Informed Forms: Introducing Climate Response into the Early Design Studio

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In an October 2017 article in Architect Magazine, editor Ned Cramer identified climate change as "the fundamental design problem of our time."[1] In the same article, he described the considerable impact - nearly 40% of annual world carbon emissions[2] – that buildings contribute to this problem, and called for change in the industry. In February of 2019, the American Institute of Architects (AIA) publicly endorsed the Green New Deal, and in September, the AIA board ratified Resolution 19-11, referred to as The Big Move, which "declares an urgent imperative for carbon reduction."[3] This resolution also advances the development of the Awards Common Application, which will require the disclosure of building energy performance metrics, and will use the Committee on the Environment Top Ten Measures for ethical and responsible design, in the consideration of all AIA Design Excellence Awards submittals.[4] These policy developments indicate a recognition within the architecture industry of the necessity to mainstream climate action and zero-carbon design. More recently, the 2020 National Architectural Accrediting Boards (NAAB) Conditions for Accreditation emphasize the same responsibility for educational institutions, identifying "Ecological Knowledge and Responsibility" as a key criteria of program evaluation (PC.3).[5] This is reinforced by the addition of the requirements that student work demonstrate "the ability to make design decisions" while considering "the measurable environmental impacts" and "the measurable outcomes of building performance" within the framework of a successful architectural design project.

As the language of The Big Move states, the need for change in architectural practice, and by extension, in architectural education is urgent. The definition of the word urgent indicates a critical or pressing situation requiring immediate action. Despite the apparent recognition of the importance of environmental issues in architectural practice and education, there is a gap between the desire to effect big changes, and the ability to disseminate the technical knowledge required to do so. This gap is perpetuated by an architectural education system in which too few instructors have the requisite technical knowledge, and too few courses incorporate climate responsiveness and building performance in substantive and fundamental ways. These topics are usually explored in advanced or technical courses that occur relatively late in architectural curricula, and thus cannot build a foundation for students' design thinking that is central to their design process. For example, the architecture faculty at the authors' university consists of thirteen full-time members. The authors conducted a survey of the faculty biographies to ascertain the foci of the faculty in their own words. In the biographies on the School of Architecture website, only four of the thirteen faculty members indicate issues such as sustainability, carbon, climate change, and energy performance as primary areas of research or teaching expertise. Of those four faculty members, one teaches in the graduate program, two teach upper level design studios and building technology courses, and only one teaches in early design studios. The authors have also taught at two previous institutions, and the distribution and percentage of engaged faculty is similar to those observed in previous positions. This indicates that there is a fundamental instructional gap in the teaching of the skills and knowledge necessary to prepare architecture students to engage with the issues of carbon emissions and climate change from the beginning of their academic careers.

Barring a substantial turnover in the instructor population or mass re-training of existing faculty, there is no reason to expect rapid or significant changes in the present situation. Moreover, even dramatic instructional changes now will inevitably see a long lag time before those changes take effect in practice. As an example, the authors joined the faculty of their current university in the Fall of 2018, with the directed charge of reformatting the technology curriculum for the School. They immediately began working with the School's administrators and Building Technology Committee to reshape the structure and pedagogy of the technical curriculum. The curriculum was reorganized into five week, one credit modules, ensuring that the core building technology subjects of structures, construction, and environmental technology, would be taught every semester, beginning in the freshman year. In this way, building technology knowledge can be built gradually, and reinforced throughout the student's architectural education. This new sequence is designed to culminate in an integrated semester in the fourth year, in which each student will take the Integrative Design Studio concurrent with Integrative Technology seminars designed to directly support the application of building technology principles to the ongoing studio design work. Curriculum revisions were presented and ratified by the faculty council in

Spring 2019, catalog changes were made in Summer of 2019 and the new coursework began in Winter 2020. Despite the rapid implementation of this new curriculum, students above the sophomore level in 2019-2020 academic year will necessarily complete their education under the existing building technology curriculum. This means that the first group of students educated in the new technical curriculum will not graduate until the spring of 2024. This is a lag time of six years from the beginning of curricular re-design to impact on graduating students. It is important to note that a small, cooperative faculty, with minimal bureaucratic complications from a larger college or the upper University administration, accomplished the rapid reconfiguration described. In a typical situation, the process could easily take years longer.

