The Ghost in the Machine: Integrated Design as a Hidden Tool of Innovation

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integrated design is fundamental to the future of the profession, and therefore needs to be fundamental to architectural education and innovation. Yet in many architectural curricula, integrated design is still marginalized and seen as an impediment to design exploration. The resulting designs "check the boxes" and thus follow the rules, but do little to advance design as a broader process of experimentation with regard to integrating design with technology, assemblies, and systems. This paper investigates an alternative approach, where design integration becomes a guiding principle; a framework for the design process. NAAB integrated-design and systems requirements are applied to a year-long Master's project, allowing the time needed for students to achieve technical knowledge embedded in their formal and spatial aspirations. Systems and assemblies are platforms for design exploration and feedback. Throughout the integrated0000 design studio, problems are assessed for potential advantage to the design vision. Architectural knowledge is implemented through experimental iterations of structure, building envelope, landscape, etc. Development progressively increases in scale and detail, with technical examinations always paired with experiential criteria. In the end, students present expansively rendered visions of their design ideas coupled with detailed documentation.

> "Rules are for the obedience of fools and the guidance of wise men."–Harry Day[1]

INTRODUCTION

In 2014, the National Architectural Accrediting Board (NAAB) revised its Conditions for Accreditation, expanding the realms of the student performance criteria (SPCs) from three realms to four. *Integrated Architectural Solutions* is now a distinct realm, no longer a subset of *Building Practices, Technical Skills and Knowledge*. This expansion must be viewed as a bold pedagogical statement from the various academic and professional stakeholders; that integrated design is fundamental to the future of the profession, and therefore must be fundamental to the education of tomorrow's architects.

Yet integrated design is also a "controversial aspect of the architectural curriculum," wherein some programs and faculty "see it as inordinately broad and too narrowly evaluated by accreditation teams."[2] Thus integrated design is still marginalized within many architectural curricula, treated as mere technical coursework. As a perceived impediment to design exploration, it is shunted onto mundane projects with simple sites, expressly shifting students' focus away from design innovation and on to simple and straightforward application of standard technical knowledge. The resulting designs are obedient to the rules, but do little to advance design as a broader process of experimentation with technology, assemblies, and systems. This unfortunately creates a feedback loop which reinforces integrated design as a too-soon introduction of complicated, yet uninteresting, systems and rules that stunt the development of more poetic notions of space, light, form, and texture. If approached this way, systems and technical requirements understandably become framed as burdens to be mitigated, instead of opportunities to be explored. This paper investigates an alternative approach, where design integration is embraced as the guiding framework of a robust studio sequence specifically bent towards design innovation.

Successfully playing the integration game requires knowing and embracing the guiding spirit of the rules; tactics of playing with/against only happen through full understanding. Given the diversification of consultants, the expansion of technology, and the growth of building regulations, the architect as focal point, integrating all aspects into a maintained vision, is more critical than ever. Instead of fighting the rules, or following them begrudgingly, the overall pedagogy of the degree highlights the integration criteria, implement them as much as — instead of as little as — possible. Within our 4+1 degree system, many aspects of integrated design are repeated throughout the undergraduate, pre-professional sequence; smaller preparatory projects for the official evidence studios in the professional Master's degree. NAAB integrated design and systems requirements are then used to structure a year-long Master's project, wherein varied aspects, from inception to detailed technical documentation, are developed and integrated into students' individual projects. This approach allows the time needed for students to investigate and achieve the technical knowledge embedded in their formal and spatial aspirations. The multiplicity of integrated design concerns is celebrated as developmental tools in the design process. Development of tectonic aspects happens concurrently with complex design investigation; each used as lens to critique the other. Systems and assemblies are thus platforms for design exploration, feedback loops which intertwine innovation and technical knowledge.

THE PERSONAL AS CATALYST

> "Innovation comes out of great human ingenuity and very personal passions." – Megan Smith[3]

Critical to achieving innovation is for each student to establish a personal attitude towards architecture as a constructed and experienced enterprise. Students begin by analyzing and evaluating a broad cross-section of current and historic precedents, gleaning insights into what aspects of architecture they most connect with. They then identify key aspirational buildings which best exemplify their architectural goals.

