Digital Haptic –
Learning from K-Zell.

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This paper describes a fabrication-centric studio as one example of the combination of digital and analogue design practice. It suggests that this combination, when applied to the constraints of a finite project, overcomes “mutual exclusivity” in favor of mutual dependence. It posits this scenario as a pedagogical model for upper division undergraduate learning.

While the tradition of full-scale fabrication studios has for a longtime been a unique and important part of architecture schools\textsuperscript{i} this studio has received renewed impetus from the advent of digital design. Today the haptic learning we associate with material experience appears to have been reinvigorated by technical mastery of computational fabrication.

In this studio however the key aspects of student’s learning were based on a critique of existing methods of computational design. This is seen in the light of the 2007 Boyer Report\textsuperscript{ii} findings on the perceived need for greater understanding of the role of computers in practice. It suggests that both Sketch-Up and Rhino’s model kernels currently lead to formally prescriptive architectural solutions and that the consequent tropes of form associated with each program presents a damaging acquiescence by students and practitioners alike and prevent active learning.
Student learning - Digital Critique

From the outset this studio aimed to generate a critique of the current trend in digital design. The papers conjectures that you can currently distinguish a Rhino and Sketch-Up design project in that they both have distinct formal signifiers. This critique is also formal. It explores the process of “draping” as a critical methodology in both analogue and digital states that occurs in three ways:

- As a physically draped form as an analogue surface
- As a surface that is generated from a drape that offers a means to challenge the typically curvilinear forms of Rhinos NURBS modeling.
- As a conceptual smothering of the reductivists language implied in Sketch-Up’s predominantly linear and planar modeling tools.

The method is used to raise the periodic discussion about the manner in which drawing techniques are embedded within the architecture of the period i.e. in the way that architecture can be understood as a product of the drawing method of the time. Each development of drawing styles or, more particularly, their means carries with them a resonance in built form. Furthermore it is an assumption that only by actively criticizing those available means do we arrive at architectural solutions of value and that do not succumb to the prevalent managerial solutions of the time.

Together these methods are motivated by an observation that digital procedures always perform some kind of “dematerialization” of the object. Similar to Roland Barthes observation on the dematerialized nature of modern materials like plastic the final outcome of digitally fabricated work adopts a similar desensitization. It suggests that work produce via the computer is imbued with a sense of its “infinite transformation” and “ubiquity made visible” and that these qualities are part of computational design and should be used proactively rather than as a consequence of contemporary means.

Requirement of signification

This critique of computational design took the form of student’s learning from conventional forms wherein they were asked to question the role of archetypal forms in architecture.

This method is played out in the design and production of a project for an entrance sequence to a steel fabrication (K-Zell) plant in Phoenix AZ completed in spring of 2010.

![Figure 01 Papier-Mache drape over an existing couch and schematic image of entrance elements based on archetypes.](image)

The theoretical propositions of the paper result from a reflection of the conditions that were imposed by the client. While at one level they had very distinct practical concerns the larger issue centered on how the company projected its workings to the public. Our client was ultimately concern that the processes of steel working he deployed grew from traditions as well as highly
contemporary methods. With this in mind we began by discussing the uses of the space in terms of objects that might typify them. We felt that actions could be conveyed through recognizable archetypes. That these archetypes carried a sense of familiarity began to communicate the client’s requirement to express the ongoing nature of steel fabrication (as opposed to a complete break from the past). At regular intervals he would remind us that computational methods stem from manual traditions i.e. the computational emerges from the analogue. Eventually we settled on four archetypical objects that summed up the program.vii

- Couch  (customer waiting)
- Bar   (leaning and talking after meetings)
- Plant Pots (horticulture)
- Ornate Gates (security)

However while these objects provided satisfactory assurances against abstraction the client also wanted to deploy them using the most advanced methods of production i.e. laser cutting, milling and NC bending. Therefore we sought a method by which signification could be retained and one which would prevent the fabrication methods and modeling tools taking over i.e. develop a conscious mis-use of common procedures. Or aim was to retain a sense of ambiguity between these extremes.

