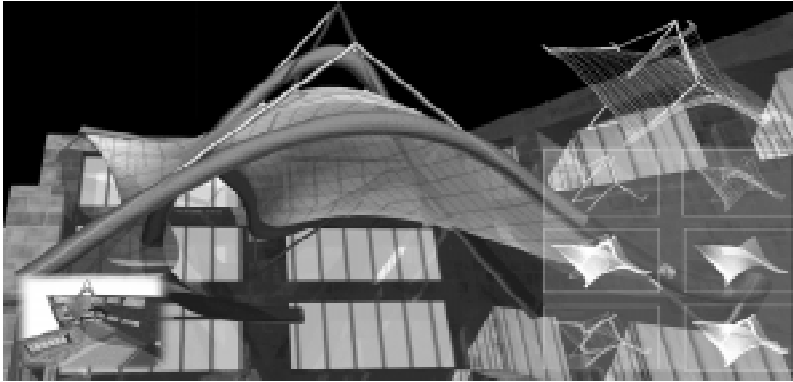


SOFTERIALS: DIGITAL MATERIALITY AND THE TRANSFORMATION OF ARCHITECTURE



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Abstract:

This paper presents the investigations into the nature of digital materiality by questioning the conventional notions of materiality. A critical framework of relationships between three digital materials (B-Rep Solids, Polynomial Surfaces and Isomorphic Polysurfaces) and three stages of design process (imagination, definition and construction) is proposed. The investigations are presented through exploratory student work.

Keywords: Digital materiality, design process, critical theory

Introduction

ma-te-ri-al (m-tîr-l) n.

Etymology: Middle English materiel, from Middle French & Late Latin; Middle French, from Late Latin materialis, from Latin materia matter

1. The substance or substances out of which a thing is or can be made.

2. Something, such as an idea or information, that is to be refined and made or incorporated into a finished effort: material for a comedy.

(www.dictionary.com)

Conventional wisdom holds that that which is not physical is not material. Little probing of the word and the concept behind it reveals that the 'matter' is not so simple or clear.

Material is that which matters. In all senses of the word. A material has to have an existence in order for it to be. That which is offers a will to be and offers resistance to a variety of forces in the process of being.

That which is is recognized by its difference. Just as a block of wood has different properties from a block of cast iron, just as a thin sheet of trace paper has different properties from a pint of water, a piece of B-Rep Solid (Boundary Representation) differs from a ply of a NURBS sheet (Non-Uniform Rational Boundary Spline) or from a glob of a Blob (Isomorphic Polysurfaces).

Just as working with bricks and mortar would lead to certain kind of spatial conception, working with solid modeling leads to a certain kind of spatial conception. Different materials ?both physical and virtual? would lend themselves to different ways of imagining, defining and building the world.

The goal of this paper is to present some of my investigations into the nature of virtual materials, which I call Softerials and the kinds of design possibilities that these softerials reveal.

Small, Medium, Medium

Discussions about the impact of media on design process have usually focused on the materiality of media. The materiality of a medium is studied for how it infuses the intended end product with a medium's material characteristics. Buildings that are designed on a drawing board with parallel bars and triangles would most likely than not end up being orthogonal or angular at 30, 60 or 45 degrees. Buildings that are designed using cardboard end up being a series of intersecting planes. Buildings that are designed using clay end up . . . you know the rest.

Material is that which matters. That which matters persists in various ways. That which persists transforms the most important dimension of life: imagination. All design work begins with the formation an idea in the small but complex neural network of the human brain. The idea then grows in a medium of drawings, databases, models etc., and finally

becomes the built work (physical or virtual), its largest manifestation.

But here is a twist. The separation between a medium and an end product was clear when physical buildings (steel, brick, stone, concrete, etceteras) were the only anticipated result. The day architects stopped using the heuristic process of building directly on site with bricks and mortar, the day architects started resorting to 2D drawing and other media before the buildings were built, the materiality of the end product ceased to be the primary factor that affects the spatiality and tectonic of the building. Like a pebble that carries the materiality of water in its smoothly rounded surface, the materiality of a medium is manifest in any building. There were times when people built a brick upon a brick and built the buildings on site without a single piece of drawing or model. Those were the times when the material of the building was the medium. Today, we find ourselves in a curious return to the fusion of medium and the end product. Today, we find ourselves in many situations where the differences between medium and product simply cease to exist. Where does a medium end and a building begin? In such cases as Asymptote's New York Stock Exchange installation, that becomes a moot question. (<http://www.architect.org/practice.html> August 2001)

Softerials: What does a vector want to be?

It is a commonly held fallacy that a computer is a thing or a tool such as a hammer or a jigsaw. Many thinkers have clarified before that the computer is an environment which contains thousands of tools. A computer is a place where one finds all sorts of magical materials and means to play and produce.

Not all vectors are the same. Depending on how vectors are defined, a host of virtual materials are created.

Some or all of these softerials maybe

already familiar to designers. However, so far, these soft materials have received only a second class citizen status in the architectural community. Akin to the plight of the Emergency Medical Hologram (doctor) in *Stratrek: Voyager®*, the softerials have been confined to the status of mere virtual media. It is time to recognize them as legitimate materials out of which very important politico-economic virtual environments are constructed.

Just as it is possible to conceive a design work in cardboard medium and build it in wood, it is possible to conceive a design work in one softerial and build it using another softerial. In the matrix below, a set of such possibilities are defined:

Softerial Matrix			
	Solids (B-rep)	Surfaces (Splines)	Blobs
Imagination (ideas)			
Definition (geometry)			
Construction (fabrication)			

Solids (Boundary Represented Solids):

In simple terms, a B-Rep solid is defined as a volume completely bounded by planar surfaces. Many of the popular CAD programs such as form*Z use B-Rep solid modeling — parametric or otherwise.

