**Pumping Up: Digital Steroids and the Design Studio**

Scott Poole, FAIA
Dean
College of Architecture + Design
University of Tennessee

**Speed**

At the beginning of their studies in architecture is there a student who does not want to be more artistically effective, intellectually agile, and just flat out fast? It is in their nature to want to be immediately brilliant.

Near the height of the controversy regarding the use of steroids in Major League Baseball, Tony Kornheiser, a sports reporter for the Washington Post facetiously confessed to taking steroids in order to become, "bigger, stronger and faster on the keyboard". "You should see me type now", he wrote, "I'm unbelievably fast, yet precise at the same time. I'm the Eric Clapton of the laptop. I can type all of 'Moby Dick' in 14 minutes. I can type faster than Evelyn Wood can read it." He goes on to say, "I couldn't believe how powerful the steroids made my words. Suddenly I could throw in a word like 'enigma' without ever worrying what it actually meant. My vocabulary expanded exponentially. I used to be a three-syllable guy at most. But under the influence of steroids I could bat out four-syllable words like – well, like 'exponentially' and five-syllable words like 'onomatopoeia'…Steroids gave me all sorts of confidence."[1]

Beginners are impetuous. They sense that quickness is something of value in the arts and they are essentially correct in this assumption. What beginners typically lack, however, is the ability to distinguish between quickness and haste, between the capacity to move swiftly with skill and precision, and the impulse to act on the spur of the moment without accuracy, attention to detail, or the background of thought and experience that speeds intuition. Understandably beginners are confused. How can they act quickly in artistic situations when the urge to act fast so often leads to outcomes that reveal their innocence and inexperience? How can they get going, and act without delay, when disciplined thinking seems to slow them down so much?

**Slowness and Substance**

Naturally, someone who has just started to learn something difficult is attracted to the possibility of a short cut to virtuosity, often overlooking the vital role that material, technique, and time play in the conception and making of a work of art.

"Long years spent in the studio," writes James Elkins, "can make a person into a treasury of nearly incommunicable knowledge about the powderliness of pastels, or the woody feel of different marbles, or the infinitesimally different iridescences of ceramic glazes."[2] In his compelling description of Rembrandt's self-portrait he acknowledges that it is an accurate visual description of the face of an aging man. But it is also, according to Elkins, "a self-portrait of paint. The oils are out in force, like the uglinous oozing waters of a swamp bottom." He goes on to say, "The thoughts that crowd in on me …are thoughts about *qualities*. I feel viscid. My body is snared in glues and emulsions, and I feel the pull of them on my thoughts. I want to wash my face."[3]

Similarly, the concrete of Louis I. Kahn's Kimbell Art Museum speaks about itself, the architect's imagination, and a refined sensibility to material that is acquired over time.[4] It is not generalized concrete, the concrete of city sidewalks and anonymous floor slabs, but an expression of the qualities, properties, and potentials of a specific material with a specific surface tension, and a particular greyness.

Concrete is watery, sloppy, thick and heavy. On the otherwise smooth exterior of the Kimbell Museum thin abrasive lines mark joints where the concrete slurry has oozed out and petrified between narrow spaces in the precisely configured formwork. Near these joints, shallow cylindrical voids capped with lead locate where the formwork has been held in place, revealing traces of the construction process.[5] Surprisingly, the concrete surfaces, inside and out, more closely resemble the waxy essence of flowers, the mottled surface of a painting, or the fluorescence of silica, than they do the dull grey of gravel.

Louis I. Kahn, detail–exterior wall of the Kimbell Art Museum.

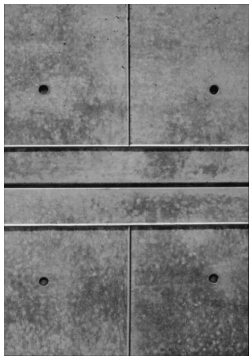


Photo: Scott Poole

Early in his career, Kahn explained that his approach to drawing involved finding a vital essence beyond the appearance of things. "I try in all my sketching not to be entirely subservient to my subject, but I have respect for it, and regard it as something tangible—alive—," he wrote.[6] It is hardly unexpected then, that he would have little regard for the bland and lifeless quality of standard concrete. Instead, he imagined for the Kimbell Museum, a surface color that resembled *moth wings*[7] suggesting not only a particular hue, but a feeling of lightness. His desire to achieve this precise quality involved, among other things, adding volcanic ash to the concrete mix[8] and searching throughout Texas and Louisiana for a particular color of sand.[9]

