

Visual Studies: Integrating Digital Media into the Design Studio Sequence

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INTENTION

Visual Studies at the University of Pennsylvania is a three-semester sequence which develops architectural representational skills through a series of technique-based exercises. Thematically, the exercises insist on the speculative nature of drawings and their capacity to provoke and communicate ideas. The sequence aims to produce keen analytical sensibilities by extending the role of drawing into territories of projection and imagination. Visual Studies III, the last in the sequence, is given in the first semester of the second year of the Graduate Program. It continues the established trajectory through the introduction of digital drawing and aims to promote new design directions through the active identification of the salient strengths and limitations of digital techniques. A series of intensive two-day workshops punctuate the studio sequence at critical points in the development of the studio project, informing and supporting the studio work with digital techniques. The aim is to provoke a reconsideration of the uses of digital representation by creating a useful discourse between visual studies and design explorations undertaken in the studio. The method arises from a view that the architectural project exists in a state of becoming, accumulating in spaces between its generative strategies and their representations, and between digital representations and material ones. The studio, given in the fall of 2000, was called *Chora* and proposed the design of a Student Center for the University of the Arts in Center City, Philadelphia, which would house a public dance theater. Through its procedural explorations and its programmatic content, the studio was positioned to consider relationships between space, time, subjectivity and materiality. The Visual Studies Workshops support these explorations. Due to their liminal position relative to the design studio, they provide the critical distance necessary to consider and evaluate design decisions.

VISUAL STUDIES WORKSHOP SEQUENCE

Each workshop follows the same basic schedule: an afternoon lecture describing the content of the workshop and elaborating its themes through examples is followed by a series of skills demonstrations in the digital design lab. Students are given information about available online tutorials and relevant texts, which address the necessary skills for the workshop. In addition, each workshop has an accompanying set of guidelines and a step-by-step schedule with requirements for three intermediary critiques. Teaching assistants are available in the evening to address software questions and problems in the studio. It is a requirement that the work must be completed by the deadline and a small reference image posted to the submissions folder of a designated server. Selected projects are made available for public view digitally. In addition, the students print their work in a large format and hang it for a gallery review before the next studio meeting. Visual studies drawings are reviewed and discussed relative to the studio work.

Workshop One: TIME IMAGE

And it is never a waste of time, whatever trade we are engaged in, to contemplate with careful regard the natural wonders, particularly when they have a bearing on our trades. Architecture is light, because it is through light that we see it.

– Amedee Ozenfant¹

While it is, as Ozenfant concludes, light that makes us see architecture, the relationship is not uni-directional. As architectures as ancient as the Pantheon attest, the relation is transitive: Light is architecture, because it is through architecture that we see it. Wallace Stevens asked, “What slice of sun does your building have?” Louis Kahn corroborates, “What slice of sun enters your room? As if to say that the sun never knew how great it was until it struck the side of a building.”² Light, and

the shadows created by light and form, are fundamental to the description of space both in architecture and in its pictorial representation. Shadows cast on surfaces orient them in space and reveal volume, color and texture. Changes in surface qualities, for example, reflectivity, can hide or distort volume and mass. Preoccupations with the material presence of light in the Western pictorial tradition can be traced from the Renaissance through to the contemporary installation works of James Turrell. The precise calculations offered by digital media to simulate light behavior in a digitally constructed scene, matched with the use of light emerging from behind the computer screen which make the calculation visible, recall the duality of light as both an object of vision and its agent.³ As an object of vision, it can operate as a sign, complicit in a visual language. As an agent, it is a natural phenomenon, one that is simulated with increasing precision by rendering algorithms in software programs. The first workshop brings this often-overlooked duality to the fore. Images are created with this duality in mind. Results of rendering algorithms (light as agent) are seen as the beginning of a process of representation whose goal it is to make the duality of light as agent and object operable. Representation uses the simulation creatively, to imagine and project new possibilities.

