

Architecture and the Soft Machine: Integrated Design, Craft and Production

Collaborative Design Studio : Spring 1996

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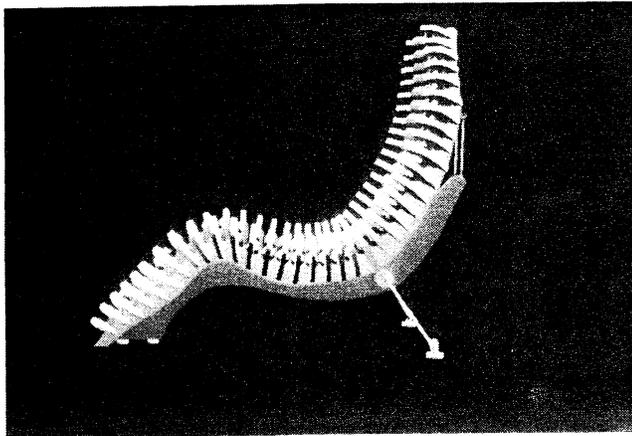
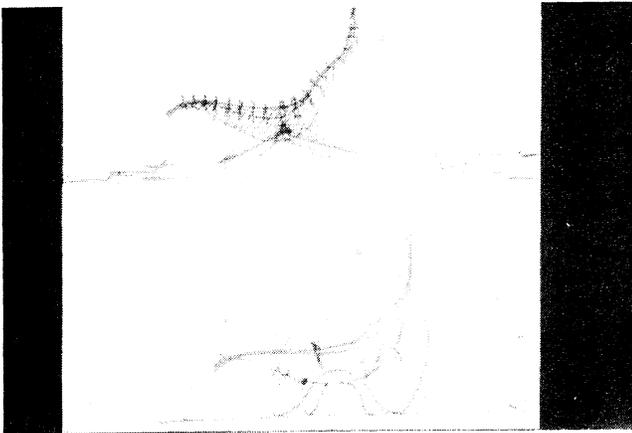


Fig. 1. Chair: Conceptual sketch

Fig. 2. The digital model

THE CONTEXT

A graduate design studio in the spring of 1996 focused upon developing an understanding of the role of the computer as an intermediary force at the crossroads of design activity. The computer is increasingly being used as a tool for making predictions about the “design proposal.” Lighting simulations, structural analysis and energy analysis applications are all intended to simulate aspects of spatial, environmental or material performance. However, design which occurs at the level of computer based visualization and analysis media alone lacks the tactility of the physical artifact. This studio focused upon understanding a relationship of digitally based production to the design process and, in so doing, researched the techniques and methodology required to integrate this capability into architectural design.

THE INDUSTRY

Rapid prototyping and CAD/CAM-based manufacturing are techniques deployed by a variety of industries; the aerospace, medical and dental technology, industrial product design and for custom made products for example, with clothing manufacturing. However, the applications in architecture have been few and far between, due perhaps to the distance between the architect, the construction industry and the means of production where separate documentation has traditionally been generated for each step of the design and construction process, leading ultimately to a split between the design activity and the technology for realization. The development of the digital model as a vehicle for efficient integrated design, testing and production has the capability to redefine the architects working relationship to the construction industry as well as the design methodology and product itself.

THE PROJECT

The studio design research was divided into two related projects. The first was for the design, prototyping and production of a “chair.” The second was for the design of a small building, a Pavilion. The “chair” was regarded as “architecture in miniature”—embodying many of the design issues required for the larger scale—and was established to develop a methodology and familiarity with techniques and computer applications for the more complex problem. In order to develop innovation and creativity with materials and a limitation upon scope of options, the students were limited to developing a design from flat sheet material alone; plywood, industrial foams or plastics operating at the edge of their structural capabilities. They also worked in small inter-disciplinary teams with architects, mechanical product engineers and structural engineers collaborating, thereby underscoring their respective roles to the design and production process. Specific issues to be addressed by the designers were: the integrated use of digital media; user needs of the product; aesthetics of the product and its materiality; structural performance; manufacturing and production issues.

THE PROCESS

The designs focused specifically, and with great success, upon the capabilities afforded by the computer mediated physical production pipeline by producing customized products tailored to the individual customer while, at the same time, developing solutions that changed in form to ergonomic loading. The ergonomic form of the human body was a common starting point and was translated into digital format through the use of 3D digitizing technology where it was then manipulated as a digital model to respond to the conceptual design ideas and the intended method of production and assembly. The capability to rapid prototype using CNC production facilities interfacing with the digital models was a testing ground for understanding the means of production especially in relation to methods of jointing assembly, stress analysis and production tolerances. Full-scale working prototypes were manufactured using a CNC water jet cutter for making the parts which were then assembled into the final product. In the second project for a Pavilion, the base of the digital infrastructure was broadened. Integrated digital media was used for visualization, energy data, structural analysis, ventilation studies, prototyping and for computer based design data communication—both for “virtual desk crits” and for a review with remote jurors connected by synchronous communications.

Fig. 3. CNC fabrication using water jet cutter

Fig. 4. Assembly of components

Fig. 5. The finished chair, the body mold, and the human form

Fig. 6. Synchronous digital design communications

