Guerilla Tactics of Parametric Design.

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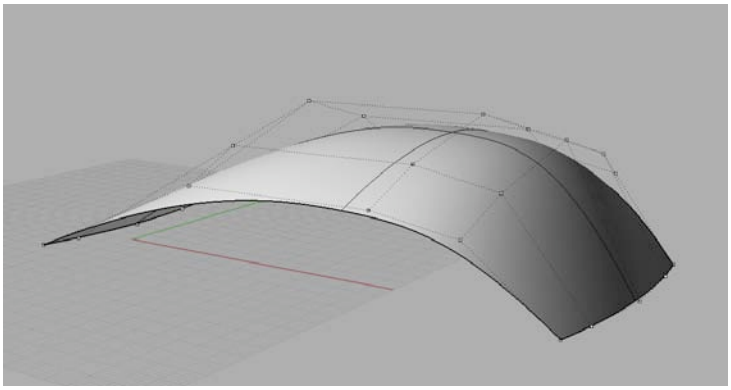
> guerrilla |gəˈrilə| (also guerilla)-- noun
>
> a member of a small independent group taking part in irregular fighting, typically against larger regular forces : this small town fell to the guerrillas | [as adj.] guerrilla warfare. ORIGIN early 19th cent. (introduced during the Peninsular War (1808–14): from Spanish, diminutive of guerra 'war.'

Our assumptions about the world of technology and design are leading us astray. We are being pulled unequivocally towards notions of efficiency (time and cost) and towards the idea that we are buying ourselves back into the business of design development. In reality we are not repossessing anything, but are simply passing our cost and time savings on to our consultants, contractors and clients. Parametric design, BIM (Building Information Modeling) and digital fabrication methods are rendering us, as architects, further obsolete and creating a world in which we are even more likely to create another big box store or a second lot of condos, with only the requisite shift in material or articulation.

We need only reference the introduction of Computer-Aided Design in the early 1980's, which promised a time of change in the field of design, to see that the speed and precision of technology is truly seductive. CAD technology was billed as device for making firms more efficient, thus reducing the amount of time spent on each project and netting the firm larger profits. This initial venture into CAD left some of the professions elder statesmen clamoring against these advancements. This resistance argued that digital software reduced design development in favor of a higher level of productivity and efficiency; as we all know the efficiency provided by CAD software has overwhelmingly won out and has now evolved into BIM. BIM software has enabled "smart models" to be utilized from early in the design process, streamlining the transition between design, documents, and construction. These smart models allow for precise material definition and custom detailing to be represented in three dimensions while producing automated versions of "traditional" construction documents, all from one three-dimensional architectural model. This time the profession, both young and old has wholeheartedly accepted the transition to information modeling under the auspices of an even more efficient model of practice. Though the reality of offering copy and paste building components once again reveals our inability to dissect the material or programmatic shifts necessary for creating a heterogeneous urban environment.

Another offshoot of the software development which was empowered by IBM's FORTRAN language, along with other CAD software, in the late 1970's, was geared towards the more

lucrative aerospace and naval engineering fields, including, CATIA, Pro/Engineer and CADAM.[1] CATIA, originally developed by Lockheed and then sold and repackaged for a larger audience by Dassault Systems, was created as a platform for aeronautic design. CATIA by definition was designed to create monocoque design forms with diaphragm structural constraints provided by two rigid skins, one interior and one exterior. It was also capable of modeling highly complex forms driven by the aerodynamics of the object. These complex forms were made utilizing geometry formulated with Non-Uniform Rational B-Splines (NURBS) based surfaces. Developed in the 1950's by French engineer Pierre Bezier spline curves were developed to accurately describe the complex curvature becoming commonplace in the automotive industry. NURBS curves are a generalized branch of Bezier curves that infer relationships between points to describe a curvilinear line or surface, these curves do not lie on the associated control points but interpolate a series of surrounding points to describe the geometry.



NURBS Surface defined by Bezier curves.

These geometric descriptors have been utilized regularly in different software platforms since the late 1980's as geometric and computational software(s) began to articulate more complex curvilinear surfaces. NURBS based geometry allows the software to describe these shapes in an efficient and precise manner. This type of articulation has been incredibly important in the advancement of computer-aided design, as it empowered a new aesthetic into the design lexicon.

