Craft and Geometry in Architecture: An Experimental Design Studio Using the Computer

Peter W. Parsons *Rensselaer Polytechnic Institute*

Craft is one of the main aspects of architecture that accounts for its strong corporeal presence. The computer used as a geometry machine lacks such tectonics. The predominant means for bringing a sense of materiality to its geometric constructions is through rendering, and in this respect the computer is not significantly different from geometric drawing. One need only recall the beautifully rendered drawings of the Beaux-Arts for a comparison. With the rise of modern architecture such 'paper' architecture was voraciously denounced in the cause of relating architectural production more closely with crafted production. Even now the interest in craft has persisted despite postmodern criticism. Therefore, a means for bringing a greater sense of craft to computer-aided design seems desirable. The architectural studio discussed in this paper was initiated partly for this purpose by intentionally confronting the computer's proclivity to move its users away from craft toward geometry, while at the same time taking advantage of its capabilities as a geometry machine.

Craft can best be understood by practicing it. Consider, for example, the use of a chisel in woodwork. As one applies force with it, one can feel the resistance of the material. Carving with the grain feels differently than carving against or across it. Carving a piece of maple feels differently than carving a piece of pine. If one presses too hard on the chisel or does not hold it at the precise angle, there is a great risk of creating an unwanted gouge. Gradually with practice the tool feels as if it is an extension of the hand that holds it. It becomes an extension of the body. One can feel the physical qualities of the wood through it. Like a limb of the body its presence can become transparent and one can learn about what one feels through it. It can imprint a memory in the mind that comes to the brain, not through the eyes alone, but through the tactile senses. On the other hand it is tiring to use a chisel for an extended period of time. One's body begins to ache and, as the body tires, the risks of making an unwanted mistake increase. Furthermore, because a tool becomes wedded to the body, it is almost impossible to use more than one tool at a time unless they are being used in conjunction with one another as one might use two limbs of the body together.

On a computer one can never 'feel' an object, the image of which is on the screen, in the same manner that one can feel with a chisel the material upon which one is working. One becomes particularly aware of this when creating a 3D computer model of a hand tool. One wants to hold it, not just look at it. Thus the artifice of the object created by means of the computer becomes very apparent, because the 'tool' has not yet taken on the qualities of a tool, although it has taken on the appearance of one.

The Studio

The studio is a vertical one with second, third, and fourth year students. During the first six weeks of the semester the focus is on a series of experimental projects, which are then followed by a more conventional one, a student competition related to craft.

The students all have IBM 386 laptop computers (gray scale screen) for their personal use, and they work in an architectural design studio equipped with color monitors, in the wood shop under the direction of a cabinetmaker (Sid Fleisher), and in the computer laboratory under the direction of its director (William Glennie).

Mallet Project

The basic ideas of the studio are introduced through a one week experimental project, in which the students are required to construct wooden mallets that will be used in subsequent work (Figure 1). The design sequence is specifically prescribed:

1. To sketch a profile of the mallet to fit the student's hand ergonomically.
2. To scan the sketch into the computer and to produce a template of it.

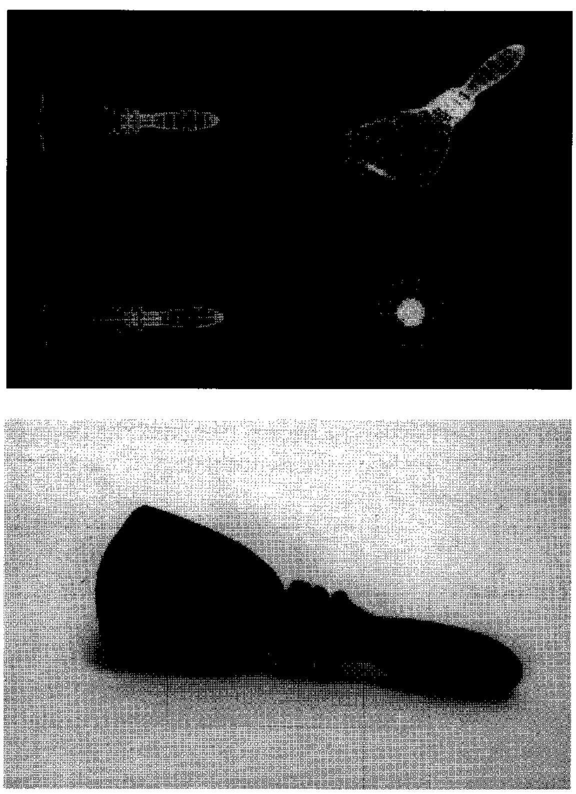

Figure 1: Mallet project.

