Intermedia: speculations about tactility in the digital design environment

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Abstract

In the digital age, what is the role of tactility in the digital design process as it is taught in schools of architecture today? Very often, students are never taught to appeal to any other sense other than sight, particularly now as digital media is embraced as a valuable design tool. Yet, is there some essential characteristic of architecture and the phenomenology of place-making that is being cast aside due to the nature of the tools being used? However true or enigmatic this may be, there is a way of working and teaching that exists somewhere between the digital and the tactile. Often there is discussion on final reviews about the flatness and glossiness of purely digital presentations, and contrapuntal criticism about the lack of accurate perspectival representations illustrating the inhabitation of students' projects without the benefit of computer renderings. Imagine if there was a methodology that by its nature simultaneously forces students to work digitally and yet with the depth and tactility of analog media?

This paper postulates a hybrid working environment in the design studio that not only takes advantage of the strengths of various design media but also focuses on reinterpreting its limits and drawbacks. The role of digital media in the realm of paper based design media will be explored and shown to potentially be as tactile and interactive as trace and chipboard. A curricular sequence of instruction will be proposed that exploits the limits of digital media and reinterprets their usefulness in a productive manner. The ultimate outcome will be a new digital media (intermedia) pedagogy that can revolutionize the way that we teach architecture and moreover computer "aided" design.

Introduction

One of the primary problems with CAD as it is taught in many schools of architecture is that it is taught at the very end of the undergraduate studio sequence as a tool to be used in internships. Quite often, CAD is relegated to a semester of two-dimensional drafting followed by a semester of rendering (and maybe animation). The timing and sequence of this sort of computer instruction restricts digital media to pure production rather than design (conceptualization). The resulting drawings are usually banal, uninspired, and flat (little layering and depth).

Fig. 1 Overly textured brick form z rendering by fundamental design student Derek Drish.

The opposite problem exists at other institutions that introduce younger students to basic modeling programs that seldom encourage students to continue developing their ideas once they are entranced by the digital visualization before them. Student work of this variety is fraught with overly textured image-mapped surfaces devoid of subtlety, no connection to the land (site), lack of subtlety and detail development, little to no understanding of the realities of construction or structure, and little concern in resulting animations for the accurate portrayal of human sequence. Only a carefully constructed curriculum closely keyed into the studio sequence

can avoid these pitfalls, and can foster a new engagement of the senses (as appropriate in the multi-sensual environment of architecture) beyond the purely visual.

What is the Problem?

Is there something lost from the design process caused by the use of digital media? Does "CAD" produce lifeless, desensitizing components of the design process when compared to traditional paper (and wood) based media? If so, does the value added by CAD as a design tool outweigh the lack of what I will simply refer to as "tactility?" As such, is there a way by which this limitation of tactility can be overcome or reinterpreted in such a manner that instills a multi-sensory component into the digital process that is more indicative of or even surpasses other "traditional" (analog) methods of working?

The nature of digital media in architecture is that it requires a conduit of conveyance, a carrier media if you would, in order to be viewed. One cannot perceive an AutoCAD drawing or Form Z model without either a monitor or a printer. One cannot simply reach inside the CPU and *touch* a model, or run one's hand across a plan and feel the space of the drawing. We must rely heavily on our sense of sight to create and read digital work (as it is typically used), which limits a truly holistic perception of the architecture. Even when music or sounds of inhabitation are incorporated (a dramatic improvement, which will be discussed later) we are still referencing only two modes of perception, thus limiting our holistic understanding.

Redefining tactility and the role of intuition

Tactility is of course defined as a quality "of or connected with the sense of touch."[1] The author has expanded the definition of tactility to encompass the perception of touch-related sensations (as in the photograph of a texture) and the ability to derive perceptual realizations through direct physical touch. This refers to an understanding of one's environment through actual touch, or the perception of what a touch would be like as well discoveries found through the touching, manipulating, and assessing of materials.

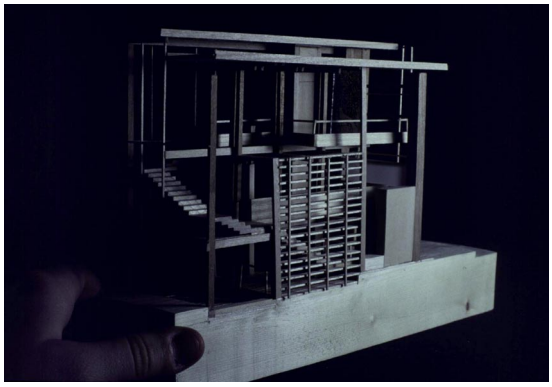

Fig. 2 Fundamental design student Meri Tepper holding physical model.