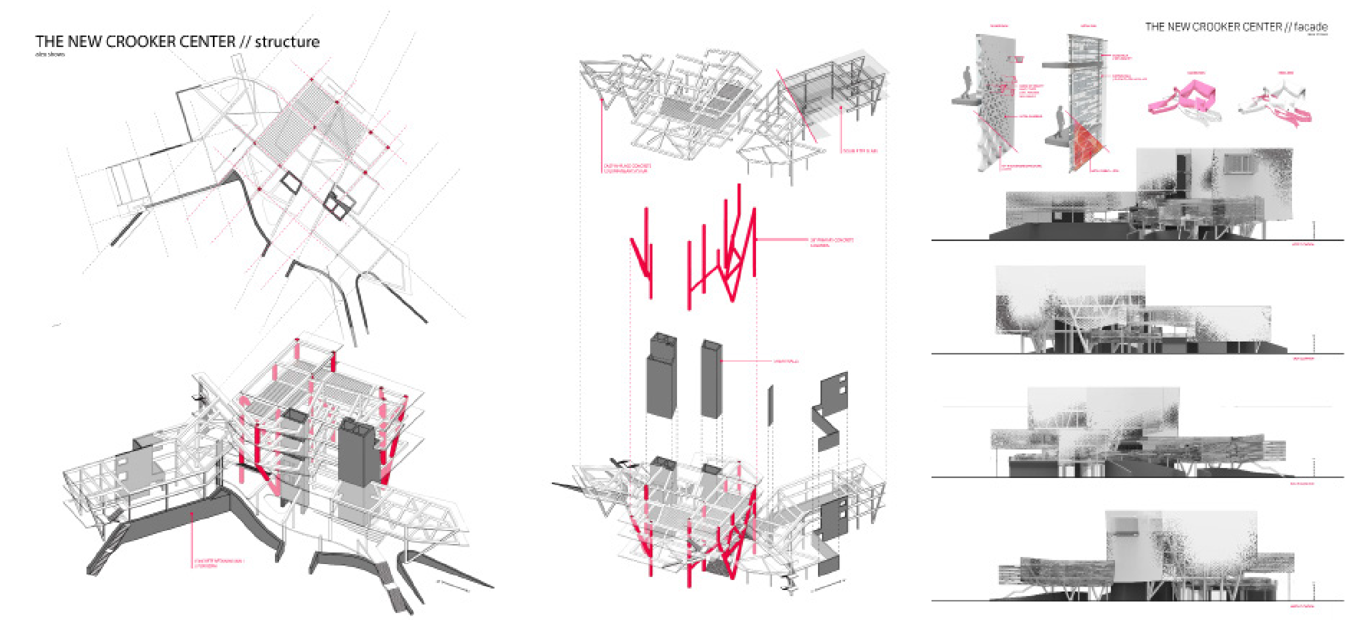

Figure 1: Structure and Facade Investigations; The New Crooker Center for University of St. Thomas. Alex Shows (2016)

Deeper analysis of these precedents bring into focus what their personal attitude toward architecture is; notions they want to explore. While open and expansive in exploration, all insights are understood within a context of NAAB integrated design goals and the pedagogical philosophy of the architectural program.

The result is a written manifesto; a clear, personal design statement which articulates their thoughts, beliefs, and general approach to the creation and goals of architecture in the 21st century. This statement is rigorously critiqued, interrogated, reworked, and clarified to establish a framework of personal guidance which runs concurrent with general architectural rules. It calibrates a set of specific design issues to be applied, investigated, and developed in the main project. Some choose to focus on a singular idea in depth; others state a desire for a complex layering of forces or issues. Some express a desire for the celebration of building structure or systems; others on phenomenological experiences and how building systems can serve those goals. Some are introspective, other contextual. Regardless, each manifesto serves as a framework for design exploration, and a constant touchstone for student and teacher with regard to design origination and evolution.