Because of the changing nature of light through the day and through the seasons, the relation of architecture and light makes apparent another fundamental phenomenon, the passage of time. In his outdoor paintings of Chartres and Rouen Cathedrals, the Haystacks, and not least the work that coined the term for the movement, *Impression: Sunrise*, Claude Monet paints one fleeting moment in a quantitatively homogeneous time. The capture of this moment, akin to the "snapshot", is a repeatable, iterative, technique. Each canvas is made in the same format, with the same viewpoint, but at a different time. Time passage is understood because the only registrable changes in the painting are those having to do with a change in the location and disposition of light and shadow. The spatial viewpoint is static. Each different light condition creates color and textural effects that suggest movement in time. The experience of viewing these images in series compresses time: changes in light and shadow over an entire day can be viewed in a few seconds.

In the Workshop, the students create a series of "fleeting" images of an intimate space of their own design. The passage of time is recorded through the movement of light through the space over the course of a single day (sunrise to sunset). The techniques of repetition and superimposition are explored relative to examples from Impressionist and Cubist painting and the photographic experiments of Jules-Etienne Marey, Eadweard Muybridge and Thomas Eakins.⁴ At least twenty views, generated and rendered in Form-Z, are superimposed and composed along with digitally scanned images using Photoshop. Mimicking the techniques of early moving pictures, the rendered views are then assembled into a short animation. In

the course of the workshop, students generate a simple 3D model with apertures for light. They learn how to manipulate the cone of vision to create views and how to set up and change the sun position. They test both the model and the quality of light by rendering the scene using only gray tones. Experiments with transparencies and reflections are done which introduce differences in various rendering algorithms including the differences between raytracing and radiosity.

Contemporaneously in the studio, analyses of site and building orientation and massing are carried out. The workshop techniques are used to study changing light and shadow on the site over the course of a day and seasonally. Building orientation, massing and apertures are designed relative to these visualizations. Students construct narratives relating light to program and to temporal qualities of use. A corollary assignment in studio requires students to construct an interior perspective of a

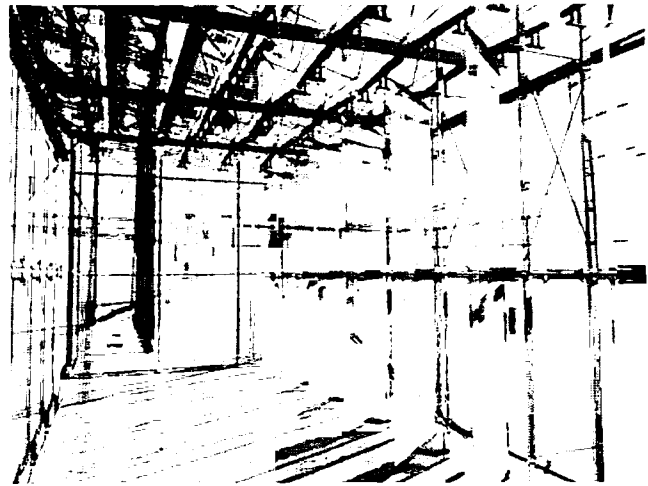


Fig. 1. Time Image, Sung Yul Yi.

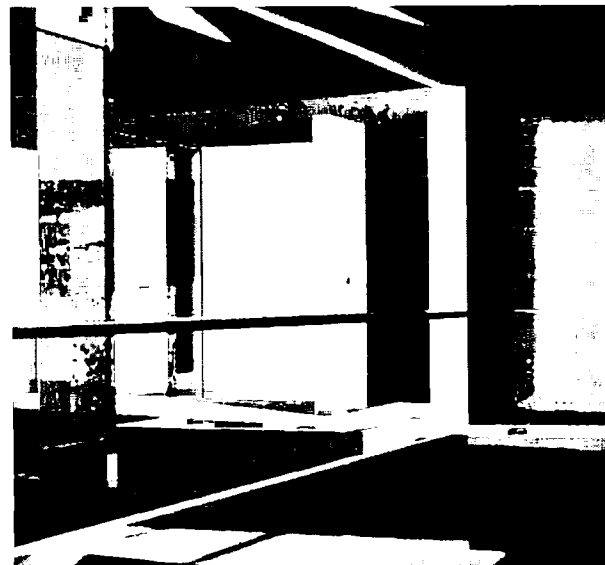


Fig. 2. Time Image, Kathryn Strand.