Materials, especially commonplace materials like concrete, do not let go of their secrets quickly or cheaply. As the Kimbell Museum developed from design to construction, considerable delays and

misunderstandings occurred between Kahn and his collaborating architect Preston Geren who had a difficult time understanding Kahn's time-consuming approach—one that involved experimentation with untried methods and a continual interplay between initial design drawings and construction documents as the building evolved.[10]

Likewise, for Peter Zumthor, architecture is slow.[11] He spent years developing and refining the technical skills that enable him to draw out the elemental force of materials with precision. Famously, at Vals, he intertwined place with a particular substance, establishing what he terms, "a primordial reaction to the rock mountain."[12] The ancient, sensual qualities of stone quarried a short walk away from the thermal baths evoke the permanence of a place remote in time, even though the form is decidedly modern. This feeling is enhanced by the moistness of the interior atmosphere, the dim light, and the murmur of water—qualities experienced over time. "Sense emerges," Zumthor writes, "when I succeed in bringing out the specific meaning of certain materials in my buildings, meanings that can only be perceived in just this way in this one building."[13]

Peter Zumthor, spring grotto, Thermal Baths at Vals, Switzerland.

Photo: Hélène Binet

In contemporary architecture there is an abundance of experimentation with new and interesting materials, but material virtuosity is rare and the combination of material intelligence and conceptual refinement even more uncommon. In his book *Building Skins*, Christian Schittich writes: "The joy in experimentation finds expression in countless innovations. However the material use isn't always successfully integrated into the overall concept." "Too often," he continues, "what results is mere decoration of skins that are separated from the building, more empty shell than skin." He concludes by saying, "drawing attention at any cost seems to be the engine that drives many such innovations, for our fast-paced world clamours ceaselessly for novelty."[14]

**Tempo and Perception**

In the world of virtual reality slowness is a relic of an exasperating past. In the dynamic, hyper-digitized, cyberceptive world speed and novelty are supreme. Information is exchanged at dizzying rates of speed, and the stream of words, sounds, and images that we create, and are exposed to, seem to multiply exponentially. To cope with the increasing acceleration of information new forms of technology promise to alter the way we perceive our surroundings. According to Roy Ascott, "Cyberception not only implies a new body and a new consciousness but a redefinition of how we might live together in the inner space between the virtual and the real."[15]

Life lived in the actual world, however, has certain constants: our inner world and the outer world are linked by way of a simple mathematical relationship—the rate at which we live affects the quality of our sensations. There is a limit, affected by speed, concentration, and attention, beyond which sense impressions no longer take hold. "If by some sudden magic," wrote Gyorgy Kepes, "we were to live a million times more rapidly than we do, in surroundings that retained their present pace, the coming and

going of day and night, the slowest movements of a sleeping child, would become a blur, a texture too smooth to be grasped by the senses."[16]

Our grasp of the world involves bringing an uninterrupted flow of memories and sense impressions into focus by controlling our perception of time. We set the tempo that enables clarity and definition; that gives priority and intensity to certain moments. We decide when time will flow swift and steady and when it will become viscous and sticky.

The tempo of our lives can also be linked with our ability to retain what we perceive. In his novel, *Slowness*, Milan Kundera, develops a basic existential equation explaining the relationship between retention and perception. "There is a secret bond between slowness and memory, between speed and forgetting", he writes, "…the degree of slowness is directly proportional to the intensity of memory; the degree of speed is directly proportional to the intensity of forgetting."[17]

The urgent task of the teacher is to put students in a position to grasp this secret bond between slowness and memory, between long attention and lasting impression, before they become seduced by the general euphoria of virtual reality, promises of enhanced velocity, and illusions of automatic virtuosity.

