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Assemblies: Full Scale Construction in the Freshman Design Sequence

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Objectives

The first year design faculty has been running a spring semester shop project for many years: Scott Smith has influenced this work as Shop Director since 1985. The examples documented in this paper are a cross section including two examples from the 1980's and several more recent examples from the last ten years. The primary objective of this paper is to document the success and variety of this work and consider the factors impacting its variation, how the particulars of the assignment contribute more or less to the project objectives, and provide some background context for other scholars who may consider applying similar projects in the foundation design studios.

The objectives of the spring shop project are to establish, very early in the architectural studio sequence, a connection between the materials we use and the forms we make, that design is an evolutionary process which continues through building; and that there is an innate value in craftsmanship. Depending on the particulars of the project brief these assignments have also served to emphasize the relationship between design and construction, to teach lessons in human factors, and the importance of precision in both methodology and thinking. The project also provides a valuable opportunity to realize a design as a full scale finished product.

Logistics

Because a shop project requires the use of the shop facility, certain aspects of the project's organization have come out of the necessary requirements for maintaining order and safety. The shop - 3000 square feet - must provide most of the workspace for the duration of the work. Because the campus is residential and the first year students are not allowed to keep a vehicle on campus, the shop must also provide and store all the necessary materials. Since 1990 the project has been scheduled to allow each of three freshman studios (with approximately 20 to 25 students in each) access to the shop for one third of the semester, approximately five weeks. In complement to this the whole of the first year spring term is broken down into three projects. While the objectives and basic framework is the same for all three studios, the specifics for each are facilitated with minor refinements by the studio faculty.

During the five weeks of the shop project students are expected to complete schematic design models and sketches, a set of working drawings, determine the necessary lumber needed to complete the project, surface the lumber, build the project and apply a finish. Typically students spend the first two to three weeks developing the design, ordering, and preparing materials leaving two weeks to cut pieces, shape, join, and finish the project. Somewhat surprisingly, most students complete all of these steps - over the history of the project the most complicated aspects to regulate have been controlling the amount of material students use (and implied in this, how much money they spend), the scale of the project, and the quantity and complexity of joints (Smith, 2002).

Particulars

With few exceptions the students build the project beginning from a rough sawn piece (or pieces) of hardwood. In some semesters the materials have been tightly prescribed as in the spring of 1999 the studios set a limit of 13.5 board feet from a single species of hardwood. This did prove to more tightly regulate the size and scale of the average project. This also led to some interesting negotiations once students were permitted to trade board feet with a classmate if it was determined that a mixture of species would enhance the project. In other semesters where the materials palette has not been prescribed students often explored a mixture of wood and metal or occasionally an all-metal design.

Part one: the design brief

In the first section the works are evaluated in relation to several project briefs. The assignment has been written many ways, but may be summarized as either encouraging invention or encouraging interpretation. Certain patterns, particularly with regard to the median level of student success, appear closely related to this distinction. The difference between these approaches is raised because we have recognized variations in success as per the following criteria: class-wide success rate, how closely the design responds to the natural characteristics of the materials, and how effectively students meet the project's particular objectives.

For the sake of clarity I would like to define invention as design which seeks to create a new paradigm or approach, typically project briefs which asked students to invent used language which specifically does not reference a known furniture type: i.e. construct an assembly for holding a collection of books. Innovation is defined as design originating from the characteristics and qualities of a paradigm: i.e. consider the innate qualities that distinguish a stool from a chair. Both methods, as applied by the project descriptions, have been successful in producing complex and comprehensive solutions.

The project briefs that follow include two early examples from the late eighties and several more recent examples from the past ten years. Each of the briefs will be explained along with illustrated examples to be followed by a summary of positive and negative aspects.

Library step stool, 1987

In the spring of 1987 students were asked to design a library step stool to extend their reach twenty inches. The project brief emphasized that the stool be compact - in consideration of narrow library aisles - and feel secure for the user. A slotted jig was built in the workshop where students could slide boards (treads) into various different heights so each student could determine an ideal proportion for their own use. The relationship of rise and run obviously had a significant impact on the proportions of overall construction. Some of the more interesting solutions related to how this otherwise large assembly might be folded or compacted when not in use (see Fig. 1).

