designing with models

A Studio Guide to Making and Using Architectural Design Models, Second Edition

CRISS B. MILLS

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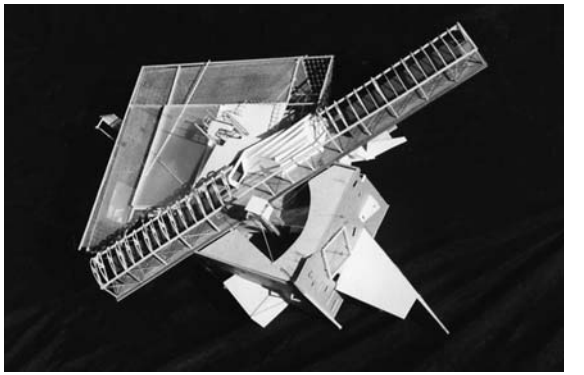
Cover images: *top row left:* Pittsburgh Children's Museum courtesy of Mack Scogin Merrill Elam Architects; Kimo Griggs Architects; *top row center:* Clemson University, College of Architecture Arts and Humanities courtesy of Studio Critic Keith Green; design by Steven Kendall Keutzer; *top row right:* Musée des Confluences, Lyon, France, courtesy of Coop Himmelb(l)au; *center:* Fine Arts Center, University of Connecticut at Storrs courtesy of Mack Scogin Merrill Elam Architects

FOREWORD

This book is about using the architectural model as a tool for discovery. When used as an integral part of the design process, study models are capable of generating information in time comparable to drawing and offer one of the strongest exploration methods available. The strategies and techniques presented here provide a broad range of options. However, because this book is primarily concerned with the design process, elaborate presentation models are not stressed. Instead, work is explored with quick-sketch constructions and simple finish models that can be built with materials suitable for studio or in-house construction. Although most of the projects are approached from an architectural perspective, the techniques apply equally well to three-dimensional artwork and industrial design.

There are several reasons why models should be part of every design process. Perhaps the most important one is the understanding to be gained by seeing form in physical space. This physical presence allows the designer to interact directly with the model and obtain instant feedback. Another benefit inherent to physical models, as opposed to computer drawings, is the relationship they share with buildings by existing in the world of dynamic forces. While the correspondence is not an exact analog, physical models can be used to predict structural behavior. This role is traditional in the case of models made for wind tunnels and ship design. Finally, the communicative power of the physical model overcomes problems inherent in conveying three-dimensional computer drawings to a gathering of clients.



INTRODUCTION

Since the first publication of this book, several changes have taken place in the design industry that need to be addressed.

The most notable change is the use of digital information for the development of design and communication. Accordingly, the information concerning digital modeling programs has been updated, along with the interface between modeling programs and the growing use of rapid prototyping processes.

With the advent of rapid prototyping, a hybrid has emerged that bridges the limitations of computer modeling and points to a future in which it will be possible to exploit the strong points of both methods. An introductory discussion of rapid prototyping can be found in Chapter 8 as well as a number of examples in Chapter 7.

Another important shift in technology is the use of digital media to record and present design work. Cumbersome tasks such as copying, modifying, and superimposing images have become quicker and less expensive. An introduction to digital equipment and design software can be found in Chapter 8.

Other topics undergoing revision include new examples of student projects as well as urban and industrial design models.

MODEL HISTORY

During Egyptian and Greco-Roman times, architectural models were made primarily as symbols. In the Middle Ages with the advent of the cathedrals, masons would move through the countryside carrying models of their particular expertise such as arch building. During the Renaissance, models were used as a means to attract the support of patrons (as in the case of the Domo in Florence, Italy). As architectural education became dominated by Beaux Arts training, models were supplanted almost completely by drawing. Architecture was conceived in large part as elevation and plan studies, with three-dimensional media having little relevance. However, by the late 1800s, architects such as Antonio Gaudi began using models as a means to explore structural ideas and develop an architectural language. By the turn of the century, the seeds of modern architecture had begun to take root. With it came a perspective that looked at architecture as the experience of movement through space. Orthographic and perspective drawing were recognized to be limited exploration methods, giving rise to the model as a design tool. In the 1920s and 1930s, the Bauhaus and architects such as Le Corbusier elevated the use of modeling to an integral component of architectural education and practice. During the 1950s, modernism embodied form by translating highly reductive designs into one or two simple Platonic solids (cube, cylinder, etc). With this shift, beyond providing a means of apprehending scale and massing, the model's role began to wane. As the hegemony of corporate modernism was fractured in the late 1970s, spatial exploration followed a number of new branches and the model regained its position as a powerful tool for exploration. In the early 1990s, the model's role was challenged by a shift in technology. At this point, it was suggested that CAD and modeling programs could substitute digital simulations for all experiences.

While many of the advantages offered by digital media did prove to offer positive benefits, the condition of removal inherent to the virtual experience could not be easily overcome. In reaction to the problem of removal, Ben Damon, an architect with Morphosis (a pioneering office in rapid prototyping), responds to the idea of a completely digital modeling environment by stating, "Physical models will never go away." He goes on to add that the immediacy and direct relationship offered by the physical model play a vital role in design development. Similar sentiments are echoed by James Glymph with Frank Gehry Partners LLP. In regard to digital modeling, Mr. Glymph points out that "it would be a serious mistake to think it could replace models and drawing entirely." With these realizations has come a resurgence of interest in traditional physical models and the introduction of rapid prototype models aimed at reconnecting digital and physical design methods.

CONTENTS

START

Equipment, Materials, and Model Types

This chapter includes the basic equipment and model definitions needed to prepare for modeling. Although an effort has been made to employ common terms, in the absence of industrywide standardization, alternate or overlapping definitions may be encountered in different studio settings.

The equipment and materials presented in this chapter are appropriate to basic study models. For additional information on materials and equipment, see Chapters 5 and 8.

Equipment

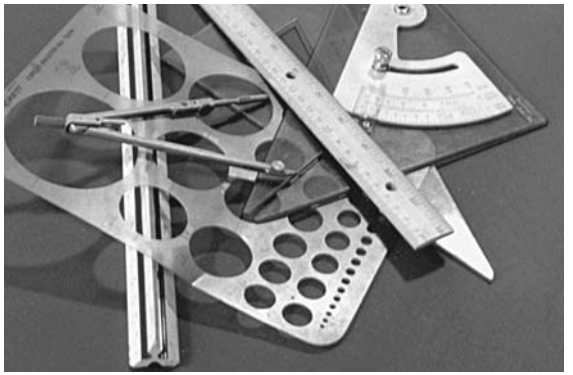
The equipment used for the majority of modeling needs is divided into two sets.