All aspects of the design process are tested against their statement, investing each student with design authority over the varied and typical building concerns. Design progresses in three phases, each 2-4 months long.

PHASE 1: PRE-DESIGN AND SCHEMATIC DESIGN

As with any design project, one must begin at the beginning. A general project typology is assigned to the class, which is adjusted yearly. Each student develops a full program for their project, including detailed issues of necessary programmatic infrastructure and systems' percentages often forgotten in student projects. This necessitates focused research and understanding of typical operational and systemic needs, and presents a first opportunity for innovation, as they can tailor relationships and operations to accentuate programmatic aspects connected to their manifesto, embedding personal goals in the 'DNA' of the project.

Concurrently, they travel to the target city to experience and document a variety of site opportunities. Upon return, they perform site analyses on the options. Questions of context, environment, proximities, circulation, etc. can provide information, but require an independent framework for evaluation. Since all site options work for the general project typology, each student must develop custom analytical frames based in their manifesto and comparatively apply these, to determine and justify site selection.

Initial schematic design is not an imposed process, but opened wide to the techniques and strengths of the student. Each individual is expected to creatively explore and develop ideas and options which embrace the issues of their design statement, and consider the common issues of architecture through that filter. Establishing a conceptual and critical methodology is key to maintaining an innovative approach to the given problem; while establishing an organizational methodology is key to embedding systemic logic. Reviews along the way with the wider faculty establish progress benchmarks, with the manifesto application and integrated design resolution always defining questions of discussion.