Of the project types this was amongst the most successful for integrating issues of human scale and usability. The range of variety in both form and joinery was broad. Most of the solutions, due to the extreme structural requirements, are straightforward in their application of materials. The project was weakest for the large number of joints students were typically required to complete in the course of the work.

Seat for a musician, 1988

In the brief students were asked to design "a seat for a musician" - not a specific paradigm. This project had the unusual result of producing both chairs and stools (see Fig. 2). Each studio was assigned a different musician from the school of music to serve as both client and model: a flutist, a french horn player, and a cellist. The form of the chair had to relate to the particular position of the body as per the act of playing. The scale of the chair had to fit two particular users - the student responsible for the design as well as the music student client. The project began with several hours spent drawing the musician at play with special attention paid to the particular leg positions, foot positions, and posture as per each instrument.

Fig. 1. Library step stool by Rebecca Mingo, 1987

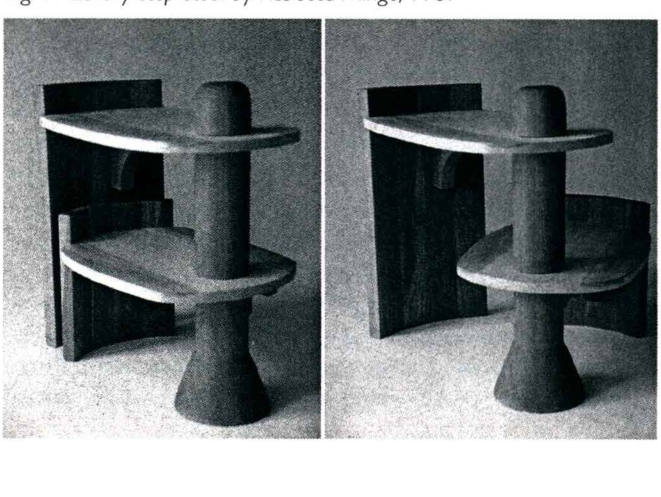


Fig. 2. Seat for a musician by Kent Suhrbier (left) and Kevin Wells (right), 1988

While several "seats" were designed to include a back all three musicians play with an upright or forward posture so that where chair backs occur they have little connection to the posture of the musician at play. While most designs were well proportioned to the height of the musician very few designs accounted for the user's overall posture. Aspects of the better designs accounted for variations in the ideal seating height between the architecture student and musician.

Stand for a collection of books, 1991

"Design and build a stand for a collection of books." This project permitted the use of multiple materials and construction methods. The size of the projects varied considerably as a product of the "collection" being accommodated. Student designs ranged greatly from obvious shelves to display stands, to racks. This project was less successful overall because most students spent too much time inventing the furniture type. Many projects were too large for the five-week duration of the project, and there was a high level of incompletion due to scale and the extreme complexity of several solutions. The extended design phase at the outset of the project did not include a thorough consideration of the structural requirements of the book collection (particularly as per load) and many stands were not adequately stable (Smith, 2002).

Parsons table to hold a particular book, 1992 through 1996

For this project students were as asked to design a Parsons table - a paradigm originating at the Parsons School of Design wherein the legs connect directly to the tabletop without intermediary support. The design of the table was to be informed by a single book, selected by the student, to be placed on the tabletop. This model of a book as source material had been used in previous semesters wherein students were to design a "stand" for a book. The decision to use the Parsons table as a model was intended to provide a clearer paradigm and a means for limiting the number of required joints. Interestingly while students were not typically given a height requirement many of the tables inevitably were tall with a small footprint - maintaining qualities of a pedestal. This