Proto-Digital – Physical drape.

In the early stages of the design process we developed a method of processing and assessing these forms by making an analogue version of a NURBs surface. While the team had some inclination to use Rhino from the beginning doing this meant the archetypal form lost its familiarity largely because of the NURBS modeling method. To overcome this we began working in a manner that would physically simulate the Rhino modeling method but would allow us to control the level of abstraction incrementally (settling on Venturi’s aphorism to describe Arc International Bureaus being abstract but not abstracted). By gradually building up a surface in papier-mâché we could make periodic judgments about the presence of the original form (and signification). While each layer of the paper gradually transferred the couch into a continuous surface that allowed us to judge by how close to the point of recognition we could go. Once the final form was removed from the original couch it became clear that the surface was a quasi-rhino surface that simulated the “drape” command. In this way the draping action could be explained in one form (analogue) and translated into another (digital) with assurances about retaining signification.

Sketch-Down.

However working back in Rhino we found that it was more difficult to simulate the archetypical quality of the object that was being draped and that any attempt to redraw the actual couch in Rhino was again subject to the NURBS-like shape and the commonality would be lost. This issue was resolved by using Sketch-up in the most deliberate manner possible and by digging out the most rudimentary Sketch-Up models available in the google warehouse. This warehouse provided an abundant supply of low quality 3D models that, by virtue of their simplicity, provided the kind of rudimentary signification of archetypical object. Sofas plant pots etc. could all be judged not by their digital sophistication but instead by their lack of it. In some cases we started using design classics and although they produced good results they were ultimately rejected because it was felt that their signification lay too close to professional circles and where not widely common. In short they were classic rather that archetypical.viii
Once the Sketch-Up models had been imported they then became subjected to a kind of re-engineering through the drape tool. Here the process was to choose the best plane from which project a mesh and the best mesh gauge based on security requirements and structural capabilities. At this stage the project was becoming mesh furniture. After reviewing the results we decided that the outcome did successfully represent the couch but that this also cut it adrift from any potential re-associations with the fence. The discussion turned to the project with the bars of the existing entrance became central to the mesh discussion i.e. could the gridded mesh adopt the functional language of utilitarian security fence? To do this required a second move within Rhino wherein the draped mesh was then treated to a similar digital manipulation. Two walls (the third being the projection gates projection wall) of the project were composed of draped and parallel-sectioned couch, plant pots, and bar.

Student concept statement. -“The approach to the K Zell warehouse entrance focused on the emphasis of metal and how it can be manipulated. When contemplating the design, an idea arose regarding abstraction. This word can be viewed in two different ways. Either it is “abstract” meaning vague, and not clear as to its purpose or “abstracted” as a version of the subject but slightly altered. The K- Zell entrance offered an opportunity to test these two ideas. Ultimately, the idea of the “abstracted” became the most intriguing. We investigated ways to portray this idea in two ways. One was the notion of metaphorically draping metal pipe over a sofa to provide outdoor seating, while giving the space a designed quality. The other by creating a folding gate that could give a modern version to a classical art of ironwork. This concept would take an image of wrought iron work and instead of using the standard traditional
means, it would use a modern technology to laser cut the image. This would give the illusion that the ironwork was present but instead of being made of iron, it would be the pixilation of the original image laser cut onto sheet metal. Both the sheet metal and metal pipes are a primary focus of K-Zell’s production, and offer an opportunity to showcase their potential and talent in metal work.”

Fabrication and NC bending

The final phase of this project involved translating the profiles into a bending schedule that could be read by the companies NC push bender. The bending schedule was developed using several different software packages in an attempt to create less postproduction work. The Rhino/Grasshopper model required converting the NURBS profiles into CNC code friendly drawing in that they had to reduce their curvature down to a C1 polyline. Then for a smoother fabrication each polyline was filleted at the corners with a 3” radius fillet that matched the available bending dye and that satisfied the minimum bend radius for the section of tube we were using i.e. bend radius is 6 times the (1/2”) tube radius. The Rhino/Grasshopper model could then interrogated for bending schedule by streaming the content of different parts of the expression to excel. As each tube is made up 15-17 bends this meant we were able to batch process key information (bend angle and the coordinates of the curve center) to the CNC benders bench computer.

