Finding Value in Material Investigations and Innovations

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Introduction

When the development of building projects survive in economic downturns, architects typically have to contend with a client’s unwillingness to spend on “excessive” design. If architects submit to these limitations producing buildings that are merely efficient, it compounds the problem of diminishing the cultural contribution of architecture. An architect unwilling to generate mediocre design must invest more effort in finding ways to be innovative within strict parameters. Phenomenological theory has brought to our attention the ways that occupants engage buildings through visual and tactile experiences and valorized material presences within the built environment. To avoid marginalization in the physical manifestation of their design, architects must intimately understand material behaviors, processes and possibilities so that they have substantial influence on the construction process and make intelligent design decisions that permit both innovation and efficiency.

Practice Context

What lessons can we extract from professional practices that conduct a kind of materials research through their projects? Can these help to inform pedagogical objectives on material thinking in architectural design education? Can this cross-fertilization develop creative processes that become beneficial in future practice? Numerous architectural practices (Williams + Tsien, Herzog & de Meuron, Office dA) foreground issues of materiality and create testing grounds to engage material exploration whether in the context of full-scale mock-ups or in the context of project commissions. Many of these practitioners are themselves design educators who find ways for the academy to infiltrate in their practice. Each commission is approached as a research project. However, often time and budget constraints require that research be done quickly and efficiently. The period of architectural education is an ideal time to nurture the skills that create a foundation for such empirical research.

Academic Context

Models for directly engaging students in materiality and assembly exist in various forms. Design/Build programs such as Rural Studio and the Howard S. Wright Neighborhood Design/Build Studio at the University of Washington provide students an opportunity to spend a year working hands-on on full-scale building projects. Rural Studio is a well-established and well-funded program that functions as independent entity within Auburn University’s Architecture School. Another alternative is students independently engaging the design of small objects at full scale to deal with material issues at a manageable size. Currently the most prevalent method of material investigations by students is group projects focused on the design and assembly of full-scale installations. In the spirit of minimalist sculpture, can material engagement be practiced as an essential set of skills required to work through material understandings and assemblies? Would the development of these skills be beneficial in the realm of professional practice?

In design education, the degree to which a typical design student engages materials research in studio varies. In our curriculum at the University of Florida, materials and processes are often remote horizons in a student’s design studio work. During the design process, drawings and models are produced at manageable scales and conceptual ideas on building materials rely on simulated materials. How could one fold in the lessons of material engagement into architecture education if a hands-on design-build program is not an option due to prohibitive issues of timing, logistics and cost? In a workshop seminar focusing on material investigations, we explored the question of whether there is value in a student’s direct physical engagement with building materials and whether a course on materiality in a workshop format is sustainable. A series of pedagogical goals were developed which focused on experimentation and failure. The premise of the workshop was testing the limitations and possibilities of selected materials and using empirical feedback to consequently uncover new
and possibly innovative ways to work with these materials.

This paper investigates the reciprocity between material thinking in practice and the academy. It reflects on pedagogical objectives and findings in an attempt to fold material thinking into creative process and future practice.

Cultivating Material Thinking: Learning from Practice

The professional practice of architecture design does not exist only in the built realm. It is common for most architects to have a large percentage of projects that remain speculative and never materialize which parallels the typical academic design studio experience. Even in practice, the architectural design process straddles between theoretical proposition and physical manifestation. Because of the unpredictable nature of project commissions, it is easy to conceive of an architecture practice where every project is a testing ground and research opportunity.

Before teaching at University of Florida, I worked for nine years at Office dA in Boston where both firm principals were deeply engaged in their practice but also in their academic responsibilities. Within the office, there was no boundary between academy and practice. Each project was approached as a speculative investigation as expected in the academic studio setting. Each project was an opportunity to challenge our creative thinking and design processes. Materiality was an issue that emerged in the forefront of every project and often informed spatial and formal design decisions. Time and budget allowances for experimentation was not always built into the project, so consequently we had to find ways to sneak in opportunities to test materials in half-scale or full-scale mock-ups. We spent countless hours talking to fabricators and manufacturers to understand the parameters when working with a material. If we could not test it on our own, we convinced fabricators to test samples for us.

