BOOK OF ABSTRACTS

Chicago Architectural Center
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Co-Chairs:

Jeanne Homer | American Institute of Steel Construction (AISC)

Terri Meyer Boake | University of Waterloo

19 May 2025

-POSTER ABSTRACTS-

TUESDAY, JUNE 3, 10:30AM

Moderator: Robert Dermody | Roger Williams University

3D Motion Graphics Using Blender to Illustrate Structural Concepts

Deborah J Oakley | University of Las Vegas Nevada

Many schools of architecture rely heavily on 3D graphics software such as Rhinoceros 3D, SketchUp, Revit, ArchiCAD and others. These programs are well tailored to developing and presenting architectural concepts, however they are relatively limited in motion graphics.

Similar in operation to Autodesk's Maya (which is geared toward the visual entertainment and game industry for the production of character animation, virtual worlds and visual effects), Blender is an open-source 3D graphics package. It is nearly as fully capable as Maya and has helped build virtual worlds in feature productions such as the Netflix series The Man in the High Castle, but as on open-source package it is free of the restrictions imposed by the software giants.

Blender has an immense worldwide following, and is under continual development by a dedicated nonprofit foundation. It is decidedly not focussed on architectural applications at all, nonetheless many professional architectural illustrators rely on it and there are numerous add-ons specifically geared toward architectural representation.

The strength of blender is that as a primarily mesh-modeling software this makes it uniquely suited to animations where every surface point can be manipulated directly. These furthermore can be combined with both static images as well as video as an overlay to explain the “hidden world” of structural forces within everyday structures.

This poster presents (albeit in static form) the types of visual graphic animations I’ve been using in basic structures classes to explain concepts such as load tracing, tension stress, compression buckling, torsion, shear, bending, structural typologies and more. The motion graphics aspect is intended to bring to life images that are normally static on a page.

Cut Fold Span Connect / The "Drop Fin" Method for Strengthening and Shaping Sheet Steel

Brian K Lee, Reese Greenlee | Kansas State University

This poster presents the "Cut Fold Span Connect" studio, a fourth-year architecture fabrication course supported by a $2400 material donation from the American Institute of Steel Construction (AISC). The studio explores innovative structural systems through the manipulation of sheet steel using CNC plasma cutting and folding techniques. Emphasizing a low waste/no waste approach, the project prioritizes material efficiency, retaining all elements of the cut pieces except for necessary bends.

The semester began with an introduction to both analog and digital metal fabrication methods. Students developed half-scale prototypes, progressing from intuitive paper folding experiments to full-scale applications in steel. This iterative process enabled students to investigate the interplay between form, strength, and structural integrity in load-bearing architectural elements.

In the second half of the semester, a collective project applied knowledge gained from prior work. The collection of individual proposals led to a larger collaborative final structure, designed and fabricated within the fabrication lab and briefly installed on-site off campus. Structural analysis simulations effectively predicted performance characteristics observed post-assembly, showcasing the practical application of theoretical learning. Students learned to navigate the complexities of design as a material process, adjusting their designs to accommodate the inherent qualities of steel. This experience not only deepened their understanding of fabrication processes but also highlighted the critical feedback loop between design and construction, akin to professional practice.

Ultimately, this studio fostered an appreciation for the malleability and strengths of materials, reinforcing the importance of embedding structural, form, and assembly information directly within the cut patterns, challenging students to innovate within the parameters of a specific material.

Enhancing Classroom Ventilation and Indoor Air Quality through Sunspace Design Optimization

Atousa Momenaei, Alexandra Rempel | University of Oregon

Andrea Soledad Martinez, Maria Isabel Rivera | Universidad de Concepción

Indoor air quality (IAQ) and thermal comfort are crucial factors impacting students' health and academic performance. However, poor IAQ and high CO2 concentrations resulting from low ventilation rates are widespread and well-documented issues worldwide. These problems are most pronounced during winter when windows stay closed to retain heat and prevent uncomfortable cold drafts. At the same time, increased use of space heating is undesirable due to fuel scarcity and the high costs of central heating systems in developing countries, as well as pollution and decarbonization priorities in developed countries.

Recent research shows that the potential for direct solar heating for heating purposes is greater across various climates than previously assumed. Solar radiation entering through windows and skylights provides immediate indoor warming and gradually releases stored heat, effectively regulating temperature fluctuations. This potential for thermal energy to preheat outdoor air raises the question of whether well-designed sunspaces could meet both the thermal and air quality needs of classrooms during the heating season by allowing higher ventilation rates without compromising indoor temperature.

To explore this, we modeled various sunspace configurations using Grasshopper, a parametric tool in Rhinoceros, and assessed their energy performance with Ladybug Tools in a case study based in Concepción, Chile. Previous field studies indicate that schools in this region often face challenges such as low indoor temperatures and elevated CO2 levels due to high student density and limited air circulation.

Our investigation tested 3,888 sunspace configurations, varying in depth, roof angle, glazing ratio, and construction materials, to identify the design with the lowest heating demand in Concepción. We also assessed the effectiveness of movable insulation controlled by energy management systems (EMS) to enhance sunspace performance during colder periods. To illustrate the impact of a well-designed sunspace in different climates, we extended the optimization to classrooms in La Serena, Santiago, and Puerto Montt.

In the baseline case without a sunspace, an outdoor air exchange rate of 2 ACH, as mandated by national regulations, led to peak CO2 levels of about 2,300 ppm during school hours in all cities. Under unheated conditions, the optimized sunspace allowed for effective warm air delivery to the classroom, supporting outdoor air exchange rates of up to 6 ACH and reducing peak CO2 levels to 1,040–1,380 ppm (approximately a 1,200 ppm reduction) while maintaining indoor operative temperatures 0.2°C higher than the base case. In contrast, applying 6 ACH in the base case without sunspaces resulted in a temperature drop of up to 3°C, compromising students' thermal comfort. For higher indoor temperatures, a 4 ACH air exchange rate was applied. In this scenario, the optimized sunspace configuration increased minimum indoor temperatures during occupancy by up to 2°C above the base case while reducing CO2 levels by around 1,000 ppm.

These findings indicate that an optimized sunspace configuration supports higher outdoor air exchange rates, lowers CO2 levels, and maintains warmer indoor conditions, thereby enhancing thermal comfort even with increased ventilation rates.

If You Build It, Will It Make a Sound? Learning through Acoustic Testing of Mass Timber Floor Assemblies

Dustin Albright, Kylee Russell | Clemson University

A hollow massive timber (HMT) floor system was developed at (Omitted) University to address several overarching objectives: long spans, low-embodied carbon, building systems integration, and end-of-life circularity. One related goal was a departure from concrete toppings, which complicate disassembly and reuse. However, concrete toppings are key contributors to sound attenuation, so the acoustic performance of the HMT system needed rigorous testing in order to determine if it could meet stringent sound rating requirements, particularly for residential and hospitality settings.

Each HMT floor cassette consists of two 3-ply cross-laminated timber flanges and two glulam web members. Designed for spans up to 40 feet, the system reduces the need for interior bearing points, promoting flexibility. The cavities are designed to meet fire compartmentalization requirements and can be used for the passage of MEP systems, with top-down access provided at periodic hatches. A variety of flange-to-web connection methods were explored to ensure both structural integrity and ease of disassembly.

Rather than outsourcing acoustic testing to a commercial facility, our team embraced a hands-on approach to promote iterative design studies while enhancing learning opportunities. With support from a Construction Logistics elective course, plus student research assistants from several disciplines, an acoustic testing chamber was built for measuring sound transmission through floor assemblies. The two-story chamber includes a sound source room (above) and a sound receiving room (below). It was

constructed in two halves and with hinged upper walls such that it can collapse down for movement between our low and high-bay lab spaces.

The chamber was designed to support ASTM-compliant testing to demonstrate whether floor assemblies meet the IBC's required sound attenuation standards, including minimum field-test ratings of 45 for airborne sound insulation and impact sound insulation, which are required for residential and hotel applications. Professional acoustic testing equipment was used for generating and measuring sound across the spectrum of discernable frequencies.

Testing began with baseline floor assemblies, placed into the 8'x20' void between source room and receiving room. Results were compared with third-party lab results to validate the sound chamber and test procedures. Testing of the HMT cassette followed, beginning with the bare assembly, and then adding various layers to study their effects. These included carpet tiles, acoustic mats, and OSB subfloor. The addition of cellulose insulation in the HMT cavities was also studied. All versions of the HMT cassette achieved the required airborne sound rating (NNIC > 45), while the versions with carpet or acoustic mat exceeded impact sound requirements (NISR > 50). These results demonstrate that HMT assemblies can meet or exceed the IBC's most stringent acoustic requirements without concrete toppings.

From planning to construction to validation and testing this hands-on study of acoustic behavior and performance provided encouraging data for the all-timber HMT system while also providing valuable educational experiences at multiple levels. Looking ahead, a detailed acoustic testing manual was created to guide future testing and education. The team is ready to examine new floor assemblies while also broadening its studies to include flanking sound above demising walls.

Forensics in Process: A Heuristic Approach Combining Topology Optimization and Computational Fluid Dynamics

Angus Eade | University of Kentucky College of Design

Forensics generally involves the application of scientific methods to investigate crimes or other legal matters. However, the term forensics is metaphorically coopted here to provoke new lines of inquiry regarding the process of design, specifically in the context of emerging double-curved shell architectures. Computational Fluid Dynamics (CFD) and Finite Element Analysis (FEA) can be conceived of as new interactive lenses that assist in revealing hidden potentials in the forces and flows at work within structures and spaces. These tools aid in identifying and developing potential architectural microclimates and climatic efficiencies that coincide with double-curved shell structural-spatial syntaxes and their expanding ontologies. Working with CFD and FEA infuses the design process with iterative cognitive feedback capabilities for designers, expanding actionable knowledge and intuition during the design process. Computational simulation makes legible invisible stresses and strains in structures/materials—in the case of FEA—and patterns of airflow and ventilation, humidity, and temperature dynamics in spaces and through construction assemblies—in the case of CFD.

