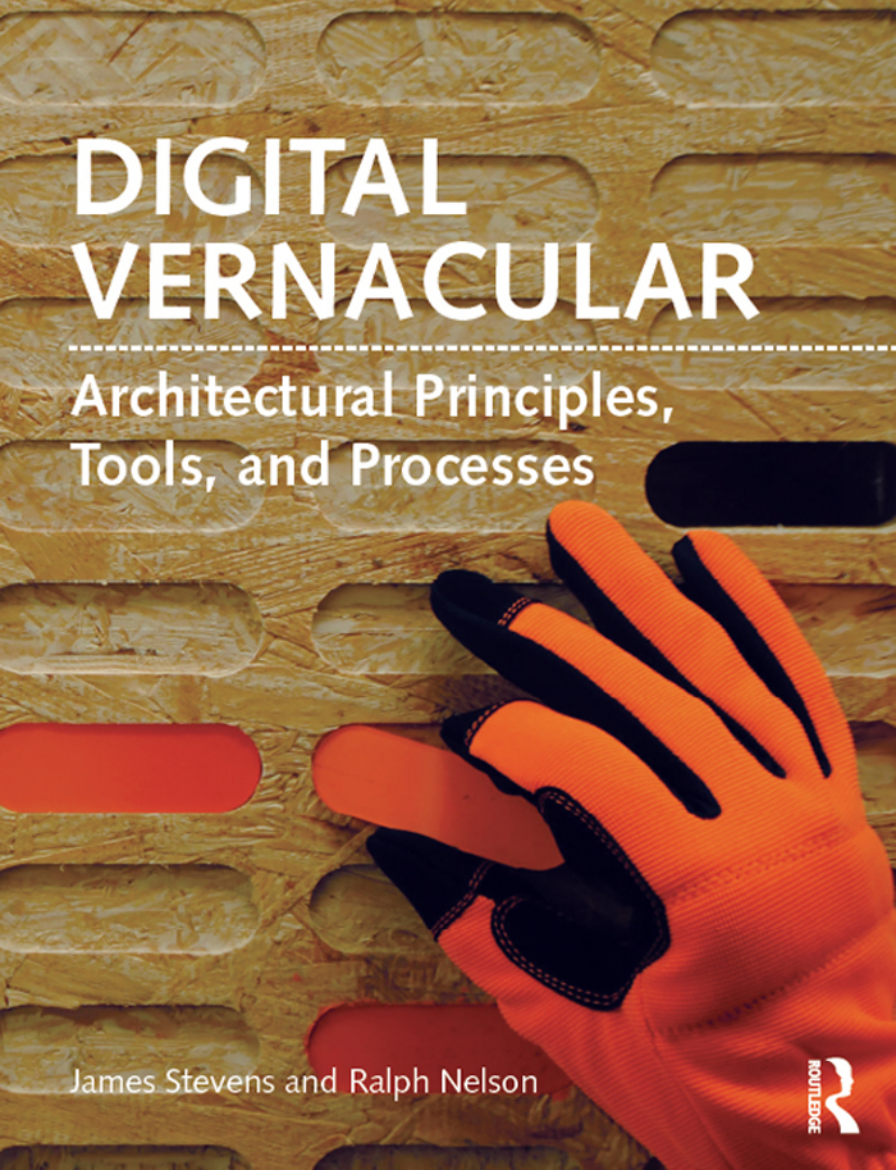
DIGITAL VERNACULAR

Architectural Principles, Tools, and Processes



James Stevens and Ralph Nelson

ROUTLEDGE

DIGITAL VERNACULAR

Digital Vernacular addresses the why and how of digital fabrication in hundreds of step-by-step color images, illuminating a set of working principles and techniques that join theory with practice. Authors James Stevens and Ralph Nelson reconcile local traditions and innovations with globally accessible methods and digital toolsets. By combining ethics with hardware, the book will root you in the origins of making, ensuring a lasting and relevant reference for your studio practice.

The book opens with the origins and principles of the digital vernacular, then outlines digital vernacular tools including computer numerically controlled (CNC) mills, laser cutters, and 3D printers. You'll even learn to create your own digital fabrication tools out of inexpensive materials. The book concludes with the processes of the digital vernacular, including techniques for removing, joining, forming, and adding.

A companion website at make-Lab.org hosts additional step-by-step processes and project outcomes.