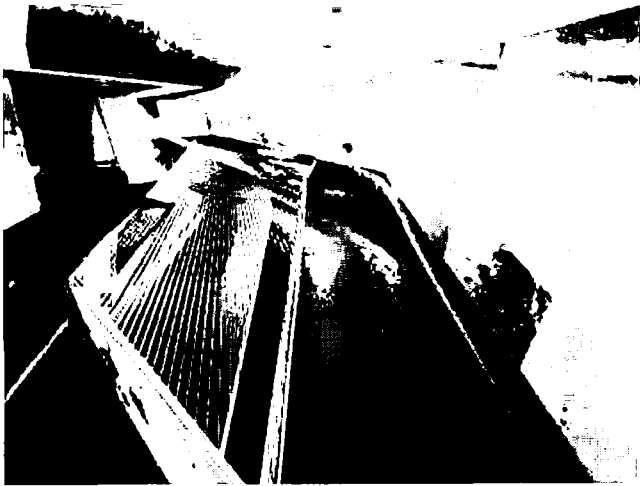


Fig. 3. Interior. Sera Baldwin.

single space in the building where at least one wall is an exterior wall with an aperture. Students are instructed how to create renderings using radiosity, where all surfaces are calculated as lights. Their projects develop using several of these studies to begin to calibrate the exterior skins of the building and its apertures to the interior spaces.

Workshop Two: 3D COLOR CONSTRUCTIONS

Colors are primordial ideas, the children of light.

—Johannes Itten⁵

The studies on brightness and quantity of light completed in the first workshop are enhanced in the second with the addition of the variable of color. The absorption or reflection of light off surfaces and consequently the levels of light in any given space is largely determined by color. In addition, color interacts perceptually with surface and volume and can be seen as constituent of form.⁶ It can modify the size of a space or object or alter the perception of distance or nearness of objects in space. Workshop Two provides a vehicle for students to learn about color systems and deploy color as a spatial technique both in the digital and material realm.

The workshop embraces both the formal and intuitive approaches to the study of color, following both the formal system of Albert Munsell⁷ and the collected sensorial experiments of Josef Albers.⁸ Johannes Itten's⁹ series of contrast relationships of are illustrated through the work of James Turrell to emphasize the potential of combining the formal and the intuitive. In addition, a short history of 19th century color theories and systems such as those of Michel Eugene Chevreul and Philipp Otto Runge background the work and are used to describe some of the history of color categorizations that lead up to the formal systems (hue, lightness and saturation) used to describe color mathematically in the digital realm.

The students are asked to compose a color accurate model, including transparencies, reflections and textures, from their reading of the spatial configuration of a painting by El Lissitzky, Wassily Kandisky, or Paul Klee. The paintings are chosen for their achievement of material and spatial effects through the use of color. El Lissitzky's writings on the *Prouns*, in particular, describe the strong association of colors with specific materials. "Color accuracy is a tricky problem."¹⁰ The chemical-physical definition of color is always opposed to the psycho-physical perception of color which is determined by comparison and contrast, depth and frame. As Albers describes, the value of color is inherently dynamic, due to its interaction with other colors or with the absence of color. Paolo Pino, a Venetian author in the 16th century, referred to the composition of colors on canvas as "the true alchemy of painting." It is not so difficult to believe that those responsible for mixing colors from pigment came to be regarded as magicians or sorcerers, capable of making lead into gold. Light seemed to glint off gold paint and pure gold in the same way; the real became equated with its representation. As James Turrell has said, "We are often fooled by visual experiences perhaps precisely because we believe so readily in what we see."

The required final image includes a plan and section of the space of the chosen painting in addition to multiple perspectival views that illustrate an understanding of color contrasts or interactions studied. To achieve this, students generate planes and volumes of various colors and materials. Techniques of synthetic spatial analysis are introduced, both to deform and transform objects and to create orthographic projections. The requirement for color accuracy dictates that they explore how to manipulate color values and surface effects. Associated effects like texture and specular maps, transparency and other surface transformations are also introduced including the more realistic procedural maps and custom shaders. Techniques from Workshop One, namely, altering scale, perspective and lighting, continue to be refined. The final image is again a superimposition, based on a visual movement through the model. Post-production techniques are introduced to further develop the image compositionally. The spatial translations from two-dimensional painting to three-dimensional digital models are constructed rigorously, attentive to the intuitive and formal properties of color as spatially constitutive. The paintings selected already suggest ambiguities concerning dimensional relationships. Research on these painters and their affiliations promote experiments in the studio which further explore relationships of color, space, form and material as related to representation.