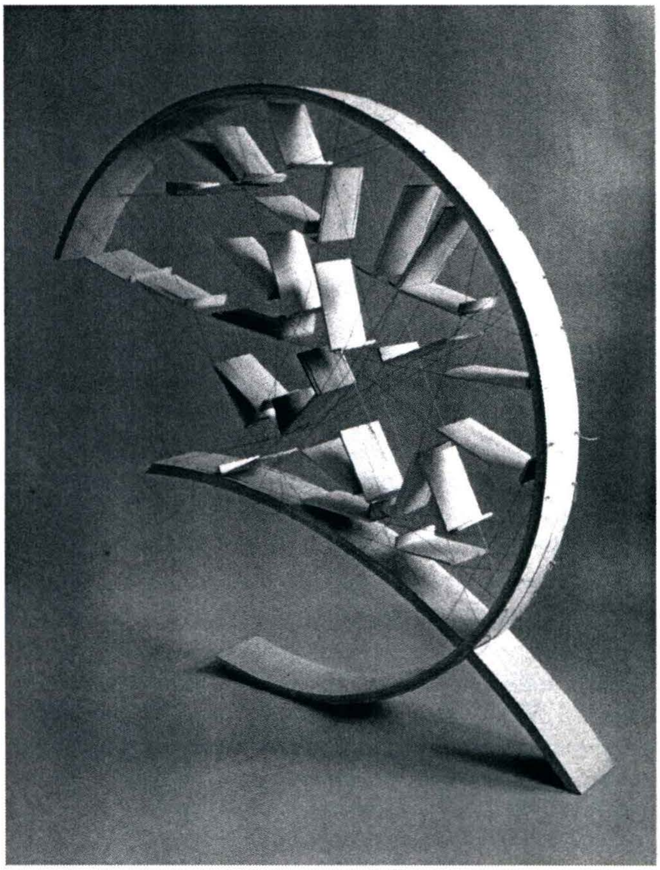


Fig. 3. Stand for a collection of books by Matt Kertesz 1991

may be attributed to the tabletop's scale in relation to the particular books. This example was particularly effective in teaching students about the power of simplicity in design along with the greater precision it required.

The faculty realized, after giving this assignment over several different semesters, that they were encouraging greater and greater complexity as a product of their own experience with past students. As a result, the decision was made to vary the shop project more frequently despite its success (Lindsey, 2002).

3 projects: four methods, 1998

In the spring of 1998 the studio instructors took a less familiar approach to the design project - assigning three different furniture types and four different building methods - in an attempt to make students explore a broad range of design solutions in a short amount of time. All three project types were introduced as paradigms. Students were to draw or model stools in response to a position of the body, folding screens which manipulated the transmission of light, and Parsons tables in response to a particular book. Each of the three furniture types was then to be developed in response to four different connection methods or assemblies: stacking/layering (lamination), framing (stick construction), planar (boards joined edge to edge), and bent (boards cut to curves to bent laminations). Students spent the first week developing 12 models or drawings of these designs. As anticipated most students had three or four well developed ideas from this starting set: this smaller group was then pared down further in consideration of complexity and opportunities for further refinement. Of the three paradigms the folding screens exhibited the greatest range of success as a product of weight limitations, the hinge detail required for folding, and the larger size. Overall, as indicated in figure 4, there were many successful solutions.

Fig. 4. Stool by Will Bossert, Folding screen by David Tsang, Parsons table by Stephanie Perkal, 1998

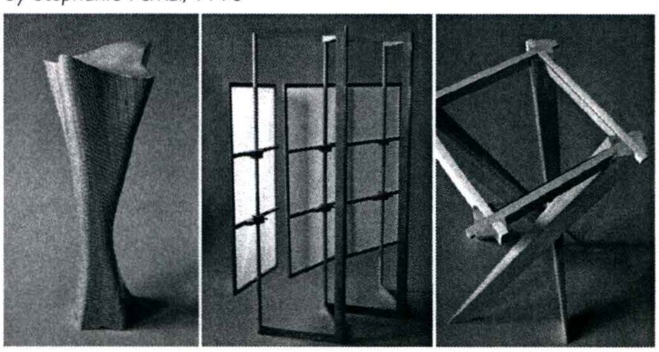
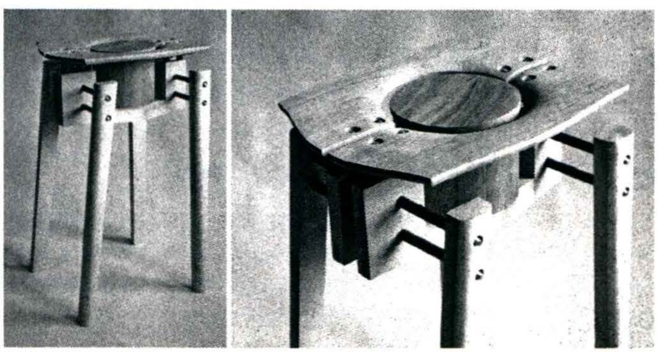