Basic Equipment

This equipment can be very simple and is adequate for most modeling tasks.

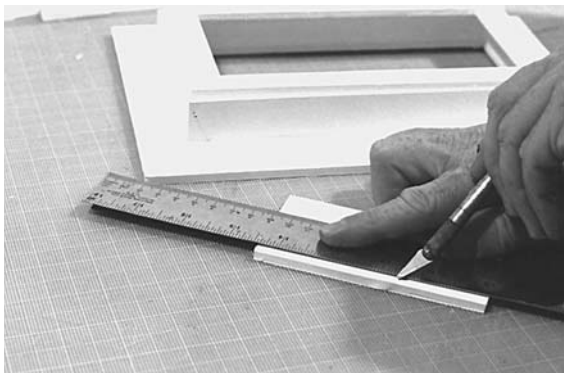
Expanded Equipment

This equipment can make the job easier and help with specialized tasks. For additional equipment, see Chapters 5 and 8.

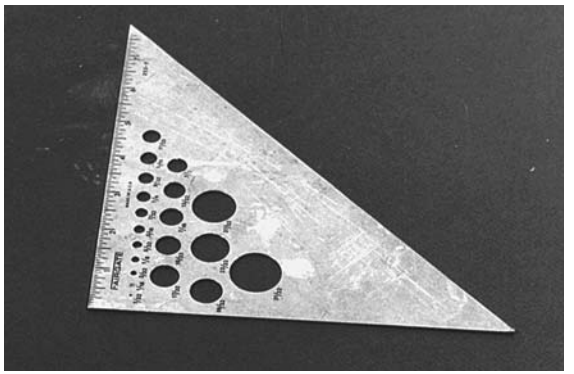


Drafting Tools
A set of common drawing tools used to lay out the model parts.

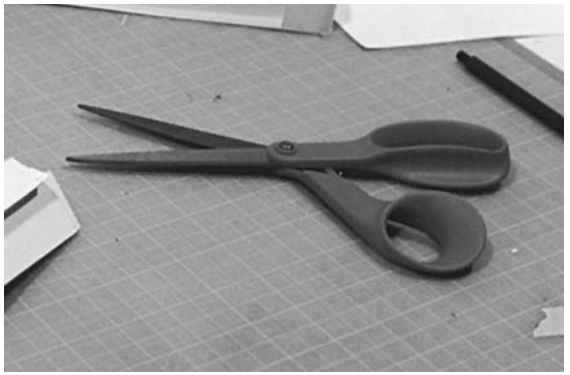
X-Acto Knife and No. 11 Blades
The primary knife. Keep knife sharp with frequent blade changes. Blades are most economically purchased in packs of 100.



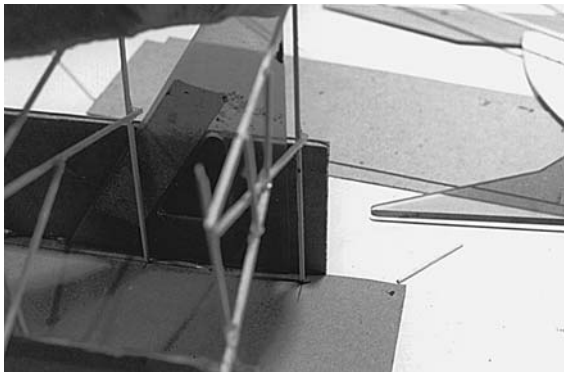
Steel Ruler
The primary cutting edge. The ruler should have a nonslip cork backing. For economy, a wooden ruler with a metal edge can be used. Avoid aluminum rulers, as they will dull knife blades very quickly.



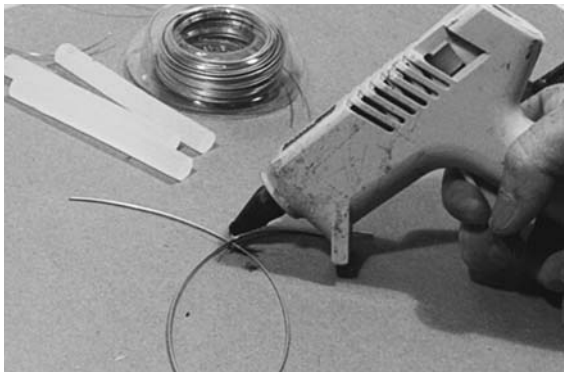
Metal Triangle
Used for right-angle cuts and drafting with the knife. Unfortunately, most metal triangles are made of aluminum, but plastic triangles with steel edges can be found at some suppliers.



Scissors
For quick study models and editing cuts.

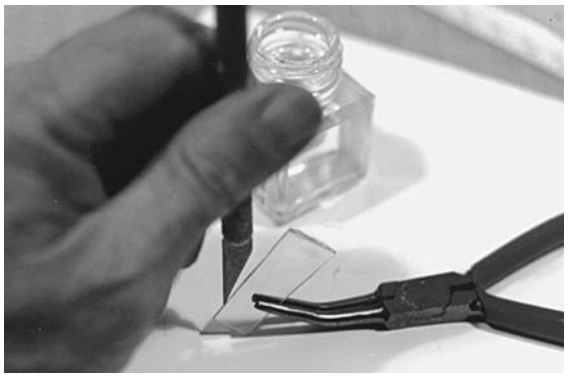


Small Plastic Triangle
Used to square and level model parts for accurate assembly.

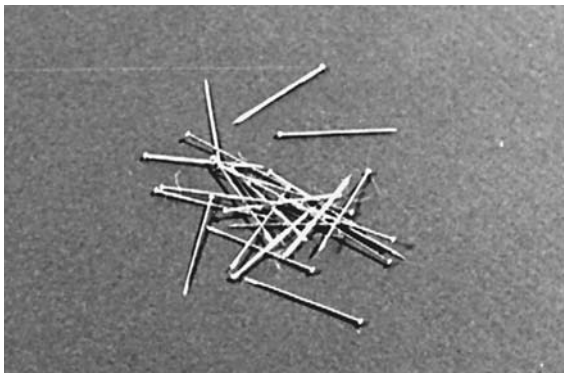


Hot Glue Gun
For quick assembly and hard-to-glue materials like metal. Can be very messy and is not well suited for finish work.

White Glue
The primary adhesive. Keep in a pool on scrap board to air-dry for working thickness. Apply sparingly with a cardboard strip to material edge.