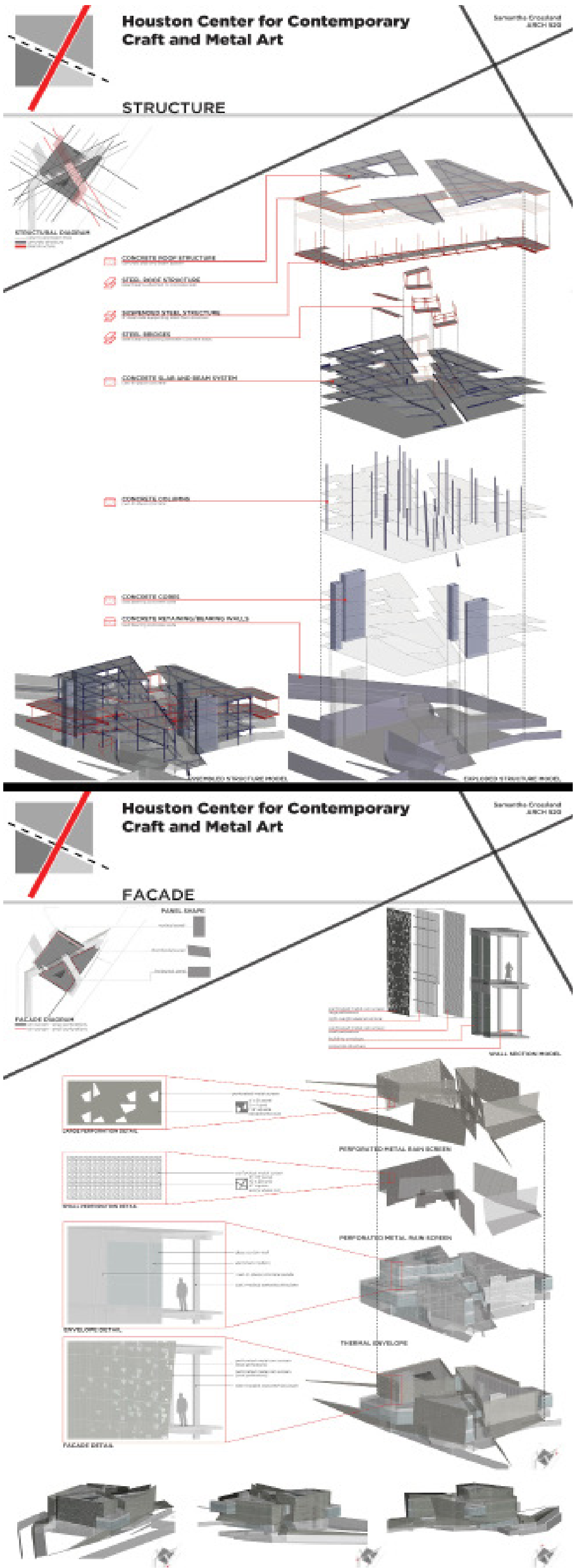

Figure 2: Structure and Facade Investigations; New Houston Center for Contemporary Craft. Samantha Crossland (2018)

PHASE 2: DEVELOPMENTAL INVESTIGATIONS

Once a general scheme of sufficient conceptual and systemic depth has been established, design development begins. The challenge for each student is to fully comprehend, expand, refine, and articulate their design intentions, relative to program and manifesto, culminating in a developed design that can be understood and assessed within the systems and contexts of design. This occurs by investigating their projects through a series of focused, recursive assignments, making decisions across a variety of scales, and working through the implications of those decisions on other aspects and scales. Throughout integrated design exploration and development, problems are assessed for potential advantage to the design vision. Architectural knowledge is implemented through experimental iterations of structure, building envelope, landscape, operational infrastructure, user experience, and building codes. Development progressively increases in scale and detail, with technical examinations always paired with experiential criteria.

Structure is one of the first items tackled, as it can have the most expansive impact across scales. Taking cues from the embedded logic of schematic design, general structural strategies and option are explored. Discussions about different systems, and their strengths and weaknesses both technically and aesthetically, happen with both design and building technology faculty or consultants. Selection and expression of structure is ultimately owned by the students, never imposed by instructors, with each student responsible for articulating the what and the why of their structural decisions. Each project must present the entire scope of structure in three-dimensional drawings depicting the assembled and disarticulated layers of their design (figures 1,2). Systems and assemblies are thus platforms for design exploration, and their feedback prevents designs from developing into superficially expressive images, lacking convincing and sustained responses to gravity.

As the most externally visible aspect of architecture, and as the boundary between exterior and interior, the building envelope presents ample opportunities for innovative aesthetics and performance. Overall approaches to envelope, having been established in schematic design, must now be investigated for their material and assembly implications. Product research is conducted and examined for climatic, contextual, and aesthetic applicability. Surfaces that are often rendered as smooth and unbroken in other projects are now developed with a required understanding of panel sizing, seaming patterns, texture, layering, and their relationship to thermal needs. An understanding of the structural needs of the façade, and the connection to building structure, is established, which impacts the thickness and detailing of the envelope. Students work back and forth between the broad scale of the total façade in its context and impact, and through enlarged fragments of the envelope assembly as