While considered innovative in terms of marrying expressive sculptural form with effective structural form, shell structures have traditionally been canonized as "structural art" However, the doubly curved geometries intrinsic in shell structures hold yet to be fully developed promises for multiple

simultaneous, passive building systems optimizations, including simultaneous monocoque integrations of natural light direction and delivery, precipitation control, and acoustic conditioning (Knippers and Cremers 2019). The intersection of computational simulation modalities is particularly promising. FEA-enabled topology optimization can identify "lazy material"—a concept introduced by Pier Luigi Nervi, referring to unnecessary material that can be subtracted from shell-structured envelopes and components—creating porosity for the transference of forces and flows, including light, air, temperature, humidity, sentient beings, and vehicles.

Forensics in Process postulates that the pursuit of optimization during the design process need not be overtly deterministic. Rather, a heuristic approach to designing with computational simulation can effectively leverage the “forensic” capacities to produce architectures that satisfy corporeal needs while uplifting the human spirit (Benvenuto 2012). This approach is intrinsic to the non-linear, free associative, inductive, and recursive nature of design processes. Forensics in Process proposes a new relationship between the qualitative and phenomenological pursuits of design—desire, belief, delight in color and form—and objective knowledge, critical assessment, identifying failure, identifying yet-to-be-known potential, and analytic quantification.

Although CFD and FEA are advanced technologies relative to traditional manual techniques (pencil and ink on paper), they are still in their infancy, with much of their potential yet to be realized (Shou and Sun 2022). Normalizing computational simulation in practice and academia could address deficiencies in conventional architectural practice, where structural, material, and environmental performance are often ignored or notionally conceived by designers who outsource difficult problems to consulting engineers. This hardens disciplinary boundaries, limits the built environment's full potential, and often results in engineering as an afterthought rather than comprehensive integration (Anderson, Tannehill, and Pletcher 2016). The conceptual framing of Forensics in Process seeks to bridge the rifts between architects and engineers, unlocking the built environment's full potential. By subverting conventional architectural practices and assumptions, which often see structural, material, and environmental performance as secondary concerns outsourced to consulting engineers, this approach emphasizes that the polarity between formal, sculpturally expressive architecture and high-performance architecture is a false dilemma.

Empowering Community through Design-Build Education: A Playhouse for CASA

Jarren Amaro, Peter Raab, Lenora Ask | Texas Tech University

This faculty-led, community-driven initiative demonstrates how design-build education can foster meaningful connections between students, faculty, and the wider community. Beginning as a one-week charrette within two fourth-year architecture studios, the project launched the semester with purpose by partnering with CASA (Court Appointed Special Advocates), a non-profit supporting foster children. Twenty-six students collaborated with faculty, staff, and community volunteers to design and construct a playhouse for CASA’s annual fundraiser. After presenting their designs, students worked with community partners who donated materials, refining details and collectively bringing the project to life.

The resulting playhouse not only supported CASA’s mission to provide healthcare and social services to foster children but also empowered students to see the tangible impact of their work. This design-build process strengthened ties between the university and the local community, showcasing how architecture can serve as a tool for advocacy and social change. By applying their skills to support the

underserved, students experienced firsthand the transformative power of architecture to create spaces that embody care, collaboration, and purpose.

Aligned with the conference theme Empowerment through the Architecture of Performance, this project illustrates the potential of architectural education to inspire lifelong engagement and foster a sense of responsibility in future architects. Through this initiative, students learned to step up as community leaders, leveraging their talents to enact change and deepen their understanding of the role of architecture in building stronger, more inclusive communities.

Let Me Go Semi-Outside: A Human-Centric Comparison of Outdoor Comfort Models in a Hot-Humid Semi-Outdoor Environment During Summer and Mid-Season

Cameron Spencer Klassen, Mili Kyropoulou | University of Houston

Modern conventions of indoor thermal comfort rely on thermal neutrality, reducing physiological adaptability to different thermal stresses and arguably associated with substantial energy consumption. Critiques often remark that it conflicts with modern sustainability standards. As a response, over the past 20 years, a marked increase in outdoor comfort model development has been observed in European and Asian countries (Zhao et al. 2021). During the Covid-19 quarantines, the results of long-term indoor stasis in 'thermally comfortable' environments have been shown to be detrimental, both through anecdotal social discourse and in the results of peer-reviewed studies (Stock et al. 2022). Evidence also shows the need for properly ventilated sheltered spaces, characteristics of the semi-outdoors, for mental and physiological health (White et al. 2019). Somewhere between the sealed box and an open field lies the semi-outdoor environment, such as balconies, courtyards, and transitional spaces. While several studies have been conducted in hot, humid outdoor environments, there is a lack of research on semi-outdoor spaces, especially in North America.

This study takes an empirical, human-centered approach to the understanding of several outdoor comfort models; PET, OUT_SET*, and UTCI. As part of a larger study to understand the relation between cognition, mood, and comfort in a semi-outdoor space, environmental data have been collected (airspeed, dry bulb temperature, relative humidity, black globe temperature) along with synchronous self-reported comfort surveys while participants are undertaking cognitive tests for approximately 60 minutes. These trials were performed in a semi-outdoor courtyard on a higher education campus between August and November 2024, representing typical summer and mid-season conditions of the local climate (hot and humid, latitude 29o45'). The courtyard has 40-foot-high walls on all sides, a large tree in the center, a mix of hardscape and softscape ground surfaces, and several ground-level openings that force higher air velocity through the space.

During the study ,55 participants sat for an hour on average, performing a series of computerized tasks, answering a series of surveys, and completing a cognition test. During the surveys, clothing levels were self-reported to properly compute thermal comfort models. Demographic information was collected from participants to determine correlations between age, sex, ethnicity, BMI, place of origin, length of time residing in local climate, and concurrent self-reported comfort levels. Using the ASHRAE 55 7-point Likert scale, subjective thermal and mood questions were asked at the beginning and the end of the 60-minute-long session. Subjective thermal and mood responses provided key data to assess the

effectiveness of thermal comfort models in real-world scenarios, and establish correlations between individual microclimatic parameters and thermal comfort specific to semi-outdoor spaces.

Preliminary data indicate that short-term experiences moderately affect thermal comfort reporting in this environment, while long-term climatic-cultural experiences exhibit a strong correlation to coping with computed discomfort as indicated by the responses at the end of the 60-minute study. Gender and BMI will also be compared to reported comfort and individual microclimatic conditions will be assessed as predictors. Air velocity was observed to be the most varying parameter exhibiting a medium correlation to thermal comfort reporting, and mean radiant temperature was the second most critical factor. The results analysis is still ongoing. This research aims to break ground toward further research and discourse that will ultimately result in making the adaptive benefits of semi-outdoor spaces the standard in building design and public space development.

Evaluating Privacy in Urban Apartment Housing

Terri Peters | Toronto Metropolitan University

Introduction: In urban apartment housing, design decisions relating to building massing, choice of materials, unit floorplans, and balcony design, are some of the considerations that must be evaluated for their impact on numerous performance factors. Holistic building performance includes indoor environmental quality, resident comfort, and especially in urban housing, views and visual privacy. Background: Certain design decisions and features in apartment designs support visual privacy and enable quality views from dwellings, and new simulation tools are increasingly able to parameterize and quantify these aspects. For example, ClimateStudio, a plug-in for Rhino, has View Analysis as a performance criteria relating to the LEED rating system's View Quality Credit in the Indoor Environmental Quality (IEQ) category. View Quality is currently understudied in the context of apartment housing and there is a related area that needs investigating: visual privacy. There is a research gap relating to evaluating visual privacy and visual connectedness and it is especially relevant in urban apartment housing. This paper reports on a project that reviewed the literature on visual privacy and explored how it can be evaluated in multi-unit residential housing. Methods: This paper reviewed relevant green building rating standards and environmental simulation tools relevant to the analysis of visual privacy. Based on this, a number of specific visual privacy challenges for urban apartment housing were identified. Case studies were selected to observe and test specific visual privacy relationships and draw conclusions about how existing standards and research would apply to these contexts. The goal of the project was to develop a researched set of visual privacy considerations relevant to this building type. Results and Discussion: Following a thematic review of published literature on visual privacy, a survey of relevant environmental simulation tools was conducted specifically focused on visual privacy and indoor environmental quality. Three main visual privacy challenges relevant to urban apartment housing were examined: facade to street relationships, balcony design including balustrade and views in and across facades, and views from building to building from windows. Observations from selected housing case studies provided examples of how residents are mitigating these visual privacy challenges and these were categorized as buffer spaces, vegetation, shades and materials. The findings of this study were contextualized within current standards and tools for visual privacy as well as within a larger discussion of related indoor environmental quality parameters. The discussion section of this paper explores a proposed framework for evaluating visual privacy specific to this building type. Conclusions:

This paper highlights an important and understudied area of research in building performance in apartment housing, and summarizes the main published literature to date on visual privacy. A typology-specific framework for evaluating visual privacy is proposed, and future work in this area is suggested.

Evaluating Healthy Housing Parameters in Coop Housing

Terri Peters | Toronto Metropolitan University

Budget, location, user groups, and program briefs all influence housing design, project quality, resident experience, and building performance. This paper presents preliminary results of a larger study that compares different housing types in terms of indoor environmental quality and certain "healthy housing" criteria. Specifically, this paper evaluates and compares daylight, ventilation and outdoor space in a number of co-op apartment housing projects in Canada to get a sense of typology-specific design challenges and benefits or healthy housing in this housing type. Background: There are many important aspects to consider in evaluating healthy housing, and this study focused specifically on three main parameters: daylight, ventilation and outdoor space. Daylight availability was evaluated because studies show that daylight positively impacts health and wellbeing. Following COVID-19, many studies on healthy buildings have focused on ventilation. Increasingly, residents in multi-family housing are concerned about being able to ventilate their apartments. In many apartments there are windows on only one facade and it is therefore impossible to have daylight reach the back of the unit, or for it to achieve natural cross ventilation. Numerous studies have shown that access to outdoor space and proximity to outdoor space are connected to people's health and wellbeing and so this was a parameter in this study. Methods: The study examined three co-operative housing examples in Canada: The Neill Wycik Co-operative College (built 1969), the Woodsworth Housing Co-operative (built 1979), and the Fraserview Towers Co-operative (built 2018). To analyze these buildings, elevations, unit and building plans were redrawn in order to determine floor areas and window to wall ratios. Three aspects of healthy buildings were evaluated, for daylight, environmental simulations were carried out including their surrounding context. The building as a whole was evaluated, and typical units were evaluated to see if they would meet LEED v4.1 Option 1 Daylight Availability using Climatestudio software. Window to Wall ratio was also calculated. For ventilation, a plan-section analysis was carried out and a determination was made about how well a dwelling could be naturally ventilated. To evaluate size and location of outdoor spaces, site plans were studied in relation to the dwellings. The results of these studies were compared to standards in green building rating systems and healthy housing rating systems. Results and Discussion: Of the three buildings studied, the Fraserview Towers Co-op scored the highest in the three areas, while the Neill Wycik and Woodsworth Co-operatives are lacking in many parameters. It was notable that each of the three buildings had a very low window-to-wall ratio (WWR) compared to typical non-co-op housing being built in Canada currently. Most bedrooms had adequate daylight although many communal areas had no direct access to windows. Conclusions: The small sample size of only three buildings made it difficult to generalize significant results about healthy housing generally. However, this study was useful in that it contributes to a growing literature about characterizing healthy housing in apartments. This work may inform future designs and renovations of this housing. Passive strategies such as natural light directed to all rooms, better natural ventilation and more focus on private and shared green spaces should be considered in the design of future housing co-operatives.