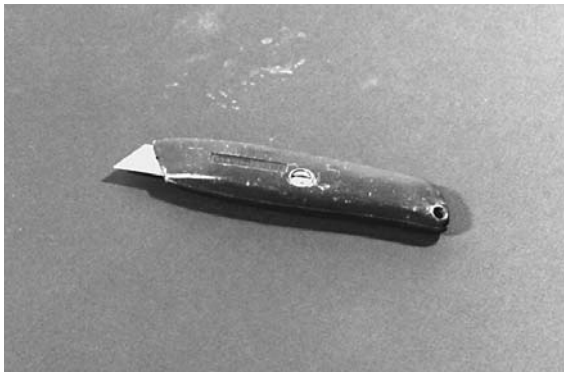


Acetate Adhesive
Used for Plexiglas. A drop on the end of a knife blade can be applied by dragging the blade along the edge of the Plexiglas.

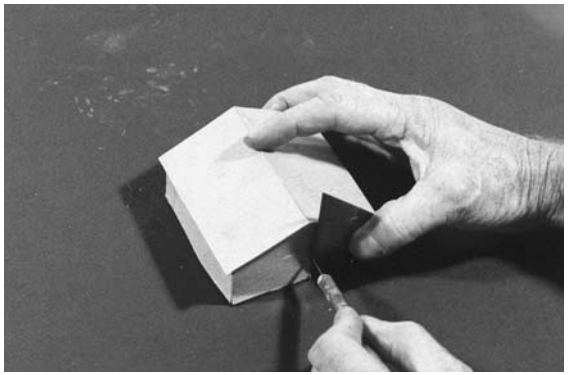


Straight Pins
Used to attach parts while glue is setting. Pins can be pulled, set for reinforcement, or cut off with side cutters.

Artist Spray Adhesive
Used for attaching paper surfaces that will buckle with white glue. A very light coat on plans allows them to be used as templates. Avoid hardware store adhesive sprays, as they are too strong for this use.

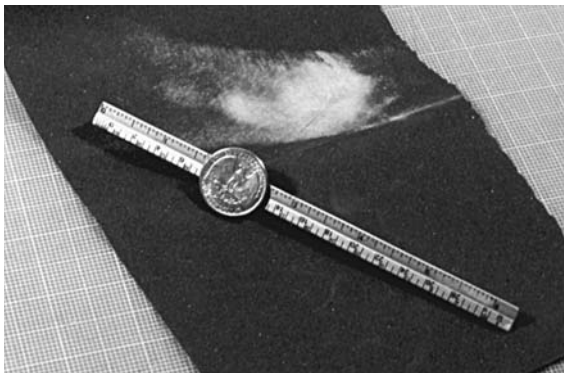


Matte Knife
For cutting very thick materials. The blade thickness on this tool is not suited for fine work.



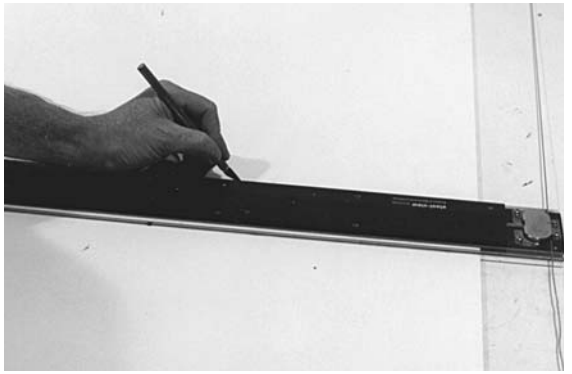
Small Metal and Plastic Triangles
Can be used to align model parts for gluing and for making accurate modification cuts directly on the model.

Drafting Tape
Used to attach parts while glue is setting. Avoid masking tape, as it will tear paper surfaces.

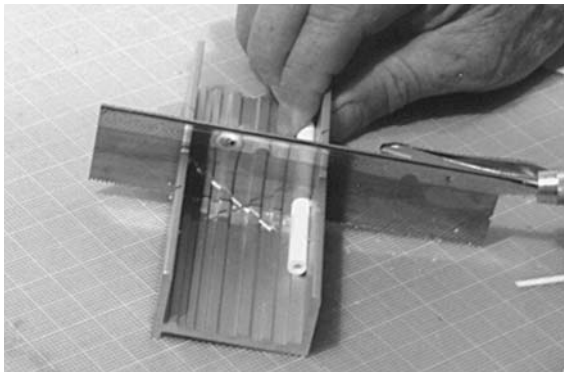


Small-Scale rule with End Cut Off
Used for taking measurements directly from the model. A scale can be drawn on a wooden stick to serve the same purpose.

Needle-Nose Pliers
Used for delicate work and as an inexpensive third hand.



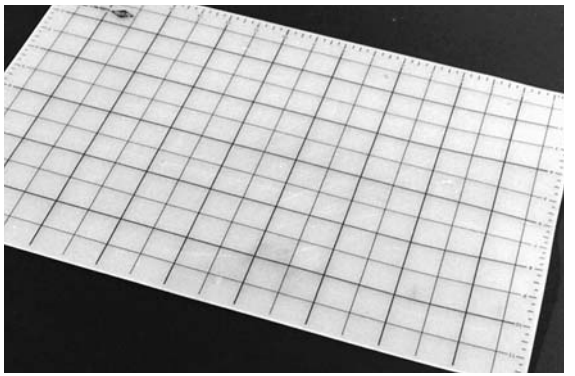
Steel-Edge Parallel Bar
Makes cutting parts much faster. Useful for manufacturing multiple pieces of the same pattern.



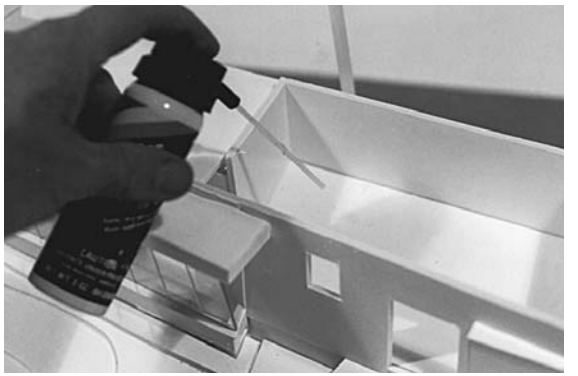
Modeling Saw and Miter Box
Used for clean cuts on small blocks and rods as well as angle cuts.

Rolling-Style Pizza Cutter
Used for transferring drawing lines to modeling surfaces. Roll cutter along lines to leave traces in modeling material. Cutters with pointed edges work best.

