Flux Architecture
Digital Sensibilities:
Quasi-Mathematical Expressions, Evolutionary Blur, Morphological Fusion

byThomas Rusher

Digital Sensibilities

Architecture finds itself at an exhilarating and dizzying confluence of multifaceted methodological approaches to design generation vis-à-vis *"digital sensibilities."* A departure from fixed static ideologies, pedagogies, and frozen prescribed typologies based on standardization and modular units is being replaced by an exhilarating liberating moment of dynamic digital design methodologies of fluctuation and evolutionary connotations, *"Flux Architecture."* The emergence of Digital Fabrication Techniques that transfer data directly from computer to controlled manufacturing devices are creating potentials for the resurgence of idiosyncratic and variable components, assemblies, and system possibilities in architecture. Linear methods of thought and modular incremental thinking are alien concepts to the multi-linked web like thought connections associated with growing digital design methods. Greg Lynn references sensual forms, developmental processes and complex assemblages as issues that designers have struggled with in the past (Architectural Design, "Folding in Architecture)[1] . Flux Architecture lends itself to variability, morphological sequencing, temporal analytical studies, evolutionary links, relational models and dynamic moments of intervention that allow designers to adapt and reevaluate design methods instantaneously. Powerful computational software like **form•Z**, 3D Studio Max, and Maya afford designers the opportunity to explore with parametric controls, intuitive real-time responsiveness, and output for prototyping.

The digital age has irrevocably changed the character of architecture. Its directions and mantras are as diverse and dispersed as quantum particles with base theories in play and new hypotheses being developed and discovered each day. We are just beginning to understand the possibilities, boundaries, and ramifications of the digital to the architectural profession. A new generation has emerged that is ostensibly comfortable with technology and seeks methods to advance and leverage the technology of their time to be as innovative and expansive as design predecessors from the previous century. New directions are being created by many as quickly as the technology changes. **form•Z**, with its new dynamic tool set, key frame animation and deformation tools give students a range of possibilities to explore temporal tectonic issues associated with flux architecture. The accelerated exponential growth and change of the digital as it relates to humanity is one of the greatest issues that face not just architects but all of civilization.

We are moving into an era of the digitally connected and disconnected. This has to do with access, familiarity, and acceptance or rejection of digital technology. It is difficult to move through our urban centers without being digitally documented with video cameras. Toll road authorities conveniently take snapshots of our vehicles and send us bills. Credit cards leave digital traces of our presence and behaviors. Society seems accepting or oblivious to the invasion of privacy at all levels from a grocery store savings card that clutters our wallets and key chains, to documenting which Web sites you frequent, the time spent there, etc. Privacy issues proliferate; liberties are eroded, while at the same time freedom of connectivity and expansion of thought breed through digital means. Those that accept seem to be very accepting, perhaps to the point of dependency. Who wants to leave home without their cell phone or all-in-one-communications device? If left at home, do we feel disconnected and incomplete? Notions of phantom buzzing from non-existent cell phones and blackberry communication devices are being equated to phantom limbs of amputees. The body readily adjusts to new associations and adapts to loss. Those that reject seem to be adamant about the glory days of pre-digital concepts or are genuinely unable to adapt to the accelerated pace that is demanded by the technology. Perhaps there is a