Clearly the direct role of touch in the architectural design process is somewhat limited, given the fact that we see drawings and see physical models, and draw conclusions from what we are looking at. Architects tend to design cerebrally through reason, but do, to a certain degree, utilize intuition in the design process. Intuition in general absorbs knowledge and awareness through the senses, and is a more direct method of understanding than conscious reasoning which requires the mental processing of gained data before understanding can be reached. Thus

many intuitive realizations result from the physical handling of design media, and from the perceived sensation of touching forms, surfaces and textures contained in images.[2]

The sense of touch, even the visual extension of the sense of touch, responds to tactile cues contained in media, and through comparison with remembered sensations, draws conclusions about the corporeality and palpability of it and what it may represent (design media). Directly or indirectly, tactility and in general a synthesis of the senses plays a strong part in how we perceive the world around us, and in particular to architecture, how we perceive and conceive the built environment. Thus, when working with architectural digital media, a media which is by nature visually based, one must be careful to engage more than just the sense of sight by virtue of how one represents the subject matter (i.e. proposed projects, existing building sites, etc.). This is of paramount importance in the rendering visible of architectural space.

Digital perception

Inarguably, the human brain receives information via neurological pathways beginning at sensory organs (eyes, ears, skin, nose, and tongue (not including other hypothesized sensory types)). Through a combined processing of this data, the brain constructs a mental approximation (or re-creation) of its surroundings and any event that has just occurred, informing a reactions to this situ. Except for cases involving various sensory impairments (i.e. blindness, deafness, etc.) at least four of our five senses are simultaneously engaged at any given time, though at different levels of primacy. Human beings have generally evolved as primarily visual operants, depending secondly on our sense of hearing, then touch. The sense of smell (and taste), while arguably the sense most able to trigger the most powerful primal memory responses, [3] has devolved largely when compared to even our closest evolutionary primate relatives, chimpanzees. Though our initial conscious awareness of our surroundings is not on the surface dependant on our sense of smell, it is (though perhaps subconsciously) shaped and affect by our sense of smell. All of our senses work in concert to inform our perception of our world around us and guide our actions and reactions within it.

Relying solely on one sense to formulate a complete approximation of one's surroundings will not provide an accurate and holistic understanding. A view of a seemingly conducive room for sleeping or contemplation may not reveal the fact that a major freeway lay five meters outside the walls of the room, causing it to endlessly pulsate in a cacophony of passing trucks and commuters. Equally, a recording of a similar environment seemingly appropriate for such an activity due to its silence and aural tranquility would not reveal the fluorescent-orange and lime-green wall surfaces, or would it reveal the all-pervasive smell of rot and decay caused by the dead rat lying in the corner under a chair. We depend on combinations of senses constantly, often when we are not even aware of it.

Similarly, when working to create something (i.e. architecture), each of our senses is going to afford us a different interrelated perception of what we are doing. To be more accurate, we work to

create different, individual components of the design process that each in and of itself reveals or explores something different within our architecture that the other components could not. Physical models provide one kind of interactive perception of an abstract architectural physicality, while rendered perspectives provide set views with material and temporal approximations of inhabitation. Plans and sections allow for cerebral understanding of relationships within an architectural project utilizing our abstract reasoning abilities, while material samples evoke a tactile understanding of the intended architectural results. However thorough an understanding of an architectural problem or solution this myriad of techniques and tools for working can provide, not one of them is singularly capable of evoking at least four of our sense at once.[4]

Drawing upon the musical world for the sake of comparison, there has for decades been a debate about the merits of electronic synthesizers and samplers that replicate the sounds produced by other instruments. When computers were first used as instruments, the electronic sound produced by early synthesizers was not yet developed enough for mimicry, and was treated in a more genuine fashion with its own sound characteristics. When they were developed enough to replicate other instruments, the authenticity of the synthesizer as an instrument in its own right was lost to some. Yet as prolific a presence the synthesizer has had in music over the past thirty plus years, it is still unable to completely capture the idiosyncratic essence of many acoustic instruments.

What makes many instruments unique is the irregularities between tones, and the particular ornamentation that the instruments allow or demand. Take the Irish uilleann pipes for example, where the timbre and color of each note is very different, and much of the sometimes guttural ornamentation that is unique to them such as crans, rolls, slurs, and popping could never be replicated to perfection by any other instrument including the synthesizer. The same argument could be said about the violin, the flute and many other instruments as easily as it could be said for non-musical artistic acts such as sculpture and painting.