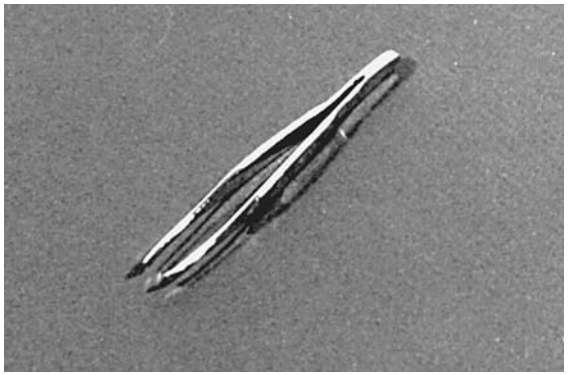
Sandpaper
Sandpaper can be used to level and remove the burrs from cuts.



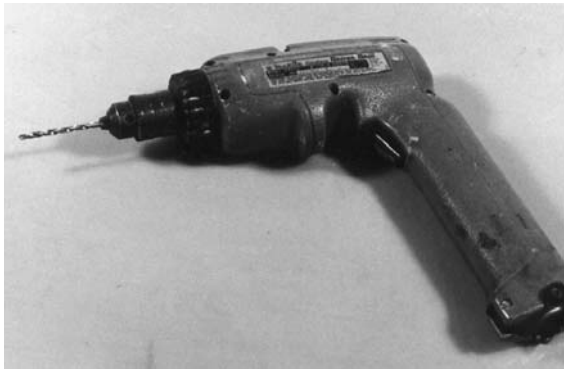
Vinyl Cutting Matte
Used to save drawing-board surfaces.



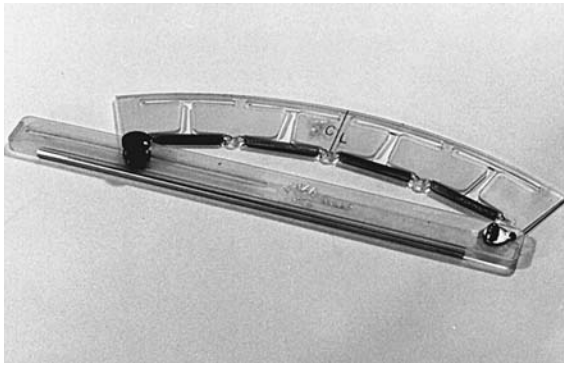
Canned Compressed-Air Cleaner
For cleaning dust off models. Works well for hard-to-reach inside corners.



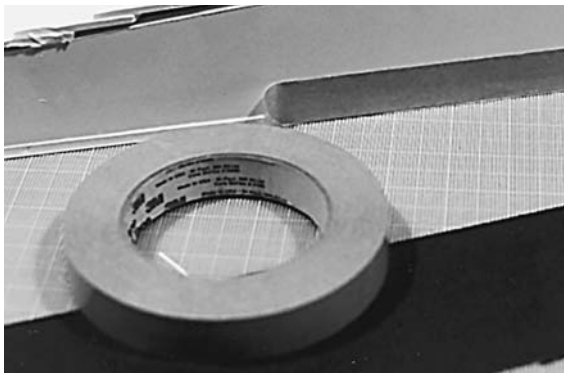
Tweezers
Used to handle delicate parts.



Electric Drill and Small Bits
Used for gang-drilling multistory column holes in floor plates and other special holes.

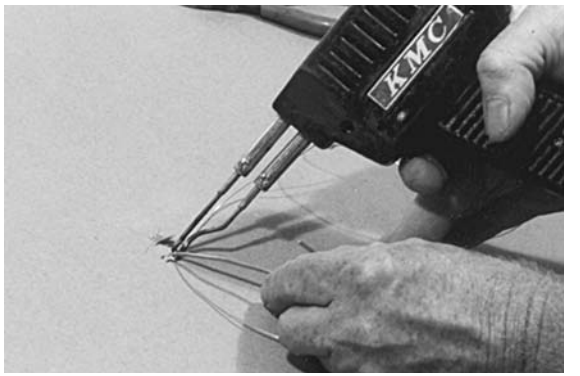


Acu-Arc
Used for drafting smooth, scaled curves.

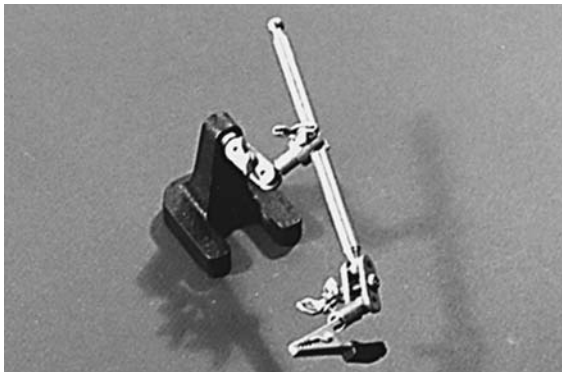


Double-Face Transfer Tape
Used to attach paper without the buckling tendencies of white glue.

Side Cutters
For cutting pins and wire.



Soldering Gun
For soldering copper and steel wire. *Note:* Use rosin-core solder.



Third Hand
Helps hold parts for gluing, drying, and other tasks.

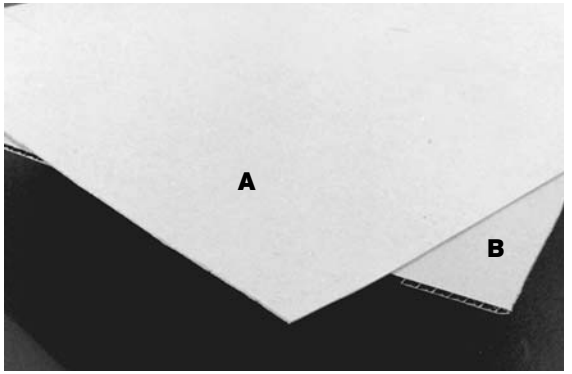
Soldering Iron
An inexpensive alternative to a soldering gun. Small irons like this produce comparatively little heat. They can be used by waiting longer for materials to heat up.

Materials

The following section describes the basic materials used for the majority of modeling tasks. Many choices are available; however, for the purpose of this book, the primary focus is on inexpensive, easily manipulated paperboard materials. See Chapters 5 and 8 for additional materials.

