The COTE Student Design Competition as a Vehicle for Integrative Architectural Education

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ABSTRACT: *As the architectural profession becomes more complex, the education of a 21st-century architect requires integrative technological processes to prepare students to design more equitable, resilient, and environmentally responsive interventions. Interwoven design logics and innovative solutions are hallmarks of a holistic architectural design. The prompts that educators devise should encourage students to consider carbon emissions in response to our rapidly changing climate. The Committee on the Environment (COTE) Competition offers a vehicle for integrating these climate-critical issues. This paper will demonstrate how contemporary architectural curriculums can use the newly adapted AIA Framework for Design Excellence to frame larger discussions about the impact of architectural design on equity, ecosystems, water, economy, well-being, resources, adaptability, discovery, and integration. Using a collaborative and integrative approach by coupling a 6-credit graduate design studio with an adjacent 3-credit technology course, architectural ideation responds to the COTE Framework for Design Excellence through the design of a comprehensive building project. Using design methodologies and materialization strategies in relation to equity, and the environment, in the age of rapid climate change demands the need for resilient and innovative architectural solutions. While the COTE Top Ten could, and should, encompass good design at any size and scope, these coordinated studios sought to craft a specific relationship with indigenous cultures and ecologies of a specific place. Our experience shows that crafting finely tuned design prompts can offer an efficient and effective vehicle for entering the design problem with maximum effect. During the past two years, we have coordinated these studios with indigenous tribes to design cultural and environmental centers, allowing the graduate students to specify exact programmatic definitions for their interventions.*
Collaboration is an essential component of the architectural profession. As part of this complex and comprehensive studio with a laundry list of requirements, we have instigated teams for this studio project to allow students to hone their designs through constant negotiation with their partner(s) while allowing for increased output throughout the 16-week semester. This inherent complexity of the competition and a client's 'real world' constraints necessitates an architectural response beyond mere formal manipulations. While students are encouraged to submit their work to the final competition, the course is more than just the submission. By learning more about the past histories of the original inhabitants of the land we now occupy, students are confronted with how previous peoples utilized local resources and designed them in relation to distinct climates. Ultimately teaching the students the importance of design integration for an equitable and environmentally conscious future using the COTE competition has allowed a vehicle for cultural discussions to allow for a deeper understanding of place, people, and the power of the design profession for exacting change in our future world.

KEYWORDS: Design Competition, Integrative Studio, Environmental Awareness

INTRODUCTION

Architects play a crucial role in addressing the causes and effects of climate change by designing the built environment. The building industry accounts for nearly 40% of the total CO^2 emissions, and the global building floor area is expected to double by 2060 (GABC 2017). Innovative design thinking is key to producing architecture that meets human needs for both function and delight, adapts to climate change projections, continues to support the health and well-being of inhabitants despite natural and human-caused disasters, and minimizes contributions to further climate change through greenhouse gas emissions. Preparing architects to envision and create a climate-adaptive, resilient, and carbon-neutral future must be an essential component and driving force in contemporary design discourse.

Climate change is here. Our design education must adapt. While it could be argued that climate change has always been present, one only needs to read the recent headlines to know the rapidity of this anthropogenic climate change occurring now and that our actions are affecting the entire globe. The education of an architect in the 21st century needs to prepare students to design safer, more equitable, resilient, and sustainable built environments. Innovative and integrated solutions are hallmarks of architecture education, the discipline, and the profession. Architects today are responsible for the impact of their work on the natural world and public health, safety, and welfare. As professionals and designers of the built environment, we embrace these responsibilities and act ethically to accomplish them. As Dipesh Chakrabarty stated, "The future emerges directly from the objects we design" (Graham 2016, 23). We need to raise awareness and curiosity within today's design students to wrestle with the complex realities of design interventions in our world. "The image

of green supersedes the actual environmental performance of green – much the same way that the modernists' aspirations for buildings as efficient and hygienic machines became an alibi for adopting the look of the machine…" (Schafer and Lawrence 2011, 4).

