Architectural Drawing: A Prospective Requiem

David R. Scheer[1]

[1]Scheer & Scheer, Inc., Salt Lake City, UT

Abstract

Drawing has been inextricably entwined with architecture since ancient times. Today, architectural drawing is moribund if not already dead, replaced by technologies that encode and store design information in digital databases. This change has taken place with unbelievable rapidity, especially viewed from an historical perspective. This paper examines how drawing has affected our fundamental ideas about architecture and what effects its demise may have on architecture in the future. The aim is to appreciate what drawing has meant for architecture and to assess the latter's drawing-less prospects, hence a "prospective requiem".

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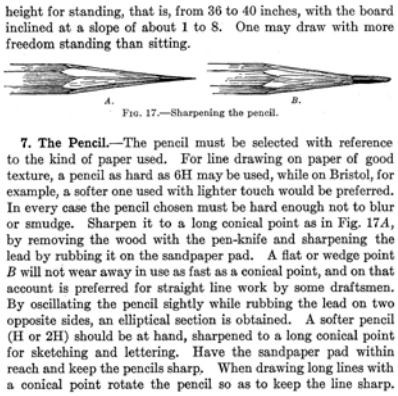
What is a drawing?

Until the advent of computer-aided drafting (CAD) systems in the mid-1980's, it would not have been necessary to define what we mean by an architectural drawing. We commonly refer to a CAD plot as a "drawing" but in several important respects doing so devalues the term. CAD plots share with drawings a conventional language of representation, but the resemblance ends there.[1] Before CAD, a drawing was the product of a human hand manipulating physical media. Drafting was a craft that involved lengthy practice to arrive at a mastery of pencil, pen and paper in order to produce a useful artifact. In the process, draftsmen were inducted into a culture that fostered and perpetuated the craft of drawing. This culture codified and transmitted the values of accuracy and composition that are the hallmarks of good architectural drawings (Figure 1).


height for standing, that is, from 36 to 40 inches, with the board inclined at a slope of about 1 to 8. One may draw with more freedom standing than sitting.

A. B.

FIG. 17.—Sharpening the pencil.

7. The Pencil.—The pencil must be selected with reference to the kind of paper used. For line drawing on paper of good texture, a pencil as hard as 6H may be used, while on Bristol, for example, a softer one used with lighter touch would be preferred. In every case the pencil chosen must be hard enough not to blur or smudge. Sharpen it to a long conical point as in Fig. 17*A*, by removing the wood with the pen-knife and sharpening the lead by rubbing it on the sandpaper pad. A flat or wedge point *B* will not wear away in use as fast as a conical point, and on that account is preferred for straight line work by some draftsmen. By oscillating the pencil sightly while rubbing the lead on two opposite sides, an elliptical section is obtained. A softer pencil (H or 2H) should be at hand, sharpened to a long conical point for sketching and lettering. Have the sandpaper pad within reach and keep the pencils sharp. When drawing long lines with a conical point rotate the pencil so as to keep the line sharp.

Figure 1. "Sharpening the pencil", an illustration from a 1924 manual of drafting.[2]

A transformation in architectural design due to digital visualization and documentation tools has been underway for about two decades[3]. These tools fall into two basic classes. The first provides a means of visualizing the finished building or parts of it. This is primarily of interest in presenting ideas to clients or the public and secondarily as a means of architects' testing their ideas. The creation of such visualization models is laborious in proportion to the realism of the result and is almost always outside the design process itself, in that the visualization tools are usually different from the documentation tools. The second class of digital tools is used to design and document buildings for construction, known as building information modeling or BIM. The difference between BIM and digital visualization tools is that the former is structured in terms of objects that represent actual building elements and contain data concerning these elements relevant to their construction. The latter merely contain a geometry of surface planes sufficient to represent the building's appearance. Although it is theoretically possible to document an entire building in BIM without recourse to drawings, BIM is presently used primarily for making "drawings" of the traditional types. There are many reasons for our continued reliance on two-dimensional and textual information, mostly having to do with the difficulty of changing the working methods of a large and diverse industry. Nevertheless, the use of BIM to produce drawings is a transitional phase between two dimensional drafting (whether manual or CAD) and the three-dimensional design and documentation of building projects. Architecture thus stands at the threshold of the first truly fundamental change in its methods since the first use of drawings millennia ago.