Table for breaking bread, 1999
Table for a ritual, 1999

Two studio projects in 1999 aspired for students to discover something spiritual in the activities of daily routine. In the first, students were asked to make a table for breaking bread. Material was limited to fourteen board feet of one or more species of hardwood. Tables were to have four legs, a top, and four additional structural members. Design solutions could have up to twelve joints. This project was amongst the most prescriptive cited in this paper. While it succeeded in its intent to limit the cost and scale of the work it was less successful for the fact that more designs trivialized the ritual rather than becoming a stage for the event. One of the more successful translations of this idea was a standing height table by Andrew Kikta that both held the bread as well as providing a standing height pedestal for the breaking of bread (figure 5).

In the second studio students were provided the more general mission of designing a table for a ritual. Students were asked to start by considering where ritual existed within their routine, raising issues of how something acquires ritualistic status. Like the previous example this project required students to take a known object - a table - and consider the juxtapo-

Fig. 5. Table for breaking bread by Andrew Kikta, 1999



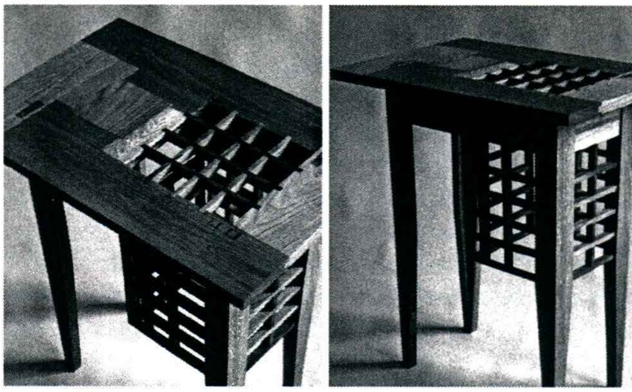


Fig. 6. Table for a ritual by Jarek Babicki, 1999

sition of the familiar form with a personally elaborated activity, for example how an object may be sized for a particular user group. Students were given a limit of thirteen and a half board feet from which to work. The majority of students elected to explore rituals of 2 people - possibly as a factor of the material limitations. The project produced interesting variations in form primarily in response to the seating positions of the participants. The project resulted in a high median of craft and completion however, with a few exceptions, the results are in many ways less inventive than projects from other semesters. One of these exceptions is a particularly sensitive and well-executed project by Jarek Babicki - a table for drying mint and making mint tea (figure 6). Overall this exercise proved to indicate a greater emphasis on craft than design wherein the effectiveness of several solutions was dependent upon the details more than the overall form.

Valet to hold your personal uniform, 1997 and 2000

In 1997 and 2000 the faculty developed an interesting project wherein students were to design a valet.The design objectives were to determine the nature of your personal uniform and develop an armature to support the components. While there is a level of paradigm for a valet this particular project evolved more as a request for invention than innovation. By enlarging the scope of the project to require an individual definition of a uniform - which for many students included equipment and baggage in addition to clothing - the relevance of the paradigm valet became less informative. The formal variations were extremely diverse. This was another project wherein the scale, volume of material, and complexity were not easily controlled. The solutions did raise interesting possibilities as required by the need to support many unlike objects. Despite the minimal direct contact between user and armature the project did provide some useful lessons in human factors as per the need to support specifically sized garments.

Bench to hold two people, spring 2000

For this project students were to design a bench to hold two people - the complexity in the assignment came from the limitation that the finished dimensions of material could be no thicker than three-eighths inches and no deeper than four inches (this varied modestly between studios). The seat of the bench was to span at least three and a half feet between supports. Beginning with a study model, students had to develop methodology and insight into how thin material might be used efficiently to support the required load. This project, unlike most of the previous examples, was not founded upon a metaphor or personal interpretation of an act. The poetry found in the most successful solutions came from the invention required in the assembly of the work. This project seemed to bridge the gap between innovation and invention: while the formal paradigm of the bench was familiar, the methods of using and combining material required a higher level of invention (at least as per the combination of methods) than is typical of the spring shop project. The bench illustrated in Figure 7 is a particularly successful project both in its response to form and execution of craft.

