard. The size of the principal community room necessitated an off-center main entrance, which the two rotating volumes then connect back to the axial courtyard and lanai. The lanai and the brise soleil colonnade, which shades this south-facing front elevation, were colored to differentiate the external volumes from the internal spaces. The shadows were cast in order to articulate the building's form and movement sequence. [ARCHITECT'S STATEMENT]

1 2 3



Section perspective

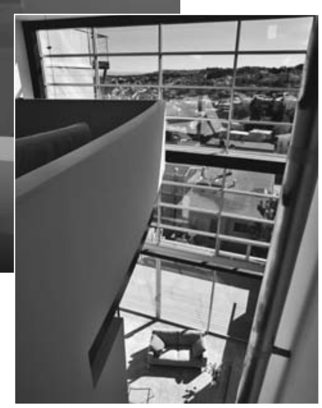
1 2 3

The top row on these two facing pages shows a nice use of the two-point perspective section in sequence (**1** to **6**) to reveal a dissected model of the residence and important details of the interior spaces. The bottom row on this page shows a three-point perspective used in the sequence (**1** to **3**) of analytical perspectives. Also note the beautiful use of computer-generated shadows in the one-point perspective section (with slight upward convergence).

4

5

6



Night perspective

Images: Buena Vista residence, San Francisco, California
Principal in Charge: Mark English
Architectural Illustrations: Star Jennings
Courtesy of Mark English Architects

All design and construction documents produced in the office are digitally created or manipulated. The CAD program used for the creation of three-dimensional drawings is ArchiCAD 6.0, in conjunction with Artlantis Renderer and Photoshop. The hardware used is the Macintosh G4, Umax 1200s scanner, and Epson Stylus Photo 1200 printer.

Mark English Architects is a young design firm located in San Francisco's Jackson Square District. The firm is dedicated to fine residential, commercial, and civic architecture and interior design. Mark English and associates Star Jennings, Alessandro Miramare, and Ani Bafarezo follow a team approach to design wherein talented builders and artisans are involved as collaborators from the beginning of the design process through construction. [ARCHITECT'S STATEMENT]

The rigorous hand methods for generating shades and shadows are very time-consuming and are no longer favored, now that instantaneous digital procedures achieve the same results. However, the hand methods of casting shades and shadows give students a deep understanding of the geometry.

8

Presentation Formats

A fine set of presentation drawings for the purpose of graphic communication is invaluable in architect–client or designer–client relationships. An architectural drawing presentation usually includes conceptual diagrams or sketches, a site plan, floor plans, exterior elevations, site sections, building sections, axonometrics, obliques, and perspectives. The initial stage of the design-drawing process is involved with conceptual diagrams and conceptual drawings. As the design concept evolves, more formal methods of presentation are needed. These presentation formats, whether conventional or avant-garde in approach, must effectively communicate to the targeted audience.

Drawings are visual data, the selection and composition of which communicates the spirit of the design. It is very effective to present any three-dimensional object or space as a major feature on a board. Other, two-dimensional elements—such as site plan, floor plan, sections, and elevations—should play a supporting role in close proximity to the featured 3-D design. This approach to presentation was well documented in the beautiful drawings of Frank Lloyd Wright and Otto Wagner at the beginning of the twentieth century. As in some of the case studies in Chapter 3, the nonrectilinear architecture built in recent years has capitalized on the advanced digital software now available to customize each image in size, color, text, and display attributes, and to visually manipulate these images to fit any composition. Now, presentation formatting is limited only by the imagination of the designer.

The intent of this chapter is to illustrate various presentation formats, from traditional wall presentations to digital online presentations.

The following are some of the important terms and concepts you will learn:

Presentation formats	Transparaline	Transoblique
Transmetric	Composite drawings	Competition panels

Standard wall presentations versus digital online presentations

By viewing a large number of student and professional competition drawings, you will develop new and fresh ideas on how to handle your own presentations.

Presentation Formats

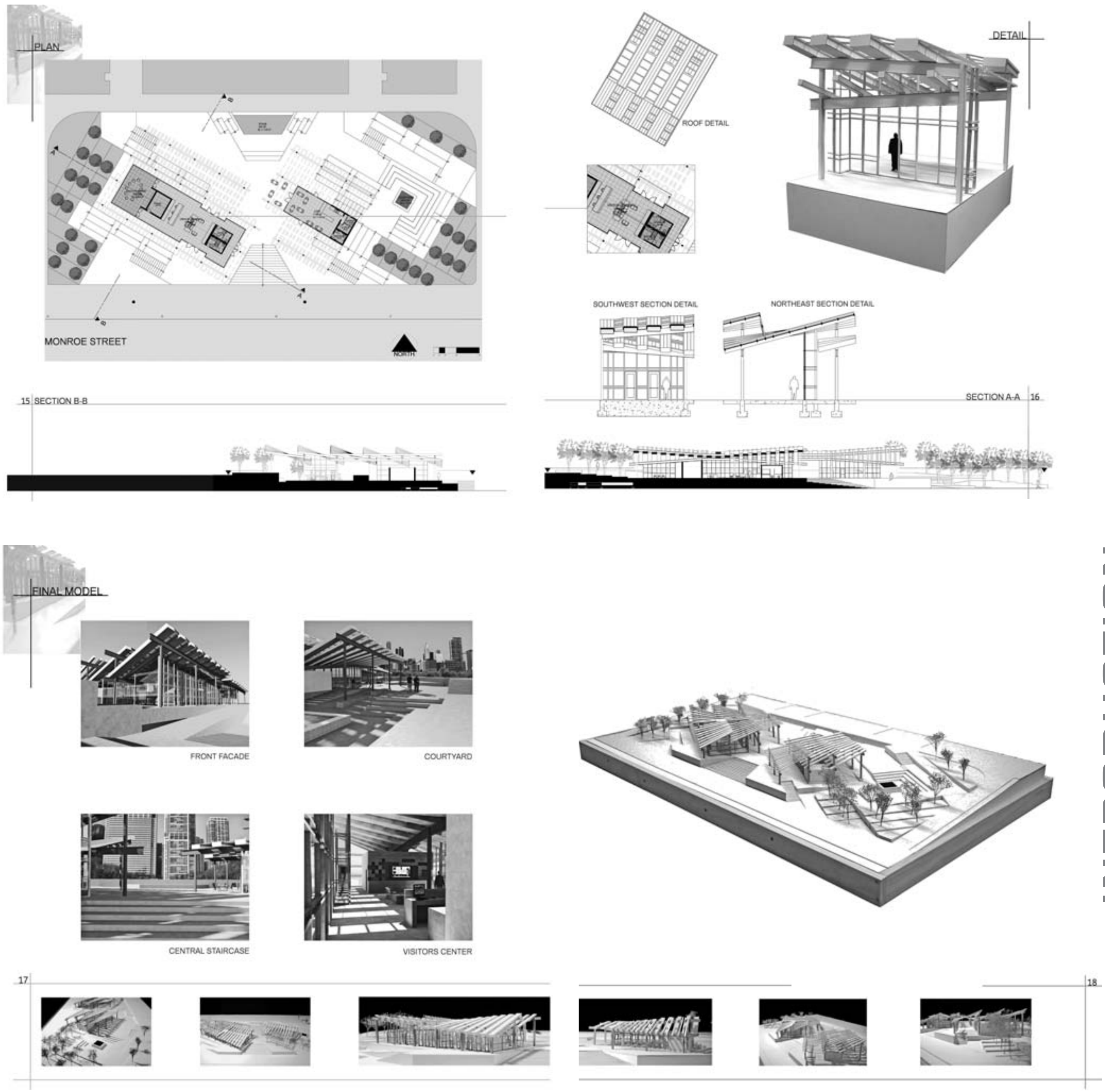
TOPIC: ARCHITECTURAL PRESENTATIONS
Ching 2009, 195–210.

TOPIC: ARCHITECTURAL COMPETITION PRESENTATIONS (EXAMPLES)

Architecture Competitions Magazine (www.arqfuture.com)

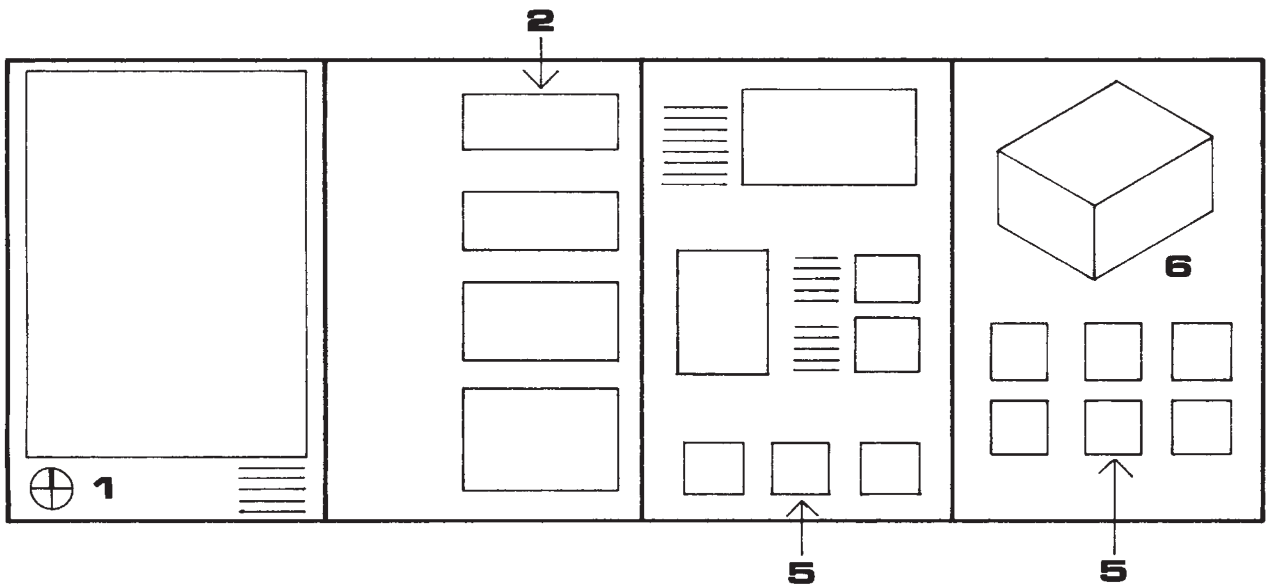
Chapter Overview

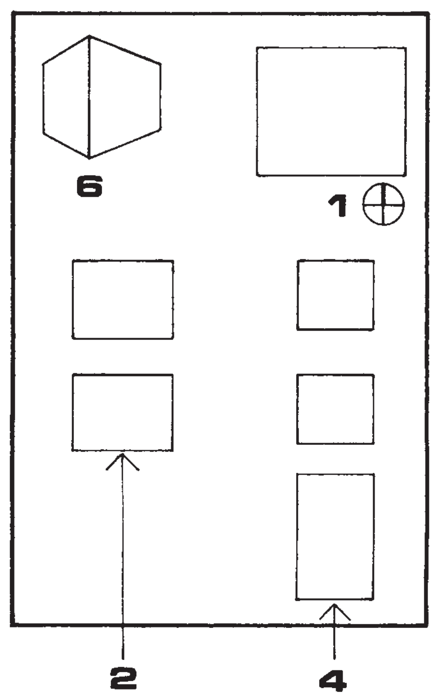
After studying this chapter, you will understand how wall presentations are laid out. You will learn about composite-integrated presentations. You will be able to glean ideas for organizing your own single-panel or multipanel presentations. For continued study, refer to Ching 2009.



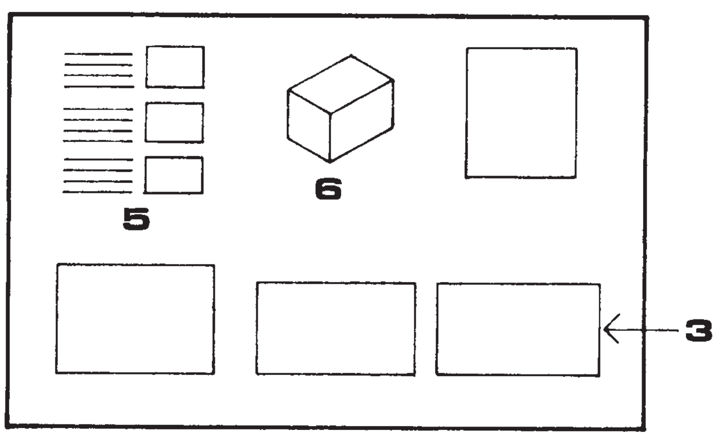
Presentation Images: Chicago Visitor's Center Pavilion
Chicago, Illinois
Medium: Drawings—AutoCAD w/Photoshop color; Renderings—
Google SketchUp & 3ds max. design;
Models—museum board & basswood;
Portfolio pages—Adobe InDesign
Courtesy of student Geunho Song
College of DuPage
Department of Architecture

The primary goal of an architectural presentation is to effectively present design concepts. Implemented design concepts should be drawn and organized in an orderly, structured *format.* Over the years, architects and designers have used many different formats, with the ultimate goal always being the same. Note the use of many drawing types and presentation strategies (model photos, etc.) in the presentation above.

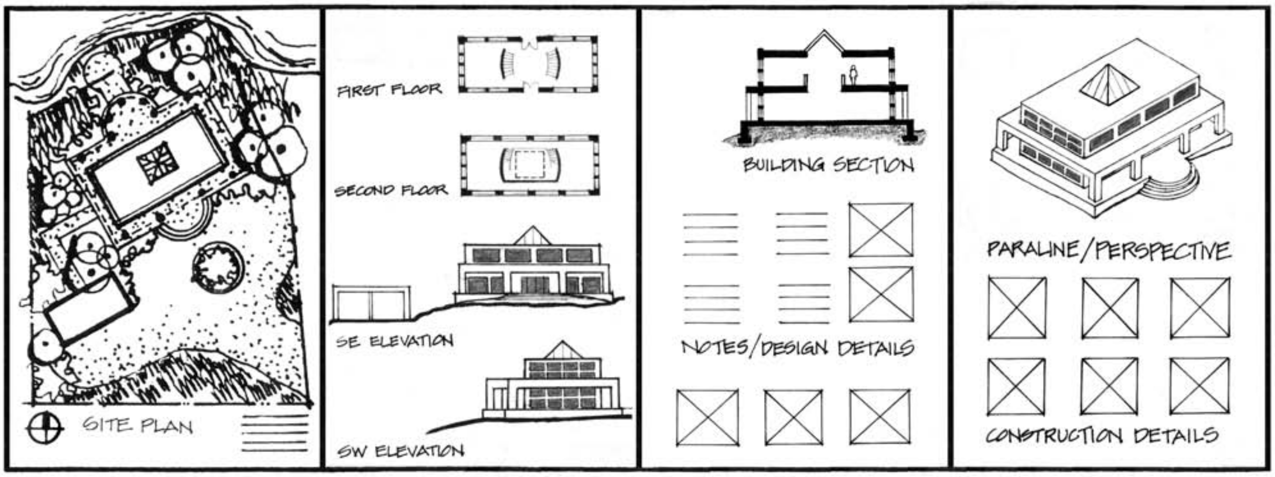




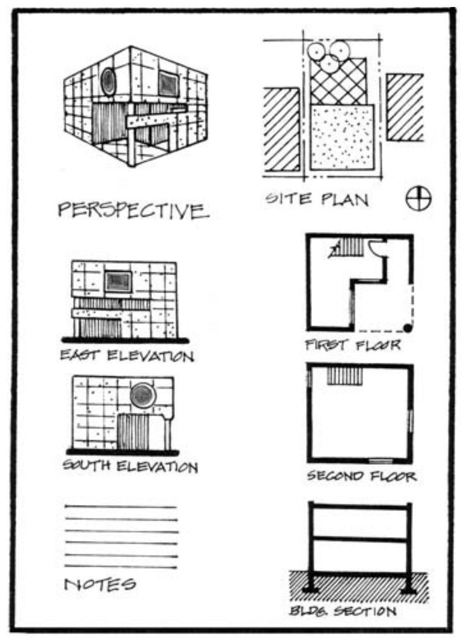
- If possible, orient the site plan with the north arrow up (**1**).
- With adequate vertical space, orient floor plans and elevations to fit in an aligned vertical order (**2**).
- Similarly, floor plans and elevations can relate horizontally if there is adequate horizontal space (**3**).
- Building sections should relate vertically or horizontally to floor plans and elevations in an aligned sequence (**4**).
- Details and notes should be grouped in a visually organized manner (**5**).
- Paralines/perspectives are the cohesive and integrative drawings that help to unify the presentation (**6**).
- The generally accepted order for exhibited drawings is left to right and top to bottom.

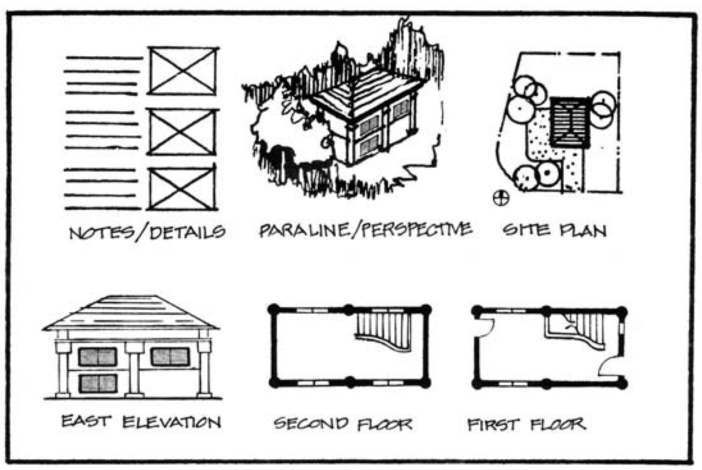


The primary architectural drawings were introduced in the section on conventional orthogonal terminology. By themselves, these drawings have little importance. However, when combined as a totality in a *presentation format,* these drawings become a strong *communicative* tool. Architectural presentations are commonly done on sequential sheets or boards. The organization and composition of drawing elements is flexible as long as there is a thread of continuity and unity, as well as a conceptual focus.

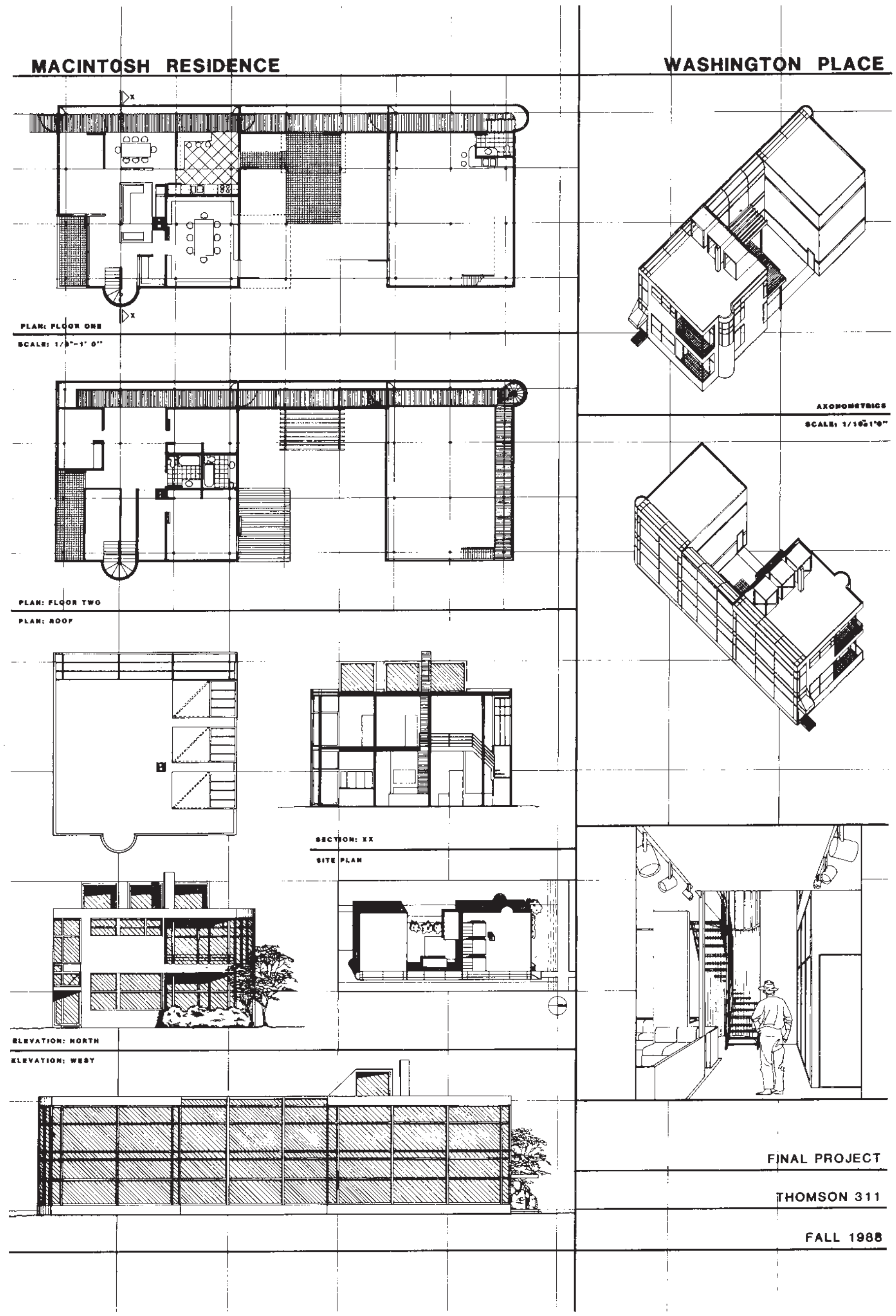


Wall presentations have the advantage of allowing a large audience to view all the drawings in context of one another. The primary components in an architectural presentation are the site plan, floor plans, elevations, sections, and paralines/perspectives. An effective presentation unifying these elements will generally require consistency in scale, orientation, and presentation technique/medium. The size of the audience and the viewing distance are normally the determinants for the choice of scale and the type of medium used.



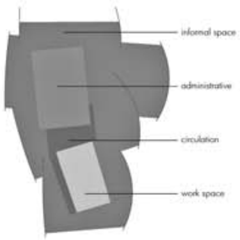


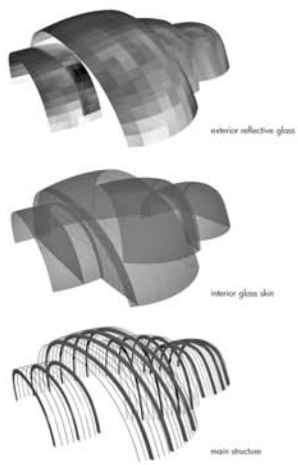
Architectural wall presentation formats are most effective when organized vertically or horizontally. The examples shown are (1) vertically oriented boards or sheets that flow and read horizontally (top row); (2) a horizontally oriented one-board or one-sheet presentation that reads as a total composition (left); and (3) a vertically oriented one-board or one-sheet presentation that reads as a total composition (right). It is often helpful to orient the site plan and floor plans in the same direction. The wall presentation is commonly supplemented with scale models, slides, reports, and the Internet (for schools, private offices, and the lay public).

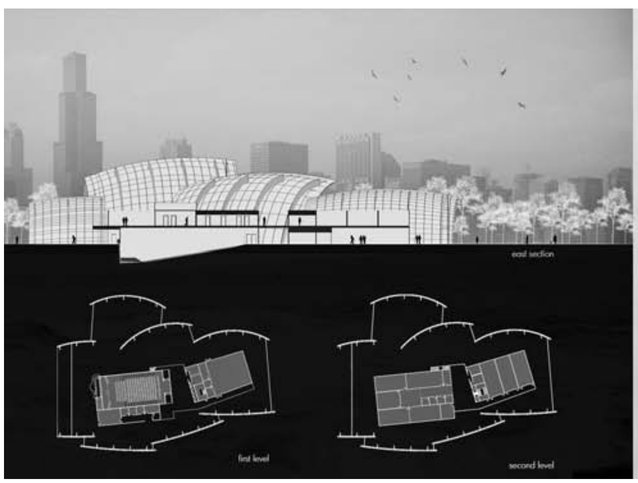


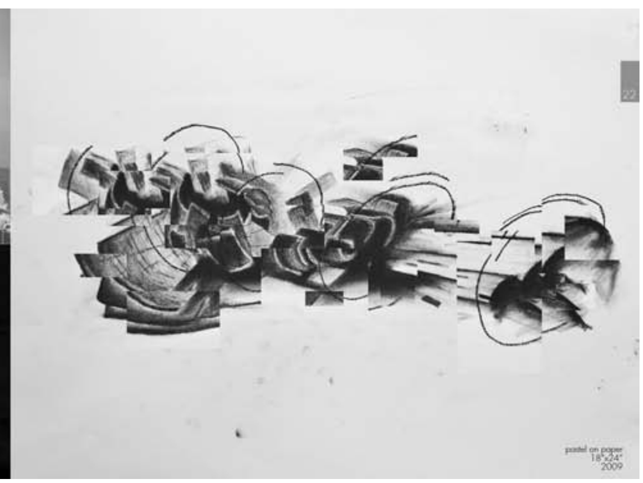
Drawing: Student project by Vaughn Dierks
Macintosh house, St. Louis, Missouri
Courtesy of Washington University School of Architecture, St. Louis, Missouri

This presentation was effectively laid out using a *grid* format. The grid is extremely effective in helping to organize all the drawings and bits of information that go into a comprehensive presentation. Grids give an organized feeling to the multiple images. Most grids are set up using squares, but rectangles can also be used. Graphics and text may be placed across or within the grid lines. The grid should be lightly drawn. The amount of negative space between the drawings is extremely important. Too much space results in drawings that “float”; too little results in a congested layout. As with any artistic composition, the proper figure–background balancing is crucial for all drawings to exist in harmony.







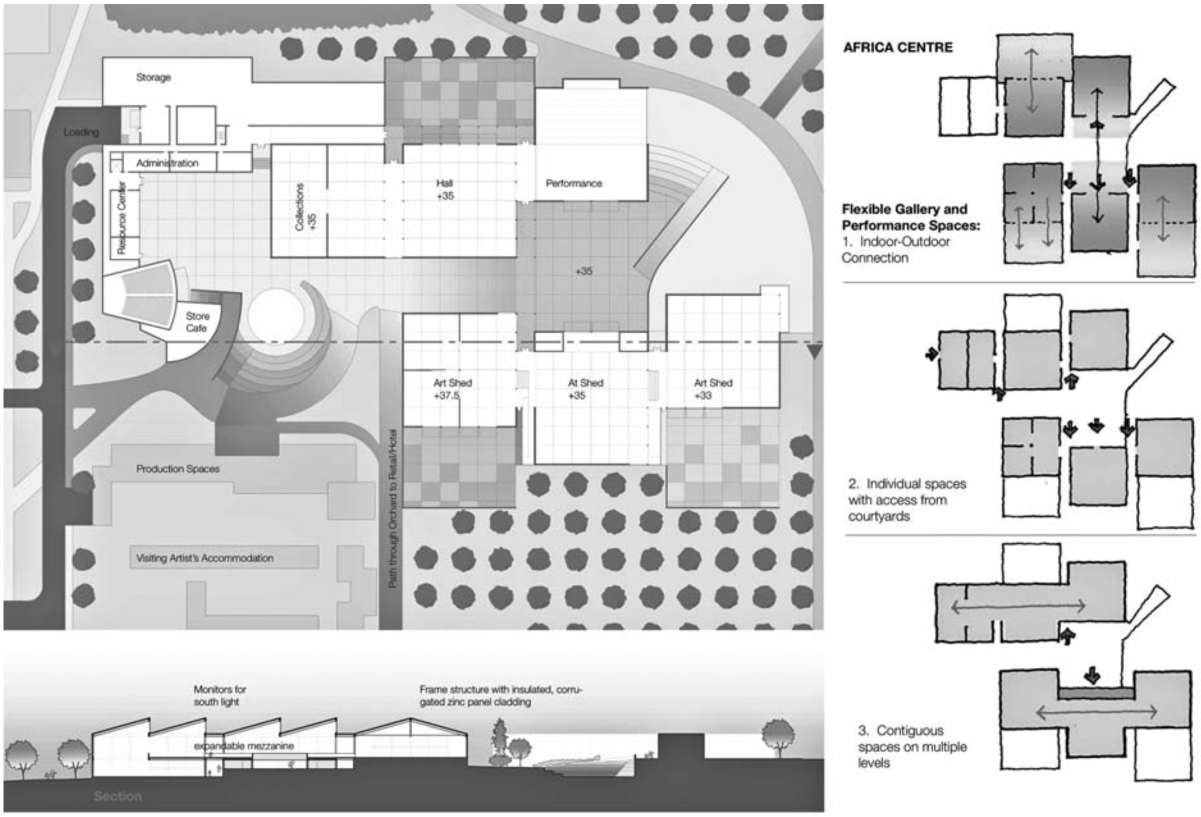


Responding to the nature of the Chicago architecture institutions merging into one building, I created an "architectural sponge" that can absorb through its porous nature the surrounding city and light while bearing a specific program. The sponge is designed to stand firm and strong within the landscape to represent the stability and growing nature of Chicago's architecture. The building creates a definite sense of presence and strength rather than simply being an idiosyncratic blob.
[Architecture student's statement]

Images: Sponge (excerpts from student portfolio)
Chicago, Illinois
Media: Line drawings—AutoCAD & Adobe Illustrator; Modelling—Rhino & Google SketchUp; Rendering—Kerkythea; Rendering postproduction—Adobe Photoshop
Courtesy of student Matthew Buyer
Bowling Green State University
Department of Architecture

See link to this portfolio on second page of portfolio chapter.

Many presentation formats are organized in other ways and by other means without relying on a grid system. For example, you can use quadrants and organize within each quadrant. Or you can simply use visual judgment in balancing all the elements.

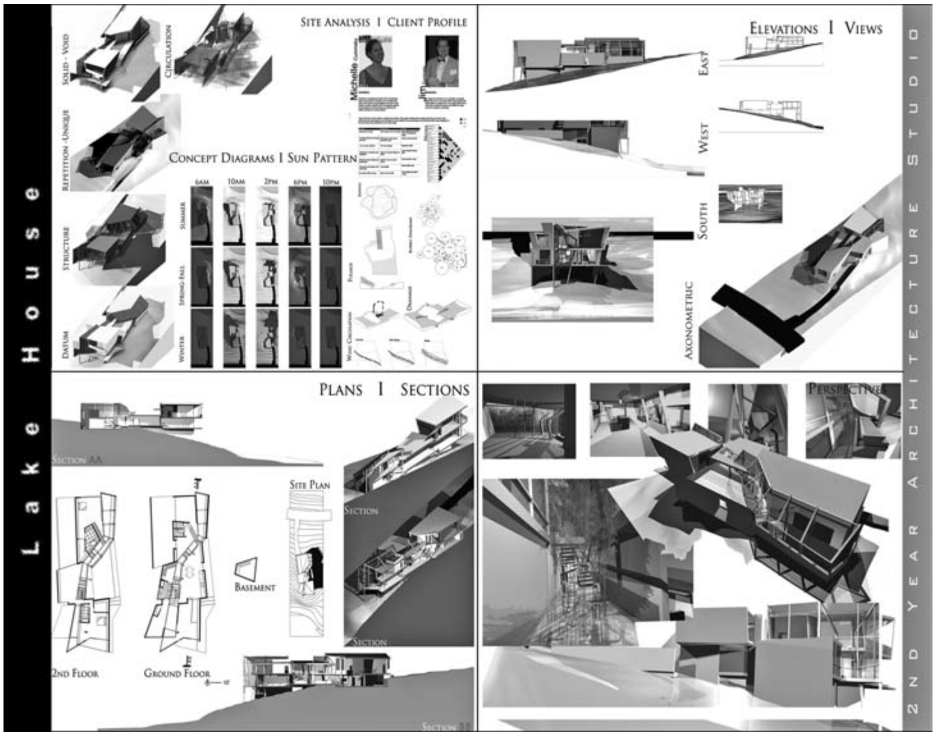


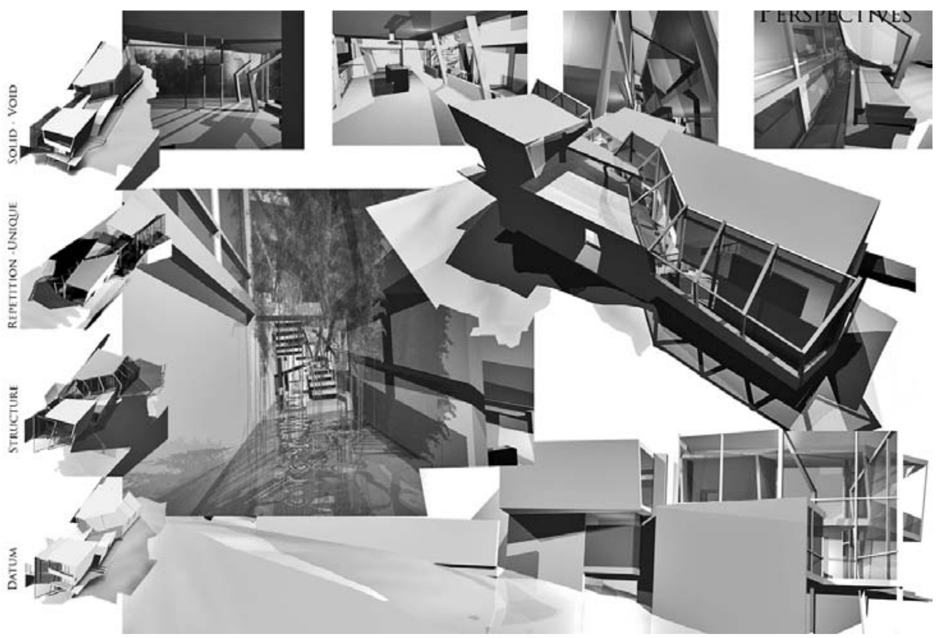
Competition Image #2 (part of an online competition submittal of ten images):
Composite plan and diagrams of the main exhibition space for the project, the Art Shed
Southbank Architectural Competition, 2006
An arts colony to be added to an agricultural estate near Cape Town, South Africa
Media: CAD drawing and hand-drawn line work with color added in Photoshop
Courtesy of Santos Prescott and Associates, Architects

Many competitions now require an online submittal of the documents, with jurors reviewing via the computer screen. This mode of presentation online requires an approach to presentation design that acknowledges the unfolding of the story line as jurors click through the images. This different mode of design must also accommodate the low resolution of the computer screen. [Architect's statement]

For quite a few decades before the 1980s, it was common practice to display a typical set of large project presentation drawings (plan, elevation, section, etc.) mounted as different pages on separate panels (also termed sheets or boards). The eighties saw a movement toward combining several drawing types into one presentation. Since the eighties and into the twenty-first century, design competitions have become more restrictive in their size requirements due to increased design submissions. This has led many competitors to experiment with and design innovative new formats. When various drawing types are combined on one panel, it is termed a *composite drawing.*

Letter size for titles or labels and any text for architectural presentations depends on how the drawings will be viewed and used. A design jury (a group of teachers, students, or peers that passes judgment on the material being presented) or client responds to the text at different viewing distances, depending on the purpose of the information. Ideally, drawings should speak for themselves; the presence of text should be as limited as possible. In general, use the smallest lettering size and the simplest style that is legible from the desired distance. In multipanel presentations, try to keep consistency in format, size, shape, orientation, and style of the drawing images. Panel continuity in the medium used can also help unify your presentation. The latter part of this chapter will show you many professional multipanel competition drawings.

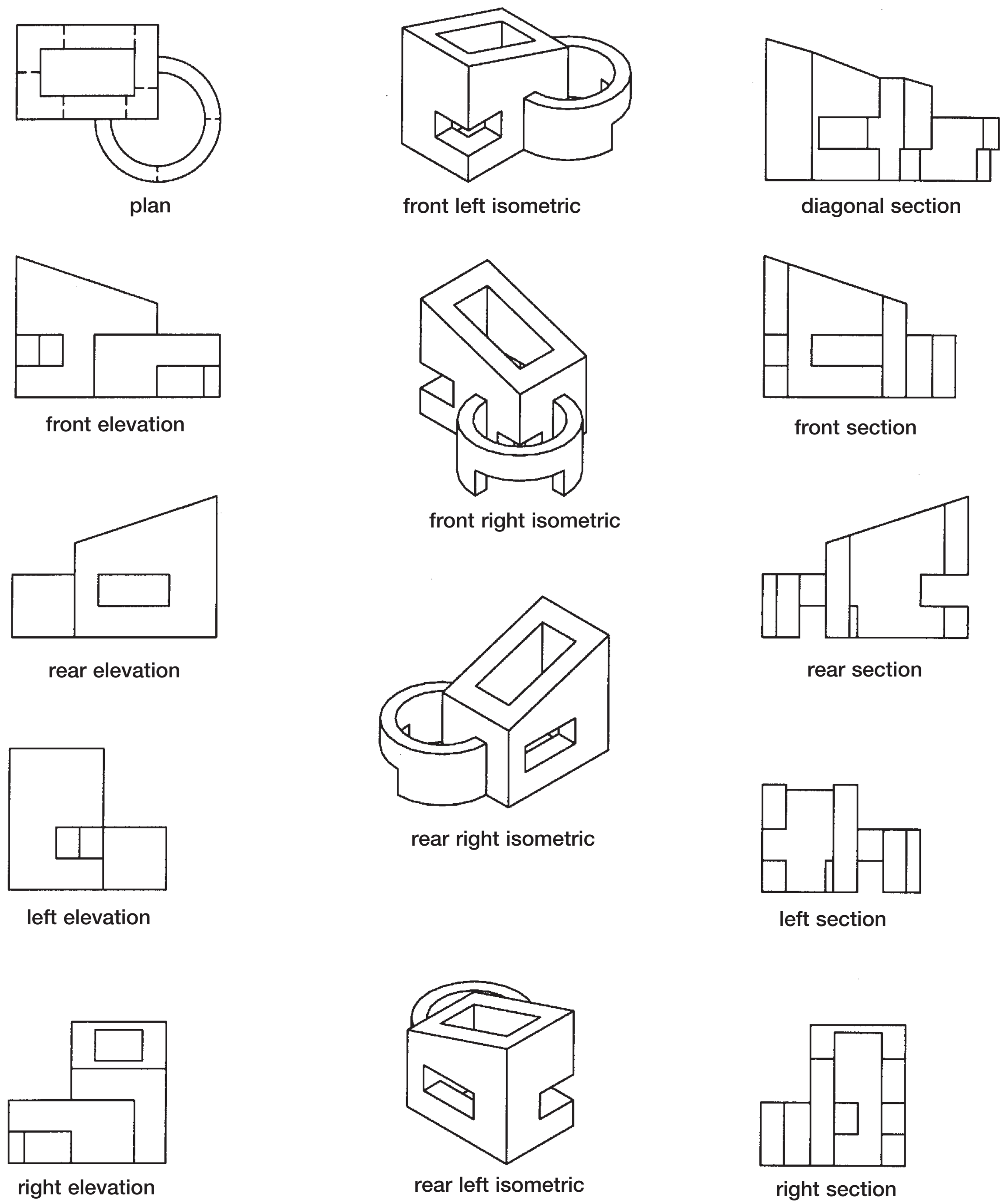




Images: Lake House
Marietta, Georgia
Media: Hand-drawn floor plans; form•Z computer models for analytical and conceptual diagrams, 3-D sections, and perspective views
Student project by Neil Patel
Courtesy of Studio Professor Dr. Saleh Uddin
Department of Architecture
Southern Polytechnic State University

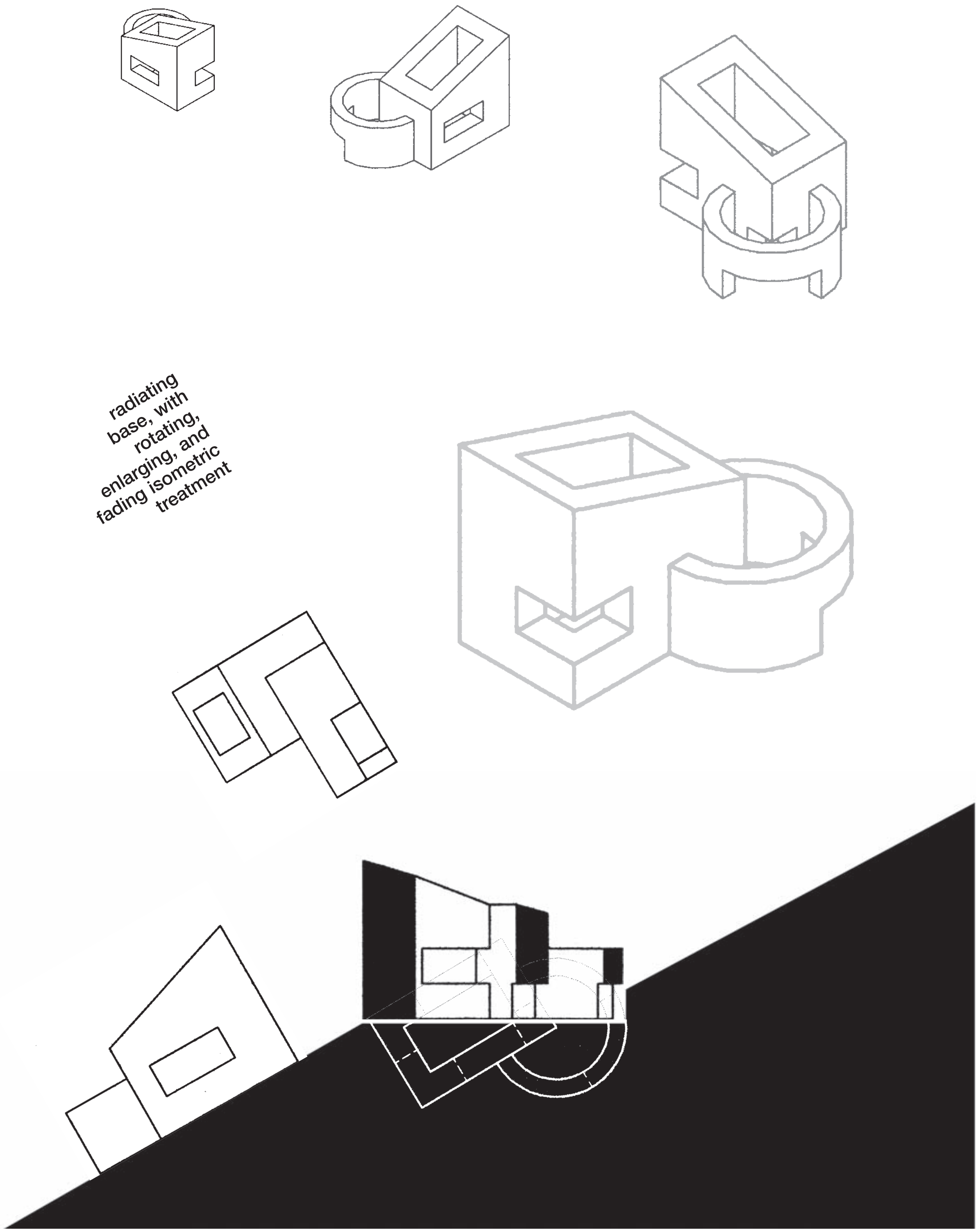
The presentation format was done on four equal quadrants (top). Beginning with analytical diagrams of site, client profile, and environmental conditions on the first quadrant, the presentation flows into the designed building environment and its interiors in the rest of the quadrants. The enlarged fourth quadrant shows computer diagrams of building datum, structure, and solid/void relationships. [Professor's statement]

In this composite drawing, many drawing types are composed as one presentation. Care must be taken so that each drawing can be read without losing its clarity. New types of composite drawings using a combination of transparent drawings, superimposed drawings, and hybrid drawings are becoming commonplace in competitions.

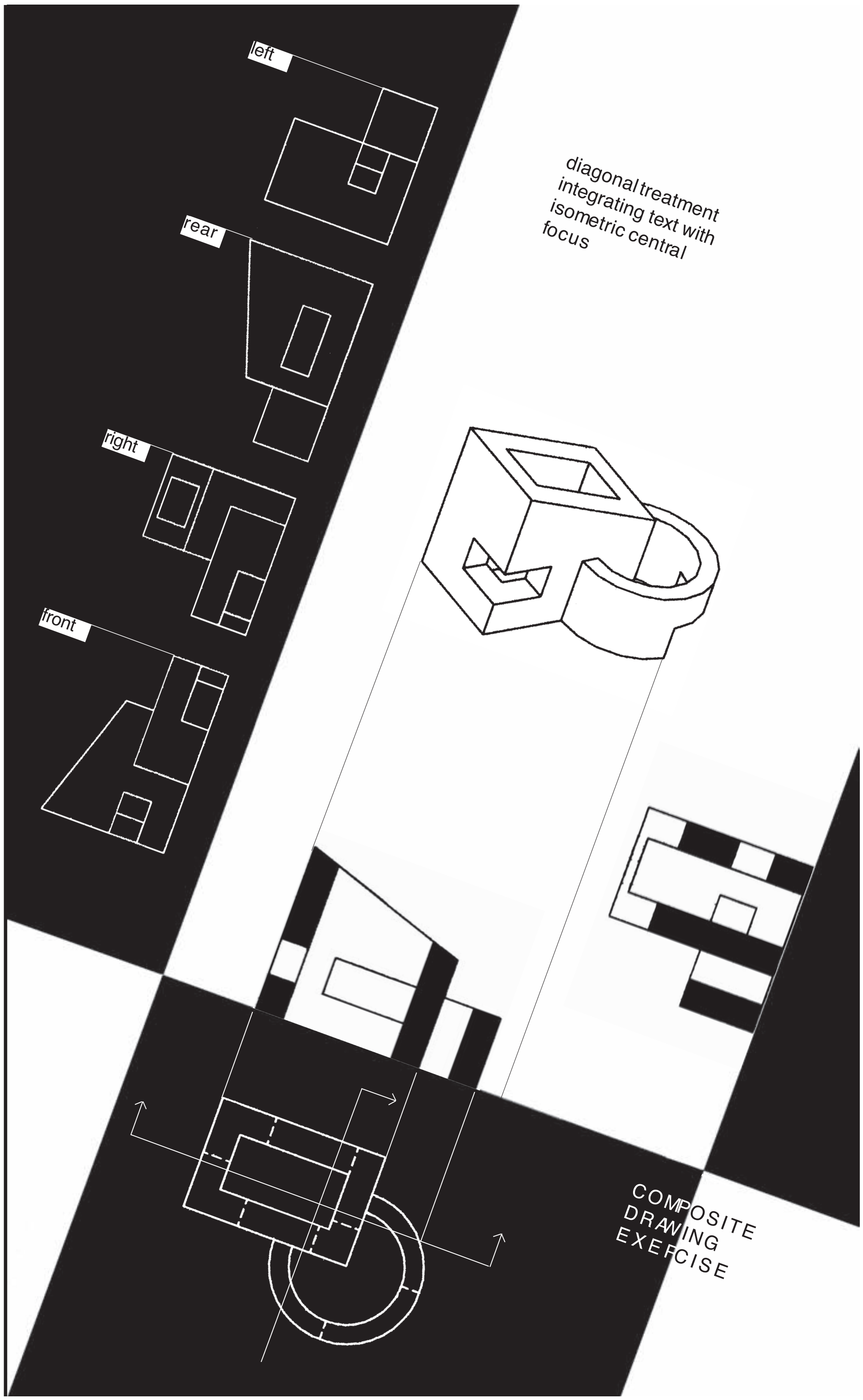


Drawings and subsequent composites designed by Kwok Tsui,
an architecture graduate of the University of Texas at Austin
Scale: $\frac{3}{32}$" = 1'0"

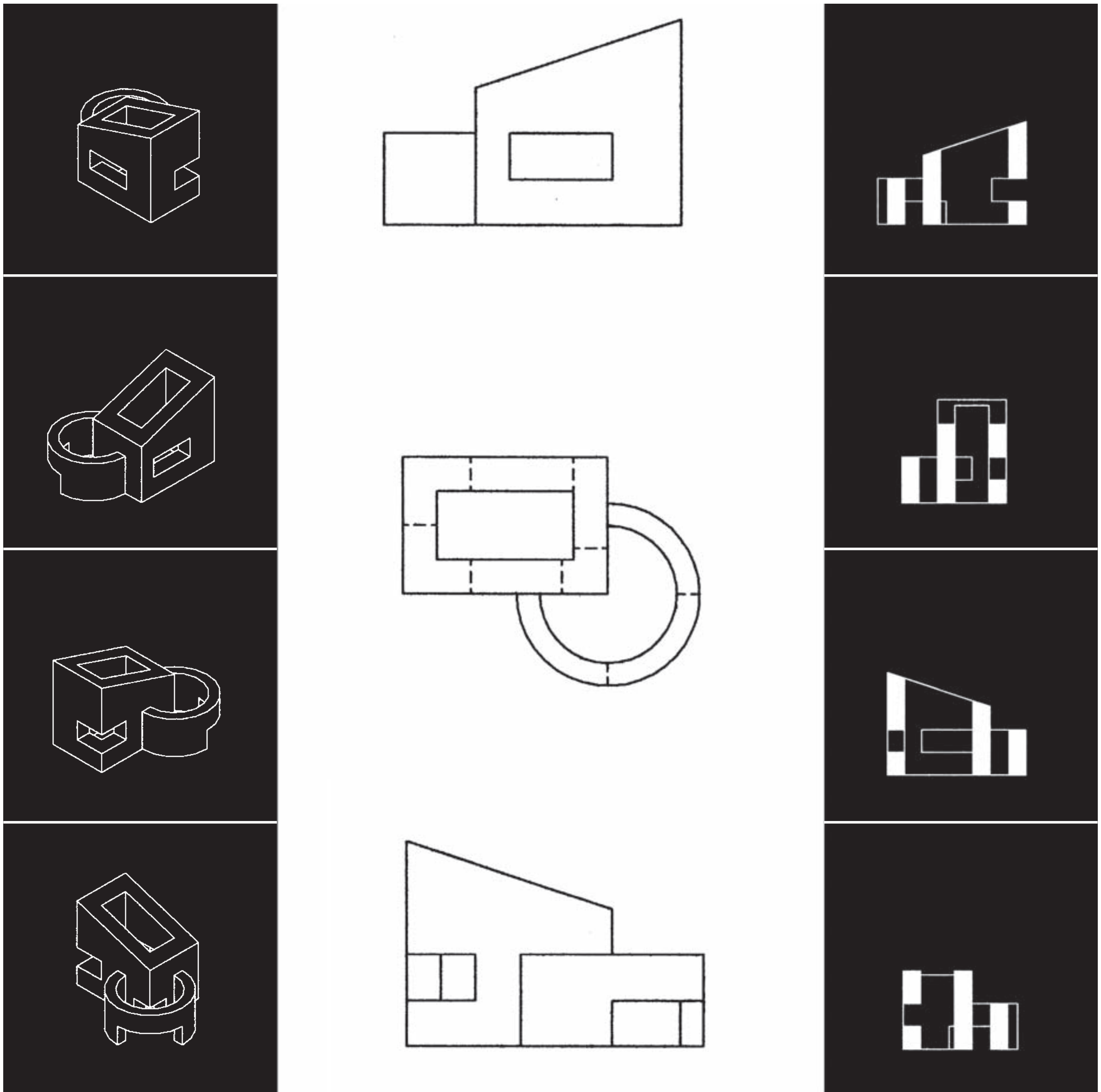
Three organizational methods for setting up a composite drawing are shown on the following three pages using the geometric elements on this page. Before designing schematic layouts for a composite drawing, be sure you have accumulated all of the drawing elements and text for the composition. Also determine whether there will be a primary center-of-focus drawing and whether all other drawings will play an equally subordinate role. Examine whether there will be any variation in the scale of the drawings. Think about how to utilize the negative space or background area, as well as how to use framing elements to establish boundaries (real or implied).



Paraline drawings like the isometrics shown here are extremely effective in composite-integrated presentations. They refer easily to and relate well with orthographic multiview drawings. Perspective drawings can also relate well to multiview drawings, but tend to be more independent. In the drawing above, the various 3-D isometric drawings are rotating counterclockwise from behind to the central focus where the floor plan, section, right, and rear elevations are located. The slanting baseline of the layout echoes the slope on the top of the structure.

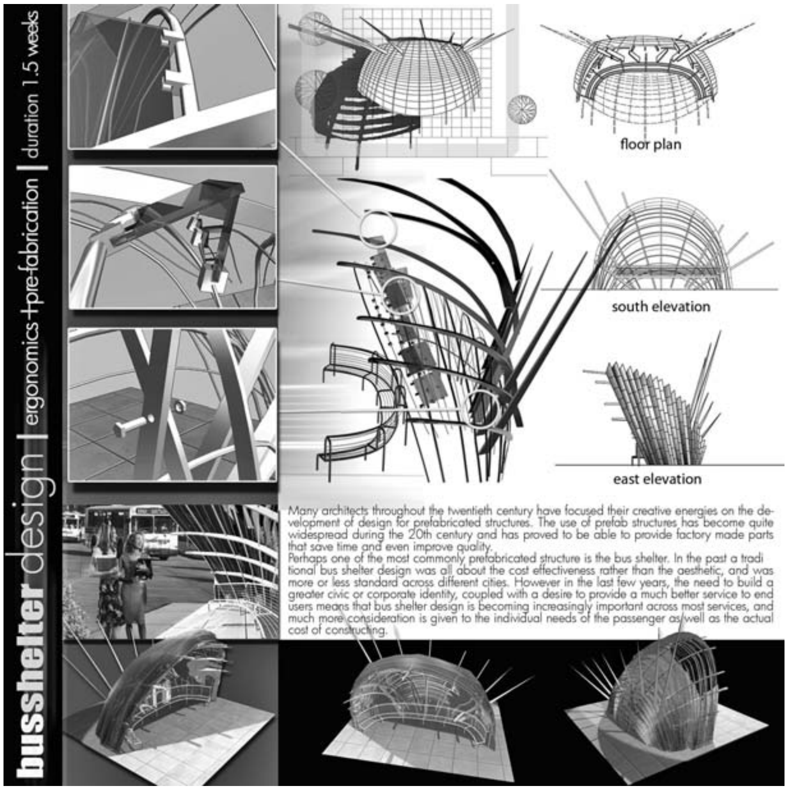


For this example, the wall thicknesses of the abstract building form have been exaggerated. The diagonal layout reflects the dynamic and interesting form of the structure. The center of interest is the floor plan, section, and isometric drawing in the middle segment, while the supporting drawing elements are placed on the sides. The drawings and the texts intertwine within the positive and negative spaces that define the design layout.



Composite Drawing Exercise: Simple Symmetrical, Side, and Base Treatment

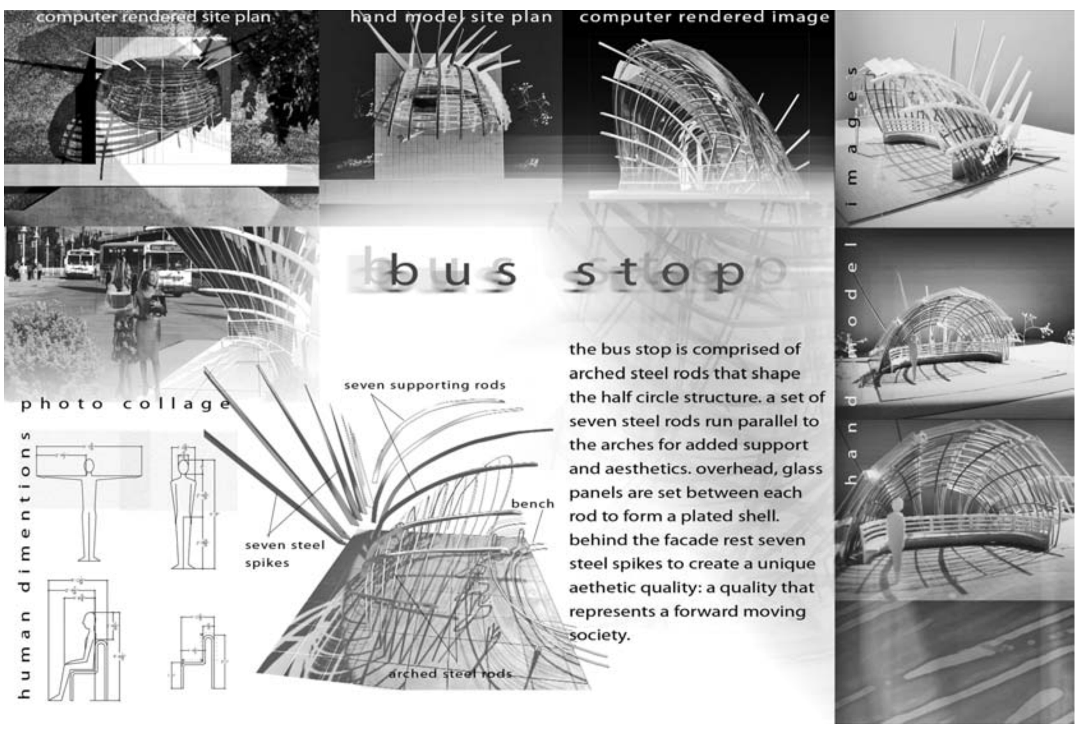
In formulating a composition for a composite drawing layout for any design project, try to be creative in balancing and arranging the elements in the drawing field. A dark or contrasting field with or without a value change can represent the base or ground area where a building sits as an elevation, a section, a perspective, etc. A dark field can also function as a negative space for text or for drawing white lines, or as a border to organize specific drawings in their relationships to one another.



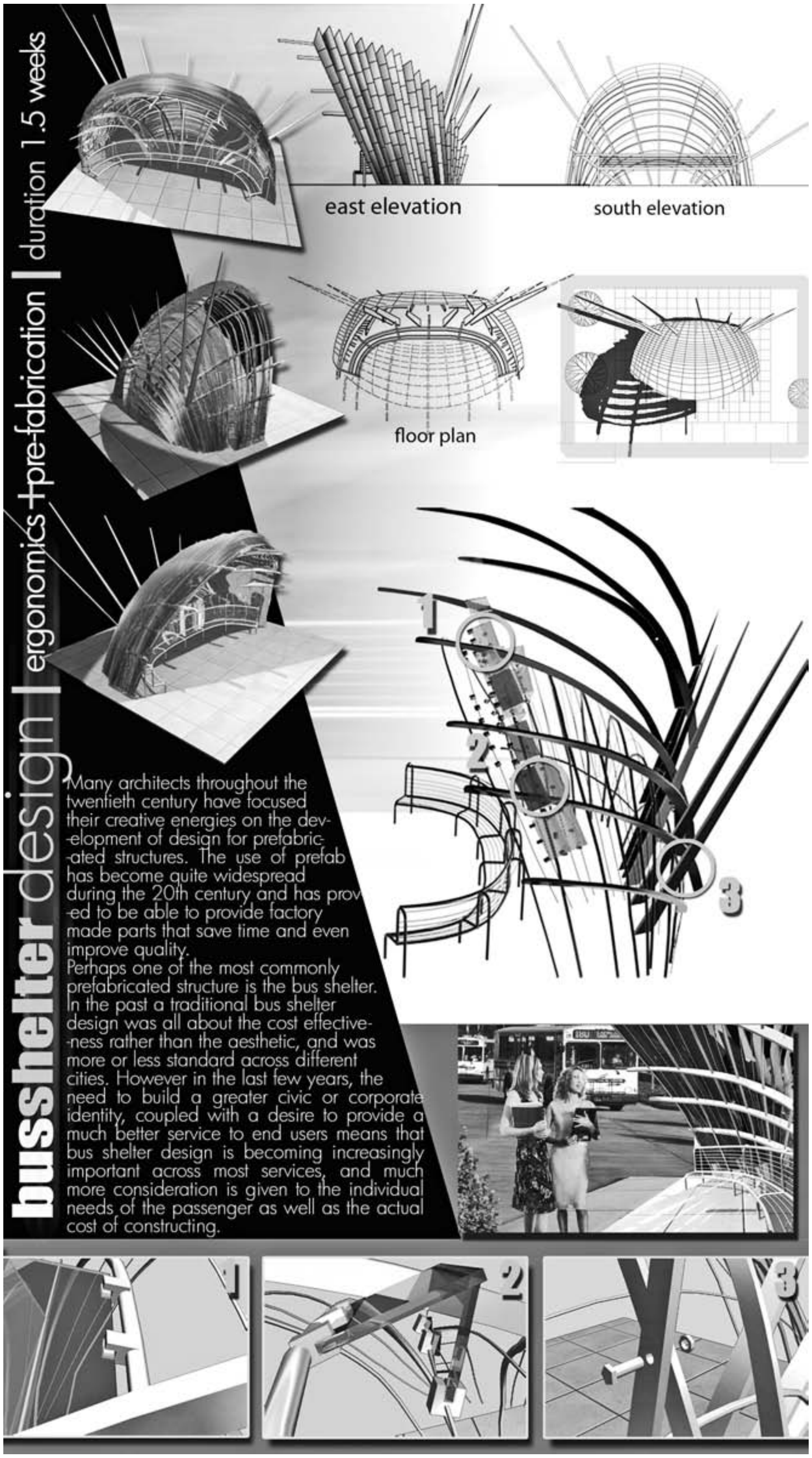
Composite drawing: Design of a bus stop
Student project by Shehreen Saleh
Department of Architectural Studies
University of Missouri–Columbia
Courtesy of Studio Professor Dr. Saleh Uddin

Image
Top: Composite board layout with allocation of rectangular blocks for individual images containing plan, elevation, assembly, site collage, and text explanation.

Bottom: Composite board layout with allocation of borderless rectangular blocks on the periphery for individual images containing images of hand-crafted model, and computer 3-D views done using AutoCAD, 3D Studio Max, and Photoshop.



***Project:** The assignment asks for a design of a bus stop in a given location using prefabricated components. The program calls for a structure with a maximum size of 20′ x 20′, to be located along the route of Georgia Cobb County Transit System. The structure should provide protection against elements but allow for convenience in waiting and boarding a bus. Introduction to basic structural principles as a determinant of design language and explorations of assembly of materials are primary goals of this project. [Professor's statement]*

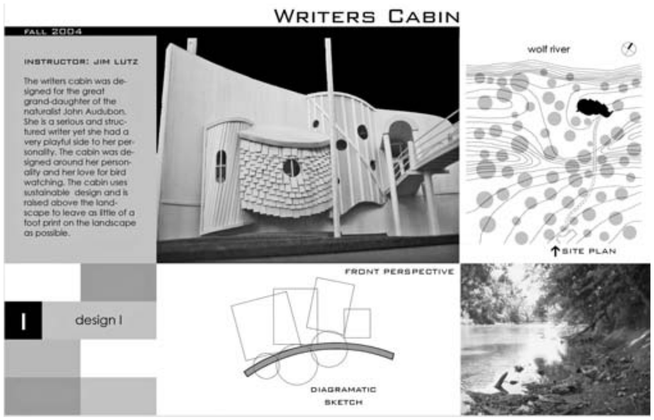


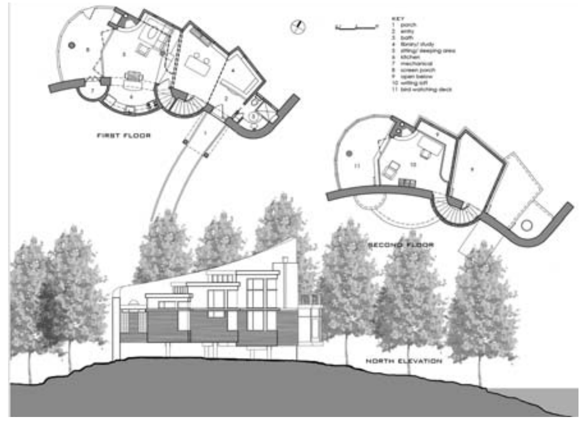
Composite drawing: Design of a bus stop
Student project by Shehreen Saleh
Department of Architectural Studies
University of Missouri–Columbia
Courtesy of Studio Professor Dr. Saleh Uddin

Image

Composite board layout using diagonal motif for allocation of computer 3-D views, and text explanation using a contrast background. Note that the strong contrasting background puts more visual emphasis on the text area as opposed to the other two presentations. [PROFESSOR'S STATEMENT]

These two facing pages illustrate three layout approaches for a composite board presentation for the same project.

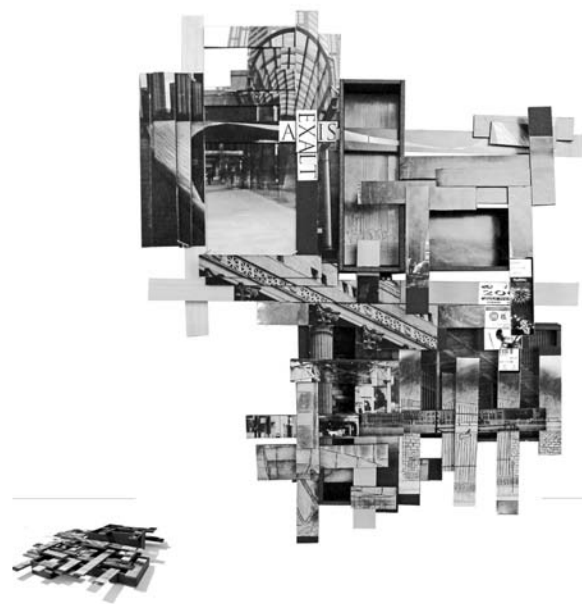




Images (above): Writer's Cabin
Courtesy of student Mario Walker
University of Memphis
Department of Architecture

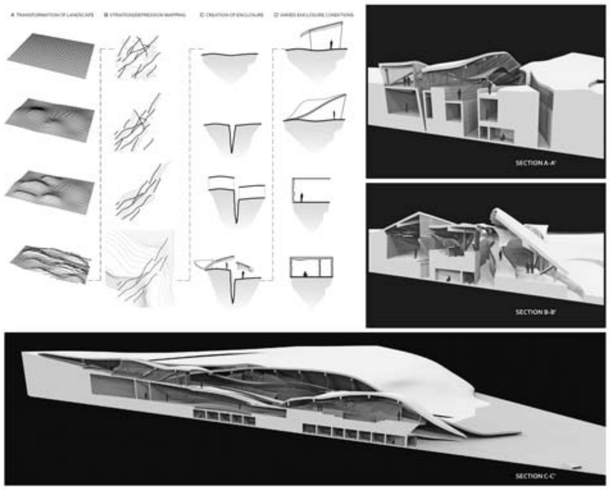
The Writer's Cabin shows a very nice juxtaposition of plan views with a site section drawing. Chicago Inspiration shows the excellent use of collage in a composite composition.

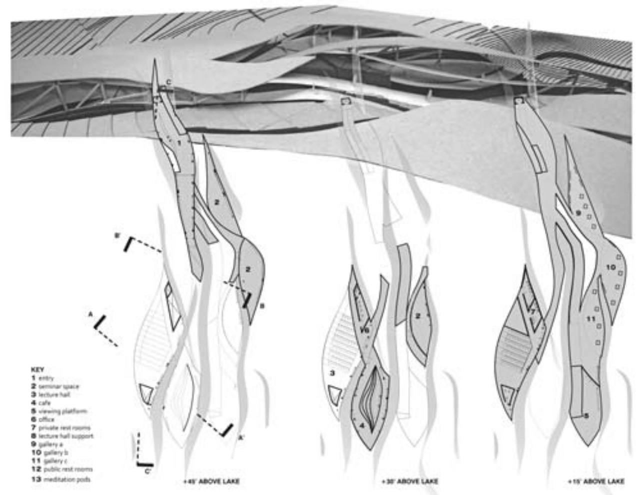
Images (below): Chicago Inspiration
Courtesy of student Geunho Song
College of DuPage
Department of Architecture



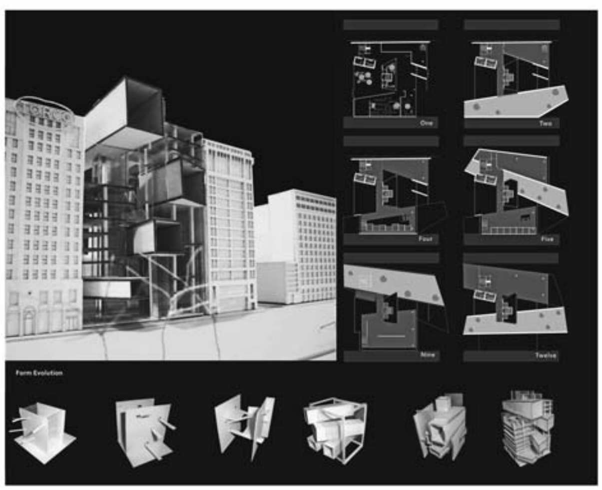
Writer's Cabin
With a simple program yet complex character, the formation of the writer's cabin referenced the client's personality, which is structured and yet capricious at different moments. With the design of the cabin expressing this "double-minded" theory, it was important to compose the boards in such a manner as to reinforce the concept. In response, the two composite boards alternate between a more controlled layout and one of "controlled chaos."
[Architecture student's statement]

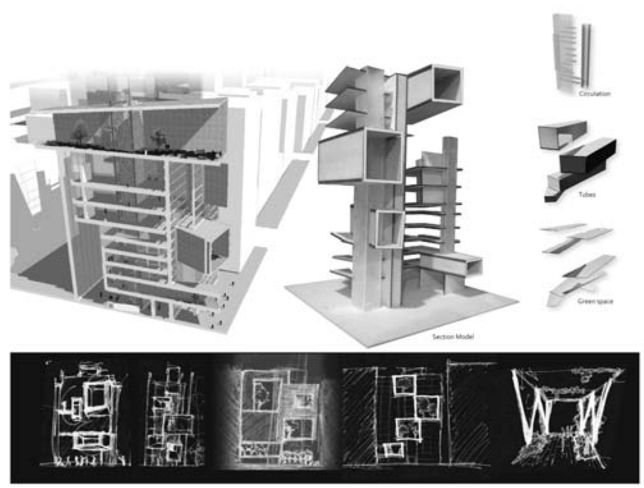
Chicago Inspiration
The objective of this project was to create a three-dimensional collage of photographs and sketches from the city of Chicago. The design process involved the fragmentations of images and three-dimensional forms to create a unified composition of form, photo, and sketch. The collage is an exploration of layered repetitive forms that serve to frame and blend the images into a cohesive collage. [Architecture student's statement]





Images: Bass Island Retreat, South Bass Island, Ohio
Media: Rhino and Flamingo renderer
Courtesy of student Drew Cowdrey
Bowling Green State University Department of Architecture
Professors Scot MacPherson and Andreas Luescher





Images: Organic Expansion, Chicago, Illinois
Media: SketchUp and Kirkythea renderer
Courtesy of student Drew Cowdrey
Bowling Green State University Department of Architecture
Professors Stan Guidera and Jon Stevens

Bass Island Retreat

With its unique program and absence of built context, diagramming the formal transformations provided a way of developing the project. Using a series of two-dimensional diagrams reduced the burden of rationalizing a complex form and instead allowed for an understanding of how the form performed.

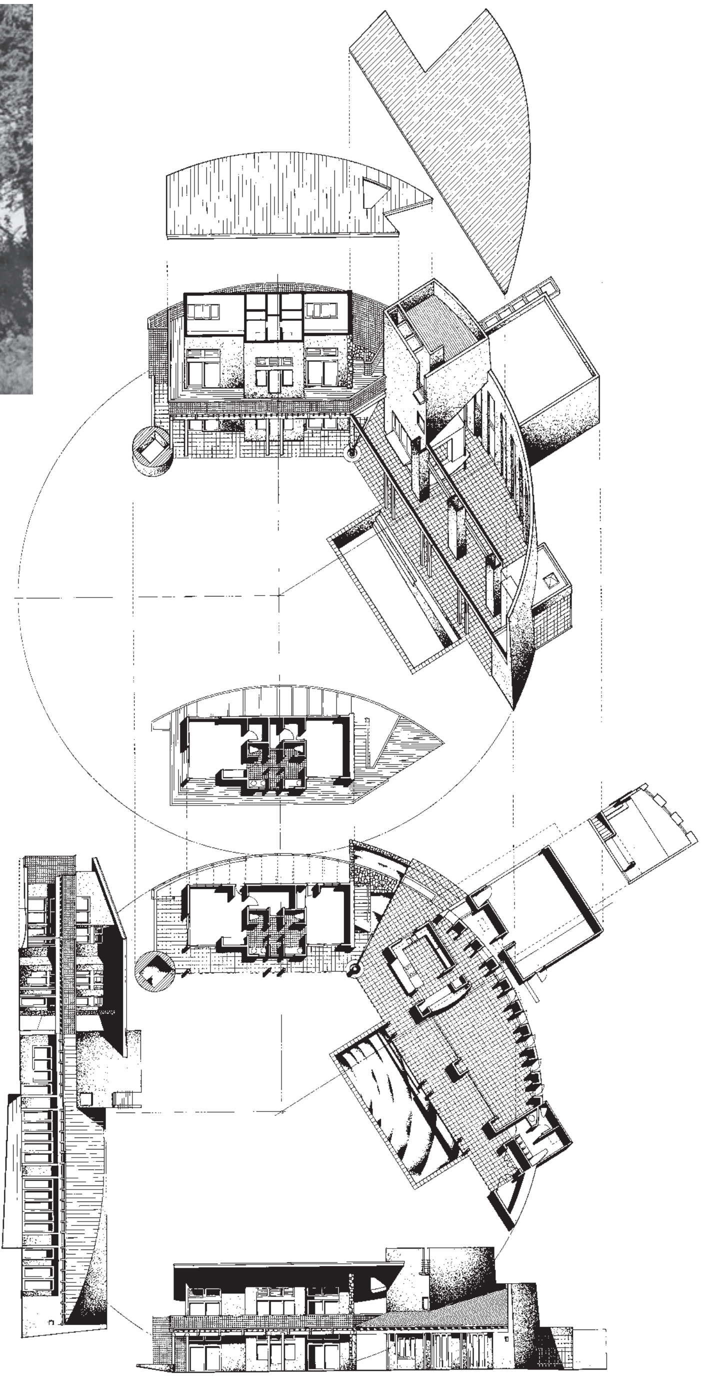
Organic Expansion

This infill project, a historic and otherwise untouched urban wall on Michigan Avenue in Chicago, prescribed a rather restrained surface intervention. The result was that I used a series of increasingly less abstract spatial models that allowed the project to evolve from thinking about a surface to thinking about a surface's interaction with the content behind it.
[Architecture student's statement]

© Michael French, photographer

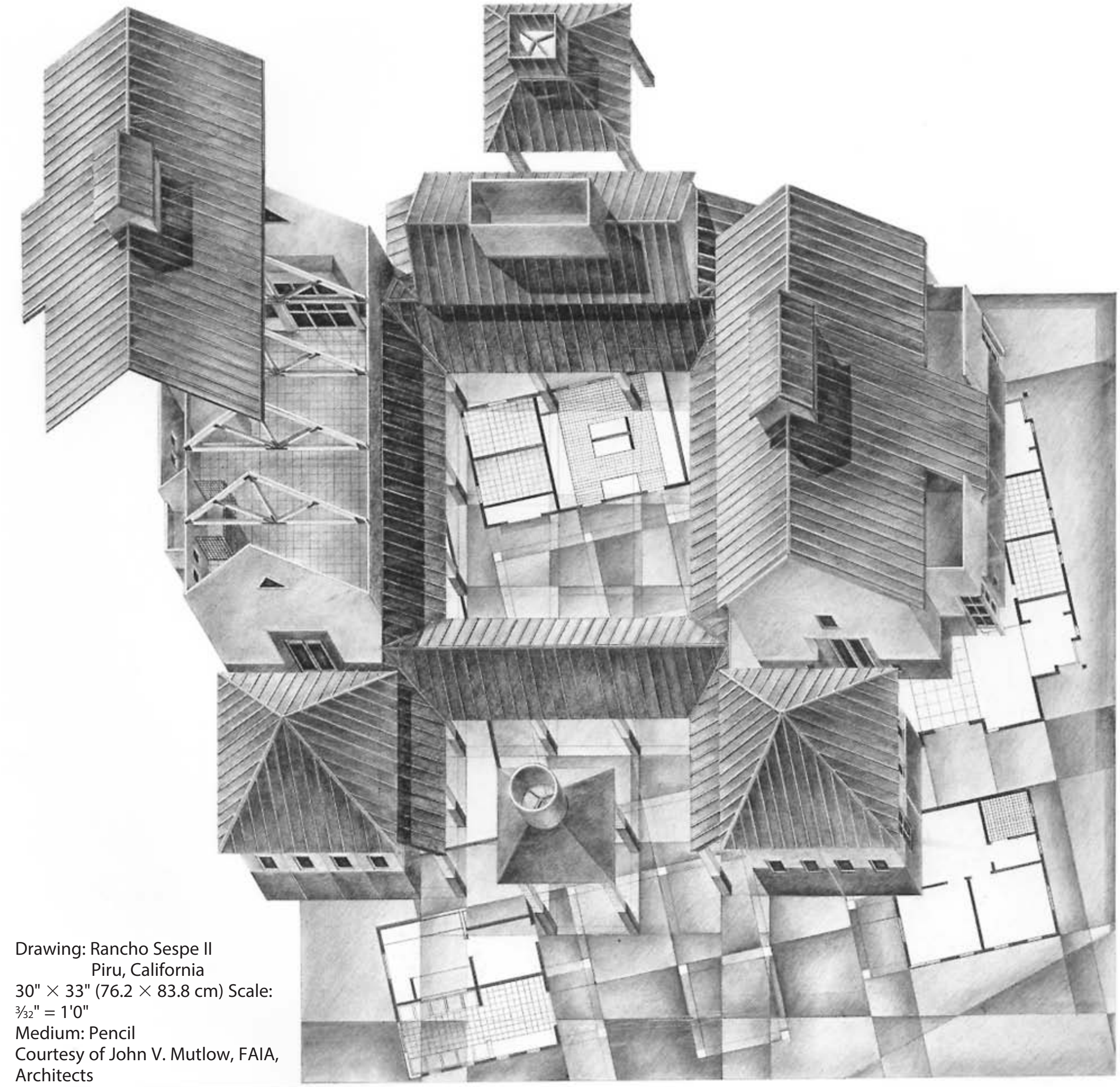
The rendering is a composite of drawings graphically laid out around the geometrics of the plan and interrelated through a system of regulating lines. By using multiple images, it is possible to understand the building plan and spatial characteristics within the framework of a single drawing. The precision of pen and ink was needed to allow for the finer features to read clearly.

Design: *A massive curving wall anchored in lava cliffs encircles and protects a tropical retreat on the island of Maui. By turning its back on the intense south and west sun, the house caters to clients who desired a site-specific home that utilizes the tropical island's unique character and lifestyle. Indoor and outdoor spaces are inseparably linked with disappearing walls that open each room onto outdoor lanais. Intricate screens cast glittering patterns of light and shadow as they trace the sun's path, while tropical vegetation cascades down the lava cliffs and spills inside, tying the feeling in this house to the lush, garden nature of the site. A linking tower offers distant views to the volcano of Haleakala and the Pacific Ocean beyond.*
[Architect's statement]



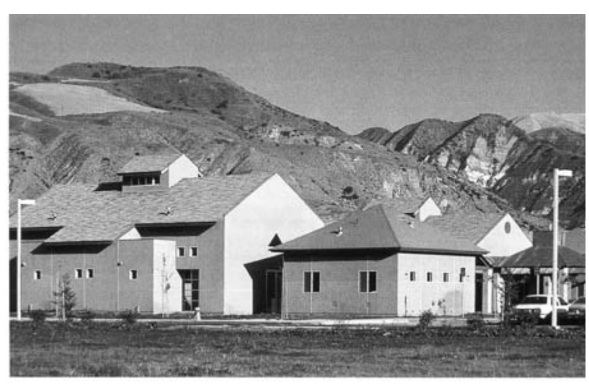
Drawing: Ka Hale Kakuna residence, Maui, Hawaii
Plan oblique, plan, and elevation composite
26" 3 48" (66 × 121.9 cm)
Media: India ink and airbrush on Mylar
Courtesy of House + House Architects, San Francisco; David Haun, Architectural Illustrator

Transparaline drawings can be either *transmetric* (showing two sides foreshortened) or *transoblique* (showing one side true size and the other either foreshortened or true size). Both elevations shown here are *transoblique* drawings.



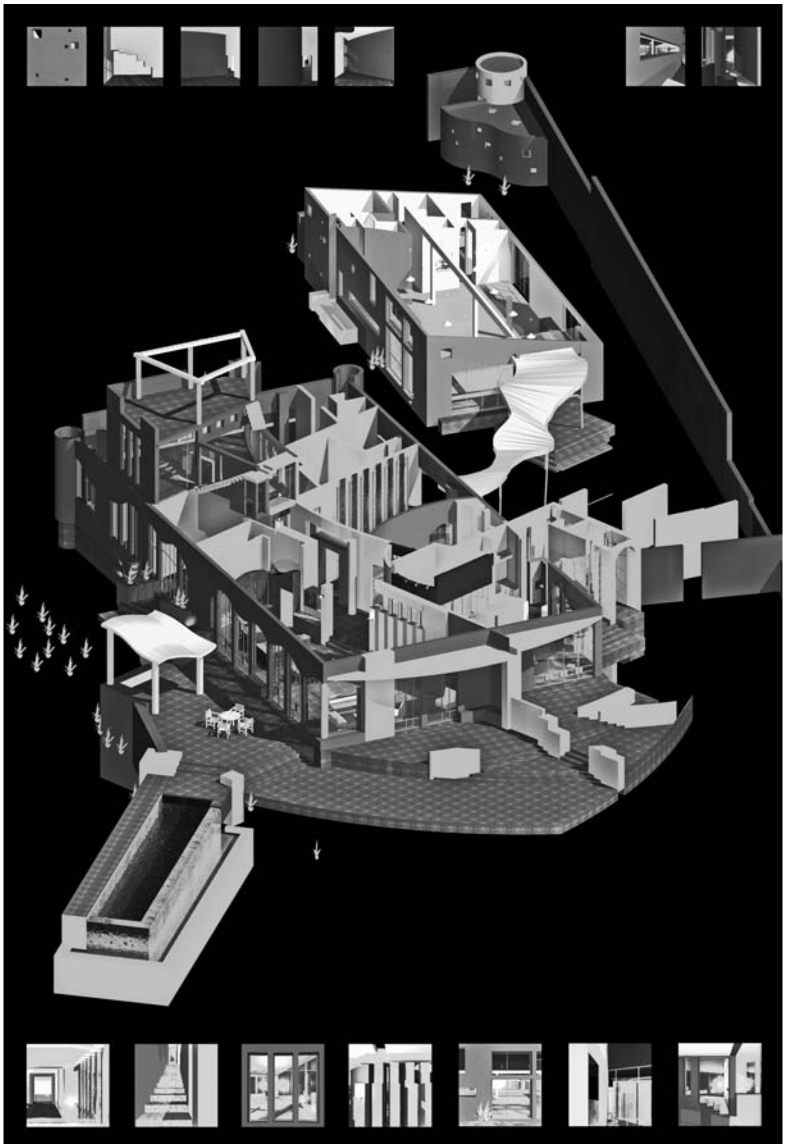
Drawing: Rancho Sespe II
Piru, California
30" × 33" (76.2 × 83.8 cm) Scale: $\frac{3}{32}$" = 1'0"
Medium: Pencil
Courtesy of John V. Mutlow, FAIA, Architects

The design intention is to assemble three basic unit types—a two-, three-, and four-bedroom townhouse—into a series of three-, four-, and five-unit attached building types. By using both the side-by-side and mirror-image dwelling unit formats, more than different building types can be developed, resulting in building differentiation and identification from economical unit repetition. This is one illustration of eight building types that were developed. The 6B pencil rendition of a two-dimensional elevation with the combination of dwelling unit floor plans assists in an understanding of the three-dimensional quality of the facade and the differentiation of the building types.
[Architect's statement]



© **John V. Mutlow, FAIA**

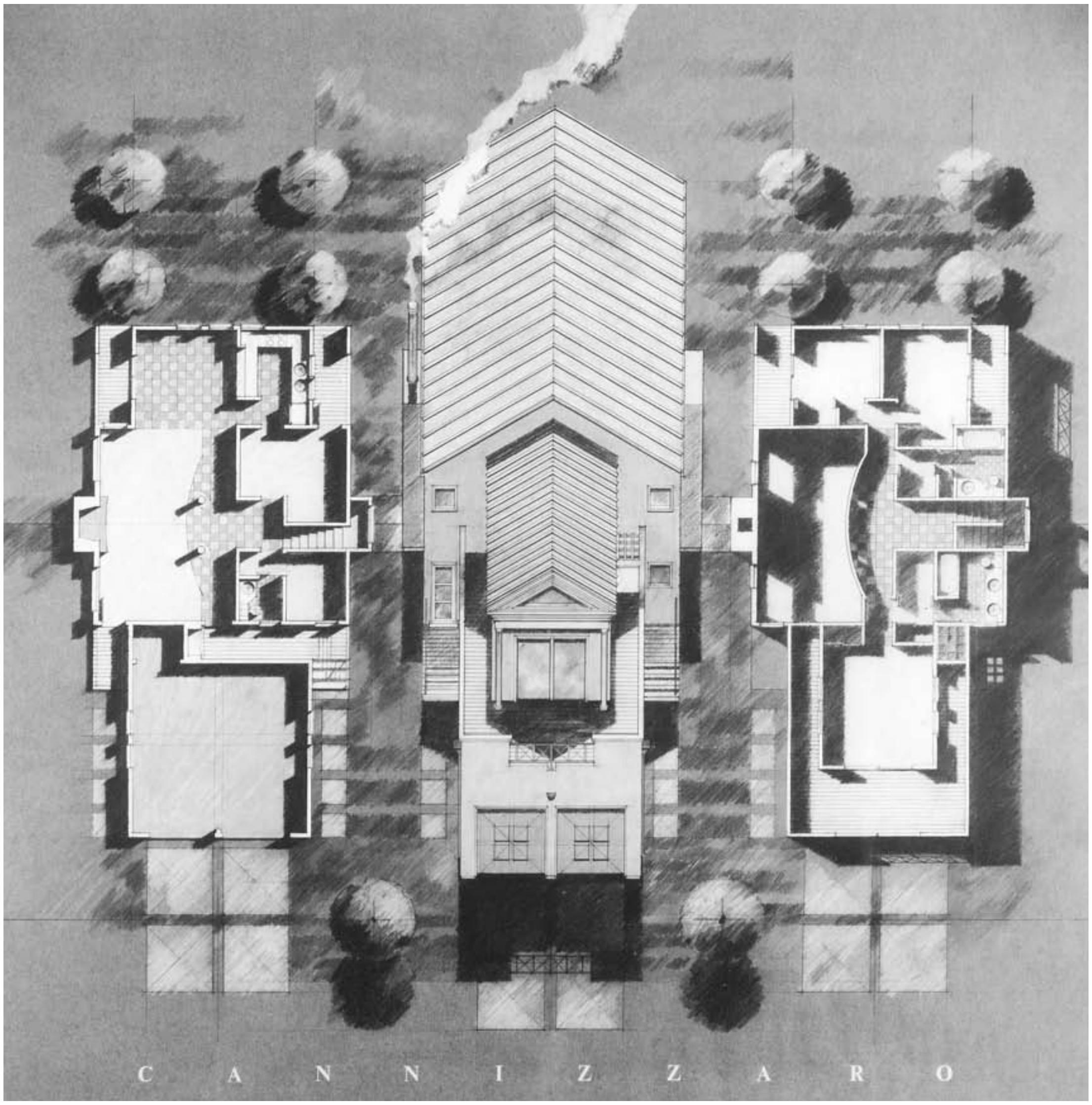
AXONOMETRIC COMPOSITE WITH DETAILS



This axonometric rendering of a former factory remodeled into a new home and folk art gallery illustrates the complexity of this unique project in central Mexico. By removing the roof, one can clearly see the layout of each room and its relationship to the various exterior terraces. The bold use of color was an important design element throughout this project and is clearly presented in this drawing. Carefully selected details were drawn as a series of squares and are located at the top and bottom of the rendering.

