Materializing the Digital: Architecture as Interface

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ABSTRACT
Digital technologies have reshaped our experience of the material world. In this augmented and hybridized condition, information (and architecture) has no social relevance unless circulated, shared, and integrated into everyday life through interfaces between the digital and physical. The 'more serious work' presented here is digital craft as a method for materializing the digital and extending the agency of computational thinking and parametric design into a new social project for architecture. In an age of digital social networks, the future of public spaces will largely depend on an architecture that navigates the interface between the material and the digital.

"That parametricism 'goes social' is not a concession to the prevailing winds of political correctness (that divert and dissolve the innovative thrust of architectural discourse). Rather, it is a sign of parametricism's maturity, confidence and readiness to take on the full societal tasks of architecture, i.e. it implies the inauguration of Parametricism 2.0 (...) After 15 years of muscle flexing it is high time to put these innovations to more serious work" Patrik Schumacher (2015: 1).

INTRODUCTION

The search for architectural autonomy has severed the discipline from its social project by insisting that architecture can be reduced to a body of formal elements and operations separate from the influences of place, time, socio-cultural and political concerns (Hays, 2010). This reliance upon formalism and a world dominated by late capitalism has left digital architecture without a clear political stance. Understood as a form of resistance to the dominance of capitalist production, autonomy in architecture is instead a sidestepping of architectural engagement of the 'serious work' of the present day, from environmental degradation to economic inequality.

Parametric design is a method that employs variable parameters or algorithms to generate geometries and objects. Architectural autonomy thus might be achieved through parametric design as an internal mechanism of architectural production, viability, and justification. The following argues that the parametric need not be reduced to a formal project and that it can and should function as a tool of social engagement through architectural interfaces. Ultimately, this is a call for the development of a more robust theoretical position about the social application of advanced parametric design and how computation and construction can support architectural agency in the development of a social project.

ARCHITECTURE AS COMMUNICATION INTERFACE

Digital technologies have indelibly transformed the visual language of design education and practice, supplanting traditional hand-made drawings and models. Digital modeling and equipment such as Computer Numerically Controlled (CNC) machines and three-dimensional (3D) printers emphasize technical proficiency over manual skills, causing older notions of creativity and craft to be reconsidered. McCullough (1996) and Sennet (2008) both challenge hand making as a prerequisite for craft and propose frameworks for considering the craft of digitally designed objects.

At the same time, the possibilities for collaboration and production opened up by computation remain threefold for architecture: a consolidation that reasserts disciplinary centricity, an expansion that dilutes architecture's disciplinary specificity, or transdisciplinary redefinitions and reconfigurations that both intensify and blur architecture's identity and limits.

Of the three possibilities, transdisciplinary redefinitions offer the most promise. Computation is the foundational language of the digital and this shared language creates opportunities for engagement across and beyond the design disciplines. In connection with the rise of digital culture, the contribution of architecture may very well lie in the domain of

augmented reality, that is, dealing with the interface between the physical and the virtual, rather than focusing almost exclusively on the latter. It is not by accident that an institution like the MIT Media Lab works mainly on questions of interface and is affiliated with a school of architecture. As Nicholas Negroponte (1995), former Chair of the MIT Media Lab once foresaw, interface has become an architectural problem.

Antoine Picon describes in Digital Culture (2010) that the development of digital technologies has reshaped our experience of the physical world. In this augmented and hybridized condition, information (and architecture) has no social relevance unless circulated, shared, and integrated into everyday life through interfaces between the digital and physical. Interface requires architecture to materialize the digital in new and unforeseen ways.

CONTEMPORARY SOCIAL PROJECT, CAPITALISM, AND THE DOMINANT CLASS

"In a certain sense there is no such thing as buildings that are politically 'opposed', since the ones that are realized are always those of the dominant class" Aldo Rossi (1982: 113).

The contemporary architectural social project is divorced from socialism as a political structure, the social sciences as a data structure, and Modernism as a theoretical structure. Tafuri (1979) Lefebvre (1992) and even Aureli (2011) express reservations about the mythologies of the architect as expert, or advocate, or guardian of some abstract "communal imaginary" (Coleman, 2015). Such views are difficult to sustain when countered by arguments such

as Architecture without Architects (Rudofsky, 1965).

Summarizing Tafuri, Hays notes:

When architecture resists, when it attempts to reassert its own disruptive voice, capitalism simply withdraws it from service, relegates it to the boudoir, so that demonstrations by architects of their works' autonomy and distance from degraded life become redundant and trivialized in advance (1998: xiv).

For Tafuri, the "return to pure architecture," that capitalism necessitates, is little more than a return, "to form without utopia (...) to sublime uselessness" (as cited in Hays, 1998, p. xiii).

The contemporary social project of architecture resides to a large extent in its communicative capacity both digital and material. "The built environment orders social processes through its pattern of spatial separations and connections that in turn facilitates a desired pattern of separate and connected social events. This is social organization via spatial organization" (Schumacher, 2016: 109).