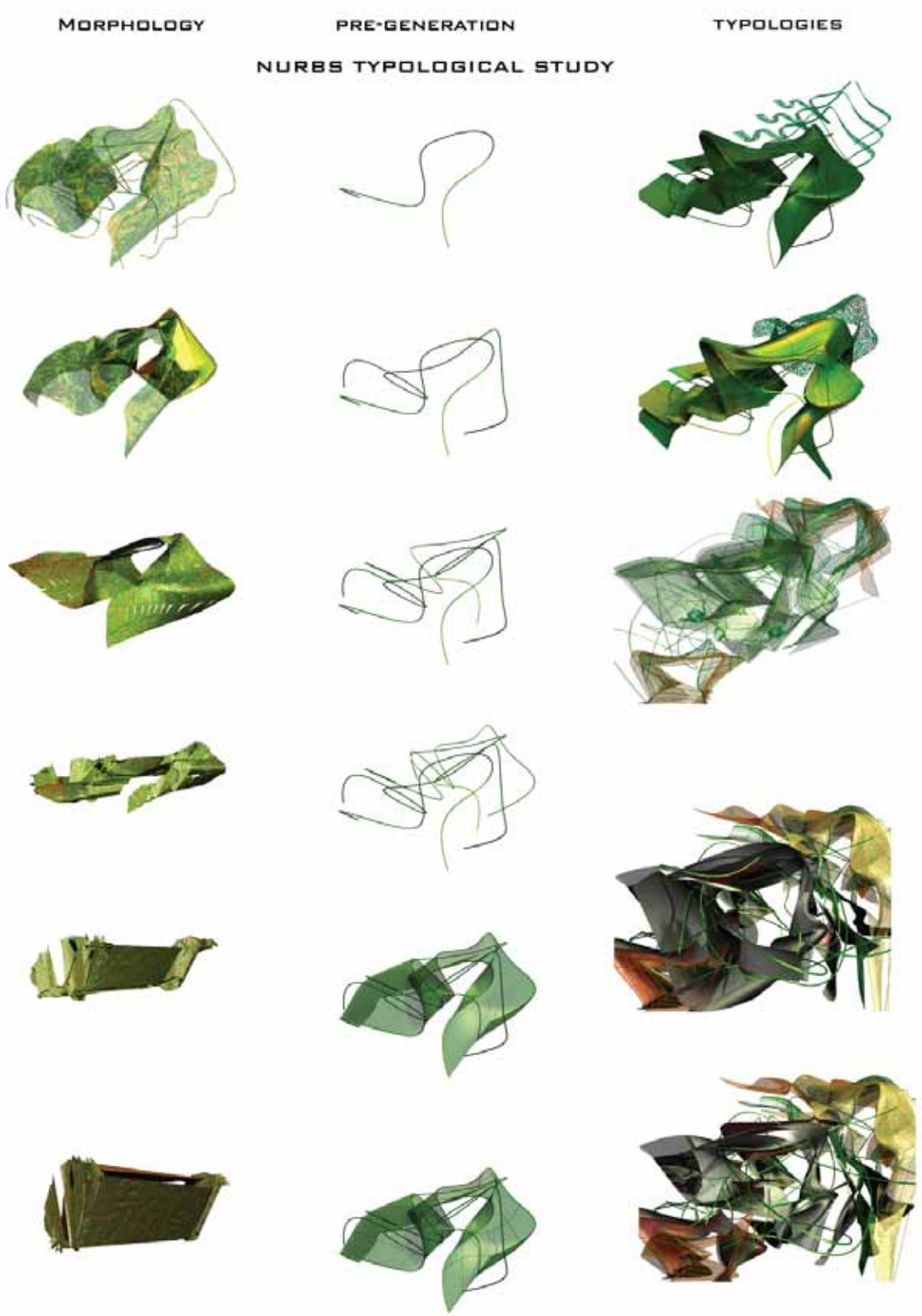

Figure 1: NURBS Typological Process Diagram of Animated Structures, by Chris Medina.

Figure 2: Fluid Component Typologies, by Jorge Trevino, Jordan Pennington, and Hyun Lee.

middle ground between being overtaken by and overly dependent on technology, and knowing when the human component should intervene in a process be it design or otherwise.

If the device automates everything for the architect/designer, will it have a soul? If the computer generates a parametric form, space or analogous tectonic device, is it valid? Do we keep it? What determines value of the discovery? What is it that makes architecture of a period a timeless event as opposed to the bastardized formulaic construction or building of established conventions, which somehow lacks a soul? What does it mean to practice architecture in the age of computers and proliferation of information both fact and fiction via the World Wide Web? The answer lays within us as the ultimate computer and human filter of design iterations.