A circuitous journey leads to the glass entry doors set deep into the home's center at the intersection of cosmic lines, flanked by fire and water. A curvaceous mango-colored roof links home to studio. Flowing lines continue in the windows, ceilings, terraces, railings, and tile murals, all softening the original simple rectilinear form. Ancient mesquite branches arc over the lap pool as it soars into the landscape.
[Architect's statement]

Drawing and photos: Casa Renacimiento
Atotonilco, Mexico
13" × 19" ArchiCAD axonometric with details
Courtesy of House + House Architects
Rafael de le Lama, Architectural Illustrator
© Steven & Cathi House, Photographers

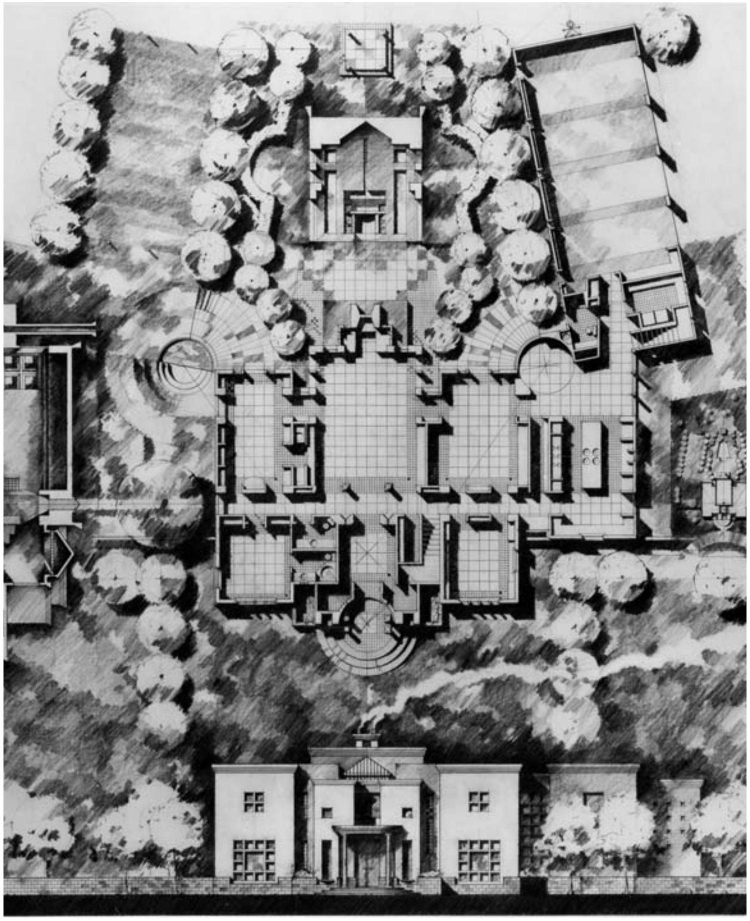


Drawing (plan and elevation-oblique composite): Cannizzaro residence, Montara, California
36" × 36" (91.4 × 91.4 cm), Scale: ¼" = 1'0"
Media: Pencil, Prismacolor, and spray paint on vellum
Courtesy of House + House Architects
James Cathcart, Architectural Illustrator

This rendering technique was selected to emphasize the formal layout of the plan and the symmetrical nature of the front elevation. After the basic pencil work was completed, the back of the vellum was spray-painted black to provide a gray background. Prismacolor was used on the back and front to create a desired soft pastel effect on the house and also to highlight the landscape elements on the front.

This modest home in a traditional neighborhood presents a formal facade to the street. Grey- and peach-colored siding with bold openings break the building's mass into highly controlled compositions. The curved bridge at the second floor provides a dramatic overview to the living room below. Pure symmetrical forms intermingle with a strong axial geometry to create a contemporary home of classic proportions. [ARCHITECT'S STATEMENT]

© **Gerald Ratto, photographer**



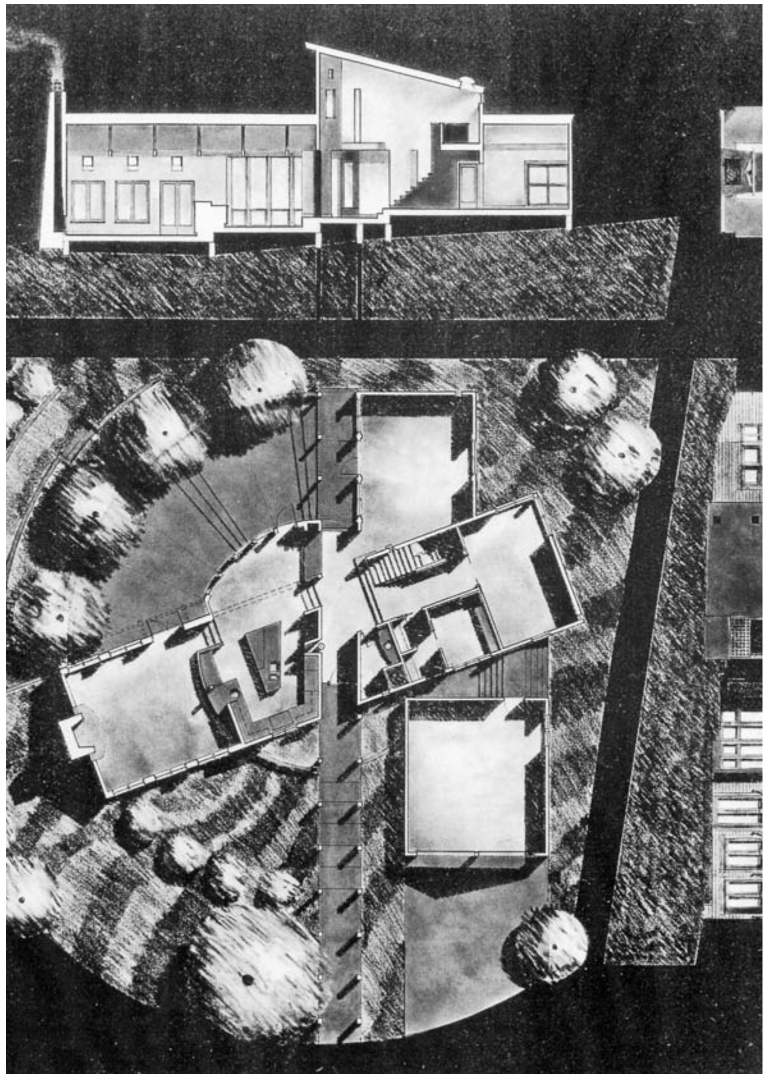
Gersch residence, Hillsborough, California
Plan, elevation, and sections composite
36" × 36", Scale: ¼" = 1'0"
Medium: Pencil and graphite on vellum
Courtesy of House + House Architects
James Cathcart, Architectural Illustrator
© Gerald Ratto, photographer

This complex drawing illustrates the formality of a modern Palladian villa built in northern California through a carefully integrated composition of defining elements. The floor plan and the front elevation dominate the drawing and express the overall formality of the house's design. Building cross-sections are positioned around the plan to reveal the clarity and detail of the interior spaces. Pencil on vellum was chosen for its timeless, classical technique and to illustrate the formal composition of the home.

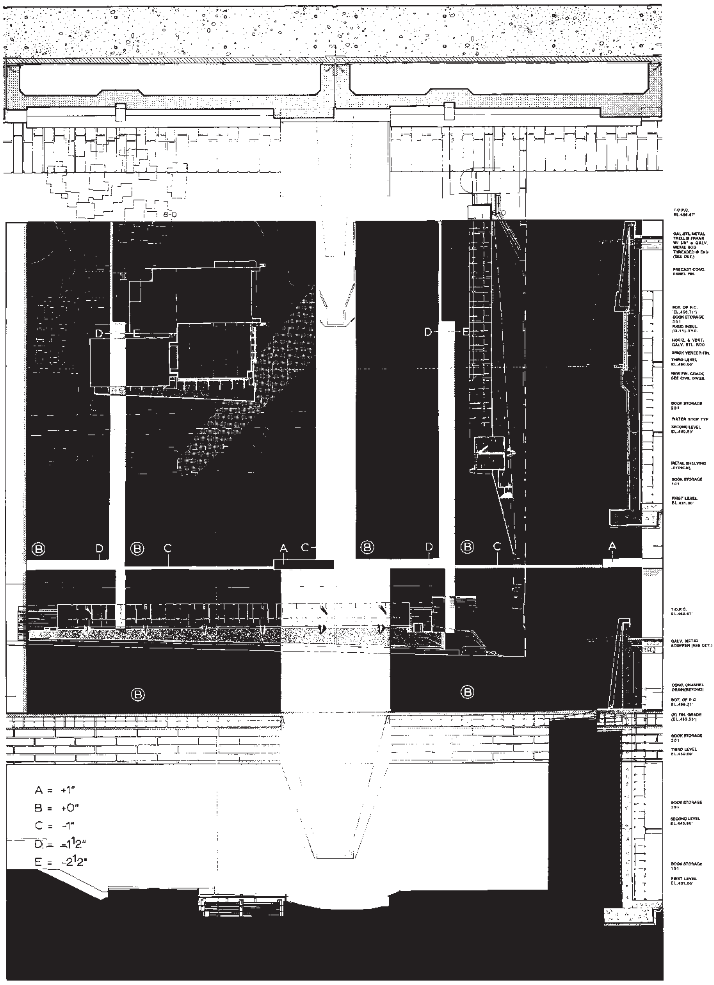
Symmetry, axiality, progression—elements of a classic modern villa that draws its proportions and stylistic references from northern Italy, yet this is a contemporary Northern California home with a primary focus on indoor-outdoor living. Rooms spill out onto sun-drenched terraces, pool and spa, and gardens enclosed by stands of mature trees. The play of light and shadows on thick walls gives solidity and a sculptural quality, which is enhanced by varying ceiling heights, limestone details, and hand-rubbed plaster. [ARCHITECT'S STATEMENT]

The overall composition of this drawing presents the form and layout of this new home that was built to replace one destroyed in Oakland, California's tragic firestorm. The ground-floor plan anchors the drawing and is surrounded by sections and an exterior elevation. The various design elements are carefully rendered to express the mass and form of the building. Prismacolor pencils are used on both front and back of the vellum to render the extensive color palette throughout the house.

The intersecting wings of this modern home divide public and private gardens, each room flooded with natural light. Exterior cedar siding stained in translucent turquoise complements the copper-plated steel brackets and copper inlays in the floor. Colored concrete terraces and counters reflect the clay tile roofing. Lofty ceilings and carefully placed windows and skylights invite patterns of light that change throughout the day. Protruding bays articulate the building's mass, while wood, stucco, and copper detailing respect the history and traditional character of the neighborhood.
[Architect's statement]



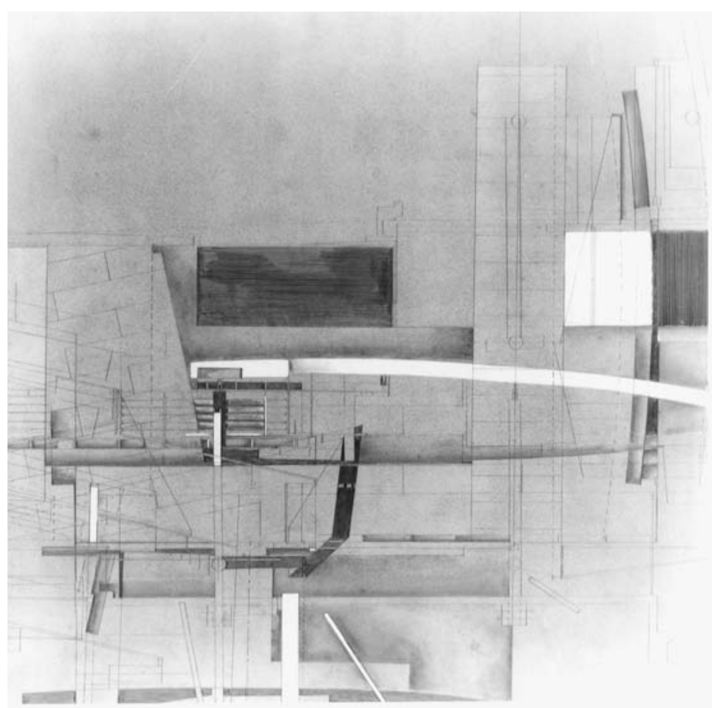
Plan, elevation, and sections composite: Langmaid residence, Oakland, California
30" × 30", Scale: ¼" = 1'0"
Medium: Colored pencil and graphite on vellum
Courtesy of House + House Architects
David Haun, Architectural Illustrator
© Mark Darley, photographer



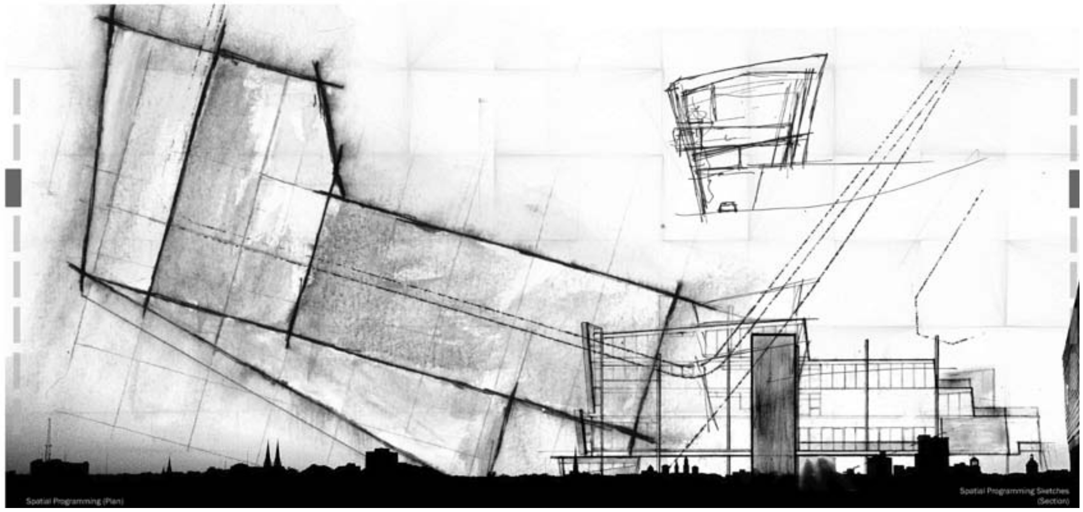
Drawing: University of California–Los Angeles Southern Regional Library Los Angeles, California
30" × 40" (76.2 × 101.6 cm), Scale: ⅛" = 1'0"
Medium: Ink and reversed printing
Courtesy of Franklin D. Israel Design Associates, Inc., Architects

Superimposed composite drawings can have the look of a beautiful abstract artistic composition. Their drawback is that the myriad array of lines and shapes used to compose them can become confusing—sometimes only their originator can understand them. However, when put together with great clarity and little ambiguity, composite hybrids force the viewer to look at the project as one integrated presentation. Composites can combine different drawing techniques and types, as well as different media. For example, you can fuse manual with digital techniques. You can even superimpose and combine different ideas.

Superimposing different drawing types allows for the maximization of information in a limited space. Composites can portray a large amount of comprehensive overview information in a single space. They should not portray conventional drawing information (such as plan, site plan, elevation, section, etc.) in adjacent but separate spaces.



Drawing: Blades residence, Goleta, California
Medium: Graphite on Mylar
Courtesy of Morphosis and Thom Mayne with Sarah Allan, Architects



Drawing (above): Spatial programming composite sketch drawing
Courtesy of student Jerome Elder
Savannah College of Art and Design
Department of Architecture

Drawing (left): House in Calderara
Imperia, Italy
Medium: Pencil
Courtesy of Professor George S. Loli
Department of Architecture
University of Louisiana–Lafayette

The drawings illustrate the emotive interpretation and use of color in the representation and exploration of space, circulation, and adjacency. Watercolor was used to freely express the movement and add emphasis to these aspects of the design. This exploration further informed the section through which the building took form three-dimensionally. The longitudinal section was a final iteration of the form and its relation to the environment during the schematic design phase. [Architecture student's statement]

This composite design sketch shows a house in disrepair undergoing a renovation where views, and consequently terraces, become important design considerations. This drawing documents the client–designer dialogue, which discusses the initial design opportunity. [Professor's statement]

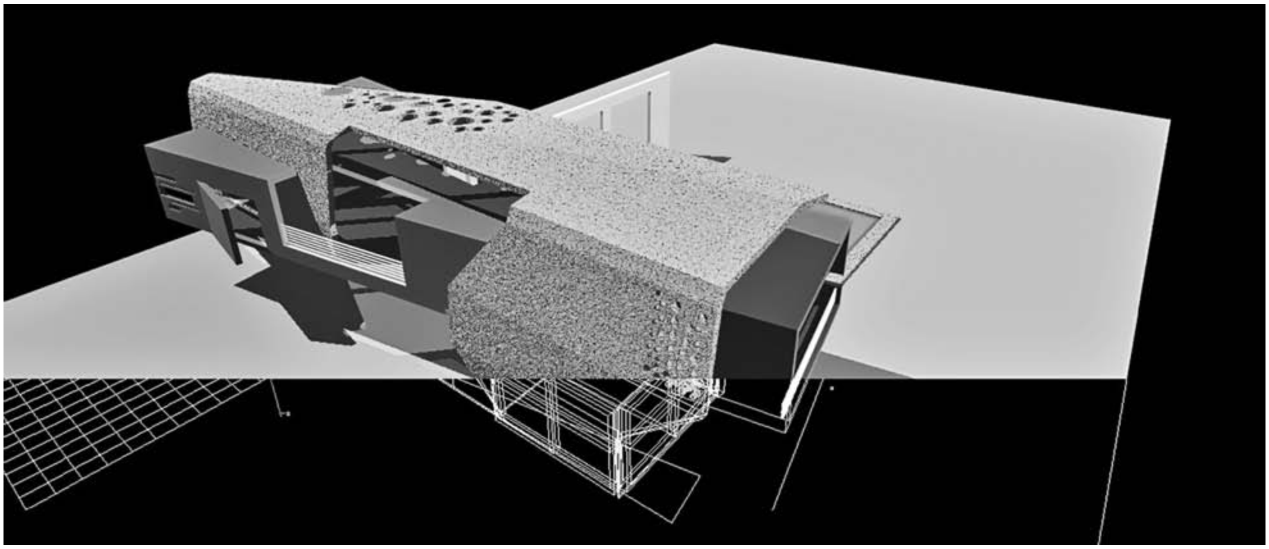
Superimposed composites can be refined hardlines or freehand conceptual sketches like the two above: the house in Calderara and the spatial programming analysis sketch . Composites, especially sketched ones, force the viewer to focus more on the interrelationship of all the drawing types. This prevents the tendency, especially among beginners, to think in terms of drawings as individual, isolated pieces of information.

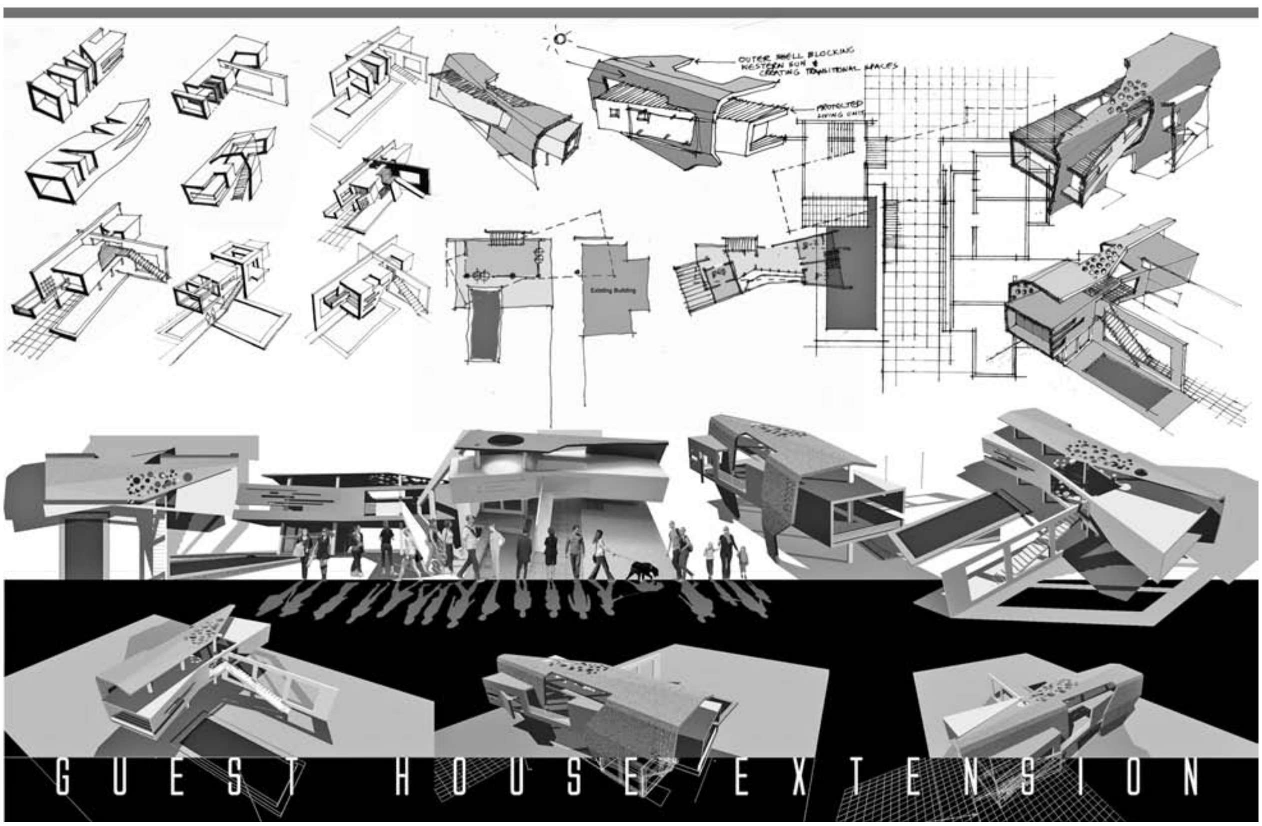
© Alan Weintraub/David Baker +Partners

© Alan Weintraub/David Baker + Partners

Drawing: Revenge of the Stuccoids house, Berkeley, California
24" × 36" (61 × 91.4 cm), Scale: ¼" = 1'0"
Medium: Ink on Canson paper
Courtesy of David Baker Associates Architects and Nancy Whitcombe

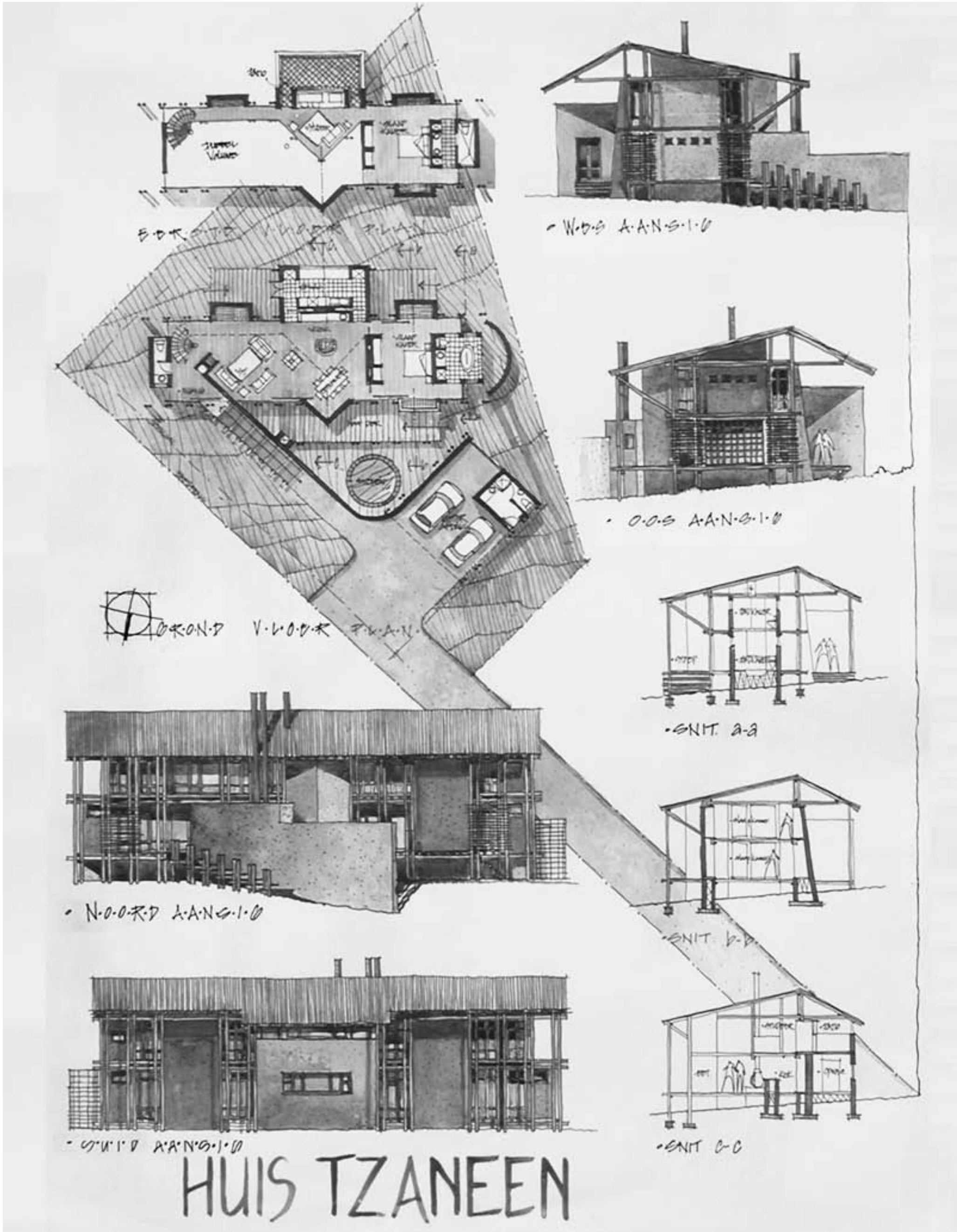
The house represented by this drawing is complex, a collage of discrete ideas and architectural strategies. The complexity of the drawing is compatible with that of the project: simple plans, elevations, and sections alone would not relate the underlying emotional content of the design. The subliminal design intent described intuitively in this composite drawing is greater than the sum of the linear information contained in the separate technical drawings that are its components. [ARCHITECT'S STATEMENT]





Images: Guest House Extension, Jabbar Jute Mill, Bhairab, Dhaka, Bangladesh
Media: Freehand pen-and-ink sketches, sketches scanned and colored in Photoshop, cardboard model, and form•Z 3-D computer model
Courtesy of Professor M. Saleh Uddin, Department of Architecture, Southern Polytechnic State University, Georgia

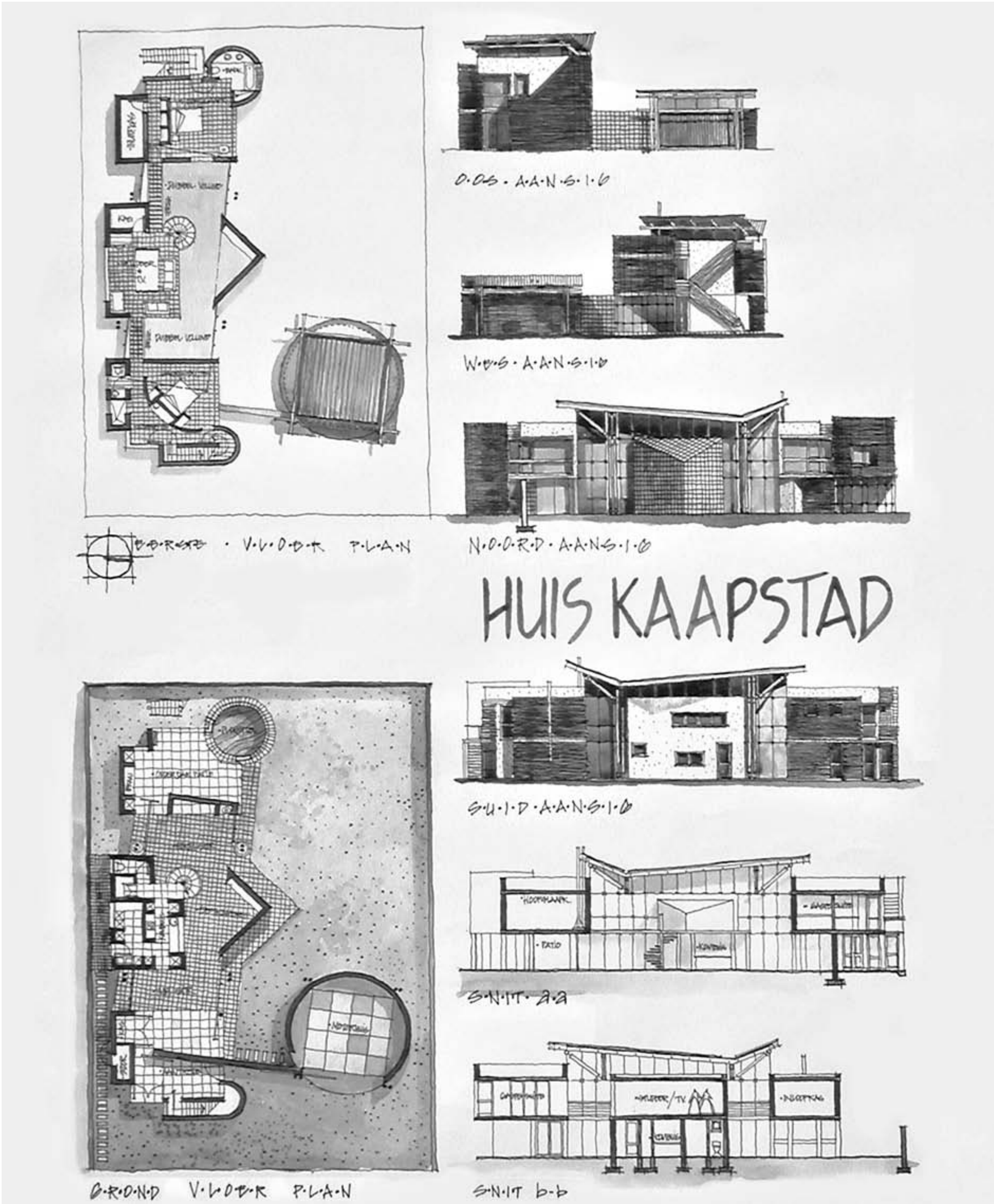
Top: *Form and structure study using form•Z 3d computer model*
Bottom: *Images showing use of various media and techniques to visualize and represent design ideas for this project during its design development stage. Hand conceptual sketches, handcrafted scale models, and a computer 3-D model were used to compare various aspects of design, including mass, solid-void, material, proportion, and scale.*
[Professor's statement]



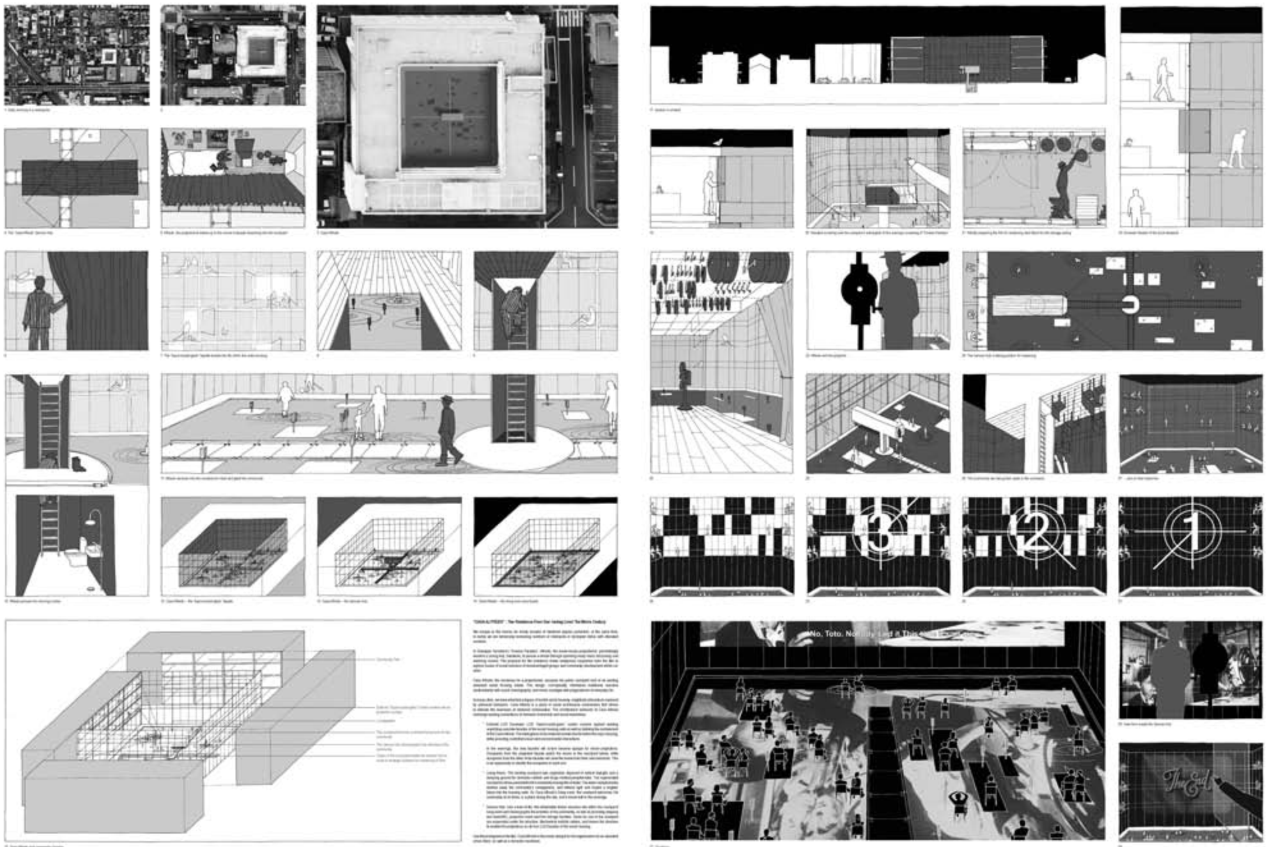
Drawings: House Notnhagel-Deiner
Tzaneen, South Africa
Medium: Watercolor and ink
Design team: 'Ora Joubert and Thomas Gouws
Courtesy of 'Ora Joubert Architects, Pretoria, South Africa

Drawings (facing page): House Bergh
Cape Town, South Africa
Medium: Watercolor and ink
Design team: 'Ora Joubert

In brief, House Notnhagel-Deiner (Tzaneen) is part of a genealogy of projects that attempts a synthesis between Eurocentric theoretical premises and socioeconomic and environmental particularities of southern Africa. To that effect, a concerted effort has been made to appropriate local circumstances through the use of readily available materials, local craft techniques, and sound climatic performance, though respecting the spatial integrity and abstract formalism of orthodox modernism. [ARCHITECT'S STATEMENT]



From a conceptual point of view, House Bergh (Cape Town) explores the universal significance of space, combined with a sustained interest in the dynamics generated by colliding geometries. Since the house is situated close to the coast and on a flat, sandy terrain, the slightly lifted floor surface aims at a delicate imprint on the sand. The choice of materials—aluminum roof and ceiling, white bagged walls alternated with flushly jointed plaster brick, and black slate floor and wall tiles—accentuates the integrity of the different formal components within the compositional ensemble. [Architect's statement]



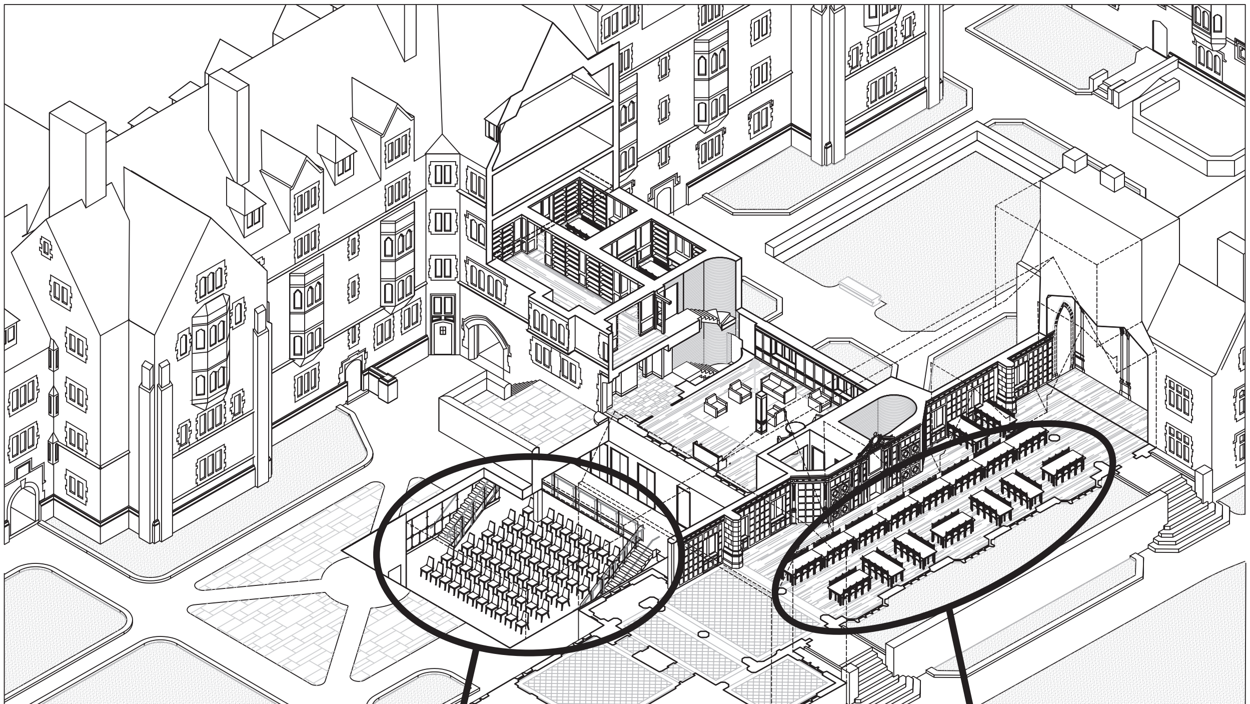
Panel Image: Casa Alfredo
Shinkenchiku Residential Design Competition 2009
The Residence from Our Having Lived the Movie Century—"Casa Alfredo"
Media: Photoshop and InDesign
Courtesy of C J Lim/Studio 8 Architects

Conventional architectural drawings negate poetic consciousness and cultural and social values in our spatial understanding. The layout concept for Casa Alfredo works on the same principles as film storyboards and comic strips—it narrates the architecture and its human inhabitation. The grid structure provides a beginning and an end to the story, while the body of images illustrate a variety of spatial occupation and scale through a protagonist. To draw the reader along the linear story, the protagonist and some key architectural elements are highlighted in red. Frames of digital drawings give a tempo to the layout and story by punctuating the field of choreographed "freehand" illustrations. The inclusion of aerial photos and film-still adds layers of ambiguity between real and fiction.

We escape to the movies for ninety minutes of idealized utopian perfection; at the same time, in reality we are witnessing increasing numbers of metropolises in dystopian status with alienated societies. In many cities, we have inherited a legacy of hostile social housing—neighborly interactions replaced by antisocial behaviors. Casa Alfredo is a piece of social architecture commentary that strives to rekindle the memories of idealized communities.

In Guiseppe Tornatore's Cinema Paradiso, the movie-house projectionist painstakingly mentors a young boy, Salvatore, to pursue a dream through spending many hours discussing and watching movies. The proposal for the residence draws metaphoric inspiration from the film to explore issues of social inclusion of disadvantaged groups and community development within our cities.

Casa Alfredo, the residence for a projectionist, occupies the public courtyard void of an existing alienated social housing estate. The design conceptually intertwines traditional narrative sentimentality with social choreography, and movie nostalgia with pragmatism of everyday life.
[Architect's statement]

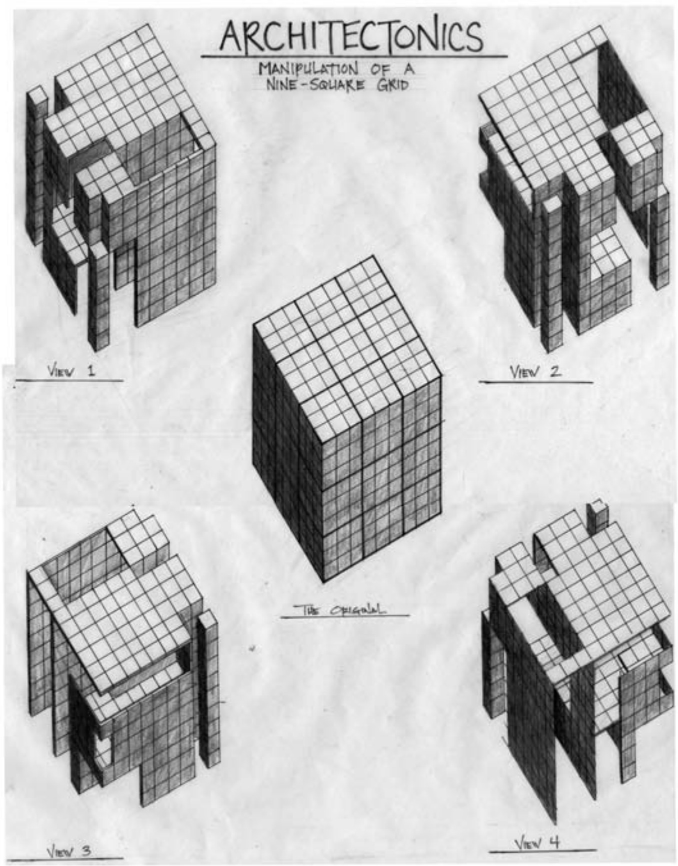


Panel image: Branford & Saybrook Colleges Library
Yale University, New Haven, Connecticut
Medium: AutoCAD
Courtesy of Perry Dean Rogers | Partners Architects

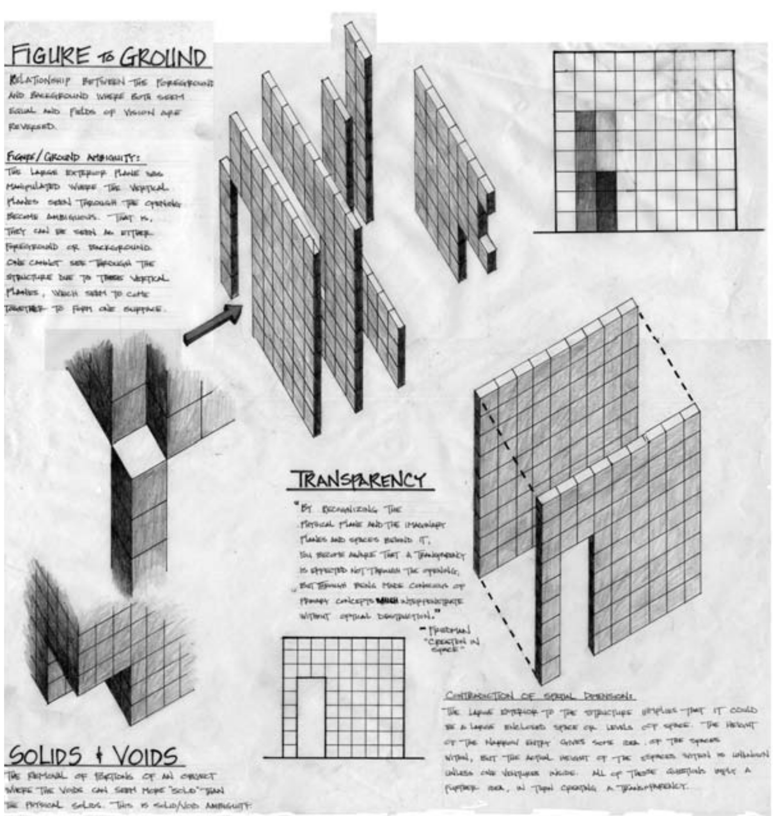
This is a very informative presentation. It gives a definitive orientation in 3-D of two very distinctly different spaces on a campus with a long history. It succeeds in illustrating small assembly spaces with unique functions by using photographs to convey historical details without relying on diagramming. This design received the 2004 Design Award for Preservation by the AIA for its extreme care in ensuring that the renovation retained the site's historic feel while providing a comfortable series of library spaces.

Assignment: Starting with a nine-square grid, develop a series of studies that explore figure and ground, solid and void, shade and shadow, and transparency. Project the grid into three-dimensional form.

Format: Using ink and pencil on two sheets of tracing paper (20″ X 20″), present your findings using sketches and drawings.
[Professor's statement]



Student project by Tommy Solomon
Courtesy of Studio Professor Michael Hagge
Department of Architecture
University of Memphis



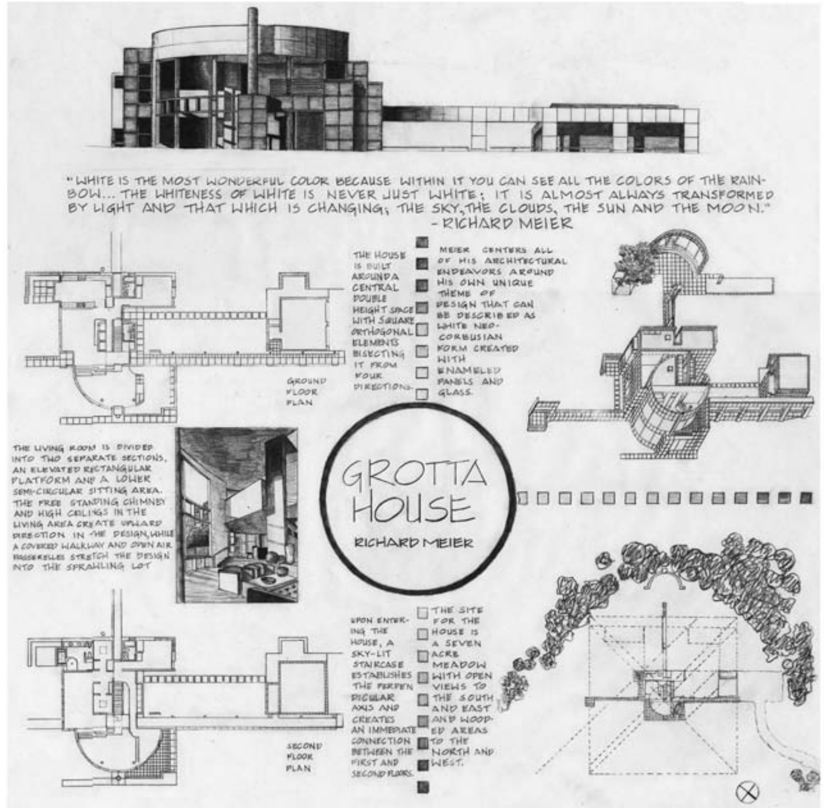
Problem courtesy of Professor Michael Hagge
Department of Architecture
University of Memphis

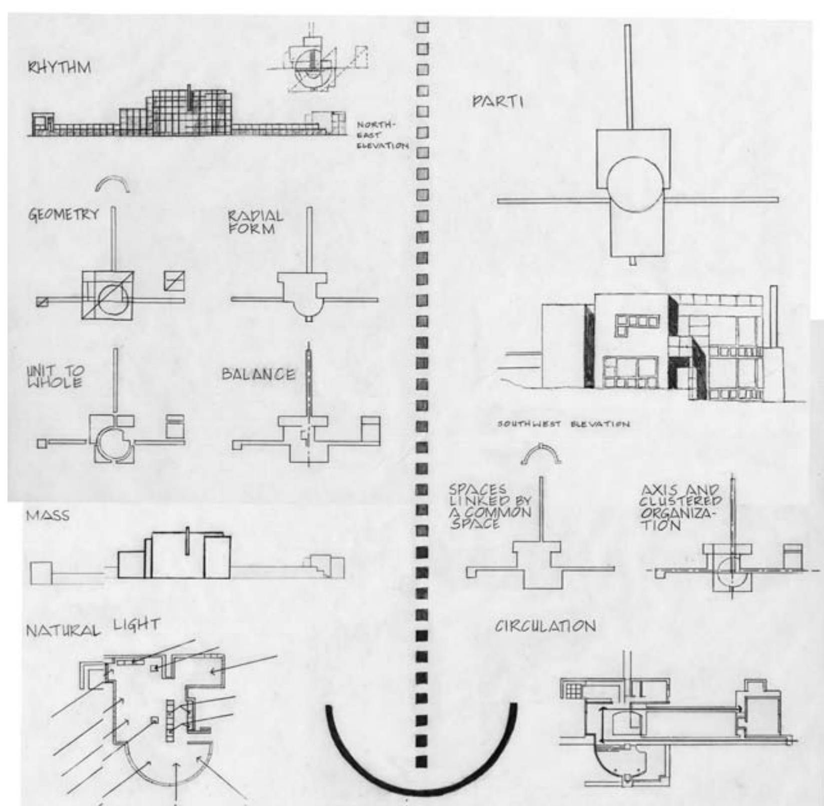
A Study of Architecture: Residential (Grotta House by Richard Meier)

Assignment: *Select a residential structure and receive approval from the faculty. Then prepare an analysis of the building. Consider geometry, scale, proportions, mass, hierarchy, texture, materials, and more. Look beyond the representation in the books and periodicals. Make decisions. Make assumptions. Put yourself into the built world. Put yourself into the place.*

Format: *This assignment must be developed using sketches and drawings. These must be presented on two 20″ x 20″ boards. Consider the composition of the boards (hint: use one for analyses and one for supporting information). All work must be drawn—no photocopies! Submit a written analysis and include appropriate graphics. The written element must be typed; the graphics should be able to stand separately from the presentation boards.*
[Professor's statement]

Problem courtesy of Professor Michael Hagge
Department of Architecture
University of Memphis



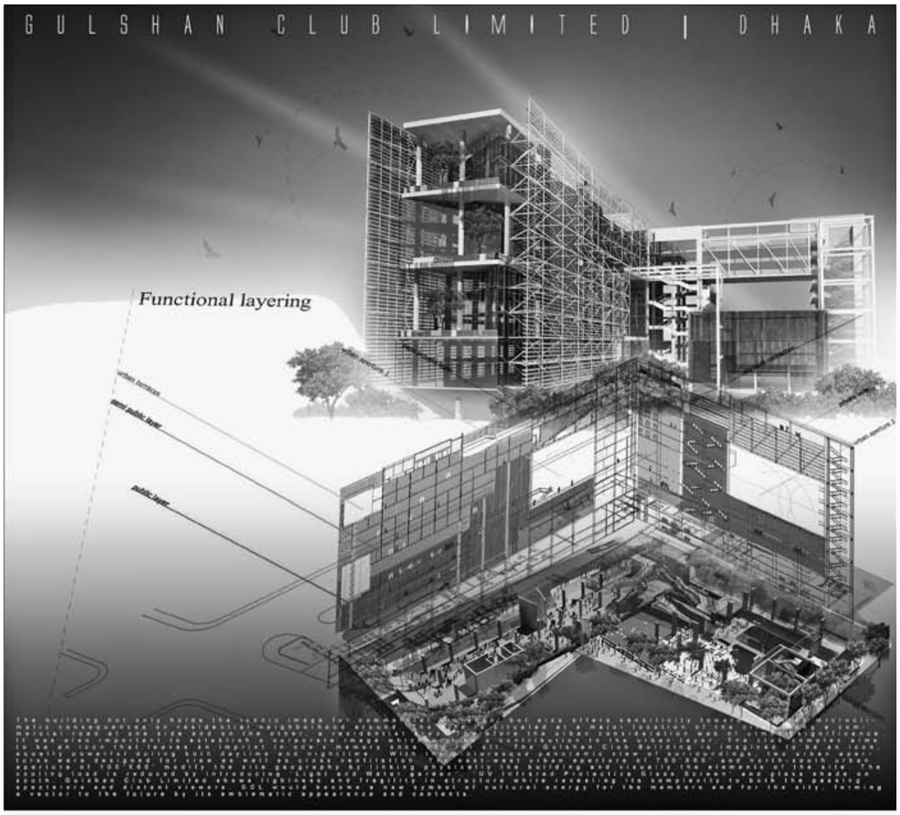


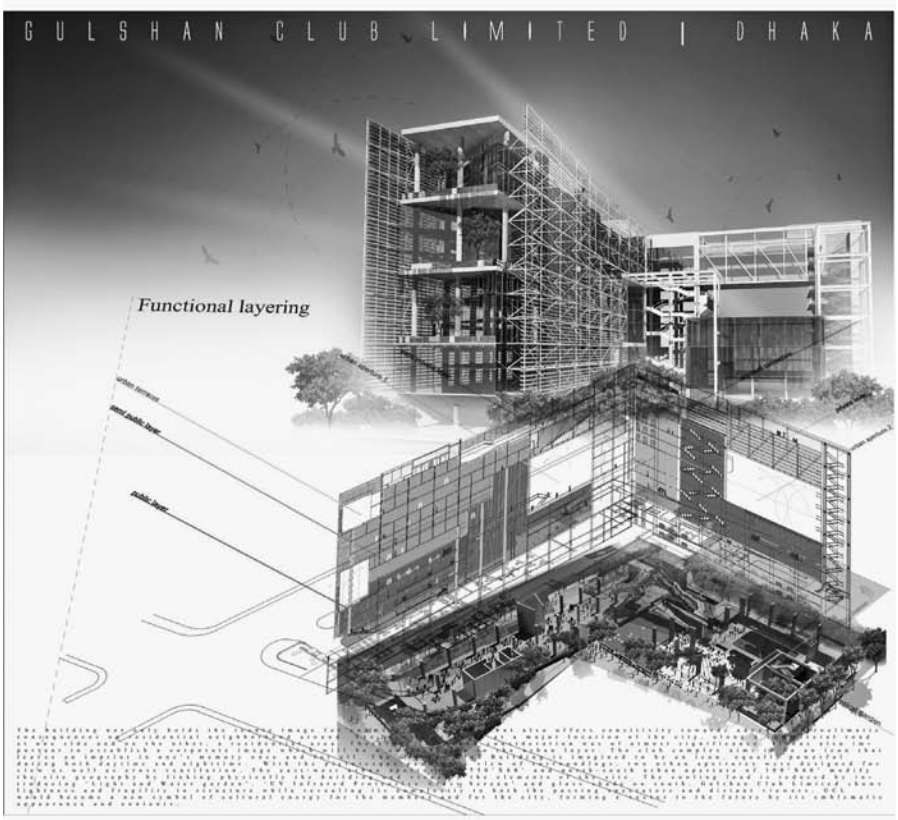
Student project by Amy Clyce
Medium: Graphite on vellum
Courtesy of Studio Professor Michael Hagge
Department of Architecture
University of Memphis

Student project by Jason Hearn: Composite presentation using a square grid system
Pass Christian Community Center, Pass Christian, Mississippi
Medium: Laser prints mounted on black foam core
Courtesy of Professor LaRaine Papa Montgomery, Savannah College of Art and Design

The course of study for which these boards were created was divided into two ten-week sessions. During the trip, the studio discovered that the wrath of Hurricane Katrina left very little, if any, site characteristics on which to base the community center designs. The focus quickly switched to community planning as a means of creating site, while the community center project was put on hold. For this reason, the boards were created ten weeks apart. A 4′ X 4′ square was used as the key proportioning unit. Each element on the boards is proportional to every other element.

Using the photograph of the surviving oak tree, the concept, problem, and solution were organized in a way that promoted the design process. The dense initial concept and background information that consistently influenced the entire twenty-week study is placed at the base of the tree trunk in rich color. Directly above the concept panel, the problem panels are placed in a horizontal band. Symbolically, this lower band of problems establishes the oldest and largest branches of the tree. Next, a horizontal band of solution panels addresses the issues introduced below, further growing and developing. Five photomontage perspectives take the information presented in the problem panels, and visually explain the information proposed in the solution panels. It is from here that the community master and neighborhood plans are finalized. Because these drawings are the final product, they are presented at a large scale and centered at the top of the board, creating the pinnacle of the live oak. The tip of a lower branch extends horizontally from the master-plan board to the new community-center board. Here, the immediate site and building issues for the center are presented. Compositionally, this keeps all problem panels in line, while giving the building design room to grow. Photographs of the physical depict structural aspects of the building that reflect the concepts of the designer, as well as those associated with sustainability. Again, photomontage is utilized in the elevation and section drawings to further the design visually. At the apex, drawn at a larger scale for emphasis, is the final master floor plan of the building. It is in this drawing that all aspects of the design are depicted: concept, program, form. Because the plan drawings run horizontally across the top, the viewer can create a clear distinction through scales, from community to neighborhood to building. When placed together, the dimensioning of both boards encompasses the initial proportioning units established from the beginning. [ARCHITECTURE STUDENT'S STATEMENT]

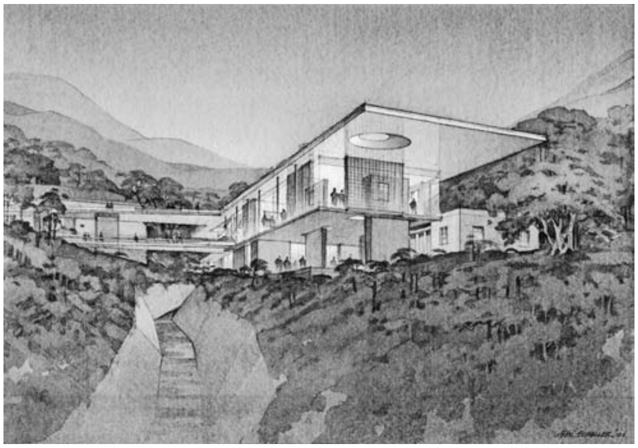


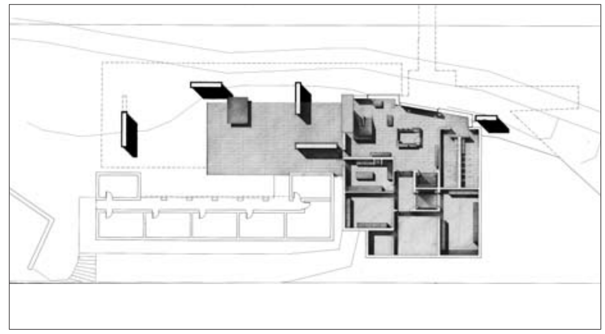


This drawing is a composite image representing a rendered 3-D perspective of a building volume and facade treatment, two vertical sections allocating the functional layering of spaces both in x-axis and y-axis, and a cut plan at the ground level, all referenced to each other for the integrated display of information in one drawing. Background shades (dark grey vs. white at the bottom) play a significant role in creating hierarchy of graphic importance.

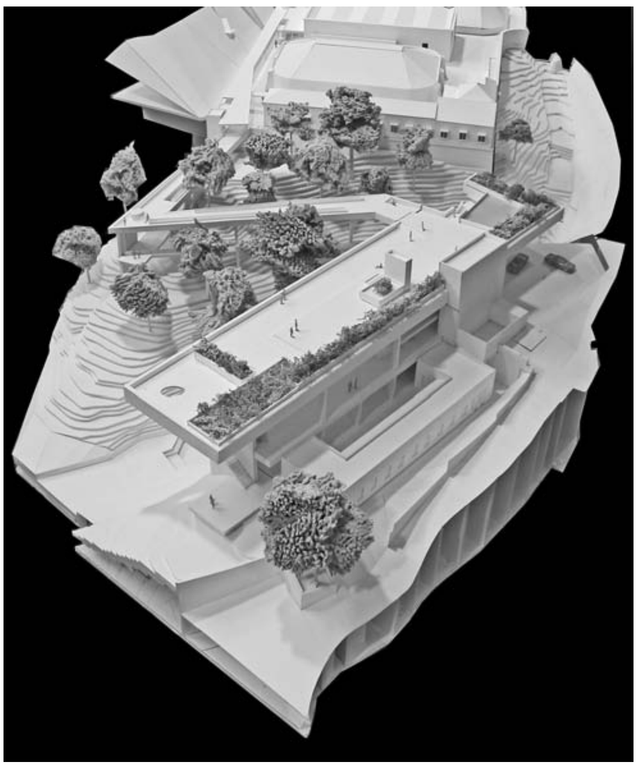
The Gulshan Club building is created to be an icon, equally powerful during both daytime and nighttime. Apertures are designed for views of the picturesque panoramic surroundings as well as for cross-ventilation. Two urban apertures modify the site geography by physically and visually linking the building with the elements of the site.
[Professor's statement]

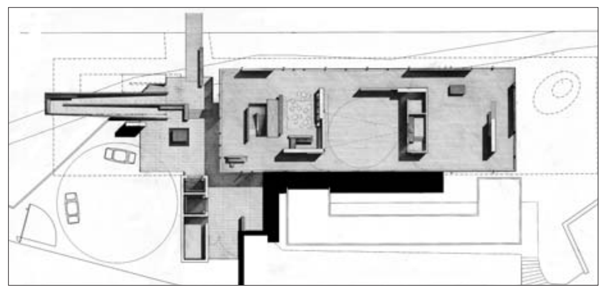
Composite drawing: Gulshan Club
Dhaka, Bangladesh
Media: 3D Studio Max and Photoshop
Design team: Dr. Saleh Uddin, Didarul Islam Bhuiyan, Dilruba Ferdous Shuvra, A. K. M. Muajjam Hossain
Courtesy of Dr. Saleh Uddin
1st place, Open Competition Winner (organized by the Institute of Architects, Bangladesh)



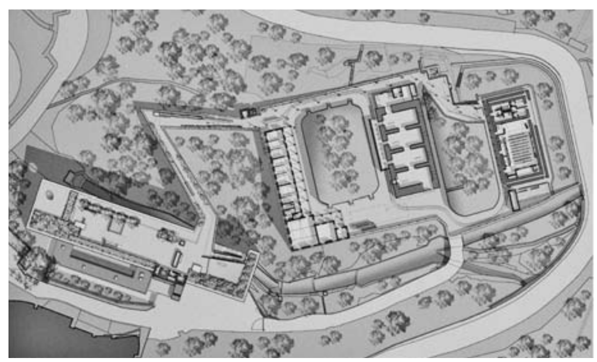


Level new building





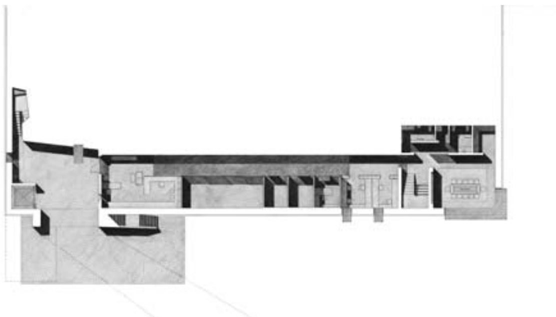
Level new building



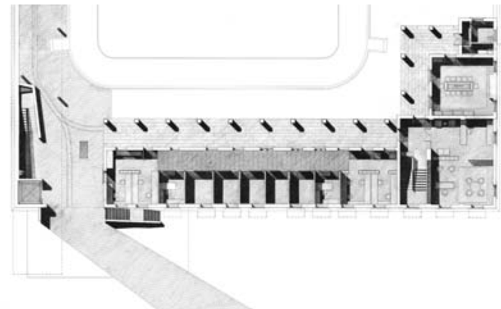
Site plan

Competition drawings: Asia Society Hong Kong Center
Hong Kong, China
Media: First drawn as line drawings in AutoCAD, then rendered by hand with graphite and colored pencil
Model: Foam core; Perspective: Watercolor
Courtesy of Tod Williams Billie Tsien Architects

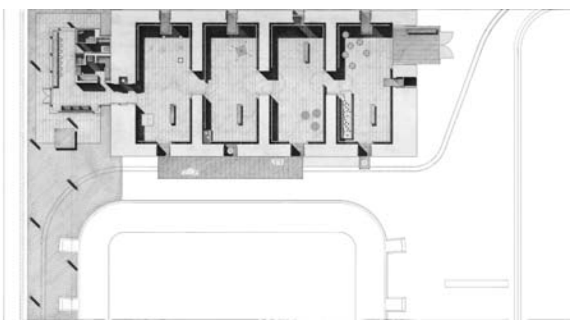
Sometimes competition requirements for a design concept presentation are somewhat loose. This project—a complex in Hong Kong for lectures, conferences, art exhibitions, performances, and film sponsored and organized by the Asia Society—is one such example. No specific number of panels was required, and the actual technique of the presentation was left to the discretion of each participating firm. Basic requirements included a 1:200 model (the base model for all competitors provided), 1:50 floor plans, a building section, a 1:20 partial elevation, and a perspective.



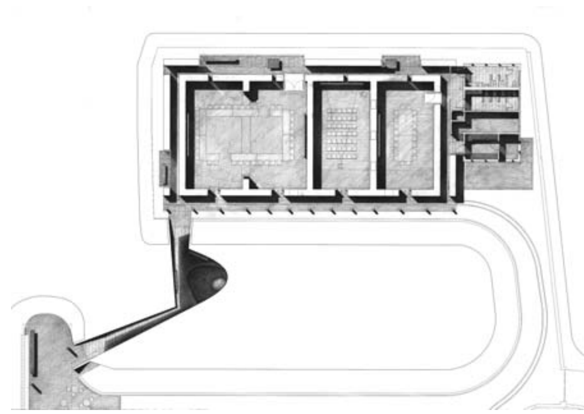
Lab plan



Lab plan



Magazine A plan



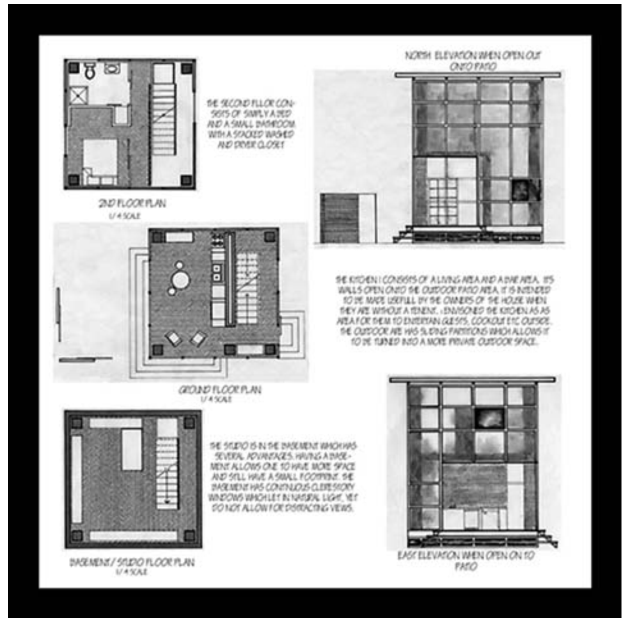
Magazine B plan

Magazine A section/partial elevation

The panels are so informal because all three competitors presented their projects in person, right after pinning up their boards. A winner was then chosen immediately after all the presentations.
[Architect's statement]

When first drawn very precisely to scale in AutoCAD, a drawing may appear cold and mechanical. This example shows that hand techniques (human touch) can enliven such a drawing.

Competition drawings: Asia Society Hong Kong Center
Hong Kong, China
Media: First drawn as line drawings in AutoCAD, then rendered by hand with graphite and colored pencil
Courtesy of Tod Williams Billie Tsien Architects



Student project by Anthea Selkirk (this and facing page)
Courtesy of Studio Professor Michael Hagge
Department of Architecture
University of Memphis

For final presentation model on facing page:
Model materials: Basswood, polycarbonate (sanded with fine-grit sandpaper to create translucent parts)
Lighting: Backlit for the photograph

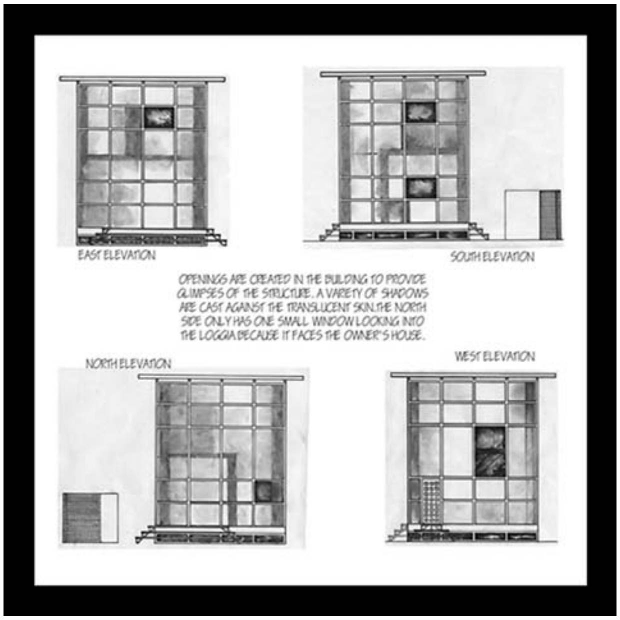
Multifunction Building in a Historic Neighborhood

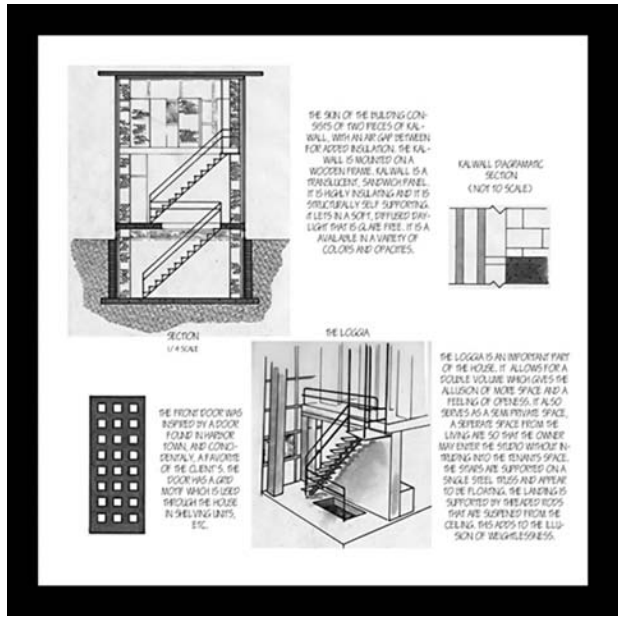
Design a two-story multifunction building consisting of a studio and a living space. The final presentation should include a site plan, floor plans, elevations, a section, a wall detail, an interior cutaway perspective, and exterior perspectives. Present the work on a unified set of four 20″ X 20″ boards containing all relevant information to enable the project to be understood without verbal communication.

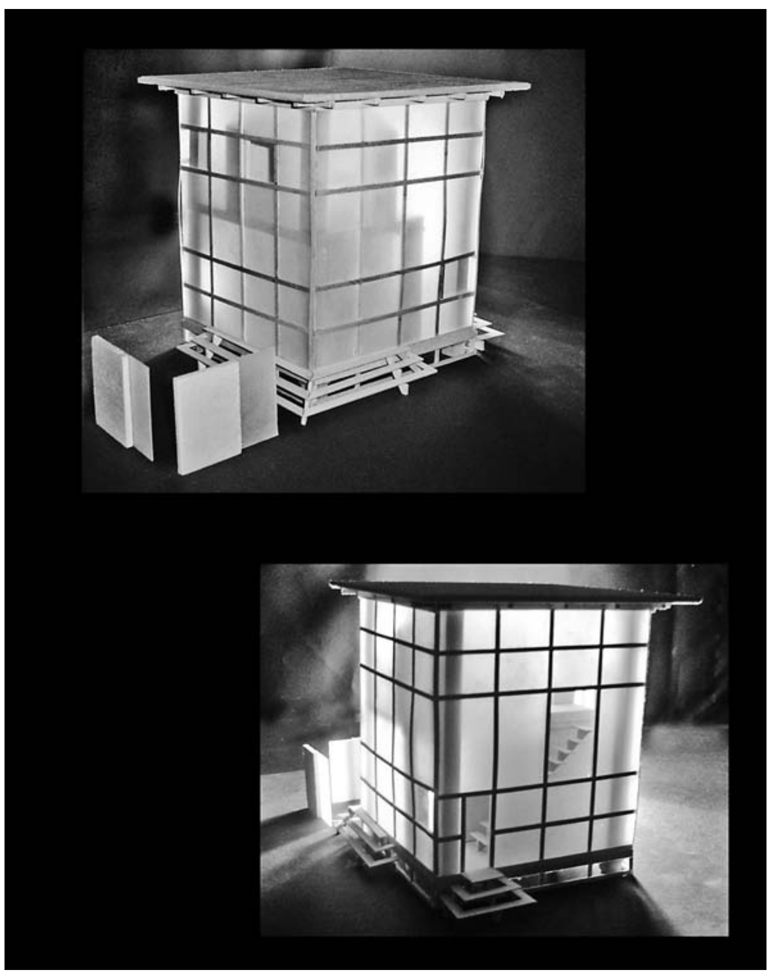
Use ink on vellum and Photoshop as the media.
[PROFESSOR'S STATEMENT]

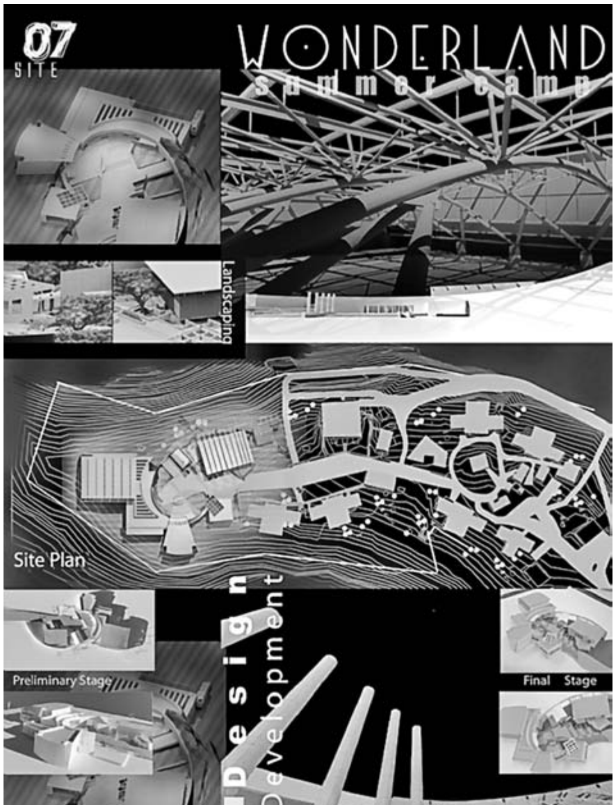
During the design-drawing process, students and professionals use very basic tools to create design communication models. Massing concept site models are used in the early stages. This is followed by more highly developed tactile, study, or process models, which can be produced anywhere along the design-development process for exploring inside/outside design issues. Materials used could be clay, cardboard, foam board, Styrofoam, wood, etc. This student's basswood final model done at an accurate scale is an example of a final stage model where a jury or client will do a detailed review of the submission.

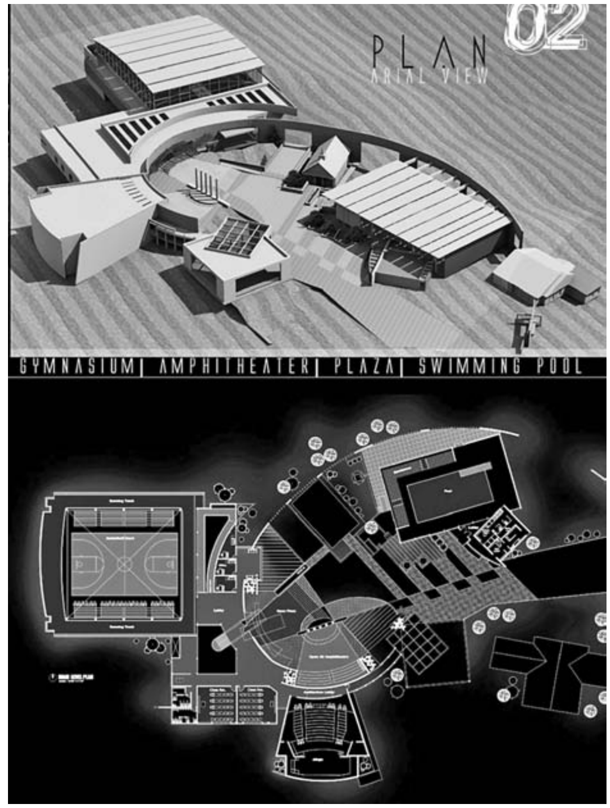
Problem courtesy of Professor Michael Hagge
Department of Architecture
University of Memphis

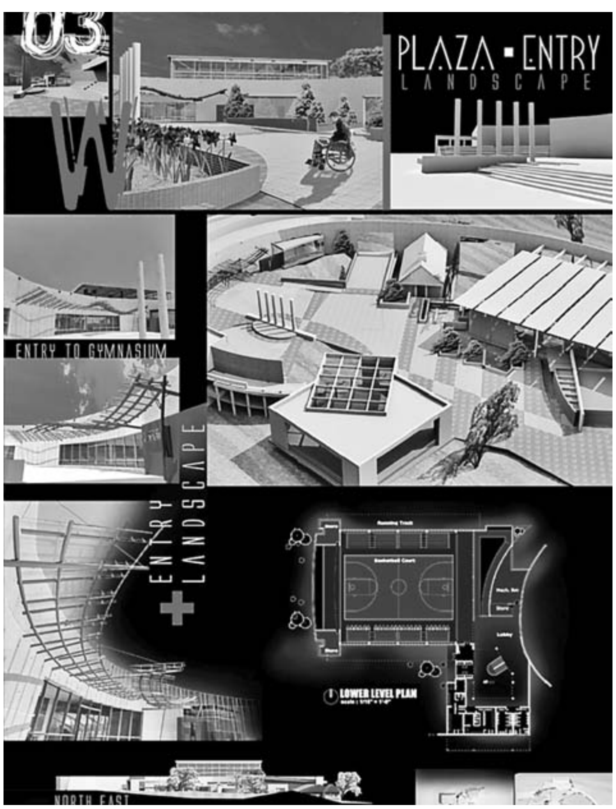

EAST ELEVATION
SOUTH ELEVATION
OPENINGS ARE CREATED IN THE BUILDING TO PROVIDE GLIMPSES OF THE STRUCTURE. A VARIETY OF SHADOWS ARE CAST AGAINST THE TRANSLUCENT SKIN.THE NORTH SIDE ONLY HAS ONE SMALL WINDOW LOOKING INTO THE LOGGIA BECAUSE IT FACES THE OWNER'S HOUSE.
NORTH ELEVATION
WEST ELEVATION

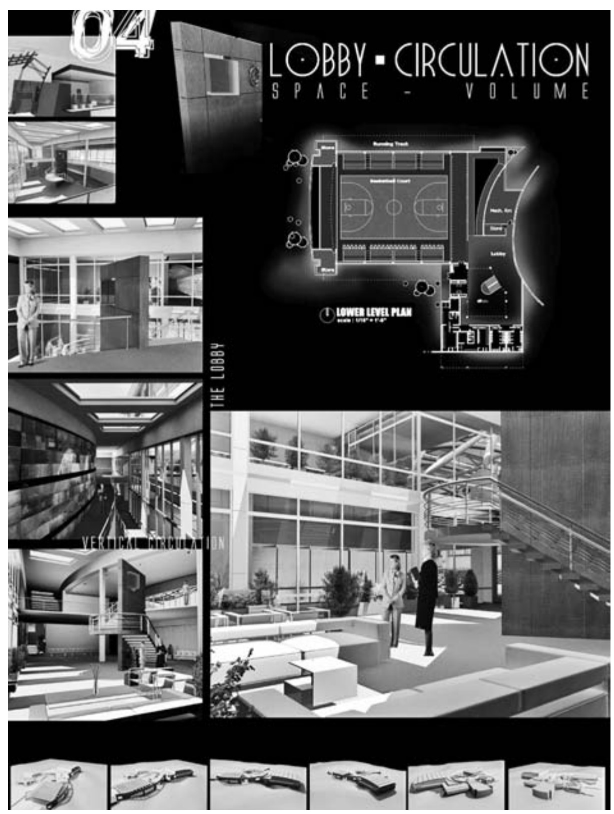

THE SKIN OF THE BUILDING CONSISTS OF TWO PIECES OF KAL-WALL, WITH AN AIR GAP BETWEEN FOR ADDED INSULATION. THE KAL-WALL IS MOUNTED ON A WOODEN FRAME. KALWALL IS A TRANSLUCENT, SANDWICH PANEL. IT IS HIGHLY INSULATING AND IT IS STRUCTURALLY SELF SUPPORTING. IT LETS IN A SOFT, DIFFUSED DAYLIGHT THAT IS GLARE FREE. IT IS A AVAILABLE IN A VARIETY OF COLORS AND OPACITIES.
KALWALL DIAGRAMATIC SECTION (NOT TO SCALE)
SECTION
1/4 SCALE
THE LOGGIA
THE FRONT DOOR WAS INSPIRED BY A DOOR FOUND IN HARBOR TOWN, AND COINCIDENTALY, A FAVORITE OF THE CLIENT'S. THE DOOR HAS A GRID MOTIF WHICH IS USED THROUGH THE HOUSE IN SHELVING UNITS, ETC.
THE LOGGIA IS AN IMPORTANT PART OF THE HOUSE. IT ALLOWS FOR A DOUBLE VOLUME WHICH GIVES THE ALLUSION OF MORE SPACE AND A FEELING OF OPENESS. IT ALSO SERVES AS A SEMI PRIVATE SPACE, A SEPERATE SPACE FROM THE LIVING ARE SO THAT THE OWNER MAY ENTER THE STUDIO WITHOUT INTRUDING INTO THE TENANTS SPACE. THE STAIRS ARE SUPPORTED ON A SINGLE STEEL TRUSS AND APPEAR TO BE FLOATING. THE LANDING IS SUPPORTED BY THREADED RODS THAT ARE SUSPENDED FROM THE CEILING. THIS ADDS TO THE ILLUSION OF WEIGHTLESSNESS.




07
SITE
WONDERLAND
summer camp
Landscaping
Site Plan
Design
Development
Preliminary Stage
Final Stage


02
PLAN
ARIAL VIEW
GYMNASIUM | AMPHITHEATER | PLAZA | SWIMMING POOL

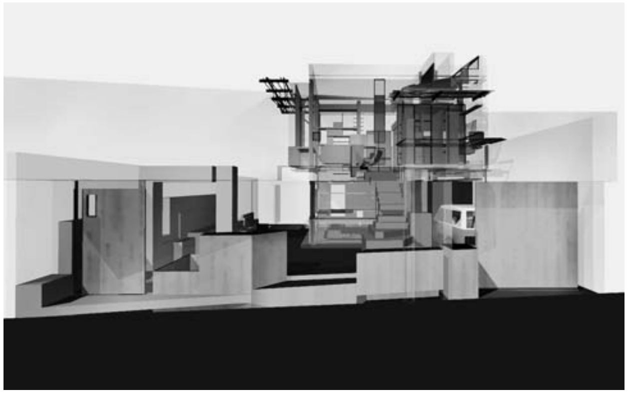

03
PLAZA ▪ ENTRY
LANDSCAPE
ENTRY TO GYMNASIUM
ENTRY
+
LANDSCAPE
LOWER LEVEL PLAN
NORTH EAST

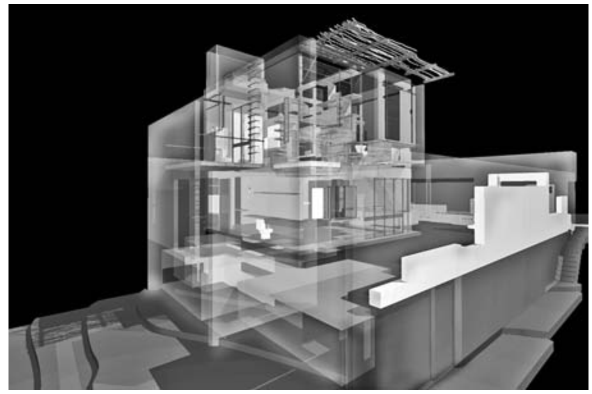

04
LOBBY ▪ CIRCULATION
SPACE - VOLUME
LOWER LEVEL PLAN
THE LOBBY
VERTICAL CIRCULATION

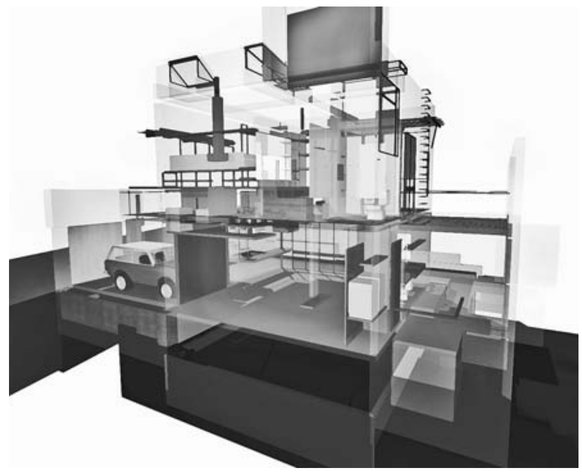
Composite boards: Wonderland Camp for Physically and Mentally Challenged Individuals
Lake of the Ozarks, Missouri
Media: AutoCAD, 3D Studio Max, handcrafted model, and Photoshop
Architect of Record: Dr. Saleh Uddin with graduate students Zahidul Islam, Silika Rahman Kona, and Shehnaz Talukder
University of Missouri–Columbia Graduate Design Studio
Courtesy of Studio Professor Dr. Saleh Uddin
Recipient of AIA Mid-Missouri Design Award/Unbuilt Category

These are composite boards, part of the total presentation that consisted of a 20-minute computer animation explaining basic concepts, functional zoning, circulation, and the building system in addition to orthographic drawings of floor plans. Each presentation board is dedicated to highlighting a particular aspect of the project or an individual building through floor plan, elevation, section, aerial, exterior perspective, and interior renderings as needed. Each board also highlighted one image (larger than other images) as a key view of that structure. Simple rectangular subdivisions were used for the layout of individual renderings.

The design scheme is meant to connect, respond, and merge the new facilities with the existing Wonderland site fabric and its characteristics. Keeping in mind that it is essential to make the entire site cater to all ages and disabilities, the design creates a thin, curved wall that wraps all the individual facilities and thus both connects and separates buildings and nature at the same time. A sense of a central plaza is accentuated by arranging various functions around this curved wall. This wall enables the campers to relate themselves both inside and outside with the natural setting.
[Professor's statement]



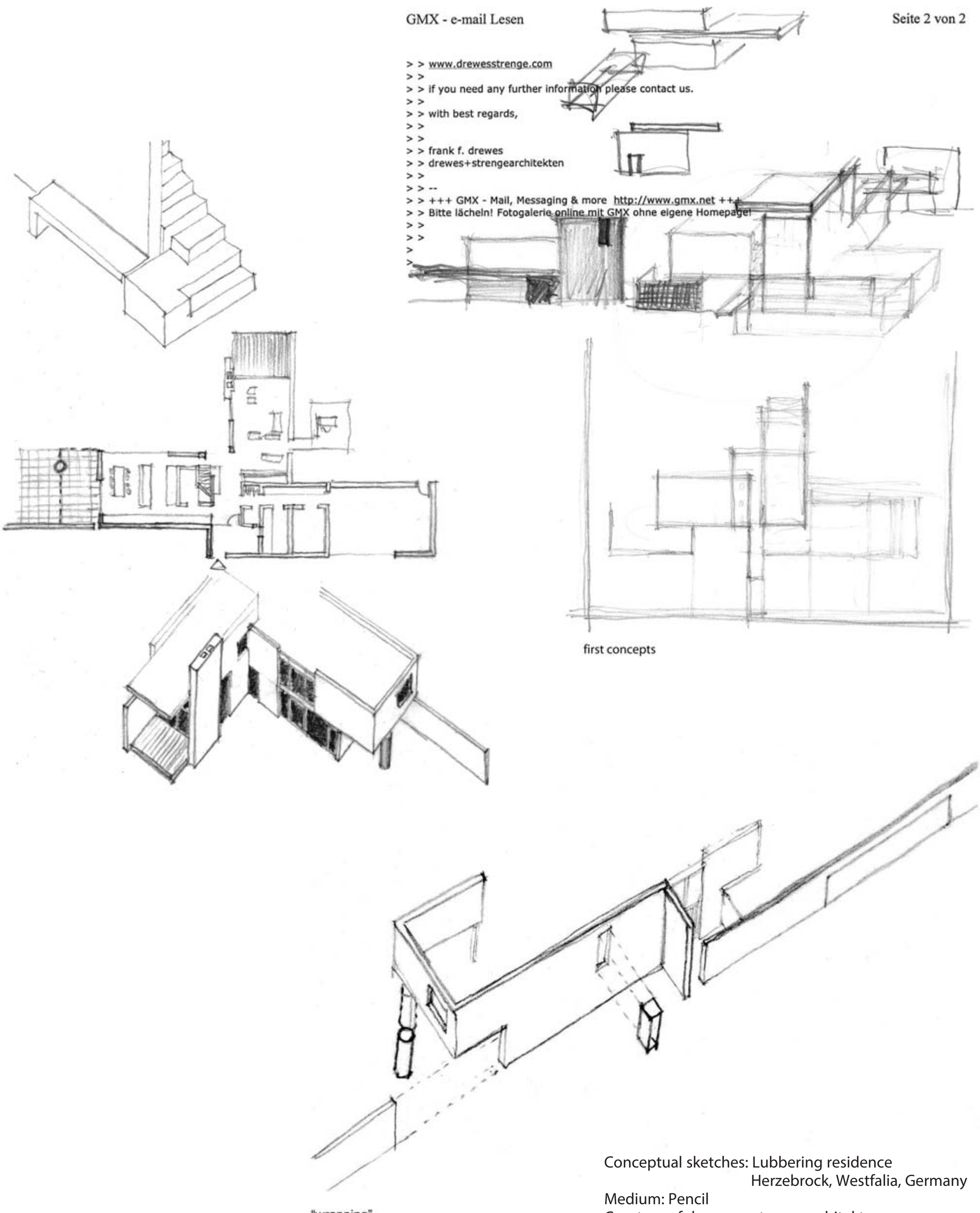




Digital images and photos: Casa Paloma
San Miguel de Allende, Mexico
16" × 20" ArchiCAD transparent perspectives
Courtesy of House + House Architects
Rafael de le Lama, Architectural Illustrator
© Steven & Cathi House, photographers

Layers of wall surfaces, large window openings, and skylights can be clearly seen in this transparent rendering of a small house in central Mexico. Exterior walls disappear, allowing the various interior design elements to be articulated and identified. The strong geometric form of the house's materiality and its relationship to the site are both illustrated through the careful use of color, texture, shadow, and detail.