Educating the Educators

Terri Peters | Toronto Metropolitan University

During their education, students of architecture in Canada take courses that cover various topics in building performance, including design for climate change and sustainability. But with rapidly changing tools, metrics, terms, and guidelines, educators cannot be sure if our professional requirements and institutional curricula are doing enough to prepare students for future practice. Their current education takes place in a housing crisis and climate emergency, and over the next few decades there will be an inevitable transition to increased use of retrofitting and renewable energy in buildings. There is a need to have a better understanding of how students feel prepared by their education for their future practice in Canada. This poster summarizes results of a web-based survey of Canadian architecture students, asking them if they feel ready for future practice based on what they've learned in their architectural education, specifically relating to design for climate change and sustainable design. Inspired by the ACAN initiatives in the UK, the goal of the survey was to collect the first national data of this kind, and to learn more about student perspectives to inform new thinking about our professional education of architects in Canada. Adapted from a questionnaire by the ARCH4Change Erasmus+ consortium, which is led by Tampere University (Finland), with Aarhus School of Architecture, Denmark; Bologna University, Italy; Taltech, Estonia; and TU Dublin, Ireland, this survey was administered online from Feb 2022 to May 2022. There were 196 responses from all twelve of Canada's accredited architecture schools. The survey asked questions about how the students rate their knowledge of general and specific building performance tools, sustainable design concepts, and climate change knowledge, how they feel building performance, sustainability and climate change are taught and evaluated in their education, and how important they see different aspects of building performance. Responses were a mix of short answer, multi-part questions, and some used a likert scale. The poster illustrates some student responses and has a link to the actual survey used. The main results were that students report a gap between what they are taught, and what they think they need to know as future practitioners; students responded that they largely do not have confidence in their knowledge about building performance specifically many climate change key terms and concepts; respondents report strong positive opinions about the connection between architecture and climate change and sustainable design; and students report that climate change/ sustainable design issues are not currently being prioritized, evaluated or focused on in design studio. This is the first survey of its kind in Canada that specifically reports on student experiences of their architectural design education specifically relating to sustainability and design for climate change. The results are discussed in connection to responses from other climate literacy reports in Canada such as the Canadian Architects Benchmark Report for practitioners and in the context of international climate literacy initiatives for the professional education of architects such as ACAN in the UK. The analyzed student responses in the survey were used to develop recommendations and conclusions. The findings were used to propose strategies for updating the education of future professionals including focusing on educating the educators. The finding that many of Canada's future practitioners do not feel equipped to tackle the challenges they will face in future practice needs further investigation and immediate action.

-PAPER ABSTRACTS-

TUESDAY, JUNE 3, 8:45AM

OPENING SESSION

Moderator: Terri Meyer Boake, University of Waterloo

Concrete City: Chicago's Role in Concrete High-Rise Engineering

Thomas Leslie, FAIA | University of Illinois, Urbana-Champaign

Carol Willis | The Skyscraper Museum, New York City

Chicago's iconic skyscrapers—the Sears Tower and John Hancock Building, in particular, have given the city a deserved reputation as a center of innovation in steel engineering and construction. However, Chicago has a parallel history as the leading center of concrete high-rise innovation, which also deserves recognition alongside its traditional steel-centric history. This was particularly true during the second half of the 20th century. More than half of the roughly 400 buildings taller than 12 stories built in Chicago from 1950 to 1986 were concrete, not steel. More significantly, six of the ten structures that claimed the title of the world's tallest concrete skyscraper from 1902 to 1989 were built in Chicago. Research done for the Spring 2025 exhibition The Modern Concrete Skyscraper at New York City's Skyscraper Museum suggests that Chicago's leadership in concrete high-rise construction was due to three main factors: its geology, the initiatives of curious, innovative designers along with entrepreneurial suppliers and contractors, and Chicago's culture of collaborative efforts among and across disciplines.

A Return to the Thick Space of the Wall

Genevieve Baudoin | Kansas State University

Bruce A. Johnson | Dual Ecologies

This paper examines a return to the thick space of the masonry wall. The wall is where a building embraces its context and where humanity can physically experience this nexus. Contemporary technologies applied to masonry construction offer a return to both tactile solidity and the space of interaction between a building and its users. Precedents from Catalan vernacular to Herzog & de Meuron will be contrasted to offer a way of thinking through the spatial potential created through the modularity and specificity of blocks.

From that comparative study, the authors propose a design methodology using their own projects as case studies in distinct contexts. These case studies mine pattern and variation in unit masonry to generate a nuanced understanding of not only structure and systems within the wall but of the overall composition of the façade/wall itself.

Virtual Reality and Structures Education?

Marci S. Uihlein | University of Illinois Urbana-Champaign

As Artificial Intelligence, Virtual Reality, and Augmented Reality become more ubiquitous, it is useful to explore their applications in education. Will there be benefits to including more digital tools in the classroom for this entirely digital generation? For example, can an interactive 3D representation of a building's structure aid student learning about the system and load flow? This paper will present the in-progress results from a collaborative research project entitled, "Virtual Reality as a Vehicle for Education in the Domains of Building Systems and Construction Materials." This funded educational research project was designed to test how immersive experiences such as virtual reality might influence the understanding of load paths in a building. The presentation will introduce the collaborative team of civil engineering and architecture, explain the goals of the funding organization, and describe the student groups being tested. The research methods will be outlined including the IRB process, the design of the virtual reality experiment, and creation of the evaluation mechanisms. Also, the outcomes from a student survey about the experience will be shown. With three years of testing completed, incomplete results will be shared as well as incomplete conclusions. Though using the same testing mechanism, the results vary significantly by discipline and remain inconclusive for architecture students. Lastly, there will be some discussion of research quandaries, lessons along.

Beyond Aesthetics: Adaptive Facades as a Bridge Between Climate Responsiveness and User Experience

Peter S. Raab | Texas Tech University, Huckabee College of Architecture

This paper presents a scalable pedagogical framework for introducing adaptive façade design as a bridge between climate-responsive architecture and user-centered experience. Recognizing the urgent demand for ecological literacy in architectural education, the curriculum integrates bioclimatic theory, parametric modeling, material systems, and environmental performance simulation across undergraduate and graduate coursework. Through a multi-course sequence—including an undergraduate seminar, a required building technology series, and a graduate design studio—students engage in both conceptual and technical dimensions of adaptive envelope design.

The structure emphasizes case study analysis, iterative prototyping, performance simulation, and interdisciplinary collaboration with industry professionals. Assignments evolve from early analytical drawing and physical models to parametric workflows using Rhino/Grasshopper and plug-ins such as Ladybug and Climate Studio. Deliverables include performance-driven façade prototypes and climate-adaptive envelope systems grounded in site-specific ecological and cultural contexts. This paper details the learning objectives, course sequence, toolsets, and outcomes across these modules, arguing that adaptive façade design offers a compelling site to integrate technical fluency, environmental ethics, and spatial creativity. By embedding this topic within a vertically integrated curriculum, the framework demonstrates how architectural education can cultivate ecological responsiveness, develop a technical skillset, and enrich climate-specific design through innovation. The paper reflects on challenges to implementation, integrates student feedback, and outlines next steps for iteration.

TUESDAY, JUNE 3, 10:30AM

EMBODIED CARBON

Moderator: Rob Whitehead | Iowa State University

Sustainable Building Envelopes: Exploring Alternative Materials for Passive Thermal Regulation Through Hotbox Testing

Safiyyah Khan, Mili Kyropoulou | University of Houston

Climate change has intensified the need for sustainable building materials that reduce carbon emissions and energy consumption. Traditional construction materials contribute significantly to climate change due to their high embodied energy and limited recyclability. This study is part of a longer project to explore the performance of alternative, sustainable building materials that might be friendlier to the environment. The study is performed using a controlled hotbox experiment. The hotbox, adapted from McCormick's design (2023), provides an accessible, low-cost method for physical testing of thermal performance.

The experimental setup consisted of a double-chambered hotbox, with an interior metering chamber and an exterior unconditioned chamber. Cork, mycelium, and sheep wool materials were developed for initial testing in the hotbox. Temperature sensors recorded heat transfer through the test materials to assess their effectiveness. The results indicated that all three materials performed comparably in limiting heat transfer, with cork maintaining the lowest interior chamber temperature, followed closely by mycelium. Wool exhibited the most stable temperature readings, suggesting strong insulation properties but also potential heat retention. These findings highlight the promise of natural, biodegradable materials as viable alternatives to conventional insulation.

While the study confirms the potential of sustainable insulation materials, further research is needed to refine testing conditions and further develop the hotbox, extend experiments to real-world applications, and evaluate long-term performance under varying environmental conditions. This research contributes to the broader movement towards eco-friendly construction, emphasizing the importance of innovative, accessible testing methodologies in developing climate-resilient building materials.

Rethinking Sustainability: A Pedagogical Approach to Explore Design for Disassembly

Anahita Khodadadi | University at Buffalo, New York

As climate change and the global waste crisis intensify, the building industry must adopt methodologies that reduce its environmental impact. This study examines a graduate-level design studio centered on Design for Disassembly (DfD), challenging students to design timber structures for multiple life cycles through material recovery, reuse, and adaptability. Students completed two interconnected design assignments, constructing half-scale prototypes that combined theoretical knowledge, digital modeling, and hands-on fabrication. The second assignment required reusing or reconfiguring components from the first, showcasing adaptability and waste minimization. This paper outlines the studio's learning

objectives, describes the instructional strategy, assignments and outcomes, and analyzes challenges and opportunities encountered during the course. Students' reflection journals revealed that they developed a deeper understanding of sustainability, critical thinking, and collaborative problem-solving, while confronting challenges like joinery complexity and material constraints. The study underscores the value of DfD in architectural education to prepare designers to address environmental challenges and advance the circular economy.