Material Considerations

- The speed with which the model is to be built
- The degree of modification and experimenting desired
- The ability of a material to hold its shape or span at scale modeling distances
- The thickness of the scaled component the model is intended to reflect

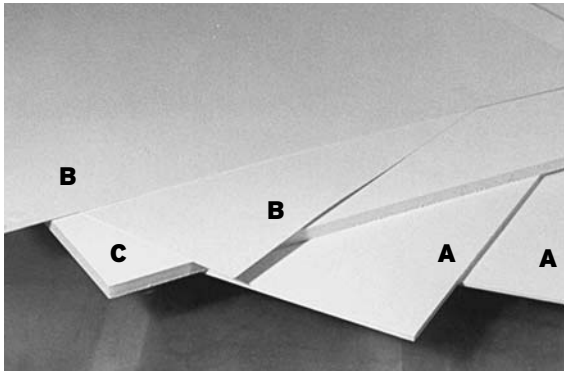


A–Gray Chipboard

- Available in two- or four-ply
- Inexpensive
- Cuts easily
- Spans moderately
- Thicker plys hard to cut
- Rougher finish
- Interesting alternative to whiteboards

B–Corrugated Cardboard

- Sheets are usually ⅛ in. thick
- Rough finish provide
- Interesting alternative
- Inexpensive and cuts easily
- Spans larger spaces well
- Reflects material thickness of midsize to larger models
- Can mock textured surface if top layer is removed



A–Foam Core

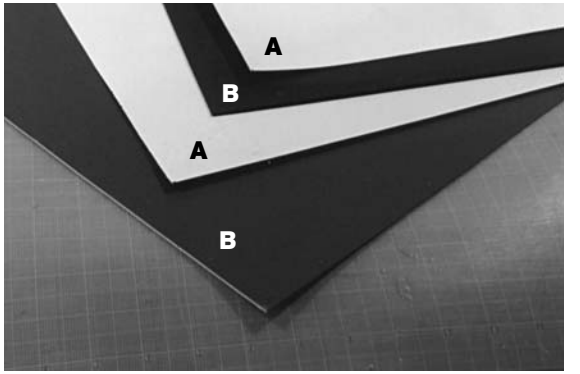
- Available in 1/16-, ⅛-, 3/16-, ½-in. thicknesses
- Finished in appearance
- Cuts easily
- Suitable for large scales
- Can be matched to scale thickness

B–White Museum Board (Strathmore)

- Available in two-, four-, five-, and six-ply thicknesses
- Finished in appearance
- Relatively expensive
- Easy to cut
- Thinner plys not suitable for large spans

C–Gatorboard

- A thick, tough board similar to foam core
- Used primarily for model bases
- Finished in appearance
- Very difficult to cut



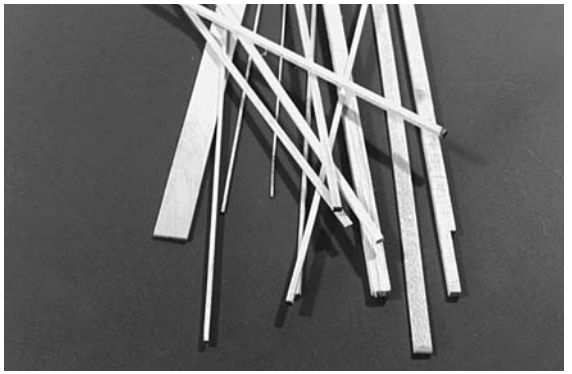
A–Poster Paper

- Similar to thin museum board
- Inexpensive
- Available at drugstores and office supply stores
- Reasonably finished in appearance
- Suitable for small models
- Easy to cut
- Spans poorly

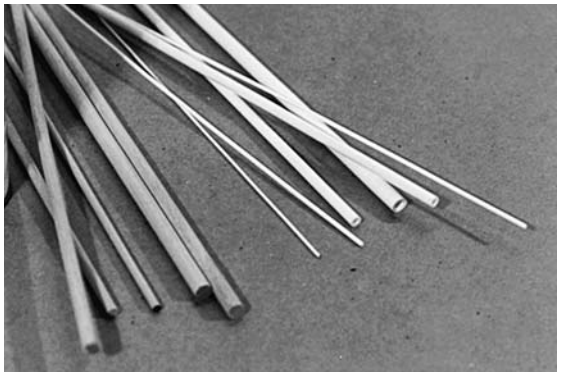
B–Colored Matte Board

- Similar to four-ply chipboard
- Takes several passes to cut
- Spans well
- Used for coding and contrast
- Edges should be mitered at 45 degrees on nonintegral color board

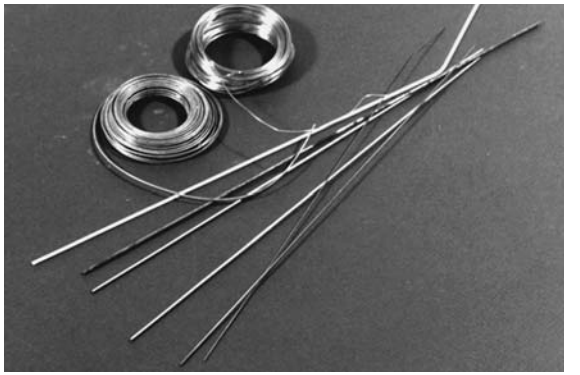
Note: Integral color board, with color going all the way through, should be used if possible. The exposed white edges of nonintegral color board severely degrades model appearance.



Plastic and Wood Modeling Sticks
Available in square and rectangular balsa or basswood shapes.

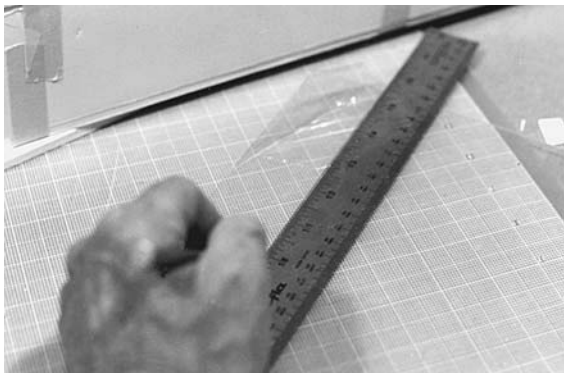


Plastic and Wood Dowels
Available in a variety of sizes and lengths.



