Digital Craft

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As we ponder the present and future of the field of architecture, it might be helpful to look at the history of design. Different versions of many of the debates currently played out in the design media, in academic conferences and in our classrooms were rehearsed at the advent of the industrial revolution and revisiting them may shed light on our present predicaments.

As early as 1797, Goethe deliberated the relative merits of hand-made vs. machine-made production. In his essay "Art and Handicraft" he argued with artistic contempt against the value of mechanically produced objects, which he found less "pure," not as "sensitive" or as "true" as their counterparts made by hand. It is fair to say that this debate and its moralistic undertones dominated much of the design theory of the nineteenth century. As technological advances and economic changes fundamentally transformed material production, despite their ideological differences, Pugin, Ruskin, Henry Cole, Richard Redgrave, Gotfried Semper, and William Morris among others, spent their time lamenting that machines had usurped the craftsman's control over the form of the product. They believed that the effect of industrialization had been to change creative practice by separating responsibility for the appearance of a product (design) from the task of fabricating it, with the consequence that the quality of design had deteriorated.

While this is partly true—design as a profession was born out of industrial production's need to separate tasks[1]—what these nineteenth century critics failed to see is that in fact most goods at the time were not made by machines, but by repetitive cheap labor. A close look at nineteenth century practices exposes that the crucial factor in ascertaining quality is the relationship of labor to capital. By failing to understand the actual means of production around them and by misplacing their critique, these theorists were unable to productively advance their practices, which included by and large, architecture.[2]

Today we see traces of these nineteenth century arguments about technology and their latent anxieties in discussions regarding current formal sophistication enabled by parametric modeling and the potential to materialize these forms by digital fabrication. There are many that misunderstand the techniques that are now available at our disposal as merely automatic—somehow removing the "hand" of the architect (or rather her/his head) from the act of creation, as if software may automatically design.[3] This critique runs the risk of over-simplification as the reality of digital production is more complex and increasingly more sophisticated.

It is true that complexity of form in many cases may mask the lack of ideas in a student's school project, but I would venture to say that it does

so no more than shades and shadows did for the students of my generation.[4] The reality is that software, like pencils and parallel rulers, are tools that enable the creation and development of ideas through form. There is a difference between what we can do digitally versus what we can do through pencil and paper. Thus while the output will differ, the presence of the author in the final outcome is, at the end, no different. Parametric modeling and scripting, for example, are often named as the usual suspects in the automatization of design. In actuality, parametric modeling software depends on the user designing form and then crafting the

parameters for its variations. Script, by definition is a computer programming language that allows control over software by the end user (the designer). They are both tools, whose intent is precisely to give us more control over the design.

Potentially more troublesome is how in parallel to these misconceptions, the relative merits of technological advances in design and fabrication are currently cast in opposition to social concerns and environmental stewardship. For many, geometric complexity, mathematical precision, capacity to produce variations, in

short: our ability to design very sophisticated forms, has gotten in the way of doing the right thing.

I would agree that architecture has been for too long focused exclusively on advancing certain disciplinary problems—I have written in the past about the conundrum of specialization for design and other disciplines.[5] However, by constructing digital technology and its corollary disciplinary advances in opposition to our engagement with the world, one precludes the possibility that form may play a vital role in the solutions to our more pressing problems.

In this sense, the debates of the nineteenth century might serve as a good lesson. While architects such as Pugin and Ruskin were arguing about styles in relationship to "good" craft, a whole building industry was being invented around them. It is in the nineteenth century that standardization of materials across large geographic areas came into being, forever transforming the way buildings are produced. The consistency of dimensional lumber or "modern" brick sizes and their implications for construction are very much part of the reality of building today. These new techniques were developed with-

out the critical input of those outside the building industry, propelled almost exclusively by economic forces, with unexpected societal and environmental consequences. The efficiency of dimensional lumber and its ease of assembly, enabled by the wide spread use of balloon framing, for example, resulted in the boom of the lumber industry, but its unexpected side effect was that two-thirds of the net loss of forests in the United States occurred between 1850 and 1900.[6] Formal concerns played no role in this history. Thus, I cannot help but wonder that if form had been reconsidered in relationship to means of production, different criteria for efficiency might have emerged with dramatically different results.