3. To construct a 3D computer model of the mallet by rotating the template about its central axis and to calculate the mallet's weight and center of gravity.
4. To construct a physical wooden mallet with a chisel and lathe in accordance with the template, revising the design if necessary.

In addition to introducing the students to both the computer and the woodworking tools, the theoretical issues immediately become evident through the act of doing, not just thinking. For example, the first ergonomic sketches precondition the students to think about how the mallets might feel, but the actual feeling of them cannot occur until after they have been physically constructed.

Cladding Project

The issue of discovering a material's physical characteristics is explored in a subsequent two week experimental project similar to one that was carried out at the Bauhaus [Itten, 1964], in which the students carve wooden panels that have been divided geometrically into sectors that are worked by using different chisels, carving knives, and other tools in a variety of ways, working both with the grain and across it (Figure 2). Photographs of these are then scanned into the computer so that they can be manipulated into different configurations while still maintaining their feeling of materiality (Figure 3). Students are then encouraged to 'play' creatively with them further through color and pattern manipulation. Invariably the quality of wood disappears but other equally compelling textural qualities emerge (Figure 4), so that the computer takes on some of the serendipitous character that was evident when carving the wooden panel, similar to the impact that wood grain has on the appearance of a panel, for example. Through the appreciation of various 'accidents' most of the students learn to observe aesthetic potential that they might otherwise have dismissed as mistakes. A few of them manage to discover certain principles within the 'accidents' and to manipulate them constructively. This project is augmented by a visit to a village filled with 19th century buildings that range from Victorian gingerbread to shingle style cladding.

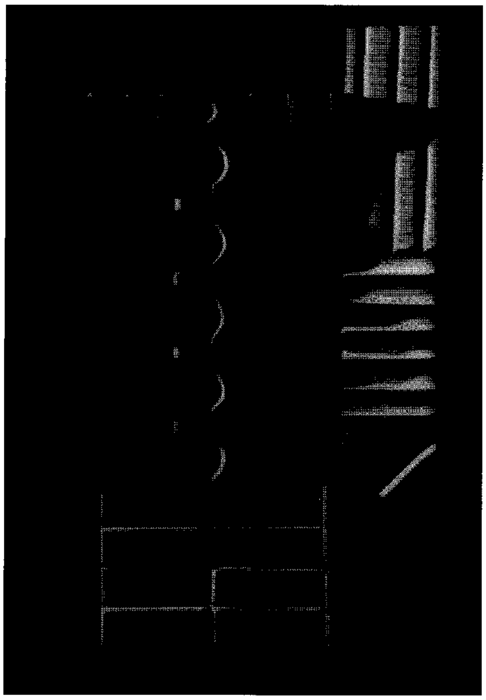

Figure 2: Cladding project.

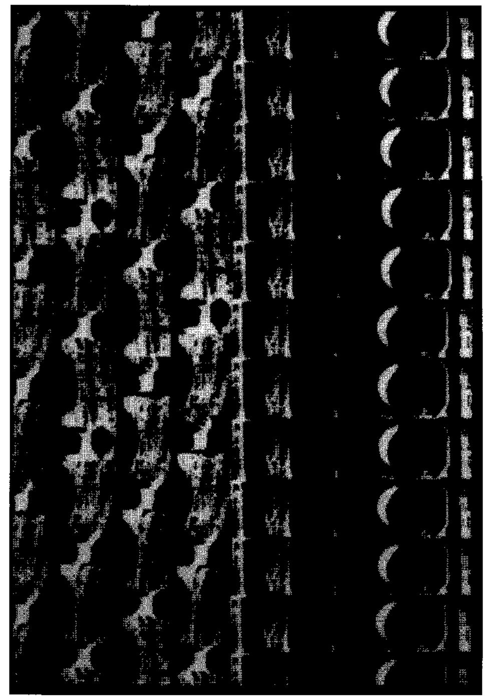

Figure 3: Cladding project recombined.

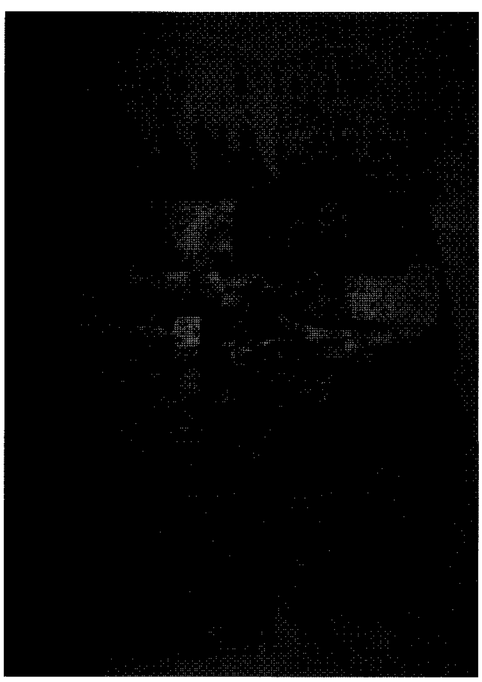

Figure 4: Cladding project color.