Architecture has the potential to be a giant navigable, information-rich interface of interaction reflected by the growing importance of occurrences, events, and scenarios.

ARCHITECTURAL VALUE AND ARCHITECTURAL KNOWLEDGE

A discipline is autonomous when it can be carried out independently of other disciplines. A discipline that lacks autonomy is one that depends on other theoretical domains for its investigation, such as architecture's reliance upon

frameworks from disciplines such as philosophy and biology. The search for architectural autonomy is a symptom of lost confidence in the possibility of a truly buildable and simultaneously culturally valid architecture. Additionally, architecture as a built project is presented as inevitably compromised. Architecture as a critique, rather than architecture as construction, frees architecture from the 'burden of utility and reality'. Utopia as a no-place is unattainable and perfection is reserved for the unknown or unknowable, or is achievable only when the problem is so reduced, or the aims set low enough, that they can be attained (Coleman, 2015).

A primary issue is the evaluation of intent rather than effect or impact. The social has been diminished by the language of naiveté, do-gooder, localized colonialism or the mistaken methods of expedited gentrification. Additionally, the ethics of designers experimenting upon populations in need typically requires a more traditional and/or known outcome which is counter to a radical project. Despite substance, these projects often demand a conservative approach as architecture cannot doubly fail those who are already disadvantaged (Ranciere, 2004) Architecture's attempt to extricate itself from the burdens of ethics led to the search for an autonomy that might allow architecture to be judged in relation to itself rather than relative to the world it constructs. It's a delightful and reassuring myth but a myth all the same.

CRAFT

Architect and theorist Stan Allen notes in his article "Artificial Ecologies" that the practice of architecture has always been in the paradoxical position of being invested in the production of real,

concrete matter yet working with tools of abstract representation (drawings, models, computer simulations and so forth). The paradox charges the question: does thinking (and its associated abstractions) or making (and its concrete matter) give architecture its agency? (Allen, 2003).

The capacity to craft, to think through making, instills architecture with an explicit agency to engage outside of the academy and the discipline. The introduction of digital craft into contemporary practice extends, rather than limits, this agency in the social (or political) project of architecture. The process of thinking through making and the accompanying non-linear methods position architects to identify pathways of thought into contemporary issues, and make visible that which remains unseen to other disciplines. Craft encourages imagination and through imagination the architect enters into the spheres of life, which are not immediate to personal experience: the social (or political) project of architecture. This imagination is a powerful agent as well (Scarry, 1985). The ability to imagine a better world equipped with the capacity to act, is to craft an object with intentionality and purpose. As the discipline continues to struggle with self-identity and the direction of its fragmented authority, craft remains the most valuable tool at the architect's disposal. Craft positions the architect as an agent of social and political change and digital craft is an extension of this agency.

Is the digital realm an extension of the imaginary space or a replacement of physical space? And does this cyberspace extend architectural agency or limit it? Digital walls do not keep out physical rain, or as McCullough states, there is "the seeming paradox of intangible craft" (1996: 22). Indeed, we may now be entering an age of the master-builder-craftsman or architect-craftsman that John Ruskin (1849/1989) sought to revive, but getting there in a way Ruskin could not have anticipated. Issues of dimension, heft, tactility, and materiality remain essential to architecture as built environment, no matter how tantalizing the pixilated world may be. Digital fabrication and its associated tools provide a tactile counterpoint to the image-based environment otherwise prevalent in digital work.

DIGITAL CRAFT

"The best way to appreciate the merits and consequences of being digital is to reflect on the differences between bits and atoms" Nicholas Negroponte (1995: 11).

For the purpose of this paper, the digital turn in architecture occurred in the early 1990s and is defined as the computerization of design, construction, and fabrication processes. This is marked by a transition from designs based upon a Cartesian grid to those constructed from a digital field condition abstracted within computational space. Specifically, the introduction of continuous computational splines that are variable within defined limits and can be notated as parametric functions or mathematical relationship between parts (Carpo, 2012). Digital craft emerges from computational thinking, digital fabrication and robotic construction, processes that allow the full participation of architects in the production of buildings and thereby extend architecture's agency to engage in a larger social and political project.

Therefore, how might digital craft re-engage the best aspects of craft, thinking through making, and the power of the digital realm? First, digital craft must embrace the spatial conditions of the computer environment. The term 'cyberspace' first appeared in William Gibson's 1982 story Burning Chrome and was subsequently popularized by his 1984 novel Neuromancer. The concept of 'other' space is woven throughout history, appearing in literature and cultural commentary from Plato's Allegory of the Cave to Descartes' Evil Demon. However, the concept of cyberspace is unique in that it offers not just a space of representation and communication but also provides a social setting within which these activities can exist. In digital culture, there is a new continuity between subject and the architectural object, with no void between them, as if the distance of vision was abolished by tactility. Craft and its inherent materiality will create the interactive corollaries between cyber and physical spaces.