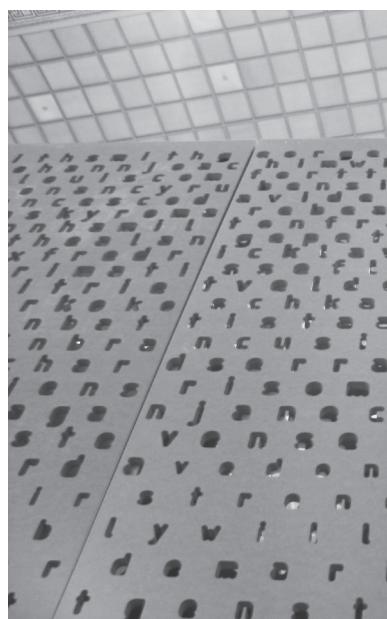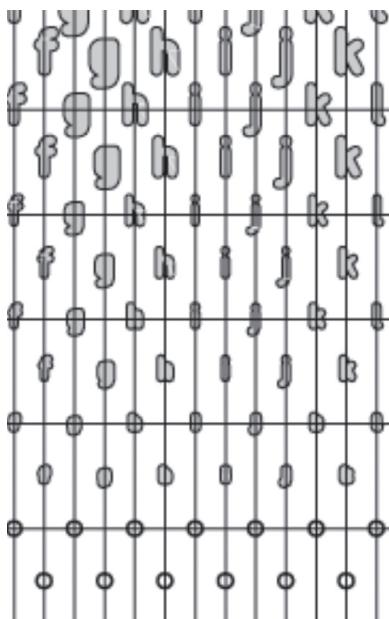Today we find ourselves at a similar crossroads. The digital revolution that has radically transformed how we acquire goods, communicate and socialize, also has had a tremendous impact in the way that we design and construct buildings.[7] However, the consequences of these techniques have not yet been exhausted. There is a potential for design to radically impact the building industry and thus the material world around us. While I am one that argues that architecture, at the end, is not the most effective tool for changing the world (not like political action and/or legislation), I do think that built form does have transformative potential. And I would argue that recent disciplinary advances will become precisely the platform that will enable such transformations.

While in the nineteenth century, industrialization tendered the prom- ise of mass production, today the combination of computer aided design software and digital fabrication offers us the potential for mass customization. This has powerful consequences. Among others, formal variation opens up the possibility of engaging multiple publics. New technology enables permutations within a single project without added cost, possibility of allowing us to design for many instead of for the average few. Similarly, geometric complexity facilitates responses to multifaceted programs that might require compound solutions. The formal precision now possible with digital tools permits us to advance mathematical topics, which have historically been at the core of our discipline, and concurrently re-examine traditional notions of efficiency through a broader lens (material, structural, fabricational, economical, cultural efficiencies). Equally important, the new technologies can afford a level of detail and craftsmanship that throughout the twentieth century was out of reach for most.

Technique, and its corollary technology, has always been related to architecture. The influence of technology on the discipline is undisputable, but need not be its only raison d'être. As technological advances change the production of architecture, new forms of practice are bound to arise that will impact notions of cultural engagement and cultural representation. Think of the transformation already afforded by rapid prototyping and the possibility of modeling more design versions than ever before, not only for our own evaluation but also giving our clients more choices and

greater engagement in the design process (Morphosis has mastered this mode of practice). In addition, by creating a direct link between the architect's means of production (drawing—in this case computer aided design) and the builder's means of production (digital fabrication) the traditional divide between design and making that has marked the profession from its inception may be eroded and brought into question, thereby appropriating craft for the discipline of architecture.