In the studio, these studies are applied to the previous radiosity solutions in research related to materials. Students test different simulations of color and texture under the specific lighting conditions determined by the previous assignment. At this time, they are asked to begin physical material studies, taking into account specific structural properties of the material they have



Fig. 4. 3D Color Construction, Sarika Bajoria.



Fig. 5. 3D Color Construction, Josh Pincus.

chosen and analyze its fabrication techniques. These material constructions are tested against the digital simulations for their phenomenal effects. The simulations, in turn, are tested against the material constructs for their tectonic qualities and structural viability.

Workshop Three: STATIC ORDERING SYSTEMS

Products of Architecture are defined as the result of the union of representation (lineamenta) and construction (structura).

– Alberti, 6th Book of Architecture

Part One: Construction Animation

Marco Frascari discusses construction itself as the manifestation of the architectural activity of *construing*: “We are concerned with the manner in which architects build in order to *construe*. The Process of construction is manual and operative and the Process of *construing* is mental and reflective.”¹¹ He further posits that true architecture, with its root of *techne* should necessarily include the activity defined as exercising rational methods towards a specific productive end. He reaches for an understanding of architecture both as a *construing*, a mental activity and construction, a physical activity. Architecture is represented as a technology produced by man and it is placed in the historical dimension and analyzed in its evolutionary and phenomenological process. Treating the architecture like the body, Frascari carries out the surgical impulse; a dissection is performed to gather knowledge. The technique is reflection – what Frascari calls, “retrospective invention of the real through a postmortem, an anatomical demonstration.”¹² The constitutive elements of the architecture are cut apart and reassembled as a way of learning about them and about the manner in which the architecture is constructed. The architectural detail is posited as the locus of resolution for the tension that exists between the construction (as object) and the *construing* (as mental activity). Drawings are constructed to record this operation. Beginning with an understanding of this technique and of the later article, “The Tell-the-Tale Detail,”¹³ the students are asked to choose a recent building in conjunction with the required Case Studies.¹⁴ They research the building and examine its design process and the application of aesthetic objectives.¹⁵ The students are asked to undertake the digital representation of a specific component. They analyze and create the pieces of the assembly, and then set them into motion using three-dimensional animations that recreate the way it comes together. The anim representation begins with the careful three-dimensional digital construction of each element, constructed in the manner delineated by Frascari in his description of the work of Rusconi:

*He collects fragments of construction and explains them genetically. His representations are not simple sections and elevations but rather sophisticated axons. Tri-dimensional representations of details tell the full story of the process of Rusconi’s *construing*. The system of representation of details also tells the full story of the process of construction.¹⁶*

Building on the first two workshops, the drawings are required to represent the detail components as closely as possible. Formal, spatial and construction accuracy is required. Students refine their use of techniques related to surface rendering including the use of color, reflection and transparency. The construction sequence is created using rendered still images.



Fig. 6. Construction Animation Exterior Wall Detail. Phoenix Public Library. Mark Meyer.

Predictably, the case studies productively inform the studio projects. In particular, students are introduced to the idea of reading buildings as a structured collection of ordered systems. They begin to see their studio projects in the same way. Environmental considerations are brought to bear on the design as well as a reconsideration of material issues related to structure. Their analyses, akin to “anatomical demonstrations”, disassemble the systems and their components in order to understand how they are re-assembled. The “mental construing” is registered as a dynamic representation.

Part Two: Digital Analytique

Given the following excerpt from Frascari, the students are challenged to create a new kind of representation called a “Digital Analytique”. The assignment is to produce a single static image, which, through its complexity, represents the component, its sequential construction, its conceptual order and its link to the conceptual order of the building as a whole. The drawings aspire to the edict engraved on the portrait of Italian Enlightenment theorist Lodoli, also discussed by Frascari: “Let representation be functional”.

