Experiments in Materials: A Design Build Research Program

PHILLIP GALLEGOS
University of Colorado at Denver

INTRODUCTION

For the past three summers, students from the College of Architecture and Planning have undertaken the design and construction of a six hundred to seven hundred square foot pavilion in a park of a small community such as Bennett, Fruita and now Pueblo, Colorado. The program has begun to identify the critical relationship of designing and building in the highly regulated world in which architecture is practiced.

The basis of the program is to establish a relationship with a community in which they contribute a park site, a statement of cultural and physical context, and sufficient funding to purchase construction materials. The community also provides a working committee to interpret, select, and refine the final design. The University, through the architecture program, in turn agrees to provide a design utilizing the format of a design competition. The program also provides an organization to support a construction team and students to construct a pavilion in two weeks.

For the program, the critical concept is the insistence on a design competition, a student run organization and the requirement that crucial decisions are made by the architecture program. The intent is to provide a full scale laboratory to examine the broadest possible range of materials issues implied in the creation of architecture. For each design, the laboratory can systematically explore material definition in the roots of the landscape, the foundation base, the spandral body, and the roof cap. The central architectural design issue is a search for the most appropriate form and detail to express material choices. Thus, the original intent of the program was to explore the integration of technology and design on a full sized scale and in the field.

A secondary issue was to explore the educational benefit to students, and the service benefit to the community. However, clearly both students and community see themselves as the primary beneficiaries of the program. Given the fact that the experiment was full sized, as opposed to model or simulation, each party could come away from the experiment with benefits.

The program is intended to replicate the complete development process within nine months. However, in the process, architecture is the integral player. Within the content of an independent study course, six students under our supervision must negotiate an architectural statement for the pavilion, negotiate a contract, hold a design competition, select a design, provide detailed drawings, and produce a list of materials. An administrative team is formed which must recruit students and meet with community counterparts such as the local public works officials. The team must also prepare site logistics, order materials, and provide an organizational framework to accomplish the work on site. Construction crews are organized as specific subcontractors on the site responsible for individual work items. The actual on site work is two weeks in August.

PROGRAM PREMISE

The underlying premise of the program is the belief in the inseparable nature of technology and architectural design. Design and technology are intertwined in the form of architecture. Further, if it is true that design, through the practice of architecture, can drive and define technological solutions and innovation, then it should also be true that technical possibilities of materials can also drive and define potential architectural solutions. In our age, we have the wonderful examples of Louis Kahn and Norman Foster who have experimented with materials and systems to drive and define their architectural solutions. Many others practicing in the profession, however, have had limited success in experimenting and defining the relationship of design and innovative technical solutions.

The purpose of the design build program is to provide an ongoing test of the hypothesis that technology can drive architectural design both in production and in the final product. In our society, the University setting is a primary symbolic place to run this type of design and build experiment. In fact, the University can and does establish the notion of experiment within the context of various disciplines, including architectural design. Experimentation is one of the founding principles of knowledge within the University.

The notion of experiments in the general practice of architecture, as in medicine, is a particularly difficult goal to achieve given the issues of design liability and client needs. While a critical practice in architecture traverses the borders of experimentation it sometimes must do so without the expressed intent of segments of the body client. Within the context of experiment in the University, both the granting body, the client, and the research body, the architecture curricula can obtain valuable knowledge through the production of a pavilion and the experimentation with material systems. The client receives an architectural artifact which is useful to it for a greatly reduced market price. However, in return the owner must accept the liability of the production and the design experiment. Given this environment, it is possible to expressly define the activity of design and build as an experiment for the public good.

Thus far, three experiments have been completed at the University of Colorado at Denver architecture department. The experiments have focused on materials and production. Materials of themselves can form their own discipline of study which can be defined as materials science. Production of itself can also form its own discipline of study which can be defined as industrial technology. Together, the complex interaction of materials and production have the potential to become more than construction if the guiding hand of architectural design can interpret material experimentation on the site. Thus, the basis of architectural design in the details can be defined by the complex relationship of materials and production.