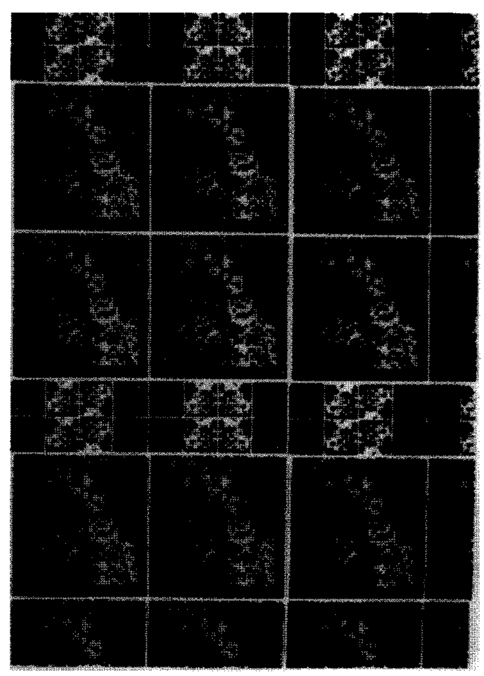

Figure 4: Cladding project patterns.

Framing Project

The relationship between craft and geometry is strengthened in a third, three week experimental project, in which the students design a wood structural framing member, construct part of it in wood (i.e. a significant detail), and make a 3D computer model (including the detail) that demonstrates the spatial possibilities of using a number of such members in conjunction with one another (Figure 5). Sketching, wood modeling, and computer scanning/drawing/rendering/modeling are all used. In this way the careful attention to detail and the unique configurations that can only be discovered when working a material, lessons that are learned from handicraft, are brought together with the ability to produce such forms en masse, making evident the great power of repeated forms to configure space geometrically as conceived in our minds. This project is augmented by a visit to a Shaker village and a factory that produces laminated wood framing members.

Competition Project

The remaining weeks of the semester focus upon the ACSA/American Wood Council Student Design Competition, in which the students undertake a more traditional design project but employ the knowledge and skills that were learned in the experimental projects. The correspondence is not direct,