Not only did CATIA fully capitalize upon the geometric capabilities of NURBS curves, but it also allowed for parametric connections to be made between those geometries and other constraints, both geometric and algebraic. The integration of parametric software into the design and construction process allows for multiple shapes or designs to be pursued quickly and simultaneously once a defined set of parameters connected to a geometrical set have been defined. These parameters enable the software to reject a possible design whenever any criteria are not matched. The power of parametric design software is paramount when dealing with the

interdependent systems and advanced compositional characteristics of alternative geometries now being utilized by architects and engineers.

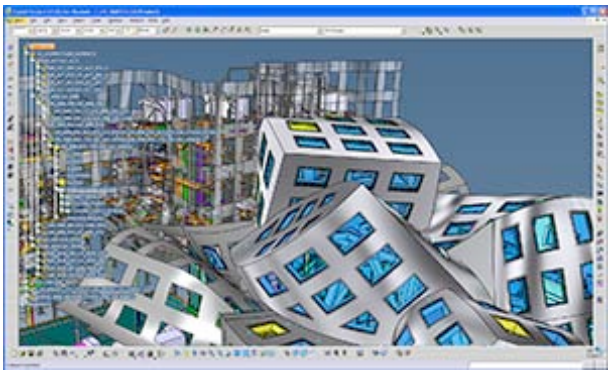
Through parametric definitions the software's capabilities mimic the controls of other three-dimensional software, except it incorporates associative geometry through a set of constraints. These constraints allow for articulated structural geometries to be parametrically linked to the control surface(s). These parameters allow the entire model (structure and skin) to be controlled by definable objects or curves, including regulating geometry, a Boolean variable or a mathematical equation. This method provides for a high level of geometric control that can easily be modified even very late in the process. As well this software allows customized details to become a variant of a base detail, essentially utilizing the software to allow a set of mass customized details to permeate the system.[2]

These customized details could be anything, they are defined only by their geometric form. As with most every three-dimensional modeler, CATIA comes preloaded with its own set of default connection methods. As CATIA was initially formulated for use in the aerospace and nautical engineering industries, it is naturally equipped with joinery more typically associated with these fields. These tend to be joints for connecting steel and aluminum in typical methods, however they are deployed in very unconventional ways. While bolted and welded connections are relatively ubiquitous in architectural design, this type of convoluted joinery is very suggestive of specific construction techniques outside of the architecture industry.

This awkward construction aesthetic is particularly apparent in the work of Frank Gehry's office. During the early 1990's, Gehry began to utilize CATIA to further pursue his ever more sophisticated curvilinear designs. He began utilizing the parametric capabilities of CATIA while pursuing the iconic Guggenheim Museum in Bilbao, Spain and fully explored the its potential in the long delayed, Walt Disney Concert Hall in Los Angeles. This software enabled Gehry's team to pursue the buildings overall geometry, structure and detailing simultaneously. Capitalizing on the power of the software, Gehry was able to calculate the number of three-dimensional panels on the façade, their curvature and directly supply the fabricators with the geometric information and detail to digitally manufacture the components.

The design aesthetic of Frank Gehry utilizes a series of predefined expressive surfaces (created with analog models) to create articulate curvilinear structures that are tightly skinned and essentially seamless. He is able to achieve this articulation through the exploitation of the fluid modeling allowed by NURBS surfaces. The ability to so softly maneuver surfaces within the software is seductive and empowers the designer to model with a level of detail beyond that of any other modeling method. The results of Gehry's design parameterization, however are derived

from a superficial aestheticism that is then engineered into a set of overly articulated panels and structural steel sections. As mentioned CATIA was initially created to geometrically describe the fuselage of an airplane and this too becomes the aesthetic of Gehry's structures; a complex structure covered with a light metal skin of three dimensionally articulated panels. Let there be no misconception Gehry's buildings are a product of a form based non-digital design process, digitized and translated through CATIA into an expensive and barely constructible set of CNC (Computer-Numerically-Controlled) manufactured components.



