Block Lofting

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Poetry and Pragmatism

Vitruvius states that architecture must exhibit the principles of firmitas, utilitas and venustas in De Architectura Libri Decem, circa 15 BC.\footnote{Firmitas and utilitas correspond to the functional realms of architecture, those governing the performance of matter and use. Venustas corresponds to beauty. The evolution of humankind has challenged the experiential dimension of use and the prescriptive classical interpretation of beauty, but these principles continue to define architecture with categorical precision and all encompassing breadth. When mutualistic and inseparable these principles constitute architecture. When they are considered autonomously they are inefficient, ineffective and result in mere buildings. These proverbial principles intimate dichotomous dimensions of architecture: the poetic ideal comprised of beauty and phenomenology, and the pragmatic reality comprised of function. The architectural academy has the traditional challenge of cultivating future architects to be adept in the synchronous conceptualization of both the poetic and the pragmatic, transforming the ideal into reality.}

The Idea of...

Consider the statement “The idea of ...”. It is a seemingly innocuous proclamation ubiquitous to the architectural academy, but it is employed with contradictory motivations and consequences. In the critical sense it is productive, stimulates the imagination and connotes conceptual profundity; acknowledging that thought and being are larger than the restrictive confines of colloquial vocabulary. This dimension of “the idea of ...” is analogous to poetry where words are lofted and juxtaposed in a manner that is expressive yet sufficiently abstract to invite the reader to participate in reflection, interpretation and the definition of meaning.

Alternatively, “the idea of ...” is employed elusively, whether intentionally or inadvertently. Consider the proclamation “I am working with the idea of sunlight”, an utterance similar to those frequently made by beginning architecture students. This statement fails to address, let alone poetically transcend, the finite construct of sunlight, nor does it address its pragmatic dimensions. In this case the statement is merely an ambiguous design objective in a realm that is critical and fertile with experiential and technical potential. Statements such as these indicate that students need clear performance criteria that are consequential and verifiable to render the poetic pragmatic and appropriate for architectural integration. “The pragmatic method is primarily a method of settling metaphysical disputes that otherwise might be interminable.”\footnote{The pragmatic method is primarily a method of settling metaphysical disputes that otherwise might be interminable.}
This example of “the idea of ...” serves as a window into the mind of the beginning design student as they transition from laypeople to architects, seeking to explore the expansiveness of ideas yet struggling to do so with pragmatic accountability. The Block Lofting exercise challenges the paradigm of separating these dimensions into autonomous silos: the design realm and the technical realm. The Block Lofting exercise establishes a precedence and seeds design strategies that are driven by poetry but are evidence-based and verifiable.

Dialectics

Dialectics is “the investigation of truth by discussion”, the use of argument to resolve disagreement. The process of architectural design is a dialectic negotiation between two dimensions of the architect’s mind, a conversation between the poetic intention and the pragmatic obligation. The Block Lofting exercise employs this methodology by challenging students to establish the poetic realm with a compositional gesture, and then proceed with its material rendering. Gravity, forces and the technics and techniques of fabrication challenge the initial poetic intention. In response, students reinterpret the gesture in consideration of the pragmatic dimensions expressed by William James, “There can be no difference anywhere that doesn’t make a difference elsewhere, no difference in abstract truth that doesn’t express itself in a difference in concrete fact.” Students are encouraged to challenge the constraints, not yield; strengthening the compositional gesture through reinterpretation. This iterative process realizes the dialectic negotiation as the poetic and the pragmatic argue back and forth until a compromise is achieved; a process that either strengthens the poetry of the gesture by encompassing the technical dimensions or erodes the gesture by yielding, resulting in poetic subservience. This dialectic process is analogous to professional practice, serving as a pedagogical introduction that establishes the paradigm that creativity in an architectural realm is subject to conditions and constraints.