James Stevens is an Associate Professor and the Director of makeLab, a digital fabrication studio in the College of Architecture and Design at Lawrence Technological University in Michigan, USA.

Ralph Nelson is an Associate Professor in the College of Architecture and Design at Lawrence Technological University and Principal of Loom, a collaborative design practice, based in Ann Arbor, Michigan, USA.

“make good things”

-Roger Clark

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Architectural Principles, Tools, and Processes

James Stevens and Ralph Nelson

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DIGITAL

At first glance, this book appears to have a contradictory title. Current design discourse on digital architecture rarely includes the "vernacular" and there is nothing "digital" in most discussions of the vernacular. The two don't seem to have much, if anything, in common. One is steeped in the latest technological advances and the other relies on centuries-old building traditions. The digital and vernacular seem to be on opposite ends of whatever comparison is applied to them. One is about the future and the other is about the past. The digital is about computer-enabled design and production and the vernacular is about the building crafts and trades. It is these patent oppositions that this remarkable book by Jim Stevens and Ralph Nelson addresses. The authors argue for a new and productive synthesis which they rightfully refer to as "Digital Vernacular."

All vernacular architecture is digital. Throughout history the human hands and fingers—the digits—have shaped mud and logs, worked metal and stone, mixed water and sand. Whatever the materials, the human fingers touched them (and still do). Whatever instruments were used to give shape to materials, the human hands held and applied them. This sense of touch and connection is too often absent when working with digital tools for design, which can create a world unto themselves and lead the architect to create an architecture that is as abstract as the tool that shaped it. Stevens and Nelson admonish early in their book that we should guide our tools, not merely let them guide us.

A concern that I share with the authors is that too much of the "digital" architecture produced around the world today—with its smooth, fluid forms and shapes—often lacks any vernacular dimension or reference. Local material and production circumstances are typically neglected. It is this lack of vernacular in the digital that the authors would like to see changed in current practices. Stevens and Nelson advocate for an accommodating transformation of current practices rather than a revolution. They are not rejecting what the digital has to offer; they are cognizant of the benefits brought by the introduction of digital technologies in representation, modeling, simulation and production. They argue for a thoughtful adoption of digital technologies by local communities of designers and builders that embrace the legacy and lessons of building practices intrinsic to the cultures and societies in which they operate.

On the other hand, if we accept that the vernacular is, as Stevens and Nelson write, "an ethic that leverages the power of community knowledge to continually develop, refine, and innovate through works of architecture and the act of building" we have to be mindful that communities are no longer strictly local as they were in the past. The authors note that the very definition of community knowledge is evolving and that both local and global knowledge can productively overlap to create work that is both worldly and regional.

Digital information technologies continue to enable the emergence and spread of the new "global" over the "local," in which unique cultural, ethic and aesthetic traditions are increasingly being transformed and homogenized. The "Digital Vernacular" is a voice critical of the unifying tyranny of the global over the local in the context of architecture. It calls for the "vernacular in the digital," in which the use of digital technologies in design and production are informed by the building practices and norms of a particular local community to create a robust hybrid. It is a plea for difference and the particular to shape unique identity. It is an embrace of the future that doesn't reject the present or the past—a call for the "new" digital informed by a "renewed" vernacular.

Branko Kolarevic
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VERNACULAR

The rise and consolidation of professional architectural education throughout the 20th century has been paralleled by the rediscovery of modest yet ingenious vernacular buildings ranging from mid-western rural barns to Route 66 roadside diners. These buildings form a tradition reliant upon the expertise of craftspeople and do-it-yourselfers who acquired their training in-situ, outside of an academic classroom. Typically, the skill-set and cultural underpinnings that motivated choices made by "unpedigreed" builders, regarding materiality, site, and structure were passed on orally from generation to generation. With very little in the way of written testimonies regarding intentions and drawings or sketches, architectural historians have had to adapt existing methodologies to analyze the role of vernacular architecture in the history of the built environment. Over the years, the contribution of pioneering critics and historians including Bernard Rudofsky and Sibyl Moholy-Nagy has been expanded by the observations of photographers of rural, commercial or industrial vernacular ranging from Norman Carver Jr to Bernd and Hilla Becher. Numerous modern and contemporary architects—from Le Corbusier, Loos, Giuseppe Pagano, and Louis Kahn to Robert Venturi and Samuel Mockbee—have used drawings, paintings, photography and written observations to record extant vernacular buildings with the aim of extracting suggestions and principles to be used in their own designs. Despite different backgrounds, most modern and contemporary architects mentioned above agreed that a living vernacular tradition embodied cultural values that were both universal and local; this conviction helped them to overcome narrowly defined approaches to nationalism, regionalism, and to a lesser degree, internationalism. More than anything else, professionally-trained modern and contemporary architects were fascinated by the ways in which vernacular builders (whether anonymous or simply too modest to demand that they be officially recognized) effectively responded to functional and programmatic requirements such as *existenz minimum* while still achieving a poetic dimension that comes out of an engagement with the realities of context and culture. In so doing, they were able to engage with tradition in a more effective way than 19th century historicism, postmodernism, and most of contemporary parametric design.