The most challenging aspect was negotiating with contractors in the U.S. to build details that were construed as 'too complex' because they deviated from conventional construction methods. It was critical to prove that you intimately understood the implications of these design details in order to avoid a 'simplification' or elimination of your design efforts. For several projects, Northeastern Multi-faith Spiritual center and Mantra restaurant, contractors were convinced that certain design elements were impossible to build. As a response to demonstrate the contrary, Office dA took on the responsibility for construction and design team members built these design elements without any difficulty. This stresses the importance of thinking through the assembly and the physical manifestation of a design proposal and understanding how to work within material conventions and parameters.

Advancements in and the prevalence of digital fabrication tools in the construction industry have increased the possibilities for inventiveness in design and provided ease in construction methods. New technologies still require a designer to contemplate the interface between materiality and the fabrication process. Knowing how to work with the materials and tools in terms of limitations and parameters is essential in creating opportunities for inventiveness.

The critical lessons learned from this professional practice experience were developing the ability to adapt and respond quickly and cultivating the skills to ensure that any innovative design cannot be value-engineered out of a project.

Enhancing the creative process of material thinking is intimately linked with hands-on material engagement, iterative making, and strategic research methodologies. This could be
considered the basis for an architectural designer to develop critical skills that enhance an understanding of how to work with the medium of building materials. The ultimate goal in professional architectural practice is motivated towards constructing physical manifestation of creative design work that is then engaged by human use and occupation. Within the architectural design education, it would seem prudent to work with matter at full-scale and cultivate a material thinking as part of the development of a creative process.

Cross-Fertilization: Attempted Methodology

In the 2012 Fall semester, I conducted a graduate level workshop seminar at the University of Florida that focused on material explorations and was motivated by reflections on practice and its potential contributions to a pedagogical discourse. Each student in the workshop selected a material of his/her choice to research and engage for the semester. The course was not supported with external funding, so considerations of material availability, accessibility and affordability were paramount. The students began by researching material characteristics, fabrication and manufacturing processes, typical applications, specifications and case studies. In the second phase, they physically experimented with the material to develop ways to join two material components together. Very simply, the students were asked to abut or turn a corner with these materials. The inherent qualities of the materials (flexible, brittle, heavy, delicate, directional, etc.), the operational logic and methodology (aggregating, weaving, casting, forming, layering, stacking, etc.) and the characteristic of the joint (exposed, hidden, loose, tight, interlocked, stitched, lapped, etc.) were to be addressed in each attempt. (Fig. 2.) Throughout the semester’s process, students were asked to document their findings and to speculate proposals for their next attempts using various drawing techniques. In the final phase, they designed through drawings and built at full-scale an architectural construct that evolved from their earlier investigations.

Embracing Failure: Pedagogical Objectives and Findings

The approach of the course centered on enhancing creative ways of thinking generated through iterative making and empirical research. Most students in the workshop had limited professional practice experience and had very little construction knowledge. The student projects generated in this course were not expected to be practical as building materials or assemblies. With lessons extracted from practice in mind, a series of pedagogical objectives for the course concentrated on developing skills in thinking, designing, and working with materials:
Figs. 3+4. Experimenting with light transmitting concrete. Drawing and process photos: Timothy Beecken

- Developing investigative skills. At the basic level, they need to be rigorous when searching for information. In the beginning, a number of students’ “research” started and stopped at Wikipedia or the first product they found. It is necessary to understand that products typically had multiple manufacturers with variations in products offered. In professional practice, broadening the range of manufacturers enables more competitive opportunities to find manufacturers and fabricators eager to work in new ways with their product.

- Working hands-on with physical matter. Most of our architectural design students will not pursue opportunities to become master craftsmen, but the experience of casting concrete, constructing a formwork and removing a formwork, even at a small scale, does provide an understanding of timing and procedure within a construction process.