Conclusion

This paper offers an overview of a fabrication based studio (ASU – SALA ADE 422 Integral Studio) and describes the process and involvement of key learning phases. This studio, akin to the design build studio, is rooted in digital design and based on practice-like constraints though collaboration with local fabrication companies and paying clients. In short the parameters of this course are that the “digital” is constrained by material affordances that in turn are constrained by the clients requirements. It charts the conceptual standpoint of the design via both analogue and digital forms of “draping”.

This process then lead to practical understanding of the forming process and how to establish protocols for information exchange especially “file to factory” procedure, batch processing of bending schedules and cutting patterns along with the use of Grasshopper in automating this procedure. This was followed by student’s direct experience of fabrication procedures in
terms of their professional involvement in shop drawings and visits to the fabrication plant and site. This experience allowed them to assess the potential of greater complexity against time saving through parametric design. In this respect student could gauge the amount of time both they and the machine operators needed and where this could be reduced.

In addition to this the project demonstrates a new pedagogical model of instructor-lead studios. Here the role of the instructor is altered from traditional design build studios in terms of facilitating collaborative networks, scheduling and design.

In this respect the students experienced a critical approach to computational design. Here “draping” was used as both a physical and digital procedure to provide incremental reduction in signification to the point at which likenesses have almost disappeared (this effect could be compared to trying to recognize a toy car by the vac-formed plastic box) i.e. to reduce tangible meaning to make the object more compelling - a process of reduction as a strategy for criticizing formalism. In this project we have suggested that this technique can be explored by coupling Rhino modeling methods in an unlikely treatment of basic Sketch-Up models. This process stands in opposition to the complete de-signification that appears to be the first compulsion on working with Rhino lofts and NURBS surface control point editing (often described in terms of paradigm shifts in architectural production) wherein any formal associations that tie the model to a tangible counterpart have been irrecoverably and enthusiastically rejected. In this realm the notion of quasi-Darwinian procedure (“adapt or survive”) finds its deceptive counterpart in an architecture of organic or quasi-naturalistic form. As a counterpoint to this trend we suggest that a return to signification can be afforded by considering an attendant archetype via a digital process that ends up returning the original in a dematerialized condition. Here the couch remade of NC bent pipes is experienced as both legible and illusive while its final form is imbued with the digital procedures that brought it into being.
This may be considered as the legacy of the Morrill Land-Grant Colleges Act i.e. to “promote the liberal and practical education of the industrial classes in the several pursuits and professions in life”. See http://www.law.cornell.edu/uscode/7/304.html

2007 Practice Analysis of Architecture. NCARB


David Greene - Book of provisional Information

Lucy Lippard – Six Years – The dematerialisation of the art object


Our use of archetypes here is intended to convey an overt familiarity to the final project. In this respect the project is influenced by the term “reality effect” coined by Roland Barthes and used to denote the descriptive style of Gustave Flaubert’s Madame Bovary.

Stacking Hommage is Dirk Winkel’s redesign of The Barcelona Chair, The Eames Lounge Chair and Le Corbusier’s LC2 as low-price stackable plastic chair. Hope the fresh graduation work of this German designer will find its way to production soon and start replacing ‘those white plastic chairs’. http://www.dirkwinkel.com/

The project refers to chairs by Harry Bertioa, and Shiro Kuramata (Begin the Beguine) – 1000 Chairs by Charlotte and Peter Fiell. Taschen

There are many examples of this perhaps the most accessible would be Chistos series of wrapped national monuments bridges etc. In design this finds outlet in the work of Gaetano Pesce. Golgotha Chair. 1972.

Thom Mayne TED lecture 2009.