Full Scale and Boundless: Performed Labor Between Design-Build and Fabrication

NICK SAFLEY
Kent State University

Keywords: Design Build, Fabrication, Labor, Mock-Up

INTRODUCTION

Architects coordinate large numbers of people and quantities of material through technical and aesthetic design decisions. These decisions are always connected to the labor needed to execute those decisions during design, manufacturing, or construction. Educating architects on the relationship between decisions made during design and the labor required to actualize material construction remains challenging for architects as coordinators of those physically constructing the material project. To address this, a seminar course titled *Full Scale* placed students in a manufacturing facility to work alongside a professional industry partner to realize full-scale mock-ups of a scalable building element. Students focused on the exterior envelope, arguably the most critical and scalable building element architects retain expertise over.[1] The course's objective was to teach students to appreciate the architect's role as coordinator of construction and manufacturing labor by directly participating in the manufacturing labor of a serial and scalable building component.

Figure 1. Curtain wall assemblies from course. Image by author.

Figure 2. Students fabricating with oversight. Image by author.

COURSE STRUCTURE & METHOD

Two pedagogical models already address the design and construction divide in American architectural education. First, design-build courses common since the early to mid-20th century commonly focus on built works where students perform the design and act as part of the construction team. Examples include The Rural Studio, Studio 804, Yale Building Project, and the many university programs that have followed their model. Although not completely uniform in their pedagogical approach, most focus on a small building-scale project with a social agenda.[2] Second, fabrication courses, formalized in many