Drawing has been the chief medium of design and communication in the building industry and, like any medium, it is not transparent. It has deeply affected our ideas about space, construction and the nature of design. To explore this, we will consider two aspects of drawing: *representation* and *artifact*.

Representation

Drawing has conditioned architecture much as a spoken language conditions the ideas it expresses. No language is transparent: there is always a distance that separates an idea from its expression in language. This separation of ideas from their linguistic expression is an integral part of thought and communication. Thoughts and their expression are distinct yet inseparable. When we seek to express a thought, the thought itself is the goal towards which we strive but never reach. Conversely, the way we express the thought reflects back on and conditions it.

A *representation* in the strict sense is a description that has its own intrinsic qualities that create a crucial distance between the representation and its object. There are crucial ambiguities in representation as to which of its effects are proper to it and which emanate from its object. Some discourses seek to narrow this distance and make the representation more transparent (e.g. science) while others make creative use of it (e.g. literature). In architecture, drawing has done both. Its precision and well-established conventions lend it clarity, while the obvious difference between a drawing and a building create a space for constructive ambiguity and creativity.

In the case of architectural drawing, the referenced object is usually a building that may exist in reality or in the imagination. The primary characteristic that is intrinsic to a drawing but not to its referent is that it is two-dimensional. Depending on the type of drawing in question, there will be many other such intrinsic characteristics, such as being composed entirely of lines, being a view that is impossible in reality (e.g. an orthographic projection), using a conventional rather than a realistic representation of materials or light effects and so on. In any event, a drawing omits or distorts many of the qualities of the building it refers to while treating others with varying degrees of abstraction. The quality of abstraction is not a shortcoming of drawing; it is in fact its entire reason for being, the secret of its purpose and function.

Those aspects of building that can be readily communicated in drawings have been the primary objects of the architect's thought. These are all in some way related to *form*. For most of human history, building construction was of a few well-understood types: stone, brick and wood. Architects since the Renaissance have not needed to have direct experience with construction techniques; they need to understand only their capabilities, not how they are performed, much as a composer doesn't need to play the violin to write music for it.[4] Under the domain of drawing, form was the architect's chief work product. Certainly architects were concerned then as now with their clients' budgets and programmatic needs, and spent much of their time working with builders. Their main role, however, was to translate these practical considerations into an appropriate form. Orthographic drawings (plans and elevations) are perfectly suited to this task. They show the placement and profile of building elements. The architect can choose to provide additional detail where the construction is critical to the finished appearance of a part of the building, but the manner of their construction is largely left to the builders.

Orthographic projections are *ideal*, in that they are never actually seen in a building. No one can ever see the plan of a building. The plan may be synthesized in the mind by walking through a building's spaces, but it cannot be directly perceived. Likewise, no one can ever see an elevation. The experience of a building's exterior is always from a particular point of view and its parts appear larger or smaller in relation to the viewer's vantage point. The elevation shows the actual distances between the building's parts without the "distortions" of vision. Thus plans and elevations are visual ideas, objects of thought; they translate the experience of a building into a form the mind can comprehend. This is to say that they are *abstractions* that reduce a rich, multi-sensory experience to quantified spatial relationships. Drawing is perfectly suited to convey this kind of information by its two-dimensional, graphic nature. Form is the intersection of the experience of a building with the capabilities of drawing. Using such tools, it is logical that architects value the ideal aspect of their designs, that is, form.

Such is their interest in the formal aspects of building captured in drawings that architects often value qualities of a drawing rather than considering their impact on the actual experience of the building. The drawings come to have a value that is quite independent of the building they describe. They become esthetic objects in their own right, things to be collected and admired for themselves.

For centuries, architects have learned, not only to communicate, but to *think* about building with drawings. Our conceptual apparatus is based on a notion of space that can be represented by projection onto two orthogonal planes (plan and section/elevation): the Cartesian representation. Many other representations of space are known. Whatever the virtues and limitations of the Cartesian representation may be (and recognizing the value of the work being done to explore the architectural possibilities of other geometries) it remains true that our naive idea of space is cubic. This leads us to the idea that drawing is a reflection of our experience of space and that the privilege accorded the Cartesian representation is not an arbitrary cultural convention.