In the Beaux Arts tradition the understanding of the role of detail as a generator of the character of buildings determined a very peculiar graphic means for the study of it, the analytique. In this graphic representation of a designed or surveyed building the details play the predominant role. They are composed in different scales in the attempt to single out the dialogue among the parts in the making of the text of the building.¹⁷

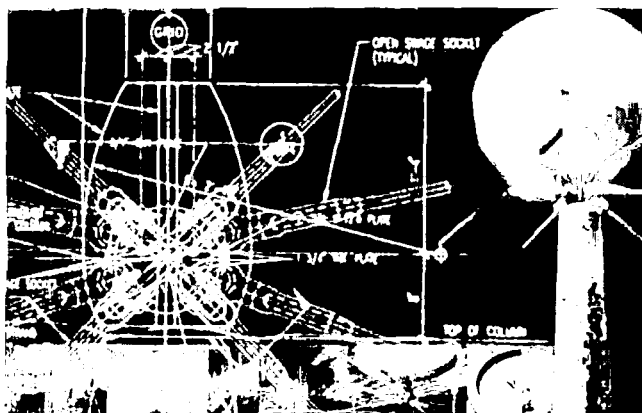


Fig. 7. Digital Analytique: Anneris Rasuk.

Workshop Four: DYNAMIC ORDERING SYSTEMS

The image of movement and movement itself are synonymous; there is no image of recorded movement in cinema, there is only a moving image.

— Christian Metz¹⁸

The culminating workshop engages both the moving image and the composite still image. The theme of the images and the workshop is motion. Rather than the often unconvincing “fly-through” of the project, the subject is the conceptual or literal assembly of the building, as a matter of logical construction, as with the case studies before, or as a matter of the sequential unfolding or accumulation of spatial experiences. This time, the analysis is directed at the student’s own studio project.

The representation of motion necessarily engages the concept of time in both its absolute and relative terms. The students study pieces from the collection of work by Marcel Duchamp at the Philadelphia Museum of Art, for instance, the collapsed motion-event, *Nude Descending A Stair No. 2 (NDS 2)* of 1912;¹⁹ *The Bride Stripped Bare by her Bachelors, Even* also known as the Large Glass, of 1915-1923; and *Etant Donne’s:1. la chute d’eau 2. Le gaz d’éclairage* of 1946-1966. Duchamp struggled with the idea of capturing time in representation and the depiction of the artist’s own endured time. Other examples include the paintings of Toulouse-Lautrec and Edward Hopper: the former capturing a fleeting moment of erotic excitement; the latter, its opposite, a long duration – the empty existence of non-activity. As the students began their project animations, notions of cinematic motion offered by Gilles Deleuze²⁰ and Peter Greenaway²¹ define the framework and guide the direction.

The first photographs, called “points of view” by their inventor, Niepce, were “a collection of objects to which the eye is directed and on which it rests within a certain distance.”²² Motion expands this “collection” and makes the “certain distance” variable. For Peter Greenaway, “the viewer’s awareness of the possibility of off screen space in the cinema is greatly enhanced, and can be understood as an extension of the dramatic space of the image, solidly part of this world, that we may look upon through the image when it is revealed to us.”²³ The technique used to achieve this effect is the moving frame. Greenaway describes it as a kind of “meta-image”. When K. Michael Hays discusses the Barcelona Pavilion, the cinematic effects are hard to miss.²⁴ He calls it “an event with temporal

duration, whose actual existence is continually being produced. . . . The architectural reality takes its place *alongside* the real world, explicitly sharing temporal and spatial conditions of that world, but obstructing their absolute authority with an alternative of material technical and theoretical precision."²⁵ The building itself seems to operate as a "meta-image," dynamically reconstructing itself in a "*montage* of contradictory, perceptual facts"²⁶ as one moves through it. The nature of the material surfaces is constantly in question because of the qualitatively heterogeneous experience of light and motion. Reflections and transparencies begin to perceptually invert tectonic relationships.