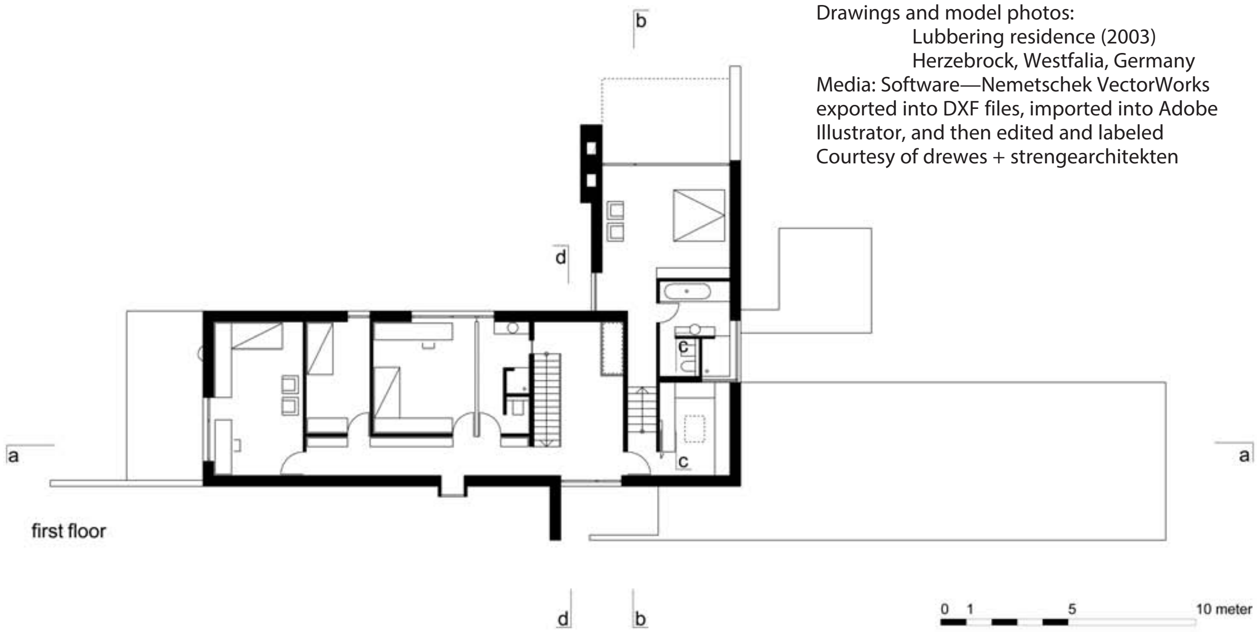
In a quiet Mexican neighborhood where stark shadows of brilliant sunlight delineate a rich culture, this small one-bedroom home is located above a garage and art studio. Bi-folding glass doors open the living areas to the outside, with shafts of sunlight from three skylights washing the walls throughout the day. The modulation of color and light is magnified in the multi-tonal qualities of the handmade tiles, the polished concrete, and the hammered copper. Sustainability was a guiding force in this home constructed entirely by hand, without power tools, by local craftsmen with local materials. [ARCHITECT'S STATEMENT]

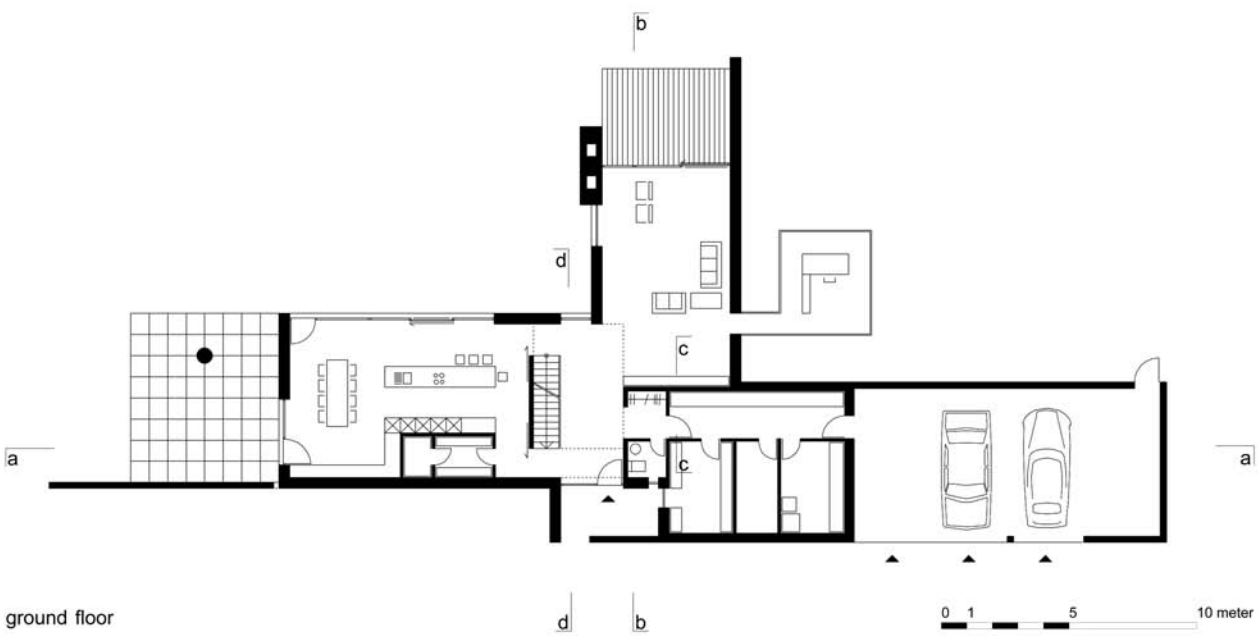


Conceptual sketches: Lubbering residence
Herzebrock, Westfalia, Germany
Medium: Pencil
Courtesy of drewes + strengearchitekten

The concept sketch (upper right) was drawn on an e-mail that had been printed. This is a good example of a conceptual sketch: ideas are placed on any kind of paper—blank or not.

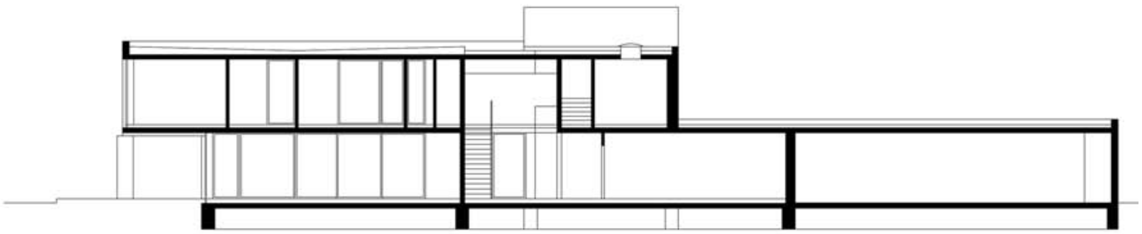
Drawings and model photos:
Lubbering residence (2003)
Herzebrock, Westfalia, Germany
Media: Software—Nemetschek VectorWorks exported into DXF files, imported into Adobe Illustrator, and then edited and labeled
Courtesy of drewes + strengearchitekten



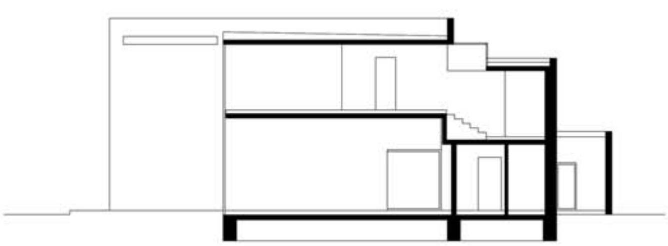


The Lubbering residence (2,717 sq. ft.) was designed for a large lot in a light industrial area, next to a recently built factory with magnificent views of the landscape. The clients, a young family, required a house that would accommodate both their public and private lives.

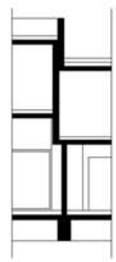
Program requirements are divided between the two angles and the two floors of the residence. The access level consists of the spacious kitchen-dining area and the living room, which are linked via a two-story atrium space. The satellite study is a remote appendix with glass walls, accessed via a glass tunnel. The upper level contains the private spaces (bedrooms, bathrooms, and guest room). The services and garage define a long, one-story public facade without any windows or openings. The tall, narrow entrance slot and a colored window on the second floor are the only hints of habitation. [Architects' statement]



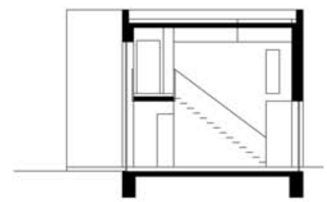
section a-a



section b-b

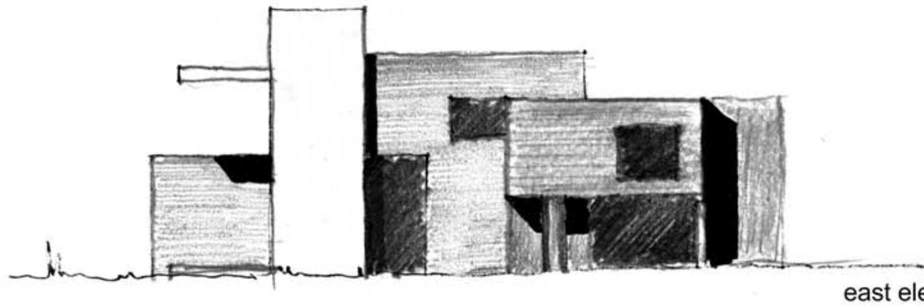


section c-c

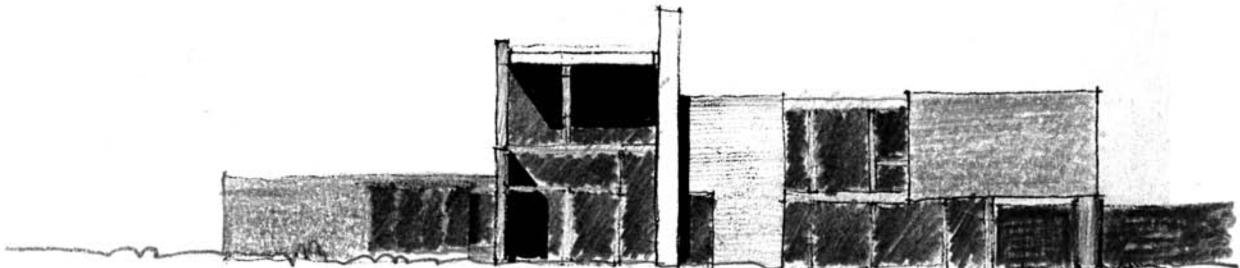


section d-d

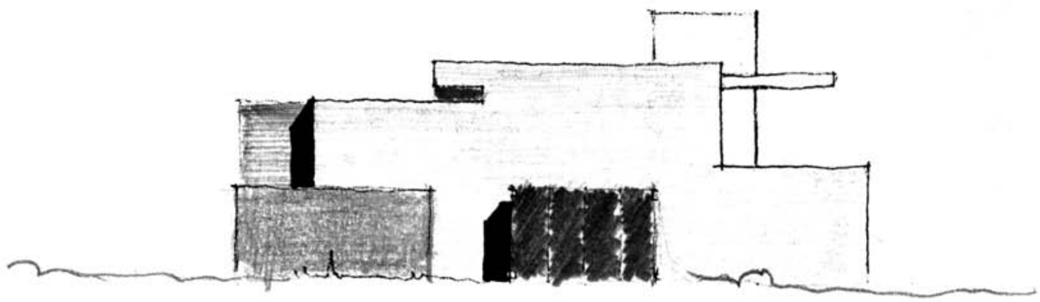
The abstract composition is intended to evoke curiosity and to formally link the residence and the factory. The different materials (stucco, steel, wood) and facade textures clarify the distinct yet interrelated components of the building. [ARCHITECTS' STATEMENT]



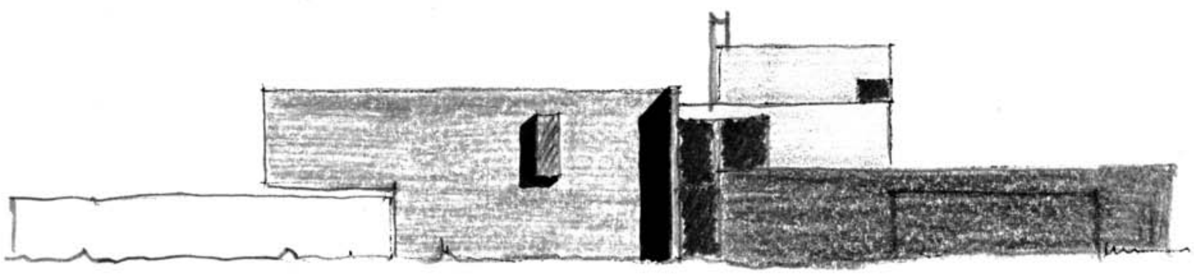
east elevation



south elevation



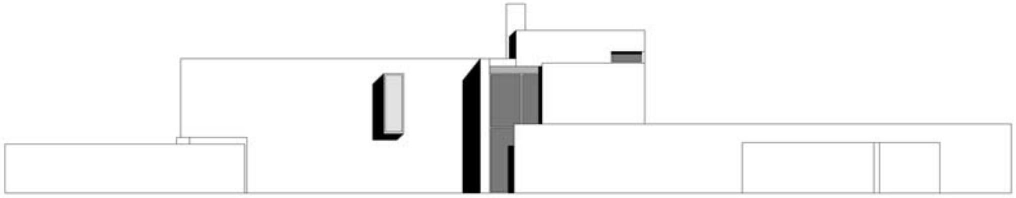
west elevation



north elevation

Drawings (this and facing page): Lubbering residence
Herzebrock, Westfalia, Germany
Media: Sketched elevation drawn by pencil, scanned, then edited with Adobe Illustrator;
Hardline elevations: Nemetschek Vectorworks
Courtesy of drewes + strengearchitekten

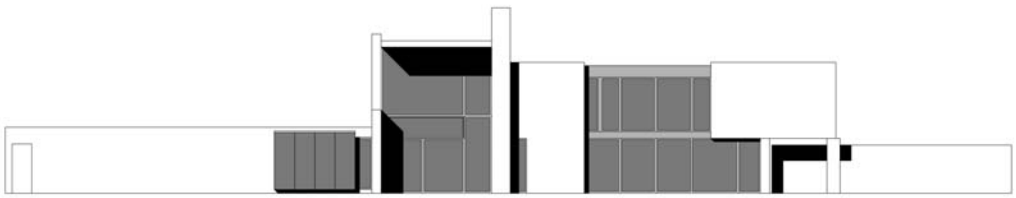
The project was a direct private commission for a commercial client of ours. We did not have to do a formal presentation because the client trusts us. The entire presentation was done on a sketch basis. However, a formal presentation and model were done for inclusion as a Global Architecture (GA) project in 2004.
[Architect's statement]



north elevation

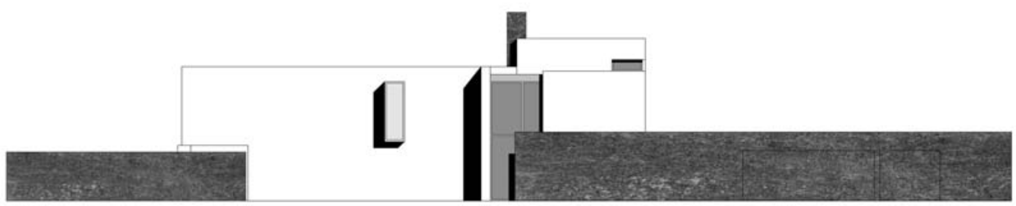
west elevation

east elevation

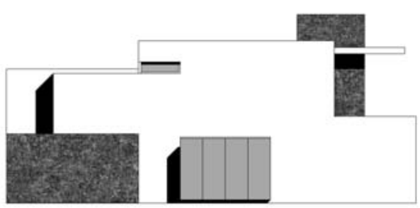


south elevation

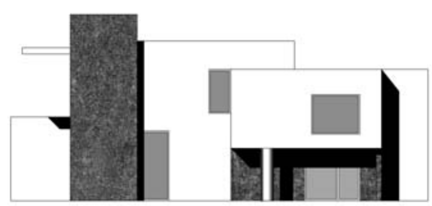
0 1 5 10 meter



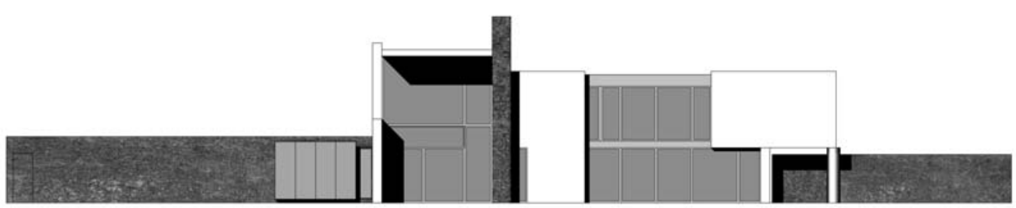
north elevation



west elevation

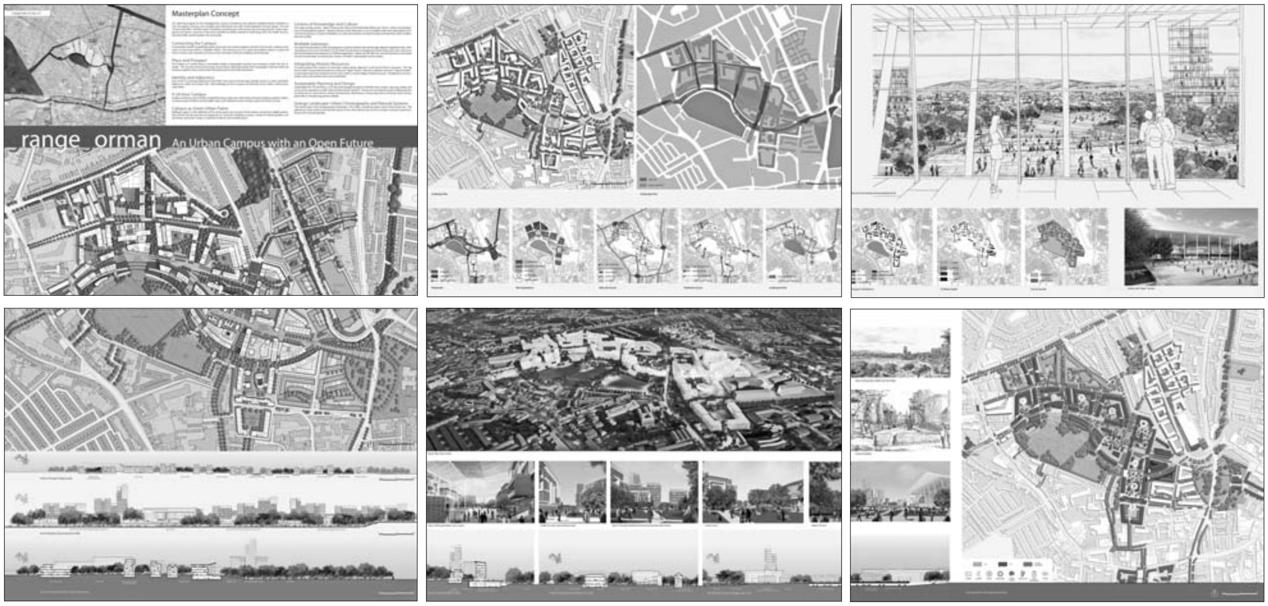


east elevation



south elevation

0 1 5 10 meter



GRANGEGORMAN MASTER PLAN (through p. 425)
Dublin, Ireland

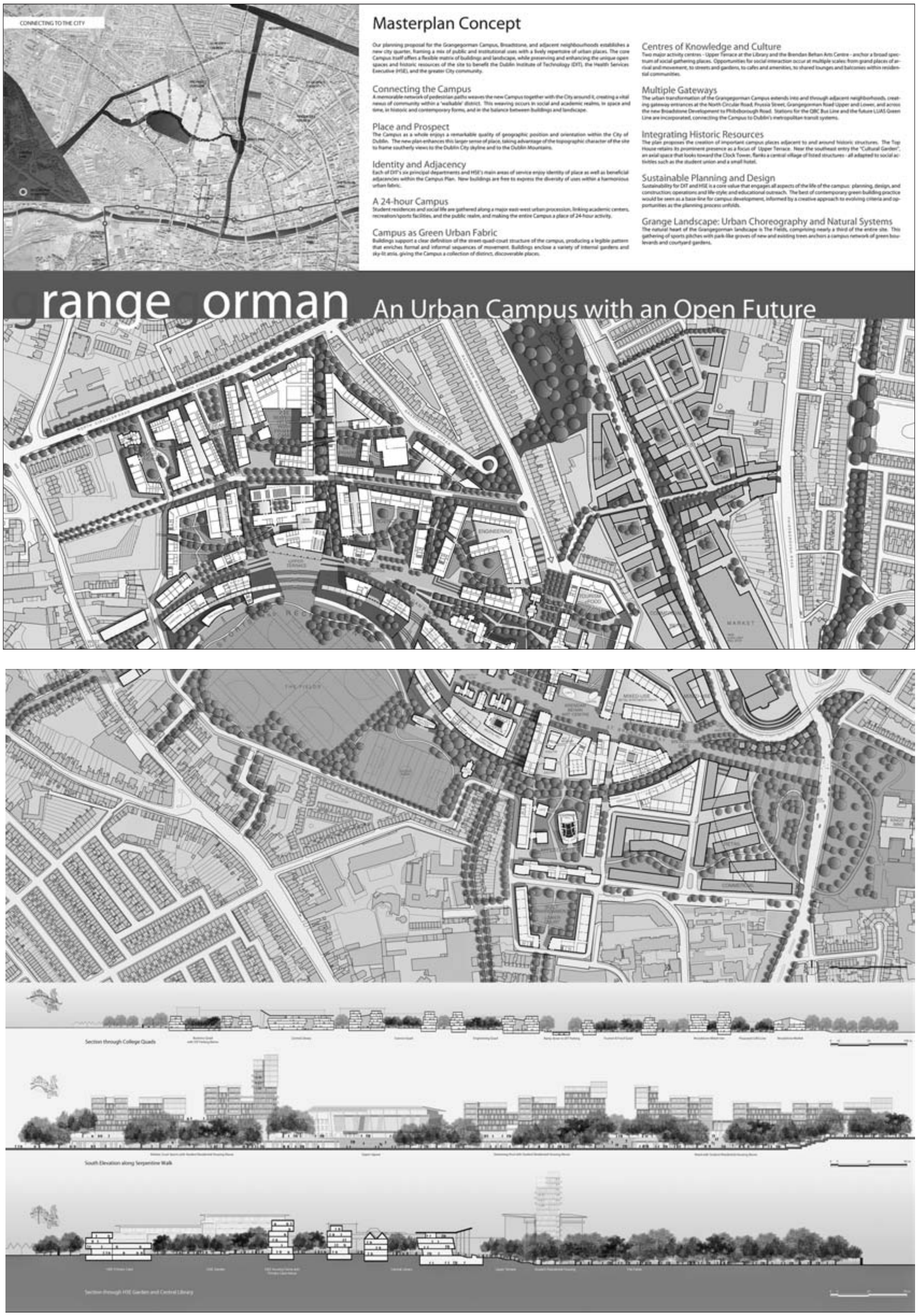
Submitted by:
Moore Ruble Yudell Architects & Planners/DMOD Architects

Client: Grangegorman Development Agency
Chief Executive: Michael Hand, Gerry Murphy

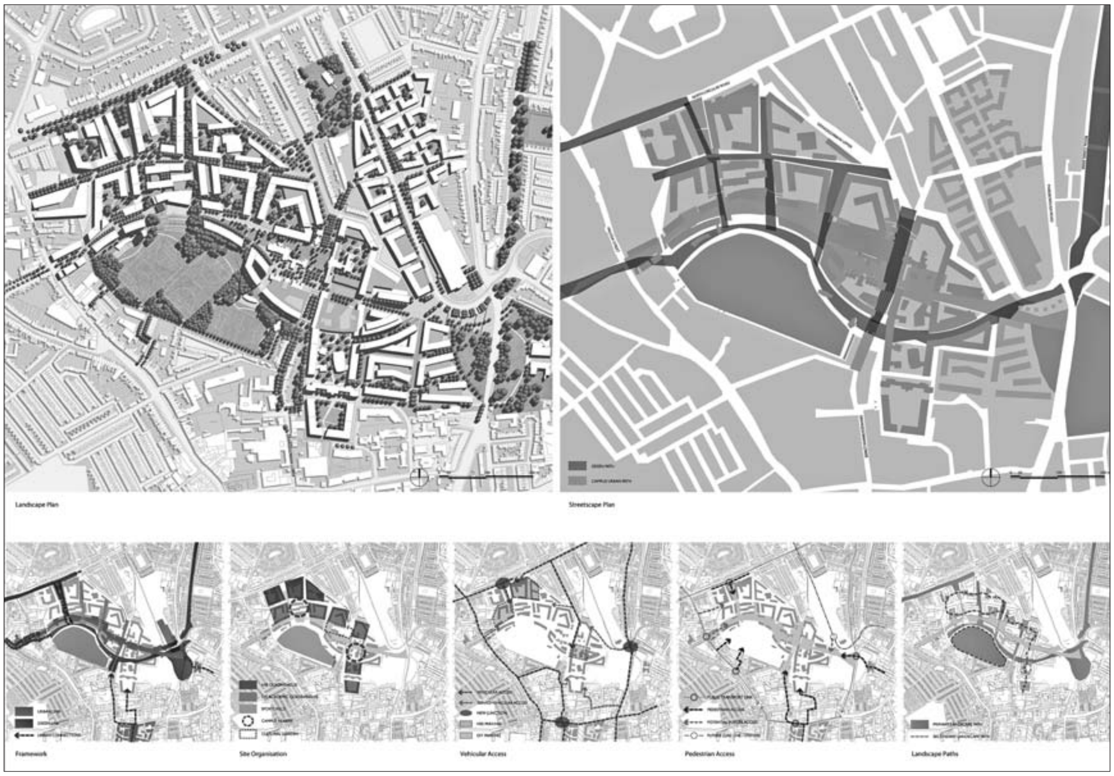
Lead Firm, Design Architect: Moore Ruble Yudell Architects & Planners, Santa Monica
Principal-in-Charge: James Mary O'Connor

Partners: John Ruble, Buzz Yudell
Project Team: JT Theeuwes, Halil Dolan, Kaoru Orime, Nozomu Sugawara, Toru Narita, Tony Tran, Carissa Shrock, Matthew Henry, Tristan Hall, Joyce Ip Leus, Alon Averbuch, Simone Barth, Pooja Bhagat
Research & Marketing: Katie Carley
Graphic Design: Ken Kim
Models: Mark Grand, Alon Averbuch, Evan Henderson, Jenny Lee, Michael Dammeyer
Local Architects: DMOD Architects, Dublin; Partner-in-Charge: John Mitchell; Ger Casey, Eoghan Garland
Architectural Conservation Consultant: Patrick Shaffrey Associates; Gráinne Shaffrey
Landscape Architect: Lützow 7; Jan Wehberg, Tim Hagenhoff
Healthcare & Educational Environment Expertise: Prof. Bryan Lawson
Transport Planning/Civil & Infrastructure: Arup Consulting Engineers; Aidan Madden, Tiago Oliveira
Sustainability & Environmental Expertise: Battle McCarthy Ltd.; Chris McCarthy, Neil Cogan
Digital Renderings: Shimahara Illustration
In-House Digital Rendering Team: Halil Dolan, Nozomu Sugawara, Matthew Henry, Tristan Hall
Watercolor Renderings: Tony Tran

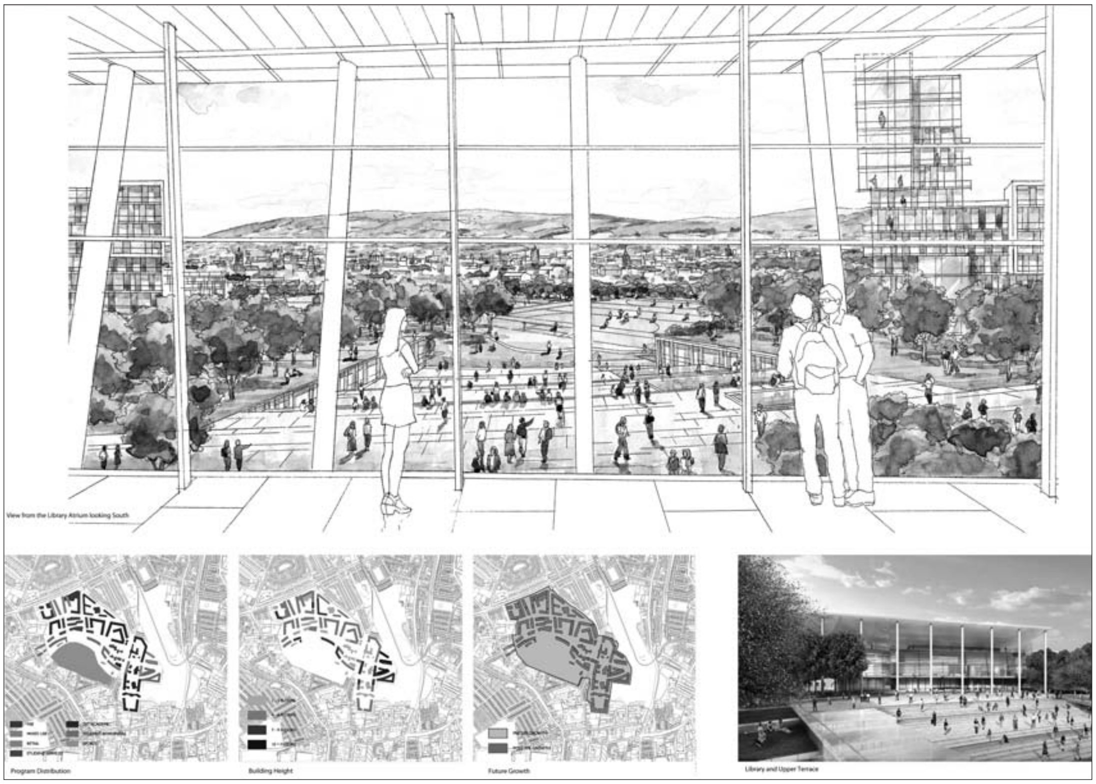
The Grangegorman site is seen as the missing piece in the urban fabric of the North Side of Dublin. It offers the unique opportunity to connect the city together, by providing links to the major surrounding historical and open spaces of the city. Our goal is to create a place that will enrich the city fabric, a place full of vitality and architectural value to serve the needs of not only the immediate users of the new quarter but indeed the entire community in the twenty-first century and beyond.

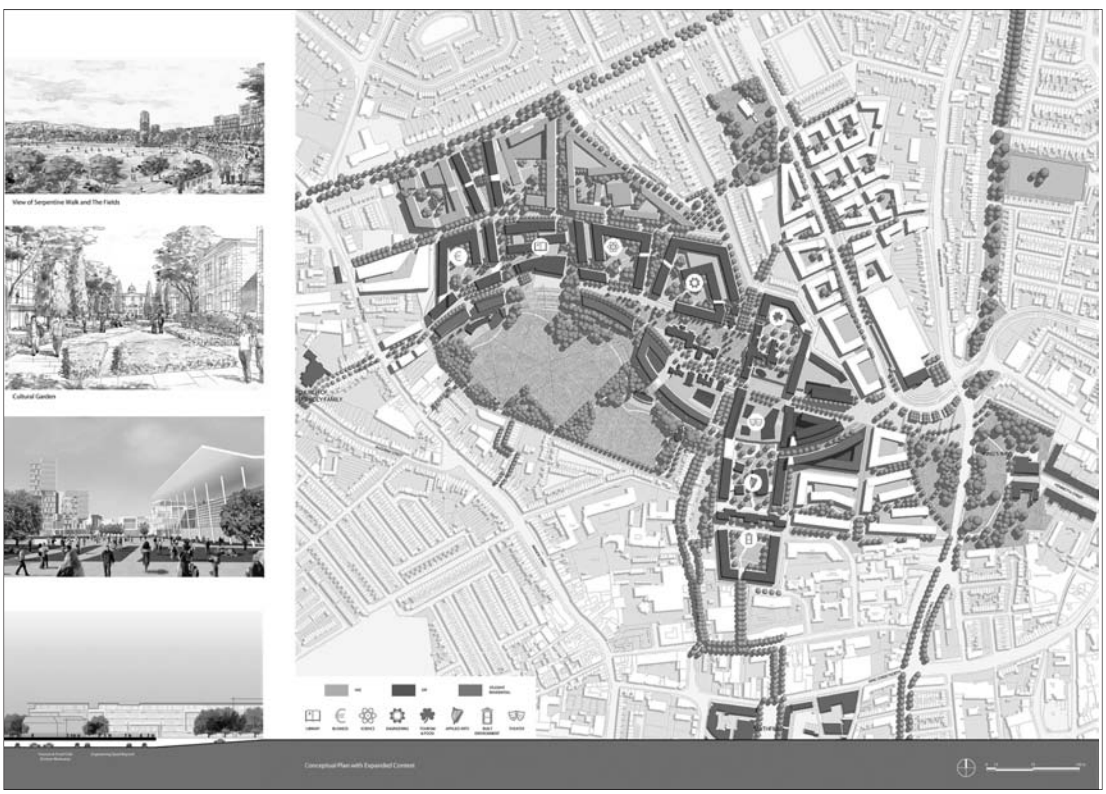


The required six horizontal competition panels were presented using a clear organization strategy that would read as one unified, integrated narrative when the six boards are put together side by side, in two rows and three columns. The size of each board is AO (841 × 1,189 mm or 33.1 × 46.8 in).



The strategy of combining all six panels into one overall presentation allows for both flexibility and a compelling composition of the graphic materials and texts. The most important images have been provided with the largest sizes in order to effectively engage the viewer's attention. These images include the perspective renderings (both digital and watercolor), and the Master Plan of the project.





Several key drawings have been enlarged and positioned on more than one panel in order to enhance their readability and impact. These include the Master Plan (on Panels 1 and 2), and the overall site section (on Panels 2 and 4). The strong organizational strategy enhanced the presentation of our Master Plan design entry and helped our team win this prestigious competition. [ARCHITECT'S STATEMENT]

Fulton Recital Hall

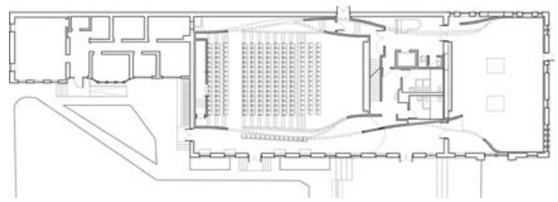
Fulton Recital Hall was placed within the masonry shell of a small existing carriage house on Brown University's campus in Providence, Rhode Island. This building is adjacent to Orwig Hall, which houses the school's Music Department on the east side of their campus. With just 145 seats, it is an intimate venue for the department's presentation of chamber music, electronic music, and smaller jazz combos.

The acoustic performance of the space was enhanced by exposing the entire volume of the carriage house and inserting two distinct wall systems within the space.

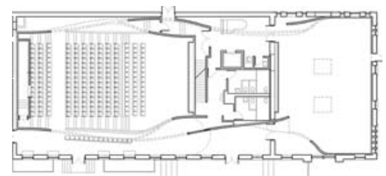
The sidewalls of the hall were shaped with a plaster and wood scrim to prevent the buildup of "flutter" within the space. An open bamboo screen envelopes the hall itself, allowing for sound to either reverberate off the masonry shell or be absorbed by retractable felt banners behind the openings.

The specific progression through the spaces—along with improved sightlines—promotes interaction between the performers and the audience, whether in a classroom or performance setting. The recital hall is also supported by a new entry, lobby and reception area, musician's room, and other general support spaces.
[Architect's statement]

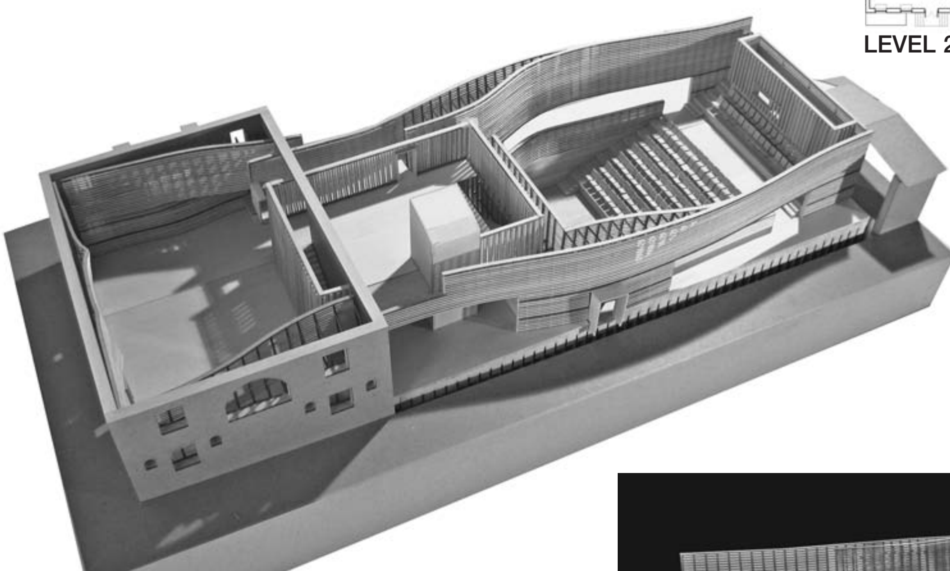
SITE PLAN

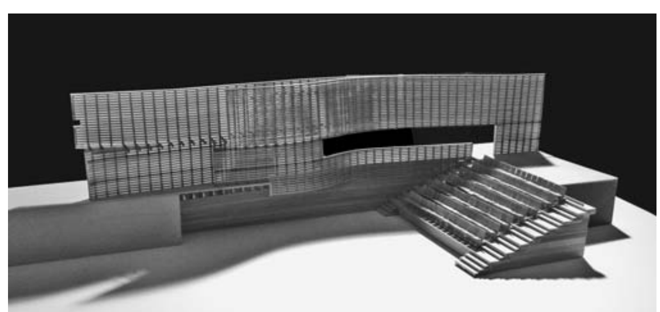


LEVEL 1 PLAN

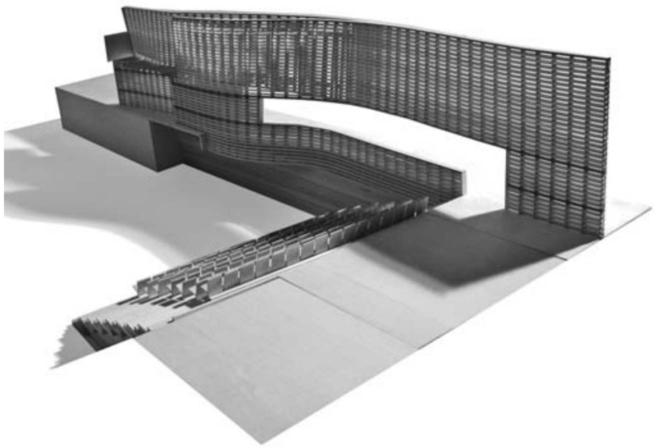


LEVEL 2 PLAN

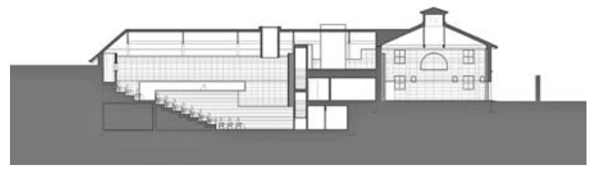




MODEL OF OPEN BAMBOO SCREEN AND SEATING

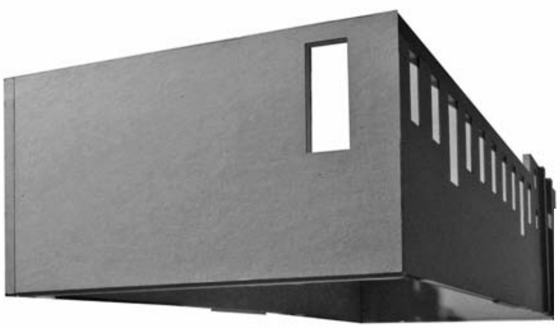


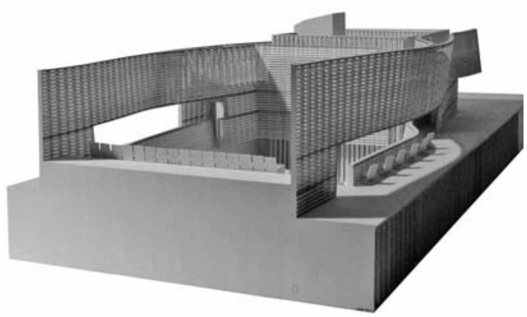
LONGITUDINAL SECTION—2

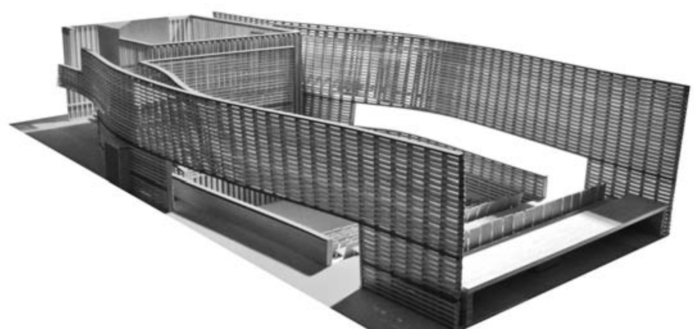


LONGITUDINAL SECTION—1

Digital drawings and model photos: Fulton Recital Hall
Brown University, Providence, Rhode Island
Media: AutoCAD, with basswood and chipboard for model
Acoustics: Kirkegaard Associates—Chicago, Illinois
Courtesy of Brian Healy Architects

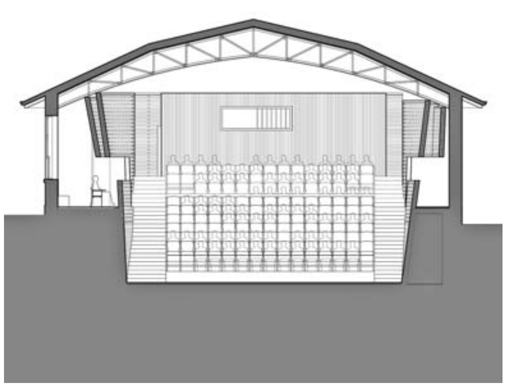




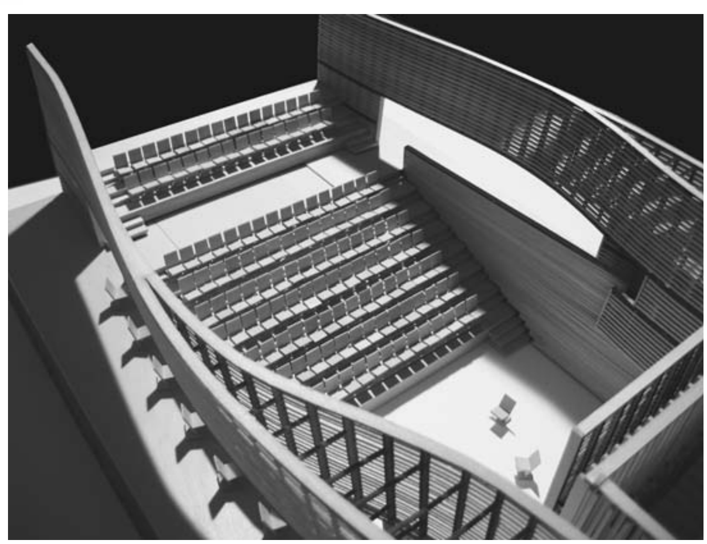


OPEN BAMBOO SCREEN

235-seat new room inserted into an existing historically significant shell; a simple massing concept.

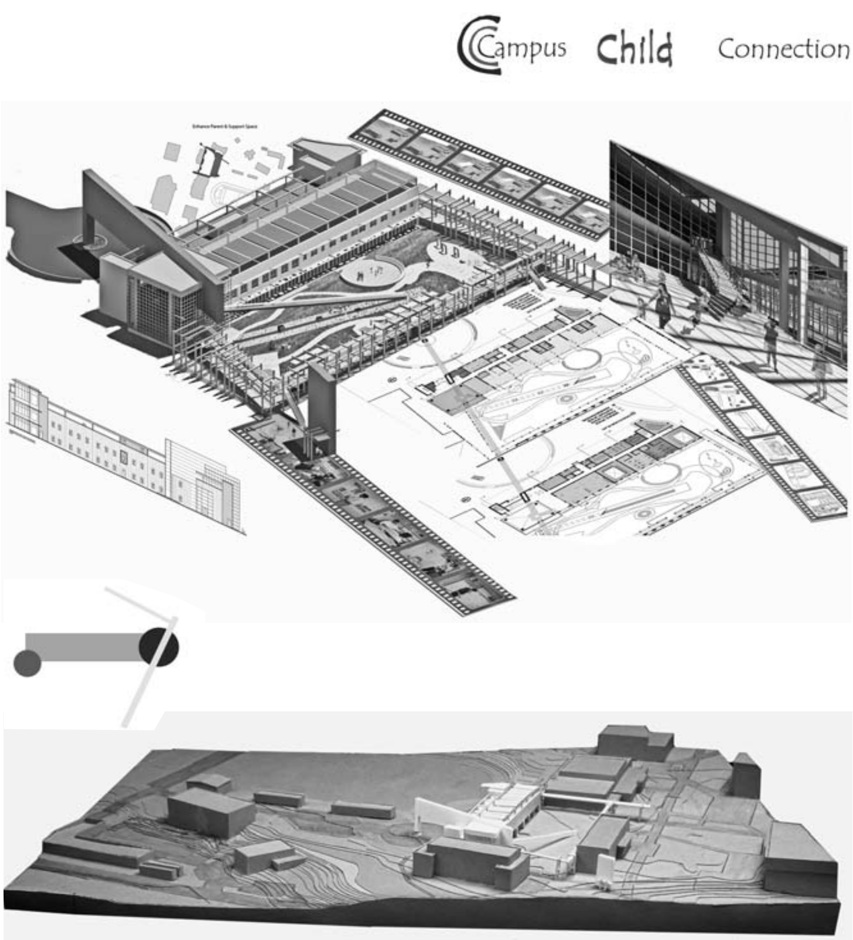


TRANSVERSE SECTION OF AUDITORIUM



Campus Plan of Morgan State University, Baltimore, Maryland

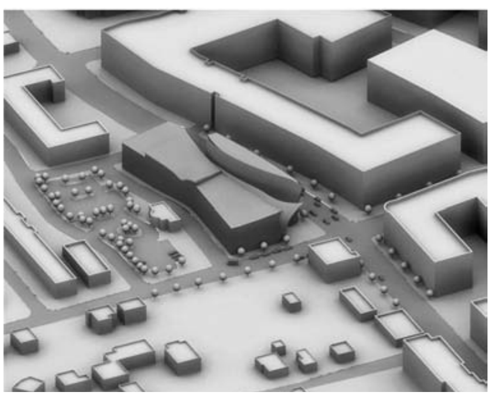
Analysis map showing walking distances and central location of site



In the thesis studio, the initial directions to students are that they are to clearly and succinctly write their philosophical and design intentions. (If they haven't yet learned that the written word is a design tool, this is the studio that imposes that lesson.) Then these designers are asked to graphically evoke a design partí, an organizing scheme for the thesis project and site organization and the project's positive contribution to its context. The graphic scheme that each student generates is then to be described, again in writing, as a spatial hierarchy. ("What is, given your design philosophy and your building program, the most important space in your project?") This literal description is then to be evoked in a schematic architectural section before a plan layout is attempted. This may prove difficult for many students who are trained to generate an architectural plan prior to schematic sections and elevations. Simple, even crude, conceptual models are employed to give credence to their initial evocations of partí building sections. This initial enterprise is to establish that the third dimension gives drama to architecture and that drama is never solely the responsibility of the architectural plan.

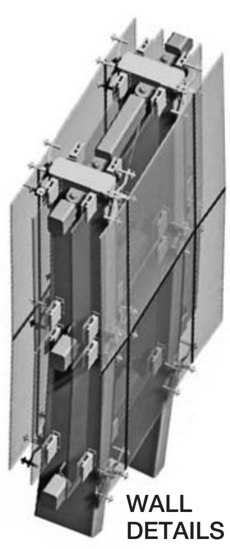
Once this basic tenet is established, design exploration continues with diagrams, conceptual sketching, and trial-and-error exploration with more advanced, but still conceptual, models—all to test, evolve, and possibly correct previous design decisions and intentions. At a particular stage unique to each student, digital media and modeling are engaged in this design exploration and refinement.
[PROFESSOR'S STATEMENT]

Images: Campus Child Connection, Morgan State University campus
Media: Revit, Rhino, and SketchUp
Student project by Vicente Oliveira
Courtesy of Studio Professor Paul Walker Clarke
School of Architecture and Planning, Morgan State University

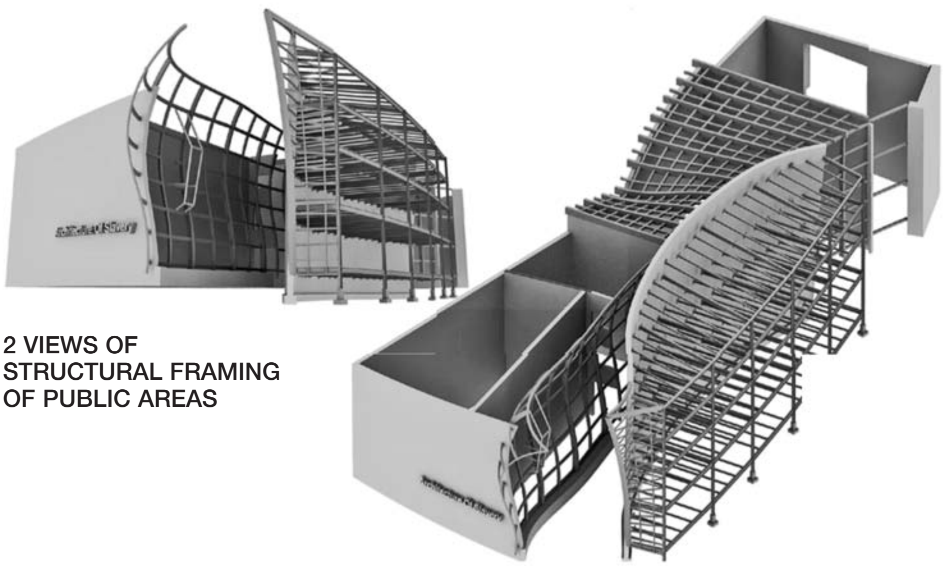


African American Museum of Slavery

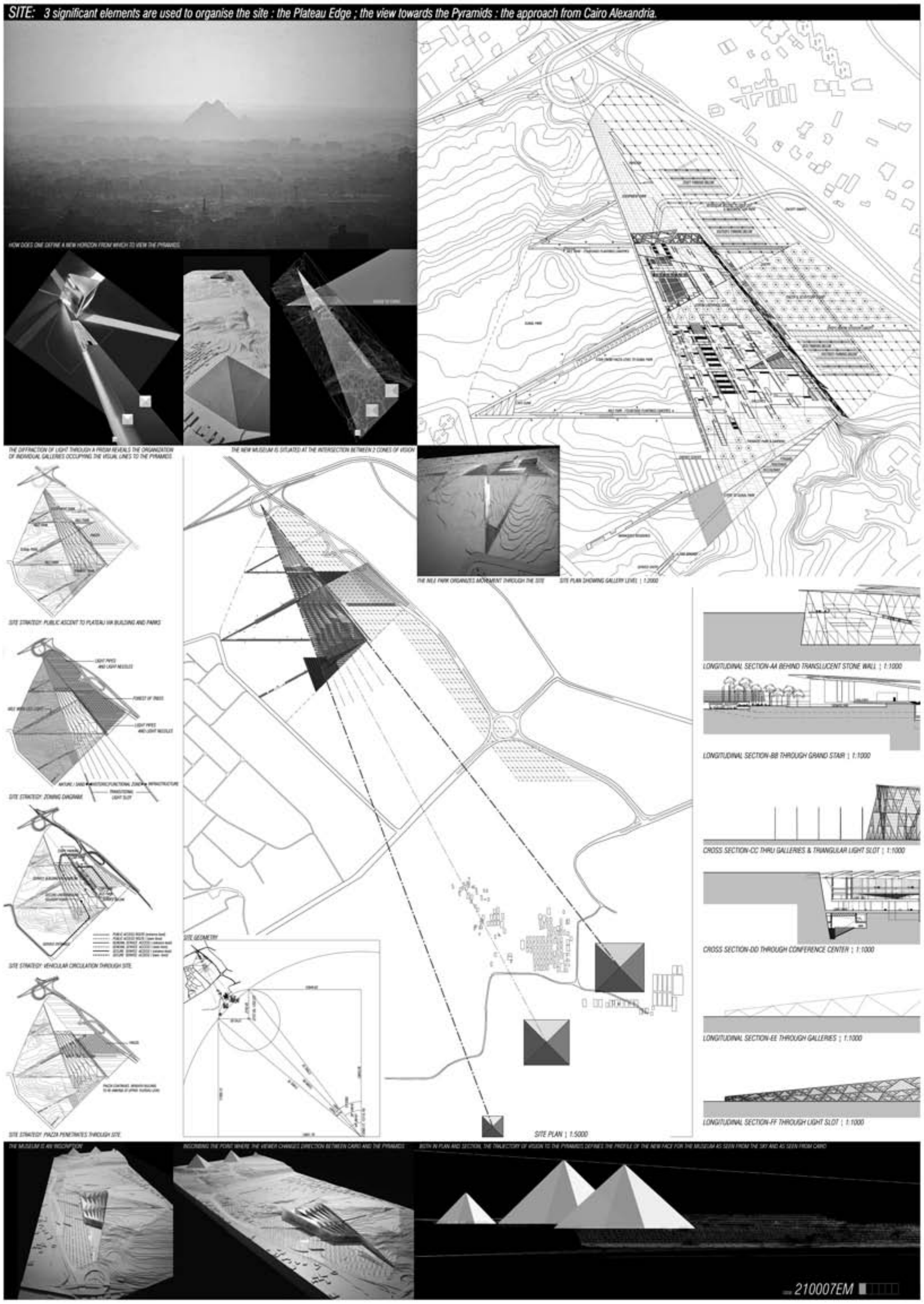
The void represents the absence—not only the physical absence of the first African American school, which was burned down, but also the symbolic loss of a platform or agenda that was established for the sole purpose of the advancement of African-Americans during this milieu. The void shall be expressed on the horizontal plane as well as the vertical plane, preferably in a location adjacent to the lobby where there is direct public pedestrian access. Located in such a prominent corner of the parcel, the void is expected to be a grand gesture that visually captivates passersby.
[Architecture student's statement]



Images (this and following page): Student project by Sanmi Farahenmi
African American Museum of Slavery, Rockville, Maryland
Media: Revit, Rhino, and SketchUp
Courtesy of Studio Professor Paul Walker Clarke
School of Architecture and Planning, Morgan State University

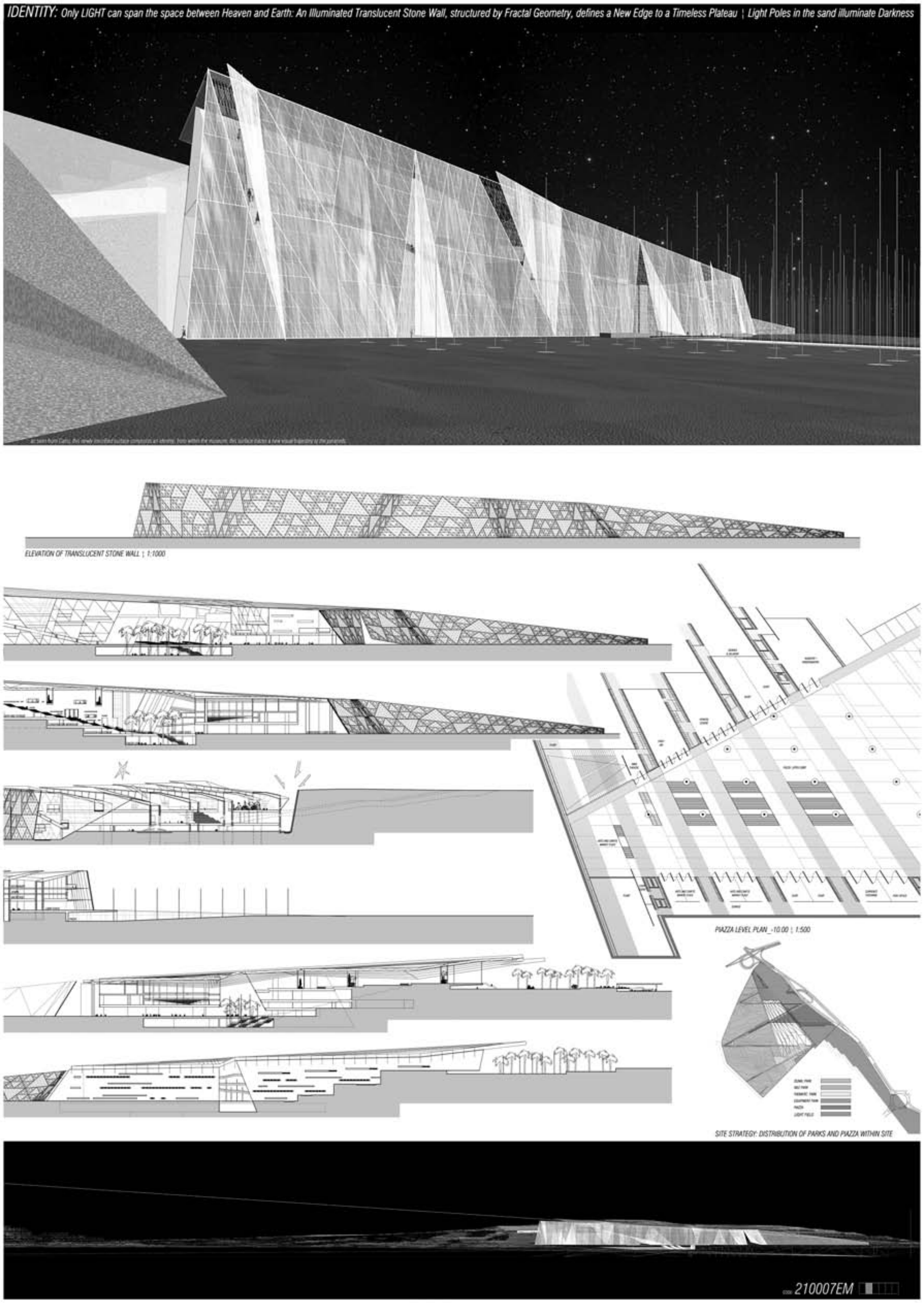


2 VIEWS OF
STRUCTURAL FRAMING
OF PUBLIC AREAS

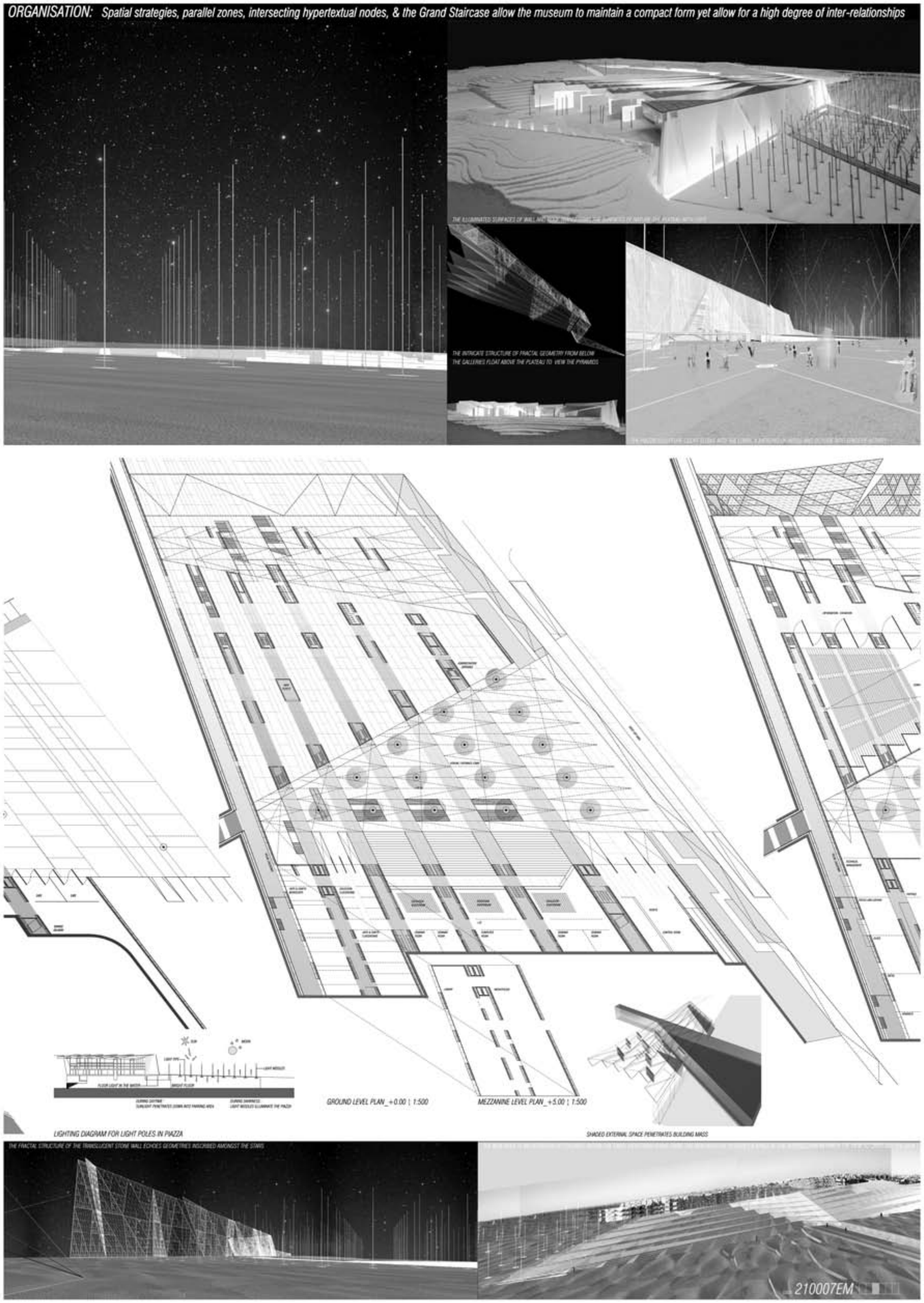


Winning competition drawings: Grand Egyptian Museum, Giza, Egypt
Media: The drawings were done in AutoCAD. The images were done in 3D Studio Max, finished in Photoshop, and then reimported into AutoCAD for printing.
Model by Kandor Modelmakers, London, England; Model photos by Richard Davies, Photographer, London, England
Courtesy of heneghan.peng.architects

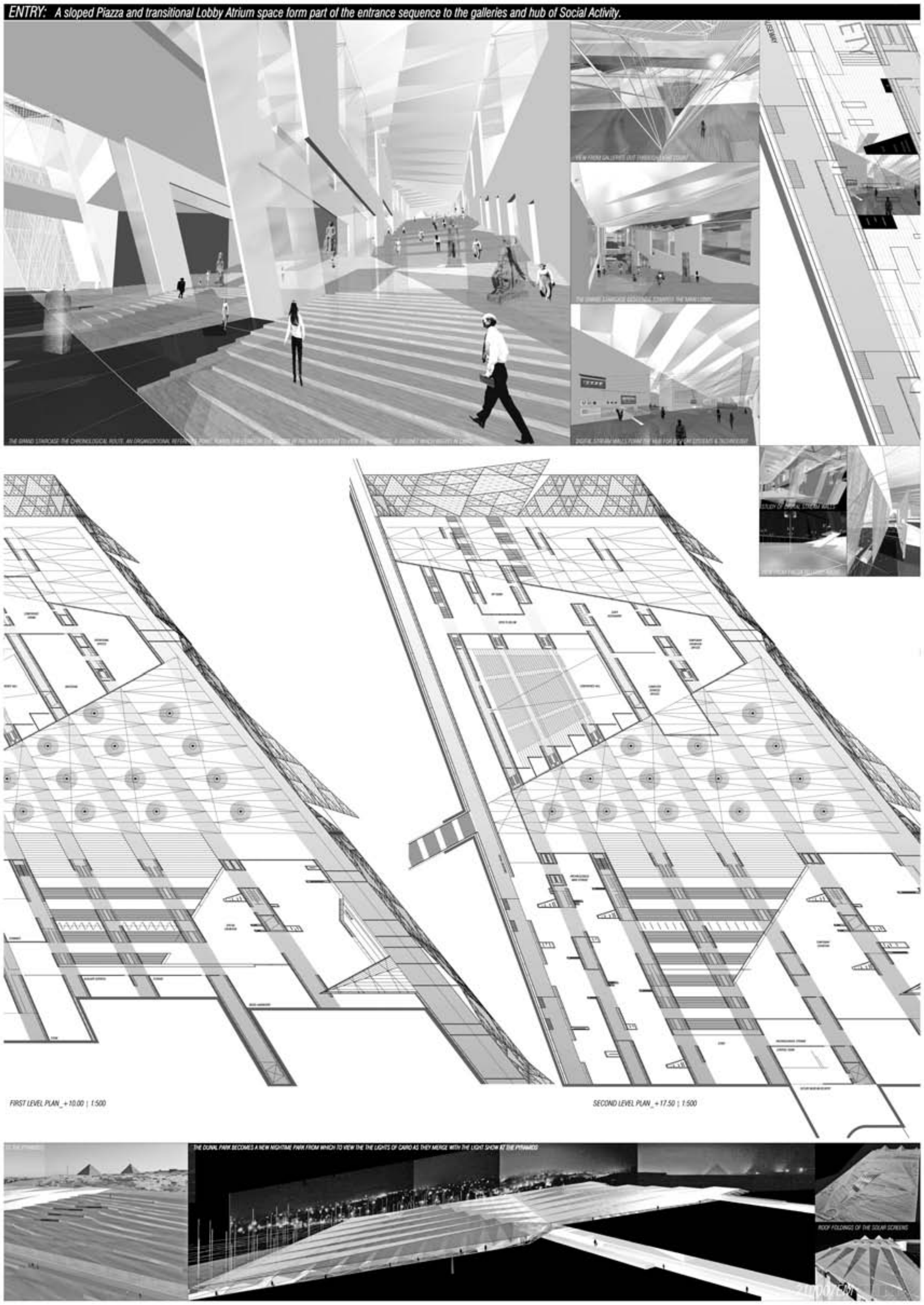
As you peruse the six panels of this beautiful set of winning competition drawings, try to find the elements that tie the panels together, making it a unified presentation. With more than 1,500 submittals, this $335 million project was one of the largest competitions ever.



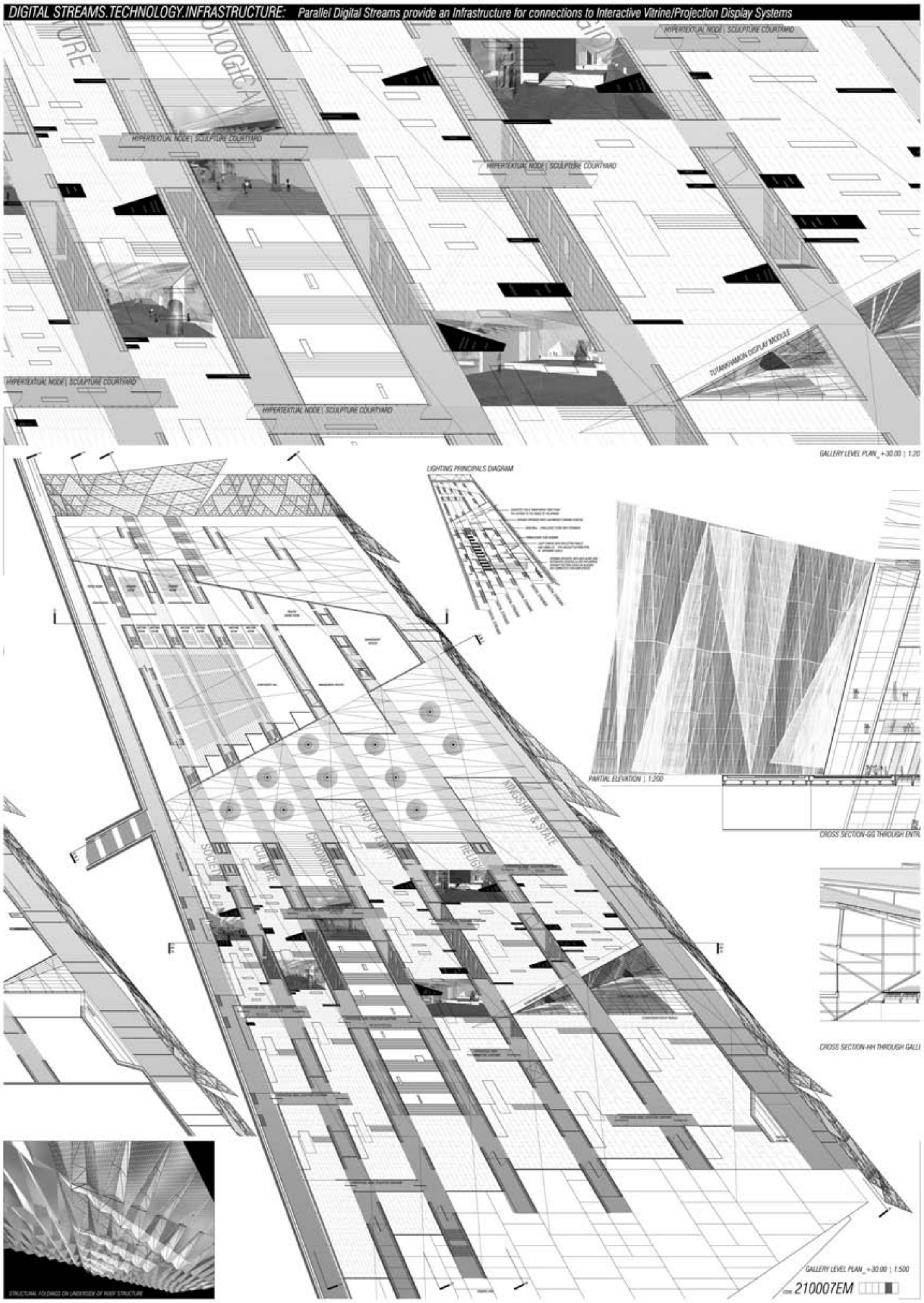
Design *competitions* in architecture have been popular historically. Globally, there has been an increase in commissions awarded on the basis of the results of design competitions. Upon closer scrutiny, architectural competitions do have their drawbacks. One major drawback is that the competitors have absolutely no contact



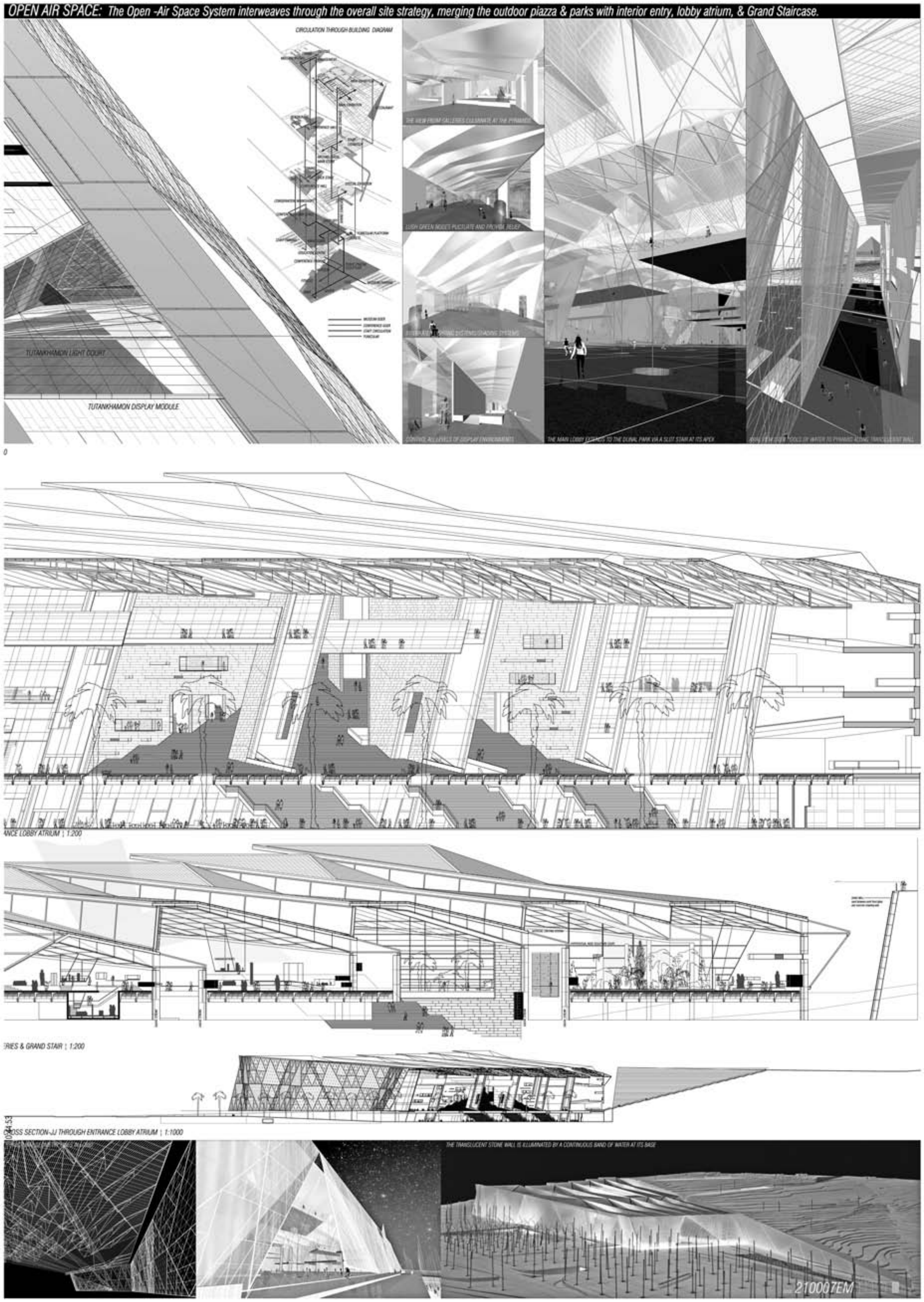
with the users, and therefore no opportunity to discuss the program and the budget with the client directly. This leaves them without a complete understanding of the design goals and objectives. Competitions also tend to be very restrictive in their requirements, and in the early stages, the competitors



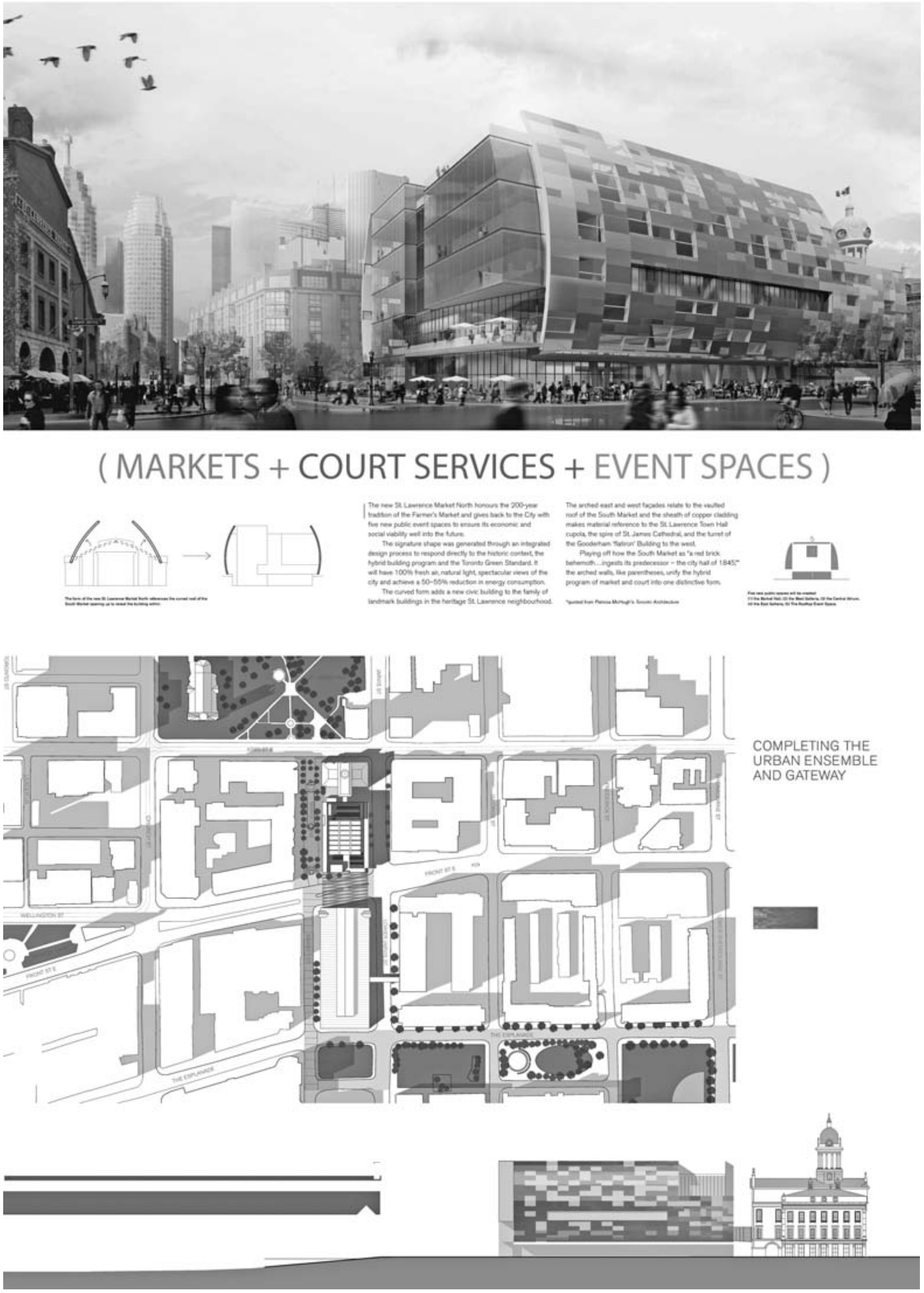
are not there to present their designs. Most competitions are judged anonymously. On the positive side, competitions can be a venue to start or launch successful careers for young architects. They are also a good creative outlet for individuals who are involved in the more mundane aspects of architectural practice.



A variety of media and every kind of drawing type are used in competition drawings for expressing and communicating design intentions to juries. This presentation used digital media as well as model photographs.

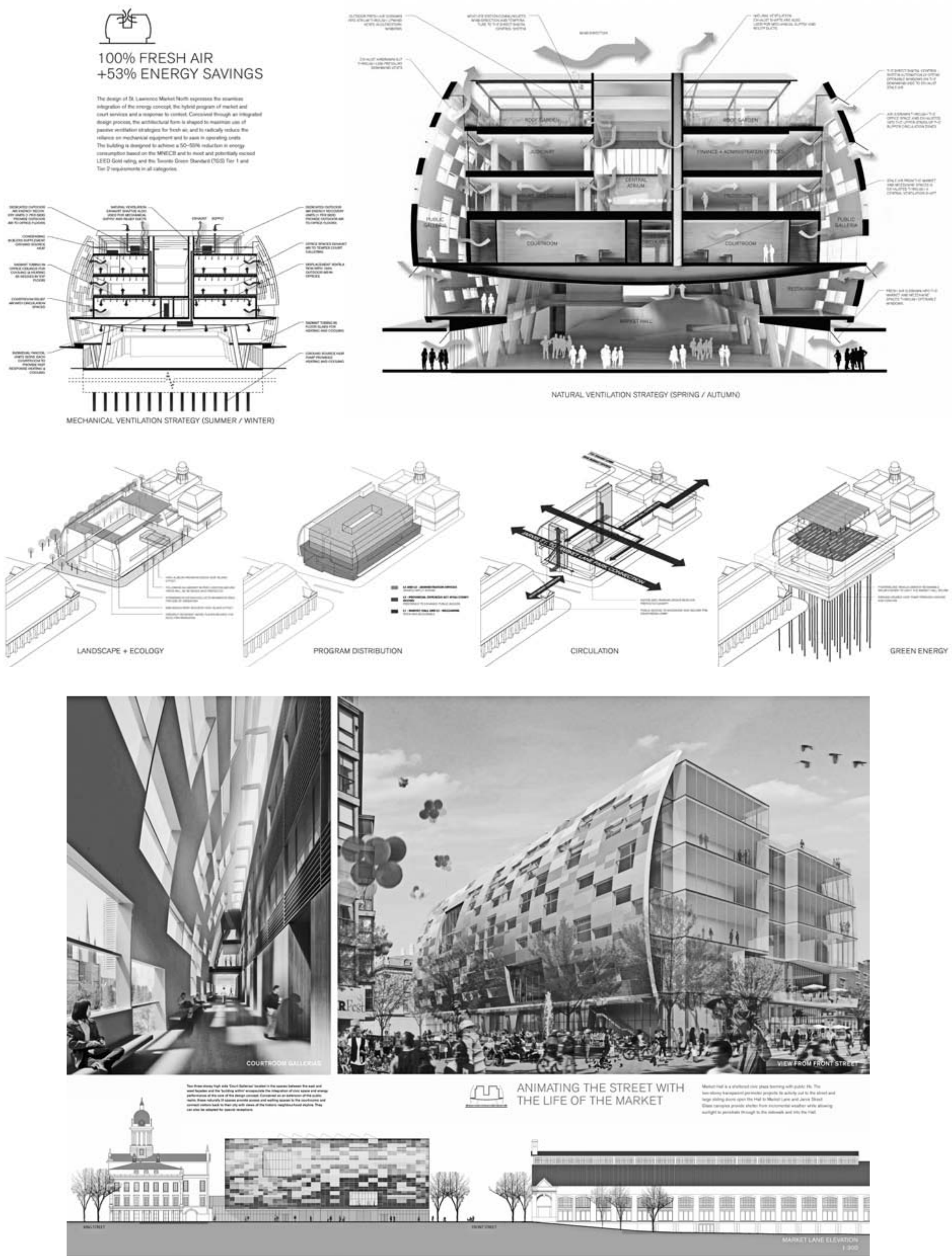


Keep in mind that the most sophisticated design idea will not win if it is not presented well or clearly. A concept must be presented imaginatively and simply so that it is readily understood by the judges.