*Digital Vernacular—Architectural Principles, Tools, and Processes i*s a book written by architects and educators. It makes a vital addition to the ongoing efforts started by twentieth-century architects to incorporate lessons learned from vernacular buildings within contemporary architecture and pedagogy. The operative aim of Jim Stevens and Ralph Nelson is to draw attention to the vernacular tradition as a source of design by twenty-first century architects who trained in professionally accredited schools. Keeping with the spirit of transformation (as opposed to revolution) which makes the appropriation of the vernacular tradition by modern and contemporary architect so productive, Stevens and Nelson's "manual" embraces and advocates for the usage of new design tools (whether analog or digital) to promote innovative outcomes that link past, present, and future. The authors of this book believe that if used appropriately, digital design tools can promote the production of new vernaculars based on common-sense principles. Neither Stevens or Nelson are populists nor luddites. On the contrary, their intelligent book and its underlying polemic promotes common-sense and hybrid practices that offer a tonic for the excesses of technological romanticism that rely exclusively on complex parametric tools and representation to promote "newness" at the expense of continuity.

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Cooler by R.B. Stevens

PREFACE

It all started with a cooler. The maker was not a designer by training or identity, only a product of his context and circumstances. Raised in rural North Carolina in the Great Depression, he sustained his early life on the milk of a single cow and the vegetables grown in his garden. When as a child I first observed the cooler lying in the sand, I recognized only the humor in its creation. A recycled stainless steel 1950s Coca-Cola box with the handle removed and a hardwood plank directly bolted to the top. He certainly had the means to buy a cooler for fishing, but he chose not to. I do not mean to imply that he debated his options; he almost certainly did not, because his first thought was to always use materials at hand. In this case he improvised the desired outcome from an old cooler and a plank of wood to serve his own purposes—to cut bait and fish. The cooler was the manifestation of an ethic of sufficiency; direct, durable, and beautiful. A clear act of vernacular design.

Our formal education as architects coincided with the introduction of personal computing as a potential tool for architectural design. We were trained in both manual and early digital techniques and were among the first generation of users of mainstream CAD and modeling software in practice. We experienced the tug-of-war between those who hoped to keep drawing and making things by hand and those who saw the potential efficiencies of the PC for representation and fabrication. This tension inevitably led to certainties of right and wrong, to assertions about why we should use or not use the PC. Often these points of view were based on lack of knowledge and fear of change, as many conflicts are. At the time, we found ourselves in the minority, seeing both sides and hoping to work in the middle, somewhere between the physical and digital. Experiencing this debate allowed us to view the evolution of technology in hindsight, to witness the unfulfilled predictions of digital utopias and to discover the tools that stuck around to change our discipline forever.

During our initial years of practice, our graduate education and subsequent academic careers, we attempted to reconcile the digital and the physical—one preoccupied with virtual progress and the other squarely rooted in

conditions of the present. Depending on where our curiosity led us and what our focus was at the time, the "cooler" paradigm, that is to say the power of the vernacular, would fade or become clearer in our consciousness.

In 2010 Jim founded makeLab,™ the digital fabrication laboratory at Lawrence Technological University, with the primary purpose of enabling architecture students to make architecture using both manual and digital tools and processes. Due to a lack of funding, the lab started out by designing and making its own digital tools and limiting itself to only the most common and affordable materials at hand. Limitation became a guiding principle of the design and fabrication process. The outcomes demonstrated how the ordinary could become extraordinary.