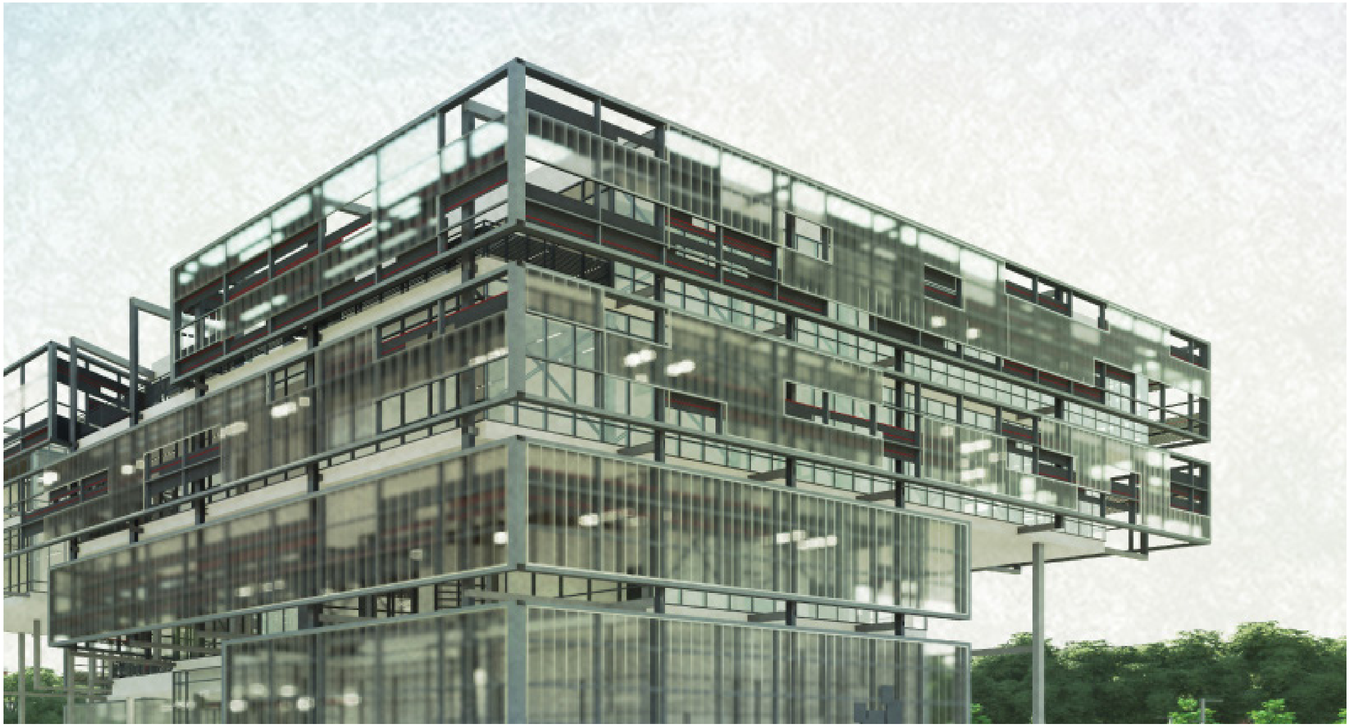

Figure 3: Rendering, New Houston Center for Contemporary Craft. Emily Greene (2018)

detailed virtual and physical models (figures 1,2). The resulting depth of understanding leads to envelope assemblies, and the renderings that communicate them, that are more realistic than student projects are generally (figure 3).

An understanding of landscape is critical, as the site is both an extension of, and the framing context of, how a building is experienced. How users approach a building, engagement with nature, the practical aspects of vehicles; all modulate the external experience of architecture. Site development is therefore conducted over several weeks of focused design. Students are charged with integrating the practical (parking, deliveries, etc.), the experiential (paths, planting, seating, etc.), and the environmental (sustainable practices, stewardship, etc.). Each of these areas is understood to be in a holistic relationship with the other two, necessitating the viewing of potential problems as opportunities for design. For example, water management and site drainage, when thoughtfully designed through pools and the sculpting of land, can enhance place-making and provide new views from building fenestration. Discussions of the seasonal nature of different plants, root requirements, and maintenance issues can create more nuanced approaches to plant selection and placement, avoiding the starkness of their absence or the shallowness of "green-washing" a project through overdone plant coverage. Even the practical needs of site lighting can become an innovative chance to rethink the experience of a building's mass and depth. Eschewing the static rendering, site issues are explored simultaneously through technical plans and video animations. Students are required to change time of day from morning through night, and time of year through seasonal shift.

Reoccurring among and between these foci are drawings. Each student produces multiple orthographic sets of drawings which gain intricacy over the entire phase through multiple critiques and redlining. Specific investigations in other media are always tested against these drawings, which remain even today the primary vehicle for professional production of buildings. Issues of user experience of form, spaces, and operation, and the infrastructural needs to support these, are placed in conjunction with systems and modes of constructive thought. The entire building is tabulated for occupancy types and loads, and thoroughly vetted for life safety and ADA compliance. These issues, an undercurrent since schematic design, are here brought into the foreground through detailed analysis and documentation. Each investigation produces more knowledge to be embedded in the drawings and questioned within the other assignments.