- Creating an assembly. Through drawings and physical constructions, the students worked on methods of joinery as a way to demonstrate the multitude of manners in which two materials can connect together. In their design studio experience, the students were mostly accustomed to physically working at small scales where adhesives are the primary means of making physical connections. During this process, the students discovered that in drawings, they did not need to contend with the physical resistances that accompany working with the actual material (Fig. 5). The awareness of material behaviors and the struggle with material tolerances and alignments are consequential experiences in developing material thinking. Many students were surprised to discover that their physical constructs did not turn out as they had drawn or imagined.

Fig. 5. Proposal to join two materials in an assembly. Drawing: Kevin Fitzgerald

- Understanding the scale of the material itself and the full-scale installation. Initially, students attempted to conserve material and produced constructs that worked against the inherent scale of the material. Students worked on 1:1 scale experiments
and installations to develop an ability to move between large scales and the small scales that are typically exercised in design studio work. Working at a 1:1 scale addressed the issues of testing their installation in space and engaging the viewer. (Fig. 6)

![Fig. 6. Full-scale installation working with plastics and polarized film. Construct: Carolina Valladares](image)

- Training the instinct to execute a procedure that integrates materials into design. In physically working with matter, it consequently informs the ways that they could be utilize in other applications. The more thorough the investigation into a material's behaviors and the processes of working with it, the more focused and precise the research becomes.

- Valuing experimentation and curiosity. The students were encouraged to follow empirical feedback even when not designing anything in particular. The process of iteratively making provided a training ground to allow and recognize when unexpected and interesting results occurred in their tests. In attempts to reproduce or improve upon characteristics, the students were charged with methodically changing slight parameters to observe and compare resulting conditions. The premise centered on knowing through making and learning to quickly respond and readjust.

- Understanding that failure was acceptable and desired in their experiments in order to expose the possibilities and to understand the limitations of the material. Most importantly, the course attempted to foster fearlessness and most students had difficulties adjusting to this mindset. They tended to expect achieving perfection in the first attempt or they tried to figure everything out before even making an attempt. The students had to train themselves to accept that not everything produced would be beautiful, but that each experiment offered learning experiences that could lead them to new possibilities.

Next Time Around: Reflections and Readjustments

The efforts made in developing this course based on my personal experience in professional practice. The development of pedagogical objectives for this course would benefit from a deeper study into how other creative professional practices have integrated materials testing and material thinking in their design process. Many architecture programs have materials libraries available to students, but what does a materials workshop look like in practice and academia?

At an administrative level, this course was offered as a workshop seminar, but ideally, it would operate best as a design studio option. As a workshop, it was demanding in time and effort, so it was difficult for students to juggle both design studio and this course. The seminar format was the only opportunity to pursue this research in our current graduate curriculum, so I'm eager to develop methods to streamline the course as a workshop seminar. The workshop was also only offered to graduate students, but University of Florida also has a vibrant four-year undergraduate design program where undergraduates enroll in eight semesters of design studios. There is the great potential to explore the impact of working with materiality and developing material thinking in early design education. In addition, the experience of this course clarified the challenges working with materials hands-on without any external support.
or funding. Efforts will be made to procure material donations and resources to ease the financial burden for students.

Looking at the course, failures in the workshop course structure resulted in low productivity and a lack of depth in student output. Numerous adjustments could be made to provide more guidance in the process. The intention of the course was to develop skills that can benefit future practice. Projects in practice are rarely produced by individual efforts; there is always a design team working together. Collaborating in groups of two or three students would be more realistic to the way the design field operates. Student would not only benefit from developing collaborative skills, but also increase the amount of effort and expand ideas in the research. In order to encourage interest and fuel energy dedicated to the research, students could chose their materials. The material selection has to be edited to ensure that the research is manageable.

Since this was the maiden voyage for the course, I was not certain how to account for timing and how to manage my expectations. My assumption was that the students would be self-motivated to advance the project, but in actuality, they needed more guidance in seeing the possibilities. A revamped course would require more structure to efficiently utilize time allotted for the workshop. This could be achieved through a series of concentrated and quick assignments that would simplify the issue being investigated while also inherently encourage rigorous efforts in testing.

The students who engaged in this workshop will graduate in a year. Whether the skills in this course make an impact on their professional practice has yet to be seen.