Real and Un-real Color

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Drawings exist for the communication of ideas. They are the containers of mankind's visual dreams and embody all of the hopes, the aspirations, and intentions of their creators. The act of drawing is itself an expression of the desire for a world that is better than what already exists. The appearance of a new drawing media does not change that purpose; it only presents new and stimulating methods of communication, better ways of conveying ideas. In ideal terms the design of a building requires a holistic procedure, one where the entire edifice is created in a single instant. The building must seem totally compete and be universally understood in order that it can be accepted, detailed, structured, and priced. This is of course not possible; there are too many aspects of architecture that are not thought about at the moment of creation.

The process of design is continuous and moves from general to specific; any drawing media, to be useful, must accommodate this continuity. Completeness, where complete thought does not exist, cannot be achieved by the pursuit of reality on the computer. There are many unknowns that prohibit the creation of "real" pictures unless one makes design assumptions that prudent process should not accept.

Color as Imagery.

A design drawing for a building should communicate the spirit of its architecture, its gestalt, its metaphysical essence, without miscommunicating design decisions that have not been reached. Real imagery is not required; nor is it often particularly useful. Perhaps surreal is a better word for whatever images imply the ambience and suggest the completion, but mask the incompleteness of thought that is a necessary part of the process.

Figure 1: "The Metaphysics of Place," computercolor design by Robert W. Heffner, Clemson University

The Ecole des Beaux-Arts, in the nineteenth century, evolved a precise method of architectural communication through drawing. Presentations were based on the use of watercolor wash, a technique that relied on layers of transparent color. There was nothing "real" about this color. Washes were applied to plans, sections, and elevations of buildings, after being delineated on heavy sheets of white paper. By applying layers of pigment and using transparent color in almost prescriptive methods, sensual images of buildings were
created that successfully conveyed impressions to the viewer of an entire epoch of architecture.

The drawings completed at the Ecole succeeded in communicating the essence of their designer's concept. They left little question as to what would be built, how it would appear, or how it would accommodate its function. The images were complete enough that costs could be developed, details studied, and contracts signed. These drawings communicated the essential qualities of an architectural style, and encouraged a respect for both architecture and the responsibilities of the architect based on the successful delineation of architectural intent. Beaux-Arts renderings were not linear abstractions that spoke only to those educated in the reading of plans, nor were they pictures of reality; they existed in the un-real space between reality and the designer's imagination. By the use of color, the drawings succeeded in conveying the architectural intent of their creator, where only concept existed as fact.

Electronic drawing has not reached this point of perfection. It is an entirely new process, the product of more or less twenty years of research that began with a simple manipulation of line and has developed, quickly, to the threshold of virtual reality. Electronic drawing now abounds in creative freedom, a freedom fired by the newly discovered potential of computers, the seemingly limitless capabilities provided in the vast electronic void of cyberspace. When design takes place on the color computer, building images can be conceived as planes of color-polygons placed in adjacency to suggest the building's form. These electronic perspectives, with their flexibility and rapid manipulation of surface, are visually compulsive and provide a fresh way of looking at architecture. Electronic drawing is a new process, but the visual principles involved are known and have been understood for a long, long time.

Communication of ideas with color is not new. The caves of Lascaux were decorated with color drawings, the hues selected in order to illustrate a prehistoric hunt. Color speaks the same language today, whether it is on the walls of a cave or on the screen of a computer. The colors do not change; only the method of manipulating them is different. The color computer is but the latest media to be informed by an enormous history of color. History illustrates powerful ways that color can enrich computer imagery by drawing from the accumulated knowledge of color interaction. The watercolors of the Ecole de Beaux-Arts are a small, but successful part of this history.

A Comparative Studio.

Architectural design today has assumed a complexity that was inconceivable in the era of the Beaux-Arts. The classical, formal, and axial architecture that was Beaux-Arts design has long been overwhelmed by a plethora of new materials, technology, and design ideology. None the less it remains a single example of an architecture that was successfully supported by a color drawing media. By a process of comparison,
the commonality between watercolor—the media of the Beaux-Arts—and computercolor can be explored, uncovering differences and permitting each to inform the other. The advantages and the limitations of each media can be seen in parallel drawings produced in graphic studio classes by two student groups, one using watercolor, the other a computer. The individuals involved were free to select their media, and for the most part were curious but unfamiliar with the specifics of their selection.