The movement studies created for Workshop Four became important components of the project presentations at the final review. As an additional form of representation, the media allowed the project to be conveyed in newly evocative terms. It also elucidated the design process. In some cases, the production of the animation created a distraction for the student, a trap that must be carefully monitored in a studio using digital media. The balance of time given to Visual Studies relative to studio was maintained by enforcing strict deadlines for submission of work. In this way, the studio work is not disrupted, although the provocations created by the representations proved productive in terms of re-doing, or refining studio work. A successful result in the studio was that the relationship between light and materials was understood experientially, not statically as a photo, but dynamically, by the body in motion through the space of the project; *Light becoming architecture, architecture becoming light*. Beginning with a study that could be called "chronophotographic", the inscription of time by light, the workshop sequence ends with a study in "cinematography", the inscription of movement in space.



Fig. 8. *Movement-Image*. Sera Baldwin.

CONCLUSION

The terms by which computer technology has been engaged have been largely according to the 19th century automation model which understands tools as a means to increase production speed and lower costs. In contrast, Visual Studies III engages an evolution model, understanding tools as dynamic possibilities, able to help us reach a higher level of complexity: "As a tool, evolution is good for three things: How to get somewhere you want but can't find the route. How to get somewhere you can't imagine. How to open up entirely new places to get to."²⁷ The course proceeds from an acknowledgment that the technological innovations of the digital revolution have had an effect not only on the means of storage, communication and distribution of culture but also on specific techniques of production and manipulation of every art, including architecture. Digital media is understood as both theoretical and pragmatic. Creative strategies towards digital technology as it relates to design and the creative process are examined in order to increase the relevance and intensity of architectural discourse with respect to our current information-based society.

Questions about the impact of representation on design are paramount in the workshop and persist in the studio. The sequence of four exercises build on each other, having as their goal a synthetic understanding of space in three dimensions and a mastery of the skills required to both project and simulate its representation in two dimensions. Rather than limit the exploration to topological surfaces or animation-driven investigations of complex forms, the drawings are seen as a performative locus: they are visual repositories of data from which information can be gleaned, geometries tested, refined and transmitted. This follows advances in parametric simulation softwares that have made possible certain dynamic simulations such as the visualization of sound to create animations from acoustical models.²⁸ *Projection* and *simulation* emphasize the representation of the formal properties of things made and their phenomenal effects. Drawings also represent how the things are constituted: processes of assembly, hierarchical relationships or generative techniques. Students experiment with the media-specific techniques demonstrated and are encouraged to create hybrids by alternating and combining virtual and material techniques.

Concurrent to the active and productive engagement of digital media, the *Chora* studio underscored a consideration of materiality in the design process. The students were required to make transformational leaps from the virtuality of digital diagrams to the constructive materiality of architectural tectonics. Through direct experimentation with the material processes of fabrication in wood, concrete, metals and glass, the students constructed material devices that tested the spatial and structural viability of their digital models. Part of the methodology of the studio was to consider material as primary and to generate

work from the layering of specific material characteristics onto a spatio-temporal condition of movement. In both the design studio and the Visual Studies Workshops, emphasis is placed on the idea of representation as a creative, generative act and is focused on transformations using perceptual and material approaches.

While I have discussed the particular interactions of the Visual Studies Workshops with my design studio, the *Chora* Project, similar but distinct interminglings were made possible in five other studios. The instructors for Visual Studies participated in the lectures and provided critiques for a different quarter of the Second Year class at each workshop. With this rotation of instructors in place, students received critiques from a different perspective for each workshop. Because the Visual Studies studios were larger than the design studios, productive interaction occurred between the design studios as well. The design studios shared a pedagogical agenda, but each had different themes, sites and programs. Productive discussion between students about their design projects (though not about digital techniques or hardware *snafus*) is a palpable casualty of the digital design studio. Ironically, the technology that has decreased physical distances and allowed students to converse with colleagues across the globe comes at the expense of more proximate interaction. Levels of distraction are also high, suggesting that architecture, identified by Benjamin as a valuable example to post-industrial art for the state of its reception, might also consider these lessons reflectively, applied towards the current state of its creation.

NOTES

¹ Amédée Ozenfant, "Colour and Method," in *Modern Color/Modern Architecture: Amédée Ozenfant and the genealogy of color in modern architecture*, by William W. Braham (London: Ashgate, 2002). First published in *The Architectural Review* 81 (February, 1937): 89.

² Louis Kahn, "From a conversation with Peter Blake," in *What will be has always been: The Words of Louis Kahn*, ed. Richard Saul Wurman (NY: Rizzoli, 1986) 72.