Holistic evaluation of formwork materials for low-carbon concrete

Alexandra Daley, Mohamed Ismail, Leopold Wehner | University of Virginia School of Architecture

In the current climate crisis, designers must explore scalable and immediate methods of reducing the embodied carbon of concrete structures. Such work depends on a quantitative understanding of the costs of concrete construction. Although the carbon costs of concrete as a material are well understood, identifying the layered costs of concrete formwork and construction is not as thoroughly documented. These costs have mainly been explored through qualitative data, but meaningful reductions in concrete's environmental cost require an understanding of the embodied carbon of concrete forms as well as the labor cost and complexity associated with different materials and methods.

This paper presents a framework for quantifying and comparing the embodied carbon and labor involved in concrete formwork and casting through several lab-scale prototypes of shape-optimized concrete built using various form materials and digital fabrication methods. Formwork options include materials that fall under traditional practice, emerging practice, and organic formwork. Procedures combine casting experiments of an optimized beam design with an embodied carbon evaluation for both formwork and concrete, comparing the strengths and weaknesses of each material. By testing and documenting a range of formwork materials, this research attempts to develop a detailed understanding of the labor and carbon associated with formwork options. Formwork materials are qualitatively and quantitatively compared for their precision, accessibility, ease of construction, and embodied carbon. After analyzing formwork materials from this casting process, key materials will be selected to scale up for full-scale prototyping and stress testing. While the outcomes of this study are highly specific, a framework of quantifiable formwork material comparisons will guide future research into scalable and accessible methods for low-carbon construction.

Hybrid Typologies: Quantifying the Operational Energy, Embodied Energy, and First Cost of Emergent Light-Wood-Framed Multifamily Construction Methods

Grant Mosey | University of Las Vegas Nevada

Historically, large apartment developments in the United States likely took one of two forms: low-rise garden apartments which offered low construction costs associated with light wood framing, or high-rise apartment buildings which were more costly but afforded greater density. Low-rise garden apartments could be build using inexpensive dimension lumber, but were limited to densities of 25-40 units-per-acre. Conversely, high-rise projects had no density limitations, but required construction using more costly fire-resistive and/or non-combustible construction.

In recent years, new typologies have emerged which seek to combine the cost effectiveness of light-wood framing with the higher densities of fire-resistive construction by combining construction types in the same building. Two popular versions of these typologies are the podium building and the wrap/donut building. These buildings allow for the construction of densities which can be more quadruple garden apartments without abandoning the cost effectiveness of light wood framing.

The construction of wrap and podium buildings has exploded, with subtypes such as the “Texas Donut” and the “Five-Over-One” now dominating new multifamily construction. Unfortunately, the scholarly understanding of these buildings has lagged behind their implementation, creating difficulty in quantifying their impact in terms of first cost, operational energy use, and embodied energy performance relative to other common multifamily types.

In this paper, we propose using permit, bid, and construction documents from recently completed projects to develop four prototype buildings, each housing the same number of units of the same size and varying construction types and representing, respectively, garden apartments, wrap buildings, podium buildings, and conventional high-rise buildings. We propose comparatively evaluating these four types, the first and last of which represent conventional solutions while the middle two represent new hybrid solutions. Evaluation will be conducted for operational energy use using an hourly energy model, embodied energy of materials using a detailed three-dimensional structural model, and cost, using quantities from the previous models in concert with industry-standard cost estimation resources such as RSMeans.

In doing so, we hope to create a “base case” understanding of light-framed podium and wrap buildings, which will allow for better accounting of their environmental and economic impact relative to the traditional garden apartment and high-rise apartment types.

TUESDAY, JUNE 3, 1:00PM

USER EXPERIENCE

Moderator: Kristi Sattler AISC

OpenHouse: A Thermodynamic Living System

Mili Kyropoulou, Jason Logan | University of Houston

This paper reports on the design and development of a housing prototype for the Gateway Decathlon international competition. Housing scarcity, global warming, and the need for resilient solutions drove the central approach that defined the design. The developed prototype challenges conventional housing layouts and operational patterns by employing theories of openness in architecture and computational analytics on environmental performance, providing the foundation for a flexible and scalable design suitable for changing conditions. Our analysis demonstrates the potential of open designs to leverage local climates in creating thermally diverse and comfortable conditions while encouraging variability.

Assessment of Indoor Environmental Quality in Educational Settings: Insights in level of stress, attention and engagement

Marjan Miri, Carlos Faubel, Antonio Martinez-Molina | Drexel University

Indoor environmental quality (IEQ) significantly influences cognitive engagement, stress, and overall well-being in educational settings. This study examines the effects of three key IEQ factors—air temperature, relative humidity, and natural light—on students' attention and relaxation using electroencephalogram (EEG) monitoring in a controlled environment. Twelve participants engaged in experimental sessions under four scenarios: baseline conditions, exposure to natural light, increased humidity, and elevated temperature. Objective EEG metrics were complemented by environmental data, including air temperature, relative humidity, lighting levels, and carbon dioxide concentrations. The results reveal distinct effects of IEQ factors on cognitive and physiological responses. Exposure to natural light improved relaxation but reduced attention, indicating its restorative effects on stress recovery while potentially introducing distractions. High humidity levels negatively impacted both attention and comfort, reinforcing the challenges associated with exceeding recommended humidity ranges. Elevated temperatures enhanced attention but slightly impaired relaxation, suggesting that warmth may promote cognitive engagement at the cost of minor discomfort. Baseline conditions recorded the highest attention levels, underscoring the value of stable and unaltered environments in fostering focus. These findings demonstrate the nuanced interplay between environmental parameters and their psychophysiological impacts. This research highlights the importance of understanding how variations in IEQ factors influence mental states in learning spaces. While individual factors have distinct effects, the dynamic interaction between air temperature, relative humidity, and lighting requires careful consideration to create environments that support both cognitive performance and emotional well-being. These insights contribute to the growing body of knowledge on designing effective and student-friendly educational environments.

Breaking the Code: A Prototype for Single-Stair Housing

Zhan Chen | Kansas State University

In the United States, code requirements for two means of egress have contributed to the widespread implementation of double-loaded corridors in multi-family housing. This configuration results in constrained unit layouts, limited natural light and ventilation, and circulation spaces that function purely as utilitarian passageways. In contrast, single-stair housing, commonly known as point-access blocks, offer greater spatial adaptability and improved living environments. Yet, despite their benefits, this typology remains largely restricted under US building codes.

However, recent policy shifts to allow single-stair housing in some cities have gained attention and support. The project presented in this paper speculates how these emerging regulatory changes could impact housing in the U.S. The Geode House is a prototype that explores how the stair can break out of its mono-functional role and facilitate various forms of human contact. By integrating shared programs, outdoor spaces, and varied circulation patterns, the Geode House challenges conventional housing models and creates new connections between private and communal domains.

TUESDAY, JUNE 3, 1:00PM

TEACHING PEDAGOGY

Moderator: Deborah J Oakley, University of Las Vegas Nevada

The B-TEAM: Curriculum Development Through Mutual Mentoring

Robert Williams, Jordan Kanter, Hellen Awino, Caryn Brause, Ray Mann | University of Massachusetts Amherst

This paper outlines an approach to department-level curriculum development and restructuring grounded in a mutual mentoring process. The paper discusses the mutual mentoring model, describes the unique institutional characteristics, presents the research methodology for peer-assessment, and concludes with a discussion of the findings and suggestions for curricular restructuring. The paper closes with reflections on the impact of the novel mutual mentoring model for this type of curricular development

Political Economy in Introductory Technical Architecture Education: Experiences and Pedagogical Methods

Keefer Dunn | School of the Art Institute of Chicago

Within the context of architecture school, technical subjects are often presented as separate, objective spheres of knowledge, divorced from socio-political concerns, theoretical critique, and even aesthetics. Sustainability is perhaps the only notable exception, but even here, the emphasis is often on quantifying how building systems and new technologies can reduce energy input rather than exploring the regulatory frameworks and political conflicts that shape our professional approach to energy conservation. While there is a renewed interest in architectural theory surrounding the political economy of construction sites, material supply chains, and labor, more work needs to be done by educators to bridge the gap between specializations.

This paper introduces an alternative pedagogical method for teaching building technology that I developed for an undergraduate architecture elective called “Construction and Design.” I have taught this course for five years at the School of the Art Institute of Chicago, and its hallmarks are its incorporation of political economic critique and focus on technical know-how that even beginning students can readily apply.

I argue that building technology educators can enhance student learning outcomes and engagement in their courses by incorporating architectural theory focused on the political economy of building through Socratic dialogues, reading discussions, and even politically provocative lectures. By helping students understand the broader stakes and contexts that surround and condition technical knowledge, they become more likely to engage with it. Although it is too early to tell, the hope is that in the long term, this approach will also encourage students to participate in the political and regulatory processes (such

as code development and administration) that shape and frame how technical knowledge is applied and developed.

I further argue that the political economy of academia and the building profession favors specialized expertise and discretized courses. While this approach is beneficial for advanced studies in architecture, it often leads to jumbled curricula where technical knowledge is introduced late in the program and results in poor learning outcomes. Therefore, I emphasize the significance of introductory course content that provide a heuristic understanding of building technology, particularly structures, that students can easily apply to their design studio work at all levels. This approach fosters a holistic understanding of construction and design and lays a stronger foundation for further advanced studies.