With this understanding of the challenges to dramatic reconfiguration of curriculum, it is plain to see the need to develop alternative ways to integrate carbon-awareness and climate-response into existing architectural curriculum, if widespread and rapid implementation is to occur. This paper proposes one possible strategy to address the knowledge shortfall – by integrating small doses of relevant content into early design studios. When short, focused, topical plug-in workshops taught by qualified instructors are coordinated with and hosted by mainstream design studio courses, there is an opportunity to incrementally integrate issues of energy and building performance into these design studios. This offers benefits over treating climate concerns as a tacked-on approach in later studios, when students' core design processes are already well established. Moreover, the building technology content presented through these workshops can be strategically calibrated to the themes of the studio, and the experience and knowledge levels of the students. These plug-ins are not proposed as a take-over of the design studio by building technology faculty, but as a strategic compliment to the studio, intended to benefit the students and enrich the work. In the experience of the authors, this requires instructors of technical courses to engage in active outreach and relationship building with studio instructors who may have less interest or expertise in technical issues. By communicating with studio faculty, technical faculty can clearly understand the topical focus and scope of the work of each studio, and thus can properly identify technical content that is appropriate to introduce to the studio. Building an ongoing discourse with studio instructors also opens up opportunities for technology instructors to become more involved in studio critiques and reviews, further weaving technical issues into the curricular fabric. It should be understood that this supplemental technical content, especially in early design studios, is most easily approached through hands-on exercises and does not require extensive time investment. In fact, the authors have found that short, focused workshops can be quite effective.

As an example of the plug-in workshop approach, we will examine a recent collaboration between the authors and a group of first-year architecture design studio instructors. This collaboration arose organically out of discussions between the respective faculty members. It demonstrates how technical topics can be introduced into design studios, with a small investment of faculty time and energy, but with potentially large benefit. The instructors of the studio in question developed a design brief that called for the development of small spaces for individual meditation sited in an open landscape. The studio instructors began the project with a focus on raising students' awareness and consideration of human multi-sensory experience and approaching spatial design through that lens. In this preliminary instruction, there was also a strong emphasis on studying the behavior of light, and its impact on space and perception. Early work on the studio focused on developing physical models and studying the effects of differing lighting conditions on those models through photography and drawing. The studio instructors shared the early work of the studio, and this early focus on physical modelling and light suggested to the authors that an introduction to the basics of solar geometry would be a suitable conceptual compliment to the studio course. Building understanding of solar geometry and the behavior of light is particularly suitable for early design students as these principals have large impacts on building performance – solar heat gain, natural light and shading strategies, renewable energy generation, and visual and spatial perception.

Basic solar geometry concepts were introduced in a one-hour lecture delivered by the building technology faculty during the studio meeting time. This lecture presented foundational concepts in solar geometry, and introduced students to the practice of using solar path charts to plot altitude and azimuth positions of the sun at different times of day and year for a given latitude. The lecture was immediately followed by a one-hour in-studio workshop focused on the use of the solar path charts in conjunction with basic heliodons to model the position of the sun and effect of sunlight relative to the physical models already created in the studio. Students worked in teams to determine solar positions and to model lighting conditions with their cell phone flashlights. Teams also worked together to photo document a variety of lighting and shadow conditions resulting from the modelled sun in each physical model. This first exposure to concepts and working methods was reinforced a week later by two hours of follow-up desk critiques by the technology faculty to clarify concepts, help with application to the studio project, and provide general feedback on the developing design work.

Admittedly, the technical content that was introduced in this workshop is not directly applicable to building performance and carbon footprint. The goal, however, was to introduce basic technical concepts in a focused and engaging way. This meant that these new concepts could be immediately applied and tested to inform and empower the students' design decision-making process. It is believed that, by planting this seed of understanding of the behavior and movement of the sun, in the context of a studio design project, the students will be