Ideal plane geometric figures, such as harmonically proportioned rectangles, have played a major role in architects' composition of building elements from the Renaissance up to the present time. These figures are created in the ideal projections of plan and elevation (Figure 2).

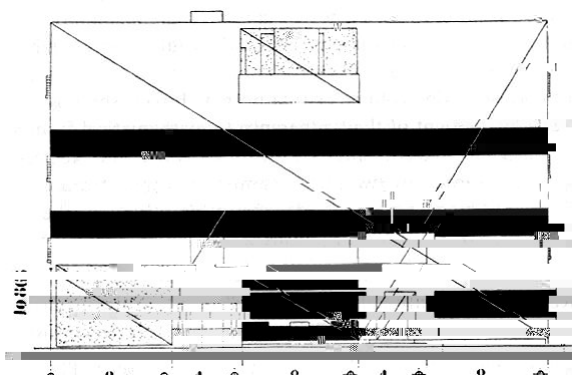


Figure 2. This famous drawing illustrates Le Corbusier's method of composing a facade using "regulating lines" that create a network of harmonic proportions among various lengths on the facade.

This practice is based on the idea that observing harmonious proportions in the abstractions of plan and elevation results in visually pleasing facades and spaces in our experiential space. This idea illustrates that, in the thinking of such architects, the abstraction is in a sense more real than our experience, that relationships in the abstract space of a drawing govern how we respond to the built, three-dimensional reality.

Simulation and performance. By contrast with drawings, the digital information models that have replaced drawing do not represent, but *simulate*, buildings. These models "behave" in a computer like the buildings they describe behave in reality, allowing them to be used to predict the buildings' performance. *Performance* of various kinds becomes the predominant design criterion. The distance between description and object is ultimately eliminated and with it the space needed for creative ambiguity.

The effects of this are already being felt by architects. Believing that architects now have the tools to perform quantitative analyses of their designs, many clients now expect us to predict energy consumption, thermal comfort, lighting, acoustic properties, visual qualities and other things as part of their design process. Building design is in the way of being redefined as a quantitative optimization problem. This is how engineers have always understood design but it is radically at odds with any notion of architecture as an art.

The digital description of buildings also affects how responsibility is shared among members of a design and construction team. As abstractions, drawings necessarily filter information and transmit only a portion of what an architect knows about a project. This has had enormous consequences for how architecture is practiced and its role in the building process. By choosing what information to share, architects can limit their responsibility for their projects. The acknowledged partial nature of the information contained in drawings distributes responsibility to other parties to a project and

implicitly defines their roles. Much of the practical training architects receive when they begin their careers has to do with learning what information to include and exclude from their drawings. It may seem paradoxical that architects purposely play dumb and withhold information they possess, but the distribution of responsibility that this upholds is the existing basis for the construction industry in this country. Drawings have been the choke point in information transfer that architects have used to distribute responsibility in an acceptable way.

With digital information and the tools to store, organize and share it, the opportunity exists to forego drawings and transmit the digital data to other parties directly. Building owners are well aware of the high cost of inefficient information transfer inherent in traditional practice.[5] They exert financial pressure on the profession to adopt technologies that allow information to flow with fewer intermediate translations that create errors and add cost. Many view this as the main reason for adopting digital technology in the industry.[6]

Due to these effects, the replacement of drawings with digital data is not neutral as regards how architects work and think. Architecture in our time has lost its romance. Very few practicing architects see themselves as artists: their experience is far too involved with meeting the expectations and requirements of others to entertain such an idea. Yet architects have been a limited but invaluable counterweight to the forces that would co-opt our built environment for narrow, venal purposes, bringing to the building process a vague yet deeply-held belief that society has other, greater interests in how and what we build. Perhaps in light of the foregoing it may not be implausible that our ability to do this has depended on the crucial role of drawing in our work.

Performativity (value based on optimizing objective criteria) has been widely recognized as a hallmark of this period in our cultural history.[7]

This impending transformation due to digital tools gives special urgency to the question of what effects the crucial role of drawing has had on architectural thought as a way of considering what changes it may undergo (or be in the process of undergoing). There are three qualities of drawings that have had a determinative influence on architectural thinking: their emphasis on *form*, their *ideal* quality and their status as *representations*.