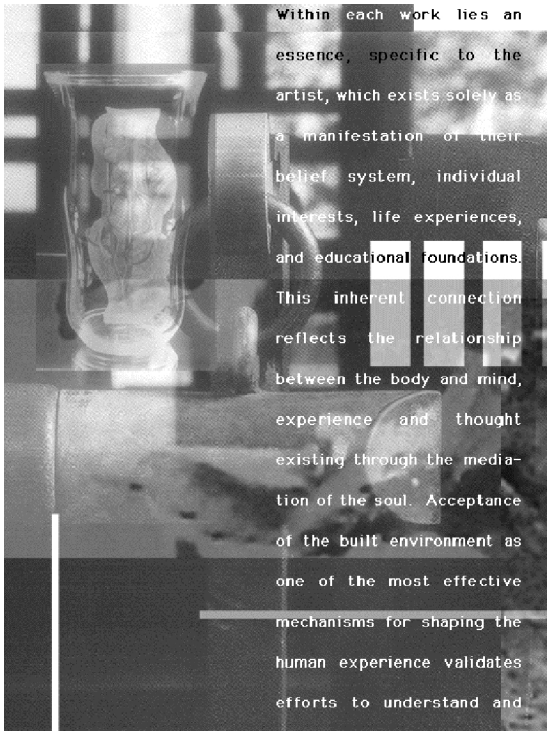

Fig. 3 Conceptual collage by graduate student Linda Chervenak. A series of these collages were sequentially placed onto a timeline in Premiere to create a narrative of the project.

Collage

As a fundamental design studio instructor and digital media instructor, I am continually aware of the pitfalls of

introducing students to digital media without an adherence to the world of the corporeal. Projects begin to completely divorce themselves from the actualities of *Place* and *Time*, grow sterile in their digitalness, [5] and lose any sense of spatiality beyond the superficial. This is partially due to the students' inability to perceive the spaces that they are creating digitally in any greater depth than what is immediately shown to them on the seventeen inch monitor (no peripheral perception, no spatial awareness or memory of what is behind them). Experiments with virtual reality visors and gloves have not yet produced a practical, workable model to use in the design studio realm. Even if one does become practical, it is questionable whether the spatial engagement of the student during the design process will improve.

In the process of redesigning a computer curriculum, the problem of non-tactile computer work is being addressed in three major categories: input of design data, digital processing of design data, and output of design data. Prior to a reevaluation and subsequent reinvention of the computer curriculum, the only available architectural computing courses were one drafting course, and one rendering course. Stand alone courses such as these seldom require students to explore issues of media and representation beyond basic literacy, and often produced results that fail to transcend banal, generic drawings and renderings.[6] The new sequence of digital media immersion begins earlier in the undergraduate curriculum, and introduces students to imaging software, modeling software, page layout techniques, web design, animation, and rendering in addition to drafting. Students are taught to switch between program types (imaging to modeling, and visa versa for example) and between analog and digital methods routinely in the course of the curriculum, using their current design studio projects in the process.

Using the notion of collage as a starting point, new design pedagogy can be authored that encourages the seamless integration of digital and analog design media. As we gradually introduce to students the tenants of design from semester to semester, beginning with basic formal manipulation and analysis and leading up to more complex design issues, a similar sequence can be created to introduce digital media. Instead of being taught in separate, stand alone drafting and modeling courses, students begin a truly multi-media design curriculum in a way that requires them to switch from one way of thinking/working to another automatically and back again, resulting in work that is always layered, tactile, evocative, and precise.

The problems I believe are at least threefold first, and a careful examination and reworking of the use of digital media in any curriculum can yield drastic improvements. First, the process by which design data is currently entered into the computer is not conducive to a holistic, multi-sensual method of designing within a physical environ. Can we intuit awareness of existing design determinants and even our own design intentions by simply moving a mouse around and tapping on a keyboard? We do indeed use our hands and touch the input devices, but do we *feel* anything more than plastic?

Second, the way in which design data is currently manipulated in the digital

environment is not consistent with how we experience space and the world around us. Do students typically amalgamate virtual and real images, textures, or models during the design process, or do they work in a linear fashion and use one mode of exploration at a time?

Thirdly, the way that design data is currently output is not entrancing to the senses, does not reflect an inherent understanding of how the media is produced (i.e. brushstrokes), nor is truly and intuitively representational of the physicality of surfaces, textures, and forms indicative of the proposed architecture. Is there a way that computer prints and plots can become more tactile, or is there another means of output that is more conducive to tactility?

