CROSS POLLINATION OF IDEAS

Design fabrication and experimentation

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Abstract. The following pages show a selection of studio projects which explore the opportunistic collaborative process between commercial fabricators, material sponsorships, and the institution. The articles speaks about the intersection of design experimentation and significance of fabrication within the contained process of [design | optimisation | fabrication]. Within this process the article intersects between practice, commercialisation, and design-research, into the development arena of architectural academic outcomes. The demonstrating fact within much of the research and development also touches upon intricate details of modularity, and designing with optimisation in mind for the purpose (and ease) of fabrication, prototyping, and ‘real-life’ production. While the focus of the academic studios deliberates and uses parametric design systems through digital and analogue modelling to contribute to a full scale designed installation, and actively working with a commercial fabricator and material sponsor (Luxx Newhouse & LG Hausys HI-MACS). The aim of the courses were to acquaint students with theoretical and practical conditions needed for the creating of experimental relational modularity between geometry, scale, and materials as well as the ability to negotiate between quick intuitive studies and definitive quantifiable decisions.

Keywords. Design fabrication; material investigation; industry collaboration; architecture; industrial design.

1. Cross-pollination of ideas

Whereas academia used to be considered the breeding ground of ‘new’ ideas and innovation within the architectural practice – having the allure as an
incubator of innovation with access to fast processes of tools and techniques and a think-tank mentality – the developmental nature and spotlight of the practice has now shifted itself from academia back to practice. Within the past few years, students and industry has combined forces to nurture developmental research within the processes of physical prototyping and fabrication methods, or have transferred their focus to seek research based collaborations with commercial (sometimes even corporate) and small design-research studios for inspiration. By seeking assistance from practicing and specialised practitioners of the field – most beneficially with industries outside architecture, like industrial design – architectural education could further prepare students to situate and incubate their research as a breeding ground for alternative methods of making and digital crafting for the built environment.

Academic collaborations with practice are nothing new. Think-Tanks and NGO groups have worked with many well-known institutions such as the Harvard Business School, Columbia Business School, and the Woodrow Wilson School of Public and International Affairs at Princeton University, just to name a few. Industrial design brands and automobile companies have also, for many years, established opportunities of incorporating research and development studios within the academic setting in Europe. A delicious example between the intersection of academia and practice is the RPI (Rensselaer Polytechnic Institute) and SOM (Skidmore Owings and Merrill) alliance. Established in 2008, RPI and SOM brings together the interest between academia and professional practice giving birth to CASE “CASE Center for Architecture Science and Ecology” (2011). In this particular instance, the joint venture between the School and the Practice (RPI + SOM = CASE) becomes a mutual benefiting collaboration of ideas and learning experiences.

Since 2009, the Massachusetts Institute of Technology (MIT), working under the name of Massachusetts Institute of Technology Energy Initiative
“Massachusetts Institute of Technology Energy Initiative” (2011), has issued a joint venture between *Masdar Institute* (a tri-fold initiative between industry, government and academia) “Masdar Institute” (2011), which researches closer within the means of the sciences and engineering of integrated sustainable development and energy technologies. Yet, whether due to financial or feasibility issues, other than the research and development on alternative and renewable energy technologies and solutions, the probability and the larger intention of cross-pollination between the academic and the construction practice still needs to come out of the woodwork.

Recently, in collaboration with Luxx Newhouse Group and LG Hausys HI-MACS, and a group of six students participated a summer studio lead by the author and co-instructor Prof. Marc Aurel Schnabel. The summer studio aimed to acquaint students with theoretical and practical conditions needed for the creating of experimental relational modularity between geometry and materials as well as the understanding of scale within architecture. The study and work was a hybrid crossover between architecture and art, with a high concentration on the developmental nature of experimentation and detail. The two projects process emphasised the analogue as much as the digital, along with a methodological design approach, between context and technique that is implicit in the process of design and integration of site.

![Figure 2. CURVAR Modular Prototype A, Individual Modulars – Variable Modulars, Image provided by Michelle Lok, Marco Chan, and Ivan Cheung.](image)

The students were asked to develop investigative design methodologies with potential prototyping capabilities working together as two teams, one team investigated the potential outcomes of an internal application of modularity within an interior condition and the other team concentrated on a design process considering an urban external condition designing a piece for exterior application. The production of the piece went through multiple iterations, while the students had the opportunity to work directly with the technicians within the factory and fabrication facilities, to learn the importance of pro-
duction and fabrication in the real-world environment. The final piece is still under construction and is slated to be exhibited in Shanghai, Singapore, and Hong Kong Shenzhen (HKSZ) Biennale.