**Durable Knowledge**

Even beginners who have spent a short time working with color understand that it is an incredibly unstable phenomenon, always changing relative to its bordering or surrounding color. A basic lesson with color involves observing the effect of a dark background and a light background on two identically colored objects. In this controlled situation the changes are obvious: the identical objects appear darker on a light background and lighter on a dark background. That the information required for possessing this knowledge was right in front of ones eyes, yet escaped notice, begins to provoke speculation about what else, embedded in the world, one is looking at yet failing to see.[18]

Through this exercise a significant modification of consciousness occurs: objects begin to have a dual nature—at once things that can be seen and touched in the material world and also sources of perceptual change. In effect the student acquires what the artist Robert Irwin calls, "an extended way of looking at the world." "Once you gain it", he continues, "you carry it with you and you live in an enriched world."[19]

This new awareness, relatively easy to grasp, is hard to forget. Donald Judd called this type of knowledge durable, implying that a clear awareness of facts learned through attentive study, has a certain resilient, long-lasting, and sturdy character. "Color as knowledge is very durable," he writes, "I find it difficult, maybe impossible, to forget".[20]

Similarly, the memory of making and depicting an actual physical object by hand is hard to forget. It is also a kind of durable knowledge because it involves changes in perception and a specific awareness of facts that one arrives at through intense observation and constructive effort.

In the following is a one-week exercise, for example, beginning students construct, and then draw a plaster sphere. The exercise begins with the casting of a plaster cube, then the transformation of the cube by turning it on the open end of a PVC pipe. A considerable effort is involved in the initial formation and subsequent transformation of the sphere, including the construction of the mold, the preparation of a place to pour, the mix of plaster and water, the meticulous cleaning of the workplace, waiting for the plaster to set, removing the mold, and finally the tedious task of turning a rectangular a solid into a spherical shape.

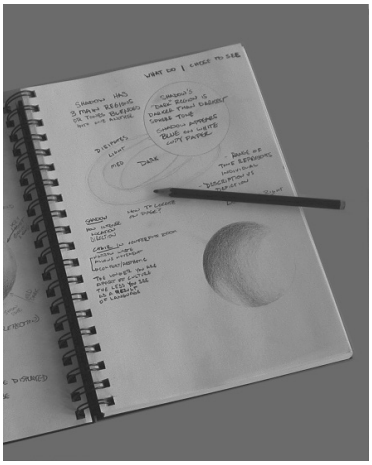
Making the sphere takes more time than anticipated. Each step in the sequence of events dilates time, and every lapse of concentration causes mistakes that multiply time. Initially, the slow pace is frustrating, but

this experience in constructive concentration leads to unexpected enrichments of later work. Mixing the plaster with their hands, feeling the heat of the curing process, and turning the sphere, over and over, makes the students immediately more attentive to the value of sensory information—in addition to giving them a new respect for the term *first-hand experience*. The lasting sensible impression of this process helps the student to mentally grasp the fact that this and other constructive acts, involve a complex sequence of events that gradually take place over time.

Hand turned plaster sphere with material removed during fabrication.

With the sphere in hand the student then constructs a drawing. Working backward from the standard practice of making drawings conceived in advance of concrete objects gives the student an edge in observation. They are already aware that the object they have made has certain qualities. They know where flaws exist and why they are there. Air, for example, is often trapped beneath the surface of the plaster. When they depict the object students often show this and other imperfections. They do this not merely because the flaw is visible, but because their sphere is no longer a conceptual object. Inevitably it retains traces of the process of construction that remain at the forefront of their consciousness.

Student notebook: written observations



and graphic depictions of the sphere.

The memory of this constructive process extends perception. It slows the student down and allows them to develop a patient and persistent approach to a series of actions. When they draw the shadow of the sphere, for example, they have already acquired a heightened awareness of material and an enhanced sense of touch that makes them more attentive to the texture of the paper, the quality of the lead, and the pressure of their hand. Each consideration takes time, and none can be acquired in a hurry.

When they begin to construct this drawing the student already knows too much to preconceive the result. They know, from close examination, that the shadow of the sphere is something more than a uniformly dark space on the surface close to an object. And they know from experience that the relationships

involved in the construction of an object are often too complex to understand in advance. For example, choosing where to position the sphere on the rectangular sheet of paper, deciding whether the shadow will be cast, to the right or the left, even settling on what hardness of lead to use involve actions based on judgments that are often reassessed as new information emerges. So they act in order to have enough information to begin again.

"Our efficiency," the architect Renzo Piano writes, "implies the complexity of doing and doing again."[21] This paradoxical efficiency, searching without the expectation of immediate success, allows specific aspects of the problem to gradually unfold and the difficult task of finding meaningful interrelationships to begin.