In 2010 Ralph joined the faculty at Lawrence Technological University after more than a decade as principal of Loom, a collaborative practice of art and architecture engaged in both design and fabrication. Loom maintained an "old school" shop for hand fabrication and employed digital tools primarily for representation, while outsourcing digital fabrication. Operating under the tenet of "minimum means to maximum effect" Loom had created a body of work that gained national recognition for projects that were low in budget but high in quality and expressed respect for the commonplace and the everyday. Loom still holds the record for the smallest budgeted project ever to receive a Progressive Architecture™ award; a grand total of $9,075.

After several years of designing, fabricating and assembling projects framed around the digital and the vernacular, our academic convergence in 2010 allowed us to see a potentially new way of understanding digital tools, vernacular design, and a model of practice that was both promising and relevant. Although we comprehended our own processes, we were not able to fully articulate the significance of the work in the makeLab and at Loom—until we began to articulate the idea of something we spontaneously termed the *Digital Vernacular*. Our subsequent interrogation, critique and research on this idea granted us the permission to join intellectual forces and formally document our shared perspectives.

We wrote this book to fill what we believe is a void in publications regarding digital technology and fabrication that aims to connect to common culture and nurture the evolution of contemporary vernacular architecture. In our research, we have observed that most publications either neglect technical or ethical content in their emphasis on representation and invention, or they discuss technical matters only in vocational or operational terms, thereby neglecting the rich cultural, intellectual, and poetic content that a vernacular mode of making deserves. We believe that this information belongs together, that one cannot exist without the other. This is why we present this book using a "why and how" approach. We balance both to engage the reader in a path of design through making, framed by the principles, tools and processes of what we have come to define as the *Digital Vernacular*.

Jim Stevens and Ralph Nelson
September 21, 2014

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working innovatively with materials and tools but also by making us laugh. The international workshops we have conducted in the makeLab clarified our understanding of the *Digital Vernacular*, and our first independent workshop in Albania would not have been possible without the help of Pandush Gaqi and Dr. Besnik Aliaj. We would also like to thank Ergys Hoxha who produced many of the drawings and graphics used in the book. His talent, thoughtfulness, and commitment are evident on every page. We are particularly indebted to Natalie Haddad. Natalie contributed to a majority of the projects seen in this book. It is easy to conclude that the Tools chapter would not be what it is without her knowledge and commitment. Along with our gratitude is the pride we share in witnessing her transformation from student to faculty colleague during the creation of this book.

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Finally, we would like to thank our families who always support us when doing the things worth doing.

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This book is dedicated to my wife Brooks Harris Stevens for teaching me to trust my instincts and for standing by me when I did; and to my kids, Madeline and Foster, for reminding me how to play.

-Jim Stevens

This book is dedicated to Richard Morrill for teaching me how to design for life; to Joe and Klara Peterson for teaching me how to make and grow things; to Tumbler, Tattoo, and Motorboat for teaching me how to be a better animal; and to Margaret Wong for teaching me how to be a better human being.

-Ralph Nelson

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INTRODUCTION

A strange and compelling contradiction exists in architecture today. As digital communication and digital tools make everyone and everything in the world more accessible and more alike, there remains a powerful desire to express qualities of difference unique to each regional community, each specific place, and each individual designer. Global digital unification also fosters an equally powerful desire to express new ideas in architecture independent of regional place, which fosters a voracious appetite for a new global architecture built around common ideas, not common place. Our book responds to this paradox of wanting to be the same and different simultaneously.

We were motivated to write this book after years of teaching and practicing architecture while searching for a mode and manner of working that was both creative and disciplined. We have realized that sound education and meaningful design is based on learning from the past and fully engaging with the present. Design innovation emerges when time-tested principles of design are synthesized with available technologies and unique circumstances of time and place.

Digital Vernacular is an idea that combines vernacular design principles of the past and digital technologies of the present with goals of accessibility and appropriate innovation in a contemporary and global design context. Our book defines the origins of the *Digital Vernacular* along with foundational principles, tools, processes, and practical applications. It is designed for students, educators, and practitioners of design who are interested in why you design and how you design.

The reader can expect to gain a new perspective on why vernacular design is persistently relevant and continually evolving, and how accessible digital technology can be integrated into the design and fabrication of contemporary vernacular architecture. Once a reader engages the principles and methods contained in this book, a new fluency of making becomes possible.