The focus of the studio investigated the use of parametric design systems through digital and analogue modelling to contribute to a one-to-one scaled prototype for a larger built system. For the students, the difficulty of utilising the computer as an active part of a design process is to interject the ability to negotiate between quick intuitive studies and definitive quantifiable decisions. The interpretive model is the design space within the workflow where ideas can remain separate and abstract. As relationships between the parts in your design coalesce, a new type of workspace is formed which deals primarily with associations of the parts and their interdependent relationship with the whole.
Meanwhile, the studio also used the facilities of a fabrication lab within the school (smaller tooling – i.e.: vacuum forming and laser-cutter) and commercial (larger machines – i.e.: silicon thermo-former flat-press and 6-axis CNC mill) context, which allowed the research to be evolved from the abstract speculation into very specific production experiments and project. The student teams were responsible for choosing one method of design and investigating different types of installation and material/fabrication methodologies. The greatest challenge within the studio was to determine different assembly strategies, structural systems, and aesthetic effects, through the use of a significant amount of physical experimentation.

![Image](image.png)

*Figure 6. CURVAR Modular Vacuum Forming Process / Prototypes A (Transparent PVC) / Prototype B (Opaque PVC).*

With the institute’s ability to mobilise large groups of educational entrepreneurs and spouting youthful energy from the student body, the opportunities between academic and practical joint ventures are endless. Yet, the question still lies on whether the practical building and construction industry has viable interest and development utility for architectural research and development for the building industry.

2. Intersected collaborations

Similarly to the academic exploration of the summer studio, an outlet from architecture could be found within my research and practice where there is an active convergence to engage the industry within my work – many times through the experimentation with industrial design and fabricators outside of architecture. Through engaging industry outside architecture and design, the designer benefits through professional advices which are not inherit to the architectural trade itself, but allows outlying professional techniques to be applied into mutual intersected explorations of innovative means of attaining the same goal, in or outside of architecture.

For example, with the project of the *Cross Fabricated Scales Wall Modular* – originally spawned from a design commission of a 7,500 sq ft office design project in Hong Kong – became investigative and collaborative journey working with both *DuPont Corian* and *LG Hausys HI-MACS*. The commercial project interjected the opportunity to better understand the ‘real-life’ applica-
tion of solid surfaces and acrylic based plastics from a research and experimental perspective, which simultaneously reacted to the industries needs into the realised project. For HI-MACS and Corian, the traditional application of the material was for countertops and sinks, whereas for the basis of academic design-research, the design exercise became a challenge and occasion to apply the solid surface material as either 1) a wall modular, or 2) as a dynamic cabinetry system that seamlessly continues within the workspace.

By establishing these active networks with the industry, the relationship between academia and industry becomes a unique synergy of significant contributions and contacts within an integral pedagogic approach. The ability to incorporate those same industry partners and sponsorships into an active milieu within academic studios become an imperative departure to the education of architecture. Collective learning and operational collaborations in exploring the scholarly journey and discovery of architecture and design, through the process of making, therefore, becomes an expansive base of design-research opportunities that surpasses the traditional research and development education within the classroom setting.

3. Architectural making and education of fabrication

Pedagogy, Research, and Practice should be understood as mutually catalytic. Architecture has become both a profession and an art that continually engages
the multiplicity of socio-economic, sustainable and cultural concerns, and more recently, accesses a variety of technological advances for fabrication, material production, and generative digital organisations. Architectural education has thereby become a normative, focused, yet exploratory field of design-research, engaging the advancement of investigations through design processes facilitated by the inquiry of skill-based training of the technical and academic curriculum. Essential to any field of design is the ability to extract and interpret abstract data from a field of sources. Architecture thus proves the importance of an active appetite for theoretical references of architectural history and philosophic jargon, yet does not allow the process of design to purely react to solely theoretical research. This brings to the point that architectural design and education should inherit a process of making (analogue) – making in terms of fabrication through experimentation and making through the processes of physical investigation past the digital (virtual) computational means. Though, fabrication itself should not be considered as purely ‘just’ an act of making, but, where making becomes and functions as a critical thought process within the contained process of [design | optimisation | fabrication]. Within this process neither steps are branded as a fixed process, but considered as a process which could be materialised through an informative feedback complimentary to each other.

**Figure 9. Diagram of contained process of [design | optimisation | fabrication], image provided by Wendy W Fok.**

### 4. Action of making within practice

Reiser and Umemoto (2006) in “Atlas of Novel Tectonics” gives a pointed statement that the “Material practice is the shift from asking “what does this mean?” to “what does this do?”.” This crucial comment questions the genesis from interpretation and meaning to performance in architectural thought, moving beyond the instrumental notion to point from a shift from meaning or value to performance or function, beyond traditional critiques that operate within metric spaces. With digital architecture’s ability to fascinate due to its visual stimulation and novelty, the saturation of advanced computational tech-
nology has clearly become available to anyone that can participate in the field through the use of digital tooling – a scope and scale of which was unavailable to people even just one generation back. By simply a click of the mouse button, people of diverse backgrounds and experiences can explore, innovate, and contribute to an ever-growing community of designers, each one with their own methods and desires. Posing the question on how our visions of objectivity, as architects, could diverge with various tendencies pushing on our understanding the limits of different material and analogue (physical) properties to further the development of architectural design.