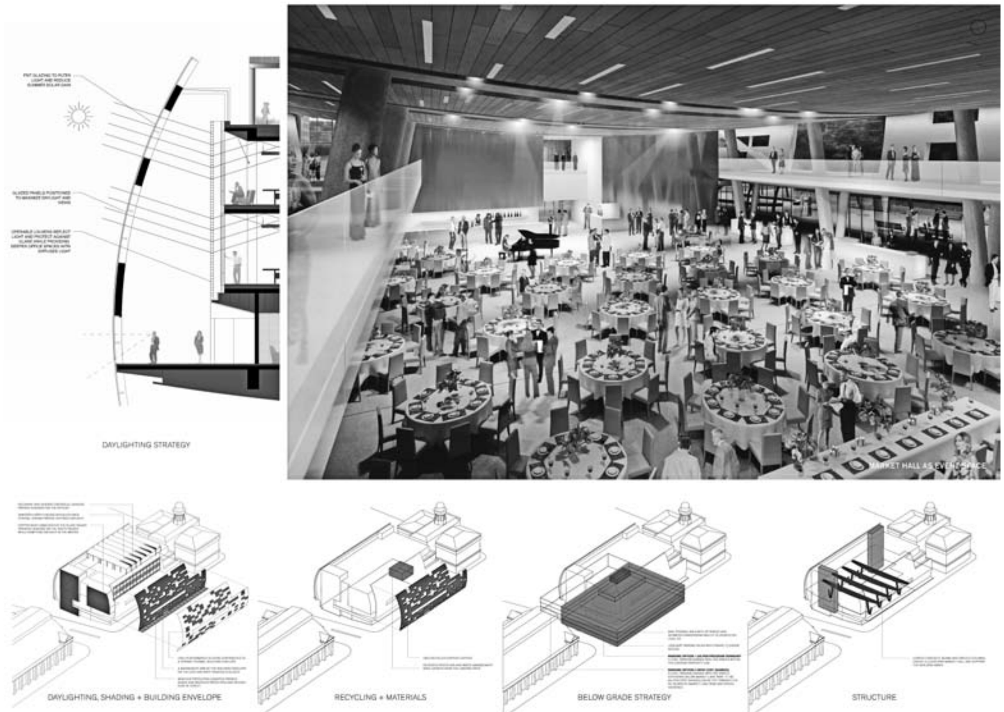


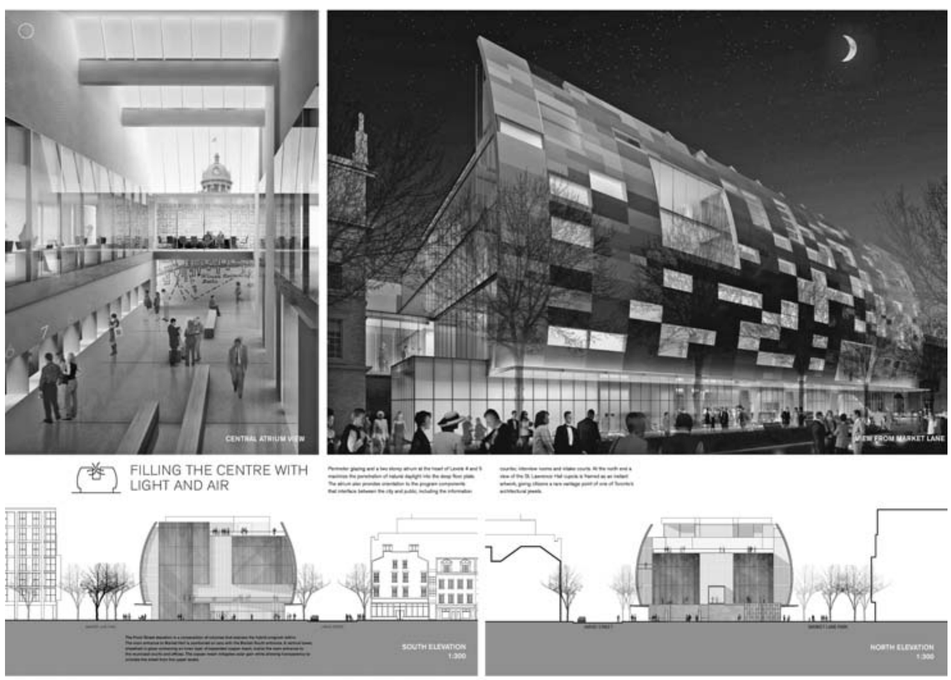
Ten panels: St. Lawrence Market North Design Competition, Toronto, Ontario, Canada
Media: Digital programs used—AutoCAD for the line drawings; Rhino and 3D Studio Max for the 3-D representation, as well as Photoshop and Illustrator

Courtesy of:
KPMB Architects—Architectural: Bruce Kuwabara, Marianne McKenna, Joseph Kan, Danielle Whitley, Amanda Sebris, Lindsay Keir, Curtis Lai
Halcrow Yolles—Structural: Barry Charnish
Crossey Engineering—Mechanical + Electrical: Wally Eley, Clive Lacey
Transsolar—Climate Engineering: Thomas Auer
Halsall—Sustainability: Doug Webber, Ian Theaker, Evelyn Koch



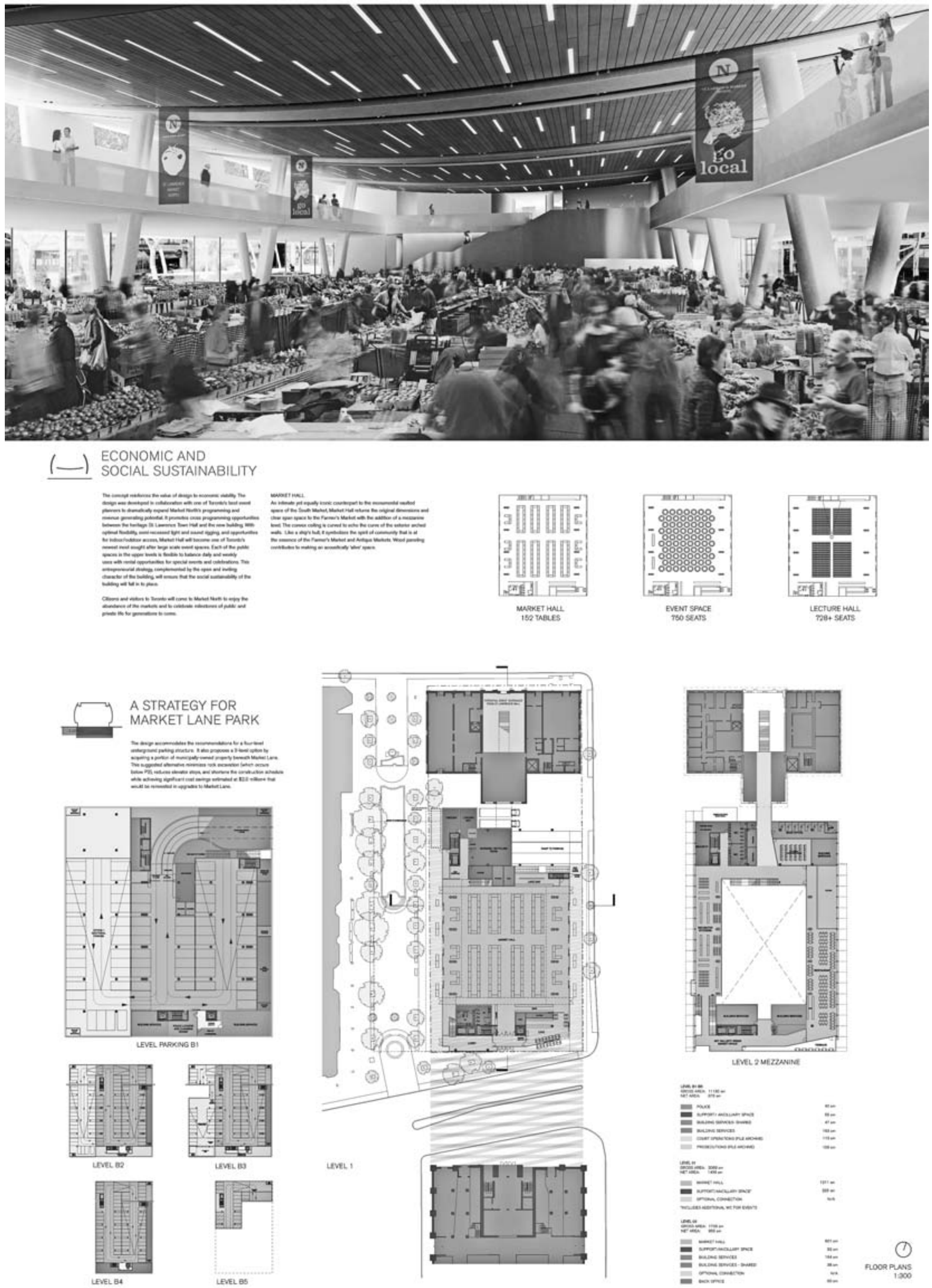
Gottschalk + Ash—Graphic Design: Udo Schliemann, Emese Ungar
CM2R—Cost: Gerard McCabe
J.C. Williams Group—Retail: Maureen Atkinson, John Archer
ERA Architects Inc.—Heritage Consultant: Michael McClelland
McNabb Roick—Event Planning: Jeffry Roick, Mark Robert
Cicada Design Inc.—Renderings: Dalibor Cizek, Jonah Humphrey, Ilya Floussov
JS Models—Architectural Model: Jack Syzmoniak



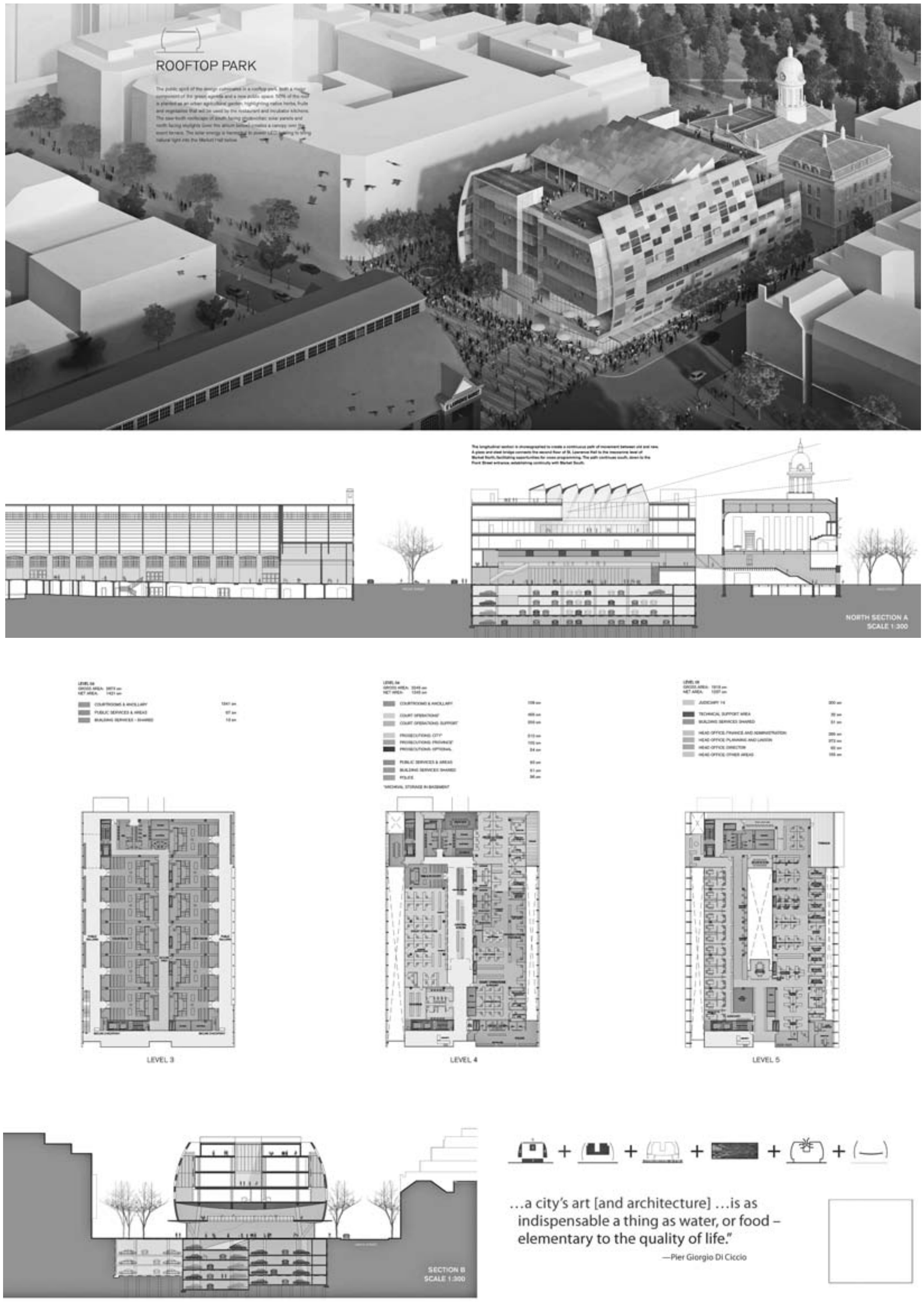


The strategy for the layout/organization followed a regular grid in which the renderings were organized in the upper two-thirds of the panels, while the line drawings, diagrams, and text were grounded in a horizontal band along the lower edge. The competition required ten panels, including a set number of line drawings, and all elevations, floor plans, and sections at a set scale of 1:300 to ensure easy comparison among the submission entries.

The main ideas of the project were conveyed through blocks of text, arranged throughout the panels, helping to unify the boards and draw the eye from one area to another. From a distance, the viewer would understand the main design ideas quickly; and on closer viewing there would be more detailed text, adjacent to the relevant illustrations.

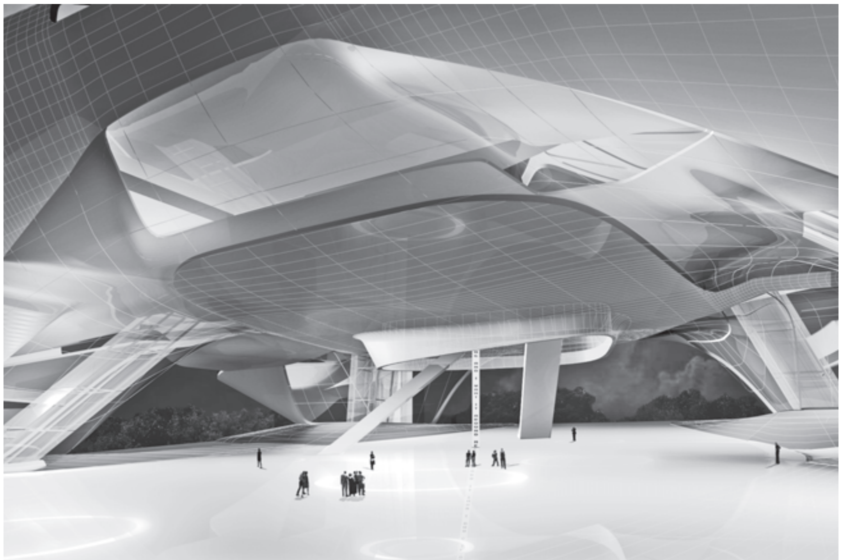


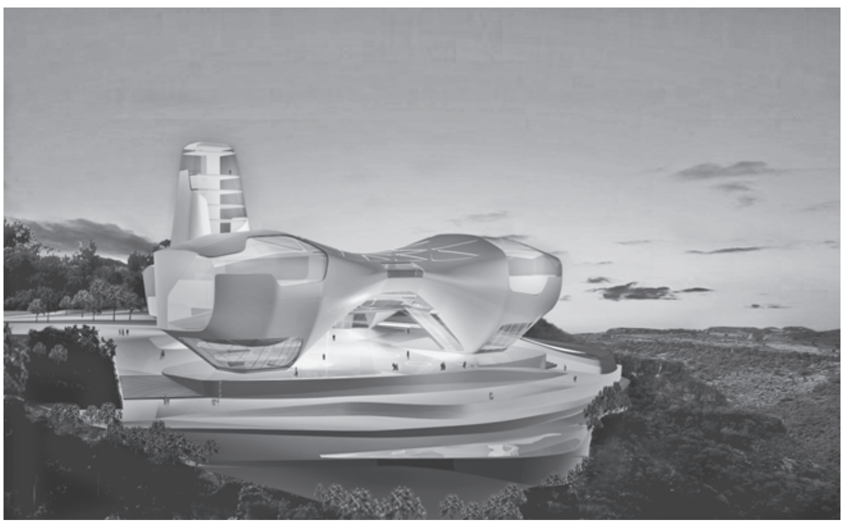
The carefully chosen vantage points highlighted in each exterior rendering tell the story of how the building integrates seamlessly with the historic fabric of the neighborhood, drawing formal cues from the historic St. Lawrence Market directly to the south and the materials palette of St. Lawrence hall (1851) to the north. The bustle of the market and animation of the street are important to sustaining life and culture in the area and thus were depicted in both different seasons and different times of day. The versatility of the main hall was explained through contrasting views of the Saturday market and a formal event space.



A sectional perspective was used to explain the sustainable features of the design, bringing to life the explanatory drawing with an illustrative quality. A series of line diagrams were developed to further explain the organizational strategies of the building, with highlights in color.

A muted palette of soft greens and oranges unified the different illustrations and alluded to the proposed copper facade and the historic significance of the site. [Architect's statement]





Standard Wall Presentation versus Digital Online Presentation

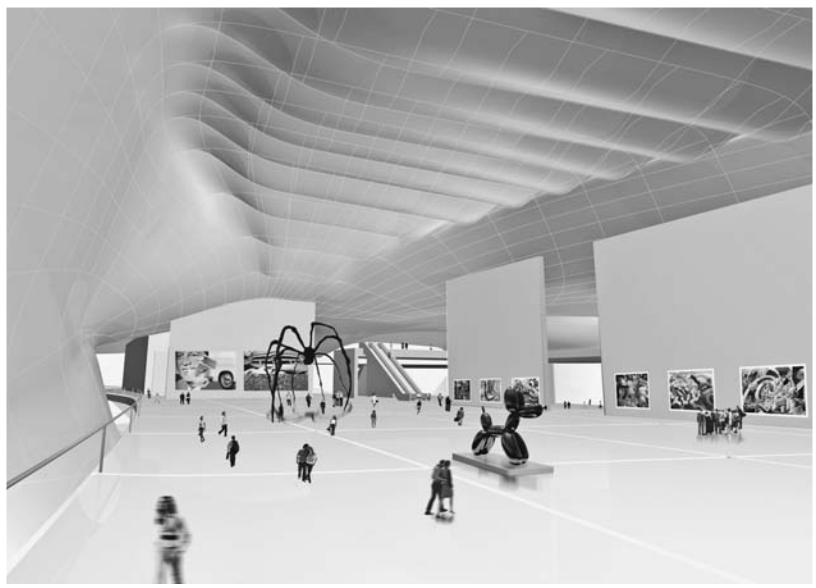
The next sequence of pages will display digital online presentations. The standard wall presentation is limited by the area of the wall and the organization of the visual display medium, which is paper with images of various sizes and compositions. The advantage of wall presentations is that it allows a viewer to study the boards and to analyze many bits of information simultaneously. This method is very frequently used in design juries. It is very similar to a museum exhibit.

Digital online presentation is very focused on a screen, onto which images move back and forth with a zooming capability. The viewer might have difficulty in cross-referencing and comparing images simultaneously at the same size and on the same viewable monitor. This method of presentation might also present a problem for a reviewer to compare one designer's work with another because he/she is constrained by the monitor. However, an advantage is that one can study the presentation in the comfort of one's home.

The two formats are as different as reading a printed book and reading an e-book.

Drawings: Guggenheim Guadalajara
Guadalajara, Mexico
Media: Maxwell Render, V-Ray, Maya, Rhino, Photoshop
Courtesy of Asymptote: Hani Rashid + Lise Anne Couture

This design projects an iconic architectural presence on a spectacular site. The four sculptural corner building volumes that rise up from the ground plane, and the sweeping surfaces of the museum suspended above, create a remarkable space that transitions between the city and the surrounding canyon. In this dynamic public space, visitors can access the public amenities housed in the corner buildings, view large-scale sculptures on exhibit, or enter the museum interior via escalators set against an extraordinary panorama.
[Architect's statement]



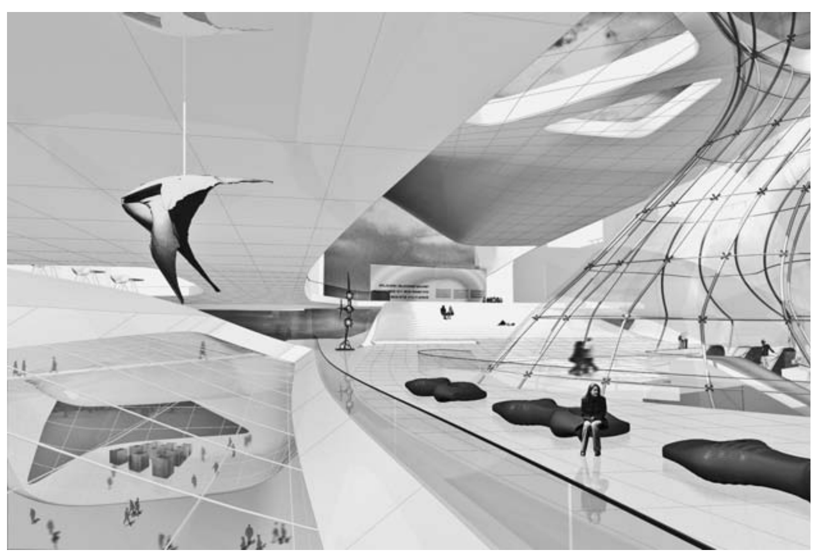


Image courtesy Diller Scofidio + Renfro

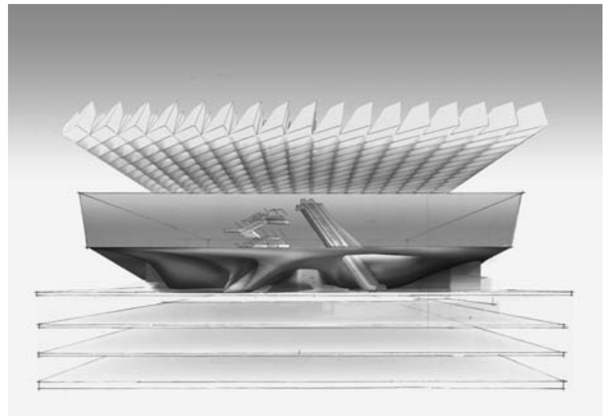


Image courtesy Diller Scofidio + Renfro

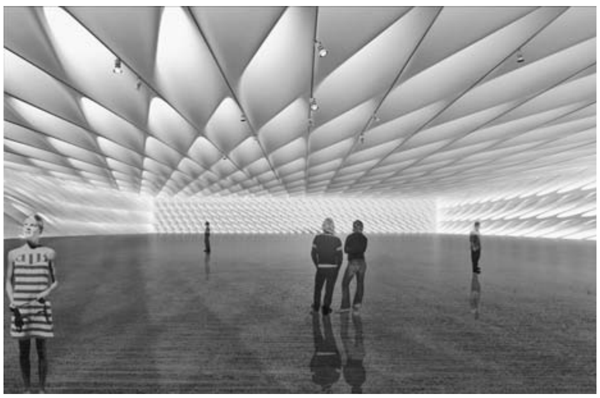


Image courtesy Diller Scofidio + Renfro

Column-free skylit gallery

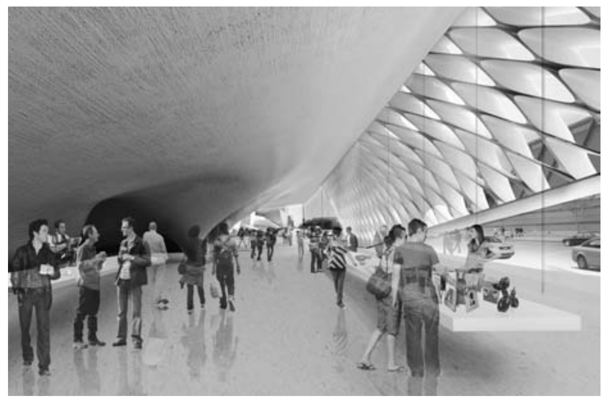


Image courtesy Diller Scofidio + Renfro

Lobby along Grand Avenue

Image courtesy Diller Scofidio + Renfro

Skylit gallery with art

Concept diagram

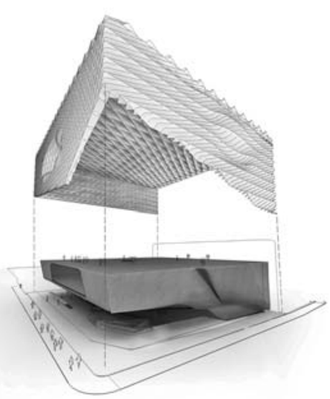
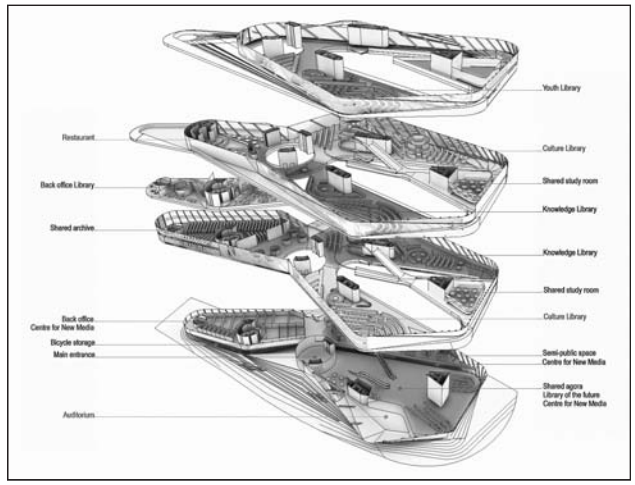


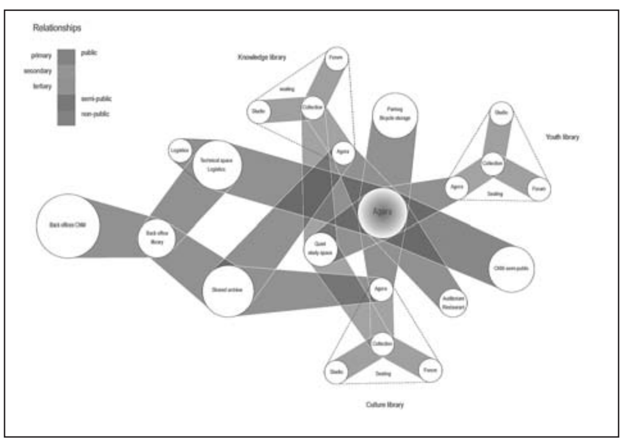
Image courtesy Diller Scofidio + Renfro

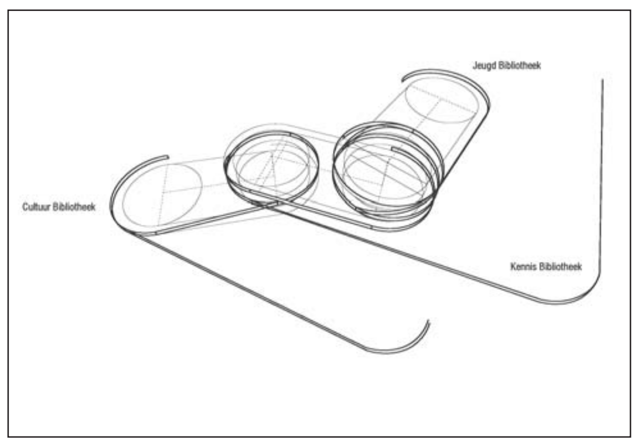
Our goal for the museum is to hold its ground, through contrast, next to Gehry's much larger and very exuberant Walt Disney Concert Hall. As opposed to Disney Hall's smooth and shiny exterior that reflects light, The Broad will be porous and absorptive, channeling light into its public spaces and galleries. The veil will play a role in the urbanization of Grand Avenue by activating two-way views that connect the museum and the street. [ARCHITECT'S STATEMENT]

The column-free interior of the museum achieves the integration of a Vierendeel truss system (which lacks diagonal or triangulated elements in the primary structure) rotated at an angle to the rectilinear grid of the building mass. This creates a dynamic skylit pattern with a seemingly non-static spatial experience as one moves through the museum space. The natural light filtering through the "porous" exterior skin brings light inside, while the interior lighting shows a glowing effect at night.

Drawings: The Broad
Los Angeles, California
Media: Autodesk AutoCAD, Autodesk 3DMax, and Adobe Photoshop
Courtesy of Diller Scofidio + Renfro

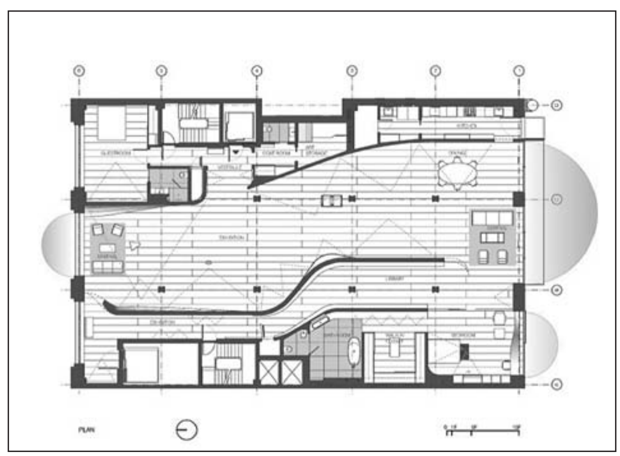






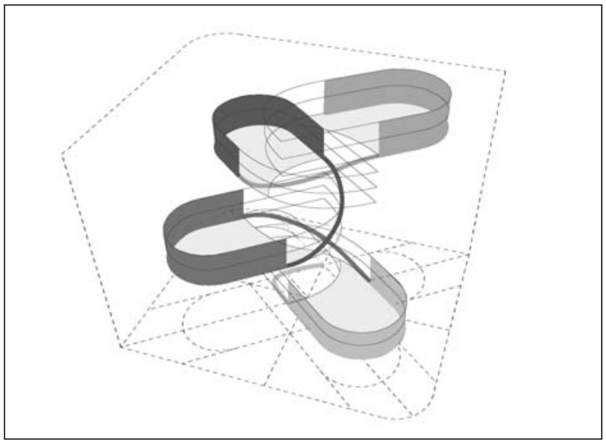
Drawings: Waalse Krook: Urban Library of the Future and Center for New Media, Gent, Belgium
Media: CAD software: AutoCAD; 3-D modeling: Rhino, 3D Studio Max, Alias Maya Complete, TopSolid, V-Ray, and T-Splines
Courtesy of UNStudio

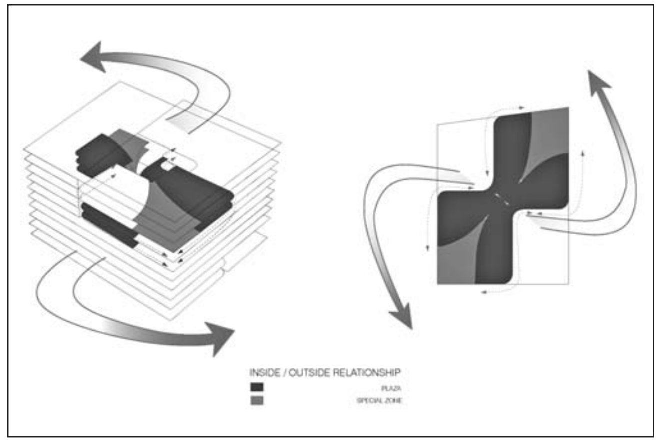
The design for this urban library creates a dynamic, flexible, and open knowledge environment. The building is fluid in form, accommodating to its surroundings, and incorporates expansive sightlines. The internal organization of the building is based on an open central void, around which the circulation takes place. This void enhances the spatial experience and creates clear orientation through the building. The structure of the building makes it possible to introduce green roof terraces whilst also ensuring low levels of direct sunlight penetration. [ARCHITECT'S STATEMENT]

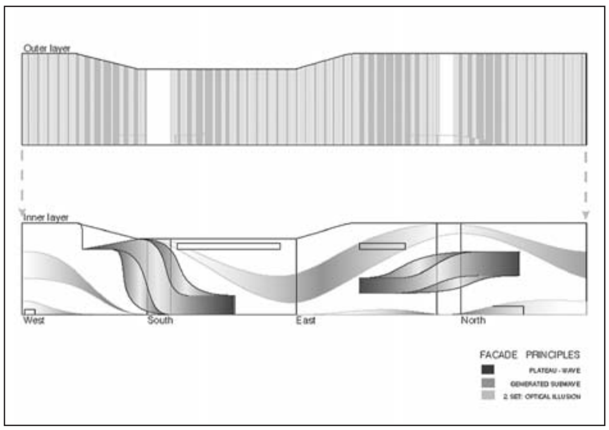


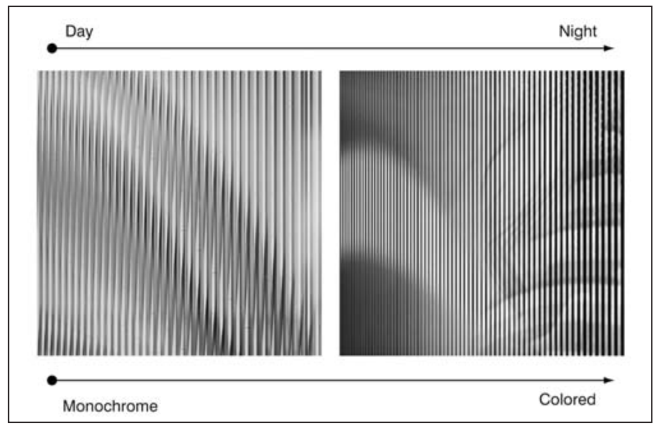
Drawings: Collector's Loft, New York, New York
Media: CAD software: AutoCAD; 3-D modeling: Rhino, 3D Studio Max, Alias Maya Complete, TopSolid, V-Ray, and T-Splines
Photos by Iwan Baan, Photographer
Courtesy of UNStudio

The design for this existing loft explores the interaction between gallery and living space. The main walls in the loft flow through the space, and together with articulated ceilings create hybrid conditions in which exhibition areas merge into living areas. While the walls form a calm and controlled backdrop for the works of art, the ceiling is more articulated in its expression of this transition. By interchanging luminous and opaque, the ceiling creates a field of ambient and local lighting conditions, forming an organizational element in the exhibition and the living areas.
[Architect's statement]



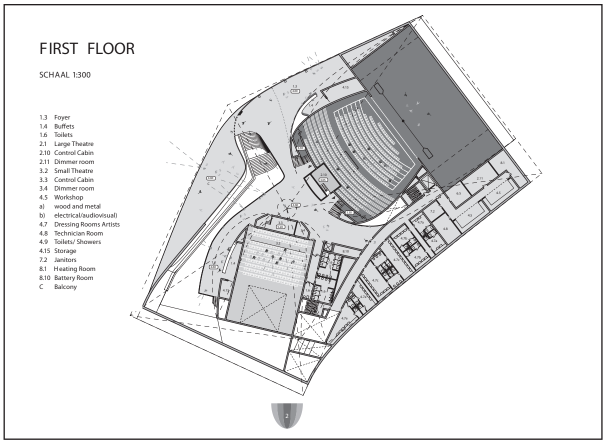


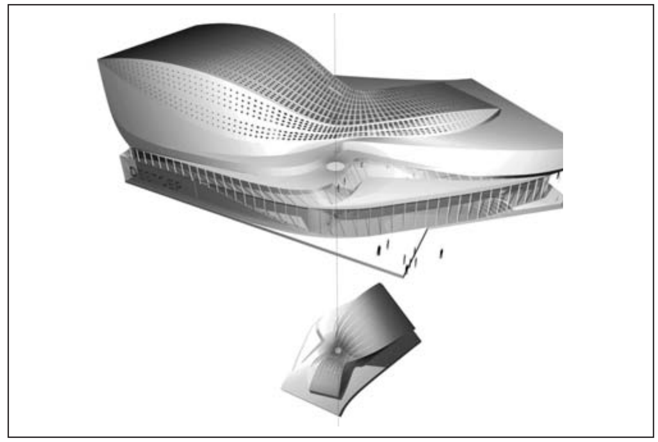


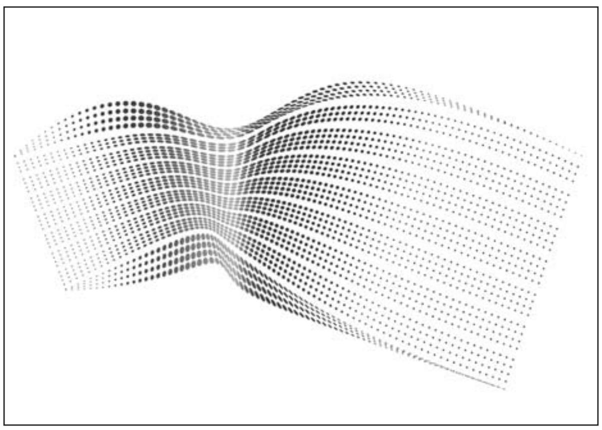


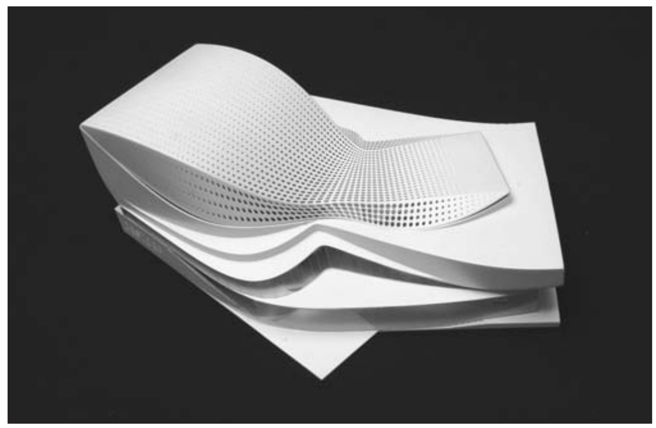
Drawing: Cheonan, Cheonan, Korea
Media: CAD software: AutoCAD; 3-D modeling: Rhino, 3D Studio Max, Alias Maya Complete, TopSolid, V-Ray, and T-Splines
Courtesy of UNStudio

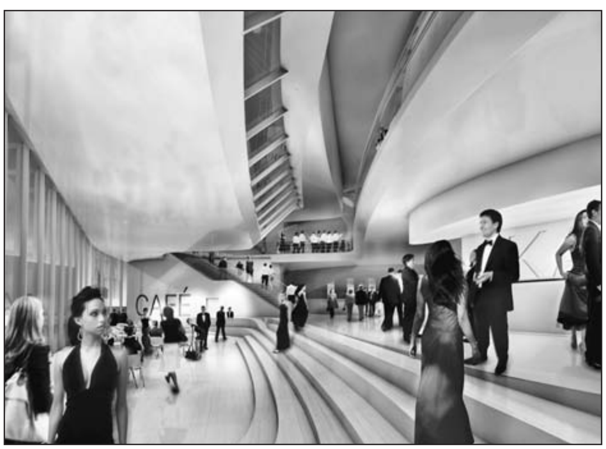
The design for this Galleria employs a propeller principle for its building organization. Four stacked program zones, each thematically combining three stories and containing public plateaus, are linked to the central void. The concept of the propeller is a fluent upstream flow of people through the building, whilst the propeller wings simultaneously stream visitors outward to the plateaus on the various levels. On the facades, a gradual transition from exterior surface to the interior plateaus accentuates the internal organization. Both the outer glass shell and the inner skin comprise a linear pattern created by the vertical mullions. During the day the building has a monochrome reflective appearance, whilst at night soft colors are used to generate waves of colored light across the facade. [Architect's statement]





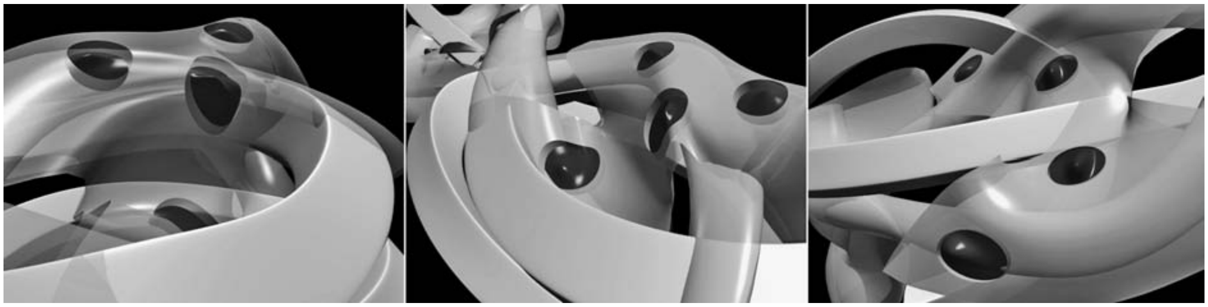






Drawings: Theater Spijkenisse
Spijkenisse, The Netherlands
Media: CAD software: AutoCAD; 3-D modeling: Rhino, 3D Studio Max, Alias Maya Complete, TopSolid, V-Ray, and T-Splines
Courtesy of UNStudio

The design for the Theater Spijkenisse focuses on the placement and orientation of the building in the urban location, whilst simultaneously providing architectural solutions for programming needs and public access. The placing of the programs within the building aims for efficient routing through the theater, coupled with a logical relationship to the surroundings, whilst the design and placement of the various volumes make use of the natural variations in the levels of the site. The two main theater spaces are positioned to receive the visitor flow directly from the foyer and the public square. From the foyer, a sculptural stairway forms the binding element toward the entrances to the theater rooms.
[Architect's statement]



Images: Guggenheim Virtual Museum, New York, New York
Media: Software—Alias, Maya, Cosmo Worlds VRML, Adobe Photoshop, Adobe Premiere, Macromedia Flash
Courtesy of Hani Rashid and Lise Ann Couture, Asymptote
Project team: John Cleater, Noboru Ota, David Serero, Florian Pfeifer, Ruth Ron, Birgit Schoenbrodt

When speaking of an architecture for the next millennium, one must consider two conditions: that the physical space of architecture as we have always known it (enclosure, form, and permanence) will without a doubt persevere, and that it will exist alongside the virtual architecture, surfacing in the digital domain of the Internet. Buildings, institutions, spaces, and objects are now being constructed, navigated, experienced, comprehended, and altered in their virtual states by countless people across global networks. This new architecture of liquidity, flux, and mutability is predicated on technological advances and fueled by a basic human desire to probe the unknown. The path that both architectures—the real and the virtual—inevitably take will be one of convergence. Historically, architecture has struggled with the dialectic of the real and the virtual: architecture's stability and actuality have always been tempered by the metaphysical and the poetic.
[Architect's statement]

9

Introduction to Portfolio Building

Drawings and models are products of a creative design process in finding a solution to a problem. They serve as media for internal dialogue as well as external communication among designers, clients, and the community. This process, if documented properly and archived systematically, enables the designer to use his or her own progress in searching for answers. Over the course of creating a design, one could communicate the ideas of the design through snapshots of selected materials from one's collection. This collection also informs one's growth, progress, and maturity, reflected by the oeuvre.

A portfolio may be a document of one particular design, illustrating the methodology of a process. It may also be a presentation of a record of work on a collection of design projects. Students use portfolios to get promotions, to apply to graduate schools, or to enter the job market. Nowadays, it is a common practice for professionals to use online Web site portfolios to introduce themselves to prospective clients. Thus, it is a unique accessible self-expressive document that stands on its own merit for show-and-tell, as well as an indication of future potential. Carry-on portfolios encompass images of drawings and models in a transportable packaged document like a protective binder. They can also be online in a digital format, as most professional office portfolios are. A portfolio is a collection of selected works to be seen and reviewed online with a precise message. A portfolio—real or digital—must set a quality tone in a clear, consistent, and legible manner, with an attitude of modesty and humility. It introduces the designer to the world.

The intent of this chapter is to give tips on how to skillfully manipulate and organize text and images for a portfolio into a unified whole that is visually coherent and uniquely sound in its inventive approach.

The following are some of the skills, terms, and concepts you will learn:

How to organize a design portfolio
How to lay out a design portfolio
How to juxtapose text and images

Portfolio Building

TOPIC: PORTFOLIOS

Mitton 2003.

Luescher 2010.

Linton 2012.

Ray, Lokko, & Marjanovic 2003.

STUDENT PORTFOLIO EXAMPLES:

http://issuu.com/drew.cowdrey/docs/cowdrey_portfolio_may2010

http://issuu.com/rtglick/docs/glick_ryan_1.11.11_high_res_portfolio_v4.11

http://issuu.com/mbuyer/docs/final_grad_portfolio_to_size

http://issuu.com/ma_pearson/docs/bojana_martinich_portfolio

http://issuu.com/ma_pearson/docs/geunho_song_portfolio

http://issuu.com/ma_pearson/docs/damian-rozkuszka-portfolio

http://issuu.com/JATAFA/docs/2010-2011_henry_portfolio

http://issuu.com/j.elder/docs/jerome_elder_undergraduate_portfolio

http://issuu.com/chrissnowden/docs/undergraduate_architecture_portfolio

http://issuu.com/mdhagge/docs/portfolio.mario.walker

http://issuu.com/glendalecommunitycollegeca/docs/arvin_shirinyans_portfolio-small

http://issuu.com/glendalecommunitycollegeca/docs/gordon_au_portfolio

http://issuu.com/TheAgencyTAMU/docs/carlos_gamez_final_portfolio_2009/1

http://issuu.com/TheAgencyTAMU/docs/alan_knox_undergraduate_portfolio_2003_tamu-arch/1

http://issuu.com/TheAgencyTAMU/docs/stephanie_cole_final_portfolio_2007/1

http://issuu.com/TheAgencyTAMU/docs/jennifer_marshall_undergraduate_portfolio_2009_ta/1

http://issuu.com/TheAgencyTAMU/docs/jennifer_marshall_final_study_portfolio_2011_tamu/1

Chapter Overview

After studying this chapter, you will understand the components of a good design portfolio. For continued study, refer to Linton 2012 and Luescher 2010.

Design portfolio excerpts
Media: Adobe Photoshop, Adobe Illustrator, Rhino, and VRay
Courtesy of student Ryan Thomas Glick and studio Professor Hiro Hata
Department of Architecture
School of Architecture and Planning
State University of New York at Buffalo
(See ISSUU link for this portfolio on second page of this chapter.)

Sample student portfolios from Architecture 2250—
Architectural Presentation and Portfolio
Courtesy of Professor Mark A. Pearson
Department of Architecture,
College of DuPage

Title Sheet

The front cover sheet or title sheet should open your portfolio with image(s) and text that focuses or attracts your attention. The front cover should be an integral part of the total designed portfolio. In this student portfolio example, the word "work" is printed in large bold type along with the student's name and portfolio objective/purpose. The lead-off page for every project should be clearly identifiable and bring your attention with fonts that stand out. Standing out does not mean to use overly stylized or scripted fonts. Use simple, clear font styles and consider using sans-serif fonts.

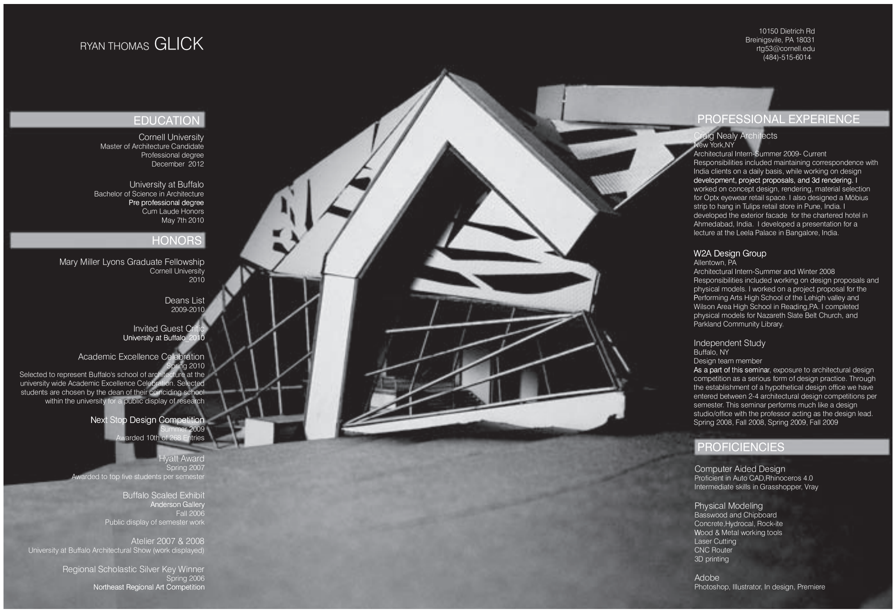
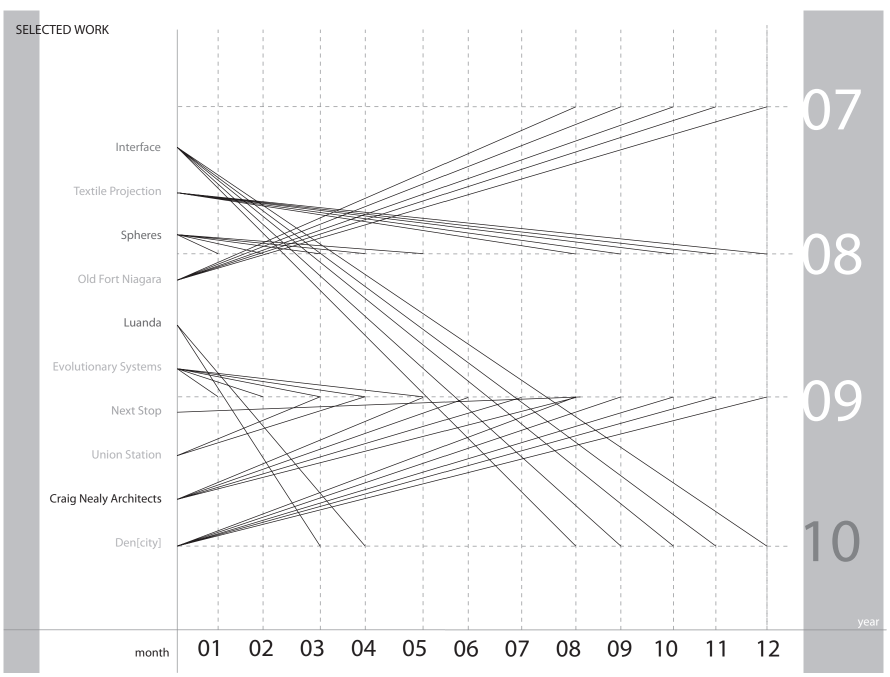


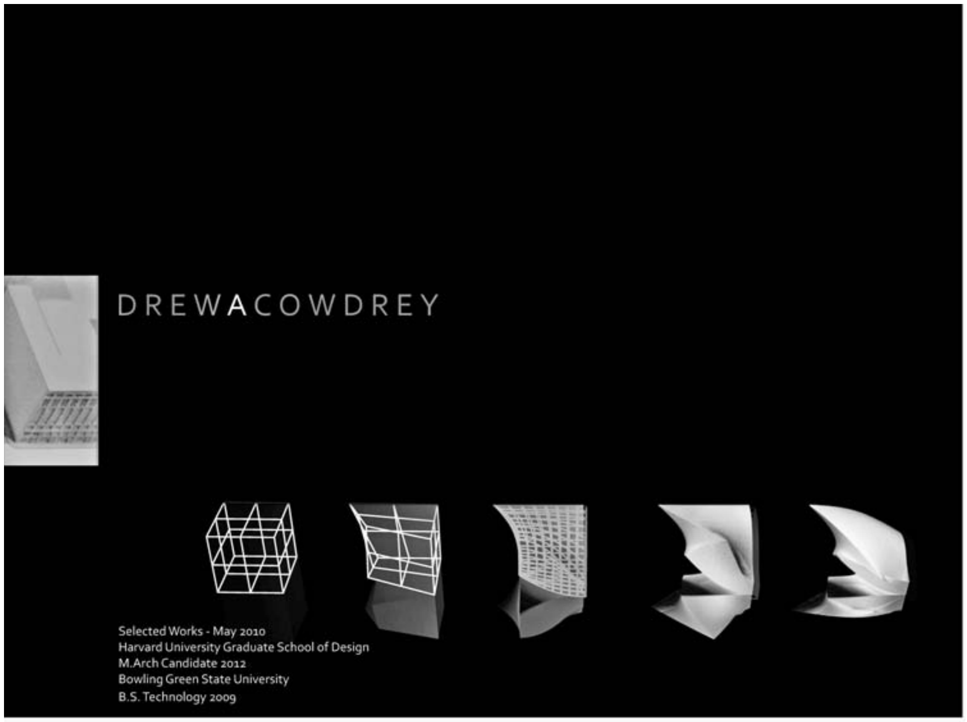
Table of Contents

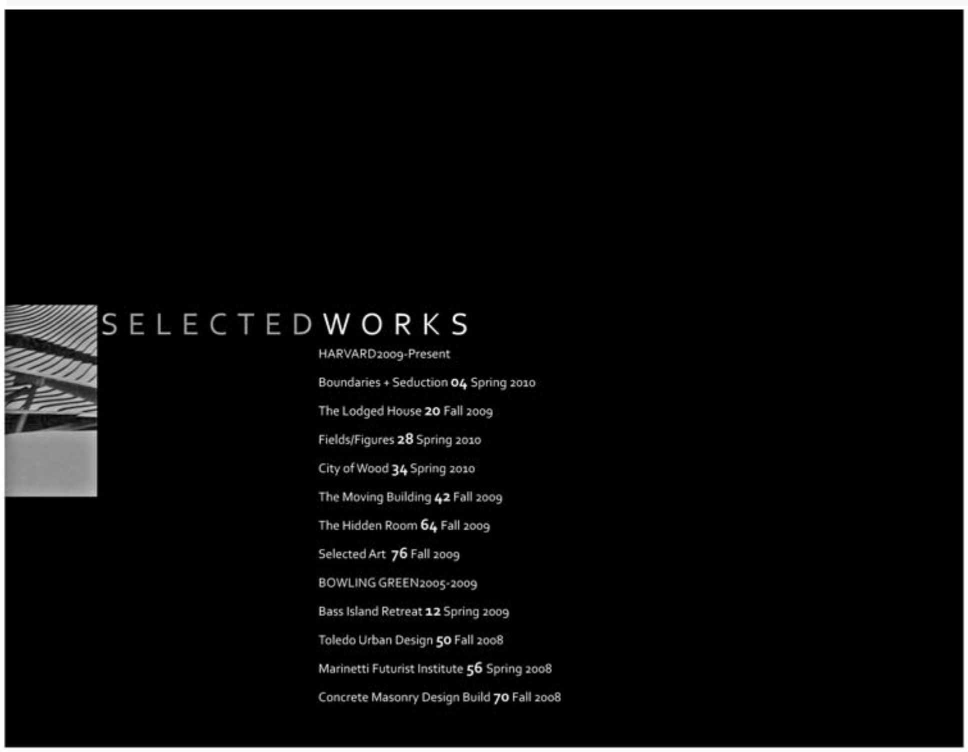
A nice way to start off a portfolio is to begin with a brief academic and professional résumé that includes summer, part-time, or full-time work; educational background; honors and awards; architecture classes completed; and personal skills such as computer familiarity and physical modeling skills. Try to give an extensive relevant listing on your résumé, whether it is for graduate school or for an intern position in an office.



Indexing Project

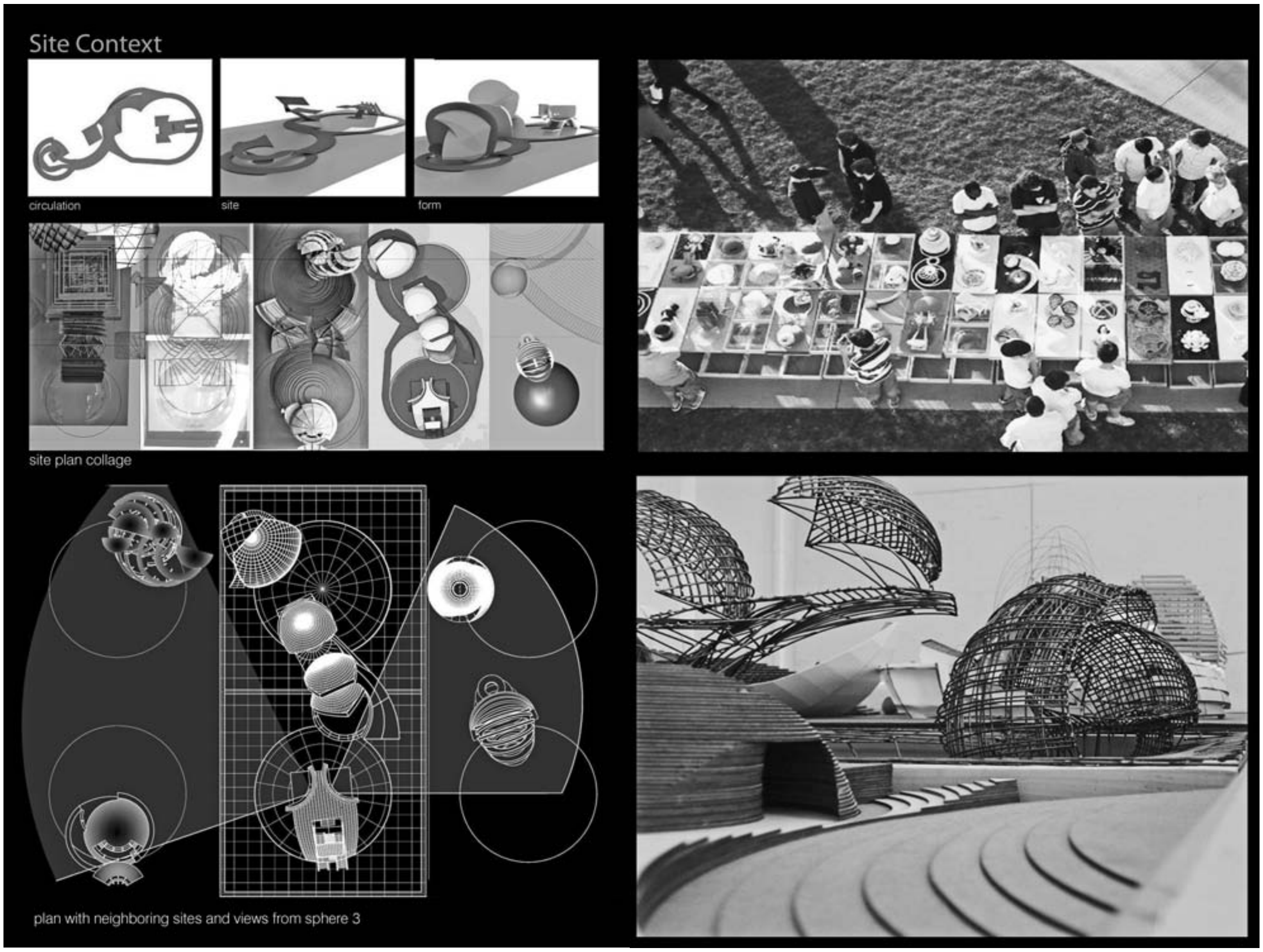
Somewhere in the very front matter, you must have an *index* to guide reviewers to all of the projects they will be viewing. Try to provide an index with strong visual impact that is also easy to follow and understand. Portfolios are commonly organized according to a yearly design studio sequence—for example, from first-year design studio to third- or fourth-year design studio. Sometimes projects may be out of time sequence; as long as they are identified in terms of semester/quarter, class title and/or description, and date executed and completed, clarity is achieved.





Student portfolio excerpt
Medium: V-Ray
Project coordinator: Danielle Etzler at Harvard GSD
Courtesy of student Drew A. Cowdrey and Professor Andreas Luescher
Bowling Green State University, Architecture Department
(See ISSUU link for this portfolio on second page of this chapter.)

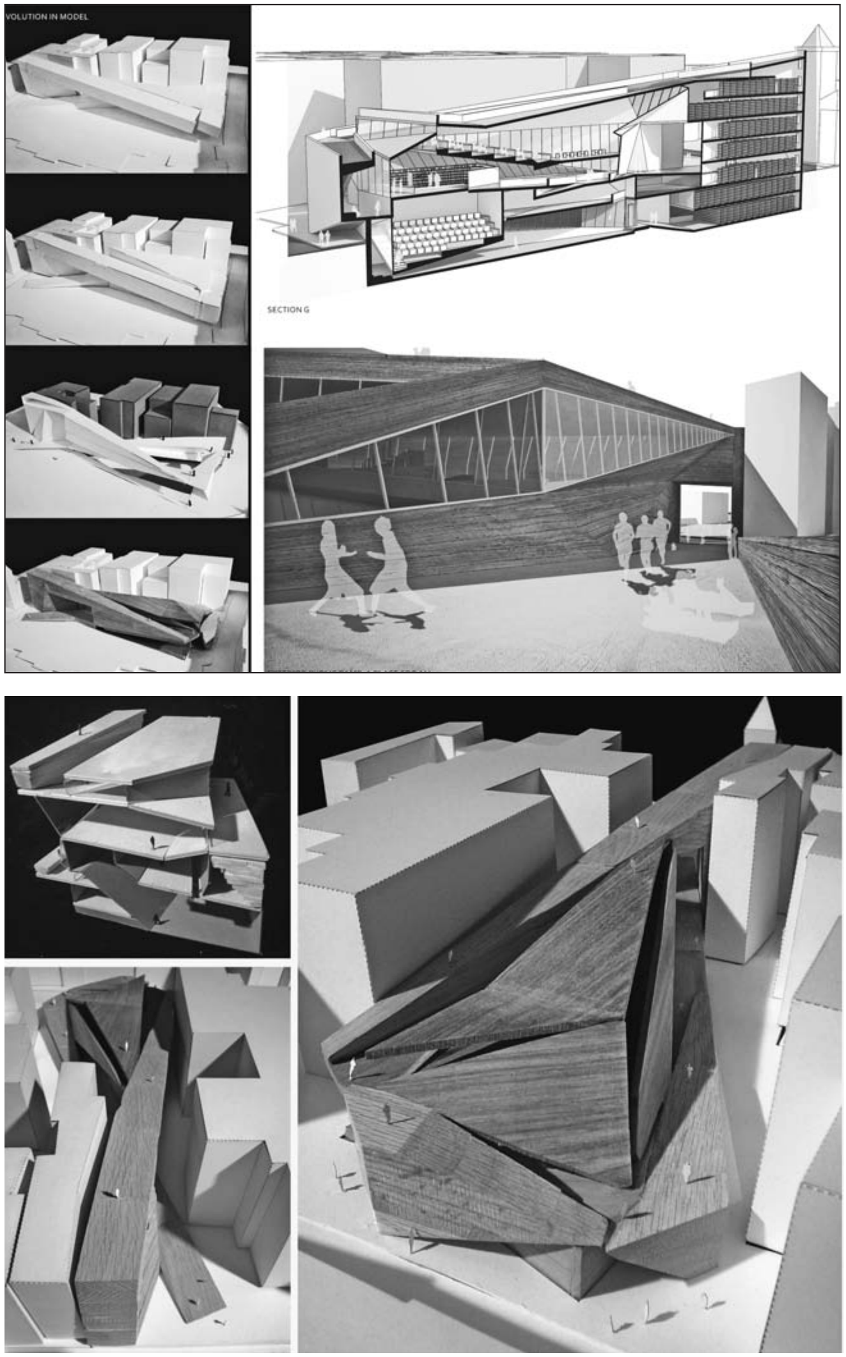
Another portfolio with very nice eye-catching graphics on the opening title page and visually pleasing typography in the Table of Contents.



Project: Spheres Arc_202
Media: Adobe Photoshop, Rhino, and V-Ray
Project coordinator: Sergio Lopez-Pineiro
Studio professor: Dennis Maher, Spring 2008
Courtesy of student Ryan T. Glick

Composing an architectural portfolio is like analyzing and solving an architectural design project; it is a continuous process. The first big decision is the arrangement of all the projects you deem worthy of showing. Sift through all of your student projects and try to decide which ones best represent your design and graphic talents. Include diagrams, conceptual sketches, and some freehand sketches, as well as finalized presentation drawings. Also, not only final pristine models but also design process models should be shown. You want to show a repertoire of design process skills.

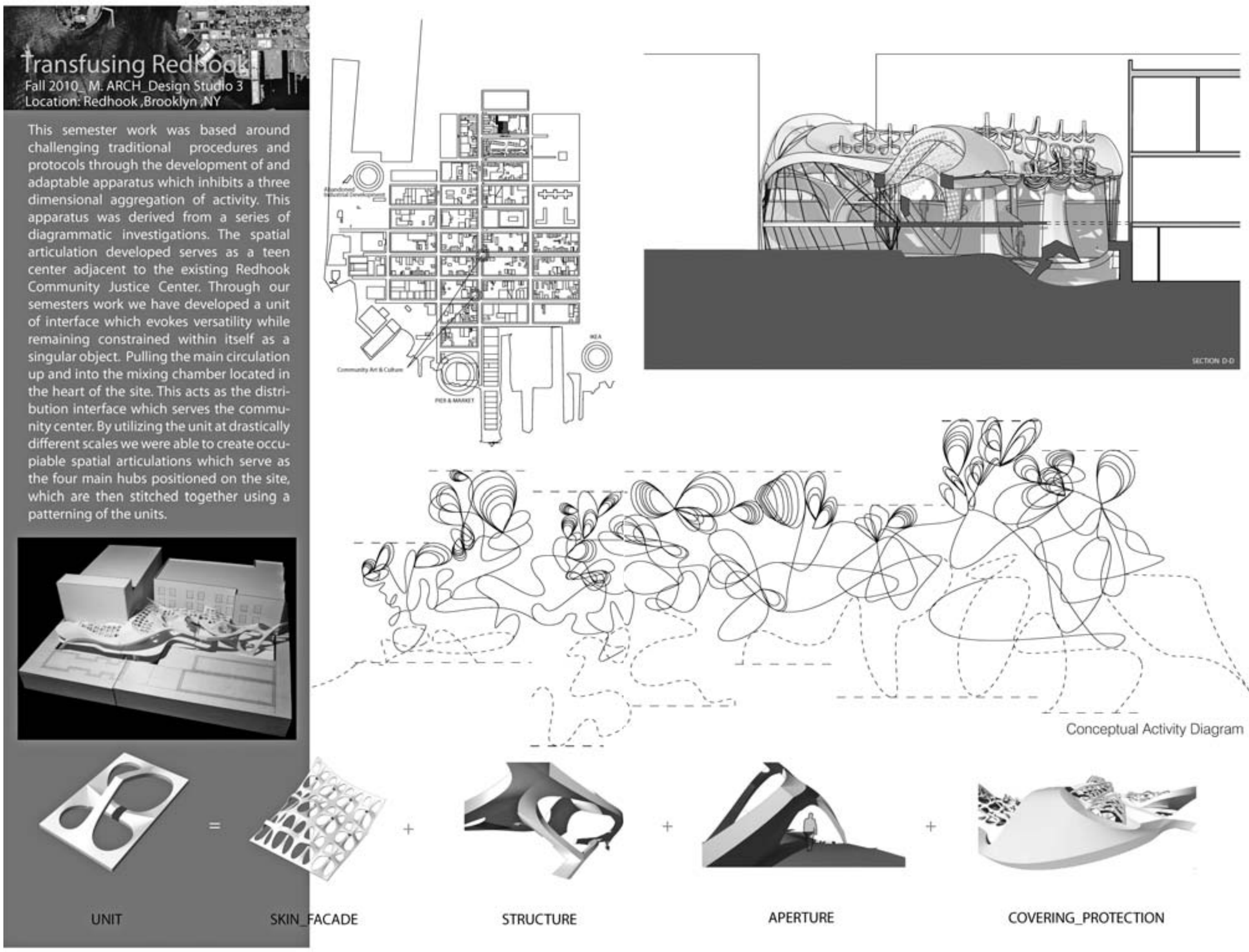
Reflecting on my "portfolio-building" experience, it is important to remember that the portfolio is a perpetually evolving document, which will not be completed in the first attempt. Personally, I found it most helpful to reassess layouts and text after a month or more of not analyzing my portfolio. Allowing myself time to revisit previous projects, I would make improvements on text and image layouts to create a clearer representation of my work. I found a reevaluation with fresh eyes to be most beneficial.
[ARCHITECTURE STUDENT'S STATEMENT]



Student portfolio excerpt: A rare-book library
Boston, Massachusetts
Medium: V-Ray
Project coordinator: Danielle Etzler at Harvard GSD
Courtesy of student Drew A. Cowdrey and Professor Andreas Luescher
Bowling Green State University, Architecture Department

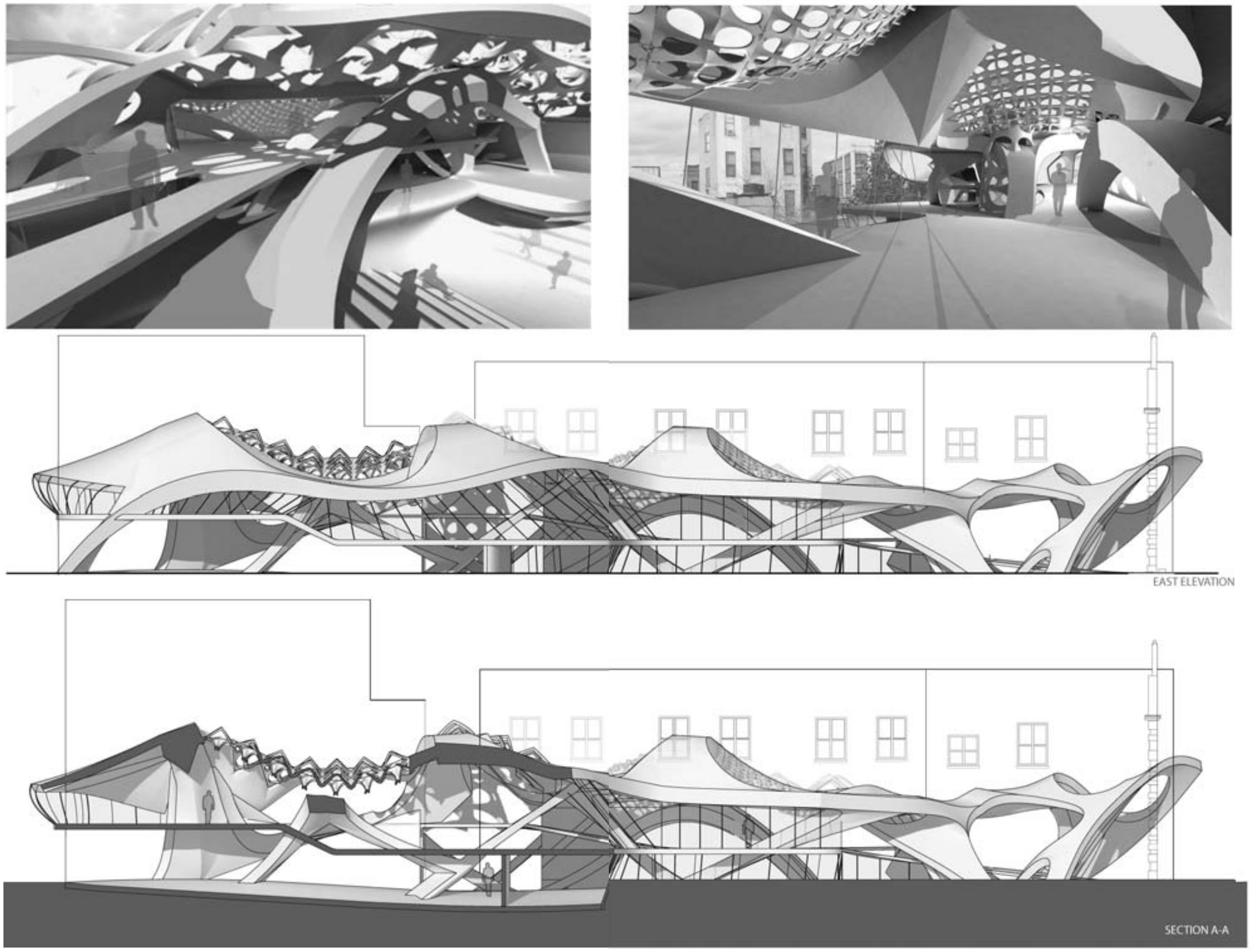
Remember that you do not have to show every project that you have ever done in your portfolio. Your ability to edit by focusing and selecting your best and most compelling work is an indication of your potential design skills.

A portfolio should tell a story—a story that is important to how your work is constructed. It may be a story about process, or a story about relationships, or even a story about diversity. Keep in mind that a story needs a common language, and this language becomes the glue that holds the projects together. [ARCHITECTURE STUDENT'S STATEMENT]



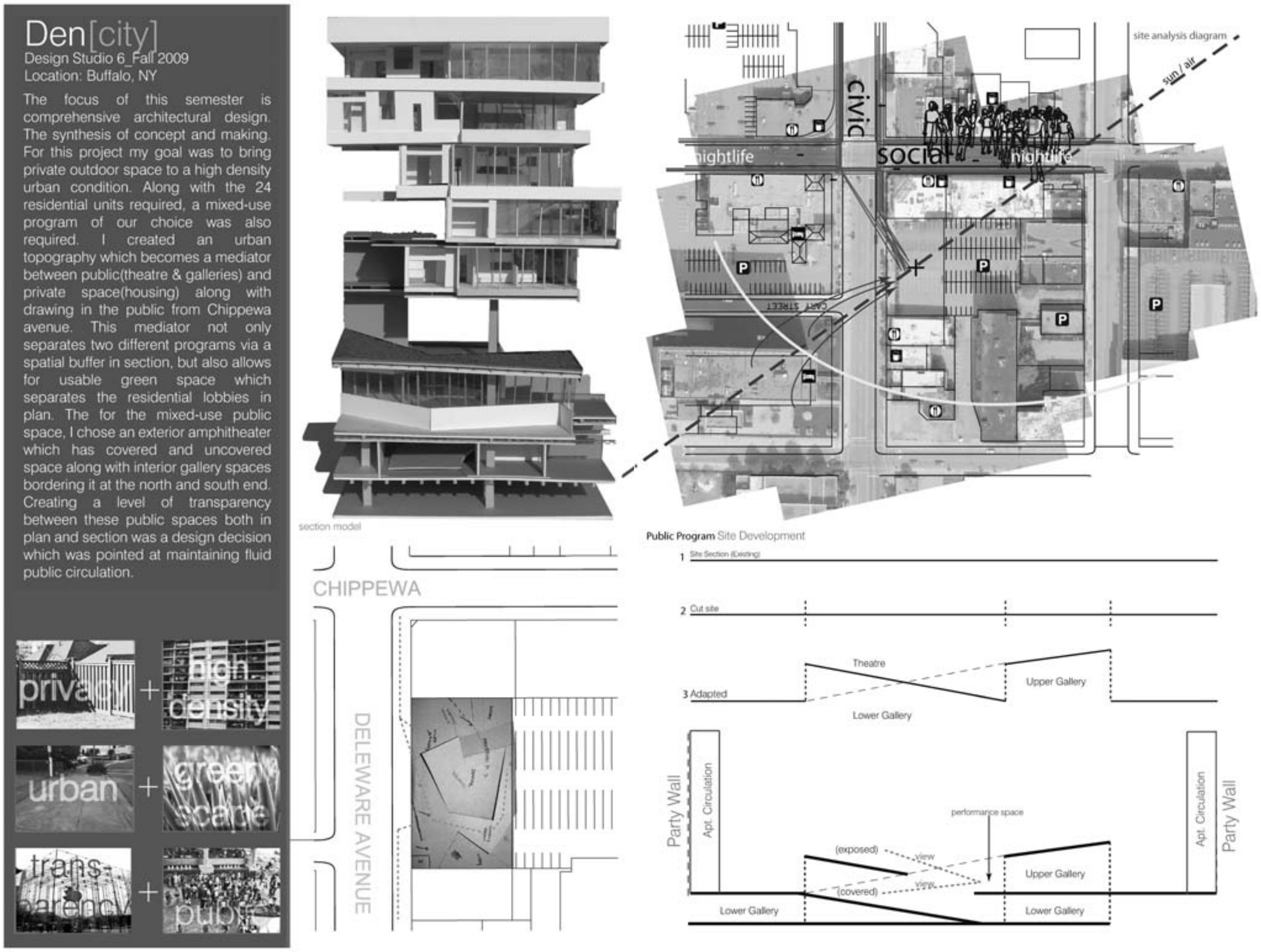
Project: Interface
Redhook, Brooklyn, New York
Media: AutoCAD, Rhino, Illustrator, 3-D printer
Studio professor: Gislea Baurmann at Cornell University
Courtesy of student Ryan T. Glick

Show enough images of each project with the necessary accompanying clear text and fonts to put your "best foot forward." Think of how text and images will juxtapose on each page. Try to arrange them in a coherent order that flows smoothly from image to image and from project to project. Decide on the appropriate page size and configuration that can accommodate the number of images you want to display per page. Decide if it will be a portrait page orientation or landscape page orientation. Do a rough content diagram of all the possible pages. Remember that the advantage of a two-page interrelated spread is that it is easily comprehended as one unified presentation.



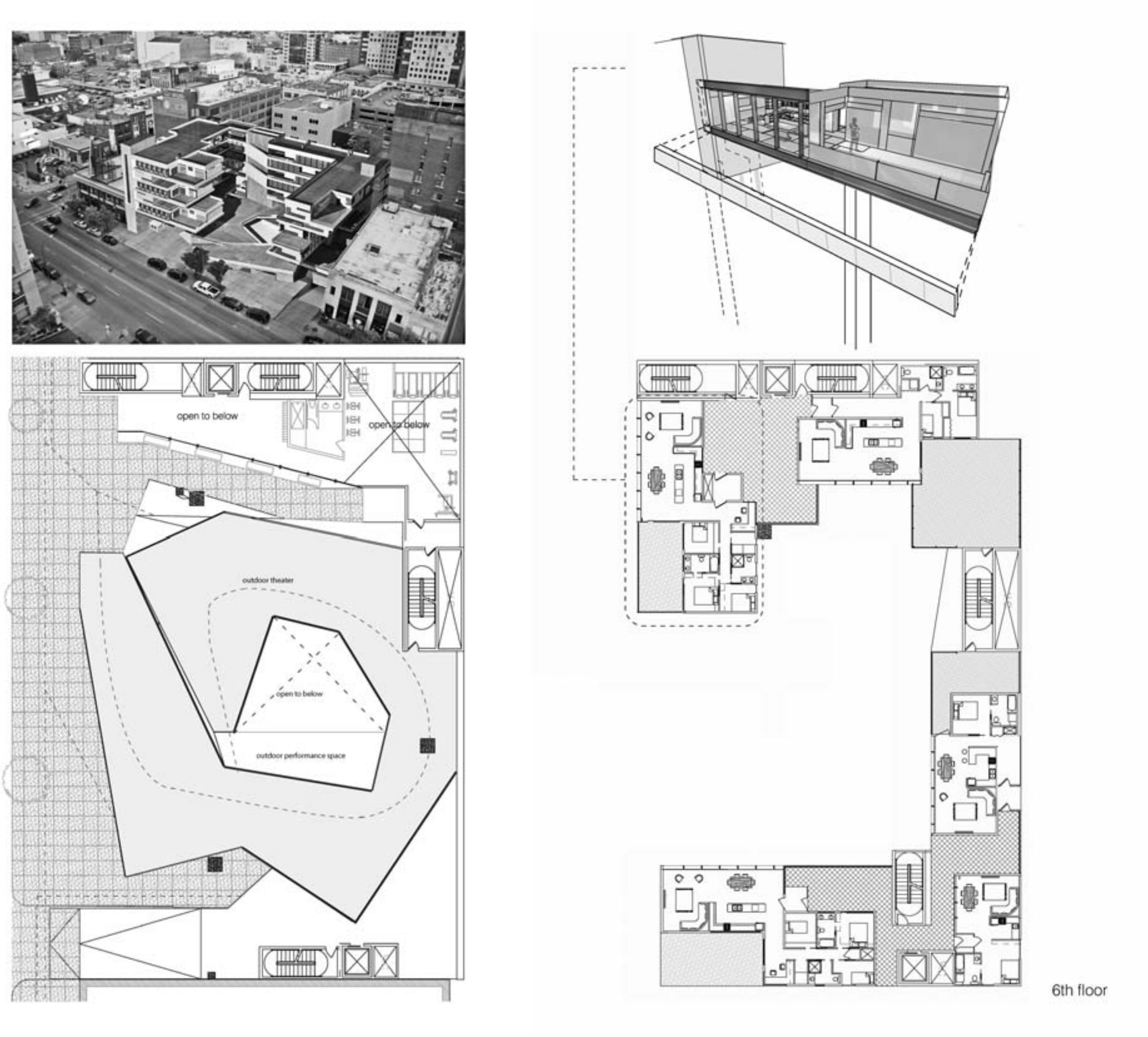
Redhook, Brooklyn, New York
Media: AutoCAD, Rhino, Illustrator, 3-D printer
Studio professor: Gislea Baurmann at Cornell University
Courtesy of student Ryan T. Glick

A good portfolio uses graphics to organize and reinforce the work it contains, without overshadowing it. Avoid the trap of utilizing flashy or trendy graphics that might distract from the work that is being composed and presented. All of the ISSUU student portfolios listed at the beginning of this chapter reinforce this idea because the focal point of these portfolio compositions is on the work itself and not on overly done graphics. These drawings, for example, are not high-contrast, which helps keep focus on the dynamic composition of the building and the fluidity of the spaces.



Project: Den[city]
Buffalo, New York
Media: Adobe Illustrator, Rhino, and V-Ray
Project coordinator: Annette LeCuyer, Arc_403
Studio professor: Hiro Hata Fall 2009
Courtesy of student Ryan T. Glick

Create a graphic sensibility and theme that is unifying throughout the portfolio. Keep a feeling of consistency throughout the graphic layout, but still allow for flexibility. A successful graphic theme allows each individual project to be organized with some flexibility related to the specific graphic needs of each project. Try to achieve a layout that is both coherent and well-designed.

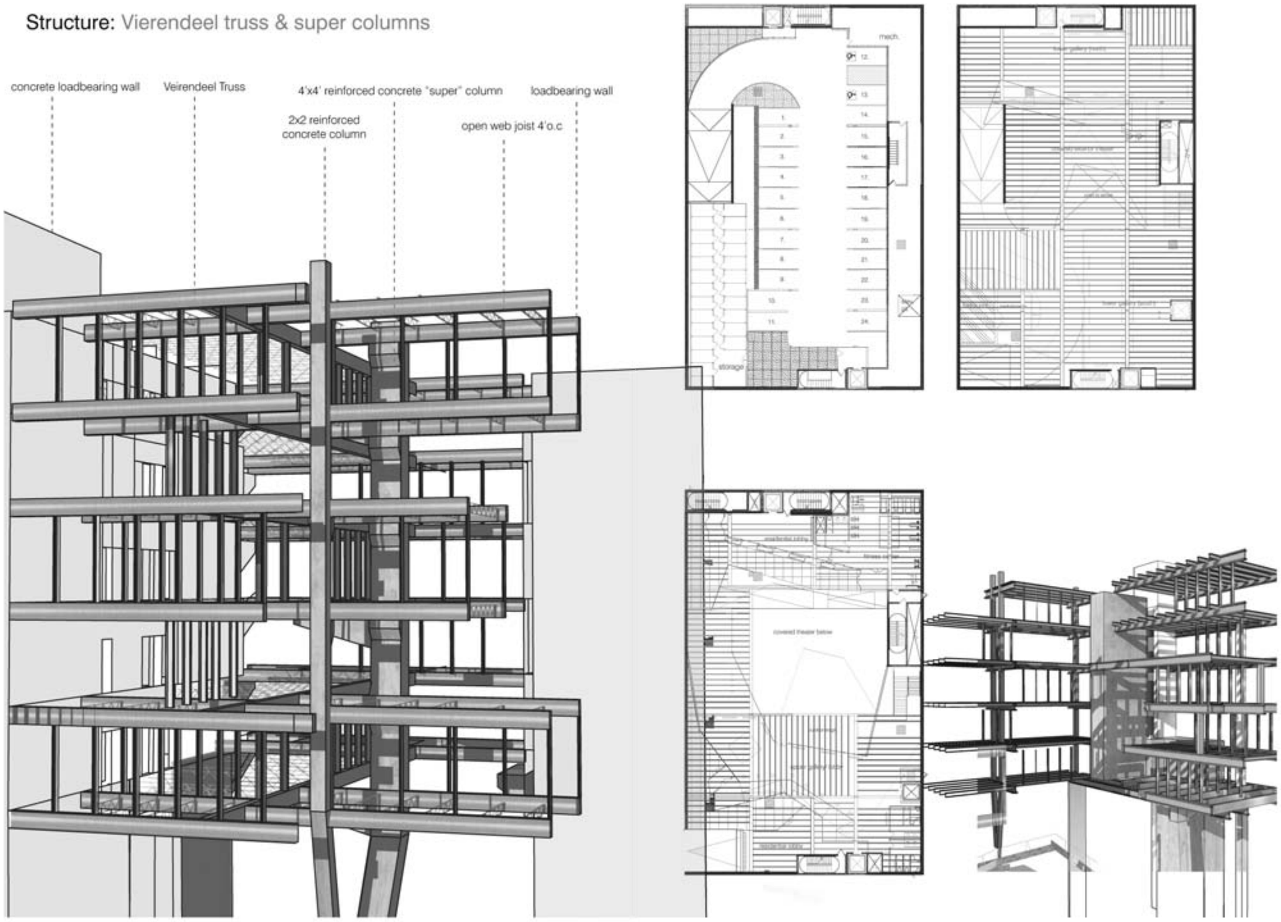


topo level

6th floor

Project: Den[city]
Buffalo, New York
Media: Adobe Illustrator, Rhino, and V-Ray
Project coordinator: Annette LeCuyer, Arc_403
Studio professor: Hiro Hata Fall 2009
Courtesy of student Ryan T. Glick

Organization and *layout* are reflections of your working and thinking skills. Your project drawings should "speak for themselves," with the goal being to limit the amount of text. However, all text included should be well-written and edited. Always try to think of ways to summarize your explanations, and remember that any text for your visuals will speak volumes on your writing skills. For students applying to four-year architecture programs or to graduate schools, project descriptions and concept statements may serve as an indication of academic writing ability in addition to providing insights about the projects.



Project: Den[city]
Buffalo, New York
Media: Adobe Illustrator, Rhino, and V-Ray
Project coordinator: Annette LeCuyer Arc_403
Studio professor: Hiro Hata Fall 2009
Courtesy of student Ryan T. Glick

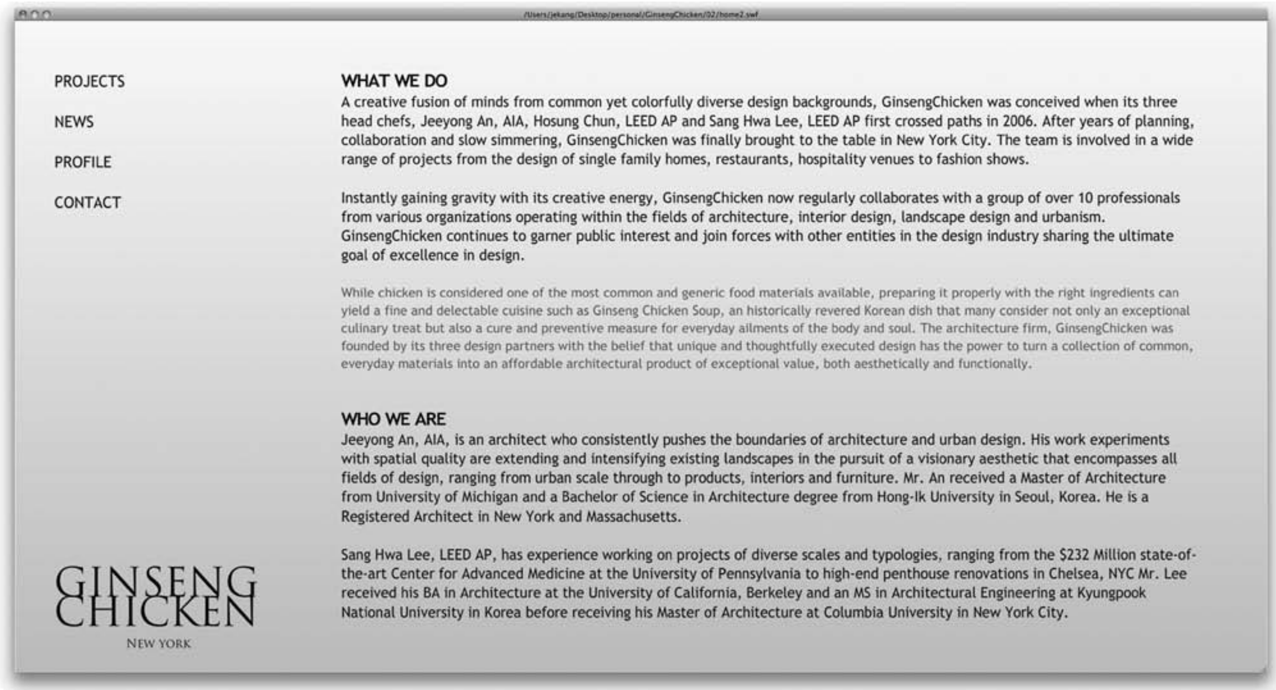
Your portfolio should be read like a storyboard of your growth or evolution as a design student or as a professional. It shows your development and maturity. As a student or professional matures, objectives change, and thus portfolio content can change over time. Examples of design project solutions are not merely about resolving a given program; they are also graphic narratives of your intellectual thoughts, whether about your frame of mind, your position, or your particular preoccupation. Try to show examples that create an overall good impression. Show enough to give an "in-depth" feeling of your work regardless of who the reviewer(s) may be.

Project: Den[city]
Buffalo, New York
Media: Adobe Illustrator, Rhino, and V-Ray
Project coordinator: Annette LeCuyer, Arc_403
Studio professor: Hiro Hata, Fall 2009
Courtesy of student Ryan T. Glick

Even with an in-depth portfolio, it is always best to decipher who the individuals are that will be sitting across the table from you. Always try to know and understand your audience. By identifying your target audience, you can more easily set your goals. Depending on the target audience, you may have to adjust your portfolio. For example, if you are applying to a four-year program or a graduate professional program your portfolio may be stronger on concept and process, whereas an architectural firm's professional portfolio may be heavier on product.

Online portfolio: Ginseng Chicken Architecture
New York, New York
Courtesy of Jeeyong An, AIA, and Sang Hwa Lee, LEED, AP

Professional portfolios that display a more commercial/promotional attitude than student portfolios are primarily seen online. The basic principles of academic portfolio design are seen in the design of professional portfolios.



In online professional portfolios, the terms “Profile” or “About Us” link to descriptions of the office’s goals and objectives, and a list of important personnel, just as the opening pages in a student portfolio define the background of the student. The term “Projects” usually has an icon that can be clicked on to view projects in greater detail.

AIA GOLD MEDAL

ROADCUT

SMITHSONIAN COPPER-HEWITT
LIFETIME ACHIEVEMENT AWARD

ROME PRIZE

DESERT BEGINNINGS

ARCHITECTURE

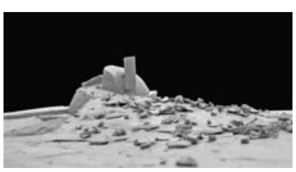
INTERVIEWS/ESSAYS

COMPETITION NEWS

DRAWINGS

MEDIA/PUBLICATIONS

THINGS



CLAY

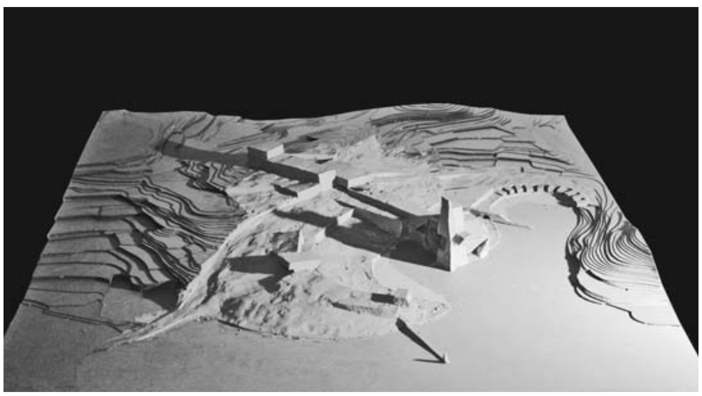
STUDIO

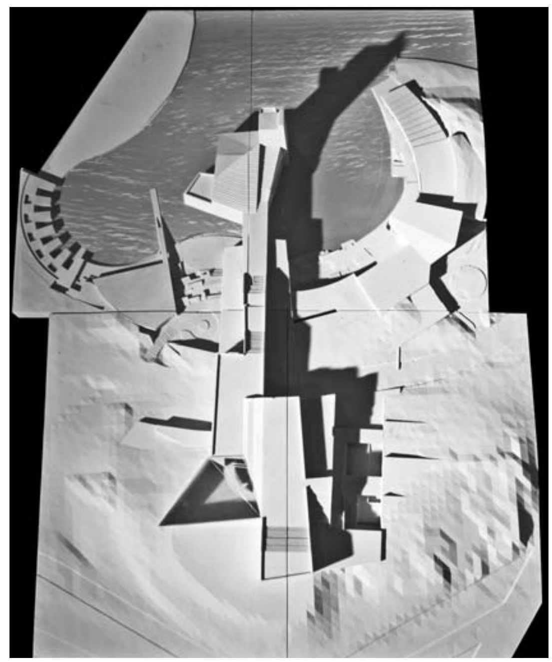
BODY/MOTION

EARTH MEETS SKY TRAILER

Online portfolio: Antoine Predock Architect PC
(next 6 pages) Albuquerque, Beijing, Tapei, Los Angeles
Courtesy of Antoine Predock Architect PC

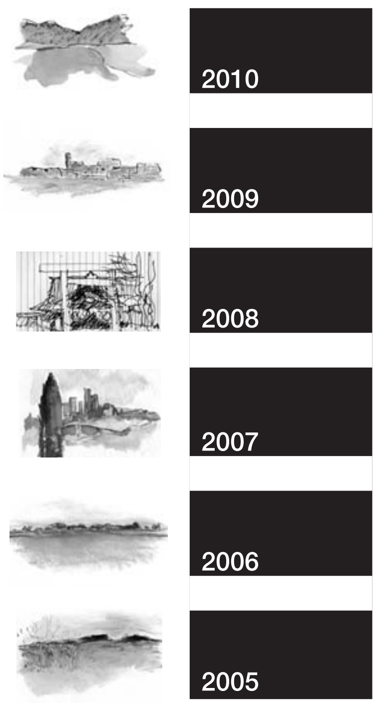
Online portfolios can be brief and simple; or they can be more detailed, with multiple topic categories to describe the firm, such as Antoine Predock's web-based portfolio, which includes categories such as awards, competition news, media/publications, and drawings.