ORIGINS

Now since architecture is an art and is essentially a reasoned state of capacity to make, and there is neither any art that is not such a state nor any such state that is not an art, art is identical with a state of capacity to make, involving a true course of reasoning. All art is concerned with coming into being, i.e. with contriving and considering how something may come into being which is capable of either being or not being, and whose origin is in the maker and not in the thing made; for art is concerned neither with things that are, or come into being by necessity, nor with things that do so in accordance with nature (since these have their origin in themselves).

-Aristotle in *Nicomachean Ethics*, Book VII

ON ORIGINS

Sensing the origin of things, where things come from, has been a part of human curiosity since time immemorial. The act of design in the discipline of architecture engages this sense of curiosity and involves making choices about the origin of each work, because the origin is "in the maker and not in the thing made." To create a work of architecture each *maker* must choose what will influence the conception and development of the work. This book defines the origin of the term *Digital Vernacular* and the specific principles, tools, and processes a *maker* can choose to guide a work of architecture into being. Origins are important because each new work of architecture is inherently defined by where it comes from. We believe that originality stems from sensing the origin of things, not merely exercising the ability to be different from everything else.

Digital Vernacular is a term to describe a particular process of thinking and making in architecture that addresses where things come from, why we do things, and how we do things within a process. It is a response to a particular mode of architecture that embraces the practical, poetic, and ethical characteristics of vernacular building design and joins them with the virtues of vernacular digital tools for communication, representation, and fabrication. It has its origins within our personal experiences, our critical observations, and our interest in a hybridized nexus of digital technology and vernacular design. We continually ask fundamental questions about the nature of architecture by reflecting on the past and engaging the present. We return to origins for clarity and inspiration to create new works of design.

My premise is that fundamental questions simply do not go away, nor can they be assigned to particular past periods. While "answers" are tied to the time of their foundation, fundamental questions in architecture persist and the understanding and experience of their persistence actually makes up the structure of architectural reality.

-David Leatherbarrow

ORIGINS

Continually returning to origins is a way of staying connected to fundamental questions in architecture that can be addressed with fresh insight and new perspective. The *Digital Vernacular* as a formal idea began to take shape through reflection on the origins of the *digital* and the *vernacular* as two words that embody powerful technological, ethical, and social ideas influencing architecture from a cultural perspective. As architects who work with digital technology and vernacular precedents to not only design but also fabricate built work we reflected on what we should call ourselves. We are architects and also builders, we make designs but also make things. We are *makers*. Though the definitions of *digital, vernacular*, and *maker* might be self-evident, we felt it was important to probe the origins of these words and understand their specific meanings today, as they form the foundation of the *Digital Vernacular*.

THE DIGITAL

The Oxford English Dictionary defines the word *digital* as originating from the Latin *digitus* and its original meaning was "of or relating to the finger or fingers." The English word *digitalle* made its first written appearance in the 15th century in a book on arithmetic describing a new meaning as that of a whole number within 10, though the word digital continued to be used in reference to fingers. This connection between 10 human digits and 10 numerical digits (0-9) persists today.

It was not until the 20th century that the word *digital* was first used in the English language as an adjective to describe "signals, information, or data represented by a series of discrete values, typically for electronic storage or processing." Early computers were analog, which used continuous quantities or physical properties to compute a desired quantity through direct analogy. In the mid-20th century mathematicians and engineers developed a new type of computer that operated electronically upon data that was represented as a series of numerical digits, typically 0 and 1. The Oxford English Dictionary now lists more than twenty unique definitions of digital as an adjective modifying a noun in specific context that always relates to numeric digits in electronic form simulating an analog or physical action. This continually evolving definition and meaning of *digital* prompted us to consider a meaning specific to the *Digital Vernacular*.

As educators, we were interested in knowing what our students were thinking about the digital world they grew up in and what critical point of view they held about a digitally-dominated world. In the spring of 2013 we held a seminar entitled "Defining the Digital Vernacular" for graduate students studying architecture at Lawrence Technological University. As an initial assignment, we asked them to define *digital* within a contemporary context, drawing on the historical evolution of the word. Their insights opened a curious and rich perspective on what *digital* can mean in the context of design and the *Digital Vernacular*.