The Dialectics of Text and Image: From Mechanical Reproductions to AI Image Productions

Ehsan Sheikholharam | Assistant Professor of Architecture, Kennesaw State University

This paper shares the outcome of a funded research project on developing a pedagogic method for harnessing AI image productions. The grant proposal included two workshops in which students experimented with refining the textual descriptions of a design scheme as well as reverse-engineering of AI image outcomes. The goal was to mediate the "translation" between the textual and the visual representations through contextualization of design intentions. We incorporated the following themes to establish the connection between design and context: geoclimatic and environmental settings, social and programmatic functions, material conditions, and building techniques. Embracing the Nietzschean notion of creativity, students staged a form of organized chaos. For Nietzsche, the creative "will to power" was animated by the tension between, on the one hand, the Apollonian spirit of order, restraint, and control, and, on the other, the Dionysian disposition towards frenzy, madness, and ecstatic intoxication. We juxtaposed this conceptualization of creativity with the notions of "Hallucinations and Bias" in Large Language Models (LLMs). The goal was to establish the conditions of possibility for aleatory variations within tools such as Midjourney, Stable Diffusion, and DALL-E. Our strategy was both accumulative and reiterative. Each prompt staged new layers of contextualization while also retaining core elements of the previous description that were deemed effective by students. Using a qualitative analytical framework, we assessed the divergence between "intended" outcomes and the "unintended" variations produced by the AI tools. This research underlines the centrality of contextualization to the productive use of AI in architectural design. These tools, we concluded, are not revolutionary when they produce exactly what is expected. They offer new avenues in creativity precisely when they don't give what was hoped for; when they generate outcomes that extend or challenge our imagination.

TUESDAY JUNE, 3 2:15PM

INTEGRATED DESIGN

Moderator: Marci S. Uihlein | University of Illinois Urbana-Champaign

Updating Materials and Methods of Construction Pedagogy for Digital Natives

Angus Eade | University Of Kentucky, School of Architecture

Charged with the responsibility of imparting essential knowledge of the materials, techniques, and processes involved in shaping the built environment, Materials and Methods of Construction courses have long been a standard component of National Architectural Accrediting Board [NAAB] core curricula guidelines. Punctuated by accelerating techno-cultural change, the recent timeframe has required a rapid sequence of course adaptations at the University of Kentucky, spurred initially by a nearly complete inaccessibility to physical learning spaces instigated by the COVID-19 pandemic and quarantine. Yet, as these immediate disruptions demanded pedagogical improvisation, a second transformation - less visible, systemic, and potentially more profound - was taking shape: the emergence of AI-enabled learning systems and alternate pathways to professional licensure. This study chronicles and analyzes two major adaptations to the course's delivery between 2018 and 2025 and proposes a speculative third version - one that responds directly to this unfolding shift and positions architectural pedagogy in critical relation to the rise of AI-enabled learning platforms and professional credentialing reform.

Beyond EUI

Keith Peiffer, Khaled Mansy, Christina McCoy, Jay Yowell | Oklahoma State University

To address climate change in academia, educators must equip current architecture and architectural engineering students with the knowledge and skills which enable them to contribute to transforming our current fossil-fuel-intensive energy system into a non-polluting sustainable energy system. Indeed, integration of this knowledge and skills in the undergraduate design studio plays a key role in this strategy, but due to the complex range of design responses to a given design project brief, assessing students' success can be challenging. Assessing building performance based solely on the building's Energy Use Intensity (EUI) is fair and simple, but our studio experience found it to be insufficient to assess the impact of specific design decisions, which may be considered a lost educational opportunity.

Through the support of a grant program that allowed us to award students with a monetary prize for high-performing projects, we have been able to refine a user-friendly methodology in our integrative design studio over the past three years. Over consecutive years of developing the assessment criteria, we refined how these awards categories were evaluated in a fair, simple, and meaningful fashion.

This paper will discuss the relationship between design-assisting tools and the resulting methodology for detailed assessment of building performance in the design studio. In doing so, we hope to provide insight for educators seeking to leverage the use of similar tools within the design studio. By maximizing

impact on student learning, we can help our students shape their future careers to face the significant challenges posed by climate change.

Case Study of an Adaptive Reuse Project using Embodied Carbon Visualizations as part of a Holistic Design Process

M. Naomi Darling | Mount Holyoke College / UMass Amherst

Garth Schwellenbach | C&H Architects

Mitsuki Ito, Xinyi Qi, Lauren Madsen | Mount Holyoke College

This paper presents a case study of a small campus building adaptive reuse and preservation project. Embodied Carbon visualizations were used as part of a holistic design process involving undergraduate students and used in conjunction with renderings and pricing to help a college facilities department make decisions about the best pathway forward in the adaptive reuse of the building. This is a replicable process to effectively communicate embodied carbon data alongside more longstanding drawings and renderings to aid design teams and owners to make decisions that consider aesthetics and embodied carbon for a low carbon building future.

Integrating regenerative design with adaptive thermal comfort: insights for sustainable rural housing in India's composite climate

Parvesh Kumar, Vijayaraghavan M Chariar | Indian Institute of Technology, New Delhi

Chitrarekha Kabre | School of Planning and Architecture, New Delhi

The architectural characteristics of traditional rural habitats in India, characterised by greater openness to the external environment, offer residents a more dynamic means of regulating indoor thermal conditions compared to modern urban apartments. This research integrates regenerative design principles with thermal comfort studies to better understand how adaptive thermal comfort strategies can inform sustainable development in rural settings. Specifically, it explores rural residents' perceptions and adaptive behaviours within India's composite climate, which remains understudied in thermal comfort literature. Field studies conducted in June and July 2020 involved 315 survey responses from 105 participants across eight villages in Bulandshahr district, Uttar Pradesh (India). They were paired with concurrent environmental measurements in typical rural dwellings. Surveys were conducted three times daily to capture shifts in comfort responses and adaptive measures such as moderating indoor air movement, reducing activity levels, and resting to restore thermal comfort.

The study revealed that rural residents rely heavily on adaptive strategies, including region-specific attire and open housing layouts, despite limitations posed by socio-cultural factors, particularly for women. The analysis identified a neutral temperature of 30.38°C and a comfort zone between 27.98°C and 32.79°C. Interestingly, even as measured conditions often exceeded comfort standards, residents accepted their indoor environments and tolerated high temperatures, underscoring their unique thermal expectations. Findings indicate that these adaptive responses not only fulfil immediate comfort needs but also align with regenerative design principles by optimising natural ventilation, minimising

mechanical cooling demands, and promoting sustainable living in rural settings. Insights from this study offer valuable guidance for energy-efficient rural housing design under the Pradhan Mantri Awas Yojana (PMAY) – Rural scheme, promoting regenerative approaches that enhance indoor thermal comfort and foster resilient, climate-responsive habitats in India's composite climate.

TUESDAY, JUNE 3, 2:15PM

INTEGRATED DESIGN

Moderator: Neal Maloo | Howard University

Integrating Material Selection and Specification Writing into Architecture Education and Practice

Jessica Garcia Fritz and Mariangel Meza Santiviago | University of Minnesota

The launch of the Construction Specification Institute (CSI) in 1948 established a codified relationship between materials and architecture in the United States through standardized divisions for specification writing. These divisions, including frameworks such as CSI MasterFormat and UniFormat, developed to aid architects in organizing material and technological systems in building projects. Over time, these standards evolved, with the expansion of MasterFormat from sixteen to fifty divisions in 2000 and further signaling a shift in both technological advancements and the specifier's role. Between 2010 and 2020, over two thousand revisions to MasterFormat divisions highlighted the growing complexity of building systems, particularly in the fields of mechanical, electrical, and sustainable technologies—domains where architects often lack full decision-making authority but are adjacent to critical decisions.

Despite these changes, architectural education largely maintains a separation between material selection, addressed in studio or building technology courses, and specification writing, typically confined to professional practice curricula. This disconnect prevents students from understanding how material selection directly informs specification decisions. This paper analyzes the evolution of specification practices and their relationship with technological advancements and sustainability pressures, focusing on the shifts within the CSI MasterFormat. By highlighting the increasing complexity of specification formats, it argues for integrating material selection with specification writing within architectural education to better prepare students for contemporary practice. From this analysis, the paper offers curricular strategies to bridge the gap between material selection and specification writing, suggesting a more holistic approach that considers the evolving role of the specifier in addressing the growing demands of sustainability and technological innovation in construction.

Design Optimization for Resilient Building Design in Coastal Environments

Soo Jeong Jo, Farzaneh Oghazian | School of Architecture, Louisiana State University

Dongkeun Lee | Department of Civil and Environmental Engineering, Southern University and A&M College

The present study aims to investigate the impact of the building form on the surrounding wind flow and support resilient form finding for designing buildings in hurricane prone areas. To achieve this, an immersive case study was conducted for a 1,350 SF single family house in a coastal area in Louisiana. The form of the roof was the tested design parameter since the roof uplift is one of the major hurricane damages in the selected area. Computational Fluid Dynamics (CFD) simulations were performed to optimize the roof form to minimize the possibility of wind uplift. Through this research, the authors tried

to respond to the following question: How can the roof form of a building better respond to extreme wind conditions? The present study may assist architectural designers in developing more resilient building form in the early stages of design and advance the understanding of environmental issues. This work will ultimately promote more sustainable and environment conscious building design.

Resilient building design has become an urgent need and critical issue in the building industry as the acceleration of climate change has increased natural disasters worldwide. The impact on coastal areas may be more frequent hurricane and storm surge events with a higher wind and water velocity, such as Hurricane Katrina, which destroyed about 300,000 houses for one million people [1]. In light of this background, the present study aims to investigate the impact of building form on the fluid flow around buildings and establish a resilient form-finding framework for building design in coastal environments. Through this study, the authors question how the formative process of architectural design can better respond to extreme conditions, such as high-velocity wind events. To answer this question, an immersive case study was conducted for an imaginary 1,350-sf single-family house located in Grand Isle, Louisiana.

Engaged Practices: A Meditation on Design-Build Pedagogy and Public Health

Hannibal Newsom | Syracuse University School of Architecture

This paper presents an experiment in design-build pedagogy performed in a Directed Research course that examines the relationship between architecture, public health, and upward mobility. It argues for the grounding of design-build work in this milieu of public health research and community impact, the prioritizing social impact over technical learning objectives, and that developing projects through multidisciplinary teams that bring together infrastructure, professionals, academics, and civic or community partners creates viable, fundable, realizable projects that can help reduce barriers to opportunity in low-budget contexts.