Project images: Luxe Lakes Gateway
Chengdu, China
Courtesy of Antoine Predock Architect PC

Under the icon "Architecture" (synonymous terms: "Projects," "The Work," etc.), numerous projects are posted, including this one for Luxe Lakes Gateway. One very important difference to note in comparing paper-based portfolios with web-based portfolios is that you navigate a Web site differently than a traditional portfolio. In designing a paper-based portfolio, you are thinking of a linear sequence that is often chronological, but not always. The design must consider a linear order. Web-based portfolios can be approached in a nonlinear fashion, in which it's easier to jump around.



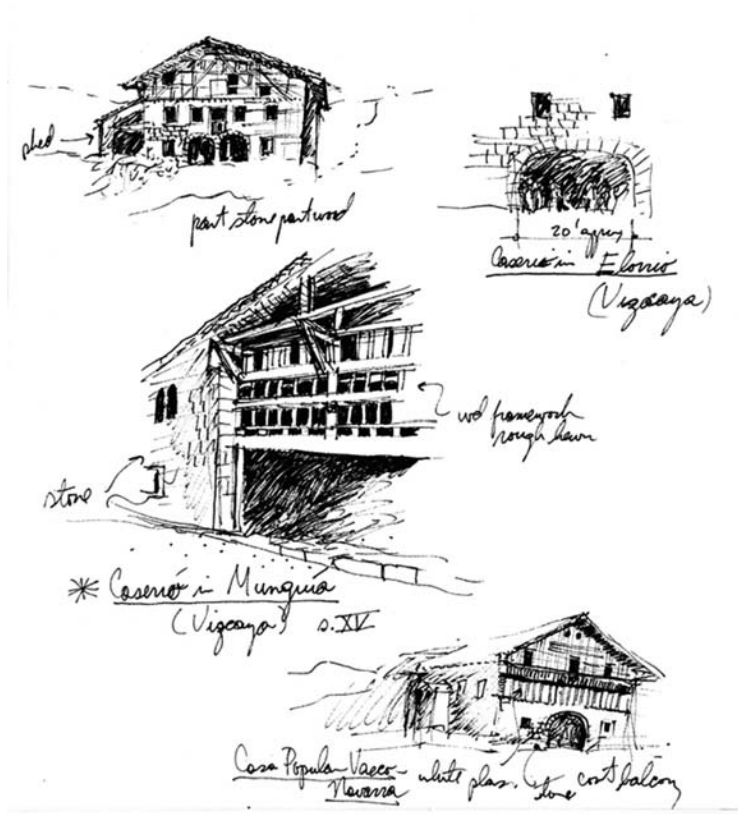
Drawing for me is both a vehicle for understanding and a gestural act unto itself. Recording an experience via drawing embodies much more than an analytical intention. In fact, my drawings aren't very analytical. When I draw historic buildings, they are inaccurate in many ways. My drawings are close, but they aren't about detail or proportion. They are about the spirit of a building or a place, and the spirit embedded in the encounter and its translation. Drawing is a way of taking on a place, absorbing it, immersing myself in it.

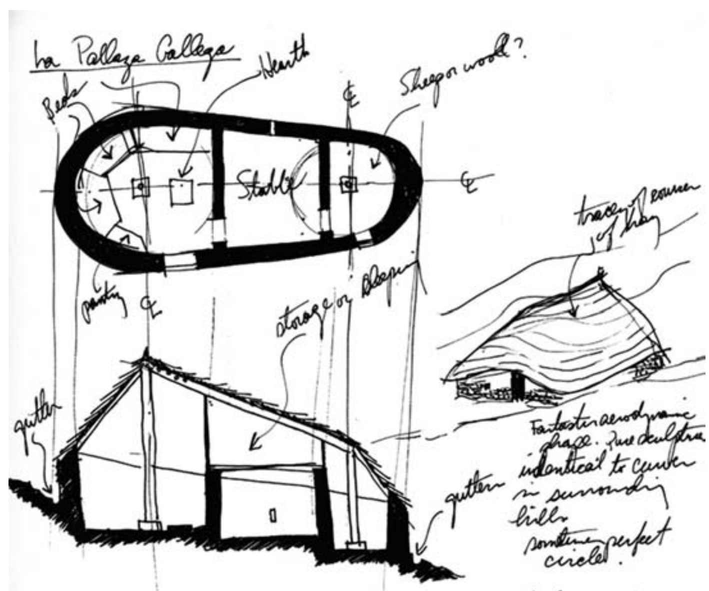
While making my early drawings, during the 1960s in particular, I was traveling on my motorcycle with only the bare essentials. I carried only a sketchbook and India Ink, and used objects I found on the site as drawing tools—bird feathers or twigs or popsicle sticks that I sharpened with a knife. Whatever was there, I drew with. An important part of the encounter was actually finding these artifacts and drawing with them. Later, I added a tiny watercolor kit. I didn't start making brush drawings with pastel until I discovered the brush pen, which is easy to travel with because it involves no clean-up.

I see the making of architecture and traveling as one interwoven experience. Assimilating different places, observing the atmospheres in different locales in the world, both real and imagined, are all journeys. These assimilations and observations accumulate and comprise the foreground for making architecture—beginning while I was a student and continuing now

Antoine Predock, from *Architectural Journeys*

Online portfolios can be viewed much more dynamically than paper-based portfolios. For example, you might look at one project image, jump to the "Profile" or "About Us" page, jump to Publications, and finally jump back to look at another project. For Predock's portfolio, you may be interested only in looking at drawings he did in 2007, and click on the corresponding icon that takes you to this page. You may never flip through an entire website portfolio; websites are designed to be viewed in this way.

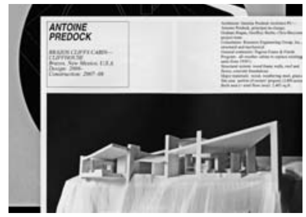




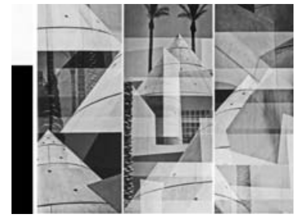
Or you may want to just see Predock's sketches in 2002 and the ones he did in Italy, and click on the icons leading to these pages. If this were a paper-based portfolio you would probably peruse most of the categories; web-based portfolios allow you to be more selective. The "Drawings" category on Antoine Predock's Web site is divided into years sketches were done; countries in which sketches were done; specific projects; earlier sketch journeys; and even student drawings. Each icon allows the viewer to browse through numerous sketches.


Architecture: Celebrating the Past, Drawing the Future 2008


Architectura Contemporanea 2008



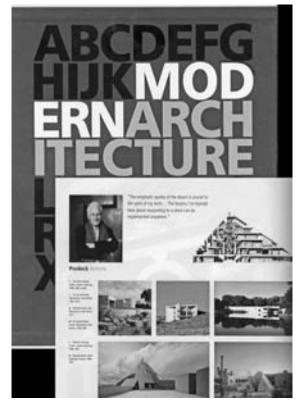
GA Houses 2008


Variations: The Architecture Photographs of Jenny Okun

H.K. Rihan Int'l Culture Spread Limited 2007

Modern Architecture 2007

Venice, CA: Art + Architecture in a Maverick Community 2007

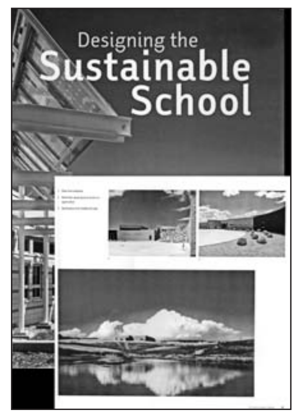


The A–Z of Modern Art

Contemporary World Interiors

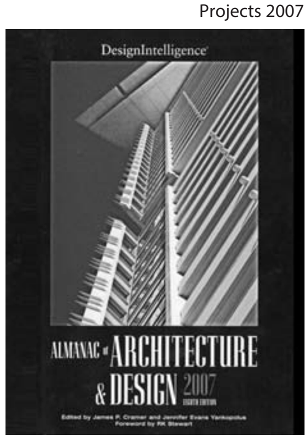
The Collection of 2006 Awarded Projects 2007

Architectural Drawing 2007

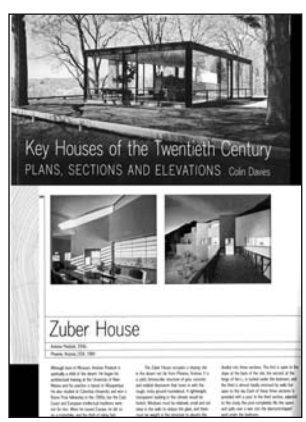


Designing the Sustainable School

2007



2007

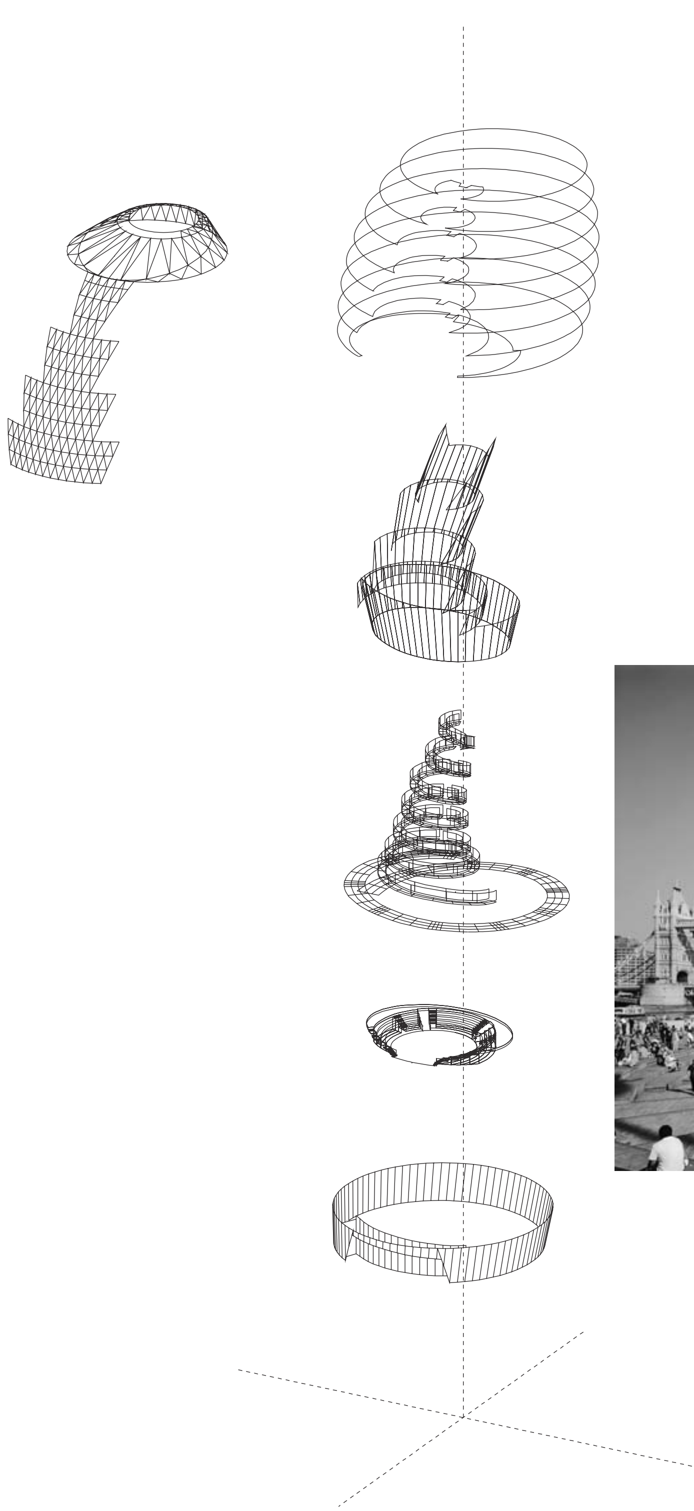


2006

2006

When designing a Web site portfolio, consider all of the different ways your work could be viewed. Design a site that allows for ease of navigation as well as a dynamic viewing experience. Publications are just one of many ways professionals show their works. On Antoine Predock's Web site, the icon "Media/Publications" shows a variety of books and magazines that have published his works.

This is just another category in this professional's portfolio that we have the option of selecting as part of the dynamic nonlinear experience. Nonlinear navigation should always be strongly considered when developing a web-based portfolio. The icon "Studio" shows photographs of the architect's workplace.



© Nigel Young/Foster and Partners

The reason that this sustainable, nonpolluting modified sphere tilts is to provide optimum energy performance by minimizing direct sunlight to the entire surface envelope. A thermal map of the cladding was thoroughly researched. Designed with movable vents for natural ventilation, it uses one-fourth of the energy consumed by any typical air-conditioned building. This series of exploded views represents a diagrammatic isolation of the various problem issues that the architect tackled and solved. It is a graphic dissection of a very comprehensive technical design problem. See the numerous early conceptual form study models on page 99.

Exploded View

Drawing: Greater London Authority Headquarters
London, England
Medium: Software—Microstation
Courtesy of Foster and Partners

Epilogue

The primary intent of this book is to provide students and design professionals with graphic tools essential to visual communication. Architectural graphics skills are a powerful tool for conceptualizing, documenting, and expressing architectural ideas. The variety of drawing types and methods demonstrates that a wide range of graphic tools and techniques are available for conveying architectural ideas in the design process. This primer introduces the various media currently being used, so that the reader may have a sense of the range of visualizing possibilities in the field.

Designers must express, develop, and communicate architectural ideas. To do so, all designers—students and professionals alike—eventually settle on the tools and techniques best suited to them, whether these are freehand conceptual sketches or hardline representational drawings. Some architects and designers enjoy the feeling of a soft lead pencil on heavy white tracing paper. The softness of graphite can create a suggestive atmospheric character, especially in perspective images. Others become prolific in their expression of ideas when they use a felt-tipped pen or colored pencil on yellow tracing paper. Prismacolor pencils give a soft, impressionistic feeling to architectural sketches.

Drawing on Mylar with sharp Prismacolor pencils is an excellent way for creating beautiful presentation drawings at any stage of the design process. These pencils can be applied to both the front and back of the Mylar, a tough surface that can take numerous redraws and erasures. The colors of these pencils remain sharp on this fairly transparent surface. Even white color works beautifully on Mylar when laid over a warm color piece of buff-colored wrapping paper. This technique of designing and presenting in the Mylar/colored-pencil medium is almost perfect for 3-D color perspectives.

Others prefer the precise feeling of ink on Mylar, especially with paraline drawings. Every medium affects the quality of not only spatial perception but also design ideas, especially at the design-drawing stage. For example, charcoal almost automatically evokes light and shadow, whereas a fine-point pen may cause you to delineate more and to think in terms of contours, connections, and details.

Because the computer and computer-generated drawings have become commonplace in design education and practice, it is all the more important to maintain a strong relationship with traditional drawing media and methods such as freehand sketching. Because of the intimate and immediate reciprocity between the human imagination and drawing, this most ancient form of expression will always remain a powerful and effective way to generate and communicate ideas.

The reader should explore the many books listed in the Bibliography that elaborate on architectural drawing as technique and/or process. Such exploration, along with a careful study of this volume and its related Web site, should enrich your knowledge of architectural drawing.

Drawing Exercises

A textbook or reference on architectural drawing would not be complete without suggestions for how to apply some of the more important techniques covered. The goal of this section on drawing exercises is to show a variety of problem/project approaches, as well as a diversity of applications. The intent is to allow architecture educators to glean information from these exercises so that they can formulate creative problems that suit their own classes and educational objectives.

Organization of the Drawing Exercises

The problems and projects in this section have been divided into two levels. Level One consists of very basic problems that are abstract in design and simple in geometric configuration. To pass a beginning course in architectural drawing/graphics, students should demonstrate an overall understanding of, and skill in, solving these exercises. Students should also be encouraged to do freehand sketches to explore possible solutions for each problem.

Level Two problems are more complex than those in Level One, and, in some cases, are more purely architectural in character. They usually involve design as well as drawing and are suitable for more experienced beginners or for classes in which students work at their own pace. As in Level One, the resolution of Level Two problem solutions should stress the incorporation of freehand sketching skills. The intent of these exercises is primarily to develop solutions by using hand drawing skills. Those who are adept at using digital skills also have the option to solve the same exercises by use of the computer.

Sketches Demonstrating Light and Shade

To work on the following exercise, you may need to bring to class a small item suitable for a still-life painting. I suggest a simple shape—a piece of fruit, vegetable, etc. You may also wish to bring a plate or cloth on which to put the item.

In this exercise you may experiment with a variety of mixed-media techniques, such as pencil sketch with watercolor, felt pen or ink line with watercolor, pencil, etc.

The intent of this exercise is to demonstrate how the use of light and shade can give an object form—a three-dimensional quality. Choose a simple object and sketch and/or paint in color four postcard-size sketches. You may use an object more than once by changing the light source (i.e., by changing the direction or strength of the light source). Alternatively, you may wish to go outside and sketch (or paint) a simple architectural or landscape subject.

Hint: Choose objects that have a simple basic form—a cube, cylinder, sphere, cone, etc.—and have one strong, directional light source. Tonal studies in pencil or monochromatic watercolor may help define light, shade, and composition.

Please include any preliminary studies with your assignment.

You will be assessed on the following criteria:

- Use of light and shade
- Technique (watercolor, mixed media, etc.)
- Use of color
- Composition

Courtesy of Professor Jane Grealy
Department of Architecture
Queensland University of Technology
Brisbane, Australia

Student project by Daniella Lancuba
Medium: Watercolor
Department of Architecture
Queensland University of Technology
Brisbane, Australia

Drawing Positive and Negative

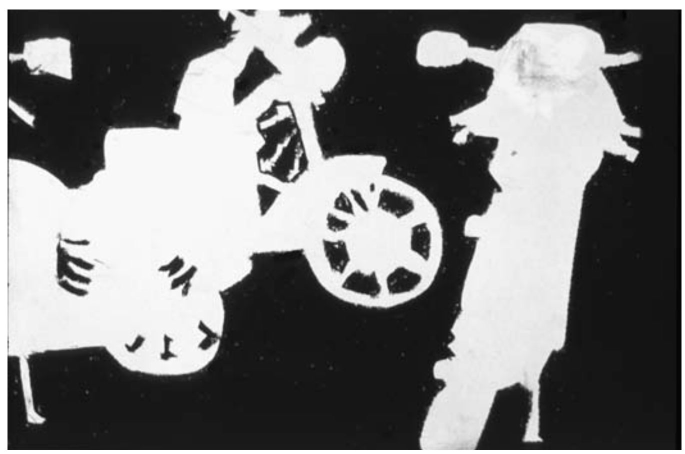
Perceiving forms and shapes is a major step in learning to draw. Everyday objects—such as forks, spoons, chairs, and lamps—make good subjects for learning to draw negative space. Beginning to understand the difference between drawing negative space (the area around the object) and positive space (the object being drawn) perceptually can alter your approach to drawing.

Drawing negative space is drawing the object of your focus by defining the space around the object. The tendency for beginning students is to want to draw the object. In this case, students must overcome preconceived notions of what they are seeing and are compelled to recognize that the negative space is just as informative about the object being drawn. Issues of foreshortening and perspective become less of a perceptual hindrance because the focus is on shape, not depth.

Charcoal is the best medium to use for this project; it makes the student focus on the importance of negative space. Observe the object from different viewpoints, looking for negative shapes. Capture the shapes of the object first as contours, being careful to capture all the nuances of the object. Once the contours are delineated, fill these areas with the charcoal.

This assignment makes the complex object simple. It simplifies all the intricate relationships of the object so the student can understand and draw it. Once the basic understanding of positive and negative space has been achieved, students may proceed to more complex objects, such as landscape or architecture. The examples presented in this exercise demonstrate drawing positive and negative space with motorcycles. Notice handlebars, mirrors, wheels, spokes, and fenders defined by the delineation of the dark negative shapes. You can even read the reclining nature of the handlebars of the motorcycle.

Project: Courtesy of Professor Fernando Magallanes
Design Fundamentals Studio—Fall 2000
College of Design
North Carolina State University



The student example is from the Design Fundamentals Studio—Fall 2000
North Carolina State University
Medium: Charcoal on 8½" × 11" sketch paper

Drawing: Student project by John Rubins
Head and face study
Medium: Ink
Courtesy of Washington University
School of Architecture, St. Louis, Missouri

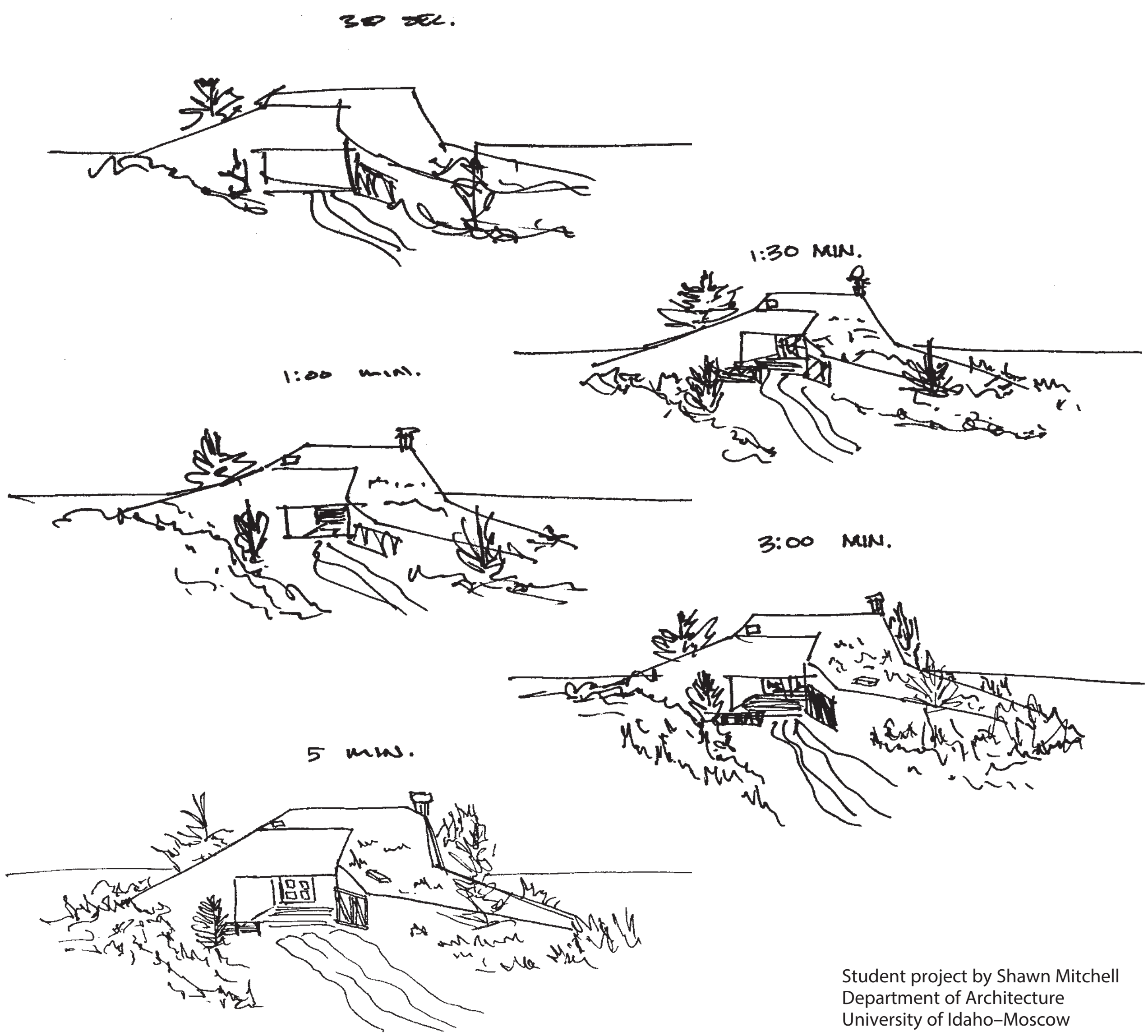
Cognizance of Negative Space

One excellent exercise is to reverse the positive and negative (figure and ground) spaces, as shown in the face study (left). Always try to draw the significant negative space by delineating the common boundary line that defines the form. It takes a keen, educated eye to recognize negative shapes because we have been conditioned to see positive shapes. Also notice that you can only make sense of the black negative areas when viewing them right side up.

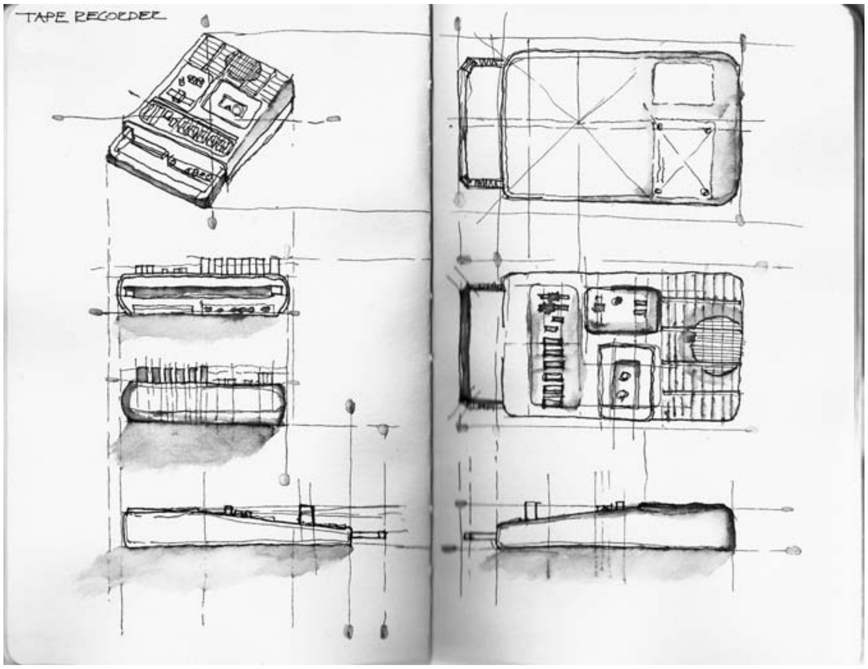
Freehand Drawing: Multiple Sketches

Break into groups and, using ink pens of varying thickness, sketch the visual images that you see displayed around the studio. We will begin with 30-second, 60-second, 1.5-minute, and 3-minute sketches. A final sketch of 5 minutes in duration will complete the exercise. The sketches will range in complexity and graphic expression. Pay close attention to the proportion of the image on the page and the style of sketch being used in the examples. Relax.…Sketch freely and quickly. Place a 5-minute sketch, 3-minute sketch, a 1.5-minute sketch, a 1-minute sketch, and a 30-second sketch on the page, as shown below.

Problem courtesy of Assistant Professor Daniel K. Mullin, AIA, NCARB
Graphic Communication course
Department of Architecture
University of Idaho–Moscow



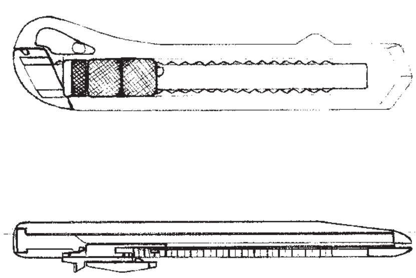
Student project by Shawn Mitchell
Department of Architecture
University of Idaho–Moscow

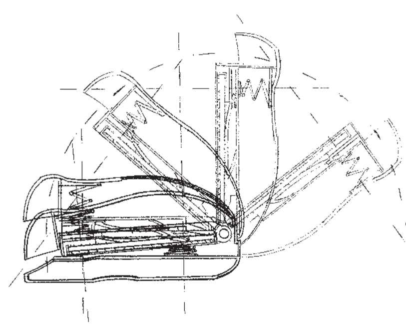


Grant Foster: Multiple-view studies

Drawing: Sketching multiple views—sketchbook exercise
Medium: Graphite or ink
Courtesy of Professor Marissa Tirone; Teaching Assistants: Kervin Brisseaux, Seth King, Brendan Rose, Elijah Yoon
Course: Representation II ¦ Sketchbook exercise
Syracuse University
School of Architecture, Spring 2009

For this week, you are asked to select a series of objects to be the basis for sketching multiple views. Choose four objects from your previous assignment on additive sketching. Redraw the complete axonometric from each study, and then add six views: top, bottom, front, back, left side, right side. This iterative process should be evident in your sketchbook, where each set of pages has the complete study including the axon and all six views. You are required to scan one complete series. [PROFESSOR'S STATEMENT]





Drawing: Sketching two-dimensional views
Medium: Graphite or ink
Course: Design Communication Foundations
Courtesy of Professor Meg Jackson
Texas A&M University

Student projects: X-acto—Jonathan Zunugia
Stapler—Mitchell Dickinson

A wide variety of drawing conventions are introduced to equip students with the skills and knowledge necessary to navigate a design process. The student is to utilize fundamental techniques for visualizing an object and then interpolate such an object into an architectural drawing. Elevation, axonometric, and plan views are used to interpret a three-dimensional object as a two-dimensional drawing. [PROFESSOR'S STATEMENT]

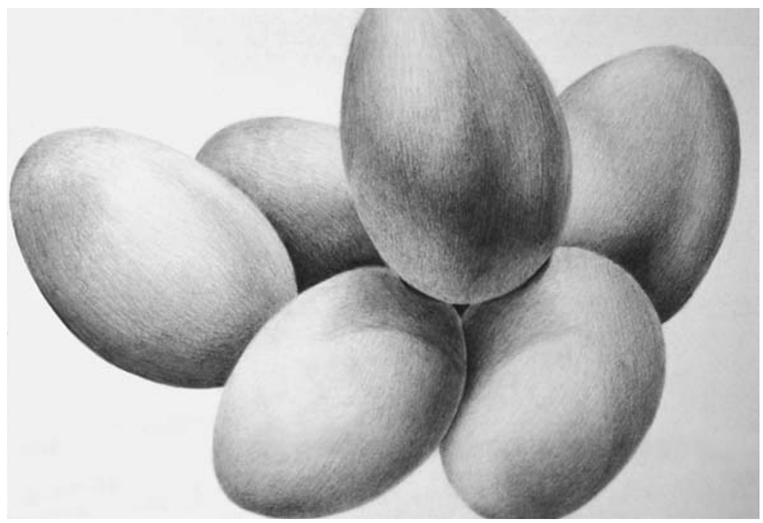
Drawing Eggs

It is essential for the beginning student to develop sensitivity to light falling on an object and an ability to draw the light qualities on a two-dimensional surface. The observation of light and the creation of shadows and tones are what the student must capture on paper. The students are asked to bring half a dozen (preferably white) eggs to drawing class. The media for this exercise can be pencil, ink, charcoal, and gray marker. The students will make three drawings, each using only one medium to allow students to learn the individual strengths and weaknesses of each medium used. One hour is spent on each drawing on 14" × 17" sketchbook paper. Various ways of creating value may be explored: line, smudging, layering, stippling, or random marks.

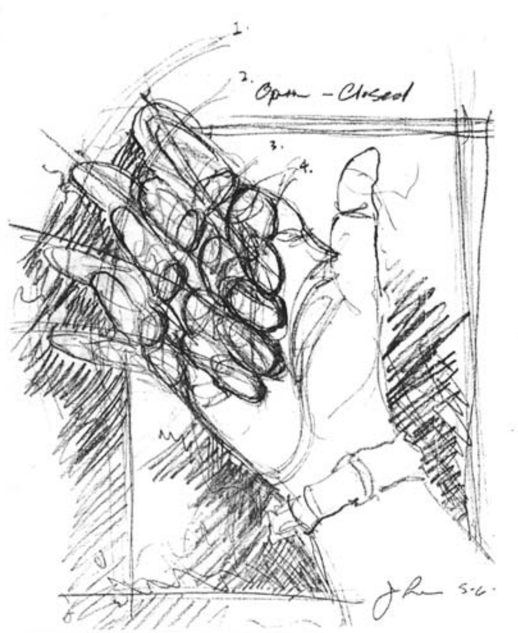
Set the eggs in different types of light. Draw first in filtered light with minor light variation. Later move the eggs to a place of intense light using full sun or a strong lamp. Place the eggs on a clean white surface, like a sheet of white sketch paper.

This exercise will introduce students to various types of light (highlight, shadow, reflective light, and shade) that become apparent in studying the light falling on the eggs. In a one-hour period the light will change, so it is important that the students make an overall still-life sketch of the eggs to work on later, outside of class.

Project: Courtesy of Professor Fernando Magallanes
Design Fundamentals Studio—Fall 2000
College of Design
North Carolina State University



Student project by Rebecca Pezdek
Medium: Pencil on 8½" × 11" sketch paper
Design Fundamentals Studio—Fall 2000
North Carolina State University



Drawing: Open and closed hand
Medium: Ink on trace 7.5" × 7.5" (19.1 X 19.1 cm)
Courtesy of Professor Jerry W. Lum
City College of San Francisco
Department of Architecture

Drawing Hands in Action

In this exercise, you will draw either the hand opposite your drawing hand or your drawing hand by using a mirror. The hand, with its wide range of possible positions, is probably the most challenging part of the human anatomy to draw. Remember that a hand's length is approximately double its width. Start sketching with frozen, still positions, and progress to showing the open and closed hand in intermediate positions (simulating the hand in motion).

The Architectural Journey

The objectives in this program—Architectural Drawing I—were to encourage students to investigate their environment through the eyes of architects in order to become proficient in a range of techniques and media, and to encourage students to explore and experiment with the design process through mark-making.

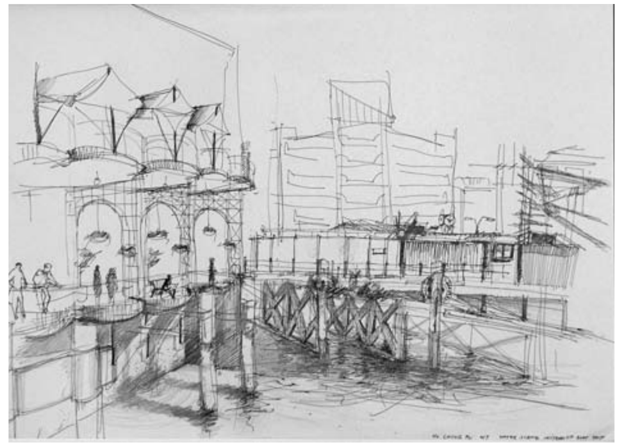
Students come to architecture school from a variety of arts backgrounds and with a wide range of skills, including graphics and technical drawing. But they do not have the flexibility to move across a wide range of media, techniques, and conventions that would allow them to focus on the chosen extent of their subjects. Along with the techniques of plan, section, elevation, axonometric, and perspective, I chose to further their experience to incorporate shadow, texture veil, transparency, and reflection. This creates a larger framework, through which they can critique and evaluate the limits of conventional techniques in order to enrich their way of seeing and designing. I encouraged students to develop their own techniques through experimentation—to consider what drawing is. I believe that knowledge of the subject—be it the human figure or architecture—comes from direct observation and experience.

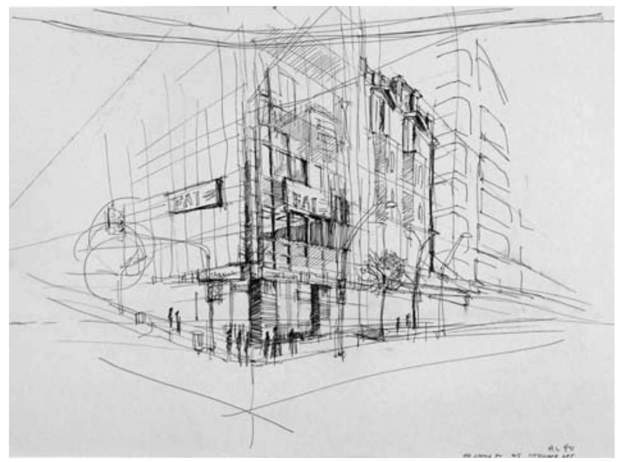
Elements of mark-making can bring attention to aspects and dimensions of the subject under consideration. The drawing process then becomes a kind of shorthand that evokes the actual subject from a mere representation. These processes are considered through sketches, thumbnails, different media, and the inclusion and exclusion of some information. Investigations of textures, outlines, and light values are all brought to bear on the more familiar conventions of plan, section, elevation, and perspective.

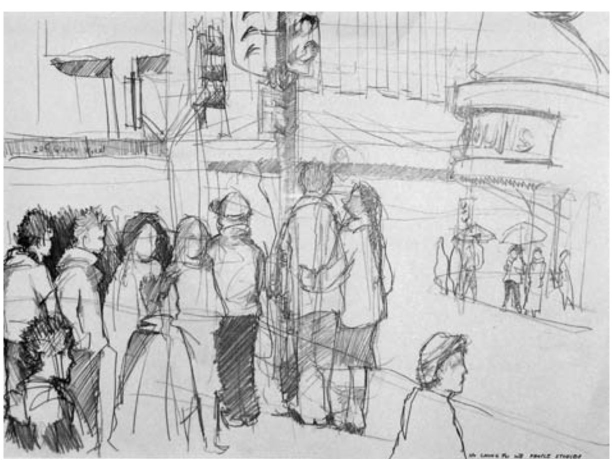
Through journeys around the city, students were encouraged to broaden their experience of buildings. The word "voyage" names both a journey of exploration and the record of that journey and its discoveries. The voyage concept was invoked to create an appreciation of drawing as a means of making and marking architectural discoveries. In this respect, architectural drawing was considered not as a neutral tool for picturing a scene, but rather as a means of analysis and critical enquiry, a means of looking to learn and discover. Therefore, the student can see the rules of perspective, such as vanishing points and planes of vision, all relative to the actual experience. Given a base in direct observation, the student has the ability to make renderings of light that are about light rather than shadow projections, perspectives that are about space rather than perspective construction, and plans that are about building experience.

My notion of drawing is founded on observation and experience: to practice seeing, practice drawing, and investigate buildings—to study reality and the experience of the building and make comparisons between the drawing and the reality of the building experienced; to practice drawing conventions and to determine how effective they are at communicating experience and space; and to encourage students to develop an understanding of their environment with all their senses so that these investigations will inform a drawing and hone their ability to construct understanding through drawing.

The key to drawing is to draw constantly; to keep the drawing and design processes open is to master the ideas of drawing for communication. Those drawings that are based on technique and convention, and those drawings used to see, perhaps do not have to be legible but should rather increase observational and exploration skills.







Problem: Courtesy of Susan Hedges, CAS Support Manager
School of Architecture
National Institute of Creative Arts and Industries
University of Auckland, New Zealand

Student project by Ho Ching Fu (Architectural Drawing I)
Courtesy of Studio Supervisor Susan Hedges
School of Architecture, National Institute of Creative Arts and Industries
University of Auckland, New Zealand

The Architect's Scale

Using the architect's scale indicated on the left, measure and draw the stipulated lengths indicated above each group. Proper order of sequence corresponds left to right with top to bottom.
3" means 3" = 1'0".

4", 3¾", 5½"

Full Scale

40'-0", 28'-6", 64'-0"

3/32"

36'-0", 25'-0", 41'-6"

1/8"

6'-0", 27'-6", 18'-6"

3/16"

10'-0", 5'-6", 22'-0"

1/4"

7'-0", 4'-6", 13'-8"

3/8"

9'-9", 7'-6", 4'-3"

1/2"

4'-3", 6'-6", 7'-0"

3/4"

3'-6", 5'-0", 5'-9"

1"

2'-0", 3'-4", 4'-0"

1½"

1'-0", 1'-6", 2'-1"

3"

The Engineer's Scale and the Metric Scale

Using the engineer's scale indicated on the left, measure and draw the stipulated lengths indicated above each group. Proper order of sequence corresponds left to right with top to bottom.
4 means 1" = 4'0"; 30 means 1" = 30'0".

For the bottom two groups: using the metric scale, measure either millimeters (mm) or centimeters (cm) to the stipulated lengths indicated above each group.

10.3', 14.0', 17.5'

3

5.0', 14.6', 22.2'

4

7.3', 22.1', 28.6'

5

26', 38', 65'

10

31', 82', 135'

20

22', 122', 170'

30

49', 163', 264'

40

25', 155', 319'

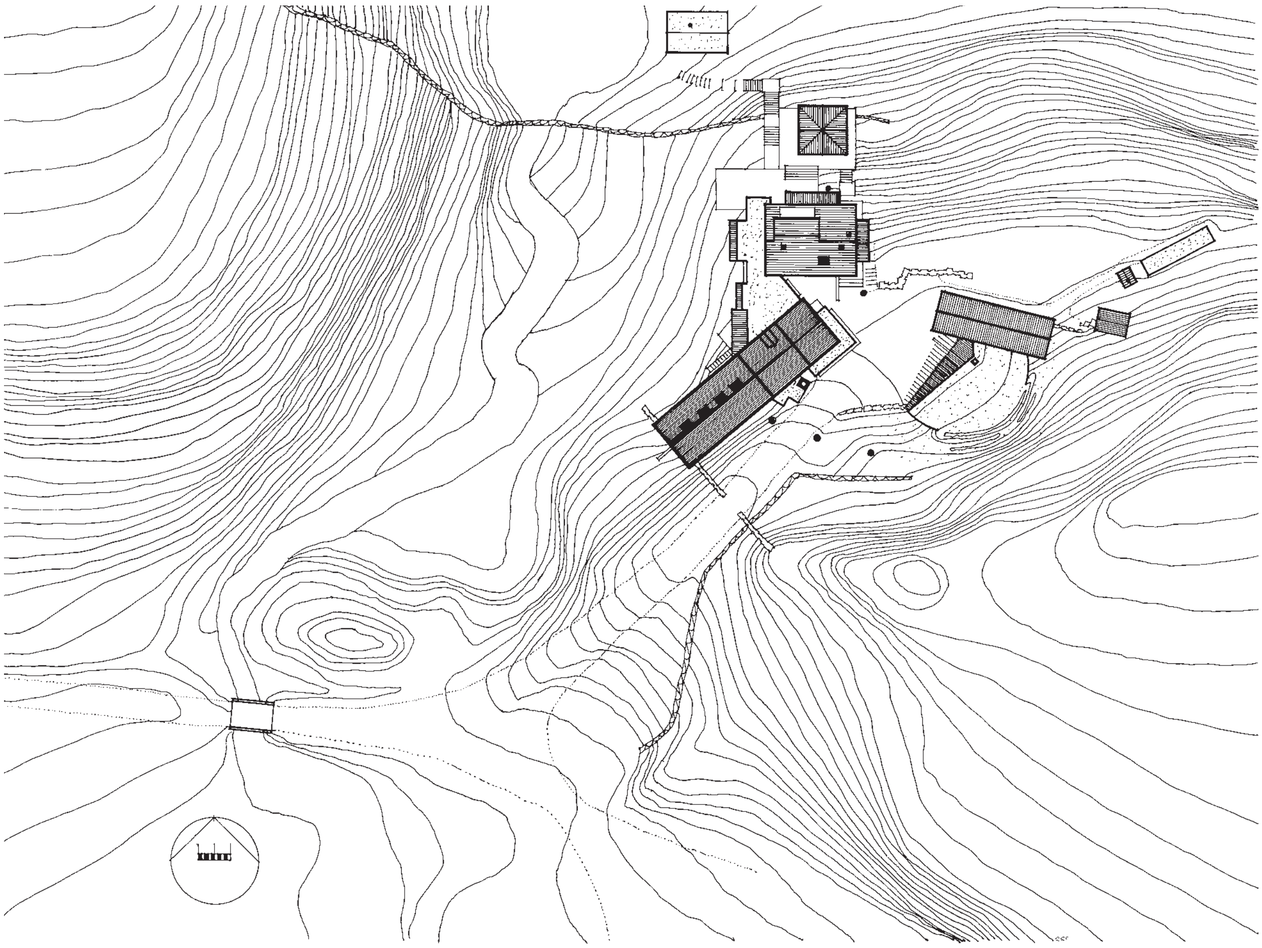
50

29,63,115

(mm)

2.54,5.2 13.7

(cm)

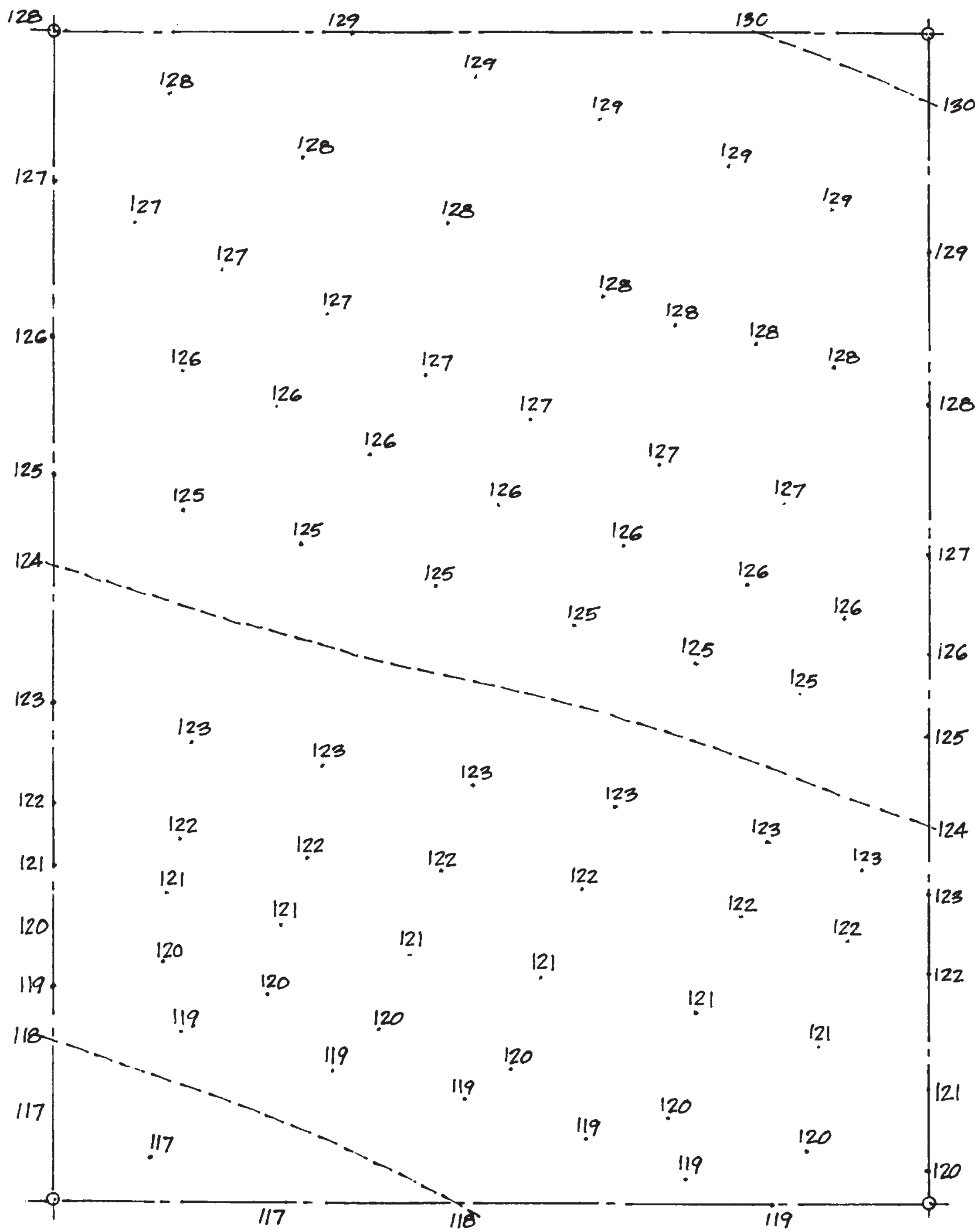


Drawing: Brandenburg's Ravenwood Studio, Ely, Minnesota
22" × 34" (55.9 × 86.4 cm)
Medium: Ink on Mylar
Courtesy of Salmela Architect

Contour Drawing

Answer the following questions about the above contour drawing.

1. Do any of the contour lines cross each other?
2. Circle and label areas where you think there is, for the most part, a constant slope.
3. Circle and label areas where you think there is, for the most part, a steep slope.
4. Circle and label areas where you think there is, for the most part, a gentle slope.
5. Circle and identify the tops of hills.



Given: a partially completed *contour* map of a building site

Required: Using a flexible curve, a French curve, or your own freehand technique, carefully connect contour lines of constant elevation. You can draw the contour lines as either continuous solid lines, a series of small dashed lines, or a series of small dots. Cut a small line segment through the contour lines and try to interpolate the correct profile.

IN-CLASS SKETCH PROBLEM: Lettering

Architectural lettering allows architects to include written information on drawings in a manner that is in keeping with the graphic content—carefully planned, composed, and executed. Lettering relies on the architect being able to control his or her tools (lead holder, straightedge) and on the hand-drafted line work used to create each letter or number. Uniformity in size, shape, and spacing of lettering are among the objectives of this exercise.

ASSIGNMENT: Week 3

Letter your name and date on the front of Assignment 2 in the lower right-hand corner. Use the image below as a guide for proportions of letters and numbers. Begin with parallel guidelines spaced at 3/16" apart using a light line weight; switch to a secondary line weight for the lines of the objects. Try 1/4" and 1/8" spacing for the guidelines as well.

Use H or HB lead on drawing paper. You may reuse the paper on which you practiced line weights in last week's class or use the back of another sheet. Your paper should be taped down. Use your mayline and a triangle to create the verticals of each letter or number and freehand the curved lines.

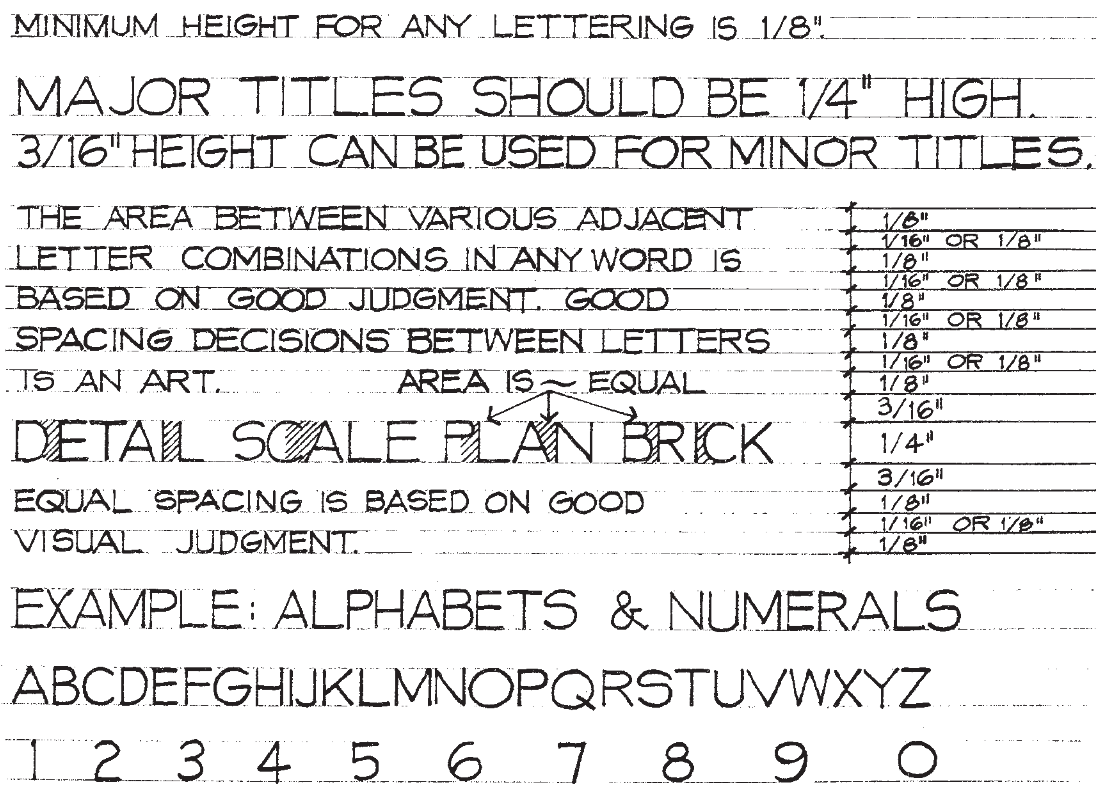
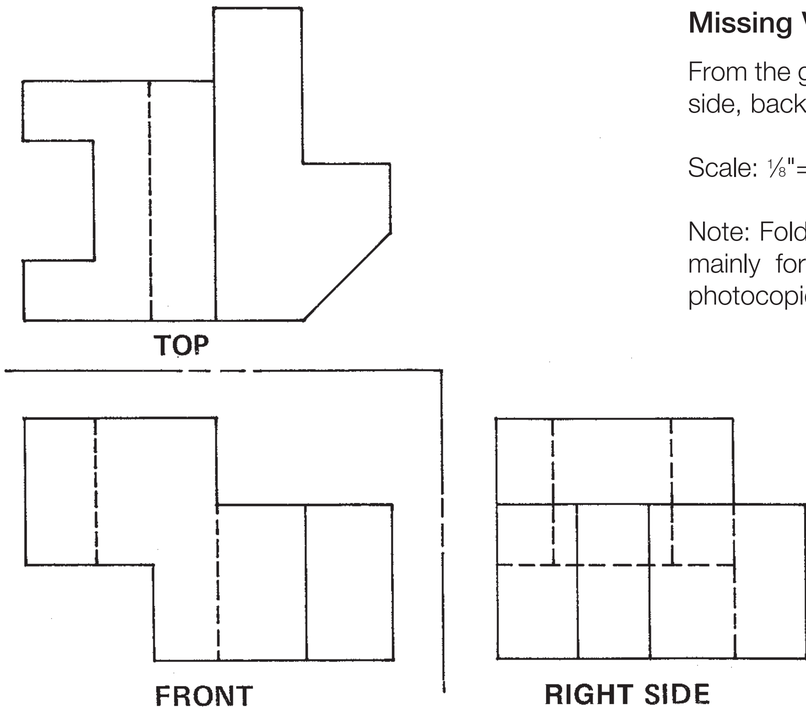


Image excerpted from *Architectural Drawing*, 3rd ed. (Rendow Yee)

Lettering exercise: Courtesy of Lauren Karwoski Magee
Instructor, Drexel University, Philadelphia, PA
Director of Instruction in Representation
Department of Architecture + Interiors
Architecture Program



Missing Views

From the given views of the object, construct the left side, back, and bottom views.

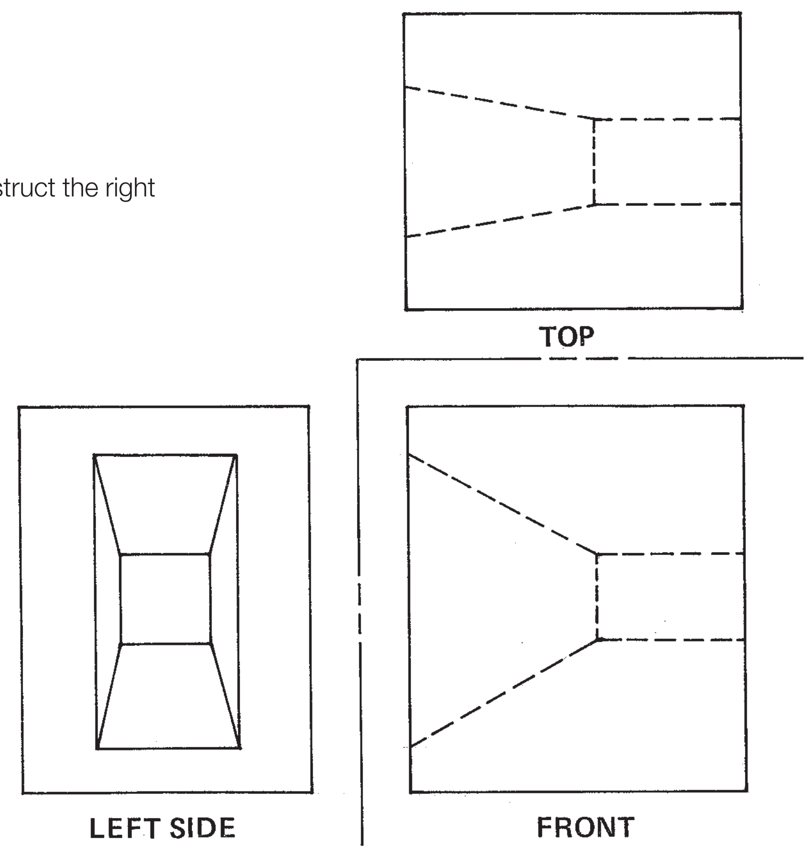
Scale: ⅛"=1'0"

Note: Folding plane lines in these two exercises are mainly for instructional purposes. Delete them in photocopies if your instructor so desires.

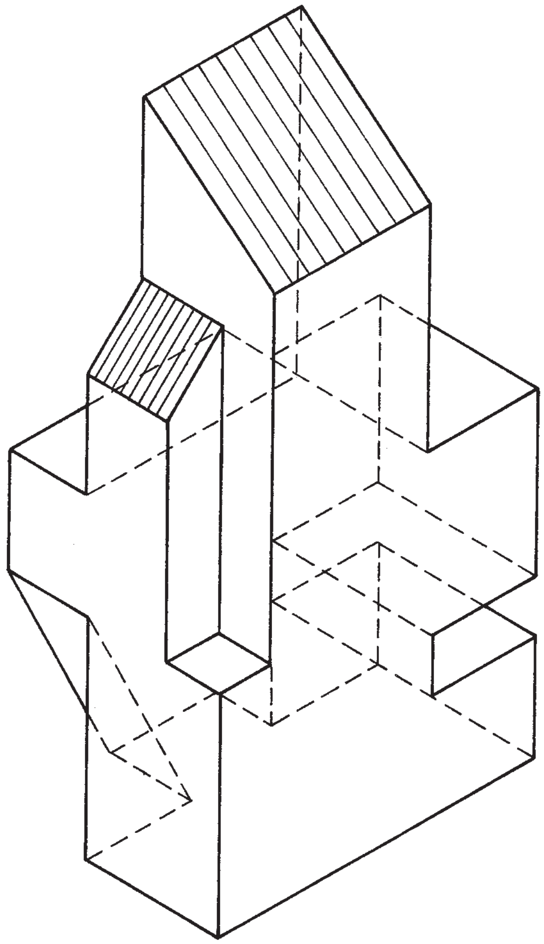
Missing Views

From the given views of the object, construct the right side, bottom, and back views.

Scale: ⅜"=1'0"



Tip: In resolving multiview problems, always try to visualize with sketches the three-dimensional construct.

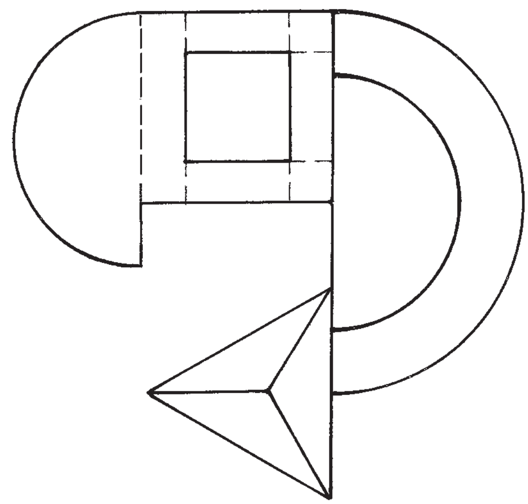


Six Orthographic Views

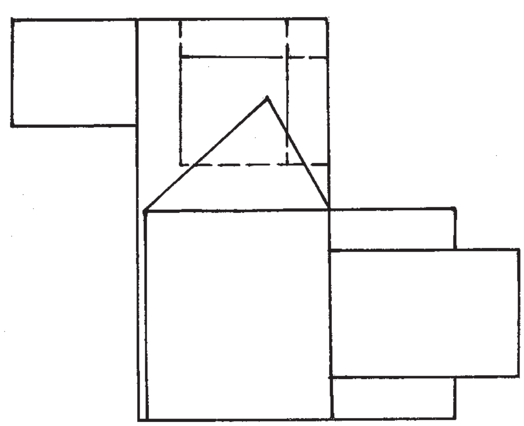
Shown at left is an isometric drawing with hidden lines to help you visualize the form. Construct six orthographic views. Draw them first with hidden lines and then without hidden lines, as would be seen in architectural plans and elevations.

Tip: when given the three-dimensional construct, do rough freehand visualization sketches of each orthographic view.

Student project by Ellen W. Ng
Courtesy of the Department of Architecture
City College of San Francisco

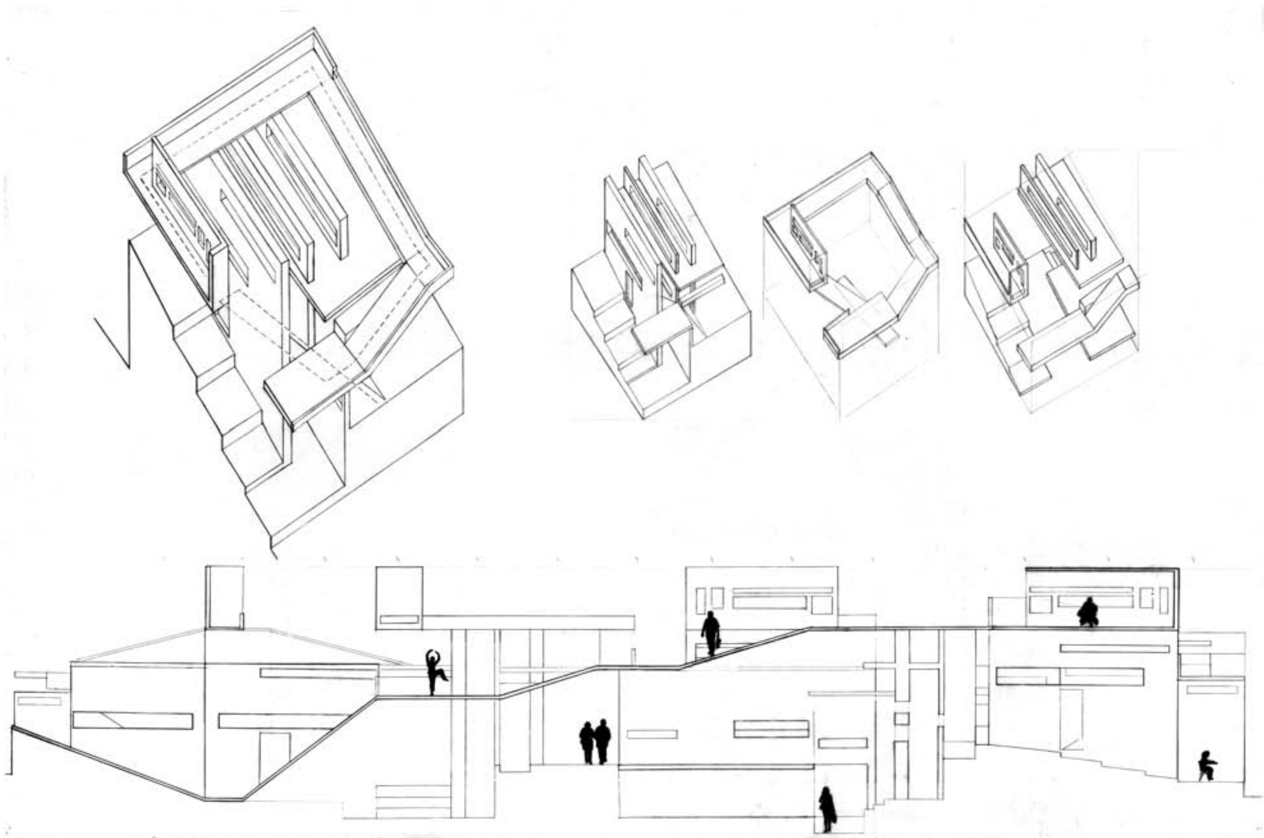


Student project by Erna Egli and Joanna Hostetler
Courtesy of the Department of Architecture
City College of San Francisco



Missing View/Isometric/Plan Oblique

Construct the missing right-side elevation from the given plan and elevation views. Then construct an isometric drawing and a plan oblique drawing at 45°–45°.



Hilary Barlow: Axon and unfolded section

Medium: Graphite on vellum
Courtesy of Professor Marissa Tirone
Teaching assistants: Anastasija Gridneva, Saritza Martinez, Alexander Raynor, Martin Sweeney
Syracuse University
School of Architecture, Spring 2010

Axon + Unfolded Section: Section as it relates to sequence

In this exercise you will combine all of your knowledge and skill in constructing axons and sections to highlight and examine the primary spatial sequence of your studio midterm project.

It is required that you first construct a transparent axonometric drawing of the entire project, indicating the spatial sequence within that drawing through the use of a different linetype. You will then cut sections along the entirety of the path and link them as an unfolded section drawing below the axon.

It will be necessary to first construct and compose these drawings on trace before finalizing them on your vellum sheet.

Pay special attention to sheet organization, line weight, and line quality to establish hierarchy.
Final drawing will be at 1/8" scale on translucent vellum, graphite only.

Assigned: 3.22.10 Monday
Due: 4.05.10 Monday

Greg Bencivengo: Sequence mapping of Alfred Hitchcock's *Rear Window*

Medium: Digital plot, Adobe Illustrator
Courtesy of Professor Marissa Tirone
Teaching assistants: Anastasija Gridneva, Saritza Martinez, Alexander Raynor, Martin Sweeney
Syracuse University
School of Architecture, Spring 2010

Sequence Mapping: Recording and cross-referencing information

After producing a series of maps for studio, you are asked to reconstruct and recompose those same maps using Adobe Illustrator. Use the software as an interface to collect information from study drawings and carefully organize a composite drawing. Consider the relationship between drawings and overall page layout. You should compose a series of four to six maps based on the following: important spatial sequences, programmatic sequences, event, time, structure, and view. Since each mapping topic might be quite different, you may consider alternative, more appropriate themes and techniques to explore. For example, you might use one main diagram that is comprised of several layers of information that then cross-references additional keyed-in mappings.

Pay special attention to sheet organization, line weight, line type, and color to establish hierarchy.
Final drawing will be a plot, 24" × 36" or 36" × 48".

Assigned: 2.03.10 Wednesday
Due: 2.15.10 Monday

Plan and Elevation Graphic Conventions

Time frame: One week

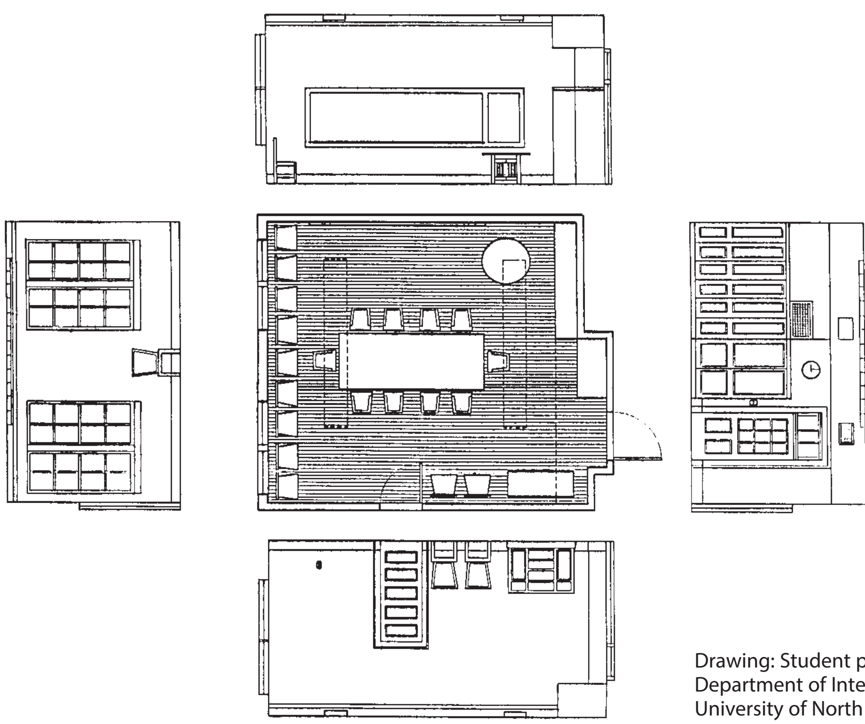
Required materials: A 25' measuring tape

1. Assemble into groups of three (use a sign-up sheet). Measure together—draw your final drawing separately.
2. Locate somewhere on campus a classroom with windows and a seating capacity of at least twenty. Measure the room. On a rough sketch of the floor plan and interior elevations, add the measurements. This will be used as a reference to draw an accurate, scaled drawing of the floor plan and interior elevations. Assume a horizontal section is cut at 4'0" above the floor. Include all furniture in both the plan and elevations.
3. Individually, each student will then draw the plan and interior elevations from the measurements in ⅜" = 1'0" scale on a single sheet of 24" × 36" vellum in graphite, according to the following format:

   The plan should be located in the center of the sheet, with north at the top of the sheet. The respective interior elevations should then be drawn as projections around the plan: the elevation you see when facing north to the top, the elevation you see when facing east to the right side, and so on.
4. Draw all furniture and built-in cabinets. Draw all wall elements. Show three-dimensional ceiling elements on the plan using the dashed-line convention. The use of templates is permitted.
5. Title block at bottom of sheet: letter on two lines at ½" high with a ¼" space between lines, as follows:

   Top line (containing the title): as-built drawings, name of campus building, room number;
   Bottom line: your name, the date, the scale used.

Project: Courtesy of Professor Stephen Temple
School of Architecture
University of Texas at San Antonio



Drawing: Student project by Christine Bottom
Department of Interior Design
University of North Carolina–Greensboro

Plan Oblique

TIME FRAME: ONE WEEK

Instructors should develop their own plan and interior elevations and give them to their students. From the plan and interior elevations on p. 495, construct a plan oblique view in ½" = 1'0" scale in graphite on a sheet of 18" × 24" vellum oriented horizontally. Use corner A for the front corner of the plan oblique. Remove walls AB and AD for a better view of the space.

Format: Draw a borderline ½" from the edge and include a 1"-high title block at the bottom. In the center of the title block, in ¾"-high lettering guidelines, letter your name, project number, and the date. The orthographic drawings should be in ¼" scale.

Turn in a blueprint for evaluation.

Give thought to the layout on your sheet so as to produce an aesthetically pleasing overall drawing effect. Line weights should be varied to aid in the perception of depth.

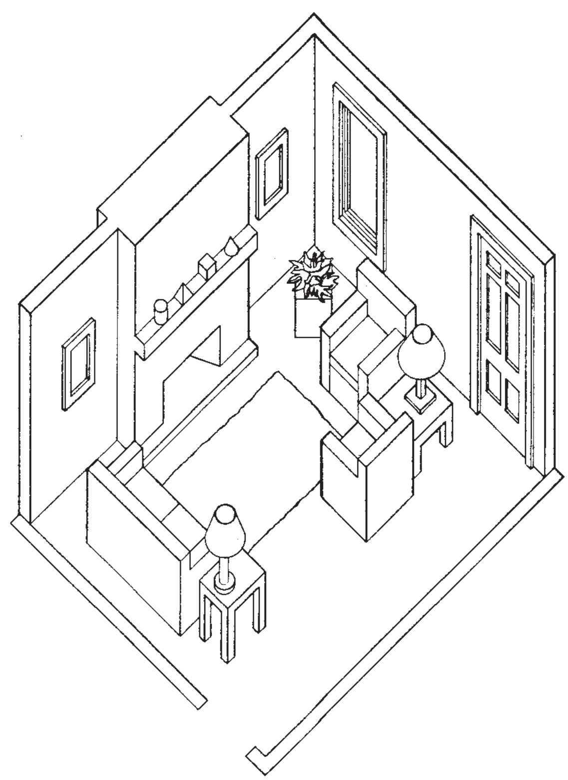
ADDITIONAL

1. Draw the grid on the floor only. (The grid may remain on the walls as light guidelines, which will not show on a blueprint).
2. Design and draw a different lamp with a round lamp shade on each of the two side tables.
3. Draw four platonic objects sitting on the fireplace mantle.
4. Draw two 18" × 28" paintings in frames on two of the walls.
5. Draw a six-panel door in the doorway of wall CD.
6. Draw a 24" × 42" casement window in wall CD above the plant. The case molding frame should be rectangular.

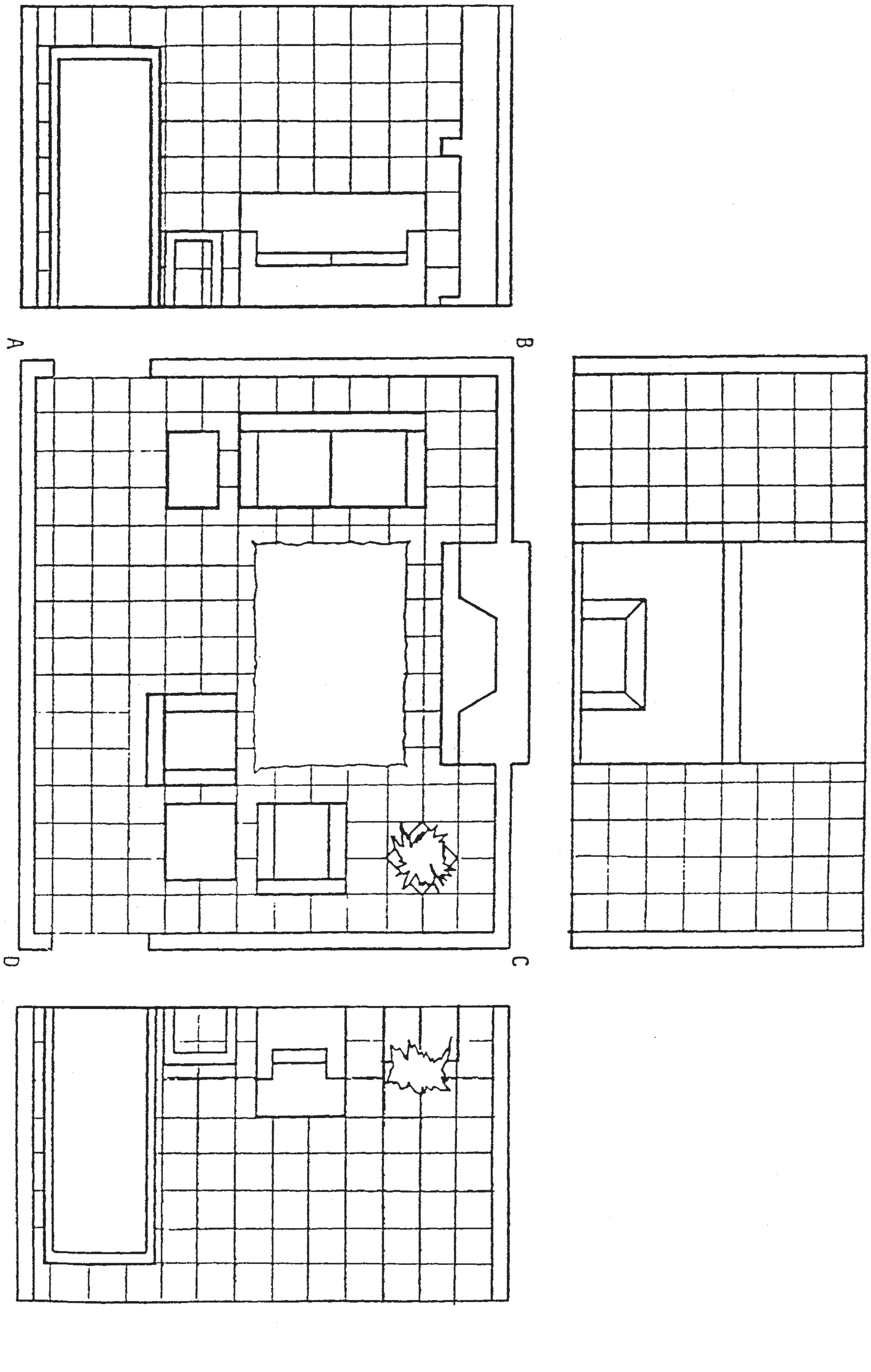
PLAN OBLIQUE (ACCORDING TO NAME)

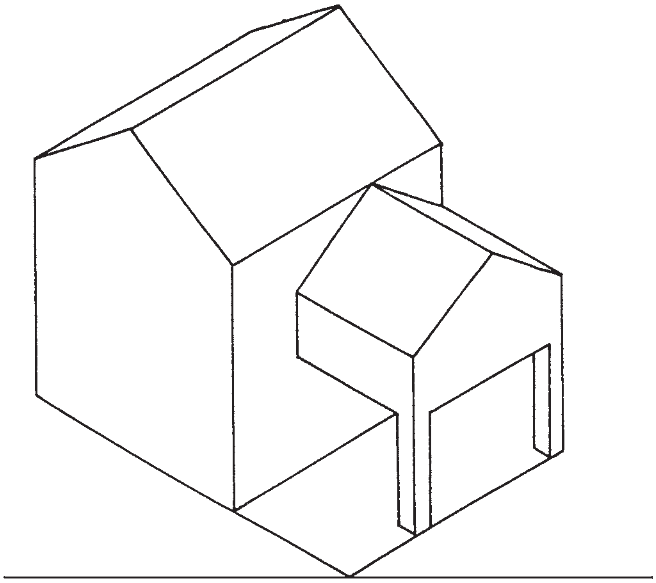
Last name A–E: 45° plan projection
Last name F–J: 30° left–60° right plan oblique
Last name K–Q: 30° isometric
Last name R–Z: 30° right–60° left plan oblique

Project: Courtesy of Professor Stephen Temple
School of Architecture
University of Texas at San Antonio



Drawing: Student project by Christine Bottom
Department of Interior Design
University of North Carolina–Greensboro

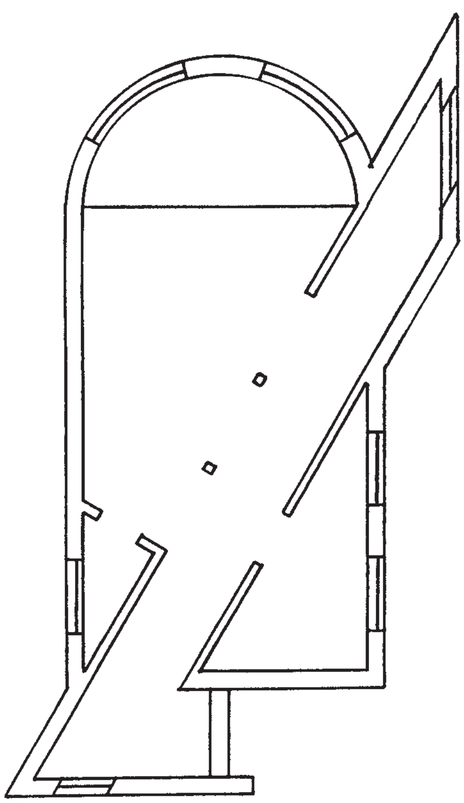

A
B
C
D



Comprehensive Paraline Problem

1. Construct the roof-plan, the front-elevation, and the side-elevation views.
2. Construct two plan obliques: one at 45°–45° and one at 60°–30°.
3. Using the plan configuration, construct a plan oblique with a nonvertical z-axis that is 60° from the horizontal.
4. Using the side elevation, construct an elevation oblique, using 45°–1:½:1.
5. Using the side elevation, construct a frontal elevation oblique 0°–1:1.
6. Construct a worm's-eye plan oblique.

Scale: 1⁄16"=1'0"

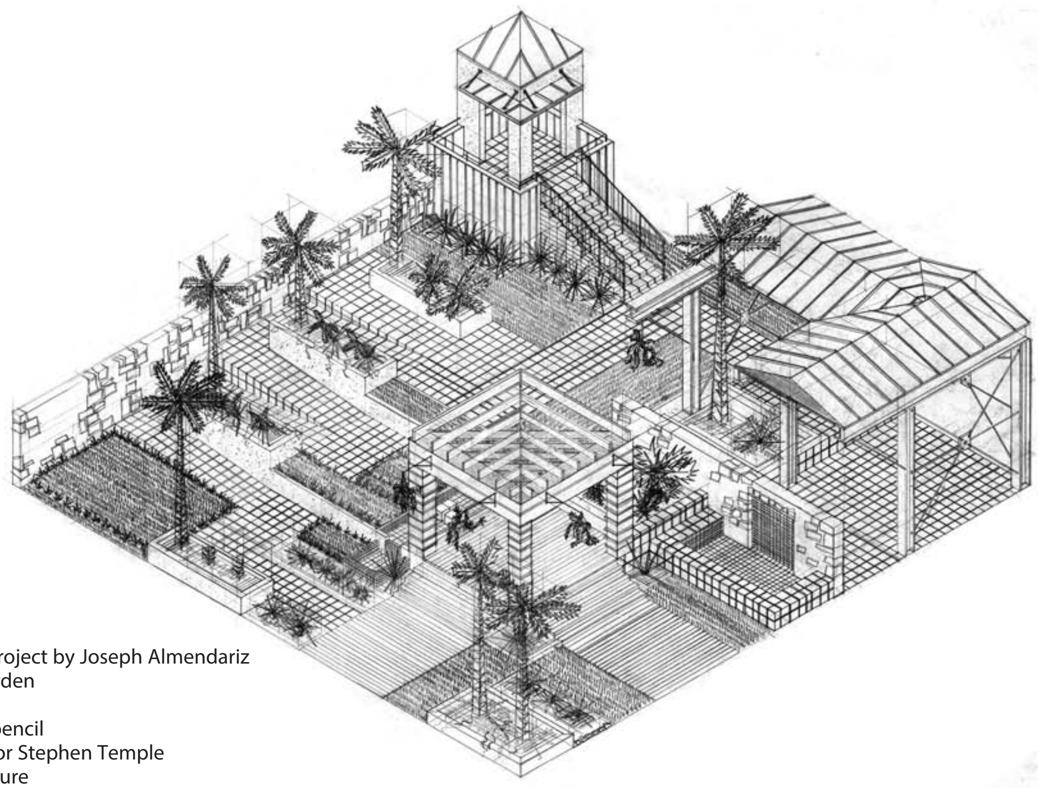


Plan Oblique

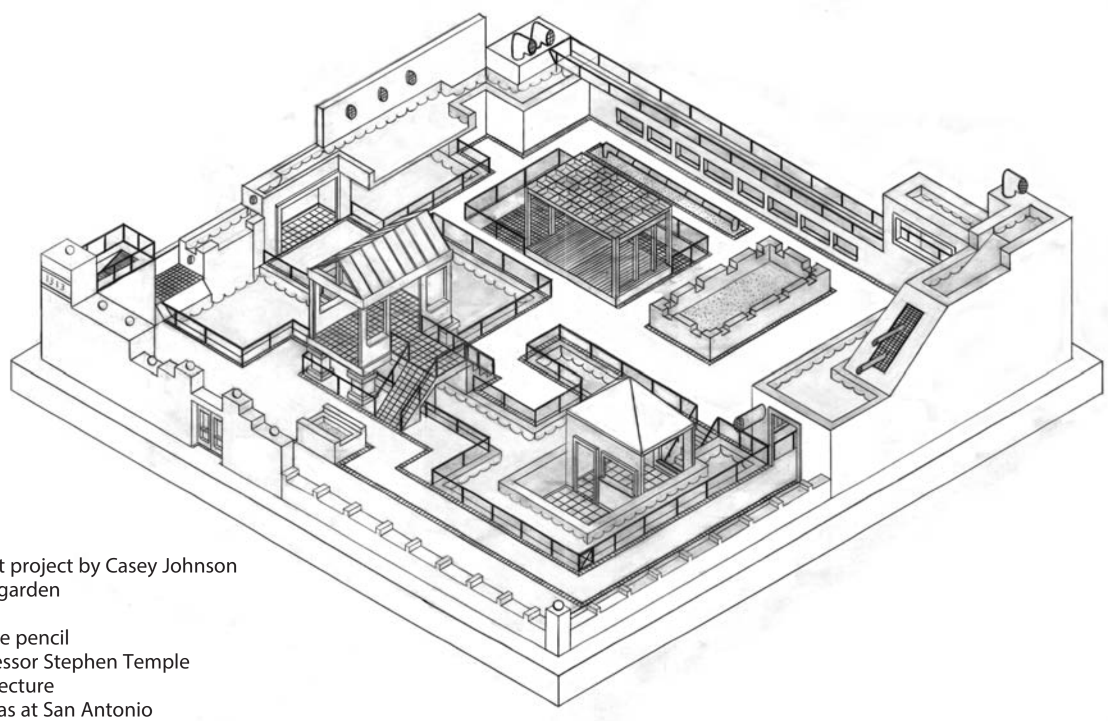
Rotate this plan view of a small building 30° from the horizontal so that you can construct a 30°–60° plan oblique view. Make the elevation of the plan cut 4' above the exterior ground level.

Scale: 3⁄32"=1'0"

Courtesy of Kwok Tsui, an architecture graduate of the University of Texas at Austin



Drawing: Student project by Joseph Almendariz
Urban garden
Size: 24" × 36"
Medium: Graphite pencil
Courtesy of Professor Stephen Temple
College of Architecture
University of Texas at San Antonio



Drawing: Student project by Casey Johnson
Urban garden
Size: 24" × 36"
Medium: Graphite pencil
Courtesy of Professor Stephen Temple
College of Architecture
University of Texas at San Antonio

This project is the culmination of a segment of a first-year drawing course that introduces paraline drawing. The urban garden project follows simpler exercises, using orthographic drawings as cues to axonometric construction. The project allows each student to design their own version at their own level of complexity while satisfying basic parameters of axonometric construction. [PROFESSOR'S STATEMENT]

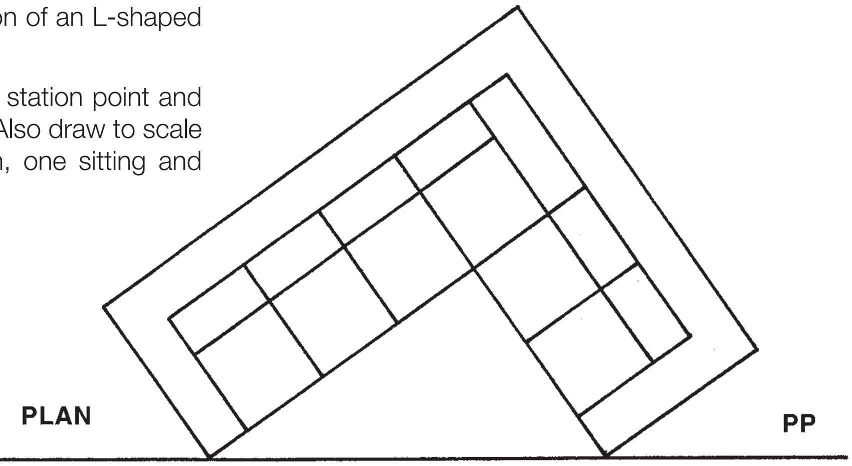
Two-Point Perspective

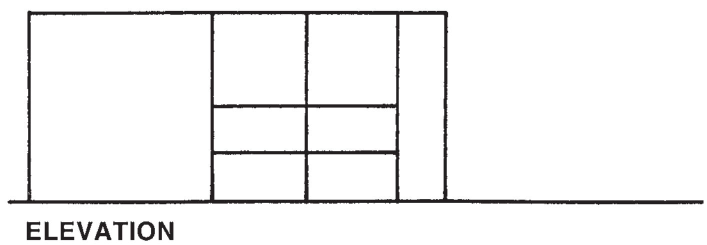
Given: A plan view and one elevation of an L-shaped seating area.

Required: Select a horizon line and station point and construct a *two-point perspective.* Also draw to scale two *human figures* in conversation, one sitting and one standing.