Drafting stool, spring 2001

This project - to design a stool for drafting - was based on a particularly familiar paradigm for the students. Working in pairs, students began this project by drawing each other full size in a specified range of positions: standing, seated with both feet on the floor, seated leaning forward, seated and reaching to the top of the drawing board, and seated in a comfortable (at ease) position. The most successful solutions to this project were a more literal response to the varying postures of the activity with a precise consideration of scale. Despite the foundation exercises drawing the various postures the impact of this foundation is not apparent in many examples of the work.

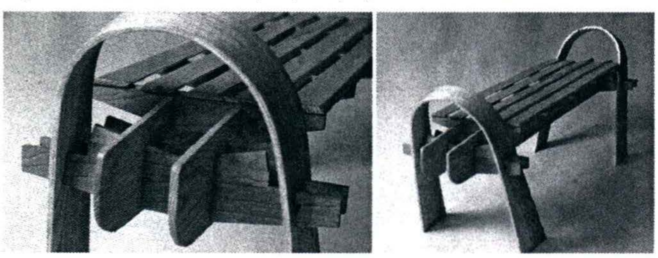
Part 2: objectives and insights

In the second section of the paper the shop projects are compared with regard to the varying success of several project objectives. These objectives include: the production of working drawings, the development of a design that is materially responsive, i.e. works with the material's natural properties, and the opportunity to teach design as a process of refinement and revision.

Completion/production of full-scale drawings

In most semesters the project requirements include the production of full-scale drawings. Typically the stronger students are more likely to keep up with the project schedule and complete a set of working drawings, ultimately leading to a higher level of completion. Whatever the preliminary work is in preparation for construction, Scott Smith remarked that the critical juncture for most students is getting them to commit

Fig. 7. A bench to hold two people by Ryan Stahlman, 2000



to an idea or intention. The fact that they are ultimately responsible for building the final product - in a limited amount of time - is very effective at first forcing students to commit to a direction for the project, and second at forcing them to pare down their idea to the most essential features or components (Smith, 2002).

This focal point of clarifying the idea and using it to derive method and form has proven to be more easily taught where the projects focus less on invention. The several examples above using the Parsons table as a model were very successful at providing students a clear enough foundation upon which to frame a metaphor or intention. The table in Figure 4 by Stephanie Perkal was designed to hold a large book on figure skating. Without evaluating the significance of the particular book, the solution is very effective. She emphasized the rotational movement of skating and the skater's connection to the ground through the edge of the skate's blade by designing table legs that tapered to a linear point of contact with the ground. Mr. Smith remarked that in semesters where there is no clear paradigm for the project students more typically begin construction with only formal intentions wherein he is limited to giving feedback purely on the mechanics of construction.

Design in response to materials (rather than design despite materials)

Effective response to material is realized either in the craftsmanship of joinery or in the method of assembly. In the first condition students gain a greater understanding of materiality through the execution of traditional wood joinery, gluing techniques, and lamination. In the second students gain insight into the directionality of material, as in varying load bearing capacity as per orientation and/or the directionality of expansion and contraction, in methods of mechanical fastening, and in the combination of varying material conditions. All of the aforementioned project statements have led to some good examples of material response, but this has been far more consistent where the design solutions begin as an exploration of assembly rather than an exploration of form. The Bench for two people was very effective due to the tight dimensional limitations for encouraging students to use wood efficiently. The example illustrated in Figure 8 also shows a very strong consideration of joinery as well. The limited board foot requirements along with the limitations of only using wood for Table for a ritual and Table for breaking bread required less extreme efficiency, but did result in a strong emphasis on joinery.

The first example of the library stool - while non prescriptive per board feet or joint configurations - was strongly influenced by structural requirements, as per the point load of a foot. In a later project, Screen for transmitting light, the scale and rigidity of a folding screen required a more comprehensive consideration of joinery methods and assembly. All but the strongest solutions sacrificed a level of material responsibility in pursuit of form.