Greening Building Enclosure for Improved Footprint: Reducing the Environmental Impact of Green Facades and Living-Wall Systems LWS

Ashraf Ragheb | Lawrence Technological University

Several concepts are used in greening the building enclosure, for example green roofs, green façades with climbing plants, and living wall systems (modular pre-vegetated panels). Greening the building enclosure allows to obtain a tangible improvement of its energy efficiency, ecological and environmental benefits, as well as an increase of air quality. Since the interest in restoring the environmental integrity of urban areas continues to increase, new developments in construction practices integrating such vertical greening systems. The integration of vegetation is not a new concept and can offer several benefits as a component of the current building enclosure. It enhances the relation between environmental benefits, air quality, energy saving, and the vertical greening systems. This represents a sustainable approach for the enclosure of new and existing buildings

This study investigates the ecology and typology of green facades and living wall systems LWS and its significance in improving indoor air quality. LWS has been defined as an air purification method. The

potential for reducing inorganic gaseous indoor pollutants, volatile organic compounds (VOC's), and CO2 concentrations have already been proved. Moreover, LWS have also been investigated for the reduction of indoor particulate matters, especially for PM10 and PM2.5, where many studies concluded with significant removal efficiency. Assessment in real indoor environment demonstrated temperature reduction capacity of vertical green systems, which ultimately can be beneficial to lower down the energy requirement for cooling purposes in the buildings.

Since construction of these systems consumes a lot of metals, the study also proposes a circular economy approach through redesigning the industrial metal waste stream used to construct these living walls skeleton. This ecological understanding of materials will reduce environmental impact and serve as a basis to create new value streams for recyclable materials. This concept of ecological material advances the environmental awareness of the benefits of available sources and applications of living walls materials, especially those metals used to construct the skeleton of these walls.

WEDNESDAY, JUNE 4, 8:30AM

TEACHING PEDAGOGY

Moderator: Dustin Albright | Clemson University

From calculations by hand to hands-on explorations: Re-thinking structural design pedagogy through interactive computational tools

Juney Lee | Carnegie Mellon University

Traditional structural design education relies on hand calculations and analytical methods, reinforcing a longstanding divide between architecture and engineering disciplines in practice. While engineers emphasize numerical results and data-driven analysis, architects engage in more intuitive, form-driven explorations. This disciplinary split extends to academia, where differing accreditation standards and pedagogical approaches further entrench these distinctions. However, emerging computational tools offer new opportunities to bridge this gap by fostering interactive, hands-on learning experiences that enhance the intuition of architecture students learning structural design.

This paper proposes a new pedagogy for structural design in architecture education that integrates computational tools as the primary medium, shifting the focus from purely analytical methods to more interactive and exploratory learning. By leveraging digital platforms such as computational graphic statics, parametric structural modeling, and algorithmic form-finding methods, students can engage with structures dynamically with real-time feedback that reinforces both conceptual intuition and computational literacy.

The proposed curriculum consists of three structural design courses, each focusing on a distinct aspect of comprehensive structural education. These courses integrate various computational tools progressively, increasing in depth and complexity as students advance. The sequence is designed to build a strong foundation of knowledge and skills, preparing students for integrated design studios in the later stages of their education. In these studios, students apply the technical skills acquired in the structural design sequence within a holistic design context, demonstrating their ability to integrate structural design into their architectural projects in innovative ways as required by the National Architectural Accrediting Board (NAAB).

Exemplary student work from the first implementation of this new curriculum is presented, illustrating how computational approaches can transform how students engage with technical subject matter and leverage it to explore new design possibilities that were previously unattainable. The primary objective is to equip architecture students with the skills needed to meet the rapidly evolving demands of the architecture, engineering, and construction (AEC) industry. By shifting from static calculations to interactive digital explorations, we can cultivate a new generation of architects capable of innovating across and beyond traditional disciplinary boundaries. The paper concludes with a discussion on current developments and future efforts to further integrate emerging computational technologies, with the overarching aim of discovering new methods of teaching and learning structural design.

Integration and Synthesis: Teaching the Parts in Anticipation of the Whole

Mehdi Ghiai, Liane Hancock | Texas Tech University, University of New Mexico

In 2020, the new NAAB conditions for accreditation marked a deliberate and important change. Systems, technologies, and assemblies are now assessed not only through synthesis and integration with design objectives, code, policy, and other systems, technologies, and assemblies but also by evaluating performance objectives through measurable environmental impacts and building performance analysis.

These new conditions present the opportunity to reframe teaching within a context of decision-making based on empirical analysis through energy modeling, daylighting analysis, building information modeling, and Life Cycle Assessment. However, students must first understand the sense of synthesis and integration. By being able to conceive of building technology in this way and its relationship to empirical analysis then, students can consider how their buildings reveal inefficient societal behaviors, but also how their design decisions can underscore and venerate myriad cultural practices – both new and old – while advocating for spaces of comfort and delight.

This paper presents two faculty members' different methods for teaching an advanced building systems course at University of Louisiana at Lafayette in our graduate program. In each case, the faculty member sought to balance analysis empirically and graphically represented through spatial coordination of systems related to design decisions. Projects included focusing upon full consideration of mechanical, electrical, and plumbing in connection to the development of interior spaces, consideration of envelope design acknowledging different environmental conditions due to orientation, focus upon core and plenum, selection of building envelope based upon environmental behavior, and finally analysis of design decisions using digital evaluation tools.

By breaking down assignments into easier-to-understand pieces, students could use their design skills to consider what they had never had a chance to consider in their studios. By changing focus, students could identify a myriad of new variables and how those variables could be synthesized and integrated to consider their projects holistically. By comparing notes, the authors additionally gained insights into the deployment of conditions across building technology coursework and how individual assignments can stand as a foundation for full synthesis and integration.

Gray-boxing: Integrating Structural Behavior into Architectural Education

Reese Greenlee | Kansas State University

The persistent divide between architectural design and structural engineering has led to a lack of intuitive and conceptual structural comprehension in architectural education. Gray-boxing is a pedagogical strategy that selectively exposes knowledge from structural analysis tools to students, allowing them to engage with structural behavior as an integral part of design. Borrowing from gray-box testing in software development, this approach leverages Karamba3D within Rhinoceros 3D and Grasshopper, providing real-time feedback on load paths, material efficiency, and stability while filtering out unnecessary complexity. Through iterative digital and physical experimentation, students develop structural competencies, treating analysis as a design collaborator rather than a technical hurdle. Case studies illustrate how gray-boxing fosters an interdisciplinary learning model, equipping students with

critical thinking and adaptability to navigate performance-driven design as a generative and exploratory process.

Discovering and Translating Building Technology through a Cultural and Technological Investigation of Carnival

Annicia Street | Louisiana State University

This paper explores design teaching methodology in a graduate design studio focused on discovering building technology and its integration in architectural design. A core goal of this approach is encapsulated in the manner Liz O'Sullivan, consultant and member of CSI's Building Technology Education Program calls attention to and defines the importance of building technology knowledge, and learning how to integrate it into design, a necessary skill that she alerts young designers have little strength in. Author Walton asserts that the design process is incomplete if technical knowledge is not made part of the creative process. This approach attempts a creative method in hopes of alleviating the weight of navigating this part of their architectural education but also to further their thinking of building technology integration, generating new and innovative ways of application. The design prompt offered a "playful" approach to the discovery, translation and integration of building technology. The prompt asks the studio to study the pre-Lenten Carnivals of three interrelated, Black African Diasporic regions – New Orleans, LA (Southern US), Trinidad and Tobago (Southern Caribbean) and Rio de Janeiro, Brazil (South America), where Carnival is not merely celebrated but venerated, and to design a 15,000 square feet community space on a given site, dedicated to the production of Carnival. Events leading up to the Carnival season, Carnival Day itself and post Carnival activities all manifest the Carnival experience and were to be synthesized in the architectural experience. Thematically, the facility is to be a place capturing the "Spirit of Carnival", a Carnival of past, present and future. Five "architectures" of Carnival were identified, researched and studied: space/venue, music, masquerade "mas", people and food. Each of these "architectures", necessary building blocks of Carnival, individually and collectively rely on forms of construction and building technology in the production of the festival. Technology, identified as a sixth "architecture" in the study, and more specifically technology used in the crafting making – the building of artifacts, provided opportunities for translating Carnival construction and technique into systems of building technology. Areas of design focus and study in generating their ideas were building mass, building structure and building envelope. The students were asked to lean heavily into researching Carnival crafting techniques such as "traditional wire bending" as seen in the Carnival productions from Trinidad and Tobago and float building construction as seen in Carnival productions in New Orleans and Rio de Janeiro. In addition to generating their ideas, maintaining a sense of cultural expression was paramount in contributing to the user experience.

WEDNESDAY, JUNE 4, 8:30AM

PROCESSES

Moderator: Genevieve Baudoin | Kansas State University

Bridging Technology and Sustainability: 3D-Printed Clay Formwork in Architectural Pedagogy

Erin Hunt | Texas Tech University Huckabee College of Architecture

This paper examines an undergraduate Bachelor of Science in Architecture seminar focused on designing and fabricating reusable, zero-waste concrete formwork using a 3D-printed mixture of clay and paper composite known as paper clay. The course integrated digital design tools, robotic fabrication, and traditional hand-building techniques to explore limiting waste in the creation of complex concrete structures that would present significant challenges for standard formwork methods. Driven by the need to reduce the environmental impact of concrete construction, the seminar investigated the potential of 3D-printed paper clay as an alternative to traditional formwork materials. The seminar's pedagogical approach, grounded in experiential learning theory, emphasized hands-on prototyping, concrete casting, and mold design. Key outcomes of the final projects demonstrated novel applications of paper clay for the creation of complex geometries with openings, alongside explorations of smoother surface finishes and robotic carving of clay formwork as an alternative to 3D-printing. These findings highlight promising new fabrication methods for creating custom, recyclable concrete formwork suitable for intricate designs, further underscoring the pedagogical value of experiential learning in cultivating a deeper understanding of material properties and design implications for sustainable architecture. This research suggests a method for reducing the environmental impact of concrete construction through reusable, recyclable formwork and emphasizes the importance of integrating new methods of fabrication into architectural education.