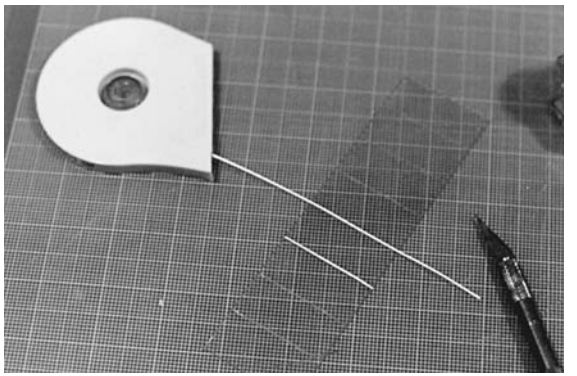
Wire

- White, plastic-coated wire
- Copper, steel, and aluminum rolls
- Straight modeling wire



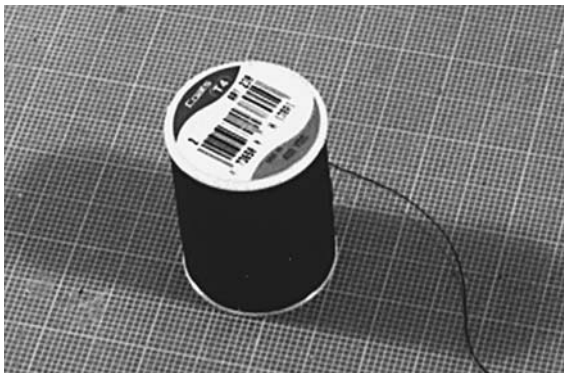
Clear Plastic and Plexiglas Sheets

- Used for glass simulation
- Available as thin Plexiglas from suppliers and hobby shops and as inexpensive picture-framing sheets; avoid thin acetate sheets.

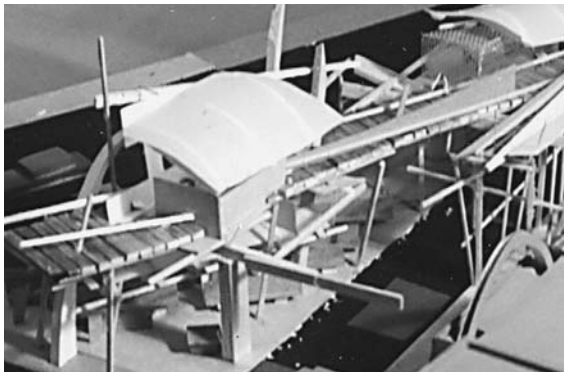


White Graphic Art Tape

- Used for mullion simulation
- 1/32 in. wide and smaller



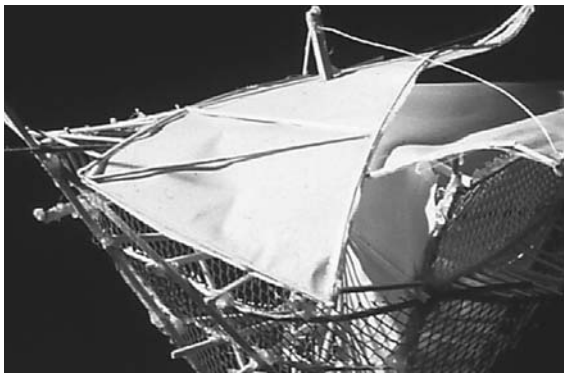
Sewing Thread
Can be used to simulate cable lines or thin rods in tension.



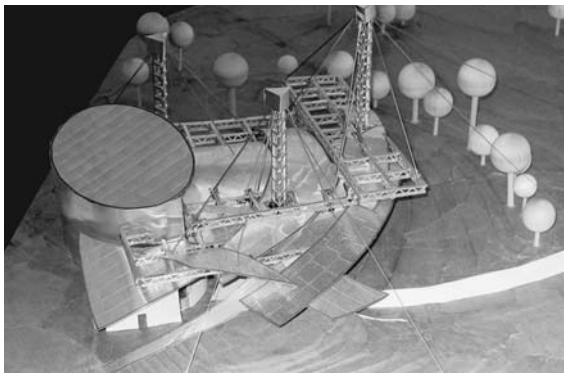
Plastic Mylar
Mylar drafting sheets can be easily cut and used for curved translucent panels.

Enamel Spray Paint

- This can be used to paint models and wood rods.
- Automobile primer should be used as an undercoat on cardboard to prevent buckling.



Cloth and Trace
Drawing trace or light cloth can be used to fill in planes and simulate translucent membranes. These materials can be curved and warped as needed.



Metal Sheets
Thin metal sheets can be used to make planes and curving forms (see Chapter 5).

Model Types

Models are referred to in a variety of ways, and terms may be used interchangeably in different settings. Although there is no standard, the following definitions in the following lists are commonly used.

All of the model types discussed (sketch, massing, development, etc.) are considered to be study models, including those used for formal presentations. As such, their purpose is to generate design ideas and serve as vehicles for refinement. They can range from quick, rough constructions to resolved models. Whatever state they are in, the term *study model* implies that they are always open to investigation and refinement.

Study models can be considered to belong to two different groups: *primary models* and *secondary models*. The primary set has to do with the level or stage of design evolution, and the secondary set refers to particular sections or aspects of the project under focus. A secondary model may be built as a primary model type, depending on the level of focus. For example, a model used to develop interior spaces would be thought of as an interior model but would also be a sketch model, development model, or presentation model, depending on its level of focus.

Primary Models

Primary models are abstract in concept and are employed to explore different stages of focus.

Sketch

Diagram

Concept

Massing

Solid void

Development

Presentation/finish

Secondary Models

Secondary models are used to look at particular building or site components.

Site contour

Site context/urban

Entourage/site foliage

Interior

Section

Facade

Framing/structure

Detail/connections

Sketch Models

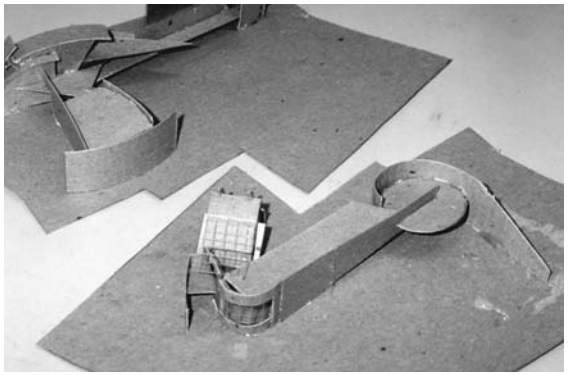
Sketch models constitute the initial phase of study models. They are like three-dimensional drawing and sketching—a medium for speed and spontaneity.

Sketch models generally are not overly concerned with craft but provide a quick way to visualize space. They are intended to be cut into and modified as exploration proceeds. These models may also be produced as a quick series to explore variations on a general design direction.