Encouraging and enabling refinement and revision

In conversations with both Mr. Smith and Professor Bruce Lindsey, former first year coordinator, they spoke of how teaching the shop assignment is a balance between prescribing aspects of the project to limit the scale and complexity, and empowering students beyond these limits in the execution of their work. Having experienced this project as a student, a mentor, a juror, and an instructor perhaps the most remarkable lesson of this assignment is discovering how students persistently surpass our expectations and their own.

In the earliest projects described (1987 and 1988), the three studios, approximately 70 students in all, were broken down into two groups: group A and B. All the students worked simultaneously on the project, but group A was assigned even numbered days to work in the shop and group B was assigned odd numbered days. While this may have permitted some greater exchange of ideas amongst the studios, the potentially longer time line seems not to have contributed to the level of completion or complexity. In 1990, when Professor Bruce Lindsey became coordinator of the first year design sequence, he scheduled the project into three five-week sessions (Smith, 2002). There are several advantages to this system. As enrollments have changed the larger classes have had less impact on overcrowding when the shop is divided into three groups. By running the shop project three times per term in succession some level of programmatic refinement can occur which typically leads to modest improvements in how the project is scaled and taught. Student in the second and third studios have the opportunity to see the work of their colleagues and take inspiration from their ideas, insights, successes, and failures.

Despite many variations in project scheduling the most critical juncture for students comes when they must order materials. Students reach a threshold where they must know both the optimal width and depth of material as well as the quantity of board feet. For many students ordering materials is the first point where they realize the commitment they are required to make in order to complete the assignment. Crossing this threshold may have had less impact during semesters where the limit of materials (i.e. spring 1999) was prescribed. One of the valuable lessons of this project is the opportunity to inform students about design and construction as an evolutionary process, one where changes are not only possible during construction, but anticipated and even welcome. When students order raw lumber for the first time they are typically unprepared for the impact of material variations - knots, checking, and warp - as well as limits in availability. Confronting these unplanned variations provides an opportunity for a design student to clarify his or her priorities: i.e. where may the proportions of a design change to accommodate the limitations of available lumber. Dealing with the inevitability of change, and rising above it, provides a valuable lesson for any construction project.

Summary

The effectiveness of the various project briefs indicates a much higher median level of success where students were asked to innovate upon a known furniture type. While this admittedly leads to more familiar (or at least more easily referenced) forms the projects nonetheless show substantial diversity. In the semesters where material was specifically rationed the scale of projects and number of joints has been more easily regulated. Where an emphasis was placed on joinery over composition there appears to be less innovation in joinery, but a higher median level of precision. With an emphasis on assembly there is a potential for extreme complexity, but also more opportunity for innovative fabrication.

Fig. 8. detail of A stool for drafting by David Kochman, 2001

Conclusion

A large-scale construction in the freshman design sequence provides many valuable lessons including the value of craftsmanship, the logistics and limitations of materials, and the reality of design as a process that carries through all aspects of fabrication. It emphasizes the importance of designing and sequencing operations: the architect's responsibility to formulate a design must carry through to the processes of making.

In a telephone conversation with Professor Lindsey he raised the following issue: upon completing this project students gain a valuable insight - beyond the particulars of form, function, or intention there is an innate value to a beautifully crafted object. This realization is implicit in the results: in the effectiveness of the work and in critical response. Outside jurors comment upon this every year at reviews. It serves as a very strong lesson as per the importance not only of how we conceive design, but also how we execute these intentions: that design can lose or achieve value through the manner of its execution (Lindsey, 2002).

References

Lindsey, Bruce. 2002. Telephone conversation with the author, 15 February.

Smith, Scott. 2002. Telephone conversation with the author, 15 February.

Acknowledgements

While I had the opportunity to impact the results indicated in this paper on three occasions, first as a student in 1987 and later as a design instructor in 1998 and 1999, much of the credit for the shop project's grand history belongs to Scott Smith and Bruce Lindsey, both passionate artisans and teachers. Their optimism and skill is apparent in all of the most successful work.

All of the photographs presented in this paper are the original work of Scott C. Smith.