One of our students, Jia Liu, defined *digital* as information with value and sensed through impulse. In the context of a finger, she defined *digital* as the sensing tool for complex subjective data with a direct and physical connection to the entire human body through the critical sense of touch. In her own words: "data and information that the hands help the brain collect." She defined *digital* in the context of a computer as the sensing tool for complex raw data with a virtual connection to the human body through all the senses. She noted that the digital finger was prone to fatigue and the digital computer was prone to stamina. In her words; digital tools "push human production capacity to unprecedented heights" to deal with an overwhelming "mass and accuracy of information."

Another student, Nick Cataldo, defined *digital* as a connector. In his own words digital is the "connection between the brain and the instrument (finger or computer) that involves the process of interactively figuring." In this context the "figuring" is defined as being a significant and noticeable part of something and a working out of explicit or tacit value. As an example he described the difference between the implicit *digital* assessment and engagement with a door as you approach and open it with a hand to the explicit *digital* assessment and engagement required to design and fabricate a door with computer aided tools.

All students in the seminar formed working points of view about the meaning of *digital* following their simple etymological investigation. They were unanimous in recognizing that our fingers and numbers, our hands and computers, share a curious connection and common origin of relationship. They recognized that both our fingers and our computers use electric signals to transfer information. They all appreciated the importance of "touch" as the most significant sense to be engaged both literally and figuratively in a process of design that uses fingers and hands, computers and brains.

"I thought then that the first feeling must have been touch. Our whole sense of procreation has to do with touch. From the desire to be beautifully in touch came eyesight. To see was only to touch more accurately."

-Louis I. Kahn

This book began with our deep interest in digital tools of design and fabrication. We were educated in the discipline of architecture utilizing analog modes of communication, design representation, and methods of fabrication. These analog modes kept us intimately in touch with the work we developed because we had to make it slowly by hand and our decisions along the way had to be careful and carefully considered. We guided our tools; our tools did not guide us. As young practitioners, we witnessed firsthand the evolution from analog to digital tools and the expanded field of awareness, speed, and capacity that digital tools fostered relative to research, representation, and construction. We are strong proponents of accessible digital tools and our daily work depends on them, yet we remain connected to our analog foundational experiences that emphasized the patient consideration and responsibility of guiding the work.

The use of digital tools for communication, design, and fabrication to produce architecture has profoundly influenced the discipline. The most apparent

influence is in the limitless possibilities to generate complex forms, though unlimited possibilities and complexity are not inherently positive for architecture. Building information modeling tools such as Revit, Grasshopper, and Digital Project are acting in response to the demands of digital practice. Perhaps the most profound influence is the streamlining between digital design tools and digital fabrication tools. What is designed can now be readily and directly fabricated using digital technology. Practicing digitally has created a process-based change to the profession and the *Digital Vernacular* is a part of this change. As Branko Kolarevic asserts in *Architecture in the Digital Age*, "It is the digitally based convergence of representation and production processes that represents the most important opportunity for a profound transformation of the profession and, by extension, of the entire building industry."[1]

The Digital Revolution has brought numerous remarkable and productive virtues to the discipline of architecture but also introduced some potentially inhibiting deficiencies. Most profound is the increased abstraction and tendency toward loss of human touch introduced with digital tools. Because electronic digital tools are ultimately based on numeric control they require specialized knowledge of an abstract set of commands and symbols. Digital tools do not yet emphasize intuitive and physical interaction and response. They require constant precision, and inhibit rough estimation. Digital tools can create a world unto themselves, with a tendency for an operator to lose themselves in a self-referential world of simulation and required procedures divorced from representing reality or intuitive process. The tools have a tendency to guide the *maker*, not the *maker* guiding the tools. Outcomes often resemble abstract mathematical models more than concrete haptic experiences defined by an individual *maker* through real material and specific context.

The *Digital Vernacular* addresses these deficiencies by implicitly demanding a sense of touch, a sense of awareness, and a sense of guidance in the conception and development of a work of design in order to bring it into being. This best occurs through simultaneous "hands-on" engagement with "virtual" engagement so that immediate and natural consequences of design opportunities and decisions can be revealed. This occurs throughout the design process during the collection of data, multiple feedback loops, and development through both virtual and physical fabrication. In this sense the digital must be defined as engaging both fingers and numbers, the human hand and electronic tools working together as instruments to gauge and develop the work appropriately.