As an augmented quantity of designers incorporate diversified parameters into their projects, an increased number of potentials within formal creation emerge; equally, as an increase in the techniques of application become available, maintaining a coherent narrative of the creation process becomes progressively more difficult to maintain as continual, real-time inputs from a variety of sources can easily turn into a cacophony of discordant voices each ripping apart what another has tried to join together. Thus, we see the fundamentality of mapping a layered approach within “design intelligence” between parameters and constraints which simply becomes the decision and knowledge accumulation incorporated through organisational efforts disposed by the architect.

Speaks (2002) has once termed “design intelligence” as a process of which “[m]aking becomes knowledge or intelligence creation. In this way thinking and doing, design and fabrication, prototype and final design becomes blurred, interactive, and part of a non-linear means of innovation.” Within this process, “design intelligence” is taking the opportunity of design to the level of one-to-one scaled model-making and prototyping, and surpassing the possibility of transitioning between design | fabrication and past the processes of optimisation ingrained within the process of design. Fundamentally speaking, the ethos of embracing digital fabrication within the architectural practice and design processes is to strike an opportunity of generating materials within the experimentation process (or, the contained design | fabrication | optimisation process), which becomes a laboratory of opportunities. These potentials for creating an optimisation for an enhanced fluidity between the design and construction could interject for either 1) a productive pre-testing ground of feasibility design analysis for the ease of further discussions with the sub/contractors and fabricators, or 2) utilised as design developments and experimentations on smaller scaled prototypes into creating junctures grounding propositions past the schematic phase within the design process.

As discussions continue to propose the difficulty of utilising the computer as an active part of a design process, designers begin to further the ability to
negotiate between quick intuitive studies and definitive quantifiable decisions. These interpretive models then alter the design processes where the workflow of ideas can remain separate and abstract. As relationships between the parts in design coalesce, a new type of workspace is formed which deals primarily with associations of the parts and their interdependent relationship with the whole. Concurrently, projects will require exploring the rigorous design methodologies that trace the developments of complex and dynamic forms in the context of their structural feasibility. While, the evolutions of topologies are of special interest, typological properties intrinsic within the technique of design will also be placed in consideration. Thus, in order to understand of “what does this do?”, the practice of architectural design, surrounded by investigative and re-combinative form finding processes and evaluation, should entail sustained lab testing of physical models within the systematic development of understanding both 2D and 3D modelling, in conjunction with computer simulation and the optimisation process.

5. Digital relief and fabricating the future

Digital tools should be looked upon as a method to further but not replace or surpass the designer’s ability to interject the interpretational process from vision to reality. While the fabrication process could be limited through the techniques applied onto the fabrication by the production tools, the ability to examine with an iterative process by physical experimentation, through thinking critically, should transcend the creative process. Moreover, through the experimentation and the iterative processes of prototyping, and experimentation of multiple materials, the ability to formulate coherent methodology could be further refined and developed, both physically and theoretically.

The ability of digital design and alternative methods of fabrication delivers, on one hand, an approach to harness the computer as a generative medium for design, while on the other hand, assesses the versatility of material experimentation within the architectural design process through one-to-one scaled prototypes. Within practice, design, and education is the ability to challenge the dynamic significance in structuring and mapping the ideals of art, architecture, and urbanism, contained by the process of making. By utilising the synergetic methods of digital and analogue fabrication as a means of full scale design and dynamic analysis, the convergence of digital design and fabrication will continue to address the late Robin Evan’s concerns about the relationship of social and spatial arrangements while operating within the understanding that physical experimentation becomes a process of discovery.

Moving forward, the potential of fabricating the future is not only to understand the formal approaches of design, but should be toward investigations of
contextual and content-related natures of fabrication, along with cradle-to-cradle\(^3\) material investigations that compliment scaled prototypes within architectural design. Although digital (virtual) investigations through computation is valuable in term of analysis and fundamental testing, analogue (physical) fabrication and prototyping alleviates the masking contained within virtual realities, which releases discussions within underlying ecological principles and material investigations. While our position as educators and designers should continually push the boundaries of digital design and manufacturing as a means of closing the gap between the intersection of architecture, practice, and education.

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**References**


**Endnotes**

1. Luxx Newhouse Group Pte: fabricator of solid surface materials located in Asia, with factories in Singapore and Panyu China.
2. LG Hausys HI-MACS: HI-MACS® is the Solid Surface material. The mineral material consists of approximately one third acrylic resin (polymethyl methacrylate or PMMA) and 5% natural pigments. Its main constituent, with 70%, is the natural mineral aluminium hydroxide (ATH) obtained from bauxite (aluminium ore).
3. Cradle-to-cradle Design: (sometimes abbreviated to C2C, or Cradle 2 Cradle, or in some circles referred to as regenerative) is a term originally termed by German chemist Michael Braungart and U.S. architect William McDonough. C2C is a biomimetic approach to the design of systems.