Creative Inquiry into Concrete Masonry Units

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Introduction

One of the most common or recognized building material in the industry is the concrete masonry unit (CMU), traditionally an 8x8x16 inch block used in worldwide application. While the CMU is the cheapest (and ugliest) thing in the built environment, it is also the most versatile building material. Architects and contractors alike rely heavily on concrete blocks, mass-produced and automated since 1882, for their compressive strength. Today’s production equipment uses the same concepts as these early machines but with much more energy and directional compaction for denser units, faster and more accurate mixing and material movement, accurate dimensional control and automated production control. Approximately 8 billion CMUs are produced annually in North America alone. Although the simplistic manufacturing process creates a very understandable and interchangeable product, the poverty of this material does not limit the wealth of its expression.

The physical and aesthetic properties of concrete masonry units provide fertile ground for imaginative exploration and discovery. Many factors contribute to its versatility, including block size and color, face texture, aggregate color, block bond pattern, and mortar color and joint type. While blocks lend themselves to linear structures, they can also be configured differently using variable stacking methods. Blocks can be used horizontally or vertically, they can be constructed to interlock, or they can be staggered in placement. Their expressive qualities can build lines, shadows, or other elements which build upon the surrounding context. Because of the universality and design versatility of the CMU, it is important for university students to become familiar with their many properties. This paper describes a design/build competition in an Architectural Materials and Methods class. The competition was crafted to focus attention on the physical properties of concrete masonry units and the logic of construction techniques. First-hand knowledge of CMU’s – not only what they look like but also their texture, heft, pliability and particular joining requirements – expands a designer’s conceptual range and design intelligence. Actual experience handling concrete blocks and meeting the demands of construction techniques gives an understanding that cannot be duplicated in any other format. The unique and particular physical qualities of concrete masonry serve as the source of subsequent design thinking and construction decisions. CMUs as a material are often hidden behind brick veneers, ceramic tiles, modular planes, or exterior finishing, yet their applications are fundamental to design and not merely ‘functional’ or ‘technical’ concerns to be worked out later. Concrete blocks and their construction techniques can be appreciated as aesthetic contributions, not just for their physics. The project explores these ideas by focusing on five interrelated objectives: (1) to investigate, (2) to sculpt, (3) to construct, (4) to assess and (5) to reflect.

To investigate

BGSU architecture students explored the theme of “Intricate Walls” using CMUs as a building block. In architecture, intricate walls allow for the exploration of considerations and concepts that
govern architecture within a tectonic tradition of craft, construction, detail and assembly. To help acquaint students with the theme of Intricate Walls, we began studying the work of Sol LeWitt (1928-2007), an artist who began his career as a draftsman in the architecture office of I. M. Pei.

LeWitt, mainly a conceptual artist, in the latter part of his career explored the manifold ways one can organize units, such as cinder and eventually concrete blocks, through repetition, variation, and arrangement. He began to design models for outdoor public sculptures in the early 1980s based on simple grid-like geometric forms and open modular structures designed in infinite combinations. His first cement Cube was built in Merian-Park in Basel, Switzerland where it stayed from 1984-1986. (Fig. 1). Today we can see his interpretations of these concrete block structures in various locations around the world. In the end, he shifted away from his well-known geometric vocabulary of forms to somewhat random curvilinear shapes and highly saturated colors.

LeWitt had the insight to see the possibilities for expression inherent in the concrete block. He was able to exploit the aesthetic and structural potential of this material. LeWitt also saw the compatibility of concrete block with a design ethos only now realizing widespread awareness. Because of that, we used his work as a precedent. Students were asked to study the interrelationship of geometry, form, tectonics, and materiality as it relates to overarching organizational systems, structural logic and physical setting.

To sculpt

After reading about LeWitt’s work, students became familiar with Kant’s statement “the hand is the window on to the mind." Another way to see how hands work with concrete was a visit to a CMU fabricator to learn about the concrete block’s straightforward production processes: mixing, weighing, feeding, molding, curing and cubing. After the visit, students were given the design challenge for the competition. Based on the design brief that outlined the program, students used a ground plot approximately 8’ x 8’ in a grassy field adjacent to a small open manmade hill to construct a free-standing Intricate Wall. Whether monolithic or airy, the composition had to be constructed of concrete blocks with rebar and gravel for stability. The design instructions were deliberately short in order to allow for maximum interpretive variation (Fig. 2).

The importance of scale and materiality in the process of architectural invention seems as intuitive as an understanding that the mind and body work in tandem. This is supported by recent knowledge of the anatomical and functional links between brain and body, pointing away from the generally accepted compartmentalized view. But the idea that learning engages the entire physiology and conversely that the body teaches the mind is neglected by the status of physical labor in architecture culture and culture-at-large where it is stigmatized by a presumed absence of thought. In this country every aspect of a building is a product of intellect. This attitude of course is
not new. Architects, like everyone else, struggle to shrug off any association of their mission with manual labor.

"Trials, discussion and resolution" was the unofficial class mantra. Each team created up to three design concepts, which were scrutinized by the entire class with the ideas of “seduction” and “ambiguity” brought to the fore as driving concepts. Using break-out sessions as a new starting point, students worked together to re-conceptualize and expand the ideas and develop a single preliminary schematic design. The chosen project capitalized on the design-build protocol to bridge the design concepts and CMU as a material and method of construction. Technical CMU standards informed the design at a very early stage, allowing students to see details as design generators and to experience construction as a creative act. Students learned to see design as an act of sculpting which evolved through the back-and-forth ‘dialogue’ central to the design/build process. Invoking precedents of the past

Fig. 2. Architecture Student Design Submission shows historical lineage to LeWitt’s work and appreciation of the visual appeal of concrete masonry units and its overall appearance; use of color, shape, and texture; and integration with the surrounding landscape.
century, the class would approach the final product as a sculptural drawing using a 1:1 scale. This evolved into two areas of exploration (attention/envelopment), which we worked to bring together as the design progressed - one visual, the other CMU as a material.