**The Promise of Digital Technology**

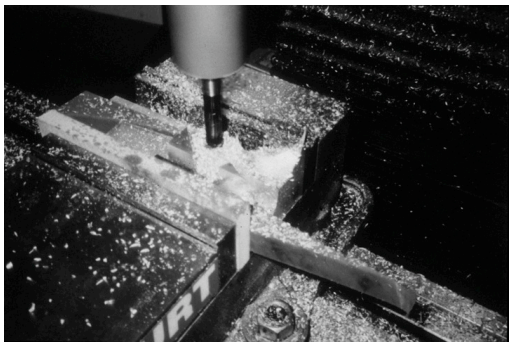
Advances in the virtual dimension promise to have a resounding impact on architects and architecture. "Technologies of simulation," according to media authority Derrick de Kerckhove, "…are becoming so flexible, affordable and user-friendly that they eliminate the need for the slow and difficult steps in drafting and modeling." He goes on to say, "They allow faster processing and rendering, hence a closer approximation to thinking. Imagining and imaging almost become one."[22] The old-fashioned 'efficiency' of slowly building a constructive imagination through repeated acts of drawing and making has mercifully come to a close. Or has it? Have advanced digital technologies and computational quickness fundamentally changed how we learn to give shape to the content of our imagination?

Without doubt simulation technology has altered the speed at which designers conceive and produce images. One obvious advantage of digital technology is the exchange of information between members of a team, who can send files across a room or around the world. That advantage is somewhat diminished by the fact that drawings often look complete at every stage of development, leading to the actual construction of embryonic ideas. Similarly, rapid prototyping devices allow a designer to quickly fabricate and make adjustments to three-dimensional objects. Again, these objects tend to look complete from the outset, rarely giving the designer any insight into how the object might actually be constructed at a large scale.

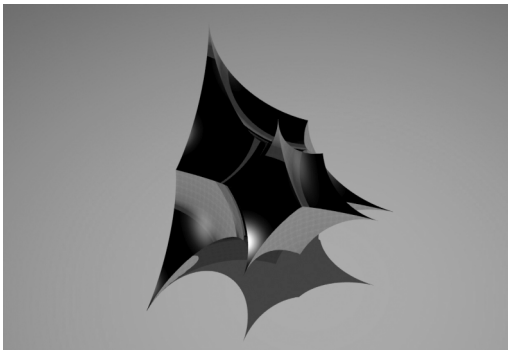
With these technological advances there is the promise of advances in the appearance and substance of architecture. Certainly, the physical simulation of mental images is at an all time high. A 3-D printer, for example, can make intricate models of computer renderings. An object that has just come to mind can be held in the hand a few hours later. Casting such objects in the past would have taken advanced skill and painstaking effort. Now complex objects can be fabricated in almost no time at all. A designer can have an idea at breakfast and an object in their hand before lunch. And, best of all, between breakfast and lunch one can be producing other digital simulations because the designer does not even need to be present while the object is being made.

A CNC milling machine, for instance, can turn a block of metal into a sensuous shape in the course of an afternoon. The CNC milling machine, however, unlike the 3-D printer, requires the expertise of a technician who installs the cutting tool, configures the blocking to immobilize the object during the cutting, and makes adjustments to the tools and blocking during the process. As a result the designer may fabricate an alluring object yet remain detached from the constructive forces that ultimately enable the fabrication.

While three dimensional software programs and rapid prototyping devices produce remarkable shapes, those shapes have less to do with finding limits, an essential aspect of art, architecture and design, than working within the *pre-established limits* of the software designers imagination.



Aluminum in the process of fabrication on a CNC milling machine.
Photo: William Sevebeck



Digital image of object modeled in the Rhinoceros NURBS modeling program.
Flamingo rendering by William Sevebeck.

**The Problem with Simulation Technology**

Does the speed of processing and rendering bring us closer to thinking or, more precisely, the kind of constructive thinking required of the architect? Proponents of simulation technology typically imply that the rate of image production and consumption is directly proportional to the intensity of imagination. In other words, our imagination will increase in force as we increase the speed at which we make and process images.

One could also make the case that our voracious consumption of images contributes to an impoverished imagination. It might be anachronistic to return to Leonardo da Vinci, but he too subscribed to the idea that imagery and imagination have a direct proportional relationship. In his advice to painters he asks them to consider a new device for stimulating the mind. "Although it may appear trivial and almost ludicrous", Leonardo nevertheless advises the painter to isolate their concentration to improve their imagination—long-looking at a wall spotted with stain, for example.[23]

Rapid simulation of mental images, detached from the veracity of matter and the means of production, can have an illusory effect on the imagination and foster constructive naiveté. When the real conditions of everyday-life are suspended there is no limit to formal preconception. Everything appears possible.