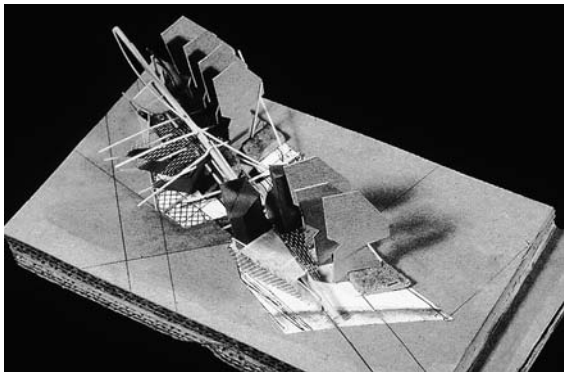
Although many of the models shown throughout the book are produced as expressive explorations, sketch models are also valuable when built with greater precision and used to explore qualities of alignment, proportion, and spatial definition.

Sketch models are generally built at relatively small scales from inexpensive materials such as chipboard or poster board.

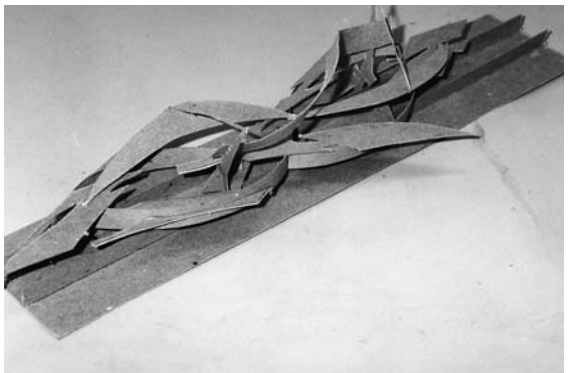
Several examples of sketch models are shown, ranging from small building propositions to ideas of space and site relationships.



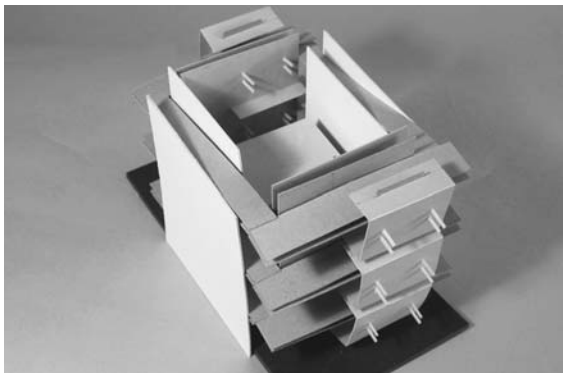
Sketch model
Small alternative sketches can be made early in the design phase to explore basic building organizations and reflect general relationships of program circulation and architectural concerns (actual size, 4 in.).



Sketch model
Sketch models can explore basic relationships between a number of program components (actual size, 11 in.).



Sketch model
Sketch models can carry genetic information about the way building spaces will flow and read. In this case, the model was a translation of drawing exercises that began incorporating the program (actual size, 6 in.).



Sketch model
Sketch models can explore sectional relationships and act as schematic three-dimensional diagrams (actual size, 6 in.).

Diagram Models

Diagram models are related to sketch models and conceptual models; however, like their two-dimensional counterparts, they map out abstract issues of program, structure, circulation, and site relationships.

Although they are similar to drawn forms, the three-dimensional quality of diagram models can begin to describe space as it relates to architectural issues and suggest ideas for further exploration.

Diagram model
A small model used to map out abstract site relationships and establish initial tectonic elements such as the circular element.

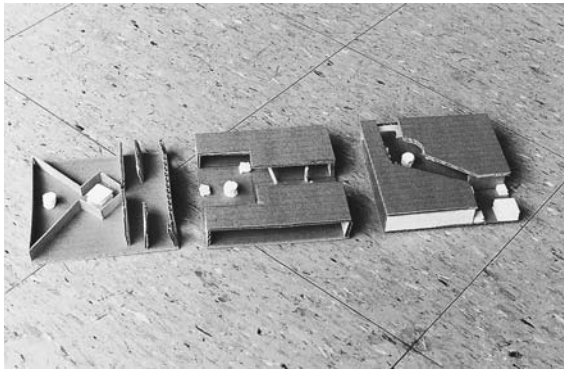


Diagram model
Three alternative spatial organizations diagram relationships between overall circulation and program issues.

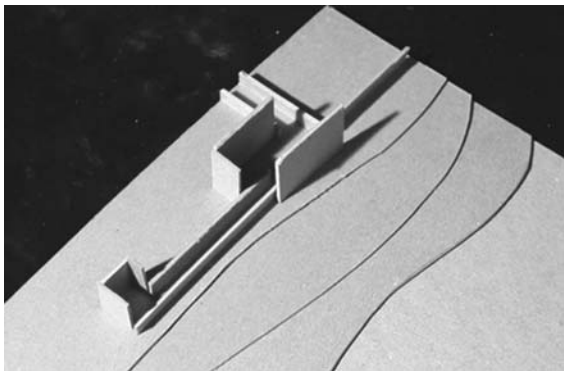


Diagram model
Diagrams can be used to explore the basic organization of site schemes.

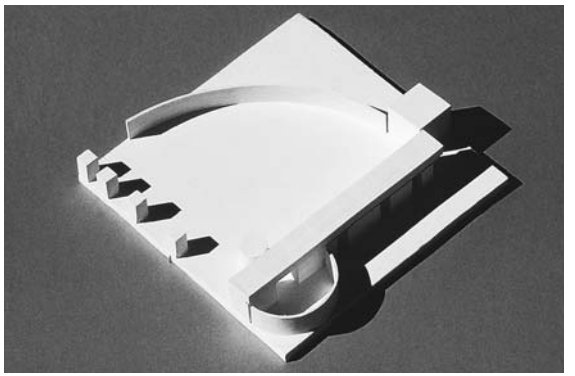


Diagram model
Diagrams can be used to explore basic organizational schemes such as a datum wall to set up overall relationships.

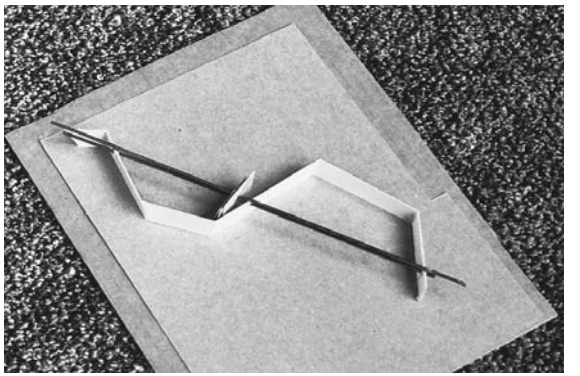


Diagram model
Another simple diagram used to describe contrasting relationship between the indirect processional element and axial the component.