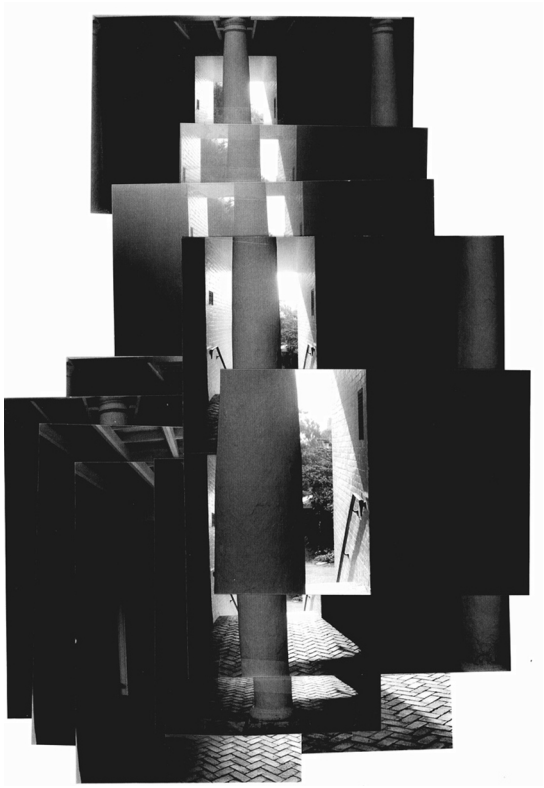

Fig. 4 Photomontage by fundamental design student Melissa Tronquet.

Inputting design data

There are research groups such as the Design Machine Group at the University of Washington who endeavor to create new digital interfaces that are more natural to the way designers tend to work. Digital pens, styluses, marker boards, and scanning wands are being developed and beta tested that allow for a more tactile, analog method of inputting data into the computer.[7] Perhaps in the near future, faculty and students can mark up their design drawings with a hand held stylus that scans the corrections directly into the model or drawing file. In this manner, the lines generated by hand as sketches can remain as vector graphics, which would allow for parametric changes to be made to them directly rather than through a series of operations that detracts from the immediacy and tactility of the sketch.

Markup boards are becoming common elements in corporate boardrooms, and in some computer classrooms. Being able to create a sketch using not a mouse, but a pen or marker and input that data directly into a vector format is a new paradigmatic shift in how we draw digitally. Students could project their drawing onto the board, and their studio critic could then mark it up similar to using trace, except that the redlines would be stored as a separate layer in the data file rather than necessitating the separate scanning of the trace paper. Hand drawn lines could remain a part of the finished drawing, and textures could be rendered by hand and directly integrated into the digital image. Designers that tend to work in sketch perspectives to study space could sketch out their ideas without the cumbersome process of using a mouse, and digitally

"paint" their sketches with scans of real materials (stone, wood, etc.). Tactile approximations of a space or building could remain visually speculative and sketchy and yet with "real" materiality and substance.

Imagine for a moment the auspicious invention of digital clay. This synthetic clay-like material would be made up of miniscule sensors and metallic power held together by a silicon-based gel. It would resemble the malleability of Plastisine (or other types of synthetic clay) and could be worked into any sort of form that would remain somewhat stable without drying like clay. As wonderful a modeling compound as this sounds, its real power is in how it relays its form via the sensors to a neighboring computer. The sensors would be able to determine their proximal location in relation to one another, and to the mass of metallic powder held by the silicon. Utilizing electromagnetic pulses through the mass, the exact shape, size, and location of each sculpted piece of digital clay would be replicated digitally in virtual space. One would be able to watch the transformations occur in the virtual version in real time as the clay is worked. Instead of simply working with a mouse or keyboard to input data to create virtual forms, or use a scanner to replicate physical objects in virtual space, one would directly create virtual form with their hands.

As with clay, physical objects could be pressed into the clay leaving a textural inverse of their surface. Stone, skin, hair, wood, engraving plates, basically anything could have its particular relief digitized in such a fashion. Similar to the childhood toys made up of a cluster of pins that would push forward when a face or hand was set into it, one could observe in real time the transformation of form in virtual space and could record such change in animation form. The possibilities of such an invention will be monumental to how designers and students of design will be able to work digitally.