1. COTE AND ENVIRONMENTAL DESIGN

1.1 Brief history of environmentally conscious design within the profession

While architectural design trends have evolved, it was a mere 30 years ago that the architecture profession began to formally recognize environmentally conscious architecture in design, founding The Committee of the Environment (COTE) in 1990. Of course, before air conditioning, when architecture was designed to work with a specific climate condition to be more sustainable, had been addressed previous to 1990 (Olygay 1963, Brundtland 1987, Barber 2020). The following year, the American Institute of Architects (AIA) held an exhibition on "Environmentally Conscious Architecture" and launched its Environmental Resource Guide" in 1992. At roughly the same time, the Building Research Establishment Environmental Assessment Method (BREEAM), based in the United Kingdom, began in 1990 to measure and recognize sustainable buildings. In 1994, the Leadership in Energy and Environmental Design (LEED) was created by the U.S. Building Council (USGBC) and most widely recognized in the United States. Other rating systems and protocols, such as Green Globes (1996), and these frameworks have evolved over the past thirty years. Initially focused on the building, many of these programs have created guidelines specific to interior design, existing buildings, and even sustainable sites and urban planning as they aim to take a holistic view of what sustainable design may mean to different subsets of the architecture and planning industry. The Living Building Challenge (LBC) was developed in 2006 as a benchmark for building standards that aimed to move the needle on environment design that not only does *less* harm but create positive change through ideas of regenerative, equitable, and ecologically sensitive design. Each guideline frames sustainable design principles through the lens of architectural building practices, also falling within the 2016 United Nations Sustainable Development Goals (SDGs) framework that demonstrates "our shared vision of humanity and a social contract" to fight inequality, climate change, poverty, and ecologies throughout the world as part of the 2030 Agenda (Ki-moon, 2015). As we approach the year 2030, the profession must make efforts to become more climatically responsive, ecologically attuned, and holistically enhance the lives of its users. Educators should introduce these metrics within our curriculum to recognize this impetus as more than a trend. Figure 01 relates the sustainable objectives of COTE, LEED, LBC, Green Globes, and BREEAM to demonstrate common language alignments while categories such as "beauty" from LBC and "economy" from COTE demonstrate some of the more noteworthy misalignments.

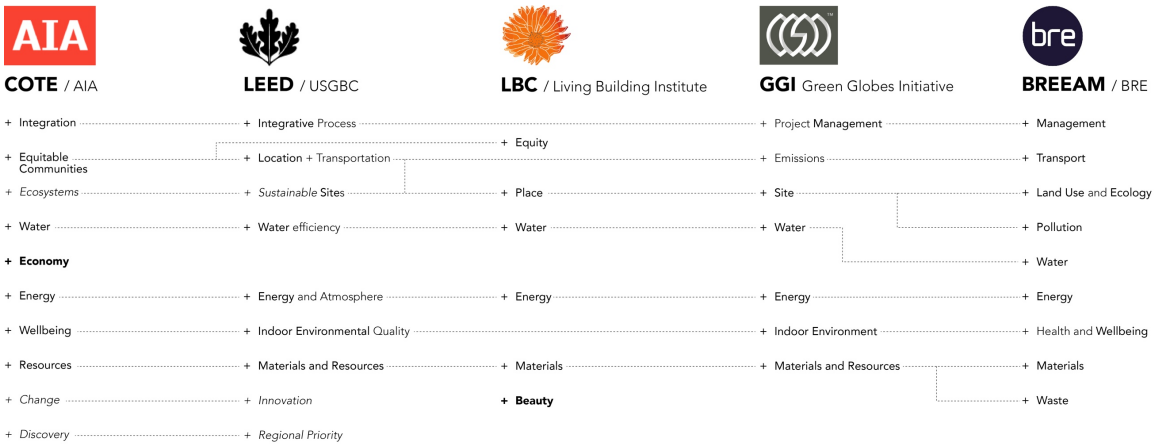

Figure 1: Alignments of several prominent professional sustainable building assessment tools. Source: (Author, 2023)

1.2 COTE international design competition

In 2015, the AIA launched the Top Ten for students with the Association for Collegiate Schools of Architecture (ACSA) to encourage faculty and schools to challenge students to submit projects that thoughtfully integrate architecture, landscape, and natural systems with technology as a design regime. Projects presenting a comprehensive and holistic approach to designing with nature to enhance existing environs. Utilizing the same AIA Framework for Design Excellence helps introduce students to the metrics while tapping into the wealth of information provided through the design guides and toolkits utilized by the architectural profession. Each year, this framework is utilized to create ACSA/ AIA COTE® Top Ten for Students International Student Competition. The competition is announced each summer, through the ACSA website, along with a copious amount of studio and design guides to assist in studio coordination, pacing and implementation.