Artifact

Traditionally, architectural drawing was a craft painstakingly acquired by young architects. Draftsmanship was a prized skill as the ability to draw clearly and precisely was essential to the architect's ability to communicate with builders and clients.

A culture based on exacting standards of precision and composition unified the architectural profession. Aspiring architects began their careers as drafters. They learned building composition and construction by drawing the designs of their employers. Achieving these standards required complete mastery of one's hand and of a specialized set of tools: T-square and triangle, pencil and ruling pen, compasses and dividers. A skill as apparently simple as sharpening a pencil so as to produce the desired line quality could take months to master. Nineteenth and early twentieth-century drawing techniques were unforgiving. Drawings were often made with ink on linen and erasing a mistake was difficult. A well-made finished sheet of drawings was an object of pride for the draftsmen and valued by his employer as well as by the builder.

Draftsmanship was thus a craft in the same sense as carpentry or masonry. During their everyday work, architects had intimate experience of the properties of physical materials like graphite and paper, the resistance these materials can present to human intentions, the effort of bending the materials to their will and of knowing how to exploit and when to yield to the materials' inherent qualities. They achieved that specific kind of mastery that comes of knowing one's materials intimately that allows the creation of a beauty that depends on their inherent qualities.

These superbly crafted drawings were the distinctive product of the architect. No other trade or profession in the building industry created them. They were the tangible evidence of the unique skills of the architect, as much by their appearance as by the information they contained. Even reproduced for use in building they were beautiful, as one can see by looking at the fragile blueprints on linen that are still in the records of city building departments around the country. The drawings contributed to and reinforced the architect's authority in building, portraying him as the master of both intellectual and physical creation.

The mastery of a craft in a sense joined architects and builders, giving them a common experience and uniting them as an industry. The time, effort and skill embodied in a set of drawings was visible to everyone. These physical products must have spoken to builders and produced a sense of kinship and respect. The intellectual mastery they displayed then could establish the architect as the master of the building process. Drawing was the cornerstone of the architect's prestige.

Like any craft, drawing could be elevated by an inspired practitioner to the status of an art, expressing far more than mastery of technique. Architectural drawings (when they were manual productions) were often beautiful in their precision, the delicacy of the linework, the composition of sheets, the harmonious relationship between images and (handwritten) text (Figures 3 and 4). Some types of drawings, such as those produced by students at the Ecole des Beaux-Arts, added color and became paintings (Figure 5).

Figure 3. In this sketch of his Einstein Tower design in Potsdam architect Erich Mendelssohn captured in a few deft pen strokes the dynamism he wished his project to convey.

Figure 4. (Top) A sketch by Frank Gehry of the Disney Theater. (Bottom) The Disney Theater as built.

Figure 5. An example of a watercolored elevation drawing typical of those made by students at the Ecole des Beaux-Arts.

Often these drawings communicated a feeling or

emotional tone that added to or even overwhelmed the quantitative information they contained. The powerful (orthographic) drawings of the project for a Cenotaph for Isaac Newton by Etienne-Louis Boullée (Figure 6) convey a sense of the grandeur and revealed mystery that Newton evoked among many of his contemporaries.