The application in which the virtual model is created would have tools that automatically regularize the surfaces and edges in any modules or to any tolerances input by the user. In this way, the designer can work with the clay as quickly and freely, or as methodically and carefully as desired. One would be able to also use X-Y-Z grid snaps, directional snaps, and orthogonal snaps that when activated would force the virtual replication to lock into whatever level of control the user needs (likewise, snaps could also be used in conjunction with sketching on mark up boards as well). Perhaps the inverse could also be true as well, where the digital clay would respond to objects in virtual space. Electro-magnetically, the clay would conform to the exact shape, size, and location displayed on the screen in real time. In this manner, one could build in virtual space, pick up their creations instantly rather than wait for a laser cutter or extrusion device to finish. The designer could change the clay's controller setting to "input" instead of "output" and continue to manipulate their project by working the clay with their hands and have the virtual model conform to those changes. Interchangeability between analog and digital would be seamlessly possible.

Manipulating design data

Once data is input into a computer, it is typically held there by the student until the resulting drawing or model is completed. Students tend to be reluctant to output a digital construction in order to complete it by hand. The general view held by students is that digital media *replaces* analog media rather than augments it. The problem does not lie in the software or the hardware, but instead lies in the attitude towards using digital media. One can introduce students to the great benefit of utilizing multiple media simultaneously and interdependently. As with musical instruments in an orchestra, each design instrument will yield different results, different discoveries, intentional and unintentional, and will allow different understandings of a student's project that is unique to its essential nature and limitations. A combination of various representational and analytic modes will produce a *gestalt* composition that can make use of the limitations of each tool and create a much richer project than otherwise possible. This attitude is dependent upon how digital media as a design tool is introduced, the sequence of instruction, and the type of projects assigned and studied.

An appropriate introduction to digital media is one that encourages students to work with subject matter that is input from the corporeal realm rather than created solely in the digital realm. Imaging software (such as Adobe PhotoShop) and scanning should be the first lessons in working in digital media, and actually require the student to procure or produce analog media to input. Students can then be taught recombination techniques as well as photomontage and collage. If the introduction occurs within or aligned with a fundamental design studio where analysis is introduced prior to design, then analytic techniques can be introduced using the imaging software.

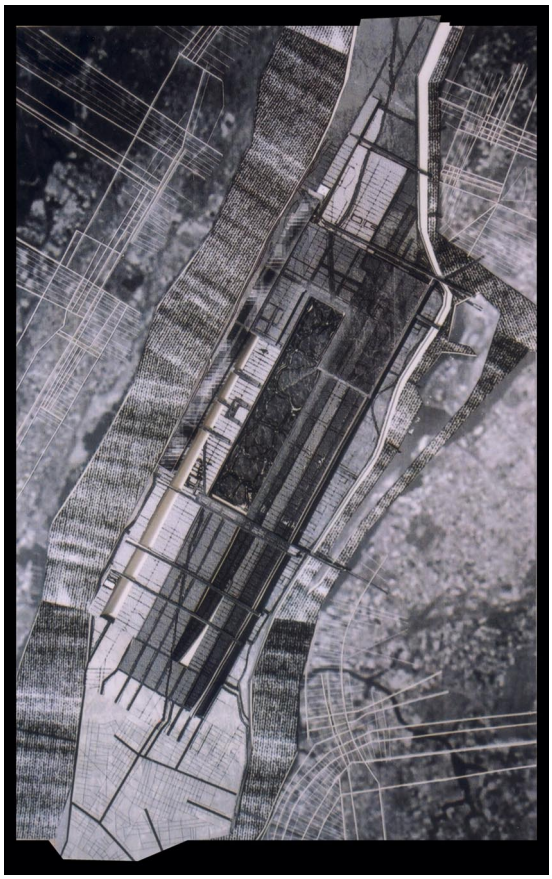

Fig. 5 Analytic collage by third year student Duy Ho.

In figure one, the student used PhotoShop to analyze the structure of Richmond, Virginia. Topography, urban infill patterns, blocks, and streets are all created using diagrams and patterns scanned into the computer. Working with "real" patterns and textures, the student cannot help but to create tactile work. Even when the textures are digitally manipulated and transformed, their

original tactile quality can be authentically retained.