Architecture has always been a slow beast for change but the connections to digital design now have forced the profession to deal with this technology and attempt to keep up with its rapid growth. In most instances, it is still a documentation and representational device being utilized to accelerate production and capitalize on one of the inherent properties of the computer, its ability to quickly modify, replicate, and output preconceptions. This is and has been an outdated approach to the digital. It has been going through revolutionary and evolutionary changes in flexibility of modeling control, digitally animated relational structures, and mathematically-based parametric controls. All of these tools lend themselves to study, enhancement, and naturally what the architect is best at, deciphering the inherent value of these tools as it relates to the constructed world and virtual domains. The same way that the elevator and the steel frame changed the face of architecture in the last century, digital design is moving architecture in many directions that have as of yet not settled on a singular approach. Perhaps this is the nature of this beast, diversity of methods.

Having stated these immense potentials for digital design, the question of Man and Machine emerges. Conceptions of Digital Automation vs. Human Intuition, Digital Fabrication vs. Conceived Fabrication, Intelligent Structures vs. Responsive Structures and finally Design Authorship, Co-Authorship and Relinquishment are issues of paramount concern. I explored these topics in a series of digital design classes as well as in Upper Level Design Studios at The University of Texas at Arlington's School of Architecture. There are three specific sensibilities toward digital design generation that are of interest to me, which are explored in each class at varying degrees of complexity. Digital generation as *Quasi-Mathematical Expression, Evolutionary Blur, and Morphological Fusion* are terms that I use for each sensibility. In all instances, varying degrees of intervention, and categorization by the designer at critical moments becomes essential in the digital design process. Digital Intuition through partial automation, Conceived Fabrication, and Responsiveness of systems lend themselves to each of the aforementioned Digital Sensibilities. This dances around the broader issue of Co-Authorship and Authorship while attempting to maintain a logical series of events and avoiding Relinquishment.

Quasi-Mathematical Expression: Tooling Up/ Labs/Digital Operatives

The use of scripting of forms, surfaces, and spaces as both repetitive and rhythmic variant structures generates fascinating formulaic mathematical possibilities. Digital objects like Meta-Clay, **(Meta-Formz)**, NURBS, C-Meshes, Inverse Kinematics and the like contain inherent properties that have behavioral attributes that are controlled by a series of parametric settings and *"Digital Operatives".* Digital Operatives are the development of a series of sequential variant transformative digital procedures that acquire behavioral attributes which have tectonic and spatial implications. Through the use of Macros in **form•Z**, students can initially set visual parameters to a digital operative and then develop variations on a macro and/or modify the formula to derive the desired visual impression. Some settings are formula based, others are manually or visually set but in each instance, it is generating a mathematic expression of the "Digital Operatives." I call this a *"Quasi-Mathematical Expression."* One that is visually set to

Figure 3: Evolutionary Components, Assemblies, and Networks: Temporal Spatial Construct, by Chris Medina.

achieve design objectives, may or may not be parametric, but can be reconstructed, regenerated, reused, and create variable conditions.

When scientists run experiments, they are running through a series of possibilities with a multiplicity of variables and constants in order to test some ideas and have discoveries. They typically have control subjects, placebos, and a variety of other elements to make logical conclusions about their findings and to test assumptions to form theories. In the process, there will be many failed experiments and a few successes. The analogy applies to digital approaches in the creation of organizational matrices, fluid surfaces, and tectonic armatures. My students begin by leveraging the wide array of digital tools available in **form•Z** and design a series of "Digital Operatives" to extract Quasi-Mathematical Expressions. Quasi-Mathematical Expressions as opposed to Pure Formulaic Expressions because of the nature of engagement of designer to machine and the visual nature of the experiment as more a qualitative study that in turn had quantitative results.

The idea behind developing specific digital operatives to uncover these visual expressions deals as much with failure as with successes similar to a scientific experiment. Empirical Model Building has long been a device for discovery. The understanding of the inherent properties of digital constructs and their value as analogous or new tectonic typologies is a complex function that students perform (Figure 1).