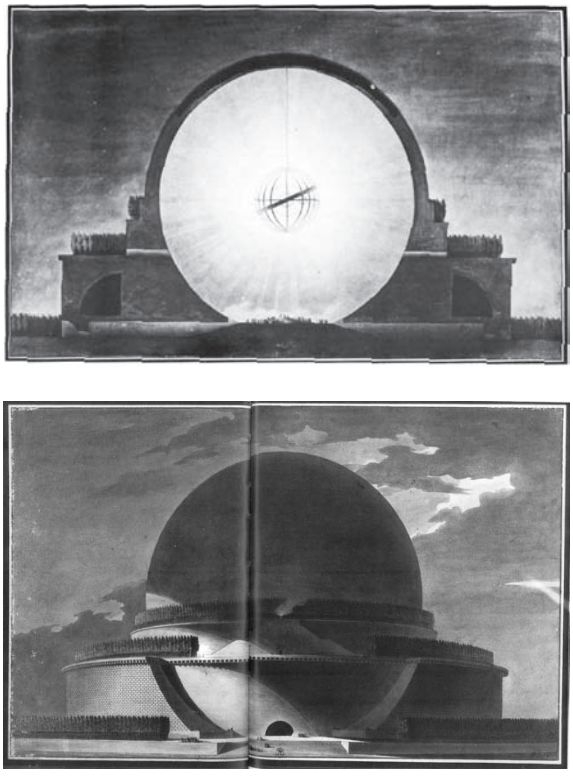


Figure 6. Etienne-Louis Boullée, project for a Cenotaph for Isaac Newton. Night-time section and elevation.

Much has been written about the intimate connections between the physical act of drawing and architectural thought. It is well established that the drawing techniques chosen by a particular architect reflect his/her primary interests in the design. Pen and ink has been used by architects chiefly interested in line (Figure 7). Colored pencil calls attention to surfaces (Figure 8). Collage highlights a built environment where successive projects relate to one another by juxtaposition, without a strict formal framework (Figure 9).

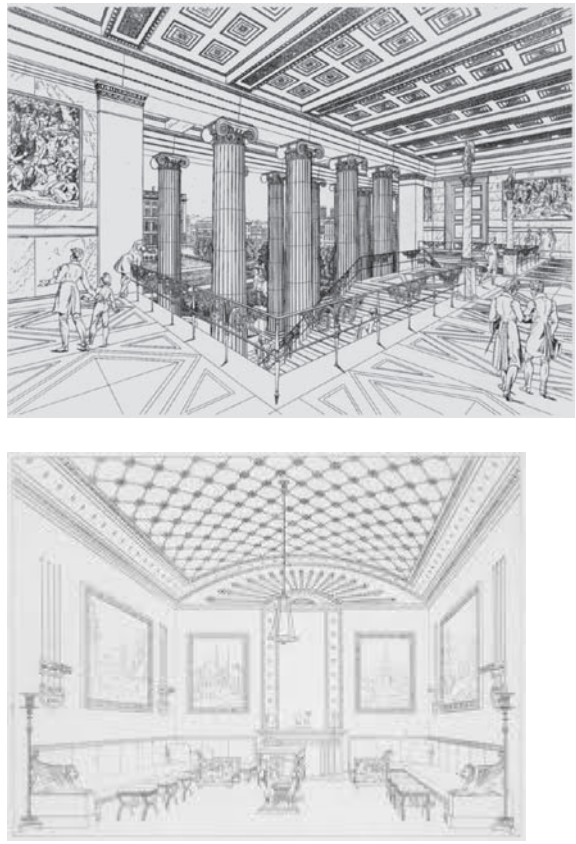


Figure 7. Top: Karl-Friedrich Schinkel (late 18th century). Bottom: Leon Krier (late 20th century).

Figure 8. A drawing by Michael Graves.

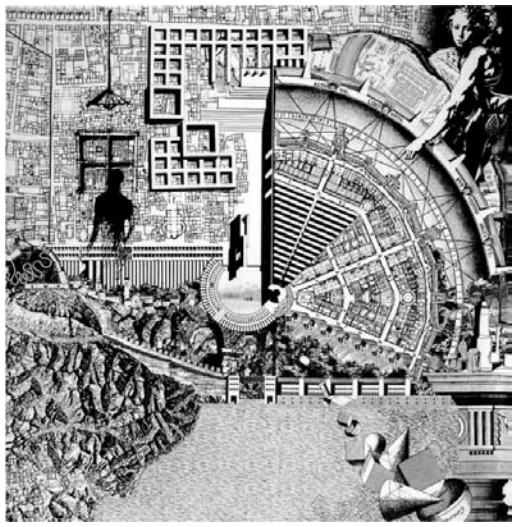


Figure 9. Aldo Rossi, "The Analogous City"

Architects also choose drawing techniques to suggest their affinity with certain historical periods or even specific architects from the past (Figures 7 and 10).

Since computers can also generate a wide variety of types of images, it might be objected that manual drawings are no more expressive by nature than computer-made drawings. This overlooks the fact that manual drawings are more than images: they made things. The parts of a drawing are not merely layers in PhotoShop, different in content but identical in nature. A drawing is composed of disparate materials that are physically placed together. The similarity of this experience and that of building has sustained the relationship between architecture and construction. It has put construction in architecture and allowed architecture and construction to share a material culture. Now that drawing has disappeared from architecture, what will provide this critical link?