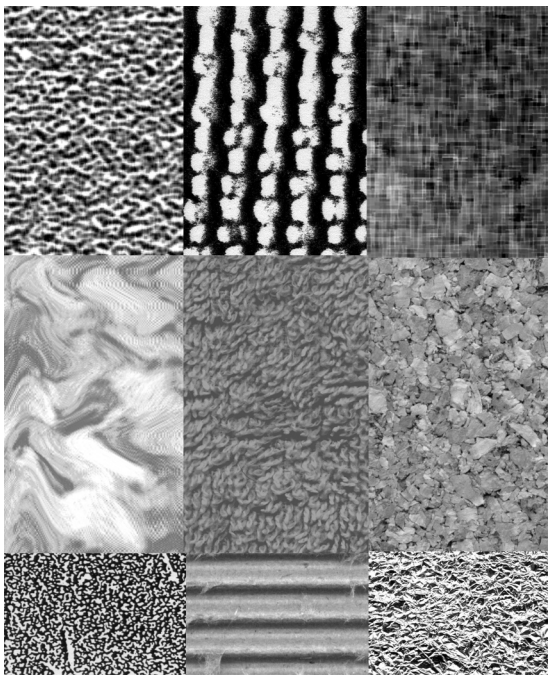

Fig. 6 Assortment of typical collage materials.

It is essential that students learn to output these first exercises soon after their completion in order to transform them manually. From the printed analytic collages, students can create multi-layered physical models of their cities (Richmond, Virginia in this case) and extrude in three dimensions what verticality they could only infer in the computer. If certain readings in their digital collages lacked coherence or clarity, it is at this time that students can manually create additional layers and edit their work. By demonstrating the interchangeability of digital and analog working methods in this manner, at an early stage in an architectural curriculum, students tend not to learn to separate the design tools. This latter problem is more indicative of stand-alone CAD courses and introductions to digital media occurring too late in the curriculum.

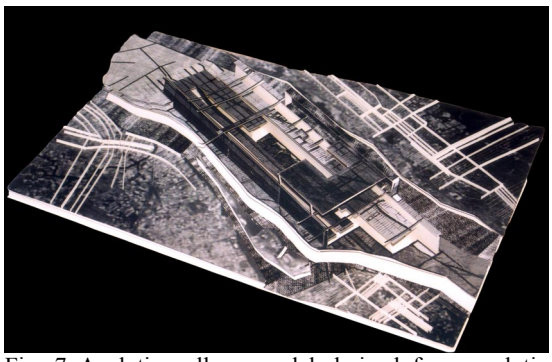

Fig. 7 Analytic collage model derived from analytic collage in fig. 5. Ideas of height and layering inferred in the two-dimensional collage are physically extruded.

The next level of interplay between digital and analog modes would require that the physical models be somehow scanned into the computer and further manipulated digitally. By use of a scanning wand**,** three-dimensional models can be input and translated into digital models. These digital models can then be developed further as architectural projects. When imported into a program like Form Z, 3D Studio Viz, or Lightscapes, irregularities in the model can be fixed, additional layers of details and design elements can be added, and a fully developed architectural digital model will emerge. One of the greatest assets that this phase of the project allows is the virtual inhabitation of the project so that it can be further resolved from the viewpoint of a user. Sequence of space can be studied by “moving” through the project, and materials can be applied (using scanned textures) to approximate the experience of actually inhabiting the intended spaces.

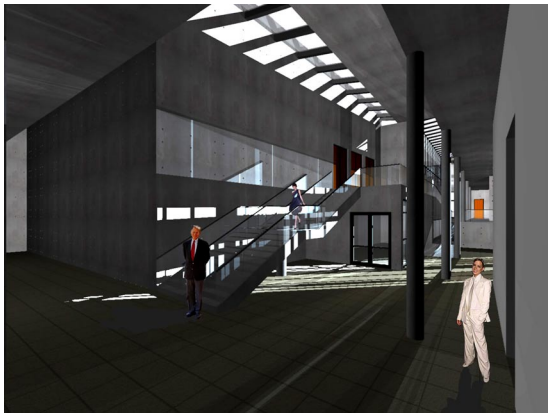

Fig. 8 Form Z rendering with montaged scale figures by Xavier Garcia. Note the concrete pattern used as a texture and image map.

At this point, if certain materials can not be convincingly manipulated or created digitally, the student can simply print the unfinished perspectival views of the project to be manually rendered. In this manner, the work retains a level of artistic sophistication that arguably might only be possible by working the image by hand. Architectural projects are by their very nature speculative up to a certain point of construction, and often a more speculative, sketchy representation technique of a designer's intentions will yield a warmer, more engaging conversation about the architecture. Clients as well as studio critics can misread fully rendered digital images as being absolute and final, rather than investigative and flexible. Students themselves can quickly become entranced by their digital creations and prematurely end their design process as a result. Encouraging students early in their educations to avoid this problem by combining media types can only prove beneficial.