Gehry Design in Digital Project[3]

Frank Gehry's relationship with CATIA has allowed him to parlay his success into the creation of an offshoot company of his booming architectural practice. Gehry Technologies is purely a software development company, releasing Digital Project in 2001, with the strong support of Dassault Systems. This new build or "silo" of CATIA, has renamed many of the aeronautic tools with definitions and an interface, which are more familiar to the architectural profession. With this venture Gehry has opened the rest of the field to the power of parametric design and enabled architects to parameterize their designs and details. Gehry's intentions with the propagation of this software is not necessarily to continue the investigation of it's capabilities, but instead to generate more complex form-making, and provide an avenue for his firm to sweep in with manufacturing and structural solutions to the proposals created with the software. While this system has functioned well in articulating the geometries desired by Frank Gehry, it is a system that is very specialized and increasingly expensive ($14,500.00/seat)[4]. Gehry's growth into the software and information systems market has further grown his already familiar brand.

The nature of the Gehry's buildings, products of his oft repeated process, have created a cultural phenomenon. This phenomenon has grown beyond that of any typical "star architect." This is most certainly a product of his architectural "brand", which expresses the elite and eccentric nature of most of his clients, and is a product of his ability to transcend familiarity within the

industry to become a household name, appearing as a character on "The Simpsons" and taking on protégés the likes of Brad Pitt.

"The Simpsons"

His designs are coveted to growing cities due to the perception that they are capable of changing cultural landscapes and/or regional economies in a fell swoop. Most exemplified in Bilbao, Spain, where his Guggenheim Museum is reported to be responsible for nearly 35% increase in the number of tourists to the Basque region from 1994-1999.[5] This change comes at a price, which few can afford, The Stata Center at MIT came to $442 per square foot, and over $650 when you include design costs, while the average cost per square foot of a typical science facility is $260 per square foot.[6] Though this perception does not come without its faults, to assume that a city can be composed of series of iconic landmarks with no structure for organized growth and public space is also problematic.[7] Additionally, the use of architecture to create a spectrum can easily be read as an attempt to create a wolf in sheep's in clothing. When a developer knows that the scale or composition of a project will provoke resistance from a community it has become a more normalized part of the process for the architectural design to be used to cloak this criticism.

Take Atlantic Yards, a development project over the Vanderbilt rail yard located between downtown Brooklyn, NY and Prospect Park. Bruce Ratner, CEO of Forest City Ratner, bought controlling interest of the New Jersey Nets (National Basketball Association Franchise) with plans of moving them to a new arena located as the hub of this 22-acre development. Formal plans for the project were announced on December 10, 2003, and reported on the next day in the New York Times as a $2.5 billion development plan with 17 towers designed by Gehry, including a projected 2.1 million square feet of commercial space and 4,500 residential units.[8] Almost immediately civic and neighborhood groups began to rally together in protest of the project.

Plan of “Atlantic Yards” as proposed in 2003.

Ratner’s purpose in choosing Gehry as the project architect is quite transparent, in a conversation with New York Magazine’s Kurt Anderson he stated that spending the 15 percent extra per square foot to hire Gehry, was a purely political ploy.

> “Ratner isn’t spending 15 percent extra on these new buildings simply because he wants to underwrite cool design. He understands that in Brooklyn, just as his quotas of apartments for poor people and construction jobs for women and minorities were ways of winning over key constituencies, hiring Gehry was politics by other means, sure to please the city’s BAM (Brooklyn Art Museum) loving chattering class. “The spirit of what you say,” Ratner agrees when I posit this theory, “is accurate.”[9] (Kurt Anderson)

Further groups have gone so far as to define the project as a cloak masking the project to the larger population.

> Jonathan Cohn states, “…the project is also a Trojan Horse. The promise of a major project in New York City by Frank Gehry has been enormously successful in muting potential opposition by the cultural "elite". But the project only looks like a gift because it’s wrapped by Frank Gehry; the architecture masks a slew of problems.”[10]

Though this is nothing new, Brooklynites and New Yorkers as a whole have a long history of vehemently resisting the most massive of development projects in the city.