The resistance of material, however, limits what can be realized. Constantin Brancusi's numerous broken birds, for instance, were initially the result of forcing stone to do something that was not in its nature. His eventual success with this brittle material is less an argument for preconceived form than it is a reason to support the interplay between the imagination of the artist and the nature of a particular material. As Brancusi himself said, "Matter should not be used merely to suit the purpose of the artist, it must not be subjected to a preconceived idea and to a preconceived form. Matter itself must suggest subject and form; both must come from within matter and not be forced upon it from without."[24] For Brancusi the ability to bring out the being in matter happened slowly. As Ann Temkin points out, it was years before he succeeded in making the veining of the marble a force in his sculpture.[25]

Rapid prototyping devices offer an illusion of instant sophistication. Students, especially beginning students, easily become enamored with how quickly their thoughts become solidified as objects. In no time at all the reality of matter, its nature and nuance, become inconsequential and formal results become the object of their attention. This overemphasis on quick reproduction is counterproductive to a student's intellectual and artistic growth. It encourages a premature confidence that, among other things, lacks constructive depth and substance.

Digital image of object designed in the Rhinoceros NURBS modeling program

Similarly, the synthetic smoothness of computer-generated images can slow the development of constructive thought by creating a false sense of technical resolution. Rather than search for criteria and limits, for the disciplinary resistance essential to cultivating a vigorous constructive imagination, too much creative energy tends to be focused on the illustration of image driven ideas. Not surprisingly, the objects and buildings often represented by these images would, more appropriately, be formed in molds as a whole rather than built up of parts. In this context it is not surprising that the word 'seamless' has gained increasing popularity in the art, architectural and design press in recent years. But is it not precisely in the construction of seams, in the joining of one thing and another, that architecture gains much of its fullness and force?

Detail of corner–  –constructed of rubber bands and nails.

According to the contemporary Italian architect and critic, Vittorio Gregotti. "Architects of image, who see their design task in terms of providing a few general sketches, have become conspicuously common in recent years. This has been particularly true in the United States, where architects can rely on an advanced system of support…" "The most obvious aspects of this phenomenon," he asserts, "represent a departure from our discipline's technical heritage, or at least an impoverishment of this heritage."[26]

**The Task of the Teacher**

Tools, in themselves, do not magically open our outlook on life. Advanced digital techniques and enhanced computational speed, while remarkable, do not inevitably bring about a heightened awareness

of the world or elevated artistic thought. On the contrary, as the architect Juhani Pallasmaa observes, "Pure utility and rationality, or even the most advanced technologies, cannot grant entry into the artistic realm. The realm of art is approached through metaphysical, existential, and poetic concerns."[27]

Architecture is more than an image driven appearance. It is an inherently constructive act bound simultaneously to the flux of life *and* the permanence of human nature. The perennial task of the teacher is to put students' in a position to structure the existential difficulties embedded in these polarities, not to pretend they do not exist.

**Accelerating Consciousness and Bodily Identification**

In his Nobel Lecture, the poet Joseph Brodsky reflected on the particular way that writing verse quickened the intensity of one's mind and enhanced one's grasp of the world: "The one who writes a poem writes it above all because verse writing is an extraordinary accelerator of consciousness, of thinking, of comprehending the universe…"[28]

Making architecture, like writing verse, is incredibly slow work because it's material form is intertwined with basic questions of being human. It develops, for the most part, through quiet reflection, with actions that move at the speed of lead. Paradoxically it is not velocity, but the ability to accustom oneself to working slowly within density that intensifies consciousness—especially at the beginning of one's education in architecture and design. Subtle links between the mind and the multiplicity of the world are internalized by the hand and move to the forefront of the students' consciousness. Information that was once considered insignificant—even trivial, becomes a vital part of an expanding perceptual horizon.

Gradually the architect within the student begins to understand the significance of their bodily identification with their work and its potential for meaningful exchange with others. "A great musician plays himself rather than the instrument," writes the architect Juhani Pallasmaa in the *Eyes of the Skin*. He goes on to say, "As the work interacts with the body of the observer, the experience mirrors the bodily sensations of the maker. Consequently, architecture is communication from the body of the architect directly to the body of the person who encounters the work, perhaps centuries later."[29]

**Two Stories About Ten Years**

In conclusion, consider these two stories about ten years. The first is the story of Chuang-Tzu, told by Italo Calvino at the conclusion of his chapter on 'Quickness' in his book *SIX MEMOS for the NEXT MILLENNIUM*.