Merging Tradition and Technology: A Zero-Waste Approach to Customizable Clay Facade Systems with Integrated Vegetation

Mark Segovia, Desiray Rodriquez, Erin Hunt | Texas Tech University Huckabee College of Architecture

This research explores a novel method for creating customizable clay façade tiles with integrated planters using robotic milling and 3D printing, positioned within the context of sustainable architecture and building performance. Addressing the theme of the BTES 2025 Conference, which emphasizes the integration of architecture and technology, this study investigates how advanced fabrication techniques can enhance water management and potentially increase biodiversity in urban environments. The methodology involves robotic milling of clay formwork, 3D printing of cross-laminated clay slabs optimized for water flow and slumping these slabs over the milled molds to create functional and customizable tiles. Preliminary testing of a half-scale mockup indicated promising water channeling capabilities to integrated planters. This study contributes to the ongoing exploration of how technology can inform sustainable architectural practices.

Ecological Performance Through Design and Digital Fabrication of Bird Habitats

Niloufar Emami | University of Illinois Urbana Champaign

The world is becoming increasingly urbanized, leading to significant land-use changes that have major implications for biodiversity. One critical consequence is habitat loss, which has severely affected numerous species of aerially insectivorous birds, making them one of the fastest declining bird groups in North America. There is an urgent need for activating architecture towards building an ecological performative environment that meets the needs of non-human species alongside those of humans. This is highly relevant since computational design and digital fabrication methods allow design and materialization of complex morphological forms.

This paper presents the process and outcomes of a design studio offered at Illinois School of Architecture. The studio challenged students to design Bird Refuge Installations for migratory birds along Chicago's Montrose Point Bird Sanctuary Lakefront. Students researched and selected their bird species as the clients of the artificial nests, which included Purple Martin (19-20 cm), Eastern Bluebird (16-21 cm), and Piping Plover (17-18 cm). The habits and habitat requirements of each species informed the design of the artificial habitat. Next, 3D printed formwork (3DPF), was employed as the digital fabrication method to produce molds for repeatable casting of artificial habitats. Students designed and prototyped at various scales — staring at 1:4 scale, scaling up to 1:2 and then 1:1. There was a frequent iterative loop between design of the habitat, design of the mold, casting a nest instance and then demolding the cast piece. All mold parts were reusable.

The pedagogy offered opportunities and challenges. Designing complex biomorphic geometries was a challenging task for students, requiring them to shift from using REVIT and its product libraries to alternative platforms such as Rhino. From another perspective, the digital fabrication method of 3DPF posed challenges and constraints to designing forms that were appropriate as bird habitats while creating a topologically interlocking mechanism between nest modules. Students overcame the challenges through hands on learning by doing and iterating between the digital model and the physical artefact. Students were empowered to understand precast and additive manufacturing (AM) technologies and the way that AM can disrupt precast construction through 3DPF. The outcome of the studio was full scale prototypes for bird habitats for multiple species.

This article exemplifies the broader impact of digital fabrication tools on ecological performance in today's architectural education. It highlights a shift from using those tools solely to enhance creativity and efficiency, to employing them in service of ecological design. By bridging the gap between innovative design and fabrication technologies and practical environmental impact, this approach redefines the role of digital fabrication as powerful tools to create scalable and valuable impacts in architectural education.

Volumetric Construction: Learning from Sweden, Finland, and the United States.

Michel Mounayar | Ball State University

The global affordable housing crisis is escalating. In the United States, particularly in the Midwest, the apparent abundance of housing belies a stark reality. Individuals of all ages with modest incomes and

full employment struggle to secure safe and affordable housing. To enhance availability and access, it is imperative to innovate and reduce production costs while increasing the construction of housing units.

The 2023 housing profile for the State of Indiana, compiled from data by the National Low Income Housing Coalition and published by state senators, underscores a severe shortage of affordable housing. The state requires an additional 120,000 units to meet demand. Only 39 out of every 100 extremely low-income individuals have access to affordable housing1. This issue is pervasive across the United States, compounded by a 60% increase in residential property prices since 2000.2

WEDNESDAY, JUNE 4 10:15AM

DESIGN BUILD

Moderator: Beth Pedota, AISC

Learning from Limitations: Design and Construction of a Rammed-Earth Community Kitchen

Hannibal Newsom, Lauren Scott | Syracuse University

Christina Chi Zhang | Syracuse University, Lehigh University

This paper explores how a spontaneous design-build project—a low-cost rammed-earth community kitchen—offered students valuable hands-on learning opportunities. Developed and built over four months on a semi-remote site, the project addressed challenges such as limited resources, communication with Deaf client-collaborators, and student training of non-specialist community volunteers. In this project we encouraged students to challenge conventional methods of architectural representation through alternative drawing techniques; use conversational, rather than technical, language in communication with collaborators and volunteers; and to develop an openness to real-time problem-solving skills in the field. This project demonstrates how limitations-driven design can provide sustainable and inclusive construction experiences while offering architecture students meaningful, practical engagement.

Collaborative Learning in Design Build Studio Culture

Sara Codarin, Karl Daubmann, Scott Shall, Masataka Yoshikawa | Lawrence Technological University, College of Architecture and Design

The Design Build Studio discussed in this contribution is an online graduate summer course where students design and build a full-scale, inhabitable structure over the duration of a semester, culminating in a final week dedicated to construction. The studio bridges the divide between architectural design and its physical realization through collaborative, hands-on construction. The course integrates conceptual design ideas with practical application, engaging students in design-build practices that closely reflect professional experience. Since 2019, six pavilions have been completed across campus, each showcasing unique design goals and constraints. The projects address challenges such as budgeting, logistics, material selection, and site-specific problem-solving, with budgets ranging from fifteen to twenty thousand dollars funded by local municipal programs. Students interact with the complexities of scale, planning, and construction through active participation in design, fabrication, and assembly. As part of the online master's program at Lawrence Technological University's College of Architecture and Design, the studio includes an eight-week virtual design phase followed by a one-week on-campus residency. Students work in teams, managing the complexities of remote collaboration and decision-making across different locations, while aiming to experiment in the physical world with materials and methods such as timber framing, metalwork, and robotic 3D printing. Each built project functions as a case study, using iterative processes and integrating material understanding with digital workflows, navigating architectural ideas as a critical design practice.

Collaborative Materiality: A New Outdoor Lab to Study Iridescent Nanocellulose

Shawn Protz, Sara Queen, Nathalie Lavoine, Harish Palani, Sea Veng, and Kunal Bhardwaj | NC State University

Design of structures at the nanoscale can render new materialities and experiences at the architectural scale. In particular, structural color—the interference and scattering of light due to the geometric organization of tiny surfaces to render dynamic and iridescent color, a property exhibited by many birds, insects, and plants—can be manufactured by tailoring wood pulp and other cellulosic resources. Cellulose nanocrystals (CNCs) are a biogenic source material with potential biodegradability and recyclability features that can be cast into a thin film that possesses this optical behavior as well as mechanical and electrical advantages, posing many promising applications in building components. This case study examines the cross-disciplinary design-build and material research process for a novel outdoor teaching lab to study exterior architectural CNC applications.

The Passive Solar Greenhouse and the Fluid Column: Two Case-Studies in Integrated Design-Build Pedagogy

Danny Wills | Cal Poly, San Luis Obispo

Poly Canyon is a 12-acre home to experimental student design-build projects, located less than a mile from California Polytechnic State University in San Luis Obispo's main campus. Scattered throughout the site are senior projects dating as early as 1961. Over time the site has gained a menagerie of experimental building forms, structural concepts, material techniques, and construction methods. Some have served very practical needs, such as bathroom facilities, housing, and pedestrian bridges, while others have crafted projects meant to push the boundaries of architectural science.

This paper will examine two specific case-study projects located in Poly Canyon and evaluate, through historical research, their performative value with regards to pedagogical intent. The first project, the Fluid Column, was a structural concept developed in 1970 by Dr. Jens G. Pohl that sought to use a pressurized rigid membrane as a column. The second project to be evaluated is the Passive Solar Greenhouse. Built over the course of seven years (1983-1990), this project was the conception of an Architecture graduate student Marc Jenefsky.

For this paper, formal research was conducted using the University's Senior Project collection, uncovering project timelines, photographic documentation, and unique perspectives from student researchers. Combined with informal searches through storage units, personal histories, and re-discovered documents, this research seeks to comprehensively tell the full story behind these unique case studies for design-build education.

WEDNESDAY, JUNE 4 10:15AM

ENERGY AND OPTIMIZATION

Moderator: Christina Harber, AISC

Enhancing Energy Efficiency in Affordable Housing: A Comparative Study of Construction Methods

Layla Iskandar, Saadet Toker-Beeson | School of Architecture and Planning, Klesse College of Engineering and Integrated Design, The University of Texas at San Antonio UTSA

Carlos Faubel | Department of Architecture, Design & Urbanism, Antoinette Westphal College of Media Arts and Design, Drexel University

Antonio Martinez-Molina | Department of Architecture, Design & Urbanism, Antoinette Westphal College of Media Arts and Design, Department of Civil, Architectural & Environmental Engineering , Drexel University

As urban areas confront the dual challenges of housing affordability and climate change, sustainable building solutions are becoming increasingly essential. This paper presents an applied research project in San Antonio, Texas, in the United States, focused on constructing energy-efficient homes for low-income families. The project involves designing and building two prototype homes: one using conventional wood-frame construction with enhanced energy-efficient features, and another utilizing rammed earth construction. Both prototypes, sharing similar design configurations, were modeled using DesignBuilder to assess and optimize energy performance. Multiple iterations were conducted to improve components such as roof, floor, and wall insulation, windows, and air infiltration. The research compared the thermal performance of the two prototypes using energy efficiency indices like cooling and heating loads, indoor temperatures, and solar heat gains. The findings showed that optimizing the wood-frame design led to significant reductions in energy use, particularly in heating and cooling loads. The rammed earth building demonstrated similar energy performance to the optimized wood-frame prototype, with even lower cooling loads. The study also underscored the importance of infiltration rates and well-sealed building envelopes, especially in hot and humid climates. The findings provide valuable insights for affordable housing design and offer guidance for future policies and energy-efficient construction methods to promote sustainable housing solutions in regions facing similar challenges.

David or Goliath?

Ralph Nelson | Lawrence Technological University

The rapid rise and projected growth of solar photovoltaic (PV) energy generation in the United States may be the most physical and visible expression of technology in the American landscape by 2050. Will new PV systems be dominated by Goliath-scale utilities or will David-scale integration with architecture and communities prevail? Determining the future of who controls energy from the Sun will likely be an epic struggle. This paper compares categorical performance characteristics of PV systems at national

utility-scale to those at local building-scale, and envisions a future of democratized energy expressed architecturally. This future is illustrated through a design project for existing buildings.