Scale: $\frac{1}{4}$"=1'0"

Student project by Amy Man
Courtesy of the Department of Architecture
City College of San Francisco

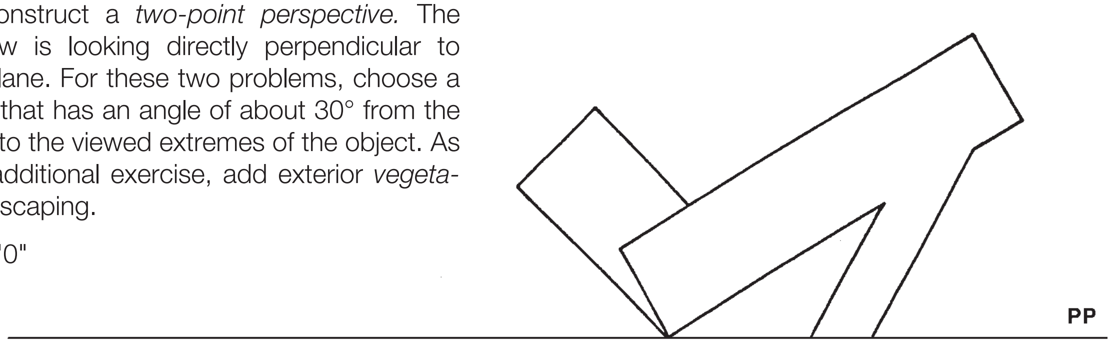


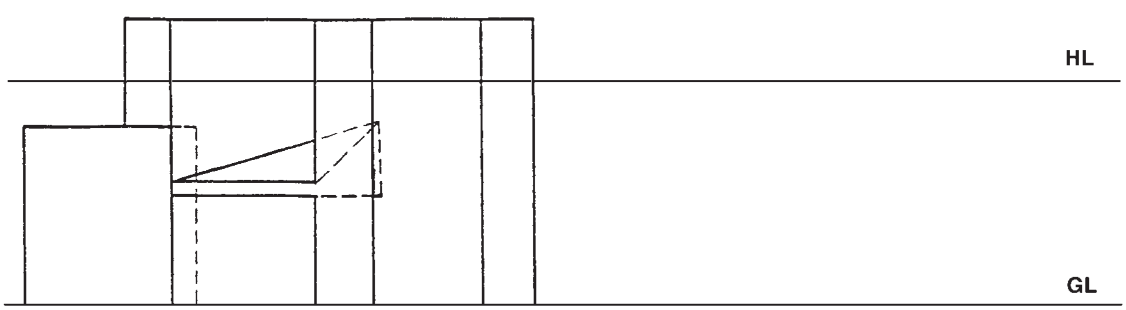


Given: A plan view and one elevation of a building form.

Required: Construct a *two-point perspective.* The elevation view is looking directly perpendicular to the picture plane. For these two problems, choose a station point that has an angle of about 30° from the station point to the viewed extremes of the object. As an optional additional exercise, add exterior *vegetation* and landscaping.

Scale: $\frac{1}{16}$"=1'0"





Two-Point Perspective

The Aim

An exercise in three-dimensional representation utilizing the method of constructing two-point architectural perspective to create a realistic or lifelike image of form and space.

The Task

Present a two-point perspective of the family house at Riva San Vitale by Mario Botta. Select a viewpoint showing the main terrace (e.g., looking at the building from the southeast corner). Position the station point and picture plane appropriately to achieve a realistic view. You may show the setup grid and construction lines in the final presentation, using a fine-tipped pen (0.1 or 0.2) with red or blue ink. Drawings must be done in black ink, drafted with either technical or felt-tipped pens (Uni Pin fine-line pens are good).

Re-present the elevations of the building with shadows, using the shading techniques described in the lectures. Note that the elevations to be shaded are separate drawings from the perspective drawing. You can cut and paste the elevations, then photocopy the whole sheet; or, for better line quality, redraw them onto your final presentation sheet. When placing the drawings, think about the layout of the sheet for readability and coherence. Pay attention to the techniques introduced in the previous lectures, including line quality and use of drafting equipment.

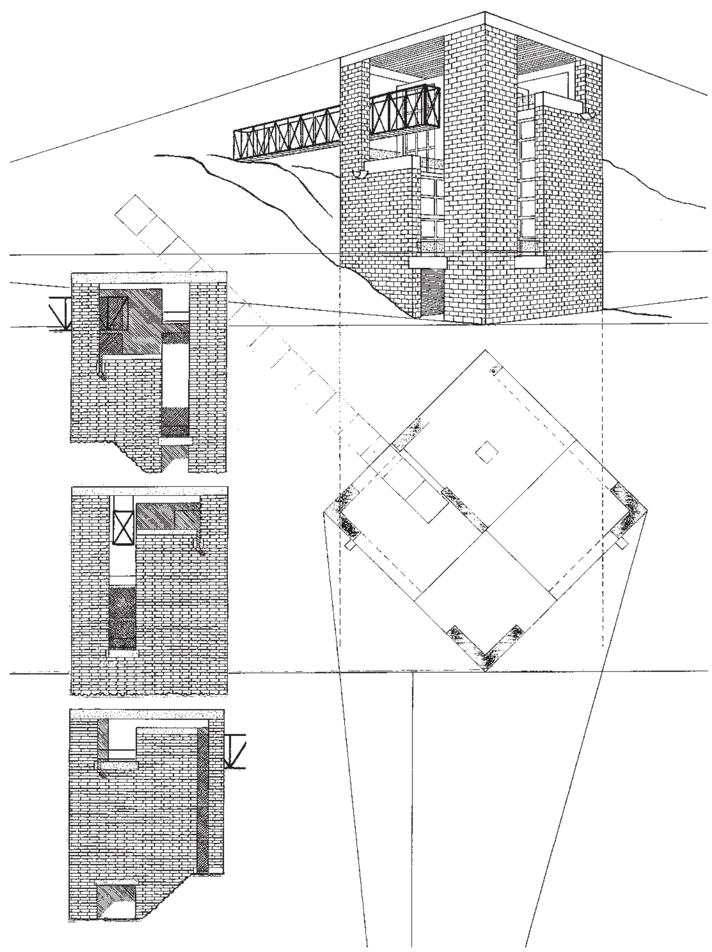
Requirements

1. In class you will be required to practice setting up two-point perspectives. Bring your drawing tools.
2. The final presentation will be a perspective view and three elevations on one A3 sheet of paper, in vertical (portrait) format, with the logo in the bottom-right corner. The drawing must be in ink.

Assessment Criteria

Students will be assessed on:

- Accuracy and coherence of perspective
- Selection of viewpoint
- Line quality and rendering
- Sheet layout and perspective setup
- Neatness of presentation



Courtesy of Dr. Samer Akkach
Drawing Architecture & Landscape I
School of Architecture, Landscape Architecture and Urban Design
Adelaide University, South Australia

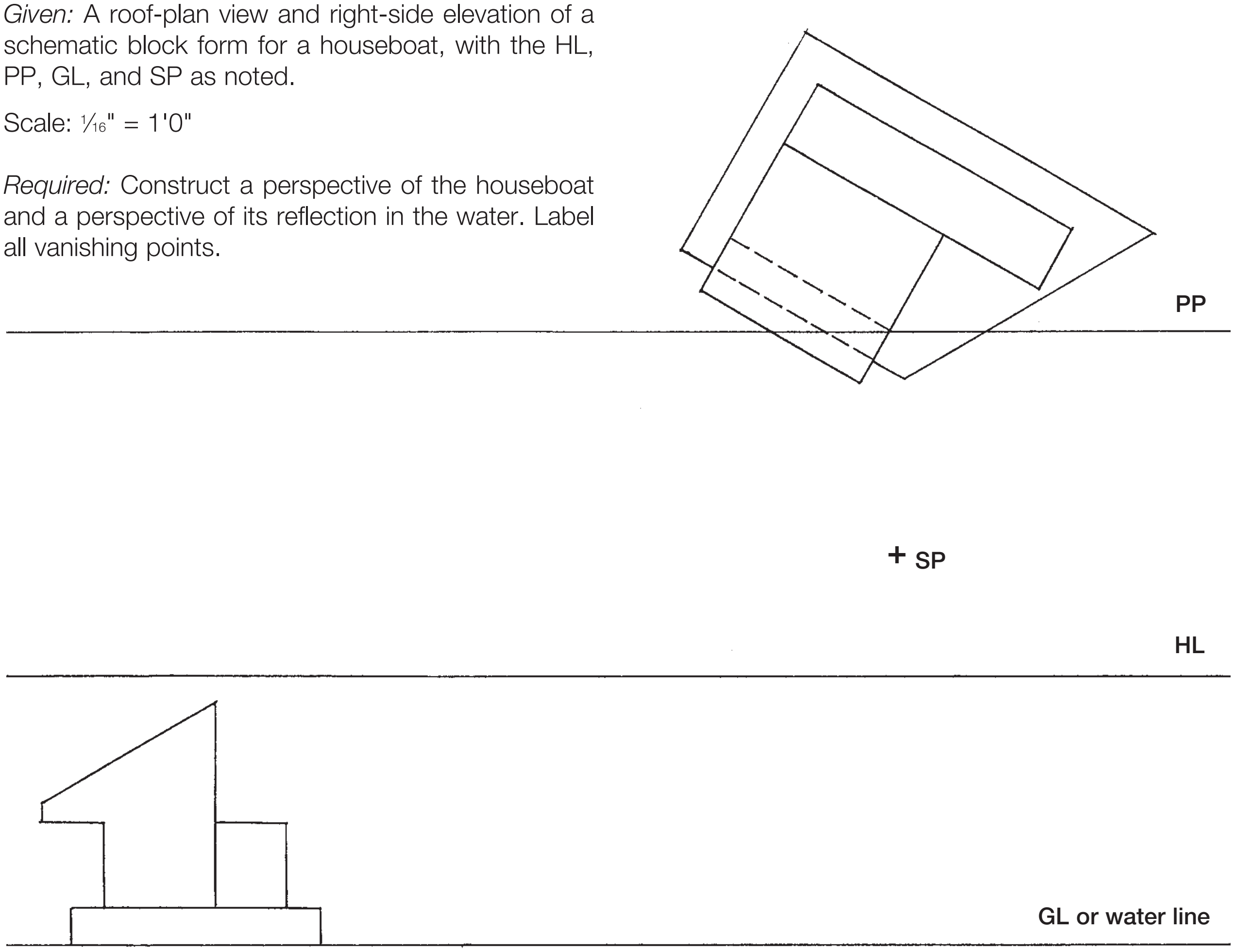
Drawing: Student project by Sue Fletcher
Courtesy of the School of Architecture, Landscape Architecture and Urban Design
Adelaide University, South Australia

Perspective Reflections

Given: A roof-plan view and right-side elevation of a schematic block form for a houseboat, with the HL, PP, GL, and SP as noted.

Scale: $\frac{1}{16}$" = 1'0"

Required: Construct a perspective of the houseboat and a perspective of its reflection in the water. Label all vanishing points.



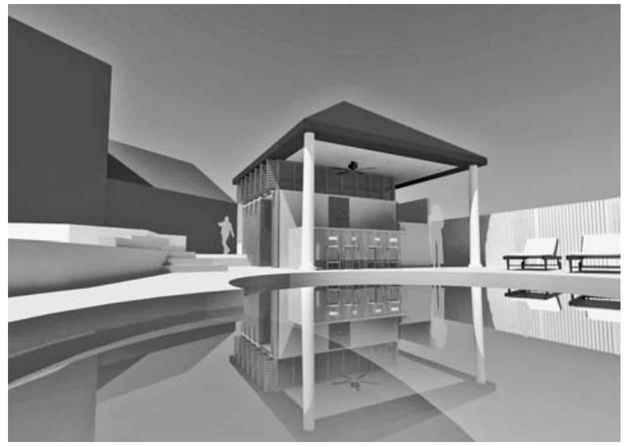
© Mark Dziewulski

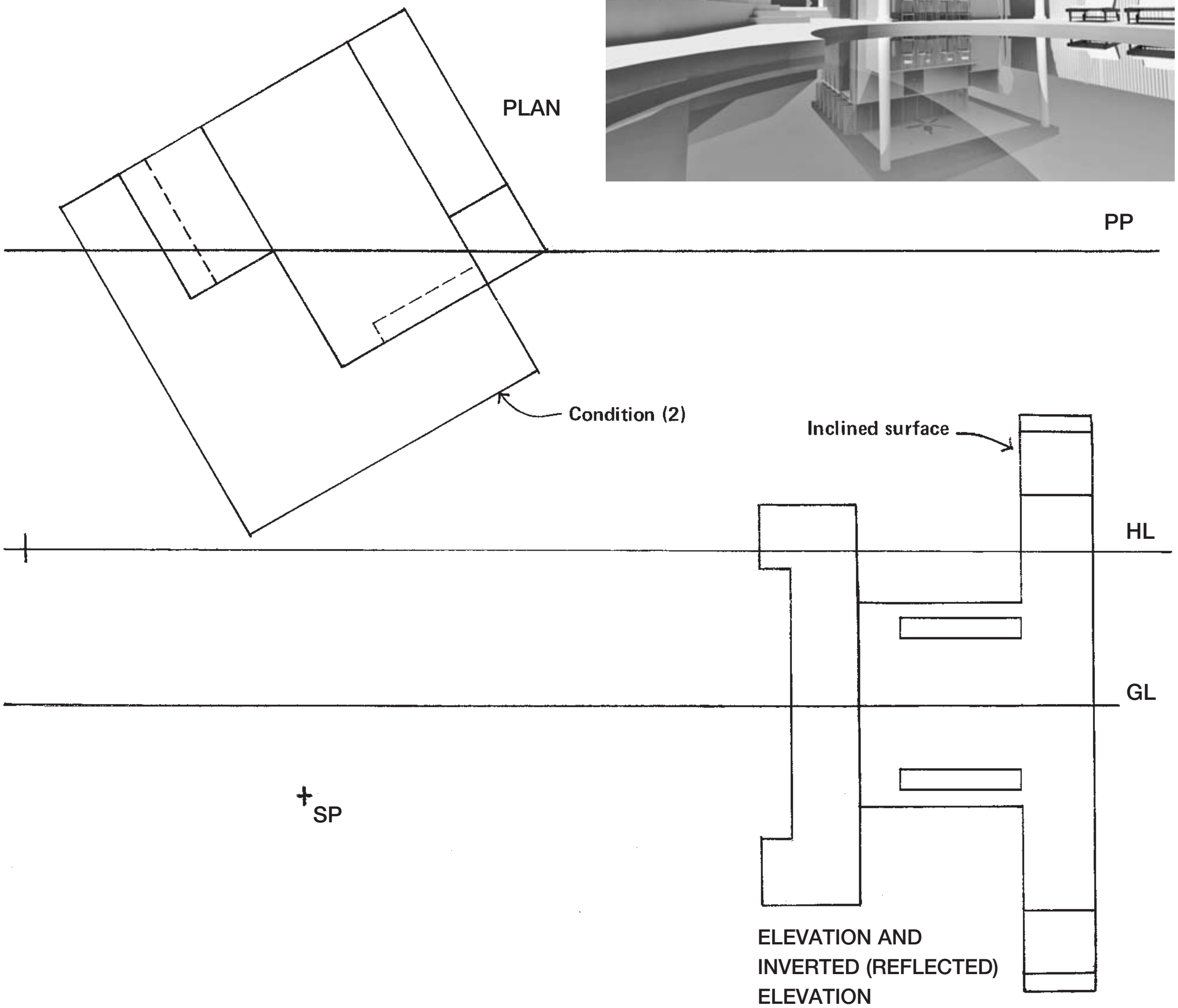
Photo: Lakeside Studio
Carmichael, California
Courtesy of Mark Dziewulski, Architect
www.dzarchitect.com

Photo by Keith Cronin

The selected HL for this exercise is considerably above normal eye level. Move the HL to roughly normal human eye level and generate another perspective. The resulting angle above the ground plane will be similar to the reflection seen in the photo of the house. This photo is an excellent example of a complete reflection of a structure in still water.

Drawing: Pool House
Knoxville, Tennessee
Media: Base model created in SketchUp Pro and rendered in V-Ray for SketchUp
Courtesy of c2 architecture studio
(Construct TWO, PLLC)





Perspective Reflections

Given: The plan, elevation, and inverted elevation of a building touching a reflecting surface.

Required: Draw a two-point perspective of the building and show its exact reflection. Scale: 1⁄16" = 1'0"

Condition (2): Draw this edge of a reflecting pool. Notice how this results in a partial reflected image. As an optional additional exercise, render the reflection in the pool.

Perspective Journey

INTRODUCTION

Space and form are the fundamental components of the architect's palette. We use forms to define spaces and to give them character. Perspective drawings are a powerful tool that allow us to explore the three-dimensional form of our designs. We will work with one-point and two-point perspective in this exercise. These two types of perspective generate natural views of spaces that seem "real" to the viewer. Facility with these techniques is an essential skill for the architect; it allows the designer to both understand and communicate his or her designs. Through these techniques we are able to develop our concepts and describe them to others.

PROBLEM

You will imagine a sequence of spaces. Put yourself in the drawing. Where do you stand or sit? Draw a series of perspective vignettes—small descriptive sketches—describing your journey through your imaginary environment. The spaces described will use simple geometric forms and architectural elements to create a variety of experiences. All of your spaces must express both inside and outside simultaneously.

You will use light and shadow to enliven the spaces. In some cases, this will be by clarifying; in other cases, it will obscure and create ambiguity.

Keep your compositions simple: conceive of them as the "bones" of the space, and do not represent details such as doors or windows.

Your spaces will be defined by using the following geometric forms:

- Cylinder
- Pyramid
- Plane
- Rectangular prism
- Staircase
- U-Shaped plane
- L-Shaped plane
- Colonnade

Your spaces should have a range of relationships with the viewer. These effects can be achieved by varying the setup for each vignette. Use high and low horizon lines and vary the locations of your vanishing points. Try for a coherent group of spaces with a consistent and clear mood and character.

PROCESS

1. Imagine a defined space within your imaginary environment.
2. Determine the shape of your field.
   - Each drawing should be between 24 and 40 square inches.
3. Determine the location of your horizon line.
   - A high horizon line gives a large foreground and can position the viewer above the space.
   - A low horizon line gives a large sky and can position the viewer below the object.
4. Determine whether a one-point or two-point perspective is most appropriate for the space.
5. Place your vanishing point(s) (VP).
   - In two-point perspectives, a more distant VP shows more of the planes; while a closer VP emphasizes depth.
6. Construct a perspective layout of your imaginary space.
7. Use overlays to study light and shadow patterns.
   - Use light VPs as you would use the altitude and angle lines for shadows in axonometric and isometric drawings.
8. Draw the final vignette.
9. These drawings will be drawn using tools for straight edges.
   - Verticals should be precisely perpendicular to horizon lines.
   - Horizon lines must be horizontal.
   - Rolling rulers are a useful tool for this assignment.

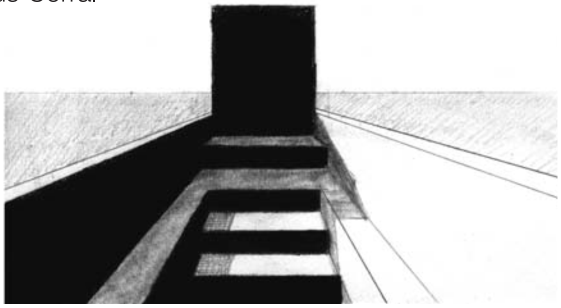
REQUIREMENTS

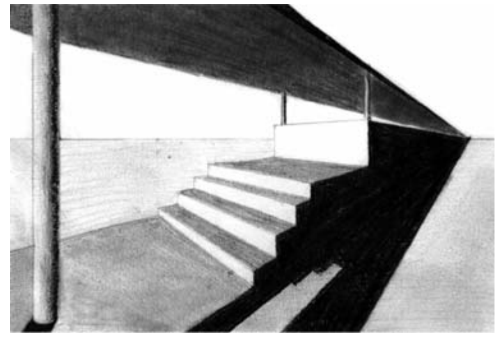
8 vignette drawings

- (4) two-point perspectives
- (4) one-point perspectives

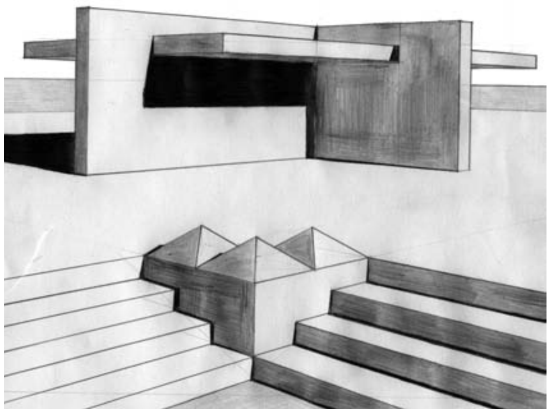
Problem statement and student projects by Jesus Corral, Brian Henks, Andres Lemus, and Will Prescott
Medium: Pencil
Courtesy of Professor Jane Ostergaard, Jesus Corral, Brian Henks, Andres Lemus, and Will Prescott
College of DuPage
Department of Architecture

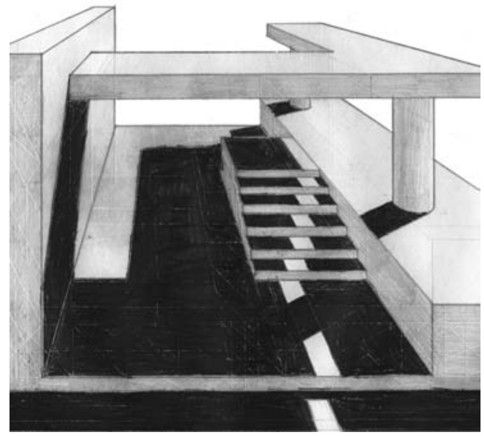
Jesus Corral



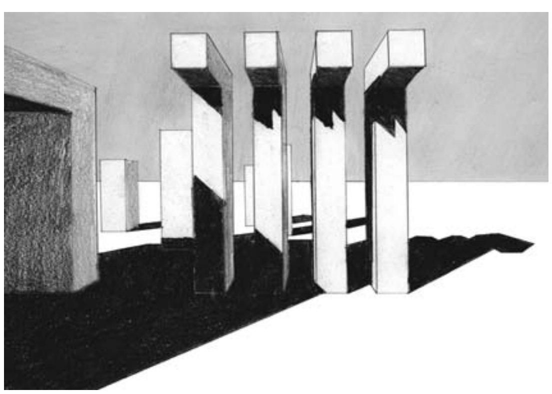


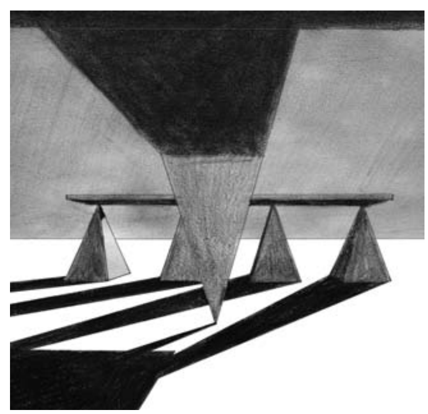
Brian Henks



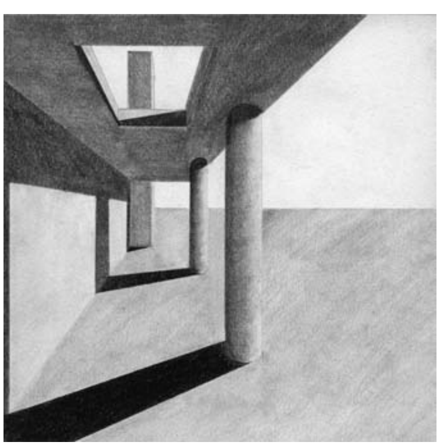


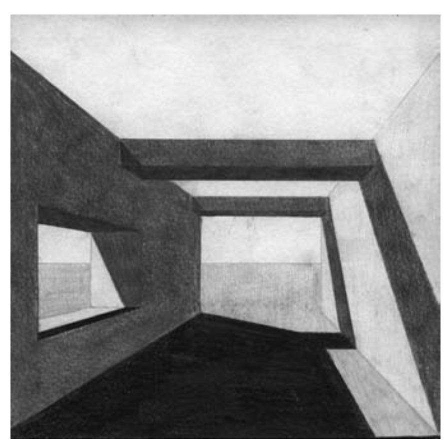
Andres Lemus





Will Prescott





Translating the narrative of *Sliding Doors* (translating diagrams into spatial design)

This project invites students to develop a spatial sequence based on the progression of a cinematic narrative, that of *Sliding Doors* (1998). Students investigate how to embed thoughts in drawing qualities. They utilize various techniques to diagram the narrative and then translate the diagrams into the design of space.

Expressive diagram and analytical diagram are focused on in this exercise. Specifically, students use gesture sketch as a form of expressive diagram to grasp the concept of the narrative and timeline as a form of analytical diagram to record critical moments in the narrative.

Gesture sketch enables students to draw in a loose manner while being conscious of the structural characteristics of objects. When using this technique to diagram, students appear to be aware of the meanings of the shapes they draw. They either articulate the shapes as a logical structure of the narrative or use the strokes of the shapes to express certain feelings that arise from the movie.

Timeline notates the relationship between time and events. To draw a timeline, one marks "when" and "what" happens. The challenge of drawing a timeline resides in what moments or events are considered significant within the continuum of the narrative.

After diagramming, students are invited to articulate these diagrams in the form of a passage space. Like other space, a passage incorporates both experiential and structural aspects of space. On one hand, as the viewer moves through the passage, he or she is bound to encounter various spatial conditions. On the other hand, after moving through the passage, he or she may retrospectively recognize the space as a structure that can never literally be seen at any angle or any moment when being moved through. The overall structure of the space heightens the conceptual aspect of space.

The whole design translation process is facilitated by various visual communication techniques—freehand drawing, digital drawing, physical modeling, digital modeling, and digital animation. Students are constantly asked to use drawing and modeling techniques to clarify design intentions, rather than using them as passive representations of the design product.

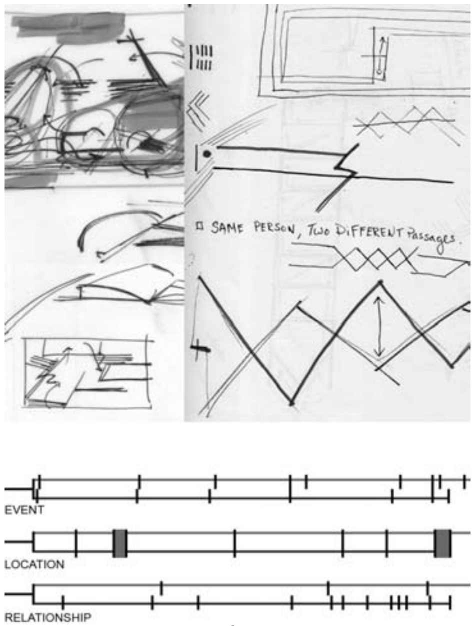
Educational objectives:

- Experimenting with visualizing design concepts.
- Experimenting with embedding concepts and feelings in the mediums of drawing and space.
- Developing an understanding of diagramming methods through gesture sketching and analytical drawing manipulation.
- Exploring how to develop design concepts through drawing.
- Exploring the translation between diagram and design of space.

Process:

- Week 1: Discussing film, collecting ideas and data.
- Week 2: Gesture sketching and timeline drawing as a means of observation.
- Week 3–4: Drawing manipulation and space development.
- Week 5: Finalization.

Courtesy of Professor Weiling He
Texas A & M University
Department of Architecture



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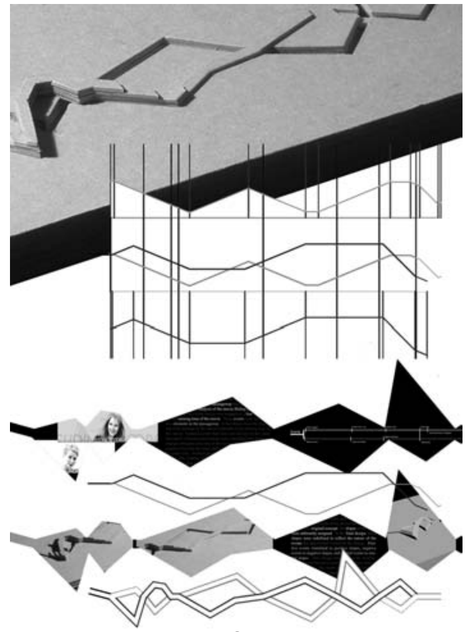

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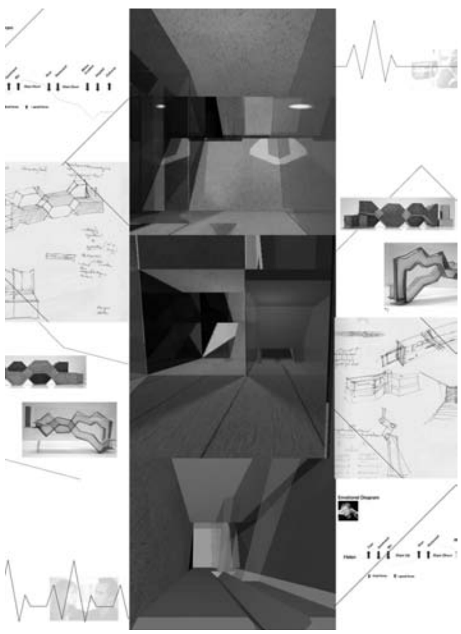

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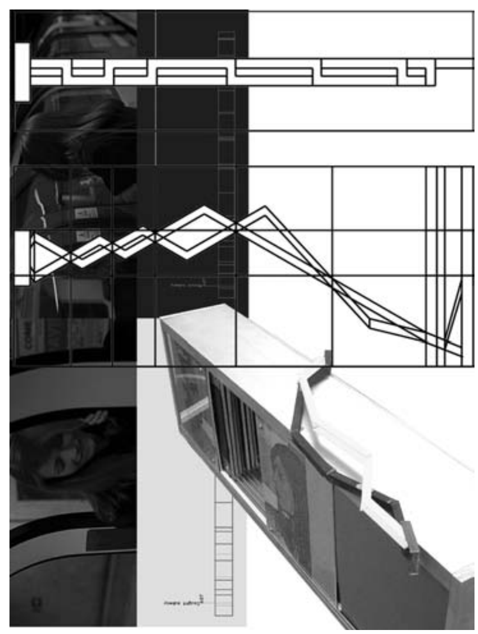


4

Student credits and mediums used:

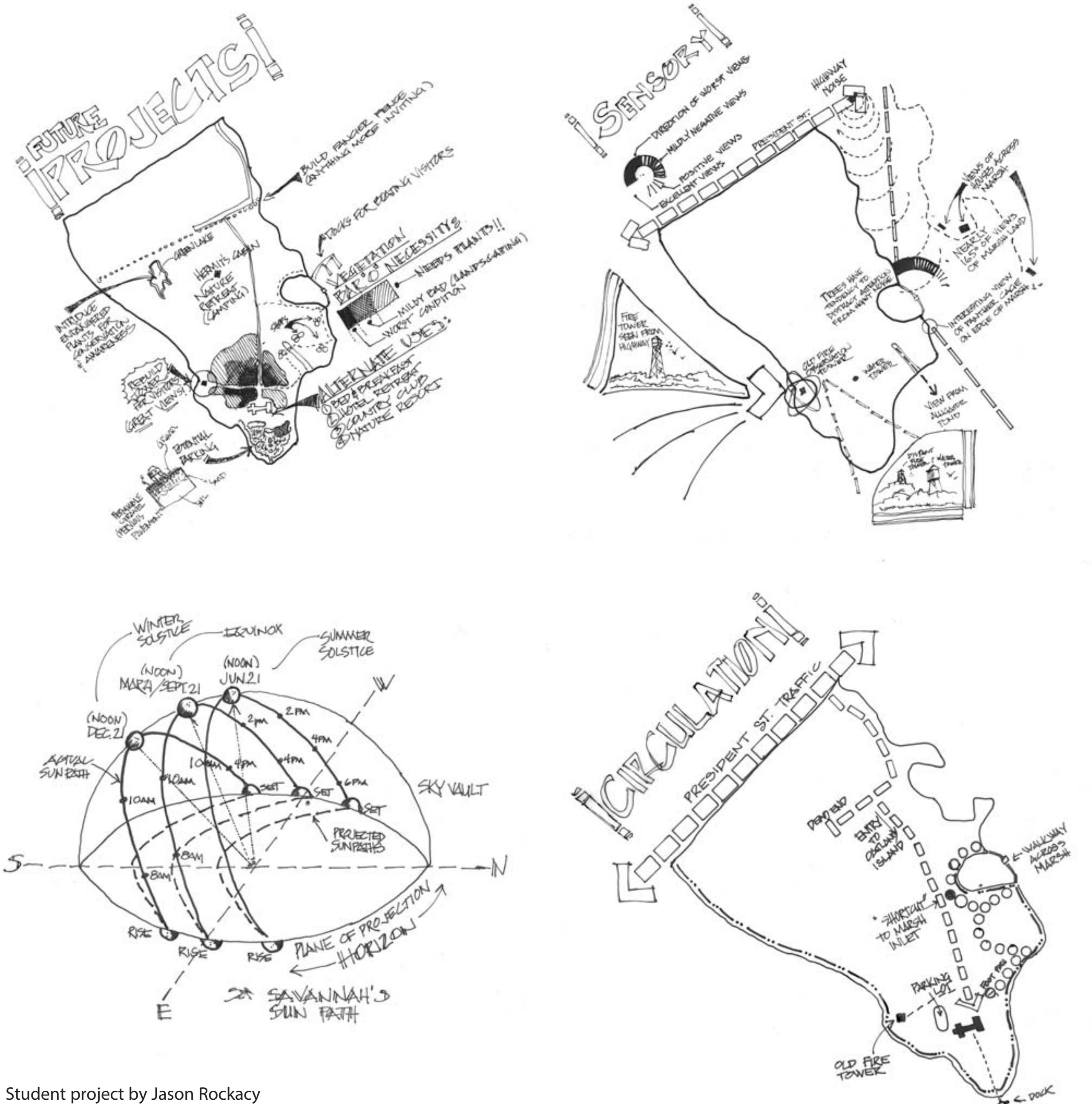
Fig. 1 Gesture sketches and timelines by Yu Jung Jang, Amanda G. Scott
Medium: Marker on velum, pencil on paper, AutoCAD

Fig. 2 "Passage" by Bruce R. Baxter
Medium: AutoCAD, chipboard, photoshop

Fig. 3 "Passage" by Amanda G. Scott
Medium: pencil on paper, AutoCAD, 3dsMax, cardboard

Fig. 4 "Passage" by Amanda L. Fry
Medium: AutoCAD, photoshop, aluminum frames, plywood, velum, Plexiglas

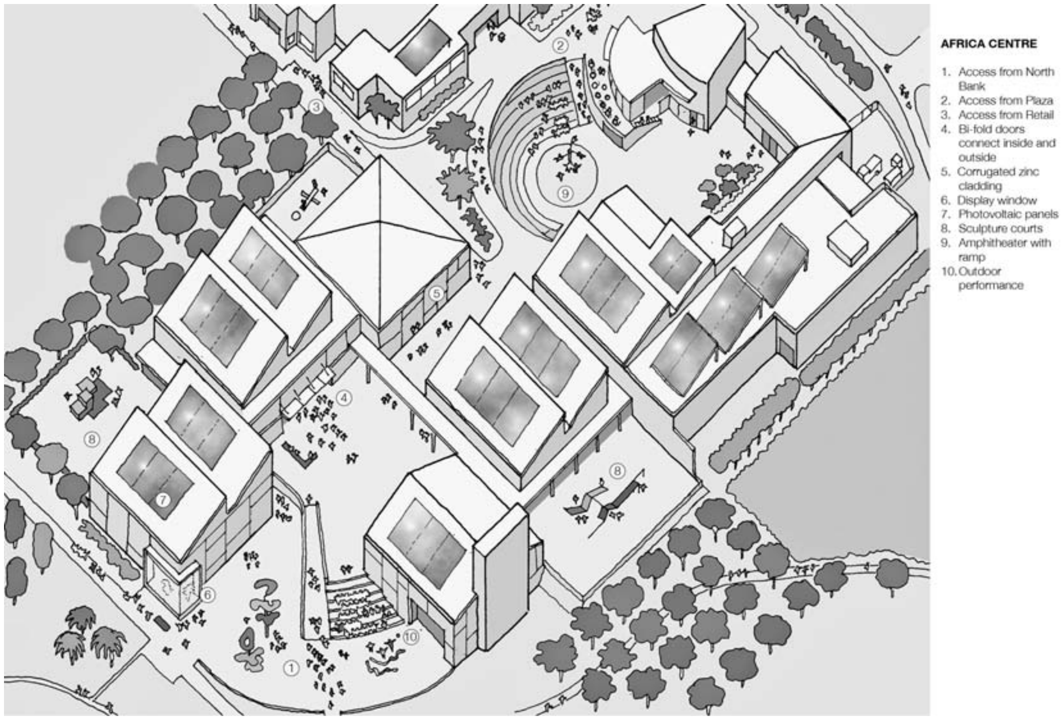
Courtesy of Professor Weiling He
Texas A & M University
Department of Architecture

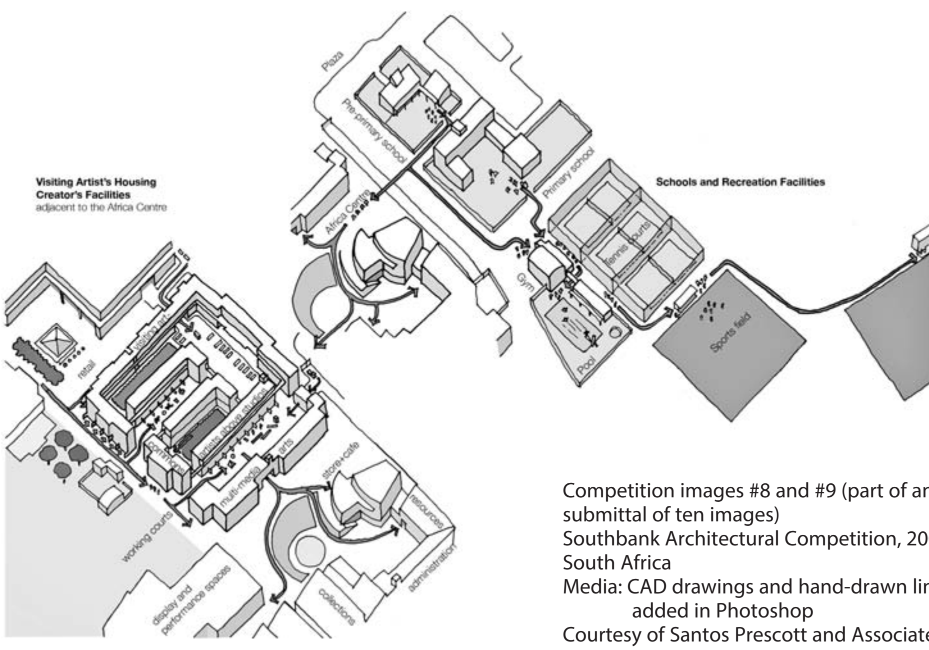


Student project by Jason Rockacy
Medium: Ink on tracing paper
Courtesy of Professor LaRaine Papa Montgomery
Savannah College of Art and Design

Site Analysis Diagrams

Assignment: Architecture students and elementary school students work together on the design of a children's discovery center dedicated to learning about the natural environment. As the teams develop building design concepts, a clear graphic diagramming language is used to communicate site forces, such as solar angles, sun and shade patterns, conservation land-use planning, and sensitive circulation through the marsh and maritime forest. Diagrams quickly illustrate complex, interrelated issues that lead to architectural decisions.



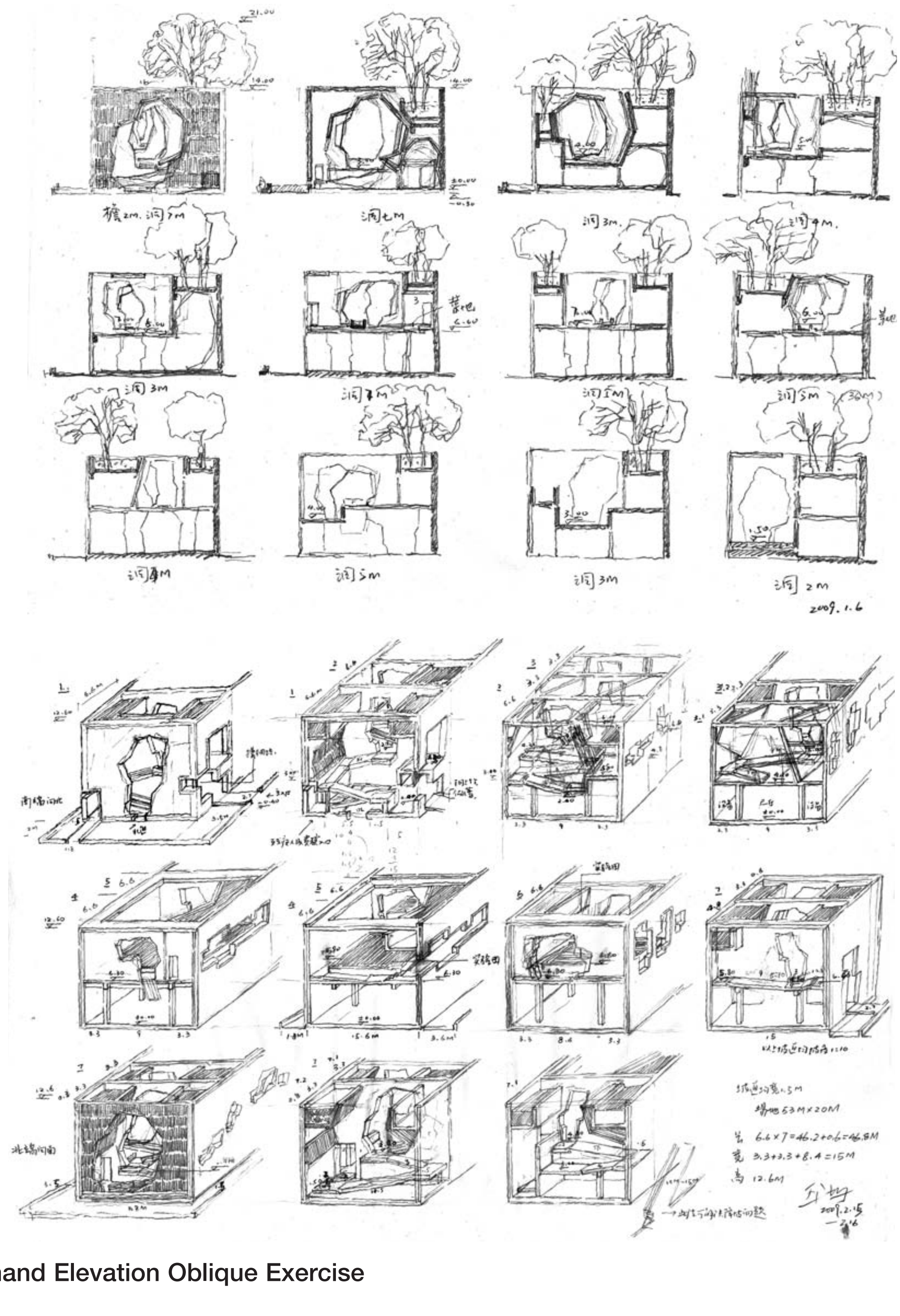


Competition images #8 and #9 (part of an online competition submittal of ten images)
Southbank Architectural Competition, 2006, near Capetown, South Africa
Media: CAD drawings and hand-drawn line work with color added in Photoshop
Courtesy of Santos Prescott and Associates, Architects

Freehand Plan Oblique and Diagramming Exercise

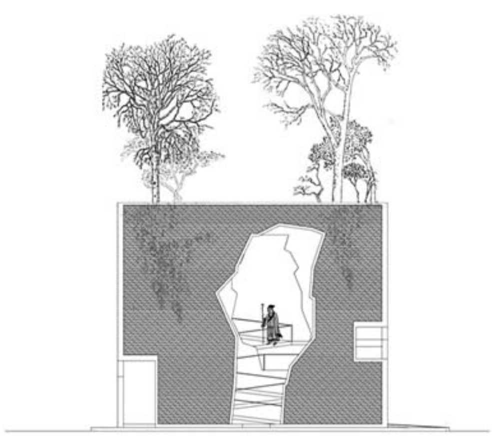
In your design studio project, do a freehand drawing of your design concept in a plan-oblique drawing type. Then do freehand diagrams using this plan oblique to analyze circulation, etc. The two example images are from a professional competition.

Bird's-eye plan obliques are similar to steep angled perspectives. Landscaping patterns, as well as vehicular and pedestrian circulation patterns, are usually more easily visible with an oblique view. As with faraway aerial perspective entourage, plan oblique entourage must add character without much detail.

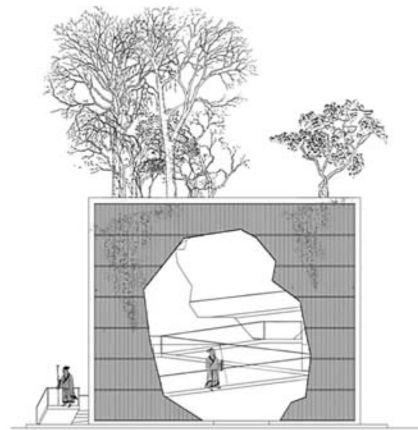


Freehand Elevation Oblique Exercise

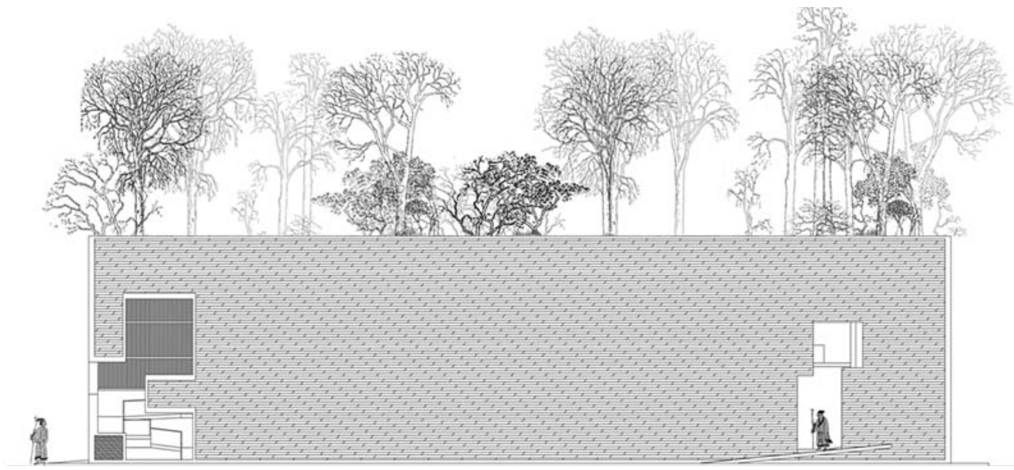
Elevation oblique sketches and elevation drawings (this and facing page): Ningbo Tengtou Pavilion Expo 2010, Shanghai, China
Medium: Pencil
Courtesy of Amateur Architecture Studio/Wang Shu & Lu Wenyu



South elevation



North elevation



East elevation

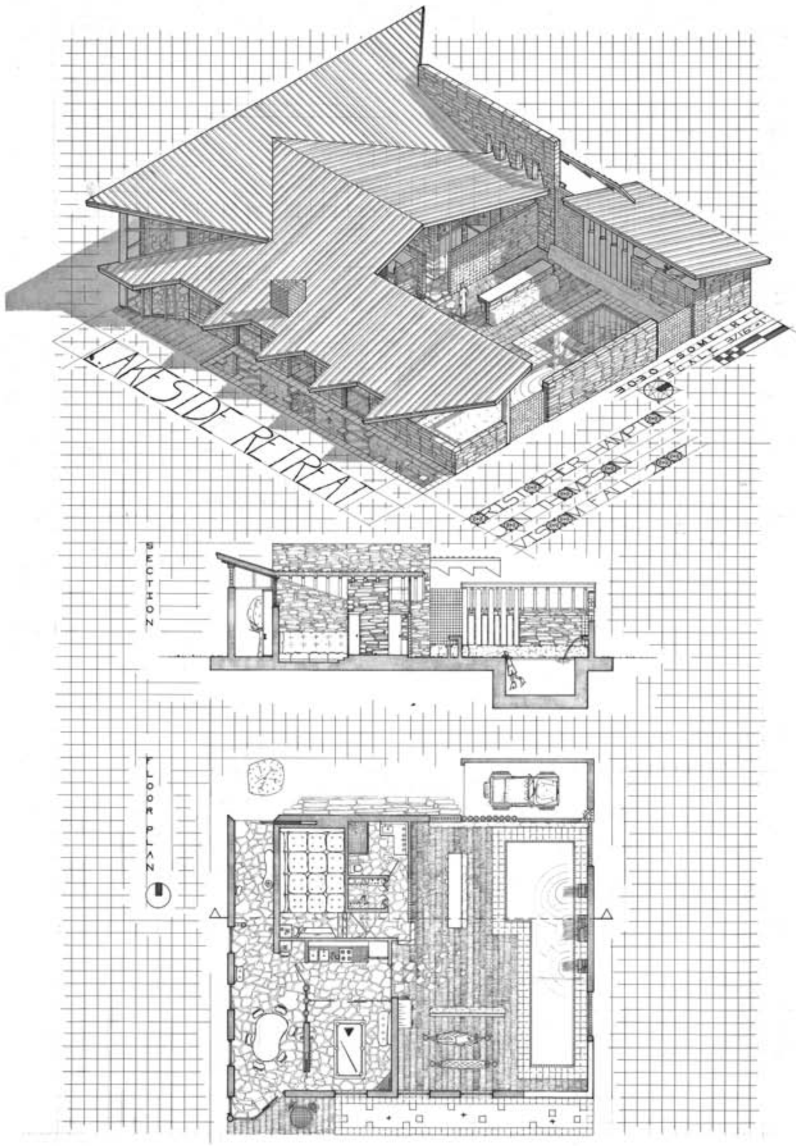
West elevation

Freehand Elevation Oblique Exercise

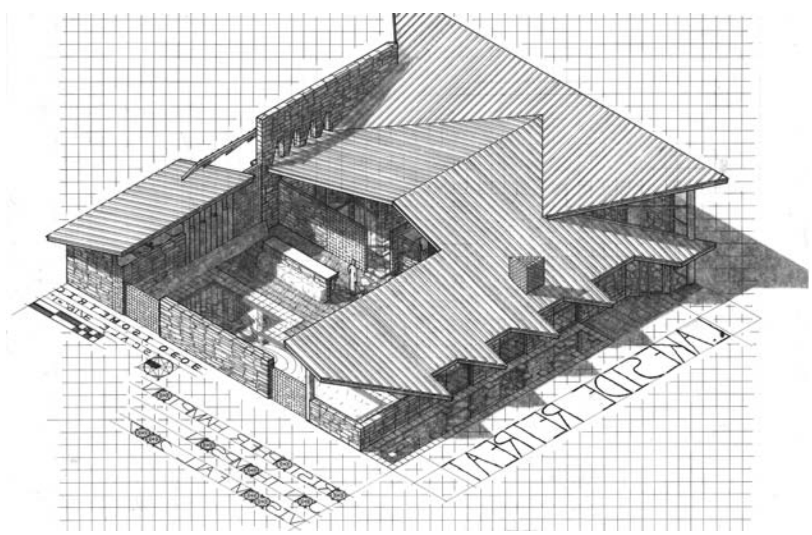
As a drawing type, elevation obliques can be effectively used in the conceptual stages of the design process. It is an excellent drawing approach for analyzing a design problem. Even though it is not used as frequently as plan obliques, the example shown on these two facing pages underscores its importance. In this case study, because of many elevation alternatives, the elevation oblique became the logical choice to do conceptual design studies. For your design studio project, experiment with the use of freehand elevation obliques to express your design concept. And when designing, don't be afraid to "think outside the box." This is an excellent example of strategically placed nonrectangular cutouts showing that a window view does not always have to be framed from a rectangular, square, or circular-shaped window.

Isometric, Shadow, and Reflection Exercise

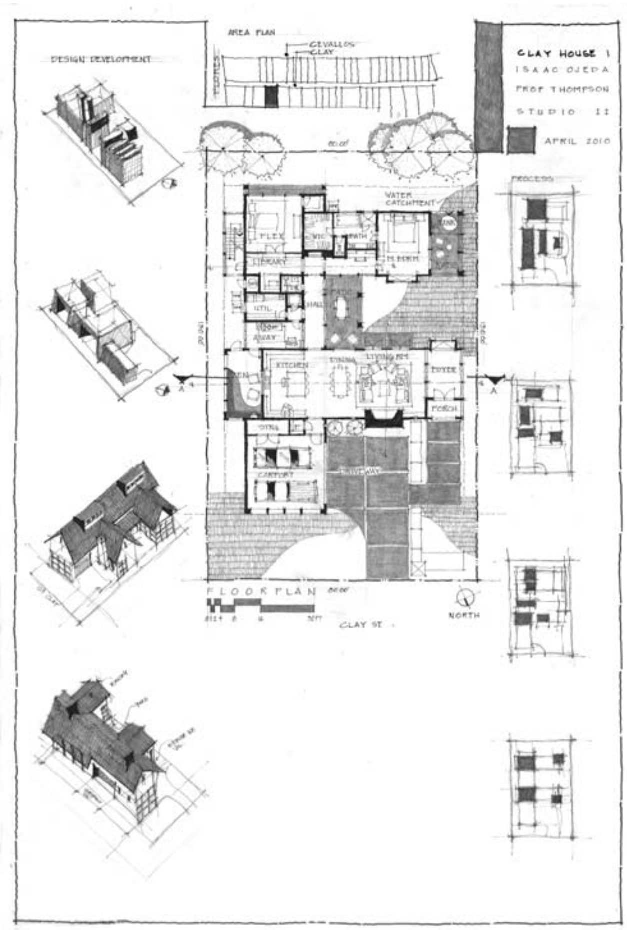
In this project, isometric drawing was used as the primary design development tool. In so doing, the building evolved in one drawing with plan, elevations, and roof. This isometric drawing was accompanied by a building section and floor plan. Once the isometric was completed, shades and shadows were constructed mechanically, then added in purple Prismacolor on the back of the tracing paper drawing. The back side is used for poché or shading to avoid obscuring the original drawing on the front. The isometric back is meant to show through the tracing paper. This manual technique truly demonstrates the use of casting the shadows as well as using both sides of the tracing paper. If fountains were included, each student was shown how to determine reflections in an isometric drawing. Although computer modeling can easily calculate and generate shades and shadows, doing so manually provides a more direct understanding of how a building reacts to the sun. [PROFESSOR'S STATEMENT]



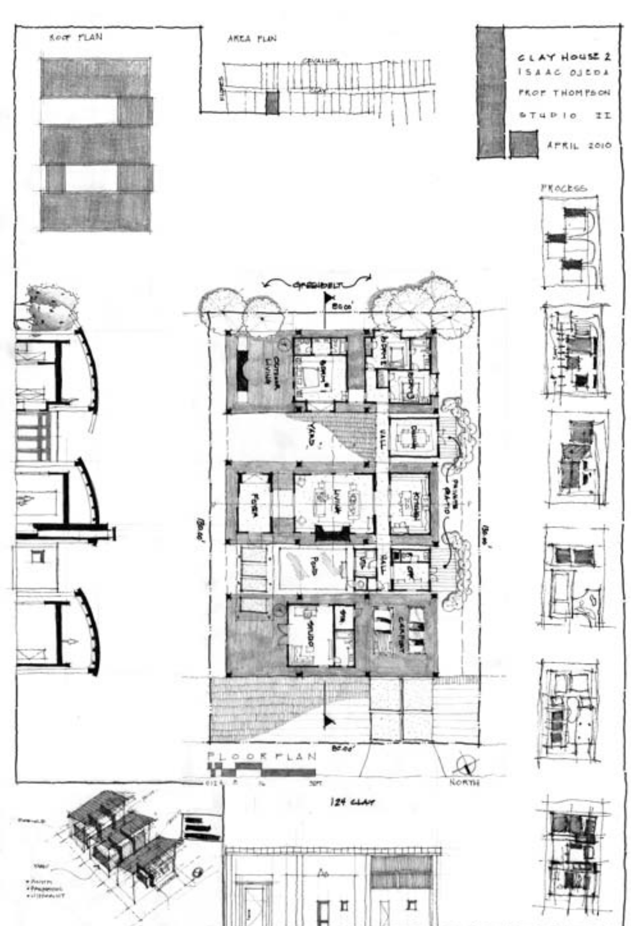
Student project by Christopher Hampton
Drawing: Isometric front
Medium: Pencil, purple pencil
Courtesy of Professor Jon Thompson
College of Architecture
University of Texas at San Antonio



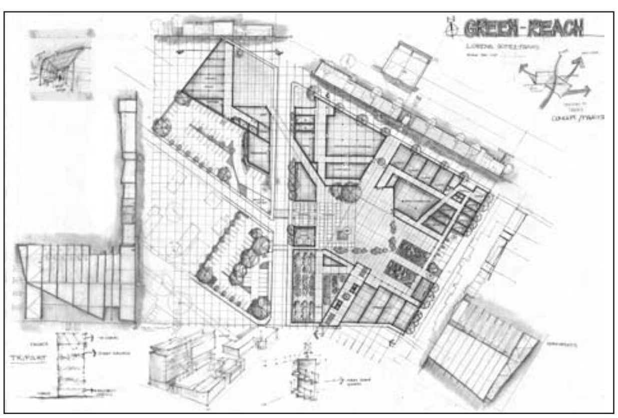
Student project by Christopher Hampton
Drawing: Isometric back
Medium: Pencil, purple pencil
Courtesy of Professor Jon Thompson
College of Architecture
University of Texas at San Antonio



A



B



C

D

A , B, and D: Student projects by Isaac Ojeda
C: Student project by Lorena Gomez-Farias
Courtesy of Professor Jon Thompson, College of Architecture, University of Texas at San Antonio

Manual Ortho as Design Development

Each project here used manual drafting and shaky trace as the primary design development tool. The design evolved as it was drawn. Using orthographic projection, one board can thoroughly explain the design. For a preliminary presentation, the pencil and ink drawings were augmented with markers and colored pencil. This type of presentation seems more appropriate for a preliminary presentation than if a computer had been used. [PROFESSOR'S STATEMENT]

Living Cube Assembly Sheet

Typography and Branding

Annotation of drawings is used to increase the understanding of graphics. Sometimes the combination of graphics and text is appropriate when a simple title or description improves the clarity of the image.

Text can be used to communicate information to others regarding the construction and specification of the design. Text can also be used to identify designer, authorship, owner, creator, and location. Sometimes, when creating or designing a trademark or a distinctive name to identify the product, the designer or manufacturer becomes important.

Whatever the use, poorly placed text, inappropriately selected fonts, or improperly sized text can detract from the image and the design. Misuse may also distract the viewer from the important information. When used properly, text can be considered another graphic element on the drawing and becomes part of the composition.

Font refers to the design of the lettering, also called *typeface*. Each typeface may come in different styles, such as bold, italic, and outline. There are thousands of fonts available, in an incredible variety of styles. It is important to carefully select the fonts used in combination with graphic drawings. The images are usually the focal point of the drawings; the text should be kept clear and legible. However, a font can be selected to reflect the style or feel of a design and can also be used to add emphasis or contrast, according to the intent of the designer.

Description of Assignment #9

You will be required to create a single, purposed composition, *The Assembly Sheet,* employing the drawing types you have used to date. These are orthographic projections, paraline isometrics, exploded sections, and renderings with text.

1. Using the Living Cube project, create *assembly instructions* for your “kit.” Create an illustrated step-by-step guide to assembling your Living Cube. Use of the *exploded drawing* is very helpful in describing connections and assemblage. Instructions must fit on 11" x 17" paper. Depending on the complexity of your project, you may need two instruction sheets. Illustrations need not be to a specific scale. Include clear and concise written instructions and/or titles along with the drawings and/or renderings. The location, size, and type of font selected should be clear and easy to read.

2. Based on the studio requirement of a targeted audience design, incorporate your appropriate product name on the assembly sheet. Design a logo for your product and/or your company and/or your name. Include the company logo and product exclusions on the assembly sheet (i.e., “batteries not included”).

3. Print your assembly sheet(s) on 11" x 17" paper in black and white on a laser printer.

4. Prepare a JPG version of your file to post on Kepler.

Objectives

To understand the importance of text as annotation to a drawing.

To explore font usage and style as it relates to designed objects.

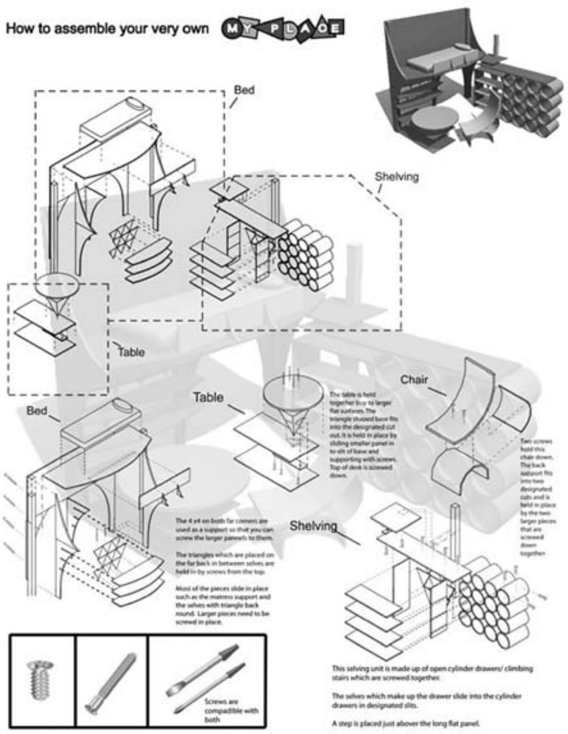
To experiment with product branding, logos, and graphic design.

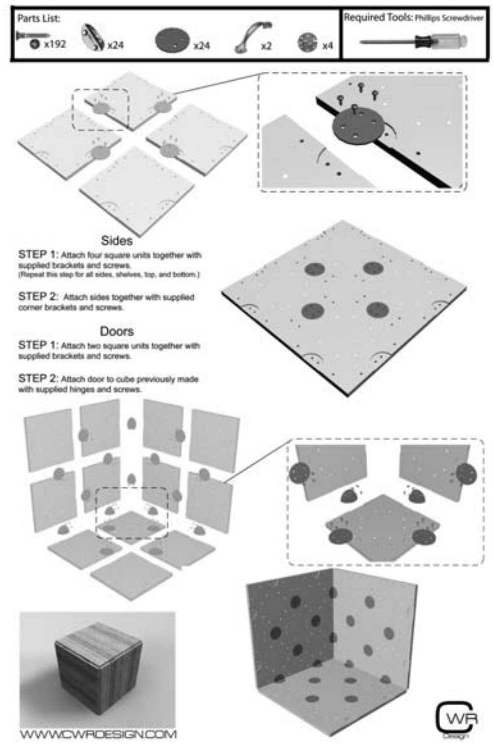
To practice compiling drawing, rendering, and text in a single, purposed composition.

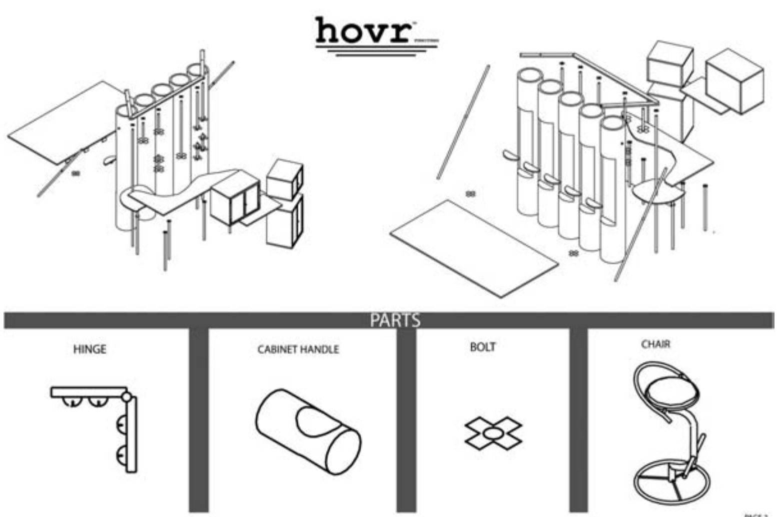
Recommended Reading

Elam 2001, pp. 43–55, 62–69, 78–83, 86–91.

Goldman 1996, pp. 96–107.







Problem: Courtesy of Kim de Freitas, AIA, LEED AP
Coordinator, Arch 155/156: Modes of Design Communication F07/S08
University Lecturer (Fall 2007–Spring 2010)
New Jersey School of Architecture
NJIT College of Architecture & Design

The Section

The building section is analogous to the plan section, except that the continuous cutting plane is vertical. Removing the part of the object or building that is in front of the plane reveals a cut section that allows us to glimpse the interior space. Sectional cuts are most commonly located parallel to the walls of either elevation. Sections must be properly annotated with section cut lines indicating the location of the section cut and direction of the view. In a vertical section drawing, the cut ground line is to be shown as a heavy solid profile line or toned area. The objects cut can be solid black, profiled with a solid heavy line, or rendered with a shade of gray (see pp. 138–141).

The Exploded or Expanded Paraline

Plan obliques and isometrics can be very powerful when the vertical and horizontal dimensions are expanded by the use of dashed lines or light solid projection lines. These exploded views illustrate how components relate to one another. The vertically and horizontally exploded elements should not overlap and are generally exploded in one direction. For complex connections, the drawing can be exploded in multiple directions. The components are displaced to a degree either perpendicular or parallel to the object axes. This technique can be used at many scales, for use in depicting anything from entire floors in a building to details in a wall section (see pp. 204–221).

Description of Assignment #8

Using the Living Cube model you have designed in studio, model your design in your preferred modeling program. From your digital model you are to extract the following orthographic and isometric drawings:

Note: You are responsible for modifying and controlling every line of your drawing. “Dumb” computer drawings will not be accepted. Failure to adjust and modify line weights and line types will result in a failing grade.

1. *Six-view drawing:* Top View, Front View, Bottom View, Right-Side View, Left-Side View, Back View
   This six-view drawing is to be plotted as a T-shaped drawing (see pp. 166–167). A minimum of four (4) line weights and three (3) line types will be required (solid, dashed above, hidden).

2. *Two sections:* We will be focusing on the section. Using the section tool, position the cut line along the two principle axes of the Living Cube. It is imperative to understand the generated section is a rough outline of the intended drawing. Modify and perfect the section drawing by assigning line weight and line type. You may consider using poche or solid fill to indicate objects that are cut. A minimum of five (5) line weights and three (3) line types will be required (solid, dashed above, hidden).

3. *One exploded isometric:* Make a copy of your computer model in a separate file. Separate and move the components of the Living Cube along one axis. Flip between your top view and an isometric/perspective view to verify that the expanded components do not overlap. Once the Living Cube components have been separated, generate the exploded isometric drawing. You may export your model from 3D Studio Max or Rhino into AutoCAD architecture and use the Document > Hidden Line Projection command to generate the line drawing. Modify and perfect the line weights and line types to complete the drawing. *Remember to add your dashed or light solid projection lines to clarify the direction of the expansion.*

4. *Print all drawings on a single sheet:* The above three drawing sets (six-view T-drawing, two sections, and exploded isometric) are to be arranged to fit on a printed 24" × 36" sheet at 1' = 1/2", or as directed by your instructor. *Note:* Remember to set all settings when printing, including paper type, paper size, orientation etc. Print to a large-format plotter. Remember to set the plot style for black lines when plotting from AutoCAD. To produce a JPG of a PDF printed from AutoCAD; open the PDF in Adobe Photoshop; set Mode to RGB and Resolution to 300 dpi.

Objectives

To continue to explore and perfect digital drawing conventions.

To perfect the use of line weights and line types used in orthographic drawing.

To learn the conventions of orthographic section drawing.

To understand the principle of an exploded Isometric drawing.

Problem: Courtesy of Kim de Freitas, AIA, LEED AP
Coordinator, Arch 155/156 Modes of Design Communication F07/S08
University Lecturer (Fall 2007–Spring 2010)
New Jersey School of Architecture
NJIT College of Architecture & Design

Living Cube Digital Rendering

Rendered Perspective View Development

Two- and three-dimensional images are generated to provide the viewer with a visual reference of the potential of an unbuilt project. Tone, color, and texture, as well as details such as people and furniture, can be added to a drawing to give desired effects and personality to a space. In addition, qualities such as materiality and light can also be represented in a drawing. A rendering, whether produced digitally or with traditional media, is the application of these perceptual enhancements. The enhanced perspective can be used as a design tool to assist the designer with developing the details of the project.

Even with the recent advent of computer-generated renderings, additions and accessories such as trees and people can be very time-consuming. Therefore, the addition of hand-sketched trees, people, and accessories is a helpful skill to perfect and can add character to any image. Postproduction software programs such as Adobe Photoshop and Corel Paint can be used to quickly insert trees and people into a computer-generated rendering. These software packages also have menu-driven effects that can be applied and combined to change the tonal quality, color, and texture of any image. With increased practice in additional vector- and raster-based image editing and layout programs, one can generate photo montages and photorealistic images as well as add shading and shadow to any orthographic, paraline, or perspective drawing or image. Over time a designer can develop a style or identity in his or her work, whether apparent in the developmental hand sketching, conceptual diagramming, or final renderings digitally or traditionally generated.

Description of Assignment #7

1. You will be required to generate a total of eight (8) views. Four (4) specific rendered views of your Living Cube must be generated using the Kepler Living Cube 3DMax Template provided; and four (4) unspecified rendered views may be generated from 3DMax, Rhino (Flamingo), or AutoCAD Architecture 2008 (AccuRender). For the four specified views, position your Living Cube so that the bottom left corner is at coordinates (0, 0, 0). Create four 35mm, 54.432 FOV cameras.

   a. *Bird's-eye view:* Camera01 (15'0", 15'0", 15'0") and Camera01 Target (2'0", 2'0", 0'0").

   b. *Eye-level view:* Camera02 (–10'0", –10'0", 6'0") and Camera02 Target (4'0", 4'0", 4'0").

   c. *Worm's-eye view:* Camera03 (12'0", –12'0", 1'0") and Camera03 Target (4'0", 4'0", 4'0").

   d. *Mid-level view:* Camera04 (–8'0", 18'0", 4'0") and Camera04 Target (4'0", 4'0", 4'0").

   e. *Create your own view:* Position Camera05 and Camera05 Target to create your own personal view.

   f. *Create your own view:* Position Camera06 and Camera06 Target to create your own personal view.

   g. *Create your own view:* Position Camera07 and Camera07 Target to create your own personal view.

   h. *Create your own view:* Position Camera08 and Camera08 Target to create your own personal view.

   (Hint: Experiment with the camera; place it in the middle of your Cube for an inside view.)

2. Of the eight (8) renderings, select four (4) for postproduction image processing. Experiment with adding people and objects, as well as with digital imaging effects. *Note:* The focus of the image is the designed Living Cube, not the added objects or graphic effects. Be sensitive to the idea behind the design—select add-ons and effects that flatter your work rather than competing with it. You may choose to add effects digitally or with traditional media such as watercolor, graphite shading, or collage.

3. Present and post all *original and modified* images. (Presentation may be digital or printed or as directed by your instructor. Traditionally modified images (sketched or painted over by traditional media) must be scanned and posted. Rendered image size must be minimum size of 1024 x 768 pixels (refer to Template).

Objectives

To generate object-specific computer-generated digital renderings.

To understand the importance of a rendered image, whether digital or traditional.

To explore various applied techniques used in postproduction renderings.

To learn the importance of character-driven images.

Recommended Reading and References

Laseau 2000, pp. 66–77.

Goldman 1996, pp. 243–266.

Problem: Courtesy of Kim de Freitas, AIA, LEED AP
Coordinator, Arch 155/156 Modes of Design Communication F07/S08
University Lecturer (Fall 2007–Spring 2010)
New Jersey School of Architecture
NJIT College of Architecture & Design

Diagramming and Analysis

Diagramming and conceptual sketches are essential in the design process. They help the designer generate and organize ideas. Conceptual sketches are those created during the early phases of the project; they represent the discovery process. This is a time when the designer is looking at precedents and making analogies between the project given and others he or she may have encountered or studied. Diagrams use an abstract simple graphic language that translates ideas into form. We can use diagrams as abstractions to explore architectural organizations and to evaluate specific ideas, including circulation, distribution of program, geometry and proportion, hierarchy, and so on. The ability to diagram the components of a project helps bring order and development to the design process.

These abstractions are used to simplify programmatic and design problems. The analysis of the problem reduces them to their essential elements. This reveals the structure and patterns of the project. Graphic abstractions are well suited for the understanding of complex concepts of form and space. Abstract analytical sketches can be defined in many ways. The power of these abstractions is related to the experience of the designer; therefore, it is the development of this skill that allows you to communicate your deepest thoughts to others (Laseau 2000, 81–113).

Description of Assignment #10:

In addition to orthographic, paraline, and perspective images, you will generate *conceptual, diagrammatic* and *analytical sketches* that define the ideas and design process of the Chaco Canyon project.

1. Prepare and *scan* any *precedents* you studied and *conceptual sketches* you made during the early phases of your design process. These are to be included in your presentation.

2. Prepare analytical diagrams using the following methods and/or any additional methods suggested by your instructor.

   Distillation: Remove from the drawing all things that are not important to the analysis of the structure of the conceptual or critical parts. Highlight the highly charged or important parts (a profile sketch highlighting the important parts).

   Reduction: Represent groups of parts as zones. This can be done at several levels, reducing at every level (a series of programmatic shaded sketches, indicating zones of program and ordering systems).

   Extraction: Using contrast or emphasis, parts can be given special attention while remaining within the context (a figure-ground drawing accentuating Pueblo Bonito, the intervention structure, la Mesa, etc).

   Comparison: Showing different parts in the same graphic language assists in the comparison of structural characteristics (a series of diagrams showing circulation, primary and secondary axes, geometry and proportion, hierarchy, etc).

3. Prepare the following *preliminary* orthographic drawings:

   Site Plan: Your intervention, with Pueblo Bonito and la Mesa to the north.

   Plan: Detailed plan of your intervention, showing location of booths, stage, and seating.

   Two elevations: Detailed, showing location of booths, stage, and seating.

   One site section: Your intervention and the site, including la Mesa and Pueblo Bonito.

   Renderings: Generate preliminary views of your project.

The mock-up and final presentation method will be defined by your instructor. This may be a printed or digital presentation. Whatever method has been selected, all students will be required to show all drawings listed. The scale of the drawing will be defined by your instructor. Those who are preparing a digital presentation will be required to show a *graphic* scale to indicate scale of the drawing.

Objectives

To learn the significance of conceptual sketches, and analytic diagramming.

To learn various defined methods of abstraction and analysis.

To learn how to transform program into schematic design, and then into final design.

To understand relationship of programmatic problems and learn how to graphically solve them.

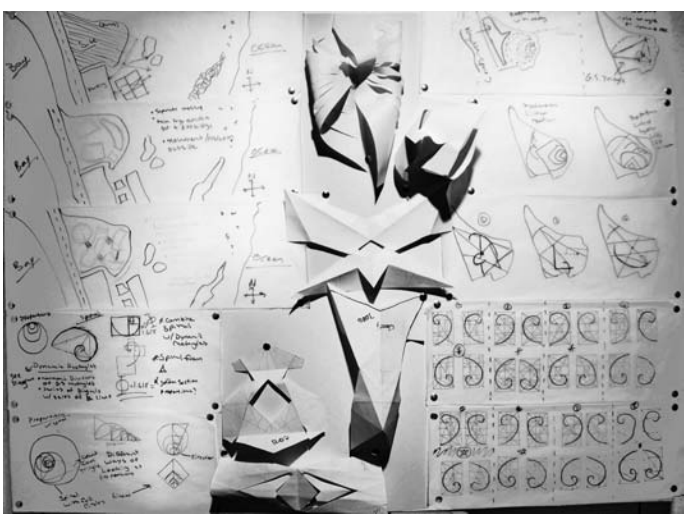
To understand design priorities as they relate to physical behavior.

To develop a graphic language as defined by abstract sketches to identify the design process.

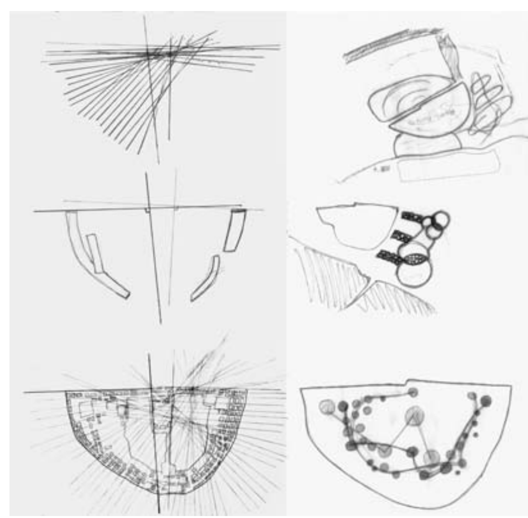
Recommended Reading

Laseau 2001, pp. 81–113, 114–139.

Goldman 1996, pp. 132–133.



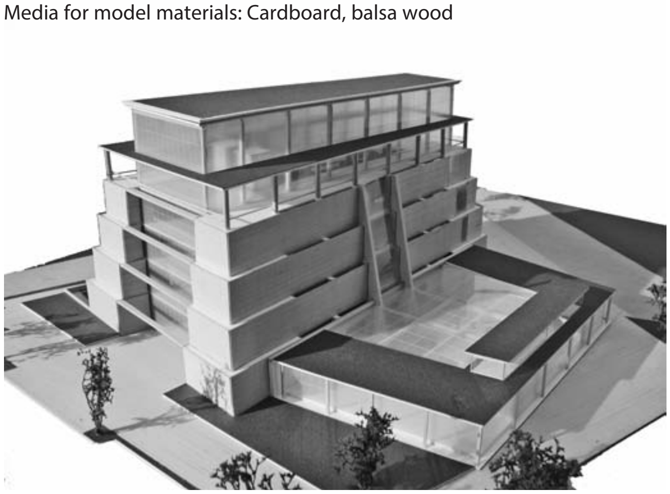
Dan Schittone (F06)



Stephanie Oliveira (F06)

Problem: Courtesy of Kim de Freitas, AIA, LEED AP
Coordinator, Arch 155/156 Modes of Design Communication F07/S08
University Lecturer (Fall 2007–Spring 2010)
New Jersey School of Architecture
NJIT College of Architecture & Design

Original scale: 1:40
Media for model materials: Cardboard, balsa wood

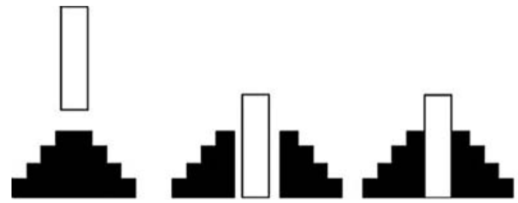


It is the studio professor's pedagogy to encourage the use of diagrams and conceptual sketching to explore philosophical underpinnings of design before beginning design with real physical models and/or a digital medium.

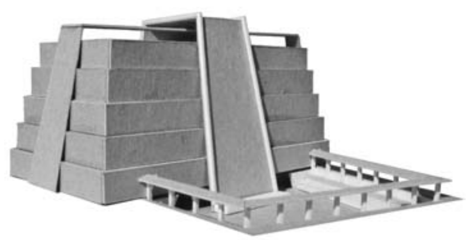
MUSEUM OF THE AMERICAN LATINO

"RECOGNIZING THE ABSENCE OF A PRESENCE"

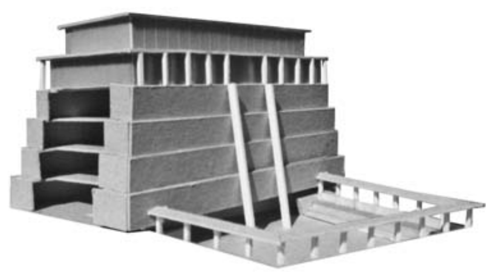
Images: Museum of the American Latino, Washington, D.C.
Media for model materials: Wood veneer, cardboard, MDF wood, acetate, foam core, artificial scaled trees
Model scale: 1:20
Student project by Julio Quintero
Courtesy of Studio Professor Paul Walker Clarke
School of Architecture and Planning
Morgan State University



Above is the partí diagram sequence in which a stepped pyramid is broken by a rectangular volume that merges right in the core, forming a gap of solid and void, positive and negative new forms. [ARCHITECTURE STUDENT'S STATEMENT]

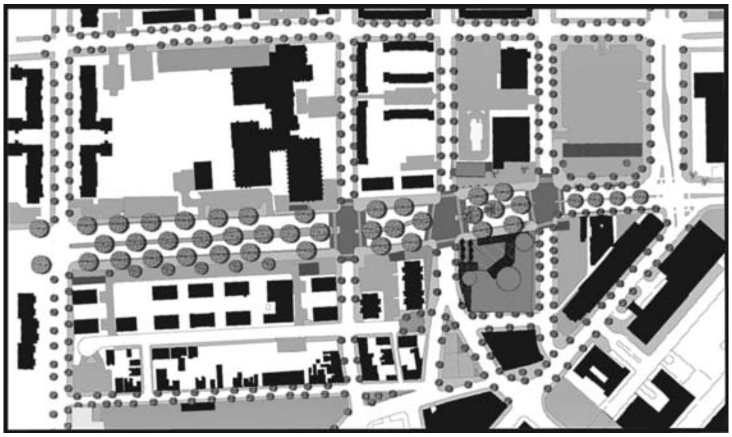


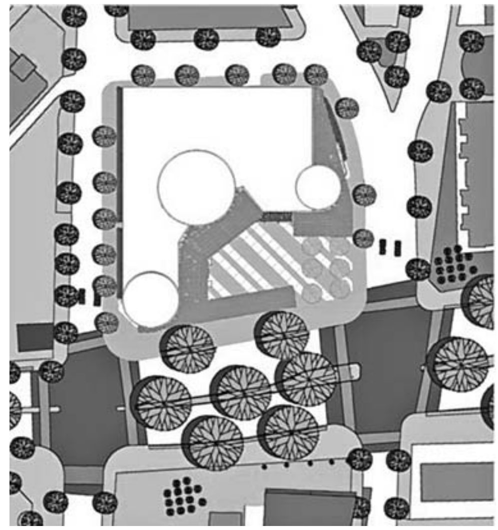
Physical Study Model 1—Initial Concept

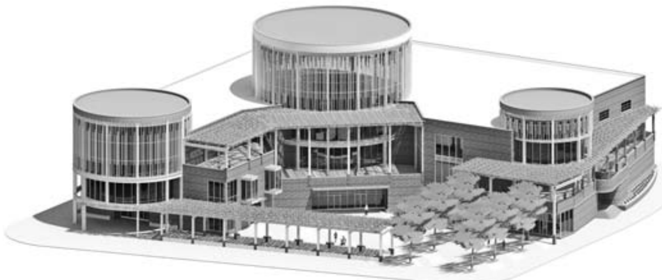


Physical Study Model 2—Initial Concept

Physical Study Model 3—Initial Concept

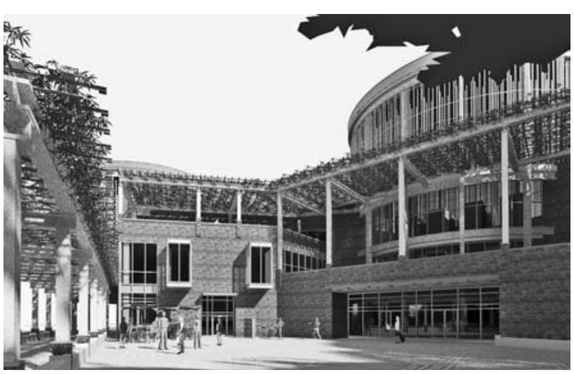


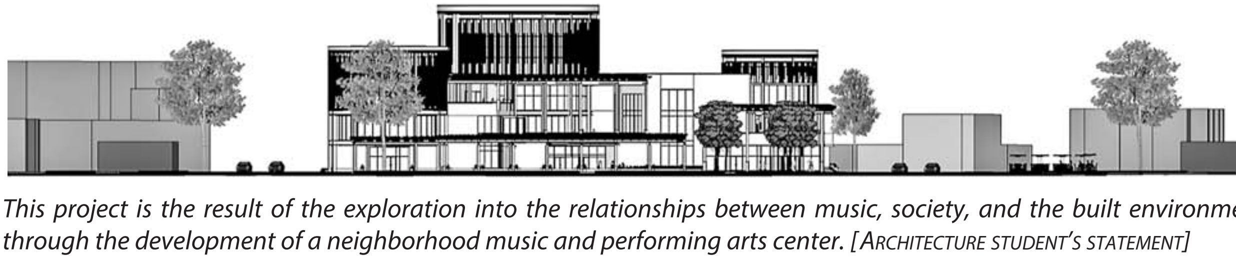




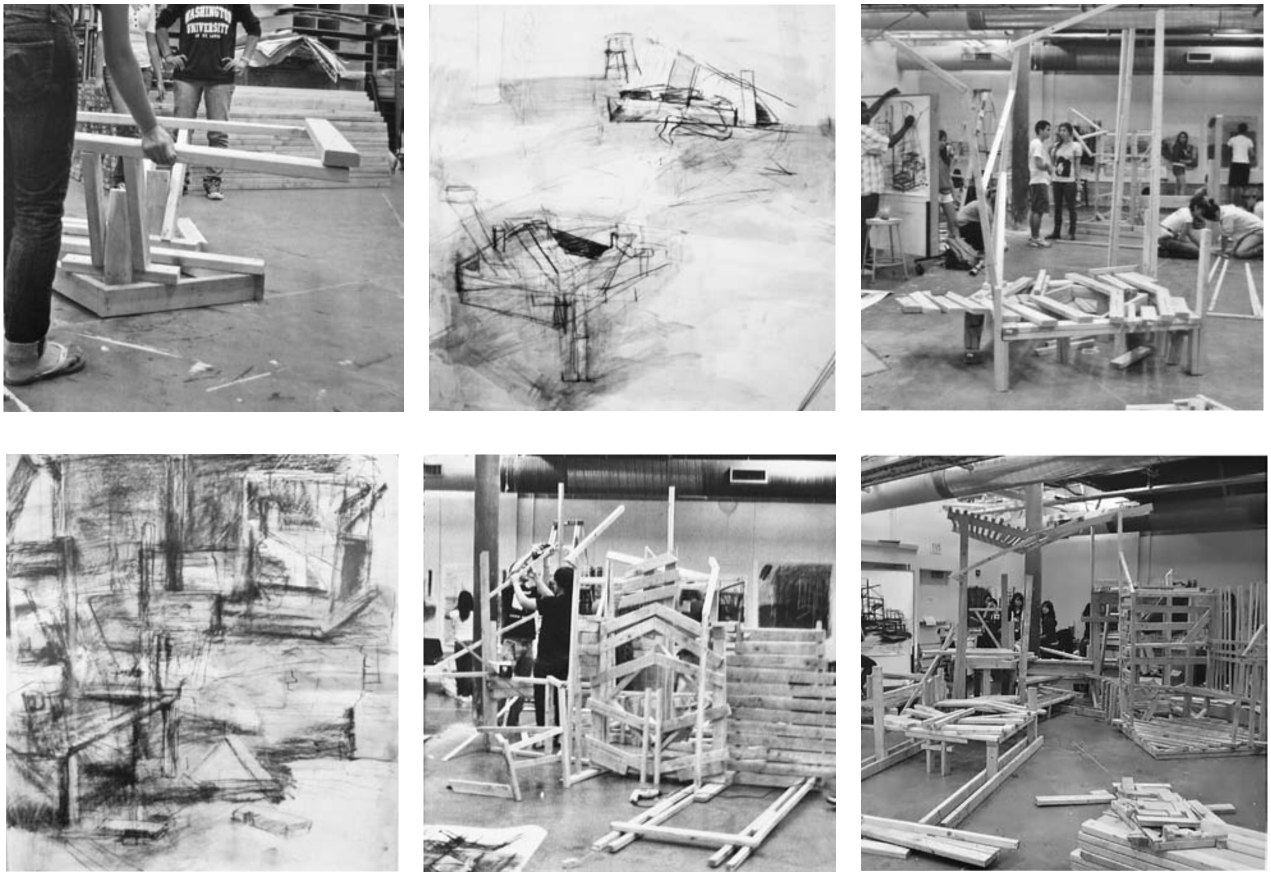
Haydn's symphony known as the Drum Roll, which begins with a tympani solo then is joined by the orchestra, was used as the music, architecture, and society concept. The center drum has individual practice rooms where the soloist is developed. [ARCHITECTURE STUDENT'S STATEMENT]

Images: Architecture Music Society
Baltimore, MD
Media: Revit, Rhino, and SketchUp
Student project by Michele Hauf
Courtesy of Studio Professor Paul Walker Clarke
School of Architecture and Planning
Morgan State University





This project is the result of the exploration into the relationships between music, society, and the built environment through the development of a neighborhood music and performing arts center. [ARCHITECTURE STUDENT'S STATEMENT]

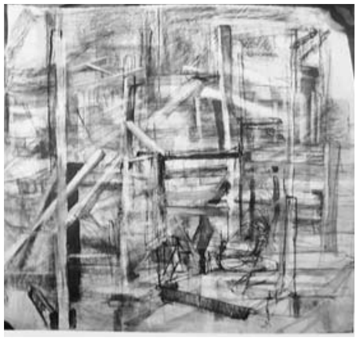


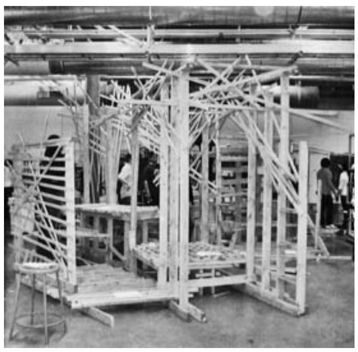
RENGA

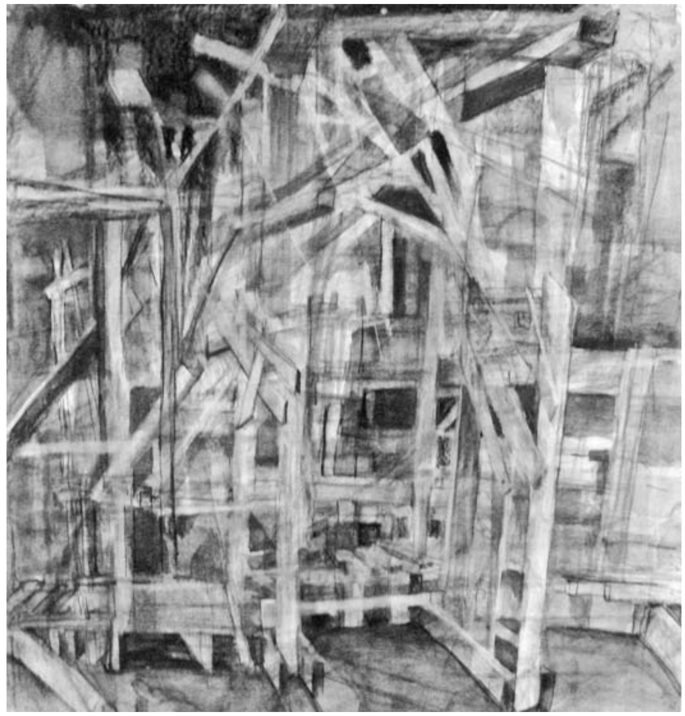
Renga is a form of Japanese collaborative poetry. A renga consists of at least two ku, or stanzas—often many more. The opening stanza of the renga, called the hokku, became the basis for the modern haiku form of poetry.