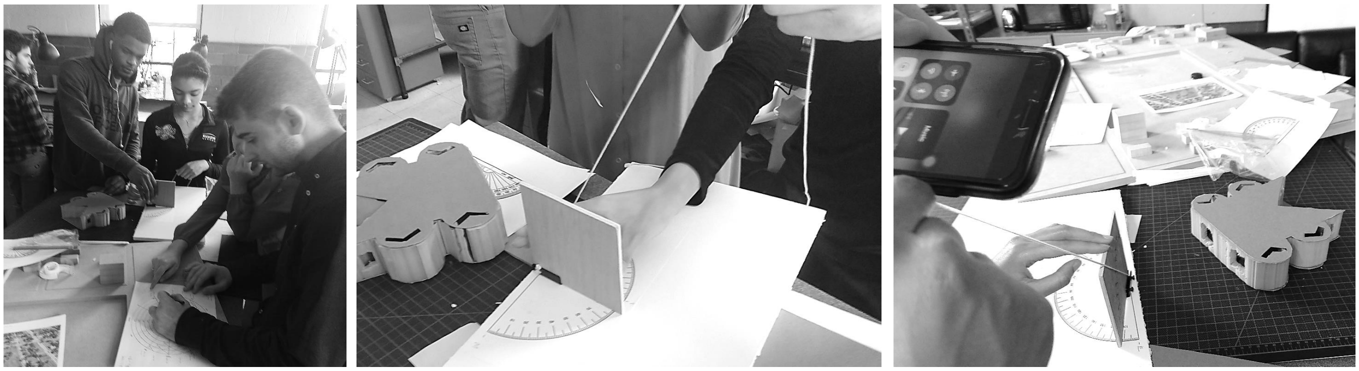

Figure 1. First year design students working on the heliodon solar geometry plug-in workshop in their studio space. Darius Britton, Taylor Tommen, Jacob Burke (students), Assistant Professor Erika Lindsey (instructor). Image courtesy of the authors.

more prepared and more receptive when these concepts are re-introduced and reinforced in later technical and design courses where the focus will be more directly on building energy and performance.

An additional project that the authors have developed for early design studio integration is a physical model carbon accounting project. This project seeks to introduce design students to basic concepts of embodied carbon and embodied energy for construction materials. The approach assigns students with keeping a detailed spreadsheet record of the weight of materials used, including waste and off-cuts, in the production of their studio physical model. Instructors provide baseline carbon and embodied energy information for common studio modeling materials. This information is used to generate an embodied carbon/energy estimate for the useful elements and the waste in each student model. By using direct measurement of the materials consumed in the production of the physical model, students can directly and intuitively grasp the concept of embodied energy and carbon cost. This is impactful and easier to understand in the context of an early design studio compared to more abstract and complex carbon accounting methodologies using software and developed digital architectural models. The project allows students to deal with complex concepts early in their education, without the need for extensive knowledge of materials and construction practice required to develop an estimate of whole-building embodied carbon. This project can be readily implemented in any studio that uses physical modelling as a design and documentation methodology. As COVID-19 has moved coursework to online formats with limited physical modeling, there has not been an opportunity to implement this project in practice. However, the intention is to integrate this project into an early studio when in-person teaching recommences.

Academia is complex and difficult to change. It will require a correspondingly long time to affect an academic response to the urgent demands of climate change in architectural practice. The authors offer the triage solution of plug-in workshops as an immediate strategy to better integrate the topics of climate change, carbon and sustainable practices into early levels of design instruction, and to meet the need for a more rapid response to perhaps the greatest challenge of our time. The workshops can be introduced with a minimum of time and effort if productive working relationships and communication between technology and studio faculty are established. These relationships can be created or augmented by building upon the shared baseline of better serving students, and eventually society. The authors offer these case studies and this approach to meet the urgent need to embed climate-responsive, low-carbon and low energy waste approaches into the foundational design processes of all beginning design students within the considerable, entrenched constraints of higher education.

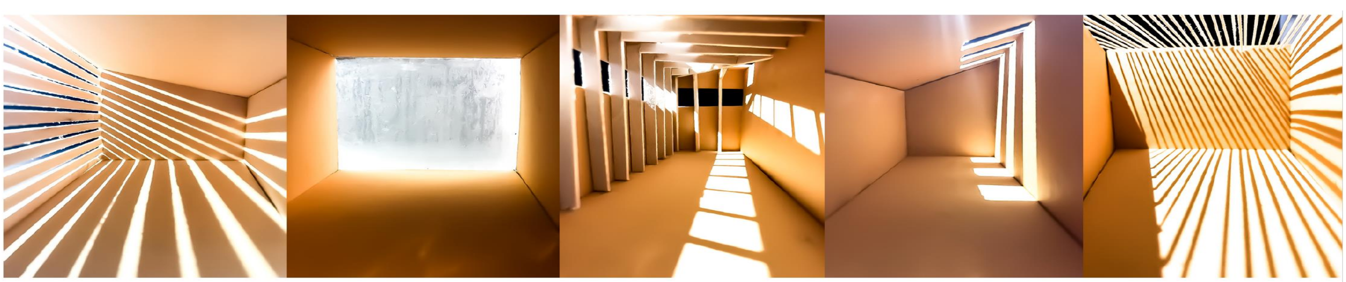

Figure 2. Final studio design project photographs, physical model interior light studies, Madison Nelson (student), Professor Allegra Pitera (instructor). Image courtesy of Madison Nelson.

ENDNOTES

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