There is a tendency to accept what the computer gives the designer simply because it is a scripted or formulaic expression. In some cases these lead to semi-predictable structures. In our case, we dive in and out from formulaic to manual override when the opportunity presents itself. Here the designer is Co-Author. To what degree depends on the sophistication of the designer's ability to digest, assimilate, and synthesize the visual data being formed. The computer used in repetitive commands is not the intent but rather to use the computational power to develop multiple iterative states rapidly is the key to initially inventing novel typologies (Figure 2). In other words, multiplicity through linked variations as apposed to simple replication or repetition.

Students ran through a series of "labs" in order to simultaneously "tool up" on **form•Z**'s extensive modeling pallet while being open to experimental possibilities. Instead of entering the vacuum of the digital with preconceived notions of "architecture" they deal with more abstract notions of developing typologies of spaces, components, assemblies, networks, and tectonic constructs through the development of "loose" digital operatives (Figure 3).

Evolutionary Blur: Animated Analysis/Typological Extraction

Time-based modeling as an analytical and generative device was a topic explored by me back when I was a graduate student at Columbia University's Graduate School of Architecture, Planning and Preservation. Having been involved in one of the first "paperless" studios there, stirring dynamic analytical digital models exploring active change over time were explored using high end software like Softimage and Alias Wavefront. At the time, **form•Z** was leveraged for its strong modeling abilities and at times exported into the other two programs as a base point of departure. Since then, software has become more expansive, relational, and nuance-based than ever before. This allows for greater parametric controls, formulaic expressions, and manual overrides at critical moments. The new animation functions in **form•Z** are now allowing students to be exposed to intriguing animated controls that have evolutionary connotations. These new tools lend themselves to the aforementioned time-based studies and relational model building as exploratory digital sensibilities.

Much can be gained and discovered by visualizing the past through abstract digital notation and extrapolating information both actual and visual from the animated analysis. Although all of my classes dealt with "Flux Architecture" as a topic this last year, the methodology to each class is unique. The upper division classes approach to "Flux Architecture" is through a series of temporal studies using the new digital modeling and animation functions in **form•Z** to run their labs. This class investigates tensile structures, digital objects such as NURBS, and performs animated surface studies to develop and categorize typologies of events, spatial conditions, tectonic structures, and surface phenomenon (Figure 4). The development of an animated temporal sequence from lab experiment(s) to new spatial typologies while creating specific relational links to synthetic digital environmental structures is one of the objectives for the Advanced Digital class. Evolutionary Blurs are constructed through animated means, then re-

Figure 4: Porous Web Assembly Typologies, by Jorge Trevino, Jordan Pennington, Hyun Lee.

worked and incorporated. The concept of the "Evolutionary Blur" is to examine moments in the morphology and make interstitial temporal connections between beginning and end states of the studies. In many cases, the intervention has more to do with co-authorship with a slant toward authorship where the extraction of events is a specific design decision. The purpose is to not simply allow the computer to continue along its animated parametric path but rather to extract temporal moments and reevaluate residual moments (Figure 5). This class has more to do with understanding the inherent qualities of digital structures and making analogs to the perceived real as both organizational potentials and physical possibilities. Issues of interdependencies, segregation, flexibility, limitations and synthesis of animated constructs are incorporated into the final animated sequence. Initial surface studies began using Non-Uniform Rational B-Splines, (NURBS) as unique interdependent rationalized digital entities. **form•Z**'s lofted NURBS capabilities are robust and combined with a variety of line generation types allows for understanding of the NURBS as a variable construct digital object type with unique properties. Pre- and post- generative exploratory labs were ran to extract, understand, and ultimately leverage the NURBS as rational variant surfaces. Placement, orientation, and rhythmic sections were studies in the development of NURBS surface types that then expanded into an aggregate of spatial and soft component typologies. Material qualities were then looked at independently of NURBS as a second surface iteration then collapsed to form layered relational conditions. A multi dimensional relational construct with surface and sub-surface connections was then designed with the previous labs. Tectonic structures emerged from assembled component typologies based on the inherent properties of each to form a logic of assembly. The use of Adobe Premiere Pro 2.0 was commissioned to add a final cinematic quality and allow for editing, splicing and reworking of the animated sequences. The use of layered animated structures, compositing of 4D renderings to evoke evolutionary and developmental phases, and sinking of sounds aided in the development of a cinematic capturing of an audience. The end results are a series of designed responsive systems assembled into a new spatial typology through temporal evolutionary links with relational interactive layered "skin" types.