³ For a discussion of the duality of light as both agent and object of vision, the interplay between surface and pictorial light, actual and simulated light of Early Italian painting circa 1250-1420, see Paul Hills, *The Light of Early Italian Painting* (New Haven & London: Yale University Press, 1987).

⁴ The University of Pennsylvania hosted Muybridge between 1884-1887 where he worked with Eakins. They published 20000 negatives in 781 folio compilations in *The 11 Parts of Animal Locomotion* in 1887. These famous photographs and a collection of Muybridge's apparatus were on view from October 2000 through March 2001 in the Documentary Photography Gallery of the National Museum of American History.

⁵ Johannes Itten, "Seven Color Contrasts" and "The Spatial use of Color" in *The Elements of Colour: A Treatise on the Colour System of Johannes Itten based on his book The Art of Colour*, Faber Birren, ed. Ernst Van Hagen, trans. (New York: Van Nostrand Reinhold, 1970).

⁶ Lois Swinoff, *Dimensional Color* (Boston and Basel: Birkhauser, 1988).

⁷ Albert Munsell, *A Grammar of Colors* (New York: Van Nostrand Reinhold, 1969).

⁸ Josef Albers, *Interaction of Color* (New Haven and London: Yale University Press, 1963).

⁹ . . . Itten, "Seven Color Contrasts".

¹⁰ Ed Wallace, quoted in a seminar for students and faculty given at the invitation of the GSEA Computing Facilities Group by managers from Charette-Repro, Philadelphia PA, 2000.

¹¹ Marco Frascari, "Sortes architecti in the eighteenth-century Veneto", University of Pennsylvania Dissertation, 1981.

¹² Marco Frascari, *Monsters of Architecture: Anthropomorphism in Architectural Theory* (Maryland: Roman & Littlefield Publishers, 1991).

¹³ Marco Frascari, "The Tell-the-Tale Detail", Paula Behrens and Anthony Fisher, eds. *VIA* 7(1984) : 23-37.

¹⁴ The field of possibilities for case study included recently completed projects by Jean Nouvel, Peter Zumthor, Herzog and de Meuron and Renzo Piano.

¹⁵ In their structural expressiveness, this is usually a modernist correlation of structural honesty/truth with beauty, although some recent work has begun to question the aesthetic of this kind of structural transparency.

¹⁶ Frascari, "Sortes architecti . . ."

¹⁷ . . . *ibid.*, 24.

¹⁸ Christian Metz, quoted in David Pascoe, *Peter Greenaway: Museums and Moving Images* (London: Reaktion Books, 1997) 17.

¹⁹ Diagrammatic dots at the center of the composition NDS 2, recall the silver buttons Marcy put on his subjects to be able to measure their movement with precision. This is pointed out in Dawn Ades, Neil Cox, David Hopkins, *Marcel Duchamp* (London: Thames and Hudson, 1999) 48.

²⁰ Gilles Deleuze, *Cinema 1: Movement-Image*, Hugh Tomlinson and Barbara Haberjam trans. (Minneapolis, MN: University of Minnesota Press, 1986).

²¹ . . . Pascoe, *Peter Greenaway: Museums and Moving Images*

²² Paul Virilio, *The Vision Machine*, Julie Rose, trans. (Bloomington and Indianapolis: Indiana University Press, 1994)19.

²³ Pascoe, 17.

²⁴ K. Micheal Hays, "Critical Architecture: Between Culture and Form," *Perspecta* 21 (1984):14-24.

²⁵ . . . *ibid.*, 25.

²⁶ . . . *ibid.*, 24 emphasis mine.

²⁷ Kevin Kelly, *Out of Control: The New Biology of Machines, Social Systems and the Economic World* (Reading, MA: Addison-Wesley Publishing Co., 1994).

²⁸ These have been applied towards performance-based evaluations and refinements of particular forms, for example in Norman Foster's Greater London Authority Headquarters in Southwark, London (1998-2002). <http://www.fosterandpartners.com/internetsite/Flash.html> has some excellent movies that describe the processes for manipulating the form and for evaluating its solar gain and the acoustical performance of an interior auditorium.