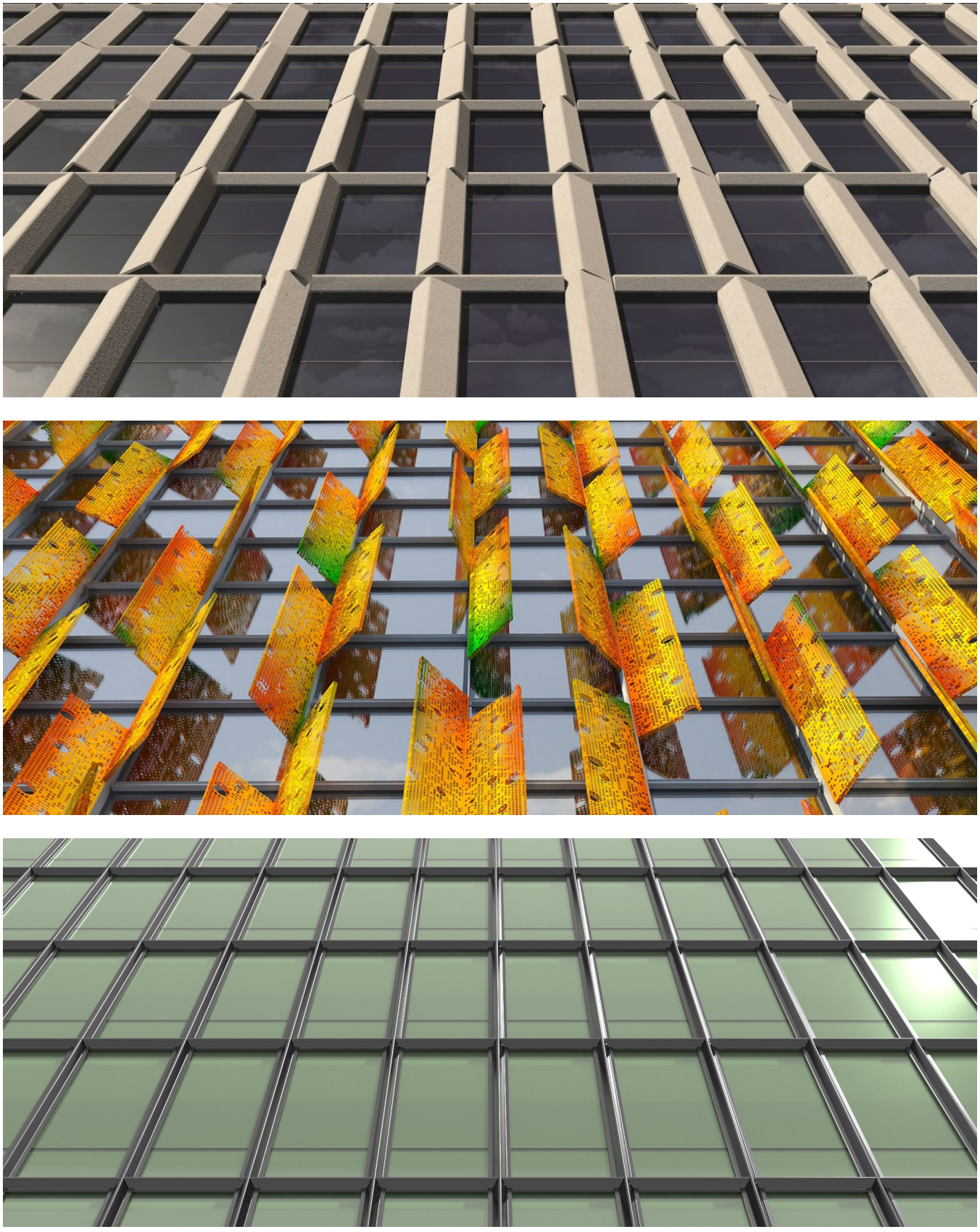

Figure 3. Rendered curtain wall pattern studies. Group 1 top, Group 2 middle, Group 3 bottom. Image by course students.

architecture colleges since the 1990s, such as those at the ETH Zurich, University of Michigan, and Carnegie Mellon University, tend to focus more on experimental material organizations utilizing digital tools as research and have little social or professional focus.[3] Neither course type adequately addresses the connections between design labor and construction labor. Full Scale focused neither on a small-scale building for social purpose nor technique-based material experimentation alone. The course intentionally sidesteps more complex systems integration questions that one might find in a design-build course and technique-based research, which one might find in a fabrication course. Full Scale proposes a pedagogical model for teaching construction that focuses upon a singular building element, prioritizing large-scale craft and human-scale assembly to expose students to material processes and labor practices in a specific industry.

Spring 2022 was the pilot version of the course for which fourteen students enrolled: five Graduate students and nine Undergraduate students. Students' year levels ranged from 3rd-year Undergraduate to 2nd-year Graduate, and they needed no fabrication, software, or practice knowledge to enroll. Teams of four or five students designed three mock-up proposals in collaboration with an industry partner.

MOCK-UP DESIGN

Students took grid-based visual precedents from visual artists and craft-based practices and attempted to translate visual qualities into unitized curtain wall assemblies. Focusing on details that produced edgeless patterns instead of bound objects was critical not to bracket the work to one typology or building scale.[4] Early individual design proposals were selected by the students, and three teams were formed. Each team member was given a defined role in the group. The author of each winning scheme served as the project coordinator, with others responsible for the budget, material procurement, rendering, and technical drawing.

The student groups completed three full-scale mock-ups of unitized curtain wall assemblies. Funding for the unitized parts was donated by the industry partner, United Architectural Metals, as material and labor. Hundreds of person-hours were spent by this partner preparing digital files, meeting and communicating with students, and producing shop drawings. In addition, a national vendor, Viracon, donated the glazed units, and the Kent State College of Architecture provided funding for custom fabrications attached to the unitized systems. The mock-ups used full-scale details and materials for all parts, but the mock-up area was reduced for cost and time considerations. Student teams built each mock-up under the oversight of construction professionals and integrated custom-fabricated elements built as more traditional digital fabrications.

Figure 4. CNC cut parts ready for student assembly. Image by author.