Morphological Fusion: 2D to 4D Frozen Dynamics

Frozen dynamics from two-dimensional to temporal constructs, analysis of tectonic structures and their evolutionary links, and variability culminating with a new series of components, assembly, and spatial typologies are concepts explored in my undergraduate classes. Students

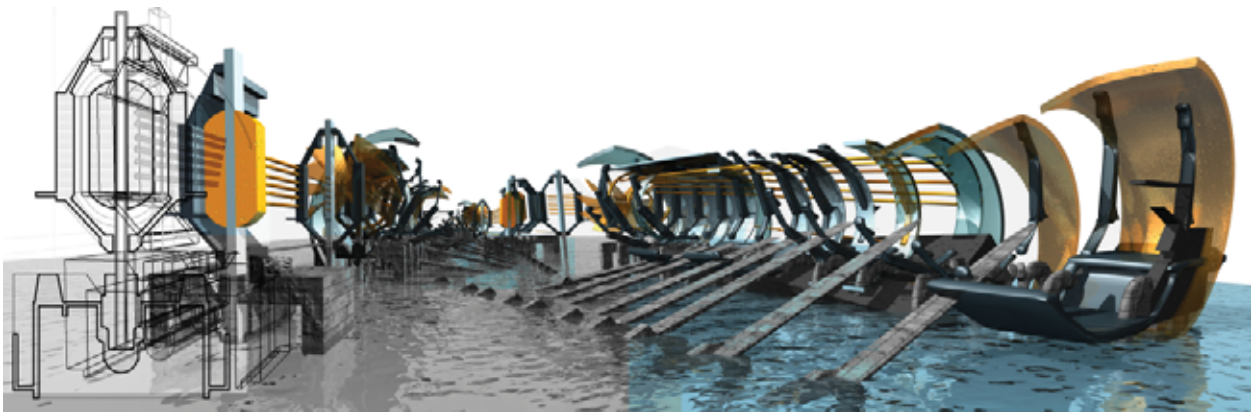

Figure 5: Temporal Extractions & Reassembly Morphological Fusion: Tectonic Event by Sean Farrell.

are given programmatic events that were linked to digital operatives. They study and extract inherent qualities from tectonic components in order to design a morphological sequence into new tectonic elements. The conceptualization of material, form, space, structure, and environmental change simultaneously collapsing temporal morphologies allows for students to explore a sophisticated range of interconnected variant conditions. Flux Architecture, but derived from extraction of evolutionary moments of disparate and connected objects with spatial, organizational, and tectonic ramifications. Analogues to known architectonic systems assemblies and components are always kept in the sites of the students. Here the students discover uncharted types from synthetic and natural structures that implicitly have within themselves organizational implications. The development of their structure combines the "tooling" aspects of digital skill acquisition, with the discovery process. Through the tooling process, students learn how to negotiate from Vector to Raster and back in order to develop an Evolutionary Spatial Typology through a "Morphological Fusion" of temporal events (Figure 6). Objectives included developing a logical Morphological Blur between pre-states, developmental moments, and formed frozen animate proposals (Figure 7). Students leveraged the inherent qualities of each program that they were exposed to, AutoCAD 2007, Photoshop CS2, and **form•Z 6.1**. The theory is to extract inherited traits from previously studied structures and develop a morphological sequence from ancestor to new type(s) to projected moments. Blurring the distinction between complementary