The AIA COTE framework was initially the COTE Top Ten Measures and only used for 'Environmentally Conscious' architectural projects; for now, adopted as the basis of professional practice and awards across the AIA). The competition recognizes ten exceptional student design studio projects that integrate health, sustainability, and equity evaluated following the same categories that the professional AIA COTE® Top Ten Award for built work uses and the AIA Framework for Design Excellence, with each of the winning projects demonstrating innovative building technologies, design for equitable communities, as well as material, energy, and resource efficiency for the complete design solution. There are benefits to working within a professionally-accredited program, as it prepares students for the architecture practice. However, architecture school is also about speculating and developing personal voices and theoretical frameworks for the graduate. The assessment protocols within the academic and professional structures should complement more exploratory and innovative pedagogical modes. The diagram below illustrates intersections between the COTE/AIA agenda and the NAAB/SC.5 + SC.6 frameworks to demonstrate alignments and misalignments.

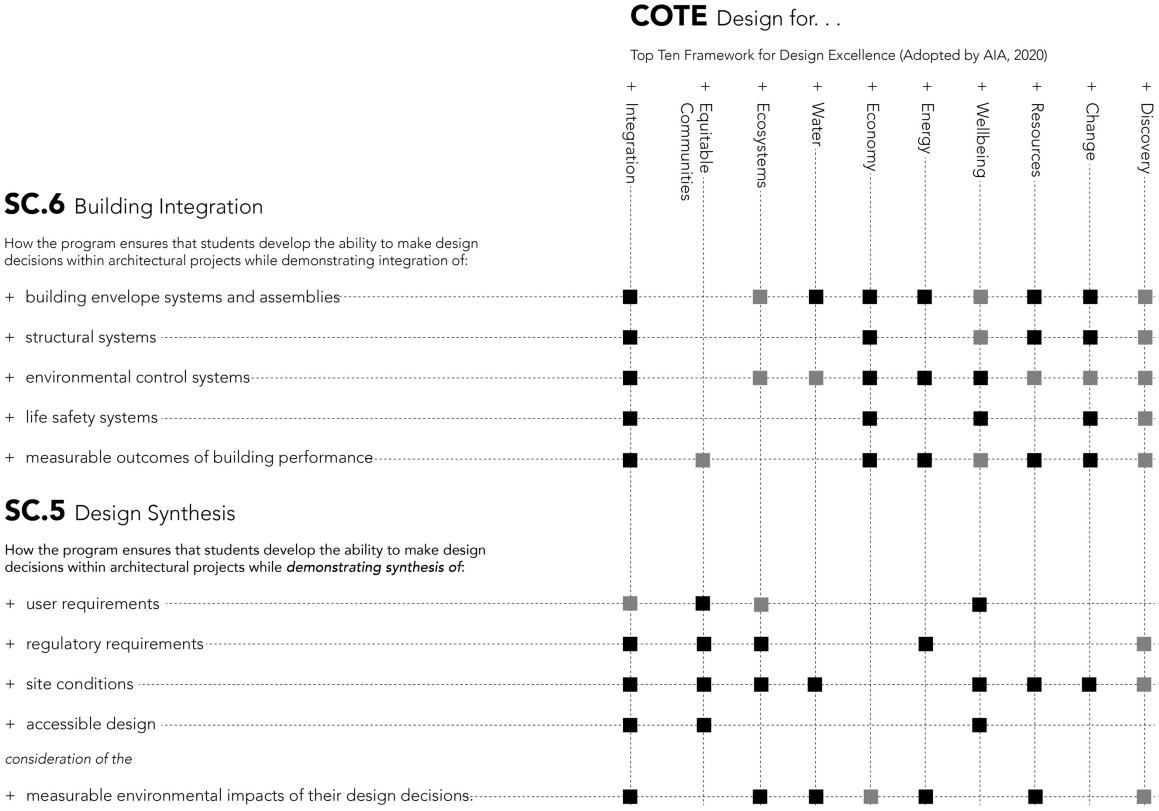

Figure 2: Matrix exploring specific line items of NAAB 2020 SC.5 + SC.6 in relation to the COTE Top Ten Framework for Design Excellence. Black squares are implicit, grey squares as potential overlaps, while no square has unclear or limited connections between the two assessment criteria frameworks. Source: (Author, 2023)