COMPUTATION + CONSTRUCTION

"Computation and materiality now seem inseparable at every level, from the macro- to the micro and nanoscales" Antoine Picon (2010: 98).

High modernism paid remote attention to generic and somewhat abstract formulations of social issues. Its translation to the North American context brought with it a particularly American blend of idealism with pragmatism. A hallmark of modernist education, the Bauhaus, aimed to fuse craft and design education with avant-garde artistic practice. In doing so, the Bauhaus methods of architectural learning-by-doing often linked experiential education with both the social agenda of modern architecture and technological experimentation (Bergdoll & Dickerman, 2009). This

pedagogy cultivated a culture of making through workshop-based teaching – one of the goals of which was to train designers for industrial production and construction. These collaborative work-sites evolved into the digital tooled design/build studios of present day (Ockman, 2012). Design/Build is a unique architectural education model of project-based learning that empowers students to construct their designs in collaboration with local communities. Digital Fabrication leverages computer-aided design/manufacturing technologies and integrates tools from the aerospace, automotive, and shipbuilding industries. It has altered both the way buildings are conceived and manufactured. The combination of these disciplines allows for direct, hands-on engagement with technology and challenges students to explore methodologies poised to have an innovative impact on the future of the architectural academy and profession.

The questions raised by the conditions of contemporary practice and its continuous introduction of new technologies demand an architecture that explores shifting boundaries between the physical and electronic worlds. As architecture education and practice becomes increasingly invested in the teaching and methods of computation, the act of construction has never before been a more important counterpoint. Examples include the rise of interdisciplinary (anti-disciplinary) design research groups such as the MIT Media Lab which exist at the convergence of technology, multimedia, science, art, and design. Rather than a resuscitation of Modernism's social project, this research considers ways in which architects, operating in a digital culture, can be designers of constructive systems and provide the foundation of a new tectonic culture.

Examples of this new turn include architectural pedagogies, research labs, and degree programs that rely upon the arrival of digital fabrication shops in architectural departments and the emergence of new and exploratory design/build programs. These educational approaches invert the gap between teaching and professional practice by introducing direct production control, digital craft, speculative projects, and methods for re-centering the architect's role around the act of construction rather than coordination.

ARCHITECTURE AS INTERFACE

An example of combining computation and construction is the 80/35 Pavilion. The project, a student designed and constructed installation for the 80/35 Festival in Des Moines, Iowa, USA, is a light-reactive structure that glows in response to the surrounding music and augments the festival atmosphere. As part of a four-month interdisciplinary option studio, sixteen students majoring in architecture, industrial design and interior design developed and fabricated the 3-by-6-meter pavilion, visually engaging the crowd and providing shade, seating and a sensory experience that blends design, music, light and color. Documentation, discussion, and communication are the only demands the design makes upon its users.

The 80/35 Festival includes a stage for national touring bands and several smaller stages featuring regional and local supporting acts. In addition to music, there are booths for local organizations, interactive art, food and beverage sales, and resting places. The festival brings an estimated attendance of approximately 30,000 people annually since 2008. A combination of free and paid stages, as well as collaboration with local businesses, nonprofits, and

other community builders makes the event a source of great value for central Iowa's economy and culture. The festival has a national and international presence through its active social media circulation and external media coverage.

The festival provided an ideal site for collaboration and an experimental design project. Made from panelized plywood constructed into modular boxes and enclosed with flash spun high-density polyethylene (Tyvek) membrane, the pavilion utilizes scripting and coding platforms to coordinate 6,500 unique CNC routed parts for hand assembly. Light emitting diode (LED) strips installed within the modules are programmed by microcontrollers set to respond to the sounds of the festival. Each module is geometrically unique, but represents a unified tectonic idea. The module serves as both a structural unit and a light pixel, embodying both an architectural idea and a digital interactive response.

The project was constructed in the Iowa State University studios, deconstructed, and reassembled on site for the two-day music festival. However, the project existed both as the catalyst for social media and communication and its impact extended by these modes. After the festival, the pavilion was disassembled and selected modules are to be distributed to local high-school students along with microprocessors, thereby transferring the knowledge embedded in this project to a larger audience.

If architectural formalism can be easily dismissed for its fetishized authorship, architectural activism often falls victim to the same temptation, even if the intentions are political rather than formal (Culpers, 2014). The project presented here does not escape this

critique. It does not aim to solve a problem or provide a solution but rather presents architecture as an interface between digital and physical systems. The studio funded by an architecture firm and without a program driven of necessity produces public engagement through placement in the public realm and wide circulation through social media.

CONCLUSION

Digital worlds should not be seen as alternatives or substitutes for the built world, but rather as an additional dimension which allows architects a new freedom of movement in the physical world. In other words, the transcendence of physicality in the digital world allows architects to extend their agency in the physical world (Carpo, 2012). The theoretical framework presented here takes the tools of the parametric (computation) and harnesses them as methods of construction rather than image making. By combining computation and construction, architecture materializes the digital and functions as both a participatory and social medium, rejecting autonomy and seeking public engagement. ▥

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