The resistance has been broad, developed and well- organized, working in both very public and also, befitting of Brooklyn, very subversive ways. Develop, Don't Destroy Brooklyn[11] (DDDB), is one group of over 800 interested volunteers that has formed to organize the public resistance. DDDB has organized a set of principles that define their objection to the project and layout alternative methods for development.[12] DDDB in conjunction with the Council of Brooklyn Neighborhoods has developed an alternative design for the site called the Unity Plan.[13] The Unity Plan purports a more human scale of develop and density, through a diversity of urban design methods focused on accessible public spaces. A second group of investors, Extell Development Company, has also developed an alternative plan, which uses as its primary principle to "disavow taking property through eminent domain."[14] A documentary film focused on the proposed design, "Brooklyn Matters"[15] has been released by Building History Productions (Directed by Isabell Hill). There have been a myriad of rallies setup throughout the city to voice public opinion regarding the project. These protests continue to be organized now in the spring of 2008.

All of this begins to describe the failure of Gehry's design to cloak anything, in particular a 17 tower development, in a frosting of acceptance and disinterest. In fact it could be said that Gehry's involvement has fanned the flames of public interest. Gehry himself has in fact become the focus of much of the reactionary protest. Beyond the typical op-ed articles in the local paper, and even beyond the candlelight vigils, which were organized in protest of the Bilbao Guggenheim.[16] Tee shirts emblazoned with "Fuck Frank Gehry" started sprouting up around Brooklyn (a creation of Barnaby Harris) which Gehry, in stride noted...

> "I thought it must have been the people in Brooklyn who are sort of angry. But then I thought, well, it must be loving, too. So I decided it was funny, and I put it on. And I wore it to the office, and everybody got a kick out of that, and then I wore it to the gym."[17]

Murals painted within Prospect Heights tie Gehry's work to the use of eminent domain to purchase pieces of the puzzle, which were missing from Ratner's scheme.

Mural in Prospect Heights- Atlantic Yards Report

"I'm a do-gooder, I see architecture as a service."[18]

By Gehry's own admission he is uncomfortable with the situation that is created by his involvement, the scale, and the methods of action, with the Atlantic Yards project. "I'm very insecure about it," Gehry said of the Brooklyn project. "I've brought all kinds of people in to beat me up, because I want to get it right."[19]

Gehry has said he had repeatedly prompted Ratner to scale back the project. Having failed at that task, he asked that others might be involved in hopes of breaking the project into more digestible pieces. Speaking at a live broadcast at Columbia University, "He [Ratner] wanted to be able to deal with one person, so he refused,"[20] Gehry said. Later he reflected, "Sometimes I think I should be less polite," -- implying that life would be easier if his buildings weren't all attention-getters. Later he called Atlantic Yards "out of scale with the existing area," and said that the project has been such a struggle that it makes him want to "jump off the Brooklyn Bridge."[21] During the question and answer session Norman Odor (Journalist who reports via his blog The Atlantic Yards Report) observed a woman wearing a " t-shirt and a sticker saying "Eminent Domain Abuse," asked, "Have any of your previous projects involved the use of eminent domain or eminent domain abuse? Does that square with your principles? And would that be enough to make you walk away from the Ratner project?" "No comment," Gehry responded.

It is reported that the new Governor of New York (as of February 2008), Gov. David A. Paterson, called for a statewide moratorium in 2005 on the use of eminent domain. On March 21, 2008, it was reported that the project has been put on indefinite hold due to a lack of financing.[22]

Gehry's work generates an air of interest, a buzz, though as a product of his notoriety, he has found that that attention is more detrimental to his work than beneficial. We would argue that this is a product of his product. His desire to create larger and larger constructions with the same methodology stands in contrast with the forms themselves. Their relationship to humans,

and to the limitations of his software. At the scale of a tower Gehry's designs are constrained to a small layer of icing on an otherwise nominal planametric layout. The product the software is developed to create is one which wants to be concealed in BOTH an exterior and an interior skin. There is no honesty to the form, no expression of material quality or character, no exposed engineering, and no ethical responsibility to the community.