1.3 COTE top ten measures

The COTE Top Ten is a list of ten measures that exemplify design excellence within the project. The full list of measures includes Design for Integration, Design for Equitable Community, Design for Ecosystems, Design for Water, Design for Economy, Design for Energy, Design for Well-Being, Design for Resources, Design for Change and Design for Discovery. Professional and student projects submitted to the competition are evaluated on a broad and inclusive definition of quality design within any number of these areas. It is likely too difficult for a single project to tackle each one of these issues with equal weight, however depending on the program emphasis, scope and design narrative of the project, design solutions likely need to address several of these measures to be successful in the competition. One understated, or maybe understood, issue expressed within the AIA professional guidelines for submissions is an emphasis on aesthetics, in addition to notions of resilience, community connections and performance. Both within the professional interface and the student design competition, the framework is set up as a series of queries to initiate an investigation of how projects address the framework.

1.4 Design for integration

Within the studio, students are required to consider three of the topics in a tangible way, to direct their study. This is often addressed after their initial scheme ideations for their projects around week three. All students must address the first topic – Design for Integration, as the studio is an integrative design studio and a large component of the student learning objectives for the course and its NAAB requirements. Questions relating to the Design for Integration components connect to the larger narrative; What is the big idea? How does the project demonstrate the intersection of design excellence and sustainable performance? Performance is a key term here, as it necessitates qualitative desires grounded in quantitative metrics. The holistic concept identified through one of the following eight or nine metrics.

1.5 Design for equitable community and well-being

Architecture is about people. Design for equity is about extending architectural modes of exploration from a discreet building to an idea of its inextricable connection to the larger community and how it can positively provide more equitable opportunities to the underserved. This differs from the modernist ideal, as a building is separate from context and potentially serves a singular purpose and asks the designer to determine unique cultural and natural characteristics of a given region for their design. In a sense, the ability for the design prompt to occur within an academic context provides a great deal of flexibility in how this can be proposed to the studio. Additionally, questions about who the project is for can also be addressed. In the context of our fall 2022 studio, working directly with the Mescalero Apache and Kiowa tribes provided both a community connection and opened important dialogues and considerations of how architecture can have a greater meaning and purpose. Design for Well-Being can also be constructive here, as the design for people considers the comfort, health, and wellness of the inhabitants and visitors of the buildings. Metrics and imagery that can pertain to Well-Being would be interior perspectives, daylight analysis, views, and connections to the exterior environment. Design for Equitable Community would require consideration of the urban fabric, walkability, and existing transportation networks to allow access to the site, along with the purposeful design of the program to benefit the larger community.

1.6 Design for ecosystems and water

Eco-systematic thinking is relatively new in terms of Eurocentric design education, however, it may have stronger roots within indigenous groups. One example could be Angkor Wat, a Cambodian temple complex built from the 9th to the 15th century AD that incorporated hydraulic structures of dykes, basins, reservoirs, and canals to work within a specific ecology to preserve and complement the existing natural setting. Similarly, investigating how indigenous cultures of North America designed environmental mediations within their surroundings during the fall 2022 semester allowed students to reconsider their own context through different eyes to learn from the cultural significance of the natural world while designing for a specific native population and place. While the previous two measures focus on human health and equitable communities, this measure goes beyond the building to investigate how architectural design can protect and even benefit the larger ecosystem, watershed, and wildlife habitats in the presence of human development. This is a tall task; especially as architectural interventions have an extremely negative impact on the existing ecosystem and wildlife. This measure may preclude the use of a virgin site for development, instead moving prompts to consider urban infill, existing buildings, or brownfields as potential sites for intervention. Additionally, consideration of exterior walls, roofs, courtyards, and landscape features as areas that could create habitat that mutually benefit humans and the larger ecosystem. This larger site consideration and the conservation of water and protects and improves water quality.