> *"Among Chuang-Tzu's many skills, he was an expert draftsman. The king asked him to draw a crab. Chuang-Tzu replied that he needed five years, a country house, and twelve servants. Five years later the drawing was still not begun. 'I need another five years,' said Chuang-Tzu. The king granted them. At the end of these ten years, Chuang-Tzu took up his brush and, in an instant, with a single-stroke, he drew a crab, the most perfect crab ever seen."*[30]

The other story was told during the first week of my architectural education. According to the story, there was a former Dean of the school having his office painted. One morning, before class, he was examining the work of the previous day and observed that the line between the wall and ceiling wavered enough to be noticeable. Irritated that the quality of the work was under scrutiny, one of the painters remarked that he had ten years experience. The Dean corrected him saying, "No, you have one year of experience, ten times."

The two stories make the same point. Speed takes time. The immediacy of intuition is not likely to be found in a naïve approach to software commands, market driven images, and novelty. Rather it is something one earns by his or her efforts to cultivate an imagination enlarged by the qualities of matter and disciplined by constructive skills—an imagination grounded in human values and focused on the enrichment of our lives.

**Illustrations:**

The exercises illustrated are the work of second year architecture students in the School of Architecture + Design at Virginia Tech.

Images of student work in order of appearance: Erin Moon–hand turned plaster sphere; Tyson Hosmer–study of sphere; Jill Guertin–aluminum object in the process of fabrication on a CNC milling machine; Jill Guertin–digital image of object modeled in the Rhinoceros NURBS modeling program; Maria Villacreces–digital image of object designed in the Rhinoceros NURBS modeling program; Peter Davies–detail of corner joint constructed of rubber bands and nails.

---

**Notes:**

[1] T. Kornheiser, 'Steroids Are Getting Me All Pumped Up', The Washington Post, May 31, 2002, p. D 1.

[2] J. Elkins, *What Painting Is*, New York: Routledge, 2000, p. 22.

[3] Elkins, *What Painting Is*, pp. 114-115.

[4] By 1969 Kahn had been working with concrete for at least a generation.

[5] K. Frampton, *Studies in Tectonic Culture: The Poetics of Construction in the Nineteenth and Twentieth Century Architecture*, Cambridge, Massachusetts: The MIT Press, 1995, p. 241.

[6] D. Brownlee, "Adventures of Unexplored Places," in *Louis I. Kahn: In the Realm of Architecture*, New York: Rizzoli International Publications, Inc., 1991, P. 23.

[7] In the early 1970's, Louis Kahn gave a lecture at Radford University, in Southwest Virginia. At a certain point in the lecture he was speaking of his desire for a specific surface quality at the Kimbell Art Museum, saying that *he desired a surface that had the color of*—and he hesitated for an uncomfortably long time, eventually closing his eyes. Some of the audience actually thought he had fallen asleep. Then he lifted his head, after this unusually long pause and said—*"Moth wings!"* From conversations with Professors Jaan Holt and Bill Gallloway, Virginia Tech.

[8] Frampton, *Studies in Tectonic Culture: the Poetics of Construction in the Nineteenth and Twentieth Century Architecture,* p. 242.

[9] Kahn was trying match the concrete of the Salk Institute and searched throughout East Texas and Louisiana to find the right color sand eventually having to crush stone to complete the project. From a conversation with Professor Lawrence Speck, University of Texas.

[10] Accademia di Architettura, *The Construction of the Kimbell Art Museum*, Milan: Skira editore, 1997, p.114.

[11] P. Zumthor, 'I am Working on the Substance, I am not working on the Form', **oris** Magazine for Architecture and Culture, Volume VI, Number 27, 2004, p.18

[12] Ibid. p.11.

[13] P. Zumthor, 'A Way of Looking at Things' in *Thinking Architecture*, Basel: Birkhäuser – Publishers for Architecture, 1998, p. 10.

[14] C. Schittich, 'Shell, Skin, Materials', in *Building Skins*, Basel: Birkhäuser – Publishers for Architecture, 2001, p. 18.