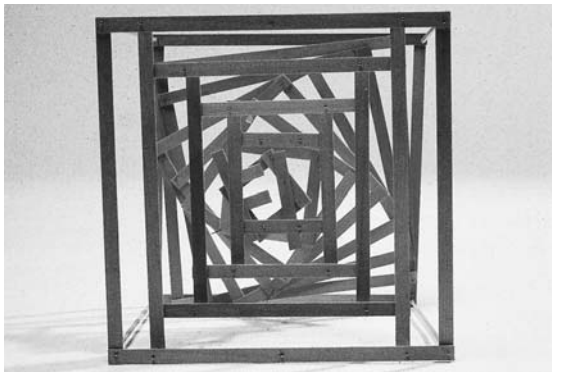
Concept Models

Concept models are built at the initial stages of a project to explore abstract qualities such as materiality, site relationships, and interpretive themes. These models can be thought of as a specialized form of the sketch models and are used as the "genetic coding" to inform architectural directions.

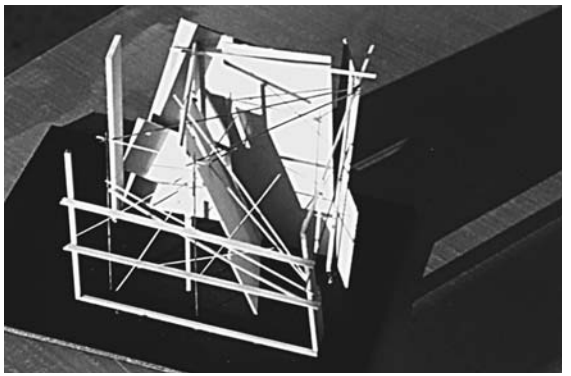
Translations can be made by a variety of means, such as dissecting the model with drawings, using suggested geometries, producing readings based on formal qualities, or interpreting literary themes.

The following concept models were established at the outset of several different projects. Although their use as genetic information is similar, their conceptual bases are quite different and illustrate the degree to which conceptual approaches can vary. Several other examples of concept models and architectural interpretations have been derived from these models. See "Interpreting" in Chapter 3.

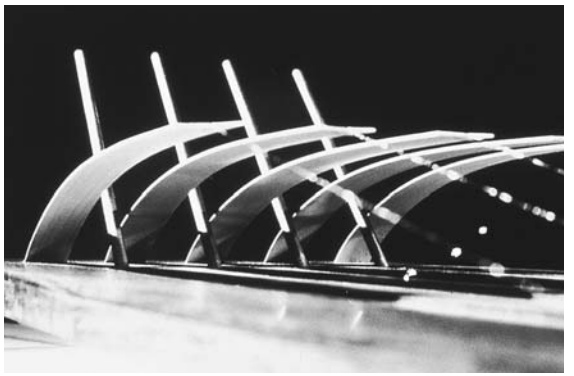
Concept model
A model made to explore ideas about shade, light, and shadow.



Concept model
A model used to make interpretations of compartments and empty space, based on Andy Warhol's book *From A to B and Back Again*.



Concept model
A model exploring abstract qualities of light and material relationships.

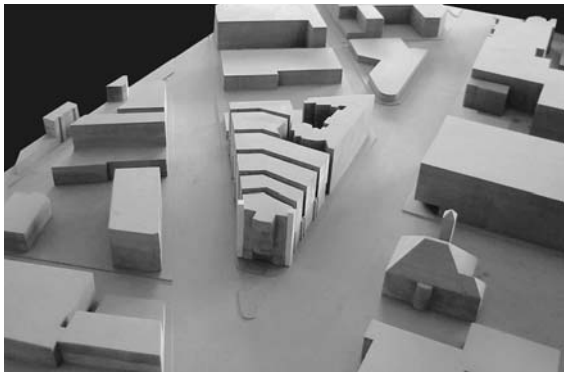


Concept model
A spatial response to interpret passages from the book *Everglades: River of Grass* by Marjory Douglas.

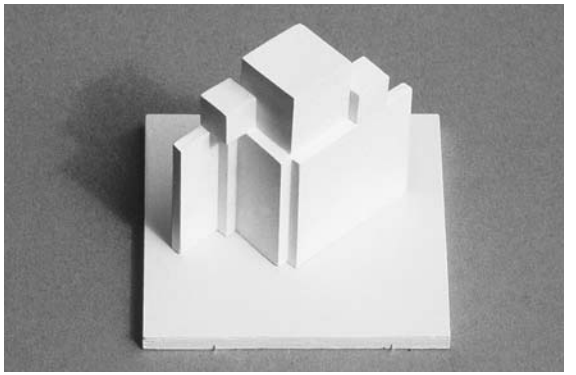
Massing Models

Massing models are simple models that depict volume and are typically devoid of openings. These models can be constructed at small scales due to their lack of detail and will quickly reflect a building's size and proportion at an early stage.

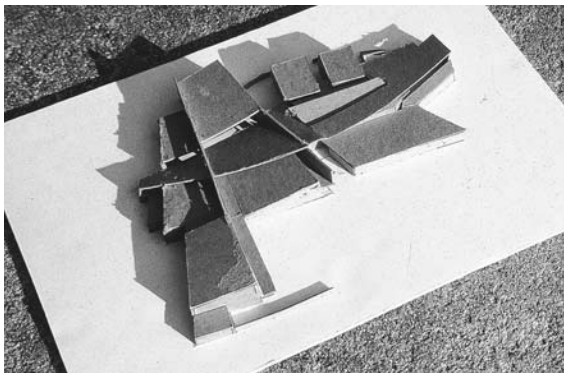
Massing models are used in a similar manner to sketch models and solid/void models. At times they may be built as partial solid/void models.



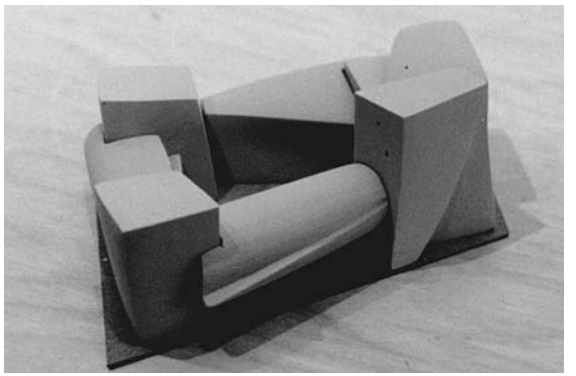
Massing model
Small massing models are typical of the building representations used for site plans.



Massing model
The kind of block massing typical of models that reflect only the solid form of the building.



Massing model
Very small models lend themselves to simple massing interpretations, as all but the largest of voids will have little meaning at this scale.



Massing model
Massing models can be made in any number of forms, but their defining characteristic is the absence of openings.