Empowering Architectural Performance through Biophilic Shading and Hands-On Teaching

Nea Maloo | Howard University

Danny Sagan | School of Architecture + Art, Norwich University

This paper presents a collaborative educational initiative between academic institutions aimed at empowering architecture students through experiential learning and design-build collaboration within an active systems curriculum. Centered on biophilic shading devices, the project explores how integrating biophilic principles into climate-responsive systems enhances building performance, occupant well-being, and sustainability. By engaging students in designing and fabricating solar control solutions, this initiative demonstrates the synergy between biophilic ornamentation and functional systems in creating efficient, health-promoting architectural outcomes.

Through hands-on coursework, students gain a comprehensive understanding of how shading devices influence thermal comfort, carbon reduction, energy efficiency, and daylighting. Leveraging advancements in digital design and fabrication, students explore the transformative potential of ornament—redefined as a functional, biophilic element—to foster deeper connections between architecture, the environment, and human experience. Case studies and prototype testing, including performance analyses and cooling load calculations, highlight how biophilia-inspired shading systems reduce energy consumption while enriching user engagement and repositioning ornament as a vital component of adaptive, climate-responsive design.

Aligned with the conference theme "Empowering through Architectural Performance," this paper underscores the transformative potential of architectural education in addressing pressing societal and environmental challenges. By cultivating creativity, ecological sensitivity, and technical expertise, the project equips future architects with tools to design sustainable, resilient, and inclusive buildings. This approach highlights architecture’s role in solving real-world problems and advancing equity and environmental consciousness in the built environment.

WEDNESDAY, JUNE 4 1:15PM

MATERIALS AND PROCESSES

Moderator: Andrea Atkins, University of Waterloo

Reflections and Speculations on the Roman Construction and Casting of the Pantheon Dome - 1.0 - How the casting of the dome was executed without massive formwork

Regin Schwaen | North Dakota State University

Nick Wickersham | North Dakota State University

During medieval times, the execution of the Florence Cathedral came to a halt because there was not enough wood in all of Italy to create the scaffolding to complete the dome. It was first in the Renaissance that architect Fillipo Brunelleschi devised a system to execute a dome using brick, without any scaffolding. By contrast the Florence Cathedral dome is slightly larger than the Pantheon in Rome, where the dome was cast in concrete. Even after 1900 years, the Pantheon remains the largest unreinforced cast in-situ concrete dome ever made. But how was it executed without deforesting the entire Mediterranean region to construct the mold required to cast such a project?

Architecture + Fashion = Cultural Expression of the Building Envelope as Explored in the Architectural Design Studio

Paolo Sanza, Awilda Rodriguez | University of Oklahoma

If, in the XX century, soccer stadia celebrated structural ingenuity as epitomized by the examples of Pier Luigi Nervi in Florence and Rome, Paulo Pinheiro Guedes in Rio de Janeiro, or Pedro Ramírez Vázquez and Rafael Mijares Alcérreca in Mexico City, the XXI century awoke with a different preoccupation, the one for the skin. The new trend in stadium design was arguably instigated by the winning design for the Allianz Arena in Munich, Germany, by Swiss architects Herzog and de Meuron, which, in place of expressing structure, proposed a façade composed by some 3,000 ETFE-foil ‘air pillows’ covering the full bowl.

Unlike other building typologies where the skin can be tasked with the dual role of providing aesthetics and environmental responsiveness, in stadia, the need for (a) skin is superfluous, and its implementation is correlated with the making of a brand. It can be compared to a haute couture garment manufactured with unique, often unusual, high-quality, expensive materials, and with an extreme attention to detail. And, as in high fashion garments, skin design in stadia is specifically tailored for the individual client, not replicable, and pricey.

The contemporary restless search for uniqueness in stadia envelope design has provided architects the grounds for fertile explorations. To the investigations of materials, patterns, and technologies, parallels a search for skin expressions more rooted in the place and an interest in finding design expressions that reduce the perceivable scale of these mega structures.

Stripped of the thermal performance requirements of other building typologies but extremely driven by tectonics and sympathetic to new materials, we argued that stadia skin design could be a worthy investigation in the architectural design studio. Therefore, as part of a fourth-year design studio, on two recent occasions and concurrently to the ambition of many Italian premier league soccer clubs to promote the construction of new facilities, we assigned our students to design respectively the proposed 52,000-seat AS Roma Stadium in Rome, Italy, and the joint-use 60,000-seat stadium for AC Milan and FC Internazionale Milano in Milan, Italy. Alongside developing proper long-span structural systems solutions to shelter fans from excessive temperatures and inclement weather, students were tasked to envelop the stadium with skin systems designed to simultaneously brand the soccer teams, draw from the unique culture of the host city, and be unmistakable Italian, while providing for refined tectonics.

This contribution examines the correlation between material culture and cultural branding of skin systems through the digital and virtual reality explorations of students' work.

Go Big or Stay Home? Structural Understanding Through the Accessibility of Precedent

Stephanie Bunt | University of New Mexico

Use of precedents when teaching structural concepts to architecture students is one way to illustrate complex structural behavior but may not be understood in all contexts. While the internet allows for many well documented buildings across the world to be studied through photos, their structural performance may be less clear to architecture students who can benefit from experiencing a building in person. In response, this research considers how students' understanding of structural behavior compares between the study of well-documented, non-local precedents and the study of local precedents that students can visit. Through a project assigned in an architectural structures class that required the students to build a structurally functional model of an existing building, the affordances of precedents in teaching structures are considered and the level of student understanding is reported.

1 to 1: Human Experience and the Process of Making Buildings

Jason Alread | University of Florida School of Architecture

Reconsidering the requirements of NAAB integration, this paper outlines a studio method that begins at 1:1 full scale assemblies and moves backwards towards the overall project. Using a reversal of a more traditional linear process, this approach works from spatial perception and material technologies as the basis of project development. A pair of studios explore material choices and assemblies as conceptual ideas that connect building technology to human experience.

WEDNESDAY, JUNE 4 1:15PM

ALTERNATIVE CONSTRUCTION

Moderator: Naomi Darling | Mount Holyoke College

Earth Construction: Alternative Building Strategies for More Equitable Housing

Robert Holton | Louisiana State University

The US Gulf South is currently experiencing a housing crisis that has been intensified by increasingly severe storms fueled by climate change, the high cost of industrialized building materials, and a shortage of construction workers. Can locally available materials such as cost effective and sustainable earthen mediums, which are often overlooked compared to more industrialized materials, be utilized by minimally trained individuals to construct enduring residential structures suitable to hot wet climates?

The 100-Mile Building: Bioregional, Biogenic Architecture

Clare Olsen, Angela Bracco | Cal Poly San Luis Obispo

In the urgent drive towards decarbonisation of the building industry, architecture and engineering practices must address both operational and embodied carbon. Yet although operational energy consumption has long been a concern for architects in the US, embodied carbon has only recently become a focus of building codes and regulations. To respond to these moral and legal obligations, increasingly more tools are available to assess embodied carbon, but aspects of material selection and specification remain opaque including the complex factors of environment and social harm resulting fro extraction, production and transport of building materials. Aiming to overcome these challenges, the authors posit that architects should maximize the use of bioregional, biobased building materials. To explore this idea with students, the authors co-taught an elective course focused on the implications of material selection with the goal of empowering soon to be graduates with the know-how and ambition to trace material histories and design with local, natural building materials, a project we termed the 100-mile building. This paper discusses the pedagogical methods and outcomes of two iterations of the course, concluding with a discussion about an expanded research agenda on the application of the 100-mile building strategy.

Enhancing Rapid-Build Structural Assemblies with Hybrid Hardwood-Softwood Mass Timber: A Cross-Cultural Comparison

Edward Becker | Virginia Tech

Hardwood timber resources are increasingly incorporated into mass timber building products in Central Europe leading to architecturally and structurally significant building outcomes; however, besides parallel strand lumber, the use of hardwood in American mass timber products is rare. In addition to solid hardwood mass timber products, hardwoods and softwoods can be combined into hybrid mass

timber products that maximize the potential of each wood type. This paper presents a cross-cultural comparison of hybrid hardwood-softwood mass timber products produced in Central Europe and the United States with an emphasis on the utilization of such products in buildings designed for rapid assembly. This study focuses specifically on the performance enhancements that hardwoods have provided in softwood mass timber products developed in Central Europe and presents key cultural and economic factors that have limited the development of such high-performance hybrid mass timber products in the United States. The paper supports the position that novel architectural form and expression in mass timber can be achieved through hardwood-related structural and affective performance enhancements. The study also indicates that the slower maturation of the European mass timber market has positively influenced hardwood utilization in mass timber products. This study was conducted within the 'Wood Urbanism' research program at Virginia Tech's campus in Switzerland in 2024.

From the Lab to the Land: Challenges of Upscaling Bio-based Materials for Architecture

Mercedes Garcia-Holguera | University of Manitoba

The field of biology offers great inspiration for sustainable design solutions through the exploration and implementation of bio-based materials in architecture. Research on this topic is increasingly viewed as a key pathway to addressing climate change, partly because bio-based materials have lower embedded energy, can be integrated into circular economy strategies, can be produced locally, and in some cases, bio-based materials have been shown to have similar or improved mechanical and hygrothermal properties compared to standard construction materials. However, significant challenges need to be addressed to facilitate a smooth and consistent transition toward a bio-based construction industry. Some of these barriers relate to growth processes, cultural perceptions, standardization, and mass production of materials. Another barrier is transitioning from micro-scale structures developed in laboratory settings to meter-scale structures used in architectural applications. Upscaling bio-based materials requires adjustments in growth techniques, workspaces, material manipulation tools, and post-processing to ensure the materials meet the requirements for use in the built environment. This document examines bacterial cellulose in this context, illustrating the process followed to upscale the production of the material and adapt it from a controlled lab environment to a larger architectural scale. The study presents and assesses the steps taken to adapt lab growing conditions, harvesting and drying techniques, and coating choices, among other critical procedures. The barriers and opportunities encountered through this process contribute to the ongoing discussion on shifting from traditional to bio-based materials in the built environment. Moreover, this research underscores the transformative role that bio-based materials like bacterial cellulose can play in advancing sustainable architectural practices and highlights the importance of interdisciplinary efforts to bridge laboratory research and large-scale built design.