Perceptions of Architectural Technologies

In the beginning it is important to cultivate, in architecture students, the perception that the architectural technologies are accessible, creative and emerging. Architectural technologies are not solely the purview of engineers, but the responsibility of the architect for effective coordination, collaboration and integration to architecture. Beyond this obligatory perspective they comprise the matter of architecture and the physiological performance, ripe with creative potential and opportunity. They are not simply applied sciences but inherently creative and conducive to incorporation into qualitative architectural design. The architectural technologies are not finite or complete; while they must obey the laws of nature they are driven by the evolving human imagination. It is important to invite students into the trajectory of the building technologies, noting the broad impact of historical milestones, such as the invention of the arch or cast iron, and the technologies that are emerging today, informing students of the opportunity to participate in this process.

The Block Lofting exercise is supported by lectures and readings intended to cultivate these perceptions of architectural technologies. Non-architectural examples are emphasized as tools to encourage students to begin to see and understand the greater world through a lens of technical design.

![Fig. 1: Evolution of the Wheel: Force Diagrams of Disc, Compression Spoke and Tension Spoke Wheels](image-url)
The evolution of the wheel [fig. 1] exemplifies the trajectory of technical design comprised of material, force and invention: beginning with the inefficiency of the disc wheel, evolving to the specificity of the compressive spoke system bound by a tension ring to the great efficiency of the pre-stressed tensile spoke wheel bound by a compression ring. The tension spoke wheel further illustrates the concept of material reduction through the introduction of force, a potent example of the spatial connotations of structural expression.

Sustainability of Structures in Architecture

Sustainability of structures in architecture can be framed about three propositions: 1. Economy of material through specificity of form 2. Efficiency through integration 3. Maximization of life cycles through universality. Each proposition must be considered qualitatively as well as quantitatively in order to be of architectural consequence. The Block Lofting exercise is not foremost an exercise in sustainable structures but it is contextualized within and serves as an introduction to these propositions.

The economy of material is an essential quantitative sustainable strategy, one dependent upon a fluency of structural principles, concepts, and methods of analysis. A sustainable structure that is architecturally significant is one with an experiential dimension, where the reduction of material contributes to a better aesthetic experience. The fabric-forming techniques for concrete developed by Mark West at the Centre for Architectural Structures and Technology at the University of Manitoba exemplify effective material reduction, “where savings in weight and material are estimated to be as high as 40%” over conventional techniques, yet express an acute and synchronous aesthetic dimension [Fig. 2]. Similarly steel diagrid structural systems like those of 30 St Mary Axe and the Hearst Tower, by Foster + Partners, utilize 20% less steel than conventional orthogonal steel frames.

Efficiency through integration of structure and architecture is another effective sustainable strategy. Structures constitute a significant portion of the material, energy and financial investments in buildings. Integrating structure architecturally, such that it serves a purpose beyond mere support, contributes to sustainability through efficiency. The Sendai Mediatheque by Toyo Ito and Mutsuro Sasaki exemplifies this strategy through integrating the structural system with services, HVAC, circulation in addition to the more common strategy of incorporating structure into the spatial order and architectural expression.

Universality is similar in effectiveness to specificity but constitutes a different strategy for rendering architectural structures sustainable. A structural system that is universal is one that can be adapted for re-use. Optimal system specification, proportions and sizing of structural bays, and member sizing define universality and offer the potential for critical reinvention through adaptation.

Project Proper

The Block Lofting exercise employs dialectic negotiation to explore the interrelationship of the poetic and pragmatic dimensions of architecture through the heuristic investigation of structural behavior and design. The project intends to cultivate structural intuition empirically; the belief that knowledge is acquired through the senses and experience. The author is considering intuition to be the highest form of knowledge, constructed through experience and logic, a knowledge that is fluent and essential to
integrate structure seamlessly with architectural design.

Teams of two students, utilizing collaboration to construct consensus from autonomous individual contributions, execute the exercise. Each team is required to fabricate a wooden block and base in accordance with prescribed dimensions. They are then charged with using drawing to develop a compositional gesture that lofts the block above the base. The students proceed to negotiate the composition with prescribed technical conditions and constraints.