To construct

“Working out steps by hand gives the mind that a feel of the materials which is essential to mastery in any art or trade.” (Barzun, 1991, 92)

Current thinking in design/build studios signals a profound redefinition of terms and ideas which helps to overcome the separation of design and construction professionals. What is being acknowledged is the fact that construction or building, too, requires a way of thinking: that embodied experience is qualitatively different from abstraction and is a critical component in the evolution of ideas (Fig. 3). Furthermore, a knowledge base of architecture based solely on paper and lines can be seen as irresponsible and arbitrary. The unity of head and hand has a long list of defenders going back to the eighteenth-century Enlightenment. One prominent defender, John Ruskin, once left his professorship of fine art at Oxford in opposition to this division at the university in defense of manual labor.6

During the build process, design decisions continued and the design for Intricate Walls fostered unexpected angles of approach; intriguing perspectives were modified up to the last minute before the final judging. Specifically, focusing on the visual and tactile qualities of CMU’s, and exploring how they might be installed differently to gain desired effects. This was simulated through the process of arranging and repositioning concrete blocks in as many different ways as they could imagine to achieve the sought out design.

In addition to the difficulties of production (e.g., tools such as concrete saw, tamper, trowel, bricklayer’s hammer, etc.), student were encouraged to collaborate and try methods of construction which shaped the evolution of the final design. Based on environmental and structural issues (height and wind resistance), major design changes were made in situ: detailing was conducted entirely in the field and through improvisation that was not dictated by standard reference because we had very few working drawings on hand. In the end, every aspect of the design, including the final placement of each Intricate Wall, was altered based on site trials.

To assess

The purpose of this exercise with sophomores and juniors was cultivation of awareness of the entire architectural process in terms of dreams, limitations, compromises, realizations and afterthoughts (Fig. 4.).7 As such, students, instructor and the department perceived the project as successful. Critical appraisal of the project has led to a re-casting of the exercise as a semester-length course in which design and fabrication detailing are conducted in a time frame allowing more students participation in multiple phases of the process, something impossible within the prior constraints of a five-week exercise.
Most beneficial to students was the experimental and collaborative learning process unique to the design/build methodology. In design studio students are normally left alone with their work except for desk and class critiques, whereas in this five week project student interactions became physically alive: a corrective to the solitary nature of the balance of the semester’s work. The process naturally demanded from students an unusually intensive and exacting collaboration, a willingness to reach a consensus with minimal compromise. This communication with teammates advanced a primary lesson that “architecture is a collaborative effort and not an exercise in isolation.” (Carpenter, 1997). The exercise also offered students opportunities for cross-disciplinary approaches and reaching out to fabricators. Hands on benefits such as learning what it’s like to use a concrete saw were matched by deeper meanings such as the freedom to connect with something students need and want. Building is one of those things you have to do in order to know.

For the professor the exercise illuminated intricacies of group dynamics and provided valuable feedback about integrating practical lessons with theory without sacrifice to either. The instructor’s position was not so much enumeration of the steps; how to do things, but questioning and pushing. For students the experience of the instructor’s authority was reduced—the instructor’s presence merely as a facilitator or referee, intervening only when a safety issue arose, was new and exciting. In other words, the leveling of the student/instructor relationship was in itself stimulating.

To reflect

The observations implicit in the design/build competition can be stated as two points: 1) Any design course is energized by democratic experimentation, one in which association (of scope, method, character) is not merely a means to pre-defined goals, but rather the process for the ongoing revision of these goals, as well as of the methods for attaining them. 2) A good design studio must invite recombination of roles and personalities of people. Two practical imperatives complement these major aims. The first is the promotion or endorsement of design/build methodology by the organizations which govern architecture and construction education. The second is to work for space in education for the recombination of groups of people and their specialized jobs.

For the students, the attraction to this competition was the opportunity to think about CMU’s at an intimate scale, along with the challenges of production (tools, concrete saw, drilling machine, etc.). This fostered student interaction and collaboration in the methods of construction. In addition, a few students volunteered to produce an iMovie documentary of the design/build competition composed of digital renderings, compilations of drawings and sketches, group discussions and construction footage used in designing and building of the CMU’s structures. The iMovie not only documented the experience of the students, it also helped observers to fully conceptualize the design build experience, by providing a means through which they could observe the work from inception to conclusion. Observing their work from this perspective allowed the design/build teams to interpret and reassess decisions about the whole experience that ultimately affected the final outcome.
At the end of the project, students didn’t leave with only plans, models and digital renderings, but also with a built structure as his or her record of action (Fig 5.). These structures remain in place in the environment where they were constructed, serving as a reflecting surface in which students can see the traces of their action, something that enables them to talk about how they are learning. Students gain an awareness of design, materials, and the collaborative process. They are exposed to the surprising notion that there are multiple ways to conceptualize, represent, and test ideas. They become participants, not merely spectators, and (in theory, at any rate) understand design and construction as an integrated process that begins with the consideration of materials. In this spirit, using methodology already in place in the professional world, we must work together to foster changes in curriculum formats that merge construction technologies and materials into their design thinking.

Notes:


2. Banausos (Ancient Greek) is an epithet of the class manual laborers or artisans in Ancient Greece.