MATERIALS AND SYSTEMS DEFINED

In our experiments, it has become useful to establish an organizational classification which assist in the sequential consideration of design and construction elements. These classifications can be defined for the projects in the broadest possible terms as earth and landscape; concrete; masonry; steel; wood; and people.

Landscape and earth are meant to include soils conditions, subsoils, grades, and existing slope conditions.

Concrete is meant to include the foundational elements of reinforcing steel, formwork, textures, connections and the foundation work required for steel superstructure and masonry.

Masonry has thus far meant to include veneer, color, and texture.

Wood has been meant to include horizontal plane, pattern, shaping, gluing bolts, cables, trusses, and wood species.

People issues include designers, motivation, egos, details, dialogue, recruiting, organization, regulating officials, gender atmosphere, legal climate, cultural imperatives, and social climate.

MATERIALS EXPLORED: EARTH, CONCRETE, MASONRY, STEEL, AND WOOD

Each material is systematically explored, designed, fabricated, refined, interpreted, and finally built. The photographs show the design examination of each of the materials, connections, and potential for the future investigations.

Of special note are some experiments in concrete which forms the base of the pavilion. As the concrete does its structural work, it can be shaped. It must also respond to torque and other loads which drive its shape in plan as well as elevation.

Also of special interest are the experiments conducted in wood. In several experiments, the wood is shaped, assembled, and laminated to form compressive struts as well as hybrid trusses. In one case the wood is curved. In another experiment the wood becomes the base material for curved shaping of higher strength steel.

Steel has thus far taken on the role of pavilion body, and in two examples, cap. Structural steel rolled shapes have been defined in locations as square and round, split into separate elements, for the purpose of intersection and formed into curved shapes at the roof cap. Light gauged steel has been shaped and formed on the curve for several roof elements. Steel has proved to be as plastic in it formation as other materials such as wood.

PRODUCTION DEFINED

Production is viewed as the ultimate integration of technology and design. Items which must be produced off the building site by students are often driven by the aesthetics of the produced object. The assembly of individual pieces at the site such as trusses, roofing, and columns require the understanding of the condition which proceeds the item and the condition which must follow as well as its own intrinsic aesthetics. These are lessons which, for instance, the modular industry has learned.

The industrial technology of fabrication at the site raises the need to integrate the design aesthetic of not only the item but also the connection and erection sequence. Material and systems can be, and frequently are modified during the erection sequence due to a new view when the products arrive on the site. And sometimes, the modification experiments are conducted because each part of the team held a different view of the final aesthetic which was driven by the construction of their own object. At those moments, the level of mechanical connection and interpretation of detail is driven to a very high plane. Intensity is often expressed on the faces of those who only short hours before did not understand the implication of materials and connections. Students become design interpreters in the flash a moment. The individual parts, builders and produced elements, thus interpret and reinterpret the concept of the whole material system which drives the design of the pavilion.

LESSONS FOR AN EXPERIMENTAL PRACTICE IN ARCHITECTURE

The lessons for both a critical and experimental practice in architecture should be conducted in an environment free from liability. The medical profession has a model of experimentation on patients with incurable diseases. This model holds that the patient waves their rights for the sake of experimentation which will advance the knowledge of medicine. These experiments are not necessarily driven by individual client needs, although the client needs of the whole are fulfilled. Thus, the University which sanctions experiments in medicine, also offers the best hope for continuous experiments in architecture, materials, and innovation through a combination of technology course work and design studio work. Indeed, in this highly regulated world of practice, the University method of experimentation holds the potential for continuous exploration of materials in design through architecture.

These experiments should be equally driven by technology and architectural design studios, which are difficult to achieve given the fear and lack of technical skills within the schools of architecture. If this discipline of architecture is to embrace a leadership role in the continuing experimentation of design and technology, then University environments offer one best hope to raise the dialogue beyond mechanical means and into a materials as well as a symbolic dialogue with technologies.