Polynomial Surfaces (Splines):

While surfaces can be represented using polygonal meshes, parametric polynomial curves such as splines have revolutionized aeronautical and automobile modeling. Their application to architecture has resulted in such works as Gehry's Guggenheim Museum, Bilbao, Spain.

Blobs (Isomorphic Polysurfaces):

Popularized by Greg Lynn (1998), blobs were originally developed for the study of complex molecules. The parameters that define blobs are such things as mutual gravity (weight), extent of influence (threshold) and form type (ellipsoid etcetera). At the level of imagination, these modalities of definition lead to works that are distinctly different

from solids or surfaces.

The following matrix can be used to understand three different levels of design activity by any designer. For instance, given below are some of the recognized designer matrices:

Frank Gehry			
	Solid (B-rep)	Surface (Splines)	Blobs
Imagination		X	
Definition		X	
Construction	X		

Clues to Gehry's imagination are evident in his recent sketches where one finds a field of flowing and complexly interwoven curves with no definite boundary definition. Compare these to his earlier sketches where the boundary conditions and tectonic are much more Euclidean and physical (for brevity purposes, illustrations could not be included here). Gehry now thinks in splines. For his purposes, Gehry quite extensively uses CATIA's surface modeling module.

Peter Eisenman			
	Solid (B-rep)	Surface (Splines)	Blobs
Imagination	X	X	
Definition	X		
Construction	X		

Eisenman's work, well until the last couple of years, has been concerned with solid geometry and transformations of solid geometry. His transformation techniques included subjecting solids to the logic of surface deformations such as Bezier curves. His Columbus Convention Center is a good example for this.

Greg Lynn			
	Solid (B-rep)	Surface (Splines)	Blobs
Imagination			X
Definition	X		
Construction	X		

Greg Lynn's work is imagined in Blobs but defined and constructed using Solids. His first built work, Korean Presbyterian Church, is much more exciting as an idea than as a built reality from this viewpoint. However, it is perhaps the first to use and popularize the softerial, Blob. In a way, Blobs were his medium.

Explorations in Softeriality

These ideas and frameworks were developed and explored in an advanced course that I taught at the University of Texas at San Antonio (Arc 4233: Computer Projects in Design). The course explored these three softerials through three different design projects. Each project focused on one softerial for imagination, definition and construction. Given below are examples of student works for each of these projects. The students were also asked to build physical models to recognize the materiality of softerials.

Conclusions

As the physical world's power structures migrate into virtual domains, virtual worlds become the powerhouses. Imagining, defining and constructing (and communicating, I might add) with softerials becomes definitely more exciting, rewarding and lucrative activity. In such a world, softerials play a more major role than does brick-and-mortar architecture.

Once the difference between medium and building vanishes, medium becomes the material out of which buildings are made. Solids, surfaces and blobs are three softerials that have begun to transform the way we imagine, define and build a world that really matters.

References

1. Greg Lynn: 1999, *Animate Form*, Princeton University Press, New York.

Solids: "Boole Box":

In this project, the students were asked to use solid modeling and boolean operations to create a 3D labyrinth for George Boole.

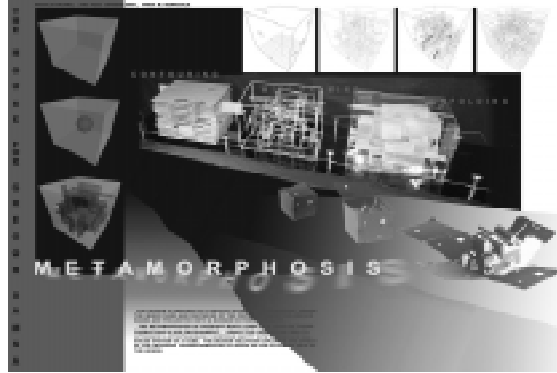


Figure 1: BooleBox "Metamorphosis" by Natalia Beard

Surfaces: "A Cloud in the Courtyard"

This project employed NURBS to create a canopy in one of the school's courtyard.

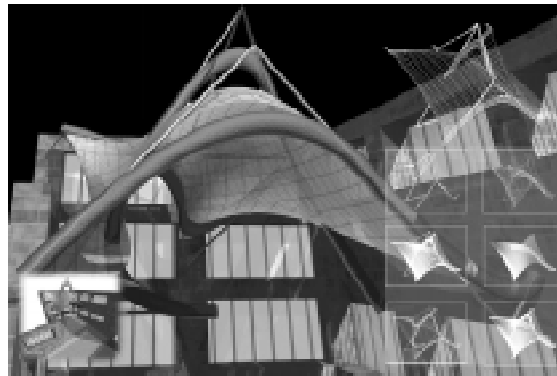


Figure 2: "Cloud in a Courtyard" by Cheryl Davani

Blobs: "Mission to Mars":

The students were assigned a virtual mission to Mars and asked to create a laboratory on planet Mars using isomorphic polysurfaces.

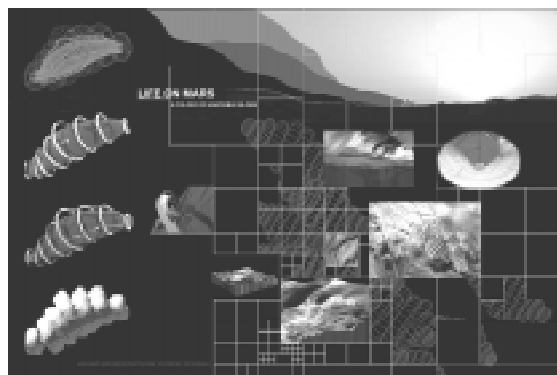


Figure 3: "Life on Mars: A Colony of Habitable Blobs" by Natalia Beard