The students, in pairs and for a half-hour at a time, get two pieces of lumber (2x4s) to cut and assemble; the ultimate goal is an inhabitable space. While each team is building, the rest of the class is drawing what they are doing. The drawings are large—around 4 feet square, often much larger—and done either tacked to the walls or flat on the floor. When the half hour is up, the next team replaces the first, with two more pieces of lumber to add to the developing structure, which must become an inhabitable space; again, everyone else draws what is happening. And so it goes, for days. The structure ultimately takes up most of the room. The media are the students' choice and often evolve as the piece evolves. The final drawing preserves, organizes, and documents the entire process, not just the static last view. The students also discover the overlaps in the 2-D and 3-D design and thinking processes, structure, joinery, material properties, the relation between material and idea, edges, entry, hierarchy, and so on.
[PROFESSOR'S STATEMENT]

Class team drawing exercise: Renga
Courtesy of Professor Bob Hansman
Washington University in St. Louis
School of Architecture

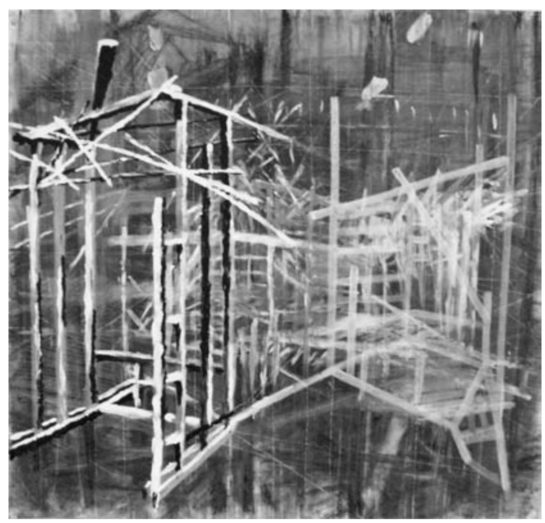






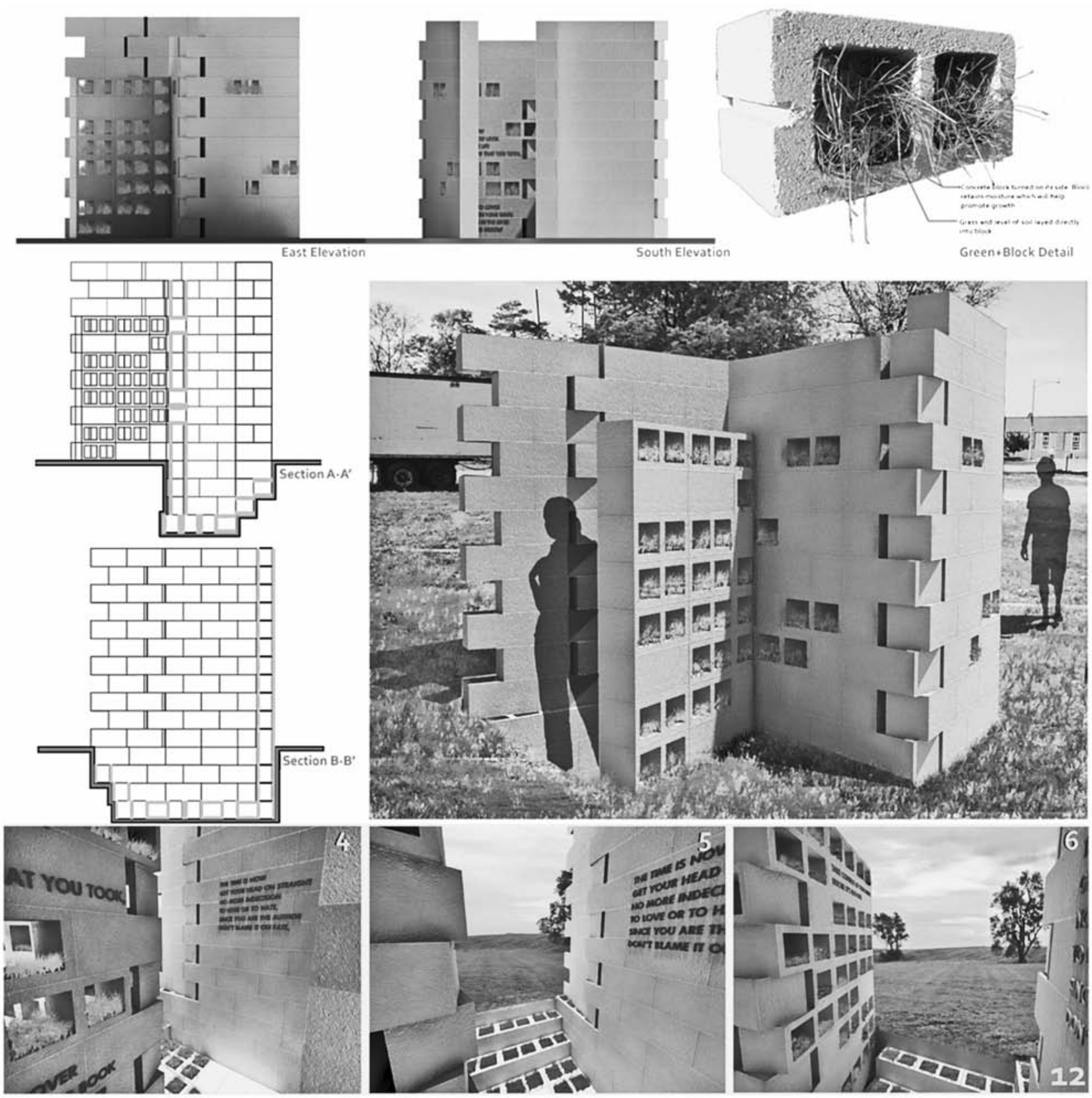
Photographs by Cari Alcombright
Drawing sequence by Cathryn Garcia-Menocal

Drawing by Connie Zheng



Drawing by Kentaro Kumanomido

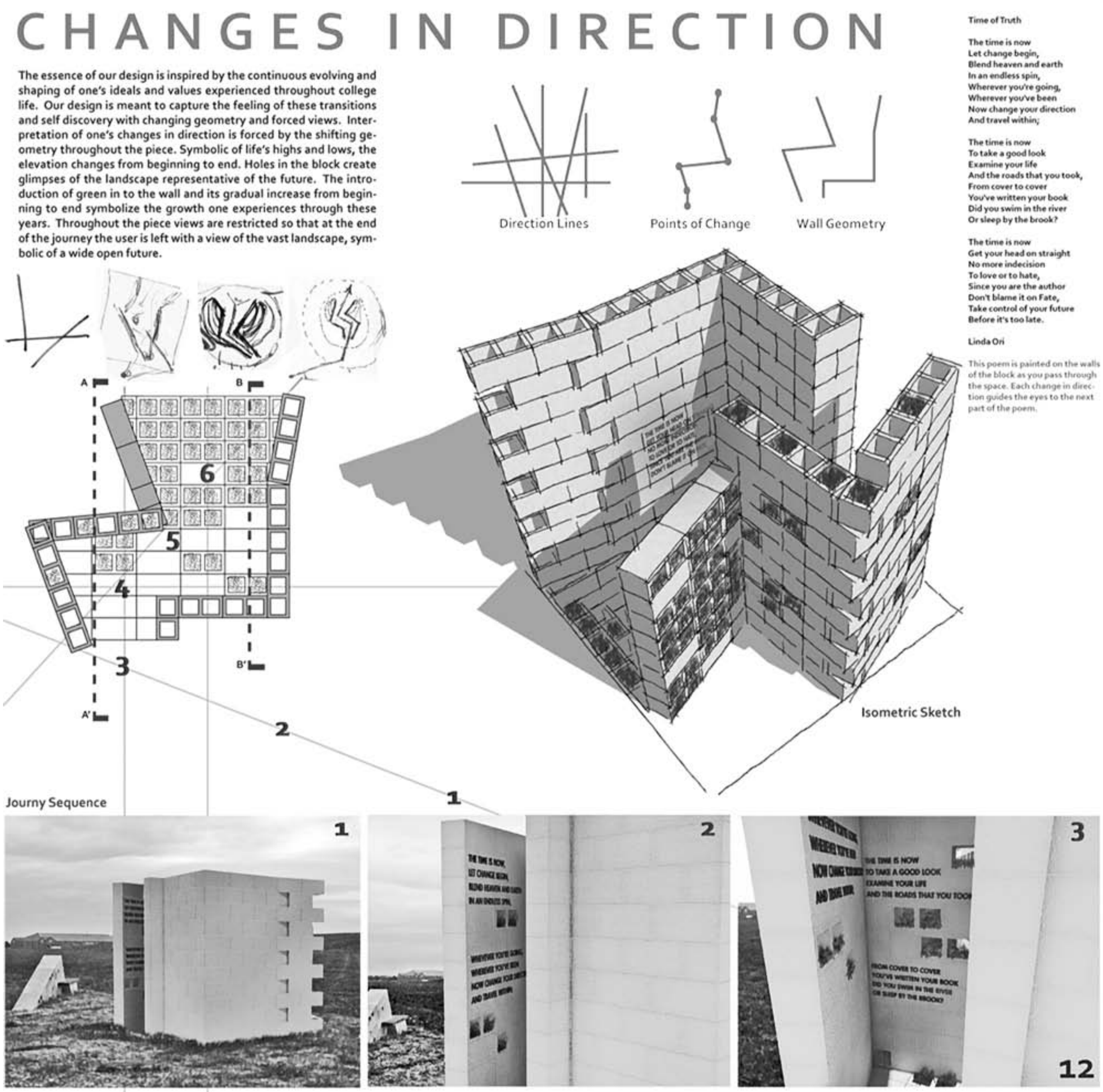
Drawings are essentially instruments of communication, at a certain level of abstraction from a building or an object that is being designed, which can be represented at any scale. If the object is small, one can visualize the design with drawings and models at manageable scales, and the designer's imagined forecast will probably correspond well with intentions. As the complexity and scale of the designed object increases, however, there can be difficulty in ascertaining final outcomes with only scaled drawings and models. Ideally, full-size design requires construction with real materials. The "Renga" project and the subsequent "concrete block" project are excellent examples of this. This level of experience is critical if students are to make imaginative connections between construction and the methods of drawing and modeling. Ultimately, building architecture involves construction. Therefore, learning design by using only drawings and models, without the experience of full-scale building, can be an incomplete process.



Aims

The purpose of this design competition was to cultivate the students' awareness of concrete masonry units (CMUs) and to engage them in dreaming of possibilities, discovering limitations, making compromises, coming to realizations, and reflecting on the process.

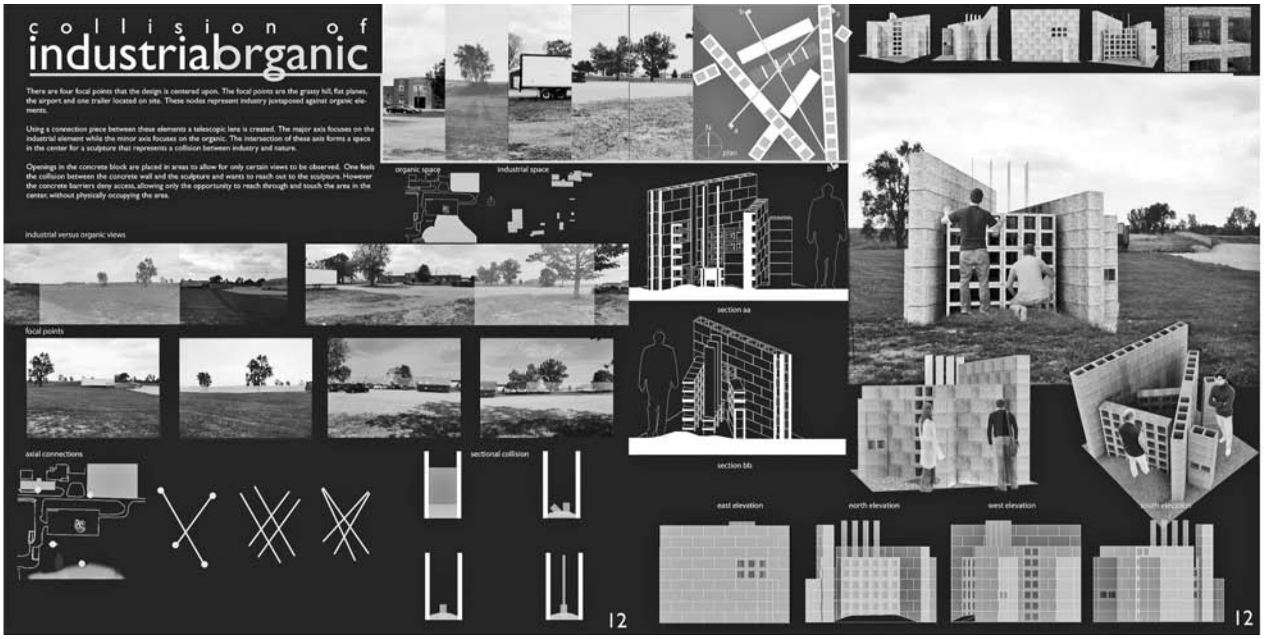
Students learn the confidence and knowledge necessary to describe the visual appeal of the concrete masonry materials, including overall appearance; the use of color, shape, and texture; and integration with the surrounding landscape graphically in a variety of styles.

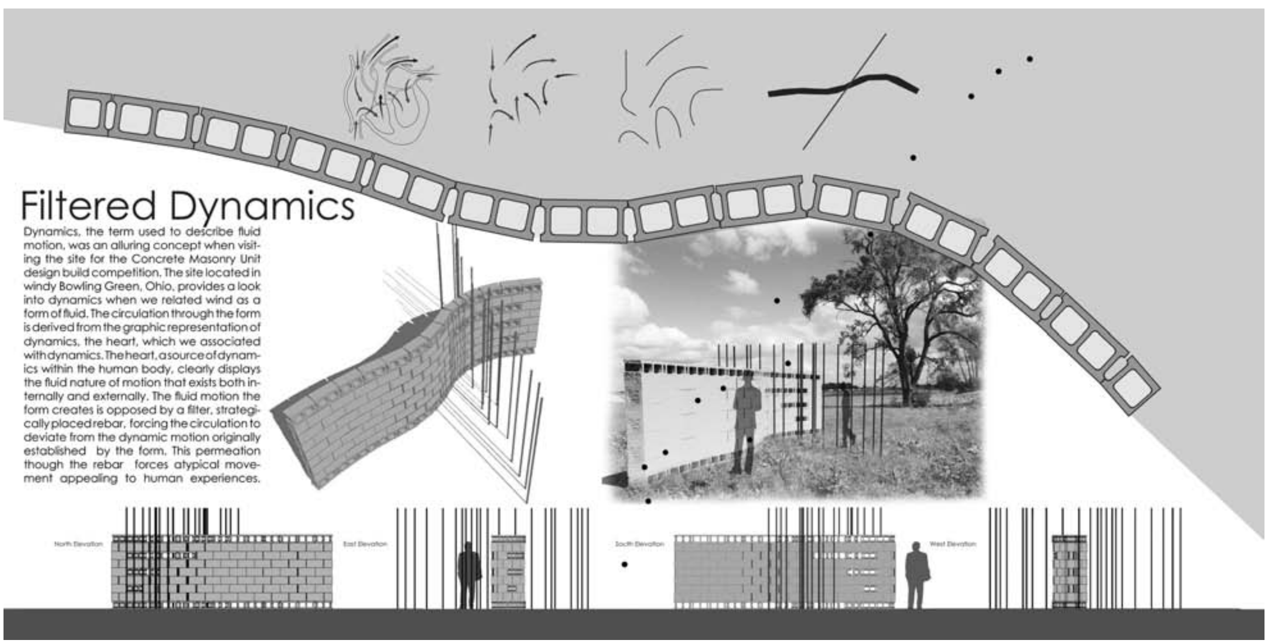


Background

"The Concrete block? The cheapest (and ugliest) thing in the building world.…Why not see what could be done with that gutter-rat?" (Frank Lloyd Wright, 1945). With Wright's creative spirtit in mind, the students were given competition guidelines to design a concrete masonry structure that goes beyond the traditional boundaries of (closed) architectural space by integrating the surrounding landscape and environment in the completed piece.

Material-specific Competition Boards: Concrete Masonry Units (CMUs)





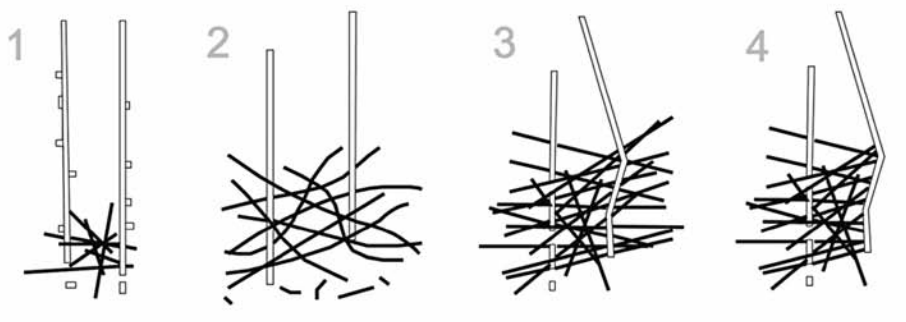
Winning design/build competition schemas on concrete masonry units (CMUs); 2 boards, each 20" x 20"
Software: Google SketchUp; Adobe Photoshop, Illustrator, and InDesign
Sponsored by the National Concrete Masonry Association Education and Research Foundation
Courtesy of Professor Andreas Luescher, Department of Architecture and Environmental Design, Bowling Green State University, Ohio

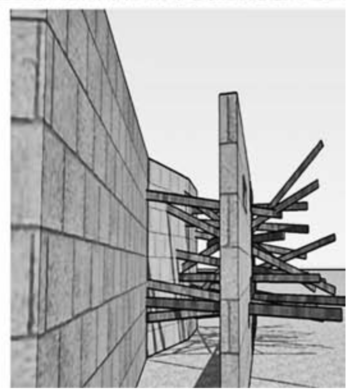
THE PATH TO CHAOS

The concept of our design comes from the idea that we, as students, have been building our knowledge and skills in a well structured system of building blocks. These building blocks are planned curriculums of classes which we follow and take, like orders from a higher authority, leading us to our goals of someday having careers. However, after being led through this well oiled machine of higher education, what are we being released into? This gives us our portion of the concept we can only describe as chaos.

Chaos, for our interpretation, consists of the state of lacking order or predictability, a sense of confusion. More specifically, as stated in the chaos theory, "tiny differences at the start of a system can lead to enormous differences in the final state of the system."

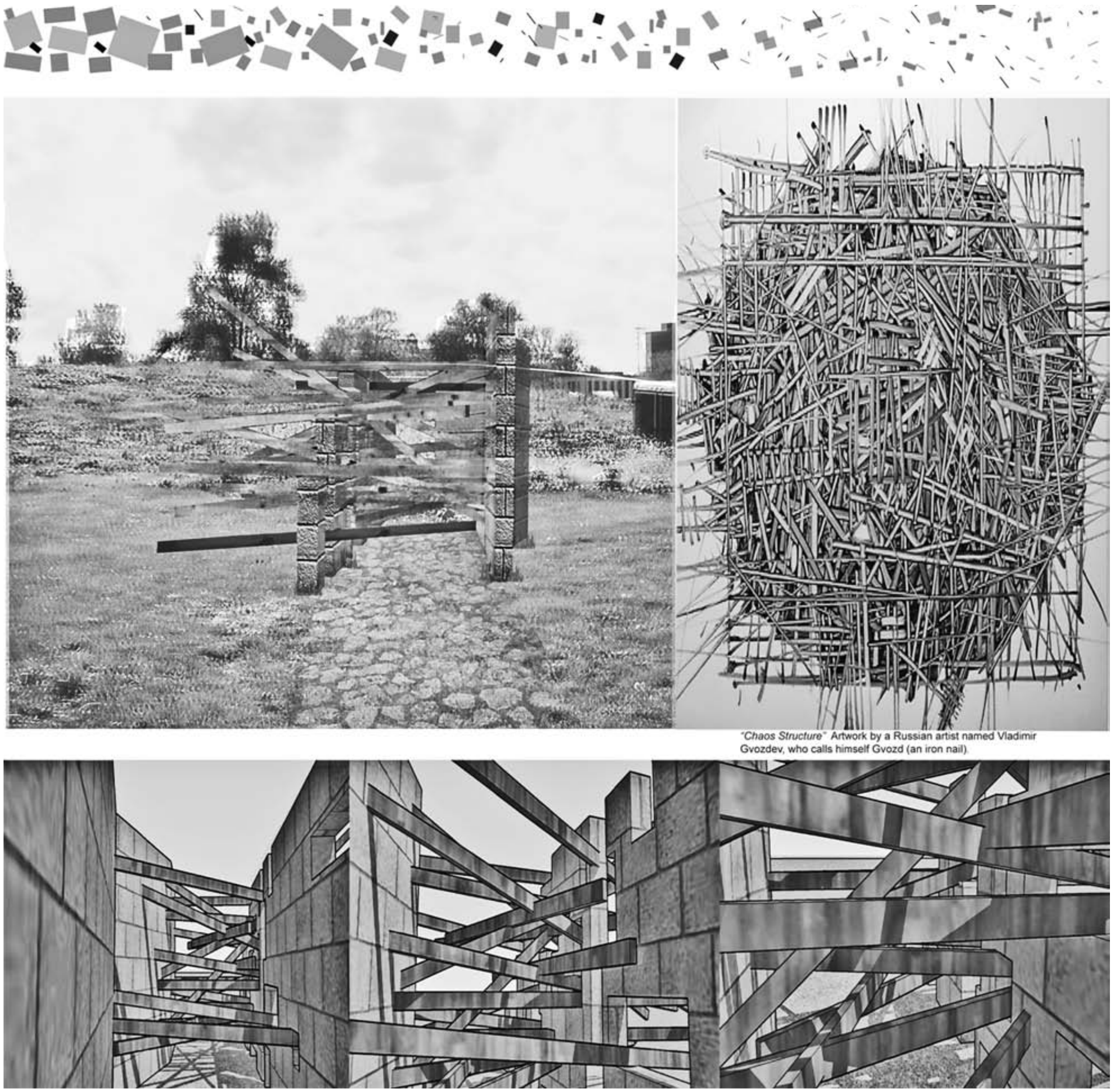
The reality is that while the real world can contain structure, it can also be a vigorous test of choice and how we navigate ourselves through the tangled mess of competing for jobs and ultimately molding and forming our life





Design Concept/Process

After a plant visit to watch the production of concrete blocks, students created both digital and physical mock-up models of their designs in order to understand the various interactions within volumetric shapes. The challenge was to visualize form and space relationships while working out the concept that the CMU product must be equally viable from all sides. Students then faced the task of refining their ideas to match their CMUs' aesthetic and physical requirements. The assignment also reinforced the importance of working in steps and allowing revision to play a role in the creative process. [PROFESSOR'S STATEMENT]



Winning design/build competition schemas on concrete masonry units (CMUs); 2 boards, each 20" × 20"
Software: Google SketchUp; Adobe Photoshop, Illustrator, and InDesign
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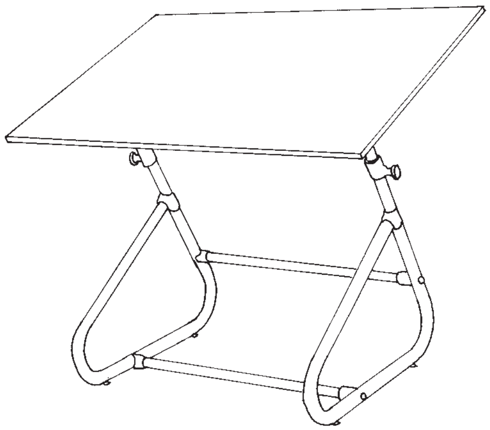
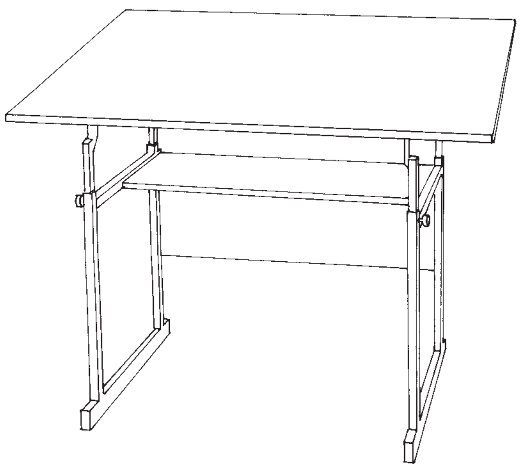
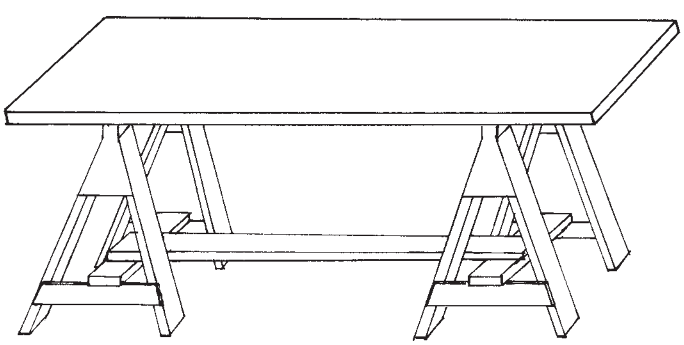
Appendix



A *metal drafting stand* is characterized by an adjustable tabletop, which can be fitted with a parallel straightedge. See latest updated table equipment at www.DraftingTables.com.



A *four-post table* has an adjustable whiteboard surface that can be moved to any comfortable work angle. It can function as a drafting table, computer workstation, or a reference table.



An economical *homemade table* can be made using a flush hollow-core door placed on top of two metal or wooden sawhorses.

Types of Drawing Table or Drawing Board Covers

Vyco is a five-ply vinyl *drawing table* or *board cover* that counteracts eye strain and self-heals when dented, scratched, or punctured. The cover softens the lead when you draw. The two sides are either green and cream, gray and white, or translucent. Another option for a cover is an illustration board that is hot press, white, heavy, and dense. Remember never to draw on hard surfaces such as glass, wood, or hard plastic.

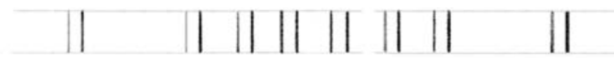
There are many different types of *drawing boards.* They can have a metal edge with a laminate surface and solid-core construction; a hard, smooth surface that resists chemicals, stains, and scratches; or a basswood surface on both sides with an ultralight core.

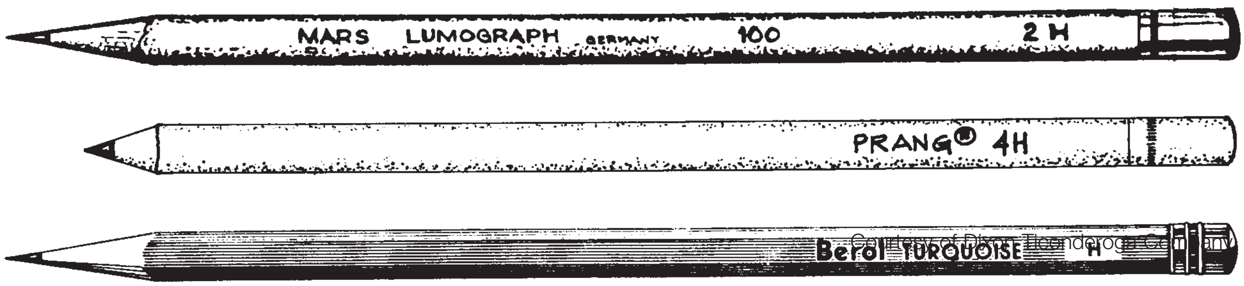
In an office setting, the preferred (and most common) arrangement is a large, flat surface (approximately 3' × 6'8") not more than 30" above the floor, although it can be higher in some offices. Pencils and pens tend to roll down a tilted work surface if you set them down while you're working.

Cylindrical pencil leads range from the smallest diameter (hardest: 9H) to the largest diameter (softest: 6B). Architectural drawings (drafted or sketched) are produced by using leads in the grade range from 4H to 4B.

HARD MEDIUM SOFT

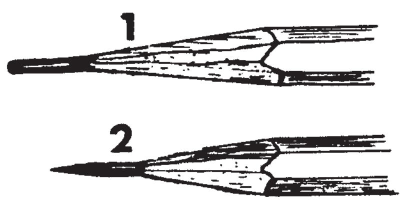
9H 8H 7H 6H 5H 4H 3H 2H H F HB B 2B 3B 4B 5B 6B





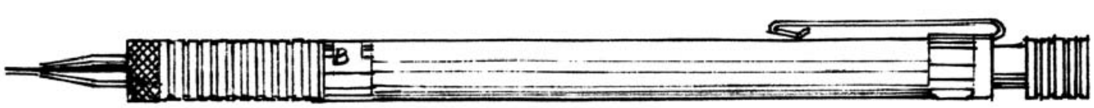
Courtesy of Dixon Ticonderoga Company

These are *woodcase* graphite pencils. See latest updated equipment at www.berol.com and www.staedtler.com.

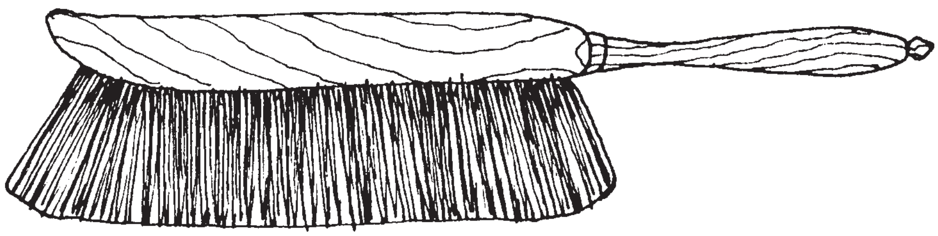


Graphite lead that contains carbon is adaptable enough to produce everything from a very thin line to heavily shaded tones. H is the code for hardness and B is the code for softness (blackness). F and H are the most commonly used multipurpose grades of lead. The softer leads (B to 6B) are used primarily for freehand sketching; B is especially good for lettering. A woodcase pencil must be sharpened by first (**1**) cutting away the wood (exposing about ⅝" of the lead) with small, deliberate movements using a scalpel, mat knife, or razor blade; and then (**2**) making a conical point on a lead with sandpaper and cleaned with paper or cloth. Small handheld conical sharpeners are also available.

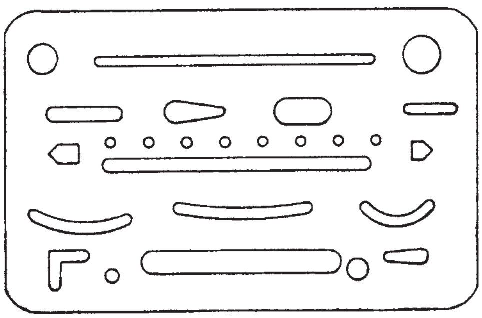
This is a mechanical leadholder or *clutch pencil.* It uses a standard-size 2-mm lead that can be drawn out or pulled back by the push button on the end. Use a pencil pointer to sharpen the leads to a taper similar to that on a common wood pencil.



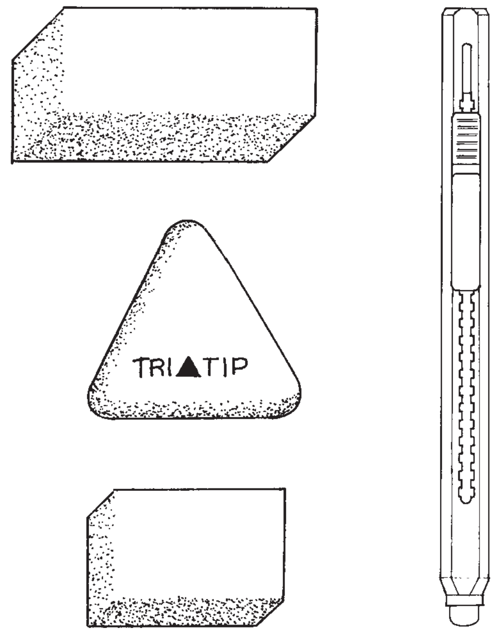
A *fine-line leadholder* with a push-button (propelling) lead advance uses a 0.3-mm to 0.9-mm lead (0.5 mm is a popular size). The lead is protected by a sliding sleeve. This type of pencil does not need to be sharpened. Lead sizes 0.7 mm and 0.9 mm can be used for sketching as well as drafting.



A drafting *duster* with horsehair or natural bristle is used to keep the drawing surface clean of graphite and eraser residue. Quic-Kleen is a finely ground white powder that keeps a drafting surface free of smudges, dirt, and dust. Similarly, Pounce cleaning powder can be used to prepare a surface for inking.

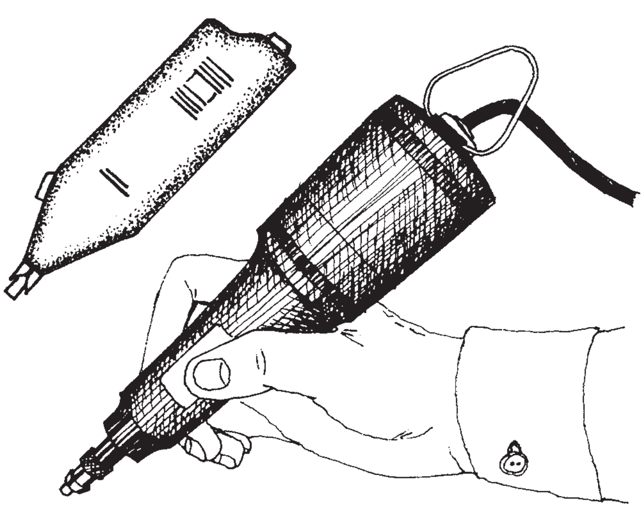


An *erasing shield* is a thin metal cover that protects drawn lines while erasing unwanted lines and areas with handheld or electric erasers. Not common—but more efficient—are those with rectilinear-cut openings.

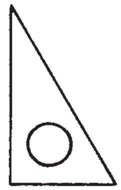


Soft vinyl or plastic *erasers* that are pliable and smudge-free yield the best results. Staedtler Mars, Magic Rub, Koh-I-Noor, and Helix are some excellent brands.

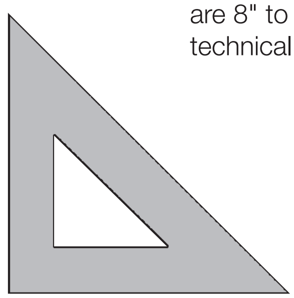
General's Tri-Tip eraser is nonabrasive and an excellent tool when sketching with pastels or charcoal. Kneaded erasers are great for charcoal and are quite malleable. Radett's pencil-style stick/click eraser is most suitable for use with an erasing shield, as are electric erasers, which are sold both with cords and in cordless—or portable—varieties. Electric erasers are very effective for ink drawings. The portable ones are about 5½" long and use AA or AAA batteries.



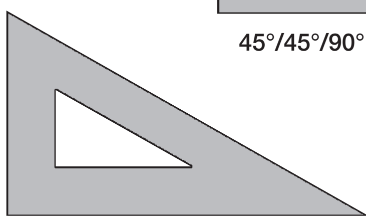
All of the small equipment mentioned in this Appendix can be stored and transported efficiently in an art box or a fishing tackle box. Drawings (especially those on large sheets) should be transported using protective tubes, which can be purchased commercially.



Small triangles (4") are ideal for producing vertical strokes for hand lettering and for producing cross-hatching.

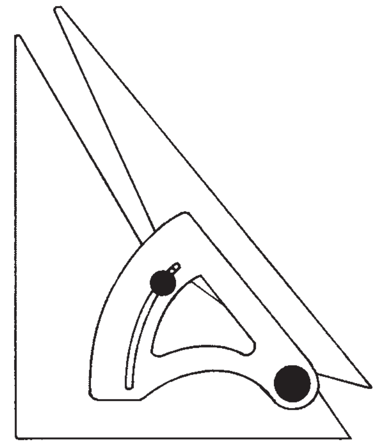


45°/45°/90° TRIANGLE

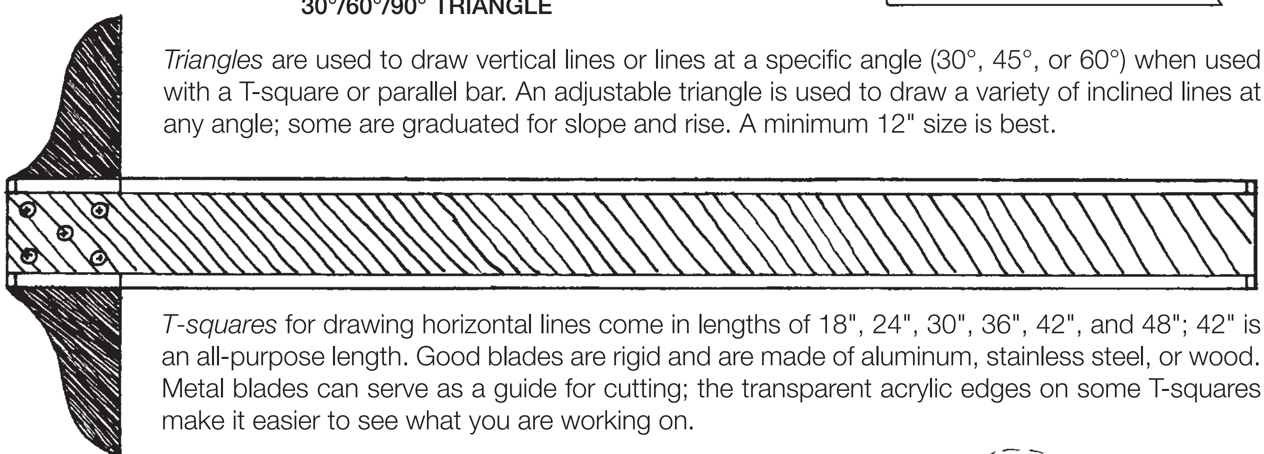


30°/60°/90° TRIANGLE

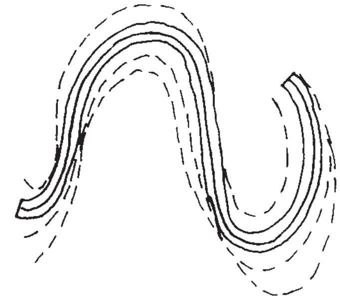
Plastic triangles come clear or fluorescent, with or without finger lifts. The most commonly used triangles are 8" to 14" in length. Some with raised edges allow technical pens to clear them for inking.



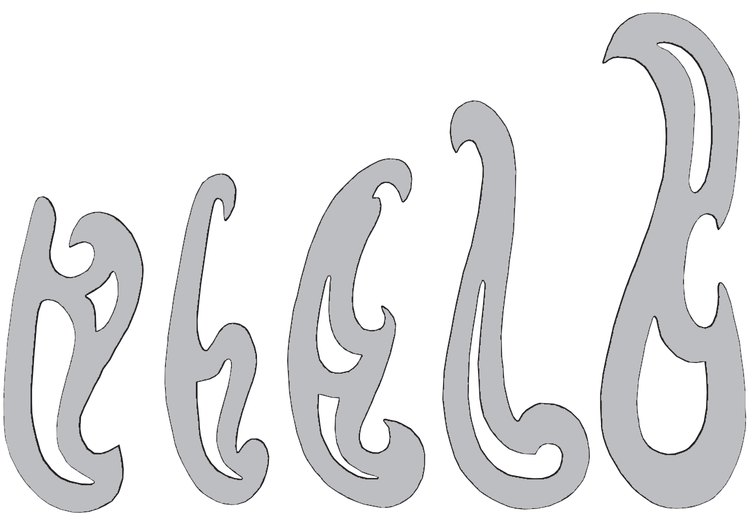
Triangles are used to draw vertical lines or lines at a specific angle (30°, 45°, or 60°) when used with a T-square or parallel bar. An adjustable triangle is used to draw a variety of inclined lines at any angle; some are graduated for slope and rise. A minimum 12" size is best.



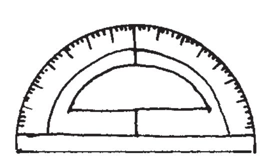
T-squares for drawing horizontal lines come in lengths of 18", 24", 30", 36", 42", and 48"; 42" is an all-purpose length. Good blades are rigid and are made of aluminum, stainless steel, or wood. Metal blades can serve as a guide for cutting; the transparent acrylic edges on some T-squares make it easier to see what you are working on.



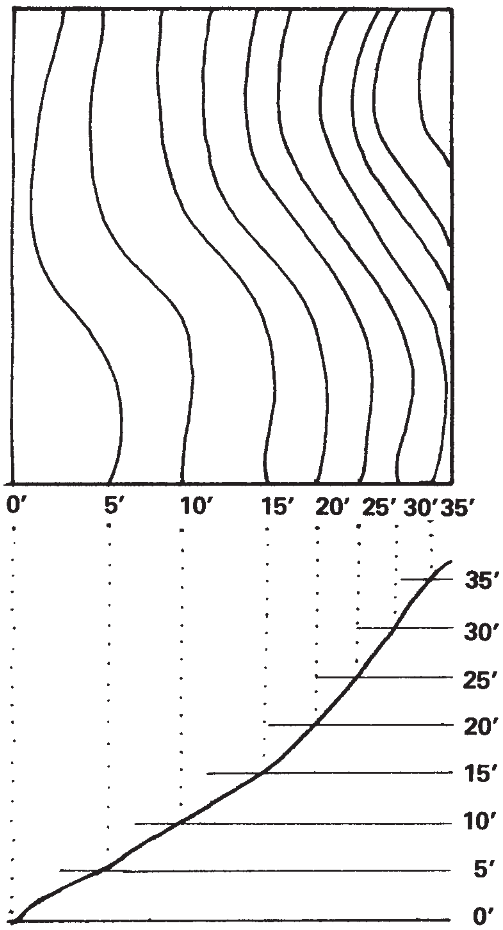
By shaping and bending it, a *flexible curve rule* can be used to draw almost any curve. The curve rule is made of plastic with a flexible core.



French curves are irregular curves that have no constant radii. Those made of clear, polished acrylic are best.



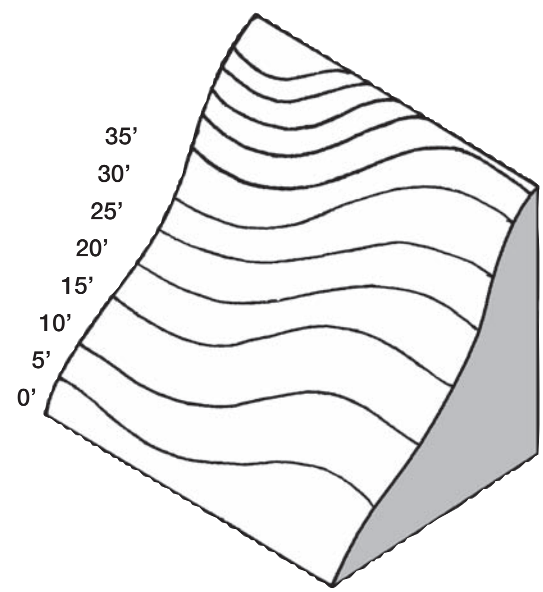
Protractors measure angles and can be either circular or semicircular.



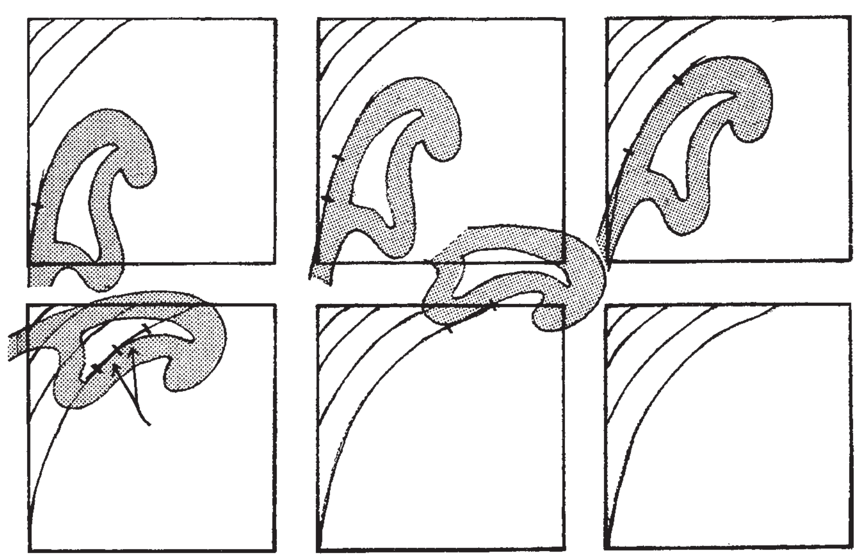
Contour lines are imaginary lines of constant elevation. Every point passes through the same elevation on the surface of the ground.

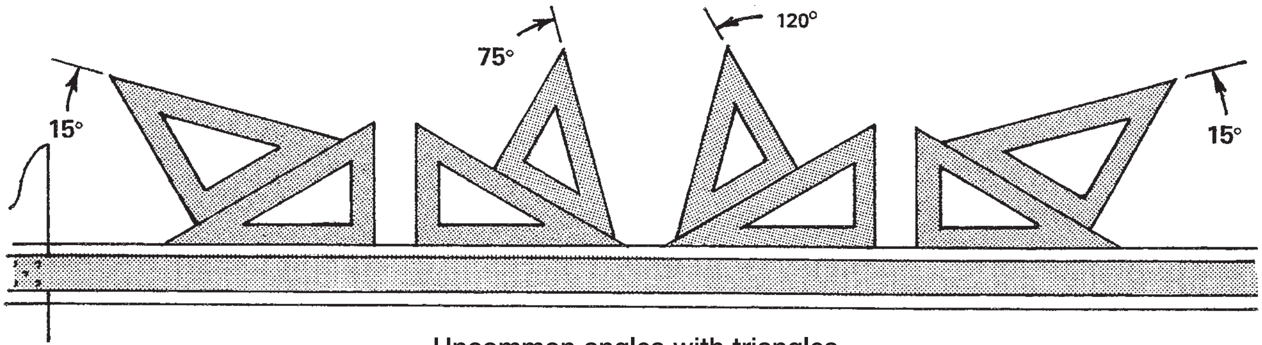
Contour intervals can be 1', 2', 5', or 10', depending on the conditions of the terrain and the size of the area being studied.

In the drawing on the left, note how the slope steepens when the contours become more closely spaced. It is less steep at the bottom since the spacing here is greater than at the top. Remember that contour lines should never cross one another.

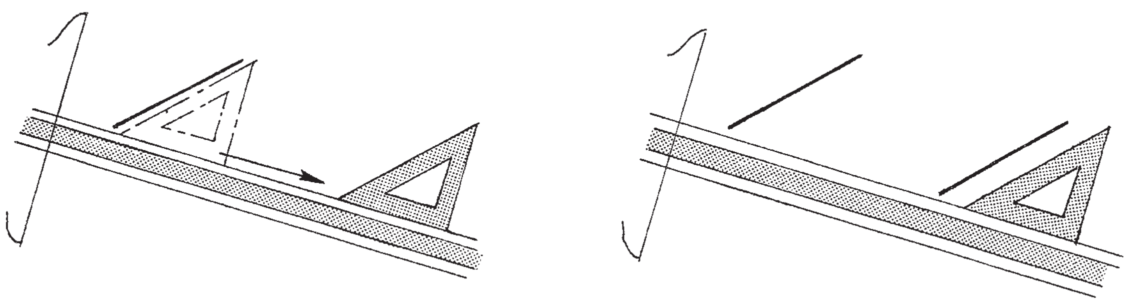


Contour lines can be drawn accurately by using a French curve. The *French curve* is used for noncircular curves. When fitting the curve through a series of points, be sure that the direction in which its curvature increases is the direction in which the curvature of the line increases.

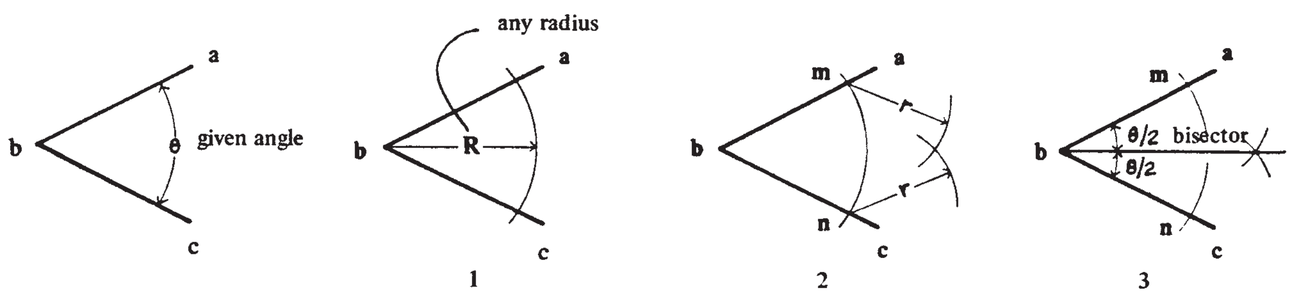




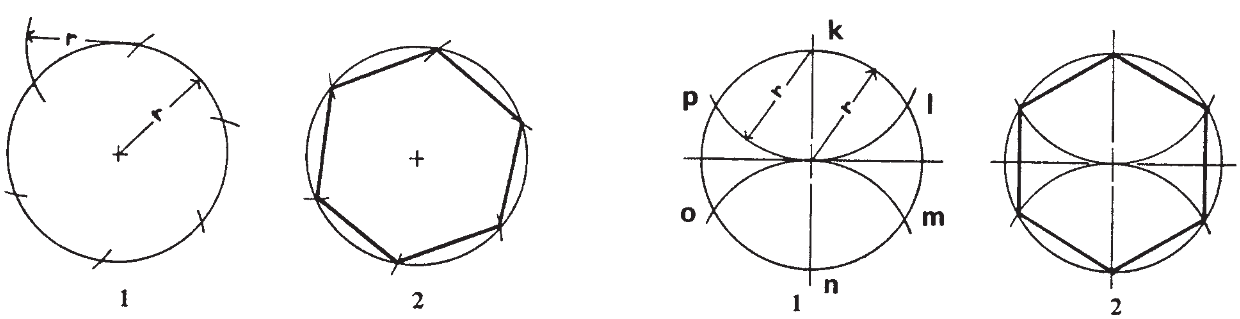
Uncommon angles with triangles



How to draw a line parallel to a given line

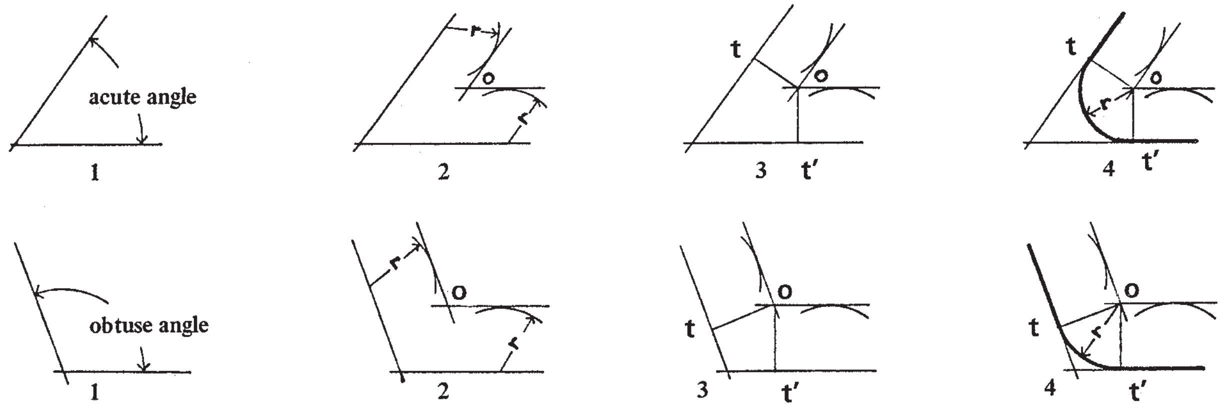


Bisecting an angle

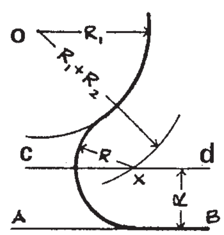


Constructing a hexagon

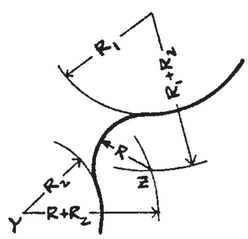
Familiarity with drafting tools can be achieved by doing simple geometric operations and constructing various geometric shapes.

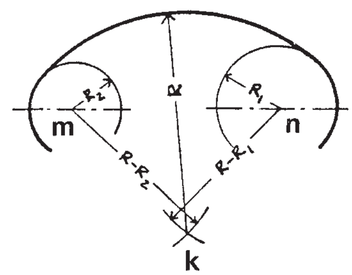


Constructing tangent arcs

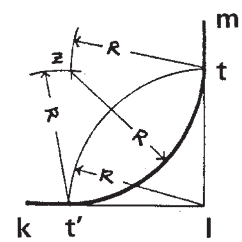


An arc tangent to a straight line and a circle. An equidistance is required.

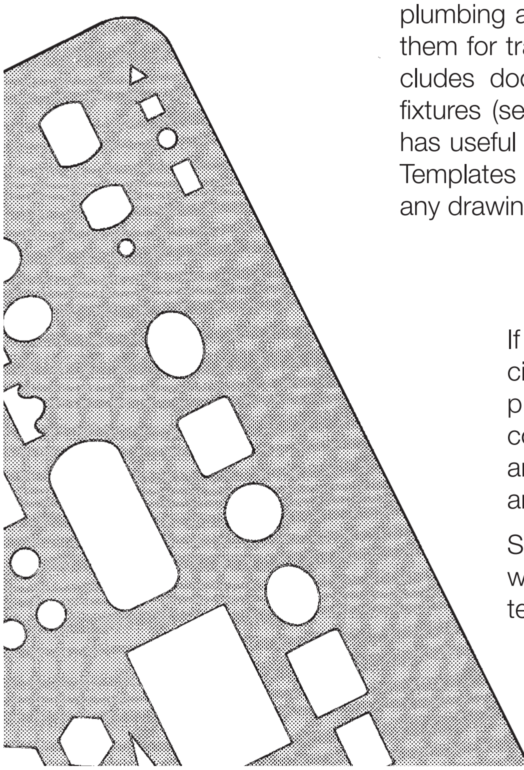




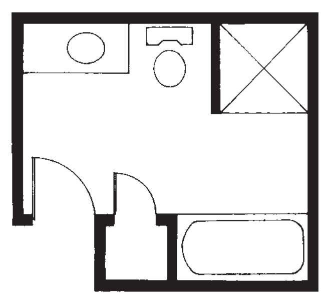
An arc tangent to two circles. The arc center must be equidistant from both circles.



An arc tangent at a right-angle corner. An equidistance R is required.

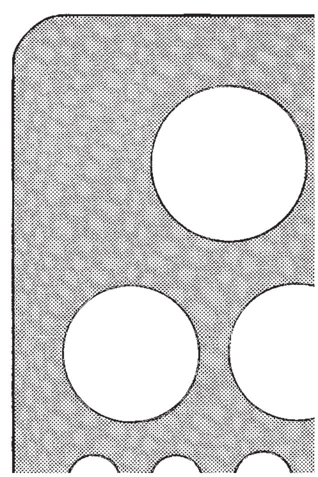


Architectural *templates* have many standard plumbing and furniture symbols cut through them for tracing. This floor plan template includes door swings, sinks, and bathroom fixtures (see bathroom plan at right). It also has useful geometric forms, such as circles. Templates come in a variety of scales to suit any drawing requirement.

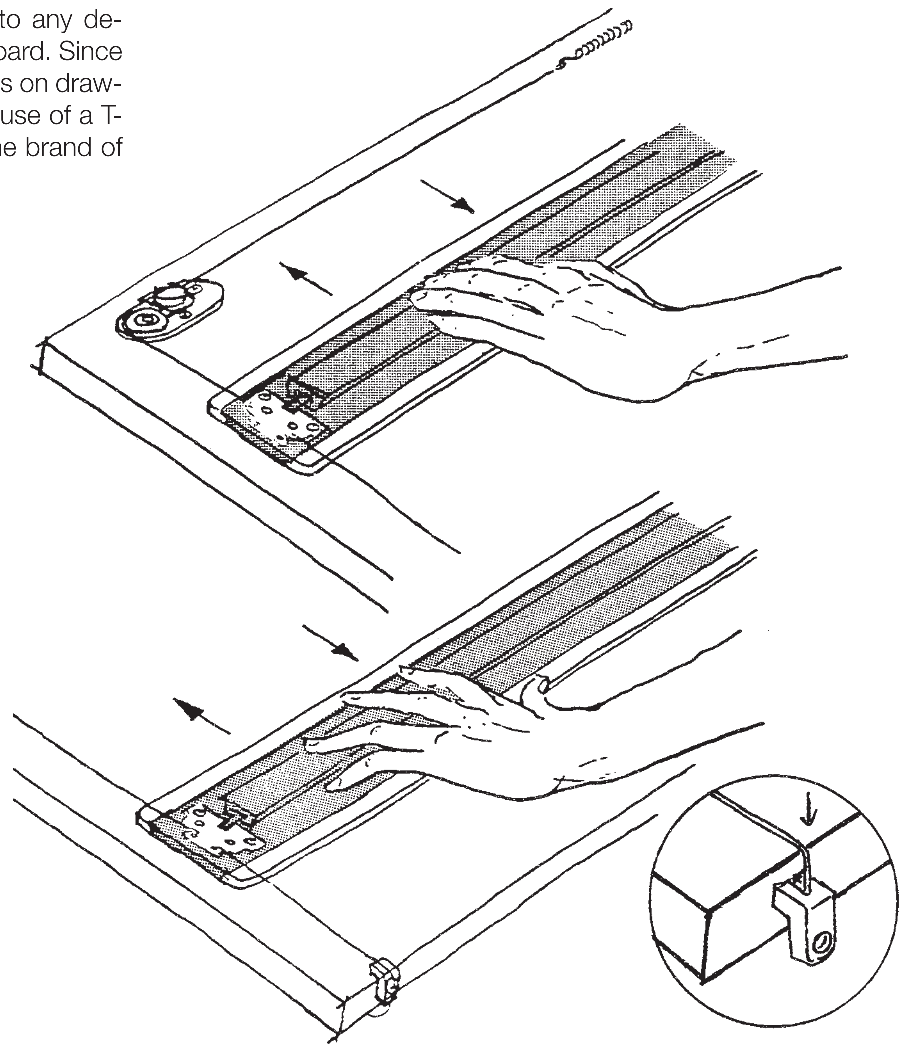


If the desired diameter of a small circle is known, a plastic circle template may be used in place of a compass. Other popular templates are classified as general purpose and elliptical.

See the variety of templates at www.DraftingSteals.com/catalog-templates.html.



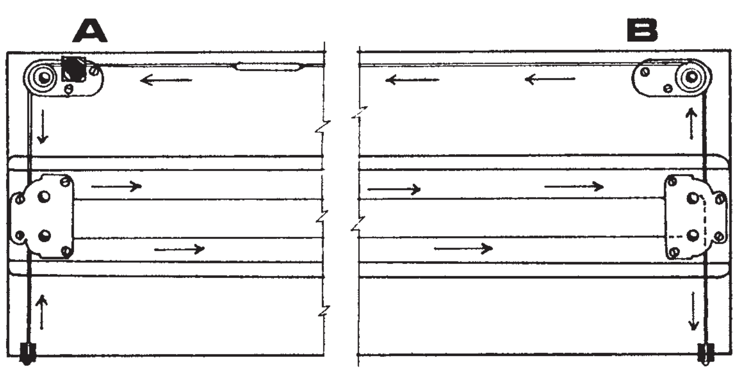
The *parallel roller rule,* with its effortless movement, has made the T-square relatively obsolete. A slight push with either hand glides the parallel rule into any desired position on the drawing board. Since it rolls on ball bearings, smudges on drawings commonly created by the use of a T-square are avoided. The Mayline brand of parallel rules are excellent.



When installing the parallel rule (also termed bar or straightedge), be sure that:

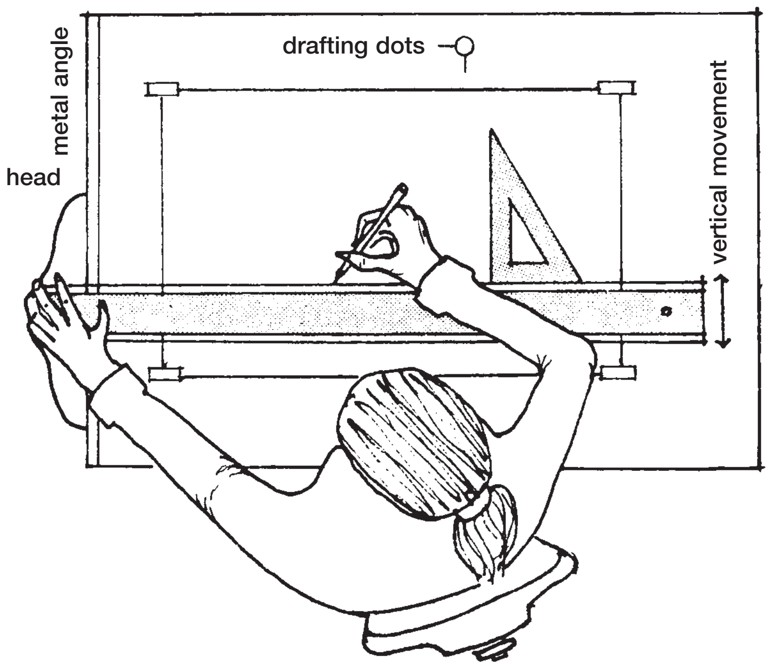
1. Corner plates A and B are firmly attached with ½"-long screws.
2. The cable wire is parallel to the edge of the drawing board on both sides.
3. The cable wire passes between the clamping washer and the plate.
4. The spring is centered between A and B.
5. The cable wire is moved in the directions indicated below.

The cable wire is inserted through the hole on top of the stop and aligned with the slot on the rear of the stop. Trim excess cable, but leave enough for future adjustments.



Long, continuous, parallel horizontal lines frequently occur on architectural drawings. The rule can also be adjusted to many inclined positions slightly away from the horizontal. Rules come in lengths of 36", 42", 48", 54", and 60". Highly recommended is the 42" rule, which permits you to work on a 30" × 40" sheet.

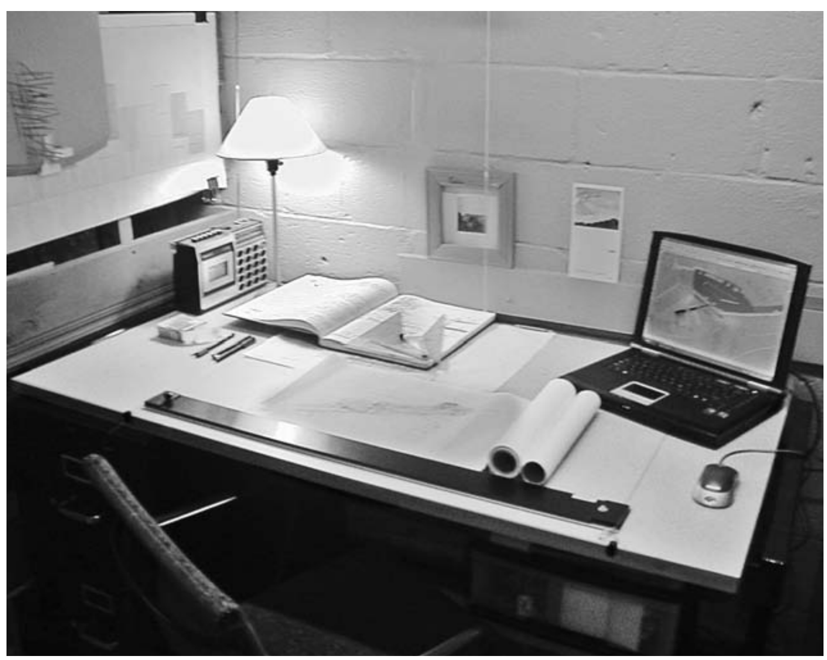
Provide yourself with a comfortable *work space* with adequate tack surface to pin up your work for reference. Have clips and push pins on hand to secure and hang drawings. Architectural drawing is normally done in a sitting position, but it can also be done standing. Avoid slouching; don't arch your back and collapse your abdominal regions. Sit erect and maintain good posture. Designing and drawing require long hours of sitting in one position. Poor posture will lead to a tired feeling, reduced drawing capacity, and a deteriorated physical state.

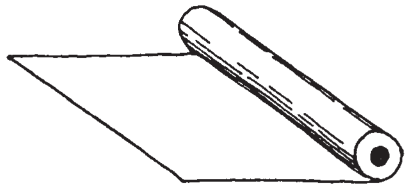


Most practitioners like a low-level, flat table surface; however, some prefer a tilted tabletop that reduces the need to lean over the work surface. A large surface gives you room for additional equipment like a laptop computer (see photo). An adjustable stool is ideal for varying the seat height and the backrest. Strive for ergonomic efficiency.

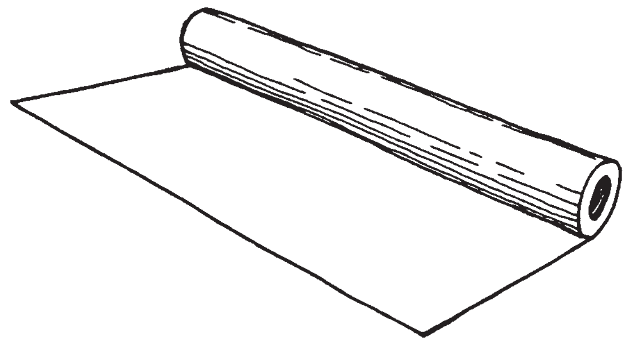
Purchase the best quality table light source that you can afford in order to prevent eyestrain. An incandescent/fluorescent combination light is excellent. The light should have an adjustable counterpoise to give it the flexibility to be positioned over your work.

Line up the drawing sheet horizontally and vertically using a T-square or parallel straightedge and triangle. It is best to apply the drafting tape broadside (on the diagonal is also OK) to prevent the sheet from slipping. Drafting dots can also be used to secure drawings to a board or table. The head of the T-square should always slide firmly up against the edge of the drawing board or table. If the head is not firm, there will be vertical movement (play) at the end of the T-square. Use a metal angle with a T-square to keep a true edge. A clean thin rag or towel can be used as a forearm rest and protector for long drawing stints.

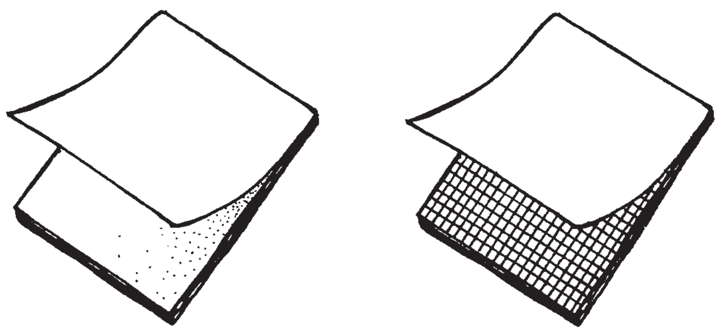




Transparent, lightweight *tracing paper* (commonly yellow or white and termed “flimsy” or “talking paper”) is excellent for use with soft leads or markers. It is used for rough sketches, overlays, and preliminary drawings. Rolls range in size from 12" to 36".

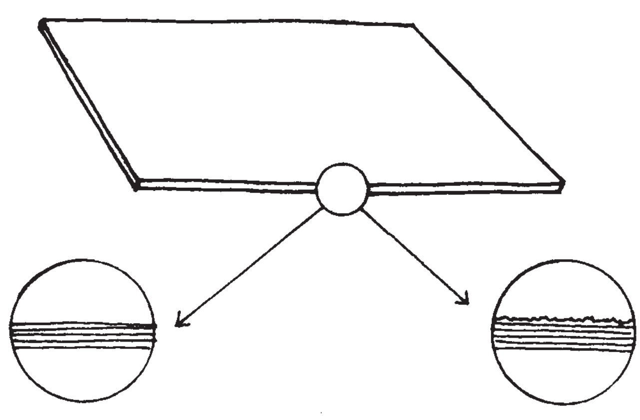


Vellums are 100-percent rag tracing papers with excellent erasability. They are available in either rolls, pads, or single sheets. Clearprint 1000H is widely used. Vellum papers are classified by weight, color, and rag content. Heavyweight (20 lb) white vellum is normally used for finished drawings. Medium-weight (16 lb) is used for rough layouts. *Plastic film* from polyester (Mylar) yields the highest quality reproductions. It is highly appropriate for ink and some pencil leads. Use erasing fluid to remove ink lines.



Tracing pad sizes are 8½" 311", 11" 3 17", with a fade-out grid and 17" × 22".

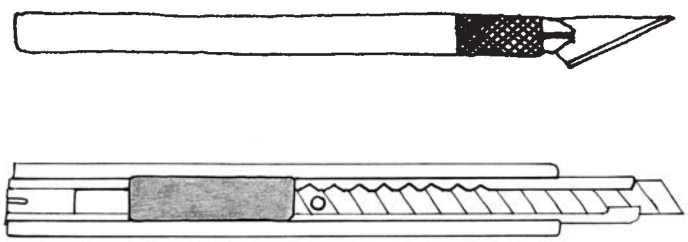
Vellums are 100-percent rag tracing papers with excellent erasability. They are available in either rolls, pads, or single sheets. Clearprint 1000H is widely used (www.clearprintpapercompany.com). Vellum papers are classified by weight, color, and rag content. Heavyweight (20 lb) white vellum is normally used for finished drawings. Medium-weight (16 lb) is used for rough layouts. *Plastic film* from polyester (Mylar) yields the highest-quality reproductions. It is highly appropriate for ink and some pencil leads. Use erasing fluid to remove ink lines.



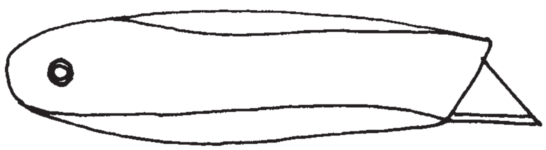
Hot press (less tooth) Cold press (more tooth)

White *illustration board* comes at $\frac{1}{16}$" and $\frac{3}{32}$" in thickness. This makes it suitable for both finished drawing presentations and fine presentation models. Cold-press boards have a more textured surface and take to pencil, whereas hot-press boards are smoother and take to ink.

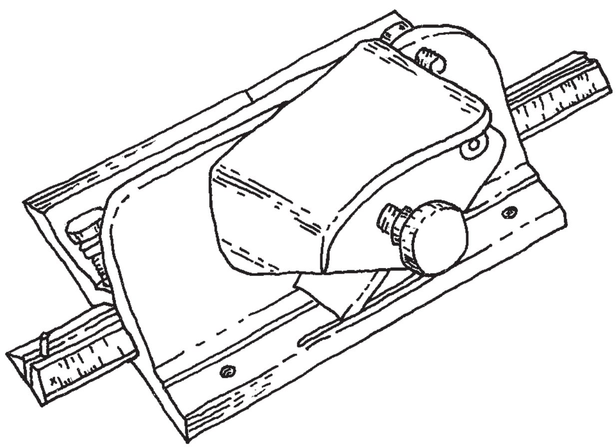
Preliminary study models are usually made of gray *chipboard.* Chipboard also comes in a variety of thicknesses. *Foam-core board* is a strong, lightweight board, excellent for model making. Use white clear-drying glue as a strong adhesive.



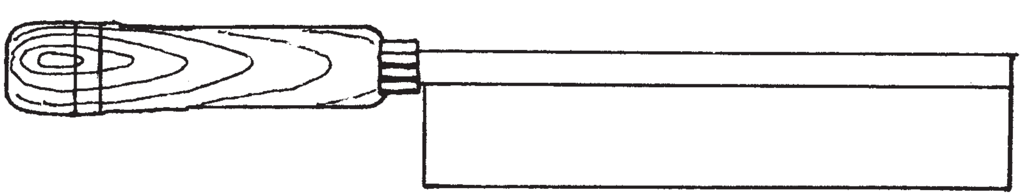
An *X-Acto knife* uses blades of several different shapes. The illustration shows the one most commonly used. It is excellent for small, detailed cuts (small apertures). A pack of #11-size blades for refills is strongly recommended. Another alternative, especially for cutting cardboard or foam-core board, is an *Olfa knife.*



Utility knives are used primarily for long cuts on heavy materials such as thick illustration board, mat board, or cardboard. They are excellent for scoring.



Good-quality *cutters* can make a clean, crisp 45° bevel. Highly recommended is the Logan Series 4000 mat cutter, which has a built-in marking system. With a pivoting blade holder, it can be used against any suitable straightedge. A *razor saw* with a thin blade and fine teeth is used for extrafine cuts on small pieces of wood, such as balsa.

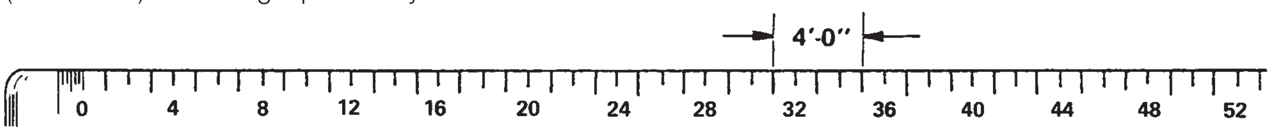


For a cutting guide, use an 18" or 36" stainless steel slip-resistant straightedge with a cork backing. A basic cutting rule of model making is to never make only one pass when cutting materials (especially thick cardboard). Make a series of light cuts. This will give you better control and accuracy. Cutting on a self-healing translucent plastic or rubber cutting surface (18" × 24" is a good mat size) will extend the life of your cutting blades.

The following are architect's scales:

12"=1'0"	1"=1'0"	¼"=1'0"
6"=1'0"	¾"=1'0"	3/16"=1'0"
3"=1'0"	½"=1'0"	⅛"=1'0"
1½"=1'0"	⅜"=1'0"	3/32"=1'0"

For architectural work, all of the above scales are used. Least used are the scales of 12"=1'0" and 6"=1'0". The scale is usually notated within the title block of an architectural drawing. It can also appear underneath the view of a particular detail. The choice of the proper scale size is dependent on the building size, the amount of detail to be drawn, and the size of paper used. Sometimes common practice dictates the size; for example, floor plans for residential buildings are normally drawn at ¼"=1'0". Construction details can use scales ranging from ½"=1'0" to 3"=1'0". For full-size project or site distance measurements, have either metal, plastic, or cloth (25' to 150') measuring tapes handy.



The actual size of the architect's scale. This scale is ⅛"=1'0"

The *architect's scale* is used primarily for drawing buildings, architectural details, structural details, and mechanical systems in buildings. The purpose is to represent large objects at a reduced scale to fit on drafting paper–size sheets. Scales come in three beveled types, one triangular type, and one rapid rule type. Staedtler, Helix, and Alvin are all good brands.

The *civil engineer's* or *engineer's scale* is used primarily for site plans, location plans, and land measurements in map drawing.

The following are civil engineer's scales:

10, 20, 30, 40, 50, 60, or 80 divisions to the inch, representing feet, 10 feet, 100 feet, rods, or miles.

Be careful not to confuse "scale" and "size."

¼"=1'0" is referred to as "quarter scale" in the architect's language, whereas ¼"=1" is referred to as "quarter size."

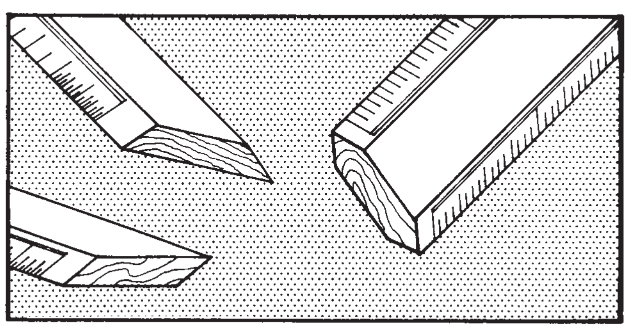
OPPOSITE BEVEL
Easy to pick up and handle

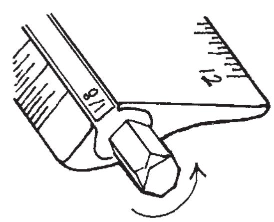
DOUBLE BEVEL
A good pocket scale

FLAT BEVEL
Easy to keep flat to a board

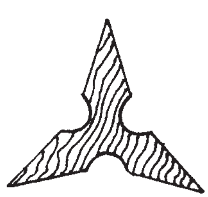
TRIANGULAR
Has many scales on the same stick.

Always observe a scale from directly above.





Rapid rule

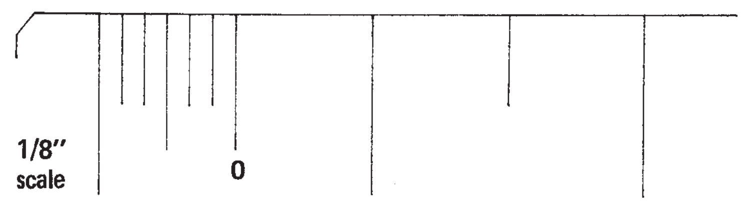


RAPID RULE
Made of lightweight, solid aluminum, you rotate a rapid rule's scale rod to see the desired scale. There's no need to search for the needed edge or read backward.

Remember to keep the scale clean; don't mark on it, and never use it as a straightedge!

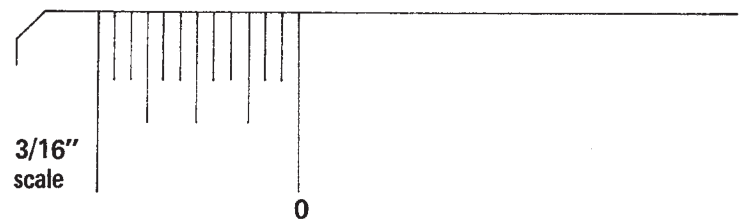
Determining How Much Each Subdivision Represents

The best procedure is to ask yourself the following question: Each subdivision represents what part of one foot?



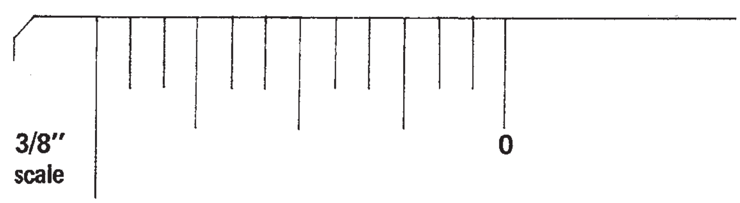
FOR ⅛" = 1'-0"

$$\frac{12''/\text{FOOT}}{6\ \text{DIVISIONS}} = 2''\ \text{PER DIVISION}$$



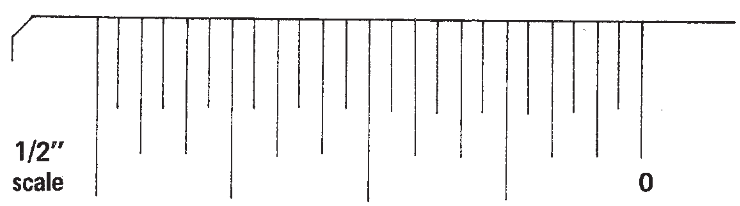
FOR 3⁄16" = 1'-0"

$$\frac{12''/\text{FOOT}}{12\ \text{DIVISIONS}} = 1''\ \text{PER DIVISION}$$



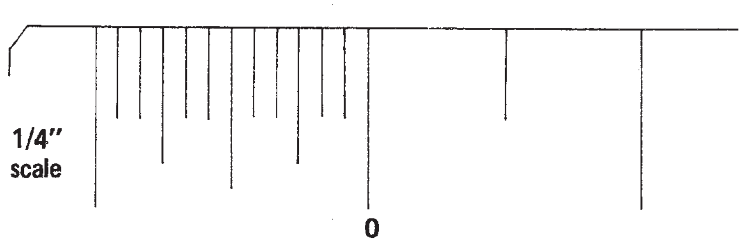
FOR ⅜" = 1'-0"

$$\frac{12''/\text{FOOT}}{12\ \text{DIVISIONS}} =1''\ \text{PER DIVISION}$$



FOR ½" = 1'-0"

$$\frac{12''/\text{FOOT}}{24\ \text{DIVISIONS}} =\tfrac{1}{2}''\ \text{PER DIVISION}$$

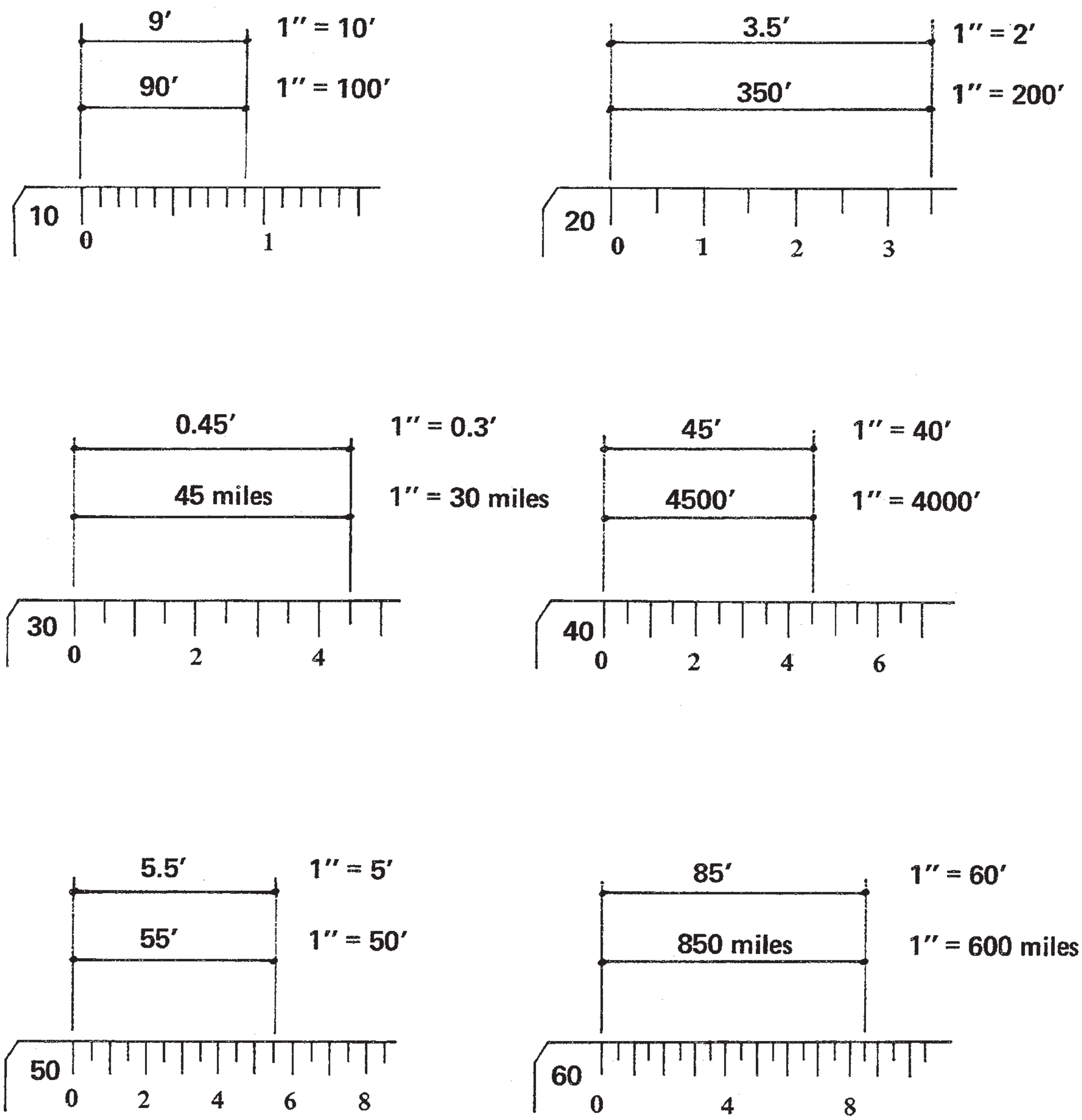


FOR ¼" = 1'-0"

$$\frac{12''/\text{FOOT}}{12\ \text{DIVISIONS}} =1''\ \text{PER DIVISION}$$

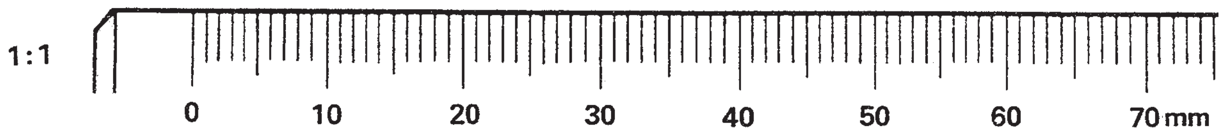
Note that in all of the reduced scales, the major divisions represent feet and their subdivisions represent inches and fractions thereof. Therefore, ½ means ½ inch = 1 foot, not ½ inch = 1 inch.

To facilitate the counting of subdivisions, the above scales have been enlarged from their actual size.



Shown above are the six standard scale units found on the *engineer's scale.* There are many possibilities for each scale unit since different lengths can be indicated for the scale unit. For example, in the case of a 10 scale, 1" can equal any one of the following: 0.1', 1', 10', 100', or 1,000 (feet or miles). Two possibilities are shown above for each of the six standard scale units. Divisions to the inch represent feet, rods, or miles.