Poetry was chosen as a common denominator for the introduction of each media. Poetry, like music and like architecture, is a communicator of ideas. It provides a common ground between two otherwise disparate media, a vehicle for both introduction and connection. The romantic poets of the nineteenth century were particularly strong in creating visual imagery. "Eldorado," by Edgar Allan Poe, is an allegorical journey to the other side of the mountain, a place where life seems richer, happier and more fulfilling. "The Rime of the Ancient Mariner," by Samuel Taylor Coleridge, likewise tells of an impossible journey, in this case to the ends of the sea. Each poem "tells" an image, and was used as a source of visual imagery. For neophytes the poems provided a subject matter with which to break the whiteness, or the blackness, of the surface. As a beginning these studies captured the joy of pure exploration in a search uninhibited by past experiences.

For the watercolorist there is an instant fascination with pigment and the effects that it produces as it is thinned and mixed on the surface of the paper. There is no such interest with computercolor. At first one marvels at its seeming brilliance, then moves quickly to the shapes that it is capable of filling.

As a drawing medium, watercolor has traditionally demanded the experienced hand, it is unforgiving of error and offers little opportunity to explore design alternatives. When well handled, however, each successive layer can amplify and clarify the previous work by producing a rich and informing image. Computer drawing has no such tradition. The colors are hard edged, filling perfect forms that must be softened by whatever means can be devised. When sketched in watercolor, the poems produce soft, allegorical images capable of multiple interpretation; this degree of abstraction is difficult to obtain by computer—one tends to draw images as objects, and must seek out ways of abstracting their meaning. The computer is more
dependent on theories of color adjacency for establishing visual appeal than is the watercolorist.

Design requires the consideration of alternatives in computer terms the exploration of parametric variation. While not easily accomplished with watercolor, a computer can generate endless design variations. Computercolor is infinitely variable—though a totally opaque commodity, its color is easy to quantify and simple to alter. As the watercolor sketch requires repetition of wash, so the computer drawing demands iteration of image, in order to successfully illustrate a design. This side by side comparison of design alternatives is a strength of the computer as a color media, that was never affordable with traditional coloring methods. Through multiple iterations, a depth of study is available that tradition could never afford. The successful watercolor is a "one time shot." It succeeds or it fails. The construction of the Beaux-Arts drawing was usually a labor of love, an exhausting and time consuming process. Once a wash was applied it could not be changed. Electronically, color can be processed, as words are processed, permitting a consideration of color selection that is denied to the watercolorist by the permanency of the media.

The Color Model. A color model is the heart of any serious color study, for it gives system to the color palette. For the informed colorist these models are like an index, providing access to each color in the collection. Color models are three-dimensional diagrams of the characteristics of color, usually expressed in terms of hue, value, and saturation. Pedagogically the model illustrates color choices; for the watercolorist it explains pigment mixing; for the electronic colorist it illustrates the preferred method of specifying color.

Constructing illustrations of the color model is an empirical process with watercolor. Beginning with a palette that approximates the hue circuit, colors are mixed by greying them with complements to reduce color saturation, or diluting them with water to lighten their value. One must wait for the paper to dry before seeing the result of this gueswork; mixing for the watercolorist is an intuitive process. With a computer such intuition is not necessary, for most systems provide color modeling automatically. The electronic colorist in fact can become a slave to color numbers, mistakenly attempting the art of color selection through mathematics and thereby expecting perfection where none exists. Computercolor is totally flexible. One identifies a hue, a level of color saturation, and a degree of brightness; the color appears immediately. Errors can be changed as quickly as they are made. For the computer user, the color model is no longer a theory of pigment mixture, rather the memorable form of this model becomes a tool for access to the color palette. These models become aesthetic objects in their own right, forms capable of endless exploration as a model for the display of color.

A watercolor wash is seldom even. It is graded across the surface of the paper as the pigment is exhausted with the stroke of a brush. Computer images, to display a texture that compares to this wash, must be divided into multiple shapes that simulate the watercolor technique. These shapes are then colored in a progression of color to achieve what could easily done with a wash. When the colors step in small divisions that visually meld together on the computer screen, the entirety is called a color ramp.

The visual effect of a color ramp differs from that of a watercolor wash. Ramps are usually linear or radial in pattern; more random shapes are not easy to form, perhaps suggesting the need for a more supple method of forming the polygons of a ramp on the computer. The wash is fluid in a way that defies computation; the paint brush is much more dexterous. But there are qualities in the ramp that cannot be found in a wash. Given adequate software, a ramp can be formed between any two colors—across changes in hue, value or saturation that are inconceivable with the brush-producing a brilliance in computer images that is not seen in watercolor. Given the present state of computer technology, the watercolor wash is far more flexible in shape, though the computercolor ramp is more controllable in color.

The Architectural Section. In the vocabulary of the Ecole des Beaux-Arts, the section is the primary drawing for indicating both architectural form and the space it encloses. The architectural section is rich in information. It indicates the enclosure of space, showing both the form of that enclosure and the proportions of
the space. Elevations, both interior and exterior, can be included. When colors are carefully selected the drawing communicates well, revealing multiple bits of design information. A relationship to the environment can be illustrated, drawn in the degree of detail that time and temperament permit. Finally, the section reveals clearly the size and thickness of the structure itself.