PHASE 3: DETAILS AND FINAL DESIGN

In the final phase, students dig deeper into technical systems and their implications, as well as consolidate their work of the year into a comprehensive exhibition of the project in its breadth and depth. Recursive assignments are again employed as feedback loops between design and technical knowledge.

While basic mechanical spatial allocation has been established from phase one, the entire building is now further explored through HVAC systems and distribution, including mechanical room needs, chases, and exterior equipment.

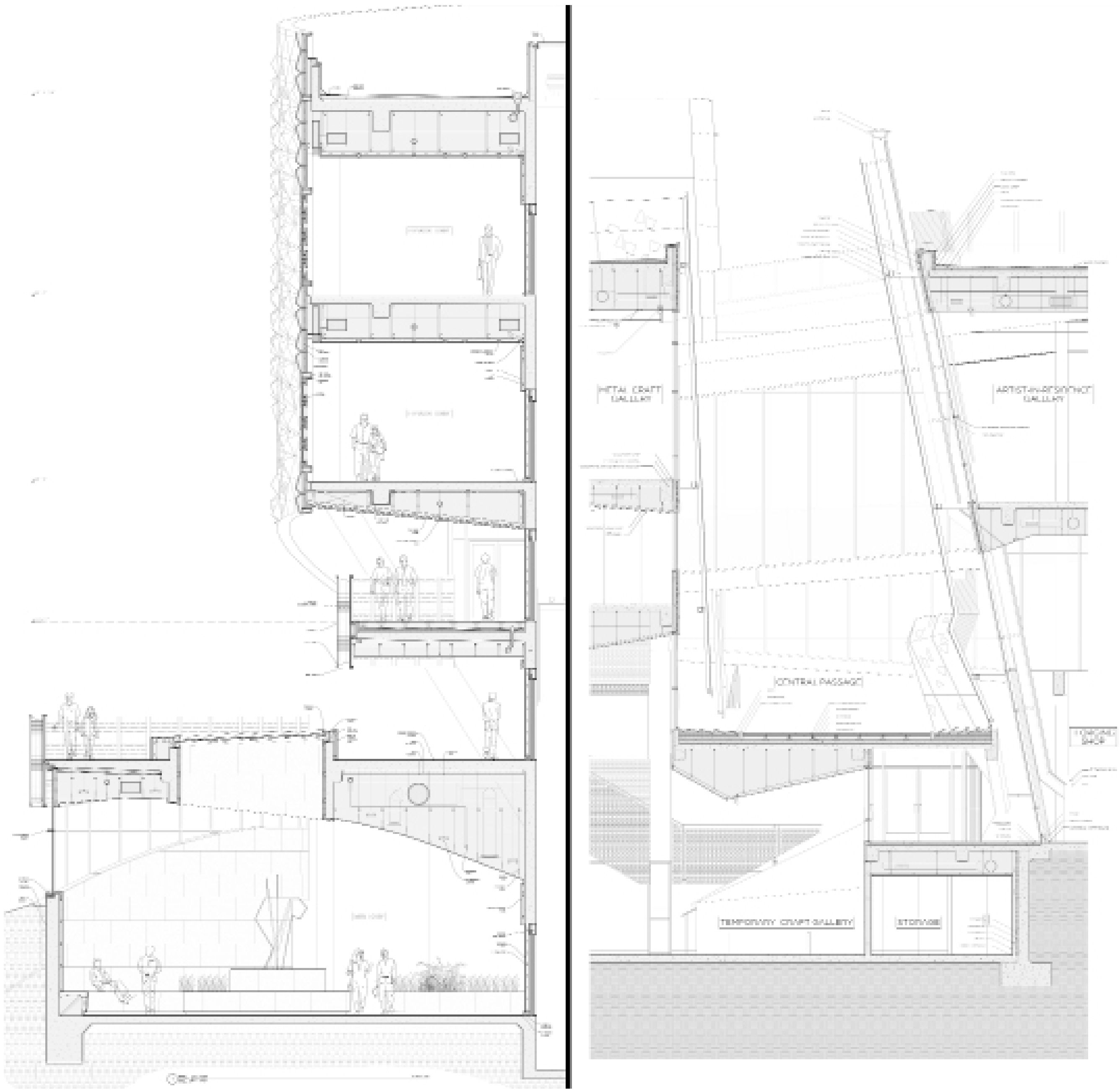

Figure 4: Final Wall Sections. a) The New Crooker Center. Alex Shows (2016). b) New Houston Center for Contemporary Craft. Samantha Crossland (2018)

Branching diagrams are produced to understand the loop of supply and return. This knowledge is then fed into the other assignments.

Reflected ceiling plans (RCP), often viewed as dry products of construction documentation, are used as a exploratory design tool and provide a rich platform for developing spatial experience. Materials, lighting, fire-suppression, and air distribution are all components of a general ceiling system infrastructure; components which must be integrally resolved to produce harmony rather than visual conflict. This requires the student to make decisions of spatial and sectional development in direct conjunction with aesthetic and spatial desires from their stated philosophical approaches. When set into the design environment of an animation or virtual-reality, the impactful nature of these multiple elements, and the imperative of consolidation and control, becomes viscerally apparent.

As a final vehicle for concentration and integration, each students produces multiple large-scale wall sections, at ¾”=1’-0”. Along with these drawings, sample specifications are written, requiring research of various material assemblies. As tall as the student when printed, these significant slices of the building allow for further resolution of tectonic and systemic

Figure 5: The New Crooker Center for University of St. Thomas. Alex Shows (2016) .

implications, envelope, site, and structure. Elements at the scale of the body such as guardrails, displays, and stairs can be developed in detail, and the results further enhance the reality of the final project. Here, the enlarged sections, done in several passes, develop in stages between the other analytical and experiential assignments. As students work between the different assignments, with their differing scales and foci, the need for integration is apparent and naturally resolved.