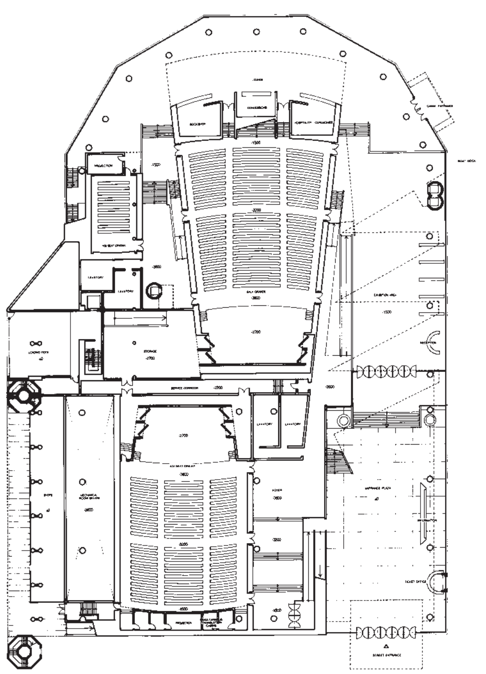
Think of the scale number, such as 10, as the number of divisions per inch. Thus, 40 would indicate 40 increments or parts per inch. A 1"=40' scale would have 40 increments, each increment being one foot. These incremental divisions are then continued along the full length of the scale. The engineer's scale is used primarily for site plans and location plans.



This metric scale has a 1:1 ratio and should be used for *full-size* drawings. For example, 10 mm on the drawing equals 10 mm on the object or building.

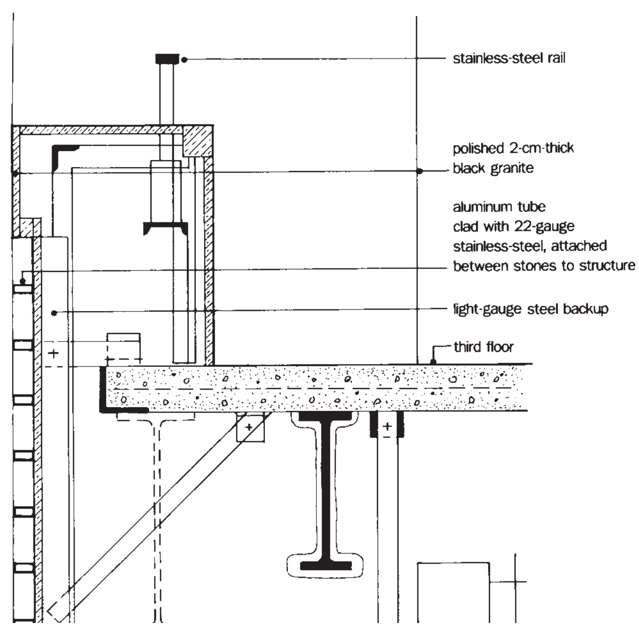
This metric scale has a 1:5 ratio and should be used for drawings *one-fifth full size.* For example, 100 mm on the drawing equals 500 mm on the object or building.

As with the architect's scale, the *metric* scales above have been enlarged for easier reading. Metric scales are expressed as ratios (examples: 1:20 or 1:200). All countries except the United States (which uses inch-pound units) use the SI (International System of Units), a modern version of the metric system. A meter is 3.281 feet in length. It is easy to work with because converting from unit to unit merely requires multiplying or dividing by powers of ten. For example, 1,000 millimeters (mm) equals 1.0 meter (m)—(i.e., 1,000 divided by 1,000). A metric scale is 150 mm long (about 6"). Architects use various metric scales for various types of drawings. For example, 1:500 is a common scale reduction ratio for site plans, whereas 1:100 is used for floor plans and elevations. Ratio reductions of 1:1 and 1:5 are frequently seen for architectural details.



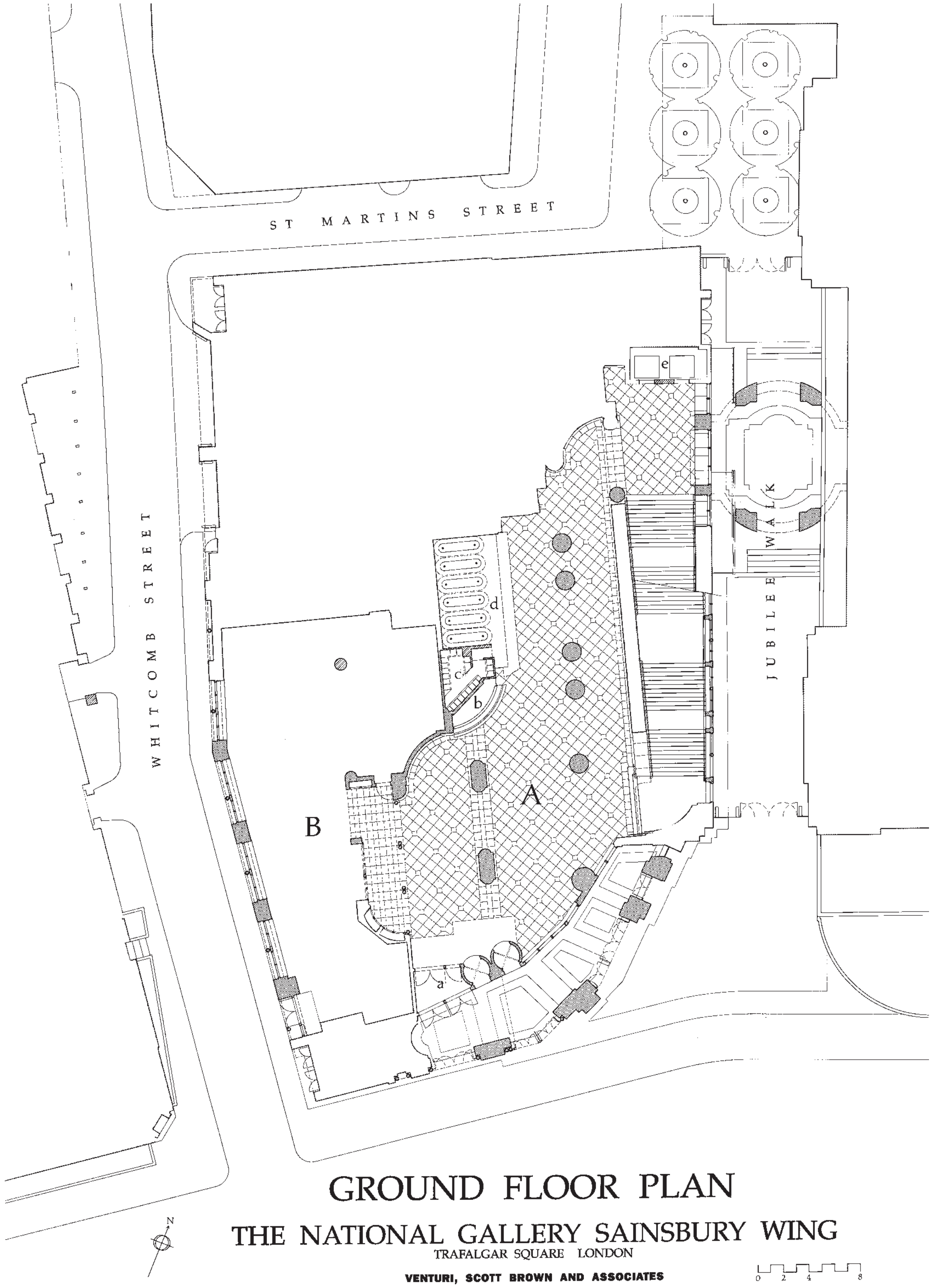
Floor Plan

Palazzo del Cinema, Venice, Italy
38 × 53 cm (15" × 20.9")
Medium: Ink on Mylar
Courtesy of Maki and Associates



Partial section detail
One O'Hare Center
Rosemont, Illinois

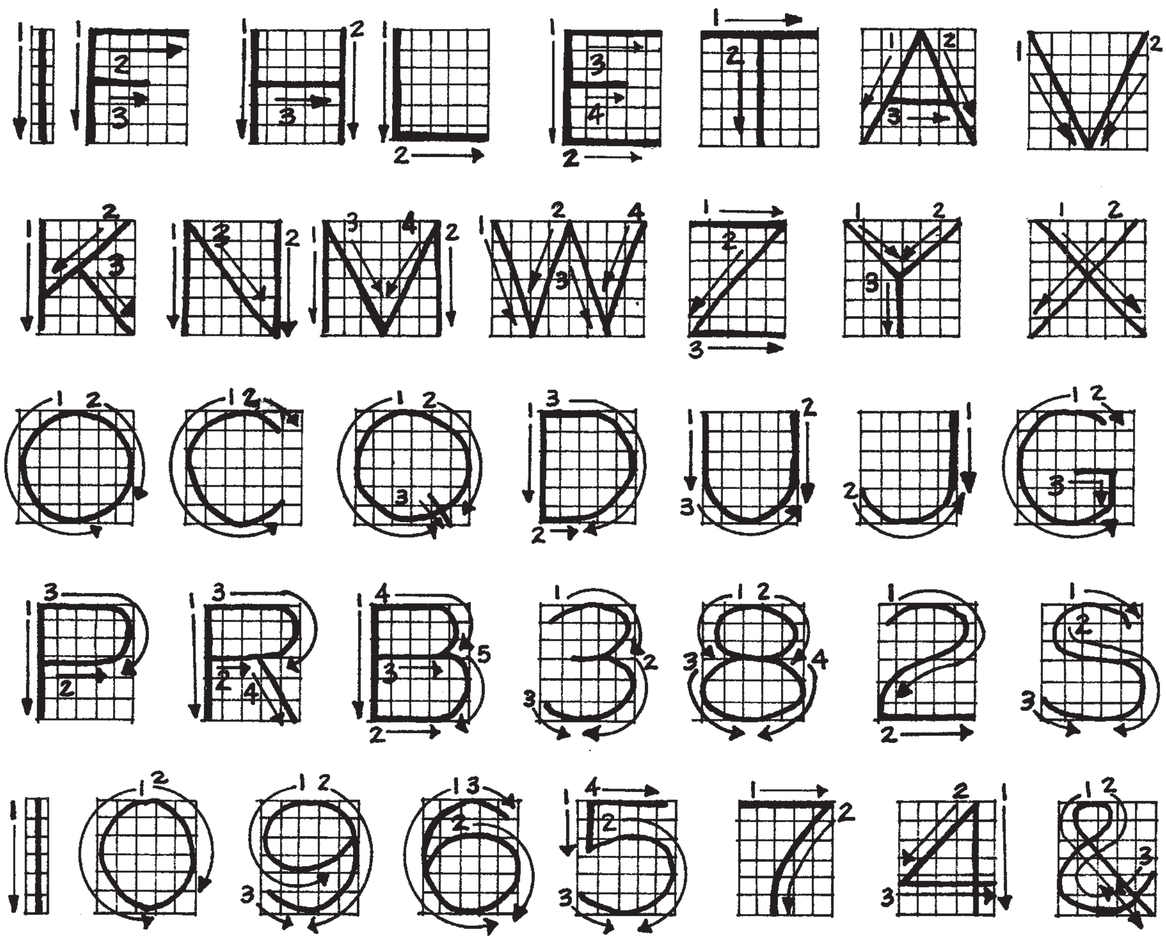
Courtesy of Kohn Pedersen Fox Associates, Architects



Drawing: Ground-floor plan, The National Gallery, Sainsbury Wing, Trafalgar Square, London, England
Medium: Ink on vellum (CAD) 30.25" x 43.5" (76.8 × 110.5 cm)
Courtesy of Venturi, Scott Brown and Associates, Inc., Architects

Title typefaces should be adjacent to the drawings they refer to. The lettering size and thickness (darkness) reflects the importance of the title. Titles, heads, subheads, and text material must be arranged in descending order of visual importance; different type styles, sizes, and weights are used to convey the relative importance of these chunks of information. Note the clear hierarchy of titles on this presentation drawing.

Architectural lettering is derived from uppercase Gothic letters; the relative proportions of each letter are easily seen using a gridded background. In actual practice a grid system is not used; try to eyeball the correct proportions for each letter. The suggested stroke order need not be followed; individuals differ in hand–eye coordination and may differ in the number of strokes needed to complete a letter. It is important to be consistent in forming an equally proportioned letter each time. For a left-handed person, the direction of the vertical strokes and curvilinear strokes remains the same, but the direction of horizontal strokes reverses.



Notice that letters and numerals can be grouped in similar family types: the horizontal and vertical family (I through T); the horizontal, vertical, and angular family (A through X); and the curvilinear family (O through S). The numeral family has all the strokes. With time and practice, you should be able to make controlled, quick, even strokes. This is especially relevant to the rounded letters and numerals. Be sure the strokes are dark and crisp for good reproducibility. Good architectural hand lettering is the art of mastering basic motions: horizontal, vertical, angular, and curvilinear. The block lettering above is illustrated to help you develop your basic strokes. However, this type of lettering has the shortcoming of using too much space because it is very wide. In architectural work, a more narrowly proportioned alphabet is more suitable.

IT IS ACCEPTABLE TO USE A SMALL TRIANGLE TO KEEP THE VERTICAL STROKES OF LETTERS VERTICAL. THIS IS COMMONLY DONE IN PROFESSIONAL PRACTICE AS A QUICK TECHNIQUE; HOWEVER, IT IS BEST TO EXECUTE FREEHAND VERTICALS IF YOU HAVE THE ABILITY TO KEEP LINES VERTICAL.

SLIGHT STYLIZATION OF LETTERS IS OFTEN DONE IN PROFESSIONAL PRACTICE; ANY DEVELOPMENT OF STYLE SHOULD ALWAYS EXHIBIT CONSISTENCY IN SPACING, PROPORTION, AND OVERALL APPEARANCE. FOR EXAMPLE, THE LETTERS ON THE PREVIOUS PAGE CAN BE STRETCHED HORIZONTALLY, AND HORIZONTAL STROKES CAN BE MADE AT A SLIGHT ANGLE TO THE HORIZONTAL. "I" AND "J" ARE EXCEPTIONS IN ATTEMPTING TO MAKE LETTERS AS WIDE AS THEY ARE HIGH. SOMETIMES IT TAKES YEARS TO MASTER THE ART OF GOOD ARCHITECTURAL LETTERING; BE PATIENT WITH YOUR PROGRESS.

EXAMPLE: ALPHABET AND NUMERALS,

A B C D E F G H I

J K L M N O P Q R

S T U V W X Y Z

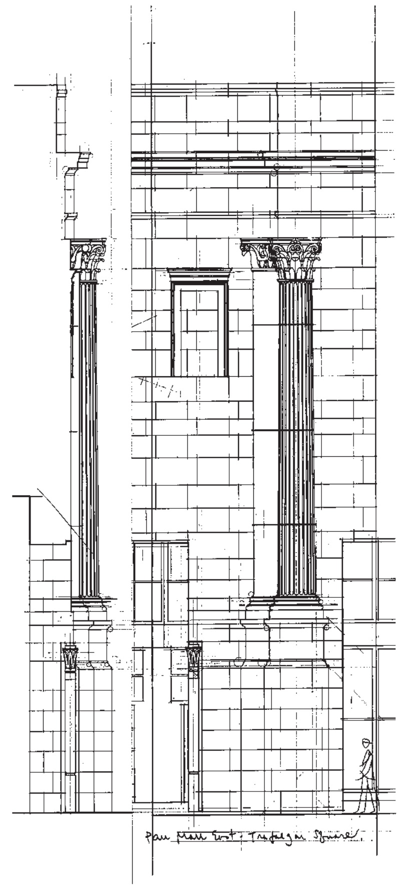
1 2 3 4 5 6 7 8 9 0

Hand lettering: Student project by Kam Wong
Medium: Pencil on vellum
Courtesy of the Department of Architecture, City College of San Francisco

A graph paper underlay is an alternative to guidelines (on translucent paper).

PENCIL LINES (for architectural drafting)	GRADE OF PENCIL TO USE
PROFILE LINE	H, F, or HB
VISIBLE/ELEVATION LINES	H, F or HB
CONSTRUCTION/LAYOUT/GRID LINES	2H or 4H
SECTION LINE	H,F, or HB
SECTION LINING	H, F, or HB
HIDDEN/DASH LINES	H or 2H
CENTER LINE	2H or 4H
DIMENSION LINE / EXTENSION LINE	2H or 4H

Heavy slash marks and dots are alternatives to arrowheads for terminating dimension lines. Arrowheads are also commonly indicated by using a wide V shape, with each leg approximately 60° to the dimension line.



Drawing: National Gallery, Sainsbury Wing London, England
2" × 26.5" (5.1 x 67.3 cm); Scale: 1:25
Medium: Ink on vellum
Courtesy of Venturi, Scott Brown and Associates, Inc., Architects

Architectural drawing in the broad sense includes both architectural drafting and architectural sketching. Pencils are the simplest drawing medium in both areas. Pencil leads are made of compressed graphite and clay. The most common grades for architectural drafting work are 4H, 2H, F, H, and HB. To save time, it is common practice to use one lead and vary the pressure to give the desired line weight. An initially drawn line must be bold and uniform, not weak and tentative. Architectural sketching work is commonly done with grades of 2B, 4B, and 6B, which are softer and allow for more expression.

Some drafting pointers:

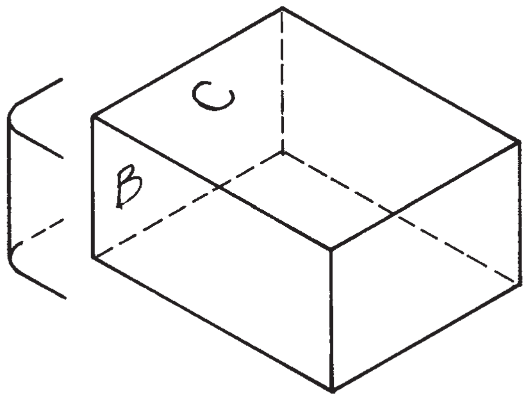
Avoid corners that do not touch.

Just touching is the generally accepted correct procedure.

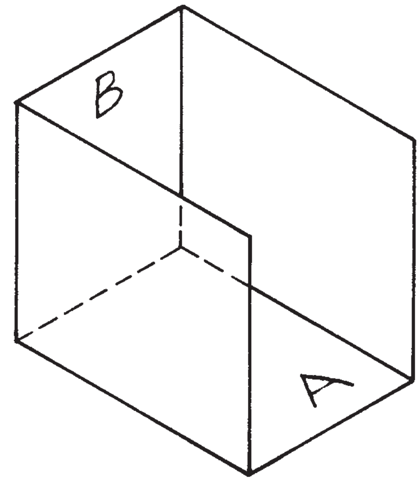
Keep an even line quality.

A very small overlap is permissible.

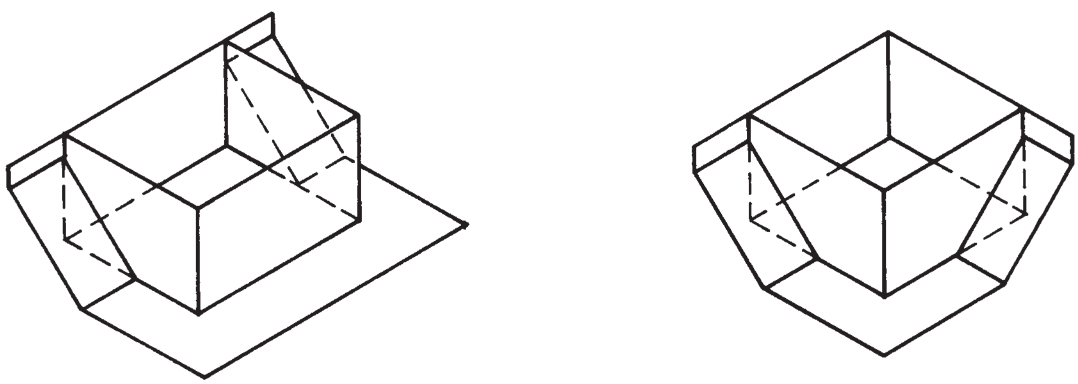
Pointing or slightly emphasizing the ends helps to strengthen their presence.



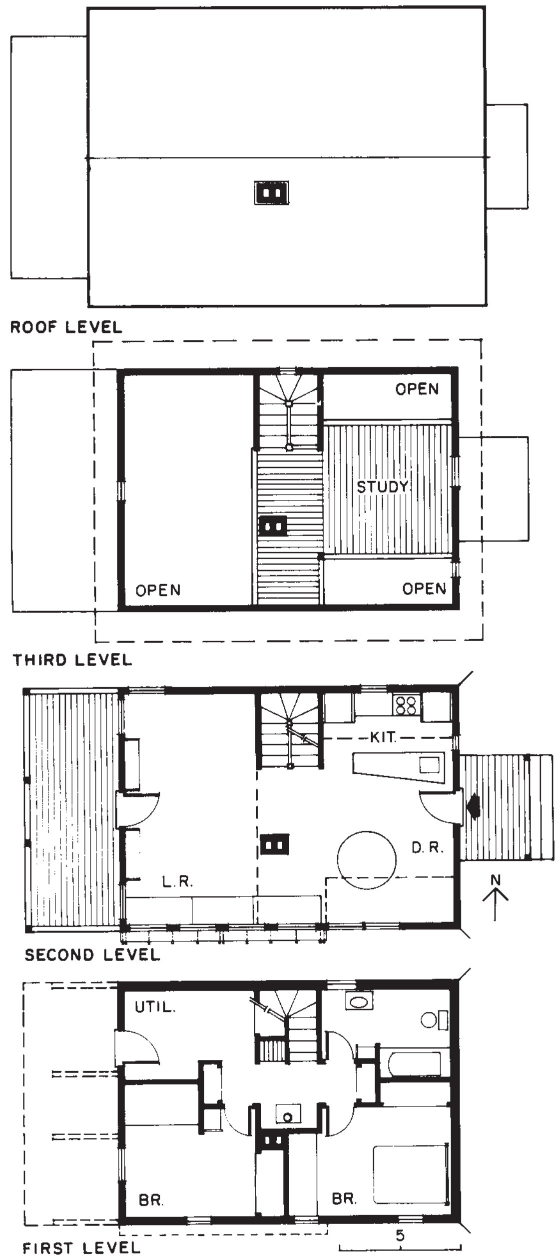
Visible line—the intersection of vertical plane B and horizontal plane C can be seen. Intersections that are not visually obstructed by solid elements of the object are defined as visible. A visible line can also be an edge of a curved surface.



Hidden line—vertical plane B and horizontal plane A intersect, resulting in an intersection line that cannot be seen from the observer's position. This is represented by a dashed line.



These pictorials (defined as pitch pockets) are part of construction documents for a contractor to use in the erection of a building. Note the use of hidden dashed lines to enhance the visualization of the details. When visible lines, hidden lines, and center lines coincide on a drawing, it is important to know which line takes precedence. A visible line takes precedence over a center line or a hidden line. A hidden line takes precedence over a center line.



Visible solid line

Dashed line below a cut

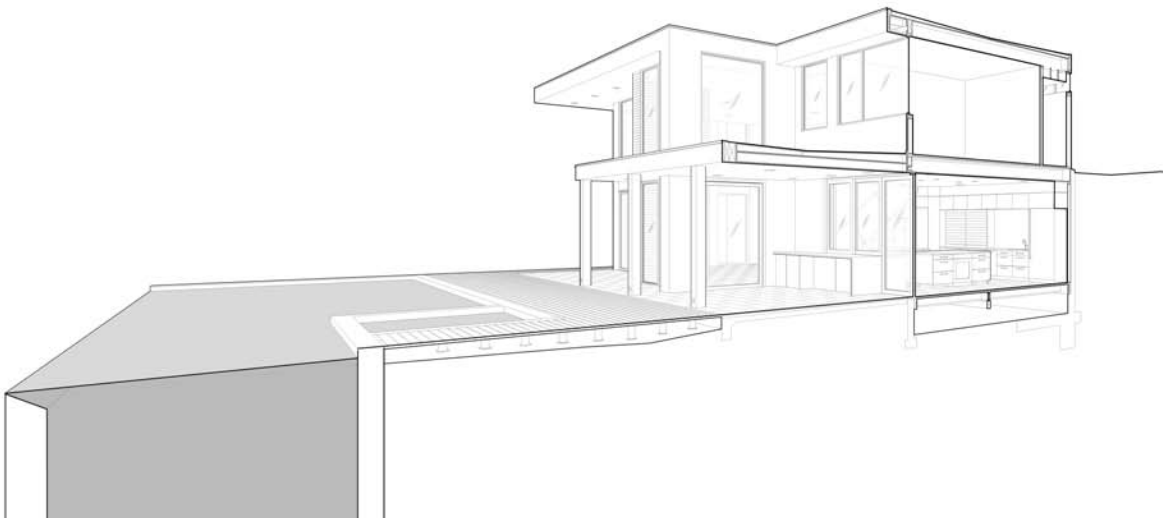
Dashed line above a cut

Visible solid lines and dashed hidden lines are two of the most important lines in finished architectural drawings. These lines are drawn with H, F, or HB lead weights. HB drawn lines erase easily, but they also tend to smear the most. Note that the dashed line below a cut is proportionally smaller than the one used above a cut. Strive to produce a consistent spacing and length for each dash.

Drawing: Hog Hill House
12" × 30" (30.5 x 76.2 cm) Scale 1⁄8"=1'0"
Medium: Ink on Mylar
Courtesy of B FIVE STUDIO

Visible lines in architectural drawings can be used for the outline of plan or section cuts (see example above) and any other intersection of planes (wall intersections in plan or elevation, etc.).

Dashed lines in architectural drawings express lines above a plan cut that the observer cannot see, such as roof overhangs (see example above), roof perforations, and skylights, as well as lines below a plan cut that are obscured by the floor, such as partitions.



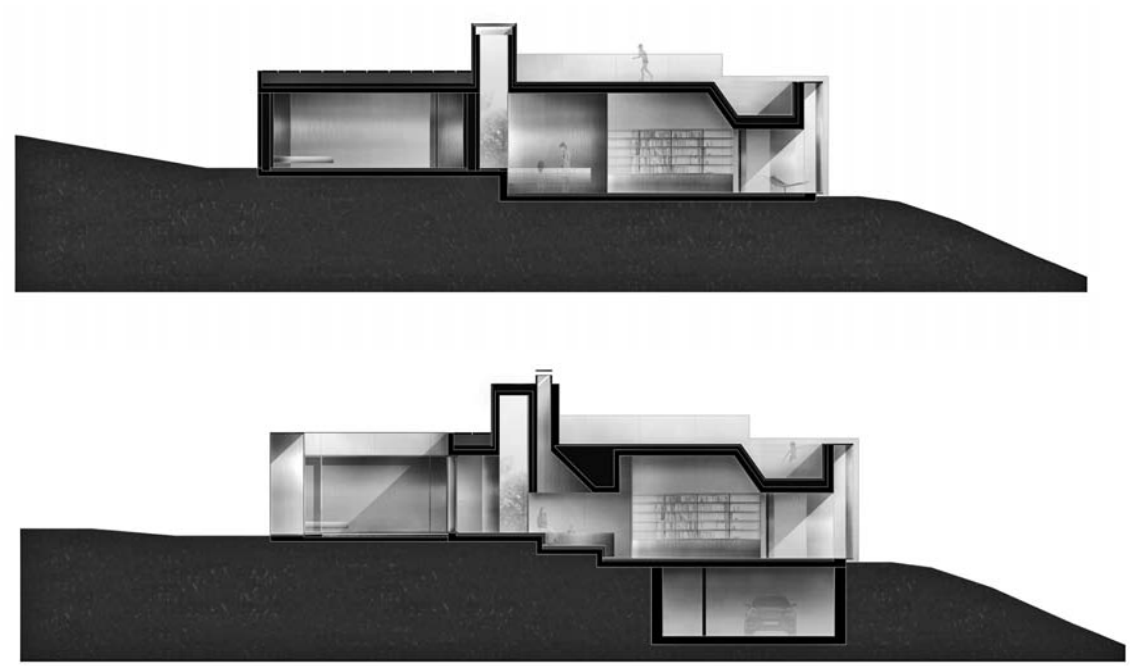
Drawings: Healdsburg residence
Healdsburg, California
Media: Archicad 8 and Photoshop 7.0 (top); Archicad 8, Artlantis 4.5, and Photoshop 7.0 (bottom)
Courtesy of Mark English Architects

Line Drawing (Top)

This drawing helped to illustrate the massing, structure, and detail at this cross section during design development. In particular, the relationship of the sliding windows and doors to the interior/exterior cabinetry was an important investigation. The drawing assisted the discussion between architect, owner, and cabinet maker when viewing the transitions between materials and systems.

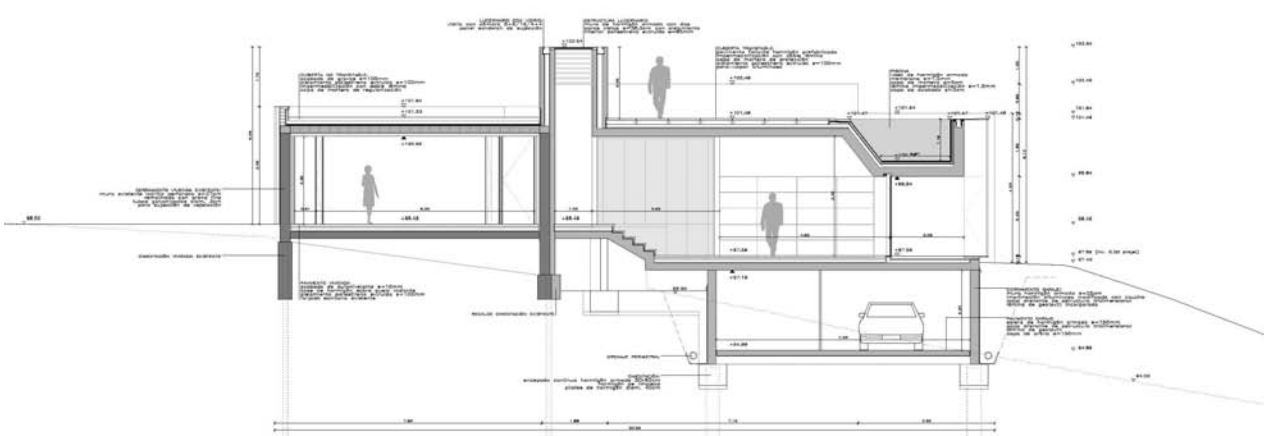
Rendered View (Bottom)

As well as conveying the overall construction and finish at this longitudinal section perspective, the transition between the stair and the kitchen cabinetry was the main purpose of this design-development drawing. The drawing illustrates the relationship of the stair and railing to the storage doors below, which are in the same plane as the kitchen cabinets. The drawing helped the owner have a more complete understanding of the architect's design intent. [Architect's statement]



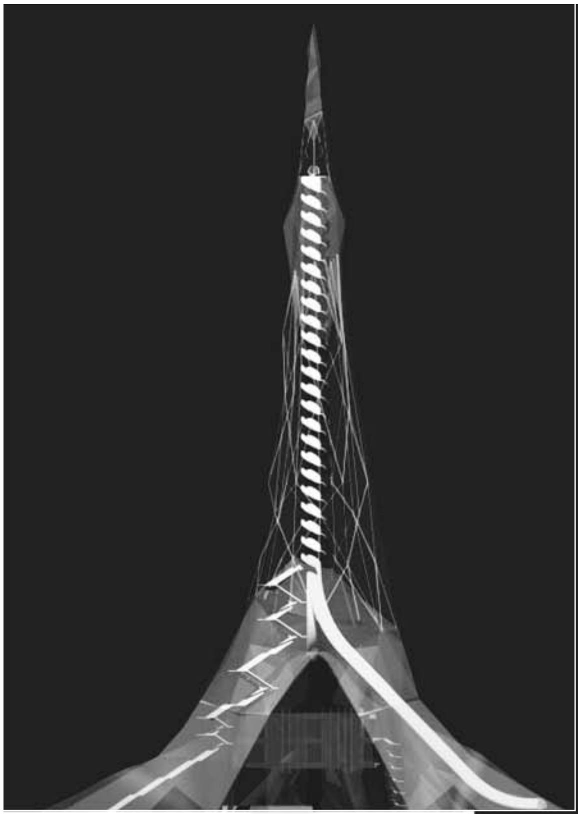
East-west sections

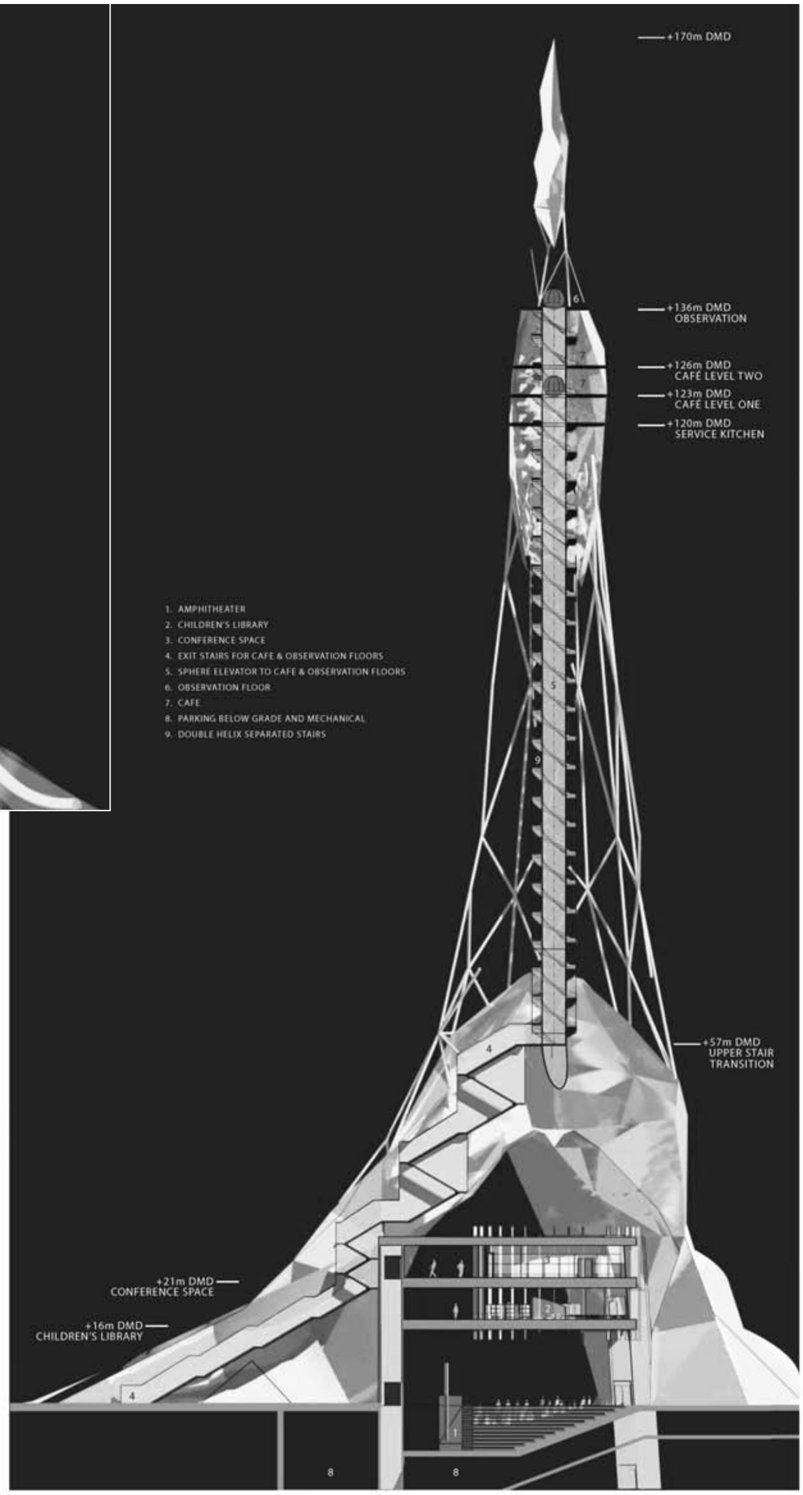
Sectional perspective



Drawings: Malecaze house
Vieille-Toulouse, France
Medium: Computer-generated
Courtesy of RCR Arquitectes

This is an excellent example showing the juxtaposition of a building's sectional perspective with design sections.

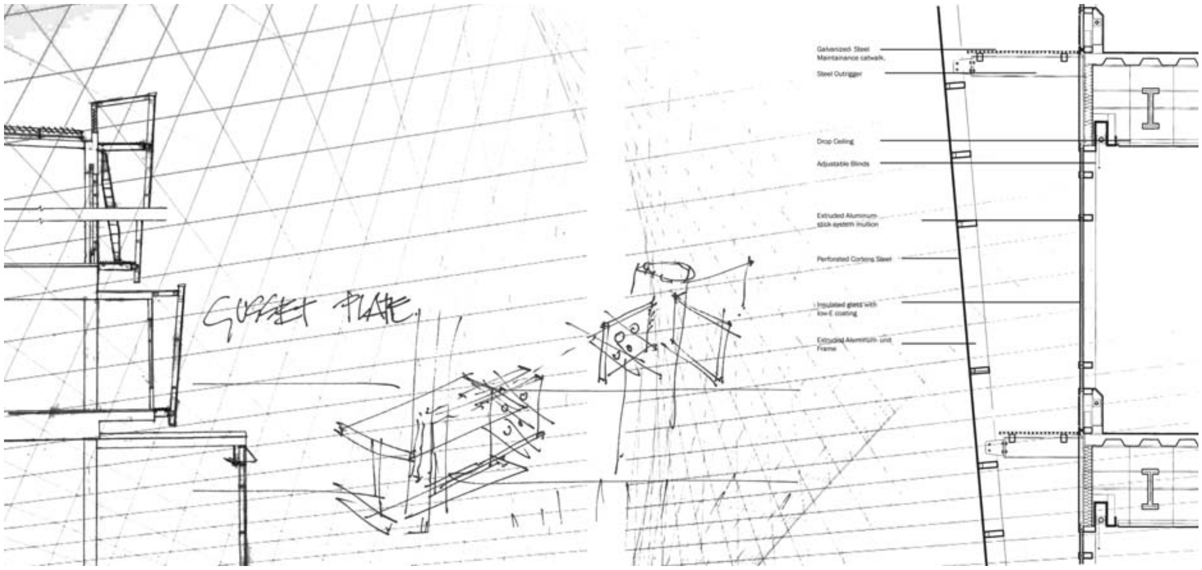




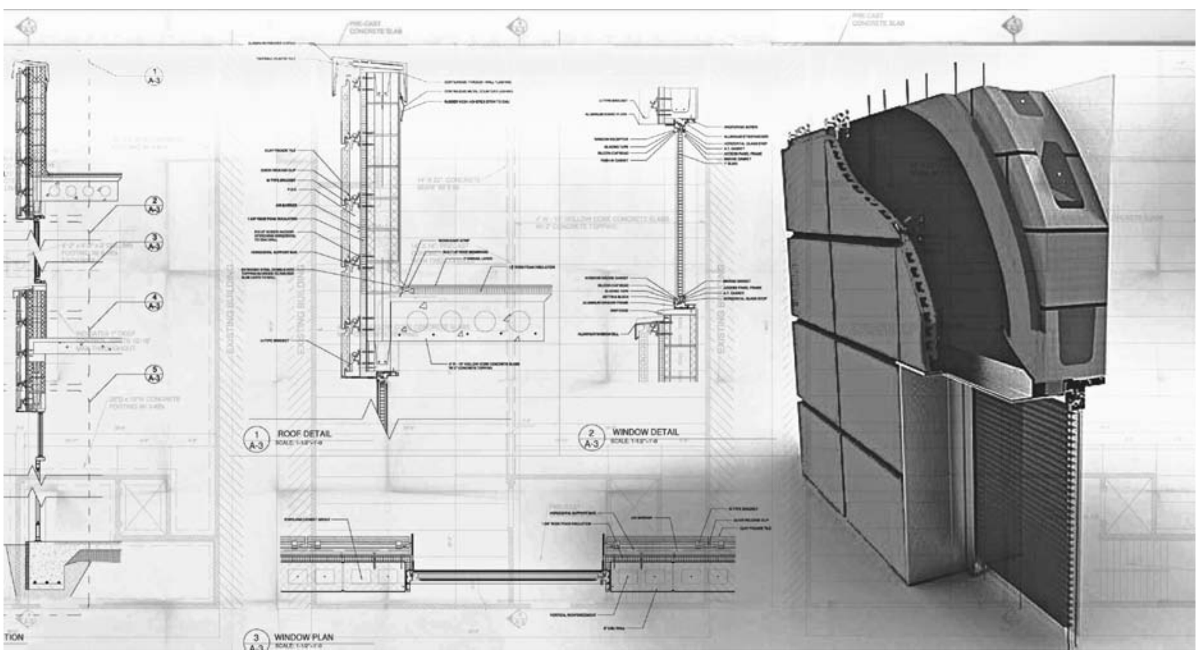
Drawings: Dune Tower
Dubai, United Arab Emirates
Competition entry for Observation Tower
Medium: 3-D CAD modeling and rendering in Bentley MicroStation V8i
Courtesy of Sami M. BaSuhail, Architect

X-ray Section: The tower sits on three large legs with a void space at the base containing a hung cylinder with a conference space and children's library. All the vertical circulation had to run in these legs. The use of transparent perspectives allowed for evaluation of the relationship of the internal circulation elements of the building relative to the exterior form and massing of the building's legs, and for interference checking between the stairs and the building skin. At points in the design development, the internal elements informed external forms and vice versa.

Cross-section: The cross-section was used primarily to study the spatial relationships between the human scale and the volumes of the public spaces formed by the building's elements. For example, at the observation deck at the top of the tower, the size, form, and distance of the floating wireless communications "gem" relative to the observers on the deck and the sight lines to the sky were developed by section. Also studied in section was the relationship of the amphitheater to the library above and how these elements relate to the arch formed by the legs of the tower. The section also served as a final geometric test of clearances. [ARCHITECT'S STATEMENT]



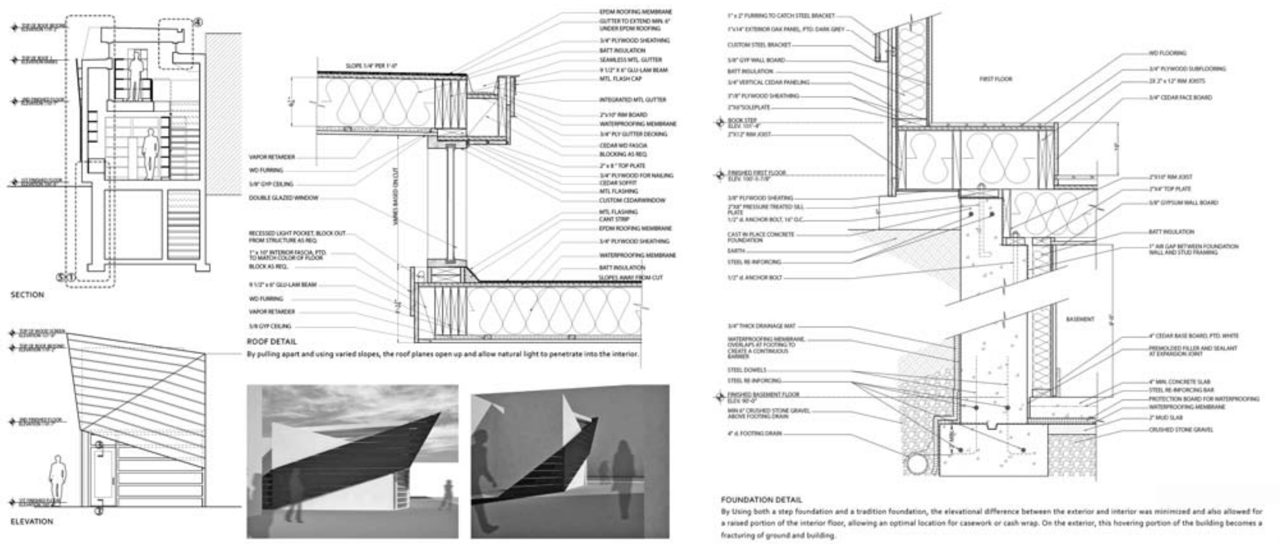
Initial sketches explored the structural column-to-beam connection, illustrating the gusset plate that was used throughout the structure, including that of the curtain wall. The other sections were used to address passive cooling and shading mechanisms within the design, with a final iteration developed in Rhino 3D. [ARCHITECTURE STUDENT'S STATEMENT]

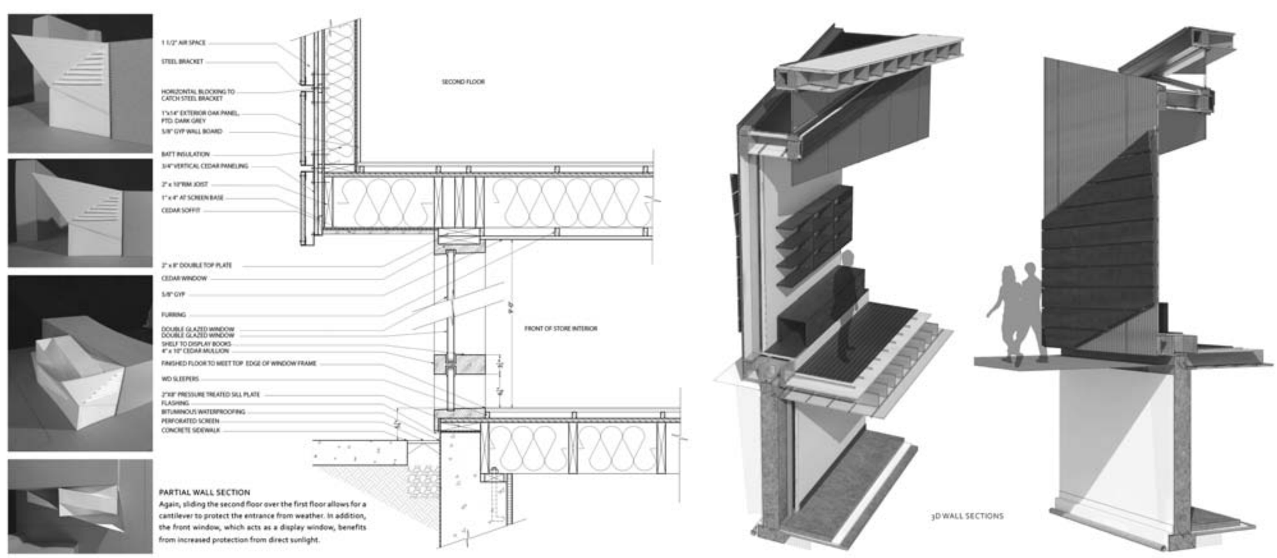


Two-dimensional AutoCAD drawings of wall sections of a building designed during Construction Technology II were imported into Rhino 3D and developed into a three-dimensional model illustrating a section perspective through the wall. This provided a better understanding of how the components came together and allowed for changes to issues found during the making of the three-dimensional model when contradictions between the horizontal and vertical sections occurred. [ARCHITECTURE STUDENT'S STATEMENT]

Drawing:(top) Sectional studies (Arch 303)
Media: Ink, graphite, Rhino 3D
Courtesy of student Jerome Elder
Savannah College of Art & Design
Department of Architecture

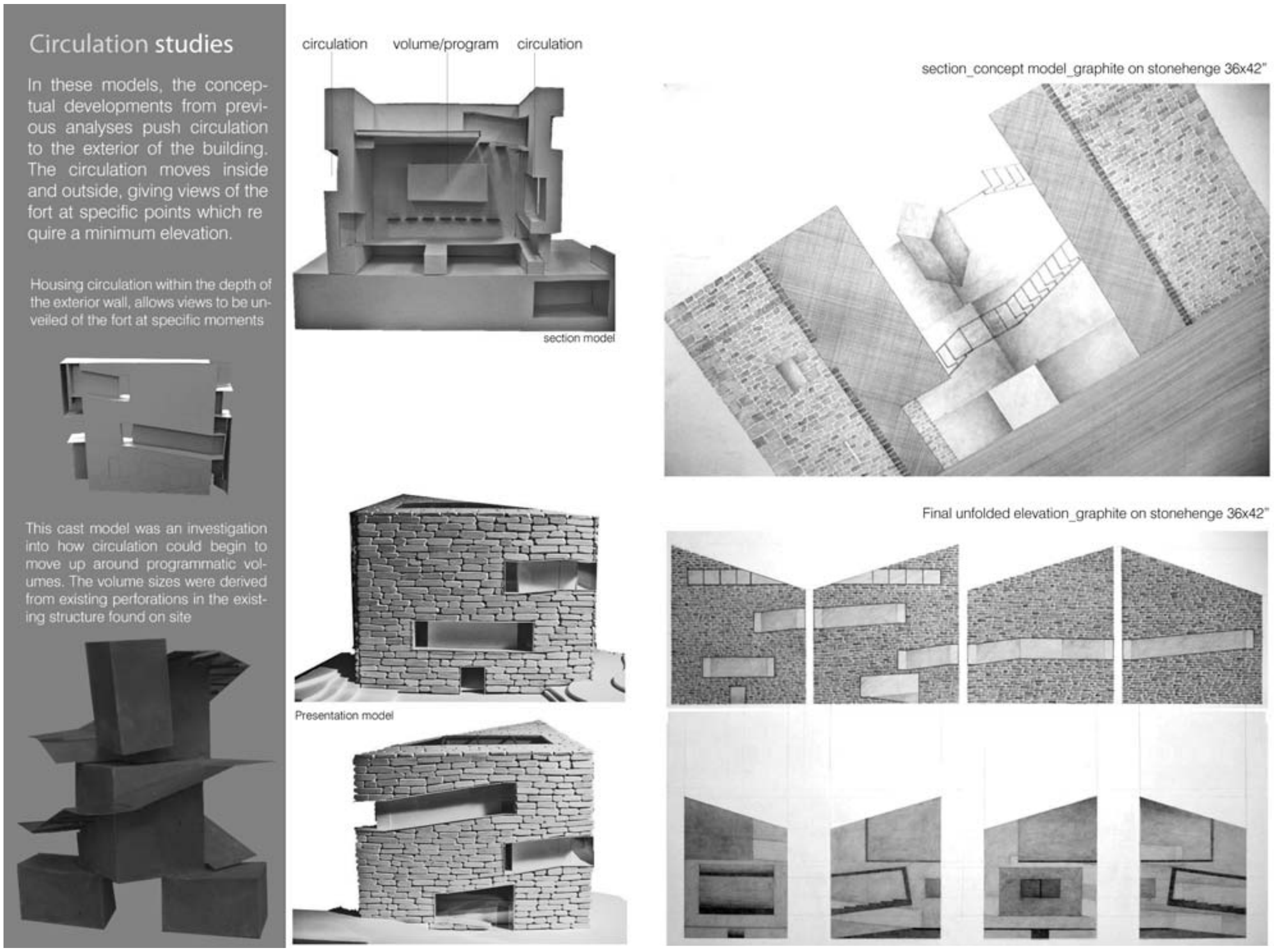
Drawing: (bottom) Sectional studies,-3-D section perspective (Arch 341)
Media: AutoCAD, Rhino 3D
Courtesy of student Jerome Elder
Savannah College of Art & Design
Department of Architecture





Designing involves many scales, not just the seductive macro one. In this project, I developed a series of building details that reinforced that macro form's idea of wrapping and fracture. At this scale, much more pragmatic issues reveal themselves, begging to be developed through sectional drawings.
[Architecture student's statement]

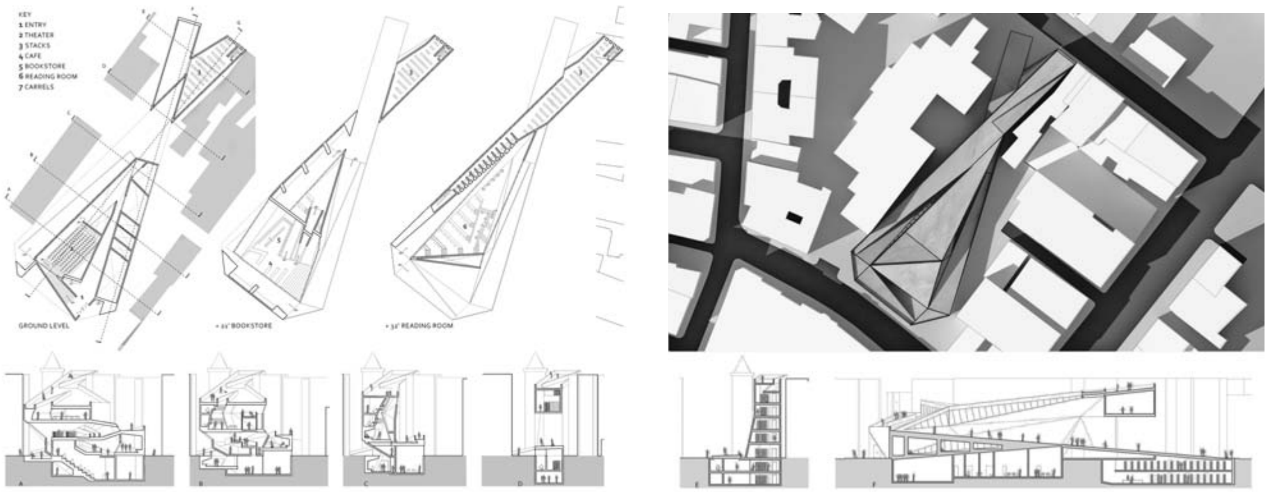
Drawings: Sectional studies
Cambridge, Massachusetts
Media: Rhino and AutoCAD
Courtesy of student Drew Cowdrey
Harvard GSD, Spring 2010
Professor: Jonathan Levi



Drawings: Old Fort Niagara, Buffalo, New York
Media: Model—pulp board, balsa wood sanded by hand, and thin Plexiglas
Project Coordinator: Merdad Hadighi
Studio Professor: James Lowder
Courtesy of student Ryan T. Glick
Department of Architecture
School of Architecture and Planning
State University of New York at Buffalo

During design development, this section model proved to be an integral tool into the examination between interior and exterior circulation. Examining the wall as a mediating inhabitable spatial condition rather than a thin envelope required sectional development that led to the opening of the facade toward views directed at key moments in the surrounding context. Analyzing circulation through sectional studies allowed for a sinuous vertical progression, while simultaneously analyzing in plan by moving from inside to outside.
[Architecture student's statement]

This very interesting project began as a conceptual design exercise. The cardboard study model gave the design a monolithic appearance without materiality. The use of very thick walls with slit cutouts opened the possibility of using small masonry units. Identifying this as the building material of choice gave scale and texture to the form. This, in turn, prompted a structural investigation concerning how to hold up the masonry units.

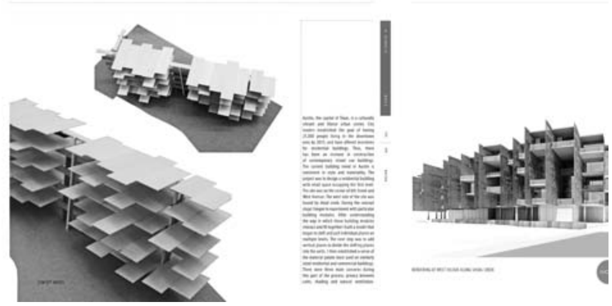


Student portfolio excerpt: A rare books library, Boston, Massachusetts
Media: Rhino, AutoCAD, and V-Ray
Project Coordinator: Danielle Etzler at Harvard GSD
Courtesy of student Drew A. Cowdrey and Professor Andreas Luescher
Bowling Green State University, Architecture Department

The site for this project forced me to address the city on not one or two sides, but four. Developing the project's relationship to the city and its program through a series of sections allowed me to generate specific episodes that were then joined together. The result is highly figural while still being responsible. [ARCHITECTURE STUDENT'S STATEMENT]

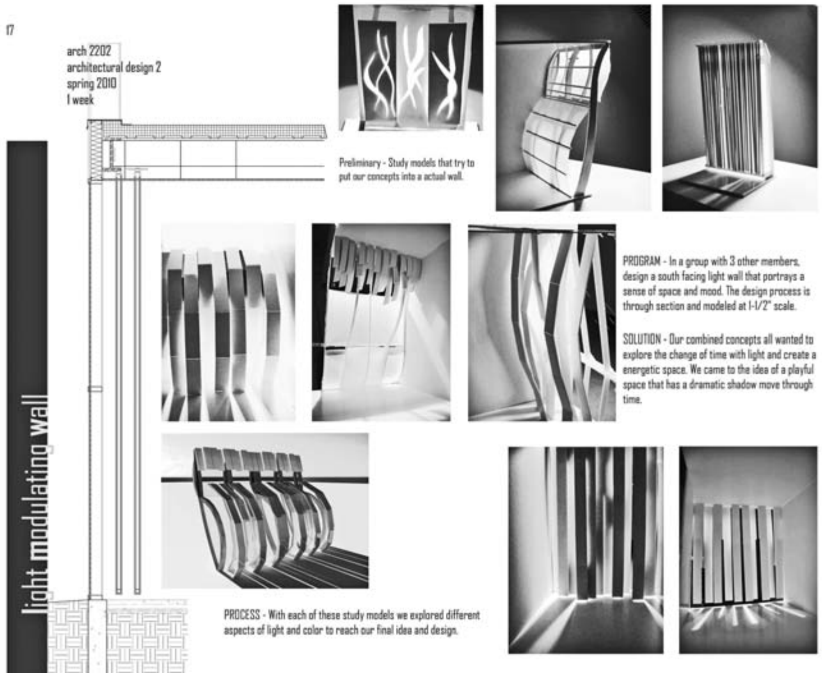
Student portfolio excerpt: Urban Infill, Chicago, Illinois
Media: AutoCAD, Google SketchUp, and Photoshop
Studio Professor: Mark A. Pearson
Courtesy of student Bojana Martinich
College of DuPage, Department of Architecture

The Urban Infill is a studio project with a limited site footprint that challenges students to design vertical spaces in section, rather than focusing strictly on the building floor plan. The design process for this project encourages students to understand and develop their design work using the section drawing as the primary design tool. Sections are used both to develop the spatial characteristics of the design as well as to understand natural daylight penetration at various times throughout the year. [PROFESSOR'S STATEMENT]



Images: Study models, drawings, and section study for
Austin Mixed-Use: Residential and Retail
Austin, Texas
Medium: Rendered and drawn in Revit
Courtesy of student Chris Snowden
Savannah College of Art and Design
Department of Architecture

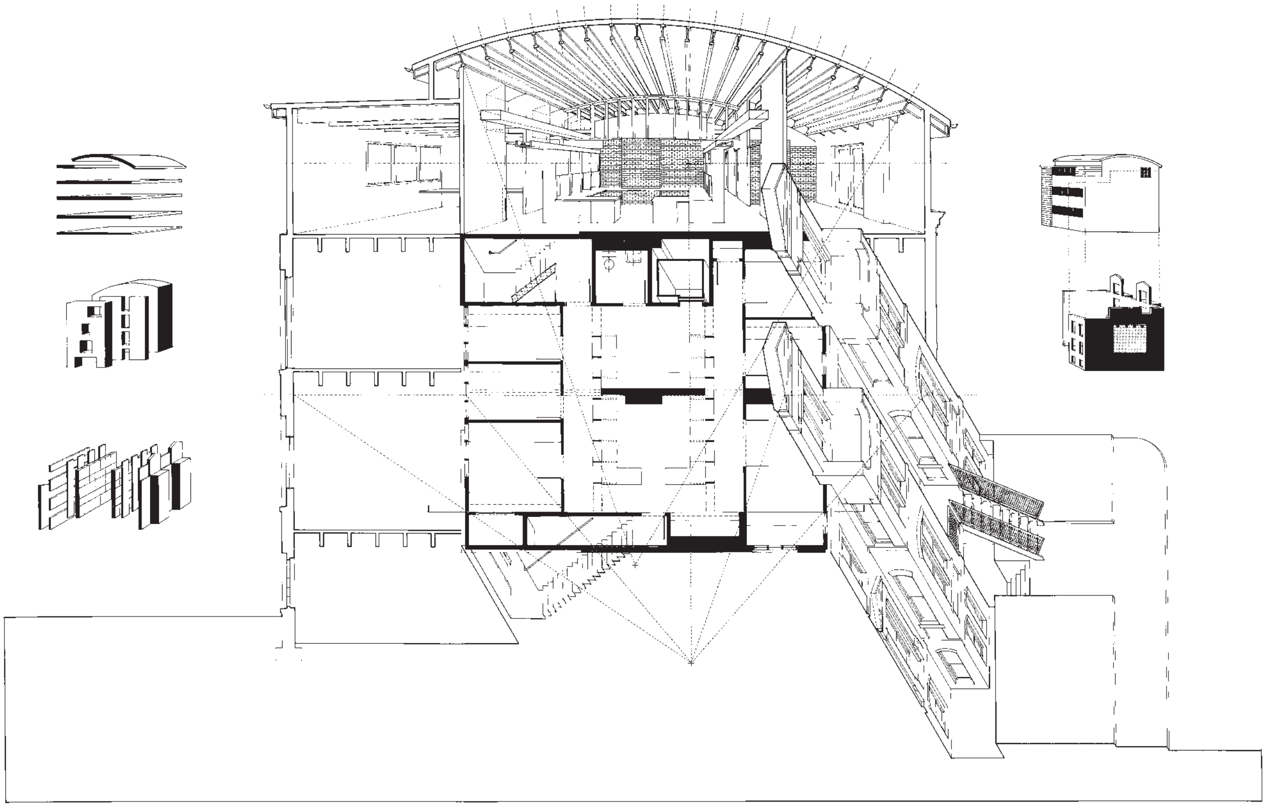
Axonometric sections are the ultimate expressive visual aids a student or professional can utilize to reveal the structure, layering, materiality, and the connections between spaces. Axonometric sections complement the 2-D plans and sections, thus allowing for a clear explanation of the entire building. The individual apartments that comprise the building include a 1-bedroom/1-bath, 2-bedroom + study/2-bath, 2-bedroom/2-bath, and 3-bedroom/2-bath. Each of these four apartment types are showcased in the 3-D axonometric section. [ARCHITECTURE STUDENT'S STATEMENT]



Media: Hand sketching, physical architectural models, AutoCAD drawings, and Google SketchUp + 3D Max for light simulations
Courtesy of student Damian Rozkuszka
Studio Professor: Mark A. Pearson AIA, LEED, AP
College of DuPage
Department of Architecture

LIGHT-MODULATING WALL

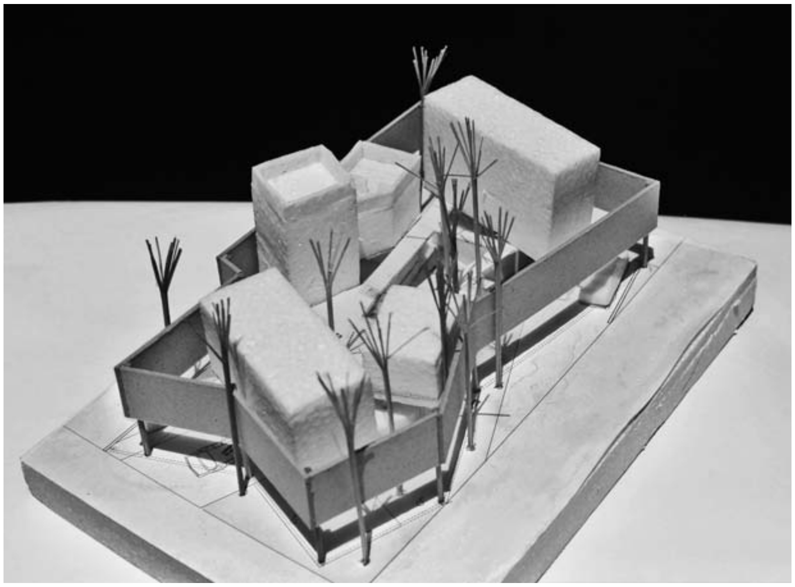
The objective of this project is for students to design a space with a sense of place through the modulation of natural daylight, using the section as the primary design tool. Students are asked to design a south-facing wall section that creates a poetic and memorable space defined by light. Throughout the design process students utilize freehand sketching, architectural section drawings, computer simulations, and large-scale models to test and develop their designs. The physical models are photographed under natural daylight conditions as a means to record and understand the effectiveness of the design. Students are expected to develop their designs in response to the knowledge gained through the model photography process. [Professor's statement]



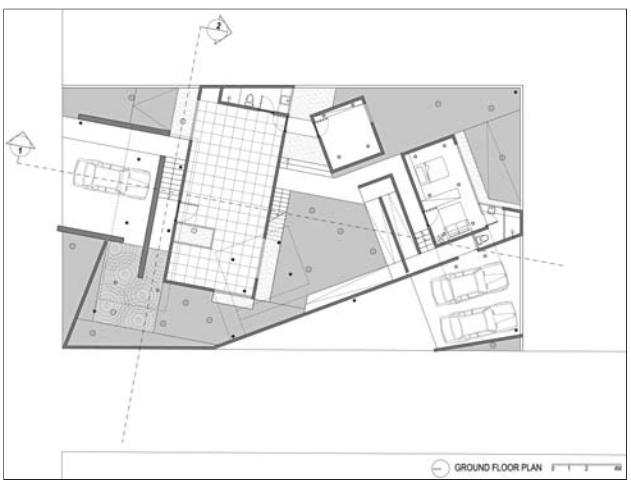
Drawing: National Minority AIDS Council, Washington, DC
30" × 42" (76.2 × 106.7 cm), Scale: ¼" = 1'0"
Medium: Ink on Mylar
Courtesy of Vyt Gureckas/CORE

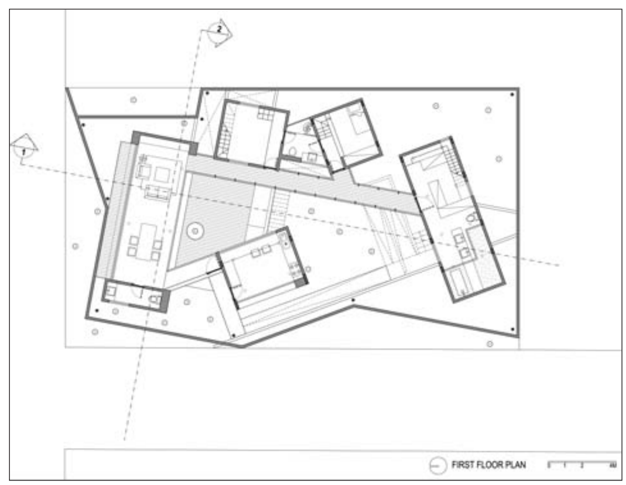
The inadequacy of representing a three-dimensional artifact in two dimensions has traditionally been overcome by generating a number of different drawings. However, the act of reconnecting the various drawings or views is left to the mind. Cubism has offered an alternative to this process by presenting simultaneous views on one surface. This drawing is an attempt to take advantage of such a strategy, but whereas cubism relies on transparency and incidental juxtaposition, this drawing employs a more precise set of tangent lines or shared edges to graft one drawing to another. Construction lines are left in place to underscore this process of delineative reconstruction.
[Architect's statement]

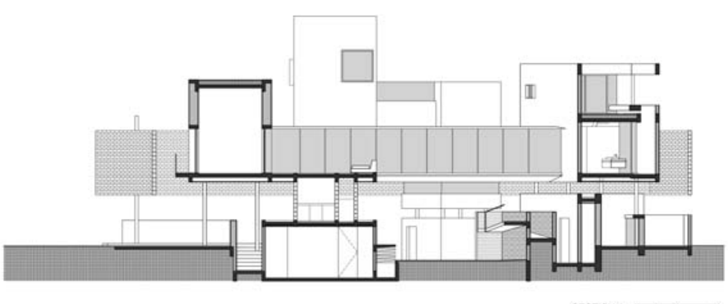
The ultimate goal of a composite presentation is to effectively combine the different types of drawing conventions and explanatory text that are being utilized. This will be dependent to a large degree on restrictions on the size and shape of the presentation panel(s) as well as the organizational method chosen for combining the drawings (grid, toned background, radiation and rotation, central focus, etc.). This *hybrid* presentation combines a one-point perspective section with a floor plan and a nonvertical z-axis plan oblique. Scan the ingenious and well-thought-out single- and multipanel presentations in Chapter 8 for hints on how to approach your own presentation format problems.

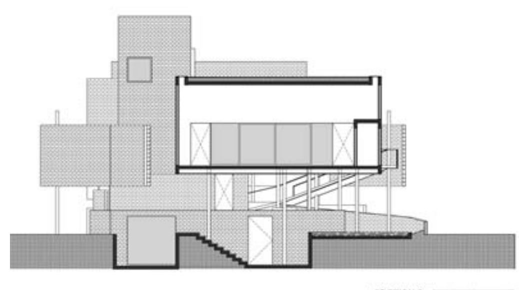


Drawings and model photo: I & L RESIDENCE
Tangerang, West Java,
Indonesia
Courtesy of Andra Matin Architect

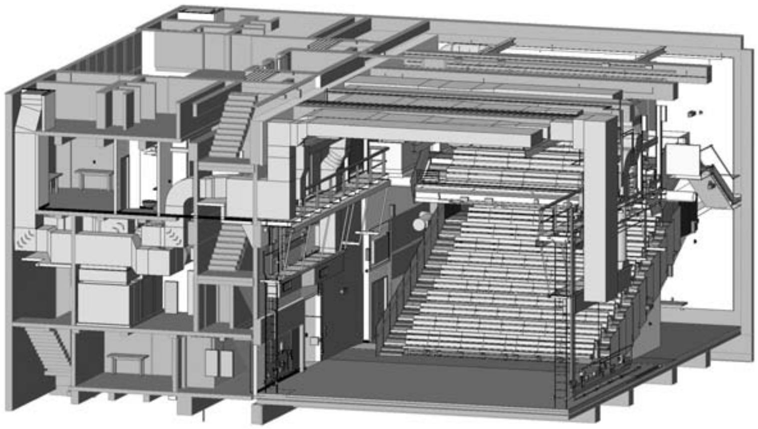


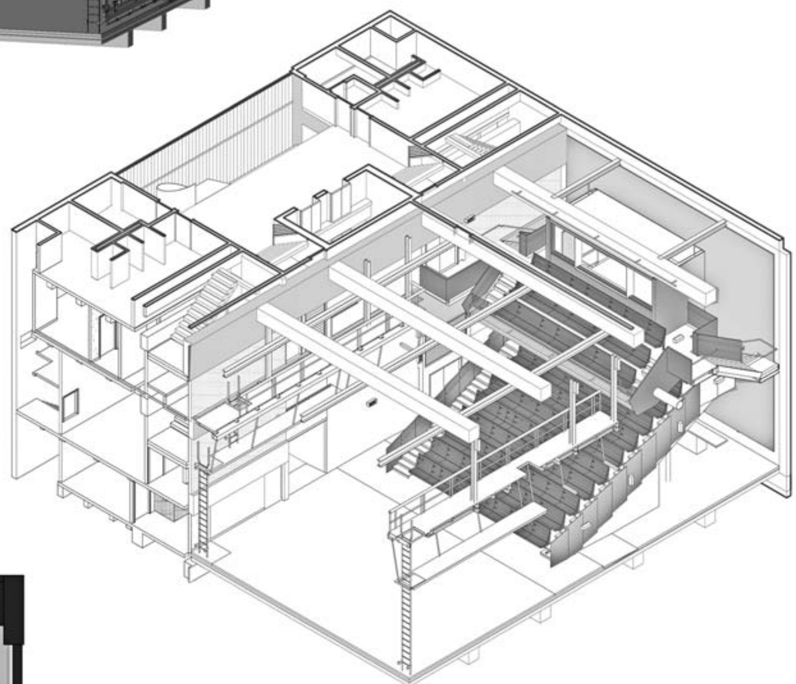


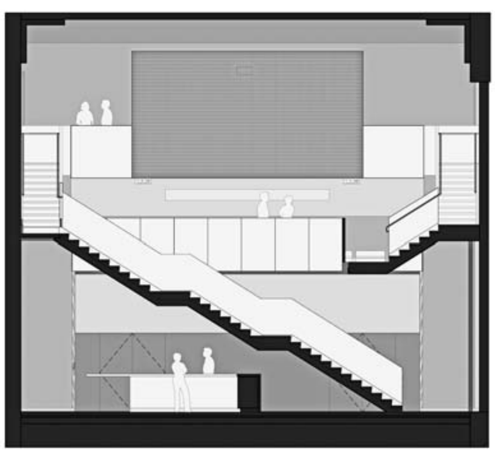




This is an outstanding example of transverse and longitudinal sections taken through a building. The selected locations of the section cuts and the direction of views clearly reveal a lot of information about the residence. When selecting locations for section cuts, always think of conveying the maximum amount of information about your design. A deviation from this approach may present itself if the building is symmetrical in that case common sense would dictate cutting a section along the axis of symmetry.

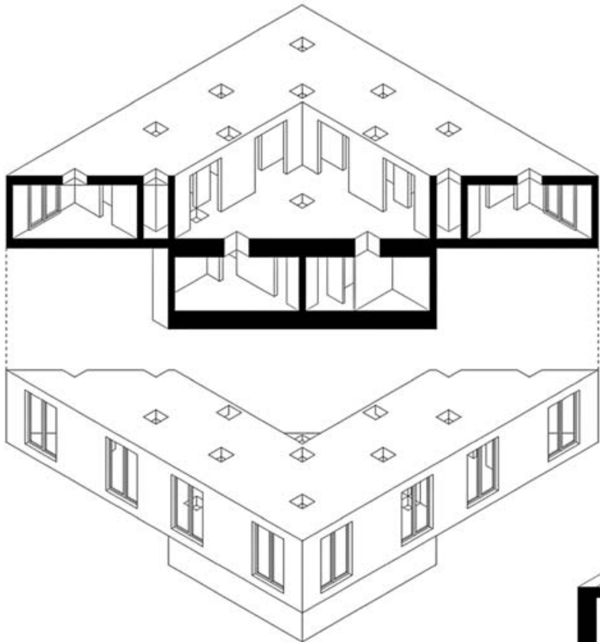






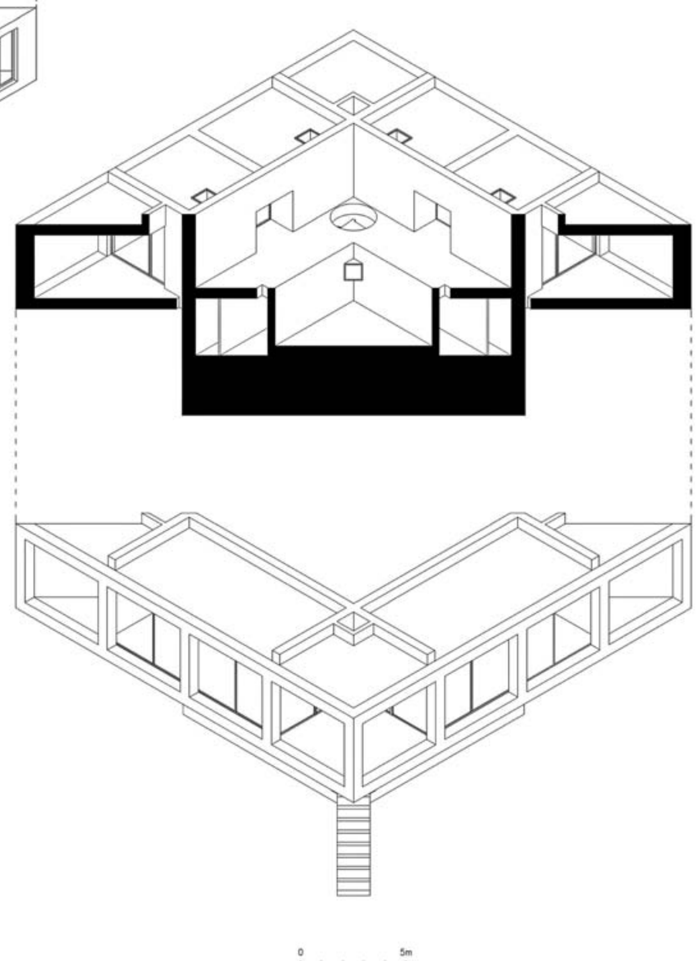
Drawings: Jerome Robbins Theater
New York, New York
Medium: Computer-generated
Courtesy of WASA/Studio A, LLP
Building design consultants: ARUP

In this excellent example, a 2-D section cut was taken through the theater lounge and two 3-D axonometric (section-plan) cuts were taken. One axonometric, which approximates an isometric drawing, allows the viewer to see intricate spaces within this building. The other axonometric, which is a dimetric drawing, allows the viewer to comprehend the mechanical systems in the building.



SOLO HOUSE
This is a singular piece that occupies a dominant position in the landscape. It is a horizontal figure separated from the ground. A sculptural structure, unitary and monolithic, that is supported by a blind podium. An elevated condition visible from a distance and another that disappears under the foliage. The platform's aerial world establishes its own cardinal directions. A perimeter ring, a panoramic rotunda measured by sixteen columns at regular distances, is occupied by a sequence of rooms with informally defined functions.

Drawing: Guna House
Llacolen Lagoon, San Pedro, Chile
Medium: Pen and ink
Courtesy of Architects: Pezo von Ellrichshausen
Status: Expected completion, 2012



SOLO HOUSE (cont.)
Transparent and symmetrical rooms articulated by open corners. There is a portico too narrow as to hold a static room and too deep as to hold a vigilance balcony. On the platform's aerial world there is a single interior room. This room has no roof. It is barely perforated in all four directions of the landscape and its base is occupied by water, a volume of water as profound as the high that separates the house from the natural ground. This contained water, the softest patio known, always finds the way to move the sky to the bottom of the earth. [ARCHITECT'S STATEMENT]

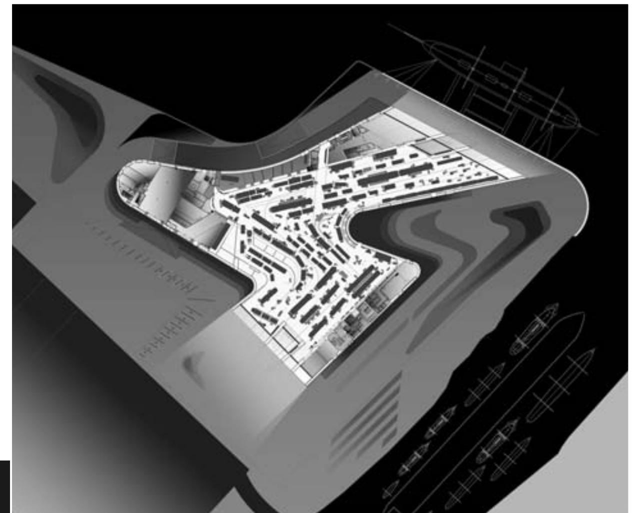
Drawing: Solo House
Cretas, Teruel Province, Spain
Medium: Pen and ink
Courtesy of Architects: Pezo von Ellrichshausen

Both of these drawings show a diagonal section cut through the building that allows the observer to peer inside. The front half of each building is dropped vertically after the slice is made. Note the use of small dashed lines or dots on the vertical showing the line of displacement after the drop.

Located where two rivers meet, the museum is a mediator between Glasgow and the rivers. The design is a sectional extrusion, with the section cuts at open ends looking like the cityscape or waves on water.

The design, combining geometric complexity with structural ingenuity and material authenticity, continues Glasgow's rich engineering traditions and will be a part of the city's future as a centre of innovation.
[Architect's statement]

Drawings: Riverside Glasgow Museum of Transport
Glasgow, Scotland
Media: Rhino, Maya, and AutoCAD
Courtesy of Zaha Hadid Architects



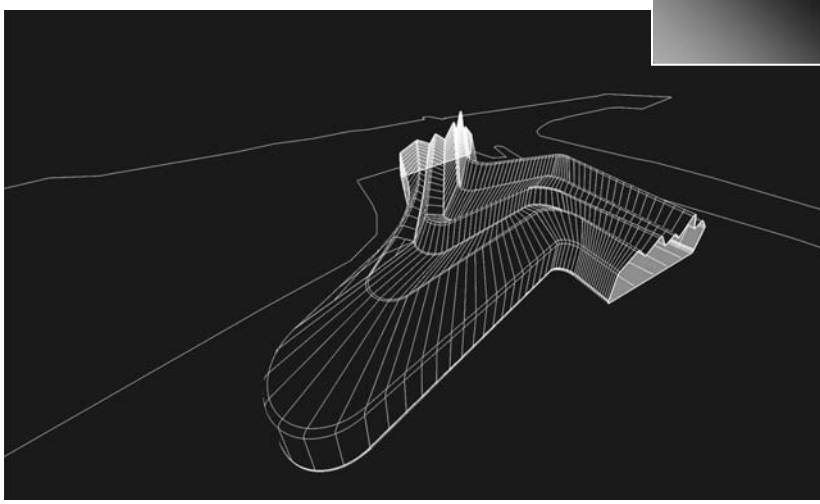


Photo © McAteer photograph / Alan McAteer
Courtesy of Arcspace

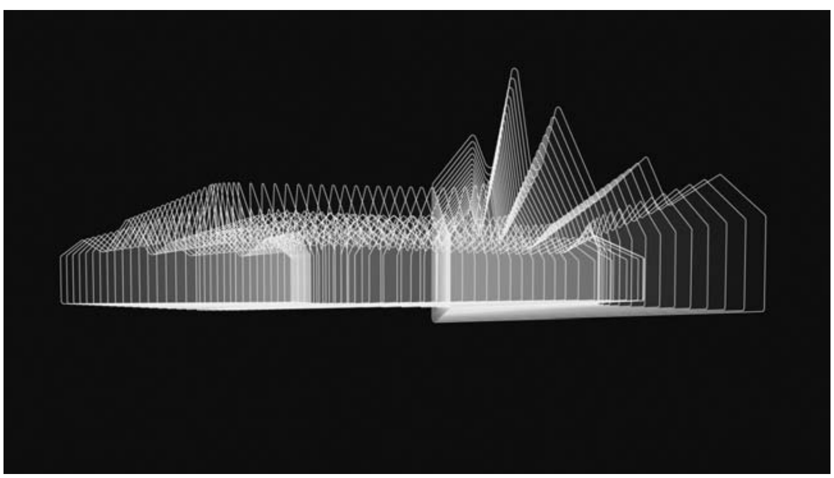
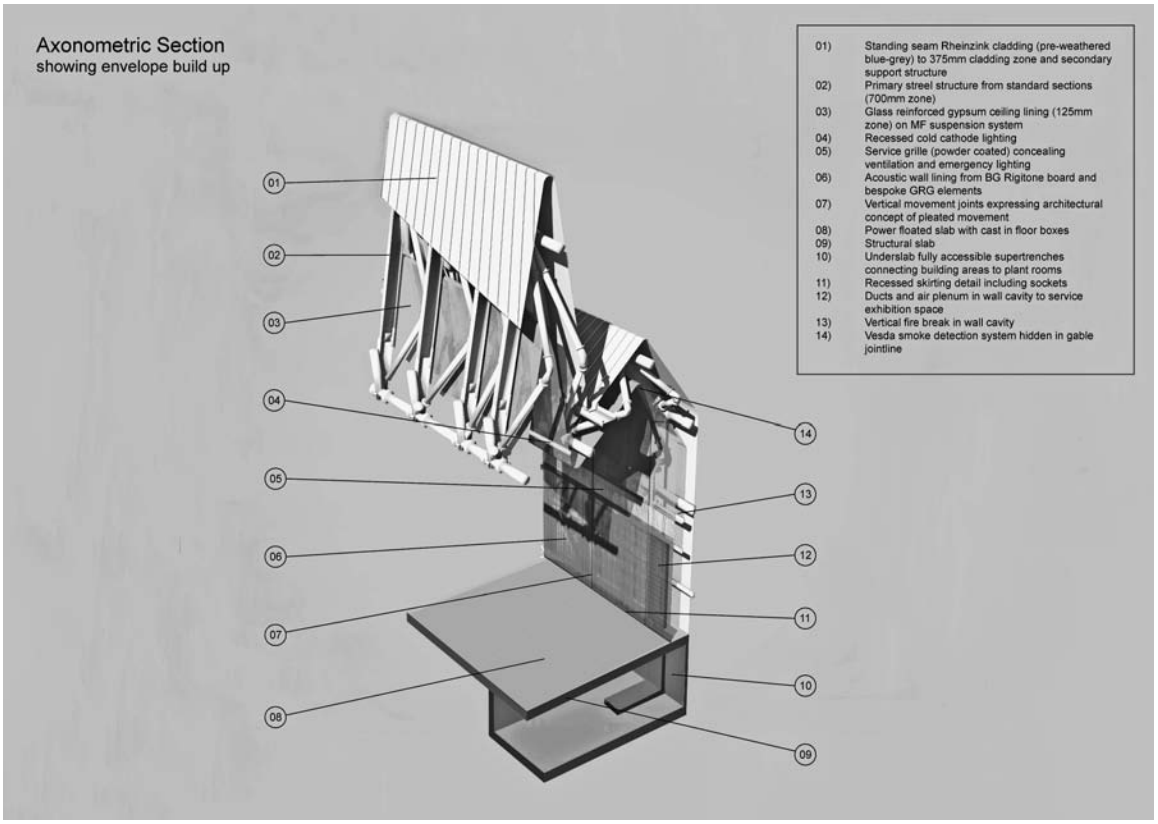
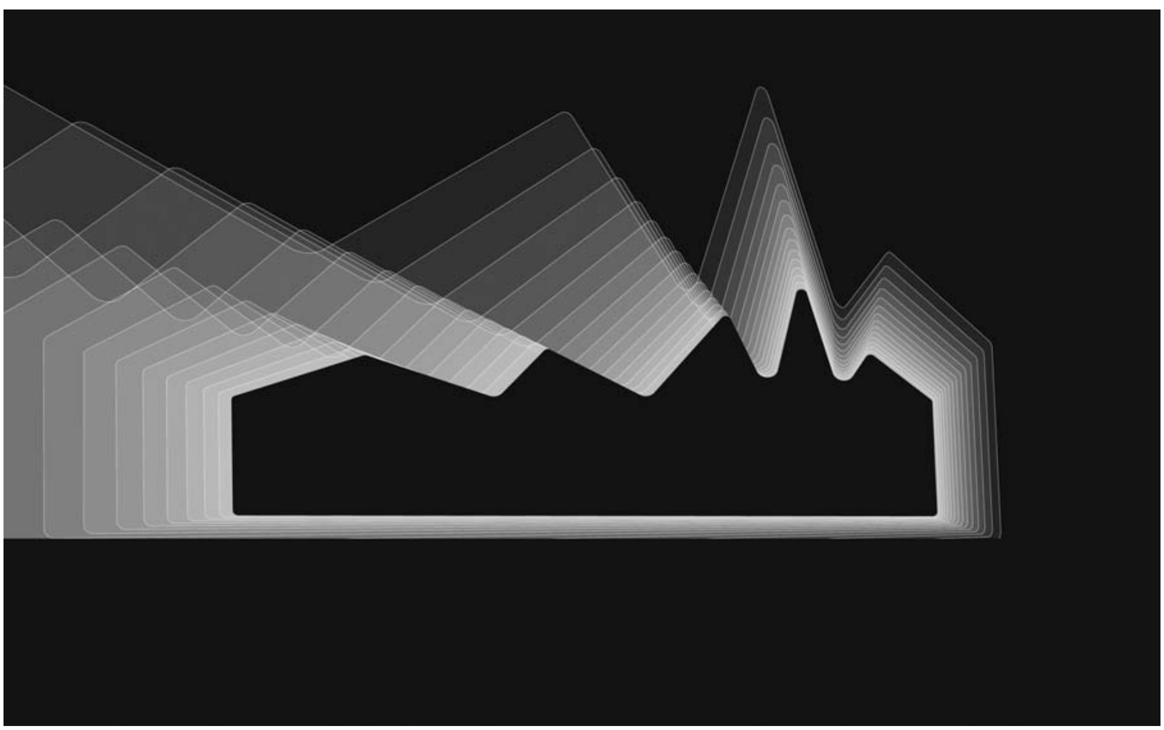


Photo © McAteer photograph / Alan McAteer
Courtesy of Arcspace

Sections can also be seen in digital wireframe drawings, as illustrated in this beautiful example. Wireframes and/or simple 3-D images such as these are very effective in the formulation of design ideas in three dimensions. Any audience without formal exposure to architectural drawings tends to look at a plan drawing very much like a map. When a plan drawing is extruded as a 3-D object, it kindles the start of a dialogue between the designer and the users. The advantage of using this kind of diagram in architectural communication early on is that it avoids the significant upfront work required for a floor plan with details. It aids the designer in posing a variety of options to facilitate initial discussions as well as engaging the client and users with design alternatives.





Axonometric section and wireframe drawing: Riverside Glasgow Museum of Transport
Glasgow, Scotland
Media: Rhino, Maya, and AutoCAD
Courtesy of Zaha Hadid Architects

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About the Author

RENDOW YEE, Professor Emeritus, received his education at the University of California at Berkeley and at Washington University in St. Louis, where he received his master of architecture degree. He was involved with architectural education for more than twenty years at the City College of San Francisco and served as chair of the architecture department there from 1982 to 1990. Professional organizations with which he has been affiliated include the American Society of Civil Engineers, the American Society for Engineering Education, the American Institute of Architects, and the California Council of Architectural Education.

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