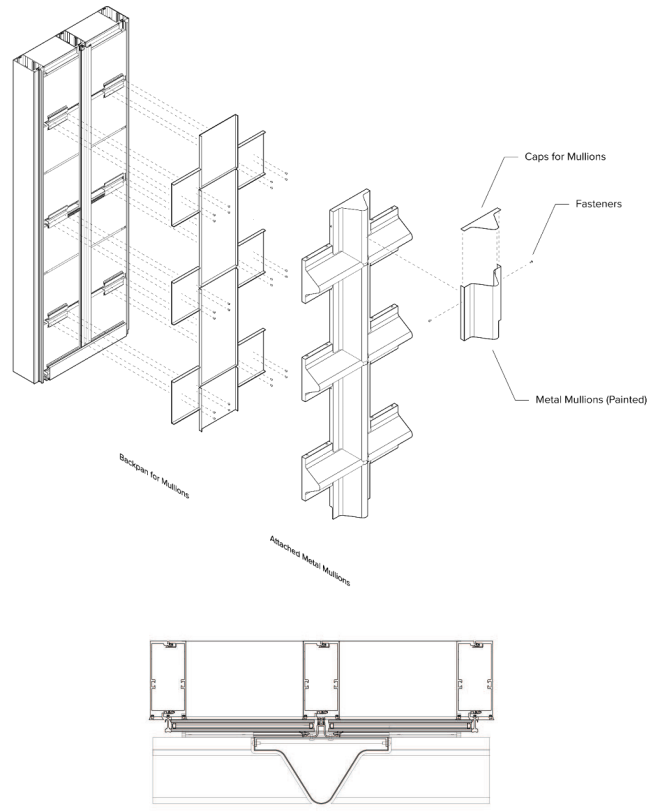

Figure 5. Formed Metal Assembly Drawing. Image by Group 3 students.

Figure 6. Group 3 Mock Up (36”W x 96”H x 16”D). Image by author.

Figure 7. Group 1 Mock Up (30”W x 72”H x 20”D). Image by author.

CONSTRUCTION & FABRICATION

The industry partner performed high-risk cutting and CNC tooling of the pieces from approved shop drawings, with students observing the process. Next, students physically assembled the parts under the supervision of the plant manager and a few assistants using hand tools. Unitized system assembly by the students took two days, including placing connection locations for the custom additions to be fabricated in the college fablab. Close communication and coordination with professional fabricators let the students fully engage and learn from this process. Finally, parallel to the curtain wall unit fabrication, students learned small-scale shop processes in the college fablab to create custom parts to integrate into their envelopes. Again, these parts were fabricated during class time with the supervision and assistance of the college shop staff.

Three distinct fabrication methods and material combinations emerged unique to each group. Group 1 studied custom-milled concrete formworks to produce soft bends in the material surface. They fabricated formwork and developed a concrete mixture with a dye additive and steel wire mesh reinforcing. Group 2 studied laser-cut steel plates to produce bent screens with painted multicolor gradients. Group 3 rolled soft profiles from sheet steel and spot-welded the parts together. A thick nontraditional coating, spray-on truck bed liner, was applied for durability, a contrasting texture, and to hide surface imperfections. Allowable materials and processes were limited so that each group could focus on a chosen technique, and each team was given a budget to manage.

CONCLUSION

Teaching students to value their position in design as coordinating labor and, thus, capital stands to prepare students to be social stewards of design’s relationship to the human component of material construction. Students should know how a particular aesthetic decision will affect the time and effort of those performing the construction. In normative practice, architectural decisions, aesthetic or otherwise, are seldom indexed in any way outside of cost, setting a contentious relationship between contractor labor and designer labor as each is abstracted from the other by professional convention. By focusing not on an entire small-scale building or technique-based material experimentation alone, this course proposes a pedagogical model for teaching construction focused on a

Figure 8. Group 2 Mock Up (60”W x 40”H x 24”D). Image by author.