Prospects

Drawing provided architects our intellectual and emotional connections with the built world. As a conceptual tool, drawing provided the geometric framework within which we made meaningful built form,

both

Figure 10. Top: Zaha Hadid. Bottom: El Lissitsky, "PROUN"

creating and reflecting our shared understanding of space.

As a physical artifact, drawing was a craft akin to the building crafts and provided a physical experience of making that allowed us to enter the world of made objects, joining us with building. How will architects replace it? How will we establish our connection with building, in what will our craft consist? The economic and technical forces that have called BIM into being will ensure that its domain is extended as quickly as the technology can evolve and old habits can be shed. As architects, we must meet this change head on.

The first thing to note is that, as architecture is changing, so is construction. The same forces that favor BIM are demanding that construction become more industrialized and automated, that information generated during design and construction be seamlessly, losslessly transmitted to the building's operators. It is not only architecture, but

the entire building industry that is becoming data-driven. Craft in the traditional sense of a discipline of making is being lost on all sides. This is not what will provide the glue that binds design and construction in the future.

Building is increasingly about information. This has always been true in a sense, but most architects did not think of their drawings as information-bearing devices. Now it is information that is clearly at the core of our activity. We no longer draw; we create *information models* that contain data about building materials and systems. We focus on how information is transmitted from one party to another, making transmission as transparent and lossless as possible using digital media. We have realized the age-old dream of living in the clouds, where our data (and our designs) now reside.

As a result, the old divisions between design and construction are blurring. Understanding design and construction as information management favors getting a particular piece of information from the entity best able to provide it accurately, minimizing the need to re-create or transmit it later during the process. Thus, mechanical subcontractors are building the 3D models of ductwork and piping because they can use the same model for design, coordination and to drive the CNC machines that fabricate the components. The model becomes the shop drawings. Architects delve more deeply into construction techniques, sharing their models with fabricators to economically produce geometrically complex building systems. We can "mass customize" buildings by making aspects of the design parametric so that variations can be produced automatically without the need to re-draw each variation.[8]

Architects will need to create a craft of computer-based design. The discipline we found in drafting must be replaced by another, just as rigorous. We will need to find ways to insert materiality into this disembodied process or risk losing our connection with the delight building materials can yield.

Finally, we will have to answer the question of whether the basically two-dimensional thought processes we relied upon, that were sustained by drawing, are the result of the limitations of our tools, or of an innate human understanding of space. Our tools now offer us the freedom to create forms that our minds could never imagine without their help. Freedom entails choice and responsibility. Because something that is possible does not mean it is good. We are living at a time when architecture is being challenged at its most basic levels: can we put technology to the uses we desire and avoid becoming its servants? What is the nature of our experienced space? Where is the balance struck between how our lives shape how we build and how our buildings affect our lives? Ours is a time for a complete re-thinking of architecture.

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[1] For an in-depth discussion of CAD's relationship to craft see Sennett, Richard. The Craftsman. New Haven: Yale University Press, 2008.

[2] French, Thomas. A Manual of Engineering Drawing for Students and Draftsmen. New York: McGraw-Hill Book Company, 1924.

[3] FormZ was introduced in 1991. This event signals as well as any other the emergence of computer graphics from academia into professional practice.

[4] Construction technology only became part of the architect's purview with the advent of new structural materials in the 19th and early 20th centuries such as steel and reinforced concrete.

[5] The Construction Users Roundtable. "Collaboration, Integrated Information, and the Project Life Cycle in Building Design, Construction and Operation (WP-1202). Cincinnati: The Construction Users Roundtable, 2003.

[6] General Services Administration. "OCA's Business Need for 3D-4D BIM", GSA BIM Guide Series 01 (2007): 5-6.

[7] Lyotard, Jean-Francois. The Postmodern Condition: A Report on Knowledge. Minneapolis: University of Minnesota Press, 1984.

[8] Kieran, Stephen and Timberlake, James. Refabricating Architecture. New York: McGraw-Hill, 2003.