[15] R. Ascott, *The Architecture of Cyberception*, Quoted in D. de Kerckhove, *The Architecture of Intelligence*, Basel: Birkhäuser – Publishers for Architecture, 2001, p. 33

> *"Cyberception not only implies a new body and a new consciousness but a redefinition of how we might live together in the inner space between the virtual and the real."*

[16] G. Kepes, ed., 'Introduction', *The Nature of Art in Motion*, New York: George Braziller, 1965 p. i.

[17] M. Kundera, *Slowness*, New York: HarperCollins, 1995, p. 39, quoted in 'Slowness' B. Tsien and T. Williams. *2G International Review of Architecture*, *N.9,* Barcelona: Editorial Gustavo Gili SA, 1997, pp. 130-137.

[18] Or, as Ludvig Wittgenstein so aptly put it, *"God grant the philosopher insight into what lies in front of everyone's eyes."* L. Wittgenstein, G. H. Von Wright, ed. *Culture and Value*, Chicago: The University of Chicago Press, 1980, p. 63e.

[19] R. Irwin, *The Beauty of Questions* (Video), Leonard Feinstein, ed., 1997.

[20] D. Judd, 'Some aspects of color in general and red and black in particular', *Daidalos* #51, Berlin: Bertelsmann Fachzeitschriften GmbH, 1994, p. 46

In his essay Judd, uses a different example—afterimage:

> *"In Part VII Albers say to paste a red circle and a white circle on a black sheet of paper and then stare at the red circle. Then, look at the white circle: it is green or blue-green, the complementary of red."*

[21] R. Piano, 'The Building Workshop' in Robbins, Edward, *Why Architects Draw*, Cambridge, Massachusetts: The MIT Press, 1994, p. 128

> *"Gallileo Galilei said something like* provandi e riprovandi*, trying and trying again. It is a sort of basic philosophy of experimental work."*

[22] D. de Kerckhove, *The Architecture of Intelligence*, p. 52.

[23] E. MacCurdy, (ed.), *The Notebooks of Leonardo Da Vinci*, New York: Garden City Publishing Co. Inc., 1941, p. 873.

[24] F. Teja Bach, 'Brancusi: The Reality of Sculpture' in *Constantin Brancusi, Ann Temkin, ed. 1876-1957,* Philadelphia: Philadelphia Museum of Art, 1995, pp. 23-24.

> *"Matter,"* he (Brancusi) declared, *"must continue its natural life when modified by the hand of the sculptor…"* According to Carola Giedion-Welcker, Brancusi *"knew he must keep continuous watch over the material, that he could give in to indulgently, then, suddenly he must get the best of it."*

see also: M. Gale, ed. 'Selected aphorisms' in *Contantin Brancusi: The essence of things*, London: Tate Publishing, 2004, p. 133.

> *"Art generates ideas, it doesn't represent them – which means that a true work of art comes into being intuitively, without preconceived motives, because it is the motive and there can be no accounting for it a priori."*

[25] A. Temkin, ed. *Constantin Brancusi 1876-1957,* Philadelphia: Philadelphia Museum of Art, 1995, pp. 170, 174-75,

In his early birds (Yellow Bird, 1919) the veining resulting from a preexisting fault in the marble is unaligned; in later works (Bird, 1923-47) the veining becomes an integral part of the sculpture.

[26] V. Gregotti, *Inside Architecture*, Boston: The MIT Press, 1996, pp. 98-99.

[27] J. Pallasmaa, 'Immateriality and Transparency', (2003) from a collection of essays, *encounters,* P. MacKeith, ed., Hämeenlinna: Rakennustieto Oy, 2005, p. 203.

> *"While I acknowledge the interdependence of science, technology, and architecture, the disciplines are also inherently different. This opposition needs to be pointed out–although here I hope that my point will be not be misunderstood. I am not underestimating the significance of technology, I merely argue that the artistic dimension of architecture arises from other concerns and another mental ground. This reflects the fundamental difference between ends and means."*

[28] J. Brodsky, 'An Uncommon Visage', (1987) from the collection of essays, *On Grief and Reason*, New York: Farrar Strauss Giroux, 1995, p. 58.

> *"Having experienced this acceleration once, one is no longer capable of abandoning the chance to repeat this experience; one falls into dependency on this process, the way others fall into dependency on drugs or alcohol. One who finds himself in this sort of dependency on language is, I suppose, what they call a poet."*

[29] J. Pallasmaa, *The Eyes of the Skin,* Chichester, Wiley-Academy, 2005, pp. 66-67.

[30] I. Calvino, *Six Memos For The Next Millennium*, New York: Random House, 1988, p.54.