1.7 Design for economy and energy

Design for Economy is not typically addressed within a design studio. We often eschew such strictures within academia, and maybe for good reason, as those constraints tend not to serve the exploration of design ideation. COTE offers this measure to consider affordable solutions around the true economy – from first to long-term operational costs while benefitting occupant health and productivity. This measure could be addressed using BIM tools to calculate the true costs of the design but also could incorporate seasonal adaptability of the interior and exterior environments to lower reliance on mechanical systems for thermal comfort and better connect buildings with their climate.

Design for Energy is one that is possibly the best studied, especially since the ubiquity of mechanical systems and building envelopes that have been the focus on architectural design for the past seventy years (Barber). Measurement tools such as Sefaira can calculate how a building's formal design, orientation and material conserves energy resources and reduces the carbon footprint while improving building performance and comfort. A sustainable design could aim to reduce the amount of conditioned space or integrate façade systems to lower thermal impacts of the surrounding environment while also anticipating future energy sources. Examples of how students used Environmental Impacts Analysis tools within the initial design phase to

determine more efficient massing and orientation strategies through comparative design, while investigating Energy Use Simulation to test different material strategies through several iterative studies (Figure 3).

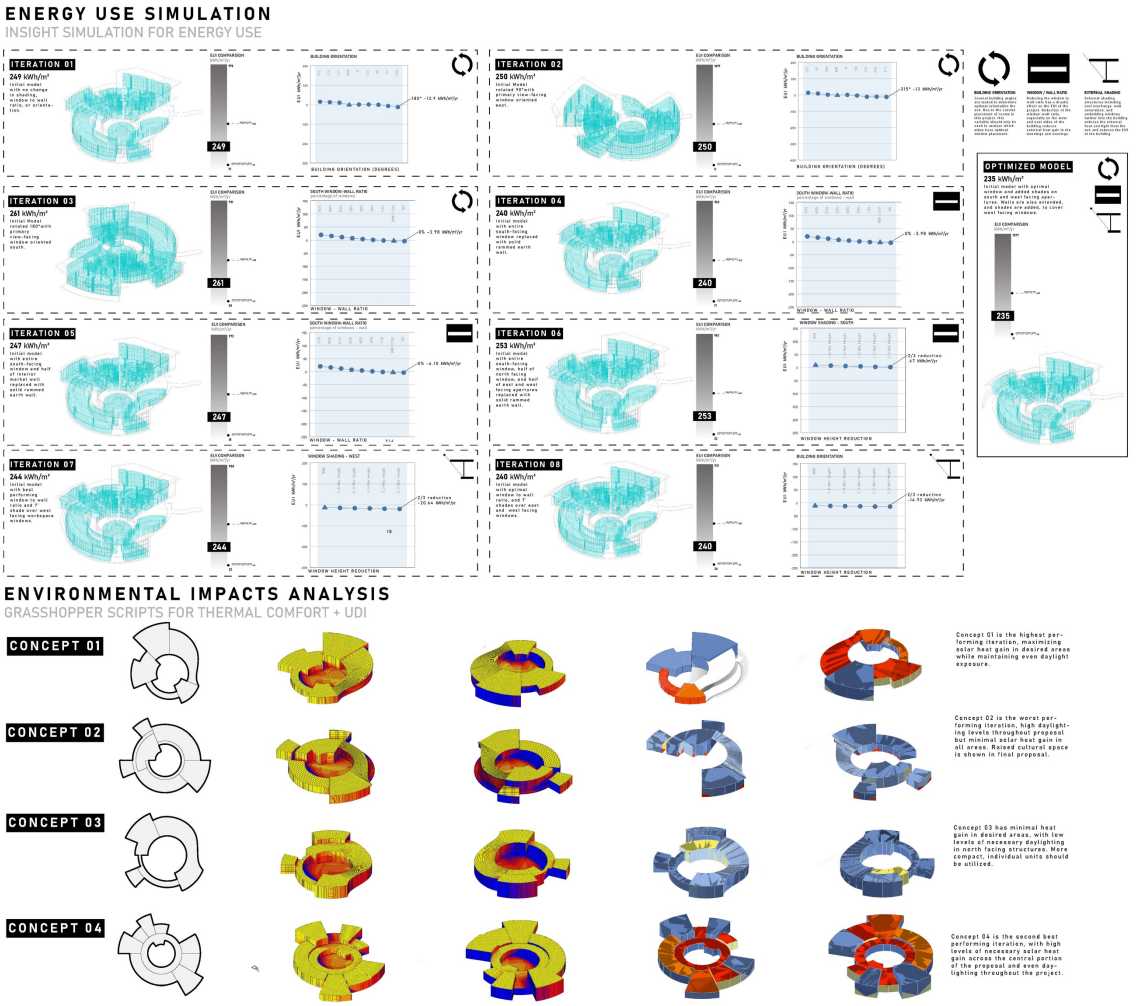

Figure 3: Using environmental analysis tools early in the process, students could revise and refine building orientation and volumetry to achieve energy use goals for their project. Source: (Tyler Glass + Matthew Stevens, Fall 2022)

1.8 Design for resources and change

These two aspects are incredibly important regarding sustainable practices. What we do with the finite materials on our planet, and how we might consider our designs to be adapted to future uses within a community. Design for Resources asks the students to make informed selections of materials and products that consider reducing life-cycle embodied carbon and other environmental impacts while enhancing building performance to prioritize occupant health and comfort. Employing Building Information Modeling (BIM) software tools within the latter stages of the design process in the studio course allows for further inspection of materials to calculate life cycle costs and embodied carbon analysis within the adjacent technology course. Design for Change anticipates adapting a building towards future uses, considerations of the oncoming climate change, and even resilience to anthropogenic (natural) disasters. While not specifically questioned within this framework, retrofitting existing building stock for future lives could also be investigated here. Several winners of past competitions delved into this typology. With the expectation of doubling our building stock within the next thirty years, consideration of dilapidated structures for the future would address both designs for resources and change.

