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Architectural Education in the Age of Digitization

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1 Introduction

At many schools of architecture, we are exploring digital visualization and production as design tools. Of primary concern is the natural inclination of these tools to create barriers between design thinking and design consequences. Regardless of whether the format is digital or analog, we seek a way of working with media that offers maximum transparency during the typical design cycle of speculation, output, testing and revision.

2 Design process and digital output: problems we've discovered

2.1 *Untruth in materials and structure*

Digital output can foster a disconnect between design and reality. Trusses made by laser cutting may be impressively precise, but are essentially two-dimensional elements cut out of a monolithic material. Lost is the knowledge gained by joining a series of small pieces and experiencing how unstable pieces can be triangulated into a rigid whole. The laser cut truss is accurate in silhouette but completely antithetical to the material reality of an actual truss.

Small scale physical models often act in similar structural ways to their full scale counterparts. Press your finger on a model with insufficient lateral bracing and it will rack. A milled foam model will rarely deflect before failure, loads will be distributed throughout the monolithic object. Heated, steamed and formed - a wooden model can only be coaxed into a radius allowed by the limits of the material's grain. Curves in digital models have no limits at all and digitally fabricated models are limited only by the cutting of the router or sweep of the computer controlled laser.

2.2 *Scalelessness*

Digital visualization suffers from a lack of scale and digital output can often compound the original problem. Not only is scale hard to visualize in an environment of continuous zoom, the material used for most digital output has little or no grain or texture to judge relative scale.

Models made with laser cutting are seductively delicate and precise - having the appeal of miniature doll-houses. Like doll houses, it is often difficult to imagine the model as a representation of full-scale space. Digitally fabricated models are often most easily read as ends in themselves, remaining as objects rather than evoking alternative readings.

2.3 Perfection

Digitally generated output are perfect. Smooth surfaces, mechanically regulated textures and improbably precise forms are instantly recognizable as machine made. This very perfection can be impenetrable. The act of altering a CAD-CAM produced piece seems like a violation, it resists modification by a human hand. The gravitas of such a complete object works well for finished products, but actually hampers its effectiveness as a study tool in a design process.

This phenomenon is well known to the software designers who give the architect the option of outputting drawings with wavy lines that simulate hand drawings - a deception that gives the designer and client the feeling that the design process is still fluid and has not crystallized into final form.

3 Design process and digital output: opportunities not yet explored

The current fascination with the formal possibilities of digital design and fabrication are unsatisfying. Increasingly, digital design seems to be drifting into personal visions of space away from rigorous exploration of universal principles. Compositional motives can drive a certain amount of geometric rigor and a pleasing mathematical logic, but we are left yearning for something more substantial.

3.1 Reconnecting with direct experience

Creating a large scale drawing engages the body, hand and eye in a different - and arguably superior - way than sketching in a handheld notebook. Drawing with a mouse or digitizer within the confines of a computer display is comparably limited. At Minnesota, Lee Anderson has developed an immersive environment where creating a form can be conceived at a one-to-one scale accomplished by gestures that engage the whole body. We are just at the beginning of studying the effects of this tool on the design process, but we speculate that it has the potential to make digital media more responsive to the design and visualization process. We are looking forward to “closing the loop” by transmitting the digital results directly to fabrication at a variety of scales.

3.2 Boundaries

Anni Albers, writing in an era where digital media was not even imagined, poignantly identifies the value of boundaries that the digital design process desperately needs:

The inherent laws of materials...introduce the boundaries for a task of free

imagination. This very freedom can be so bewildering to the searching person that it may lead to resignation if he is faced with the immense welter of possibilities; but within set limits the imagination can find something to hold to. There still remains a fullness of choice but one not as overwhelming as that offered by unlimited opportunities. These boundaries may be conceived as the skeleton of a structure.(Albers 1937)

Loads, connections, enclosure, energy performance, acoustics and light are elusive as design determinants but could be powerful generators of form. Structural efficiencies, material limits, limits of the fabrication processes should be embraced as necessary boundaries.

3.3 Systems

Digital manufacturing is ideally suited to the production of repetitive or regularly varied forms. Variations might be regulated by the ephemeral factors listed above. Refer for example, to *Drift House* by Sleeve Design highlighted in the ACADIA poster session 2004, where complex programmatic needs are legible in a gradient of surface changes that allow differing amounts of noise, light, air or visual connection.

4 Conclusions

Digital visualization and output have enormous untapped potential in design education. There are obvious time and money constraints that architectural educators must work within, but the more serious obstacles arise in the inherent weakness of the media to foster connections between design process and physical reality. The opacity of digital manipulation and its sometimes deceptive nature must be compensated for by clear design pedagogy. This pedagogy must invent ways to introduce productive parameters that can provide traction in a slippery digital world.

References

Lee Anderson and his Digital Design Consortium (a collaboration between computer scientists and architects at the University of Minnesota) have developed an immersive environment and design tools described in “A Virtual Environment for Conceptual Design in Architecture” ACM International Conference Proceedings Series, pdf can be found at <<http://portal.acm.org/citation.cfm?id=769960>>

Albers, Anni (1937) “Work with Material”, *Bulletin 5*, Black Mountain College

Swackhamer, Marc (2004) *Drift House*, ACSA Northeast Regional Proceedings