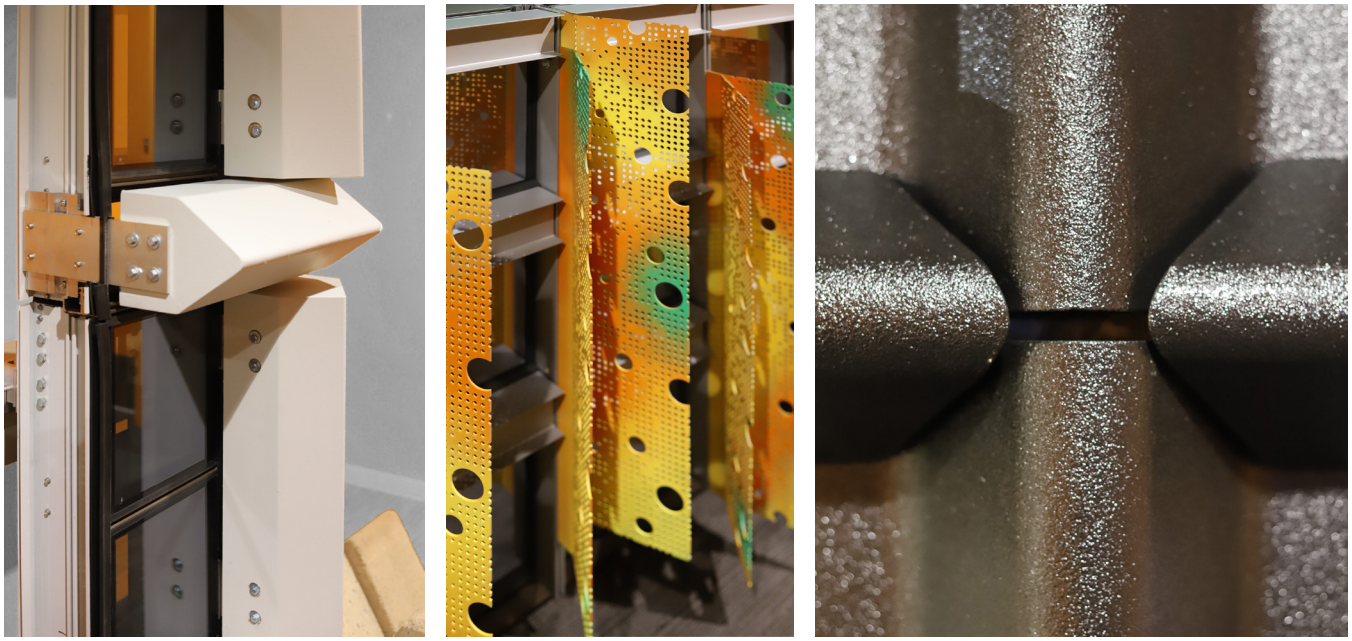

Figure 9. Detail View of Curtain Wall Assmeblies. Image by author.