Output

Imagine experiencing a digital representation of a building that allows one to smell the linseed oil on the floor, or the stone on the walls. How would one's intuitive engagement with the architectural design differ than when only vision was used? The same can be said for the sound of footsteps on different flooring materials, the warmth felt in a light filled space, or the smoothness of a polished wooden handrail. The intended experiential qualities of architecture can be conveyed and studied simply by working with media that does not only appeal to the sense of sight, but engages a combination of senses, promoting a multi-sensual gestalt understanding of a project.

When contemplating the need for conveying intentions, the vehicle for the transmission of ideas is critical. Without the proper manner of conveyance, or output, communication is impossible. Students need to be encouraged to think beyond typical print media and models to communicate their design intentions. Sonic recordings, material samples, full scale details, and other similar techniques of exploring the phenomenological characteristics of a project both deepen a student's understanding of their work as well as more thoroughly describes the essential quality of inhabitation being designed. It is perhaps the computer that in the near future can provide a truly multi-sensory understanding of a project through the use of smell synthesizers, sound samplers, photomontage animations, texture synthesizers, and thermal radiators, all technologies in existence today.

Strangely, the problem is not necessarily the inability to make the computer more *tactile*. Computers themselves are not tactile devices. They are processors of digital code that can be programmed to process input data; they

not multi-sensory beings. It is frankly impossible for a computer itself to work in a tactile fashion without the sense of touch. What is problematic is how students view the relationship between digital output and completion. Once an output device has delivered a plot or print to a student's eager hands, the task is commonly viewed as 100% complete. Whatever the condition of the drawing at this point (in regards to line weight, trimmed corners, hatching and shading, etc.) it is what it is and will be presented as such. Very seldom will a student take the time to thoroughly review the drawing for printing (or drafting) errors, and make the appropriate corrections. Perhaps students put too much trust in the capabilities of the computer to "create' their presentation drawings for them, rather than regarding the computer as merely a tool representing only a part of the process. Instead, students should be encouraged to intervene in the evolution of the drawing, and render visible the textures and irregularities that exist in reality, and in doing so transforming otherwise purely digital creations into artistic endeavors.

This antipodal condition of utilizing the digital tool to create rendered views of architectural intentions in lieu of constructing and rendering perspectives by hand, but still having to further "work" the output by hand is not an easy sell to students. Students tend to be seduced by what they see on the monitor, perhaps partially due to growing up in the MTV generation of television viewers. What they know of performers is what they see in their music video, so a unique rapture with the delivered image pervades their mentality. Video games create a similar infatuation with the delivered image, and the immediacy of being engaged by this hyperactive, hyper-realistic environment.

Conclusions

One could discuss the sterile, generic conditions of suburbia that most architecture students grow up in today. One could continue to generalize about the type of superficial broadcast media in front of which students spent countless hours, or about the sensory-deadening effects that video games can produce in excess. Without questioning the changing values and priorities that are always in flux in the continuum of human civilization, one could instead speculate about how to overcome observed deficits in the use of the most prolific design tool ever to be embraced by the design profession.

So, the mental barrier that the process ends upon the print must be broken if digital medial is to have the tactile appeal to the senses that other sorts of media have. Printing to other sorts of media other than standard bond paper (i.e. watercolor paper, cloth, etc.) can gain a tooth to the print, but inherently the image upon the paper is still devoid of time. Time is readily perceived in projects that are worked and layered as part of a process of conception, and allows the work to transcend the canvas, becoming much more than paint (ink, pencil, etc.) on paper. The work instead becomes "real" and imperfect. The effect is similar to the sound of fingers sliding along the strings of an acoustic guitar, a sound that is not a note or ornament of the music per se, but is a side effect of the process of making the music. It is this sort of corporeal sound that reminds us that an imperfect human being is playing the guitar rather than an electronic

synthesizer. As the music remains a human endeavor when it is allowed to retain its authentic essence and beauty, so can a "worked" piece of digital art once it has had the benefit of human intervention.

Architecture is inherently a human act. It is conceived of and created by a human being ultimately for other human beings. Architecture is experienced spatially by all of our human senses, not just one, and it is the combined collage of sensory input that constitutes our perception of it. If there is a lack of sensory input in the perception of a place (i.e. as in a photograph), the human mind cannot fully embrace an understanding of the place, whether natural or built. The result is an incomplete, superficial engagement.