Additional Text about the RISD Library:

To illustrate these points I have included an example from my own practice. I do not mean to imply that we are the only ones exploring these issues. There are plenty of practitioners and academics researching similar techniques. I use an example from my own practice to put my money where my mouth is so to speak.

Located in a 1920s former banking hall in Providence Rhode Island, the project posed numerous challenges and opportunities that were addressed through engagement with new design and fabrication techniques. The project had a low budget, a compressed construction schedule and limited site access, in addition to the sensitivity of intervening in a space on the National Register of Historic Places.

In this project, digital technology allowed us to explore in depth the possibility that mass customization might enable the application

of principles of Universal Design at a public scale. Universal Design argues that we should not think of people in two categories (able and disable) but instead we should design for people with various ranges of abilities. To that end, instead of designing for the average person (as per graphic standards), at RISD, all components of the study areas (tables, seats, shelves) are dimensionally different (heights, widths, depths) allowing us to accommodate people of all sizes and abilities, as well as providing flexibility in occupation. These variations are today technically possible and affordable because the digitally guided router does not care what shape it is cutting. Instead repetition in assembly (what is done by hand)

was the key to the affordability of the project. The two largest elements of the intervention (the pavilions) were broken into pre-assembled modules that were bolted together on site. We explored an alternative delivery model whereby conventional shop drawings were eliminated. The pavilions were designed in three-dimensions. Each component was then taken from the 3D model, labeled for ease of assembly, and organized into 2D files that the fabricator could use for production. These flattened components were nested in the most materially efficient manner. The fabricator then reviewed both our 3D and 2D files, looking for conflicts and discrepancies thereby retaining the liability. The files were then used for

fabrication, thereby eliminating the distance between the designer and the means of production. In turn, the millwork package was drawn as a guide for assembly. This balance between offsite-prefabrication and ease of on site assembly allowed the project to be delivered on time and within a low budget. In turn, the method of assembly enables the project's possible future disassembly a strategy that anticipates that the use of this former banking hall might in the future change once again.

Notes

1. The issues around the nature of design as a practice are of course very different for architects. In architecture, this separation between design and fabrication is at the inception of the discipline. Architecture was born out of the distance between those who delineated (drew) a building, and those who actually erected it.

2. It is important to note that most of the theorists mentioned also set out practices alternative to the trends of the time where they sought to demonstrate their points of view.

3. See Tim Love's essay "Between mission statement and parametric modeling" at DesignObserver.com, November 5, 2009. He argues, among other issues, that current technology has removed design from the architects' responsibility and it is "rather controlled indirectly by the design of software that controls inputted information."

4. In Venezuela (where I am from) to render drawings is known as envenenar (to poison) and this term is used to describe the technique of making drawings seductive in the hopes your teacher may not notice how bad a project is.

5. It is important to point out that focusing on disciplinary problems is also precisely what has allowed us to advance the field in ways previously unimaginable.

6. Building alone is not responsible for this dramatic depletion of resources. Growth of the boat building and the furniture industries also had an impact in the consumption of wood during this period.

7. The impact of digital technology is wider than we realize. Who could have foreseen that all classical moldings today would be Computer Numerically Control (CNC) milled.

The Fleet Library of the RISD Library, Project Credits

Office dA: Monica Ponce de Leon, Nader Tehrani, lead designer; Daniel Gallagher, project architect; Arthur Chang, senior designer; Kurt Evans, Lisa Huang, Anna Goodman, Ghazal Abassy, Sean Baccei, design team. General Contractor: Shawmut Design and Construction, Matt Dempsey, Project Manager.Structural Engineers: Simpson Gumpertz & Heger Inc., Matthew H. Johnson, P.E., Senior Project Manager. Mechanical/HVAC: Harry Grodsky & Co., Inc. Electrical: Dykeman Electrical.