1.9 Design for discovery

This measure is possibly a bit more difficult to design for, as it asks what the building or design process can present best practices for sustainable design as an evolution through documented performance and shared knowledge of lessons learned. This measure is most readily discussed through precedents as evidence of how buildings can be instructive for the students' designs. Potentially, more community or educational-type

facilities could teach users of the building about the power of architecture. Still, this measure might not be discovered until later in the design process. Along with the existing professional examples and toolkits that are readily available and open-sourced on the AIA Knowledge Community website, there are also copious examples of winning student projects over the past eight years. Also, on the ACSA website, there are several program guides available as teaching tools to equip both instructor and learner to the frameworks above, giving a design narrative, questions, and means and methods of addressing each of the ten areas, including suggested graphics, metrics, and sample strategies. Many of the slides are exemplary built projects and winning examples of how these areas are graphically and numerically diagrammed.

2. INTEGRATIVE CURRICULAS

2.1 Technology and design

A three-credit-hour advanced integrated building systems course aligns with this graduate design studio. During this course, professional projects garnering previous COTE recognition for environmental attunement are analyzed, documented, and presented to the entire cohort to share the lessons learned from the environmentally conscious design precedents. Throughout the design process, this supplementary course teaches building performance software that assists students in measuring their own design solutions throughout the design process to determine how their buildings compare with their intentions. Exercises are integrated throughout the semester as their designs grow in complexity. Initial studies on massing and orientation are coupled with energy analysis. Upon determination of initial material and organizational understandings, secondary studies on energy analysis and daylighting are introduced. Finally, once student ideations are codified, extensive structural and material analysis is linked with life-cycle analysis programs to determine the total environmental impact their designs have on the environment. At each iteration, students must compare their written design statements, often organized within the AIA Top Ten Framework for Design Excellence against their ideations' measurable outcomes. The ability to draw on multiple professors' expertise and connect these courses meaningfully during the semester leads to better understanding for the students and more comprehensive projects at the final review. Much like the profession, where consultants are brought in to advise and direct certain aspects of the design process, this adjacent course allows for a richer dialogue throughout the semester.