For the electronic delineator, the architectural section is an opportunity to explain a design. Many computer tools are useful for this, tools such as stretching, shrinking, rotating, and repeating elements. The architectural section, be it a horizontal plan or vertical cut, is ideal for probing these tools, using them to explore endless iterations of form variation. To draw in a manner that communicates this information, however, requires careful manipulation of color as well as form. The delineators of the Beaux-Arts were masters at selecting colors which made sections understandable. Interior color contrasts were different from those on the exterior; the differentiation of space and form was always clear.

The mechanics of perspective drawing were well known to the Beaux-Arts architect; numerous projects were illustrated with perspective views. Using manual techniques the construction of a perspective was a tedious, day-long process. Perspectives are easily created by computation, often they become a favored means of presentation. A shift from section to perspective as the fundamental architectural drawing technique, as is advocated by some software developers, would have profound changes on the architecture produced. One would anticipate buildings designed from a perspectival point of view, with multiple considerations for what is seen from the changing viewpoint. The proportion of parts, correspondingly, would become less important in the final design. Current tendencies toward de-construction appear to reinforce this change in emphasis. Issues of color selection in perspective are as complex as those in section.

Color Drawing.

The use of color enhances a drawings appeal and increases the potential information it

Figure 5: "Architectural Section," computer color design by David D. McManus, Jr., Clemson University

Figure 6: "Architectural Section," watercolor design by John R. Edwards, Clemson University
communicates. No one wants black and white computers anymore; we demand color. In computercolor there is a range of color that cannot be matched in watercolor or in any other medium. These are mostly strong, intense colors that are not found in nature. Colors exist, too, in the watercolor palette which cannot be matched by computer. In selecting colors for either drawings or buildings, one must be aware of the shortcomings of each medium.

Through comparative study it became clear that several methods existed for thinking about color and its application to the drawing. Three methods were explored in the studio, comparing the outcome of watercolor with the computercolor. Comparisons in each case were made through color slides of the original works: secondary media that provided a common denominator for two divergent means of expression.

Form definition with Shade and Shadow. The drawings of the Ecole des Beaux-Arts were dependent on the watercolor wash to model buildings in shade and shadow. Color values were chosen to delineate sunlight, shade, and shadow tones for each material in the composition. It is this color selection that illuminates the drawings, directing the sunlight to each part of the drawing, so that forms are more clearly modeled.

The rules for constructing shadows in a drawing are similar to those of constructing perspective, and can be written into computer software. The sun is assumed as a light source originating in infinity, casting parallel light rays across the drawing area at 45 degrees. By this process the drawing is divided into areas of sunlight, shade, and shadow—three distinctly different colors for each material.

Rendering by using these colors has proven difficult to automate. The colors on each form can be handled well, with shade values assigned according to the angle of incidence to the sun. Once software has made these calculations, a color ramp can be assigned to render the form. But the shadow area is the section of most difficulty. Shadows are not a simple drawing problem. The difficulty is not in the calculation of shadow areas, but in the selection of color for drawing the shadow infill. The Beaux-Arts technique conveys considerable graphic information in shadow areas, information developed from the exaggeration of both reflected light and light from secondary sources. These techniques do not easily submit to automation. They can be applied to computer drawings, but are highly intuitive and dependent on the personal color choice.

Secondary light sources, reflections from the building's surfaces and from the sky itself, all produce complications to the color palette. For a watercolorist, this is an intuitive drop of water here, or a dab of color there. To calculate these areas is challenging at best; to produce an intuitive exaggeration, like those found in watercolors, seems impossible. The science of radiosity is making rapid progress, realism is soon to be achieved. There is nothing "real" about a good watercolor—one could not mistake a watercolor for a photograph, or for the view out a window. Drawings are not "real" images.

The mechanical provision of shade is now part of most good rendering packages, shadowing is more difficult to find. Today the success of shade and shadow programming is dependent on the color knowledge and sensitivity of the programmer. The colors seen by default seem most often to produce an effect which is neither correct nor desirable. Pedagogically such programs are of little interest. Designers must select their own color. To do this well they must be familiar with the appearance of each color in sunlight conditions as well as in shade; they must have software that provide them such color selection, rather than software that relies on the prescriptive choices of the programmer.