Why then should the act of design be anything less than a truly multi-sensory experience when it is possible to work as a designer (or design student) in a tactile, holistic manner? Even though the computer itself is a lifeless, plastic and metal design tool capable of many splendorous feats, if used carefully can be capable of multi-sensory work. It is the manner in which the designer uses the tool that can be carefully shaped to produce work that is significantly holistic in its engagement of the senses. A careful sequence of study that maintains an emphasis on the physicality of the world and moves between analog and digital modes of working will take advantage of the limitations of digital media, and reinterpret them into tactile working methods.

Notes:

1 The Concise Oxford Dictionary of Current English, Claredon Press, Oxford, England, 1990, page 1241. Other similar definitions contain similar references to the sense of touch, of course. The Oxford Dictionary continues on to describe "tactility" as being "tangible" and "concerning the effect of three-dimensional solidity." Arguably, one can make the assertion that there is a visual extension of the sense of touch, similar to the "synesthesia" described by Diane Ackerman in A Natural History of the Senses, Vintage Books, New York, NY, 1991.

2 When the body and mind encounter an architectural (or other) image that contains surfaces and textures to which it cannot relate, a degree of intuitive understanding is inherently lost. The perception of the subject is more limited and superficial, the understanding of it lessened.

3 Nowhere is this better illustrated than by Diane Ackerman. In A Natural History of the Senses, she begins with a chapter on the sense of smell. The first association a human infant has with his mother is her scent and the sound of her heartbeat. Infact, not until the "mirror stage" of child development does the child visually separate itself from the mother.

4 By using synthesizer technology, digital media is perhaps the paradoxically one of the best media for engaging at least four senses at once. Smells, sounds, textures, and of course images can all be synthesized digitally. The most multi-sensual item in my possession is a wooden musical instrument (I of course have several). Imagine if digital media had such an evocative, essential tactility similar to an old wooden instrument, with the finger holes worn down from years of use.

5 How many of us have seen students grow fascinated with using the computer, and reveling in how digital, how slick and ephemeral their projects become? I remember hearing a student remark after a live performance that the musicians sound almost as good as they sounded on their CD. In the digital world of late capitalism, the simulacra of recorded media is preferred by many to the actual performance that the CD is trying to emulate.

6 After developing and teaching digital media courses at two universities, and being a graduate teaching assistant instrumental in developing one at another, I have seen that digital media courses that actively teach the tool as a design tool rather than just a representation tool yield a more seamless integration of the tool with the design studio. Moreover, students using the tool for projects they are designing for studio tend to bring the computer into the studio rather than just working in a separate lab. Because the projects being used are the students' designs, they tend to put more time and energy into their digital renderings and drawings.

7 Ellen Yi-Luen Do, Mark D. Gross, and Brian R. Johnson at the University of Washington's Design Machine Group are working to reinvent the computer interface. "Spacepen" is one such invention as is their version of a freehand digital modeling interface they call "Digital Clay." Their version of the latter is dramatically different than my own.

8 Earlier inceptions of cinematic creations such as the "Star Wars" saga were filmed completely using analog technology. Sets and props were created physically, and characters were portrayed by human beings (even the non-human characters such as R2D2 and C3PO). Costumes that were not physically inhabitable by human actors were made as puppets and controlled by humans in hiding off screen. The results of film productions made in this manner were "funkier", shakier, and seemed more imperfect and flawed than those of their digitally generated counterparts. Even in the StarTrek series, the invention of the "Holodeck" allowed for imperfection to exist in cyberspace. Fairhave, the hologram of an Irish village was so full of "real" personalities and qualities

of Earth, that some members of the starship's crew became addicted to the virtual experience.

9 Heidegger's *Place* vs. *CyberPlace*

"…the French philosopher Rene Descartes, using algebra and a coordinate system, developed an abstract geometry that also enabled the description of three-dimensional perspective on a two-dimensional plane. With Descarte's geometry, there was no need for tools or, in fact, for reference to the real world. His method defined abstract objects in an imaginary world of a selected coordinate space, and gave equations to calculate points of intersection, perspective, and depth algebraically." (Steven R. Holtzman, Digital Mantras: The Language of Abstract and Virtual Worlds, The MIT Press, Cambridge, Massachusetts 1994, pg. 194.)

10 Please note that this paper serves more as a discussion of possibilities than it does a research report. In inventing a computer curriculum at the University of Florida, reflecting back on my prior utilization of digital media and the architectural design process, and researching the curricula of other institutions, these thoughts have emerged. The question of appropriateness is always coupled with possibilities, as is the history of representation in architecture coupled with an understanding of perception. Please send any thoughts to my attention at maze@ufl.edu.