Fig. 3: Dimensional Parameters

Conditionality and constraints do not hinder creativity or the poetic potential but are instead necessary boundaries that clarify the creative realm. The project pedagogy presents the conditions of the exercise, albeit abstract, as analogous to those in the professional practice of architecture. The project conditions define the dimensions of the block and base, and the dimensional boundaries limiting the relationship of the block to the base [fig. 3]. The material palette is restricted to wood and piano wire. The block must be lofted and indirectly supported by the base.

The project sequence consists of three iterations. Student teams are required to develop different solutions in response to the constant conditions, cultivating the perception that each problem holds the potential for multiple solutions. Multiple iterations afford students the opportunity to incrementally develop concepts and strategies such as member form, connection type and lateral stability; taking the pragmatic experience and reinventing the poetic gesture. The iterative process is a critical educational tenet, affording students the opportunity for trial and error, in-depth investigation, failure and success.

Project 1 sequence [Fig. 4]

The initial compositional gesture is a modest illustration of asymmetrical balance where the block is lofted beyond the base by a single lenticular compressive element and thrust against the extent of the buildable area yet constrained by a network of tensile stays. The column demonstrates economy of material through specificity of form with more material about the mid span to resist buckling stresses. The reduction of material at the extremities of the column expresses its pin connections and the fact the block receives no lateral stability from the column. The second iteration illustrates an increased compositional challenge by furthering the disassociation of the block from the base through a two-tier tensegrity system. For the third iteration, the students solicited permission to pursue two blocks as an additional challenge, while this is a pedagogical contradiction regarding the respect for conditions, it is at times
pedagogically important to allow students to go beyond the confines of an assignment when they have proven ready and capable. The composition draws upon the preceding iterations, supporting one block with the other which in turn is supported by the base. The weight of the blocks is considerable and makes this composition particularly challenging. A composition of this depth and complexity is a significant poetic and pragmatic achievement.

Project 2: iteration three [Fig. 5]

The gesture is comprised of symmetrical balance, gravity and the expression of momentum. The design positions the block symmetrically about the base, suspended from a compressive A-frame that is stabilized by the base through tensile stays. The A-frame is comprised of form-specific lenticular members bound by a moment-free pin connection at the apex and roller connections at the base. The mass of the block induces lateral translation in the legs, facilitated by the roller connections.

This tendency to translate is constrained by tensile lines connecting the roller connections through the block; configured diagonally to laterally stabilize the block. The block simultaneously induces and constrains the physical displacement of the A-frame, illustrating the potential for design to invite the observer into the structural performance with aesthetic and spatial expression.
The gesture of this third iteration project examines asymmetrical balance. Two blocks are lofted above the base by the extremities of a curved flexure-resisting element. The blocks are bound and stabilized to each other and the flexural bow by tensile rigging. The flexural bow bears on the base with a roller connection; rotation and translation is constrained by tensile stays.

![Project 3: iteration three model](image)

The blocks and base are made of reconstituted bamboo flooring; the grain is coordinated with the spatial orientation of the blocks. Linear cavities are milled into the blocks to conceal doweled connections utilized for the termination of the tensile lines. The flexural bow has chisel points at its extremities to support the blocks and bifurcates into chords at the fillet, affording connection of tensile members via the cavity.

**Conclusions**

Most conventional academic design exercises remain in the hypothetical realm and are subjectively developed and evaluated. Students have expressed appreciation for the Block Lofting exercise as a microcosm of the architectural design and delivery process, transforming an idea into reality. The students express a robust appetite for reality, having their ideas realized in material and subject to verifiable performance criteria. They have also expressed appreciation for the exercise in the structural realm as a means to explore structural behavior and design. It is a vehicle for students to experience and creatively interact with principles and concepts (e.g., lateral stability, geometric efficiency, material capacities and fundamental stresses) that are often perceived by the beginning student to be abstract and abstruse.

**Notes**


6 West, Mark. “Fabric-Formed Concrete Structures.” http://www.umanitoba.ca/cast_building/assets/downloads/PDFS/Fabric_Formwork/Fab-Form_conc_structs.pdf [accessed May 08, 2012]