Many successful responses demonstrate design methodologies that display technical knowledge through the thoughtful integration of passive design strategies, material innovation, and active systems. Many other projects focus on low-carbon material strategies, hydrology, and ecological impacts of the built environment. The integration of these ideas is represented within graphs, data, and diagrams, along with renderings and written words to describe the methodologies deployed and the anticipated effects of the design solutions. Several projects, especially recently, have been specifically designed to enhance an existing community through adaptive reuse, urban infill, and re-using brownfield sites within the larger design strategy. This intelligent land use can positively affect site ecology and address social issues to impact health and wellness. While unable to determine with certainty, several projects seemed to link social and community issues with the overall design prompt. The opportunity here allows for a project to have a life beyond just the classroom and aim for a larger connection with the affected community. If designed correctly, the course could involve a real client group to find more specific data and human feedback on the student's designs. During this past semester, our studio worked with several federally recognized indigenous tribes to attune the students' projects to the needs of the specific community. On several instances throughout the semester, students learned the importance of cultural histories within the designs for their people. This is an important lesson that architectural design is not within a vacuum but needs to address the client's specific concerns. While this step of engagement is not necessary for a successful COTE studio, it provides a potential platform to further the Design for Equitable Community framework that can benefit the community through sharing the final projects.

2.2 NAAB and the profession

Within the longer NAAB descriptions, one can understand how a full COTE competition submission would ensure that students "understand the established and emerging systems, technologies, and assemblies of building construction, and the methods and criteria architects use to assess those technologies against the design, economics, and performance objectives of projects", as described in SC.4 (NAAB 2020). Demonstrated performance metrics throughout the iterative process to determine the right sizing of a given building, attempts to achieve net zero through demonstrative diagrams and performance simulations during a rigorous design process. In SC.5 Design Synthesis, a COTE submission that begins with the ecology, climate, and specific site and addresses a specific population group would ultimately show a "synthesis of user requirements, regulatory requirements, site conditions, and accessible design, and consideration of the measurable environmental impacts of their design decisions" (ibid). Measuring the environmental impacts of an architecture designed under the AIA Framework for Design Excellence is essential for an integrated design project. Accessible design and regulatory requirements could be explored during the initial and thorough site analysis. Lastly, SC.6 Building Integration requires students to "develop the ability to make design decisions

within architectural projects while demonstrating integration of building envelope systems and assemblies, structural systems, environmental control systems, life safety systems, and the measurable outcomes of building performance." (Ibid). Many of the requisite drawings for the competition entry include the analytical building section diagramming how external and internal environments are mediated and running these designs through evaluative software such as Insight, Sefaira, and LCA analysis software such as Tally or Athena.