We propose to reconceive the way in which we use the capabilities of this software. Having considered the process of design utilized by the Skunk Works[23] in the 1970's to design the F-117A stealth fighter, and previously the SR-71 spy plane. Skunk Works in the development of the crystalline form of the F-117a fighter first calculated how to create the minimal radar signature of their aircraft, a parameter that had to be absolutely perfect. By defining one specific parameter they were ensured of a successful design per at least one definition. Once this primary task is successfully developed, they worked to solve all of the other limitations articulated by the primary parameter, the geometry. This required a fly by wire system, an on board computer which constantly monitors the aircrafts, speed and orientation and makes instantaneous minute adjustments to keep it steady. We propose using Gehry's software with the same method of prioritization. We must begin by defining the formal limitations of the material or construction method we intend to use.

The use of CATIA, or other parametric design software, could just as simply use a bow/banana truss or a space frame as construction methods, if only the form were linked back to the definition of these components. We propose that in fact this is a far more ethical and constrained method for deploying the software. We begin by defining and analyzing a system that we would like to explore. One of the first methods we attempted to use was conventional standing seam metal roofing, manufactured throughout the world and deployed in a myriad of environments and programs. We envision a tessellated use of the standing seam, maintaining the typical interlocked connection along seams and through a bracket back to a structural system. The system we proposed will cut the seam along each edge at particular intervals defined by the system. This geometrically defined and constrained system limits the form, by connecting the moves which are made along one edge of a surface by pulling or pushing on the opposing edge, to increase the area of the shape near the altered edge. Though the form doesn't accommodate specific forms that a designer may envision, it gives the designer a form driven by its materiality, in a smarter method similar to that of algorithmically defined form-making, so popular in academic circles. This method can make for a much more culturally coherent and connected design method, one which expresses efficiency and takes advantage of digital fabrication methods not as a method for making elitist icons, but for making inexpensive poignant designs. Gehry's own public image could use a change of this sort, it has changed

dramatically over the last five years as he has struggled with his choice to remain cornered with an elite list of clientele.

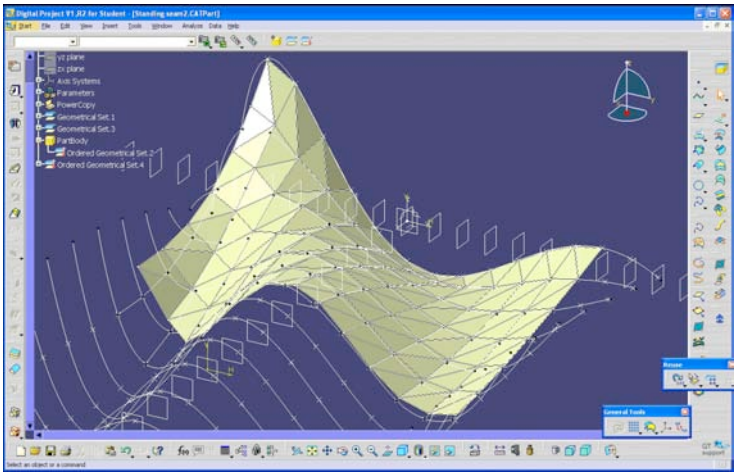


Figure 1- Gehry Technologies Digital Project (CATIA) model of Standing seam metal roofing bent (broken) to form an unconventional skin.

The tools embedded in the parametric technology such as CATIA create a system for the use of large sheet metal goods to be cut down inefficiently and applied to skeletons of disjointed and grotesque usages of steel and structure. These same tools can be reverse engineered to create systems using inexpensive and conventional cuts of materials to create objects that are identifiable and unique while remaining within the constraints of typical construction processes. In contrast, by creating methods for deploying conventional materials and methods in unconventional we ways we can educate the profession to create buildings of craft and precision, icon and expression, for clients that can really use them for the betterment of their business or cause. Though parametric software has become synonymous with excess and flippant design, the software also comes with the ability to utilize materials in unconventional and affordable ways. Technology, perhaps for the first time, is capable of understanding a material's constraints; we must choose how to employ these tools or risk that our profession will become further removed from the definition of our environment.

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