Beaux-Arts drawings remain unsurpassed in their mastery of shade and shadow in architectural rendering, but computation can offer a formidable challenge to this leadership. The computer can calculate both shade and shadow areas; it can create the contorted shapes that shadows often cast. Through ray tracing it can carefully predict the amount of light that each tiny area is to receive. In the hands of a sensitive colorist such drawings could be turned to visual magic, delighting and informing the eye through creative color choices. Color iterations can be explored, manually for pedagogical purposes, or by computer generation in practice.
Forms Implied by Color Interaction. The paintings of the Impressionists at the end of the nineteenth century suggested whole new ways to look at space through coloration. Seurat, Monet and Van Gogh abandoned traditional shadowing techniques to imply space and form in their drawings through the juxtaposition of color. In the era of the Bauhaus—that tense period of time between the two world wars—the careful rendering processes of Beaux-Arts architects were rejected in favor of a more "pure" approach to drawing and to color. The methods of the Impressionists came into favor; the longstanding architectural traditions of the Beaux-Arts were rejected, and the art of coloration was to experience many changes during this period.

Josef Albers explored the effects of color adjacency, of how space and form could be articulated solely through color selection. The abstractions of Albers illustrate the importance of color boundaries—the edges where two colors collide. He spoke of weak and strong boundaries, with depth being implied at the strong edge, while adjacency and continuity of surface is implied at the weak edge. Through the manipulation of these color boundaries a composition can become dimensional, generating perspective without the traditional construction. These principles were exploited by Picasso and the Cubist painters, who used boundary techniques to define shape and form. The effects are simply demonstrated when one has two shapes, perhaps five colors in an abstracted composition, as is the case in many of Josef Albers' illustrations. When the subject is compounded, however, where hundreds of adjacencies appear as in architectural rendering, then the plot is more complex. Computation can handle this complexity. If the simple principle is understood, as in the pure demonstrations of Albers, then through programming and through careful color selection, these principles can be applied to computer imagery.

Comparison has shown these techniques are easily adapted to computers, for their origin is in the hard-edged art of the Bauhaus era; there is an easy translation to computer-logic. They do not translate easily to the more fluid techniques of watercolor. They are techniques which achieve the definition of form and space through color adjacency, through knowledgeable color choices that often are intuitive and defy computation. Such techniques afford rich opportunities for personal expression through the designer's careful selection of computer color.

Metaphysical Form. It was the painter, Georgio de Chirico, that most successfully rebuffed the polish of Beaux-Arts techniques in the early twentieth century. An Italian Square, as rendered by de Chirico, contains none of the carefully calculated proportion that one finds in either a good Beaux-Arts watercolor, or in a well plotted computer drawing. Vanishing points are everywhere, and mostly where they are not supposed to be. Light sources are no longer over the shoulder, but seen to come from everywhere. His paintings of Italian Squares possess a feeling that transcends the reality of the square, they achieve a reality beyond the senses—a metaphysical aesthetic. To de Chirico, The Italian Square contained the metaphysical essence of Italian architecture.

To achieve a metaphysical quality in an architectural presentation, designers must be permitted an enormous amount of freedom. They should not be constrained by built-in vanishing points, or computer established light sources, but rather must be free to follow their impulses. They should not be constrained by software generated color choices. If rules need to be bent in order to convey emotional content, then the facility to change them must be at hand. This should be considered an exciting privilege that is afforded the designer—a good design image, after all, is seldom built on the imitation of reality. Though the techniques are different, such feelings can be conveyed with either watercolor or computercolor. The computer user can marvel at the dexterity of the watercolor brush in this regard, but given the ability to manipulate computer program, the emotional impact of computer techniques can be very effective.

As architectural design transcends the almost brutal logic of modernism, emotional response becomes a necessary ingredient for the presentation of architecture. History has shown that it is possible to achieve these feelings with watercolor, or with oil paints as was done by de Chirico. There have been astonishing beginnings made in the art of computer visualization. It remains to be shown, however, that computation as a media for visualizing architectural design is capable of rendering such emotion.
The comparative techniques in this studio have illustrated advantages in each media. Through its long history the watercolor brush is better informed today, and rendering techniques seem surer. But the last century has seen much in the way of “hard-edged” art that can also inform computation. The lessons and the methods of these bodies of work should not be lost to the new media. Knowledge is accumulative. In an expansive search for new techniques it is essential to not loose what is already there.

The conceptual drawings of a designer must take an attitude toward the examination of form. Computational techniques can do this through radiosity, through ray tracing, or through the pursuit of virtual reality, but the definition of form can also be achieved through the thoughtful manipulation of color principle. A designer must be free to select from the tools available in order to formulate his personal method of self-expression. Whatever medium is selected, one must give choice to the designer in selecting all aspects of color, for through these selections the meaning and intent of a design is conveyed. As design tools, computer images need not be become more real, but more informative, more communicative of the designers intent. In conceptual design there must be room for real-as well as un-real color.