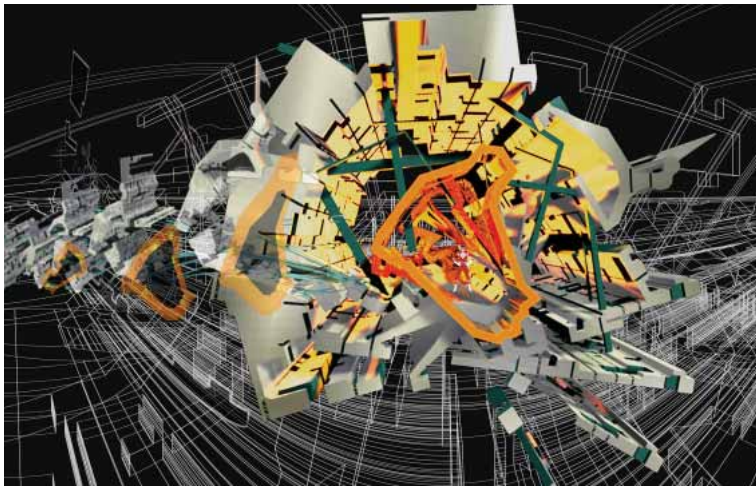

Figure 6: Morphological Fusion, by Montano Giancarlo.

software packages and collapsing ideas, discoveries, and graphics to convey a fused temporal evolutionary spatial construct is the final outcome of the project. Variability, transformative conditions, and intuitive responses were characteristic of the Morphological Fusion.

References:

[1] Greg Lynn, Architectural Design, "Folding in Architecture,", Revised Edition, Introduction, Published by Wiley-Academy, a division of Wiley & Sons Ltd. Copyright 2004.

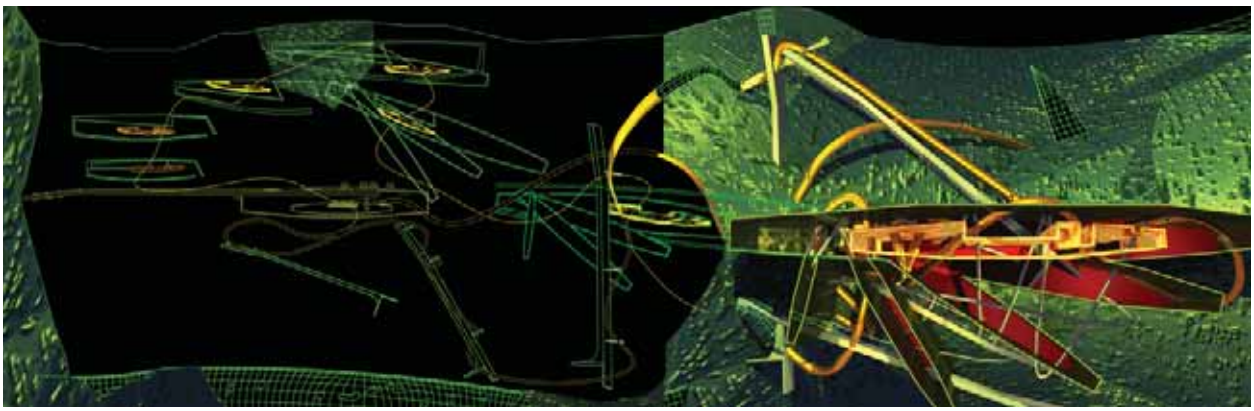

Figure 7: Morphological Sequence, by Triana Vidargas.

Thomas Rusher was born in New York City and has a Master of Architecture: Columbia University GSAPP, NYC, B.SCI. Architecture: University of Texas at Arlington. He is the recipient of the Ronald E. McNair Graduate Research Fellowship in Architectural Design. He is currently an Adjunct Professor of Architecture at the University of Texas at Arlington's School of Architecture. He worked for Skidmore, Owings, and Merrill LLP, NYC, Columbia University Planning Department, NYC, Polshek & Partners LLP., NYC, B-Five Studio LLP, NYC and is currently the principal of Rusher Studio LLC, a design consulting firm in the DFW area. At Columbia he received the Lucille Smyser Lowenfish Memorial Prize for best design thesis in Greg Lynn's Studio (1996). His works are published in Abstract 1994-1995, Abstract 1995-1996 (cover), Interior Design, Skidmore, Owings, and Merrill: Architecture & Urbanism 1995-2000, Texas Architecture, Tex Files, and AutoDesSys Joint Study Annual Report 2002, 2003, 2004, 2005, 2006.