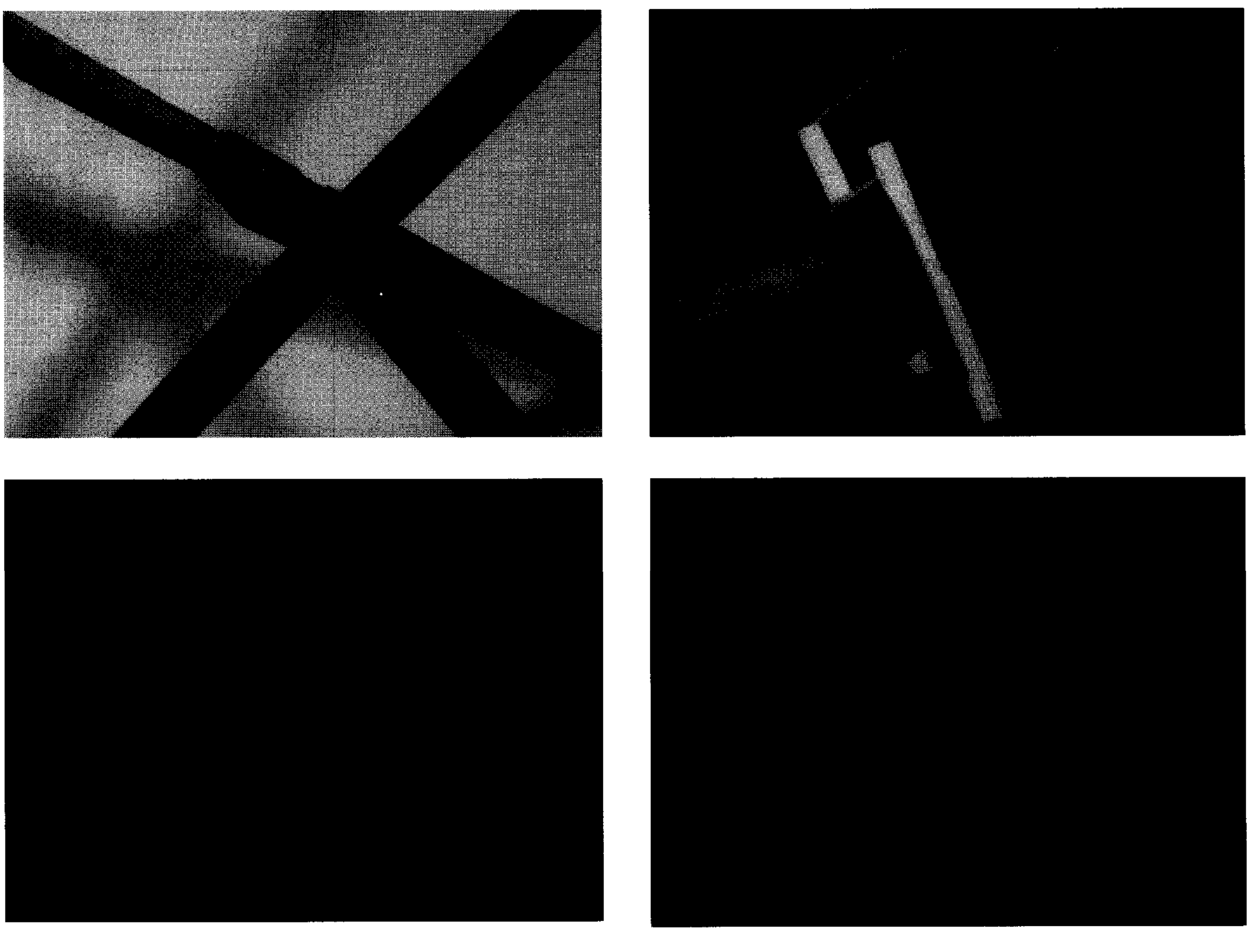

Figure 5: Framing project.

but the students continue to employ woodworking and the computer because they have become comfortable with them. The synthesis of craft and geometry that occurred in the framing project is the most readily adopted practice (Figure 6), both because the geometry in the computer has taken on a corporeal presence since it can be associated with what was learned from crafting a piece of wood, thus seeming familiar, and because the computer as a geometry machine served as a valuable complement to the crafted wood joinery.

Figure 6: Architectural framing project.

Conclusion

This studio demonstrates that virtual environments have the potential to contribute as much to the design process as traditional design processes if used in conjunction with them. In this respect the computer is not significantly different from the discovery of scientific perspective, orthographic projection, or axonometric drawing. With each there was a period where a new abstraction challenged the established means for understanding materials and form until a synergistic reconciliation was achieved. Their great power was the potential to make new discoveries, or rather to construct different mental frameworks through strange-making [Shklovsky 1965], i.e. a means of distancing ourselves from the familiar and from corporeal gratification in order to provoke new discoveries. For example, it is this capacity of the computer that permitted the wooden panels to be transformed serendipitously into beautiful, yet unpredictable colored texture patterns, the precise utility of which remains unknown, and that permitted the crafted wood joinery to be complemented by geometric visualization. In other words there is a strong value in maintaining the difference from other design media that virtual environments possess as a means for nurturing discovery. Attempts to blur that distinction by trying to get the computer to simulate materials through 'realistic' renderings or to produce 'artistic' and 'handmade' drawings [Lischewski 1994] may actually work contrarily to what a designer needs in order to discover new possibilities. At the same time there is also a need to bring corporeal presence to abstract discoveries in order to understand their implications. Too often, however, the one overpowers the other, thereby robbing them both of their creative potential.

For the students this occurred in two ways. Some, the majority, became enamored with the tangibility of craft, its seeming 'reality', and allowed it to dominate their design projects. A few preferred the abstract geometry of the computer and attempted to define their entire projects through it. Both approaches produced both good and bad designs. Fortunately, another few struggled in the space between, exploring the implications of the juxtaposition while simultaneously attempting to reconcile the differences. These proved to be the most interesting, just as some of the most interesting mallets took on qualities of scepters instead of more utilitarian forms, reflecting the influence of wire frame computer models, as some of the panels in the computer took on qualities very different than those of the physical wooden ones, and as some of the architectural framing projects in the computer took on qualities of woodcraft.

References

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Shklovsky, V., "Art as Technique" (1917) translated in Russian Formalist Criticism, Four Essays, L.T. Lemon and M.J. Reis, eds., London, 1965, pp.3-24.