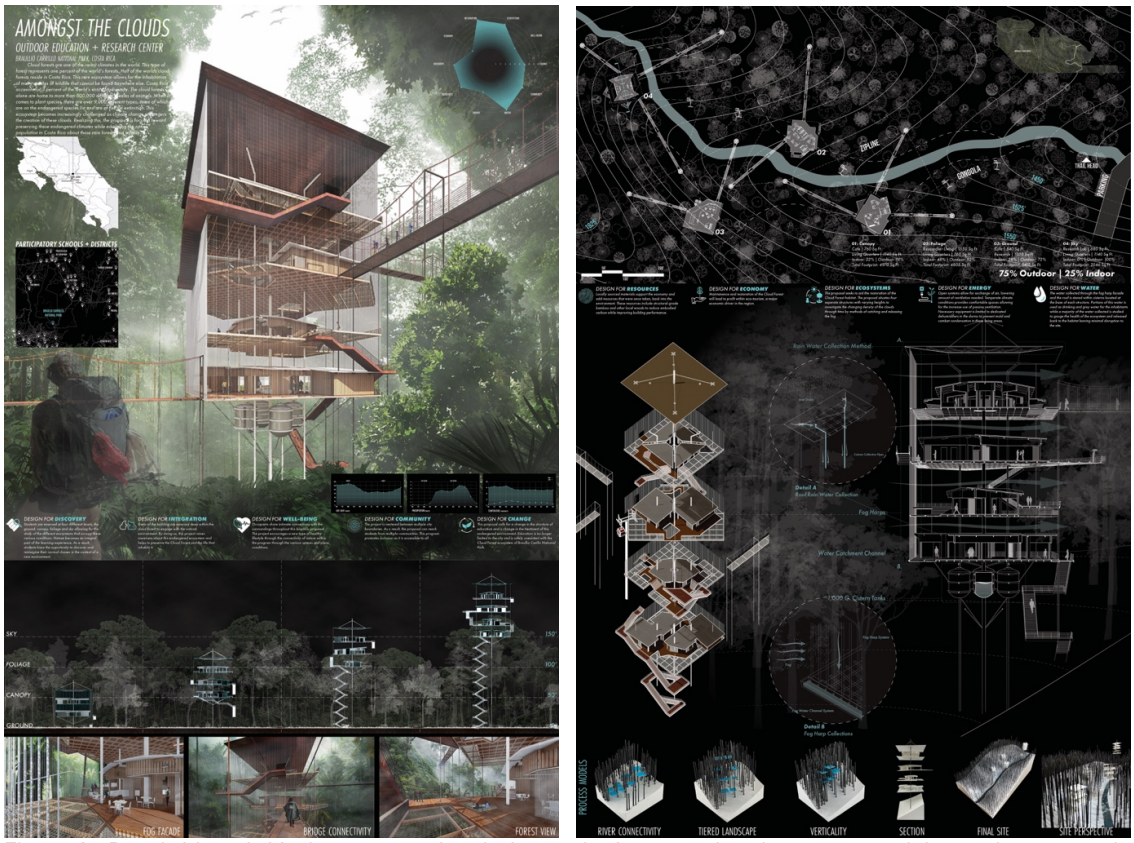

Figure 2: Board 01 and 02 demonstrate the design project's comprehensive nature and integrative approach to environmental constraints and architectural response. Source: (Jared Tejeda, Brandon Geiger, Fall 2021)

2.3 Criticisms and successes

The comprehensive nature of a studio that sets its sights on the COTE Student Competition can be both rigorous and rewarding. In addition to satisfying many of the NAAB criteria, the competition also prepares students for the profession with evidence of a collaborative design project that provides ample evidence of their understanding of the complexities of the architectural profession. Of course, students have struggled at various points within the semester. Initial hurdles are met when students consolidate initial ideations towards a collaborative narrative that they need to translate into a formal design strategy. Secondly, students must be flexible with their initial designs to allow for measurable, evidence-based design solutions to be synthesized into their design process. This may be the first time in their education that they must go beyond pure aesthetic, experiential and rule-of-thumb notions of iterative design strategies to rigorously test their designs in a measurable manner. Another issue is the scaling and curation of larger-scale drawings and physical models into the final dimensions required for the competition submittals. Several design exercises, such as wall sections, detail drawings, and physical fragment models to study specific moments within the comprehensive design project require large-scale outputs for design reviews to provide a beneficial critique. Best practices have been to use informal and in-class design reviews to operate in a more flexible manner using physical models, digital and printed mediums for discussion. In contrast, more formal mid-term and final reviews operate within the more spatially restrictive requirements provided by the competition.

Site selection and initial programmatic frameworks can help students jumpstart their design process, while providing room for dialogue and research to individualize student design solutions during the first half of the semester. Students learn about the difficulties and benefits of working with colleagues on design projects. A student's familiarity with BIM software allows for the many evidenced-based assignments within the adjacent course to be integrated within the design studio with ease. In surveying several students who successfully

completed this integrative project found that many highlighted this collaborative, sustainably focused studio project within their portfolio which allowed them to get jobs and do extremely well in professional firms, often leading design competitions within their offices.

CONCLUSION

Using varied interrogation modes, students must delve more deeply into a series of analytical exercises developed collaboratively to elicit thoughtful, comprehensive, and environmentally appropriate massing, orientation, and material strategies (Raab 2019). As this studio is the entry to the professional graduate program, students typically have an architectural undergraduate degree in architecture that prepares them for the rigors of the COTE Competition. While discreet exercises could address several components listed under NAAB's SC.5 and SC.6, NAAB 2020 requires synthetic integration of these elements within a comprehensive project. Utilizing the framework of the COTE and the structure of the ACSA/COTE Student Design Competition allows the combination of the NAAB criteria through a singular design project. Students benefit from the given competition framework, several years' worth of winning projects – both student-led and professional – and necessitates an integrative approach to complex issues. Professional education needs to prepare students to comprehend the complexities of current and future practices while speculating on the breadth of what health, safety, and welfare mean within contemporary society, and the COTE competition provides a curricular structure where students can understand the architectural profession in open dialogue with the bioclimatic, social, and ecological systems that surround us.

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