CONCLUSION

> "A great building must begin with the immeasurable, must go through measurable means when it is being designed, and in the end must be unmeasured." – Louis Kahn

In the end, students present expansively rendered visions of their design ideas coupled with detailed documentation; the building understood as a multi-polar event, fully realized as a complex yet integrated set of forms and spaces.

Throughout integrated design exploration and development, problems are assessed for potential advantage to the design vision. Architectural knowledge is implemented through experimental iterations of structure, building envelope, landscape, etc. As development progressively increases in scale and detail, technical examinations are always paired with experiential criteria, and checked against the stated beliefs from the project's inception. The use of sectional models, orthographics, exploded drawings, diagrams, renderings, and virtual animations all assist in the assessment of project success relative to stated incepting parameters and desires. As Kahn said "In the end, the beginning must be felt."

Ideas, imagination, and design poetics can be maintained in, and in fact strengthened by, integrated design. Students create detailed technical documentation of the varied systems, and have implemented these to achieve fuller, more intricate representations of their building. Complexity, either manifest or hidden, exists as a set of implications of the practical for the poetic, and the poetic for the practical. In the age of the internet and social media, the power of the image can be seductive. For some, "Everything is already an image" in that architectural technology is a fundamental shift towards the mediated image and away from underlying systems.[4] By establishing a pedagogy where innovation is holistic instead of skin-deep, understanding the reality of building technology becomes a virtue, a useful tool that enhances architectural intricacy. Technical knowledge regains its importance as process, allowing the conceptual to be made real.

ENDNOTES

1. Brickhill, Paul. *Reach for the Sky: The Story of Douglas Bader DSO, DFC.* London: Odhams Press Ltd., 1954.
2. ACSA. "Webinar 2: Integrated Design in the Curriculum." www.acsa-arch.org/programs-events/webinars/webinar-2-integrative-design-in-the-curriculum (accessed October 11, 2018)
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