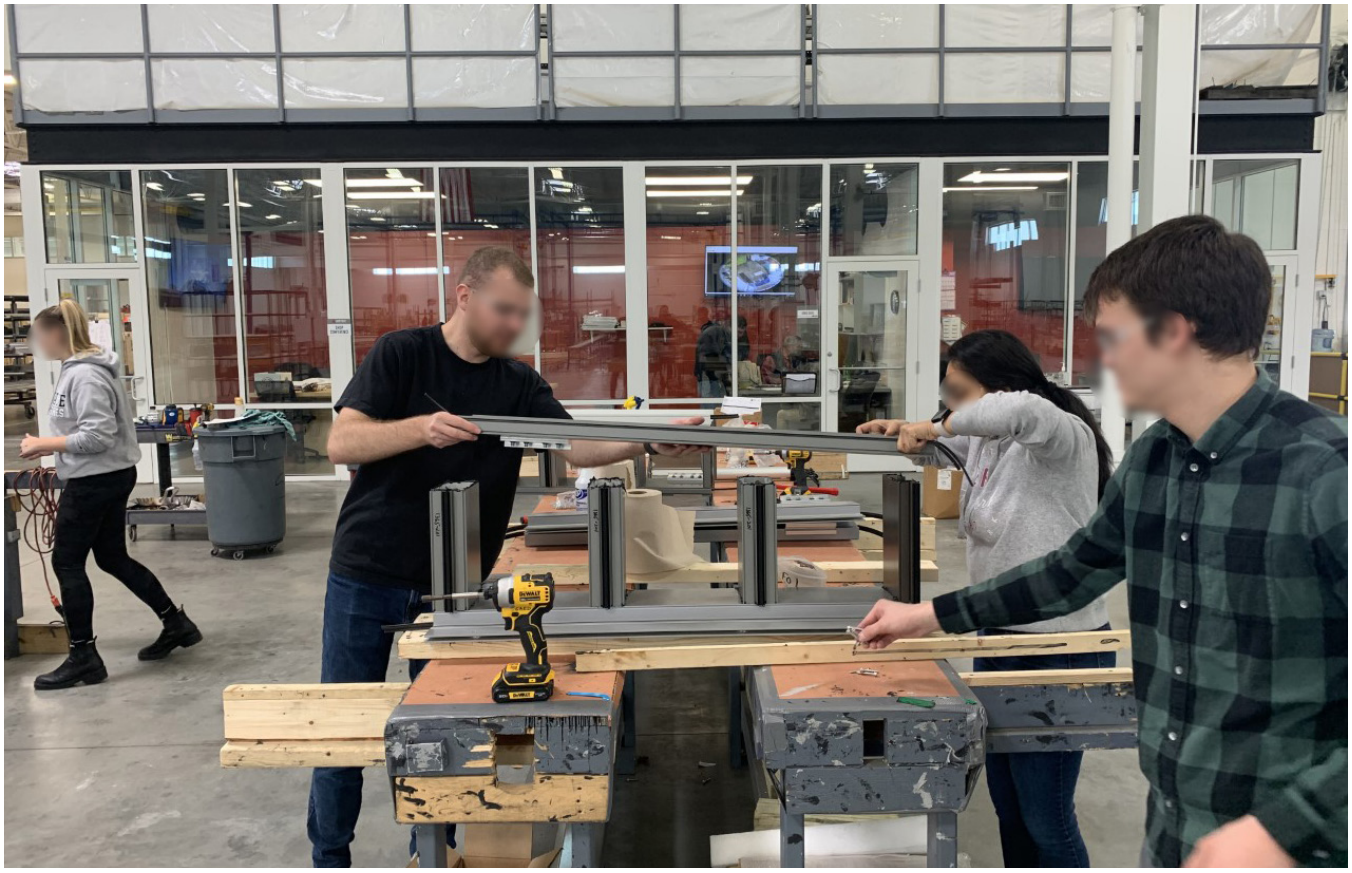

Figure 10. Students assembling a unitized curtain wall unit in manufactures shop. Image by author.

singular building element. Placing students in a large-scale manufacturing facility to work alongside professionals to realize full-scale building elements, in this case, three unitized curtain wall mock-ups, moves students into a direct relationship with labor. Full Scale is a model that could be delivered multiple times or pivoted to focus on other building elements to a similar effect. Through the performance of labor directly, students can make informed design decisions in the future through direct knowledge.

Acknowledgements

Group 1: Caleb O'Bryon, Olivia Muchewicz, Jayda Vorndran, Drashty Rana, Devanshi Jariwala

Group 2: Chance Vidovic, Joel Dalzell, Brooklynne Irwin, Kalp Champaneri, Hunter Edmiston

Group 3: Austin Bayer, Ethan Prodin, Charles Thompson, Olivia Newbrough

ENDNOTES

1. Zaera-Polo, Alejandro, and Jeffrey S. Anderson. "Envelopes: A Material and Environmental Ontology." Introduction. In The Ecologies of the Building Envelope: A Material History and Theory of Architectural Surfaces, 8–25. Barcelona: Actar, 2021.
2. Canizaro, Vincent. "Design-Build in Architectural Education: Motivations, Practices, Challenges, Successes and Failures." International Journal of Architectural Research Archnet-IJAR 6, no. 3 (November 2012): 20–36.
3. Carpenter, William Joseph. "Digital Fabrication and the Design Build Studio." In 102nd ACSA Annual Meeting Proceedings, Globalizing Architecture/ Flows, and Disruptions. Miami Beach, 2014.
4. Nicholas, Claire, and Arlene Oak. "Make and Break Details: The Architecture of Design-Build Education." Design Studies 66 (2020): 35–53.